Electronic Supplementary Information (ESI)

Tetracoordinate Borates as Catalysts for Reductive Formylation of Amines with Carbon Dioxide

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1. General information

Unless otherwise stated, all the materials were purchased from commercial suppliers (Adamas, TCI) and were used as received. CO_2 (99.99%) was purchased from Messer (Wujiang, China). Solvents were dried by solvent purification system from LC Technology Solution Inc. Flash chromatography was performed on silica gel. The products were characterized by ^{1}H NMR and ^{13}C NMR spectroscopy. ^{1}H and ^{13}C NMR spectra were recorded on Bruker 400 MHz spectrometer. The NMR chemical shift values refer to $CDCl_3$ (δ (^{1}H), 7.26 ppm; δ (^{13}C), 77.16 ppm). Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet, br. = broad singlet), coupling constants (Hz) and integration. GC-MS data were obtained shimadzu GCMS-QP 2010 SE, GC data were obtained shimadzu GC-2010 Plus, HRMS data were obtained on Agilent 6530 spectrometer. All measurements were carried out at room temperature unless otherwise stated.

2.1 General Procedure for the reactions in (Table S1, 2)

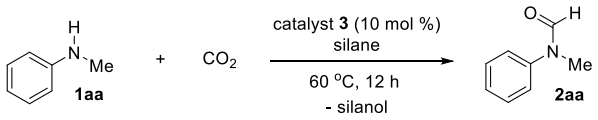
To a 4 mL sealing tube in an nitrogen-filled glove box, the *N*-methylaniline (0.2 mmol), sodium aromatic borate catalyst and silane reductant were added followed by addtion of solvent (1 mL). Then the tube was sealed, taken out of the glove box, and placed into the autoclave. The autoclave was sealed and purged three times with CO_2 gas, then pressurized to 2.5 atm. At last, the autoclave was stirred at 60 °C for 12 h. The yield was determined by GC analysis using *n*-hexadecane as an internal standard.

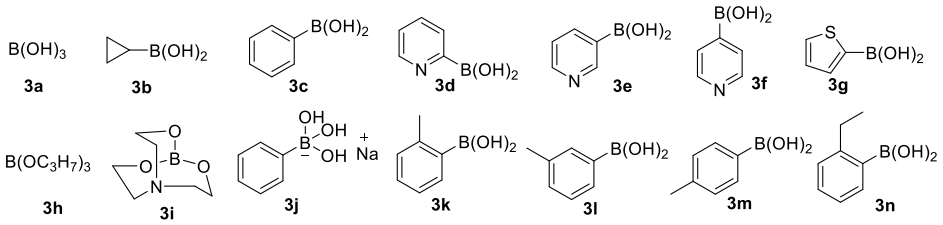
2.2 General Procedure for the reactions in (Table S3, 4, 5)

To a 4 mL sealing tube in an nitrogen-filled glove box, the different kinds of substrate (0.2 mmol), sodium (trihydroxy)phenylborate (10 mol%) and phenylsilane were added followed by addtion of solvent (1 mL) under N_2 atomsphere. Then the tube was sealed , taken out of the glove box, and placed into the autoclave. The autoclave was sealed and purged three times with CO_2 gas, then pressurized to 2.5 atm. At last, the autoclave was stirred at 60 °C for 12 h. The yield was determined by GC analysis or the product was purified by silica gel to give the isolated yield.

2.3 Conditions optimization for the reaction of *N*-methylaniline and carbon dioxide.

Table S1 Investigation of different catalyst for the reaction of *N*-methylaniline and carbon dioxide.[a]

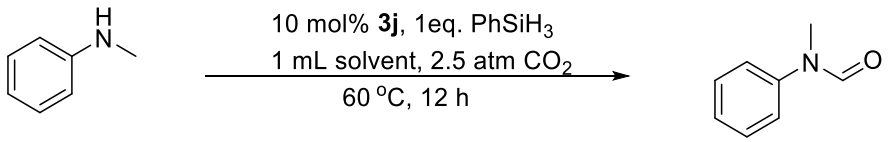




Entry	[B]10 mol%	[Si]1 eq.	Solvent	Yield (%)[b]
1	**-**	$PhSiH_3$	DGDE	none
2	**3a**	$PhSiH_3$	DGDE	none
3	**3b**	$PhSiH_3$	DGDE	none
4	**3c**	$PhSiH_3$	DGDE	none
5	**3d**	$PhSiH_3$	DGDE	9
6	**3e**	$PhSiH_3$	DGDE	3
7	**3f**	$PhSiH_3$	DGDE	none
8	**3g**	$PhSiH_3$	DGDE	none
9	**3h**	$PhSiH_3$	DGDE	none
10	**3i**	$PhSiH_3$	DGDE	none
11	**3j**	$PhSiH_3$	DGDE	45
12	**3k**	$PhSiH_3$	DGDE	none
13	**3l**	$PhSiH_3$	DGDE	none
14	**3m**	$PhSiH_3$	DGDE	none
15	**3n**	$PhSiH_3$	DGDE	none

[a]Reaction conditions: 1**aa** (0.2 mmol, 1 eq.), catalyst **3** (0.02 mmol, 10 mol%), phenylsilane (0.2 mmol, 1eq.), CO_2 (0.25 MPa) in DGDE (1 mL) at 60 °C for 12 h. [b]Determined by GC analysis using n-hexadecane as an internal standard. DGDE = Diethylene glycol dimethyl ether.

Table S2 Investigation of different solvents for the reaction of *N*-methylaniline and carbon dioxide.[a]

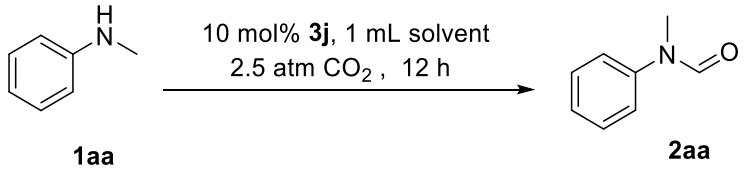


1aa **2aa**

Entry	[B]10 mol%	[Si]1 eq.	Solvent	Yield (%)[b]
1	**3j**	$PhSiH_3$	CH_3CN	trace
2	**3j**	$PhSiH_3$	THF	trace
3	**3j**	$PhSiH_3$	DGDE	43
4	**3j**	$PhSiH_3$	NMP	8
5	**3j**	$PhSiH_3$	1,4-dioxane	3
6	**3j**	$PhSiH_3$	mesitylene	none
7	**3j**	$PhSiH_3$	heptane	none
8	**3j**	$PhSiH_3$	DCE	none
9	**3j**	$PhSiH_3$	toluene	none
10	**3j**	$PhSiH_3$	CPME	none

[a]Reaction conditions: 1**aa** (0.2 mmol, 1 eq.), catalyst **3j** (0.02 mmol, 10 mol%), phenylsilane (0.2 mmol, 1eq.), CO_2 (0.25 MPa) in different solvents (1 mL) at 60 °C for 12 h. [b]Determined by GC analysis using *n*-hexadecane as an internal standard. THF = Tetrahydrofuran. NMP = *N*-methylpyrrolidone. DCE = 1,2-Dichloroethane. CPME = Cyclopentyl methyl ether.

Table S3 Investigation of different silicanes and temperature for the reaction of *N*-methylaniline and carbon dioxide.[a]



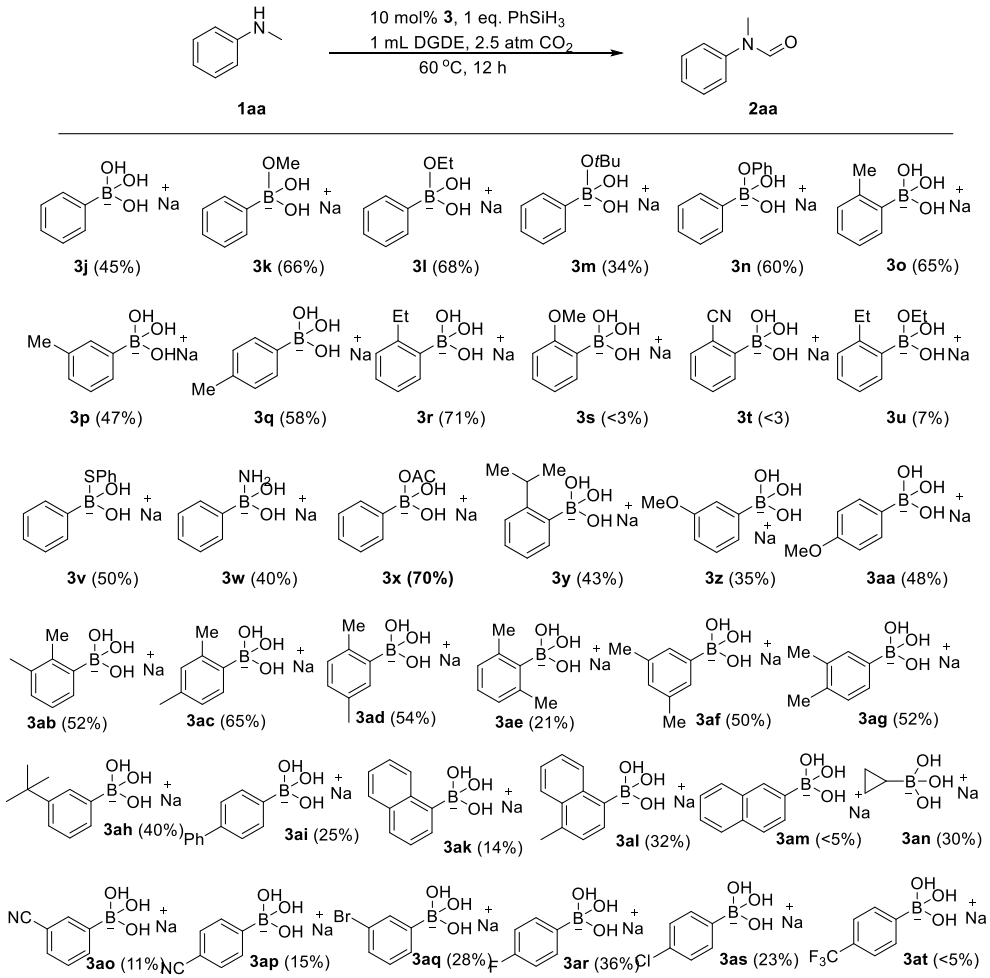
1aa **2aa**

Entry	[B]10 mol%	[Si]1 eq.	Solvent	T(°C)	Yield (%)[b]
1	**3j**	$PhSiH_3$	DGDE	60	45
2	**3j**	$PhSiH_3$(2 eq.)	DGDE	60	68
3	**3j**	PhSiH3	DGDE	100	78

4	**3j**	$PhSiH_3$	THF	100	25
5	**3j**	$PhSiH_3$(2 eq.)	DGDE	60	88
6	**3j**	TMDS	DGDE	60	<3
7	**3j**	PMHS(5 eq.)	DGDE	60	<3
8	**3j**	PMHS(5 eq.)	DGDE	100	22

[a]Reaction conditions: 1**aa** (0.2 mmol, 1 eq.), catalyst **3j** (0.02 mmol, 10 mol%), silane, CO_2 (0.25 MPa) in DGDE (1 mL) for 12 h. [b]Determined by GC analysis using *n*-hexadecane as an internal standard.

Table S4 Investigation of different sodium aromatic borates prepared by in-situ mixing aromatic boronic acids with NaOH or sodium alkoxides for the reaction of *N*-methylaniline and carbon dioxide.[a]



[a]Reaction conditions: 1**aa** (0.2 mmol, 1 eq.), catalyst **3** (0.04 mmol, 20 mol%), phenylsilane (0.2 mmol, 1 eq.), CO_2 (0.25 MPa) in DGDE (1 mL) at 60 °C for 12 h. [b]Determined by GC analysis using n-hexadecane as an internal standard.

3. Control Experiments

3.1 Procedure for reaction in Figure. S1--Eq. 1[1a]

To a Schlenk tube in an nitrogen-filled glove box, the sodium phenyltrihydroxyborate (0.2 mmol), $PdCl_2$ (1 mol%) and PPh_3(1 mol%), were added followed by addtion of degassed toluene (1.0 mL) under N_2 atomsphere. Finally, benzoyl chloride(0.22 mmol) was added dropwisely. The Schlenk tube was taken out of the glove box. The reaction mixture was stirred at 60 °C for 3 h. The yield was determined by GC analysis using *n*-tetradecane as an internal standard.

3.2 Procedure for reaction in Figure. S1--Eq. 2[1a]

To a Schlenk tube in an nitrogen-filled glove box, the sodium phenyltrihydroxyborate (0.2 mmol), $PdCl_2$ (1 mol%) and PPh_3(1 mol%) and phenylsilane (1 mmol) were added followed by addtion of degassed toluene (1.0 mL) under N_2 atomsphere. Finally, benzoyl chloride(0.22 mmol) was added dropwisely. The Schlenk tube was taken out of the glove box. The reaction mixture was stirred at 60 °C for 3 h. The yield was determined by GC analysis using *n*-tetradecane as an internal standard.

3.3 Procedure for reaction in Figuer. S1--Eq. 3[1b]

To a Schlenk tube in an nitrogen-filled glove box, the 4-iodoanisole (0.2 mmol), sodium phenyltrihydroxyborate (0.22 mmol) and $Pd(OAc)_2$ (1 mol%) were added followed by addtion of degassed dioxane (1.0 mL) under N_2 atomsphere. Finally the Schlenk tube was taken out of the glove box. The reaction mixture was stirred at 60 °C for 3 h. The yield was determined by GC analysis using *n*-tetradecane as an internal standard.

3.4 Procedure for reaction in Figuer. S1--Eq. 4[1b]

To a Schlenk tube in an nitrogen-filled glove box, the 4-iodoanisole (0.2 mmol), sodium phenyltrihydroxyborate (0.22 mmol), $Pd(OAc)_2$ (1 mol%) and phenylsilane (1 mmol) were added followed by addtion of degassed dioxane (1.0 mL) under N_2 atomsphere. Finally the Schlenk tube was taken out of the glove box. The reaction mixture was stirred at 60 °C for 3 h. The yield was determined by GC analysis using *n*-tetradecane as an internal standard.

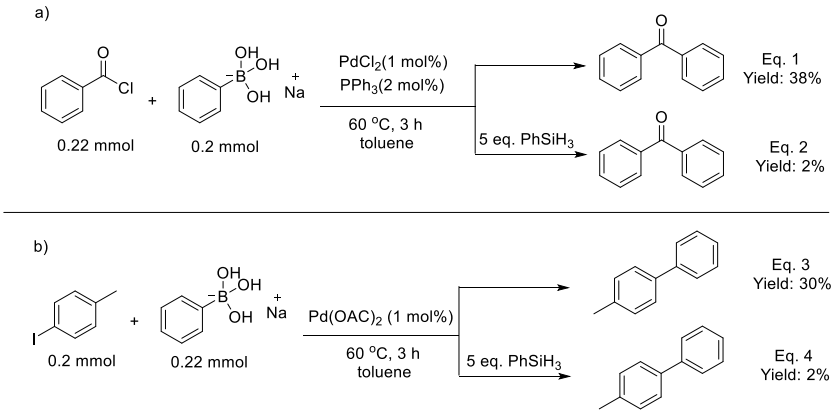


Figure S1. The silane effect in Pd-catalyzed Suzuki reactions.

3.5 Non-catalytic methods[2]

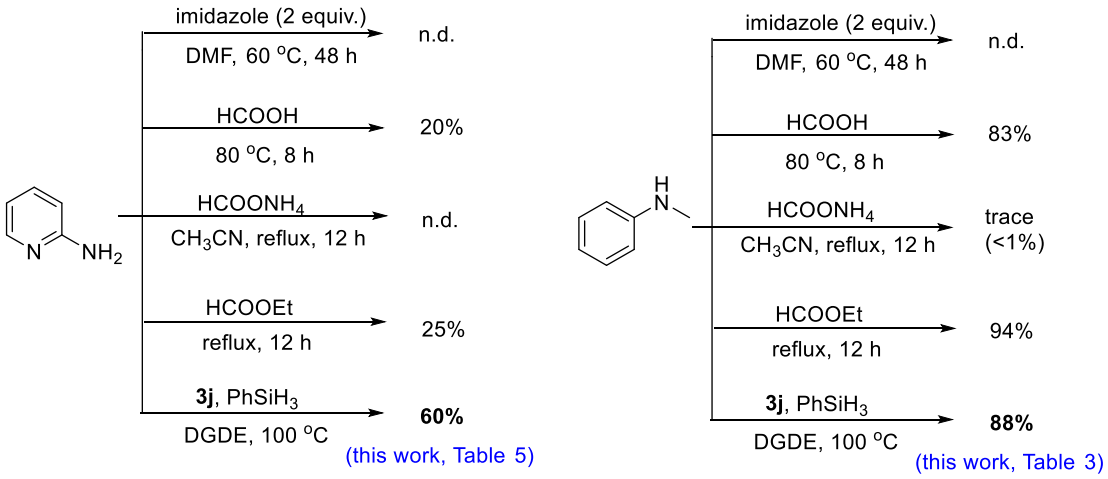
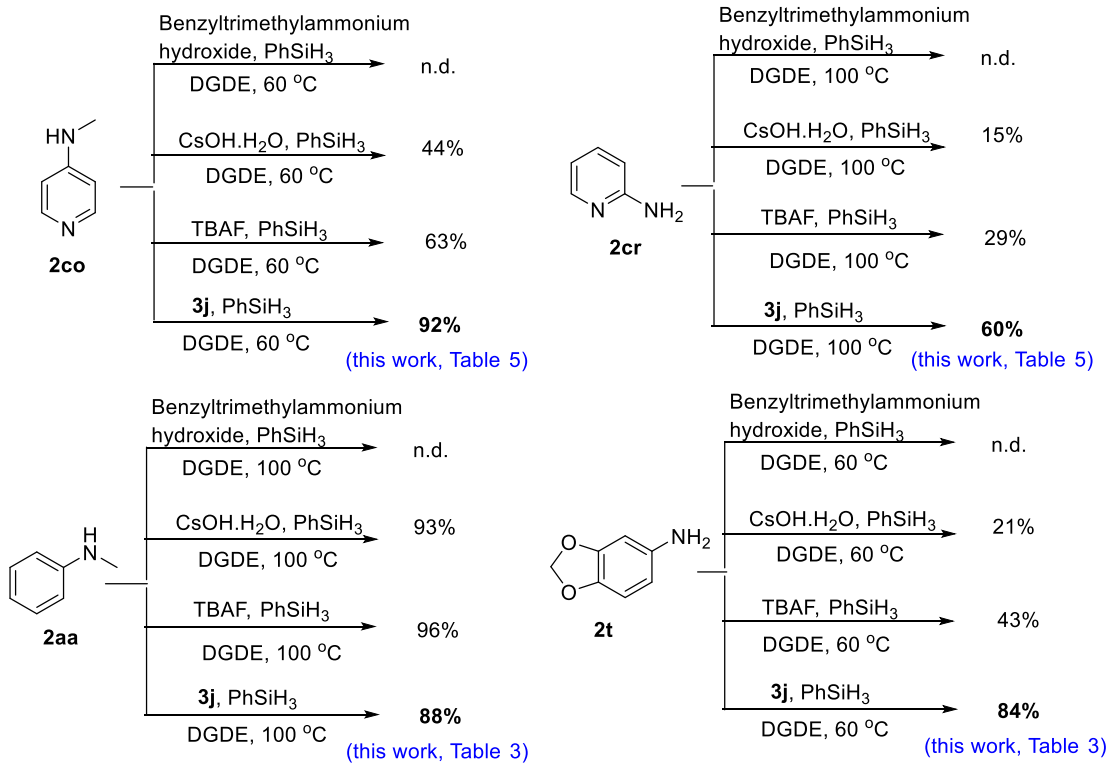


Figure S2. Control experiments using non-catalytic methods.

3.6 Different kinds of catalyst that actives silane



Reaction conditions: substrate (0.2 mmol, 1 eq.), catalyst (0.02 mmol, 10 mol%), phenylsilane (0.2 mmol, 1 eq.), CO_2 (0.25 MPa) in DGDE (1 mL) at 60 °C or 100°C for 12 h. Yields were determined by GC analysis.

Figure S3. Control experiments using different kinds of catalyst that actives silane.

4. DFT calculation experiments

4.1. DFT calculation details

All DFT calculations were carried out employing the Gaussian 16 program.[3] The M06-2X[4a] corrected with Grimme's D3 dispersion[4b] correction combined with 6-311g(d,p) basis set for C, H, O, B, Na, Si atoms was used for geometry optimization. Dispersion-corrected, spin-component scaled doubly-hybrid functional DSD-PBEP86 was confirmed working well on thermochemical, weak interaction and so on and approaching the accuracy of composite *ab initio* schemes.[4c,4d] Therefore, the optimized geometries obtained at the M06-2X-D3/6-311G(d,p) level were further verified by a single point energy calculation based on DSD-PBEP86 in conjunction with def2-TZVPP basis set.[4e] All geometries were fully optimized without any symmetry constraints. Solvent effects (tetrahydrofuran) were considered in all calculations using the polarizable continuum model (PCM)[5] implemented in Gaussian 16. Vibrational frequency analysis was performed to confirm the minima nature of the stationary points. If not specified, the energies are discussed based on DSD-PBEP86/def2-TZVPP level.

4.2 DFT-Calculated Interaction Modes

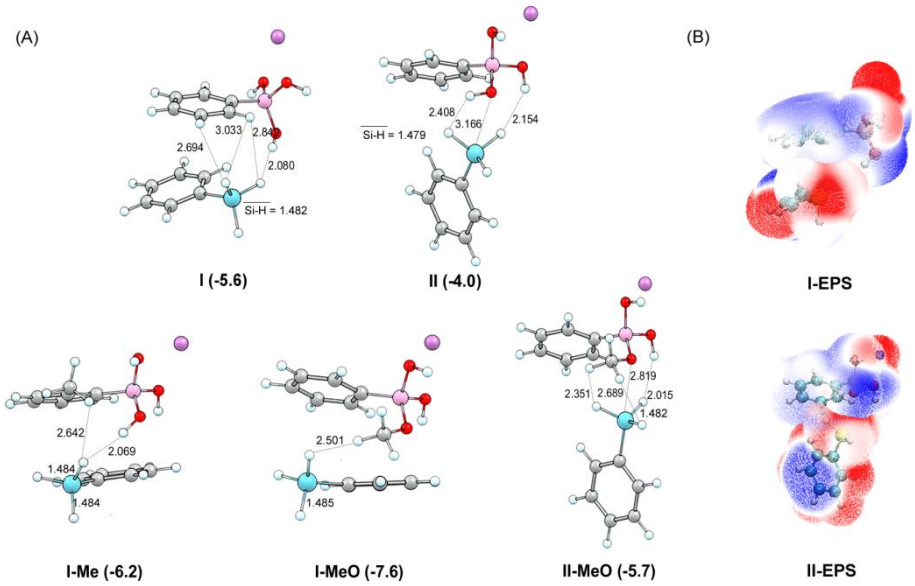


Figure S4. (A) Optimized complex structures of sodium aryl borates (**3j**, **3k**, **3o**) with phenylsilane at the M06-2X-D3/6-311G(d, p) level of theory. Values in parenthesis denote the binding energies (in kcal mol^{-1}) calculated at DSD-PBEP86/def2-TZVPP level. Bond lengths are in Å. (B) Electrostatic potential map for the catalyst-silane interaction.

Table S5. Energies of I, II, I-Me, I-MeO, II-MeO, and sodium aromatic borates (**3j, 3k, 3o**) calculated at M06-2X-D3/6-311G(d,p) level and DSD-PBEP86/def2-TZVPP level in solvent.

Complexes	M06-2X-D3/6-311G(d,p)		DSD-PBEP86/def2-TZVPP	
	E[a]	**ΔE**[b]	**E**	**ΔE**
I	-1169.294935	-7.4	-1167.890408	-5.6
II	-1169.293489	-6.5	-1167.887991	-4.0
I-Me	-1208.603744	-8.2	-1207.143507	-6.2
I-MeO	-1208.583317	-10.5	-1207.120437	-7.6
II-MeO	-1208.580002	-8.4	-1207.117401	-5.7
$PhSiH_3$	-522.8713551		-522.2928466	
3j	-646.4117964		-645.5886984	
3o	-685.7193318		-684.840776	
3k	-685.6952477		-684.8154567	

[a] The energies **E** and **ΔE** are in a.u. and kcal mol^{-1}, respectively.

[b] **ΔE** = **E**(complex) – **E**($PhSiH_3$) – E(**3**), (**3** = **3j**, **3k**, or **3o**)

Table S6. Mulliken charges for the optimized $PhSiH_3$, **3j**, **3k**, **3o** and complexes **I**, **II**, **I-Me**, **I-MeO**, **II-MeO** calculated at DSD-PBEP86/def2-TZVPP level.

	H(Si)	Si	Ph(Si)	H(OH)	O	B	Na	Ph(B)	Me
$PhSiH_3$	-0.26	0.42	-0.16						
3j				0.67	-1.81	0.56	0.91	-0.32	
3o				0.65	-1.83	0.61	0.92	-0.33	-0.01
3k				0.42	-1.70	0.51	0.92	-0.32	0.18
I	-0.28	0.39	-0.13	0.65	-1.78	0.56	0.91	-0.31	
II	-0.31	0.43	-0.16	0.65	-1.80	0.58	0.91	-0.30	
I-Me	-0.27	0.40	-0.12	0.64	-1.85	0.59	0.92	-0.30	-0.01
I-MeO	-0.28	0.39	-0.13	0.44	-1.73	0.56	0.91	-0.29	0.13
II-MeO	-0.32	0.51	-0.23	0.44	-1.71	0.56	0.91	-0.29	0.14

The coordinates of all stationary points calculated at M062X-D3/6-311g(d,p) level of theory

I				B	-2.43021400	0.38884200	-0.59573300
C	0.09820300	-2.21290800	0.97556300	O	-1.78969700	1.24204100	-1.60142200
C	-0.90086100	-1.64058900	0.19020000	H	-1.08934100	1.75283400	-1.18955500
C	-1.34394500	-0.32836200	0.39147400	O	-3.38274400	1.16404100	0.25380700
C	-0.74922100	0.38177100	1.44449600	H	-3.66785100	1.91833500	-0.26924900
C	0.24858200	-0.17633400	2.24052700	O	-3.27350800	-0.60521800	-1.32204800
C	0.68073000	-1.47915200	2.00388700	H	-2.77812800	-1.01577600	-2.03166600
H	0.42801300	-3.22858700	0.78268900	C	4.19382800	-0.86838900	-0.28631200
H	-1.34485600	-2.23203900	-0.60651100	C	3.71004000	0.35782000	0.15420600
H	-1.08540500	1.39588900	1.64647200	C	2.47062700	0.84369900	-0.28510900
H	0.69161700	0.40245500	3.04451000	C	1.72948400	0.06584500	-1.17991600
H	1.46297400	-1.91614700	2.61445000	C	2.21450700	-1.16064800	-1.62725100

C	3.44517000	-1.62883600	-1.18234400
H	5.15272500	-1.23107700	0.06553200
H	4.30591200	0.93984700	0.85140100
H	0.75270000	0.40099400	-1.51532200
H	1.62248200	-1.75477800	-2.31406300
H	3.82074800	-2.58516000	-1.52763900
Si	1.82785700	2.49980700	0.30863300
H	0.49829600	2.75482300	-0.29373300
H	1.71577200	2.55179600	1.78414500
H	2.74727800	3.58566700	-0.11203700
Na	-4.89883100	-0.54645500	0.18628700

II

C	-0.30198000	2.14884300	1.08535800
C	-1.05661900	0.97909000	1.00437300
C	-1.87668700	0.69865500	-0.09462000
C	-1.93433200	1.67302100	-1.10103200
C	-1.18659200	2.84594900	-1.03847700
C	-0.35733400	3.08457600	0.05589900
H	0.33332600	2.32872700	1.94654100
H	-0.99384100	0.25568600	1.81250900
H	-2.57765800	1.50406900	-1.96155800
H	-1.24646100	3.57489500	-1.83976500
H	0.23186300	3.99324000	0.10899400
B	-2.63513700	-0.73688600	-0.28841100
O	-2.02503700	-1.52825400	-1.36631500
H	-1.73282400	-0.94382100	-2.06942300
O	-4.08190200	-0.48512900	-0.56048700
H	-4.36474800	-1.16057200	-1.18281700
O	-2.60994400	-1.55808000	0.95387400
H	-1.72658800	-1.89612100	1.11001300
C	4.32828900	1.05296000	0.41950800
C	3.07029600	0.63841000	-0.00908900
C	2.79972000	-0.71433500	-0.25490700
C	3.83478200	-1.63856400	-0.06478700
C	5.09473100	-1.22960000	0.36196200
C	5.34231100	0.11830900	0.6060790
H	4.51843000	2.10403700	0.6042110
H	2.28751300	1.37796100	-0.15459600
H	3.65910000	-2.69312900	-0.25516400
H	5.88341800	-1.96003800	0.50103200
H	6.32318700	0.43912700	0.9371340
Si	1.07361000	-1.24977100	-0.7821100
H	1.18691700	-2.44126500	-1.65674800
H	0.29555500	-1.62046700	0.42015200
H	0.45866000	-0.11991300	-1.50700000
Na	-4.65410300	-0.99394400	1.59453600

I-Me

C	0.65563000	0.91651500	2.35956200
C	-0.18542500	0.12554300	1.57899700
C	-0.93365400	0.63706500	0.51365500
C	-0.82089800	2.02296900	0.26003900
C	0.03445600	2.81345400	1.03027900
C	0.77494700	2.27065600	2.07822300
H	1.22562800	0.47256200	3.16915600
H	-0.25198200	-0.93564700	1.80004500
H	0.11713200	3.87438800	0.81118600
H	1.43272800	2.90251700	2.66500300
B	-1.89453900	-0.34791600	-0.38650700
O	-1.52610900	-0.32776200	-1.80992300
H	-0.69198300	0.12943900	-1.92392300
O	-3.33832000	0.02480300	-0.27145700
H	-3.56218500	0.56154300	-1.03312500
O	-1.87832200	-1.74262700	0.14674900
H	-0.99182200	-2.10242500	0.07416500
C	2.99003300	-1.58936600	1.12883000
C	2.96773100	-0.42730300	0.36281100
C	2.22419300	-0.35498300	-0.81934100
C	1.50549900	-1.48937300	-1.21958900
C	1.52159200	-2.65245300	-0.45579800
C	2.26191300	-2.70217800	0.72354600
H	3.56711700	-1.62181400	2.04578700
H	3.52098300	0.44099500	0.7065090
H	0.91240700	-1.47135900	-2.12831900
H	0.96333000	-3.52265300	-0.78423000
H	2.27296500	-3.60698600	1.32015700
Si	2.18226700	1.23390200	-1.81610100
H	0.81668400	1.48294600	-2.33996300
H	2.61188400	2.36465700	-0.96489300
H	3.09279300	1.14562800	-2.98420900
Na	-4.05097000	-1.95234600	0.47598000
C	-1.65647500	2.69450700	-0.80828200
H	-1.67535700	2.11492600	-1.73204900
H	-2.69268400	2.79103800	-0.47001500
H	-1.28124900	3.69538800	-1.02965200

I-MeO

C	0.43042900	1.79177300	1.7286200
C	-0.15826500	0.65113000	1.18398100
C	-1.21284200	0.72135600	0.26518000
C	-1.66428700	2.00722400	-0.06846900
C	-1.09010900	3.15809800	0.46681800
C	-0.03406700	3.05361800	1.36916900
H	1.25366800	1.69502400	2.4298380
H	0.22970500	-0.32148700	1.47758800
H	-2.49485100	2.10397300	-0.76210200
H	-1.46403800	4.13626800	0.18289100
H	0.42037000	3.94478900	1.7878630
B	-1.88399700	-0.62370500	-0.38883500
O	-1.40911700	-0.95276700	-1.73384300
O	-3.36454900	-0.42649800	-0.38247400
O	-1.63381500	-1.82014200	0.46383800
H	-0.70413200	-2.05758600	0.42966400
C	3.06821500	-1.81630400	1.28441800
C	3.19226500	-0.53016700	0.76487200
C	2.50637000	-0.15187600	-0.39445500
C	1.69556500	-1.10167700	-1.02594100
C	1.57189800	-2.38992700	-0.51484500
C	2.25556000	-2.74856200	0.64526900
H	3.60137500	-2.08970500	2.18765300
H	3.81688200	0.19093200	1.2832190
H	1.11179400	-0.83325700	-1.89996500
H	0.93285900	-3.10730800	-1.01814000
H	2.15490300	-3.74962700	1.04864400
Si	2.55237600	1.61138000	-1.03520500
H	1.17979000	2.07478200	-1.33901900
H	3.18379400	2.48343600	-0.01704000
H	3.35941900	1.68977200	-2.27940100
Na	-3.49216600	-1.48994400	1.63963000
C	-1.42774000	0.07217200	-2.68980900
H	-0.68865200	0.85458600	-2.46877200
H	-1.19618700	-0.35389000	-3.67006800
H	-2.41204700	0.55708600	-2.75375500
H	-3.72220900	-0.97509100	-1.08700900

II-MeO

C	1.13165800	2.68748800	-0.83709000
C	1.31309700	1.30763500	-0.90832400
C	2.09812200	0.60982000	0.01952900
C	2.71545100	1.37453100	1.01907300
C	2.54541500	2.75516300	1.10534500
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H	0.51362900	3.19427900	-1.57083500
H	0.82871600	0.75786300	-1.71093300
H	3.34769500	0.87000100	1.74397300
H	3.03463200	3.31595400	1.89479900
H	1.60884000	4.49101700	0.23953900
B	2.24366600	-1.01967300	-0.02809500
O	1.29093400	-1.70856200	0.85591400
O	3.65259300	-1.35134400	0.30995400
H	3.67932400	-2.27947600	0.56292800
O	2.02338400	-1.54972800	-1.40135000
H	1.08949300	-1.55709900	-1.61816200
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C	-3.45819800	0.95995500	-0.06838000
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C	-5.52500400	-0.88525600	-0.26122000
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H	-0.78409300	-1.19405000	-0.97206700
H	-0.70772900	0.12160700	1.09160300
C	1.38843200	-1.43096300	2.22924900
H	1.13857900	-0.38599800	2.45547200
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H	2.39876400	-1.62506400	2.61011900
Na	4.15589900	-1.13856400	-1.93852300

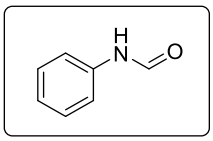
5. Crystallographic data

5.1 Crystallographic data of *N*-(3,5-difluorophenyl)formamide (**2q**)

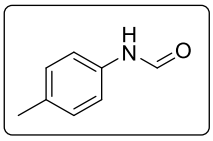
Empirical formula	$C_7H_5F_2NO$
Formula weigh	157.12
Crystal system	monoclinic
Space group	P21/c
a (Å)	4.3520(8)
b (Å)	10.590(2)
c (Å)	14.532(3)
α (°)	90
β (°)	98.269(2)
γ (°)	90
V (Å^3)	662.8(2)
Z	4
Temperature/K	296(2)
F (000)	320
θ min, θ max (deg)	2.39, 29.19
R(int)	0.0210
Final R_1, wR_2 [$I>2\sigma(I)$]	0.0425, 0.1107
R_1, wR_2 (all data)	0.0407, 0.1345

CCDC 1971981 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from the Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.

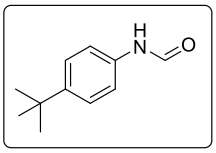
6. Characterization data



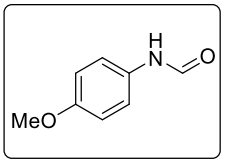
N-phenylformamide (**2a**)[6], 83% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.70, 8.37 (d, *J* = 11.4 Hz and *J* = 1.5 Hz, total 1H), 8.50, 7.61 (br., total 1H), 7.54 (d, *J* = 8.1 Hz, 1H), 7.36 - 7.31 (m, 2H), 7.19 - 7.06 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.8, 136.9, 129.8, 129.8, 125.3, 120.1, 120.1.



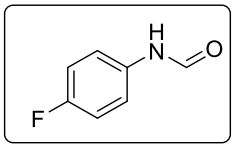
N-p-tolylformamide (**2b**)[7], 86% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.73, 8.58 (d, *J* = 10.6 Hz and *J* = 8.0 Hz, total 1H), 8.26, 7.82 (s, and br., total 1H), 7.41 (d, *J* = 7.8 Hz, 1H), 7.12 (t, *J* = 9.4 Hz, 2H), 6.96 (d, *J* = 7.7 Hz, 1H), 2.32 (d, *J* = 8.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.2, 135.2, 134.5, 130.3, 130.3, 120.2, 120.2, 21.0.



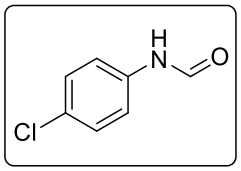
N-(4-(tert-butyl)phenyl)formamide (**2e**)[8], 80% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.65, 8.35 (d, *J* = 11.5 Hz and *J* = 1.7 Hz, total 1H), 8.17 (s, 1H), 7.46 (d, *J* = 11.2 Hz, 1H), 7.36 (t, *J* = 7.5 Hz, 2H), 7.03 (d, *J* = 11.3 Hz, 1H), 1.30(d, *J* = 4.7 Hz, total 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.5, 148.6, 134.3, 126.6, 126.6, 119.9, 119.9.



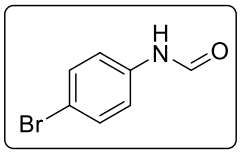
N-(4-methoxybenzyl)formamide (**2f**)[8], 85% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.51, 8.30 (d, *J* = 11.5 Hz and *J* = 1.6 Hz, total 1H), 8.34, 7.66 (d, *J* = 9.8 Hz and br., total 1H), 7.44 (d, *J* = 9.0 Hz, 1H), 7.04 (d, *J* = 8.9 Hz, 1H), 6.87 (dd, *J* = 13.0, 9.0 Hz, 2H), 3.79 (d, *J* = 6.6 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 163.2, 157.6, 130.0, 121.9, 121.9, 114.9, 114.9, 55.6.



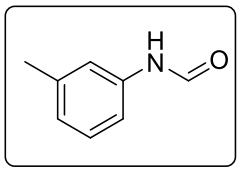
N-(4-fluorophenyl)formamide (**2g**)[8], 84% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.58, 8.35 (d, *J* = 11.3 Hz and *J* = 1.5 Hz, total 1H), 7.57 - 7.44, 7.08 - 6.98 (m, total 4H). ^{13}C NMR (100 MHz, $CDCl_3$; due to the complexity, C-F coupling is not shown) δ 162.9, 160.06, 132.8, 121.9, 121.3, 116.7, 115.9.



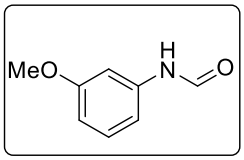
N-(4-chlorophenyl)formamide (**2h**)[9], 83% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.71, 8.63 (d, *J* = 11.1 Hz and br., total 1H), 8.41, 7.62 (s, total 1H), 7.55 (d, *J* = 8.5 Hz, 1H), 7.41 - 7.29 (m, 2H), 7.09 (d, *J* = 8.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.5, 159.0, 135.4, 135.3, 130.8, 129.9, 129.2, 121.2, 120.1.



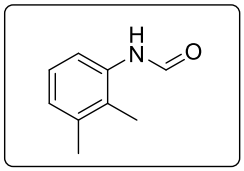
N-(4-bromophenyl)formamide (**2i**)[8], 79% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.66, 8.38 (d, *J* = 11.3 Hz and *J* = 1.6 Hz, total 1H), 8.34 (br., 1H), 7.47, 6.98 (d, *J* = 6.7 Hz and *J* = 8.8 Hz, total 2H), 7.44 (s, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.9, 135.9, 132.1, 132.1, 121.5, 121.5, 117.5.



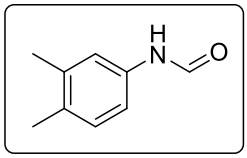
N-m-tolylformamide (**2k**) [9], 81% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.06, 8.74 (d, *J* = 11.2 Hz, and br, total 1H), 8.37, 8.02 (s, 1H, and bs, 1H, total 1H), 7.48 - 7.34 (m, 1H), 7.33 - 7.20 (m, 1H), 7.04 - 6.95 (m, 2H), 2.37 (s, *J* = 10.0 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.2, 159.5, 139.9, 139.1, 137.0, 136.8, 129.6, 129.0, 126.1, 125.6, 120.8, 119.5, 117.2, 115.7, 21.5.



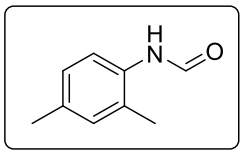
N-(3-methoxyphenyl)formamide (**2l**)[10], 84% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.70, 8.45 (d, *J* = 11.6 Hz, 1H and br., total 1H), 8.36, 7.60 (d, *J* = 7.9 Hz, and br., total 1H), 7.30 - 7.20, 6.75 - 6.67 (m, 3H), 7.02, 6.63 (d, *J* = 8.0 Hz and t, *J* = 2.2 Hz total 1H), 3.81, 3.79 (s, total 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.6, 160.7, 137.9, 130.6, 110.9, 110.4, 104.9, 55.4.



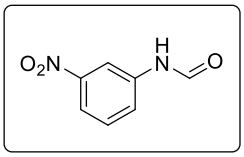
N-(2,3-dimethylphenyl)formamide (**2m**)[11], 80% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.46, 8.44 (d, *J* = 12.0 Hz and *J* = 4.0 Hz , total 1H), 7.58 (d, *J* = 8.0 Hz, 1H), 7.14 - 6.98 (m, 3H), 2.32, 2.31 (s, total 3H), 2.20, 2.18 (s, total 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.4, 138.4, 128.9, 127.9, 126.3, 121.9, 119.6, 20.5, 13.6.



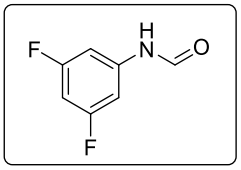
N-(3,4-dimethylphenyl)formamide (**2n**)[11], 83% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.61, 8.34 (d, *J* = 11.5 Hz and *J* = 1.7 Hz, total 1H), 7.88, 7.20 (br., total 1H), 7.33, 7.25, 7.23 (d, *J* = 1.8 Hz, total 1H), 7.09 (t, *J* = 8.3 Hz, 1H), 6.87 - 6.80 (m, 1H), 2.26 - 2.22 (m, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.6, 138.2, 134.3, 133.9, 130.7, 121.4, 117.5, 19.8, 19.2.



N-(2,4-dimethylphenyl)formamide (**2o**)[12], 82% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.46, 8.40 (d, *J* = 12.0 Hz and *J* = 1.6 Hz, total 1H), 7.78, 7.10 (br., total 1H), 7.71 - 7.65, 7.05 - 7.01 (m, total 3H), 2.31, 2.29 (s, total 3H), 2.26, 2.24 (s, total 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.4, 136.0, 132.4, 131.9, 129.9, 127.5, 123.4, 20.8, 17.6.

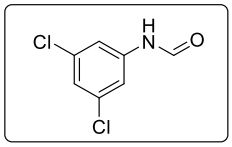


N-(3-nitrophenyl)formamide (**2p**)[9], 67% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.66, 10.46 (s and d, *J* = 10.3 Hz, total 1H), 8.95, 8.61 (d, *J* = 10.7 Hz and *J* = 1.9 Hz, total 1H), 8.38, 8.02 (s, total 1H), 7.91, 7.69 (dd, *J* = 16.0, 8.4 Hz and d, *J* = 7.9 Hz, total 2H), 7.62 (t, *J* = 7.1 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ165.6, 153.2, 144.5, 135.6, 130.2, 123.3, 118.6.

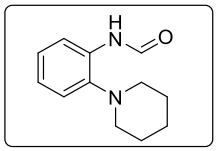


N-(3,5-difluorophenyl)formamide (**2q**)[13], 76% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.72, 8.39 (d, *J* = 11.1 Hz and s total 1H), 8.46, 7.60 (br., total 1H), 7.20 - 7.12, 6.72 - 6.45 (m, total 3H). ^{13}C NMR (100 MHz, $CDCl_3$) 164.5, 162.0, 159.2, 138.9, 103.0, 101.4, 100.2.

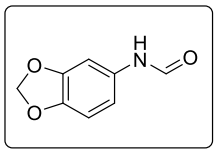
HRMS: $C_7H_5F_2NO[M^+H^+]$; calculated: 158.0412, found: 158.0422.



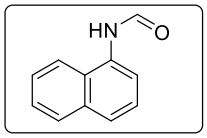
N-(3,5-dichlorophenyl)formamide (**2r**)[14], 75% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.70, 8.38 (d, *J* = 11.1 Hz and *J* = 0.8 Hz, total 1H), 8.25, 7.40 (d, *J* = 8.0 Hz and br. total 1H), 7.51, 7.01 (d, *J* = 1.6 Hz, total 2H), 7.19 - 7.13 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.7, 138.5, 135.5, 124.9, 124.9, 118.2, 118.2.
HRMS: $C_7H_5Cl_2NO[M^+H^+]$; calculated: 189.9821, found: 189.9829.



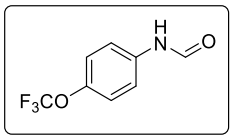
N-(2-(piperidin-1-yl)phenyl)formamide (**2s**)[15], 81% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.92, 8.55 (d, *J* = 12.0 Hz and s, total 1H), 8.60, 8.25 (br., total 1H), 8.41, 7.25 (d, *J* = 6.8 Hz, *J* = 7.8 Hz, total 1H), 7.25 - 7.10 (m, 3H), 2.87 - 2.79 (m, 4H), 1.83 - 1.74 (m, 4H), 1.69 - 1.56 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ158.8, 142.6, 132.7, 125.2, 124. 2, 120.8, 120.1, 53. 9, 53.6, 26.9, 26.6, 24.0.
HRMS: $C_{12}H_{16}N_2O[M^+H^+]$; calculated: 205.1335, found: 205.1335.



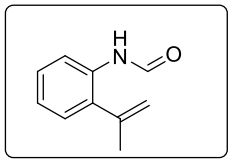
N-(benzo[*d*][*1,3*]dioxol-5-yl)formamide (**2t**)[16], 84% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.53, 8.33 (d, *J* = 11.4 Hz and s, total 1H), 8.06, 7.39 (br., total 1H), 7.27, 6.66 (d, *J* = 1.9 Hz, total 1H), 6.88, 6.58 (dd, *J* = 8.2, 1.9 Hz, total 1H), 6.79 (dd, *J* = 11.5, 8.3 Hz, 1H), 6.00 (d, *J* = 12.6 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.9, 148.7, 145.7, 131.0, 113.3, 108.7, 102.9, 101.7.



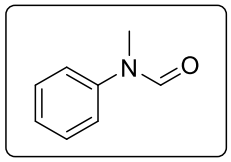
N-(naphthalen-1-yl)formamide (**2w**)[9], 85% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.64, 8.62 (br. and s, total 1H), 8.01 (d, *J* = 8.0 Hz, 1H), 7.91 - 7.86, 7.31 (m and d, *J* = 8.0 Hz, 2H), 7.79, 7.72 (d, *J* = 8.0 Hz, 1H), 7.62 - 7.42 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.9, 134.3, 132.0, 128.6, 127.8, 127.0, 126.5, 126.2, 125.6, 121.3, 119.1.



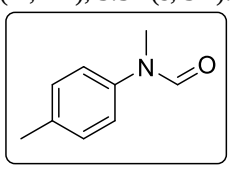
N-(4-(trifluoromethoxy)phenyl)formamide (**2y**)[9], 80% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.67, 8.39 (d, *J* = 11.3 Hz and *J* = 1.5 Hz, total 1H), 8.37, 7.55(br., total 1H), 7.61 - 7.56, 7.16 - 7.10 (m, total 2H), 7.21 (dd, *J* = 16.5, 8.6 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$; due to the complexity, C-F coupling is not shown) δ 162.4, 146.5, 135.5, 122.6, 121.8, 121.2, 120.1, 120.45.



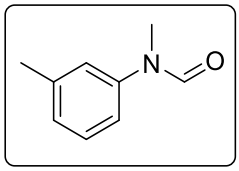
N-(2-(prop-1-en-2-yl)phenyl)formamide (**2z**)[17], 77% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.76 - 8.71, 8.40 - 8.31 (m, total 1H), 8.50 - 8.40, 7.37 - 7.27 (m, total 2H), 7.25 - 7.11 (m, 2H), 5.43 (d, *J* = 17.2 Hz, 1H), 5.07 (d, *J* = 8.5 Hz, 1H), 2.14 - 2.08 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.2, 142.7, 134.8, 133. 0, 129.1, 128.0, 125.1, 121.3, 117.6, 24.5.



