Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

The synthesis of arylcyanamides: Copper-catalyzed consecutive desulfurization and C-N cross-coupling strategy

S N Murthy Boddapati,[ab] Naresh Polam[a], Baby Ramana Mutchu[a], Hari Babu Bollikolla[a,*]

[a]*Department of Chemistry, Acharya Nagarjuna University, NNagar-522 510, Guntur, AP-India*

[b] *Department of Chemistry, C R Reddy P G College, Eluru-534002, AP-India*

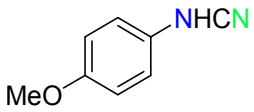
Contents **Page**

General Information: Thiourea, DMSO, EtOH, EtOAC, n-Hexane, n-Heptane, 1,10-Phenanthroline, $CuSO_4 \cdot 5H_2O$ (98 %), CuI (98 %), CuBr (98 %), Cu_2O (97 %), CuCl (99 %), $CuSO_4 \cdot 5H_2O$ (99 %) and $Cu(OAc)_2 \cdot H_2O$ (98 %), Et_3N, sodium bicarbonate, $K_3PO_4 \cdot 3H_2O$, KOH, K_2CO_3, Cs_2CO_3 were purchased from Aldrich and used without further purification. The solvents were purchased and dried according to standard procedure prior to use.[1] ^1H NMR (400 MHz) spectra were recorded with a Varian 400 spectrometer. Infrared (IR) spectra recorded on a Perkin Elmer Spectrum one FT-IR spectrometer. VKSI Medico Centrifuge machine was used for our experimental procedure for the synthesis of substituted cyanamides.

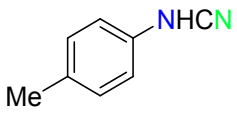
Experimental section:

General Procedure for construction of Phenylcyanamide: To a stirred solution of DMSO solvent (2-3 mL), thiourea (1 mmol, 76 mg) was added slowly followed by Et_3N (1 mmol, 101 mg) and $CuSO_4.5H_2O$ (50 mol %, 125 mg) at room temperature. The whole reaction mixture is stirred for one hour (until get the black color) at room temperature. After completion of the reaction (monitored by TLC), to this, iodobenzene (1 mmol, 204 mg), Cs_2CO_3 (1 mmol, 325 mg), $CuSO_4.5H_2O$ (10 mol %, 25 mg) and 1,10-phenanthroline (20 mol %, 36 mg) were slowly added consecutively for several minutes and the reaction mixture was stirred for 12 h at 80 °C. The progress of the reaction was investigated by TLC (5 % ethylacetate in hexane). After completion of reaction, the reaction mixture was transferred into centrifuged tubes and the mixture was centrifuged for 10 min by using centrifugation machine. Black color solid was settled in the bottom of centrifuged tubes. The clear solution was concentrated by using rotary evaporator and the crude mixture was purified by silica gel (60-120 mesh) column chromatography using 5 % ethylacetate in hexane as eluent to obtain a phenyl cyanamide **2a** as a white solid.

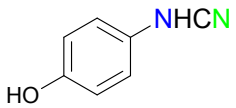
Phenylcyanamide 2a[1]: Analytical TLC on silica gel, 1:19 ethyl acetate/hexane R_f = 0.8; yield 90 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37-7.33 (m, 2H), 7.29-7.25 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 137.8, 130.6, 130.1, 128.9, 114.3; FT-IR (KBr) 3350, 3064, 2222, 1693, 1489, 1250, 1070, 909 cm^{-1}. Anal. Calcd. for $C_7H_6N_2$: C, 71.17; H, 5.12; N, 23.71. Found: C, 71.28; H, 5.09; N, 23.62.



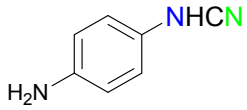
4-Methoxyphenylcyanamide 2b[2]: Analytical TLC on silica gel, 1:19 ethyl acetate/hexane R_f = 0.8; yield 95 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.18 (d, J = 8.8 Hz, 2H), 7.02 (d, J = 9.6 Hz, 2H), 5.81 (br s, 1NH), 3.33 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.1, 138.6, 131.9, 127.8, 121.7, 55.4; FT-IR (KBr) 3357, 3076, 2899, 2236, 1587, 1253, 1212, 1104, 1055, 941, 808 cm^{-1}. Anal. Calcd. for $C_8H_8N_2O$: C, 64.85; H, 5.44; N, 18.91; O, 10.80. Found: C, 64.99; H, 5.42; N, 18.85.



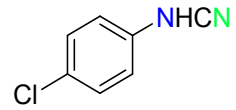
4-Methylphenylcyanamide 2c[1]: Analytical TLC on silica gel, 1:19 ethyl acetate/hexane R_f = 0.8; yield 95 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23-7.17 (m, 2H), 7.01 (d, J = 9.6 Hz, 2H), 2.33 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 142.3, 132.4, 128.5, 124.6, 120.0, 21.3; FT-IR (KBr) 3378, 3097, 2896, 2835, 2200, 1601, 1580, 1503, 1252, 1179, 1028, 927 cm^{-1}. Anal. Calcd. for $C_8H_8N_2$: C, 72.70; H, 6.10; N, 21.20. Found: C, 72.79; H, 6.09; N, 21.12.



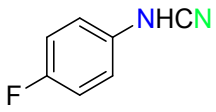
4-Hydroxyphenylcyanamide 2d: Analytical TLC on silica gel, 1:19 ethyl acetate/hexane R_f = 0.8; yield 79 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26-7.17 (m, 2H), 7.04-7.01 (m, 2H), 5.81 (br s, 1NH); ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.1, 138.0, 132.0, 127.8, 115.7; FT-IR (KBr) 3357, 3087, 2236, 1587, 1287, 1201, 1123, 1055, 971, 808 cm^{-1}. Anal. Calcd. for $C_7H_6N_2O$: C, 62.68; H, 4.51; N, 20.88; O, 11.93. Found: C, 62.82; H, 4.48; N, 20.82.



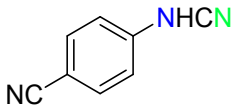
4-Aminophenylcyanamide 2e: Analytical TLC on silica gel, 1:19 ethyl acetate/hexane R_f = 0.8; yield 67 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.25-7.18 (m, 2H), 6.48-6.41 (m, 2H), 5.28 (br s, NH_2); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.1, 132.5, 130.6, 129.1, 117.1; FT-IR (KBr) 3378, 3357, 3097, 2200, 1615, 1556, 1221, 1154, 927 cm^{-1}. Anal. Calcd. for $C_7H_7N_3$: C, 63.14; H, 5.30; N, 31.56. Found: C, 63.24; H, 5.27; N, 31.49.



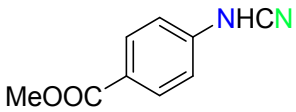
4-Chlorophenylcyanamide 2f[1]: Analytical TLC on silica gel, 1:19 ethyl acetate/hexane R_f = 0.6; Yield 80%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22 (d, *J* = 8.8, 2H), 6.97-6.93 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.1, 132.5, 130.6, 129.1, 117.1; FT-IR (KBr) 3399, 3076, 2214, 1670, 1505, 1250, 1114, 1023, 959, 817 cm^{-1}. Anal. Calcd. for $C_7H_5ClN_2$: C, 55.10; H, 3.30; Cl, 23.24; N, 18.36. Found: C, 55.25; H, 3.28; N, 18.30.



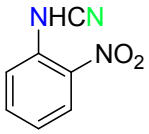
4-Fluorophenylcyanamide 2g: Analytical TLC on silica gel, 1:5 ethyl acetate/hexane R_f = 0.6; yield 72 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32-7.29 (m, 2H), 7.22 (d, *J* = 8.8 Hz, 2H), 6.39 (br s, 1NH); ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.7, 136.5, 126.2, 120.3, 114.9; FT-IR (KBr) 3359, 3056, 2217, 1654, 1554, 1394, 1279, 1140, 939, 822 cm^{-1}. Anal. Calcd. for $C_7H_5FN_2$: C, 61.76; H, 3.70; F, 13.96; N, 20.58. Found: C, 61.92; H, 3.67; N, 13.89.



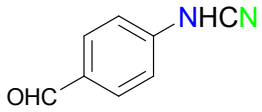
4-(Cyanoamino)benzonitrile 2h: Analytical TLC on silica gel, 1:5 ethyl acetate/hexane R_f = 0.5; yield 40 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40-7.37 (m, 2H), 7.34-7.31 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.4, 132.7, 128.1, 120.0, 115.6, 115.0; FT-IR (KBr) 3355, 3100, 2256, 2217, 1667, 1526, 1348, 1277, 1078, 973, 892 cm^{-1}. Anal. Calcd. for $C_8H_5N_3$: C, 67.12; H, 3.52; N, 29.35. Found: C, 67.20; H, 3.50; N, 29.29.



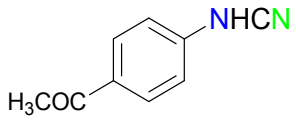
Methyl-4-(cyanoamino)benzoate 2i[1]: Analytical TLC on silica gel, 1:4 ethyl acetate/hexane R_f = 0.5; yield 40 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (d, *J* = 9.6 Hz, 2H), 7.38-7.33 (m, 2H), 5.91 (br s, 1NH), 3.80 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.8, 142.8, 134.4, 130.5, 130.0, 121.7, 54.8; FT-IR (KBr) 3415, 3082, 2896, 2234, 1749, 1675, 1607, 1524, 1459, 1345, 1261, 1145, 1099, 870 cm^{-1}. Anal. Calcd. for $C_9H_8N_2O_2$: C, 61.36; H, 4.58; N, 15.90; O, 18.16. Found: C, 61.50; H, 4.56; N, 15.84.



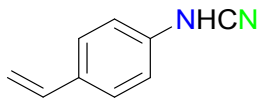
2-Nitrophenylcyanamide 2j: Analytical TLC on silica gel, 1:4 ethyl acetate/hexane R_f = 0.5; yield 60 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.40 (d, J = 9.2 Hz, 2 H), 7.65 (d, J = 8.8 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.6, 141.6, 136.7, 134.0, 132.1, 120.9, 115.1; FT-IR (KBr) 3375, 3065, 2215, 1656, 1564, 1490, 1379, 1229, 1125, 1036, 941, 832 cm^{-1}. Anal. Calcd. for $C_7H_5N_3O_2$: C, 39.73; H, 3.33; N, 10.30. Found: C, 39.88; H, 3.30; N, 10.23.



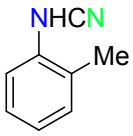
4-Formylphenylcyanamide 2k: Analytical TLC on silica gel, 1:9 ethyl acetate/hexane R_f = 0.8; yield 57 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.33 (s, 1H), 7.76-7.67 (m, 2H), 7.04-7.01 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 192.1, 145.6, 134.0, 132.1, 120.9, 115.1; FT-IR (KBr) 3355, 3219, 2256, 1750, 1687, 1603, 1556, 1352, 1254, 1102, 973, 892 cm^{-1}. Anal. Calcd. for $C_8H_6N_2O$: C, 65.75; H, 4.14; N, 19.17; O, 10.95. Found: C, 65.89; H, 4.12; N, 19.10.



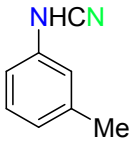
4-Acetylphenylcyanamide 2l: Analytical TLC on silica gel, 1:5 ethyl acetate/hexane R_f = 0.8; yield 61 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (d, J = 9.6 Hz, 2H), 7.38-7.33 (m, 2H), 5.91 (br s, 1NH), 2.52 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 190.9, 144.5, 128.1, 120.0, 115.6, 115.0, 25.6; FT-IR (KBr) 3415, 3102, 2902, 2234, 1749, 1645, 1597, 1532, 1459, 1353, 1254, 1156, 1045, 892 cm^{-1}. Anal. Calcd. for $C_9H_8N_2O$: C, 67.49; H, 5.03; N, 17.49; O, 9.99. Found: C, 67.61; H, 5.01; N, 17.43.



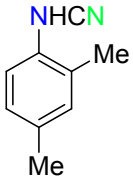
4-Vinylphenylcyanamide 2m: Analytical TLC on silica gel, 1:9 ethyl acetate/hexane R_f = 0.8; yield 62 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35-7.30 (m, 2H), 7.26-7.21 (m, 2H), 6.73 (dd, *J* = 12.4, 16 Hz, 1H), 6.09 (br, s, 1H), 5.55 (d, *J* = 14 Hz, 1H), 4.95 (d, *J* = 8.8 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.6, 137.8, 134.5, 130.9, 129.9, 117.7, 113.9; FT-IR (KBr) 3375, 3199, 2215, 1656, 1602, 1564, 1490, 1379, 1229, 1125, 1036, 941, 832 cm^{-1}. Anal. Calcd. for $C_9H_8N_2$: C, 74.98; H, 5.59; N, 19.43. Found: C, 75.08; H, 5.56; N, 19.36.



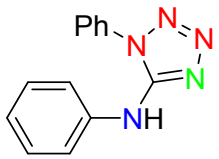
o-Tolylcyanamide 2o[2]: Analytical TLC on silica gel, 1:19 ethyl acetate/hexane R_f = 0.8; yield 82 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26-7.21 (m, 1H), 7.17-7.12 (m, 2H), 6.99 (d, *J* = 8.8 Hz, 1H), 6.09 (br s, 1NH), 2.14 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.0, 139.6, 137.8, 134.5, 130.9, 129.9, 117.0, 20.6; FT-IR (KBr) 3412, 3074, 2867, 2223, 1690, 1435, 1379, 1229, 1125, 1036, 941, 875 cm^{-1}. Anal. Calcd. for $C_8H_8N_2$: C, 72.70; H, 6.10; N, 21.20. Found: C, 72.80; H, 6.02; N, 21.12.



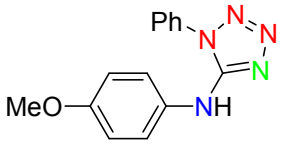
m-Tolylcyanamide 2p[2]: Analytical TLC on silica gel, 1:19 ethyl acetate/hexane R_f = 0.8; yield 80 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 (s, 1H), 7.22 (d, *J* = 8.8, 1H), 6.97-6.93 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.6, 131.6, 131.3, 130.4, 120.3, 120.0, 115.4, 24.1; FT-IR (KBr) 3423, 3048, 2899, 2217, 1656, 1588, 1490, 1409, 1288, 1261, 1123, 1078, 823. Anal. Calcd. for $C_8H_8N_2$: C, 72.70; H, 6.10; N, 21.20. Found: C, 72.80; H, 6.02; N, 21.12.



2,4-Dimethylphenylcyanamide 2q[1]: Analytical TLC on silica gel, 1:19 ethyl acetate/hexane R_f = 0.8; yield 93 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.03 (s, 1H), 6.85 (d, *J* = 7.6 Hz, 1H), 6.56 (d, *J* = 8.0 Hz, 1H), 2.30 (s, 3H), 2.27 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.6, 137.8, 134.5, 130.9, 129.9, 119.9, 113.9, 20.6, 18.2; FT-IR (KBr) 3368, 3077, 2888, 2863, 2212, 1635, 1599, 1513, 1491, 1287, 1215, 1027, 823 cm^{-1}. Anal. Calcd. for $C_9H_{10}N_2$: C, 73.94; H, 6.89; N, 19.16. Found: C, 74.02; H, 6.88; N, 19.09.

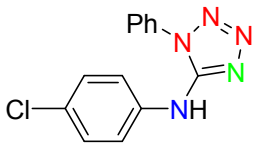


***N*,1-Diphenyl-1*H*-tetrazol-5-amine A**: Analytical TLC on silica gel, 3:7 ethyl acetate/hexane R_f = 0.7; yield 88 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54-7.41 (m, 7H), 6.85 (d, *J* = 8.8 Hz, 3H), 6.02 (br s, 1NH); ^{13}C NMR (100 MHz, $CDCl_3$) δ 138.4, 132.8, 131.6, 129.2, 128.5, 128.1, 121.5, 120.9, 117.6; FT-IR (KBr) 3426, 3097, 1645, 1631, 1567, 1512, 1491, 1287, 1250, 1146, 1027, 896 cm^{-1}. Anal. Calcd. for $C_{13}H_{11}N_5$: C, 65.81; H, 4.67; N, 29.52. Found: C, 65.90; H, 4.65; N, 29.45.

