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Electronic Supplementary Information

Efficient Reductive Amination of 5-Hydroxymethylfurfural by Iridium-Catalysed Transfer Hydrogenation

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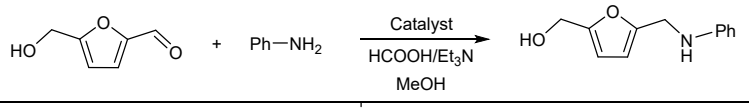
1. General information

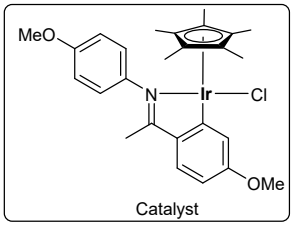
Unless otherwise specified, all reagents were obtained commercially and used without further purification. Methanol (MeOH) was purchased from *Energy Chemical*, and used without further purification. Dichloromethane (DCM) was dried over CaH_2 and distilled prior to use. Analytical thin-layer chromatography (TLC) was conducted with TLC plates (Silica gel 60 F254, Qingdao Haiyang). Flash column chromatography was performed on silica gel of 200-300 mesh. ^1H NMR spectra were recorded on a Bruker Advance 400 MHz NMR spectrometer and reported in units of parts per million (ppm) relative to tetramethyl silane (δ 0 ppm) or $CDCl_3$ (δ 7.26 ppm). Multiplicities are given as: brs (broad singlet), s (singlet), d (doublet), t (triplet), q (quartet), dd (doublets of doublet), dt (doublets of triplet), td (triplets of doublet) or m (multiplet). Coupling constants were reported as *J* value in Hz. ^{13}C NMR spectra was recorded on a Bruker Advance 400 NMR spectrometer with an operating frequency of 100 MHz and reported in ppm relative to tetramethyl silane (δ 0 ppm) or $CDCl_3$ (δ 77.16 ppm). HRMS data was recorded on a Bruker UHR-TOF mass spectrometer. Imines used for catalyst preparation were synthesized according to the literature.[1]

2. Optimization of reaction conditions

Table S1: The effect of solvents

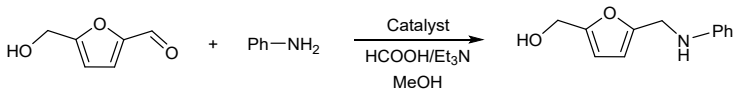


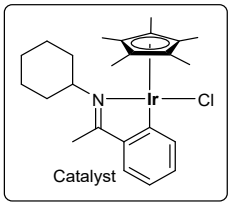
Entry	Solvent	Yield (%)[b]	Entry	Solvent	Yield (%)[b]
1	MeOH	83	7	Dioxane	28
2	EtOH	79	8	Acetonitrile	trace
3	tert-amyl alcohol	-	9	Dichloroethane	41
4	Toluene	trace	10	DMF	76
5	Cyclohexane	trace	11	DMSO	74
6	THF	42	12	Trifluoroethyl alcohol	-



[a] Reaction Conditions: HMF (0.5 mmol), aniline (0.5 mmol), catalyst (0.5 mol%), MeOH (3 mL), F/T (0.5 mL), 80 °C, under N_2; [b] Determined by ^1H NMR with 1,3,5-trimethoxybenzene as an internal standard. F/T = $HCOOH/Et_3N$.

Table S2: The effect of the molar ratio of HCOOH/Et_3N

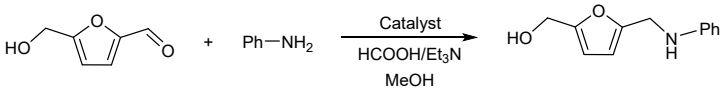


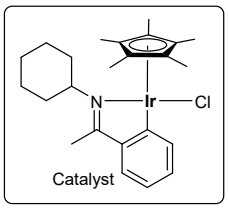


Entry	Molar ratio of HCOOH : Et_3N	Yield (%)[b]
1	HCOOH	47
2	5 : 1	86
3	5 : 2	93
4	5 : 3	93
5	5 : 4	88
6	5 : 5	85

[a] Reaction Conditions: HMF (0.5 mmol), aniline (0.9 mmol), catalyst (0.5 mol%), MeOH (3 mL), F/T (0.5 mL), under N_2; [b] Determined by ^1H NMR with 1,3,5-trimethoxybenzene as an internal standard. F/T = HCOOH/Et_3N.

Table S3: The effect of reaction temperature

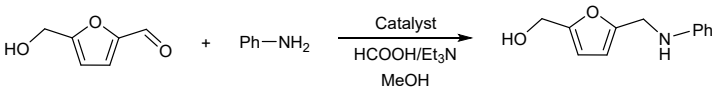


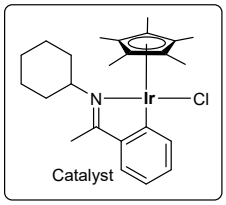


Entry	Reaction Temperature (^oC)	Yield (%)[b]
1	60	82
2	80	96
3	100	96

[a] Reaction Conditions: HMF (0.5 mmol), aniline (0.9 mmol), catalyst (0.5 mol%), MeOH (3 mL), F/T (0.1 mL), under N_2; [b] Determined by ^1H NMR with 1,3,5-trimethoxybenzene as an internal standard. F/T = HCOOH/Et_3N.

Table S4: The controlled experiments of this reaction





Entry	Reaction conditions	Yield (%)[b]
1	standard conditions	96
2	no HCOOH/Et_3N	0

[a] Reaction Conditions: HMF (0.5 mmol), aniline (0.9 mmol), catalyst (0.5 mol%), MeOH (3 mL), F/T (0.1 mL), under N_2; [b] Determined by ^1H NMR with 1,3,5-trimethoxybenzene as an internal standard. F/T = HCOOH/Et_3N.

3. General procedure for preparation of cyclometalated complexes

$[Cp^*IrCl_2]_2$ (1 equiv.), an imine ligand (2.2 equiv.) and NaOAc (10 equiv.) were placed into a Schlenk tube. The tube was then degassed and recharged with argon three times. DCM was then added and the resulting mixture was stirred at room temperature overnight. The reaction mixture was filtered through celite, and dried over Na_2SO_4. Following removal of the solvent under vacuum the resulting solid was washed with diethyl ether/hexane. The characterization of complexes **1a-1d** has been reported in our previous paper.[2]

4. Typical procedure for reductive amination of HMF

In the glove box, a pressure tube (35 mL) equipped with a magnetic stir bar was charged with catalyst (0.5 mol%), HMF (0.5 mmol), and amine (0.9 mmol). To the mixture was injected 3 mL of distilled MeOH and 0.1 mL of HCOOH/Et_3N azeotrope. The tube was sealed with a Teflon screw valve and moved out of the glovebox. The resulting mixture was stirred at 80 °C for 12 h. Following cooling to room temperature, the reaction was quenched with water and basified with aqueous NaOH solution, extracted with ethyl acetate and purified by flash chromatography (Petroleum ether : Ethyl acetate = 10:1 to 3:1).

5. Procedures for gram scale reaction and ten-gram scale reaction

Gram-scale synthesis of **3a**: A 250 mL round-bottom flask equipped with a magnetic stir bar was charged with HMF (1.26 g, 10 mmol), aniline (1.68 g, 18 mmol), **1e** (0.56 mg, 0.01 mol%), F/T (2 mL) and 60 mL of MeOH. The system was degassed 3 times with Ar and connected to an Ar balloon. The mixture was stirred at 80 °C with reflux under Ar atmosphere for 12 h. Following cooling to room temperature, the mixture was quenched with water and basified with aqueous NaOH solution, extracted with ethyl acetate and purified by flash chromatography (Petroleum ether : Ethyl acetate = 10:1 to 3:1) to obtain product **3a** (1.87 g, 92% yield). Product **3af** was synthesized via the same procedure as the gram-scale synthesis of **3a** at 10 mmol scale.

Ten Gram-scale synthesis of **3a**: A 1000 mL round-bottom flask equipped with a magnetic stir bar was charged with HMF (12.6 g, 100 mmol), aniline (16.8 g, 180 mmol), **1e** (5.6 mg, 0.01 mol%), F/T (20 mL) and 600 mL of MeOH. The system was degassed 3 times with Ar and connected to an Ar balloon. The mixture was stirred at 80 °C with reflux under Ar atmosphere for 12 h. Following cooling to room temperature, the mixture was quenched with water and basified with aqueous NaOH solution, extracted with ethyl acetate and purified by flash chromatography (Petroleum ether : Ethyl acetate = 10:1 to 3:1) to obtain product **3a** (16.86 g, 83% yield).

Ten Gram-scale synthesis of **3af**: A 1000 mL round-bottom flask equipped with a magnetic stir bar was charged with HMF (12.6 g, 100 mmol), NMe_2 in MeOH (180 mL, 1 M), **1e** (5.6 mg, 0.01 mol%), F/T (20 mL) and 400 mL of MeOH. The system was degassed 3 times with Ar and connected to an Ar balloon. The mixture was stirred at 80 °C with reflux under Ar atmosphere for 12 h. Following cooling to room temperature, the mixture was quenched with water and basified with aqueous NaOH solution, extracted with ethyl acetate to give the product **3af** (13.18 g, 85% yield).

6. Procedures for the synthesis of Ranitidine , CPA-1 and 3at

6.1 Procedure for the synthesis of Ranitidine and CPA-1

Synthesis of **3aq**: A 100 mL round-bottom flask equipped with a magnetic stir bar was charged with **3af** (13.18 g, 85 mmol), cysteamine hydrochloride (9.66 g, 85 mmol) and concentrated hydrochloric acid (24 mL). The mixture was stirred at 55 °C under argon for 3 h and then cooled to room temperature and diluted with water. The pH was adjusted to 14 by the addition of 50% aqueous NaOH solution, with cooling, and the solution was extracted with ethyl acetate. The combined organic phases were washed with brine and concentrated under reduced pressure. The product was purified by flash chromatography (DCM : MeOH : Et_3N = 95 : 5 : 1) to obtain product **3aq** (73% yield, 13.3 g) as a light-yellow oil.

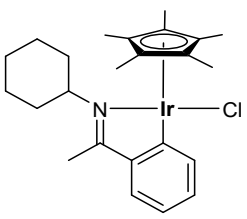
Synthesis of **Ranitidine**: A solution of **3aq** (13.3 g, 62 mmol) in water (15 mL) was added dropwise to a stirred suspension of *N*-Methyl-1-(methylthio)-2-nitroethylen-1-amine (9.2 g, 62 mmol) in water (15 mL). The mixture was stirred at 55 °C under argon for 8 h. After cooling to room temperature, the reaction was quenched by the addition of water, extracted with chloroform, the combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under vacuum to give crude Ranitidine as yellow oil. The oil was crystallized in ether to give Ranitidine (69% yield, 13.5 g) as a yellow solid.

Synthesis of **CPA-1**: In the glove box, a pressure tube (35 mL) equipped with a magnetic stir bar was charged with **3aq** (1 mmol), 3-chloro-4-methylphenylisocyanate (1.05 mmol) and DCE (8 mL). The tube was sealed with a Teflon screw valve and moved out of the glovebox. The resulting mixture was stirred at 50 °C overnight. Following cooling to room temperature, the solvent was removed under reduced pressure and the residue was purified by flash chromatography ($CHCl_3$: MeOH = 8 : 1) to give **CPA-1** (76% yield, 289.7 mg) as a yellow solid.

6.2 Procedure for the synthesis of 3at

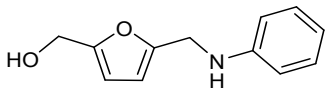
In the glove box, a pressure tube (35 mL) equipped with a magnetic stir bar was charged with **1e** (1 mol%), **3l** (0.5 mmol), 4-bromoaniline (0.6 mmol), and K_2CO_3 (5 mol%). To the mixture was injected 2.6 mL of TFE. The tube was sealed with a Teflon screw valve and moved out of the glovebox. The resulting mixture was stirred at 100 °C for 12 h. Following cooling to room temperature, the reaction was quenched with water and basified with aqueous NaOH solution, extracted with ethyl acetate and purified by flash chromatography (DCM) to give **3at** (43%, 93.3 mg) as colorless oil.

7. Characterization data of an iridium catalyst and products



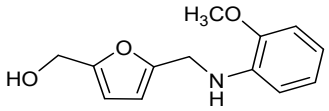
Iridium complex formed from *N*-Cyclohexyl-1-phenylethan-1-imine (1e):
yellow solid; ^{1}H NMR ($CDCl_3$, 600 MHz) δ (ppm): 7.72 (d, *J* = 7.6 Hz, 1H), 7.39 (d, *J* = 7.7 Hz, 1H), 7.13 (t, *J* = 7.3 Hz, 1H), 6.94 (t, *J* = 7.3 Hz, 1H), 4.16 (t, *J* = 11.8 Hz, 1H), 2.68 (s, 3H), 2.19 (d, *J* = 11.3 Hz, 2H), 1.98 (q, *J* = 12.8 Hz, 1H), 1.89 (m, 2H), 1.78-1.72 (m, 3H), 1.68 (s, 15H), 1.42 (q, *J* = 13.1 Hz, 2H), 1.28 (q, *J* = 13.0 Hz, 1H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm): 179.3,

167.0, 149.3, 135.0, 127.1, 121.1, 89.1, 70.3, 32.7, 31.2, 26.0, 25.6, 25.5, 17.8, 9.7. HRMS (ESI) *m/z* calc. for $C_{24}H_{33}IrN$ $[M\text{-}Cl]^+$: 528.2238, found: 528.2230.



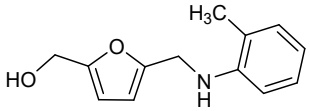
(5-((Phenylamino)methyl)furan-2-yl)methanol (3a)[3]

yellow oil (86% yield, 87.3 mg), Rf: 0.5 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.20 (t, *J* = 7.8 Hz, 2H), 6.76 (t, *J* = 7.3 Hz, 1H), 6.68 (d, *J* = 8.0 Hz, 2H), 6.20 (d, *J* = 2.7 Hz, 1H), 6.18 (d, *J* = 2.9 Hz, 1H), 4.54 (s, 2H), 4.29 (s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 152.6, 147.5, 129.1, 118.0, 113.2, 108.5, 107.7, 57.1, 41.4.



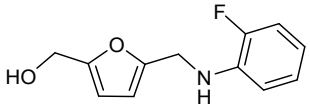
(5-(((2-Methoxyphenyl)amino)methyl)furan-2-yl)methanol (3b)[4]

yellow oil (85% yield, 99.1 mg), Rf: 0.5 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.88 (td, *J* = 7.6, 1.2 Hz, 1H), 6.81-6.79 (m, 1H), 6.74-6.69 (m, 2H), 6.20-6.19 (m 2H), 4.54 (s, 2H), 4.32 (s, 2H), 3.84 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 152.9, 147.0, 137.5, 121.1, 117.2, 110.3, 109.5, 108.5, 107.7, 57.3, 55.4, 41.2.



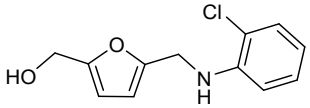
(5-((o-Tolylamino)methyl)furan-2-yl)methanol (3c)[3]

yellow oil (83% yield, 90.1 mg) , Rf: 0.5 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.16 (t, *J* = 5.0 Hz, 1H), 7.11 (d, *J* = 4.9 Hz, 1H), 6.75-6.71 (m, 2H), 6.23 (d, *J* = 2.1 Hz, 1H), 6.21 (d, *J* = 2.1 Hz, 1H), 4.55 (s, 2H), 4.36 (s, 2H), 2.19 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 152.8, 145.4, 130.1, 127.0, 122.4, 117.7, 110.2, 108.5, 107.7, 57.2, 41.4, 17.4.



(5-(((2-Fluorophenyl)amino)methyl)furan-2-yl)methanol (3d)

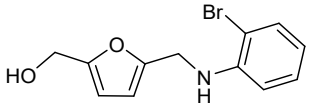
yellow oil (83% yield, 91.8 mg) , Rf: 0.8 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.01-6.95 (m, 2H), 6.79-6.74 (m, 1H), 6.69-6.63 (m, 1H), 6.22 (d, *J* = 3.1 Hz, 1H), 6.19 (d, *J* = 3.1 Hz, 1H), 4.57 (s, 2H), 4.34 (s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.6, 152.3, 151.7 (d, $^1J_{C\text{-}F}$ = 237.1 Hz), 135.9 (d, $^3J_{C\text{-}F}$ = 11.5 Hz), 124.5 (d, $^4J_{C\text{-}F}$ = 3.5 Hz), 117.4 (d, $^3J_{C\text{-}F}$ = 7.1 Hz), 114.5 (d, $^2J_{C\text{-}F}$ = 18.3 Hz), 112.6 (d, $^4J_{C\text{-}F}$ = 3.0 Hz), 108.6, 107.9, 57.4, 41.1. HRMS (ESI) *m/z* calc. for $C_{12}H_{12}FNO_2Na$ $[M+Na]^+$: 244.0744, found: 244.0744.



(5-(((2-Chlorophenyl)amino)methyl)furan-2-yl)methanol (3e)[3]

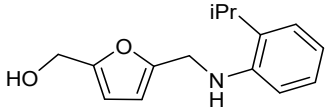
yellow oil (85% yield, 100.8 mg) , Rf: 0.6 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.25 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.14-7.09 (m, 1H), 6.71 (dd, *J* = 8.2, 1.1Hz, 1H), 6.65 (td, *J* = 7.7, 1.3 Hz, 1H), 6.20 (d, *J* = 3.2 Hz, 1H), 6.17 (d, *J* = 3.1 Hz, 1H), 4.68 (brs, 1H),

4.54 (s, 2H), 4.34 (d, *J* = 2.5 Hz, 2H), 2.12 (brs, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.6, 152.2, 143.4, 129.2, 127.7, 119.4, 117.9, 111.6, 108.6, 107.9, 57.4, 41.1.



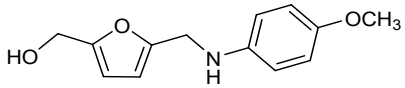
(5-(((2-Bromophenyl)amino)methyl)furan-2-yl)methanol (3f)

yellow oil (95% yield, 133.5 mg) , Rf: 0.8 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.43 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.19-7.15 (m, 1H), 6.71 (dd, *J* = 8.1, 1.1 Hz, 1H), 6.60 (td, *J* = 7.7, 1.4 Hz, 1H), 6.22 (d, *J* = 3.2 Hz, 1H), 6.19 (d, *J* = 3.1 Hz, 1H), 4.71 (brs, 1H), 4.58 (s, 2H), 4.37 (d, *J* = 2.8 Hz, 2H), 1.90 (brs, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.6, 152.2, 144.4, 132.5, 128.5, 118.5, 111.7, 110.0, 108.7, 107.9, 57.5, 41.4. HRMS (ESI) *m/z* calc. for $C_{12}H_{12}BrNO_2Na$ $[M+Na]^+$: 303.9944, found: 303.9938.



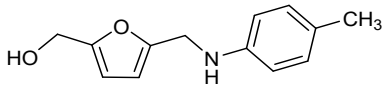
(5-(((2-Isopropylphenyl)amino)methyl)furan-2-yl)methanol (3g)

yellow oil (84% yield, 103.0 mg) , Rf: 0.6 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.18 (d, *J* = 7.6 Hz, 1H), 7.12 (td, *J* = 8.0, 1.4 Hz, 1H), 6.79 (t, *J* = 7.5 Hz, 1H), 6.72 (d, *J* = 8.0 Hz, 1H), 6.23 (d, *J* = 3.1 Hz, 1H), 6.20 (d, *J* = 3.1 Hz, 1H), 4.58 (s, 2H), 4.36 (s, 2H), 2.95-2.88 (m, 1H), 1.27 (d, *J* = 6.8 Hz, 6H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 153.0, 144.2, 132.7, 126.6, 125.0, 118.1, 111.0, 108.6, 107.7, 57.4, 41.8, 27.1, 22.4. HRMS (ESI) *m/z* calc. for $C_{15}H_{19}NO_2Na$ $[M+Na]^+$: 268.1308, found: 268.1305.



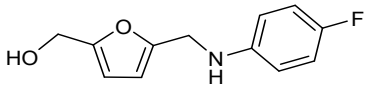
(5-(((4-Methoxyphenyl)amino)methyl)furan-2-yl)methanol (3h)

yellow oil (95% yield, 110.7 mg) , Rf: 0.3 (Petroleum ether : Ethyl acetate = 1:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.79-6.77 (m, 2H), 6.65-6.62 (m, 2H), 6.19 (d, *J* = 3.0 Hz, 1H), 6.15 (d, *J* = 3.0 Hz, 1H), 4.53 (s, 2H), 4.23 (s, 2H), 3.73 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 153.0, 152.6, 141.6, 114.8, 108.5, 107.7, 57.3, 55.7, 42.5. HRMS (ESI) *m/z* calc. for $C_{15}H_{19}NO_2Na$ $[M+Na]^+$: 268.1308, found: 268.1305.



(5-((p-Tolylamino)methyl)furan-2-yl)methanol (3i)[3]

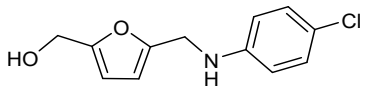
yellow oil (87% yield, 94.4 mg) , Rf: 0.5 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.00 (d, *J* = 8.1 Hz, 2H), 6.60 (d, *J* = 8.2 Hz, 2H), 6.20 (d, *J* = 2.9 Hz, 1H), 6.17 (d, *J* = 2.7 Hz, 1H), 4.54 (s, 2H), 4.27 (s, 2H), 2.25 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 153.0, 145.2, 129.7, 127.4, 113.5, 108.6, 107.7, 57.4, 41.9, 20.4.



(5-(((4-Fluorophenyl)amino)methyl)furan-2-yl)methanol (3j)[3]

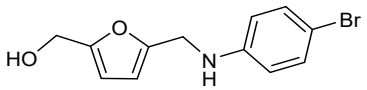
yellow oil (85% yield, 94.0 mg) , Rf: 0.5 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$,

400 MHz) δ (ppm): 6.88 (t, *J* = 8.8 Hz, 2H), 6.61-6.57 (m, 2H), 6.20 (d, *J* = 3.1 Hz, 1H), 6.16 (d, *J* = 3.1 Hz, 1H), 4.54 (s, 2H), 4.24 (s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 156.2 (d, $^{1}J_{C\text{-}F}$ = 234.3 Hz), 153.5, 152.6, 143.8, 115.7 (d, $^{2}J_{C\text{-}F}$ = 22.4 Hz), 114.2 (d, $^{3}J_{C\text{-}F}$ = 7.4 Hz), 108.6, 107.9, 57.4, 42.1.



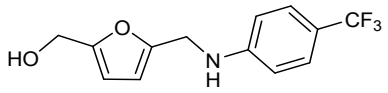
(5-(((4-Chlorophenyl)amino)methyl)furan-2-yl)methanol (3k)[3]

yellow oil (92% yield, 109.0 mg) , Rf: 0.6 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.12 (d, *J* = 8.9 Hz, 2H), 6.58 (d, *J* = 8.8 Hz, 2H), 6.22 (d, *J* = 3.1 Hz, 1H), 6.17 (d, *J* = 3.1 Hz, 1H), 4.57 (s, 2H), 4.27 (s, 2H), 4.07 (brs, 1H), 1.86 (brs, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.5, 152.3, 146.1, 129.0, 122.6, 114.3, 108.6, 108.0, 57.3, 41.5.



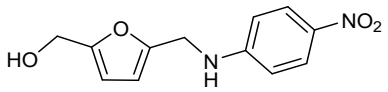
(5-(((4-Bromophenyl)amino)methyl)furan-2-yl)methanol (3l)[3]

yellow oil (93% yield, 130.7 mg) , Rf: 0.5 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.21 (d, *J* = 8.3 Hz, 2H), 6.49 (d, *J* = 8.3 Hz, 2H), 6.16 (s, 1H), 6.13 (s, 1H), 4.49 (s, 2H), 4.19 (s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.5, 152.1, 146.5, 131.8, 114.7, 109.6, 108.6, 107.9, 57.2, 41.3.



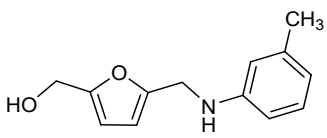
(5-(((4-(Trifluoromethyl)phenyl)amino)methyl)furan-2-yl)methanol (3m)

yellow oil (89% yield, 120.6 mg) , Rf: 0.4 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.40 (d, *J* = 8.5 Hz, 2H), 6.65 (d, *J* = 8.5 Hz, 2H), 6.21 (d, *J* = 3.1 Hz, 1H), 6.18 (d, *J* = 3.1 Hz, 1H), 4.55 (s, 2H), 4.31 (s, 2H), 2.27 (brs, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.6, 151.9, 150.0, 126.6 (q, $^{3}J_{C\text{-}F}$ = 3.9 Hz), 124.9 (q, $^{1}J_{C\text{-}F}$ = 268.8 Hz), 119.4 (q, $^{2}J_{C\text{-}F}$ = 32.3 Hz), 112.2, 108.7, 108.1, 57.4, 40.9. HRMS (ESI) *m/z* calc. for $C_{13}H_{12}F_3NO_2Na$ $[M+Na]^+$: 294.0712, found: 294.0708.



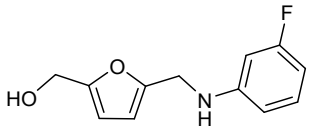
(5-(((4-Nitrophenyl)amino)methyl)furan-2-yl)methanol (3n)

yellow solid (63% yield, 78.1 mg) , Rf: 0.3 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR (Acetone-d_6, 400 MHz) δ (ppm): 8.04 (d, *J* = 9.2 Hz, 2H), 6.82-6.79 (m, 2H), 6.28 (d, *J* = 3.1 Hz, 1H), 6.21 (d, *J* = 3.1 Hz, 1H), 4.48-4.45 (m, 4H), 4.24 (brs, 1H), 2.97 (brs, 1H); ^{13}C NMR (Acetone-d_6, 100 MHz) δ (ppm): 156.1, 154.8, 151.9, 138.4, 126.7, 112.1, 109.0, 108.5, 57.2, 40.7. HRMS (ESI) *m/z* calc. for $C_{12}H_{12}N_2O_4$ $[M+Na]^+$: 271.0689, found: 271.0691.



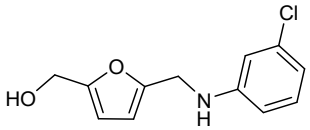
(5-((m-Tolylamino)methyl)furan-2-yl)methanol (3o)[3]

colorless oil (94% yield, 102.0 mg) , Rf: 0.7 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.08 (t, *J* = 7.6 Hz, 1H), 6.58 (d, *J* = 7.4 Hz, 1H), 6.50-6.48 (m, 2H), 6.21 (s, 1H), 6.18 (s, 1H), 4.57 (s, 2H), 4.29 (s, 2H), 2.28 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 152.9, 147.6, 139.0, 129.1, 119.1, 114.1, 110.3, 108.7, 107.7, 57.5, 41.5, 21.6.



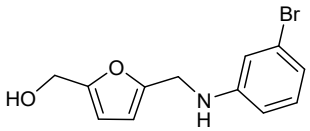
(5-(((3-Fluorophenyl)amino)methyl)furan-2-yl)methanol (3p)

yellow oil (87% yield, 96.2 mg) , Rf: 0.4 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.10 (q, *J* = 6.9 Hz, 1H), 6.44-6.39 (m, 2H), 6.37-6.33 (m, 1H), 6.22 (d, *J* = 3.1 Hz, 1H), 6.18 (d, *J* = 3.0 Hz, 1H), 4.56 (s, 2H), 4.27 (s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 163.9 (d, $^1J_{C\text{-}F}$ = 241.3 Hz), 153.5, 152.1, 149.3 (d, $^3J_{C\text{-}F}$ = 10.6 Hz), 130.2 (d, $^3J_{C\text{-}F}$ = 10.2 Hz), 109.0 (d, $^4J_{C\text{-}F}$ = 2.1 Hz), 108.6, 108.0, 104.3 (d, $^2J_{C\text{-}F}$ = 21.5 Hz), 99.8 (d, $^2J_{C\text{-}F}$ = 25.1 Hz), 57.2, 41.2. HRMS (ESI) *m/z* calc. for $C_{12}H_{12}FNO_2Na$ $[M+Na]^+$: 244.0744, found: 244.0743.



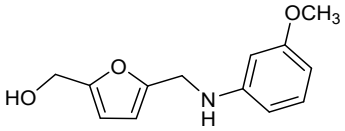
(5-(((3-Chlorophenyl)amino)methyl)furan-2-yl)methanol (3q)[3]

yellow oil (92% yield, 109.0 mg) , Rf: 0.5 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.07 (t, *J* = 8.0 Hz, 1H), 6.69 (dd, *J* = 7.9, 1.1 Hz, 1H), 6.63 (t, *J* = 2.0 Hz, 1H), 6.52 (dd, *J* = 8.2, 1.8 Hz, 1H), 6.21 (d, *J* = 3.1 Hz, 1H), 6.18 (d, *J* = 3.1 Hz, 1H), 4.55 (s, 2H), 4.26 (s, 2H), 2.12 (brs, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.5, 152.1, 148.6, 134.9, 130.2, 117.8, 112.8, 111.4, 108.6, 108.0, 57.3, 41.2.



(5-(((3-Bromophenyl)amino)methyl)furan-2-yl)methanol (3r)

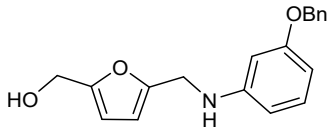
yellow oil (95% yield, 133.5 mg) , Rf: 0.5 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.01 (t, *J* = 8.0 Hz, 1H), 6.84 (d, *J* = 7.9 Hz, 1H), 6.79 (t, *J* = 2.0 Hz, 1H), 6.56 (dd, *J* = 8.2, 2.1 Hz, 1H), 6.20 (d, *J* = 3.2 Hz, 1H), 6.17 (d, *J* = 3.1 Hz, 1H), 4.54 (s, 2H), 4.24 (s, 2H), 3.17 (brs, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.6, 152.0, 148.7, 130.5, 123.2, 120.8, 115.8, 111.9, 108.7, 108.1, 57.4, 41.2. HRMS (ESI) *m/z* calc. for $C_{12}H_{12}BrNO_2Na$ $[M+Na]^+$: 303.9944, found: 303.9940.



(5-(((3-Methoxyphenyl)amino)methyl)furan-2-yl)methanol (3s)[4]

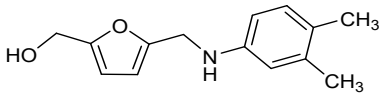
yellow oil (63% yield, 73.4 mg) , Rf: 0.4 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.09 (t, *J* = 8.1 Hz, 1H), 6.33-6.24 (m , 3H), 6.20 (d, *J* = 3.0 Hz, 1H), 6.18 (d, *J* = 3.0 Hz, 1H), 4.55 (s, 2H), 4.27 (s, 2H), 3.76 (s , 3H), 3.05 (brs, 2H); ^{13}C NMR ($CDCl_3$, 100

MHz) δ (ppm): 160.8, 153.5, 152.6, 148.8, 130.0, 108.6, 108.0, 106.4, 103.4, 99.5, 57.4, 55.1, 41.6.



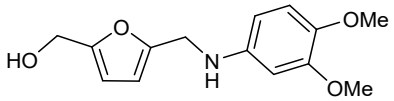
(5-(((3-(Benzyloxy)phenyl)amino)methyl)furan-2-yl)methanol (3t)

yellow solid (75% yield, 115.9 mg) , Rf: 0.4 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.44-7.31 (m, 5H), 7.10 (t, *J* = 8.0 Hz, 1H), 6.41-6.38 (m, 1H), 6.32-6.29 (m, 2H), 6.21 (d, *J* = 3.1 Hz, 1H), 6.17 (d, *J* = 3.1 Hz, 1H), 5.03 (s, 2H), 4.55 (s, 2H), 4.27 (s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 160.0, 153.4, 152.7, 149.0, 137.2, 130.0, 128.5, 127.9, 127.5, 108.6, 107.8, 106.6, 104.1, 100.2, 69.9, 57.4, 41.4. HRMS (ESI) *m/z* calc. for $C_{19}H_{19}NO_3Na$ $[M+Na]^+$: 332.1257, found: 332.1252.



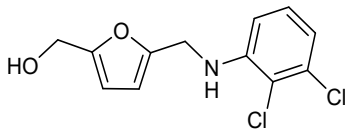
(5-(((3,4-Dimethylphenyl)amino)methyl)furan-2-yl)methanol (3u)

yellow oil (99% yield, 114.4 mg) , Rf: 0.4 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.95 (d, *J* = 8.0 Hz, 1H), 6.52 (d, *J* = 2.1 Hz, 1H), 6.46 (dd, *J* = 8.0, 2.4 Hz, 1H), 6.20 (d, *J* = 3.1 Hz, 1H), 6.17 (d, *J* = 3.0 Hz, 1H), 4.56 (s, 2H), 4.27 (s, 2H), 2.92 (brs, 2H), 2.20 (s, 3H), 2.16 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 153.0, 145.6, 137.2, 130.2, 126.2, 115.3, 110.7, 108.5, 107.6, 57.2, 41.8, 20.0, 18.6. HRMS (ESI) *m/z* calc. for $C_{14}H_{17}NO_2Na$ $[M+Na]^+$: 254.1151, found: 254.1149.



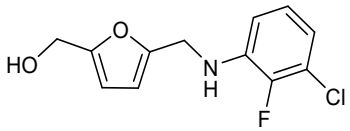
(5-(((3,4-Dimethoxyphenyl)amino)methyl)furan-2-yl)methanol (3v)

red oil (83% yield, 109.2 mg) , Rf: 0.2 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.74 (d, *J* = 8.5 Hz, 1H), 6.31 (d, *J* = 2.4 Hz, 1H), 6.23-6.20 (m, 2H), 6.17 (d, *J* = 3.0 Hz, 1H), 4.56 (s, 2H), 4.25 (s, 2H), 3.82 (s, 3H), 3.79 (s, 3H), 2.83 (brs, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 152.8, 149.8, 142.3, 142.0, 113.0, 108.5, 107.7, 104.1, 99.5, 57.3, 56.6, 55.7, 42.3. HRMS (ESI) *m/z* calc. for $C_{14}H_{17}NO_4Na$ $[M+Na]^+$: 286.1050, found: 286.1048. HRMS (ESI) *m/z* calc. for $C_{14}H_{17}NO_4Na$ $[M+Na]^+$: 286.1050, found: 286.1048.



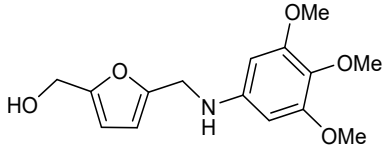
(5-(((2,3-Dichlorophenyl)amino)methyl)furan-2-yl)methanol (3w)

yellow oil (93% yield, 126.0 mg) , Rf: 0.6 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.18 (d, *J* = 8.7 Hz, 1H), 6.71 (d, *J* = 2.7 Hz, 1H), 6.47 (dd, *J* = 8.7, 2.7 Hz, 1H), 6.22 (d, *J* = 3.1 Hz, 1H), 6.17 (d, *J* = 3.1 Hz, 1H), 4.56 (s, 2H), 4.24 (s, 2H), 4.18 (brs, 1H), 2.00 (brs, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.7, 151.8, 147.0, 132.8, 130.6, 120.5, 114.2, 112.8, 108.7, 108.2, 57.4, 41.3. HRMS (ESI) *m/z* calc. for $C_{12}H_{11}Cl_2NO_2Na$ $[M+Na]^+$: 294.0059, found: 294.0055.



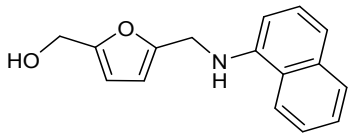
(5-(((3-Chloro-2-fluorophenyl)amino)methyl)furan-2-yl)methanol (3x)

colorless oil (93% yield, 118.6 mg) , Rf: 0.5 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.93-6.88 (m, 1H), 6.74-6.63 (m, 2H), 6.23 (d, *J* = 3.1 Hz, 1H), 6.19 (d, *J* = 3.0 Hz, 1H), 4.58 (s, 2H), 4.34 (s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.8, 151.8, 147.3 (d, $^{1}J_{C\text{-}F}$ = 239.2 Hz), 137.0 (d, $^{3}J_{C\text{-}F}$ = 11.4 Hz), 124.6 (d, $^{4}J_{C\text{-}F}$ = 4.7 Hz), 120.6 (d, $^{2}J_{C\text{-}F}$ = 15.1 Hz), 118.3, 110.8 (d, $^{4}J_{C\text{-}F}$ = 2.8 Hz), 108.7, 108.2, 57.5, 41.1. HRMS (ESI) *m/z* calc. for $C_{12}H_{11}ClFNO_2Na$ $[M+Na]^+$: 278.0355, found: 278.0350.



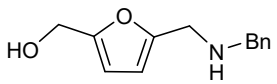
(5-(((3,4,5-Trimethoxyphenyl)amino)methyl)furan-2-yl)methanol (3y)

yellow oil (94% yield, 137.8 mg) , Rf: 0.1 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.22 (d, *J* = 3.1 Hz, 1H), 6.19 (d, *J* = 3.1Hz, 1H), 5.91 (s, 2H), 4.58 (s, 2H), 4.27 (s, 2H), 3.81 (s, 6H), 3.76 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.9, 153.5, 152.7, 144.4, 130.5, 108.6, 107.8, 90.9, 61.1, 57.4, 55.9, 41.9. HRMS (ESI) *m/z* calc. for $C_{15}H_{19}NO_5Na$ $[M+Na]^+$: 316.1155, found: 316.1150.



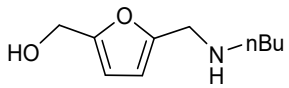
(5-((Naphthalen-1-ylamino)methyl)furan-2-yl)methanol (3z)[5]

yellow solid (82% yield, 103.8 mg) , Rf: 0.6 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 600 MHz) δ (ppm): 7.82 (t, *J* = 7.1 Hz, 2H), 7.48-7.42 (m, 2H), 7.36 (t, *J* = 7.9 Hz, 1H), 7.30 (d, *J* = 8.2 Hz, 1H), 6.70 (d, *J* = 7.4 Hz, 1H), 6.25 (d, *J* = 3.1 Hz, 1H), 6.23 (d, *J* = 3.1 Hz, 1H), 4.57 (s, 2H), 4.46 (s, 2H); ^{13}C NMR ($CDCl_3$, 150 MHz) δ (ppm): 153.6, 152.5, 142.7, 134.2, 128.6, 126.4, 125.8, 124.9, 123.6, 120.0, 118.2, 108.7, 108.1, 105.0, 57.4, 41.7.



