Electronic Supplementary Material (ESI) for Green Chemistry.

[bmIm]OH-catalyzed amidation of azides and aldehydes: An efficient route to amides

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Supporting Information

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(A) Materials and equipment

Reagents were obtained commercially and used as received. Solvents were purified and dried by standard methods. Substrates **1** were prepared according the literature methods.[1] [bmIm]OH was prepared according to our previous reported method.[2] All title products were characterized by Infrared (IR), MS, ^{1}H NMR, ^{13}C NMR and High Resolution mass spectrometer (HRMS). ^{1}H NMR spectra were recorded on 400 MHz in $CDCl_3$, and ^{13}C NMR spectra were recorded on 100 MHz in $CDCl_3$ using tetramethylsilane (TMS) as an internal standard. Chemical shift values (δ) are given in ppm. Coupling constants (*J*) were measured in Hz. Mass spectra were obtained with ionization voltages of 70 eV. HRMS spectra were obtained by ESI on a TOF mass. 200-300 mesh silica gel was used for column chromatography.

(B) Experimental procedure

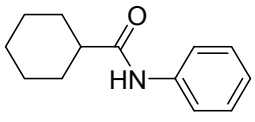
Typical Experimental Procedure for the Synthesis of compounds 3:

To a Schlenk tube were added aryl azides **1** (0.3 mmol), aldehydes **2** (0.36 mmol), [bmIm]OH (10% mmol), DMSO (2 mL). Then the tube was charged with argon, and was stirred at 30 ˚C for about 5 h, then 10 mL saturated NH_4Cl was added. the reaction mixture was stirred at 25 ˚C for about 0.5 h. The reaction mixture was extracted with 40 mL ethyl acetate, The extract was washed with brine, dried (Na_2SO_4) and concentrated in vacuum, and the resulting residue was purified by silica gel column chromatography (hexane/ethyl acetate) to afford the desired products **3**.

Experimental Procedure for the Synthesis of compounds 4:

To a Schlenk tube were added aryl azides **1** (0.3 mmol), aldehydes **2** (0.36 mmol), [bmIm]OH (4 mmol). Then the tube was charged with argon, and was stirred at 25 ˚C for about 5 h. After the reaction was finished, the reaction mixture was extracted with 8 mL $CDCl_3$ to give the crude 1,2,3-triazolines **4**.

(C) Analytical data

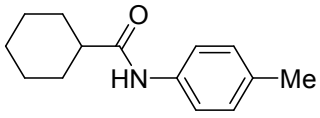


3aa

N-Phenylcyclohexanecarboxamide (3aa):

^{1}H NMR (400 MHz, $CDCl_3$) *δ*: 7.53 (d, *J* = 7.6 Hz, 2H), 7.32-7.21 (m, 3H), 7.10 (t, *J* = 7.4 Hz, 1H), 2.25 (t, *J* = 11.0 Hz, 1H), 1.96 (d, *J* = 12.4 Hz, 2H), 1.84 (d, *J* = 10.4 Hz, 2H), 1.71 (s, 1H), 1.58 (q, *J* = 11.2 Hz, 2H), 1.35-1.22 (m. 3H); ^{13}C NMR (100 MHz, $CDCl_3$) *δ*: 174.3, 138.0, 128.9, 124.0,

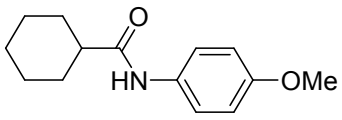
119.7, 46.6, 29.6, 25.6; LRMS (EI 70 ev) *m/z* (%): 203 (M^+, 100); HRMS m/z (ESI) calcd for $C_{13}H_{18}NO$ $(M+H)^+$ 204.1362, found 204.1368.



3ab

N-*p*-Tolylcyclohexanecarboxamide (3ab):

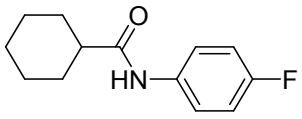
^1H NMR (400 MHz, $CDCl_3$) δ: 7.41 (d, J = 7.6 Hz, 2H), 7.15 (s, 1H), 7.11 (d, J = 8.0 Hz, 2H), 2.33-2.17 (m, 4H), 1.96 (d, J = 12.0 Hz, 2H), 1.84 (d, J = 11.2 Hz, 2H), 1.71 (s, 1H), 1.54-1.48 (m, 2H), 1.31-1.21 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.2, 135.4, 133.6, 129.4, 119.7, 46.5, 29.6, 25.7, 20.8; LRMS (EI 70 ev) *m/z* (%): 217 (M^+, 100); HRMS m/z (ESI) calcd for $C_{14}H_{20}NO$ $(M+H)^+$ 218.1519, found 218.1514.



3ac

N-(4-Methoxyphenyl)cyclohexanecarboxamide (3ac):

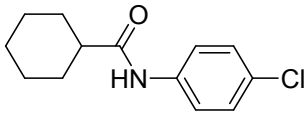
^1H NMR (400 MHz, $CDCl_3$) δ: 7.43 (d, J = 8.4 Hz, 2H), 7.03 (s, 1H), 6.83 (d, J = 8.0 Hz, 2H), 3.81 (s, 1H), 2.22 (d, J = 13.0 Hz, 1H), 1.97 (d, J = 16.8 Hz, 2H), 1.85 (d, J = 11.2 Hz, 2H), 1.72 (s, 1H), 1.59-1.48 (m, 2H), 1.33-1.19 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.4, 156.8, 131.3, 121.8, 115.0, 55.7, 46.4, 29.2, 25.4; LRMS (EI 70 ev) *m/z* (%): 233 (M^+, 100); HRMS m/z (ESI) calcd for $C_{14}H_{20}NO_2$ $(M+H)^+$ 234.1468, found 234.1471.



3ad

N-(4-Fluorophenyl)cyclohexanecarboxamide (3ad):

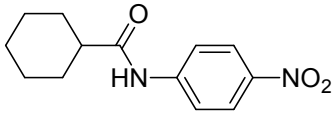
^1H NMR (400 MHz, $CDCl_3$) δ: 7.49 (dd, J = 4.8 Hz, J = 5.2 Hz, 2H), 7.21 (s, 1H), 7.01 (t, J = 8.6 Hz, 2H), 2.24 (d, J = 11.6 Hz, 1H), 1.96 (d, J = 12.4 Hz, 2H), 1.84 (d, J = 10.4 Hz, 2H), 1.71 (s, 1H), 1.63-1.48 (m, 2H), 1.34-1.22 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.3, 160.4 (d, J = 240 Hz), 134, 121.6 (d, J = 10 Hz), 115.7 (d, J = 20 Hz), 46.4, 29.7, 25.7; LRMS (EI 70 ev) *m/z* (%): 221 (M^+, 100); HRMS m/z (ESI) calcd for $C_{13}H_{17}FNO$ $(M+H)^+$ 222.1268, found 222.1276.



3ae

N-(4-chlorophenyl)cyclohexanecarboxamide (3ae):

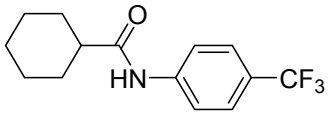
^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.49 (d, J = 8.0 Hz, 2H), 7.34 (t, J = 8.4 Hz, 3H), 2.24 (t, J = 11.2 Hz, 1H), 1.95 (d, J = 12.8 Hz, 2H), 1.84 (d, J = 10.8 Hz, 2H), 1.71 (s, 1H), 1.57 (d, J = 12.4 Hz, J = 12.0 Hz, 2H), 1.34-1.92 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.4, 136.6, 129.1, 128.9, 120.9, 46.5, 29.6, 25.6; LRMS (EI 70 ev) *m/z* (%): 237 (M^+, 67); HRMS m/z (ESI) calcd for $C_{13}H_{17}ClNO$ $(M+H)^+$ 238.0973, found 238.0979.



3af

N-(4-Nitrophenyl)cyclohexanecarboxamide (3af):

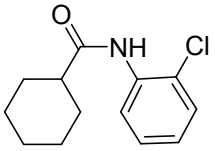
^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.21 (d, J = 8.4 Hz, 2H), 7.78 (d, J = 8.8 Hz, 2H), 7.55 (brs, 1H), 2.31 (t, J = 13.8 Hz, 1H), 2.02 (d, J = 10.0 Hz, 2H), 1.93 (d, J = 11.2 Hz, 2H), 1.84-1.71 (m, 1H), 1.57 (dd, J = 8.0 Hz, J = 8.8 Hz, 2H), 1.35-1.27 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.8, 144.0, 143.1, 125.0, 119.1, 46.6, 29.3, 25.4; LRMS (EI 70 ev) *m/z* (%): 248 (M^+, 100); HRMS m/z (ESI) calcd for $C_{13}H_{17}N_2O_3$ $(M+H)^+$ 249.1146, found 249.1150.



3ag

N-(4-(Trifluoromethyl)phenyl)cyclohexanecarboxamide (3ag):

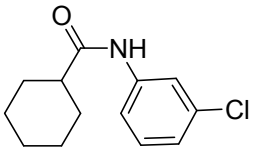
^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.11 (d, J = 7.6 Hz, 2H), 7.78 (d, J = 8.0 Hz, 2H), 7.49 (s, 1H), 2.33 (t, J = 13.2 Hz, 1H), 2.00 (d, J = 10.4 Hz, 2H), 1.81 (d, J = 12.0 Hz, 2H), 1.64 (s, 1H), 1.52-1.43 (m, 2H), 1.31-1.24 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 175.0, 148.4, 128.9, 126.7 (q, J = 3.7 Hz), 126.2, 123.5, 120.9, 120.4 (q, J = 32.4 Hz), 114.1, 46.2, 28.9, 25.8; LRMS (EI 70 ev) *m/z* (%): 271 (M^+, 100); HRMS m/z (ESI) calcd for $C_{14}H_{17}F_3NO$ $(M+H)^+$ 272.1236, found 272.1245.