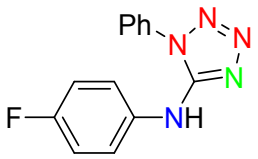


***N*-(4-Methoxyphenyl)-1-phenyl-1*H*-tetrazol-5-amine B**: Analytical TLC on silica gel, 3:7 ethyl acetate/hexane R_f = 0.7; yield 80 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, *J* = 7.6 Hz, 2H), 7.54-7.47 (m, 5H), 6.85 (d, *J* = 8.4 Hz, 2H), 6.02 (br s, 1NH), 3.77 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.7, 142.9, 133.7, 132.6, 129.7, 129.5, 129.3, 126.1, 121.4, 55.0; FT-IR (KBr)

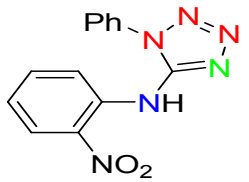
3426, 3082, 2900, 1657, 1612, 1586, 1514, 1448, 1325, 1216, 1145, 1099, 829 cm^{-1}. Anal. Calcd. for $C_{14}H_{13}N_5O$: C, 62.91; H, 4.90; N, 26.20; O, 5.99. Found: C, 63.05; H, 4.88; N, 26.14.



***N*-(4-Chlorophenyl)-1-phenyl-1*H*-tetrazol-5-amine C**: Analytical TLC on silica gel, 3:7 ethyl acetate/hexane R_f = 0.7; yield 82 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77-7.48 (m, 4H), 7.25 (d, *J* = 6.8 Hz, 3H), 7.16 (d, *J* = 8.8 Hz, 2H), 5.96 (br s, 1NH); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.7, 137.0, 132.3, 128.3, 128.1, 127.8, 127.0, 124.7, 118.1; FT-IR (KBr) 3420, 3090, 1645, 1601, 1590, 1489, 1125, 1036, 941, 854, 788, 612 cm^{-1}. Anal. Calcd. for $C_{13}H_{10}ClN_5$: C, 57.47; H, 3.71; Cl, 13.05; N, 25.78. Found: C, 57.62; H, 3.69; N, 25.72.

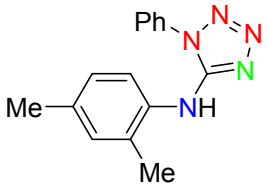


***N*-(4-Fluorophenyl)-1-phenyl-1*H*-tetrazol-5-amine D**: Analytical TLC on silica gel, 3:7 ethyl acetate/hexane R_f = 0.7; yield 85 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64-7.33 (m, 7H), 7.12 (d, *J* = 8 Hz, 2H), 5.98 (br s, 1H, 1NH); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.0, 142.1, 134.7, 133.0, 128.6, 128.5, 120.6, 119.3, 114.3,114.0; FT-IR (KBr) 3389, 3088, 1693, 1612, 1543, 1489, 1421, 1400, 1239, 1121, 1070, 927, cm^{-1}. Anal. Calcd. for $C_{13}H_{10}FN_5$: C, 61.17; H, 3.95; F, 7.44; N, 27.44. Found: C, 61.32; H, 3.93; N, 27.37.



***N*-(2-Nitrophenyl)-1-phenyl-1*H*-tetrazol-5-amine E**: Analytical TLC on silica gel, 3:7 ethyl acetate/hexane R_f = 0.7; yield 70 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.92 (br s, 1NH), 8.09-8.06 (m, 2H), 8.05-7.76 (m, 2H), 7.74 (d, *J* = 2Hz, 2H), 7.05 (d, *J* = 7.2Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.8, 146.3, 143.8, 141.8, 137.3, 129.6, 127.1, 125.6, 121.0, 120.7, 118.0; FT-IR

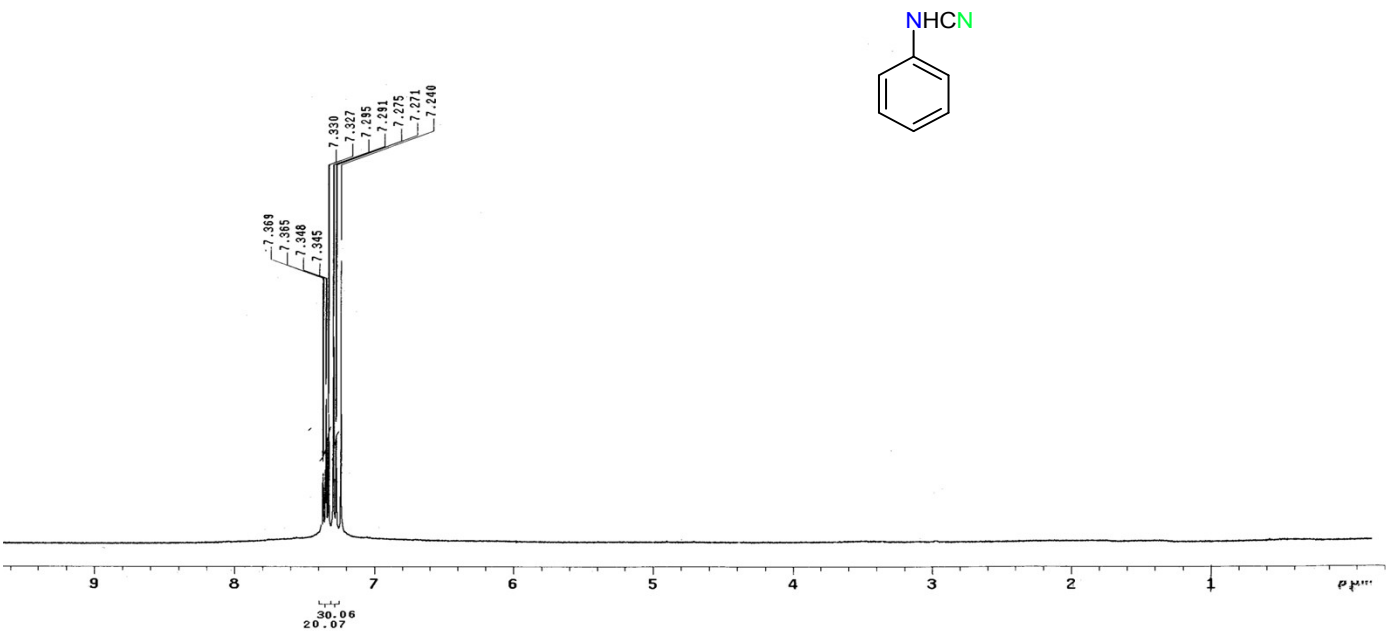
(KBr) 3417, 3087, 1667, 1654, 1612, 1567, 1521, 1458, 1394, 1332, 1265, 1104, 1080, 941 cm^{-1}. Anal. Calcd. for $C_{13}H_{10}N_6O_2$: C, 55.32; H, 3.57; N, 29.77; O, 11.34. Found: C, 55.49; H, 3.53; N, 29.70.



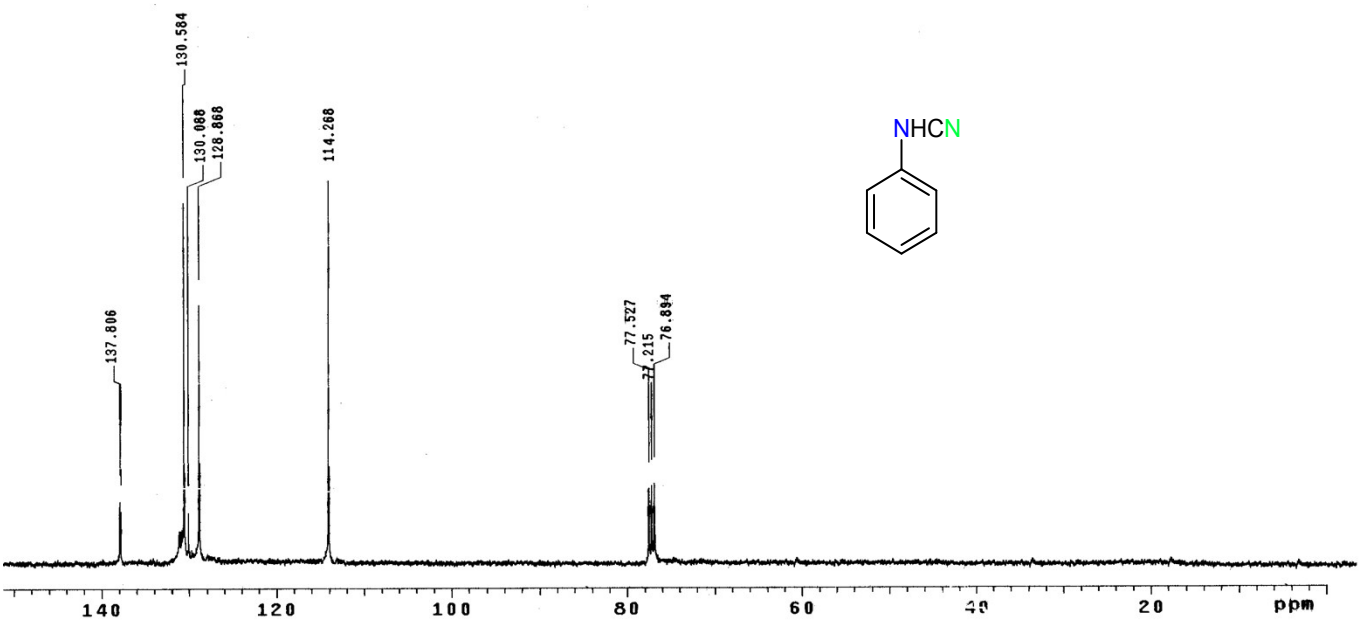
***N*-(2,4-Dimethylphenyl)-1-phenyl-1*H*-tetrazol-5-amine F**: Analytical TLC on silica gel, 3:7 ethyl acetate/hexane R_f = 0.7; yield 80 %; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68-7.27 (m, 5H), 7.09 (s, 1H), 6.84 (d, *J* = 7.2 Hz, 2H), 5.90 (br s, 1H, 1NH), 2.47 (s, 3H), 2.34 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.4, 135.3, 134.8, 134.1, 133.2, 131.4, 130.0, 129.9, 127.1, 125.5, 121.4, 21.0, 20.9; FT-IR (KBr) 3424, 3054, 2896, 2855, 1651, 1602, 1580, 1503, 1358, 1252, 1179, 1056, 1028, 898 cm^{-1}. Anal. Calcd. for $C_8H_6Br_2N_2O$: C, 31.41; H, 1.98; N, 9.16; Found: C, 31.55; H, 1.96; N, 9.10.

References:

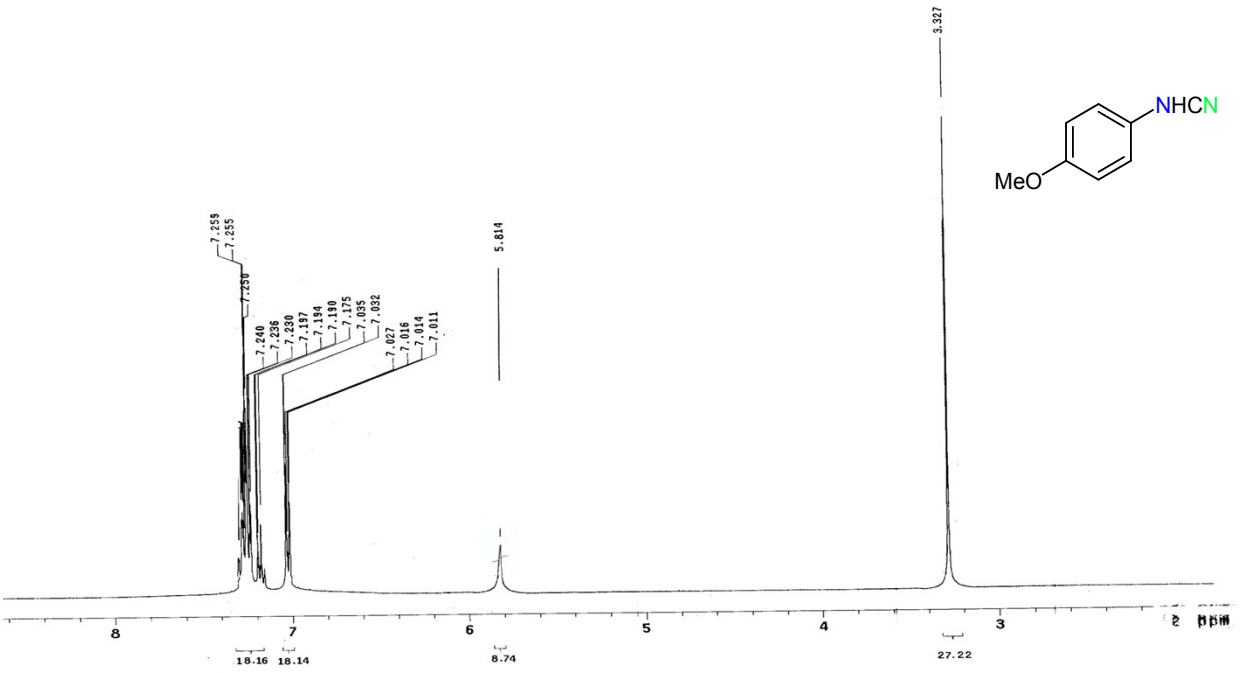
1. Ghosh, H.; Yella, R.; Ali, A. R.; Sahoo, S. K.; Patel, B. K. *Tetrahedron Lett.* **2009**, *50*, 2407.
2. Chen, C.-Y.; Wong, F. F.; Huang, J.-J.; Lin, S.–K.; Yeh, M.-Y. *Tetrahedron Lett.* **2008**, *49*, 6505.