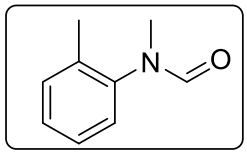
N-methyl-*N*-phenylformamide (**2aa**)[18], 90% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.45 (s, 1H), 7.45 - 7.27 (m, 4H), 7.19 - 7.16 (m, 1H), 3.31 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.3, 142.2, 129.7, 129.7, 126.0, 122.8, 122.8, 31.9.



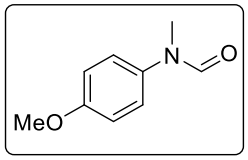
N-methyl-*N*-(p-tolyl)formamide (**2ab**)[7], 91% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.44 (s, 1H), 7.23 (d, *J* = 8.0 Hz, 2H), 7.08 (d, *J* = 8.1 Hz, 2H), 3.31 (s, 3H), 2.38 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.4, 139.7, 136.3, 130.2, 122.5, 32.2, 20.9.



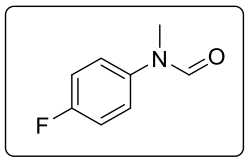
N-methyl-*N*-(m-tolyl)formamide (**2ac**)[6], 79% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.46 (s, 1H), 7.29 (t, *J* = 7.5 Hz, 1H), 7.09 (d, *J* = 7.3 Hz, 1H)， 6.97 (d, *J* = 7.2 Hz, 2H), 3.30 (s, 3H), 2.38 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.3, 142.1, 139.6, 129.4, 127.1, 123.0, 119.4, 32.0, 21.4.



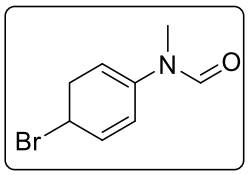
N-methyl-N-(o-tolyl)formamide (**2ad**)[18], 68% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.31, 8.13 (s, total 1H), 7.31 - 7.26, 7.25 - 7.22 (m, total 3H), 7.11 (dd, *J* = 5.6, 2.9 Hz, 1H), 3.27, 3.20 (s, total 3H), 2.27, 2.22 (s, total 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.1, 140.8, 135.5, 131.5, 128.4, 127.8, 127.2, 33.1, 17.7.



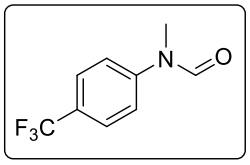
N-(4-methoxyphenyl)-*N*-methylformamide (**2ae**)[7], 87% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.33 (s, 1H), 7.09 (d, *J* = 8.9 Hz, 2H), 6.92 (d, *J* = 8.8 Hz, 2H), 3.81 (s, 3H), 3.26 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.6, 158.7, 135.0, 124.8, 114.9, 55.7, 32.8.



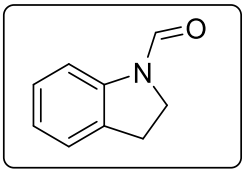
N-(4-fluorophenyl)-*N*-methylformamide (**2af**)[6], 80% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.38 (s, 1H), 7.20 - 7.05 (m, 4H), 3.30 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.3, 159.8, (d, *J* = 250 Hz) 138.3, 124.6 (d, *J* = 8.4 Hz), 116.5 (d, *J* = 22.8 Hz), 32.5.



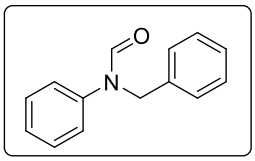
N-(4-bromophenyl)-*N*-methylformamide (**2ah**)[19], 78% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.46, 8.36 (s, total 1H), 7.56 - 7.51 (m, 2H), 7.37 - 7.33, 7.08 - 7.04 (m, total 2H), 3.34, 3.30 (s, total 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.9, 141.2, 132.7, 132.7, 123.8, 123.8, 119.7, 31.8.



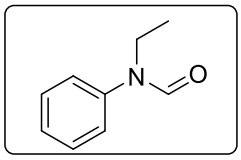
N-methyl-*N*-(4-(trifluoromethyl)phenyl)formamide (**2ai**)[6], 73% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.63 (s, 1H), 7.82 - 7.61 (m, 2H), 7.35 (t, *J* = 13.9 Hz, 2H), 3.39 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.0, 145.2, 128.2 (d, J = 33.1 Hz), 124.0 (d, J = 244.2 Hz), 121.5, 31.7.



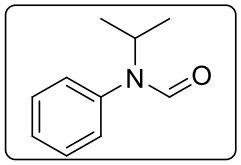
Indoline-1-carbaldehyde (**2aj**)[9], 95% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.93, 8.52, (s, total 1H), 7.28 - 7.13 (m, 3H), 7.07 (t, *J* = 7.1 Hz, 1H), 4.11 - 4.04 (m, 2H), 3.19 - 3.13 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.3, 157.6, 141.0, 131.9, 127.5, 126.0, 124.8, 124.5, 124.2, 116.6, 109.4, 46.9, 44.6, 27.7, 27.1.



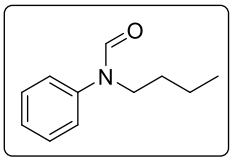
N-benzyl-*N*-phenylformamide (**2am**)[8], 92% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.56 (s, 1H), 7.36 - 7.26, 7.25 - 7.20 (m, total 8H), 7.13 - 7.07 (m, 2H), 5.00 (s, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.4, 141.1, 136.7, 129.6, 129.6, 128.6, 128.6, 127.9, 127.9, 127.5, 126.9, 124.1, 124.1, 48.9.



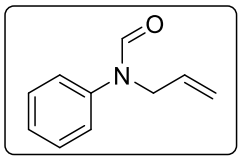
N-ethyl-*N*-phenylformamide (**2an**)[9], 73% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.38 (s, 1H), 7.46 - 7.43 (m, 2H), 7.37 - 7.28 (m, 1H), 7.20 (d, *J* = 7.8 Hz, 2H), 3.92 - 3.87 (m, 2H), 1.21 - 1.17 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.1, 140.8, 129.7, 126.9, 124.3, 40.1, 13.1.



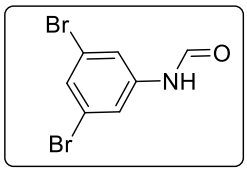
N-Isopropyl-*N*-phenylformamide (**2ao**)[11], 67% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.42, 8.17 (s, total 1H), 7.59 - 7.33 (m, 3H), 7.17 - 7.14 (m, *2*H), 4.85 - 4.74, 4.14 - 4.07 (m, total 1H), 1.27, 1.20 (d, *J* = 6.8 Hz, total 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.5, 138.4, 129.2, 129.2, 128.9, 128.9, 128.1, 45.8, 20.9, 20.9.



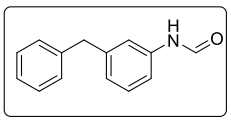
N-butyl-*N*-phenylformamide (**2aq**)[6], 72% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.37, 8.33 (s, total 1H), 7.41 (t, *J* = 7.7 Hz, 2H), 7.29 (t, *J* = 8.6 Hz, 1H), 7.17 (d, *J* = 7.5 Hz, 2H), 3.92 - 3.70 (m, 2H), 1.64 - 1.45 (m, 2H), 1.34 -1.28 (m, 2H), 0.89 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.2, 140.9, 129.6, 126.7, 124.1, 44.6, 29.6, 19.9, 13.6.



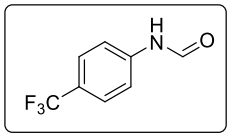
N-allyl-*N*-phenylformamide (**2at**)[6], 44% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.51 (s, 1H), 7.44 - 7.41(m, 2H), 7.32 - 7.29 (m, 1H), 7.23 - 7.21 (m, 2H), 5.93 - 5.83 (m, 1H), 5.24 - 5.19 (m, 2H), 4.45 (d, *J* = 5.4 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.0, 141.1, 132.5, 129.6, 126.7, 123.5, 117.6, 47.9.



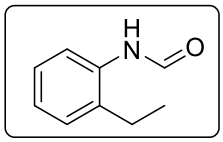
N-(3,5-dibromophenyl)formamide (**2au**)[20], 76% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.68, 8.37 (d, *J* = 11.1 Hz and s, total 1H), 7.80, 7.24 (br., total 1H), 7.71, 7.19 (d, *J* = 1.5 Hz, total 2H), 7.49 - 7.44 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 145.8, 133.4, 133.4, 127.7, 125.8, 125.8.
HRMS: $C_7H_5Br_2NO[M^+H^+]$; calculated: 279.8790, found: 279.8800.



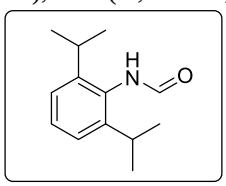
N-(3-benzylphenyl)formamide (**2aw**), 89% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.63, 8.32 (d, *J* = 11.4 Hz and *J* = 1.5 Hz, total 1H), 8.00, 7.42 (d, *J* = 9.8 Hz and *J* = 8.0 Hz, total 1H), 7.32 - 6.86 (m, 9H), 3.96 (d, *J* = 4.3 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.9, 143.3, 140.6, 137.0, 129.8, 129.0, 129.0, 128.7, 128.7, 126.4, 126.0, 120.4, 117.8, 41.8.
HRMS: $C_{14}H_{14}NO[M^+H^+]$; calculated: 212.1070, found: 212.1080.



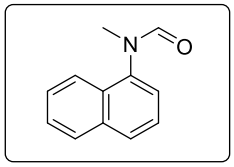
N-(4-(trifluoromethyl)phenyl)formamide (**2ax**)[9], 72% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.69, 8.37 (d, *J* = 11.4 Hz and *J* = 1.6 Hz, 1H), 7.54 (dd, *J* = 8.5, 0.9 Hz, 1H), 7.39 - 7.28, 7.21 - 7.08 (m, total 2H). ^{13}C NMR (100 MHz, $CDCl_3$; due to the complexity, C-F coupling is not shown) δ 162.7, 139.2, 133.8, 129.8, 129.8, 125.3, 120.0, 120.0, 37.0.



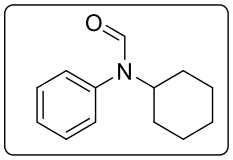
N-(2-ethylphenyl)formamide (**2ay**)[21], 78% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.50, 8.42 (d, *J* = 11.2 Hz, *J* = 1.6 Hz, total 1H), 7.85, 7.28 - 7.26 (d, *J* = 8.0 Hz and m, total 1H),8.36, 7.49 (br. total 1H), 7.23 - 7.11 (m, 3H), 2.64 (dq, *J* = 15.1, 7.6 Hz, 2H), 1.23 (td, *J* = 7.6, 2.5 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.8, 136.2, 134.4, 129.4, 127.0, 126.5, 121.6, 24.2, 14.2



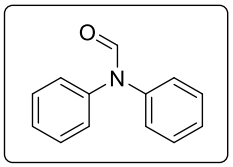
N-(2,6-diisopropylphenyl)formamide (**2az**)[8], 70% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.45, 8.03 (s and *J* = 11.9 Hz, total 1H), 7.32 (dd, *J* = 15.4, 7.7 Hz, 1H), 7.20 (dd, *J* = 7.7, 5.5 Hz, 2H), 3.26 - 3.08 (m, 2H), 1.21 (dd, *J* = 6.9, 3.8 Hz, 12H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.3, 146.8, 130.0, 130.0, 128.9, 123.8, 123.8, 28.4, 23.6.



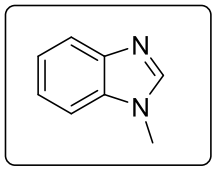
N-methyl-*N*-(naphthalen-1-yl)formamide (**2bb**)[6], 83% yield. ^{1}H NMR(400 MHz, $CDCl_3$) δ 8.31 (s, 1H), 7.98 - 7.79 (m, 3H), 7.62 - 7.43 (m, 3H), 7.35 (d, *J* = 7.1 Hz, 1H), 3.41 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.5, 138.2, 134.5, 130.4, 128.9, 128.6, 127.4, 126.7, 125.5, 125.1, 122.3, 34.2.



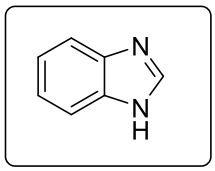
N-cyclohexyl-*N*-phenylformamide (**2bc**), 40% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.42, 8.15 (s, total 1H), 7.41-7.38 (m, 3H), 7.17 - 7.14 (m, 2H), 4.47 - 4.33 (m, 1H), 1.87 (d, *J* = 13.9 Hz, 2H), 1.77 (d, *J* = 13.9 Hz, 2H), 1.66 - 1.57 (m, 1H), 1.43 - 1.27 (m, 4H), 1.05 - 0.95 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.5 (s), 138.8, 129.3, 129.3 129.1, 129.1, 128.2, 53.8, 31.4, 31.4, 25.8, 25.8, 25.3.



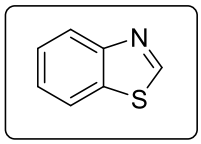
N,*N*-diphenylformamide (**2bd**)[9], 58% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.67 (s, 1H), 7.44 - 7.35 (m, 4H), 7.34 - 7.23 (m, 4H), 7.21 - 7.12 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.80, 141.9, 139.7, 129.6, 129.6, 129.2, 129.2, 127.0, 126.9, 126.1, 126.1, 125.1, 125.1.



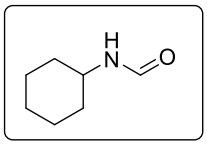
1-methyl-1*H*-benzo[*d*]imidazole (**2bf**)[22], 46% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (s, 1H), 7.81 (d, *J* = 7.0 Hz, 1H), 7.39 (d, *J* = 7.2 Hz, 1H), 7.34 - 7.27 (m, 2H), 3.83 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.8, 143.5, 134.6, 122.9, 122.1, 120.3, 109.3, 31.0.



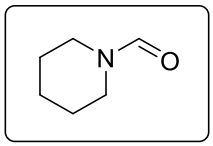
1*H*-benzo[*d*]imidazole (**2bg**)[22], 55% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (s, 1H), 7.68 (dd, *J* = 5.9, 3.2 Hz, 2H), 7.34 - 7.27 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ140.6, 137.6, 123.2, 115.7.



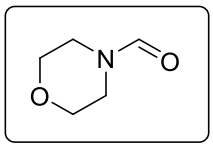
benzo[*d*]thiazole(**2bh**)[22], 52% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.96 (s, 1H), 8.14 (d, *J* = 8.2 Hz, 1H), 7.94 (d, *J* = 8.1 Hz, 1H), 7.53 - 7.47 (m, 1H), 7.42 (t, *J* = 7.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.9, 153.2, 126.2, 125.5, 123.7, 121.9.



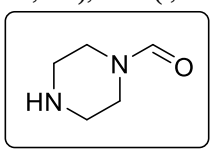
N-cyclohexylformamide (**2bi**)[21], 81% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23, 8.19 (d, *J* = 4 Hz and s, total 1H), 6.04 - 5.79 (m, 1H), 4.06 - 3.87, 3.45 - 3.30 (m, total 1H), 2.05 - 1.95 (m, 2H), 1.89 - 1.77 (m, 2H), 1.76 - 1.68 (m, 1H), 1.53 - 1.21 (m, 5H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.3, 47.3, 33.1, 33.1, 25.5, 24.9, 24.9.



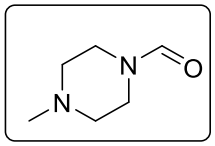
Piperidine-1-carbaldehyde (**2bj**)[7], 78% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 - 8.07 (m, 1H), 3.50 - 3.53(m, 2H), 3.31 - 3.35(m, 2H), 1.76 - 1.54 (m, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.0, 46. 9, 40.7, 26.6, 25.2, 24.8.



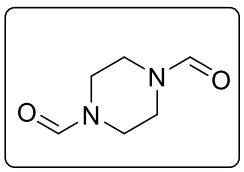
Morpholine-4-carbaldehyde (**2bk**)[23], 77% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (s, 1H), 3.69 (t, *J* = 4.8, 2H), 3.65 (t, *J* = 4.6, 2H), 3.56 (t, *J* = 4.8, 2H), 3.39 (t, *J* = 4.6, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.8, 67.2, 66.4, 45.8, 40.6.



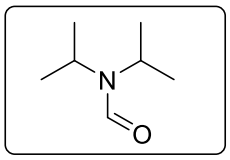
Piperazine-1-carbaldehyde (**2bl**)[7], 74% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (t, *J* = 11.2 Hz, 1H), 3.54 (t, *J* = 4.6 Hz, 2H), 3.36 (t, *J* = 4.2 Hz, 2H), 2.88 - 2.80 (m, 4H), 1.86 (br., 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.9, 47.3, 46.8, 45.5, 41.3.



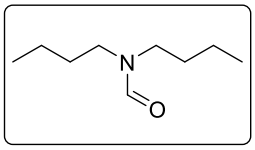
4-methylpiperazine-1-carbaldehyde (**2bm**)[23], 80% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21, 8.03 (s, total 1H), 3.59 (d, *J* = 4.3 Hz, 2H), 3.42 (dd, *J* = 10.2, 5.6 Hz, 2H), 2.48 - 2.37 (m, 4H), 2.34 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ160.7, 55.3, 54.1, 45.9, 45.4, 39.7.



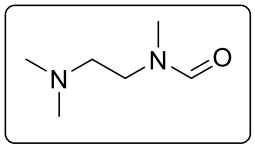
Piperazine-1,4-dicarbaldehyde (**2bn**)[18], 58% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12, 8.10 (s and br. total 2H), 3.65 - 3.54 (m, 4H), 3.48 - 3.36 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.0, 160.8, 46.1, 45.0, 40.5, 39.5.



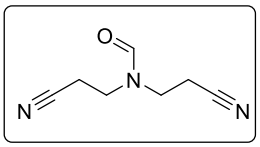
N,*N*-diisopropylformamide (**2bp**)[24], 75% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24, 8.22 (br. and d, *J* = 4.4 Hz, total 1H), 4.25 - 4.17 (m, 1H), 3.67 - 3.59 (m, 1H), 1.34 - 1.26 (m, 12H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.6, 46.5, 44.1, 23.6, 23.6, 20.30, 20.3.



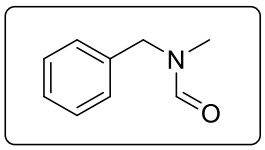
N,*N*-dibutylformamide (**2bq**)[23], 93% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (s, 1H), 3.31 (t, *J* = 7.2 Hz, 2H), 3.21 (t, *J* = 7.2 Hz, 2H), 1.60 - 1.45 (m, 4H), 1.40 - 1.26 (m, 4H), 0.95 (td, *J* = 7.3, 2.7 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162. 7, 47.2, 41.9, 30.7, 29.4, 20.2, 19.6, 13.8, 13.6.



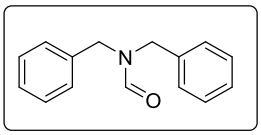
N-(2-(dimethylamino)ethyl)-N-methylformamide (**2br**)[24], 90% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, *J* = 2.3 Hz, 1H), 3.45 (t, *J* = 6.7 Hz, 1H), 3.31 (t, *J* = 6.7 Hz, 1H), 2.97, 2.89 (s, total 3H), 2.44 (dt, *J* = 10.0, 6.7 Hz, 2H), 2.26 (s, 3H) , 2.25 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.7, 56.7, 45.6, 45.2, 32.4.



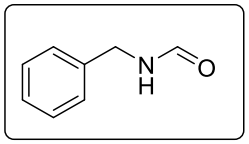
N,*N*-bis(2-cyanoethyl)formamide (**2bs**)[23], 92% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27, 8.25 (br. and s, total 1H), 3.80 -3.65 (m, 4H), 2.80 - 2.71 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.0, 118.2, 116. 8, 44.5, 40.3, 19.2, 16.5.



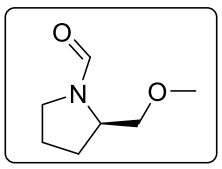
N-benzyl-*N*-methylformamide (**2bt**)[7], 86% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29, 8.16 (s, total 1H), 7.49 - 6.85 (m, 5H), 4.52, 4.39 (s, total 2H), 2.85, 2.78 (s, total 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.7, 136.1, 135.80 (s), 128.9, 128.9, 128.3, 127.4, 127.4, 53.6, 33.9.



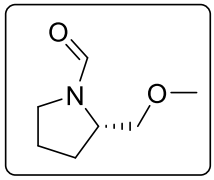
N, *N*-dibenzylformamide (**2ce**)[7], 87% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.42 (s, 1H), 7.40 - 7.28 (m, 6H), 7.21 - 7.16 (m, 4H), 4.42 (s, 2H), 4.26 (s, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.9, 136.1, 135.7, 128.9, 128.9, 128.7, 128.7, 128.5, 128.5, 128.2, 127.7, 127.7, 127.6, 50.28, 44.71.



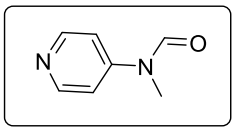
N-benzylformamide (**2cj**)[7], 88% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26, 8.19 (s, and d, *J* = 11.9 Hz, total 1H), 7.40 - 7.24 (m, 5H), 5.86 (br., 1H), 4.49, 4.41 (d, *J* = 5.9 Hz and *J* = 6.5 Hz, total 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.9, 137.6, 128.8, 128.8, 127.8,127.8, 126.9, 42.1.



(*R*)-2-(methoxymethyl)pyrrolidine-1-carbaldehyde (**2cm**)[25], 94% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.33, 8.26 (s, total 1H), 4.19 - 3.93 (m, total 1H), 3.65 - 3.50 (m, 2H), 3.40 - 3.27 (m, 5H), 2.09 - 1.75 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.7, 75.4, 58.9, 56.4, 43.6, 27.4, 22.8.

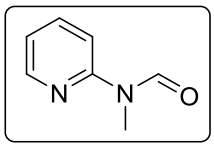


(*S*)-2-(methoxymethyl)pyrrolidine-1-carbaldehyde (**2cn**)[25], 96% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.33, 8.26 (s, total 1H), 4.16 - 3.95 (m, total 1H), 3.68 - 3.49 (m, 2H), 3.41 - 3.26 (m, 5H), 2.02 - 1.72 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.9, 75.4, 59.1, 56.8, 43.7, 27.8, 22.2.

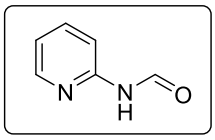


N-methyl-*N*-(pyridin-4-yl)formamide (**2co**), 92% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.82 (s, 1H), 8.59 (d, *J* = 6.3 Hz, 2H), 7.10 (d, *J* = 4.8 Hz, 2H), 3.34 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.1, 151.2, 151.2, 148.9, 113.7, 113.7, 30.2.

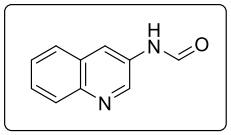
HRMS: $C_7H_9N_2O[M^+H^+]$; calculated: 137.0709, found: 137.0709.



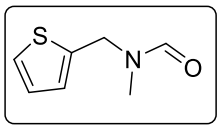
N-methyl-*N*-(pyridin-2-yl)formamide (**2cq**)[26], 58% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.35 (s, 1H), 8.40 (dd, *J* = 4.8, 1.2 Hz, 1H), 7.81 - 7.63 (m, 1H), 7.17 - 7.07 (m, 1H), 7.02 (d, *J* = 8.3 Hz, 1H), 3.35 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.2, 154.0, 148.6, 138.5, 120.1, 111.3, 28.8.



N-(pyridin-2-yl)formamide (**2cr**)[26], 60% yield. ^{1}H NMR (400 MHz, CDCl3) δ 9.47, 9.28 (br., total 1H), 9.32, 8.52 (d, *J* = 10.3 Hz, s total 1H), 8.33 (d, *J* = 6.0 Hz, 1H), 8.25, 6.91 (d, *J* = 8.4 Hz, total 1H), 7.71 (dt, *J* = 17.2, 8.1 Hz, 1H), 7.08 (dd, *J* = 13.0, 8.0 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.3, 150.7, 147.6, 138.8, 120.2, 115.0.



N-(quinolin-3-yl)formamide (**2cu**)[27], 88% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (equilibrium mixture of E/Z isomers) 9.84, 9.51 (br., total 1H), 9.17, 8.75 (d, *J* = 11.7 Hz and s, total 1H), 8.86 (dd, *J* = 4.1, 1.2 Hz, 1H), 8.81 - 8.78 (m, 1H), 8.22 (d, *J* = 6.9 Hz, 1H), 7.64 - 7.56 (m, 2H), 7.51 (dd, *J* = 8.2, 4.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.2, 148.5, 138.3, 136.4, 133.8, 127.9, 127.3, 122.2, 121.8, 117.6.



N-methyl-*N*-(thiophen-2-ylmethyl)formamide (**2cz**)[28], 85% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24, 8.06 (s, total 1H), 7.25 (dd, *J* = 16.4, 5.0 Hz, 1H), 7.00 - 6.92 (m, 2H), 4.66 (s, 1H), 4.55 (s, 1H), 2.90, 2.83 (s, total 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.4, 138.9, 127.2, 126.8, 125.9, 48.4, 33.8.

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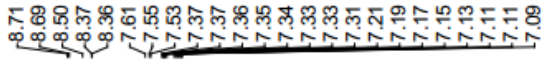
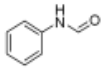
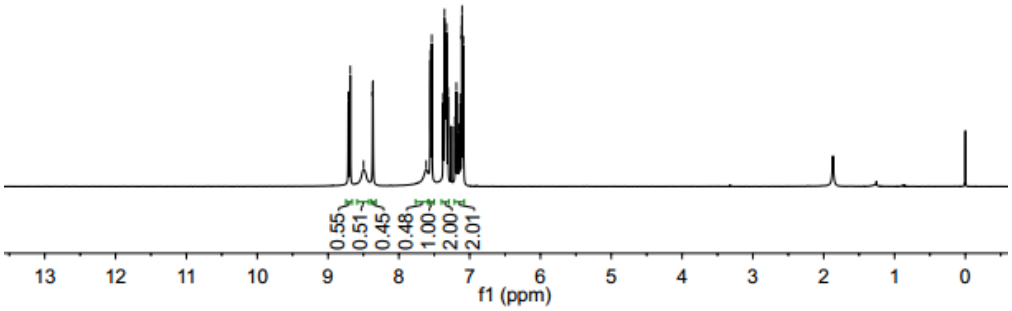
8. Copies of product NMR

^{1}H NMR for *N*-phenylformamide, **2a**

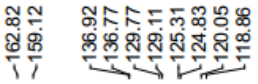


2a, ^{1}H NMR (400 MHz, $CDCl_3$)

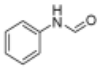


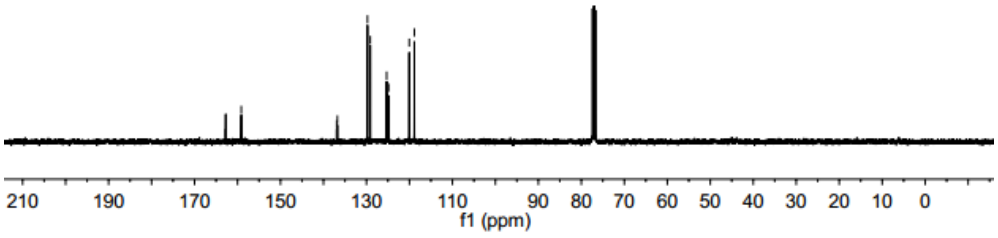


^{13}C NMR for *N*-phenylformamide, **2a**

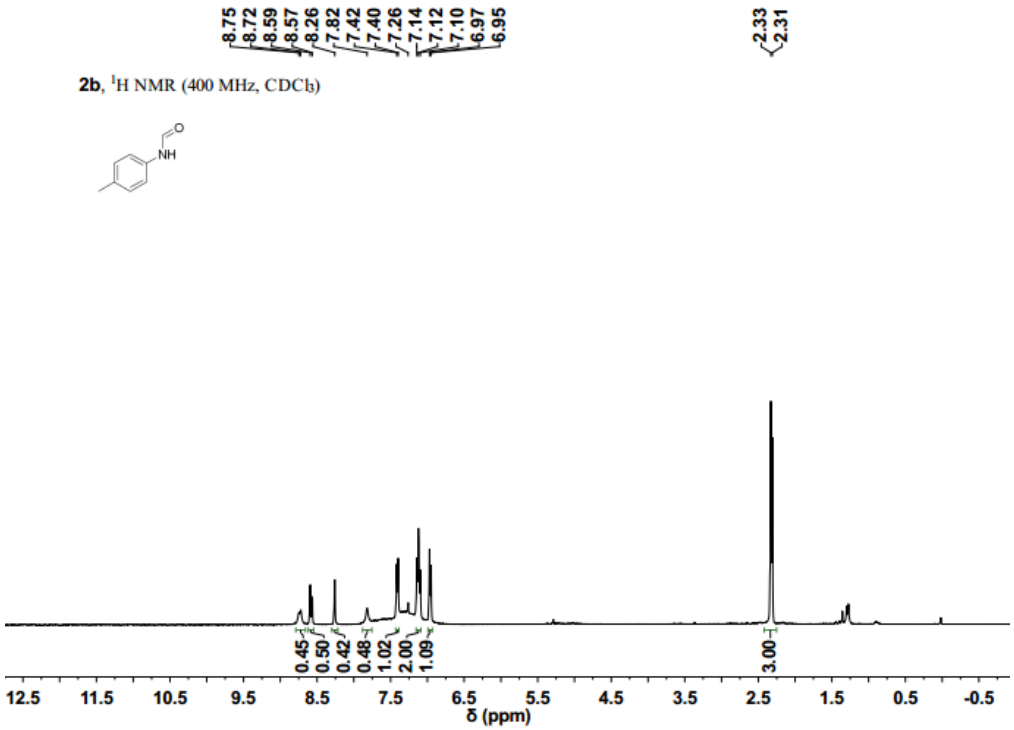


2a, ^{13}C NMR (100 MHz, $CDCl_3$)

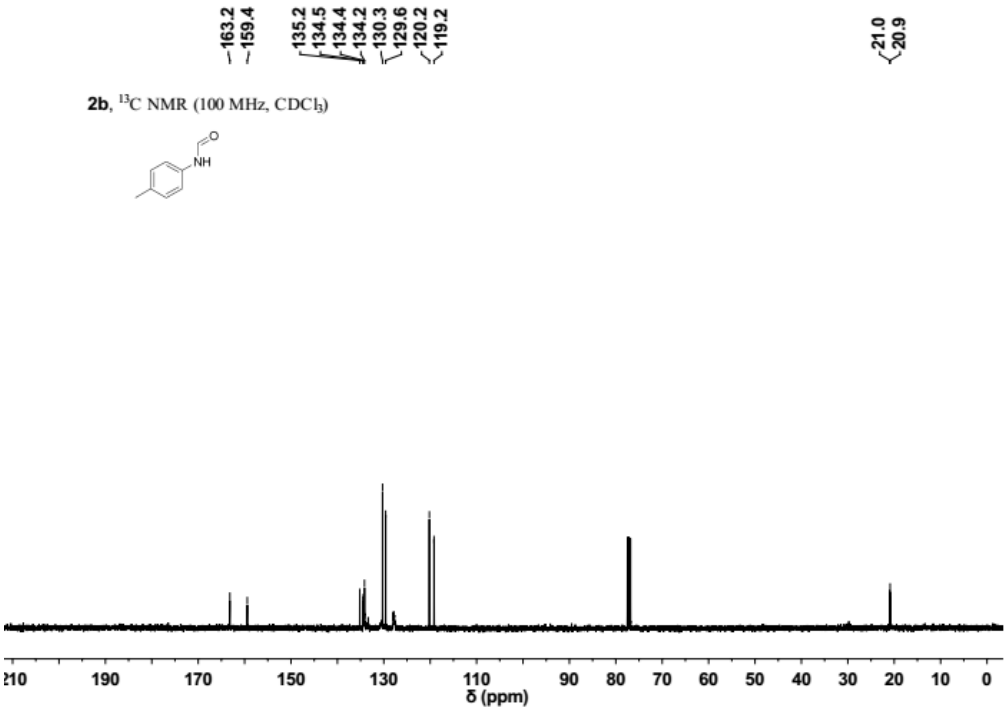




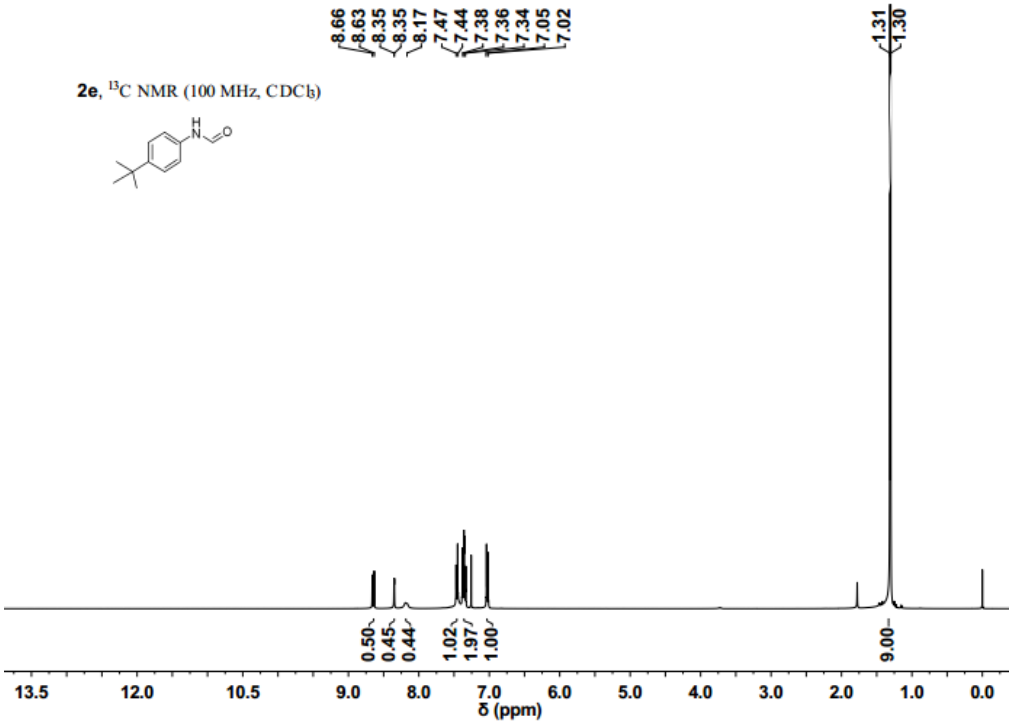
^{1}H NMR for *N*-p-tolylformamide, **2b**



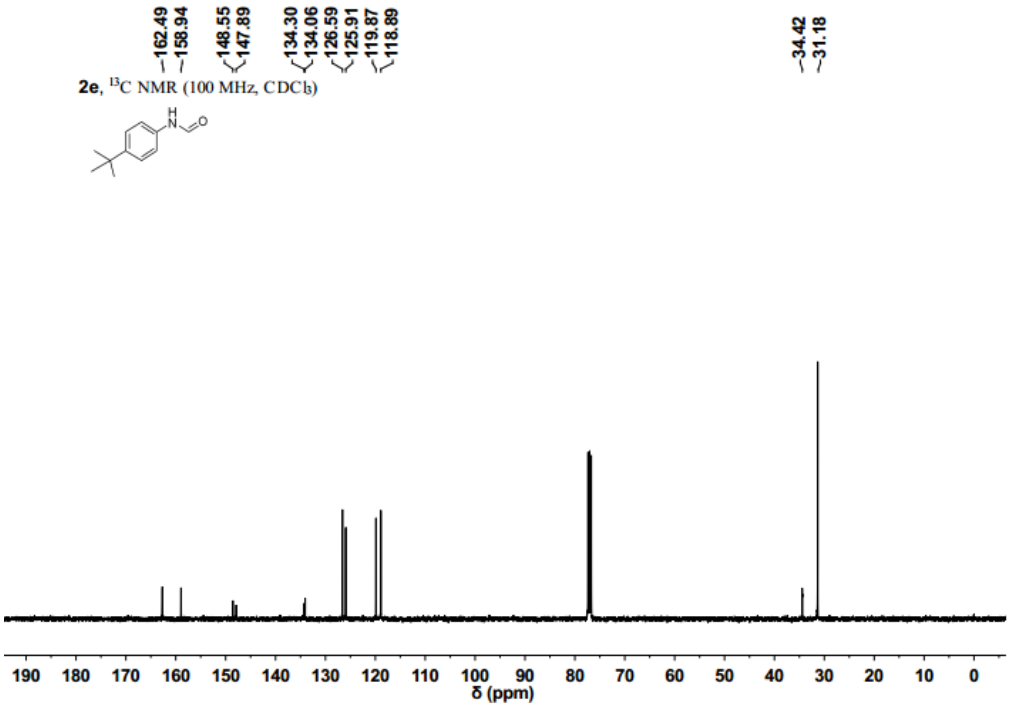
^{13}C NMR for *N*-p-tolylformamide, **2b**



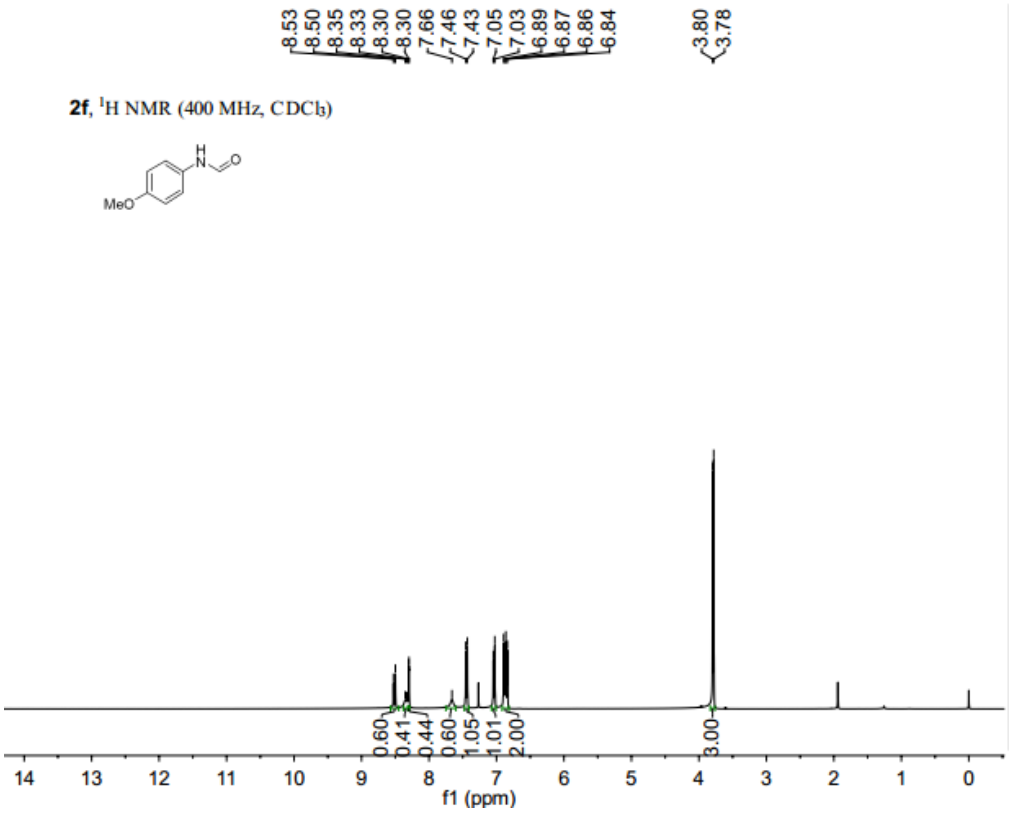
^{1}H NMR for *N*-(4-(tert-butyl)phenyl)formamide, **2e**



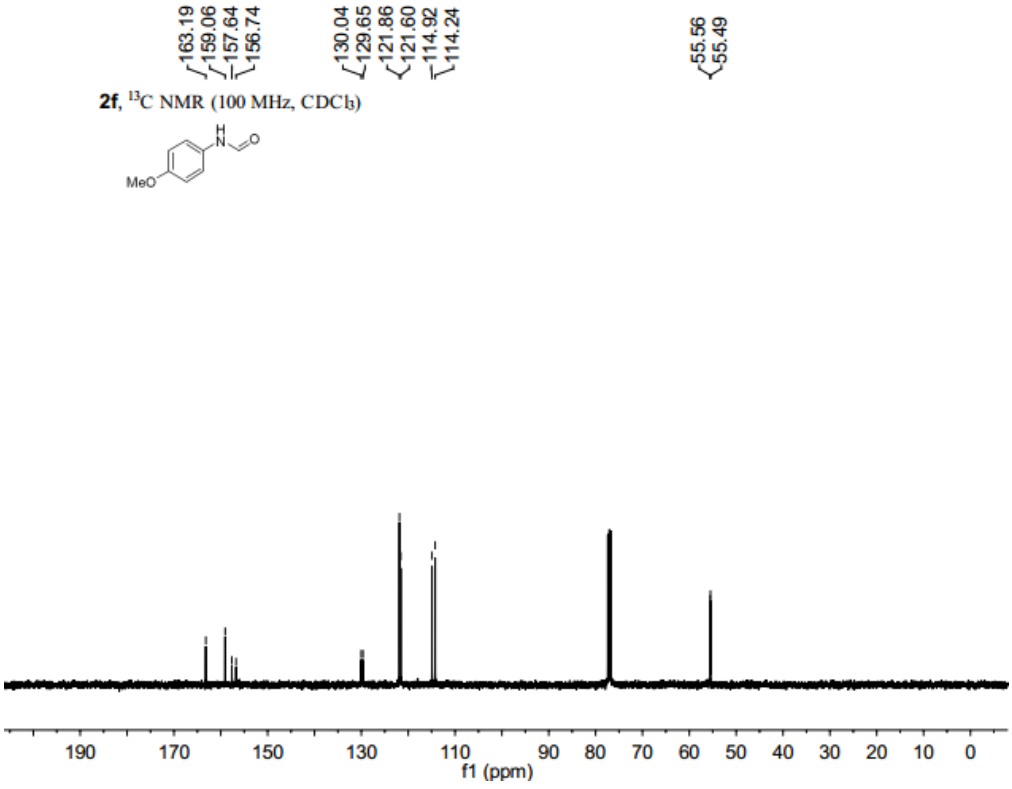
^{13}C NMR for *N*-(4-(tert-butyl)phenyl)formamide, **2e**



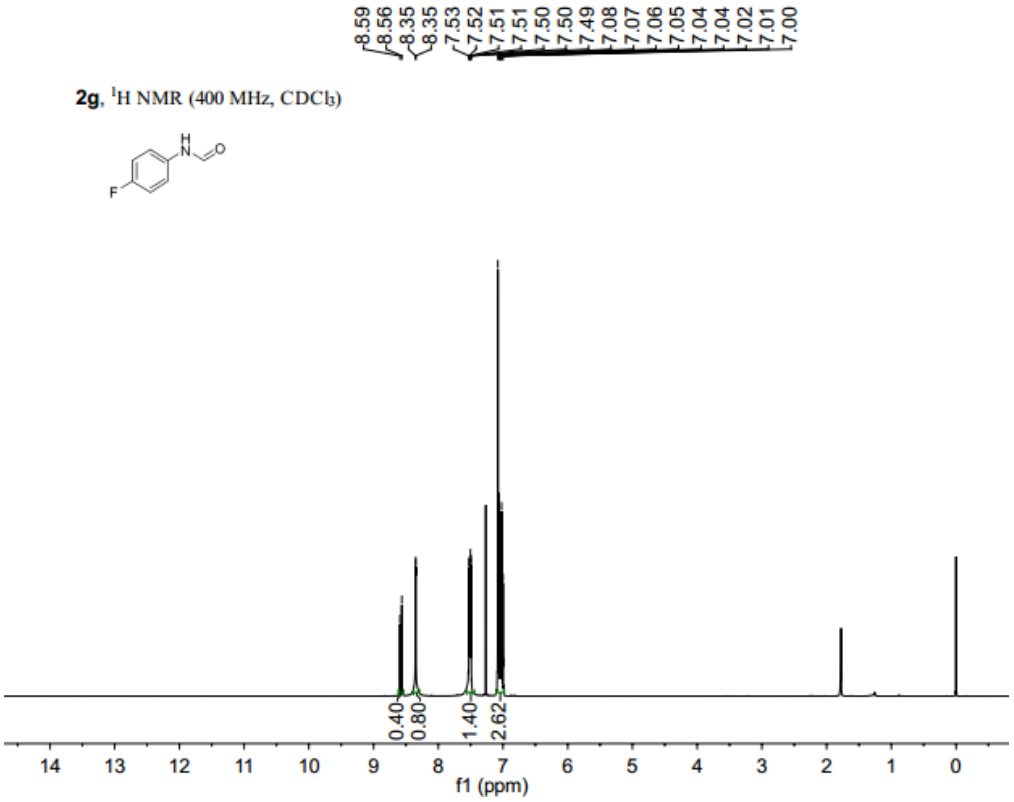
^{1}H NMR for *N*-(4-methoxybenzyl)formamide, **2f**



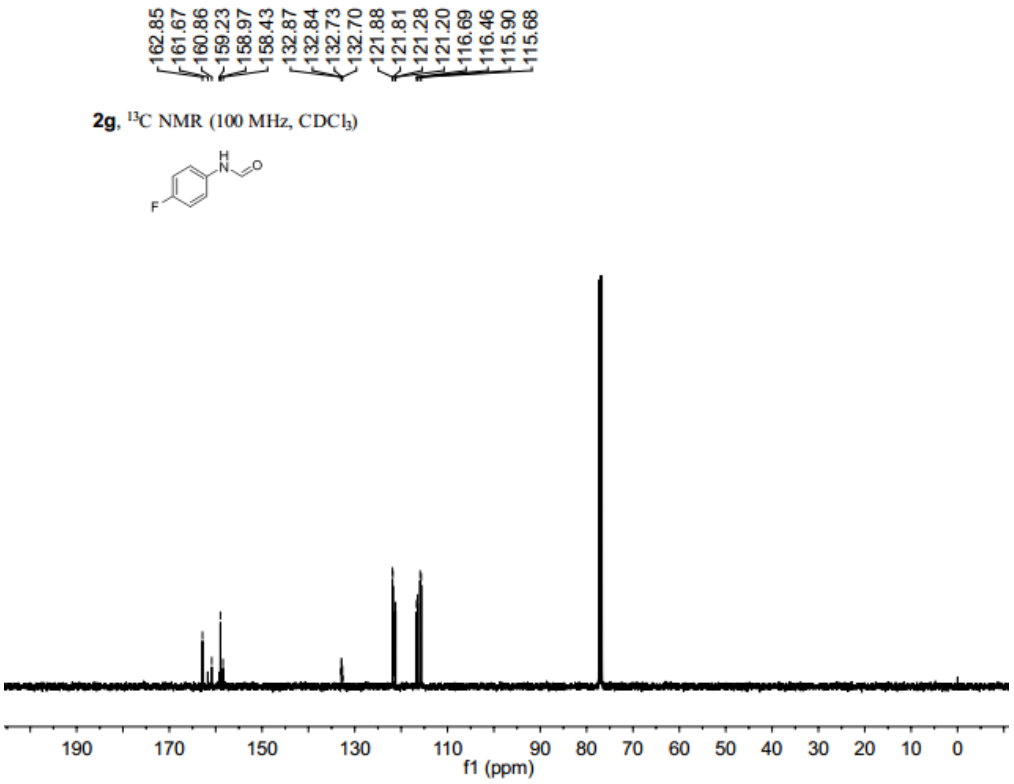
^{13}C NMR for *N*-(4-methoxybenzyl)formamide, **2f**



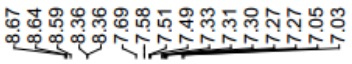
^{1}H NMR for *N*-(4-fluorophenyl)formamide, **2g**



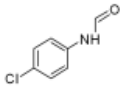
^{13}C NMR for *N*-(4-fluorophenyl)formamide, **2g**

