Supporting Information

An efficient copper-mediated aerobic oxidative Synthesis of Benzimidazo Fused quinazolines

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Contents:

1. General Considerations

All the reagents and solvents were purchased from Sigma-Aldrich or Merck chemical Co. and were used directly without any further purification. Organic solvents were concentrated under reduced pressure on a Büchi rotary evaporator. The progress of reaction was checked by thin-layer chromatography. The plates were visualized first with UV illumination followed by iodine. ^{1}H NMR spectra were recorded at 300 or 400 MHz using Brucker DRX-300, or 400 spectrometer and are reported in parts per million (ppm) on the δ scale relative to TMS as an internal standard. Coupling constants (*J*) reported in Hz. ^{13}C NMR spectra were recorded at 50, 75 or 100 MHz. Mass spectra were obtained using JEOL SX-102 (ESI) instrument. Elemental analysis was performed using a Perkin-Elmer autosystem XL analyzer.

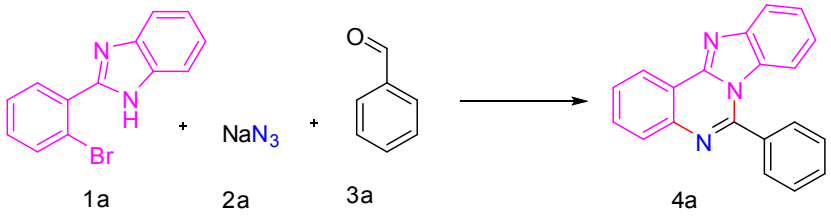
2. General procedure for the synthesis of 2-(2-halophenyl)-1H-benzo[d]imidazole derivatives

2-Halobenzoic acid (10.0 mmol) and substituted 1,2-phenylenediamine (10.0 mmol) were added to a flask charged with polyphosphoric acid (PPA) (20.0 g) and the mixture was stirred at 160 $^{\circ}$C for 10 h. The reaction solution was poured into crushed ice and neutralized with ice-cold $NaHCO_3$ aqueous solution till no gas was released.The reaction mass was then extracted with ethyl acetate (2 x 50 ml) and dried over anhydrous magnesium sulfate and concentrated. The crude compound was purified by recrystallisation from hot aq. ethanol to obtain pure desired solid product.

3. General Method for the Preparation of benzimidazo [1,2-c]quinazolines

A 50 flask equipped with a magnetic stirring bar charged with 2-(2-halophenyl)-1H-benzoimidazole (1.0 mmol), benzaldehyde (1.2 mmol), NaN_3 (2.0 mmol), Cu-powder (10 mol%), L-proline (20 mol%), and Cs_2CO_3(1.0 mmol) were taken in 4.0 mL of DMSO. The reaction mixture was heated to 80 °C for 12 h under air atmosphere. After cooling, the mixture was poured into the EtOAc (50.0 mL), washed with brine (25.0 mL) and water (2 × 25.0 mL), dried over $MgSO_4$, and passed through a Celite. Evaporation of the solvent under reduced pressure provided the crude product, which was purified by column chromatography.

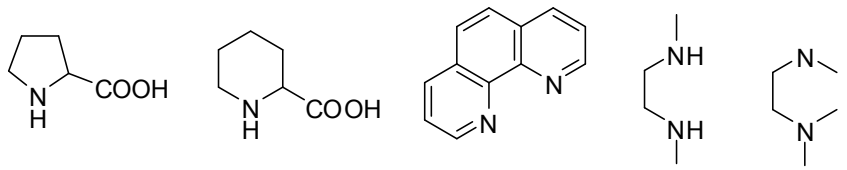
Table 1. Optimization of reaction conditions for the syn-thesis of Benzimidazo [1,2-c]quinazoline



1a 2a 3a 4a

Entry	Catalyst	Ligand	Base	Solvent	Yield[b]
1	CuI	A	Cs_2CO_3	DMSO	70
2	CuBr	A	Cs_2CO_3	DMSO	64
3	CuCl	A	Cs_2CO_3	DMSO	60
4	$Cu(OAc)_2$	A	Cs_2CO_3	DMSO	40
5	-	A	Cs_2CO_3	DMSO	0
6	**Cu powder**	**A**	**Cs_2CO_3**	**DMSO**	**89**
7	Cu powder	B	Cs_2CO_3	DMSO	55
8	Cu powder	C	Cs_2CO_3	DMSO	50
9	Cu powder	D	Cs_2CO_3	DMSO	35
10	Cu powder	E	Cs_2CO_3	DMSO	58
11	Cu powder	A	Cs_2CO_3	DMF	76
12	Cu powder	A	K_2CO_3	DMSO	40
13	Cu powder	A	K_3PO_4	DMSO	50
14	Cu powder	A	Cs_2CO_3	CH_3CN	44
15	Cu Powder	A	Cs_2CO_3	DMSO:CH_2Cl_2(1:3)	16
16.	Cu powder	A	Cs_2CO_3	DMSO:CH_2Cl_2(3:1)	64

[a]Reaction conditions:2-(2-bromophenyl)-1H-benzo[d]imidazole (1.0 mmol), Benzaldehyde (1.2 mmol), Sodium azide (2.0 mmol), Cu catalyst (10 mol%), Ligand (20 mol%), and Base (1.0 mmol) in solvents (4-5 mL) , at 80 ˚C for 12hr. [b]Isolated yield



A B C D E

Ligands Screened

4. Characterization data for synthesized compounds

6-phenylbenzo[4,5]imidazo[1,2-c]quinazoline(4a)[1,2]

Physical state: White solid; Yield 89%; mp 166-168 ˚C; ^{1}H NMR (400 MHz, $CDCl_3$) δ_H: 8.71 (d, J = 7.8 Hz, 1H), 7.95 (d, J = 8.0 Hz, 2H), 7.76 (d, J = 8.2 Hz, 1H), 7.68 (t, J = 7.2 Hz, 1H), 7.64 (d, J = 1.6 Hz, 2H), 7.56-7.50 (m, 3H), 7.44 (t, J = 7.6 Hz, 1H), 7.13 (t, J = 7.6 Hz, 1H), 6.64 (d, J = 8.3 Hz, 1H); ^{13}C NMR (75 MHz, CDCl3) δc: 148.5, 148.0, 144.4, 142.4, 134.3, 131.9, 131.0, 129.3, 129.2, 128.4, 128.3, 128.2, 125.6, 124.2, 122.6, 120.0, 118.4, 114.4; Molecular formula- $C_{20}H_{13}N_3$; ESI-MS (m/z): 296 (M+H)+; Analysis calculated for $C_{20}H_{13}N_3$: C 81.34, H 4.44, N 14.23, Found: C 81.30, H 4.45, N 14.25.

4-(benzo[4,5]imidazo[2,1-a]isoquinolin-6-yl)-N,N-dimethylaniline (4b)

Physical state: White solid; Yield 88%; mp 172-174 ˚C; ^{1}H NMR (400 MHz, DMSO-d_6) δ_H: 8.66-8.64 (m, 1H), 7.91 (d, *J* = 8.2 Hz, 2H), 7.71-7.67 (m, 1H), 7.60-7.56 (m, 3H), 7.41-7.37 (m, 1H), 7.11-7.06 (m, 1H), 6.98 (d, *J* = 8.4Hz, 1H), 6.80 (d, *J* = 8.8 Hz, 2H), 3.04 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_c: 152.4, 149.4, 148.6, 144.4, 142.8, 131.7, 129.7, 128.0, 127.6, 125.4, 124.1, 122.2, 121.28, 119.8, 118.1, 115.0, 111.8, 40.3; Molecular formula- $C_{22}H_{18}N_4$; ESI-MS (m/z): 339 $(M+H)^+$; Analysis calculated for $C_{22}H_{18}N_4$: C 78.08, H 5.36, N 16.56, Found: C 78.05, H 5.42, N 16.58.

2,4-dichlorophenyl)benzo[4,5]imidazo[2,1-a]isoquinoline(4c)

Physical state: White solid; Yield 75%; mp > 250 ˚C; ^{1}H NMR (400 MHz, $CDCl_3$) δ_H: 8.71 (d, *J* = 7.8 Hz, 1H), 7.95 (d, *J* = 8.0 Hz, 2H), 7.78-7.74 (m, 1H), 7.70-7.63 (m, 2H), 7.57-7.51 (m, 2H), 7.44 (t, *J* = 7.6 Hz, 1H), 7.13 (t, *J* = 7.6 Hz, 1H), 6.44 (d, *J* = 8.3 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_c: 147.5, 144.9, 144.3, 142.1, 137.8, 134.5, 132.2, 132.0, 131.3, 130.3, 128.9, 128.8, 128.4, 128.4, 125.9, 124.3, 123.4, 120.2, 118.7, 112.8; Molecular formula- $C_{21}H_{11}Cl_2N_2$; ESI-MS (m/z): 364 $(M+H)^+$; Analysis calculated for $C_{20}H_{11}Cl_2N_3$: C 65.95, H 3.04, N 11.54, Found: C 65.91, H 3.05, N 11.58.

6-(naphthalen-1-yl)benzo[4,5]imidazo[1,2-c]quinazoline (4d)

Physical state: White solid; Yield 94%; mp > 250 ˚C; ^{1}H NMR (400 MHz, $CDCl_3$ d_6) δ_H: 8.84 (d, *J* = 7.6 Hz, 1H), 8.21 (d, *J* = 7.9 Hz, 1H), 8.05 (t, *J* = 9.0 Hz, 2H), 7.96 (d, *J* = 7.6

Hz, 1H), 7.87-7.72 (m, 4H), 7.55 (t, *J* = 7.2 Hz, 1H), 7.48 (d, *J* = 8.3 Hz, 1H), 7.37 (d, *J* = 6.3 Hz, 2H), 6.87 (t, *J* = 7.6 Hz, 1H), 5.93 (d, *J* = 8.4 Hz, 1H);^{13}C NMR (75 MHz, $CDCl_3$) δ_c: 147.8, 147.6, 144.3, 142.5, 133.7, 131.9, 131.6, 131.1, 130.7, 129.0, 128.7, 128.5, 128.4, 127.8, 127.0, 126.9, 125.7, 125.6, 124.4, 124.3, 122.9, 119.8, 118.6, 113.9; Molecular formula- $C_{24}H_{15}N_3$; ESI-MS (m/z): 346 $(M+H)^+$; Analysis calculated for $C_{24}H_{15}N_3$: C 83.46, H 4.38, N 12.17, Found: C 83.43, H 4.40, N 12.18.

4-nitrophenyl)benzo[4,5]imidazo[1,2-c]quinazoline (4e)

Physical state: Yellow solid; 65%; mp 240-242 ˚C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 8.80 (d, *J* = 7.6 Hz, 1H), 8.56 (d, *J* = 7.5 Hz, 2H), 8.03 (t, *J* = 7.2 Hz, 4H), 7.86 (t, *J* = 7.3 Hz, 1H,), 7.78 (t, *J* = 7.8 Hz, 1H), 7.54 (t, *J* = 7.4 Hz, 1H), 7.20 (t, *J* = 8.1Hz, 1H), 6.69 (d, *J* = 8.4 Hz, 1H);^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6) δ_c: 149.2, 144.2, 140.2, 132.4, 130.6, 129.0, 128.4, 125.9, 124.6, 124.2, 123.1, 120.0, 118.6, 114.2; Molecular formula- $C_{20}H_{12}N_4O_2$; ESI-MS (m/z): 341 $(M+H)^+$; Analysis calculated for $C_{20}H_{12}N_4O_2$: C 70.58, H 3.55, N 16.46, Found: C 70.59, H 3.50, N 16.50.