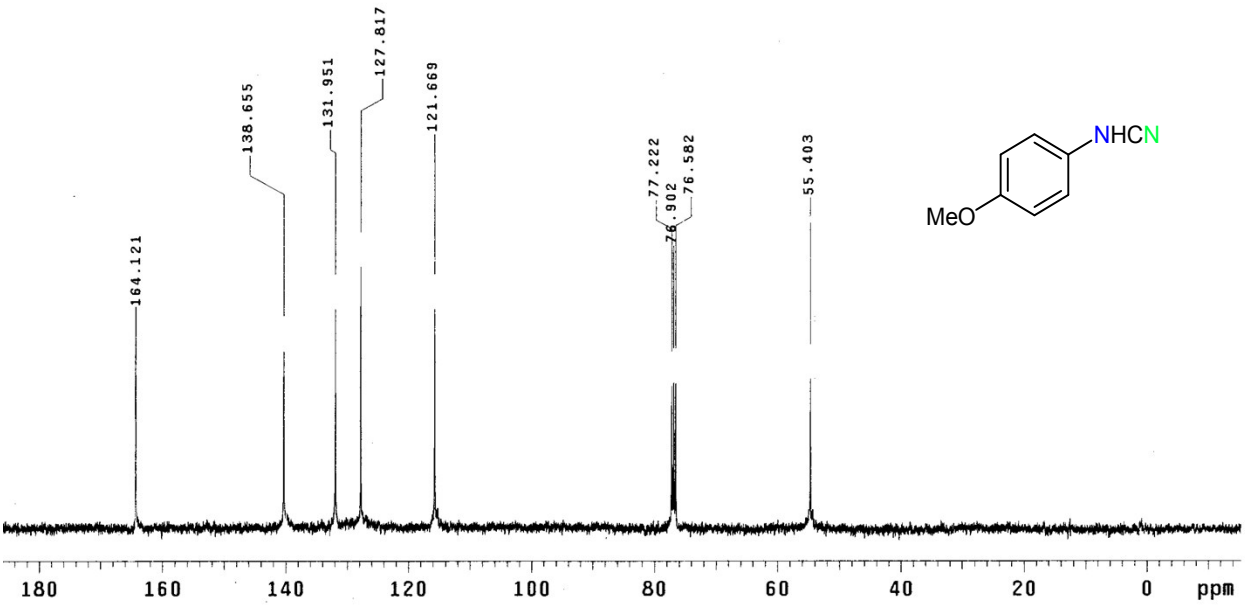
^{1}H NMR Spectra of Compound-**2a**



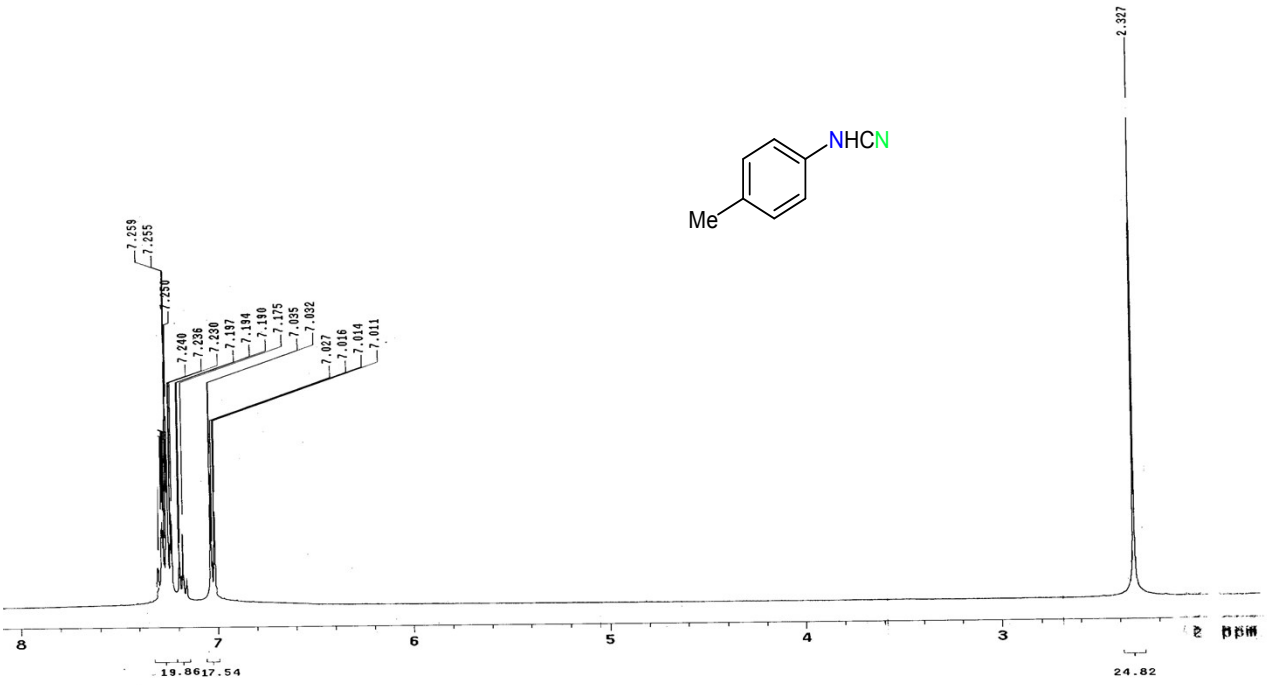
^{13}C NMR Spectra of Compound-**2a**



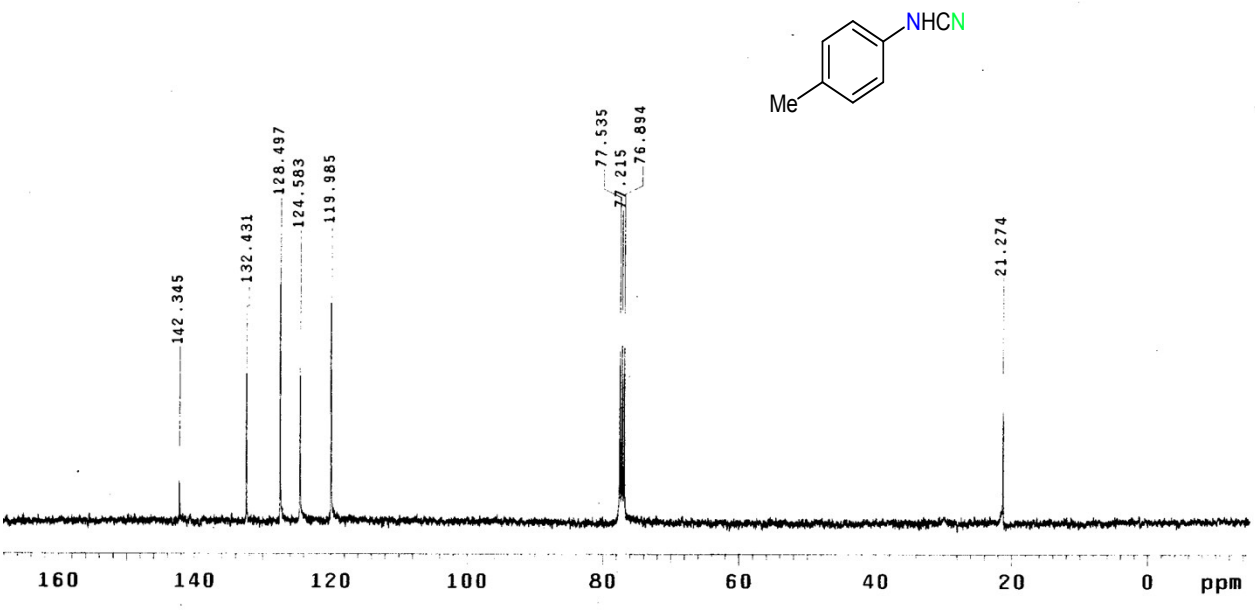
^{1}H NMR Spectra of Compound-**2b**



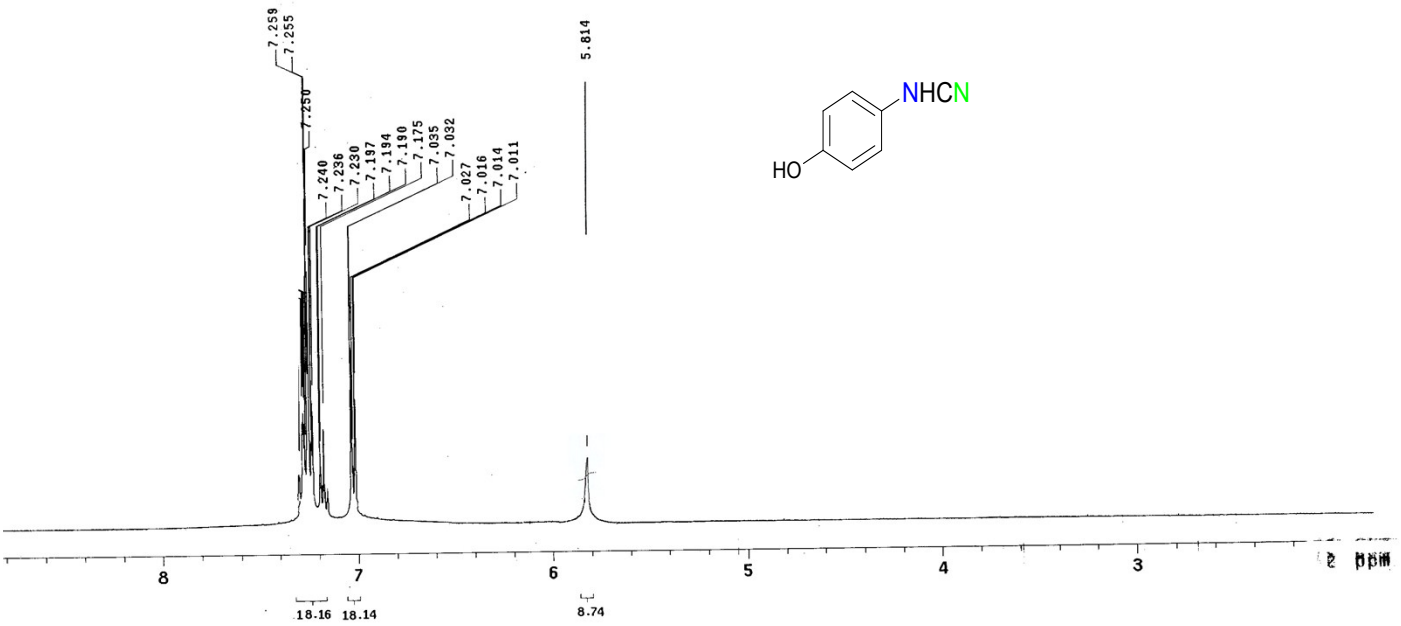
^{13}C NMR Spectra of Compound-**2b**



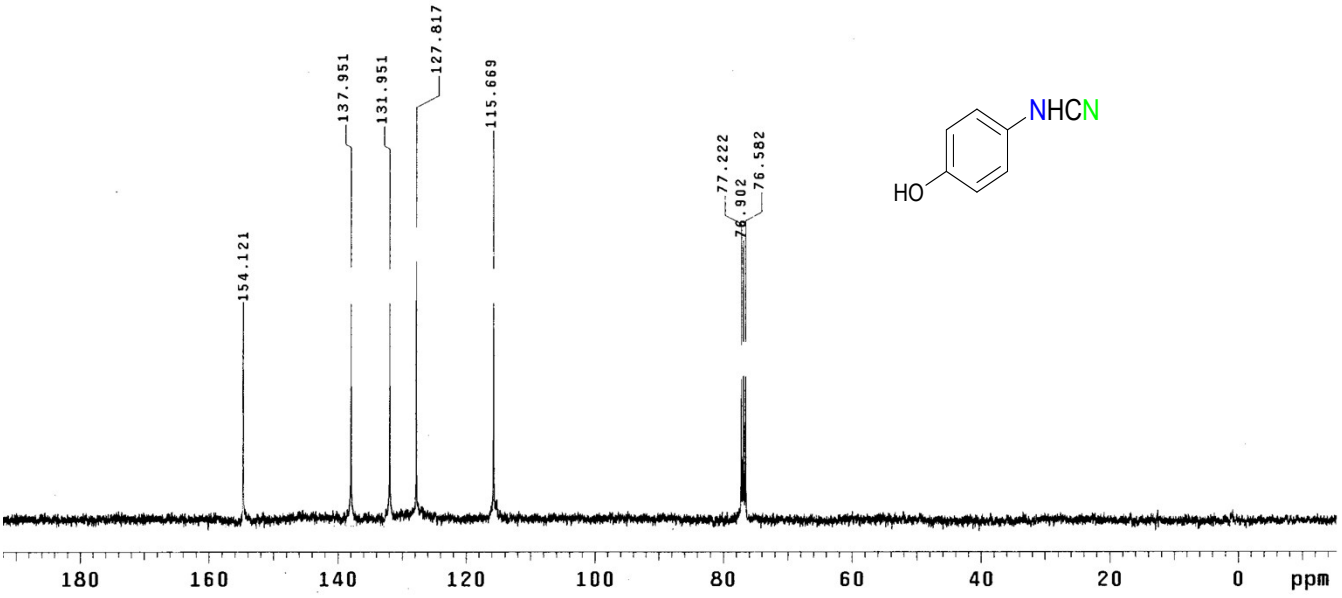
^{1}H NMR Spectra of Compound-**2c**



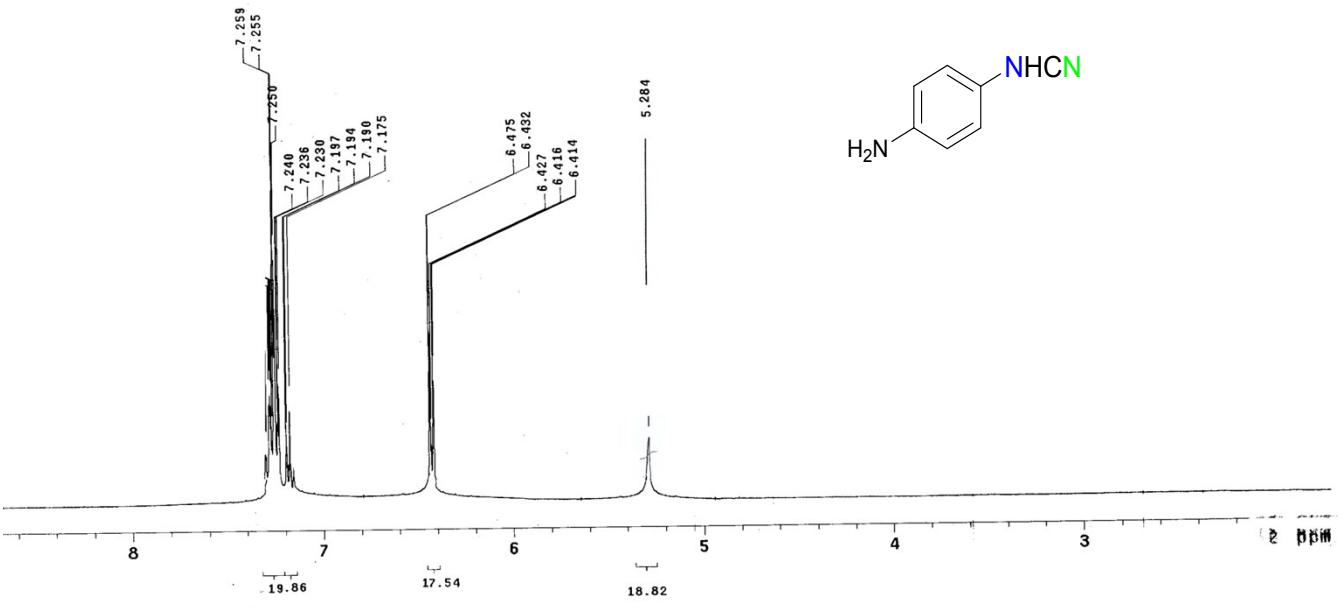
^{13}C NMR Spectra of Compound-**2c**



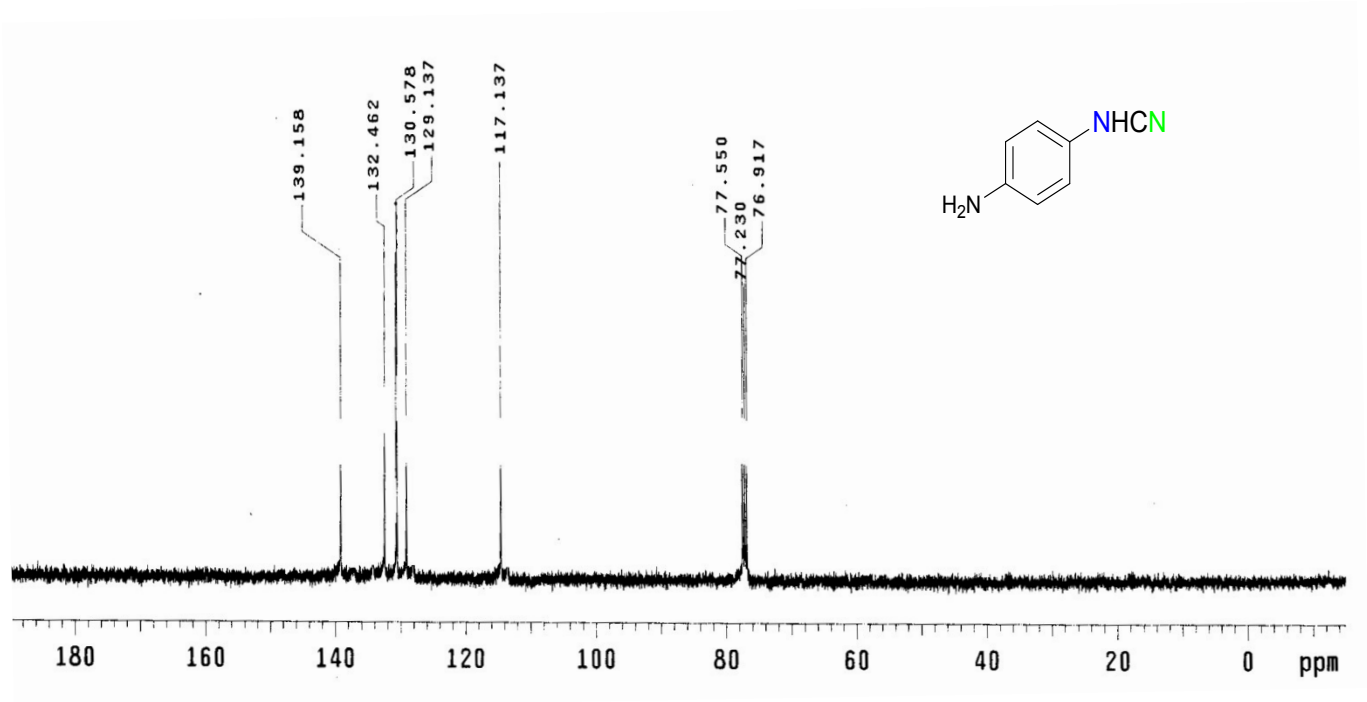
