Electronic Supplementary Information

Carbon Nanodots, Ru Nanodots and Hybrid Nanodots: Preparation and Catalytic Property

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Instrumentations

UV-Vis spectroscopy study: UV-Vis absorption spectra were recorded on a Hewlett-packard (model 8453) UV-Vis spectrophotometer (varian carry 50.bio). All experiments have been carried out in an optical quartz cell and monitored the spectra time to time over a range of wavelengths 350-800 nm.

Fluorescence Study: The fluorescence spectra were obtained using a Perkin-Elmer Spectrofluorimeter

X-ray Photoelectron Spectroscopic (XPS) Study: XPS analysis was carried out by using an X–ray photoelectron spectroscopic (XPS, Omicron, model: 1712–62–11) method. Measurement was done by using an Al-Kα radiation source under 15 kV voltages and 5 mA current.

Transmission Electron Microscopy (TEM) Study: Transmission Electron Microscopic (TEM) experiments were carried out to investigate the morphology of these nanodots. TEM images and EDX analyses were recorded on a JEM 2010F electron microscope at an accelerating voltage of 200 KV.

NMR spectroscopy Study: NMR studies of all biphenyl derivatives were carried out on a Bruker ADVANCE 400 MHz and 500 MHz spectrometer. All compounds were taken DMSO-d_6 solvent.

FTIR spectroscopy Study: FTIR spectrum was recorded using the KBr disk technique on a Nicolate 380 FTIR spectrophotometer (Thermo Scientific).

Table S1 Quantum yield (%) of carbon nanodots in different conditions.

Carbon source	Peptide	Temperature (°C)	Time (hr)	Quantum Yield (%)
Citric acid	GGDn	200	2	59.1
Citric acid	GG	200	2	61.2
Malic acid	GGDn	200	2	5.9
Malic acid	GG	200	2	5.4
Citric acid	GGDn	300	2	69.8
Citric acid	GG	300	2	65.6
Malic acid	GGDn	300	2	6.5
Malic acid	GG	300	2	6.3
Citric acid	GGDn	200	3	57.2
Citric acid	GG	200	3	57
Malic acid	GGDn	200	3	4.5
Malic acid	GG	200	3	3.8
Citric acid	GGDn	300	3	45.3
Citric acid	GG	300	3	40.2
Malic acid	GGDn	300	3	3.9
Malic acid	GG	300	3	4.1

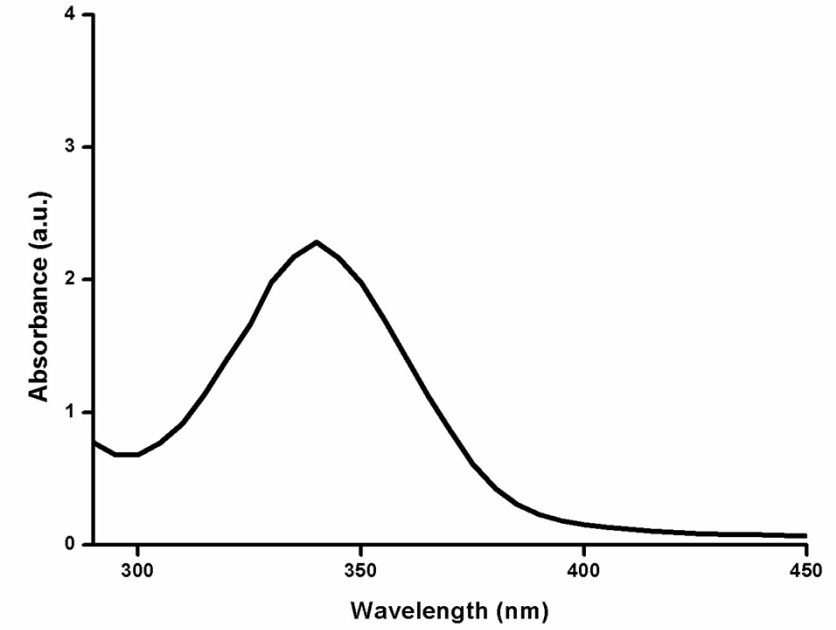


Fig. S1 UV-Vis absorption spectrum of carbon nanodots (citric acid-GGDn) in aqueous solutions.

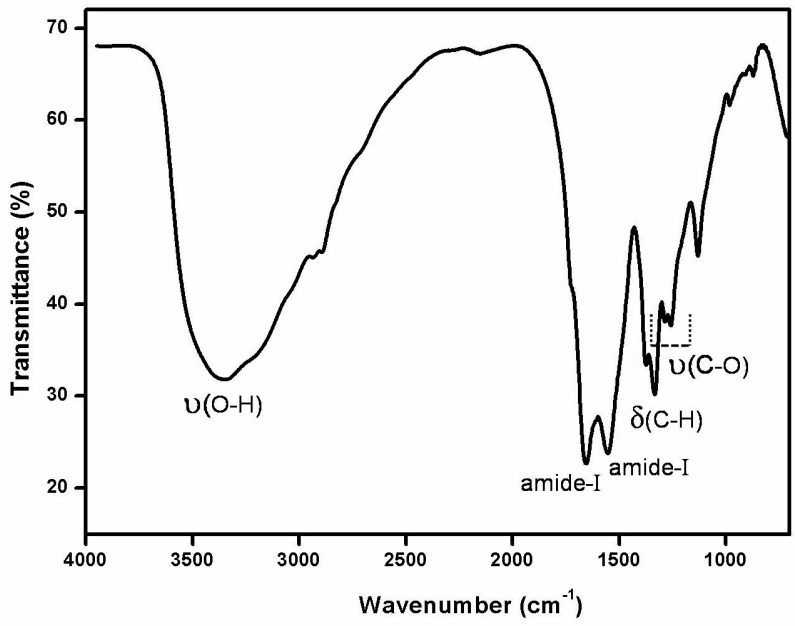


Fig. S2 FTIR spectrum of carbon nanodots showing the presence of -OH, amide, C-O and –CH functionalities.

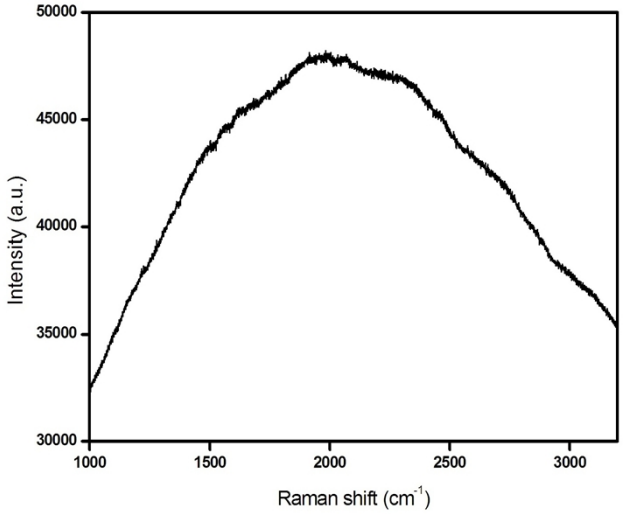


Fig. S3 Raman Spectrum of carbon nanodots. The absence of D and G band indicates the amorphous nature of the carbon nanodots.

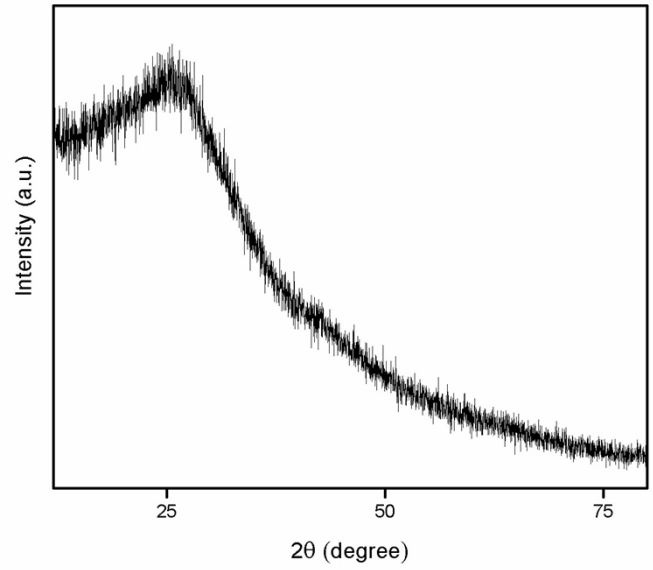


Fig. S4 XRD pattern of carbon nanodots.

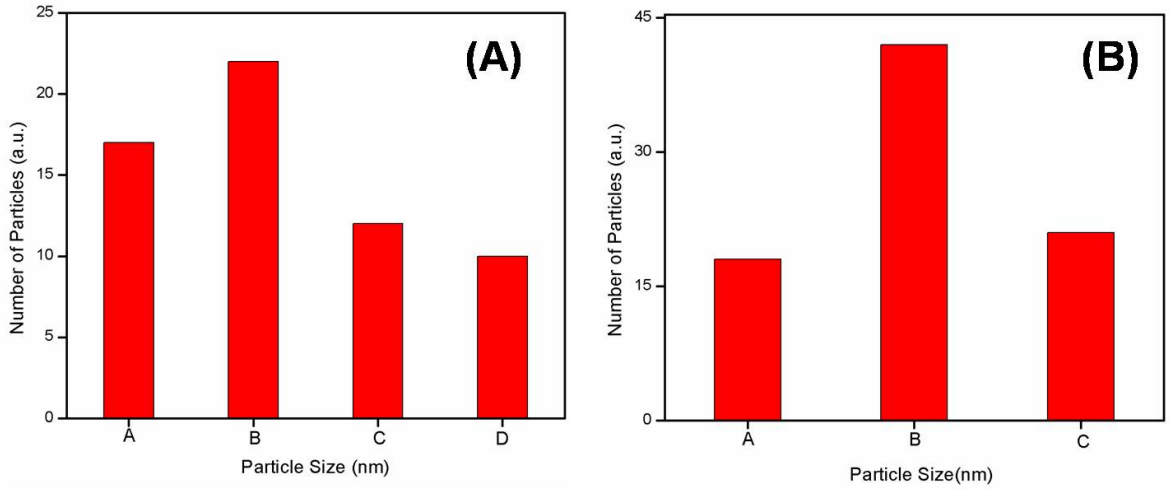


Fig. S5 Particle size distribution of (A) carbon nanodots with their size (nm): A, B, C and D signify 1-2.5, 2.6-3.5, 3.6-4.5 and 4.6-5.5 respectively; (B) Ru nanodots with their size (nm): A, B and C signify 1-1.9, 2-3 and 3.1-4 respectively.

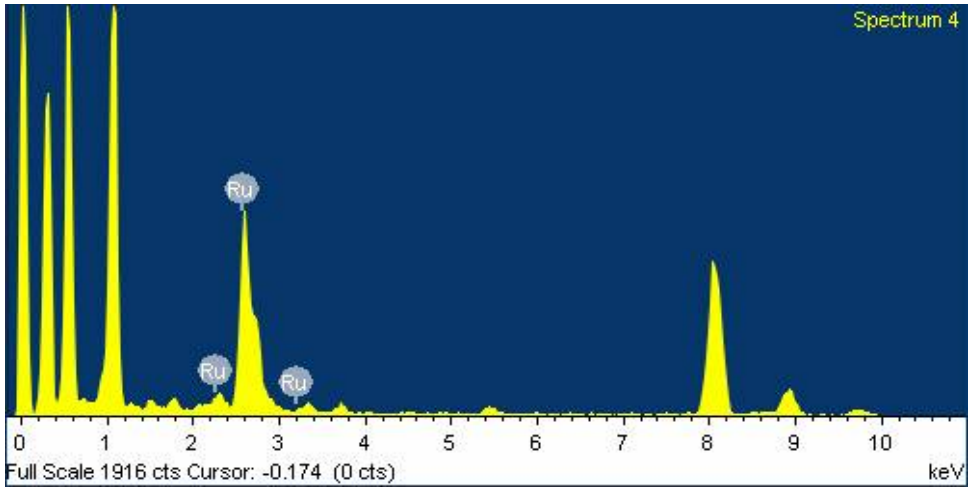


Fig. S6 EDS analysis of Ru nanodots.

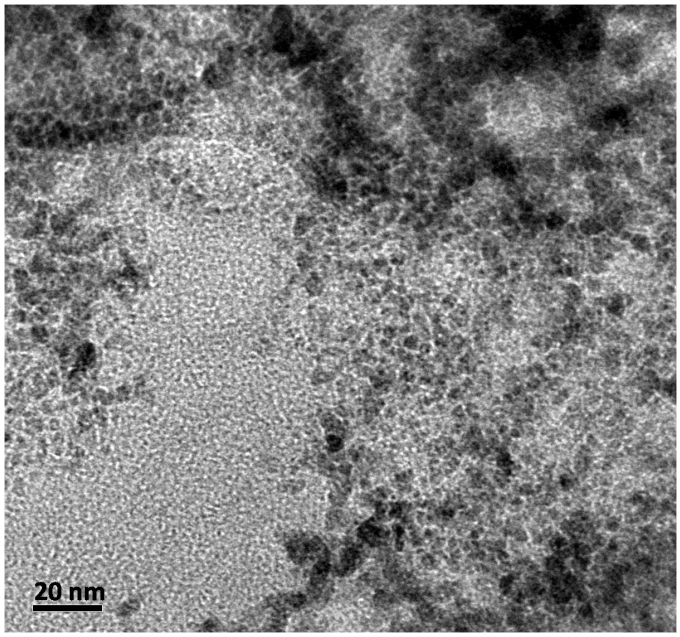


Fig. S7 TEM image of Ru nanodots prepared with peptide (glycylglicine) as a stabilizing agent.

