

Supporting Information

Aerobic C(sp³)-H Oxidation and Oxygenation of Quaternized Quinolines and Pyridines by Visible-Light-Induced Photocatalysis

Tonghao Han, Yunqi Jiang, Xiaochen Ji, Guo-Jun Deng, and Huawen
Huang**

Key Laboratory for Green Organic Synthesis and Application of Hunan Province, Key
Laboratory of Environmentally Friendly Chemistry and Application of Ministry of
Education, College of Chemistry, Xiangtan University, Xiangtan 411105, China
E-mail: xcji@xtu.edu.cn; hwhuang@xtu.edu.cn

Table of Content

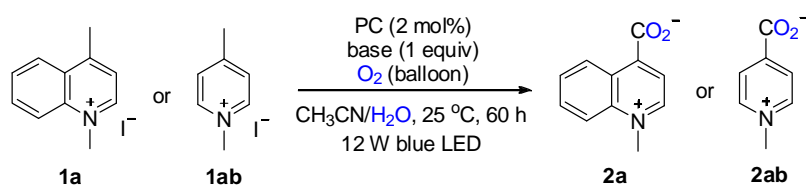
1. General information	S2
2. Optimization of reaction conditions	S3
3. General procedures for the photoredox oxygenation	S5
4. Mechanistic investigations.....	S6
4.1. The correspondence between time and yield at different reaction temperature	S6
4.2. Control experiments.....	S7
4.3. Stern-Volmer fluorescence quenching experiments	S11
4.4. Cyclic Voltammetry experiments.....	S13
5. Characterization data of products.....	S14
6. ¹ H NMR and ¹³ C NMR spectra of products	S43

1. General information

The reactions via general procedure were carried out under an atmosphere of oxygen unless otherwise noted. Column chromatography was performed using silica gel (200-300 mesh) or thin layer chromatography was performed using silica gel (GF254). ^1H NMR and ^{13}C NMR spectra were recorded on Bruker-AV (400 and 100 MHz, respectively) instrument using CD_3OD , D_2O , acetone- d_6 or dimethyl sulfoxide- d_6 as solvent. High-resolution mass spectra (ESI) were obtained with the Thermo Scientific LTQ Orbitrap XL mass spectrometer. Melting points were measured with a YUHUA X-5 melting point instrument and were uncorrected. Quaternized N-heterocycles were prepared from the corresponding N-heterocycles and alkylhalides (I or Br) that were obtained from commercial suppliers without further purification. Other reagents including photocatalysts and solvents were obtained from commercial suppliers without further purification. Cyclic voltammograms were recorded with a CHI830B potentiostat at room temperature in CH_3CN . $n\text{-Bu}_4\text{NBF}_4$ (0.1 M) was used as the supporting electrolyte, and a glass carbon electrode was used as the working electrode. The auxiliary electrode was a platinum wire electrode. All potentials are referenced against the Ag/AgCl redox couple. The scan rate was $100\text{ mV}\cdot\text{s}^{-1}$.

2. Optimization of reaction conditions

Table S1 Optimization of Reaction conditions^a



Entry	1	Catalyst	Additive	Solvent	Product, Yield[%] ^b
1	1a	[Ru]	K ₂ HPO ₄	CH ₃ OH	2a , 11
2	1a	[Ru]	K ₂ HPO ₄	CH ₂ Cl ₂	2a , trace
3	1a	[Ru]	K ₂ HPO ₄	THF	2a , trace
4	1a	[Ru]	K ₂ HPO ₄	CH ₃ CN	2a , 37
5	1a	[Ru]	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 77
6	1a	[Ru]	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1.5:0.5)	2a , 62
7	1a	[Ru]	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1.0:0.5)	2a , 57
8	1a	[Ru]	K ₂ HPO ₄	H ₂ O	2a , 14
9	1a	[Ir]	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 33
10	1a	Rose Bengal	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 52
11	1a	Ru(bpy) ₃ (BF ₆) ₂	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 47
12	1a	Eosin Y	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 46
13	1a	[Ru]	KH ₂ PO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 17
14	1a	[Ru]	Cs ₂ CO ₃	CH ₃ CN:H ₂ O (1:1)	2a , 21
15	1a	[Ru]	NaO ^t Bu	CH ₃ CN:H ₂ O (1:1)	2a , 15
16	1a	[Ru]	K ₃ PO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 25
17	1a	[Ru]	DBU	CH ₃ CN:H ₂ O (1:1)	2a , 12
18	1a	[Ru]	KOH	CH ₃ CN:H ₂ O (1:1)	2a , 10
19	1a	[Ru]	0.5 eq K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 49
20	1a	[Ru]	2.0 eq K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 63
21	1a	[Ru]	3.0 eq K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 60

22	1a	none	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , ND
23	1a	[Ru]	none	CH ₃ CN:H ₂ O (1:1)	2a , ND
24 ^c	1a	[Ru]	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 76
25 ^d	1a	[Ru]	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , ND
26 ^e	1a	[Ru]	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 23
27 ^f	1a	[Ru]	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , trace
28 ^g	1a	[Ru]	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2a , 87
29 ^g	1ab	[Ru]	K ₂ HPO ₄	CH ₃ CN:H ₂ O (1:1)	2ab , ND
30 ^g	1ab	[Ru]	Cs ₂ CO ₃	CH ₃ CN:H ₂ O (1:1)	2ab , 54
31 ^g	1ab	[Ru]	NaO ^t Bu	CH ₃ CN:H ₂ O (1:1)	2ab , 79
32 ^g	1ab	[Ru]	KO ^t Bu	CH ₃ CN:H ₂ O (1:1)	2ab , 70
33 ^g	1ab	[Ru]	K ₃ PO ₄	CH ₃ CN:H ₂ O (1:1)	2ab , 45

^a reaction conditions: **1a** (0.2 mmol), base (1 equiv), catalyst (2 mol%), O₂ balloon, solvent (2 mL), 12 W blue LED, 25 °C, 60 h. [Ru] = Ru(bpy)₃Cl₂·6H₂O [Ir] = [Ir(dF(CF₃)ppy)₂(dtbbpy)](PF₆)^b Isolated yields were given and product in trace amount was determined by TLC. ND refers to not detected. ^c O₂ (sealed tube). ^d No light. ^e 40 W CFL instead of LED. ^f Under N₂ atmosphere. ^g Using 2*12 W blue LEDs.

3. General procedures for the photoredox oxygenation

General procedure A: Quinolinium salt or pyridinium salt (**1** or **3**) (0.2 mmol), K_2HPO_4 (1.0 equiv.), $Ru(bpy)_3Cl_2 \cdot 6H_2O$ (2 mol%), H_2O (1.0 mL), and acetonitrile (1.0 mL) were added into a 15 mL tube successively. The tube was attached to an oxygen balloon. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED for 60 h. After completion, purification by flash column chromatography (CH_3OH) gave the pure product **2**. Or otherwise the resulting mixture was concentrated under reduced pressure and washed by CH_3OH to yield the crude product, which was purified by recrystallization from acetone/ethyl acetate to afford the product **4**.

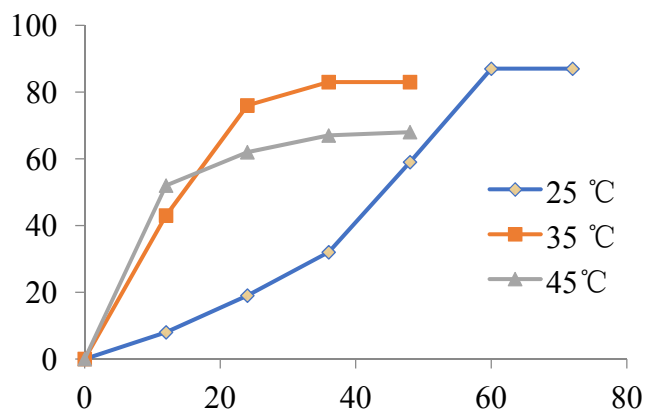
General procedure B: Pyridinium salt **1** (0.2 mmol), NaO^tBu (1.0 equiv.), $Ru(bpy)_3Cl_2 \cdot 6H_2O$ (2 mol%), H_2O (1.0 mL), and acetonitrile (1.0 mL) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED with an oxygen balloon for 60 h. After completion, purification by flash column chromatography (CH_3OH) gave the pure product.

4. Mechanistic investigations

4.1. The correspondence between time and yield at different reaction temperature

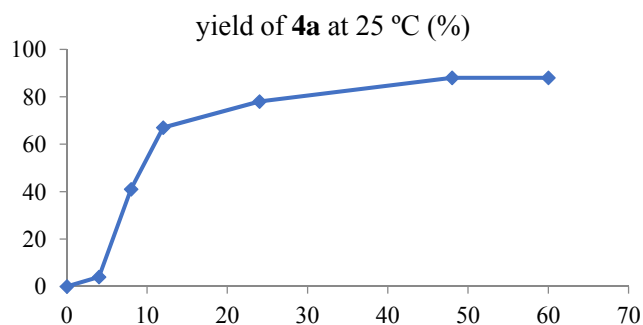
1a (0.2 mmol), K_2HPO_4 (1.0 equiv.) and $Ru(bpy)_3Cl_2 \cdot 6H_2O$ (2 mol%), and H_2O (1.0 mL), acetonitrile (1.0 mL) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C, 35 °C and 45 °C under the irradiation by two 12 W blue LED with an oxygen balloon for different time. After completion, yield of **2a** were determined from the crude 1H NMR spectra using CH_2Br_2 as an internal standard. The studies on the correspondence between time and yield at different reaction temperature revealed that elevated reaction temperature (35 °C and 45 °C) indeed accelerated the initial reaction rate of the desired aerobic oxidation. However, milder conditions (25 °C) afforded the best final yield within prolonged reaction time to 60 h.

time (h)	0	12	24	36	48	60	72
yield at 25 °C (%)	0	8	19	32	59	87	87
yield at 35 °C (%)	0	43	76	83	83		
yield at 45 °C (%)	0	52	62	67	68		



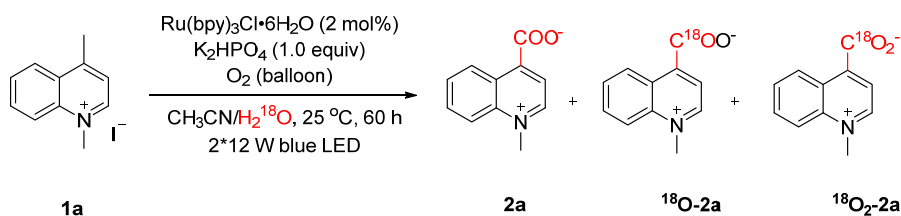
Then, the yield of **4a** at 25 °C within different reaction time was determined according to the same way.

time (h)	0	4	8	12	24	48	60
yield at 25 °C (%)	0	4	41	67	78	88	88

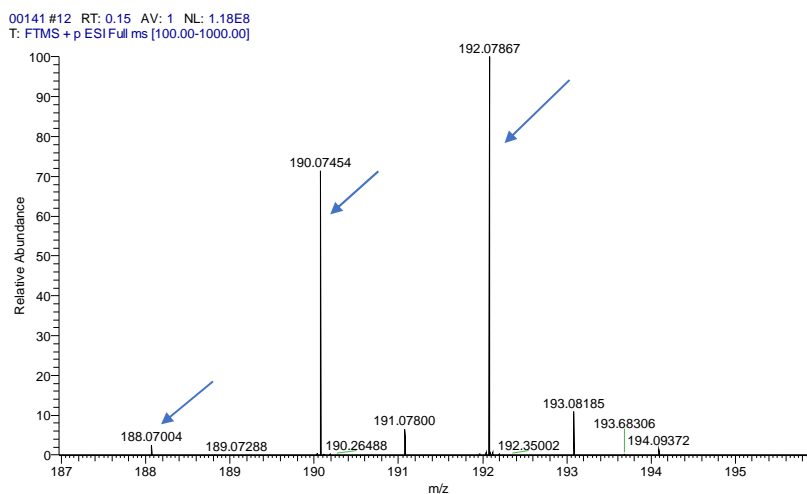


4.2. Control experiments

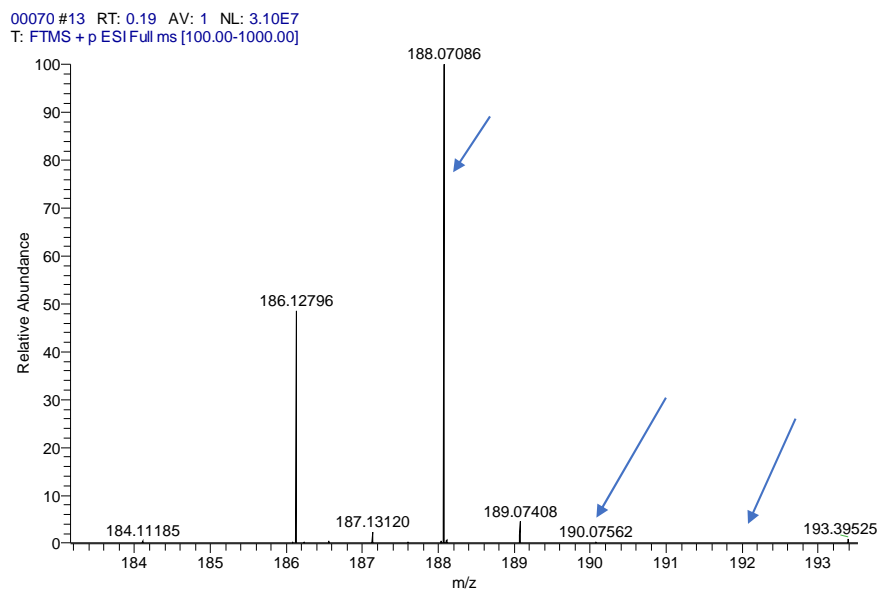
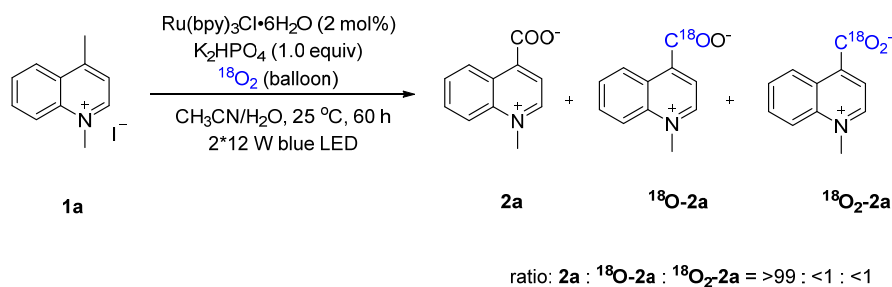
(a) The following reaction was carried out under **General procedure A**: **1a** (0.2 mmol), K₂HPO₄ (1.0 equiv.) and Ru(bpy)₃Cl₂·6H₂O (2 mol%), and H₂¹⁸O (1.0 mL), and acetonitrile (1.0 mL) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED for 60 h under O₂ balloon. After completion, purification by flash column chromatography (CH₃OH) gave the pure product. High resolution positive ion electrospray mass spectra (HRMS-ESI) for the final products were shown.



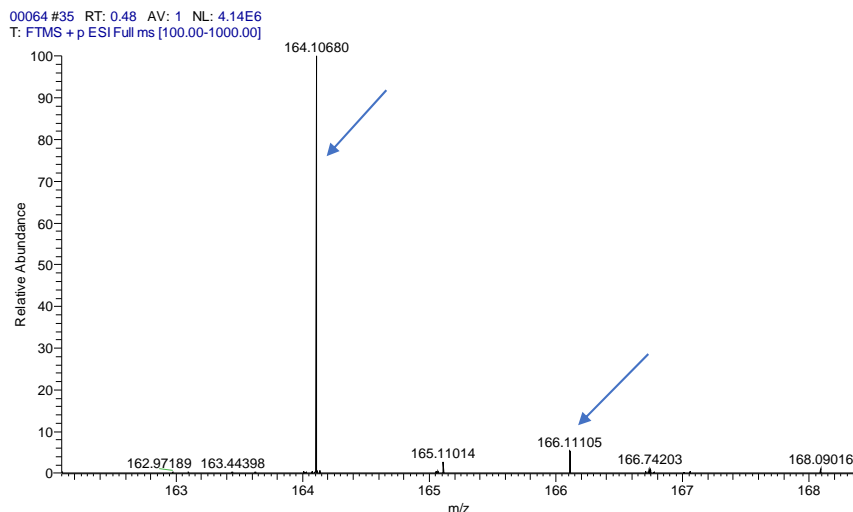
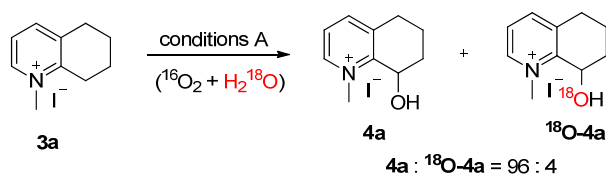
ratio: **2a** : **¹⁸O-2a** : **¹⁸O₂-2a** = 2 : 41 : 57



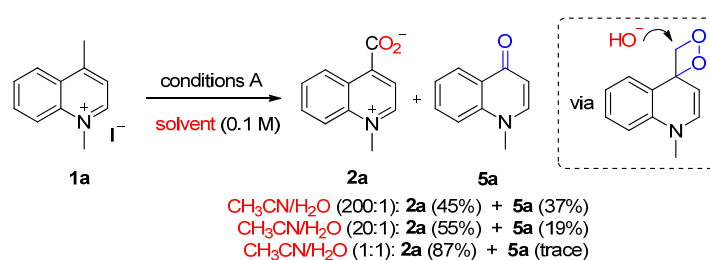
(b) The following reaction was carried out under **General procedure A**: **1a** (0.2 mmol), K₂HPO₄ (1.0 equiv.) and Ru(bpy)₃Cl₂·6H₂O (2 mol%), H₂O (1.0 mL), and acetonitrile (1.0 mL) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED for 60 h under ¹⁸O₂ balloon. After completion, purification by flash column chromatography (CH₃OH) gave the pure product. High resolution positive ion electrospray mass spectra (HRMS-ESI) for the final products were shown.



(c) The following reaction was carried out under **General procedure A**: **3a** (0.2 mmol), K₂HPO₄ (1.0 equiv.) and Ru(bpy)₃Cl₂·6H₂O (2 mol%), and H₂¹⁸O (1.0 mL), acetonitrile (1.0 mL) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED with an oxygen balloon for 60 h. After completion, purification by flash column chromatography (CH₃OH) gave the pure product. High resolution positive ion electrospray mass spectra (HRMS-ESI) for the final products were shown.

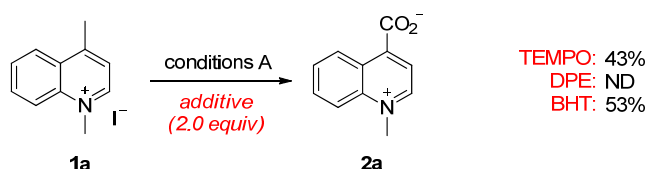


(d) The following reaction was carried out under **General procedure A**, **1a** (0.2 mmol), K_2HPO_4 (1.0 equiv.) and $\text{Ru}(\text{bpy})_3\text{Cl}_2 \cdot 6\text{H}_2\text{O}$ (2 mol%), and $\text{CH}_3\text{CN}/\text{H}_2\text{O}$ (200:1) or (20:1) or (1:1) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED with an oxygen balloon for 60 h. After completion, purification by flash column chromatography (CH_3OH) gave the pure product. The 4-quinolone **5a** was competitively formed when the amount of water was dramatically reduced, which indicated that a dioxetane intermediate was probably involved in the formation of carboxylate products.

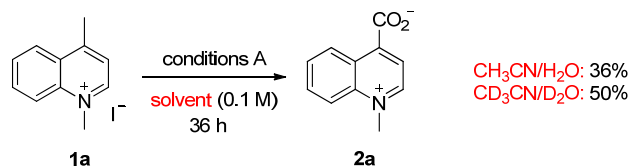


(e) The following reaction was carried out under **General procedure A**: **1a** (0.2 mmol), K_2HPO_4 (1.0 equiv.) and $\text{Ru}(\text{bpy})_3\text{Cl}_2 \cdot 6\text{H}_2\text{O}$ (2 mol%), and H_2O (1.0 mL), acetonitrile (1.0 mL), and radical inhibitor TEMPO or DPE or BHT (2.0 equiv.) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED with an

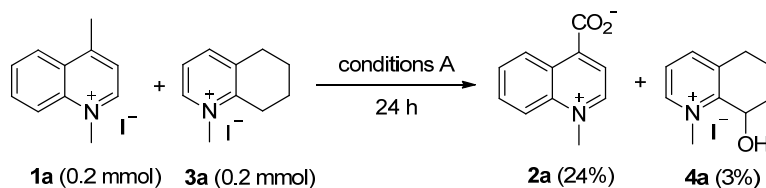
oxygen balloon for 60 h. After completion, yield of **2a** were determined from the crude ^1H NMR spectra using CH_2Br_2 as an internal standard. The addition of TEMPO and BHT afforded the product in moderate yield, DPE completely quenched the formation of **2a** and instead benzophenone was generated.



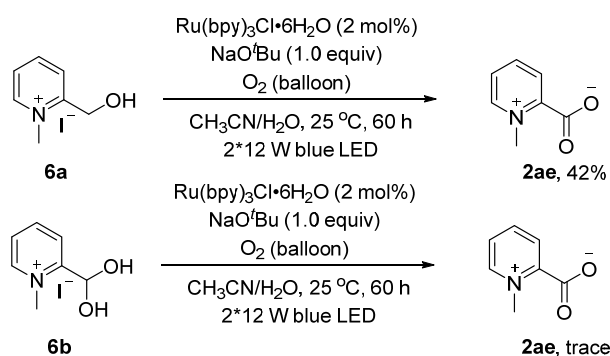
(f) The following reaction was carried out under **General procedure A**: **1a** (0.2 mmol), K_2HPO_4 (1.0 equiv.) and $\text{Ru}(\text{bpy})_3\text{Cl}_2 \cdot 6\text{H}_2\text{O}$ (2 mol%), and $\text{CH}_3\text{CN}:\text{H}_2\text{O}$ or $\text{CD}_3\text{CN}:\text{D}_2\text{O}$ (1:1) (2 mL) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED with an oxygen balloon for 60 h. After completion, yield of **2a** were determined from the crude ^1H NMR spectra using CH_2Br_2 as an internal standard, and the result indicates higher yield was obtained when deuterated solvent was used and the formation of photoexcited singlet oxygen in this reaction system because of longer lifetime of singlet oxygen in deuterated solvents.



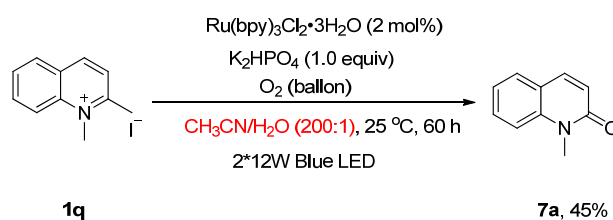
(g) The following reaction was carried out under **General procedure A**: **1a** (0.2 mmol), **3a** (0.2 mmol), $\text{Ru}(\text{bpy})_3\text{Cl}_2 \cdot 6\text{H}_2\text{O}$ (2 mol%), H_2O (1.0 mL), and acetonitrile (1.0 mL) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED with an oxygen balloon for 24 h. After completion, crude ^1H NMR analysis of the reaction mixture revealed the yield of **2a** and **4a** to be 24% and 3%, respectively.



(h) The following reaction was carried out under **General procedure B**: **6a** or **6b** (0.2 mmol), NaO^tBu (1.0 equiv.) and Ru(bpy)₃Cl₂·6H₂O (2 mol%), and H₂O (1.0 mL), acetonitrile (1.0 mL) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED with an oxygen balloon for 60 h. After completion, yield of **2ae** were determined from the crude ¹H NMR spectra using CH₂Br₂ as an internal standard. The direct subjection of hydroxy methylpyridinium (**6a**) afforded carboxylate **2ae** in a moderate yield (42%). Moreover, only trace amounts of the target product were detected when dihydroxy methylpyridinium (**6b**) was used.



(i) The following reaction was carried out under **General procedure A**: **1q** (0.2 mmol), K₂HPO₄ (1.0 equiv.) and Ru(bpy)₃Cl₂·6H₂O (2 mol%), and CH₃CN : H₂O (200:1) (2 mL) were added into a 15 mL tube successively. The reaction mixture was stirred at 25 °C under the irradiation by two 12 W blue LED with an oxygen balloon for 60 h. After completion, purification by flash column chromatography (CH₃OH) gave the **7a**, (White solid, 45%).



4.3. Stern-Volmer fluorescence quenching experiments

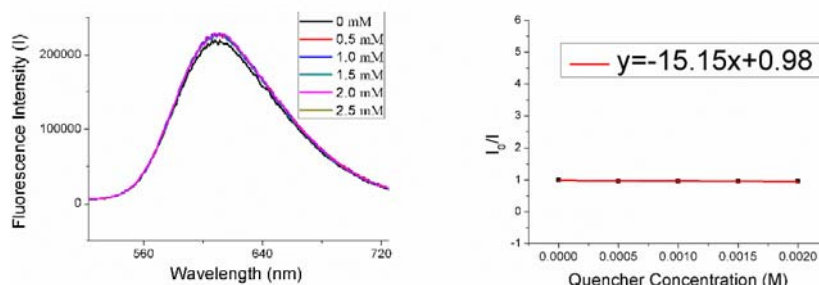
Formulation solution: 1,4-dimethylquinolin-1-ium iodide (715 mg) was dissolved in CH₃CN/H₂O = (1/1) in a 25 mL volumetric flask to set the concentration to be 0.1 M.

Photocatalyst $\text{Ru}(\text{bpy})_3\text{Cl}_2 \cdot 6\text{H}_2\text{O}$ (1.9 mg) was dissolved in $\text{CH}_3\text{CN}/\text{H}_2\text{O} = (1/1)$ (25.0 mL) to set the concentration to be 0.1 mM.

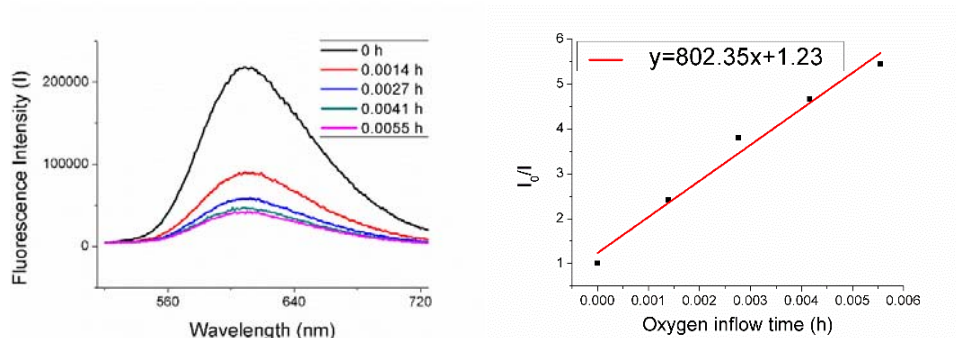
Experimental procedure: The resulting 0.1 mM solution (25 μL) was added to cuvette to obtain different concentrations of catalyst solution. This solution was then diluted to a volume of 2.0 mL by adding $\text{CH}_3\text{CN}/\text{H}_2\text{O} = (1/1)$ to prepare a 1.25 μM solution. 10.0 μL of a 1,4-dimethylquinolin-1-ium iodide solution was successively added and uniformly stirred, and the resulting mixture was bubbled with nitrogen for 3 minutes and irradiated at 493 nm. Fluorescence emission spectra of 0 μL , 10.0 μL , 20.0 μL , 30.0 μL , 40.0 μL , 50.0 μL , 60.0 μL fluorescence intensity. Follow this method and make changes to the amount to obtain the Stern–Volmer relationship in turn.

Subsequently, we performed another Stern–Volmer fluorescence quenching experiment to investigate the influence of oxygen. In a typical experiment, 2.0 mL of solution of $\text{Ru}(\text{bpy})_3\text{Cl}_2 \cdot 6\text{H}_2\text{O}$ (1.25 μM) in $\text{CH}_3\text{CN}/\text{H}_2\text{O} = (1/1)$ was bubbled a stream of oxygen for several seconds. The solution was excited at $\lambda = 493$ nm.

(a) Stern-Volmer quenching of **1a** to [Ru] photocatalyst.



(b) Stern-Volmer quenching of O_2 to [Ru] photocatalyst.



4.4. Cyclic Voltammetry experiments

Cyclic voltammetry experiments were performed using a CHI830B potentiostat, a glassy carbon working electrode, a platinum mesh counter electrode, and a Ag/AgCl (0.01M) reference electrode. Samples were prepared with a substrate concentration of 0.1 M in a 0.1 M tetraethylammonium hexafluorophosphate in acetonitrile electrolyte solution. From the result, $E_{1/2ox}$ (**6a**) = -0.092 V vs SCE in CH₃CN, $E_{1/2ox}$ (**6b**) = -0.390 V vs SCE in CH₃CN, $E_{1/2ox}$ (**4a**) = -0.251 V vs SCE in CH₃CN.

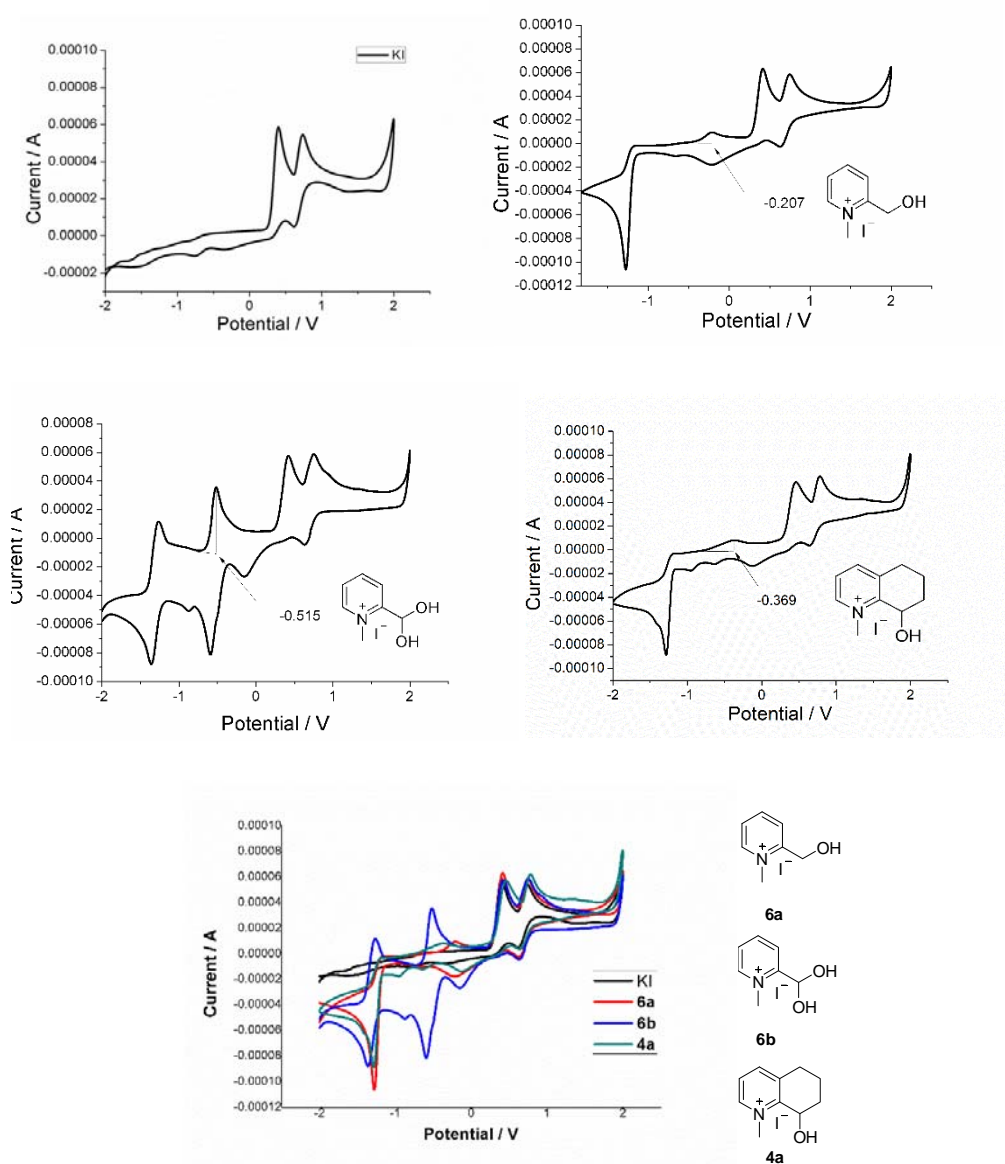
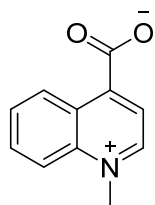


Figure S5. Cyclic voltammetry experiments. Experiment conditions: Init E = 2.0 V, High E = 2.0 V, Low E = -2.0 V, Init P/N = N, Scan Rate = 0.1 V/s, Sample Interval = 0.001 V, Quiet Time = 2 s, Sensitivity = 2e-4 A/V.

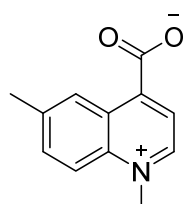
5. Characterization data of products



1-methylquinolin-1-ium-4-carboxylate (2a)

According to **General procedure A**, **2a** was obtained as white solid in 87% yield (32.5 mg), using CH₃OH (*R_f* = 0.2) as eluent. mp: 161 – 164 °C.

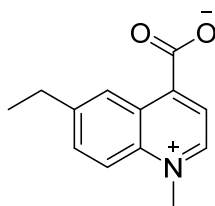
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.25 (d, *J* = 6.0 Hz, 1H), 8.60 (d, *J* = 8.5 Hz, 1H), 8.44 (d, *J* = 9.0 Hz, 1H), 8.23 (ddd, *J* = 8.8, 7.0, 1.4 Hz, 1H), 8.00 (t, *J* = 7.7 Hz, 1H), 7.88 (d, *J* = 5.9 Hz, 1H), 4.64 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 170.8, 159.3, 151.1, 140.9, 136.7, 131.0, 130.3, 127.3, 119.7, 119.1, 46.0. HRMS (ESI) *m/z* calcd for C₁₁H₁₀NO₂⁺ (*M*+*H*)⁺ 188.0706, found 188.0707.



1,6-dimethylquinolin-1-ium-4-carboxylate (2b)

According to **General procedure A**, **2b** was obtained as white solid in 71% yield (28.6 mg) using CH₃OH (*R_f* = 0.2) as eluent. mp: 175 – 177 °C.

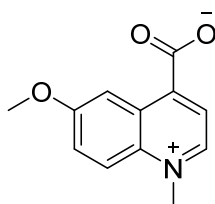
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.16 (d, *J* = 6.0 Hz, 1H), 8.32 (s, 1H), 8.27 (d, *J* = 9.0 Hz, 1H), 8.01 (dd, *J* = 9.0, 1.8 Hz, 1H), 7.69 (d, *J* = 5.9 Hz, 1H), 4.49 (s, 3H), 2.57 (s, 3H); ¹³C NMR (100 MHz, Deuterium Oxide) δ 171.6, 154.9, 148.3, 141.7, 137.6, 126.5, 125.3, 118.0, 117.3, 45.2, 20.7. HRMS (ESI) *m/z* calcd for C₁₂H₁₂NO₂⁺ (*M*+*H*)⁺ 202.0863, found 202.0862.



6-ethyl-1-methylquinolin-1-ium-4-carboxylate (2c)

According to **General procedure A**, **2c** was obtained as white solid in 76% yield (32.7 mg) using CH₃OH (*R_f* = 0.2) as eluent. mp: 187 – 188 °C.

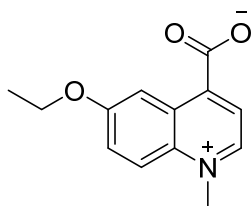
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.17 (d, *J* = 5.9 Hz, 1H), 8.38 (s, 1H), 8.36 (d, *J* = 7.2 Hz, 1H), 8.12 (d, *J* = 9.2 Hz, 1H), 7.83 (d, *J* = 5.9 Hz, 1H), 4.62 (s, 3H), 2.96 (q, *J* = 7.6 Hz, 2H), 1.37 (t, *J* = 7.6 Hz, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 148.7, 136.4, 126.3, 118.2, 117.6, 48.3, 48.0, 47.8, 47.6, 47.41, 47.2, 47.0, 44.5, 28.3, 13.9. HRMS (ESI) *m/z* calcd for C₁₃H₁₄NO₂⁺ (*M*+*H*)⁺ 216.1019, found 216.1019.



6-methoxy-1-methylquinolin-1-ium-4-carboxylate (2d)

According to **General procedure A**, **2d** was obtained as white solid in 81% yield (35.2 mg) using CH₃OH (*R_f* = 0.2) as eluent. mp: 213 – 215 °C.

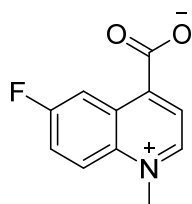
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.05 (d, *J* = 5.9 Hz, 1H), 8.35 (d, *J* = 9.7 Hz, 1H), 7.93 (d, *J* = 2.6 Hz, 1H), 7.85 (d, *J* = 5.9 Hz, 1H), 7.81 (dd, *J* = 9.6, 2.7 Hz, 1H), 4.61 (s, 3H), 4.01 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 169.5, 159.9, 155.5, 146.5, 135.3, 128.0, 127.7, 119.9, 118.5, 106.0, 55.4, 44.7. HRMS (ESI) *m/z* calcd for C₁₂H₁₂NO₃⁺ (*M*+*H*)⁺ 218.0812, found 218.0811.



6-ethoxy-1-methylquinolin-1-ium-4-carboxylate (**2e**)

According to **General procedure A**, **2e** was obtained as white solid in 89% yield (41.1 mg) using CH₃OH (*R_f* = 0.2) as eluent. mp: 161 – 162 °C.

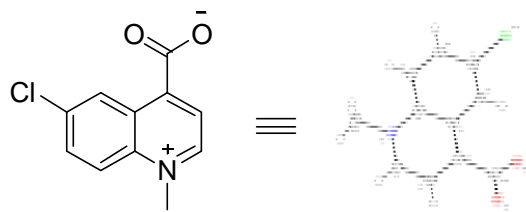
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.06 (d, *J* = 5.9 Hz, 1H), 8.29 (d, *J* = 9.6 Hz, 1H), 8.04 (d, *J* = 2.9 Hz, 1H), 7.78 (dd, *J* = 9.6, 2.8 Hz, 1H), 7.73 (d, *J* = 5.9 Hz, 1H), 4.48 (s, 3H), 4.18 (q, *J* = 7.1 Hz, 2H), 1.41 (t, *J* = 6.9 Hz, 3H); ¹³C NMR (100 MHz, DMSO-*d*₆) δ 166.4, 158.4, 158.2, 147.4, 135.1, 128.1, 127.0, 120.9, 118.7, 108.2, 64.6, 45.3, 14.8. HRMS (ESI) *m/z* calcd for C₁₃H₁₄NO₃⁺ (*M*+*H*)⁺ 232.0968, found 232.0966.



6-fluoro-1-methylquinolin-1-ium-4-carboxylate (**2f**)

According to **General procedure A**, **2f** was obtained as white solid in 79% yield (32.4 mg) using CH₃OH (*R_f* = 0.2) as eluent. mp: 217 – 218 °C.

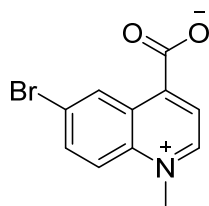
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.28 (d, *J* = 5.9 Hz, 1H), 8.56 (dd, *J* = 9.7, 4.6 Hz, 1H), 8.36 (dd, *J* = 9.3, 2.9 Hz, 1H), 8.14 – 8.00 (m, 1H), 7.97 (d, *J* = 5.9 Hz, 1H), 4.68 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 169.9, 163.0 (d, *J* = 251.3 Hz), 158.0 (d, *J* = 5.5 Hz), 150.9, 138.1, 129.2 (d, *J* = 10.9 Hz), 126.2 (d, *J* = 26.6 Hz), 123.8 (d, *J* = 9.6 Hz), 120.3, 113.8 (d, *J* = 24.3 Hz), 46.5. HRMS (ESI) *m/z* calcd for C₁₁H₉FNO₂⁺ (*M*+*H*)⁺ 206.0612, found 206.0612.



6-chloro-1-methylquinolin-1-ium-4-carboxylate (2g, CCDC NO. 1973939)

According to **General procedure A**, **2g** was obtained as white solid in 61% yield (27.0 mg) using CH₃OH (R_f = 0.2) as eluent. mp: 230 – 231 °C.

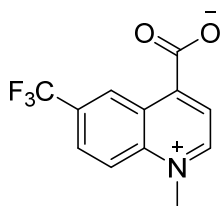
¹H NMR (400 MHz, Deuterium Oxide) δ 9.17 (d, *J* = 5.7 Hz, 1H), 8.34 (s, 1H), 8.32 (d, *J* = 8.8 Hz, 1H), 8.10 (d, *J* = 9.4 Hz, 1H), 7.89 (d, *J* = 5.8 Hz, 1H), 4.59 (s, 3H); ¹³C NMR (100 MHz, Deuterium Oxide) δ 170.6, 154.7, 150.0, 138.0, 136.2, 136.0, 126.7, 126.2, 120.4, 118.9, 45.6. HRMS (ESI) *m/z* calcd for C₁₁H₉ClNO₂⁺ (M+H)⁺ 222.0316, found 222.0315.



6-bromo-1-methylquinolin-1-ium-4-carboxylate (2h)

According to **General procedure A**, **2h** was obtained as white solid in 62% yield (33.4 mg) using CH₃OH (R_f = 0.2) as eluent. mp: 215 – 217 °C.

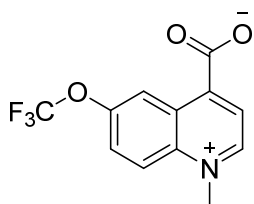
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.30 (d, *J* = 5.9 Hz, 1H), 8.82 (d, *J* = 2.1 Hz, 1H), 8.39 (d, *J* = 9.4 Hz, 1H), 8.30 (dd, *J* = 9.4, 2.2 Hz, 1H), 7.95 (d, *J* = 5.9 Hz, 1H), 4.65 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 169.8, 157.7, 151.7, 139.7, 139.4, 132.2, 128.5, 125.1, 121.9, 120.8, 46.3. HRMS (ESI) *m/z* calcd for C₁₁H₉BrNO₂⁺ (M+H)⁺ 265.9811, found 265.9813.



1-methyl-6-(trifluoromethyl)quinolin-1-ium-4-carboxylate (2i)

According to **General procedure A**, **2i** was obtained as white solid in 73% yield (37.2 mg) using CH₃OH (*R_f* = 0.2) as eluent. mp: 161 – 164 °C.

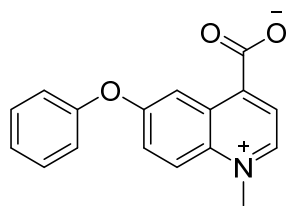
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.45 (d, *J* = 5.9 Hz, 1H), 9.08 (s, 1H), 8.69 (d, *J* = 9.3 Hz, 1H), 8.45 (d, *J* = 9.2 Hz, 1H), 8.10 (d, *J* = 5.9 Hz, 1H), 4.71 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 169.6, 159.6, 153.5, 142.2, 132.2 (q, *J* = 33.5 Hz), 131.7 (q, *J* = 3.1 Hz), 128.2 (q, *J* = 4.7 Hz), 127.1, 124.6 (q, *J* = 270.5 Hz) 122.0, 121.3, 46.4. HRMS (ESI) *m/z* calcd for C₁₂H₉F₃NO₂⁺ (*M*+*H*)⁺ 256.0580, found 256.0582.



1-methyl-6-(trifluoromethoxy)quinolin-1-ium-4-carboxylate (2j)

According to **General procedure A**, **2j** was obtained as white solid in 46% yield (25.0 mg) using CH₃OH (*R_f* = 0.2) as eluent. mp: 225 – 226 °C.

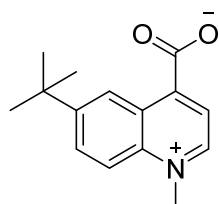
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.35 (d, *J* = 5.8 Hz, 1H), 8.64 (s, 1H), 8.62 (d, *J* = 9.6 Hz, 1H), 8.15 (d, *J* = 9.3 Hz, 1H), 8.05 (d, *J* = 5.8 Hz, 1H), 4.69 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 169.7, 158.3, 151.9, 150.1 (q, *J* = 1.8 Hz), 139.3, 129.7, 128.6, 123.1, 121.8 (q, *J* = 256.8 Hz), 121.2, 119.8, 46.5. HRMS (ESI) *m/z* calcd for C₁₂H₉F₃NO₃⁺ (*M*+*H*)⁺ 272.0529, found 272.0531.



1-methyl-6-phenoxyquinolin-1-ium-4-carboxylate (2k)

According to **General procedure A**, **2k** was obtained as white solid in 41% yield (22.9 mg) using CH₃OH (*R_f* = 0.2) as eluent. mp: 141 – 143 °C.

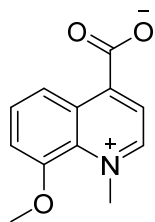
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.13 (d, *J* = 5.8 Hz, 1H), 8.47 (d, *J* = 9.3 Hz, 1H), 7.96 (d, *J* = 8.8 Hz, 1H), 7.94 (s, 1H), 7.84 (d, *J* = 5.8 Hz, 1H), 7.48 (t, *J* = 7.3 Hz, 2H), 7.29 (t, *J* = 7.4 Hz, 1H), 7.19 (d, *J* = 7.9 Hz, 2H), 4.63 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 170.5, 160.0, 157.5, 156.1, 149.2, 137.2, 131.6, 129.1, 129.1, 126.7, 122.1, 121.5, 119.9, 113.2, 46.2. HRMS (ESI) *m/z* calcd for C₁₇H₁₄NO₃⁺ (*M*+*H*)⁺ 280.0968, found 280.0971.



6-(*tert*-butyl)-1-methylquinolin-1-ium-4-carboxylate (2l)

According to **General procedure A**, **2l** was obtained as white solid in 91% yield (44.1 mg) using CH₃OH (*R_f* = 0.2) as eluent. mp: 253 – 256 °C.

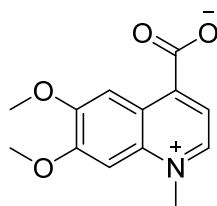
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.18 (d, *J* = 5.9 Hz, 1H), 8.57 (s, 1H), 8.39 – 8.38 (m, 2H), 7.86 (d, *J* = 5.9 Hz, 1H), 4.63 (s, 3H), 1.47 (s, 9H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 171.1, 159.0, 154.6, 150.1, 139.4, 135.8, 127.3, 125.3, 119.4, 119.1, 45.8, 36.4, 31.1. HRMS (ESI) *m/z* calcd for C₁₅H₁₈NO₂⁺ (*M*+*H*)⁺ 244.1332, found 244.1333.



8-methoxy-1-methylquinolin-1-ium-4-carboxylate (2m)

According to **General procedure A**, **2m** was obtained as white solid in 53% yield (23.0 mg) using CH₃OH (R_f = 0.2) as eluent. mp: 243 – 245 °C.

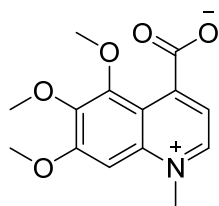
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.06 (d, *J* = 5.9 Hz, 1H), 8.03 (d, *J* = 8.4 Hz, 1H), 7.86 (t, *J* = 8.2 Hz, 1H), 7.77 (d, *J* = 5.9 Hz, 1H), 7.69 (d, *J* = 8.0 Hz, 1H), 4.83 (s, 3H), 4.13 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 171.2, 159.2, 153.1, 152.7, 133.1, 131.4, 129.5, 121.6, 118.9, 117.0, 57.6, 53.0. HRMS (ESI) *m/z* calcd for C₁₂H₁₂NO₃⁺ (M+H)⁺ 218.0812, found 218.0811.



6,7-dimethoxy-1-methylquinolin-1-ium-4-carboxylate (2n)

According to **General procedure A**, **2n** was obtained as white solid in 61% yield (30.1 mg) using CH₃OH (R_f = 0.15) as eluent. mp: 260 – 263 °C.

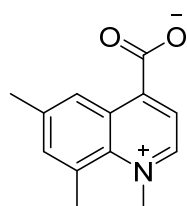
¹H NMR (400 MHz, Methanol-*d*₄) δ 8.89 (d, *J* = 6.1 Hz, 1H), 7.93 (s, 1H), 7.72 (d, *J* = 6.1 Hz, 1H), 7.54 (s, 1H), 4.54 (s, 3H), 4.18 (s, 3H), 4.04 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 171.4, 158.8, 155.2, 153.2, 146.3, 139.2, 123.8, 117.9, 107.0, 98.9, 57.6, 56.9, 45.8. HRMS (ESI) *m/z* calcd for C₁₃H₁₄NO₄⁺ (M+H)⁺ 248.0917, found 248.0918.



5,6,7-trimethoxy-1-methylquinolin-1-ium-4-carboxylate (2o)

According to **General procedure A**, **2o** was obtained as white solid in 67% yield (37.1 mg) using CH₃OH (*R_f* = 0.15) as eluent. mp: 177 – 179 °C.

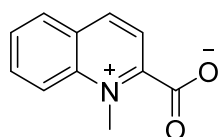
¹H NMR (400 MHz, DMSO-*d*₆) δ 8.93 (d, *J* = 6.2 Hz, 1H), 7.33 (s, 1H), 7.26 (d, *J* = 6.1 Hz, 1H), 4.38 (s, 3H), 4.12 (s, 3H), 3.88 (s, 3H), 3.87 (s, 3H); ¹³C NMR (100 MHz, DMSO-*d*₆) δ 167.4, 159.6, 158.5, 150.0, 147.3, 142.1, 137.6, 116.5, 115.1, 94.8, 62.2, 60.8, 57.1, 44.6. HRMS (ESI) *m/z* calcd for C₁₅H₁₈NO₅⁺ (*M*+*H*)⁺ 292.1180, found 292.1184.



1,6,8-trimethylquinolin-1-ium-4-carboxylate (2p)

According to **General procedure A**, **2p** was obtained as white solid in 67% yield (28.8 mg) using CH₃OH (*R_f* = 0.25) as eluent. mp: 245 – 246 °C.

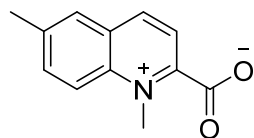
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.09 (d, *J* = 6.1 Hz, 1H), 8.09 (s, 1H), 7.69 (s, 1H), 7.62 (d, *J* = 6.0 Hz, 1H), 4.56 (s, 3H), 2.96 (s, 3H), 2.68 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 174.1, 159.2, 149.5, 148.7, 142.5, 140.4, 135.3, 123.8, 118.5, 117.0, 46.5, 22.4, 20.9. HRMS (ESI) *m/z* calcd for C₁₃H₁₄NO₂⁺ (*M*+*H*)⁺ 216.1019, found 216.1019.



1-methylquinolin-1-ium-2-carboxylate (2q)

According to **General procedure A**, **2q** was obtained as white solid in 75% yield (29.6 mg) using CH₃OH (R_f = 0.25) as eluent. mp: 161 – 163 °C.

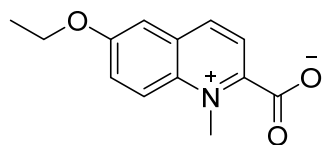
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.07 (d, *J* = 8.5 Hz, 1H), 8.48 (d, *J* = 9.0 Hz, 1H), 8.38 – 8.30 (m, 1H), 8.27– 8.23 (m, 1H), 8.00 (t, *J* = 7.2 Hz, 1H), 7.95 (d, *J* = 8.5 Hz, 1H), 4.60 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 166.2, 159.3, 148.6, 139.5, 137.0, 131.7, 130.8, 129.9, 121.6, 120.0, 42.1. HRMS (ESI) *m/z* calcd for C₁₁H₁₀NO₂⁺ (M+H)⁺ 188.0706, found 188.0707.



1,6-dimethylquinolin-1-ium-2-carboxylate (2r)

According to **General procedure A**, **2r** was obtained as white solid in 86% yield (34.6 mg) using CH₃OH (R_f = 0.25) as eluent. mp: 175 – 177 °C.

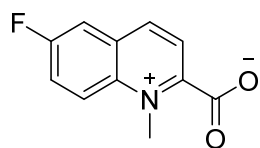
¹H NMR (400 MHz, Methanol-*d*₄) δ 8.95 (d, *J* = 8.5 Hz, 1H), 8.35 (d, *J* = 9.6 Hz, 1H), 8.22 – 7.99 (m, 2H), 7.89 (d, *J* = 8.5 Hz, 1H), 4.57 (s, 3H), 2.65 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 166.3, 158.4, 147.8, 142.0, 138.9, 137.9, 130.3, 130.0, 121.5, 119.7, 42.0, 21.2. HRMS (ESI) *m/z* calcd for C₁₂H₁₂NO₂⁺ (M+H)⁺ 202.0863, found 202.0863.



6-ethoxy-1-methylquinolin-1-ium-2-carboxylate (2s)

According to **General procedure A**, **2s** was obtained as white solid in 87% yield (40.1 mg) using CH₃OH (R_f = 0.2) as eluent. mp: 163 – 164 °C.

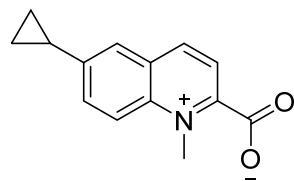
^1H NMR (400 MHz, Methanol- d_4) δ 8.90 (d, $J = 8.6$ Hz, 1H), 8.36 (d, $J = 9.7$ Hz, 1H), 7.86 (d, $J = 8.6$ Hz, 1H), 7.80 (dd, $J = 9.7, 2.8$ Hz, 1H), 7.66 (d, $J = 2.8$ Hz, 1H), 4.56 (s, 3H), 4.28 (q, $J = 7.0$ Hz, 2H), 1.51 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 166.4, 160.5, 156.5, 146.7, 134.8, 131.9, 129.2, 121.9, 121.5, 109.6, 66.0, 42.1, 14.8. HRMS (ESI) m/z calcd for $\text{C}_{13}\text{H}_{14}\text{NO}_3^+$ ($\text{M}+\text{H}$) $^+$ 232.0968, found 232.0969.



6-fluoro-1-methylquinolin-1-ium-2-carboxylate (**2t**)

According to **General procedure A**, **2t** was obtained as white solid in 71% yield (29.1 mg) using CH_3OH ($R_f = 0.25$) as eluent. mp: 182 – 183 $^\circ\text{C}$.

^1H NMR (400 MHz, Methanol- d_4) δ 9.04 (d, $J = 8.6$ Hz, 1H), 8.63 – 8.55 (m, 1H), 8.14 – 8.03 (m, 2H), 7.99 (d, $J = 8.6$ Hz, 1H), 4.62 (s, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 165.9, 163.0 (d, $J = 251.5$ Hz), 159.0, 147.9 (d, $J = 4.9$ Hz), 136.6, 131.4 (d, $J = 10.3$ Hz), 126.2 (d, $J = 26.3$ Hz), 123.4 (d, $J = 9.3$ Hz), 122.8, 115.0 (d, $J = 23.0$ Hz), 42.5. HRMS (ESI) m/z calcd for $\text{C}_{11}\text{H}_9\text{FNO}_2^+$ ($\text{M}+\text{H}$) $^+$ 206.0612, found 206.0612.

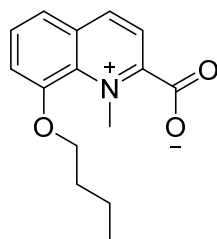


6-cyclopropyl-1-methylquinolin-1-ium-2-carboxylate (**2u**)

According to **General procedure A**, **2u** was obtained as white solid in 43% yield (19.5 mg) using CH_3OH ($R_f = 0.3$) as eluent. mp: 113 – 114 $^\circ\text{C}$.

