Supporting Information

Chromium-catalysed selective synthesis of 3-oxo and 3-amino quinolines using β-O-4′ lignin models or α-amino ketones

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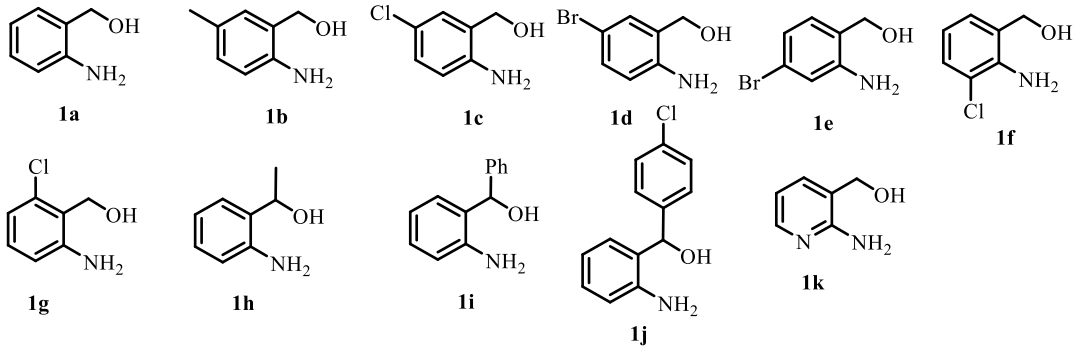
1. General Experimental

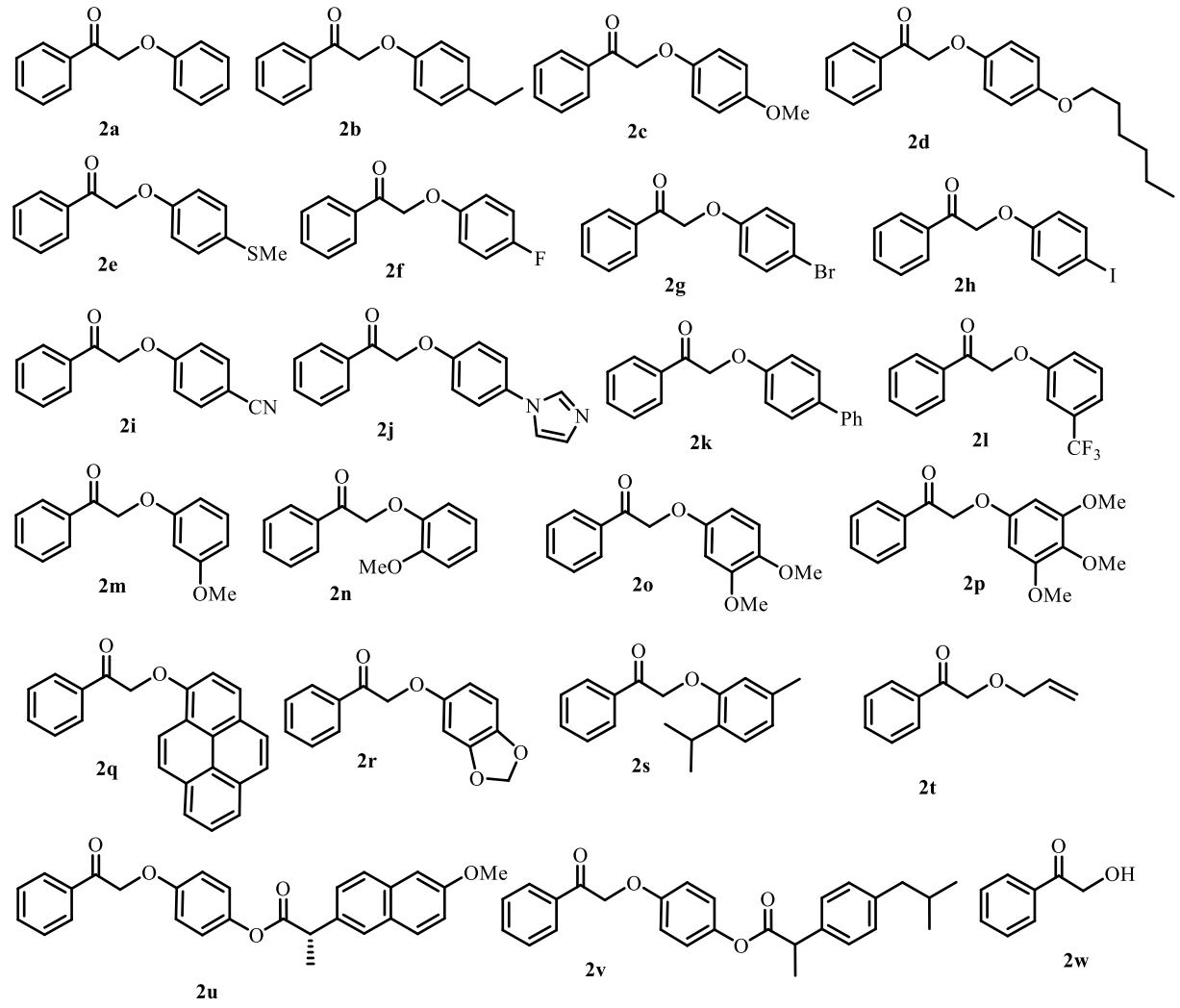
All the reagents and chemicals were purchased from common commercial suppliers like Sigma-Aldrich, Alfa Aesar, Merck, BLD Pharma, Spectrochem, Avra Synthesis Pvt. Ltd., Finar Chemicals and directly used as received without any further purification unless otherwise mentioned. Compound 2-(allyloxy)-1-phenylethan-1-one (**2u**),[1] and **H_2L^1**, **H_2L^2**, **Cr-1**, **Cr-1^{Me}**, **Cr-2** was prepared according to the reported literature.[2] THF and toluene were freshly distilled over sodium–benzophenone before use. ^{1}H, ^{13}C, and ^{19}F NMR spectra of the compounds were measured in $CDCl_3$, DMSO-d_6, CD_3OD as a solvent by using TMS as an internal standard. Chemical shifts, δ (in ppm), are reported relative to TMS δ (^{1}H) 0.0 ppm, δ (^{13}C) 0.0 ppm, which was used as the internal reference. Otherwise the solvents residual proton resonance and carbon resonance ($CHCl_3$, δ (^{1}H) 7.26 ppm, δ (^{13}C) 77.16 ppm; DMSO-d_6, (^{1}H) 2.50 ppm, δ (^{13}C) 39.52 ppm; CD_3OD, δ (^{1}H) 3.31 ppm, δ (^{13}C) 49 ppm) were also used for calibration. Bruker Avance III 600 and 400 spectrometers were used to record the NMR spectra. Chemical shifts (δ) values were reported in ppm and spin-spin coupling constant (J) were expressed in Hz, and other data were reported as follows: s = singlet, d = doublet, dd = doublet of doublet, dt = doublet of triplet, t = triplet, m = multiplet, q = quartet, sext = sextet, br = broad, and brs = broad singlet. IR spectra were recorded on Perkin Elmer Instrument at normal temperature making KBr pellet grinding the sample with KBr (IR Grade). MS (ESI-HRMS): Mass spectra were recorded on an Agilent Accurate-Mass Q-TOF LC/MS 6520. Merck silica gel 60-120 was used for column chromatography. GC instrument fitted with Elite-1 column (30 m length, 0.32 mm ID) using the following method: Injection volume: 1 μL, inlet temperature: 280 °C, FID detector temperature: 280 °C, oven temperature: start at 60 °C hold time 1 min, ramp: 12 °C /min, upto 320 °C, Flow rate (carrier): 25 mL/min (N2). All the annulation reaction was performed under air in the closed reaction tube.

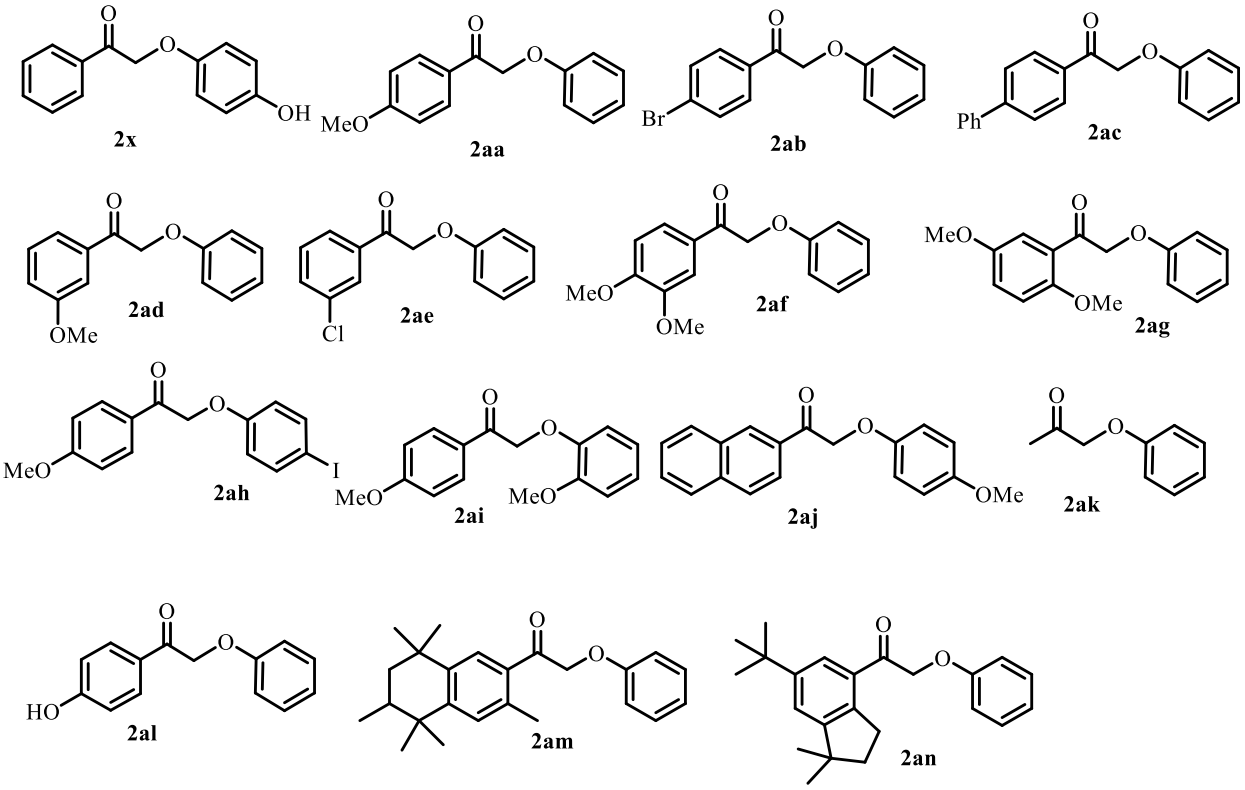
Synthesis of starting materials:

2-aminobenzyl alcohol employed in the reaction:

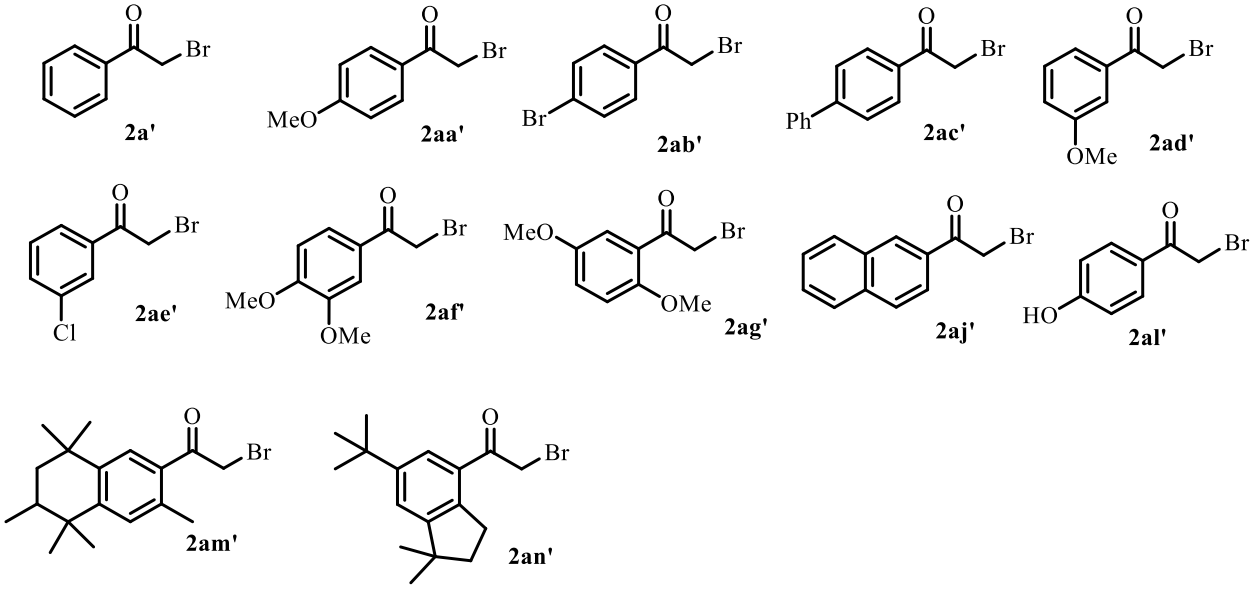


α-aryloxy, α-alkoxy, or α-hydoxy ketones substrates employed in the reaction:

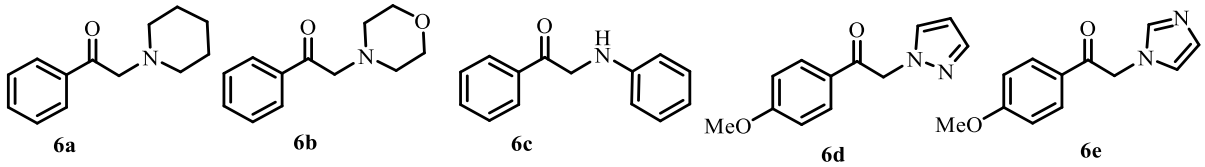




α-bromoacetophenone substrates employed in the reaction:

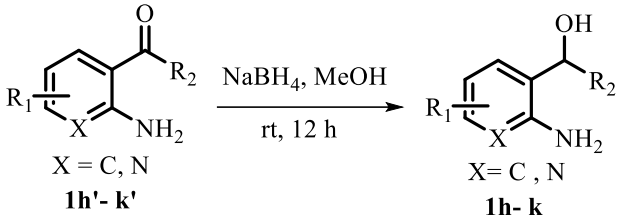


α-Amino ketones substrates employed in the reaction:



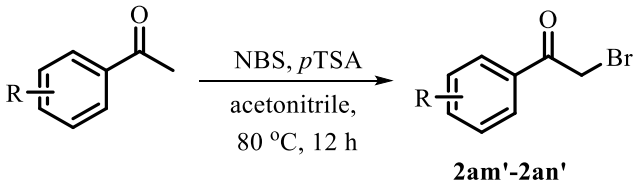
2. Experimental procedure for the synthesis of starting material:

General Procedure I (GP-I)



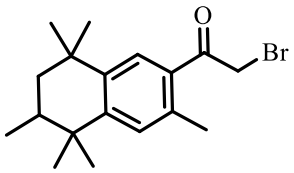
To a solution of substituted 2-aminoaryl ketone (1 equiv.) in methanol (2 mL), solid $NaBH_4$ (1.5 equiv.) was added at 0 ºC portion wise. After the completion of the addition, the reaction mixture was allowed to stirred for 12 h at room temperature. Then water was added to the reaction mixture, and extracted by using dichloromethane (5 mL). Afterwards, in the organic layer Na_2SO_4 was added to remove excess water. The corresponding product was obtained after removing the solvents under reduced pressure. Compound **1h-1k** were prepared by the following method.[3]

General Procedure II (GP-II)



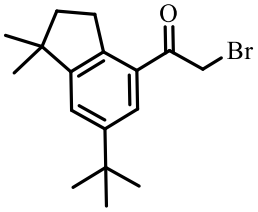
A mixture of acetophenone (2.0 mmol), *N*-bromosuccinimide (4.0 mmol), *p*-toluenesulfonic acid (1.0 mmol, 50 mol%), and acetonitrile (5 mL) was loaded in an oven-dried Schleck tube equipped with stirring bar. The reaction mixture was allowed to stirred at 90 ℃ for 12hrs. After completion of the reaction, all the volatiles were removed under reduced pressure and the compound was extracted from ethyl acetate and the crude reaction mixture was purified by column chromatography using ethyl acetate and petroleum ether as eluents to get the tittle compounds.

2-bromo-1-(3,5,5,6,8,8-hexamethyl-5,6,7,8-tetrahydronaphthalen-2-yl)ethan-1-one (2am'):



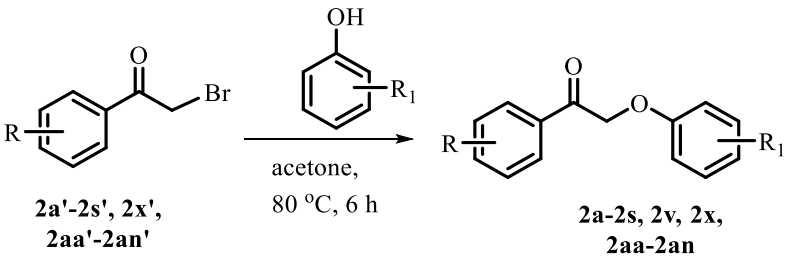
Using **GP-II** the title compound **2am'** was isolated as colourless liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:1, R_f = 0.40); (225 mg, 60%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.67 (s, 1H), 7.24 (s, 1H), 4.43 (s, 2H), 2.50 (s, 3H), 1.91 – 1.85(s, 1H), 1.67 – 1.64 (m, 1H), 1.61 – 1.59 (m, 1H), 1.33 (s, 6H), 1.27 (s, 3H), 1.08 (s, 3H), 1.00 (d, J = 6.8 Hz, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 193.7, 151.5, 142.6, 136.8, 131.6, 131.1, 128.5, 43.4, 38.2, 34.5, 34.2, 33.8, 32.5, 32.1, 28.4, 24.89, 21.69, 16.9. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{17}H_{24}BrO$ 336.1162; found 337.1168.

2-bromo-1-(6-(tert-butyl)-1,1-dimethyl-2,3-dihydro-1H-inden-4-yl)ethan-1-one (2an'):



Using **GP-II** the title compound **2an'** was isolated as colourless liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:1, R_f = 0.50); (257 mg, 80%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.71 (brs, 1H), 7.39 (s, 1H), 4.48 (s, 2H), 3.18 (t, J = 7.2 Hz, 2H), 1.95 (t, J = 7.2 Hz, 2H), 1.36 (s, 9H), 1.27 (s, 6H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 192.9, 155.1, 150.2, 142.5, 130.4, 124.9, 124.4, 43.6, 41.4, 34.9, 33.2, 31.6, 30.9, 30.2, 28.9. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{17}H_{24}BrO$ 323.1006; found 323.1004.

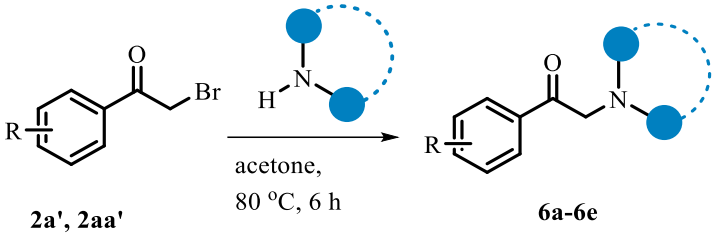
General Procedure III (GP-III)



A mixture of substituted phenacyl bromide (1.0 mmol, 1 equiv.), substituted phenol (1.5 mmol, 1 equiv.), K_2CO_3 (2.0 mmol, 1 equiv.) and acetone (5 mL) was taken in an oven-dried Schleck tube equipped with stirring bar. The reaction mixture was allowed to stirred at 80 °C for 6 hrs. After completion of the reaction, all the volatiles were removed under reduced pressure and the compound was extracted from ethyl acetate. Afterwards the organic layers were dried over Na_2SO_4

and removed under vacuum which give the corresponding compound. **2a-2s, 2v**, **2x, 2aa-2an** were prepared by following this method.[4,5] All compounds spectral data were in accordance with the literature.[4]

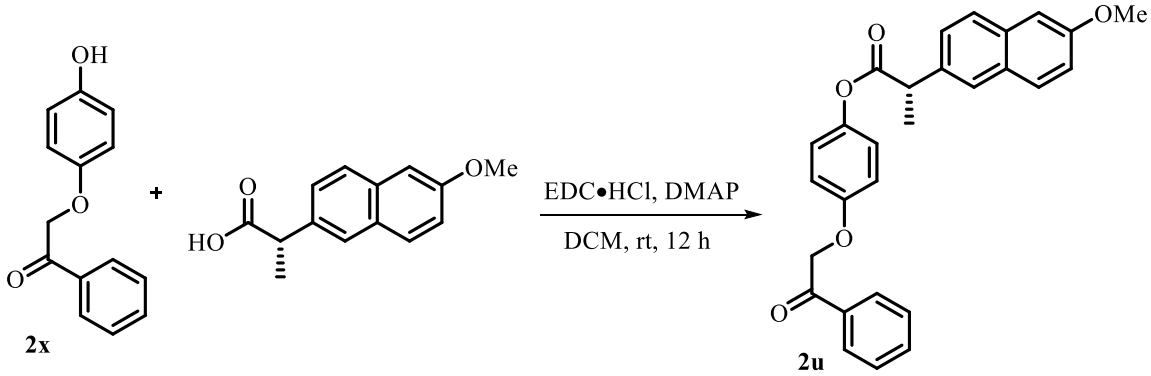
General Procedure IV (GP-IV)



2a', 2aa' **6a-6e**

A mixture of substituted phenacyl bromide (1.0 mmol, 1 equiv.), α-amino ketones (1.5 mmol, 1 equiv.), K_2CO_3 (2.0 mmol, 1 equiv.) and acetone (5 mL) was taken in an oven-dried Schleck tube equipped with stirring bar. The reaction mixture was allowed to stirred at 80 °C for 6 hrs. After completion of the reaction, all the volatiles were removed under reduced pressure and the compound was extracted from ethyl acetate. Afterwards the organic layers were dried over Na_2SO_4 and removed under vacuum which give the corresponding compound. **6a-6e** were prepared by following this method.[4] All compounds spectral data were in accordance with the literature.[6]

Synthesis of 4-(2-oxo-2-phenylethoxy)phenyl (S)-2-(6-methoxynaphthalen-2-yl)propanoate (2u):



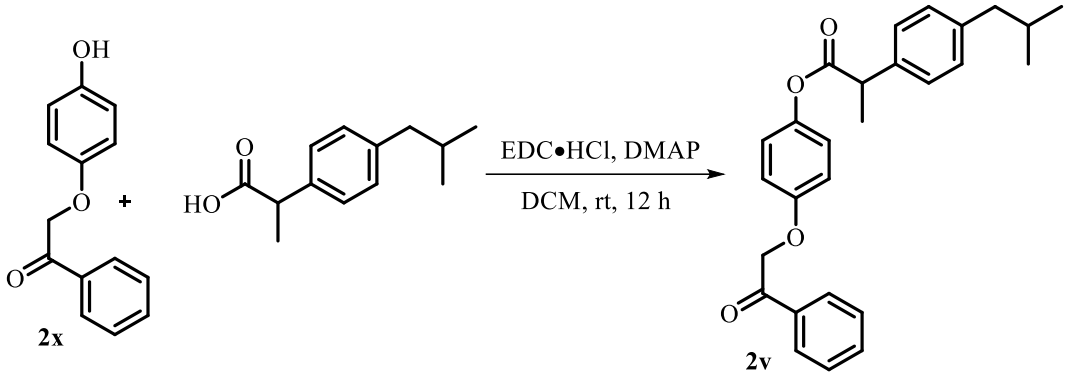
2x **2u**

In a pressure tube 2-(4-hydroxyphenoxy)-1-phenylethan-1-one (0.5 mmol, 1 equiv.) was taken in DCM (4.0 mL). To this (S)-2-(6-Methoxynaphthalen-2-yl)propanoic acid (1.0 mmol, 2 equiv.), EDC•HCl (1.5 mmol, 3 equiv.) and DMAP (0.13 mmol, 0.25 equiv.) was added. The reaction mixture was then stirred for 12 h at room temperature. After completion of the reaction the solution was concentrated in vacuo. The resulting crude compound was then purified by using silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 1:10, R_f = 0.40) to get the tittle compound **2u** as colourless liquid with 95% yield (209 mg).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.00 – 7.98 (m, 2H), 7.76 – 7.72 (m, 2H), 7.63 – 7.59 (m, 1H), 7.51 – 7.49 (m, 3H), 7.15 – 7.14 (m, 1H), 6.83 – 6.79 (m, 3H), 6.74 – 6.71 (m, 3H), 5.22 (s, 2H),

4.10 – 4.08 (m, 1H), 3.92 (s, 2H), 1.68 (d, J = 7.2 Hz, 3H).$^{13}C\{^1H\}$ NMR (151 MHz, $CDCl_3$): δ 195.4, 174.2, 157.8, 153.6, 152.1, 150.8, 134.6, 134.1, 133.9, 129.5, 129.0, 128.2, 127.5, 126.3, 126.2, 122.3, 119.2, 116.3, 116.2, 116.0, 105.7, 71.8, 55.5, 45.6, 18.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{28}H_{25}NO_5$ 441.1697; found 441.1706.

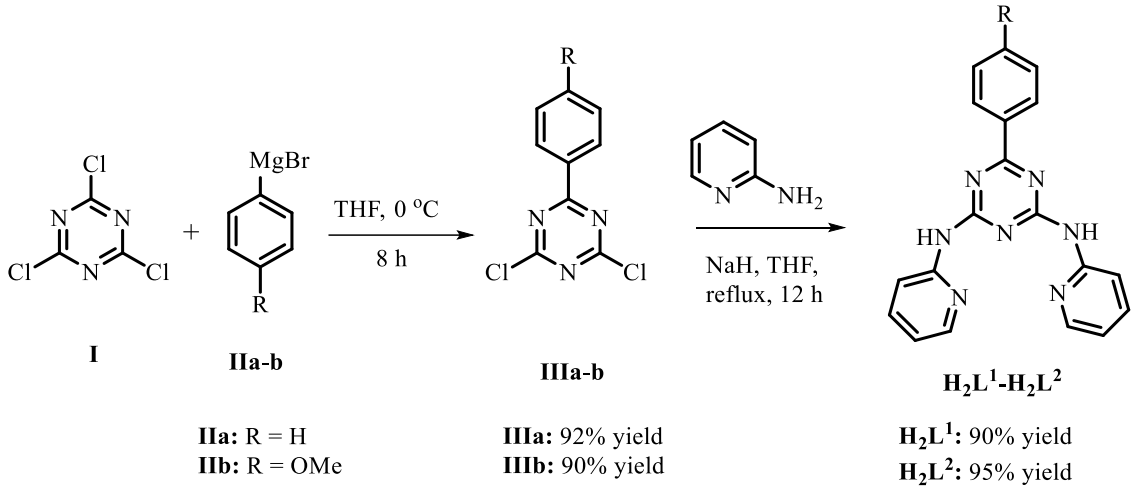
Synthesis of 4-(2-oxo-2-phenylethoxy)phenyl 2-(4-isobutylphenyl)propanoate (2v):



In a pressure tube 2-(4-hydroxyphenoxy)-1-phenylethan-1-one (0.5 mmol, 1 equiv.) was taken in DCM (4.0 mL). To this 2-(4-isobutylphenyl)propanoic acid (1.0 mmol, 2 equiv.), EDC•HCl (1.5 mmol, 3 equiv.) and DMAP (0.13 mmol, 0.25 equiv.) was added. The reaction mixture was then stirred for 12 h at room temperature. After completion of the reaction the solution was concentrated in vacuo. The resulting crude compound was then purified by using silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 1:10, R_f = 0.40) to get the tittle compound **2v** as colourless oil with 92% yield (191 mg).

^1H NMR (600 MHz, $CDCl_3$): δ 7.99 – 7.97 (m, 2H), 7.61 (t, J = 7.2 Hz, 1H), 7.49 (t, J = 7.8 Hz, 2H), 7.28 (d, J = 8.4 Hz, 2H), 7.13 (d, J = 7.8 Hz, 2H), 6.92 – 6.89 (m, 4H), 5.23 (s, 2H), 3.91 (q, J = 7.2 Hz, 1H), 2.46 (d, J = 7.2 Hz, 2H), 1.88 – 1.85 (m, 1H), 1.59 (d, J = 7.2 Hz, 3H), 0.91 (d, J = 6.6 Hz, 6H). $^{13}C\{^1H\}$ NMR (151 MHz, $CDCl_3$): δ 194.5, 173.6, 155.7, 145.3, 140.9, 137.4, 134.1, 129.6, 129.0, 128.3, 127.3, 122.5, 115.6, 71.4, 45.3, 45.2, 30.3, 22.5, 18.7. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{27}H_{29}NO_3$ 417.2061; found 417.2065.

Synthesis of ligands H_2L^1-H_2L^2



Scheme S1. Ligand synthesis

Synthesis of H_2L^1:

Sodium hydride (60% suspension in paraffin oil, 0.512 g, 12.8 mmol, 3.0 equiv) was taken in a dry two neck flask and washed with dry petroleum ether to remove the paraffin oil. 2-aminopyridine (0.80 g, 8.54 mmol, 2 equiv) was added to the stirred suspension of sodium hydride in THF (10 mL) and refluxed over night for the complete deprotonation the 2-aminopyridine. Afterwards the reaction mixture was brought to room temperature. A solution of 2,4-dichloro-6-phenyl-1,3,5-triazine **IIIa** (0.96 g, 4.27 mmol, 1 equiv) in dry THF (20 mL) was added dropwise to the reaction mixture. The resultant solution was refluxed for 12 hours. The reaction mixture was then quenched with water and extracted three times with ethyl acetate (3 × 20 mL). Solvent was removed under reduced pressure and washed with water to give grey powder of **H_2L^1** (1.33 g, 92%).

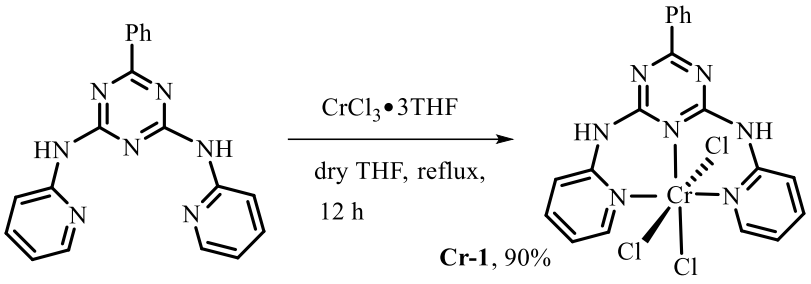
^{1}H NMR (600 MHz, $CDCl_3$): δ 8.53 – 8.48 (m, 6H), 7.82 (t, J = 8.4 Hz, 2H), 7.60 (t, J = 7.2 Hz, 1H), 7.55 (t, J = 7.8 Hz, 2H), 7.08 – 7.06 (m, 2H). ^{13}C NMR (151 MHz, $CDCl_3$): δ 172.9, 164.5, 148.3, 138.0, 132.3, 128.9, 128.7, 118.7. HRMS (ESI) *m/z:* $[M+H]^+$ calculated for $C_{19}H_{16}N_7$: 342.1462; found 342.1459.

Synthesis of H_2L^2:

Sodium hydride (60% suspension in paraffin oil, 0.512 g, 12.8 mmol, 3.0 equiv) was taken in a dry two neck flask and washed with dry petroleum ether to remove the paraffin oil. 2-aminopyridine (0.80 g, 8.54 mmol, 2 equiv) was added to the stirred suspension of sodium hydride in THF (10 mL) and refluxed over night for the complete deprotonation the 2-aminopyridine. Afterwards the reaction mixture was brought to room temperature. A solution of 2,4-dichloro-6-(4-methoxyphenyl)-1,3,5-triazine **IIIb** (1.09 g, 4.27 mmol, 1 equiv) in dry THF (20 mL) was added dropwise to the reaction mixture. The resultant solution was refluxed for 12 hours. The reaction mixture was then quenched with water and extracted three times with ethyl acetate (3 × 20 mL). Solvent was removed under reduced pressure and washed with water to give light orange powder of **H_2L^2** (1.50 g, 90%).

^{1}H NMR (600 MHz, $CDCl_3$): δ 8.50 – 8.48 (m Hz, 4H), 8.44 (d, J = 9.0 Hz, 2H), 7.79 – 7.77 (m, 2H), 7.05 – 7.02 (m, 4H), 3.91 (s, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 171.6, 164.3, 163.2, 152.5, 148.3, 138.0, 130.7, 118.6, 114.0, 55.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{20}H_{18}N_7O$ 372.1568; found 372.1569.

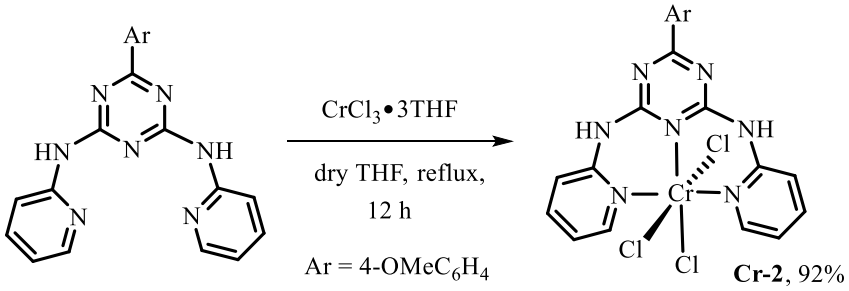
Synthesis of Cr-1:



Scheme S2. Synthesis of complex **Cr-1**

Procedure: A mixture of $CrCl_3$•3THF (0.375 g, 1.0 mmol, 1 equiv) and $\mathbf{H_2L^1}$ (0.341 g, 1.0 mmol, 1 equiv) was taken in a round bottom flask equipped with stirring bar. and under nitrogen flow dry THF (5mL) was added to the mixture and refluxed for 12 hours with continuous stirring. It was then brought to ambient temperature. The resulting mixture was filtered and the filtrate was collected and removed the solvent in vacuum to afford dark brown solid. Solvent was removed in vacuum to afford olive green solid. Slow diffusion of diethyl ether in DMF gave **Cr-1** as green crystal (0.448 g, 90%). The complex was stable in air and moisture. HRMS (ESI) *m/z*: $[M–Cl]^+$ calculated for $C_{19}H_{15}Cl_2N_7Cr$ 463.0171; found: 463.0170.

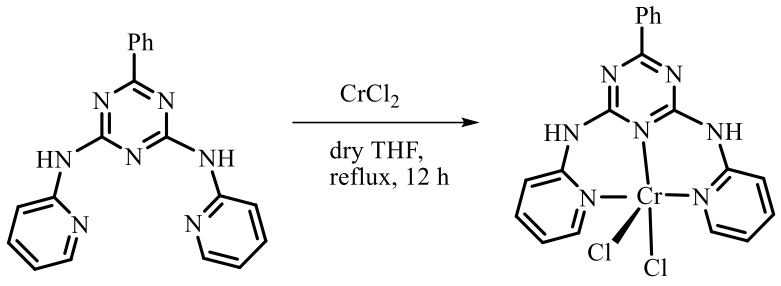
Synthesis of Cr-2:



Scheme S3. Synthesis of complex **Cr-2**

Procedure: A mixture of $CrCl_3$•3THF (0.375 g, 1.0 mmol, 1 equiv) and $\mathbf{H_2L^2}$ (0.371 g, 1.0 mmol, 1 equiv) was taken in a round bottom flask equipped with stirring bar. and under nitrogen flow dry THF (5mL) was added to the mixture and refluxed for 12 hours with continuous stirring. It was then brought to ambient temperature. The resulting mixture was filtered and the filtrate was collected and removed the solvent in vacuum to afford dark brown solid. Solvent was removed in vacuum to afford olive green solid. Slow diffusion of diethyl ether in DMF afforded **Cr-2** as green crystal (0.484 g, 92%). The complex was stable in air and moisture. HRMS (ESI) *m/z*: $[M–Cl]^+$ calculated for $C_{20}H_{17}Cl_2N_7OCr$ 493.0277; found: 493.0274.

Synthesis of Cr-3:

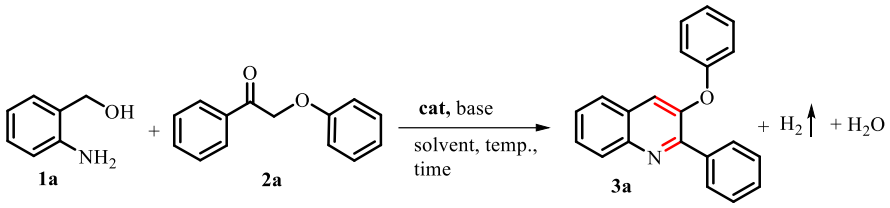


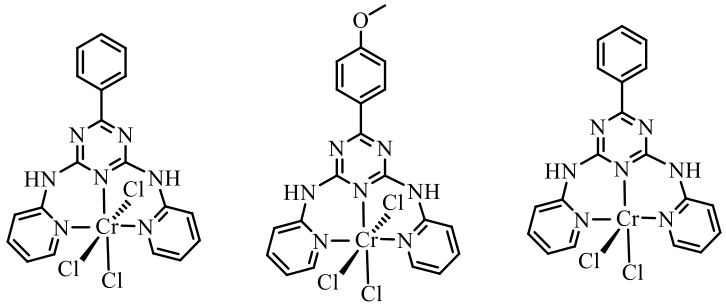
Cr-3, 85%

Procedure: A mixture of anhydrous $CrCl_2$ (0.111 g, 1.0 mmol, 1 equiv) and **H_2L^1** (0.341 g, 1.0 mmol, 1 equiv) was taken in a round bottom flask equipped with stirring bar. Under nitrogen atmosphere, dry THF (5 mL) was added to the mixture and refluxed for 12 hours with continuous stirring. It was then brought to ambient temperature. The resulting mixture was filtered and the filtrate was collected and removed the solvent in vacuum to afford green solid. Solvent was removed in vacuum to afford green solid. HRMS (ESI) *m/z*: $[M]^+$ calculated for $C_{31}H_{15}Cl_2N_7Cr$ 463.0171; found: 463.0167.

3. Synthetic scope of acceptorless dehydrogenative coupling reactions

Table S1. Optimization studies[a]



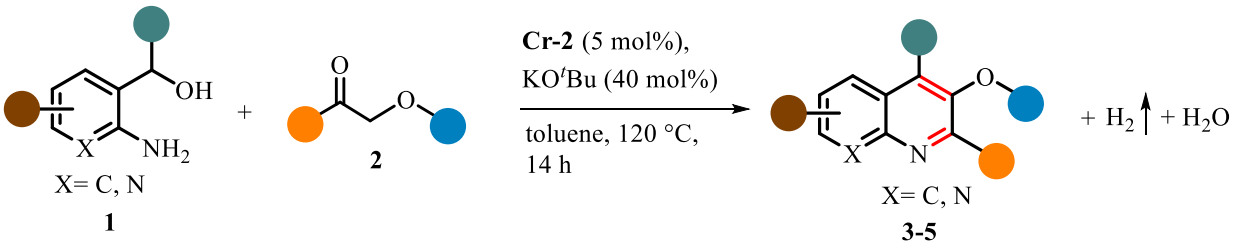


Entry	**cat.** (mol%)	KO^{t}Bu (mol%)	temp (°C)	time (h)	yield (%)
1	**Cr-1** (5)	40	120	14	79%
2	**Cr-2** (5)	40	120	14	86%
3	**Cr-3** (5)	40	120	14	75%
4	**$CrCl_3$•3THF** (5)	40	120	14	68%

	+ **H_2L^1** (5)				
5	**$CrCl_3$•3THF** (5) + **H_2L^2** (5)	40	120	14	71%
6	**Cr-2** (5)	40	110	14	60%
7	**Cr-2** (5)	40	100	14	35%
8	**Cr-2** (5)	40	90	14	11%
9	**Cr-2** (5)	30	120	14	64%
10	**Cr-2** (2)	40	120	14	43%
11	**$CrCl_3$•3THF** (5)	40	120	14	20%
12	**$CrCl_3$•$6H_2O$** (5)	40	120	14	15%
13	**Cr-2** (5)	40	120	8	53%
14	–	40	120	14	13%, 0%[b]
15	**Cr-2** (5)	–	120	14	n.d.
16	**Cr-2** (5)	40	120	14	46%[c]

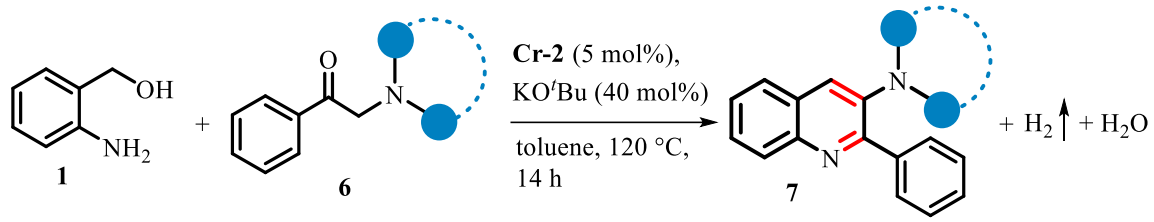
[a]Reaction conditions: **1b** (1 mmol), **2a** (1 mmol), KO^{t}Bu (x mol%), toluene (2 mL) were heated in a closed 50 mL reaction tube for given time. Isolated yield. **H_2L^2** is [6-(4-methoxyphenyl)-N^2, N^4-di(pyridin-2-yl)-1,3,5-triazine-2,4-diamine].[2] [b]Under air-free conditions. [c]In xylene at 150 °C.

General procedure for synthesis of 3-oxo quinolines (GP-V)



In a reaction tube a mixture of substituted 2-aminoaryl alcohol **1** (0.4 mmol, 1 equiv.), α-substituted ketone **2** (0.4 mmol, 1 equiv.), **Cr-2** (5 mol%), KO^{t}Bu (40 mol%), toluene (2 mL) were taken. The reaction tube was properly closed under air and placed in a preheated oil bath at 120 °C with continuous stirring for 14 h. The resulting mixture was then passed through a bed of celite, the filtrate was collected and concentrated under reduced pressure. The crude reaction mixture was purified by column chromatography over silica gel using petroleum ether or ethyl acetate/ petroleum ether mixture as an eluent.

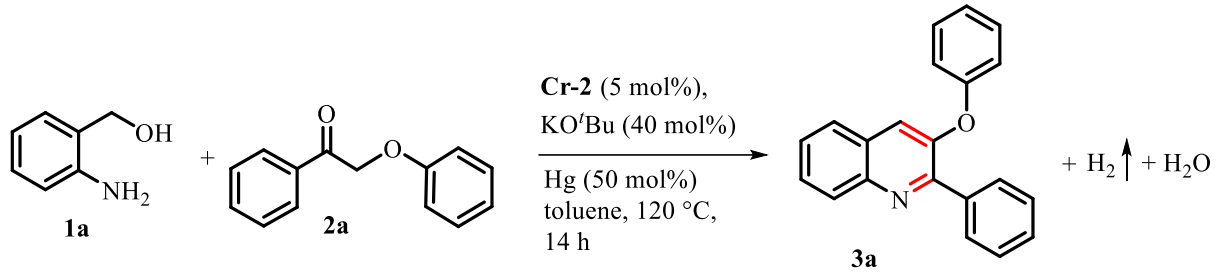
General procedure for synthesis of 3-amino quinolines (GP-VI)



In a reaction tube a mixture of substituted 2-aminobenzylalcohol **1** (0.4 mmol, 1 equiv.), substituted α-amino ketone **6** (0.4 mmol, 1 equiv.), **Cr-2** (5 mol%), KO^{t}Bu (40 mol%), toluene (2 mL) were taken. The reaction tube was properly closed under air and placed in a preheated oil bath at 120 ºC with continuous stirring for 14 h. The resulting mixture was then passed through a bed of celite, the filtrate was collected and concentrated under reduced pressure. The crude reaction mixture was purified by column chromatography over silica gel using petroleum ether or ethyl acetate/ petroleum ether mixture as an eluent.

4. Mechanistic studies

4.1. Mercury drop test

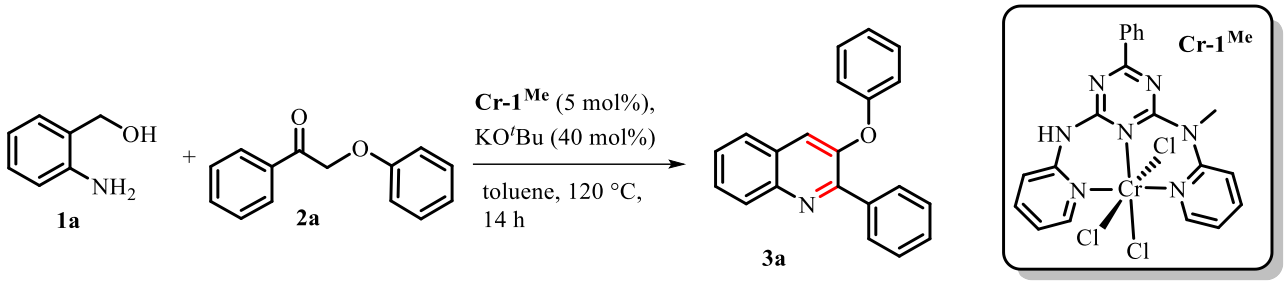


Scheme S4. Mercury drop experiment

To establish the homogeneity of **Cr-2** in ADC reaction of 2-aminobenzylalcohol and α-aryloxy ketone mercury drop experiment was carried out.

Experimental procedure for 3a: In this test, the reaction tube was charged with 0.4 mmol of **1a** (50 mg), 0.4 mmol of **2a** (85 mg), 0.2 mmol of mercury (50 mg), 40 mol% of KO^{t}Bu (18 mg) and 5 mol% of complex **Cr-2** (11 mg) along with 2 mL of toluene. The whole reaction mixture was then allowed to heated at 120 ºC for 14 h in an oil bath. The product **3a** was obtained in 73% of yield (86 mg), suggests that homogenous behavior of the catalyst.

4.2. The influence of the NH functionality in chromium complex



Scheme S5. The impact of the –NH functionality in catalysis

Experimental procedure for 3a: A mixture of **1a** (0.4 mmol, 1 equiv.), **2a** (0.4 mmol, 1 equiv.), **Cr-1^{Me}** (5 mol%), KO^{t}Bu (40 mol%) and toluene (2 mL) was added into a reaction tube equipped with stirring bar. The reaction tube was properly closed and placed in a preheated oil bath at 120 ºC with continuous stirring for 14 hours. The resulting mixture was then passed through a bed of celite, the filtrate was collected and concentrated under reduced pressure. Analytically pure product (32 mg, 30%) was obtained by column chromatography over silica gel using ethyl acetate /petroleum ether mixture as an eluent.

4.3. Detection of evolved gas by GC-Thermal Detector (GC-TCD):

A mixture of 2-aminobenzyl alcohol, **1a** (246 mg, 2.0 mmol, 1.0 equiv.), 2-phenoxy-1-phenylethan-1-one, **2a** (424 mg, 2.0 mmol, 1 equiv.), **Cr-2** (5 mol %), KO^{t}Bu (40 mol%) was added into a pressure tube (50 mL) equipped with stirring bar. The reaction tube was then properly closed without exclusion of air and kept it in a preheated oil bath at 120 ℃ with continuous stirring for 14 hours. After completion of the reaction, the pressure tube was cooled at 0 °C, the evolved gas was syringe out and detected from PerkinElmer clarus-590 GC instrument using Elite Plot-Q column (30 m length x 530 µm x 20 µm ID) employing the following method:

TCD starting temperature: 40 °C

Oven temperature: 60 °C

Time at starting temperature: 0 min

Hold time: 5 min

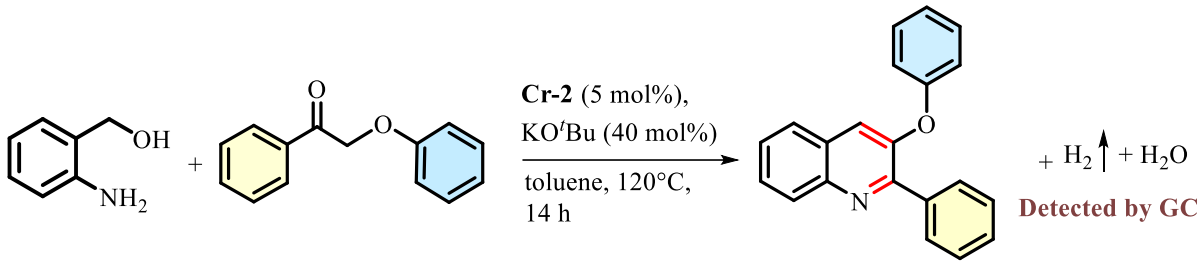
Ramp: 28 °C/ min up to 200 °C

Flow rate: 5 ml/ min (N_2)

Split ration: 20

Inlet temperature: 40 °C

Detector temperature TCD: 200 °C



Scheme S6. Detection of evolved gas by GC

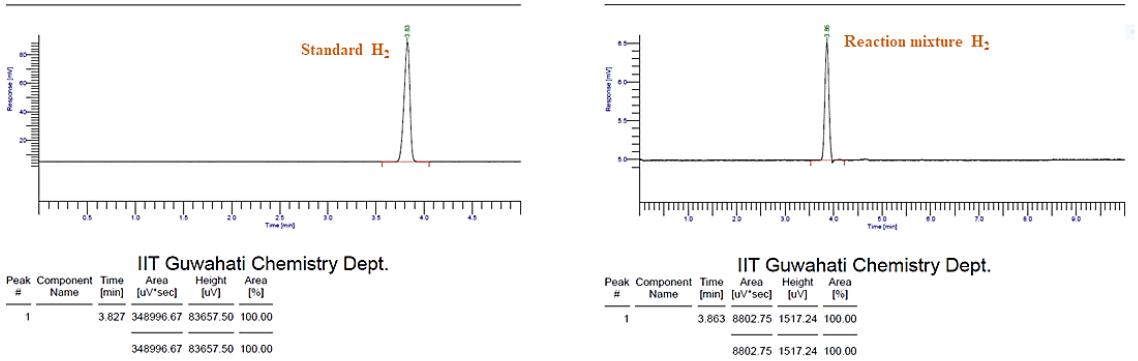


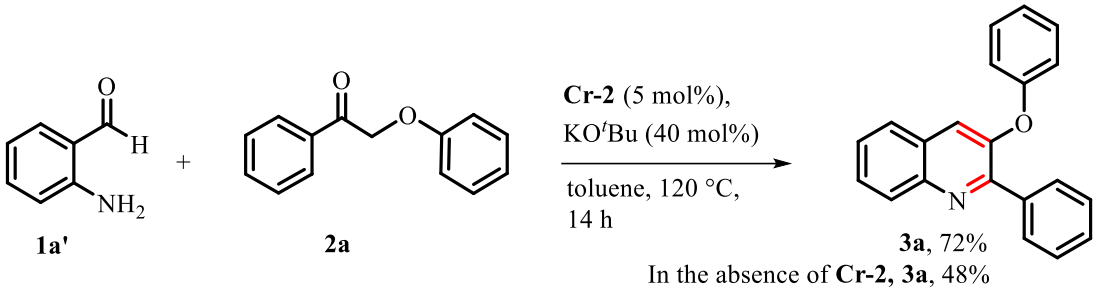
Figure S1. GC-TCD analysis of the standard H_2 gas and H_2 gas evolved from the reaction mixture.

Hydrogen gas quantification- A volumetric quantitative analysis:

The volumetric quantification of hydrogen gas was accomplished according to the previously reported literature methods.[7] A mixture of 2-aminobenzylalcohol **1a** (1 mmol, 1equiv.), 2-phenoxy-1-phenylethan-1-one, **2a** (1.0 mmol, 1 equiv.), **Cr-2** (5 mol%) KO^{t}Bu (40 mol%) was added into schenck flask (10 mL) equipped with stirring bar after that 2 mL of toluene was added to the reaction mixture and joined with a one neck adapter condenser set up. The adapter was connected to the gas collection apparatus (standard water displacement apparatus, using a graduated cylinder to determine the volume) and the entire system was flushed with argon for 5 minutes and allowed to equilibrate for 5 minutes. The reaction vessel was placed in a preheated oil-bath to the appropriate temperature (120 °C). The reaction was stirred vigorously at a constant temperature until gas evolution ceased. The volume of collected gas was noted. After 14 h, the reaction mixture was removed from preheated oil-bath, subjected to cool at room temperature. The desired compound was purified by using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2) with 86% of yield. The collected volume of gas in that experiment was 23 mL. The experiment was repeated twice to obtain consistent readings and the number of moles of hydrogen was evolved was calculated considering the vapor pressure of water at 298 K = 23.7695 Torr. Volume of water displaced = 23 mL. Atmospheric Pressure = 758.3124 Torr, R = 62.3635 L Torr K^{-1} mol^{-1}

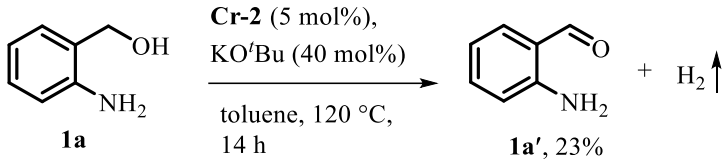
$nH_2 = [(P_{atm} - P_{water}) \times V] / RT = 0.00090$ moles = 0.90 mmoles. The yield of molecular hydrogen 90%.

4.4. Proof for the formation of intermediate 2-amino benzaldehyde



Scheme S7. Proof for the formation of 2-amino benzaldehyde intermediate in catalysis

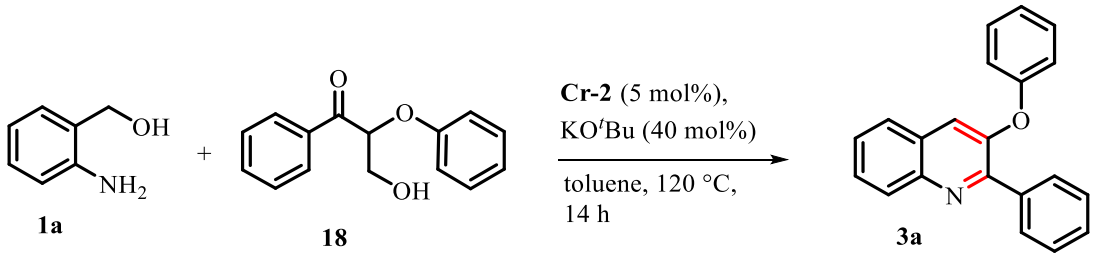
Experimental procedure for 3a: A mixture of **1a'** (0.4 mmol, 1 equiv.), **2a** (0.4 mmol, 1 equiv.), **Cr-2** (5 mol%), KO^{t}Bu (40 mol%) and toluene (2 mL) was loaded into the reaction tube and heated at 120 ℃ for 14 h. The product **3a** was isolated in 72% of yield. In the absence of **Cr-2**, product **3a** was isolated in 48% yield.



Scheme S8. Proof for the formation of 2-amino benzaldehyde intermediate

Experimental procedure for 1a': A mixture of **1a** (0.4 mmol, 1 equiv.), **Cr-2** (5 mol%), KO^{t}Bu (40 mol%) and toluene (2 mL) was loaded into the reaction tube and heated at 120 ℃ for 14 h. The product **1a'** was isolated in 23% yield.

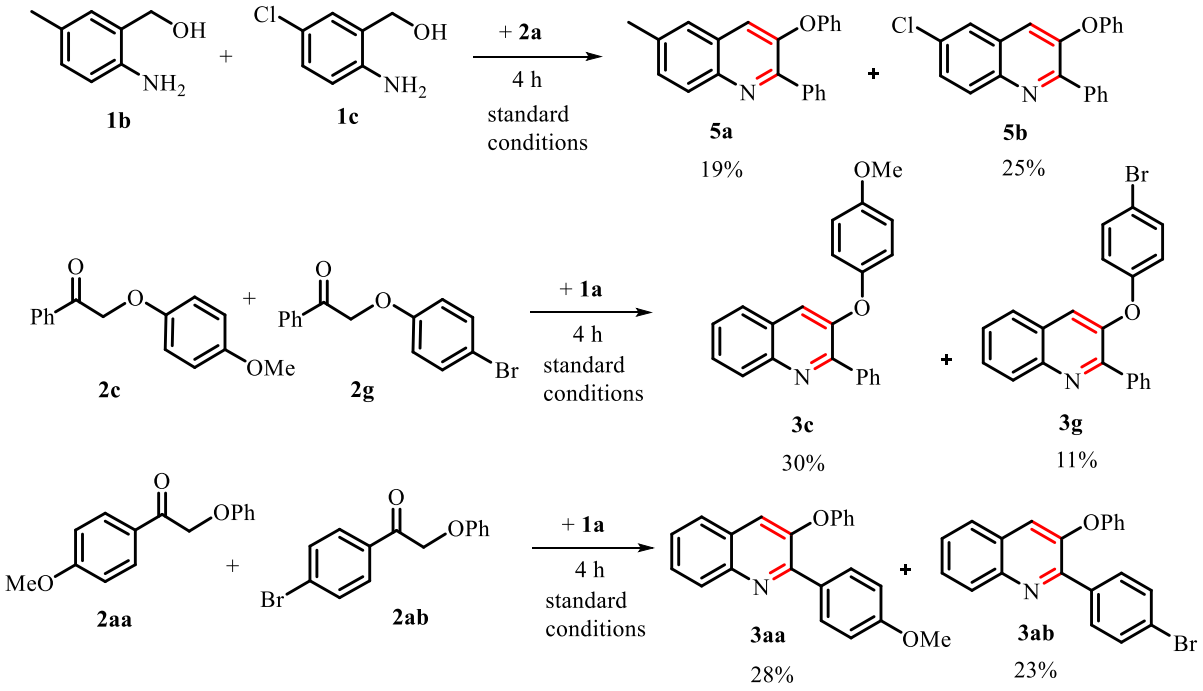
4.5. Reaction with *β*-O-4′ lignin model (18):



Scheme S9. Reaction with β-O-4′ lignin model

Experimental procedure for 3a: A mixture of **1a'** (0.4 mmol, 1 equiv.), **18** (0.4 mmol, 1 equiv.), **Cr-2** (5 mol%), KO^{t}Bu (40 mol%) and toluene (2 mL) was loaded into the reaction tube and heated at 120 ℃ for 14 h. The product **3a** was isolated in 21% of yield.

4.6. Competitive cyclization reaction with electronically different substrates

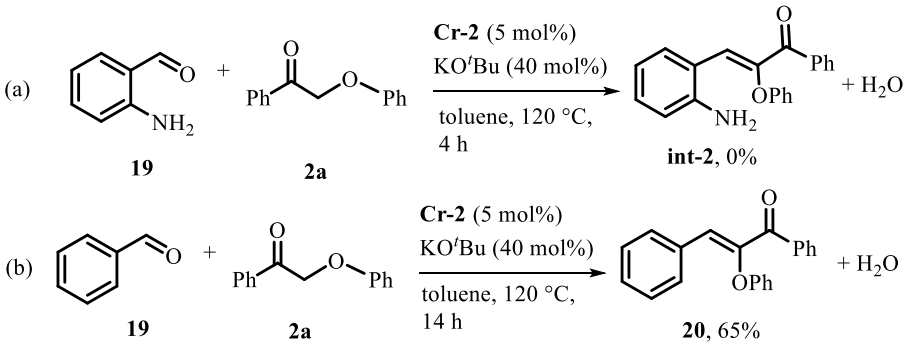


Scheme S10. Competitive cyclization reaction with electronically different substrates

Reaction conditions: In an oven-dried reaction tube, a mixture of substituted 2-aminobenzyl alcohol (1 mmol, 1 equiv.), substituted α-aryloxy (1 mmol, 1 equiv.), KO^{t}Bu (40 mol%), **Cr-2** (5 mol%), and toluene (2 mL) were taken. The reaction tube was properly closed and placed in a preheated oil bath at 120 ℃ for 4 h. The compound **5a, 5b**, **3c, 3g, 3aa, 3ab** were isolated in each case after specified time.

It has been observed that the electron-withdrawing group (-Cl) on the aminobenzyl alcohol afforded higher yield with respect to an electron-donating group (-Me) and the electron donating group (-OMe) on the *C*-terminal and *O*-terminal benzene ring bearing phenoxy acetophenone enhanced the reaction rate with respect to an electron-withdrawing substituent (-Br).

4.7. Proof for the formation of intermediate unsaturated ketone



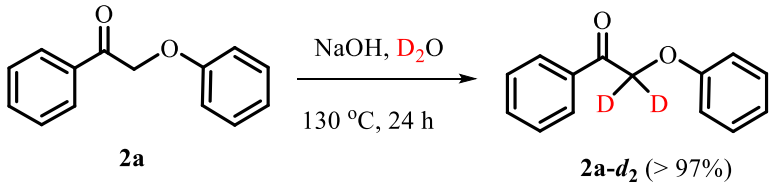
Scheme S11. Proof for the formation of unsaturated ketone

Reaction conditions for (a): In an oven-dried reaction tube, a mixture of 2-aminobenzaldehyde **1a'** (1 mmol, 1 equiv.), 2-phenoxyacetophenone **2a** (1 mmol, 1 equiv.), KO^{t}Bu (40 mol%), **Cr-2** (5 mol%), and toluene (2 mL) were taken. The reaction tube was properly closed and placed in a preheated oil bath at 120 ℃ for 4 h. The unsaturated ketone **int-2** was not obtained.

Reaction conditions for (b): In an oven-dried reaction tube, a mixture of benzaldehyde **19** (1 mmol, 1 equiv.), 2-phenoxyacetophenone **2a** (1 mmol, 1 equiv.), KO^{t}Bu (40 mol%), **Cr-2** (5 mol%), and toluene (2 mL) were taken. The reaction tube was properly closed and placed in a preheated oil bath at 120 ℃ for 14 h. The unsaturated ketone **20** was isolated in 65% yield.

4.8. Deuterium-labeling experiments

a) Synthesis of deuterated 2-phenoxy-1-phenylethan-1-one 2a-*d*$_2$:



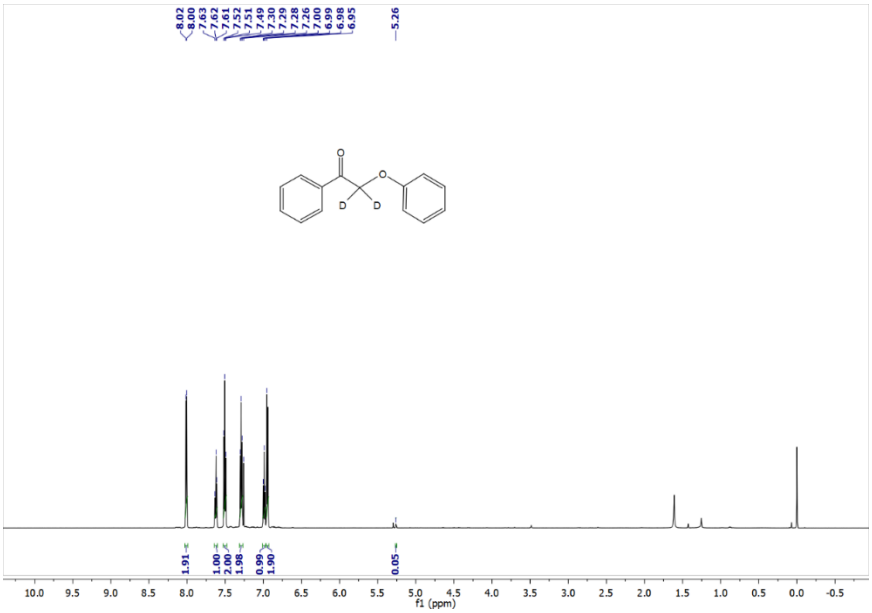
2a **2a-*d*$_2$** (> 97%)

Scheme S12. Synthesis of **2a-*d*$_2$**

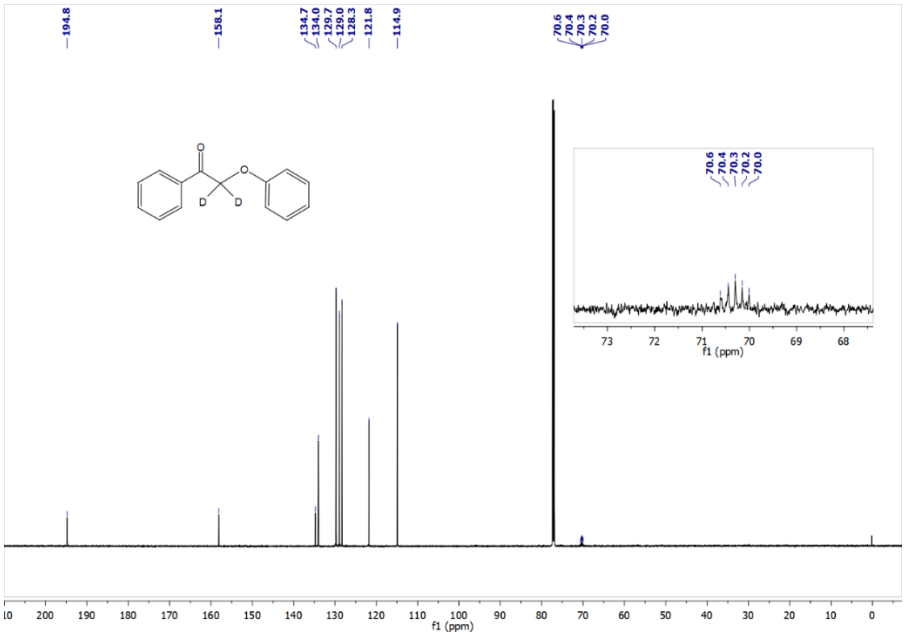
Procedure: In a pyrex tube degassed D_2O (99.9% D, 3 mL) was taken and to it under nitrogen flow a mixture of 2-phenoxy-1-phenylethan-1-one **2a** (424 mg, 2 mmol) and NaOH (40 mg, 1.0 mmol) was added. The reaction tube was properly closed and placed in a preheated oil bath at 130 ºC with continuous stirring for 24 hours under nitrogen atmosphere. Upon completion of the reaction, the reaction mixture was extracted with chloroform (5 mL × 3) and dried over Na_2SO_4. The solvent was evaporated under vacuum to afford the desired product **2a-*d*$_2$** (93%, 390mg) with 97% D as a light brown solid.

^{1}H NMR (600 MHz, $CDCl_3$): δ 8.01 (d, J = 7.2 Hz, 2H), 7.62 (t, J = 7.2 Hz, 1H), 7.51 (t, J = 7.8 Hz, 2H), 7.29 (t, J = 8.4 Hz, 2H), 6.99 (t, J = 7.2 Hz, 1H), 6.95 (d, J = 8.4 Hz, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 194.8, 158.1, 129.7, 129.0, 128.3, 121.8, 115.0, 70.6 – 70.0 (m).

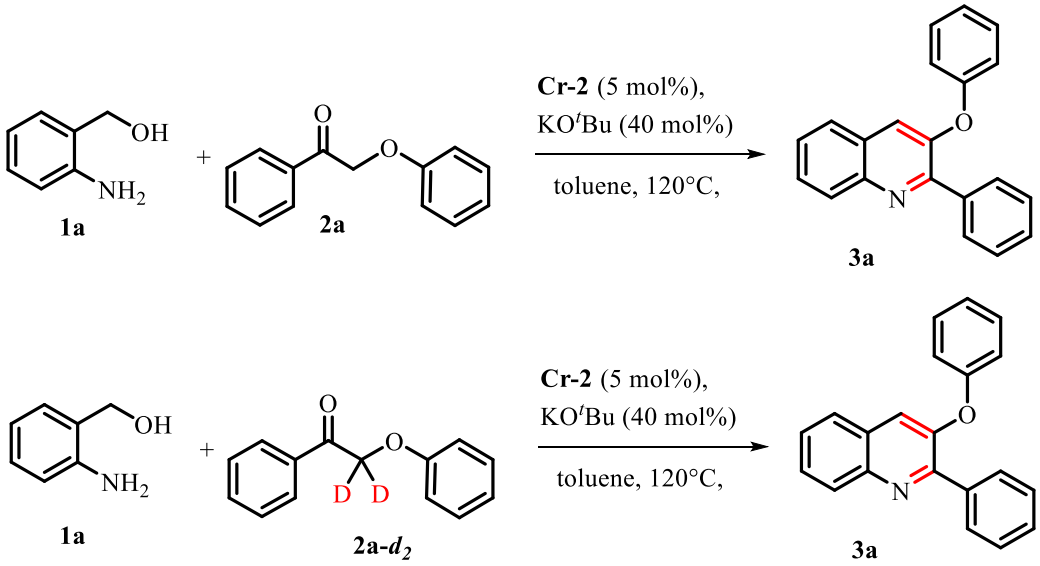
^{1}H NMR spectrum of **2a-*d*$_2$** ($CDCl_3$, 600 MHz, 298 K)**:**



^{13}C{^{1}H} NMR spectrum of **2a-*d*$_2$** ($CDCl_3$, 151 MHz, 298 K):



b) Deuterium kinetic isotope effect (DKIE) experiment:



Scheme S13. DKIE studies

By following the standard catalytic procedure, two parallel reactions were performed by using **2a** (1 mmol) and **2a-*d*$_2$** (1.0 mmol) as substrates. Then the compound **3a** was isolated at different time intervals. Then the initial rates of product formation were obtained from the plot of the concentration of product *vs* time (Figure S2). The $k_H/k_D = 2.62 \pm 0.26$ was obtained by comparing the initial rates of these two reactions.

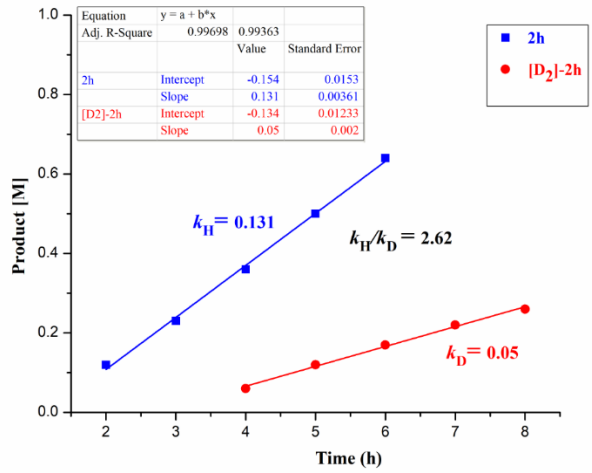


Figure S2. Concentration [Product] *vs* time plot of ADC reactions of **2a** and **2a-*d*$_2$**

4.9. Synthesis and spectroscopic characterization for active chromium species:

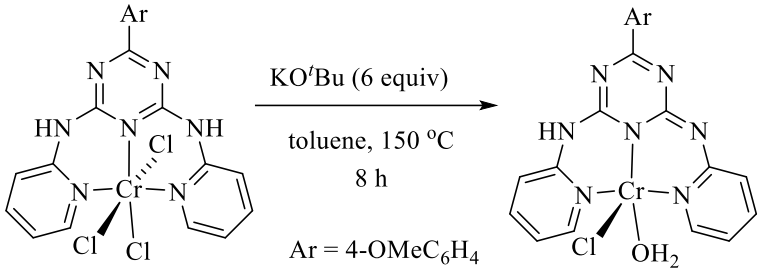
Magnetic moment of Cr-2 and Cr-2' in solution (using Evan's method):

Magnetic moment of **Cr-2** and **Cr-2'** in solution was measured according to NMR method described by Evans.[2]

For **Cr-2**:

A solution of **Cr-2** (2.9 mg, 0.0055 mmol) in a 1 mL mixture of DMSO-d_6/^{t}BuOH (98:2) was prepared and loaded in the NMR tube. To the same NMR tube a capillary containing 2% ^{t}BuOH in DMSO-d_6 solution was put in. Then NMR spectrum was measured at 25 ºC on a Bruker 600 MHz NMR spectrometer. A chemical shift difference of the ^{t}BuOH signal between the inner and outer tubes was observed at 90 Hz. The magnetic moment was calculated using the following equation: $\mu_{eff} = 798\sqrt{(\chi_M T)}$, $\chi_M = (3\Delta f)/(1000fc)$, T = 298 K, f = frequency of NMR instrument in MHz, Δf = paramagnetic shift of the solvent in Hz, c = molar concentration of the complex. $\mu_{eff} = 798\sqrt{(\chi_M T)} = (4.91 \times 10^{-3} \times 798) = 3.92$ B.M. The magnetic moment for **Cr-2** was obtained as 3.92 B.M.

For **Cr-2'**: The sample for **Cr-2'** was obtained by the reaction of complex **Cr-2** (4.1 mg, 1 equiv.), KO^{t}Bu (6 equiv.), in dry toluene (0.5 mL) at 120 ºC in an oil bath for 14 h under the nitrogen atmosphere. After removal of the volatiles under reduced pressure, the compound was loaded in 1 mL mixture of DMSO-d_6/^{t}BuOH (98:2) and then the magnetic moment of the **Cr-2'** was measured as mentioned above. NMR spectrum was measured at 25 ºC on a Bruker 600 MHz NMR spectrometer. A chemical shift difference of the ^{t}BuOH signal between the inner and outer tubes was observed at 198 Hz. The magnetic moment was calculated for **Cr-2'** using above equation. $\mu_{eff} = 798\sqrt{(\chi_M T)} = (6.13 \times 10^{-3} \times 798) = 4.9$ B.M. The result is in agreement with the line of HS Cr(II) species.



Cr-2
precatalyst
(EPR active)
μ_{eff} = 3.9 B.M

Cr-2'
active catalyst
(EPR silent)
μ_{eff} = 4.9 B.M

EPR Study:
To gain more insight into the active chromium species [Cr(III) or Cr(II)] in the catalytic cycle, a titration experiment was performed by adding a base into precatalyst **Cr-2**, and monitoring the EPR spectra. Upon loading the base, the paramagnetic signal of chromium(III) is disappeared and formed EPR-silent chromium (II) species. Due to non-Kramers S = 2 ground states, it is expected not to observe EPR signal.

Experimental procedure: The reaction tube was equipped with a stir bar, complex **Cr-2** (10 mg, 1 equiv), KO^{t}Bu (6 equiv.), and toluene (0.5 mL). The reaction mixture was stirred at 120 ºC for 14 h in an oil bath. The resulting solution was cooled to room temperature; all the volatile was

removed under reduced pressure. The obtained green residue was then dissolved in toluene (0.5 mL) and subjected for EPR analysis at 298 K.

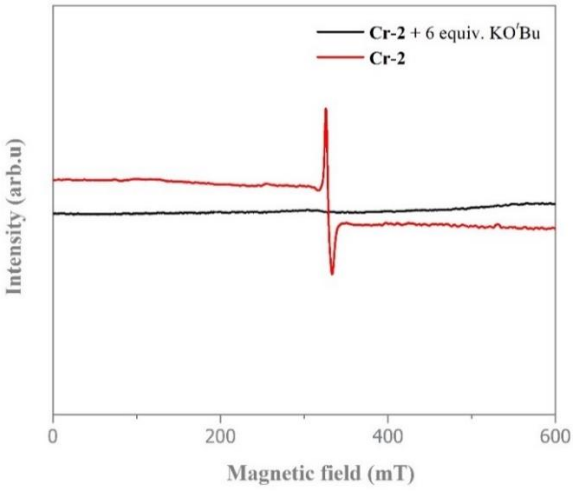


Figure S3. EPR spectrum of **Cr-2** (red) and **Cr-2** with base (black). X-band microwave frequency (GHz): 9.14, modulation frequency (KHz): 100.

HRMS Study:

Procedure: The reaction tube was equipped with a stir bar, complex **Cr-2** (10 mg, 1 equiv), varying equivalent of KO^{t}Bu (6 equiv.), and toluene (0.5 mL). The reaction mixture was stirred at 120 ºC for 14 h in an oil bath. The resulting solution was cooled to room temperature; all the volatile was removed under reduced pressure. The obtained green residue was then dissolved in methanol, and quickly analyze the ESI-HRMS.

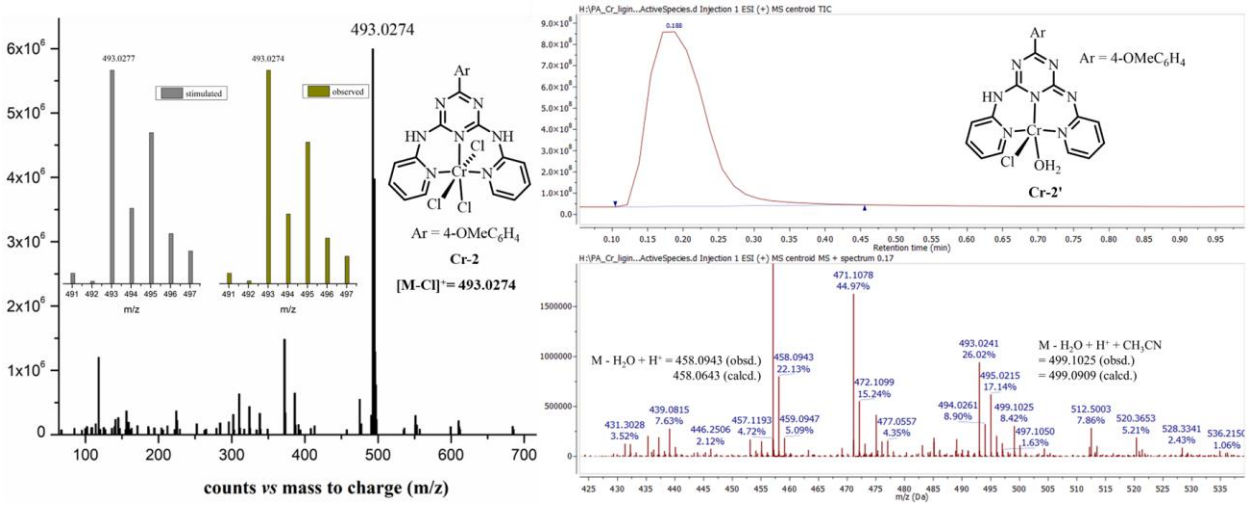


Figure S4. HRMS (ESI) spectra of active species **Cr-2** and **Cr-2'**.

Procedure: The reaction tube was equipped with a stir bar, complex **Cr-1** (10 mg, 1 equiv), varying equivalent of KO^{t}Bu (6 equiv.), and toluene (0.5 mL). The reaction mixture was stirred at 120 ºC for 14 h in an oil bath. The resulting solution was cooled to room temperature, all the

volatile was removed under reduced pressure. The obtained green residue was then dissolved in methanol, and analyze the ESI-HRMS.

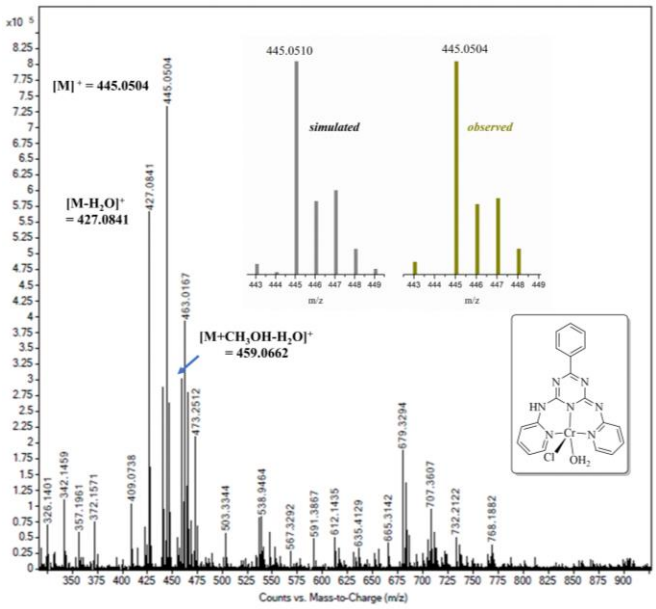


Figure S5. HRMS (ESI) spectra of active species **Cr-1'**.

XPS analysis:

Cr-2: XPS studies was performed by using freshly synthesized **Cr-2** complex.

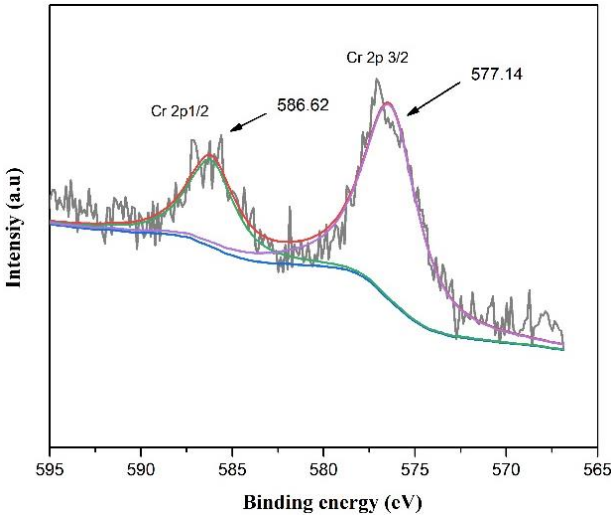


Figure S6. Binding energies of XPS spectra for the analysis of valent states of Cr-species.

Cr-2': The sample for XPS studies was obtained by reaction of complex **Cr-2** (10 mg, 1 equiv), KO^{t}Bu (6 equiv.), in toluene (0.5 mL) at 120 ºC for 14 h in an oil bath. After removal of the volatiles under reduced pressure, the sample was analyzed by XPS studies without further purification.

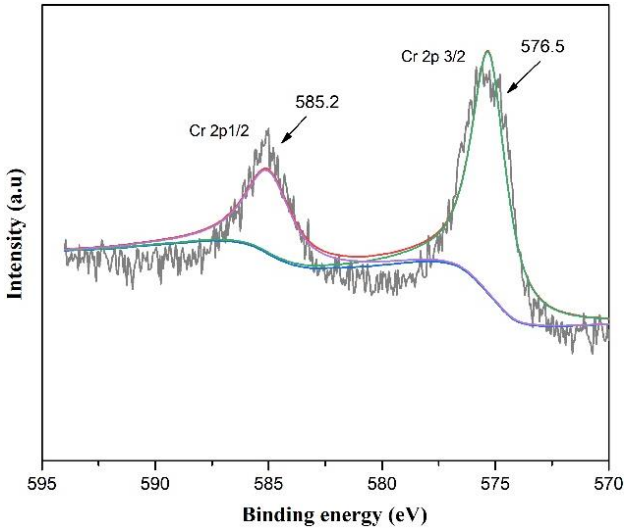


Figure S7. Binding energies of XPS spectra for the analysis of valent states of Cr- species.

We examined the oxidation state of Cr after the reaction of **Cr-2** with base by analysis of Cr 2p by core-level X-ray photoelectron spectroscopy (XPS), which was fitted with spin–orbital split $2p_{1/2}$ and $2p_{3/2}$ components. Two sets of XPS peaks appeared at 585.2 and 576.5 eV for the binding energies of the $2p_{1/2}$ and $2p_{3/2}$ components, respectively (Figure S7). In comparison with the related data that were obtained for the **Cr-2** mixture (see Figure S6), the formation of Cr(II) by a reaction with base can be considered. Observation is in accordance with the literature.[2]

5. Photophysical properties

It is noteworthy to showcase that some selected 3-oxoquninoline compounds for examples **3a**, **4a** with 260 nm photoexcitation display a fluorescence emission band at 377-405 nm.

