Supporting information for

Electrophotocatalytic hydroxymethylation of azaarenes with methanol

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MATERIALS AND METHODS

Solvents and reagents: Unless otherwise stated, all solvents and commercially available reagents were purchased in reagent grades and used without further purification.

General methods: All air- and moisture-insensitive reactions were carried out under an ambient atmosphere and monitored by thin-layer chromatography (TLC) and Gas Chromatography-mass spectroscopy (GC-MS). TLCs were performed on silica gel 60 F_{254}, using aluminum plates and visualized by exposure to ultraviolet light. Flash column chromatography (FC) was performed using Merck silica gel 60 (230–400 mesh). Yields refer to purified compounds unless otherwise stated.

Setup: The photoelectrocatalytic reactions were conducted using IKA ElectraSyn 2.0 Pro equipment, with undivided cell and IKA electrodes (5x1x0.1 cm), fixing the current intensity or the voltage and using the corresponding vials. Each reaction mixture (rxm) was irradiated with one 18 W EvoluChem LEDs 450PF radiating at 450 nm with a total irradiance of 34 mW $\times$ cm^{-2} (for light spectrum and other details, see: https://www.hepatochem.com/product/hck1012-xx-002/).

Analytical Information:

NMR spectra were recorded at 300 or 400 MHz for ^{1}H and 75 or 101 MHz for ^{13}C, using $CDCl_3$, MeOD-d_4 or DMSO-d_6 as solvent. For ^{1}H-NMR in $CDCl_3$, TMS was used as an internal standard (0.00 ppm). For ^{1}H-NMR in DMSO-d_6, the residual signal was used as the internal standard (2.50 ppm). Data are reported as (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet or unresolved, brs = broad signal, coupling constant(s) in Hz, integration). ^{13}C-NMR spectra were recorded with ^{1}H-decoupling at 101 MHz and referenced to $CDCl_3$ at 77.16 ppm or DMSO-d_6 at 39.52 ppm.

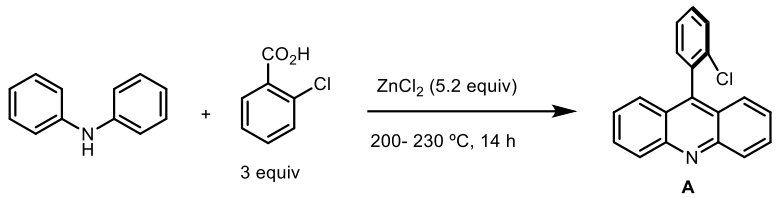
LRMS were obtained using an Agilent 5977B mass spectrometer with a quadrupole analyzer coupled with a gas chromatographer Agilent 8890. The oven temperature was: 3 min at 80 ºC, then 20 ºC/min ramp until 300 ºC, then 3 min at 300 ºC.

HRMS analyses were carried out in the electron impact mode (EI) at 70 eV using a quadrupole mass analyzer or by Q-TOF using electrospray ionization (ESI) mode.

GENERAL METHODS

Preparation of acridine catalysts

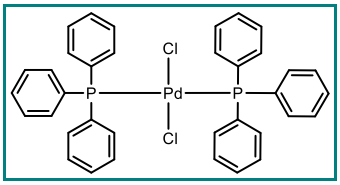
Preparation of 9-(2-Chlorophenyl)-2,7-dimethylacridine (A)



A

Following a procedure previously reported, 9-(2-Chlorophenyl)-2,7-dimethylacridine (**A**) was prepared.[1]

Preparation of bis(triphenylphosphine)palladium chloride



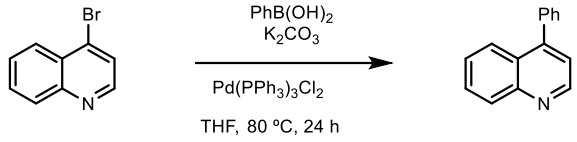
This catalyst was prepared according to a reported procedure.[2]

$PdCl_2$ (53 mg, 0.30 mmol) was added to an oven-dried Schlenck flask, followed by dry THF (3 mL) and LiCl (26 mg, 0.6 mmol) under Ar atmosphere. The reaction mixture was stirred under an Ar atmosphere for 5 min at 25 ºC. After this time, PPh_3 (157 mg, 0.60 mmol) was added to the resulting grey suspension, and the reaction mixture (rxm) was stirred for at least 2 h at 25 ºC. The formed pale-yellow suspension remained under the Ar atmosphere.

Preparation of starting materials

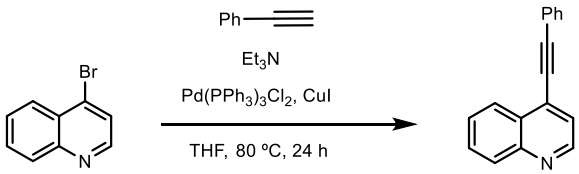
All substrates examined in this study were commercially available except for the following ones:

Synthesis of 4-phenylquinoline



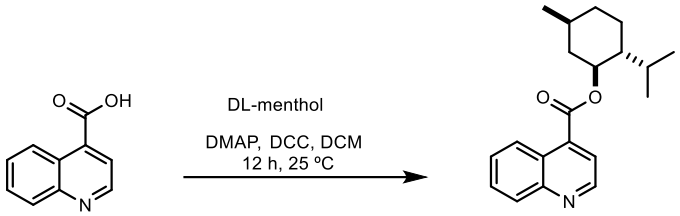
Following a reported protocol,[3] K_2CO_3 (0.5 mL, 2M) was added to a solution of 4-bromoquinoline (104 mg, 0.5 mmol) and phenylboronic acid (73 mg, 0.6 mmol) in THF dry (1 mL). The mixture was stirred at room temperature for 30 min under Ar atmosphere. $Pd(PPh_3)_2Cl_2$ (5 mol%) was added to the rxm and stirred at 80 ºC for 16 h. After reaching rT, extraction with EtOAc (3 x 10 mL) was followed by washing with brine (2 x 5 mL). The organic layers were collected and dried over $MgSO_4$, filtered, and concentrated *in vacuo* to give an orange oil. The crude was purified by FC using from 0% to 10% EtOAc in *n*-hexane as the eluent to give a white solid (90 mg, 0.44 mmol, 88%).

Synthesis of 4-(phenylethynyl)quinoline



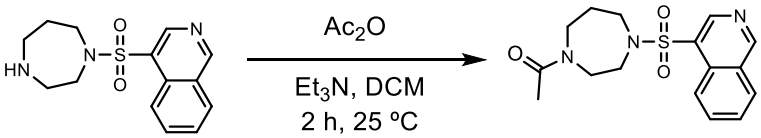
Following a reported protocol,[4] 4-bromoroquinoline (400 mg, 2.0 mmol), the palladium catalyst (5 mol%) and CuI (5 mol %) were added to a 20-mL-pressure tube. TEA (0.80 mmol, 4 equiv.) was degassed and added to the rxm, followed by a solution of phenylacetylene (0.32 mL, 3 mmol, 1.5 equiv.) in THF (16 mL). The rxm was put under the Ar atmosphere and stirred at 80 ºC for 24 h. After evaporation of volatiles, K_2CO_3 (aq. sat.,10 mL) was added, and the product was extracted with EtOAc (2x20 mL). The combined organic layers were dried with $MgSO_4$ and concentrated under vacuum. The crude product was purified by FC using from 0% to 30% EtOAc in *n*-hexane as the eluent to give a black oil (330 mg, 1.38 mmol, 70%).

Synthesis of (1*S**,2*R**,5*S**)-2-isopropyl-5-methylcyclohexyl quinoline-4-carboxylate



Following a reported protocol,[5] quinoline-4-carboxylic acid (415 mg, 2.4 mmol, 1.2 equiv.), menthol (312 mg, 2 mmol, 1 equiv.) and DMAP (25 mg, 0.2 mmol, 10 mol%) were added to a 50 mL round-bottomed flask, followed by CH_2Cl_2 (10 mL). Then, a solution of DCC (495 mg, 2.4 mmol, 1.2 equiv.) in CH_2Cl_2 (10 mL) was slowly added at room temperature. The rxm was stirred at room temperature for 12 h. At this point, the urea was filtered out, and the solution was concentrated *in vacuo*. Then, the residue was diluted with water and extracted with CH_2Cl_2 (3 x 20 mL). The combined organic layers were dried over $MgSO_4$ and filtered. The solvent was removed under reduced pressure, and the residue was purified by FC using a gradient from 0% to 30% of EtOAc in *n*-hexane as the eluent. The product was obtained as a white oil (500 mg, 1.6 mmol, 80%).

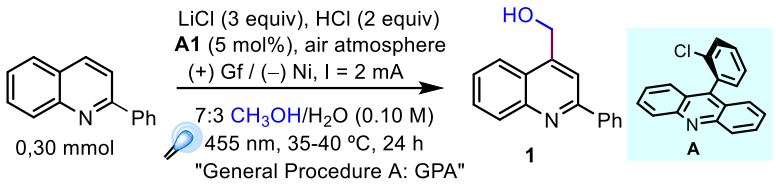
Synthesis of *N*-acetyl fasudil



This compound was prepared according to a reported procedure.[6] The product was obtained as a white oil (55 mg, 0.16 mmol, 55%).

OPTIMIZATION OF REACTION CONDITIONS

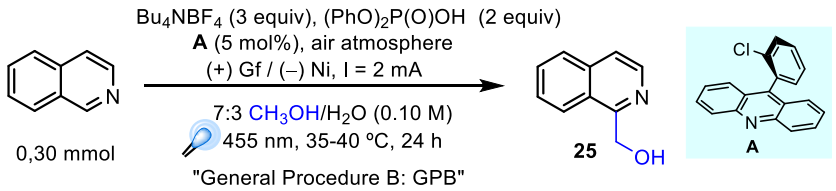
Table S1: Hydroxymethylation of 2-phenylquinoline



Entry	Deviation from the GPA	Yield (%)[a]
1	none	80 (78)[b]
2	Gf /Pt / Ni foam as cathode	10 / 40 / 60
3	Glassy Carbon as anode	55
4	16 h instead of 24 h	50
5	HNO_3 / $(PhO)_2P(O)OH$ / TFA, instead of HCl	40 /10 / 0
6	NaCl / KCl, instead of LiCl	67 /72
7	Argon atmosphere	35
8	*w/o* acid or *w/o* electricity	0
9	*w/o* **A** or *w/o* light	0

[a] GC yield based on remaining SM without calibration. [b] Isolated pure product.

Table S2: Hydroxymethylation of isoquinoline.



Entry	Deviation from the GPB	Yield (%)[a]
1	none	56 (51)[b]
2	HNO_3 / H_3PO_4, instead of $(PhO)_2P(O)OH$	30 / 0
3	Bu_4NPF_6/ $LiClO_4$, instead of Bu_4NBF_4	36 / 30
4	Argon atmosphere[c]	40[d]
5	*w/o* acid or *w/o* electricity	0
6	*w/o* **A** or *w/o* light	0

[a] GC yield based on remaining SM without calibration. [b] Isolated pure product. [c] Three cycles of freeze-pump-thaw with Ar, then an Ar balloon connected. [d] 10% of 1-methylisoquinoline was also obtained.

GENERAL PROCEDURES

General procedure A (GPA):

In a 10 mL ElectraSyn vial -equipped with a stirring bar- was added the azaarene (0.30 mmol), LiCl (38 mg, 0.90 mmol, 3 equiv., in 1.2 mL of H_2O) and 9-(2-chlorophenyl)-2,7-dimethylacridine (**A**, 4.5 mg, 0.015 mmol, 5 mol%), followed by MeOH (4.2 mL) and HCl (1 M, 0.6 mL, 2 equiv.). All reagents were added in open-air conditions. The electrodes Gf (+)/Ni (-) were then inserted, and the reaction was stirred under galvanostatic conditions (2 mA) using ElectraSyn 2.0 while irradiated with blue LEDs (455 nm) at a distance of 5 cm for 24 h at room temperature (30-35ºC). Once this time elapsed, a saturated solution of K_2CO_3 was added (3 mL), and the organic phase was extracted with EtOAc (3x10 mL). After collecting and drying the organic phases over $MgSO_4$, the solvent was removed under reduced pressure, and the residue was purified by FC.

GPB:

In a 10 mL ElectraSyn vial -equipped (Figure S1) with a stirring bar- was added the azaarene (0.30 mmol), Bu_4NBF_4 (294 mg, 0.9 mmol, 3 equiv.), diphenyl phosphate (150 mg, 0.6 mmol, 2 equiv.) and 9-(2-chlorophenyl)-2,7-dimethylacridine (**A**, 4.5 mg, 0.015 mmol, 5 mol%), followed by H_2O (1.8 mL) and MeOH (4.2 mL). All reagents were added in open-air conditions. The electrodes Gf(+)/Ni (-) were then inserted, and the reaction was stirred under galvanostatic conditions (2 mA) using ElectraSyn 2.0 while irradiated with blue LEDs (455 cm) at a distance of 5 cm for 24 h at room temperature (30-35ºC). Once this time elapsed, a saturated solution of K_2CO_3 was added, and the organic phase was extracted with EtOAc (3x10 mL). After collecting and drying the organic phases over $MgSO_4$, the solvent was removed under reduced pressure, and the residue was purified by FC.

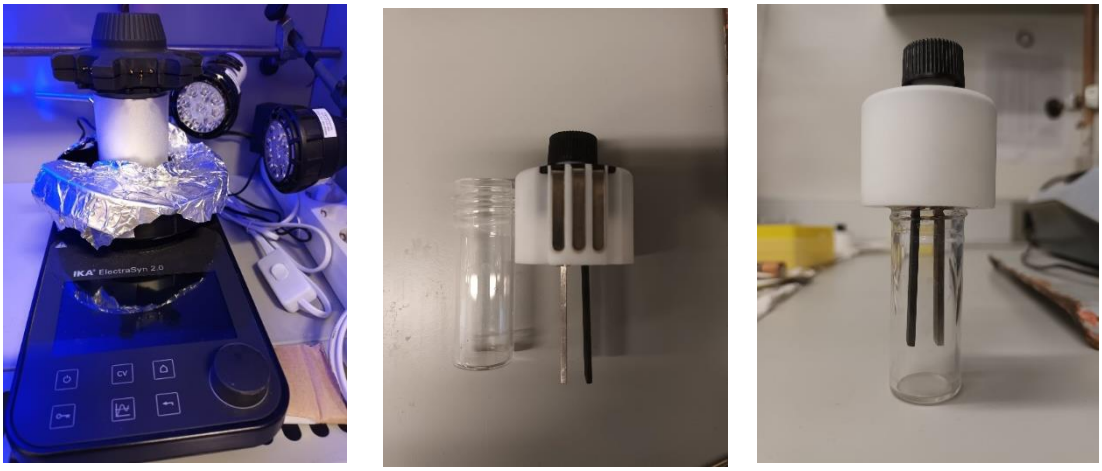
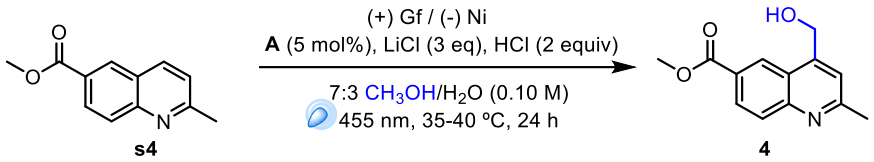


Figure S1: Equipment and electrodes used in the electrophotocatalytic reactions.

SCALE UP



Four reactions were run simultaneously using a carrousel designed for the IKA ElectraSyn 2.0 Pro equipment (Figure S2). Each reaction was set in a 10 mL vial equipped with a stirring bar, which was fed with methyl-2-methylquinoline-6-carboxylate (0.5 mmol), LiCl (64 mg, 1.5 mmol, 3 equiv., in 2 mL of H_2O) and 9-(2-chlorophenyl)-2,7-dimethylacridine (**A**, 7.5 mg, 5 mol%), followed by MeOH (7 mL) and HCl (1 M, 1 mL, 2 equiv.). The electrodes Gf(+)/Ni (-) were then inserted, and the reaction was stirred under galvanostatic conditions (2.5 mA) for 35 h (6.5 F·mol^{-1}) at room temperature (30-35 ºC). Once this time elapsed, all the rxms were collected and washed with a saturated solution of K_2CO_3 (1x10 mL). The aqueous phase was extracted with EtOAc (3x 50 mL), and the collected organic layers were dried over $MgSO_4$. After removal of the solvent under reduced pressure, EtOAc was added, and the precipitated solid was filtered and washed with more EtOAc to give product **4** as a pure white solid (310 mg, 1.34 mmol, 67%).

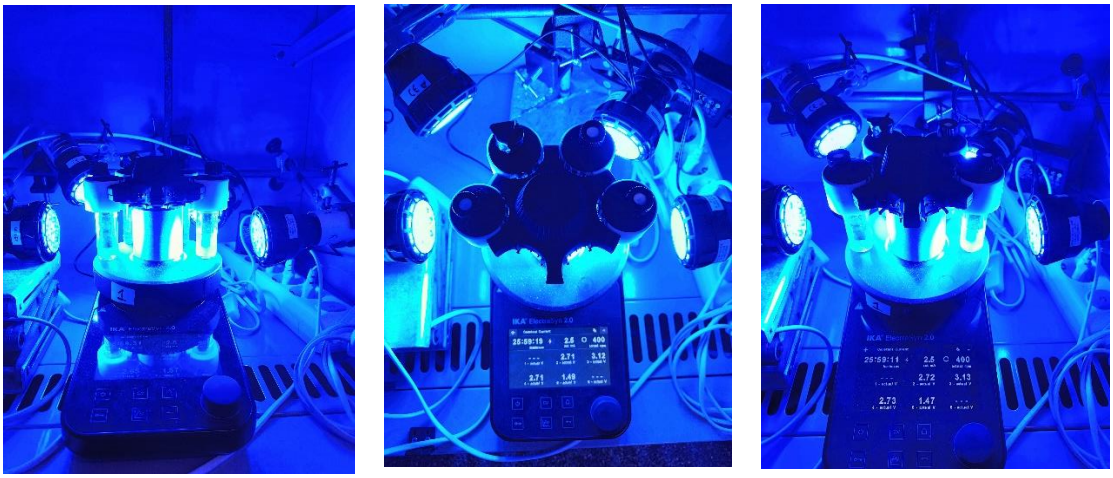


Figure S2: Set up used for the scale-up reaction.

USE OF A 1.5 V BATTERY AS A POWER SOURCE

In a 10 mL vial -equipped with a stirring bar- was added Methyl-2-methylquinoline-6-carboxylate (**s4**, 60 mg, 0.30 mmol), LiCl (38 mg, 0.90 mmol, 3 equiv, in 1.2 mL of H_2O) and 9-(2-chlorophenyl)-2,7-dimethylacridine (**A**, 4.5 mg, 0.015 mmol, 5 mol%), followed by MeOH (4.2 mL) and HCl (1 M, 0.6 mL, 2 equiv). The electrodes Gf(+)/Ni (-) were then inserted, and the reaction was stirred under 1.5 V connected by a battery while irradiated with blue LEDs (455 nm) for 24 h at room temperature (30-35ºC). Once this time elapsed, a saturated solution of K_2CO_3 was added (3 mL), and the organic phase was extracted with EtOAc (3x10 mL). After collecting and drying the organic phases over $MgSO_4$, the solvent was removed under reduced pressure. EtOAc was added, and the precipitated solid was filtered and washed with more EtOAc to give product **4** as a white solid (42 mg, 60%).

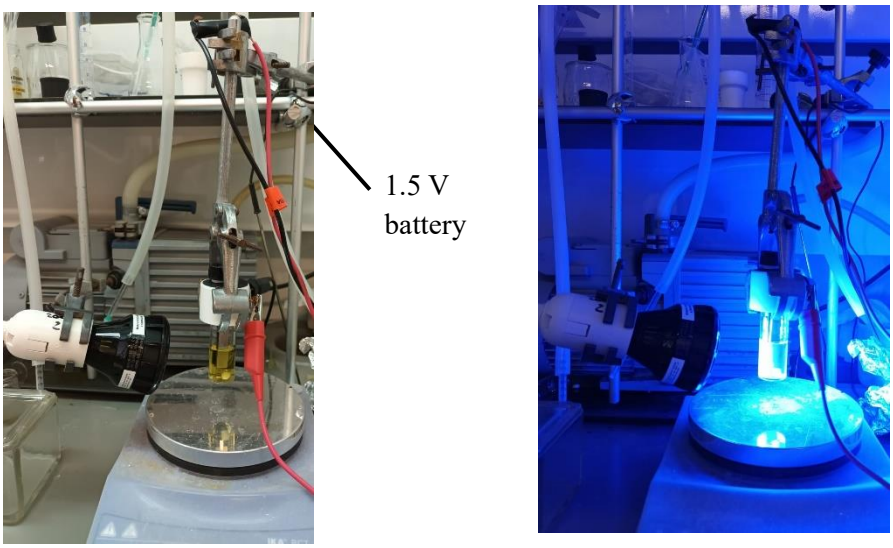


Figure S3: Reaction performed using a 1.5 V battery, and blue LEDs.

USE OF 1.5 V BATTERY UNDER SUNLIGHT IRRADIATION

In a 10 mL vial was added methyl-2-methylquinoline-6-carboxylate (60 mg, 0.30 mmol), LiCl (38 mg, 0.90 mmol, 3 equiv, in 1.2 mL of H_2O) and 9-(2-chlorophenyl)-2,7-dimethylacridine (**A**, 4.5 mg, 0.015 mmol, 5 mol%), followed by MeOH (4.2 mL) and HCl (1 M, 0.6 mL, 2 equiv). The electrodes Gf(+)/Ni (-) were then inserted, and the reaction was stirred under 1.5 V connected by a battery while irradiated with the sun for 48 h without stirring (about 4 days in total, Figure S4). Once this time elapsed, a saturated solution of K_2CO_3 was added (3 mL), and the organic phase was extracted with EtOAc (3x10 mL). After collecting and drying the organic phases over $MgSO_4$, the solvent was removed under reduced pressure. EtOAc was added, and the precipitated solid was filtered and washed with more EtOAc to give product **4** as a white solid (40 mg, 57%).

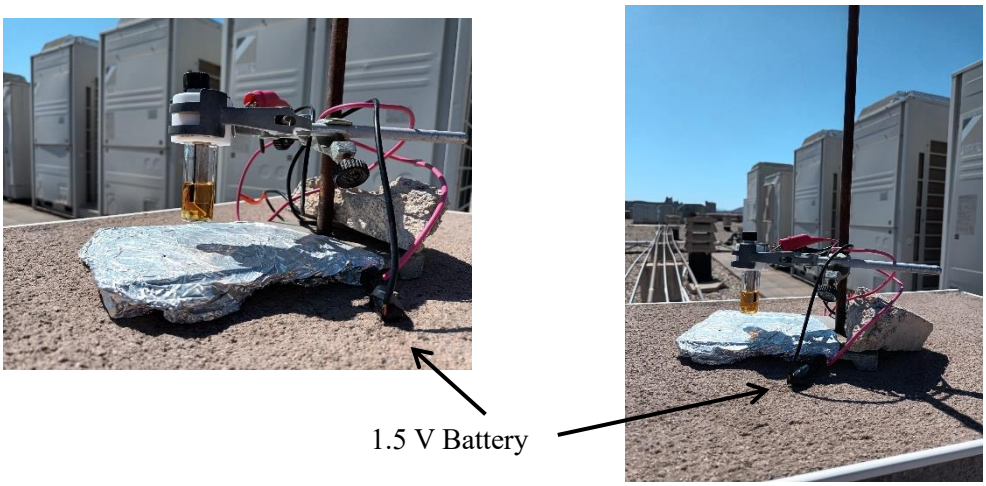
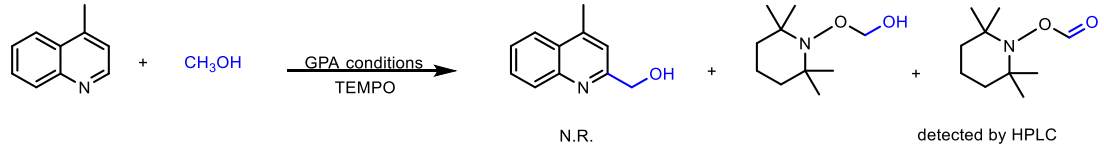


Figure S4: Reaction performed using a 1.5 V battery under solar irradiation.

MECHANISTIC STUDIES

Addition of TEMPO



In a 10 mL vial equipped with a stirring bar was added lepidine (0.30 mmol), LiCl (38 mg, 0.90 mmol, 3 equiv., in 1.2 mL of H_2O), 9-(2-chlorophenyl)-2,7-dimethylacridine (**A**, 4.5 mg, 0.015 mmol, 5 mol%) and TEMPO (94 mg, 0.6 mmol, 2 equiv.), followed by MeOH (4.2 mL) and HCl (1 M, 0.6 mL, 2 equiv.). The electrodes Gf(+)/Ni (-) were then inserted, and the reaction was stirred under galvanostatic conditions (2 mA) for 24 h at room temperature. Once the time elapsed, the reaction mixture was analyzed by HPLC (ES+). While the hydroxymethyl derivative was not observed, an adduct of TEMPO with formaldehyde (**Ad1** in Figure S5) was detected, likely from trapping the hydroxymethyl radical and further oxidation.

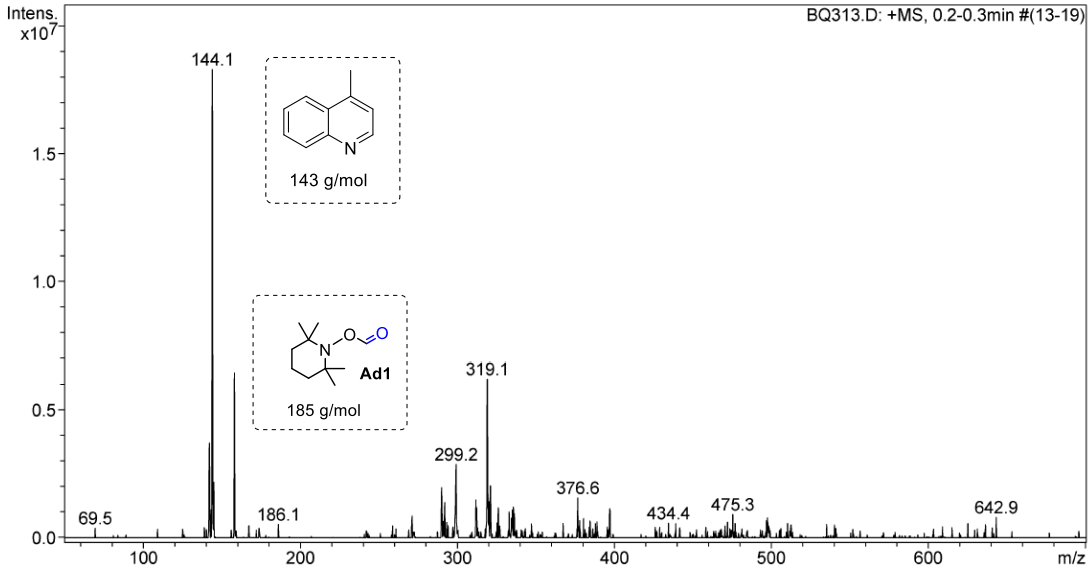
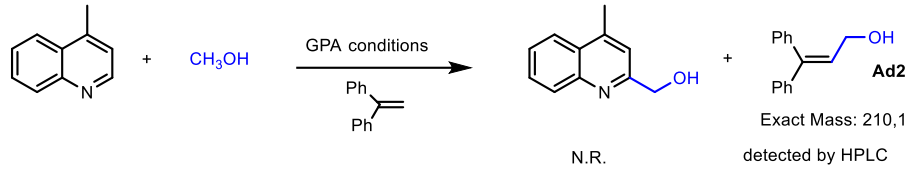


Figure S5: MS obtained for the reaction performed under GPA conditions and 2 equivalents of TEMPO.

Addition of 1,1-Diphenylethylene



In a 10 mL vial equipped with a stirring bar was added lepidine (0.30 mmol), LiCl (38 mg, 0.90 mmol, 3 equiv., in 1.2 mL of H_2O), 9-(2-chlorophenyl)-2,7-dimethylacridine (**A**, 4.5 mg, 0.015 mmol, 5 mol%) and 1,1- diphenylethylene (DPE, 104 µL, 0.6 mmol, 2 equiv.), followed by MeOH (4.2 mL) and HCl (1 M, 0.6 mL, 2 equiv.). The electrodes Gf(+)/Ni (-) were then inserted, and the reaction was stirred under galvanostatic conditions (2 mA) for 24 h at room temperature. Once the time elapsed, the reaction mixture was analyzed by HPLC (ES+). +). While the hydroxymethyl derivative was not observed, an adduct of DPE with the hydroxymethyl radical (**Ad2** in Figure S5) was detected.

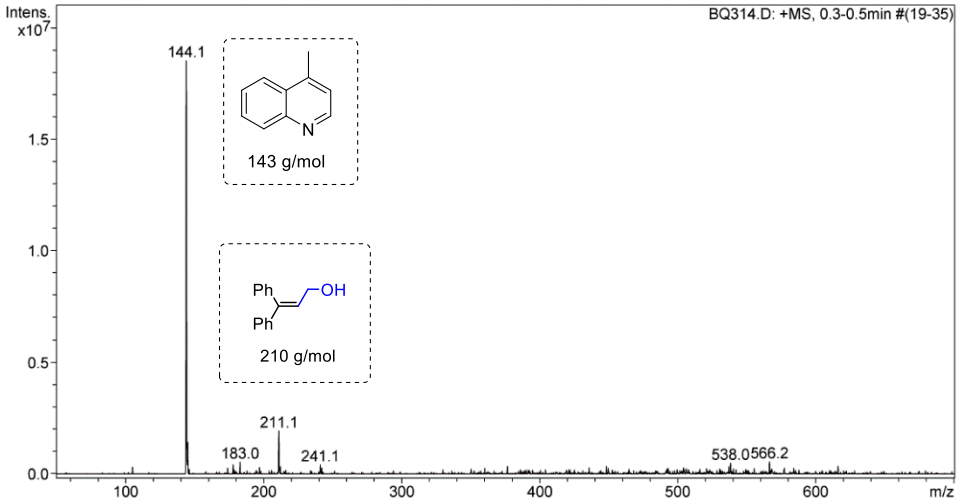


Figure S5: MS obtained for the reaction performed under GPA conditions and 2 equiv. of DPE.

Trapping Cl radical with 1,1-Diphenylethylene

In a 10 mL vial equipped with a stirring bar was added 1,1- diphenylethylene (53 µL, 0.30 mmol), LiCl (38 mg, 0.90 mmol, 3 equiv., in 1.2 mL of H_2O), 9-(2-chlorophenyl)-2,7-dimethylacridine (**A**, 4.5 mg, 0.015 mmol, 5 mol%) followed by MeCN (4.2 mL) and HCl (1 M, 0.6 mL, 2 equiv.). The electrodes Gf(+)/Ni (-) were then inserted, and the reaction was stirred under galvanostatic conditions (2 mA) for 24 h at room temperature. Once the time elapsed, the reaction mixture was analyzed by HPLC (ES+), observing the formation of 2-chloro-1,1-diphenylethan-1-ol by MS (Figure S6) and ^{1}H-NMR (Figure S7).

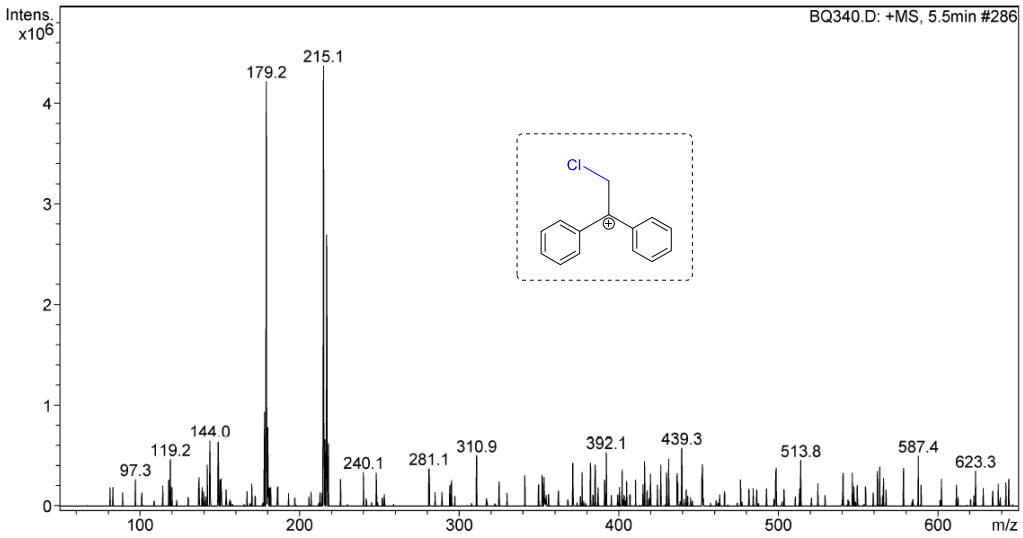


Figure S6: MS of the reaction performed without azaarene using 1 equiv. of DPE.