^1H NMR (400 MHz, Methanol- d_4) δ 8.94 (d, $J = 8.5$ Hz, 1H), 8.35 (d, $J = 9.1$ Hz, 1H), 8.08 – 7.92 (m, 2H), 7.88 (d, $J = 8.5$ Hz, 1H), 4.56 (s, 3H), 2.28 – 2.22 (m, 1H), 1.25 – 1.20 (m, 2H), 0.99 –

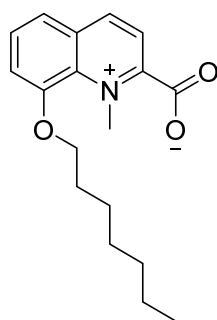
0.95 (m, 2H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 166.3, 158.1, 148.5, 147.6, 137.9, 135.4, 130.17, 126.6, 121.6, 119.8, 42.0, 16.1, 11.2. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{14}\text{NO}_2^+$ (M+H) $^+$ 228.1019, found 228.1023.



8-butoxy-1-methylquinolin-1-ium-2-carboxylate (2v)

According to **General procedure A**, **2v** was obtained as white solid in 41% yield (21.2 mg) using CH_3OH ($R_f = 0.3$) as eluent. mp: 160 – 161 $^\circ\text{C}$.

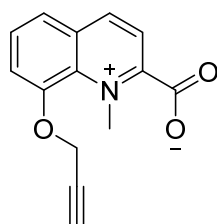
^1H NMR (400 MHz, Methanol- d_4) δ 8.97 (d, $J = 8.5$ Hz, 1H), 7.95 – 7.78 (m, 3H), 7.72 (dd, $J = 7.6, 1.6$ Hz, 1H), 4.78 (s, 3H), 4.31 (t, $J = 6.4$ Hz, 2H), 2.00 – 1.93 (m, 2H), 1.64 – 1.55 (m, 2H), 1.04 (t, $J = 7.4$ Hz, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 166.6, 160.7, 152.7, 148.6, 132.4, 132.4, 131.5, 131.3, 123.3, 121.6, 118.5, 71.9, 48.3, 32.1, 20.6, 14.1. HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_{18}\text{NO}_3^+$ (M+H) $^+$ 260.1281, found 260.1286.



8-(heptyloxy)-1-methylquinolin-1-ium-2-carboxylate (2w)

According to **General procedure A**, **2w** was obtained as white solid in 39% yield (23.5 mg) using CH_3OH ($R_f = 0.4$) as eluent. mp: 107 – 108 $^\circ\text{C}$.

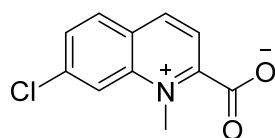
^1H NMR (400 MHz, Methanol- d_4) δ 9.00 (d, J = 8.5 Hz, 1H), 7.96 – 7.80 (m, 3H), 7.74 (dd, J = 7.6, 1.5 Hz, 1H), 4.80 (s, 3H), 4.32 (t, J = 6.5 Hz, 2H), 2.04 – 1.97 (m, 2H), 1.61 – 1.54 (m, 2H), 1.47 – 1.36 (m, 6H), 0.93 (t, J = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 166.7, 160.5, 152.7, 148.7, 132.4, 131.5, 131.3, 123.2, 121.6, 118.5, 72.2, 48.3, 32.9, 30.1, 30.0, 27.3, 23.6, 14.4. HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{24}\text{NO}_3^+$ ($\text{M}+\text{H}$) $^+$ 302.1751, found 302.1757.



1-methyl-8-(prop-2-yn-1-yloxy)quinolin-1-ium-2-carboxylate (**2x**)

According to **General procedure A**, **2x** was obtained as white solid in 31% yield (14.9 mg) using CH_3OH (R_f = 0.3) as eluent. mp: 151 – 153 $^\circ\text{C}$.

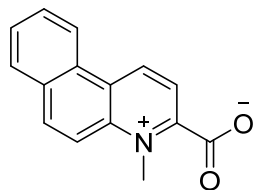
^1H NMR (400 MHz, Methanol- d_4) δ 8.99 (d, J = 8.5 Hz, 1H), 8.02 – 7.77 (m, 4H), 5.14 (s, 2H), 4.78 (s, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 166.3, 161.2, 151.0, 148.6, 132.3, 131.7, 131.2, 124.5, 121.8, 120.2, 78.9, 78.1, 59.1, 48.2. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{12}\text{NO}_3^+$ ($\text{M}+\text{H}$) $^+$ 242.0812, found 242.0815.



7-chloro-1-methylquinolin-1-ium-2-carboxylate (**2y**)

According to **General procedure A**, **2y** was obtained as white solid in 63% yield (27.9 mg) using CH_3OH (R_f = 0.3) as eluent. mp: 147 – 149 $^\circ\text{C}$.

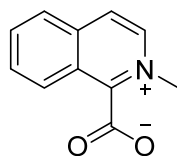
^1H NMR (400 MHz, Methanol- d_4) δ 9.08 (d, J = 8.5 Hz, 1H), 8.62 (s, 1H), 8.34 (d, J = 8.8 Hz, 1H), 8.00 (dd, J = 8.8, 1.7 Hz, 1H), 7.95 (d, J = 8.5 Hz, 1H), 4.57 (s, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 165.8, 160.0, 148.4, 143.3, 140.1, 133.2, 131.7, 128.5, 121.9, 120.0, 42.3. HRMS (ESI) m/z calcd for $\text{C}_{11}\text{H}_9\text{ClNO}_2^+$ ($\text{M}+\text{H}$) $^+$ 222.0316, found 222.0315.



4-methylbenzo[f]quinolin-4-ium-3-carboxylate (**2z**)

According to **General procedure A**, **2z** was obtained as white solid in 43% yield (20.3 mg) using CH₃OH (R_f = 0.2) as eluent. mp: 162 – 164 °C.

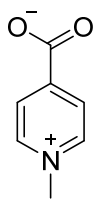
¹H NMR (400 MHz, Methanol-*d*₄) δ 9.89 (d, *J* = 8.7 Hz, 1H), 8.94 (d, *J* = 8.2 Hz, 1H), 8.58 (d, *J* = 9.6 Hz, 1H), 8.35 (d, *J* = 9.6 Hz, 1H), 8.21 (d, *J* = 7.8 Hz, 1H), 8.10 (d, *J* = 8.7 Hz, 1H), 7.98 (t, *J* = 7.1 Hz, 1H), 7.92 (t, *J* = 7.4 Hz, 1H), 4.68 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 166.5, 157.3, 142.4, 140.6, 139.3, 132.7, 131.3, 131.0, 130.6, 129.8, 128.3, 124.8, 122.0, 116.9, 42.9. HRMS (ESI) *m/z* calcd for C₁₅H₁₂NO₂⁺ (M+H)⁺ 238.0863, found 238.0864.



2-methylisoquinolin-2-ium-1-carboxylate (**2aa**)

According to **General procedure A**, **2aa** was obtained as white solid in 51% yield (19.1 mg) using CH₃OH (R_f = 0.25) as eluent. mp: 171 – 172 °C.

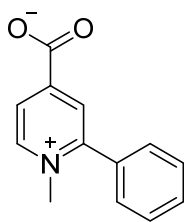
¹H NMR (400 MHz, Methanol-*d*₄) δ 8.42 (d, *J* = 6.9 Hz, 1H), 8.38 (d, *J* = 7.9 Hz, 1H), 8.31 – 8.21 (m, 2H), 8.21 – 8.14 (m, 1H), 8.03 – 8.00 (m, 1H), 4.42 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 164.6, 160.1, 139.2, 137.7, 135.9, 132.4, 130.9, 128.7, 125.2, 125.0, 46.4. HRMS (ESI) *m/z* calcd for C₁₁H₁₀NO₂⁺ (M+H)⁺ 188.0706, found 188.0707.



1-methylpyridin-1-ium-4-carboxylate (**2ab**)

According to **General procedure B**, **2ab** was obtained as white solid in 79% yield (21.6 mg) using CH₃OH (*R_f* = 0.3) as eluent. mp: 251 – 252 °C.

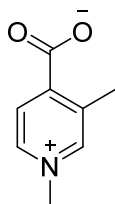
¹H NMR (400 MHz, Methanol-*d*₄) δ 8.90 (d, *J* = 6.5 Hz, 2H), 8.31 (d, *J* = 6.4 Hz, 2H), 4.41 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 167.8, 155.2, 147.0, 128.0, 48.5. HRMS (ESI) *m/z* calcd for C₇H₈NO₂⁺ (*M*+*H*)⁺ 138.0550, found 138.0549.



1-methyl-2-phenylpyridin-1-ium-4-carboxylate (**2ac**)

According to **General procedure B**, **2ac** was obtained as white solid in 52% yield (22.2 mg) using CH₃OH (*R_f* = 0.35) as eluent. mp: 201 – 204 °C.

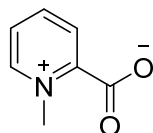
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.01 (d, *J* = 6.3 Hz, 1H), 8.18 (dd, *J* = 6.2, 1.6 Hz, 1H), 7.98 (d, *J* = 1.5 Hz, 1H), 7.69 – 7.61 (m, 5H), 4.06 (s, 3H); ¹³C NMR (100 MHz, DMSO-*d*₆) δ 163.0, 156.6, 154.7, 146.5, 132.3, 130.9, 129.1, 128.0, 125.0, 46.4. HRMS (ESI) *m/z* calcd for C₁₃H₁₂NO₂⁺ (*M*+*H*)⁺ 214.0863, found 214.0864.



1,3-dimethylpyridin-1-ium-4-carboxylate (2ad)

According to **General procedure B**, **2ad** was obtained as white solid in 47% yield (14.2 mg) using CH₃OH (R_f = 0.3) as eluent. mp: 233 – 234 °C.

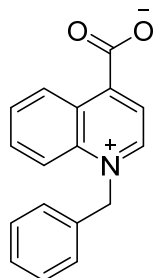
¹H NMR (400 MHz, Methanol-*d*₄) δ 8.73 (s, 1H), 8.66 (d, *J* = 6.1 Hz, 1H), 7.83 (d, *J* = 6.1 Hz, 1H), 4.33 (s, 3H), 2.54 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 171.1, 157.7, 147.2, 144.2, 136.0, 125.2, 48.1, 17.1. HRMS (ESI) *m/z* calcd for C₈H₁₀NO₂⁺ (M+H)⁺ 152.0706, found 152.0708.



1-methylpyridin-1-ium-2-carboxylate (2ae)

According to **General procedure B**, **2ae** was obtained as white solid in 71% yield (19.5 mg) using CH₃OH (R_f = 0.3) as eluent. mp: 171 – 173 °C.

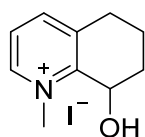
¹H NMR (400 MHz, Methanol-*d*₄) δ 8.78 (d, *J* = 6.2 Hz, 1H), 8.61 – 8.42 (m, 1H), 8.08 (d, *J* = 7.2 Hz, 1H), 8.00 – 7.87 (m, 1H), 4.43 (s, 3H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 165.2, 155.5, 147.00 146.5, 127.5, 47.4. HRMS (ESI) *m/z* calcd for C₇H₈NO₂⁺ (M+H)⁺ 138.0550, found 138.0550.



1-benzylquinolin-1-ium-4-carboxylate (2af)

According to **General procedure A**, **2af** was obtained as white solid in 43% yield (22.6 mg) using CH₃OH (R_f = 0.5) as eluent. mp: 161 – 164 °C.

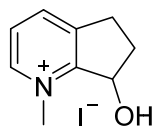
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.58 (d, *J* = 6.0 Hz, 1H), 8.57 (d, *J* = 8.4 Hz, 1H), 8.38 (d, *J* = 9.0 Hz, 1H), 8.08 (t, *J* = 7.9 Hz, 1H), 7.90 – 7.86 (m, 2H), 7.42 – 7.32 (m, 5H), 7.33 (s, 1H), 6.29 (s, 2H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 170.7, 159.9, 151.1, 140.1, 136.8, 134.6, 131.0, 130.5, 130.2, 128.3, 127.8, 120.3, 119.3, 61.9. HRMS (ESI) *m/z* calcd for C₁₇H₁₄NO₂⁺ (M+H)⁺ 264.1019, found 264.1022.



8-hydroxy-1-methyl-5,6,7,8-tetrahydroquinolin-1-ium iodide (4a)

According to **General procedure A**, **4a** was obtained as white solid in 88% yield (51.2 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 141 – 143 °C.

¹H NMR (400 MHz, Methanol-*d*₄) δ 8.83 (d, *J* = 6.0 Hz, 1H), 8.37 (d, *J* = 8.0 Hz, 1H), 7.90 (dd, *J* = 8.0, 6.0 Hz, 1H), 5.18 (t, *J* = 2.7 Hz, 1H), 4.52 (s, 3H), 3.15 – 3.10 (m, 1H), 3.00 – 2.92 (m, 1H), 2.25 – 2.21 (m, 1H), 2.06 – 1.98 (m, 2H), 1.95 – 1.88 (m, 1H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 153.7, 148.1, 146.7, 141.2, 127.1, 63.2, 46.0, 32.1, 29.6, 16.6. HRMS (ESI) *m/z* calcd for C₁₀H₁₄NO⁺ (M)⁺ 164.1070, found 164.1066.

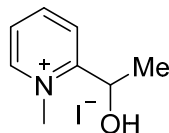


7-hydroxy-1-methyl-6,7-dihydro-5H-cyclopenta[b]pyridin-1-ium iodide (4b)

According to **General procedure A**, **4b** was obtained as pale yellow solid in 83% yield (45.9 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 121 – 123 °C.

¹H NMR (400 MHz, Methanol-*d*₄) δ 8.71 (d, *J* = 6.0 Hz, 1H), 8.43 (d, *J* = 7.8 Hz, 1H), 8.02 – 7.84 (m, 1H), 5.60 (dd, *J* = 7.7, 4.2 Hz, 1H), 4.44 (s, 3H), 3.41 – 3.32 (m, 1H), 3.14 – 3.06 (m, 1H),

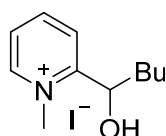
2.74 – 2.64 (m, 1H), 2.23 – 2.15 (m, 1H); ^{13}C NMR (100 MHz, DMSO- d_6) δ 158.8, 144.2, 143.8, 142.3, 126.9, 71.7, 44.3, 32.6, 28.0. HRMS (ESI) m/z calcd for $\text{C}_9\text{H}_{12}\text{NO}^+$ (M) $^+$ 150.0913, found 150.0910.



2-(1-hydroxyethyl)-1-methylpyridin-1-ium iodide (4c)

According to **General procedure A**, **4c** was obtained as pale yellow solid in 86% yield (45.6 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 109 – 111 °C.

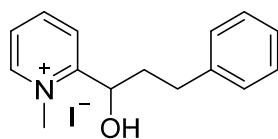
^1H NMR (400 MHz, Methanol- d_4) δ 8.87 (d, J = 6.2 Hz, 1H), 8.58 (t, J = 7.9 Hz, 1H), 8.28 (d, J = 8.1 Hz, 1H), 7.96 (t, J = 6.9 Hz, 1H), 5.37 (q, J = 6.5 Hz, 1H), 4.42 (s, 3H), 1.61 (d, J = 6.5 Hz, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 163.0, 147.2, 127.4, 126.8, 65.7, 46.3, 22.3. HRMS (ESI) m/z calcd for $\text{C}_8\text{H}_{12}\text{NO}^+$ (M) $^+$ 138.0913, found 138.0918.



2-(1-hydroxypentyl)-1-methylpyridin-1-ium iodide (4d)

According to **General procedure A**, **4d** was obtained as pale yellow solid in 90% yield (55.3 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 87 – 89 °C.

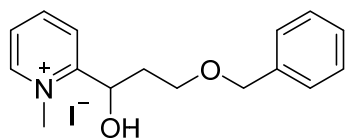
^1H NMR (400 MHz, Methanol- d_4) δ 8.85 (d, J = 6.2 Hz, 1H), 8.56 (t, J = 7.9 Hz, 1H), 8.25 (d, J = 8.1 Hz, 1H), 7.95 (t, J = 6.9 Hz, 1H), 5.17 (dd, J = 8.9, 3.4 Hz, 1H), 4.40 (s, 3H), 1.94 – 1.85 (m, 1H), 1.80 – 1.71 (m, 1H), 1.61 – 1.38 (m, 4H), 0.96 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 162.7, 147.8, 147.0, 127.4, 127.3, 69.6, 46.4, 36.7, 28.8, 23.4, 14.3. HRMS (ESI) m/z calcd for $\text{C}_{11}\text{H}_{18}\text{NO}^+$ (M) $^+$ 180.1383, found 180.1380.



2-(1-hydroxy-3-phenylpropyl)-1-methylpyridin-1-ium iodide (4e)

According to **General procedure A**, **4e** was obtained as pale yellow solid in 73% yield (51.9 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 111 – 113 °C.

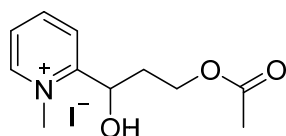
^1H NMR (400 MHz, Methanol- d_4) δ 8.80 (d, $J = 6.1$ Hz, 1H), 8.53 (t, $J = 8.2$ Hz, 1H), 8.27 (d, $J = 8.1$ Hz, 1H), 7.95 – 7.84 (m, 1H), 7.31 – 7.25 (m, 4H), 7.22 – 7.17 (m, 1H), 5.10 (dd, $J = 9.3, 2.9$ Hz, 1H), 4.18 (s, 3H), 2.99 – 2.85 (m, 2H), 2.19 – 2.11 (m, 1H), 2.08 – 1.99 (m, 1H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 162.7, 147.8, 147.0, 142.1, 129.7, 129.6, 127.4, 127.3, 127.3, 68.5, 46.1, 38.8, 32.5. HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_{18}\text{NO}^+$ ($\text{M}+\text{H}$) $^+$ 228.1383, found 228.1382.



2-(3-(benzyloxy)-1-hydroxypropyl)-1-methylpyridin-1-ium iodide (4f)

According to **General procedure A**, **4f** was obtained as pale yellow solid in 83% yield (64.1 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 97 – 99 °C.

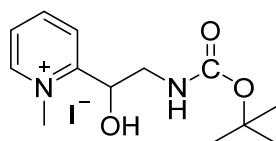
^1H NMR (400 MHz, Methanol- d_4) δ 8.74 (d, $J = 6.1$ Hz, 1H), 8.50 (t, $J = 7.9$ Hz, 1H), 8.27 (d, $J = 8.1$ Hz, 1H), 7.92 – 7.76 (m, 1H), 7.38 – 7.21 (m, 5H), 5.40 (dd, $J = 8.0, 4.0$ Hz, 1H), 4.50 – 4.41 (m, 2H), 4.35 (s, 3H), 3.83 – 3.78 (m, 1H), 3.70 – 3.65 (m, 1H), 2.27 – 2.19 (m, 1H), 2.12 – 2.04 (m, 1H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 163.0, 147.4, 146.7, 139.4, 129.5, 128.9, 128.8, 127.5, 127.2, 74.1, 67.2, 66.9, 46.3, 37.6. HRMS (ESI) m/z calcd for $\text{C}_{16}\text{H}_{20}\text{NO}_2^+$ (M) $^+$ 258.1489, found 258.1489.



2-(3-acetoxy-1-hydroxypropyl)-1-methylpyridin-1-ium iodide (4g)

According to **General procedure A**, **4g** was obtained as pale yellow solid in 66% yield (44.5 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 86 – 87 °C.

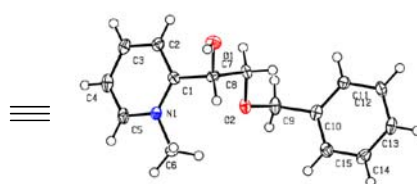
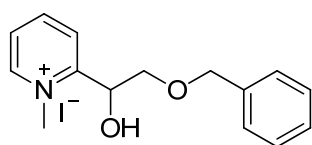
^1H NMR (400 MHz, Methanol- d_4) δ 8.87 (d, J = 6.1 Hz, 1H), 8.57 (t, J = 8.0 Hz, 1H), 8.29 (d, J = 7.9 Hz, 1H), 7.96 (t, J = 6.7 Hz, 1H), 5.32 (dd, J = 9.2, 2.9 Hz, 1H), 4.40 (s, 3H), 4.36 – 4.27 (m, 2H), 2.30 – 2.21 (m, 1H), 2.10 – 2.03 (m, 1H), 2.01 (s, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 172.7, 162.1, 148.0, 147.2, 127.6, 127.4, 66.7, 61.6, 46.2, 35.8, 20.8. HRMS (ESI) m/z calcd for $\text{C}_{11}\text{H}_{16}\text{NO}_3^+$ (M) $^+$ 210.1125, found 210.1120.



2-(2-((tert-butoxycarbonyl)amino)-1-hydroxyethyl)-1-methylpyridin-1-ium iodide (4h)

According to **General procedure A**, **4h** was obtained as pale yellow solid in 74% yield (56.2 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 77 – 79 °C.

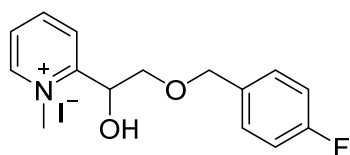
^1H NMR (400 MHz, Methanol- d_4) δ 8.91 (d, J = 6.1 Hz, 1H), 8.56 (t, J = 7.9 Hz, 1H), 8.28 (d, J = 8.0 Hz, 1H), 7.97 (t, J = 6.8 Hz, 1H), 5.38 (t, J = 4.6 Hz, 1H), 4.50 (s, 3H), 3.50 (t, J = 4.6 Hz, 2H), 1.31 (s, 9H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 160.6, 158.4, 147.7, 146.5, 128.4, 127.5, 80.5, 69.4, 46.5, 45.9, 28.6. HRMS (ESI) m/z calcd for $\text{C}_{13}\text{H}_{21}\text{N}_2\text{O}_3^+$ (M) $^+$ 253.1547, found 253.1545.



2-(2-(benzyloxy)-1-hydroxyethyl)-1-methylpyridin-1-ium iodide (4i, CCDC NO. 1973937)

According to **General procedure A**, **4i** was obtained as pale yellow solid in 73% yield (51.2 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 104 – 105 °C.

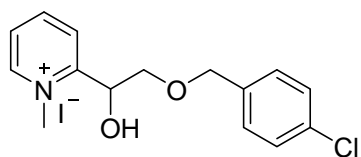
^1H NMR (400 MHz, Methanol- d_4) δ 8.87 (d, J = 6.1 Hz, 1H), 8.55 (t, J = 8.0 Hz, 1H), 8.26 (d, J = 8.0 Hz, 1H), 7.97 (t, J = 6.9 Hz, 1H), 7.32-7.27 (m, 3H), 7.24 – 7.15 (m, 2H), 5.45 (t, J = 12.4 Hz, 1H), 4.54 (q, J = 12.0 Hz, 2H), 4.42 (s, 3H), 3.98 (dd, J = 9.7, 5.4 Hz, 1H), 3.74 (dd, J = 9.7, 6.9 Hz, 1H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 160.9, 147.6, 146.77, 138.8, 129.5, 129.0, 128.2, 128.2, 127.7, 74.5, 73.7, 68.4, 47.1. HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_{18}\text{NO}_2^+$ (M) $^+$ 244.1332, found 244.1328.



2-(2-((4-fluorobenzyl)oxy)-1-hydroxyethyl)-1-methylpyridin-1-ium iodide (4j)

According to **General procedure A**, **4j** was obtained as pale yellow solid in 69% yield (53.7 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 125 – 127 °C.

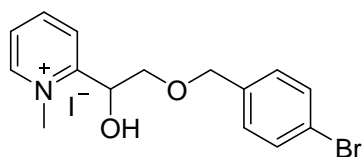
^1H NMR (400 MHz, Methanol- d_4) δ 8.89 (d, J = 6.1 Hz, 1H), 8.57 (t, J = 7.9 Hz, 1H), 8.27 (d, J = 9.2 Hz, 1H), 7.98 (t, J = 7.7 Hz, 1H), 7.32 – 7.19 (m, 2H), 7.11 – 6.97 (m, 2H), 5.51 (t, J = 6.0 Hz, 1H), 4.52 (q, J = 11.6 Hz, 2H), 4.45 (s, 3H), 3.98 (dd, J = 9.8, 5.5 Hz, 1H), 3.76 (dd, J = 9.8, 6.7 Hz, 1H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 165.0, 161.6 (d, J = 243.2 Hz), 147.7, 146.8, 134.9 (d, J = 3.1 Hz), 131.0 (d, J = 8.3 Hz), 128.2, 127.7, 116.1 (d, J = 21.5 Hz), 73.7, 73.7, 68.4, 47.2. HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_{17}\text{FNO}_2^+$ (M) $^+$ 262.1238, found 262.1235.



2-(2-((4-chlorobenzyl)oxy)-1-hydroxyethyl)-1-methylpyridin-1-ium iodide (4k)

According to **General procedure A**, **4k** was obtained as pale yellow solid in 65% yield (52.5 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 103 – 105 °C.

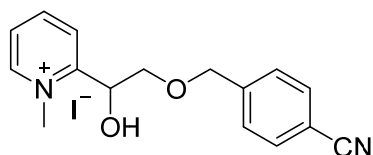
^1H NMR (400 MHz, Methanol- d_4) δ 8.89 (d, J = 6.0 Hz, 1H), 8.57 (t, J = 7.5 Hz, 1H), 8.28 (d, J = 8.1 Hz, 1H), 7.98 (t, J = 7.6 Hz, 1H), 7.40 – 7.27 (m, 2H), 7.24 – 7.22 (m, 2H), 5.52 (t, J = 5.8 Hz, 1H), 4.53 (q, J = 12.0 Hz, 2H), 4.45 (s, 3H), 3.99 (dd, J = 9.8, 5.5 Hz, 1H), 3.77 (dd, J = 9.8, 6.7 Hz, 1H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 160.7, 147.7, 146.8, 137.7, 134.6, 130.5, 129.6, 128.2, 127.7, 73.9, 73.6, 68.5, 47.2. HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_{17}\text{ClNO}_2^+$ (M) $^+$ 278.0942, found 278.0942.



2-(2-((4-bromobenzyl)oxy)-1-hydroxyethyl)-1-methylpyridin-1-ium iodide (**4l**)

According to **General procedure A**, **4l** was obtained as pale yellow solid in 64% yield (57.5 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 140 – 141 °C.

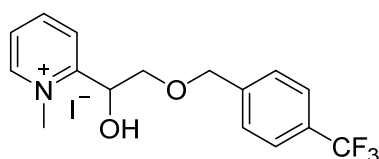
^1H NMR (400 MHz, Methanol- d_4) δ 8.85 (d, J = 6.1 Hz, 1H), 8.26 (s, 1H), 7.97 (t, J = 7.5 Hz, 1H), 7.46 (d, J = 8.3 Hz, 2H), 7.15 (d, J = 8.3 Hz, 2H), 5.48 (t, J = 6.5 Hz, 1H), 4.50 (q, J = 12.1 Hz, 2H), 4.42 (s, 3H), 3.98 (dd, J = 9.7, 5.4 Hz, 1H), 3.74 (dd, J = 9.7, 6.8 Hz, 1H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 160.8, 147.7, 146.8, 138.2, 132.6, 130.8, 128.2, 127.7, 122.7, 74.0, 73.7, 68.5, 47.1. HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_{17}\text{BrNO}_2^+$ (M) $^+$ 322.0437, found 322.0434.



2-(2-((4-cyanobenzyl)oxy)-1-hydroxyethyl)-1-methylpyridin-1-ium iodide (**4m**)

According to **General procedure A**, **4m** was obtained as pale yellow solid in 68% yield (53.9 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 151 – 154 °C.

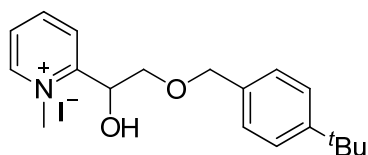
^1H NMR (400 MHz, Methanol- d_4) δ 8.89 (d, J = 5.9 Hz, 1H), 8.58 (t, J = 7.6 Hz, 1H), 8.31 (d, J = 8.0 Hz, 1H), 7.99 (t, J = 7.5 Hz, 1H), 7.69 (d, J = 8.3 Hz, 2H), 7.43 (d, J = 8.2 Hz, 2H), 5.53 (t, J = 5.9 Hz, 1H), 4.68 – 4.59 (m, 2H), 4.46 (s, 3H), 4.01 (dd, J = 9.8, 5.5 Hz, 1H), 3.82 (dd, J = 9.8, 6.4 Hz, 1H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 160.6, 147.8, 146.9, 144.8, 133.4, 129.3, 128.3, 127.8, 119.6, 112.5, 74.2, 73.5, 68.5, 467.0. HRMS (ESI) m/z calcd for $\text{C}_{16}\text{H}_{17}\text{N}_2\text{O}_2^+$ (M) $^+$ 269.1285, found 269.1284.



2-(1-hydroxy-2-((4-(trifluoromethyl)benzyl)oxy)ethyl)-1-methylpyridin-1-ium iodide (4n)

According to **General procedure A**, **4n** was obtained as pale yellow solid in 65% yield (57.1 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 167 – 169 °C.

^1H NMR (400 MHz, Methanol- d_4) δ 8.89 (d, J = 6.1 Hz, 1H), 8.57 (t, J = 7.9 Hz, 1H), 8.30 (d, J = 8.1 Hz, 1H), 7.99 (t, J = 6.9 Hz, 1H), 7.62 (d, J = 8.1 Hz, 2H), 7.44 (d, J = 8.0 Hz, 2H), 5.53 (t, J = 6.0 Hz, 1H), 4.76 – 4.56 (m, 2H), 4.46 (s, 3H), 4.03 (dd, J = 9.8, 5.5 Hz, 1H), 3.82 (dd, J = 9.8, 6.5 Hz, 1H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 160.8, 147.9, 146.9, 143.6, 131.0, 129.2, 128.4, 127.9, 126.5, (q, J = 3.9 Hz), 125.7 (q, J = 269.9 Hz), 74.3, 73.7, 68.6, 47.2. HRMS (ESI) m/z calcd for $\text{C}_{16}\text{H}_{17}\text{F}_3\text{NO}_2^+$ (M) $^+$ 312.1206, found 312.1203.

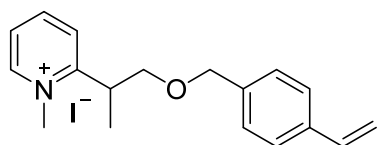


2-(2-((4-(tert-butyl)benzyl)oxy)-1-hydroxyethyl)-1-methylpyridin-1-ium iodide (4o)

According to **General procedure A**, **4o** was obtained as pale yellow solid in 63% yield (53.8 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 117 – 119 °C.

^1H NMR (400 MHz, Methanol- d_4) δ 8.86 (d, J = 6.0 Hz, 1H), 8.53 (t, J = 7.9 Hz, 1H), 8.24 (d, J =

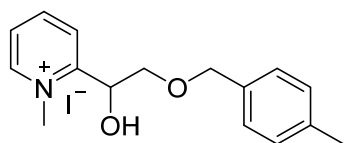
9.0 Hz, 1H), 7.96 (t, $J = 6.9$ Hz, 1H), 7.33 (d, $J = 8.3$ Hz, 2H), 7.12 (d, $J = 8.3$ Hz, 2H), 5.47 (dd, $J = 6.8, 5.6$ Hz, 1H), 4.54 – 4.43 (m, 2H), 4.40 (s, 3H), 3.96 (dd, $J = 9.7, 5.4$ Hz, 1H), 3.71 (dd, $J = 9.7, 7.0$ Hz, 1H), 1.29 (s, 9H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 161.0, 152.1, 147.6, 146.7, 135.7, 128.9, 128.2, 127.7, 126.4, 74.3, 73.7, 68.4, 47.0, 35.4, 31.8. HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{26}\text{NO}_2^+$ (M) $^+$ 300.1958, found 300.1954.



1-methyl-2-(1-((4-vinylbenzyl)oxy)propan-2-yl)pyridin-1-ium iodide (**4p**)

According to **General procedure A**, **4p** was obtained as pale yellow solid in 61% yield (48.2 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 131 – 133 °C.

^1H NMR (400 MHz, Methanol- d_4) δ 8.85 (d, $J = 6.0$ Hz, 1H), 8.54 (t, $J = 7.9$ Hz, 1H), 8.26 (d, $J = 8.1$ Hz, 1H), 7.97 (t, $J = 6.9$ Hz, 1H), 7.37 (d, $J = 8.1$ Hz, 2H), 7.16 (d, $J = 8.0$ Hz, 2H), 6.72 (dd, $J = 17.6, 10.9$ Hz, 1H), 5.77 (d, $J = 17.6$ Hz, 1H), 5.51 – 5.45 (m, 1H), 5.23 (d, $J = 10.9$ Hz, 1H), 4.56 – 4.46 (m, 2H), 4.41 (s, 3H), 3.98 (dd, $J = 9.7, 5.4$ Hz, 1H), 3.73 (dd, $J = 9.7, 7.0$ Hz, 1H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 159.5, 146.1, 145.3, 137.3, 136.8, 136.2, 127.8, 126.7, 126.2, 125.8, 112.9, 72.7, 72.3, 67.0, 45.4. HRMS (ESI) m/z calcd for $\text{C}_{17}\text{H}_{20}\text{NO}_2^+$ (M) $^+$ 270.1489, found 270.1485.

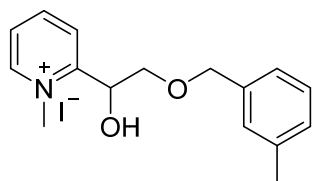


2-(1-hydroxy-2-((4-methylbenzyl)oxy)ethyl)-1-methylpyridin-1-ium iodide (**4q**)

According to **General procedure A**, **4q** was obtained as pale yellow solid in 67% yield (51.7 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 122 – 123 °C.

^1H NMR (400 MHz, Methanol- d_4) δ 8.86 (d, $J = 6.1$ Hz, 1H), 8.54 (t, $J = 7.8$ Hz, 1H), 8.24 (d, $J = 8.1$ Hz, 1H), 7.97 (t, $J = 7.6$ Hz, 1H), 7.12 – 7.06 (m, 4H), 5.47 (t, $J = 5.6$ Hz, 1H), 4.471 (q, $J = 11.6$ Hz, 2H), 4.41 (s, 3H), 3.96 (dd, $J = 9.8, 5.4$ Hz, 1H), 3.72 (dd, $J = 9.7, 7.0$ Hz, 1H); ^{13}C NMR

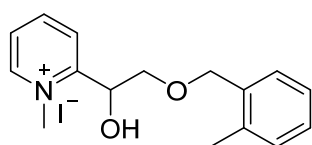
(100 MHz, Methanol- d_4) δ 161.0, 147.6, 146.7, 138.9, 135.7, 130.1, 129.2, 128.2, 127.7, 74.3, 73.58, 68.4, 47.1, 21.2. HRMS (ESI) m/z calcd for $C_{16}H_{20}NO_2^+$ (M) $^+$ 258.1489, found 258.1485.



2-(1-hydroxy-2-((3-methylbenzyl)oxy)ethyl)-1-methylpyridin-1-ium iodide (4r)

According to **General procedure A**, **4r** was obtained as pale yellow solid in 73% yield (56.4 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 117 – 119 °C.

1H NMR (400 MHz, Methanol- d_4) δ 8.88 (d, J = 6.1 Hz, 1H), 8.55 (t, J = 7.8 Hz, 1H), 8.24 (d, J = 9.2 Hz, 1H), 7.97 (t, J = 7.7 Hz, 1H), 7.17 (t, J = 7.5 Hz, 1H), 7.08 (d, J = 7.6 Hz, 1H), 7.01 (s, 1H), 6.69 (d, J = 12.0 Hz, 1H), 5.49 (t, J = 6.4 Hz, 1H), 4.55 – 4.45 (m, 2H), 4.42 (s, 3H), 3.97 (dd, J = 9.8, 5.5 Hz, 1H), 3.73 (dd, J = 9.8, 6.9 Hz, 1H) 2.29 (s, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 160.9, 147.6, 146.7, 139.2, 138.6, 129.7, 129.4, 128.2, 127.7, 126.1, 74.5, 73.6, 68.4, 47.1, 21.4. HRMS (ESI) m/z calcd for $C_{16}H_{20}NO_2^+$ (M) $^+$ 258.1489, found 258.1485.

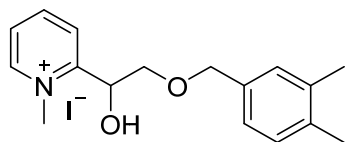


2-(1-hydroxy-2-((2-methylbenzyl)oxy)ethyl)-1-methylpyridin-1-ium iodide (4s)

According to **General procedure A**, **4s** was obtained as pale yellow solid in 74% yield (57.1 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 130 – 132 °C.

1H NMR (400 MHz, Methanol- d_4) δ 8.87 (d, J = 6.1 Hz, 1H), 8.55 (t, J = 8.1 Hz, 1H), 8.26 (d, J = 8.1 Hz, 1H), 7.97 (t, J = 7.6 Hz, 1H), 7.26 – 7.15 (m, 2H), 7.13 – 7.10 (m, 2H), 5.57 – 5.44 (m, 1H), 4.61 – 4.52 (m, 2H), 4.40 (s, 3H), 4.00 (dd, J = 9.8, 5.5 Hz, 1H), 3.77 (dd, J = 9.8, 6.8 Hz, 1H), 2.16 (s, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 160.9, 147.6, 146.8, 138.1, 136.5, 131.3,

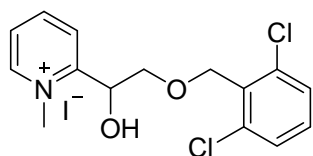
130.1, 129.3, 128.2, 127.7, 126.8, 73.7, 72.9, 68.5, 47.1, 18.8. HRMS (ESI) m/z calcd for $C_{16}H_{20}NO_2^+$ (M)⁺ 258.1489, found 258.1485.



2-(2-((3,4-dimethylbenzyl)oxy)-1-hydroxyethyl)-1-methylpyridin-1-ium iodide (4t)

According to **General procedure A**, **4t** was obtained as pale yellow solid in 71% yield (56.8 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 125 – 127 °C.

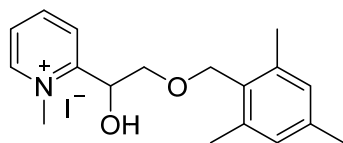
¹H NMR (400 MHz, Methanol-*d*₄) δ 8.84 (d, *J* = 6.1 Hz, 1H), 8.52 (t, *J* = 7.9 Hz, 1H), 8.21 (d, *J* = 7.7 Hz, 1H), 7.95 (t, *J* = 7.5 Hz, 1H), 7.03 (d, *J* = 7.6 Hz, 1H), 6.92 (s, 1H), 6.89 (d, *J* = 7.6 Hz, 1H), 5.54 – 5.42 (m, 1H), 4.49 – 4.36 (m, 5H), 3.94 (dd, *J* = 9.8, 5.4 Hz, 1H), 3.69 (dd, *J* = 9.7, 7.0 Hz, 1H), 2.20 (d, *J* = 6.0 Hz, 6H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 161.0, 147.5, 146.7, 137.7, 137.4, 136.0, 130.6, 130.4, 128.2, 127.7, 126.8, 74.4, 73.5, 68.5, 47.1, 19.8, 19.5. HRMS (ESI) m/z calcd for $C_{17}H_{22}NO_2^+$ (M)⁺ 272.1645, found 272.1647.



2-(2-((2,6-dichlorobenzyl)oxy)-1-hydroxyethyl)-1-methylpyridin-1-ium iodide (4u)

According to **General procedure A**, **4u** was obtained as pale yellow solid in 53% yield (46.5 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 123 – 125 °C.

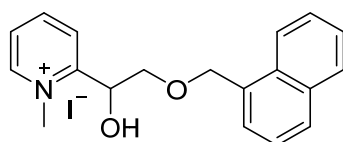
¹H NMR (400 MHz, Methanol-*d*₄) δ 8.84 (d, *J* = 6.1 Hz, 1H), 8.51 (t, *J* = 7.9 Hz, 1H), 8.22 (d, *J* = 9.1 Hz, 1H), 8.00 – 7.88 (m, 1H), 7.42 – 7.30 (m, 3H), 7.30 – 7.26 (m, 1H), 5.47 (dd, *J* = 7.8, 5.3 Hz, 1H), 4.83 – 4.72 (m, 2H), 4.13 (dd, *J* = 9.3, 5.3 Hz, 1H), 3.73 (dd, *J* = 9.3, 7.9 Hz, 1H); ¹³C NMR (100 MHz, Methanol-*d*₄) δ 161.3, 147.5, 146.8, 137.7, 133.6, 131.9, 129.8, 128.0, 127.7, 74.7, 68.6, 68.1, 47.0. HRMS (ESI) m/z calcd for $C_{15}H_{16}Cl_2NO_2^+$ (M)⁺ 312.0553, found 312.0552.



2-(1-hydroxy-2-((2,4,6-trimethylbenzyl)oxy)ethyl)-1-methylpyridin-1-ium iodide (4v)

According to **General procedure A**, **4v** was obtained as pale yellow solid in 70% yield (57.8 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 191 – 193 °C.

^1H NMR (400 MHz, Acetonitrile- d_3) δ 8.57 (d, $J = 6.1$ Hz, 1H), 8.42 (t, $J = 7.9$ Hz, 1H), 8.15 (d, $J = 8.0$ Hz, 1H), 7.85 (t, $J = 6.6$ Hz, 1H), 6.80 (s, 2H), 5.42 (t, $J = 5.9$ Hz, 1H), 4.93 (s, 1H), 4.50 (q, $J = 10.9$ Hz, 2H), 4.25 (s, 3H), 3.92 (dd, $J = 9.7, 5.5$ Hz, 1H), 3.71 (dd, $J = 9.7, 6.6$ Hz, 1H), 2.21 (s, 3H), 2.16 (s, 6H); ^{13}C NMR (100 MHz, Acetonitrile- d_3) δ 160.5, 146.9, 146.3, 138.8, 138.7, 131.7, 129.6, 128.2, 127.3, 73.0, 68.1, 68.0, 47.3, 21.0, 19.5. HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{24}\text{NO}_2^+$ (M) $^+$ 286.1802, found 286.1799.



2-(1-hydroxy-2-(naphthalen-1-ylmethoxy)ethyl)-1-methylpyridin-1-ium iodide (4w)

According to **General procedure A**, **4w** was obtained as pale yellow solid in 66% yield (55.6 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 99 – 102 °C.

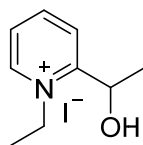
^1H NMR (400 MHz, Methanol- d_4) δ 8.50 (d, $J = 6.2$ Hz, 1H), 8.24 (t, $J = 7.9$ Hz, 1H), 7.99 (d, $J = 8.7$ Hz, 1H), 7.86 – 7.78 (m, 3H), 7.71 – 7.64 (m, 1H), 7.50 – 7.46 (m, 1H), 7.43 – 7.39 (m, 3H), 5.41 (dd, $J = 7.8, 5.3$ Hz, 1H), 5.06 (d, $J = 12.0$ Hz, 1H), 4.81 (d, $J = 12.0$ Hz, 1H), 4.24 (s, 3H), 4.09 (dd, $J = 9.5, 5.2$ Hz, 1H), 3.70 (dd, $J = 9.5, 7.9$ Hz, 1H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 161.0, 147.0, 146.1, 135.3, 133.8, 132.9, 130.2, 129.7, 128.7, 127.7, 127.5, 127.3, 127.0, 126.2, 124.8, 73.6, 72.7, 68.2, 47.0. HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{20}\text{NO}_2^+$ (M) $^+$ 294.1489, found 294.1486.



1-ethyl-8-hydroxy-5,6,7,8-tetrahydroquinolin-1-ium iodide (4x)

According to **General procedure A**, **4x** was obtained as pale yellow solid in 60% yield (36.6 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 191 – 192 °C.

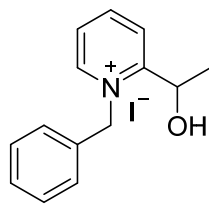
^1H NMR (400 MHz, Methanol- d_4) δ 8.94 (d, J = 6.1 Hz, 1H), 8.37 (d, J = 8.0 Hz, 1H), 7.95 (t, J = 7.1 Hz, 1H), 5.20 (t, J = 3.2 Hz, 1H), 4.99 – 4.90 (m, 1H), 4.83 – 4.74 (m, 1H), 3.14 – 3.10 (m, 1H), 3.01 – 2.92 (m, 1H), 2.25 – 2.18 (m, 1H), 2.10 – 2.88 (m, 3H), 1.68 (t, J = 7.3 Hz, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 153.2, 148.0, 141.4, 127.6, 62.9, 53.9, 32.2, 29.9, 17.4, 16.6. HRMS (ESI) m/z calcd for $\text{C}_{11}\text{H}_{16}\text{NO}^+$ (M) $^+$ 178.1226, found 178.1224.



1-ethyl-2-(1-hydroxyethyl)pyridin-1-ium iodide (4y)

According to **General procedure A**, **4y** was obtained as pale yellow solid in 81% yield (45.2 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 151 – 153 °C.

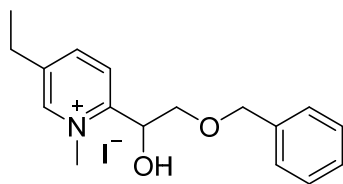
^1H NMR (400 MHz, Methanol- d_4) δ 9.00 (d, J = 6.2 Hz, 1H), 8.60 (t, J = 8.4 Hz, 1H), 8.30 (d, J = 7.9 Hz, 1H), 8.02 (t, J = 7.4 Hz, 1H), 5.42 (q, J = 6.5 Hz, 1H), 4.77 (q, J = 7.3 Hz, 2H), 1.69 – 1.61 (m, 6H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 162.6, 147.2, 146.4, 128.0, 127.4, 65.5, 54.4, 23.4, 17.0. HRMS (ESI) m/z calcd for $\text{C}_9\text{H}_{14}\text{NO}^+$ (M) $^+$ 152.1070, found 152.1066.



1-benzyl-2-(1-hydroxyethyl)pyridin-1-ium iodide (**4z**)

According to **General procedure A**, **4z** was obtained as pale yellow solid in 80% yield (54.5 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 86 – 87 °C.

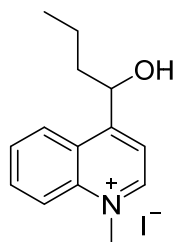
^1H NMR (400 MHz, DMSO- d_6) δ 9.12 (d, J = 5.8 Hz, 1H), 8.69 (t, J = 7.8 Hz, 1H), 8.31 (d, J = 8.1 Hz, 1H), 8.18 – 8.04 (m, 1H), 7.50 – 7.33 (m, 3H), 7.29 – 7.18 (m, 2H), 6.37 (brs, 1H), 6.03 (q, J = 15.5 Hz, 2H), 5.30 (q, J = 6.3 Hz, 1H), 1.31 (d, J = 6.4 Hz, 3H); ^{13}C NMR (100 MHz, DMSO- d_6) δ 161.9, 146.8, 146.1, 134.1, 129.3, 128.9, 127.5, 126.8, 126.6, 63.8, 59.6, 23.1. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{16}\text{NO}^+$ (M) $^+$ 214.1226, found 214.1221.



2-(2-(benzyloxy)-1-hydroxyethyl)-5-ethyl-1-methylpyridin-1-ium iodide (**4aa**)

According to **General procedure A**, **4aa** was obtained as pale yellow solid in 67% yield (53.5 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 143 – 145 °C.

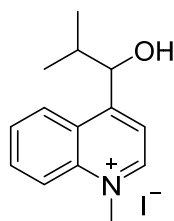
^1H NMR (400 MHz, Methanol- d_4) δ 8.78 (s, 1H), 8.41 (d, J = 8.3 Hz, 1H), 8.12 (d, J = 8.3 Hz, 1H), 7.32 – 7.23 (m, 3H), 7.22 – 7.15 (m, 2H), 5.50 – 5.28 (m, 1H), 4.59 – 4.46 (m, 2H), 4.38 (s, 3H), 3.96 (dd, J = 9.8, 5.4 Hz, 1H), 3.73 (dd, J = 9.8, 6.9 Hz, 1H), 2.87 (q, J = 7.6 Hz, 2H), 1.34 (t, J = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 158.0, 146.6, 146.3, 144.8, 138.8, 129.5, 129.0, 129.0, 127.7, 74.5, 73.8, 68.2, 46.9, 26.4, 14.8. HRMS (ESI) m/z calcd for $\text{C}_{17}\text{H}_{22}\text{NO}_2^+$ (M) $^+$ 272.1645, found 272.1643.



4-(1-hydroxybutyl)-1-methylquinolin-1-ium iodide (4ab)

According to **General procedure A**, **4ab** was obtained as pale yellow solid in 67% yield (46.0 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 91 – 93 °C.

^1H NMR (400 MHz, Methanol- d_4) δ 9.37 (d, $J = 6.2$ Hz, 1H), 8.63 – 8.49 (m, 2H), 8.29 – 8.26 (m, 1H), 8.21 (d, $J = 6.4$ Hz, 1H), 8.13 – 8.00 (m, 1H), 5.72 (dd, $J = 8.4, 3.6$ Hz, 1H), 4.69 (s, 3H), 1.93 – 1.84 (m, 1H), 1.81 – 1.72 (m, 1H), 1.67 – 1.55 (m, 2H), 0.98 (t, $J = 7.4$ Hz, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 166.6, 150.5, 139.8, 136.4, 131.1, 127.9, 127.0, 120.6, 119.7, 70.1, 46.6, 42.1, 20.1, 14.2. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{18}\text{NO}^+$ (M) $^+$ 216.1383, found 216.1378.



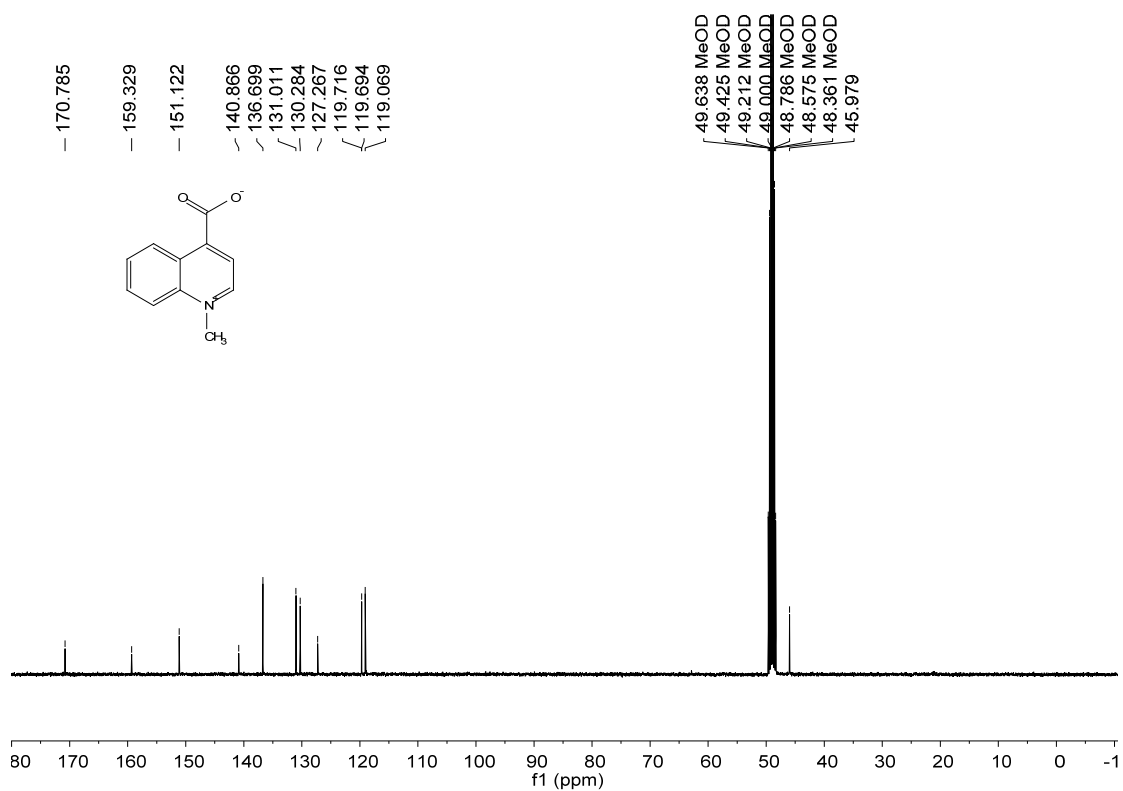
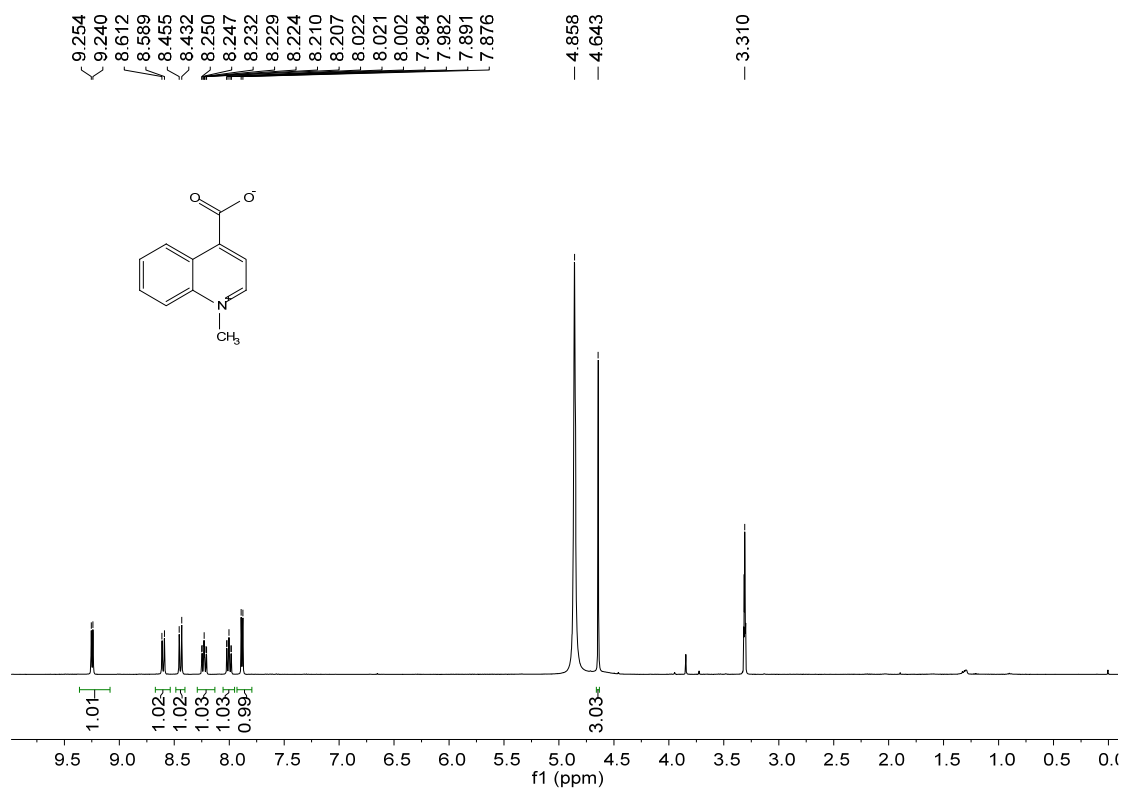
4-(1-hydroxy-2-methylpropyl)-1-methylquinolin-1-ium iodide (4ac)

According to **General procedure A**, **4ac** was obtained as pale yellow solid in 74% yield (50.7 mg), purified by recrystallization from (acetone/ethyl acetate). mp: 87 – 89 °C.