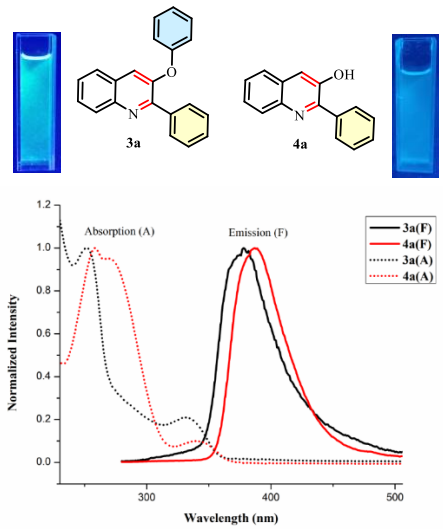


Figure S8. Normalized emission and absorbance spectra of some selected molecules. Concentration: 10 μM in Methanol. Excitation wavelength: 260 nm.

6. Crystallographic data

Crystallographic data of Cr-1:

Single crystals of compound **Cr-1** suitable for X-ray diffraction were obtained by slow evaporation of the diethyl ether in DMF at room temperature. X-ray crystallographic data were collected using Bruker D8 QUEST diffractometer. Data refinement and cell reduction were carried out by *APEX4*. Structures were solved by direct methods using Olex2 1.5 and refined by a full-matrix least-squares method using Olex2 1.5. All of the non-H atoms were refined anisotropically. The ORTEP diagram was obtained with ORTEP3 software with 50% thermal ellipsoid (see below, Figure S9). The crystallographic parameters and refinement data were listed in Table S2.

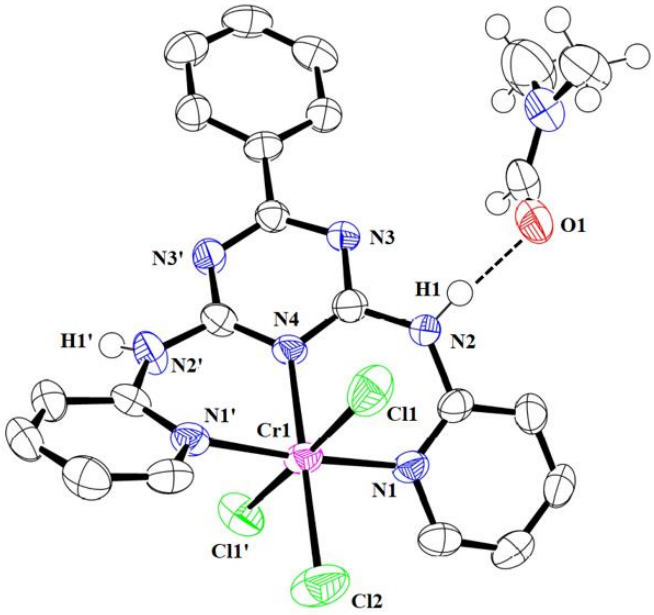


Figure S9: Molecular structure of compound **Cr-1** (thermal ellipsoid 50% probability level). Selected Bond lengths (in Å): Cr1-Cl1 2.320(10), Cr1-Cl2 2.308(14), Cr1-N4 2.066(3), Cr1-N1 2.078(2), N2-C6 1.358(4), N2-C1 1.387(4), NH(2)···O(1) hydrogen bond 2.042. Selected Bond Angles (in °): Cl2-Cr1-Cl1 91.67(3), N4-Cr1-Cl1 88.33(3), N1-Cr1-Cl2 92.62(6).

Table S2. Crystal data and structure refinement for **Cr-1**

Identification code	PA-3_Cr
CCDC	2295250
Empirical formula	$C_{21}H_{14}FNO$
Formula weight	107.65

Temperature	131 K
Wavelength	0.71073 Å
Crystal system	monoclinic
Space group	$C_1\ 2/c_1$
Unit cell dimensions	a = 19.977(6) Å α = 90°
	b = 17.502(5) Å β = 104.986(11)°
	c = 8.487(2) Å γ = 90°
Volume	2866.6(14) $Å^3$
Z	24
Density (calculated)	1.497 g/cm^3
Absorption coefficient	0.720 mm^{-1}
F(000)	1332.0
Crystal size	0.21 × 0.12 × 0.09 mm^3
2Θ range for data collection	2.33 to 24.60°
Index ranges	$-23 \leq h \leq 23$, $-20 \leq k \leq 20$, $-10 \leq l \leq 10$
Reflections collected	28368
Independent reflections	2532 [R_{int} = 0.0692, R_{sigma} = 0.067]
Completeness to theta = 25.094°	99.5%
Data/restraints/parameters	2532/0/186
Goodness-of-fit on F^2	1.096
Final R indexes [I>=2σ (I)]	R_1 = 0.0428, wR_2 = 0.1076
Final R indexes [all data]	R_1 = 0.0648, wR_2 = 0.1127
Largest diff. peak and hole	0.377 and -0.425 e $Å^{-3}$

Crystallographic data of Cr-2

Single crystals of compound **Cr-2** suitable for X-ray diffraction were obtained by slow diffusion of the diethyl ether in DMF at room temperature. X-ray crystallographic data were collected using Bruker D8 QUEST diffractometer. Data refinement and cell reduction were carried out by *APEX4*. Structures were solved by direct methods using Olex2 v1.5 and refined by a full-matrix least-

squares method using Olex2 v1.5. All of the non-H atoms were refined anisotropically. The ORTEP diagram was obtained with ORTEP3 software with 50% thermal ellipsoid (see below, Figure S10). The crystallographic parameters and refinement data were listed in Table S3.

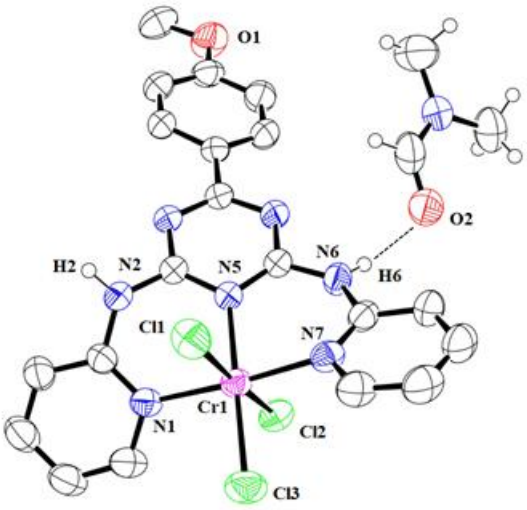


Figure S10: Molecular structure of compound **Cr-2** (thermal ellipsoid 50% probability level). Selected Bond lengths (in Å): Cr(1)–N(1), 2.084(3), Cr(1)–N(5) 2.069(2), Cr(1)–N(7) 2.089(3), Cr(1)–Cl(1) 2.3050(10), Cr(1)–Cl(2) 2.3205(9), Cr(1)–Cl(3) 2.3400(10), NH(6)···O(2) hydrogen bond 1.952. Selected Bond Angles (in °): N(7)–Cr(1)–Cl(2) 91.51(7), N(1)–Cr(1)–N(7) 176.10(10), N(5)–Cr(1)–Cl(1) 88.04(7), N(1)–Cr(1)–Cl(3) 91.78(7), Cl(2)–Cr(1)–Cl(3) 91.81(4), Cl(1)–Cr(1)–Cl(2) 174.89(4).

Table S3. Crystal data and structure refinement for **Cr-2**

Identification code	PA_Cr_5	
CCDC:	2295248	
Empirical formula	$C_{20}H_{17}Cl_3CrN_7O$	
Formula weight	602.85	
Temperature	297K	
Wavelength	0.71073 Å	
Crystal system	Monoclinic	
Space group	*P 21/n*	
Unit cell dimensions	a = 10.4284(13)Å	α = 90°.
	b = 24.577(3) Å	β = 106.257(3)
	c = 12.9275(16) Å	γ = 90°.
Volume	3180.8(7) $Å^3$	

Z	4
Density (calculated)	1.259 mg/m^3
Absorption coefficient	0.643 mm^{-1}
F(000)	1236.0
Crystal size	0.46 × 0.36 × 0.30 mm^3
Theta range for data collection	2.38 to 25.86°
Index ranges	$-12 \leq h \leq 12$, $-29 \leq k \leq 29$, $-15 \leq l \leq 15$
Reflections collected	76227
Independent reflections	5917 [R_{int} = 0.0403, R_{sigma} = 0.065]
Completeness to theta = 25.50°	99.7%
Refinement method	Full-matrix least-squares on F2
Data / restraints / parameters	5917 / 0/ 337
Goodness-of-fit on F^2	1.089
Final R indices [I>2sigma(I)]	R1 = 0.0473, wR2 = 0.1448
R indices (all data)	R1 = 0.0599, wR2 = 0.1638
Largest diff. peak and hole	0.413 and -0.314 e.$Å^{-3}$

Crystallographic data of 3a:

Single crystals of compound **3a** suitable for X-ray diffraction were obtained by slow evaporation of the saturated solution of the compound in $CHCl_3$ at room temperature. X-ray crystallographic data were collected using Bruker D8 QUEST diffractometer. Data refinement and cell reduction were carried out by *APEX4*. Structures were solved by direct methods using Olex2 v1.5 and refined by a full-matrix least-squares method using Olex2 v1.5. All of the non-H atoms were refined anisotropically. The ORTEP diagram was obtained with ORTEP3 software with 50% thermal ellipsoid (see below, Figure **S11**). The crystallographic parameters and refinement data were listed in Table **S4**

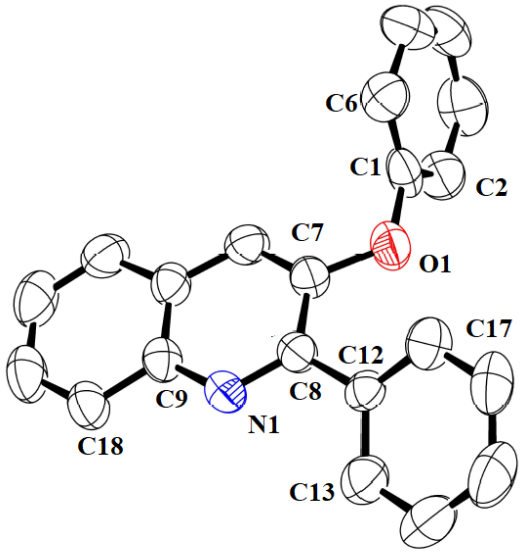


Figure S11: Molecular structure of compound **3a** (thermal ellipsoid 50% probability level). Selected Bond lengths (in Å): O1-C1 1.394(5), O1-C7 1.386(5), N1-C8 1.318(5), N1-C9 1.376(5), C7-C8 1.428(6). Selected Bond Angles (in °): C7-O1-C1 119.4(3), C8-N1-C9 119.8(4), O1-C7-C8 115.8(4), C11-C7-O1 123.5(4).

Table S4. Crystal data and structure refinement for **3a**

Identification code	PA_LIGN_Q	
CCDC	2347692	
Empirical formula	$C_{42}H_{30}N_2O_2$	
Formula weight	594.68	
Temperature	297 K	
Wavelength	0.71073 Å	
Crystal system	triclinic	
Space group	P-1	
Unit cell dimensions	a = 10.9446(12) Å	α = 98.612(3)°
	b = 11.0130(11) Å	β = 100.767(3)°
	c = 15.4815(16) Å	γ = 116.484(3)°
Volume	1582.1(3) $Å^3$	
Z	2	

Density (calculated)	1.248 g/cm^3
Absorption coefficient	0.077 mm^{-1}
F(000)	624.0
Crystal size	0.24 × 0.22 × 0.20 mm^3
2Θ range for data collection	2.778 to 48.994°
Index ranges	$-12 \leq h \leq 12$, $-12 \leq k \leq 12$, $-18 \leq l \leq 18$
Reflections collected	30619
Independent reflections	5104 [R_{int} = 0.0575, R_{sigma} = 0.0451]
Completeness to theta = 24.497°	97.0%
Data/restraints/parameters	5104/0/415
Goodness-of-fit on F^2	1.122
Final R indexes [I>=2σ (I)]	R_1 = 0.0986, wR_2 = 0.2212
Final R indexes [all data]	R_1 = 0.1354, wR_2 = 0.2497
Largest diff. peak and hole	0.34 and -0.23 e $Å^{-3}$

Crystallographic data of 3f:

Single crystals of compound **3f** suitable for X-ray diffraction were obtained by slow evaporation of the saturated solution of the compound in $CHCl_3$ at room temperature. X-ray crystallographic data were collected using Bruker D8 QUEST diffractometer. Data refinement and cell reduction were carried out by *APEX4*. Structures were solved by direct methods using Olex2 v1.5 and refined by a full-matrix least-squares method using Olex2 v1.5. All of the non-H atoms were refined anisotropically. The ORTEP diagram was obtained with ORTEP3 software with 50% thermal ellipsoid (see below, Figure **S12**). The crystallographic parameters and refinement data were listed in Table **S5**

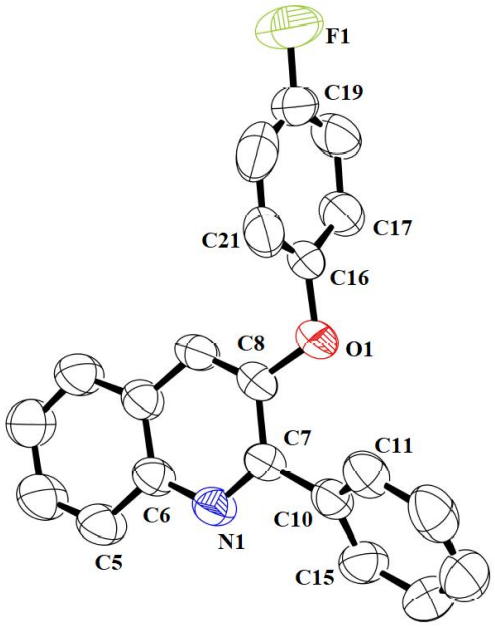


Figure S12: Molecular structure of compound **3f** (thermal ellipsoid 50% probability level). Selected Bond lengths (in Å): F1-C19 1.357(3), O1-C8 1.380(3), O1-C16 1.397(3), O1-C22 1.279(5), N1-C6 1.367(3), N1-C7 1.316(3), C7-C8 1.424(3). Selected Bond Angles (in °): C8-O1-C16 118.20(18), C7-N1-C6 119.65(19), N1-C6-C5 118.6(2), O1-C8-C7 115.3(2), F1-C19-C18 118.7(3).

Table S5. Crystal data and structure refinement for **3f**

Identification code	AH_PA_40	
CCDC	2347691	
Empirical formula	$C_{21}H_{14}FNO$	
Formula weight	315.33	
Temperature	295 K	
Wavelength	0.71073 Å	
Crystal system	monoclinic	
Space group	$P2_1/n$	
Unit cell dimensions	a = 9.8424(7) Å	α = 90°
	b = 10.3061(7) Å	β = 93.515(2)°
	c = 16.0655(11) Å	γ = 90°
Volume	1626.57(19) $Å^3$	

Z	4
Density (calculated)	1.288 g/cm^3
Absorption coefficient	0.087 mm^{-1}
F(000)	656.0
Crystal size	0.39 × 0.35 × 0.30 mm^3
2Θ range for data collection	4.698 to 52.914°
Index ranges	$-12 \leq h \leq 12$, $-12 \leq k \leq 12$, $-20 \leq l \leq 20$
Reflections collected	40066
Independent reflections	3330 [R_{int} = 0.0544, R_{sigma} = 0.0306]
Completeness to theta = 26.457°	99.3%
Data/restraints/parameters	3330/0/217
Goodness-of-fit on F^2	1.154
Final R indexes [I>=2σ (I)]	R_1 = 0.0642, wR_2 = 0.1241
Final R indexes [all data]	R_1 = 0.1152, wR_2 = 0.1516
Largest diff. peak and hole	0.18 and -0.18 e $Å^{-3}$

Crystallographic data of 3h:

Single crystals of compound **3h** suitable for X-ray diffraction were obtained by slow evaporation of the saturated solution of the compound in CH_3CN at room temperature. X-ray crystallographic data were collected using Bruker D8 QUEST diffractometer. Data refinement and cell reduction were carried out by *APEX4*. Structures were solved by direct methods using Olex2 v1.5 and refined by a full-matrix least-squares method using Olex2 v1.5. All of the non-H atoms were refined anisotropically. The ORTEP diagram was obtained with ORTEP3 software with 50% thermal ellipsoid (see below, Figure **S13**). The crystallographic parameters and refinement data were listed in Table **S6**

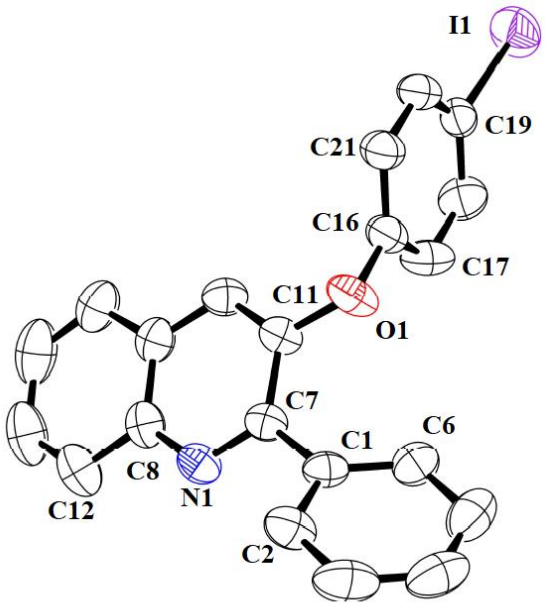


Figure S13: Molecular structure of compound **3h** (thermal ellipsoid 50% probability level). Selected Bond lengths (in Å): I1-C1 92.097(2), O1-C11 1.380(3), O1-C16 1.392(3), N1-C7 1.320(3), N1-C8 1.369(3), C7-C11 1.423(3). Selected Bond Angles (in °): C16-O1-C11 116.42(17), C8-N1-C7 118.98(19), C7-C11-O1 116.97(19), C18-C19-I1 120.04(17).

Table S6. Crystal data and structure refinement for **3h**

Identification code	PA_I_N	
CCDC	2347693	
Empirical formula	$C_{21}H_{14}INO$	
Formula weight	423.256	
Temperature	297 K	
Wavelength	0.71073 Å	
Crystal system	triclinic	
Space group	P-1	
Unit cell dimensions	a = 9.7474(5) Å	α = 88.270(1)°
	b = 9.9183(5) Å	β = 73.649(1)°
	c = 10.3831(5) Å	γ = 64.637(1)°
Volume	865.63(8) $Å^3$	
Z	2	

Density (calculated)	1.624 g/cm^3
Absorption coefficient	1.856 mm^{-1}
F(000)	415.4
Crystal size	0.36 × 0.30 × 0.21 mm^3
2Θ range for data collection	4.12 to 50.06°
Index ranges	$-11 \leq h \leq 11$, $-11 \leq k \leq 11$, $-12 \leq l \leq 12$
Reflections collected	18709
Independent reflections	2977 [R_{int} = 0.0290, R_{sigma} = 0.0178]
Completeness to theta = 25.030°	97.0%
Data/restraints/parameters	2977/0/217
Goodness-of-fit on F^2	1.079
Final R indexes [I>=2σ (I)]	R_1 = 0.0262, wR_2 = 0.0608
Final R indexes [all data]	R_1 = 0.0608, wR_2 = 0.0630
Largest diff. peak and hole	0.61 and -0.60 e Å^{-3}

Crystallographic data of 3q:

Single crystals of compound **3q** suitable for X-ray diffraction were obtained by slow evaporation of the saturated solution of the compound in CH_3CN at room temperature. X-ray crystallographic data were collected using Bruker D8 QUEST diffractometer. Data refinement and cell reduction were carried out by *APEX4*. Structures were solved by direct methods using Olex2 v1.5 and refined by a full-matrix least-squares method using Olex2 v1.5. All of the non-H atoms were refined anisotropically. The ORTEP diagram was obtained with ORTEP3 software with 50% thermal ellipsoid (see below, Figure **S14**). The crystallographic parameters and refinement data were listed in Table **S7**

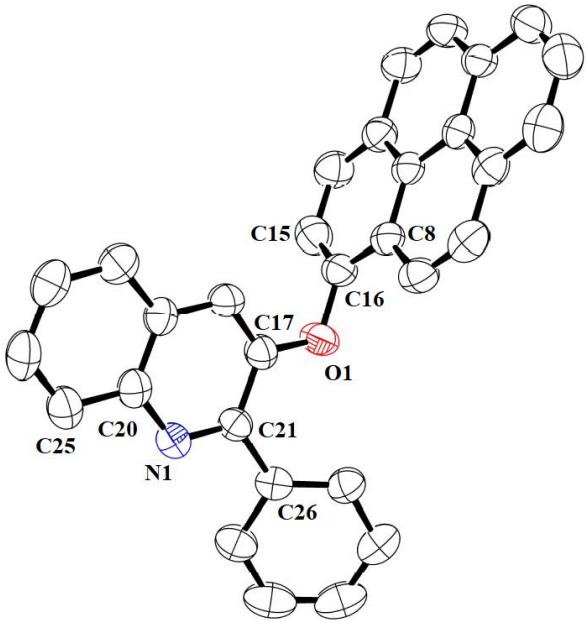


Figure S14: Molecular structure of compound **3q** (thermal ellipsoid 50% probability level). Selected Bond lengths (in Å): O1-C16 1.406(3), O1-C17 1.380(3), N1-C20 1.366(3), N1-C21 1.321(3), C17-C21 1.429(3). Selected Bond Angles (in °): C17-O1-C16 117.16(19), C21-N1-C20 119.8(2), N1-C21-C26 115.6(2), C8-C16-O1 118.7(2), N1-C20-C19 122.2(2), N1-C20-C25 118.8(2).

Table S7. Crystal data and structure refinement for **3q**

Identification code	PA_1115	
CCDC	2349816	
Empirical formula	$C_{31}H_{19}NO$	
Formula weight	421.47	
Temperature	300.00 K	
Wavelength	0.71073 Å	
Crystal system	triclinic	
Space group	P-1	
Unit cell dimensions	a = 9.7290(9) Å	α = 82.158(2) °
	b = 10.2569(9) Å	β = 81.034(3) °
	c = 10.7927(10)Å	γ = 84.630(3) °
Volume	1051.01(17) $Å^3$	
Z	2	

Density (calculated)	1.332 g/cm^3
Absorption coefficient	0.080 mm^{-1}
F(000)	440.0
Crystal size	0.25 × 0.21 × 0.17 mm^3
2Θ range for data collection	3.85 to 50.874°
Index ranges	$-11 \leq h \leq 11$, $-12 \leq k \leq 12$, $-13 \leq l \leq 12$
Reflections collected	23376
Independent reflections	3835 [R_{int} = 0.0435, R_{sigma} = 0.0351]
Completeness to theta = 25.437°	98.7%
Data/restraints/parameters	3835/0/298
Goodness-of-fit on F^2	1.147
Final R indexes [I>=2σ (I)]	R_1 = 0.0649, wR_2 = 0.1203
Final R indexes [all data]	R_1 = 0.1009, wR_2 = 0.1381
Largest diff. peak and hole	0.18 and -0.21 e $Å^{-3}$

Crystallographic data of 5e:

Single crystals of compound **5e** suitable for X-ray diffraction were obtained by slow evaporation of the saturated solution of the compound in $CHCl_3$ at room temperature. X-ray crystallographic data were collected using Bruker D8 QUEST diffractometer. Data refinement and cell reduction were carried out by *APEX4*. Structures were solved by direct methods using Olex2 v1.5 and refined by a full-matrix least-squares method using Olex2 v1.5. All of the non-H atoms were refined anisotropically. The ORTEP diagram was obtained with ORTEP3 software with 50% thermal ellipsoid (see below, Figure **S15**). The crystallographic parameters and refinement data were listed in Table **S8**.

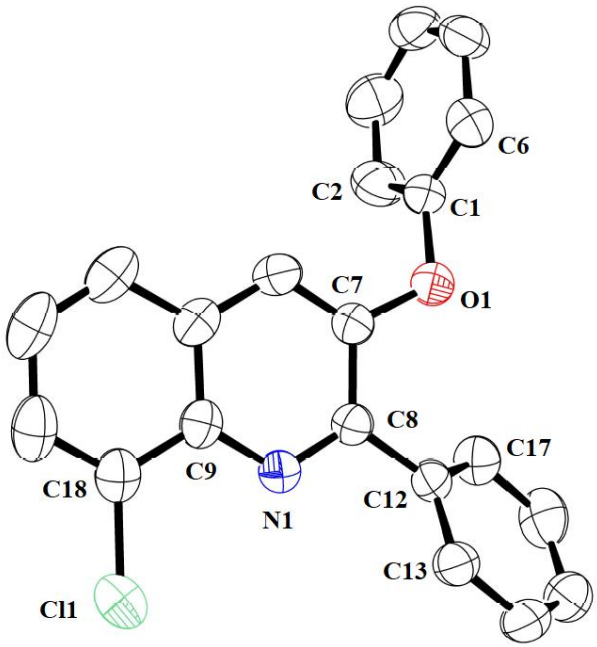


Figure S15: Molecular structure of compound **5e** (thermal ellipsoid 50% probability level). Selected Bond lengths (in Å): Cl1-C18 1.732(2), O1-C1 1.398(2), O1-C7 1.376(2), N1-C8 1.319(2), N1-C9 1.362(2), N1-C9 1.362(2). Selected Bond Angles (in °): C7-O1-C1 117.51(13), C9-N1-C8 119.47(14), C8-C7-O1 116.64(15), C9-C18-Cl1 119.14(14).

Table S8. Crystal data and structure refinement for **5e**

Identification code	AH_PA_1061	
CCDC	2347694	
Empirical formula	$C_{21}H_{14}ClNO$	
Formula weight	331.804	
Temperature	297 K	
Wavelength	0.71073 Å	
Crystal system	triclinic	
Space group	P-1	
Unit cell dimensions	a = 9.6282(4) Å	α = 78.651(1)°
	b = 10.0026(4) Å	β = 63.960(1)°
	c = 10.3941(4) Å	γ = 66.233(1) °
Volume	822.89(6)$Å^3$	
Z	2	

Density (calculated)	1.339 g/cm^3
Absorption coefficient	0.238 mm^{-1}
F(000)	344.5
Crystal size	0.32 × 0.27 × 0.21 mm^3
2Θ range for data collection	4.46 to 52.7°
Index ranges	-12 ≤ h ≤ 12, -12 ≤ k ≤ 12, -12 ≤ l ≤ 12
Reflections collected	14000
Independent reflections	3326 [R_{int} = 0.0495, R_{sigma} = 0.0381]
Completeness to theta = 26.350°	99.0%
Data/restraints/parameters	3326/0/217
Goodness-of-fit on F^2	1.112
Final R indexes [I>=2σ (I)]	R_1 = 0.0475, wR_2 = 0.1043
Final R indexes [all data]	R_1 = 0.0607, wR_2 = 0.1159
Largest diff. peak and hole	0.19 and -0.27 e Å^{-3}

Crystallographic data of 5k:

Single crystals of compound **5k** suitable for X-ray diffraction were obtained by slow evaporation of the saturated solution of the compound in CH_3CN at room temperature. X-ray crystallographic data were collected using Bruker D8 QUEST diffractometer. Data refinement and cell reduction were carried out by *APEX4*. Structures were solved by direct methods using Olex2 v1.5 and refined by a full-matrix least-squares method using Olex2 v1.5. All of the non-H atoms were refined anisotropically. The ORTEP diagram was obtained with ORTEP3 software with 50% thermal ellipsoid (see below, Figure **S16**). The crystallographic parameters and refinement data were listed in Table **S9.**

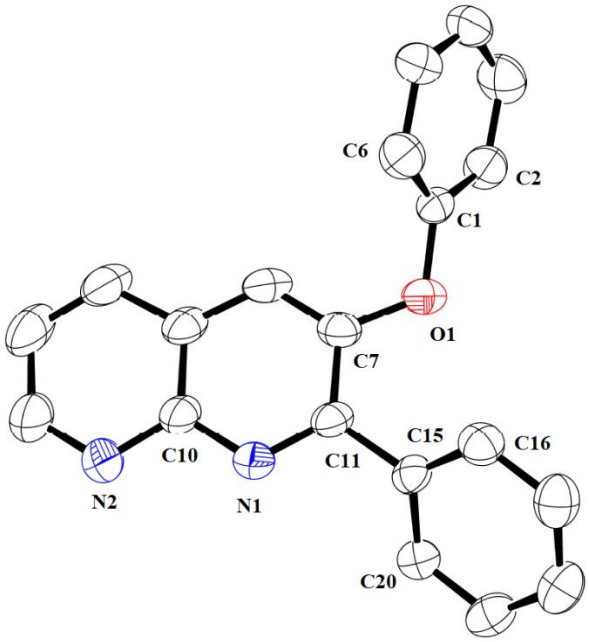


Figure S16: Molecular structure of compound **5k** (thermal ellipsoid 50% probability level). Selected Bond lengths (in Å): O1-C1 1.388(5), O1-C7 1.386(5), N1-C10 1.370(5), N1-C11 1.320(5), N2-C10 1.360(6), N2-C14 1.312(6), C7-C11 1.421(6). Selected Bond Angles (in °): C7-O1-C1 117.9(3), C11-N1-C10 118.7(4), C14-N2-C10 115.8(5), C6-C1-O1 117.4(4), N2-C10-N1 114.6(4), C9-C10-N1 121.9(4), C9-C10-N2 123.5(4), C7-C11-N1 121.9(4), C15-C11-N1 115.8(4)

Table S9. Crystal data and structure refinement for **5k**

Identification code	PA_917	
CCDC	2347695	
Empirical formula	$C_{20}H_{14}N_2O$	
Formula weight	298.347	
Temperature	296 K	
Wavelength	0.71073 Å	
Crystal system	monoclinic	
Space group	$P2_1/n$	
Unit cell dimensions	a = 13.6973(12) Å	α = 90°
	b = 9.7865(9) Å	β = 102.578(3)°
	c = 11.7031(10)Å	γ = 90(1) °
Volume	1531.1(2)$Å^3$	
Z	4	

Density (calculated)	1.294 g/cm^3
Absorption coefficient	0.081 mm^{-1}
F(000)	624.4
Crystal size	0.37 × 0.24 × 0.21 mm^3
2Θ range for data collection	5.16 to 50°
Index ranges	$-16 \leq h \leq 16$, $-11 \leq k \leq 11$, $-14 \leq l \leq 14$
Reflections collected	33515
Independent reflections	2694 [R_{int} = 0.0892, R_{sigma} = 0.0599]
Completeness to theta = 25.0°	100%
Data/restraints/parameters	2694/0/208
Goodness-of-fit on F^2	1.156
Final R indexes [I>=2σ (I)]	R_1 = 0.0999, wR_2 = 0.1443
Final R indexes [all data]	R_1 = 0.1459, wR_2 = 0.1640
Largest diff. peak and hole	0.52 and -0.49 e $Å^{-3}$

Crystallographic data of 12:

Single crystals of compound **12** suitable for X-ray diffraction were obtained by slow evaporation of the saturated solution of the compound in CH_3CN at room temperature. X-ray crystallographic data were collected using Bruker D8 QUEST diffractometer. Data refinement and cell reduction were carried out by *APEX4*. Structures were solved by direct methods using Olex2 v1.5 and refined by a full-matrix least-squares method using Olex2 v1.5. All of the non-H atoms were refined anisotropically. The ORTEP diagram was obtained with ORTEP3 software with 50% thermal ellipsoid (see below, Figure **S17**). The crystallographic parameters and refinement data were listed in Table **S10.**

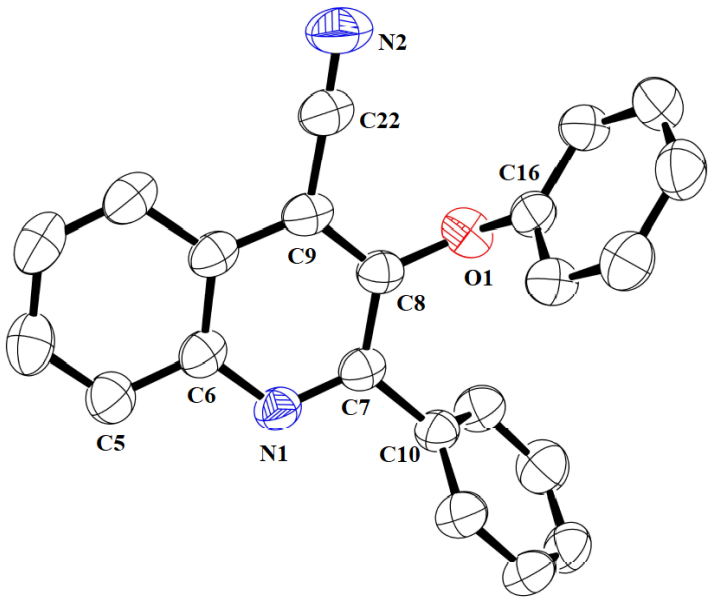


Figure S17: Molecular structure of compound **12** (thermal ellipsoid 50% probability level). Selected Bond lengths (in Å): O1-C8 1.3755(16), O1-C16 1.3997(16), N1-C6 1.3686(17), N1-C7 1.3208(17), N2-C22 1.1395(19), C9-C22 1.4410(19). Selected Bond Angles (in °): C8-O1-C16 117.41(10), C7-N1-C6 119.64(11), N1-C6-C1 122.43(13), N1-C6-C5 118.37(12), N1-C7-C8 121.51(12), N2-C22-C9 178.26(18).

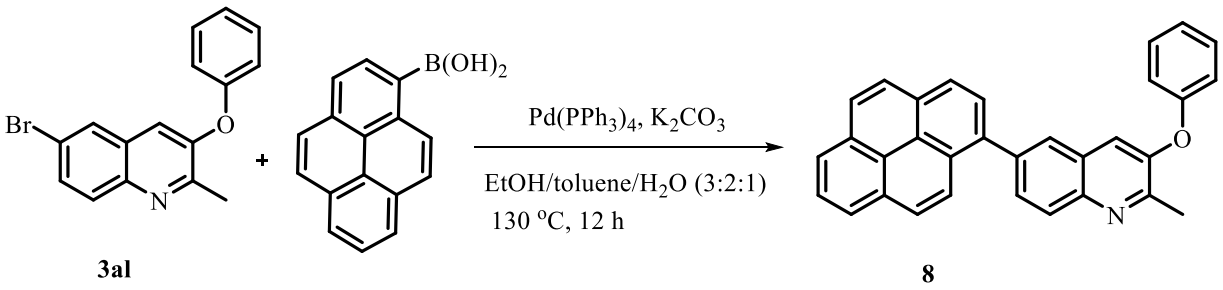
Table S10. Crystal data and structure refinement for **12**

Identification code	PA_1116	
CCDC	2349817	
Empirical formula	$C_{22}H_{14}N_2O$	
Formula weight	322.35	
Temperature	299.00 K	
Wavelength	0.71073 Å	
Crystal system	monoclinic	
Space group	$P2_1/c$	
Unit cell dimensions	a = 12.8115(9) Å	α = 90 °
	b = 5.8300(4) Å	β = 103.523(2) °
	c = 22.4700(16) Å	γ = 90 °
Volume	1631.8(2) $Å^3$	
Z	4	

Density (calculated)	1.312 g/cm^3
Absorption coefficient	0.082 mm^{-1}
F(000)	672.0
Crystal size	0.28 × 0.23 × 0.12 mm^3
2Θ range for data collection	3.728 to 51.388°
Index ranges	-15 ≤ h ≤ 15, -7 ≤ k ≤ 7, -27 ≤ l ≤ 27
Reflections collected	36842
Independent reflections	3074 [R_{int} = 0.0476, R_{sigma} = 0.0200]
Completeness to theta = 25.694°	99.2%
Data/restraints/parameters	3074/0/226
Goodness-of-fit on F^2	1.102
Final R indexes [I>=2σ (I)]	R_1 = 0.0378, wR_2 = 0.0863
Final R indexes [all data]	R_1 = 0.0485, wR_2 = 0.0967
Largest diff. peak and hole	0.15 and -0.13 e Å^{-3}

7. Post Synthetic Modification

2-methyl-3-phenoxy-6-(pyren-1-yl)quinoline (8):

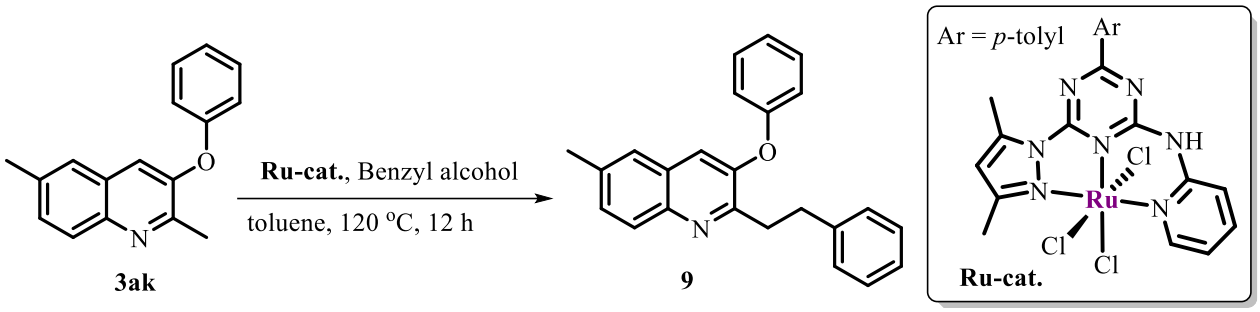


3al **8**

3al (63 mg, 0.2 mmol) and pyrene boronic acid (0.3 mmol, 1.5 equiv.) were stirred at room temperature in mixture of solvents EtOH/toluene/H_2O (3:2:1) (4 mL) for 15 minutes. To this, $Pd(PPh_3)_4$ (11.56 mg, 0. 01 mmol, 5.0 mol%), K_2CO_3 (110 mg, 0.8 mmol, 4.0 equiv.) were added. Then reaction mixture was reflux for 12 hours with continuous stirring on a preheated oil bath at 130 ℃. After completion of the reaction the solvent was removed under vacuum pressure. The mixture was extracted using ethyl acetate and solvent was removed under vacuum. The crude compound was purified by column chromatography eluting with pet ether-ethyl acetate mixture (v/v = 2:50, R_f = 0.50) to give the pure product **8** as off-white solid with 55% yield (48 mg).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.25 – 8.20 (m, 3H), 8.20 – 8.15 (m, 3H), 8.11 (s, 1H), 8.04 – 8.02 (m, 3H), 7.90 – 7.85 (m, 2H), 7.49 (s, 1H), 7.44 – 7.40 (m, 2H), 7.21 – 7.18 (m, 1H), 7.12 – 7.10 (m, 2H), 2.82 (s, 3H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 156.4, 154.3, 150.8, 139.4, 137.0, 131.6, 131.1, 131.0, 130.4, 128.7, 128.4, 128.2, 127.9, 127.8, 127.6, 126.2, 125.4, 125.2, 125.1, 124.8, 124.3, 120.2, 119.3, 20.8. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{32}H_{22}NO$ 436.1696; found 436.1692.

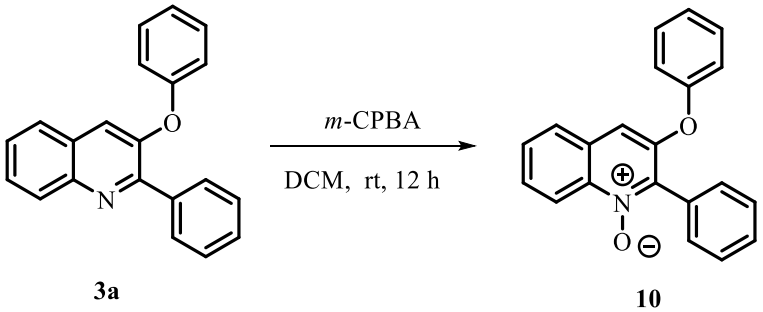
6-methyl-2-phenethyl-3-phenoxyquinoline (9):



A mixture of 2,6-dimethyl-3-phenoxyquinoline (0.2 mmol, 1 equiv.), benzyl alcohol (0.24 mmol, 1.2 equiv.), **Ru-cat** (0.1 mol%),[8] KO^{t}Bu (10 mol%) and toluene (1 mL) was added into a reaction tube (25 mL) equipped with stirring bar. The reaction tube was then properly closed without exclusion of air and kept it on a preheated oil bath at 120 ℃ with continuous stirring for 12 hours. After completion of the reaction, the resulting mixture was passed through a bed of celite, the filtrate was collected and concentrated under reduced pressure. The resulting crude compound was purified by silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 1:50, R_f = 0.50) to get the tittle compound as light yellow oil with 90% yield (61 mg).

^{1}H NMR (600 MHz, $CDCl_3$): δ 7.96 (d, J = 9.0 Hz, 1H), 7.44 (d, J = 8.4 Hz, 1H), 7.40 – 7.38 (m, 3H), 7.32 (s, 1H), 7.26 – 7.25 (d, J = 4.8 Hz, 4H), 7.19 – 7.17 (m, 2H), 7.00 (d, J = 7.8 Hz, 2H), 3.37 – 3.34 (m, 2H), 3.18 – 3.15 (m, 2H), 2.49 (s, 3H).^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 156.6, 155.4, 150.1, 142.1, 136.3, 130.2, 130.2, 128.7, 128.5, 126.0, 125.8, 124.1, 112.0, 119.2, 35.7, 34.9, 21.7. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{24}H_{22}NO$ 340.1696; found 340.1688.

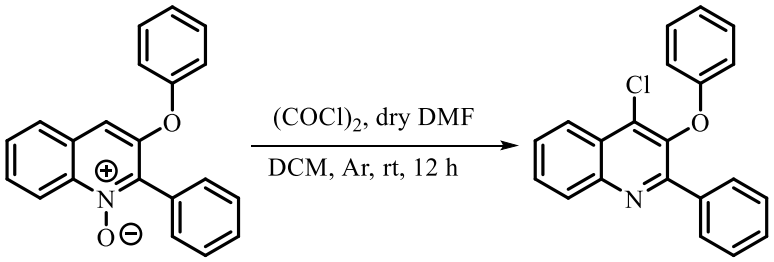
3-phenoxy-2-phenylquinoline 1-oxide (10):



In a round-bottom flask, **3a** (0.5 mmol, 1 equiv.) was dissolved in dichloromethane (2 mL). Then, to this solution *m*-chloroperbenzoic acid (*m*-CPBA) (1 mmol, 2 equiv.) in dichloromethane (2 mL) was added portion wise at 0 ℃. After completion of the addition, the reaction mixture was allowed to cool down to room temperature and stirred for 12 hours. The mixture was diluted with dichloromethane (5 mL) after completion and combined organic part was washed with 6 N aqueous KOH solution followed by brine solution. The organic part was dried over Na_2SO_4 and solvent was removed under reduced pressure. The resulting crude compound was purified by silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 50:25, R_f = 0.40) to get the title compound **10** as light brown solid with 95% yield (147 mg).

^{1}H NMR (600 MHz, $CDCl_3$): δ 8.74 (d, J = 8.4 Hz, 1H), 7.68 – 7.65 (m, 4H), 7.60 (t, J = 7.8 Hz, 1H), 7.49 (t, J = 7.8 Hz, 2H), 7.45 – 7.42 (m, 1H), 7.36 (t, J = 7.8 Hz, 2H), 7.19 – 7.16 (m, 2H), 7.01 (d, J = 7.8 Hz, 2H).^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ ^{13}C NMR (151 MHz, $CDCl_3$): δ 155.9, 150.8, 141.8, 139.4, 130.3, 130.2, 129.5, 129.4, 129.2, 129.0, 128.6, 128.3, 127.4, 124.7, 120.4, 119.6, 111.8. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{16}NO_2$ 314.1176; found 314.1169.

4-chloro-3-phenoxy-2-phenylquinoline (11) from 10:

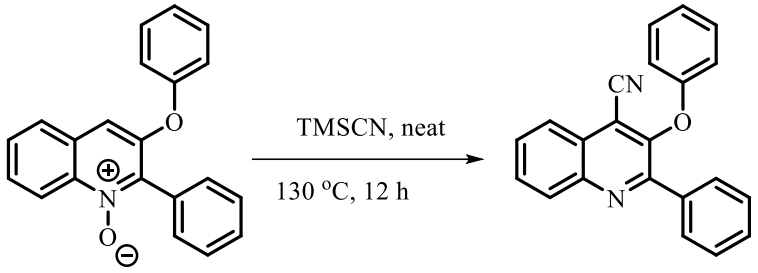


10 **11**

In a schlenk flask, quinoline *N*-oxide (0.5 mmol, 1 equiv.) was dissolved in DCM (1.0 mL). To this solution, dry DMF (1.0 mL) was added under nitrogen flow at 0 ºC followed by the addition of $(COCl)_2$ (1.0 mmol). The reaction mixture was stirred for 12 h. The resulting mixture was evaporated under reduced pressure. The resulting crude compound was purified by using silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 50:15, R_f = 0.50) to get the tittle compound **11** as light brown oil with 75% yield (124 mg).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.25 – 8.22 (m, 2H), 7.94 – 7.92 (m, 2H), 7.80 – 7.77 (m, 1H), 7.69 – 7.65 (m, 1H), 7.41 – 7.36 (m, 3H), 7.21 – 7.17 (m, 2H), 6.98 – 6.93 (m, 1H), 6.75 – 6.77 (m, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 157.1, 155.4, 146.1, 143.0, 137.0, 135.2, 130.1, 129.9, 129.7, 129.4, 129.4, 128.4, 127.9, 126.7, 124.0, 122.5, 115.4. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{15}ClNO$ 332.0837; found 332.0842.

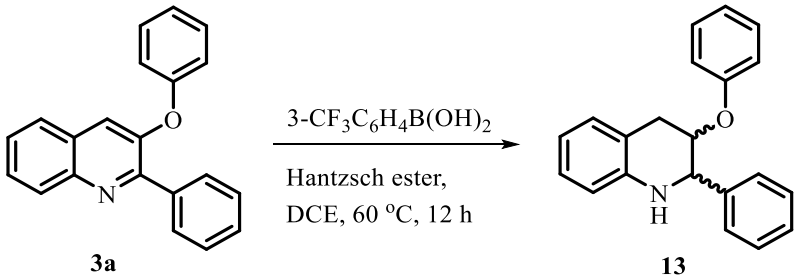
3-phenoxy-2-phenylquinoline-4-carbonitrile (12) from 10:



In a schlenk flask, quinoline *N*-oxide (0.2 mmol, 1 equiv.) was taken and to this TMSCN (0.4 mmol, 1 equiv.) was added and stirred the reaction mixture at 130 °C for 12h. The resulting mixture was collected by using DCM and then evaporated under reduced pressure. The resulting crude compound was purified by using silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 50:20, R_f = 0.40) to get the title compound **12** as white solid with 95% yield (61 mg).

^{1}H NMR (600 MHz, $CDCl_3$): δ 8.27 (d, J = 8.4 Hz, 1H), 8.14 (d, J = 8.3 Hz, 1H), 7.93 (d, J = 5.5 Hz, 2H), 7.84 (t, J = 7.4 Hz, 1H), 7.76 (t, J = 7.5 Hz, 1H), 7.40 (d, J = 6.6 Hz, 3H), 7.22 (t, J = 7.9 Hz, 2H), 7.01 (t, J = 7.4 Hz, 1H), 6.81 (d, J = 8.1 Hz, 2H).^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 157.4, 154.9, 149.9, 145.3, 136.0, 130.5, 130.4, 129.9, 129.5, 129.4, 128.6, 126.4, 124.5, 123.6, 116.5, 112.9, 112.0. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{22}H_{15}N_2O$ 323.1179; found 323.1181. FT-IR (KBr, selected band): 2232 cm^{-1} (CN).

3-phenoxy-2-phenyl-1,2,3,4-tetrahydroquinoline (13):

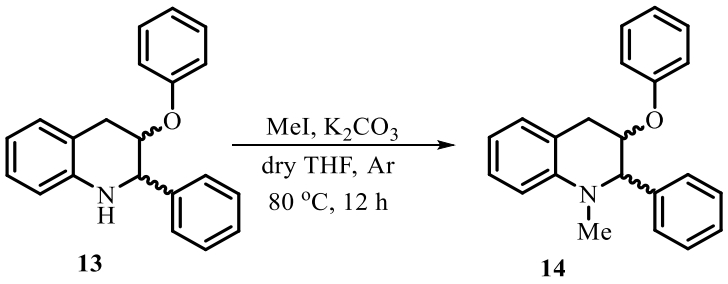


In a reaction tube (25 mL), **3a** (149 mg, 0.5 mmol), Hantzsch ester (2.5 equiv.), 3-trifluoromethylphenylboronic acid (25 mol%), and DCE (5 ml) were taken. Then the tube was properly closed and placed on a preheated oil bath at 60 °C with continuous stirring. After 12 h, volatile solvent was removed and the resulting crude compound was purified by silica gel column

chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 50:1, R_f = 0.50) to get the title compound **13** as colourless oil with 95% yield (143 mg).

^{1}H NMR (500 MHz, $CDCl_3$): (*cis : trans* = 6:4) δ 7.40 (d, *J* = 7.0 Hz, 2H, major + minor), 7.31 – 7.27 (m, 3H, major + minor), 7.24 – 7.21 (m, 2H, major + minor), 7.07 (t, *J* = 7.5 Hz, 1H, major + minor), 6.98 (d, *J* = 7.5 Hz, 1H, major + minor), 6.92 (t, *J* = 7.5 Hz, 1H, major + minor), 6.84 (d, *J* = 8.0 Hz, 2H, major + minor), 6.69 (t, *J* = 7.5 Hz, 1H, major + minor), 6.64 (d, *J* = 8.0 Hz, 1H, major + minor), 4.87 – 4.84 (m, 1H), 4.75 (brs, 1H), 4.23 (s, 1H), 3.13 (d, *J* = 4.0 Hz, 1H, minor, 40%), 3.10 (d, *J* = 4.0 Hz, 1H, major, 60%), 2.99 (d, *J* = 6.5 Hz, 1H, major, 60%), 2.96 (d, *J* = 6.5 Hz, 1H, minor, 40%). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 157.8, 143.9, 140.9, 130.1, 129.6, 128.3, 128.1, 127.9, 127.5, 121.3, 117.9, 116.4, 113.9, 73.1, 58.1, 30.8. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{20}NO$ 304.1540; found 302.1547.

1-methyl-3-phenoxy-2-phenyl-1,2,3,4-tetrahydroquinoline (14) from 13:

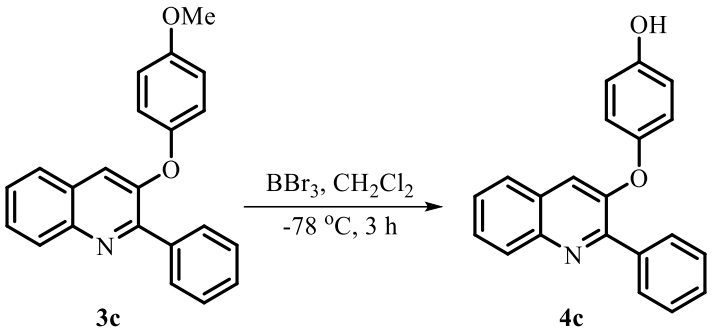


13 **14**

In a schlenk flask, **13** (0.5 mmol, 1 equiv.) was taken in dry THF (1.0 mL). To this solution, methyl iodide (3.0 mmol, 6 equiv.) and potassium carbonate (1.5 mmol, 3 equiv.) was added was under nitrogen flow. The reaction mixture was then stirred for 12h at 80 °C. After completion of the reaction, the solution was concentrated in vacuo and extracted with ethyl acetate three times. The organic layers were dried over Na_2SO_4 and removed under vacuum. The resulting crude compound was then purified by using silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 2:50, R_f = 0.50) to get the title compound **14** as light brown oil with 68% yield (107 mg).

^{1}H NMR (600 MHz, $CDCl_3$):): (*cis : trans* = 6:4) δ 7.31 (t, *J* = 7.2 Hz, 2H, major + minor), 7.26 – 7.25 (m, 3H, major + minor), 7.20 (t, *J* = 7.8 Hz, 1H, major + minor), 7.09 – 7.08 (m, 2H, major + minor), 7.02 (d, *J* = 7.2 Hz, 1H, major + minor), 6.99 – 6.96 (m, 3H, major + minor), 6.71 – 6.67 (m, , 2H, major + minor), 5.05 – 5.03 (m, 1H, major + minor), 4.79 (brs, 1H), 3.00 (d, *J* = 4.8 Hz, minor, 40%), 2.97 (d, *J* = 4.2 Hz, 1H, major, 60%), 2.93 (s, 3H, major + minor), 2.89 – 2.86 (m, 1H, minor, 40%), 2.84 – 2.82 (m, 1H, major, 60%). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 157.5, 145.5, 138.5, 129.8, 129.7, 128.3, 128.2, 128.1, 127.6, 121.3, 119.0, 116.5, 115.9, 109.8, 71.9, 65.0, 38.2, 30.1. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{22}H_{22}NO$ 316.1696; found 316.1705.

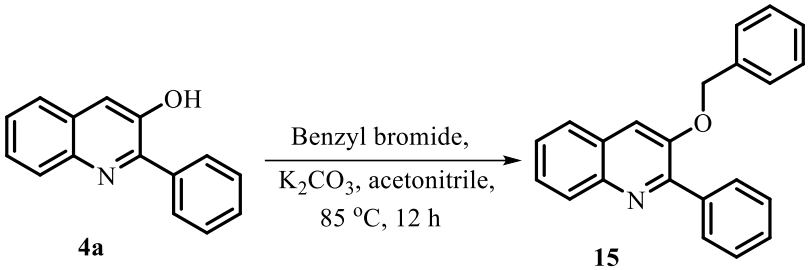
4-((2-phenylquinolin-3-yl)oxy)phenol (4c) from 3c:



3c **4c**

In a schlenk flask, **3c** (0.2 mmol, 1 equiv.) was taken in dry DCM and cooled the solution to -20 °C. To this solution, BBr_3 (0.6 mmol, 3 equiv.) was added dropwise over the time period of 30 minutes under an inert atmosphere. The reaction was allowed to stirrer for about 3h at -78 °C until all the substrate was consumed which is monitored by TLC. After completion of the reaction the solution was allowed to warm to room temperature. The reaction mixture was quenched with saturated NaCl solution and then extracted three times with ethyl acetate. The solution was then dried over anhydrous Na_2SO_4, and the solvent was removed in vacuum. The crude compound was purified by column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 1:10, R_f = 0.50) to get the title compound **4c** as yellow solid with 50% yield (31 mg).

3-(benzyloxy)-2-phenylquinoline (15) from 4a:



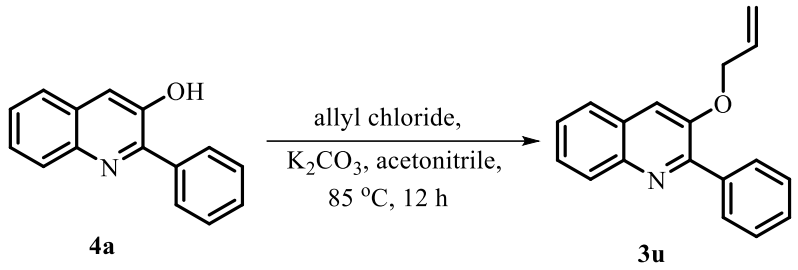
4a **15**

In a pressure tube, **4a** (0.2 mmol, 1 equiv.) was taken in acetonitrile (1.0 mL). To this solution benzyl bromide (0.6 mmol, 3 equiv.) and potassium carbonate (0.6 mmol, 3 equiv.). The reaction mixture was then stirred for 12 h at 85 ℃. After completion of the reaction the solution was concentrated in vacuo and extracted with ethyl acetate three times. The organic layers were dried over Na_2SO_4 and removed under vacuum. The resulting crude compound was then purified by using silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 1:10, R_f = 0.40) to get the title compound **15** as white solid with 90% yield (56 mg).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.11 (d, J = 8.4 Hz, 1H), 8.04 – 8.01 (m, 2H), 7.72 (d, J = 8.8 Hz, 1H), 7.59 – 7.56 (m, 1H), 7.56 (s, 1H), 7.51 – 7.46 (m, 4H), 7.43 – 7.34 (m, 5H), 5.26 (s, 2H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 152.4, 150.8, 143.4, 138.0, 136.4, 130.0, 129.5, 128.9, 128.8,

128.7, 128.1, 127.2, 127.1, 126.9, 126.4, 114.8, 70.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{22}H_{18}NO$ 312.1383; found 312.1375.

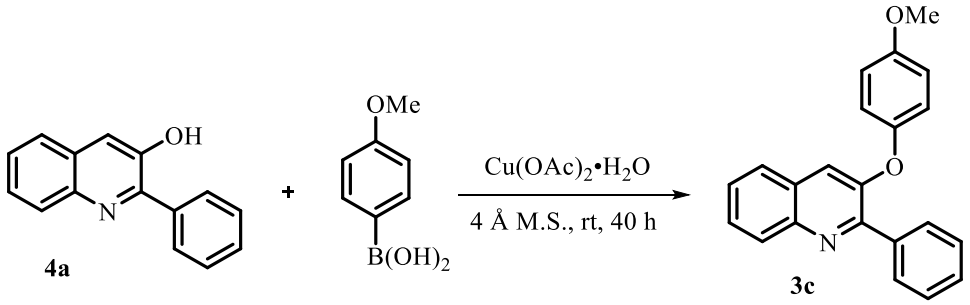
3-(allyloxy)-2-phenylquinoline (3u) from 4a:



4a **3u**

In a pressure tube **4a** (0.2 mmol, 1 equiv.) was taken in acetonitrile (1.0 mL). To this solution allyl chloride (0.6 mmol, 3 equiv.) and potassium carbonate (0.6 mmol, 3 equiv.). The reaction mixture was then stirred for 12 h at 85 ℃. After completion of the reaction the solution was concentrated in vacuo and extracted with ethyl acetate three times. The organic layers were dried over Na_2SO_4 and removed under vacuum. The resulting crude compound was then purified by using silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 1:10, R_f = 0.50) to get the title compound **3u** as colourless oil with 88% yield (46 mg).

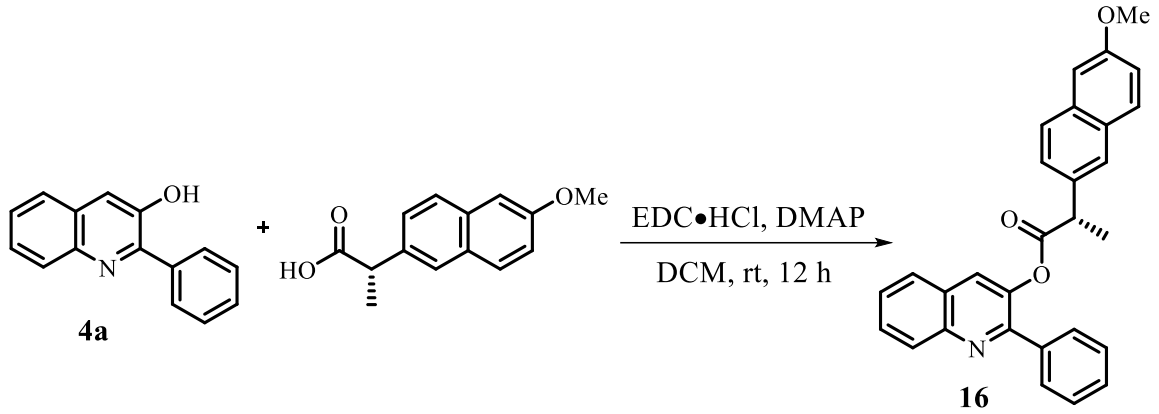
3-(4-methoxyphenoxy)-2-phenylquinoline(3c) from 4a:



4a **3c**

In a reaction tube **4a** (0.2 mmol, 1 equiv.), 4-Methoxyphenylboronic acid (0.2 mmol, 1.0 equiv.), $Cu(OAc)_2•H_2O$ (0.16 mmol, 0.7 equiv.), 4 Å M.S. and DCE (1 mL) was taken. The reaction mixture was allowed to stirred on a preheated oil bath at 60 °C with continuous stirring for 40 h at room temperature. After completion of the reaction, the reaction mixture was then passed through a bed of celite, the filtrate was collected and concentrated under reduced pressure. The crude reaction mixture was purified by petroleum ether/ ethyl acetate mixture as eluent (v/v = 50:3, R_f = 0.40) to get the tittle compound **3c** as white with 50% yield (33 mg).

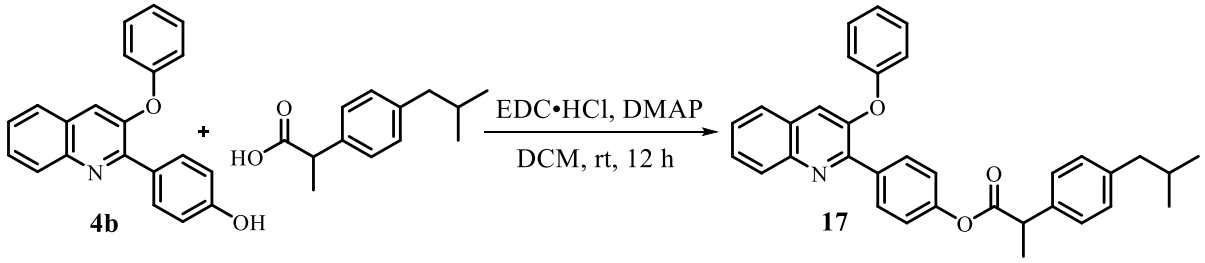
2-phenylquinolin-3-yl (S)-2-(6-methoxynaphthalen-2-yl)propanoate (16) from 4a:



In a pressure tube, 2-phenylquinolin-3-ol (0.2 mmol, 1 equiv.) was taken in DCM (2.0 mL). To this (S)-2-(6-Methoxynaphthalen-2-yl)propanoic acid (0.4 mmol, 2 equiv.), EDC•HCl (0.6 mmol, 3 equiv.) and DMAP (0.05 mmol, 0.25 equiv.) was added. The reaction mixture was then stirred for 12 h at room temperature. After completion of the reaction the solution was concentrated in vacuum. The resulting crude compound was then purified by using silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 1:10, R_f = 0.40) to get the title compound **16** as white solid with 91% yield (78 mg).

^{1}H NMR (600 MHz, $CDCl_3$): δ 8.14 (d, J = 8.4 Hz, 1H), 7.88 (s, 1H), 7.77 (d, J = 7.8 Hz, 1H), 7.71 – 7.68 (m, 3H), 7.62 – 7.59 (m, 3H), 7.53 (t, J = 7.2 Hz, 1H), 7.34 (d, J = 9.6 Hz, 1H), 7.24 – 7.22 (m, 1H), 7.19 – 7.15 (m, 4H), 4.00 (q, J = 7.2 Hz, 1H), 3.95 (s, 3H), 1.61 (s, 3H), 1.55 (d, J = 7.2 Hz, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 172.9, 158.0, 154.0, 146.3, 134.4, 134.1, 129.6, 129.5, 129.5, 129.1, 129.1, 128.8, 128.2, 128.0, 127.5, 127.3, 127.2, 126.5, 126.2, 119.2, 105.7, 55.5, 45.7, 18.5. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{29}H_{24}NO_3$ 434.1751; found 434.1755.

4-(3-phenoxyquinolin-2-yl)phenyl 2-(4-isobutylphenyl)propanoate (17) from 4b:



In a pressure tube, **4b** (0.2 mmol, 1 equiv.) was taken in DCM (2.0 mL). To this 2-(4-Isobutylphenyl)propanoic acid (0.4 mmol, 2 equiv.), EDC•HCl (0.6 mmol, 3 equiv.) and DMAP (0.05 mmol, 0.25 equiv.) was added. The reaction mixture was then stirred for 12 h at room temperature. After completion of the reaction, the solution was concentrated in vaccum. The

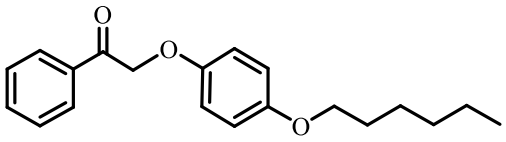
resulting crude compound was then purified by using silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 1:10, R_f = 0.40) to get the tittle compound **17** as colourless oil with 75% yield (75 mg).

^{1}H NMR (600 MHz, $CDCl_3$): δ 8.13 (d, J = 8.4 Hz, 1H), 8.07 – (d, J = 8.4 Hz, 2H), 7.64 – 7.62 (m, 2H), 7.55 (s, 1H), 7.50 – 7.47 (m,1H), 7.37 (t, J = 7.8 Hz, 2H), 7.30 (d, J = 7.8 Hz, 2H), 7.18 – 7.14 (m, 3H), 7.11 (d, J = 8.4 Hz, 2H), 7.05 (d, J = 7.8 Hz, 2H), 3.95 (q, J = 7.2 Hz, 1H), 2.47 (d, J = 7.2 Hz, 2H), 1.89 – 1.83 (m, 1H), 1.62 (s, 3H), 0.91 (d, J = 6.6 Hz, 6H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 173.2, 156.4, 151.9, 149. 9, 141.0, 137.4, 135.0, 130.9, 130.2, 129.7, 129.5, 128.4, 128.3, 127.4, 127.17, 126.7, 124.3, 122.0, 121.3, 119.5, 45.5, 45.2, 30.3, 22.5, 18.7. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{34}H_{31}NO_3$ 502.2377; found 502.2382.

8. Analytical data of the starting materials and products:

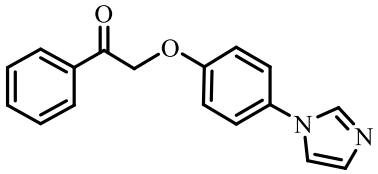
For the starting materials

2-(4-(hexyloxy)phenoxy)-1-phenylethan-1-one (2d):



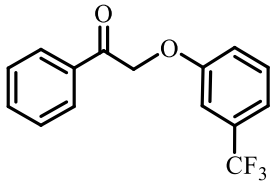
^{1}H NMR (400 MHz, $CDCl_3$): δ 8.01 – 7.99 (m, 2H), 7.61 (t, J = 7.6 Hz, 1H), 7.49 (t, J = 7.6 Hz, 2H), 6.90 – 6.87 (m, 2H), 6.83 – 6.80 (m, 2H), 5.22 (s, 2H), 3.89 (t, J = 6.4 Hz, 2H), 1.78 – 1.71 (m, 2H), 1.47 – 1.42 (m, 2H), 1.34 – 1.34 (m, 4H), 0.90 (t, J = 6.8 Hz, 3H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 195.1, 154.2, 152.2, 134.8, 133.9, 128.9, 128.3, 116.1, 116.1, 115.7, 115.6, 72.0, 68.7, 31.7, 29.4, 25.9, 22.7, 14.2. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{20}H_{25}NO_3$ 313.1799; found 313.1804.

2-(4-(1H-imidazol-1-yl)phenoxy)-1-phenylethan-1-one (2j):



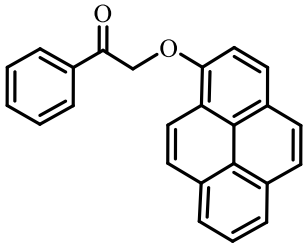
^{1}H NMR (400 MHz, $CDCl_3$): δ 8.02 – 8.00 (m, 2H), 7.79 (brs, 1H), 7.67 – 7.63 (m, 1H), 7.55 – 7.53 (m 2H), 7.30 (d, J = 8.8 Hz, 2H), 7.20 – 7.19 (m, 2H), 7.03 (d, J = 8.8 Hz, 2H), 5.35 (s, 2H).^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 194.0, 157.5, 134.4, 134.3, 129.1, 128.2, 123.4, 116.8, 116.0, 70.9. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{17}H_{15}N_2O_2$ 279.1129; found 279.1139.

1-phenyl-2-(3-(trifluoromethyl)phenoxy)ethan-1-one (2l):



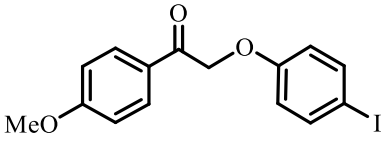
^{1}H NMR (600 MHz, $CDCl_3$): δ 8.00 (d, J = 7.8 Hz, 2H), 7.65 (t, J = 7.8 Hz, 1H), 7.54 – 7.50 (t, J = 7.8 Hz, 2H), 7.40 (t, J = 7.8 Hz, 1H), 7.26 – 7.25 (m, 1H), 7.19 (s, 1H), 7.12 – 7.10 (m, 1H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 193.7, 158.3, 134.4, 134.3, 130.3, 129.1, 128.2, 118.51 (q, J = 3.7 Hz), 118.2 112.0, 112.0, 70.8. ^{19}F NMR (565 MHz, $CDCl_3$): δ -62.69. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{15}H_{12}NF_3O_2$ 281.0784; found 281.0788.

1-phenyl-2-(pyren-1-yloxy)ethan-1-one (2q):



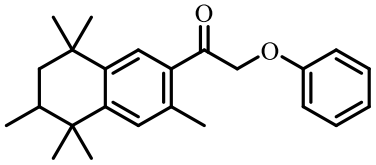
^{1}H NMR (400 MHz, $CDCl_3$): δ 8.55 (d, J = 9.2 Hz, 1H), 8.14 – 8.07 (m, 5H), 8.00 – 7.90 (m, 3H), 7.65 – 7.62 (m, 1H), 7.53 – 7.48 (m, 3H), 5.62 (s, 2H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 194.8, 152.1, 134.8, 134.1, 131.8, 131.8, 129.0, 128.4, 127.3, 127.0, 126.4, 126.2, 126.1, 125.7, 125.4, 124.9, 124.7, 124.6, 121.4, 120.9, 109.7, 72.2. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{24}H_{17}NO_2$ 337.1224; found 337.1232.

2-(4-iodophenoxy)-1-(4-methoxyphenyl)ethan-1-one (2ah):



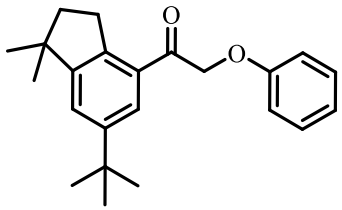
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.98 (d, J = 8.8 Hz, 2H), 7.55 (d, J = 9.2 Hz, 2H), 6.97 (d, J = 8.8 Hz, 2H), 6.71 (d, J = 9.2 Hz, 2H), 5.19 (s, 2H), 3.89 (s, 3H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 192.7, 164.3, 158.2, 138.5, 130.6, 127.6, 117.3, 114.2, 83.9, 70.7, 55. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{15}H_{14}IO_3$ 368.9983; found 368.9988.

1-(3,5,5,6,8,8-hexamethyl-5,6,7,8-tetrahydronaphthalen-2-yl)-2-phenoxyethan-1-one (2am):



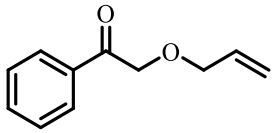
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.66 (s, 1H), 7.29 – 7.23 (m, 4H), 6.99 – 6.95 (m, 1H), 6.93 – 6.90 (m, 2H), 5.14 (s, 2H), 2.49 (s, 3H), 1.90 – 1.85 (m 1H), 1.67 – 1.60 (m, 1H), 1.42 – 1.38 (m, 1H), 1.32 (d, J = 6.0 Hz, 6H), 1.26 (s, 3H), 1.07 (s, 3H), 1.00 (d, J = 6.8 Hz, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 197.8, 158.2, 151. 1, 142.4, 136.2, 132.2, 131.0, 129.7, 127.6, 121.6, 114.8, 71.8, 43.5, 38.1, 34.5, 34.2, 32.6, 32.1, 28.4, 24.8, 21.3, 16.9. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{24}H_{31}O_2$ 351.2319; found 351.2320.

1-(6-(tert-butyl)-1,1-dimethyl-2,3-dihydro-1H-inden-4-yl)-2-phenoxyethan-1-one (2an):



^{1}H NMR (600 MHz, $CDCl_3$): δ 7.72 (brs, 1H), 7.39 (brs, 1H), 7.30 – 7.27 (m, 2H), 6.99 – 6.95 (m, 1H), 6.94 (d, J = 7.8 Hz, 2H), 5.24 (s, 2H), 3.18 (t, J = 7.2 Hz, 2H), 1.95 (t, J = 7.2 Hz, 2H), 1.36 (s, 9H), 1.27 (s, 6H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 196.3, 158.2, 154.9, 150.2, 141.9, 129.7, 124.2, 123.6, 121.6, 114.9, 71.7, 43.6, 41.5, 34.9, 31.6, 30.7, 30.2, 28.9. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{23}H_{29}O_2$ 337.2163; found 337.2169.

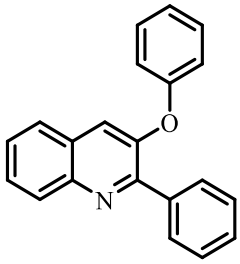
2-(allyloxy)-1-phenylethan-1-one (2t):



^{1}H NMR (600 MHz, $CDCl_3$): δ 7.93 (d, J = 7.2 Hz, 2H), 7.58 (t, J = 7.2 Hz, 1H), 7.47 (t, J = 7.2 Hz, 2H), 5.99 – 5.93 (m, 1H), 5.33 (d, J = 17.4 Hz, 1H), 5.25 (d, J = 10.2 Hz, 1H), 4.76 (s, 2H), 4.16 (d, J = 5.4 Hz, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 196.4, 135.1, 134.1, 133.7, 128.8, 128.0, 118.4, 72.7, 72.6. The spectral data is in accordance with the literature.[1]

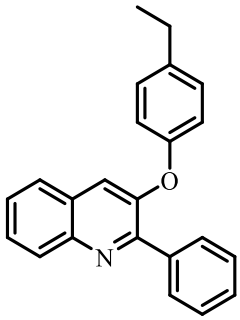
Analytical data for the products

3-phenoxy-2-phenylquinoline (3a):



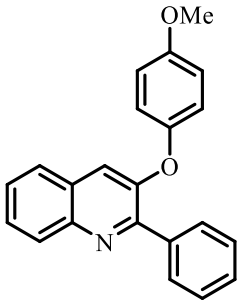
Using **GP-V** the title compound **3a** was isolated as light yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (102 mg, 86%). M.p. 129-131 ºC. ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.17 (d, J = 8.4 Hz, 1H), 8.06 – 8.05 (m, 2H), 7.67 – 7.63 (m, 2H), 7.58 (s, 1H), 7.51 – 7.46 (m, 3H), 7.46 – 7.42 (m, 1H), 7.39 – 7.36 (m, 2H), 7.17 – 7.15 (m, 1H), 7.09 – 7.06 (m, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.6, 153.1, 149.9, 144.9, 137.6, 130.2, 129.8, 129.6, 129.1, 128.5, 128.3, 128.3, 127.0, 126.7, 124.2, 122.0, 119.5. The spectral data is in accordance with the literature.[5]

3-(4-ethylphenoxy)-2-phenylquinoline (3b):



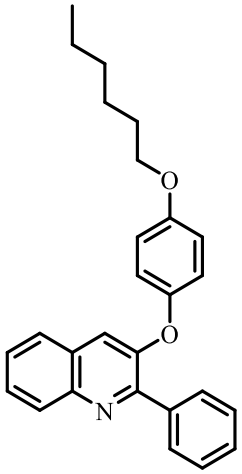
Using **GP-V** the title compound **3b** was isolated as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.40); (106 mg, 81%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.15 (d, J = 8.4 Hz, 1H), 8.07 (d, J = 7.8 Hz, 2H), 7.65 – 7.61 (m, 2H), 7.52 (s, 1H), 7.48 (t, J = 7.8 Hz, 3H), 7.43 (t, t, J = 7.8 Hz, 1H), 7.22 (d, J = 8.4 Hz, 2H), 7.02 (d, J = 8.4 Hz, 2H), 2.67 (q, J = 7.2 Hz, 2H), 1.26 (t, J = 7.2 Hz, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 154.1, 152.8, 144.6, 140.4, 137.6, 129.8, 129.5, 129.1, 128.5, 128.3, 128.1, 127.0, 126.6, 121.0, 119.7, 28.3, 15.8. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{23}H_{20}NO$ 326.1540; found 326.1544.

3-(4-methoxyphenoxy)-2-phenylquinoline (3c):



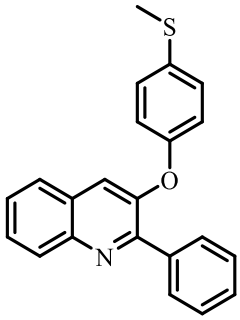
Using **GP-V** the title compound **3c** was isolated as white solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:3, R_f = 0.40); (109 mg, 83%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.15 (d, J = 8.4 Hz, 1H), 8.10 – 8.07 (d, J = 7.2 Hz, 2H), 7.62 – 7.60 (m, 2H), 7.51 – 7.45 (m, 4H), 7.43 (s, 1H), 7.06 (d, J = 9.0 Hz, 2H), 6.95 (d, J = 9.0 Hz, 2H), 3.83 (s, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.6, 152.5, 151.2, 149.3, 144.4, 137.6, 129.8, 129.5, 129.1, 128.5, 128.3, 128.0, 127.0, 126.6, 121.4, 119.8, 115.3, 55.8. The spectral data is in accordance with the literature.[5]

3-(4-(hexyloxy)phenoxy)-2-phenylquinoline (3d):



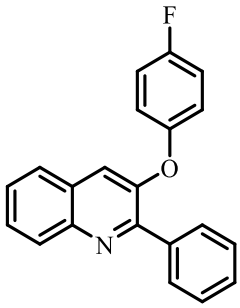
Using **GP-V** the title compound **3d** was isolated as colourless oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (98 mg, 62%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.17 – 8.13 (m, 1H), 8.08 (d, J = 7.8 Hz, 2H), 7.62 – 7.59 (m, 2H), 7.55 – 7.52 (m, 1H), 7.49 – 7.45 (m, 3H), 7.42 (s, 1H), 7.04 (d, J = 9.0 Hz, 2H), 6.93 (d, J = 9.0 Hz, 2H), 3.96 (t, J = 6.6 Hz, 2H), 1.81 – 1.78 (m, 2H), 1.36 – 1.35 (m, 3H), 0.93 – 0.91 (m, 3H), 0.89 – 0.88 (m, 3H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 156.2, 152.5, 149.2, 129.8, 129.5, 129.1, 129.0, 128.3, 127.9, 127.0, 126.6, 121.3, 119.8, 115.9, 68.7, 31.8, 29.9, 29.4, 25.9, 22.8, 14.2. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{27}H_{27}NO_2$ 398.2115; found 398.2122.

3-(4-(methylthio)phenoxy)-2-phenylquinoline (3e):



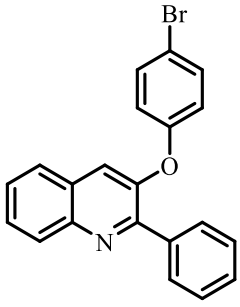
Using **GP-V** the title compound **3e** was isolated as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:3, R_f = 0.40); (112 mg, 82%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.16 (d, J = 8.4 Hz, 1H), 8.04 – 8.02 (m, 2H), 7.66 – 7.63 (m, 2H), 7.56 (s, 1H), 7.56 – 7.44 (m, 4H), 7.30 – 7.28 (m, 2H), 7.02 – 7.00 (m, 2H), 2.49 (s, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 154.4, 152.9, 149.9, 144.8, 137.4, 133.6, 129.7, 129.6, 129.2 129.2, 128.4, 128.4, 128.3, 127. 1, 126.7, 121.8, 120.1, 17.0. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{28}H_{18}NOS$ 344.1104; found 344.1109.

3-(4-fluorophenoxy)-2-phenylquinoline (3f):



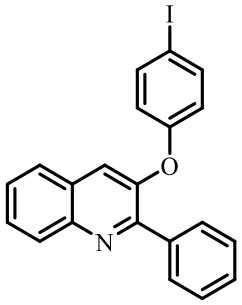
Using **GP-V** the title compound **3f** was as light yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:3, R_f = 0.50); (95 mg, 75%). M.p. 131-133 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.17 (d, J = 9.2 Hz, 1H), 8.05 – 8.03 (m, 2H), 7.67 – 7.62 (m, 2H), 7.51 – 7.44 (m, 6H), 7.09 – 7.04 (m, 4H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 160.1, 158.5, 152.8 152.1, 150.2, 144.8, 137.4, 129.7, 129.6, 129.2, 128.4, 128.35, 128.33, 127.1, 126.6, 121.3, 121.1, 121.0, 116.9, 116.7. ^{19}F NMR (565 MHz, $CDCl_3$): δ -121.88. HRMS (ESI) *m/z:* $[M+H]^+$ calculated for $C_{21}H_{15}FNO$ 316.1133; found 316.1141.

3-(4-bromophenoxy)-2-phenylquinoline (3g):



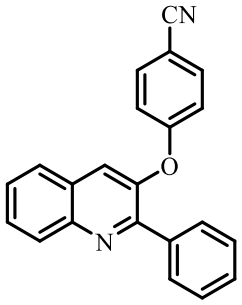
Using **GP-V** the title compound **3g** was isolated as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:1, R_f = 0.50); (117 mg, 78%). M.p. 140-142 ºC. ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.17 (d, J = 8.4 Hz, 1H), 8.00 – (m, 2H), 7.70 – 7.65 (m, 2H), 7.61 (s, 1H), 7.54 – 7.50 (m, 1H), 7.48 – 7.44 (m, 5H), 6.92 (d, J = 8.8 Hz, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 155.9, 149.1, 145.1, 137.3, 133.1, 129.6, 129.3, 128.7, 128.4, 128.3, 127.2, 126.8, 122.8, 120.8, 116.6. HRMS (ESI) *m/z:* $[M+H]^+$ calculated for $C_{21}H_{15}BrNO$ 376.0332; found 376.0336.

3-(4-iodophenoxy)-2-phenylquinoline (3h):



Using **GP-V** the title compound **3h** was isolated was isolated as white solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:1, R_f = 0.50); (138 mg, 82%). M.p. 142-144 ºC. ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.17 (d, J = 8.5 Hz, 1H), 7.99 (d, J = 7.0 Hz, 2H), 7.70 – 7.67 (m, 2H), 7.64 – 7.63 (m, 3H), 7.52 (t, J = 7.5 Hz, 1H), 7.47 – 7.42 (m, 3H), 6.80 (d, J = 8.5 Hz, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.81, 153.14, 148.98, 145.19, 139.09, 137.25, 129.63, 129.6, 129.3, 128.7, 128.4, 128.3, 127.2, 126.8, 123.0, 121.1. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{15}INO$ 424.0193; found 424.0194.