3ah

N-(2-Chlorophenyl)cyclohexanecarboxamide (3ah):

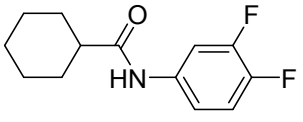
^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.41 (d, J = 8.4 Hz, 1H), 7.76 (s, 1H), 7.37 (d, J = 8.0 Hz, 1H), 7.28 (t, J = 8.0 Hz, 1H), 7.04 (t, J = 7.6 Hz, 1H), 2.35 (t, J = 11.6 Hz, 1H), 2.03 (d, J = 11.2 Hz, 2H), 1.87 (d, J = 12.0 Hz, 2H), 1.74 (d, J = 11.2 Hz, 1H), 1.59 (q, J = 12.0 Hz, 2H), 1.47-1.36 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.2, 134.5, 128.7, 127.5, 124.3, 122.5, 121.4, 46.4, 29.5, 25.53, 25.50; LRMS (EI 70 ev) *m/z* (%): 237 (M^+, 63); HRMS m/z (ESI) calcd for $C_{13}H_{17}ClNO$ $(M+H)^+$ 238.0973, found 238.0981.



3ai

N-(3-Chlorophenyl)cyclohexanecarboxamide (3ai):

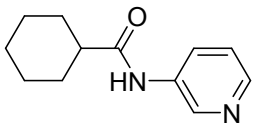
^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.51 (s, 1H), 7.42 (dd, J = 4.0 Hz, J = 4.4 Hz, 2H), 7.28 (t, J = 2.4 Hz, 2H), 2.28 (t, J = 10.0 Hz, 1H), 1.96 (d, J = 12.8 Hz, 2H), 1.84 (d, J = 12.4 Hz, 2H), 1.74 (d, J = 7.6 Hz, 1H), 1.54-1.49 (m, 2H), 1.32-1.23 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.8, 133.6, 130.4, 128.1, 124.2, 119.1, 118.0, 46.7, 29.5, 25.3; LRMS (EI 70 ev) *m/z* (%): 237 (M^+, 63); HRMS m/z (ESI) calcd for $C_{13}H_{17}ClNO$ $(M+H)^+$ 238.0973, found 238.0977.



3aj

N-(3,4-Difluorophenyl)cyclohexanecarboxamide (3aj):

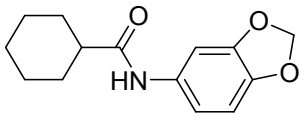
^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.49 (dd, J = 0.8 Hz, J = 2.4 Hz, 1H), 7.41-7.38 (m, 1H), 7.27-7.22 (m, 2H), 2.31 (t, J = 13.2 Hz, 1H), 2.00 (d, J = 13.0 Hz, 2H), 1.86 (d, J = 9.6 Hz, 2H), 1.72 (d, J = 3.2 Hz, 1H), 1.57-1.51 (m, 2H), 1.34-1.24 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.8, 151.8, 151.7, 149.4, 149.3, 144.8, 144.7, 143.5, 143.4, 142.4, 142.3, 117.56, 117.55, 117.38, 117.37, 110.32, 110.29, 110.27, 110.24, 103.9, 103.7, 46.9, 29.7, 25.5; LRMS (EI 70 ev) *m/z* (%): 239 (M^+, 100); HRMS m/z (ESI) calcd for $C_{13}H_{16}F_2NO$ $(M+H)^+$ 240.1174, found 240.1181.



3ak

N-(Pyridin-3-yl)cyclohexanecarboxamide (3ak):

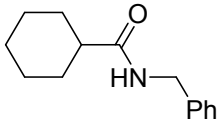
^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.59 (s, 1H), 8.29 (s, 1H), 8.13 (d, J = 6.4 Hz, 1H), 7.77 (s, 1H), 7.29 (d, J = 4.8 Hz, 1H), 2.33-2.26 (m, 1H), 1.97 (d, J = 12.8 Hz, 2H), 1.87 (d, J = 10.4 Hz, 2H), 1.73 (d, J = 12.4 Hz, 1H), 1.57-1.50 (m, 2H), 1.34-1.24 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 175.0, 144.4, 140.7, 136.1, 126.3, 123.7, 46.7, 29.6, 25.66, 25.62; LRMS (EI 70 ev) *m/z* (%): 204 (M^+, 100); HRMS m/z (ESI) calcd for $C_{12}H_{17}N_2O$ $(M+H)^+$ 205.1247, found 205.1255.



3al

N-(Benzo[d][1,3]dioxol-5-yl)cyclohexanecarboxamide (3al):

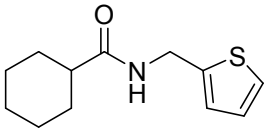
^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.79 (d, J = 8.4 Hz, 1H), 7.59 (s, 1H), 7.21 (s, 1H), 6.93 (d, J = 8.4 Hz, 1H), 3.95 (s, 2H), 2.32-2.24 (m, 1H), 2.04 (d, J = 10.8 Hz, 2H), 1.73 (d, J = 8.4 Hz, 2H), 1.57 (s, 1H), 1.53-1.48 (m, 2H), 1.38-1.24 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 171.8, 153.6, 148.6, 124.6, 121.6, 112.1, 110.2, 56.1, 46.7, 30.2, 25.8; LRMS (EI 70 ev) *m/z* (%): 247 (M^+, 100); HRMS m/z (ESI) calcd for $C_{14}H_{18}NO_3$ $(M+H)^+$ 248.1261, found 248.1269.



3am

N-Benzylcyclohexanecarboxamide (3am):

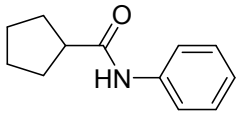
^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.31 (t, J = 7.0 Hz, 2H), 7.23 (d, J = 7.6 Hz, 3H), 6.16 (s, 1H), 4.38 (d, J = 5.2 Hz, 2H), 2.14 (t, J = 11.8 Hz, 1H), 1.86 (d, J = 12.8 Hz, 2H), 1.77 (d, J = 9.6 Hz, 2H), 1.65 (s, 1H), 1.47 (dd, J = 7.6 Hz, J = 12.0 Hz, 2H), 1.27-1.15 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 176.1, 138.4, 128.4, 127.5, 127.2, 45.3, 43.1, 29.5, 25.5; LRMS (EI 70 ev) *m/z* (%): 217 (M^+, 100); HRMS m/z (ESI) calcd for $C_{14}H_{20}NO$ $(M+H)^+$ 218.1519, found 218.1523.



3an

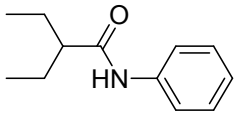
N-((Thiophen-2-yl)methyl)cyclohexanecarboxamide (3an):

^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.79 (d, J = 8.4 Hz, 1H), 7.59 (s, 1H), 6.93 (d, J = 8.4 Hz, 1H), 6.23 (s, 1H), 3.95 (s, 2H), 2.22 (d, J = 12.8 Hz, 1H), 1.94 (d, J = 8.4 Hz, 2H), 1.85 (d, J = 10.0 Hz, 2H), 1.73 (s, 1H), 1.55 (d, J = 7.6 Hz, J = 12.4 Hz, 2H), 1.34-1.23 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 171.7, 146.5, 126.9, 125.8, 125.1, 45.4, 38.2, 29.6, 25.7; LRMS (EI 70 ev) *m/z* (%): 223 (M^+, 100); HRMS m/z (ESI) calcd for $C_{12}H_{18}NOS$ $(M+H)^+$ 224.1083, found 224.1090.



3ba

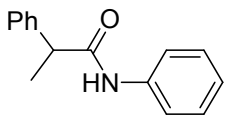
N-Phenylcyclopentanecarboxamide (3ba): ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.55 (d, J = 8.0 Hz, 2H), 7.35 (d, J = 7.8 Hz, 2H), 7.14 (s, 1H), 7.11 (d, J = 7.0 Hz, 1H), 2.57-2.51 (m, 1H), 1.95-1.89 (m, 4H), 1.78 (t, J = 3.8 Hz, 2H), 1.64-1.61 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.8, 138.6, 129.7, 124.4, 120.1, 47.2, 30.3, 26.3; LRMS (EI 70 ev) *m/z* (%): 189 (M^+, 100); HRMS m/z (ESI) calcd for $C_{12}H_{16}NO$ $(M+H)^+$ 190.1205, found 190.1213.



3ca

2-Ethyl-N-phenylbutanamide (3ca):

^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.56 (d, J = 7.6 Hz, 2H), 7.34 (t, J = 7.4 Hz, 2H), 7.17 (s, 1H), 7.12 (t, J = 7.2 Hz, 1H), 2.02 (d, J = 4.4 Hz, 1H), 1.76-1.66 (m, 2H), 1.59-1.53 (m, 2H), 0.97 (t, J = 7.2 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.2, 137.8, 128.9, 124.1, 119.7, 52.5, 25.8, 12.1; LRMS (EI 70 ev) *m/z* (%): 191 (M^+, 100); HRMS m/z (ESI) calcd for $C_{12}H_{18}NO$ $(M+H)^+$ 192.1361, found 192.1356.

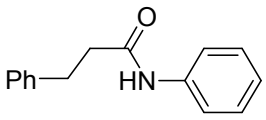


3da

N,2-Diphenylpropanamide (3da):

^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.44-7.33 (m, 6H), 7.32-7.27 (m, 1H), 7.25 (d, J = 4.0 Hz, 1H), 7.08 (s, 1H), 7.07 (d, J = 7.6 Hz, 1H), 3.76 (q, J = 5.6 Hz, 1H), 1.48 (d, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 172.3, 140.8, 137.9, 129.4, 129.1, 127.8, 127.7, 124.2, 119.6, 48.1, 18.6; LRMS (EI 70 ev) *m/z* (%): 225 (M^+, 100); HRMS m/z (ESI) calcd for $C_{15}H_{16}NO$ $(M+H)^+$ 226.1293, found

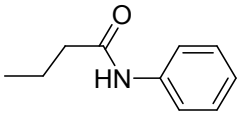
226.1297.



3ea

N,3-Diphenylpropanamide (3ea):

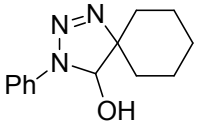
^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.46 (d, J = 8.0 Hz, 2H), 7.32 (s, 4H), 7.23 (s, 3H), 7.13 (t, J = 5.6 Hz, 2H), 3.10 (t, J = 7.4 Hz, 2H), 2.70 (t, J = 7.6 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 170.3, 140.5, 137.6, 128.9, 128.6, 128.3, 126.3, 124.2, 119.8, 39.5, 31.5; LRMS (EI 70 ev) *m/z* (%): 225 (M^+, 100); HRMS m/z (ESI) calcd for $C_{15}H_{16}NO$ $(M+H)^+$ 226.1293, found 226.1299.