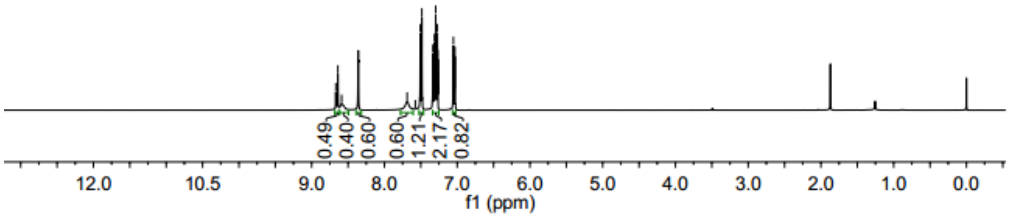


^{1}H NMR for *N*-(4-chlorophenyl)formamide, **2h**

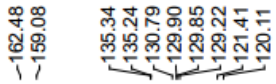


2h, ^{1}H NMR (400 MHz, $CDCl_3$)

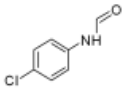


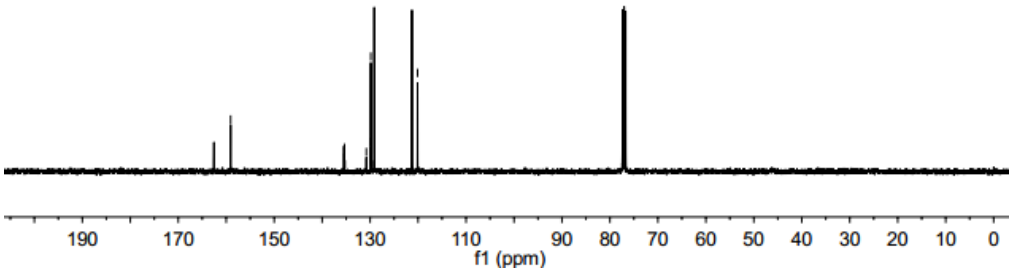


^{13}C NMR for *N*-(4-chlorophenyl)formamide, **2h**

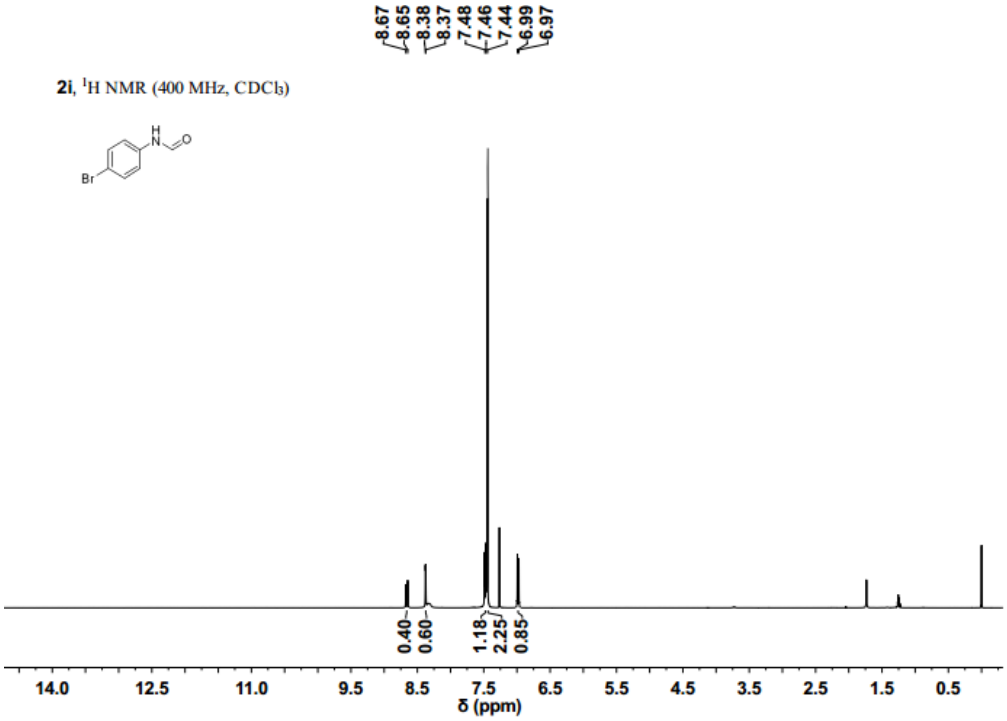


2h, ^{13}C NMR (100 MHz, $CDCl_3$)

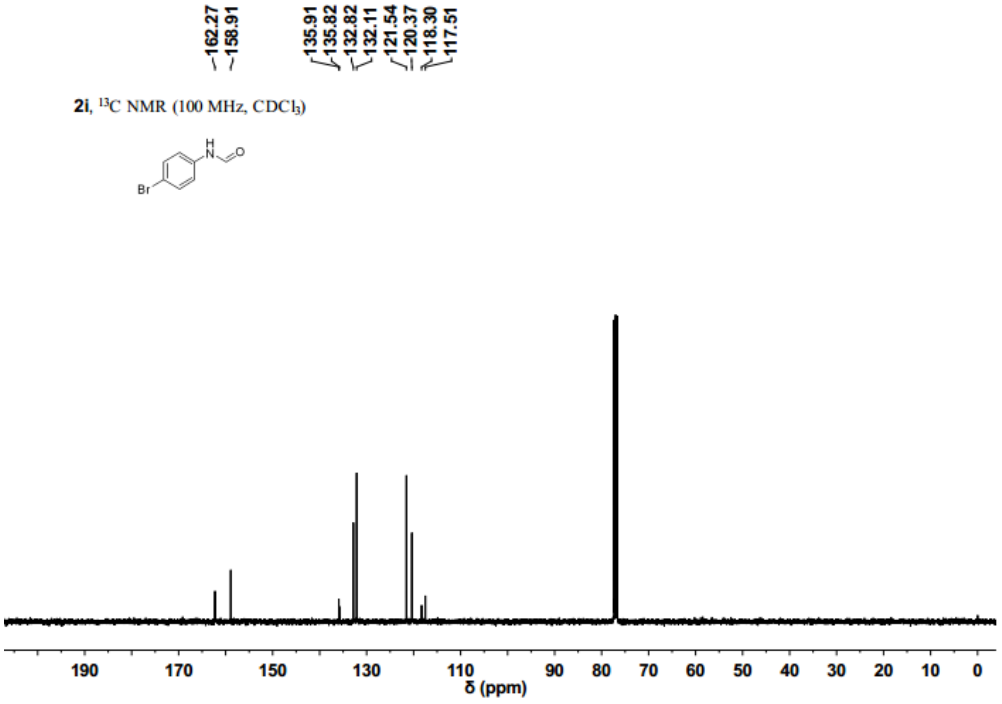




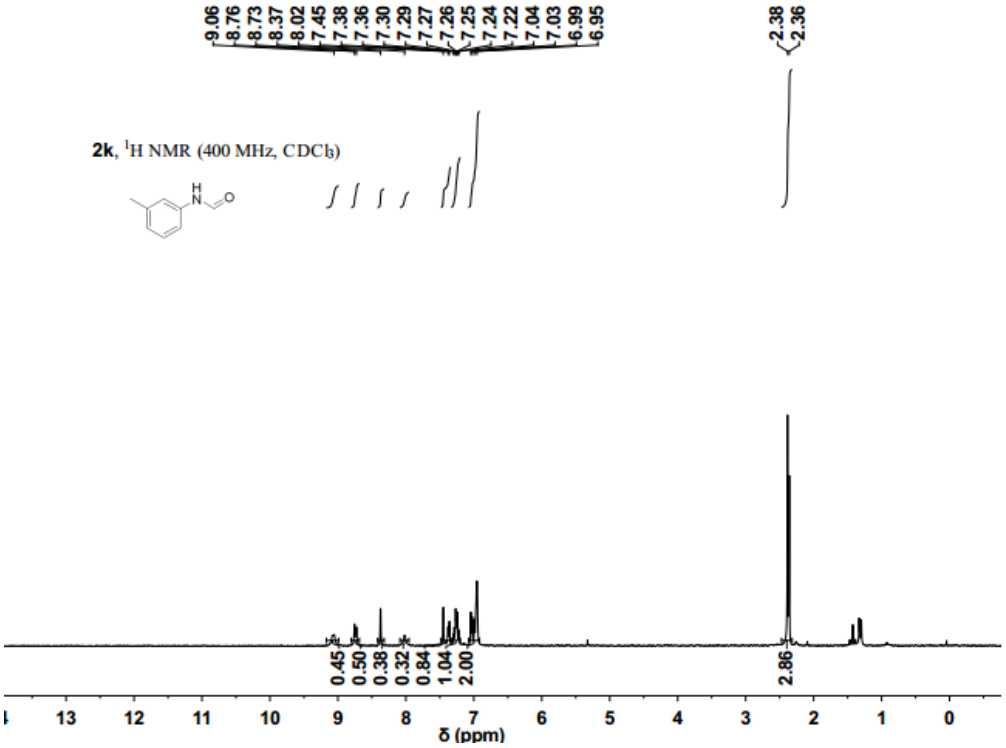
^{1}H NMR for *N*-(4-bromophenyl)formamide, **2i**



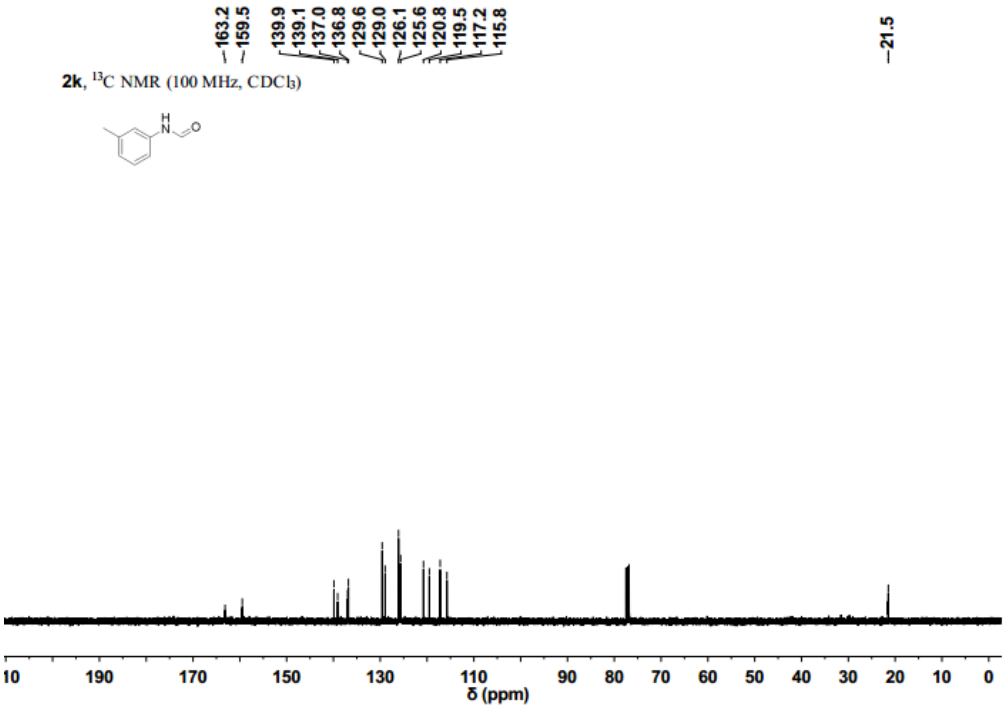
^{13}C NMR for *N*-(4-bromophenyl)formamide, **2i**



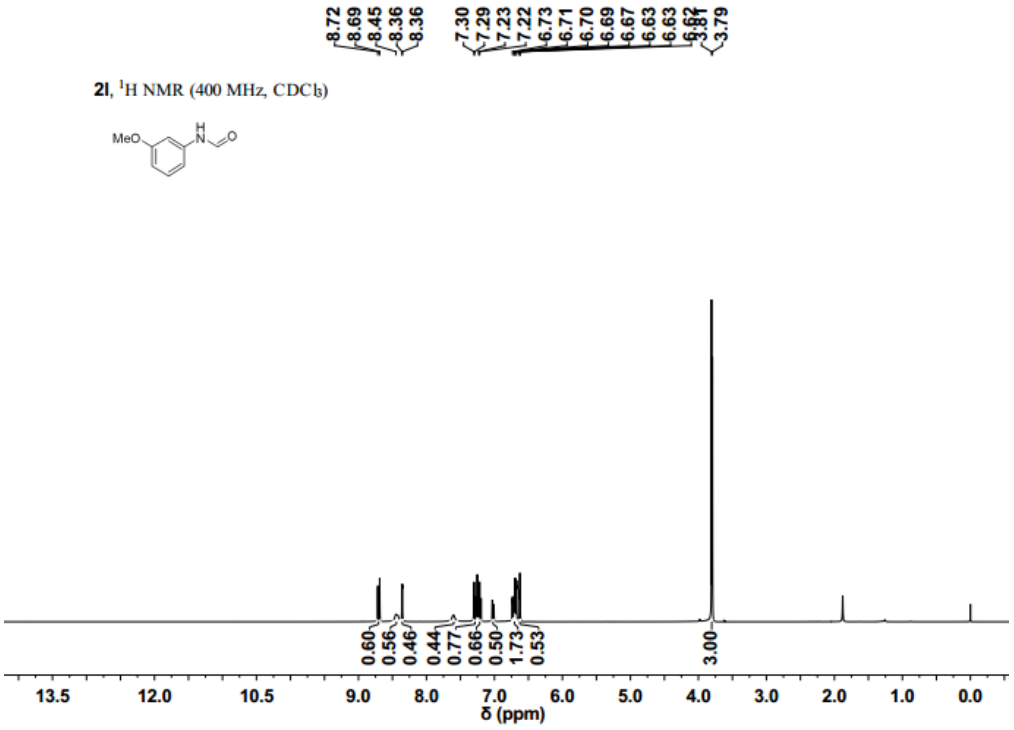
^{1}H NMR for *N*-m-tolylformamide, **2k**



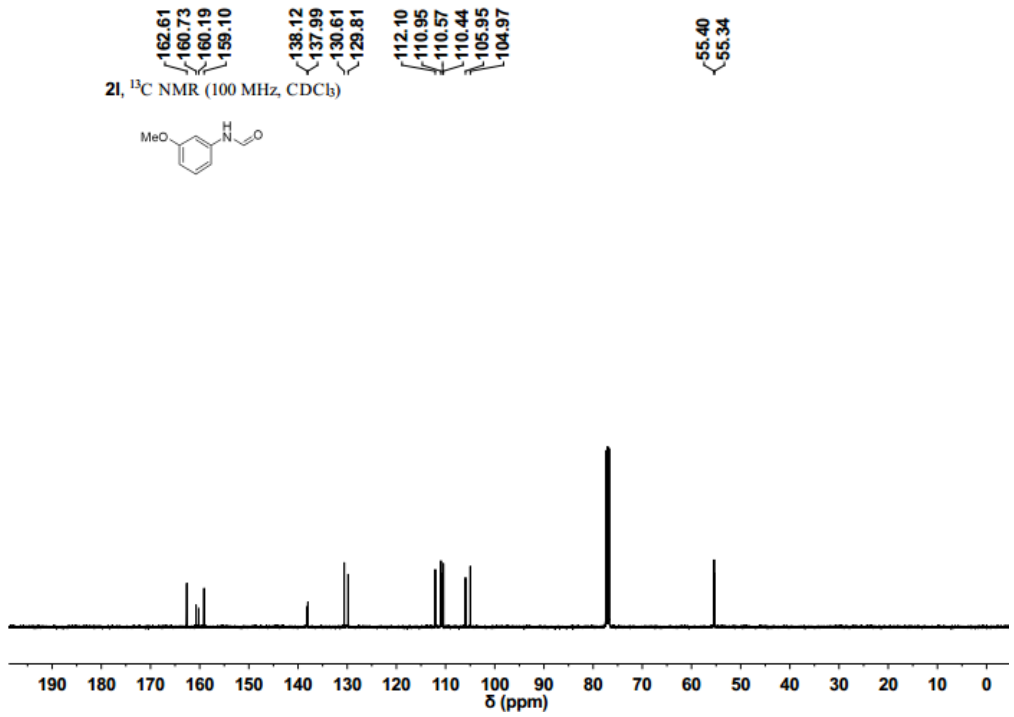
^{13}C NMR for *N*-m-tolylformamide, **2k**



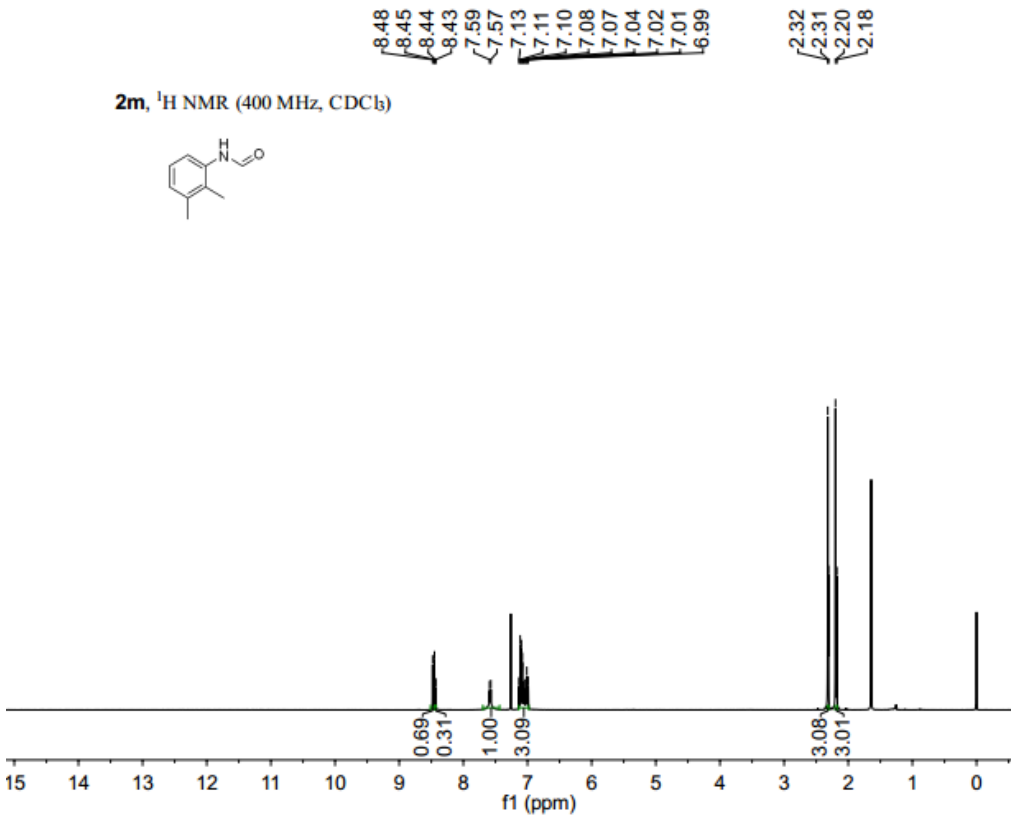
^{1}H NMR for *N*-(2,3-dimethylphenyl)formamide, **2l**



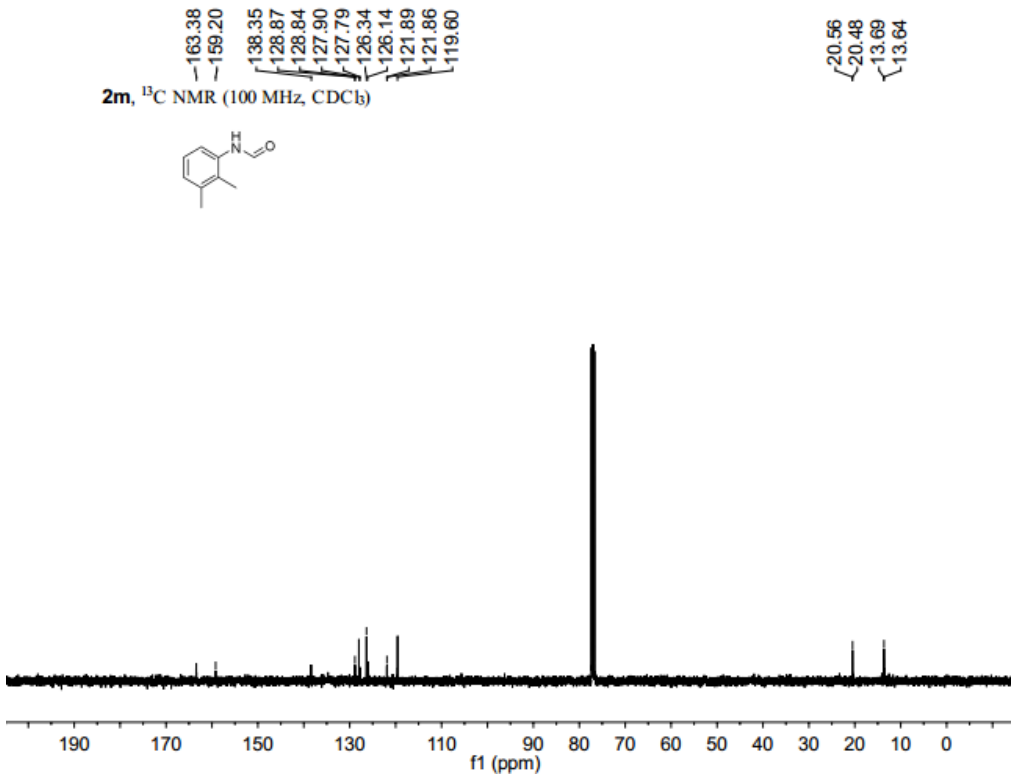
^{13}C NMR for *N*-(4-chlorophenyl)formamide, **2l**



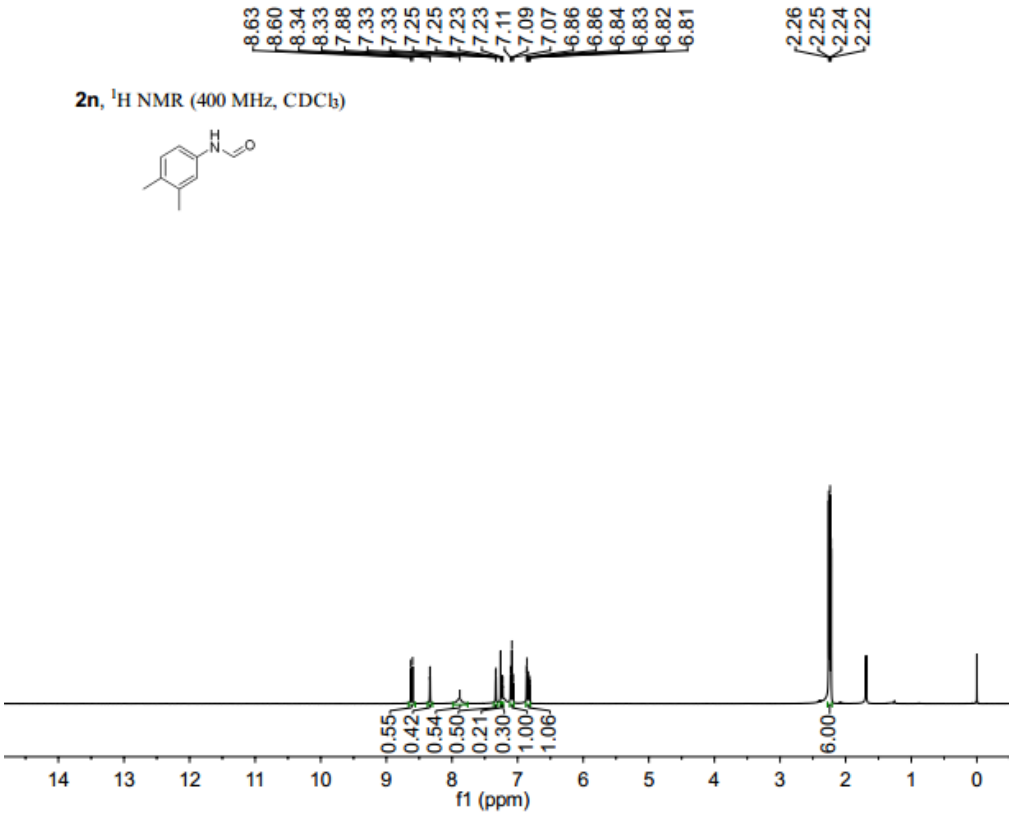
^{1}H NMR for *N*-(2,3-dimethylphenyl)formamide, **2m**



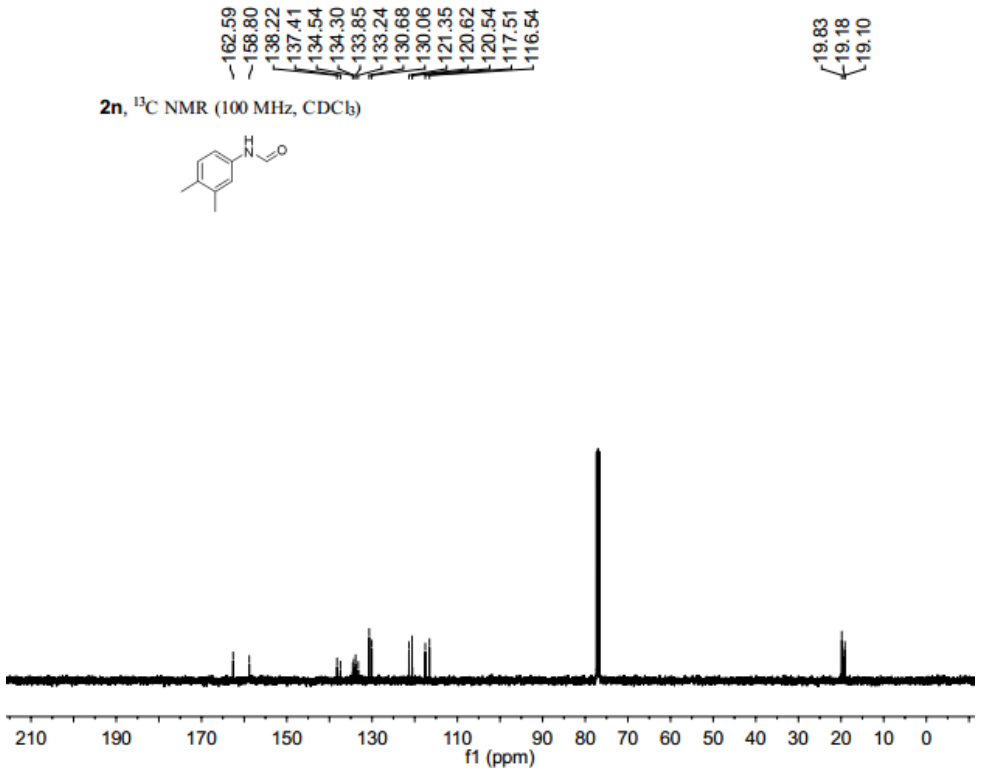
^{13}C NMR for *N*-(2,3-dimethylphenyl)formamide, **2m**



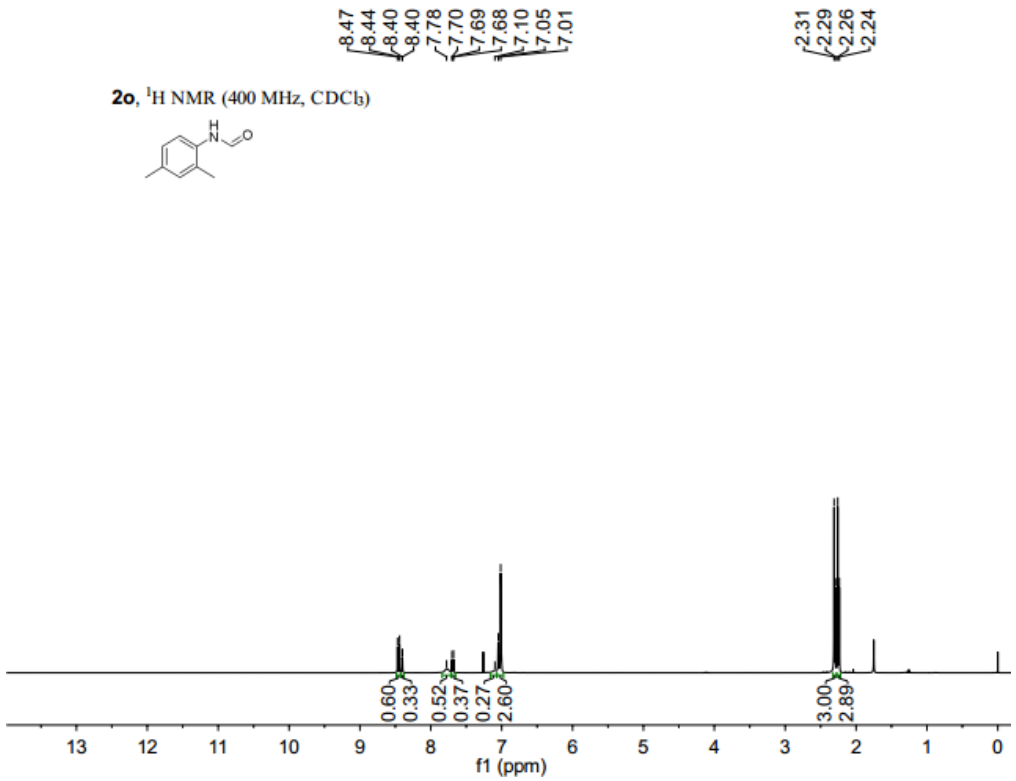
^{1}H NMR for *N*-(3,4-dimethylphenyl)formamide, **2n**



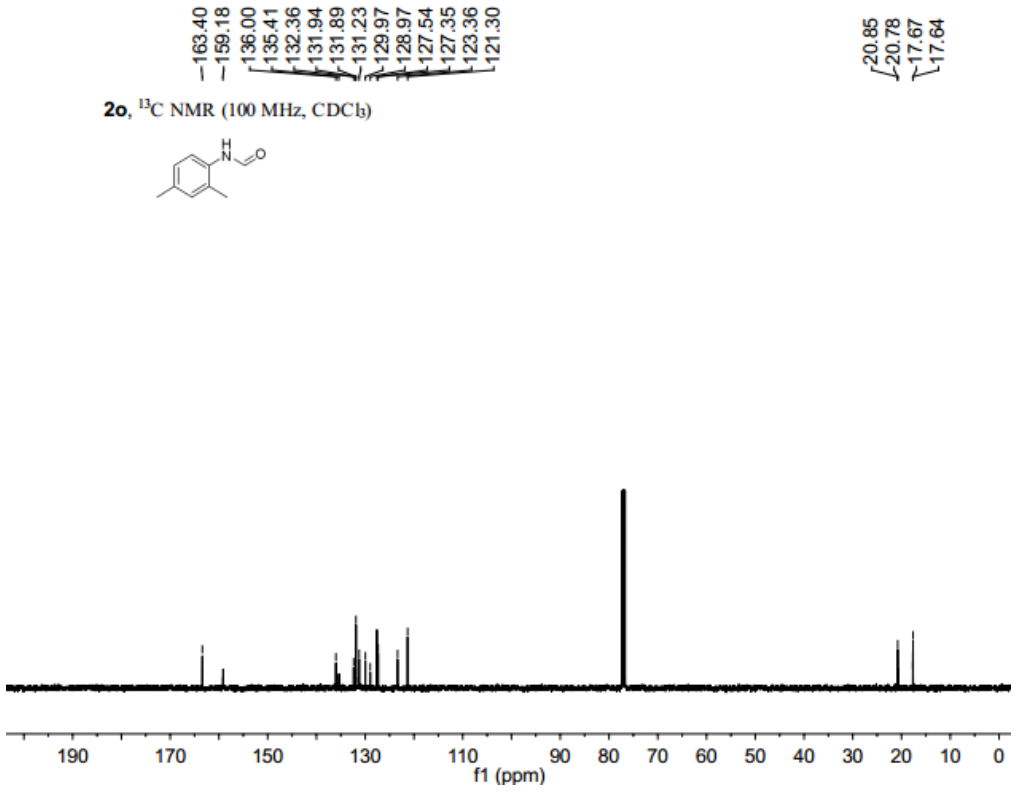
^{13}C NMR for *N*-(3,4-dimethylphenyl)formamide, **2n**



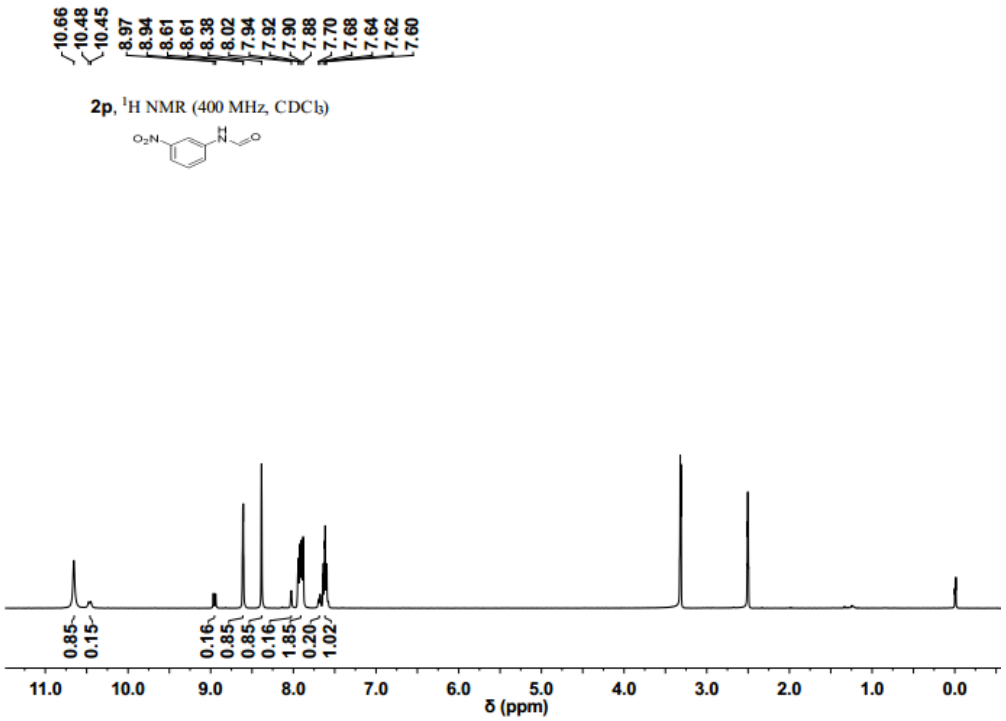
^{1}H NMR for *N*-(2,4-dimethylphenyl)formamide, **2o**



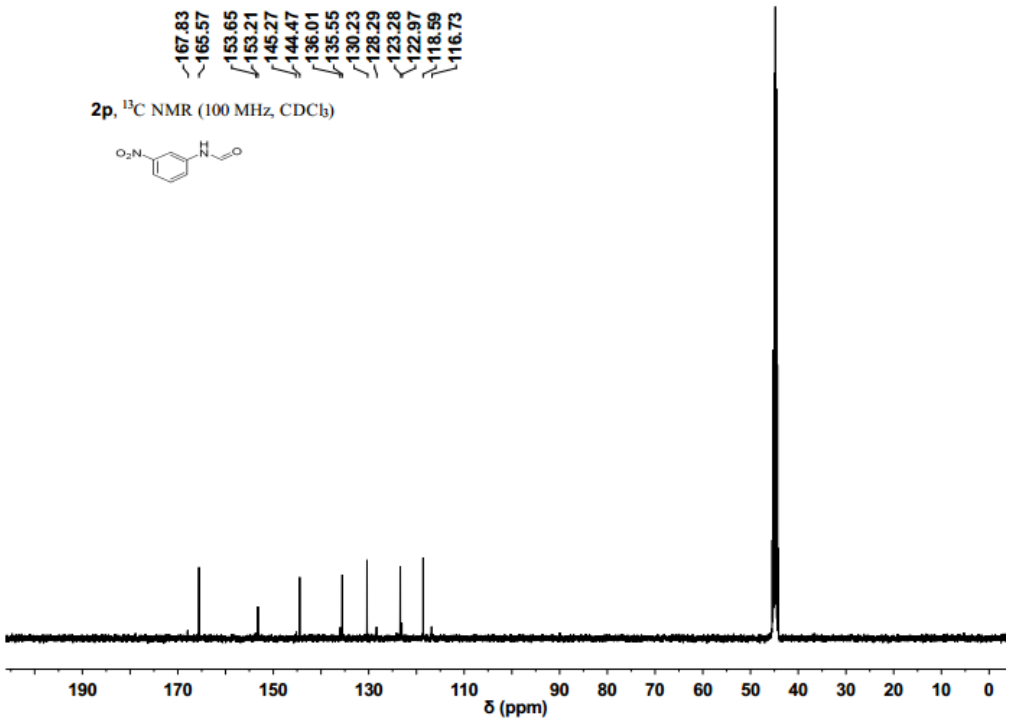
^{13}C NMR for *N*-(2,4-dimethylphenyl)formamide, **2o**



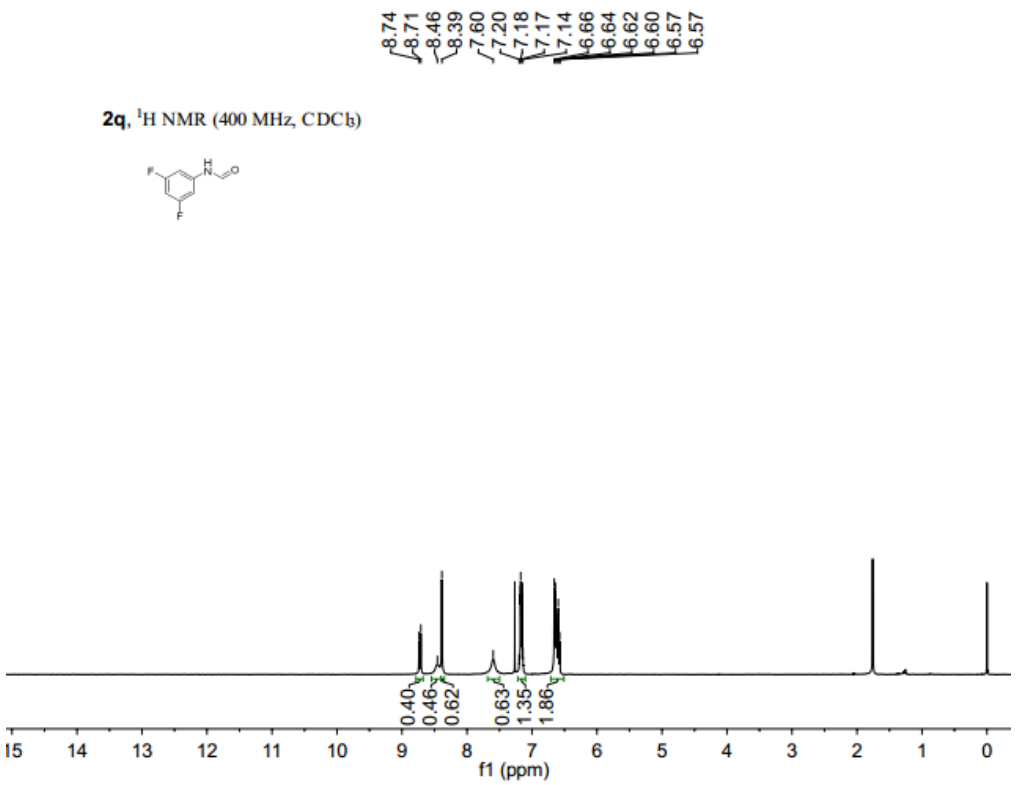
^{1}H NMR for *N*-(3-nitrophenyl)formamide, **2p**



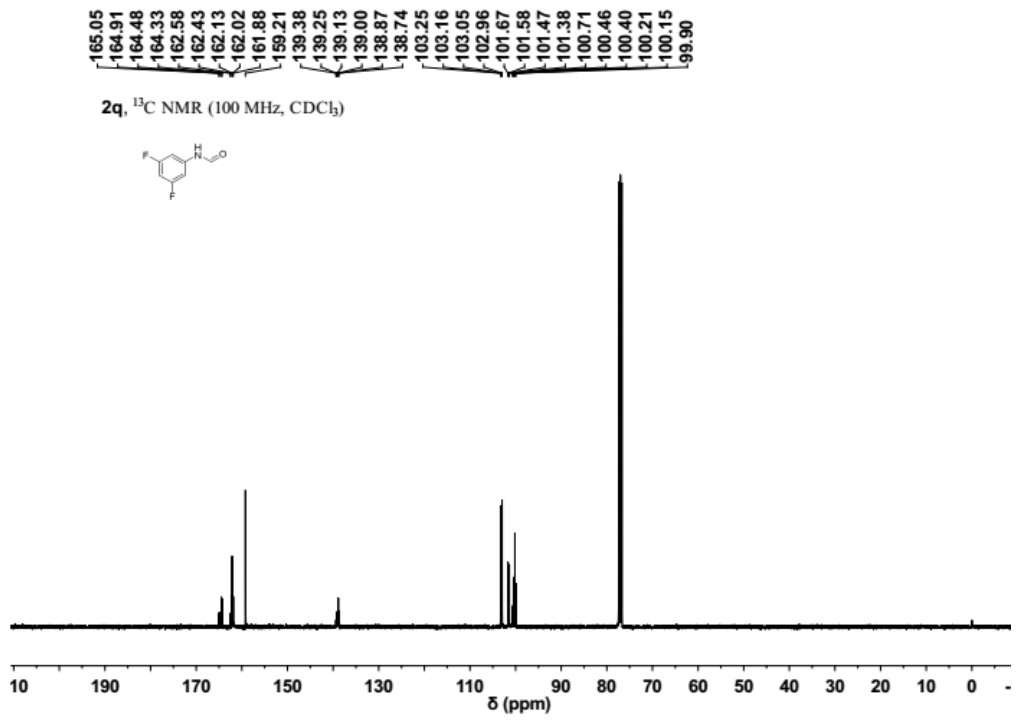
^{13}C NMR for *N*-(3-nitrophenyl)formamide, **2p**



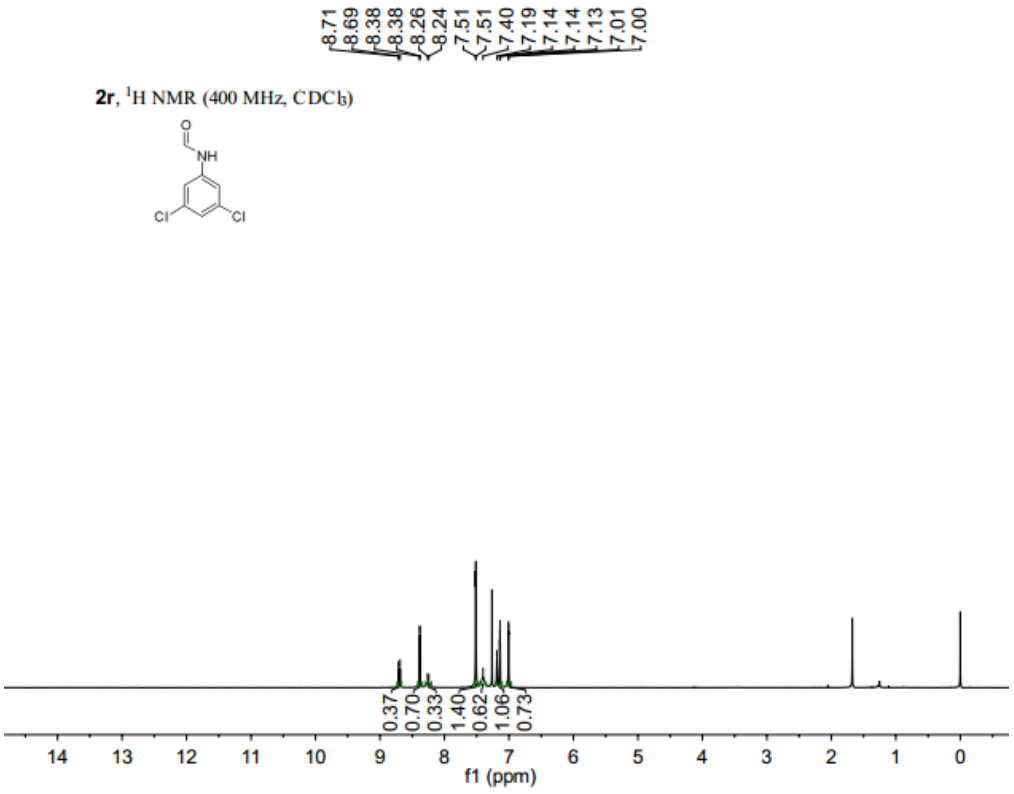
^{1}H NMR for *N*-(3,5-difluorophenyl)formamide, **2q**



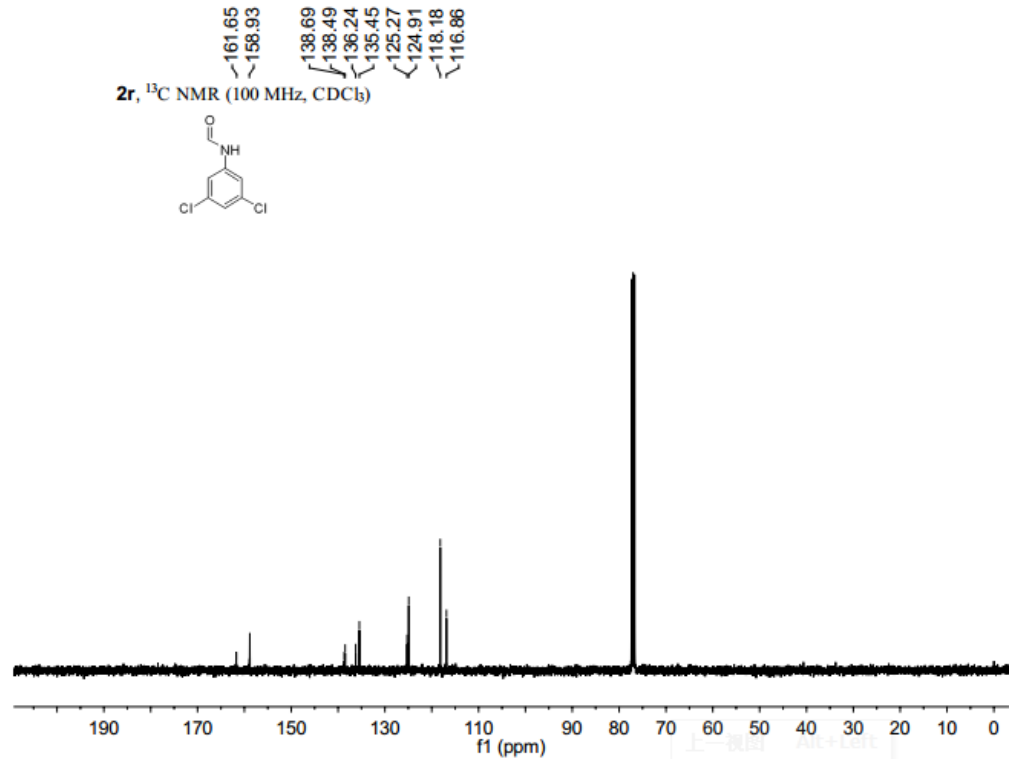
^{13}C NMR for *N*-(3,5-difluorophenyl)formamide, **2q**



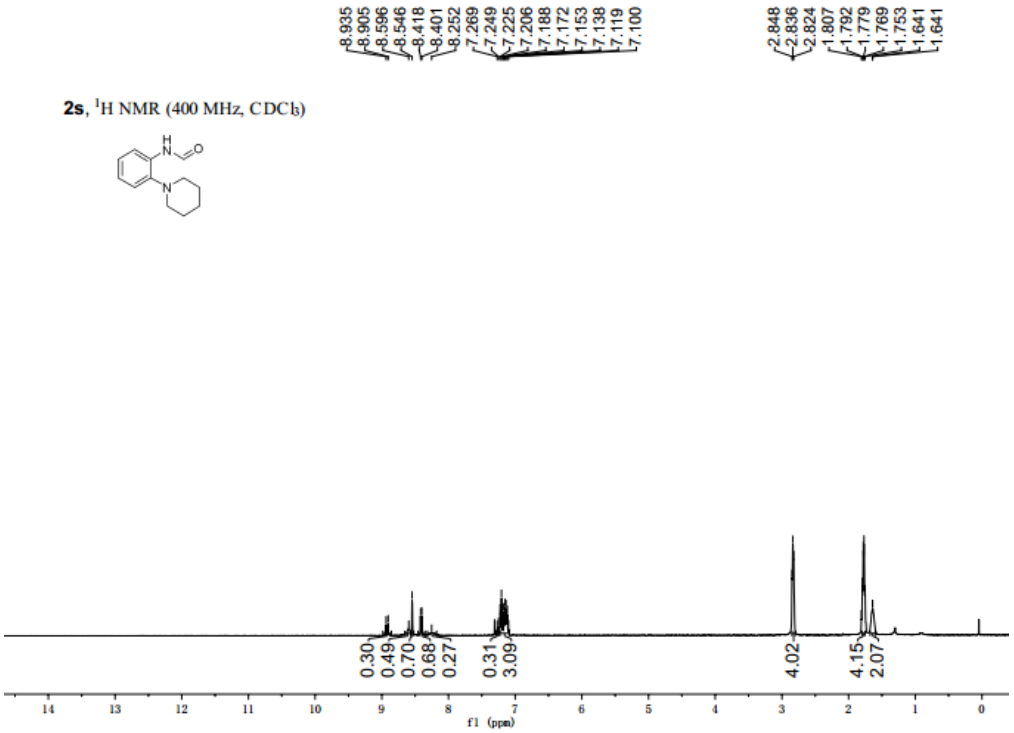
^{1}H NMR for *N*-(3,5-dichlorophenyl)formamide, **2r**