6-(2,5-dimethoxyphenyl)benzo[4,5]imidazo[1,2-c]quinazoline (4f)

Physical state: White solid; Yield 82%; mp > 250 ˚C; ^{1}H NMR (300 MHz, DMSO-d_6) δ_H: 8.66 (d, *J* = 7.9 Hz, 1H), 8.00-7.89 (m, 3H), 7.81 (t, *J* = 7.5 Hz, 1H), 7.61 (t, *J* = 7.3Hz, 1H), 7.31 (s, 3H), 7.22 (t, *J* = 7.8 Hz, 1H), 6.50 (d, *J* = 8.3Hz, 1H), 3.80 (s, 3H), 3.55 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6) δ_c: 154.0, 151.4, 147.3, 146.5, 144.2, 142.5, 132.5, 129.4, 128.9, 128.4, 125.9, 124.2, 124.0, 123.3, 120.0, 118.5, 117.9, 115.7, 113.5, 56.5, 56.2; Molecular formula- $C_{22}H_{17}N_3O_2$; ESI-MS (m/z): 356 $(M+H)^+$; Analysis calculated for $C_{22}H_{17}N_3O_2$: C 74.35, H 4.82, N 11.82, Found: C 74.38, H 4.83, N 11.85.

6-(3,5-dimethoxyphenyl)benzo[4,5]imidazo[1,2-c]quinazoline (4g)

Physical state: Light yellow solid; Yield 85%; mp > 250 ˚C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 8.76 (d, *J* = 7.9 Hz, 1H), 8.01 (t, *J* = 7.7 Hz, 2H), 7.81 (t, *J* = 7.3Hz, 1H), 7.72 (t, *J* = 7.7 Hz, 1H), 7.49 (t, *J* = 7.6Hz, 1H), 7.18 (t, *J* = 7.9 Hz, 1H), 6.85 (s, 2H), 6.76 (d, *J* = 7.8 Hz, 2H), 3.85 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_c: 161.6, 148.2, 147.9, 144.4, 142.3, 135.8, 131.9, 129.2, 128.3, 125.7, 124.2, 122.8, 119.9, 118.5, 114.6, 106.1, 103.4, 55.7; Molecular

formula- $C_{22}H_{17}N_3O_2$; ESI-MS (m/z): 356 $(M+H)^+$; Analysis calculated for $C_{22}H_{17}N_3O_2$: C 74.35, H 4.82, N 11.82, Found: C 74.30, H 4.84, N 11.85.

6-(2,4,5-trimethoxyphenyl)benzo[4,5]imidazo[1,2-c]quinazoline(4h)

Physical state: Yellow solid; Yield 80%; mp > 250 ˚C; ^{1}H NMR (300 MHz, DMSO-d_6) δ_H: 8.65 (d, *J* = 7.6 Hz, 1H), 7.99-7.87 (m, 3H),7.79 (t, *J* = 4.4Hz, 1H), 7.50 (t, *J* = 7.5Hz, 1H), 7.25 (t, *J* = 7.0Hz, 3H), 6.57 (d, *J* = 8.4Hz, 1H), 3.85 (s, 3H), 3.79(s, 6H); ^{13}C NMR (75 MHz, DMSO-d_6) δ_c: 158.6, 153.3, 152.5, 149.1, 147.2, 144.4, 137.2, 134.6, 134.3, 133.5, 133.0, 130.6, 129.0, 127.8, 124.7, 123.3, 119.4, 111.2, 65.7, 61.5; Molecular formula- $C_{23}H_{19}N_3O_3$; ESI-MS (m/z): 386$(M+H)^+$; Analysis calculated for $C_{23}H_{19}N_3O_3$: C 71.67, H 4.97, N 10.90, Found: C 71.69, H 5.00, N 10.85.

4-(benzo[4,5]imidazo[1,2-c]quinazolin-6-yl)phenol (4i)

Physical state: white solid; Yield 79%; mp 174-176 ˚C; ^{1}H NMR (400 MHz, DMSO-d_6) δ_H: 10.17 (s, 1H), 8.63-8.61 (m, 1H), 7.95-7.92 (m, 2H), 7.89-7.85 (m, 1H), 7.77-7.73 (m, 1H), 7.65-7.62 (m, 2H), 7.49-7.45 (m, 1H), 7.22-7.18 (m, 1H), 7.06-7.03 (m, 2H), 6.69 (d, *J* = 8.4Hz, 1H); ^{13}C NMR (75 MHz, DMSO-d_6) δ_c: 160.0, 149.2, 148.0, 144.4, 142.6, 132.3, 130.6, 129.7, 128.4, 128.2, 125.7, 125.3, 124.2, 122.7, 120.0, 118.4, 116.1, 114.7.; Molecular formula- $C_{20}H_{13}N_3O$; ESI-MS (m/z): 312$(M+H)^+$; Analysis calculated for $C_{20}H_{13}N_3O$: C 77.16, H 4.21, N 13.50, Found: C 77.20, H 4.23, N 13.45.

6-(3,4,5-trimethoxyphenyl)benzo[4,5]imidazo[1,2-c]quinazoline (4j)

Physical state: White solid; Yield 81%; mp >250 ˚C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 8.78 (d, *J* = 7.0 Hz, 1H), 8.03 (d, *J* = 3.0 Hz, 2H),7.84 (t, *J* = 3.6 Hz, 1H), 7.52 (t, *J* = 7.2 Hz, 1H), 7.25 (d, *J* = 7.2 Hz, 1H), 7.21(t, *J* = 4.9 Hz, 1H), 6.98 (s, 2H),6.81 (d, *J* = 8.3 Hz, 1H), 4.62 (s, 3H), 3.91 (s, 6H);^{13}C NMR (100 MHz, DMSO-d_6) δ_c: 153.9, 148.6, 142.5, 132.4, 129.9, 129.6, 128.7, 128.3, 125.8, 124.2, 123.0, 120.0, 114.7, 106.5, 60.9, 56.7; Molecular formula- $C_{23}H_{19}N_3O_3$; ESI-MS (m/z): 386 $(M+H)^+$; Analysis calculated for $C_{23}H_{19}N_3O_3$: C 71.67, H 4.97, N 10.90, Found: C 71.69, H 4.98, N 10.92.

9-nitro-6-(2,4,5-trimethoxyphenyl)benzo[4,5]imidazo[1,2-c]quinazoline(4k)

Physical state: White solid; Yield 65%; mp > 250 ˚C; ^{1}H NMR (400 MHz, DMSO-d_6) δ_H: 8.74(d, *J* = 2.3 Hz, 1H), 8.68-8.66 (m, 1H), 8.15-8.13 (m, 1H),8.01-7.93 (m, 2H), 7.85-7.81(m,1H), 7.23 (s, 2H), 6.75 (d, *J* = 9.7 Hz, 1H), 3.87 (s, 3H), 3.80 (s, 6H);^{13}C NMR (100 MHz, DMSO-d_6) δ_c: 154.0, 150.9, 148.3, 145.3, 143.9, 142.6, 140.0, 133.7, 133.4, 129.3, 129.2, 128.5, 124.6, 118.0, 115.4, 106.6, 60.9, 56.1.; Molecular formula- $C_{23}H_{18}N_4O_5$; ESI-MS (m/z): 431 $(M+H)^+$;Analysis calculated for $C_{23}H_{18}N_4O_5$: C 64.18, H 4.22, N 13.02, Found: C 64.19, H 4.21, N 13.05.

4-(benzo[4,5]imidazo[1,2-c]quinazolin-6-yl)benzonitrile (4l)

Physical state: White solid; 60%, mp 230-232 ˚C; ^{1}H NMR (300 MHz, DMSO-d_6) δ_H: 8.39-8.32 (m, 3H), 7.88 (d, *J* = 7.7Hz, 1H), 7.67 (t, *J* = 7.4Hz, 2H), 7.56-7.36 (m, 6H); ^{13}C NMR (75 MHz, DMSO-d_6) δ_c: 147.4, 146.3, 143.3, 136.9, 132.0, 131.4, 130.4, 128.4, 124.7, 124.2, 123.4, 123.1, 118.9, 115.6, 114.5, 111.5; Molecular formula-$C_{21}H_{12}N_4$; ESI-MS (m/z): 321 (M+H); Analysis calculated for $C_{21}H_{12}N_4$: C 78.73, H 3.78, N 17.49, Found: C 78.76, H 3.77, N 17.47.

9-nitro-6-(3,4,5-trimethoxyphenyl)benzo[4,5]imidazo[1,2-c]quinazoline(4m)

Physical state: White solid; Yield 61%; mp >250 ˚C; ^{1}H NMR (400 MHz, $CDCl_3$) δ_H: 8.32(d, *J* = 7.2 Hz, 1H), 8.31-8.07 (m, 1H), 7.76-7.71 (m, 1H),7.46-7.32 (m, 4H), 6.54 (s, 2H), 3.75 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_c: 153.3, 152.7, 148.8, 143.7, 143.1, 137.3, 134.2, 133.2, 131.6, 128.1, 128.0, 126.4, 119.2, 118.5, 115.9, 111.7, 109.0, 105.0, 60.9, 56.1; Molecular formula- $C_{23}H_{18}N_4O_5$; ESI-MS (m/z): 431 $(M+H)^+$;Analysis calculated for $C_{23}H_{18}N_4O_5$: C 64.18, H 4.22, N 13.02, Found: C 64.19, H 4.24, N 13.06.

6-(4-chlorophenyl)benzo[4,5]imidazo[1,2-c]quinazoline(4n)

Physical state: White solid; Yield 79%; mp 234-236˚C; ^{1}H NMR (300 MHz, $CDCl_3$)δ_H: 8.68 (d, *J* = 8.2 Hz, 1H), 7.95-7.91 (m, 2H), 7.74 (t, *J* = 6.9 Hz, 1H), 7.65 (d, *J* = 8.6 Hz, 3H), 7.58 (d, *J* = 8.4 Hz, 2H), 7.42 (t, *J* = 7.5 Hz, 1H), 7.34 (t, *J* = 6.9 Hz, 1H), 7.10 (t, *J* = 7.6 Hz, 1H), 6.67 (d, *J* = 8.4 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_c: 142.3, 137.3, 132.0, 130.0, 129.6, 129.0, 128.5, 128.2, 125.8, 124.3, 122.7, 120.2, 118.4, 114.2; Molecular formula-$C_{20}H_{12}ClN_3$;ESI-MS (m/z): 330 $(M+H)^+$;Analysis calculated for $C_{20}H_{12}ClN_3$: C 72.84, H 3.67, N 12.74, Found: C 72.80, H 3.68, N 12.77.