^{1}H NMR Spectra of Compound-**2d**



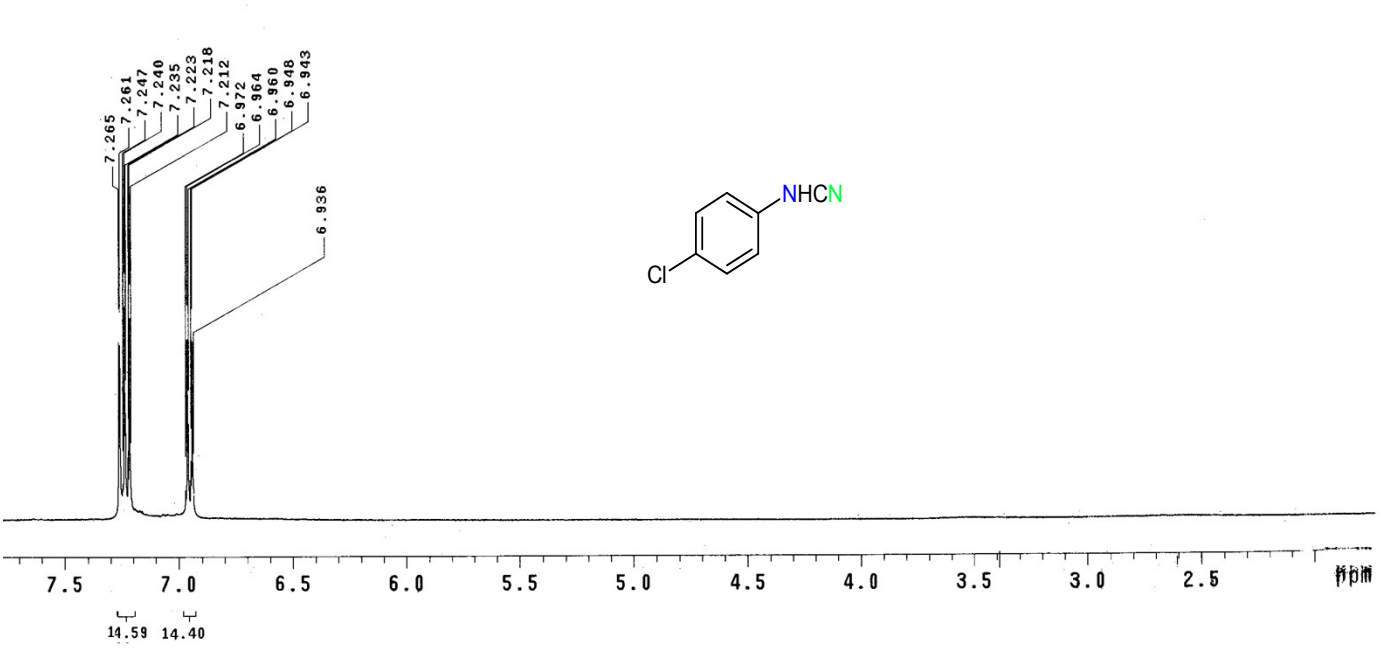
^{13}C NMR Spectra of Compound-**2d**



^{1}H NMR Spectra of Compound-**2e**

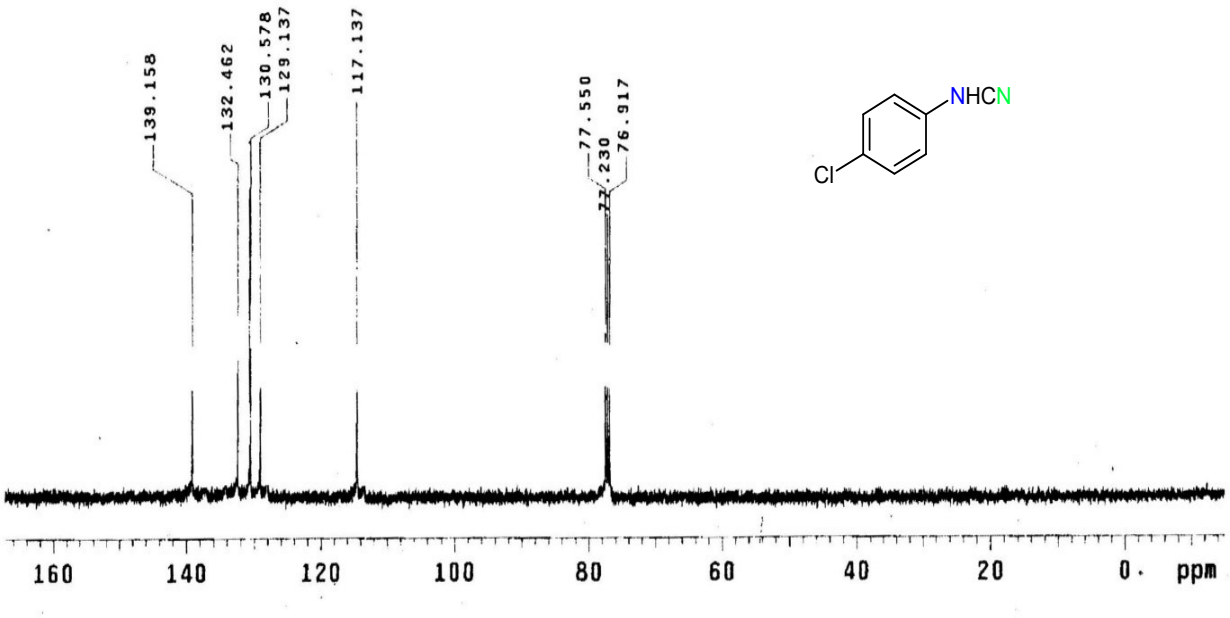


^{13}C NMR Spectra of Compound-**2e**

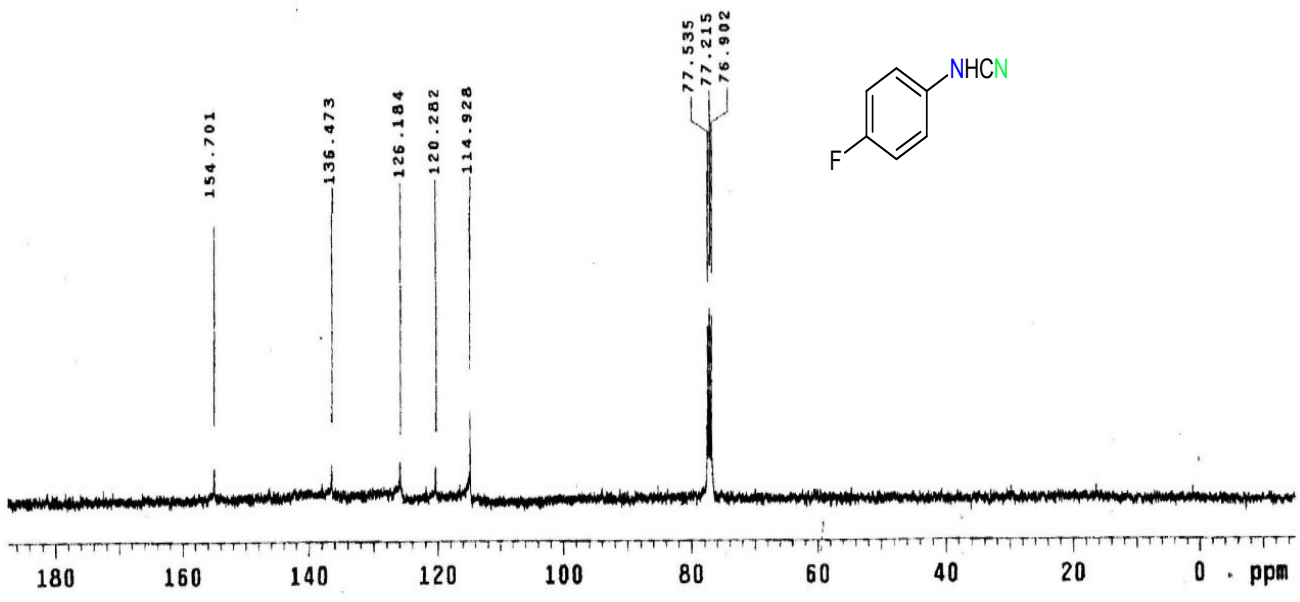


^{1}H NMR Spectra of Compound-**2f**

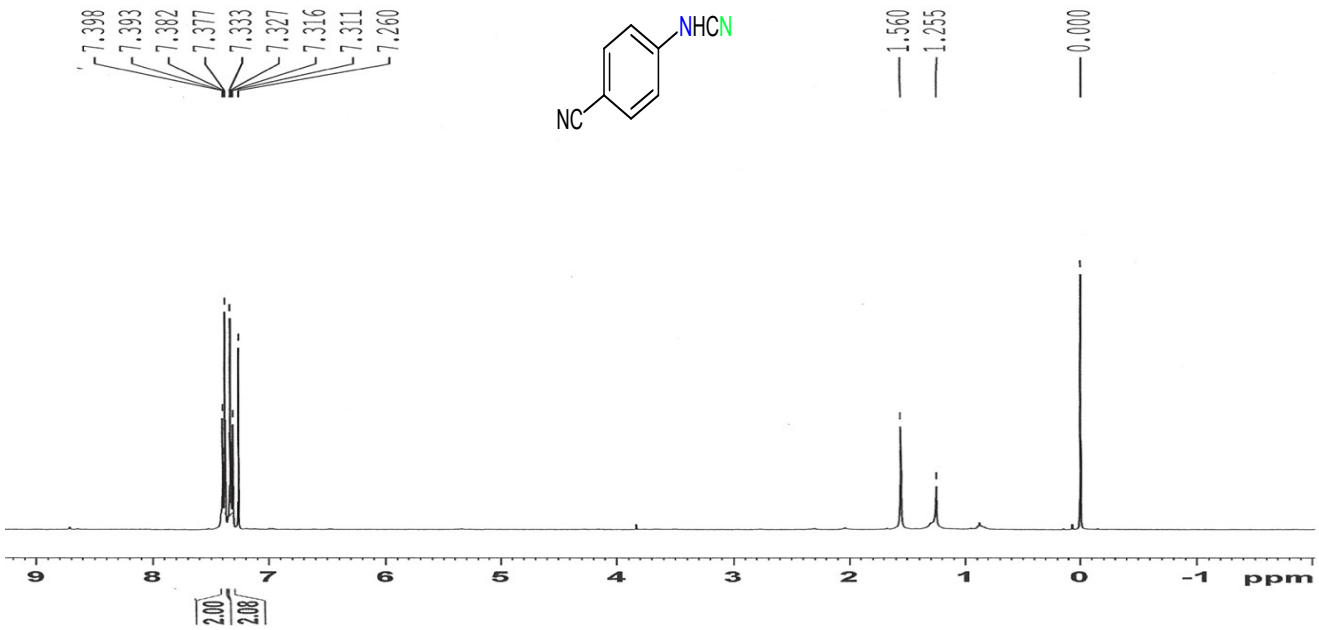
^{13}C NMR Spectra of Compound-**2f**



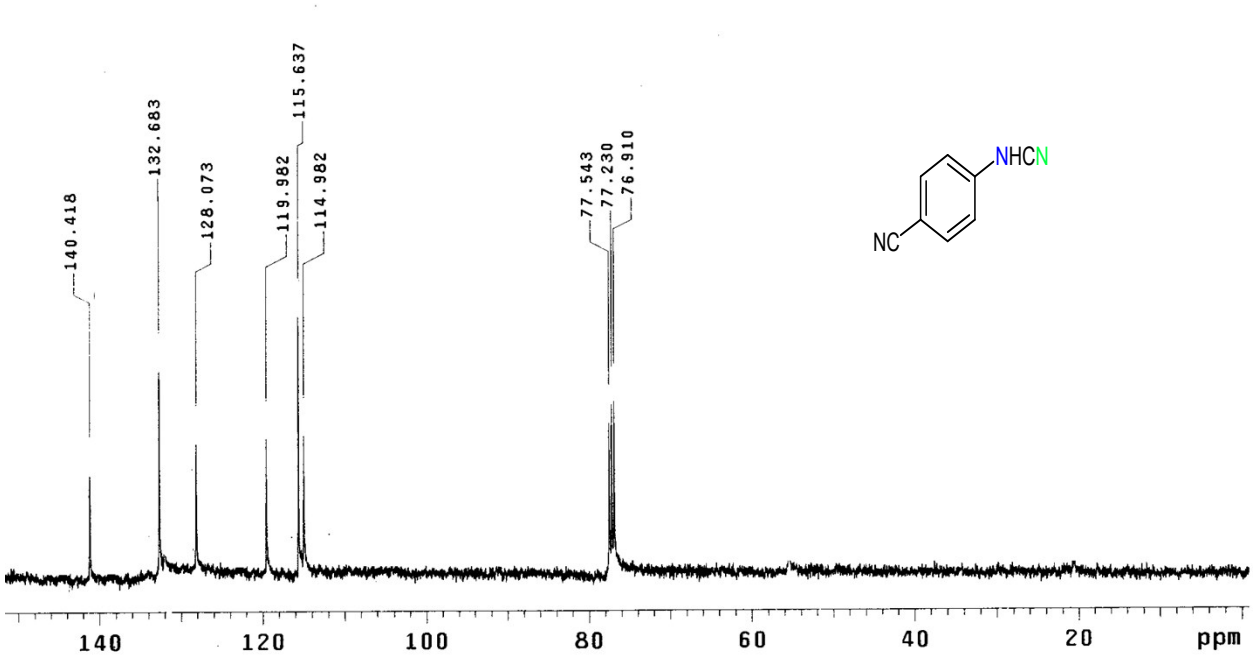
^{1}HNMR Spectra of Compound-**2g**