3fa

N-Phenylbutyramide (3fa):

^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.53 (t, J = 10.0 Hz, 2H), 7.32 (t, J = 7.4 Hz, 2H), 7.11 (t, J = 7.2 Hz, 1H), 2.34 (t, J = 7.4 Hz, 2H), 1.79-1.72 (m, 2H), 1.00 (t, J = 7.4 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 171.4, 137.9, 128.9, 124.1, 119.7, 39.5, 19.0, 13.7; LRMS (EI 70 ev) *m/z* (%): 163 (M^+, 100); HRMS m/z (ESI) calcd for $C_{10}H_{14}NO$ $(M+H)^+$ 164.1047, found 164.1041.



4a

1,2,3-triazolines (4):

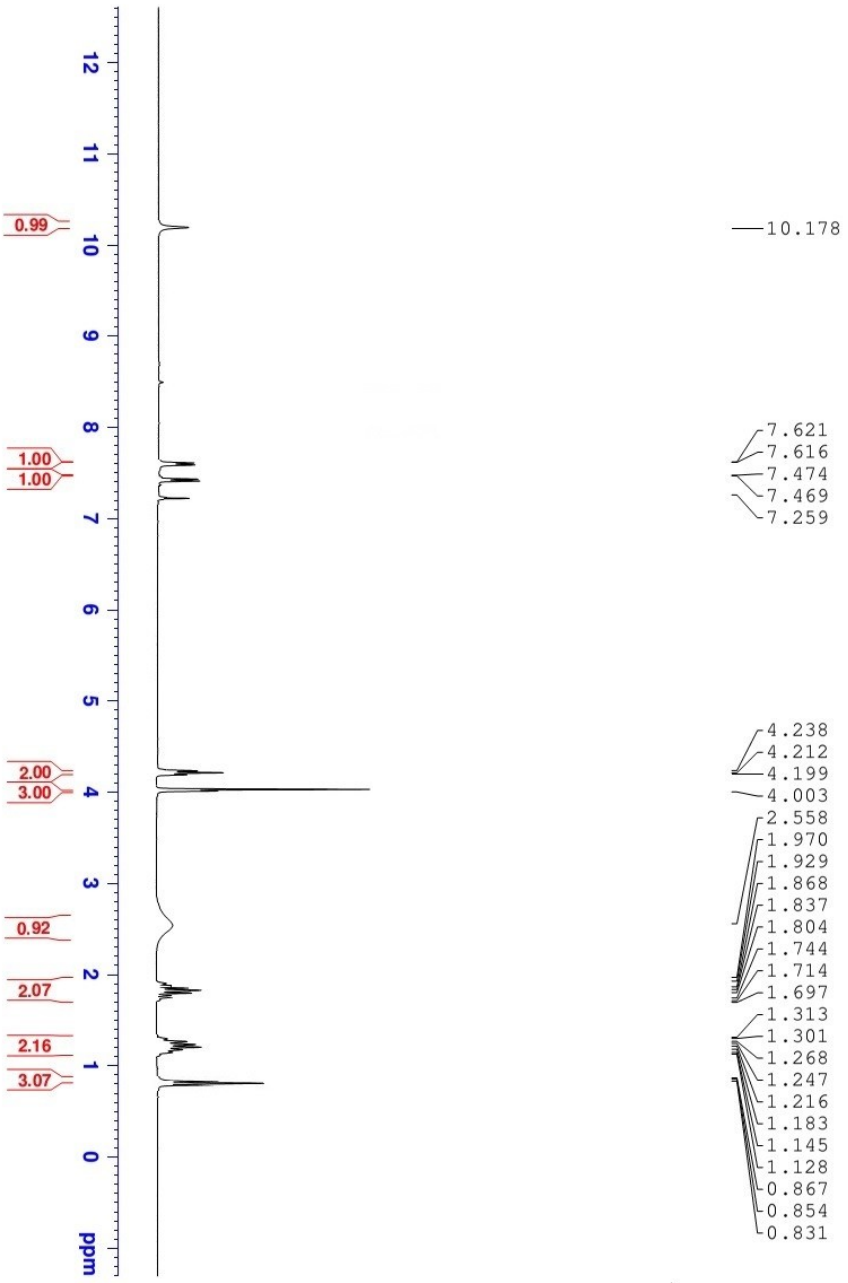
^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.45 (d, J = 8.0 Hz, 2H), 7.31 (t, J = 7.80 Hz, 2H), 6.99 (t, J = 7.6 Hz, 1H), 5.28 (s, 1H), 4.97 (brs, 1H), 1.86-1.79 (m, 4H), 1.59-1.49 (m, 4H), 1.29-1.19 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 140.6, 129.2, 121.9, 115.8, 82.8, 82.1, 32.0, 27.4, 25.3, 22.9, 22.3.

(D) References

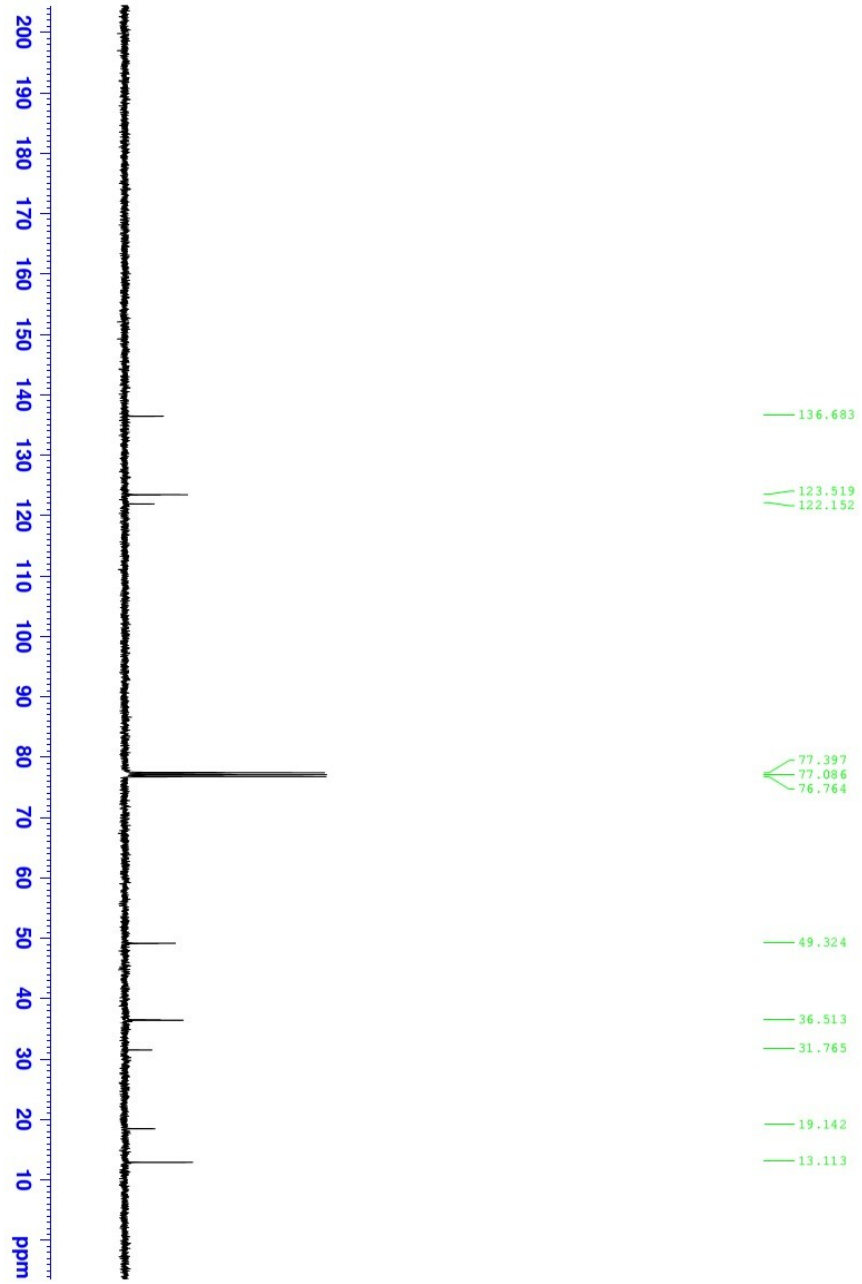
1. Keana, J. F. W.; Cai, S. X., J. Org. Chem. 1990,55, 3640