9-nitro-6-phenylbenzo[4,5]imidazo[1,2-c]quinazoline (4o)

Physical state: White solid; Yield 74%; mp 242-244 ˚C; ^{1}H NMR (400 MHz, $CDCl_3$) δ_H: 8.84 (d, *J* = 2.0 Hz, 1H), 8.77 (d, *J* = 7.8 Hz, 1H), 8.05-7.99 (m, 2H), 7.88 (t, *J* = 8.2 Hz, 1H), 7.79-7.68 (m, 6H), 6.68 (d, *J* = 9.2 Hz, 1H); ^{13}C NMR (75 MHz, DMSO-d_6) δ_c: 153.3, 152.7, 148.8, 143.7, 143.1, 137.3, 134.2, 133.2, 131.6, 128.1, 128.0, 126.4, 119.2, 118.5, 115.9, 111.6, 109.0, 105.0, 60.9, 56.1; Molecular formula- $C_{20}H_{12}N_4O_2$; ESI-MS (m/z): 341 $(M+H)^+$; Analysis calculated for $C_{20s}H_{12}N_4O_2$: C 70.58, H 3.55, N 16.46, Found: C 70.54, H 3.56, N 16.49.

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2. Sang, P.; Xie, Y.; Zou, J.; Zhang, Y. *Org. Lett*. **2012**, *15*, 3895.

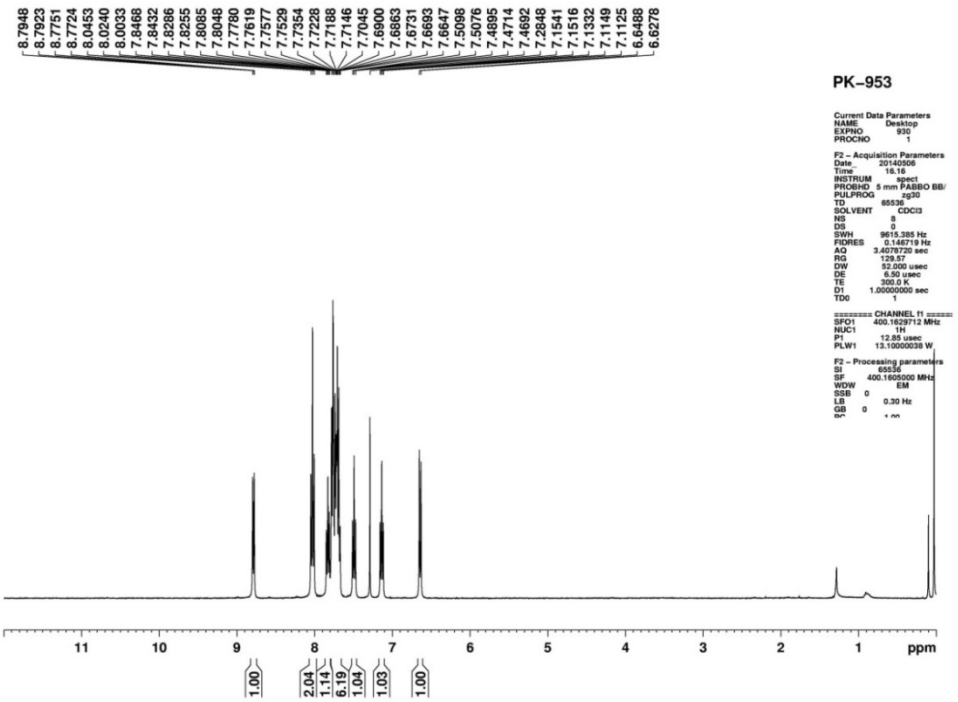

Figure 3: ^{1}H NMR of compound (4a)

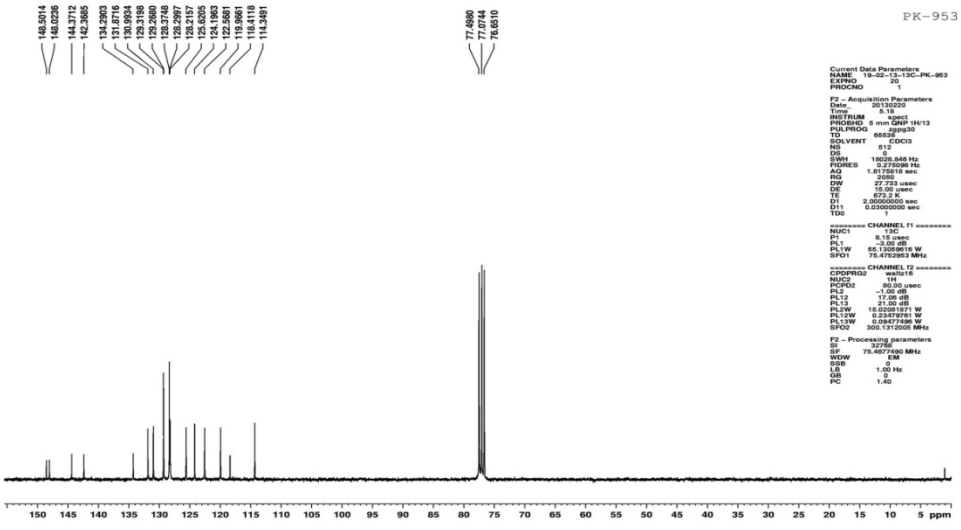

Figure 4: ^{13} C NMR of compound (4a)

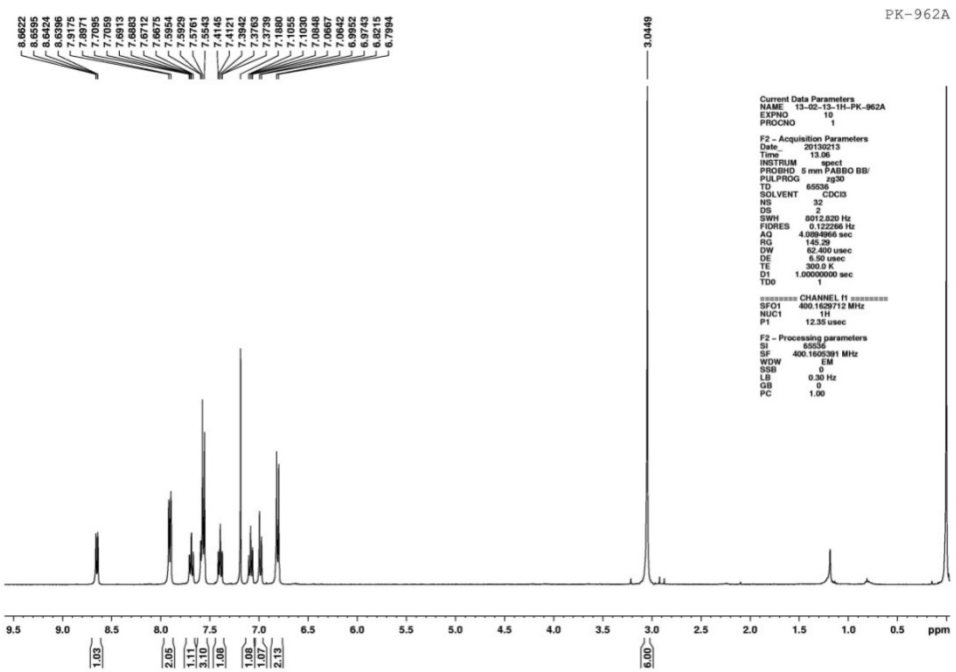

Figure 1: ^{1}H NMR of compound (4b)

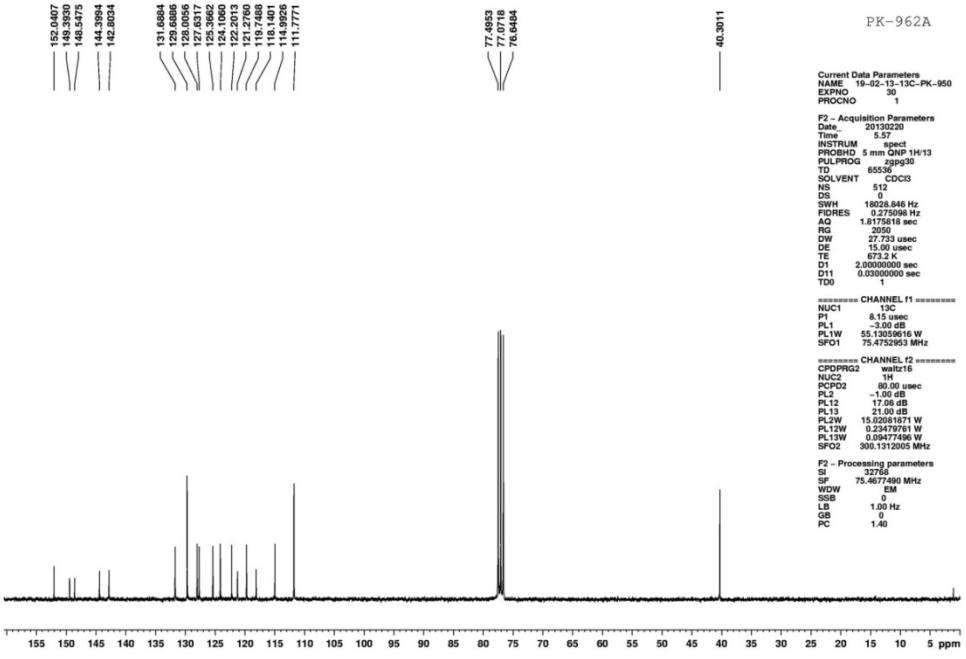

Figure 2: ^{13}C NMR of compound (4b)

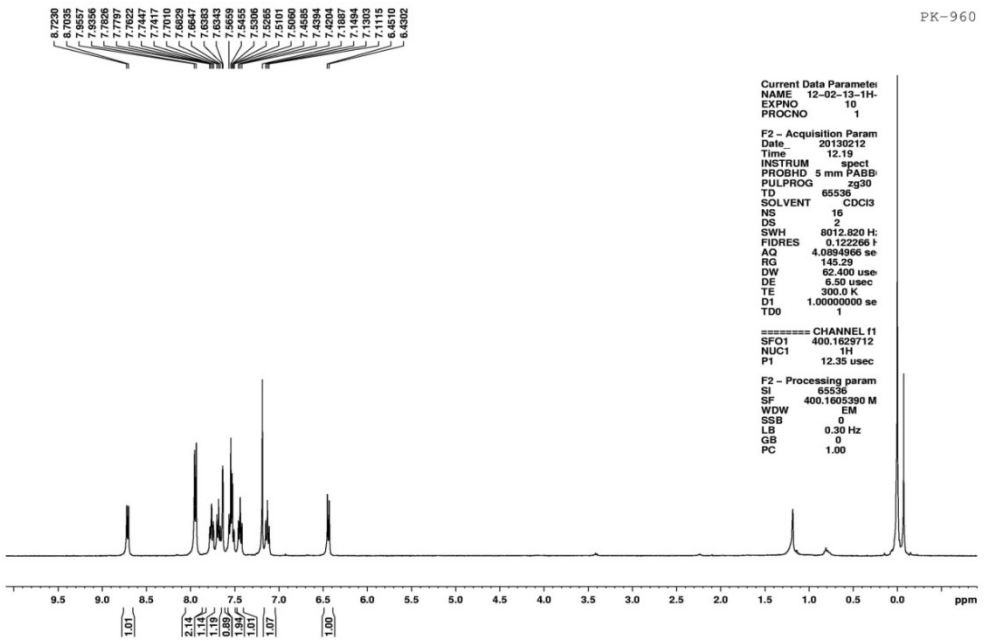

Figure 5: ^{1}H NMR of compound (4c)