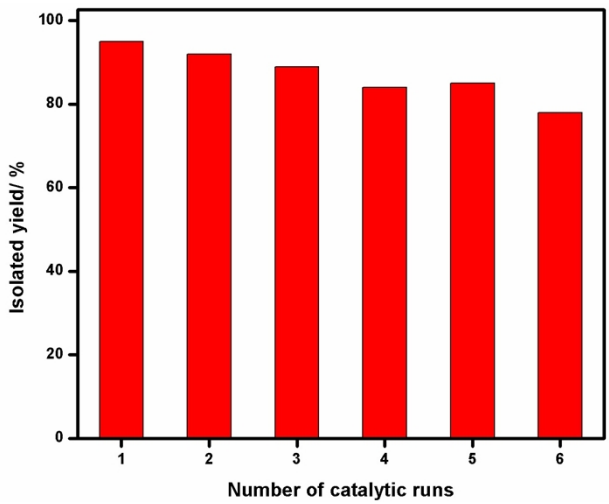


Fig. S8 Recyclability chart of the aromatic azide reduction by using Ru/CND catalyst. Phenyl azide was taken as a substrate for recyclability test.

Table S1 Summarization of azide reduction[a] by using different catalyst

Catalyst	**Time (hr)**	**Yield (%)**
Carbon nanodots	4.5	No reaction
Ru/pep	2.5	52
Ru/Pep	4.5	68
Ru/CND	2.5	95

[a] Phenylazide was taken as a substrate for all cases in water at 100 °C.

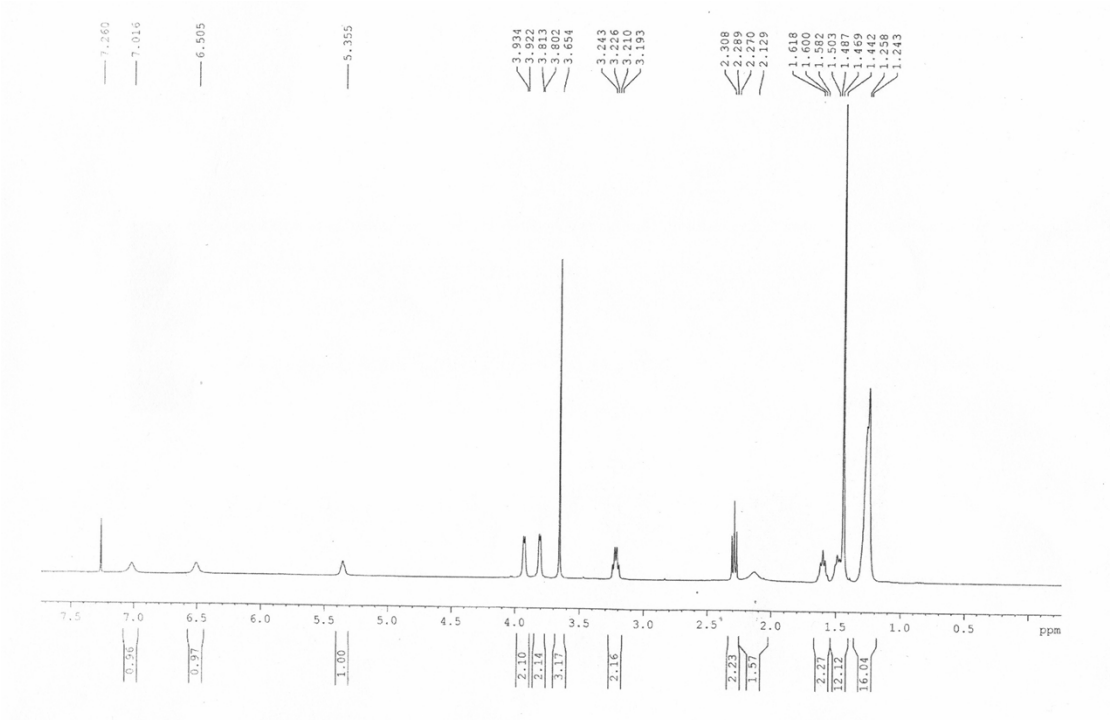


Fig. S9 ^{1}H NMR spectrum of Boc-Gly-Gly-DNDn-OMe in $CDCl_3$.

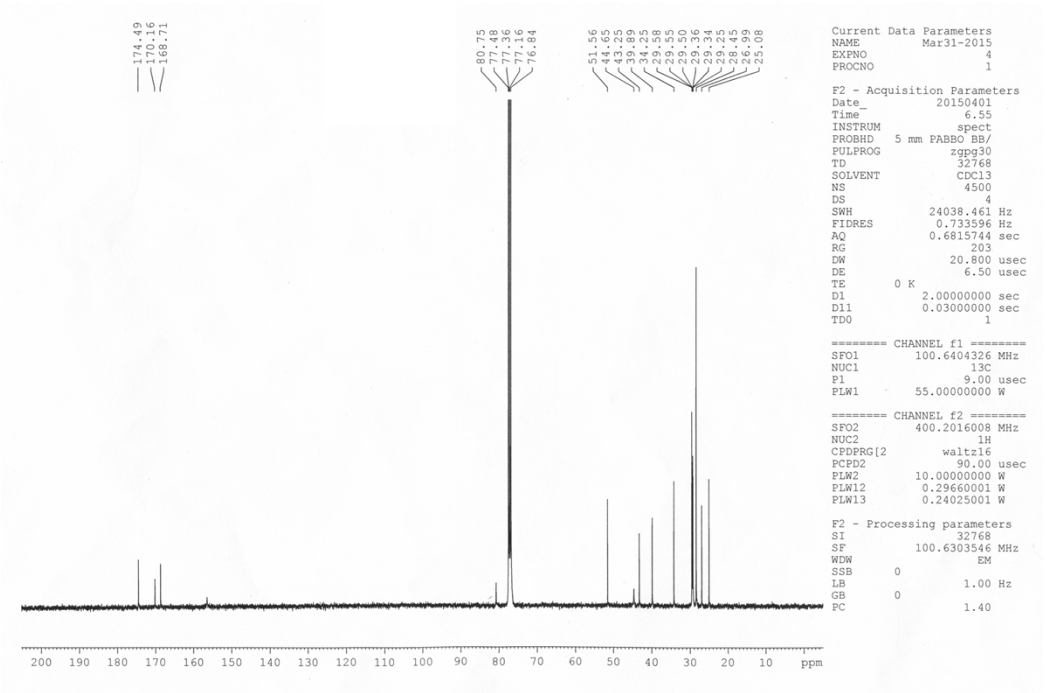


Fig. S10 ^{13}C NMR spectrum of Boc-Gly-Gly-DNDn-OMe in $CDCl_3$.

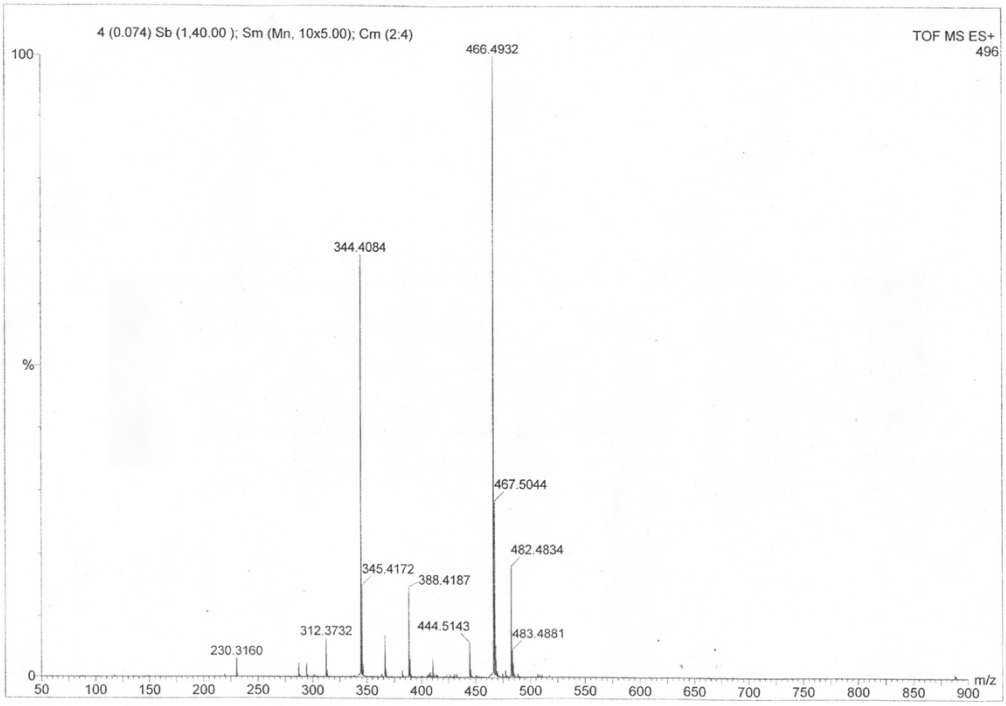


Fig. S11 HRMS spectrum of Boc-Gly-Gly-DNDn-OMe.

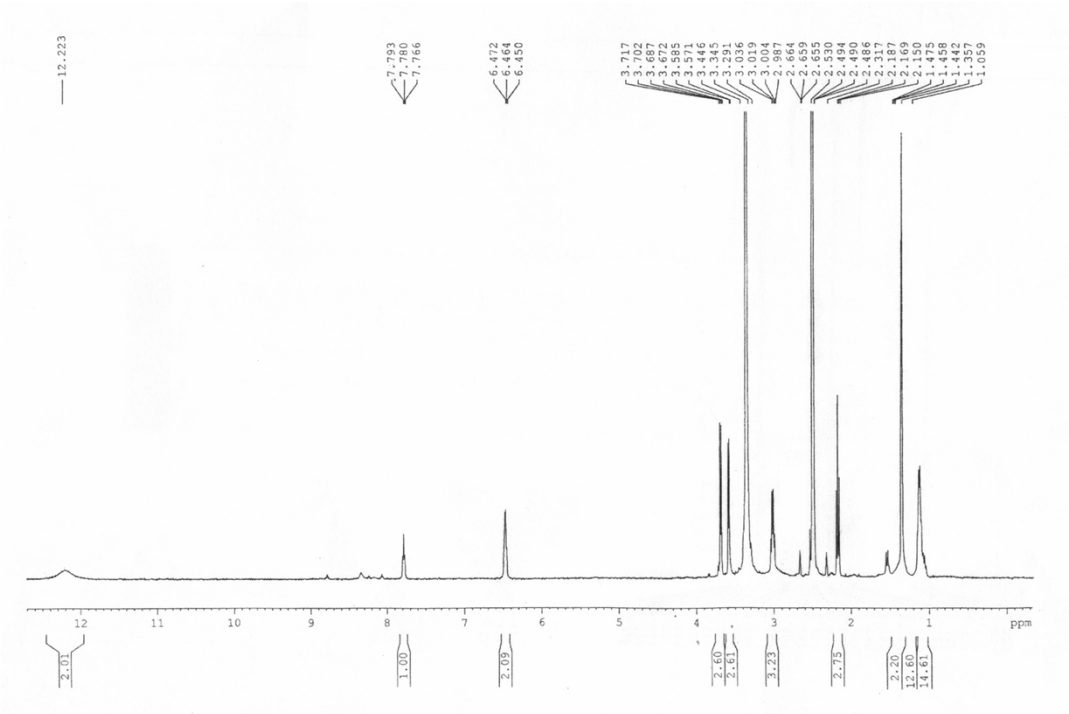


Fig. S12 ^{1}H NMR spectrum of Boc-Gly-Gly-DNDn-OH in DMSO-D_6.