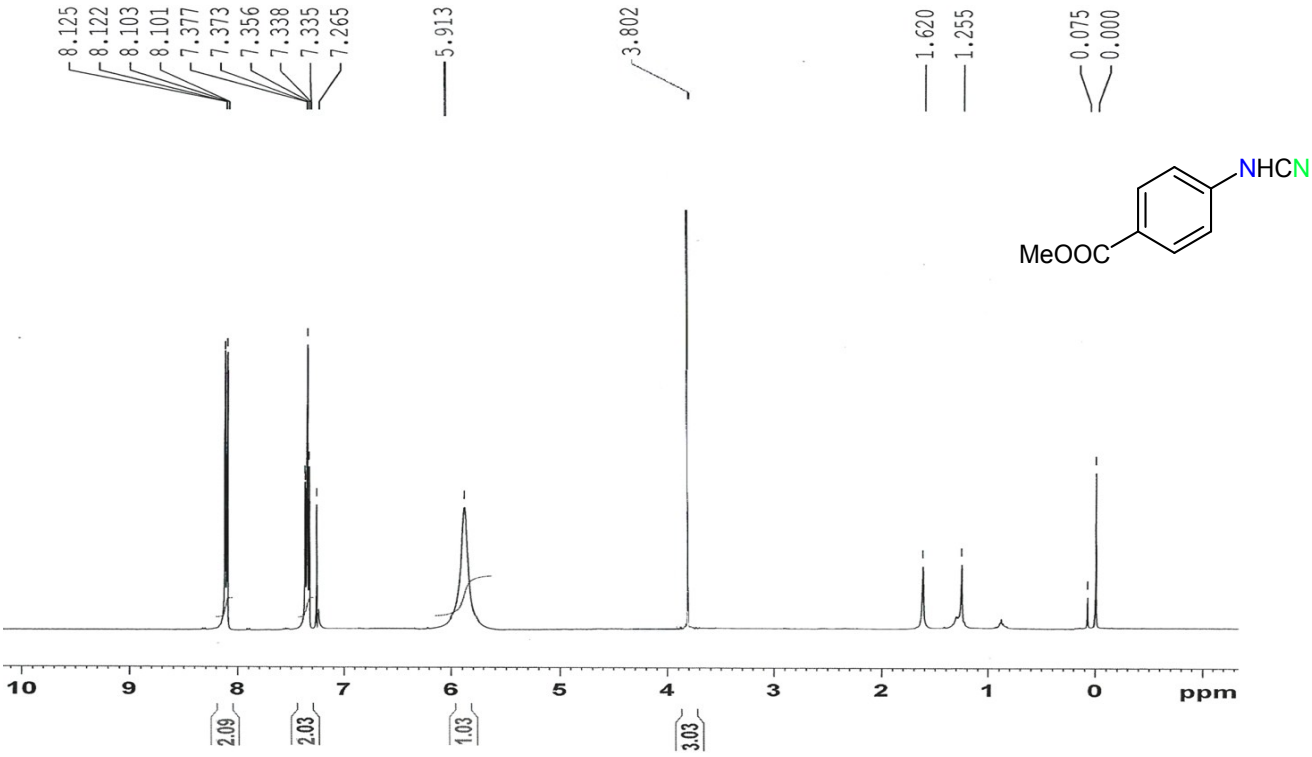
^{13}C NMR Spectra of Compound-**2g**



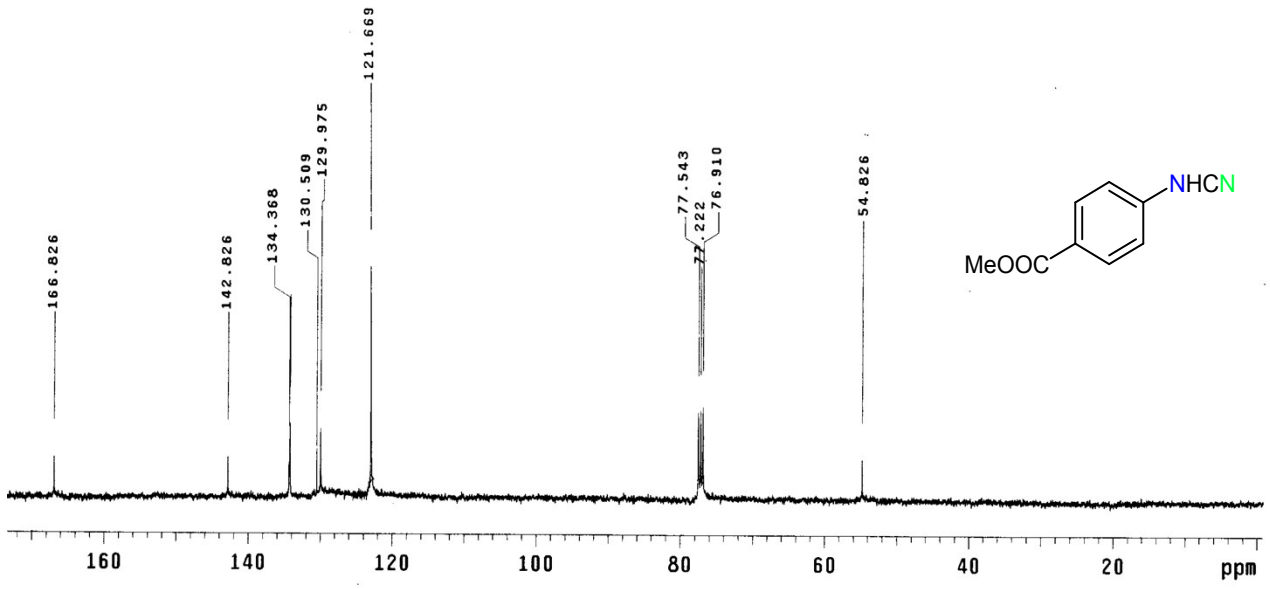
^{1}H NMR Spectra of Compound-**2h**



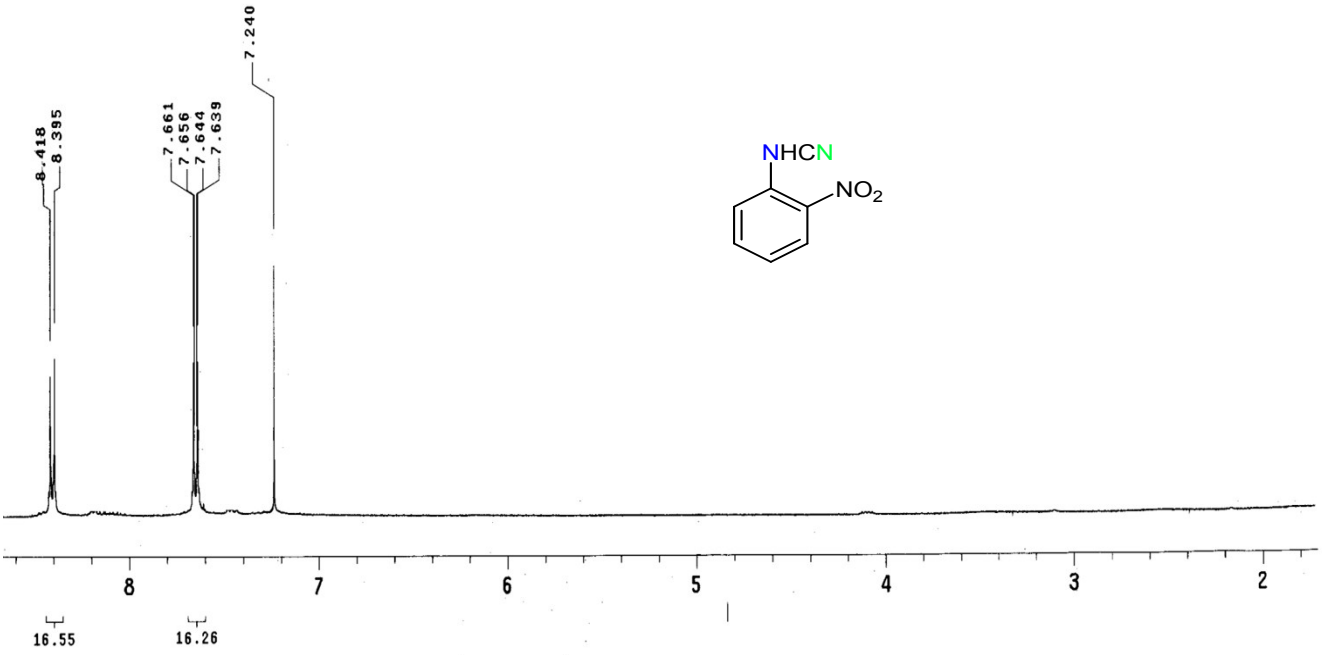
^{13}C NMR Spectra of Compound-**2h**



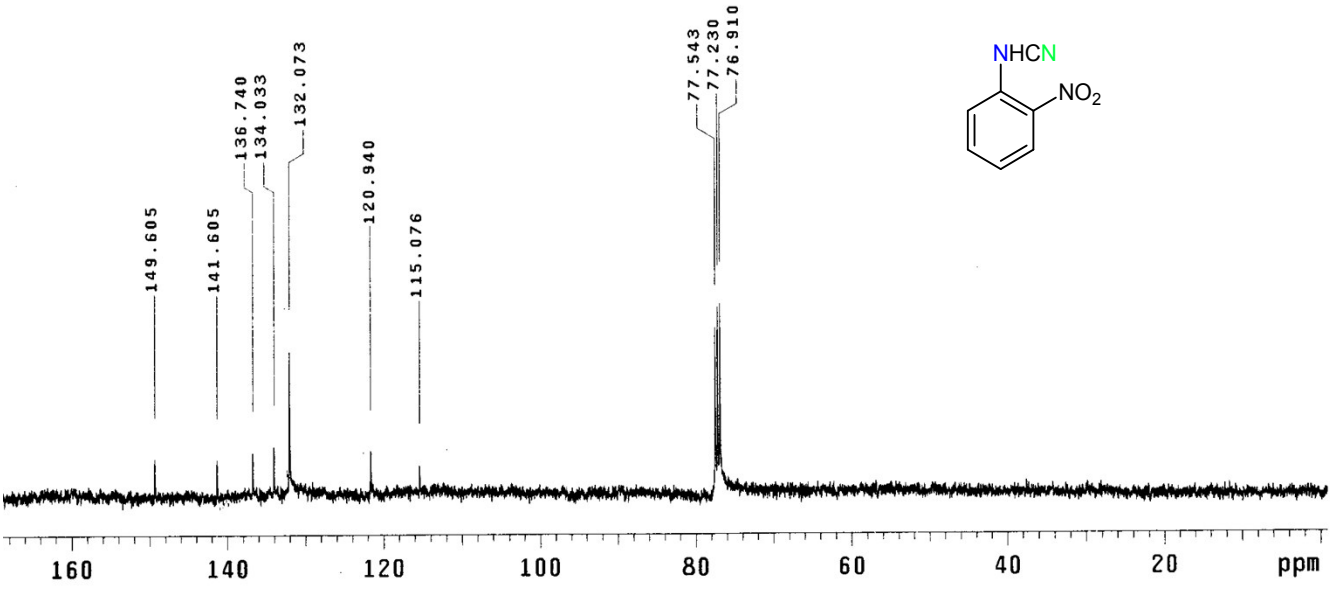
^{1}H NMR Spectra of Compound-**2i**



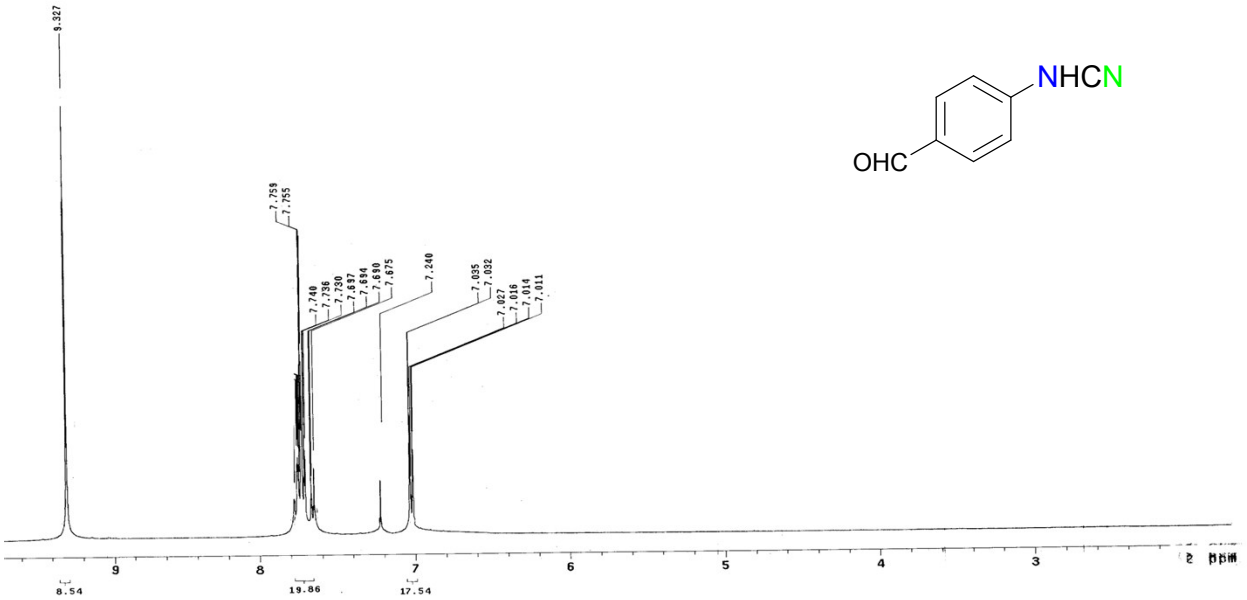
^{13}C NMR Spectra of Compound-**2i**



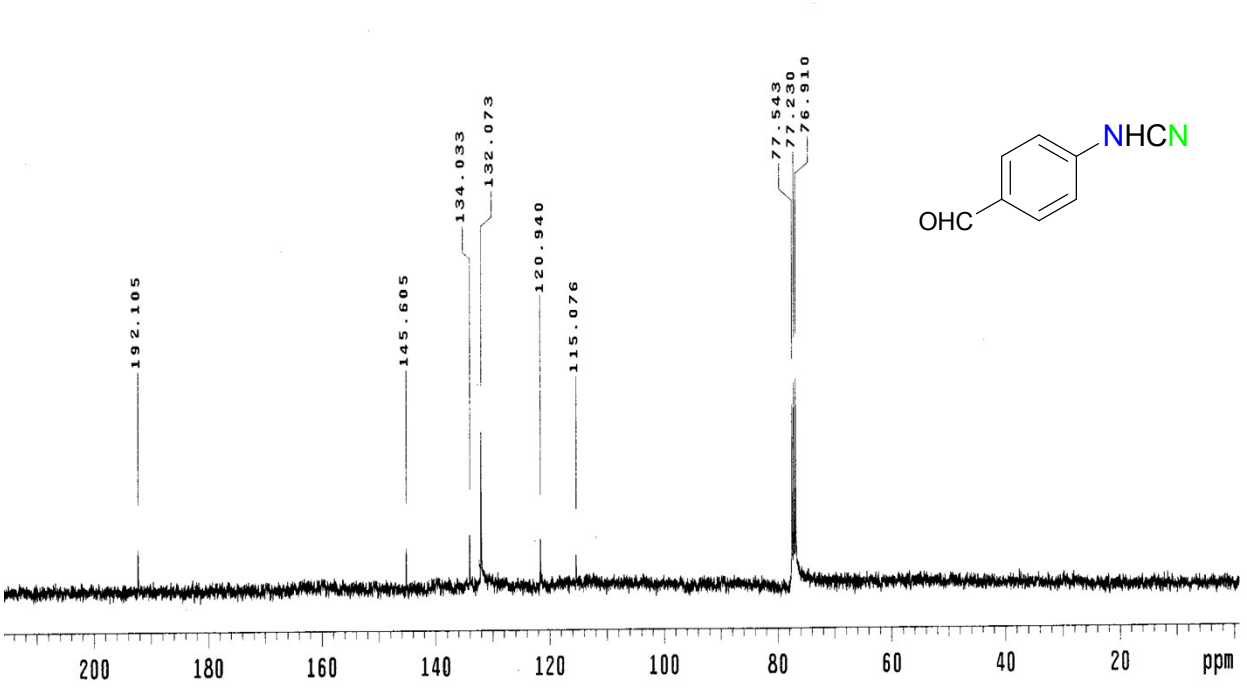
^{1}H NMR Spectra of Compound-**2j**



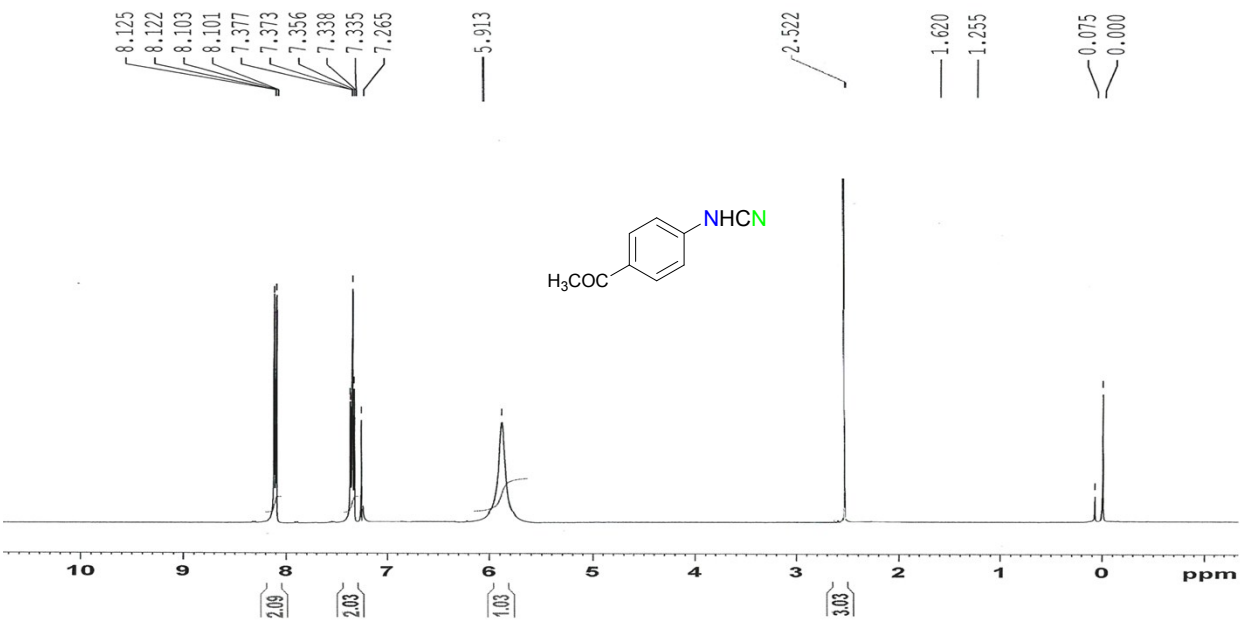