(5-((Benzylamino)methyl)furan-2-yl)methanol (3aa)[3]

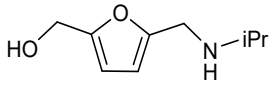
yellow oil (65% yield, 70.6 mg) , Rf: 0.2 (Petroleum ether : Ethyl acetate = 1:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.29-7.19 (m, 5H), 6.13 (d, *J* = 3.1 Hz, 1H), 6.07 (d, *J* = 3.1 Hz, 1H), 4.49 (s, 2H), 3.73 (s, 2H), 3.70 (s, 2H), 2.20 (brs, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.7, 153.6, 139.6, 128.5, 128.3, 127.1, 108.3, 108.0, 57.4, 52.8, 45.4.



(5-((Butylamino)methyl)furan-2-yl)methanol (3ab)[3]

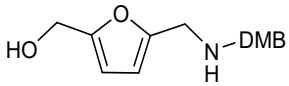
yellow oil (70% yield, 64.1 mg) , Rf: 0.2 (Petroleum ether : Ethyl acetate = 1:1); ^{1}H NMR ($CDCl_3$,

400 MHz) δ (ppm): 6.19 (d, *J* = 3.0 Hz, 1H), 6.13 (d, *J* = 3.0 Hz, 1H), 4.55 (s, 2H), 3.76 (s, 2H), 2.61 (t, *J* = 7.3 Hz, 2H), 2.39 (brs, 2H),1.52-1.45 (m, 2H), 1.37-1.28 (m, 2H), 0.90 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.7, 153.4, 108.3, 108.0, 57.4, 48.8, 46.1, 31.8, 20.4, 14.0.



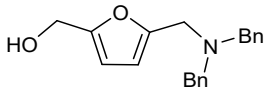
(5-((Isopropylamino)methyl)furan-2-yl)methanol (3ac)[4]

yellow oil (95% yield, 80.3 mg) , Rf: 0.2 (Petroleum ether : Ethyl acetate = 1:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.13 (s, 1H), 6.10 (s, 1H), 4.48 (s , 2H), 3.73 (s, 2H), 3.53 (brs, 2H), 2.86-2.80 (m, 1H), 1.07 (s, 3H), 1.06 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 154.1, 152.5, 108.1, 108.0, 56.8, 47.8, 43.3, 22.1.



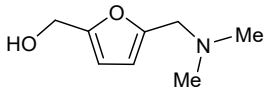
(5-(((3,4-Dimethylbenzyl)amino)methyl)furan-2-yl)methanol (3ad)

yellow oil (78% yield, 95.6 mg) , Rf: 0.2 (Petroleum ether : Ethyl acetate = 1:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.10 (d, *J* = 8.0 Hz, 1H), 6.44-6.41 (m, 2H), 6.16 (d, *J* = 3.0 Hz, 1H), 6.11 (d, *J* = 3.0 Hz, 1H), 4.51 (s, 2H), 3.79 (s, 6H), 3.72 (s, 2H), 3.69 (s, 2H), 2.42 (brs, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 160.6, 158.8, 154.2, 151.8, 131.2, 118.2, 108.8, 108.2, 103.9, 98.5, 57.1, 55.4, 55.3, 47.3, 44.5. HRMS (ESI) *m/z* calc. for $C_{15}H_{20}NO_4$ $[M+H]^+$: 278.1387, found: 278.1384.



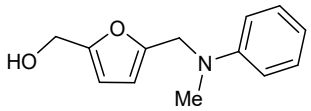
(5-((Dibenzylamino)methyl)furan-2-yl)methanol (3ae)

yellow oil (63% yield, 96.8 mg) , Rf: 0.7 (Petroleum ether : Ethyl acetate = 1:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.40 (d, *J* = 7.2 Hz, 4H), 7.31 (t, *J* = 7.2 Hz, 4H), 7.23 (t, *J* = 7.2 Hz, 2H), 6.22 (d, *J* = 3.1 Hz, 1H), 6.14 (d, *J* = 3.1 Hz, 1H), 4.57 (s, 2H), 3.62 (s, 4H), 3.61 (s, 2H), 1.80 (brs, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 152.8, 139.2, 128.8, 128.2, 126.9, 109.3, 108.3, 57.6, 57.5, 49.4. HRMS (ESI) *m/z* calc. for $C_{20}H_{22}NO_2$ $[M+H]^+$: 308.1645, found: 308.1640.



(5-((Dimethylamino)methyl)furan-2-yl)methanol (3af)[3]

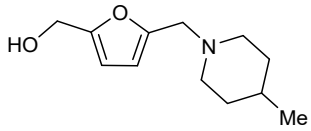
yellow oil (95% yield, 73.7 mg) , Rf: 0.2 (Petroleum ether : Ethyl acetate = 1:2); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.20 (s, 1H), 6.17 (s, 1H), 4.56 (s, 2H), 3.48 (s, 2H), 2.64 (brs, 1H), 2.28 (s, 6H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 154.2, 151.5, 109.8, 108.2, 57.5, 55.7, 44.8.



(5-((Methyl(phenyl)amino)methyl)furan-2-yl)methanol (3ag)[3]

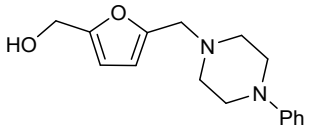
yellow oil (74% yield, 80.3 mg) , Rf: 0.6 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.15-7.11 (m, 2H), 6.71 (d, *J* = 8.1 Hz, 2H), 6.64 (t, *J* = 7.3 Hz, 1H), 6.05 (d, *J*

= 3.1 Hz, 1H), 5.95 (d, *J* = 3.1 Hz, 1H), 4.39 (s, 2H), 4.32 (s, 2H), 2.87 (s, 3H), 2.28 (brs, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.4, 152.2, 149.3, 129.1, 117.2, 113.1, 108.4, 108.0, 57.3, 50.0, 38.3.



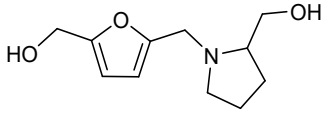
(5-((4-Methylpiperidin-1-yl)methyl)furan-2-yl)methanol (3ah)

colorless solid (67% yield, 70.1 mg) , Rf: 0.3 (Petroleum ether : Ethyl acetate = 1:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.16 (d, *J* = 3.1 Hz, 1H), 6.10 (d, *J* = 3.0 Hz, 1H), 4.52 (s, 2H), 3.51 (brs, 1H), 3.44 (s, 2H), 2.83 (d, *J* = 11.7 Hz, 2H), 1.94 (t, 11.4 Hz, 2H), 1.56 (d, *J* = 11.4 Hz, 2H), 1.28-1.21 (m, 2H), 0.88 (d, *J* = 6.0 Hz, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 154.2, 151.5, 109.6, 107.9, 57.1, 55.2, 53.6, 33.9, 30.5, 21.7. HRMS (ESI) *m/z* calc. for $C_{12}H_{20}NO_2$ $[M+H]^+$: 210.1489, found: 210.1485.



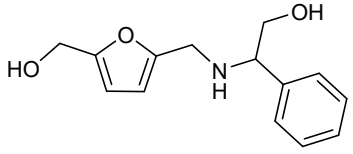
(5-((4-Phenylpiperazin-1-yl)methyl)furan-2-yl)methanol (3ai)

yellow oil (69% yield, 93.9 mg) , Rf: 0.2 (Petroleum ether : Ethyl acetate = 1:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.25-7.21 (m, 2H), 6.89 (d, *J* = 8.1 Hz, 2H), 6.84 (t, *J* = 7.3 Hz, 1H), 6.18 (d, *J* = 3.1 Hz, 1H), 6.16 (d, *J* = 3.1 Hz, 1H), 4.52 (s, 2H), 3.53 (s, 3H), 3.17 (t, *J* = 4.8 Hz, 4H), 2.61 (t, *J* = 4.9 Hz, 4H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 154.3, 151.1, 150.7, 129.0, 119.8 ,116.1, 109.9, 108.0, 57.0, 54.8, 52.6, 48.8. HRMS (ESI) *m/z* calc. for $C_{16}H_{21}N_2O_2$ $[M+H]^+$: 273.1598, found: 273.1593.



(1-((5-(Hydroxymethyl)furan-2-yl)methyl)pyrrolidin-2-yl)methanol (3aj)

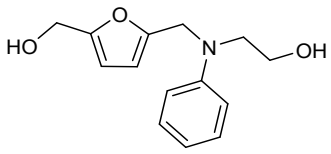
yellow oil (83% yield, 87.6 mg) , Rf: 0.2 (Petroleum ether : Ethyl acetate = 1:2); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.18 (d, *J* = 3.1 Hz, 1H), 6.10 (d, *J* = 3.1 Hz, 1H), 4.52 (s, 2H), 3.79 (d, *J* = 14.2 Hz, 1H), 3.56 (d, *J* = 14.2 Hz, 1H), 3.47 (dd, *J* = 11.0, 3.9 Hz, 1H), 3.37 (dd, *J* = 11.0, 3.2 Hz, 1H), 3.06-3.01 (m, 1H), 2.73-2.67 (m, 1H), 2.42 (q, *J* = 8.6 Hz, 1H), 1.90-1.82 (m, 1H), 1.76-1.65 (m, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.9, 152.6, 108.8, 108.2, 63.8, 62.6, 57.2, 54.7, 50.5, 27.8, 23.4. HRMS (ESI) *m/z* calc. for $C_{16}H_{21}N_2O_2$ $[M+H]^+$: 273.1598, found: 273.1593. HRMS (ESI) *m/z* calc. for $C_{11}H_{17}NO_3Na$ $[M+Na]^+$: 234.1101, found: 234.1101.



2-(((5-(Hydroxymethyl)furan-2-yl)methyl)amino)-2-phenylethan-1-ol (3ak)

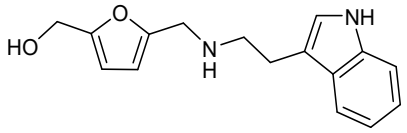
colorless oil (53% yield, 65.5 mg) , Rf: 0.3 (Petroleum ether : Ethyl acetate = 1:2); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.37-7.29 (m, 5H), 6.17 (d, *J* = 2.8 Hz, 1H), 6.03 (d, *J* = 2.8 Hz, 1H); 4.54 (s, 2H), 3.79-3.66 (m, 3H), 3.60-3.54 (m, 2H), 2.71 (brs, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm):

153.9, 152.9, 139.5, 128.7, 127.8, 127.6, 108.3, 108.2, 66.7, 63.3, 57.0, 43.4. HRMS (ESI) *m/z* calc. for $C_{14}H_{18}NO_3$ $[M+H]^+$: 248.1281, found: 248.1279.



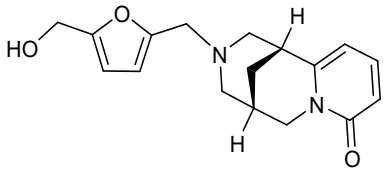
2-(((5-(Hydroxymethyl)furan-2-yl)methyl)(phenyl)amino)ethan-1-ol (3al)

yellow oil (79% yield, 97.6 mg) , Rf: 0.2 (Petroleum ether : Ethyl acetate = 2:1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.24-7.20 (m, 2H), 6.85 (d, *J* = 8.2 Hz, 2H), 6.76 (t, *J* = 7.3 Hz, 1H), 6.18 (d, *J* = 3.0 Hz, 1H), 6.11 (d, *J* = 3.0 Hz, 1H), 4.52 (s, 2H), 4.47 (s, 2H), 3.76 (t, *J* = 5.6 Hz, 2H), 3.55 (t, *J* = 5.6 Hz, 2H), 2.42 (brs, 1H), 2.33 (brs, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.6, 152.3, 148.5, 129.2, 117.7, 113.4, 108.6, 108.3, 60.1, 57.2, 53.5, 49.0. HRMS (ESI) *m/z* calc. for $C_{14}H_{17}NO_3Na$ $[M+Na]^+$: 270.1101, found: 270.1101.



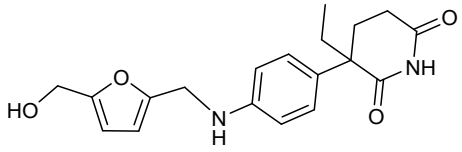
(5-(((2-(1H-indol-3-yl)ethyl)amino)methyl)furan-2-yl)methanol (3am)

yellow oil (75% yield, 101.3 mg) , Rf: 0.1 (Petroleum ether : Ethyl acetate = 1:2); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 8.54 (s, 1H), 7.56 (d, *J* = 7.8 Hz, 1H), 7.30 (d, *J* = 8.1 Hz, 1H), 7.17 (t, *J* = 7.3 Hz, 1H), 7.09 (t, *J* = 7.5 Hz, 1H), 6.88 (s, 1H), 6.12 (d, *J* = 3.0 Hz, 1H), 6.05 (d, *J* = 3.0 Hz, 1H), 4.45 (s, 2H), 3.69 (s, 2H), 2.93 (s, 4H), 2.86 (brs, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.9, 153.0, 136.5, 127.3, 122.4, 121.9, 119.1, 118.7, 113.0, 111.3, 108.10, 108.06, 56.9, 48.5, 45.8, 25.2. HRMS (ESI) *m/z* calc. for $C_{16}H_{19}N_2O_2$ $[M+H]^+$: 271.1441, found: 271.1439.



(1*R*,5*S*)-3-((5-(Hydroxymethyl)furan-2-yl)methyl)-1,2,3,4,5,6-hexahydro-8H-1,5-methanopyrido[1,2-a][1,5]diazocin-8-one (3an)

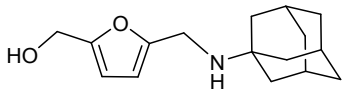
yellow oil (86% yield, 129.1 mg) , Rf: 0.1 (Petroleum ether : Ethyl acetate = 1:2); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.31-7.27 (m, 1H), 6.46 (d, *J* = 8.9 Hz, 1H), 6.14 (d, *J* = 2.7 Hz, 1H), 5.99 (d, *J* = 6.8 Hz, 1H), 5.91 (d, *J* = 2.6 Hz, 1H), 4.49 (s, 2H), 4.05 (d, *J* = 15.3 Hz, 1H), 3.83 (dd, *J* = 15.3, 6.6 Hz, 1H), 3.44 (s, 2H), 2.95 (s, 1H), 2.87-2.85 (m, 2H), 2.48 (d, *J* = 10.3 Hz, 1H), 2.38 (d, *J* = 9.9 Hz, 2H), 1.88 (d, *J* = 12.7 Hz, 1H), 1.74 (d, *J* = 12.6 Hz, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 163.7, 153.9, 151.5, 151.3, 138.7, 116.4, 108.6, 107.8, 104.9, 59.7, 58.8, 57.0, 54.2, 49.9, 35.5, 27.9, 25.5. HRMS (ESI) *m/z* calc. for $C_{17}H_{21}N_2O_3$ $[M+H]^+$: 301.1547, found: 301.1543.



3-Ethyl-3-(4-(((5-(hydroxymethyl)furan-2-yl)methyl)amino)phenyl)piperidine-2,6-dione (3ao)

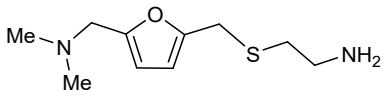
white solid (46% yield, 78.7 mg) , Rf: 0.1 (Petroleum ether : Ethyl acetate = 1:2); ^{1}H NMR ($CDCl_3$,

400 MHz) δ (ppm): 8.27 (s, 1H), 7.04 (d, *J* = 8.7 Hz, 2H), 6.61 (d, *J* = 8.7 Hz, 2H), 6.19 (d, *J* = 3.1 Hz, 1H), 6.15 (d, *J* = 3.1 Hz, 1H), 4.54 (s, 2H), 4.25 (s, 2H), 2.57-2.51 (m, 1H), 2.46-2.37 (m, 1H), 2.31-2.25 (m, 1H), 2.17-2.09 (m, 1H), 2.02-1.93 (m, 1H), 1.89-1.80 (m, 1H), 0.83 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 175.8, 172.9, 153.6, 152.5, 146.8, 127.5, 127.0, 113.4, 108.6, 107.9, 57.3, 50.2, 41.3, 32.9, 29.3, 26.9, 9.0. HRMS (ESI) *m/z* calc. for $C_{19}H_{22}N_2O_4Na$ $[M+Na]^+$: 365.1472 found: 365.1471.



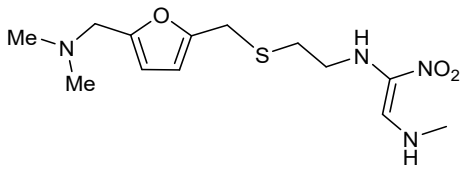
(5-((((1*R*,3*R*,5*S*)-Adamantan-1-yl)amino)methyl)furan-2-yl)methanol (3ap)

yellow solid (51% yield, 66.6 mg) , Rf: 0.2 (Petroleum ether : Ethyl acetate = 1:2); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 6.12 (d, *J* = 3.0 Hz, 1H), 6.09 (d, *J* = 3.0 Hz, 1H), 4.46 (s, 2H), 3.73 (s, 2H), 2.96 (brs, 2H), 2.06 (s, 3H), 1.67-1.58 (m, 12H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 153.9, 153.6, 108.1, 107.4, 57.0, 51.3, 42.1, 37.8, 36.5, 29.5. HRMS (ESI) *m/z* calc. for $C_{16}H_{23}NO_2$ $[M+H]^+$:262.1797, found: 262.1802.



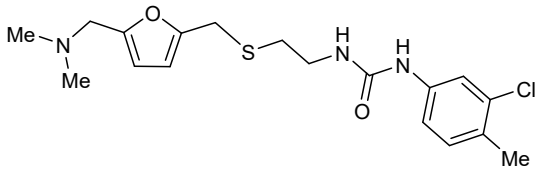
2-(((5-((Dimethylamino)methyl)furan-2-yl)methyl)thio)ethan-1-amine (3aq)[6]

Yellow oil (73% yield, 13.3 g); Rf : 0.4, (DCM : MeOH : Et3N = 95 : 5 : 1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 5.99 (s, 2H), 3.58 (s, 2H), 3.30 (s, 2H), 2.71 (t, *J* = 6.3 Hz, 2H), 2.49 (t, *J* = 6.3 Hz, 2H), 2.13 (s, 6H), 1.85 (s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 151.7, 151.0, 109.1, 107.7, 55.6, 44.7, 40.5, 35.4, 27.9.



***N*-[2-[[[5-[(Dimethylamino)methyl]-2-furanyl]methyl]thio]ethyl]-*N′*-methyl-2-nitro-1-ethenediamine (Ranitidine) (3ar)**[6-7]

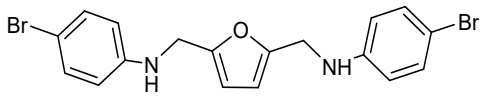
Yellow solid (69% yield, 13.5 g); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 10.18 (brs, 1H), 6.52 (s, 1H), 6.17-6.04 (m, 3H), 3.65 (s, 2H), 3.41 (brs, 1H), 3.34 (s, 2H), 3.23 (brs, 1H), 2.91 (brs, 1.3H), 2.79 (brs, 1.7H), 2.67 (t, *J* = 6.8 Hz, 2H), 2.16 (s, 6H), ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 156.3, 151.9, 150.2, 109.1, 108.1, 100.0, 55.5, 44.7, 41.3, 40.1, 30.6, 30.1, 28.8, 28.1, 27.9, 27.5.



1-(3-Chloro-4-methylphenyl)-3-(2-(((5-((dimethylamino)methyl)furan-2-yl)methyl)thio)ethyl)urea (3as)[8]

Yellow solid (76% yield, 290.0 mg); Rf : 0.3 (CHCl3 : MeOH = 8 : 1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.74 (s, 1H), 7.32 (s, 1H), 7.08 (d, *J* = 8.2 Hz, 1H), 7.03 (d, *J* = 8.2 Hz, 1H), 6.09 (d, *J* = 4.3 Hz, 2H), 5.95-5.93 (m, 1H), 3.71 (brs, 1H), 3.67 (s, 2H), 3.41 (s, 2H), 3.32 (q, *J* = 5.9 Hz, 2H),

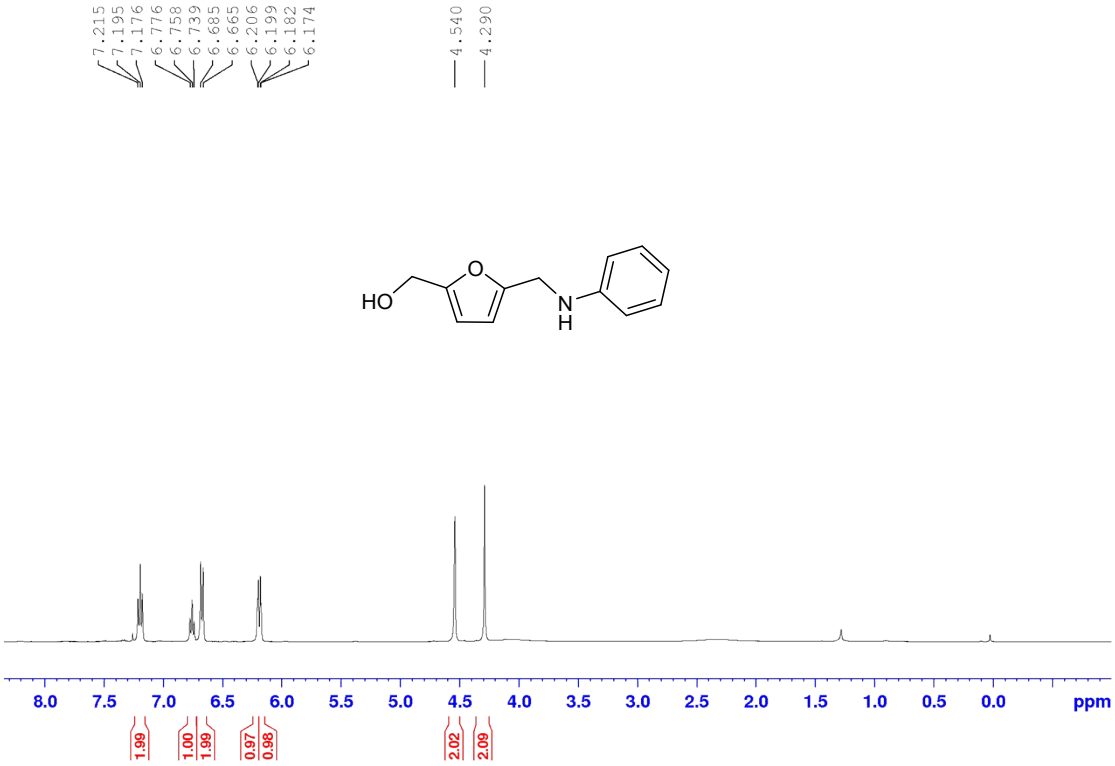
2.64 (t, *J* = 6.1 Hz, 2H), 2.25 (s, 9H), ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm):156.0, 151.4, 151.37, 138.1, 134.3, 130.9, 130.1, 120.5, 118.3, 109.9, 108.2, 55.9, 45.0, 39.1, 32.7, 28.5, 19.2.



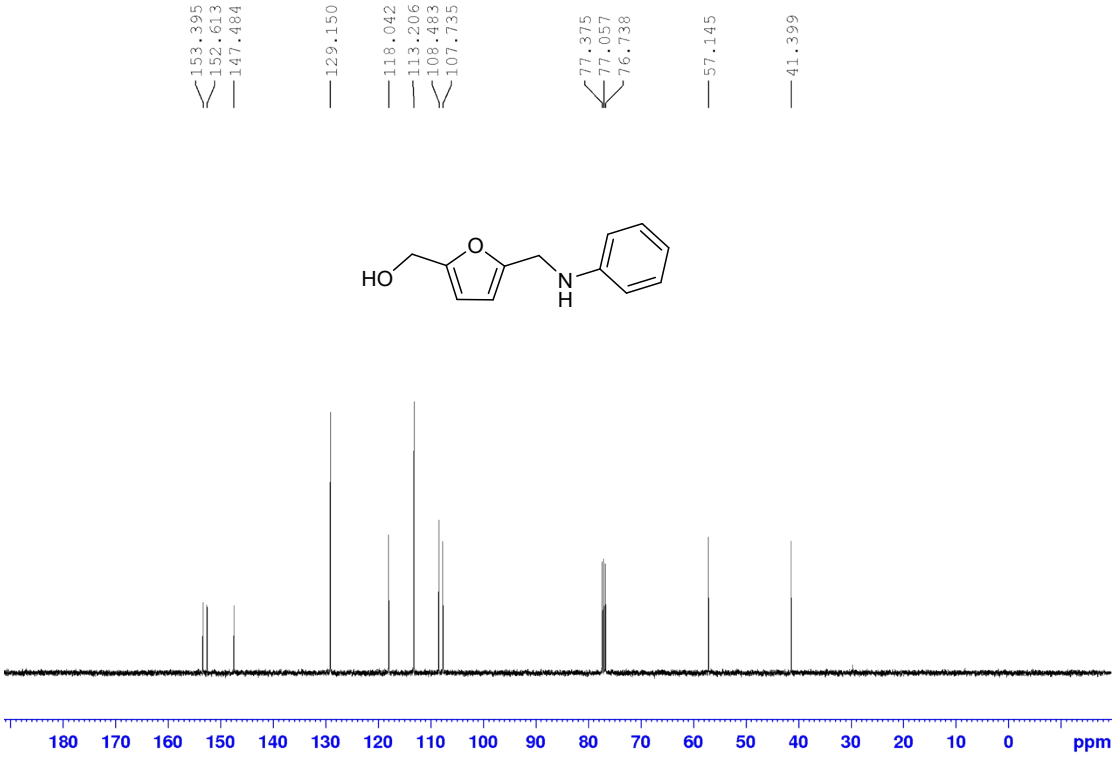
***N,N′*-(Furan-2,5-diylbis(methylene))bis(4-bromoaniline) (3at)**

Yellow oil (43% yield, 93.3 mg); Rf: 0.4 (DCM); ^{1}H NMR ($CDCl_3$, 400 MHz) δ (ppm): 7.26 (d, J =8.3 Hz, 4H), 6.55 (d, *J* = 8.4 Hz, 4H), 6.15 (s, 2H), 4.25 (s, 4H), ^{13}C NMR ($CDCl_3$, 100 MHz) δ (ppm): 151.8, 146.5, 132.0, 114.8, 109.8, 108.1, 41.4. HRMS (ESI) *m/z* calc. for $C_{18}H_{16}Br_2N_2ONa$ $[M+Na]^+$:456.9522, found: 456.9522.

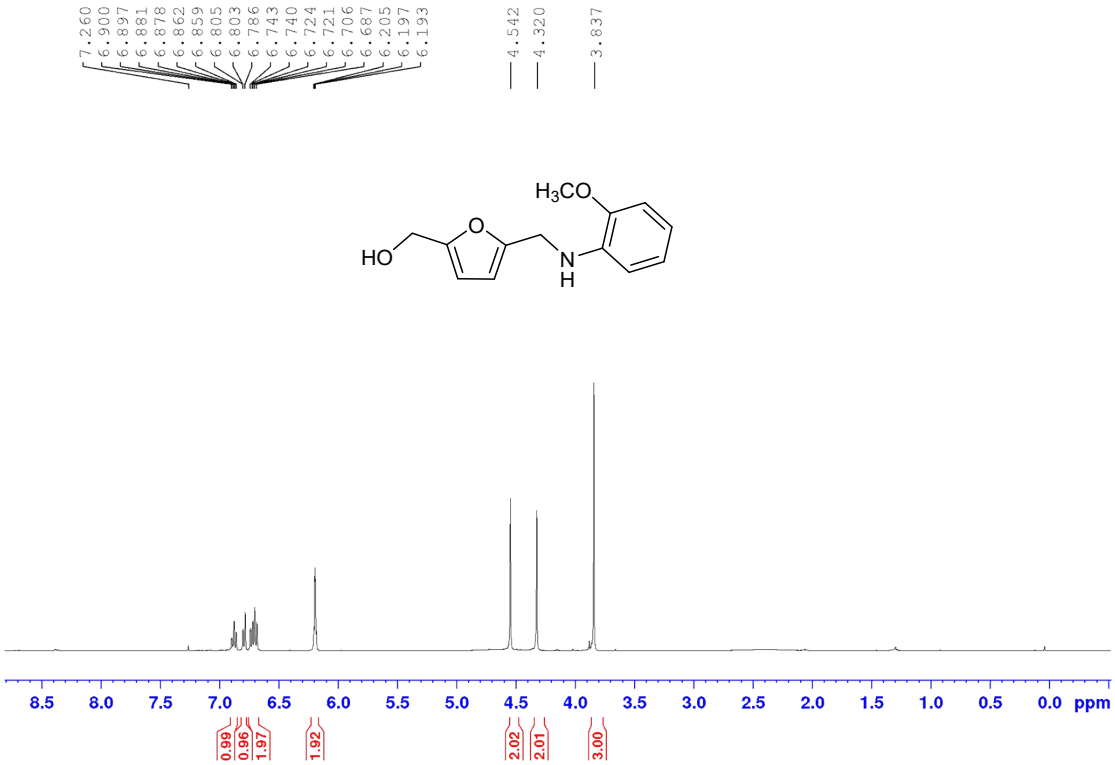
8. ^{1}H and ^{13}C NMR spectra of products