2. X. Li, C. Jin and L. Gu, *J. Org. Chem.* 2005, 8**0**, 2443

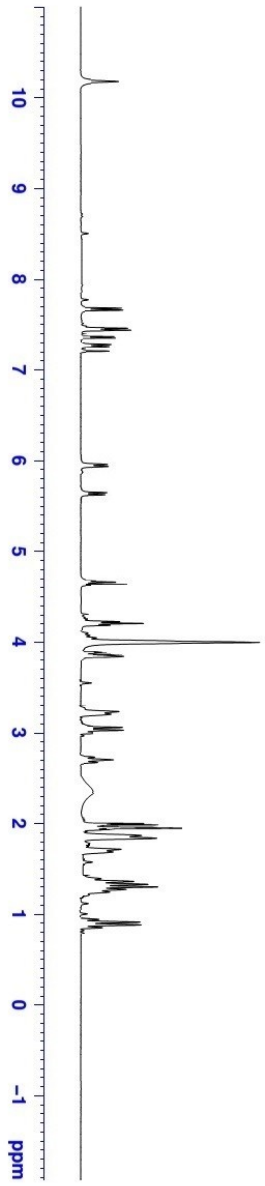
(E) **Spectra**



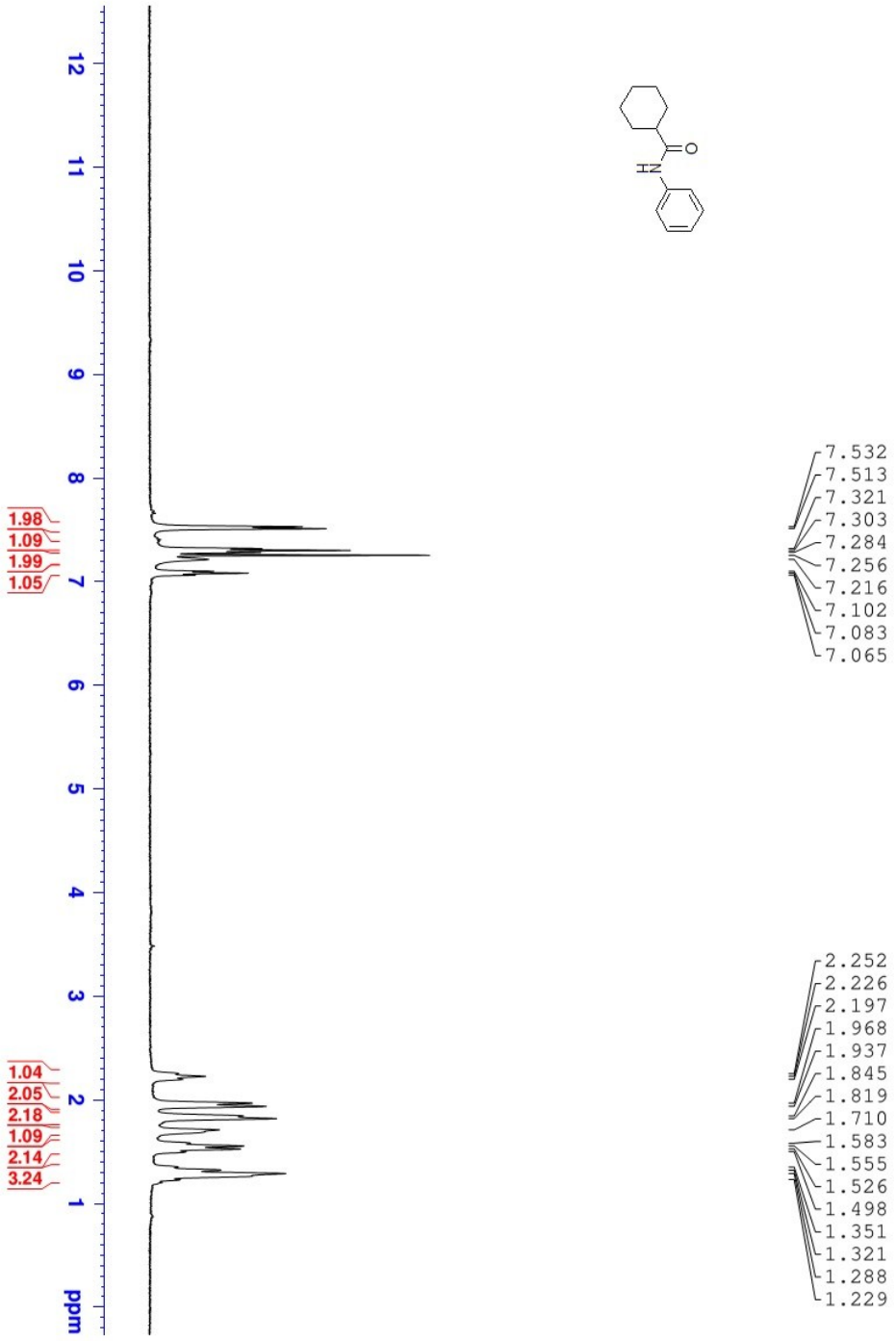
^{1}H NMR of pure [bmim][OH]



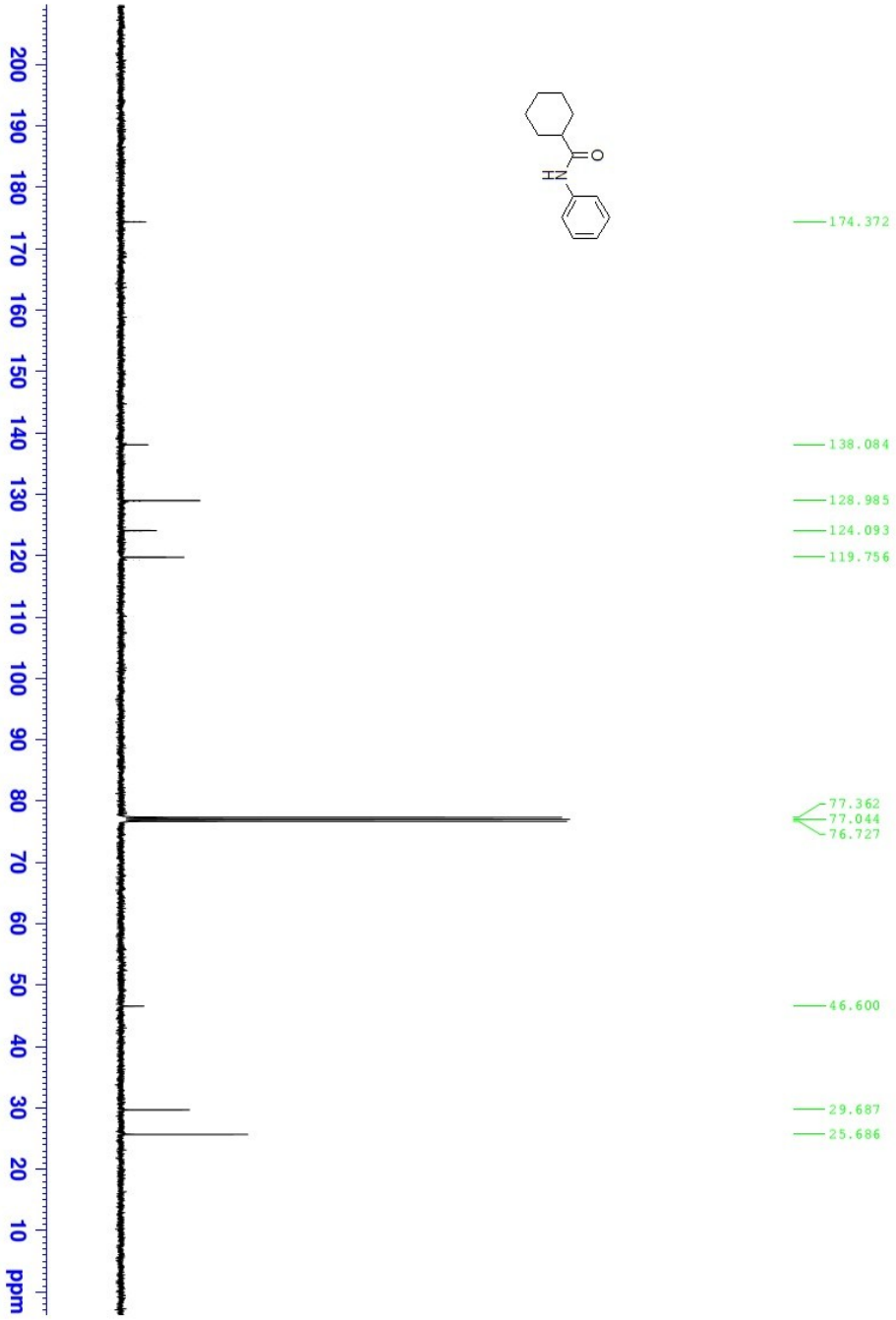
^{13}C NMR of pure [bmim][OH]



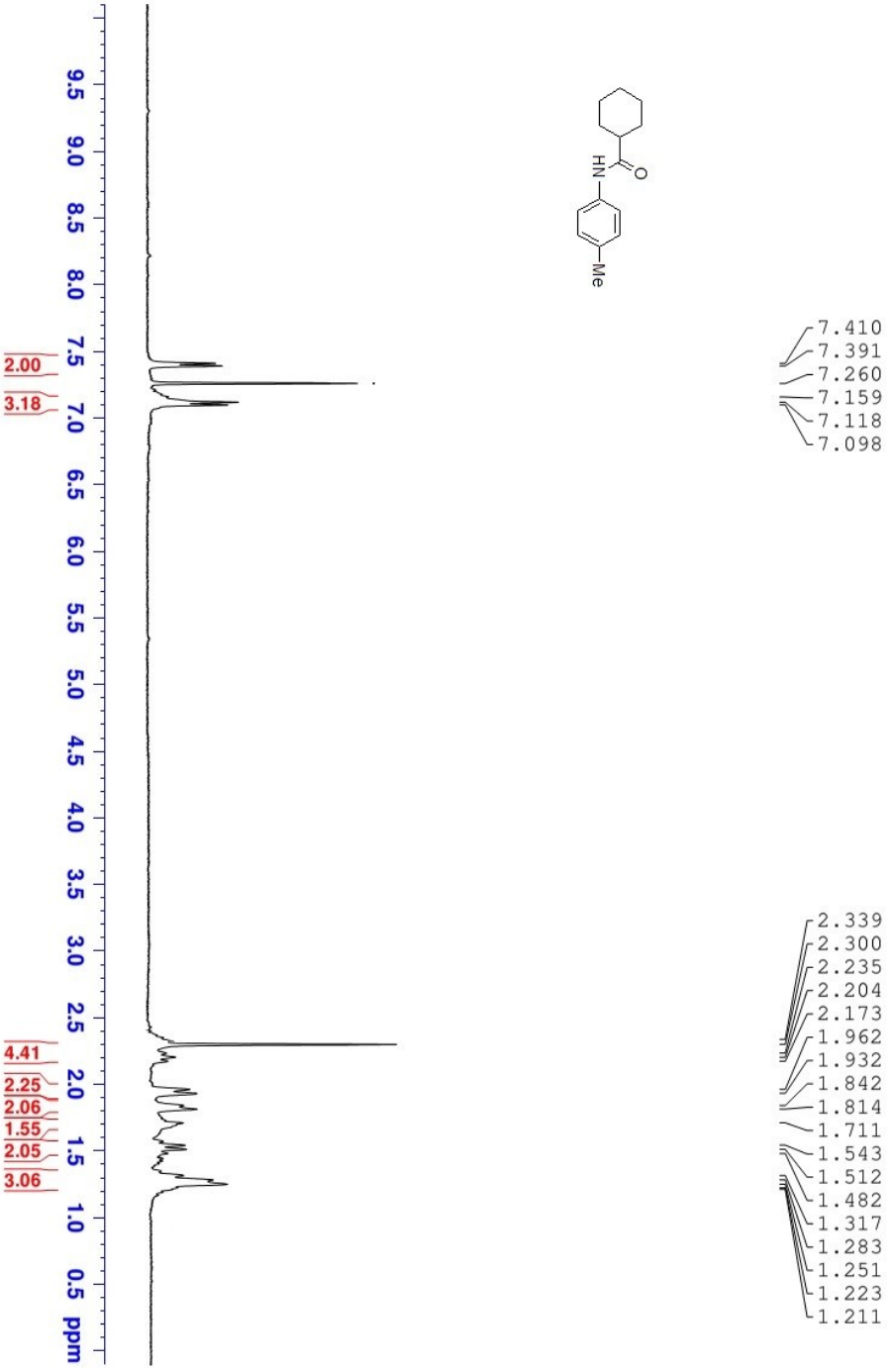
^{1}H NMR of [bmim][OH] after 5th cycle of reaction