^{13}C NMR Spectra of Compound-**2j**



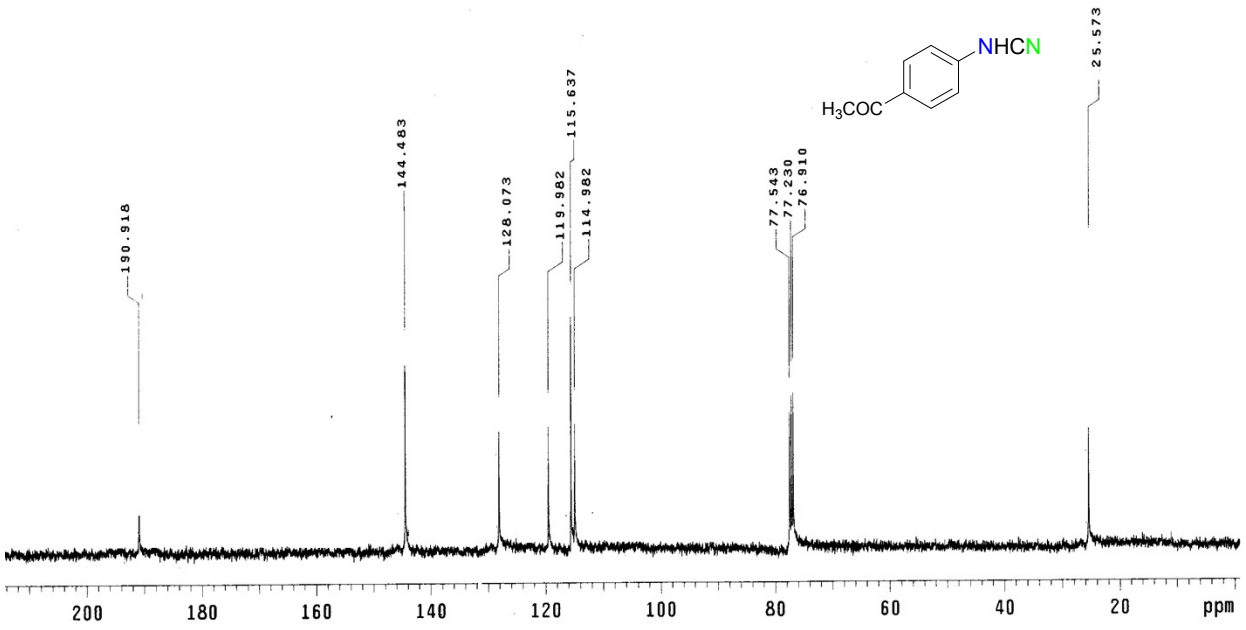
^{1}H NMR Spectra of Compound-**2k**



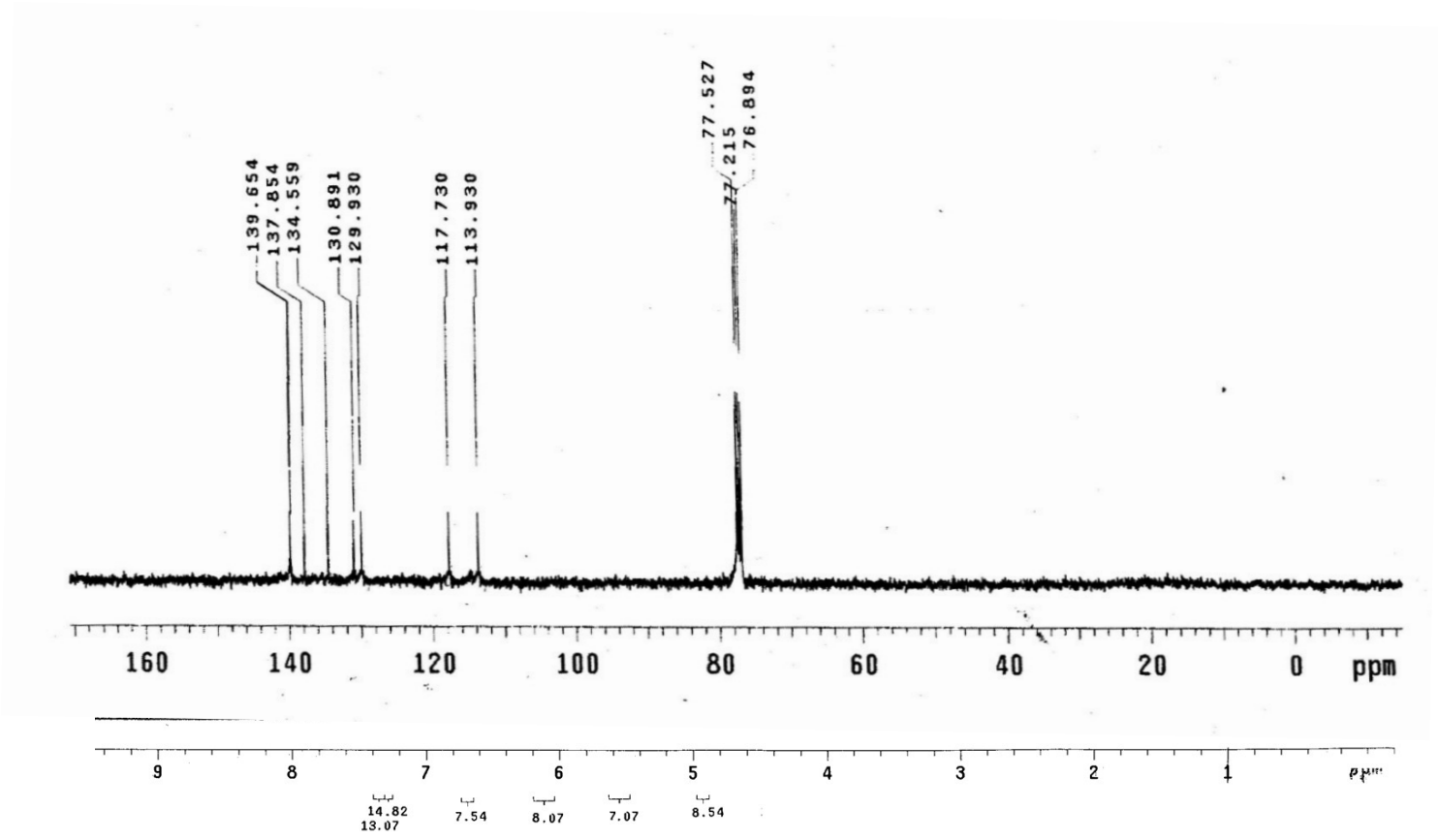
^{13}C NMR Spectra of Compound-**2k**



^{1}H NMR Spectra of Compound-**2l**

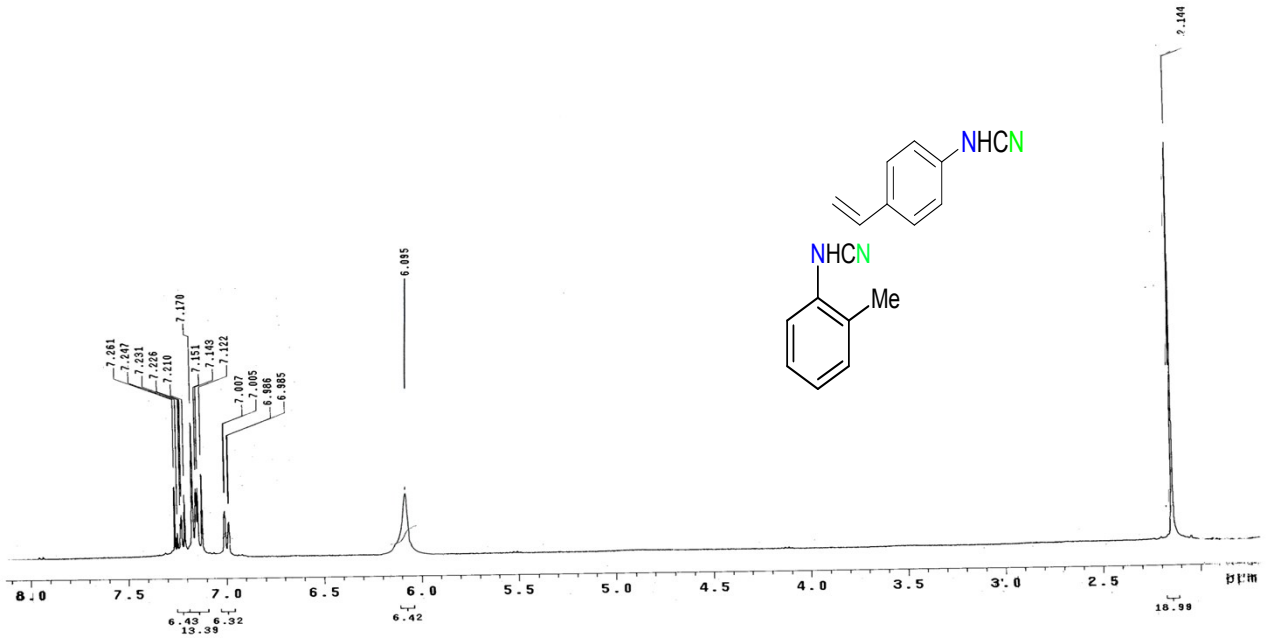


^{13}C NMR Spectra of Compound-**2l**

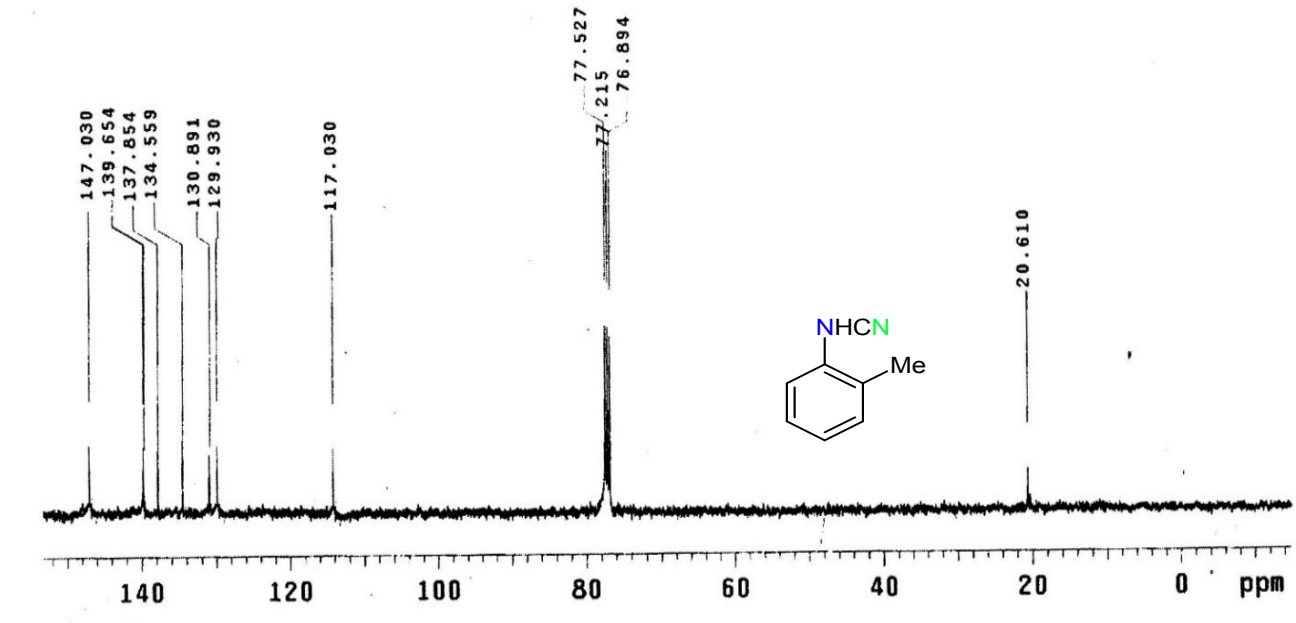


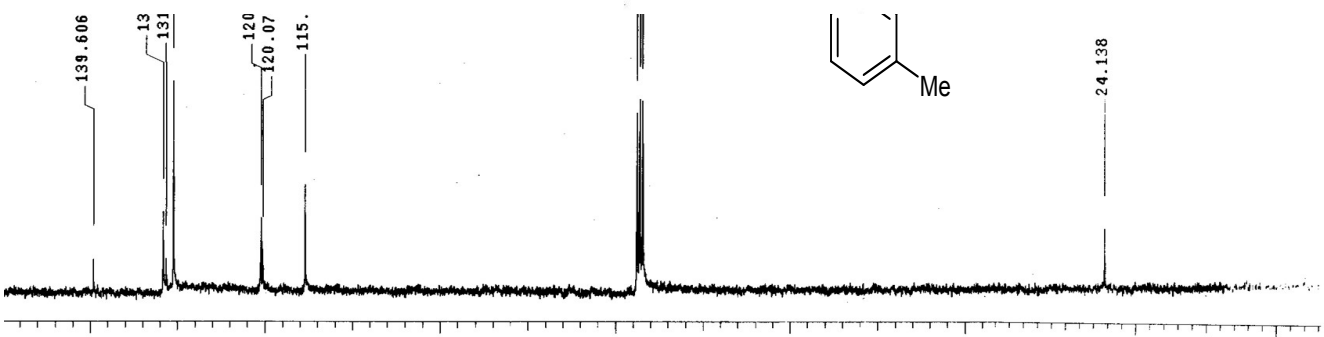
^{1}H NMR Spectra of Compound-**2m**

^{13}C NMR Spectra of Compound-**2m**

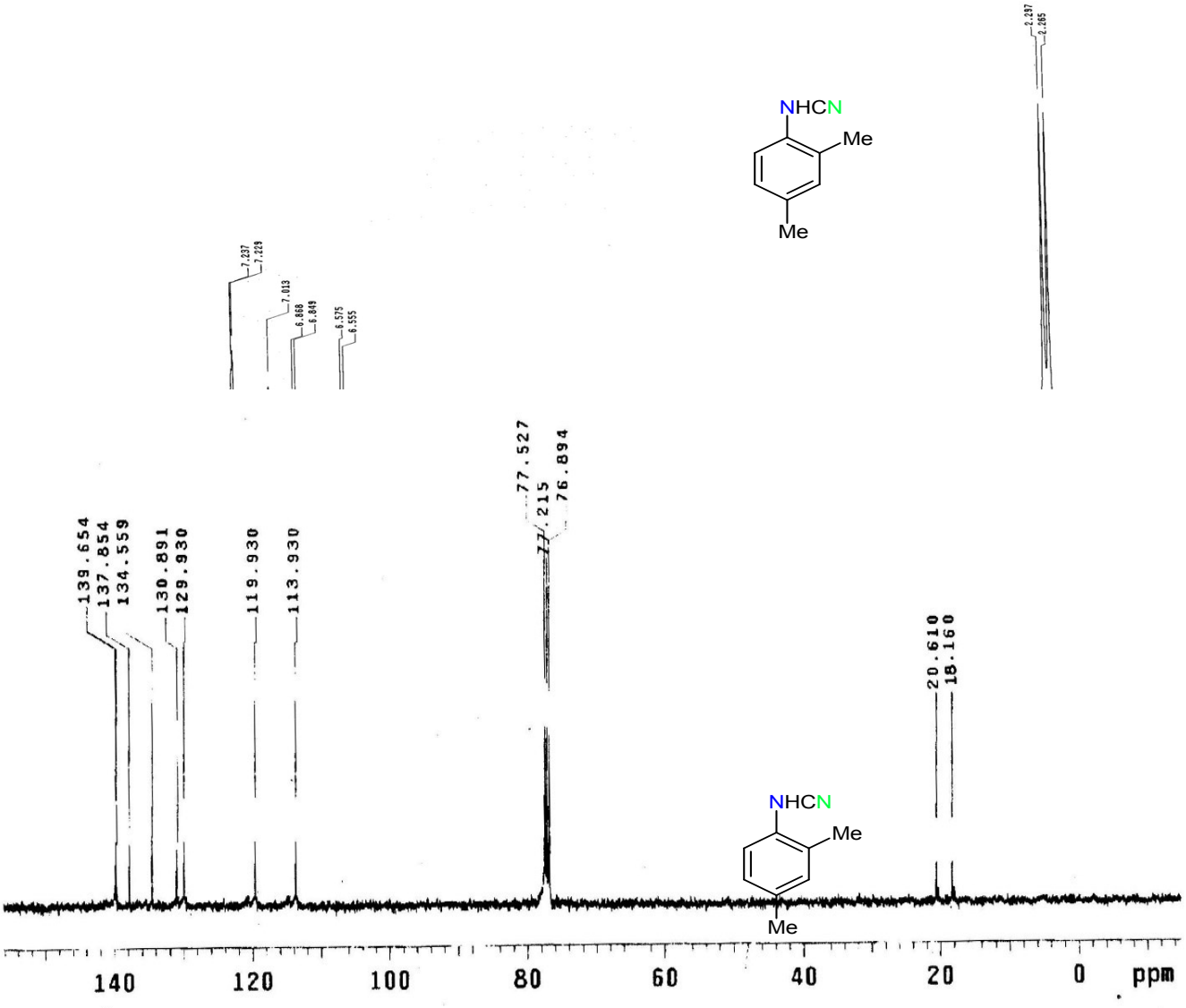