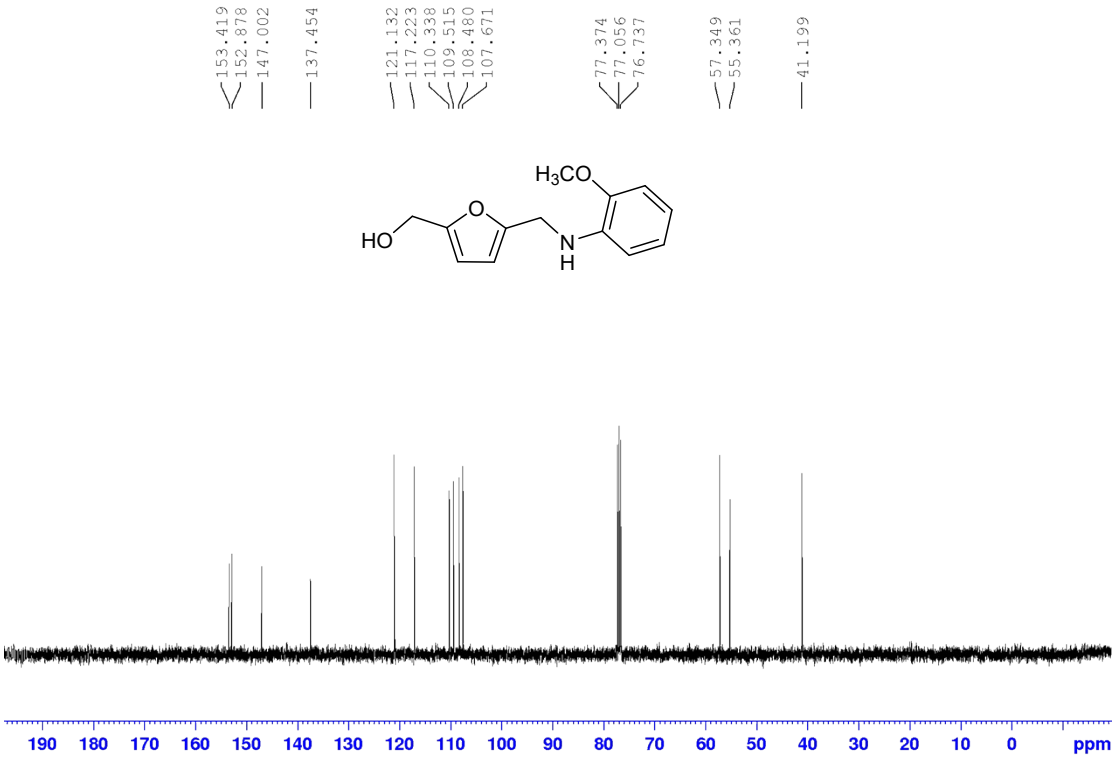
^{1}H NMR of compound **3a**



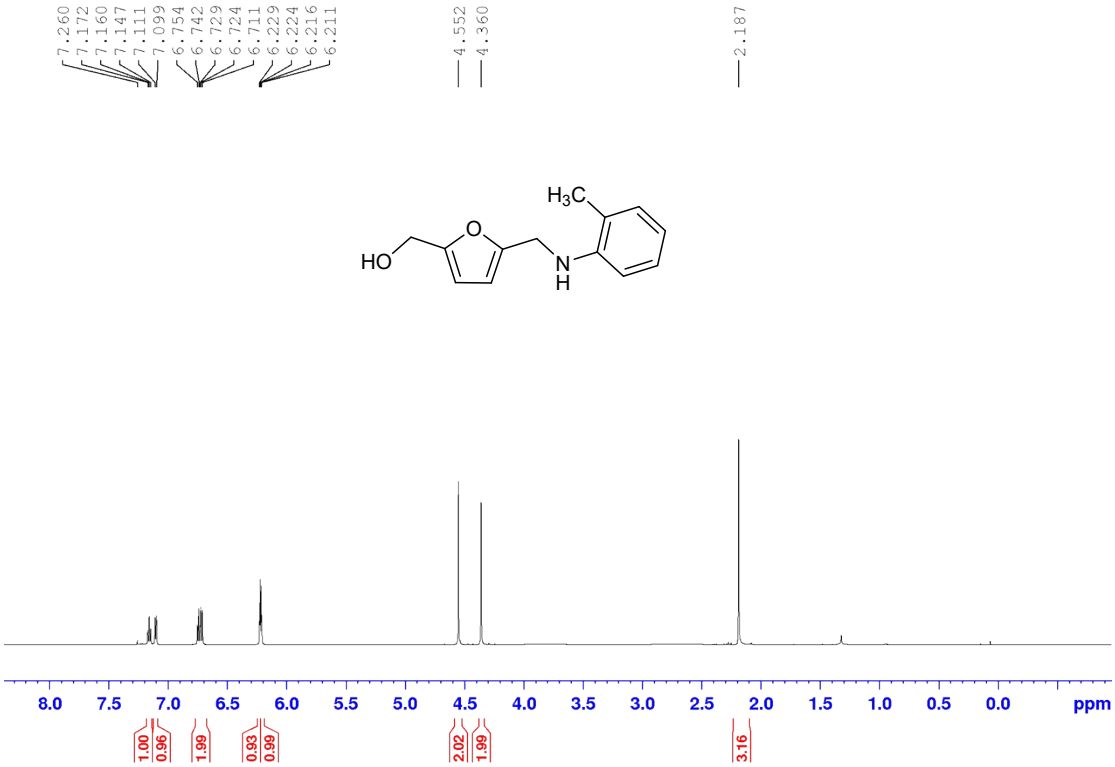
^{13}C NMR of compound **3a**



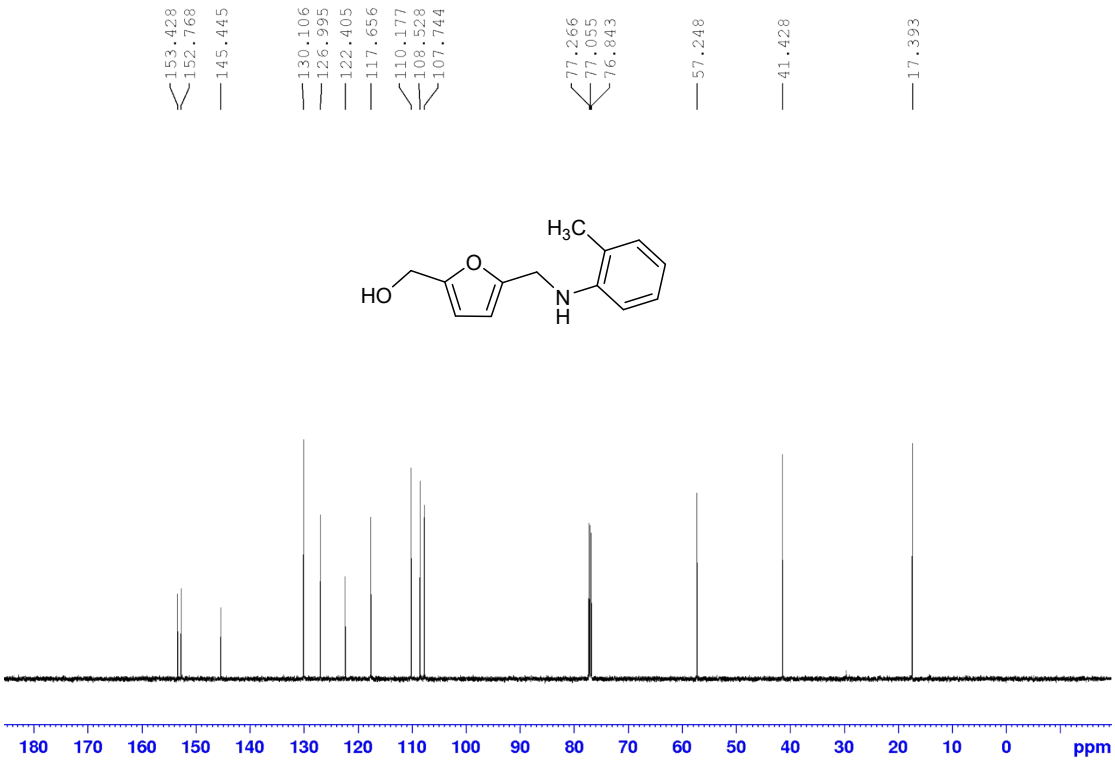
^{1}H NMR of compound **3b**



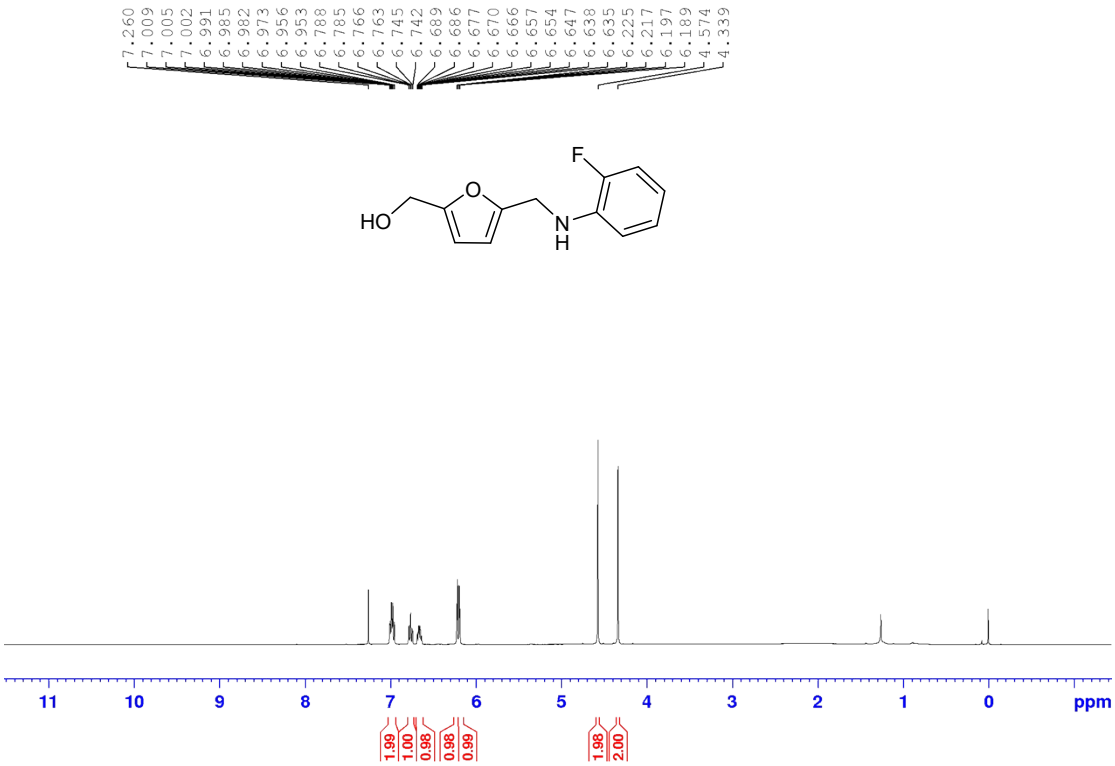
^{13}C NMR of compound **3b**



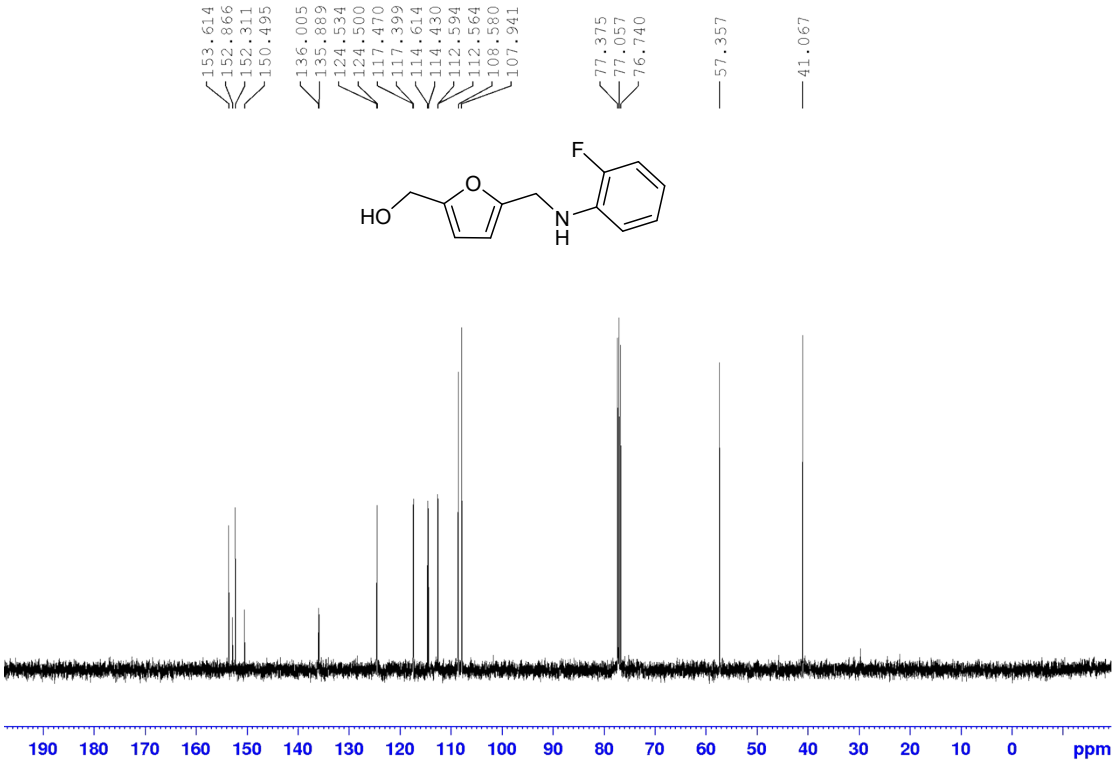
^{1}H NMR of compound **3c**



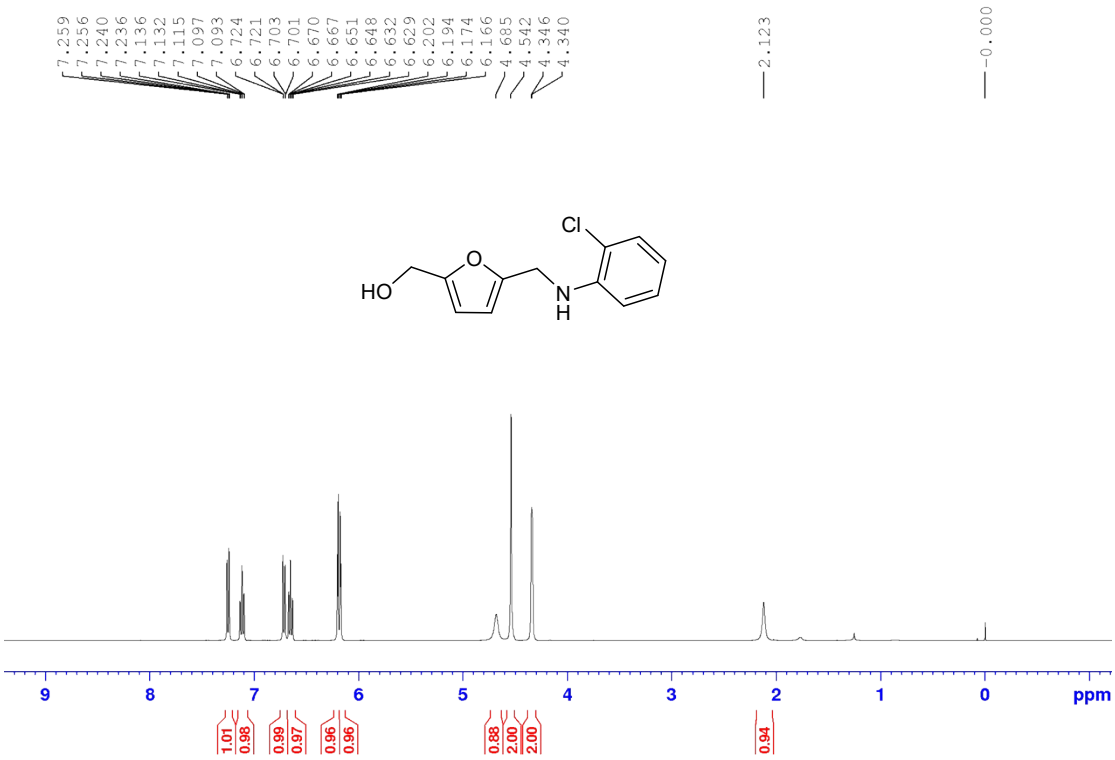
^{13}C NMR of compound **3c**



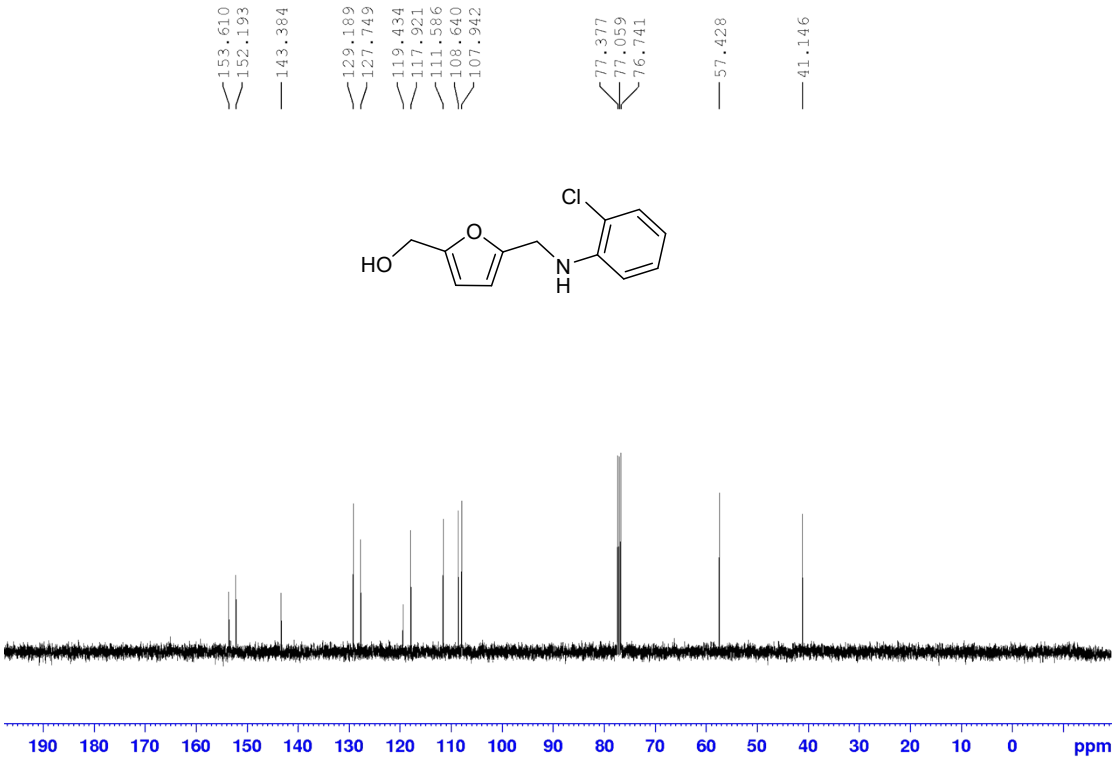
^{1}H NMR of compound **3d**



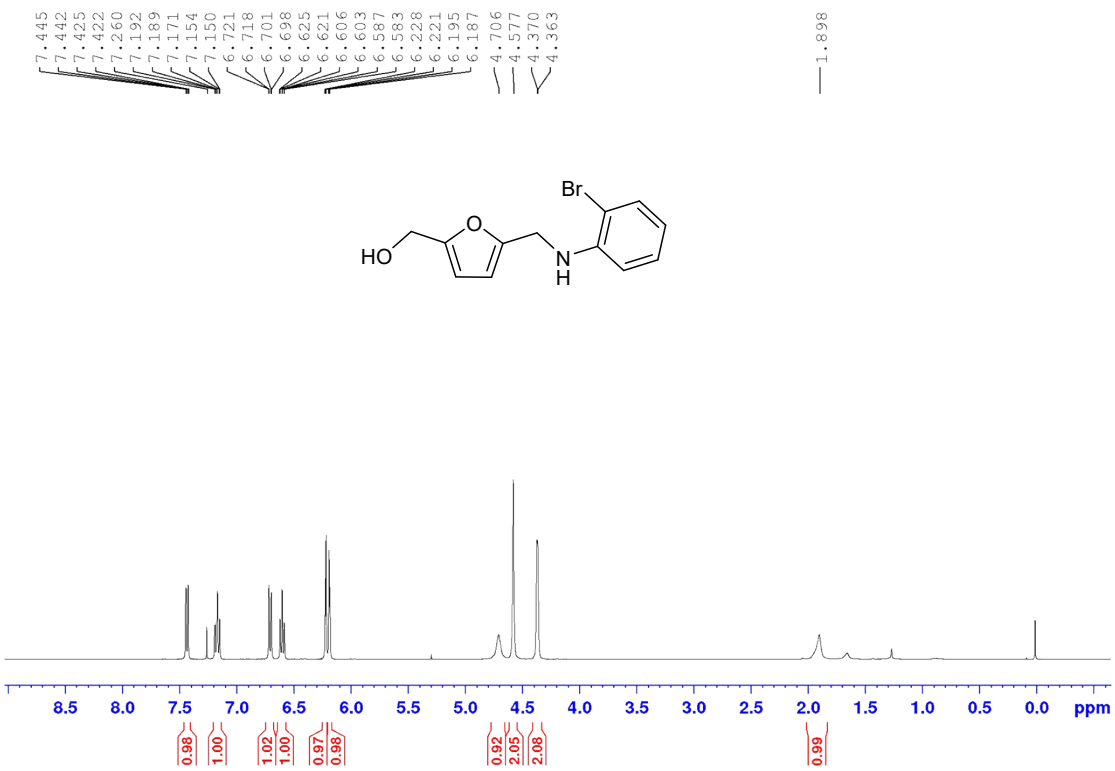
^{13}C NMR of compound **3d**



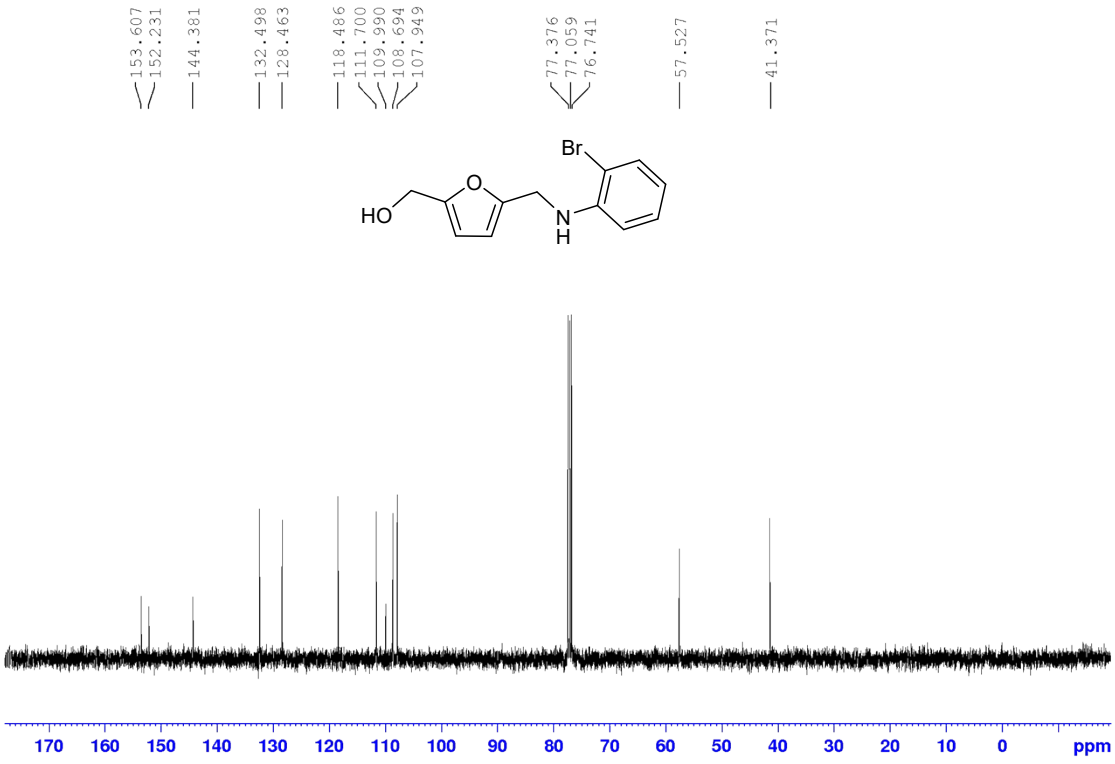
^{1}H NMR of compound **3e**



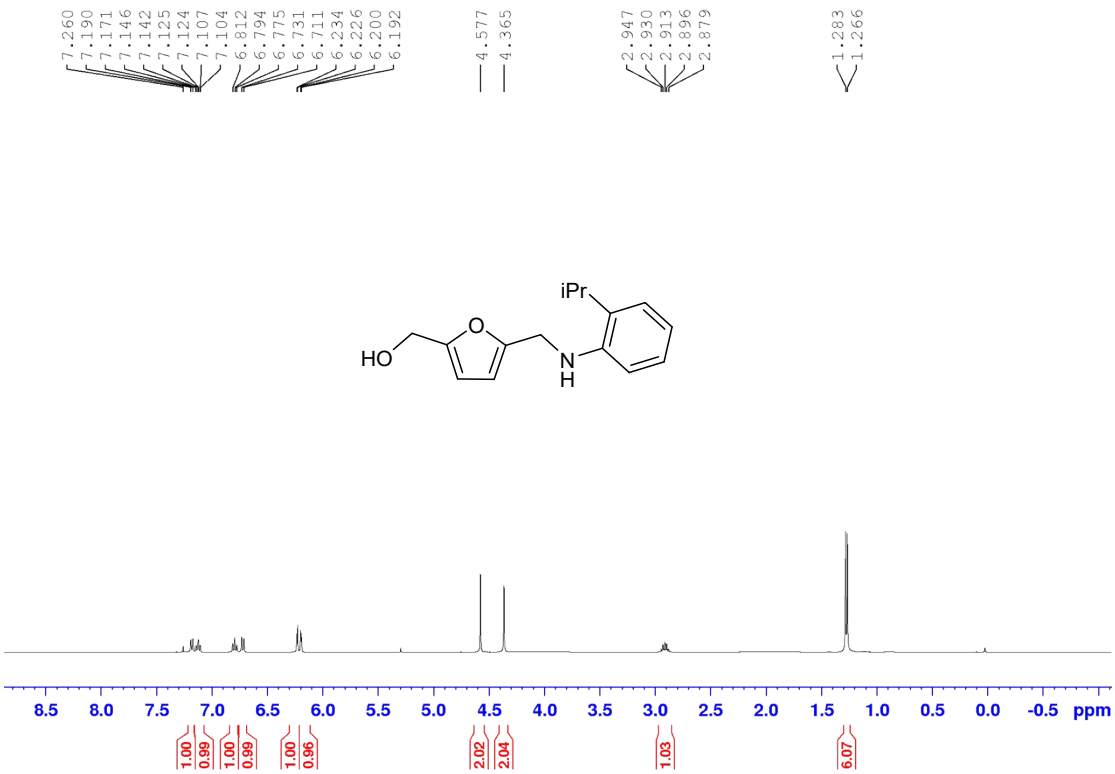
^{13}C NMR of compound **3e**



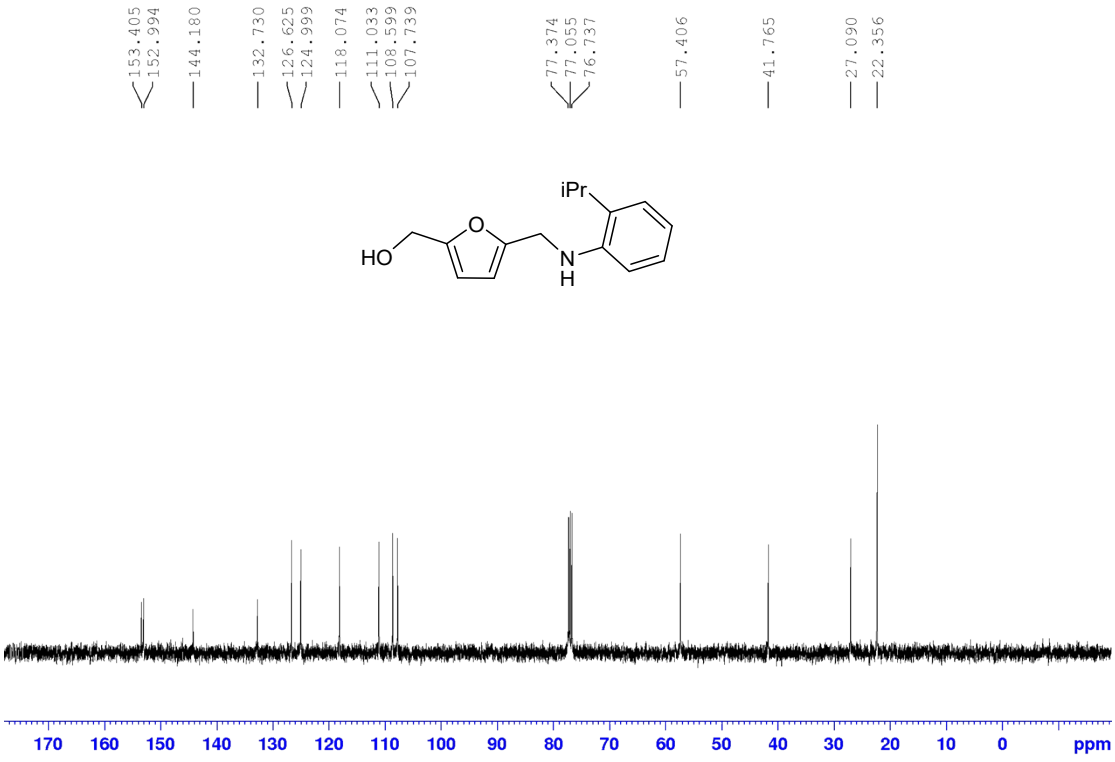
^{1}H NMR of compound **3f**



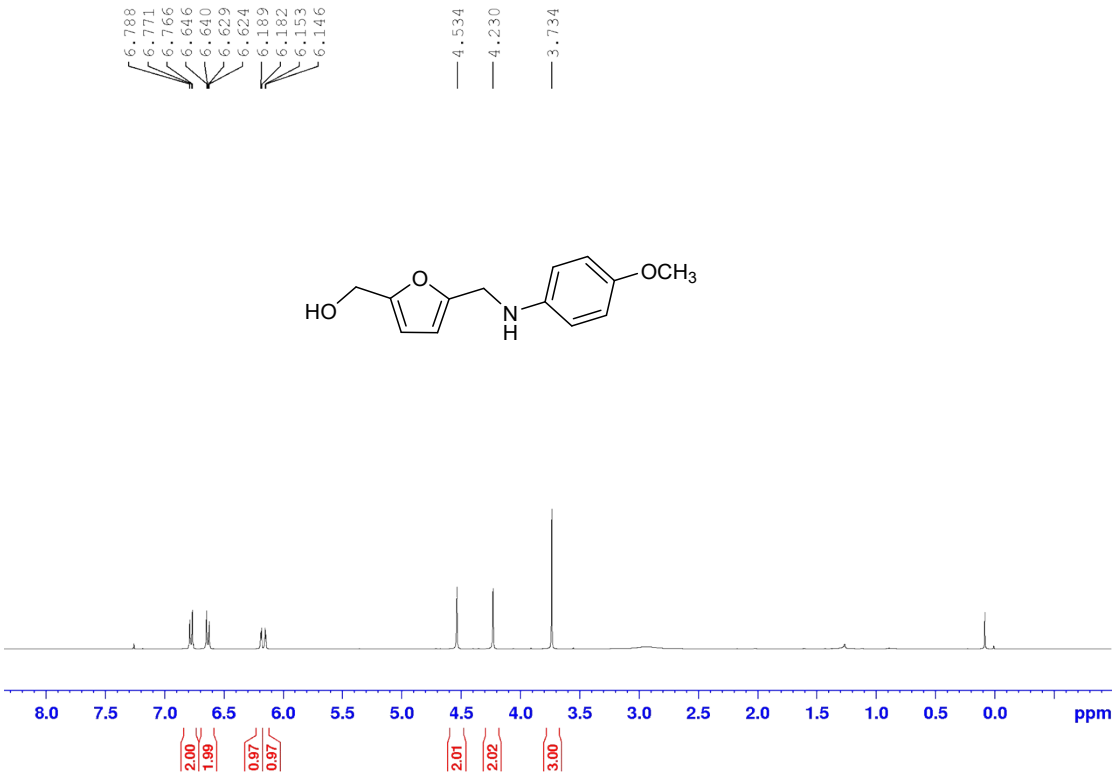
^{13}C NMR of compound **3f**



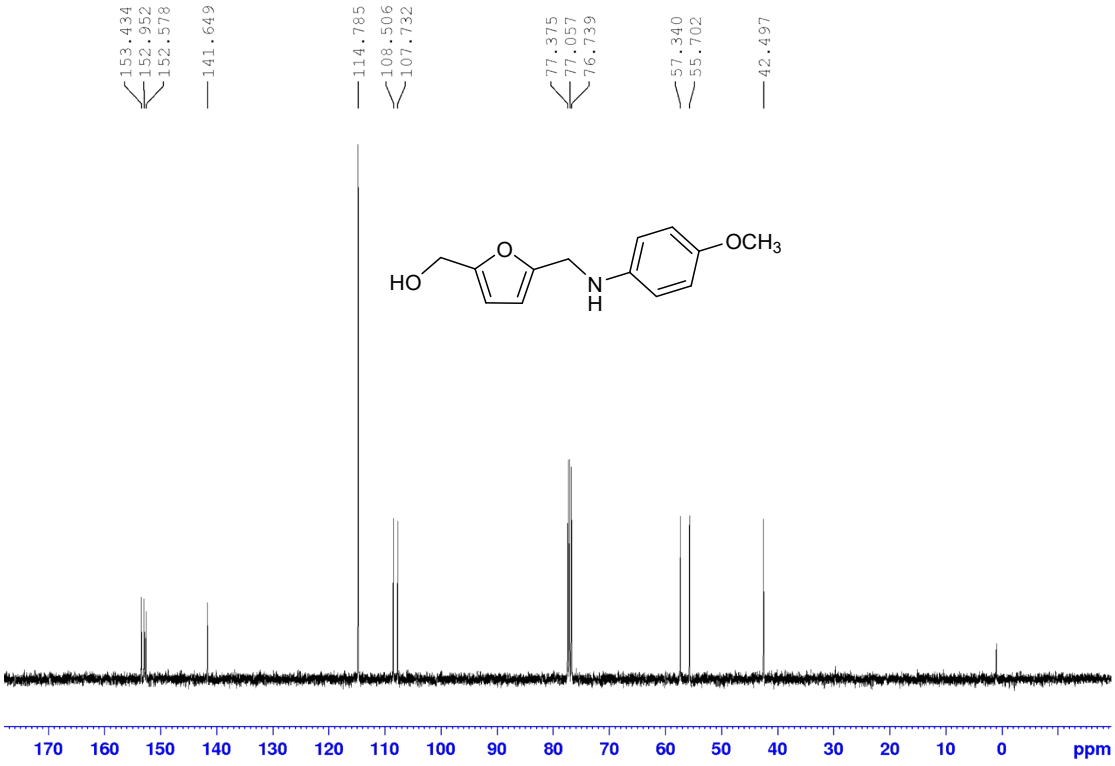
^{1}H NMR of compound **3g**



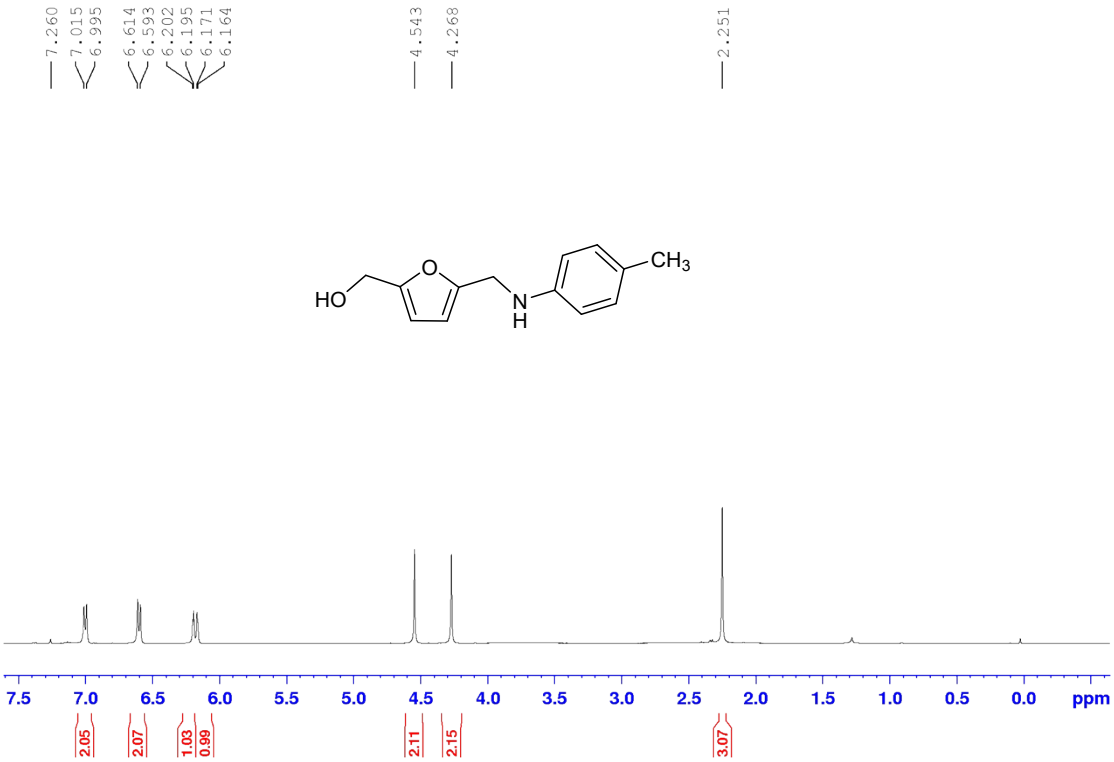
^{13}C NMR of compound **3g**



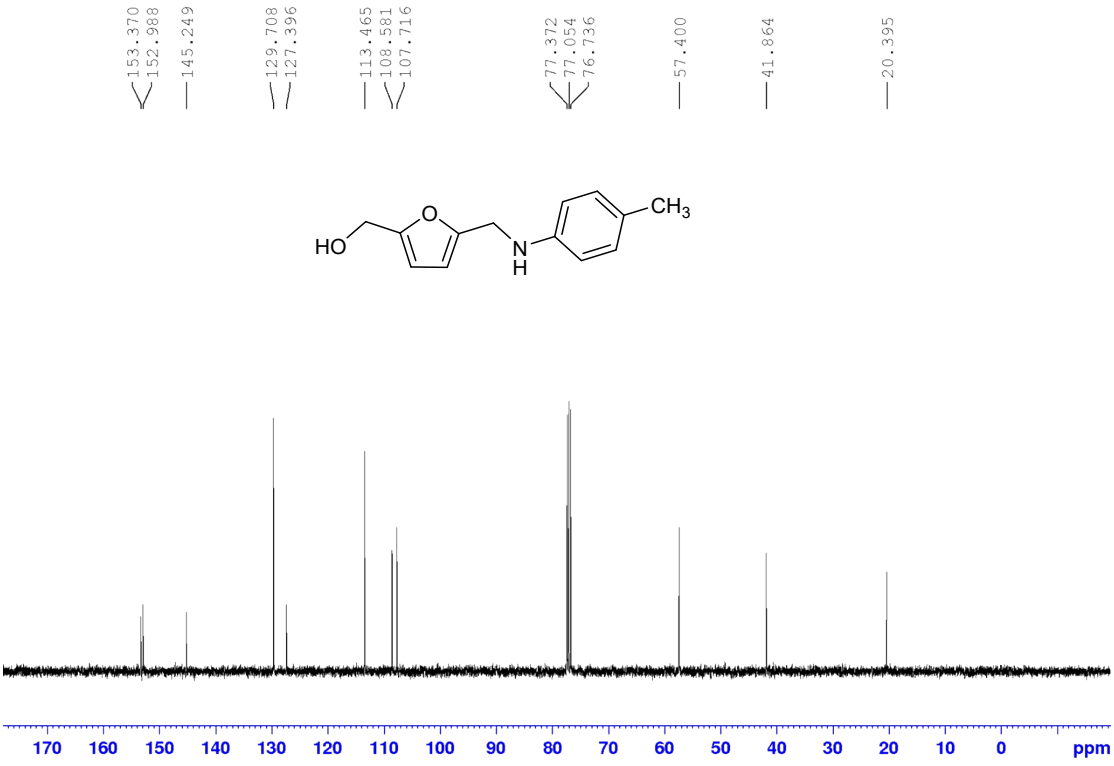
^{1}H NMR of compound **3h**