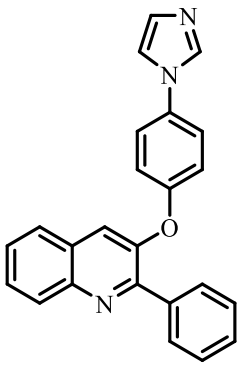
4-((2-phenylquinolin-3-yl)oxy)benzonitrile (3i):



Using **GP-V** the title compound **3i** was isolated as white solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:3, R_f = 0.50); (90 mg, 70%). M.p. 145-147 ºC. ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.21 (d, J = 8.4 Hz, 1H), 7.91 (d, J = 7.2 Hz, 2H), 7.83 (s, 1H), 7.78 (d, J = 8.4 Hz, 1H), 7.74 (t, J = 7.8 Hz, 1H), 7.58 (d, J = 7.8 Hz, 1H), 7.55 (d, J = 8.4 Hz, 1H), 7.43 – 7.39 (m, 3H), 6.98 (d, J = 8.4 Hz, 2H).^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 161.0, 153.6, 146.9, 146.0, 136.8, 134.4, 129.8, 129.5, 129.4, 129.4, 128.5, 128.2, 127.5, 127.0, 126.0,

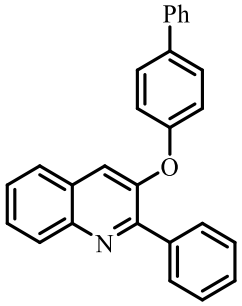
118.7, 118.0, 106.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{22}H_{15}N_2O$ 323.1179; found 323.1181. FT-IR (KBr, selected band): 2234 cm^{-1} (CN).

3-(4-(1H-imidazol-1-yl)phenoxy)-2-phenylquinoline (3j):



Using **GP-V** the title compound **3j** was isolated as dark brown solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 2:10, R_f = 0.50); (117 mg, 81%). M.p. 140-142 ºC. ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.19 (d, J = 9.0 Hz, 1H), 8.02 – 8.01 (m, 2H), 7.81 (s, 1H), 7.72 – 7.68 (m, 3H), 7.54 (t, J = 7.2 Hz, 1H), 7.48 – 7.43 (m, 3H), 7.35 – 7.34 (m, 2H), 7.23 (s, 1H), 7.20 (s, 1H), 7.13 – 7.12 (m, 2H) .^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.2, 153.2, 148.0, 145.3, 137.2, 135.8, 133.2, 130.3, 129.3, 128.8, 128.4, 128.3, 127.3, 126.8, 123.5, 123.4, 120.0, 118, 116.7, 116.0. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{24}H_{18}N_3O$ 364.1445; found 364.1450.

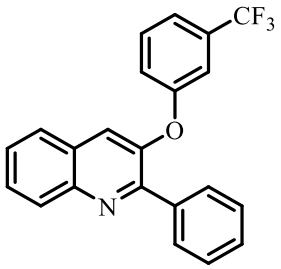
3-([1,1'-biphenyl]-4-yloxy)-2-phenylquinoline (3k):



Using **GP-V** the title compound **3k** was isolated as white solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (124 mg, 83%). M.p. 99 -100 ºC. ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.18 (d, J = 8.4 Hz, 1H), 8.08 – 8.07 (m, 2H), 7.69 (d, J = 7.8 Hz, 1H), 7.66 – 7.65 (m, 2H), 7.59 (t, J = 8.4 Hz, 4H), 7.51 – 7.44 (m, 6H), 7.35 (t, J = 7.8 Hz, 1H), 7.14 (d, J = 8.4 Hz, 2H).^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.1, 149.8, 145.0, 140.4, 137.5, 137.2, 129.8, 129.6, 129.2, 129.0, 128.9, 128.45, 128.38, 128.37, 127.38, 127.1, 127.1,

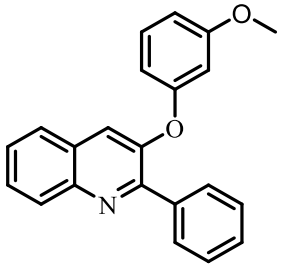
126.7, 122.3, 119.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{27}H_{20}NO$ 374.1540; found 374.1547.

2-phenyl-3-(3-(trifluoromethyl)phenoxy)quinoline (3l):



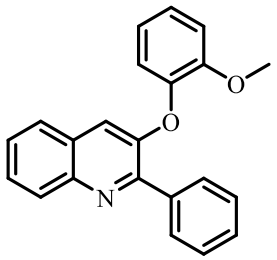
Using **GP-V** the title compound **3l** as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:1, R_f = 0.50); (105 mg, 72%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.22 (d, J = 8.4 Hz, 1H), 7.99 (d, J = 7.2 Hz, 2H), 7.73 – 7.69 (m, 2H), 7.68 (s, 1H), 7.55 (t, J = 7.2 Hz, 1H), 7.47 – 7.42 (m, 4H), 7.38 – 7.37 (m, 1H), 7.28 (s, 1H), 7.17 – 7.16 (m, 1H). $^{13}C\{^1H\}$ NMR (151 MHz, $CDCl_3$): δ 157.1, 153.2, 148.6, 145.2, 137.0, 132.6 (q, J = 33.0 Hz), 130.7, 129.6, 129.5, 129.4, 129.0, 128. 4, 128.3, 127.4, 126.9, 123.7, 121.9, 120.5, 115.8. ^{19}F NMR (565 MHz, $CDCl_3$): δ -62.70. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{22}H_{15}F_3NO$ 366.1101; found 366.1107.

3-(3-methoxyphenoxy)-2-phenylquinoline (3m):



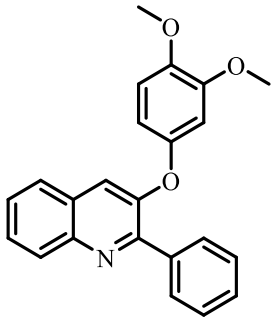
Using **GP-V** the title compound **3m** was isolated as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (99 mg, 76%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.17 (d, J = 8.4 Hz, 1H), 8.04 (d, J = 7.2 Hz, 2H), 7.68 – 7.64 (m, 2H), 7.62 (s, 1H), 7.52 – 7.46 (m, 3H), 7.44 – 7.42 (m, 1H), 7.28 – 7.25 (m, 1H) 6.72 – 6.70 (m, 1H), 6.65 – 6.64 (m, 1H), 6.63 – 6.62 (m, 1H), 3.78 (s, 3H). $^{13}C\{^1H\}$ NMR (151 MHz, $CDCl_3$): δ 161.3, 157.7, 153.0, 149.6, 144.9, 137.5, 130.6, 129.7, 129.6, 129.1, 128.4, 128.4, 128.3, 127.0, 126.7, 122.4, 111.4, 109.8, 105.4, 55.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{22}H_{18}NO_2$ 328.1333; found 328.1335.

3-(2-methoxyphenoxy)-2-phenylquinoline (3n):



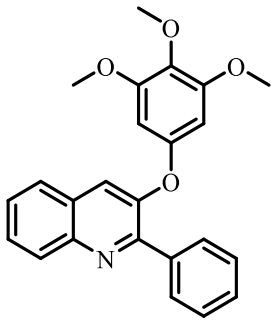
Using **GP-V** the title compound **3n** was isolated as colourless oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (106 mg, 81%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.17 – 8.14 (m, 3H), 7.60 – 7.58 (m, 2H), 7.51 – 7.48 (m, 2H), 7.47 – 7.43 (m, 2H), 7.28 (s, 1H), 7.25 – 7.22 (m, 1H), 7.10 (d, J = 7.8 Hz, 1H), 7.05 (d, J = 8.2 Hz, 1H), 6.99 (t, J = 7.8 Hz, 1H), 3.79 (s, 3H). ^{13}C {^{1}H} NMR (151 MHz, $CDCl_3$): δ 152.1, 151.7, 150.9, 143.8, 137.8, 129.9, 129.5, 129.0, 128.5, 128.2, 127.6, 126.8, 126.5, 126.1, 122.5, 121.4, 118.2, 113.2, 56.0. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{22}H_{18}NO_2$ 328.1333; found 328.1342.

3-(3,4-dimethoxyphenoxy)-2-phenylquinoline (3o):



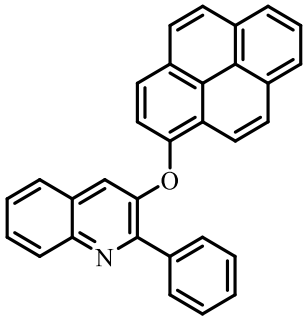
Using **GP-V** the title compound **3o** was isolated as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.40); (131 mg, 92%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.15 (d, J = 8.4 Hz, 1H), 8.09 – 8.07 (m, 2H), 7.65 – 7.60 (m, 2H), 7.51 – 7.44 (m, 4H), 6.88 – 6.85 (m, 2H), 6.69 – 6.68 (m, 1H), 6.66 – 6.63 (m, 1H), 3.90 (s, 3H), 3.84 (s, 3H). ^{13}C {^{1}H} NMR (151 MHz, $CDCl_3$): δ 151.0, 150.3, 149.6, 146.1, 144. 4, 137.6, 129.8, 129.5, 129.2, 128.4, 128.0, 127.0, 126.6, 120.1, 111.9, 111.4, 104.8, 56.4, 56.2. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{23}H_{19}NO_3$ 358.1438; found 358.1435.

2-phenyl-3-(3,4,5-trimethoxyphenoxy)quinoline (3p):



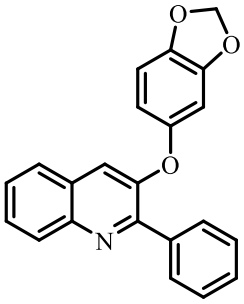
Using **GP-V** the title compound **3p** was isolated as white solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:3, R_f = 0.30); (139 mg, 90%). M.p. 160-162 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.16 (d, J = 8.4 Hz, 1H), 8.07 – 8.05 (m, 2H), 7.69 – 7.62 (m, 2H), 7.56 (s, 1H), 7.52 – 7.44 (m, 4H), 6.33 (s, 2H), 3.85 (s, 3H), 3.79 (s, 6H). ^{13}C {^{1}H} NMR (151 MHz, $CDCl_3$): δ 154.3, 152.5, 152.3, 150.4, 144.7, 137.5, 134.8, 129.8, 129.6, 129.2, 128.4, 128.4, 128.2, 127.1, 126.7, 120.9, 97.5, 61.2, 56.3. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{24}H_{22}NO_4$ 388.1548; found 388.1544.

2-phenyl-3-(pyren-1-yloxy)quinoline (3q):



Using **GP-V** the title compound **3q** was isolated as yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (143 mg, 85%). M.p. 151-152 ºC. ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.29 – 8.27 (m, 3H), 8.22 – 8.16 (m, 4H), 8.08 – 8.03 (m, 4H), 7.69 (d, J = 8.4 Hz, 1H), 7.63 – 7.61 (m, 1H), 7.53 – 7.50 (m, 2H), 7.48 – 7.42 (m, 3H), 7.35 (s, 1H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 152.4, 151.4, 149.4, 144.7, 137.6, 131.45, 131.43, 129.9, 129.6, 129.3, 128.50, 128.45, 128.2, 128.1, 127.2, 127.1, 127.0, 126.6, 126.3, 125.9, 125.5, 125.3, 123.2, 121.0, 120.6, 117.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{31}H_{20}NO$ 422.1540; found 422.1536.

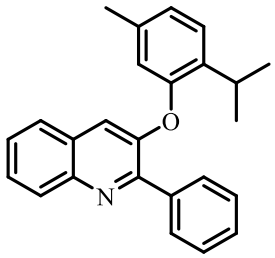
3-(benzo[d][1,3]dioxol-5-yloxy)-2-phenylquinoline (3r):



Using **GP-V** the title compound **3r** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (124 mg, 91%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.15 (d, J = 8.4 Hz, 1H), 8.05 (d, J = 7.2 Hz, 2H), 7.66 – 7.62 (m, 2H), 7.50 – 7.43 (m, 4H), 7.46 – 7.43 (m, 1H), 6.80 (d, J = 8.4 Hz, 1H), 6.64 (s, 1H), 6.55 (d, J = 8.4 Hz, 1H), 6.00 (s, 2H). ^{13}C {^{1}H} NMR (151 MHz, $CDCl_3$): δ 152.5, 150.8, 150.6, 148.8, 144.55,

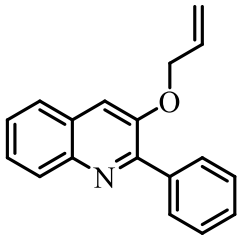
144.49, 137.5, 129.8, 129.5, 129.1, 128.4, 128.3, 128.1, 127.0, 126.6, 120.5, 112.4, 108.7, 102.5, 101.8. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{22}H_{16}NO_3$ 342.1125; found 342.1132.

3-(2-isopropyl-5-methylphenoxy)-2-phenylquinoline (3s):



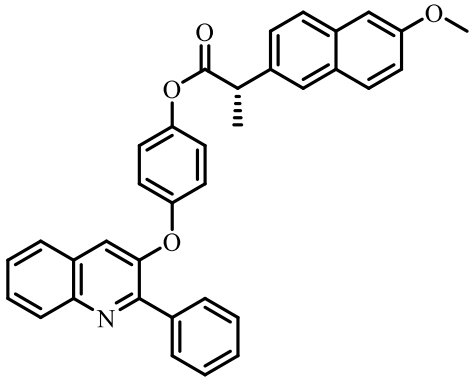
Using **GP-V** the title compound **3s** was isolated as white solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (131 mg, 93%). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.17 (d, J = 8.5 Hz, 1H), 8.10 (d, J = 7.5 Hz, 2H), 7.64 – 7.60 (m, 2H), 7.51 – 7.44 (m, 4H), 7.37 (s, 1H), 7.29 (d, J = 7.5 Hz, 1H), 7.02 (d, J = 7.5 Hz, 1H), 6.79 (s, 1H), 3.23 – 3.17 (m, 1H), 2.29 (s, 3H), 1.19 (d, J = 7.0 Hz, 6H). ^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 152.7, 152.5, 150.9, 144.3, 137.7, 137.4, 137.4, 129.8, 129.5, 129.1, 128.56, 128.25, 127.8, 127.2, 127.0, 126.6, 125.9, 120.7, 119.4, 27.1, 23.3, 21.1. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{25}H_{24}NO$ 354.1853; found 354.1857.

3-(allyloxy)-2-phenylquinoline (3t):



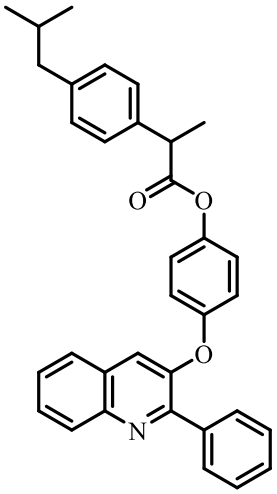
Using **GP-V** the title compound **3t** was isolated as colourless oil using silica gel column chromatography using petroleum ether/ ethyl acetate mixture as eluent (v/v = 1:10, R_f = 0.50) ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.11 (d, J = 8.4 Hz, 1H), 8.02 – 8.00(m, 2H), 7.74 (d, J = 9.2 Hz, 1H), 7.59 – 7.55 (m, 1H), 7.52 – 7.44 (m, 5H), 6.12 – 6.06 (m, 1H), 5.46 – 5.41 (m, 1H), 5.32 – 5.29 (m, 1H), 4.71 – 4.70 (m, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 152.3, 150.6, 143.3, 137.9, 132.5, 130.0, 129.5, 128.9, 128.7, 128.1, 127.1, 126.9, 126.3, 117.8, 114.4, 69.2. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{18}H_{16}NO$ 262.1227; found 262.1224.

4-((2-phenylquinolin-3-yl)oxy)phenyl (S)-2-(6-methoxynaphthalen-2-yl)propanoate (3u):



Using **GP-V** the title compound **3u** was isolated as colourless oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (136 mg, 65%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.16 (d, J = 8.0 Hz, 1H), 8.03 – 8.01(m, 2H), 7.75 – 7.73 (m, 3H), 7.66 – 7.62 (m, 2H), 7.55 (s, 1H), 7.49 – 7.43 (m, 5H), 7.18 – 7.15 (m, 2H), 7.03 – 6.98 (m, 4H), 4.12 – 4.08 (m, 1H), 3.92 (s, 3H), 1.70 (d, J = 7.2 Hz, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 173.5, 157.9, 153.8, 152.8, 149.9, 147.0, 144.8, 137.4, 135.1, 134.0, 129.7, 129.5, 129.4, 129.2, 128.4, 127.6, 127.1, 126.7, 126.3, 126.2, 123.1, 121.8, 120.2, 119.3, 105.7, 55.5, 45.7, 18.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{35}H_{28}NO_4$ 526.2013; found 526.2015.

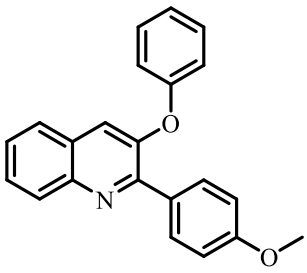
4-((2-phenylquinolin-3-yl)oxy)phenyl 2-(4-isobutylphenyl)propanoate (3v):



Using **GP-V** the title compound **3v** was isolated as colourless oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (110 mg, 55%). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.15 (d, J = 8.0 Hz, 1H), 8.02 (d, J = 7.5 Hz, 2H), 7.66 – 7.62 (m, 2H), 7.56 (s, 1H), 7.51 – 7.42 (m, 4H), 7.30 (d, J = 8.0 Hz, 2H), 7.15 (d, J = 8.0 Hz, 2H), 7.05 – 6.99 (m, 4H), 3.94 (q, J = 7.0 Hz, 1H), 2.47 (d, J = 7.0 Hz, 2H), 1.89 – 1.84 (m, 1H), 1.61 (d, J = 7.0 Hz, 3H), 0.91 (d, J = 6.5 Hz, 6H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 173.5, 153.9, 149.9, 147.1, 144.9, 141.1, 137.3, 129.7, 129.6, 129.2, 128.4, 128.4, 127.3, 127.1, 126.7, 123.1, 121.8, 120.2,

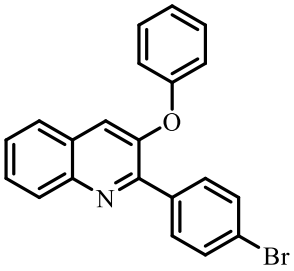
45.4, 45.2, 30.3, 22.5, 18.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{34}H_{32}NO_4$ 502.2377; found 502.2371.

2-(4-methoxyphenyl)-3-phenoxyquinoline (3aa):



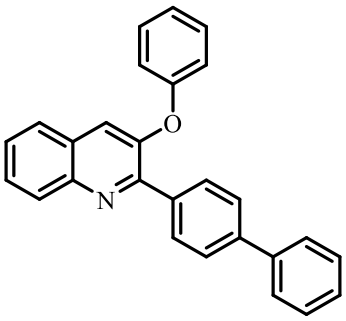
Using **GP-V** the title compound **3aa** was isolated as colourless liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (106 mg, 81%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.16 (d, J = 8.4 Hz, 1H), 8.09 (d, J = 7.8 Hz, 2H), 7.64 – 7.63 (m, 2H), 7.55 (s, 1H), 7.47 (t, J = 7.2 Hz, 1H), 7.38 (t, J = 7.5 Hz, 2H), 7.17 (t, J = 7.2 Hz, 1H), 7.08 (d, J = 7.2 Hz, 2H), 7.01 (d, J = 8.4 Hz, 2H), 3.86 (s, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 160.5, 156.6, 152.5, 149.8, 144.9, 131.2, 130.2, 130.0, 129.4, 128.2, 128.2, 126.7, 126.61, 124.1, 122.1, 119.4, 113.8, 55.4. The spectral data is in accordance with the literature.[5]

2-(4-bromophenyl)-3-phenoxyquinoline (3ab):



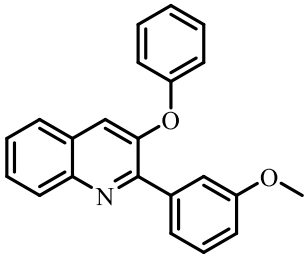
Using **GP-V** the title compound **3ab** was isolated as yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (109 mg, 73%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.14 (d, J = 8.8 Hz, 1H), 7.97 (d, J = 8.4 Hz, 2H), 7.67 – 7.65 (m, 2H), 7.61 (s, 1H), 7.58 – 7.57 (m, 2H), 7.52 – 7.48 (m, 1H), 7.40 – 7.36 (m, 2H), 7.18 (t, J = 7.2 Hz, 1H), 7.05 (d, J = 8.0 Hz, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.3, 151.6, 149.8, 144.8, 136.4, 131.5, 131.4, 130.3, 129.5, 128.5, 128.5, 127.3, 126.7, 124.4, 123.7, 122.2, 119.4. The spectral data is in accordance with the literature.[5]

2-([1,1'-biphenyl]-4-yl)-3-phenoxyquinoline (3ac):



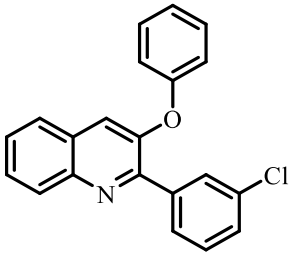
Using **GP-V** the title compound **3ac** was isolated as light red solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (114 mg, 77%). M.p. 101-103 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.19 – 8.17 (m, 3H), 7.72 – 7.70 (m, 2H), 7.67 – 7.63 (m, 4H), 7.58 (s, 1H), 7.52 – 7.44 (m, 3H), 7.42 – 7.34 (m, 3H), 7.20 – 7.17 (m, 1H), 7.13 – 7.10 (m, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.5, 152.5, 150.1, 144.9, 141.9, 136.5, 130.3, 130.2, 129.6, 128.9, 128.4, 128.3, 127.6, 127.3, 127.1, 127.1, 126.7, 124.3, 121.9, 119.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{27}H_{20}NO$ 374.1540; found 374.1551.

2-(3-methoxyphenyl)-3-phenoxyquinoline (3ad):



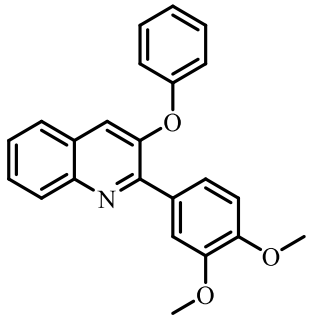
Using **GP-V** the title compound **3ad** was isolated as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (99 mg, 76%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.20 (d, J = 8.4 Hz, 1H), 7.69 – 7.68 (m, 3H), 7.63 (s, 1H), 7.61 (s, 1H), 7.53 (t, J = 7.2 Hz, 1H), 7.40 (t, J = 7.8 Hz, 3H), 7.19 (t, J = 7.2 Hz, 1H), 7.10 (d, J = 7.8 Hz, 2H), 7.01 (d, J = 7.2 Hz, 1H), 3.87 (s, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 159.5, 156.9, 149.8, 144.8, 138.7, 130.2, 129.7, 129.5, 129.3, 128.5, 128.3, 127.1, 126.7, 124.1, 122.3, 119.3, 115.3, 114.9, 55.4. The spectral data is in accordance with the literature.[5]

2-(3-chlorophenyl)-3-phenoxyquinoline (3ae):



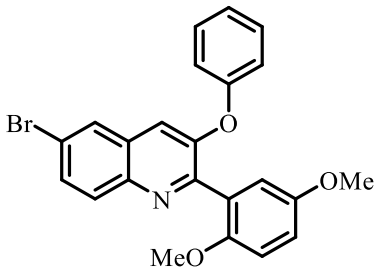
Using **GP-V** the title compound **3ae** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.60); (99 mg, 75%). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.15 (d, J = 8.5 Hz, 1H), 8.09 (s, 1H), 7.97 – 7.96 (m, 1H), 7.67 – 7.64 (m, 2H), 7.58 (s, 1H), 7.53 – 7.50 (m, 1H), 7.40 – 7.37 (m, 3H), 7.19 – 7.16 (m, 1H), 7.06 (d, J = 8.0 Hz, 2H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 156.3, 151.3, 149.8, 144.8, 139.2, 134.3, 130.3, 129.9, 129.6, 129.5, 129.2, 128.6, 128.5, 128.0, 127.4, 126.7, 124.4, 122.1, 119.5. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{15}NClO$ 332.0837; found 332.0847.

2-(3,4-dimethoxyphenyl)-3-phenoxyquinoline (3af):



Using **GP-V** the title compound **3af** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (118 mg, 83%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.15 (d, J = 8.4 Hz, 1H), 7.73 – 7.72 (m, 1H), 7.69 (brs, 1H), 7.66 – 7.63 (m, 2H), 7.59 (s, 1H), 7.48 (t, J = 7.8 Hz, 1H), 7.37 (t, J = 7.8 Hz, 2H), 7.15 (t, J = 7.2 Hz, 1H), 7.06 (d, J = 8.4 Hz, 2H), 6.95 (d, J = 8.4 Hz, 1H), 3.93 (s, 3H), 3.92 (s, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.8, 150.1, 149.5, 148.8, 145.0, 130.2, 130.2, 129.4, 128.4, 128.2, 126.8, 126.7, 124.0, 122.9, 122.8, 119.0, 112.9, 110.9, 56.1, 56.0. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{23}H_{20}NO_3$ 358.1438; found 358.1436.

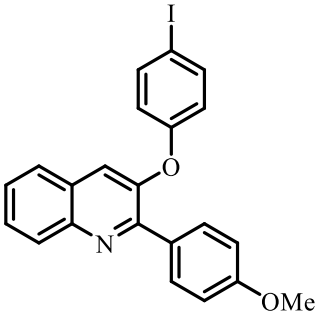
6-bromo-2-(2,5-dimethoxyphenyl)-3-phenoxyquinoline (3ag):



Using **GP-V** the title compound **3ag** was isolated as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.40); (142 mg, 82%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.00 (d, J = 9.0 Hz, 1H), 7.81 (d, J = 2.1 Hz, 1H), 7.66 (dd, J = 9.0, 2.4 Hz, 1H), 7.38 – 7.36 (m, 3H), 7.17 (t, J = 7.2 Hz, 1H), 7.08 – 7.07 (m, 3H), 6.96 – 6.94 (m,

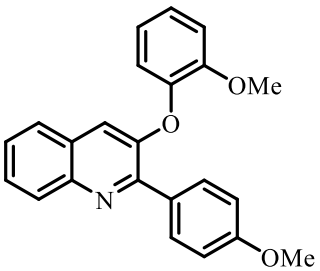
1H), 6.89 (d, J = 9.0 Hz, 1H), 3.81 (s, 3H), 3.66 (s, 3H). $^{13}C\{^{1}H\}$ NMR (151 MHz, $CDCl_3$): δ 156.3, 153.8, 153.1, 151.9, 151.7, 142.9, 131.2, 131.1, 130.1, 129.9, 128.7, 127.6, 124.4, 121.0, 119.9, 118.6, 116.1, 115.8, 112.2, 56.2, 56.0. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{23}H_{18}BrNO_3$ 436.0543; found 436.0440.

3-(4-iodophenoxy)-2-(4-methoxyphenyl)quinoline (3ah):



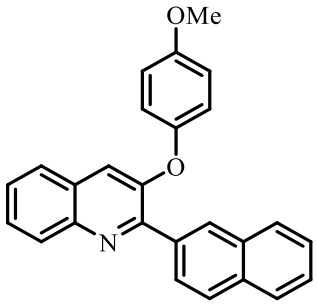
Using **GP-V** the title compound **3ah** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (122 mg, 87%). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.14 (d, J = 8.5 Hz, 1H), 8.01 (d, J = 8.5 Hz, 2H), 7.67 – 7.62 (m, 4H), 7.60 (s, 1H), 7.51 – 7.48 (m, 1H), 6.98 (d, J = 9.0 Hz, 2H), 6.79 (d, J = 8.5 Hz, 2H), 3.85 (s, 3H). $^{13}C\{^{1}H\}$ NMR (126 MHz, $CDCl_3$): δ 160.6, 156.9, 152.6, 148.9, 145.3, 139.1, 131.1, 129.8, 129.5, 128.6, 128.1, 126.9, 126.7, 123.2, 121.0, 113.9, 55.5. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{23}H_{17}NIO_2$ 354.0299; found 354.0300.

3-(2-methoxyphenoxy)-2-(4-methoxyphenyl)quinoline (3ai):



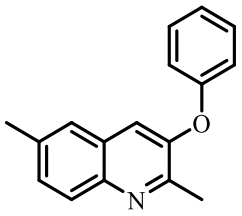
Using **GP-V** the title compound **3ai** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (119 mg, 84%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.17 (d, J = 9.0 Hz, 2H), 8.11 (d, J = 9.0 Hz, 1H), 7.59 – 7.56 (m, 2H), 7.43 (t, J = 7.8 Hz, 1H), 7.25 (s, 1H), 7.24 – 7.21 (m, 1H), 7.09 – 7.03 (m, 2H), 7.02 (d, J = 9.0 Hz, 2H), 7.00 – 6.98 (m, 1H), 3.87 (s, 3H), 3.79 (s, 3H).$^{13}C\{^{1}H\}$ NMR (151 MHz, $CDCl_3$): δ 160.4, 151.7, 151.6, 150.8, 144.3, 131.4, 130.4, 129.3, 128.3, 127.6, 126.5, 126.5, 126.0, 122.4, 121.4, 118.2, 113.7, 113.2, 56.0, 55.5. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{23}H_{20}NO_3$ 358.1438; found 358.1440.

3-(4-methoxyphenoxy)-2-(naphthalen-2-yl)quinoline (3aj):



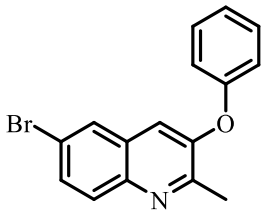
Using **GP-V** the title compound **3aj** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (131 mg, 87%). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.61 (s, 1H), 8.23 (d, J = 8.5 Hz, 1H), 8.19 (d, J = 8.5 Hz, 1H), 7.96 – 7.94 (m, 2H), 7.89 – 7.87 (m, 1H), 7.65 – 7.62 (m, 2H), 7.51 – 7.48 (m, 4H), 7.08 (d, J = 9.0 Hz, 2H), 6.94 (d, J = 9.0 Hz, 2H), 3.83 (s, 3H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 156.6, 151.4, 149.4, 144.5, 135.1, 133.7, 133.4, 129.7, 129.5, 129.0, 128.5, 128.0, 127.7, 127.3, 127.0, 126.7, 126.6, 126.1, 121.3, 120.1, 115.3, 55.8. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{26}H_{20}NO_2$ 378.1489; found 378.1492.

2,6-dimethyl-3-phenoxyquinoline (3ak):



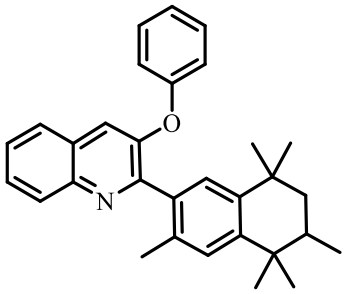
Using **GP-V** the title compound **3ak** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (68 mg, 78%). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.91 (d, J = 8.5 Hz, 1H), 7.44 – 7.37 (m, 4H), 7.34 (s, 1H), 7.17 (t, J = 7.4 Hz, 1H), 7.03 (d, J = 8.0 Hz, 2H), 2.70 (s, 3H), 2.48 (s, 3H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 156.7, 153.0, 150.2, 143.1, 136.2, 130.3, 130.2, 128.2, 125.8, 124.0, 120.1, 118.9, 21.6, 20.7. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{17}H_{16}NO$ 250.1227; found 250.1223.

6-bromo-2-methyl-3-phenoxyquinoline (3al):



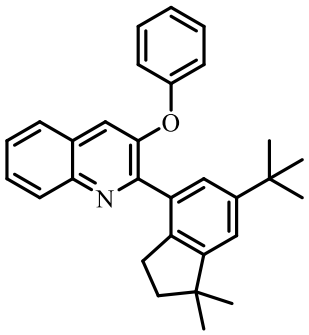
Using **GP-V** the title compound **3al** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:10, R_f = 0.50); (87 mg, 70%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.87 (d, J = 8.8 Hz, 1H), 7.75 – 7.74(m, 1H), 7.65 – 7.62 (m, 1H), 7.44 – 7.40 (m, 2H), 7.24 – 7.20 (m, 2H), 7.07 – 7.05 (m, 2H), 2.73 (s, 3H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 155.9, 154.5, 151.3, 142.8, 131.2, 130.4, 130.2, 129.4, 128.8, 124.7, 120.2, 119.6, 118.0, 20.8. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{17}H_{16}NO$ 314.0176; found 314.0183.

2-(3,5,5,6,8,8-hexamethyl-5,6,7,8-tetrahydronaphthalen-2-yl)-3-phenoxyquinoline (3am):



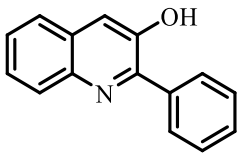
Using **GP-V** the title compound **3am** was isolated as colourless oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (130 mg, 75%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.14 (d, J = 8.4 Hz, 1H), 7.69 (d, J = 8.4 Hz, 1H), 7.63 (t, J = 7.2 Hz, 1H), 7.59 (s, 1H), 7.51 (t, J = 7.2 Hz, 1H), 7.32 – 7.29 (s, 3H), 7.20 (s, 1H), 7.10 (t, J = 7.2 Hz, 1H), 6.97 (d, J = 7.8 Hz, 2H), 2.28 (s, 3H), 1.87 – 1.83 (m, 1H), 1.62 – 1.61 (m, 2H), 1.32 (s, 3H), 1.19 (s, 3H), 1.17 (s, 3H), 1.05 (s, 3H), 0.97 (d, J = 6.6 Hz, 3H).^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.7, 146.3, 144.5, 141.7, 133.3, 129.9, 129.5, 128.9, 128.4, 128.1, 127.9, 126.9, 126.7, 123.9, 121.5, 119.3, 43.9, 37.7, 34.7, 34.1, 32.6, 32.1, 28.7, 25.0, 19.8, 17.0. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{31}H_{34}NO$ 434.2635; found 436.2641.

2-(6-(tert-butyl)-1,1-dimethyl-2,3-dihydro-1H-inden-4-yl)-3-phenoxyquinoline (3an):



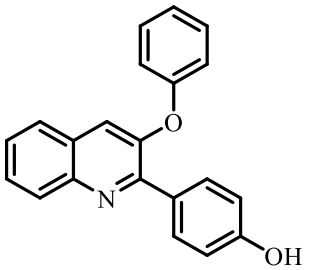
Using **GP-V** the title compound **3an** was isolated as colourless oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (122 mg, 73%). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.13 (d, J = 8.5 Hz, 1H), 7.69 (d, J = 8.0 Hz, 1H), 7.63 (t, J = 7.5 Hz, 1H), 7.59 (s, 1H), 7.50 (t, J = 7.5 Hz, 1H), 7.40 (s, 1H), 7.31 – 7.28 (m, 2H), 7.16 (s, 1H), 7.11 – 7.08 (m, 1H), 6.96 (d, J = 7.5 Hz, 2H), 2.93 (t, J = 7.1 Hz, 2H), 1.89 (t, J = 7.1 Hz, 2H), 1.29 (d, J = 1.7 Hz, 9H), 1.27 (s, 6H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 156.7, 152.8, 149.9, 144.6, 139.4, 129.9, 129.5, 128.4, 128.1, 126.9, 126.7, 124.8, 123.9, 121.6, 119.5, 119.3, 44.1, 41.8, 34.8, 31.7, 29.9, 29.0, 28.9. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{30}H_{32}NO$ 422.2479; found 422.2489.

2-phenylquinolin-3-ol (4a):



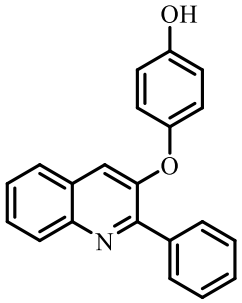
Using **GP-V** the title compound **4a** was isolated as light yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:10, R_f = 0.50); (51 mg, 58%). M.p. 210-212 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.10 (d, J = 8.4 Hz, 1H), 7.86 – 7.84 (m, 2H), 7.71 (d, J = 8.0 Hz, 1H), 7.58 – 7.54 (m, 4H), 7.52 – 7.48 (m, 2H), 5.77 (s, 1H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 150.7, 147.5, 143.8, 136.7, 129.6, 129.4, 129.4, 129.1, 127.3, 127.1, 126.3, 118.2. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{15}H_{12}NO$ 222.0914; found 222.0922.

4-(3-phenoxyquinolin-2-yl)phenol (4b):



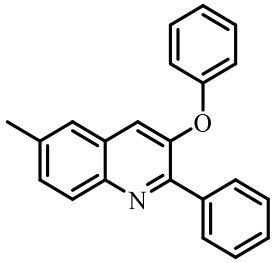
Using **GP-V** the title compound **4b** was isolated as light yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:10, R_f = 0.50); (81 mg, 65%). M.p. 201-203 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.18 (d, J = 8.4 Hz, 1H), 7.90 (d, J = 8.8 Hz, 2H), 7.62 – 7.60 (m, 2H), 7.56 (s, 1H), 7.47 (t, J = 7.6 Hz, 1H), 7.37 (t, J = 7.6 Hz, 2H), 7.16 (t, J = 7.2 Hz, 1H), 7.06 (d, J = 7.6 Hz, 2H), 6.81 (d, J = 8.8 Hz, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 157.5, 156.4, 153.0, 149.9, 144.5, 131.4, 130.2, 128.7, 128.5, 128.2, 126.9, 126.7, 124.2, 122.2, 119.5, 115.6. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{16}NO_2$ 314.1176; found 314.1180.

4-((2-phenylquinolin-3-yl)oxy)phenol (4c):



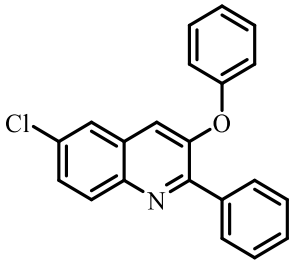
Using **GP-V** the title compound **4c** was isolated as light yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 10:1, R_f = 0.50); (87 mg, 70%).^{1}H NMR (600 MHz, $CDCl_3$): δ 8.15 (d, J = 8.4 Hz, 1H), 8.05 (d, J = 7.8 Hz, 2H), 7.63 – 7.60 (m, 2H), 7.49 – 7.47 (m, 3H), 7.45 – 7.43 (m, 2H), 6.97 (d, J = 8.4 Hz, 2H), 6.83 (d, J = 7.8 Hz, 2H), 5.45 (brs, 1H).^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 152.6, 152.6, 151.2, 149.3, 144.3, 137.5, 129.8, 129.4, 129.2, 128.5, 128.3, 128.0, 127.1, 126.6, 121.5, 119.9, 116.8. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{16}NO_2$ 314.1176; found 314.1179.

6-methyl-3-phenoxy-2-phenylquinoline (5a):



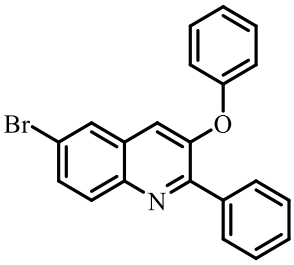
Using **GP-V** the title compound **5a** was isolated as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:1, R_f = 0.50); (102 mg, 82%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.06 – 8.02 (m, 3H), 7.50 (s, 1H), 7.48 – 7.44 (m, 3H), 7.42 – 7.40 (m, 2H), 7.36 (t, J = 8.4 Hz, 2H), 7.15 (t, J = 7.2 Hz, 1H), 7.05 (d, J = 8.4 Hz, 2H), 2.51 (s, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.7, 152.1, 149.9, 143.5, 137.0, 130.6, 130.1, 129.7, 129.2, 129.0, 128.5, 128.3, 125.6, 124.0, 121.7, 119.3, 21.8. The spectral data is in accordance with the literature.[5]

6-chloro-3-phenoxy-2-phenylquinoline (5b):



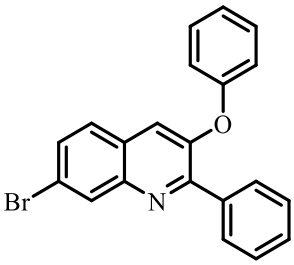
Using **GP-V** the title compound **5b** was isolated as colourless oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (112 mg, 85%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.09 – 8.05 (m 3H), 7.62 (d, J = 1.8 Hz, 1H), 7.55 (dd, J = 9.0, 2.4 Hz, 1H), 7.49 – 7.44 (m, 3H), 7.42 – 7.39 (m, 3H), 7.20 (t, J = 7.2 Hz, 1H), 7.08 (d, J = 7.8 Hz, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 155.9, 153.0, 151.0, 143.0, 137.2, 132.8, 131.1, 130.3, 129.7, 129.4, 129.1, 129.1, 128.4, 125.3, 124.7, 120.2, 119.9. The spectral data is in accordance with the literature.[5]

6-bromo-3-phenoxy-2-phenylquinoline (5c):



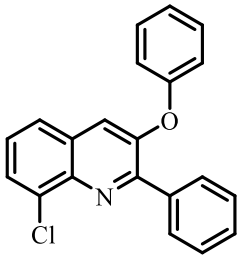
Using **GP-V** the title compound **5c** was isolated as colourless oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (130 mg, 87%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.06 (d, J = 7.2 Hz, 2H), 8.01 (d, J = 9.0 Hz, 1H), 7.80 (brs, 1H), 7.69 – 7.67 (m, 1H), 7.49 – 7.44 (m, 3H), 7.42 – 7.39 (m, 3H), 7.20 (d, J = 7.2 Hz, 1H), 7.09 (d, J = 8.4 Hz, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 155.9, 153.1, 150.9, 143.2, 137.1, 131.6, 131.2, 130.3, 129.7, 129.4, 128.6, 128.4, 124.7, 121.0, 120.0, 119.9. The spectral data is in accordance with the literature.[5]

7-bromo-3-phenoxy-2-phenylquinoline (5d):



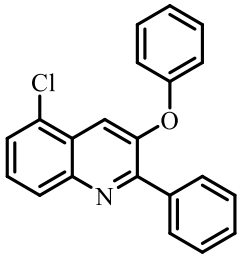
Using **GP-V** the title compound **5d** was isolated as colourless oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.40); (129 mg, 86%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.35 (s, 1H), 8.06 (d, J = 7.8 Hz, 2H), 7.57 – 7.56 (m, 1H), 7.52 – 7.44 (m, 5H), 7.40 (t, J = 7.8 Hz, 2H), 7.19 (t, J = 7.8 Hz, 1H), 7.08 (d, J = 8.4 Hz, 2H).^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.1, 153.7, 150.4, 137.1, 131.8, 130.5, 130.3, 129. 8, 129.5, 128.4, 127.9, 127.0, 124.6, 121.9, 121.3, 119.7. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{15}NBrO$ 376.0332; found 376.0335.

8-chloro-3-phenoxy-2-phenylquinoline (5e):



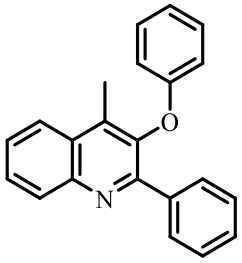
Using **GP-V** the title compound **5e** was isolated as yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:3, R_f = 0.40); (103 mg, 78%). M.p 133-135 ºC ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.24 – 8.22 (m, 2H), 7.74 (d, J = 7.2 Hz, 1H), 7.56 – 7.53 (m, 2H), 7.50 – 7.45 (m, 3H), 7.42 – 7.38 (m, 3H), 7.20 (t, J = 7.2 Hz, 1H), 7.09 (d, J = 8.0 Hz, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.1, 152.7, 151.0, 140.7, 137.2, 133.9, 130.3, 130.2, 129.8, 129.6, 128.4, 128.3, 127.0, 125.7, 124.6, 121.7, 119.8. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{15}NClO$ 332.0837; found 332.0839.

5-chloro-3-phenoxy-2-phenylquinoline(5f):



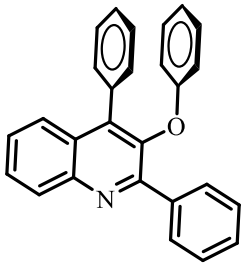
Using **GP-V** the title compound **5f** was isolated as yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:3, R_f = 0.40); (113 mg, 86%).^{1}H NMR (400 MHz, $CDCl_3$): δ 8.10 – 8.06 (m, 3H), 7.96 (s, 1H), 7.56 – 7.54 (m, 2H), 7.48 – 7.46 (m, 3H), 7.42 – 7.38 (m, 2H), 7.20 – 7.17 (m, 1H), 7.10 – 7.08 (m, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 156.1, 153.7, 150.8, 145.2, 136.9, 130.3, 130.2, 130.0, 129.9, 129.7, 129.5, 128.7, 128.4, 128.3, 127.8, 126.9, 126.8, 124.5, 119.5, 119.4, 118.9. The spectral data is in accordance with the literature.[5]

4-methyl-3-phenoxy-2-phenylquinoline (5g):



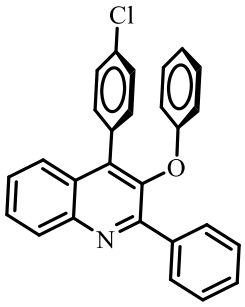
Using **GP-V** the title compound **5g** was isolated as colourless oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:2, R_f = 0.50); (93 mg, 75%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.20 (d, J = 8.4 Hz, 1H), 8.00 (d, J = 8.0 Hz, 1H), 7.87 – 7.85 (m, 2H), 7.74 – 7.70 (m, 1H), 7.62 – 7.58 (m, 1H), 7.36 – 7.30 (m, 3H), 7.14 (t, J = 8.0 Hz, 2H), 6.89 (t, J = 7.6 Hz, 1H), 6.67 (d, J = 8.0 Hz, 2H), 2.56 (s, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 157.9, 155.0, 145.7, 144.3, 137.9, 136.6, 130.4, 129.7, 129.4, 128.9, 128.8, 128.6, 128.2, 126.8, 124.0, 121.9, 115.2, 12.0. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{22}H_{18}NO$ 312.1383; found 312.1381.

3-phenoxy-2,4-diphenylquinoline (5h):



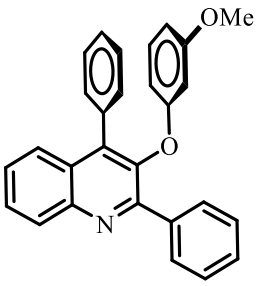
Using **GP-V** the title compound **5h** was isolated as yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:3, R_f = 0.50); (134 mg, 90%). M.p. 129-131 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.26 (d, J = 8.4 Hz, 1H), 7.95 – 9.93 (m, 2H), 7.74 – 7.72 (m, 1H), 7.62 – 7.60 (m, 1H), 7.49 – 7.47 (m, 1H), 7.37 – 7.31 (m, 8H), 6.98 – 6.94 (m, 2H), 6.76 – 6.73 (m, 1H), 6.50 – 6.48 (m, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 158.1, 155.3, 146.2, 143.8, 140.8, 137.8, 133.3, 130.1, 129.9, 129.5, 129.1, 129.0, 128.9, 128.28, 128.25, 128.22, 128.18, 126.9, 125.9, 121.6, 116.0. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{27}H_{20}NO$ 374.1540; found 374.1546.

4-(4-chlorophenyl)-3-phenoxy-2-phenylquinoline (5i):



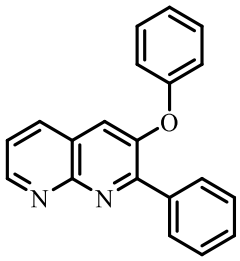
Using **GP-V** the title compound **5i** was isolated as yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:3, R_f = 0.60); (126 mg, 78%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.25 (d, J = 8.0 Hz, 1H), 7.93 – 7.91 (m, 2H), 7.74 – 7.70 (m, 1H), 7.58 – 7.55 (m, 1H), 7.50 – 7.46 (m, 1H), 7.36 – 7.31 (m, 5H), 7.27 (s, 1H), 7.26 – 7.25 (m, 1H), 7.00 – 6.95 (m, 2H), 6.77 (t, J = 7.2 Hz, 1H), 6.48 (d, J = 7.8 Hz, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 158.0, 146.2, 143.8, 139.5, 137.6, 134.4, 131.8, 131.5, 130.0, 129.5, 129.2, 129.1, 129.1, 128.6, 128.3, 127.9, 127.2, 125.5, 121.987, 115.9. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{27}H_{19}ClNO$ 408.1150; found 408.1152.

3-(3-methoxyphenoxy)-2,4-diphenylquinoline (5j):



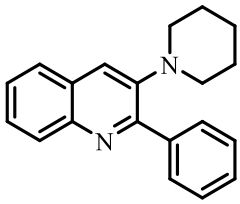
Using **GP-V** the title compound **5j** was isolated as yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:3, R_f = 0.40); (138 mg, 86%).^{1}H NMR (600 MHz, $CDCl_3$): δ 8.25 (d, J = 8.4 Hz, 1H), 7.94 – 7.93 (m, 2H), 7.72 (t, J = 7.8 Hz, 1H), 7.61 (d, J = 8.4 Hz, 1H), 7.48 (t, J = 7.8 Hz, 1H), 7.37 – 7.32 (m, 8H), 6.86 (t, J = 7.8 Hz, 1H), 6.31 (d, J = 7.2 Hz, 1H), 6.08 (d, J = 11.9 Hz, 2H), 3.59 (s, 3H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 160.4, 159.3, 143.7, 140.8, 137.8, 133.3, 130.1, 129.9, 129.5, 129.5, 129.0, 128.9, 128.30, 128.3, 128.2, 128.1, 126.9, 125.9, 108.5, 107.4, 102.5, 55.3. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{28}H_{22}NO_2$ 404.1646; found 406.1651.

3-phenoxy-2-phenyl-1,8-naphthyridine (5k):



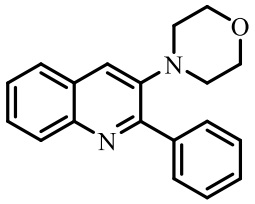
Using **GP-V** the title compound **5k** was isolated as white solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:50, R_f = 0.60); (84 mg, 92%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 9.06 – 9.05 (m, 1H), 8.26 – 8.24 (m, 2H), 8.02 – 8.00 (m, 1H), 7.51 (s, 1H), 7.48 – 7.45 (m, 3H), 7.43 – 7.40 (m, 3H), 7.23 – 7.21 (m, 1H), 7.12 – 7.10 (m, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 155.8, 155.4, 152.4, 152.2, 151.0, 136.7, 135.9, 130.4, 130.2, 129.8, 128.2, 124.8, 122.8, 122.3, 121.6, 119.9. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{20}H_{15}N_2O$ 299.1179; found 229.1175.

2-phenyl-3-(piperidin-1-yl)quinoline (7a):



Using **GP-VI** the title compound **7a** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:4, R_f = 0.40); (94 mg, 82%). ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.05 (d, J = 7.6 Hz, 3H), 7.71 (d, J = 8.4 Hz, 1H), 7.58 (s, 1H), 7.54 (t, J = 7.2 Hz, 1H), 7.47 – 7.43 (m, 3H), 7.41 – 7.39 (m, 1H), 2.86 (s, 4H), 1.55 – 1.54 (m, 4H), 1.51 – 1.50 (m, 2H). ^{13}C{^{1}H} NMR (151 MHz, $CDCl_3$): δ 155.9, 146.5, 144.1, 140.7, 129.329, 128.9, 128.3, 128.3, 127.2, 126.6, 126.5, 121.9, 52.8, 25.9, 24.1. HRMS (ESI) *m/z*: $[M+H]^{]+}$ calculated for $C_{20}H_{21}N_2O$ 289.1700; found 289.1694.

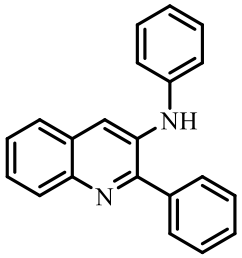
4-(2-phenylquinolin-3-yl)morpholine (7b):



Using **GP-VI** the title compound **7b** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:4, R_f = 0.40); (87 mg, 75%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.06 – 8.02 (m, 3H), 7.74 (d, J = 6.8 Hz, 1H), 7.60 (s, 1H), 7.57 – 7.56 (m, 1H), 7.51 – 7.46 (m, 3H), 7.43 – 7.41 (m, 1H), 3.70 – 3.68 (m, 4H), 2.94 – 2.91 (m, 4H). ^{13}C{^{1}H}

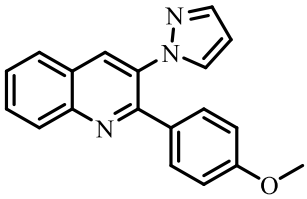
NMR (151 MHz, $CDCl_3$): δ 155.5, 144.9, 144.4, 140.3, 129.4, 128.9, 128.8, 128.5, 128.3, 127.7, 126.9, 126.6, 122.0, 66.9, 51.7. HRMS (ESI) *m/z*: $[M+H]^{]+}$ calculated for $C_{19}H_{19}N_2O$ 291.1492; found 291.1493.

***N*,2-diphenylquinolin-3-amine (7c):**



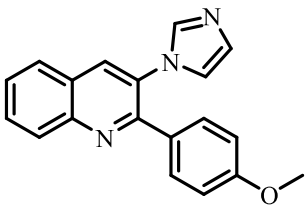
Using **GP-VI** the title compound **7c** was isolated as yellow liquid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:4, R_f = 0.40); (94 mg, 80%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.05 (d, J = 8.4 Hz, 1H), 7.92 (s, 1H), 7.78 – 7.76 (m, 2H), 7.65 – 7.62 (m, 1H), 7.56 – 7.45 (m, 5H), 7.37 – 7.33 (m, 2H), 7.19 – 7.17 (m, 2H), 7.07 – 7.04 (m, 1H), 5.82 (brs, 1H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 152.6, 143.4, 141.9, 138.1, 135.7, 129.8, 129.35, 129.28, 129.26, 129.2, 128.7, 127.0, 126.7, 126.2, 122.8, 119.8, 117.1. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{17}N_2$ 297.1387; found 297.1396.

2-(4-methoxyphenyl)-3-(1H-pyrazol-1-yl)quinoline (7d):



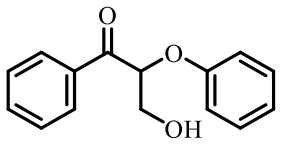
Using **GP-VI** the title compound **7d** as yellow solid using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:20, R_f = 0.40); (108 mg, 90%). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.36 (s, 1H), 8.20 (d, J = 8.5 Hz, 1H), 7.87 (d, J = 8.0 Hz, 1H), 7.78 – 7.75 (m, 2H), 7.60 – 7.56 (m, 1H), 7.36 – 7.56 (d, J = 8.8 Hz, 2H), 7.27 – 7.26 (m, 1H), 6.89 – 6.86 (m, 2H), 6.33 – 6.32 (m, 1H), 3.82 (s, 3H). ^{13}C{^{1}H} NMR (126 MHz, $CDCl_3$): δ 160.5, 154.3, 147.5, 141.2, 133.6, 133.2, 131.8, 130.50, 130.45, 130.3, 129.6, 127.8, 127.3, 127.1, 114.1, 107.4, 55.4. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{19}H_{16}N_3O$ 302.1288; found 302.1297.

3-(1H-imidazol-1-yl)-2-(4-methoxyphenyl)quinoline (7e):



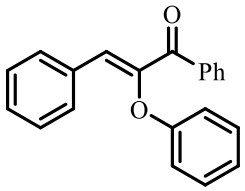
Using **GP-VI** the title compound **7e** was isolated as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:20, R_f = 0.40); (111 mg, 92%).^{1}H NMR (600 MHz, $CDCl_3$): δ 8.21 (d, J = 8.4 Hz, 1H), 8.14 (s, 1H), 7.88 (d, J = 7.8 Hz, 1H), 7.80 (t, J = 8.4 Hz, 1H), 7.63 – 7.61 (m, 2H), 7.33 (d, J = 9.0 Hz, 2H), 7.18 (s, 1H), 6.97 (s, 1H), 6.87 (d, J = 8.4 Hz, 2H), 3.81 (s, 3H). $^{13}C\{^1H\}$ NMR (151 MHz, $CDCl_3$): δ 160.7, 154.6, 147.8, 133.4, 130.9, 130.0 129.7, 129.7, 127.7, 127.5, 126.8, 121.0, 114.3, 55.4. Spectral data is in accordance with the literature.[9]

3-hydroxy-2-phenoxy-1-phenylpropan-1-one (18):



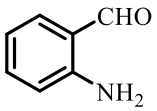
^{1}H NMR (600 MHz, $CDCl_3$): δ 8.05 (d, J = 7.8 Hz, 2H), 7.60 (t, J = 7.2 Hz, 1H), 7.47 (t, J = 7.8 Hz, 2H), 7.23 (t, J = 7.8 Hz, 2H), 6.96 (t, J = 7.2 Hz, 1H), 6.89 (d, J = 8.4 Hz, 2H), 5.60 – 5.58 (m, 1H), 4.18 – 4.09 (m, 2H), 2.87 (s, 1H). $^{13}C\{^1H\}$ NMR (151 MHz, $CDCl_3$): δ 196.9, 157.3, 134.1, 129.7, 129.0, 128.8, 122.0, 115.3, 81.2, 63.3. Spectral data is in accordance with the literature.[10]

(Z)-2-phenoxy-1,3-diphenylprop-2-en-1-one (20):



The title compound 20 was isolated as yellow oil using silica gel column chromatography with petroleum ether/ethyl acetate (v/v = 50:10, R_f = 0.40); (111 mg, 65%).^{1}H NMR (400 MHz, $CDCl_3$): δ 7.88 – 7.86 (m, 2H), 7.76 – 7.74 (m, 2H), 7.51 – 7.49 (m, 1H), 7.42 – 7.38 (m, 3H), 7.35 – 7.33 (m, 2H), 7.22 – 7.18 (m, 2H), 7.01 – 6.93 (m 4H). $^{13}C\{^1H\}$ NMR (151 MHz, $CDCl_3$): δ 192.20, 156.18, 148.19, 137.11, 132.96, 132.71, 130.58, 129.83, 129.76, 129.44, 128.87, 128.42, 128.21, 122.95, 116.22. HRMS (ESI) *m/z*: $[M+H]^+$ calculated for $C_{21}H_{17}O_2$ 301.1224; found 301.1216.

2-aminobenzaldehyde (1a'):



^{1}H NMR (500 MHz, $CDCl_3$): δ 9.87 (s, 1H), 7.48 (d, J = 8.0 Hz, 1H), 7.31 (t, J = 7.0 Hz, 1H), 6.75 (t, J = 7.5 Hz, 1H), 6.65 (d, J = 8.0 Hz, 1H), 6.11 (brs, 2H). $^{13}C\{^{1}H\}$ NMR (126 MHz, $CDCl_3$): δ 194.1, 149.9, 135.7, 135.2, 118.9, 116.4, 116.0. Spectral data is in accordance with the literature.[11]

9. ^{1}H, ^{13}C, and ^{19}F NMR spectra of the starting materials and products:

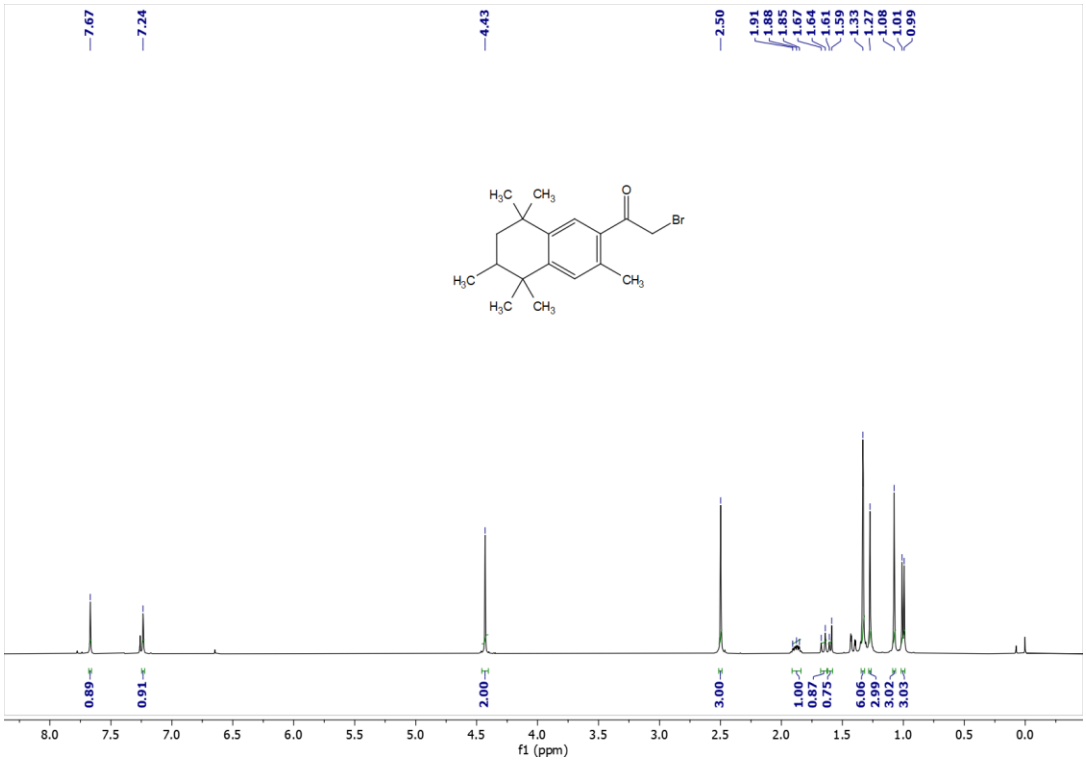


Figure S18: ^{1}H NMR Spectrum of **2am′** ($CDCl_3$, 400 MHz, 298 K)

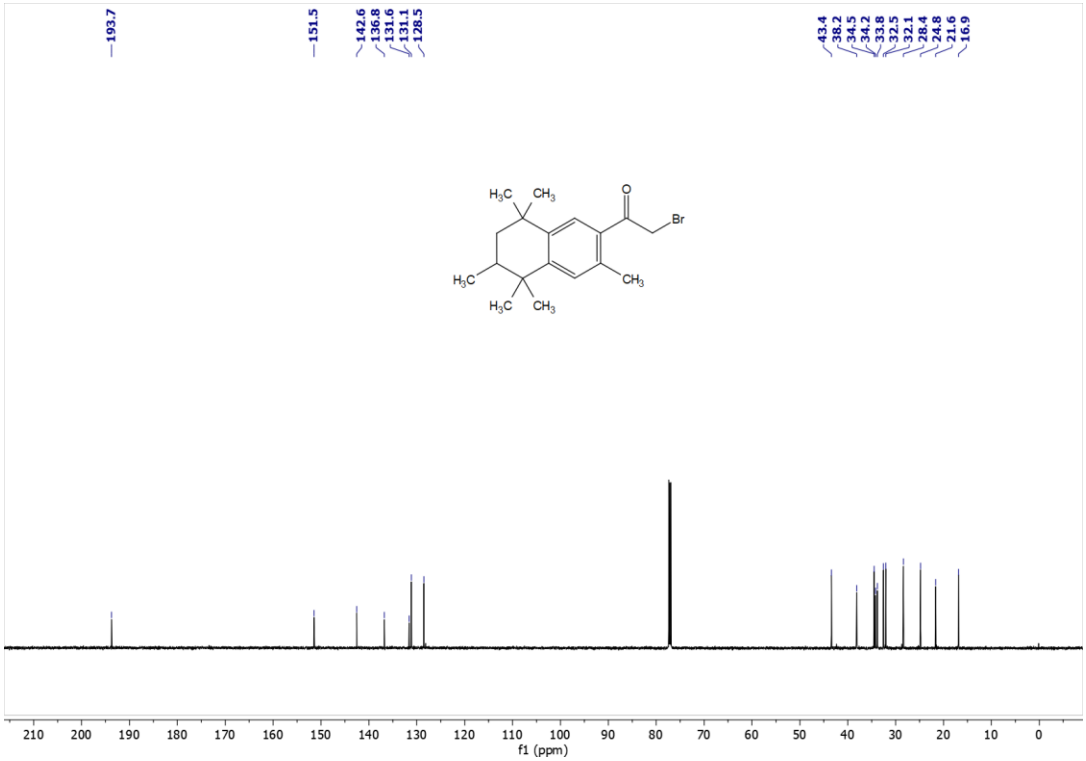


Figure S19: $^{13}C\{^{1}H\}$ NMR Spectrum of **2am′** ($CDCl_3$, 151 MHz, 298 K)

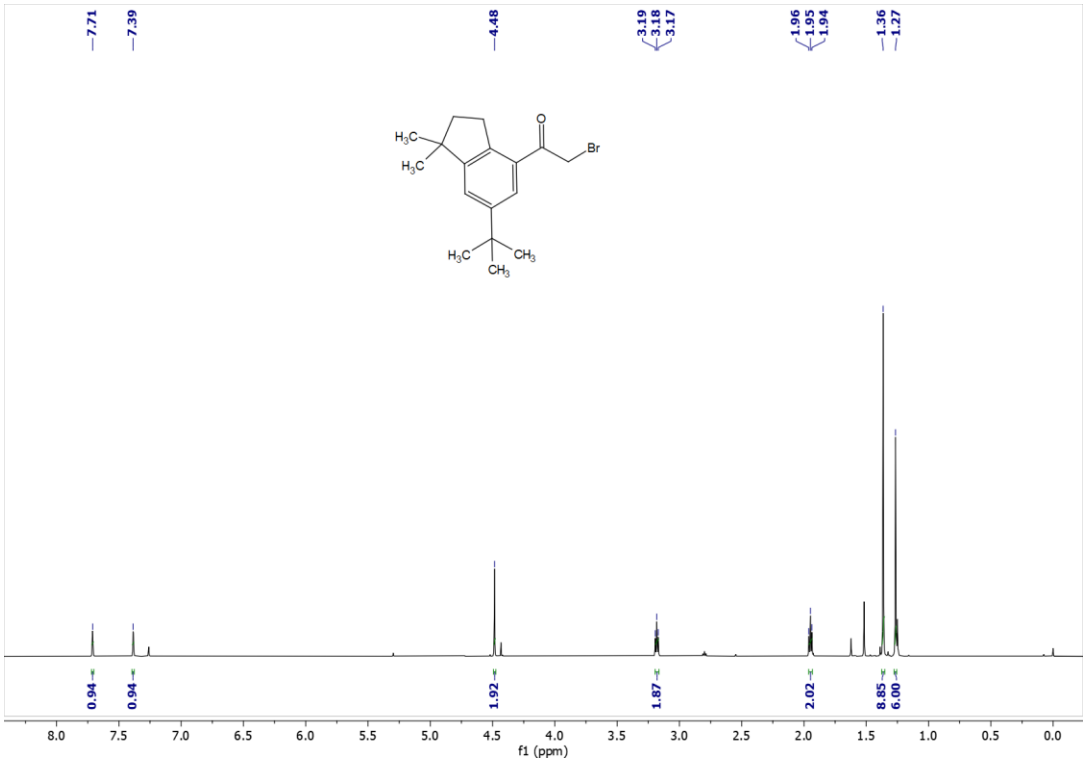


Figure S20: ^{1}H NMR Spectrum of **2an′** ($CDCl_3$, 600 MHz, 298 K)

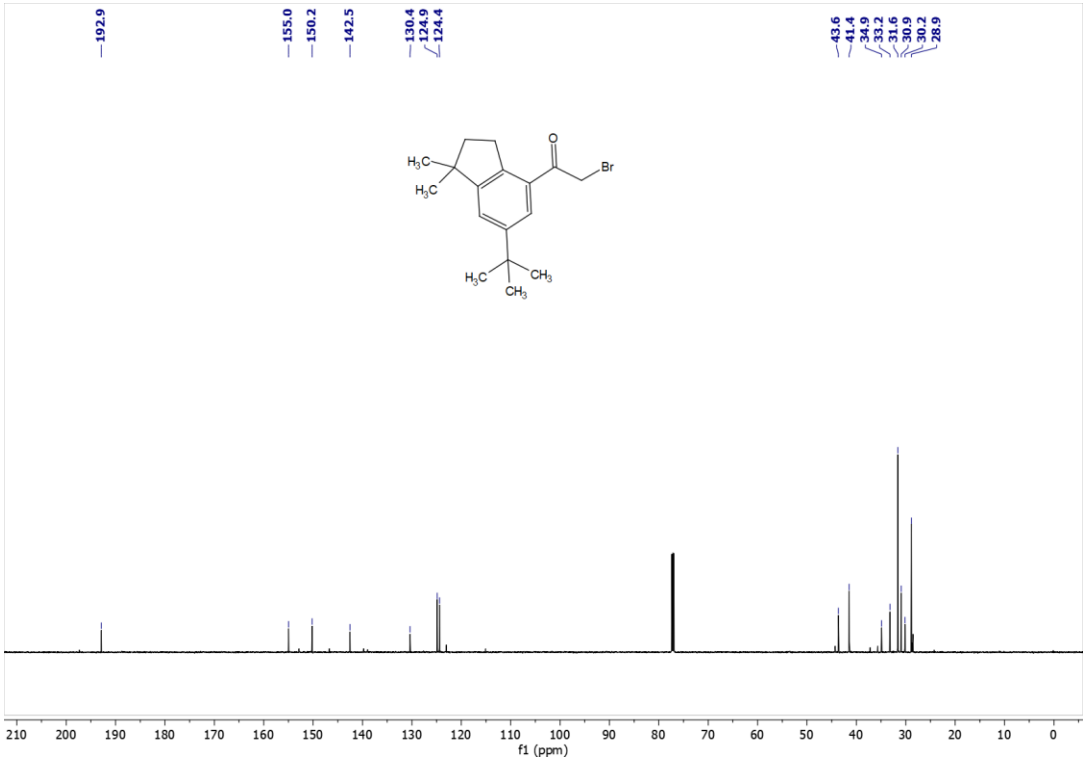


Figure S21: $^{13}C\{^{1}H\}$ NMR Spectrum of **2an′** ($CDCl_3$, 151 MHz, 298 K)

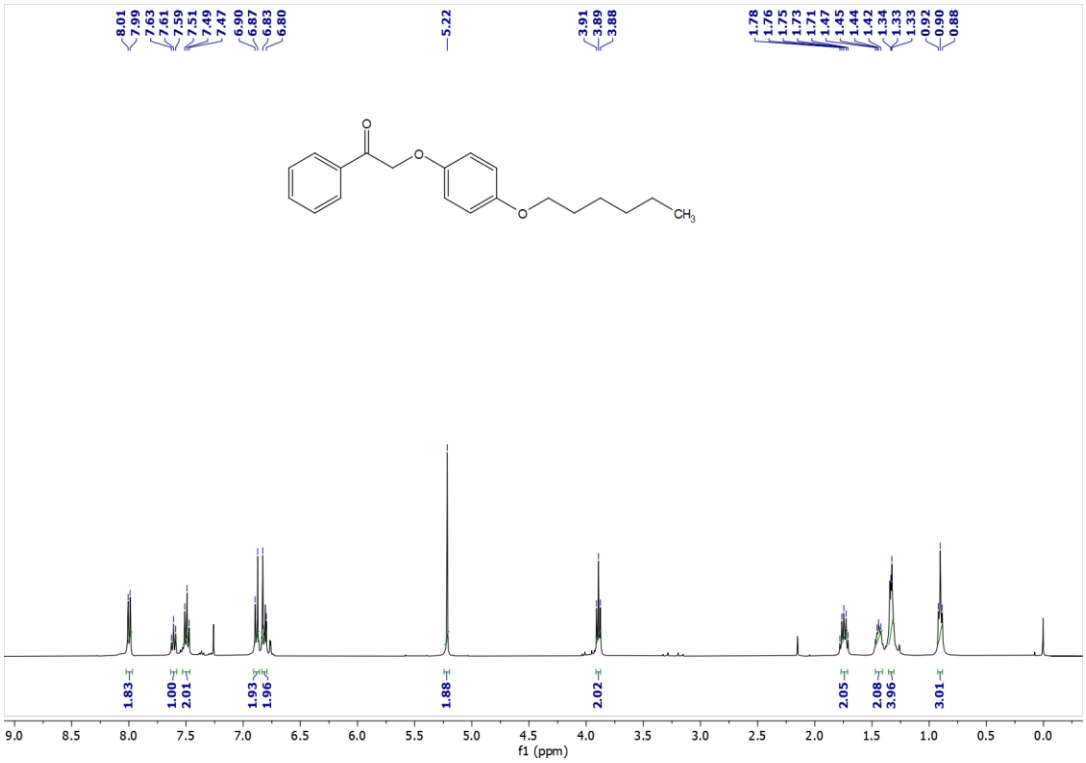


Figure S22: ^{1}H NMR Spectrum of **2d** ($CDCl_3$, 400 MHz, 298 K)

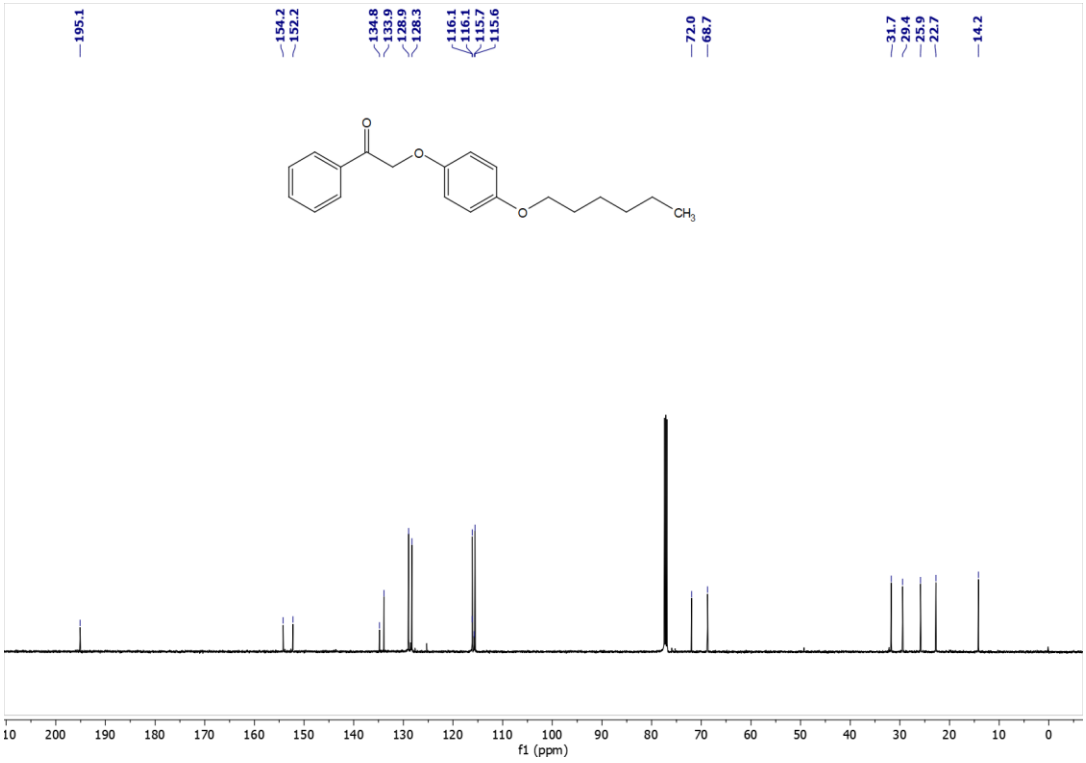


Figure S23: $^{13}C\{^{1}H\}$ NMR Spectrum of **2d** ($CDCl_3$, 126 MHz, 298 K)

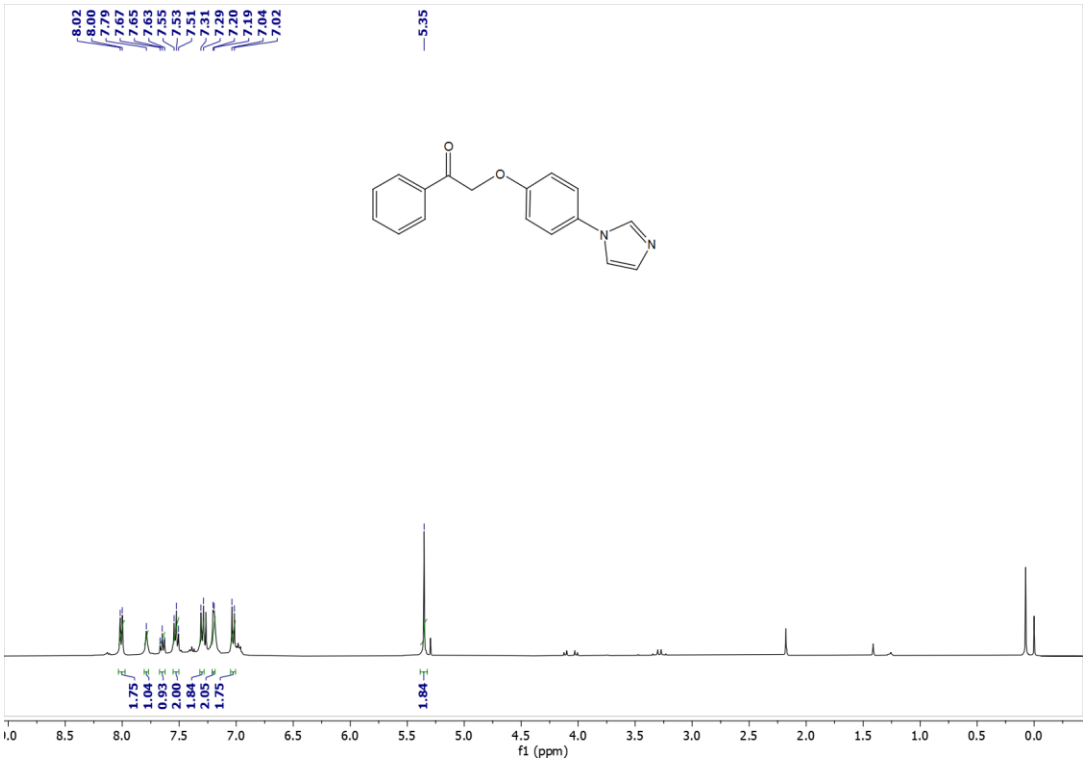


Figure S24: ^{1}H NMR Spectrum of **2j** ($CDCl_3$, 400 MHz, 298 K)

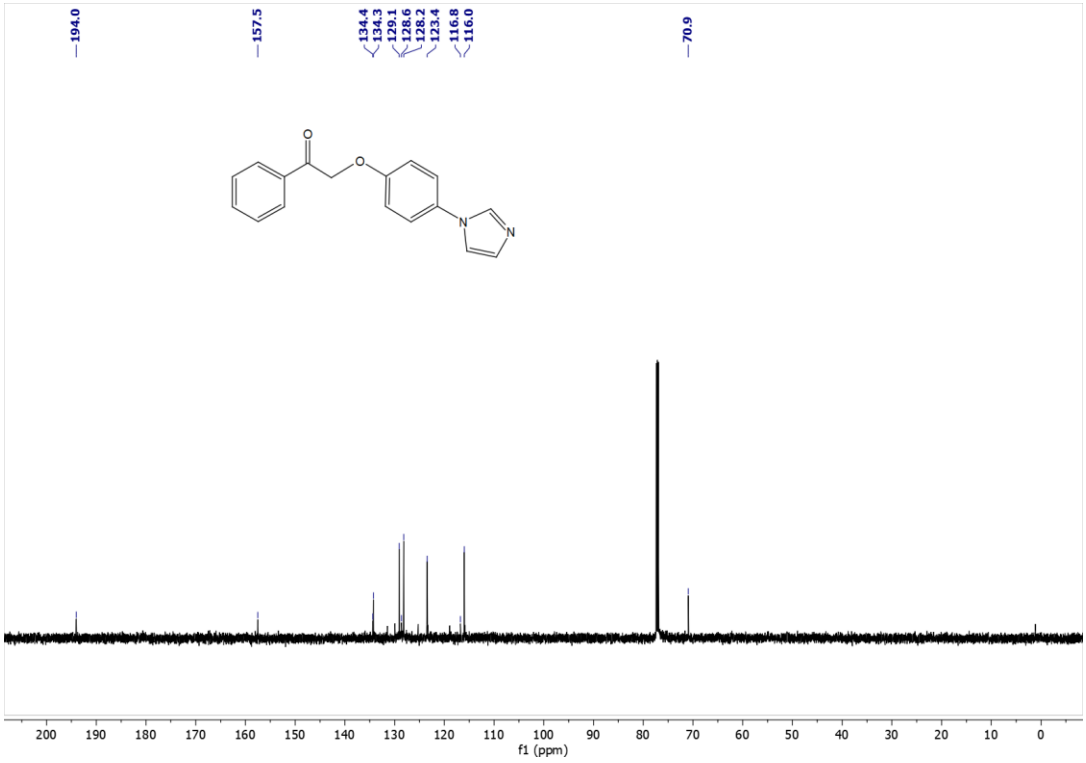


Figure S25: $^{13}C\{^{1}H\}$ NMR Spectrum of **2j** ($CDCl_3$, 151 MHz, 298 K)

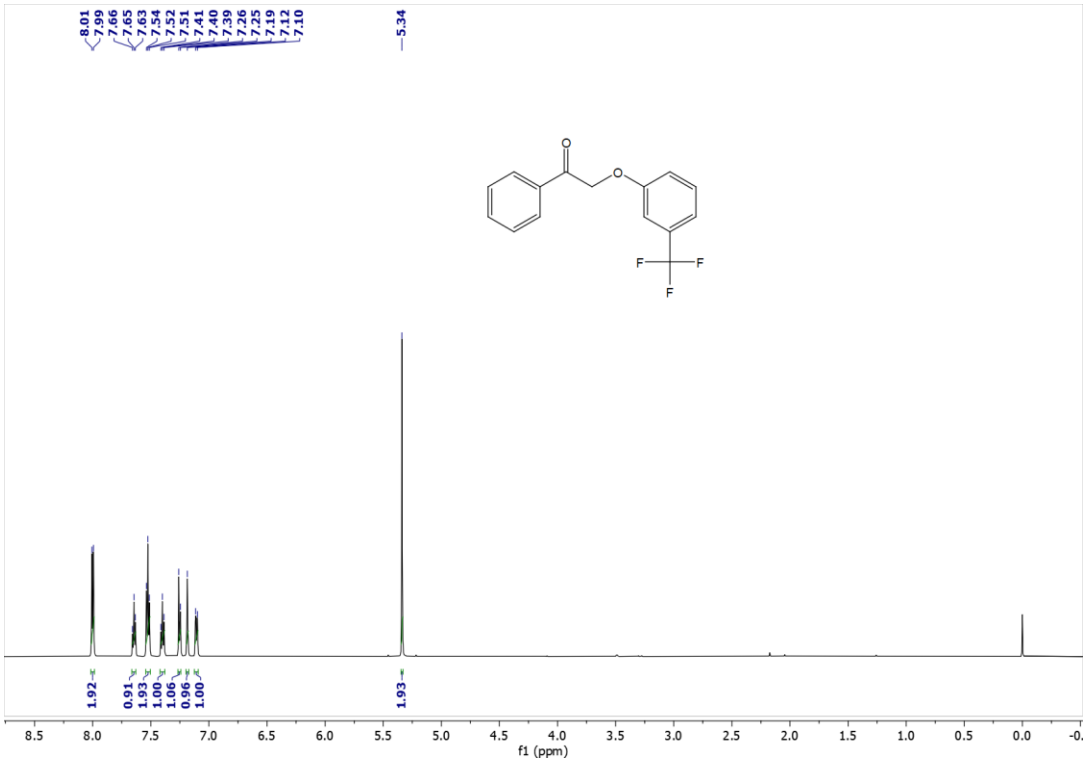


Figure S26: ^{1}H NMR Spectrum of **2l** ($CDCl_3$, 600 MHz, 298 K)