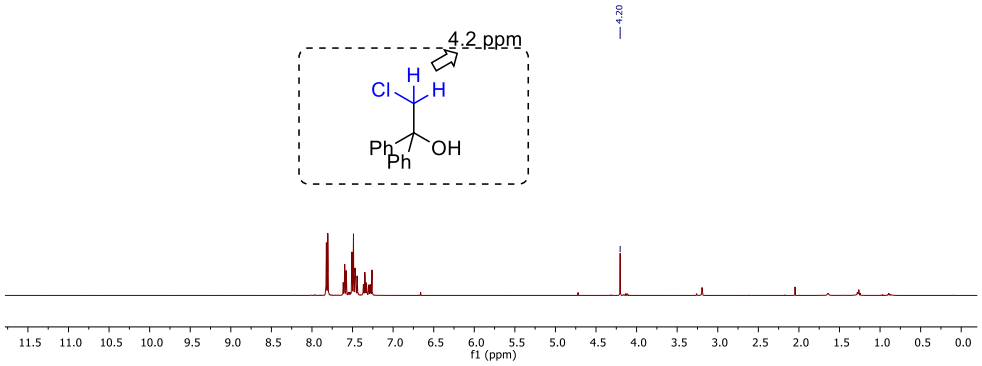


Figure S7: ^{1}H-NMR of the reaction performed without azaarene using 1 equiv. of DPE.

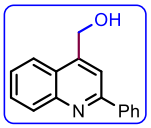
Addition of $CuCl_2$

In a 10 mL vial equipped with a stirring bar was added lepidine (0.30 mmol), LiCl (38 mg, 0.90 mmol, 3 equiv., in 1.2 mL of H_2O), 9-(2-chlorophenyl)-2,7-dimethylacridine (**A**, 4.5 mg, 0.015 mmol, 5 mol%) and $CuCl_2$ (120 mg, 0.9 mmol, 3 equiv.), followed by MeOH (4.2 mL) and HCl (1 M, 0.6 mL, 2 equiv). The electrodes Gf (+)/Ni (-) were then inserted, and the reaction was stirred under galvanostatic conditions (2 mA) for 24 h at room temperature. Once the time elapsed, the reaction mixture was analyzed by GC/MS, and no reaction was observed. This result suggests that electron transfers are key steps of this reaction.

CHARACTERIZATION OF PRODUCTS

(2-Phenyl-4-yl)methanol (1):

Following GPA with 2-phenylquinoline (62 mg, 0.30 mmol) in 24 h. The product was obtained as a white oil (55 mg, 0.23 mmol, 78%) after FC using a gradient from 0% to 30% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[7]



TLC: Rf = 0.48 (7:3 hexane/EtOAc, UV).

GC (Ti= 80 ºC): Rt 9.5 min.

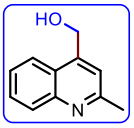
MS: *m/z* (%) 235 (M^+ 100), 234 (68), 206 (64), 204 (41), 205 (32).

^{1}H NMR (400 MHz, DMSO-d_6): δ 8.29 – 8.22 (m, 2H), 8.17 (d, J = 1.2 Hz, 1H), 8.10 (dd, J = 8.6, 1.3 Hz, 1H), 8.07 (dd, J = 8.4, 1.4 Hz, 1H), 7.77 (ddd, J = 8.4, 6.8, 1.4 Hz, 1H), 7.62 – 7.48 (m, 4H), 5.75 – 5.61 (m, 1H), 5.11 (d, J = 4.2 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 156.3, 149.2, 147.8, 139.3, 130.1, 130.0, 129.3, 127.5, 126.7, 125.1, 123.9, 115.7, 60.4.

(2-Methyl-4-yl)methanol (2):

Following GPA at 4 mA with quinaldine (40 µL, 0.30 mmol) in 24 h. The product was obtained as a white solid (46 mg, 0.26 mmol, 89%) after FC using a gradient from 0% to 50% of EtOAc in n-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[8]



TLC: Rf = 0.17 (7:3 hexane/EtOAc, UV)

GC (Ti= 80 ºC): Rt 6.7 min.

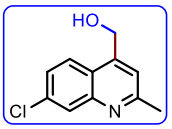
MS: *m/z* (%) 144 (M^+ 100), 173 (94).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.00 (d, J = 8.5 Hz, 1H), 7.85 (dd, J = 8.3, 1.4 Hz, 1H), 7.70 – 7.59 (m, 1H), 7.46 (t, J = 7.6 Hz, 1H), 7.39 (s, 1H), 5.17 (s, 2H), 2.63 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 159.0, 147.3, 146.5, 129.3, 128.8, 125.8, 124.1, 122.6, 119.1, 61.2, 25.1.

(2-Methyl-7-chloroquinoline -4-yl)methanol (3):

Following GPA at 4 mA with 2-methyl-7-chloroquinoline (53 mg, 0.30 mmol) in 24 h. The product was obtained as a white solid (35 mg, 0.17 mmol, 56%) after FC using a gradient from 0% to 50% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[8]



TLC: Rf = 0.20 (7:3 hexane/EtOAc, UV)

GC (Ti= 80 ºC): Rt 7.6 min.

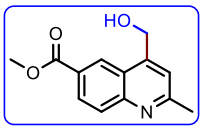
MS: *m/z* (%) 207 (M^+ 100), 178 (92), 209 (32).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.88 (d, J = 2.2 Hz, 1H), 7.74 (d, J = 8.9 Hz, 1H), 7.39 – 7.35 (m, 1H), 7.35 (d, J = 2.1 Hz, 1H), 5.01 (s, 2H), 2.61 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 160.3, 147.5, 147.4, 135.2, 127.2, 126.6, 124.1, 122.5, 119.2, 60.6, 24.7.

Methyl 4-(hydroxymethyl)-2-methylquinoline-6-carboxylate (4):

Following GPA with methyl-2-methylquinoline-6-carboxylate (60 mg, 0.30 mmol) in 24 h. After concentrating the rxm under vacuum, EtOAc (5 mL) was added and the white precipitated was filtered out and washed with EtOAc (2x 5 mL) to obtain the pure product (50 mg, 0.22 mmol, 72%). The spectroscopy data matched with previously reported in the literature. [9]



TLC: Rf = 0.25 (6:4 hexane/EtOAc, UV)

GC (Ti= 80 ºC): Rt 8.8 min.

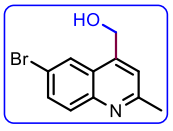
MS: *m/z* (%) 200 (M^+ 100), 231 (93), 142 (92), 202 (42), 144 (36), 207 (32).

^{1}H NMR (400 MHz, DMSO-d_6): δ 8.64 (d, J = 1.9 Hz, 1H), 8.16 (d, J = 10.7 Hz, 1H), 8.00 (d, J = 8.8 Hz, 1H), 7.53 (s, 1H), 5.65 (t, J = 5.3 Hz, 1H), 5.03 (d, J = 6.5 Hz, 2H), 3.92 (s, 3H), 2.68 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6): δ 166.5, 161.9, 149.6, 149.2, 129.7, 128.5, 126.6, 123.8, 120.5, 60.2, 52.8, 25.6.

2-Methyl-6-bromoquinoline -4-yl)methanol (5):

Following GPA at 4 mA with of 2-methyl-6-bromoquinoline (66 mg, 0.30 mmol) in 24 h. The product was obtained as a white solid (45 mg, 0.18 mmol, 60%) after FC using a gradient from 0% to 50% of EtOAc in n-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[9]



TLC: Rf = 0.27 (6:4 hexane/EtOAc, UV)

GC (Ti= 80 ºC): Rt 7.9 min.

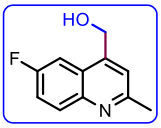
MS: *m/z* (%) 251 (M^+ 100), 253 (94), 222 (68), 224 (65), 143 (52), 144 (33).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.94 (d, J = 2.2 Hz, 1H), 7.75 (d, J = 9.0 Hz, 1H), 7.63 (dd, J = 9.0, 2.1 Hz, 1H), 7.39 (t, 1H), 4.96 (s, 2H), 2.59 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 159.5, 146.5, 145.5, 132.6, 129.9, 125.4, 125.2, 119.8, 119.7, 60.4, 24.6.

2-Methyl-6-fluoroquinoline -4-yl)methanol (6):

Following GPA with 2-methyl-6-fluoroquinoline (48 mg, 0.30 mmol) in 24 h. The product was obtained as a white solid (37 mg, 0.19 mmol, 65%) after FC using a gradient from 0% to 60% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[9]



TLC: Rf = 0.14 (7:3 hexane/EtOAc, UV)

GC (Ti= 80 ºC): Rt 7.0 min.

MS: *m/z* (%) 162 (M^+ 100), 191 (90).

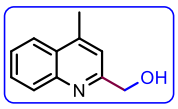
^{1}H NMR (400 MHz, $CDCl_3$): δ 8.03 (dd, J = 9.2, 5.5 Hz, 1H), 7.51 (dd, J = 9.8, 2.8 Hz, 1H), 7.47 – 7.39 (m, 2H), 5.11 (s, 2H), 2.71 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 161.2, 158.3, 145.3, 144.7, 131.5, 119.8, 119.3, 119.1, 106.7, 61.6, 25.2.

^{19}F NMR (377 MHz, CDCl3): δ -113.30.

(4-Methylquinolin-2-yl)methanol (7):

Following GPA at 4 mA with lepidine (43 µL, 0.30 mmol) in 24 h. The product was obtained as a white solid (49 mg, 0.28 mmol, 95%) after FC using a gradient from 0% to 50% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[10]



TLC: Rf = 0.2 (7:3 hexane/EtOAc, UV).

GC (Ti= 80 ºC): Rt 6.7 min.

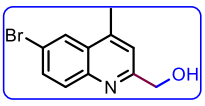
MS: *m/z* (%) 172 (M^+ 100), 173 (82), 144 (73), 143 (43), 115 (33), 142 (32).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.08 (d, J = 8.4 Hz, 1H), 7.98 (d, J = 8.3 Hz, 1H), 7.71 (t, J = 7.6 Hz, 1H), 7.56 (t, J = 7.6 Hz, 1H), 7.13 (s, 1H), 4.87 (s, 2H), 2.70 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 158.5, 146.4, 145.2, 129.5, 129.1, 127.6, 126.1, 123.8, 118.9, 63.9, 18.8.

4-Methyl-6-bromoquinolin-2-yl)methanol (8):

Following GPA with 2-methyl-6-bromoquinoline (67 mg, 0.30 mmol) in 24 h. The product was obtained as a yellow solid (41 mg,0.16 mmol, 55%) after FC using a gradient from 0% to 50% of EtOAc in n-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[11]



TLC: Rf = 0.23 (7:3 hexane/EtOAc, UV)

GC (Ti= 80 ºC): Rt 7.8 min.

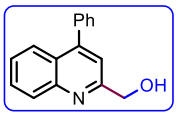
MS: *m/z* (%) 252 (M^+ 100), 250 (95), 251 (87), 222 (81), 253 (79), 224 (66), 142 (59), 143 (48), 115 (41), 141 (35), 223 (33).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.09 (d, J = 2.2 Hz, 1H), 7.90 (d, J = 8.9 Hz, 1H), 7.75 (dd, J = 8.9, 2.2 Hz, 1H), 7.13 (s, 1H), 4.84 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 159.2, 145.1, 144.2, 132.8, 130.8, 128.8, 126.3, 120.1, 119.7, 64.0, 18.7.

4-Phenylquinolin-2-yl)methanol (9):

Following GPA with 4-phenylquinoline (62 mg, 0.30 mmol) in 24 h. The product was obtained as a yellow solid (45 mg,0.19 mmol, 65%) after FC using a gradient from 0% to 40% of EtOAc in *n*-hexane as the eluent.



TLC: Rf = 0.25 (7:3 hexane/EtOAc, UV).

GC (Ti= 80 ºC): Rt 8.8 min.

MS: *m/z* (%) 234 (M^+ 100), 235 (74), 206 (56), 204 (42).

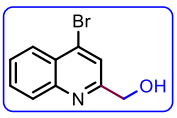
HRMS (Q-TOF): *m/z* calcd for $C_{16}H_{13}NO$ 235.0997, found 235.0969.

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.14 (dt, J = 8.4, 1.0 Hz, 1H), 7.90 (dd, J = 8.5, 1.4 Hz, 1H), 7.76 – 7.67 (m, 1H), 7.56 – 7.40 (m, 6H), 7.25 (s, 1H), 4.96 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 158.6, 149.3, 147.2, 137.9, 129.6, 129.4, 128.9, 128.6, 128.5, 126.4, 126.2, 125.9, 118.6, 64.2.

4-Bromoquinolin-2-yl)methanol (10):

Following GPA with 4-bromoquinoline (62 mg, 0.30 mmol) in 24 h. The product was obtained as a red solid (32 mg,0.13 mmol, 45%) after FC using a gradient from 0% to 40% of EtOAc in n-hexane as the eluent. The spectroscopy data matched with previously reported in the literature. [10]



TLC: Rf = 0.17 (8:2 hexane/EtOAc, UV).

GC (Ti= 80 ºC): Rt 7.2 min.

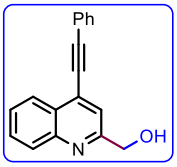
MS: *m/z* (%) 238 (M^+ 100), 236 (96), 128 (79), 237 (76), 208 (74), 239 (73), 129 (60), 210 (55), 127 (43), 101 (42).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.18 (d, J = 10.0 Hz, 1H), 8.06 (d, J = 8.6 Hz, 1H), 7.77 (ddd, J = 8.4, 7.0, 1.4 Hz, 1H), 7.68 – 7.60 (m, 2H), 4.90 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 159.1, 147.3, 134.7, 130.7, 129.0, 127.6, 126.8, 124.2, 122.3, 63.8.

(4-(Phenylethynyl)quinolin-2-yl)methanol (11):

Following GPA at constant voltage with 4-(phenylethynyl)quinoline (69 mg, 0.30 mmol) in 24 h. The product was obtained as a yellow oil (31 mg, 0.12 mmol, 40%) after FC using a gradient from 0% to 60% of EtOAc in *n*-hexane as the eluent.



TLC: Rf = 0.25 (7:3 hexane/EtOAc, UV).

GC (Ti= 80 ºC): Rt 18.181 min

GC/MS: *m/z* (%) 258 (M^+ 100), 259 (80), 230 (40).

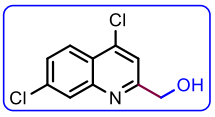
HRMS (Q-TOF): *m/z* calcd for $C_{18}H_{13}NO$ 259.0979, found 203.0971.

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.36 (d, J = 8.3 Hz, 1H), 8.11 (d, J = 8.0 Hz, 1H), 7.78 (d, J = 6.9 Hz, 1H), 7.65 (d, J = 12.6 Hz, 3H), 7.50 (s, 1H), 7.45 – 7.42 (m, 3H), 4.93 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 158.5, 146.5, 132.0, 130.3, 129.4, 128.8, 128.6, 127.0, 126.0, 122.1, 120.9, 98.7, 84.9, 64.0.

4,7-Dicholoroquinolin-2-yl)methanol (12):

Following GPA at constant voltage with 4,7-dichloroquinoline (59 mg, 0.30 mmol) in 24 h. The product was obtained as a yellow oil (35 mg, 0.15 mmol, 51%) after FC using a gradient from 0% to 30% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[12]



TLC: Rf = 0.27 (8:2 hexane/EtOAc, UV).

GC (Ti= 80 ºC): Rt 7.5 min.

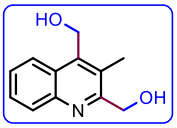
MS: *m/z* (%) 226 (M^+ 100), 228 (75), 227 (74), 198 (71), 229 (50), 162 (45), 200 (43).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.14 (d, J = 8.9 Hz, 1H), 8.07 (d, J = 2.1 Hz, 1H), 7.57 (dd, J = 8.9, 2.0 Hz, 1H), 7.42 (s, 1H), 4.89 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 160.6, 147.9, 143.2, 136.9, 128.3, 128.0, 125.6, 124.2, 118.6, 64.0.

(3-Methylquinoline-2,4-diyl)dimethanol (13):

Following GPA with 3-methylquinoline (43 mg, 0.30 mmol) in 24 h. The product was obtained as a white solid (45 mg, 0.22 mmol, 74%) after FC using a gradient from 0% to 80% of EtOAc in *n*-hexane as the eluent.



TLC: Rf = 0.35 (6:4 hexane/EtOAc, UV)

GC (Ti= 80 ºC): Rt 15.5 min.

GC/MS: *m/z* (%) 203 (M^+ 100), 167 (42), 281 (35), 231 (34).

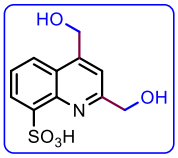
HRMS (Q-TOF): *m/z* calcd for $C_{12}H_{13}NO_2$ 203.0946, found 203.0937.

^{1}H NMR (400 MHz, MeOD-d_4): δ 8.26 (d, J = 8.5 Hz, 1H), 8.04 (d, J = 10.0 Hz, 1H), 7.68 (t, J = 8.3 Hz, 1H), 7.63 – 7.56 (m, 1H), 5.12 (s, 2H), 4.88 (s, 2H), 2.54 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6): δ 159.8, 145.3, 143.6, 129.1, 128.6, 128.1, 126.9, 126.5, 124.9, 64.3, 55.9, 13.5.

2,4-Bis(hydroxymethyl)quinoline-8-sulfonic acid (14):

Following GPA with 4-phenylquinoline (63 mg, 0.30 mmol) in 24 h. After filtration from the reaction mixture, the product was obtained as a white solid (40 mg, 0.15 mmol, 50%) and washed with EOtAc.

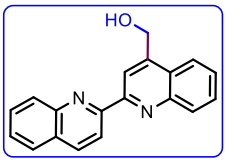


^{1}H NMR (400 MHz, DMSO-d_6): δ 8.37 (t, J = 9.6 Hz, 2H), 8.07 (s, 1H), 8.00 – 7.90 (m, 1H), 5.30 (s, 2H), 5.21 (s, 2H).

^{13}C NMR (101 MHz, DMSO-d_6): δ 161.2, 160.9, 137.3, 132.2, 131.5, 129.1, 126.6, 125.0, 115.96, 60.6, 60.4.

[2,2'-Biquinolin]-4-ylmethanol (15):

Following GPA with 2,2'-biquinoline (77 mg, 0.30 mmol) in 24 h. The product was obtained as a yellow solid (40 mg, 0.14 mmol, 47%) after FC using a gradient from 0% to 40% of EtOAc in *n*-hexane as the eluent.



TLC: Rf = 0.4 (7:3 hexane/EtOAc, UV)

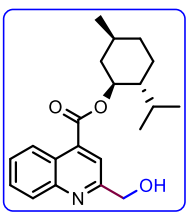
HRMS (Q-TOF): *m/z* calcd for $C_{19}H_{14}N_2O$ 286.1106, found 286.1105.

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.90 (s, 1H), 8.82 (d, J = 8.6 Hz, 1H), 8.33 (d, J = 8.8 Hz, 1H), 8.29 – 8.20 (m, 2H), 8.05 (d, J = 8.2 Hz, 1H), 7.89 (d, J = 8.1 Hz, 1H), 7.79 – 7.72 (m, 2H), 7.59 (td, J = 7.5, 6.9, 3.5 Hz, 2H), 5.30 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 156.2, 156.1, 147.9, 146.5, 136.8, 130.5, 129.8, 129.6, 129.4, 128.4, 127.6, 127.1, 127.0, 126.8, 126.0, 123.1, 119.4, 116.7, 62.3.

(1S*,2R*,5S*)-2-Isopropyl-5-methylcyclohexyl 2-(hydroxymethyl)quinoline-4-carboxylate (16):

Following GPA with ((1S*,2R*,5S*)-2-isopropyl-5-methylcyclohexyl quinoline-4-carboxylate) (94 mg, 0.30 mmol) in 24 h. The product was obtained as a red oil (46 mg, 0.13 mmol, 45%) after FC using a gradient from 0% to 50% of EtOAc in *n*-hexane as the eluent.



TLC: Rf = 0.4 (6:4 hexane/EtOAc, UV).

GC (Ti= 80 ºC): Rt 18.874 min

GC/MS: *m/z* (%) 204 (M^+ 80), 186 (60), 341 (40).

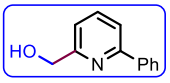
HRMS (Q-TOF): *m/z* calcd for $C_{21}H_{27}NO_3$ 341.1991, found 341.1973.

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.70 (d, J = 9.5 Hz, 1H), 8.12 (d, J = 8.4 Hz, 1H), 7.78 (s, 2H), 7.63 (t, J = 8.3 Hz, 1H), 5.14 – 5.06 (m, 1H), 4.98 (s, 2H), 2.21 (d, J = 19.6 Hz, 1H), 1.94 (s, 1H), 1.76 (d, J = 12.6 Hz, 3H), 1.64 – 1.55 (m, 2H), 1.26 – 1.11 (m, 3H), 0.97 (d, J = 6.5 Hz, 3H), 0.93 (d, J = 7.0 Hz, 3H), 0.84 (d, J = 7.0 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 165.6, 158.5, 147.6, 136.7, 130.0, 129.1, 127.7, 125.6, 124.5, 119.3, 76.1, 64.2, 47.1, 40.9, 34.1, 31.5, 26.4, 23.3, 22.0, 20.8, 16.2.

(2-Phenylpyridin-6-yl)methanol (17a):

Following GPA with 2-phenylpyridine (43 µL, 0.30 mmol) in 24 h. The products were obtained as yellow oils (C6 isomer: 6 mg, 0.03 mmol, 10%) (C4 isomer: 28 mg, 0.15 mmol, 50 %) after FC using a gradient from 0% to 40% of EtOAc in n-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[14]

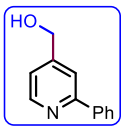


TLC: Rf = 0.53 (7:3 hexane/EtOAc, UV)

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.02 (d, J = 8.2 Hz, 2H), 7.76 (t, 1H), 7.66 (d, 1H), 7.56 – 7.39 (m, 3H), 7.17 (d, 1H), 4.82 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 138.7, 137.4, 129.2, 129.2, 128.7, 126.8, 119.0, 118.7, 63.8.

(2-Phenylpyridin-4-yl)methanol (17b):



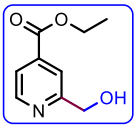
TLC: Rf = 0.26 (7:3 hexane/EtOAc, UV)

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.60 (d, J = 6.6 Hz, 1H), 7.95 (d, J = 7.4 Hz, 2H), 7.69 (s, 1H), 7.44 (dt, J = 13.6, 7.0 Hz, 3H), 7.19 (d, J = 4.9 Hz, 1H), 4.76 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 157.7, 150.8, 149.6, 139.2, 129.0, 128.7, 127.0, 119.6, 118.0, 63.6.

Ethyl 2-(hydroxymethyl)isonicotinate (18):

Following GPA with ethyl isonicotinate (46 µL, 0.30 mmol) in 24 h. The product was obtained as a white oil (19 mg, 0.10 mmol, 35%) after FC using a gradient from 0% to 50% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature. [13]



TLC: Rf = 0.28 (7:3 hexane/EtOAc, UV)

GC (Ti= 80 ºC): Rt 5.692 min.

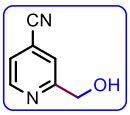
GC/MS: *m/z* (%) 181 (M^+ 100), 152 (90), 181 (61), 136 (40), 124 (39), 153 (33).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.70 (d, J = 5.1 Hz, 1H), 7.83 (dd, J = 1.6, 0.9 Hz, 1H), 7.77 (ddt, J = 5.2, 1.6, 0.7 Hz, 1H), 4.84 (s, 2H), 4.42 (q, J = 7.1 Hz, 2H), 1.41 (t, J = 7.1 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 165.0, 160.2, 149.3, 138.4, 121.6, 119.8, 64.2, 61.9, 14.2.

2-(Hydroxymethyl)isonicotinonitrile (19):

Following GPA with 4-cyanopyridine (31 mg, 0.30 mmol) in 24 h. The product was obtained as a yellow solid (17 mg, 0.13 mmol, 42%) after FC using a gradient from 0% to 50% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[9]



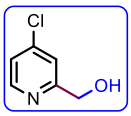
TLC: Rf = 0.4 (7:3 hexane/EtOAc, UV)

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.75 (d, J = 4.9 Hz, 1H), 7.58 (s, 1H), 7.45 (d, J = 5.7 Hz, 1H), 4.85 (s, 2H), 3.24 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 161.2, 149.7, 123.8, 122.2, 121.1, 116.4, 64.1.

(4-Chloropyridin-2-yl)methanol (20):

Following GPA with 4-chloropyridine (34 mg, 0.30 mmol) in 24 h. The product was obtained as a white solid (26 mg, 0.18 mmol, 60%) after FC using a gradient from 0% to 40% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[14]



TLC: Rf = 0.35 (6:4 hexane/EtOAc, UV)

GC (Ti= 80 ºC): 4.031 min

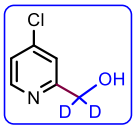
GC/MS: *m/z* (%) 142 (M^+ 100), 143 (39), 114 (38), 144 (33).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.45 (d, J = 5.3 Hz, 1H), 7.35 – 7.29 (m, 1H), 7.22 (d, J = 7.3 Hz, 1H), 4.75 (s, 2H), 3.56 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 161.0, 149.5, 144.8, 122.8, 120.8, 64.0.

(4-Chloropyridin-2-yl)methan-D_2-ol (21):

Following GPA with 4-chloropyridine (34 mg, 0.30 mmol) in 24 h. The product was obtained as a white solid (22 mg, 0.15 mmol, 51%) after FC using a gradient from 0% to 50% of EtOAc in *n*-hexane as the eluent.



TLC: Rf = 0.34 (6:4 hexane/EtOAc, UV)

GC (Ti= 80 ºC): 4.010 min

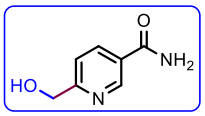
GC/MS: *m/z* (%) 143 (M^+ 100), 145 (92), 115 (43), 144 (35).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.45 (d, J = 5.3 Hz, 1H), 7.32 (d, J = 1.7 Hz, 1H), 7.22 (dd, J = 5.4, 2.0 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 161.0, 149.5, 144.8, 122.8, 120.9.

6-(Hydroxymethyl)nicotinamide (22):

Following GPA at constant voltage with nicotinamide (37 mg, 0.30 mmol) in 24 h. The product was obtained as a yellow oil (20 mg, 0.13 mmol, 44%) after FC using a gradient from 0% to 40% of EtOAc: EtOH: NH_3 (49:49:2) in *n*-hexane as the eluent.



TLC: Rf = 0.35 (6:4 hexane/ EtOAc: EtOH:NH_3 ((49:49:2)), UV)

GC (Ti= 80 ºC): 13.020 min

GC/MS: *m/z* (%) 151 (M^+100), 152 (90).

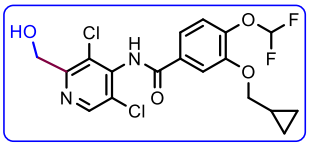
HRMS (Q-TOF): *m/z* calcd for $C_7H_8N_2O_2$ 152.0586, found 152.0574.

^{1}H NMR (400 MHz, DMSO-d_6): δ 8.93 (dd, J = 2.3, 0.8 Hz, 1H), 8.21 (dd, J = 8.1, 2.3 Hz, 1H), 8.12 (s, 1H), 7.58 – 7.47 (m, 2H), 5.54 (t, J = 5.8 Hz, 1H), 4.60 (d, J = 5.8 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 166.9, 165.2, 148.2, 136.1, 128.3, 119.8, 64.5.

3-(cyclopropylmethoxy)-N-(3,5-dichloro-2-(hydroxymethyl)pyridin-4-yl)-4-(difluoromethoxy)benzamide (23):

Following GPA at constant voltage with Roflumilast (129 mg, 0.30 mmol) in 24 h. The product was obtained as a brown solid (44 mg, 0.10 mmol, 34%) after FC using a gradient from 0% to 70% of EtOAc in *n*-hexane as the eluent.



TLC: Rf = 0.30 (6:4 hexane/EtOAc, UV)

HRMS (Q-TOF): *m/z* calcd for $C_{18}H_{16}Cl_2F_2N_2O_4$ 432.0455, found 432.0473.

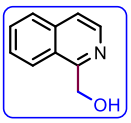
^{1}H NMR (400 MHz, $CDCl_3$): δ 8.54 (s, 1H), 7.91 (s, 1H), 7.58 (d, J = 2.1 Hz, 1H), 7.48 (dd, J = 8.3, 2.1 Hz, 1H), 7.29 – 7.26 (m, 1H), 6.74 (t, J = 74.8 Hz, 1H), 4.79 (s, 2H), 3.95 (d, J = 6.9 Hz, 2H), 1.34 – 1.28 (m, 1H), 0.70 – 0.63 (m, 2H), 0.37 (dt, J = 6.0, 4.7 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.8, 155.3, 150.9, 146.1, 140.2, 130.7, 127.8, 126.0, 122.3, 119.9, 115.6, 114.2, 74.2, 61.7, 10.0, 3.3.

^{19}F NMR (377 MHz, CDCl3): δ -82.05.

Isoquinolin-1-ylmethanol (24):

Following GPB with isoquinoline (36 µL, 0.30 mmol) in 24 h. The product was obtained as a white solid (25 mg, 0.16 mmol, 51%) after FC using a gradient from 0% to 40% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[8]



TLC: Rf = 0.30 (7:3 hexane/EtOAc, UV)

GC (Ti= 80 ºC): 6.171 min

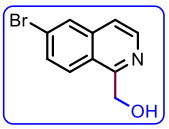
GC/MS: *m/z* (%) 130 (M^+ 100), 158 (61), 159 (57), 128 (40), 129 (35).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.45 (d, J = 5.8 Hz, 1H), 7.93 (d, J = 9.3 Hz, 1H), 7.87 (d, J = 8.2 Hz, 1H), 7.74 – 7.70 (m, 1H), 7.64 (d, J = 9.6 Hz, 1H), 7.60 (d, J = 5.7 Hz, 1H), 5.24 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 157.4, 140.3, 135.9, 130.5, 130.1, 127.5, 127.4, 123.1, 120.3, 61.4.

(6-Bromoisoquinolin-1-yl)methanol (25):

Following GPB with 6-bromoisoquinoline (62 mg, 0.30 mmol) in 24 h. The product was obtained as a red oil (35 mg, 0.15 mmol, 50%) after FC using a gradient from 0% to 40% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[10]



TLC: Rf = 0.35 (7:3 hexane/EtOAc, UV)

GC (Ti= 80 ºC): 6.677 min

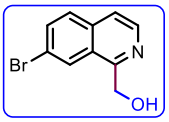
GC/MS: *m/z* (%) 207 (M^+ 90), 209 (85), 237 (60), 235 (64).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.47 (d, J = 5.8 Hz, 1H), 8.05 (d, J = 1.8 Hz, 1H), 7.80 (d, J = 8.9 Hz, 1H), 7.71 (d, J = 7.0 Hz, 1H), 7.52 (d, J = 5.8 Hz, 1H), 5.21 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 157.7, 141.5, 137.0, 131.1, 129.5, 125.3, 124.9, 123.4, 119.3, 61.3.

(7-Bromoisoquinolin-1-yl)methanol (26):

Following GPB with 7-bromoisoquinoline (62 mg, 0.30 mmol) in 24 h. The product was obtained as an orange solid (34 mg, 0.14 mmol, 48%) after FC using a gradient from 0% to 50% of EtOAc in *n*-hexane as the eluent.



TLC: Rf = 0.25 (7:3 hexane/EtOAc, UV)

GC (Ti= 80 ºC): 6.801 min

HRMS (Q-TOF): *m/z* calcd for $C_{10}H_8BrNO$ 236.9789, found 236.9755.

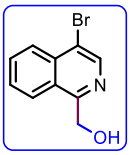
GC/MS: *m/z* (%)207 (M^+ 100), 209 (90), 235 (60).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.49 (d, J = 5.8 Hz, 1H), 8.08 (s, 1H), 7.80 (d, J = 8.8 Hz, 1H), 7.75 (d, J = 8.8 Hz, 1H), 7.58 (d, J = 5.6 Hz, 1H), 5.19 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 156.6, 140.9, 134.3, 134.0, 129.1, 125.9, 125.7, 121.4, 120.0, 61.4.

(4-Bromoisoquinolin-1-yl)methanol (27):

Following GPB with 4-bromoisoquinoline (62 mg, 0.30 mmol) in 24 h. The product was obtained as a red oil (21 mg, 0.09 mmol, 30%) after FC using a gradient from 0% to 50% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[9]



TLC: Rf = 0.20 (7:3 hexane/EtOAc, UV)

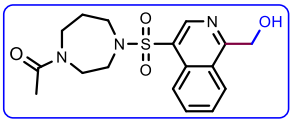
GC (Ti= 80 ºC): 7.345 min

GC/MS: *m/z* (%) 238 (M^+ 100), 236 (90), 251 (51).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.66 (s, 1H), 8.23 (dt, J = 8.5, 1.0 Hz, 1H), 7.93 (dt, J = 8.4, 1.0 Hz, 1H), 7.84 (tt, J = 8.7, 1.5 Hz, 1H), 7.70 (tt, J = 7.0, 1.2 Hz, 1H), 5.21 (s, 2H), 4.69 (s, 1H).

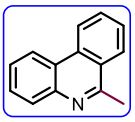
^{13}C NMR (101 MHz, $CDCl_3$): δ 157.0, 142.1, 134.5, 131.7, 128.5, 126.8, 126.0, 123.5, 118.9, 61.3.

1-(4-((1-(hydroxymethyl)isoquinolin-4-yl)sulfonyl)-1,4-diazepan-1-yl)ethan-1-one (28):
Following GPB with *N*-acetyl fasudil (54 mg, 0.15 mmol) in 24 h. The product was obtained as a green oil (19 mg, 0.052 mmol, 35%) after FC using a gradient from 0% to 10% of MeOH in dichloromethane as the eluent. The spectroscopy data matched with previously reported in the literature. [15]



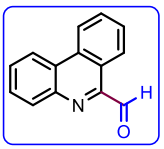
TLC: Rf = 0.4 (10:1 Dichloromethane/MeOH, UV)
^{1}H NMR (400 MHz, $CDCl_3$): δ 8.67 – 8.57 (m, 1H), 8.44 – 8.28 (m, 2H), 8.22 – 8.13 (m, 1H), 7.77 – 7.64 (m, 1H), 5.28 (s, 2H), 4.83 (s, 1H), 3.74 – 3.59 (m, 4H), 3.51 – 3.37 (m, 4H), 2.07 (s, 1H), 2.05 (s, 2H), 2.01 – 1.95 (m, 2H).
^{13}C NMR (101 MHz, $CDCl_3$): δ 170.2, 142.6, 142.6, 132.9, 132.8, 131.8, 128.9, 128.8, 126.1, 116.9, 116.9, 61.7, 50.8, 49.1, 47.8, 47.6, 46.8, 44.4, 29.7, 28.9, 21.5, 21.0.