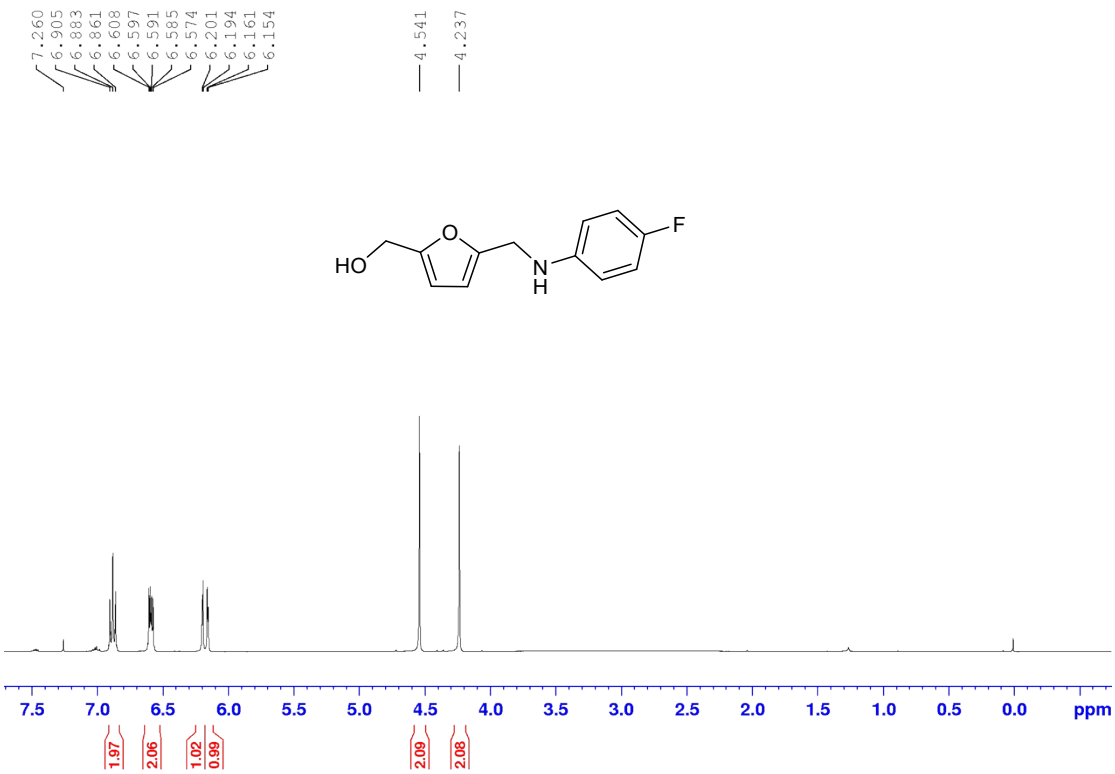
^{13}C NMR of compound **3h**



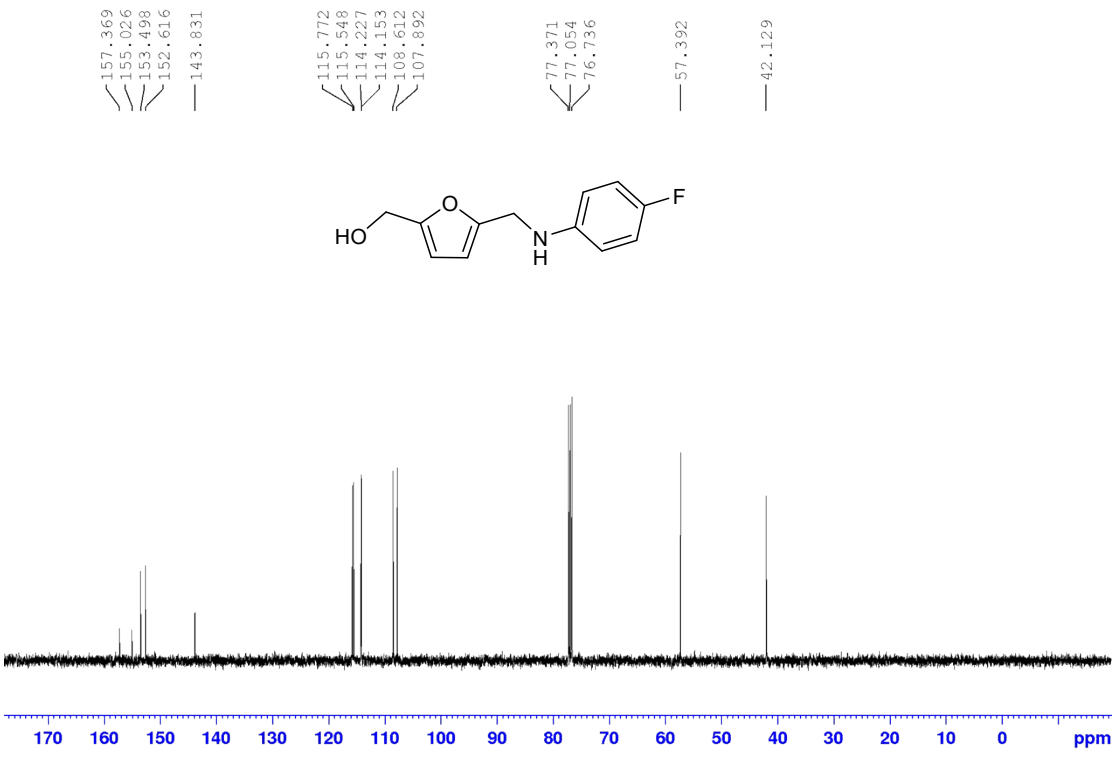
^{1}H NMR of compound **3i**



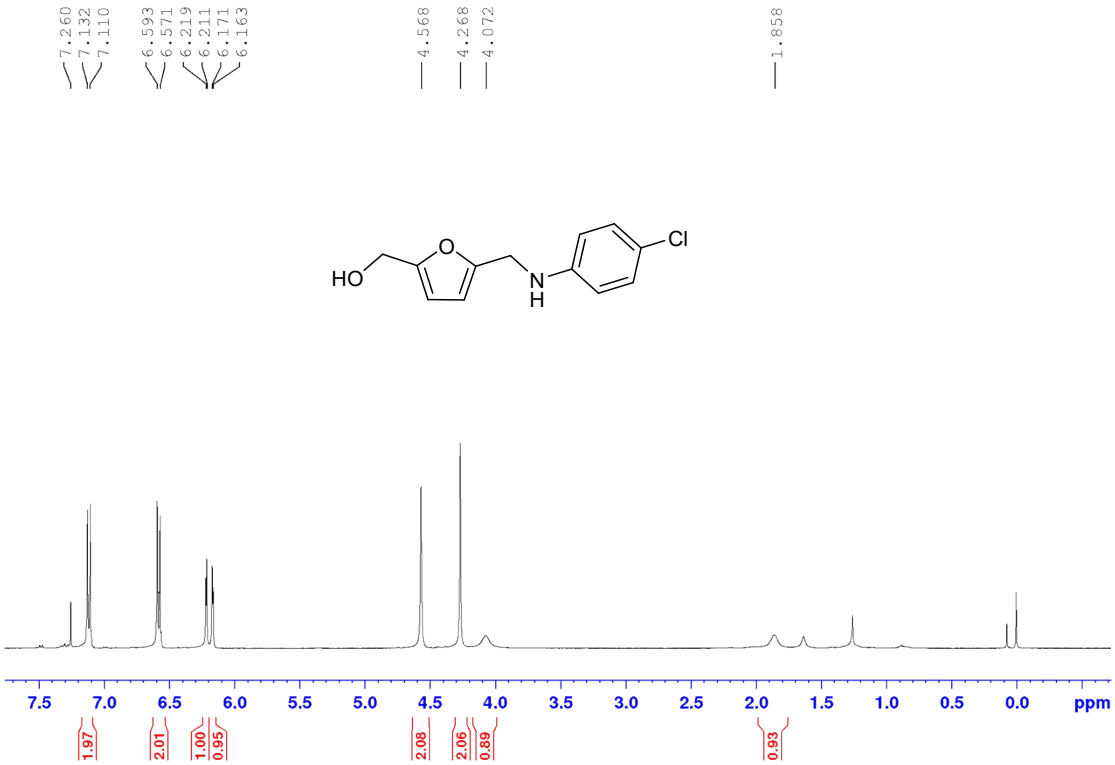
^{13}C NMR of compound **3i**



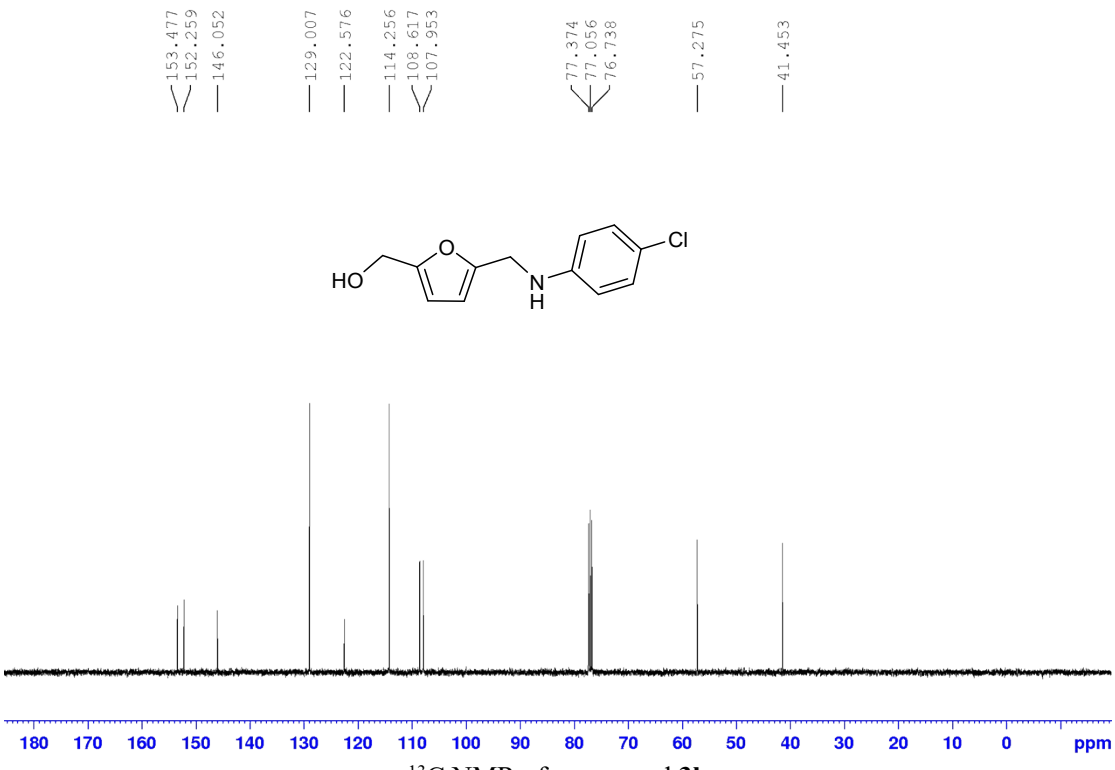
^{1}H NMR of compound **3j**



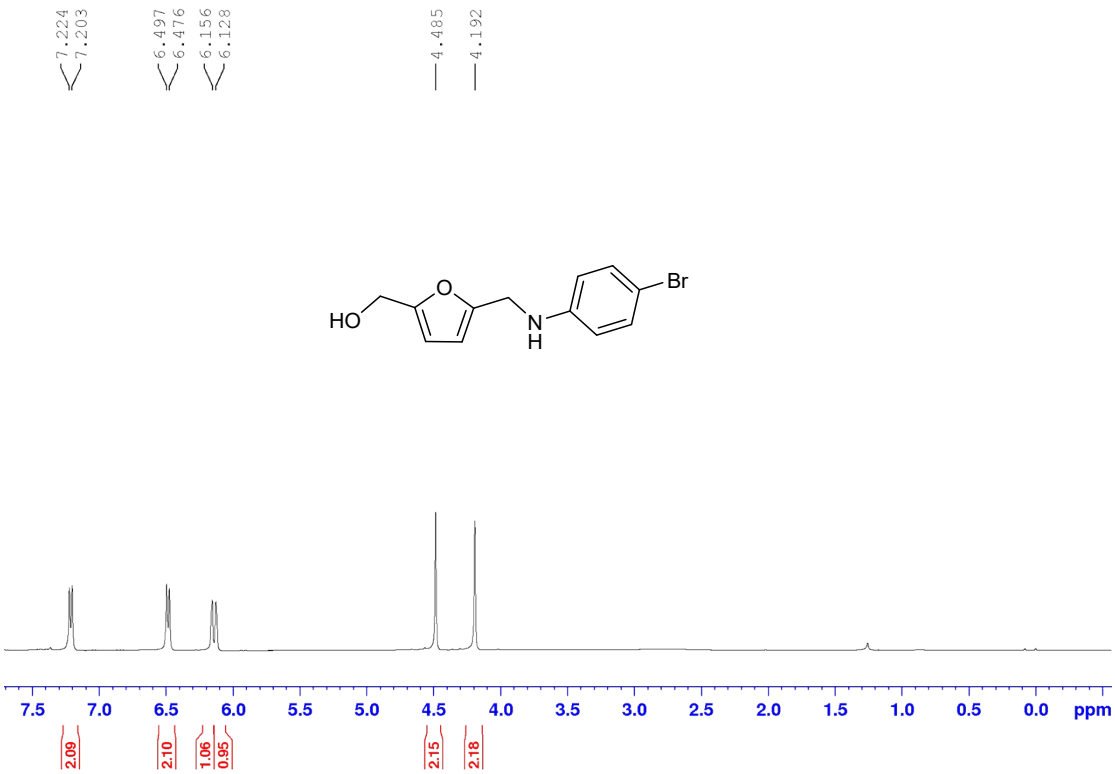
^{13}C NMR of compound **3j**



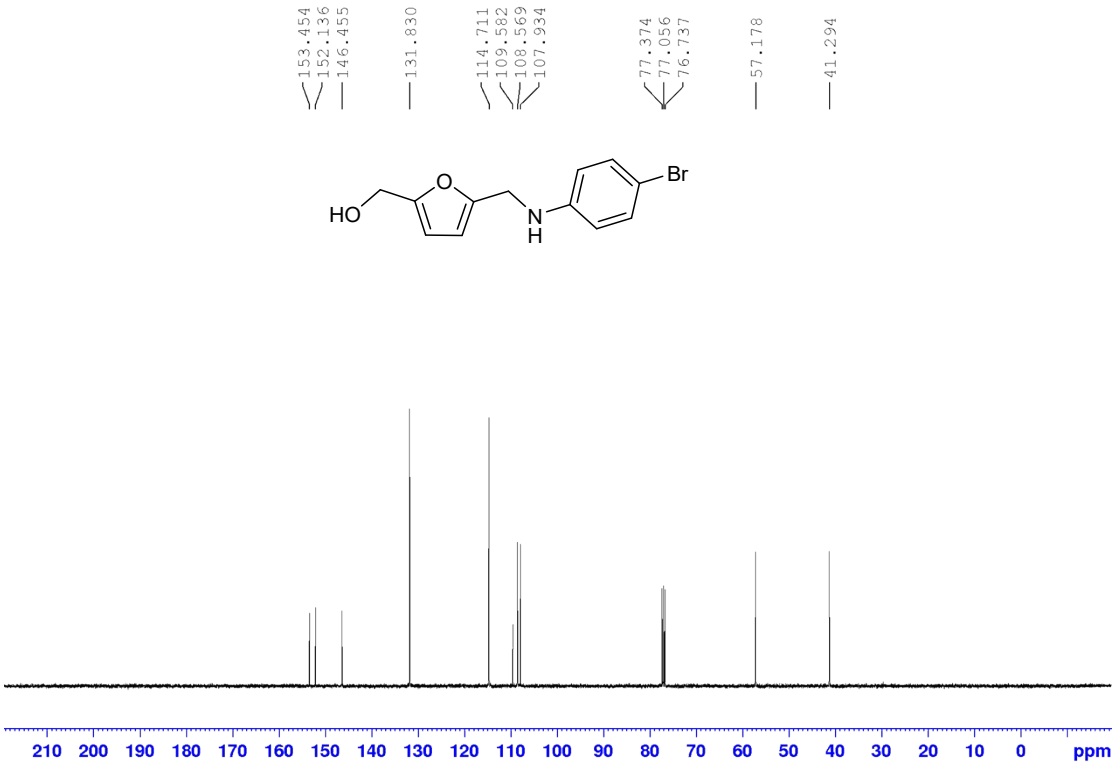
^{1}H NMR of compound **3k**



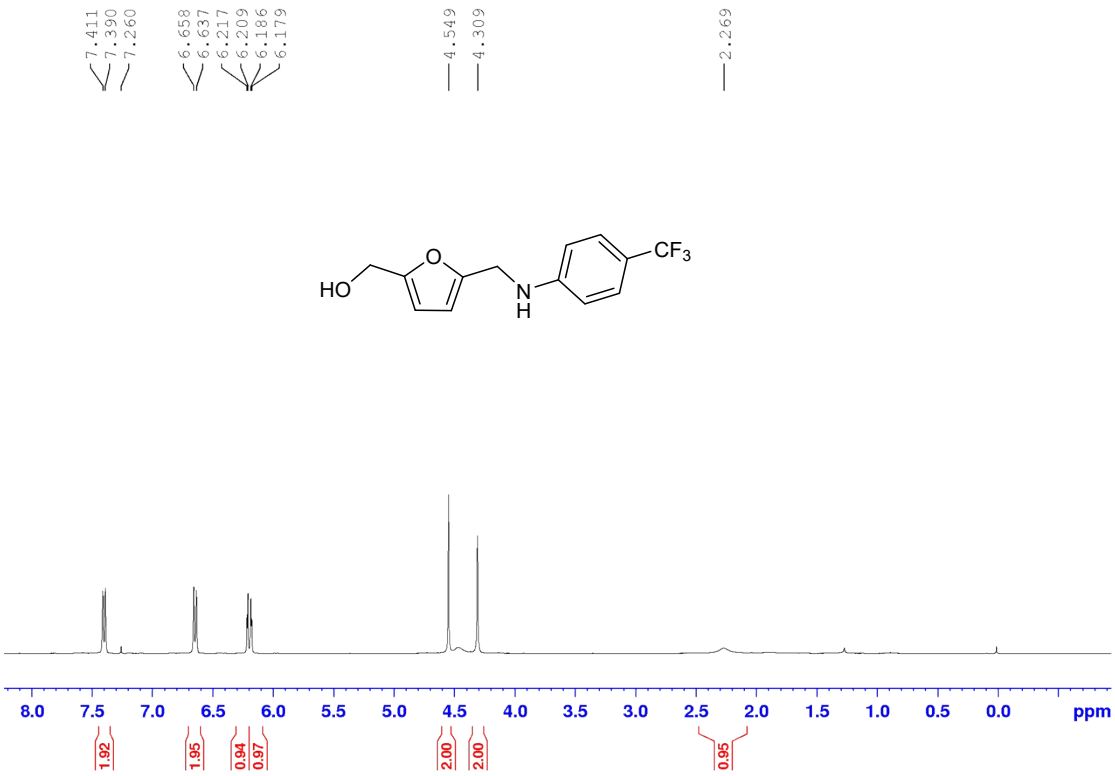
^{13}C NMR of compound **3k**



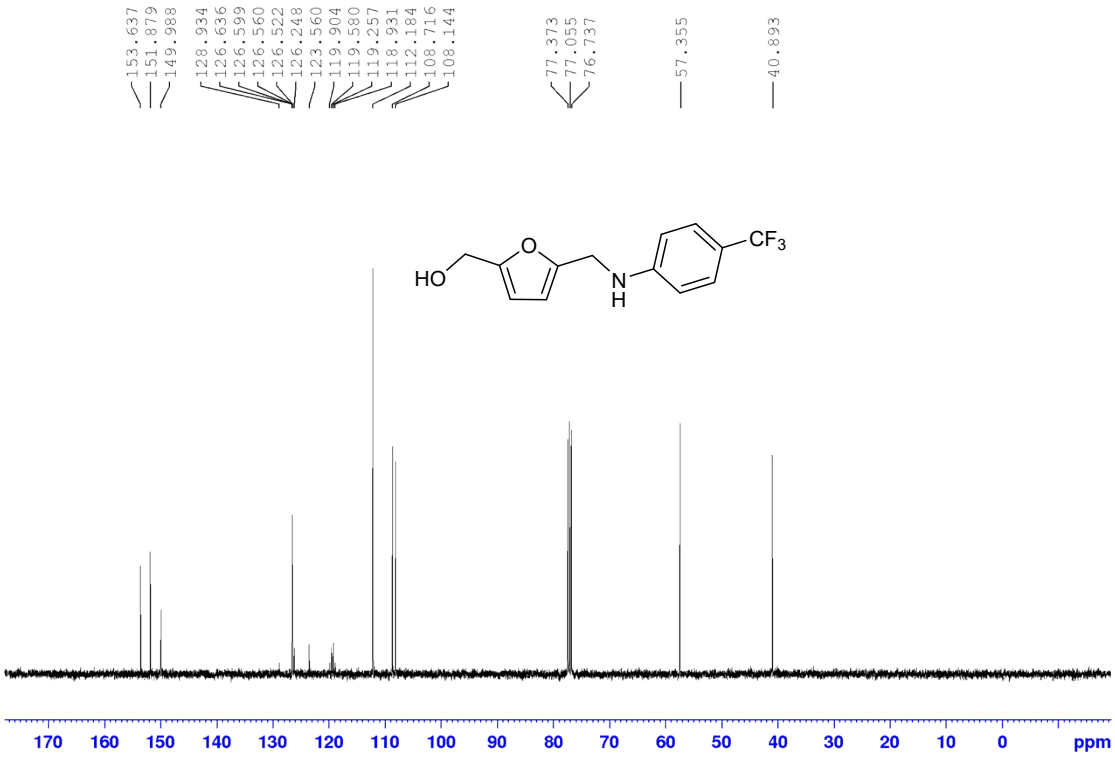
^{1}H NMR of compound **3l**



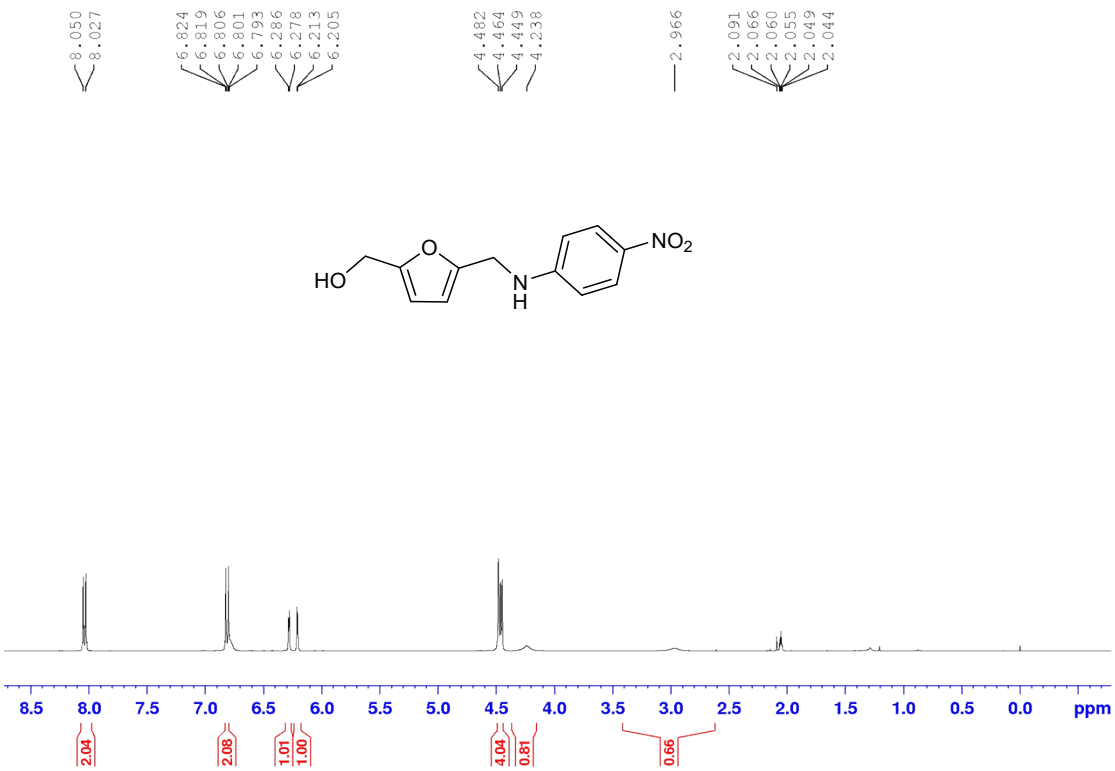
^{13}C NMR of compound **3l**



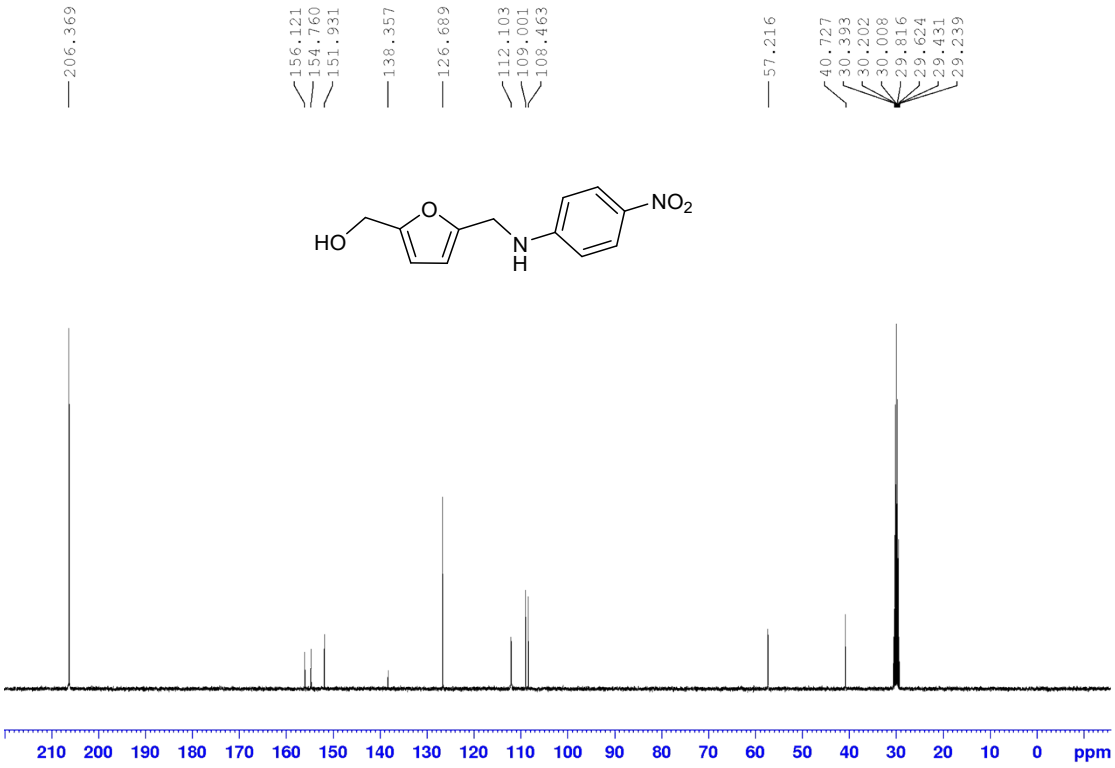
^{1}H NMR of compound **3m**



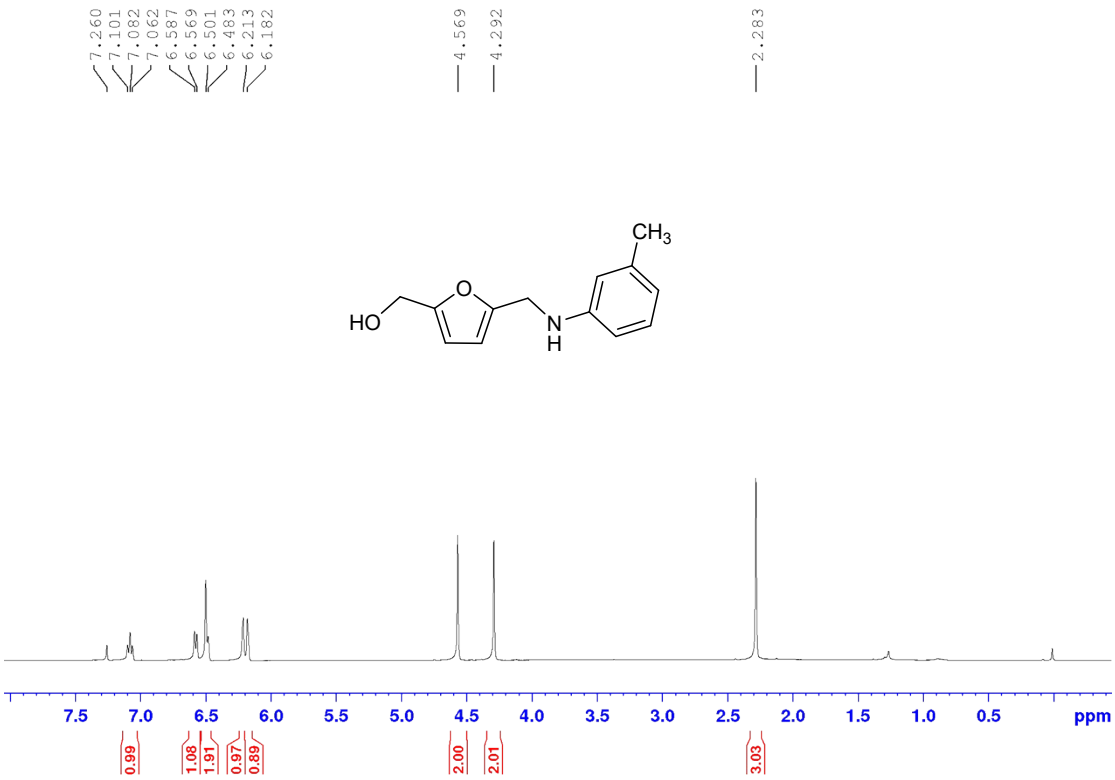
^{13}C NMR of compound **3m**



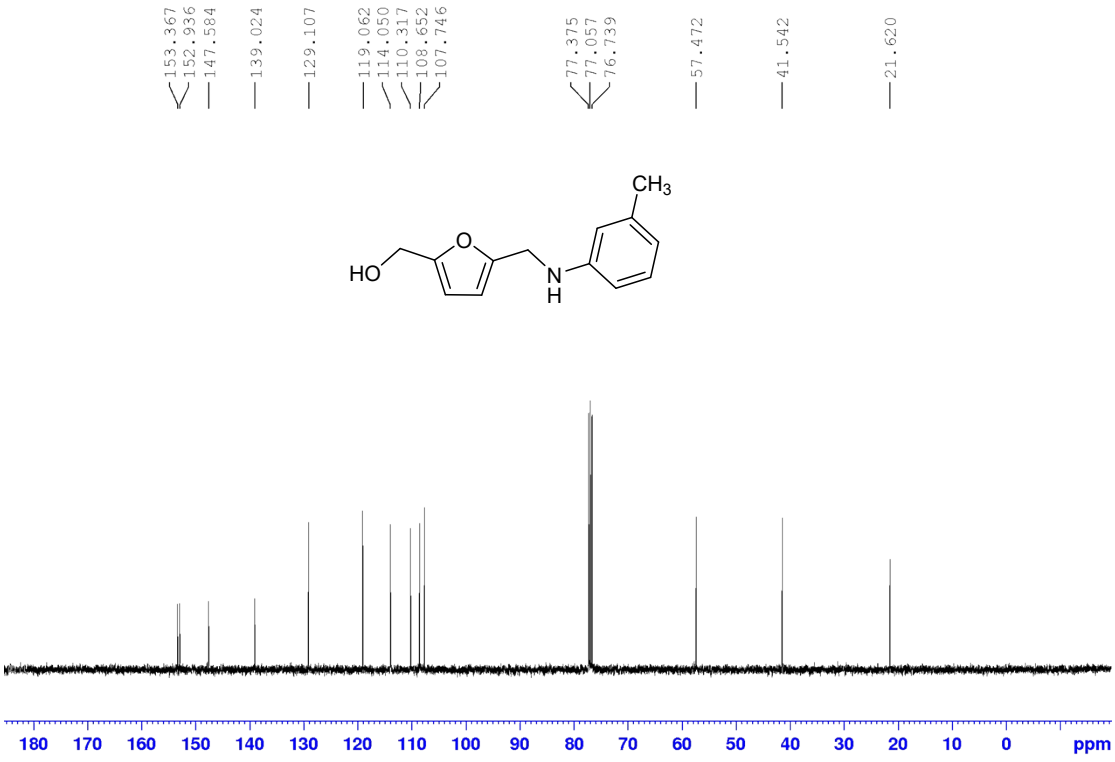
^{1}H NMR of compound **3n**



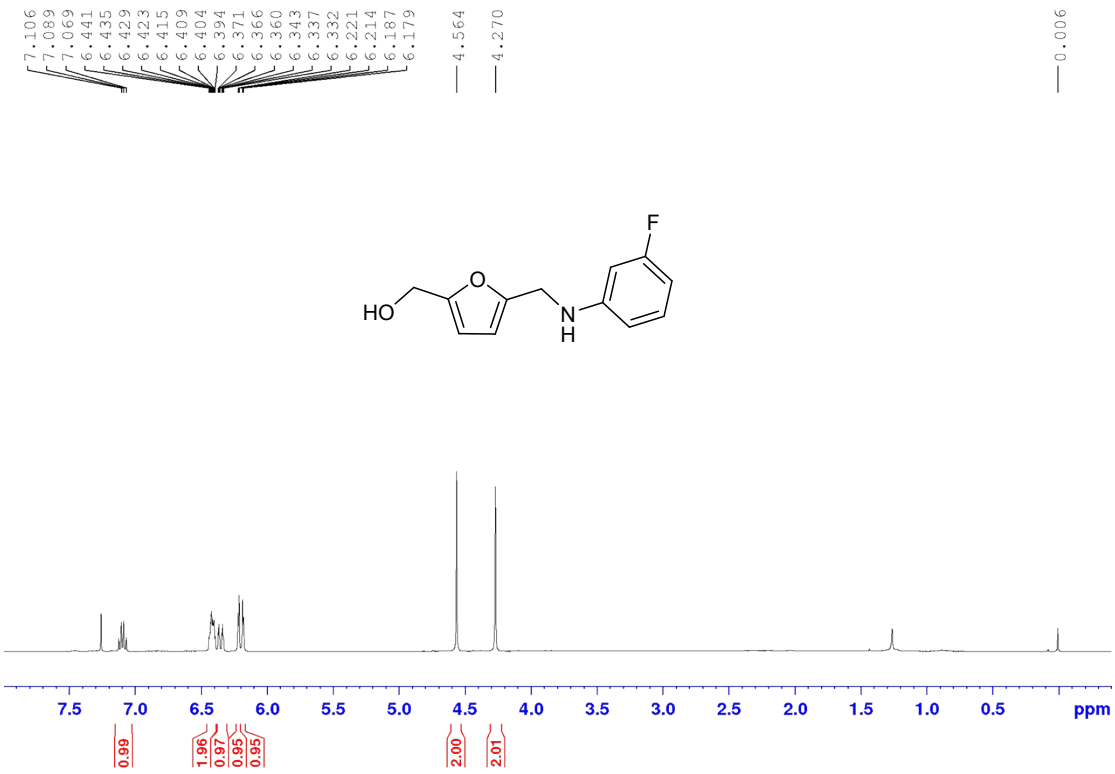
^{13}C NMR of compound **3n**



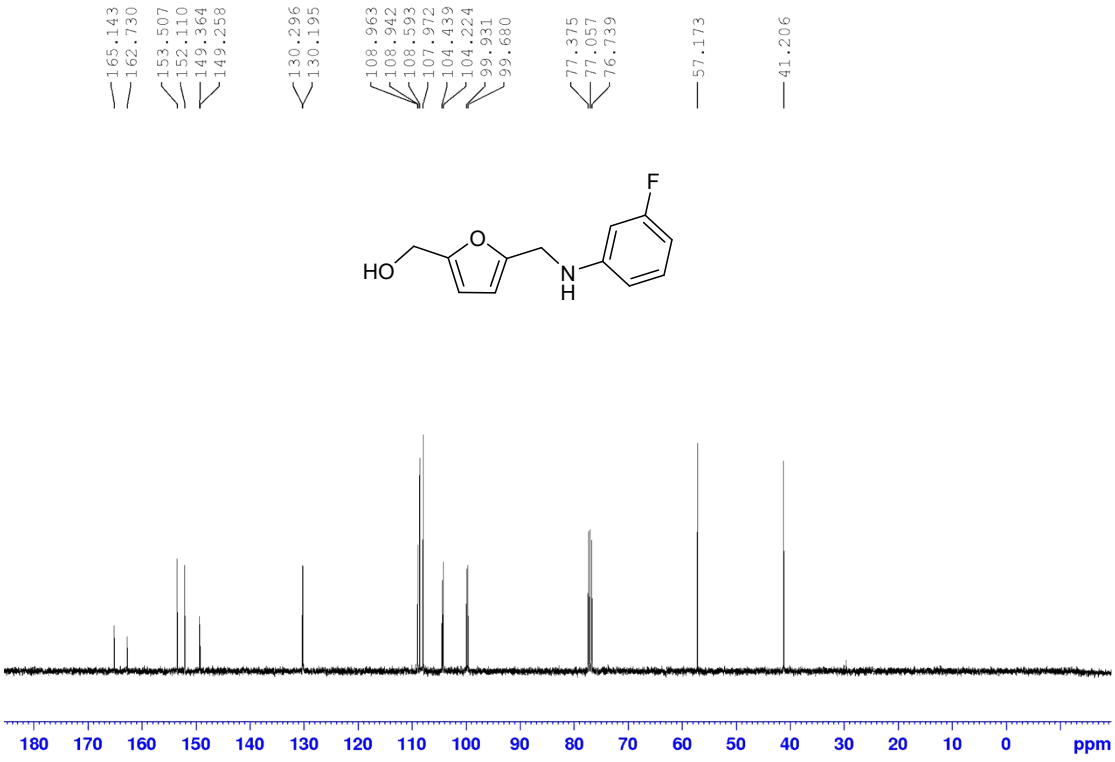
^{1}H NMR of compound **3o**



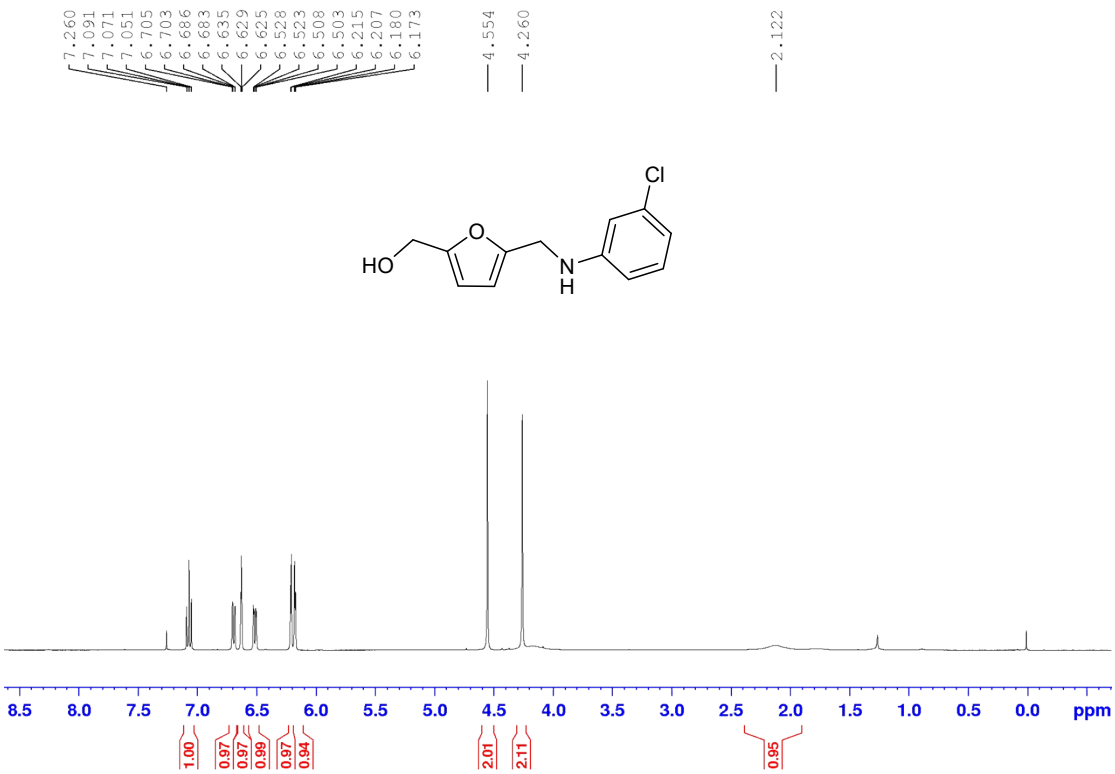
^{13}C NMR of compound **3o**



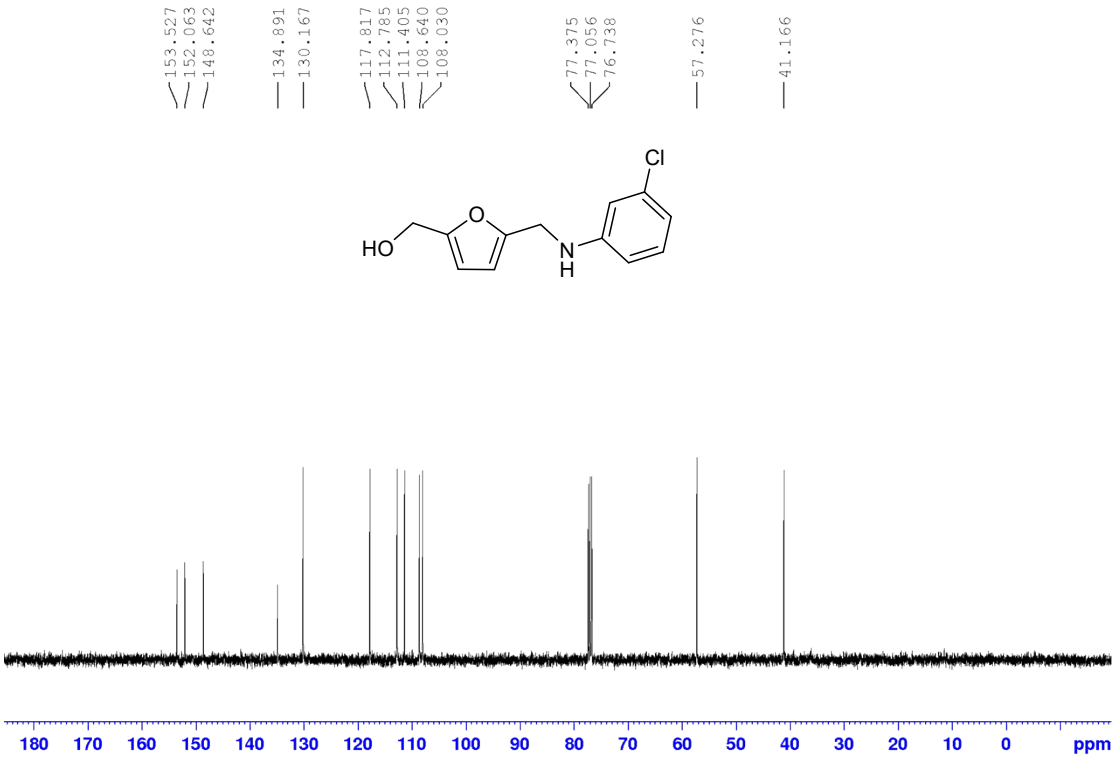