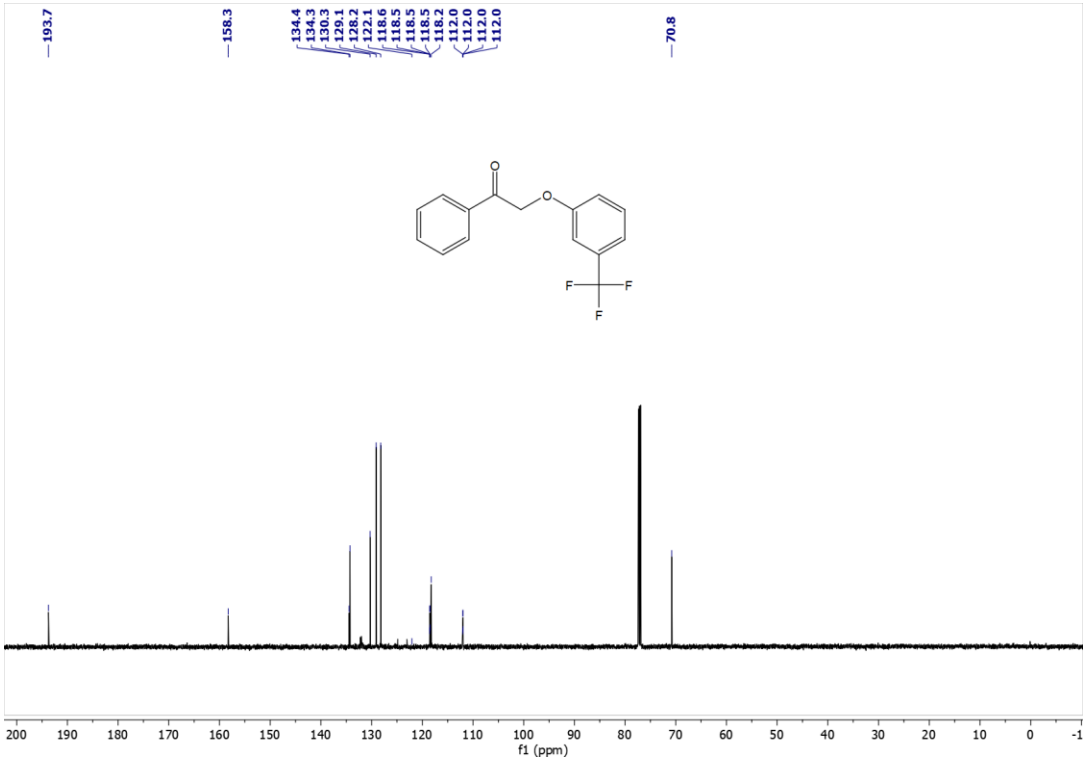


Figure S27: $^{13}C\{^{1}H\}$ NMR Spectrum of **2l** ($CDCl_3$, 151 MHz, 298 K)

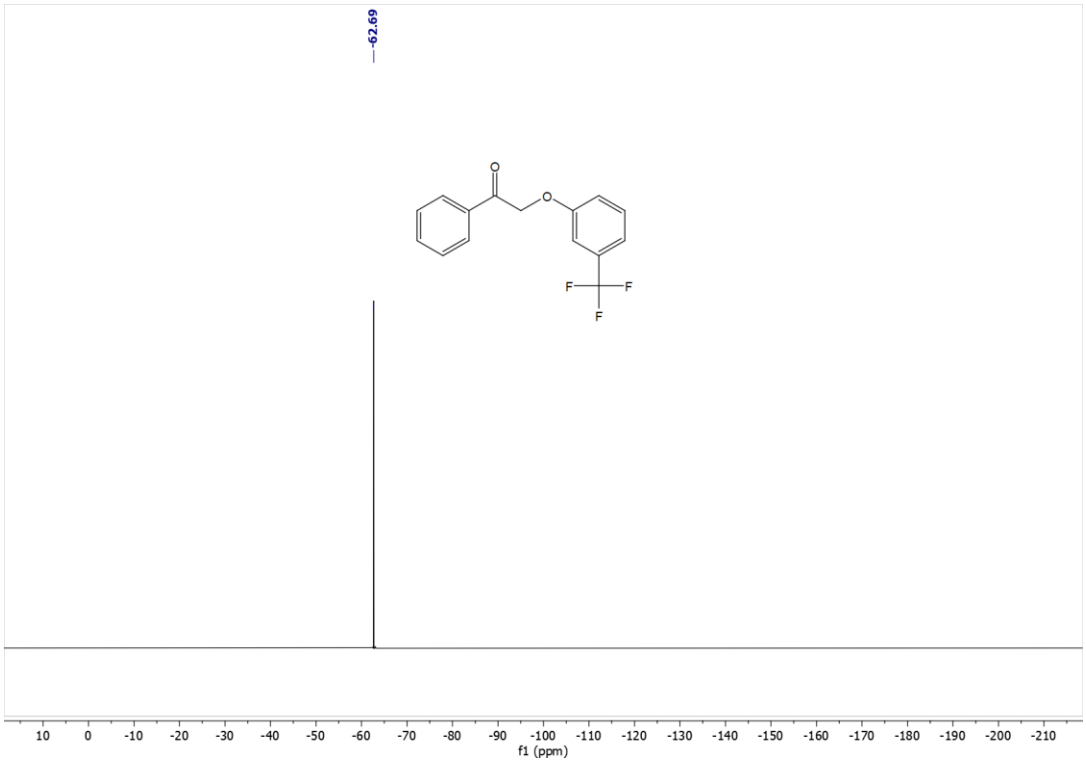


Figure S28: $^{19}F\{^{1}H\}$ NMR Spectrum of **2l** ($CDCl_3$, 565 MHz, 298 K)

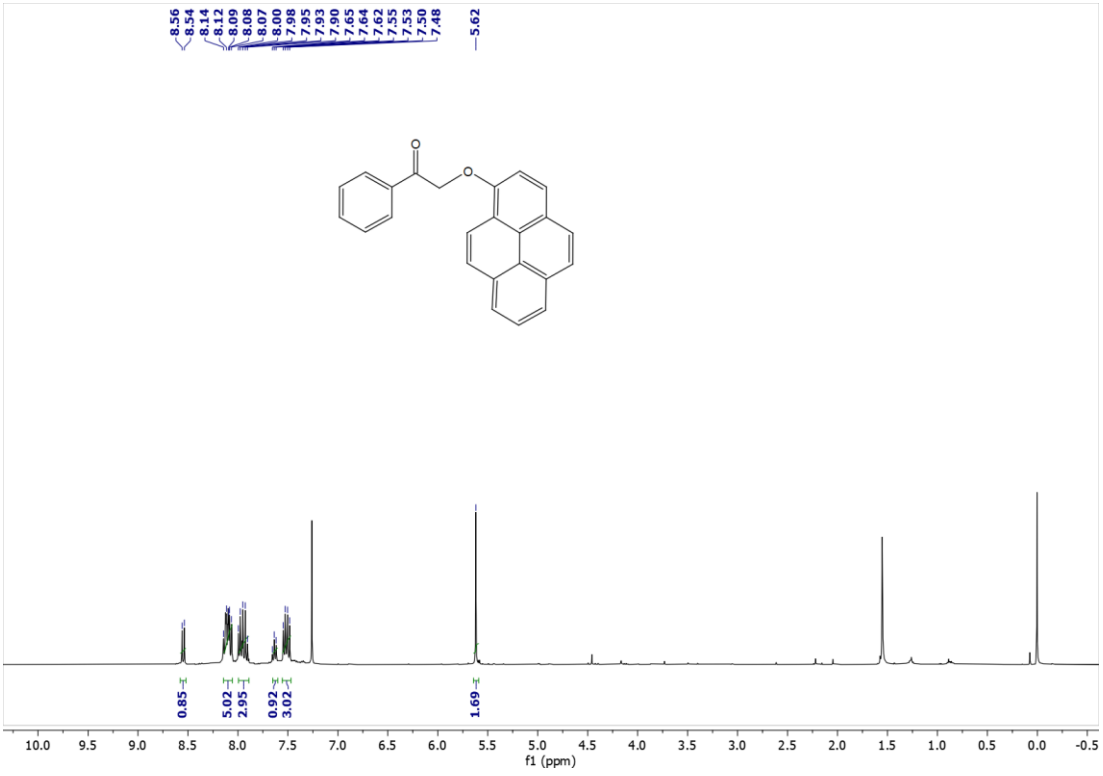


Figure S29: ^{1}H NMR Spectrum of **2q** ($CDCl_3$, 400 MHz, 298 K)

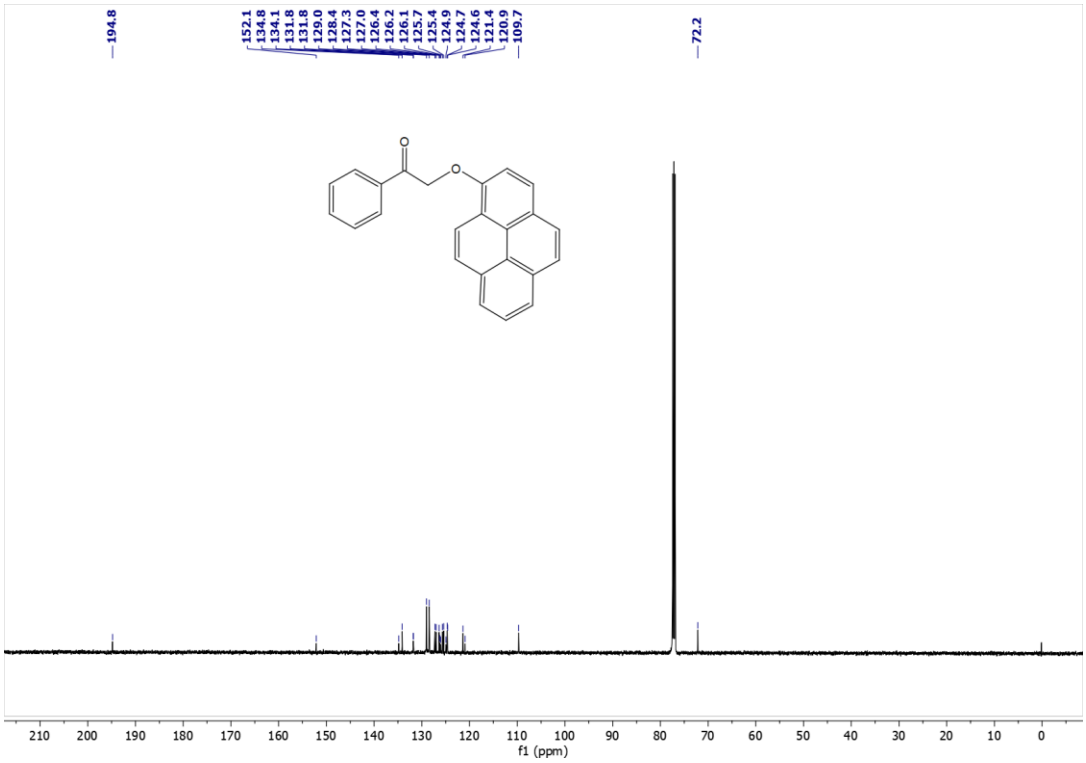


Figure S30: $^{13}C\{^{1}H\}$ NMR Spectrum of **2q** ($CDCl_3$, 126 MHz, 298 K)

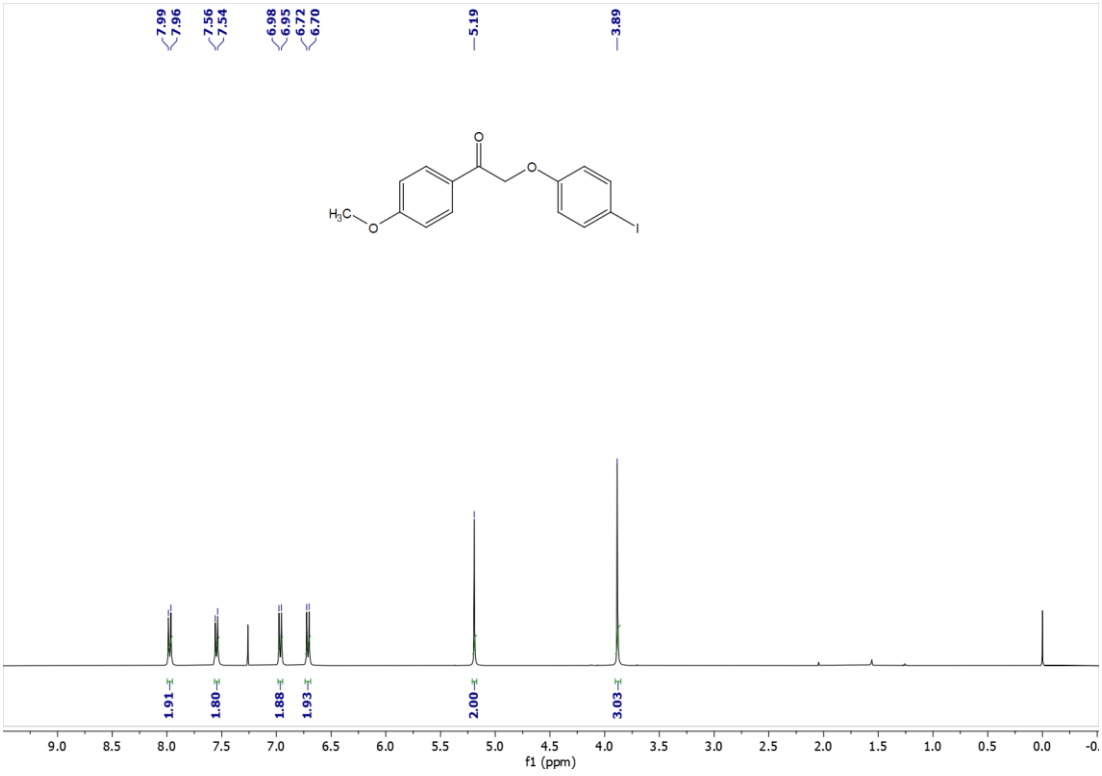


Figure S31: ^{1}H NMR Spectrum of **2ah** ($CDCl_3$, 400 MHz, 298 K)

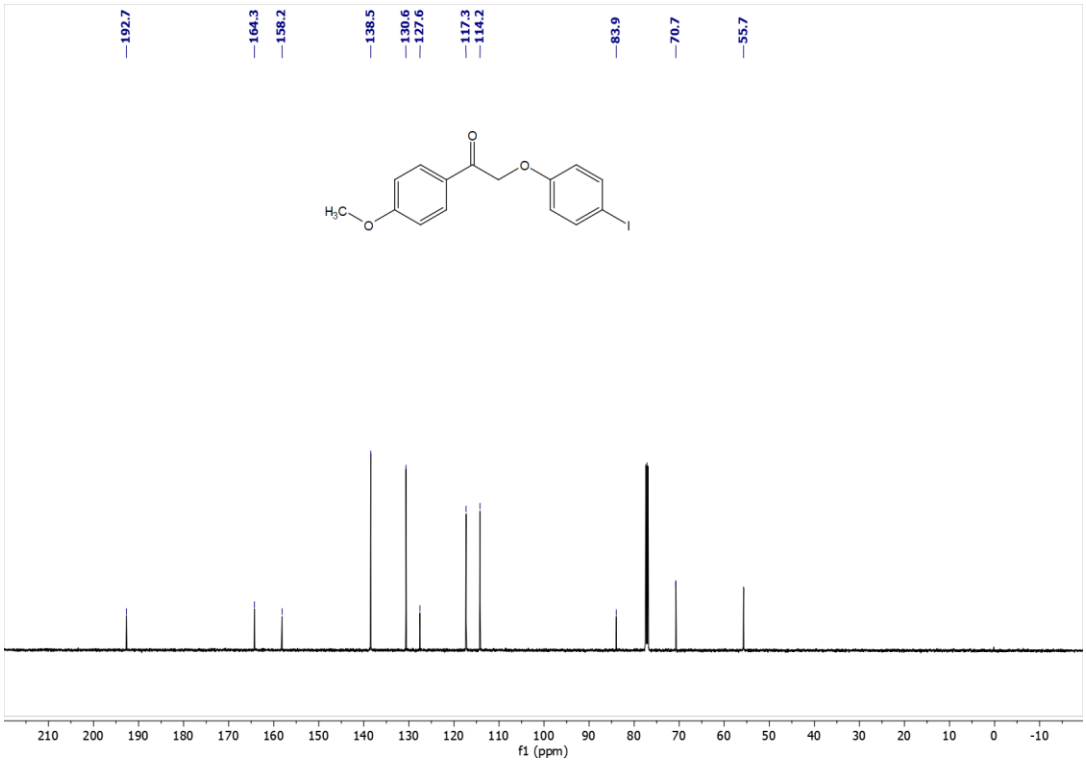


Figure S32: $^{13}C\{^{1}H\}$ NMR Spectrum of **2ah** ($CDCl_3$, 126 MHz, 298 K)

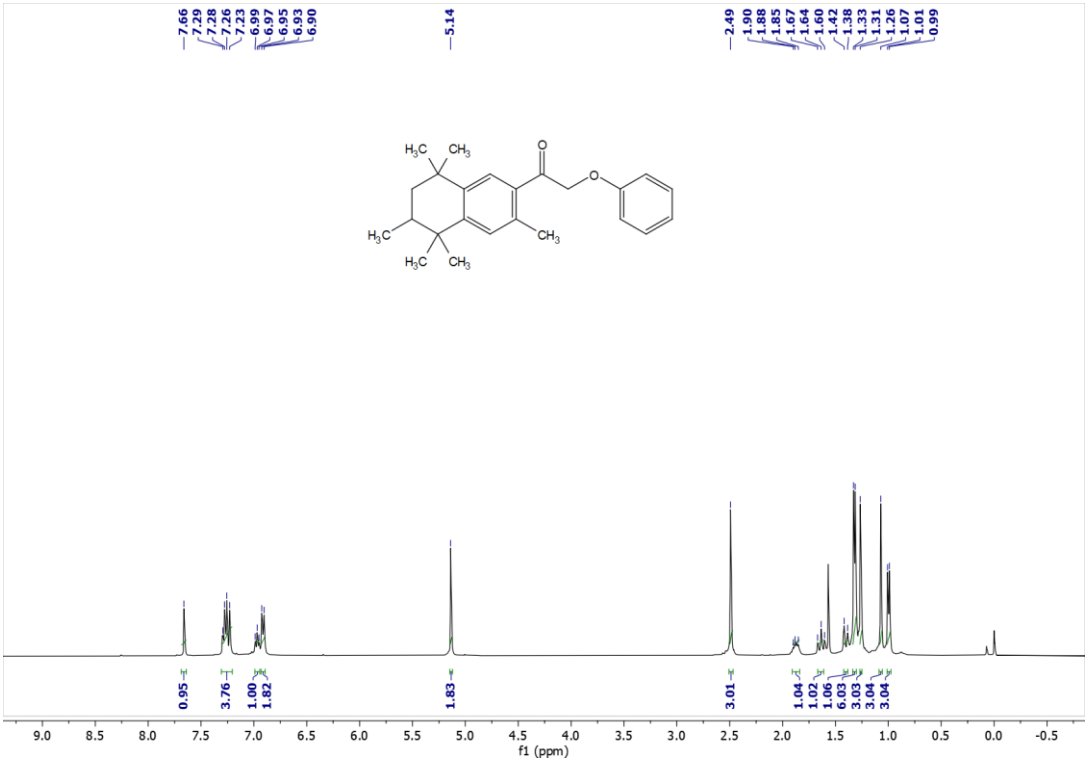


Figure S33: ^{1}H NMR Spectrum of **2am** ($CDCl_3$, 400 MHz, 298 K)

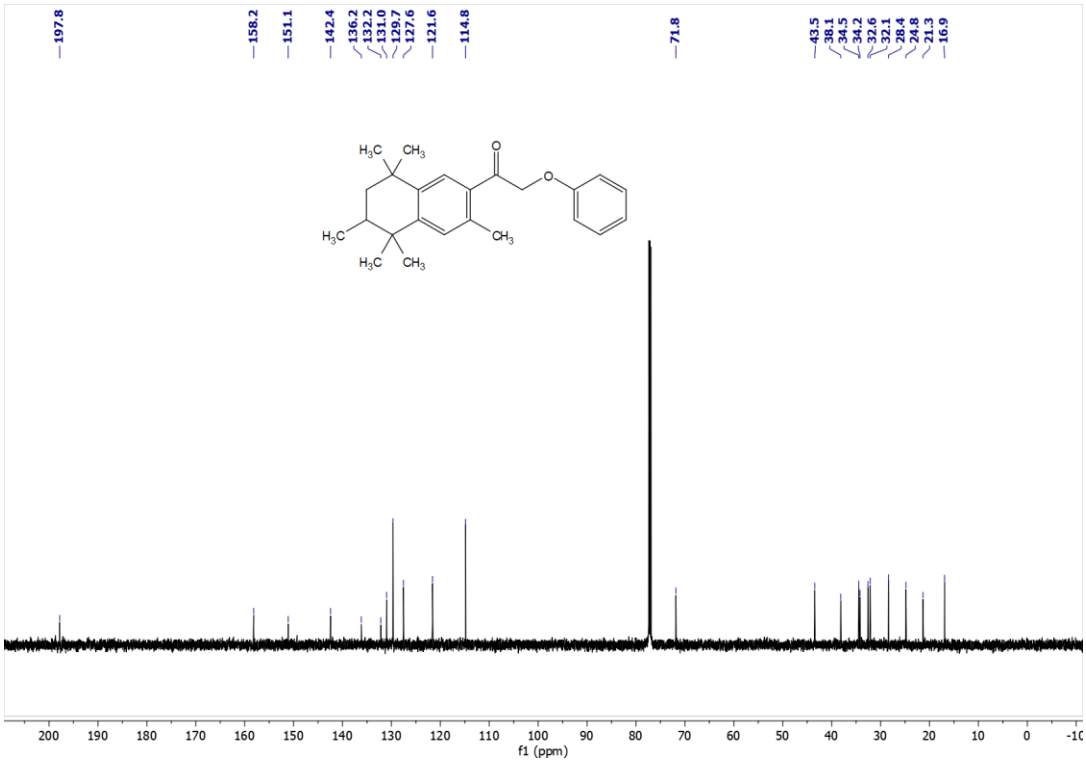


Figure S34: $^{13}C\{^{1}H\}$ NMR Spectrum of **2am** ($CDCl_3$, 151 MHz, 298 K)

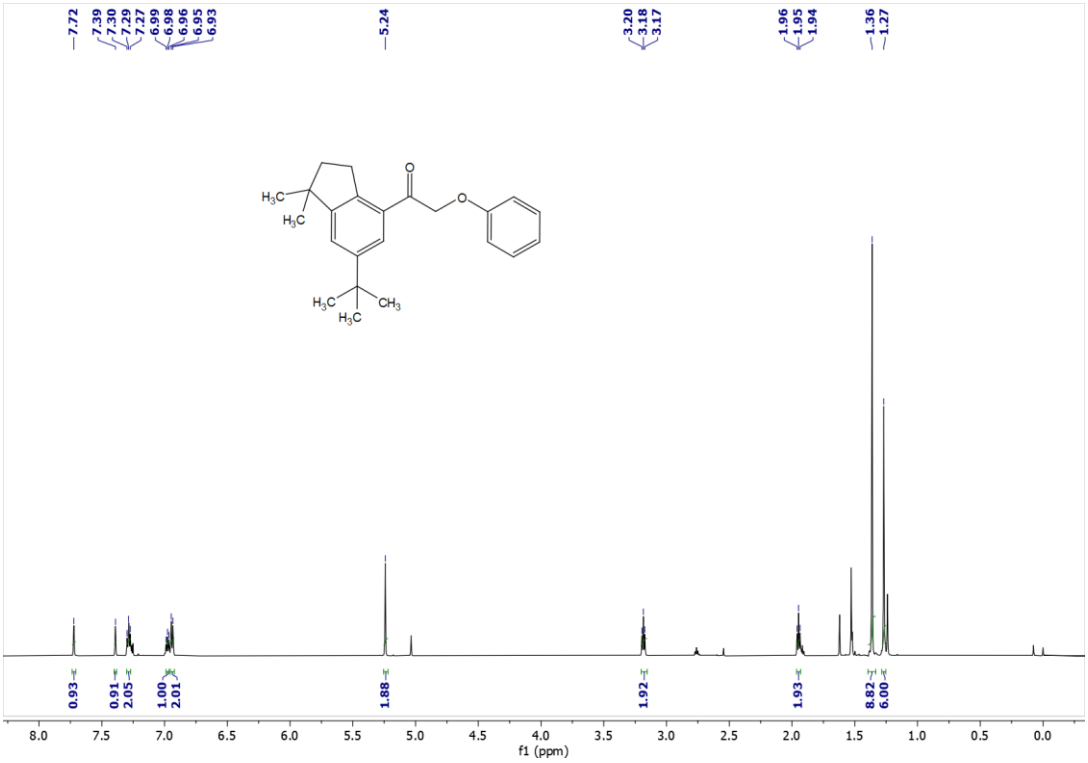


Figure S35: ^{1}H NMR Spectrum of **2an** ($CDCl_3$, 600 MHz, 298 K)

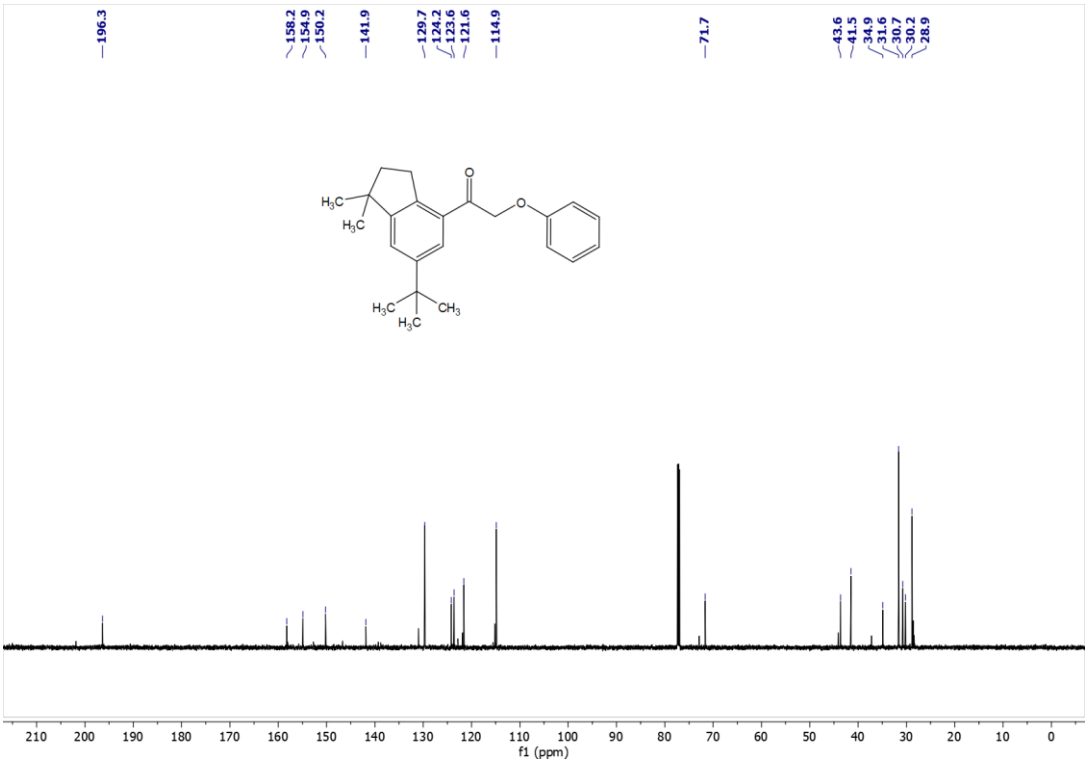


Figure S36: $^{13}C\{^{1}H\}$ NMR Spectrum of **2an** ($CDCl_3$, 151 MHz, 298 K)

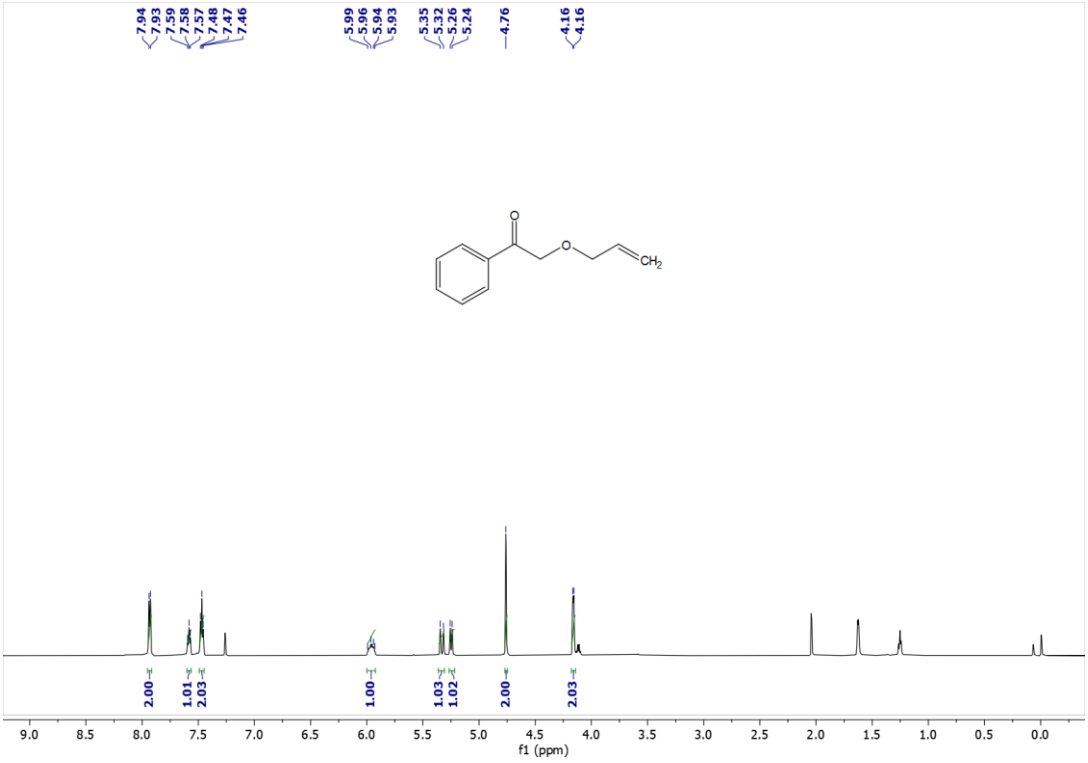


Figure S37: ^{1}H NMR Spectrum of **2t** ($CDCl_3$, 600 MHz, 298 K)

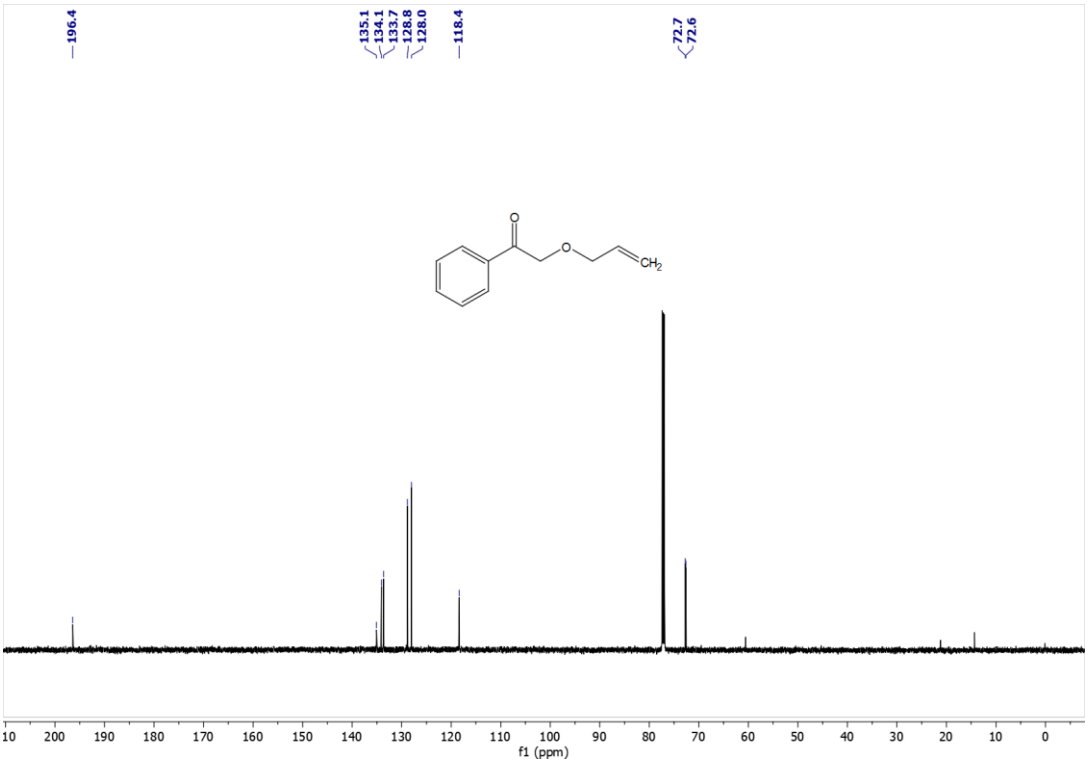


Figure S38: $^{13}C\{^{1}H\}$ NMR Spectrum of **2t** ($CDCl_3$, 151 MHz, 298 K)

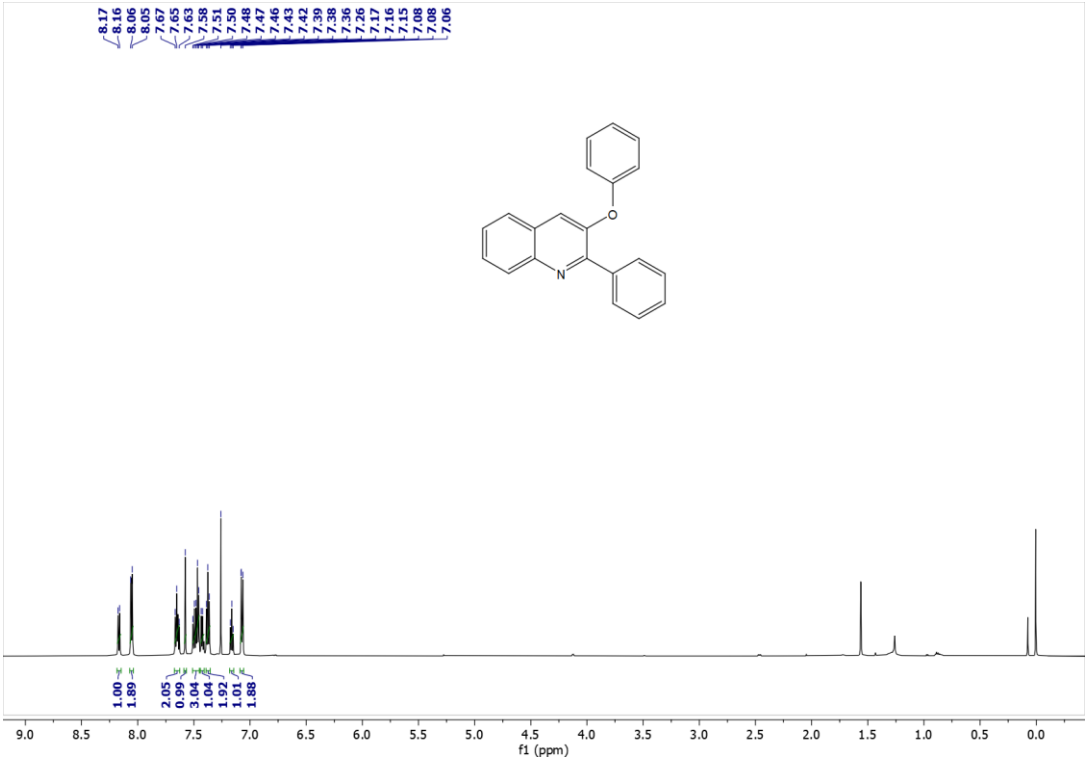


Figure S39: ^{1}H NMR Spectrum of **3a** ($CDCl_3$, 600 MHz, 298 K)

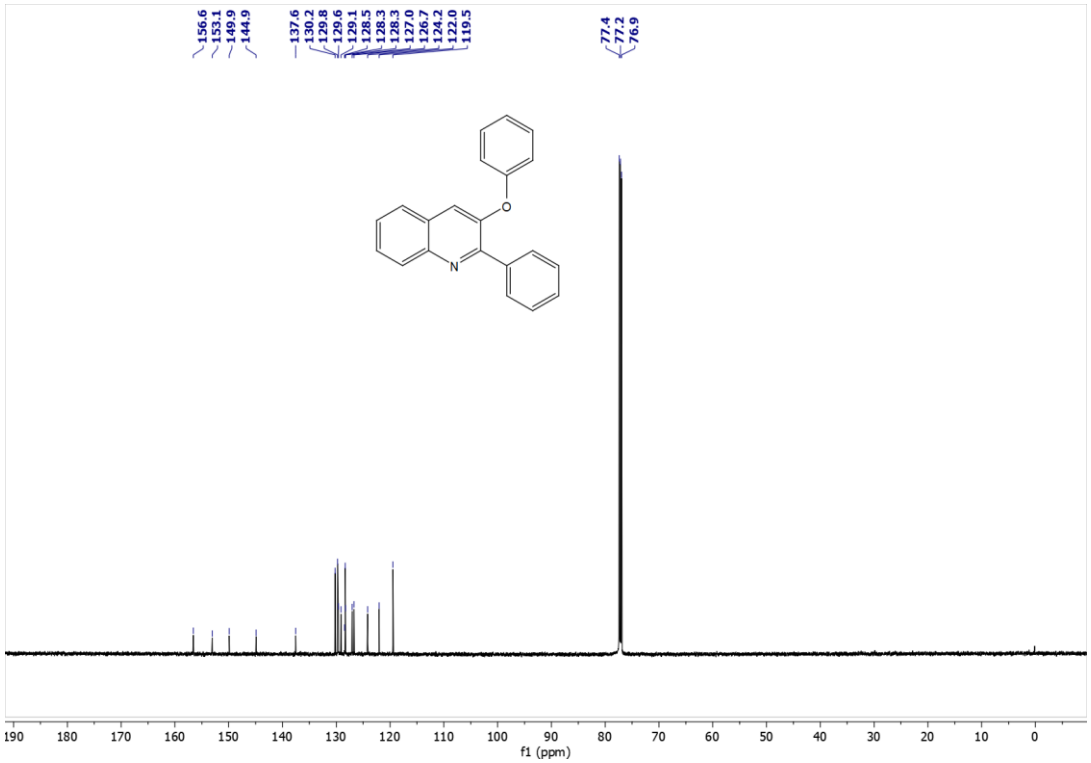


Figure S40: $^{13}C\{^{1}H\}$ NMR Spectrum of **3a** ($CDCl_3$, 151 MHz, 298 K)

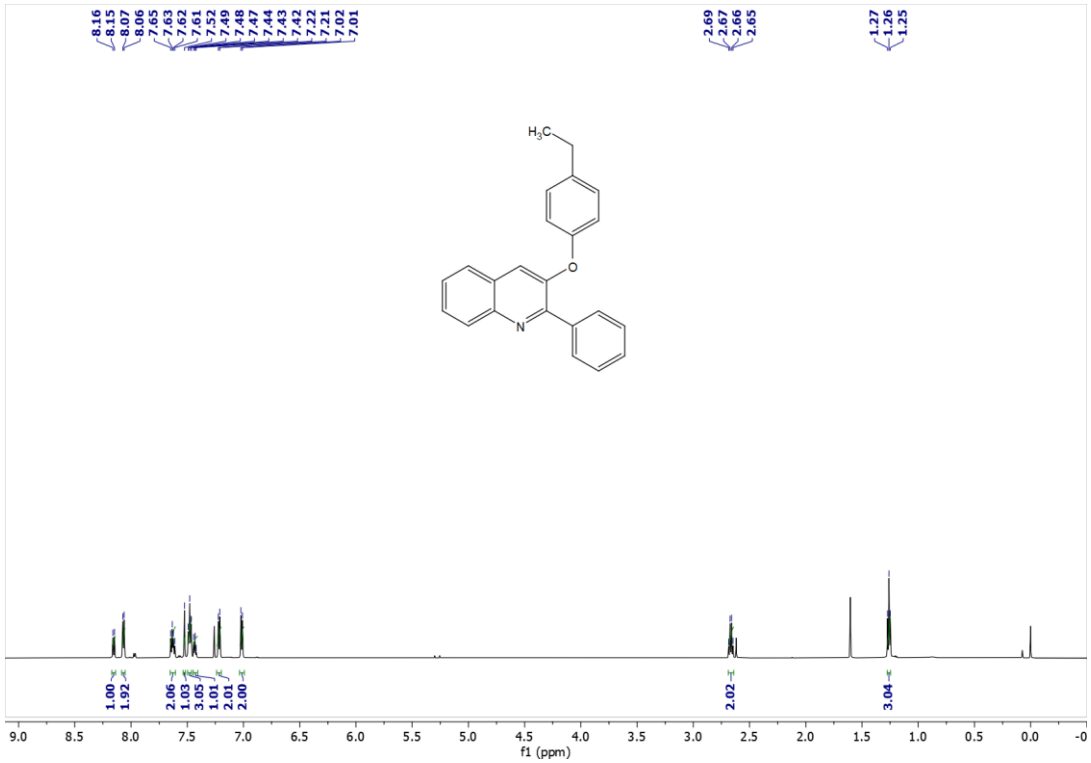


Figure S41: ^{1}H NMR Spectrum of **3b** ($CDCl_3$, 600 MHz, 298 K)

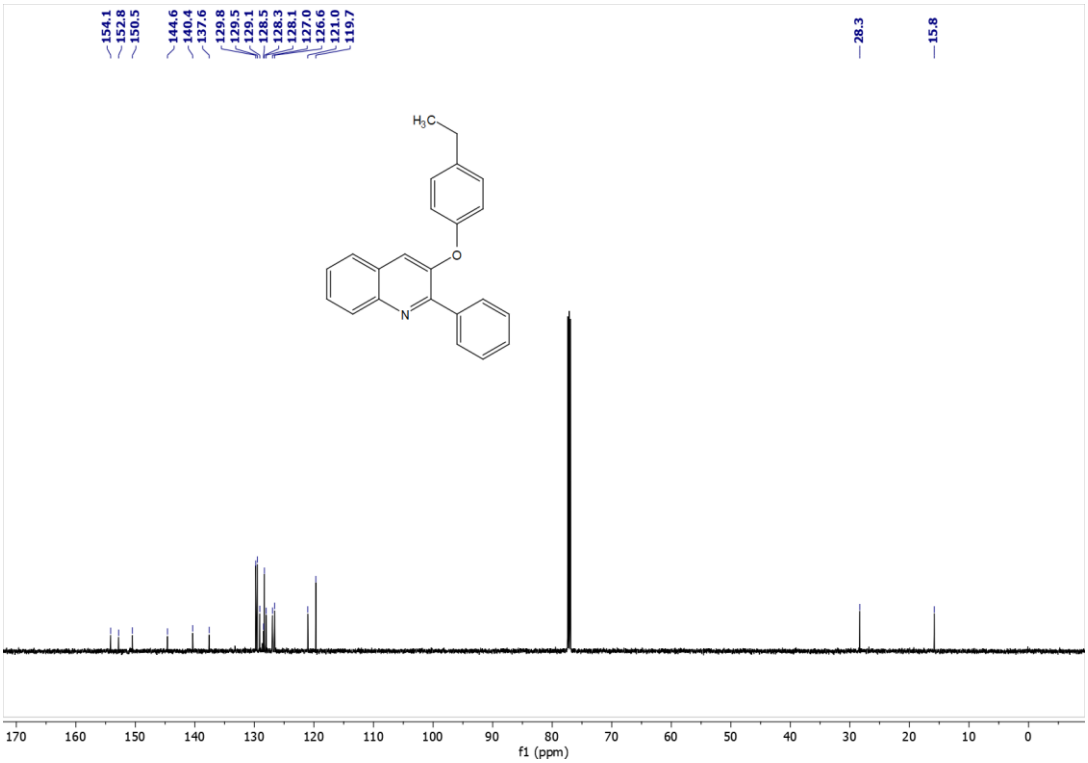


Figure S42: $^{13}C\{^{1}H\}$ NMR Spectrum of **3b** ($CDCl_3$, 151 MHz, 298 K)

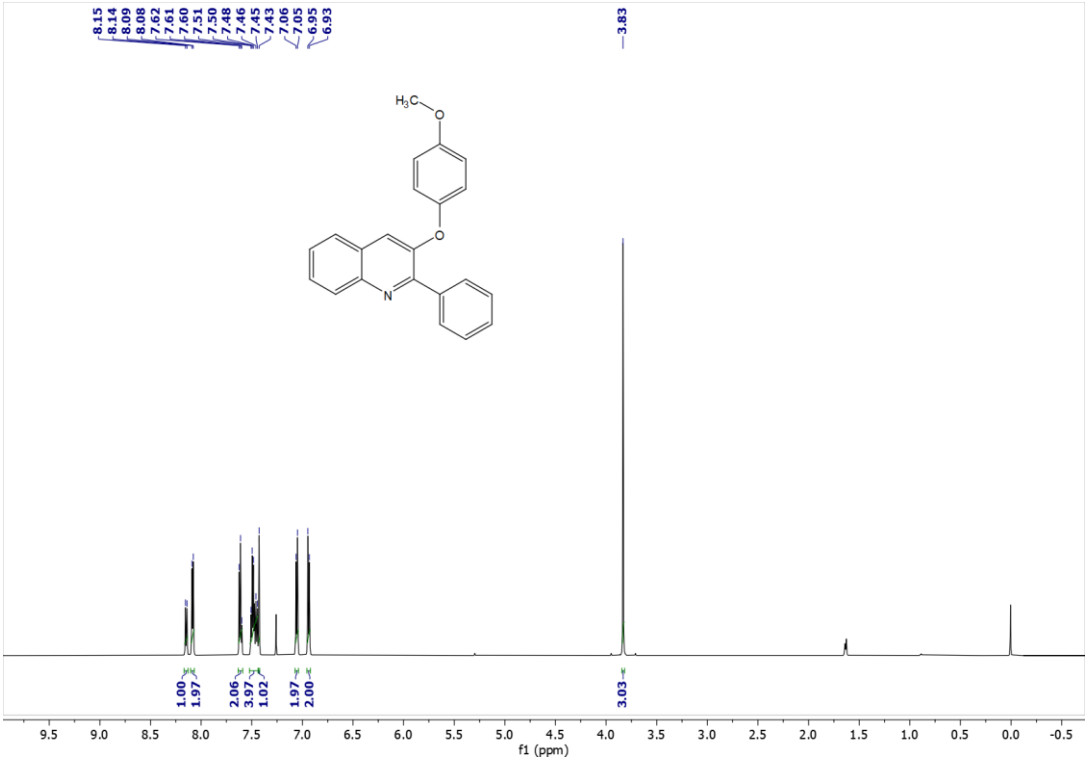


Figure S43: ^{1}H NMR Spectrum of **3c** ($CDCl_3$, 600 MHz, 298 K)

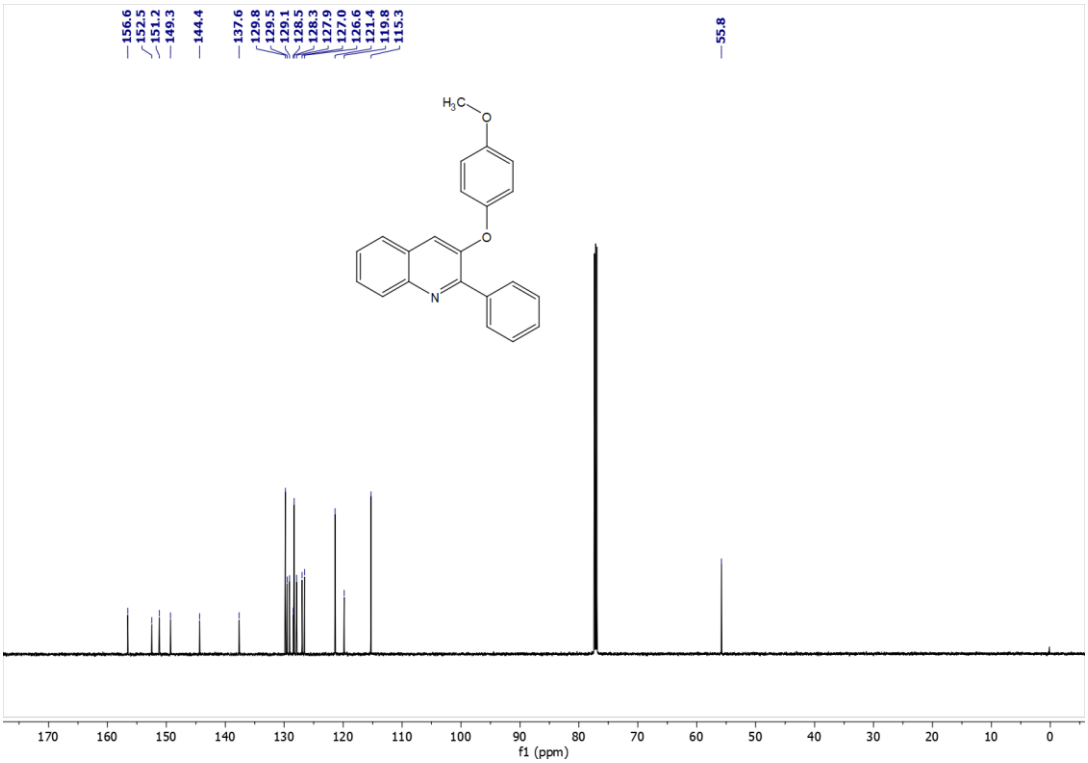


Figure S44: $^{13}C\{^{1}H\}$ NMR Spectrum of **3c** ($CDCl_3$, 151 MHz, 298 K)

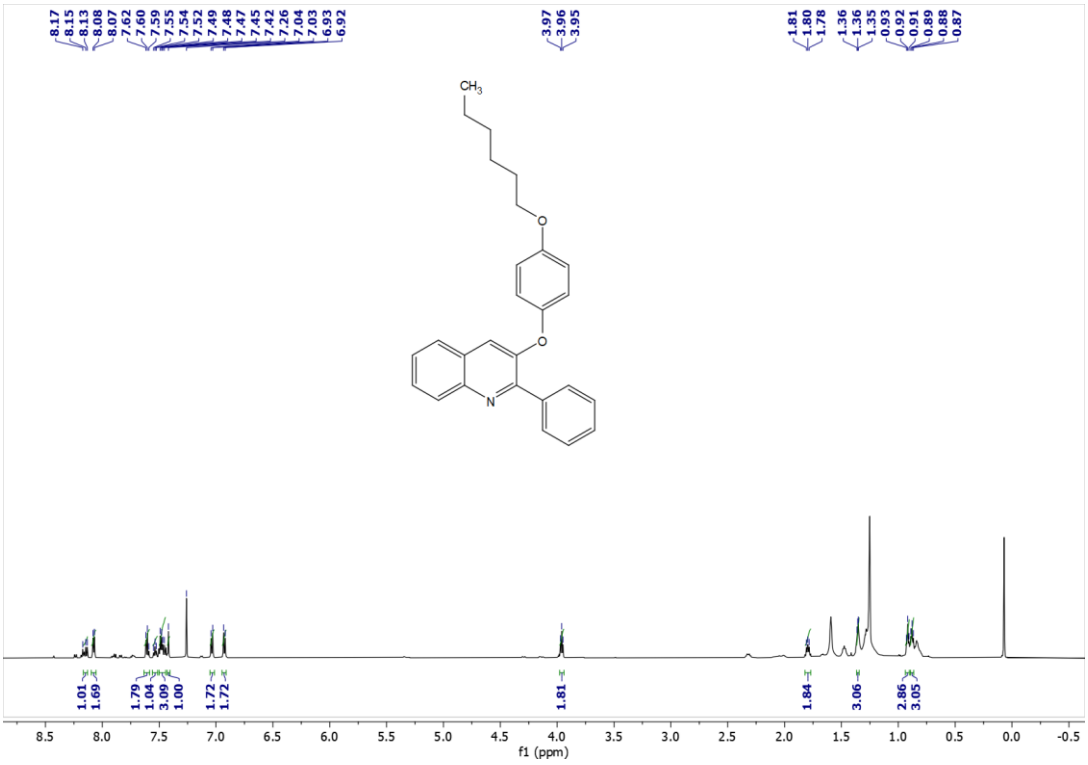


Figure S45: ^{1}H NMR Spectrum of **3d** ($CDCl_3$, 600 MHz, 298 K)

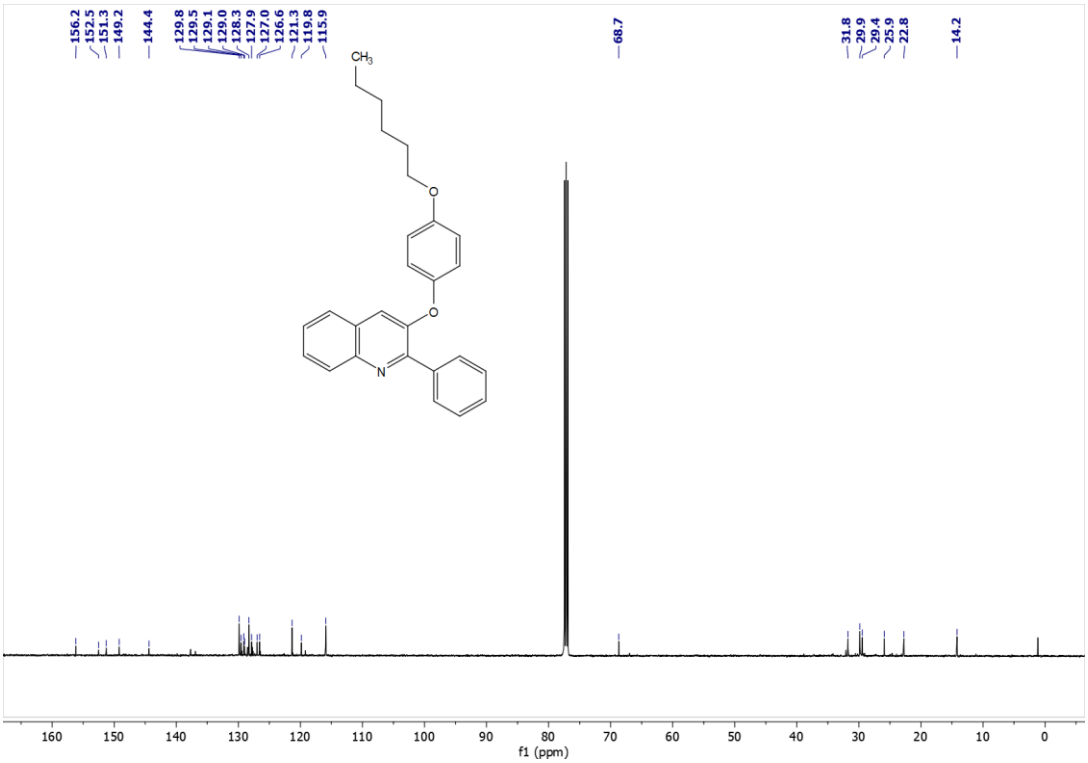


Figure S46: $^{13}C\{^{1}H\}$ NMR Spectrum of **3d** ($CDCl_3$, 126 MHz, 298 K)

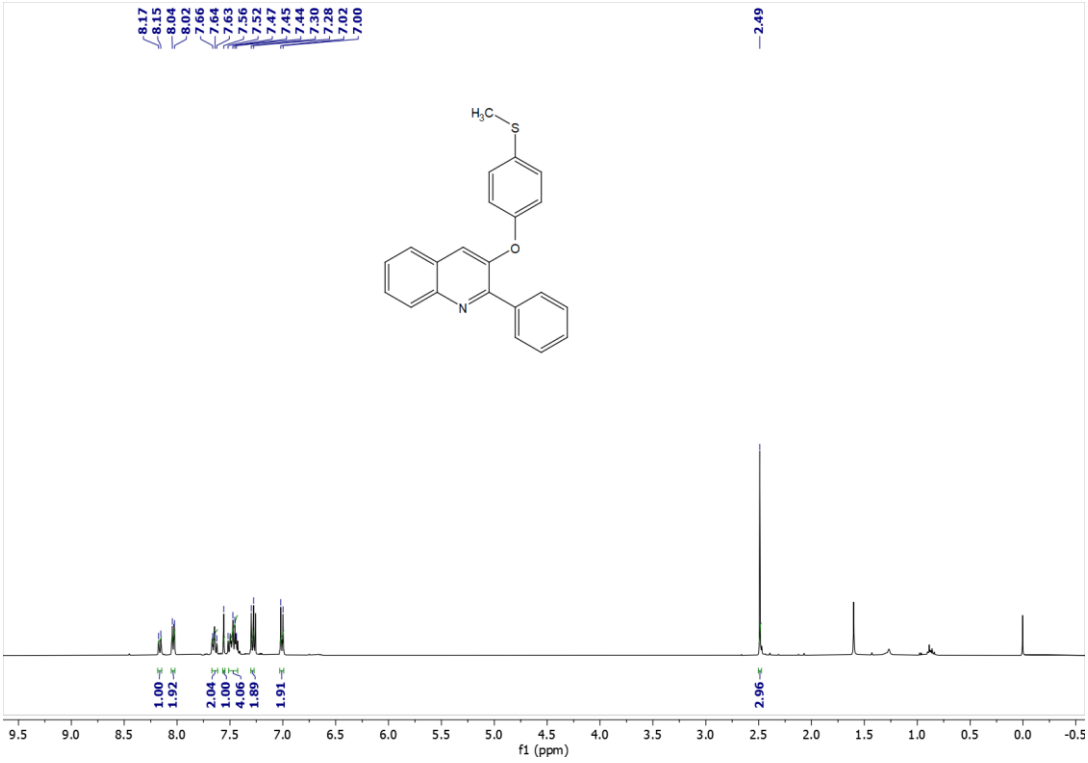


Figure S47: ^{1}H NMR Spectrum of **3e** ($CDCl_3$, 400 MHz, 298 K)

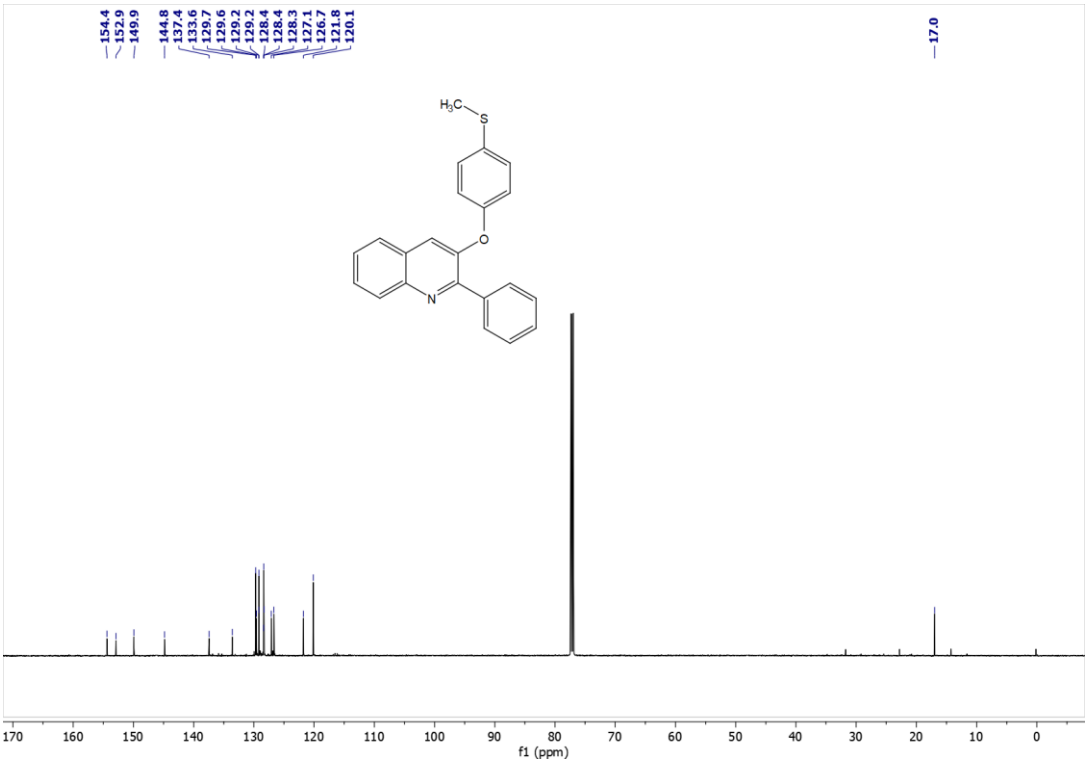


Figure S48: $^{13}C\{^{1}H\}$ NMR Spectrum of **3e** ($CDCl_3$, 151 MHz, 298 K)

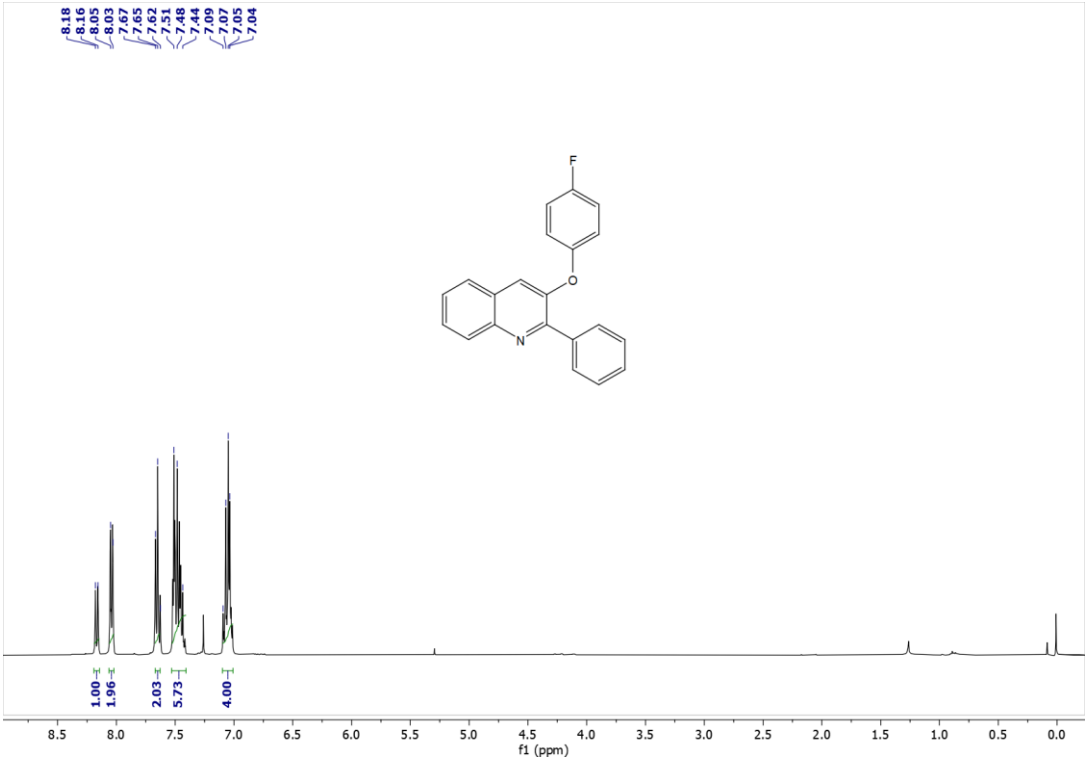


Figure S49: ^{1}H NMR Spectrum of **3f** ($CDCl_3$, 400 MHz, 298 K)

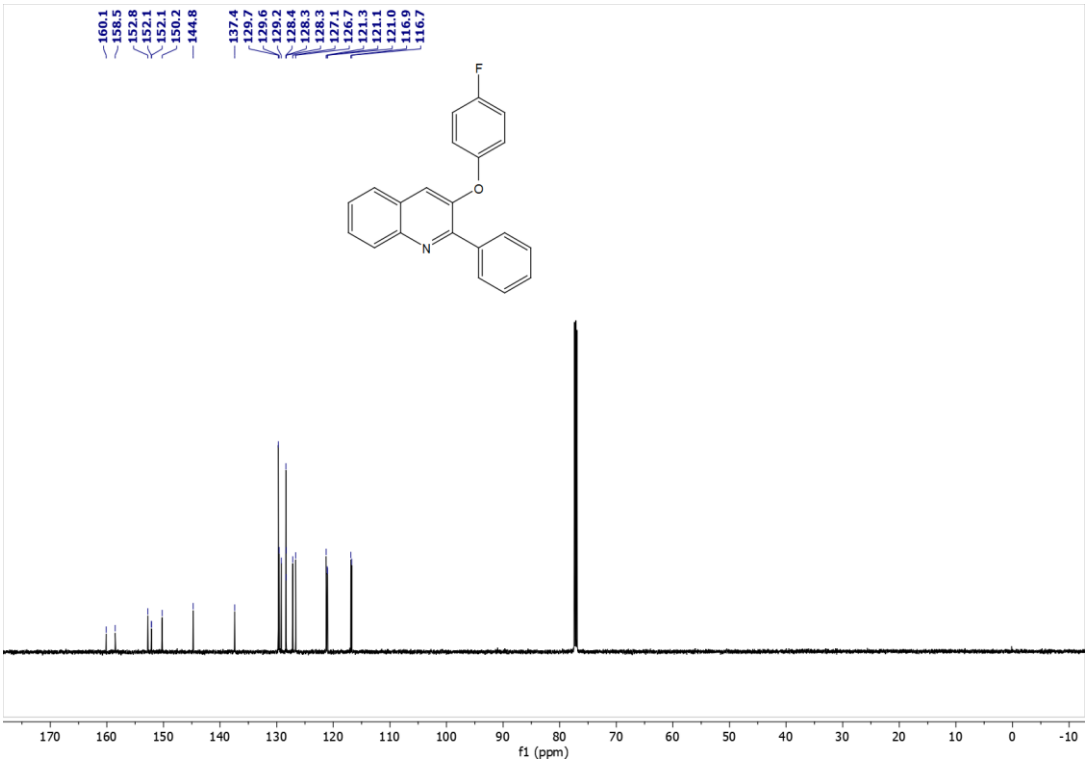


Figure S50: $^{13}C\{^{1}H\}$ NMR Spectrum of **3f** ($CDCl_3$, 151 MHz, 298 K)

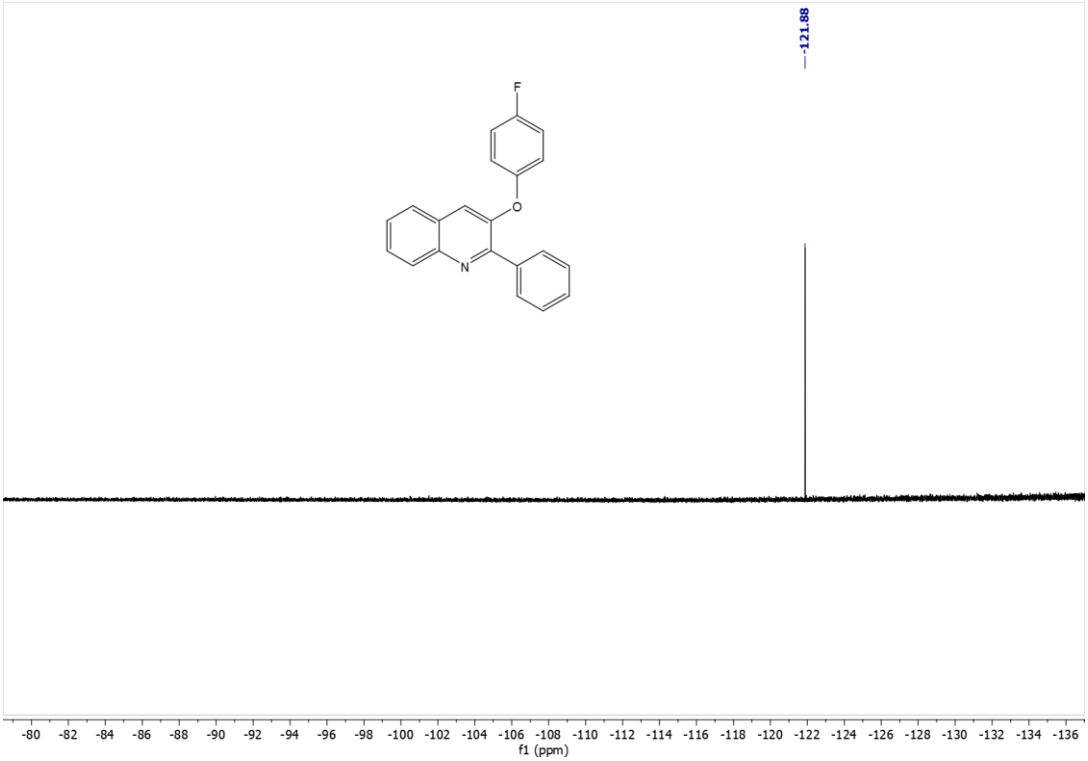


Figure S51: $^{19}F\{^{1}H\}$ NMR Spectrum of **3f** ($CDCl_3$, 565 MHz, 298 K)

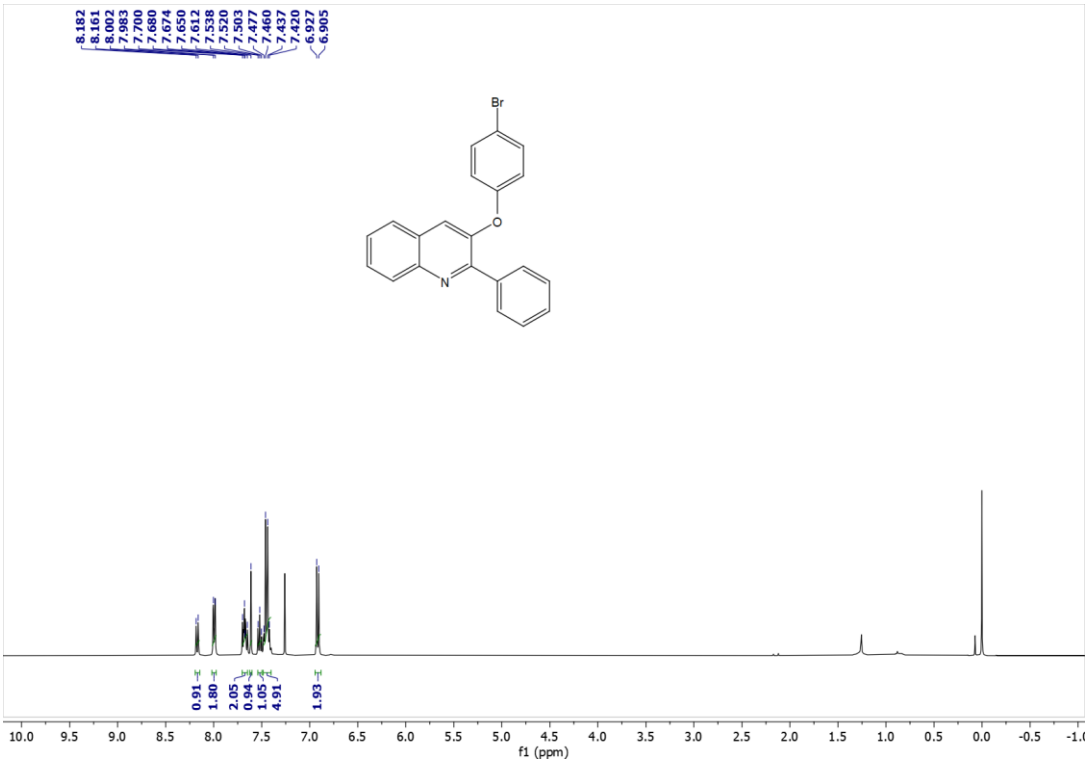


Figure S52: ^{1}H NMR Spectrum of **3g** ($CDCl_3$, 400 MHz, 298 K)

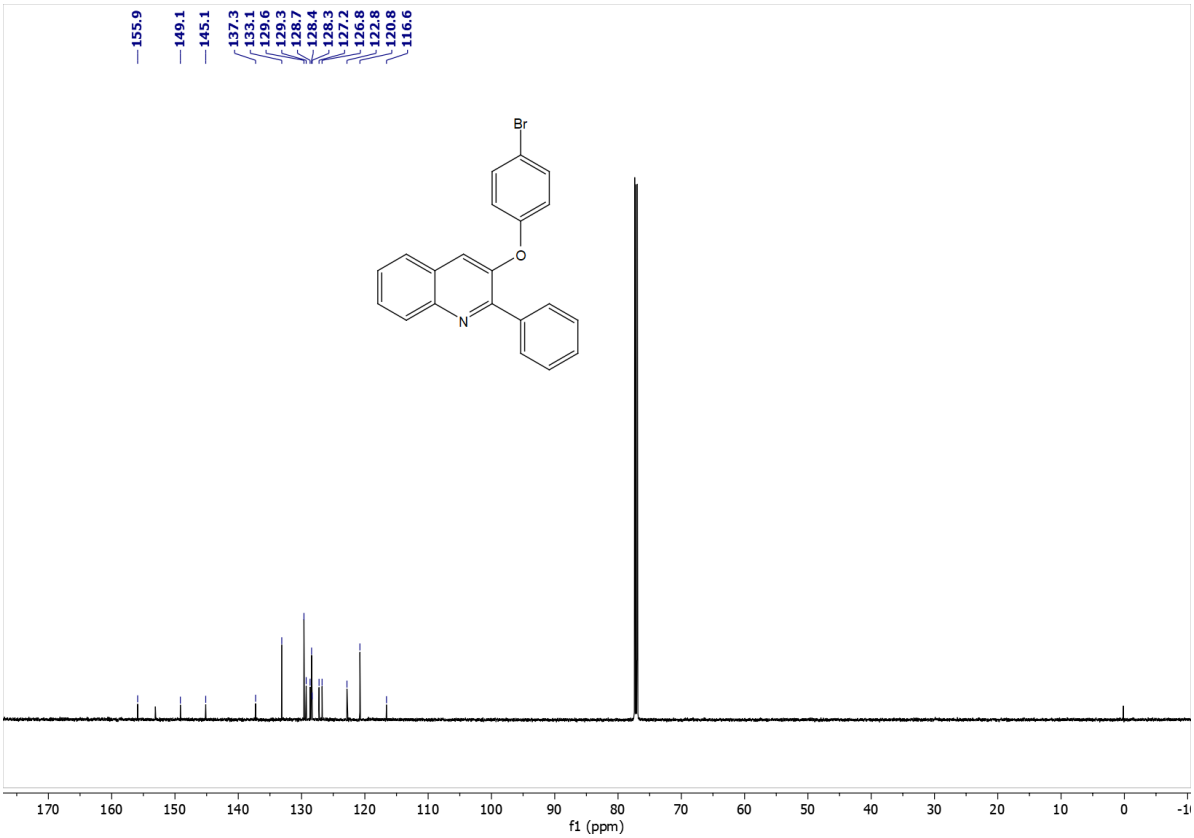


Figure S53: $^{13}C\{^{1}H\}$ NMR Spectrum of **3g** ($CDCl_3$, 151 MHz, 298 K)

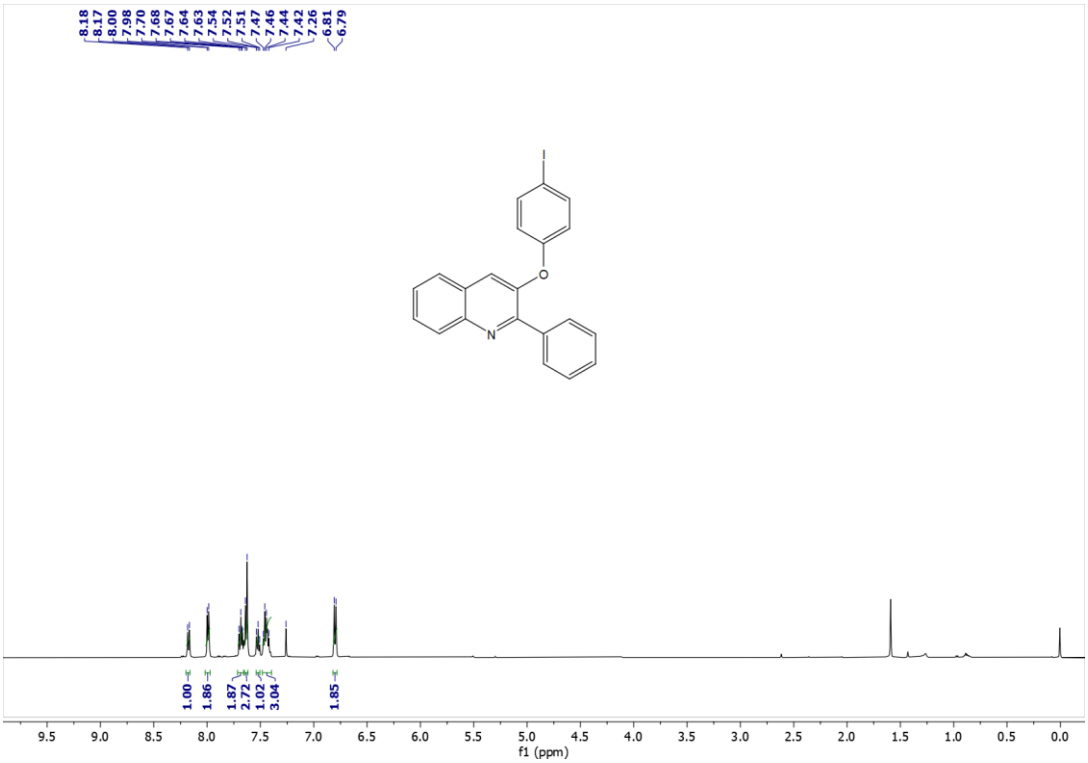


Figure S54: ^{1}H NMR Spectrum of **3h** ($CDCl_3$, 500 MHz, 298 K)

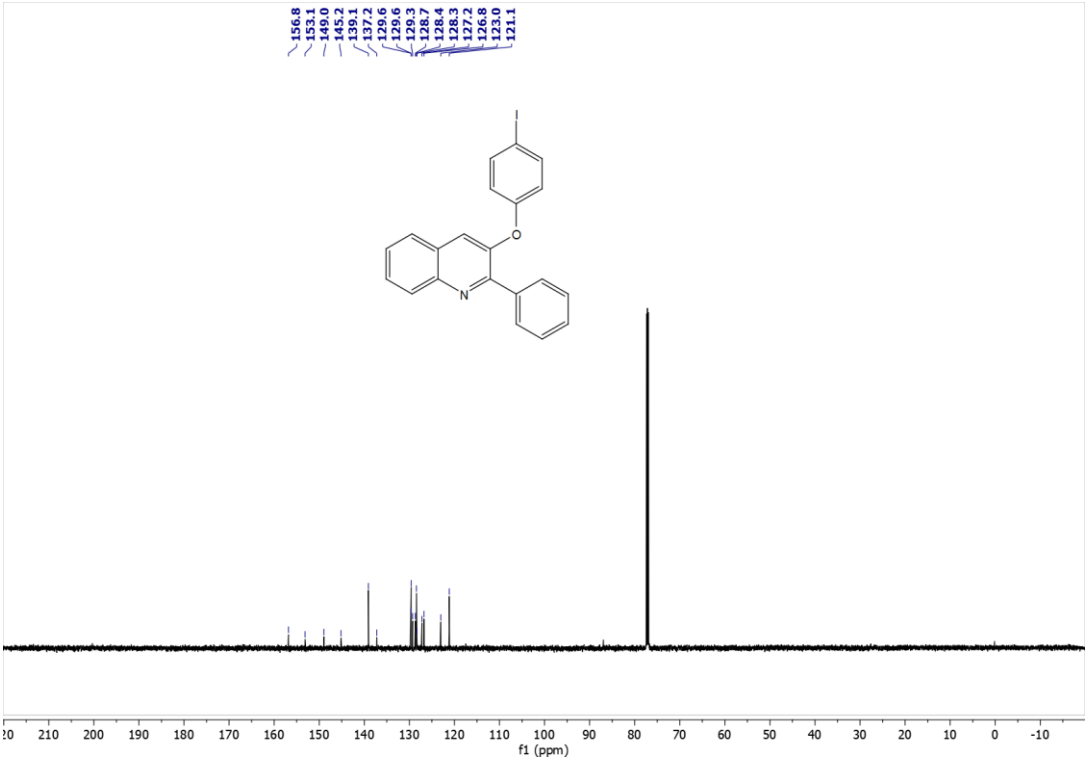


Figure S55: $^{13}C\{^{1}H\}$ NMR Spectrum of **3h** ($CDCl_3$, 151 MHz, 298 K)

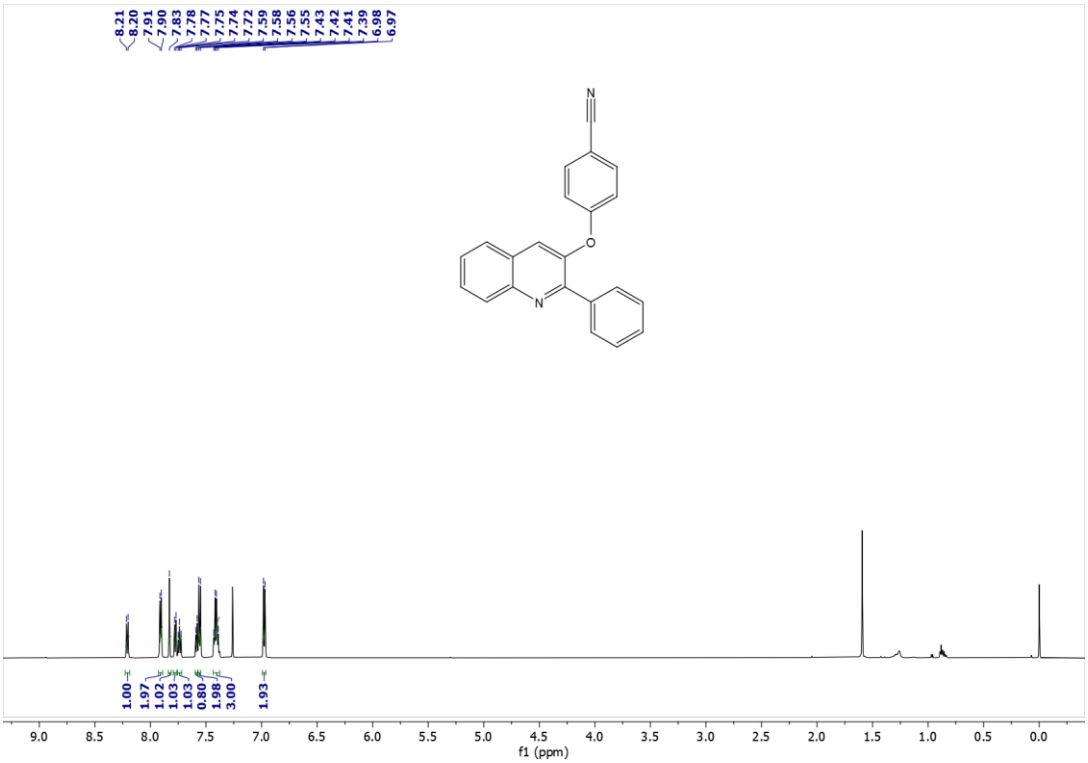


Figure S56: ^{1}H NMR Spectrum of **3i** ($CDCl_3$, 600 MHz, 298 K)