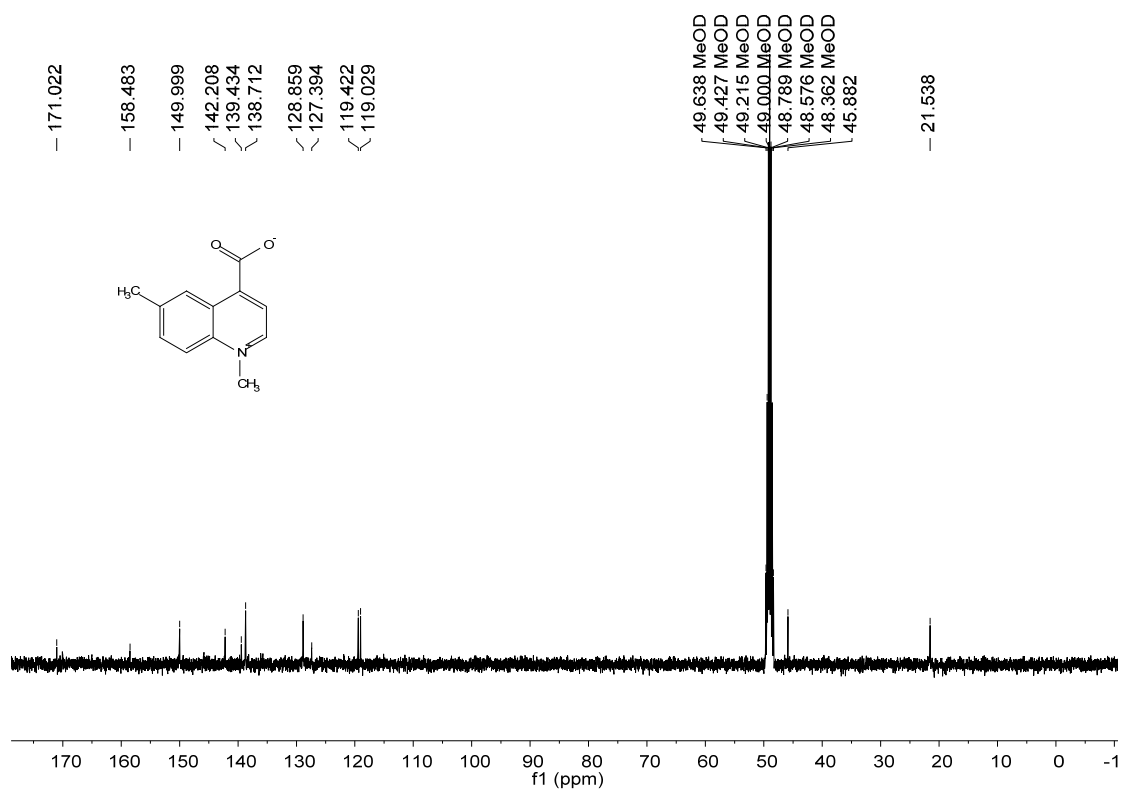
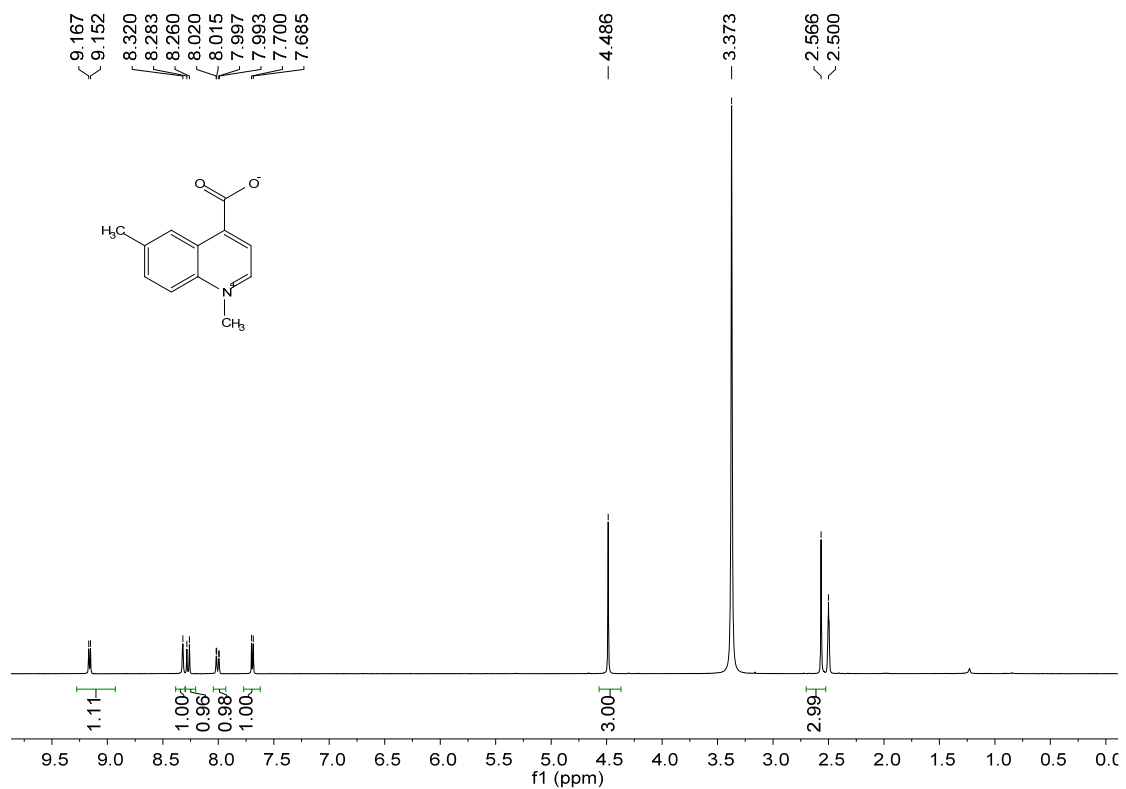
^1H NMR (400 MHz, Methanol- d_4) δ 9.35 (d, $J = 6.2$ Hz, 1H), 8.61 (d, $J = 8.6$ Hz, 1H), 8.51 (d, $J = 8.9$ Hz, 1H), 8.28 – 8.24 (m, 1H), 8.18 (d, $J = 6.1$ Hz, 1H), 8.09 – 7.99 (m, 1H), 5.53 (d, $J = 4.4$ Hz, 1H), 4.68 (s, 3H), 2.21 – 2.13 (m, 1H), 1.11 (d, $J = 6.8$ Hz, 3H), 0.87 (d, $J = 6.7$ Hz, 3H); ^{13}C NMR (100 MHz, Methanol- d_4) δ 165.8, 150.0, 139.8, 136.4, 130.9, 128.3, 127.4, 120.7, 120.5, 74.4, 46.6, 36.6, 20.5, 16.5. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{18}\text{NO}^+$ (M) $^+$ 216.1383, found 216.1382.

6. ^1H NMR and ^{13}C NMR spectra of products

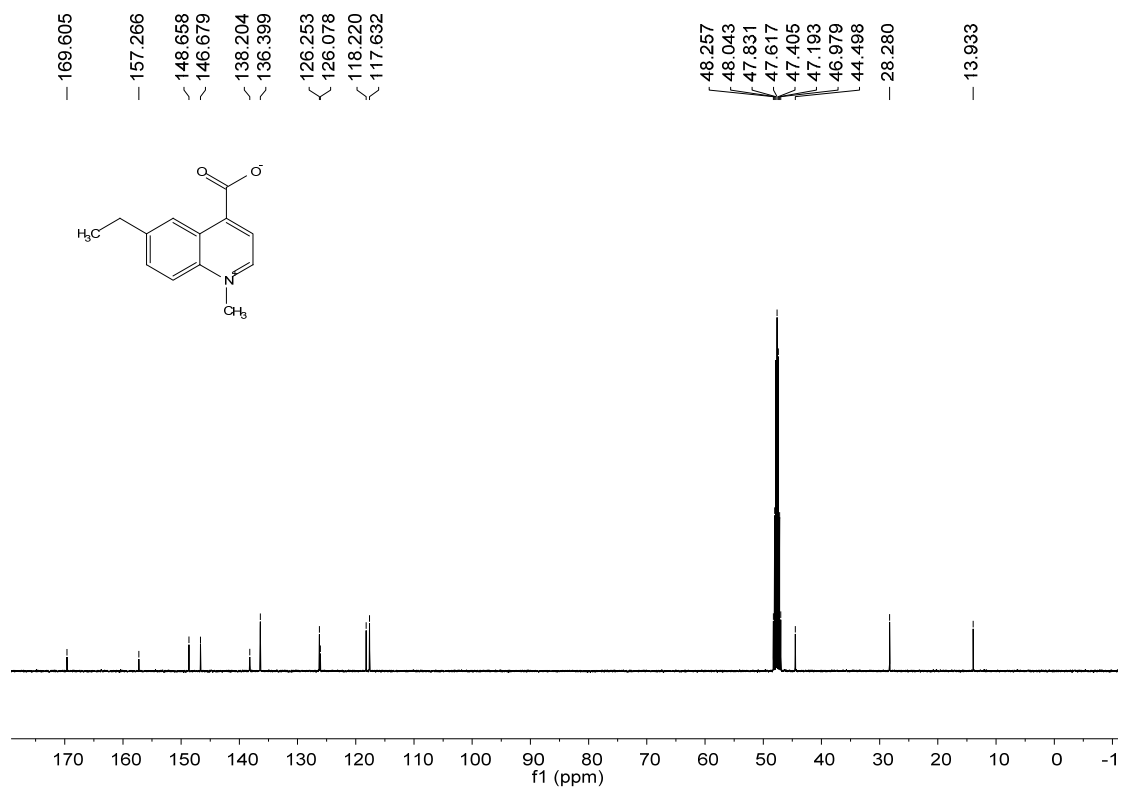
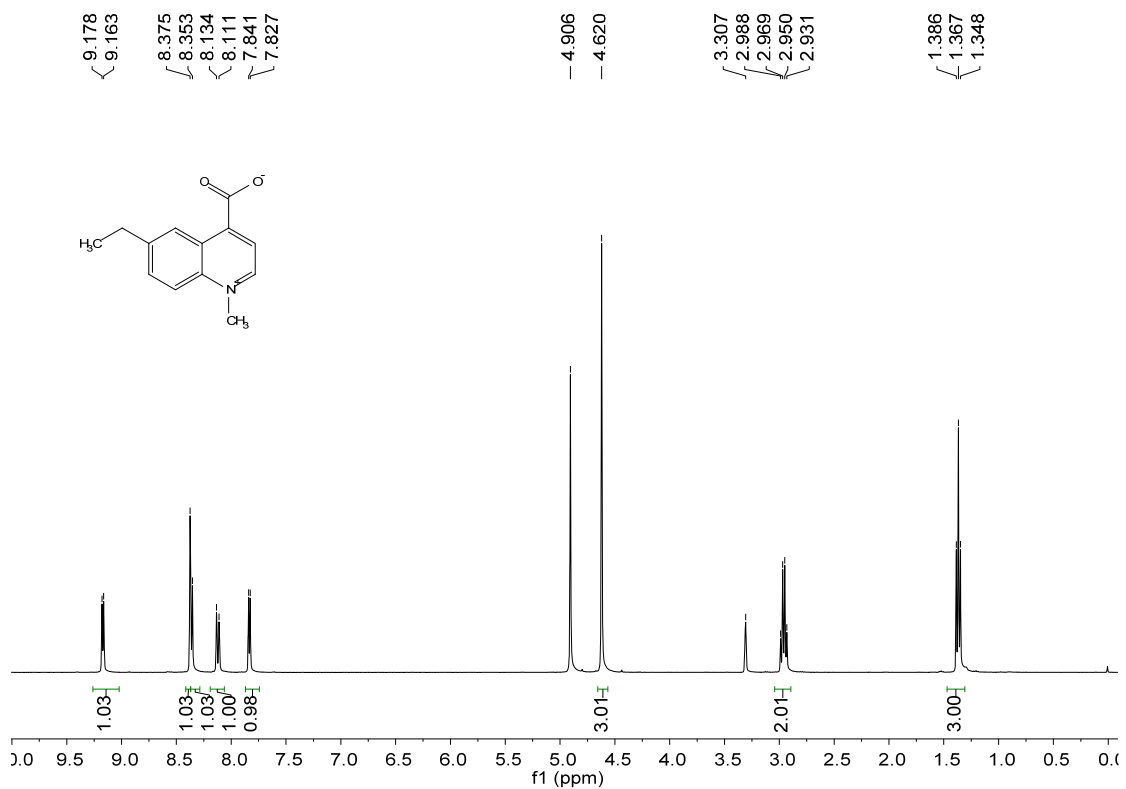
^1H and ^{13}C NMR spectra of **2a**



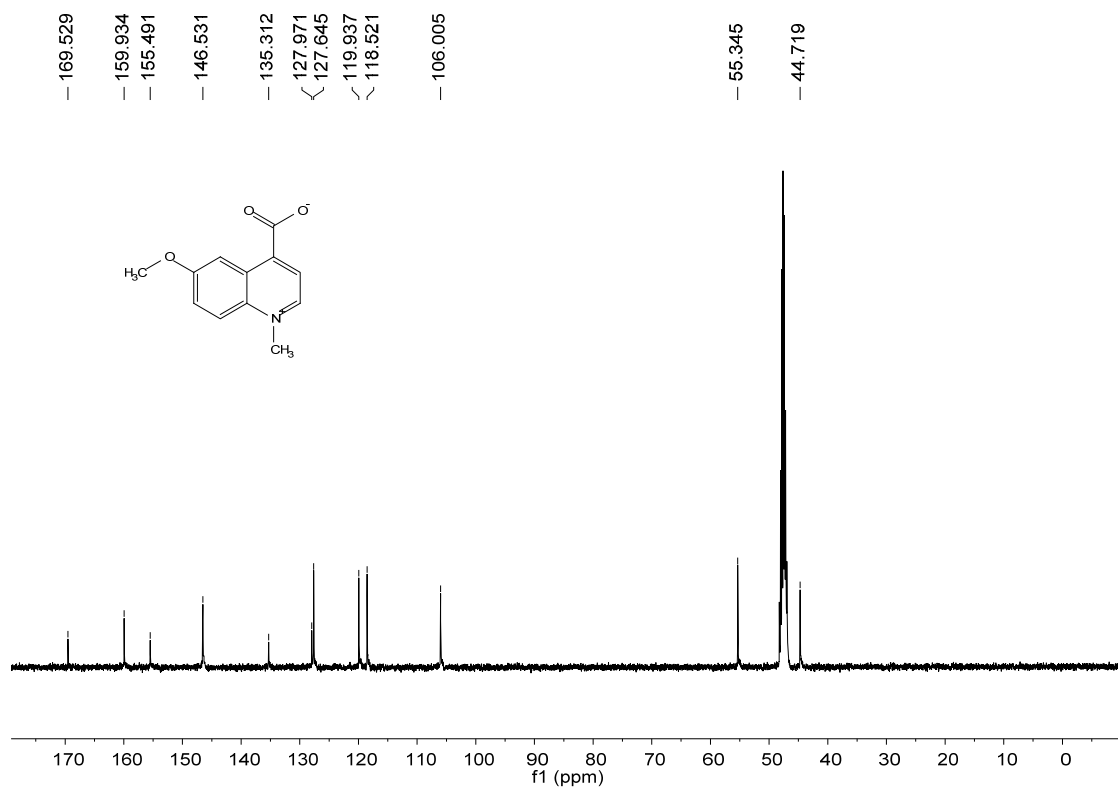
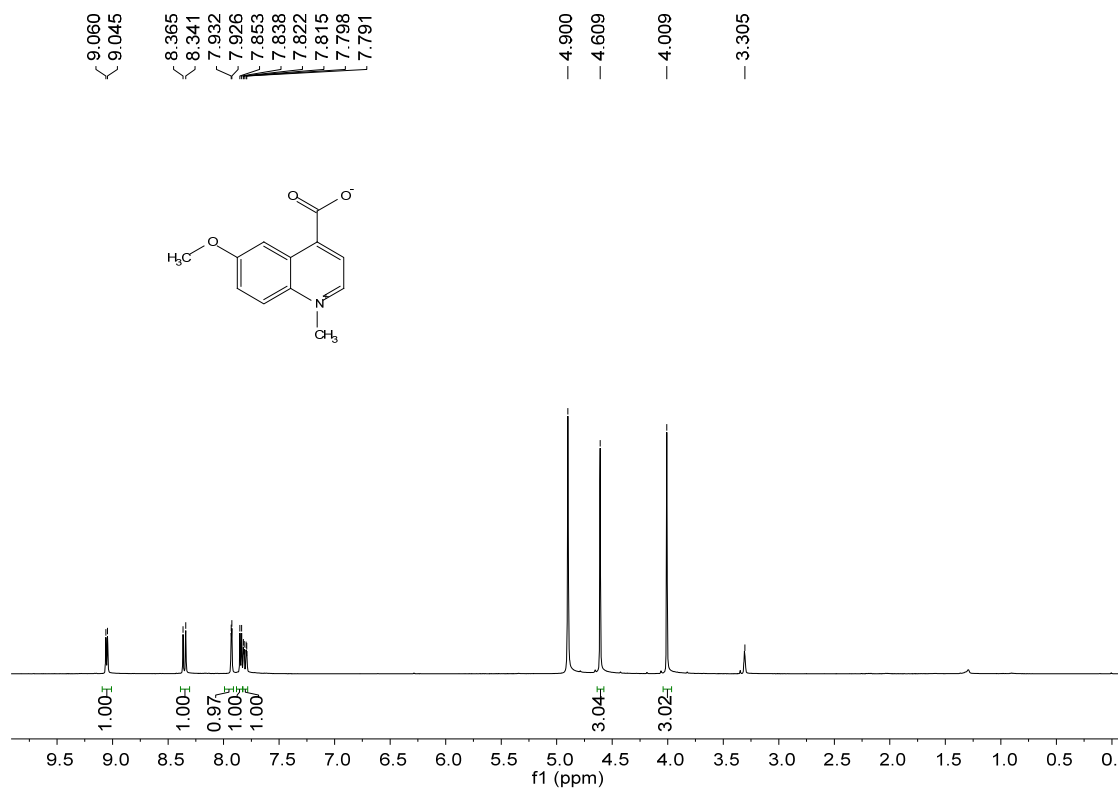
^1H and ^{13}C NMR spectra of **2b**



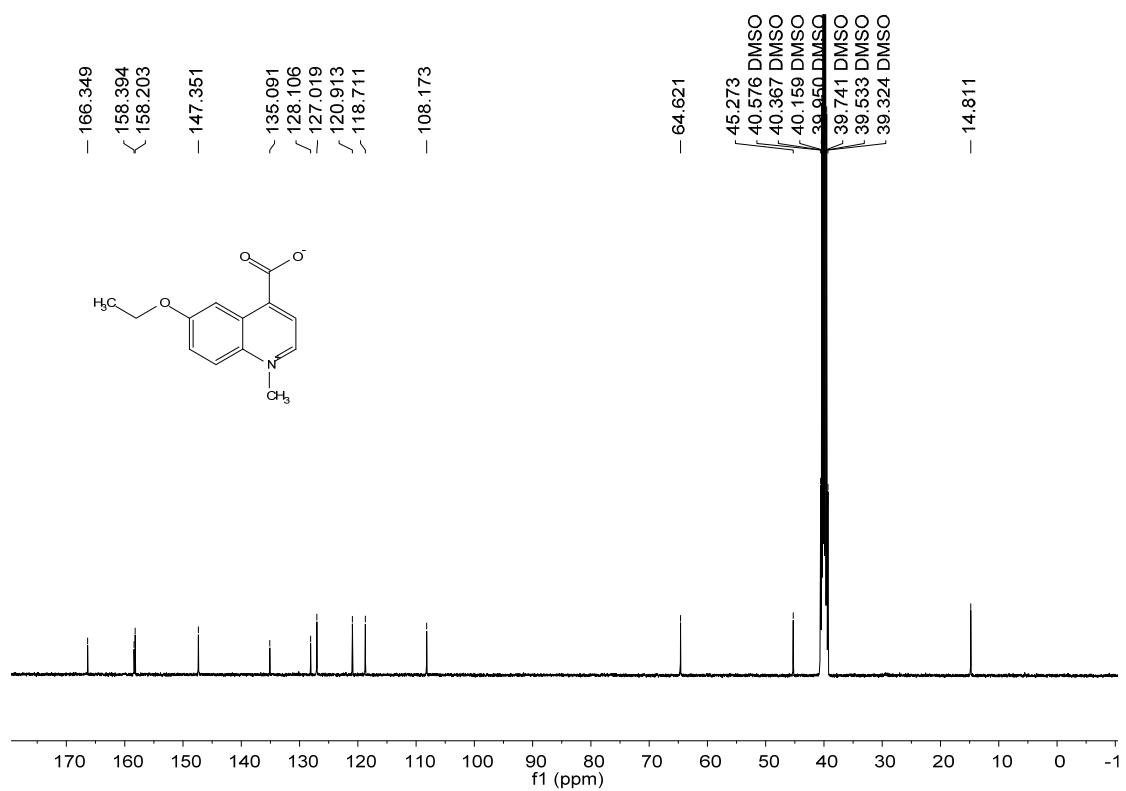
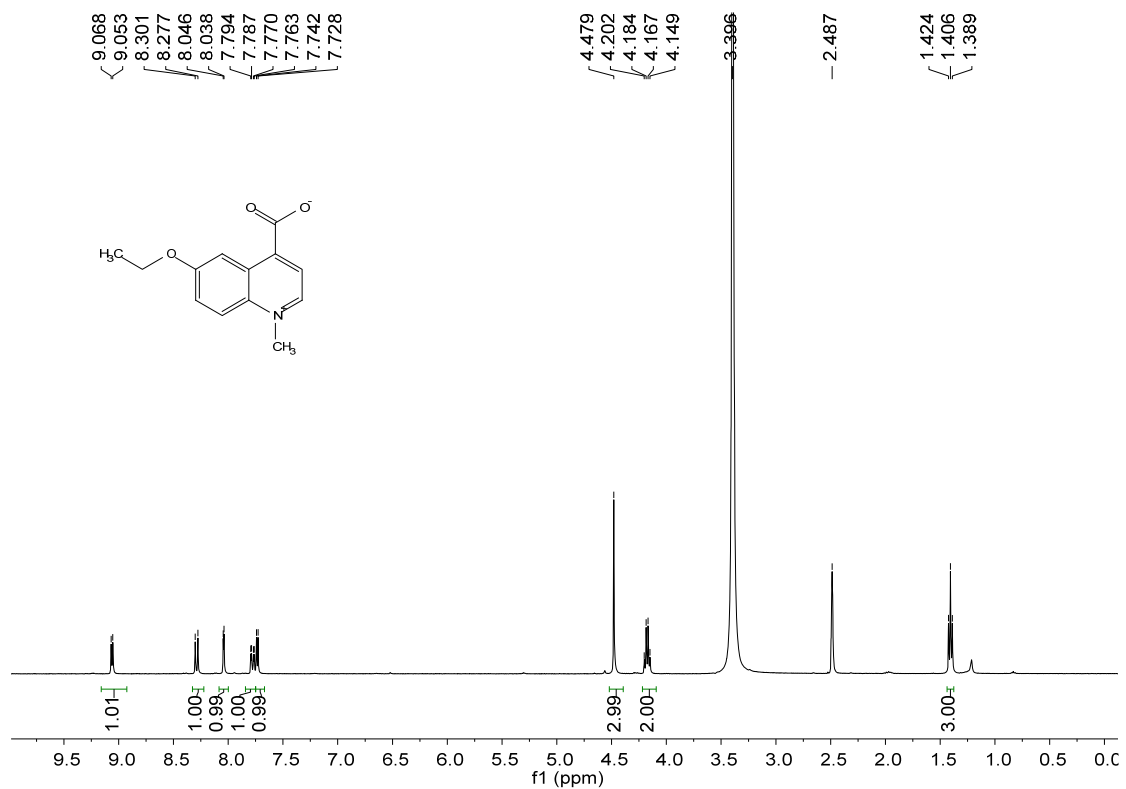
^1H and ^{13}C NMR spectra of **2c**



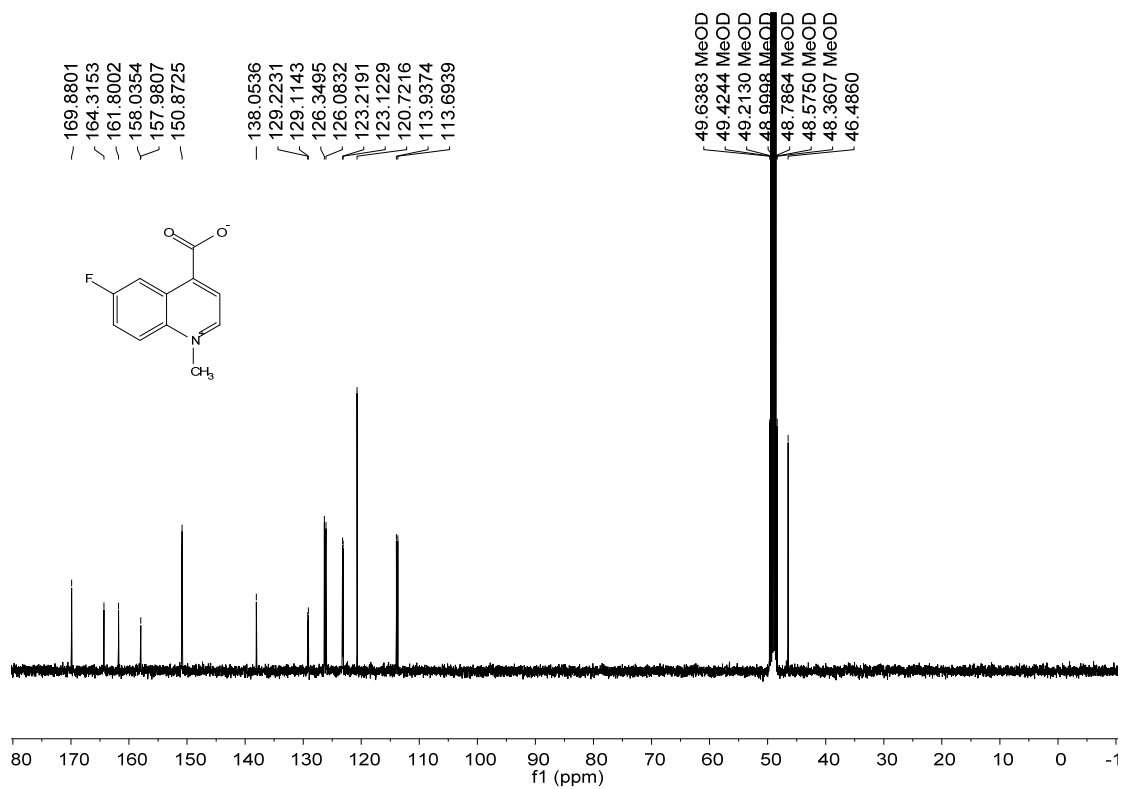
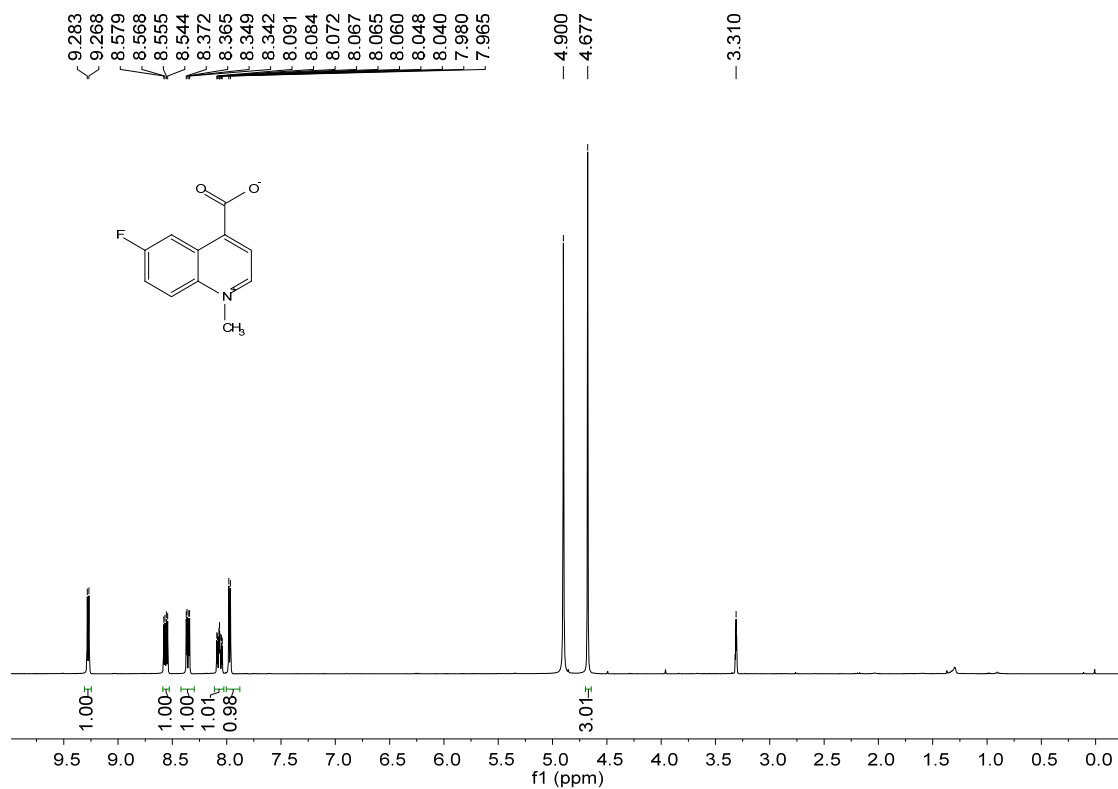
^1H and ^{13}C NMR spectra of **2d**



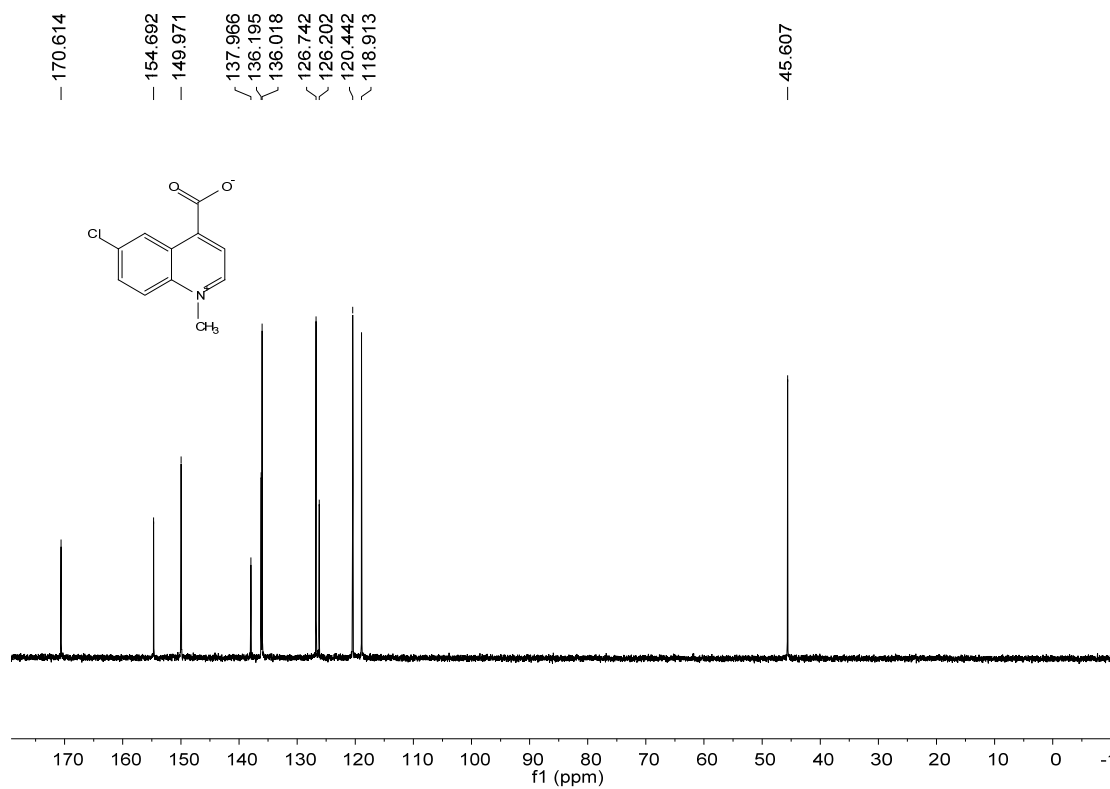
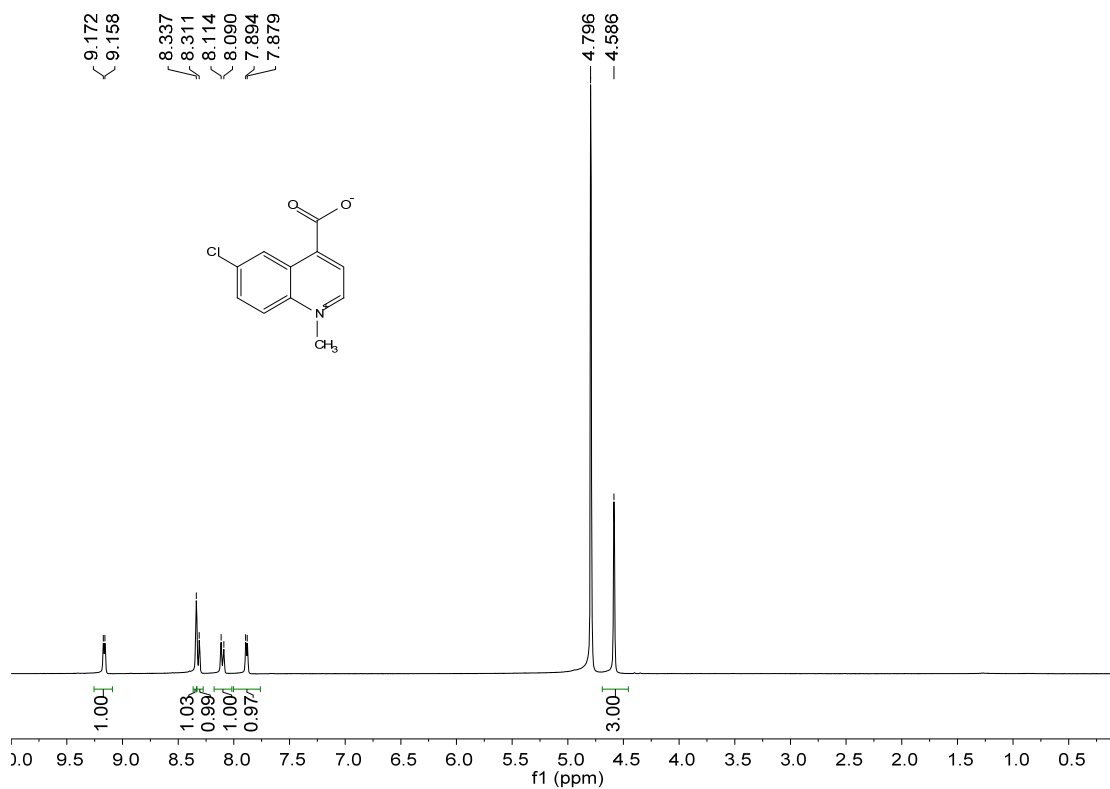
^1H and ^{13}C NMR spectra of **2e**



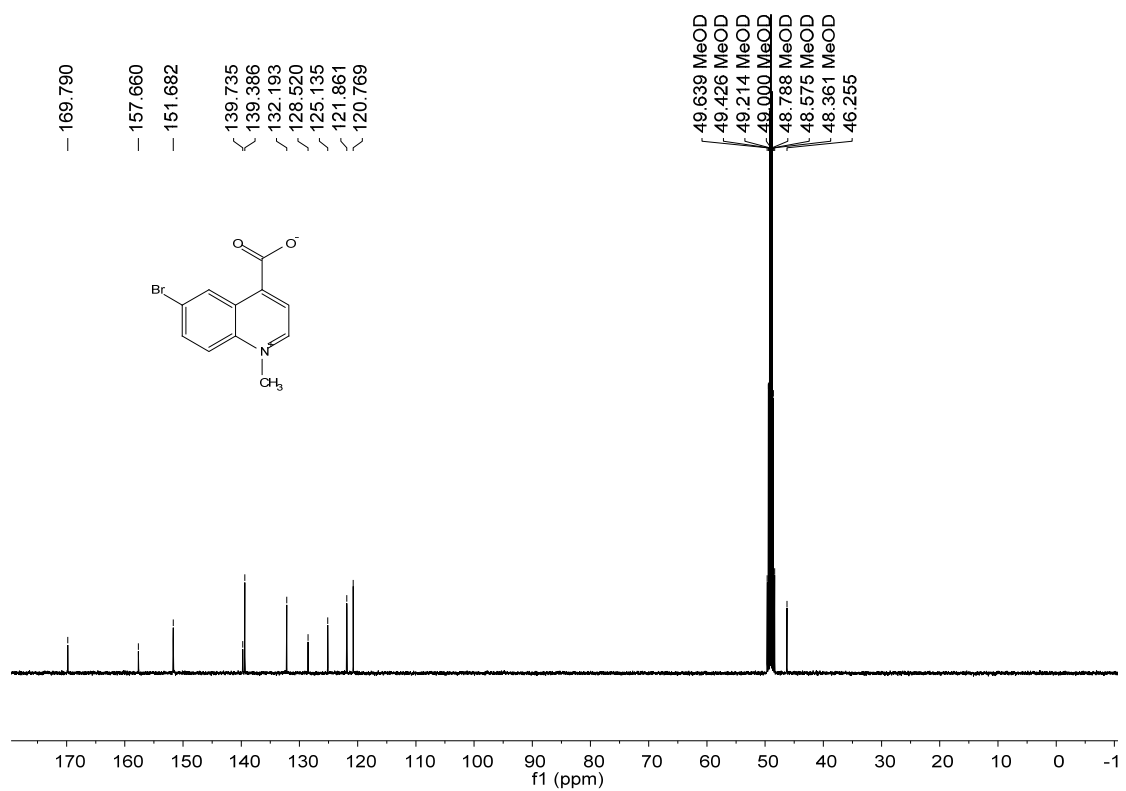
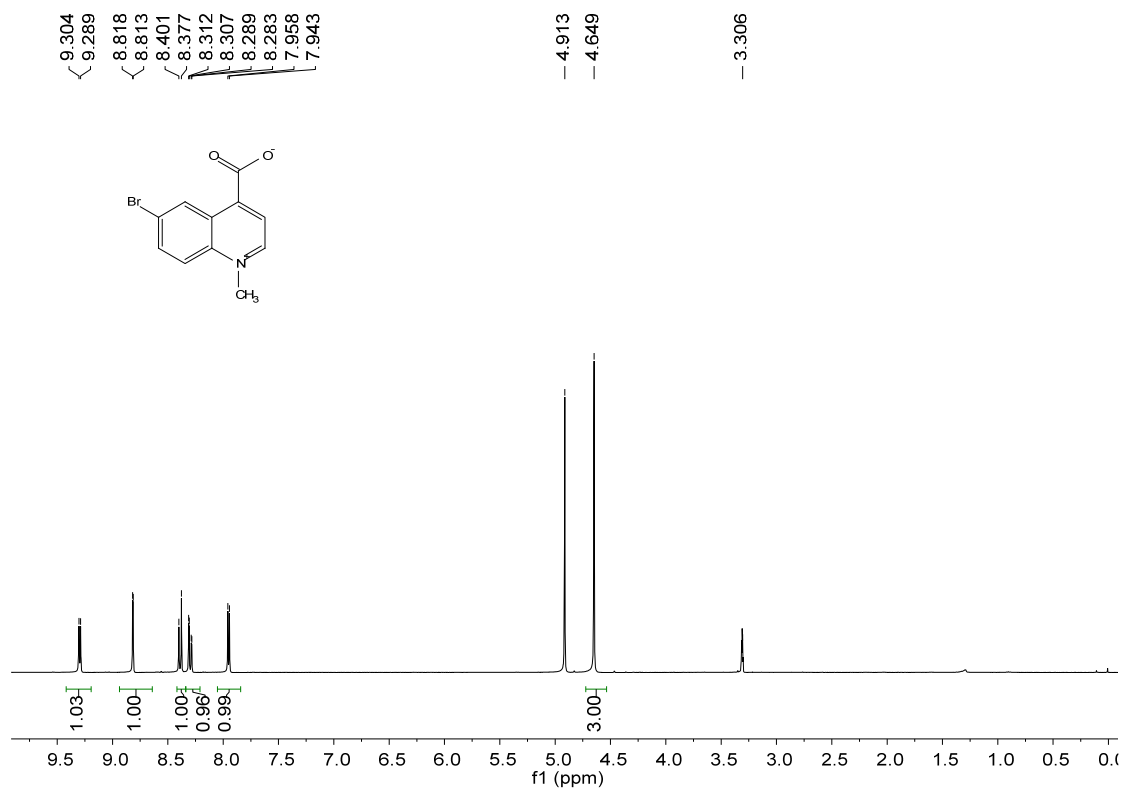
^1H and ^{13}C NMR spectra of **2f**



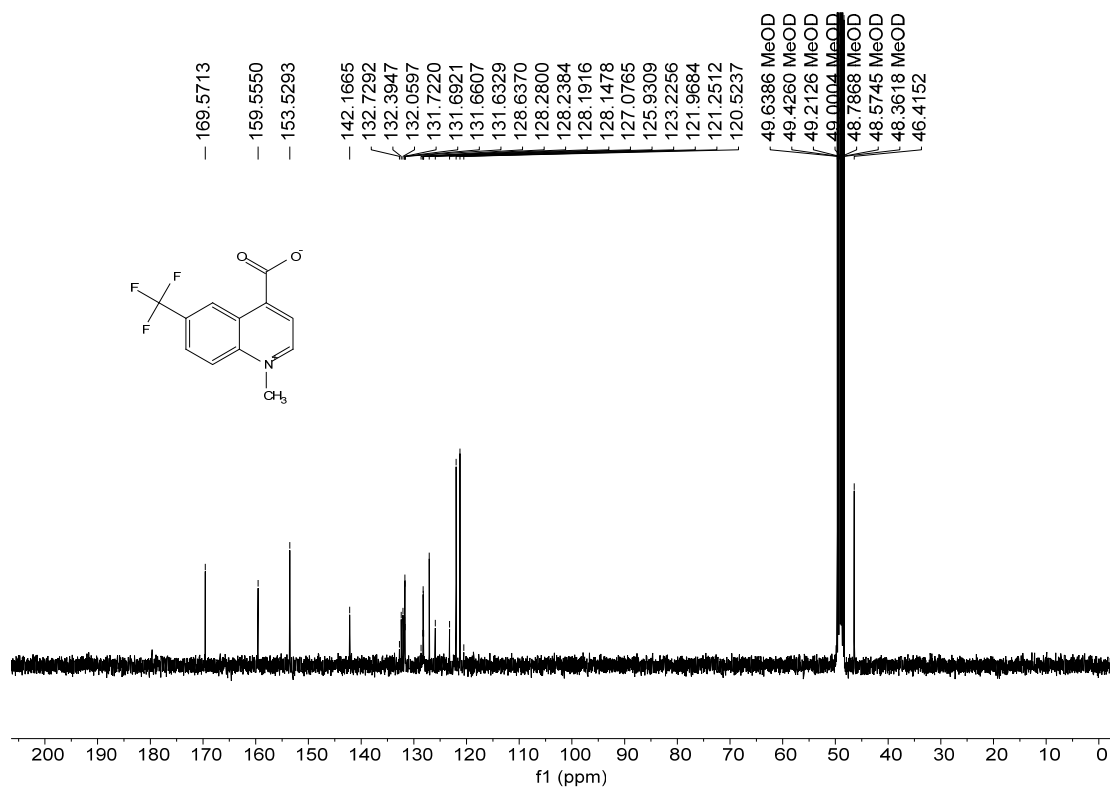
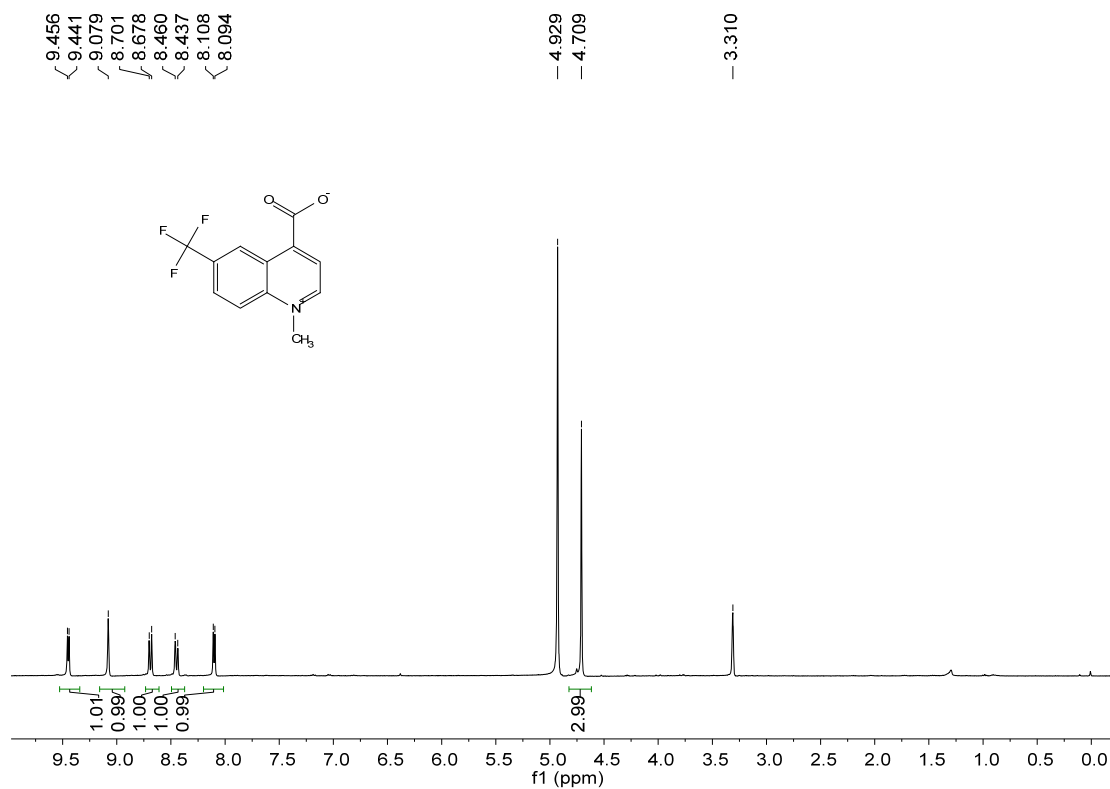
^1H and ^{13}C NMR spectra of **2g**



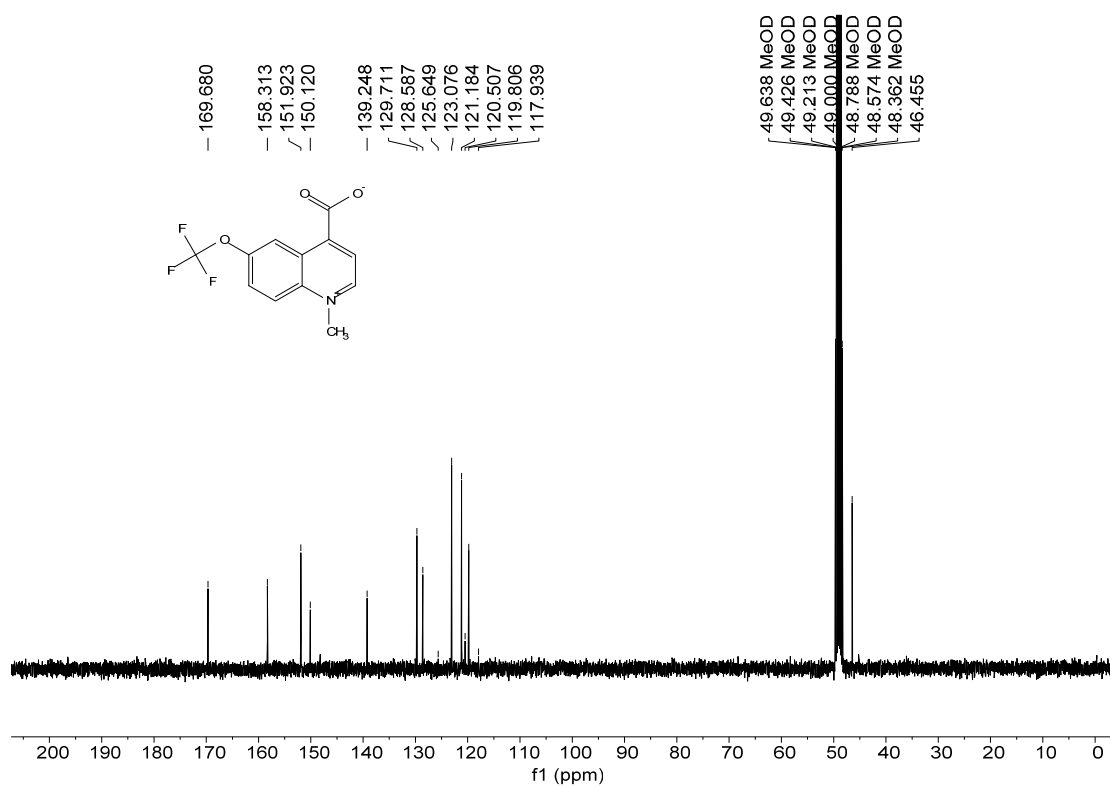
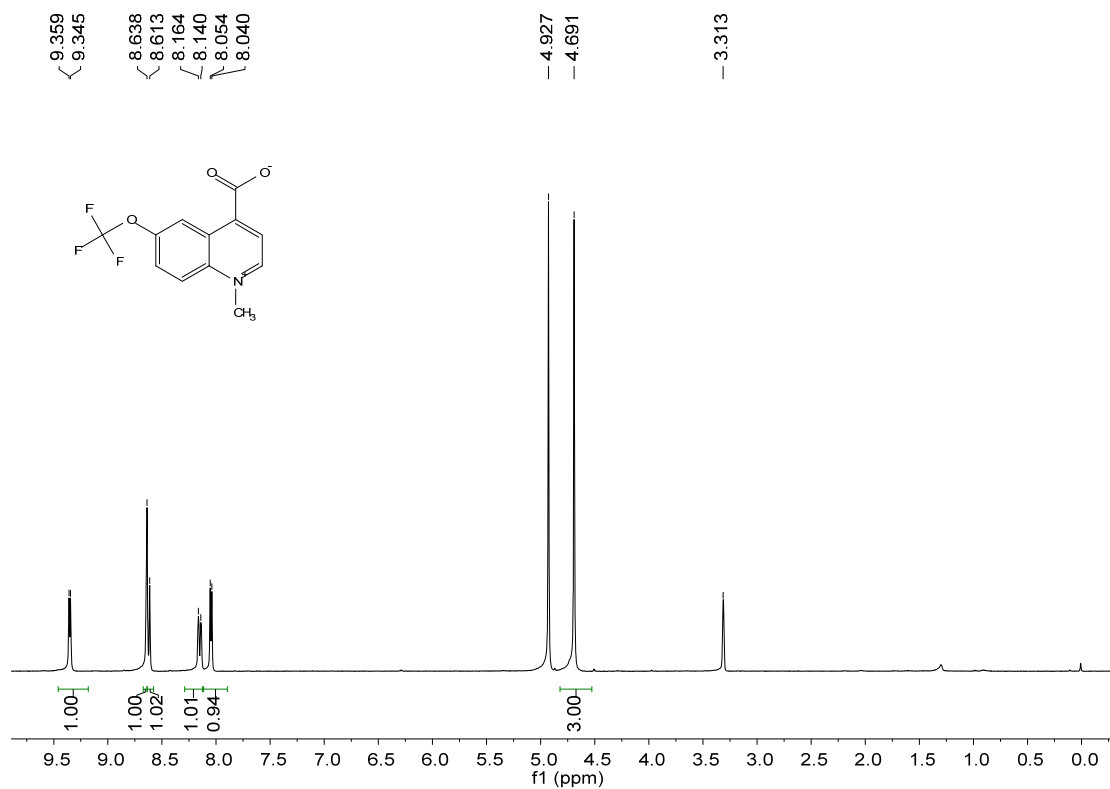
^1H and ^{13}C NMR spectra of **2h**



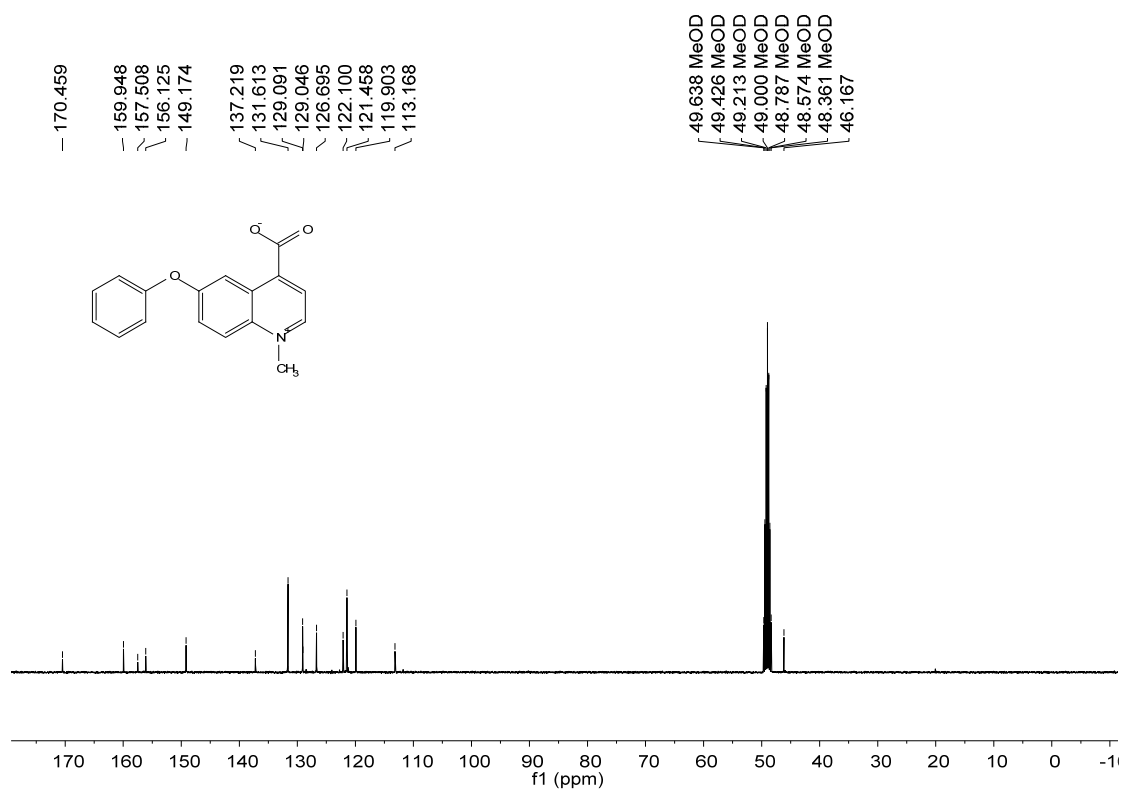
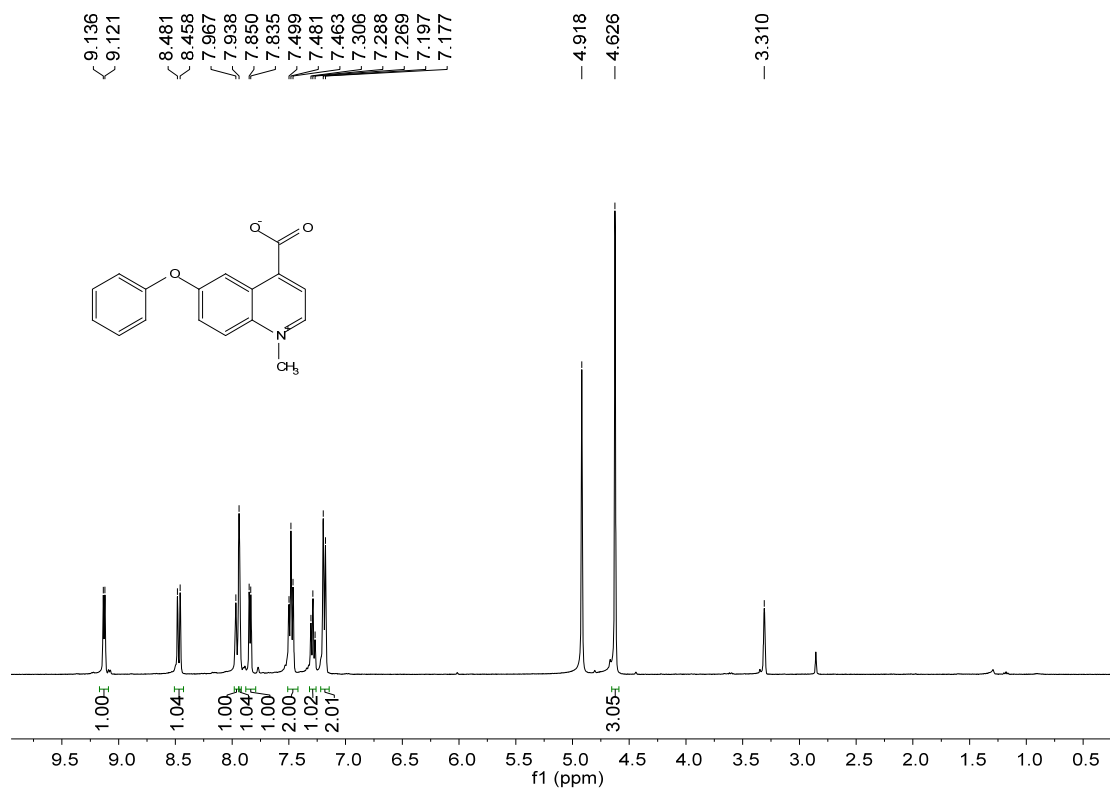
^1H and ^{13}C NMR spectra of **2i**