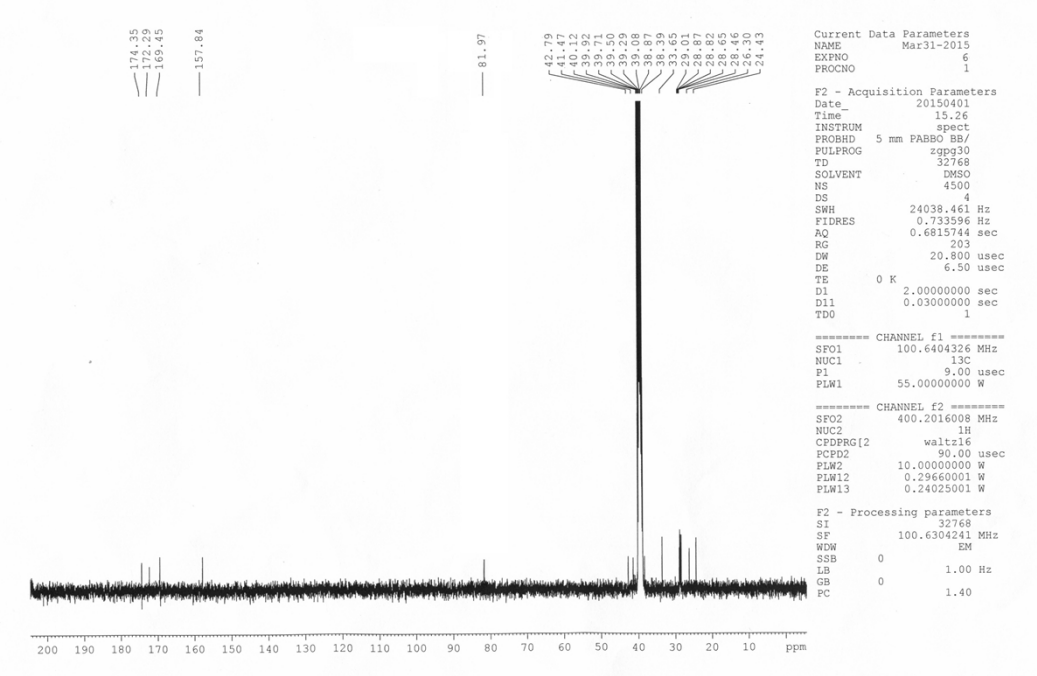


Fig. S13 ^{13}C NMR spectrum of Boc-Gly-Gly-DNDn-OH in DMSO-D_6.

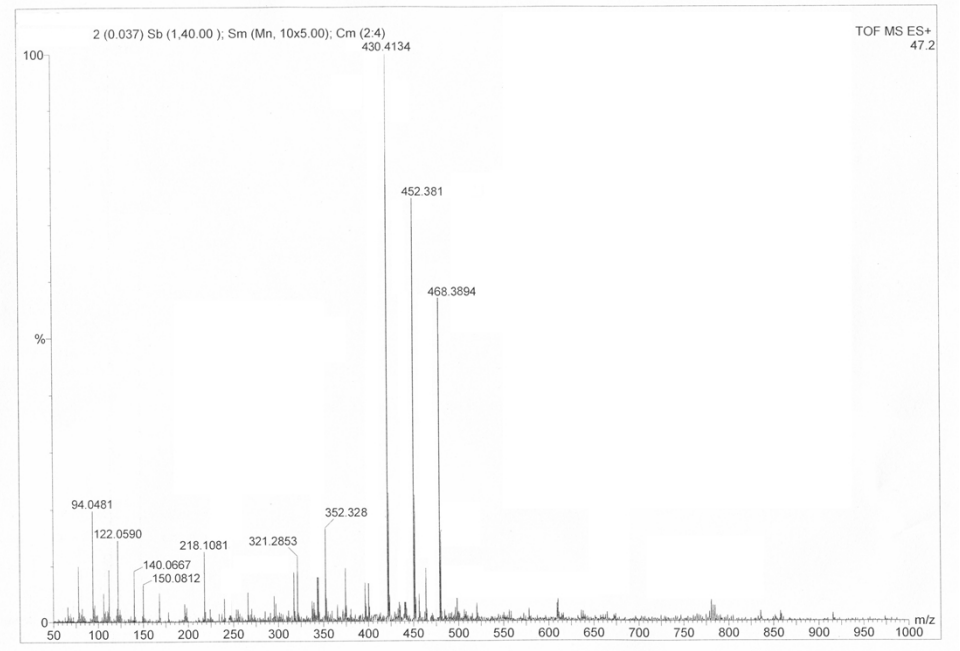


Fig. S14 HRMS spectrum of Boc-Gly-Gly-DNDn-OH.

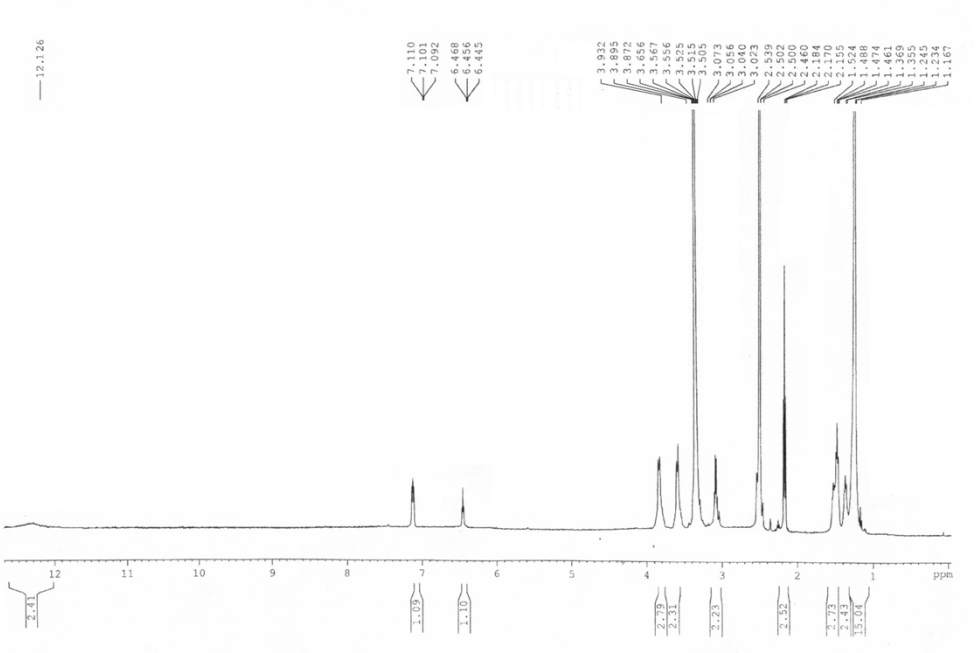


Fig. S15 ^{1}H NMR spectrum of H-Gly-Gly-DNDn-OH in DMSO-D_6.

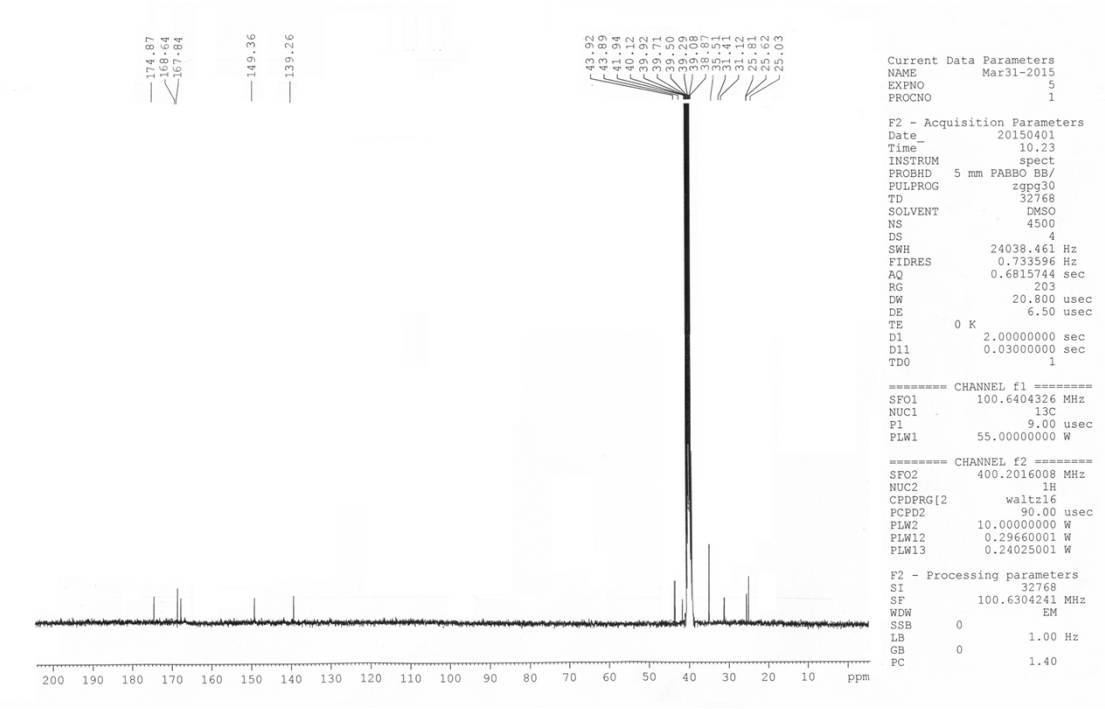


Fig. S16 ^{13}C NMR spectrum of H-Gly-Gly-DNDn-OH in DMSO-D_6.

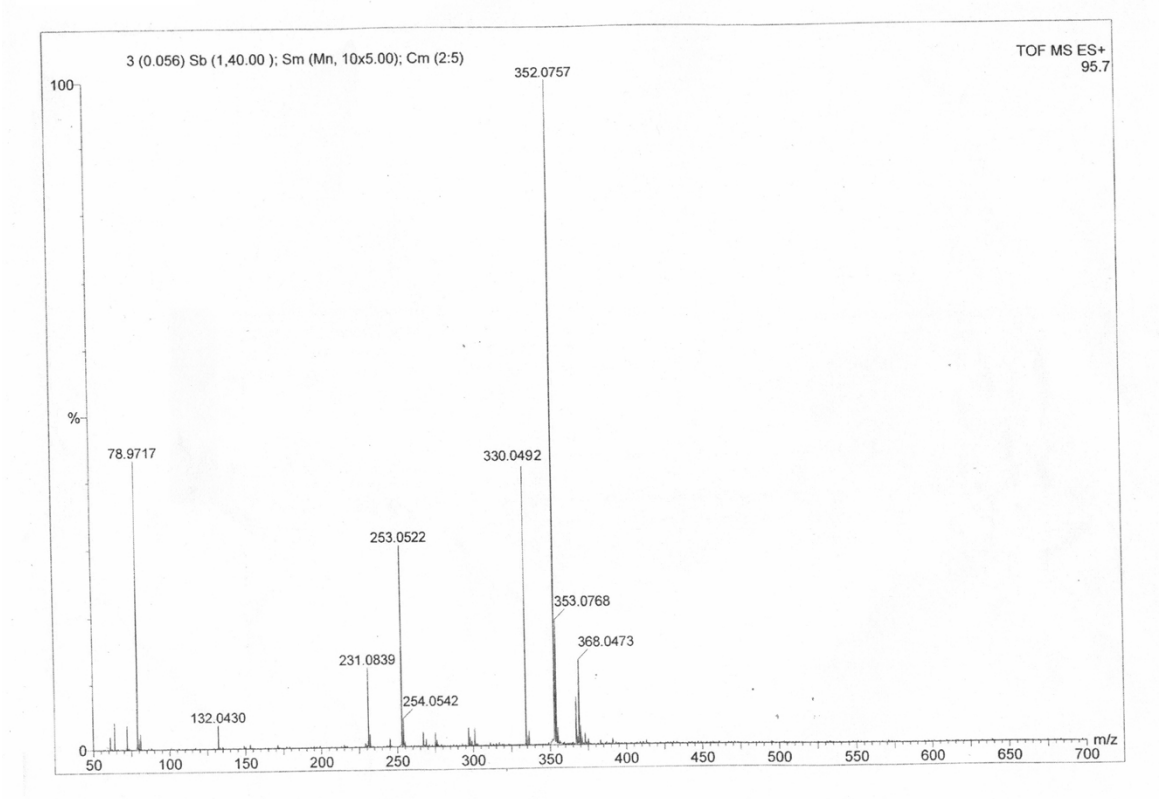
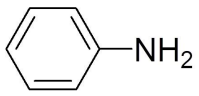
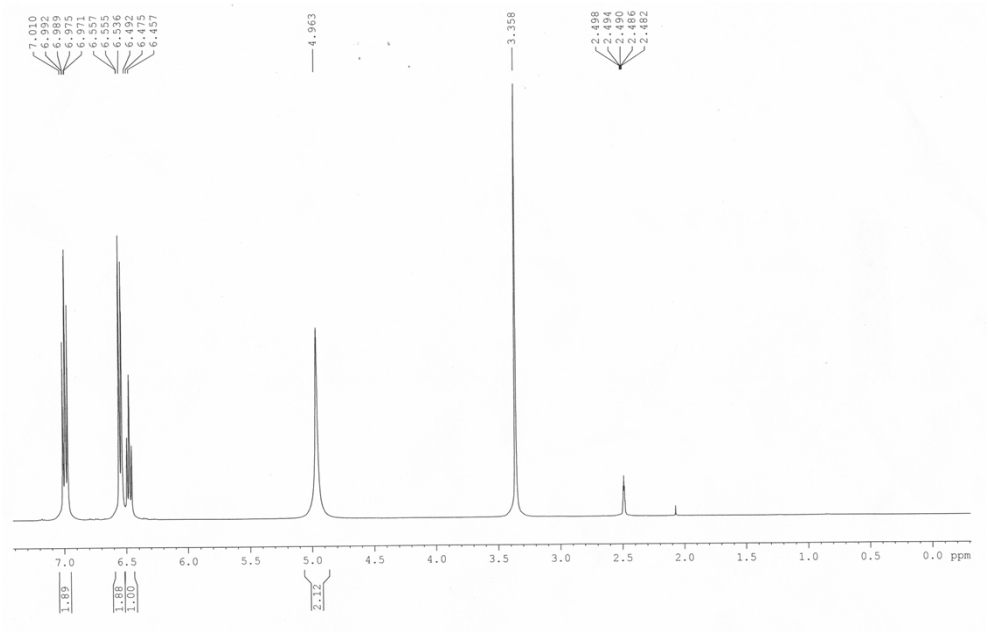
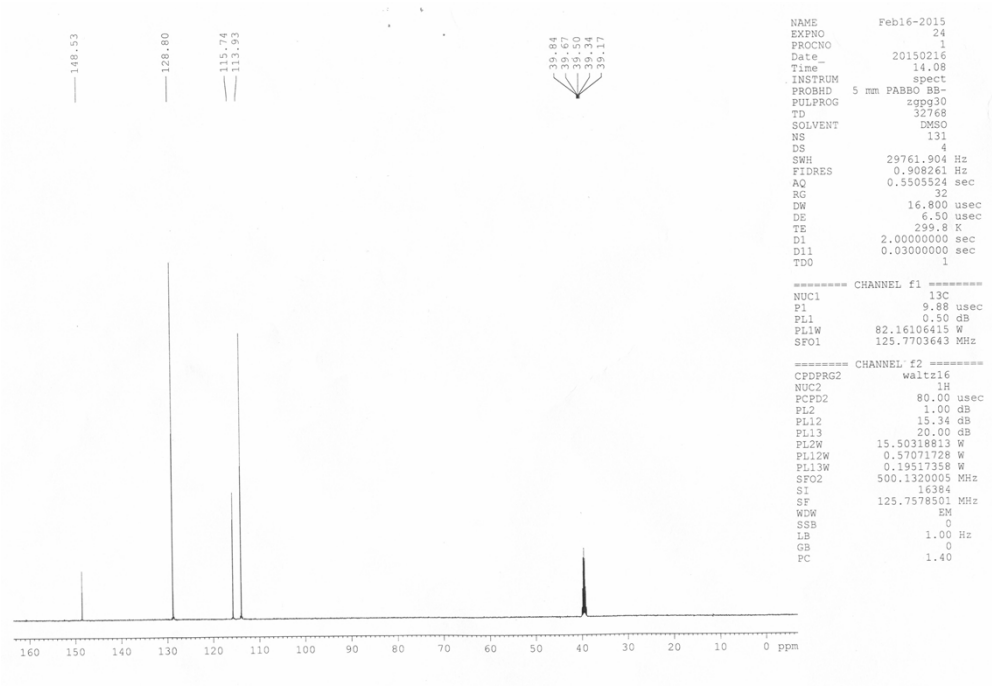