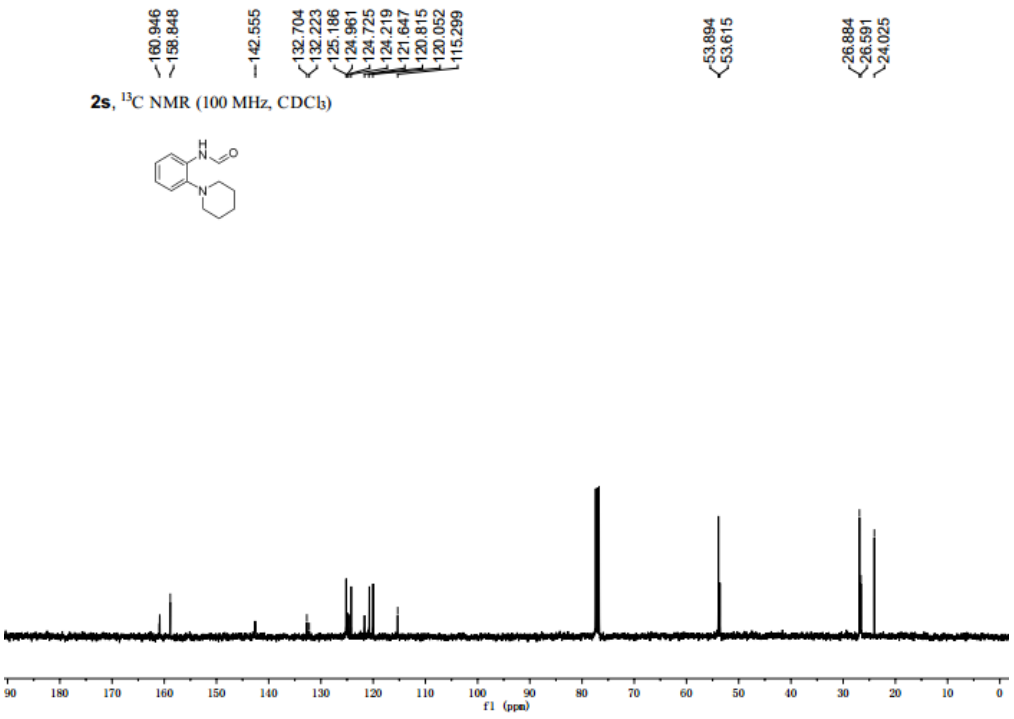
^{13}C NMR for *N*-(3,5-dichlorophenyl)formamide, **2r**



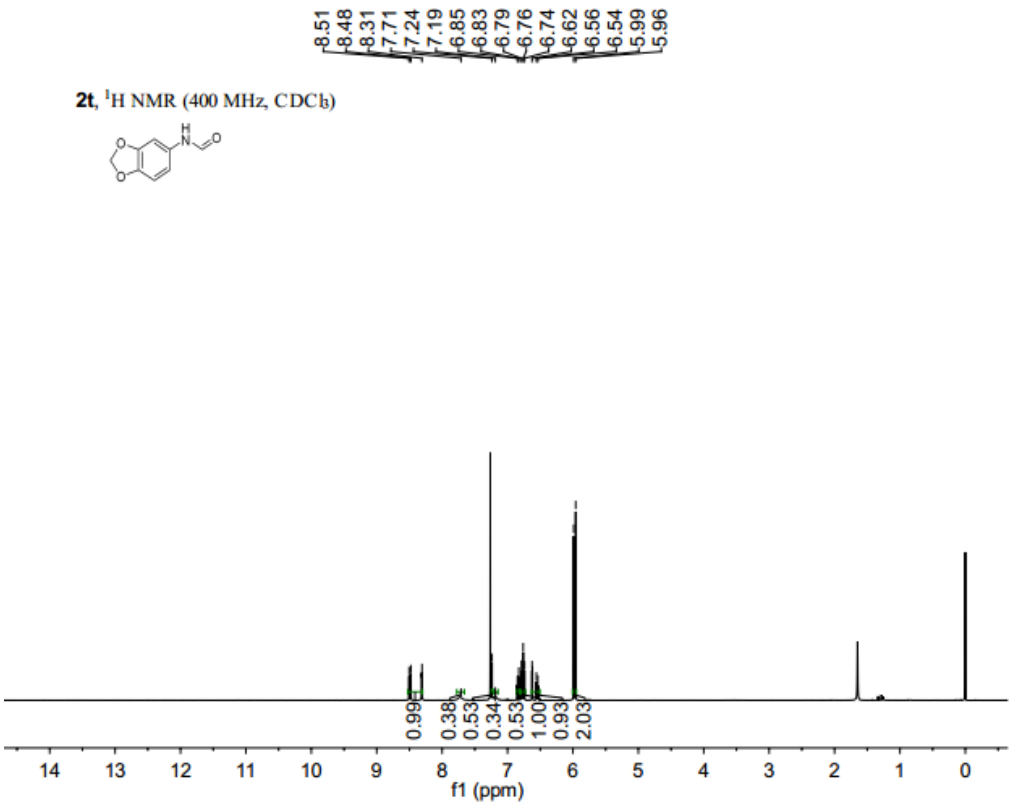
^{1}H NMR for *N*-(2-(piperidin-1-yl)phenyl)formamide, **2s**



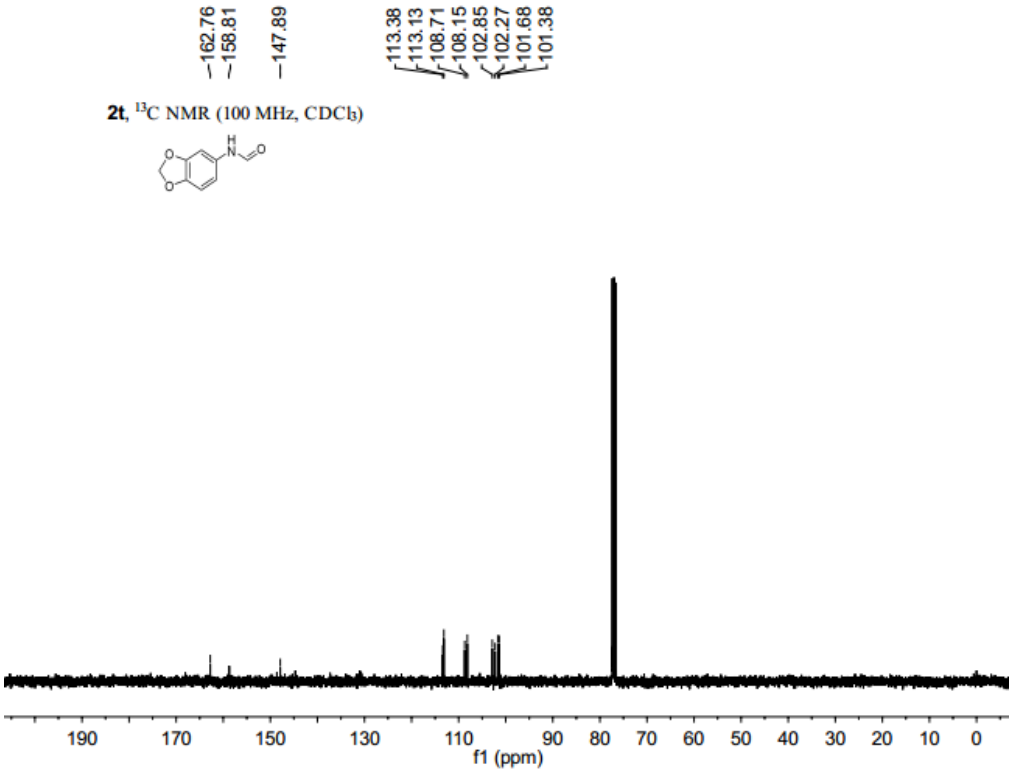
^{13}C NMR for *N*-(2-(piperidin-1-yl)phenyl)formamide, **2s**



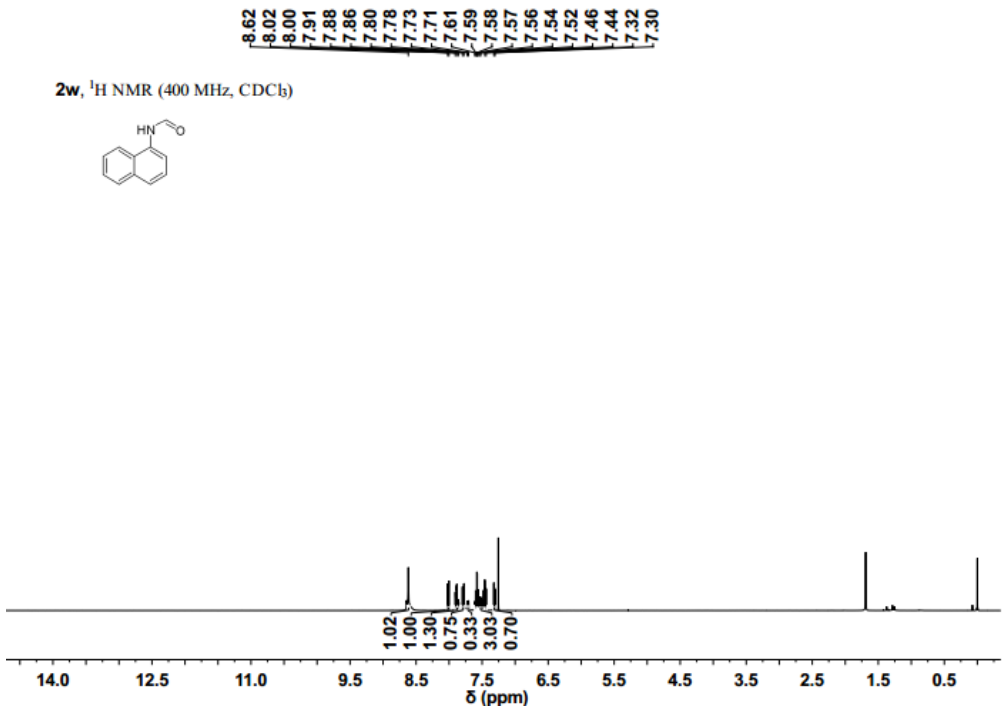
^{1}H NMR for *N*-(benzo[*d*][*1*,*3*]dioxol-5-yl)formamide, **2t**



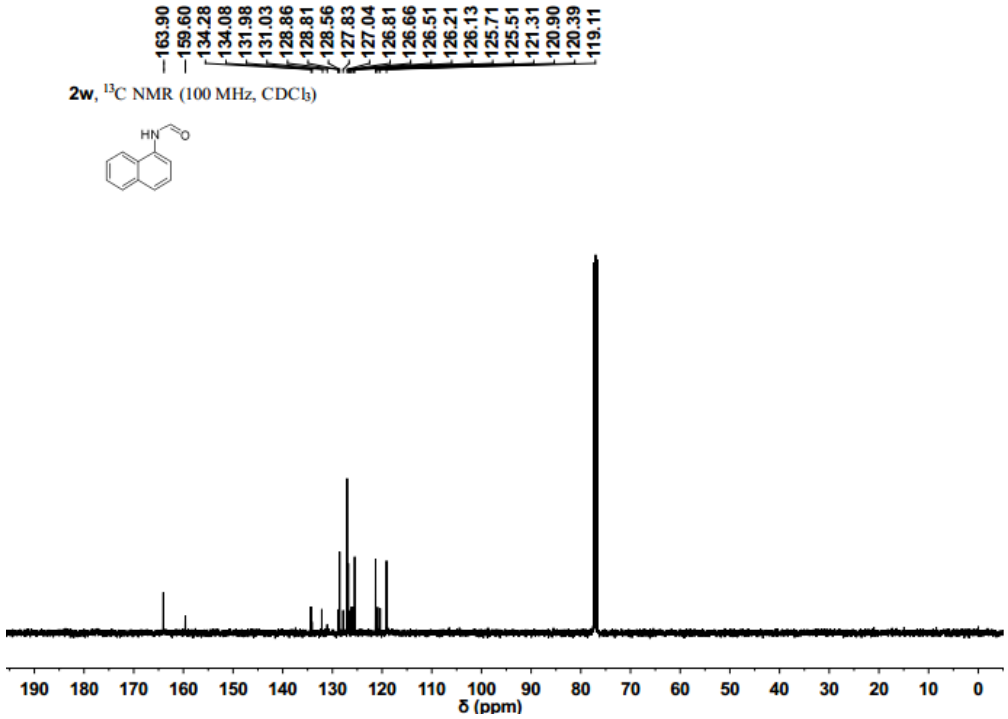
^{13}C NMR for *N*-(benzo[*d*][*1*,*3*]dioxol-5-yl)formamide, **2t**



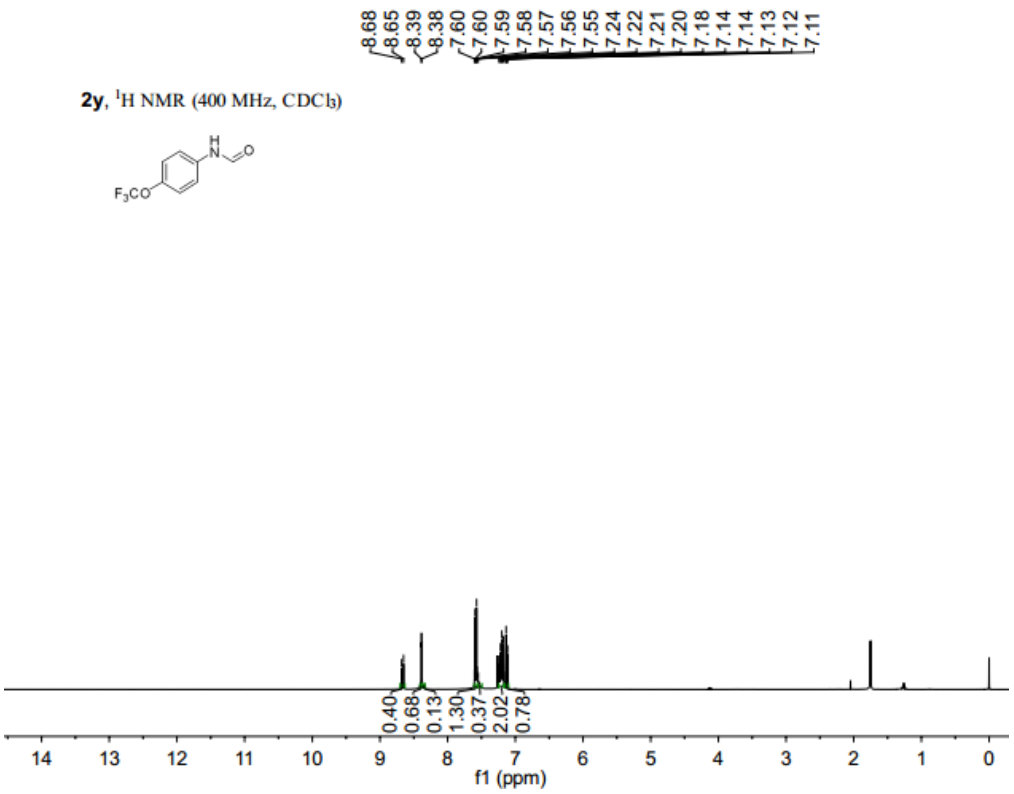
^{1}H NMR for *N*-(naphthalen-1-yl)formamide, **2w**



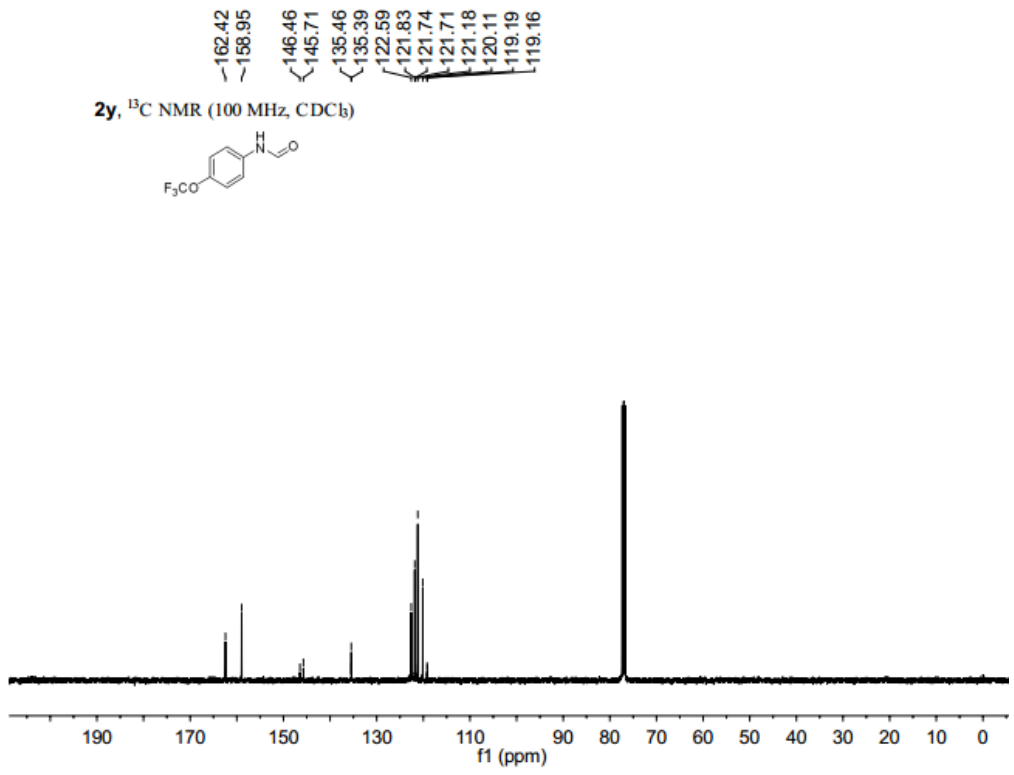
^{13}C NMR for *N*-(naphthalen-1-yl)formamide, **2w**



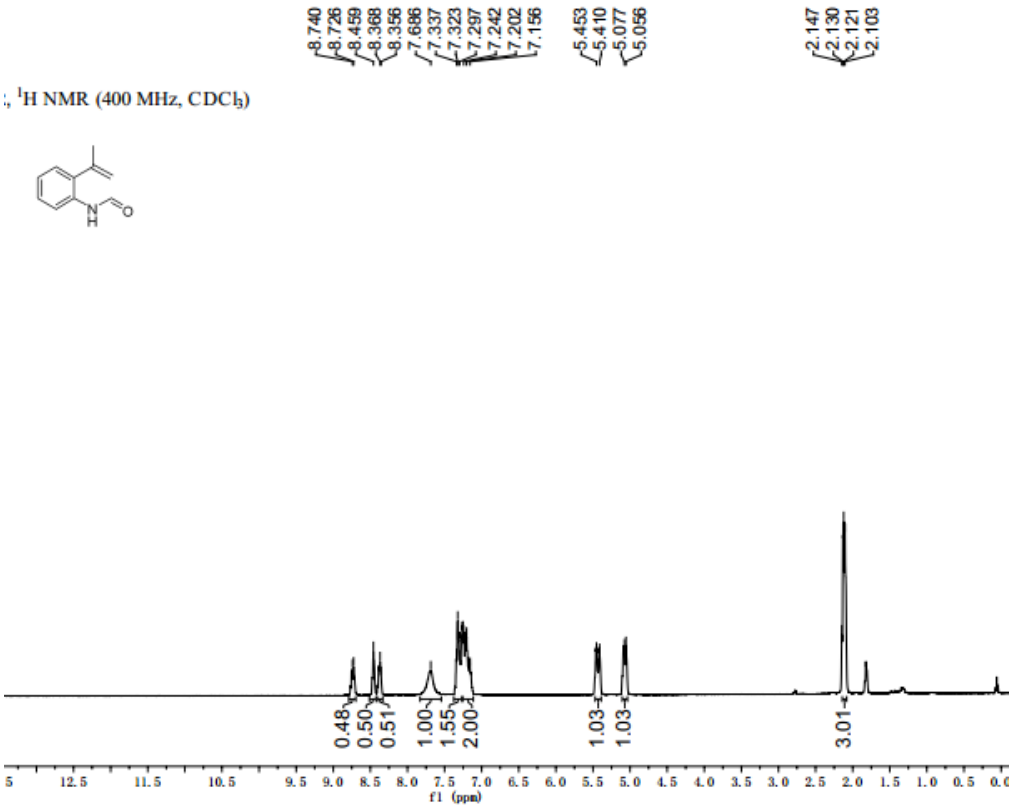
^{1}H NMR for *N*-(4-(trifluoromethoxy)phenyl)formamide, **2y**



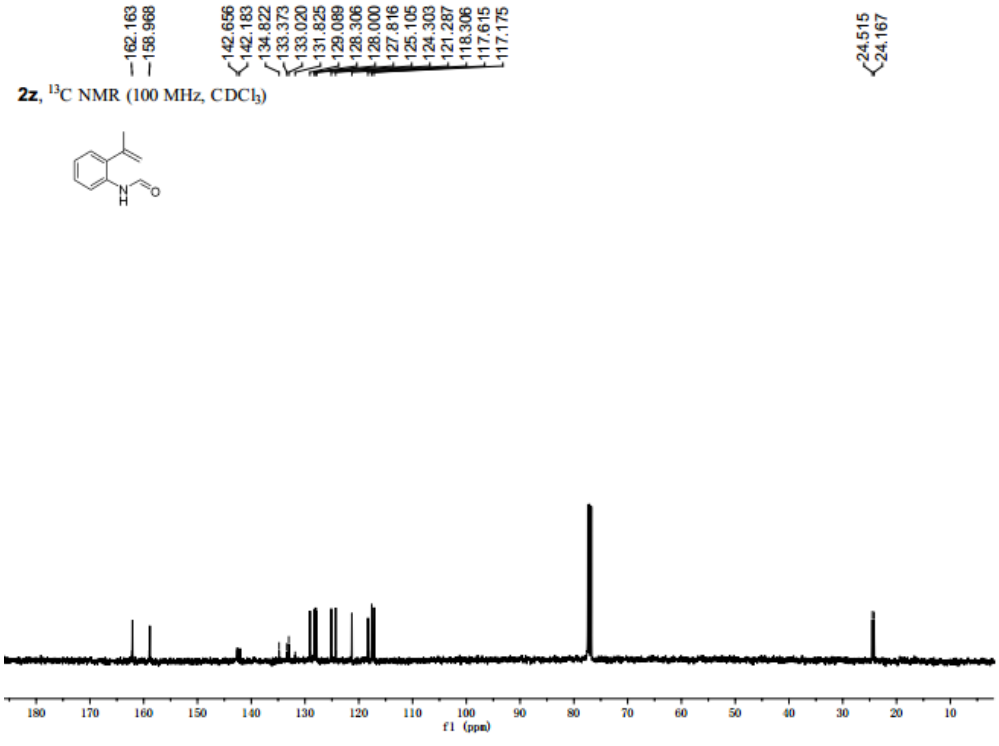
^{13}C NMR for *N*-(4-(trifluoromethoxy)phenyl)formamide, **2y**



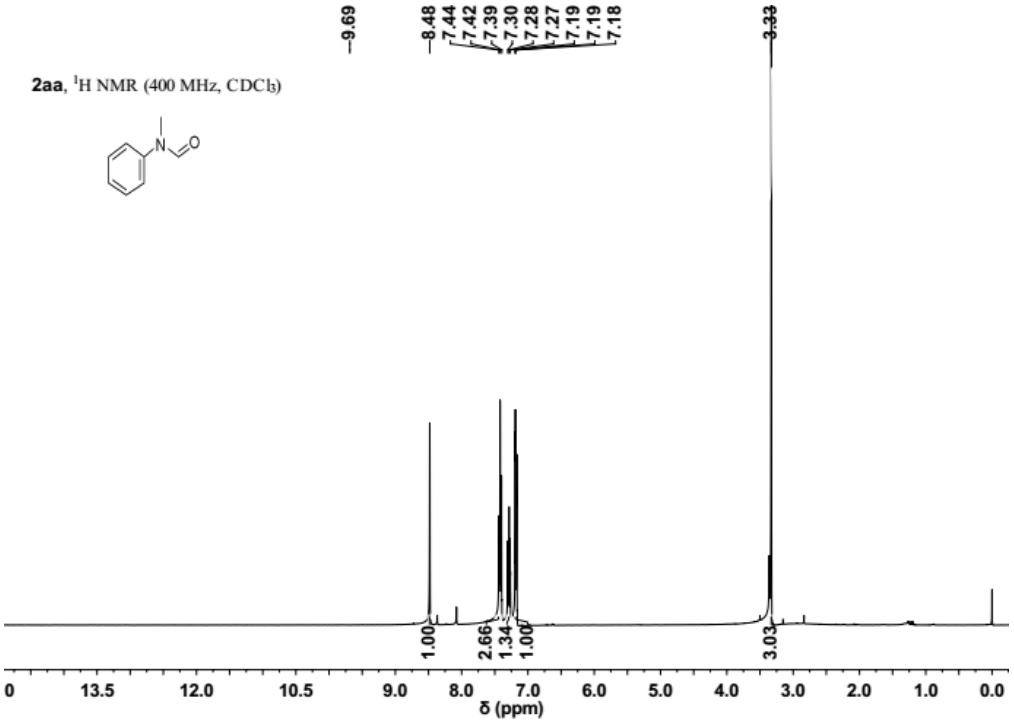
^{1}H NMR for *N*-(2-(prop-1-en-2-yl)phenyl)formamide, **2z**



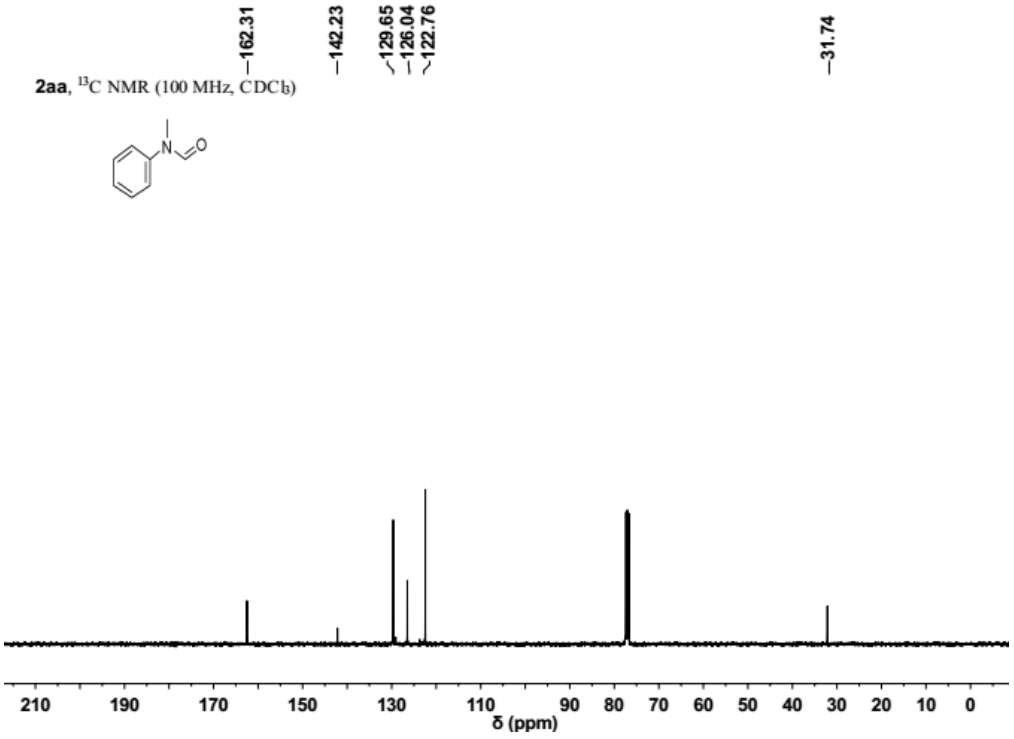
^{13}C NMR for *N*-(2-(prop-1-en-2-yl)phenyl)formamide, **2z**



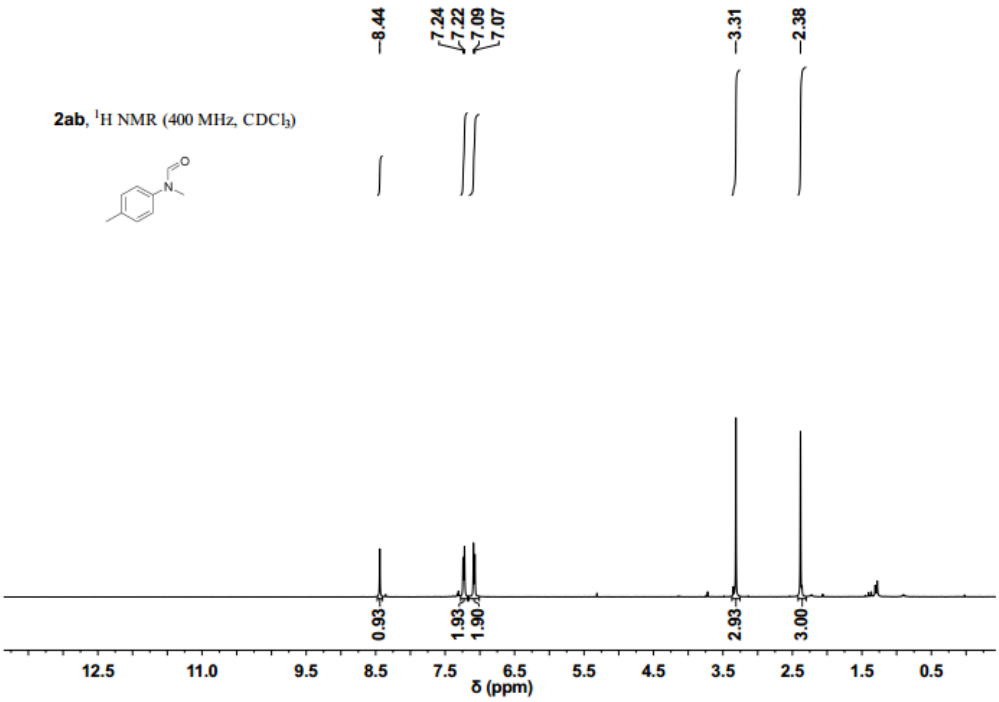
^{1}H NMR for *N*-methyl-*N*-phenylformamide, **2aa**



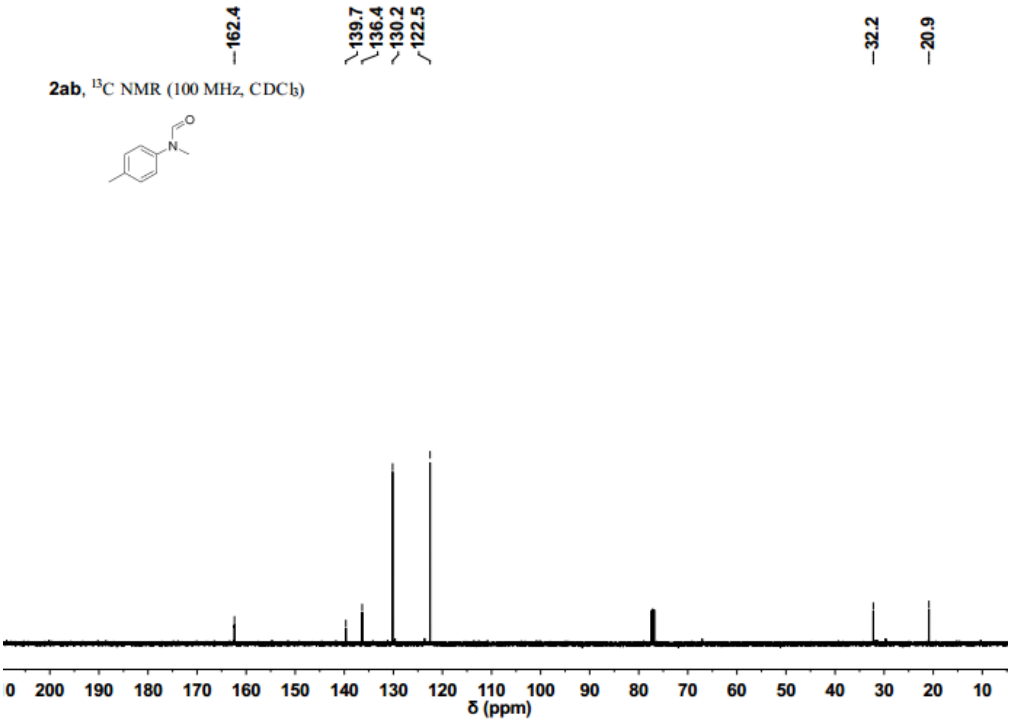
^{13}C NMR for *N*-methyl-*N*-phenylformamide, **2aa**



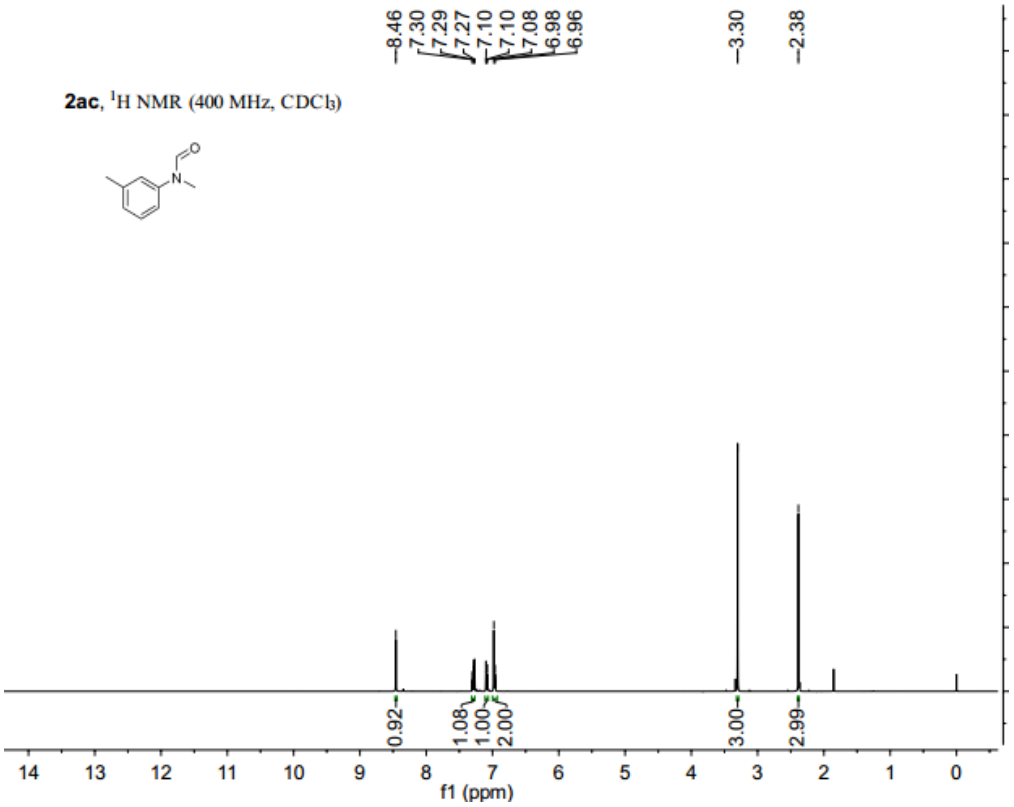
^{1}H NMR for *N*-methyl-*N*-(p-tolyl)formamide, **2ab**



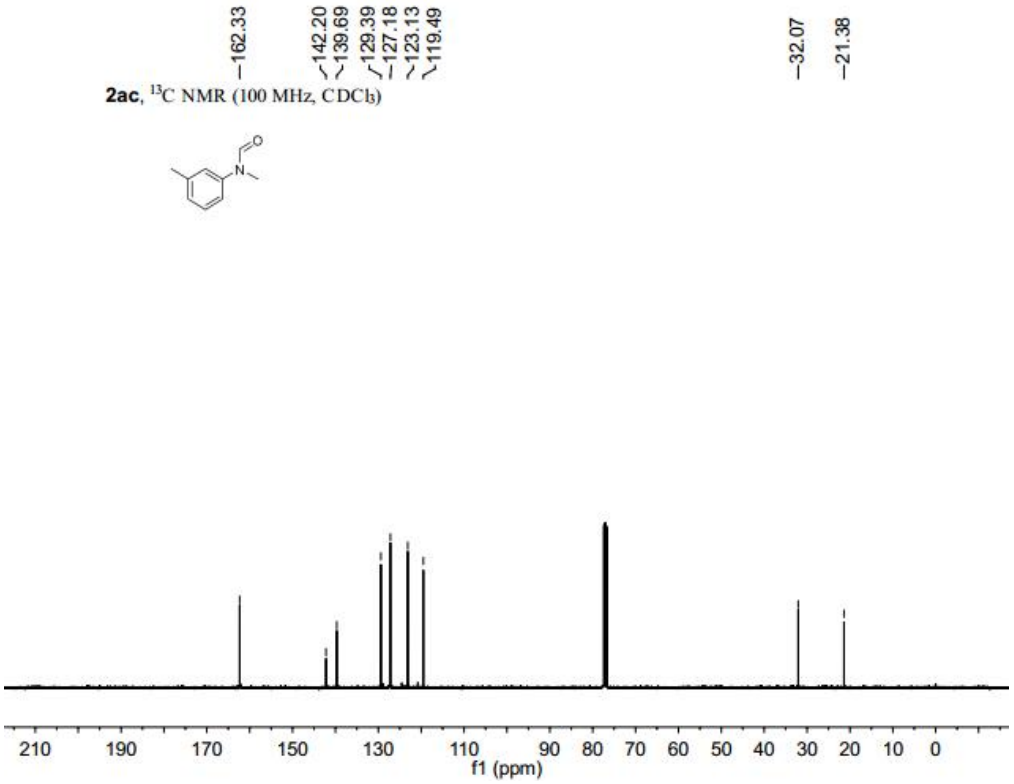
^{13}C NMR for *N*-methyl-*N*-(p-tolyl)formamide, **2ab**



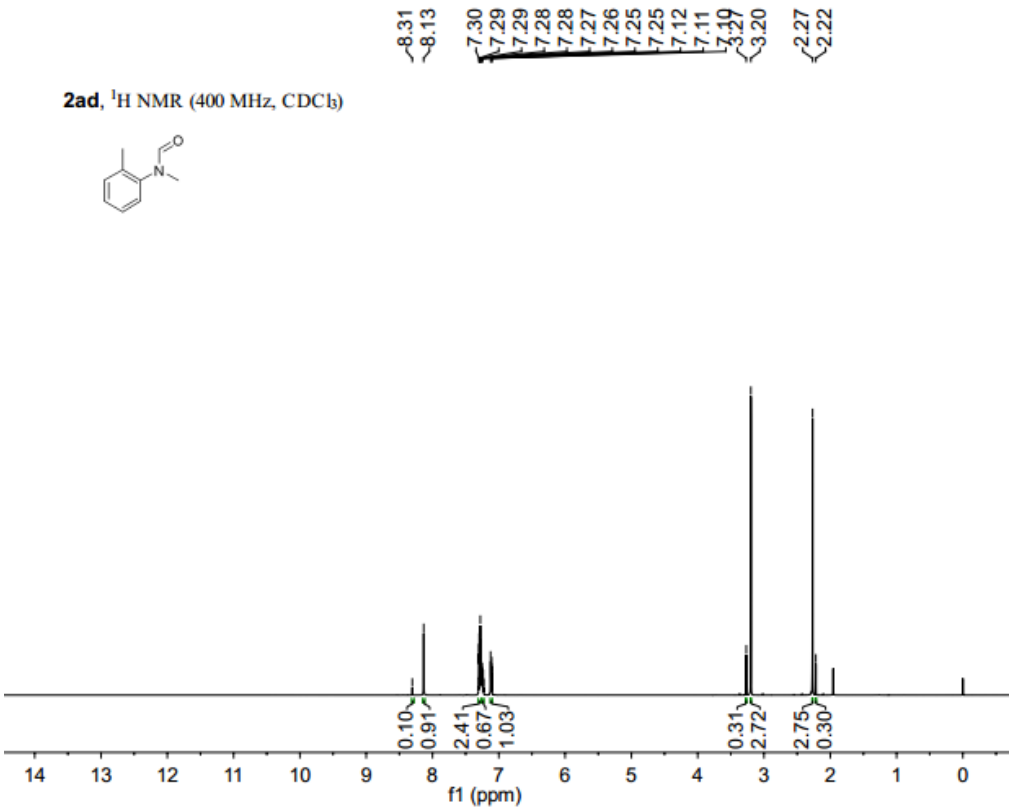
^{1}H NMR for *N*-methyl-*N*-(m-tolyl)formamide, **2ac**



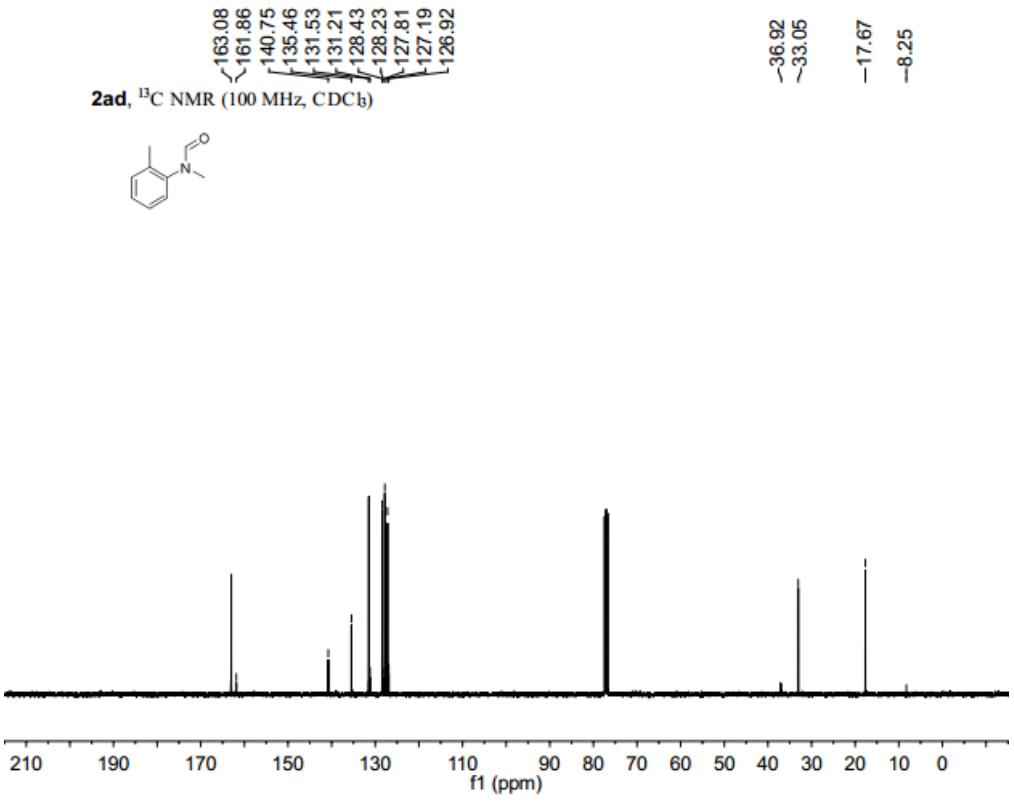
^{13}C NMR for *N*-methyl-*N*-(m-tolyl)formamide, **2ac**



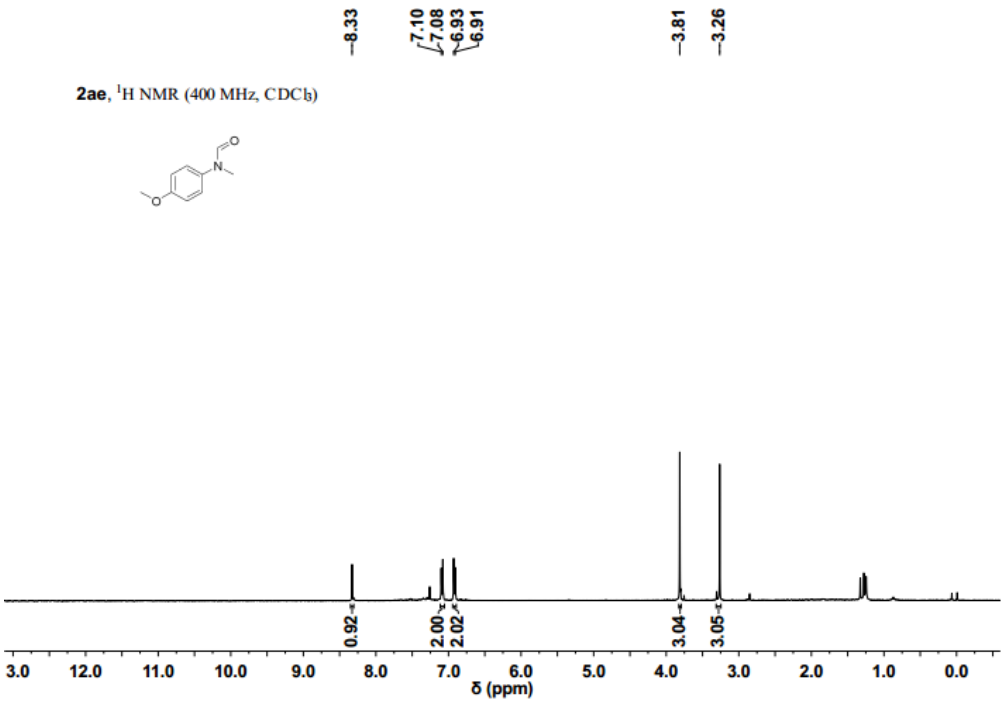
^{1}H NMR for *N*-methyl-N-(o-tolyl)formamide, **2ad**



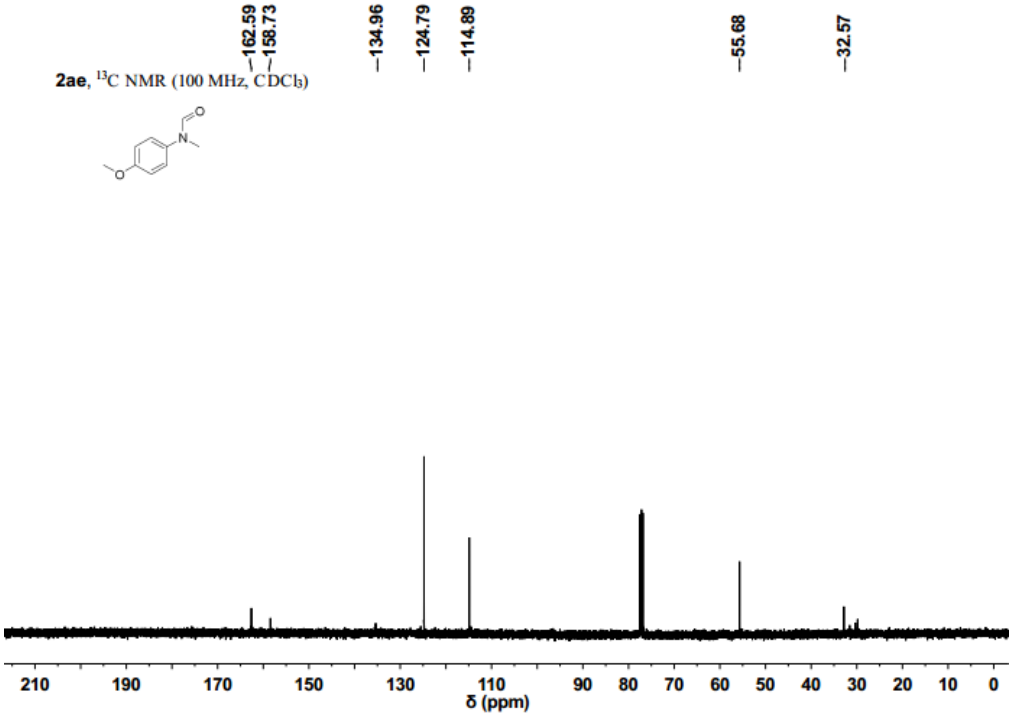
^{13}C NMR for *N*-methyl-N-(o-tolyl)formamide, **2ad**