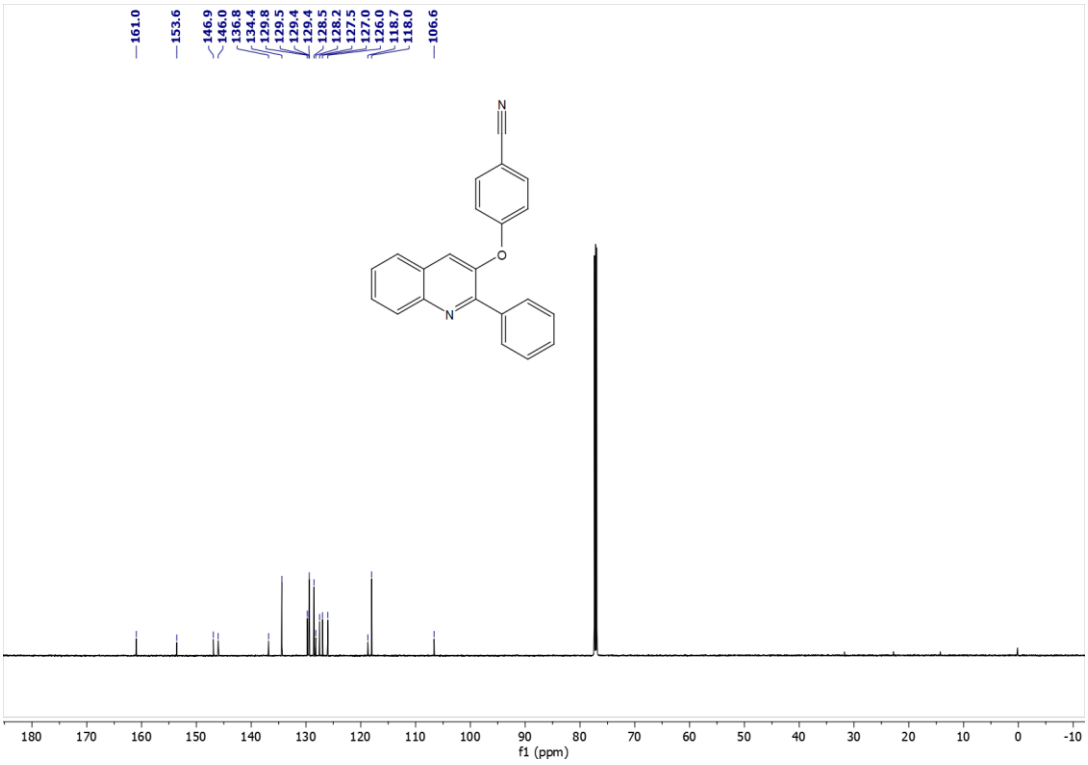


Figure S57: $^{13}C\{^{1}H\}$ NMR Spectrum of **3i** ($CDCl_3$, 151 MHz, 298 K)

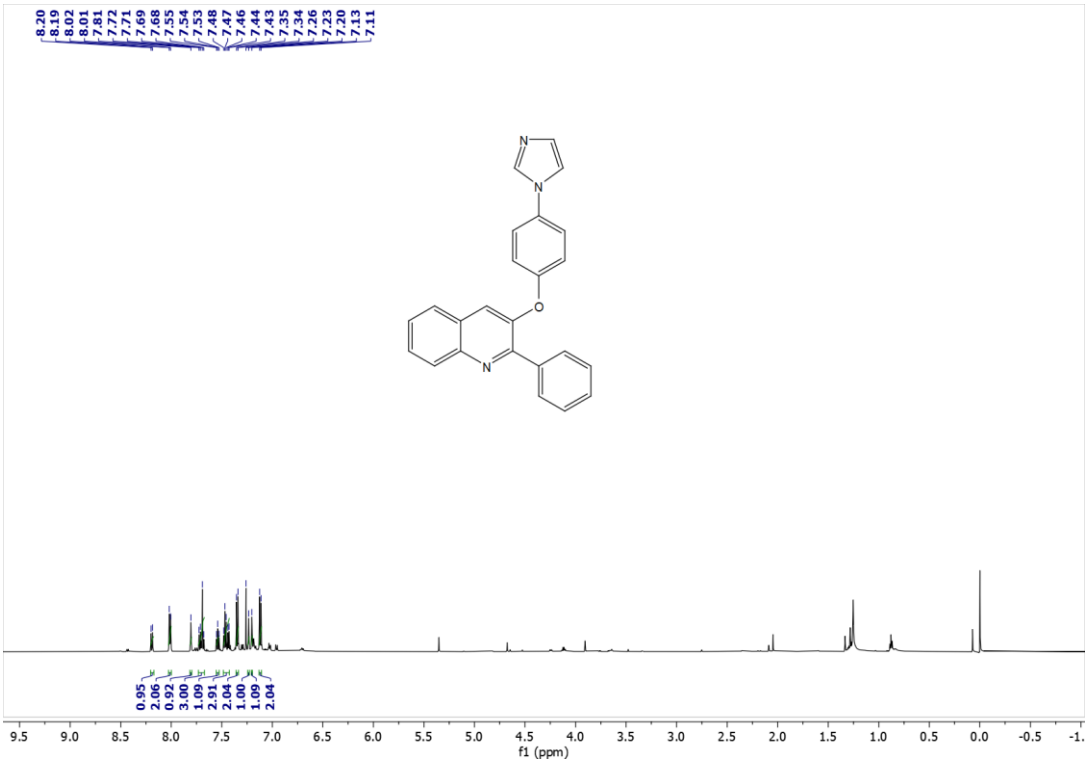


Figure S58: ^{1}H NMR Spectrum of **3j** ($CDCl_3$, 600 MHz, 298 K)

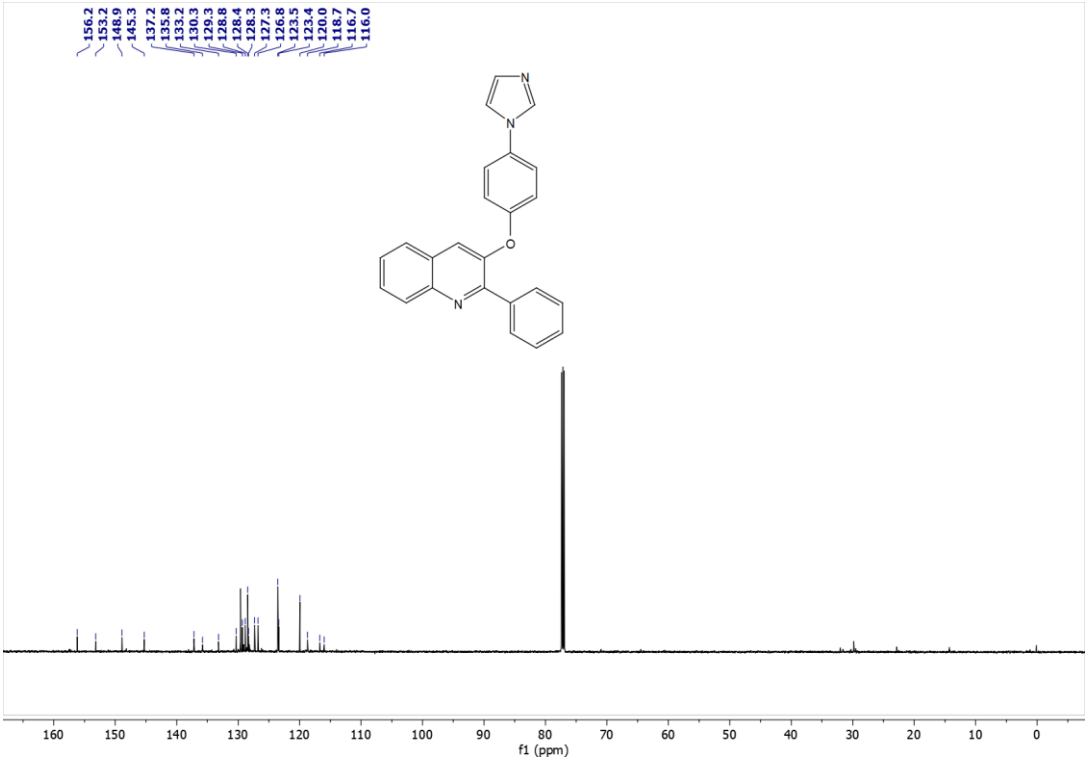


Figure S59: $^{13}C\{^{1}H\}$ NMR Spectrum of **3i** ($CDCl_3$, 151 MHz, 298 K)

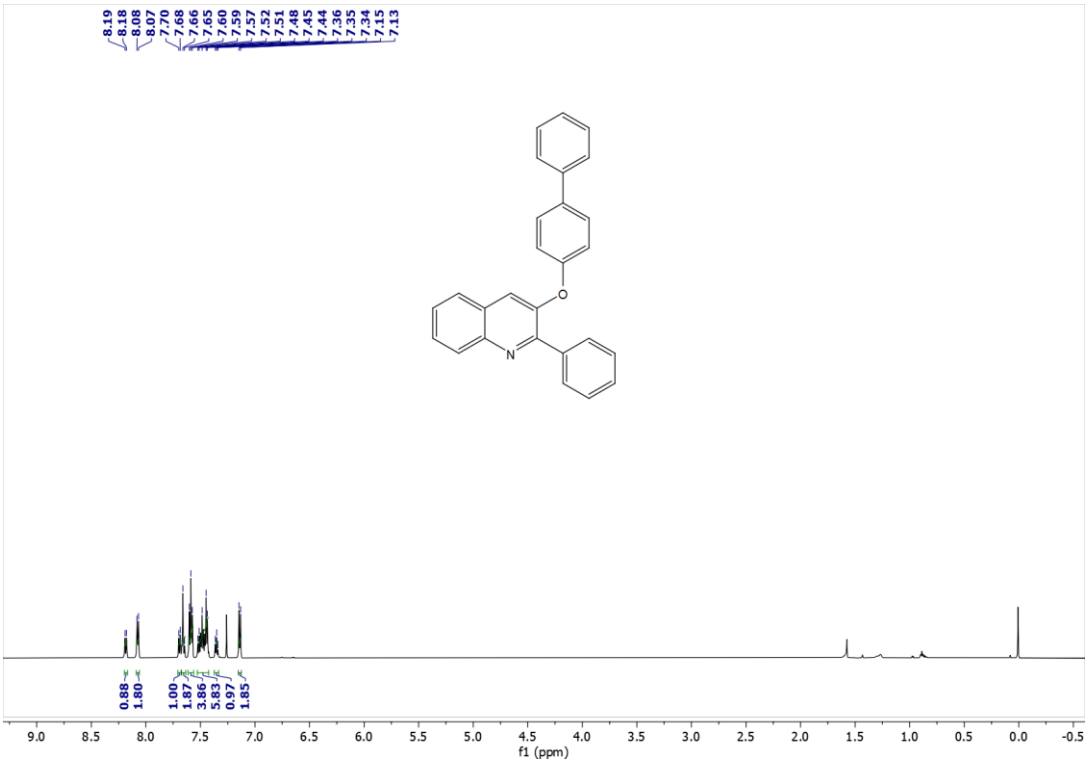


Figure S60: ^{1}H NMR Spectrum of **3k** ($CDCl_3$, 600 MHz, 298 K)

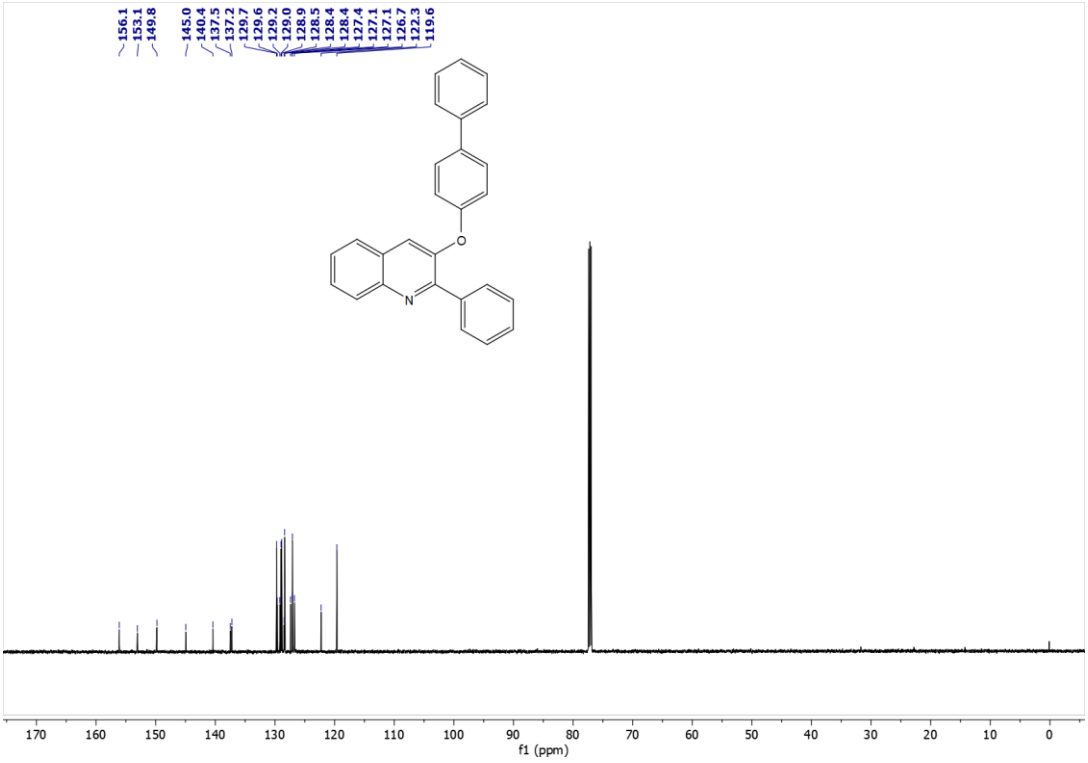


Figure S61: $^{13}C\{^{1}H\}$ NMR Spectrum of **3k** ($CDCl_3$, 151 MHz, 298 K)

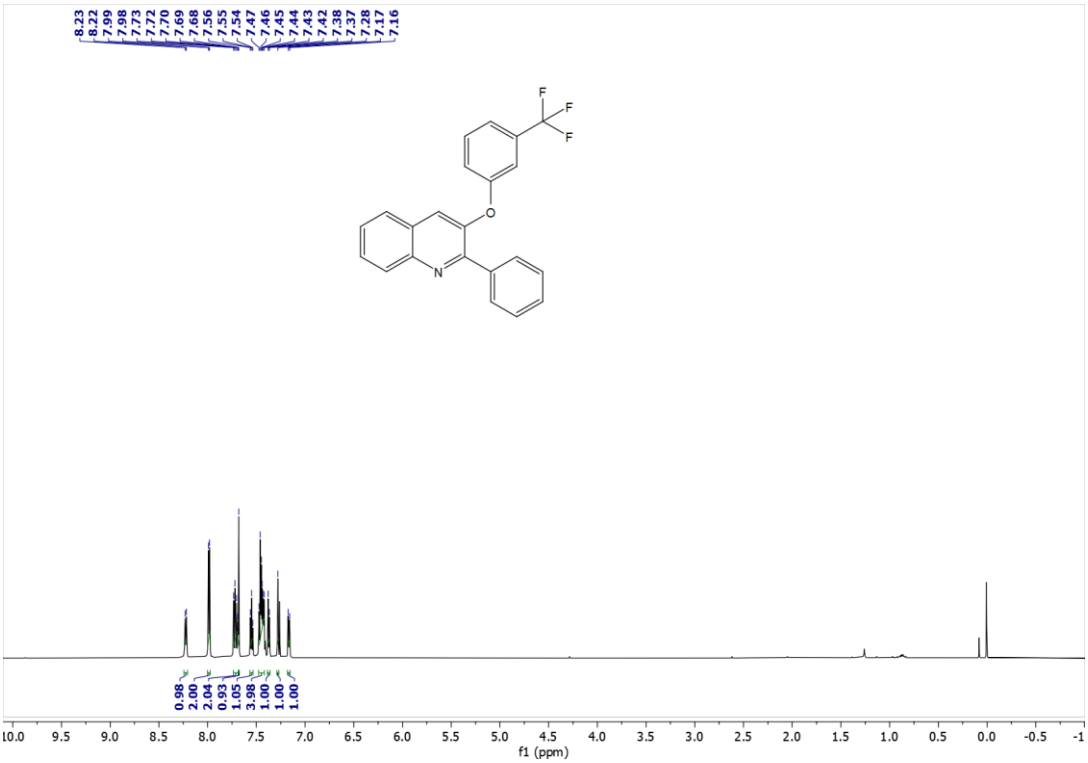


Figure S62: ^{1}H NMR Spectrum of **3l** ($CDCl_3$, 600 MHz, 298 K)

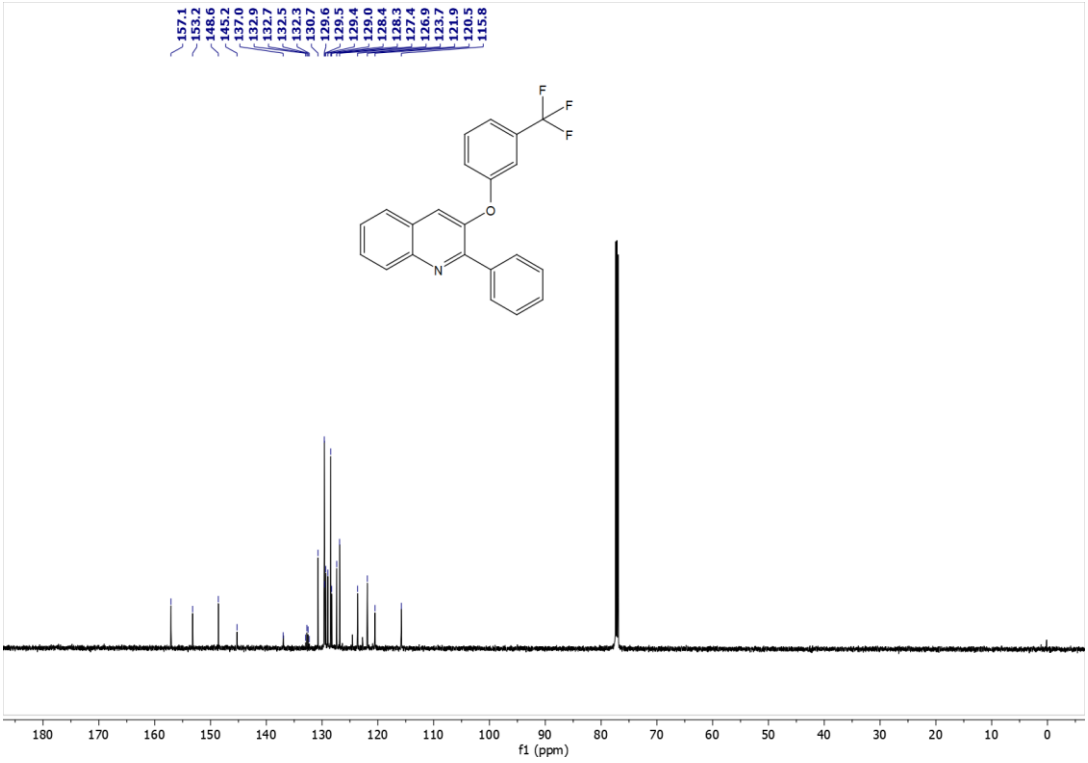


Figure S63: $^{13}C\{^{1}H\}$ NMR Spectrum of **3l** ($CDCl_3$, 151 MHz, 298 K)

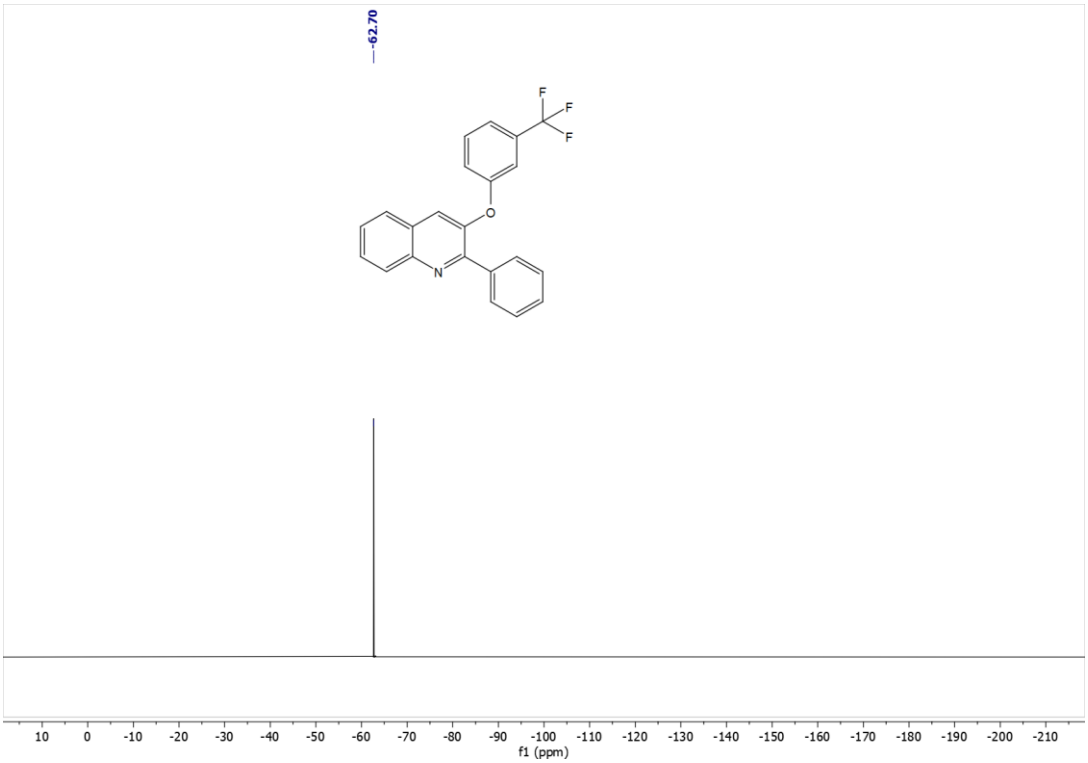


Figure S64: $^{19}F\{^{1}H\}$ NMR Spectrum of **3l** ($CDCl_3$, 565 MHz, 298 K)

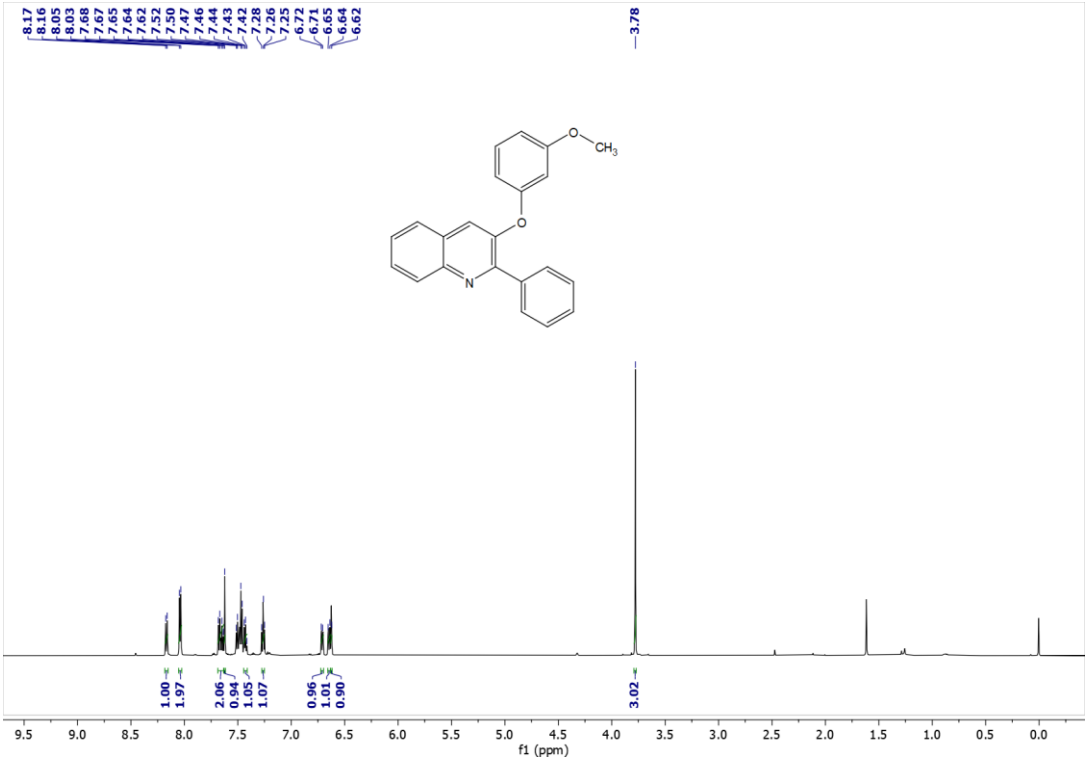


Figure S65: ^{1}H NMR Spectrum of **3m** ($CDCl_3$, 600 MHz, 298 K)

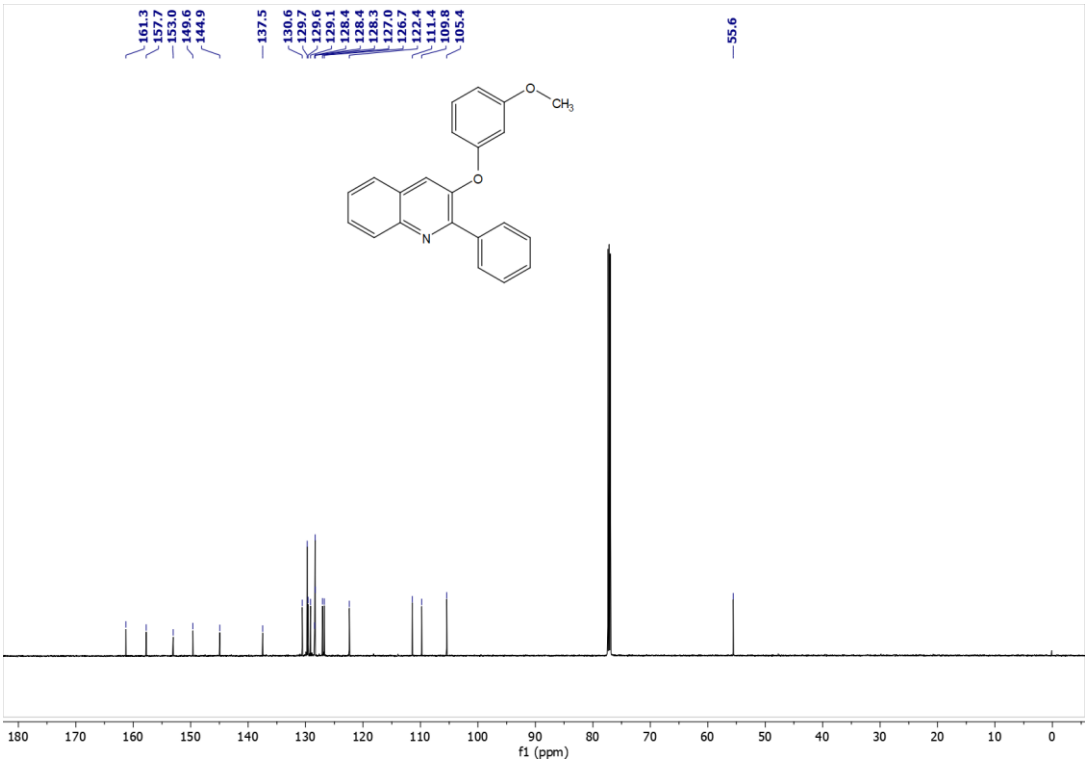


Figure S66: $^{13}C\{^{1}H\}$ NMR Spectrum of **3m** ($CDCl_3$, 151 MHz, 298 K)

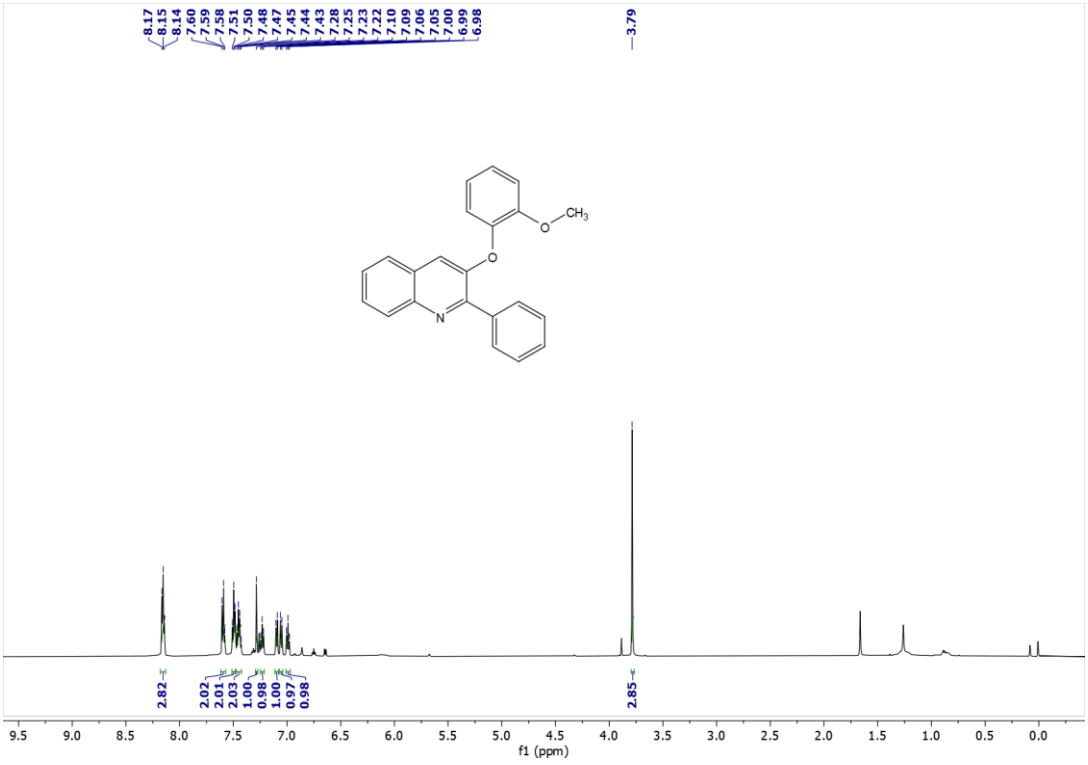


Figure S67: ^{1}H NMR Spectrum of **3n** ($CDCl_3$, 600 MHz, 298 K)

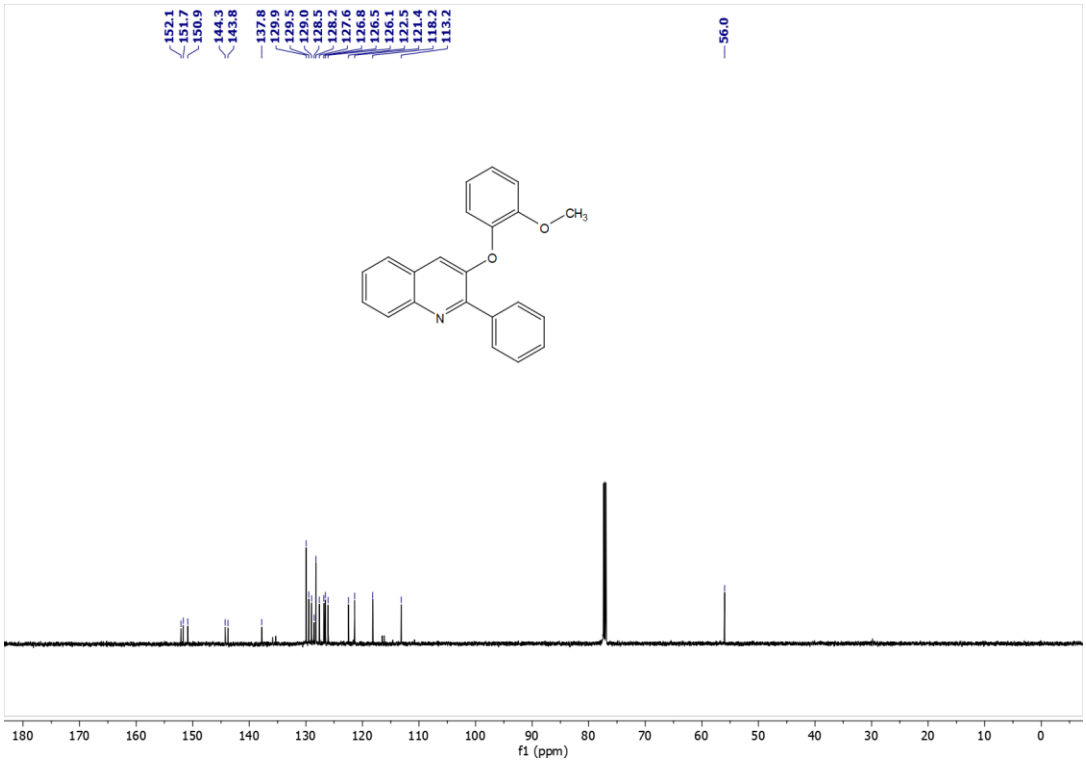


Figure S68: $^{13}C\{^{1}H\}$ NMR Spectrum of **3n** ($CDCl_3$, 151 MHz, 298 K)

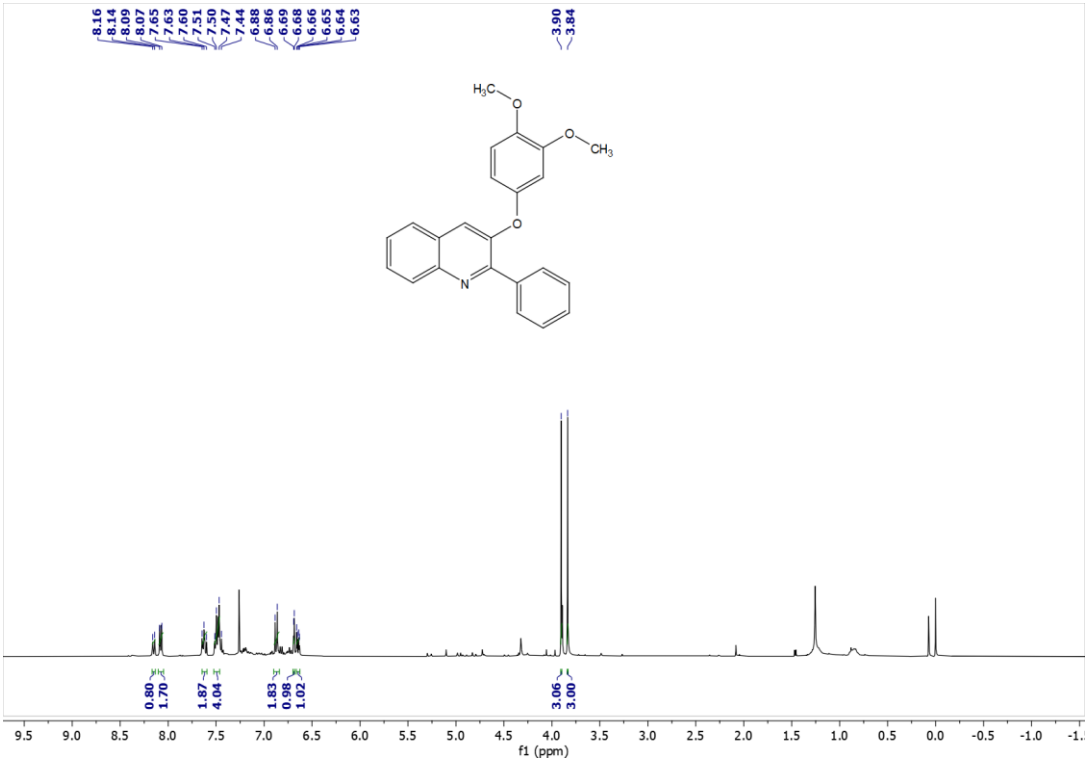


Figure S69: ^{1}H NMR Spectrum of **3o** ($CDCl_3$, 400 MHz, 298 K)

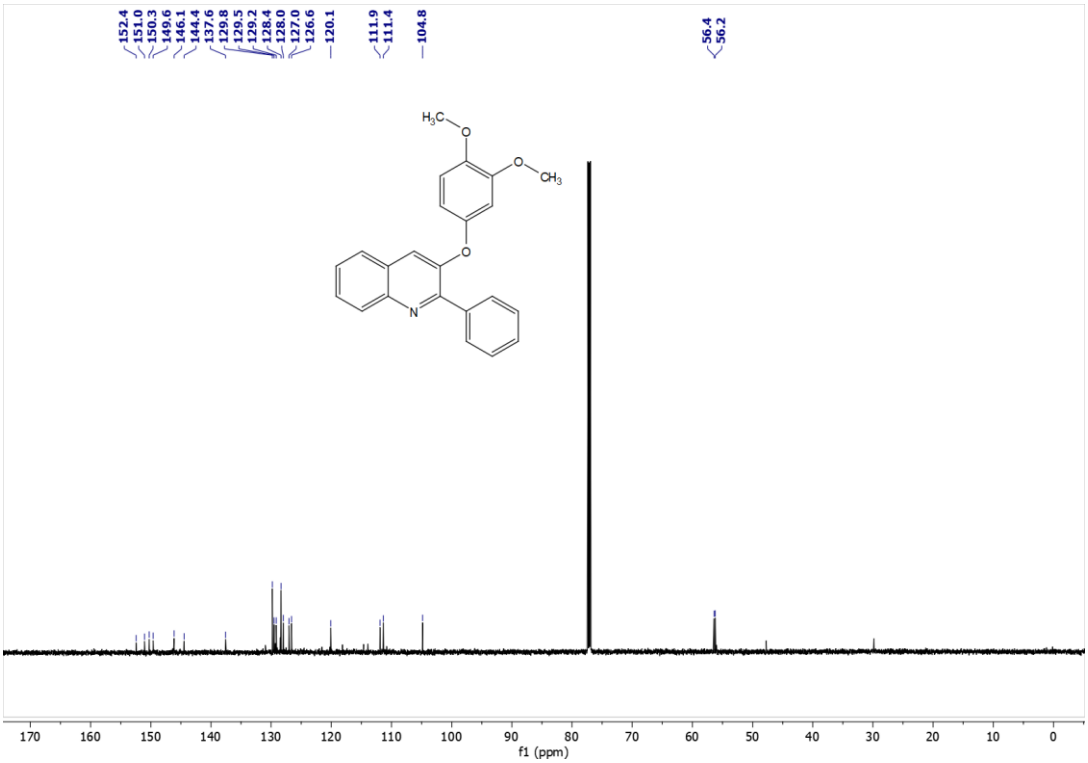


Figure S70: $^{13}C\{^{1}H\}$ NMR Spectrum of **3o** ($CDCl_3$, 151 MHz, 298 K)

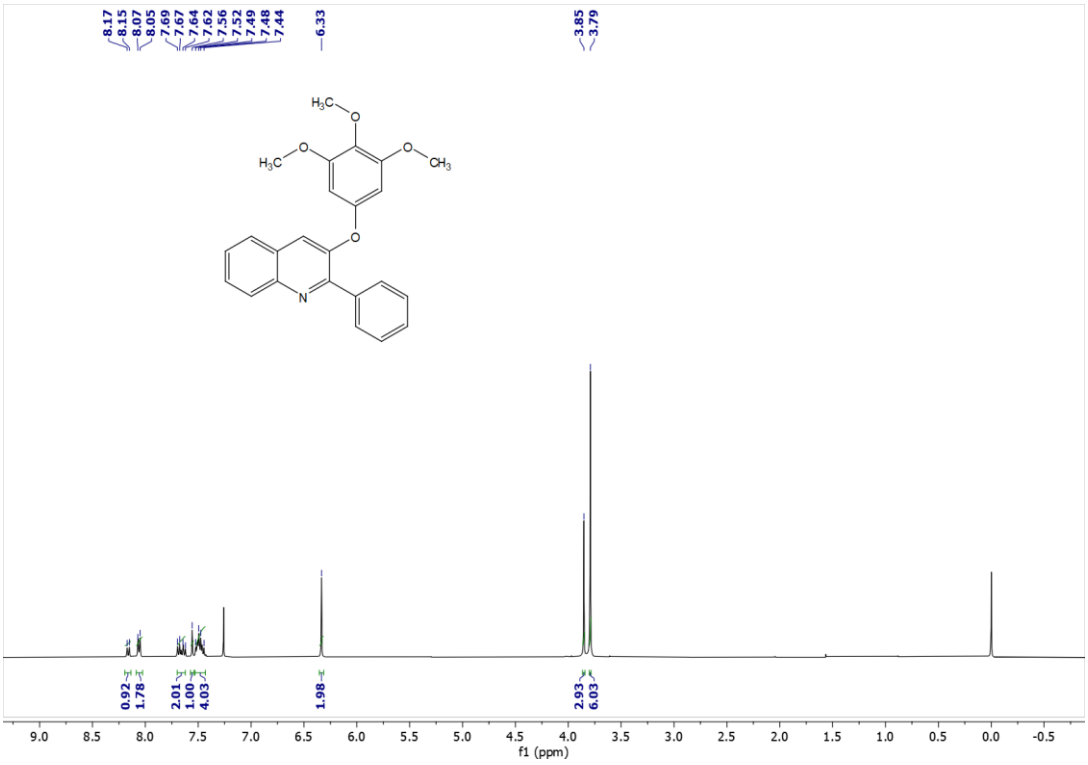


Figure S71: ^{1}H NMR Spectrum of **3p** ($CDCl_3$, 400 MHz, 298 K)

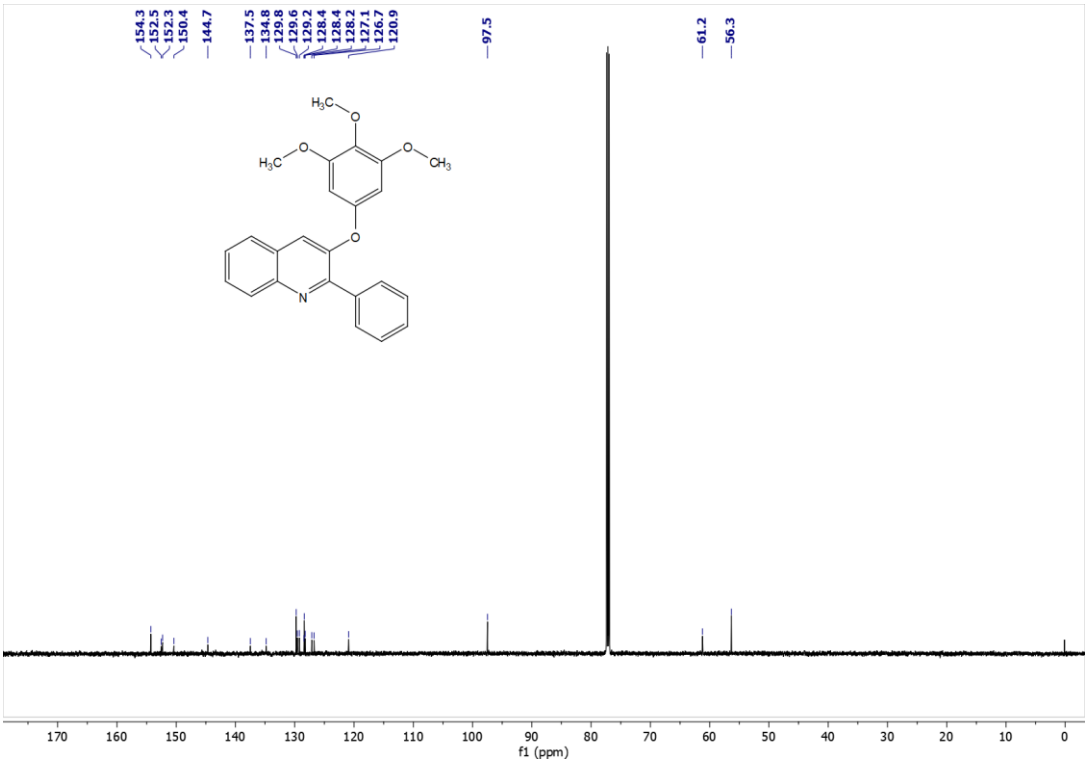


Figure S72: $^{13}C\{^{1}H\}$ NMR Spectrum of **3p** ($CDCl_3$, 151 MHz, 298 K)

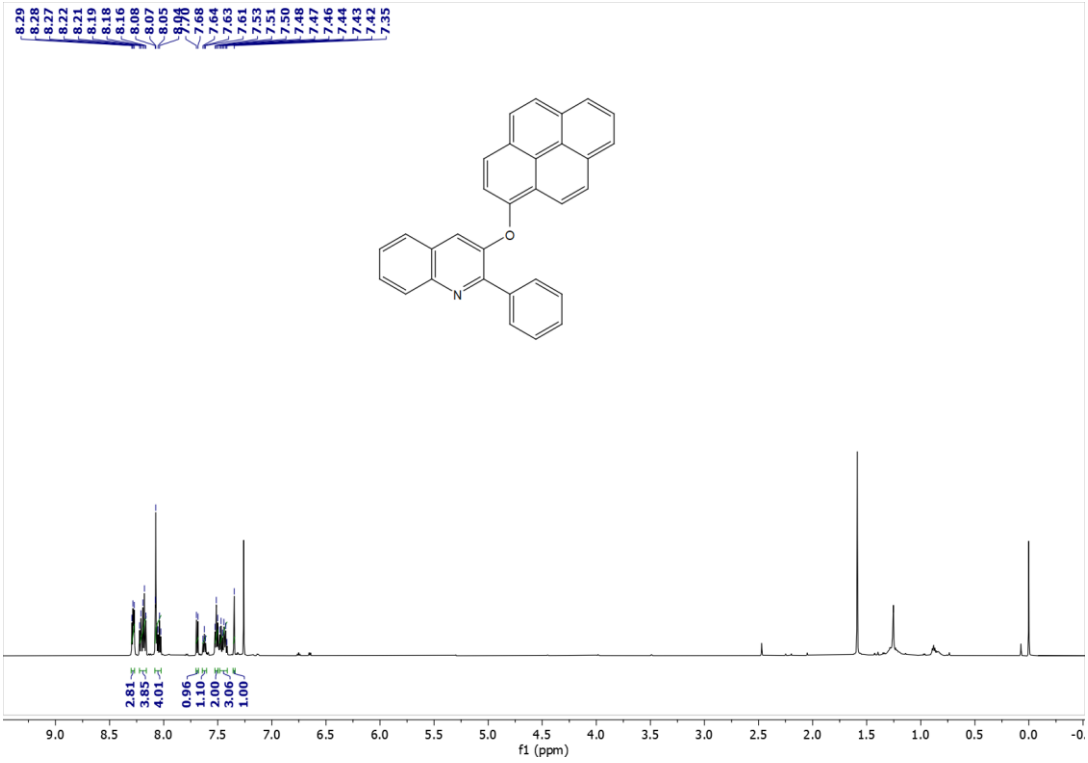


Figure S73: ^{1}H NMR Spectrum of **3q** ($CDCl_3$, 600 MHz, 298 K)

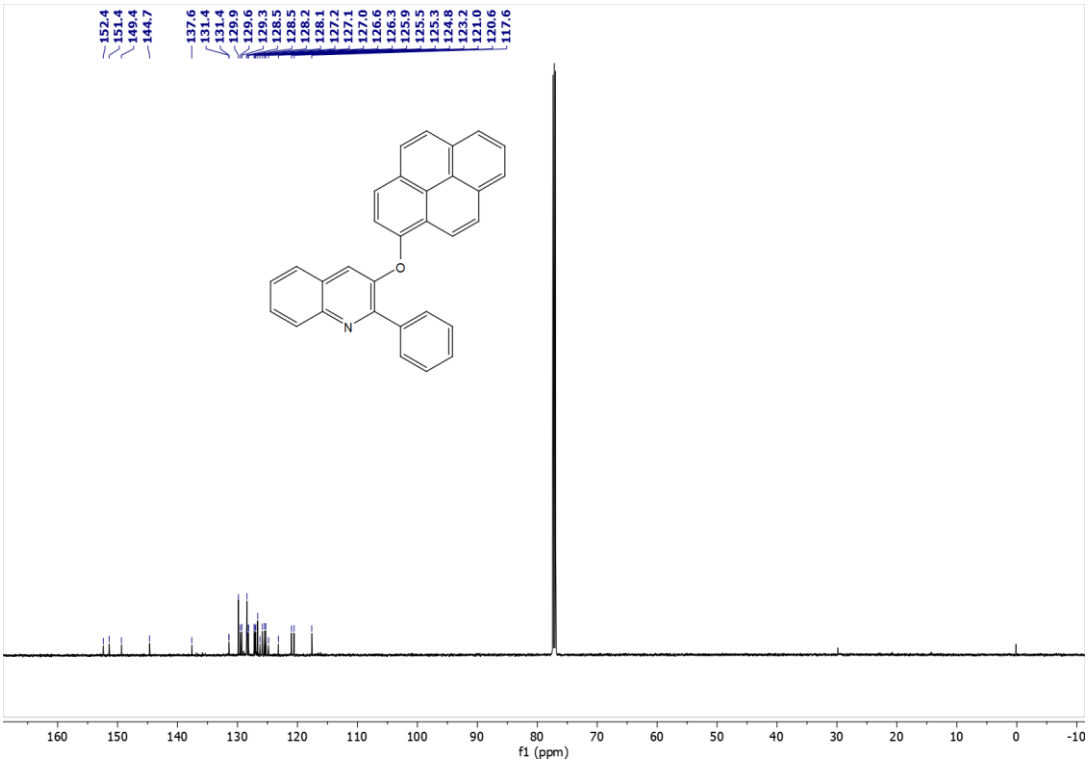


Figure S74: $^{13}C\{^{1}H\}$ NMR Spectrum of **3q** ($CDCl_3$, 151 MHz, 298 K)

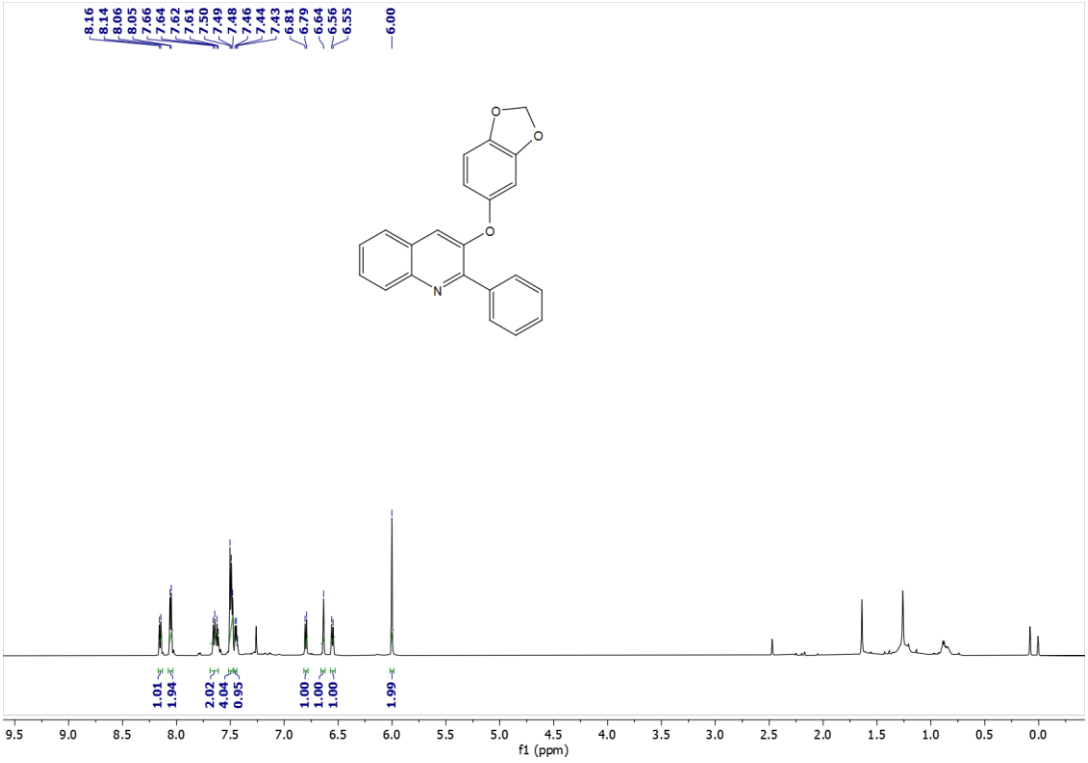


Figure S75: ^{1}H NMR Spectrum of **3r** ($CDCl_3$, 600 MHz, 298 K)

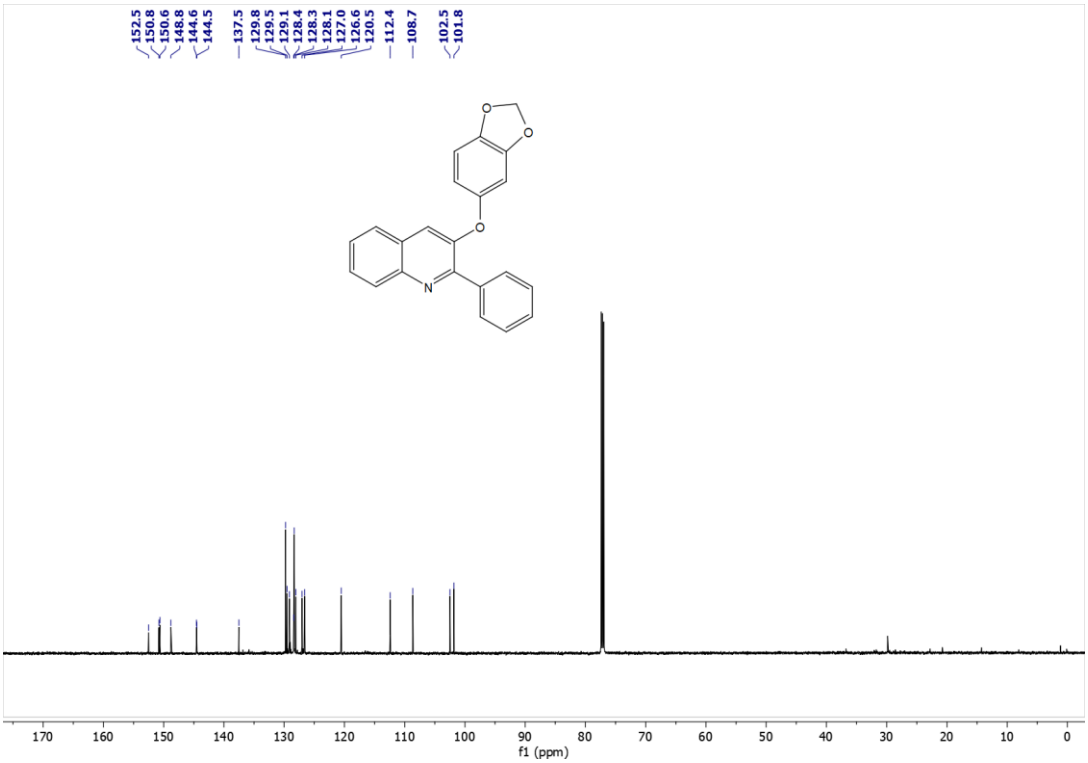


Figure S76: $^{13}C\{^{1}H\}$ NMR Spectrum of **3r** ($CDCl_3$, 151 MHz, 298 K)

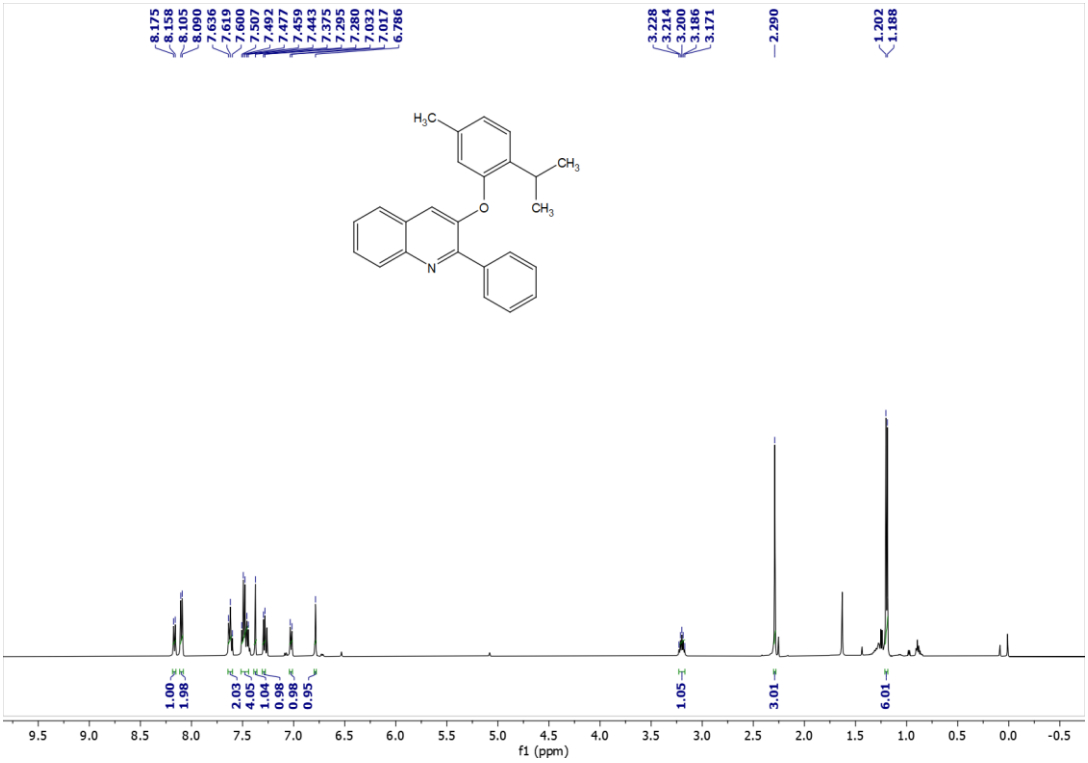


Figure S77: ^{1}H NMR Spectrum of **3s** ($CDCl_3$, 500 MHz, 298 K)

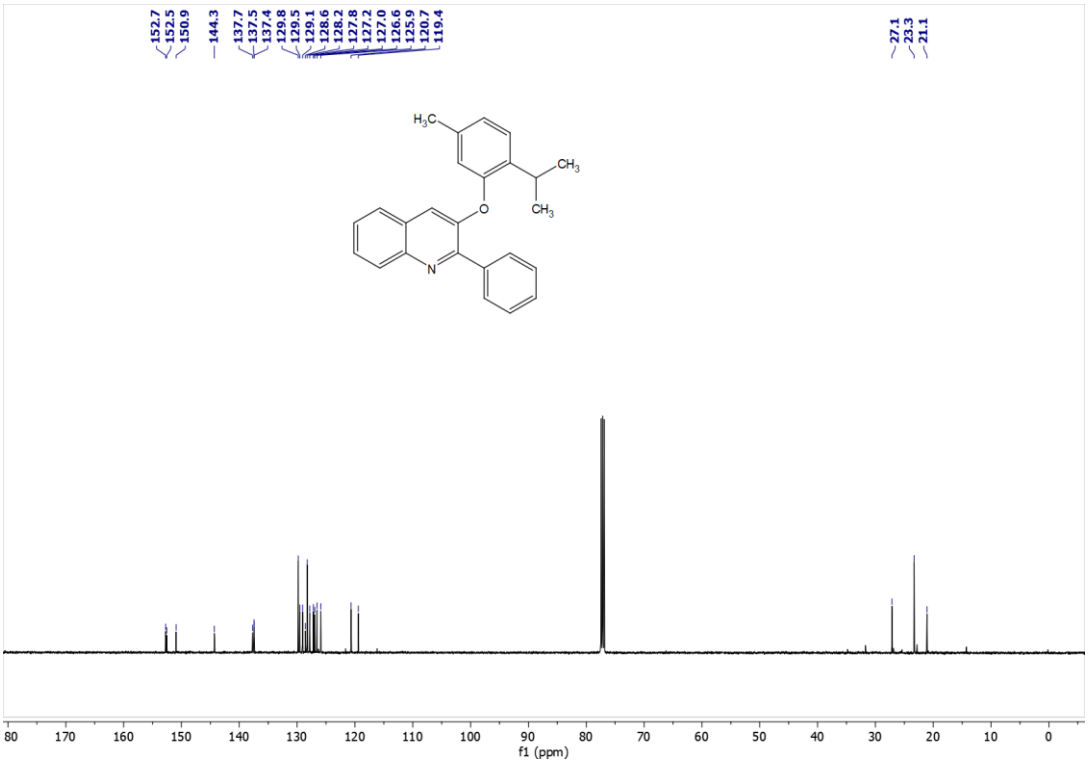


Figure S78: $^{13}C\{^{1}H\}$ NMR Spectrum of **3s** ($CDCl_3$, 126 MHz, 298 K)

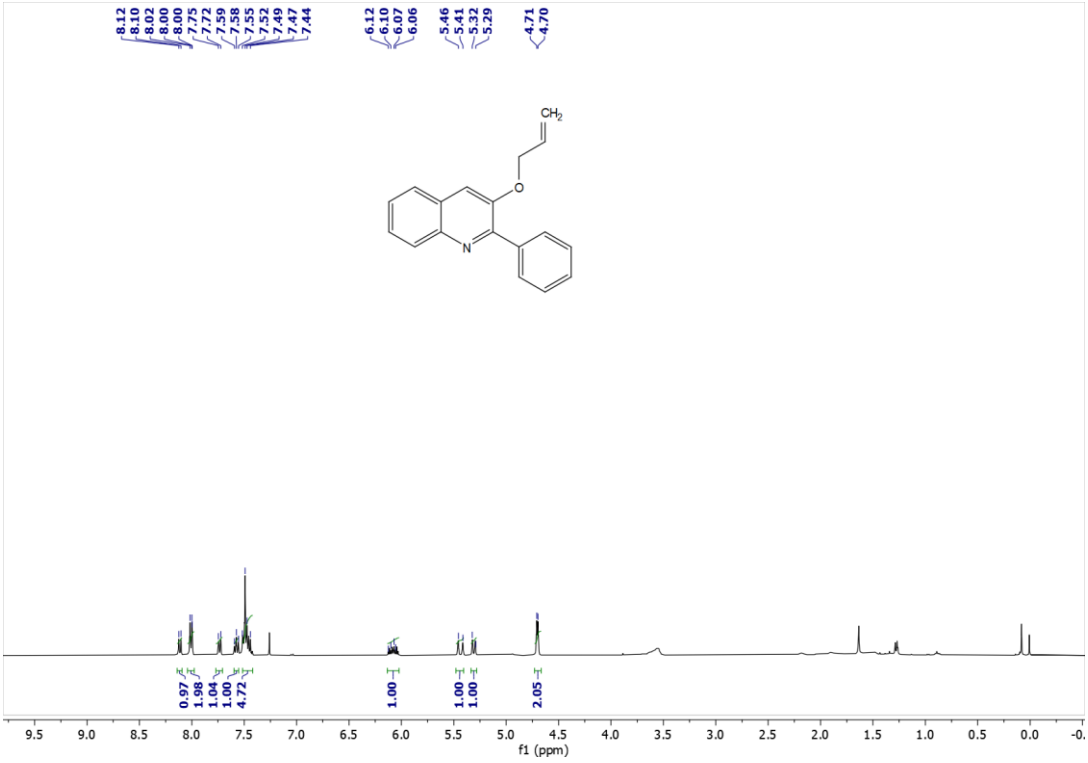


Figure S79: ^{1}H NMR Spectrum of **3t** ($CDCl_3$, 400 MHz, 298 K)

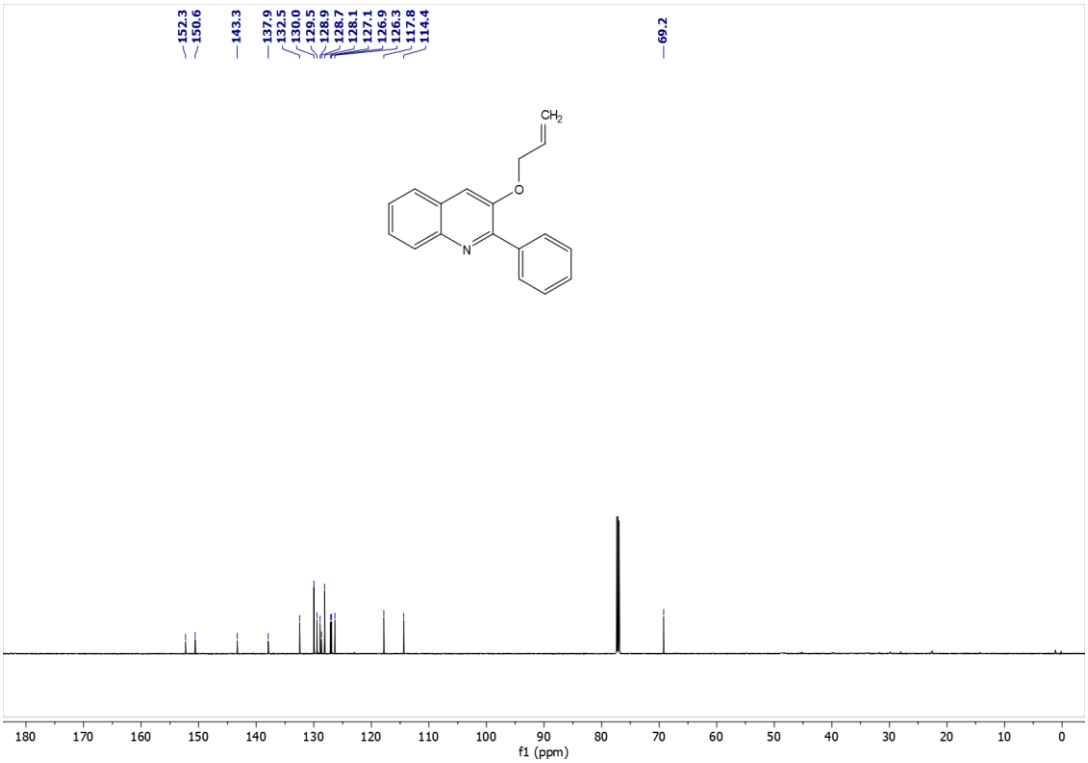


Figure S80: $^{13}C\{^{1}H\}$ NMR Spectrum of **3t** ($CDCl_3$, 151 MHz, 298 K)

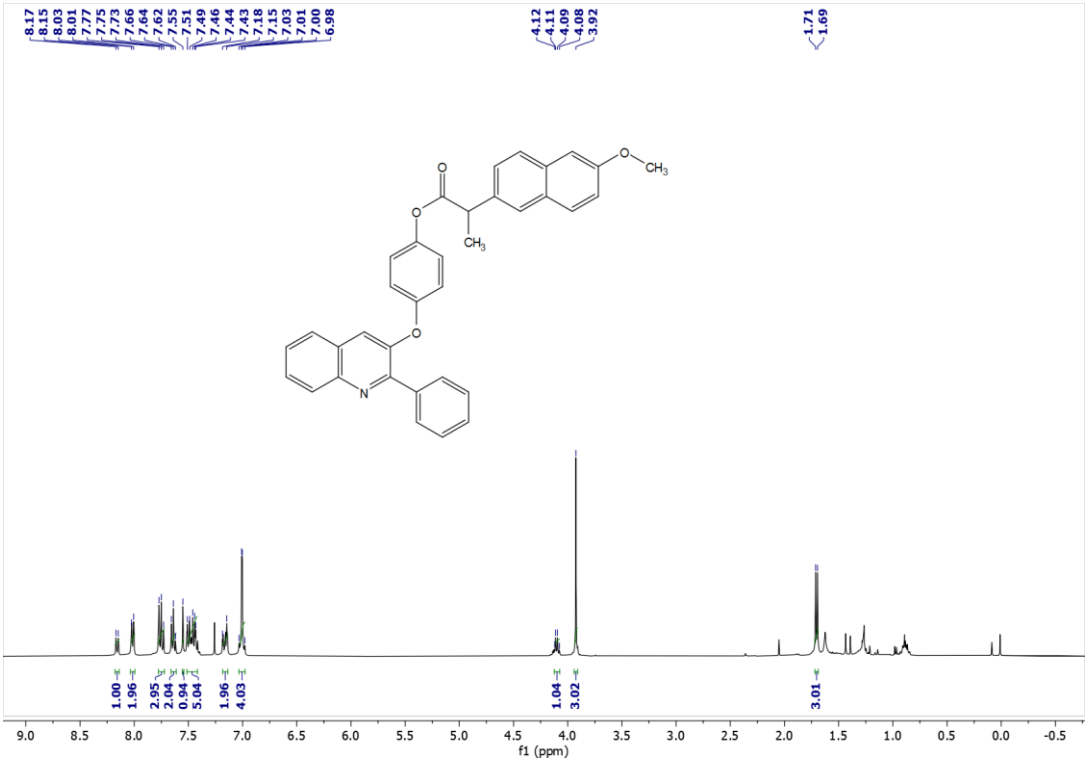


Figure S81: ^{1}H NMR Spectrum of **3u** ($CDCl_3$, 400 MHz, 298 K)

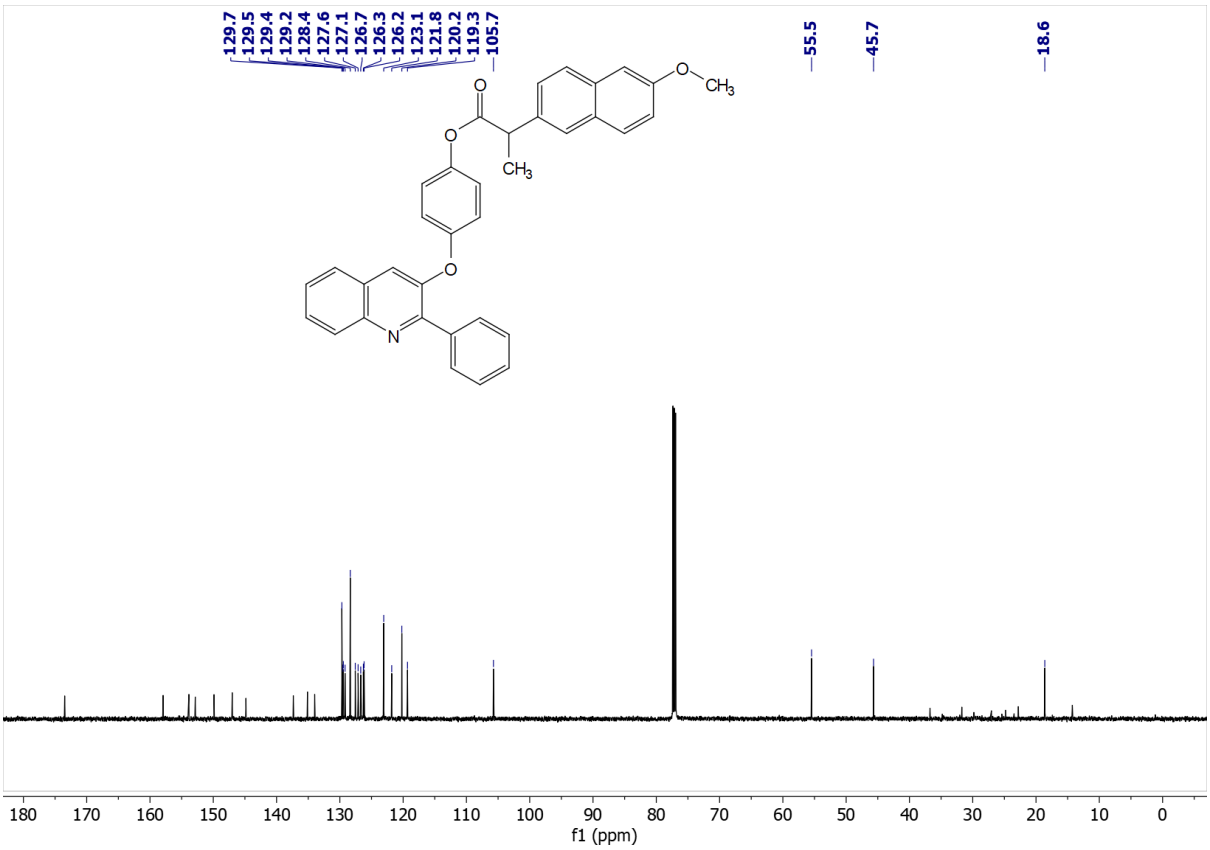


Figure S82: $^{13}C\{^{1}H\}$ NMR Spectrum of **3u** ($CDCl_3$, 151 MHz, 298 K)

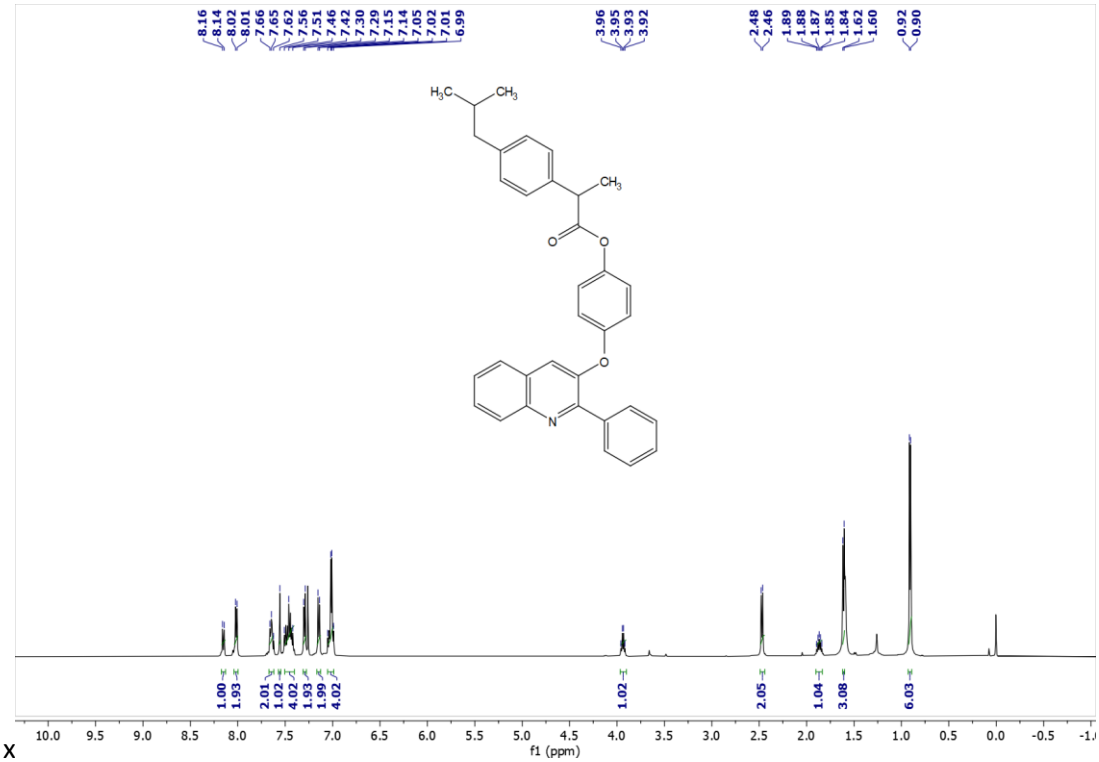


Figure S83: ^{1}H NMR Spectrum of **3v** ($CDCl_3$, 500 MHz, 298 K)

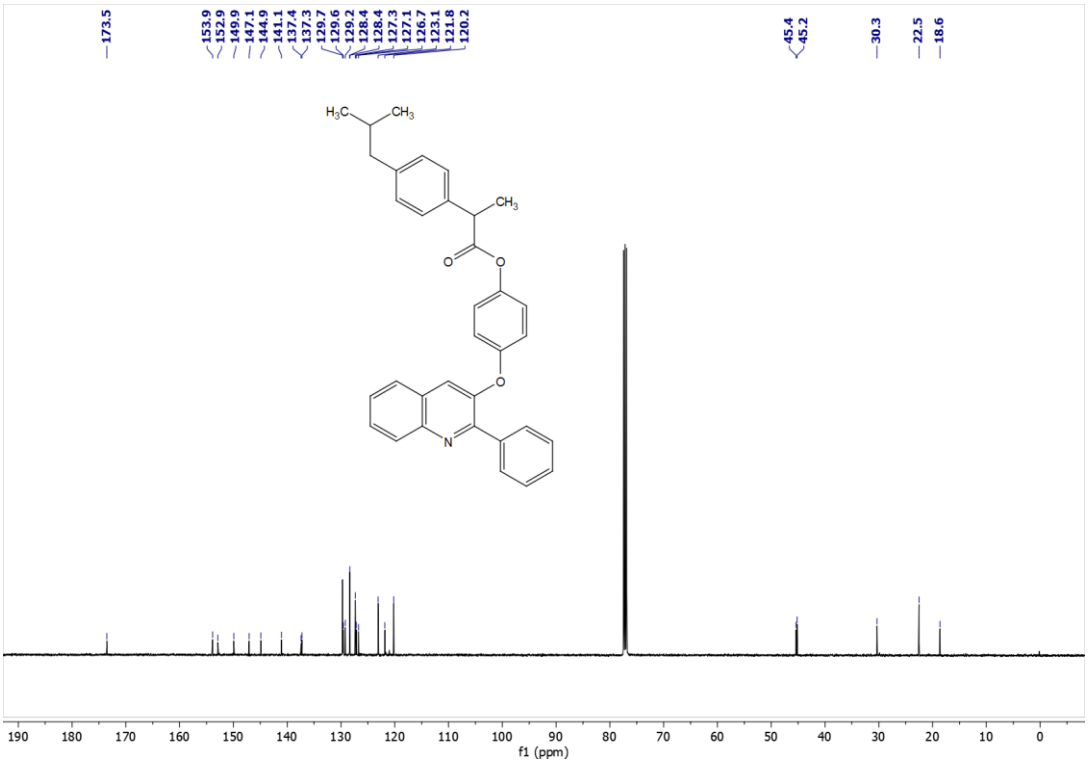


Figure S84: $^{13}C\{^{1}H\}$ NMR Spectrum of **3v** ($CDCl_3$, 126 MHz, 298 K)

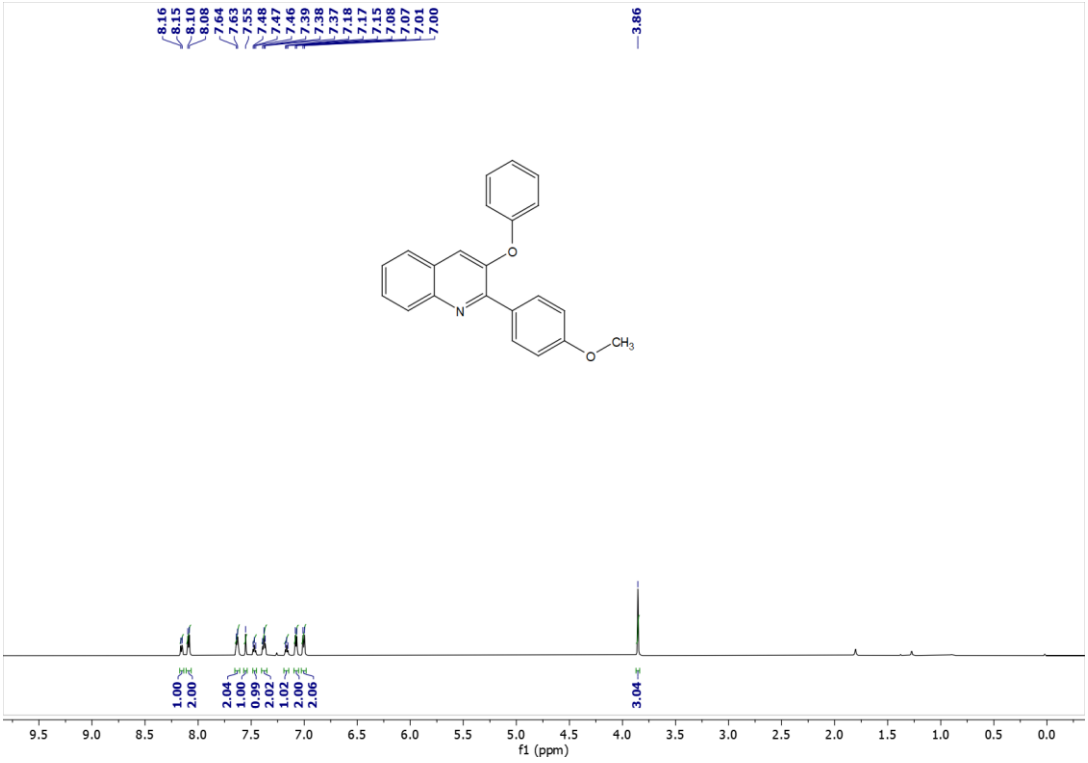


Figure S85: ^{1}H NMR Spectrum of **3aa** ($CDCl_3$, 600 MHz, 298 K)

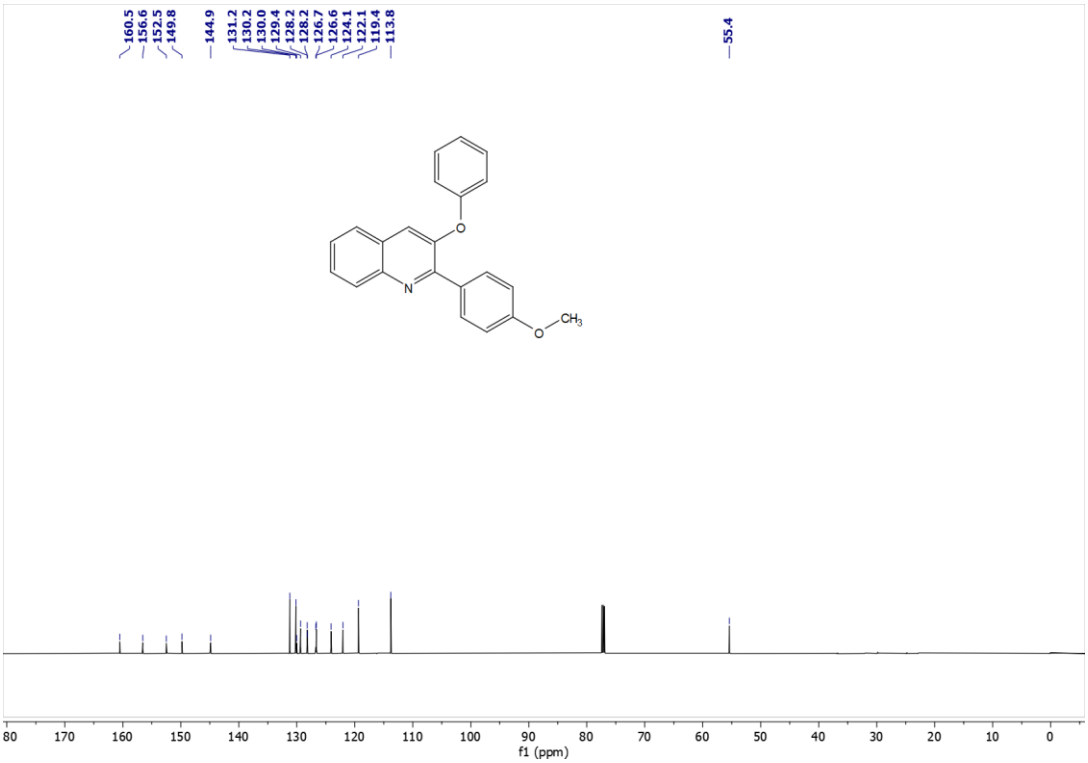


Figure S86: $^{13}C\{^{1}H\}$ NMR Spectrum of **3aa** ($CDCl_3$, 151 MHz, 298 K)