^{1}H NMR of compound **3p**



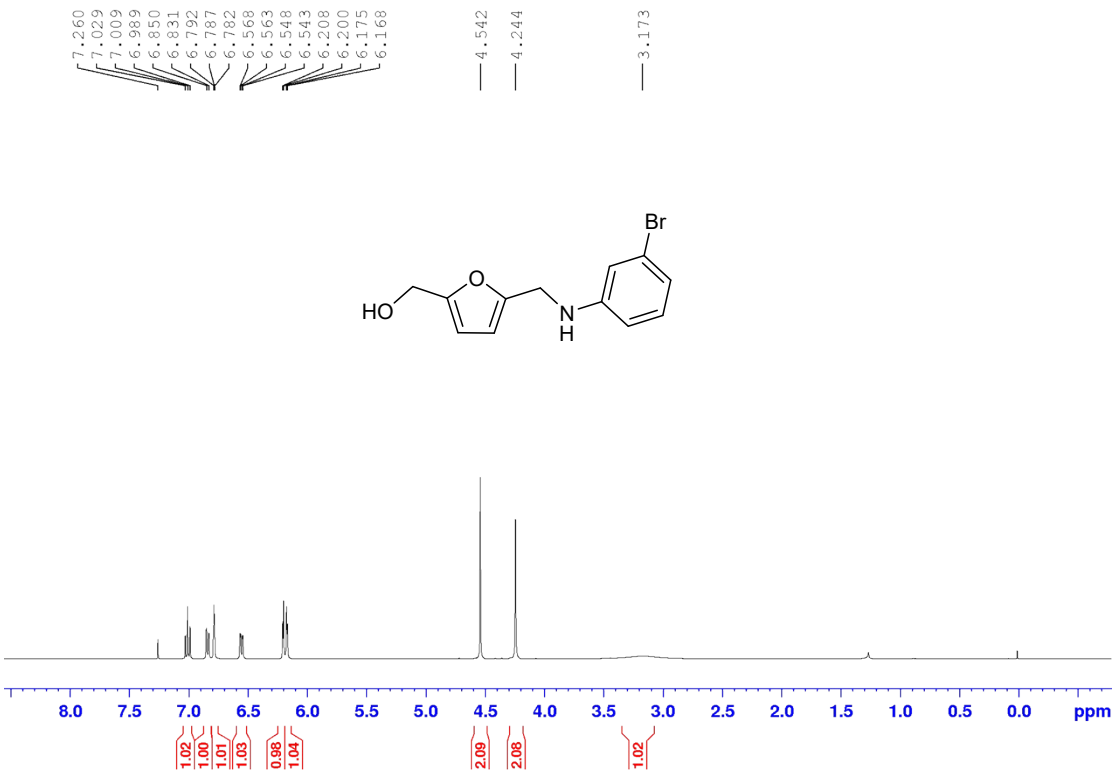
^{13}C NMR of compound **3p**



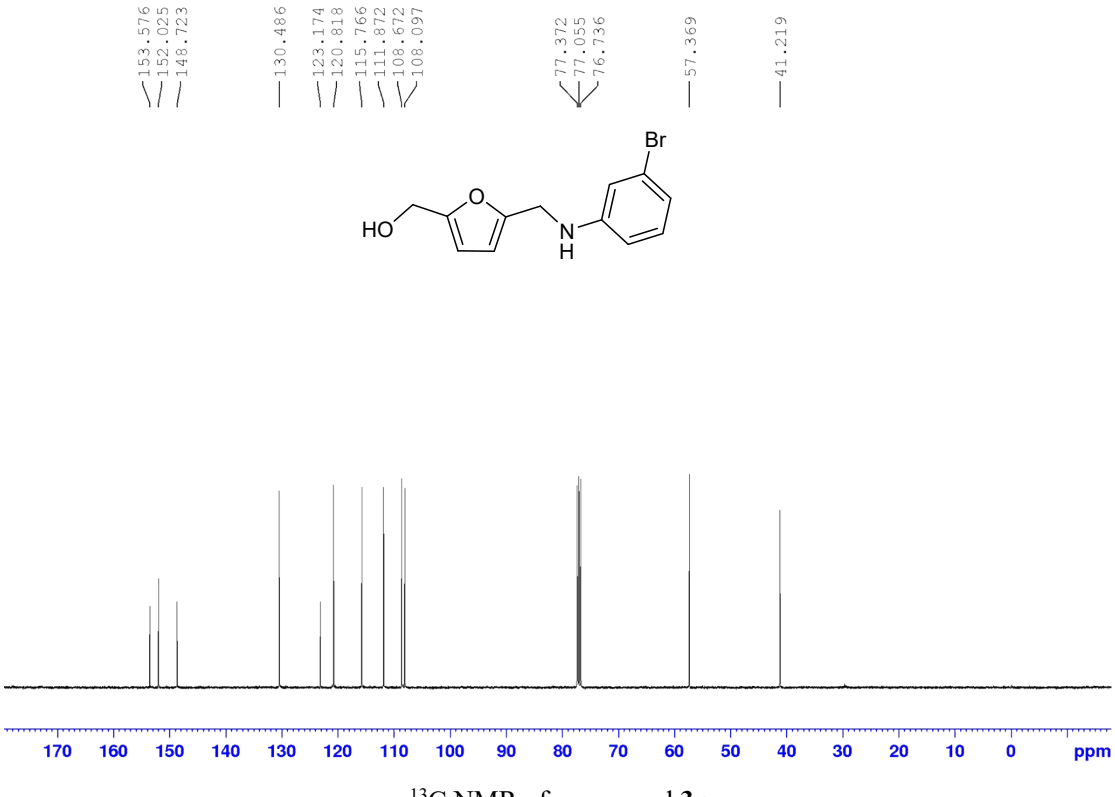
^{1}H NMR of compound **3q**



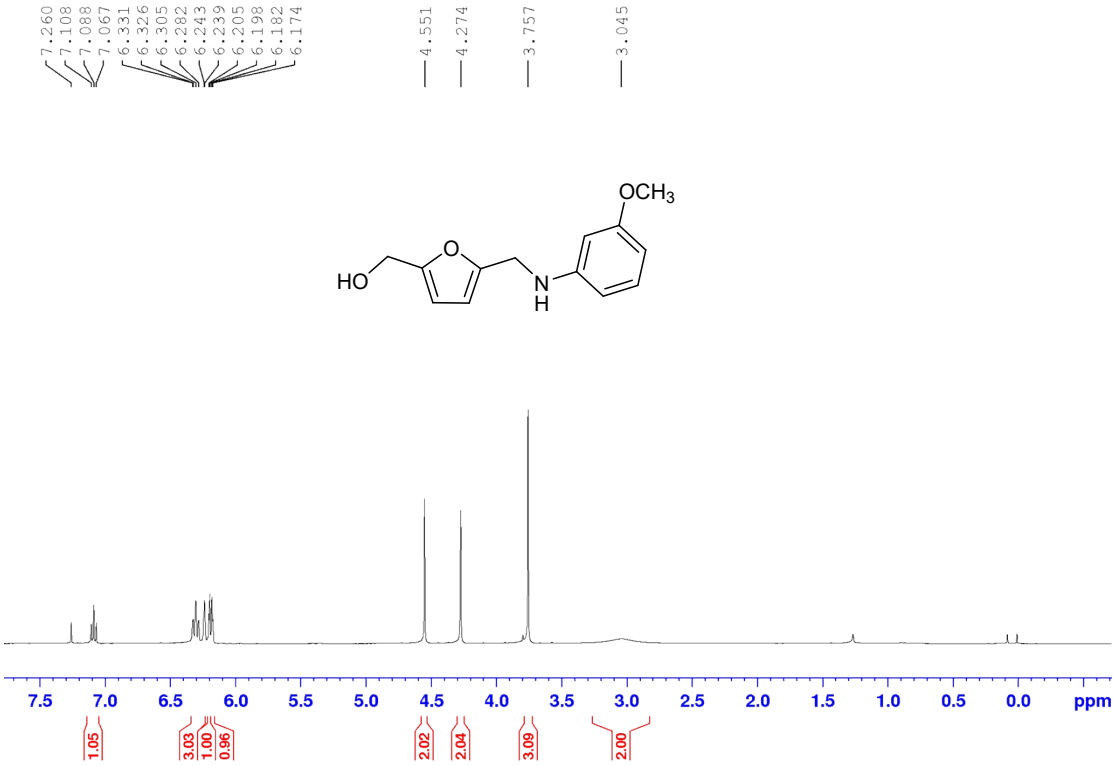
^{13}C NMR of compound **3q**



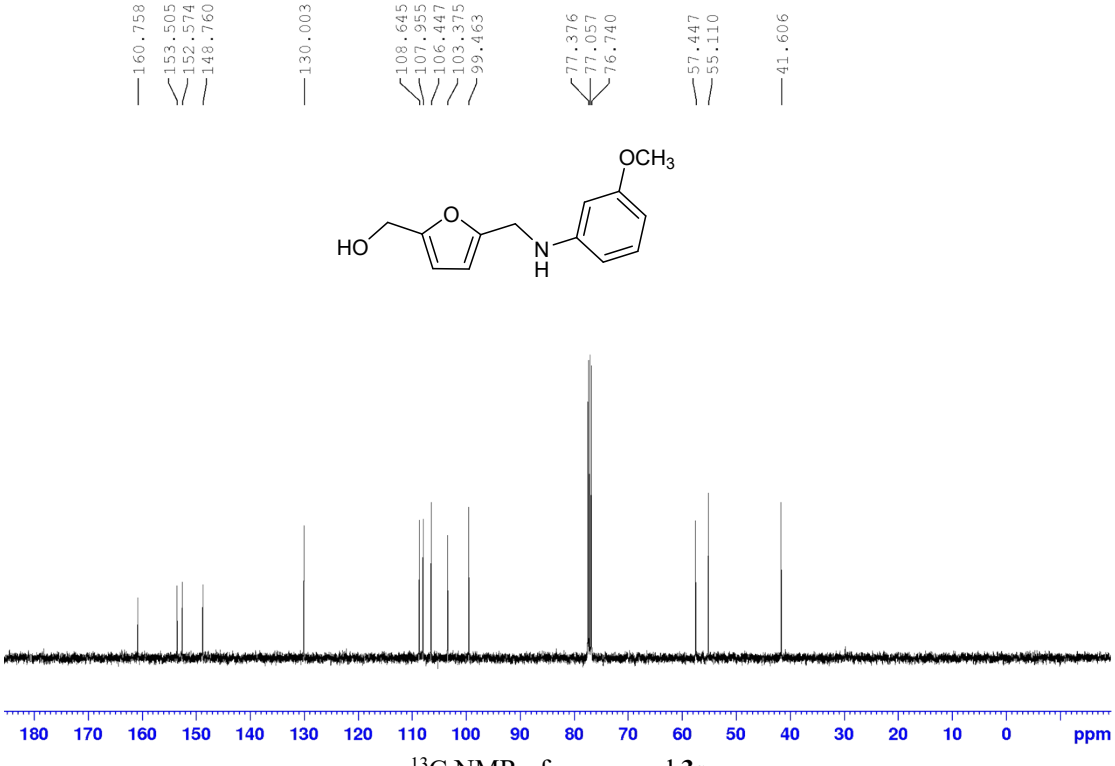
^{1}H NMR of compound **3r**



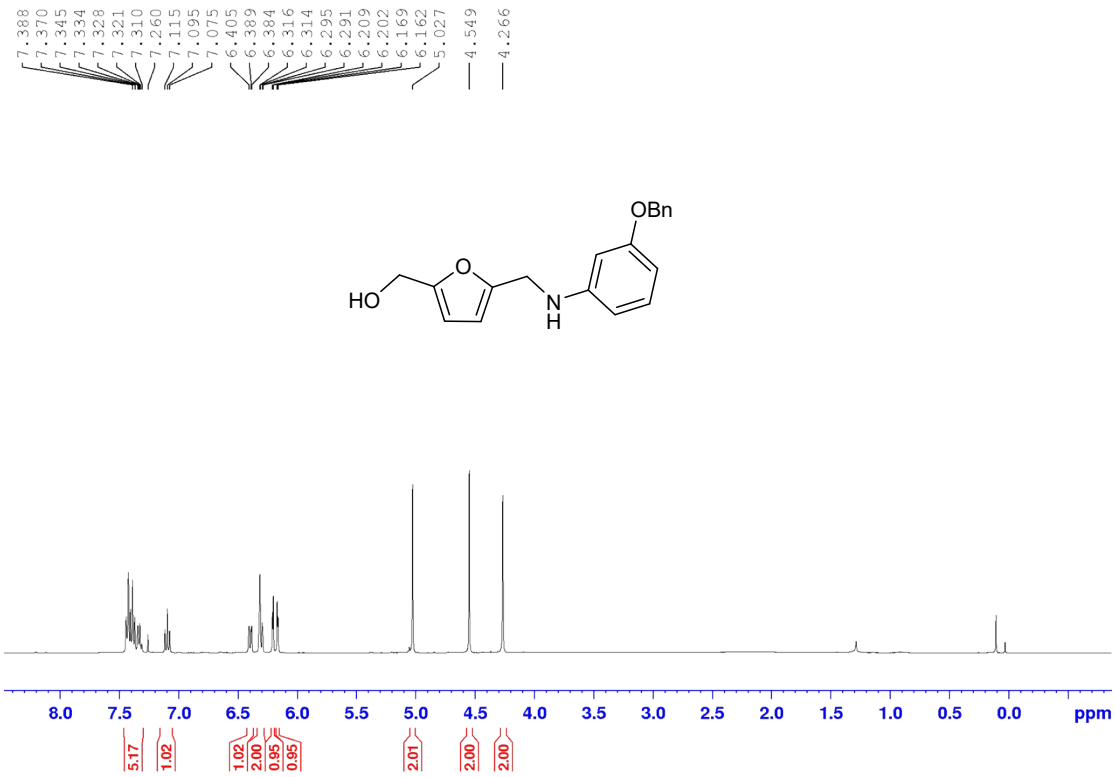
^{13}C NMR of compound **3r**



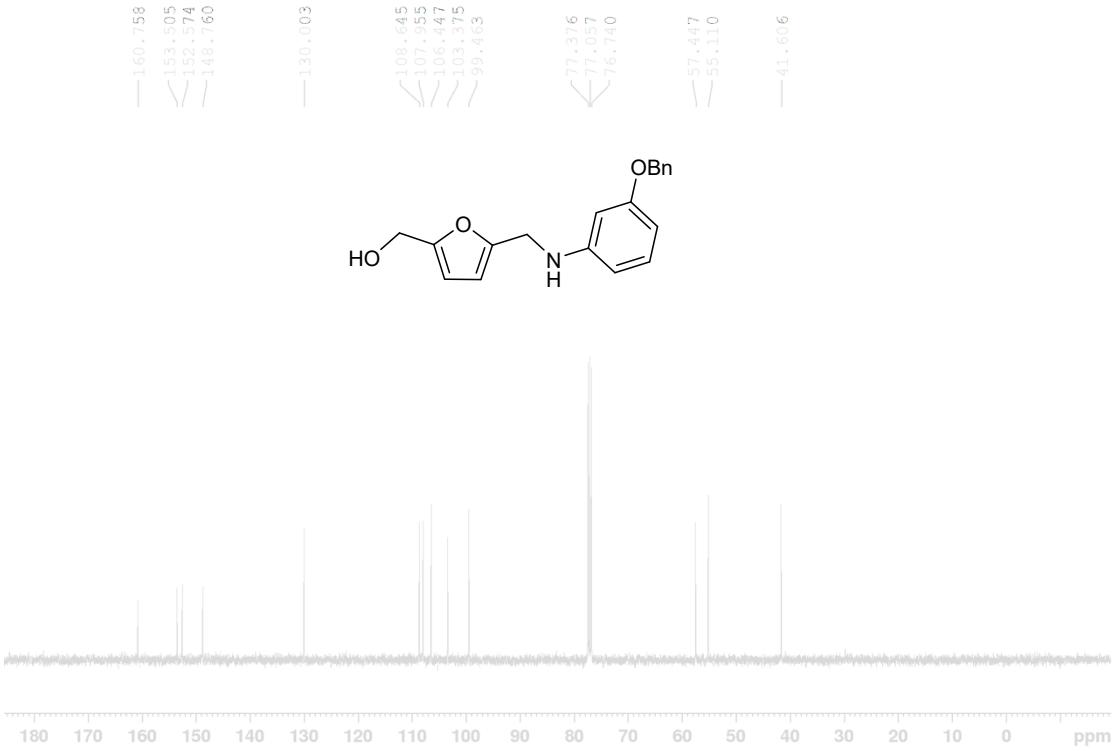
^{1}H NMR of compound **3s**



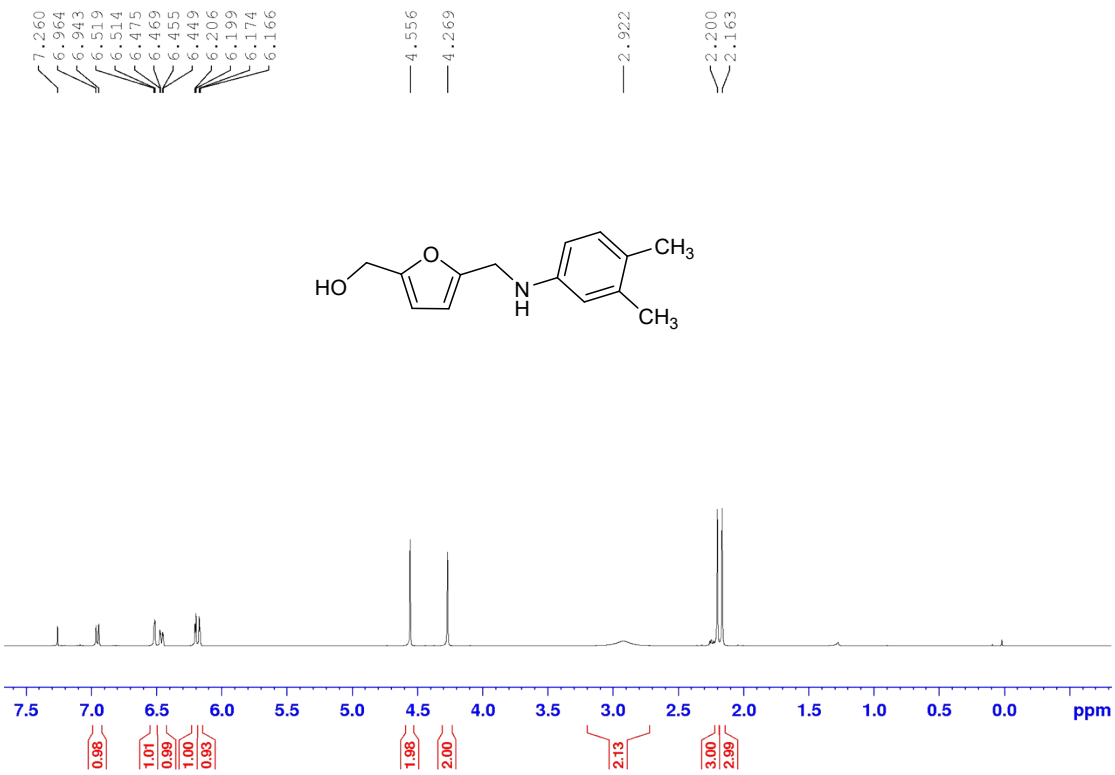
^{13}C NMR of compound **3s**



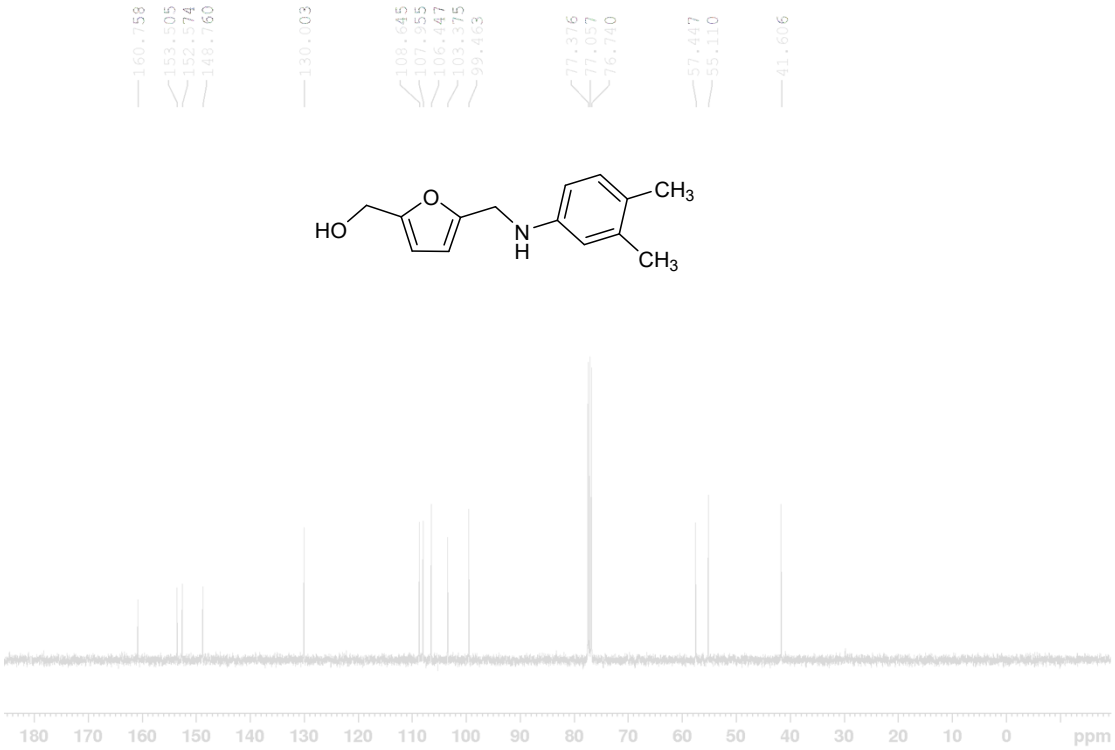
^{1}H NMR of compound **3t**



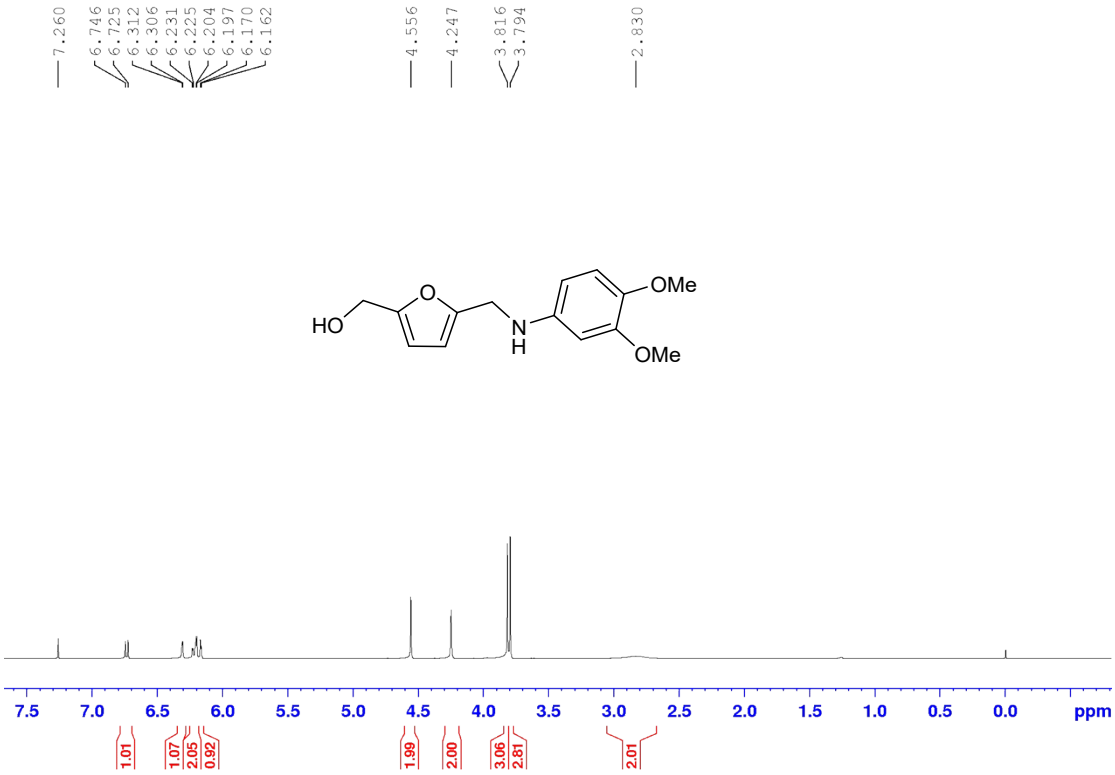
^{1}H NMR of compound **3t**



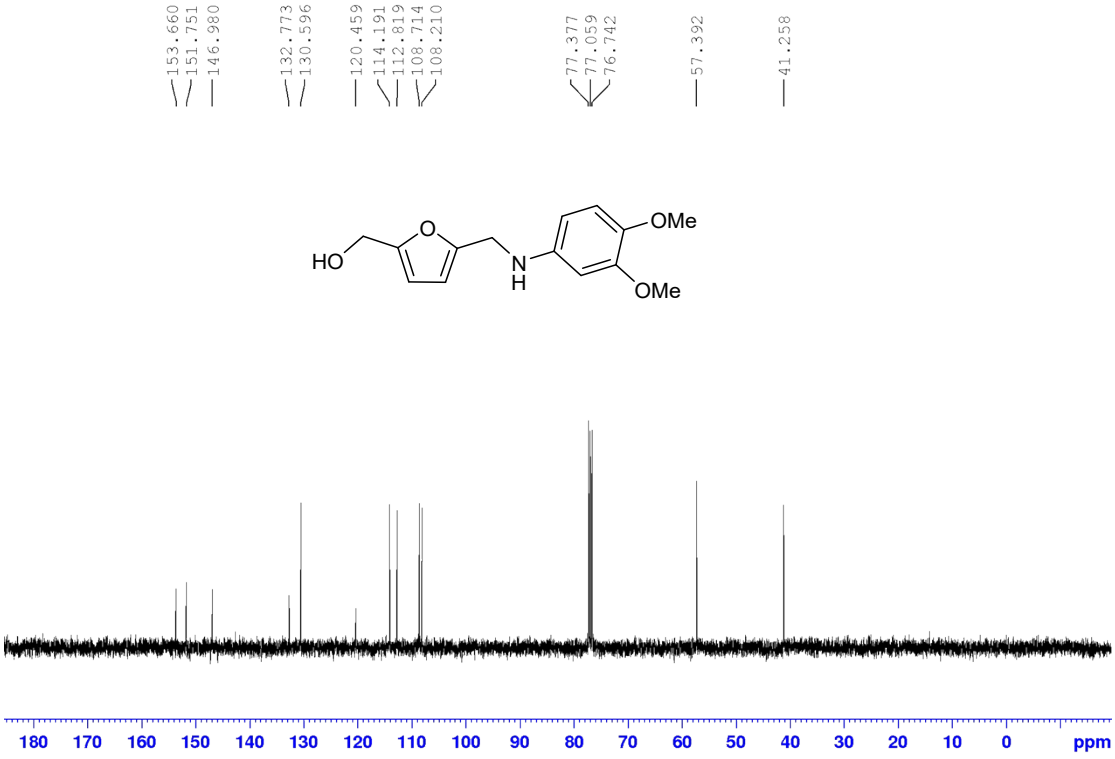
^{1}H NMR of compound **3u**



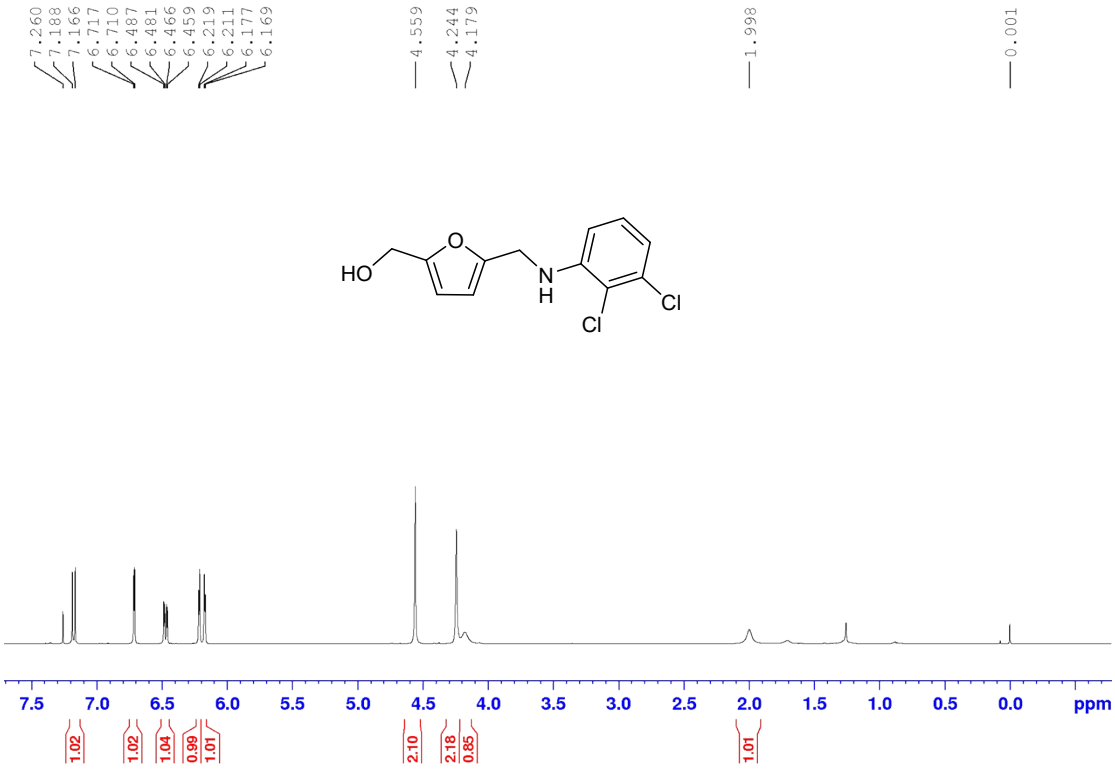
^{1}H NMR of compound **3u**



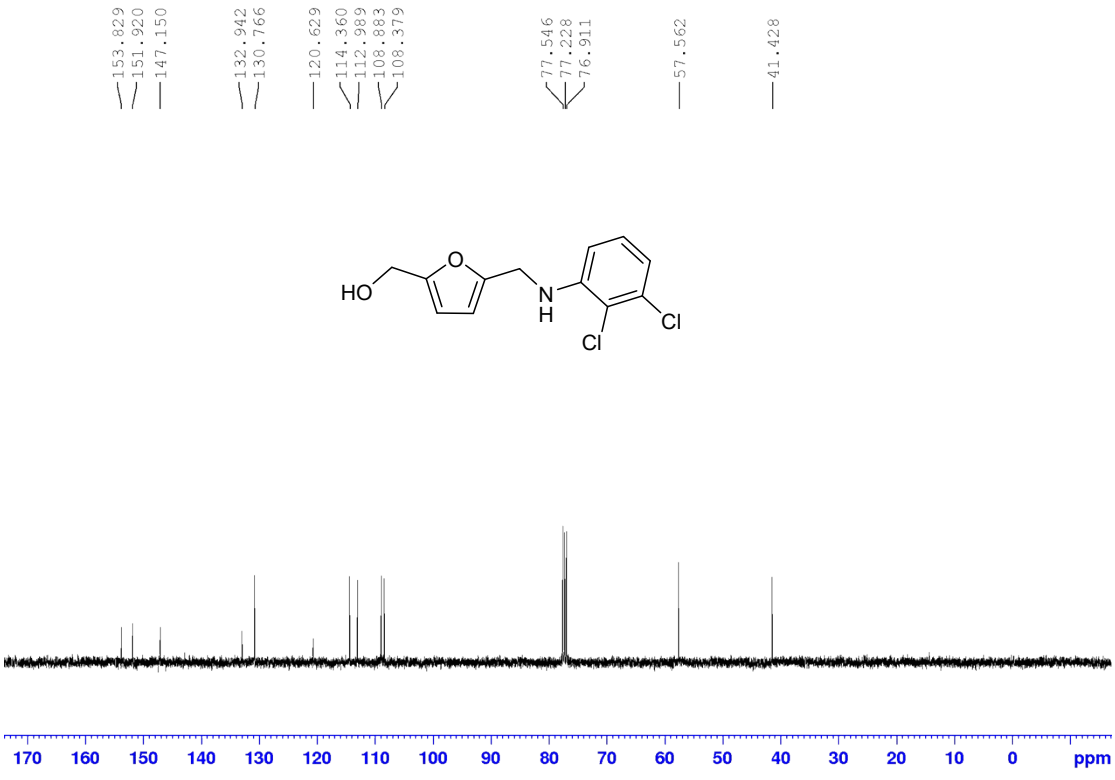
^{1}H NMR of compound **3v**



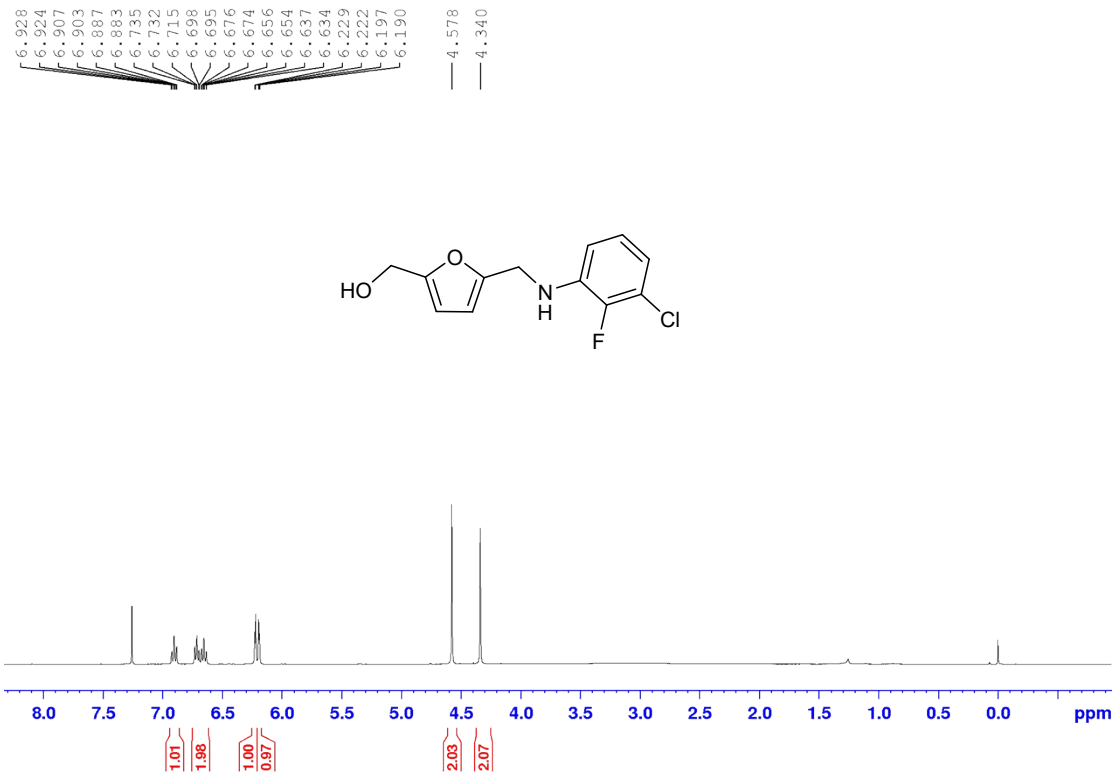
^{13}C NMR of compound **3v**



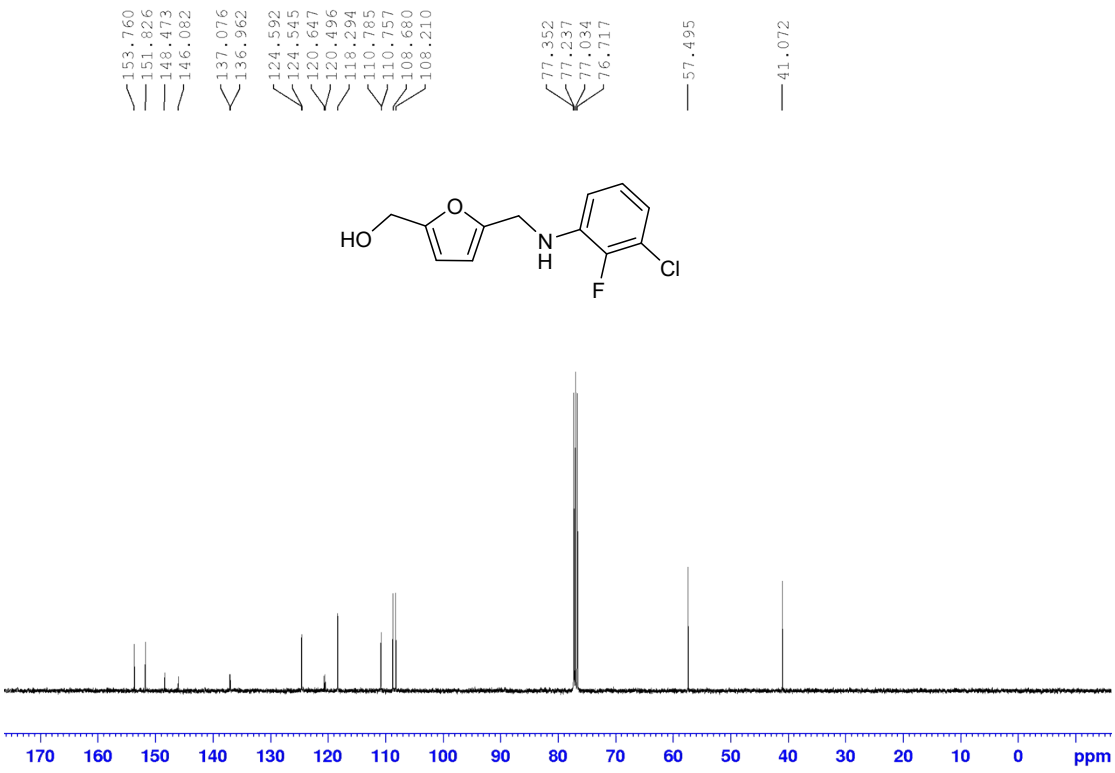
^{1}H NMR of compound **3w**



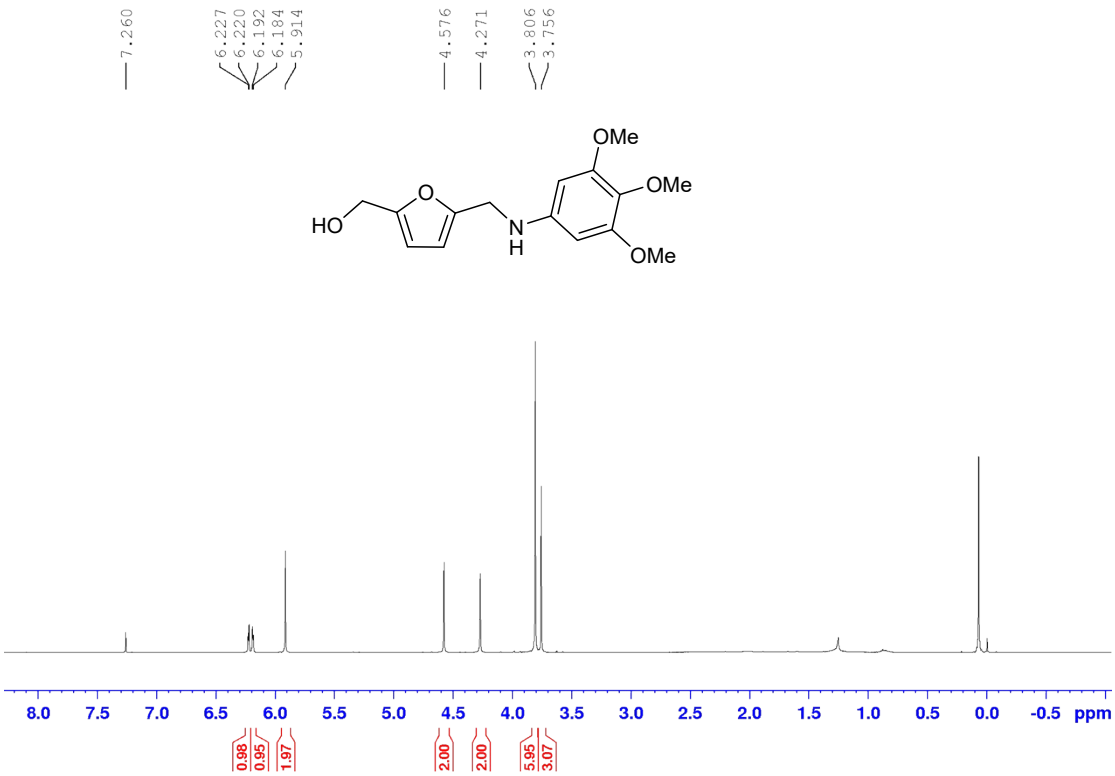