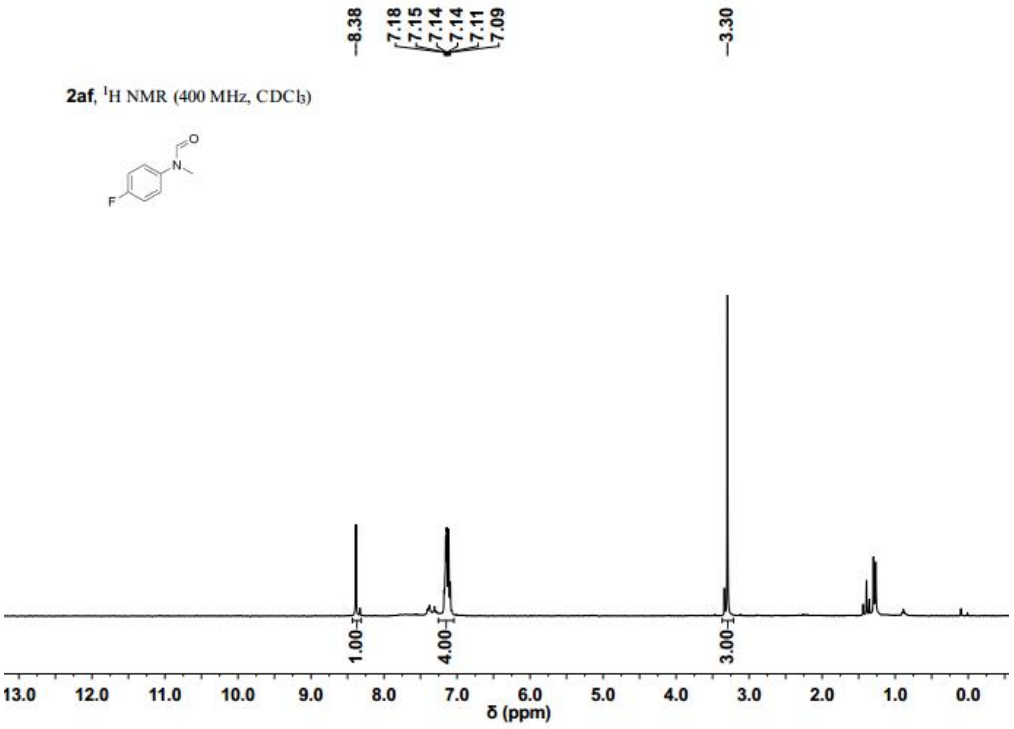
^{1}H NMR for *N*-(4-methoxyphenyl)-*N*-methylformamide, **2ae**



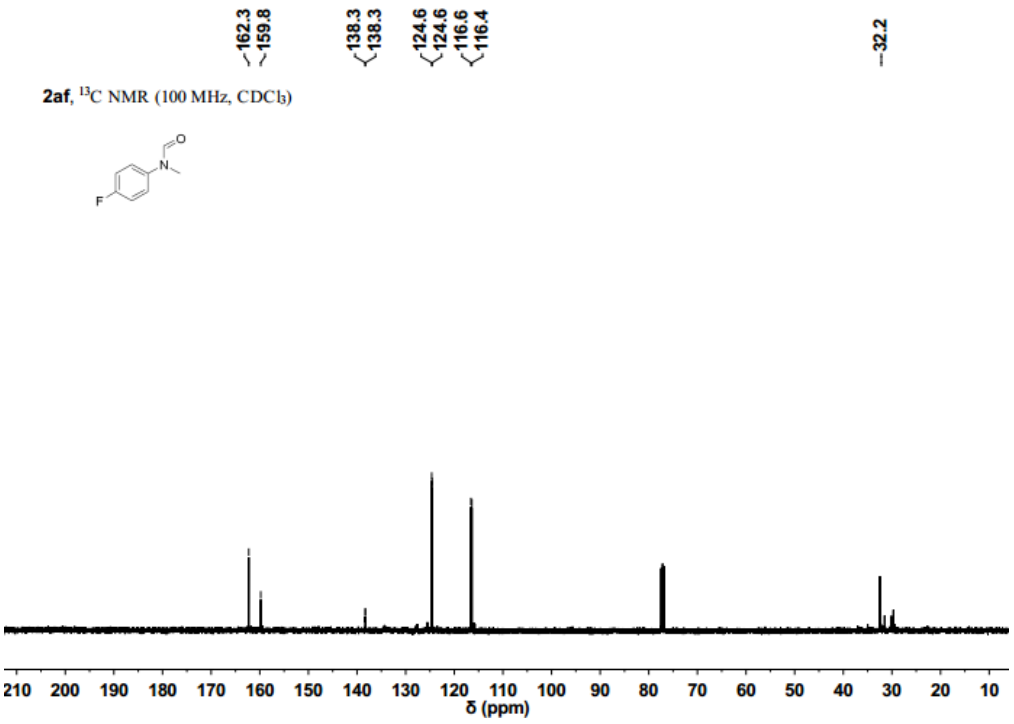
^{13}C NMR for *N*-(4-methoxyphenyl)-*N*-methylformamide, **2ae**



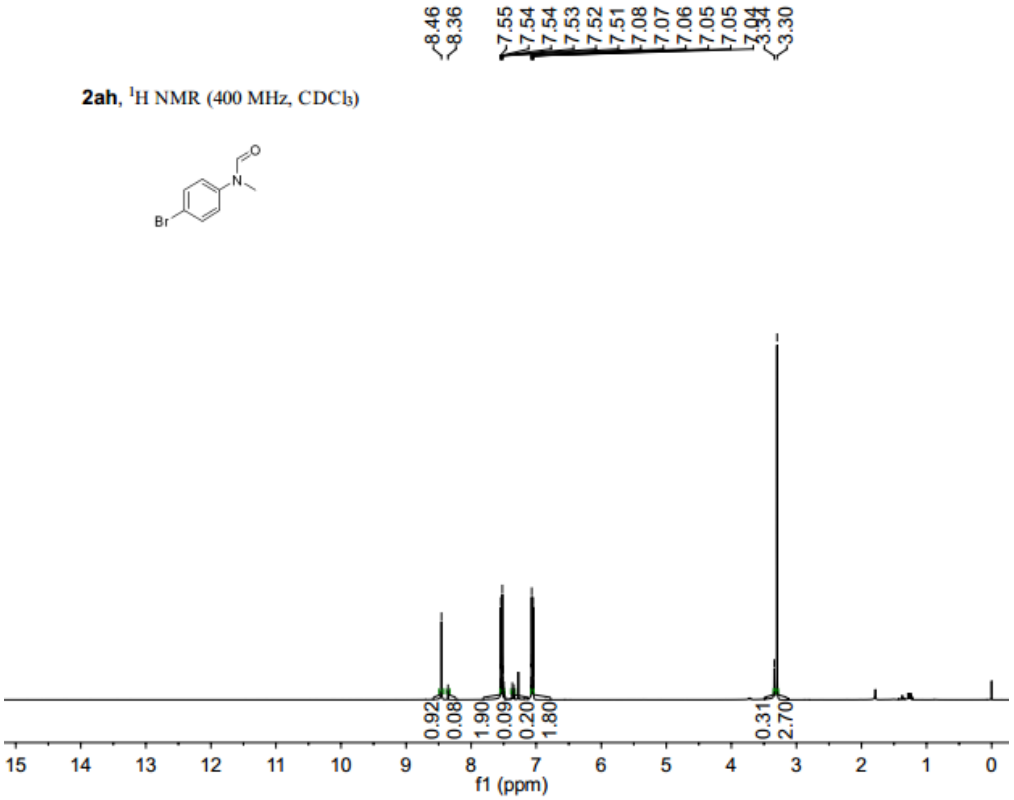
^{1}H NMR for *N*-(4-fluorophenyl)-*N*-methylformamide, **2af**



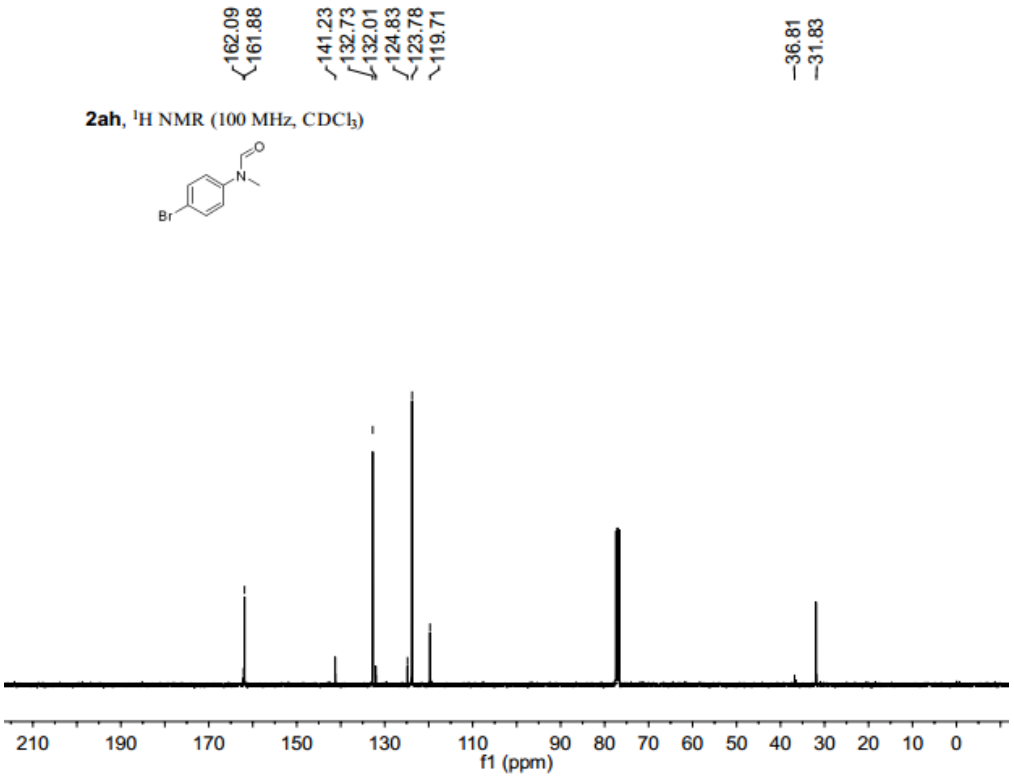
^{13}C NMR for *N*-(4-fluorophenyl)-*N*-methylformamide, **2af**



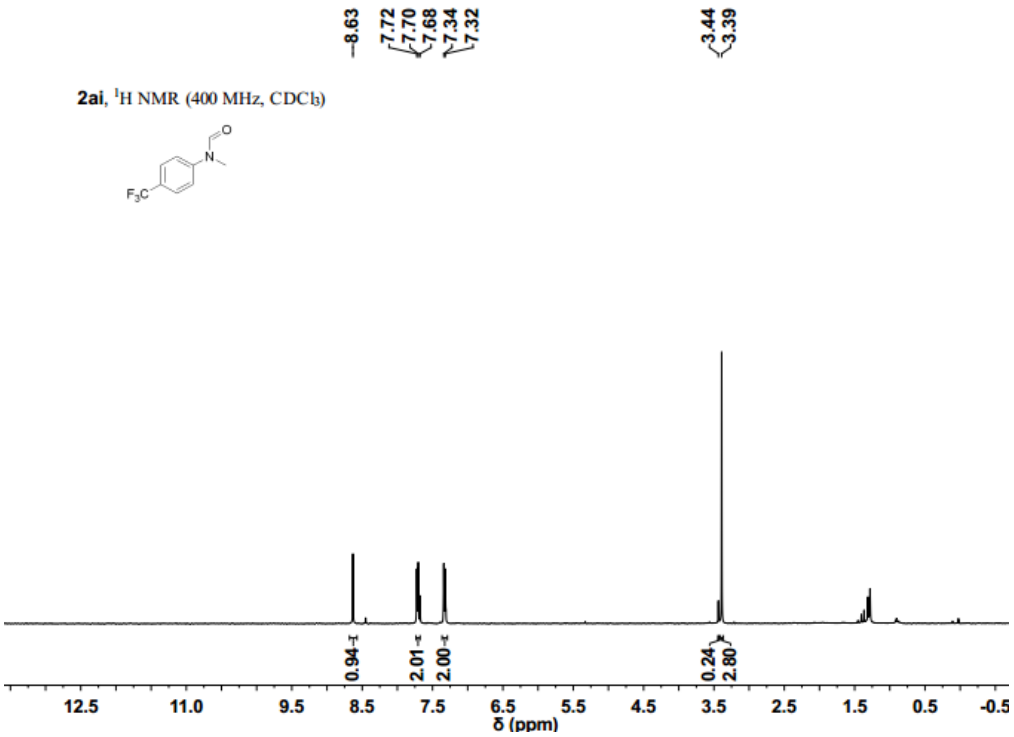
^{1}H NMR for *N*-(4-bromophenyl)-*N*-methylformamide, **2ah**



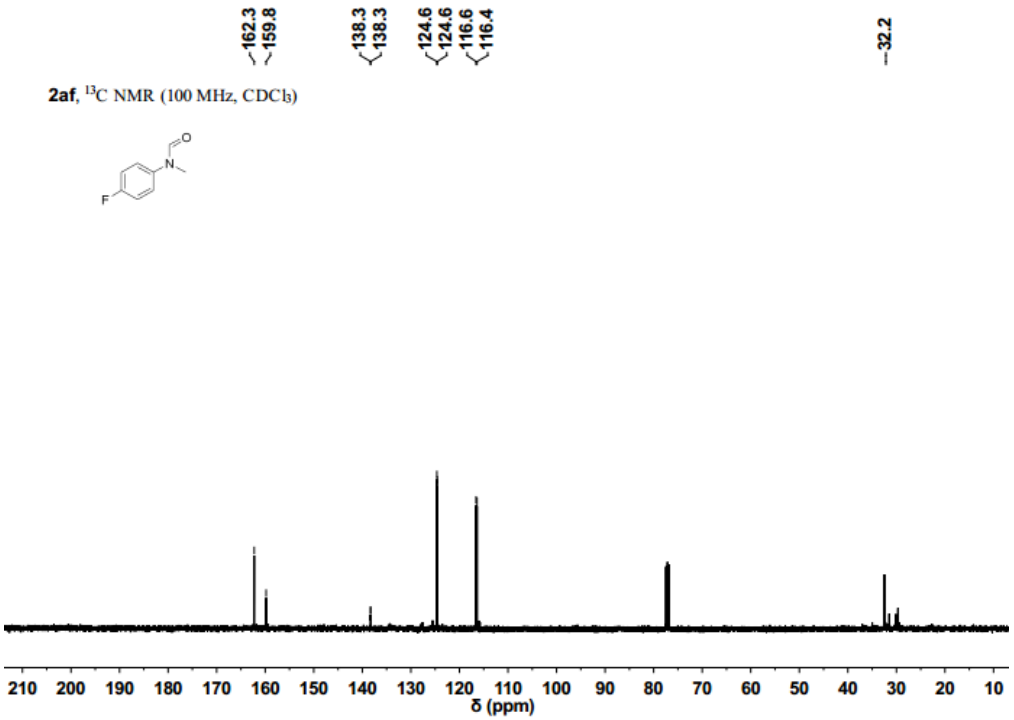
^{13}C NMR for *N*-(4-bromophenyl)-*N*-methylformamide, **2ah**



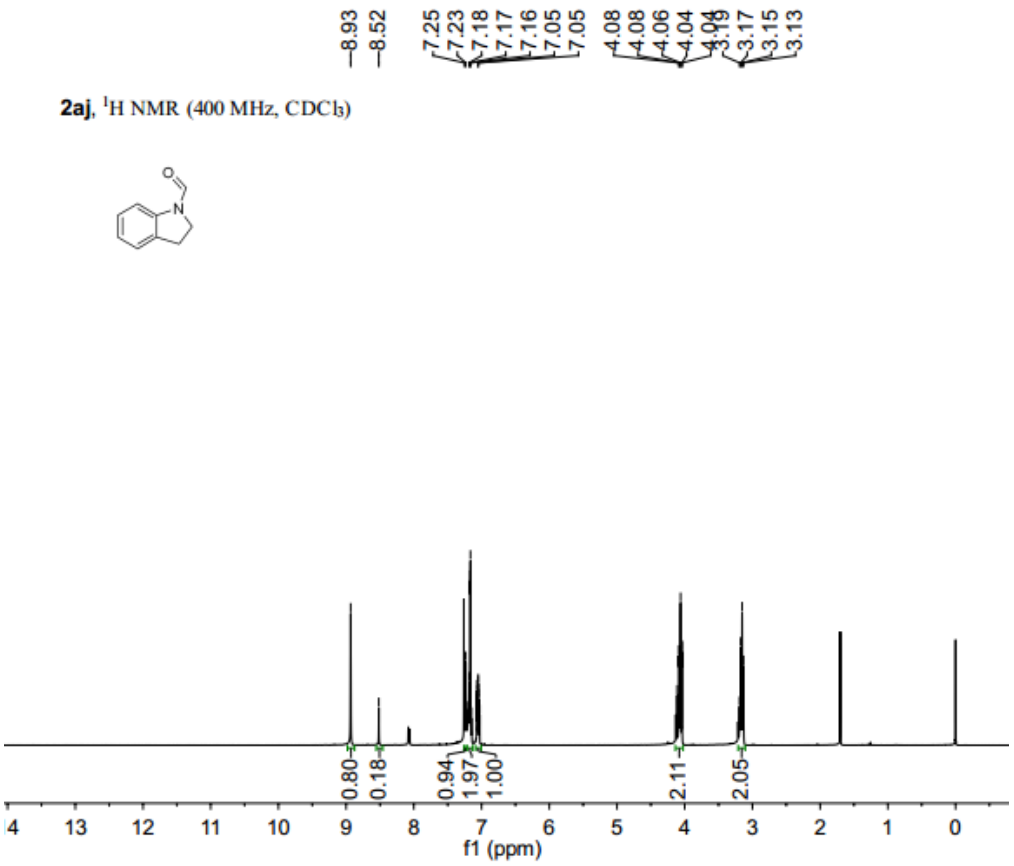
^{1}H NMR for *N*-methyl-*N*-(4-(trifluoromethyl)phenyl)formamide, **2ai**



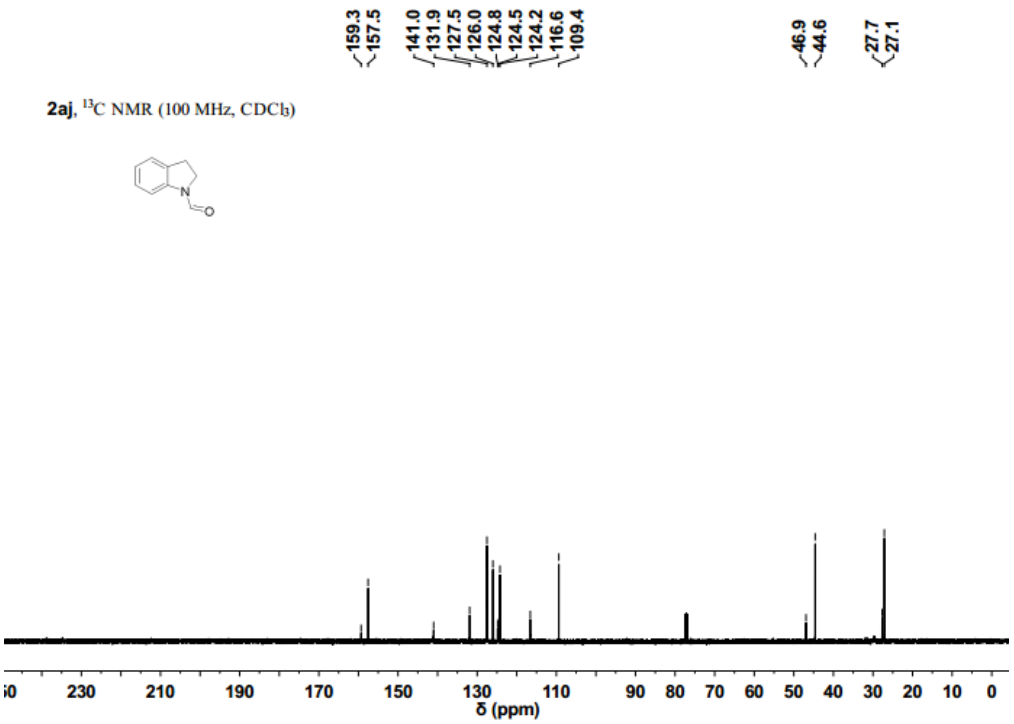
^{13}C NMR for *N*-methyl-*N*-(4-(trifluoromethyl)phenyl)formamide, **2ai**



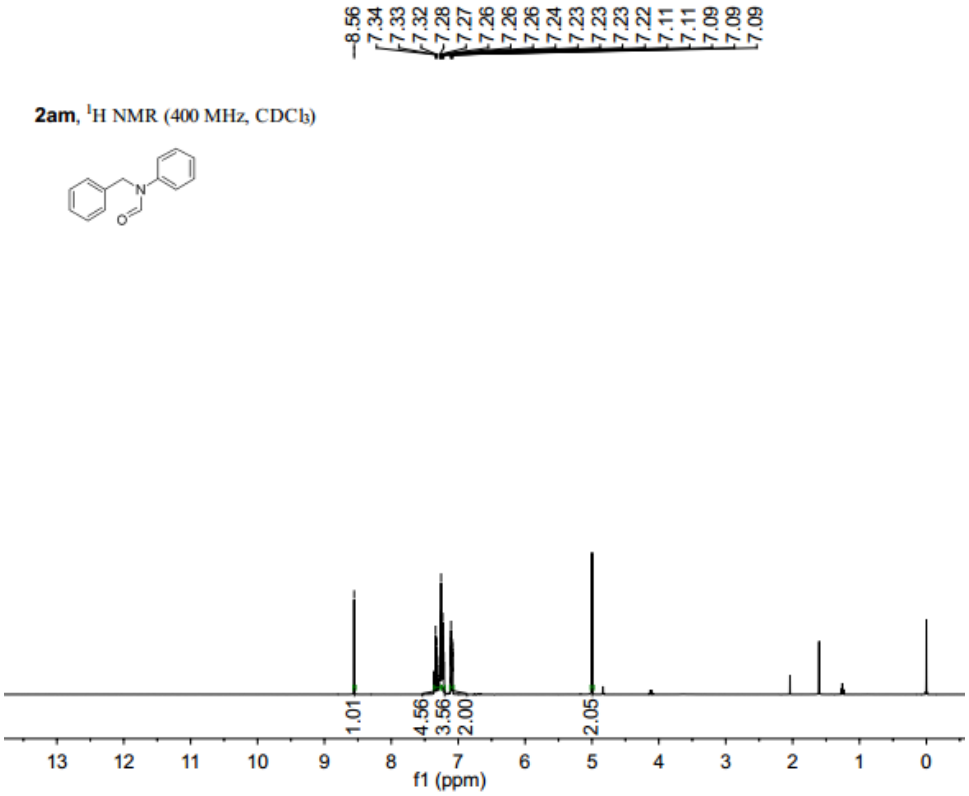
^{1}H NMR for indoline-1-carbaldehyde, **2aj**



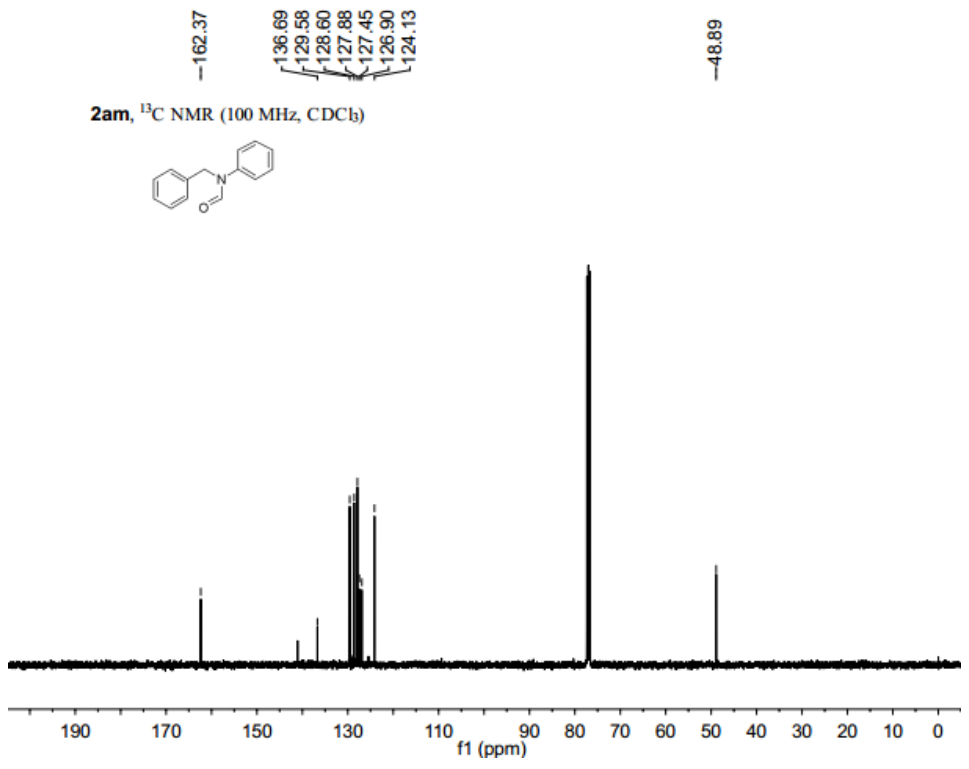
^{13}C NMR for indoline-1-carbaldehyde, **2aj**



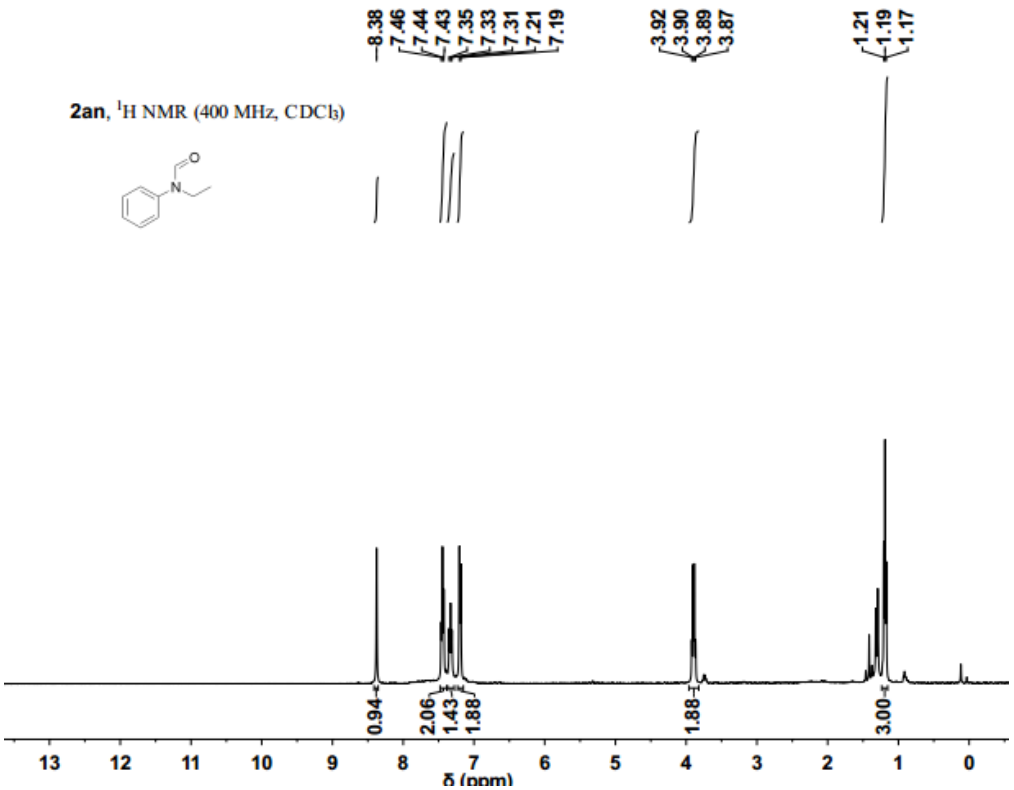
^{1}H NMR for *N*-benzyl-*N*-phenylformamide, **2am**



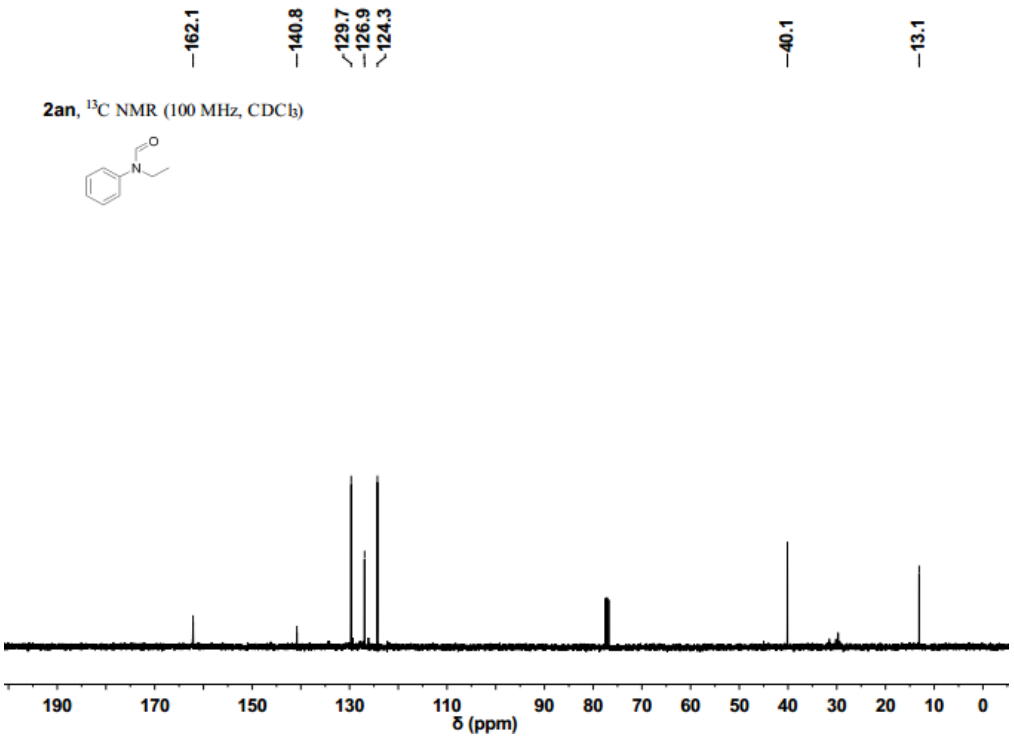
^{13}C NMR for *N*-benzyl-*N*-phenylformamide, **2am**



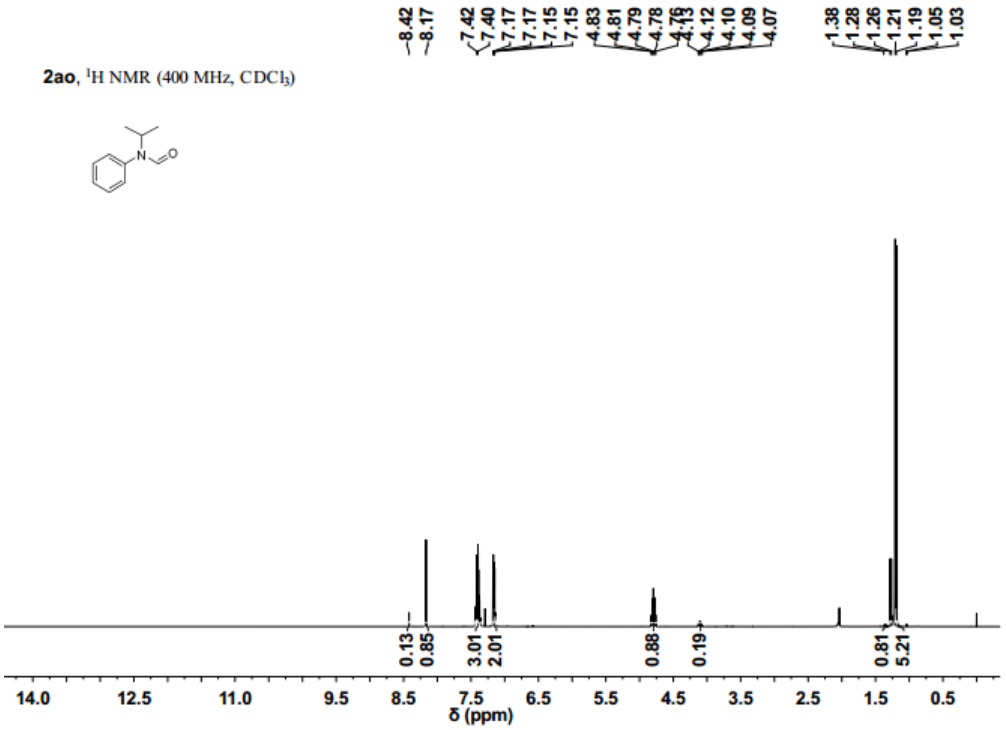
^{1}H NMR for *N*-ethyl-*N*-phenylformamide, **2an**



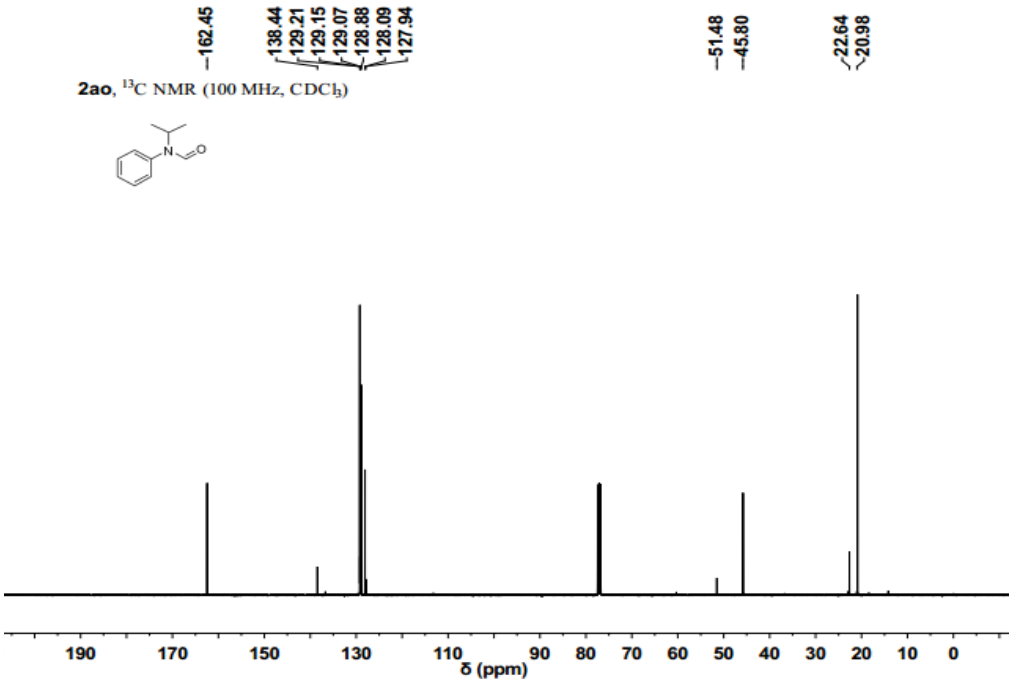
^{13}C NMR for *N*-ethyl-*N*-phenylformamide, **2an**



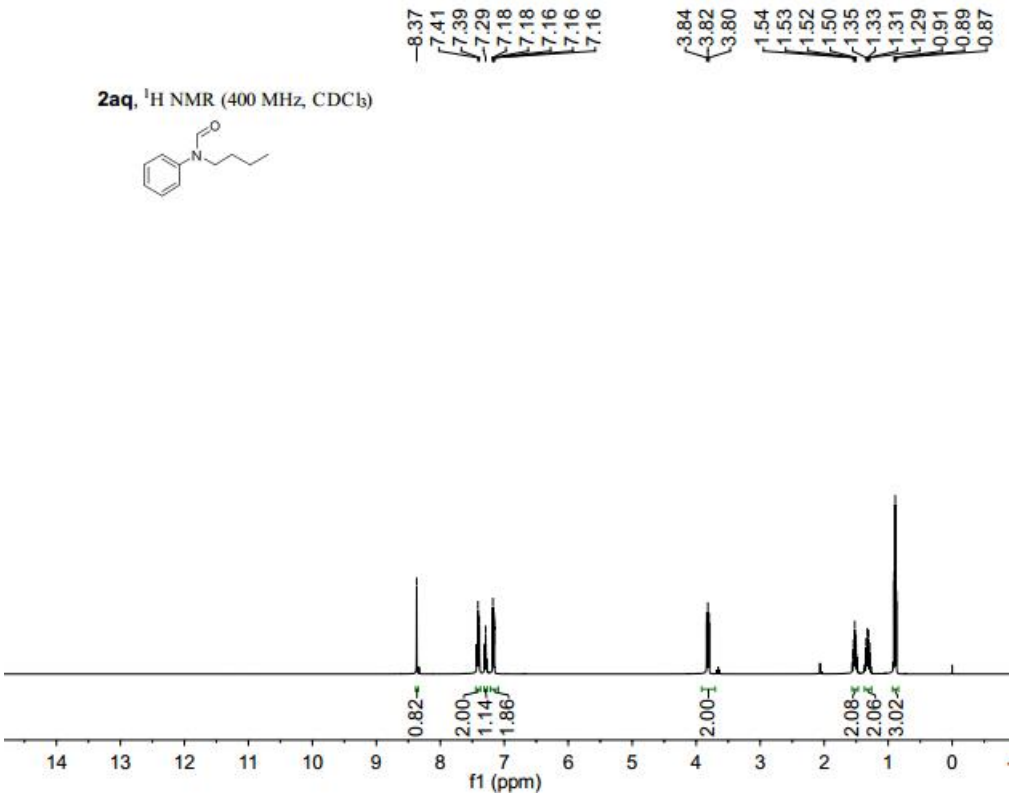
^{1}H NMR for *N*-isopropyl-*N*-phenylformamide, **2ao**



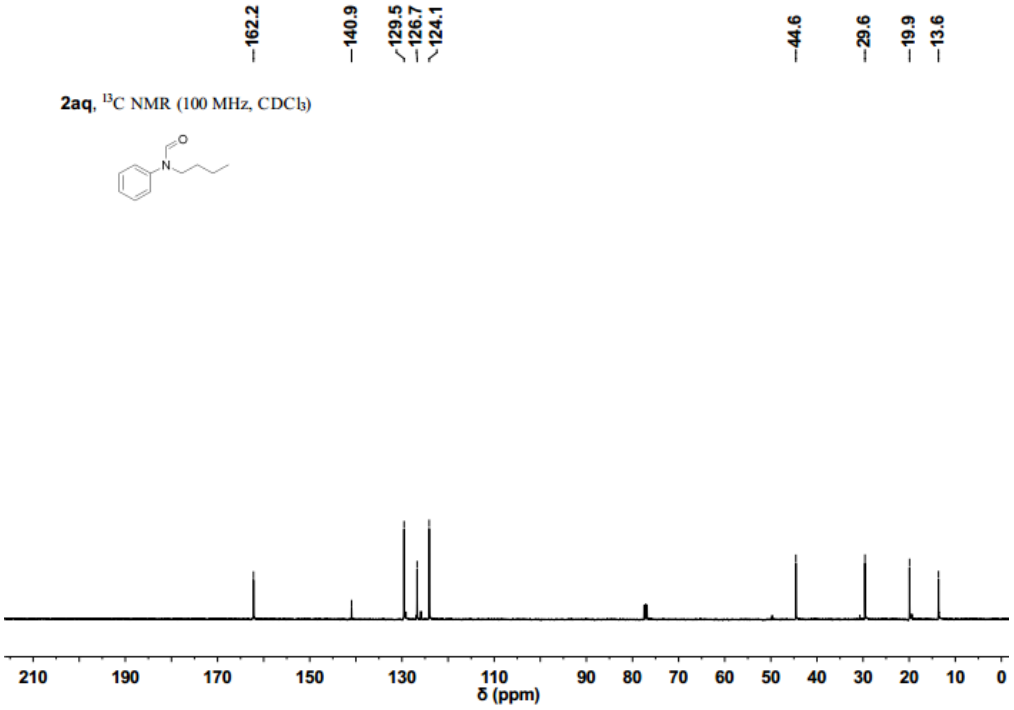
^{13}C NMR for *N*-isopropyl-*N*-phenylformamide, **2ao**



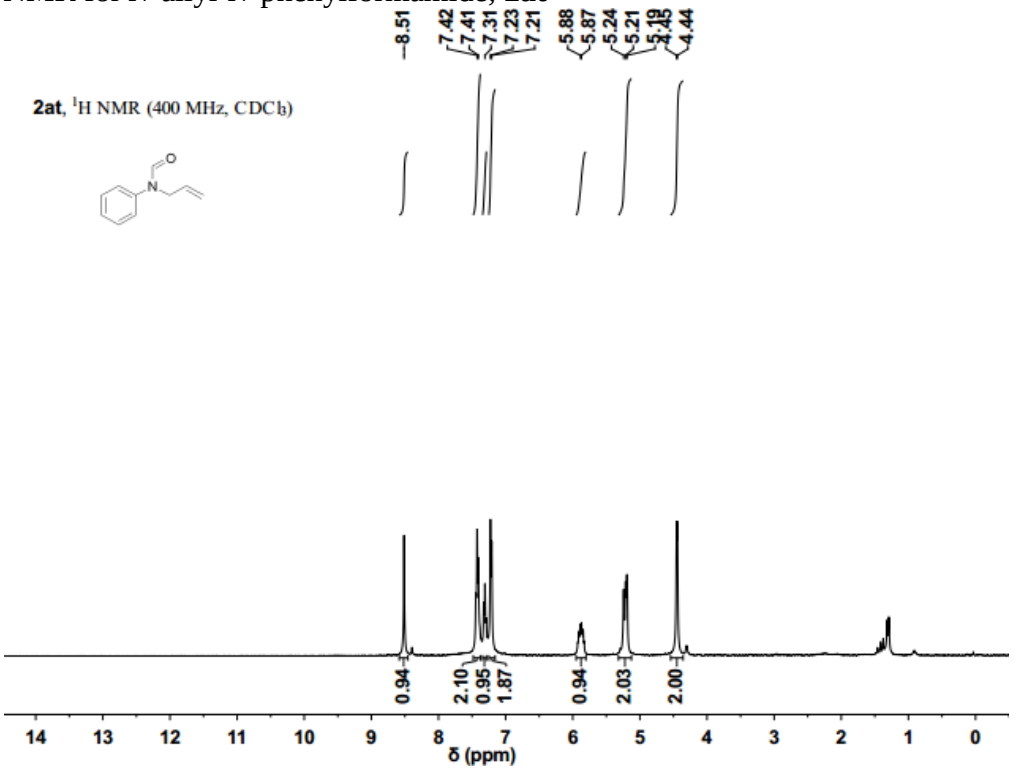
^{1}H NMR for *N*-butyl-*N*-phenylformamide, **2aq**



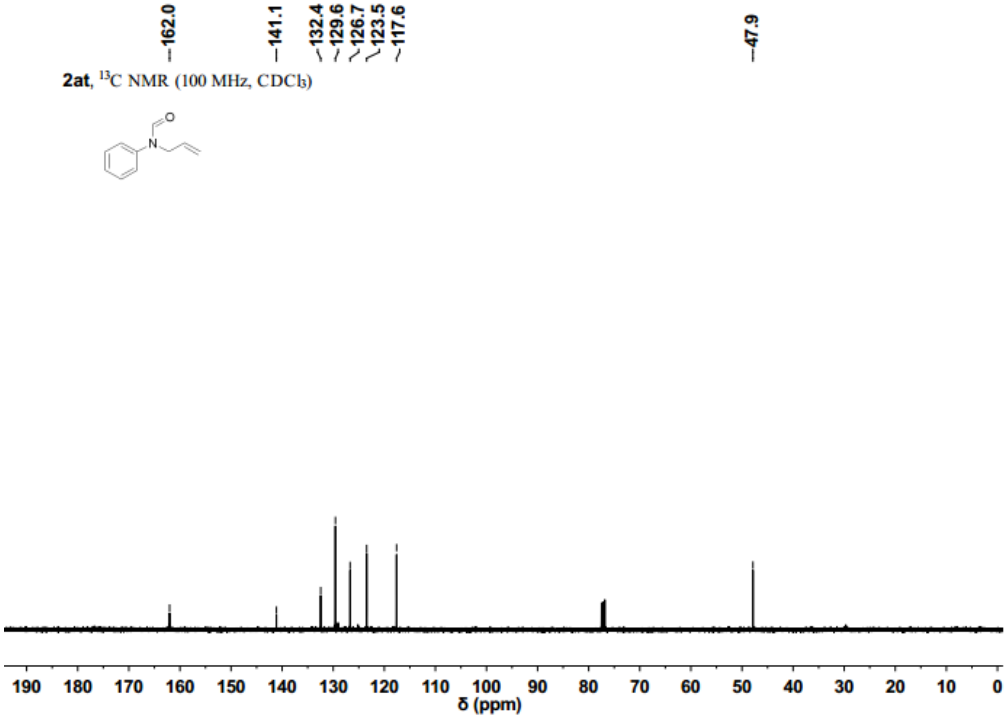
^{13}C NMR for *N*-butyl-*N*-phenylformamide, **2aq**



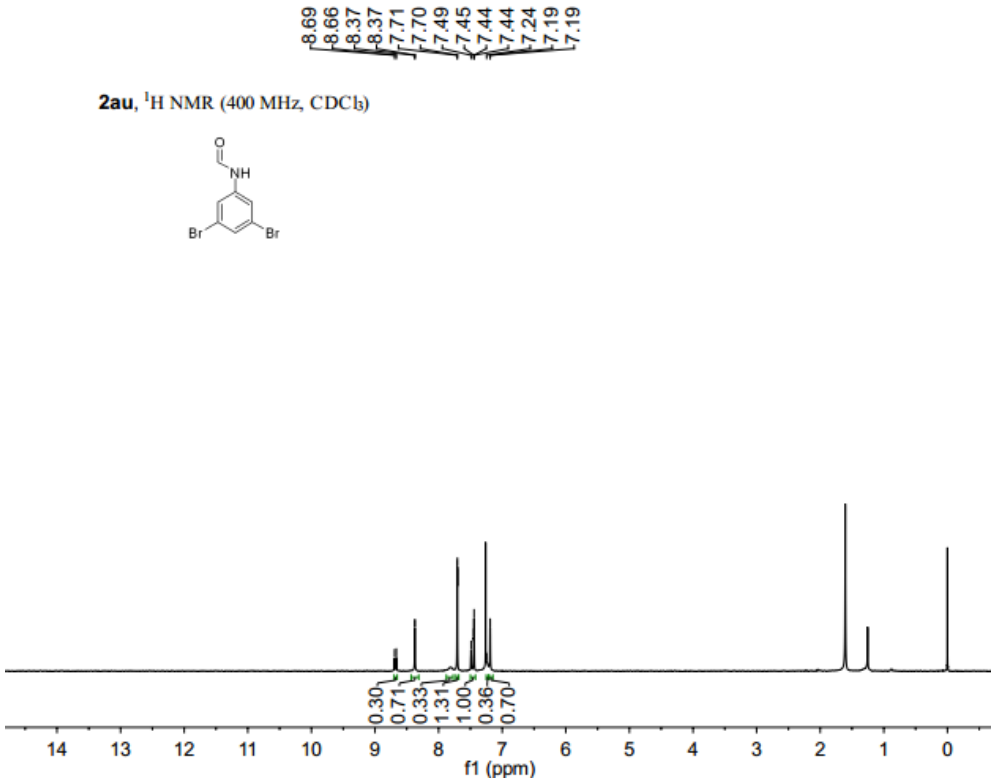
^{1}H NMR for *N*-allyl-*N*-phenylformamide, **2at**