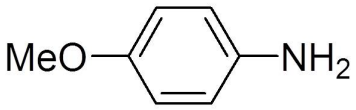
Fig. S17 HRMS spectrum of H-Gly-Gly-DNDn-OH in DMSO-D_6.



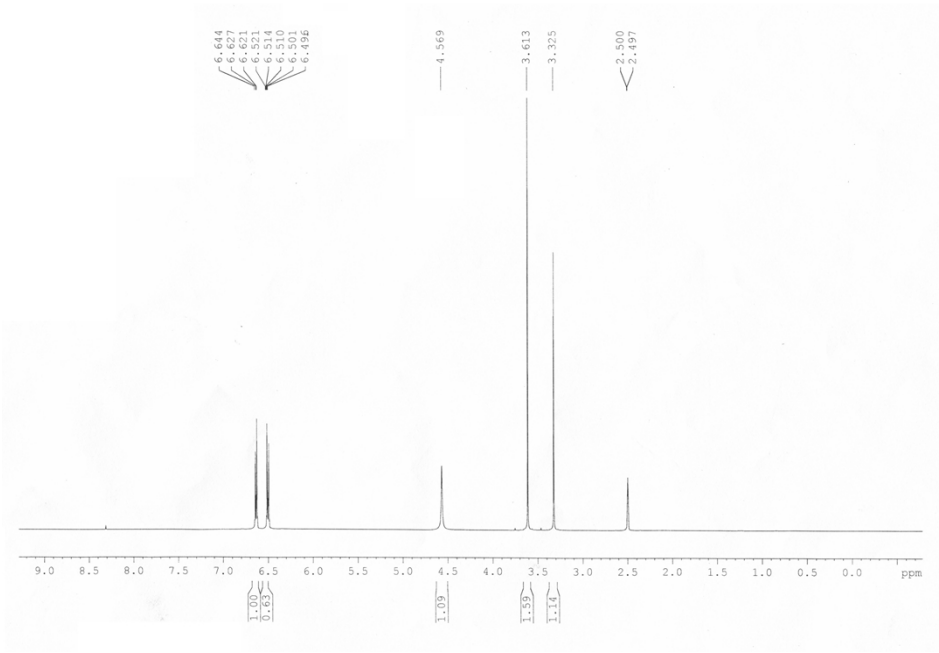
^{1}H NMR (500 MHz, DMSO-D_6, δ): 7.010-6.971 (m, 2H), 6.557-6.536 (m, 2H), 6.492-6.457 (m, 1H), 4.963 (S, 2H); ^{13}C NMR (125 MHz, DMSO-D_6, δ): 148.53, 128.80, 115.74, 113.93.

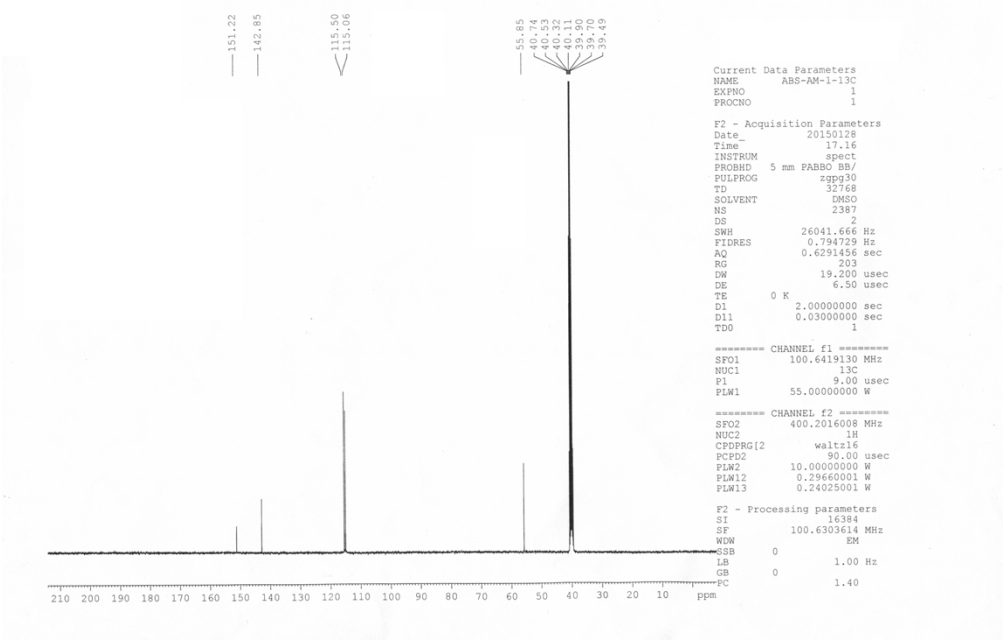


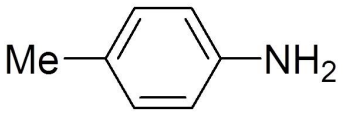




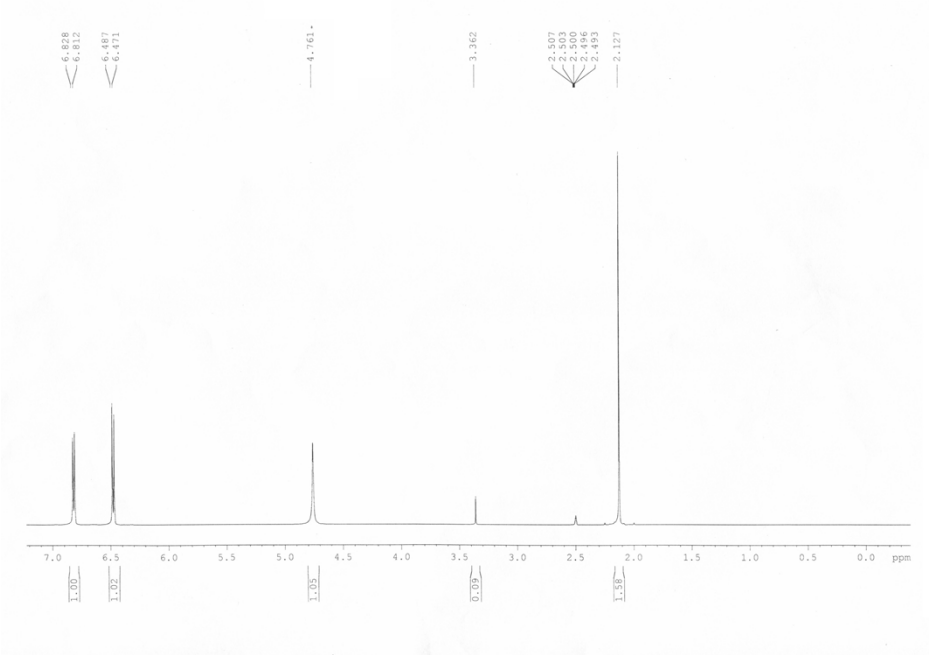
^{1}H NMR (500 MHz, DMSO-D_6, δ): 6.644-6.621 (m, 2H), 6.521-6.496 (m, 2H), 4.569 (s, 2H), 3.613 (s, 3H); ^{13}C NMR (125 MHz, DMSO-D_6, δ): 151.22, 142.85, 115.50, 115.06, 55.85.