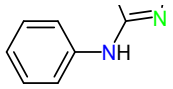
^{1}H NMR Spectra of



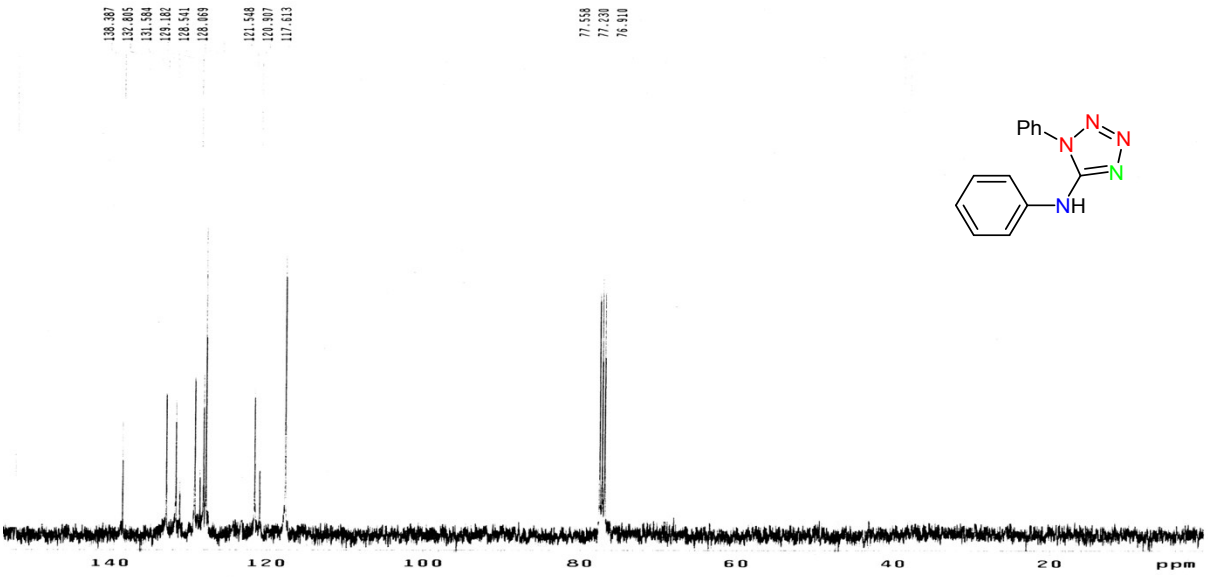


^{13}C NMR Spectra of Compound-**2p**

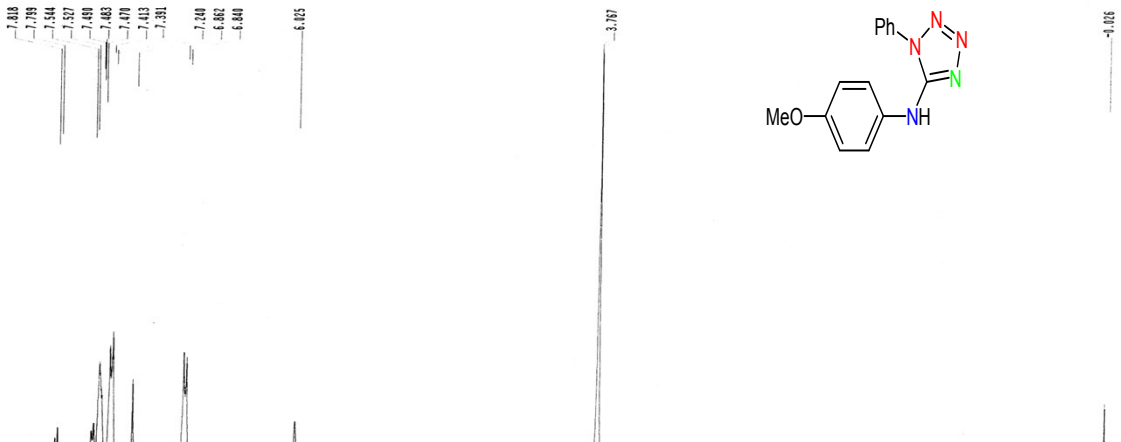




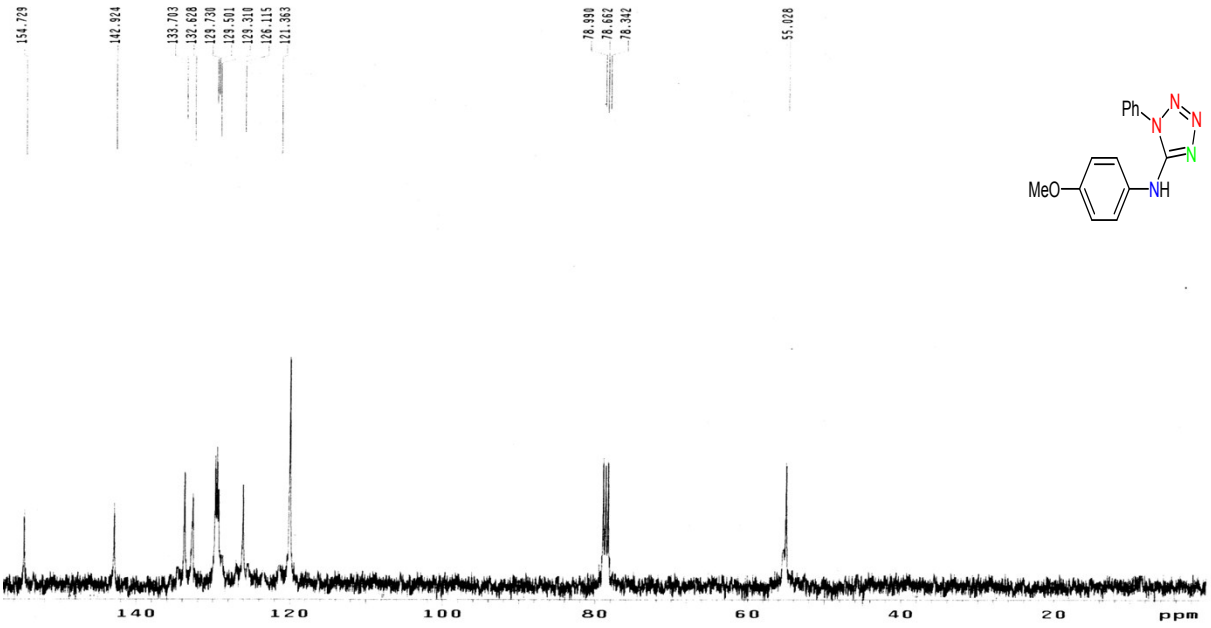
^{1}H NMR Spectra of Compound-**A**



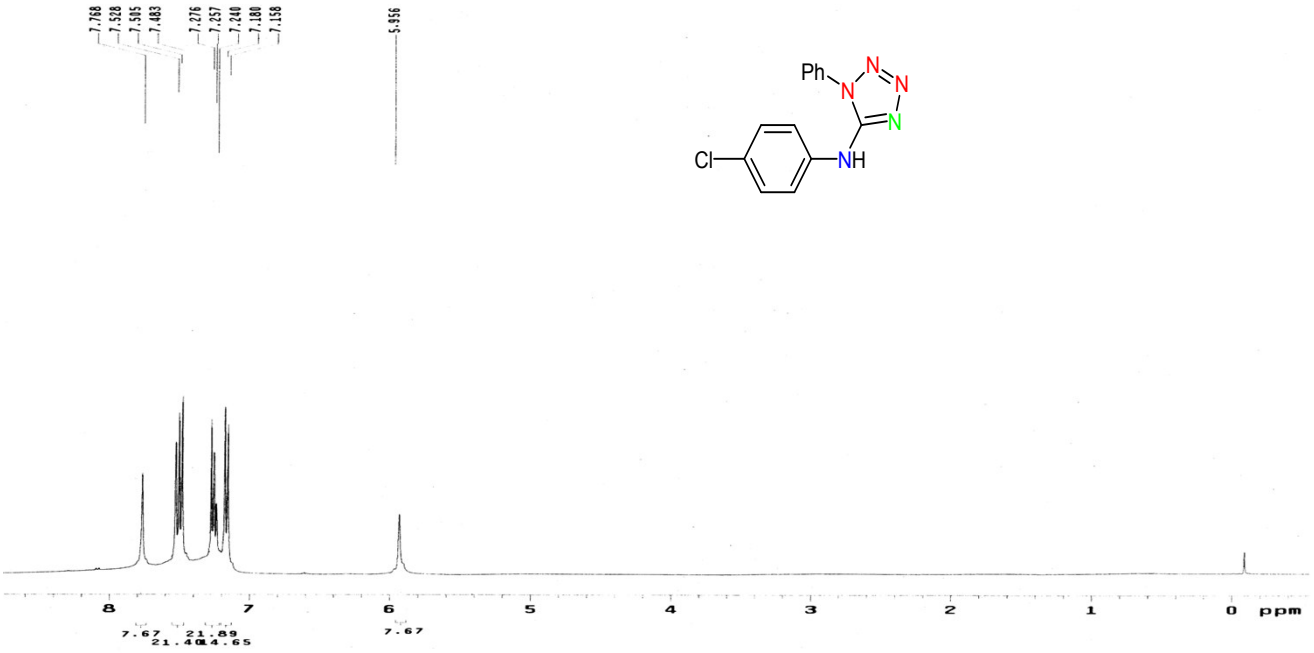
^{13}C NMR Spectra of Compound-**A**



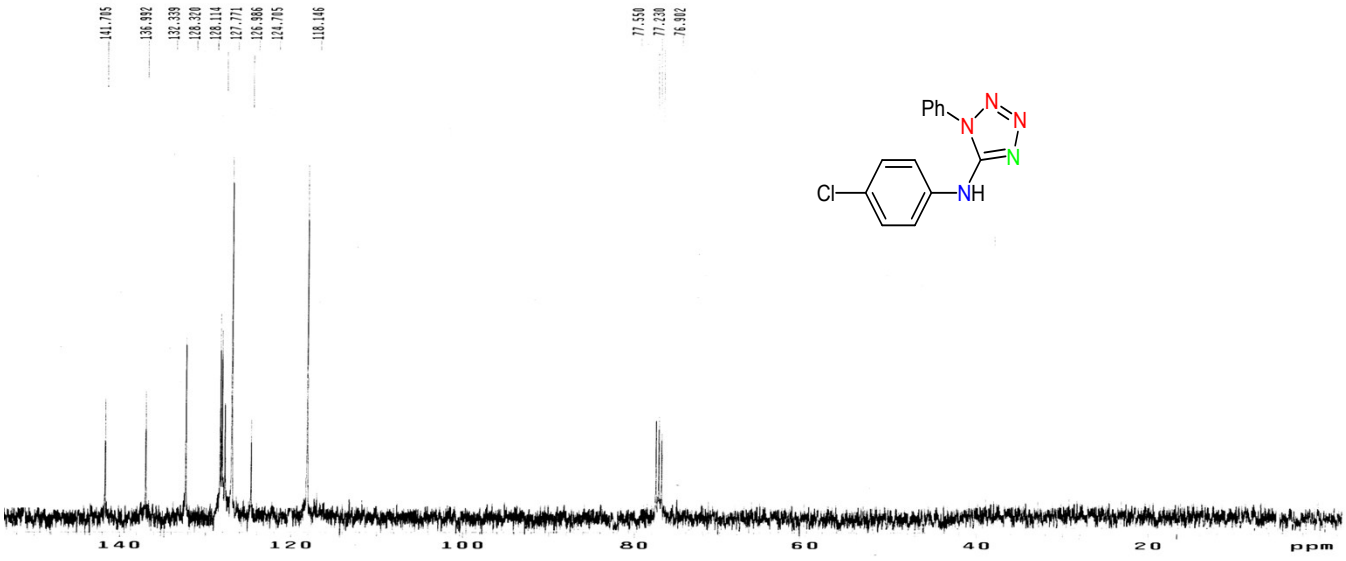
^{1}H NMR Spectra of Compound-**B**



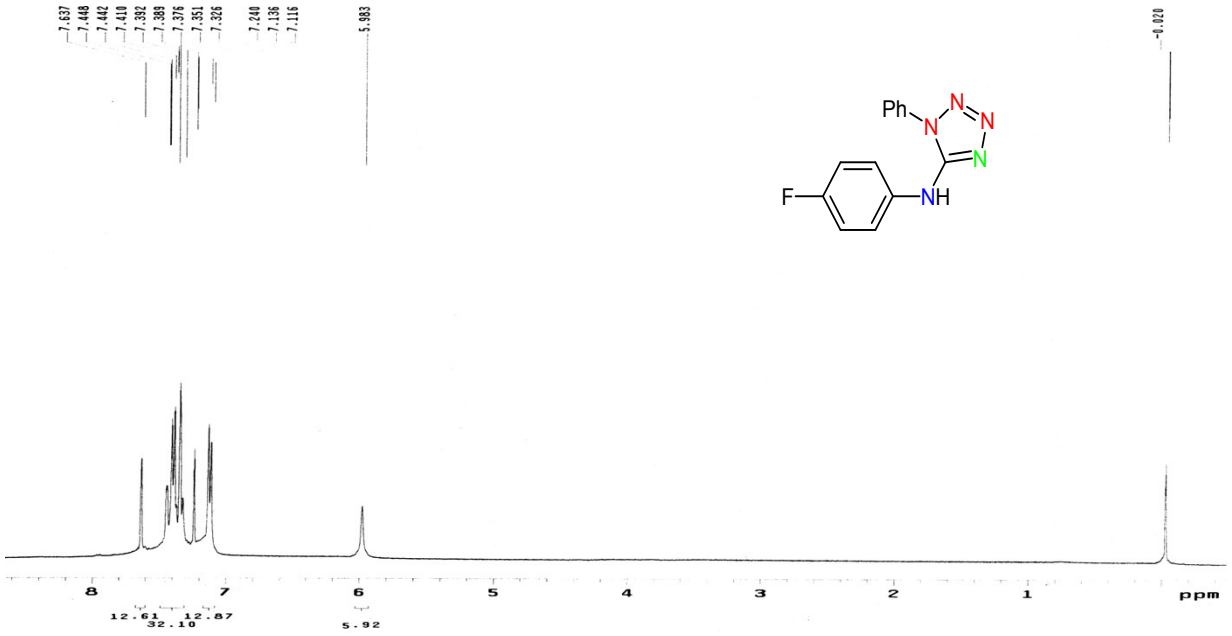
^{13}C NMR Spectra of Compound-**B**