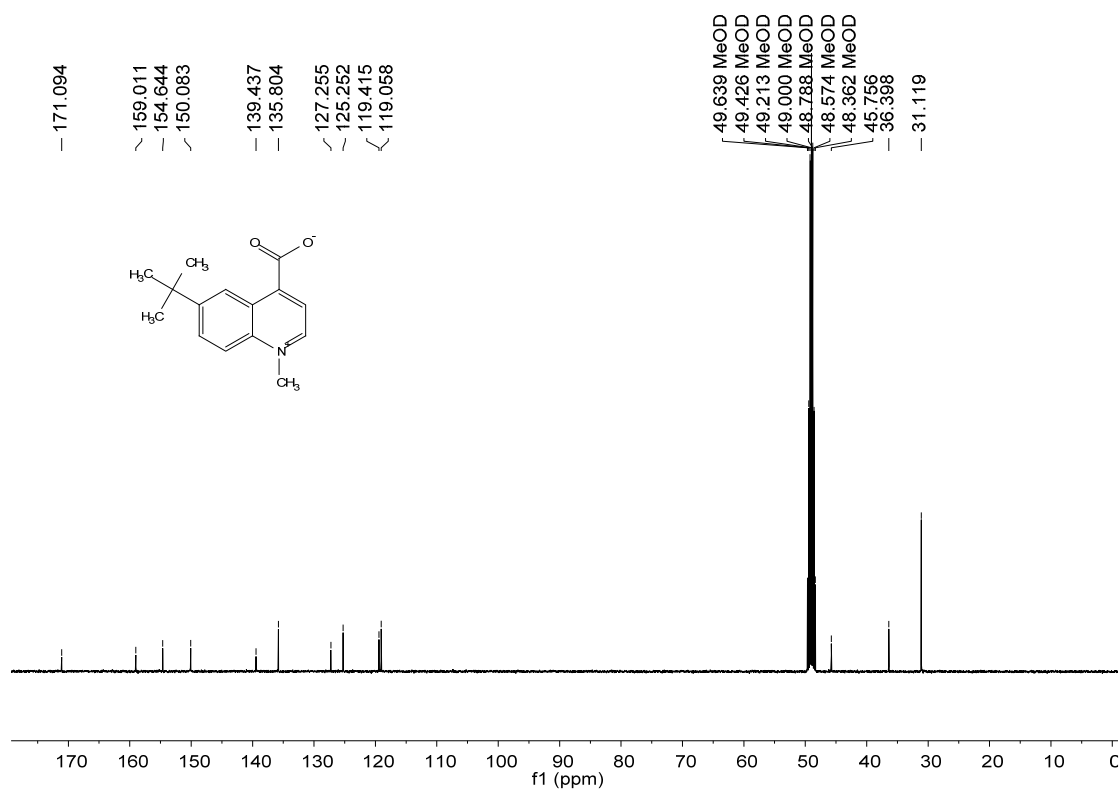
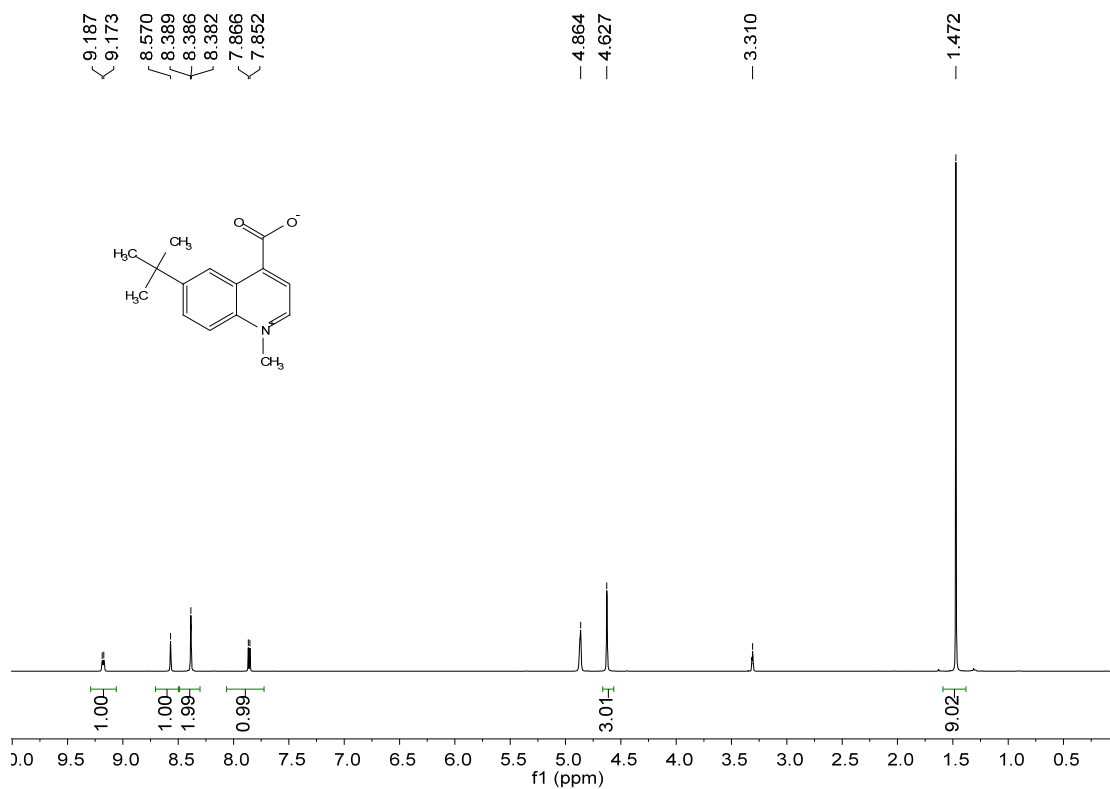
^1H and ^{13}C NMR spectra of **2j**



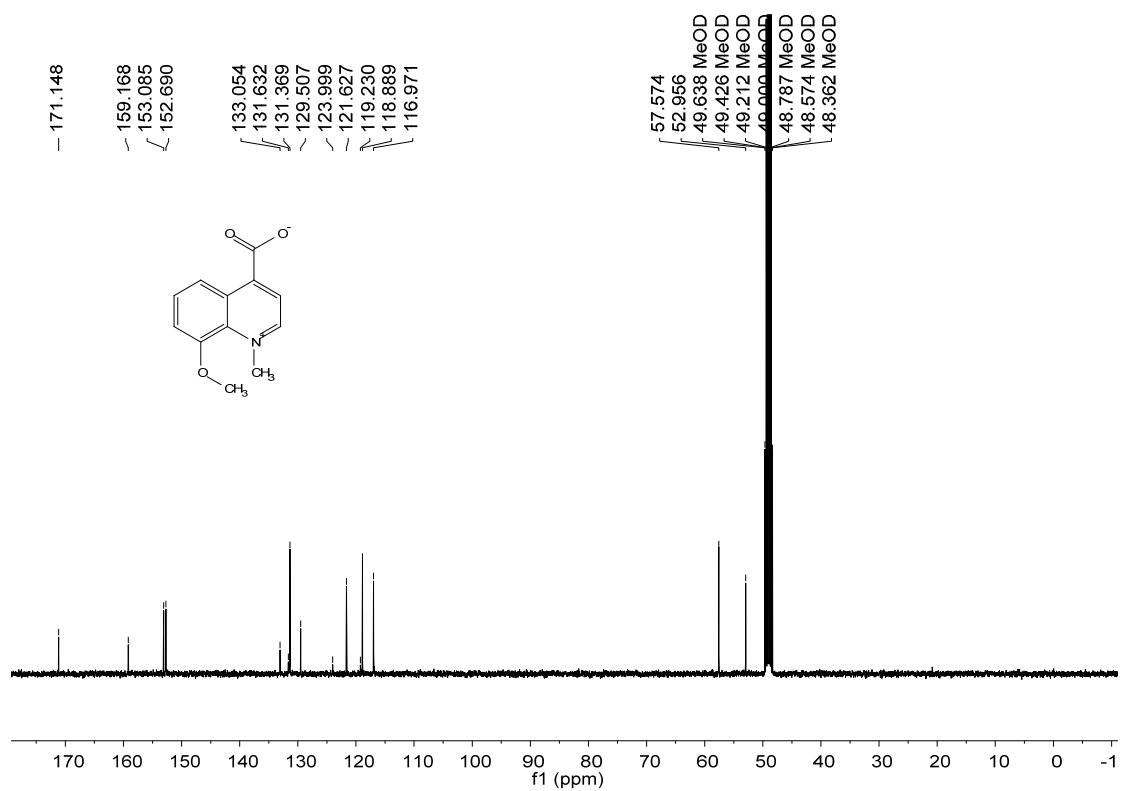
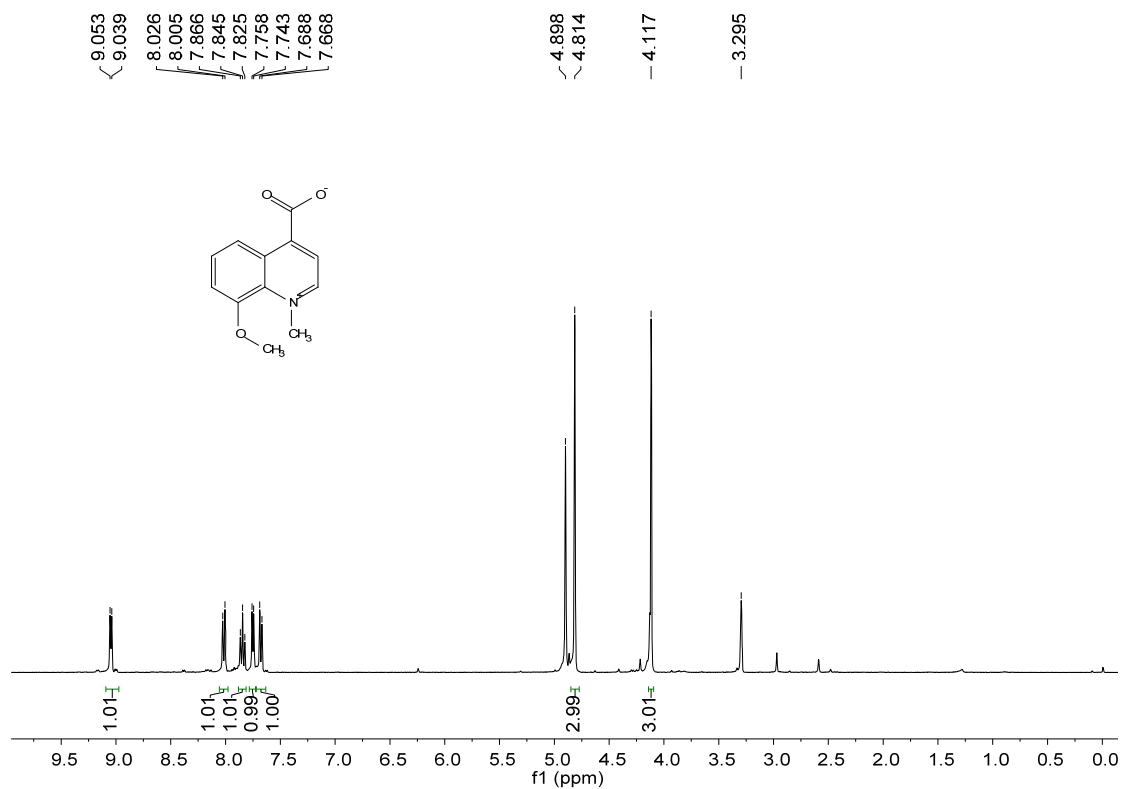
^1H and ^{13}C NMR spectra of **2k**



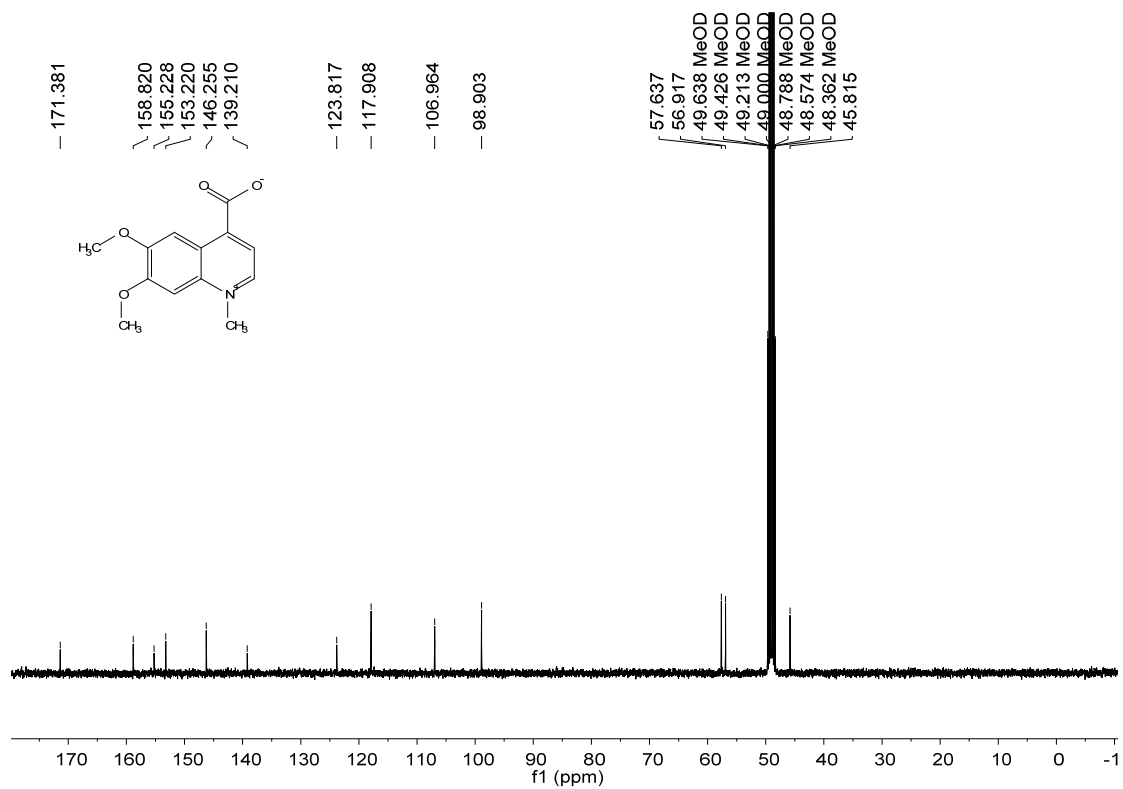
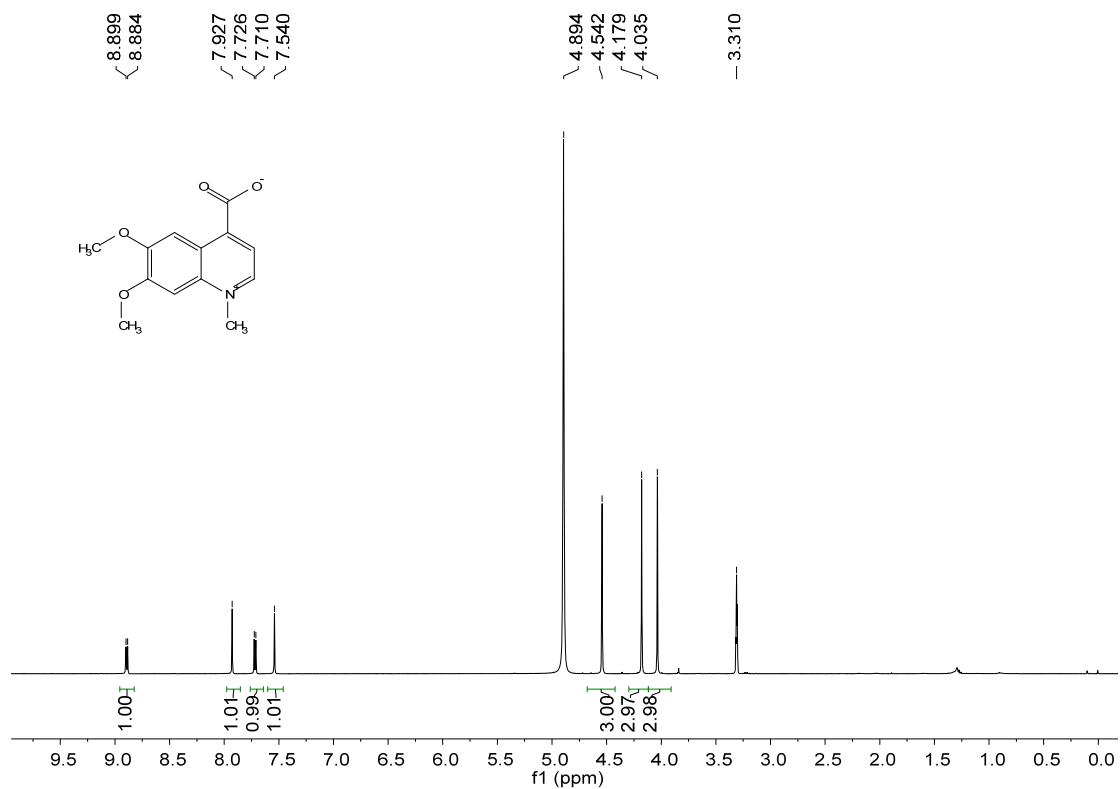
^1H and ^{13}C NMR spectra of **21**



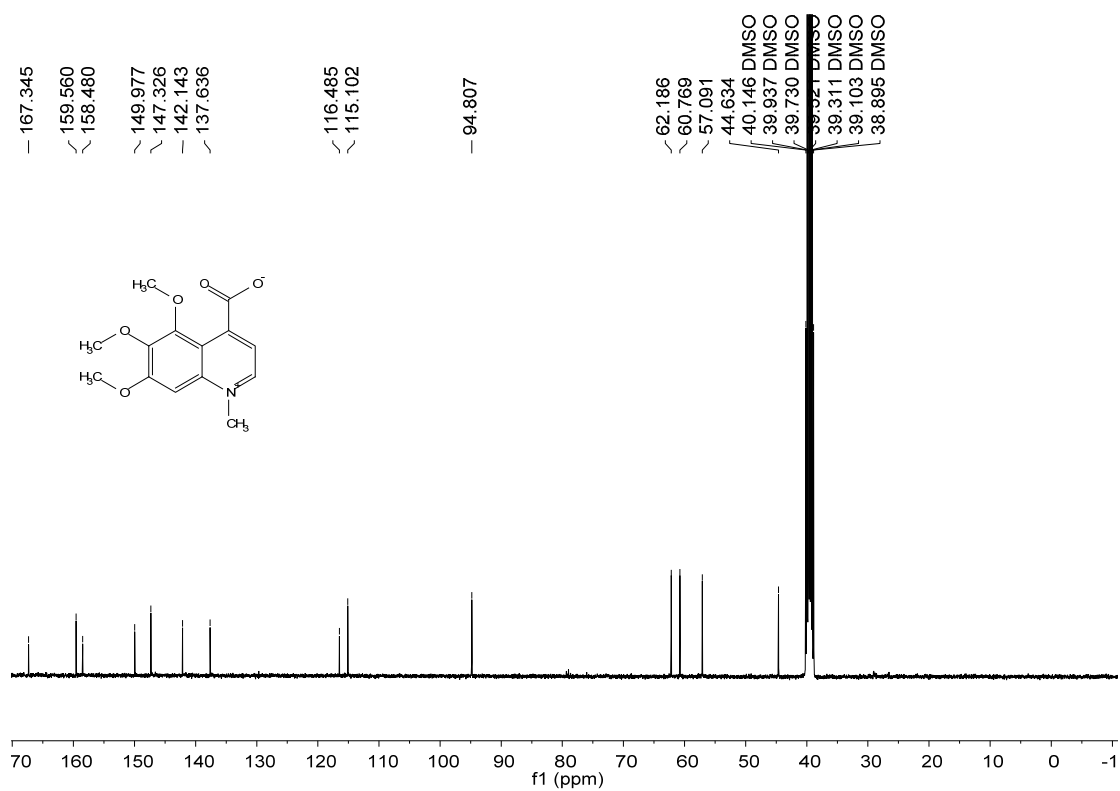
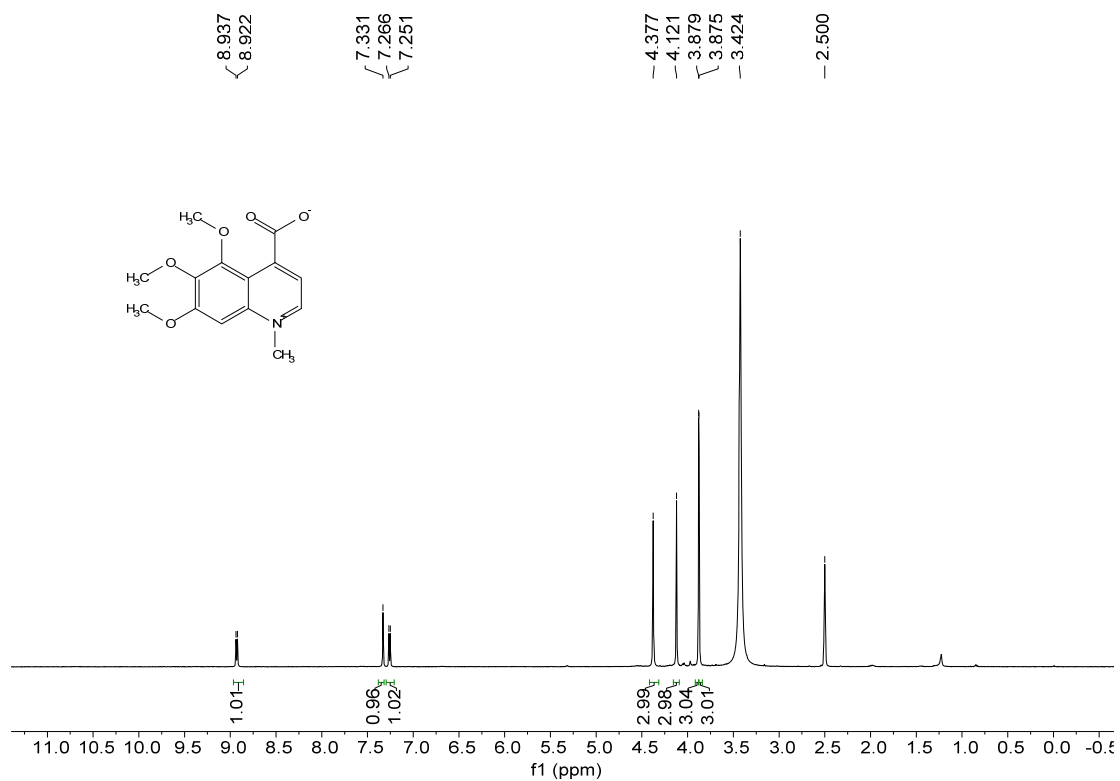
^1H and ^{13}C NMR spectra of **2m**



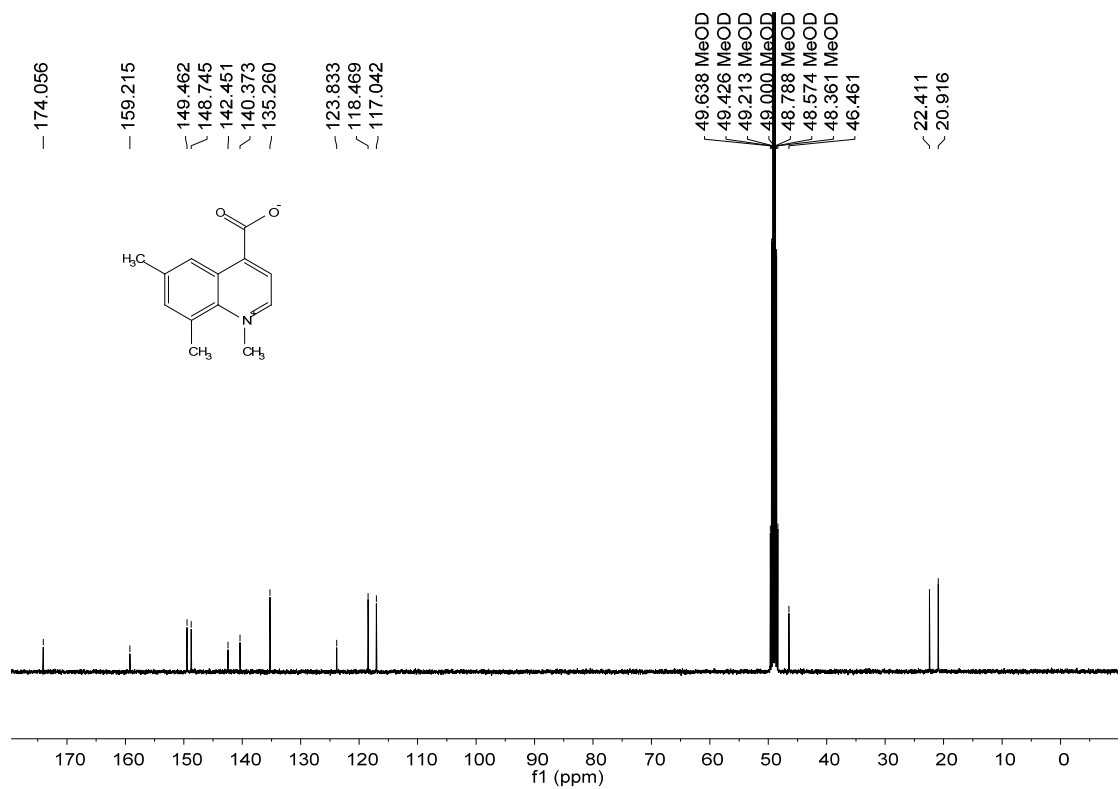
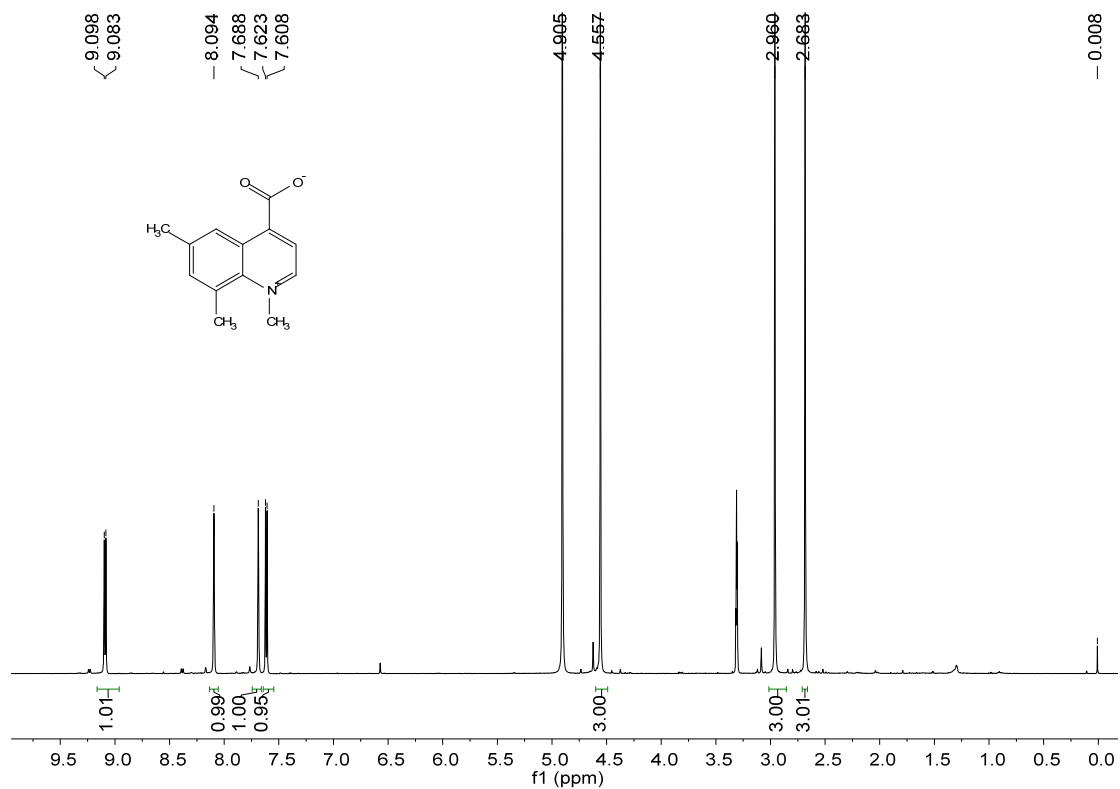
^1H and ^{13}C NMR spectra of **2n**



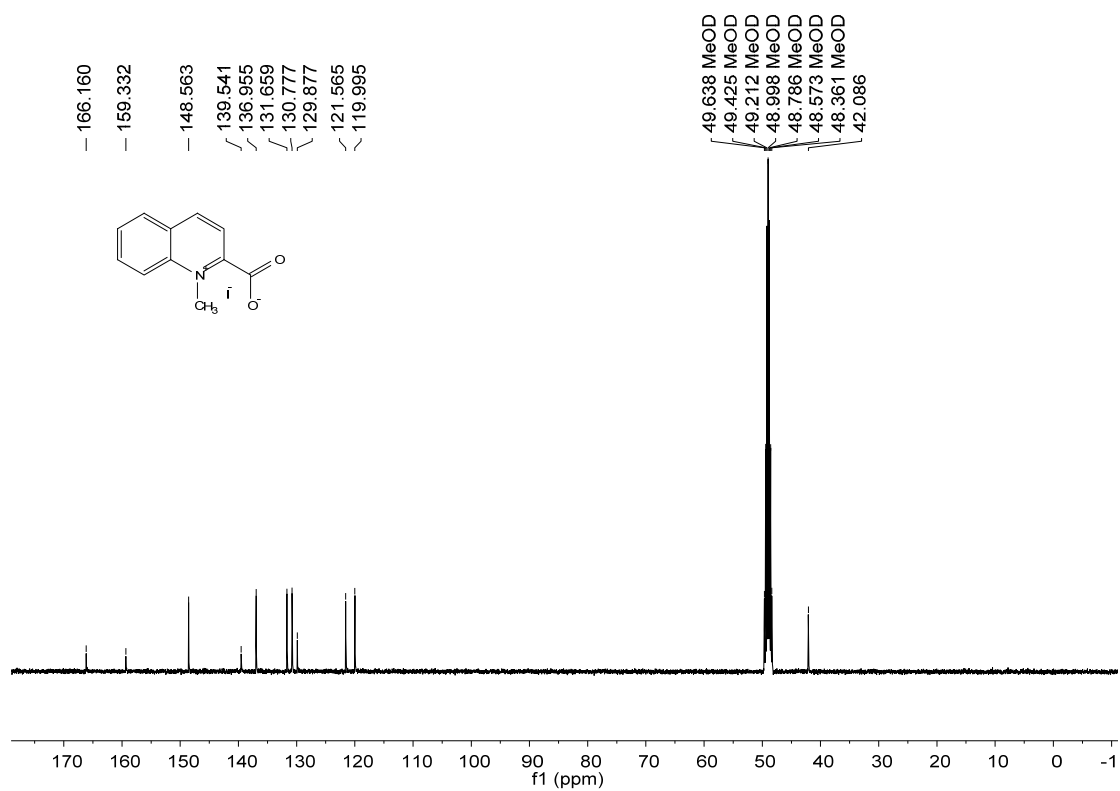
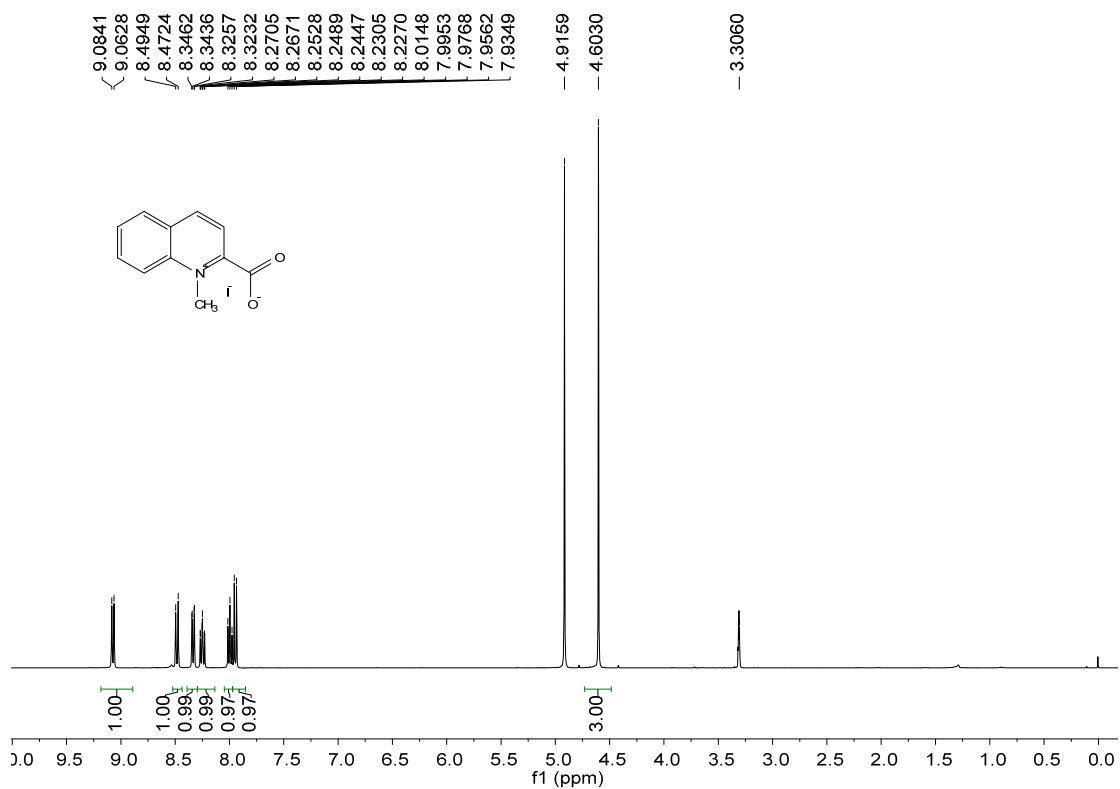
^1H and ^{13}C NMR spectra of **2o**



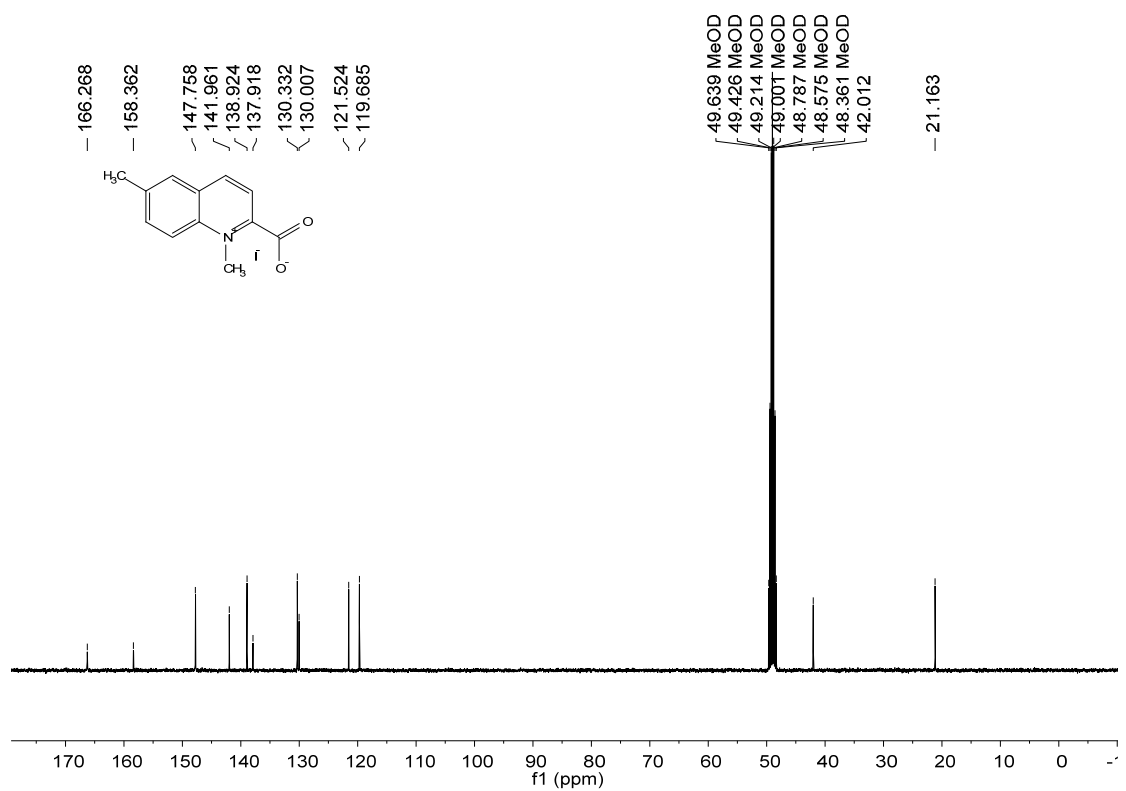
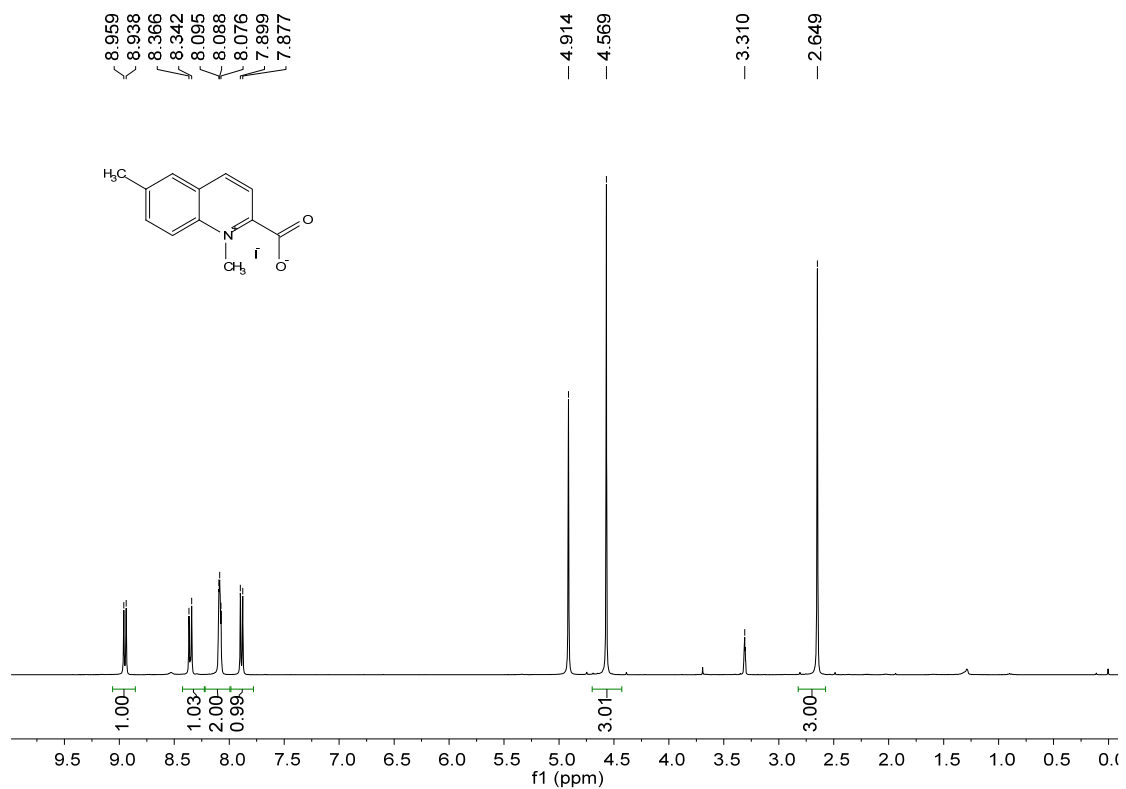
^1H and ^{13}C NMR spectra of **2p**



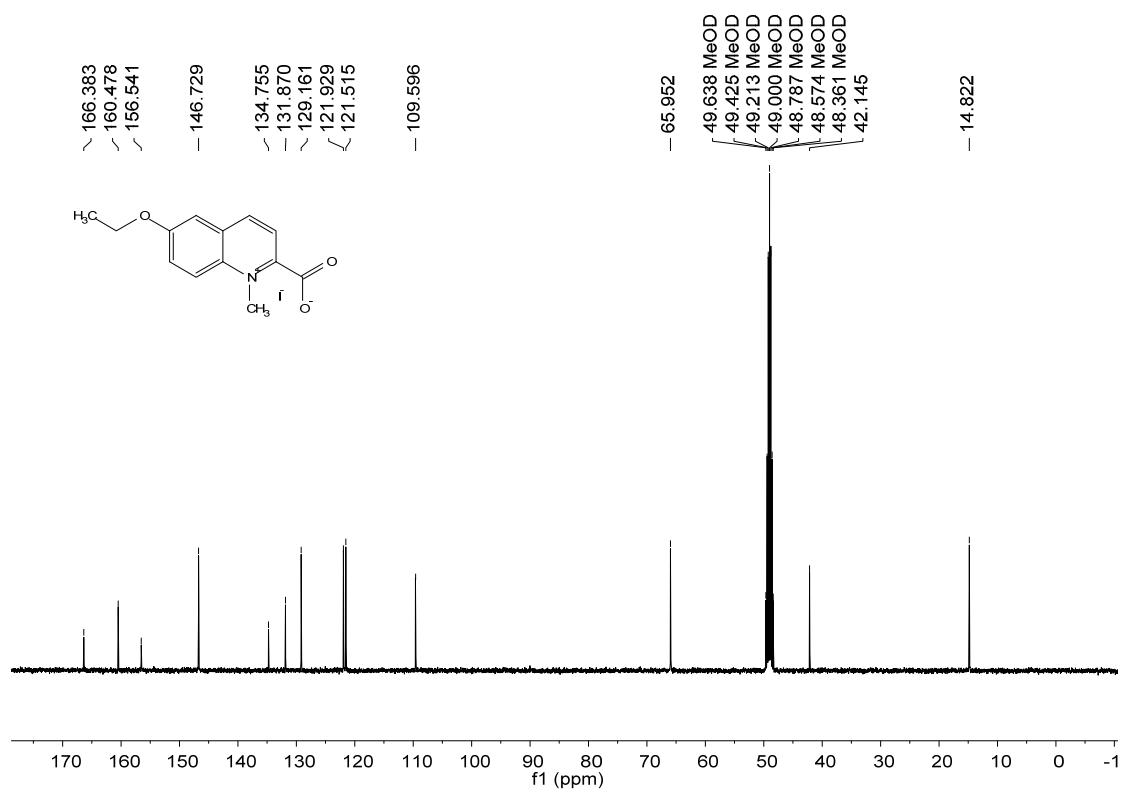
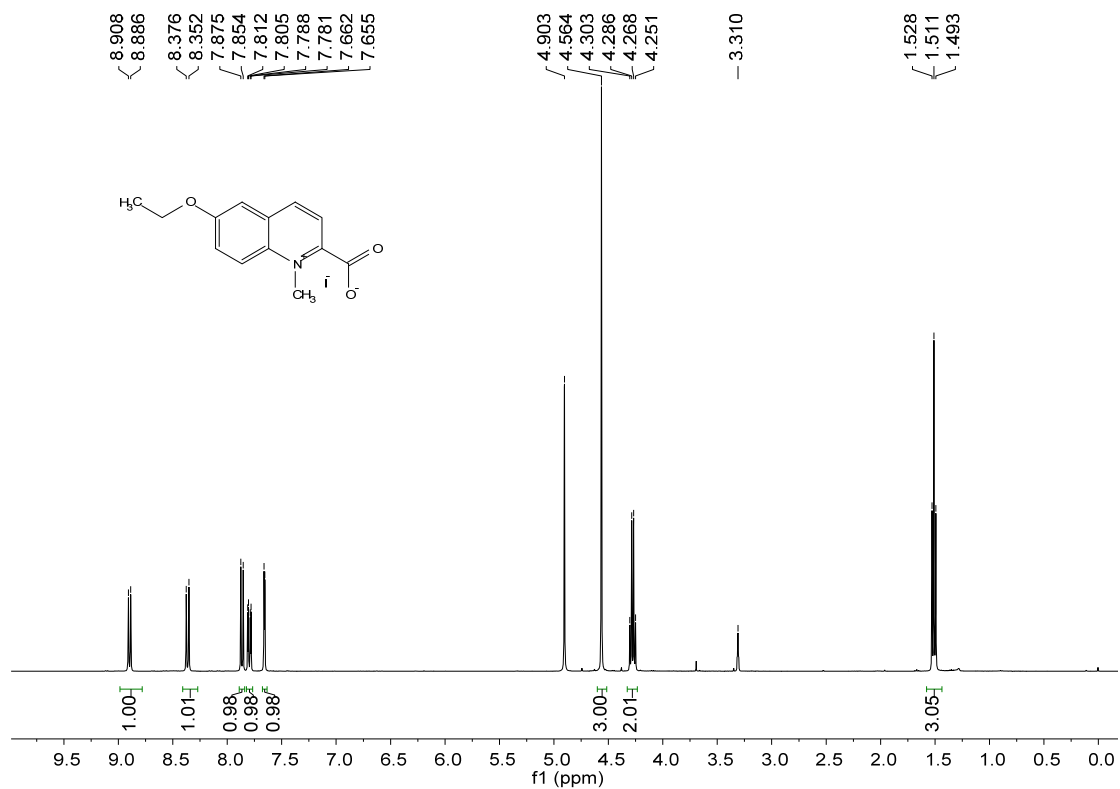
^1H and ^{13}C NMR spectra of **2q**



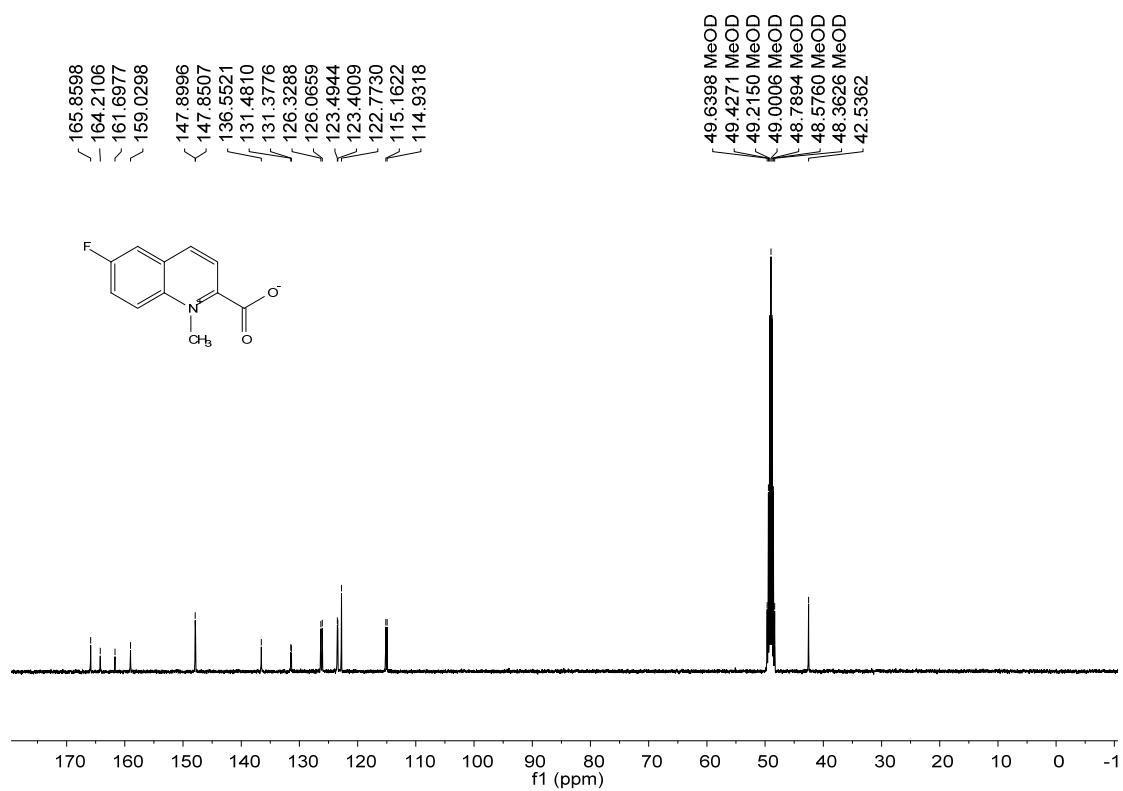
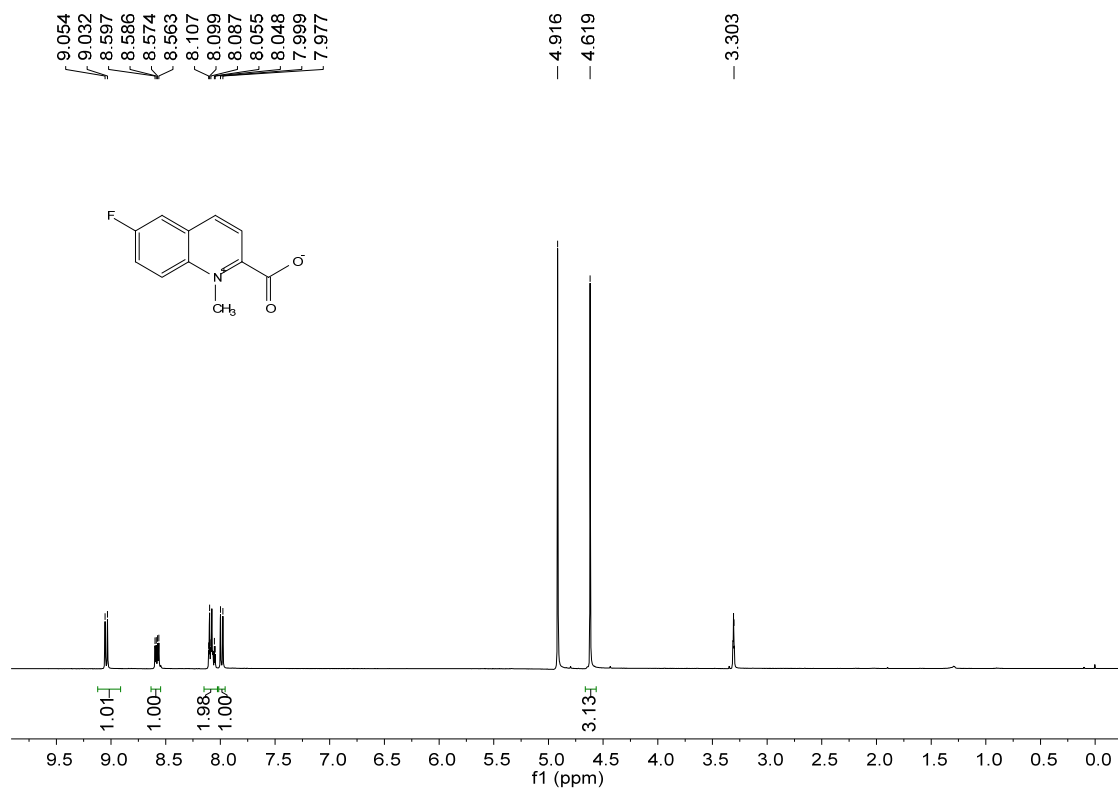
^1H and ^{13}C NMR spectra of **2r**



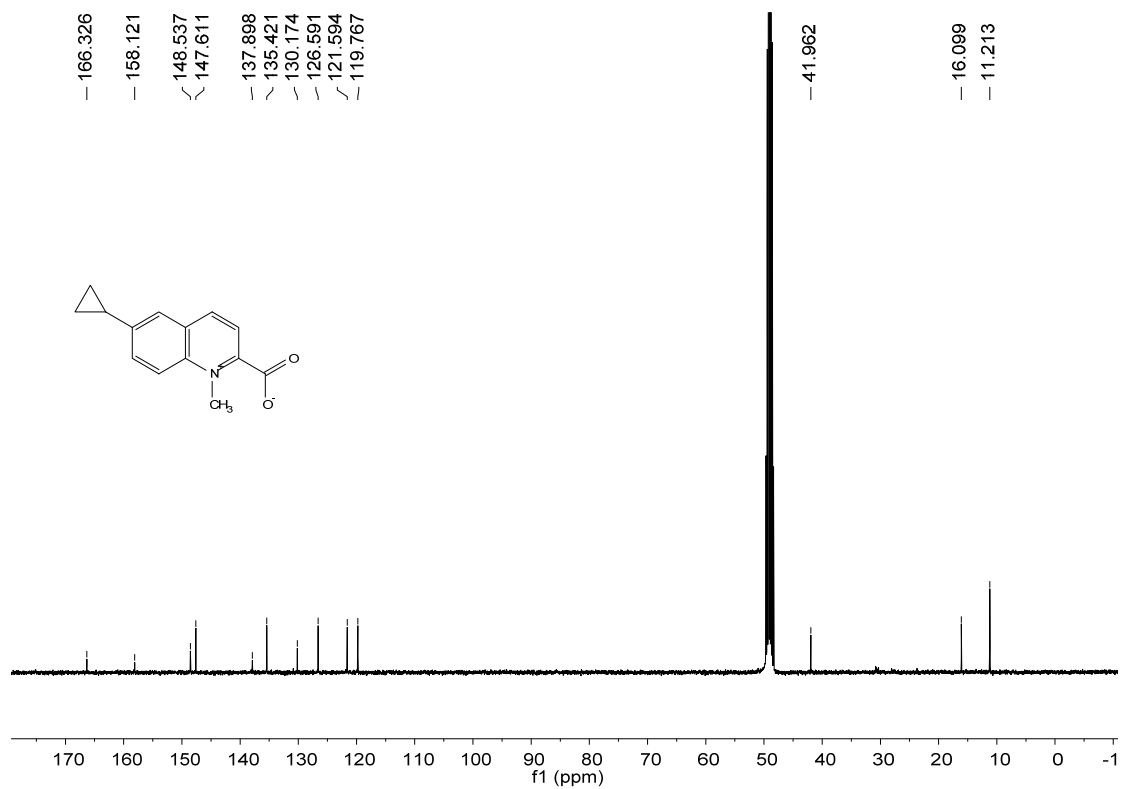
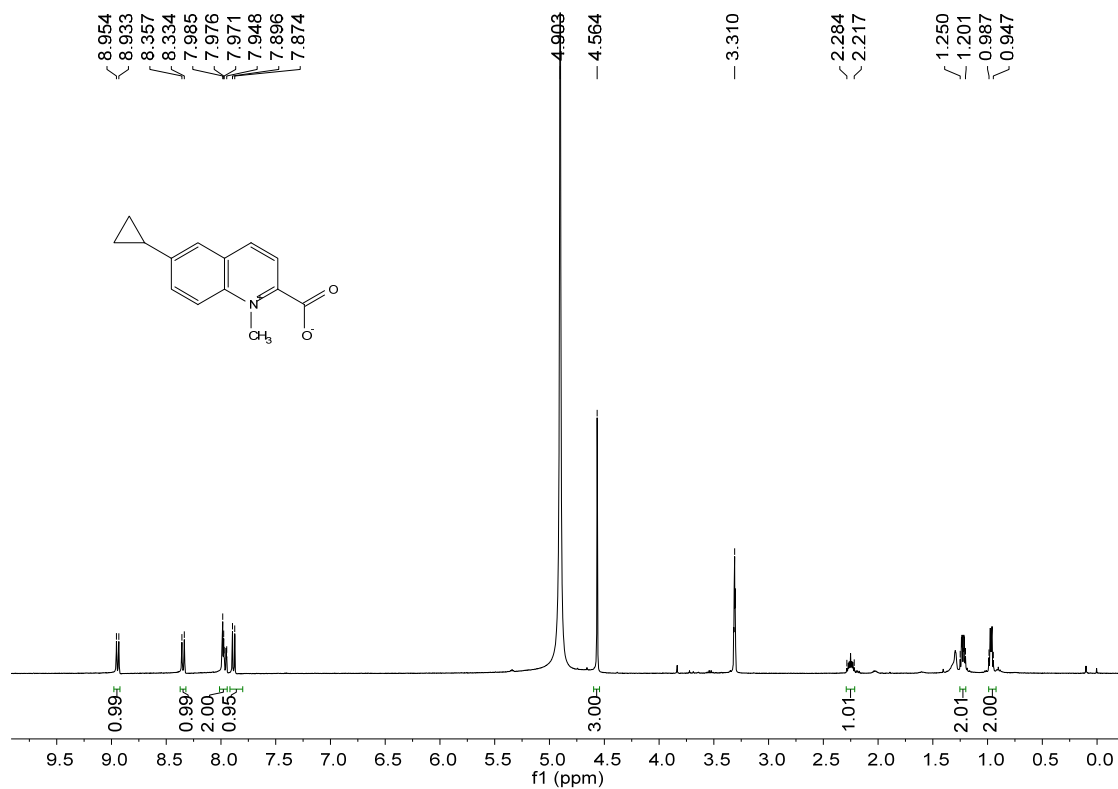
^1H and ^{13}C NMR spectra of **2s**