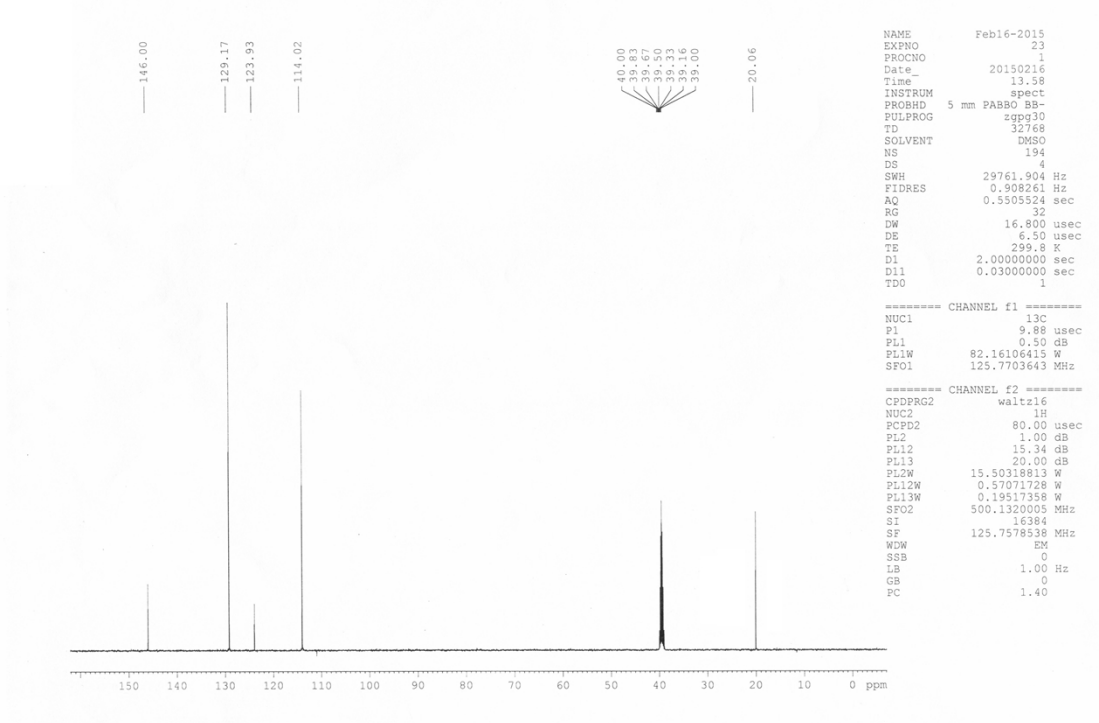


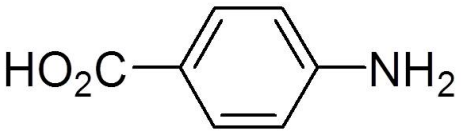




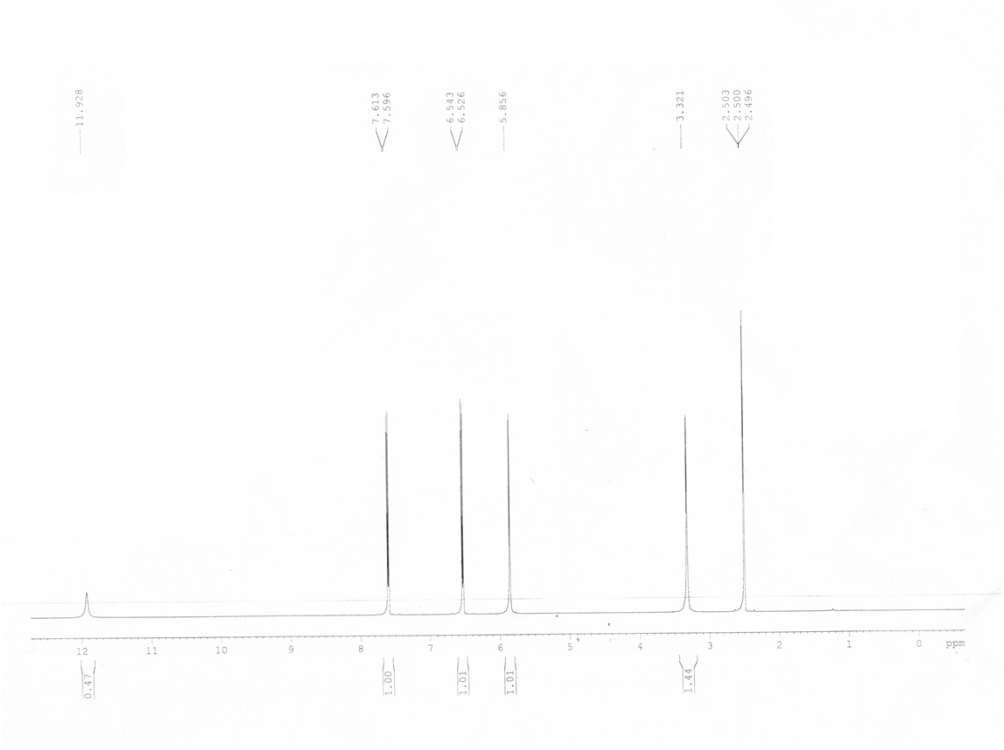
^{1}H NMR (500 MHz, DMSO-D_6, δ): 6.828-6.812 (d, J=8.0 Hz, 2H), 6.487-6.471 (d, J=8.0 Hz, 2H), 4.761 (s, 2H), 2.121 (s, 3H); ^{13}C NMR (125 MHz, DMSO-D_6, δ): 146.00, 129.17, 123.93, 114.02, 20.06.

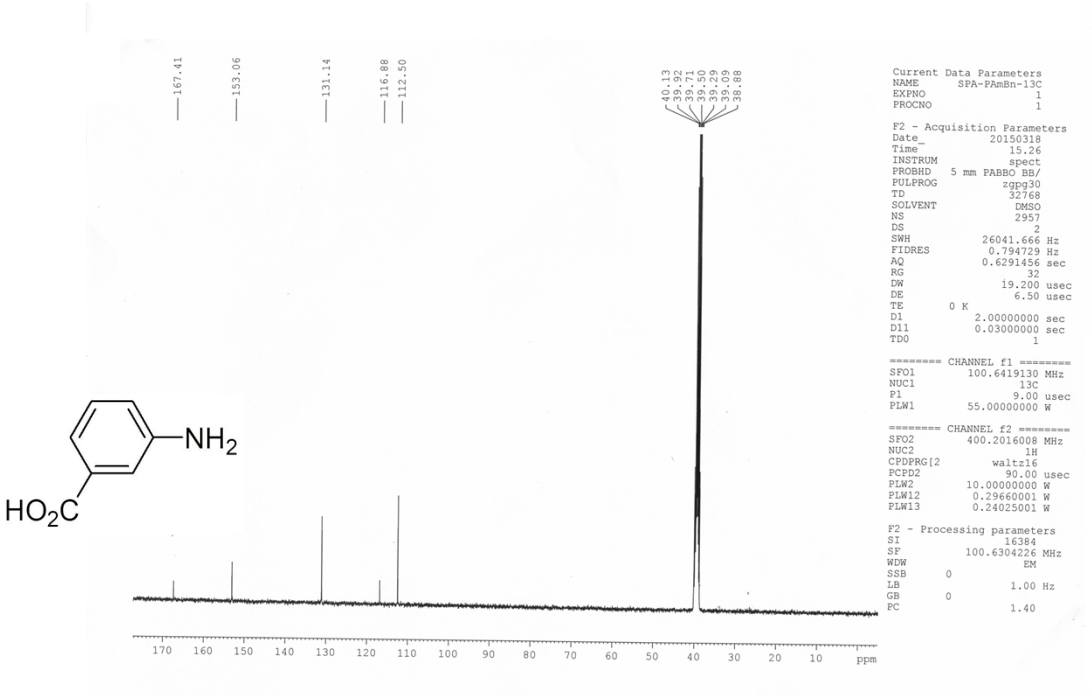




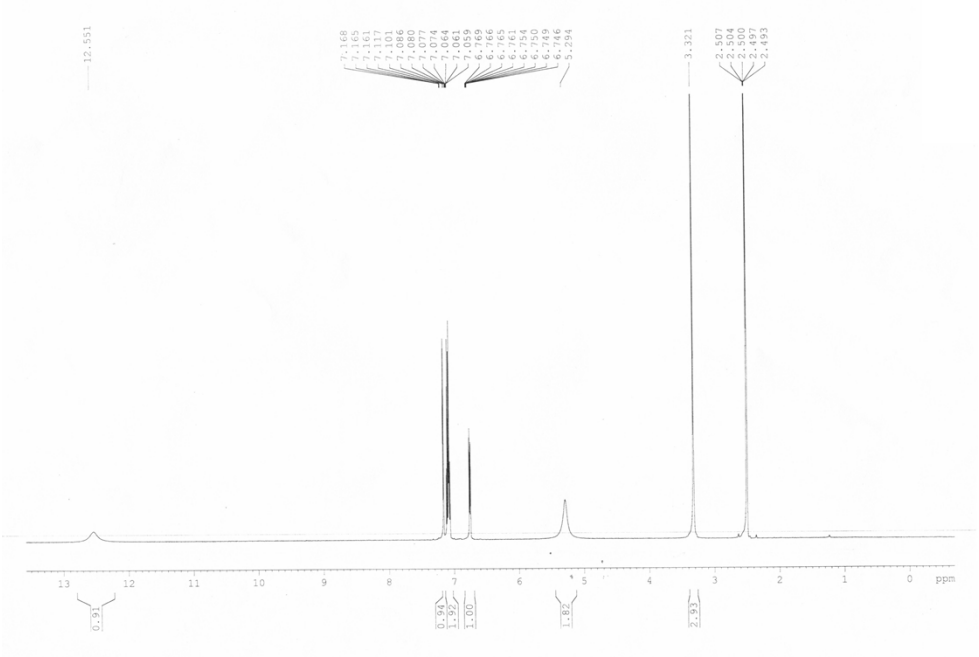


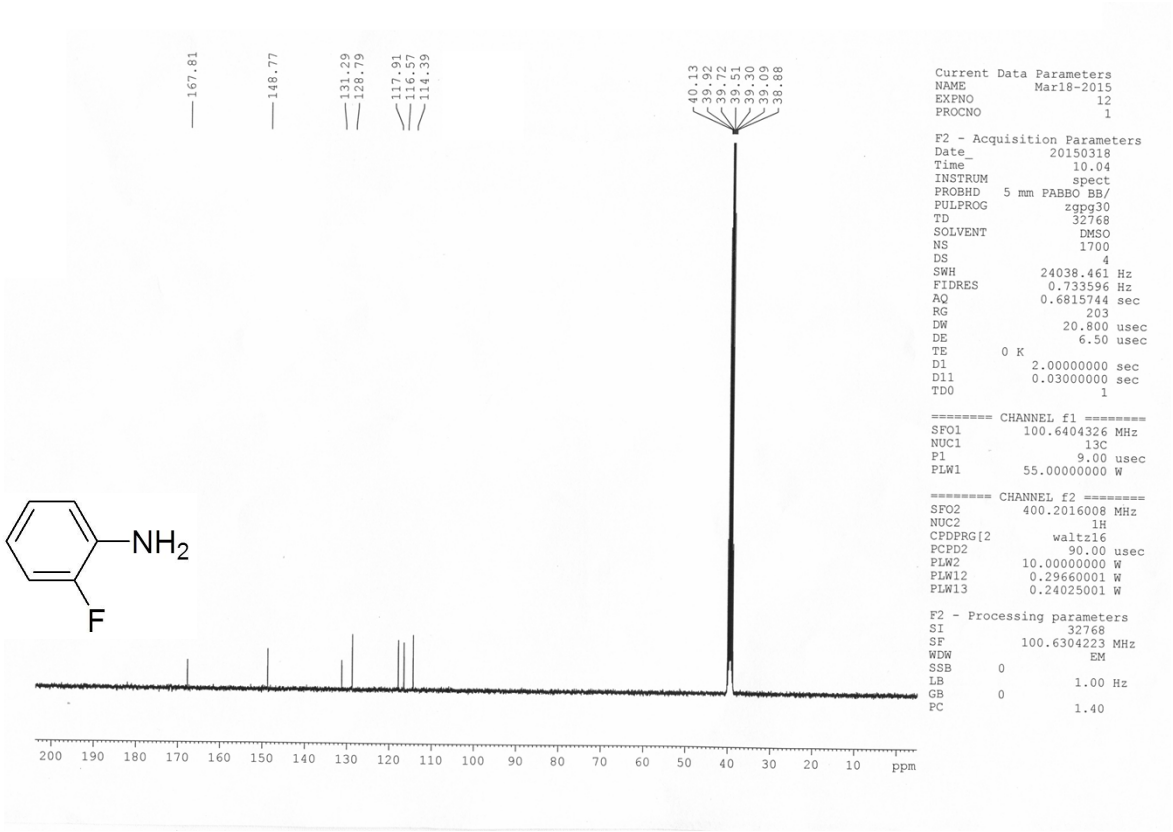
^{1}H NMR (500 MHz, DMSO-D_6, δ): 11.928 (s, 1H), 7.613-7.596 (d, J=8.5Hz, 2H), 6.543-6.526 (d, J=8.5Hz, 2H), 5.856 (s, 2H); ^{13}C NMR (125 MHz, DMSO-D_6, δ): 167.41, 153.06, 131.14, 116.88, 112.50.