^{13}C NMR of compound **3w**



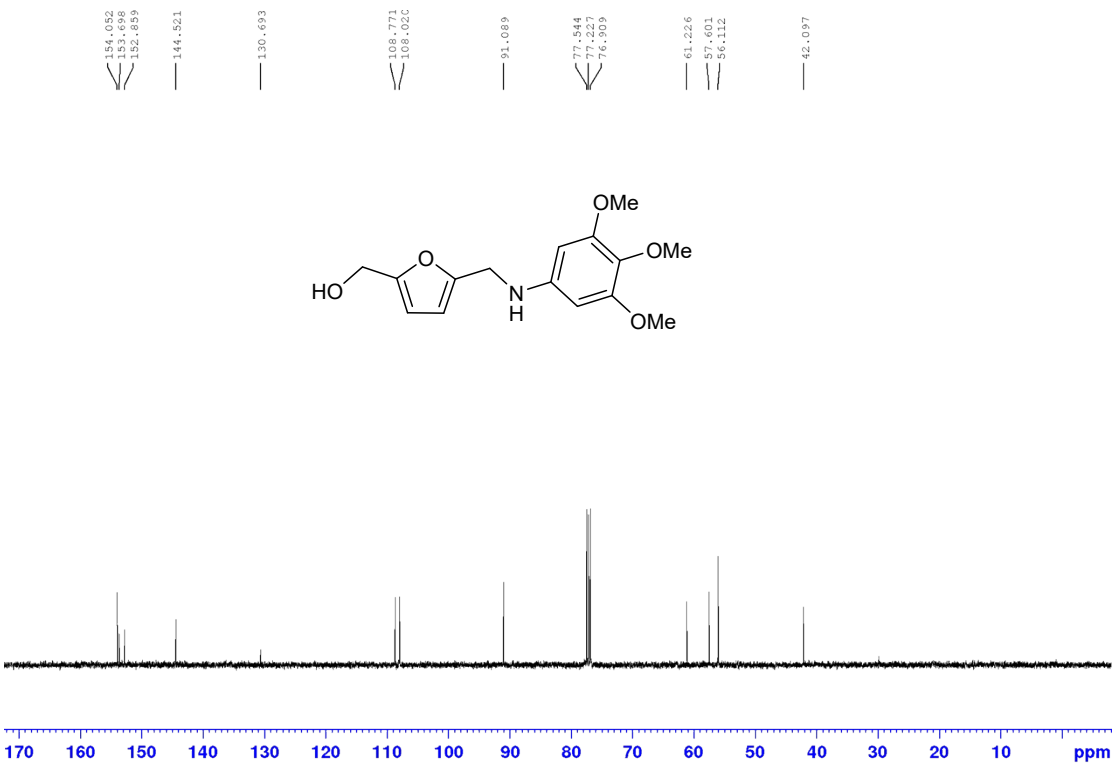
^{1}H NMR of compound **3x**



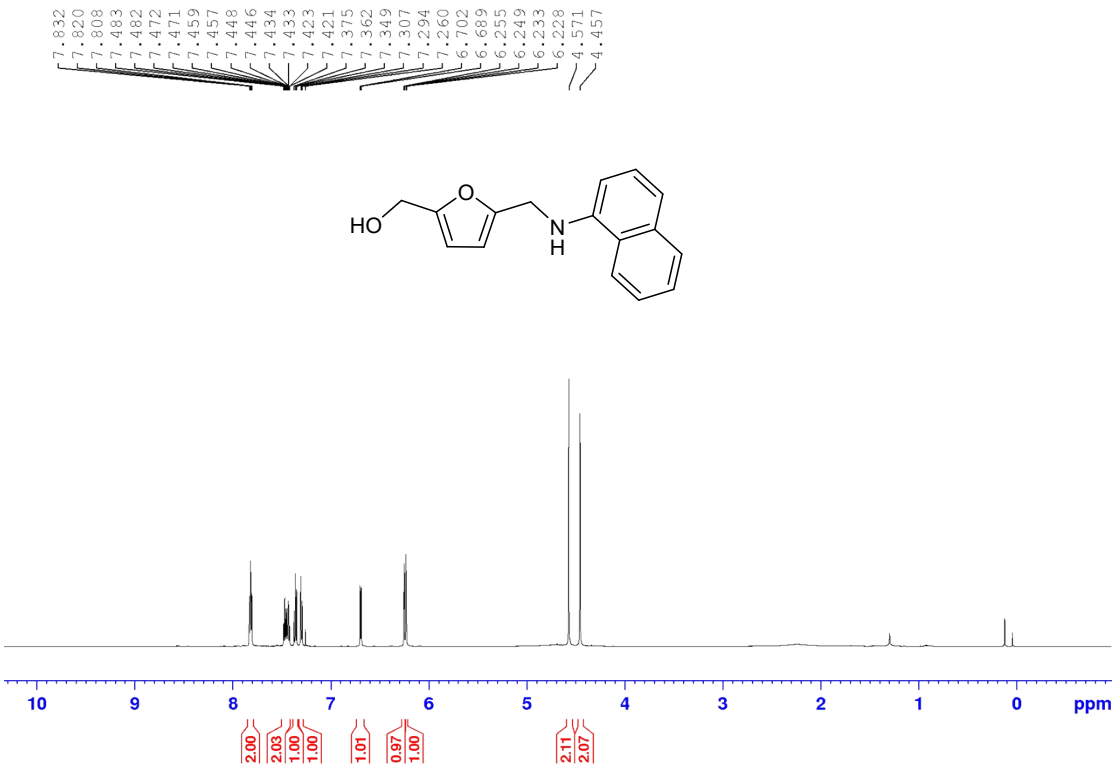
^{13}C NMR of compound **3x**



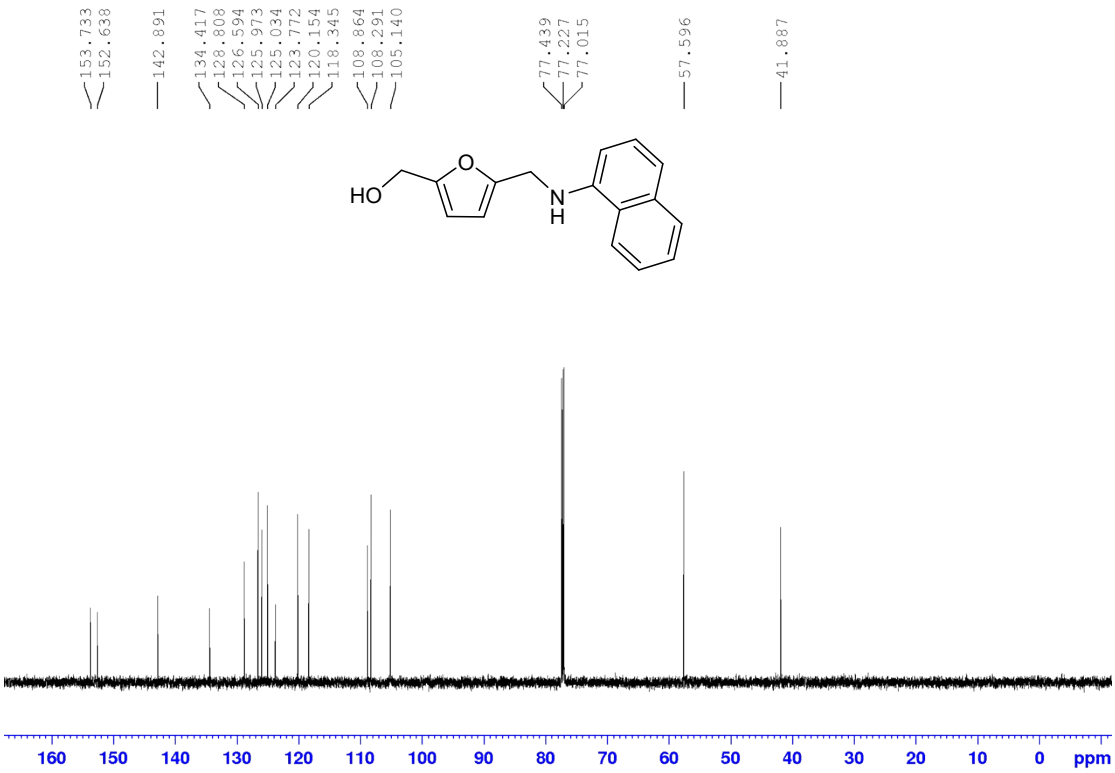
^{1}H NMR of compound **3y**



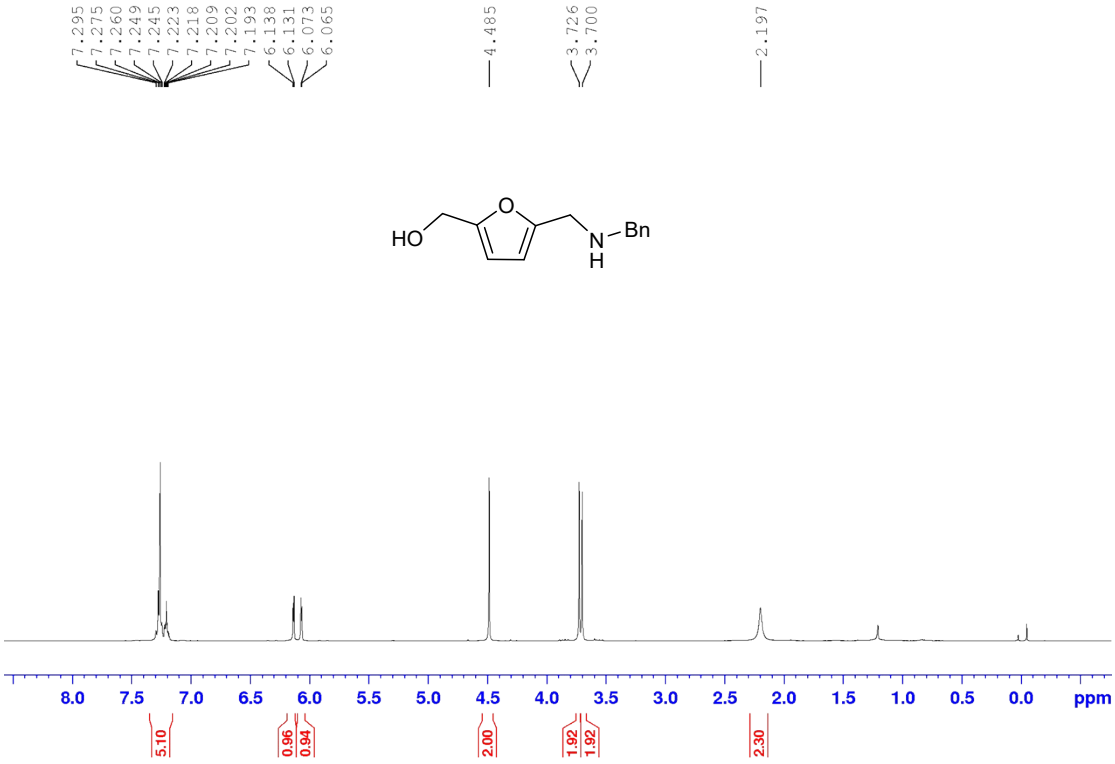
^{13}C NMR of compound **3y**



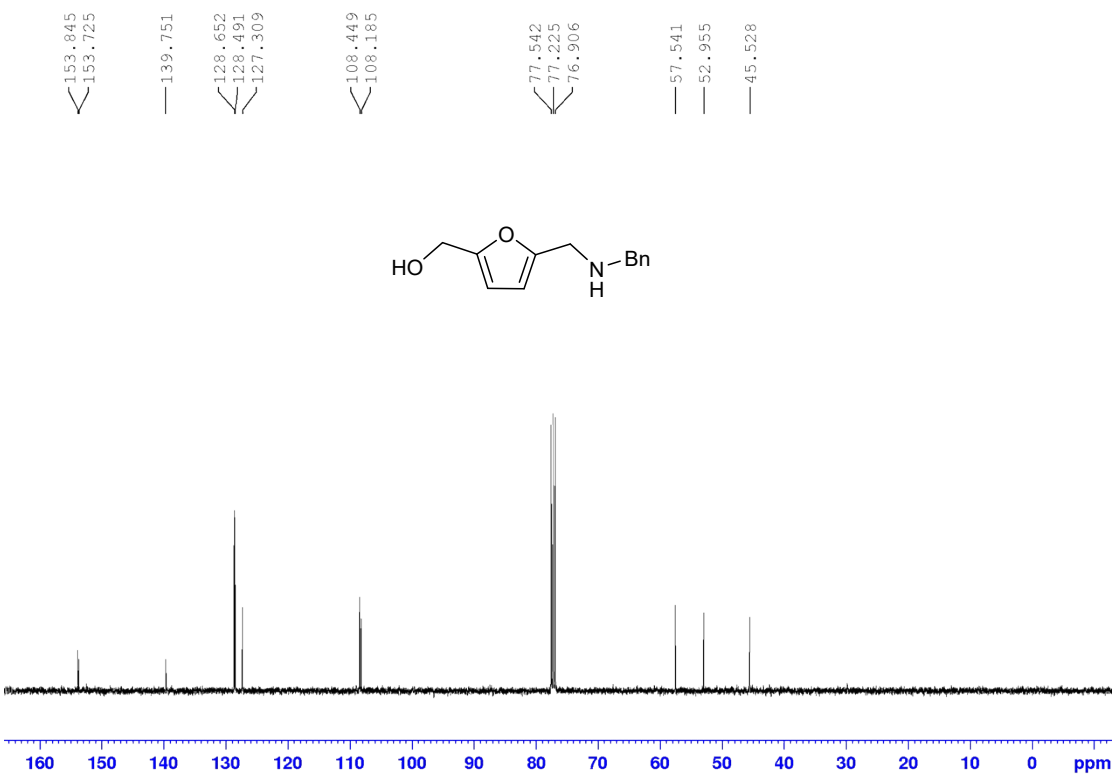
^{1}H NMR of compound **3z**



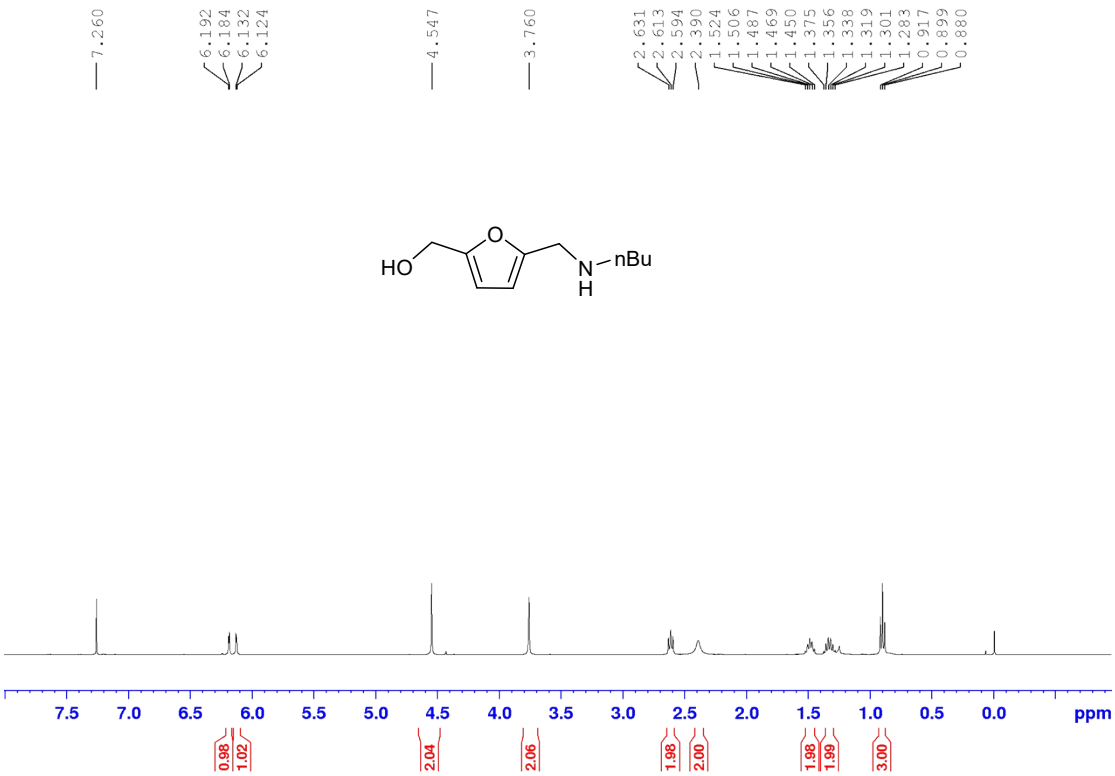
^{13}C NMR of compound **3z**



^{1}H NMR of compound **3aa**

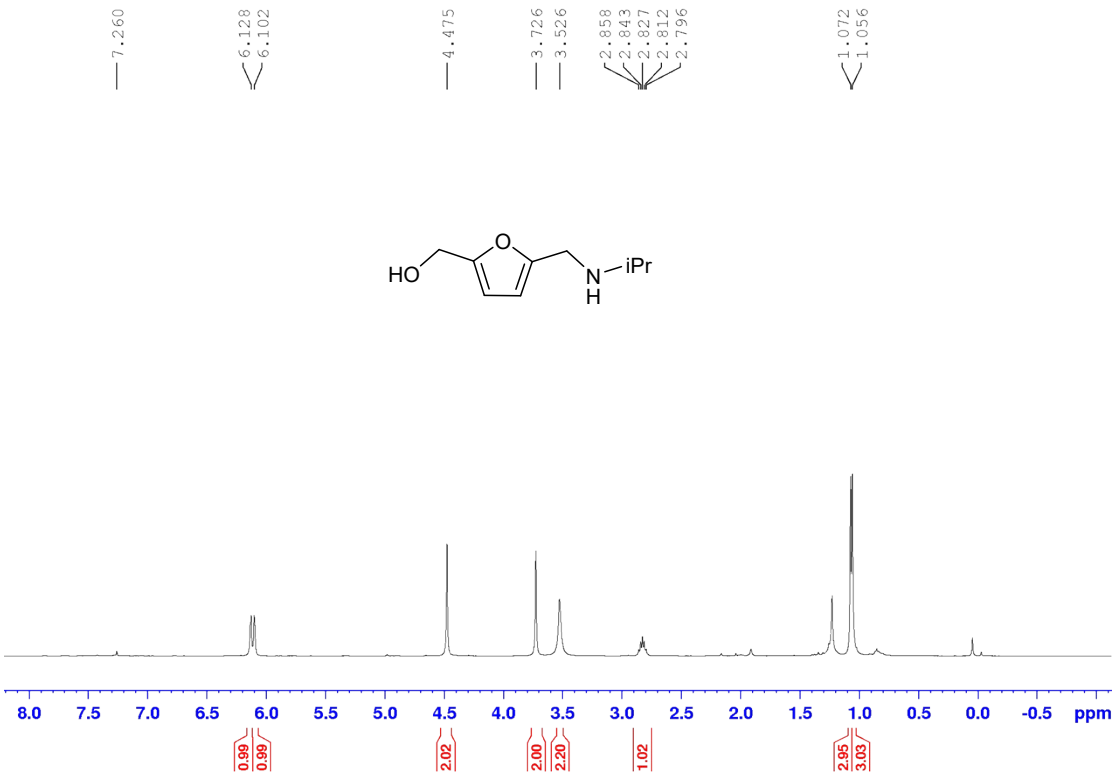


^{13}C NMR of compound **3aa**

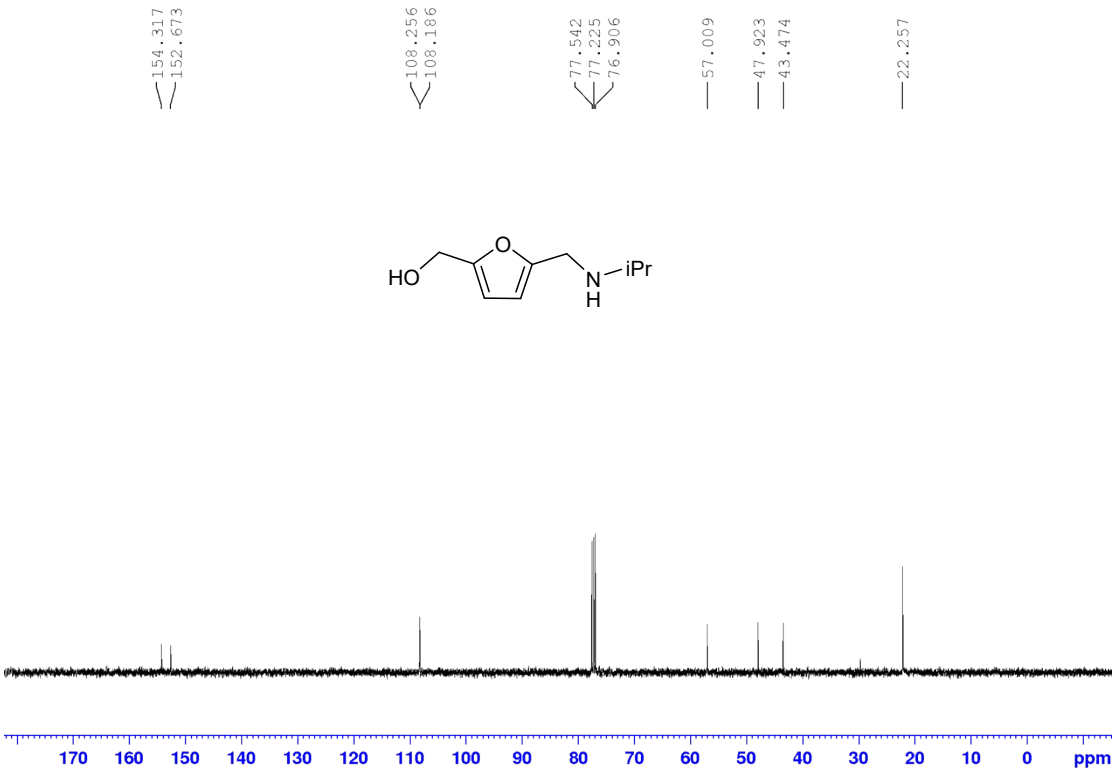


^{1}H NMR of compound **3ab**

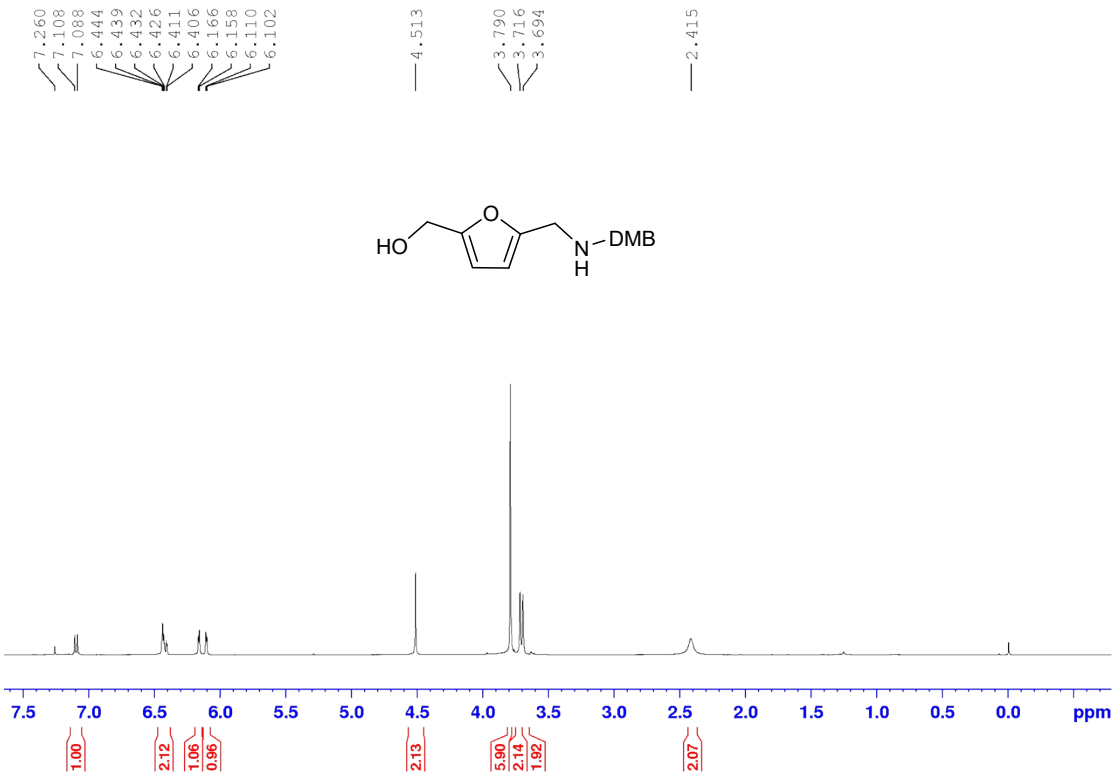
^{13}C NMR of compound **3ab**



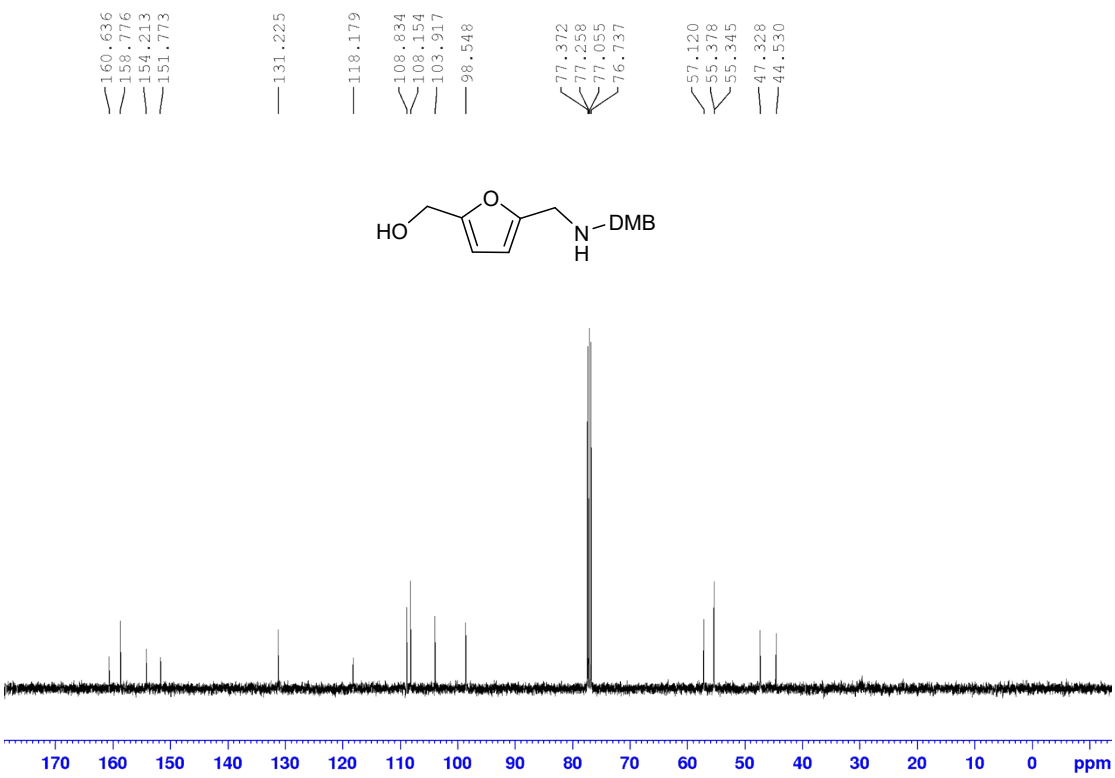
^{1}H NMR of compound **3ac**



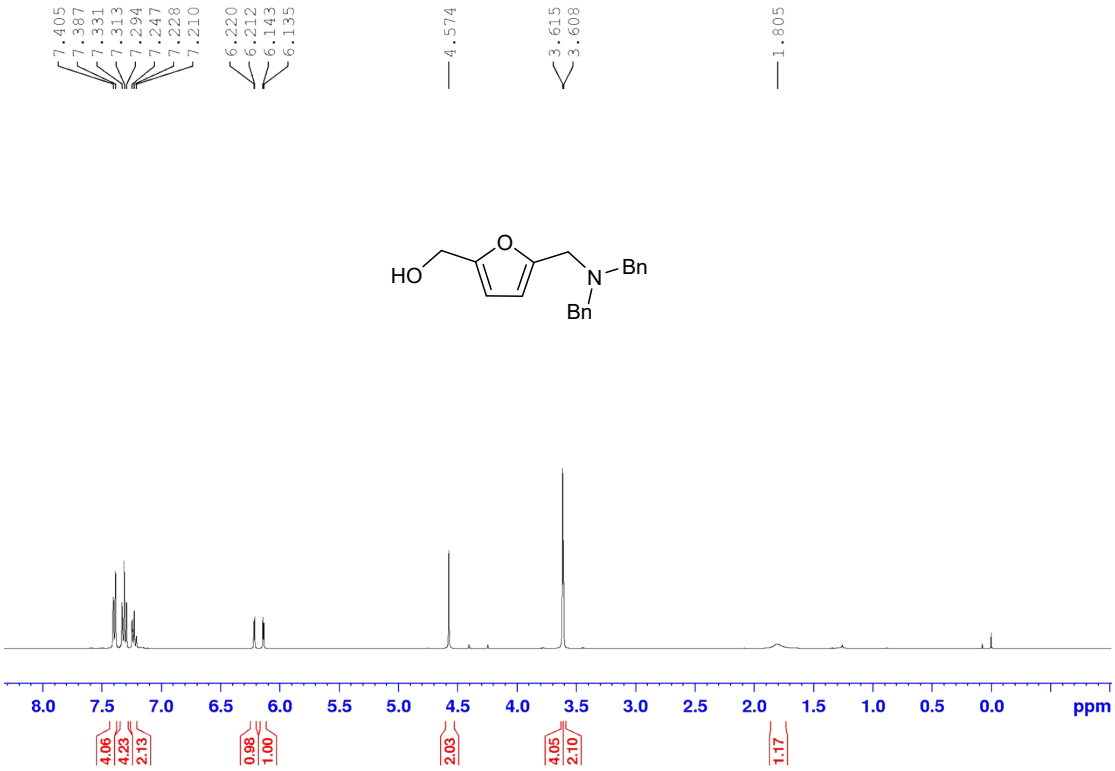
^{13}C NMR of compound **3ac**



^{1}H NMR of compound **3ad**



^{13}C NMR of compound **3ad**



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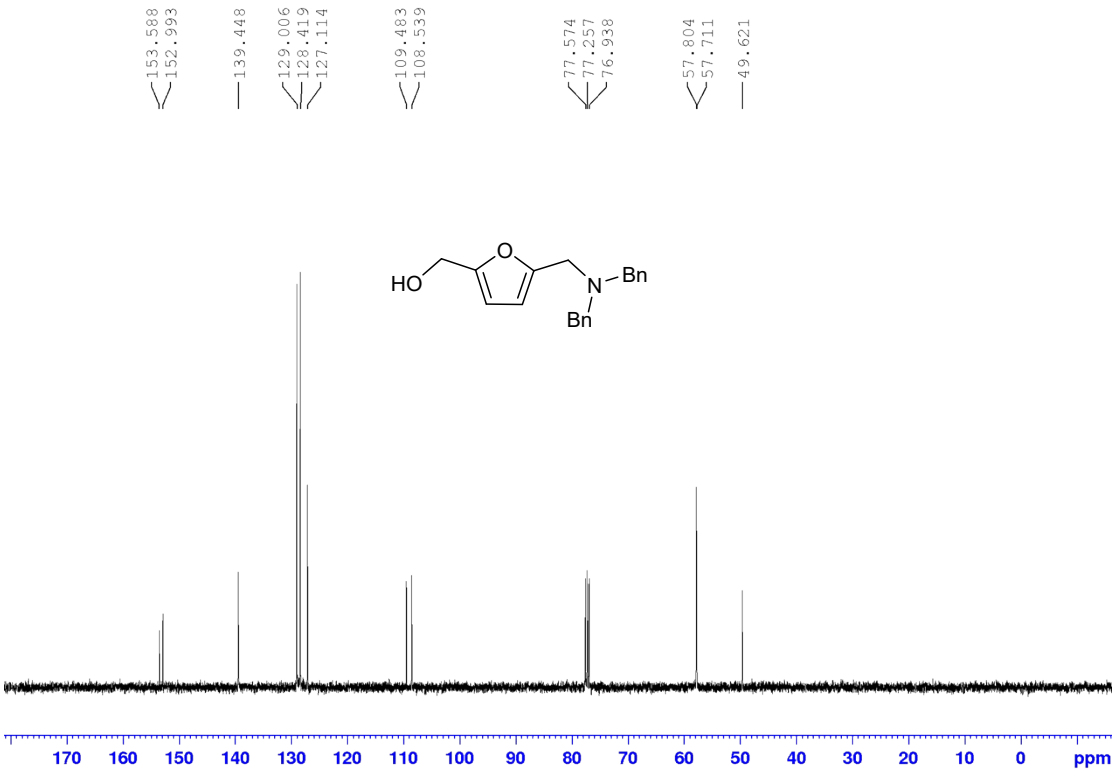
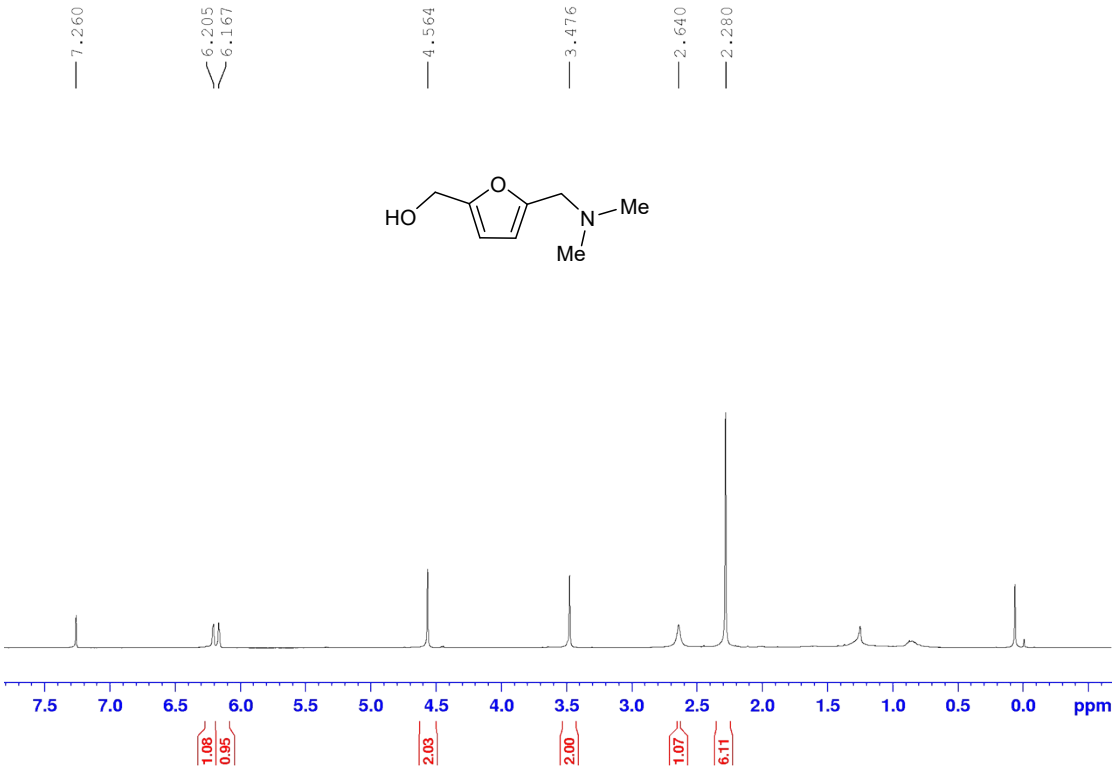
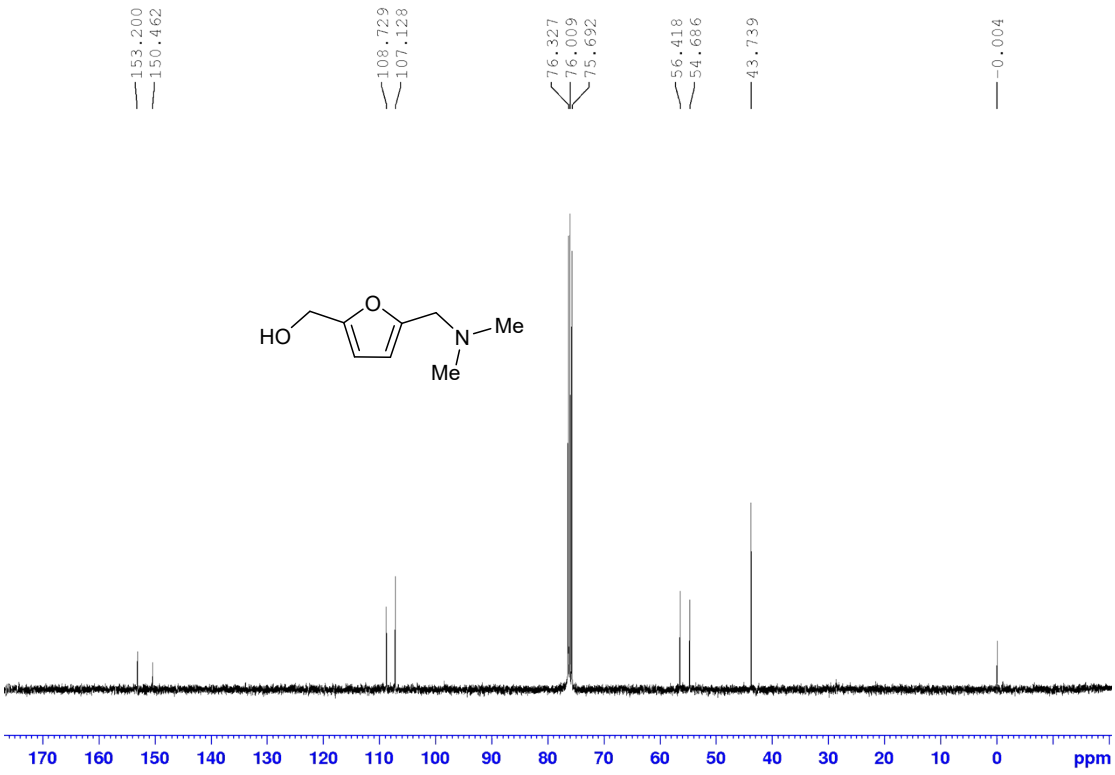