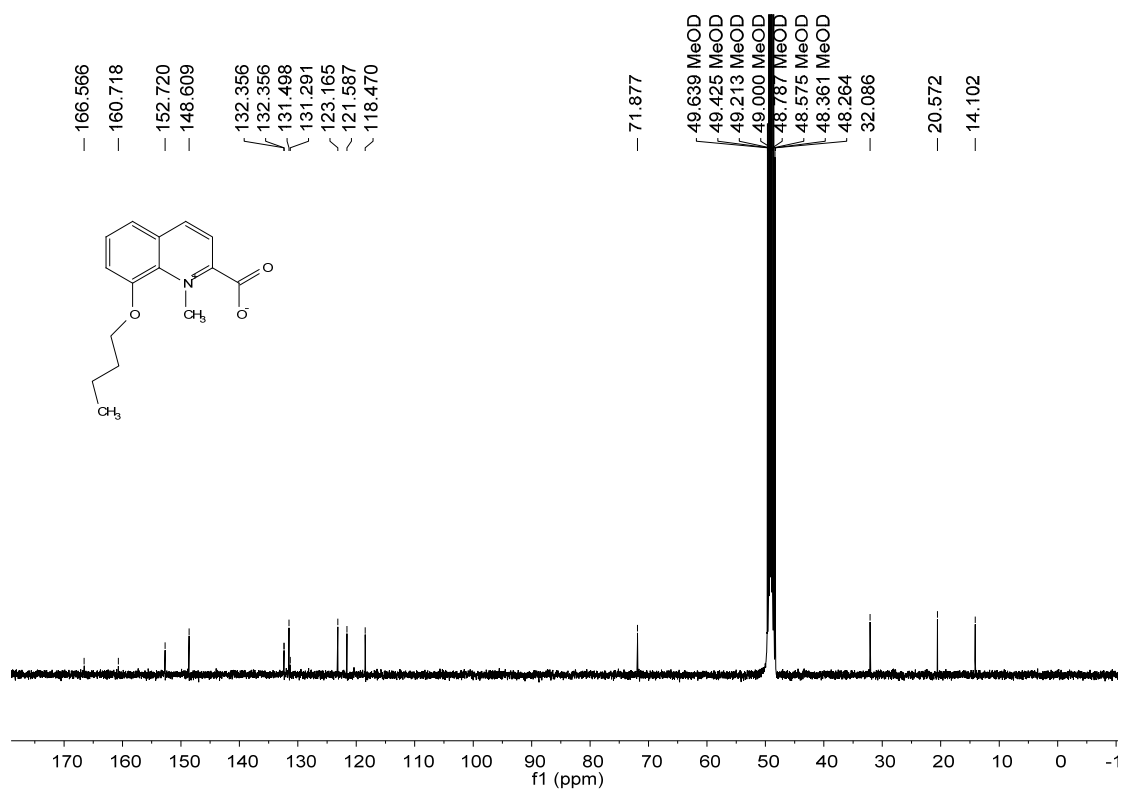
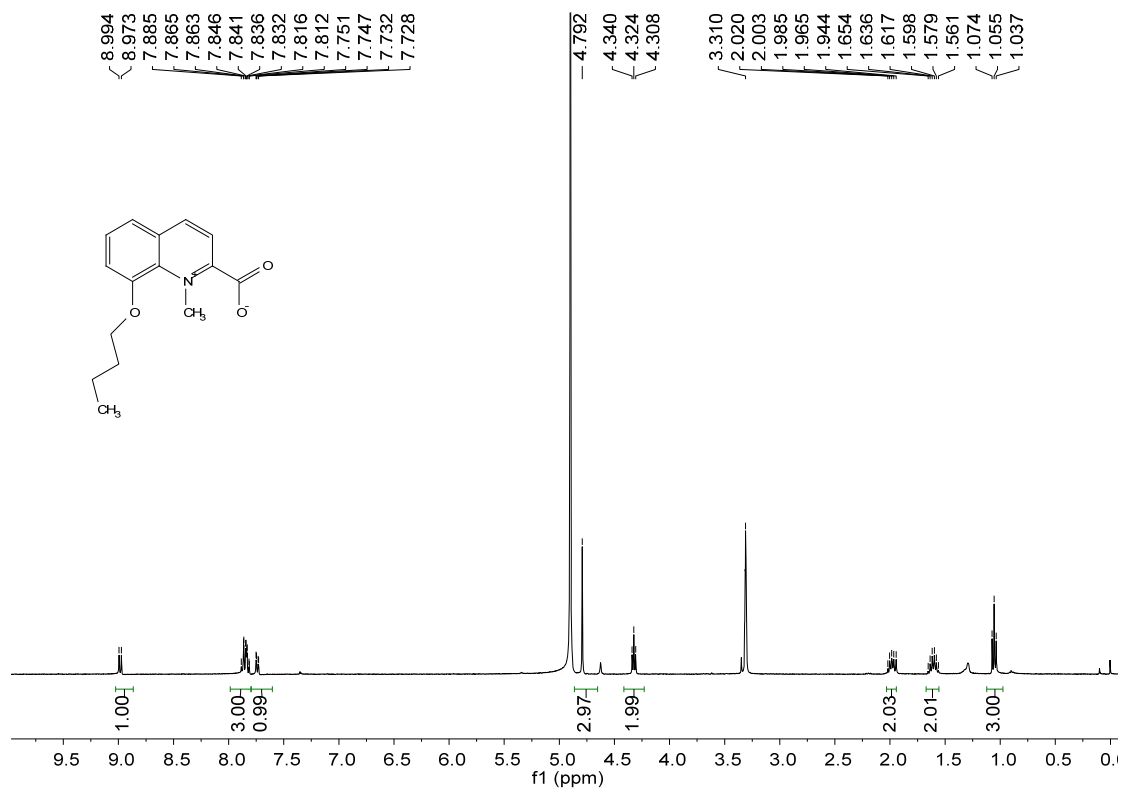
^1H and ^{13}C NMR spectra of **2t**



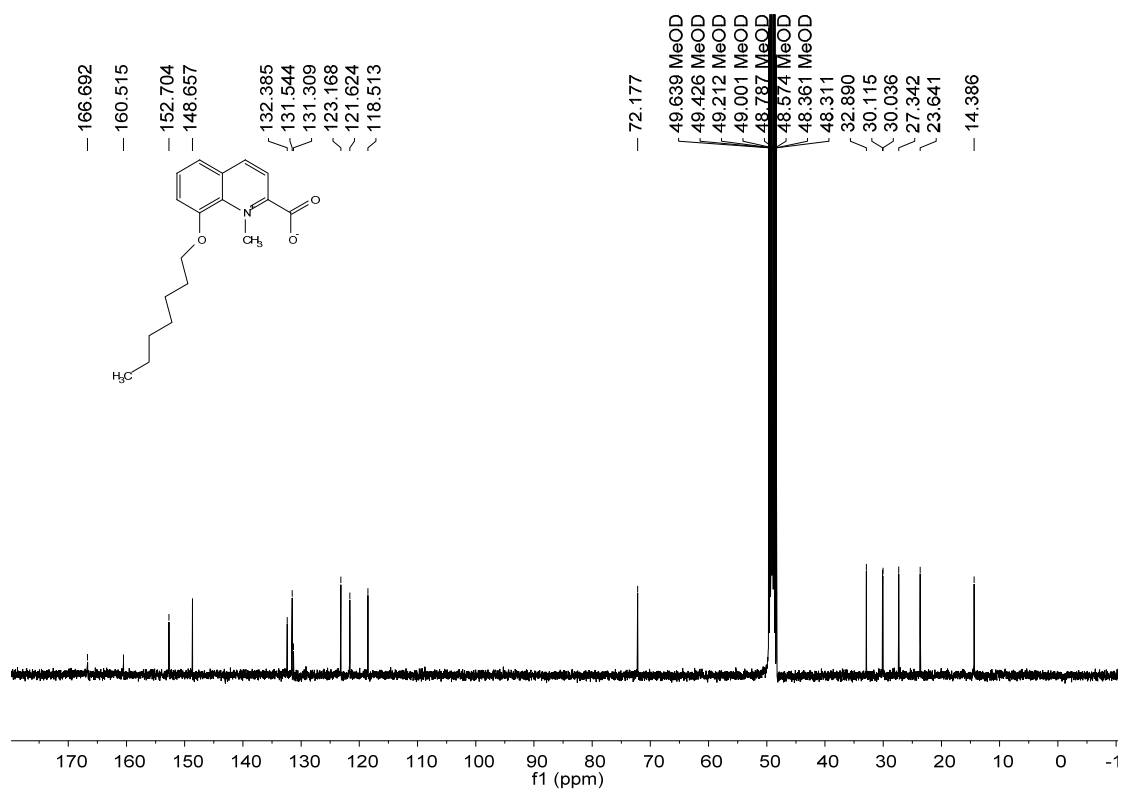
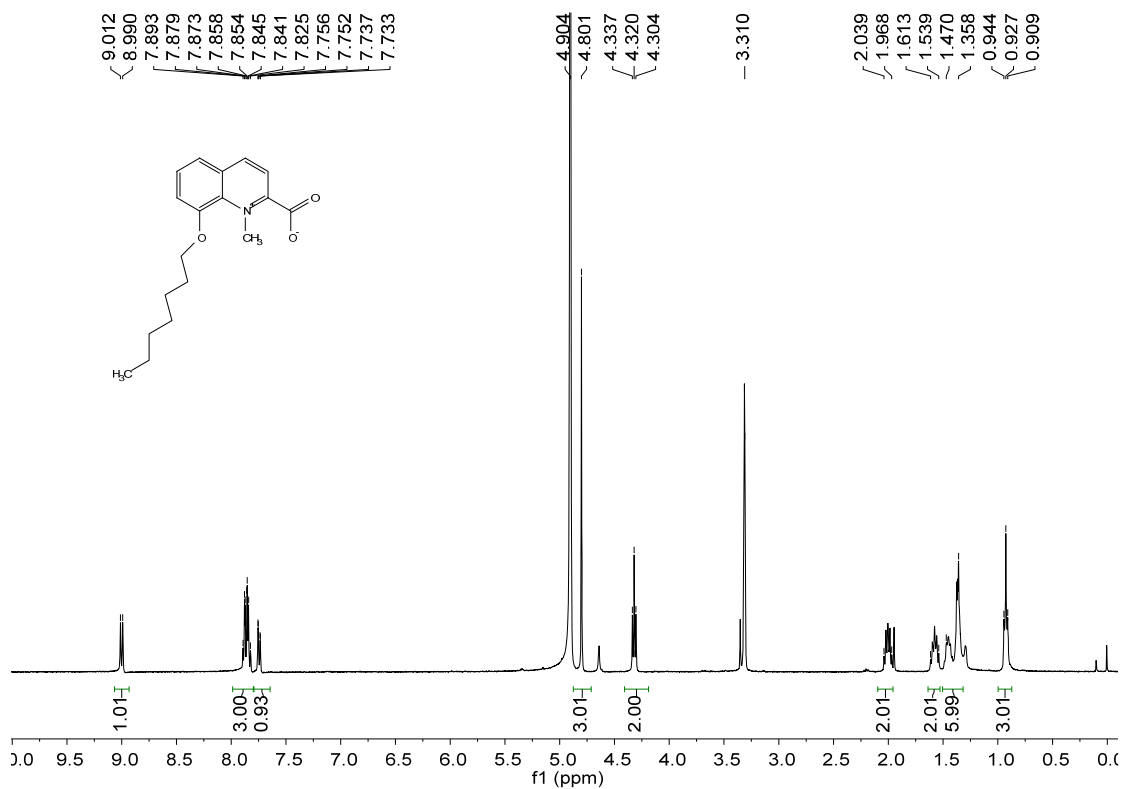
^1H and ^{13}C NMR spectra of **2u**



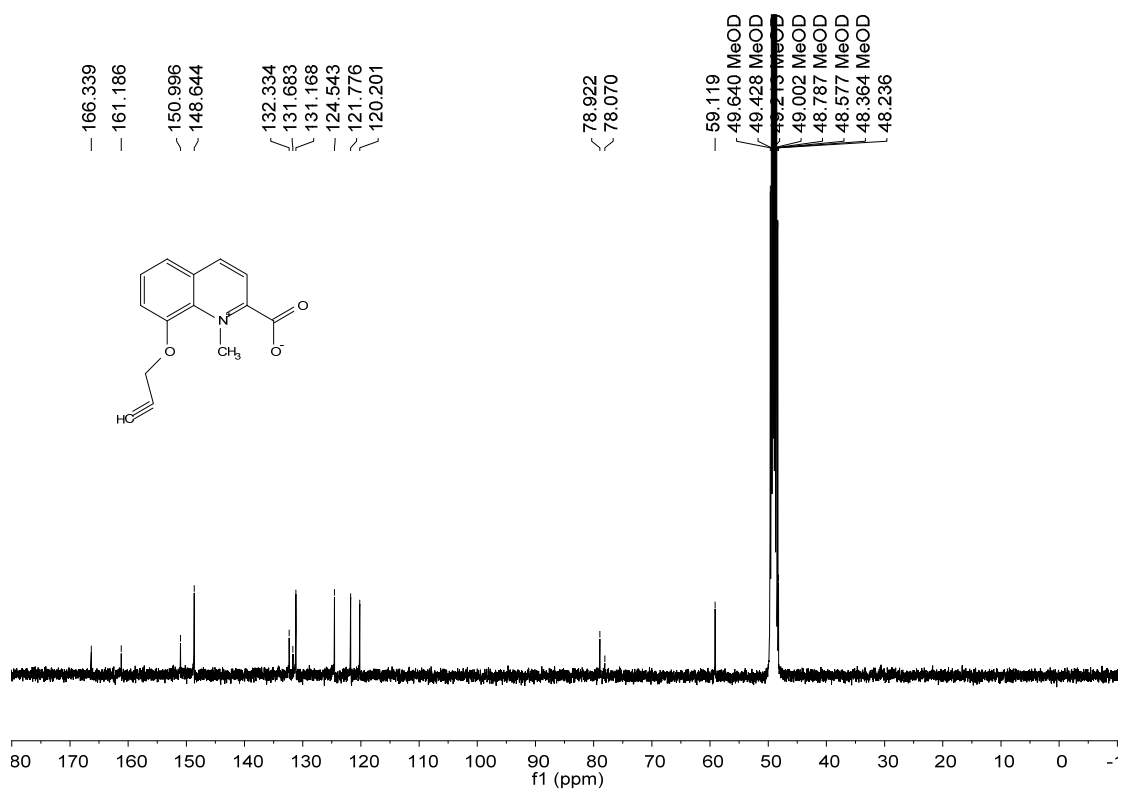
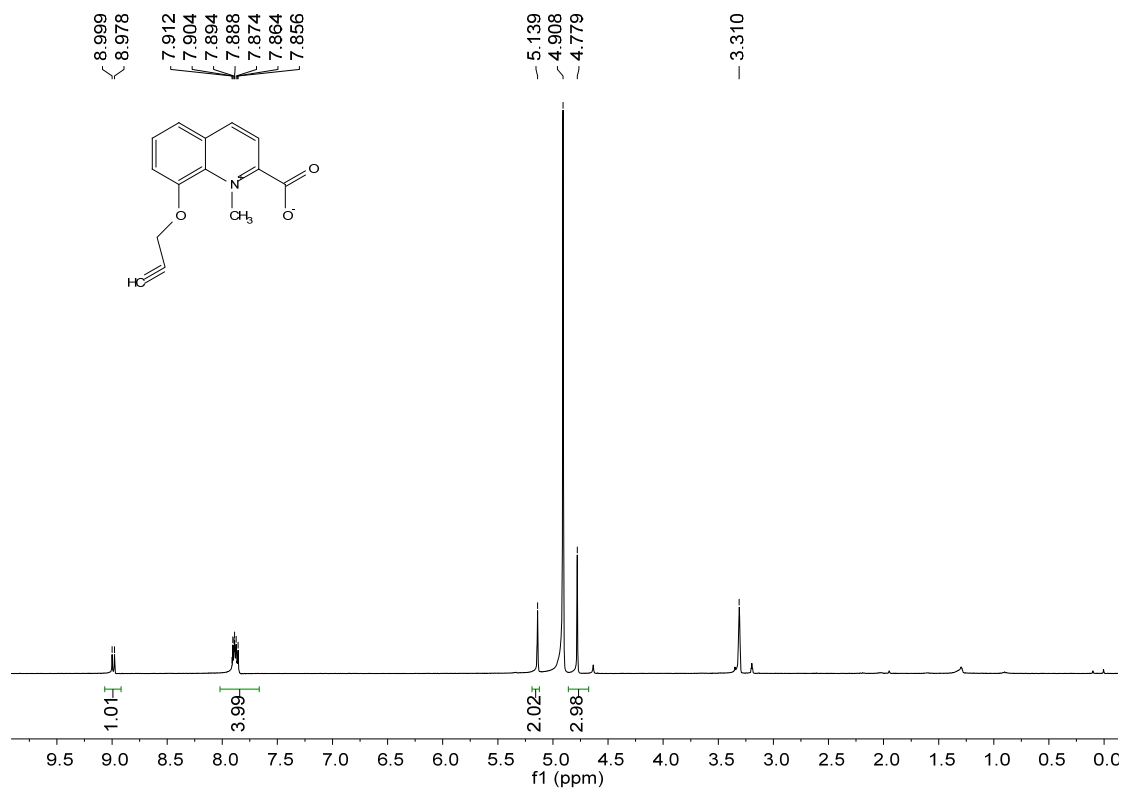
^1H and ^{13}C NMR spectra of **2v**



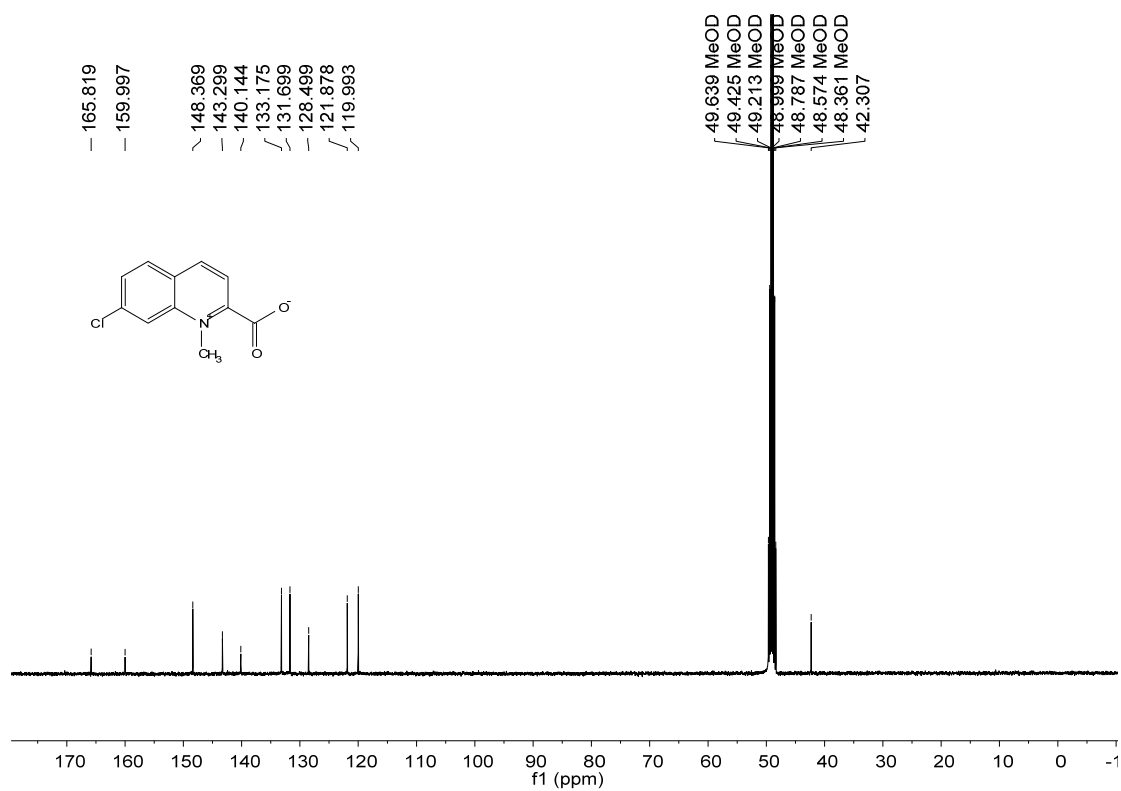
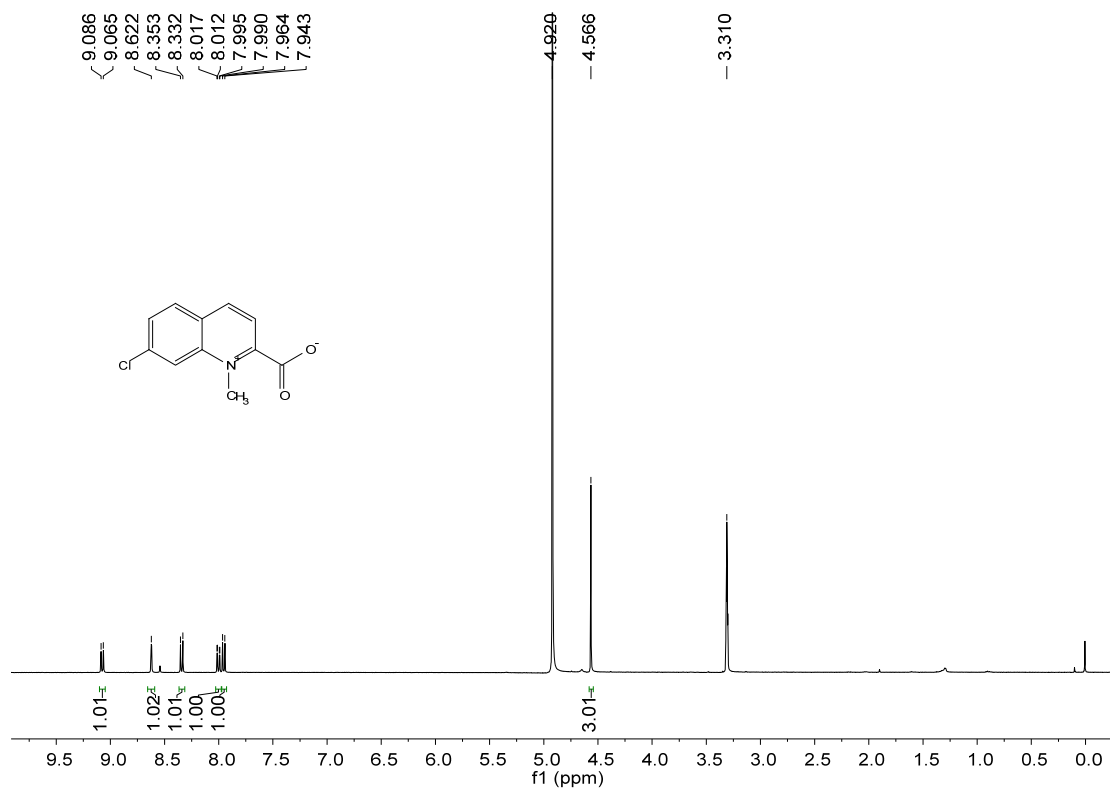
^1H and ^{13}C NMR spectra of **2w**



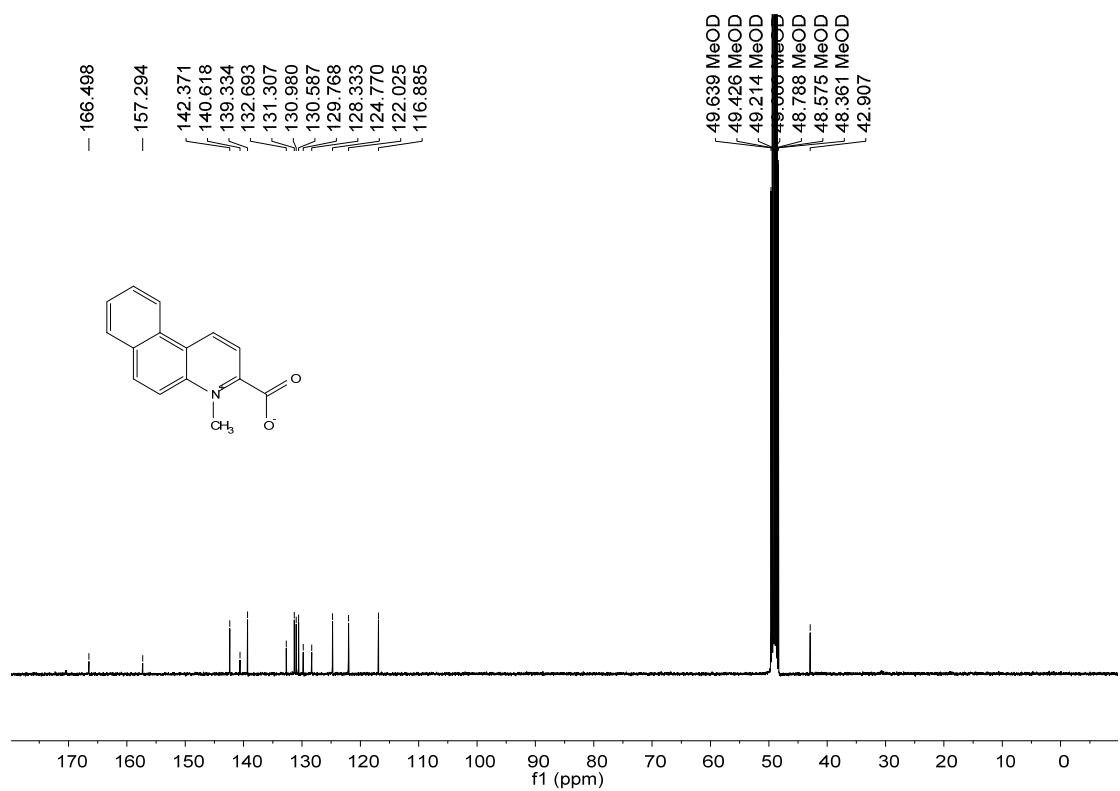
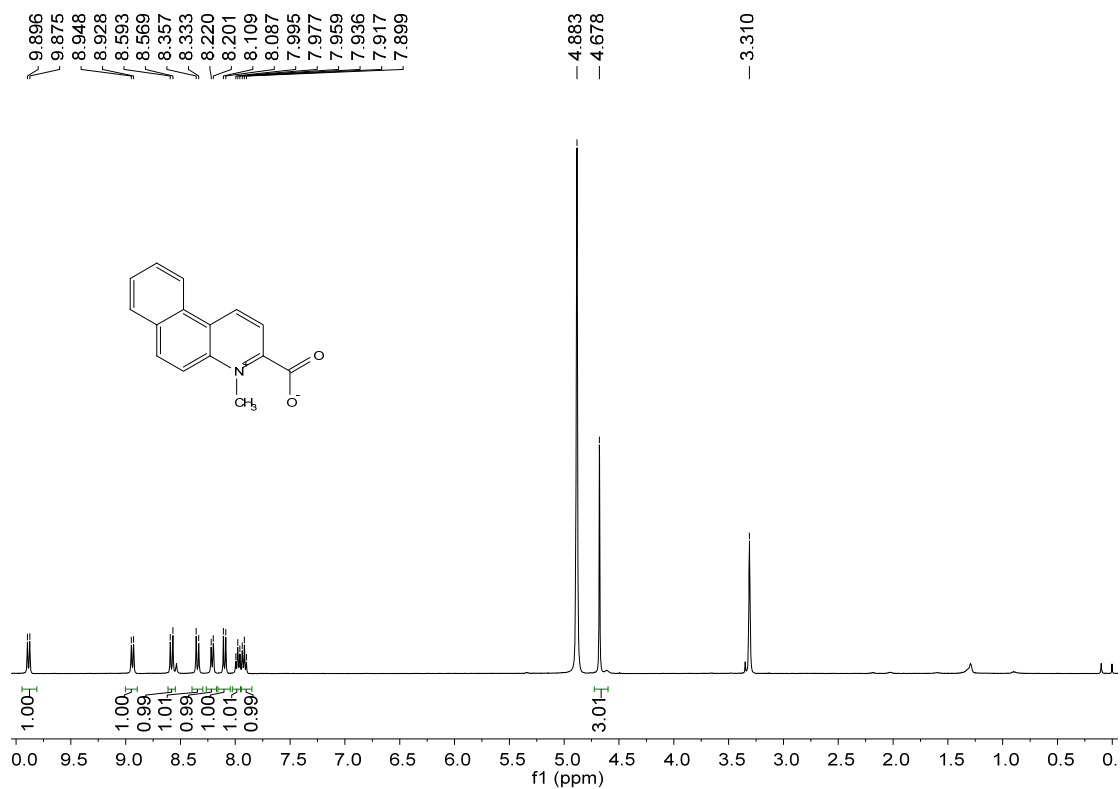
^1H and ^{13}C NMR spectra of **2x**



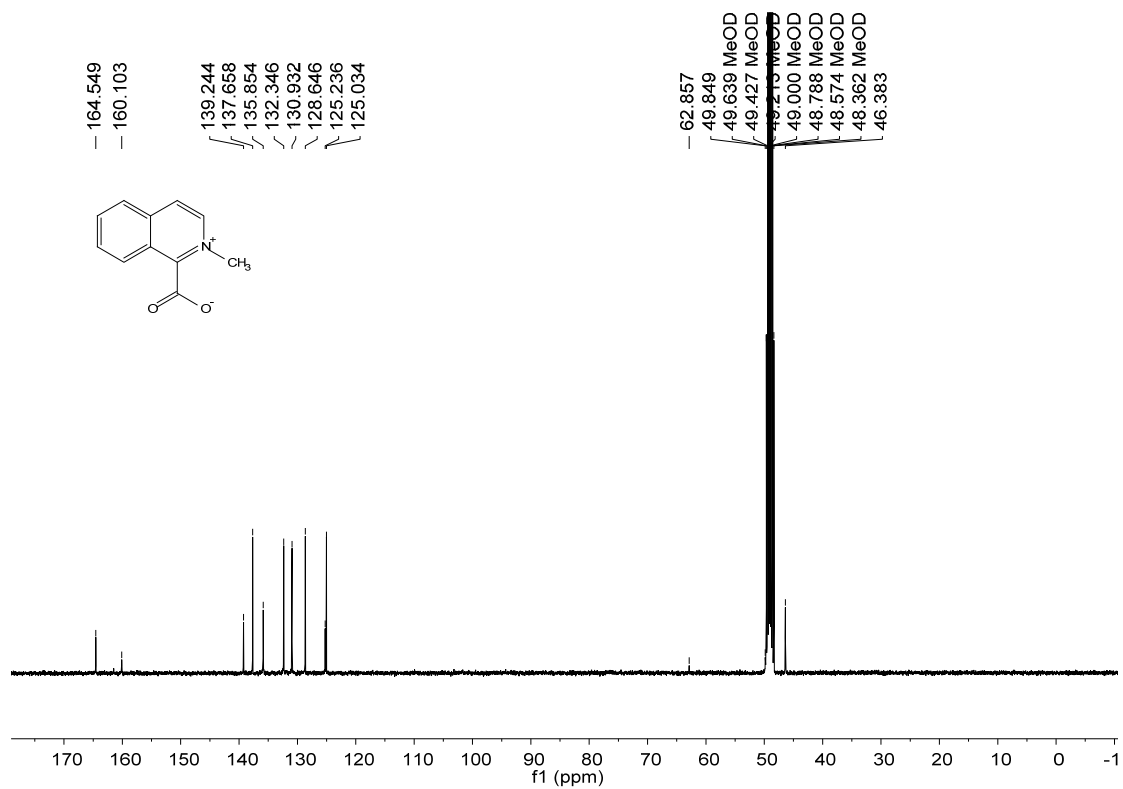
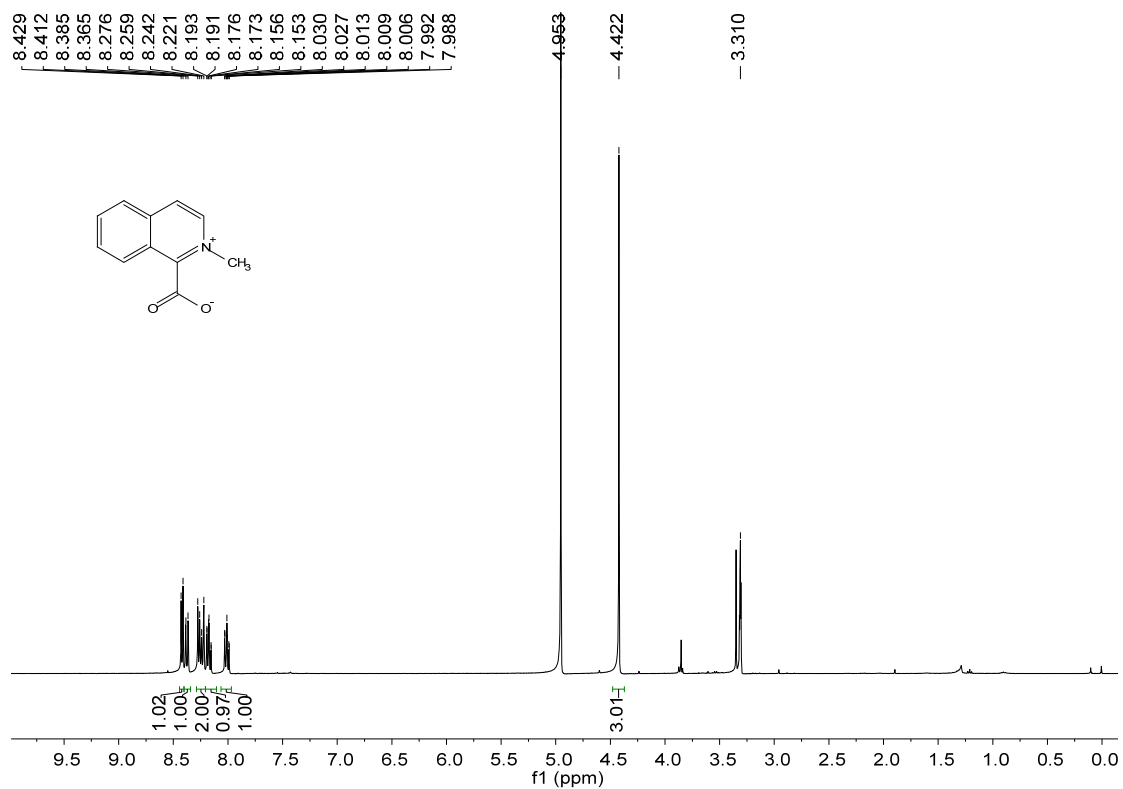
^1H and ^{13}C NMR spectra of **2y**



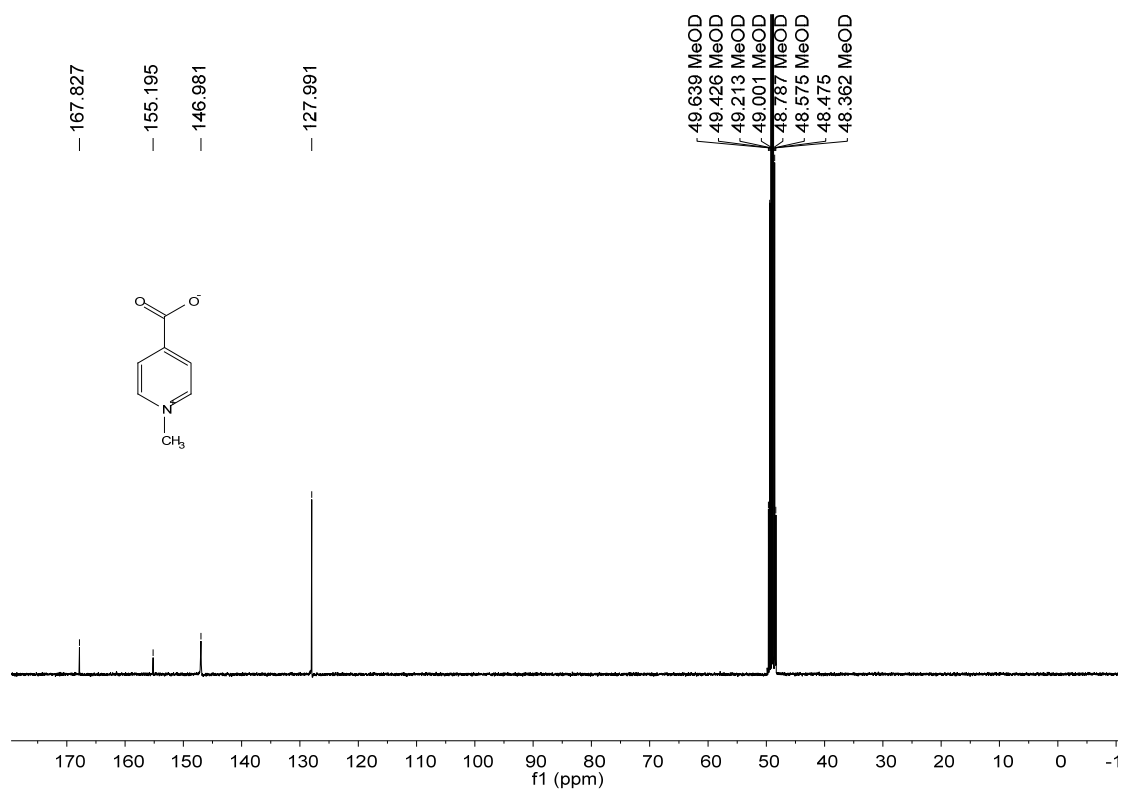
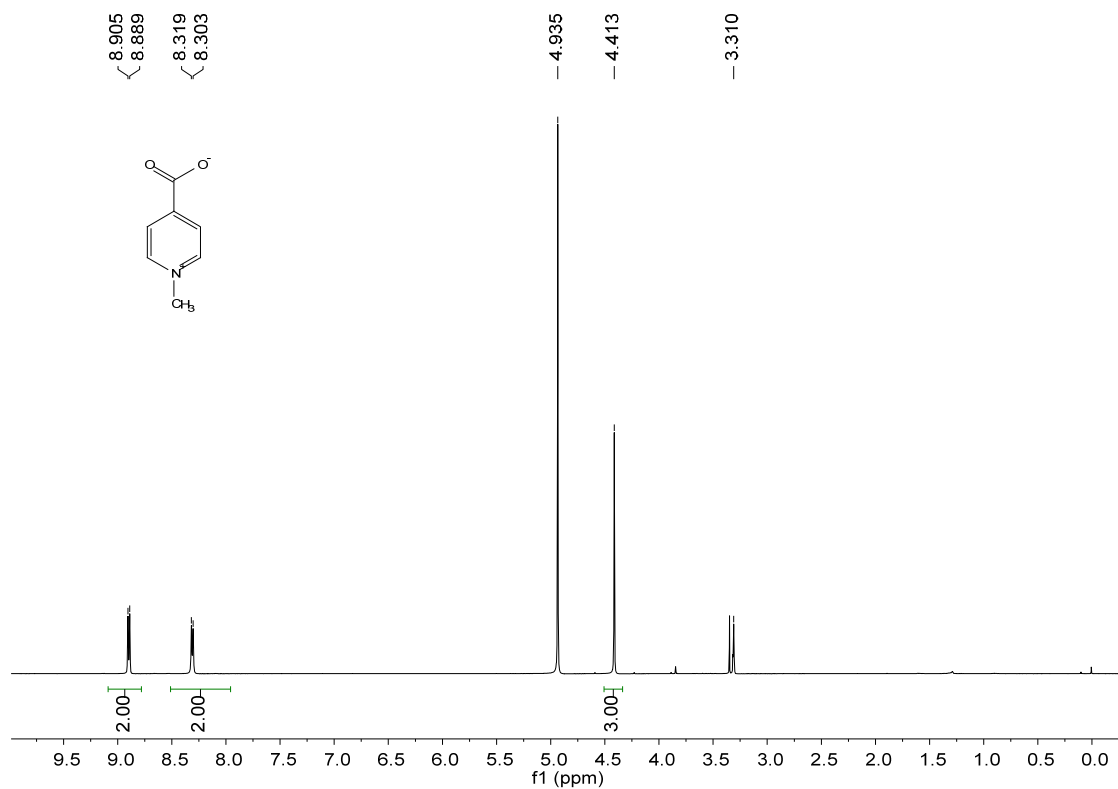
^1H and ^{13}C NMR spectra of **2z**



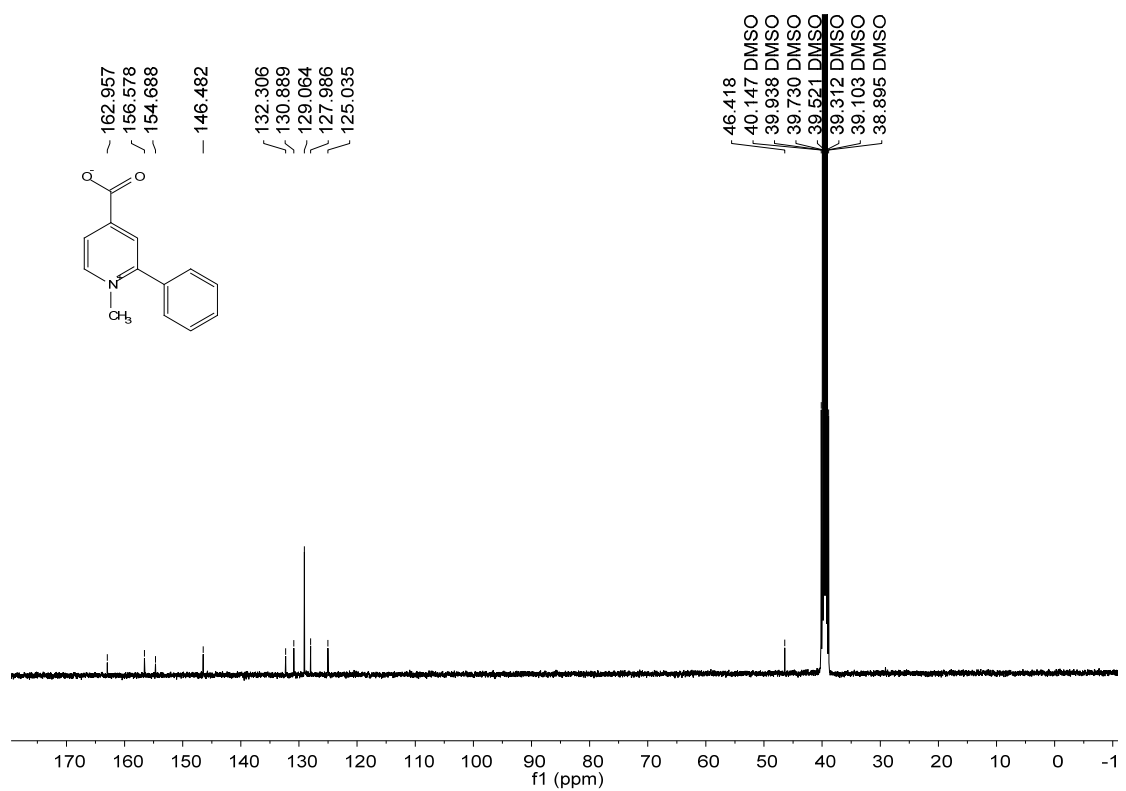
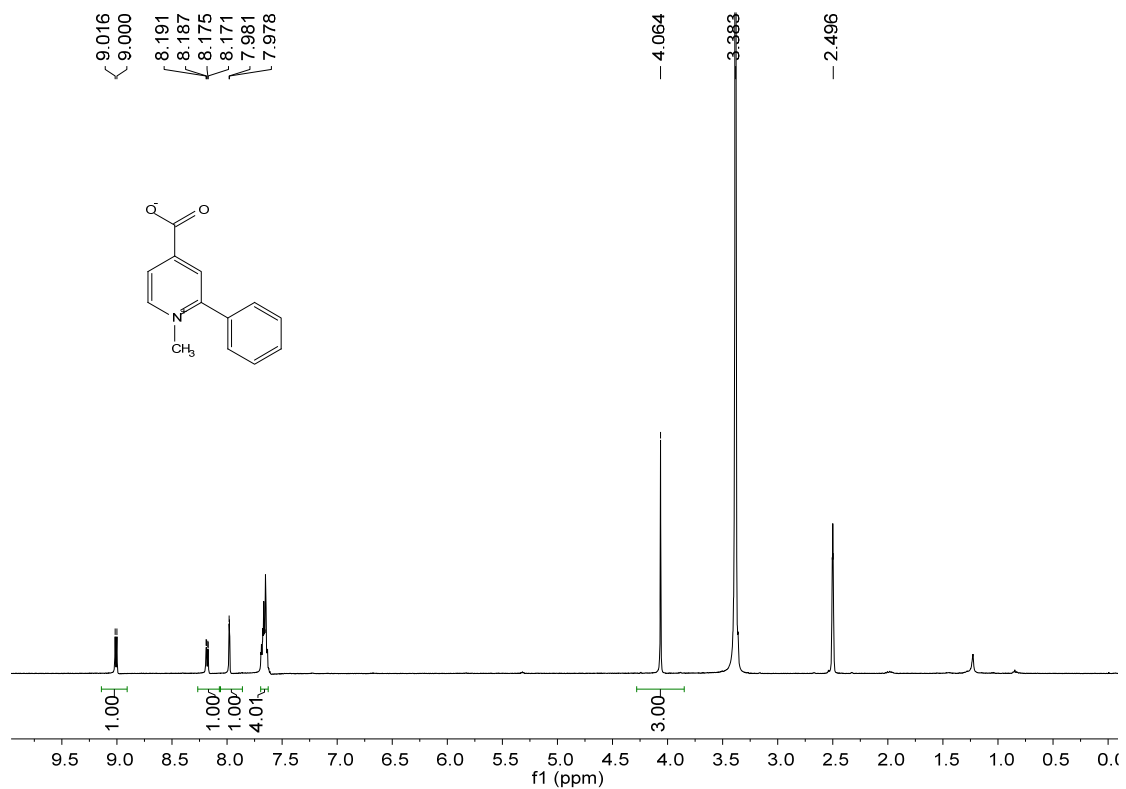
^1H and ^{13}C NMR spectra of **2aa**



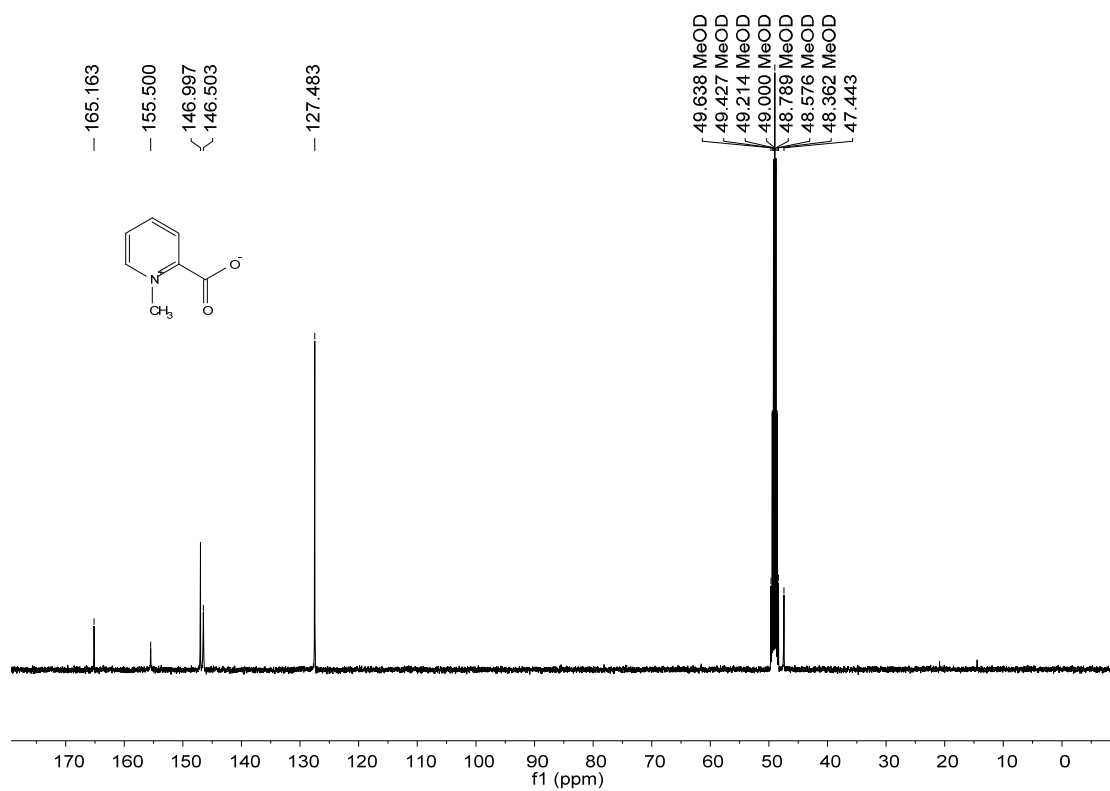
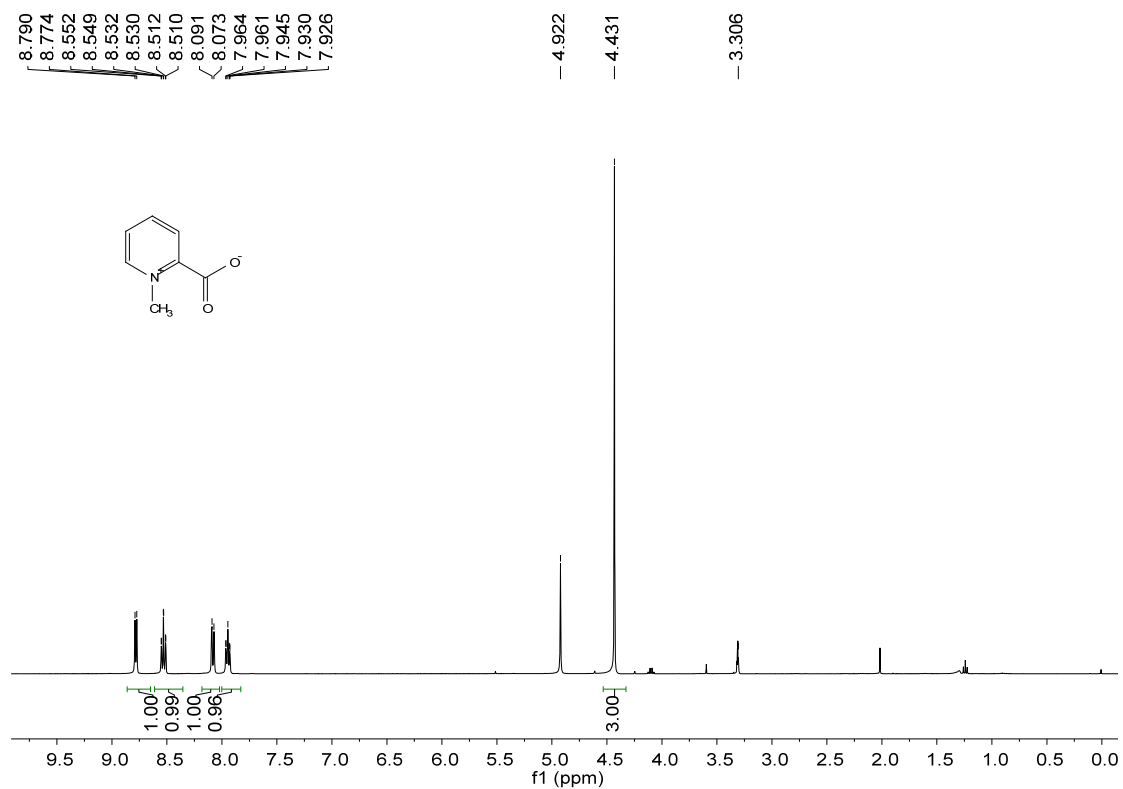
^1H and ^{13}C NMR spectra of **2ab**