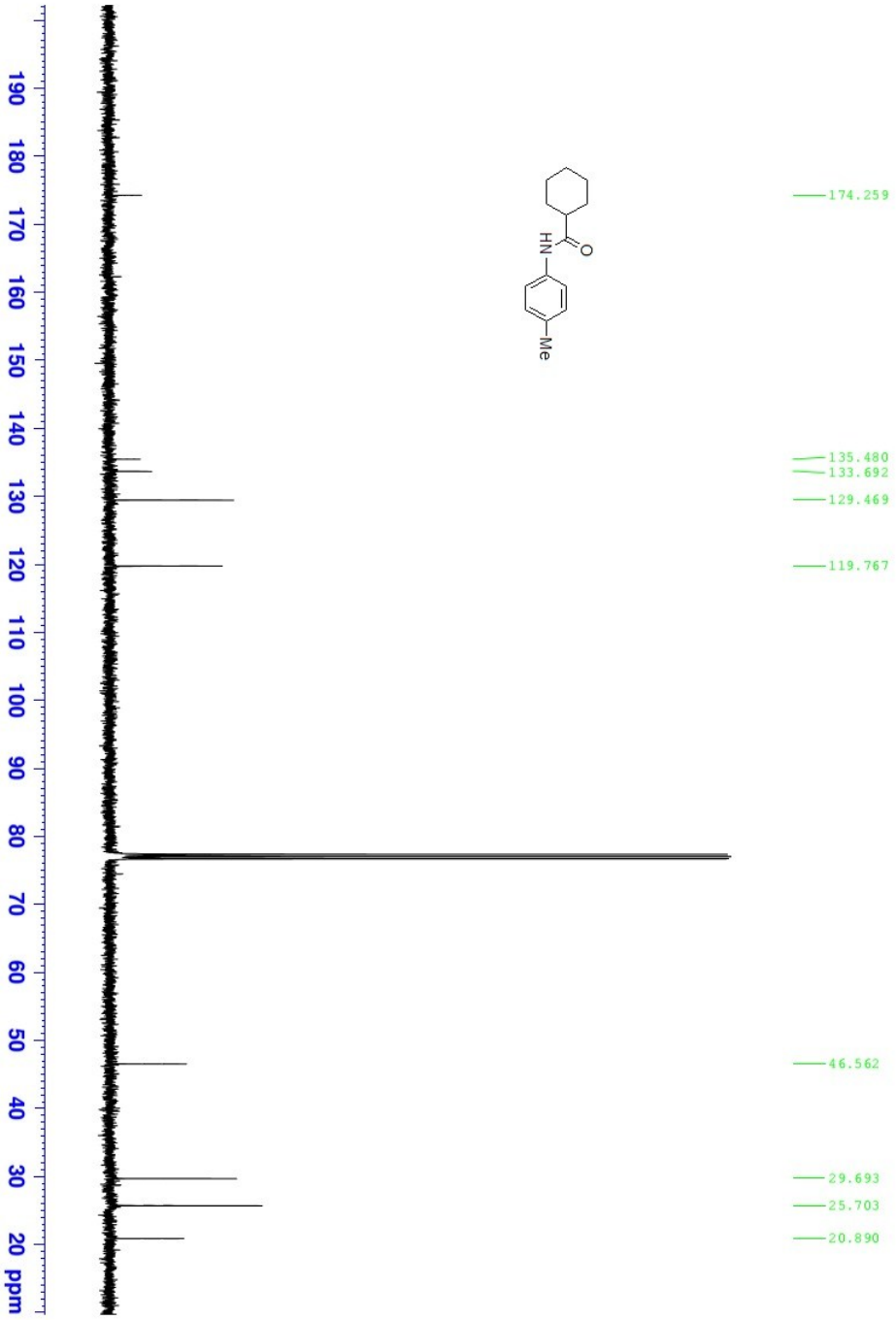
^{1}H NMR of Compound 3aa



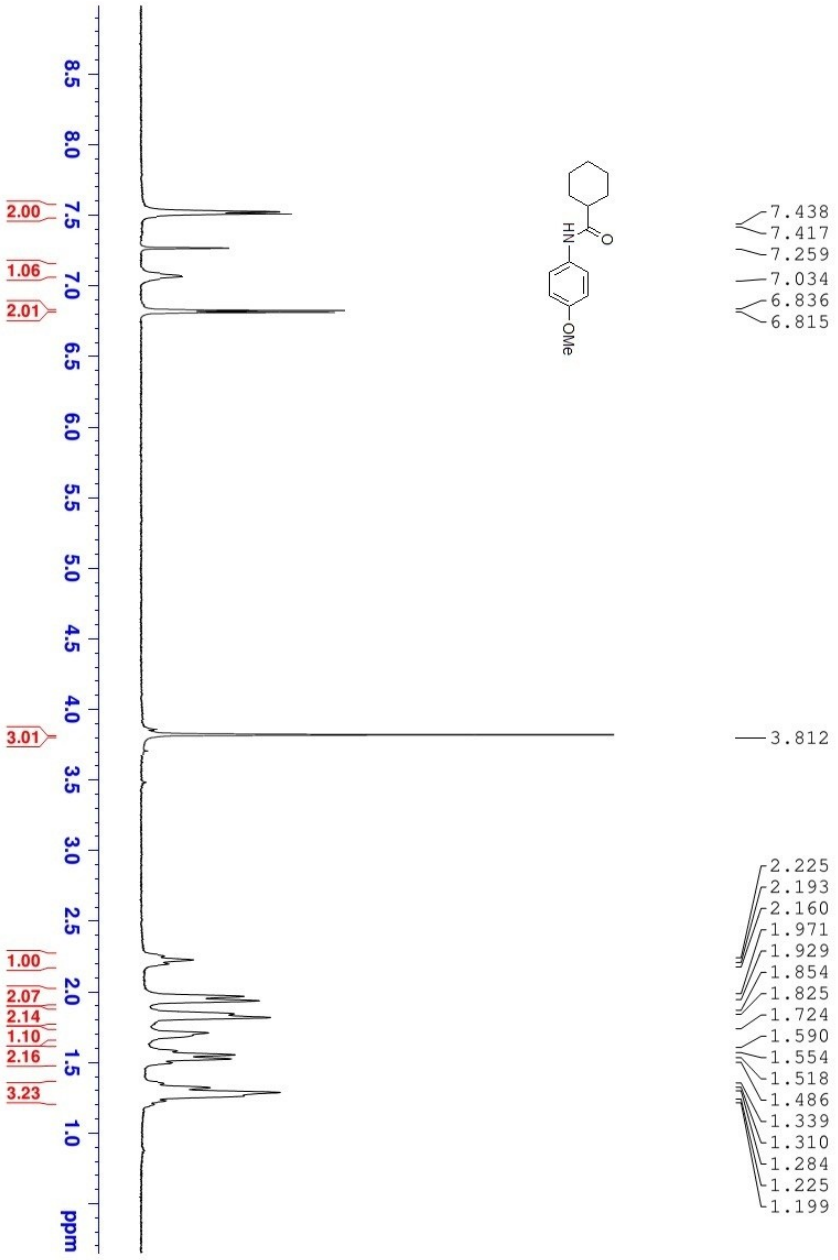
^{13}C NMR of Compound 3aa



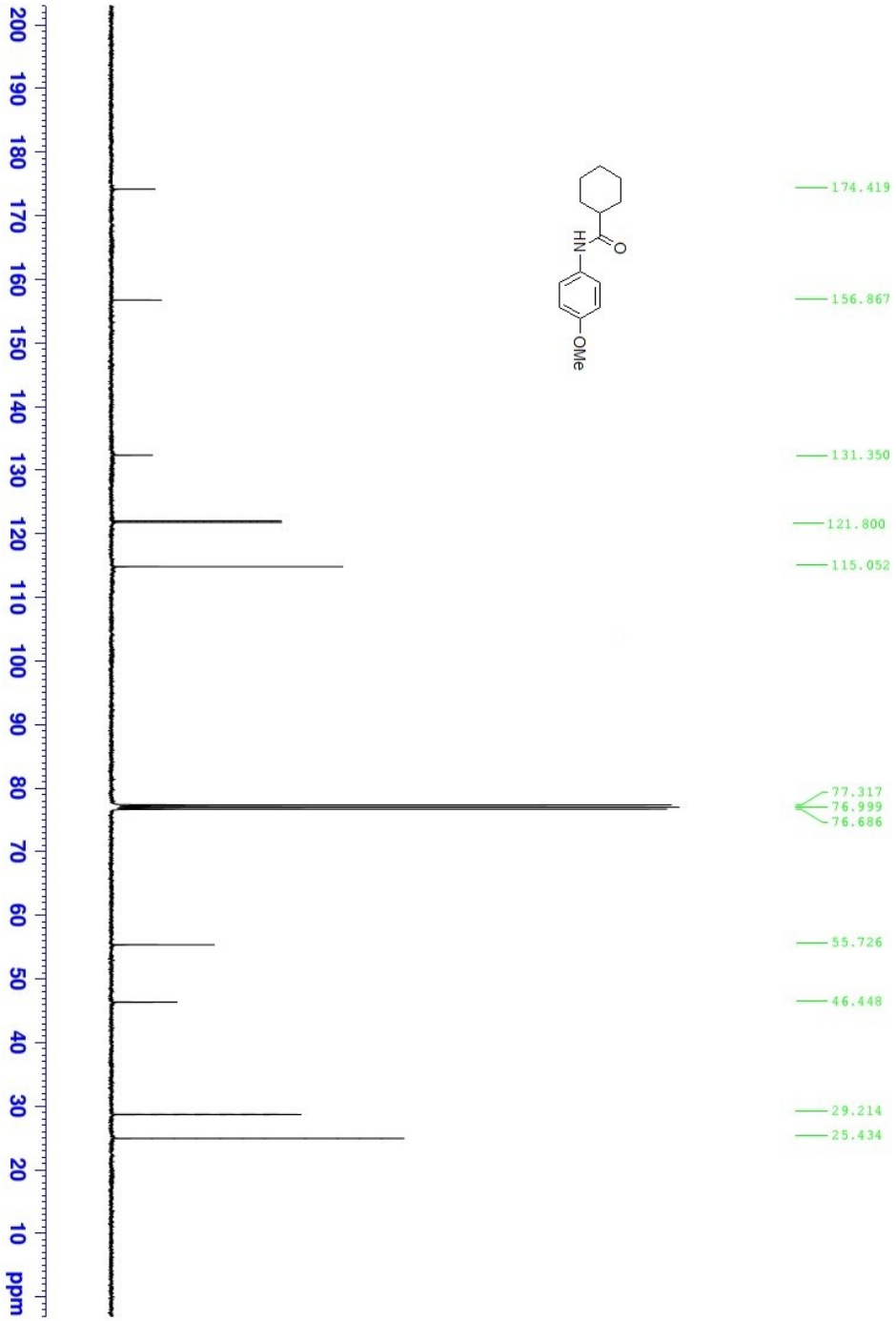