Phenanthridine-6-methyl (29):
Following GPA with phenantridine (54 mg, 0.30 mmol) in 24 h. The product was obtained as a white solid (40 mg, 0.21 mmol, 70%) after FC using a gradient from 0% to 10% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[17]



TLC: Rf = 0.4 (9:1 hexane/EtOAc, UV).
GC (Ti= 80 ºC): 7.580 min.
GC/MS: *m/z* (%) 193 (M^+ 100).
^{1}H NMR (300 MHz, $CDCl_3$): δ 8.59 (d, J = 8.7 Hz, 1H), 8.51 (d, J = 8.1 Hz, 1H), 8.19 (d, J = 7.7 Hz, 1H), 8.10 (d, J = 8.1 Hz, 1H), 7.86 – 7.76 (m, 1H), 7.72 (d, J = 8.4 Hz, 1H), 7.67 (s, 1H), 7.66 – 7.56 (m, 1H), 3.03 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$): δ 158.8, 143.6, 132.5, 130.4, 129.3, 128.6, 127.2, 126.5, 126.3, 125.8, 123.7, 122.3, 121.9, 23.4.

Phenanthridine-6-carbaldehyde (30):
Following GPB with phenantridine (54 mg, 0.30 mmol) in 24 h, but fixing the voltage at 1.5 V. The product was obtained as a yellow solid (40 mg, 0.19 mmol, 64%) after FC using a gradient from 0% to 10% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[16] When the same reaction was conducted under Ar atmosphere, 55% of the product was obtained (34 mg, 0.16 mmol).



TLC: Rf = 0.5 (9:1 hexane/EtOAc, UV)

GC (Ti= 80 ºC): 7.967 min

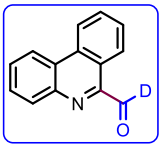
GC/MS: *m/z* (%) 179 (M^+ 100), 207 (55), 178 (38), 142 (32).

^{1}H NMR (400 MHz, $CDCl_3$): δ 10.41 (s, 1H), 9.41 (d, J = 9.0 Hz, 1H), 8.66 (d, J = 8.3 Hz, 1H), 8.61 (d, J = 9.6 Hz, 1H), 8.34 (s, 1H), 7.90 (t, J = 7.7 Hz, 1H), 7.79 (d, J = 18.4 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 195.7, 150.2, 143.3, 133.4, 131.3, 131.2, 129.9, 129.2, 128.7, 126.9, 125.6, 123.5, 122.2, 121.9.

Phenanthridine-6-carbaldehyde-D (31):

Following GPB with phenantridine (27 mg, 0.15 mmol) in 24 h, but fixing the voltage at 1.5 V. The product was obtained as a white solid (25 mg, 0.12 mmol, 80%) after FC using a gradient from 0% to 10% of EtOAc in *n*-hexane as the eluent.



TLC: Rf = 0.50 (9:1 hexane/EtOAc, UV)

GC (Ti= 80 ºC): 7.947 min

GC/MS: *m/z* (%) 180 (M^+ 100), 208 (66),142 (48), 178 (37), 179 (35), 151 (31).

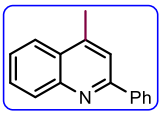
HRMS (Q-TOF): *m/z* calcd for $C_{14}H_8DNO$ 208.0747, found 208.0749.

^{1}H NMR (400 MHz, $CDCl_3$): δ 9.42 (d, J = 8.2 Hz, 1H), 8.75 – 8.51 (m, 2H), 8.40 – 8.24 (m, 1H), 7.96 – 7.68 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 195.3, 150.2, 143.3, 133.4, 131.2, 131.1, 129.9, 129.2, 128.7, 126.9, 125.6, 123.5, 122.2, 121.9.

4-Methyl-2-phenylquinoline (32):

In a two-dram vial equipped with a stirring bar, was added 2-phenylquinoline (66 mg, 0.30 mmol), pyridine *N*-oxide (8.4 mg, 0.09 mmol, 30 mol%), and 9-(2-Chlorophenyl)-2,7-dimethylacridine (**A**, 4.4 mg, 0.015 mmol, 5 mol%), followed by a mixture of MeOH/H_2O (7:3, 3 mL). Then, TFA (45 µL, 0.60 mmol, 2 equiv.) was added, and the mixture was stirred and irradiated with blue LEDs at room temperature for 24h. The product was obtained as a white solid (53 mg, 0.24 mmol, 80%) after FC using a gradient from 0% to 10% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature.[18]



TLC: Rf = 0.42 (9:1 Hexane/EtOAc, UV).

GC (Ti= 80 ºC): 8.512 min.

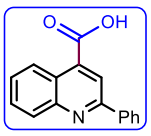
GC/MS: *m/z* (%) 204 (M^+ 100), 219 (88), 218 (83), 217 (48), 220 (36).

^{1}H NMR (300 MHz, $CDCl_3$): δ 8.22 – 8.13 (m, 3H), 8.00 (d, J = 9.3 Hz, 1H), 7.77 – 7.69 (m, 2H), 7.58 – 7.49 (m, 3H), 7.47 (d, J = 7.3 Hz, 1H), 2.77 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 157.1, 148.1, 144.8, 139.8, 130.3, 129.3, 129.2, 128.8, 127.5, 126.0, 123.6, 119.8, 19.0.

2-Phenylquinoline-4-carbaldehyde (33):

To an undivided three-necked flask were added (2-phenyl-4-yl)methanol (70 mg, 0.30 mmol), $^{n}Bu_4NBF_4$ (164 mg, 0.5 mmol, 0.05 M), TFA (27 µL, 0.36 mmol, 1.2 equiv.) and CH_3CN (10 mL). The flask was equipped with graphite felt as anode and platinum plate electrode as cathode. The reaction mixture was stirred and electrolyzed at a constant current (5 mA) under air at 60 °C for 5 h. The product was obtained as a white solid (28 mg, 0.12 mmol, 40%) after FC using a gradient from 0% to 20% of EtOAc in *n*-hexane as the eluent. The spectroscopy data matched with previously reported in the literature. [19]



TLC: Rf = 0.4 (9:1 Hexane/EtOAc, UV).

GC (Ti= 80 ºC): 8.850 min.

GC/MS: *m/z* (%) 204 (M^+ 100), 233 (97), 205 (42).

^{1}H NMR (300 MHz, $CDCl_3$): δ 10.60 (s, 1H), 9.00 (dd, J = 8.5, 1.5 Hz, 1H), 8.30 – 8.19 (m, 4H), 7.83 (ddd, J = 8.4, 6.9, 1.5 Hz, 1H), 7.71 (ddd, J = 8.3, 6.9, 1.4 Hz, 1H), 7.61 – 7.49 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 192.9, 157.4, 149.4, 138.5, 137.7, 130.3, 130.3, 130.0, 129.0, 128.9, 127.4, 124.1, 124.0, 122.9.

UNSUCCESSFUL SUBSTRATES

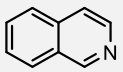
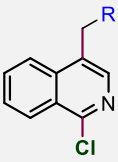
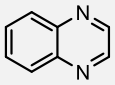
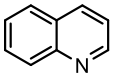
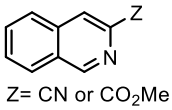
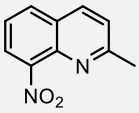
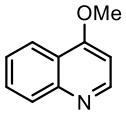
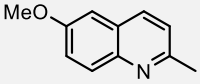
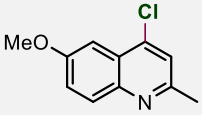
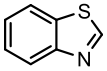
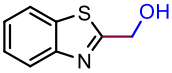
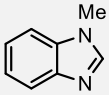
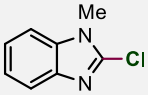
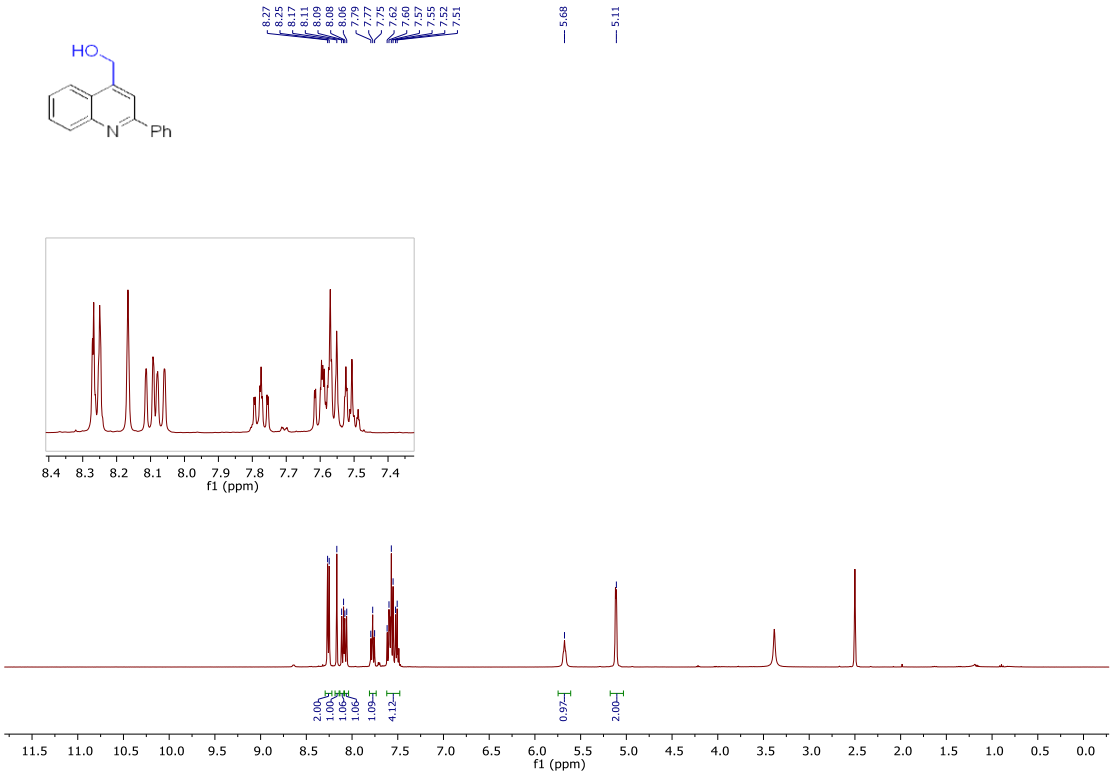
Substrate	Method: result	Substrate	Method: result
	 **GPA:** R= OH (26%) R= H (19%)		**GPA**: decompose
	**GPA:** Many products	 Z= CN or CO_2Me	**GPB**: decompose
	**GPA:** No reaction	Camptothecin	**GPA or GPB:** Low conversion
	**GPA or GPB:** No reaction	Chinchonine	**GPA or GPB:** Low conversion
	 **GPA:** low yield	Quinine	**GPA or GPB:** Low conversion
	 **GPA:** 10%	Nicotine	**GPA or GPB:** Low conversion
	 **GPA:** 16%		

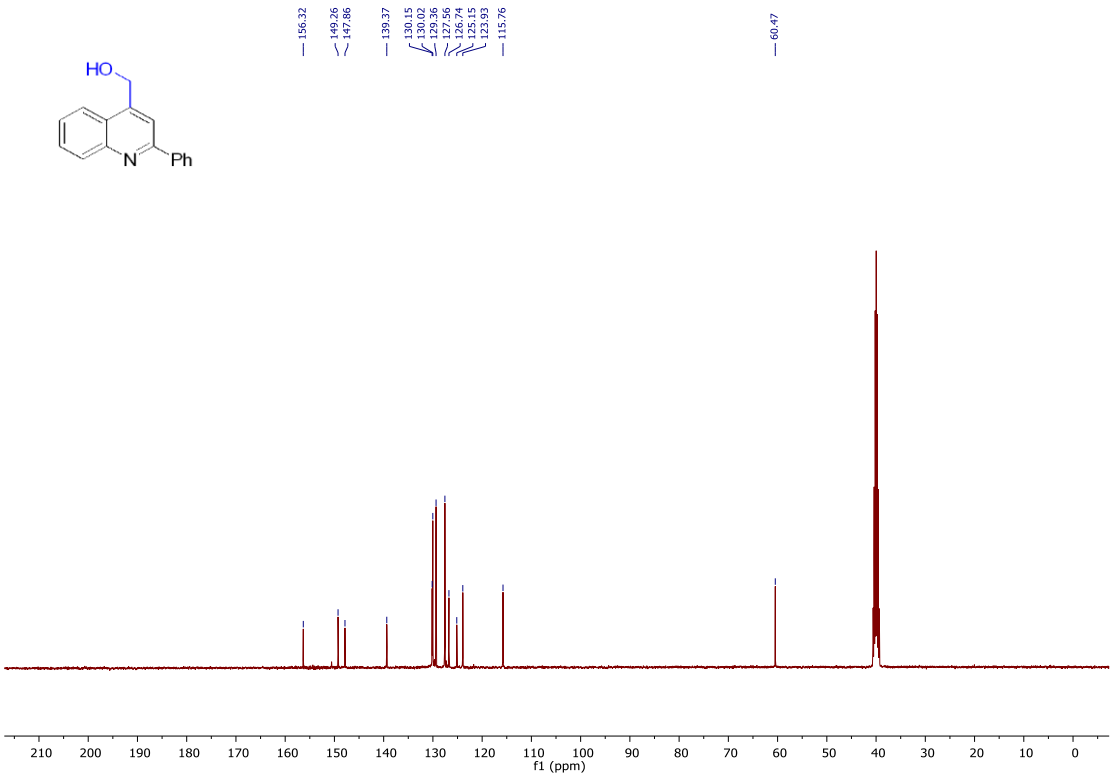
Table S3: Unsuccessful starting materials.

NMR SPECTRA OF SYNTHESIZED COMPOUNDS

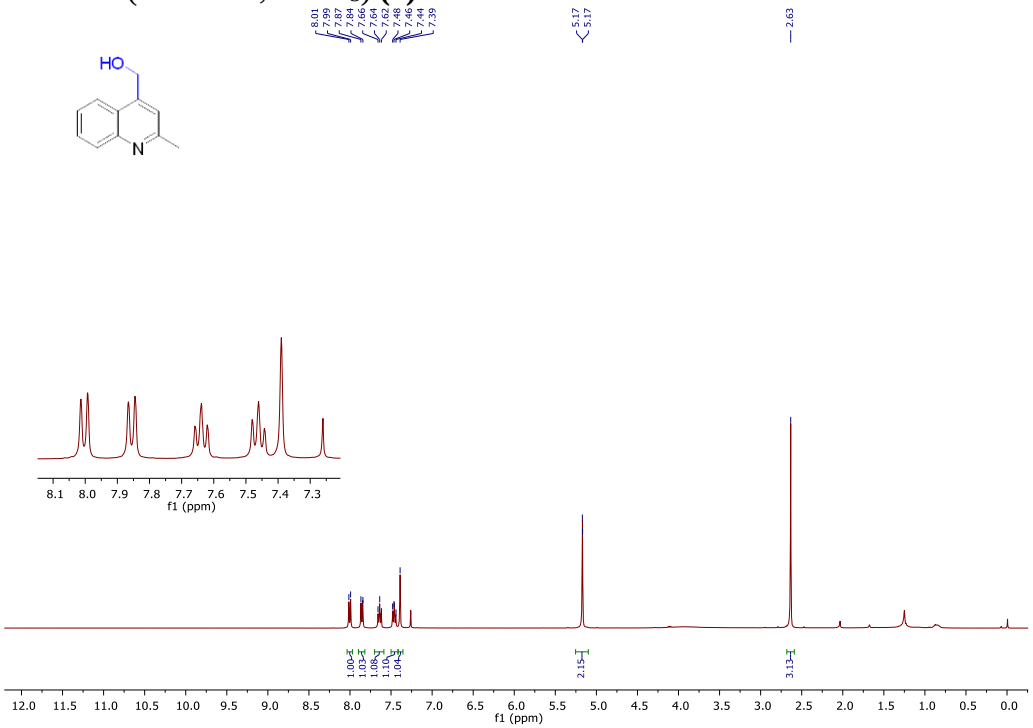
^{1}H NMR (400 MHz, DMSO-d_6) **(1)**



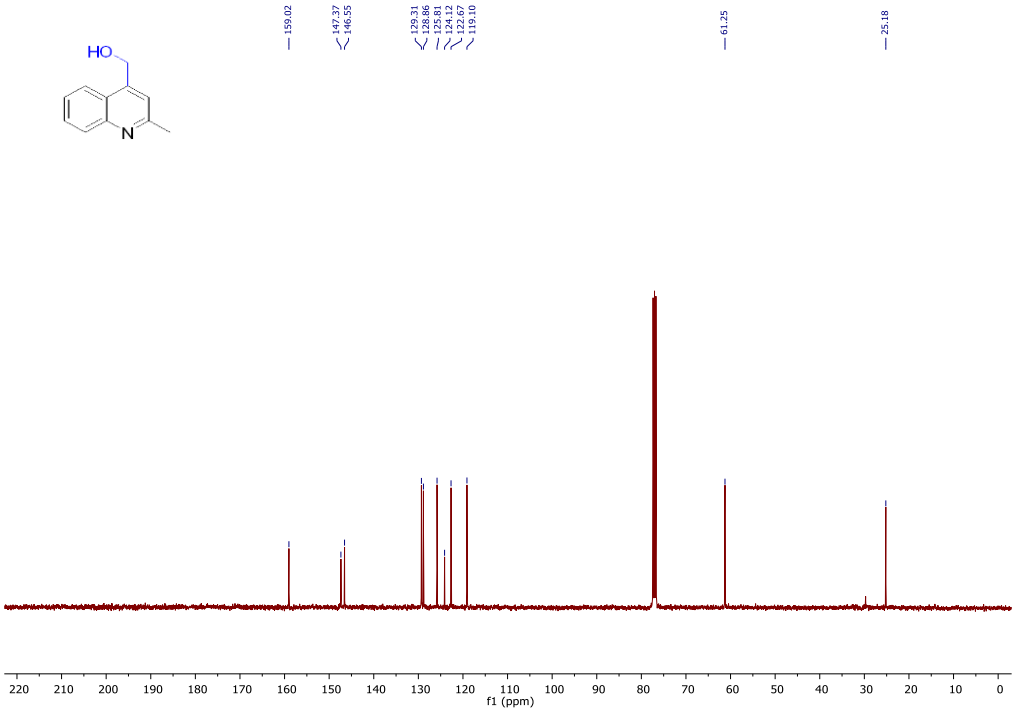
^{13}C NMR (101 MHz, DMSO-d_6) **(1)**



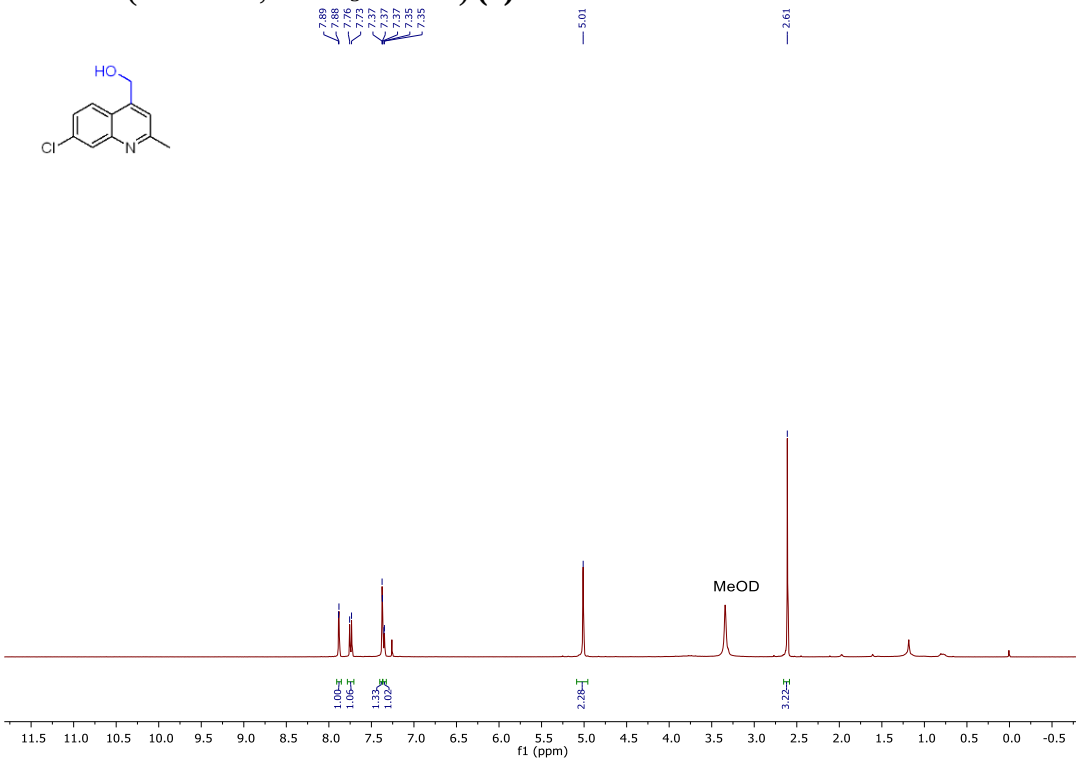
^{1}H NMR (400 MHz, $CDCl_3$) **(2)**



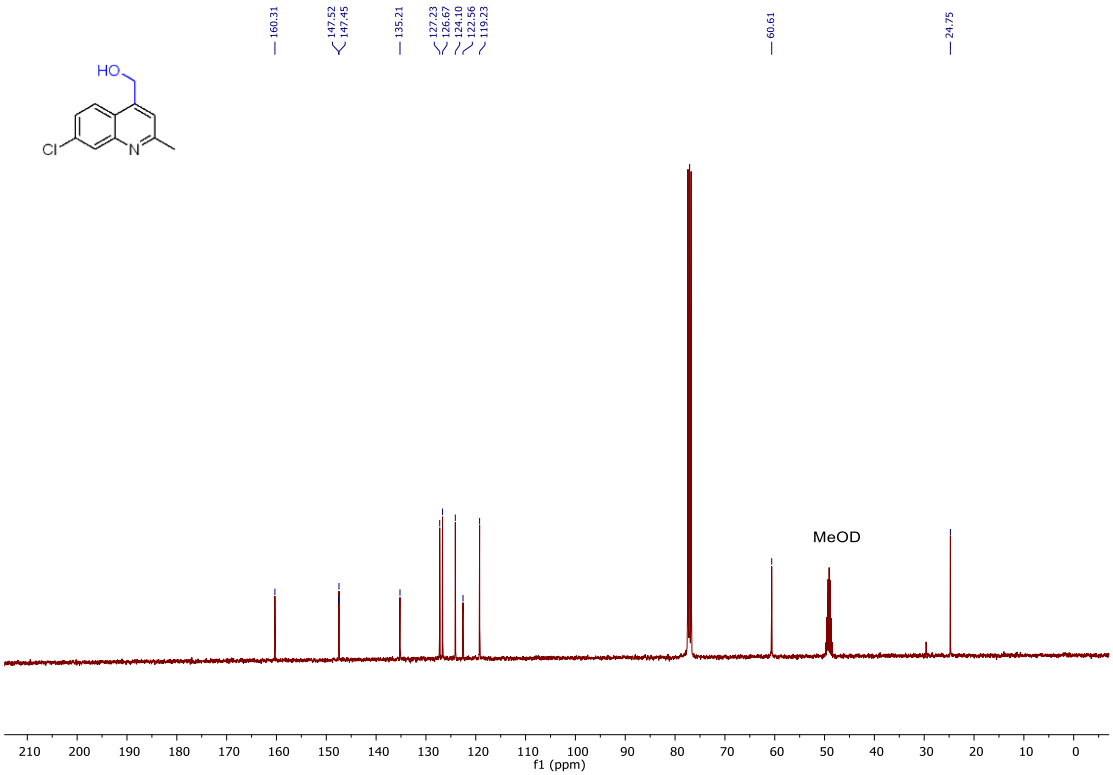
^{13}C NMR (101 MHz, $CDCl_3$) **(2)**



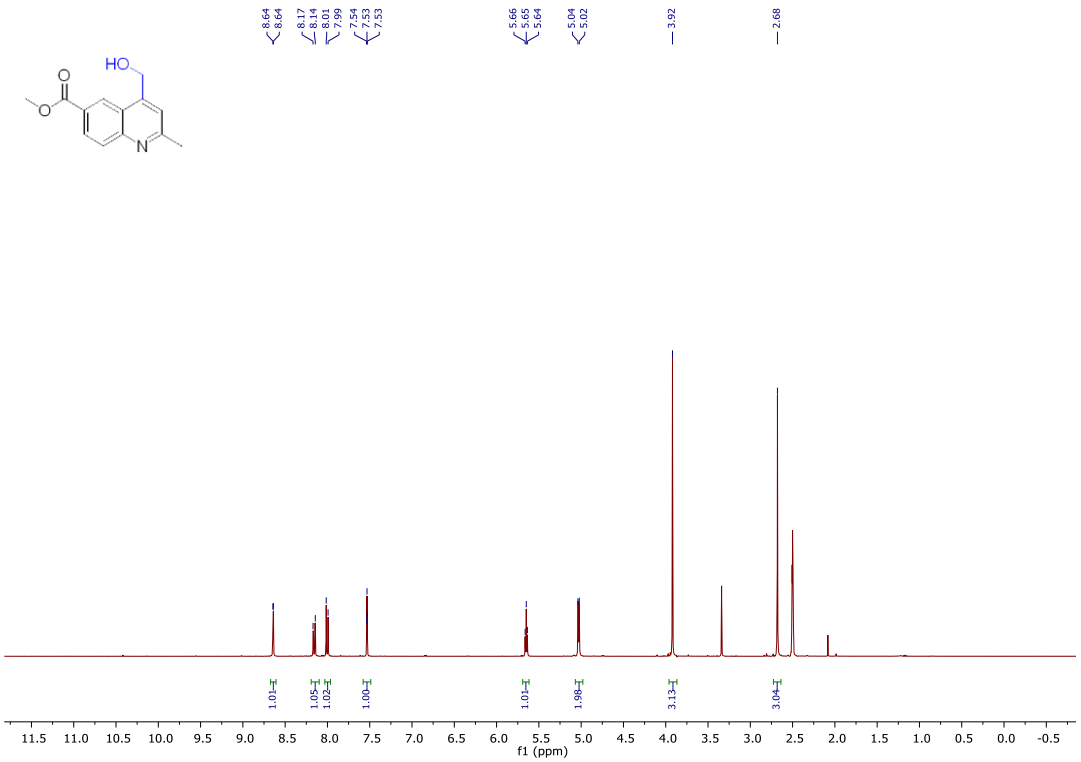
^{1}H NMR (400 MHz, $CDCl_3$/MeOD) **(3)**



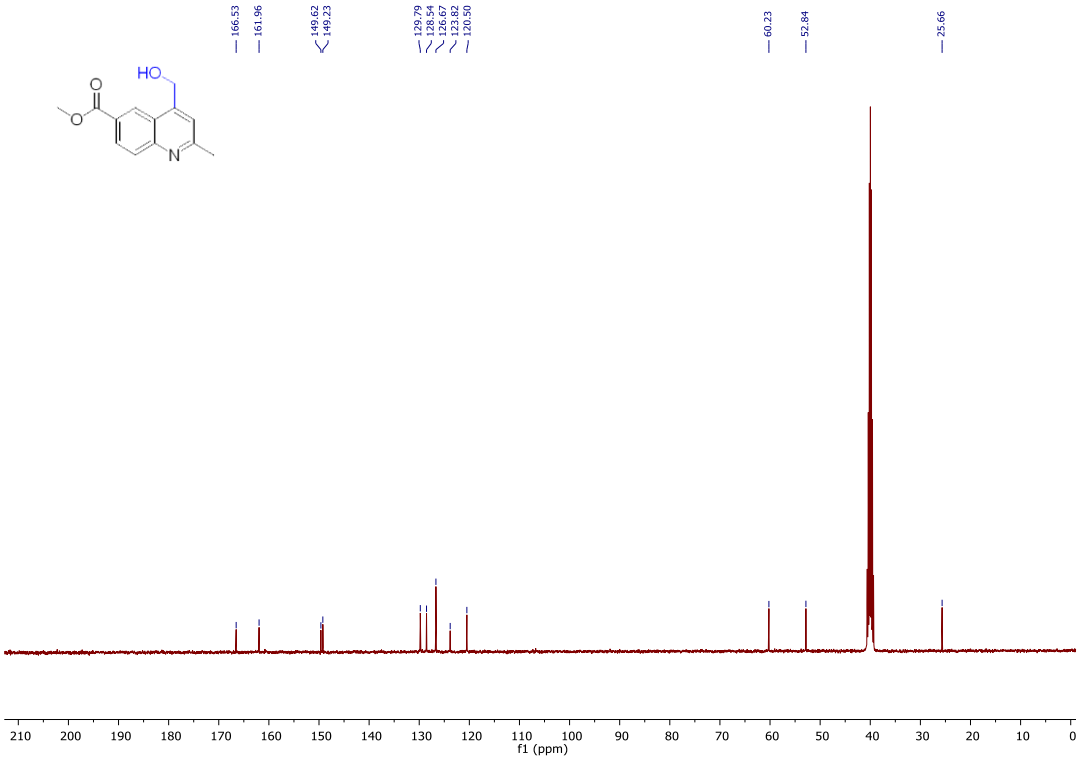
^{13}C NMR (101 MHz, $CDCl_3$/MeOD) **(3)**