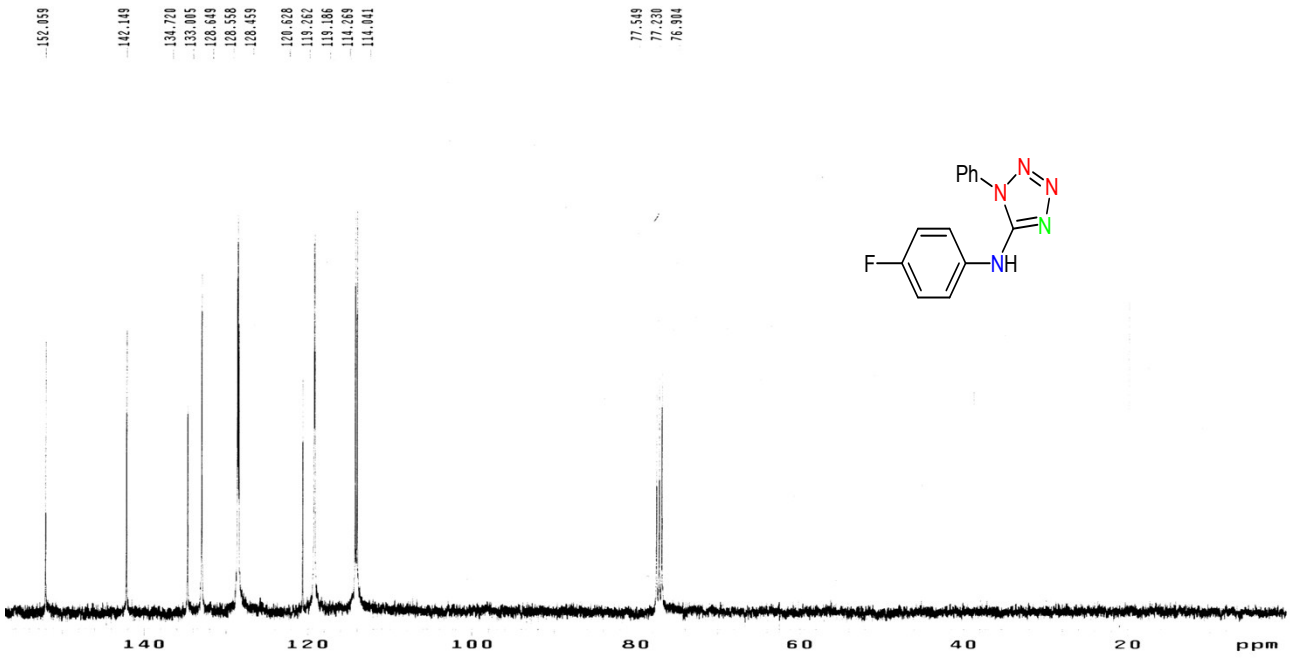
^{1}H NMR Spectra of Compound-**C**



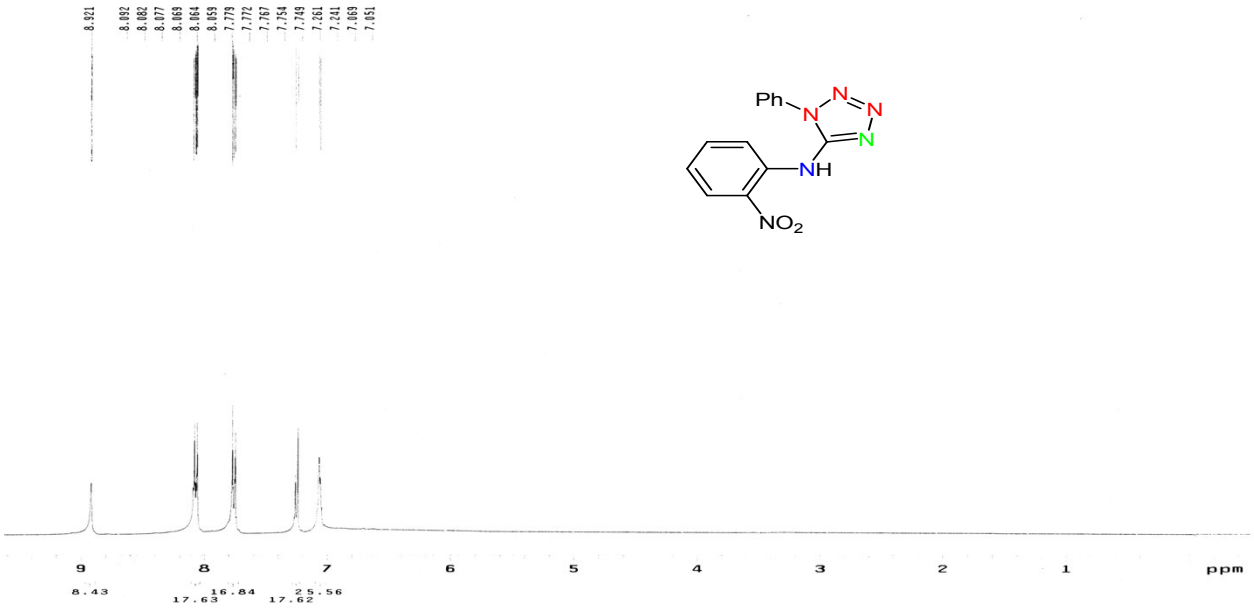
^{13}C NMR Spectra of Compound-**C**



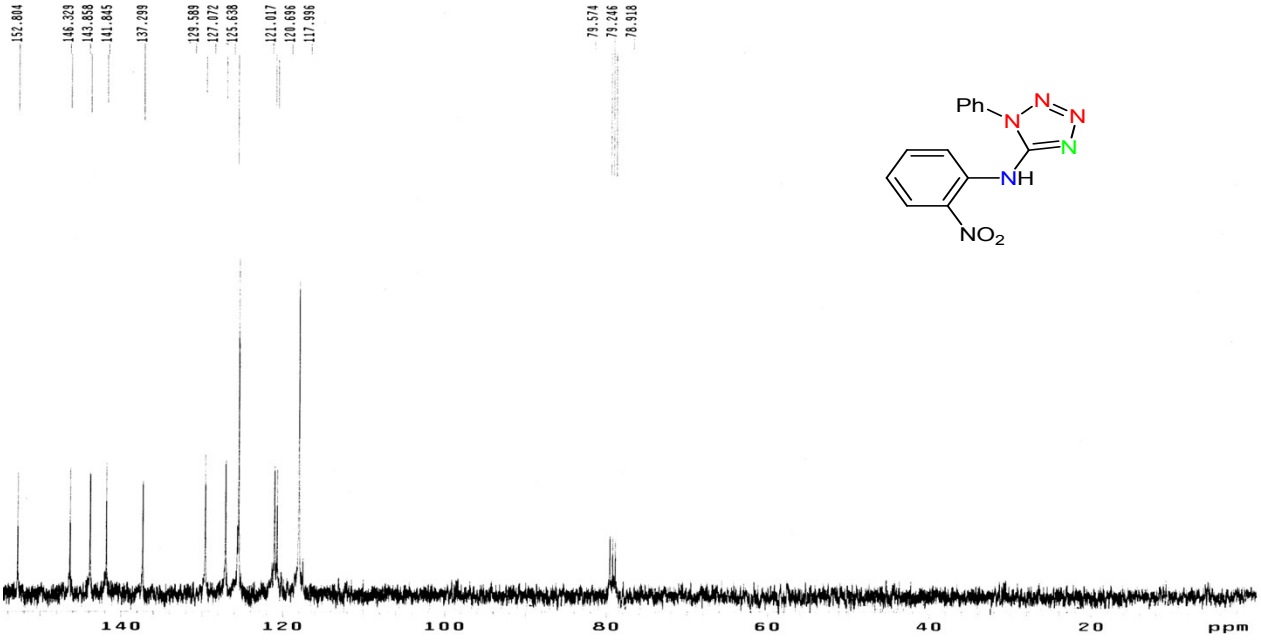
^{1}H NMR Spectra of Compound-**D**



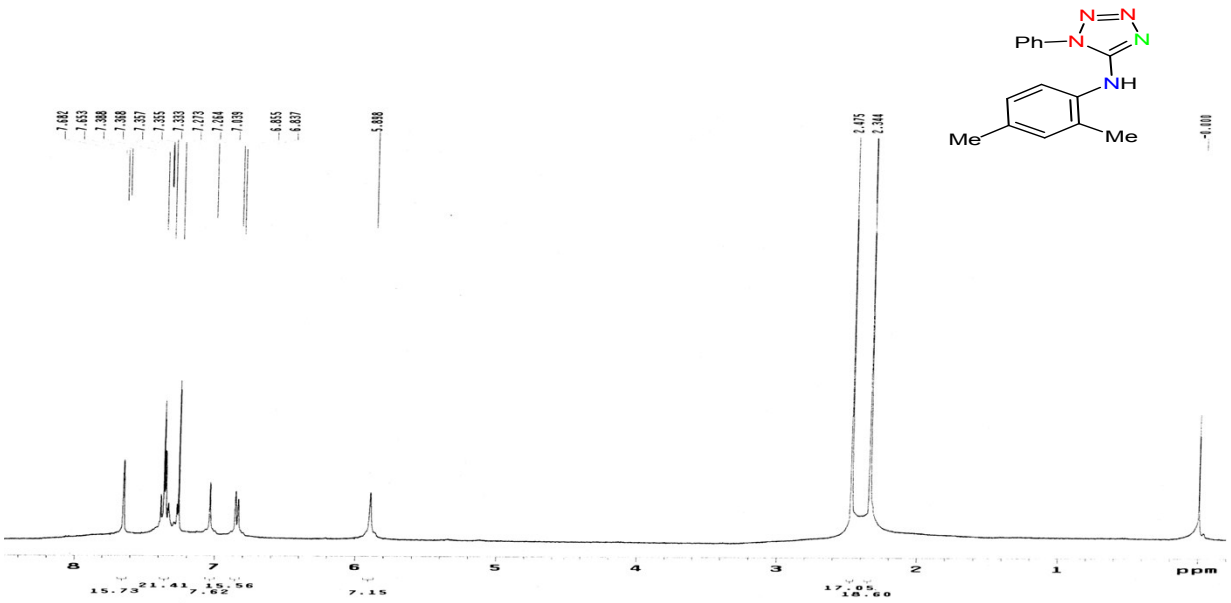
^{13}C NMR Spectra of Compound-**D**



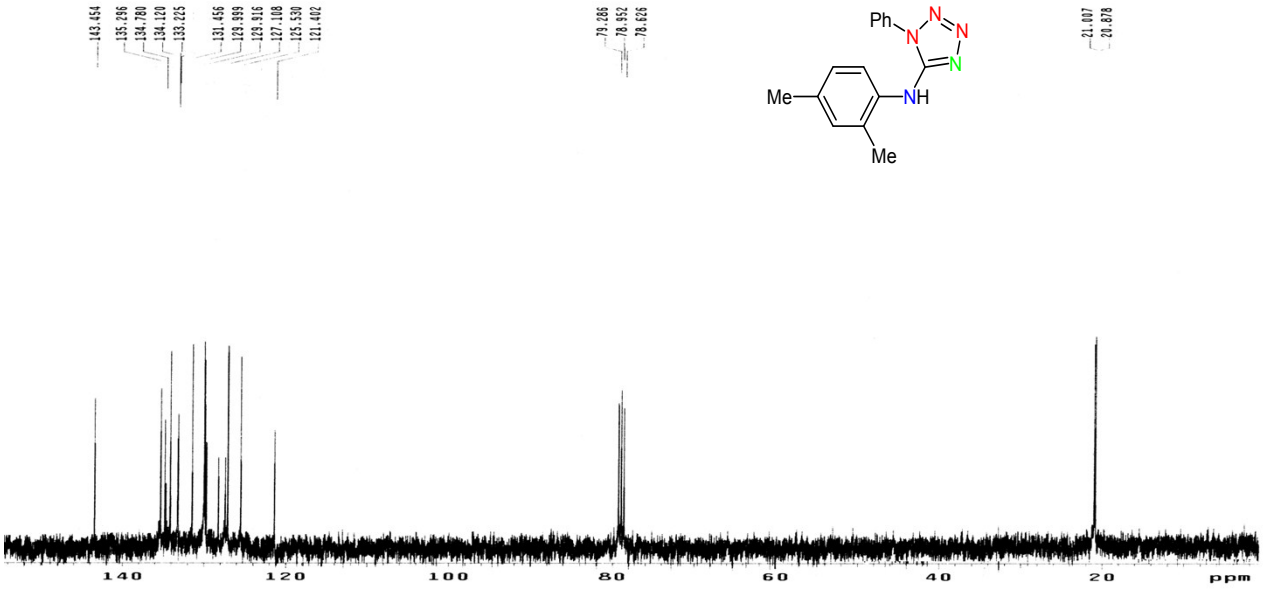
^{1}H NMR Spectra of Compound-**E**



^{13}C NMR Spectra of Compound-**E**



^{1}H NMR Spectra of Compound-**F**



^{13}C NMR Spectra of Compound-**F**