^{1}H NMR of Compound 3ab



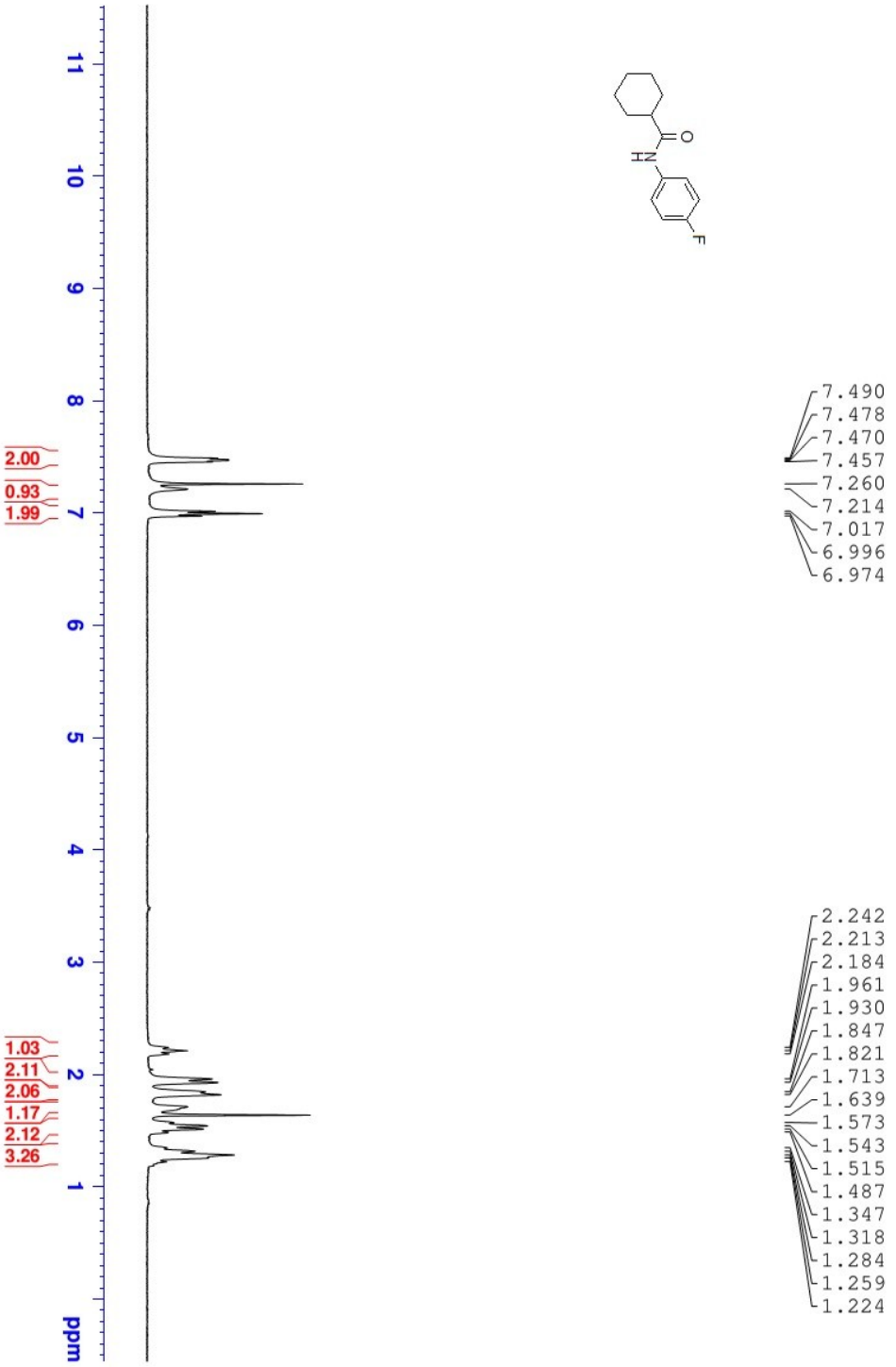
^{13}C NMR of Compound 3ab



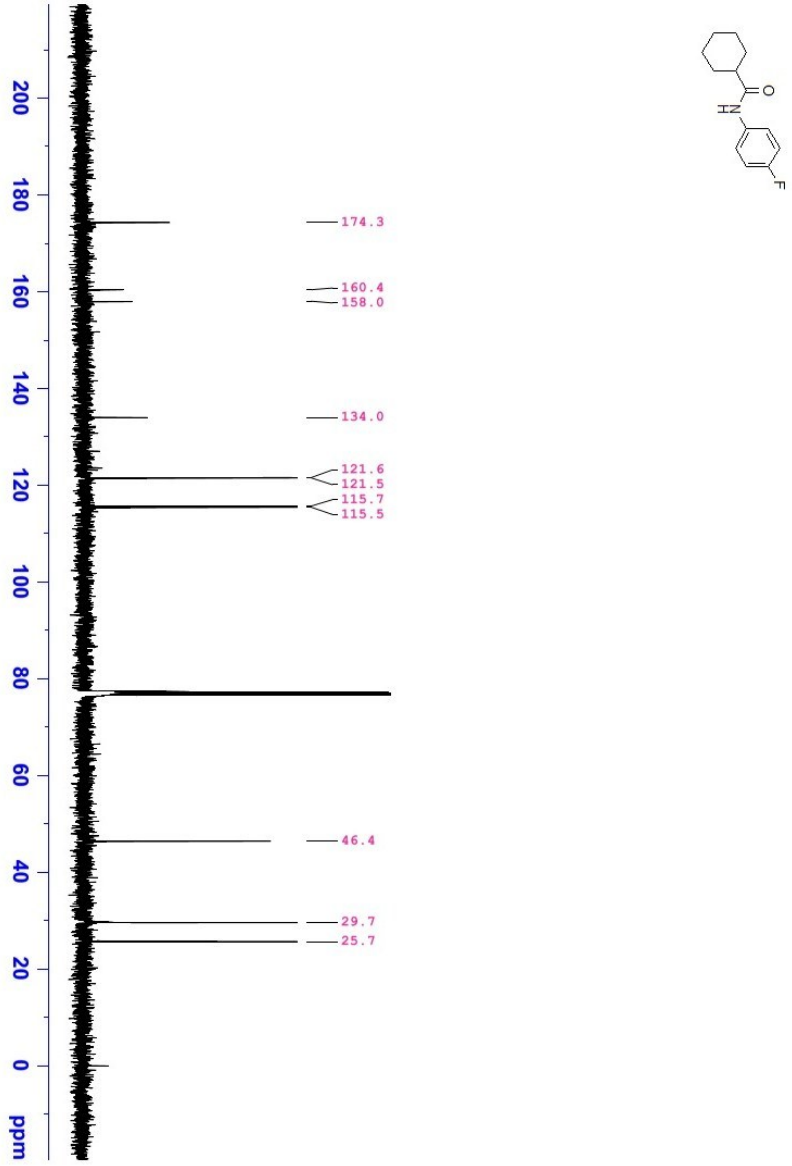
^{1}H NMR of Compound 3ac



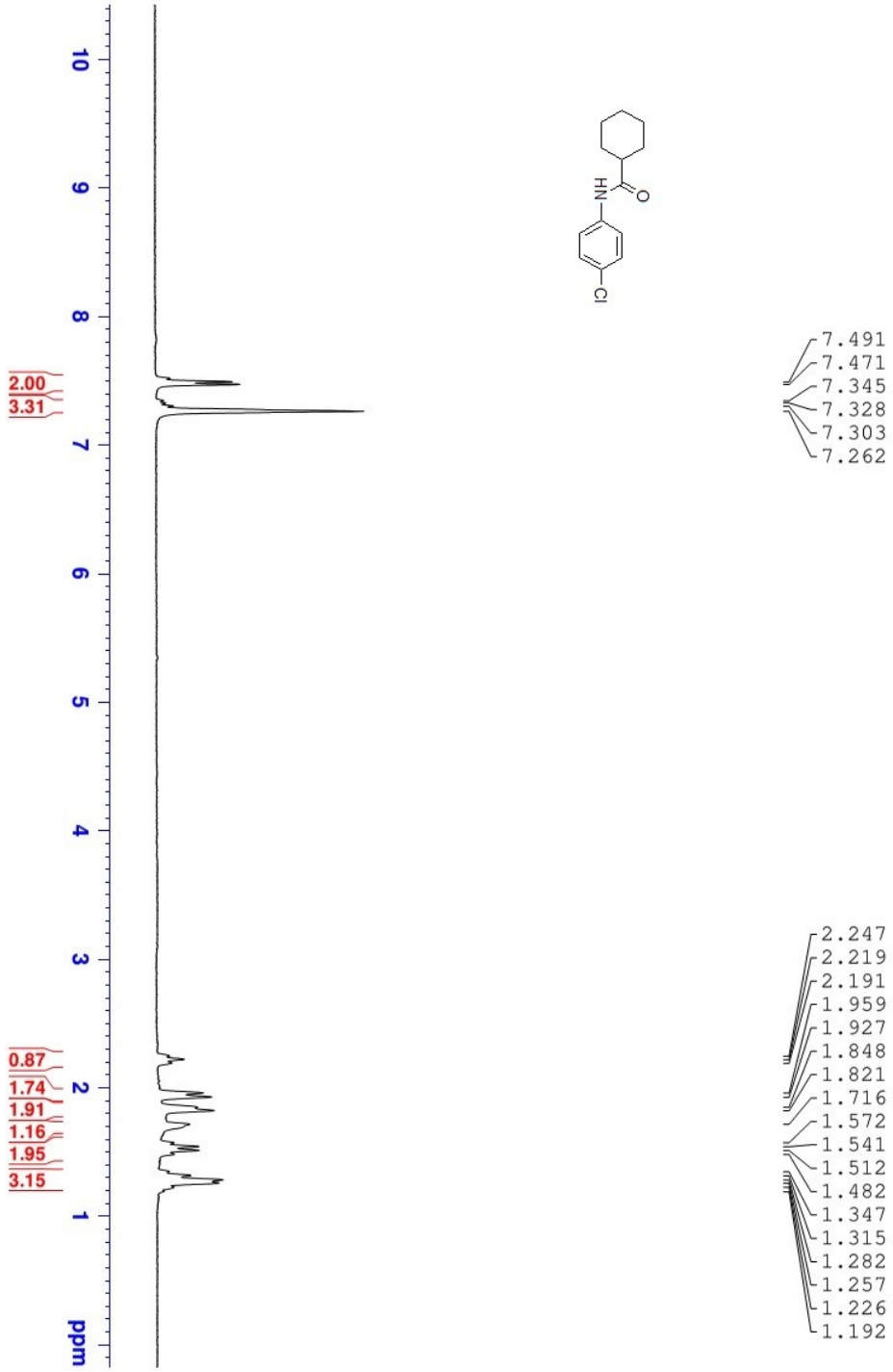