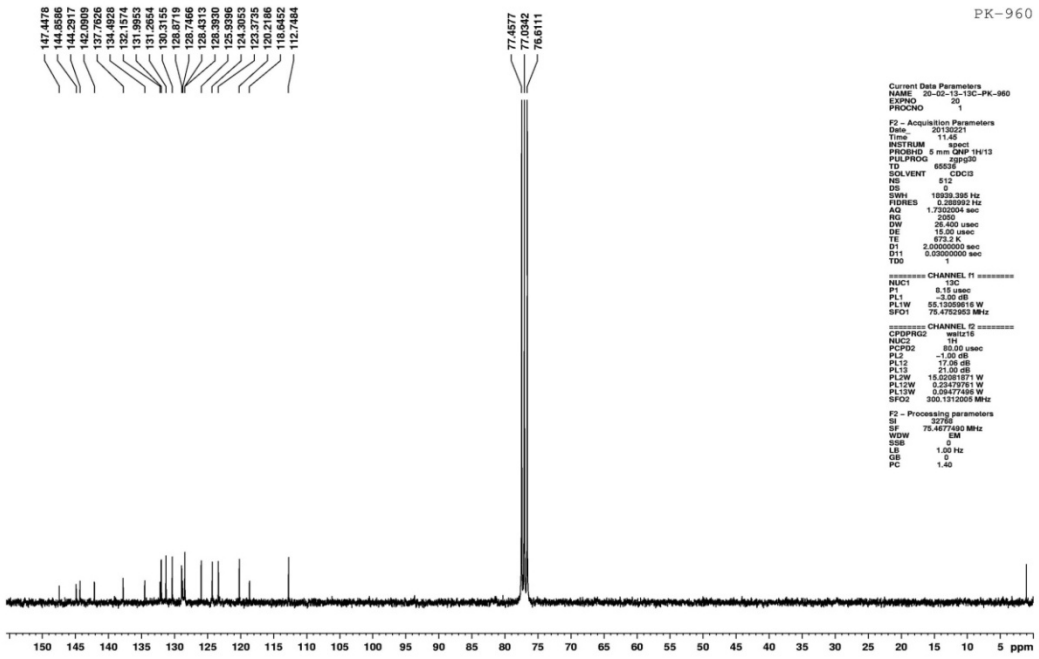

Figure 6: ^{13} C NMR of compound (4c)

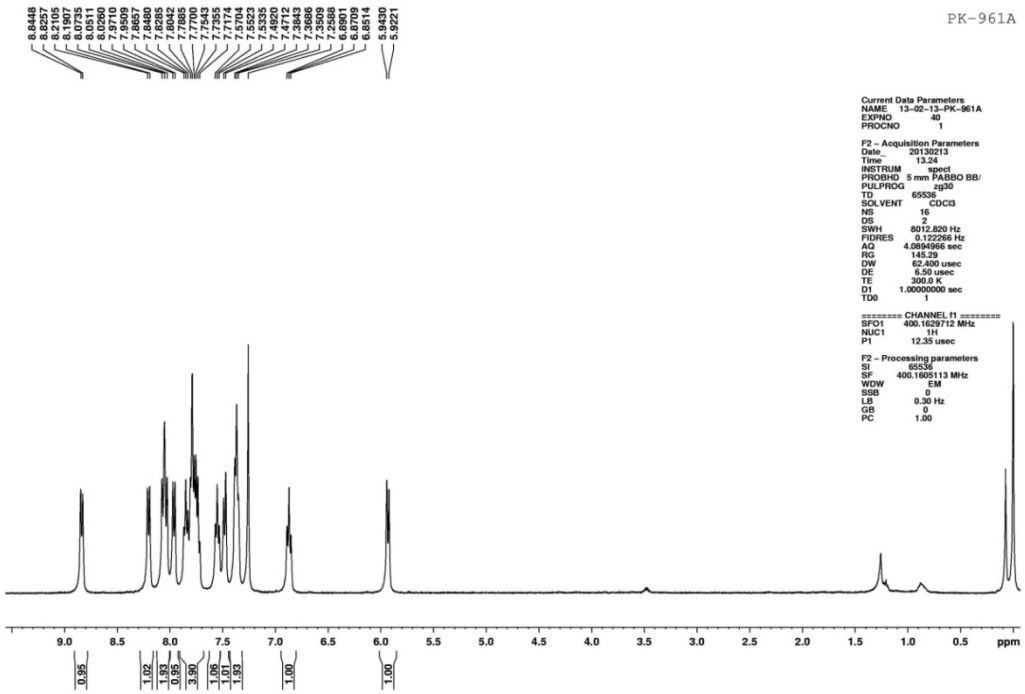

Figure 7: ^{1}H NMR of compound (4d)

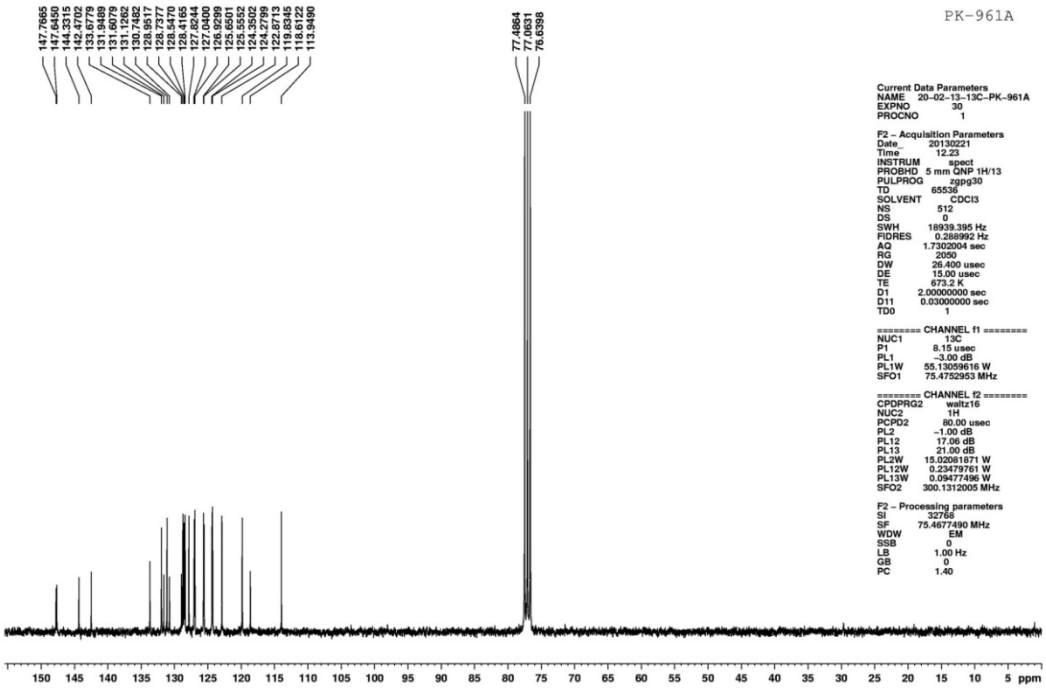

Figure 8: ^{13}C NMR of compound (4d)

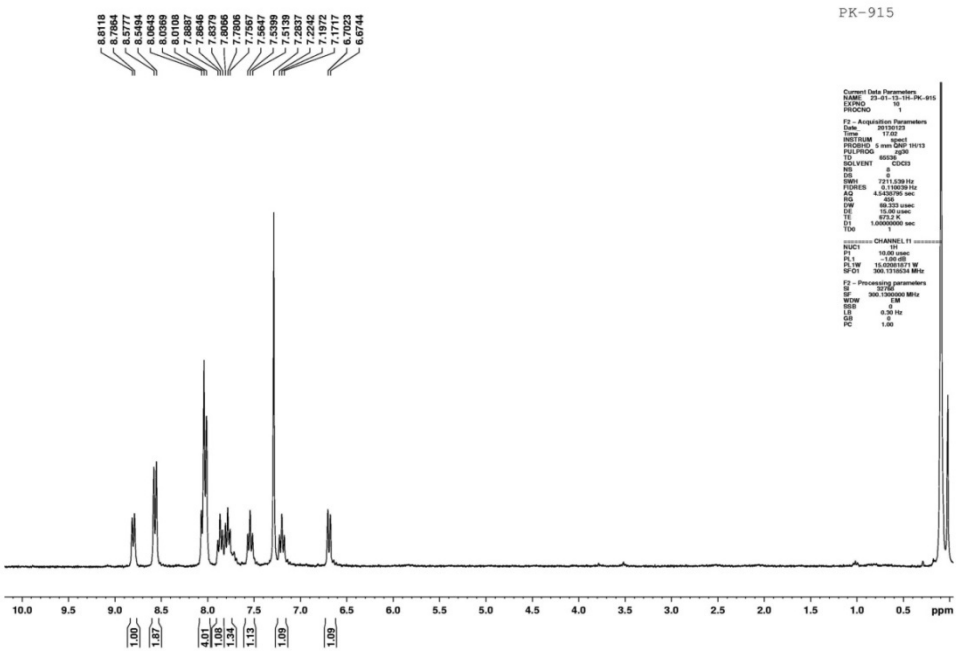

Figure 9: ^{1}H NMR of compound (4e)

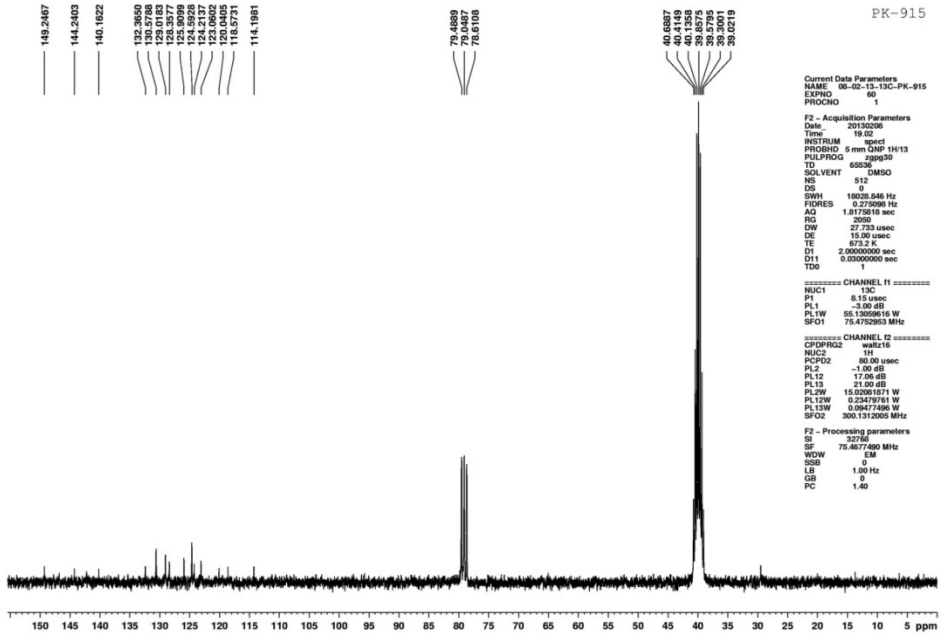

Figure 10: ^{13} C NMR of compound (4e)