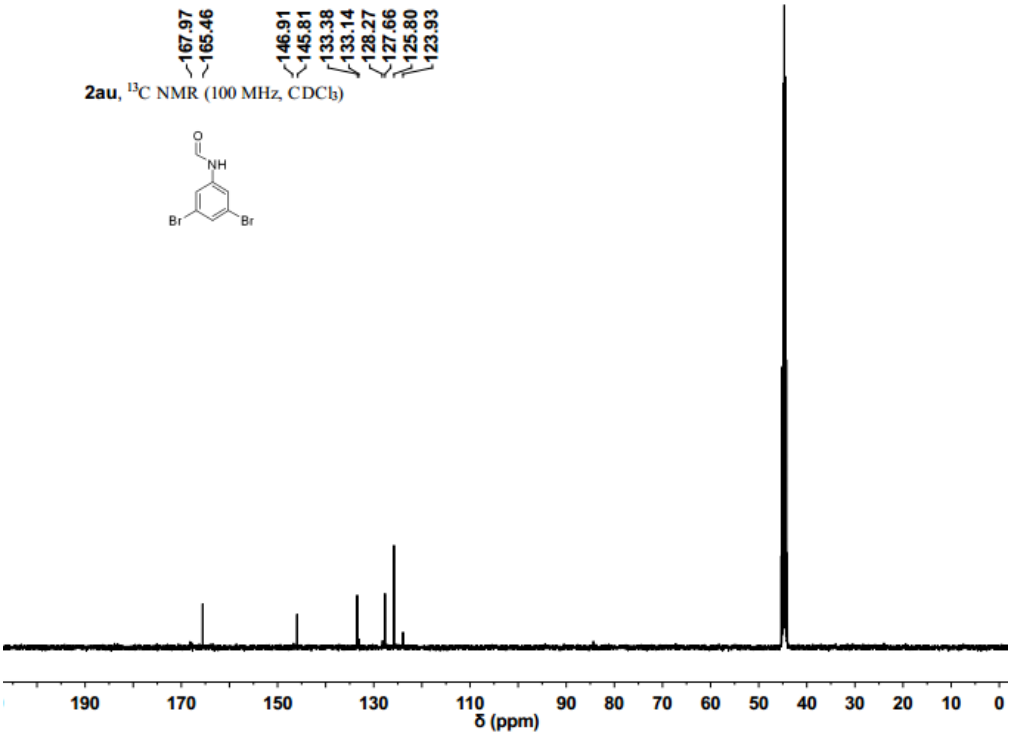
^{13}C NMR for *N*-allyl-*N*-phenylformamide, **2at**



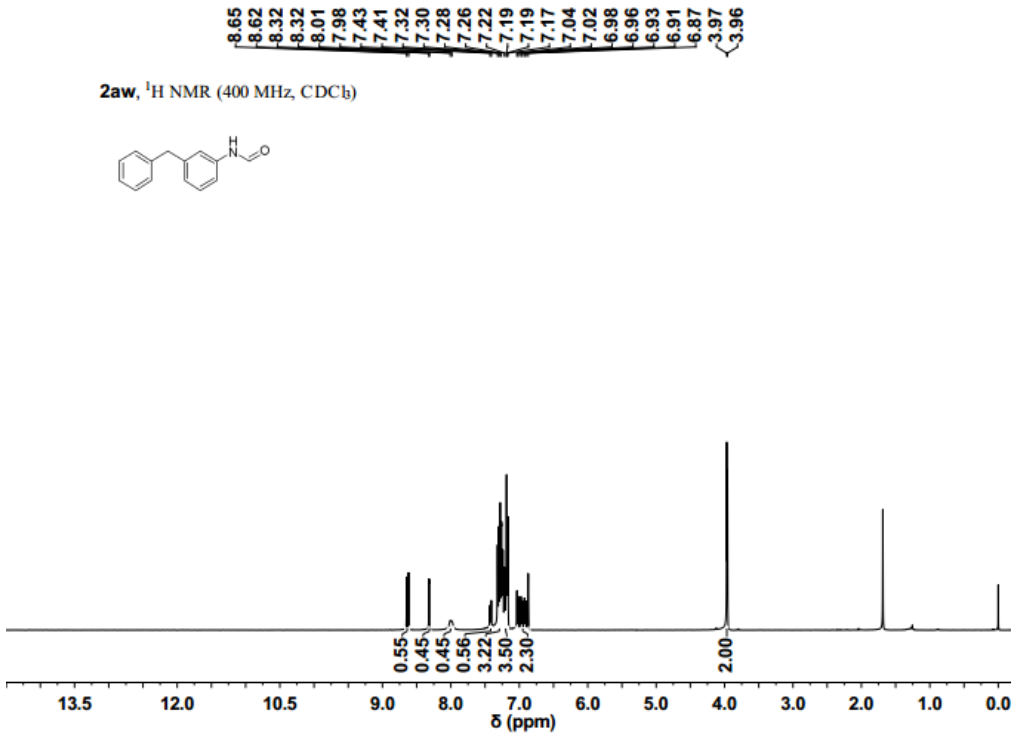
^{1}H NMR for ***N***-(3,5-dibromophenyl)formamide, **2au**



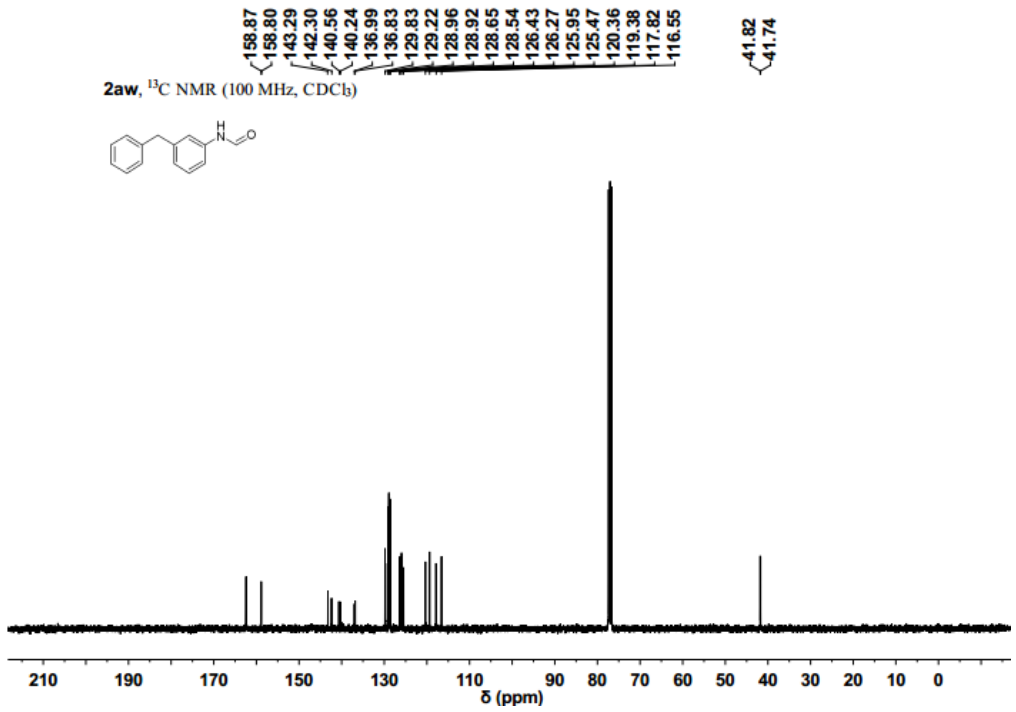
^{13}C NMR for ***N***-(3,5-dibromophenyl)formamide, **2au**



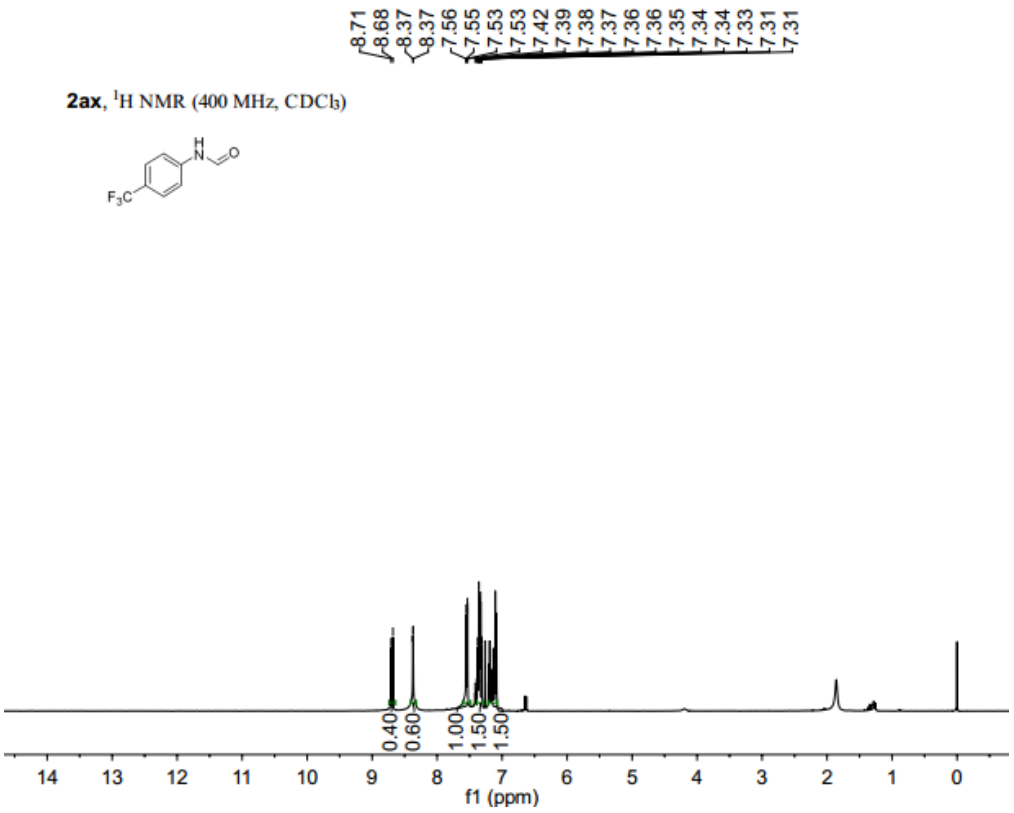
^{1}H NMR for *N*-(3-benzylphenyl)formamide, **2aw**



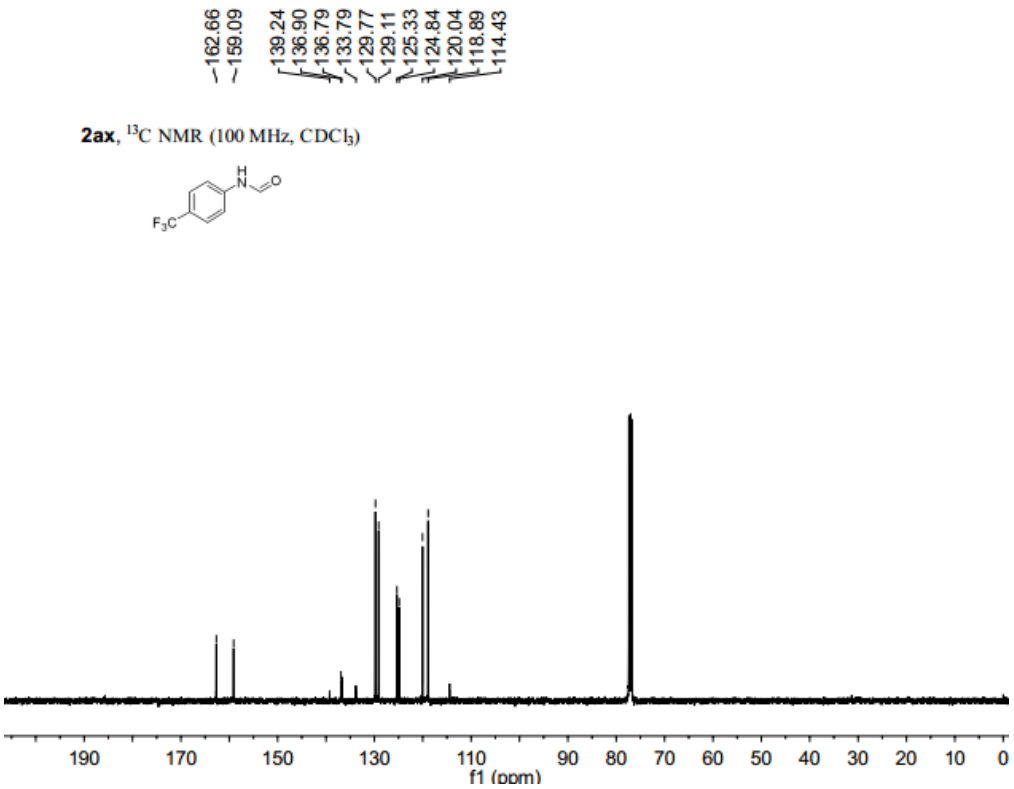
^{13}C NMR for *N*-(3-benzylphenyl)formamide, **2aw**



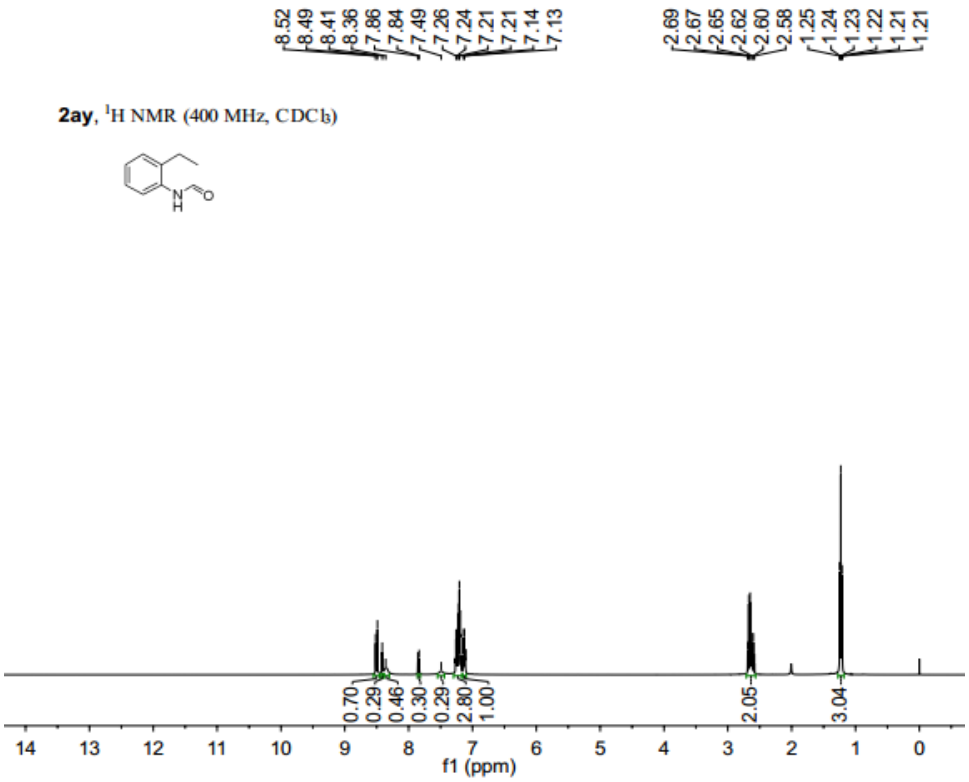
^{1}H NMR for *N*-(4-(trifluoromethyl)phenyl)formamide, **2ax**



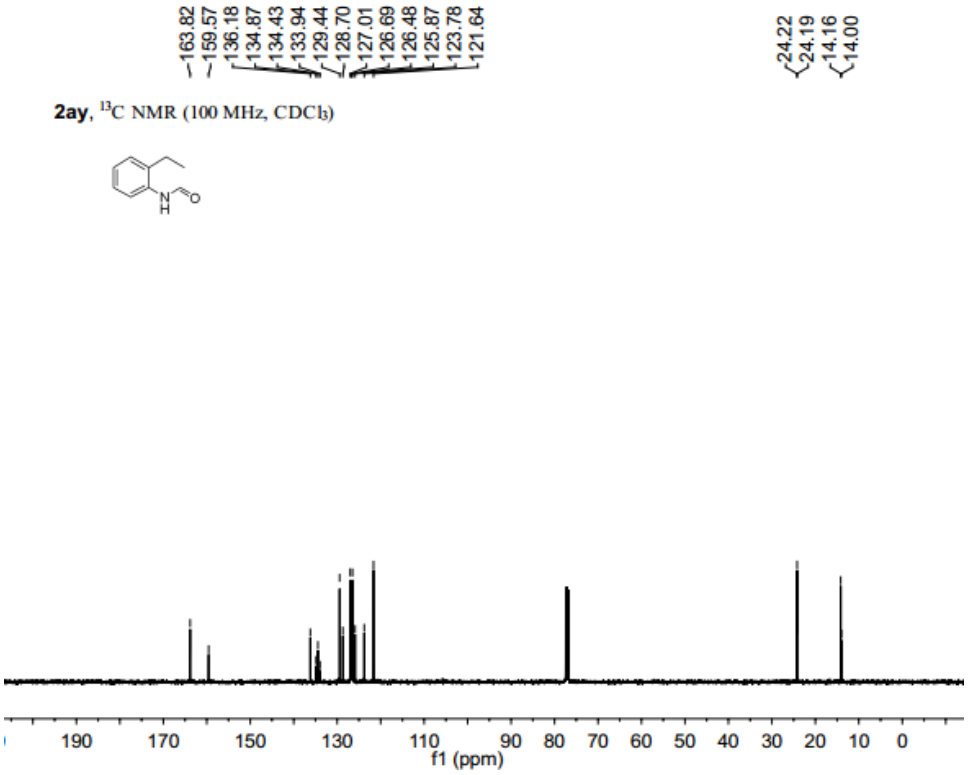
^{13}C NMR for *N*-(4-(trifluoromethyl)phenyl)formamide, **2ax**



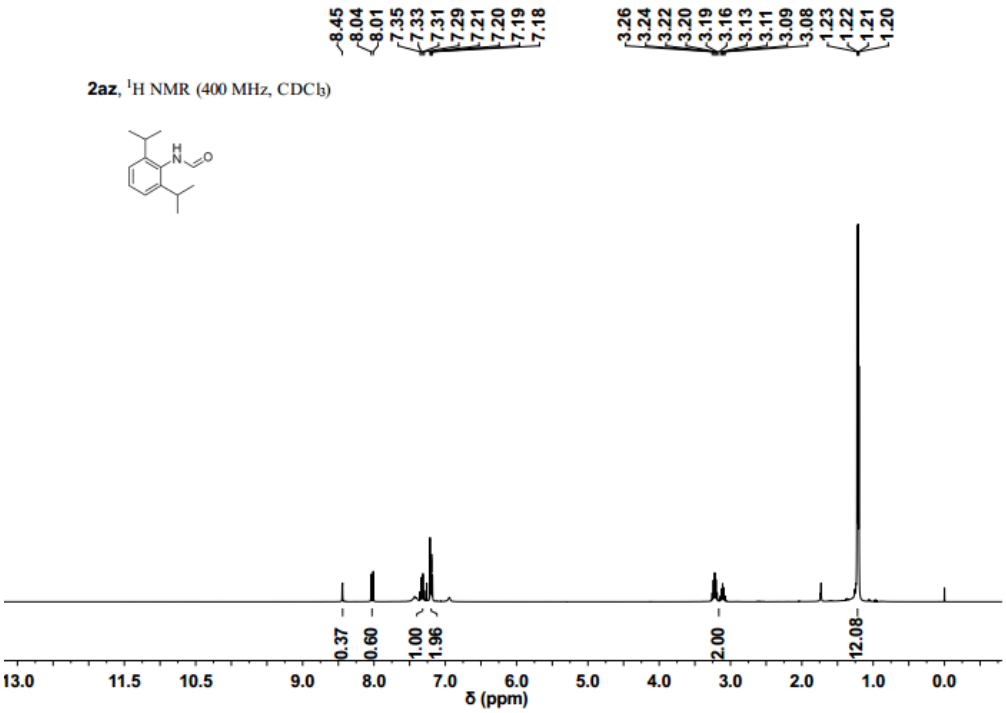
^{1}H NMR for *N*-(2-ethylphenyl)formamide, **2ay**



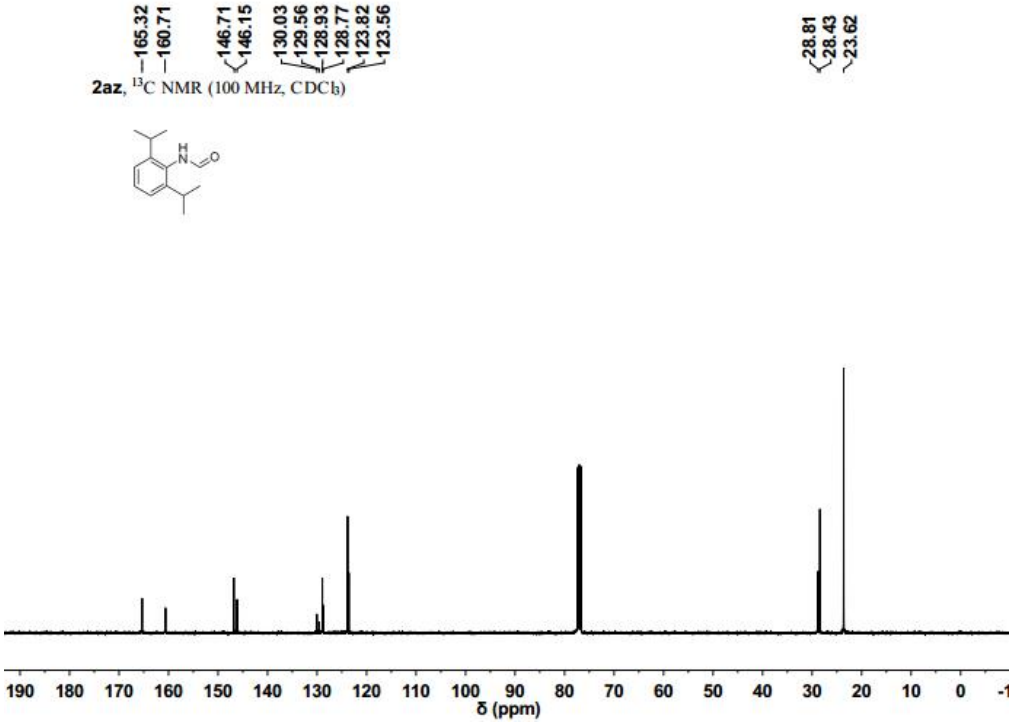
^{13}C NMR for *N*-(2-ethylphenyl)formamide, **2ay**



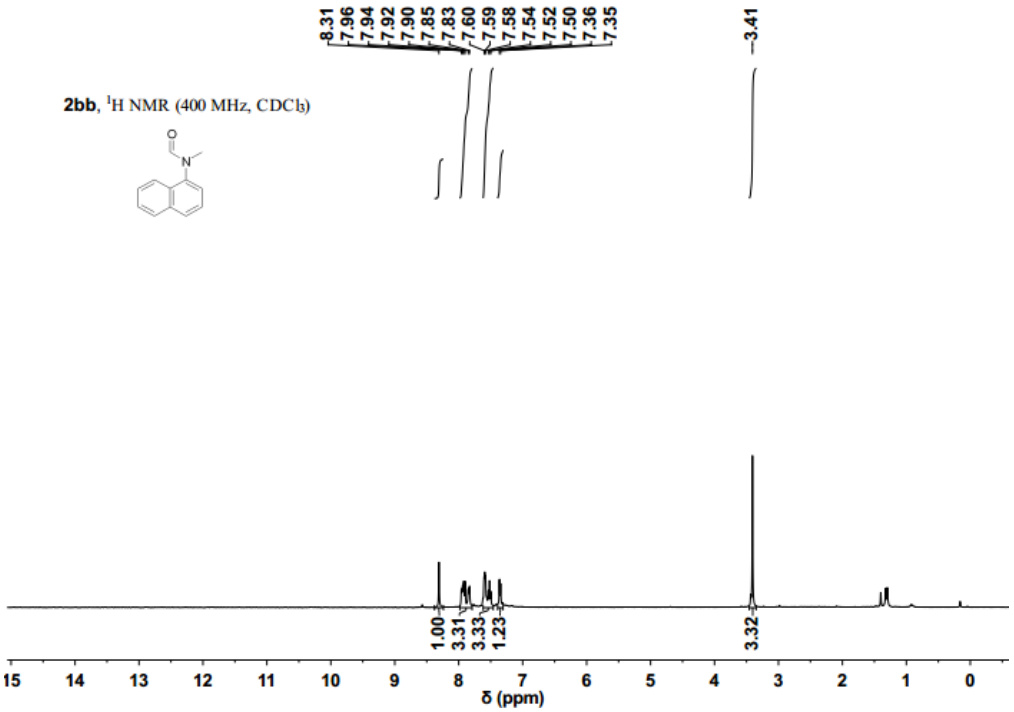
^{1}H NMR for *N*-(2,6-diisopropylphenyl)formamide, **2az**



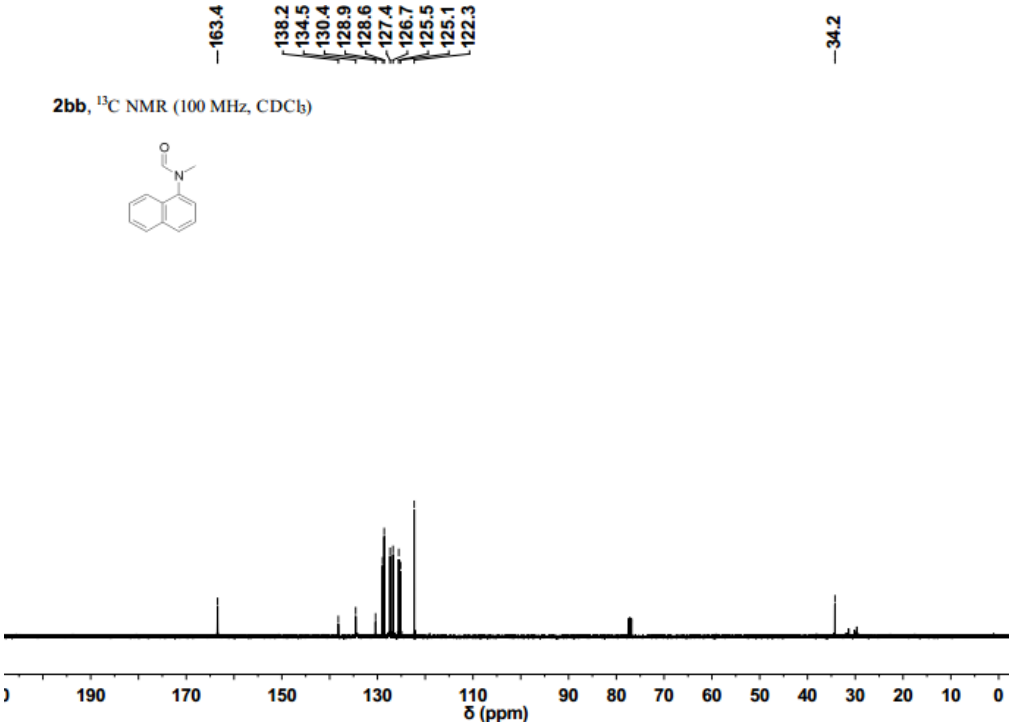
^{13}C NMR for *N*-(2,6-diisopropylphenyl)formamide, **2az**



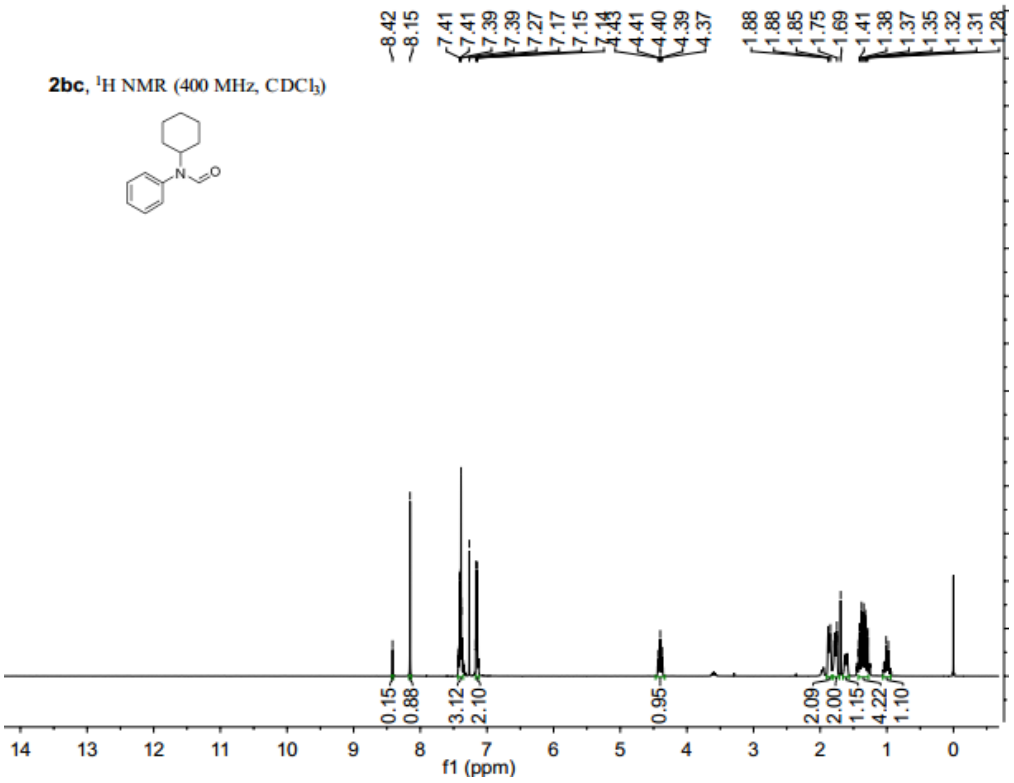
^{1}H NMR for *N*-methyl-*N*-(naphthalen-1-yl)formamide, **2bb**



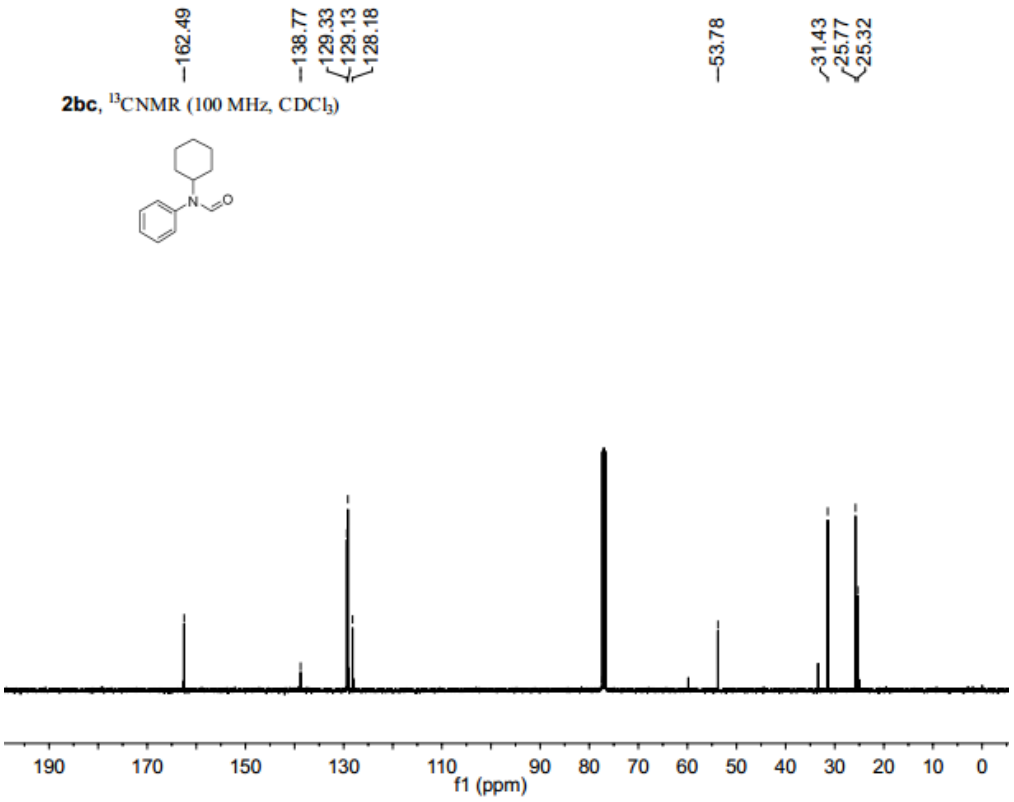
^{13}C NMR for *N*-methyl-*N*-(naphthalen-1-yl)formamide, **2bb**



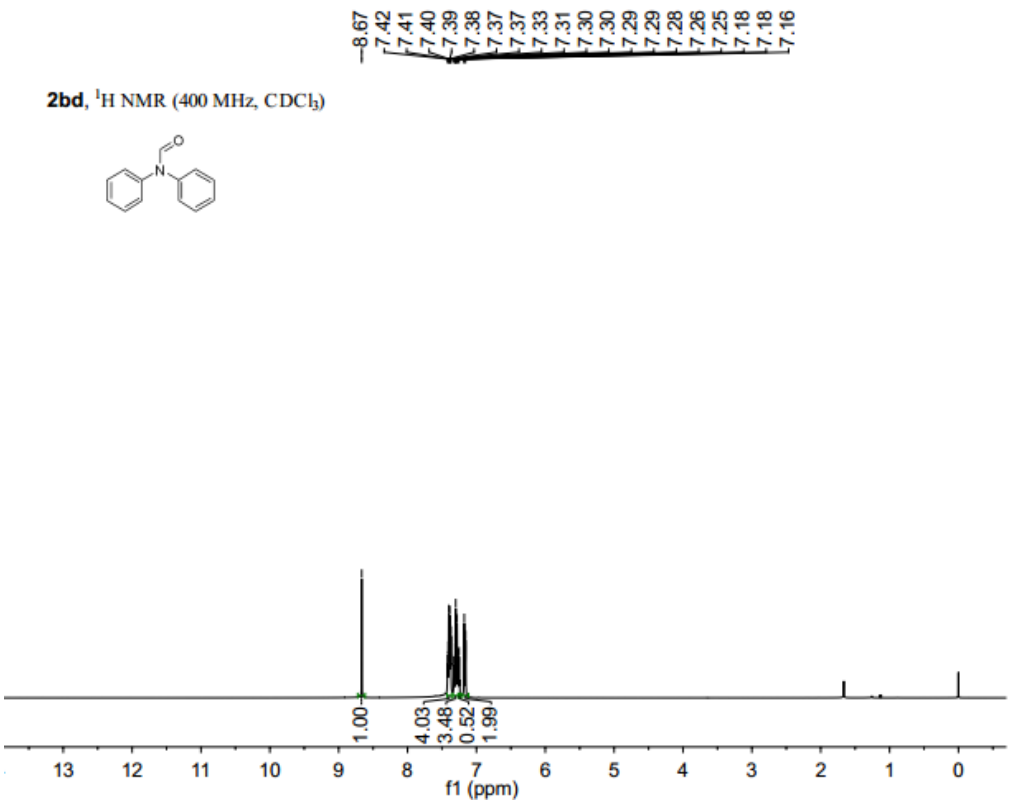
^{1}H NMR for *N*-cyclohexyl-*N*-phenylformamide, **2bc**



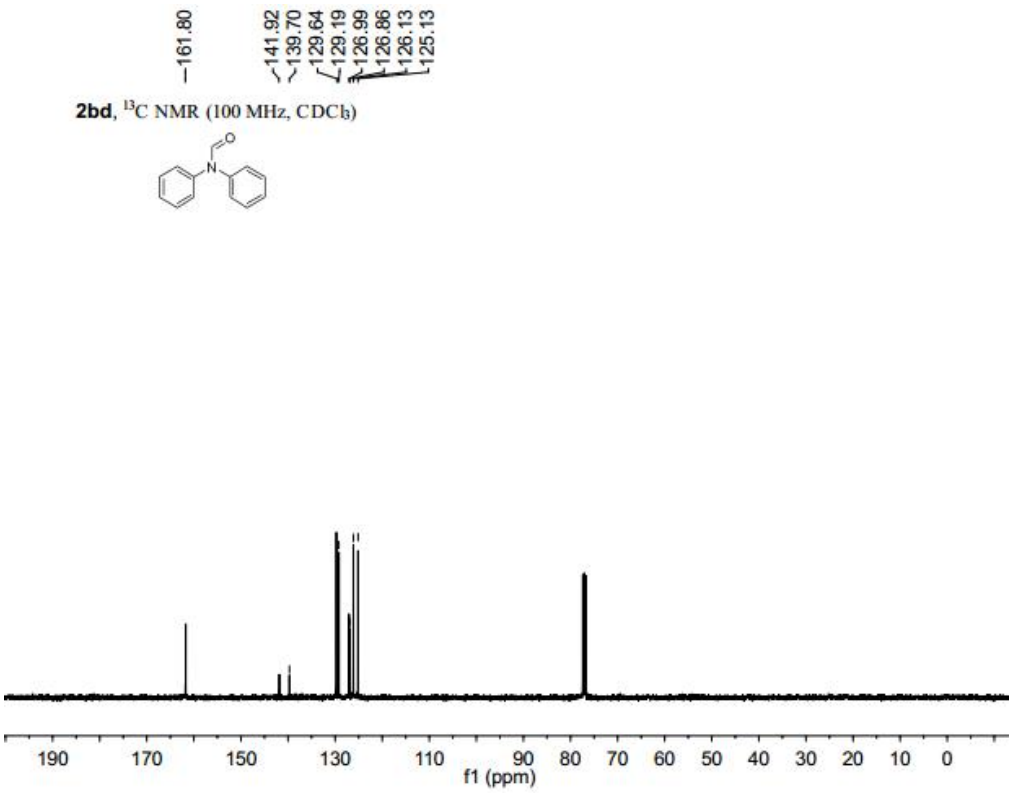
^{13}C NMR for *N*-cyclohexyl-*N*-phenylformamide, **2bc**



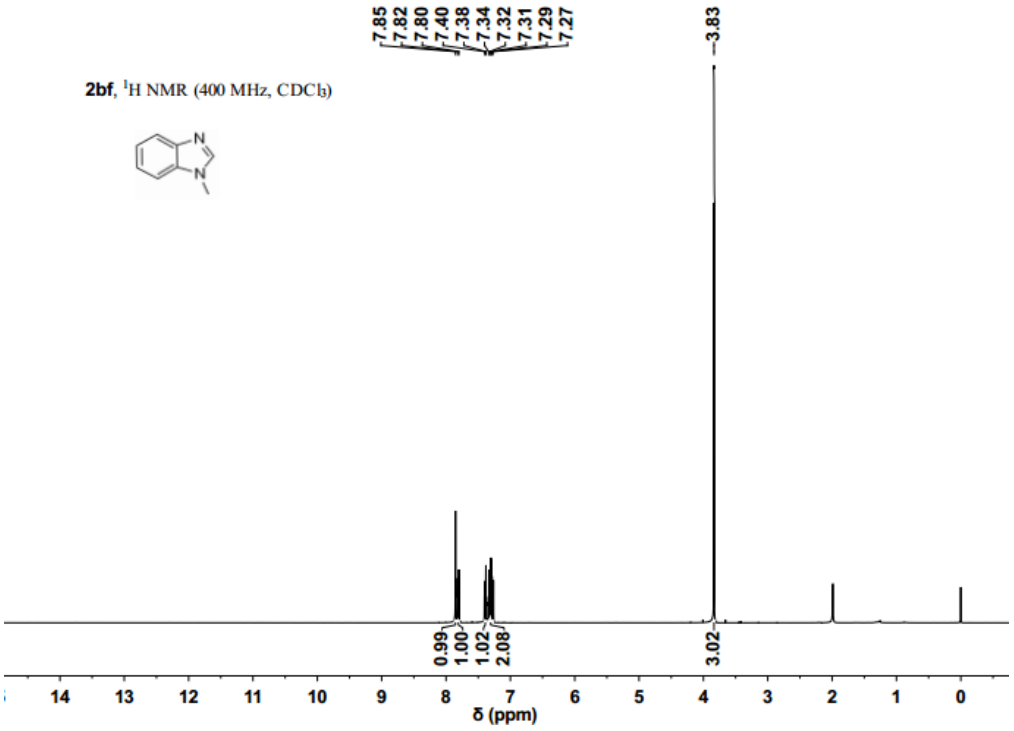
^{1}H NMR for *N*,*N*-diphenylformamide, **2bd**



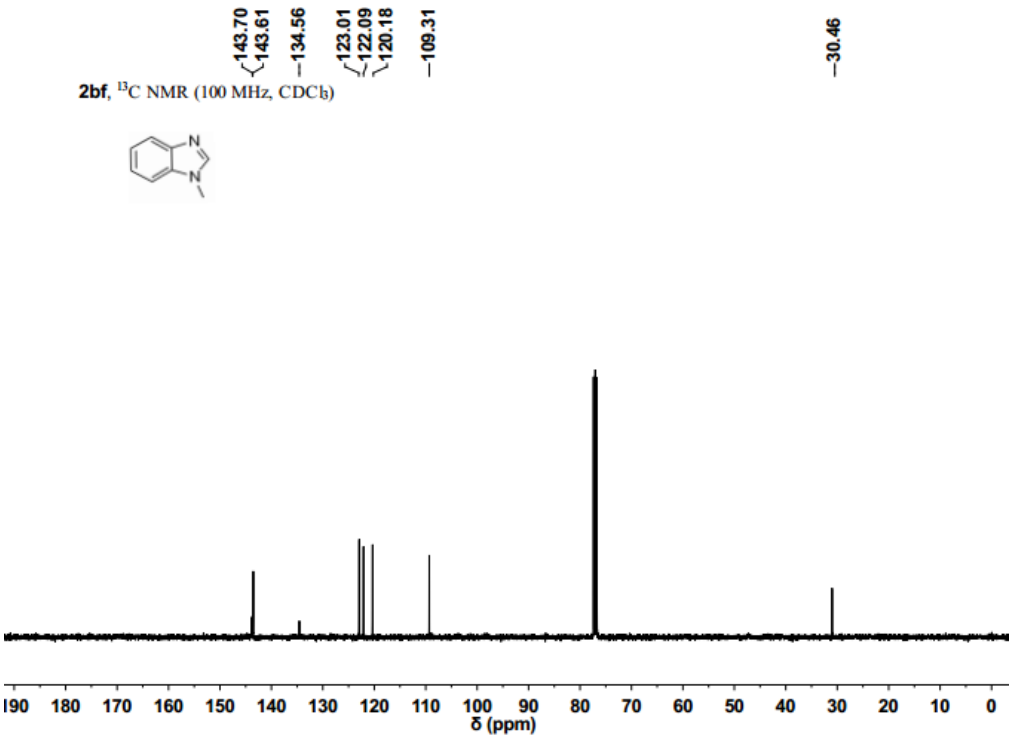
^{13}C NMR for *N*,*N*-diphenylformamide, **2bd**



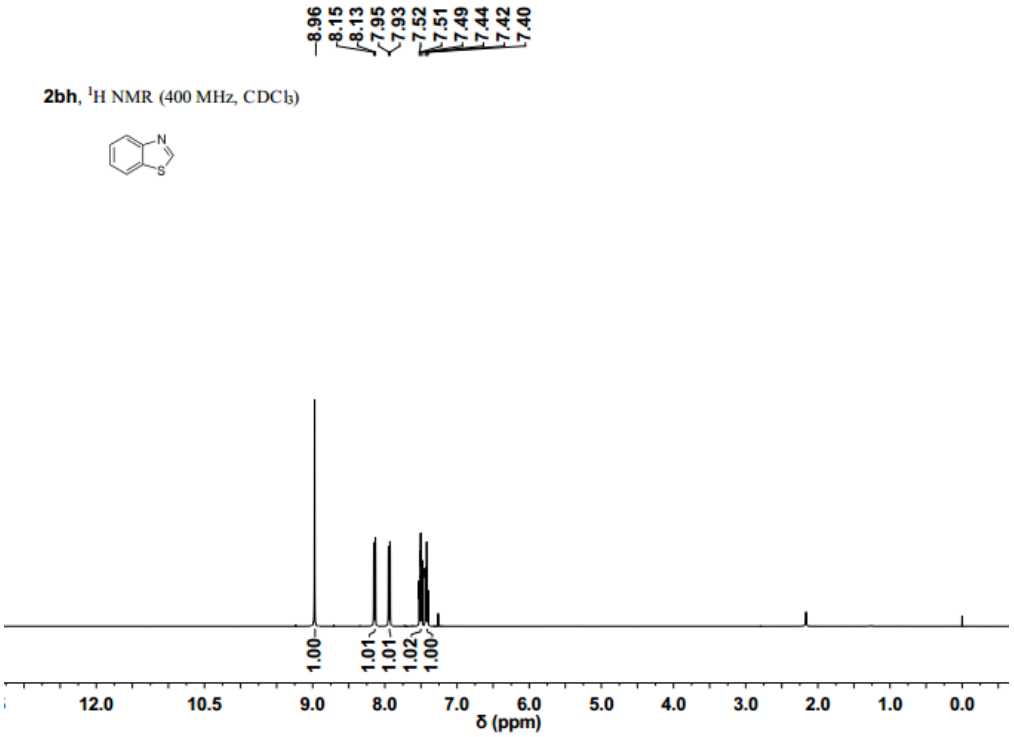
^{1}H NMR for 1-methyl-1*H*-benzo[*d*]imidazole, **2bf**



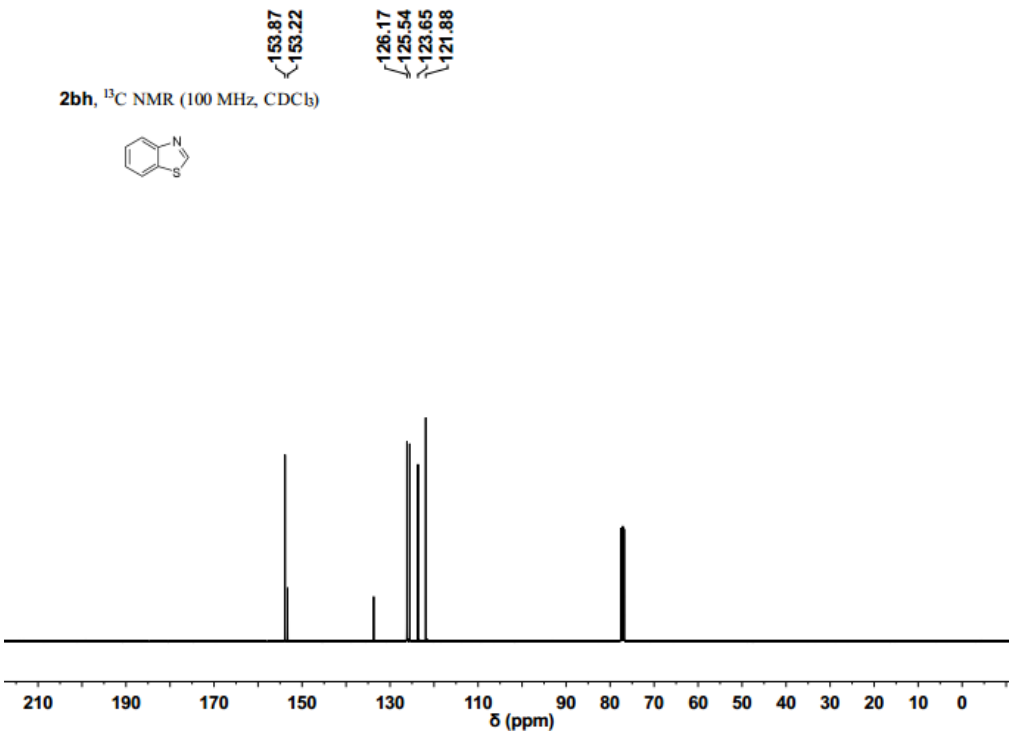
^{13}C NMR for 1-methyl-1*H*-benzo[*d*]imidazole, **2bf**