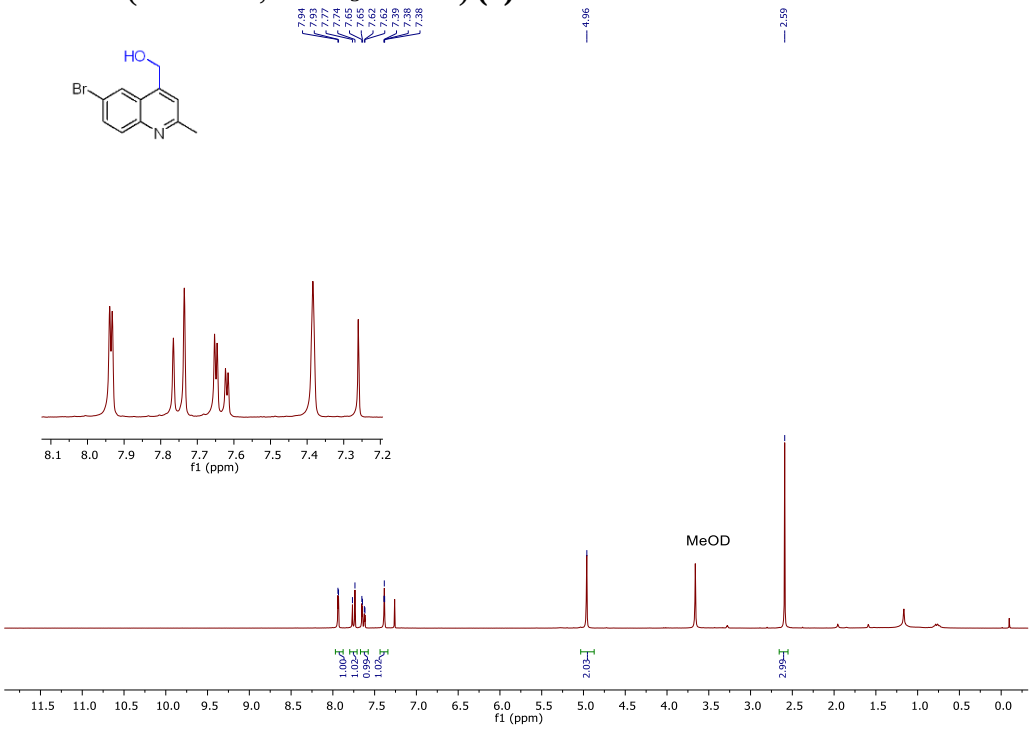
^{1}H NMR (400 MHz, DMSO-d6) **(4)**



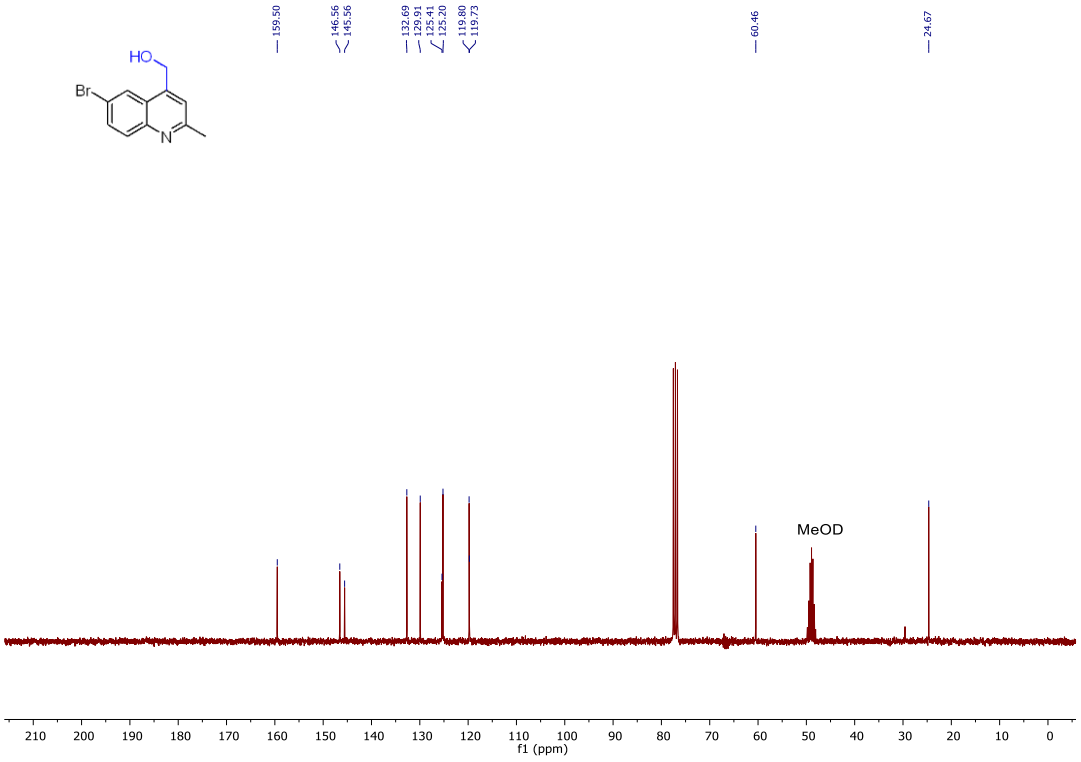
^{13}C NMR (101 MHz, DMSO-d6) **(4)**



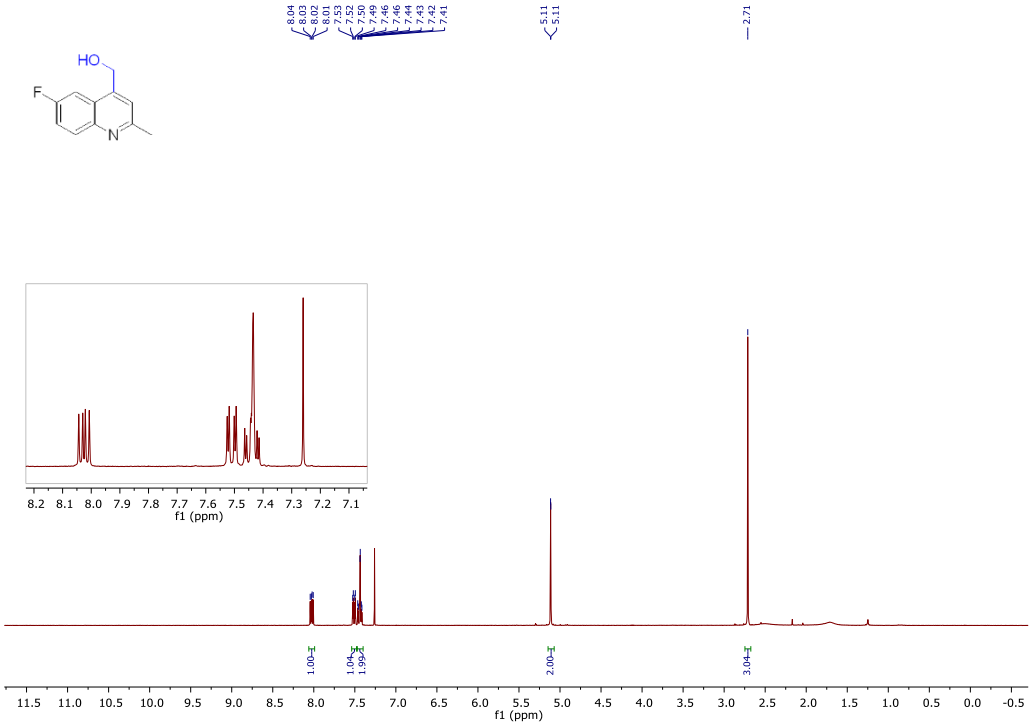
^{1}H NMR (400 MHz, $CDCl_3$/MeOD) **(5)**



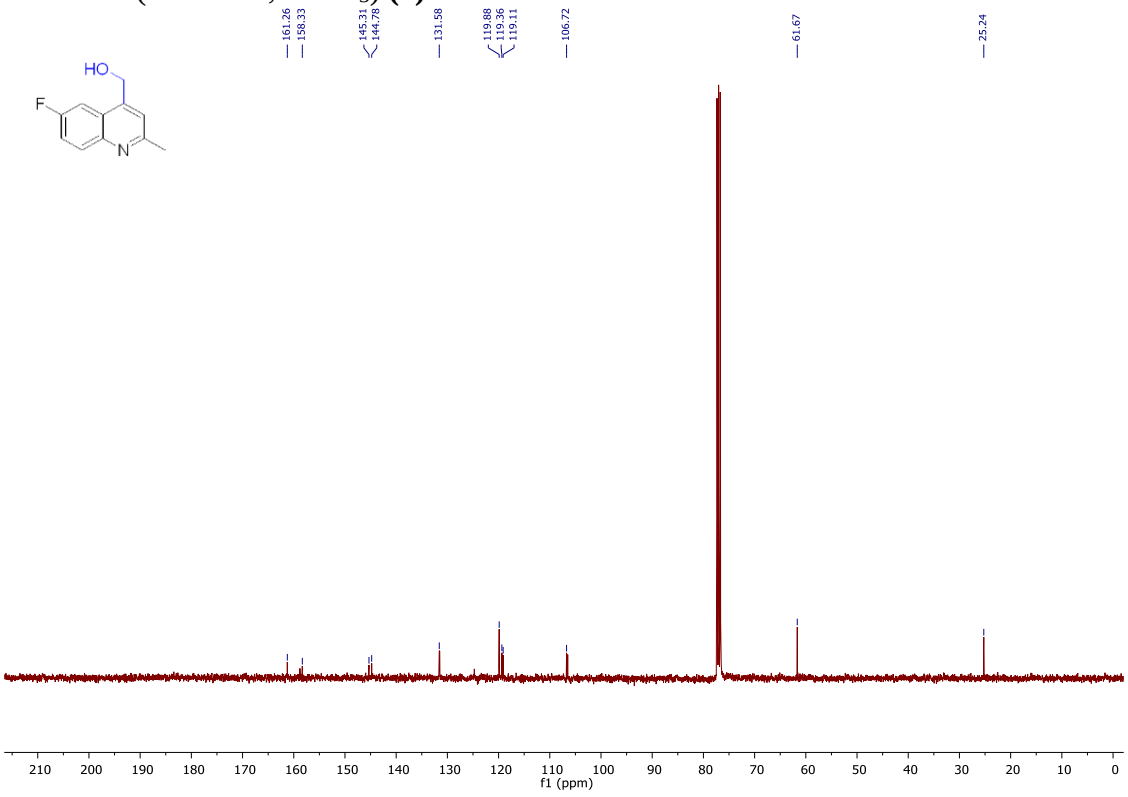
^{13}C NMR (101 MHz, $CDCl_3$/MeOD) **(5)**