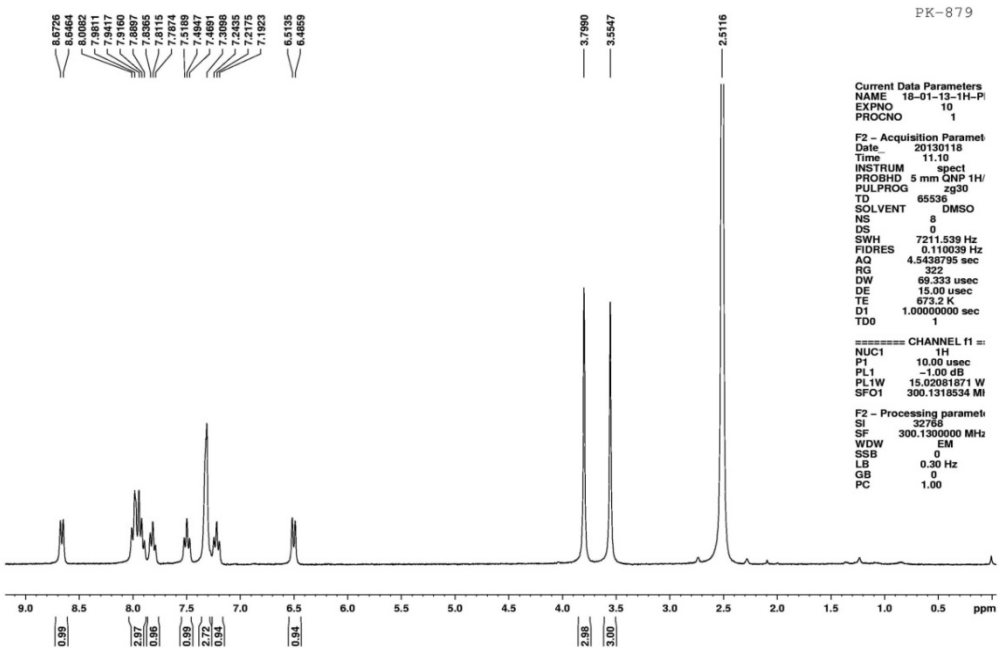

Figure 11: ^{1}H NMR of compound (4f)

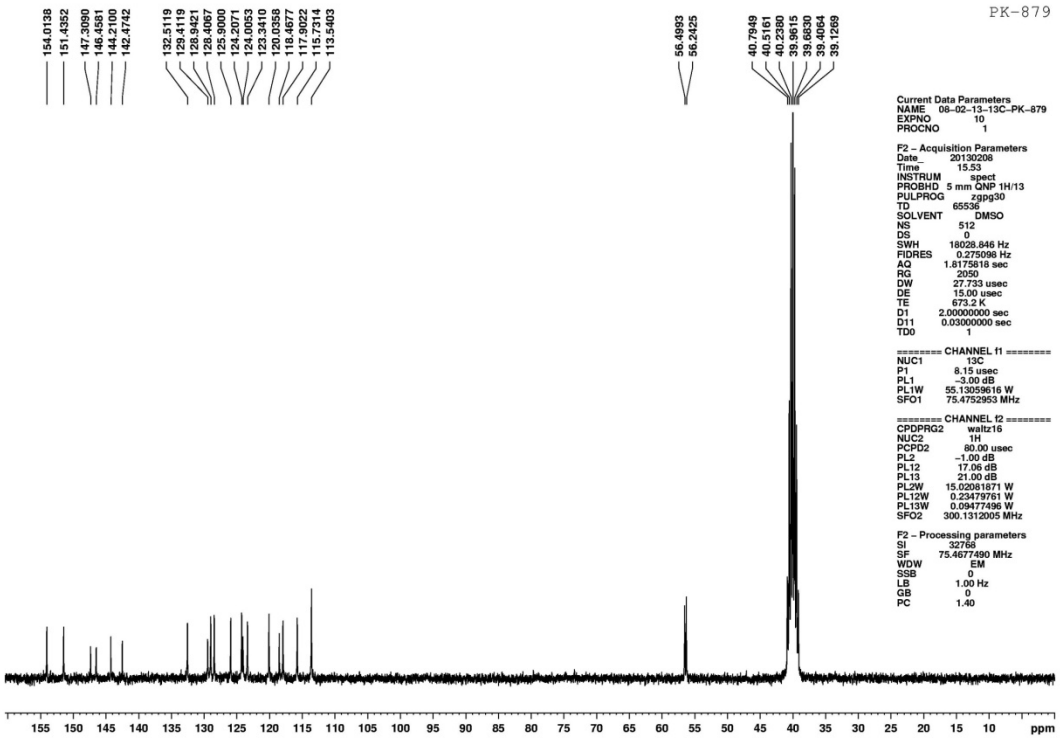

Figure 12: ^{13} C NMR of compound (4f)

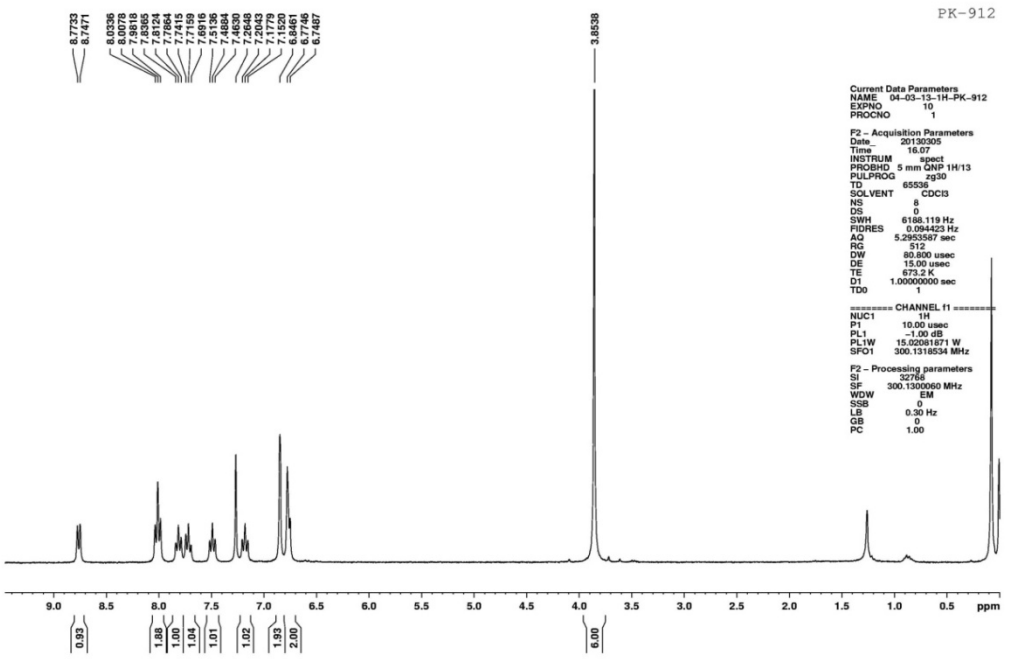

Figure 13: ^{1}H NMR of compound (4g)

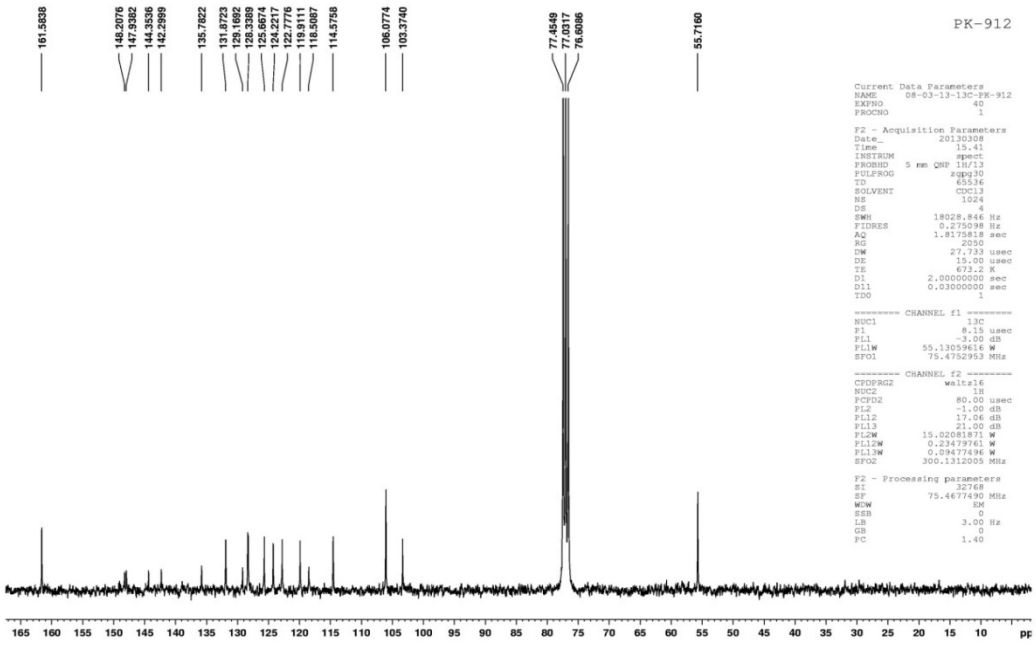

Figure 14: ^{13} C NMR of compound (4g)

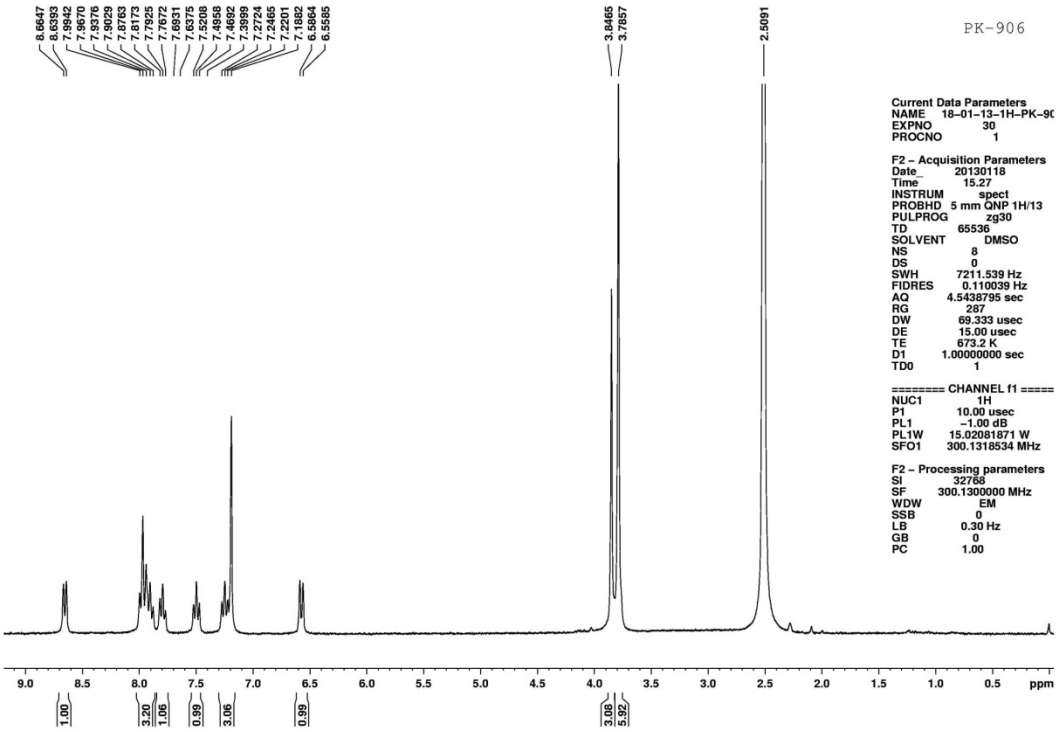

Figure 15: ^{1}H NMR of compound (4h)