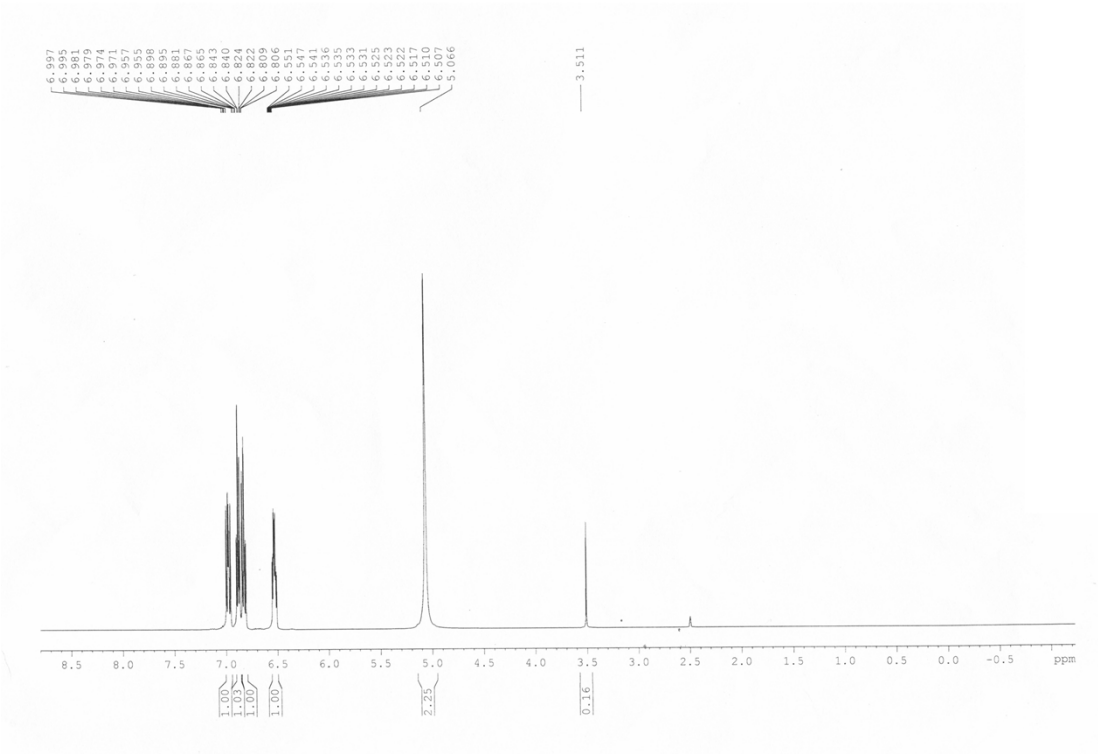


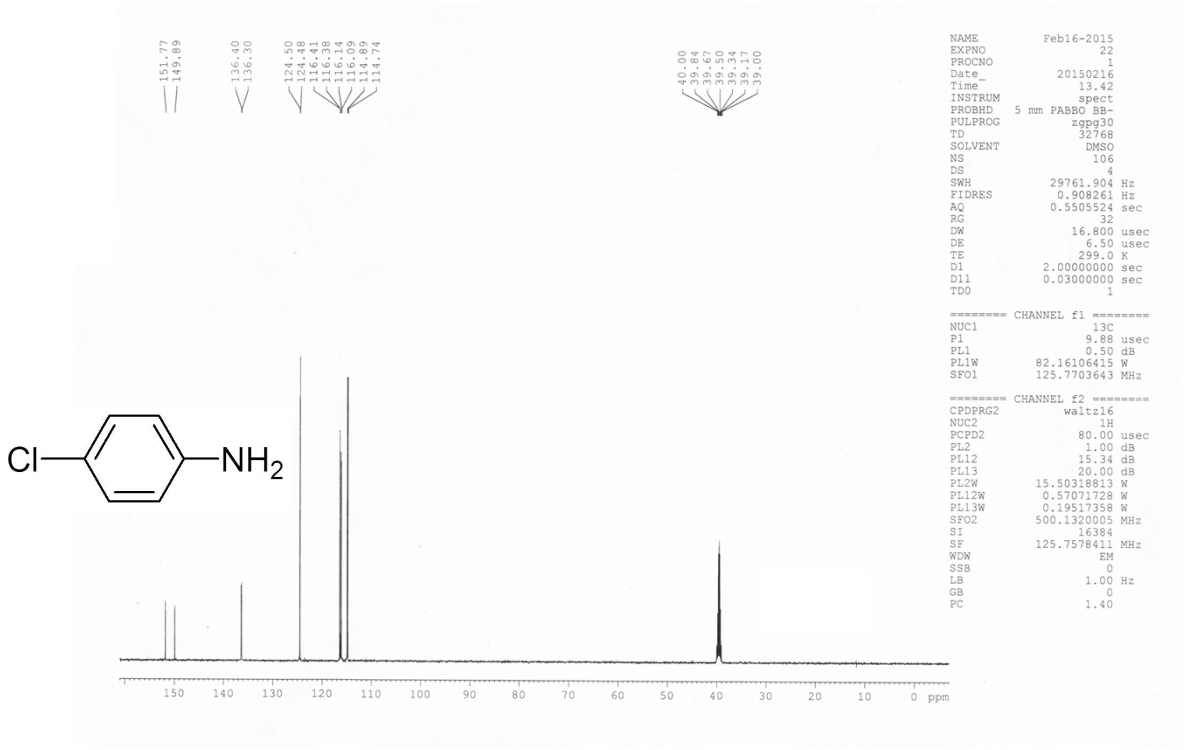
^{1}H NMR (500 MHz, DMSO-D_6, δ): 12.551 (s, 1H), 7.168-7.161 (m, 1H), 7.117-7.059 (m, 1H), 6.769-6.746 (m, 1H), 5.294 (s, 2H); ^{13}C NMR (125 MHz, DMSO-D_6, δ): 167.81, 148.77, 131.29, 128.79, 117.91, 116.57, 114.39.





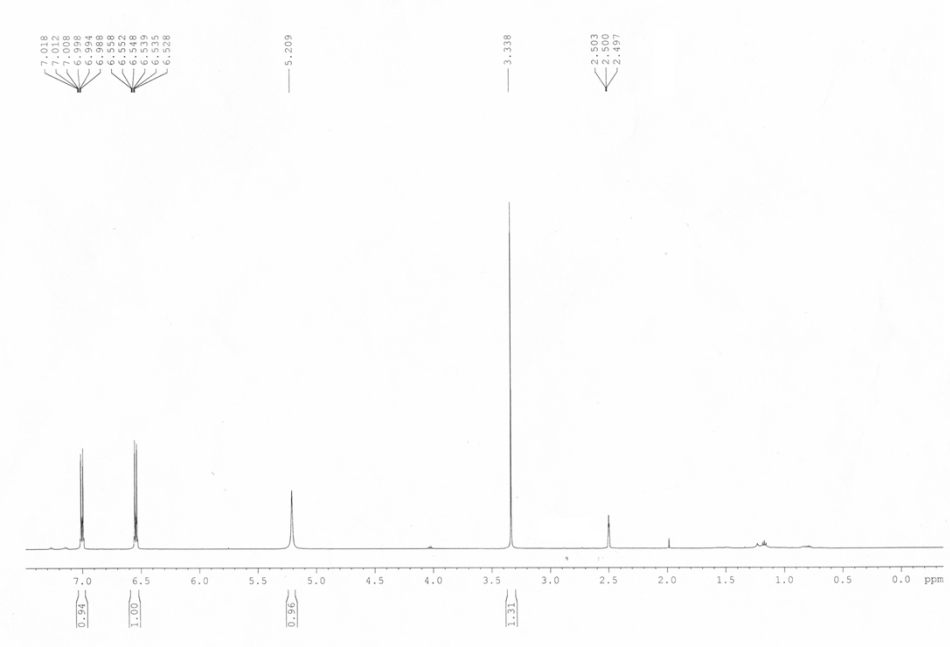
^{1}H NMR (500 MHz, DMSO-D_6, δ): 6.997-6.955 (m, 1H), 6.898-6.865 (m, 1H), 6.843-6.806 (m, 1H), 6.551-6.507 (m, 1H), 5.066 (s, 2H); ^{13}C NMR (125 MHz, DMSO-D_6, δ): 151.77, 149.89, 136.40, 136.30, 124.50, 124.48, 116.41, 116.38, 116.14, 116.09, 114.89, 114.74.

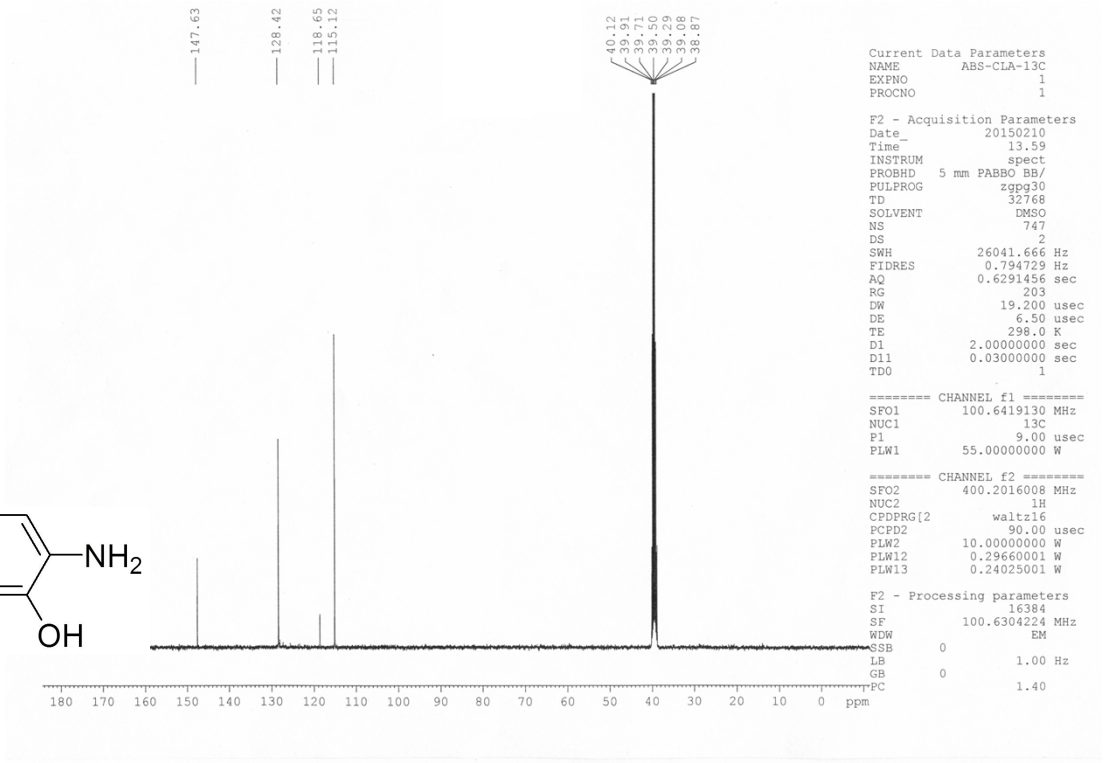




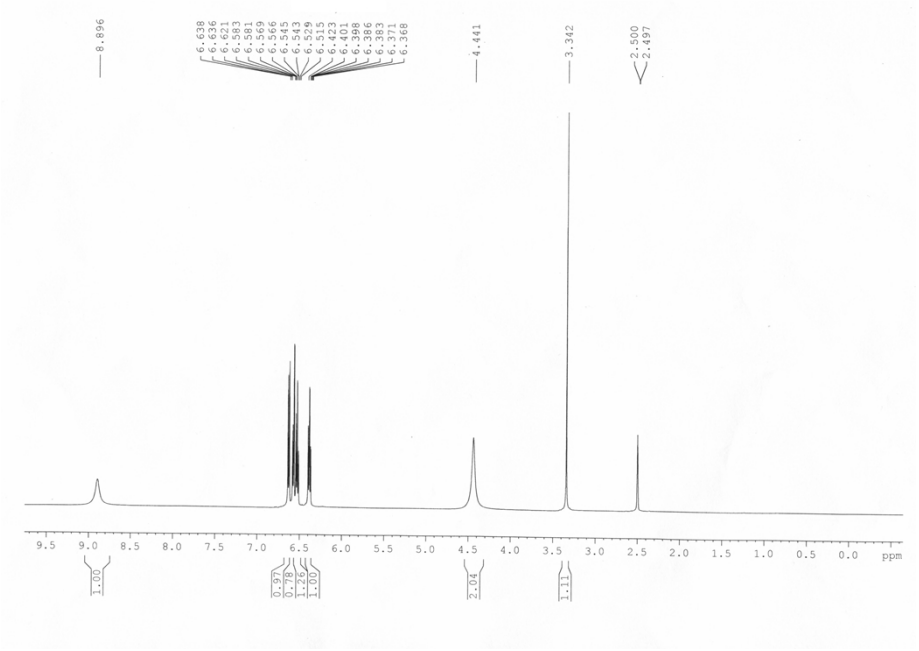
^{1}H NMR (500 MHz, DMSO-D_6, δ): 7.018-6.988 (m, 2H), 6.558-6.528 (m, 2H), 5.209 (s, 2H);

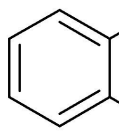
^{13}C NMR (125 MHz, DMSO-D_6, δ): 147.63, 128.42, 118.42, 115.12.



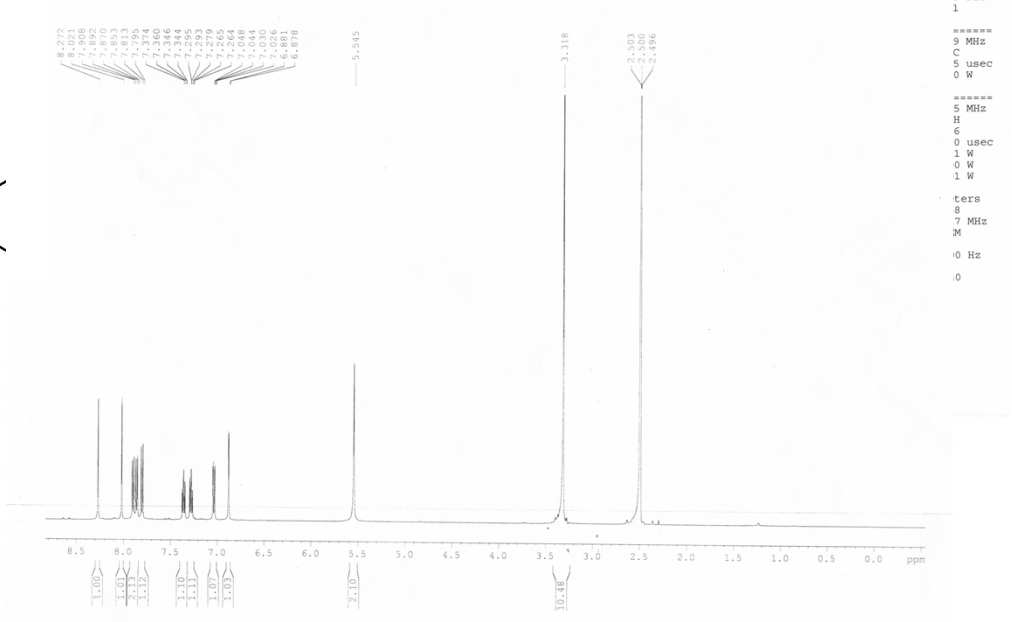


^{1}H NMR (500 MHz, DMSO-D_6, δ): 8.896 (br, 1H), 6.638-6.621 (m, 1H), 6.583-6.566 (m, 1H), 6.545-6.515 (m, 1H), 6.423-6.368 (m, 1H), 4.441 (s, 2H); ^{13}C NMR (125 MHz, DMSO-D_6, δ): 143.99, 136.51, 119.51, 116.46, 114.46, 114.39.