^{13}C NMR of compound **3ae**



^{1}H NMR of compound **3af**



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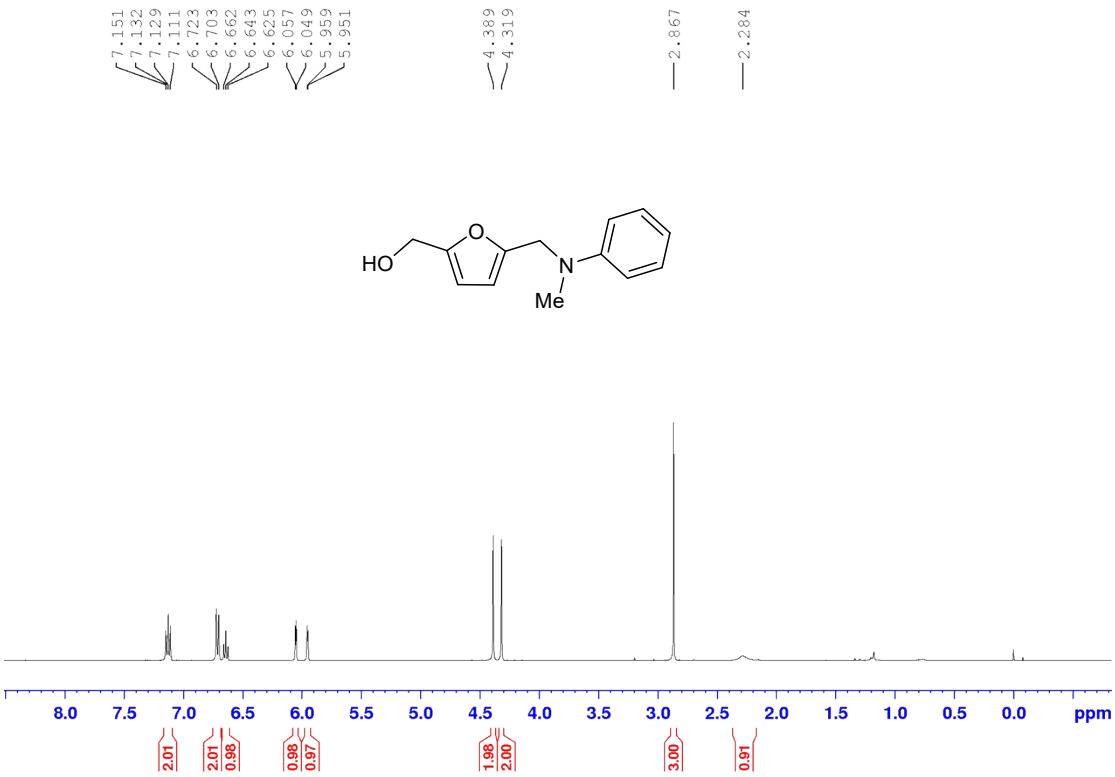
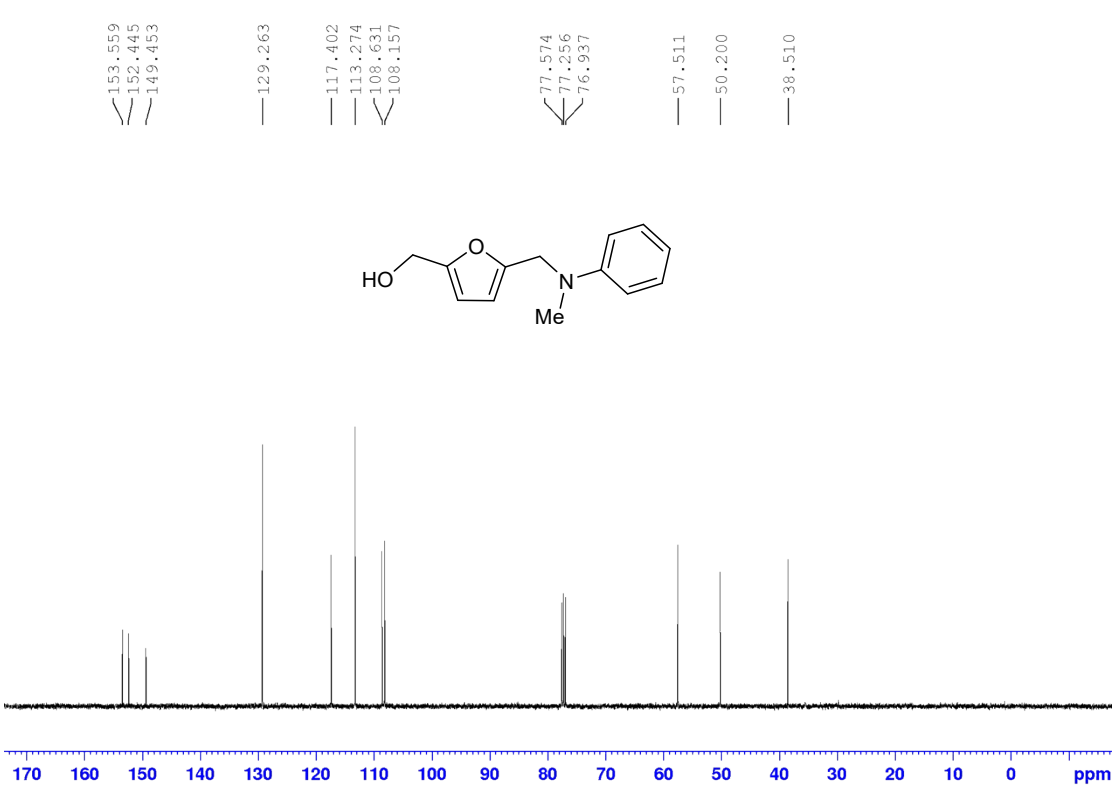
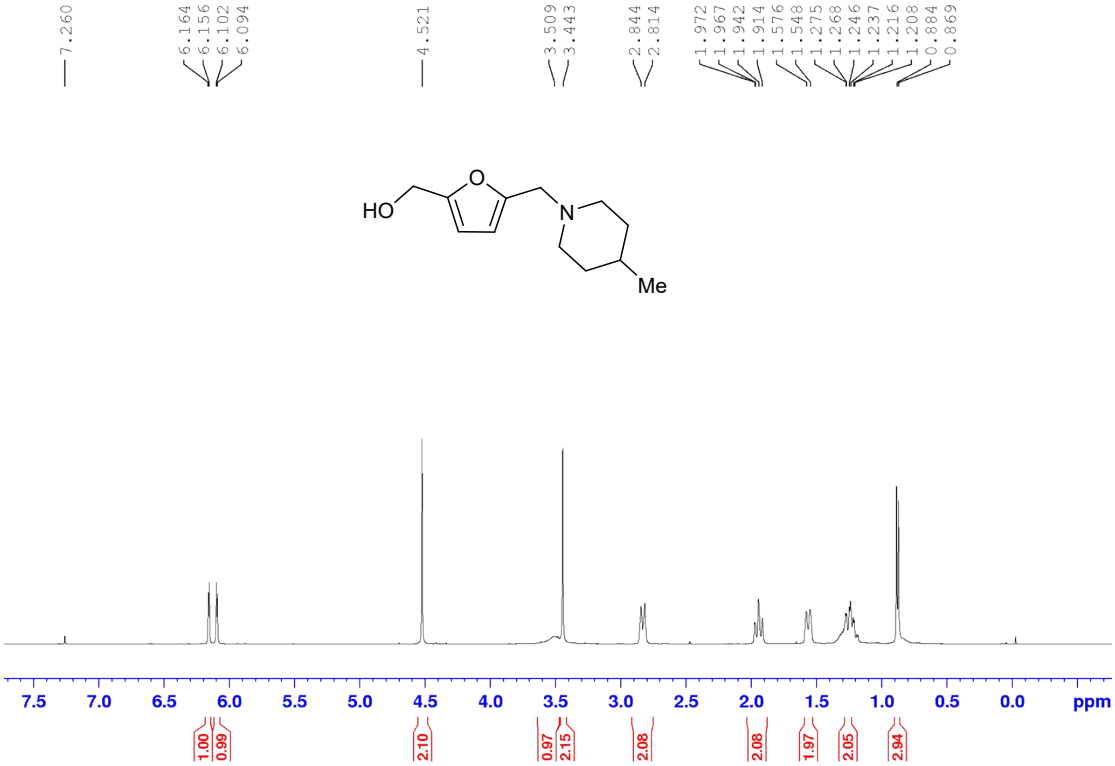


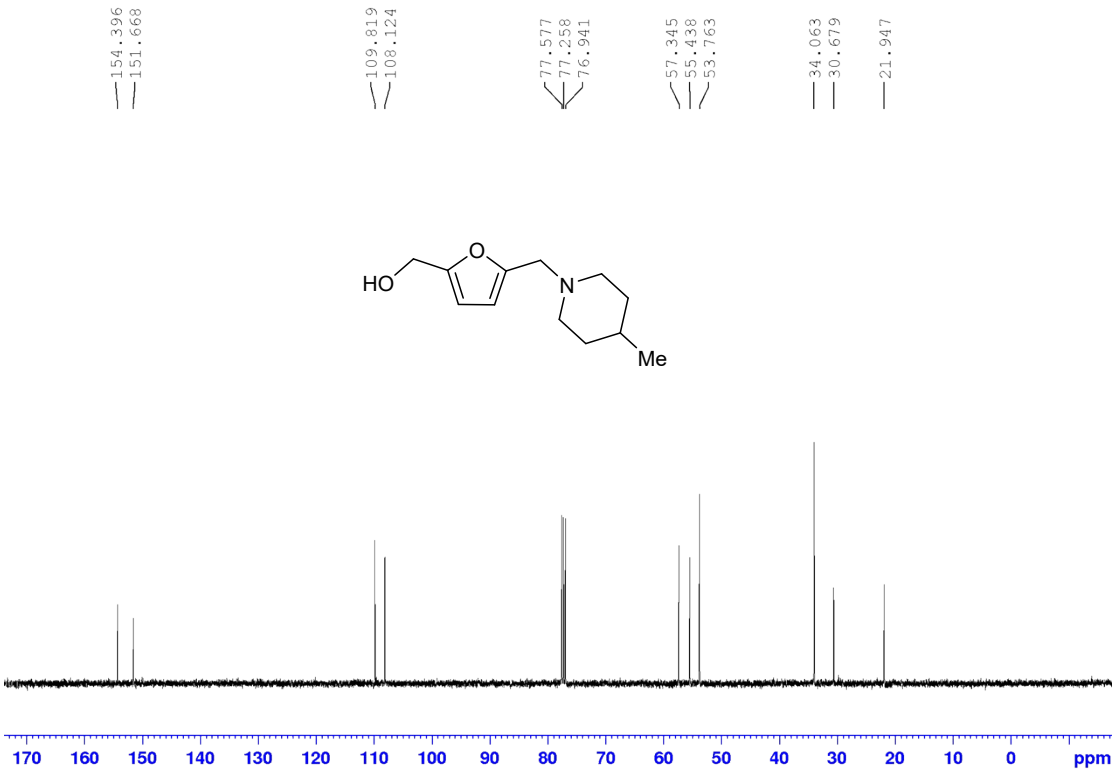
^{1}H NMR of compound **3ag**



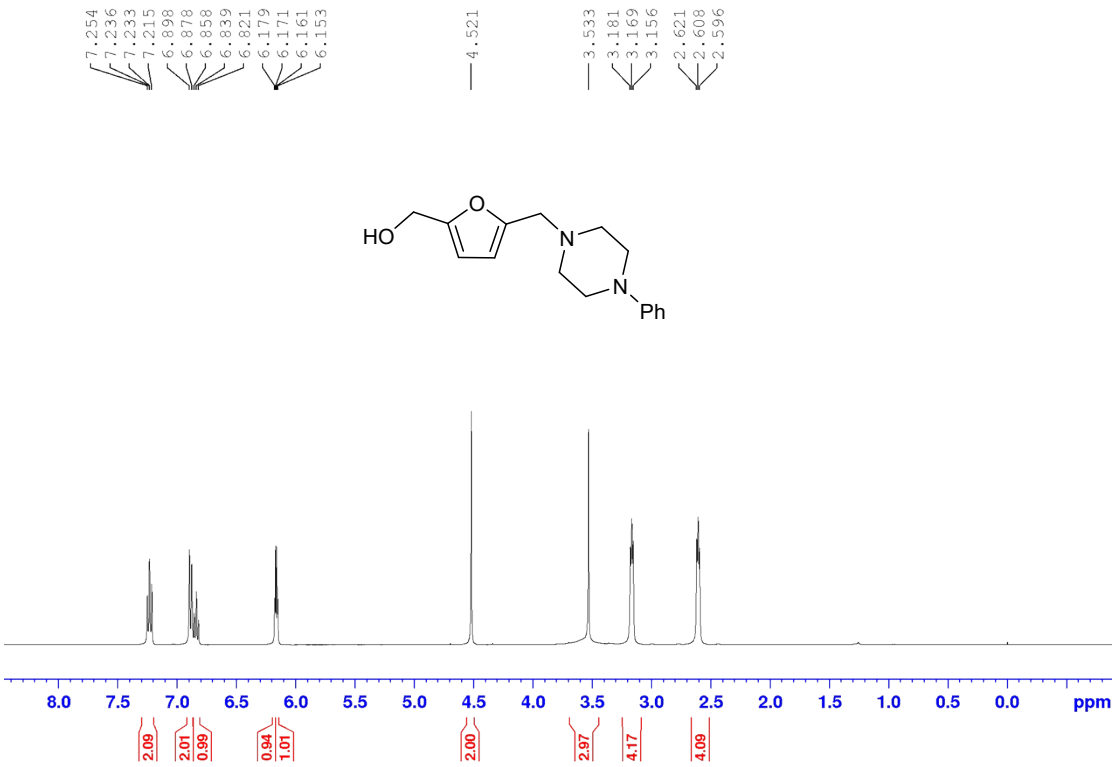
^{13}C NMR of compound **3ag**



^{1}H NMR of compound **3ah**



^{13}C NMR of compound **3ah**



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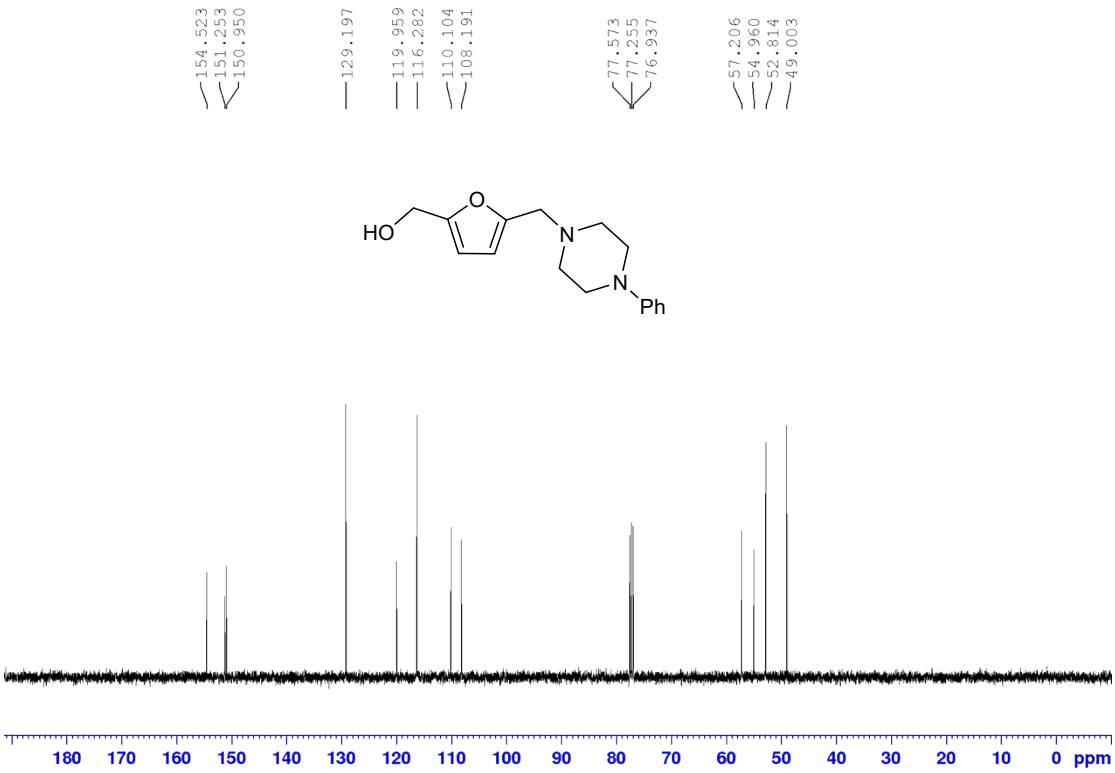

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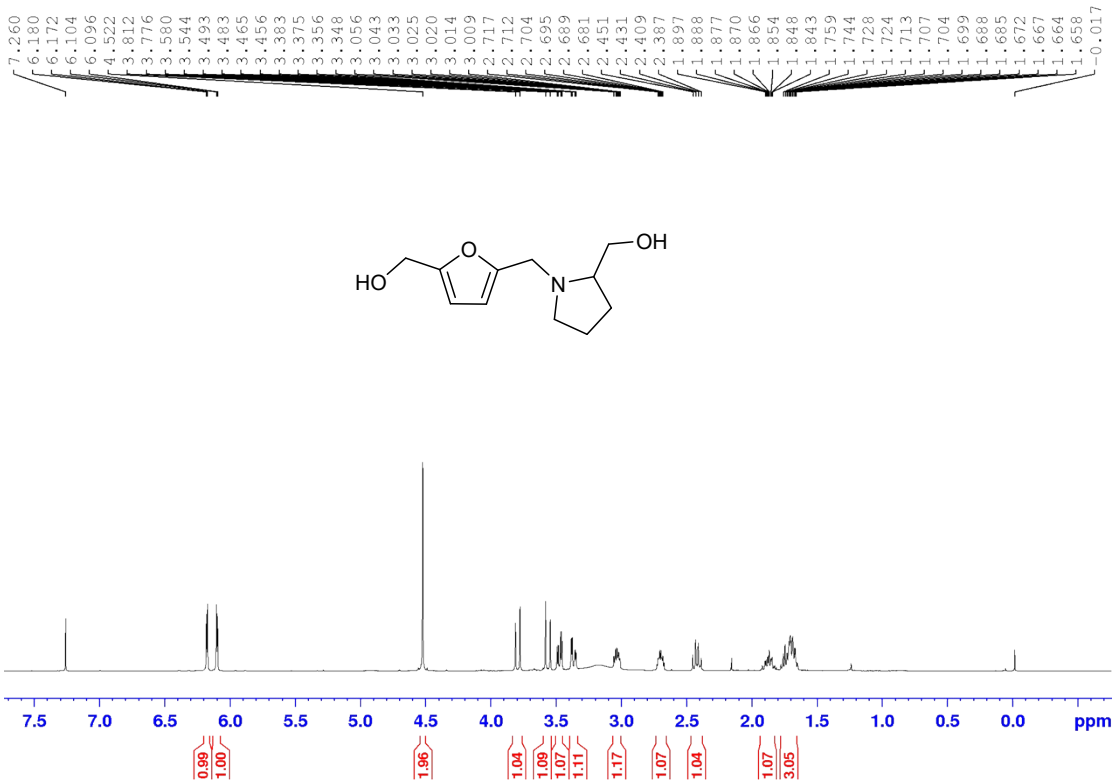

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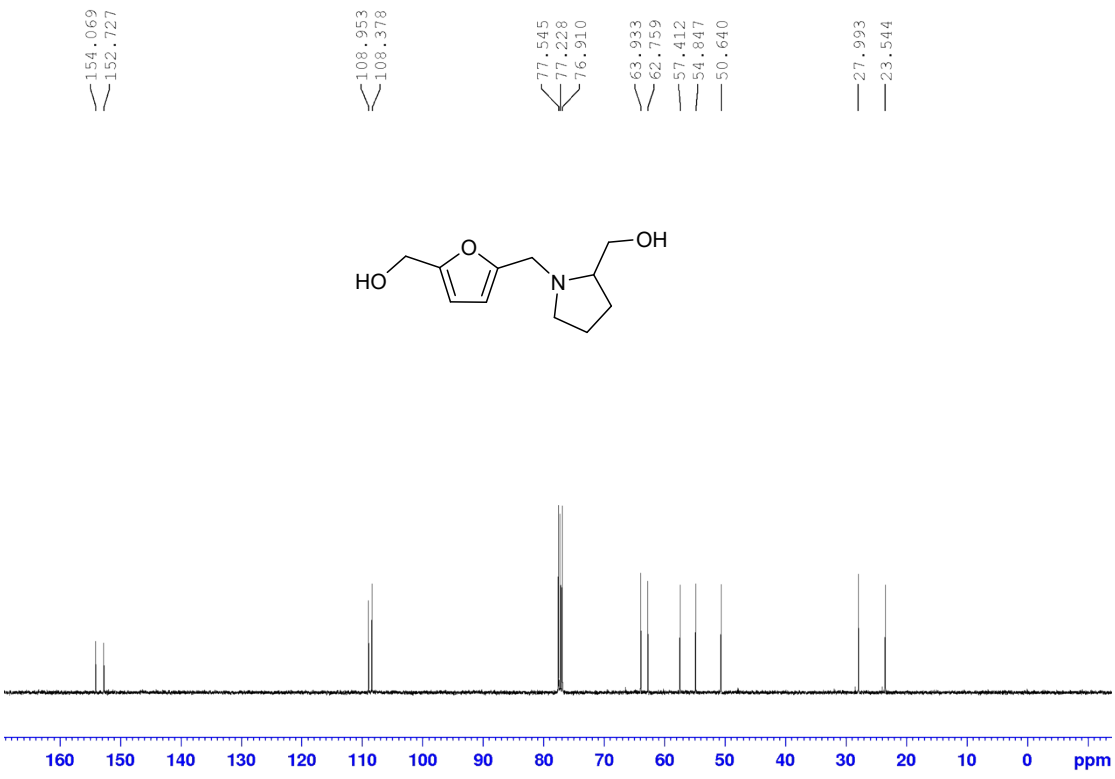

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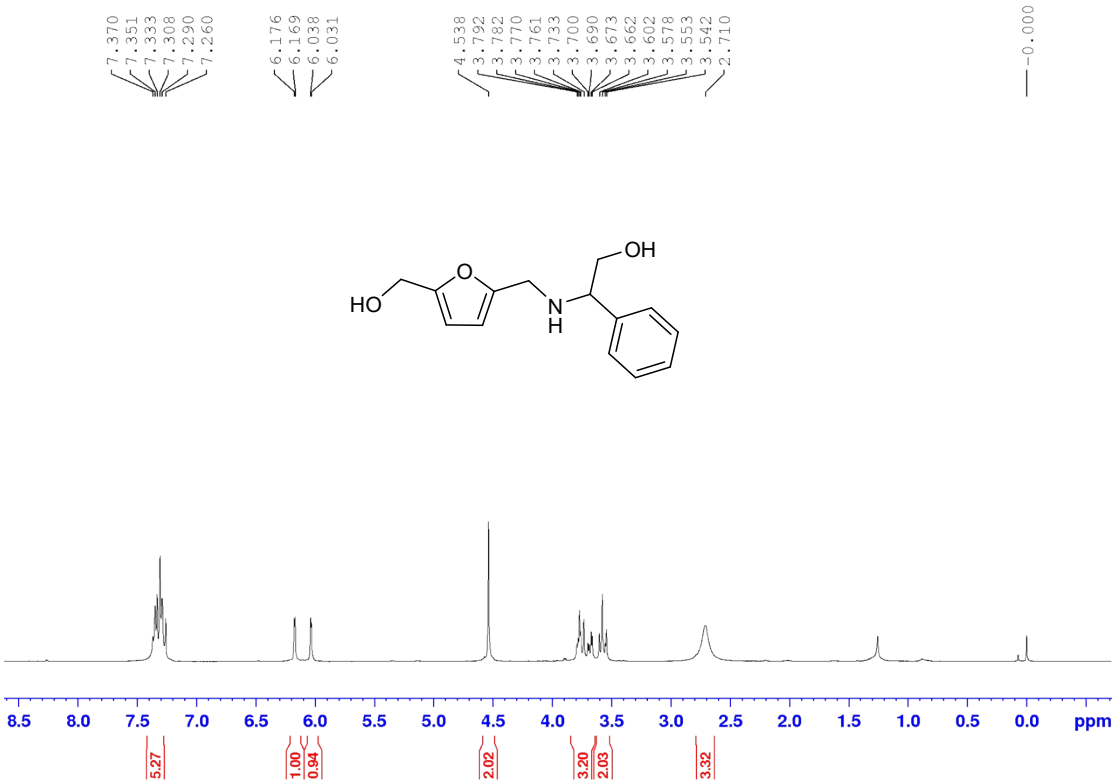

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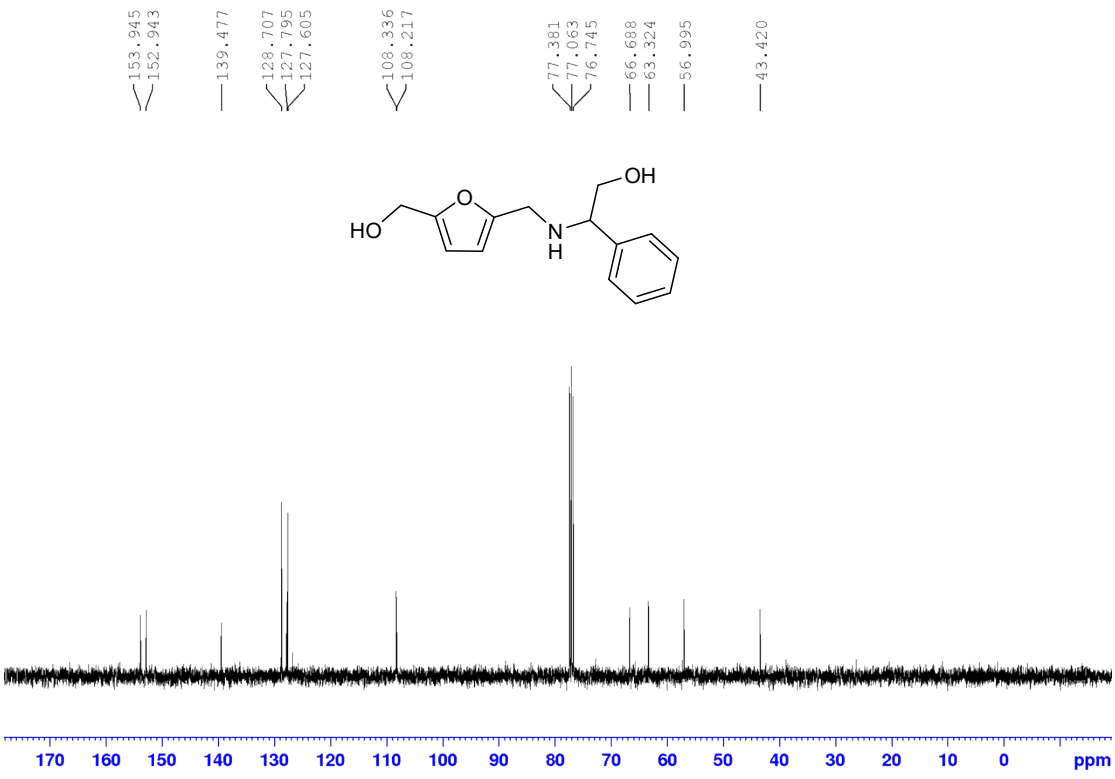

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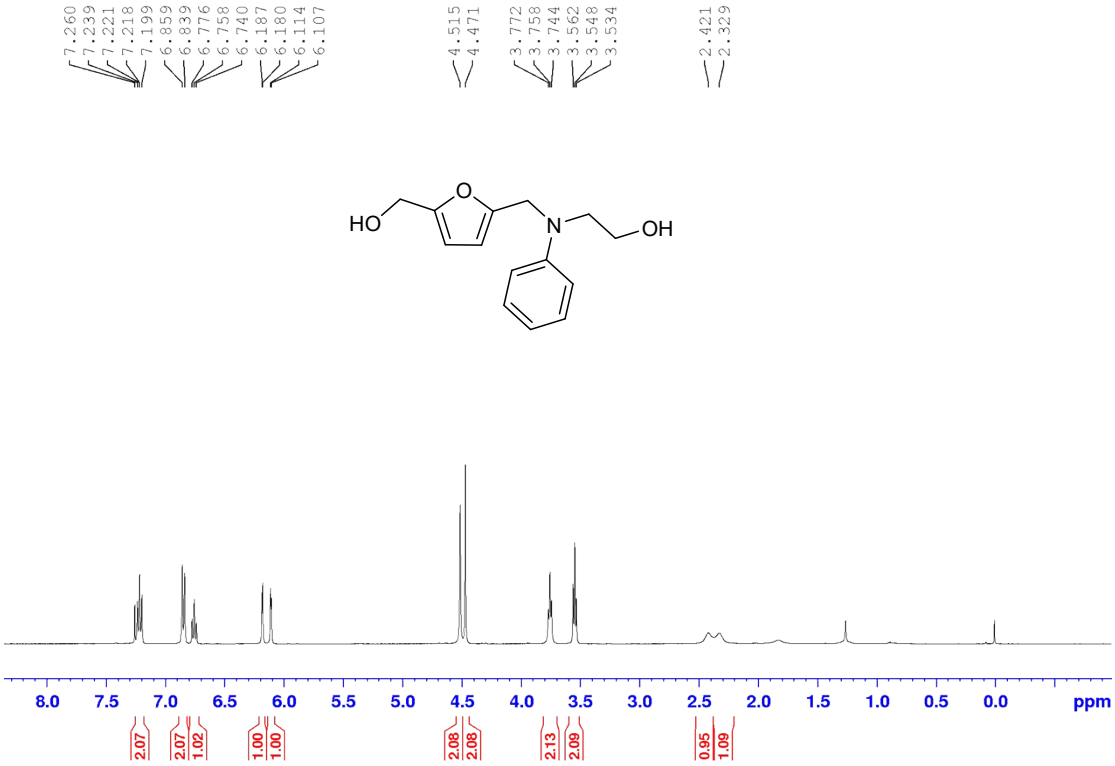
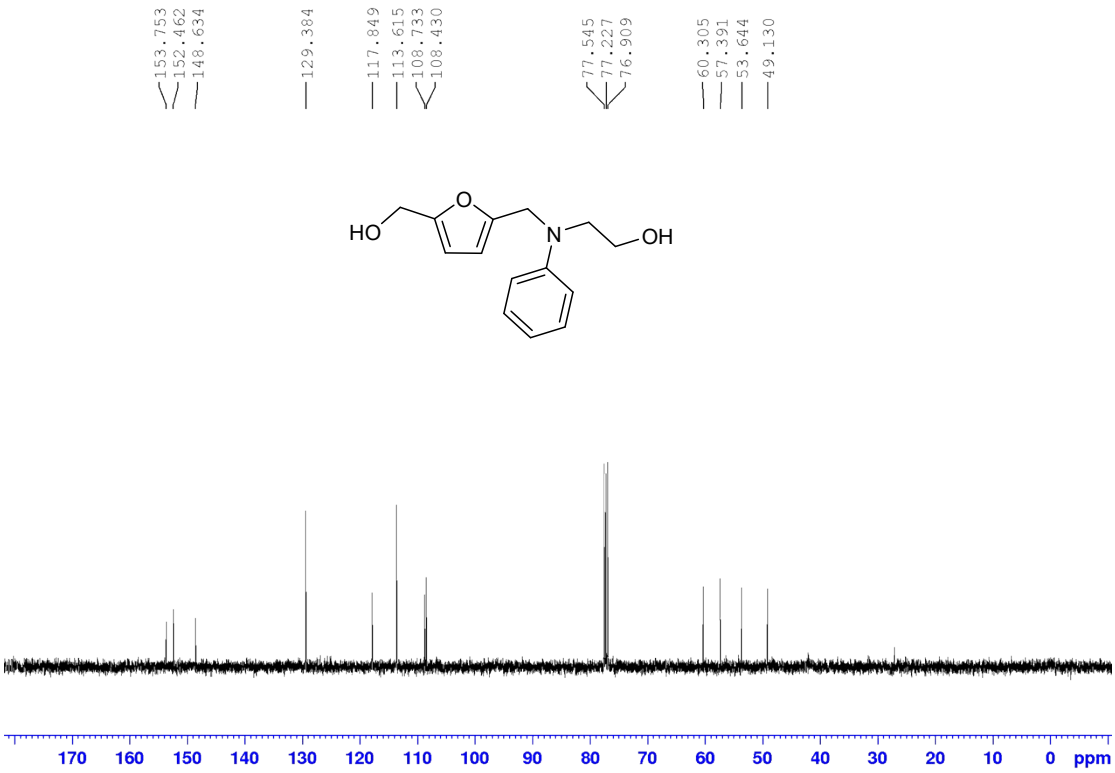
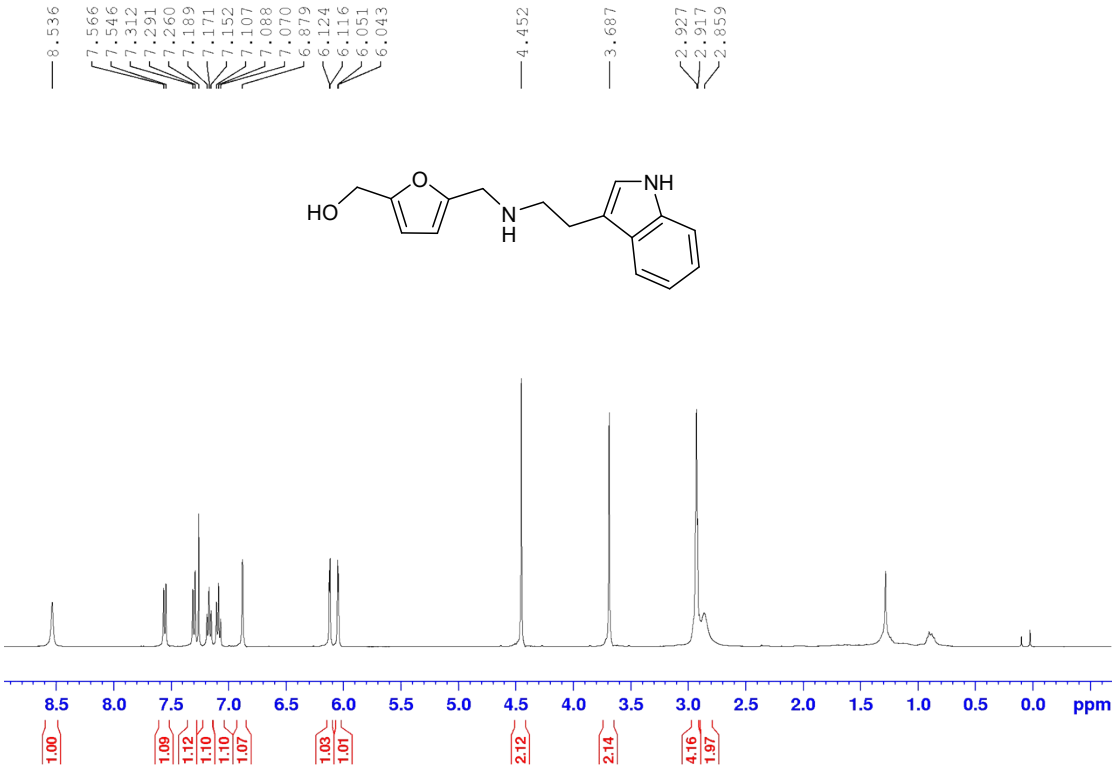


^{1}H NMR of compound **3al**



^{13}C NMR of compound **3al**



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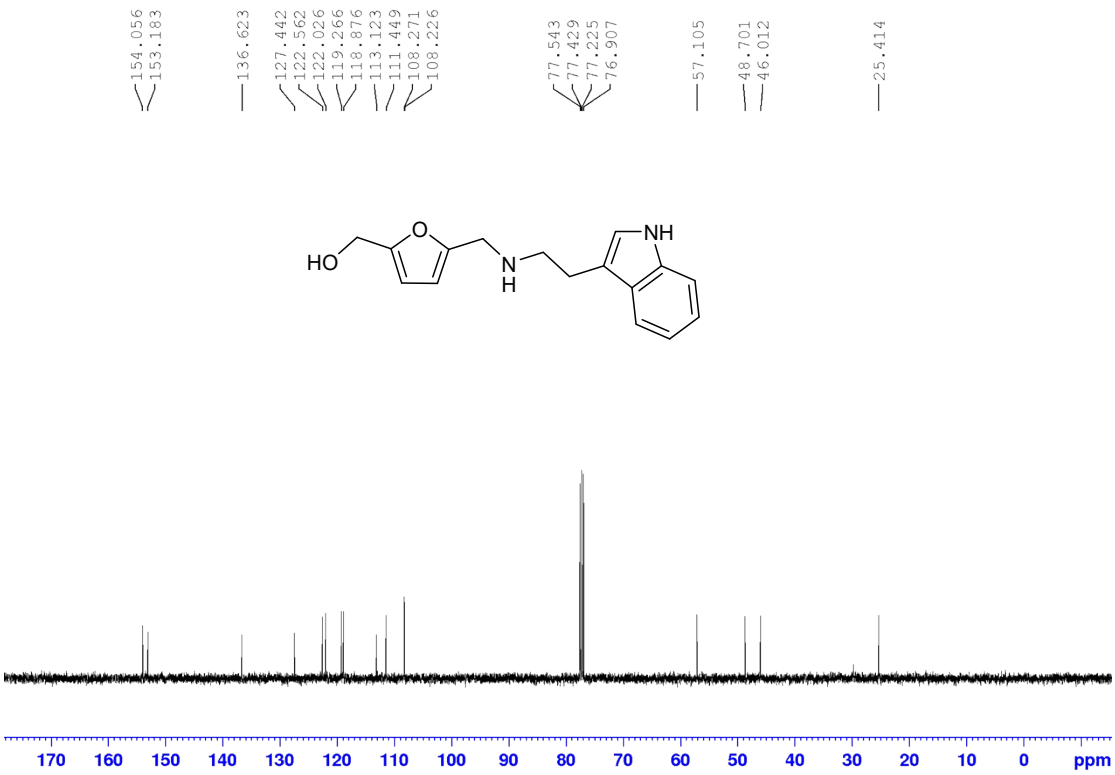