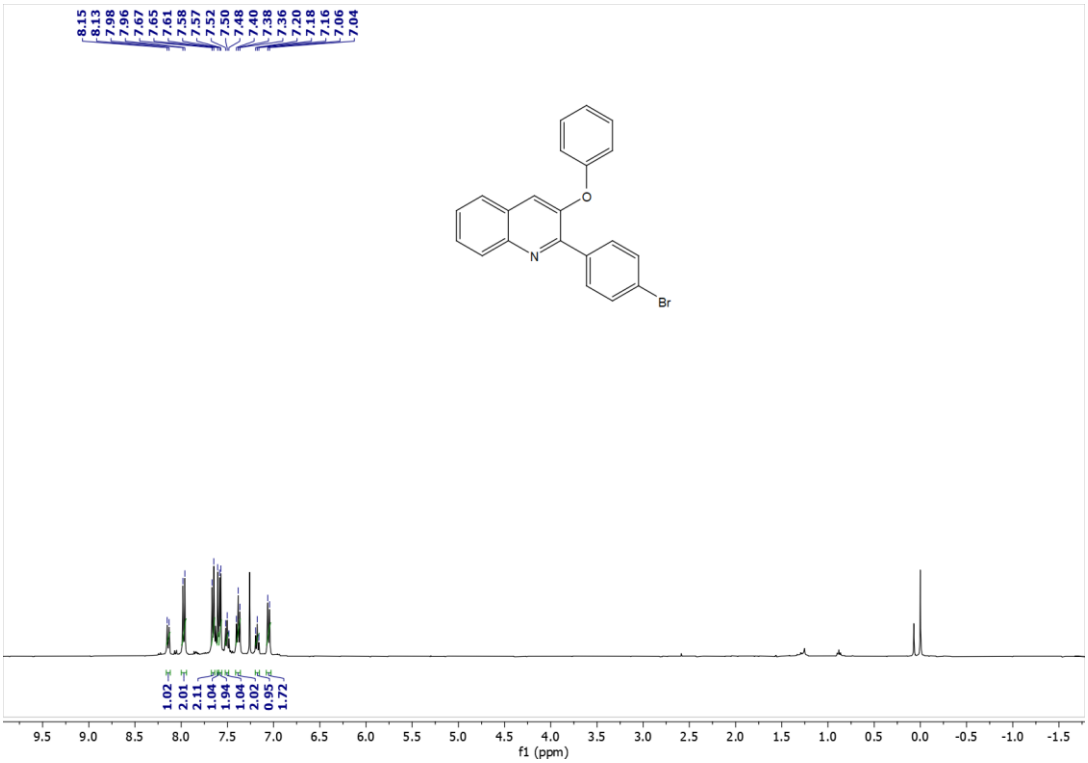


Figure S87: ^{1}H NMR Spectrum of **3ab** ($CDCl_3$, 400 MHz, 298 K)

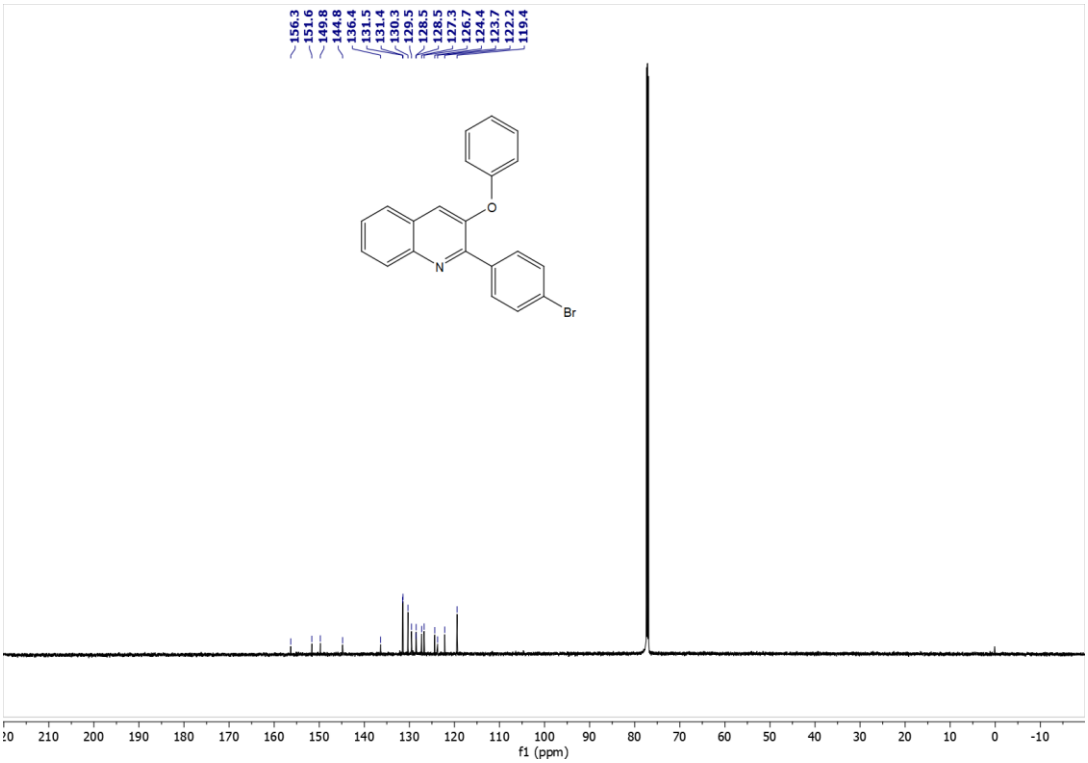


Figure S88: $^{13}C\{^{1}H\}$ NMR Spectrum of **3ab** ($CDCl_3$, 151 MHz, 298 K)

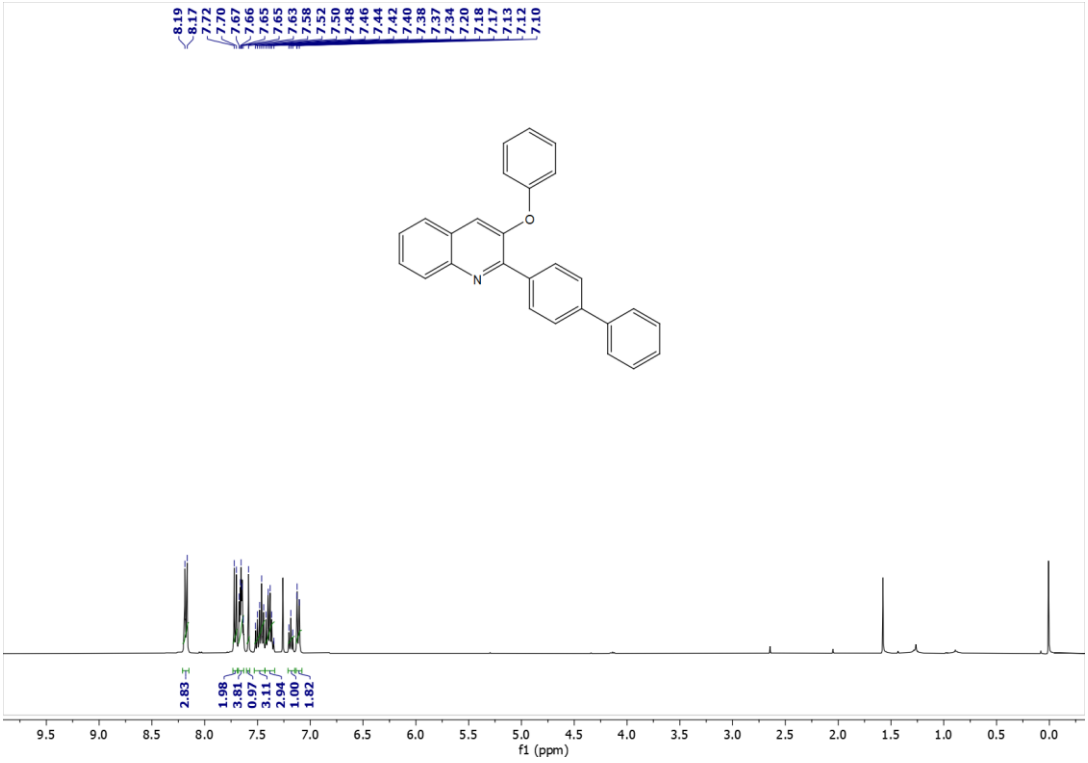


Figure S89: ^{1}H NMR Spectrum of **3ac** ($CDCl_3$, 400 MHz, 298 K)

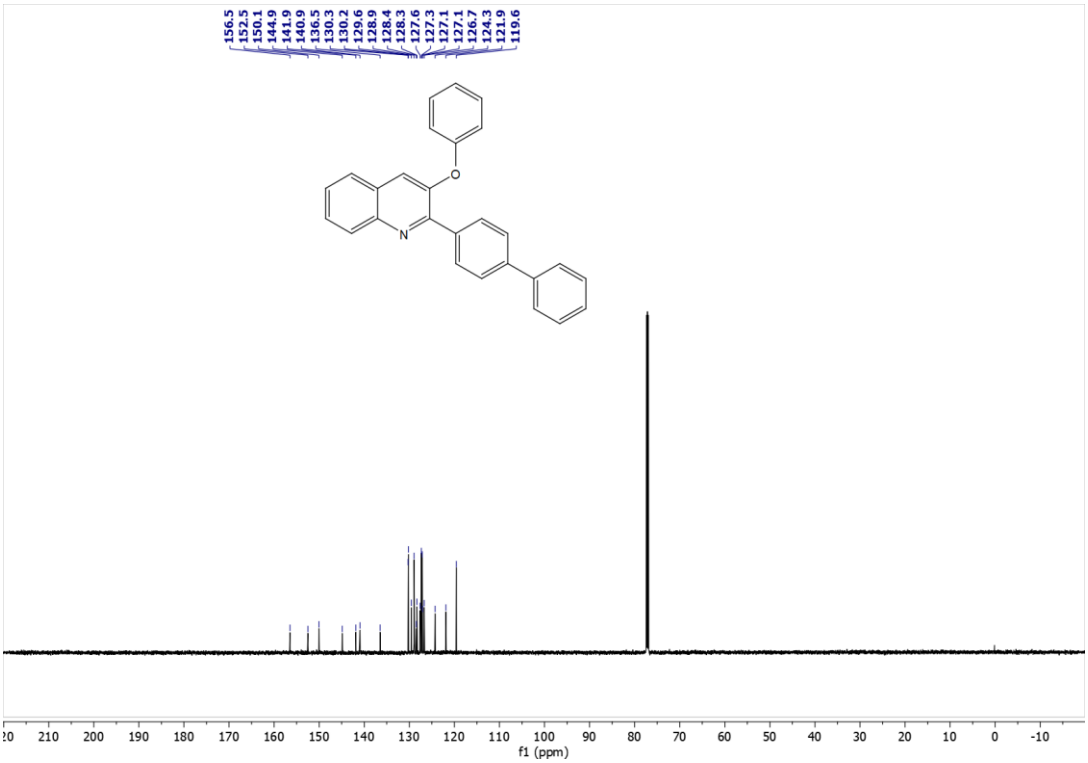


Figure S90: $^{13}C\{^{1}H\}$ NMR Spectrum of **3ac** ($CDCl_3$, 151 MHz, 298 K)

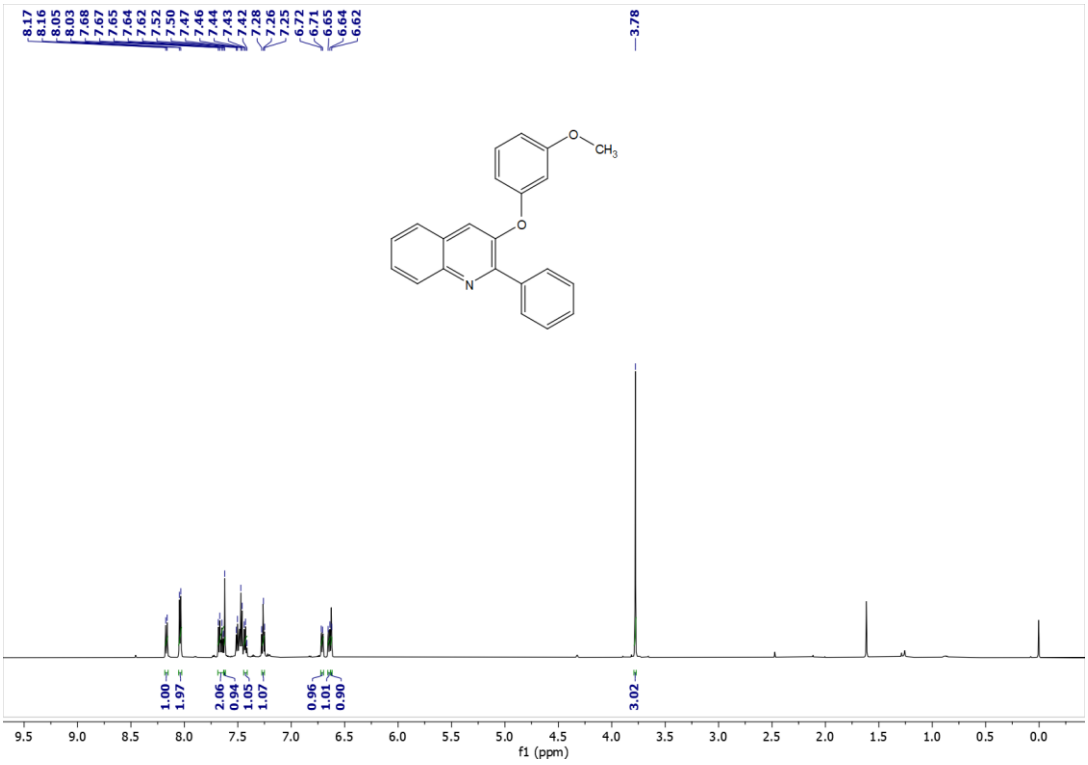


Figure S91: ^{1}H NMR Spectrum of **3ad** ($CDCl_3$, 400 MHz, 298 K)

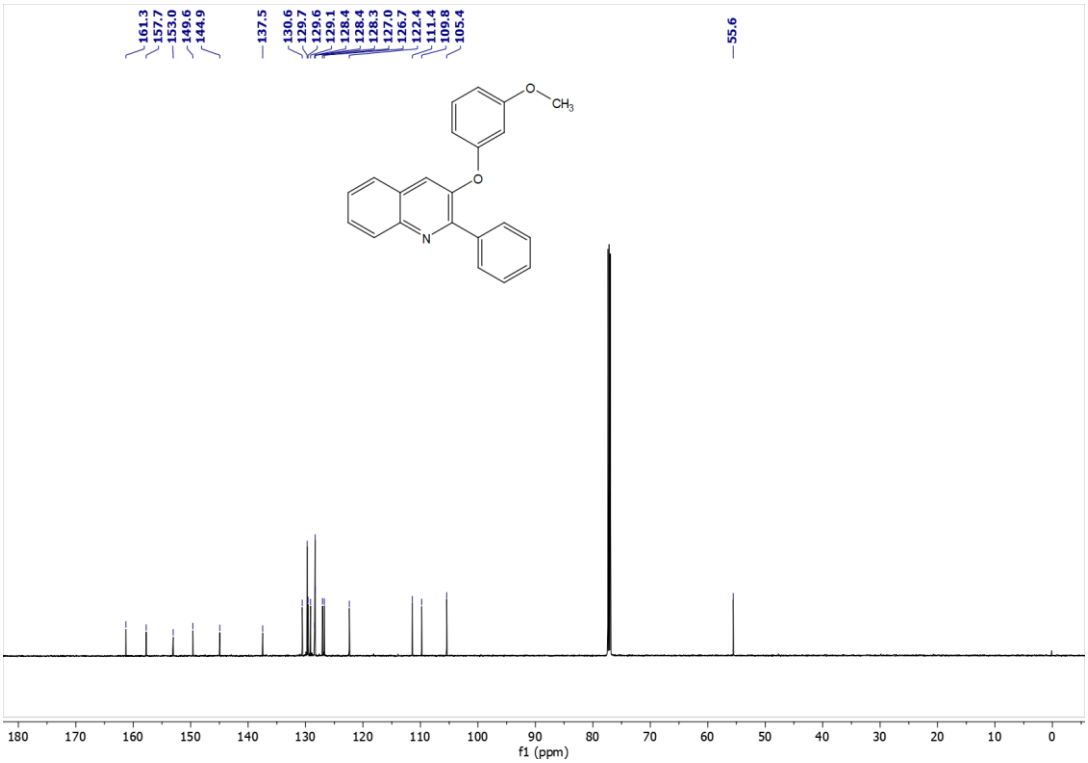


Figure S92: $^{13}C\{^{1}H\}$ NMR Spectrum of **3ad** ($CDCl_3$, 151 MHz, 298 K)

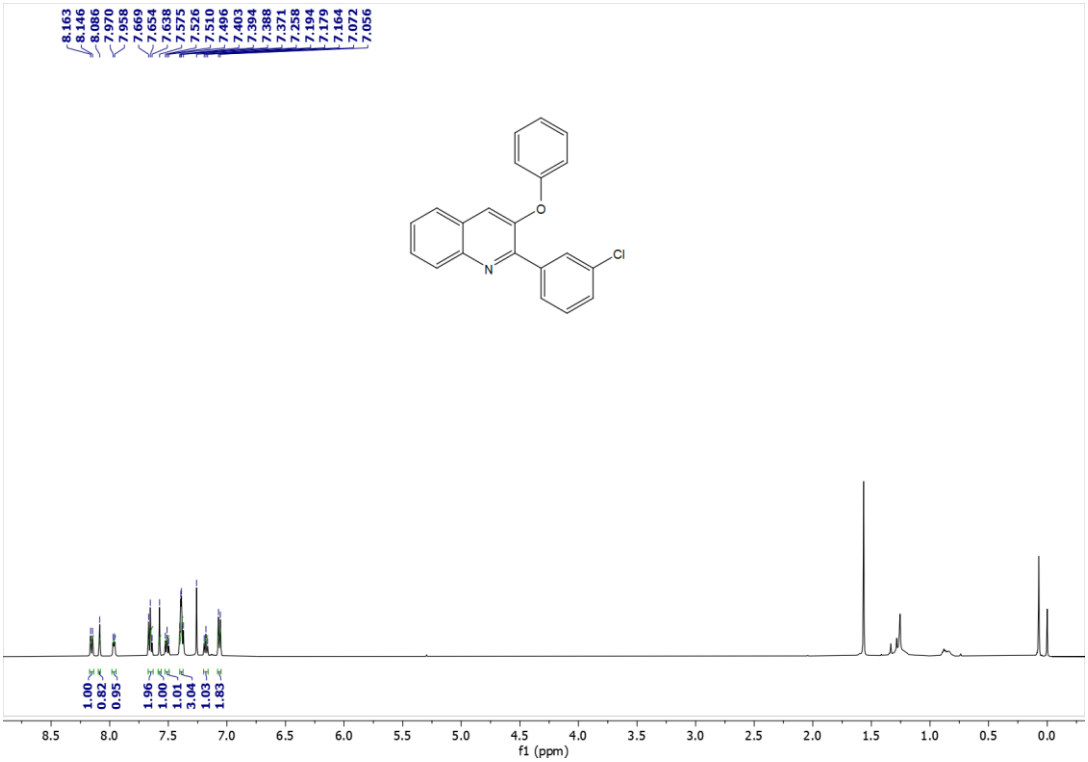


Figure S93: ^{1}H NMR Spectrum of **3ad** ($CDCl_3$, 500 MHz, 298 K)

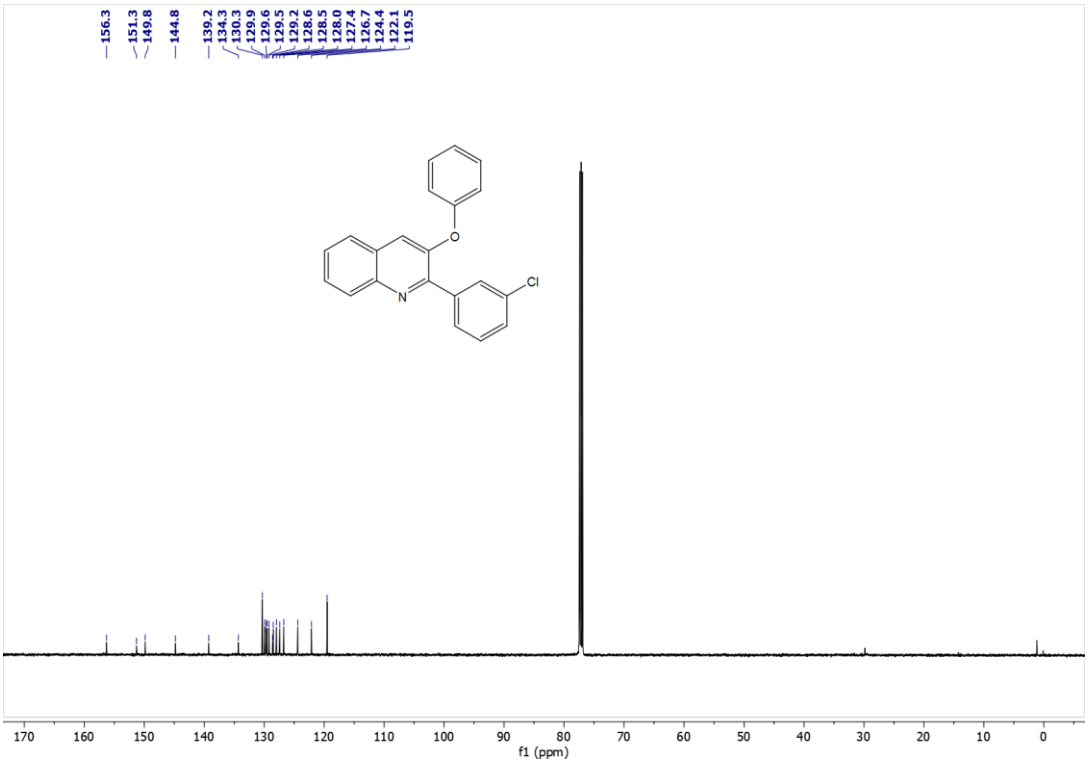


Figure S94: $^{13}C\{^{1}H\}$ NMR Spectrum of **3ae** ($CDCl_3$, 126 MHz, 298 K)

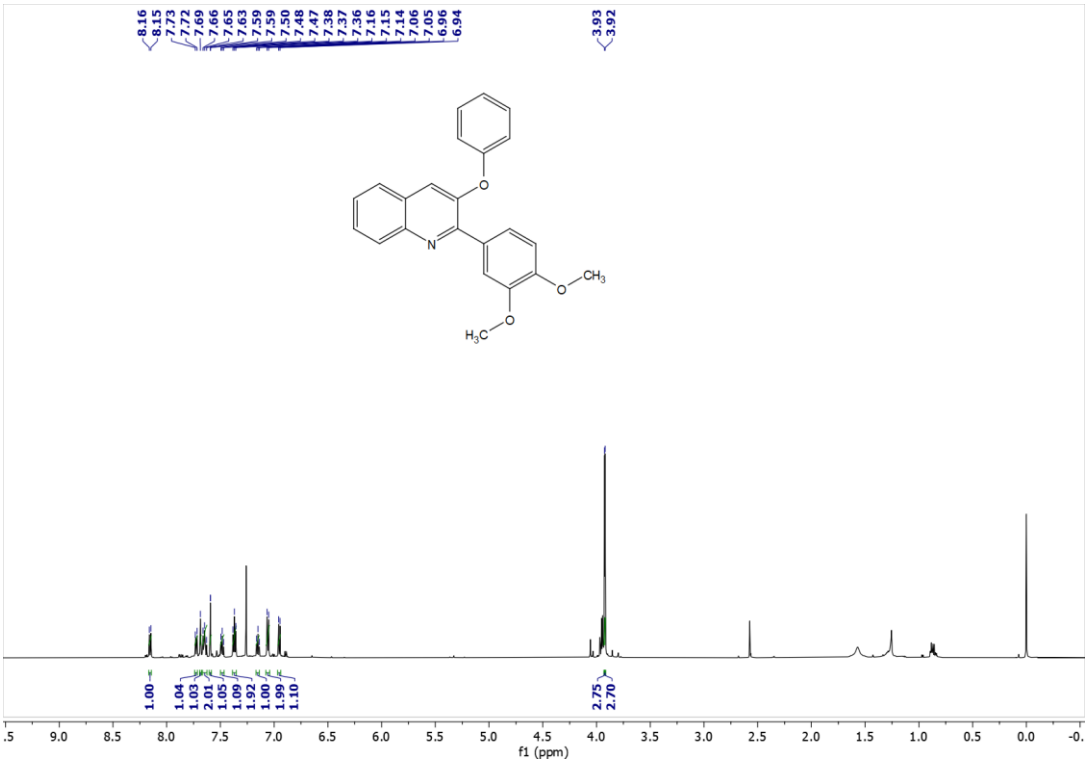


Figure S95: ^{1}H NMR Spectrum of **3af** ($CDCl_3$, 600 MHz, 298 K)

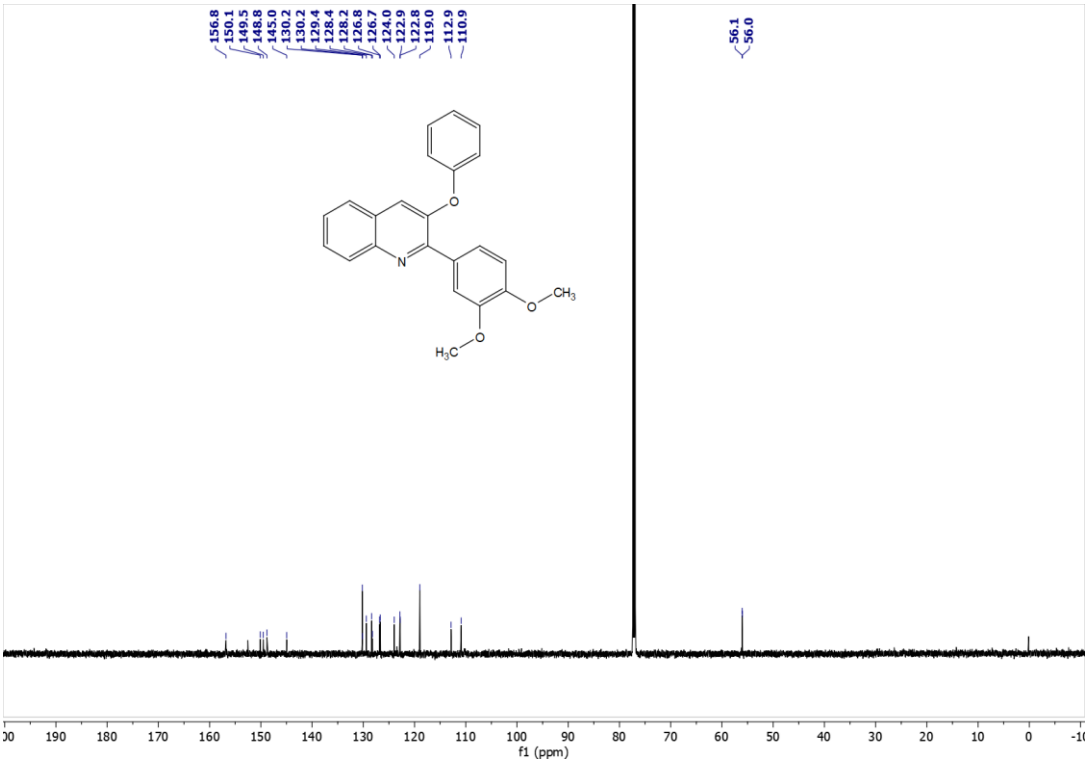


Figure S96: $^{13}C\{^{1}H\}$ NMR Spectrum of **3af** ($CDCl_3$, 151 MHz, 298 K)

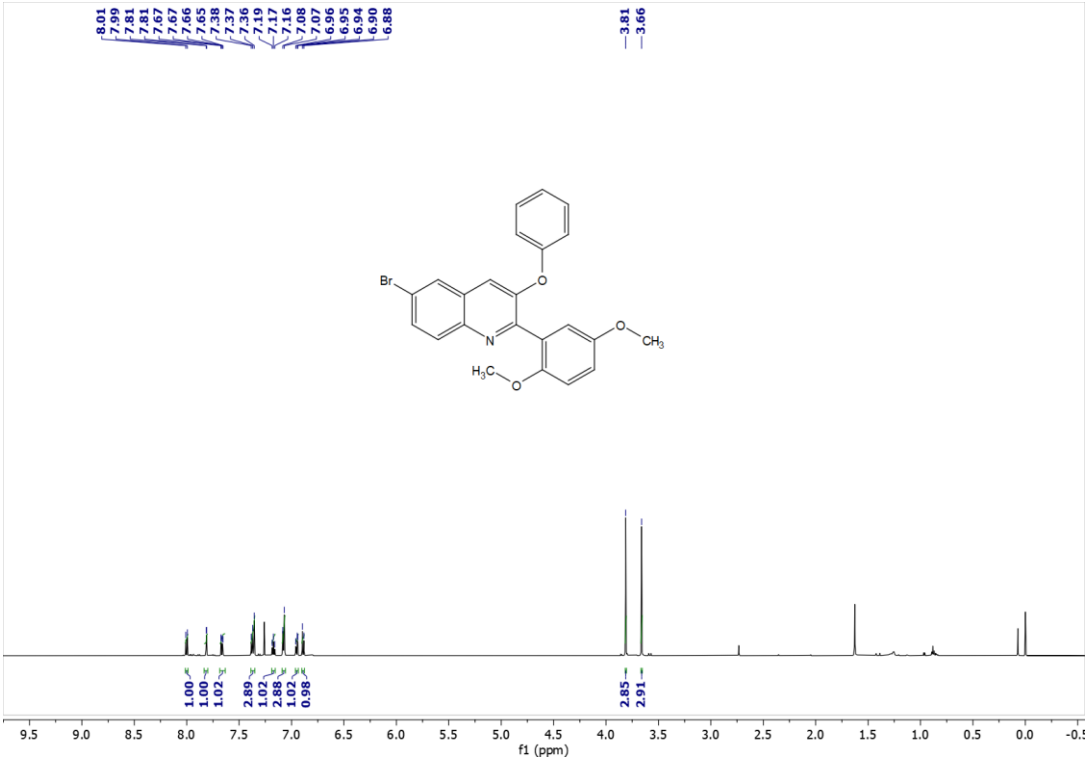


Figure S97: ^{1}H NMR Spectrum of **3ag** ($CDCl_3$, 600 MHz, 298 K)

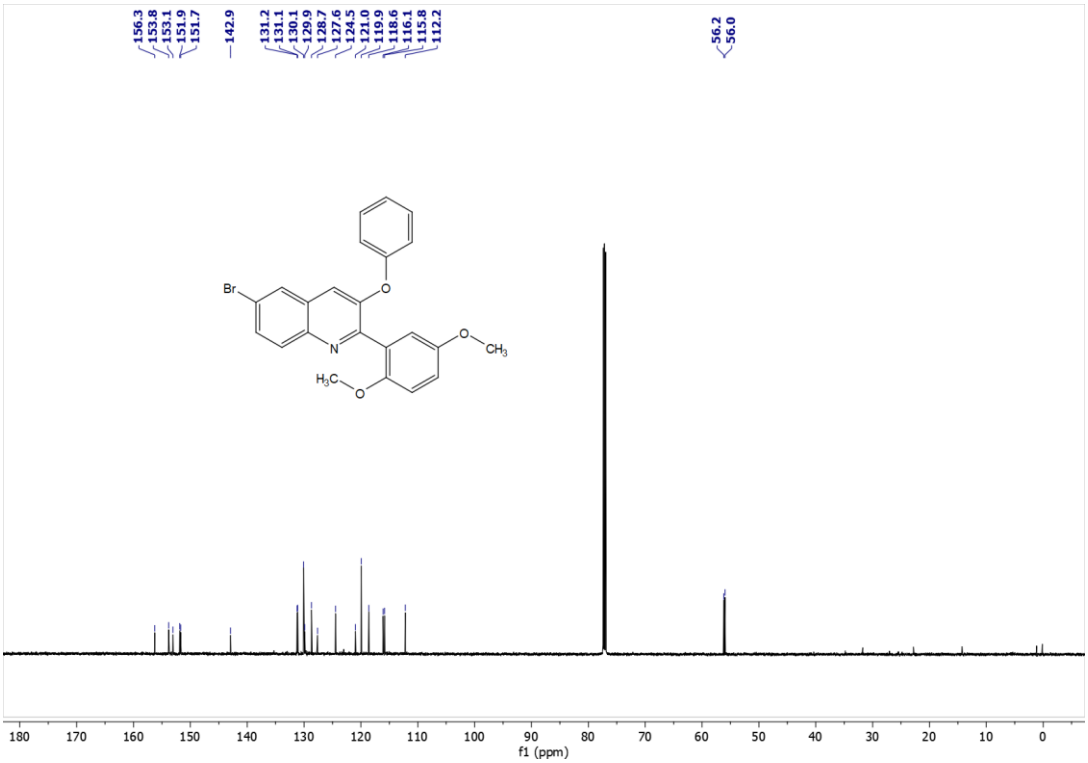


Figure S98: $^{13}C\{^{1}H\}$ NMR Spectrum of **3ag** ($CDCl_3$, 151 MHz, 298 K)

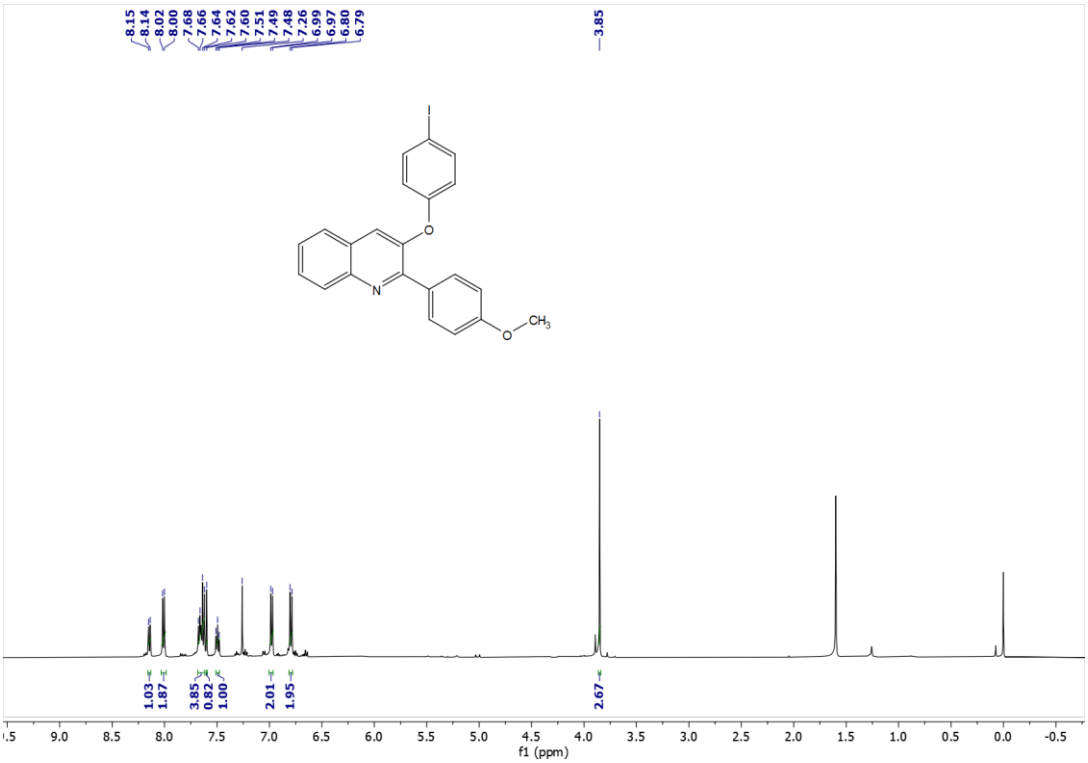


Figure S99: ^{1}H NMR Spectrum of **3ah** ($CDCl_3$, 500 MHz, 298 K)

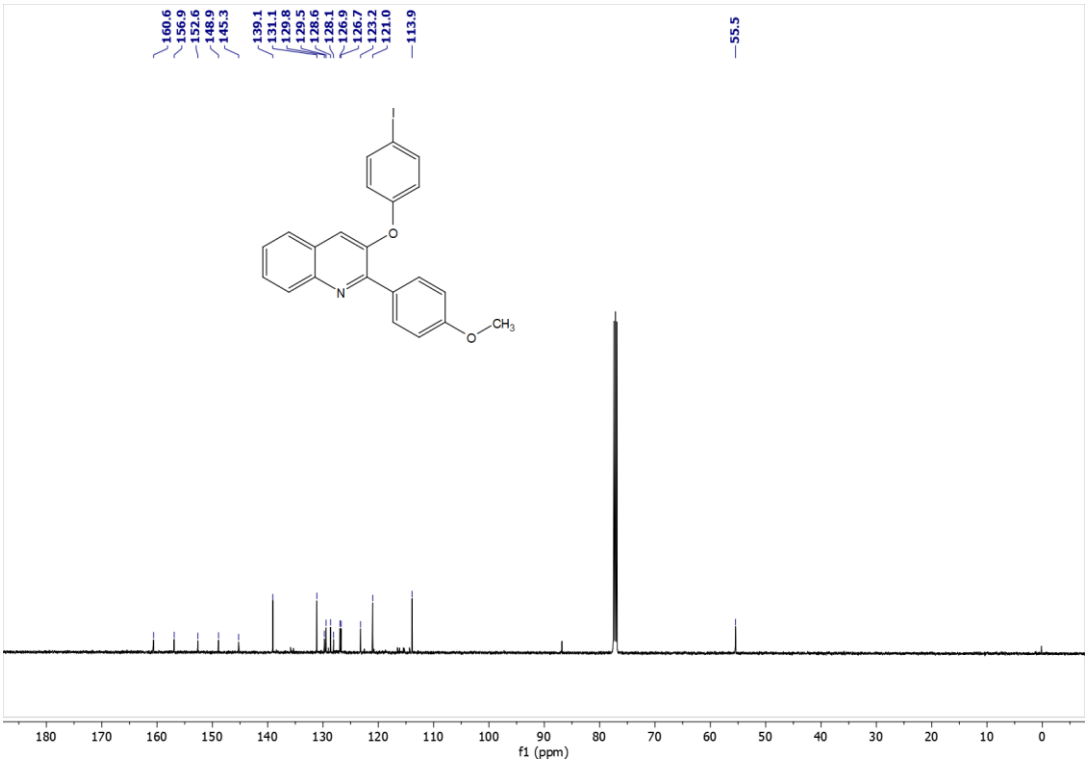


Figure S100: $^{13}C\{^{1}H\}$ NMR Spectrum of **3ah** ($CDCl_3$, 126 MHz, 298 K)

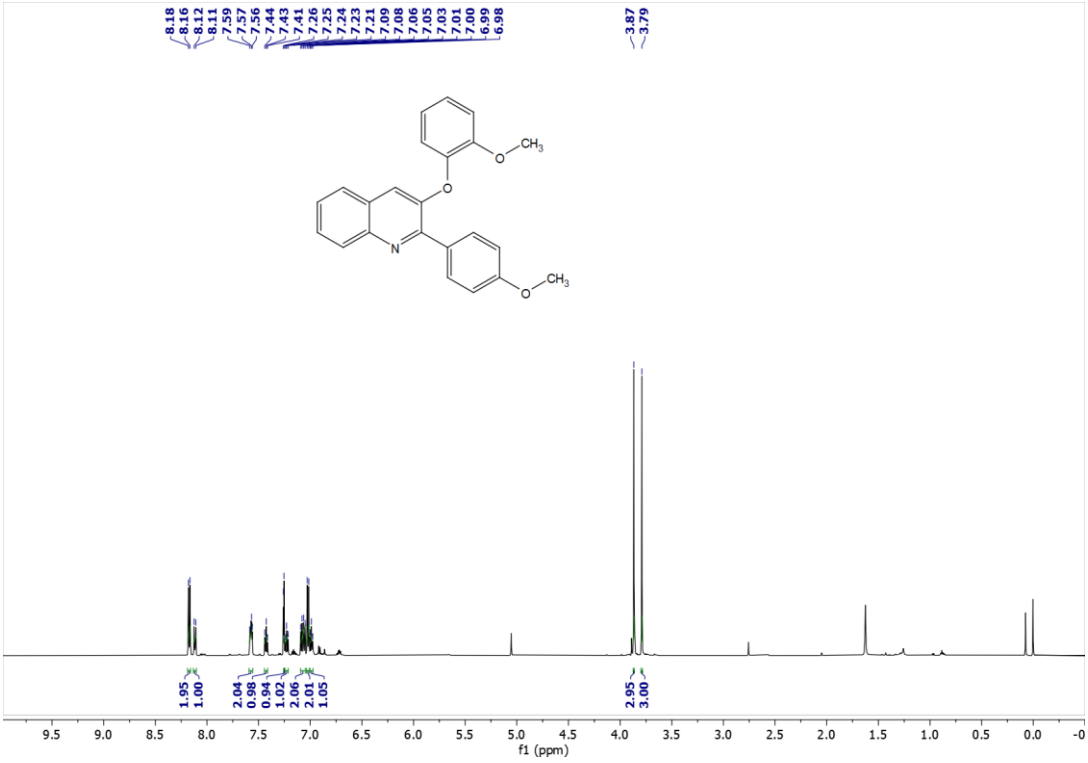


Figure S101: ^{1}H NMR Spectrum of **3ai** ($CDCl_3$, 600 MHz, 298 K)

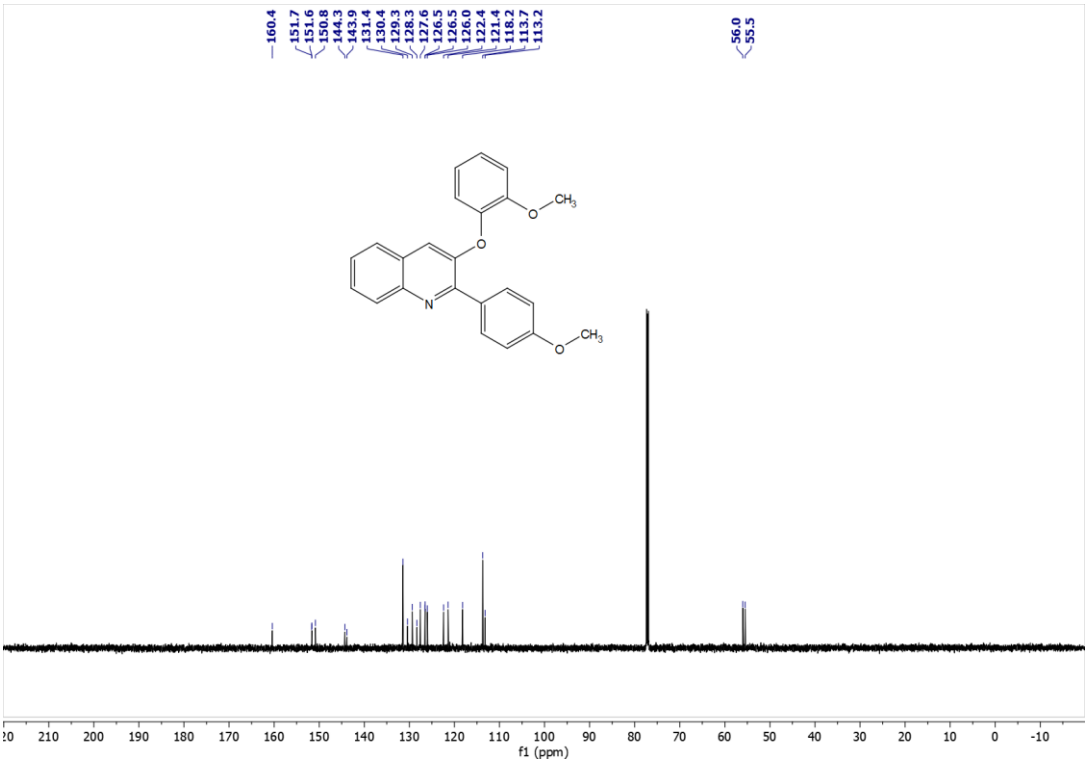


Figure S102: $^{13}C\{^{1}H\}$ NMR Spectrum of **3ai** ($CDCl_3$, 151 MHz, 298 K)

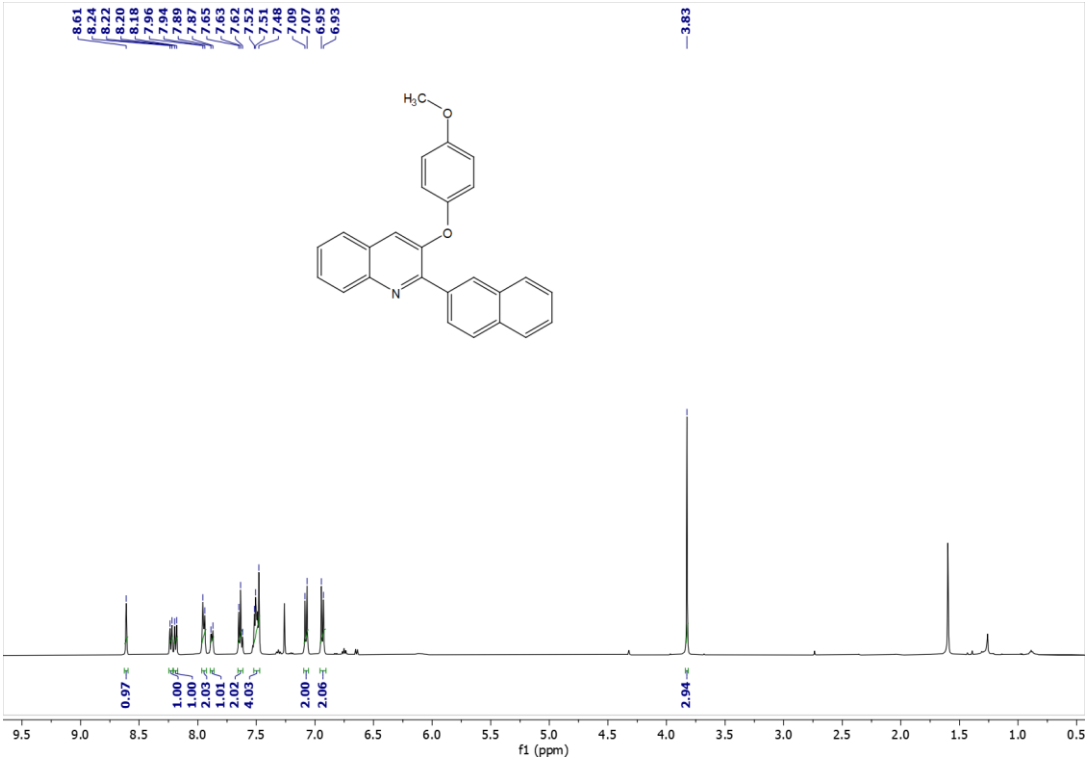


Figure S103: ^{1}H NMR Spectrum of **3aj** ($CDCl_3$, 500 MHz, 298 K)

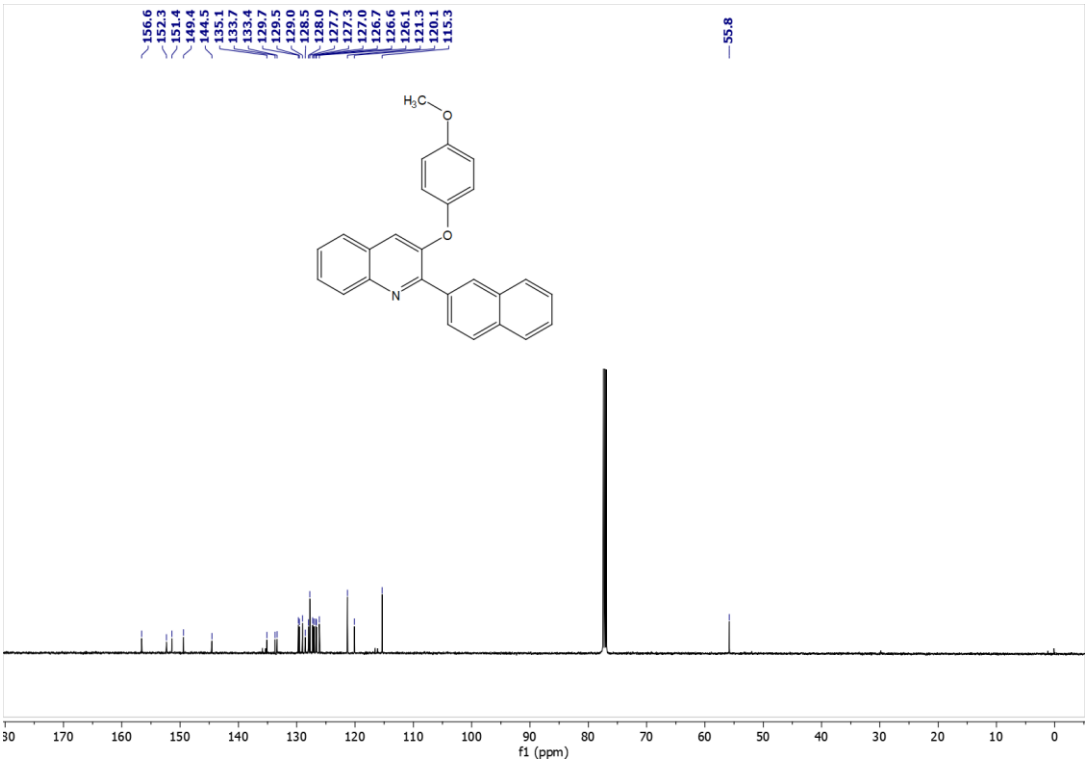


Figure S104: $^{13}C\{^{1}H\}$ NMR Spectrum of **3aj** ($CDCl_3$, 126 MHz, 298 K)

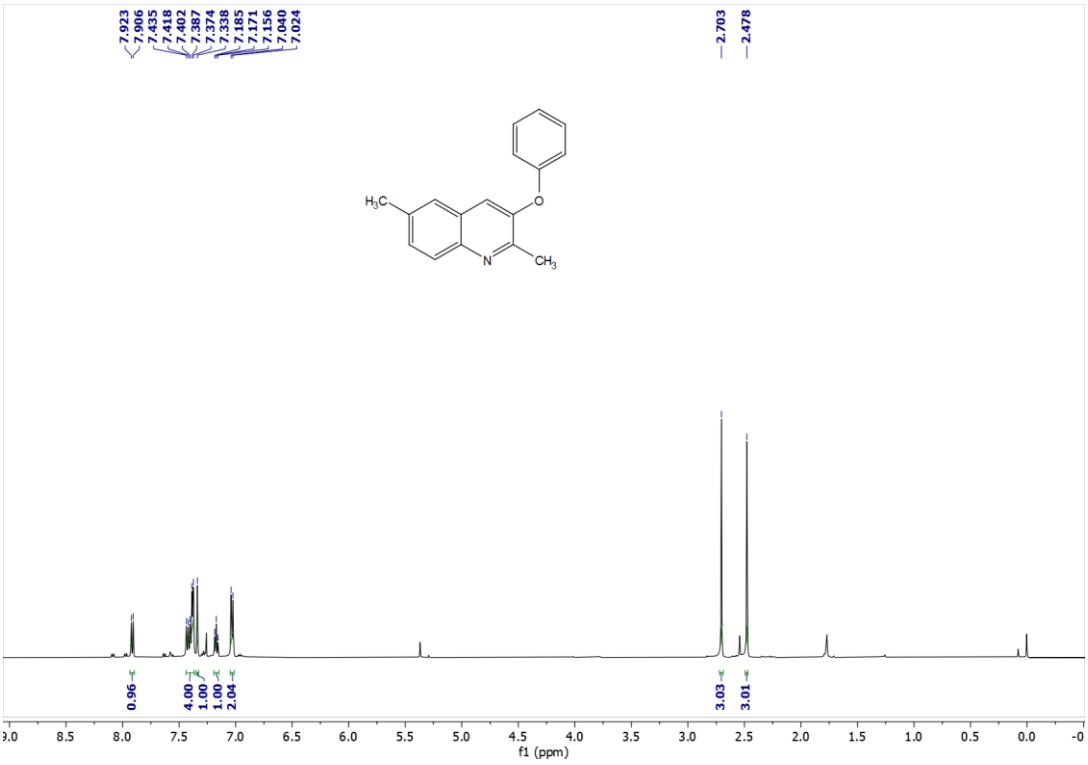


Figure S105: ^{1}H NMR Spectrum of **3ak** ($CDCl_3$, 500 MHz, 298 K)

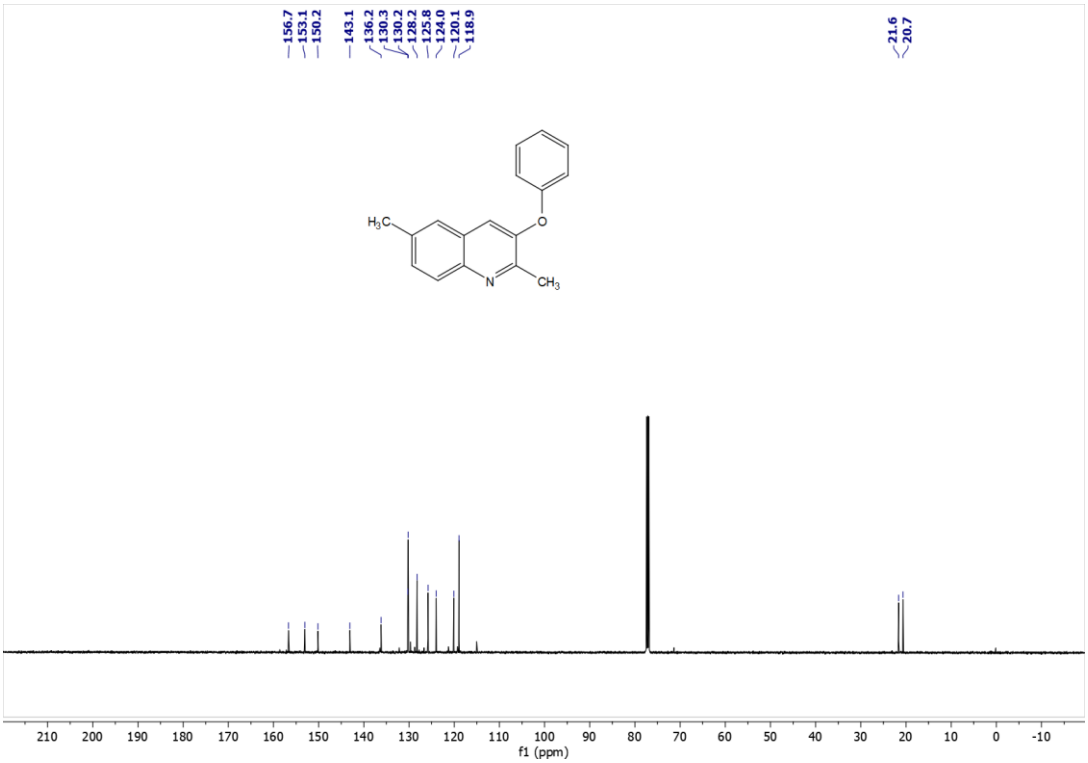


Figure S106: $^{13}C\{^{1}H\}$ NMR Spectrum of **3aI** ($CDCl_3$, 126 MHz, 298 K)

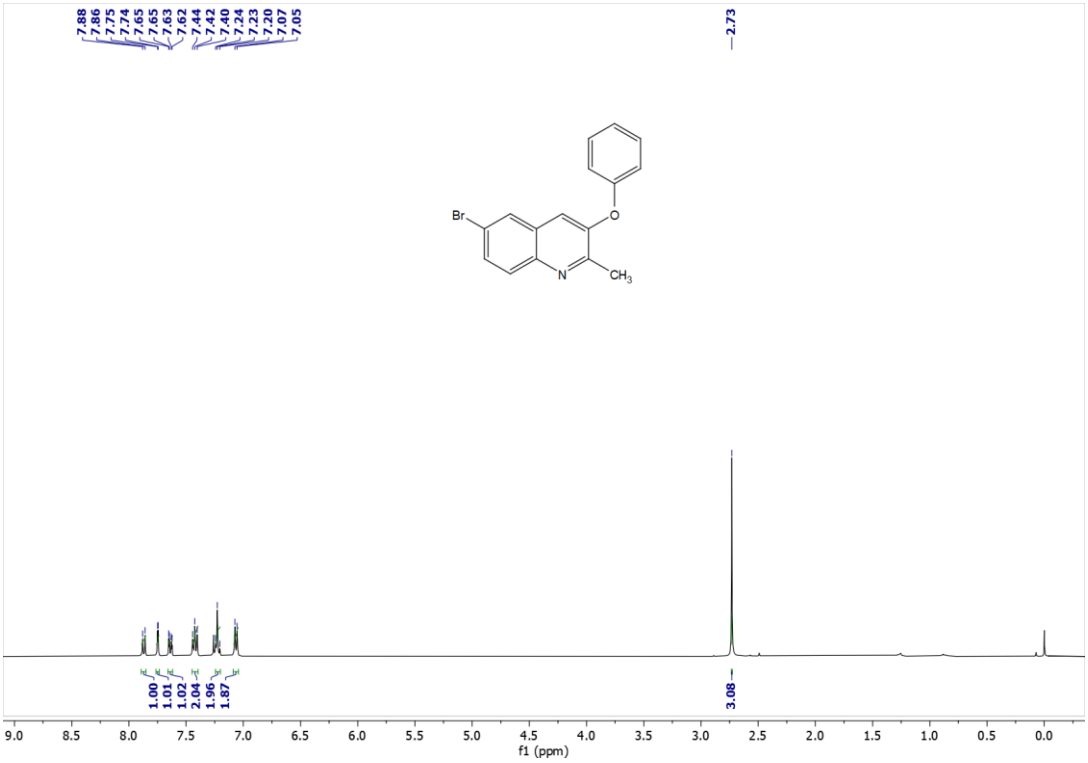


Figure S107: ^{1}H NMR Spectrum of **3aI** ($CDCl_3$, 400 MHz, 298 K)

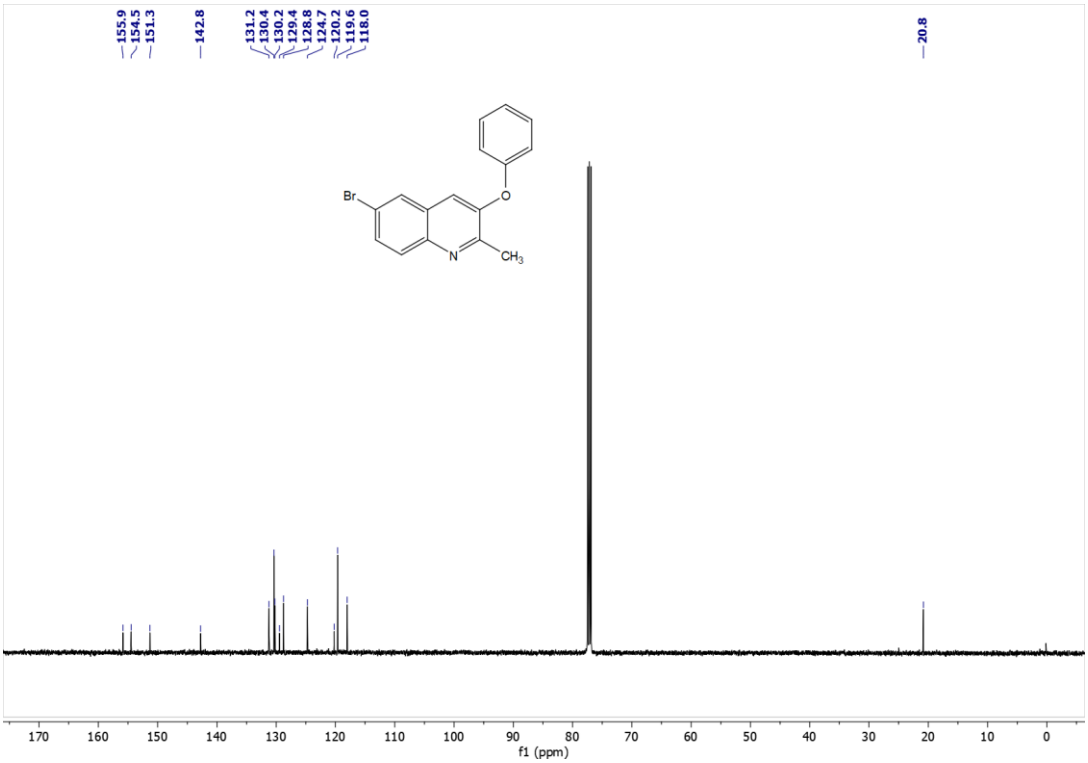


Figure S108: $^{13}C\{^{1}H\}$ NMR Spectrum of **3ak** ($CDCl_3$, 126 MHz, 298 K)

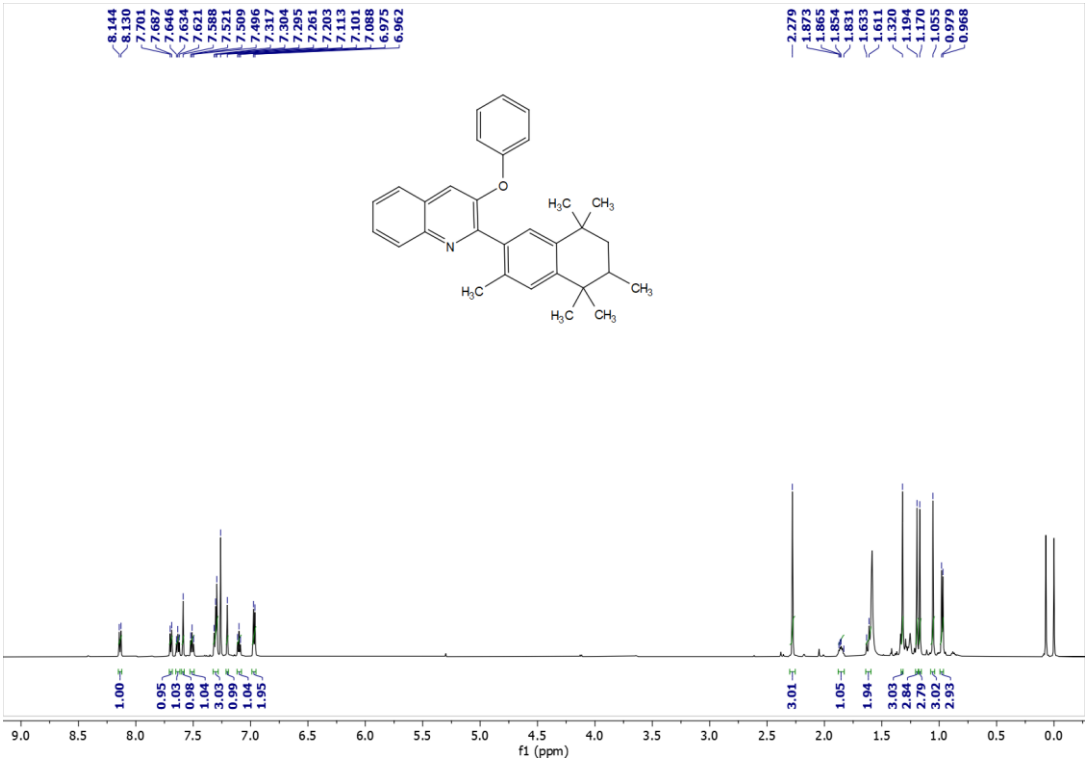


Figure S109: ^{1}H NMR Spectrum of **3am** ($CDCl_3$, 600 MHz, 298 K)

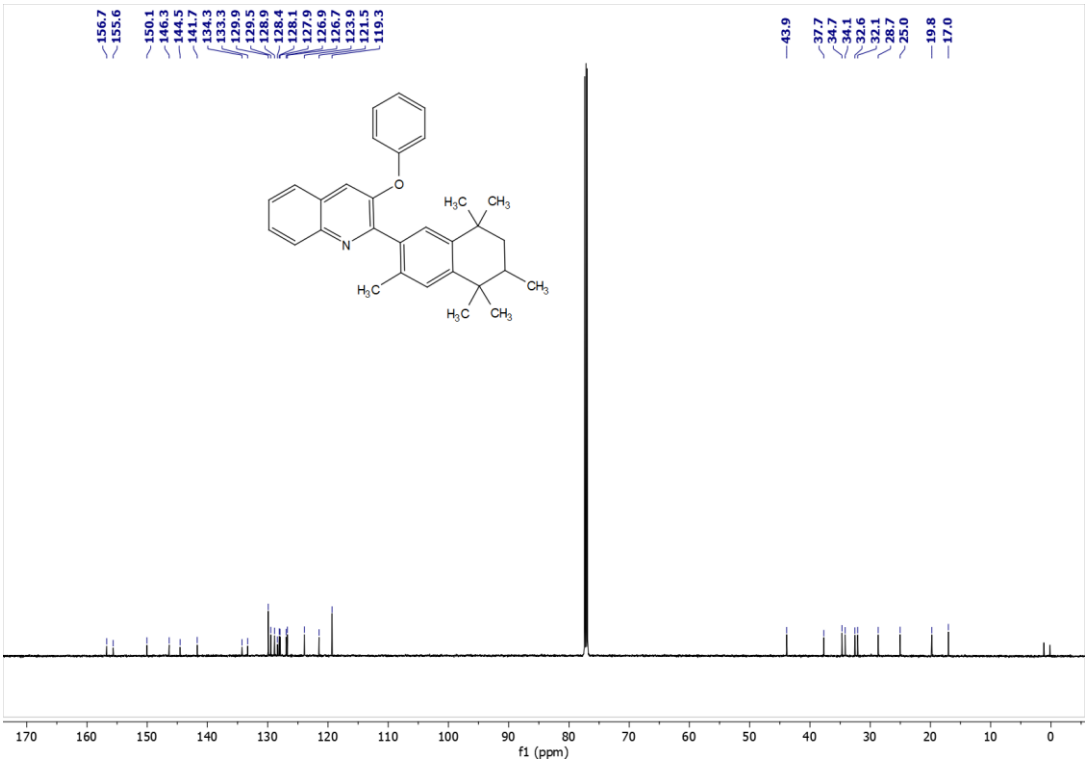


Figure S110: $^{13}C\{^{1}H\}$ NMR Spectrum of **3am** ($CDCl_3$, 151 MHz, 298 K)

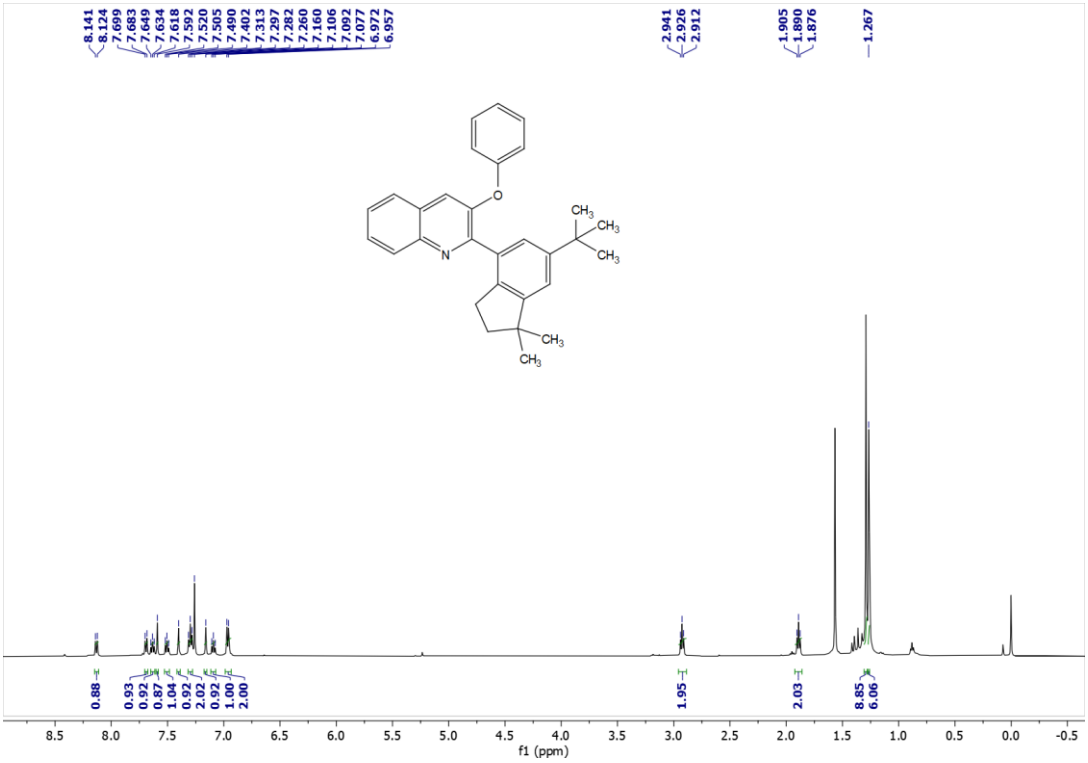


Figure S111: ^{1}H NMR Spectrum of **3am** ($CDCl_3$, 500 MHz, 298 K)

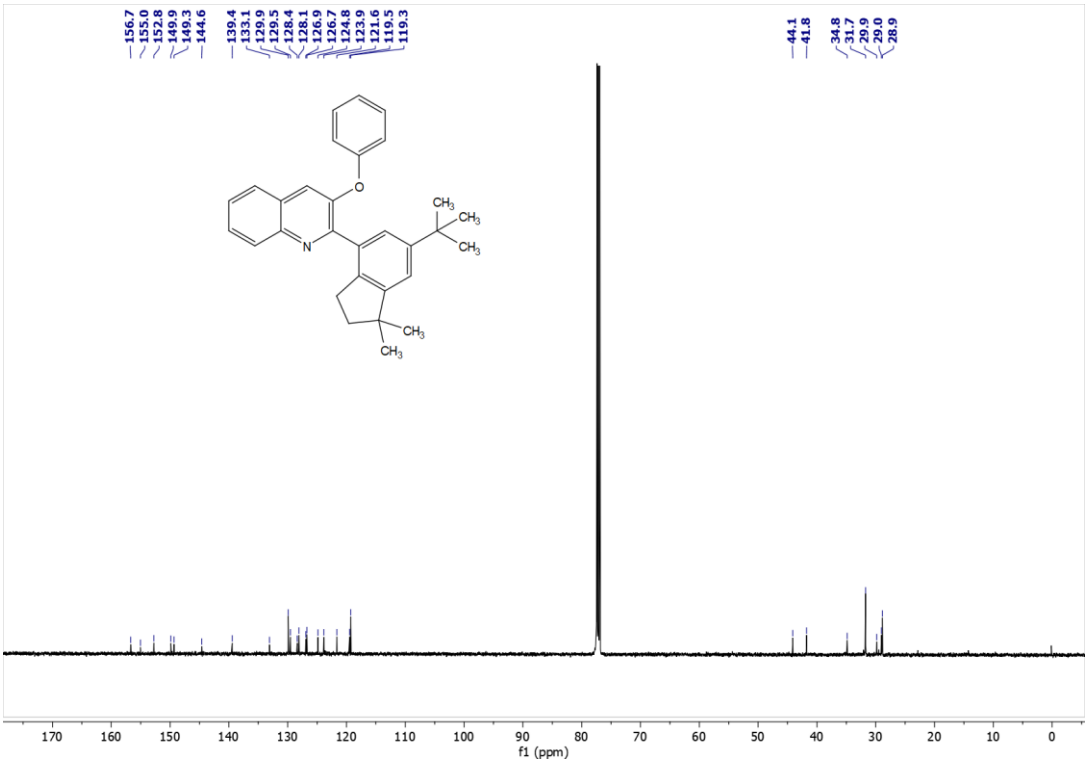


Figure S112: $^{13}C\{^{1}H\}$ NMR Spectrum of **3am** ($CDCl_3$, 126 MHz, 298 K)

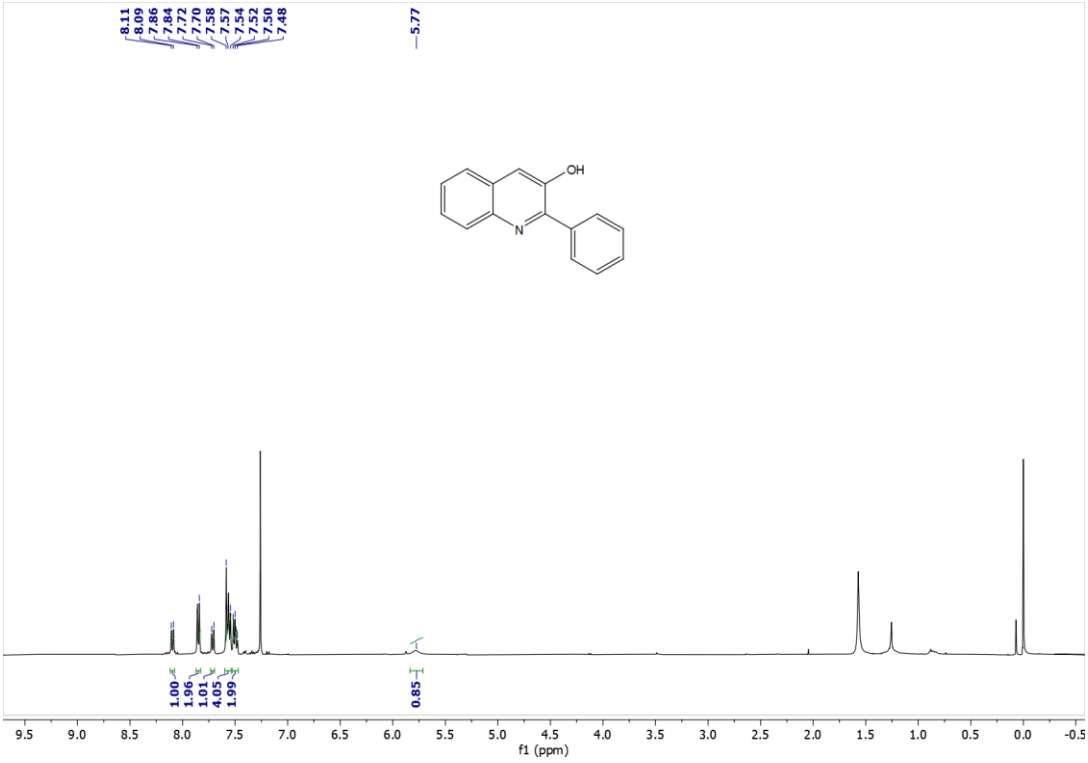


Figure S113: ^{1}H NMR Spectrum of **4a** ($CDCl_3$, 400 MHz, 298 K)

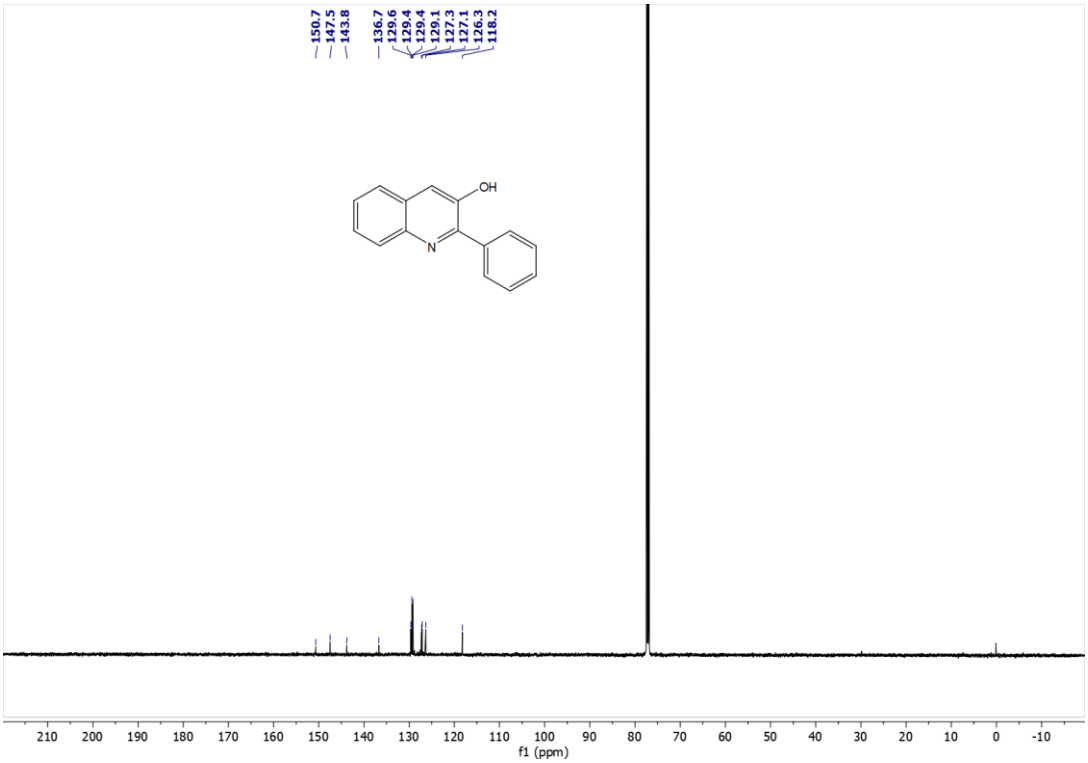


Figure S114: $^{13}C\{^{1}H\}$ NMR Spectrum of **4a** ($CDCl_3$, 126 MHz, 298 K)

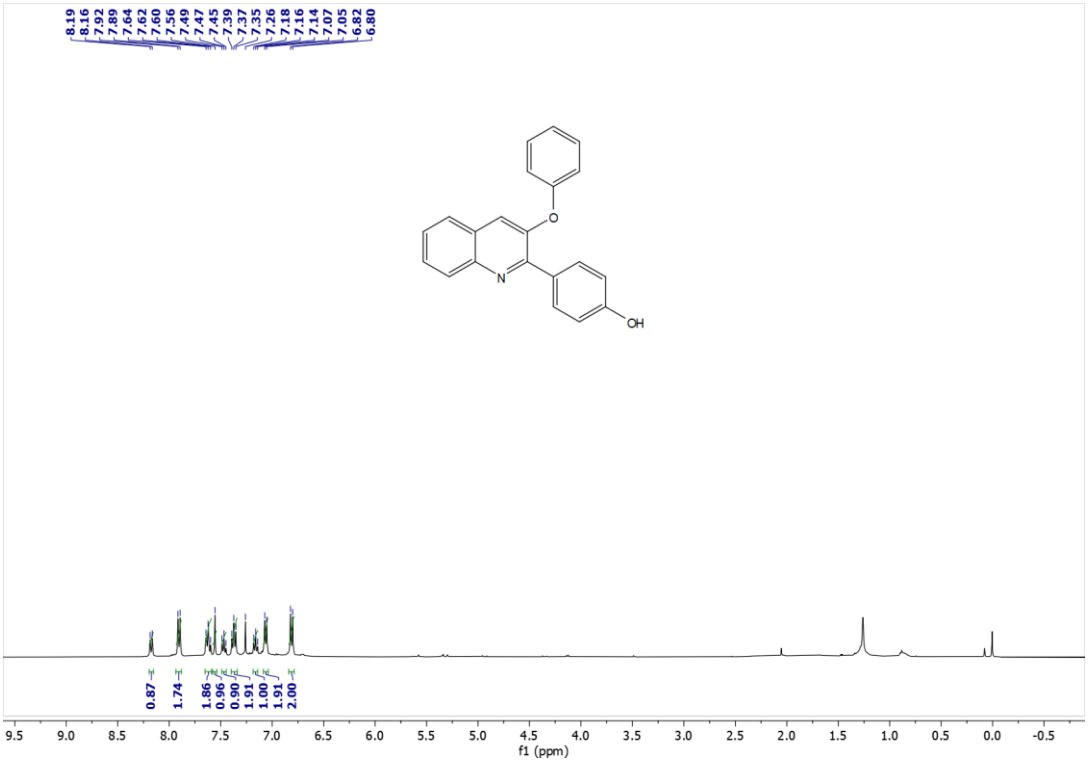


Figure S115: ^{1}H NMR Spectrum of **4b** ($CDCl_3$, 400 MHz, 298 K)

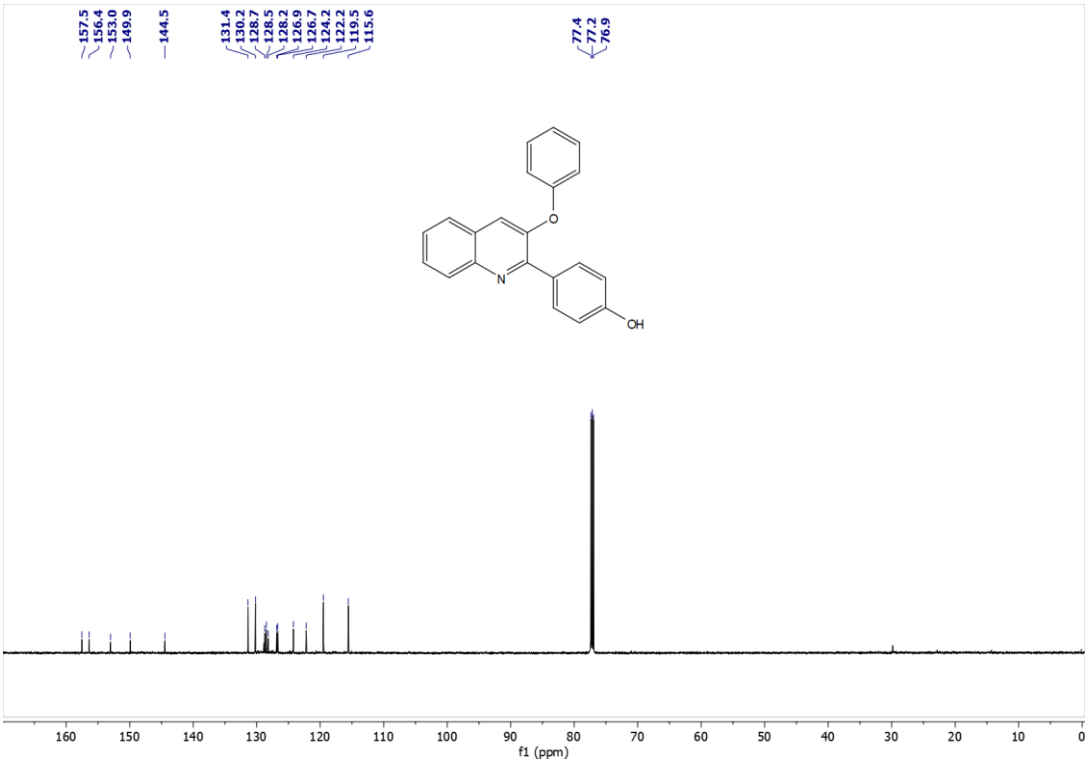


Figure S116: $^{13}C\{^{1}H\}$ NMR Spectrum of **4b** ($CDCl_3$, 151 MHz, 298 K)