^{13}C NMR of Compound 3ac



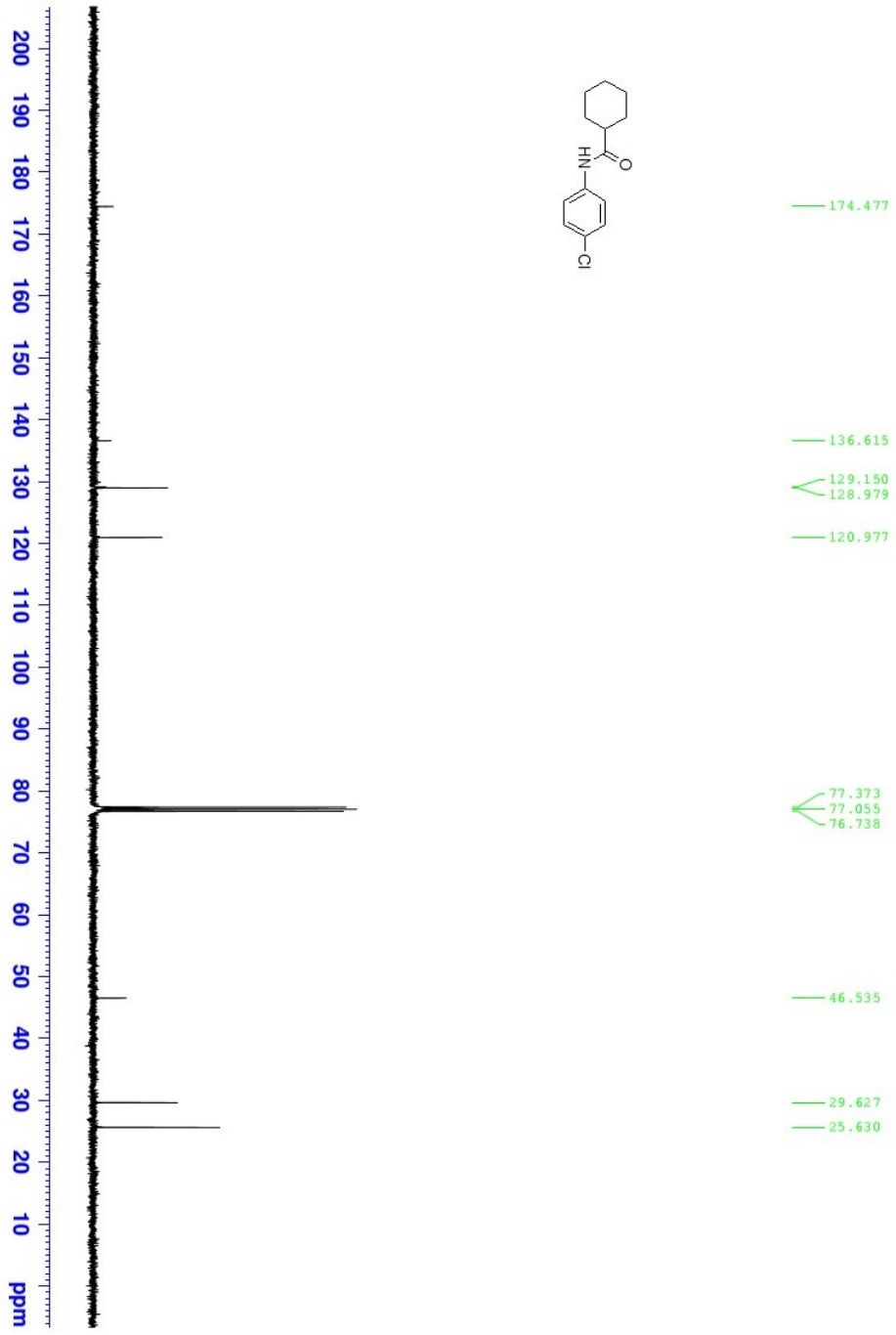
^{1}H NMR of Compound 3ad



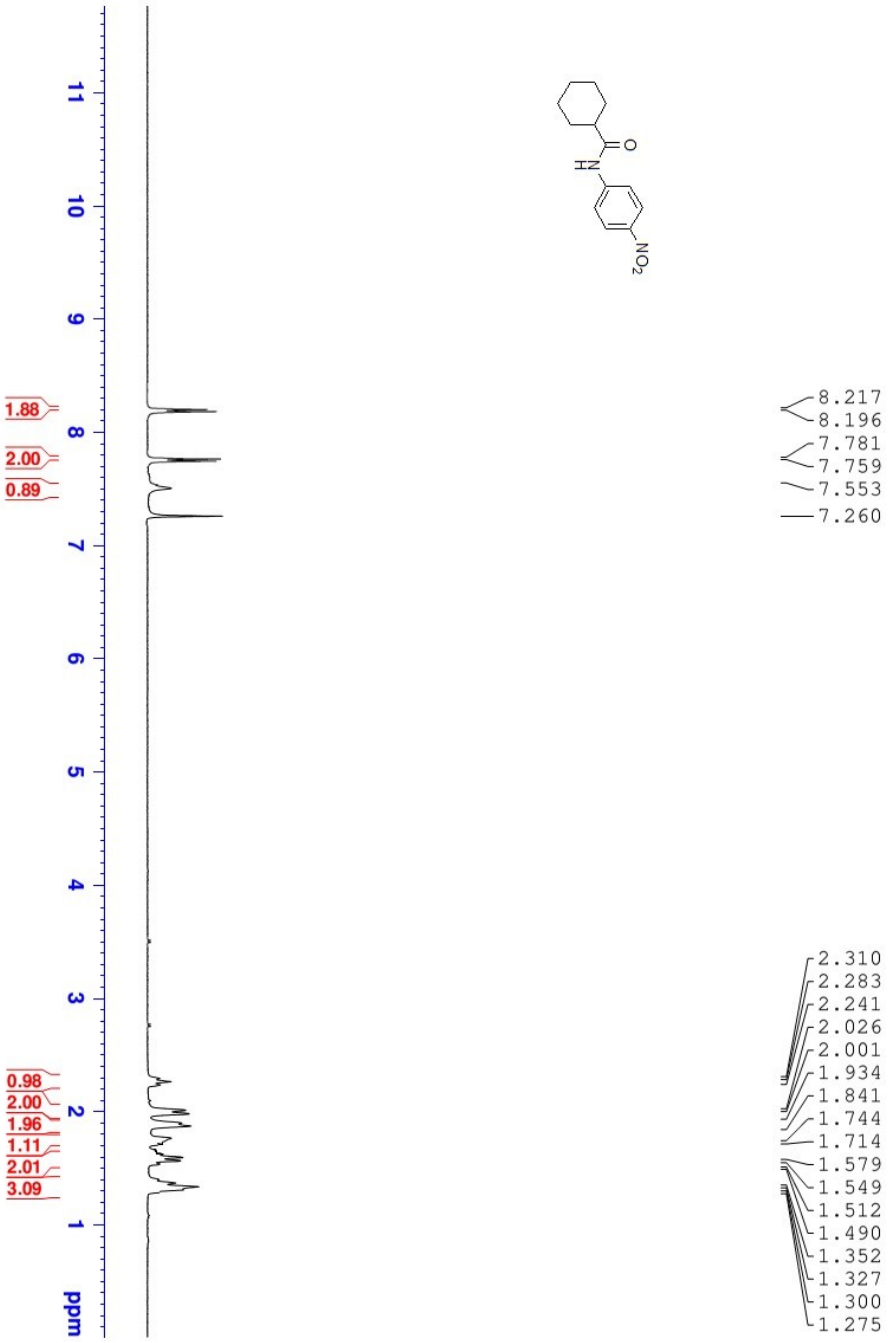
^{13}C NMR of Compound 3ad