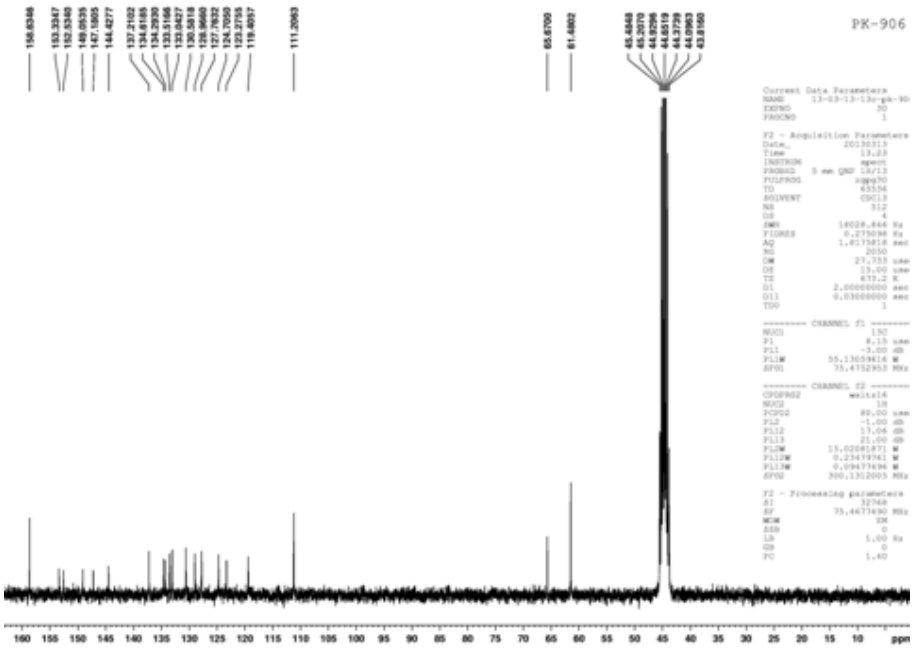

Figure 16: ^{13}C NMR of compound (4h)

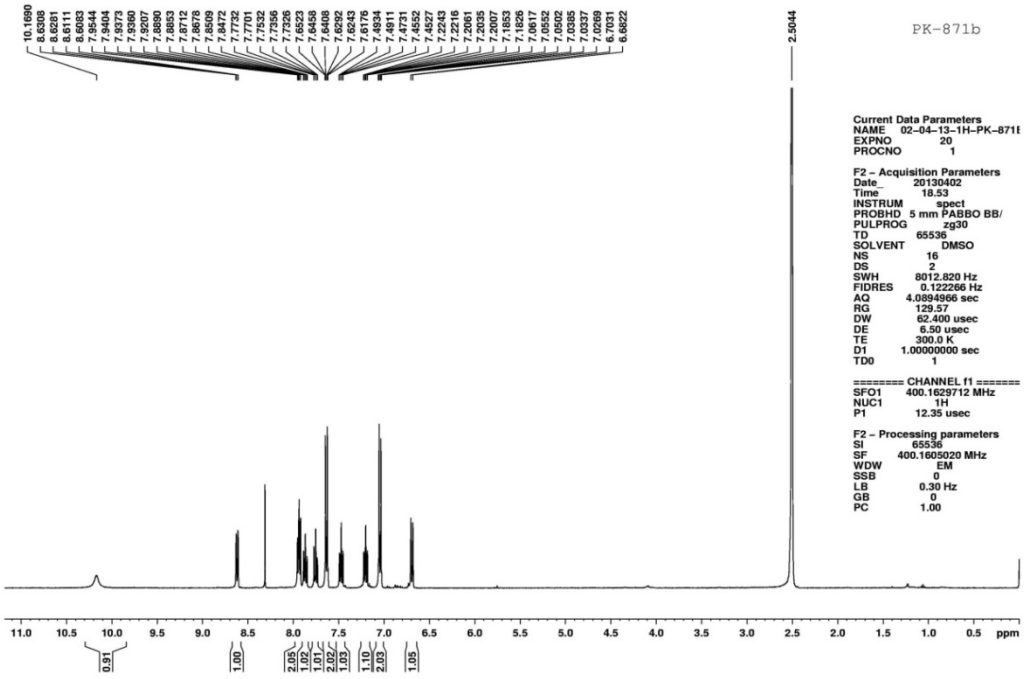

Figure 17: ^{1}H NMR of compound (4i)

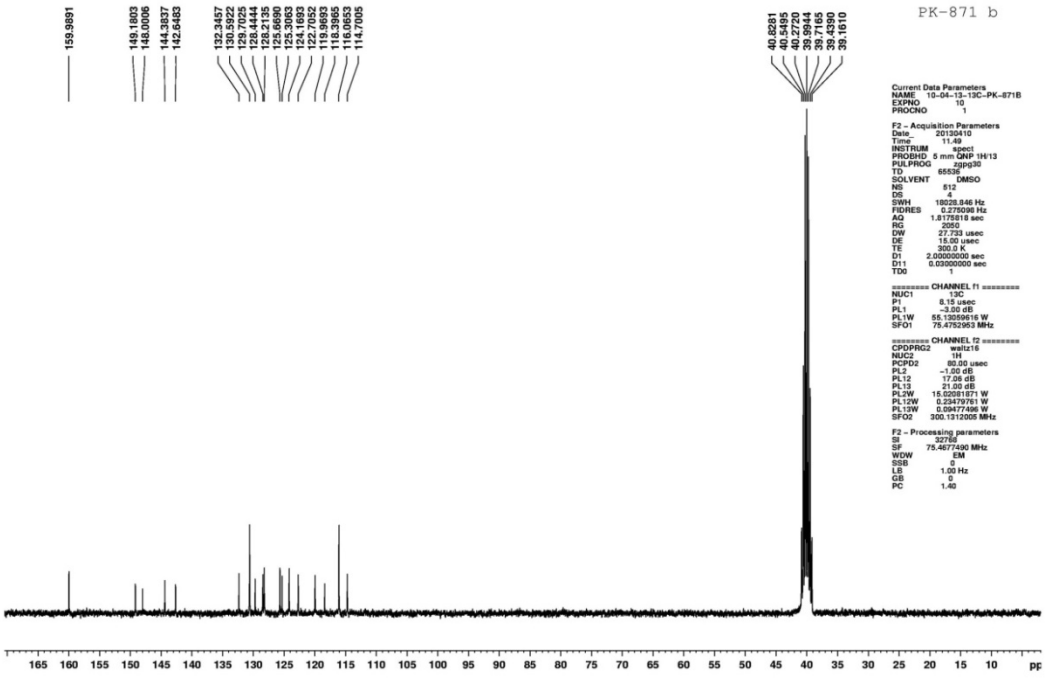

Figure 18: ^{13}C NMR of compound (4i)

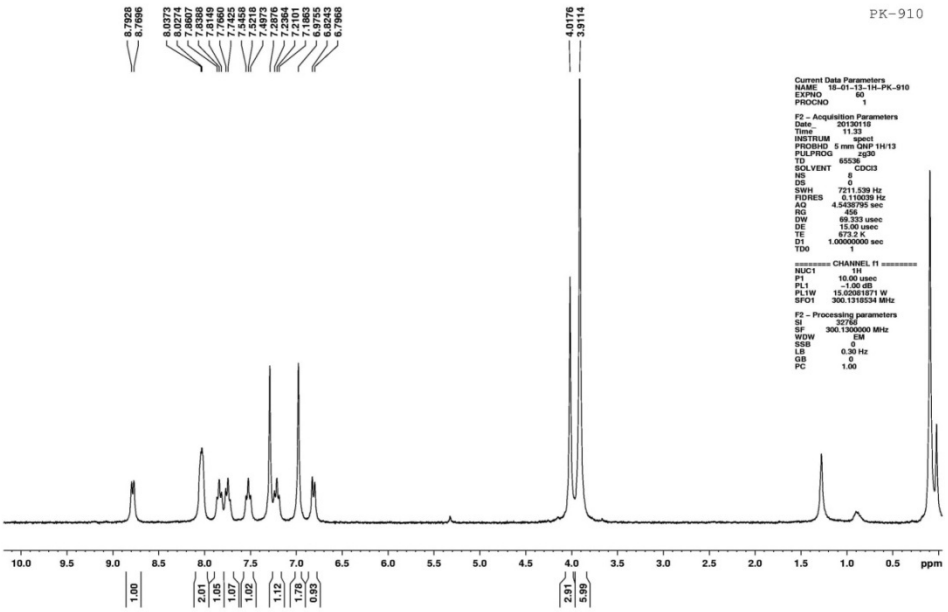

Figure 19: ^{1}H NMR of compound (4j)

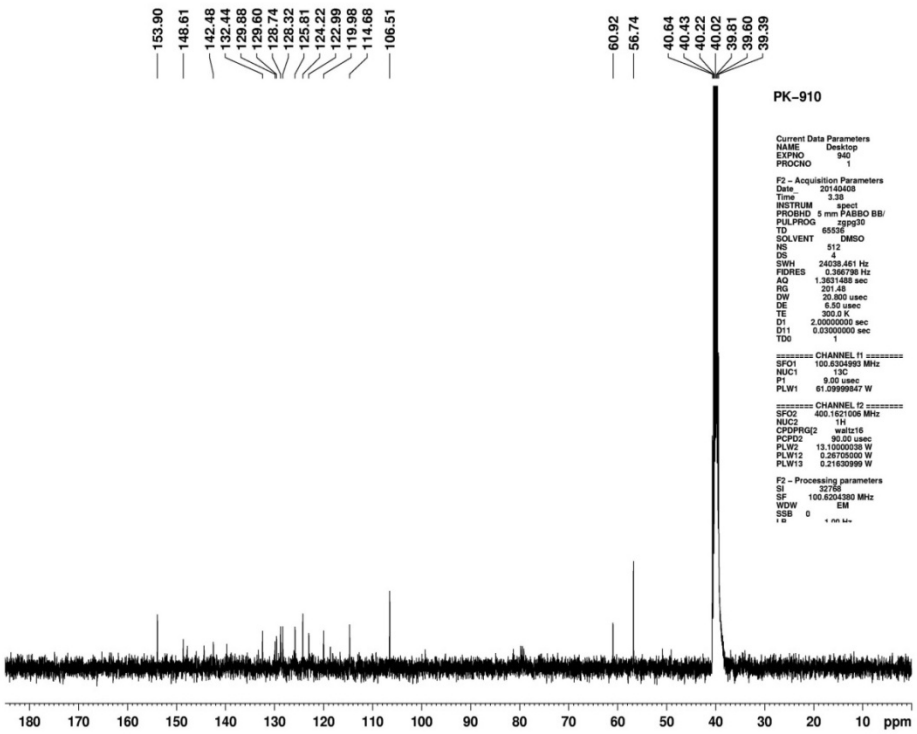

Figure 20: ^{13}C NMR of compound (4j)