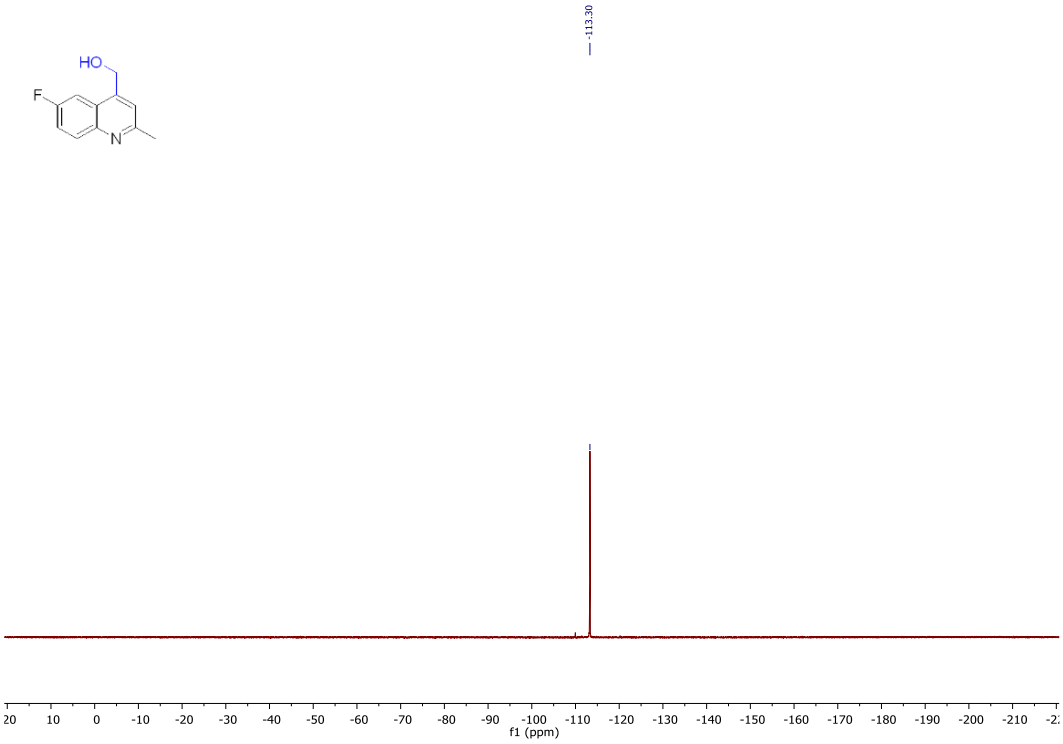
^{1}H NMR (400 MHz, $CDCl_3$) **(6)**



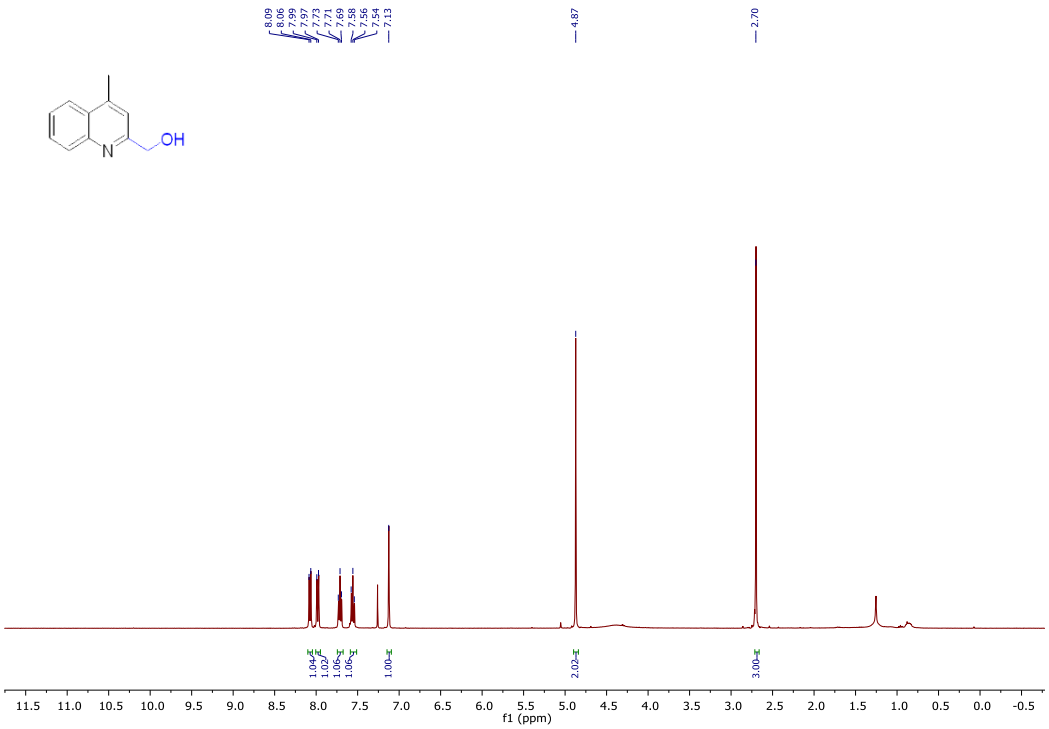
^{13}C NMR (101 MHz, $CDCl_3$) **(6)**



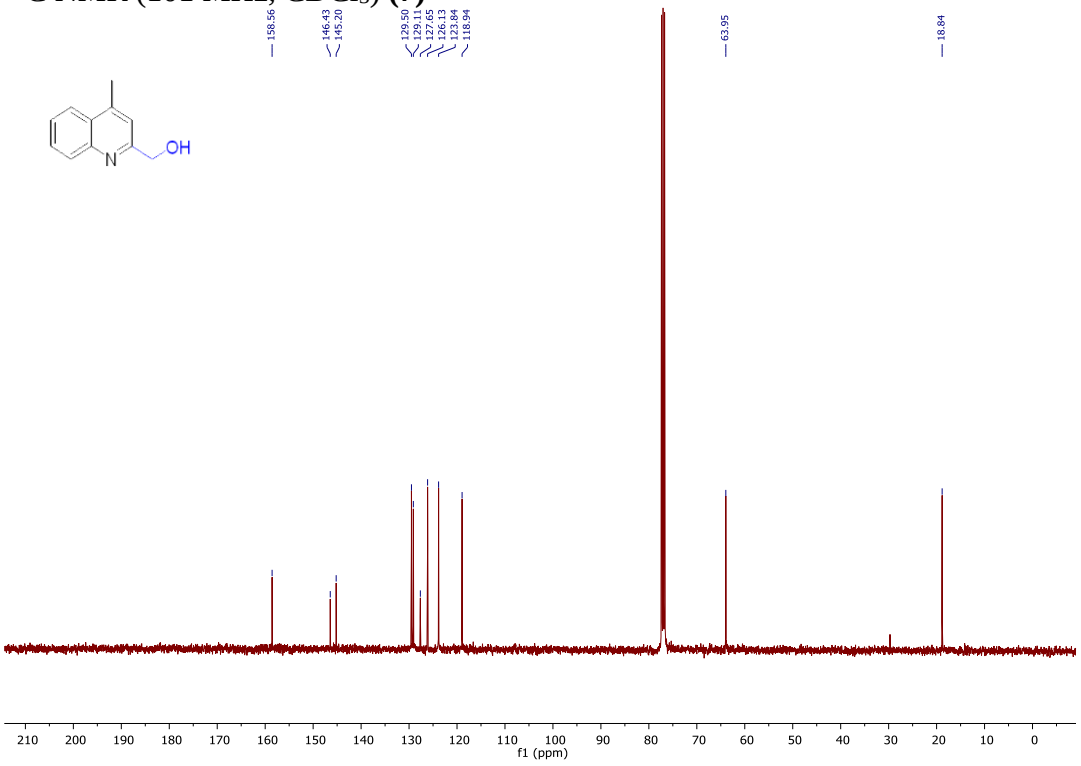
^{19}F NMR (101 MHz, $CDCl_3$) **(6)**



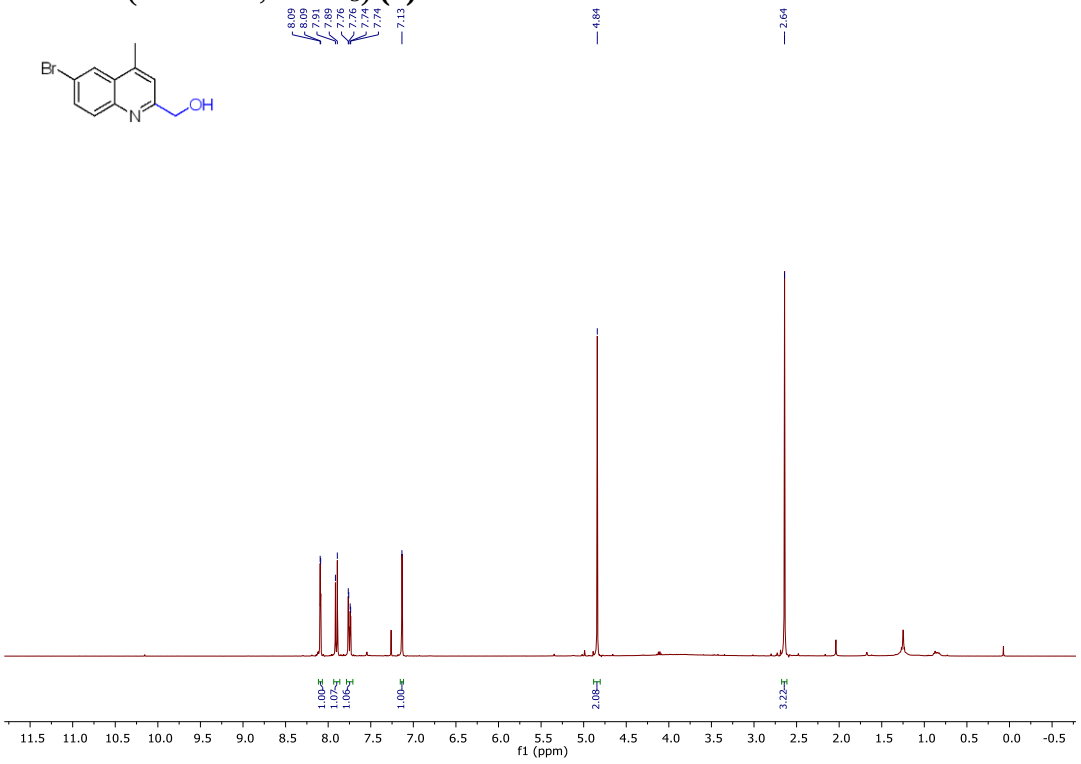
^{1}H NMR (400 MHz, $CDCl_3$) **(7)**



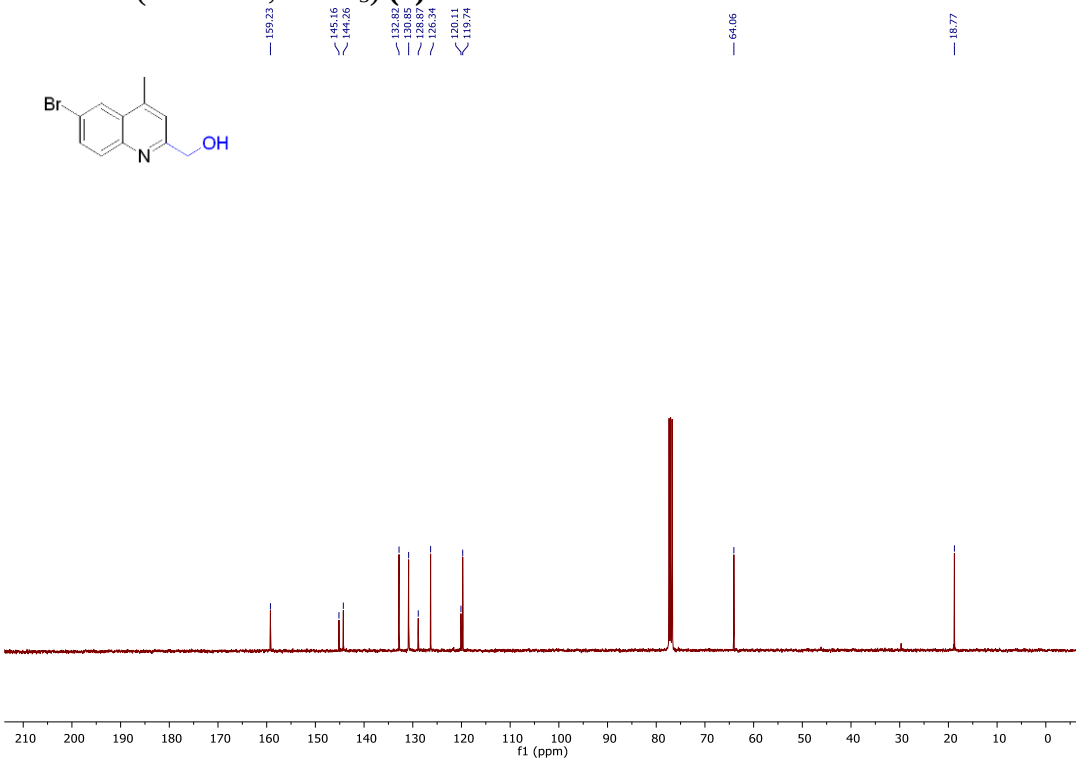
^{13}C NMR (101 MHz, $CDCl_3$) **(7)**



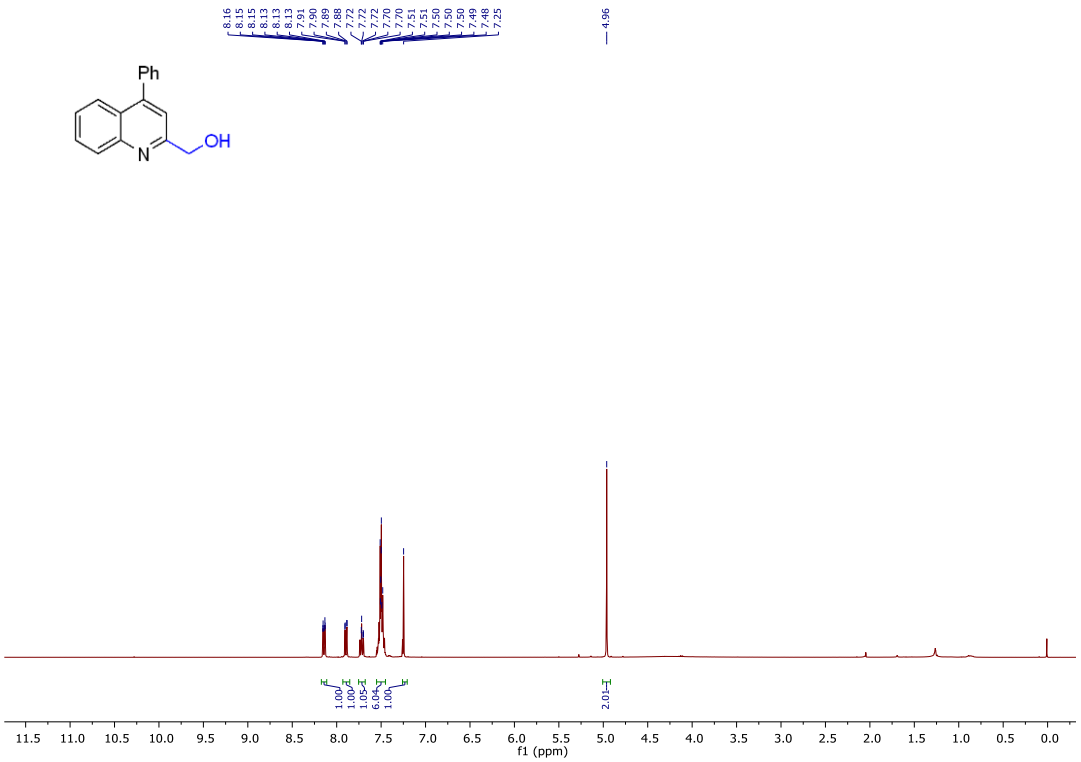
^{1}H NMR (400 MHz, $CDCl_3$) **(8)**



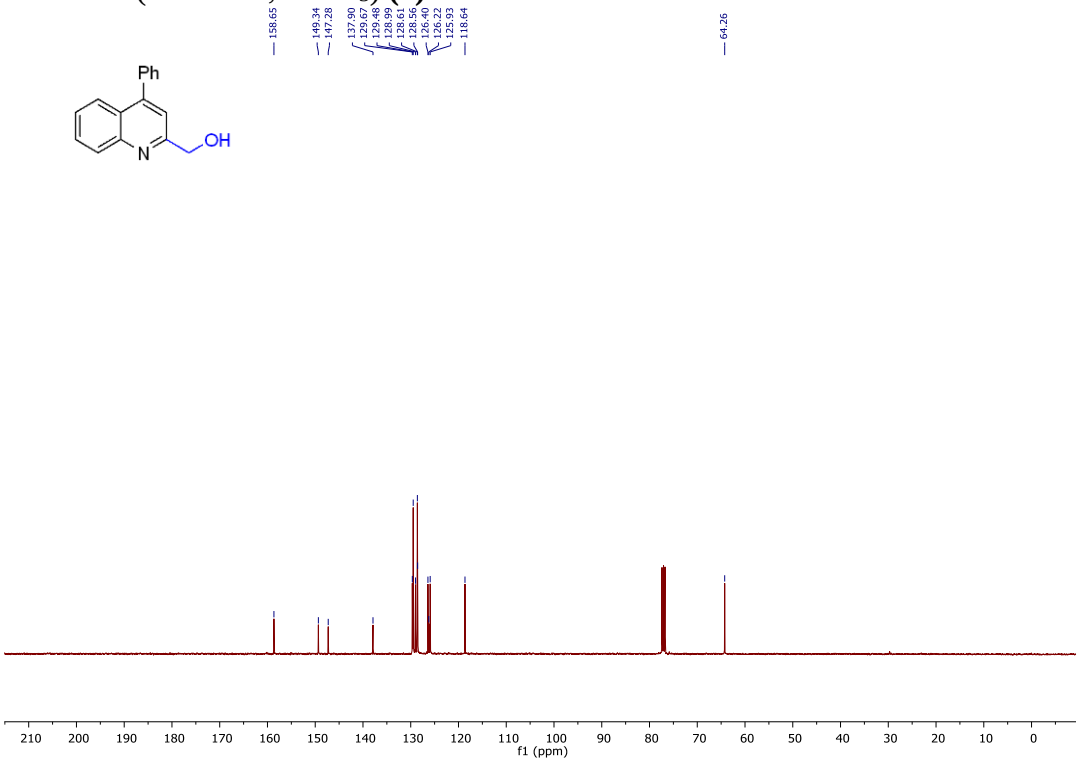
^{13}C NMR (101 MHz, $CDCl_3$) **(8)**



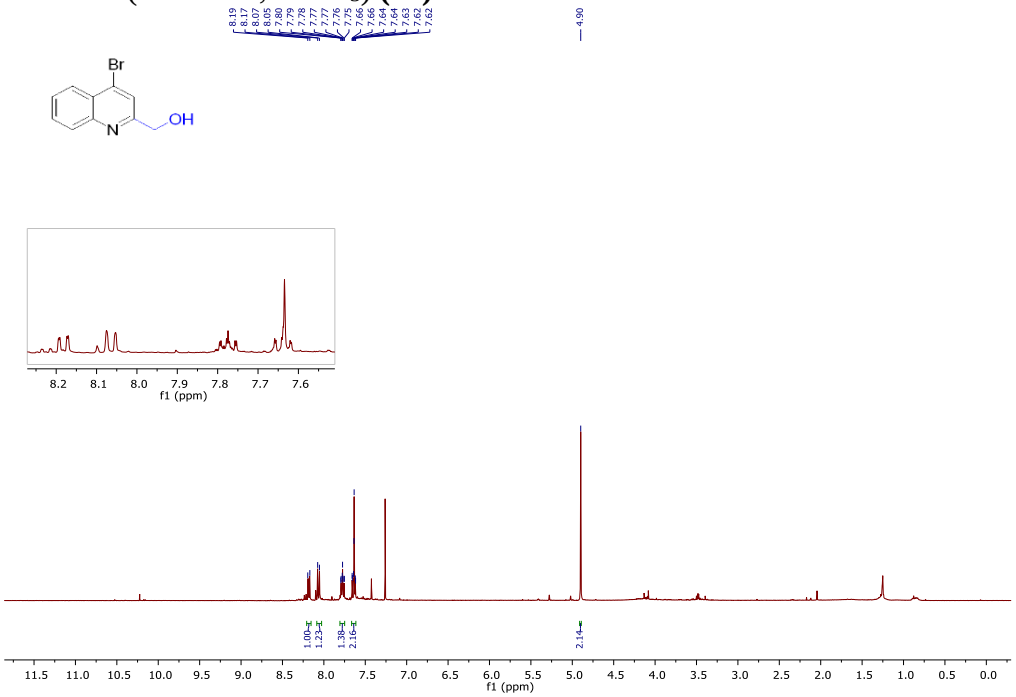
^{1}H NMR (400 MHz, $CDCl_3$) **(9)**



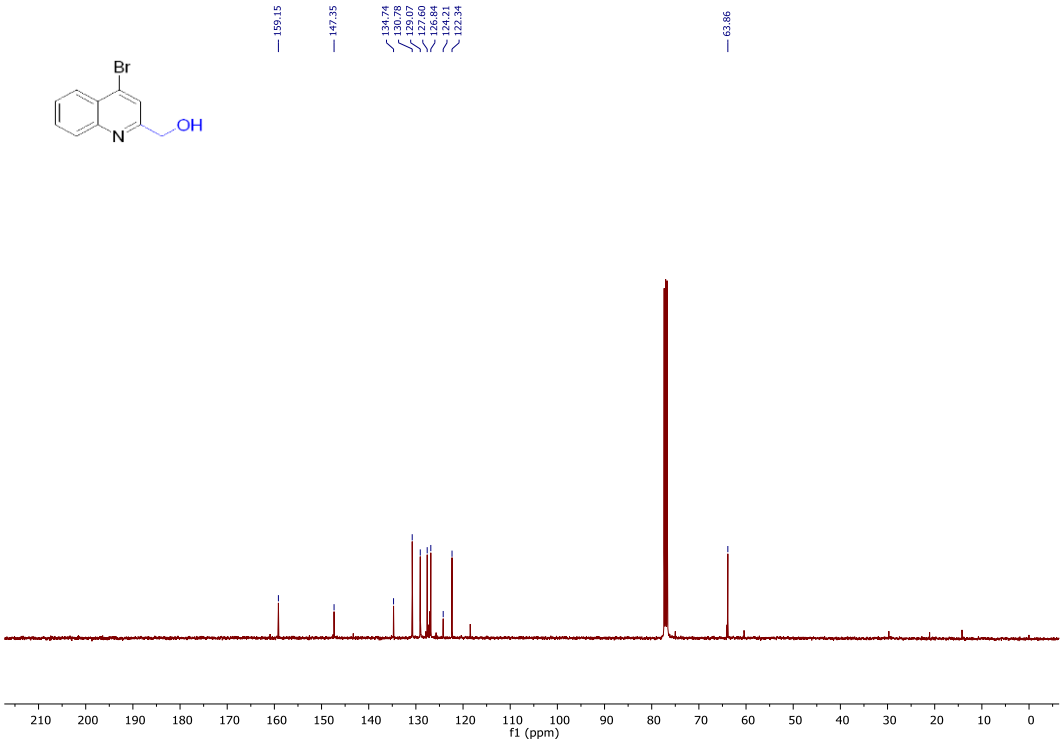
^{13}C NMR (101 MHz, $CDCl_3$) **(9)**



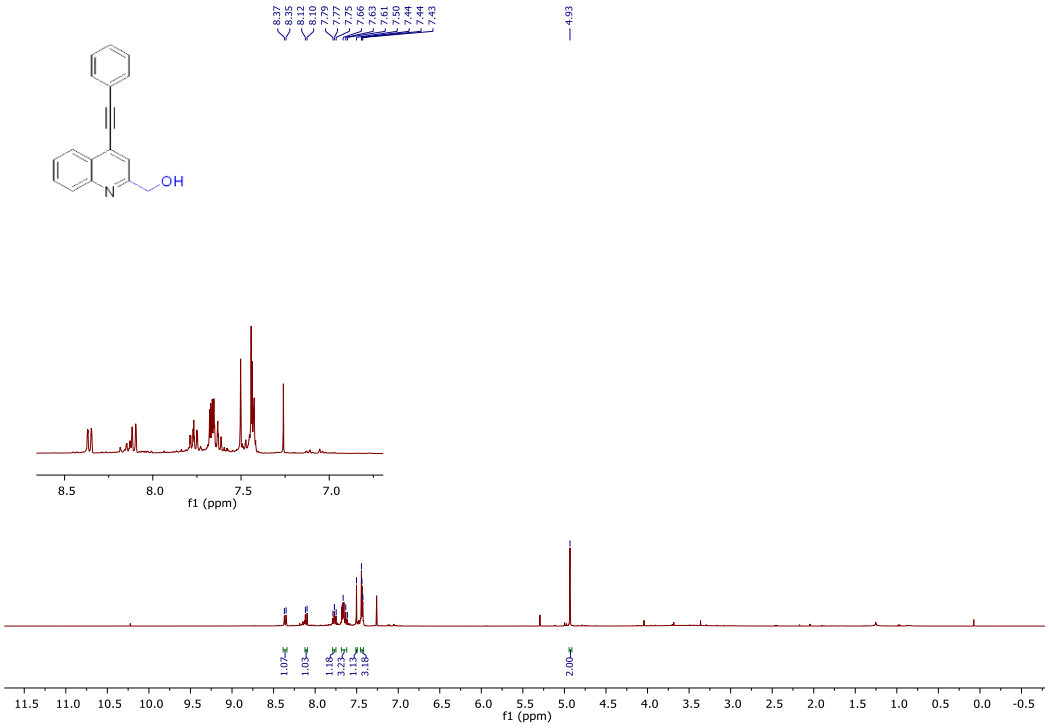
^{1}H NMR (400 MHz, $CDCl_3$) **(10)**



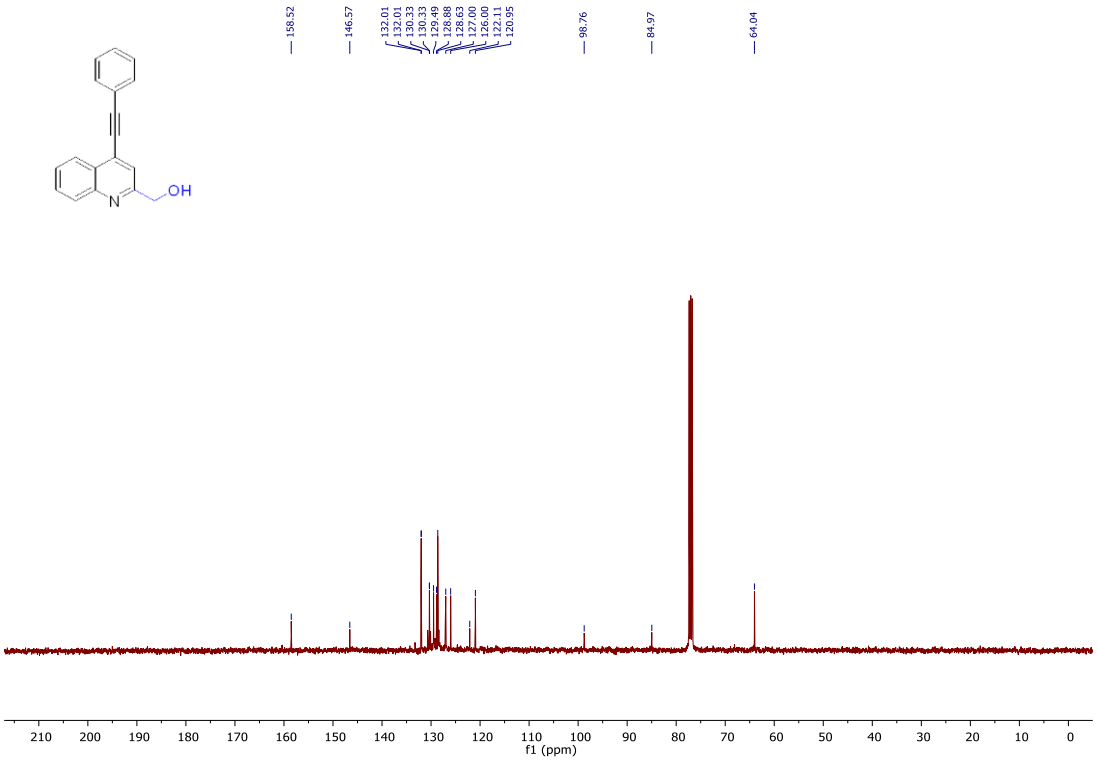
^{13}C NMR (101 MHz, $CDCl_3$) **(10)**



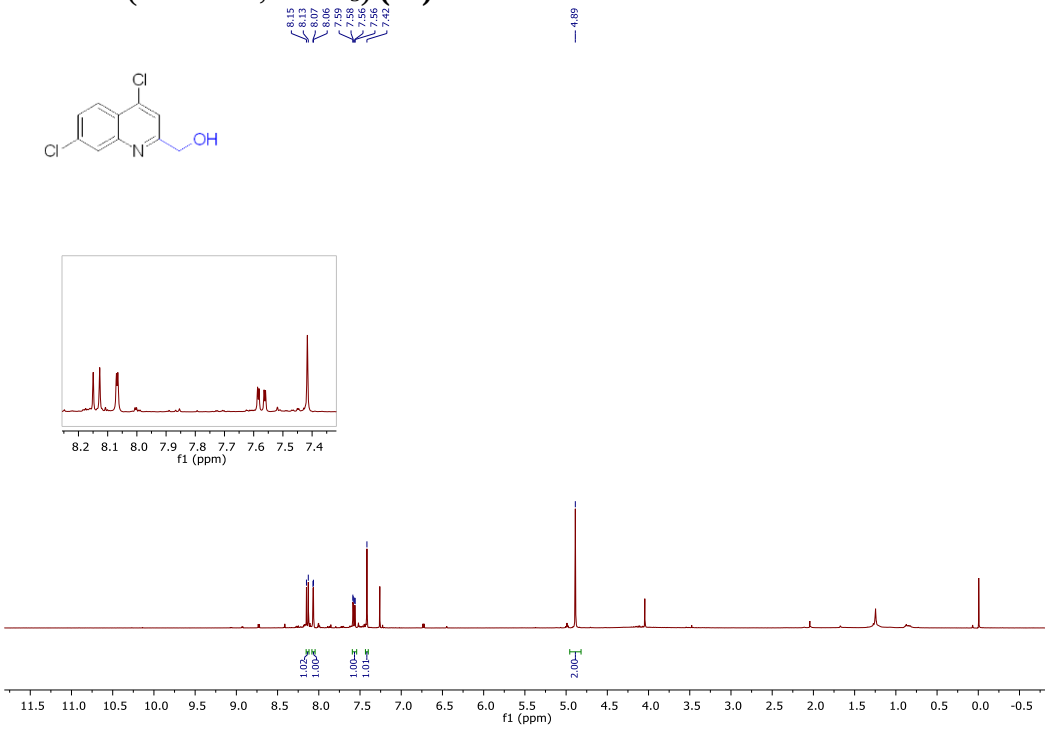
^{1}H NMR (400 MHz, $CDCl_3$) **(11)**



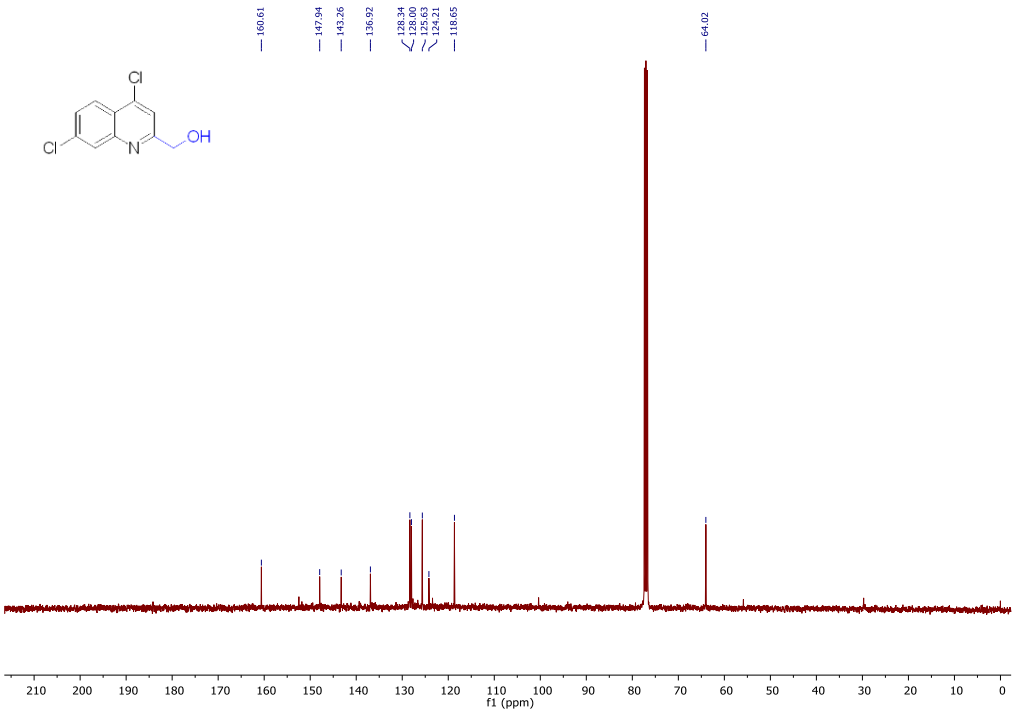
^{13}C NMR (101 MHz, $CDCl_3$) **(11)**



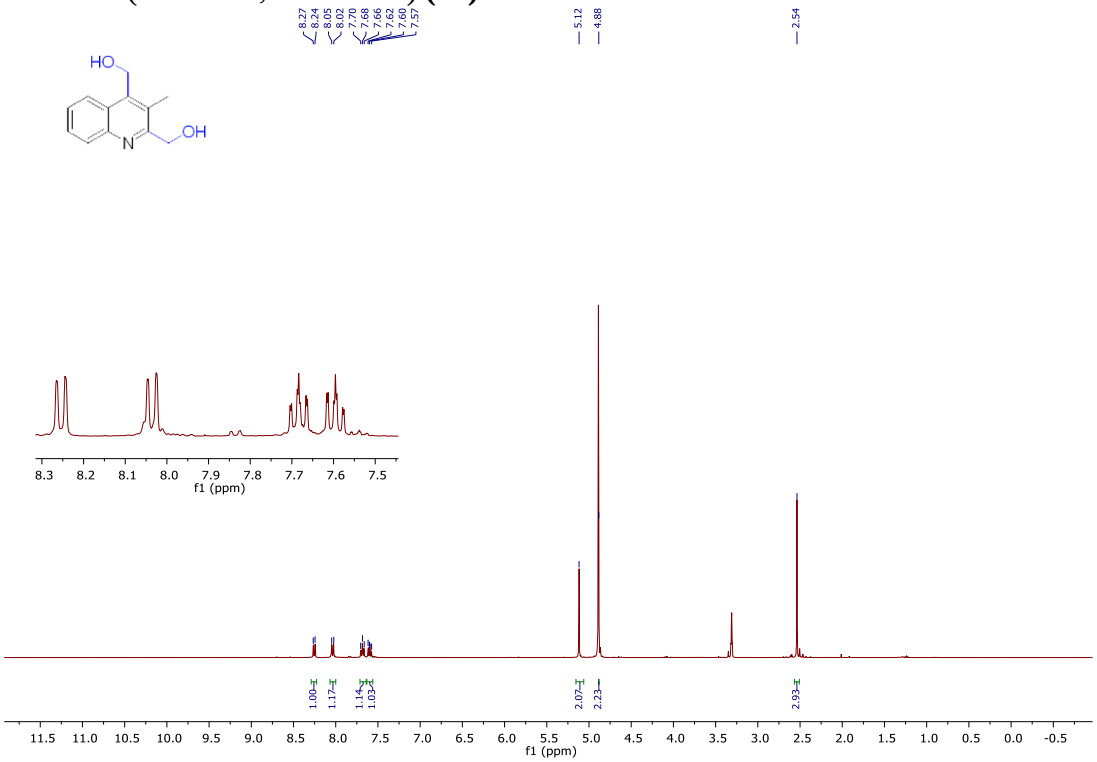
^{1}H NMR (400 MHz, $CDCl_3$) **(12)**



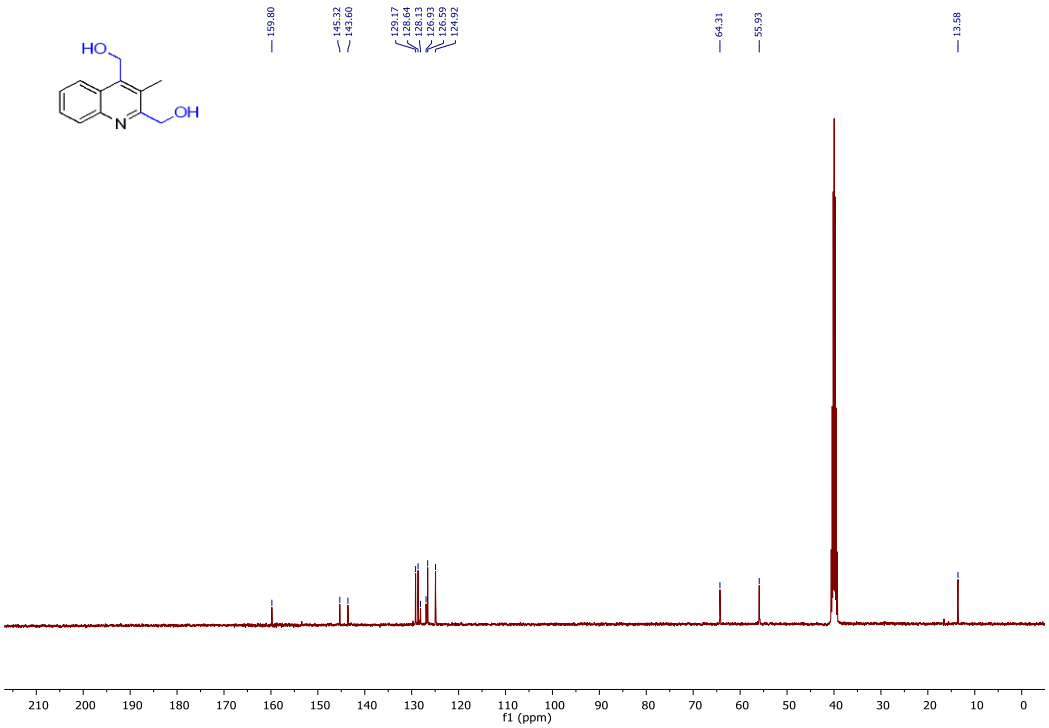
^{13}C NMR (101 MHz, $CDCl_3$) **(12)**



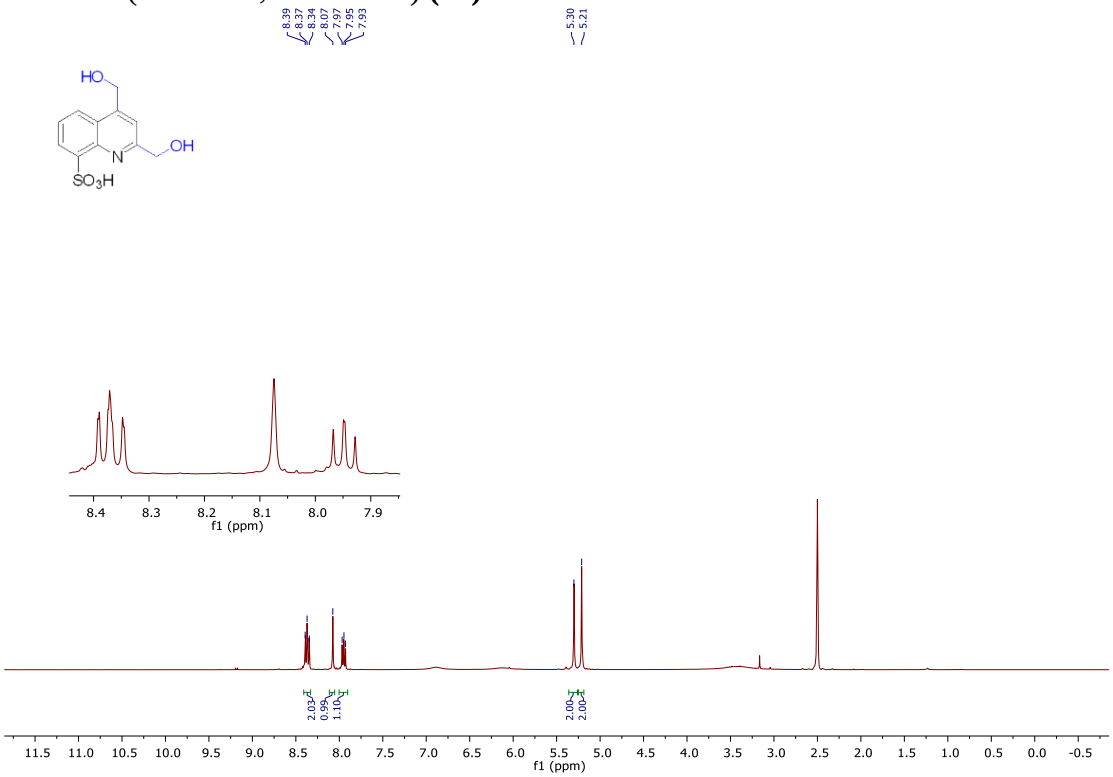
^{1}H NMR (400 MHz, MeOD-d4) **(13)**



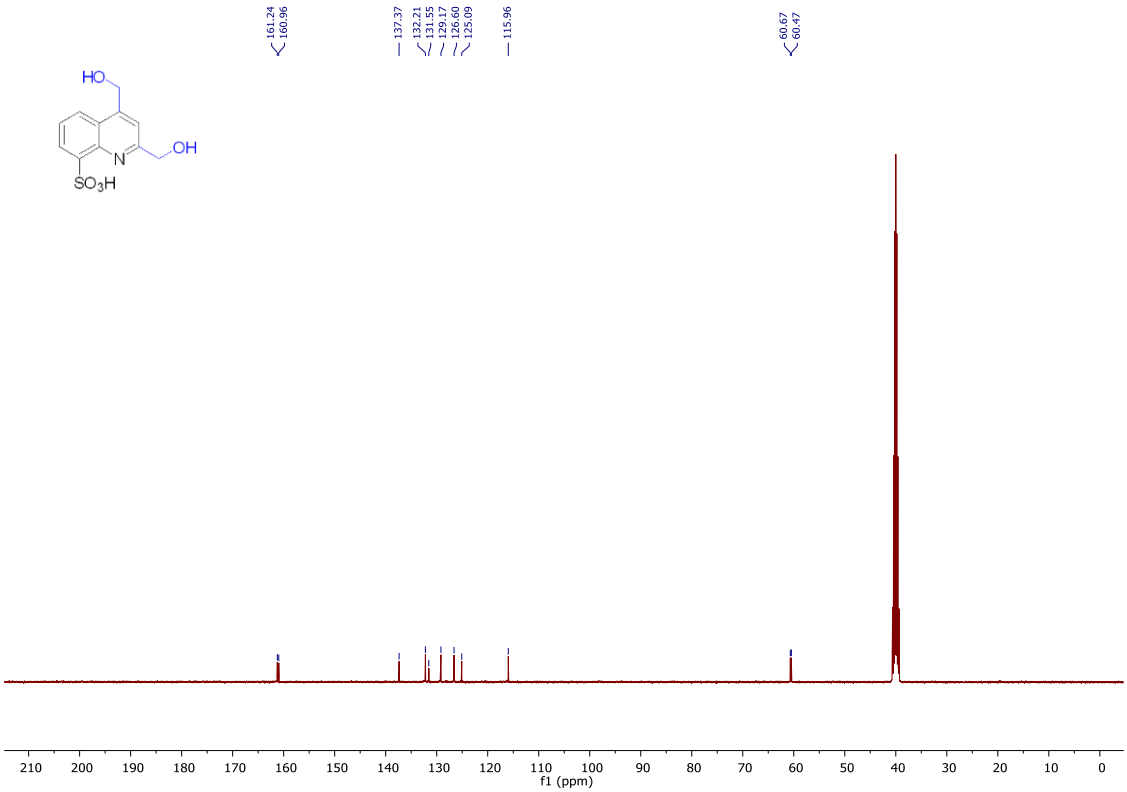
^{13}C NMR (101 MHz, DMSO-d$_6$) **(13)**