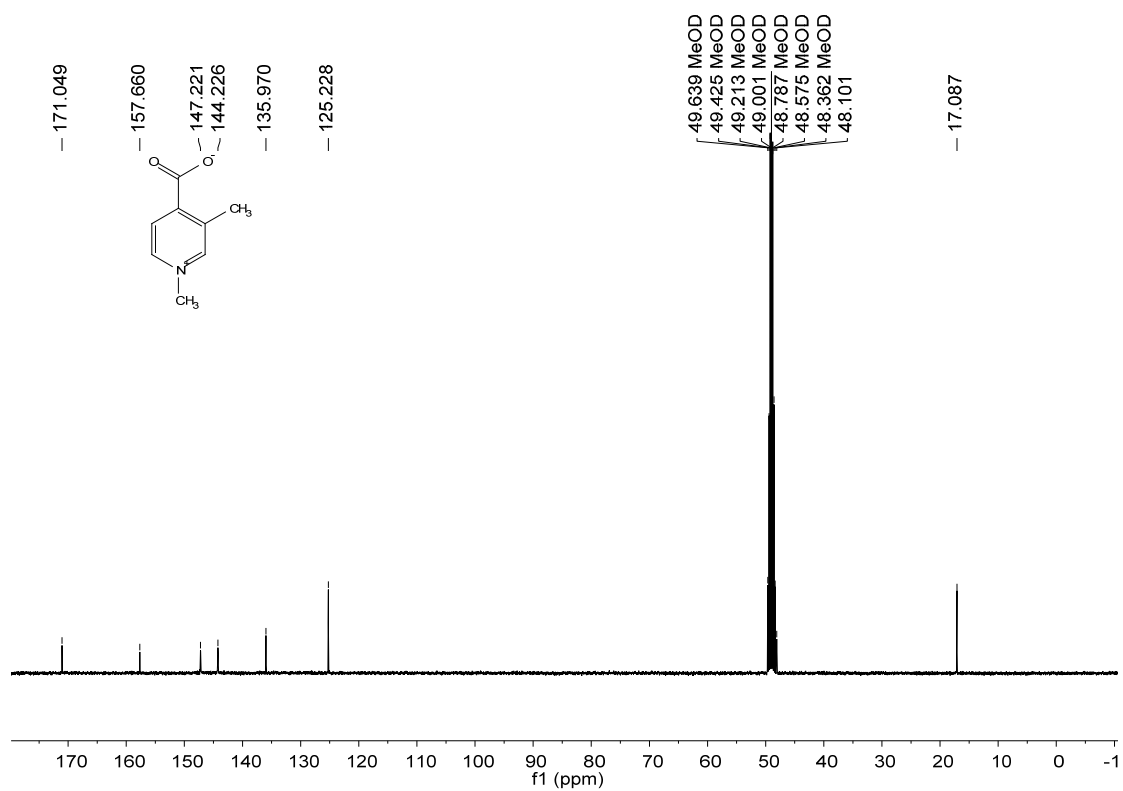
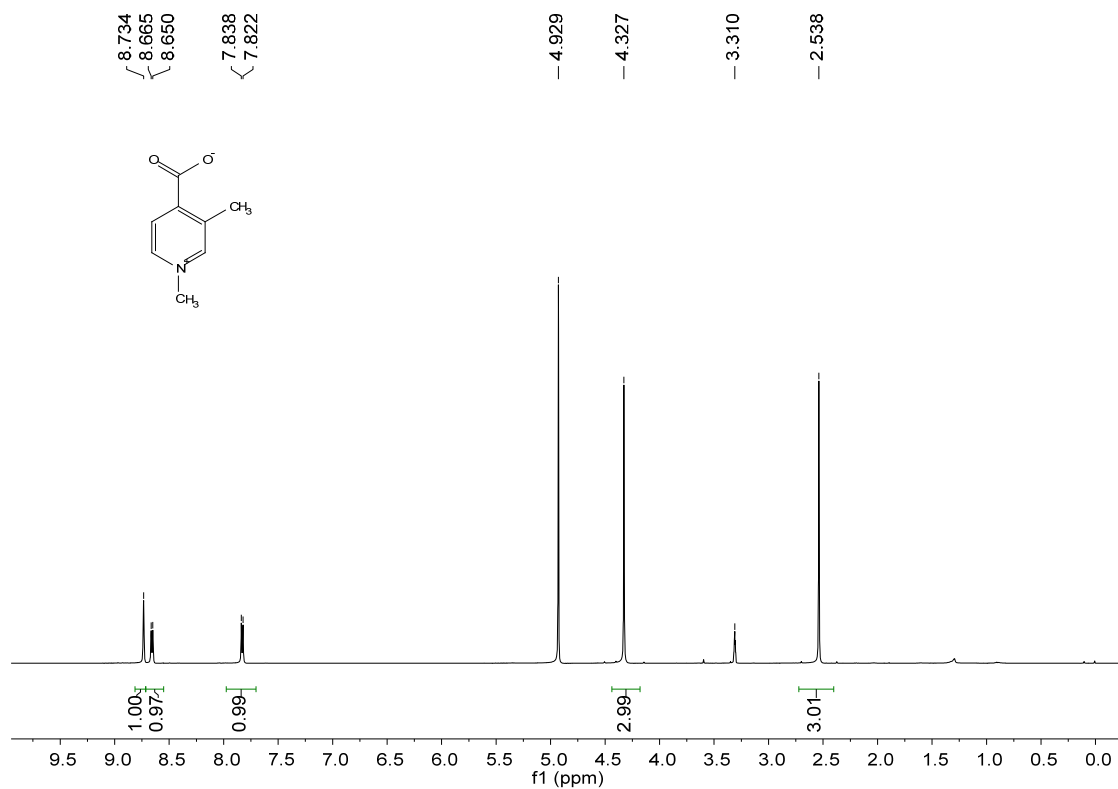
^1H and ^{13}C NMR spectra of **2ac**



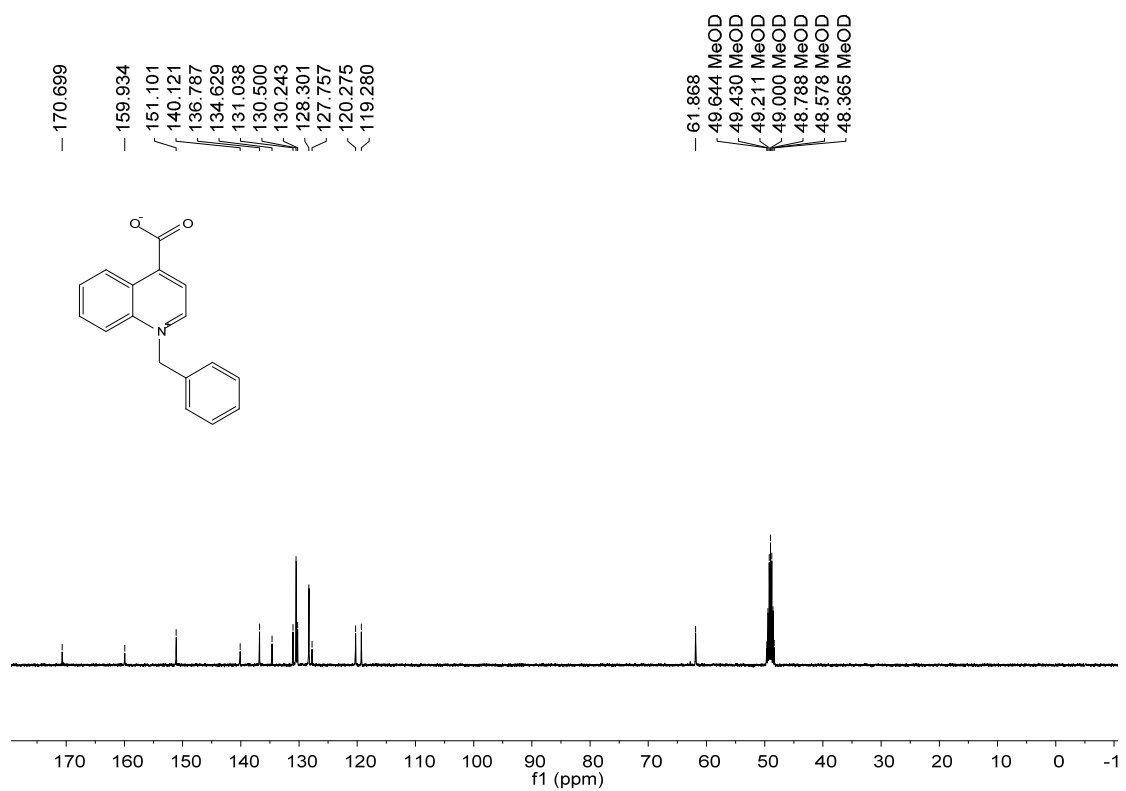
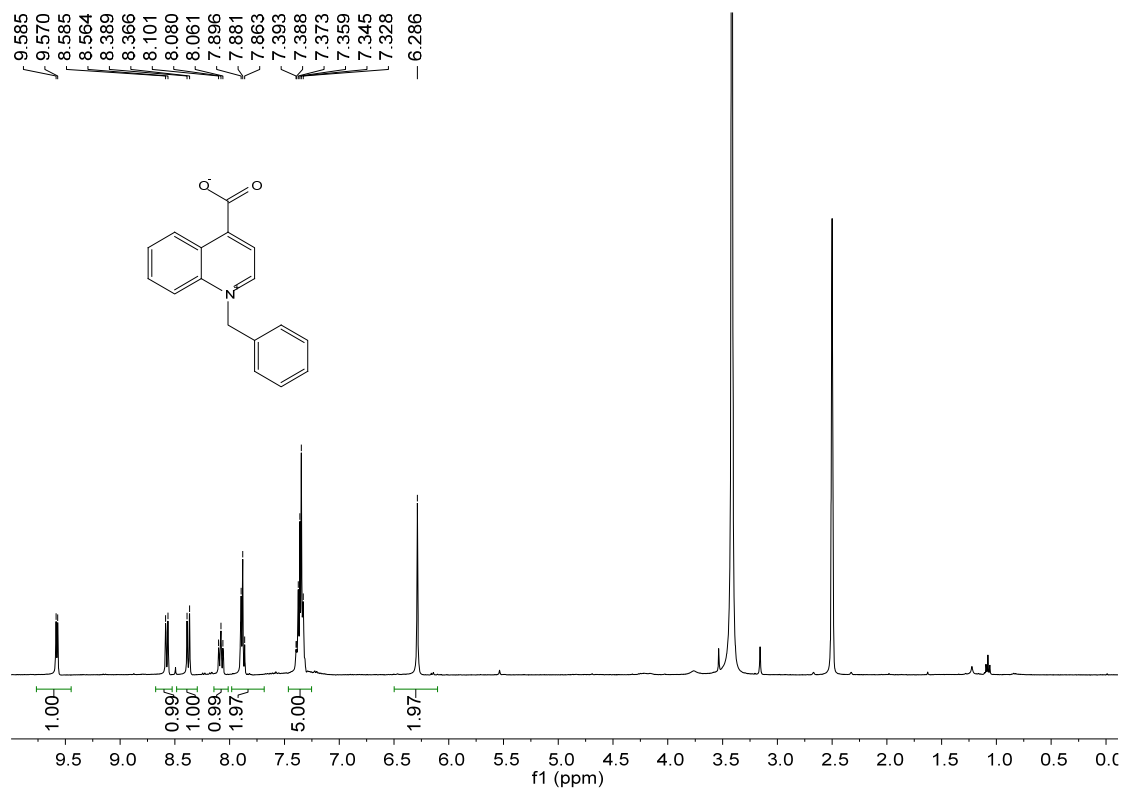
^1H and ^{13}C NMR spectra of **2ad**



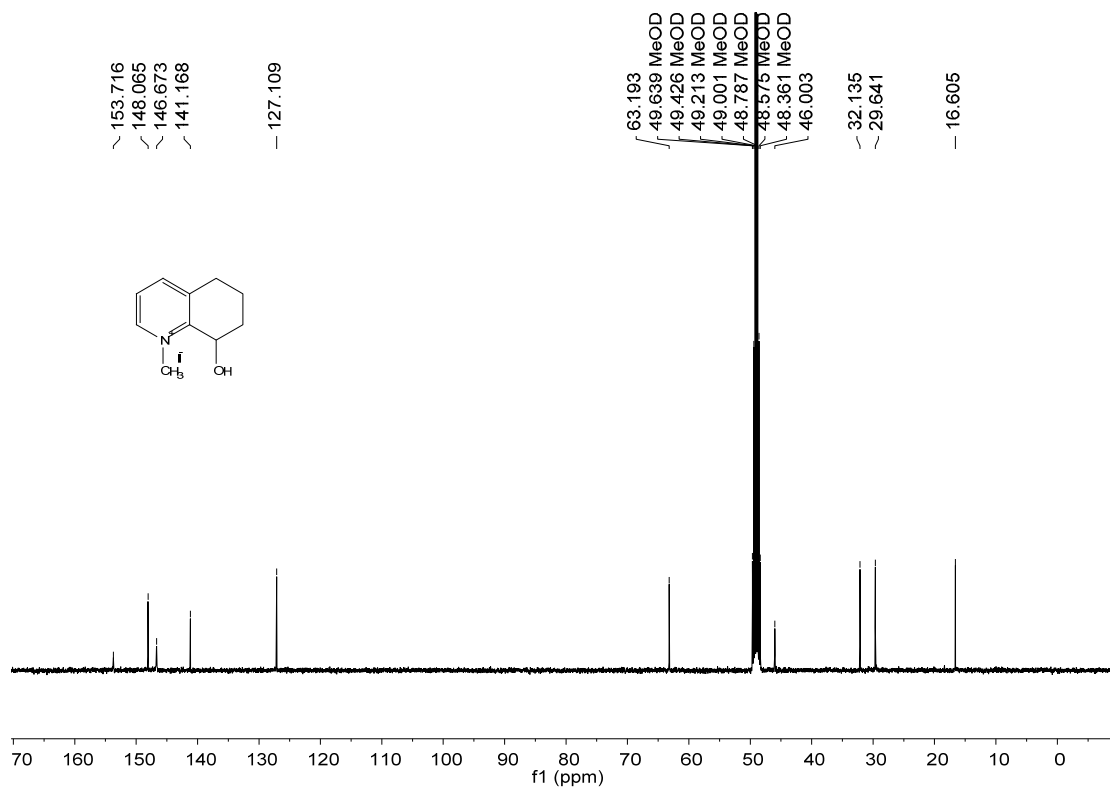
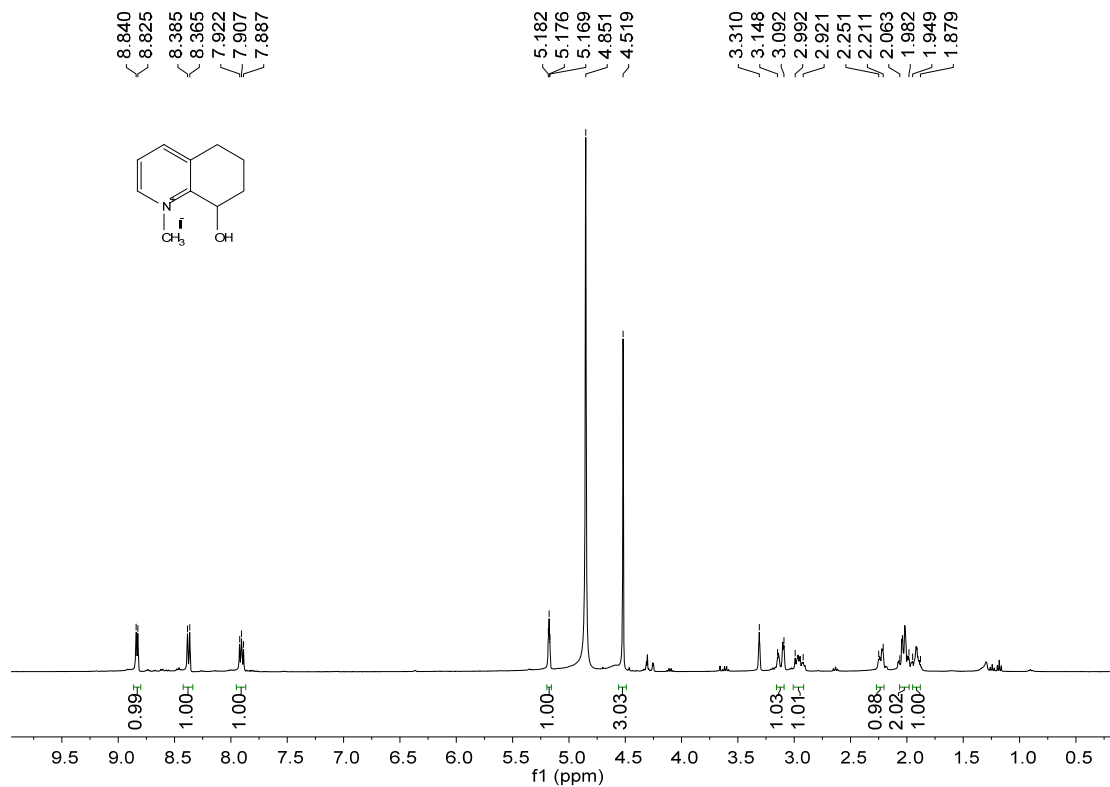
^1H and ^{13}C NMR spectra of **2ae**



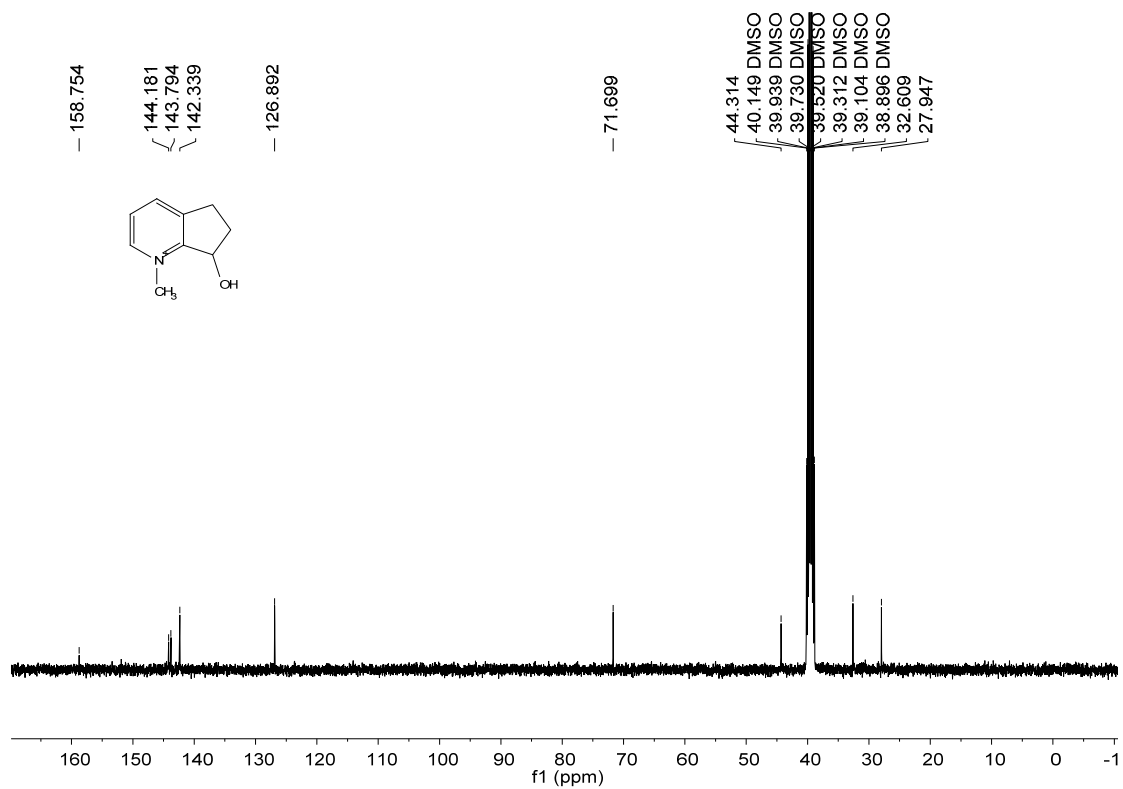
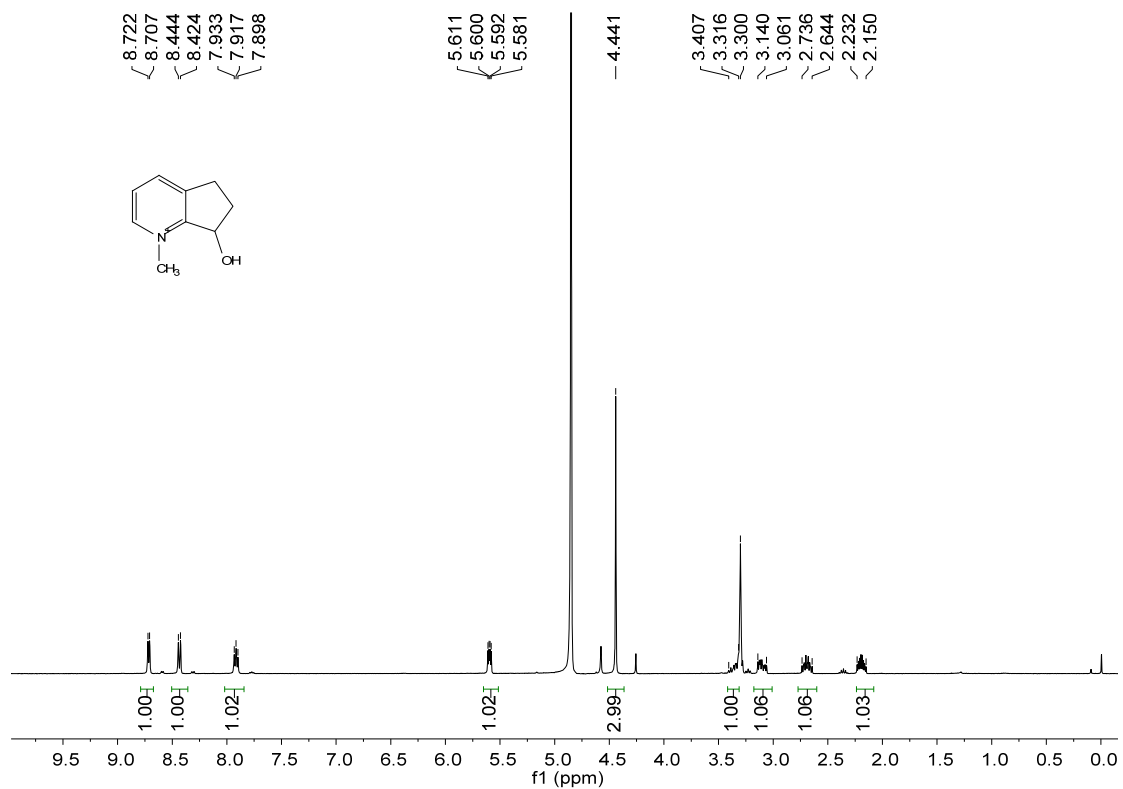
^1H and ^{13}C NMR spectra of **2af**



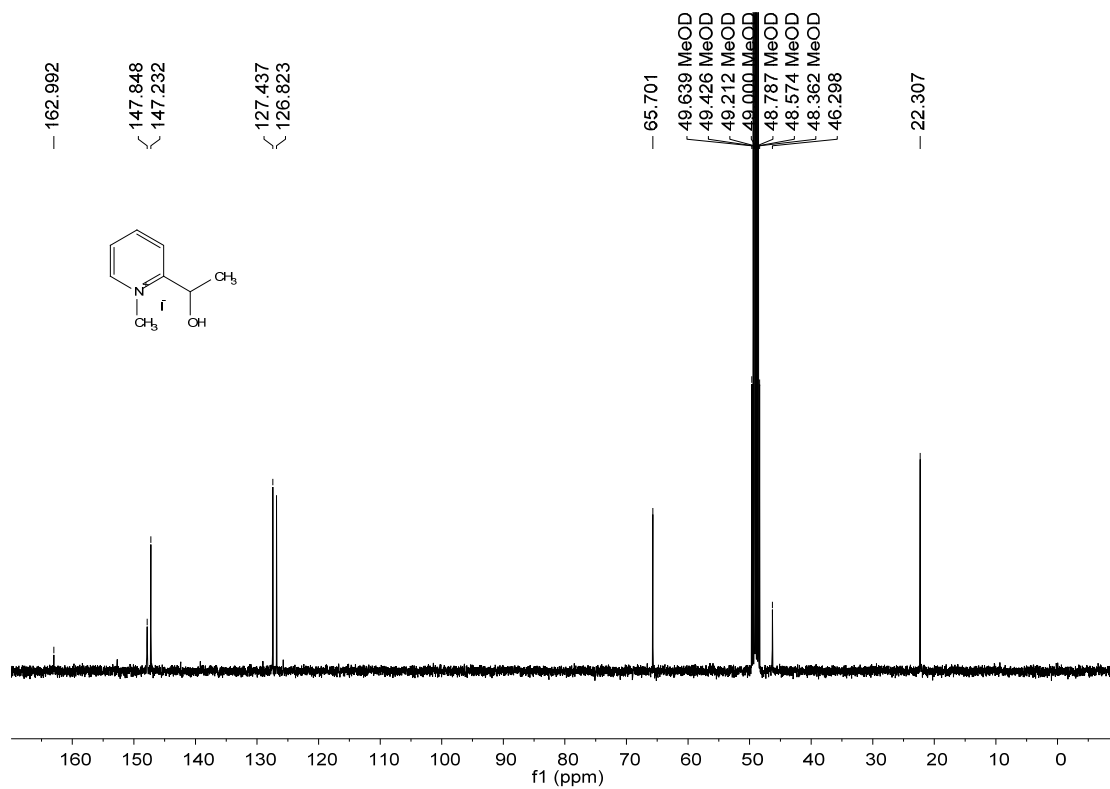
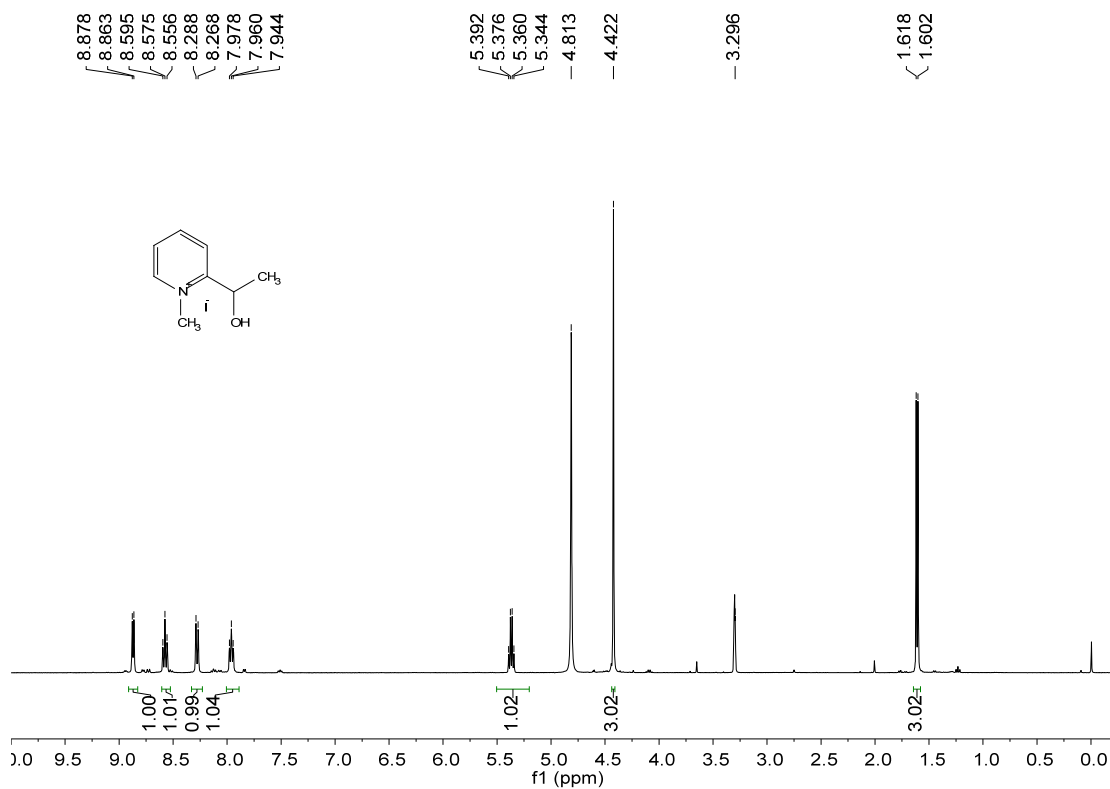
^1H and ^{13}C NMR spectra of **4a**



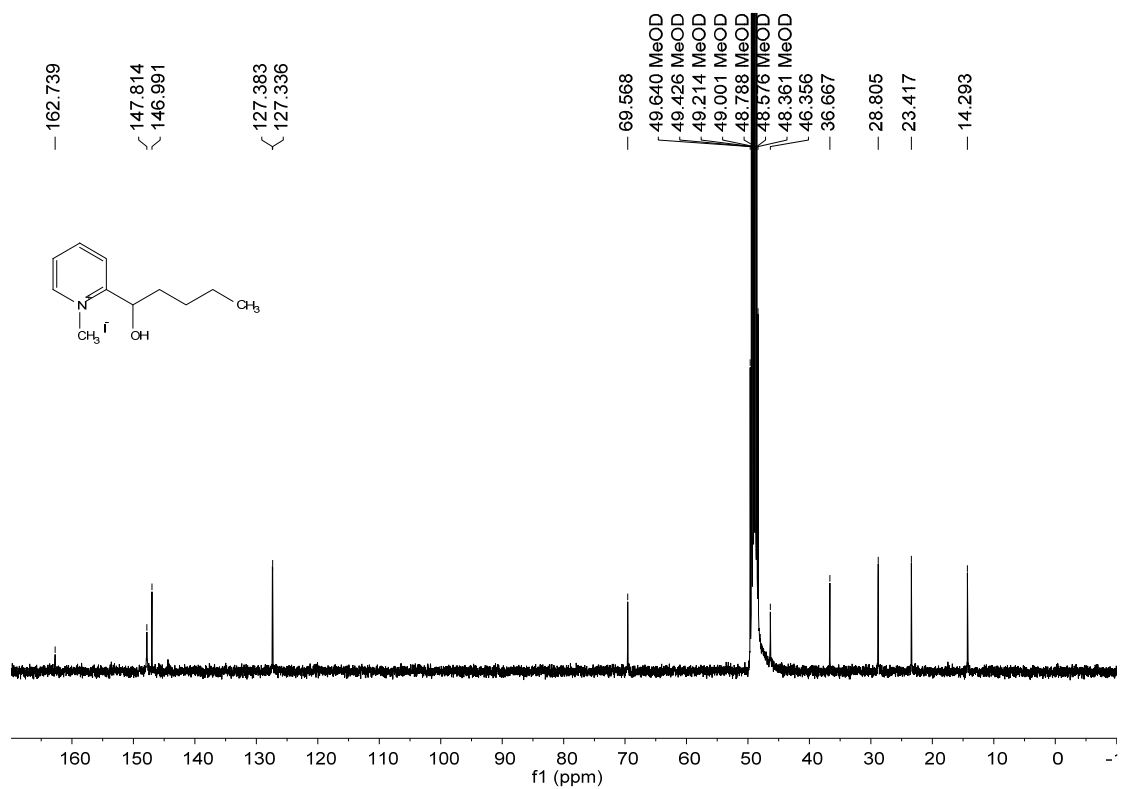
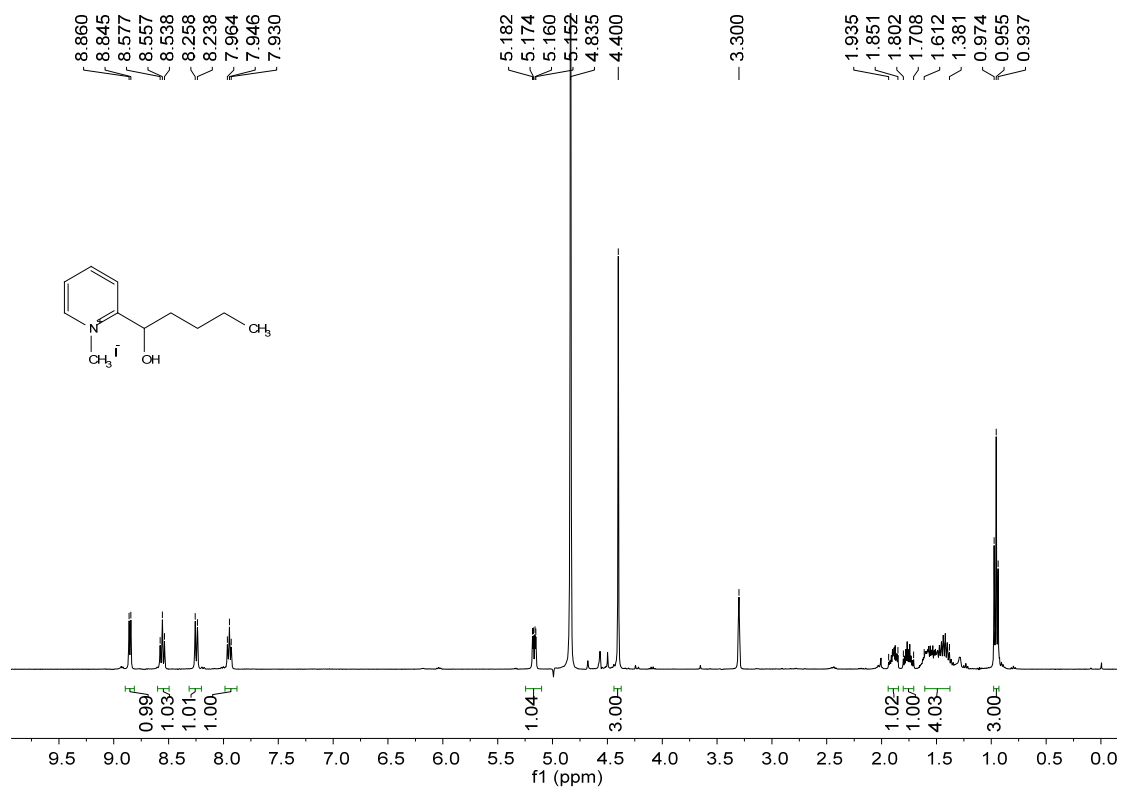
^1H and ^{13}C NMR spectra of **4b**



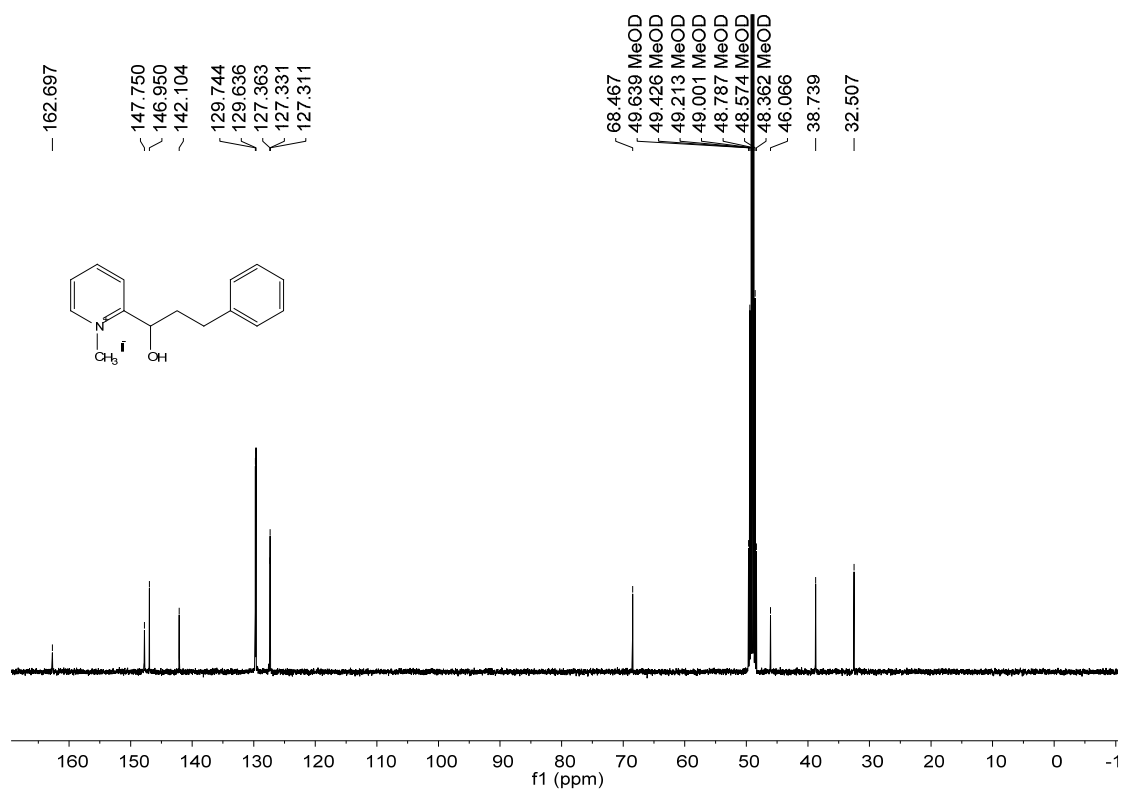
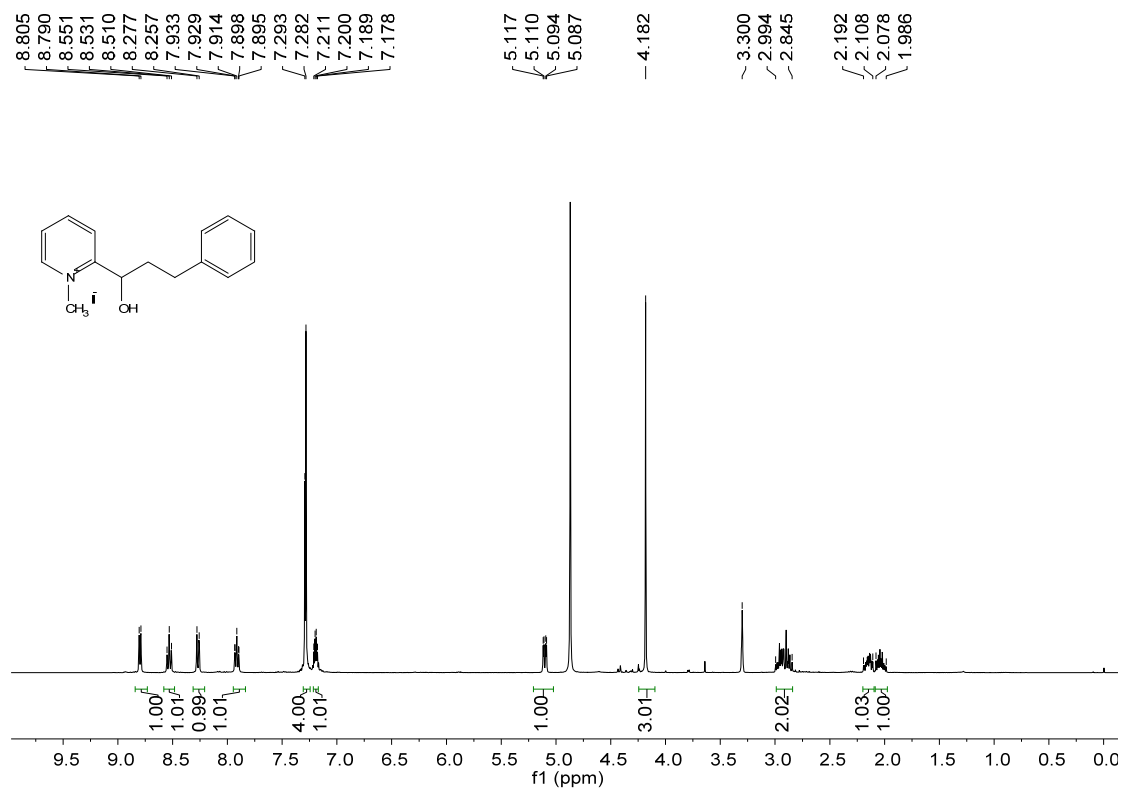
^1H and ^{13}C NMR spectra of **4c**



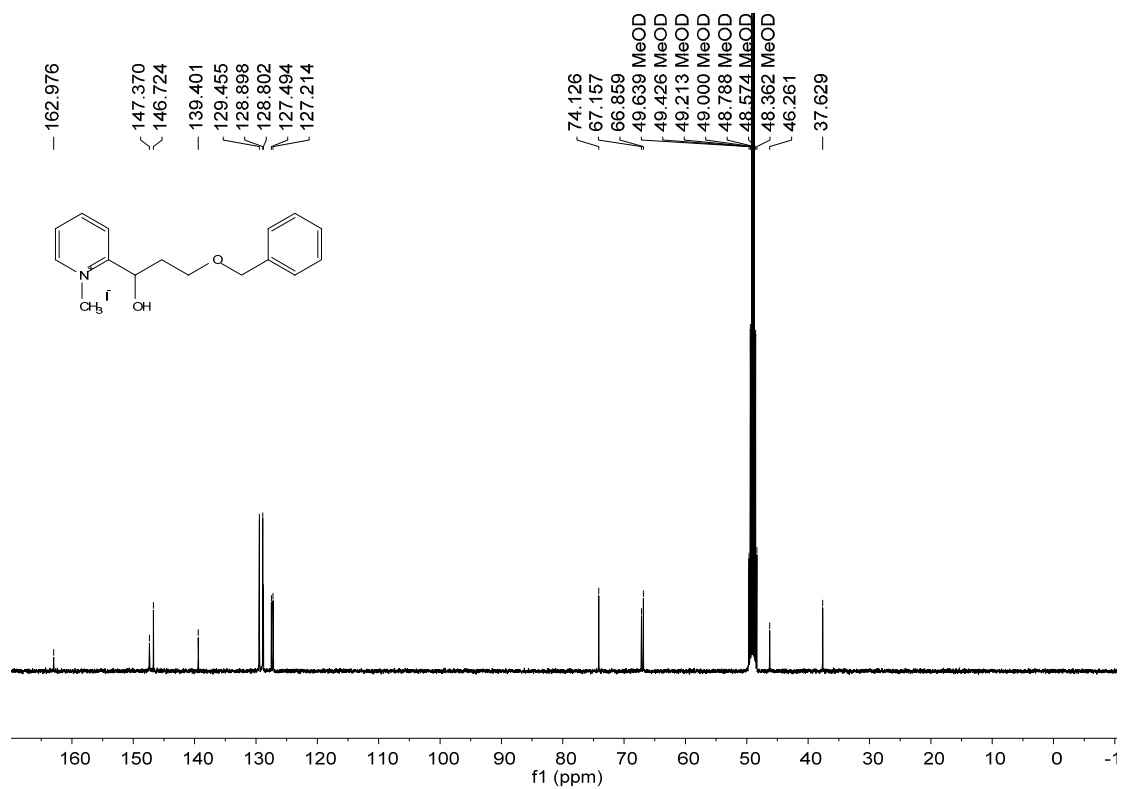
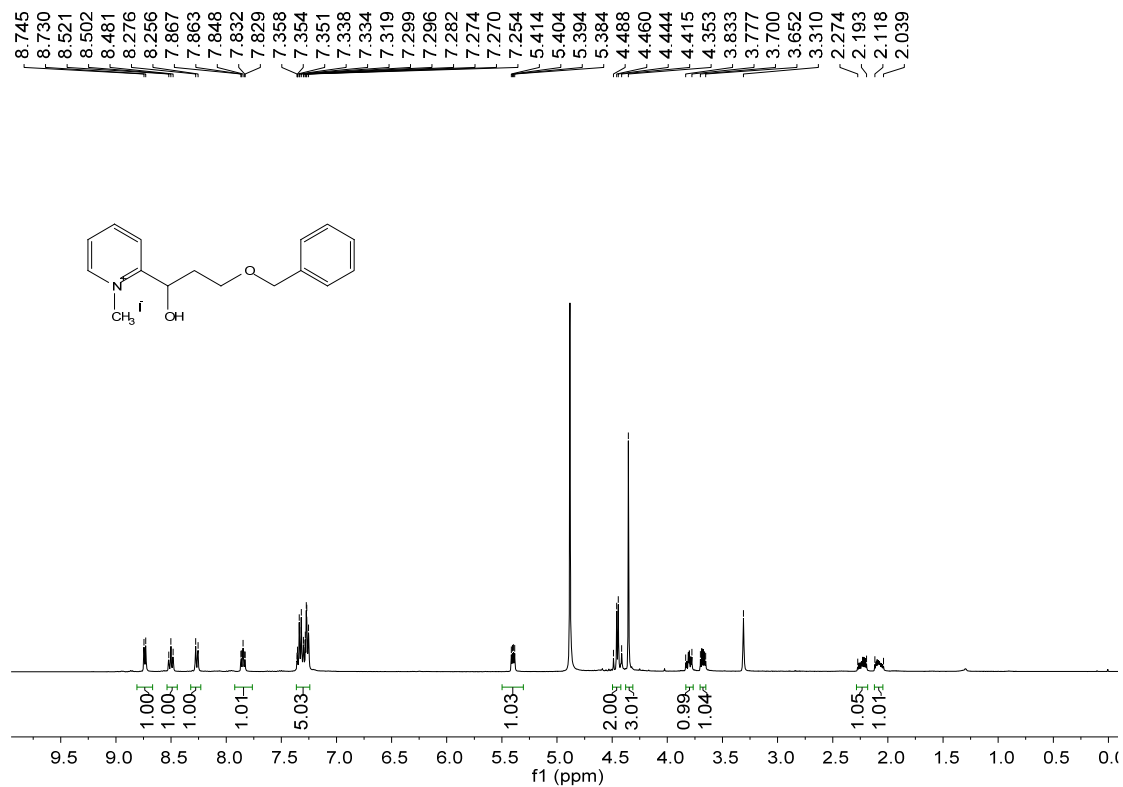
^1H and ^{13}C NMR spectra of **4d**



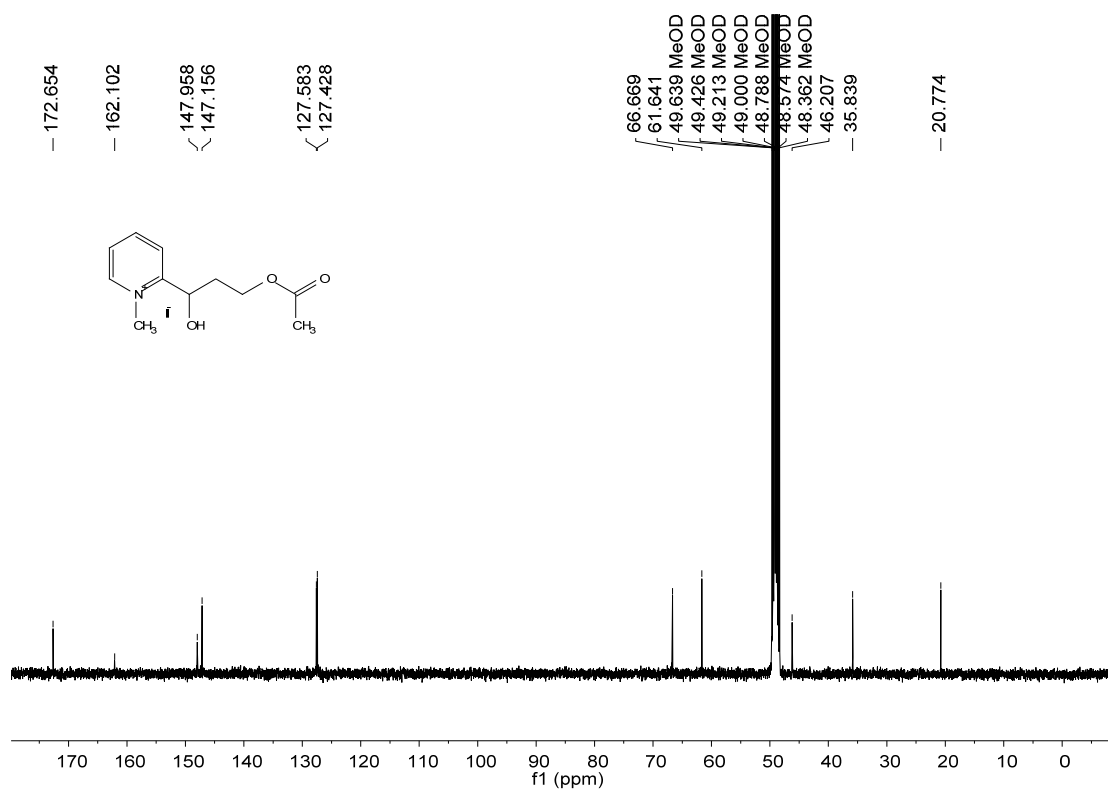
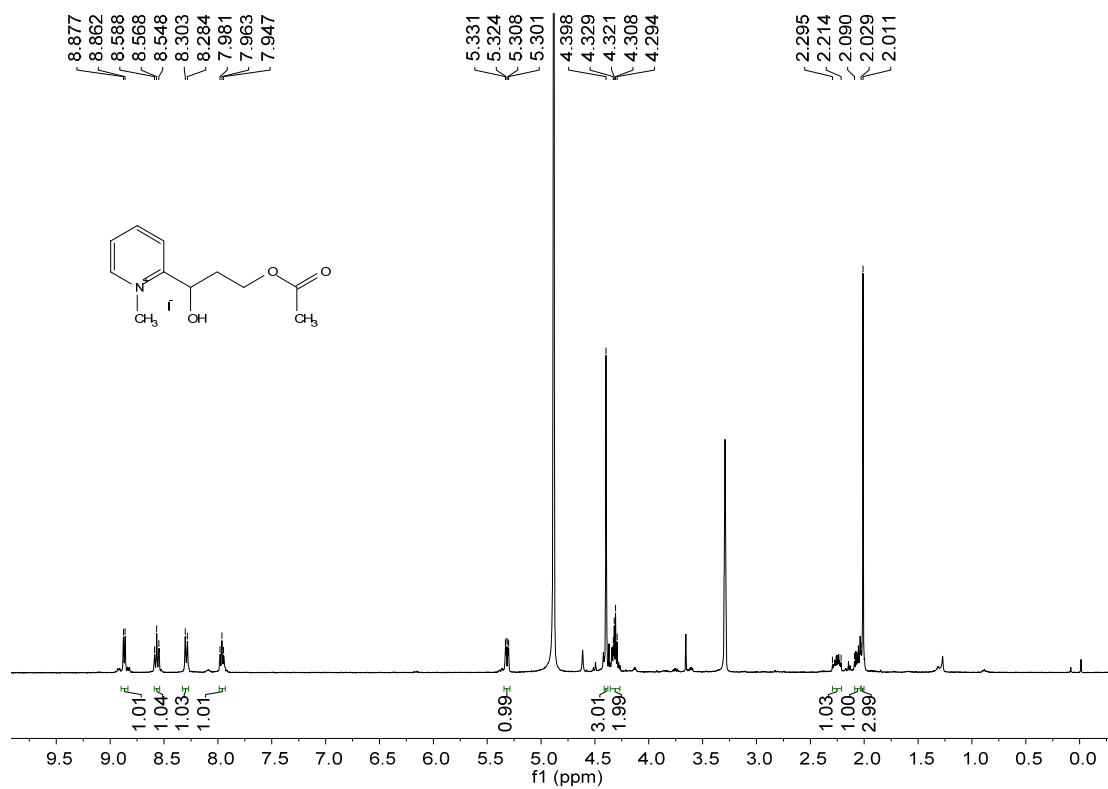
^1H and ^{13}C NMR spectra of **4e**



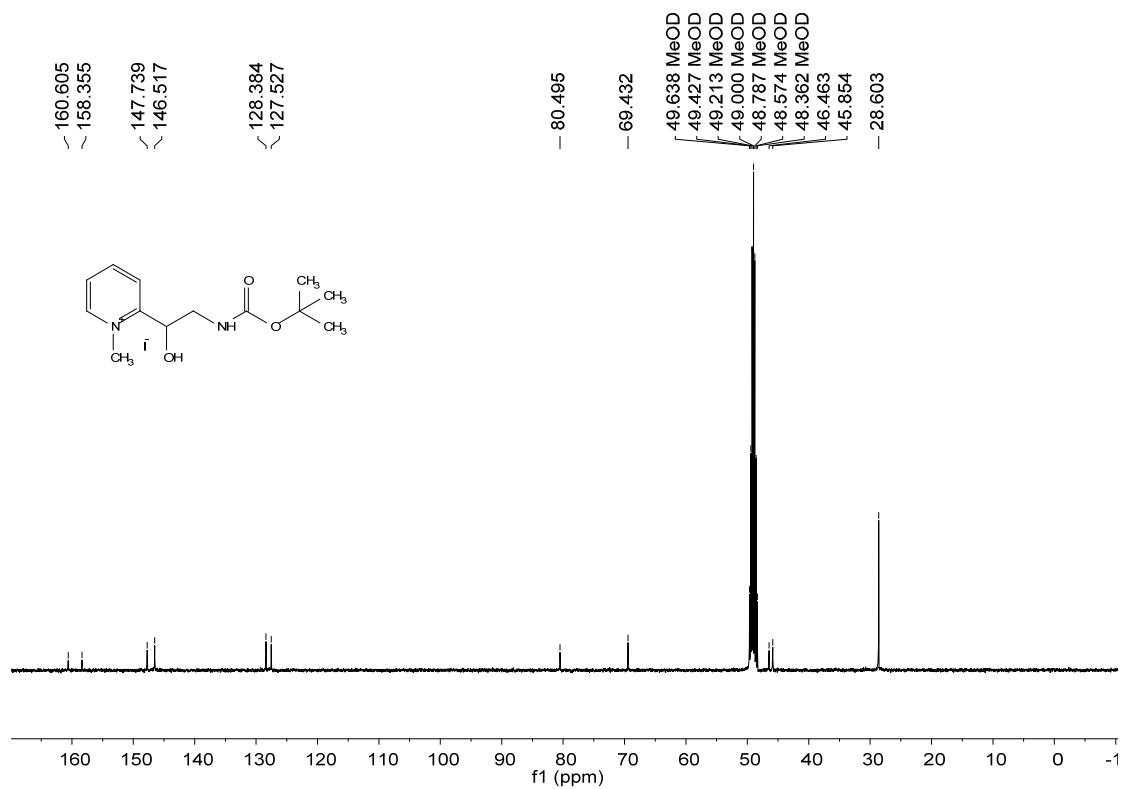
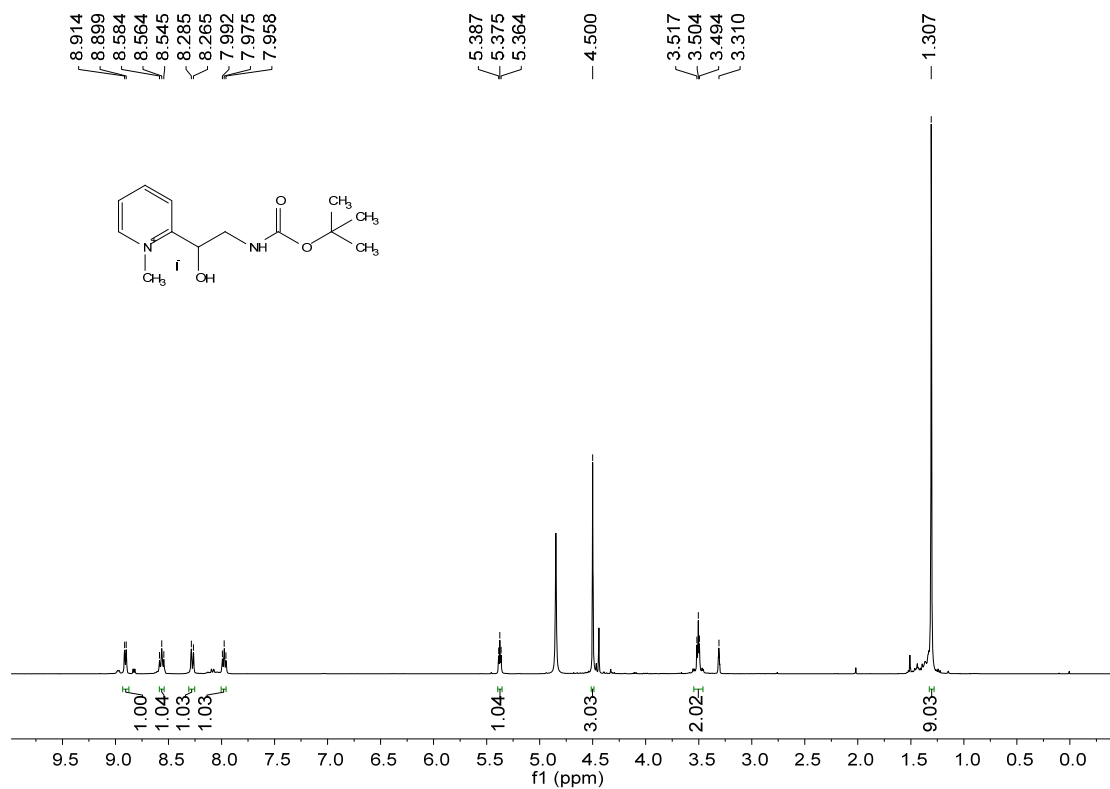
^1H and ^{13}C NMR spectra of **4f**