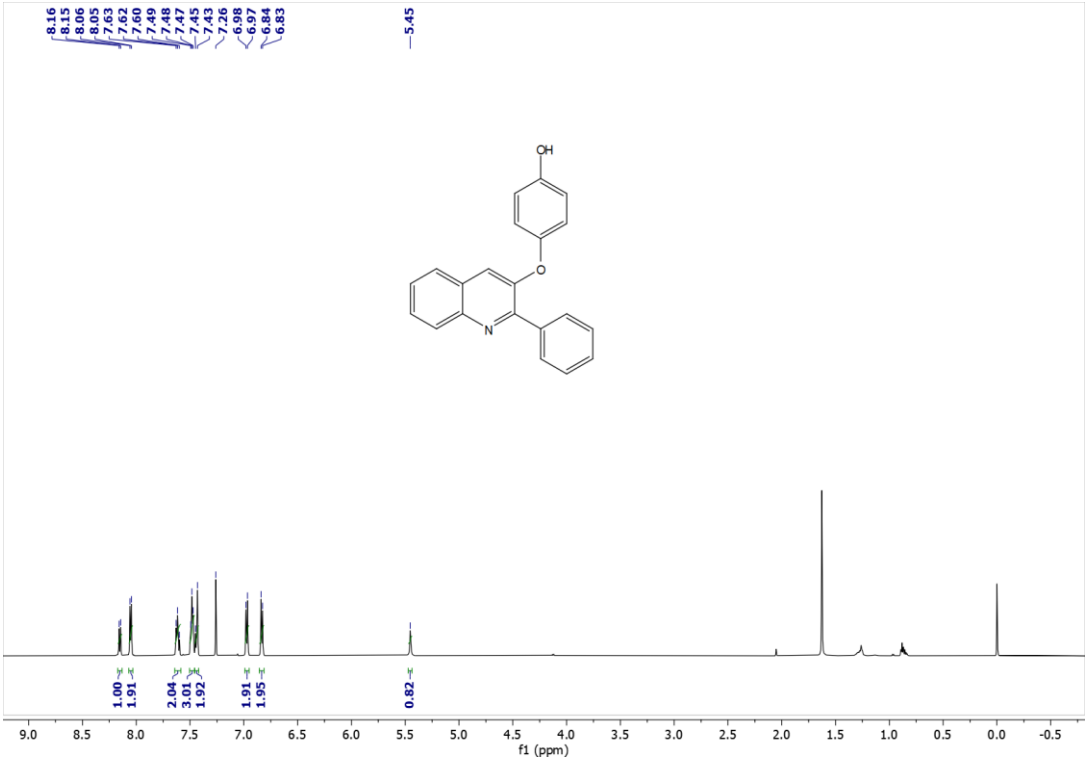


Figure S117: ^{1}H NMR Spectrum of **4c** ($CDCl_3$, 600 MHz, 298 K)

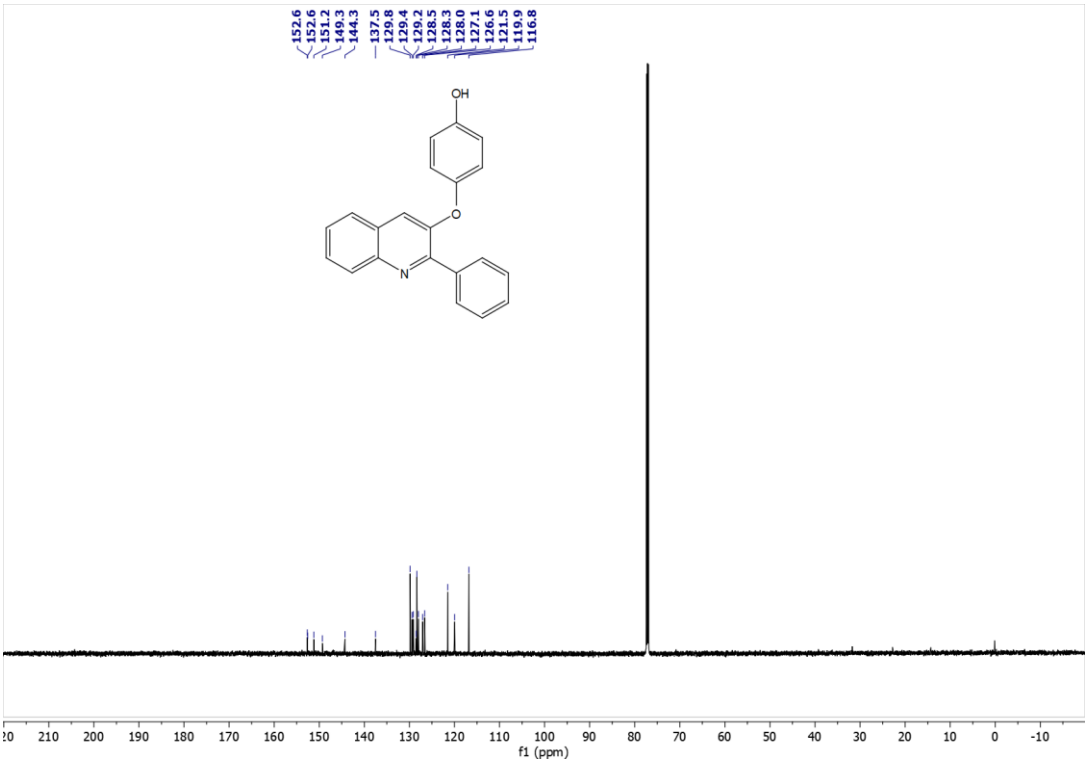


Figure S118: $^{13}C\{^{1}H\}$ NMR Spectrum of **4c** ($CDCl_3$, 151 MHz, 298 K)

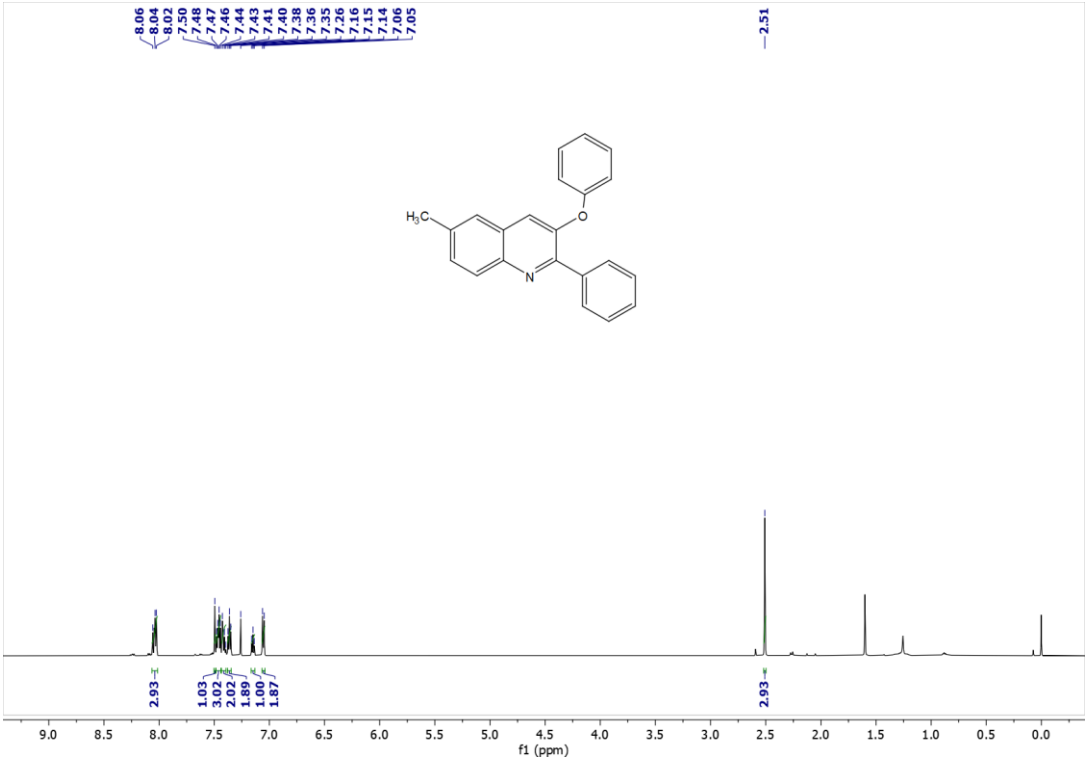


Figure S119: ^{1}H NMR Spectrum of **5a** ($CDCl_3$, 600 MHz, 298 K)

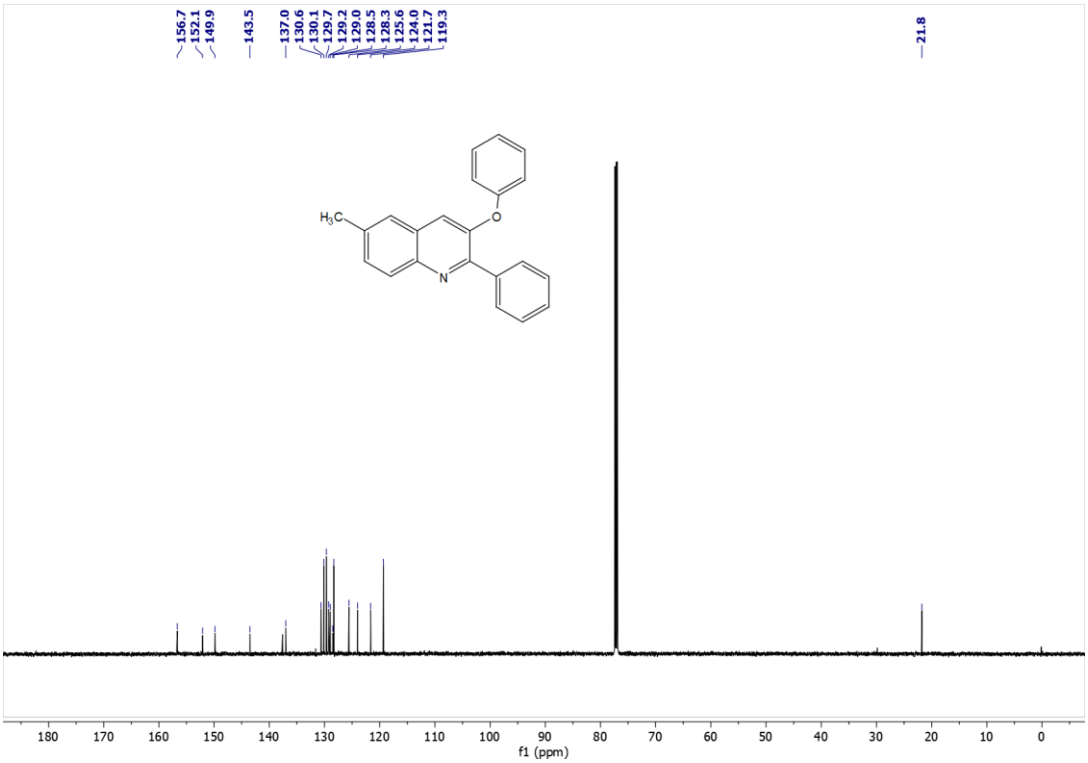


Figure S120: $^{13}C\{^{1}H\}$ NMR Spectrum of **5a** ($CDCl_3$, 151 MHz, 298 K)

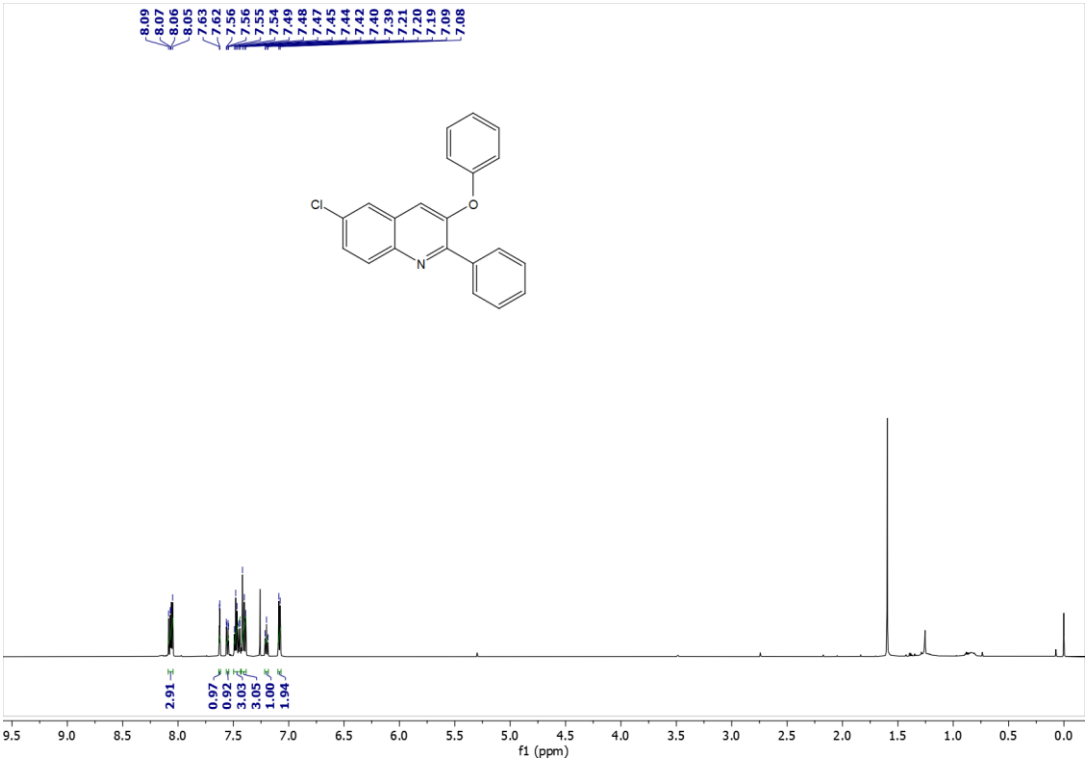


Figure S121: ^{1}H NMR Spectrum of **5b** ($CDCl_3$, 600 MHz, 298 K)

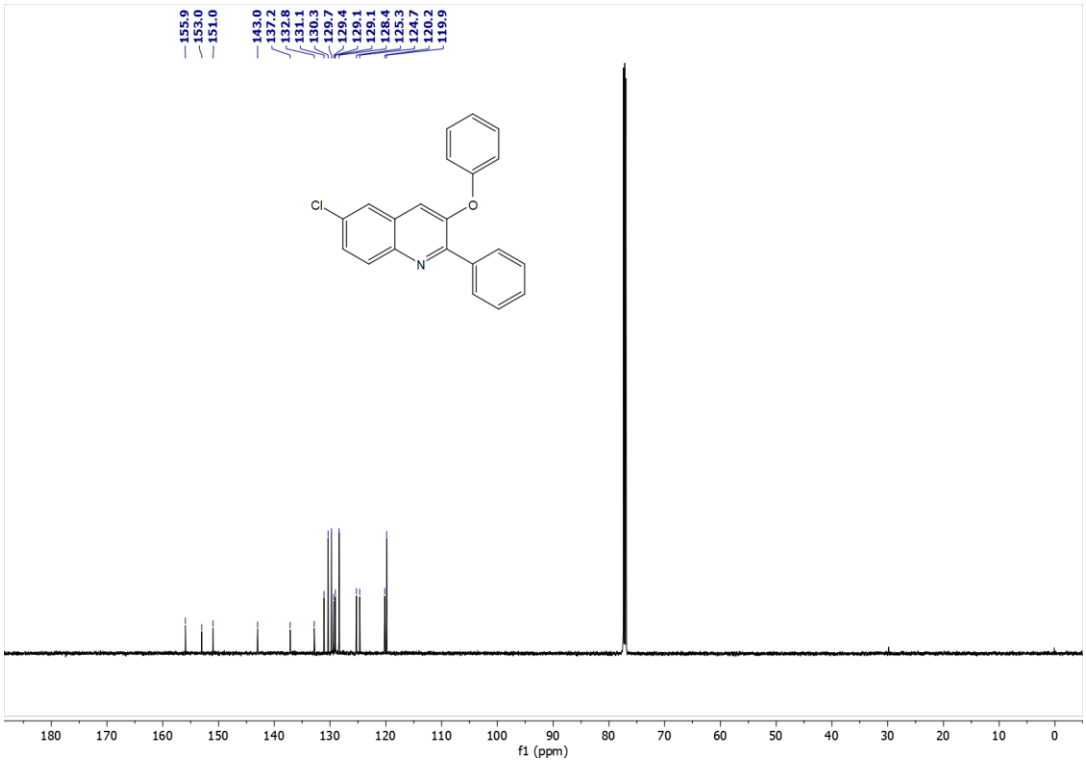


Figure S122: $^{13}C\{^{1}H\}$ NMR Spectrum of **5b** ($CDCl_3$, 151 MHz, 298 K)

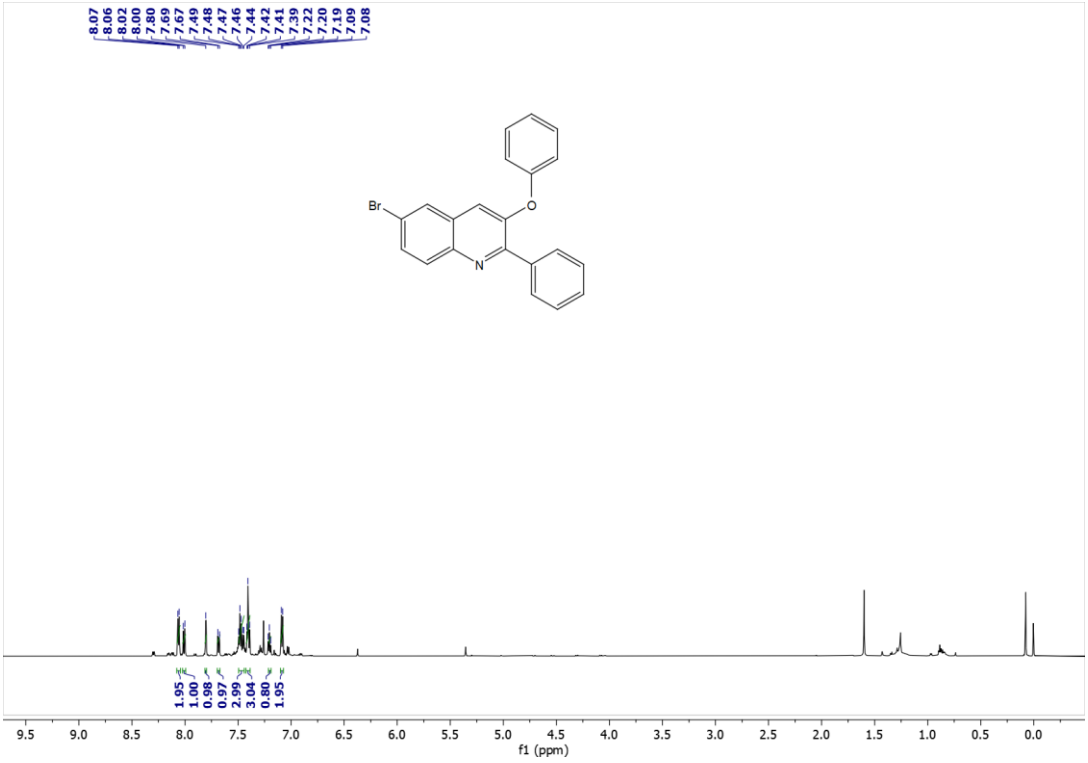


Figure S123: ^{1}H NMR Spectrum of **5c** ($CDCl_3$, 600 MHz, 298 K)

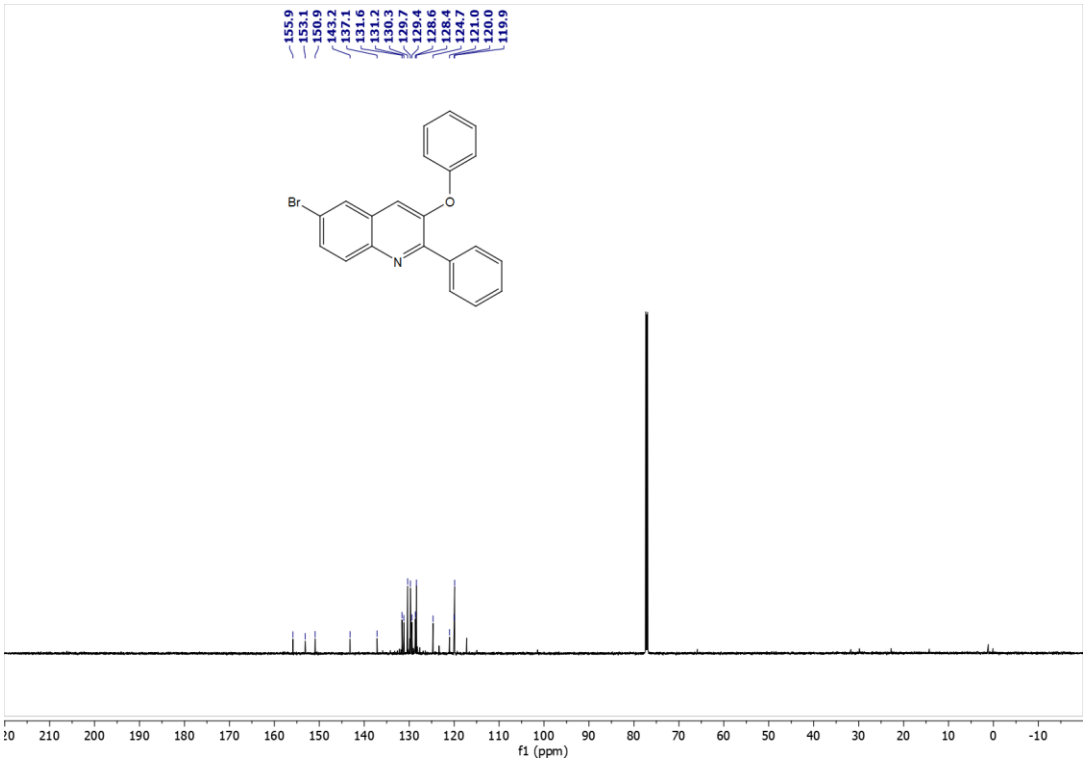


Figure S124: $^{13}C\{^{1}H\}$ NMR Spectrum of **5c** ($CDCl_3$, 151 MHz, 298 K)

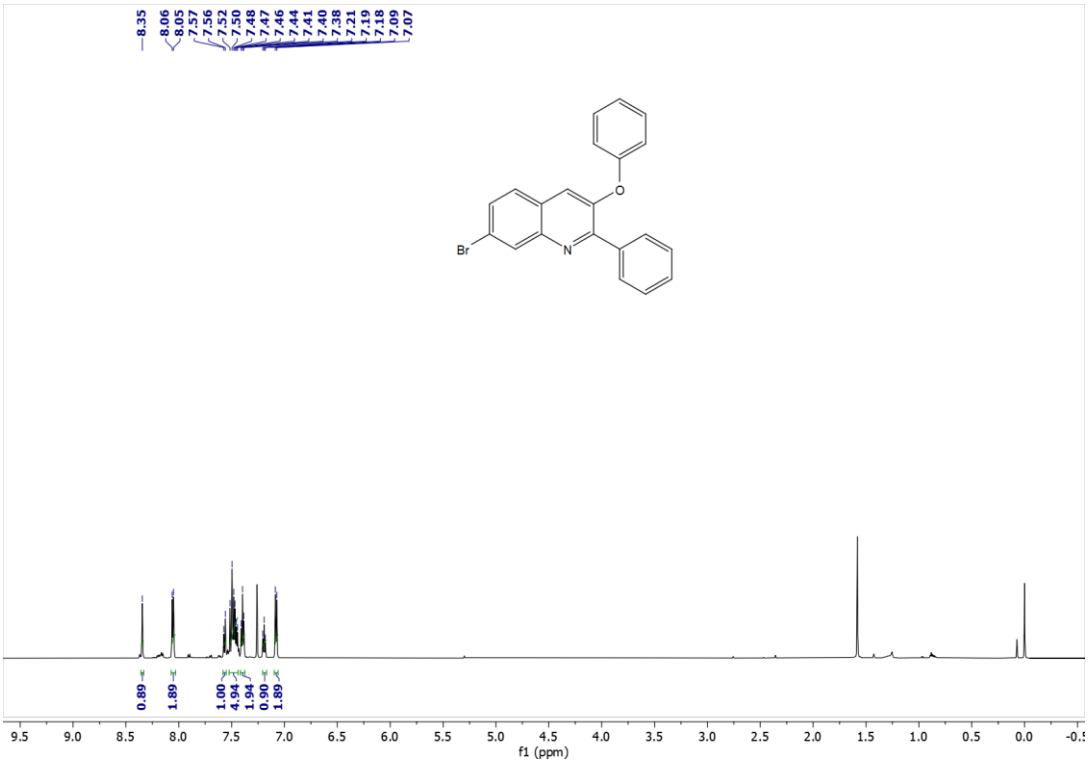


Figure S125: ^{1}H NMR Spectrum of **5d** ($CDCl_3$, 600 MHz, 298 K)

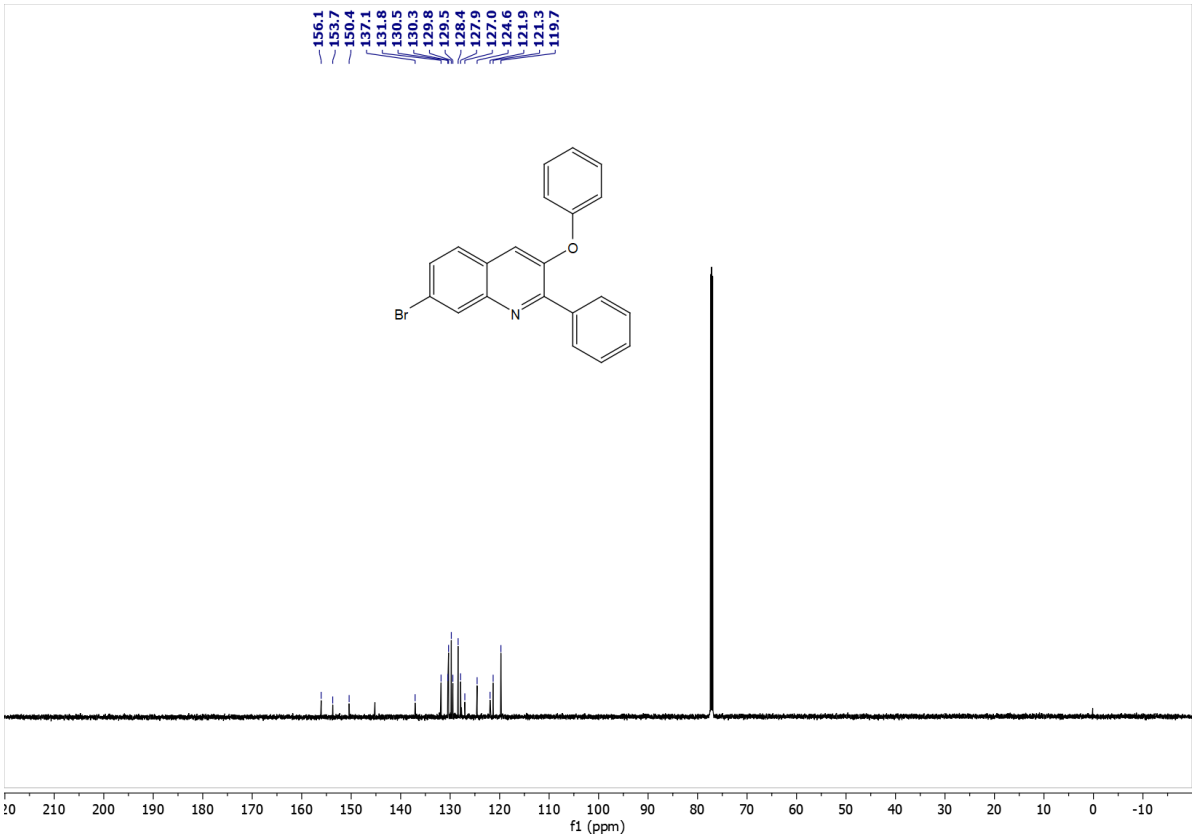


Figure S126: $^{13}C\{^{1}H\}$ NMR Spectrum of **5d** ($CDCl_3$, 151 MHz, 298 K)

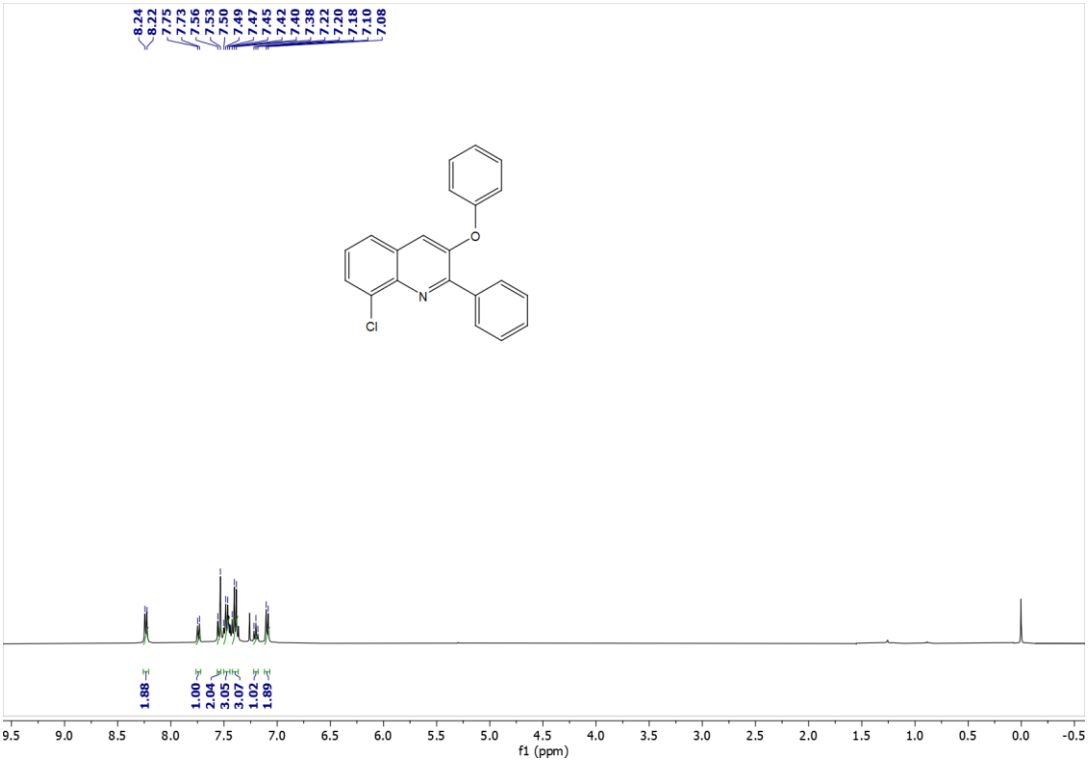


Figure S127: ^{1}H NMR Spectrum of **5e** ($CDCl_3$, 400 MHz, 298 K)

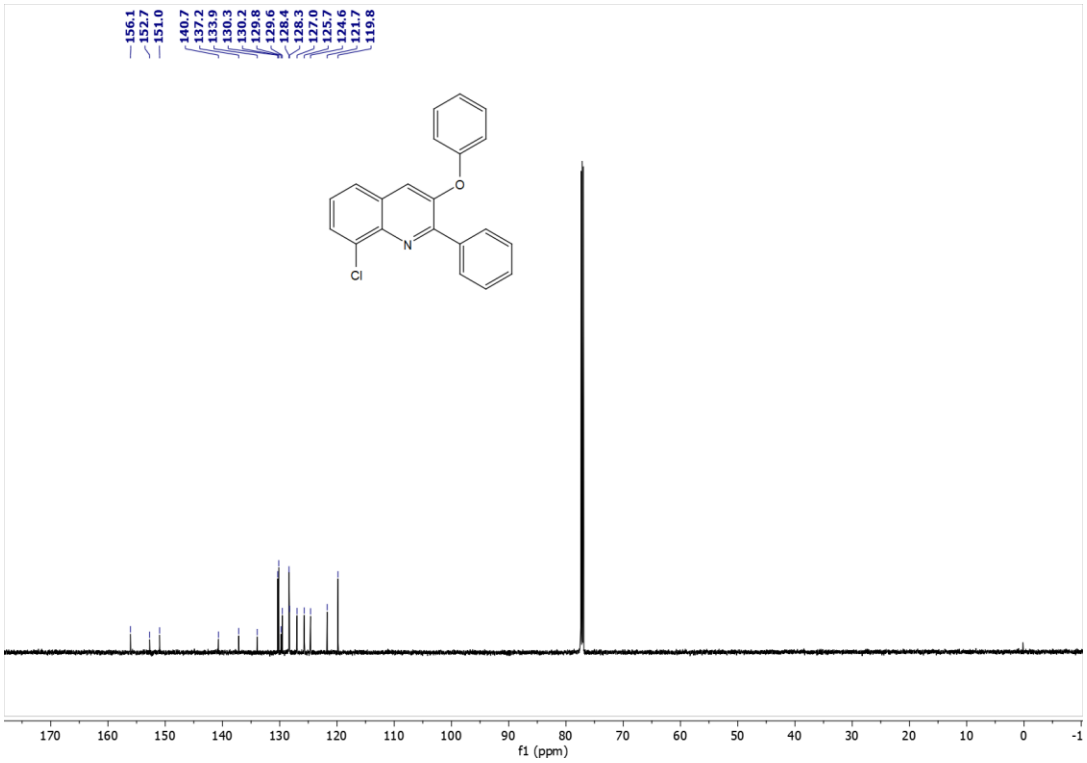


Figure S128: $^{13}C\{^{1}H\}$ NMR Spectrum of **5e** ($CDCl_3$, 151 MHz, 298 K)

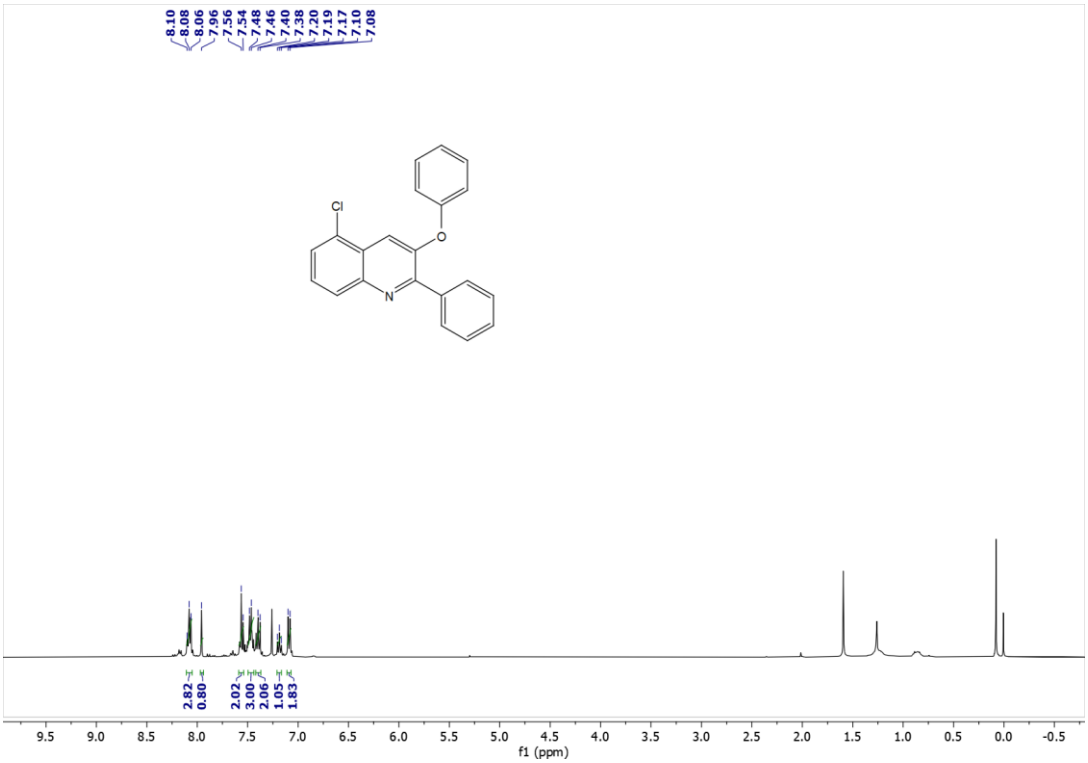


Figure S129: ^{1}H NMR Spectrum of **5f** ($CDCl_3$, 400 MHz, 298 K)

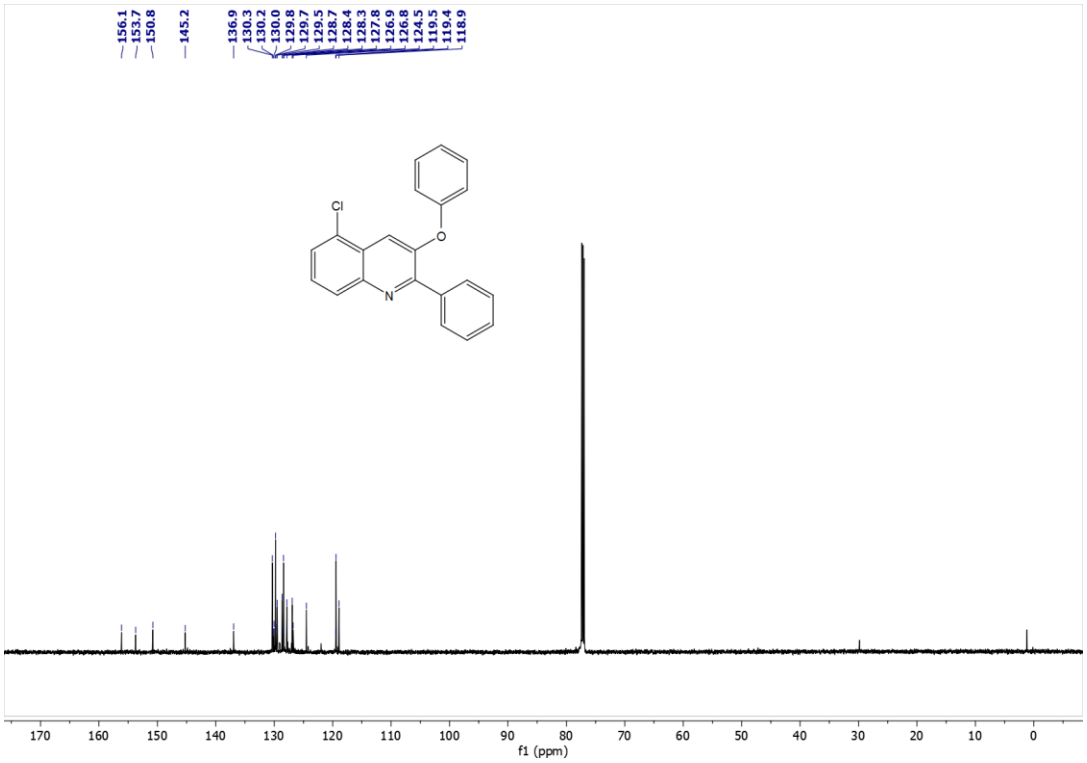


Figure S130: $^{13}C\{^{1}H\}$ NMR Spectrum of **5f** ($CDCl_3$, 151 MHz, 298 K)

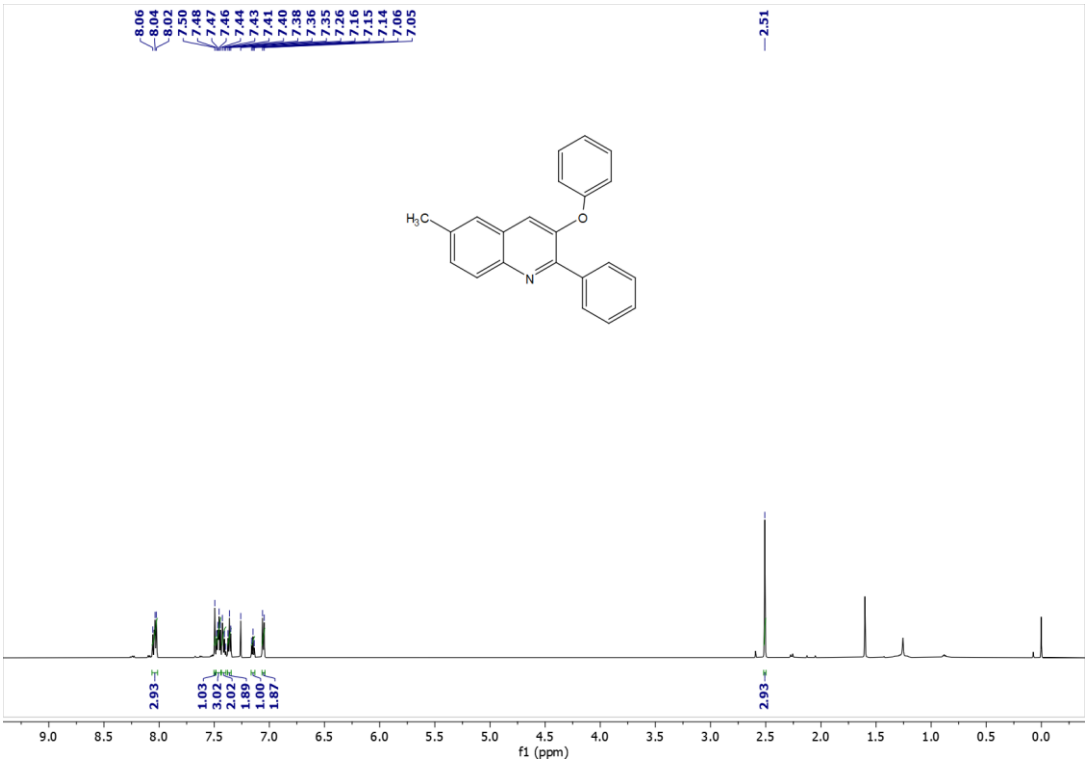


Figure S131: ^{1}H NMR Spectrum of **5g** ($CDCl_3$, 400 MHz, 298 K)

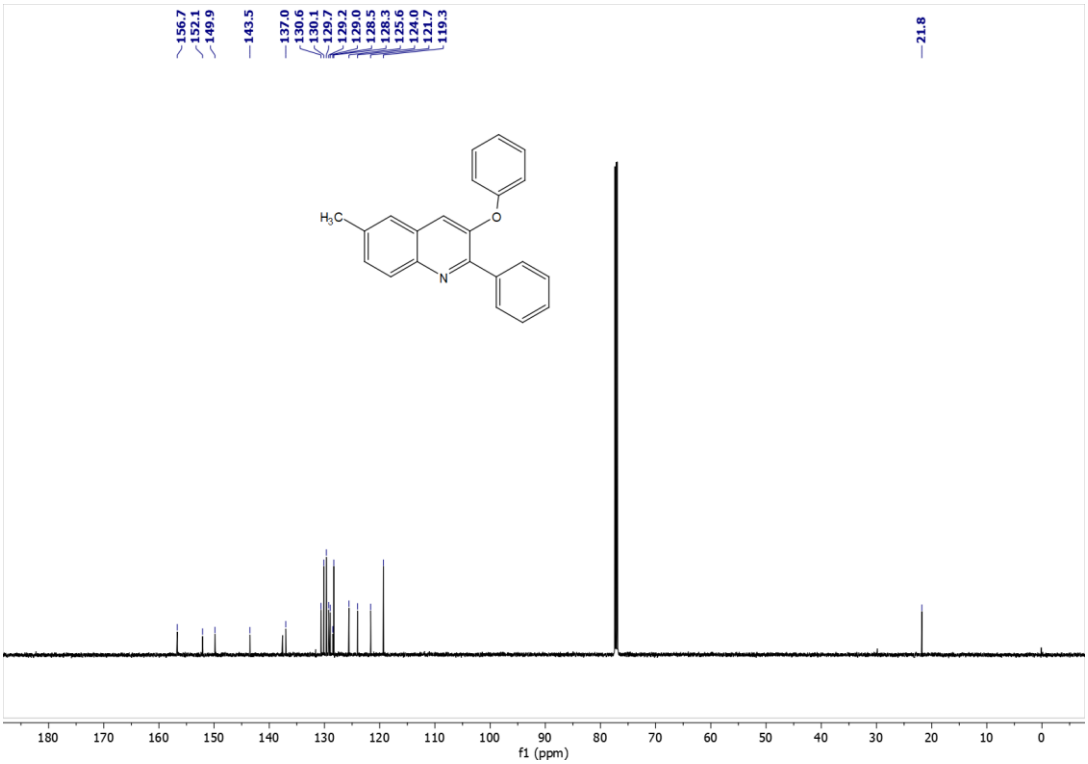


Figure S132: $^{13}C\{^{1}H\}$ NMR Spectrum of **5g** ($CDCl_3$, 151 MHz, 298 K)

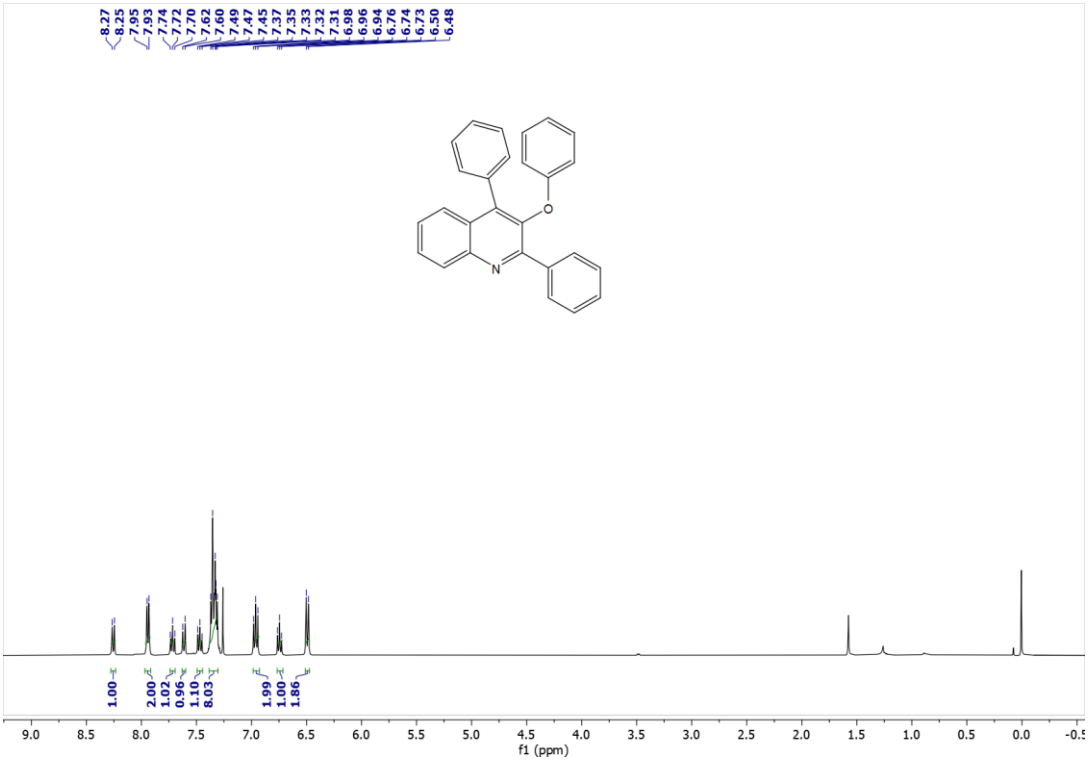


Figure S133: ^{1}H NMR Spectrum of **5h** ($CDCl_3$, 400 MHz, 298 K)

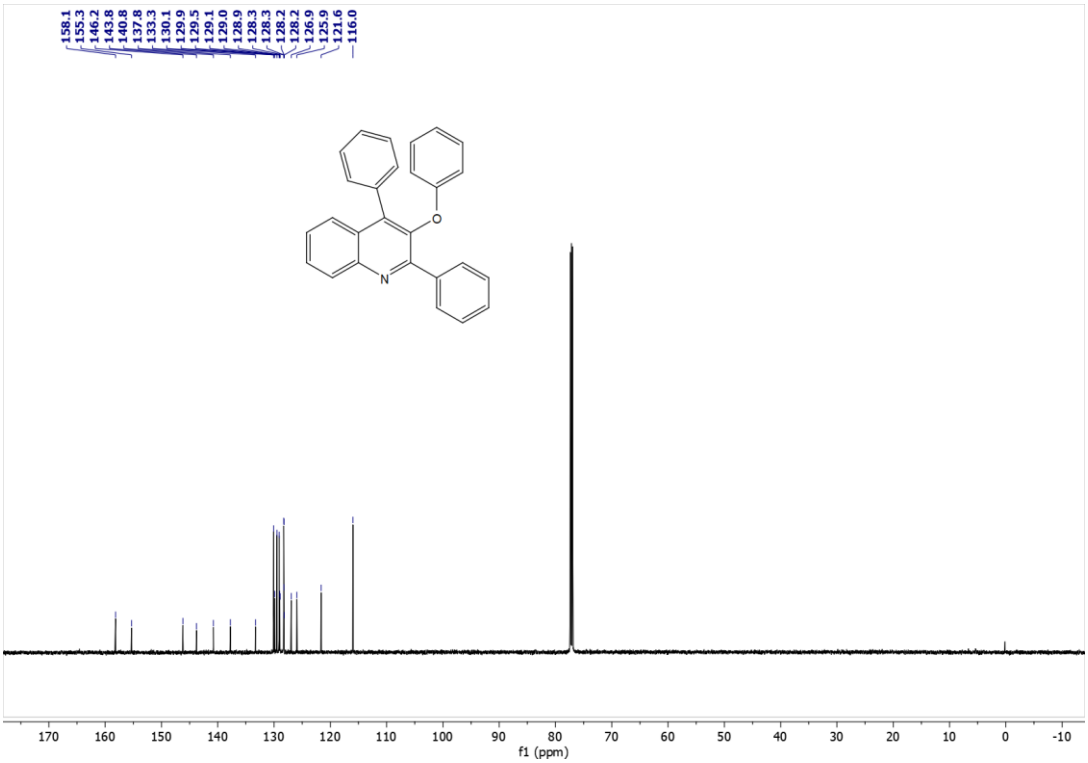


Figure S134: $^{13}C\{^{1}H\}$ NMR Spectrum of **5h** ($CDCl_3$, 151 MHz, 298 K)

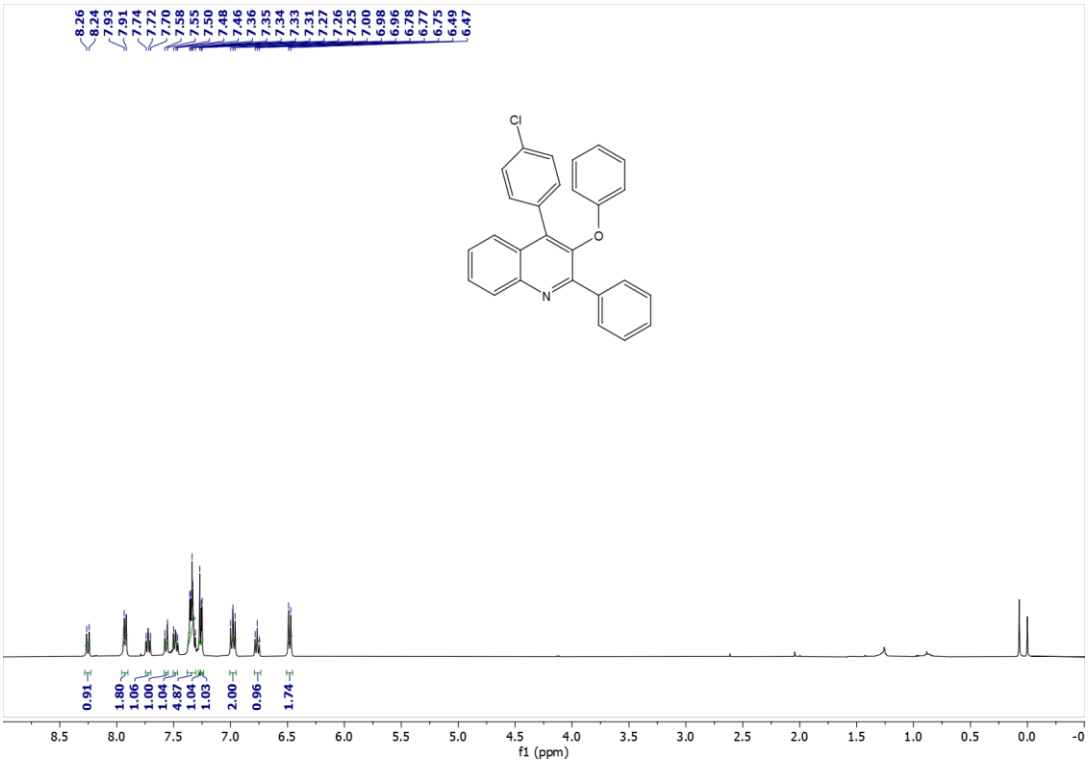


Figure S135: ^{1}H NMR Spectrum of **5h** ($CDCl_3$, 400 MHz, 298 K)

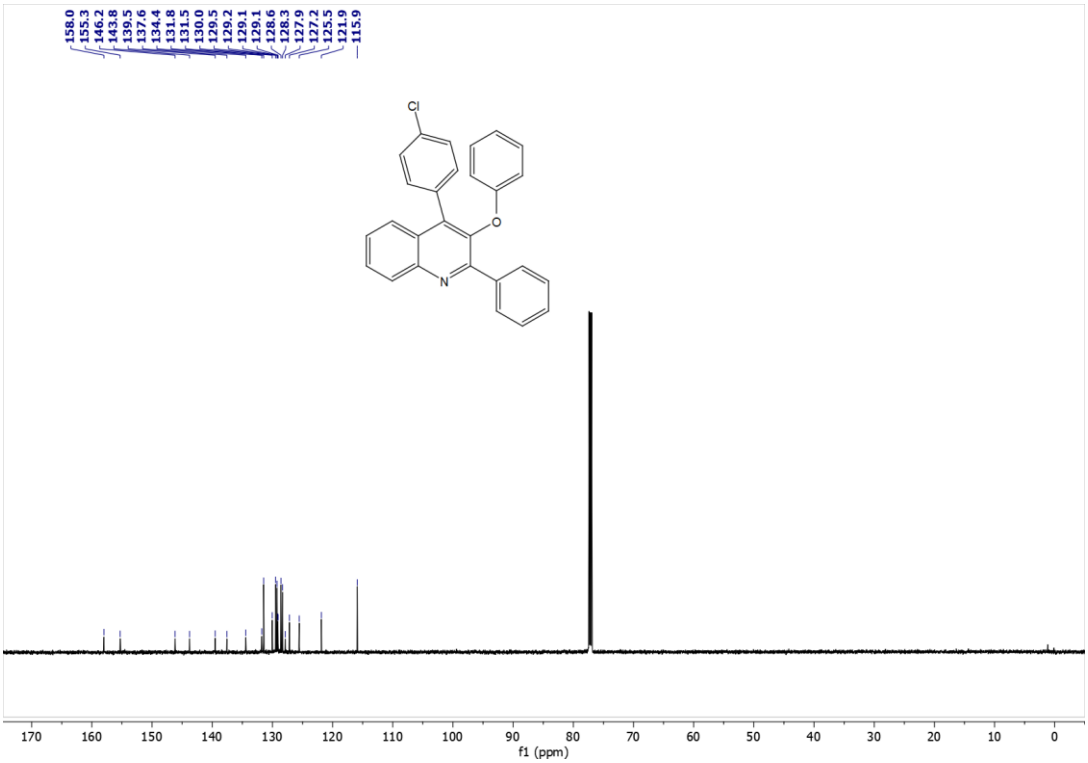


Figure S136: $^{13}C\{^{1}H\}$ NMR Spectrum of **5i** ($CDCl_3$, 151 MHz, 298 K)

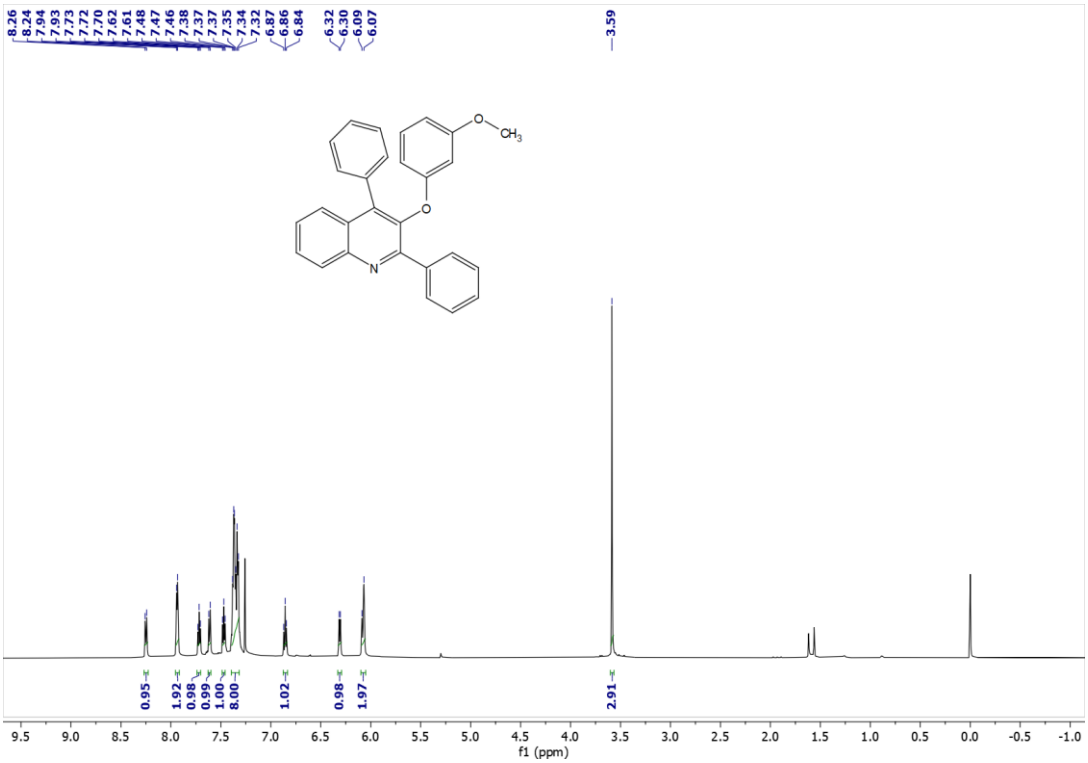


Figure S137: ^{1}H NMR Spectrum of **5j** ($CDCl_3$, 600 MHz, 298 K)

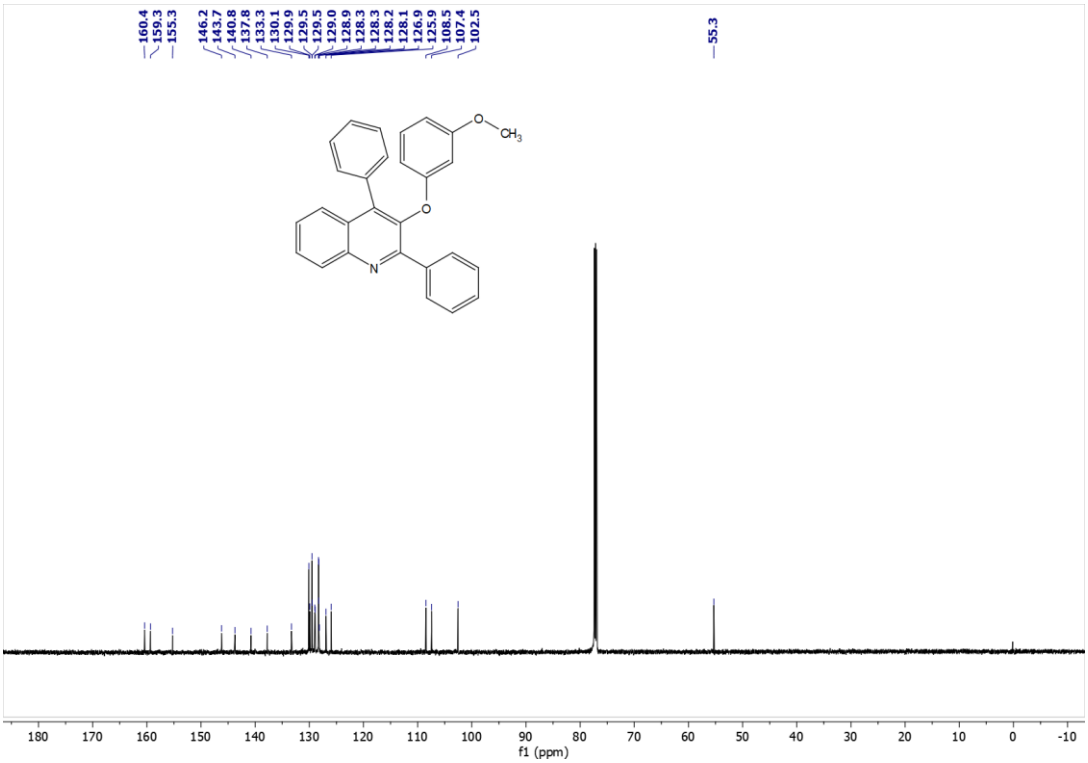


Figure S138: $^{13}C\{^{1}H\}$ NMR Spectrum of **5j** ($CDCl_3$, 151 MHz, 298 K)

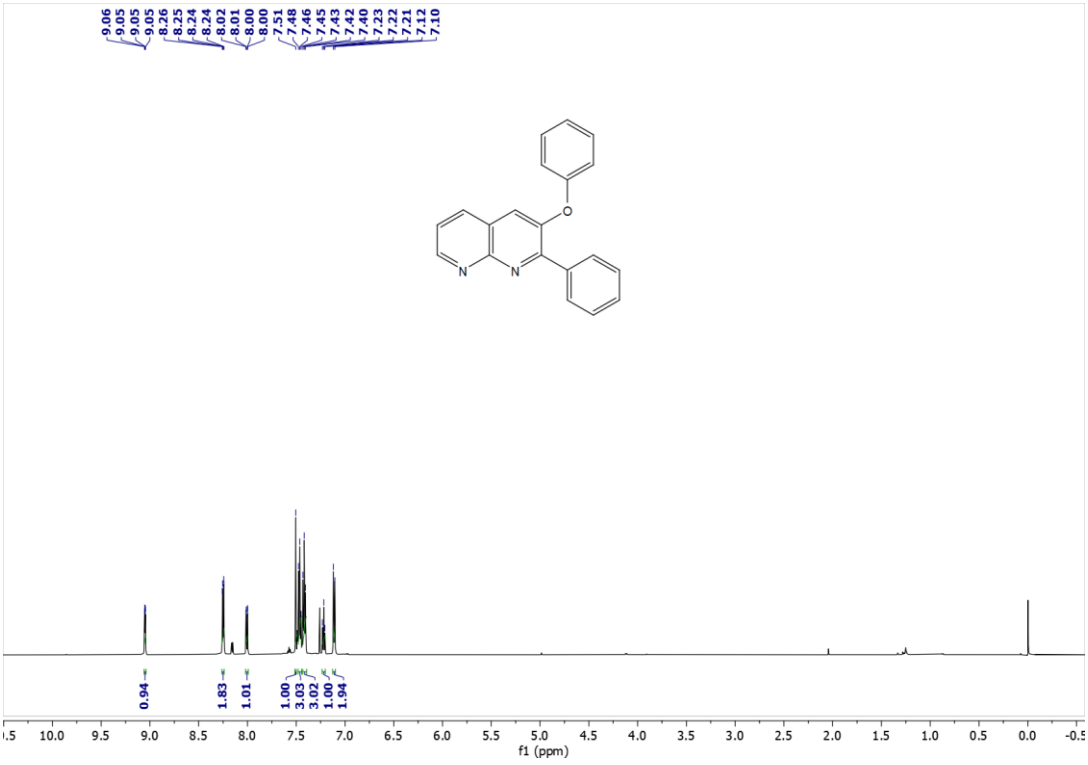


Figure S139: ^{1}H NMR Spectrum of **5k** ($CDCl_3$, 600 MHz, 298 K)

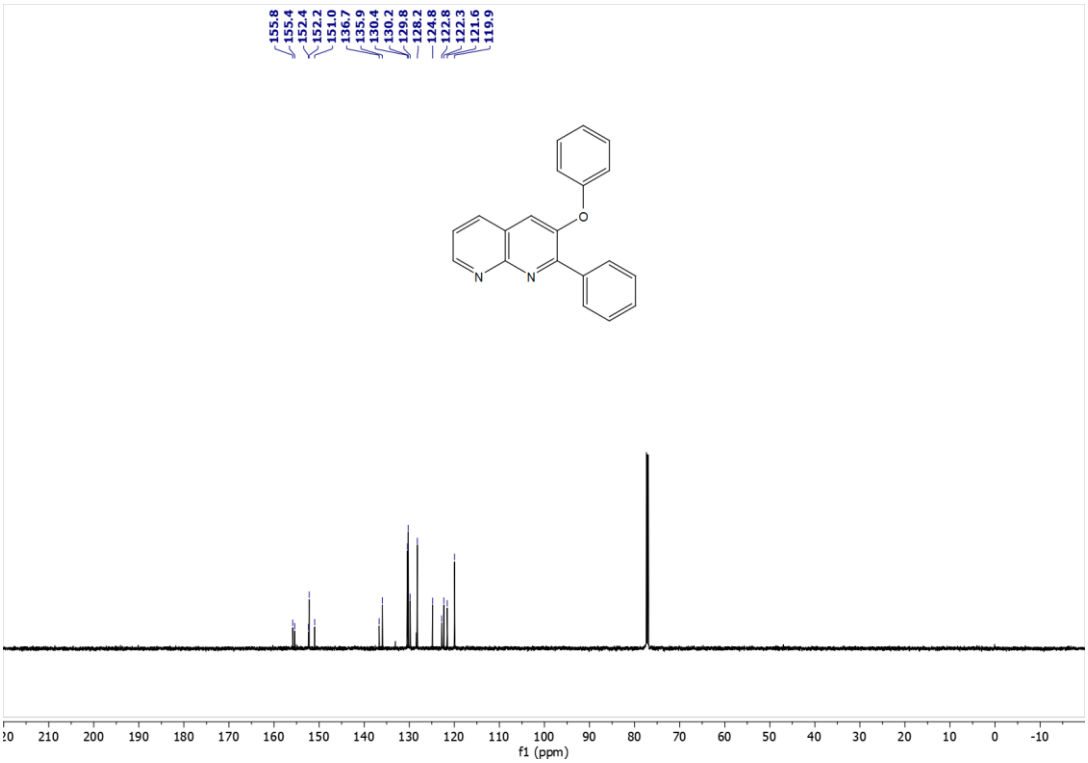


Figure S140: $^{13}C\{^{1}H\}$ NMR Spectrum of **5k** ($CDCl_3$, 151 MHz, 298 K)

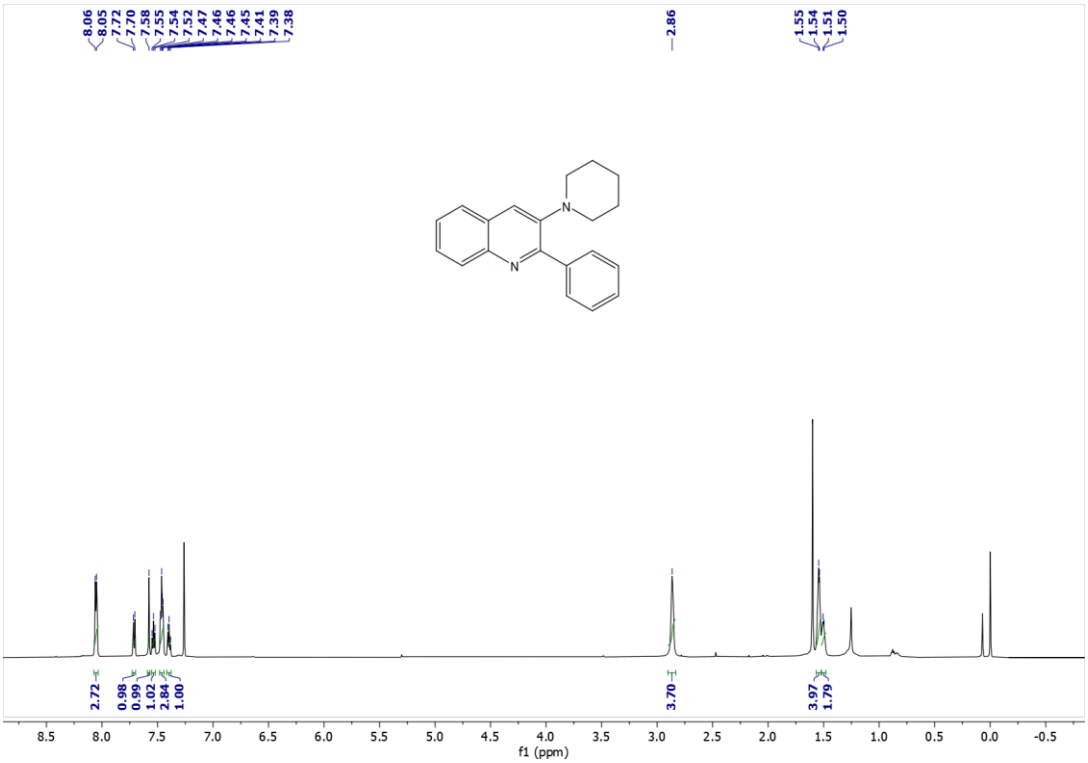


Figure S141: ^{1}H NMR Spectrum of **7a** ($CDCl_3$, 600 MHz, 298 K)

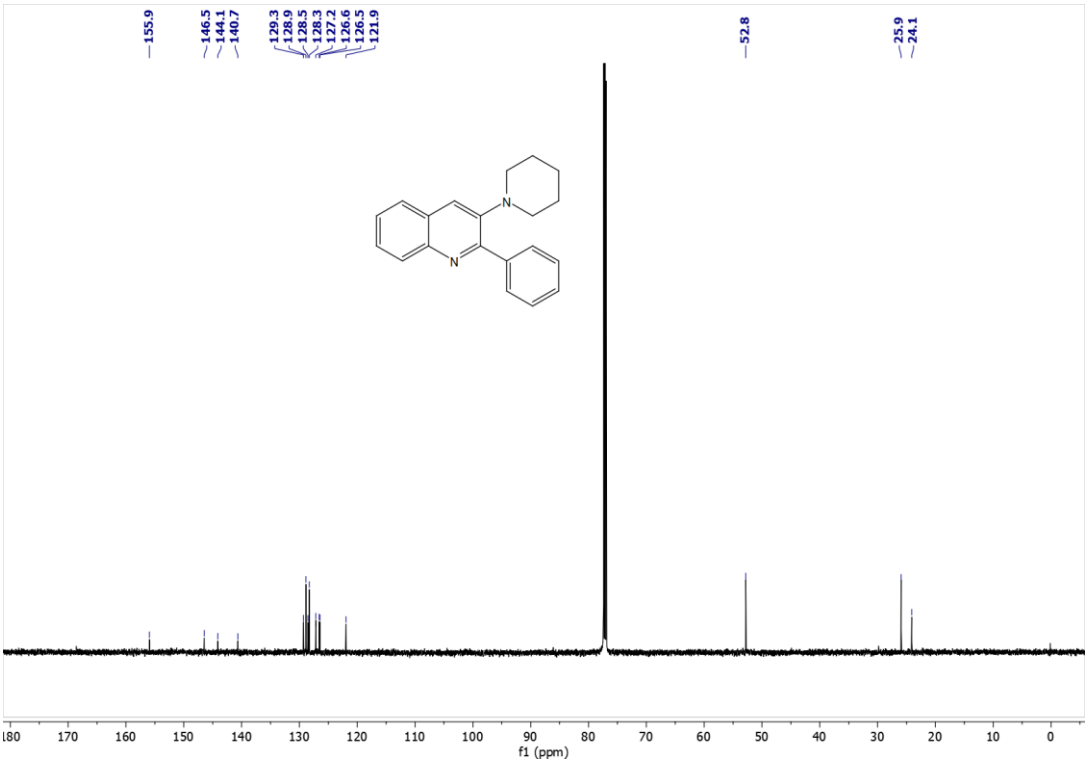


Figure S142: $^{13}C\{^{1}H\}$ NMR Spectrum of **7a** ($CDCl_3$, 151 MHz, 298 K)

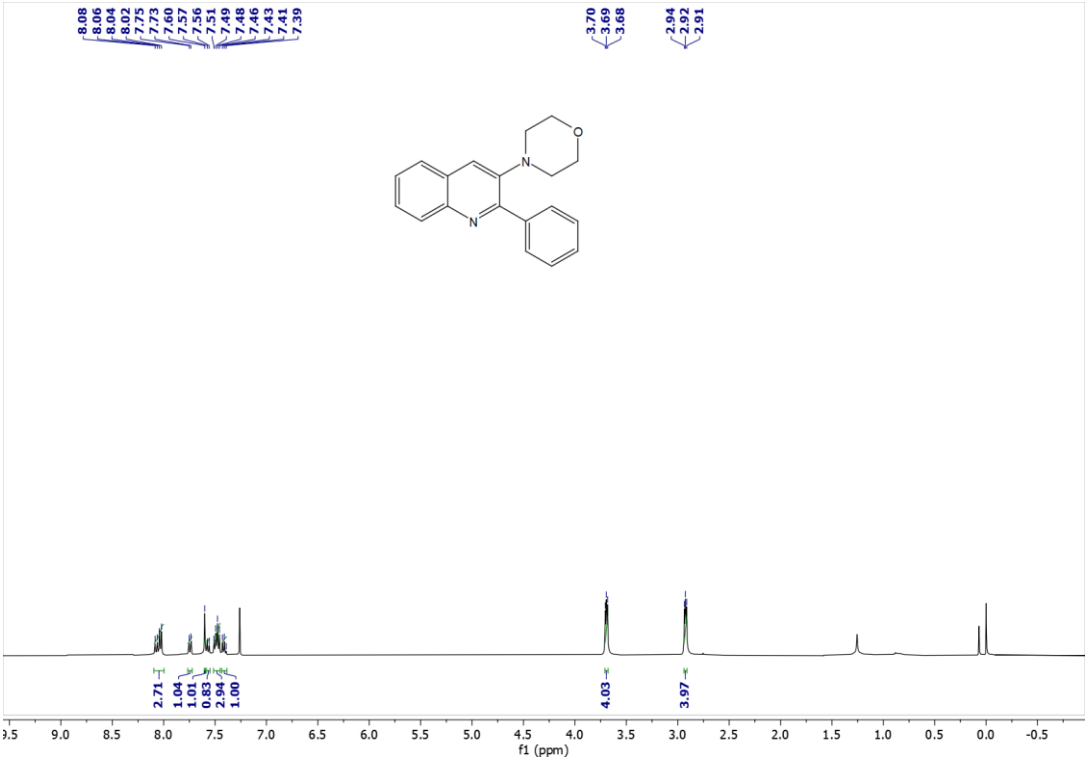


Figure S143: ^{1}H NMR Spectrum of **7b** ($CDCl_3$, 400 MHz, 298 K)

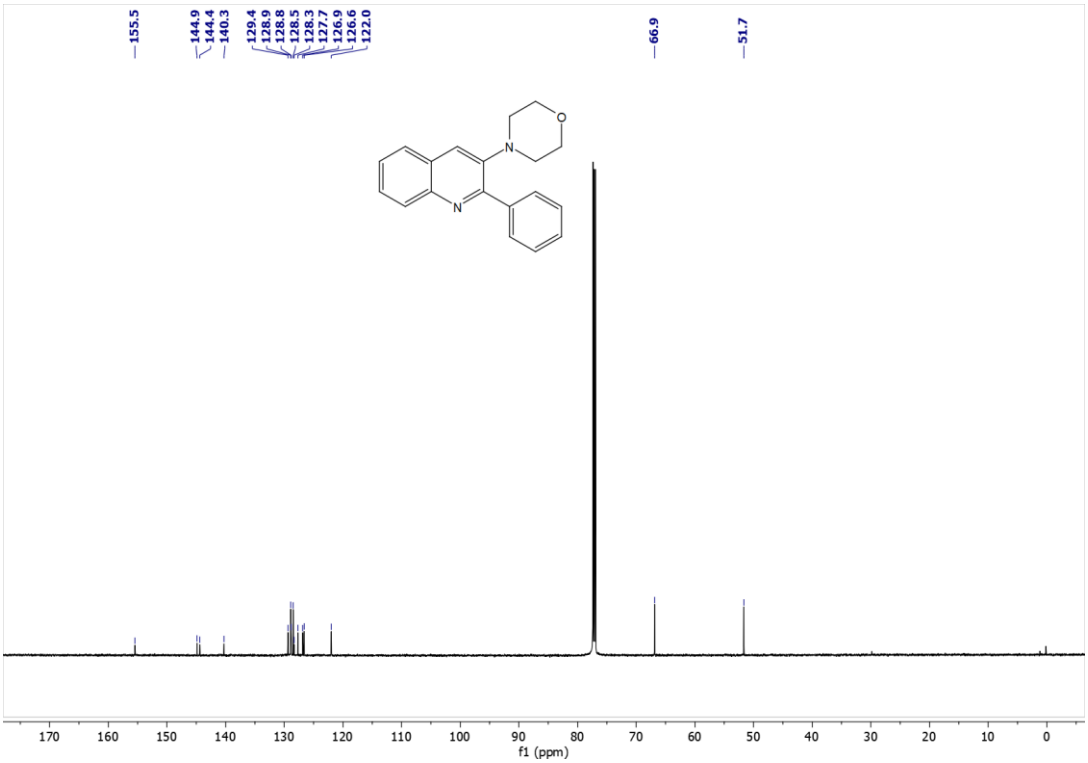


Figure S144: $^{13}C\{^{1}H\}$ NMR Spectrum of **7b** ($CDCl_3$, 151 MHz, 298 K)

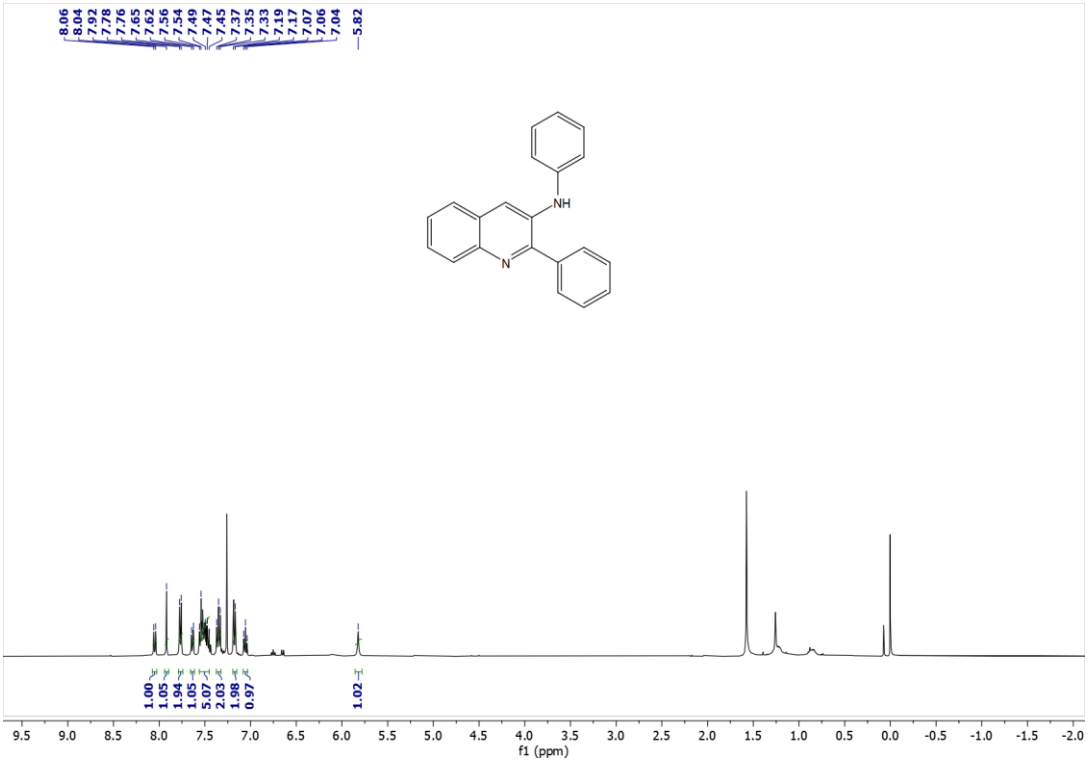


Figure S145: ^{1}H NMR Spectrum of **7c** ($CDCl_3$, 400 MHz, 298 K)

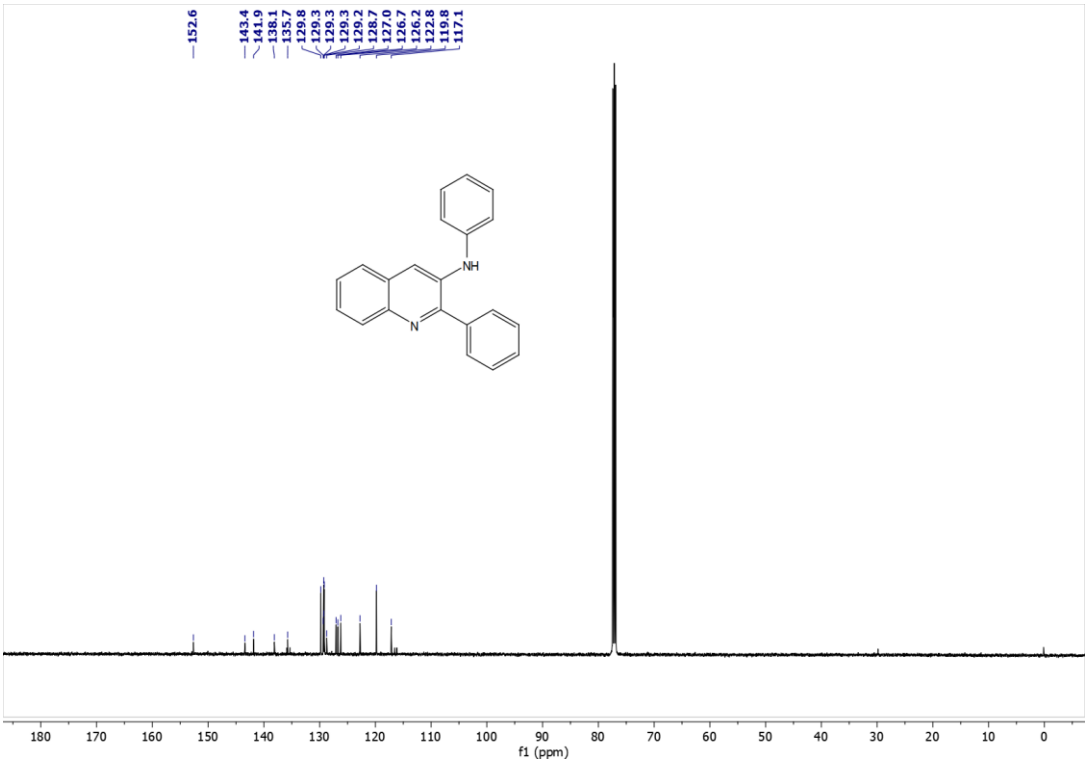


Figure S146: $^{13}C\{^{1}H\}$ NMR Spectrum of **7c** ($CDCl_3$, 126 MHz, 298 K)