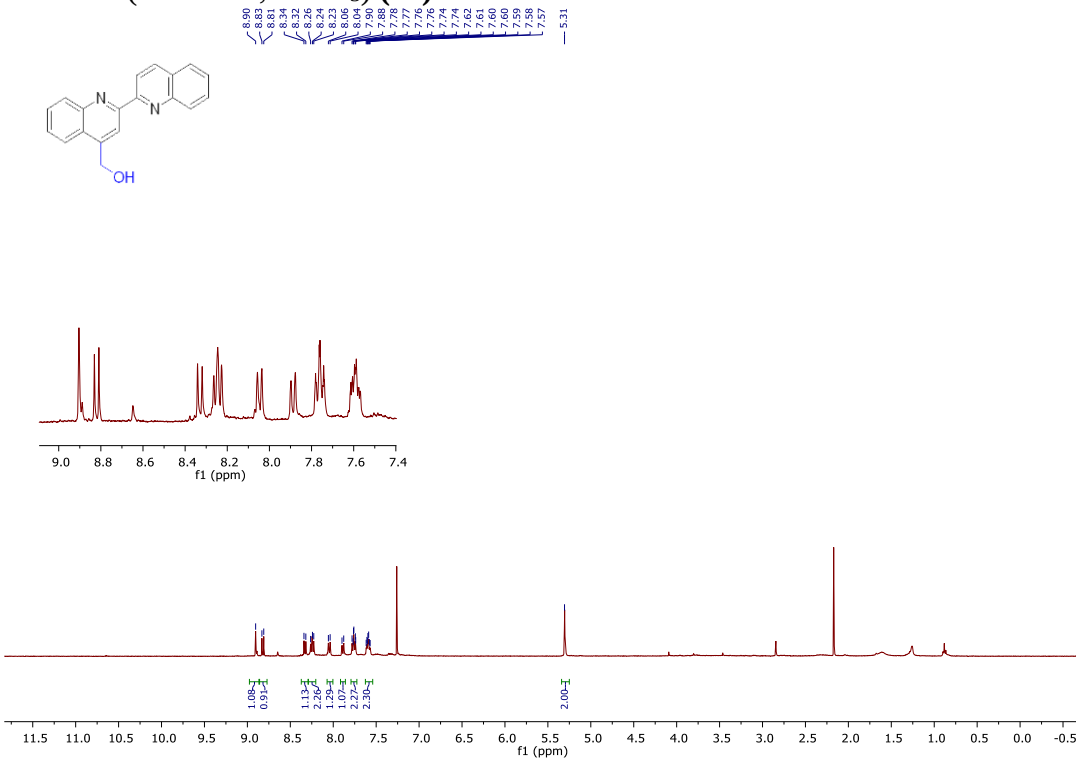
^{1}H NMR (400 MHz, DMSO-d6) **(14)**



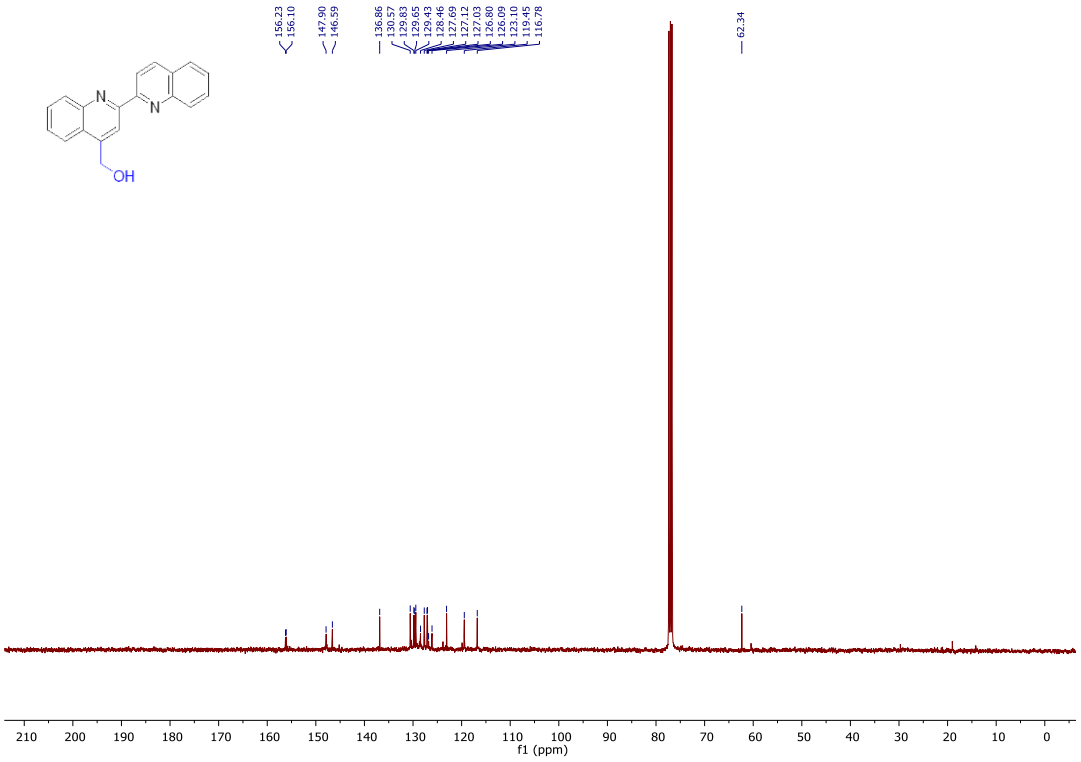
^{13}C NMR (101 MHz, DMSO-d6) **(14)**



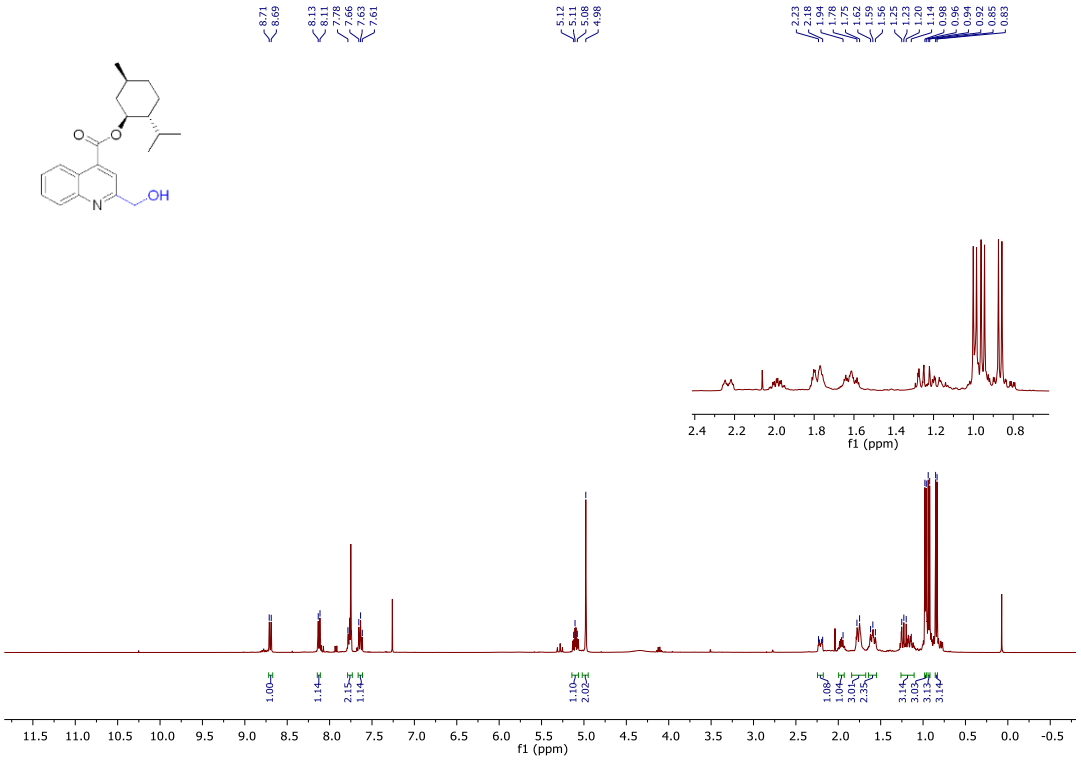
^{1}H NMR (400 MHz, $CDCl_3$) **(15)**



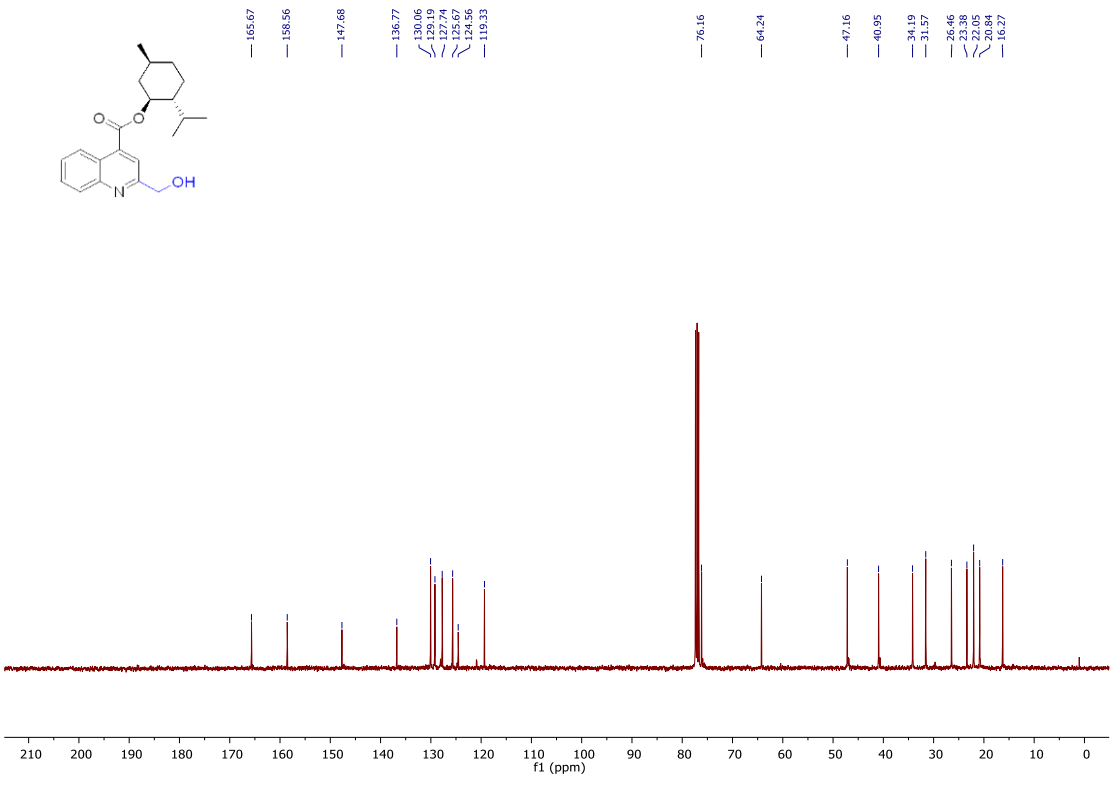
^{13}C NMR (101 MHz, $CDCl_3$) **(15)**



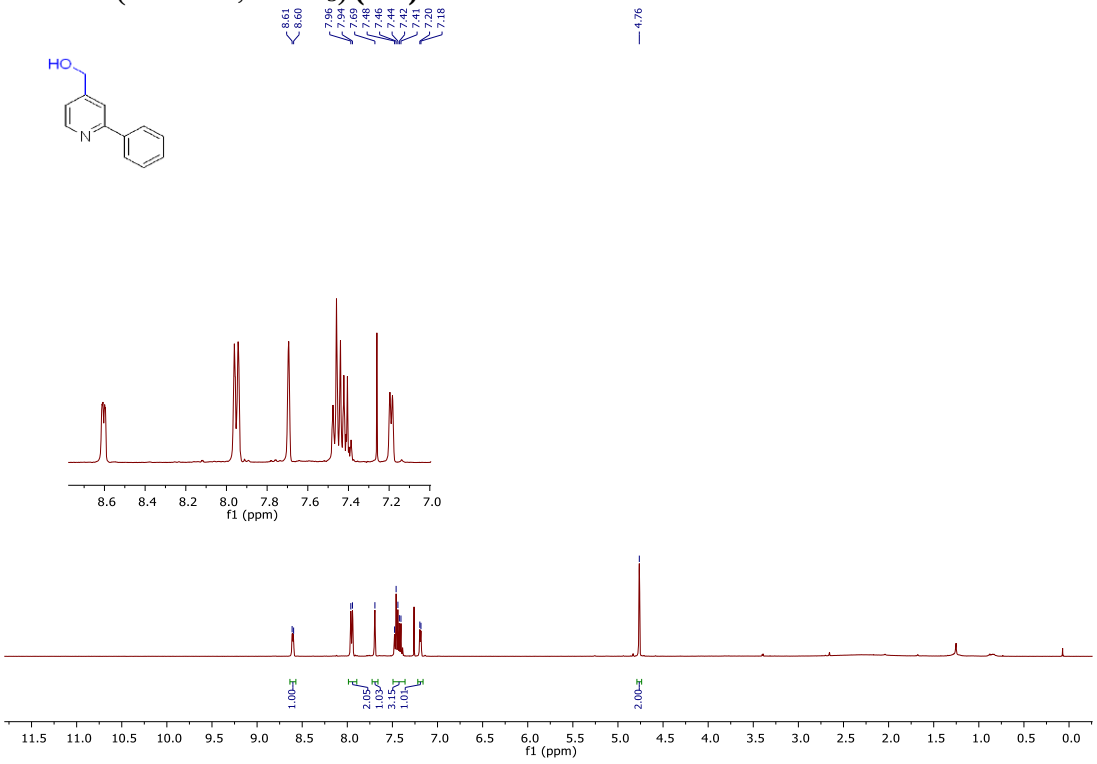
^{1}H NMR (400 MHz, $CDCl_3$) **(16)**



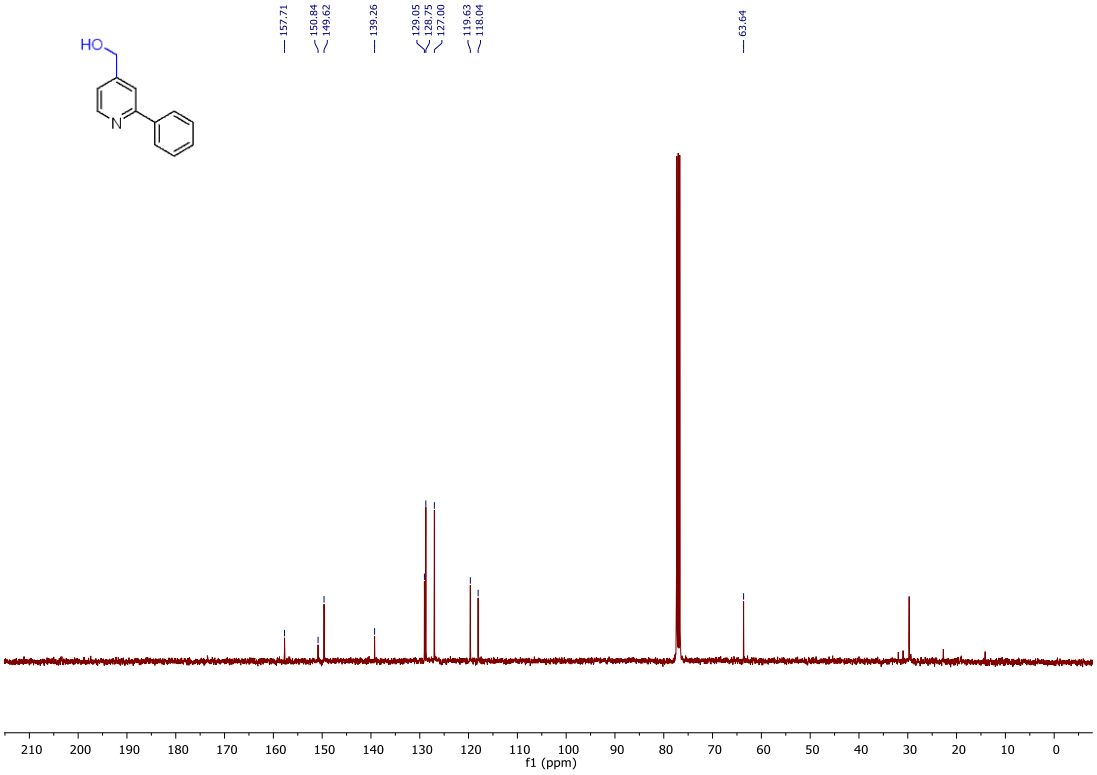
^{13}C NMR (101 MHz, $CDCl_3$) **(16)**



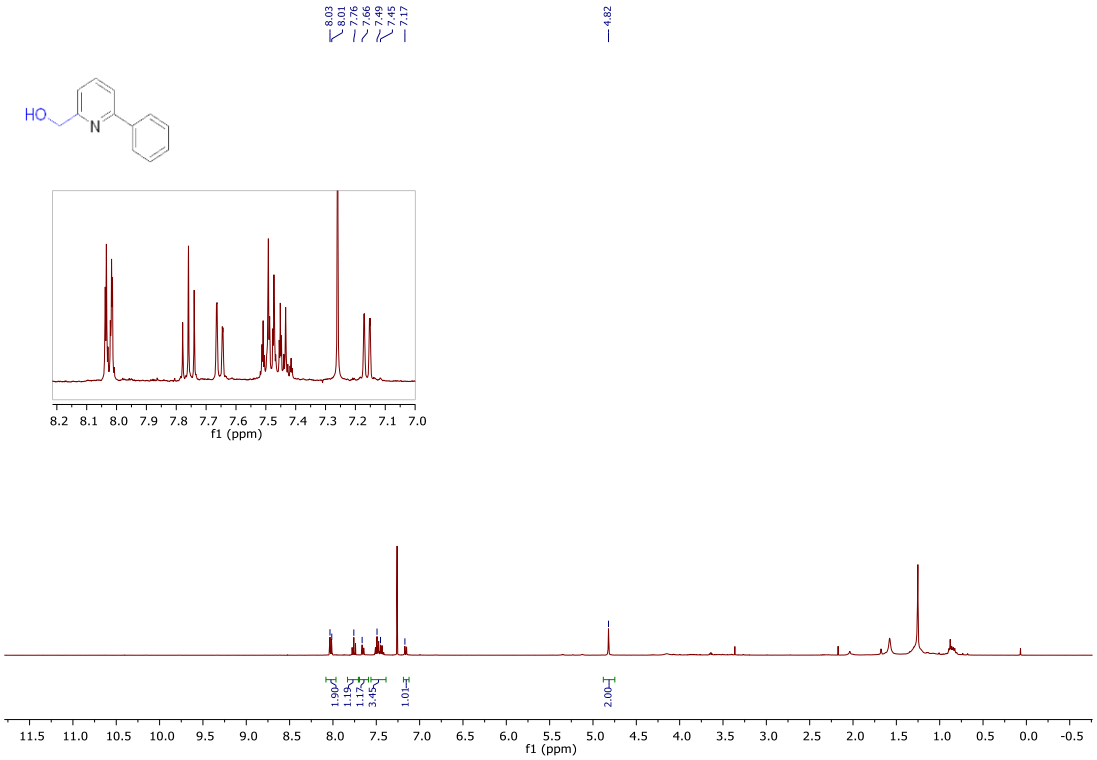
^{1}H NMR (400 MHz, $CDCl_3$) **(17a)**



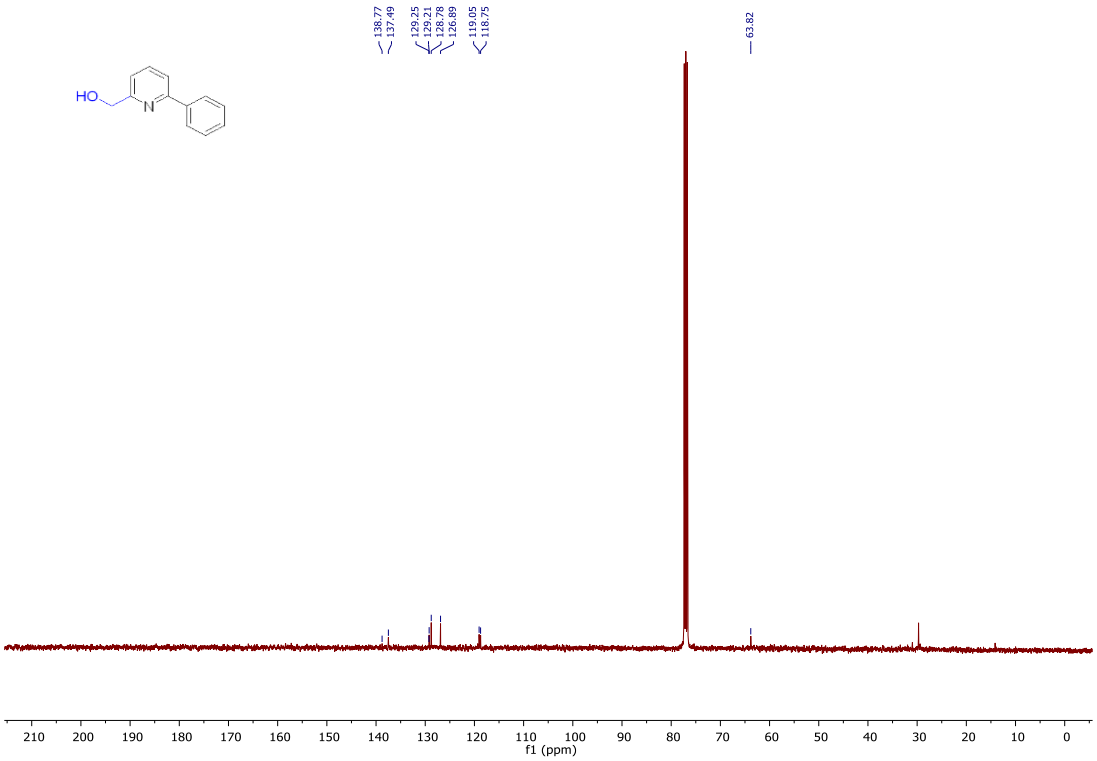
^{13}C NMR (101 MHz, DMSO-d6) **(17a)**



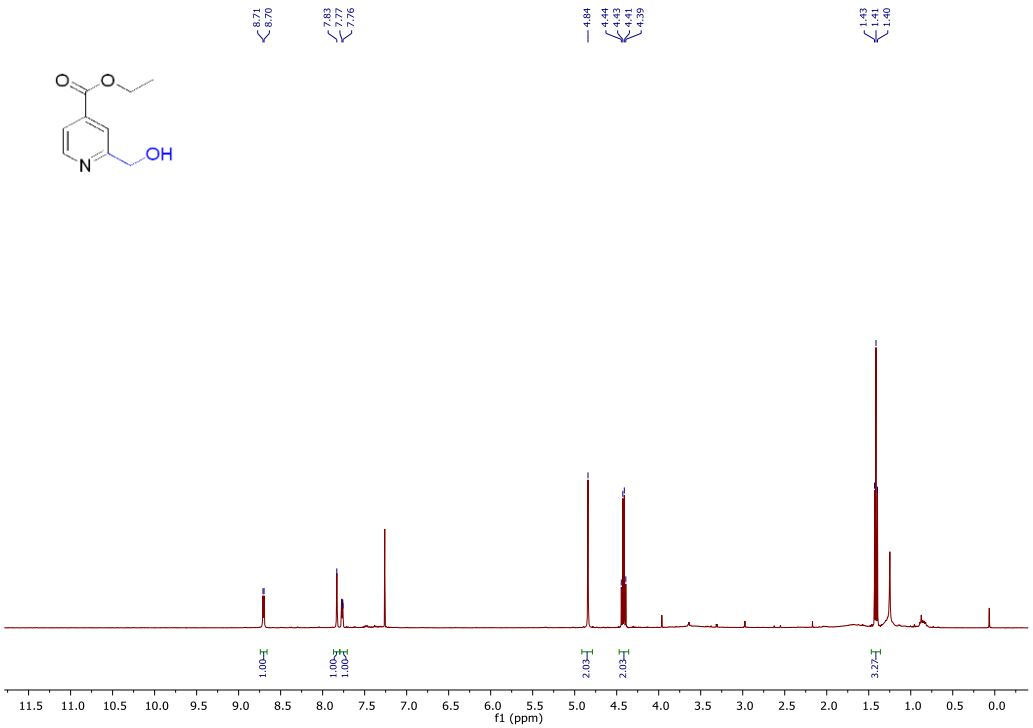
^{1}H NMR (400 MHz, $CDCl_3$) **(17b)**



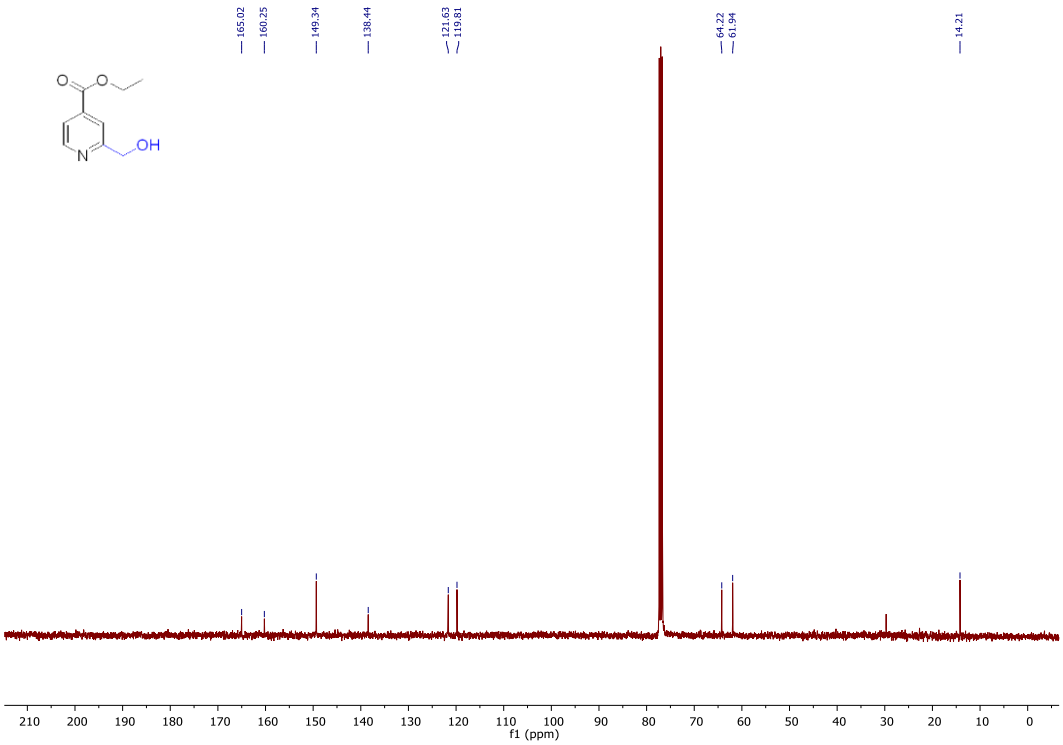
^{13}C NMR (101 MHz, $CDCl_3$) **(17b)**



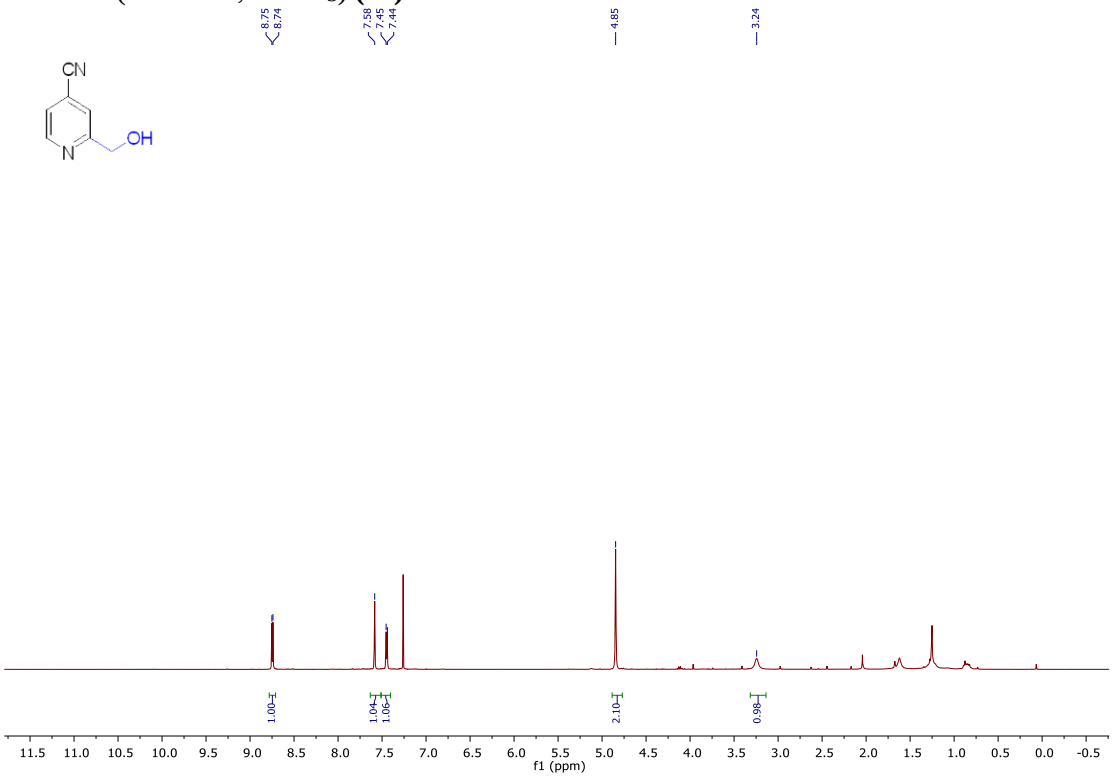
^{1}H NMR (400 MHz, $CDCl_3$) **(18)**



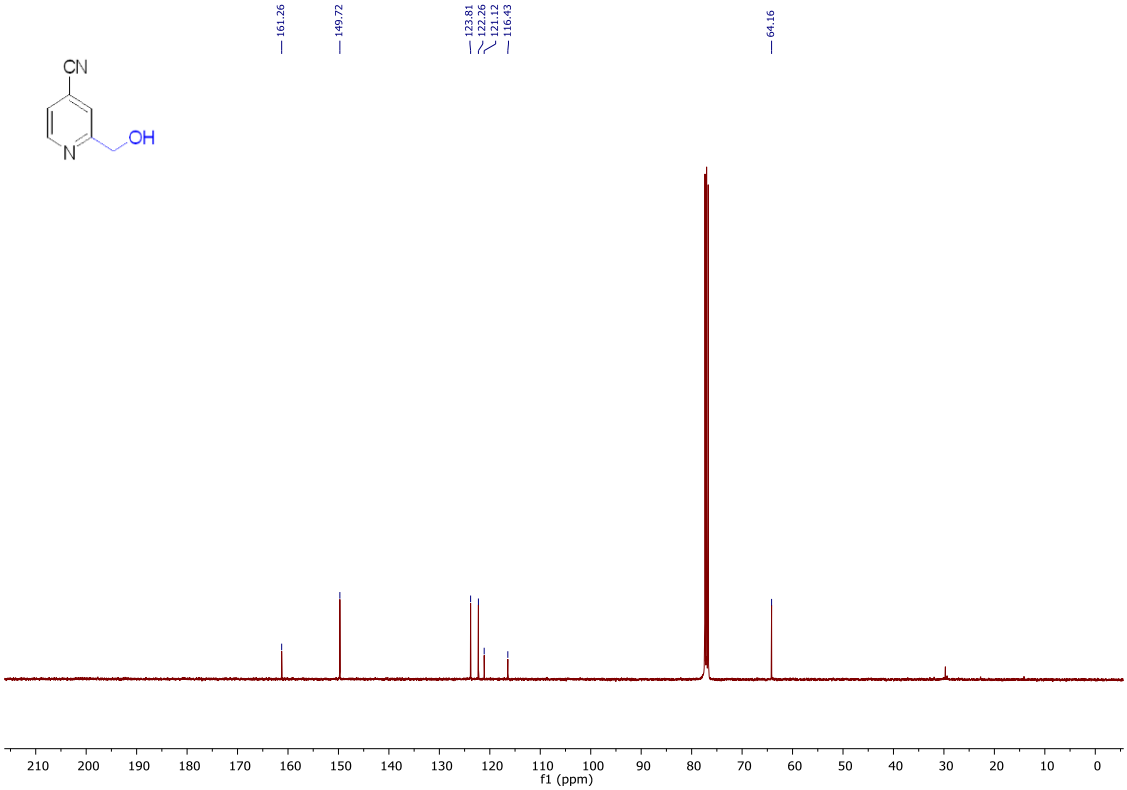
^{13}C NMR (101 MHz, $CDCl_3$) **(18)**



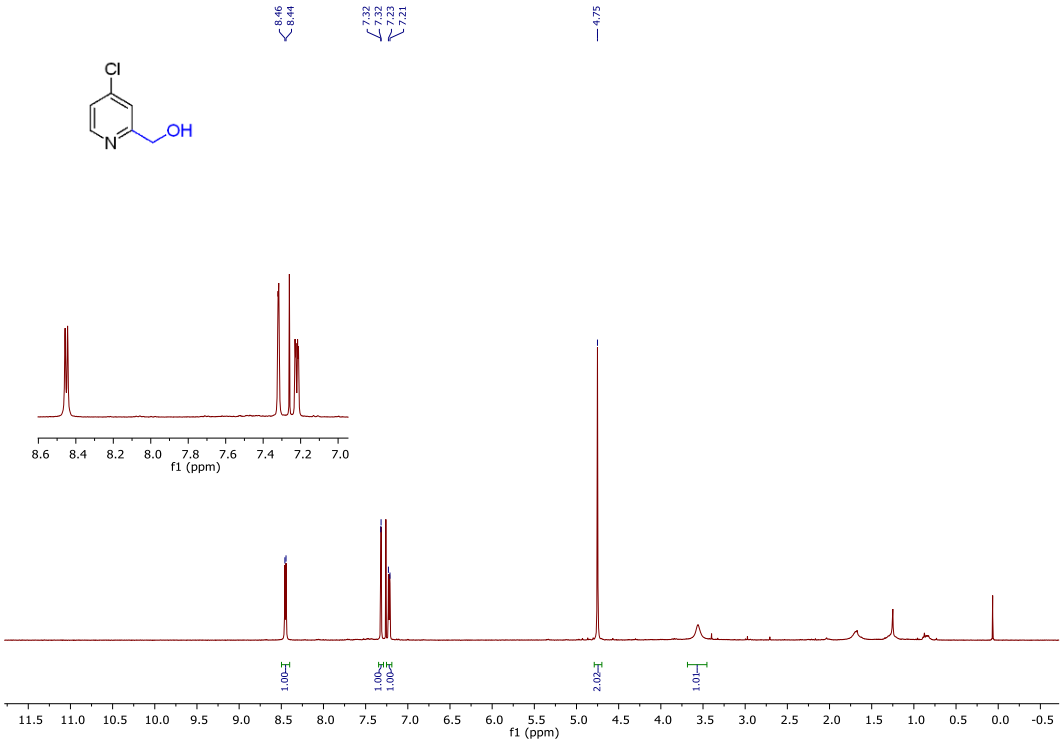
^{1}H NMR (400 MHz, $CDCl_3$) **(19)**



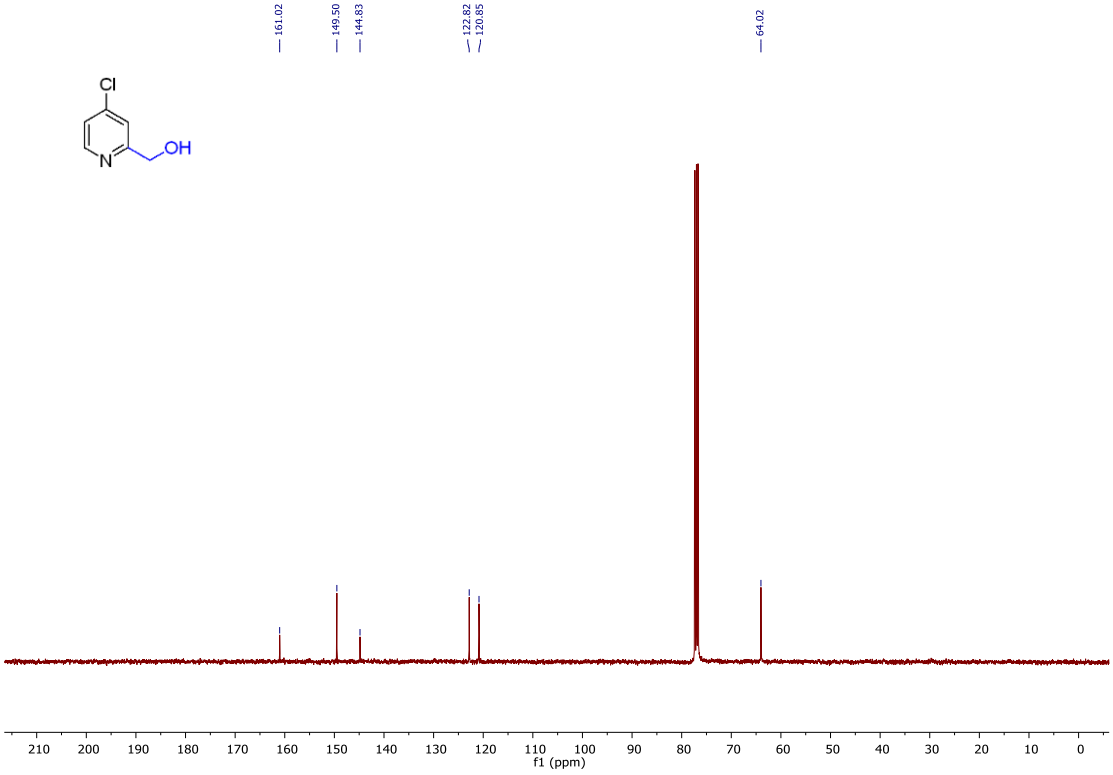
^{13}C NMR (101 MHz, $CDCl_3$) **(19)**



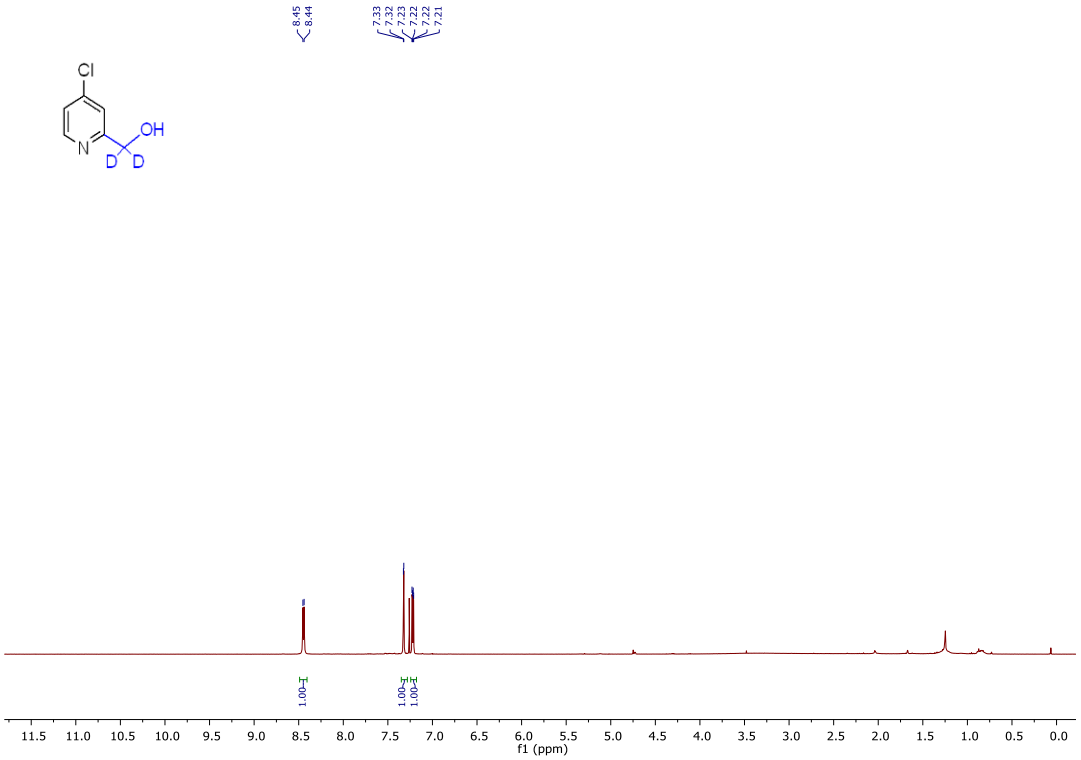
^{1}H NMR (400 MHz, $CDCl_3$) **(20)**



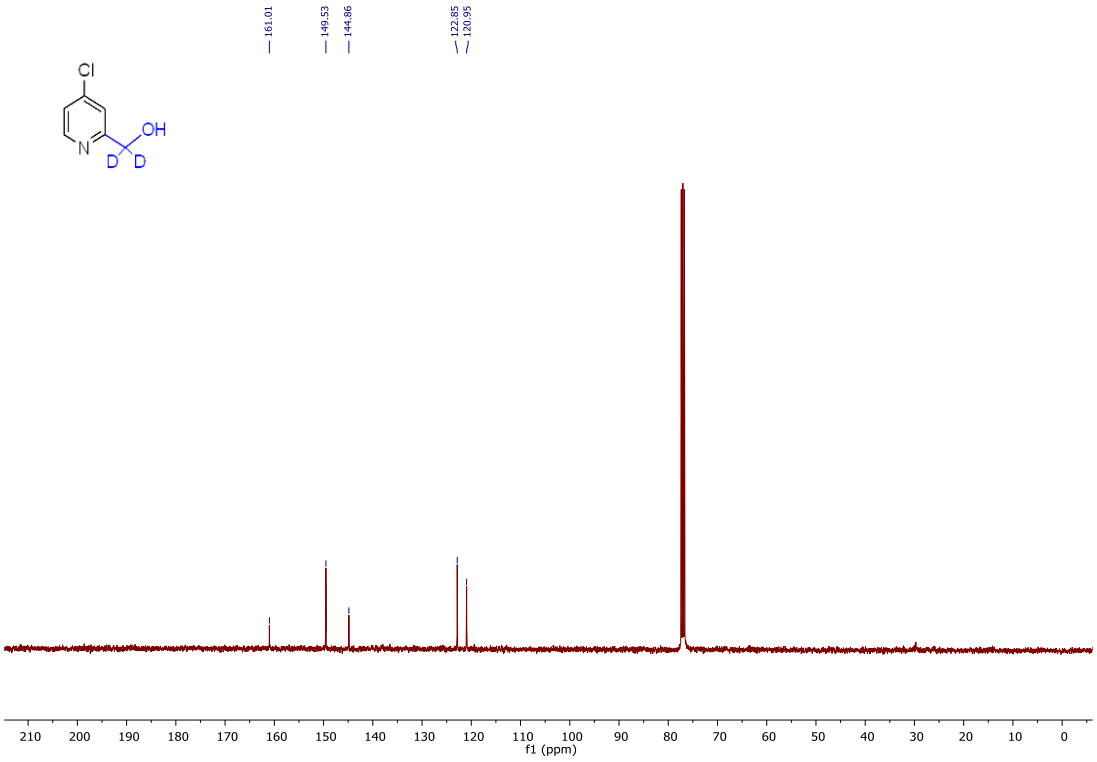
^{13}C NMR (101 MHz, $CDCl_3$) **(20)**



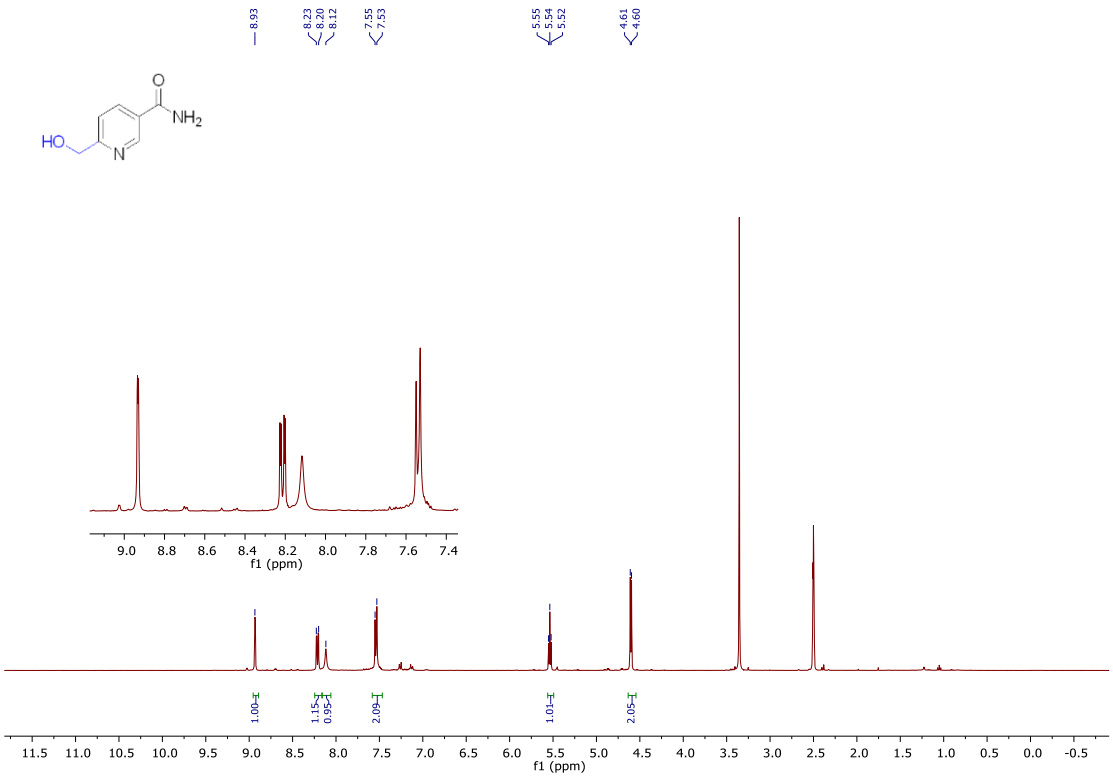
^{1}H NMR (300 MHz, $CDCl_3$) **(21)**



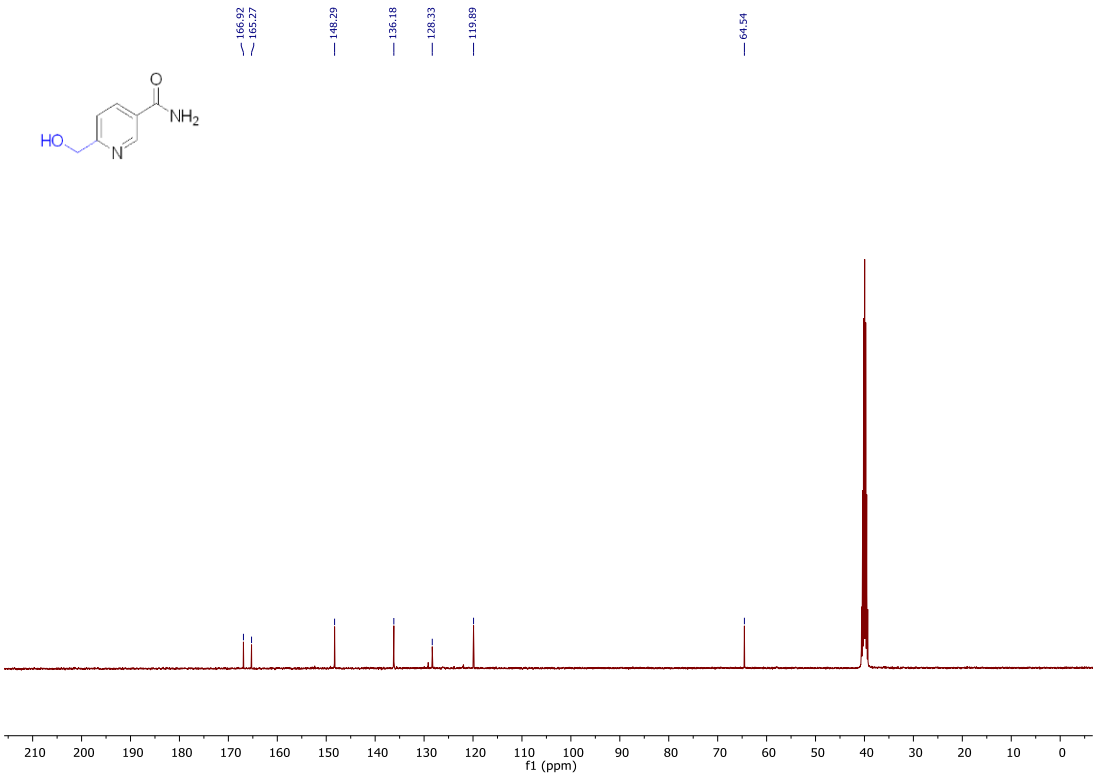
^{13}C NMR (101 MHz, $CDCl_3$) **(BQ21)**