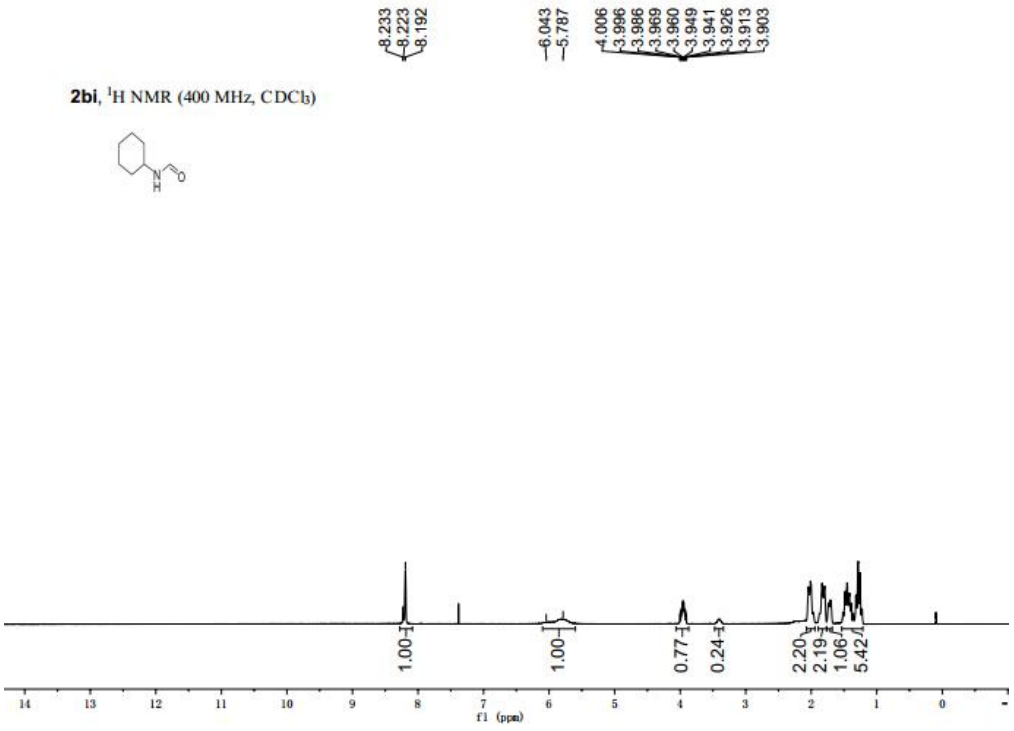
^{1}H NMR for benzo[*d*]thiazole, **2bh**



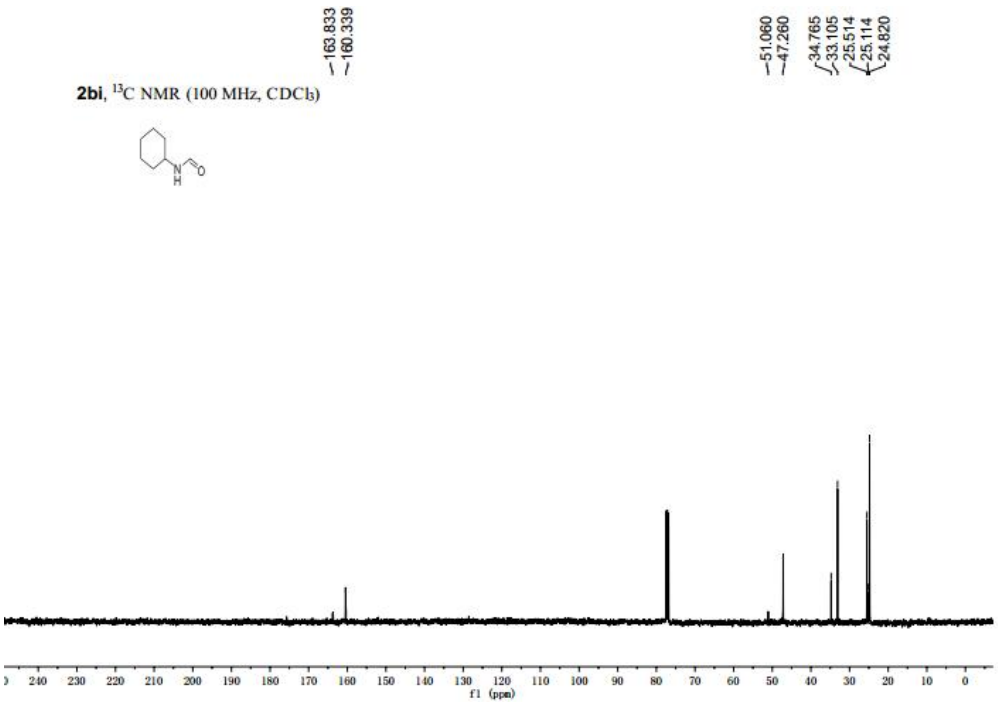
^{13}C NMR for benzo[*d*]thiazole, **2bh**



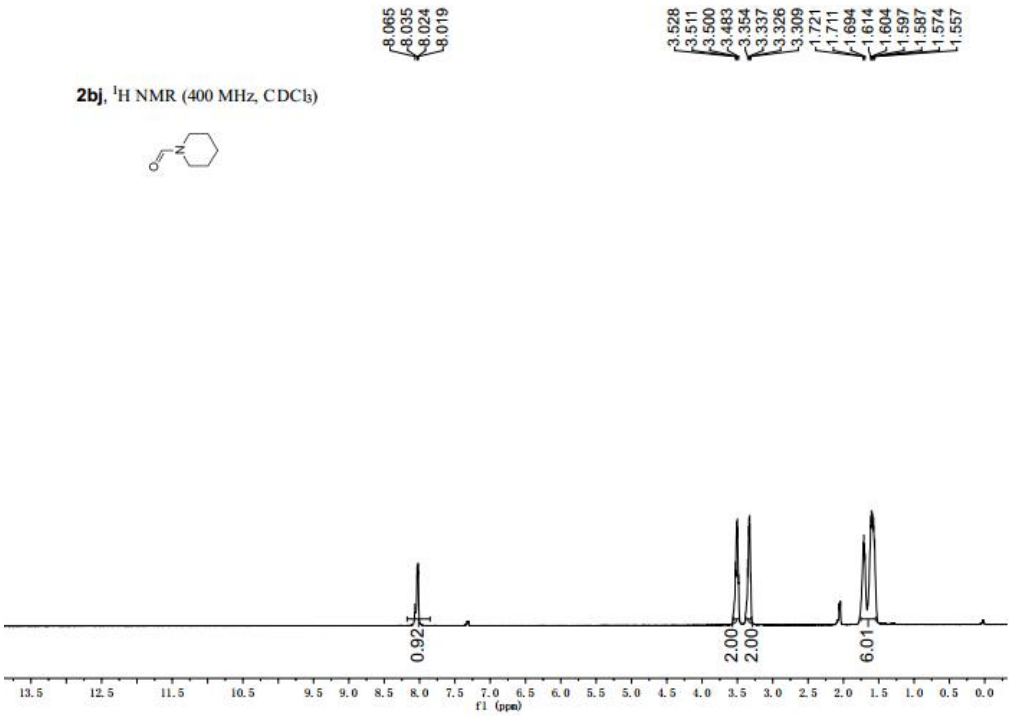
^{1}H NMR for *N*-cyclohexylformamide, **2bi**



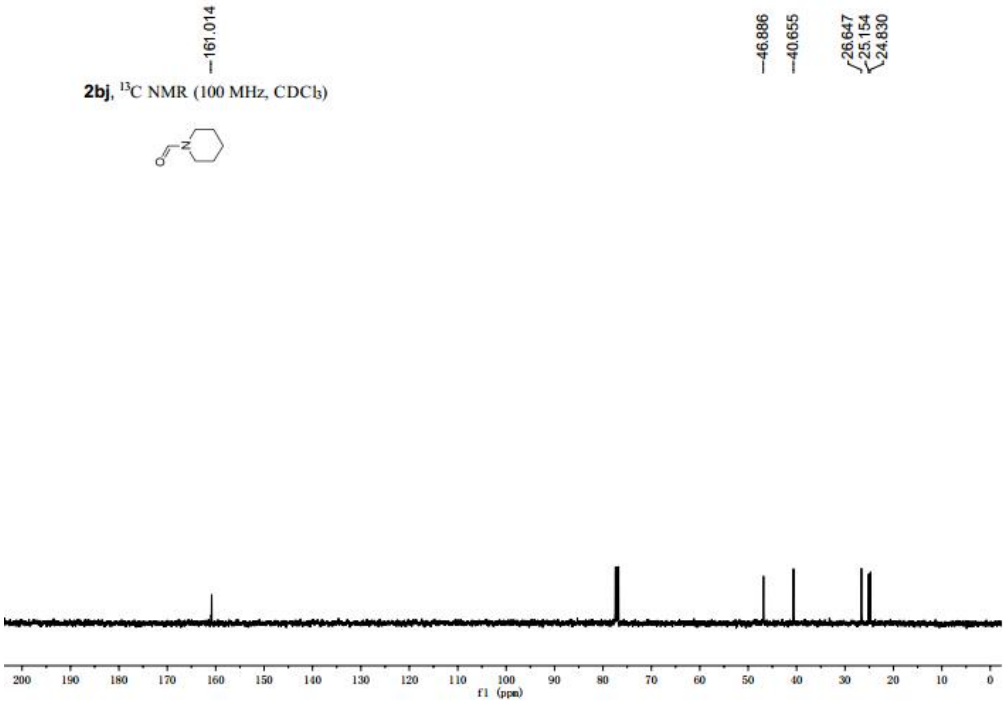
^{13}C NMR for *N*-cyclohexylformamide, **2bi**



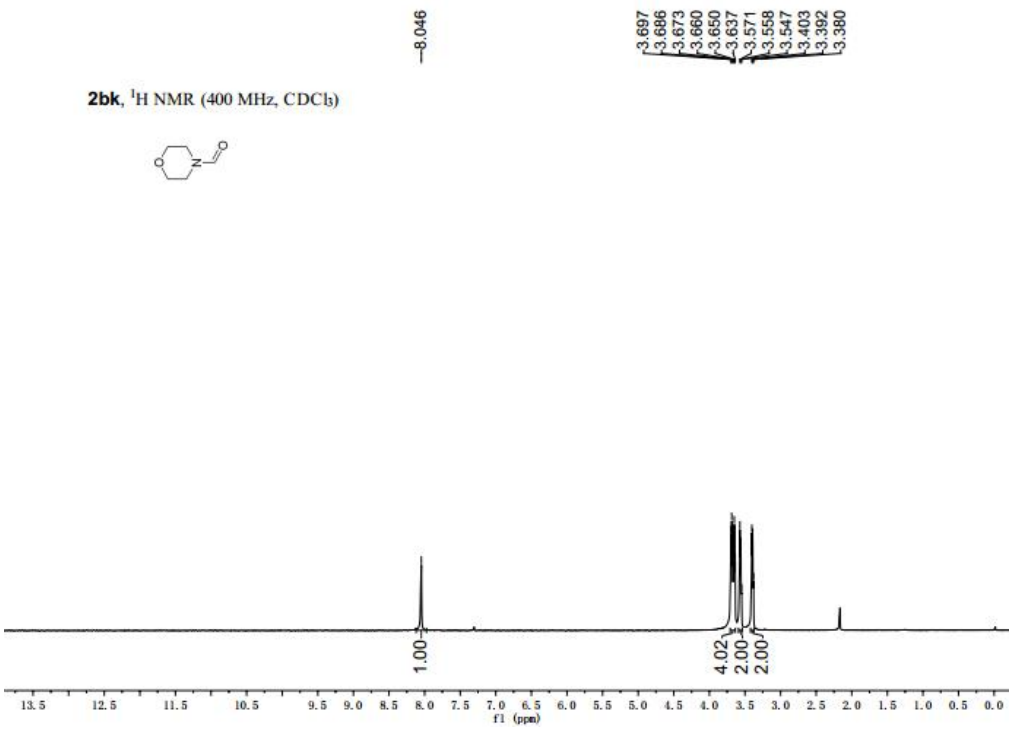
^{1}H NMR for piperidine-1-carbaldehyde, **2bj**



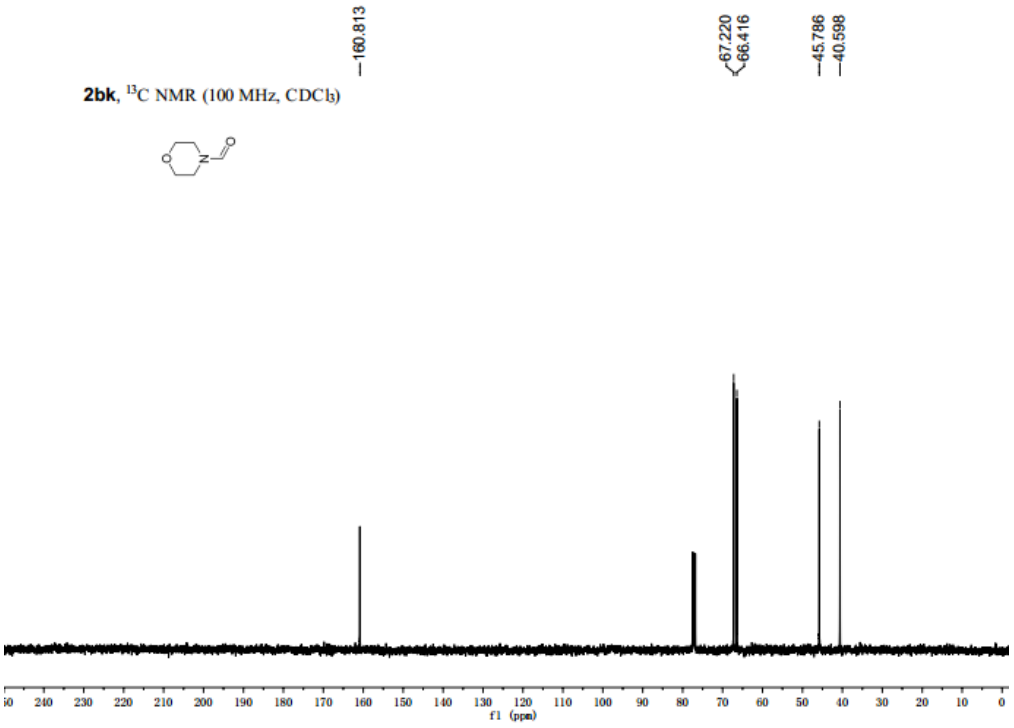
^{13}C NMR for piperidine-1-carbaldehyde, **2bj**



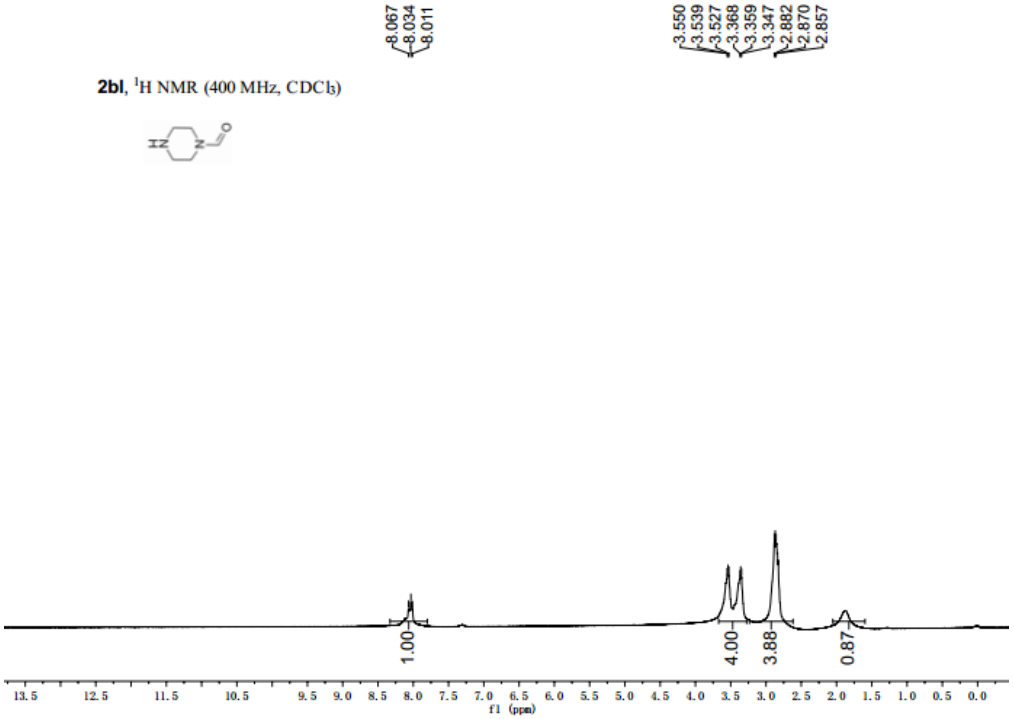
^{1}H NMR for morpholine-4-carbaldehyde, **2bk**



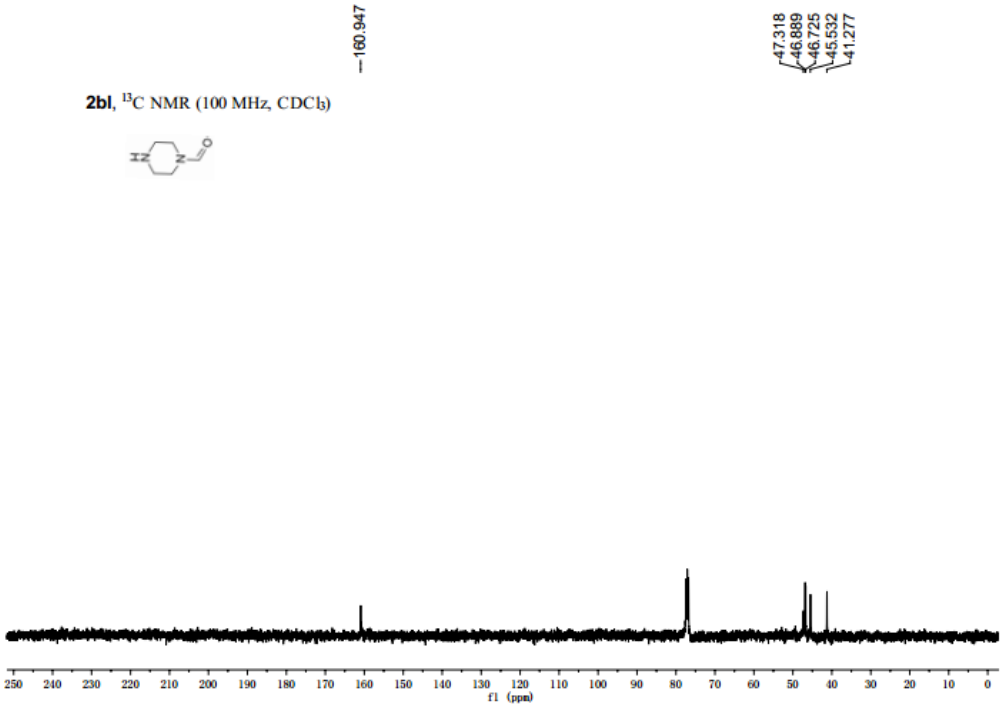
^{13}C NMR for morpholine-4-carbaldehyde, **2bk**



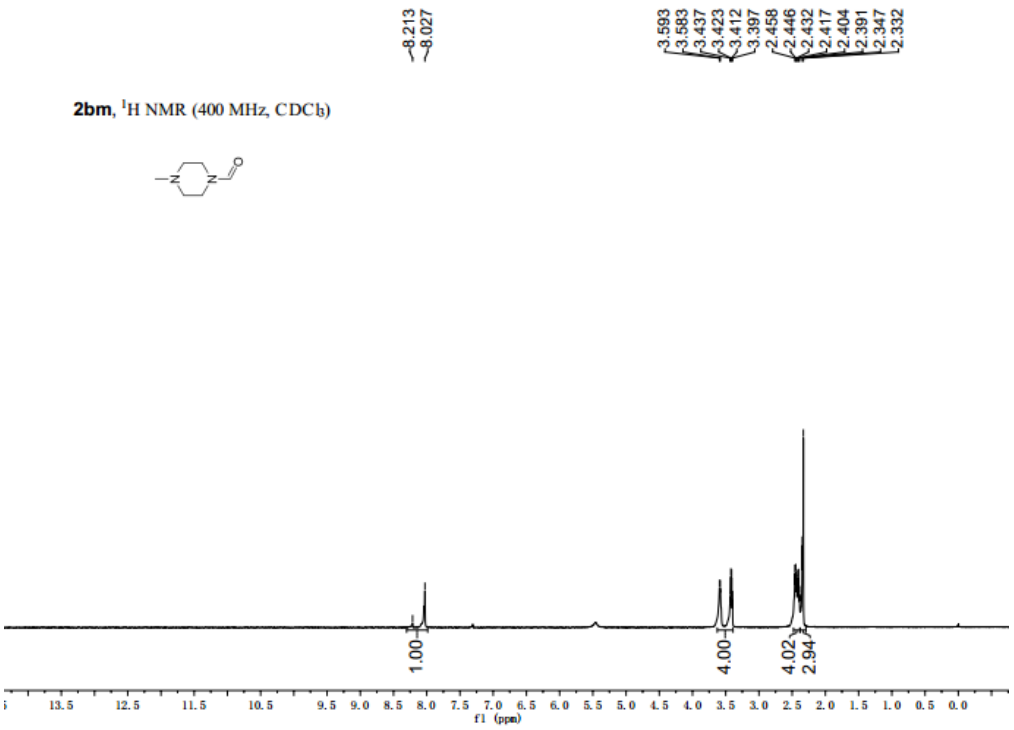
^{1}H NMR for piperazine-1-carbaldehyde, **2bl**



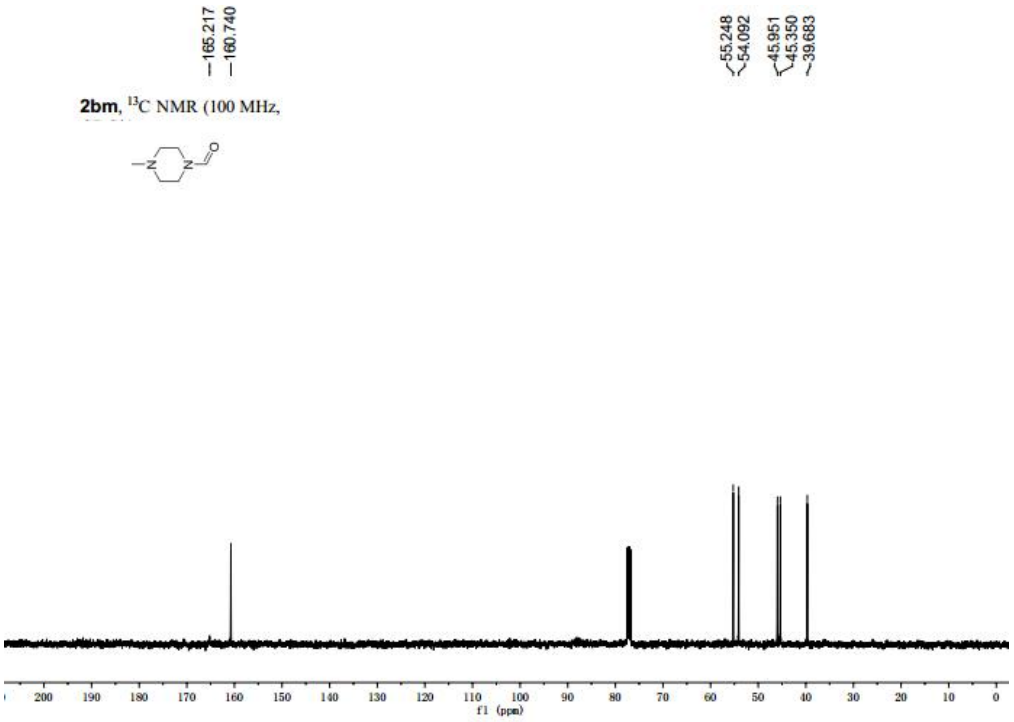
^{13}C NMR for piperazine-1-carbaldehyde, **2bl**



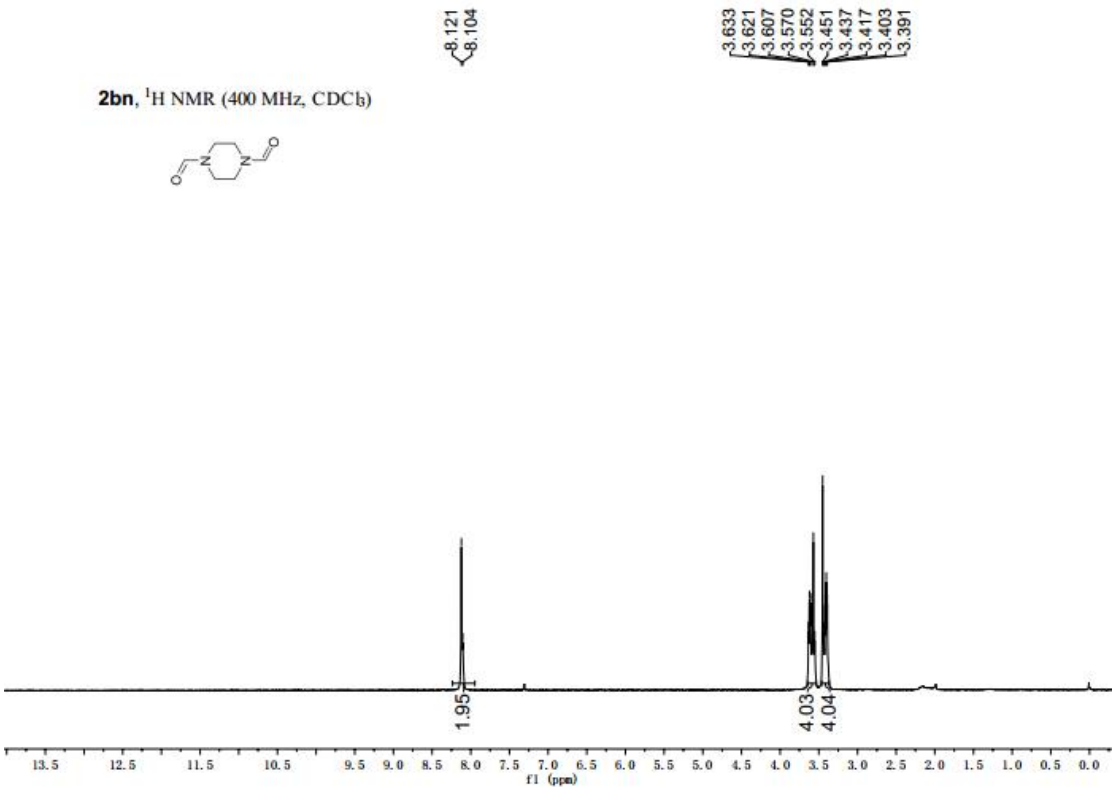
^{1}H NMR for 4-methylpiperazine-1-carbaldehyde, **2bm**



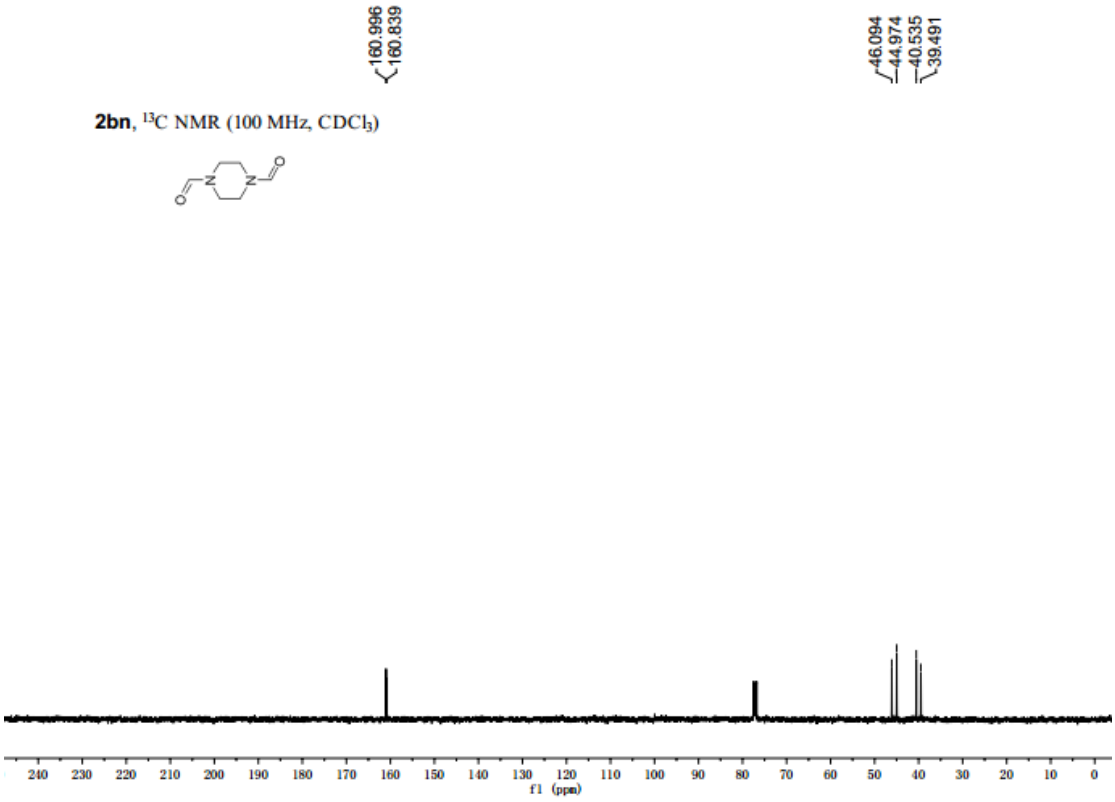
^{13}C NMR for 4-methylpiperazine-1-carbaldehyde, **2bm**



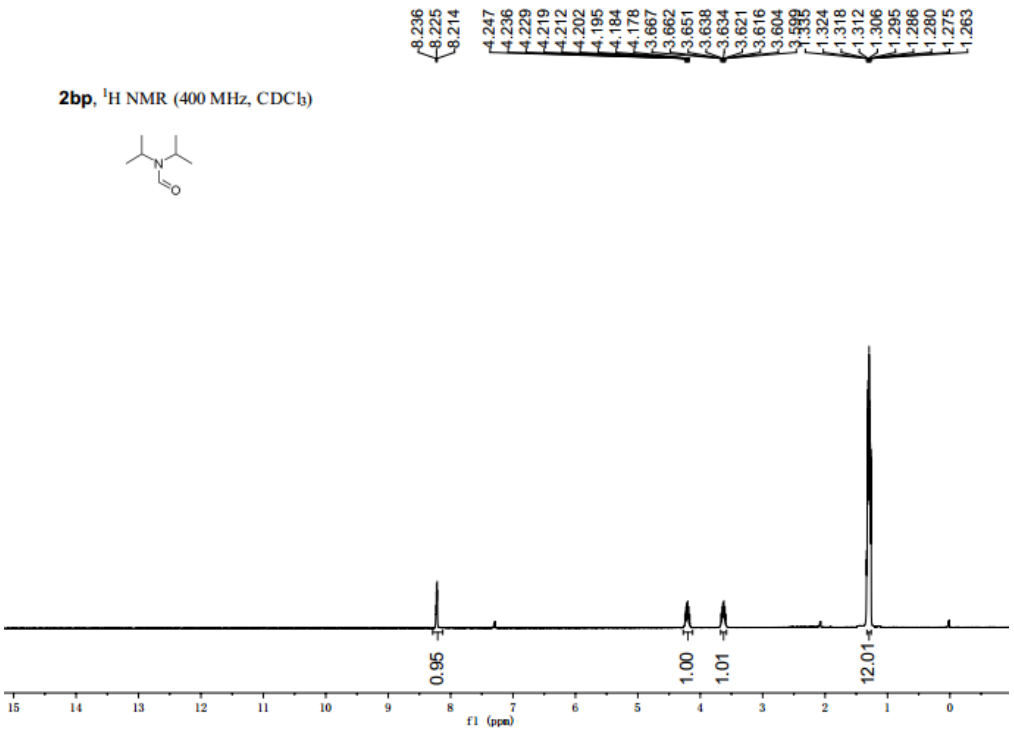
^{1}H NMR for piperazine-1,4-dicarbaldehyde, **2bn**



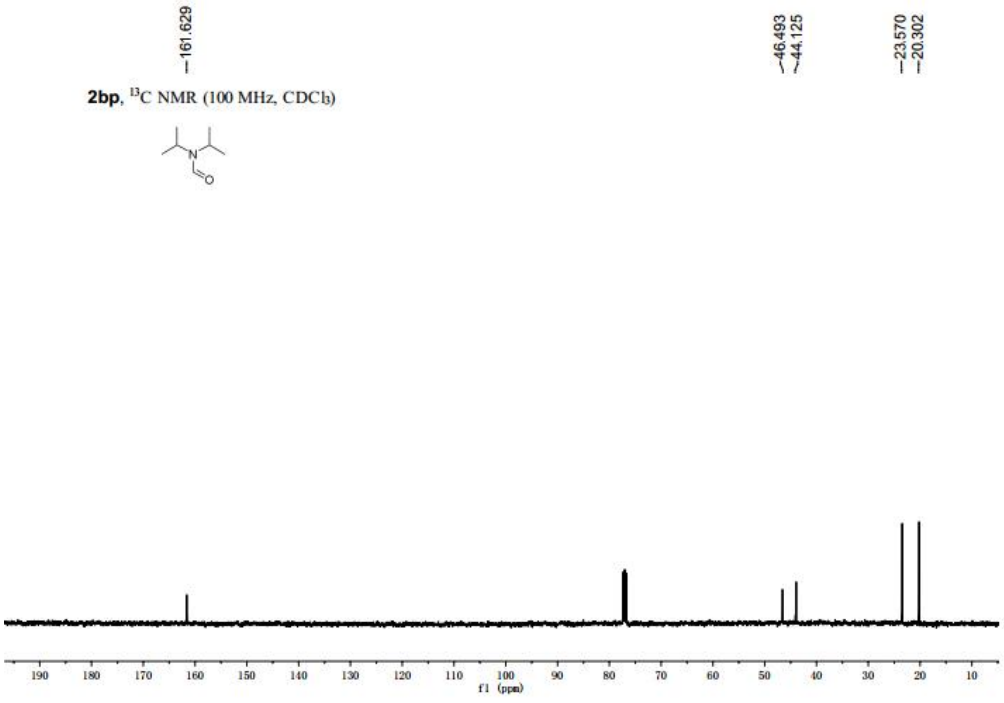
^{13}C NMR for piperazine-1,4-dicarbaldehyde, **2bn**



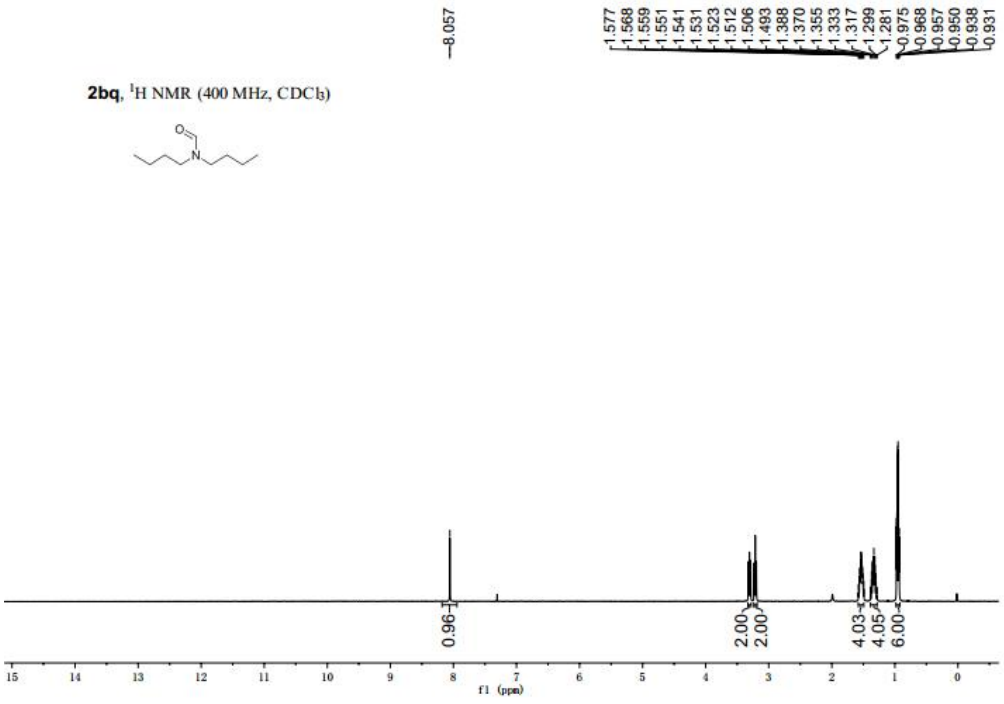
^{1}H NMR for *N*,*N*-diisopropylformamide, **2bp**



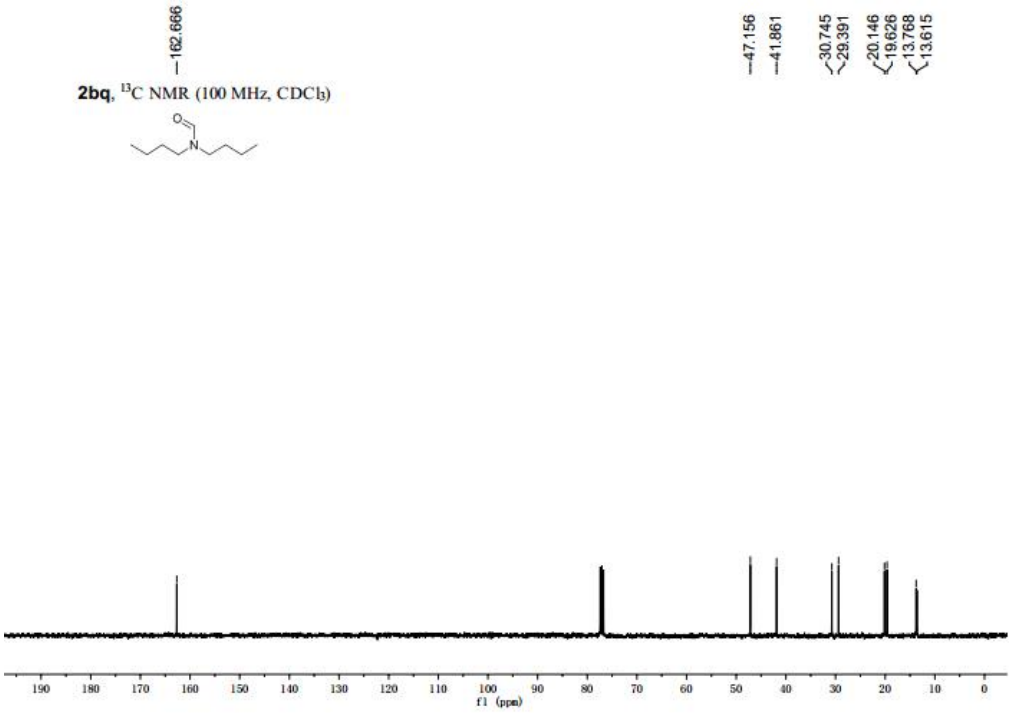
^{13}C NMR for *N*,*N*-diisopropylformamide, **2bp**



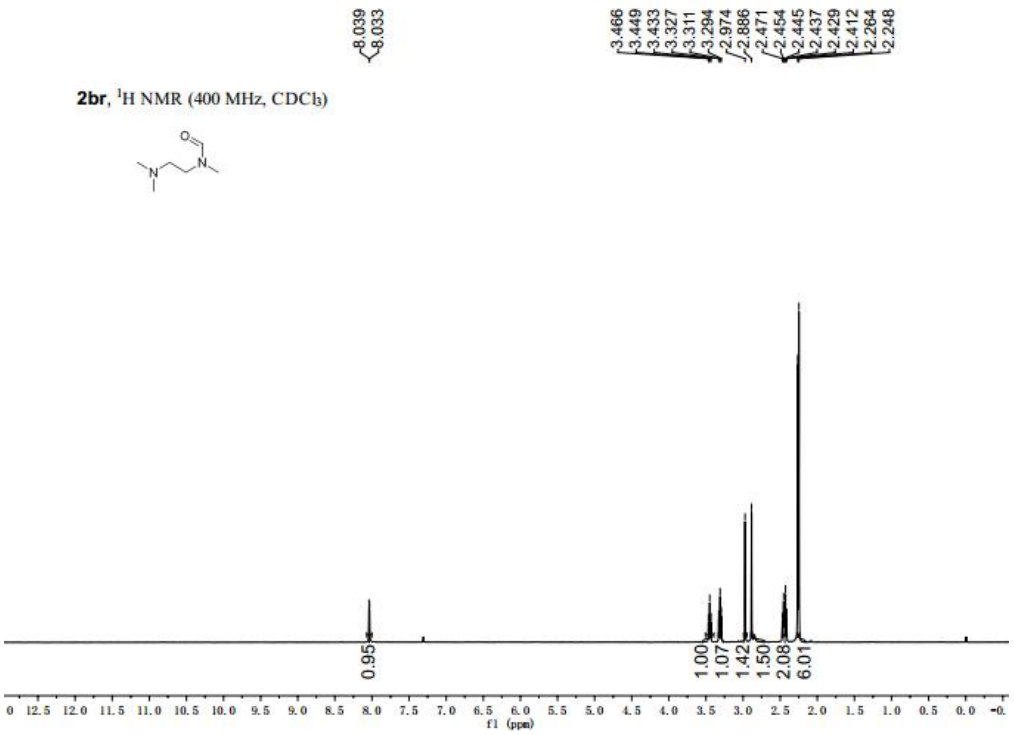
^{1}H NMR for *N*,*N*-dibutylformamide, **2bq**



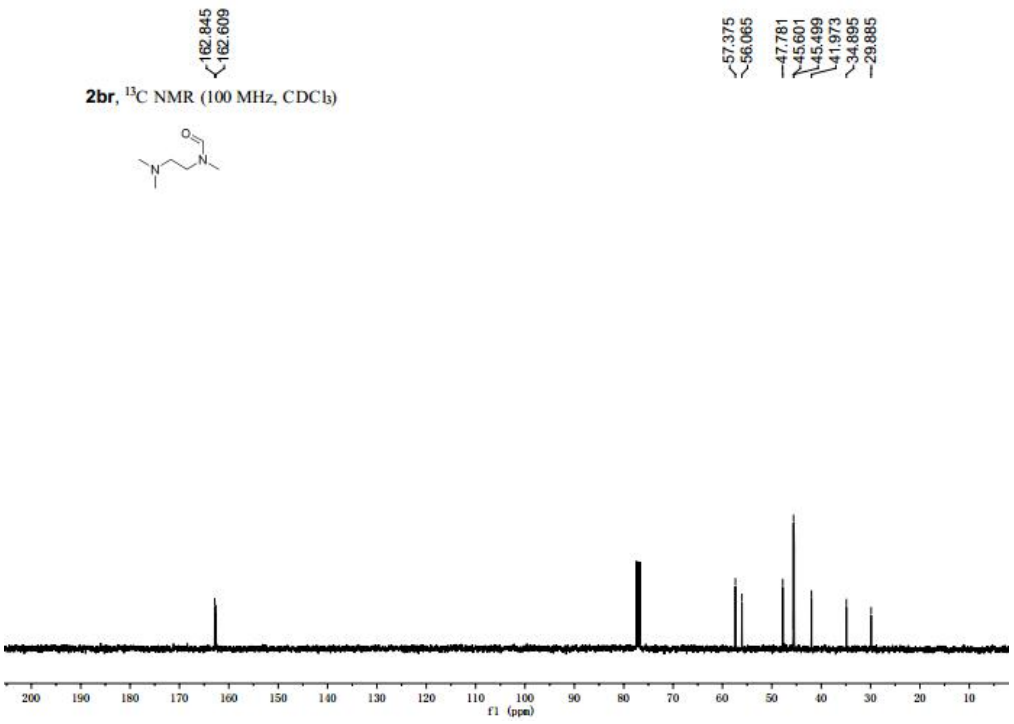
^{13}C NMR for *N*,*N*-dibutylformamide, **2bq**



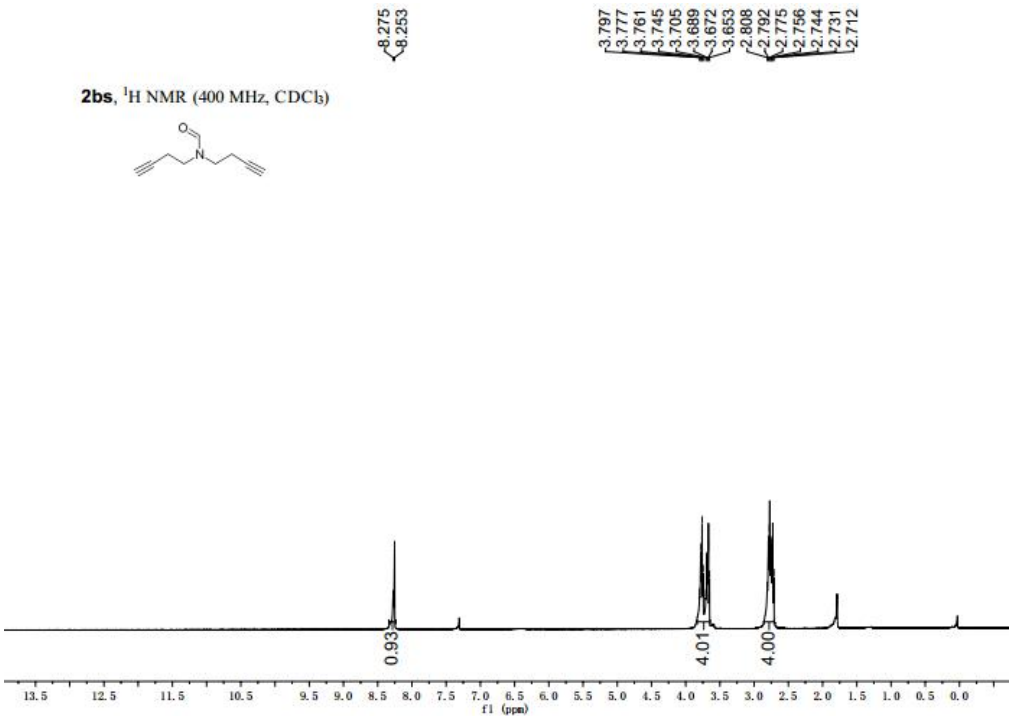
^{1}H NMR for *N*-(2-(dimethylamino)ethyl)-*N*-methylformamide, **2br**



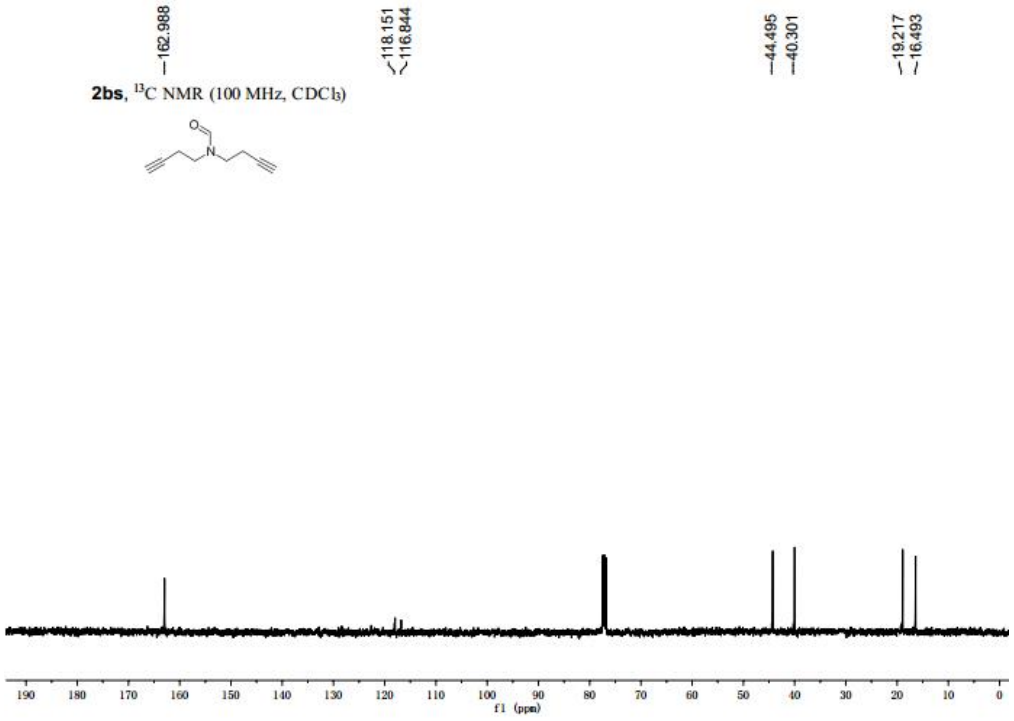
^{13}C NMR for *N*-(2-(dimethylamino)ethyl)-*N*-methylformamide, **2br**