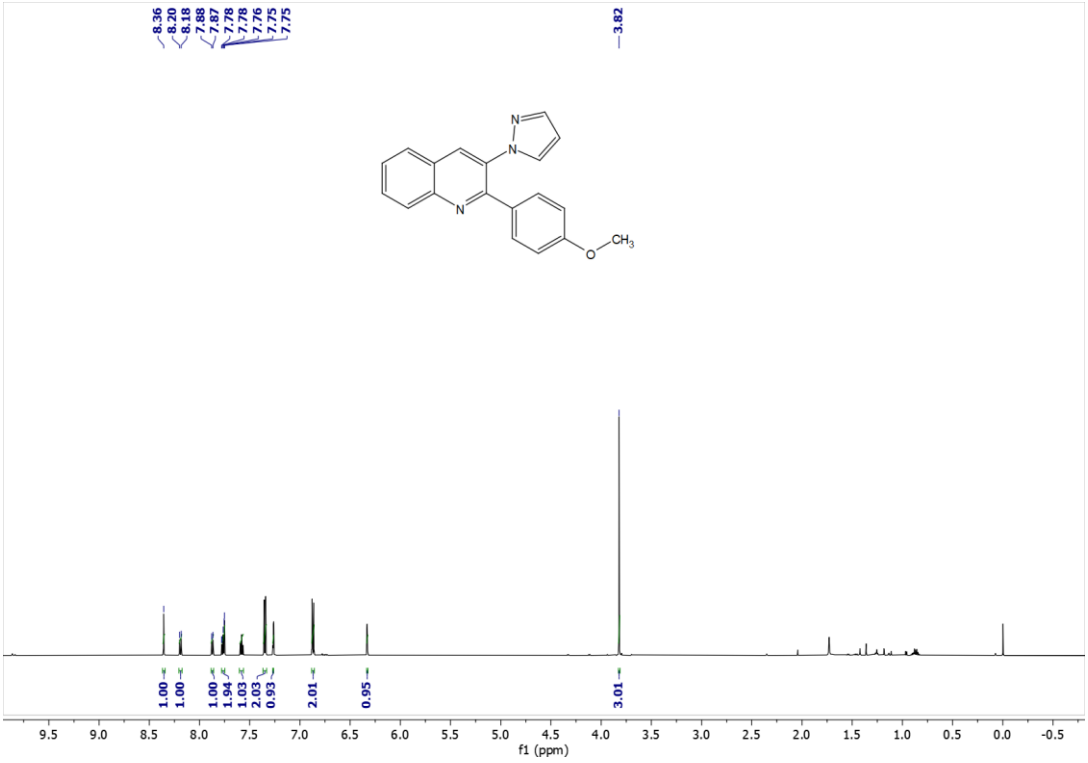


Figure S147: ^{1}H NMR Spectrum of **7d** ($CDCl_3$, 500 MHz, 298 K)

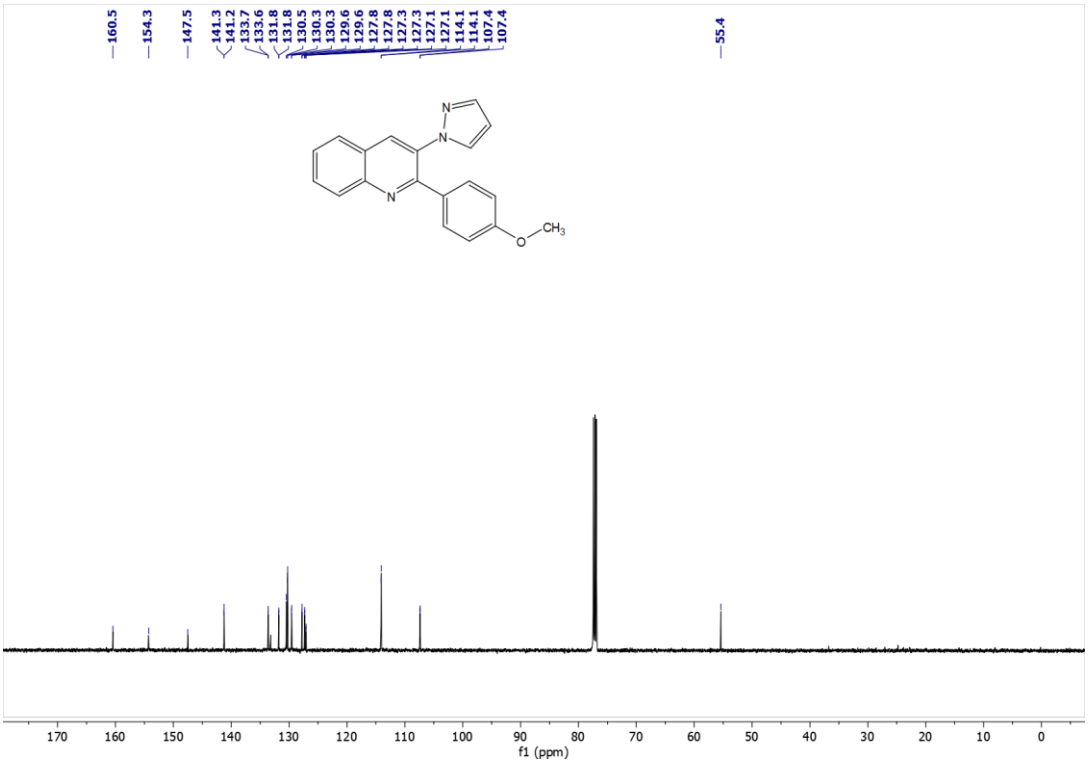


Figure S148: $^{13}C\{^{1}H\}$ NMR Spectrum of **7d** ($CDCl_3$, 126 MHz, 298 K)

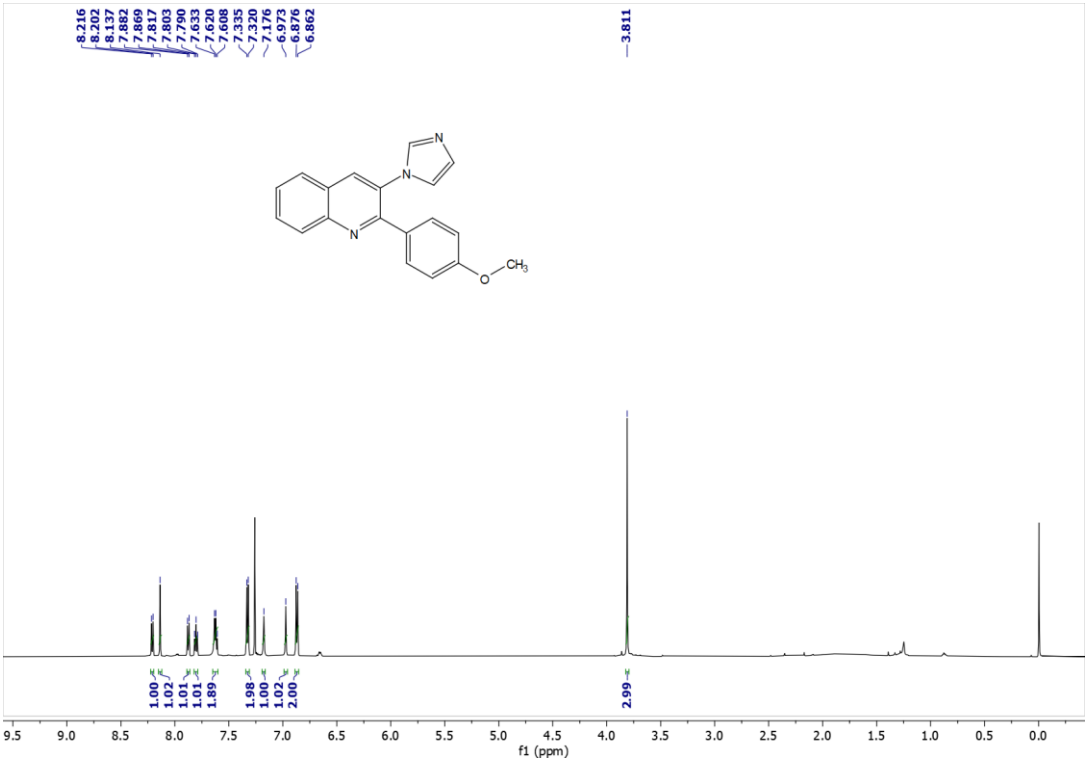


Figure S149: ^{1}H NMR Spectrum of **7e** ($CDCl_3$, 600 MHz, 298 K)

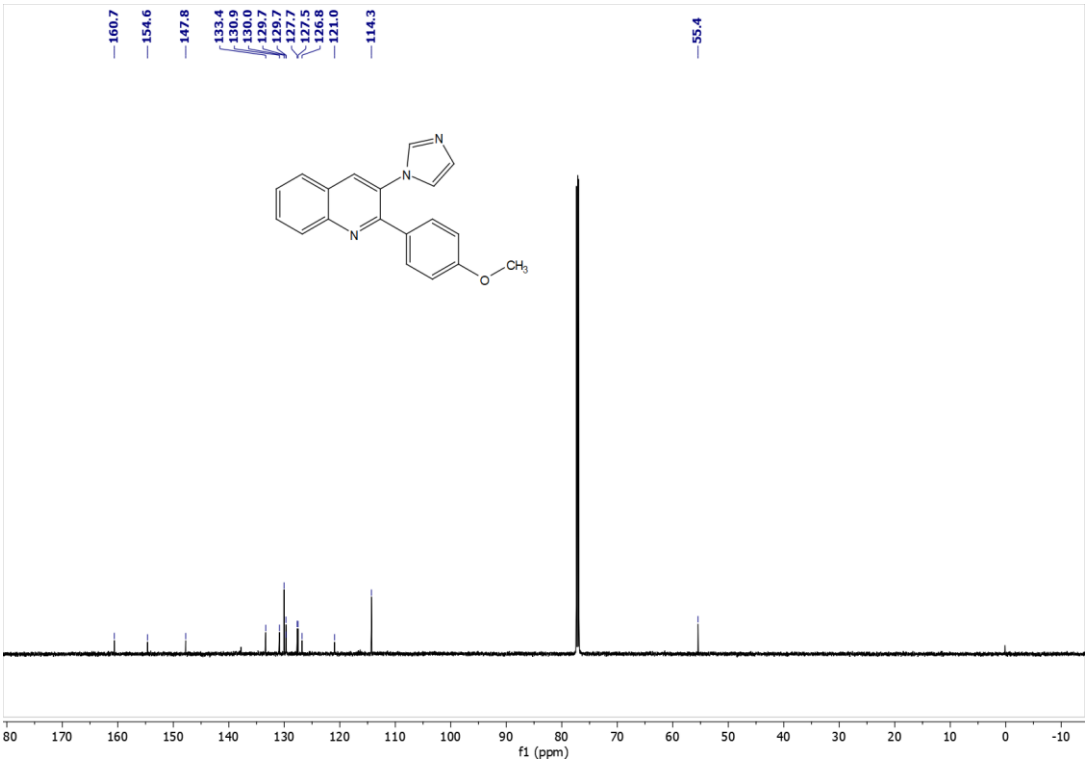


Figure S150: $^{13}C\{^{1}H\}$ NMR Spectrum of **7e** ($CDCl_3$, 151 MHz, 298 K)

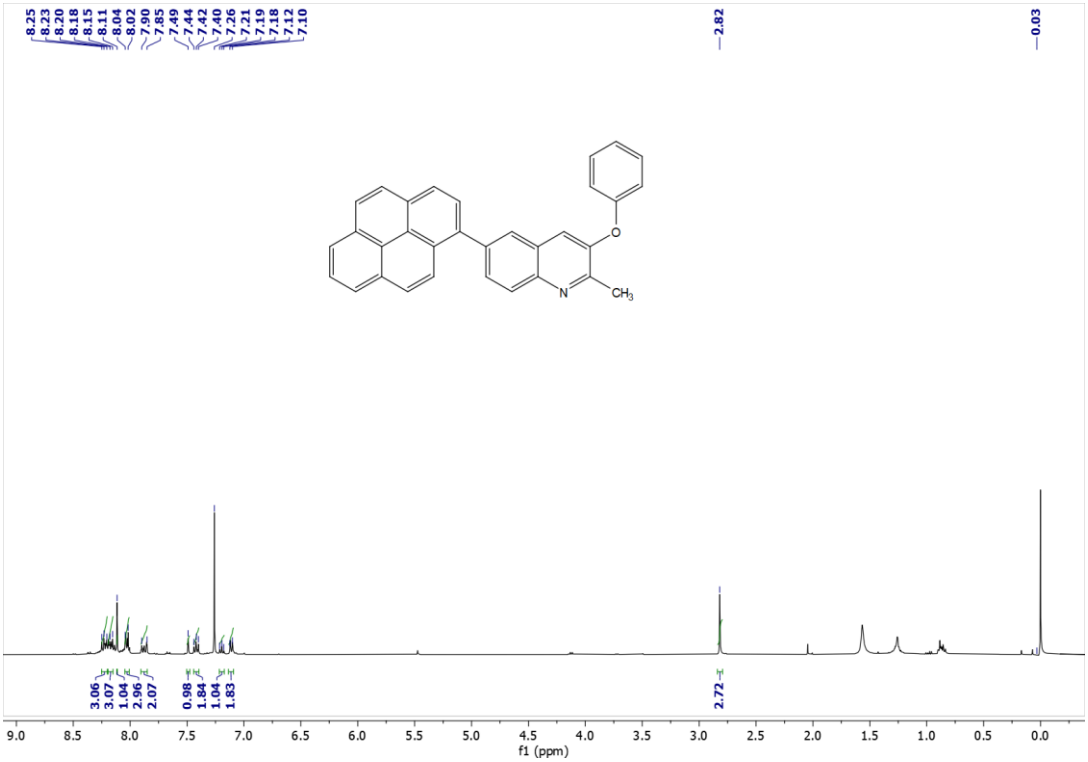


Figure S151: ^{1}H NMR Spectrum of **8** ($CDCl_3$, 400 MHz, 298 K)

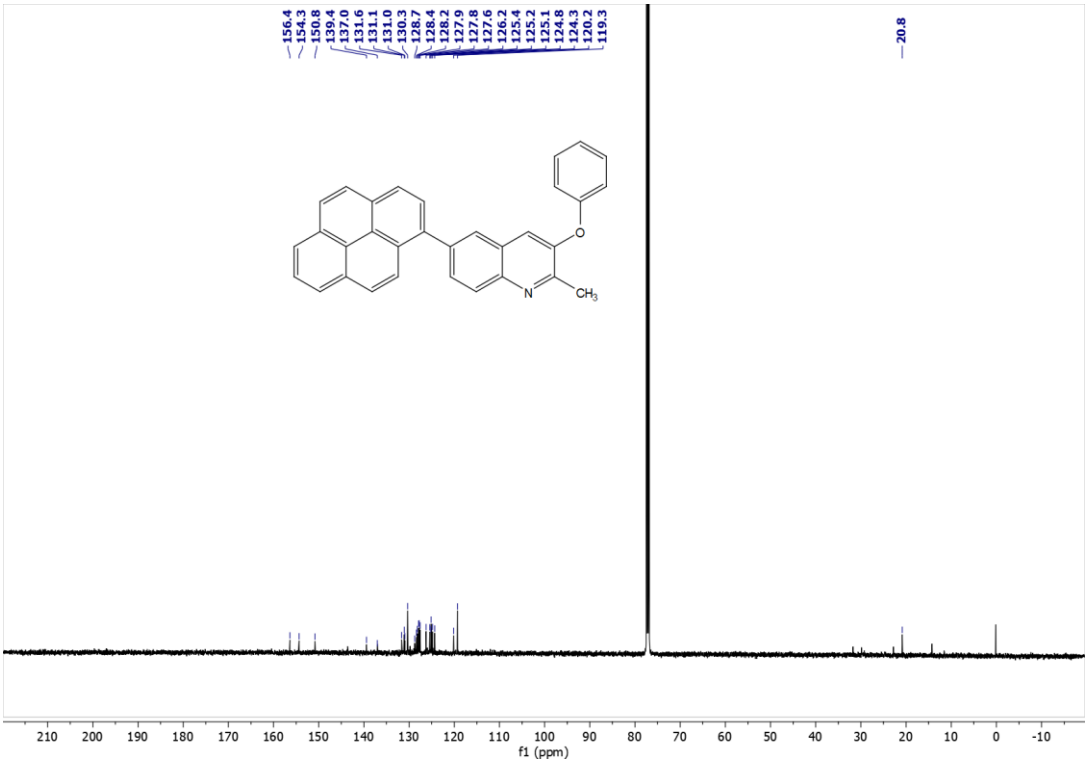


Figure S152: $^{13}C\{^{1}H\}$ NMR Spectrum of **8** ($CDCl_3$, 126 MHz, 298 K)

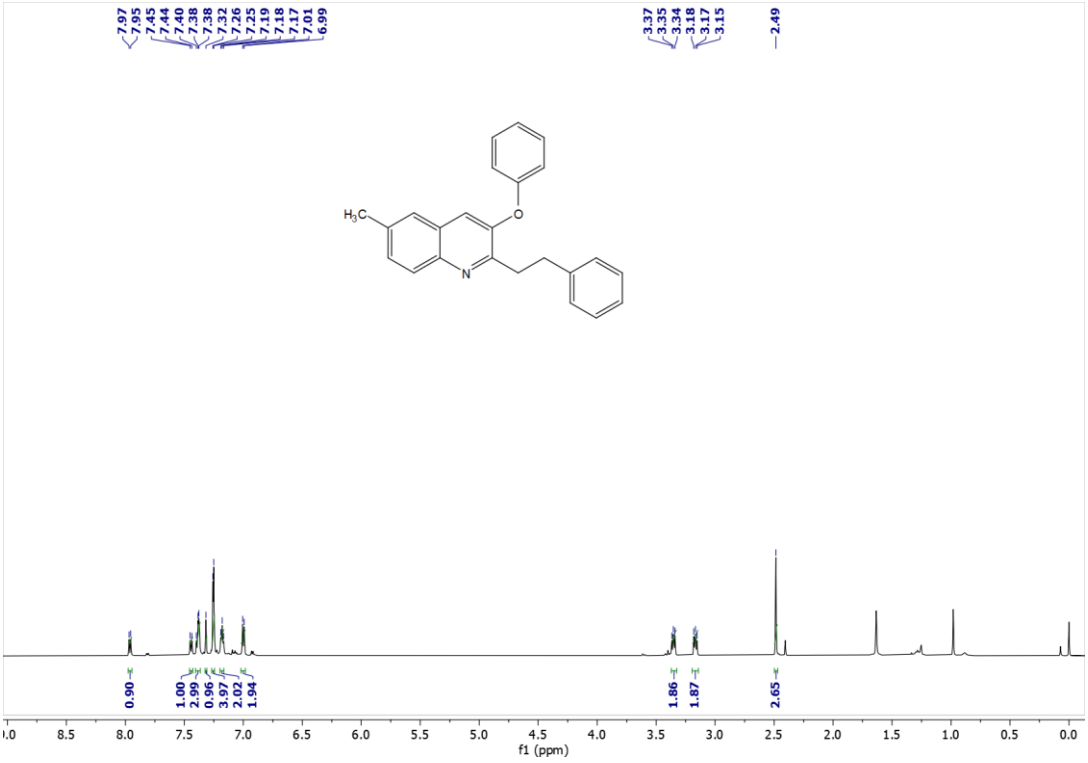


Figure S153: ^{1}H NMR Spectrum of **9** ($CDCl_3$, 600 MHz, 298 K)

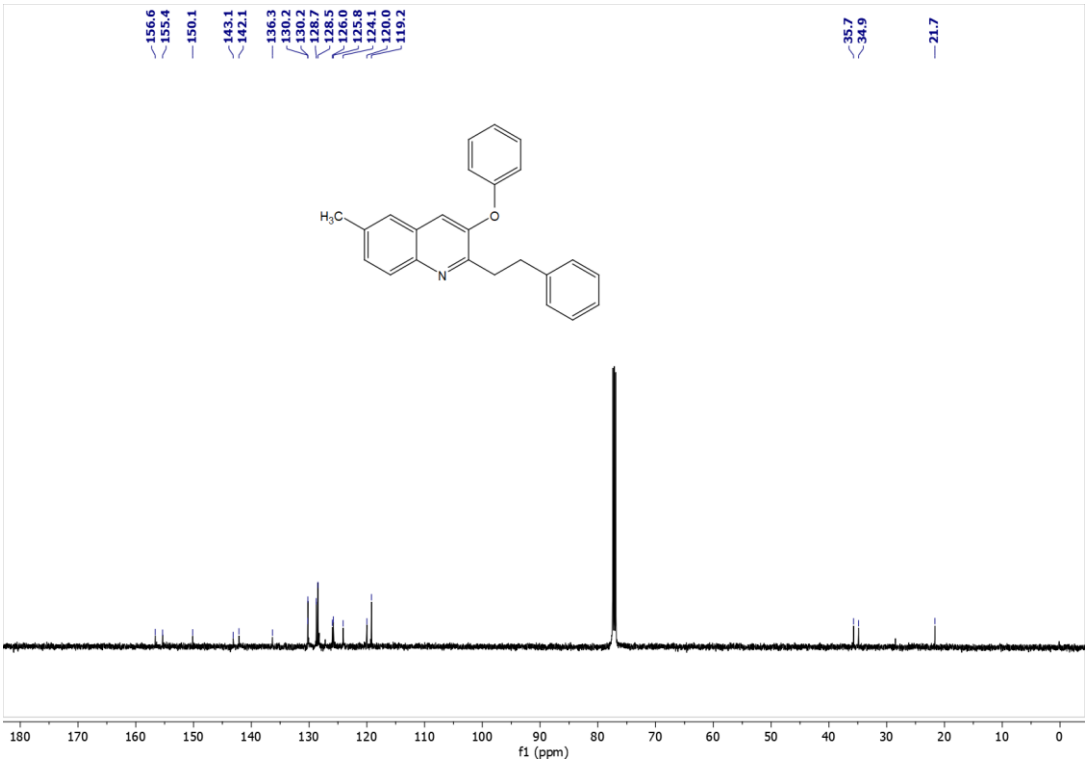


Figure S154: $^{13}C\{^{1}H\}$ NMR Spectrum of **9** ($CDCl_3$, 126 MHz, 298 K)

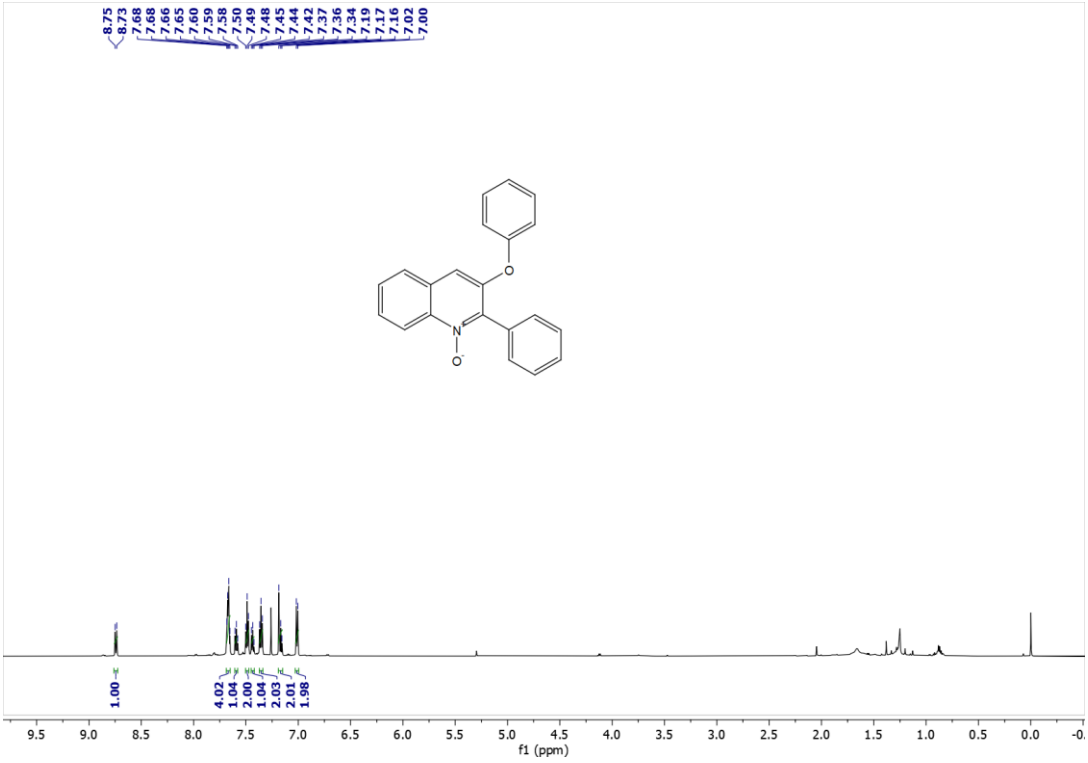


Figure S155: ^{1}H NMR Spectrum of **10** ($CDCl_3$, 600 MHz, 298 K)

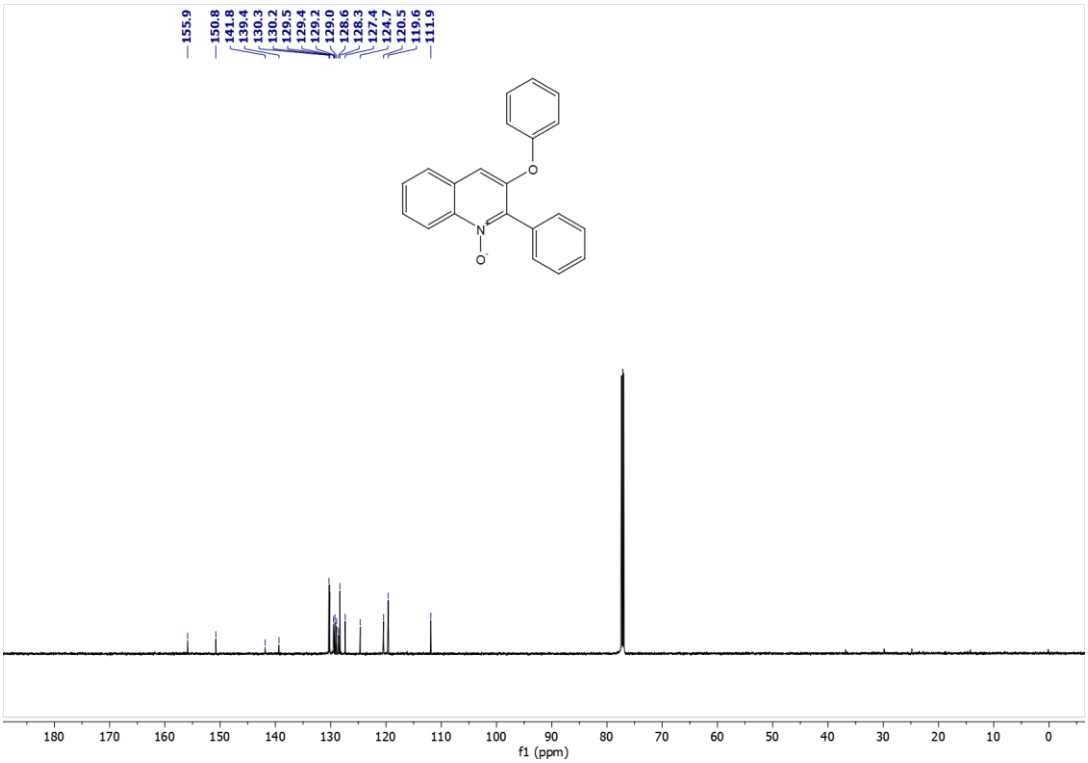


Figure S156: $^{13}C\{^{1}H\}$ NMR Spectrum of **10** ($CDCl_3$, 151 MHz, 298 K)

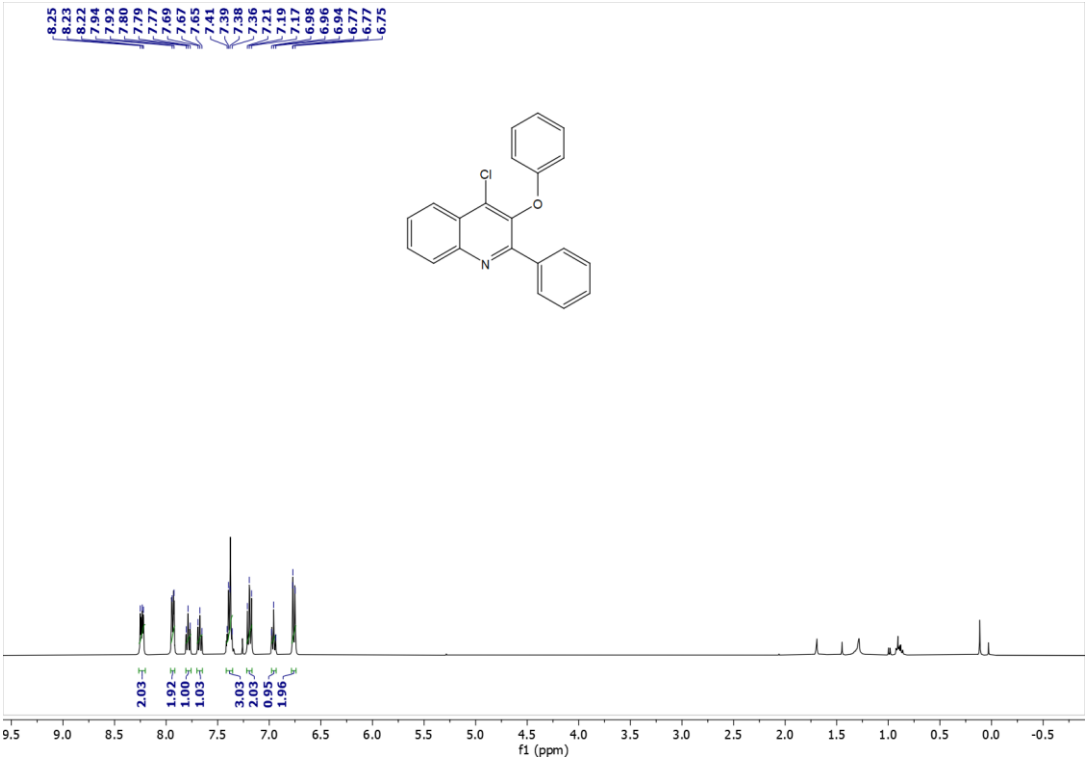


Figure S157: ^{1}H NMR Spectrum of **11** ($CDCl_3$, 400 MHz, 298 K)

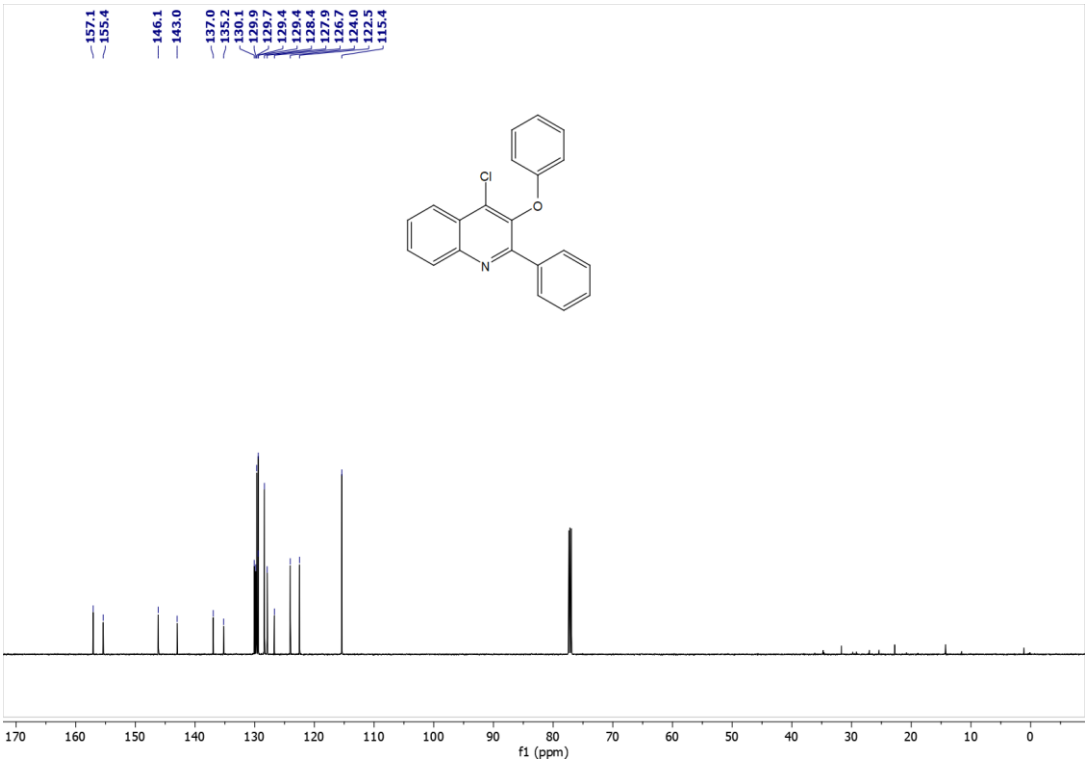


Figure S158: $^{13}C\{^{1}H\}$ NMR Spectrum of **11** ($CDCl_3$, 151 MHz, 298 K)

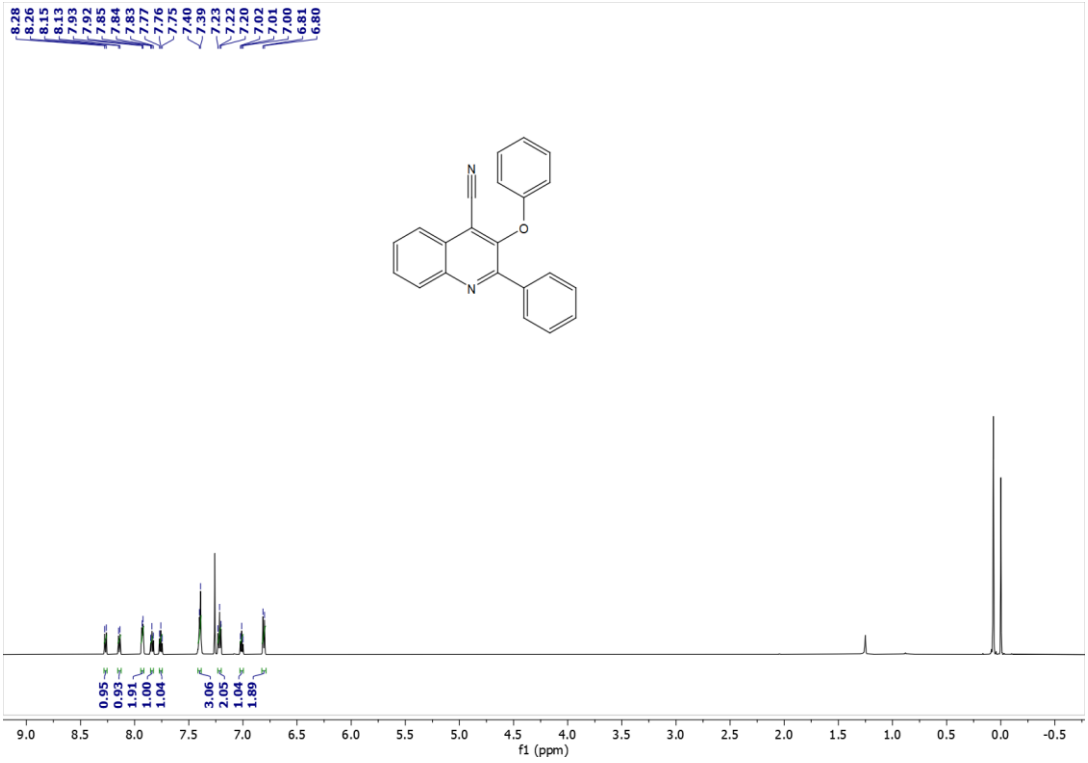


Figure S159: ^{1}H NMR Spectrum of **12** ($CDCl_3$, 600 MHz, 298 K)

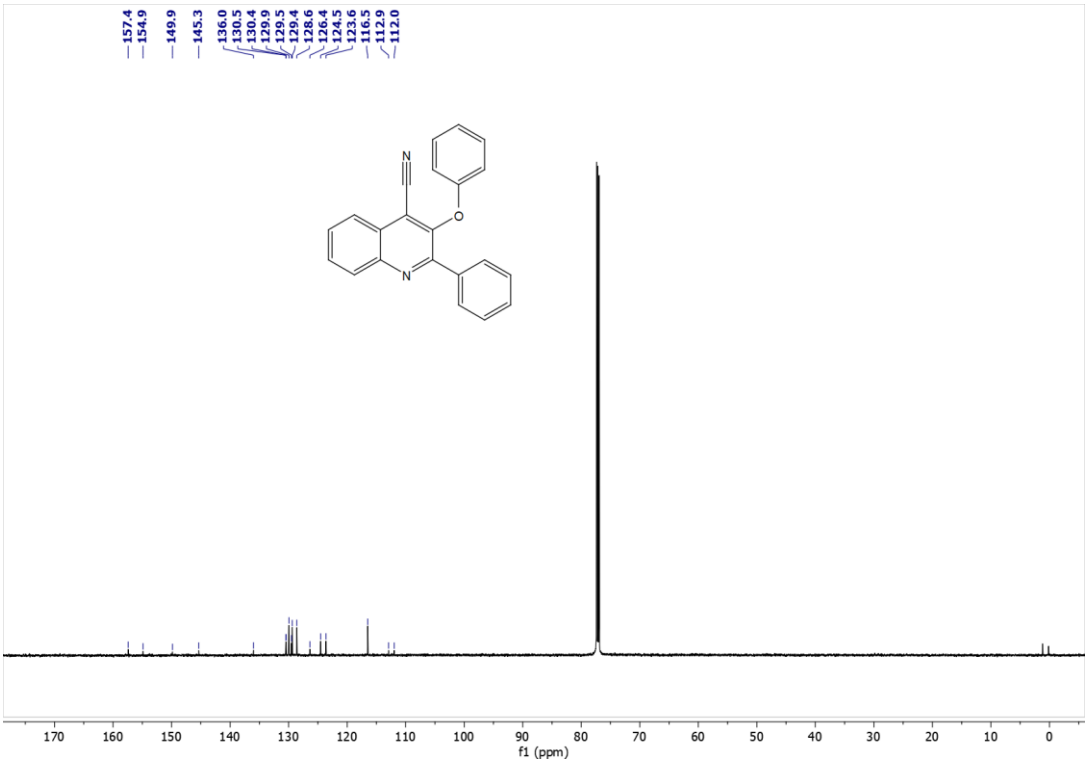


Figure S160: $^{13}C\{^{1}H\}$ NMR Spectrum of **12** ($CDCl_3$, 151 MHz, 298 K)

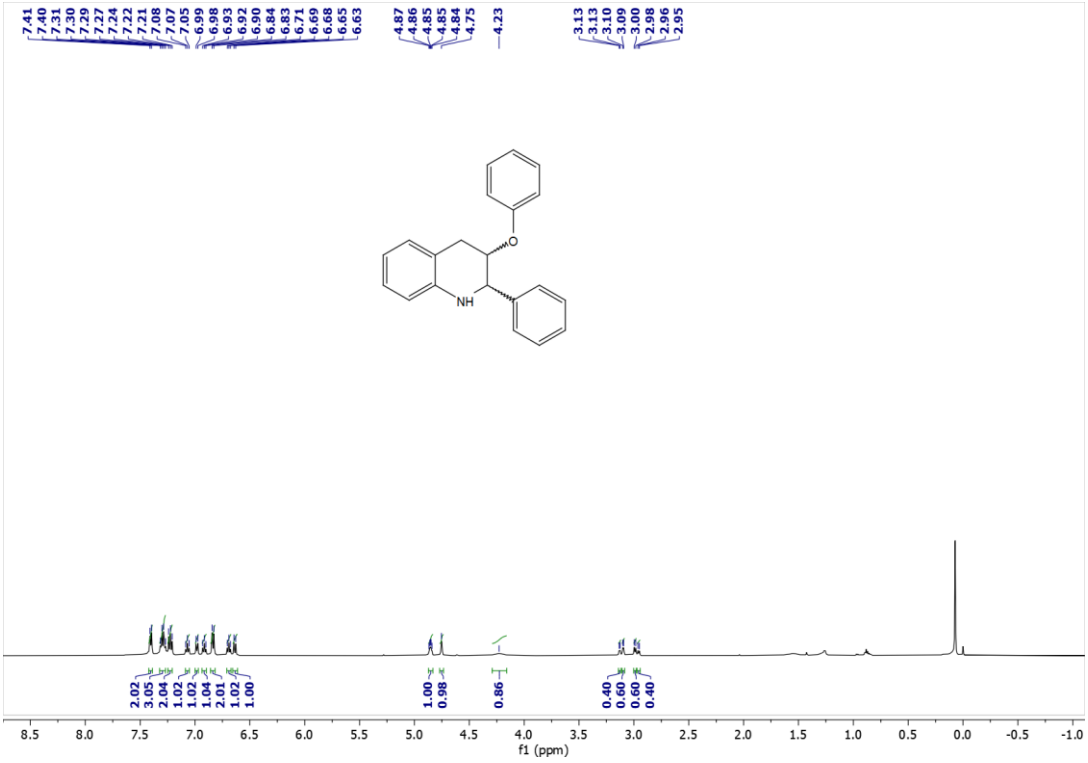


Figure S161: ^{1}H NMR Spectrum of **13** ($CDCl_3$, 500 MHz, 298 K)

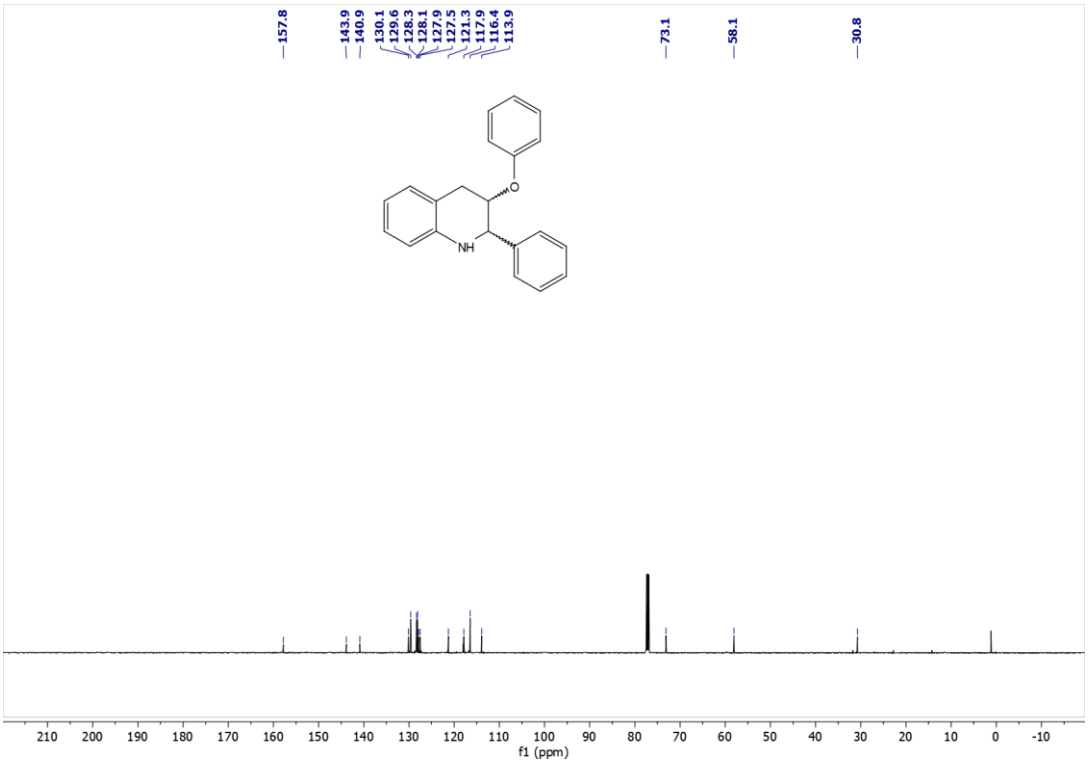


Figure S162: $^{13}C\{^{1}H\}$ NMR Spectrum of **13** ($CDCl_3$, 126 MHz, 298 K)

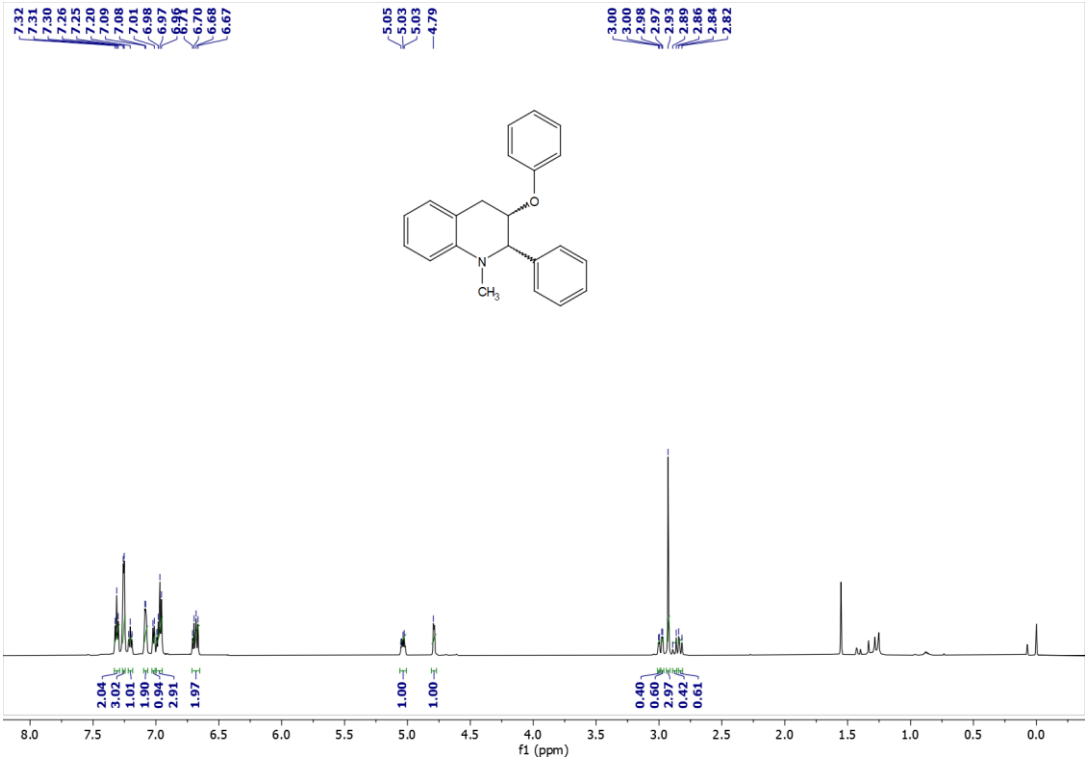


Figure S163: ^{1}H NMR Spectrum of **14** ($CDCl_3$, 600 MHz, 298 K)

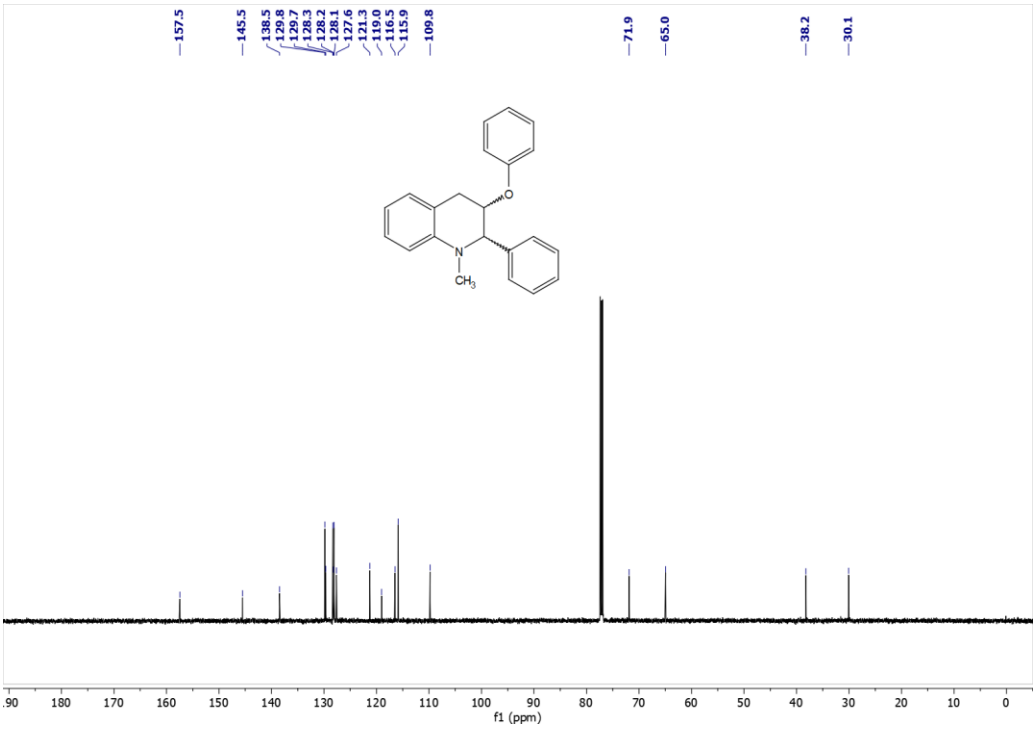


Figure S164: $^{13}C\{^{1}H\}$ NMR Spectrum of **14** ($CDCl_3$, 151 MHz, 298 K)

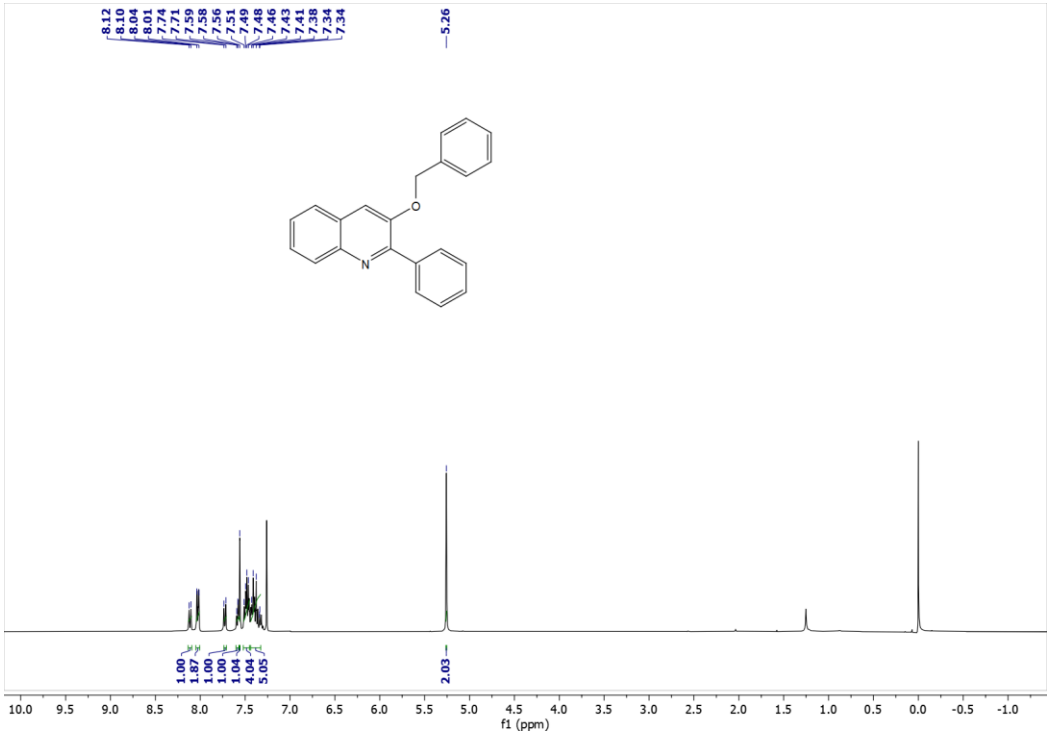


Figure S165: ^{1}H NMR Spectrum of **15** ($CDCl_3$, 400 MHz, 298 K)

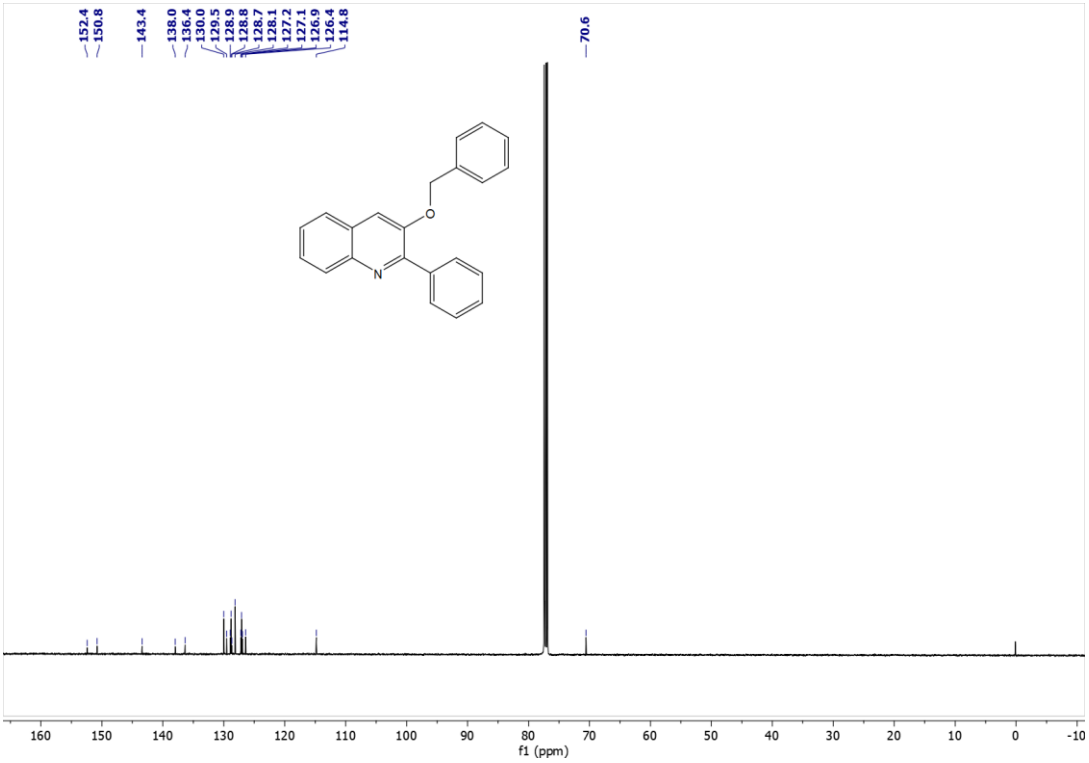


Figure S166: $^{13}C\{^{1}H\}$ NMR Spectrum of **15** ($CDCl_3$, 126 MHz, 298 K)

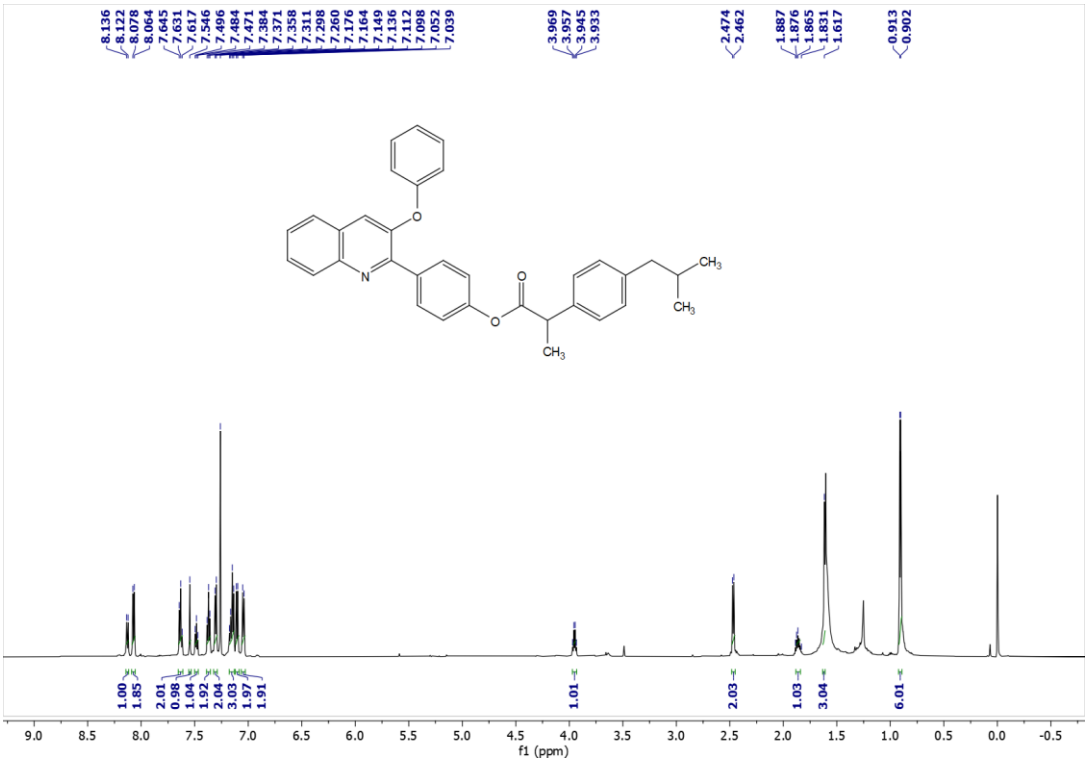


Figure S167: ^{1}H NMR Spectrum of **16** ($CDCl_3$, 600 MHz, 298 K)

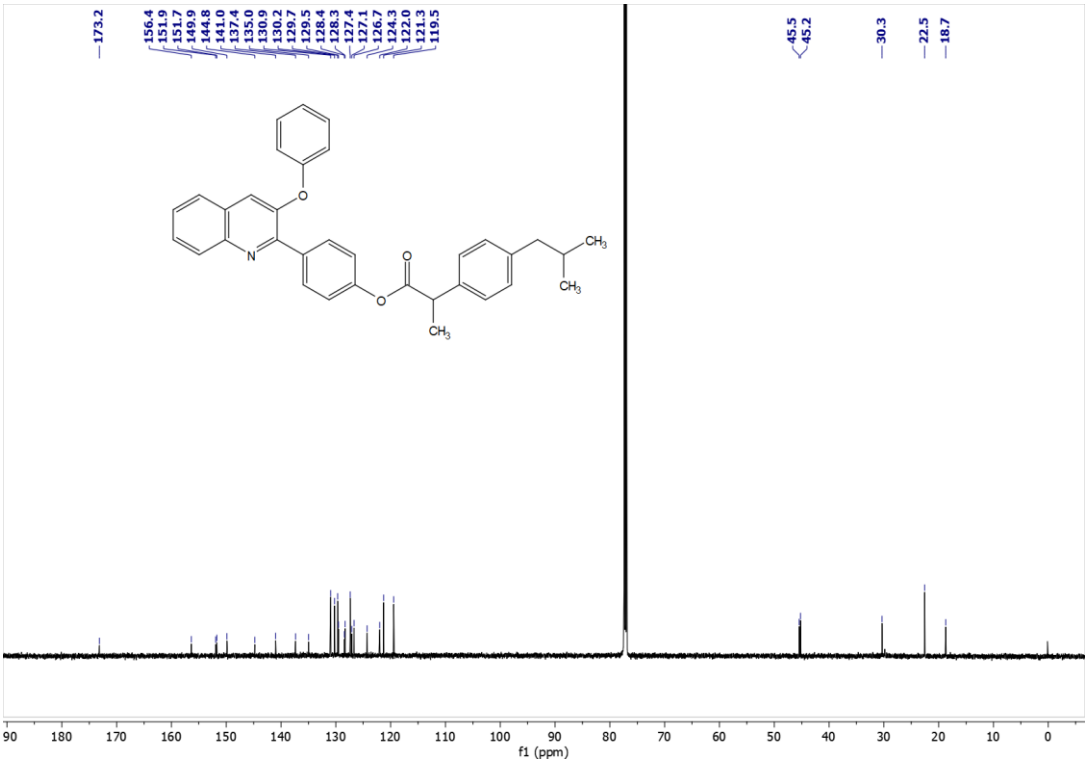


Figure S168: $^{13}C\{^{1}H\}$ NMR Spectrum of **16** ($CDCl_3$, 151 MHz, 298 K)

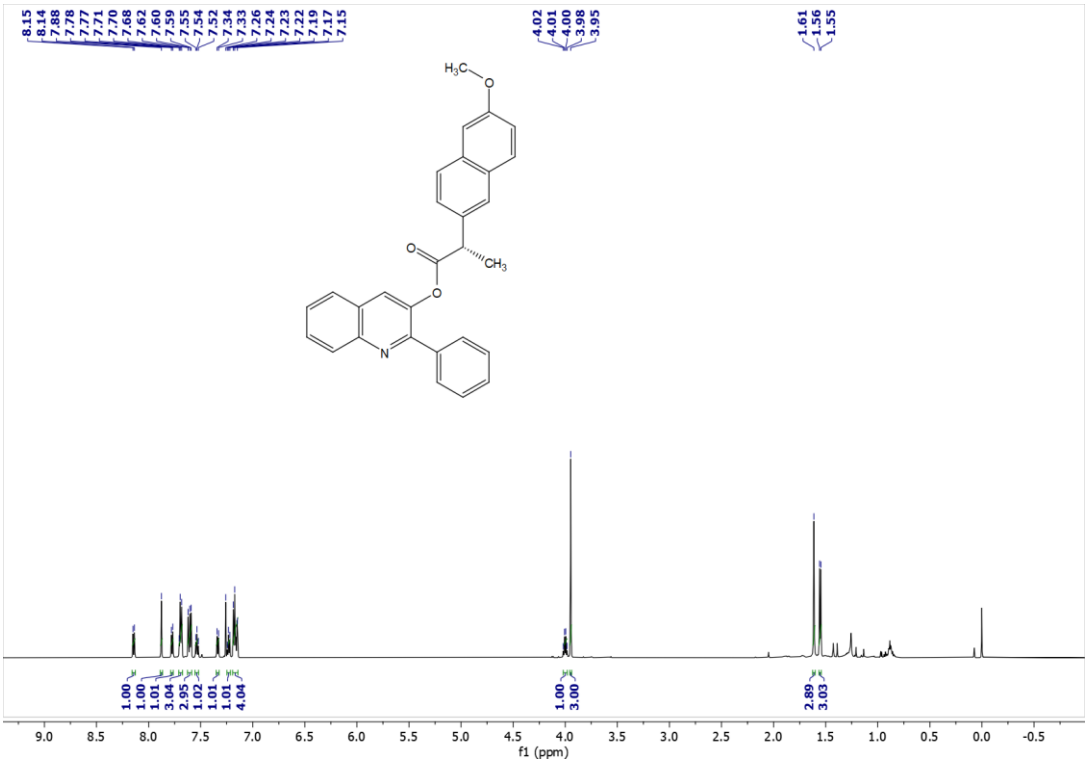


Figure S169: ^{1}H NMR Spectrum of **17** ($CDCl_3$, 600 MHz, 298 K)

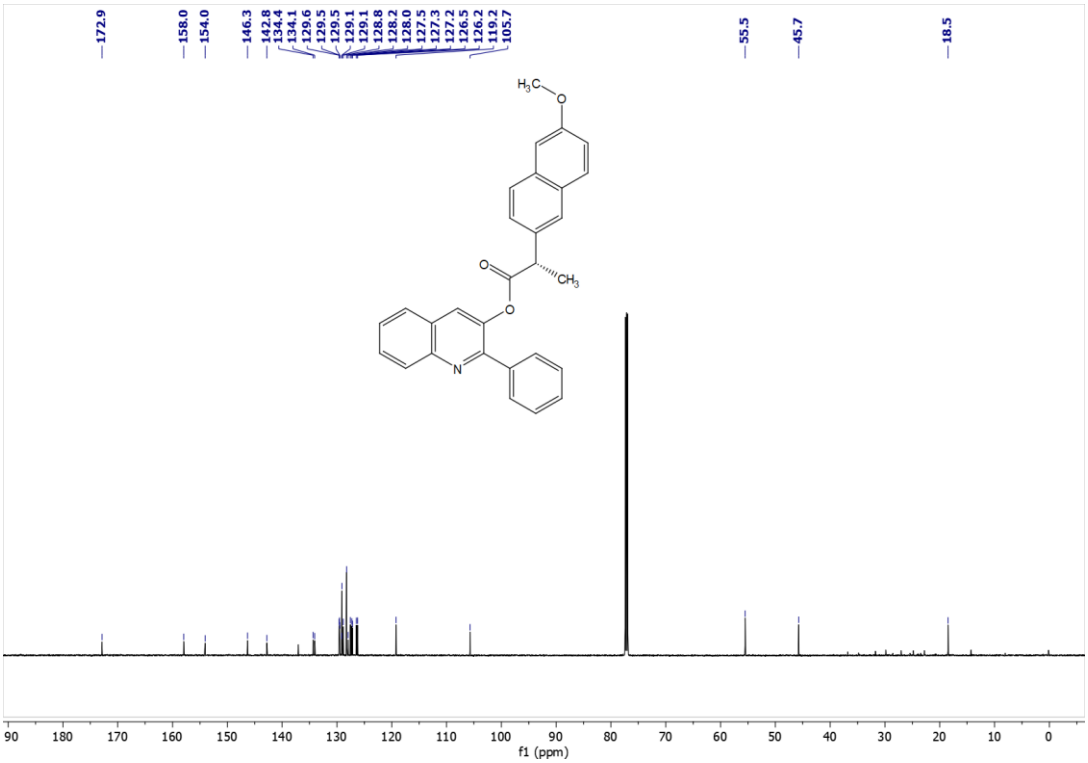


Figure S170: $^{13}C\{^{1}H\}$ NMR Spectrum of **17** ($CDCl_3$, 151 MHz, 298 K)

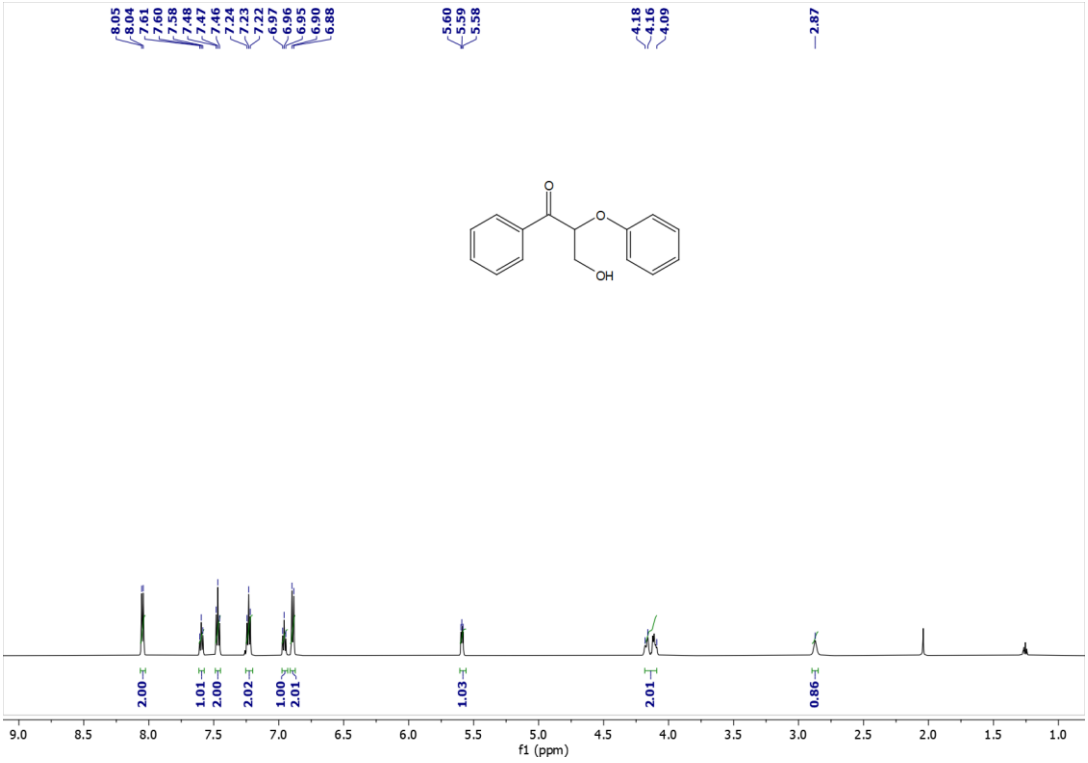


Figure S171: ^{1}H NMR Spectrum of **18** ($CDCl_3$, 600 MHz, 298 K)

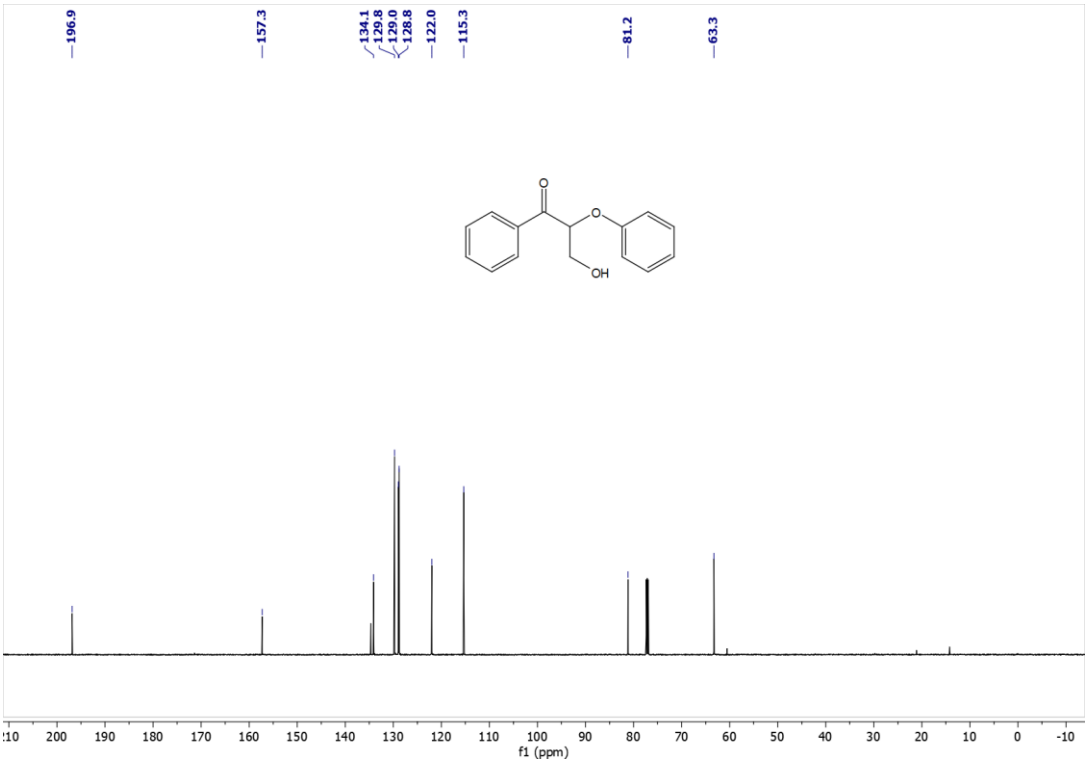


Figure S172: $^{13}C\{^{1}H\}$ NMR Spectrum of **18** ($CDCl_3$, 151 MHz, 298 K)

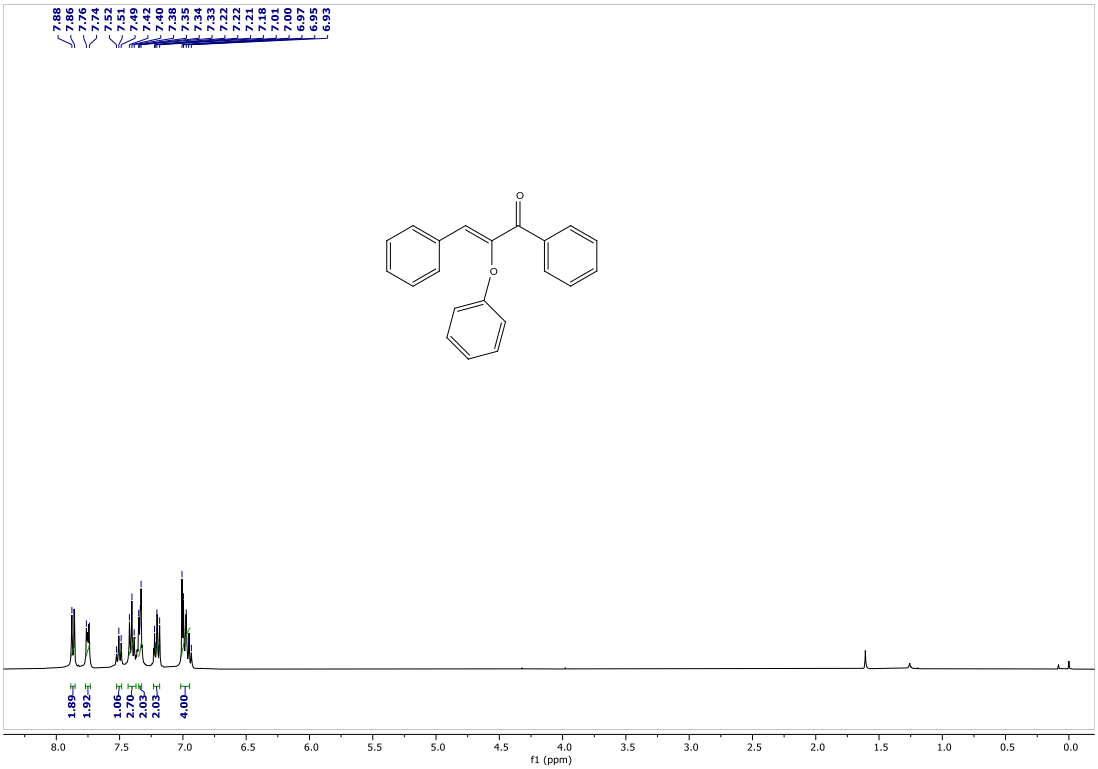


Figure S173: ^{1}H NMR Spectrum of **20** ($CDCl_3$, 400 MHz, 298 K)

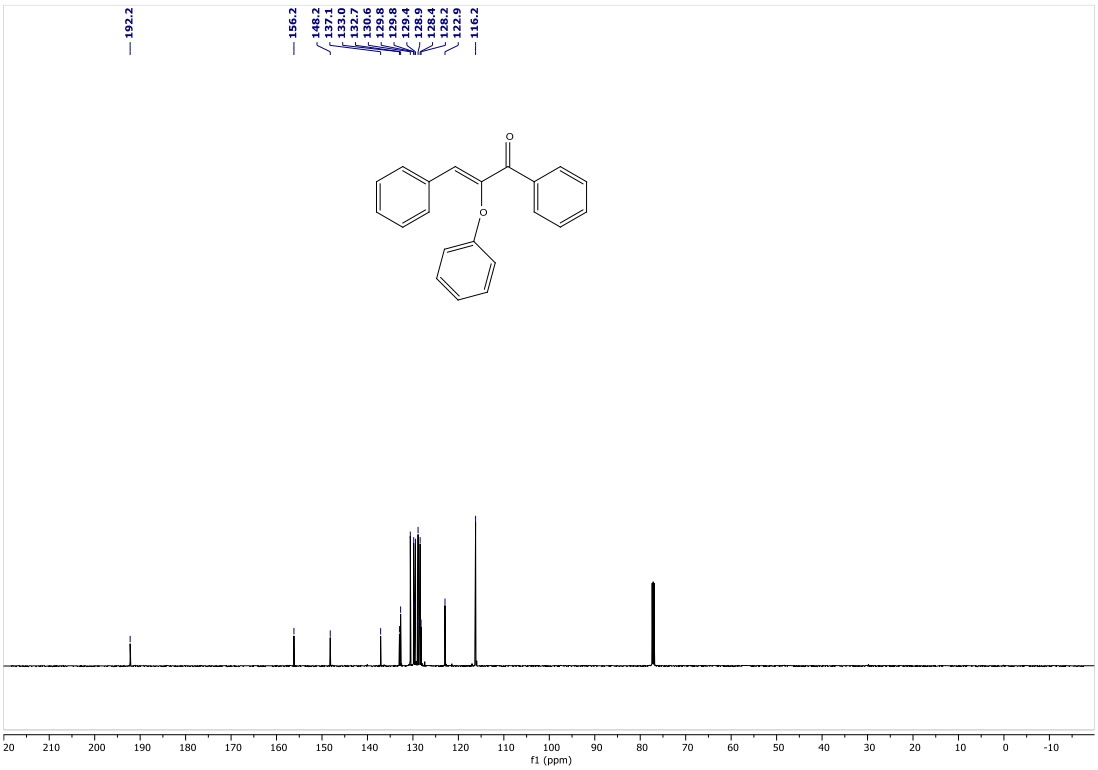


Figure S174: $^{13}C\{^{1}H\}$ NMR Spectrum of **20** ($CDCl_3$, 151 MHz, 298 K)

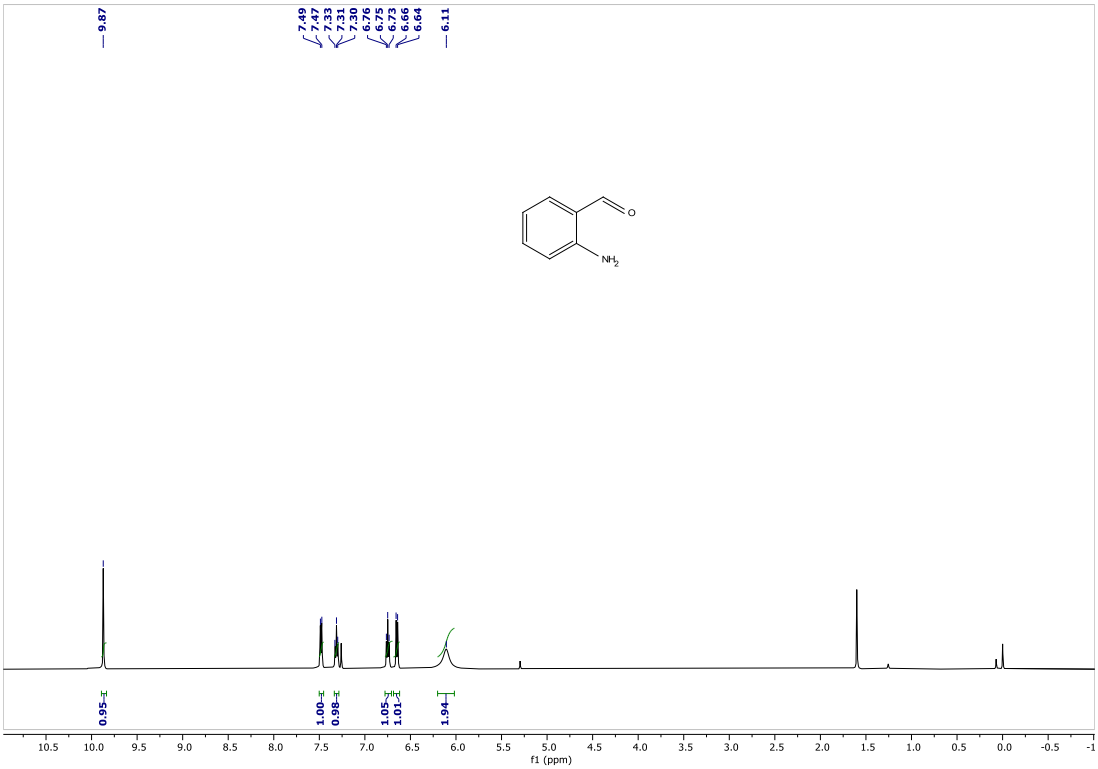


Figure S175: ^{1}H NMR Spectrum of **1a'** ($CDCl_3$, 500 MHz, 298 K)

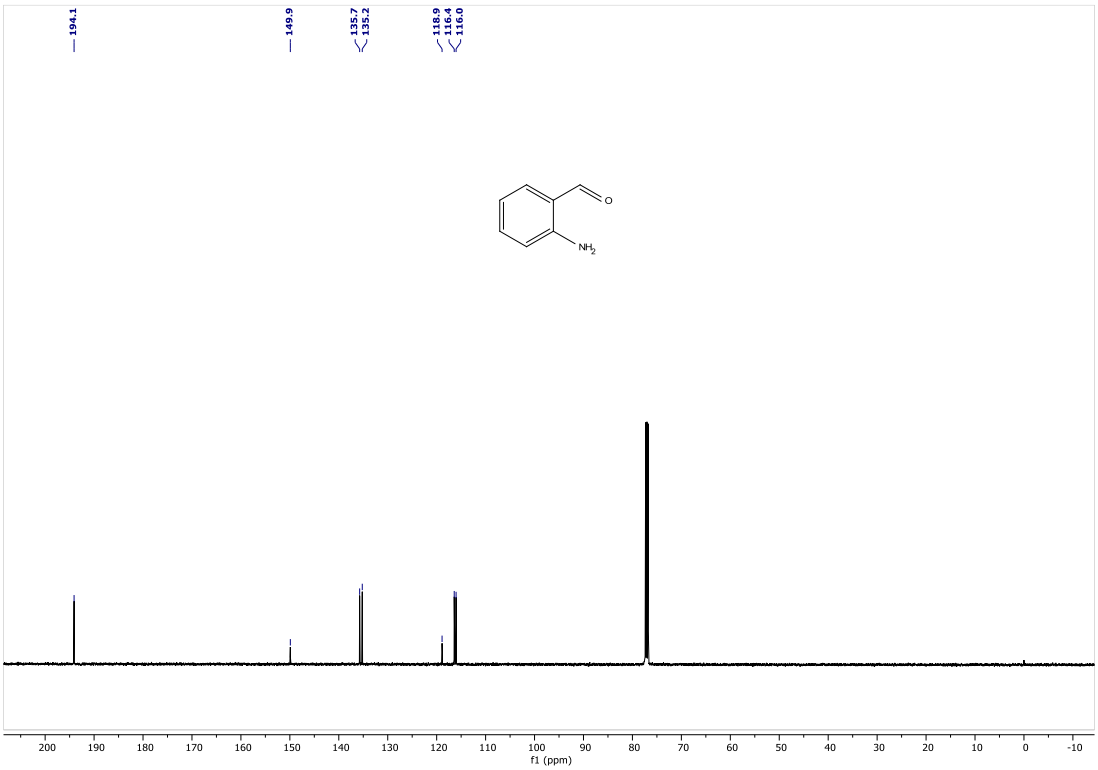


Figure S176: $^{13}C\{^{1}H\}$ NMR Spectrum of **1a'** ($CDCl_3$, 126 MHz, 298 K)

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