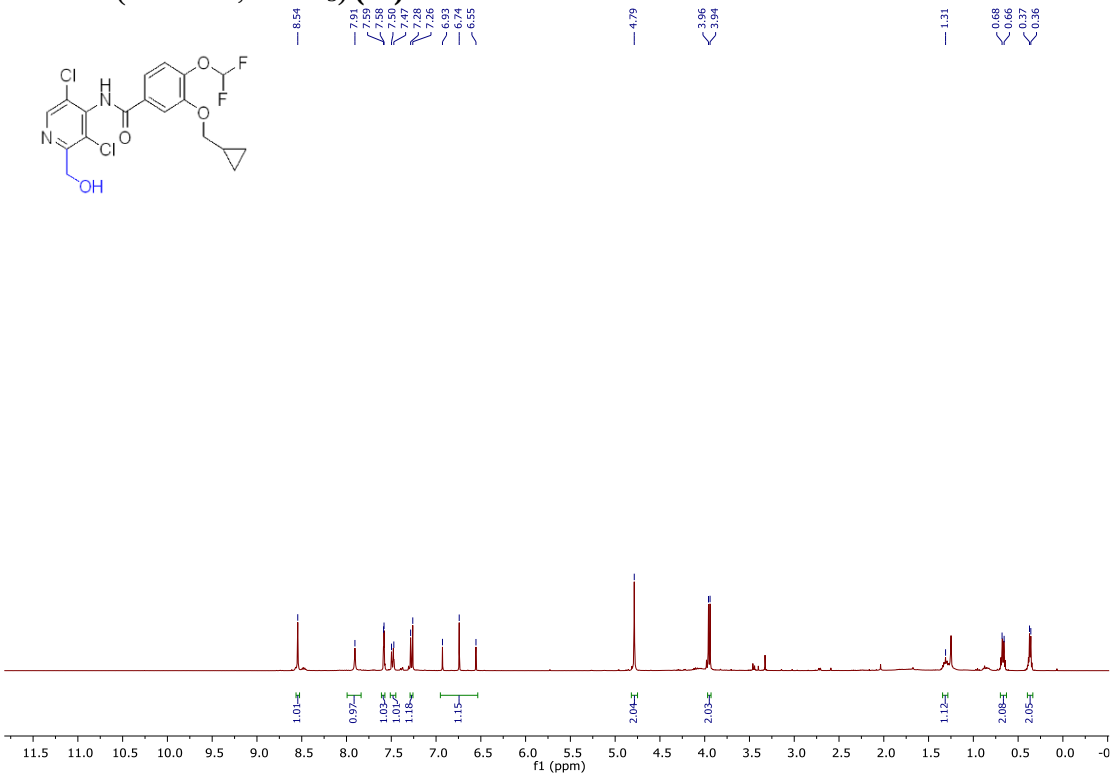
^{1}H NMR (400 MHz, DMSO-d_6) **(22)**



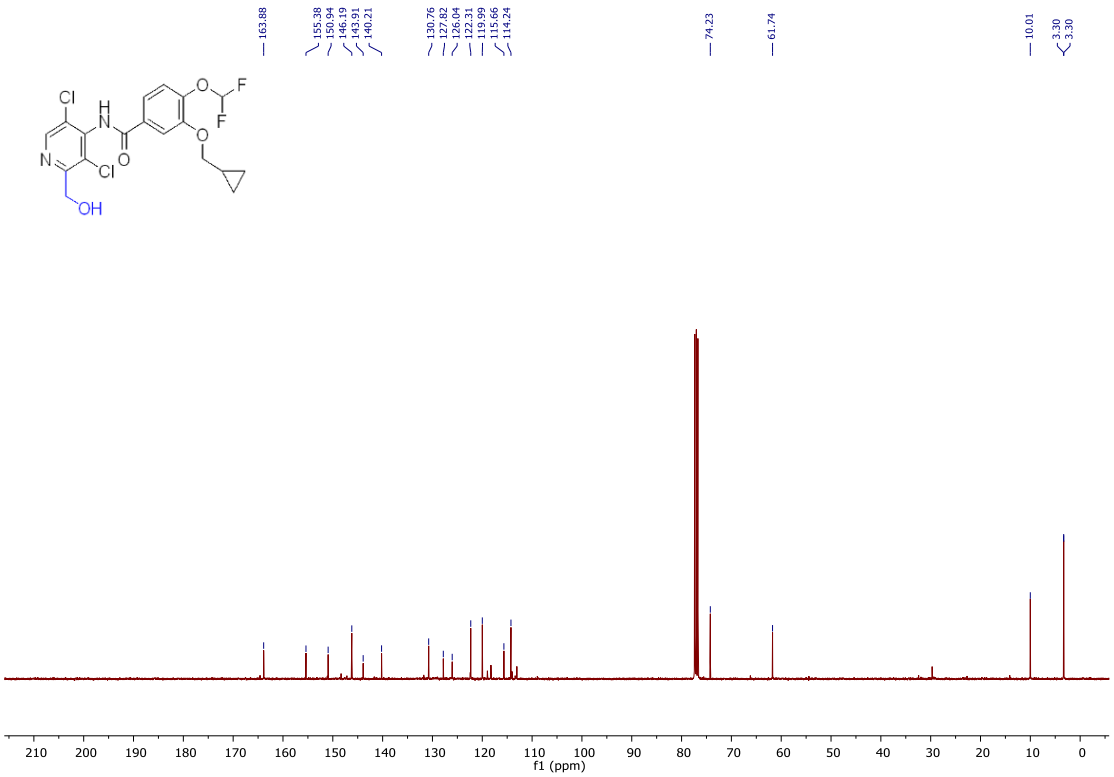
^{13}C NMR (101 MHz, DMSO-d_6) **(22)**



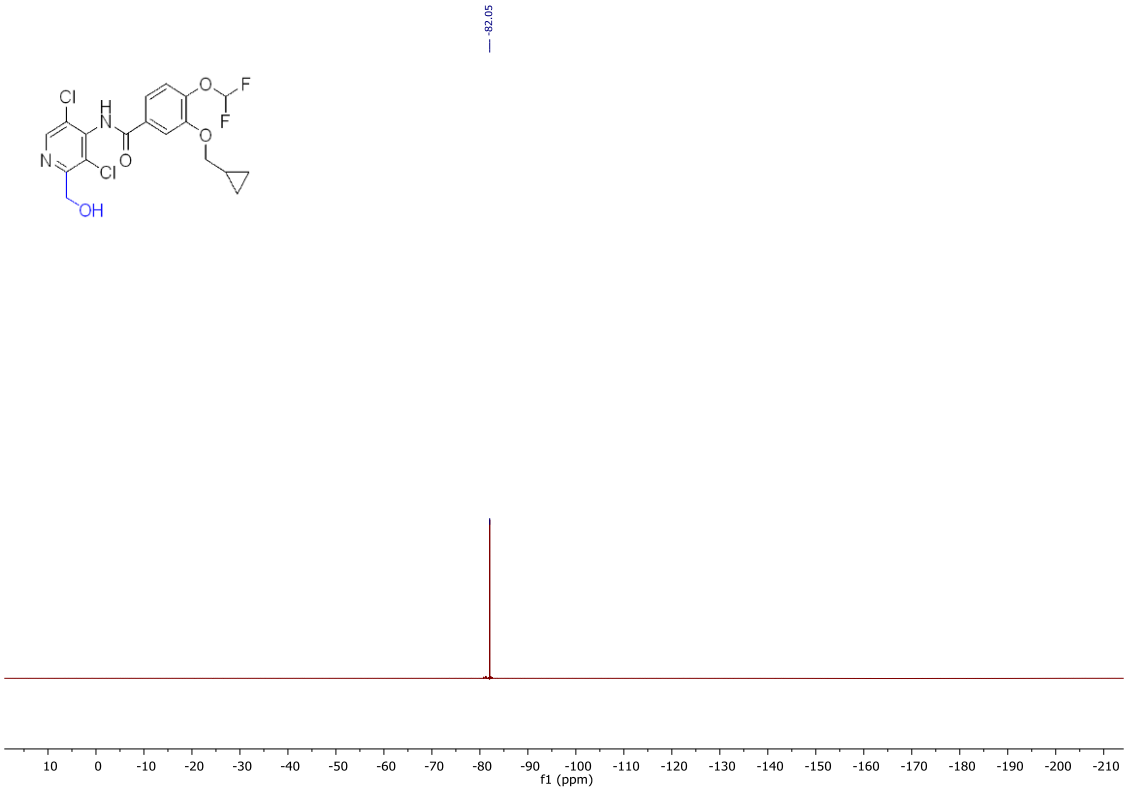
^{1}H NMR (400 MHz, $CDCl_3$) **(23)**



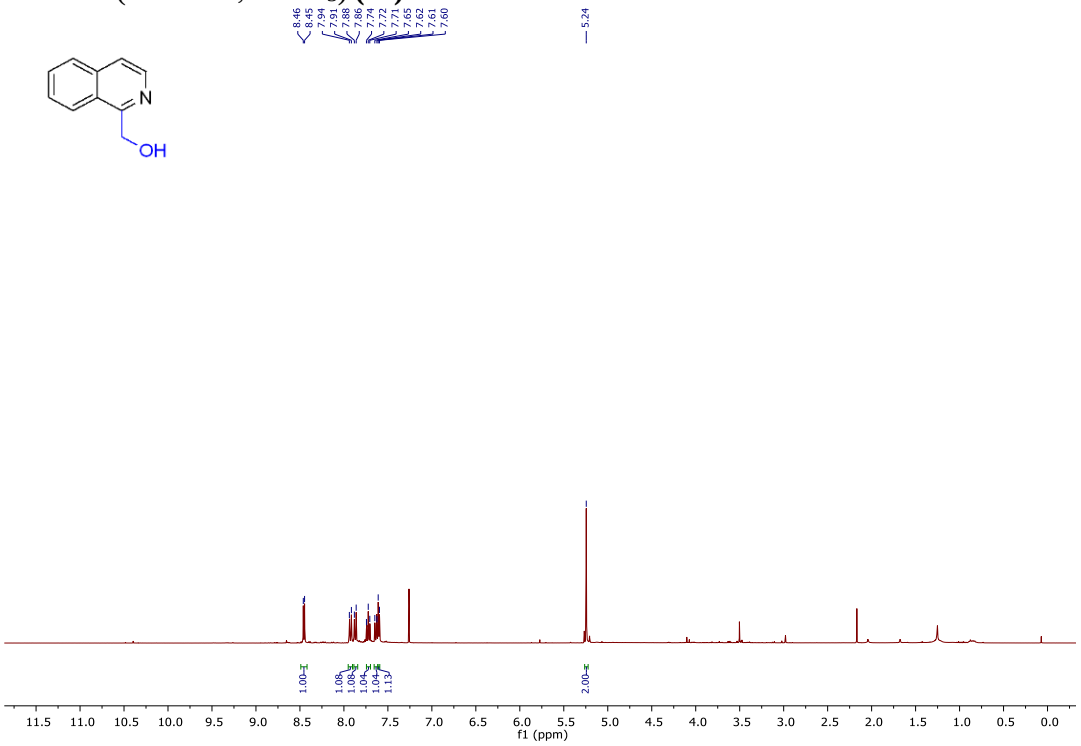
^{13}C NMR (101 MHz, $CDCl_3$) **(23)**



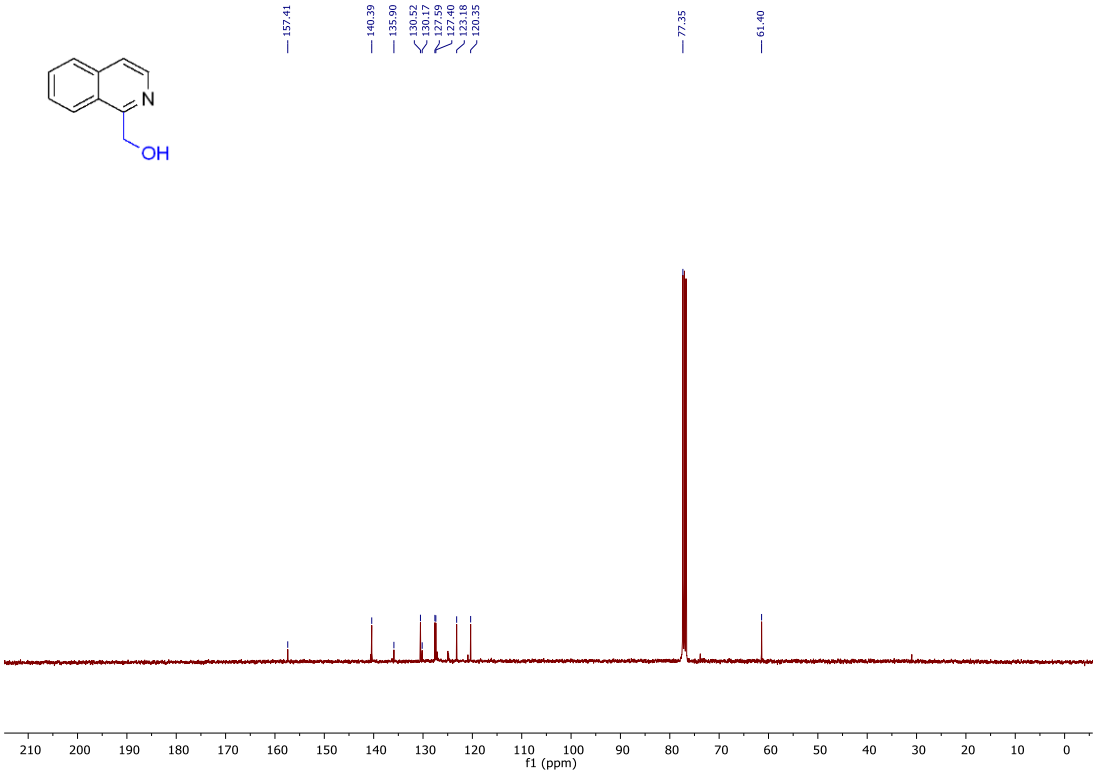
^{19}F NMR (377 MHz, $CDCl_3$) **(23)**



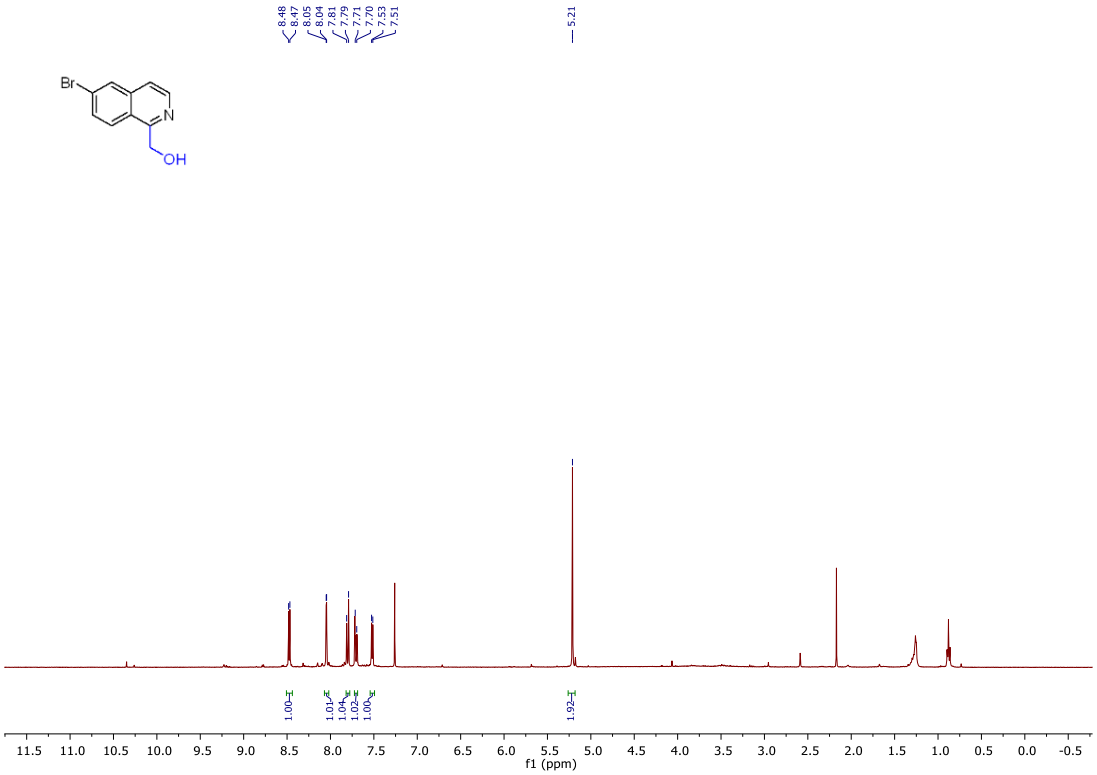
^{1}H NMR (400 MHz, $CDCl_3$) **(24)**



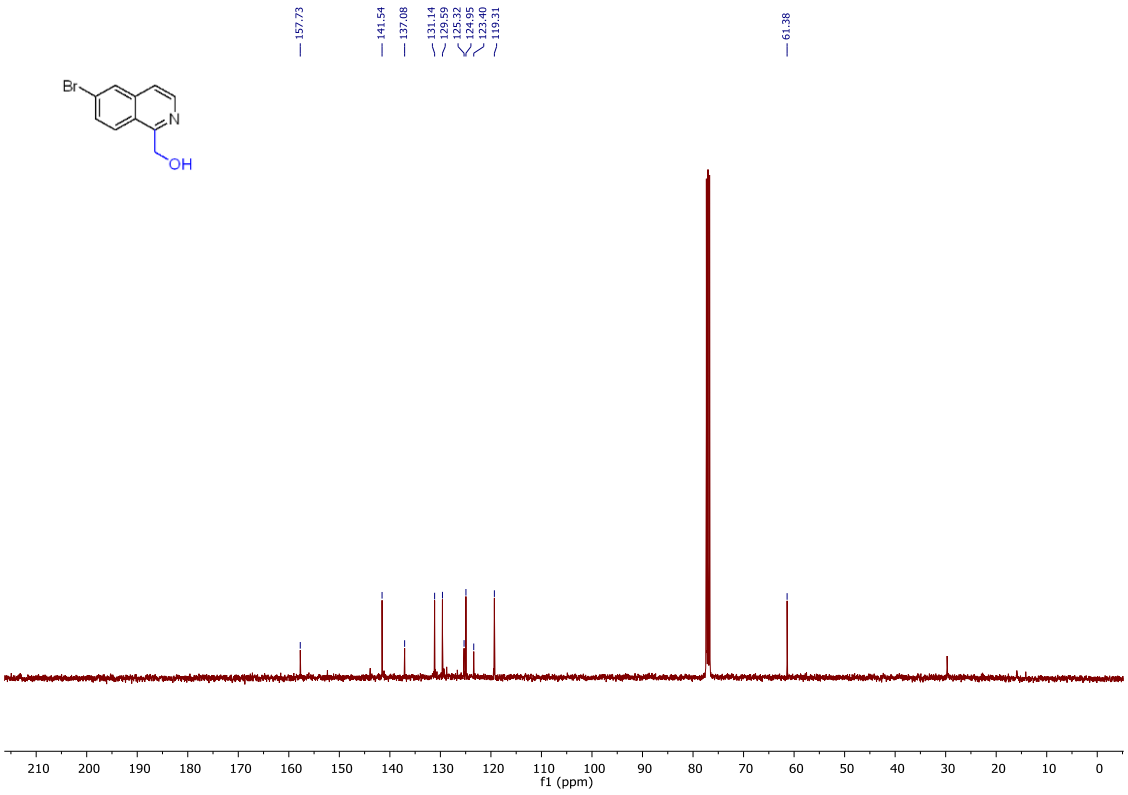
^{13}C NMR (101 MHz, $CDCl_3$) **(24)**



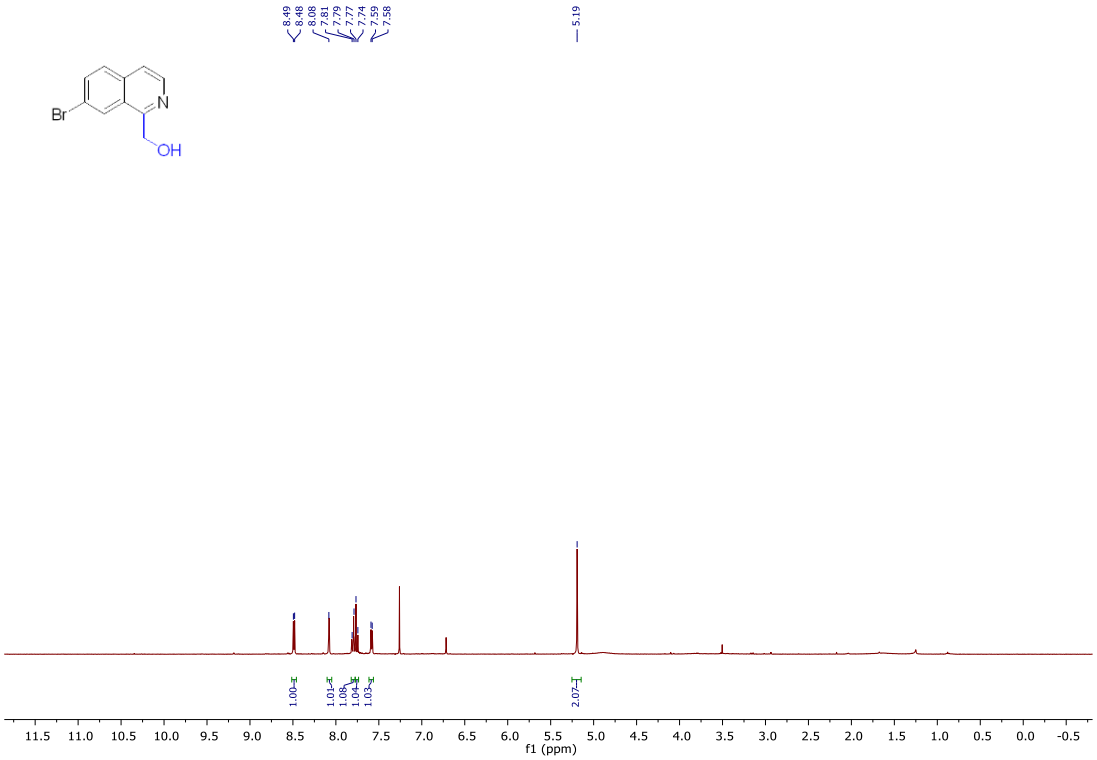
^{1}H NMR (400 MHz, $CDCl_3$) **(25)**



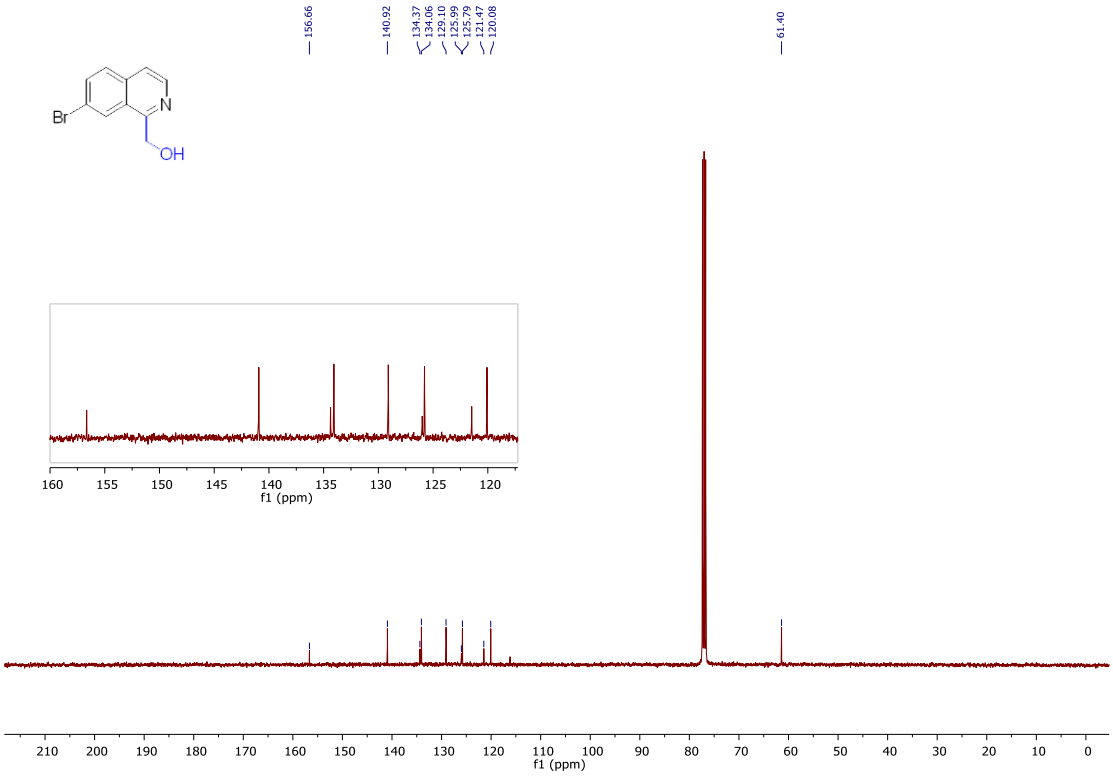
^{13}C NMR (101 MHz, $CDCl_3$) **(25)**



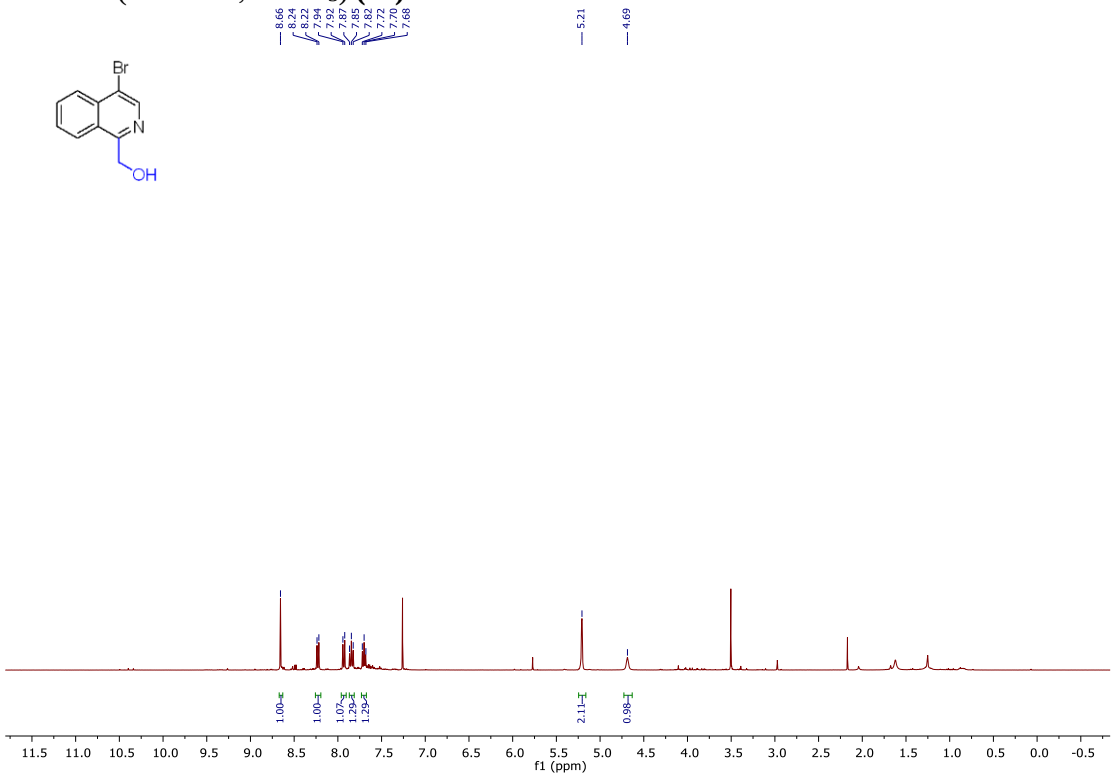
^{1}H NMR (400 MHz, $CDCl_3$) **(26)**



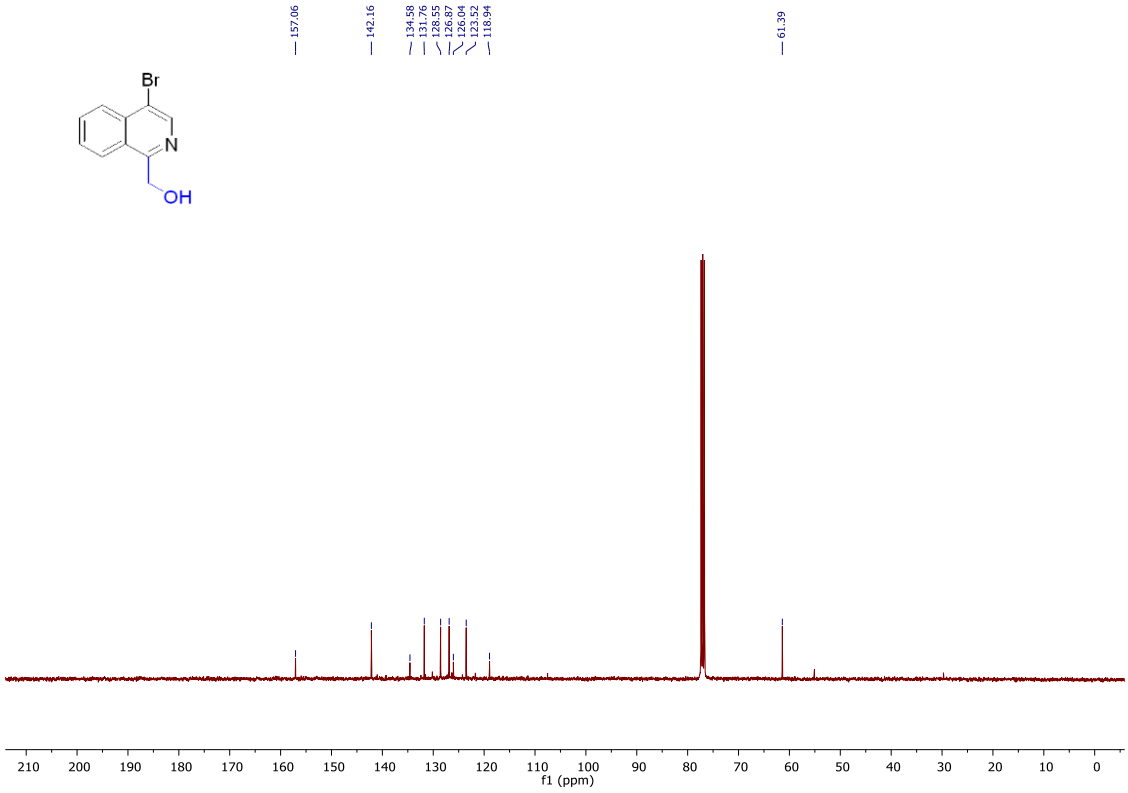
^{13}C NMR (101 MHz, $CDCl_3$) **(26)**



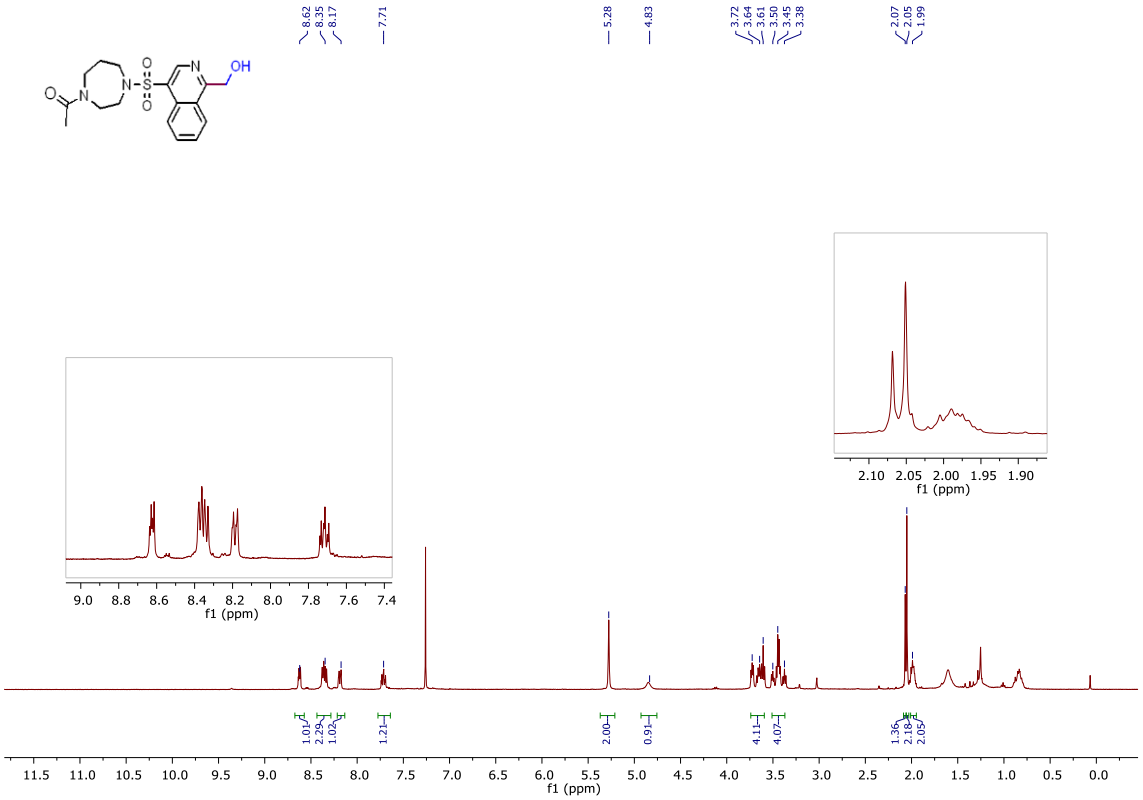
^{1}H NMR (400 MHz, $CDCl_3$) **(27)**



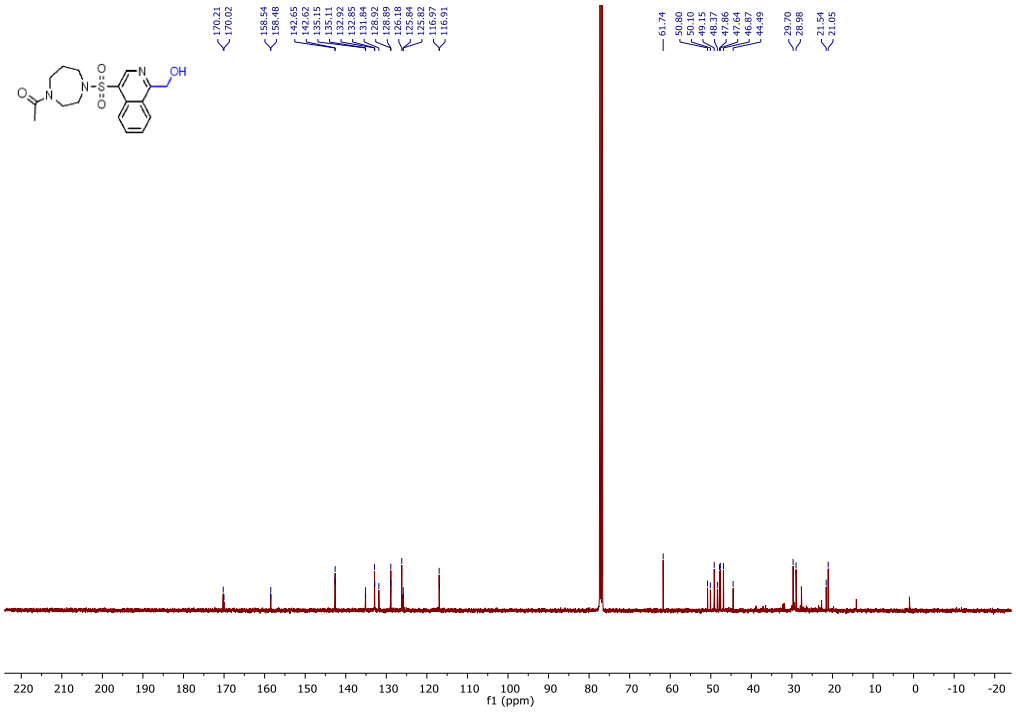
^{13}C NMR (101 MHz, $CDCl_3$) **(27)**



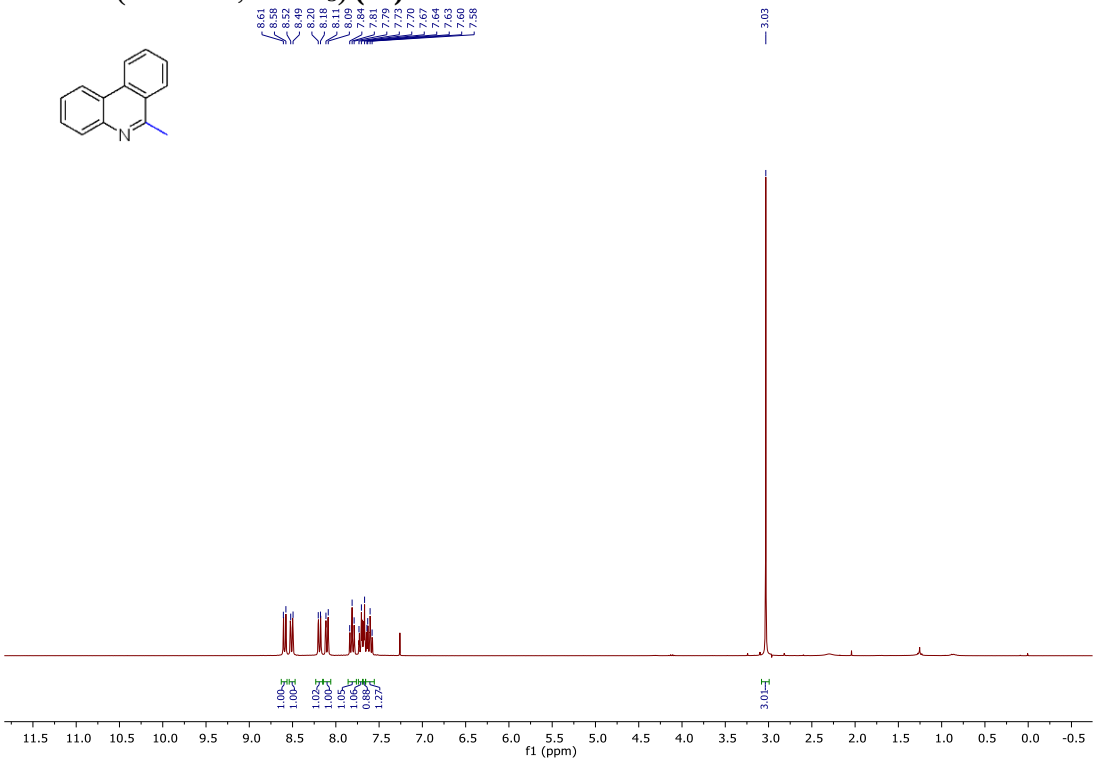
^{1}H NMR (400 MHz, $CDCl_3$) **(28)**



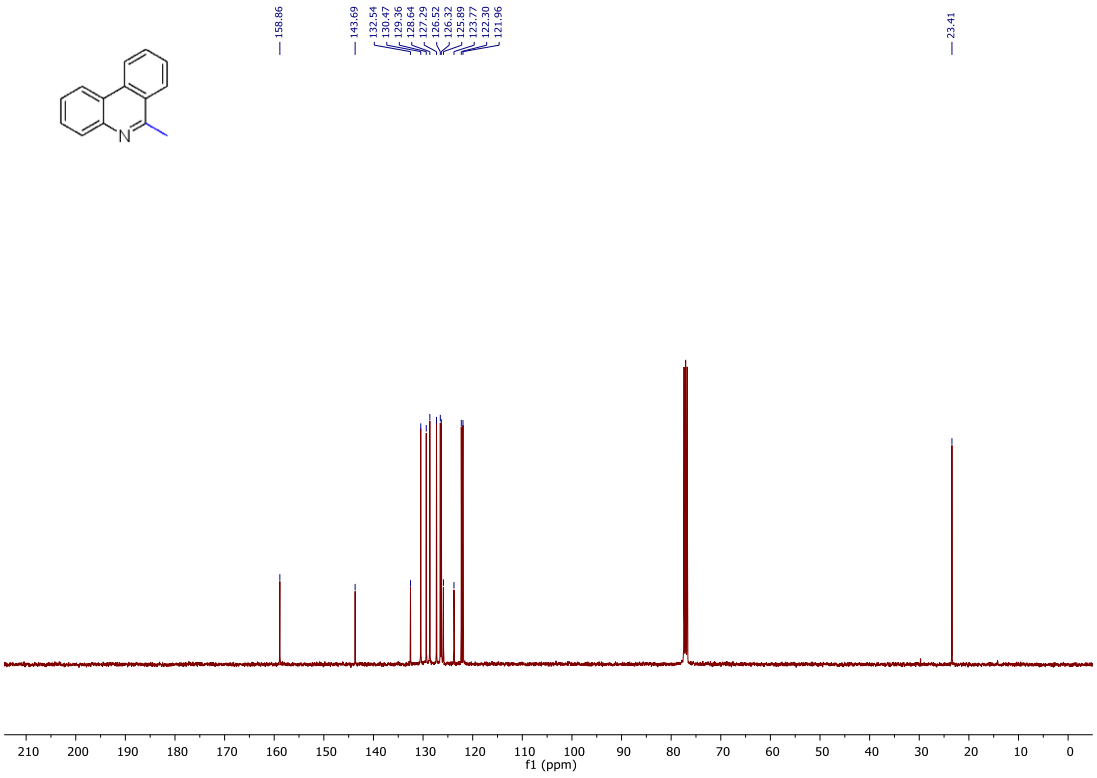
^{13}C NMR (101 MHz, $CDCl_3$) **(28)**



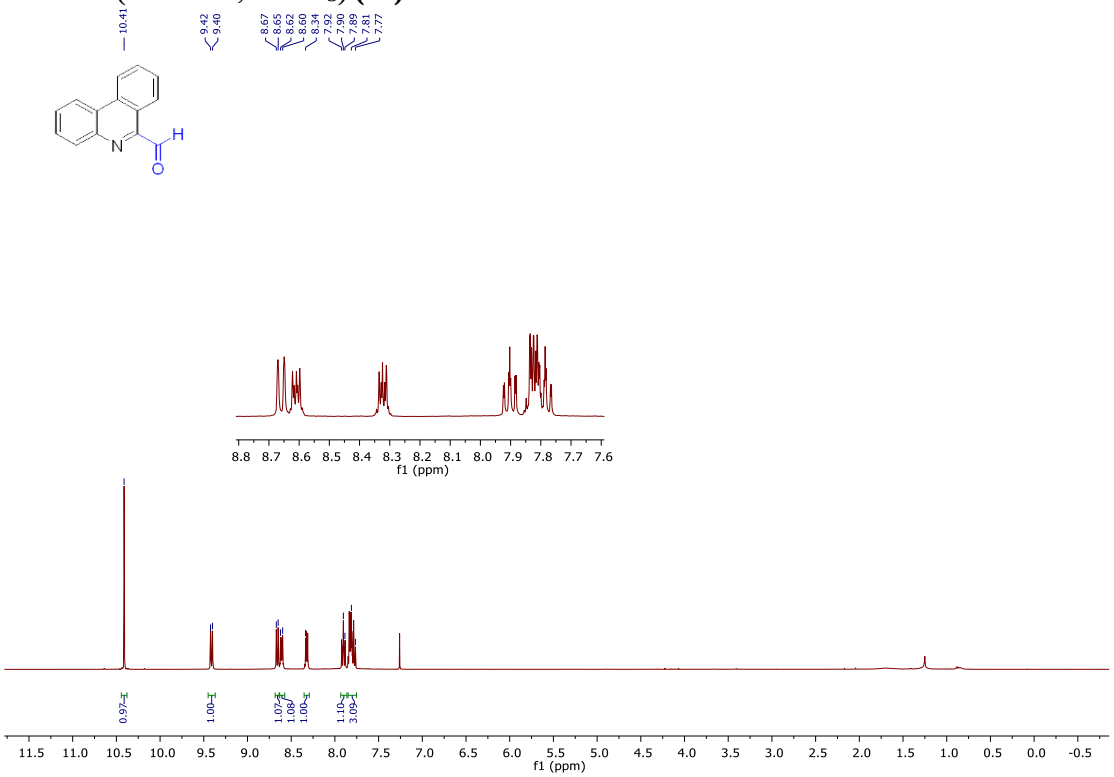
^{1}H NMR (300 MHz, $CDCl_3$) **(29)**



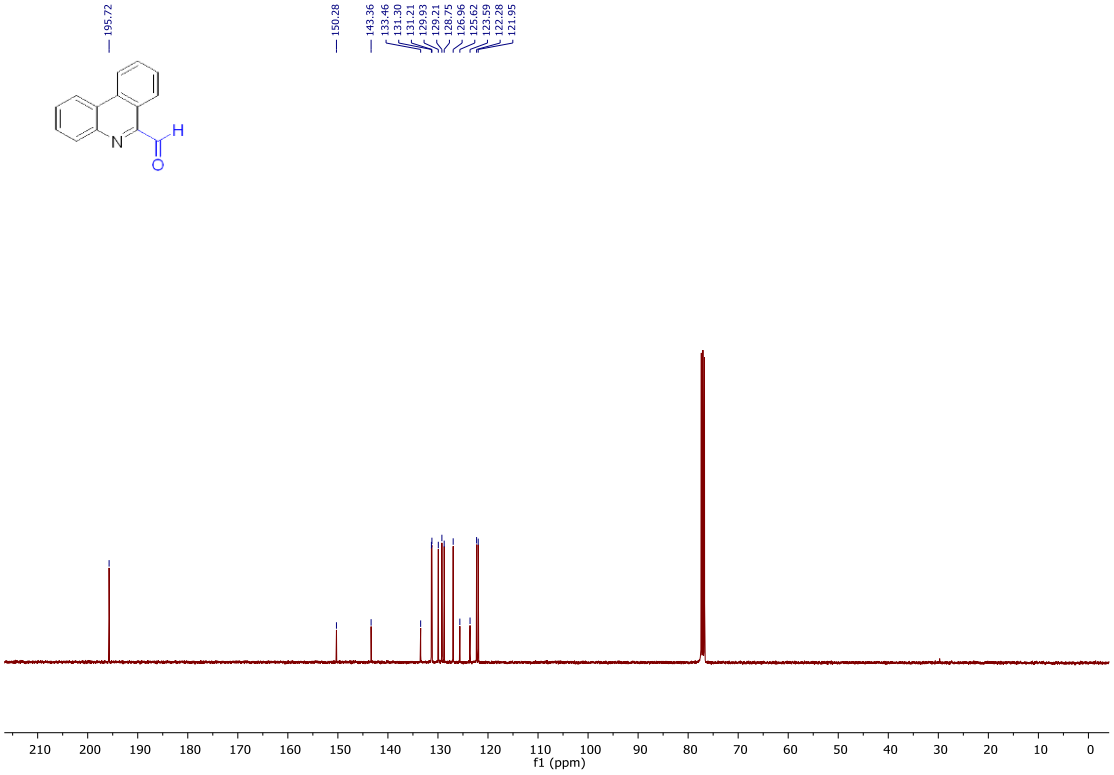
^{13}C NMR (101 MHz, $CDCl_3$) **(29)**



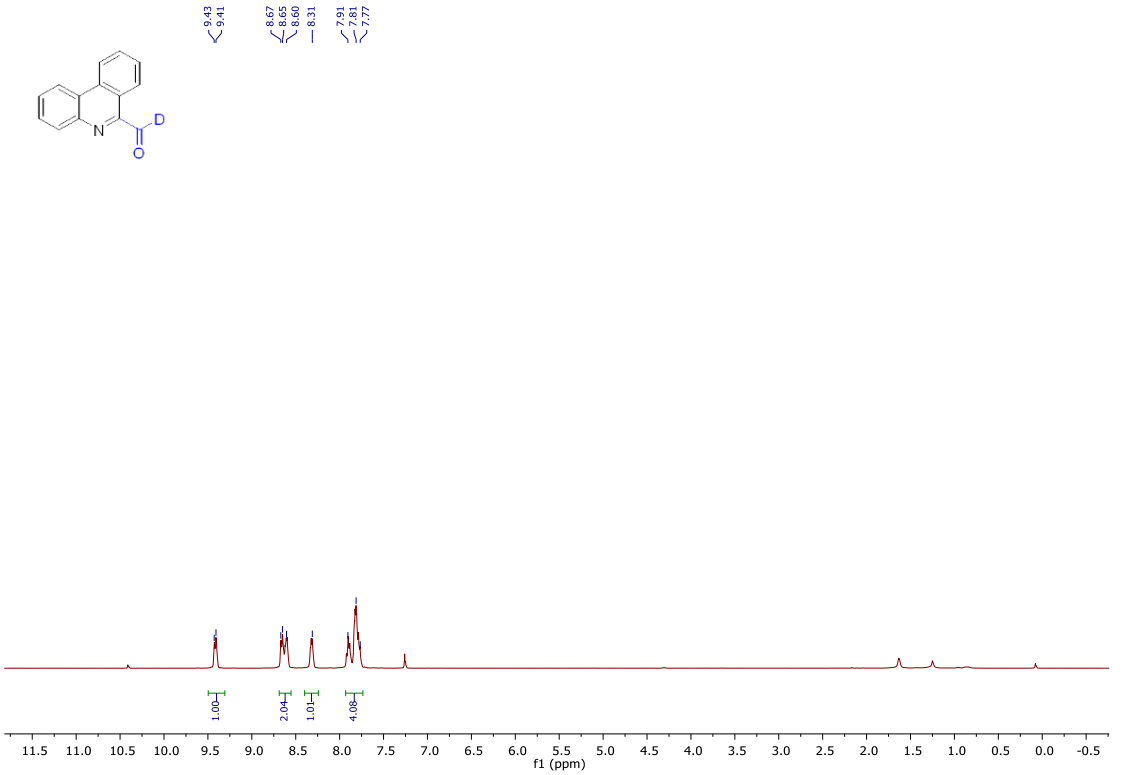
^{1}H NMR (400 MHz, $CDCl_3$) **(30)**



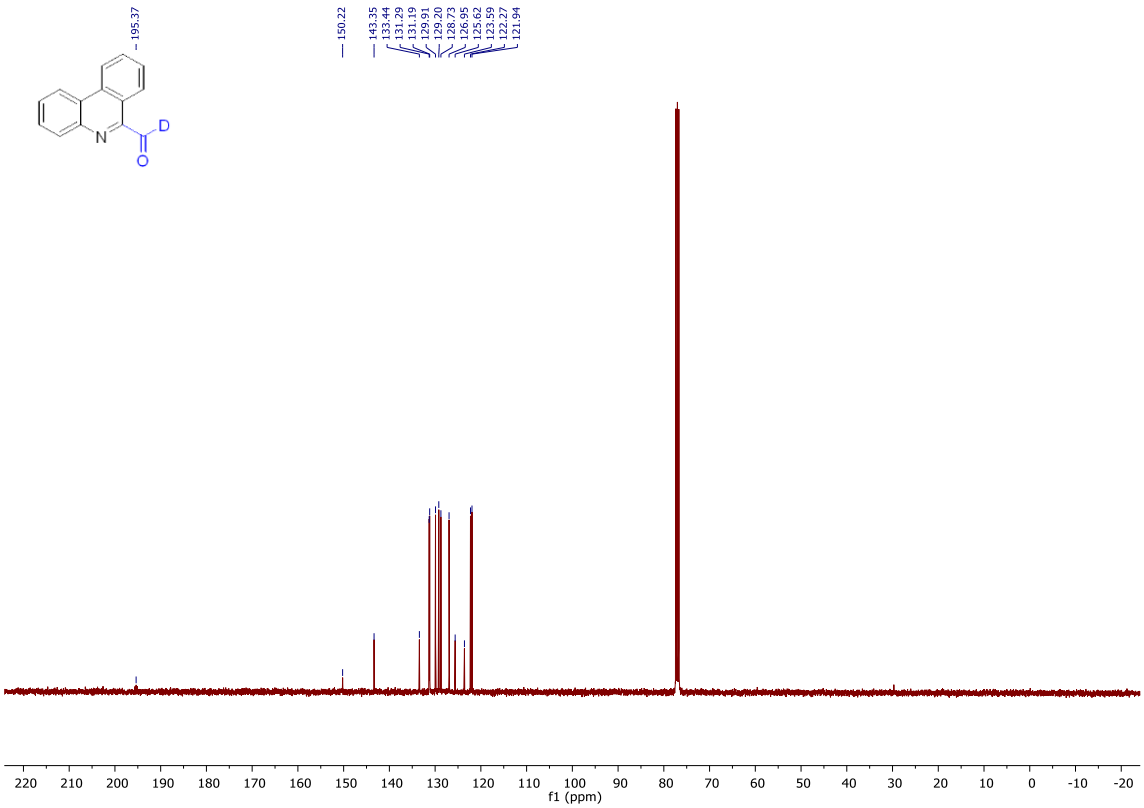
^{13}C NMR (101 MHz, $CDCl_3$) **(31)**



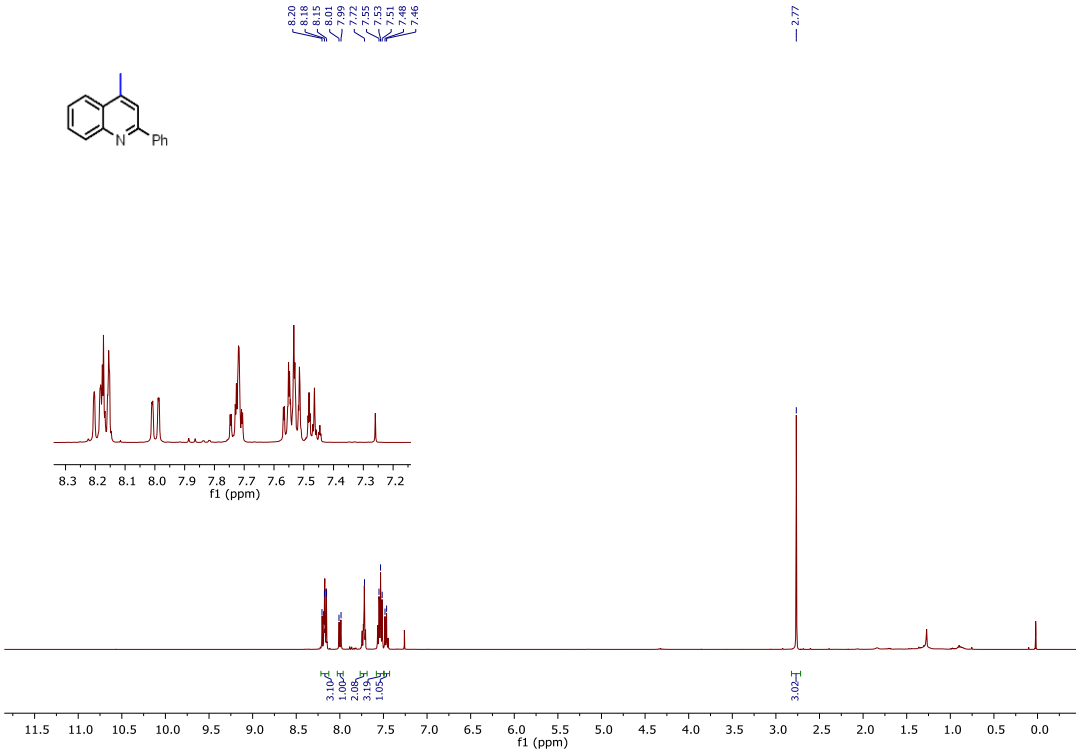
^{1}H NMR (400 MHz, $CDCl_3$) **(31)**



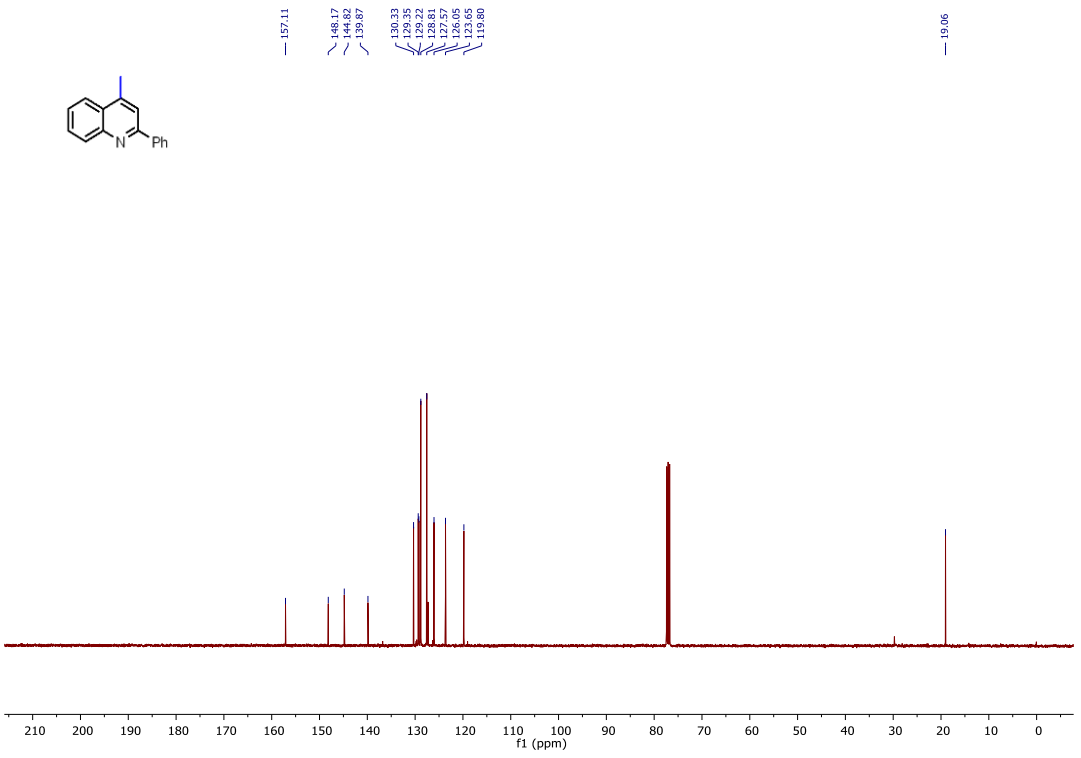
^{13}C NMR (101 MHz, $CDCl_3$) **(31)**



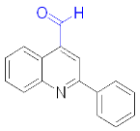
^{1}H NMR (400 MHz, $CDCl_3$) **(32)**

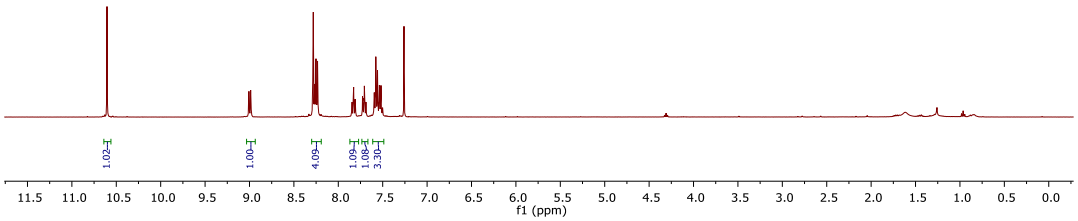


^{13}C NMR (101 MHz, $CDCl_3$) **(32)**

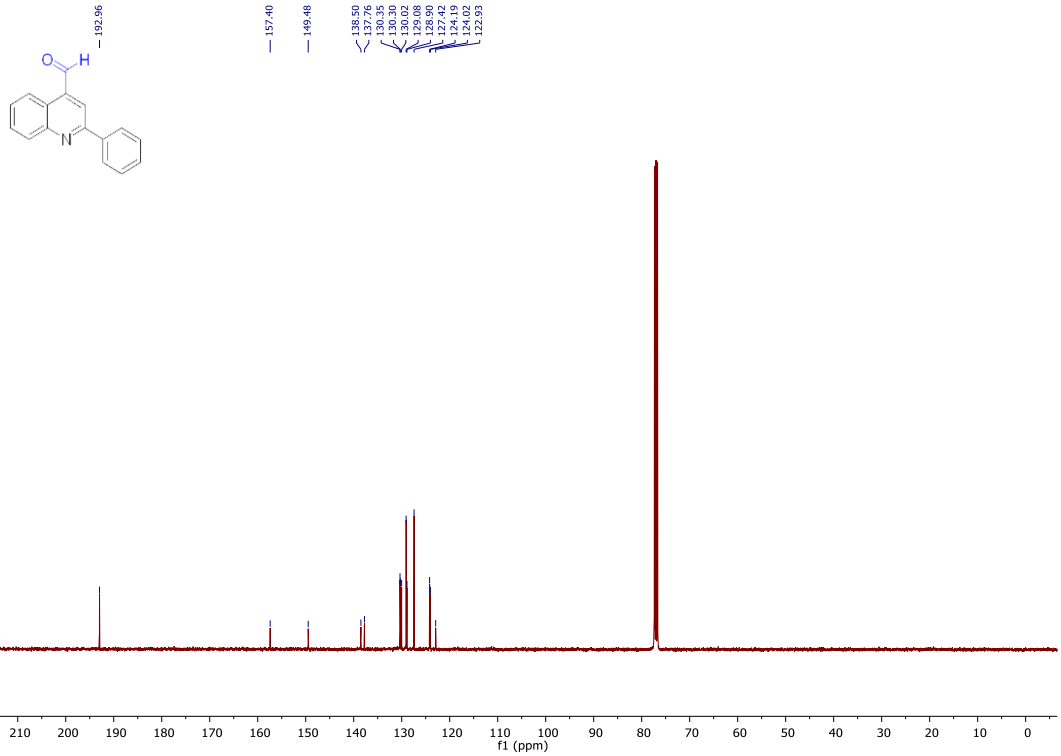


^{1}H NMR (400 MHz, $CDCl_3$) **(33)**





^{13}C NMR (101 MHz, $CDCl_3$) **(33)**



REFERENCES

(1) Laze, L.; Quevedo-Flores, B.; Bosque, I.; Gonzalez-Gomez, J. C. Alkanes in Minisci-Type Reaction under Photocatalytic Conditions with Hydrogen Evolution. *Org. Lett.* **2023**, *25* (48), 8541–8546.

(2) Ramirez, N. P.; Bosque, I.; Gonzalez-Gomez, J. C. Photocatalytic Dehydrogenative Lactonization of 2-Arylbenzoic Acids. *Org. Lett.* **2015**, *17* (18), 4550–4553.

(3) Proctor, R. S. J.; Davis, H. J.; Phipps, R. J. Catalytic Enantioselective Minisci-Type Addition to Heteroarenes. *Science* **2018**, *360* (6387), 419–422.

(4) Elangovan, A.; Yang, S.-W.; Lin, J.-H.; Kao, K.-M.; Ho, T.-I. Synthesis and Electrogenerated Chemiluminescence of Donor-Substituted Phenylquinolinylethynes and Phenylisoquinolinylethynes: Effect of Positional Isomerism. *Org. Biomol. Chem.,* **2004**, 2, 1597-1602.

(5) Jiang, C.; Liao, Y.; Li, H.; Zhang, S.; Liu, P.; Sun, P.; Electrochemical Silylation of Electron-Deficient Heterocycles Using N-Hydroxyphthalimide as HAT Catalyst. *Adv. Synth. Catal.* **2023**, 365, 1205-1210.