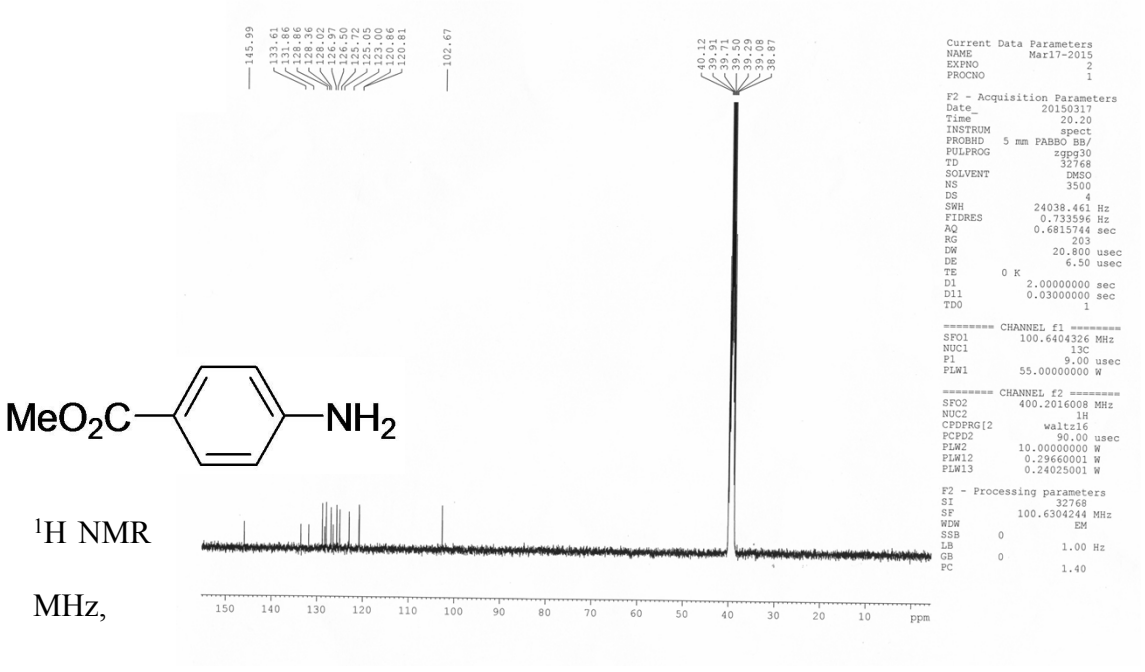




^{1}H NMR

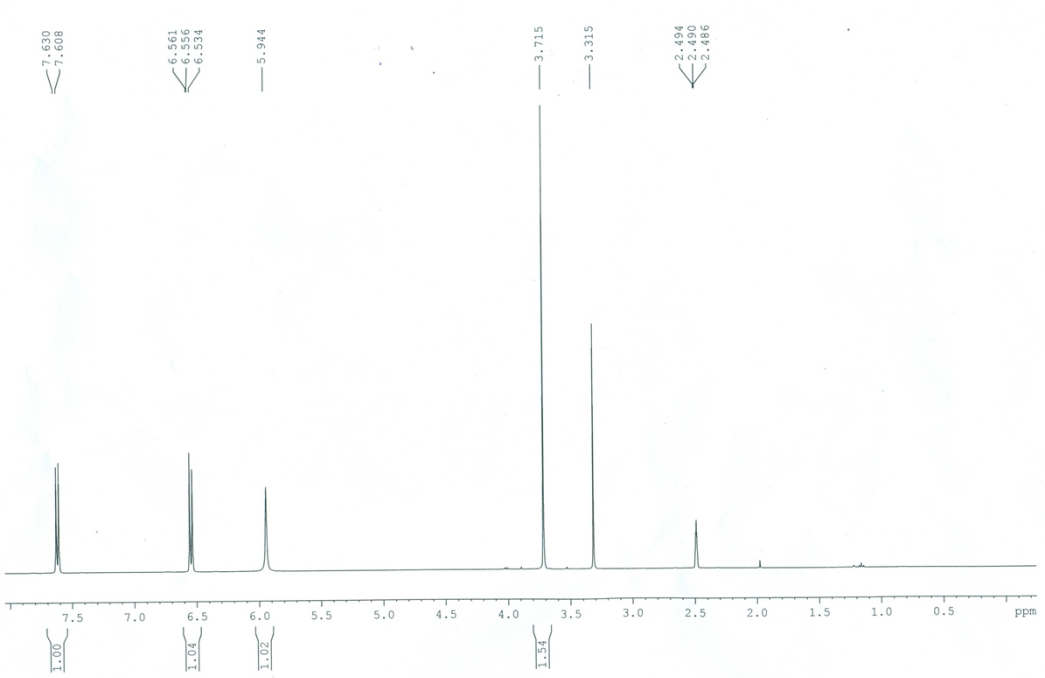


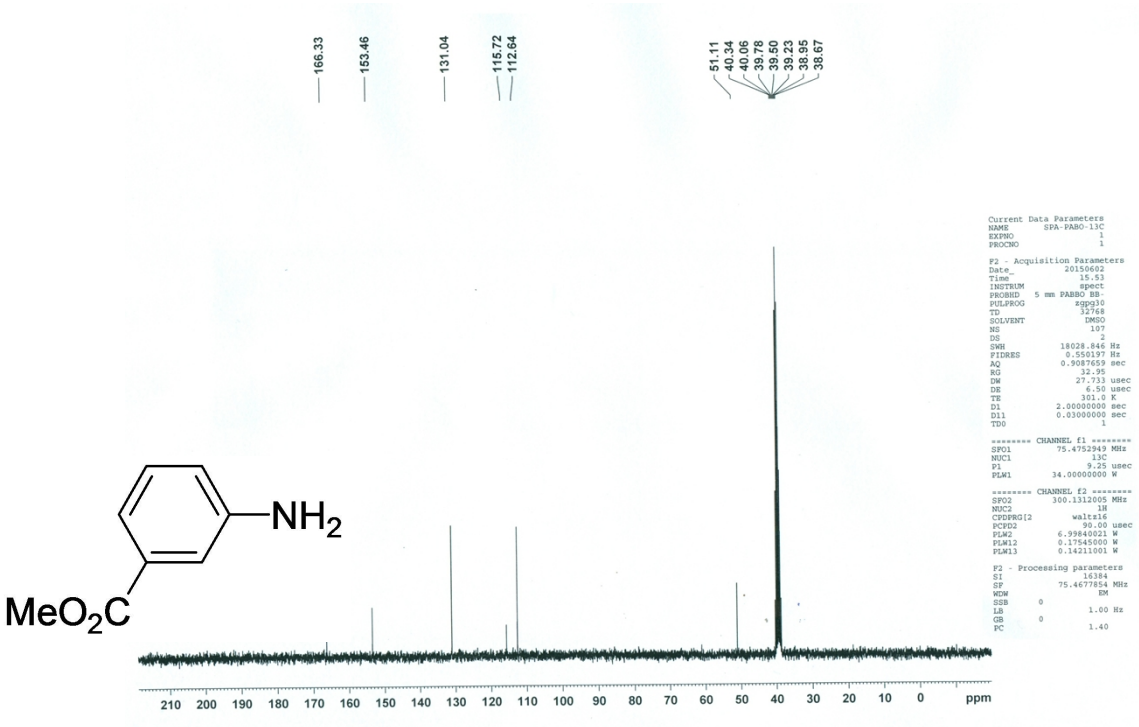
(500 MHz, DMSO-D_6, δ): 8.272 (s, 1H), 8.021 (s, 1H), 7.908-7.853 (dd, J=11Hz, 8Hz, 2H), 7.813-7.795 (d, J=9Hz, 1H), 7.374-7.344 (m, 1H), 7.295-7.264 (m, 1H), 7.048-7.026 (dd, J=4Hz, 2Hz, 1H), 6.881-6.878 (d, J=1.5Hz, 1H), 5.545 (s, 2H); ^{13}C NMR (125 MHz, DMSO-D_6, δ): 145.99, 133.61, 131.86, 128.86, 128.36, 128.02, 126.97, 126.50, 125.72, 125.05, 123.00, 120.86, 120.81, 102.67.



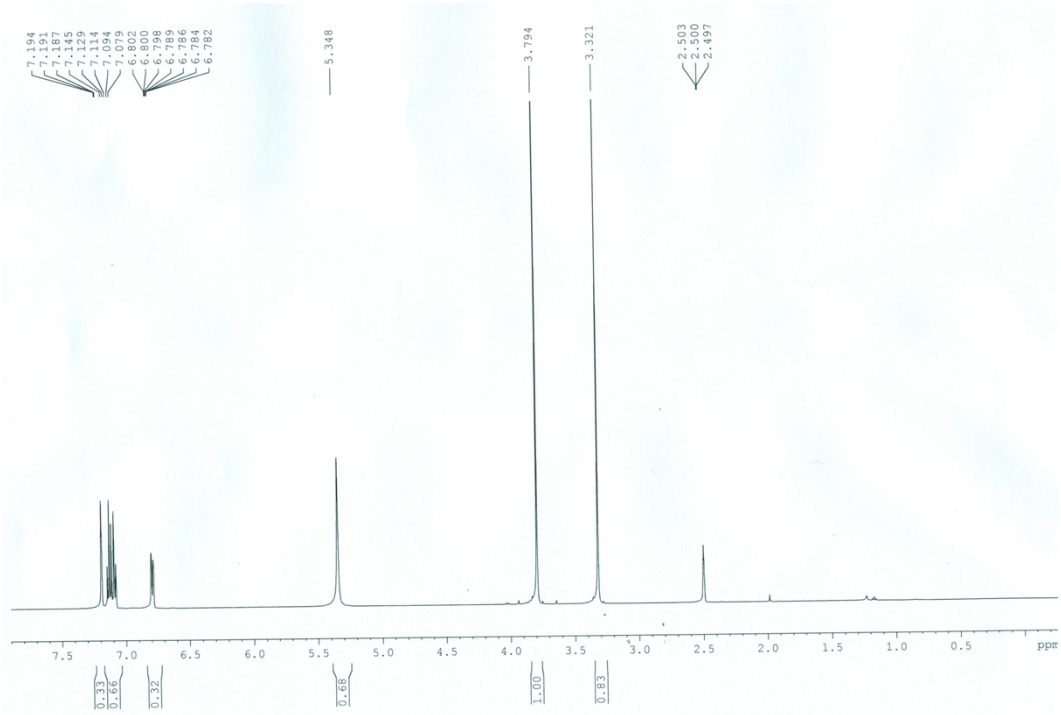
^{1}H NMR (400 MHz, DMSO-

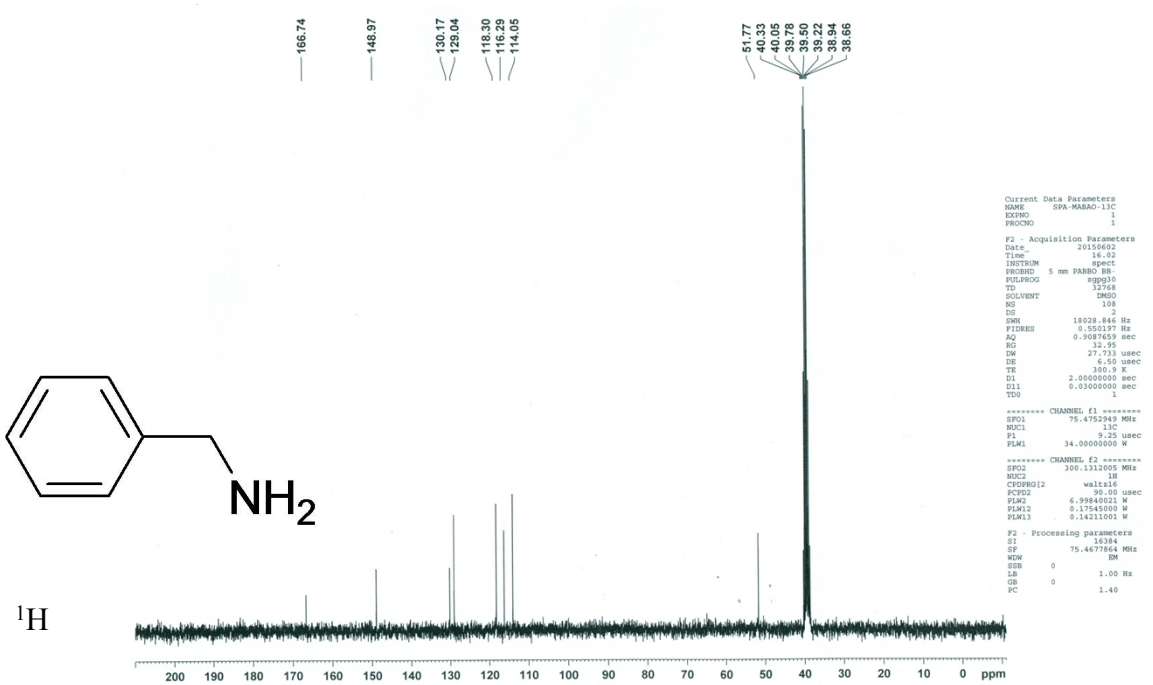
D_6, δ): 7.630-7.608 (d, J=8.8 Hz, 2H), 6.561-6.534 (m, 2H), 5.944 (s, 2H), 3.715 (s, 3H); ^{13}C NMR (75 MHz, DMSO-D_6, δ): 166.33, 153.46, 131.04, 115.72, 112.64, 51.11.