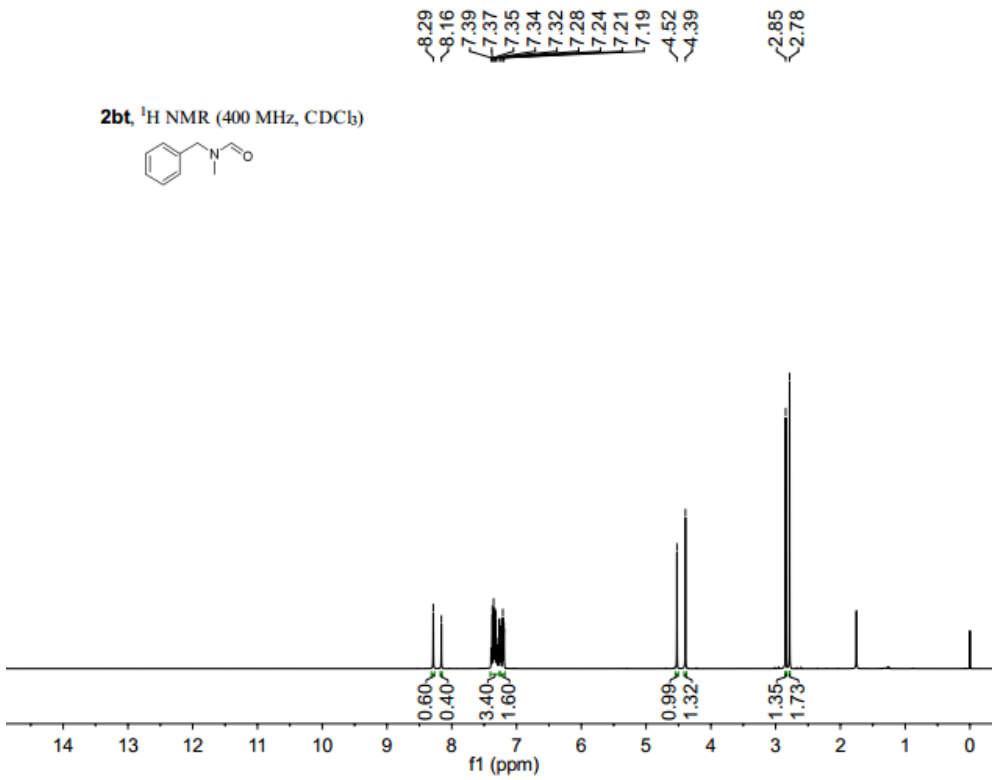
^{1}H NMR for *N*,*N*-bis(2-cyanoethyl)formamide, **2bs**



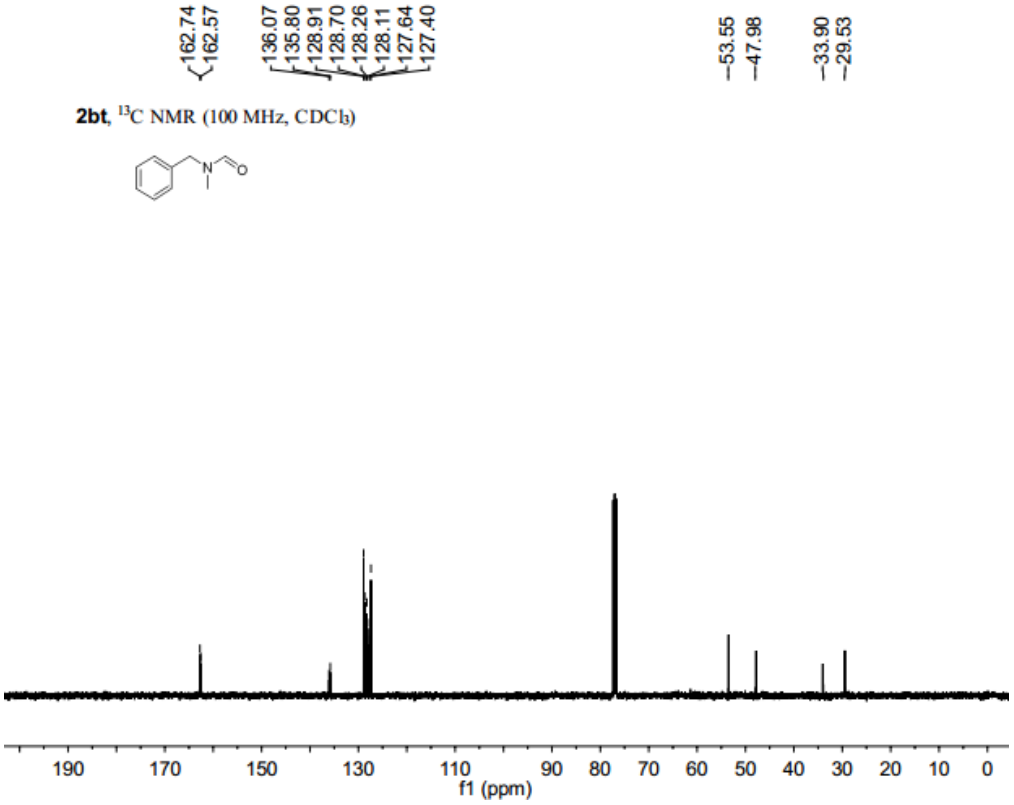
^{13}C NMR for *N*,*N*-bis(2-cyanoethyl)formamide, **2bs**



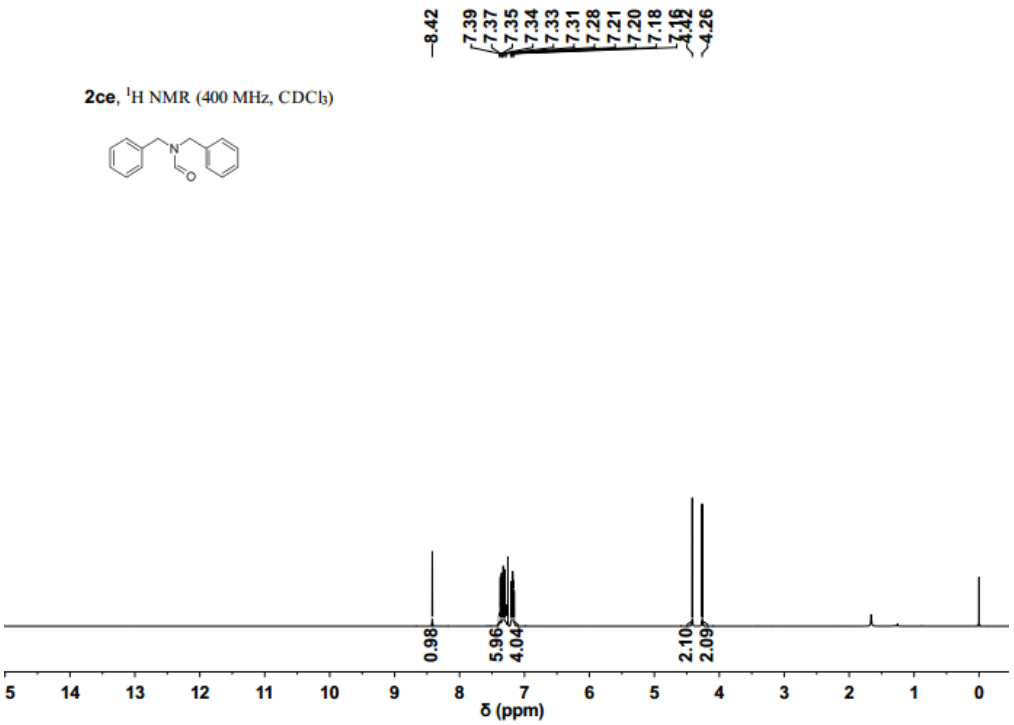
^{1}H NMR for *N*-benzyl-*N*-methylformamide, **2bt**



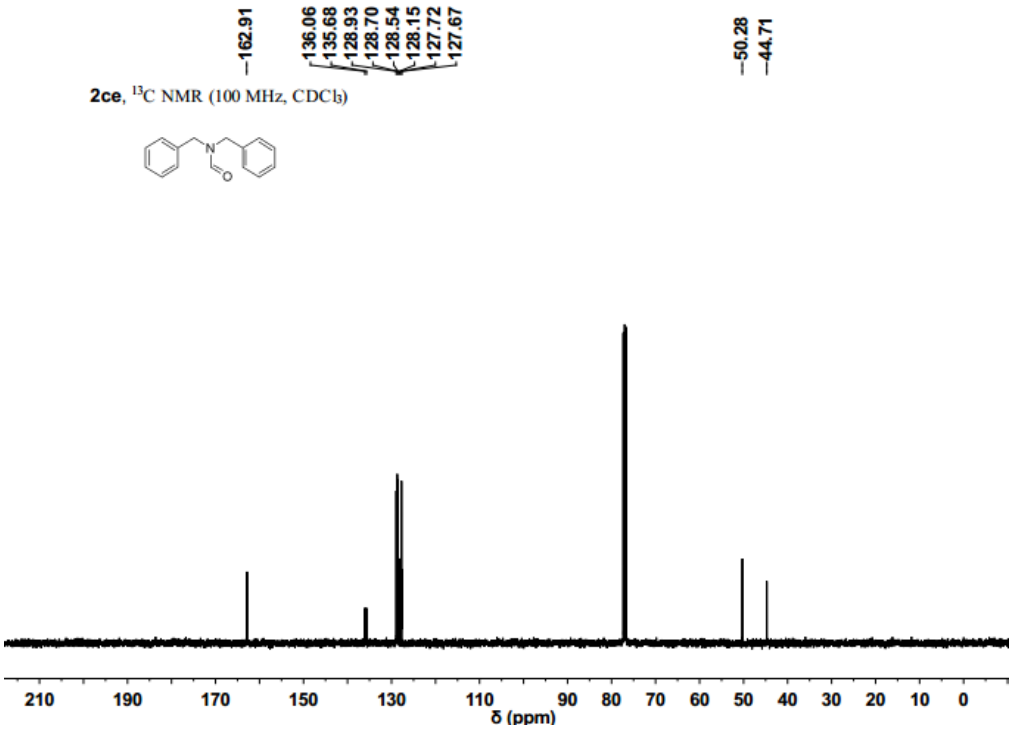
^{13}C NMR for *N*-benzyl-*N*-methylformamide, **2bt**



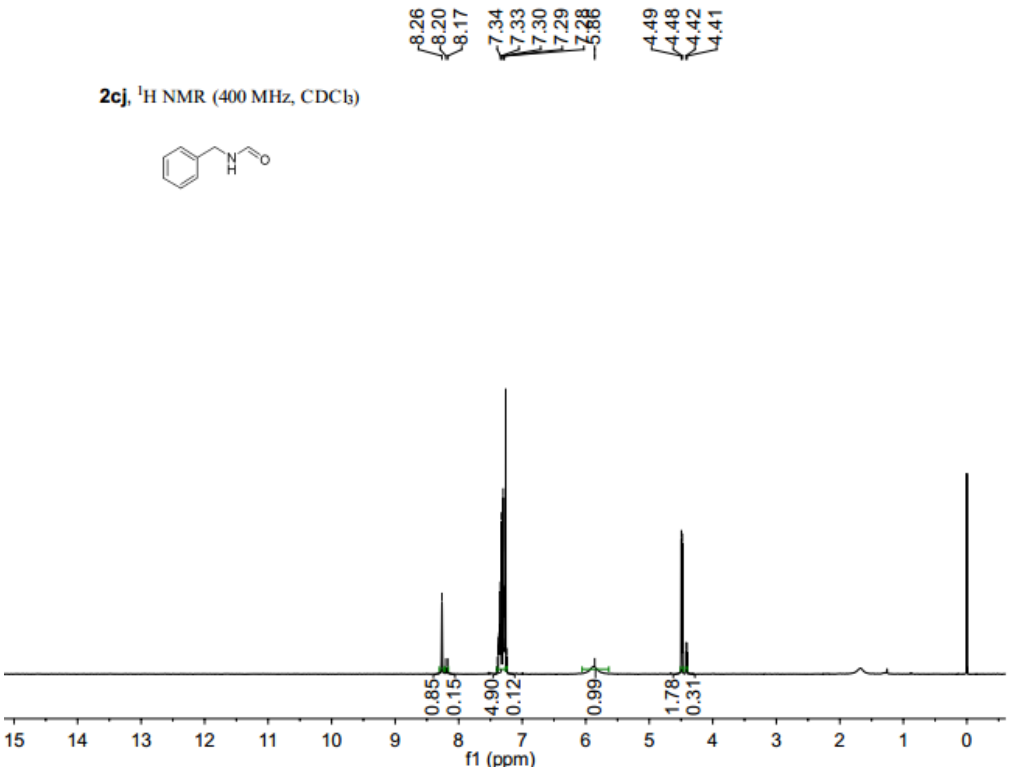
^{1}H NMR for *N*,*N*-dibenzylformamide, **2ce**



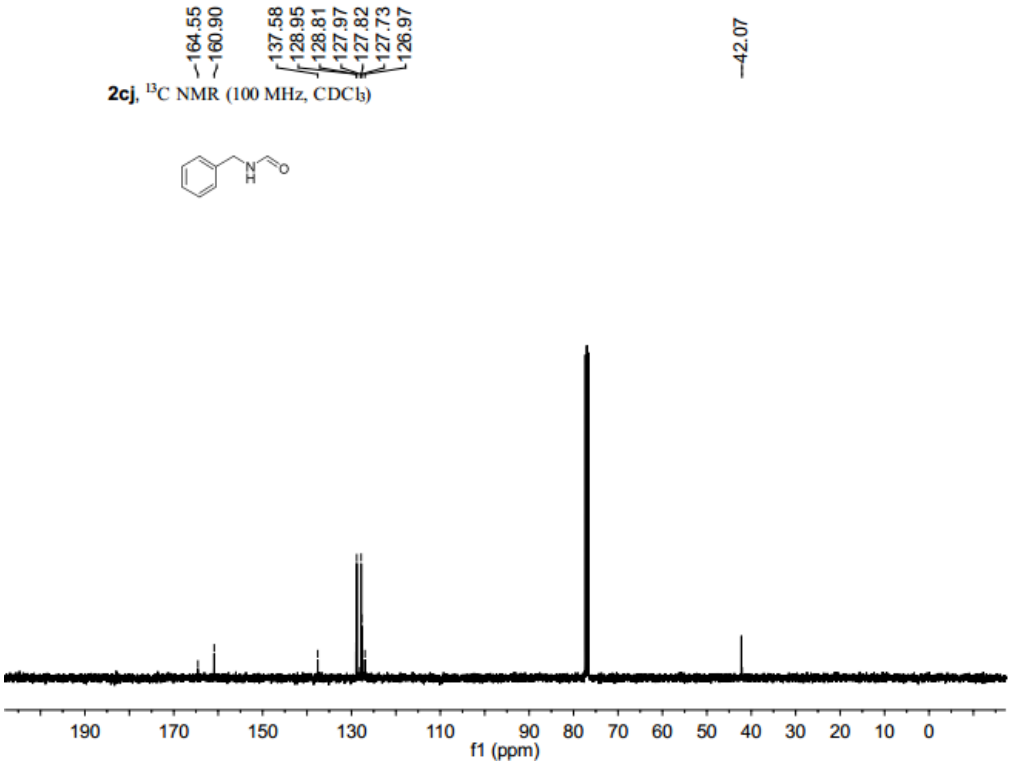
^{13}C NMR for *N*,*N*-dibenzylformamide, **2ce**



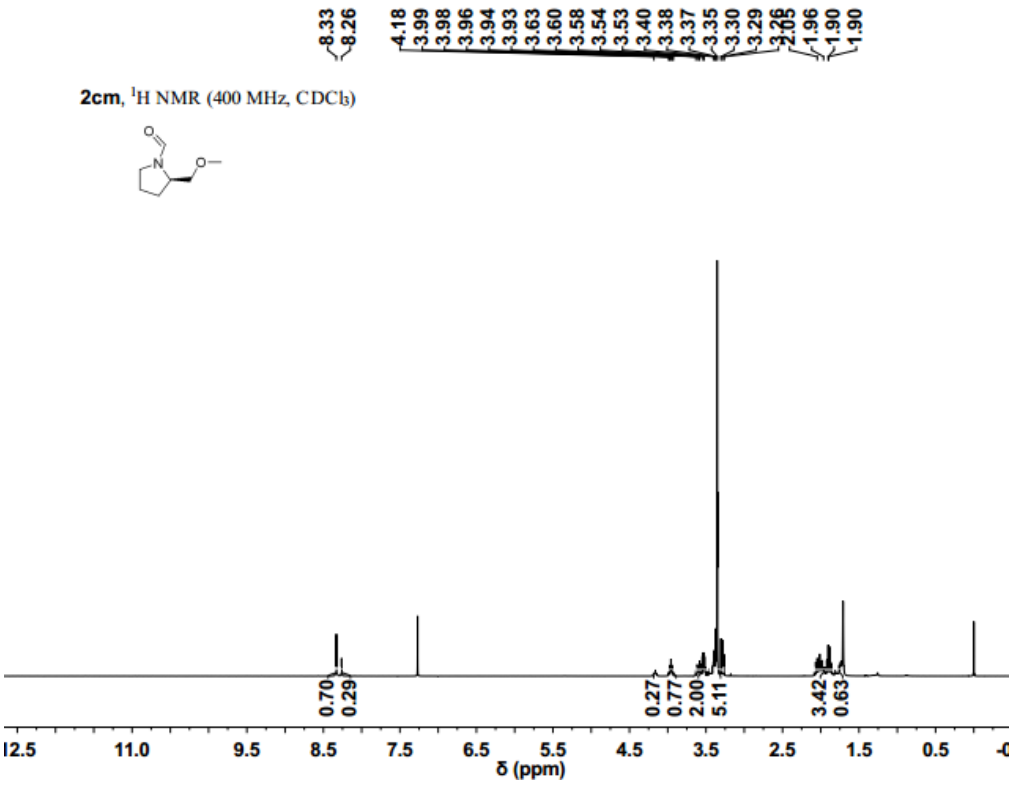
^{1}H NMR for *N*-benzylformamide, **2cj**



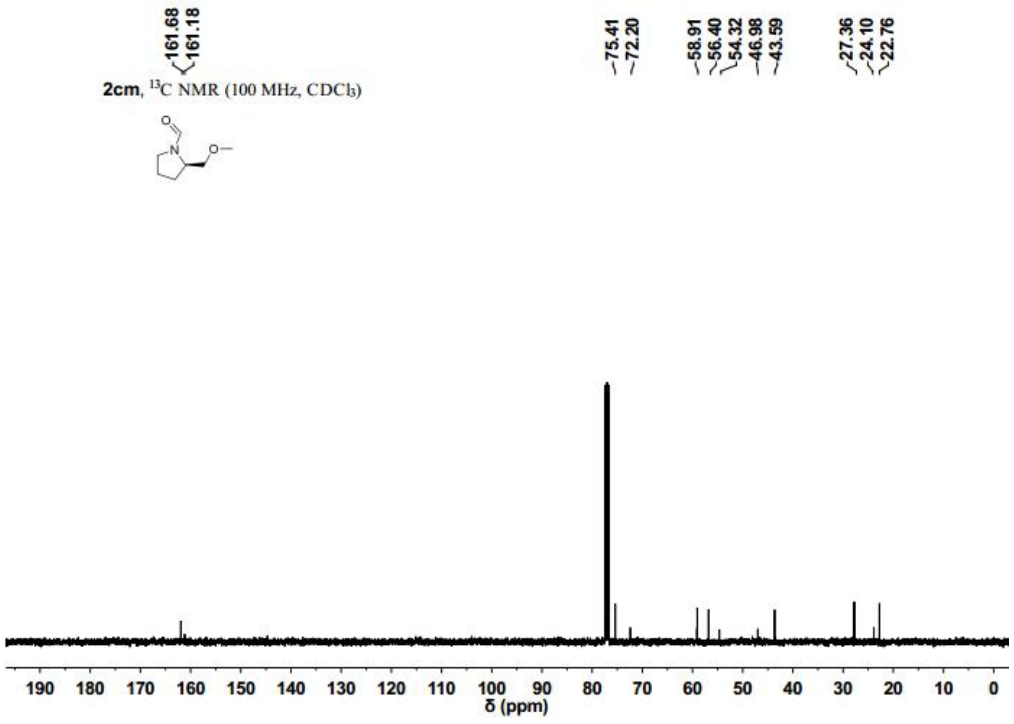
^{13}C NMR for *N*-benzylformamide, **2cj**



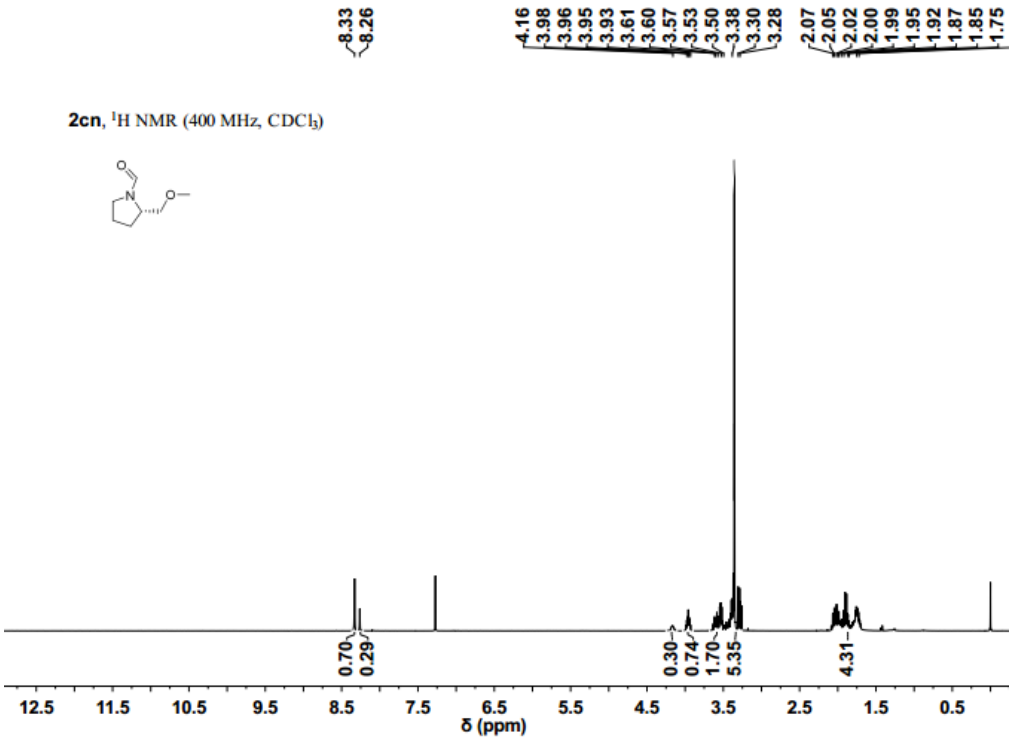
^{1}H NMR for (*R*)-2-(methoxymethyl)pyrrolidine-1-carbaldehyde, **2cm**



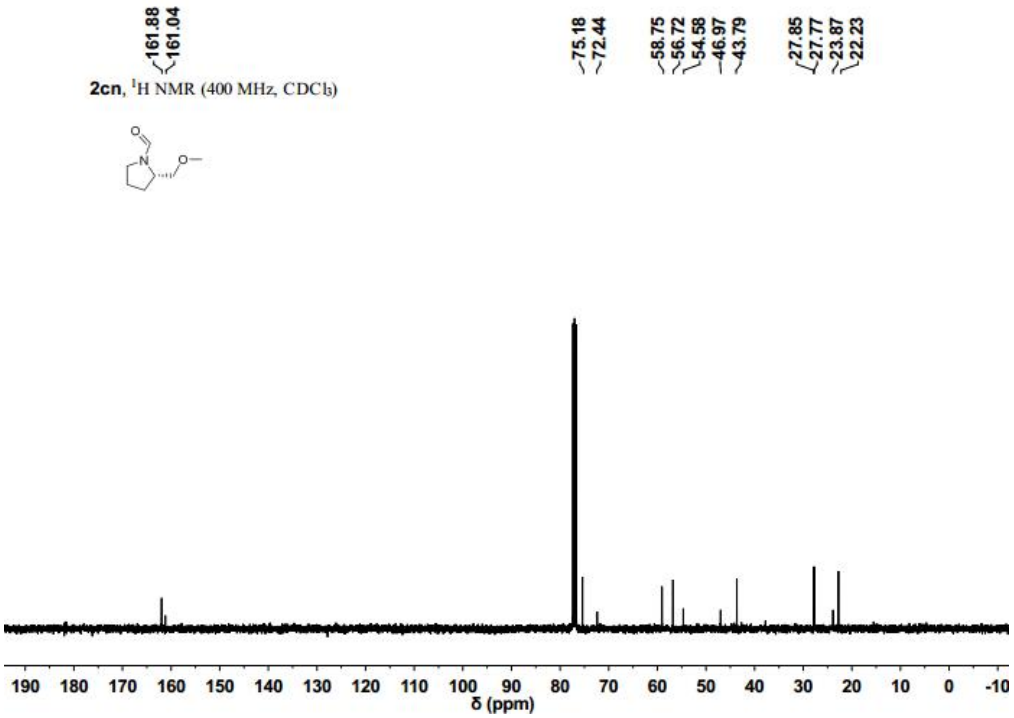
^{13}C NMR for (*R*)-2-(methoxymethyl)pyrrolidine-1-carbaldehyde, **2cm**



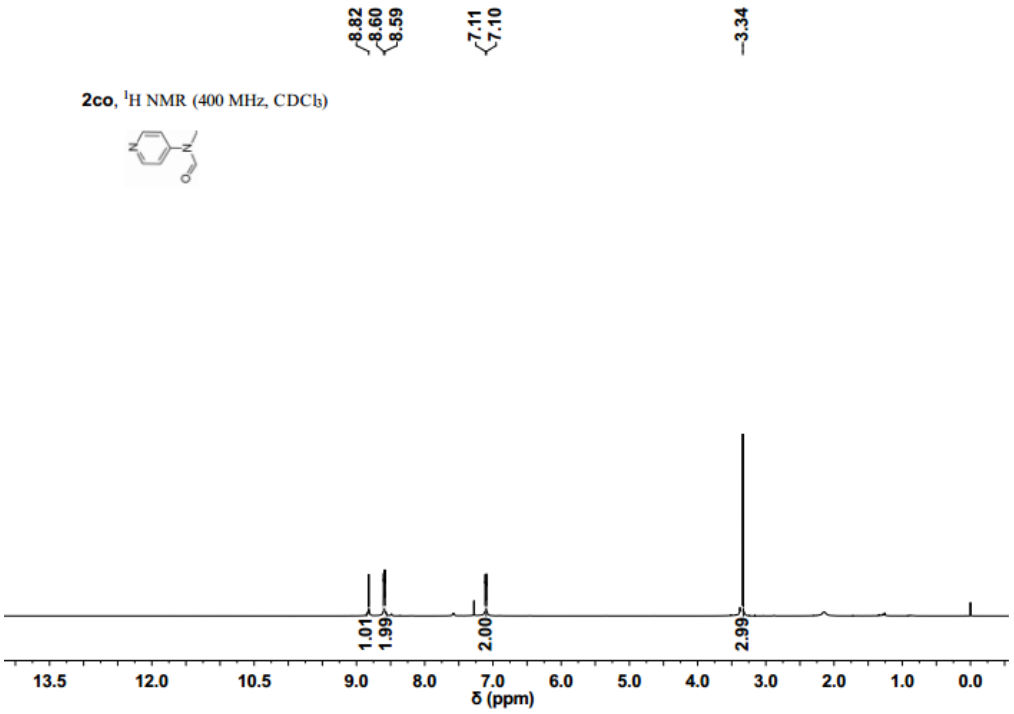
^{1}H NMR for (*S*)-2-(methoxymethyl)pyrrolidine-1-carbaldehyde, **2cn**



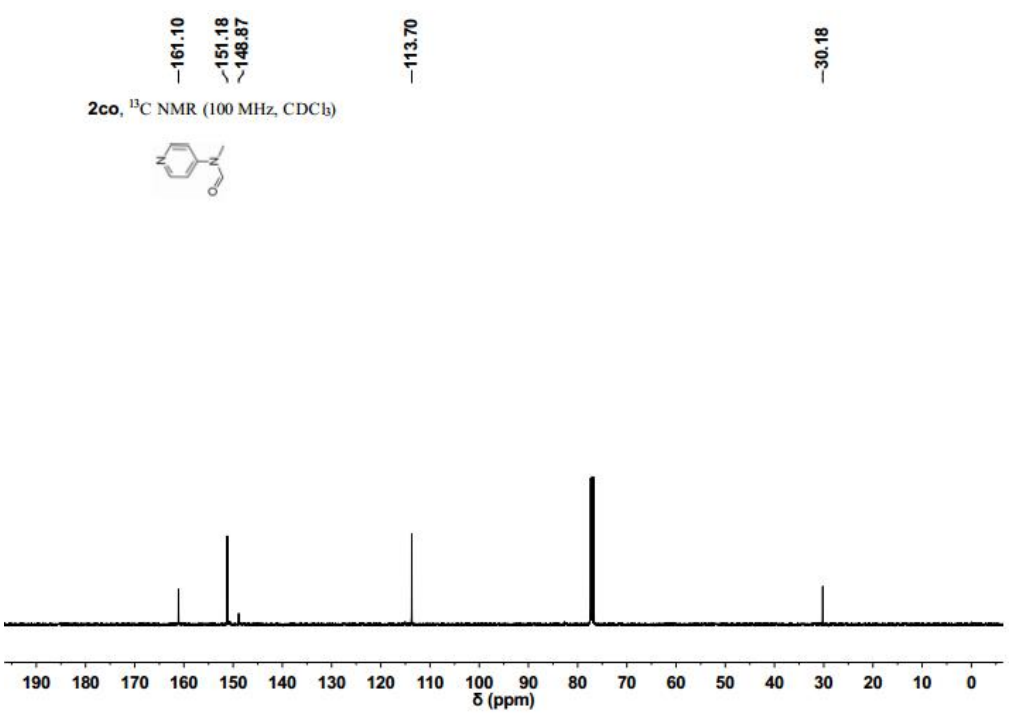
^{13}C NMR for (*S*)-2-(methoxymethyl)pyrrolidine-1-carbaldehyde, **2cn**



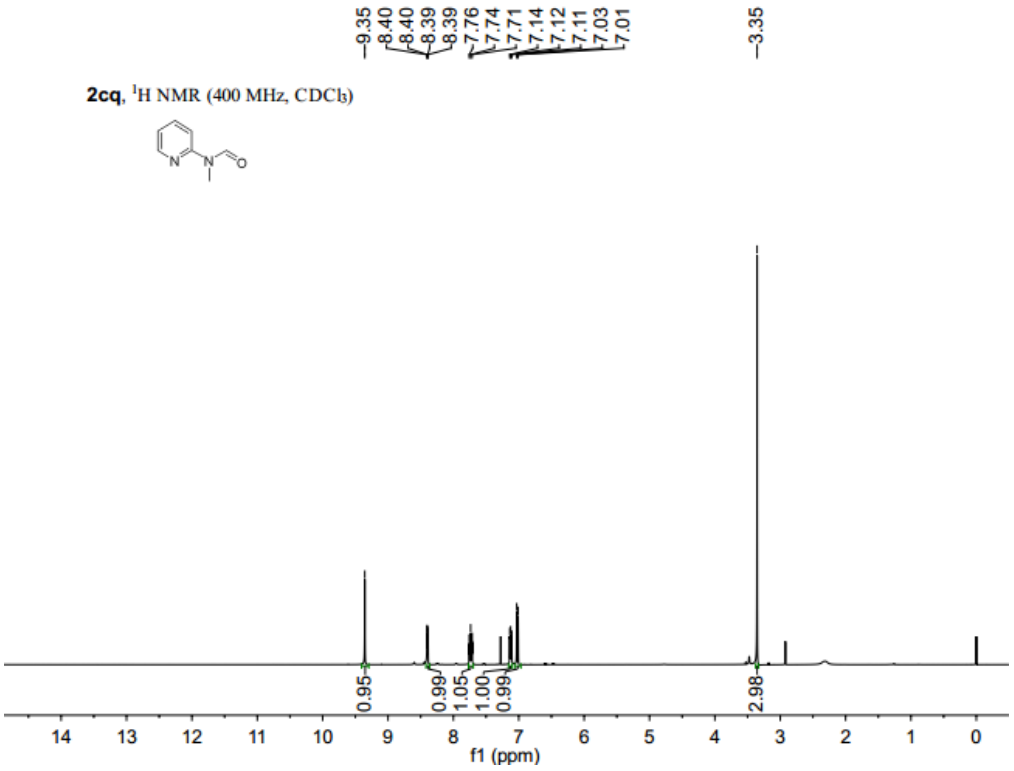
^{1}H NMR for *N*-methyl-*N*-(pyridin-4-yl)formamide, **2co**



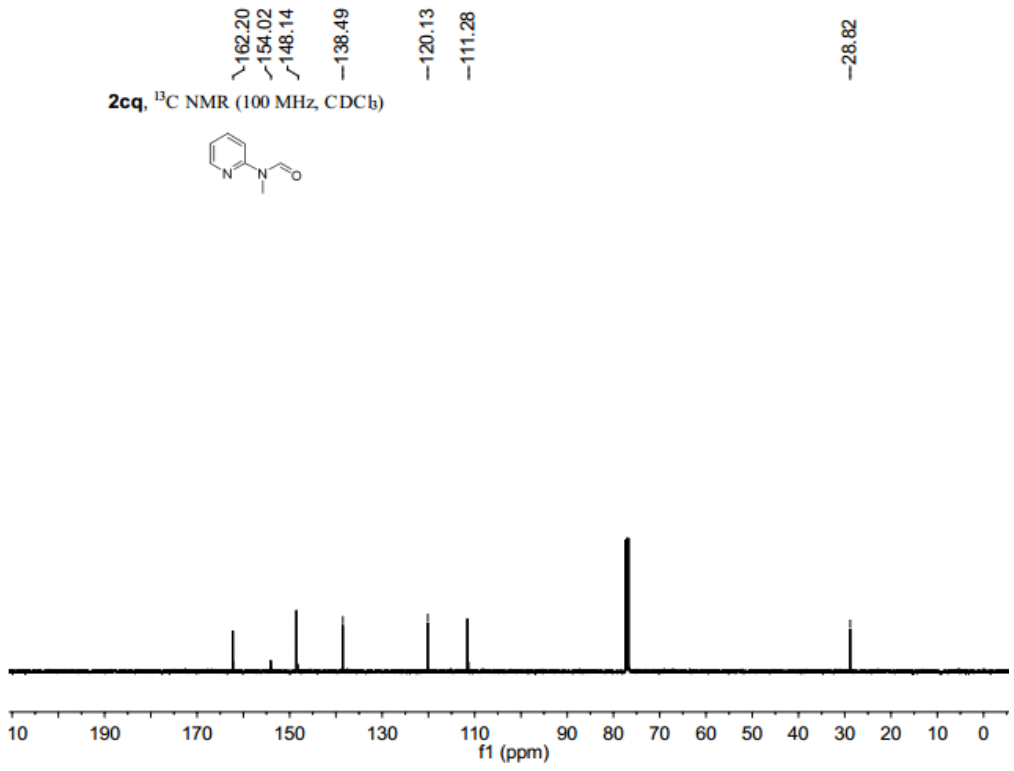
^{13}C NMR for *N*-methyl-*N*-(pyridin-4-yl)formamide, **2co**



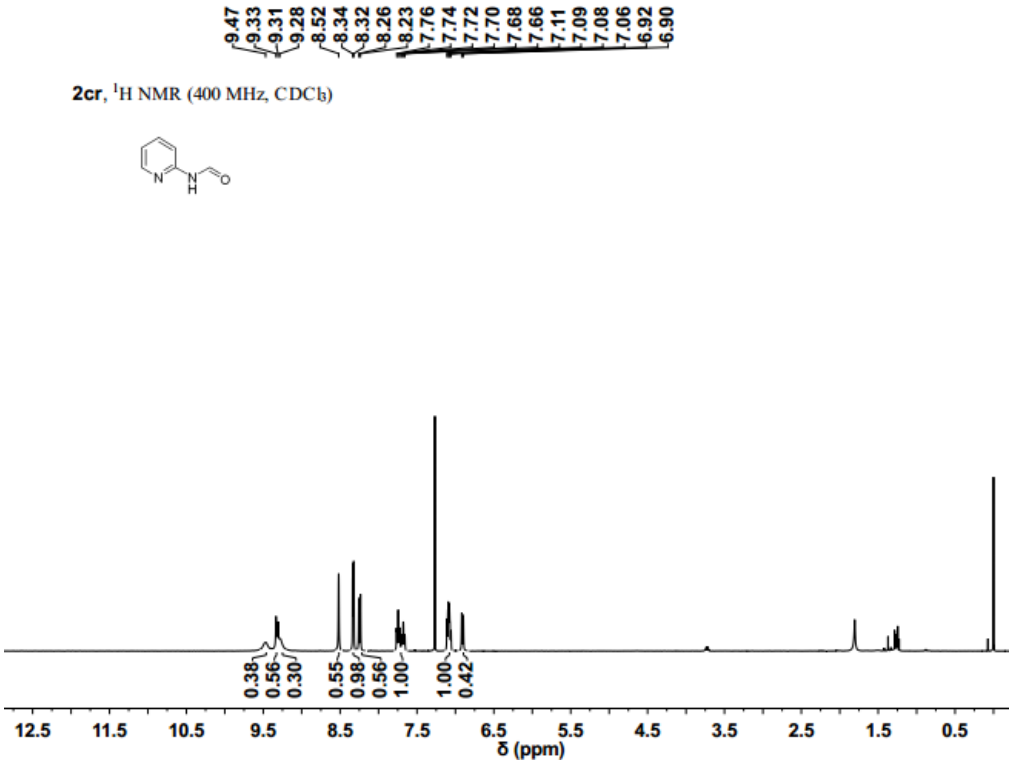
^{1}H NMR for *N*-methyl-*N*-(pyridin-2-yl)formamide, **2cq**



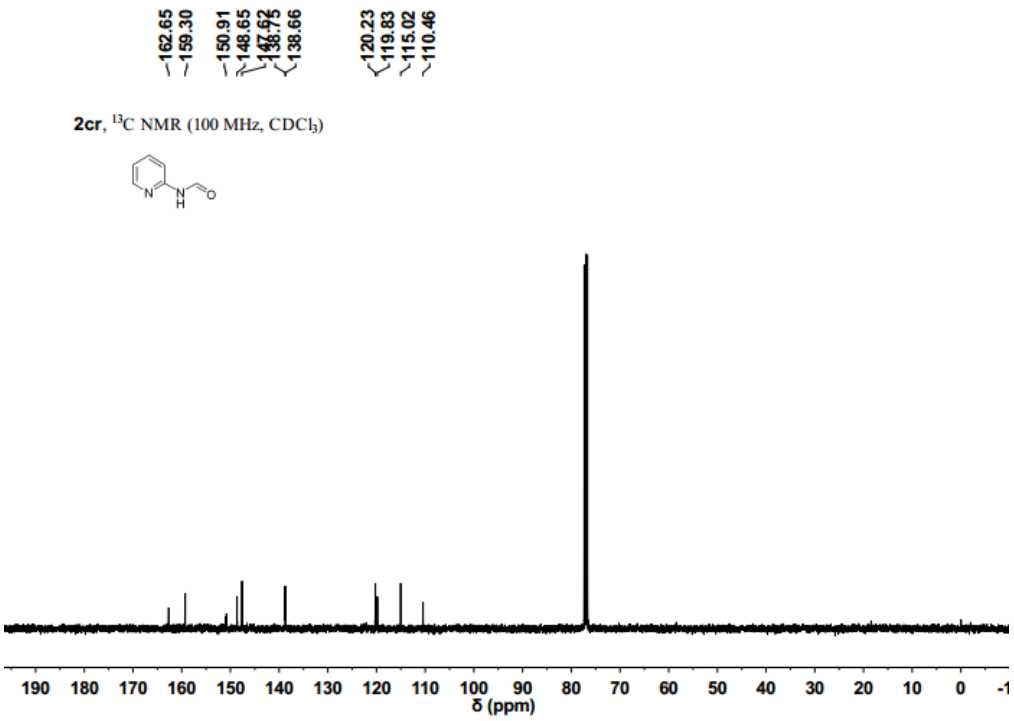
^{13}C NMR for *N*-methyl-*N*-(pyridin-2-yl)formamide, **2cq**



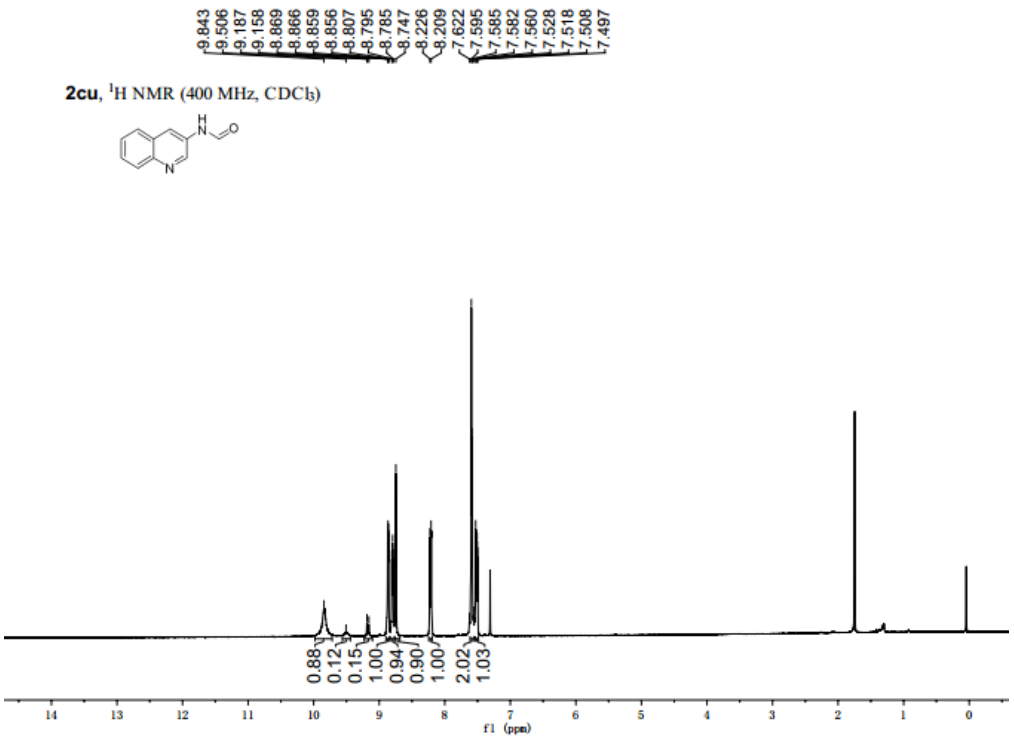
^{1}H NMR for *N*-(pyridin-2-yl)formamide, **2cr**



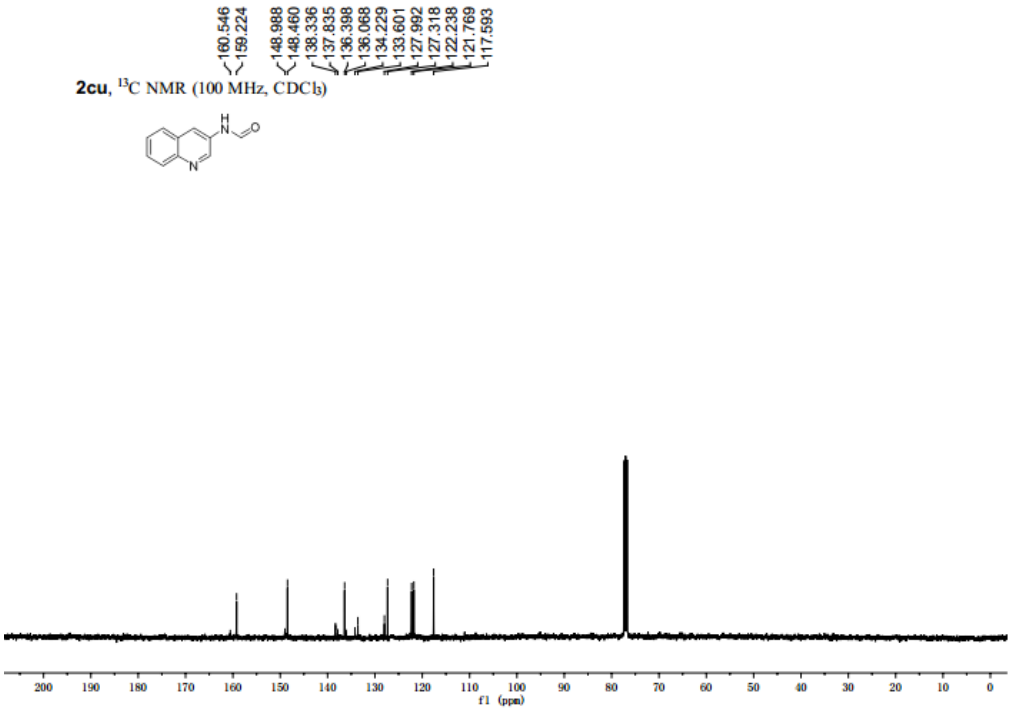
^{13}C NMR for *N*-(pyridin-2-yl)formamide, **2cr**



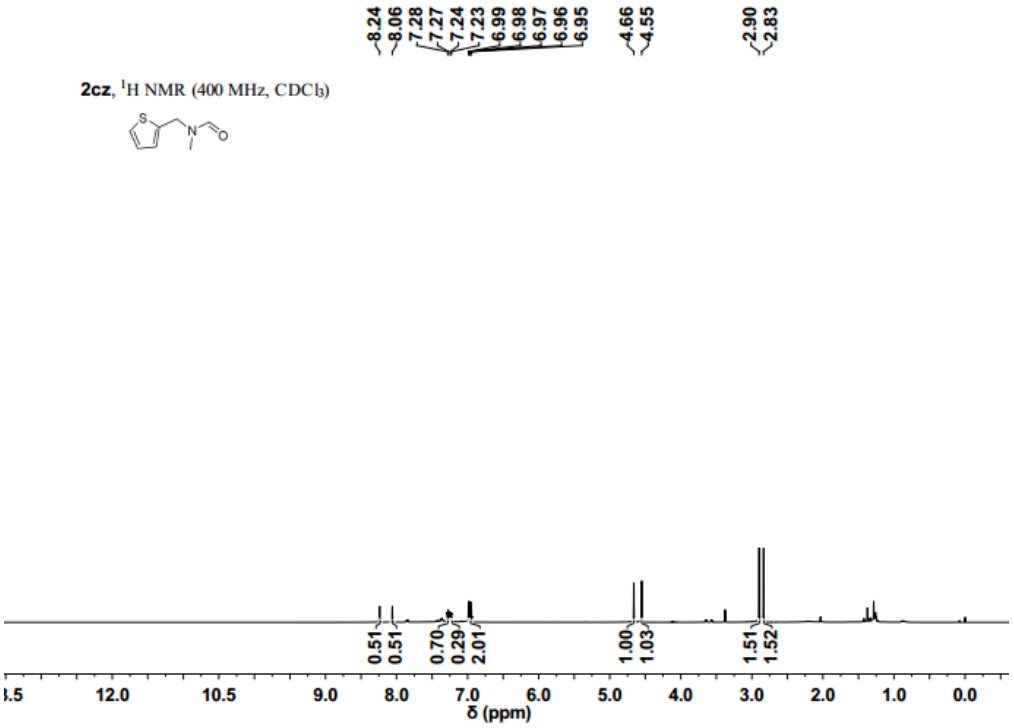
^{1}H NMR for *N*-(quinolin-3-yl)formamide, **2cu**



^{13}C NMR for *N*-(quinolin-3-yl)formamide, **2cu**



^{1}H NMR for *N*-methyl-*N*-(thiophen-2-ylmethyl)formamide, **2cz**



^{13}C NMR for *N*-methyl-*N*-(thiophen-2-ylmethyl)formamide, **2cz**