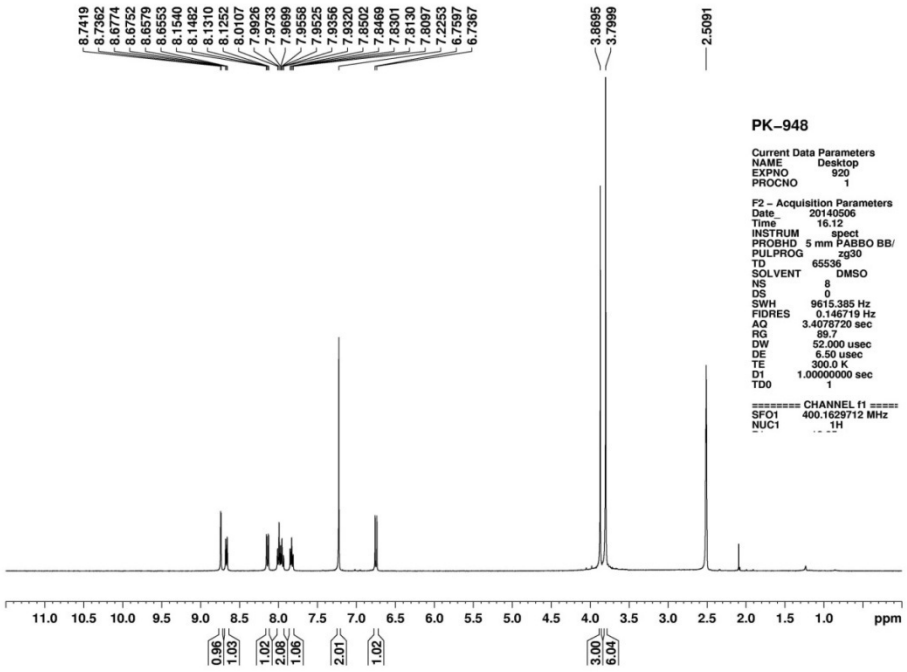

Figure 21: ^{1}H NMR of compound (4k)

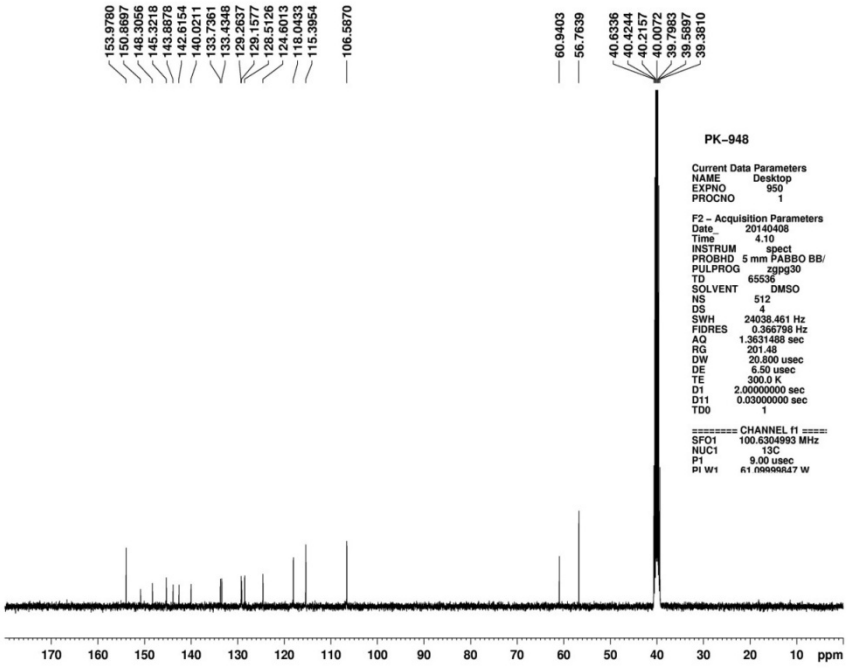

Figure 22: ^{13} C NMR of compound (4k)

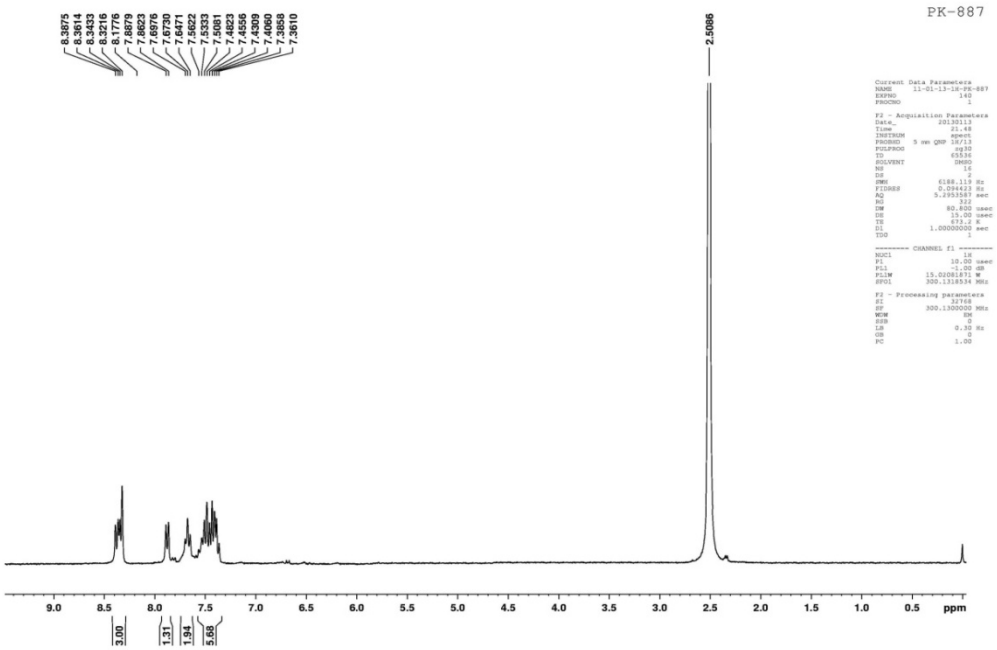

Figure 23: ^{1}H NMR of compound (4l)

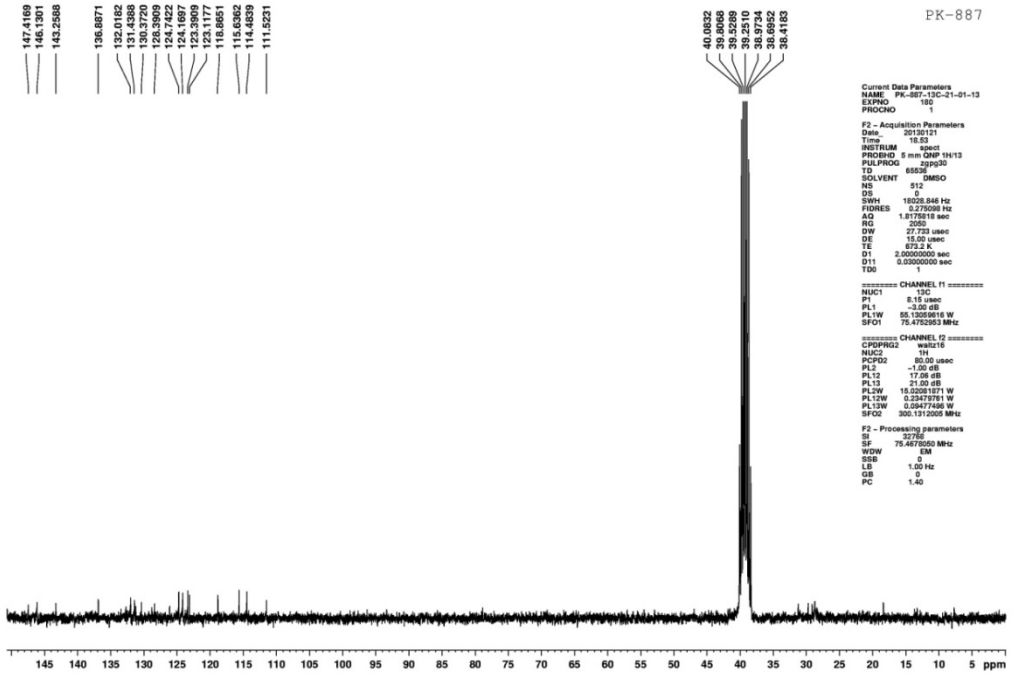

Figure 24: ^{13}C NMR of compound (4l)

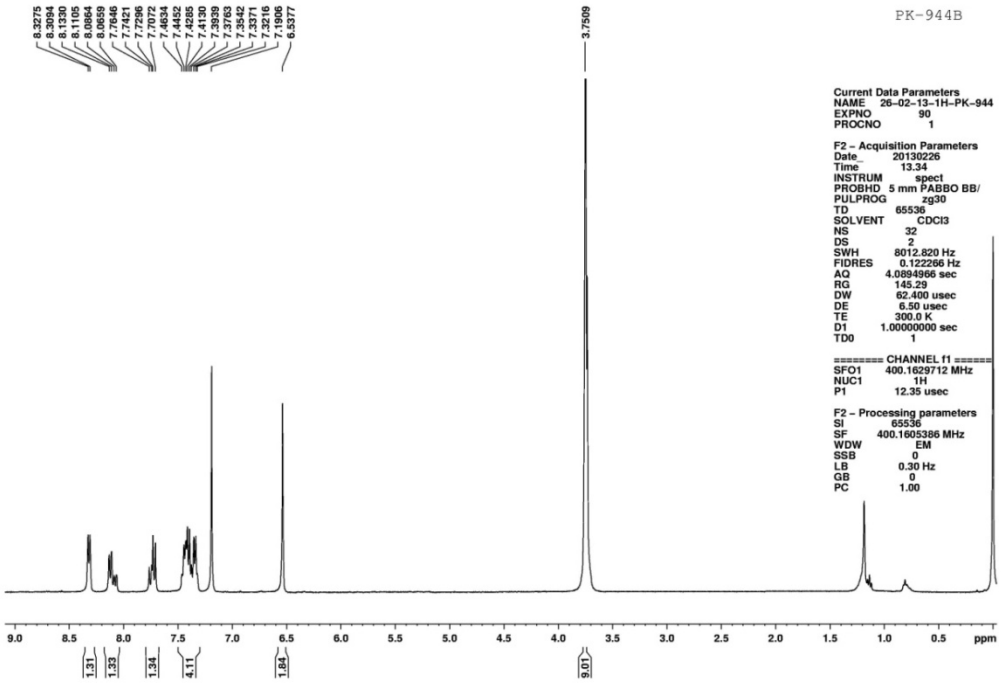

Figure 25: ^{1}H NMR of compound (4m)