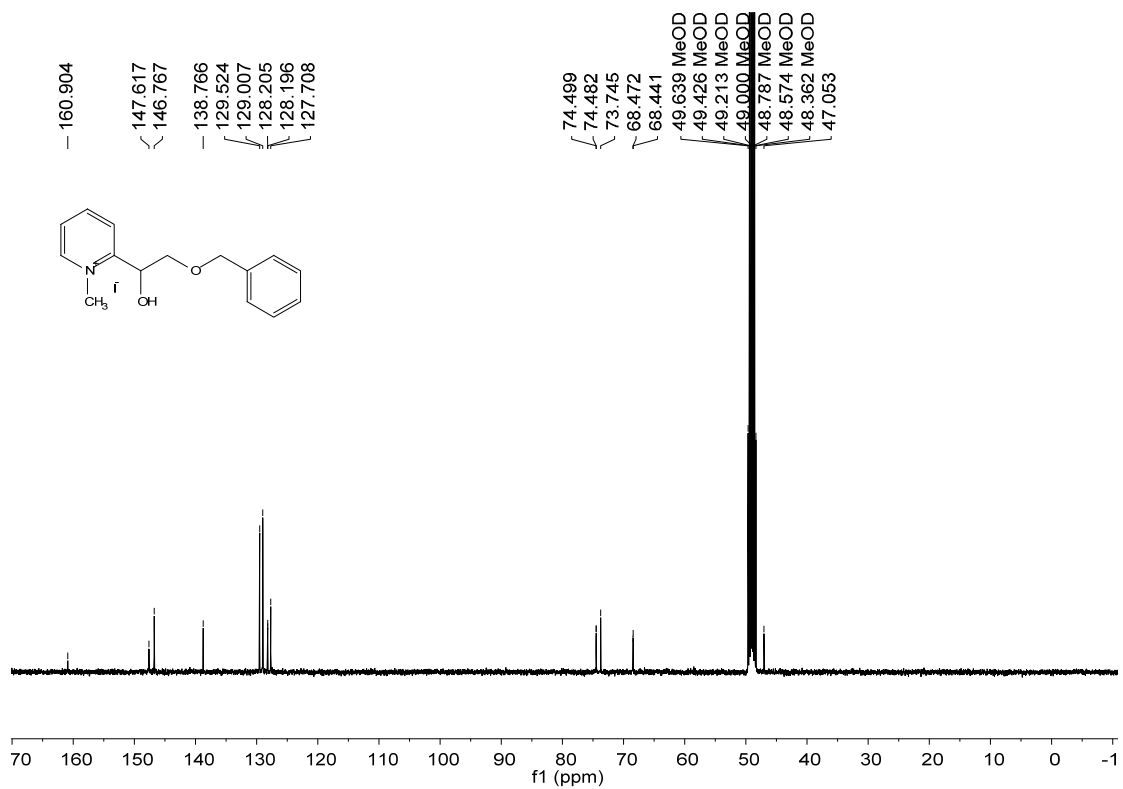
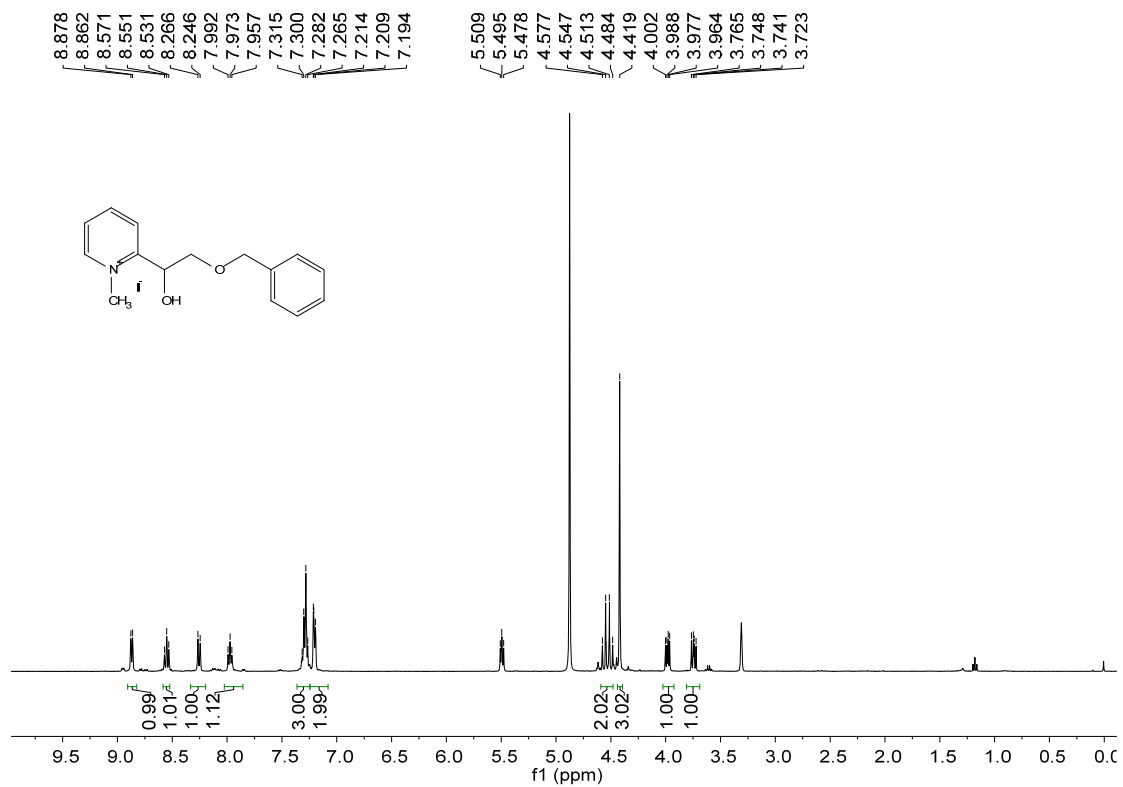
^1H and ^{13}C NMR spectra of **4g**



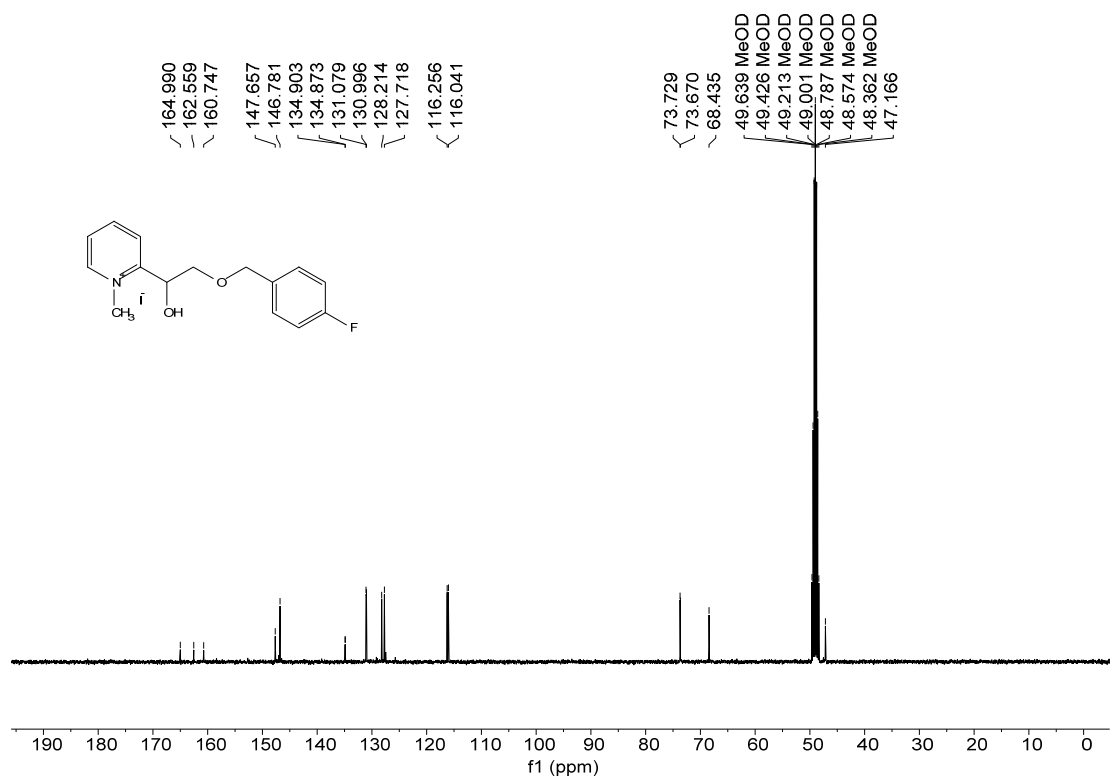
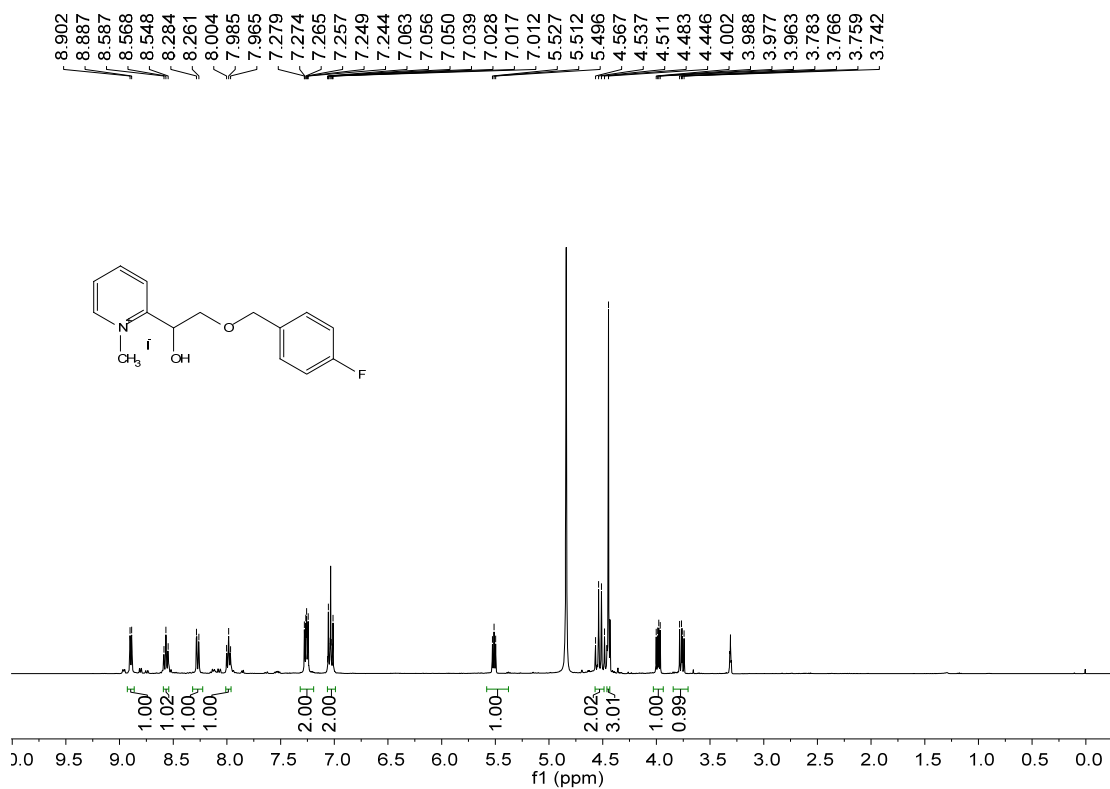
^1H and ^{13}C NMR spectra of **4h**



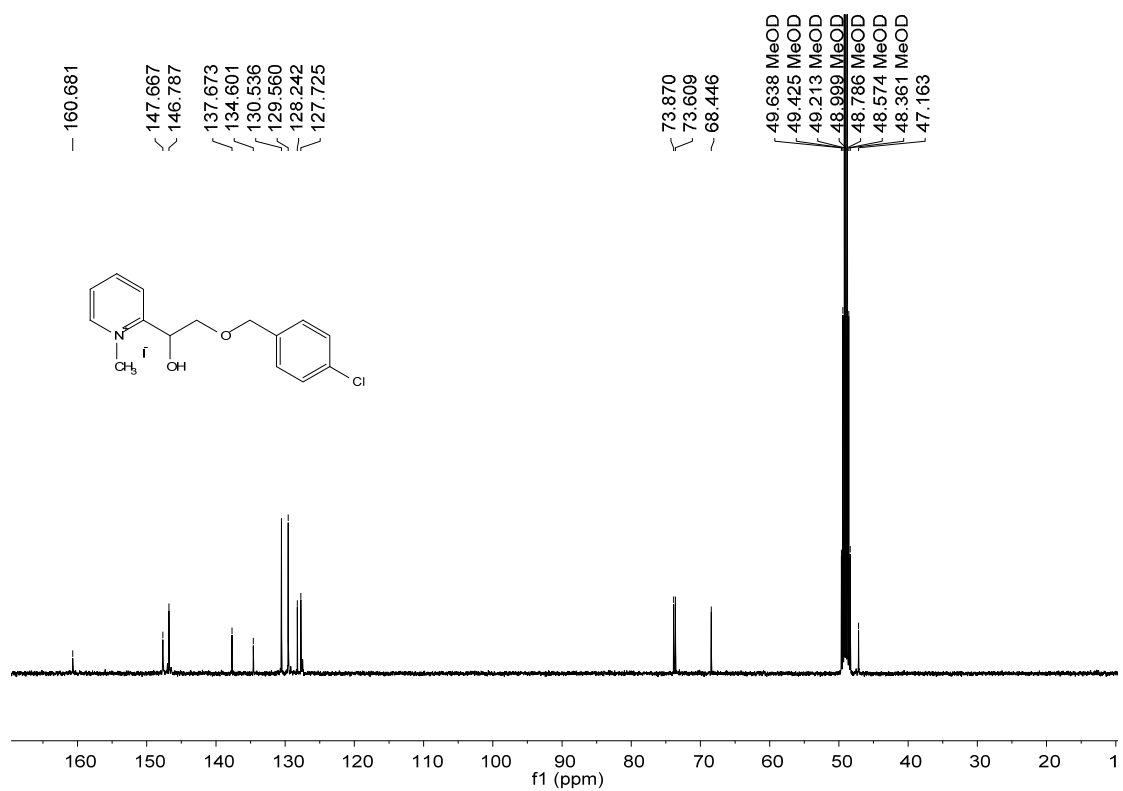
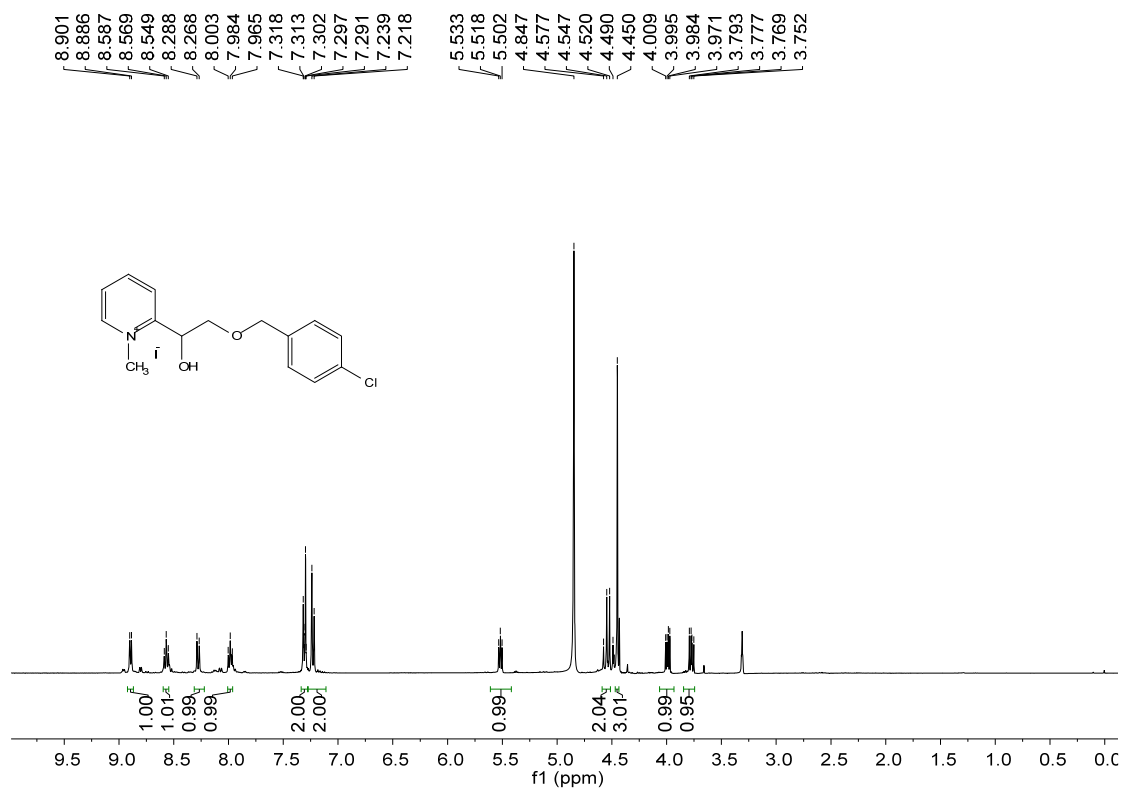
¹H and ¹³C NMR spectra of **4i**



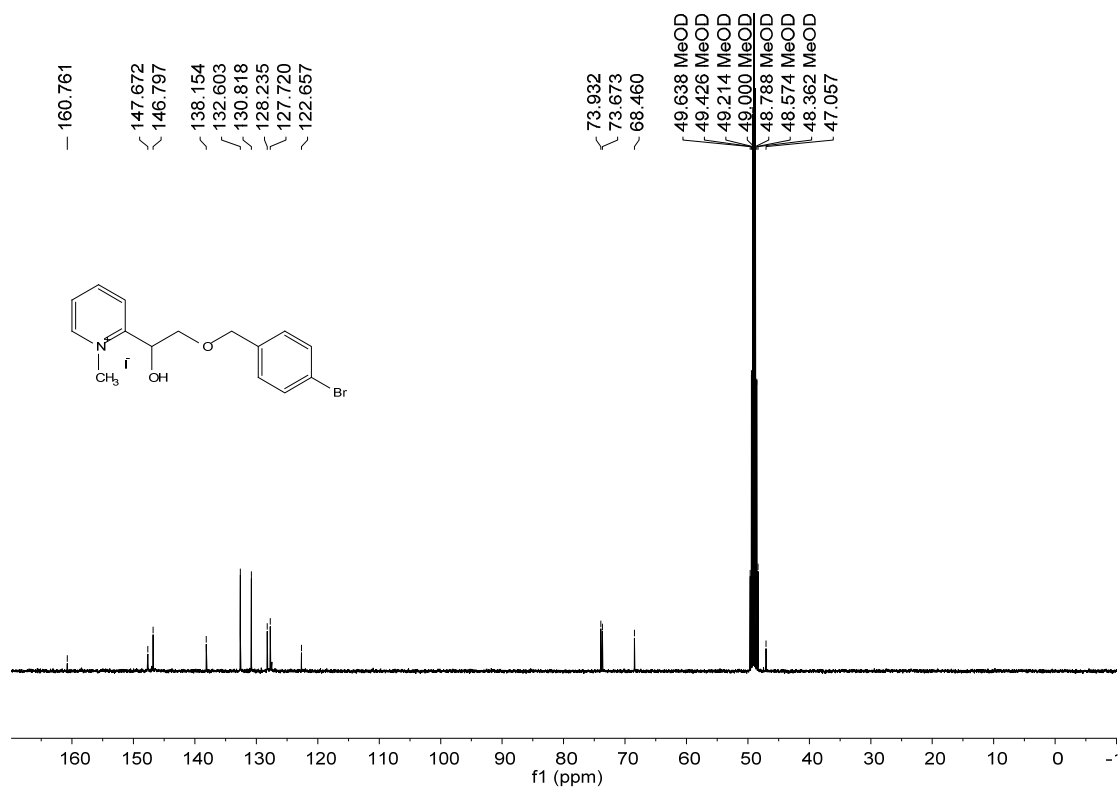
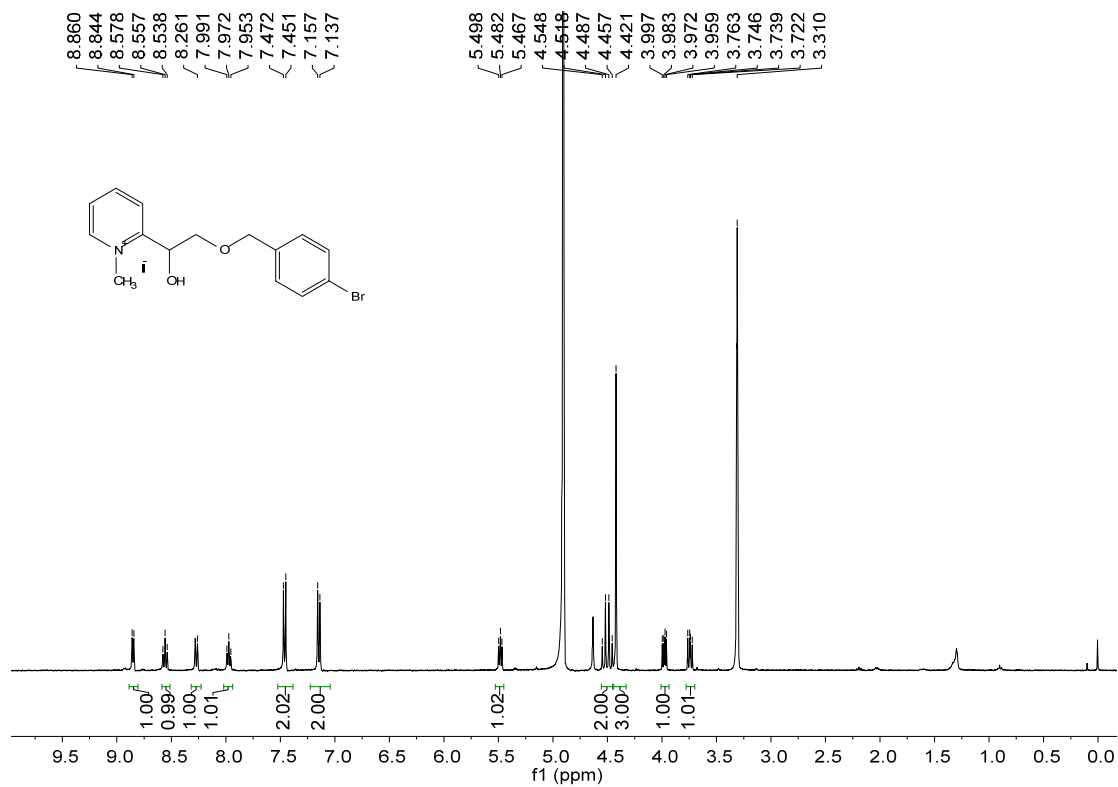
^1H and ^{13}C NMR spectra of **4j**



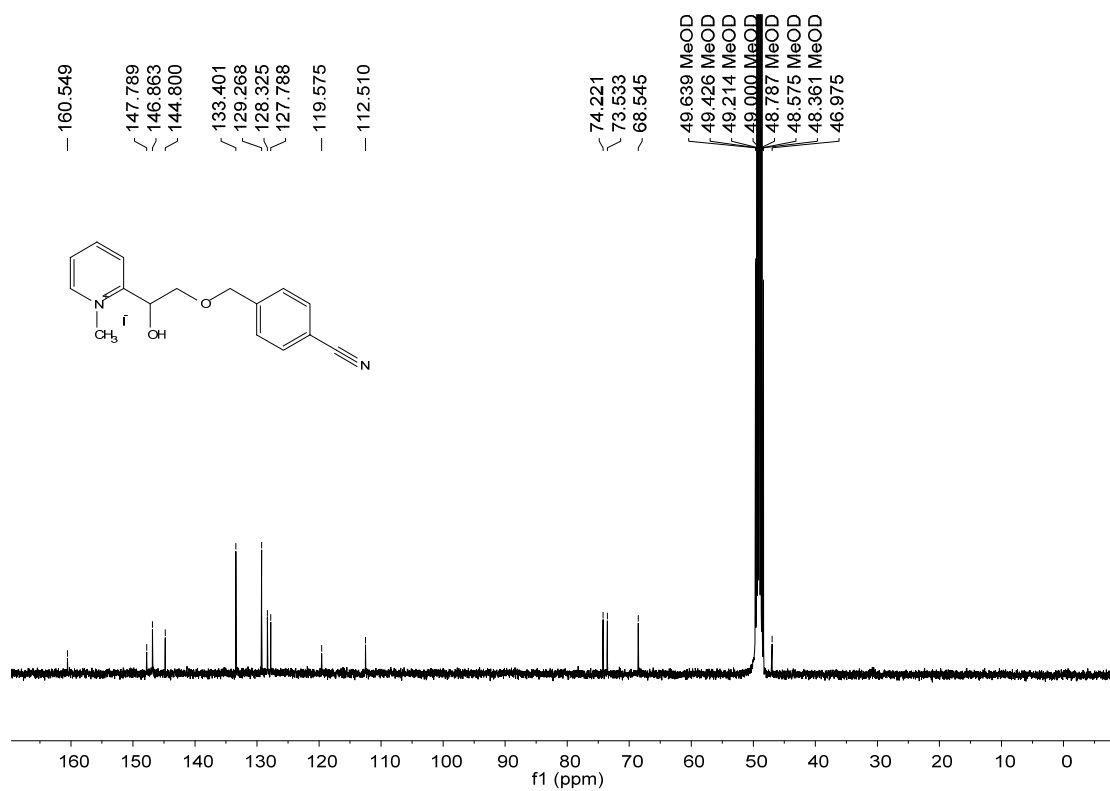
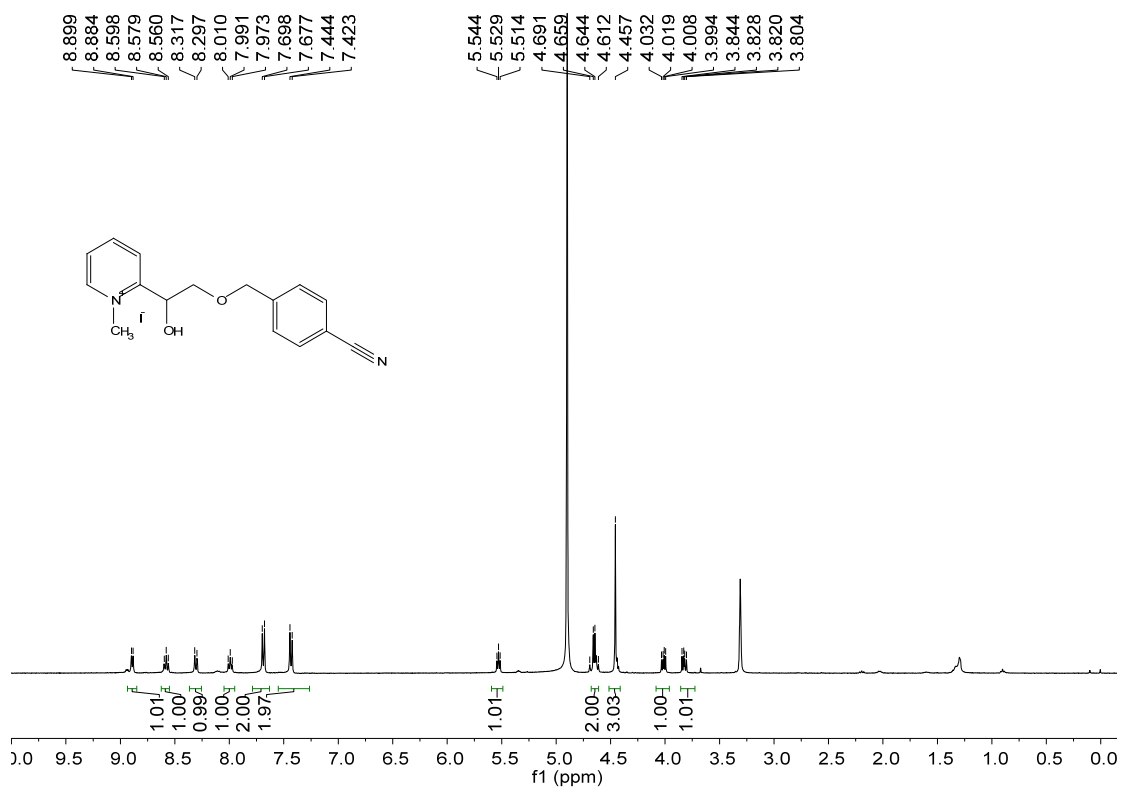
^1H and ^{13}C NMR spectra of **4k**



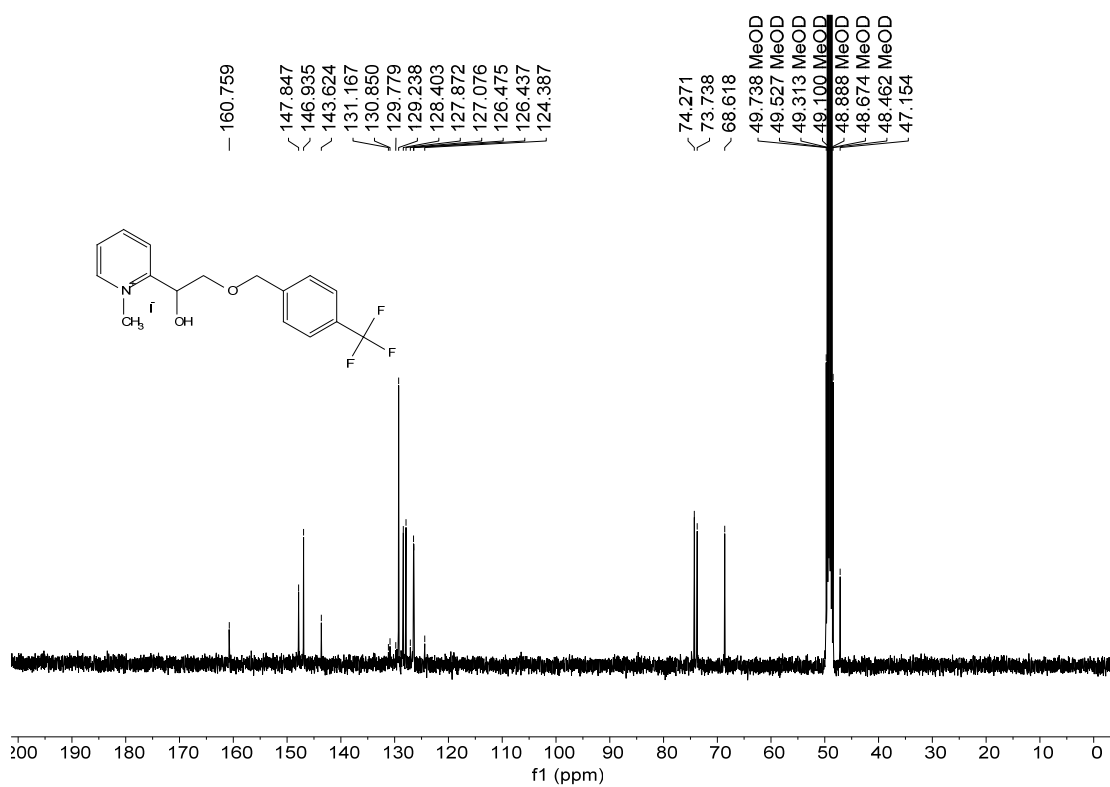
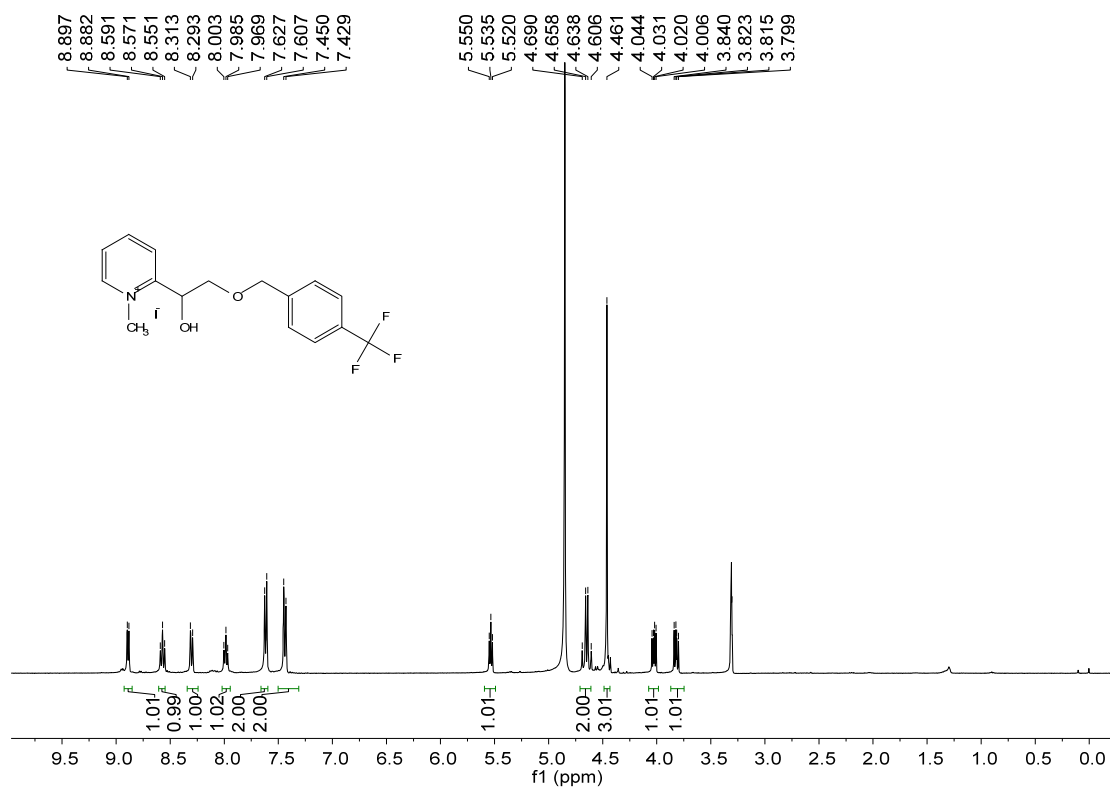
^1H and ^{13}C NMR spectra of **41**



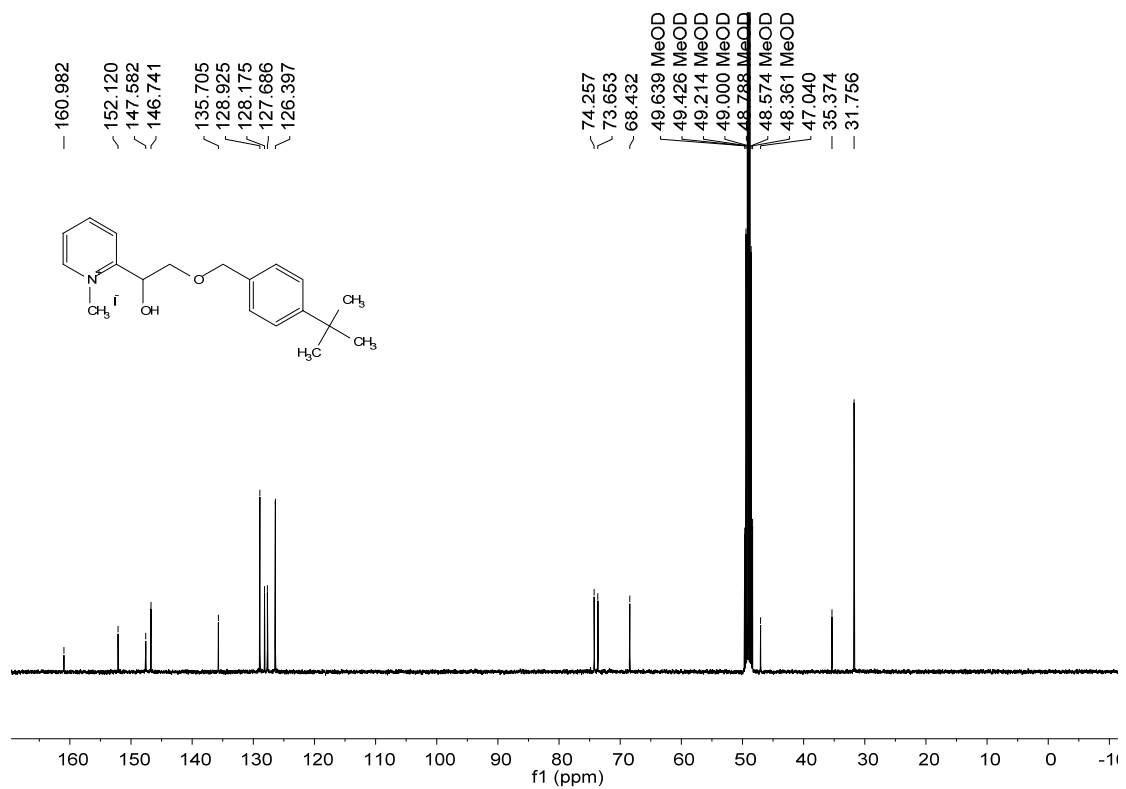
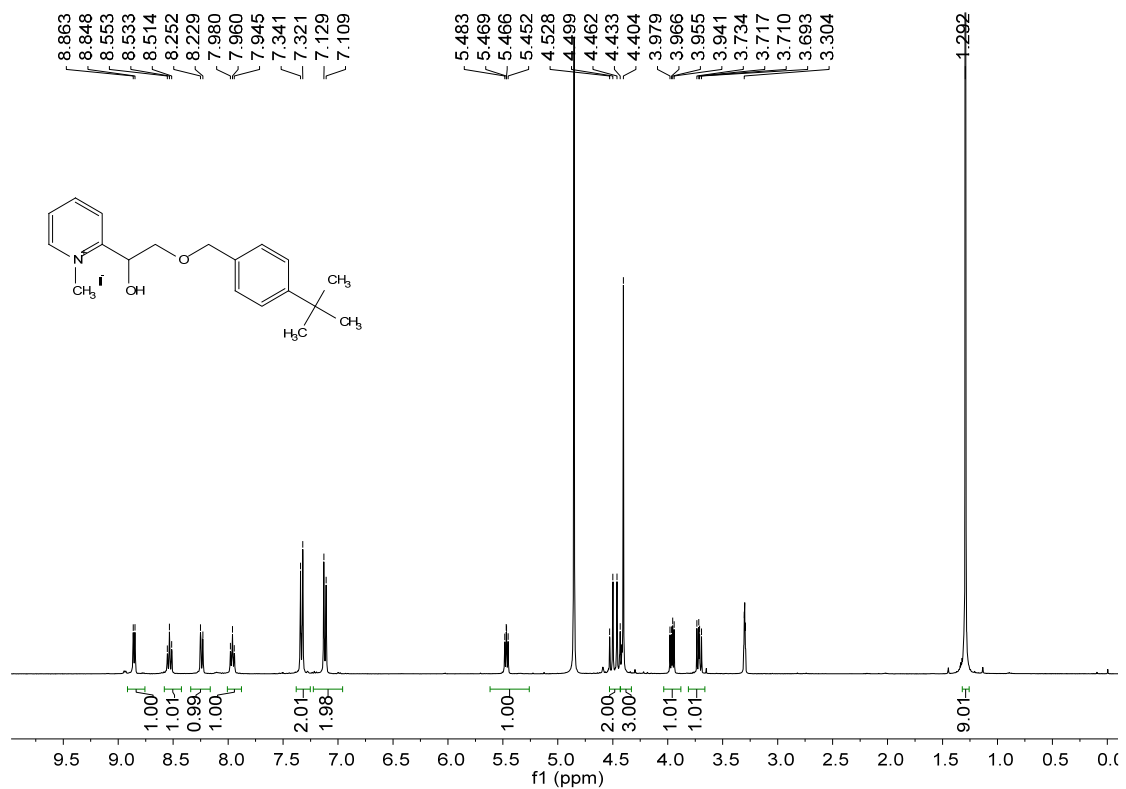
^1H and ^{13}C NMR spectra of **4m**



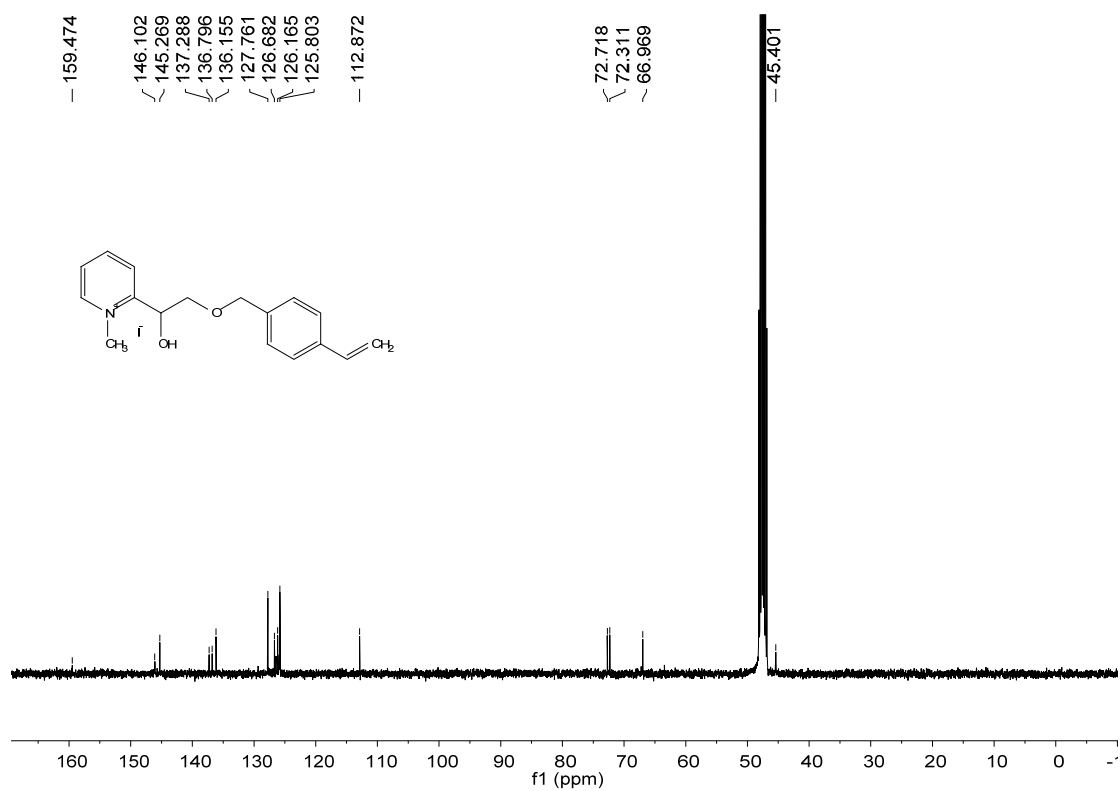
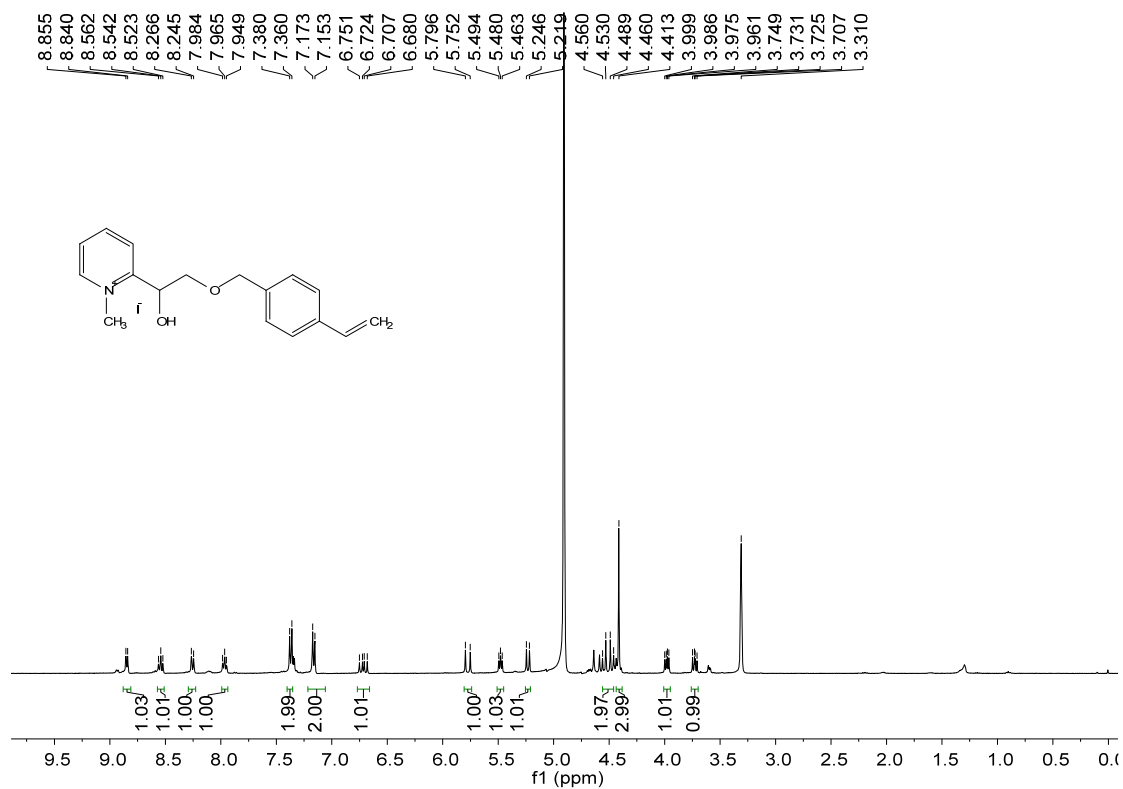
^1H and ^{13}C NMR spectra of **4n**



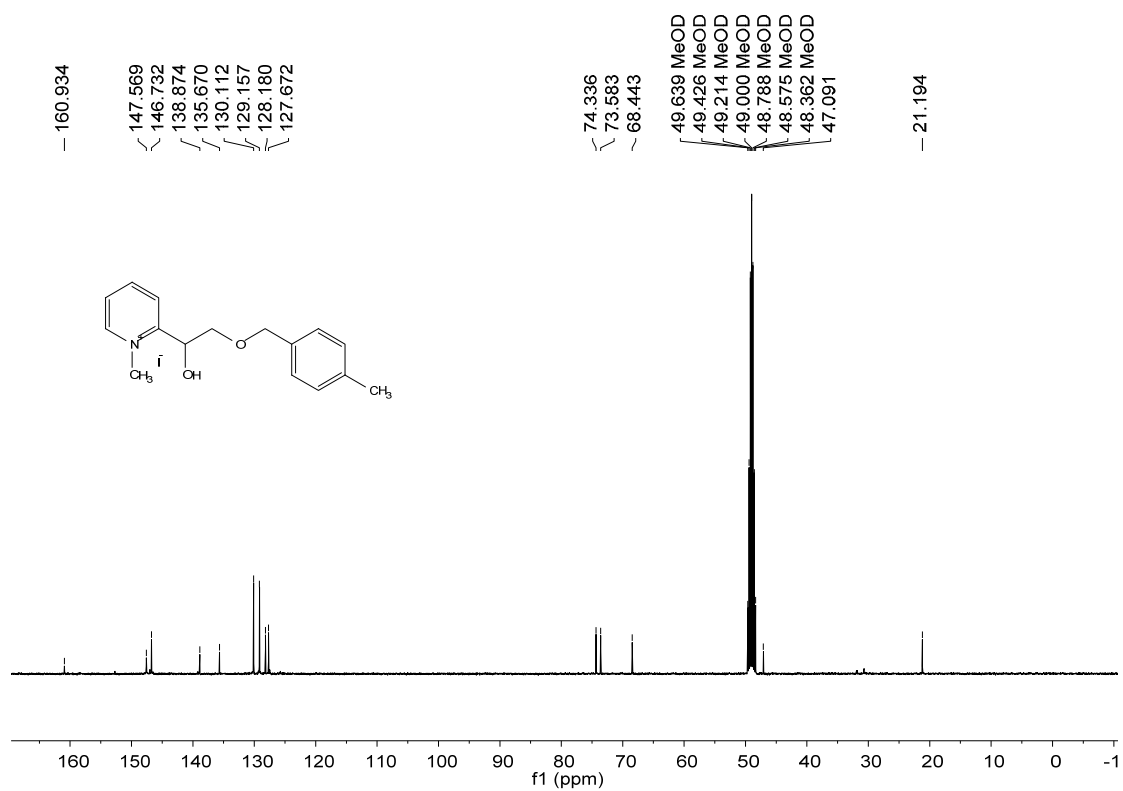
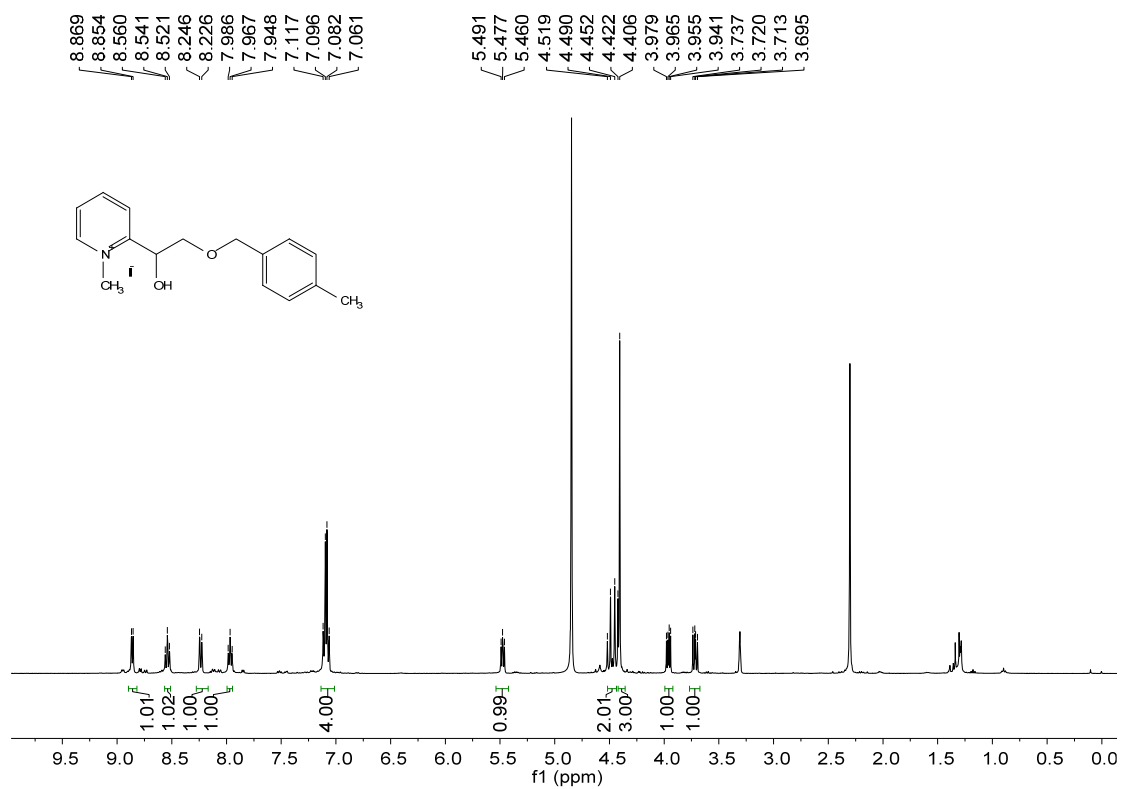
^1H and ^{13}C NMR spectra of **4o**



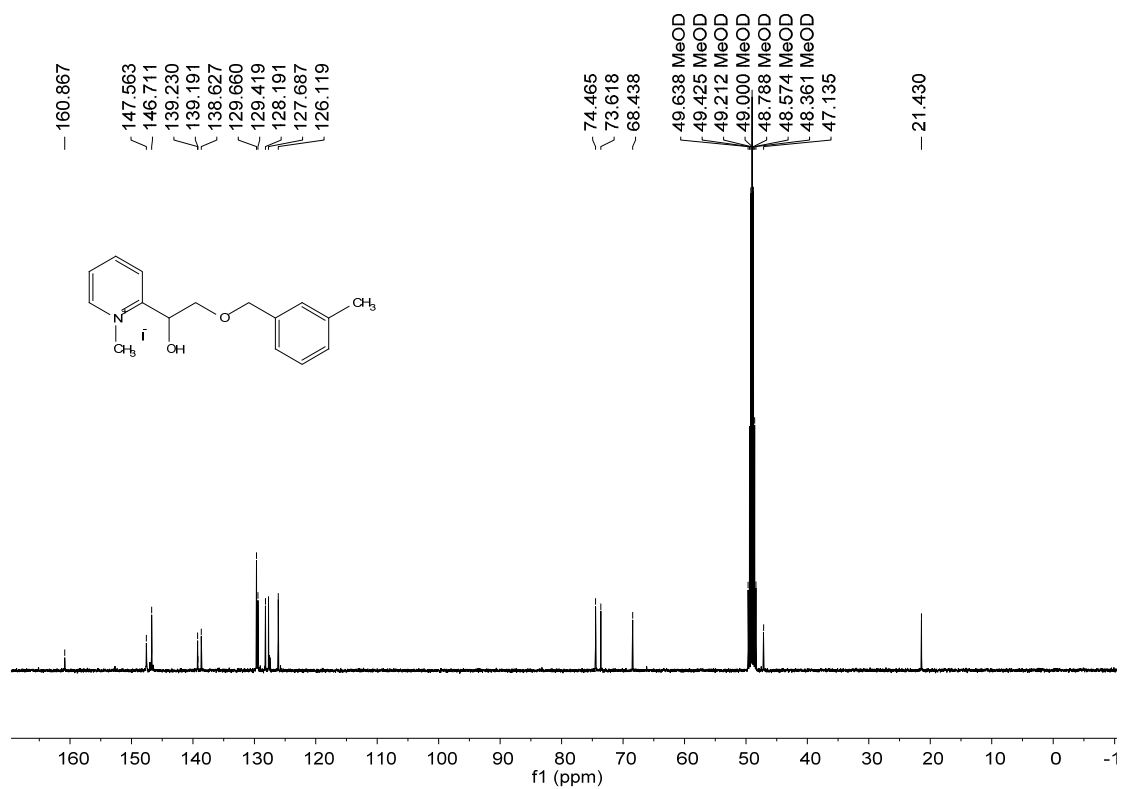
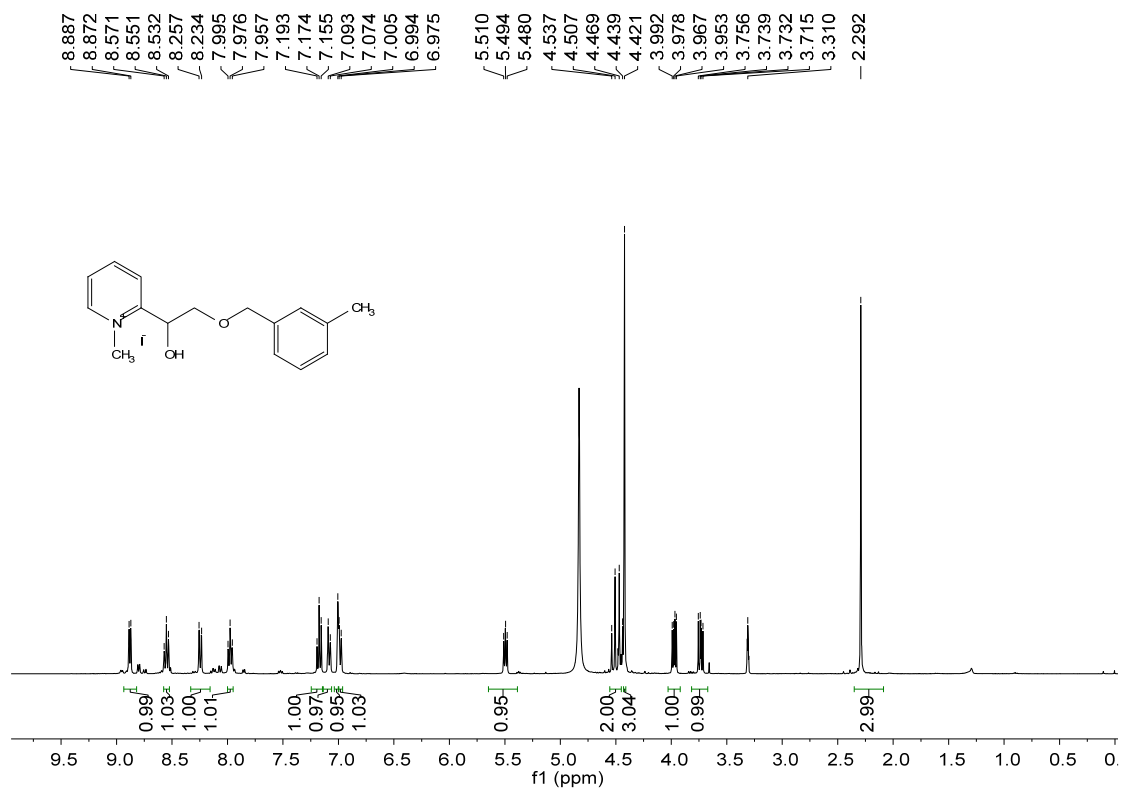
^1H and ^{13}C NMR spectra of **4p**