(6) Yang, J.-F.; Liu, Y.-F.; Wei, L.-L.; Qiao, K.-K.; Zhao, Y.-Q.; Shi, L. Minisci-Type Dehydrogenative Coupling of N-Heteroaromatic Rings with Inert C(Sp^3)–H Enabled by a Visible-Light-Catalyzed Intermolecular Hydrogen Atom Transfer Process. *J. Org. Chem.* **2024**, *89* (6), 4249–4260.

(7) Zeng, C.-L.; Wang, H.; Gao, D.; Zhang, Z.; Ji, D.; He, W.; Liu, C.-K.; Yang, Z.; Fang, Z.; Guo, K. CF_3 SO_2 Na-Mediated Visible-Light-Induced Cross-Dehydrogenative Coupling of Heteroarenes with Aliphatic C(Sp^3)–H Bonds. *Org. Lett.* **2022**, *24* (17), 3244–3248.

(8) Niu, L.; Liu, J.; Liang, X.-A.; Wang, S.; Lei, A. Visible Light-Induced Direct α C–H Functionalization of Alcohols. *Nat. Commun.* **2019**, *10* (1), 467.

(9) Zhou, L.; Okugawa, N.; Togo, H. Hydroxymethylation of Quinolines with $Na_2S_2O_8$ by a Radical Pathway. *Eur. J. Org. Chem.* **2017**, *2017* (41), 6239–6245.

(10) Zhang, Y.; Yue, X.; Zhu, J.; Peng, J.; Zhou, C.; Wu, J.; Zhang, P. Visible Light-Induced Hydroxymethylation and Formylation of (Iso)Quinolines with Alcohols. *Mol. Catal.* **2022**, *530*, 112594.

(11) Stenkamp, D.; Mueller, S. G.; Lustenberger, P. **(2005)**. ALKYNE COMPOUNDS WITH MCH ANTAGONISTIC ACTIVITY AND MEDICAMENTS COMPRISING THESE COMPOUNDS. (U.S. Patent No. 7,592,358 B2).

(12) Esparza-Ruiz, A.; Herrmann, C.; Chen, J.; Patrick, B. O.; Polishchuk, E.; Orvig, C. Synthesis and in Vitro Anticancer Activity of Ferrocenyl-Aminoquinoline-Carboxamide Conjugates. *Inorganica Chim. Acta* **2012**, *393*, 276–283.

(13) Uhlig, N.; Martins, A.; Gao, D. Selective DIBAL-H Monoreduction of a Diester Using Continuous Flow Chemistry: From Benchtop to Kilo Lab. *Org. Process Res. Dev.* **2020**, *24* (10), 2326–2335.

(14) Rammal, F.; Gao, D.; Boujnah, S.; Hussein, A. A.; Lalevée, J.; Gaumont, A.-C.; Morlet-Savary, F.; Lakhdar, S. Photochemical C–H Silylation and Hydroxymethylation of Pyridines and Related Structures: Synthetic Scope and Mechanisms. *ACS Catal.* **2020**, *10* (22), 13710–13717.

(15) Xu, P.; Chen, P.; Xu, H. Scalable Photoelectrochemical Dehydrogenative Cross-Coupling of Heteroarenes with Aliphatic C−H Bonds. *Angew. Chem. Int. Ed.* **2020**, *59* (34), 14275–14280.

(16) Xu, Z.; Zhang, L. Methanol as a Formylating Agent in Nitrogen Heterocycles. *Org. Biomol. Chem.* **2021**, *19* (43), 9476–9482.

(17) Jin, J.; MacMillan, D. W. C. Alcohols as Alkylating Agents in Heteroarene C–H Functionalization. *Nature* **2015**, *525* (7567), 87–90.
(18) Shantharjun, B.; Vani, D.; Unnava, R.; Sandeep, M.; Reddy, K. R. Hydroxymethylation of Quinolines *via* Iron Promoted Oxidative C–H Functionalization: Synthesis of Arsindoline-A and Its Derivatives. *Org. Biomol. Chem.* **2021**, *19* (3), 645–652.
(19) Dong, J.; Wang, X.; Song, H.; Liu, Y.; Wang, Q. Photoredox-Catalyzed Redox-Neutral Minisci C−H Formylation of N-Heteroarenes. *Adv. Synth. Catal.* **2020**, *362* (11), 2155–2159.