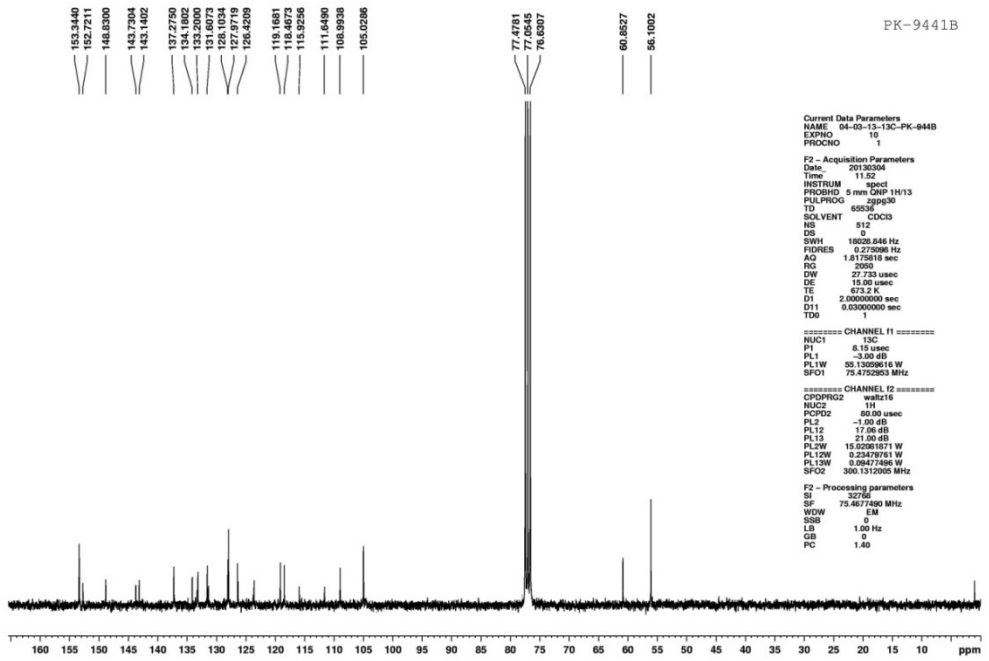

Figure 26: ^{13}C NMR of compound (4m)

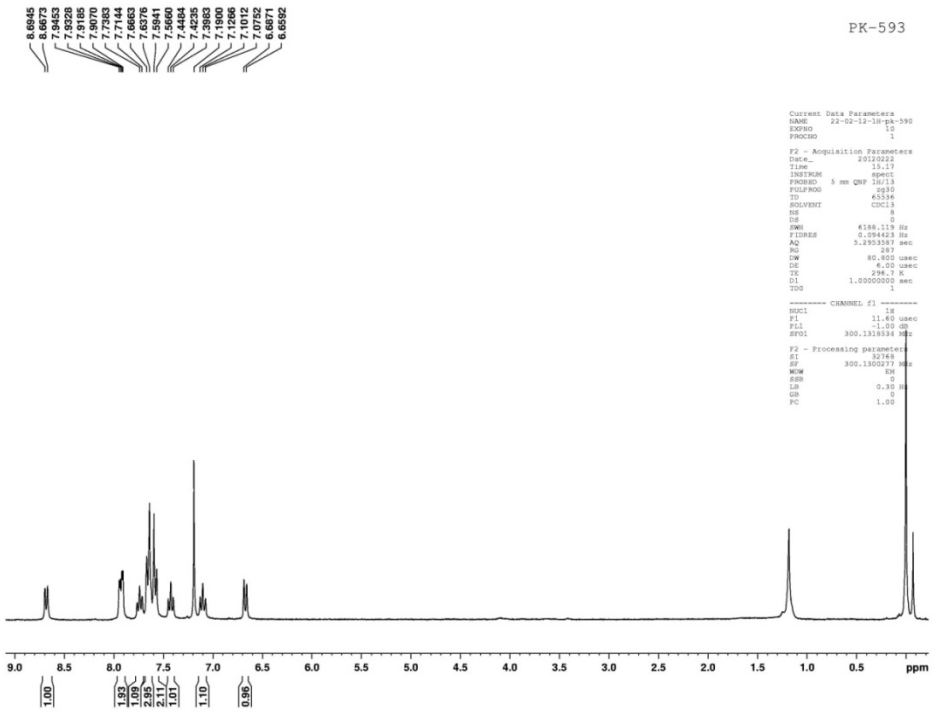

Figure 27: ^{1}H NMR of compound (4n)

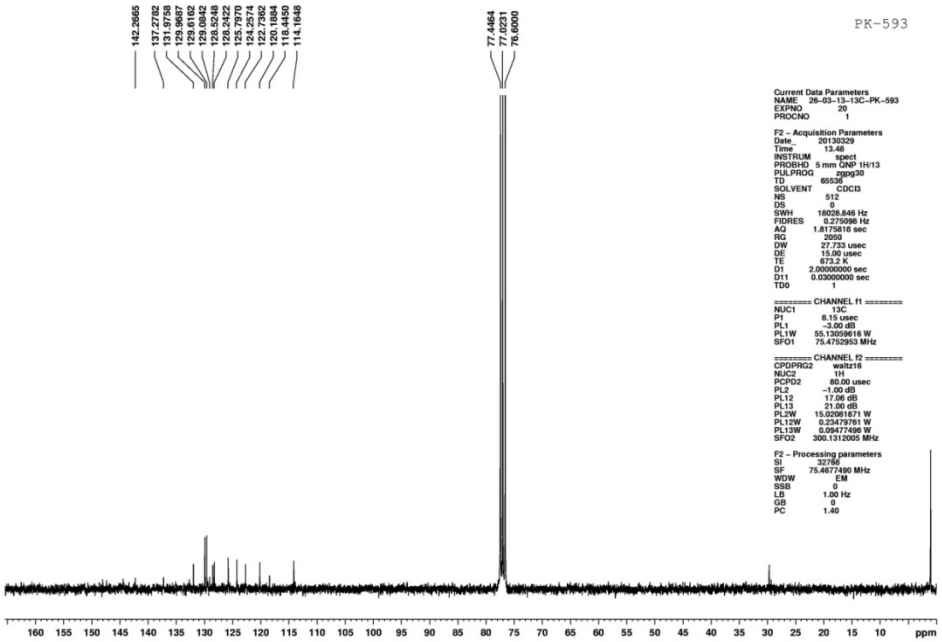

Figure 28: ^{13}C NMR of compound (4n)

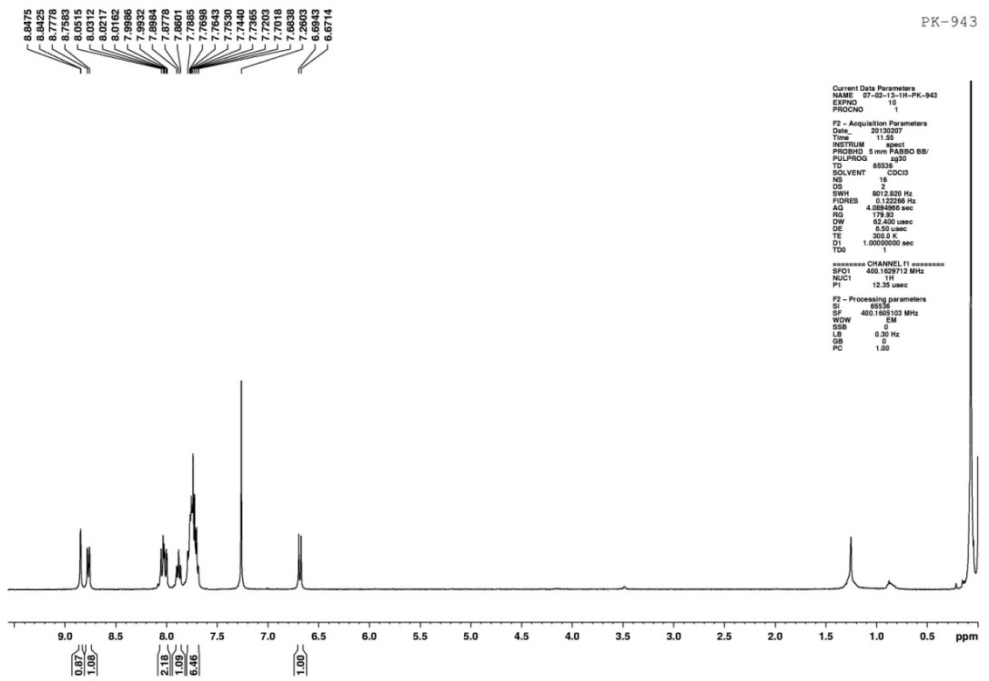

Figure 29 ^{1}H NMR of compound (4o)

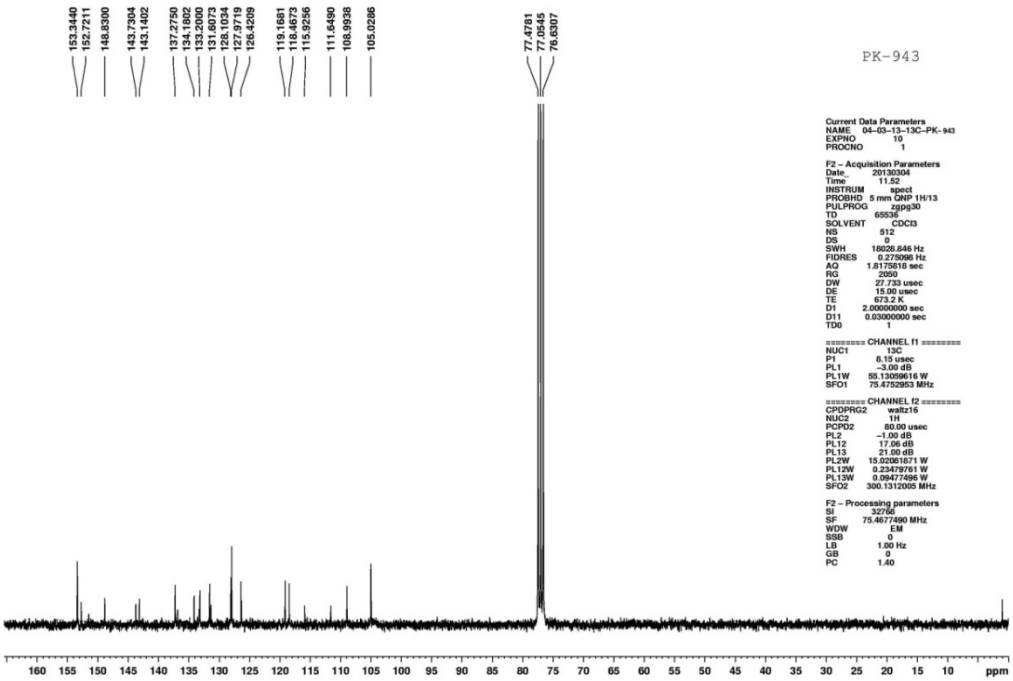

Figure 30: ^{13}C NMR of compound (4o)