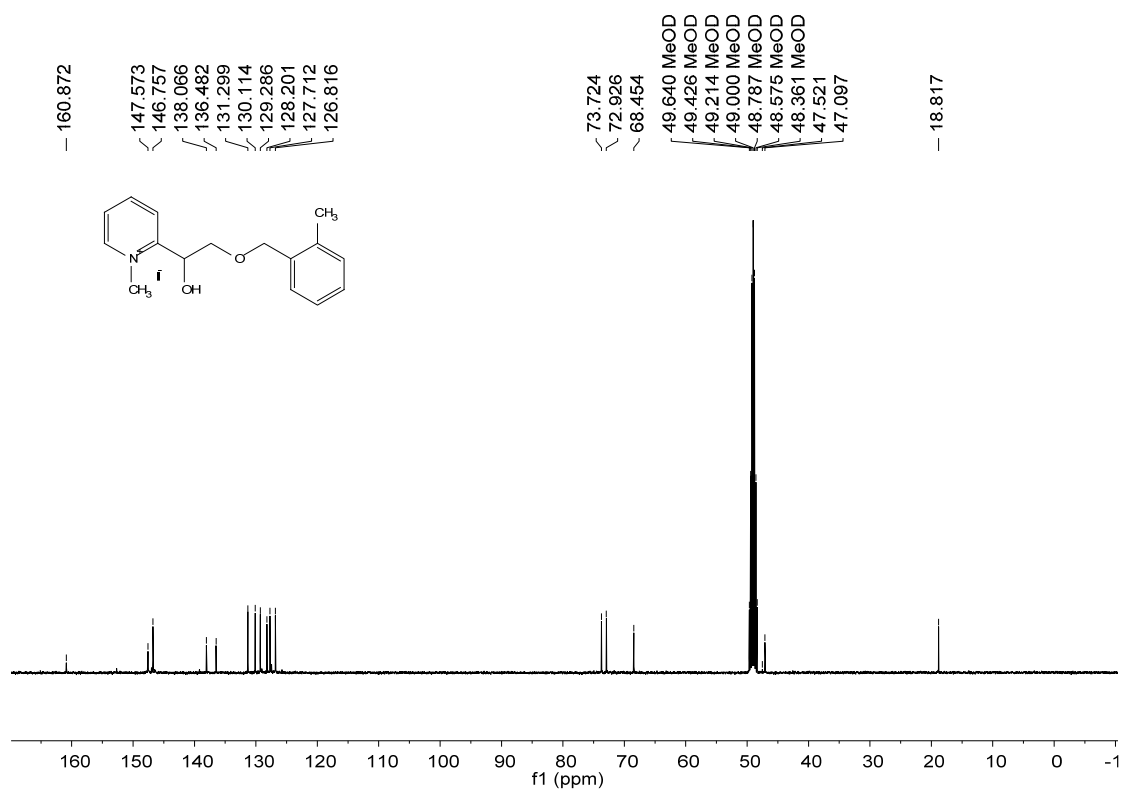
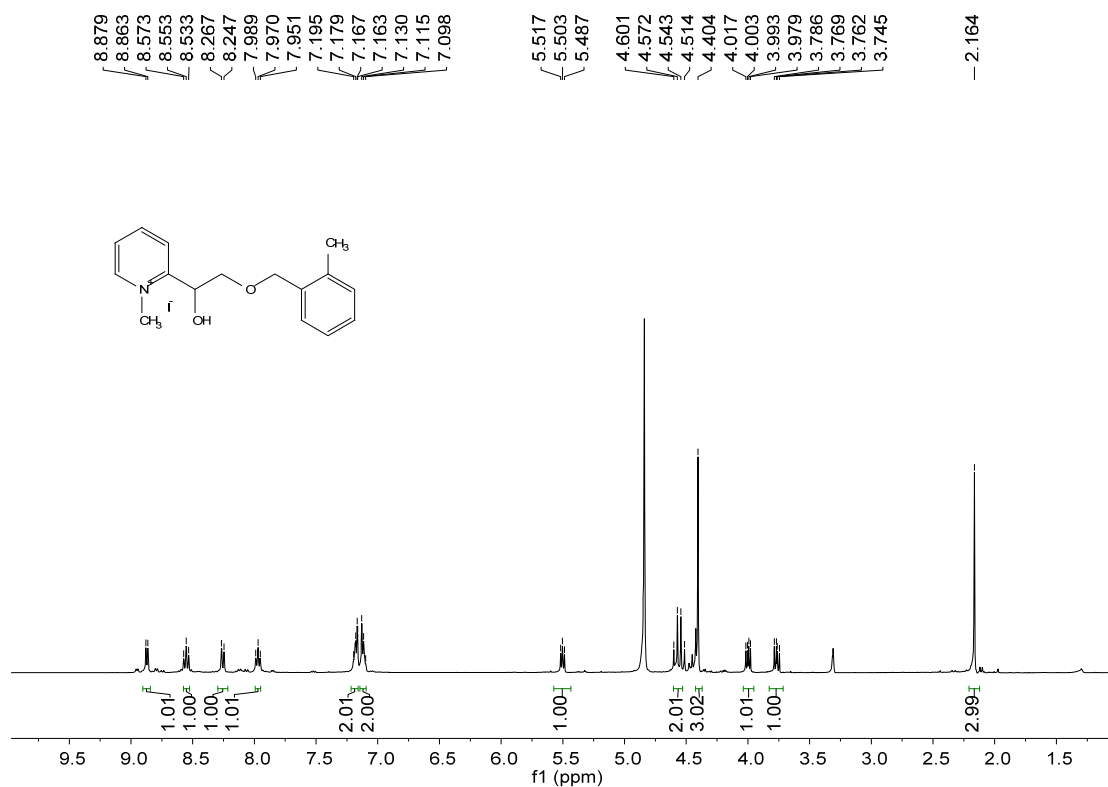
^1H and ^{13}C NMR spectra of **4q**



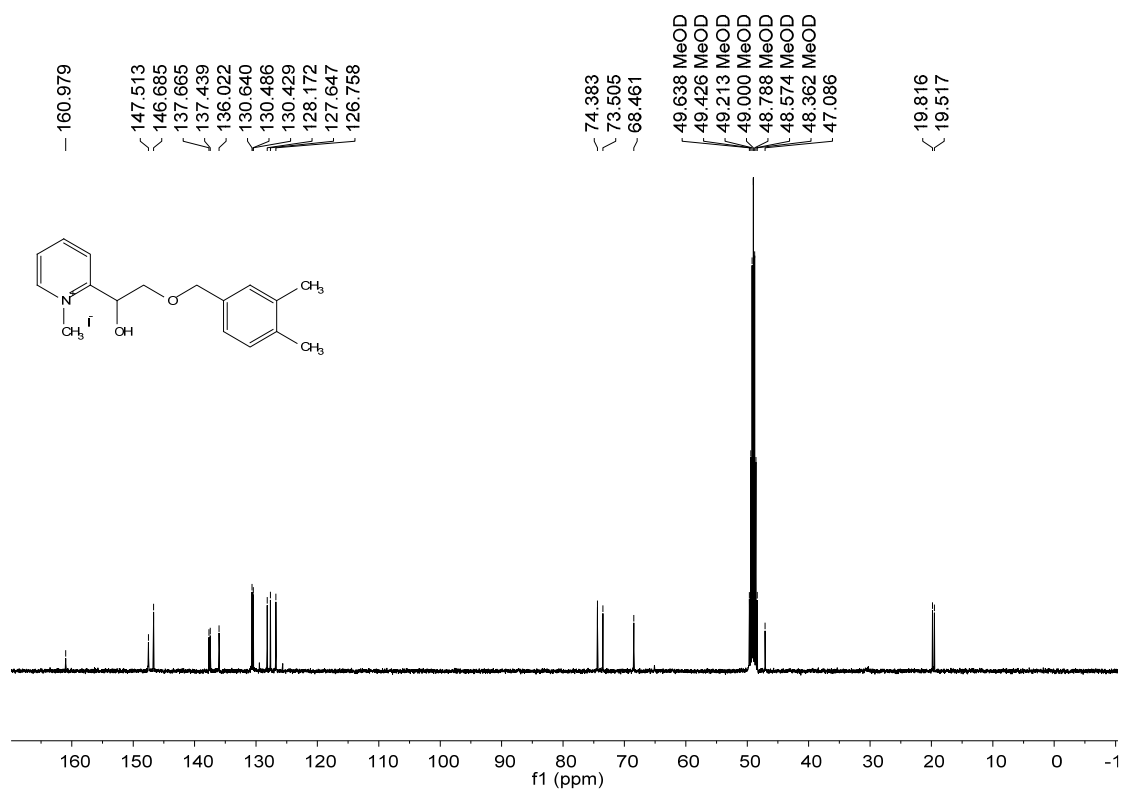
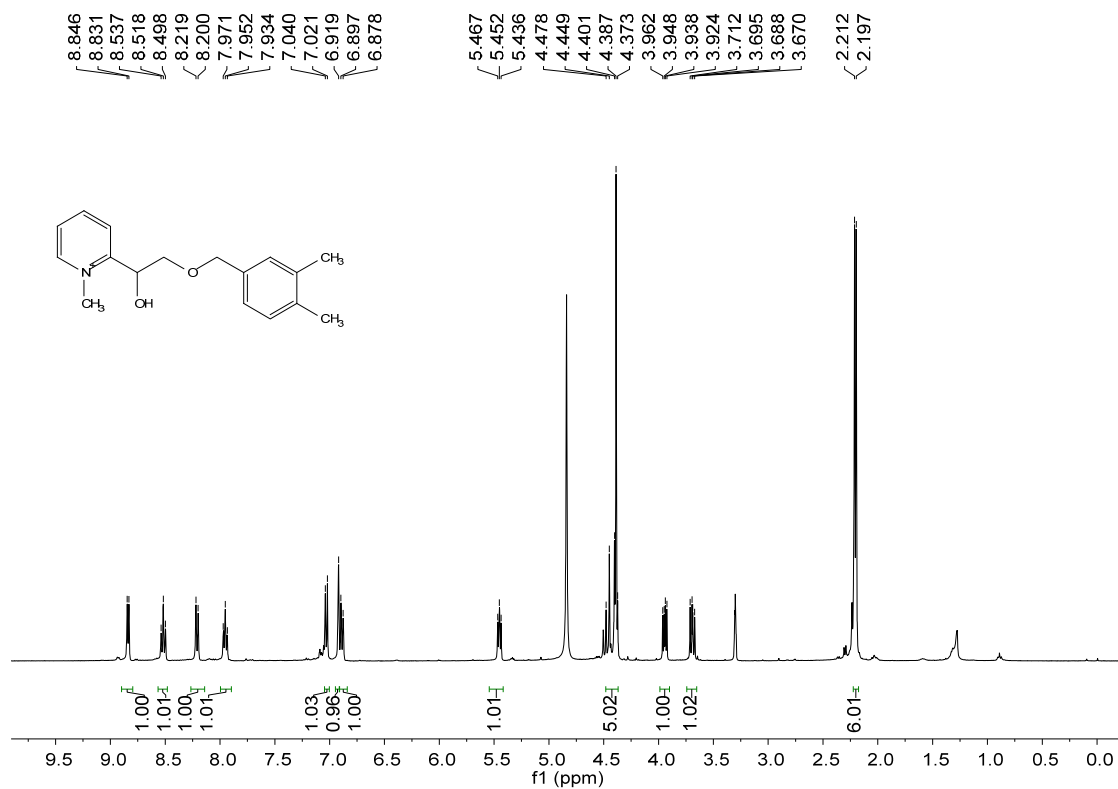
^1H and ^{13}C NMR spectra of **4r**



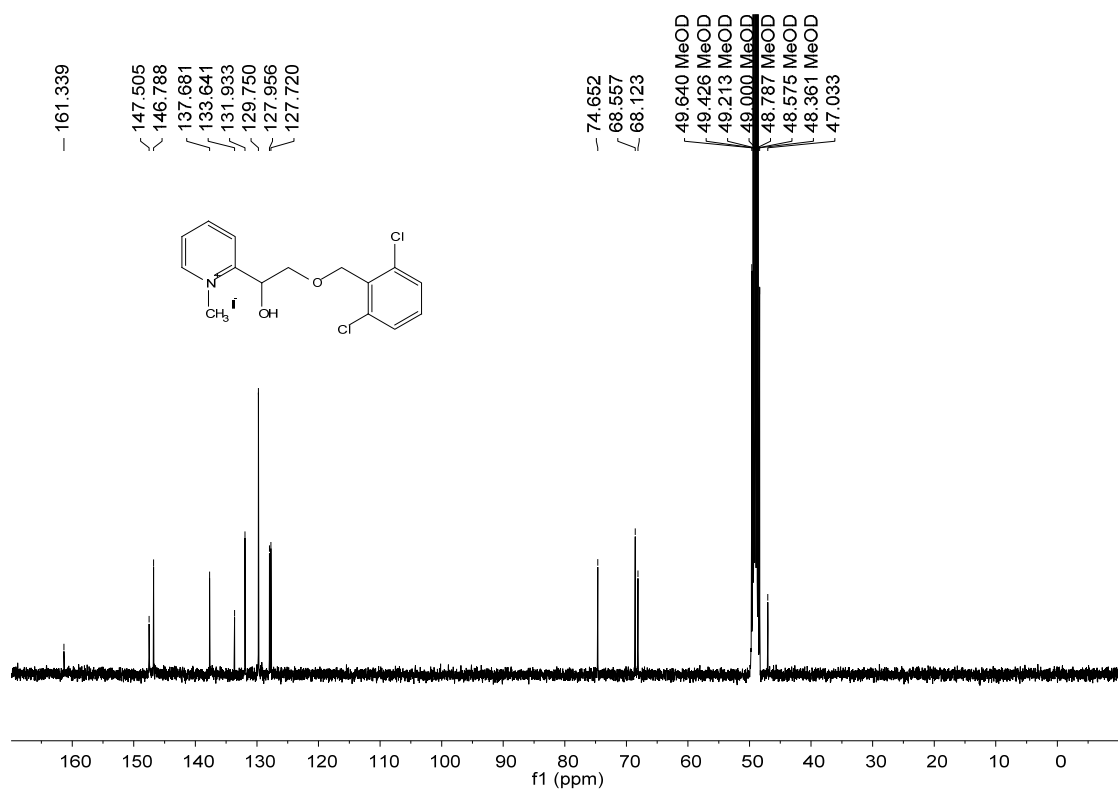
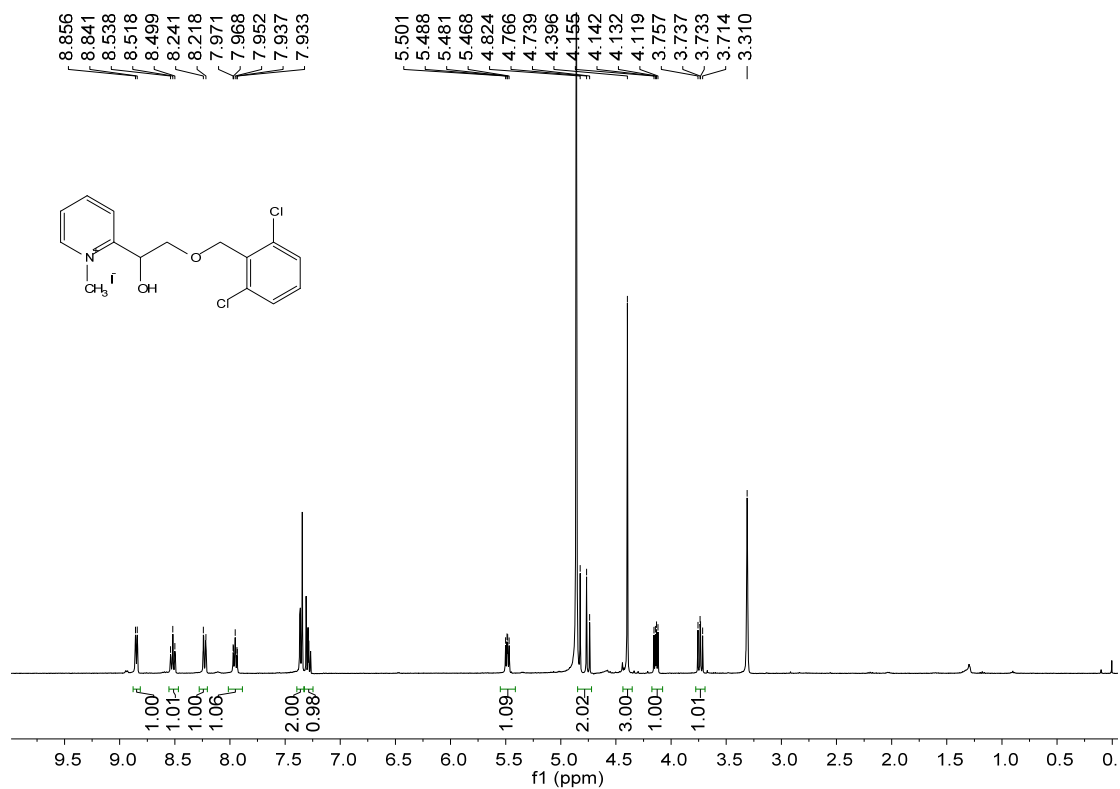
^1H and ^{13}C NMR spectra of **4s**



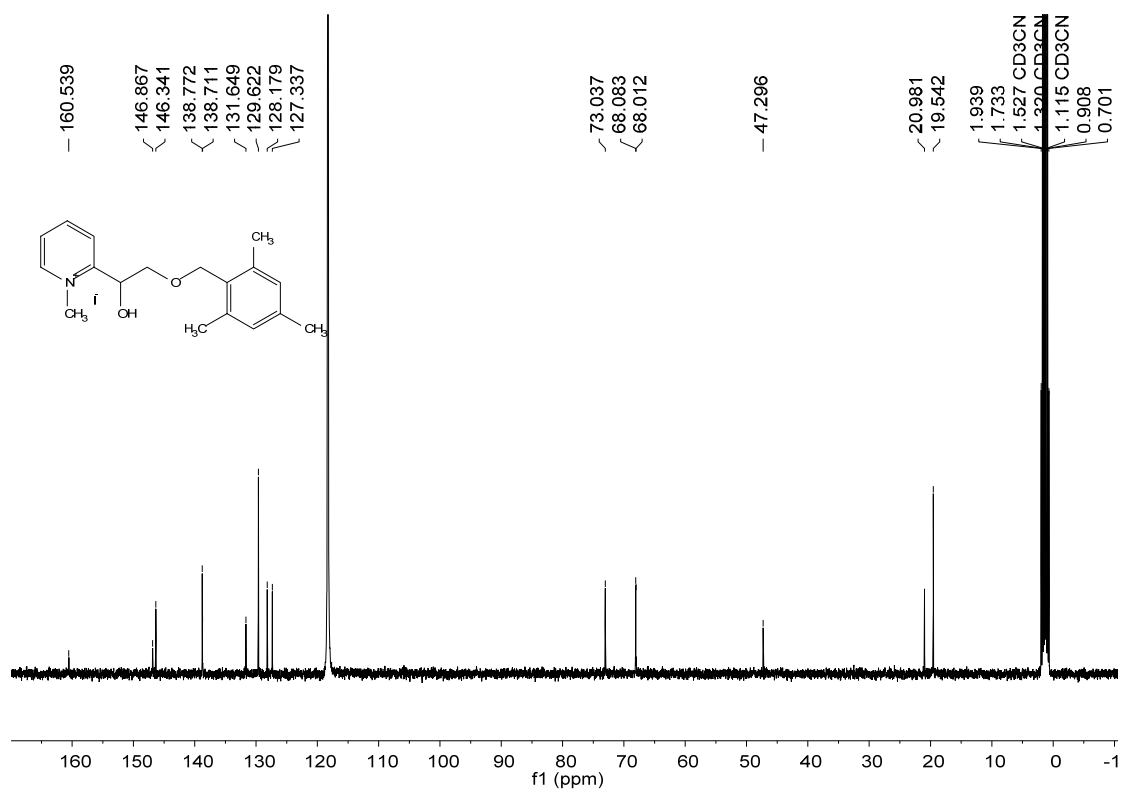
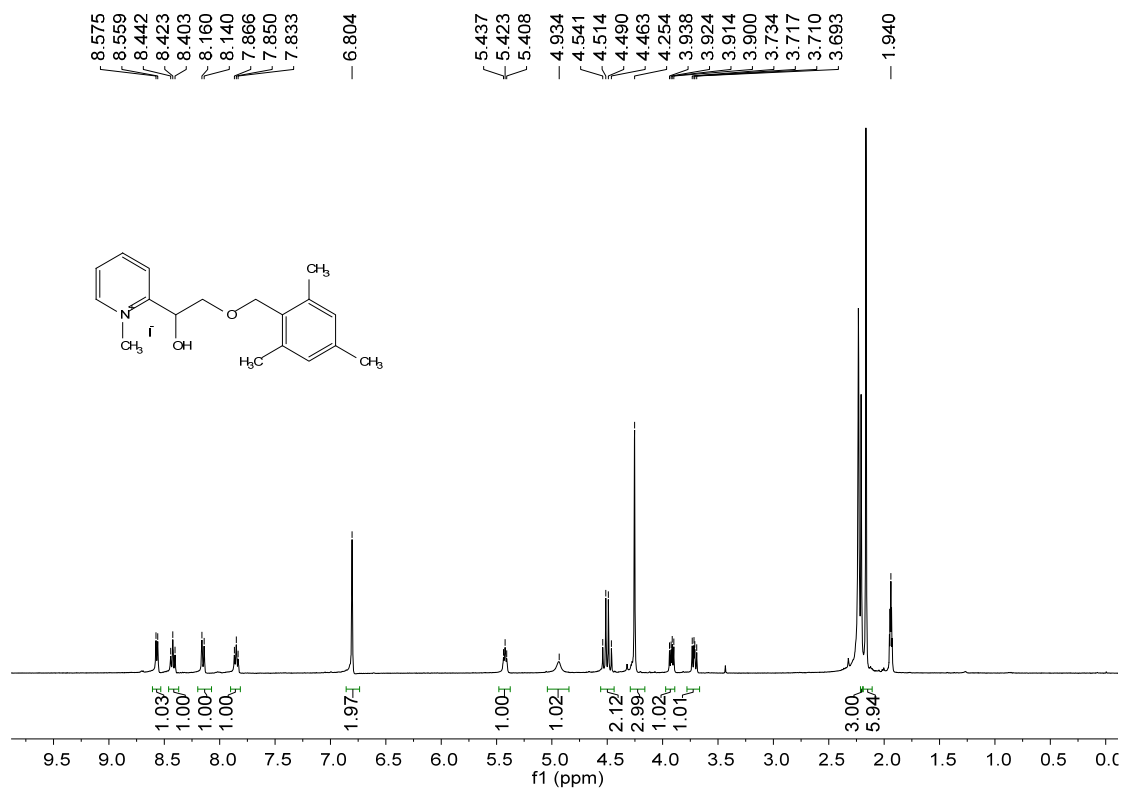
^1H and ^{13}C NMR spectra of **4t**



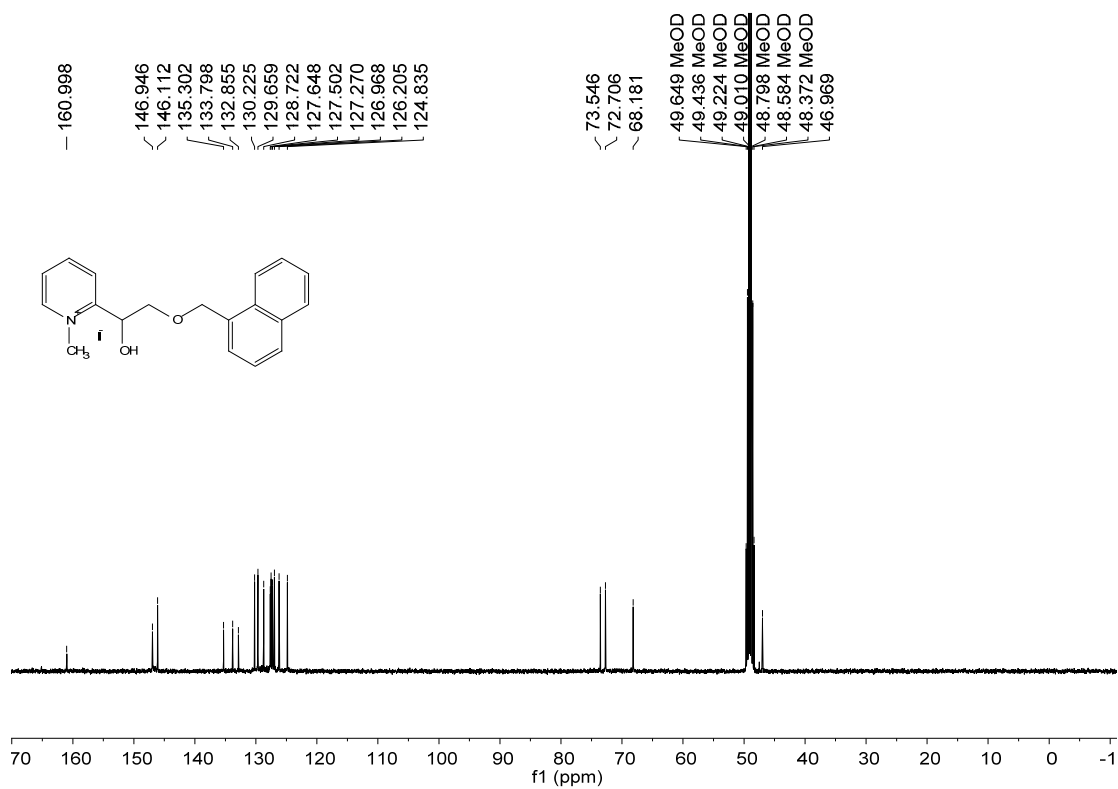
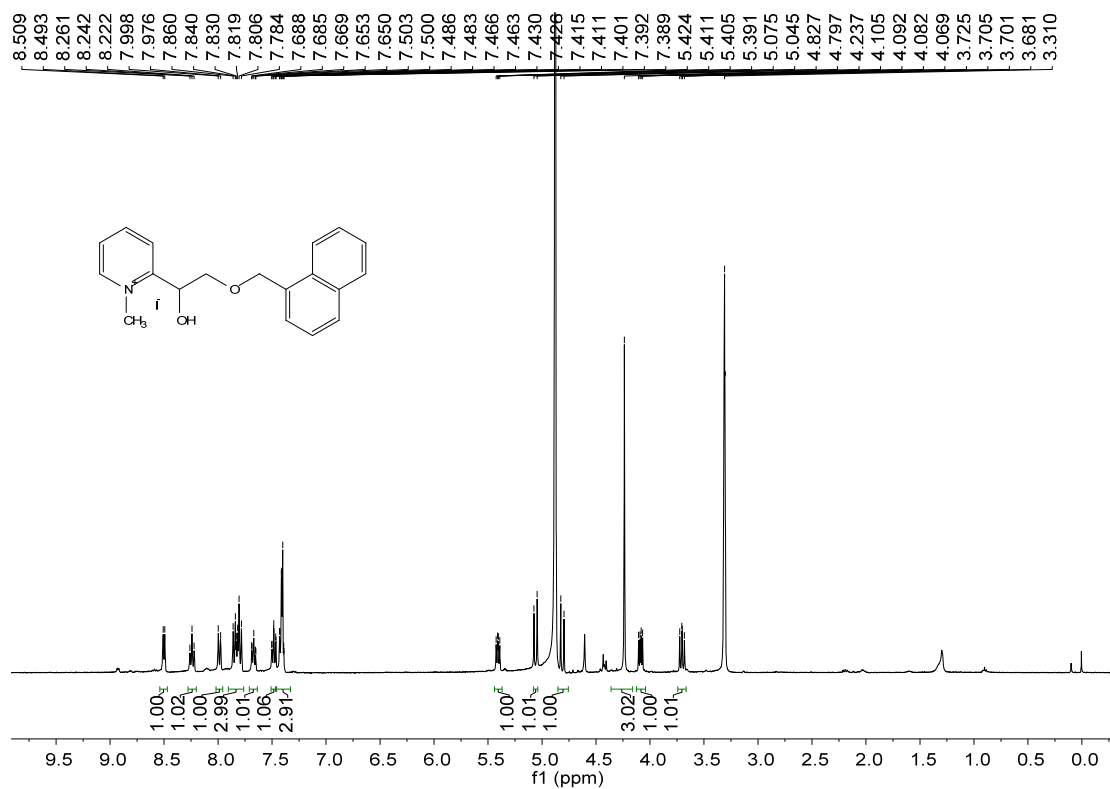
^1H and ^{13}C NMR spectra of **4u**



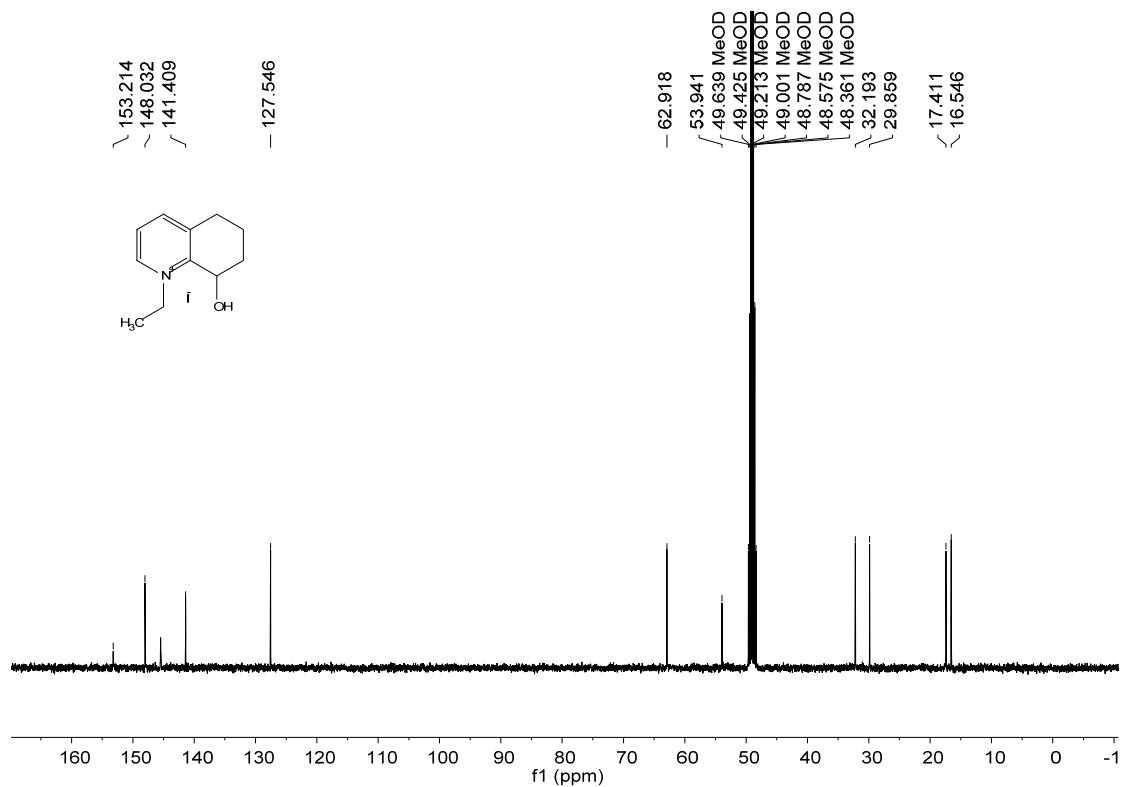
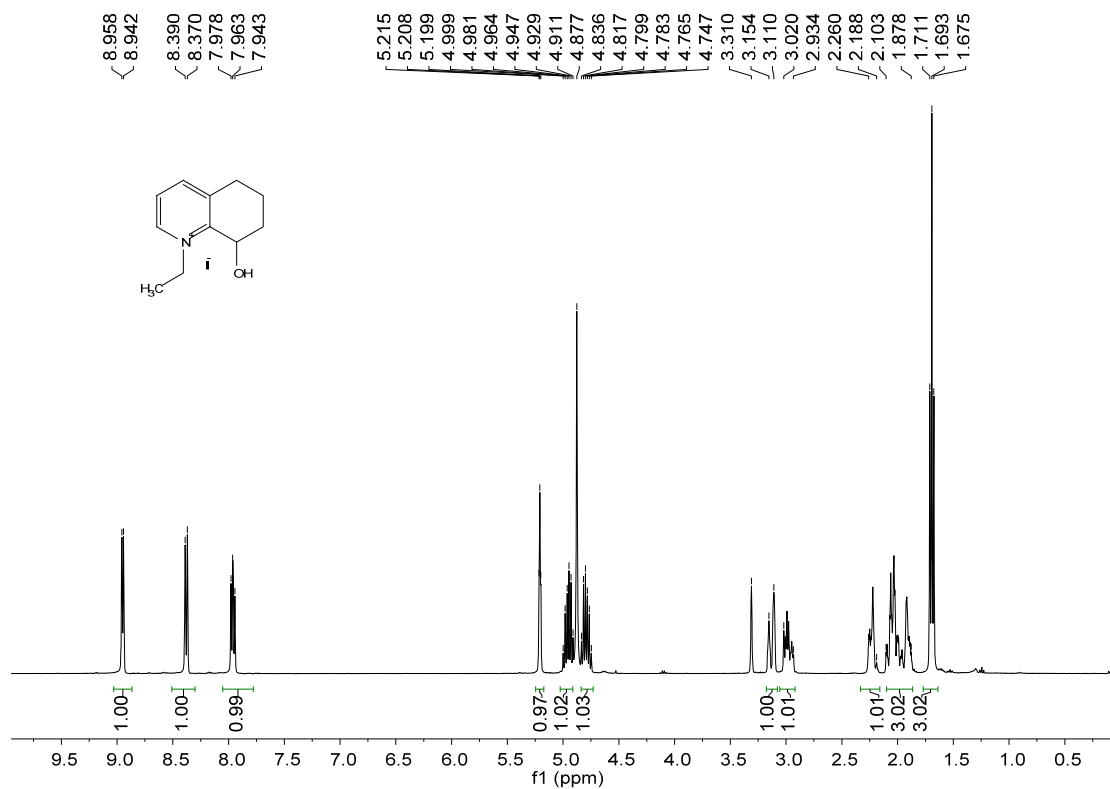
^1H and ^{13}C NMR spectra of **4v**



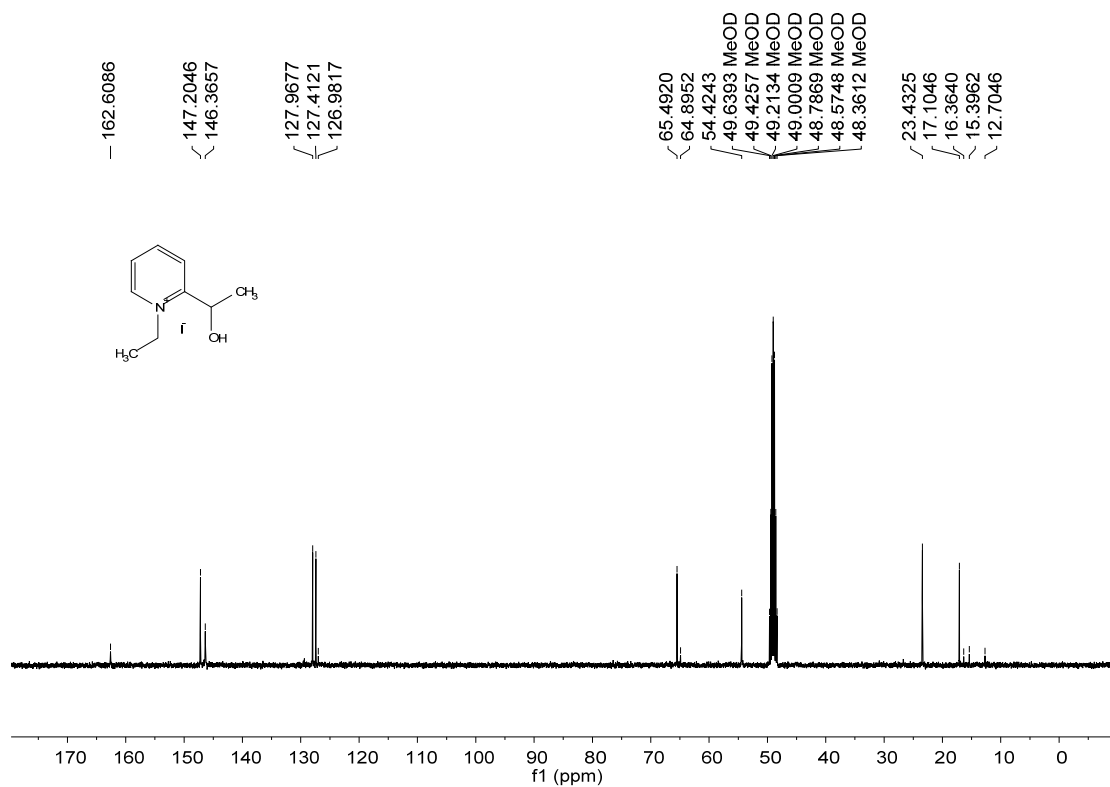
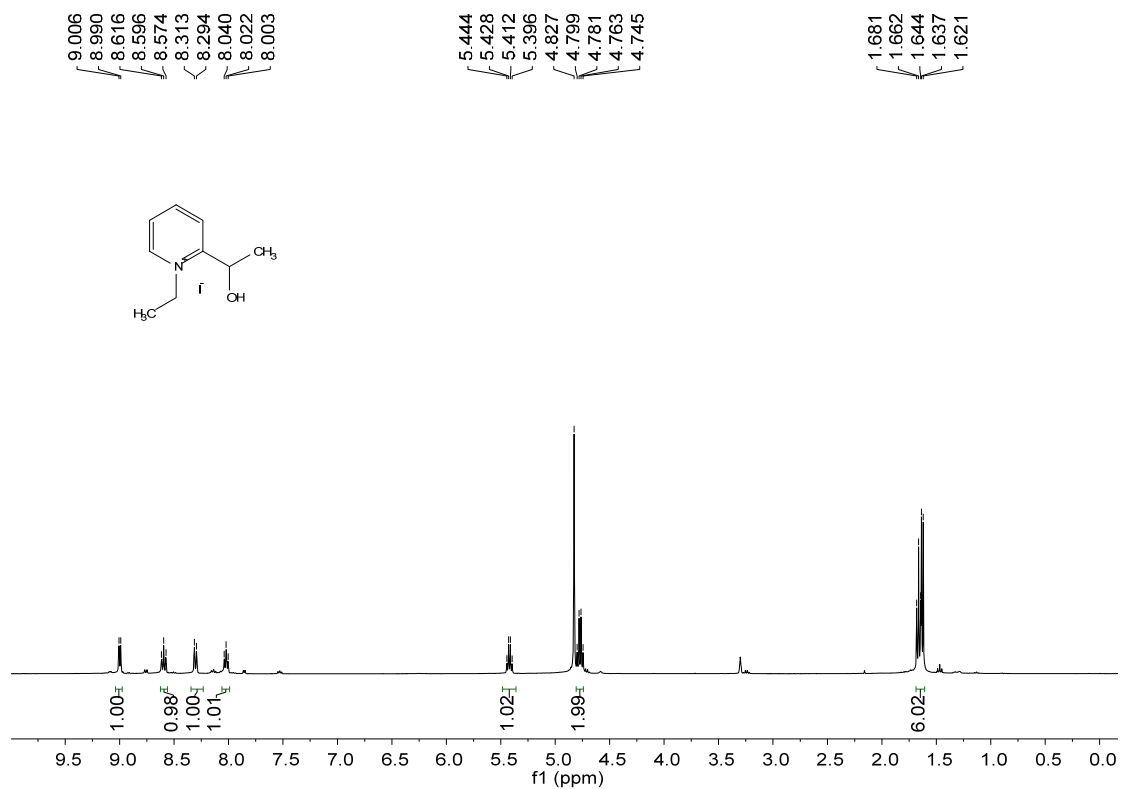
^1H and ^{13}C NMR spectra of **4w**



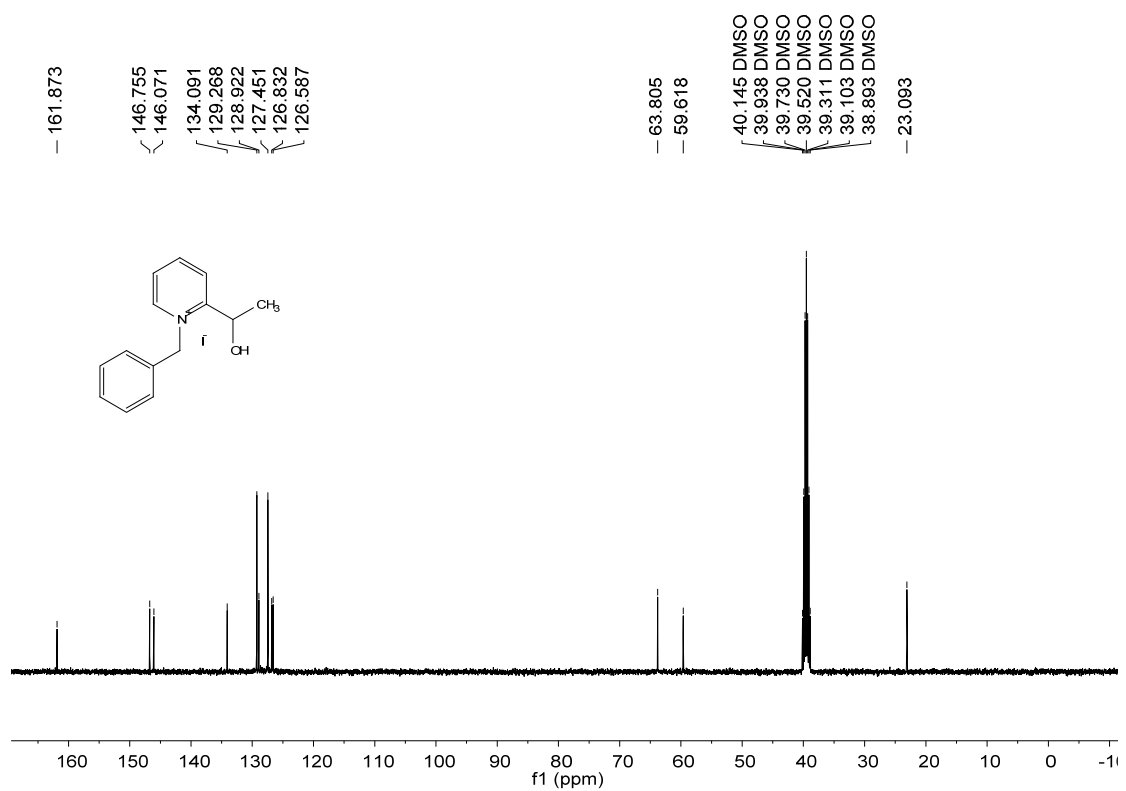
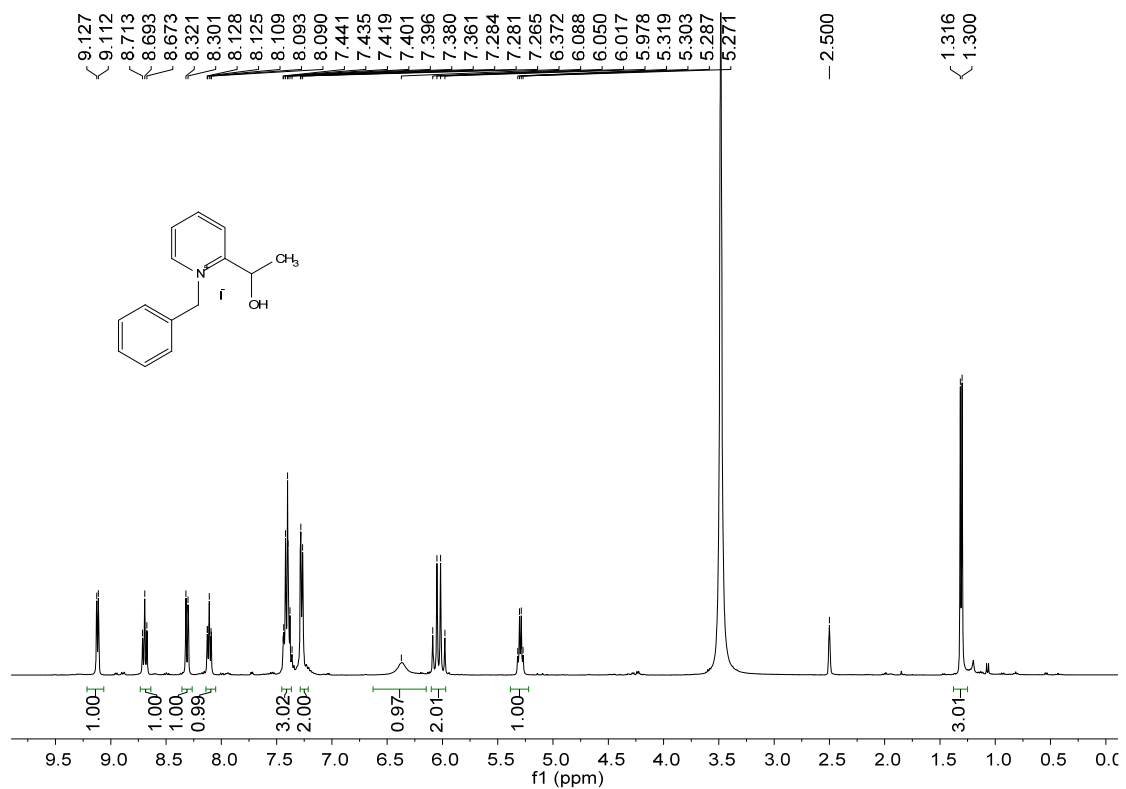
^1H and ^{13}C NMR spectra of **4x**



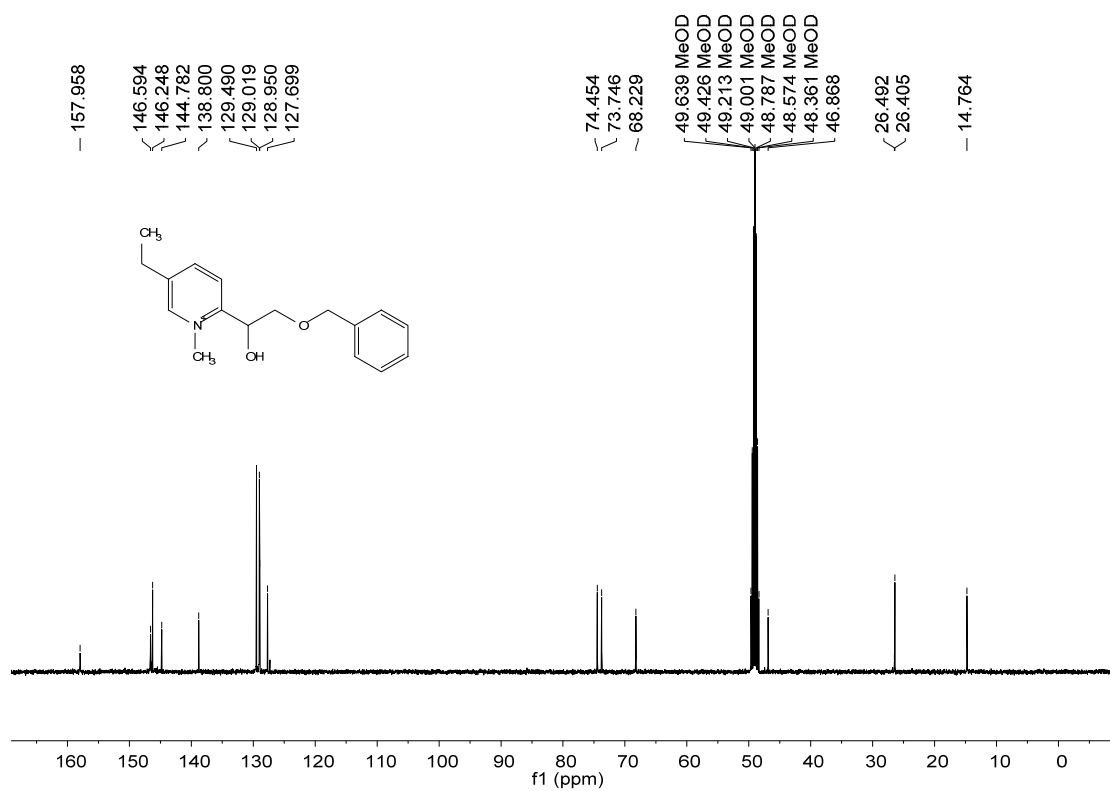
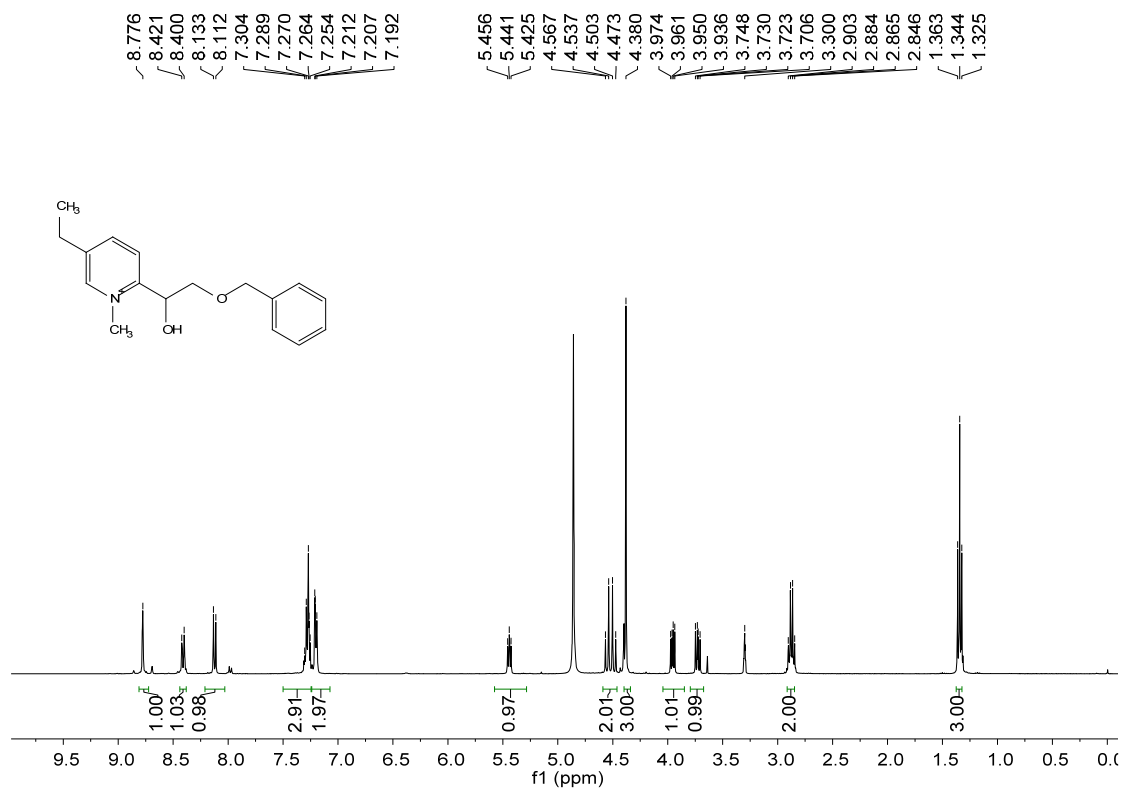
^1H and ^{13}C NMR spectra of **4y**



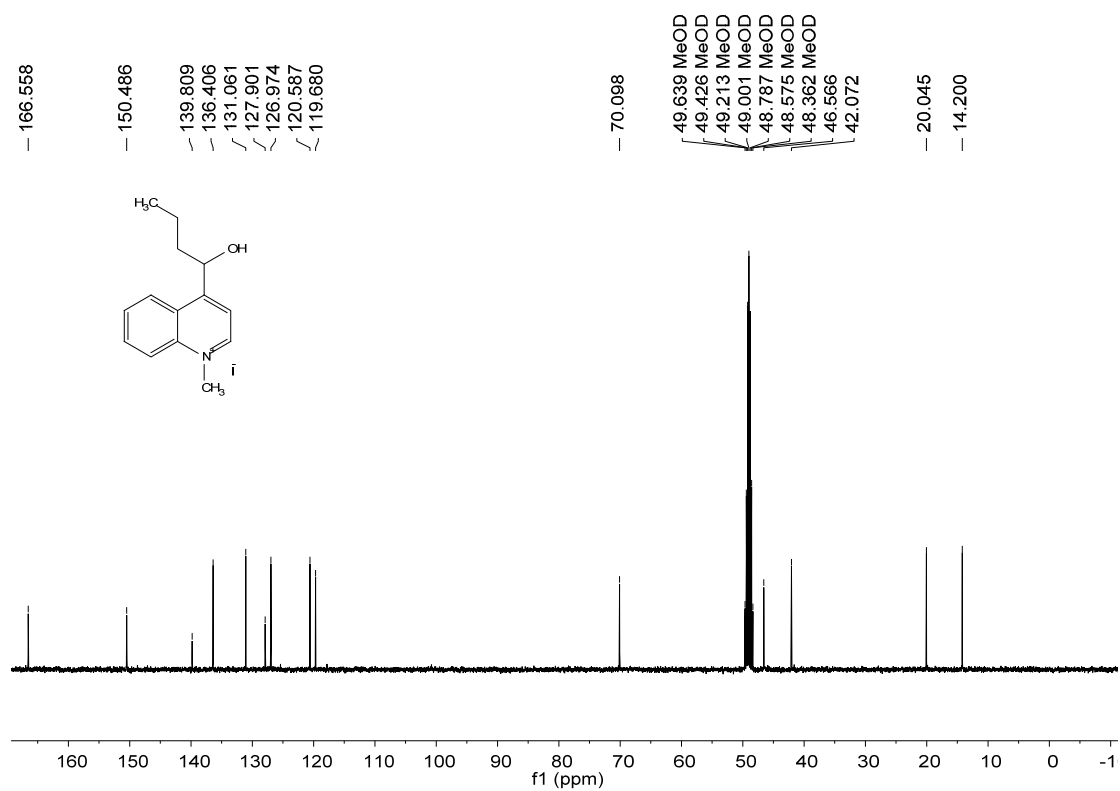
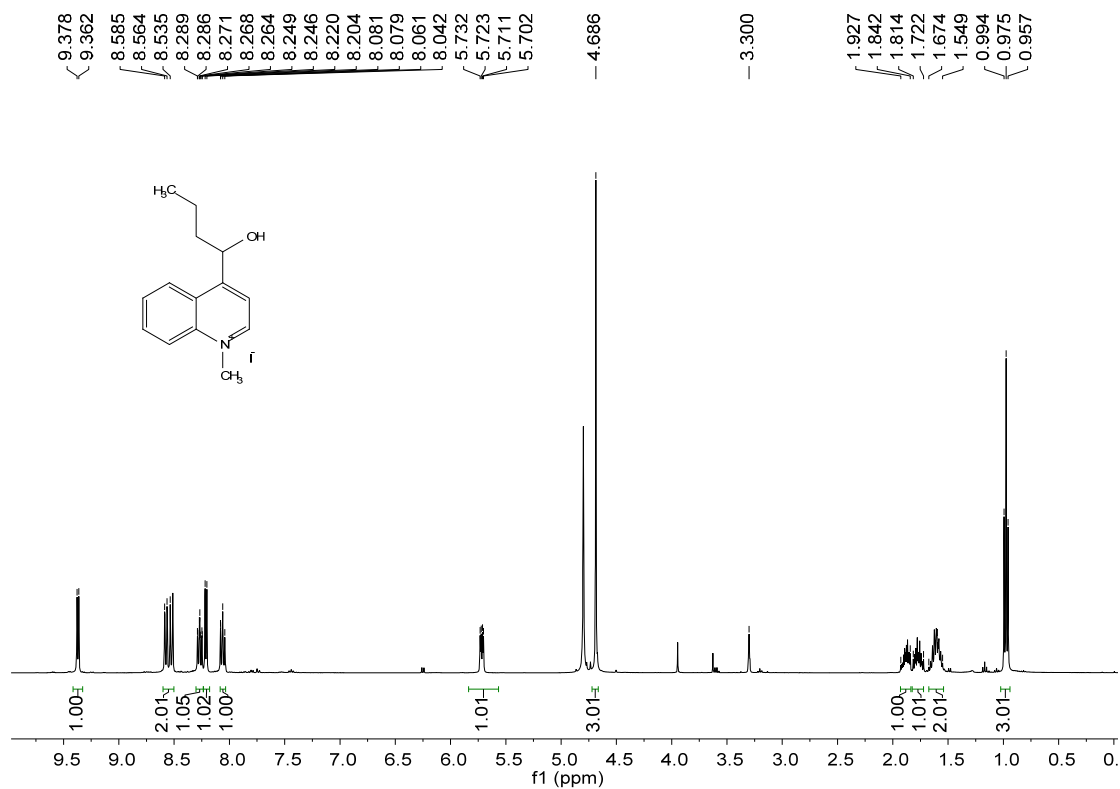
^1H and ^{13}C NMR spectra of **4z**



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



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



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