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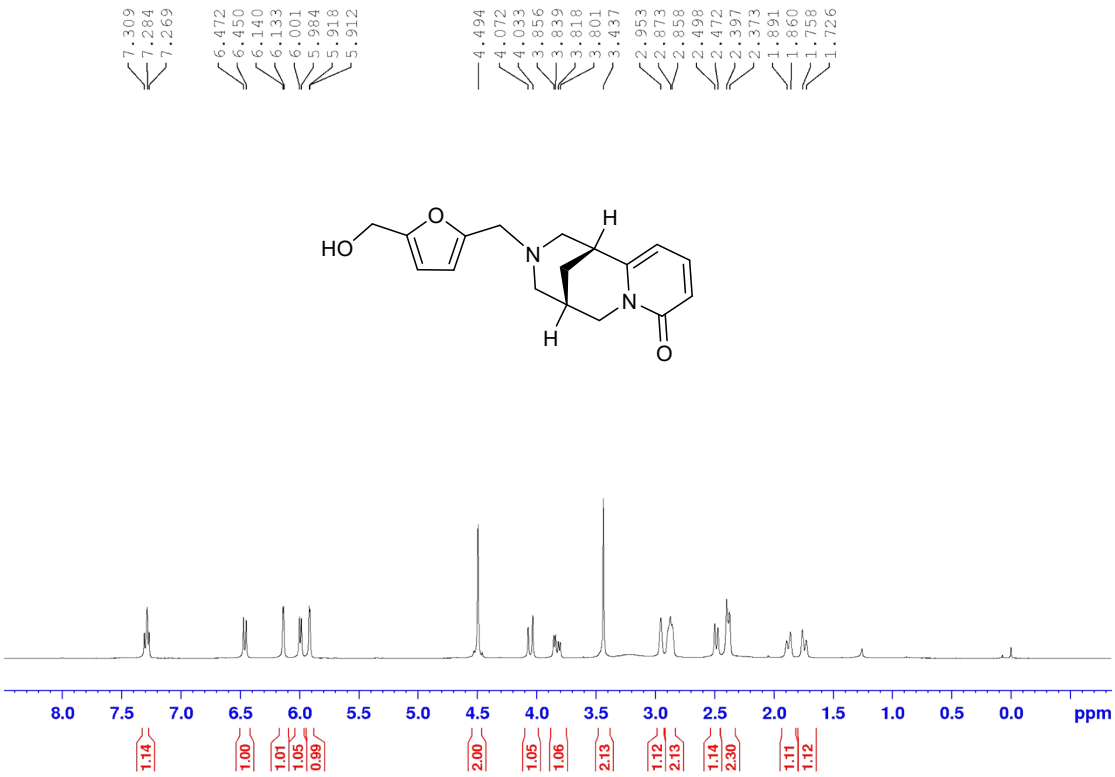
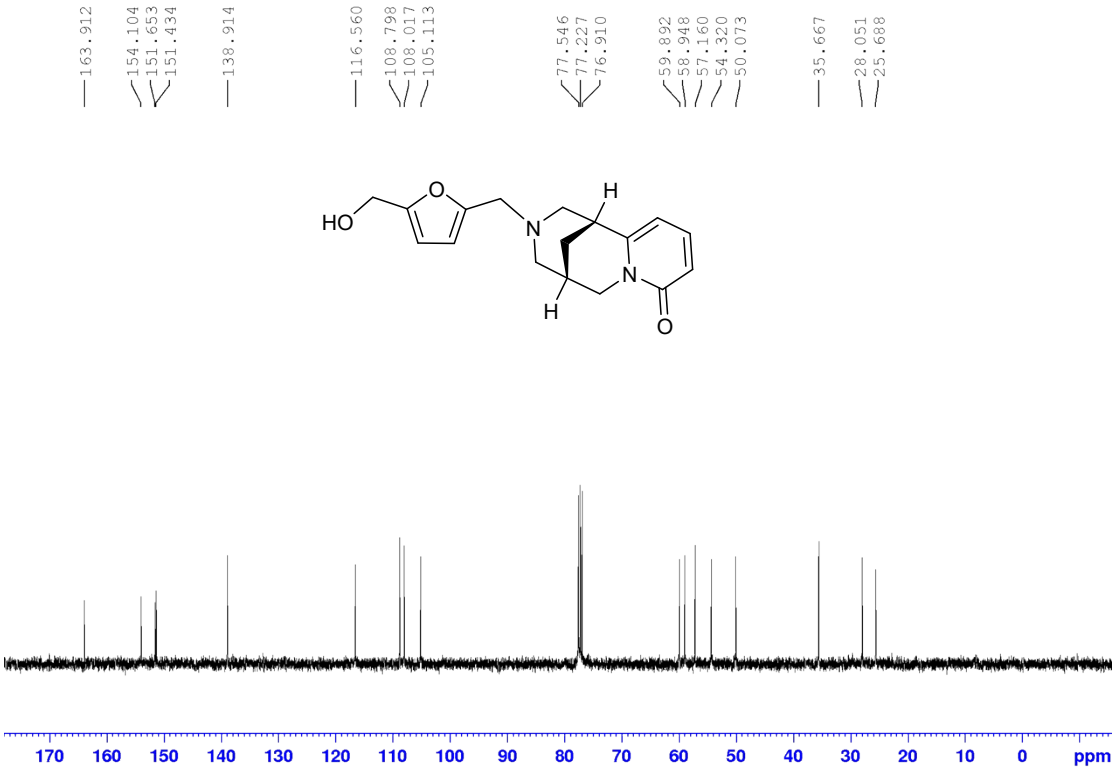


^{1}H NMR of compound **3an**



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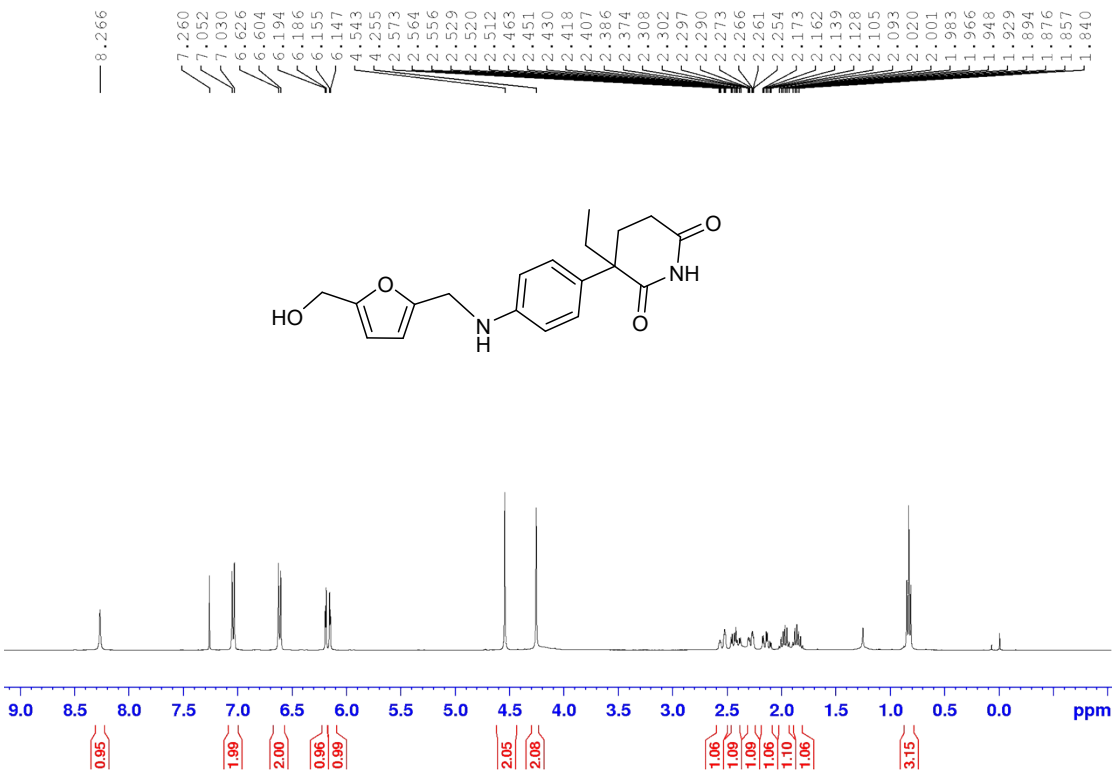

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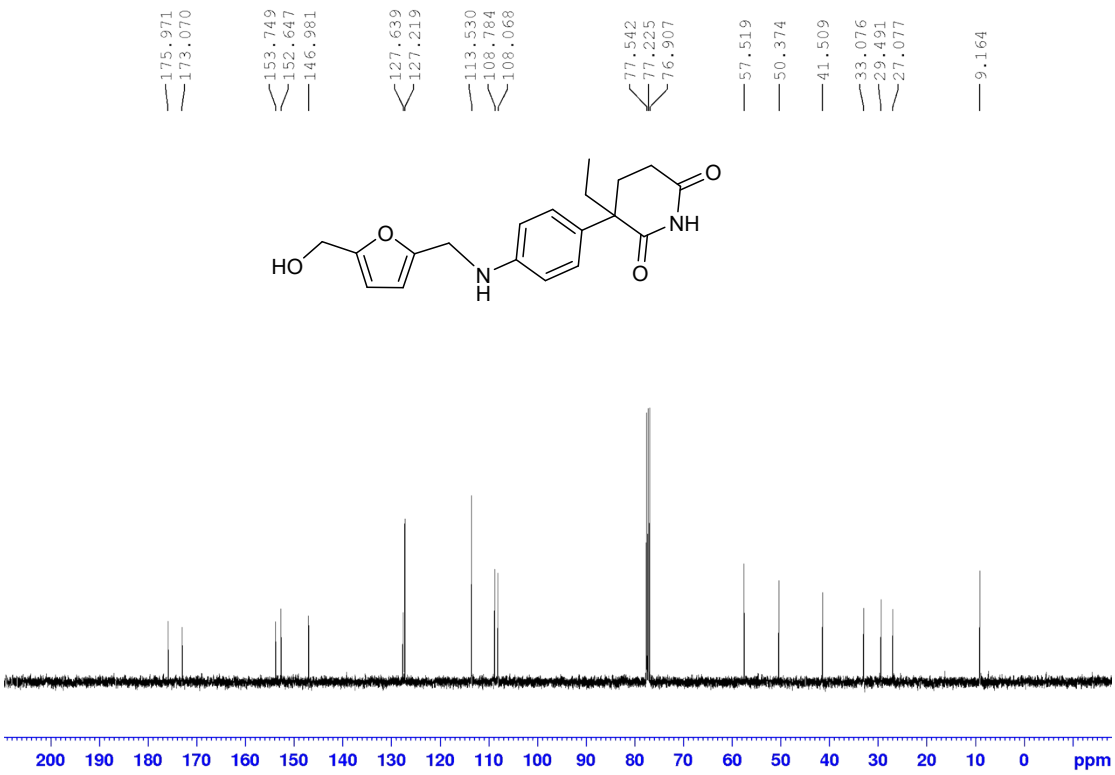

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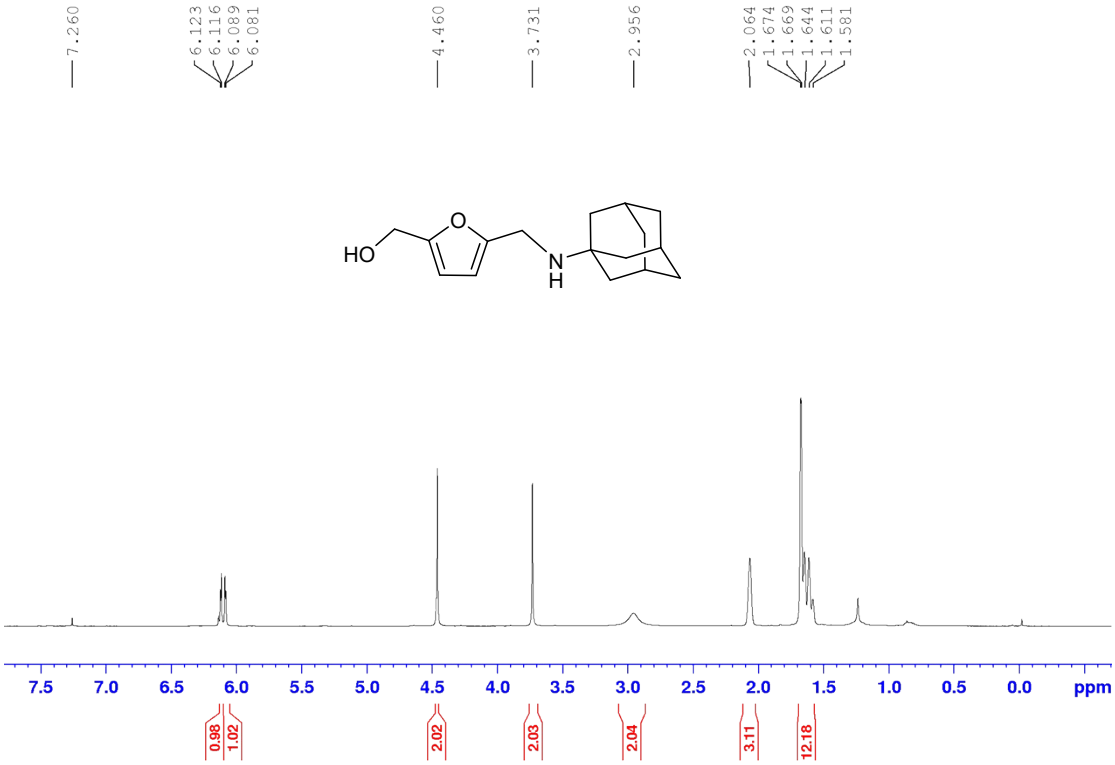

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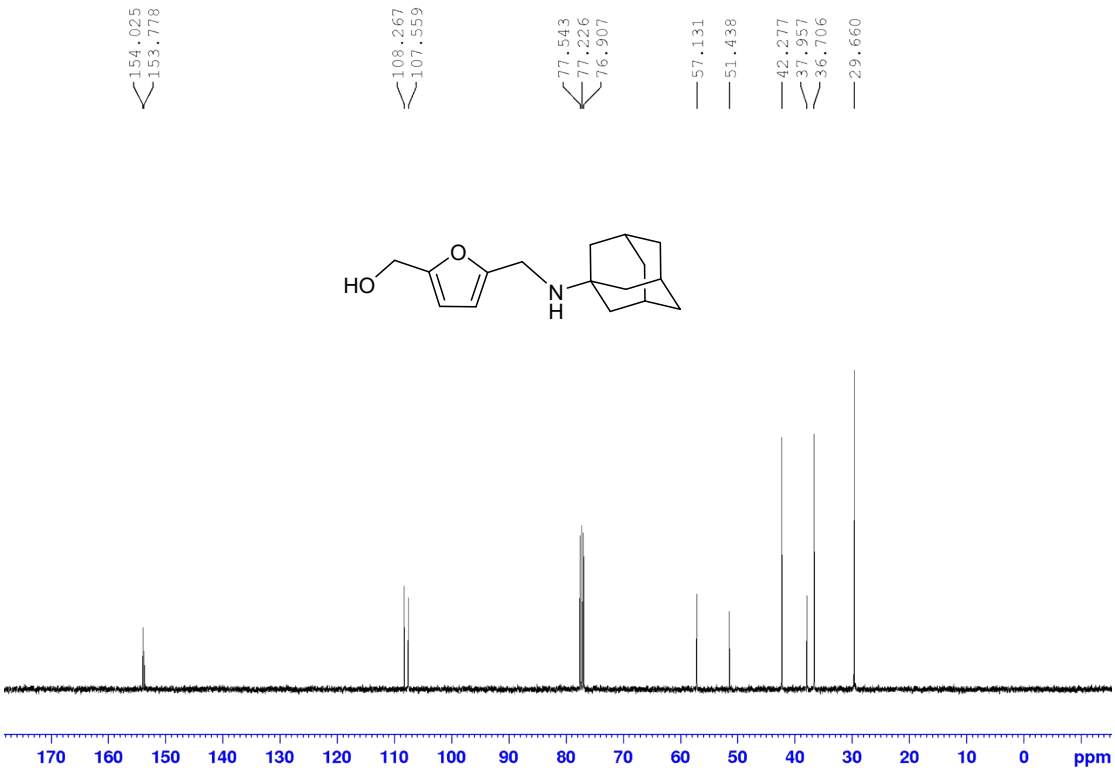

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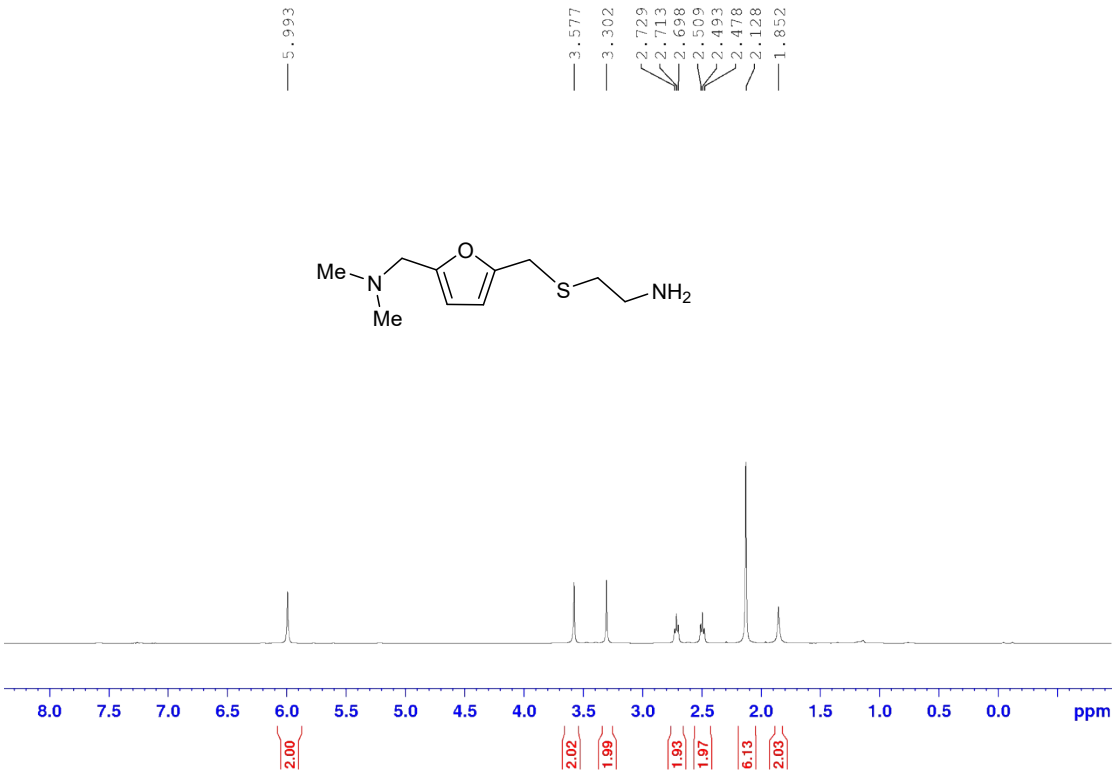

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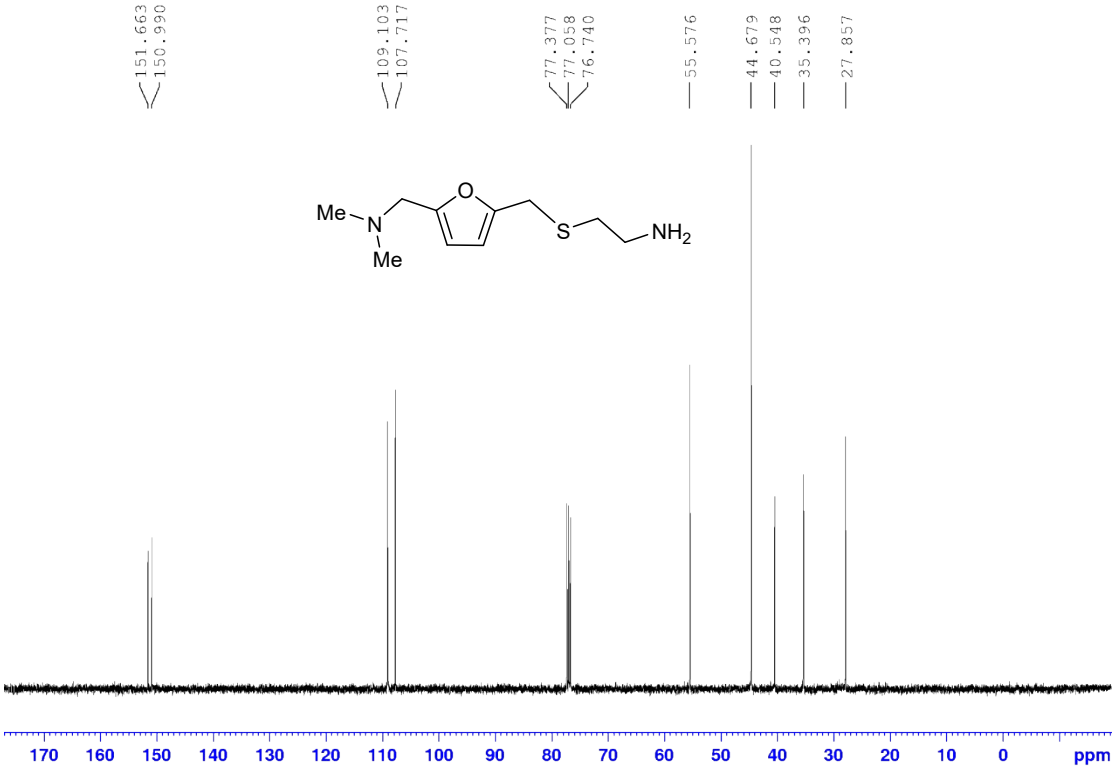

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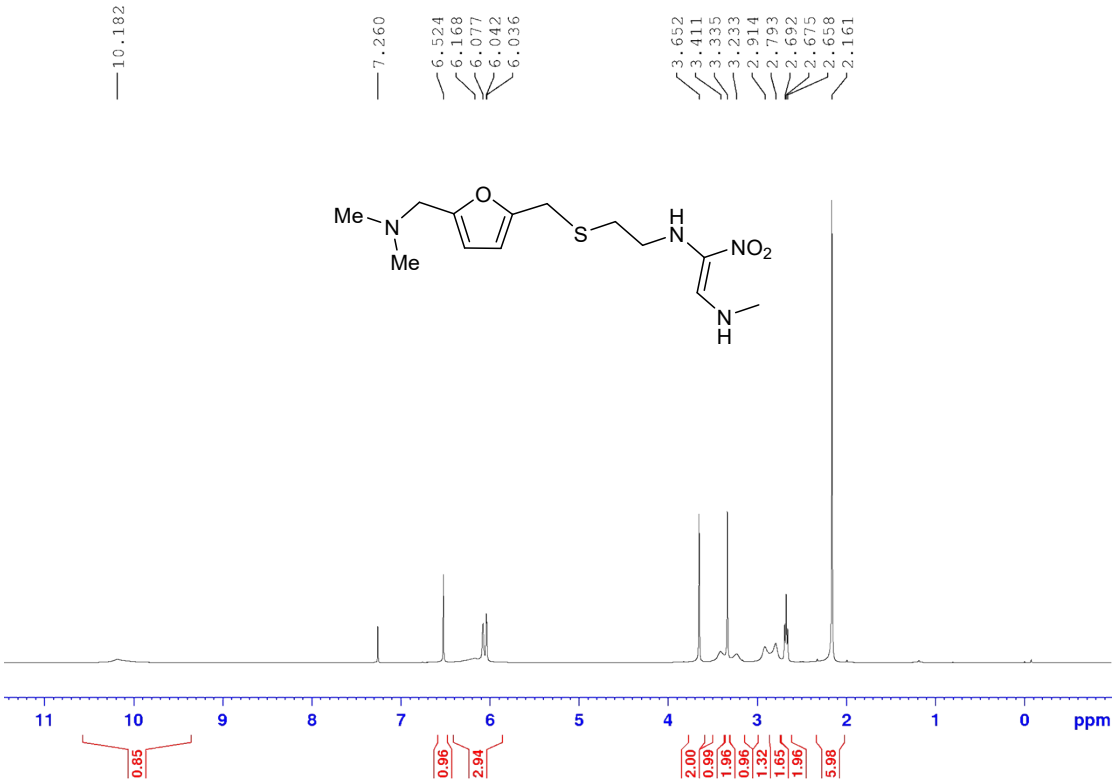
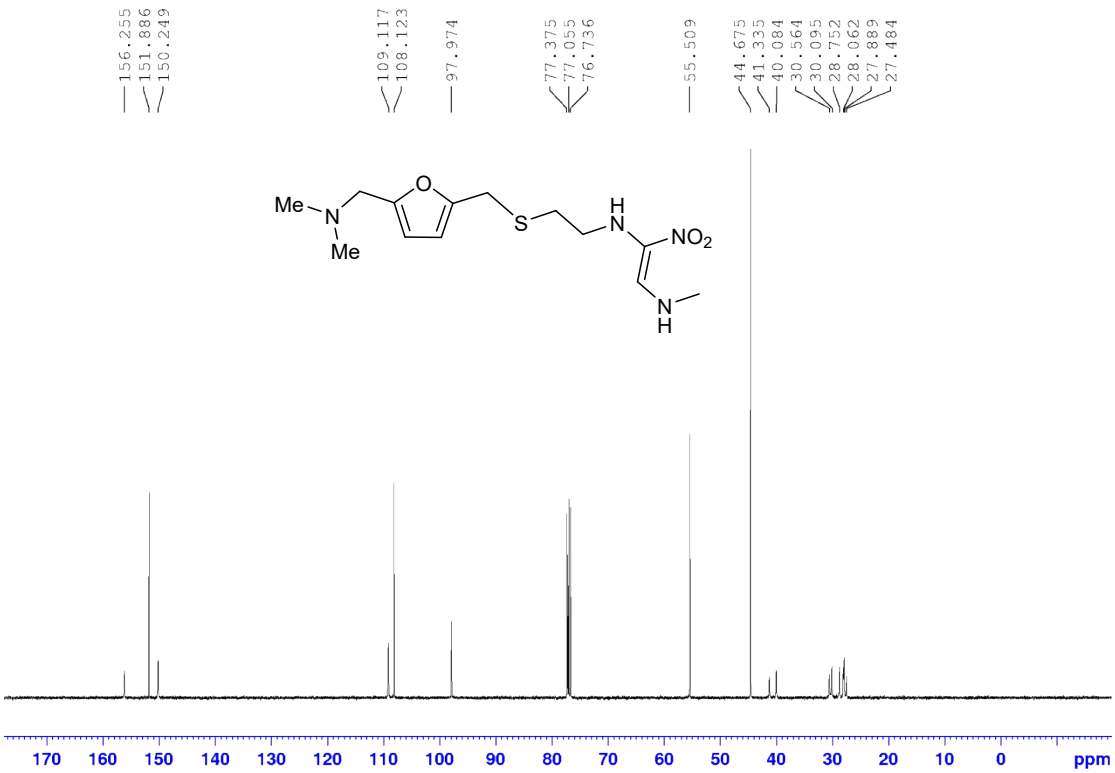
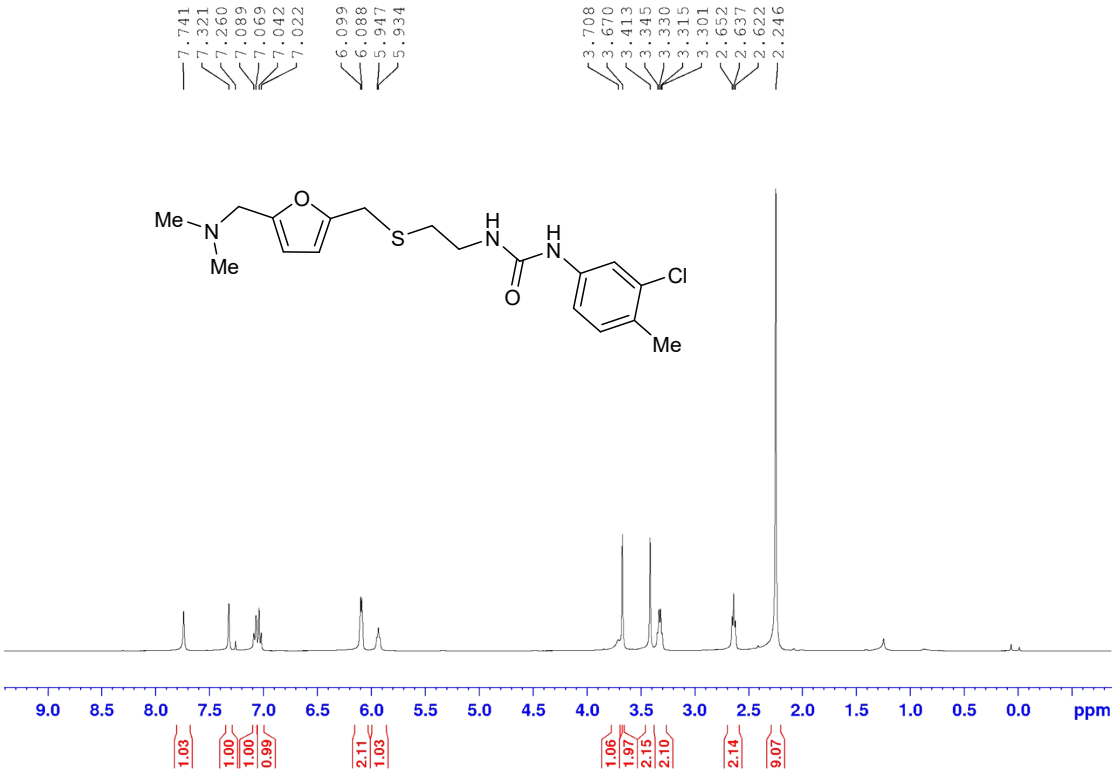


^{1}H NMR of compound **3ar**



^{13}C NMR of compound **3ar**



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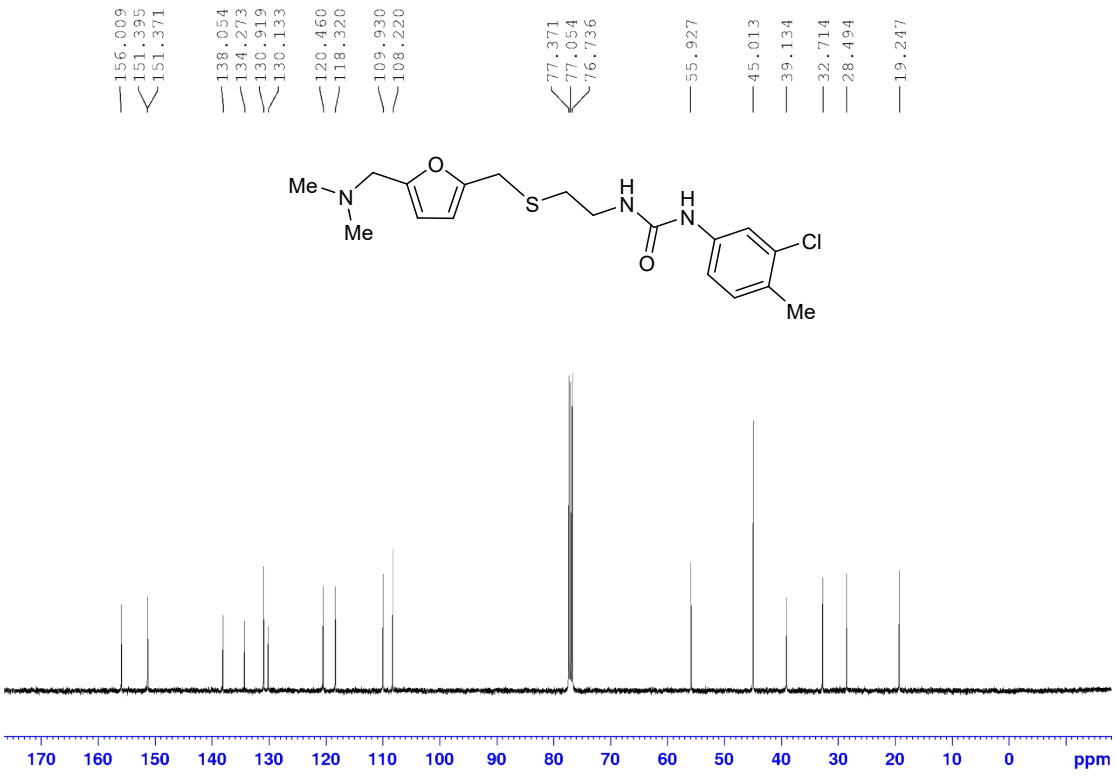

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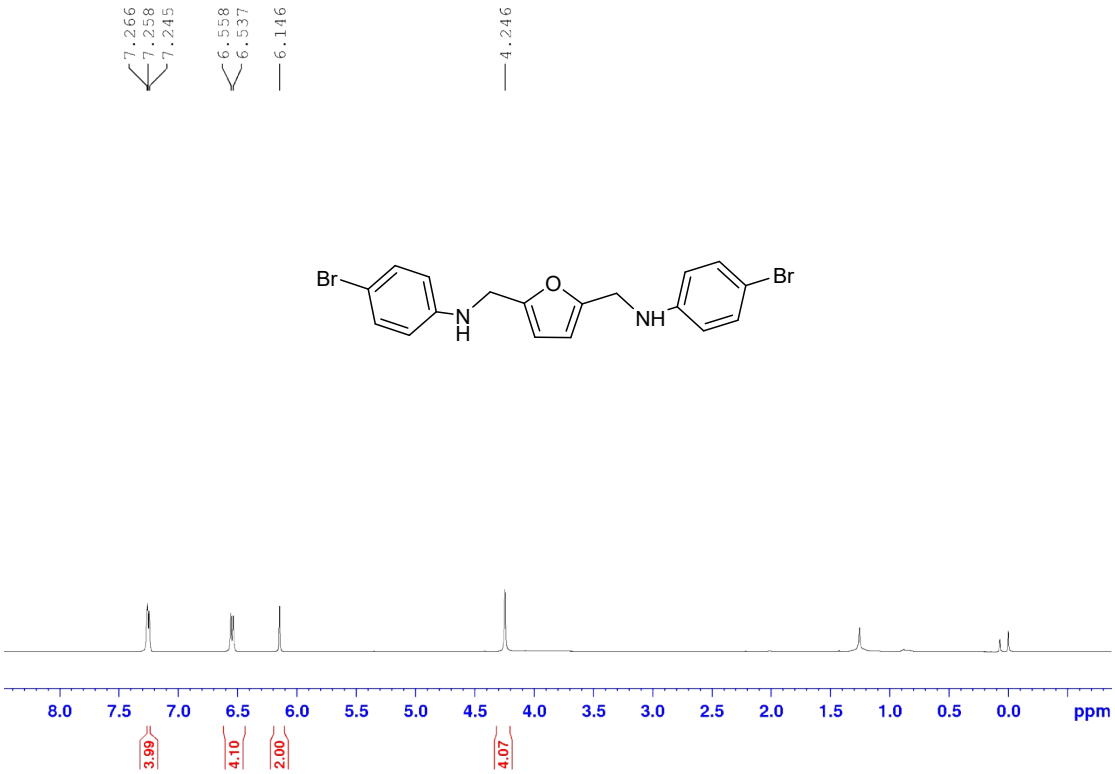
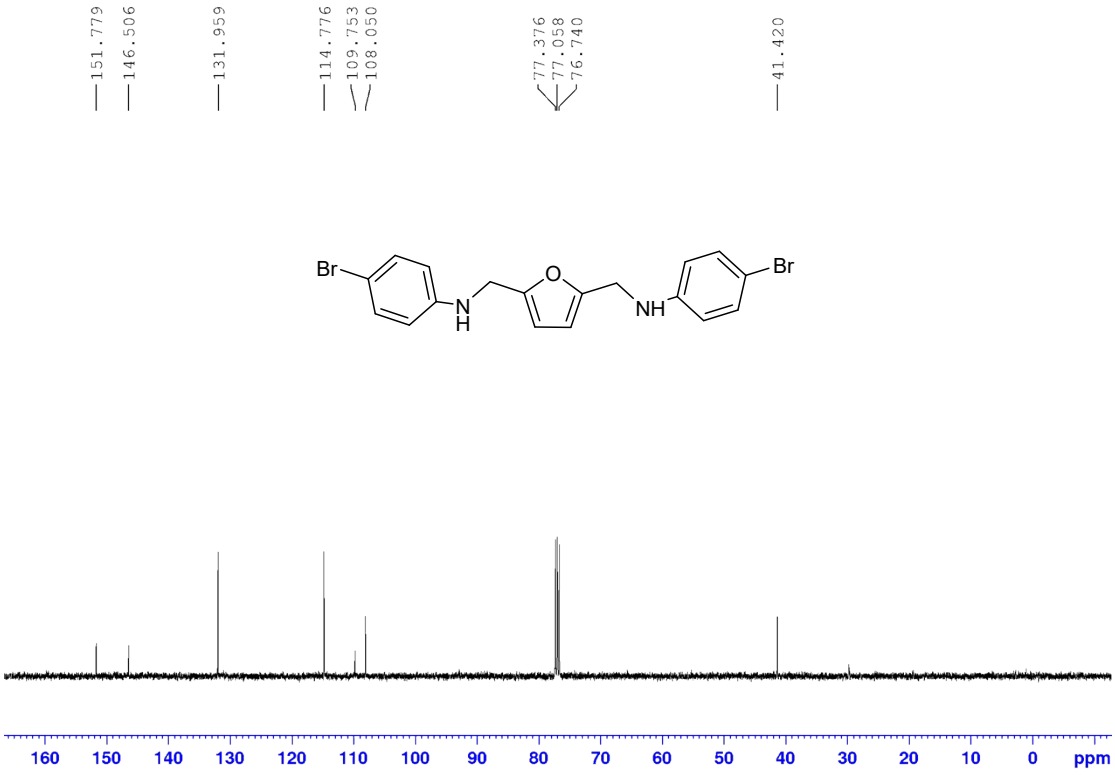


^{1}H NMR of compound **3at**



^{13}C NMR of compound **3at**

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