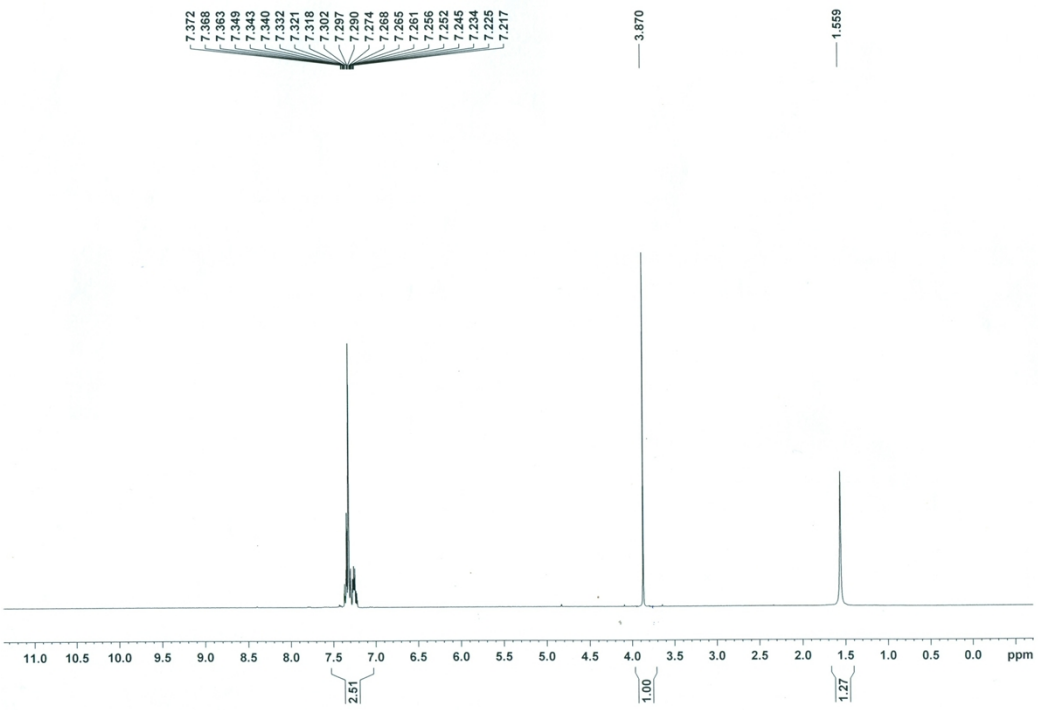
^{1}H NMR (500 MHz, DMSO-D_6, δ): 7.194-7.187 (m, 1H), 7.145-7.079 (m, 2H), 6.802-6.782 (m, 1H), 5.348 (s, 2H), 3.794 (s, 3H); ^{13}C NMR (75 MHz, DMSO-D_6, δ): 166.74, 148.97, 130.17, 129.04, 118.30, 116.29, 114.05, 51.77.

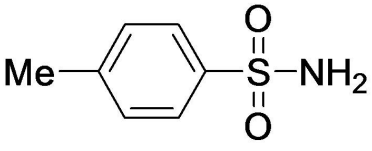


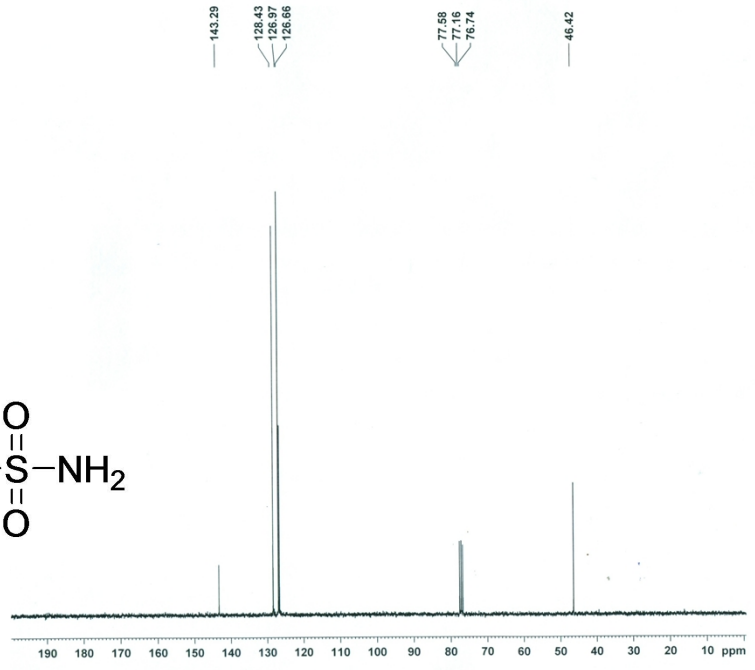


^{1}H NMR

(300 MHz, $CDCl_3$, δ): 7.372-7.217 (m, 5H), 3.870 (s, 2H), 1.559 (s, 2H); ^{13}C NMR (75MHz, $CDCl_3$, δ): 143.29, 128.43, 126.97, 126.66, 77.58, 77.16, 76.74, 46.42.





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Current Data Parameters
NAME                  BNAM-13C
EXPNO                        1
PROCNO                       1

F2 - Acquisition Parameters
Date_              20150602
Time_                 15.46
INSTRUM               spect
PROBHD   5 mm PABBO BB-
PULPROG             zgpg30
TD                   32768
SOLVENT              CDCl3
NS                      55
DS                       2
SWH               18028.846 Hz
FIDRES             0.550197 Hz
AQ                 0.9087659 sec
RG                    32.95
DW                   27.733 usec
DE                    6.50 usec
TE                   301.3 K
D1                2.00000000 sec
D11               0.03000000 sec
TD0                          1

======== CHANNEL f1 ========
SFO1              75.4752949 MHz
NUC1                     13C
P1                     9.25 usec
PLW1             34.00000000 W

======== CHANNEL f2 ========
SFO2             300.1312005 MHz
NUC2                      1H
CPDPRG[2              waltz16
PCPD2                 90.00 usec
PLW2              6.99840021 W
PLW12             0.17545000 W
PLW13             0.14211001 W

F2 - Processing parameters
SI                       16384
SF                75.4677569 MHz
WDW                         EM
SSB          0
LB                     1.00 Hz
GB           0
PC                     1.40
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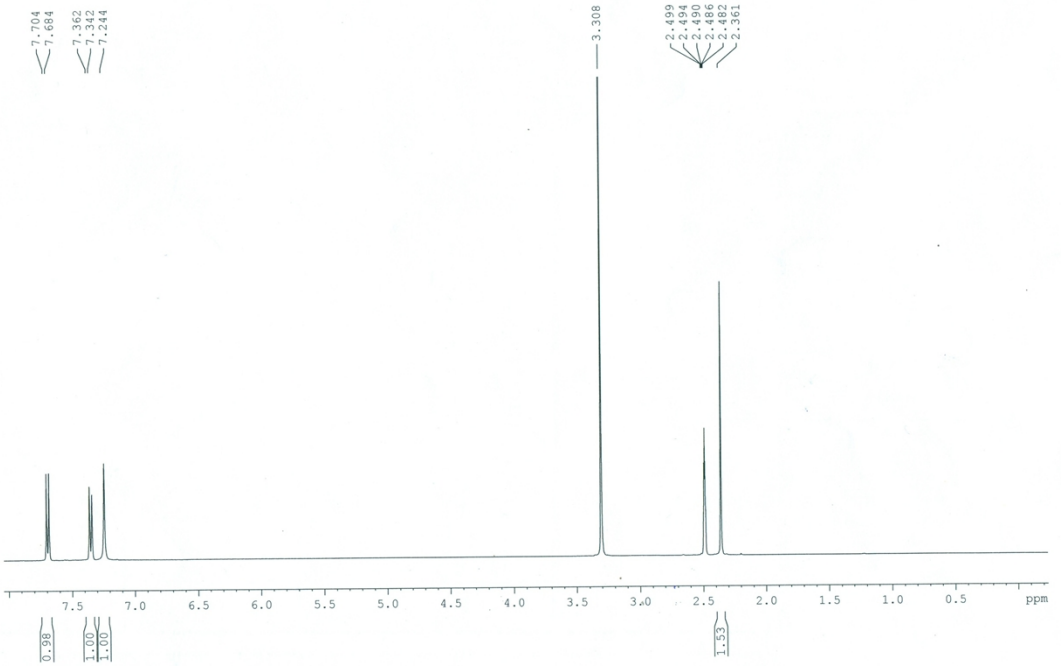
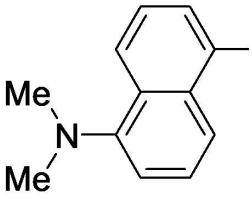
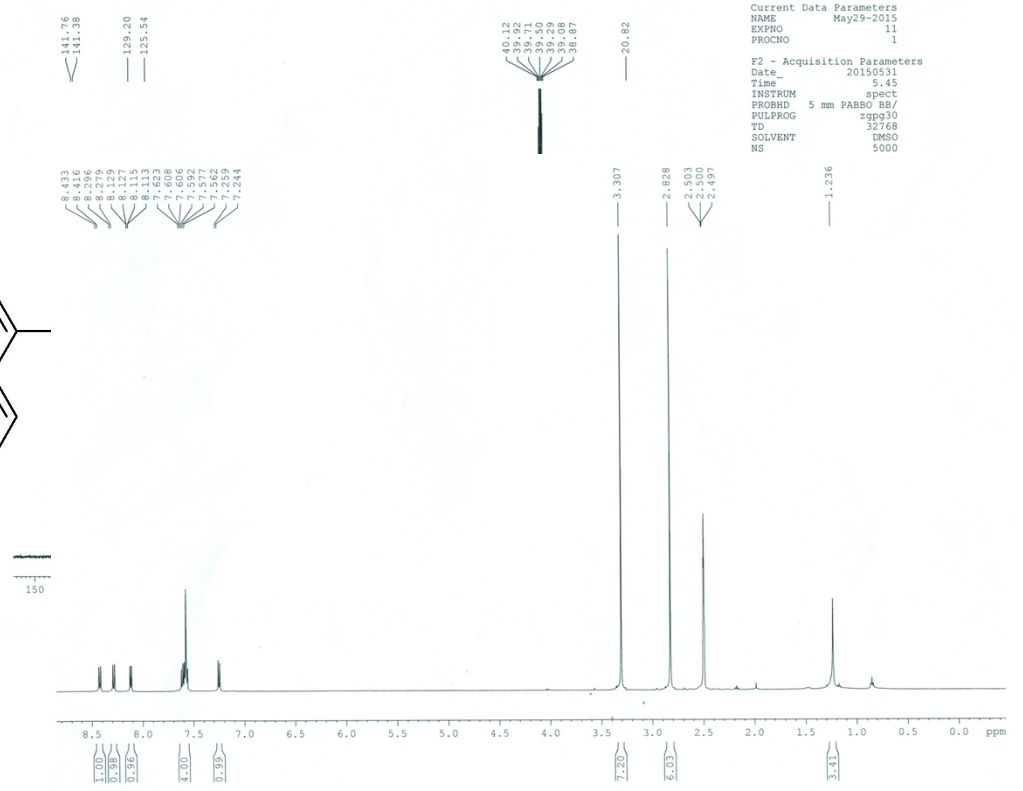
^{1}H NMR (400 MHz, DMSO-D_6, δ): 7.704-7.684 (d, J=8.0 Hz, 2H), 7.362-7.342 (d, J=8.0 Hz, 2H), 7.244 (s, 2H), 2.361 (s, 3H); ^{13}C NMR (100 MHz, DMSO-D_6, δ): 141.76, 141.38, 129.20, 125.54, 20.82.





^{1}H NMR (500



MHz, DMSO-D_6, δ): 8.433-8.416 (d, J=8.5 Hz, 2H), 8.296-8.279 (d, J=8.5 Hz, 2H), 8.129-8.113 (m, 2H), 7.623-7.562 (m, 4H), 7.259-7.244 (d, 8.5 Hz, 1H), 2.828 (s, 6H); ^{13}C NMR (75 MHz, DMSO-D_6, δ): 151.86, 140.25, 129.53, 129.30, 128.13, 126.90, 124.11, 120.13, 115.55, 45.65.