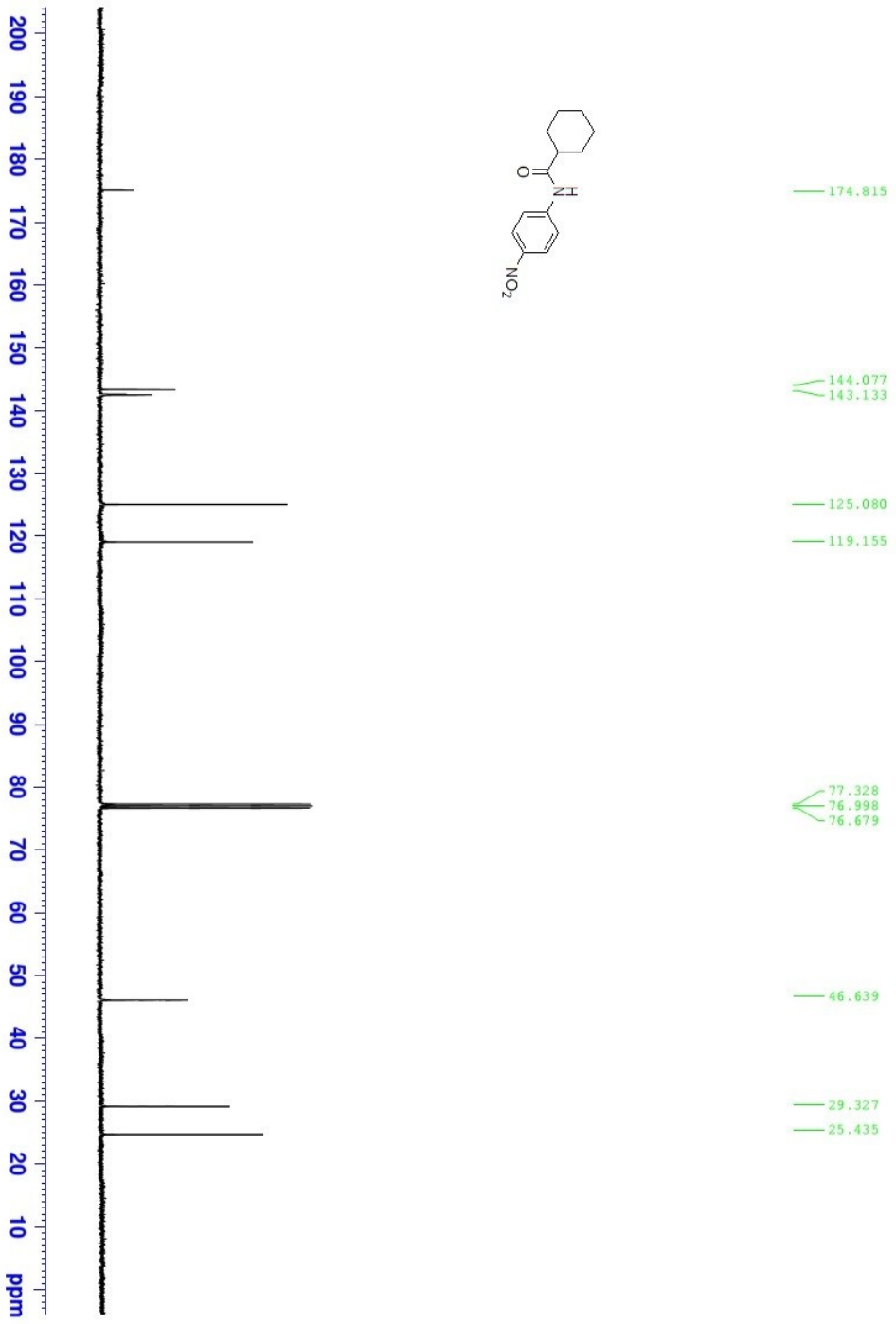
^{1}H NMR of Compound 3ae



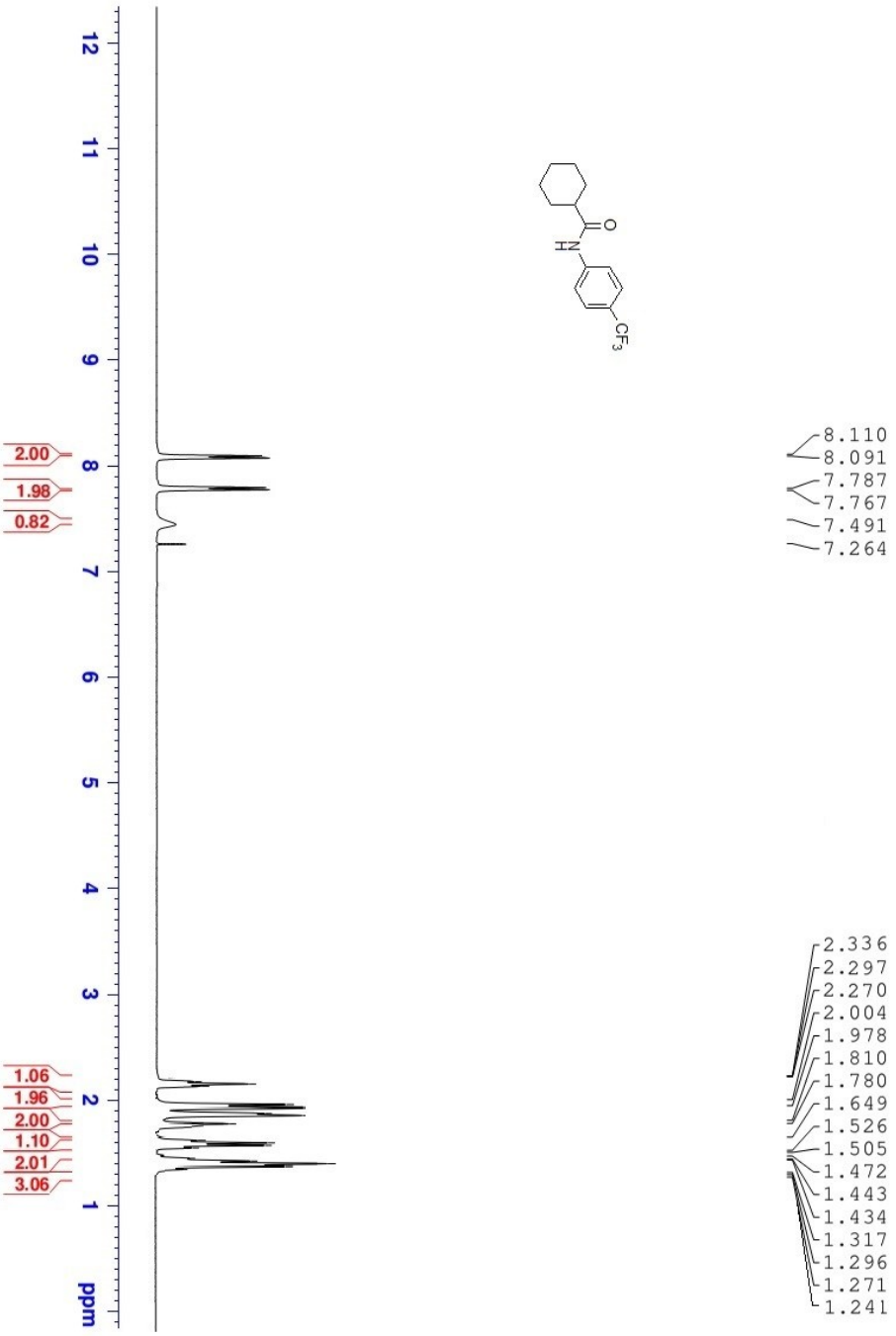
^{13}C NMR of Compound 3ae



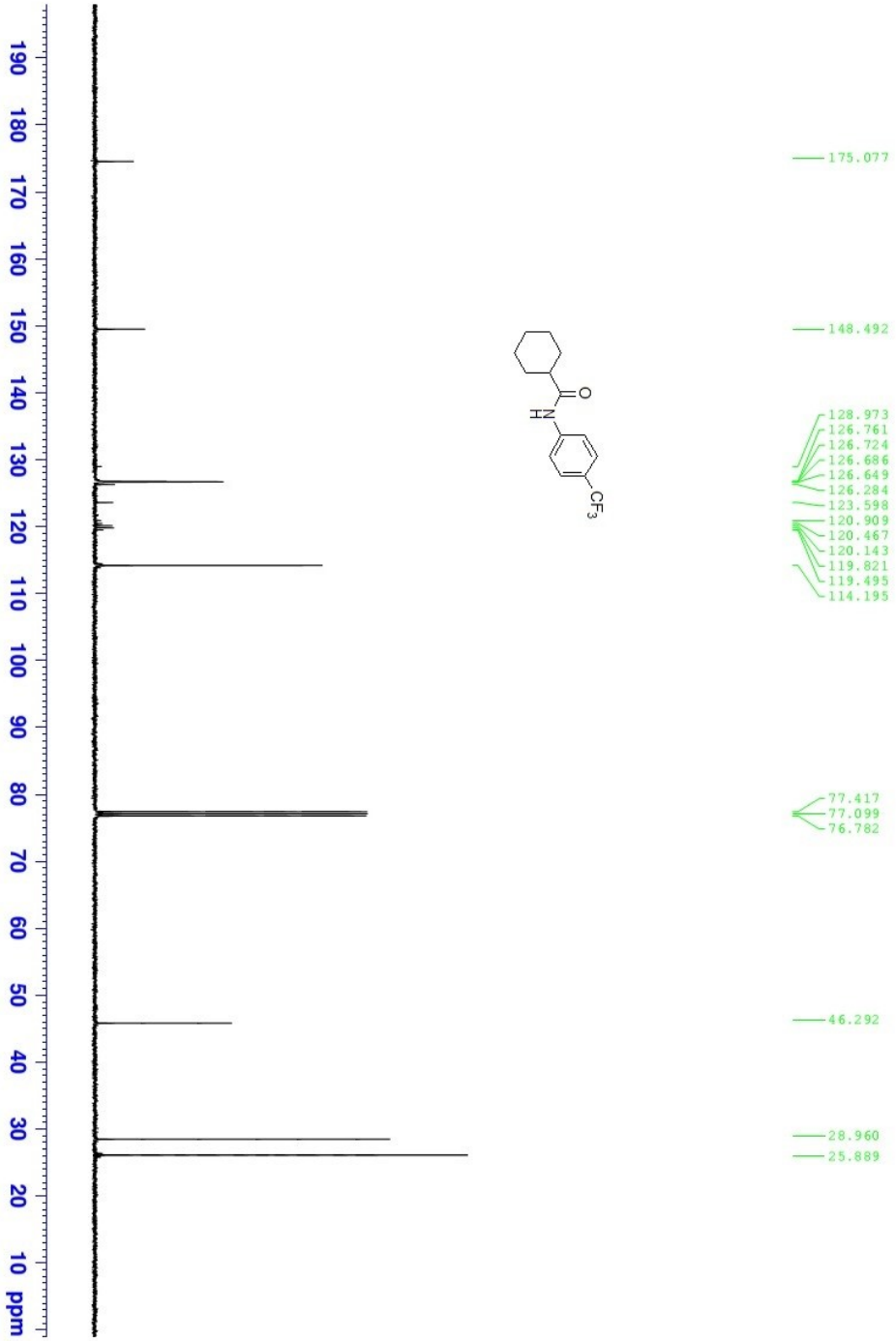
^{1}H NMR of Compound 3af



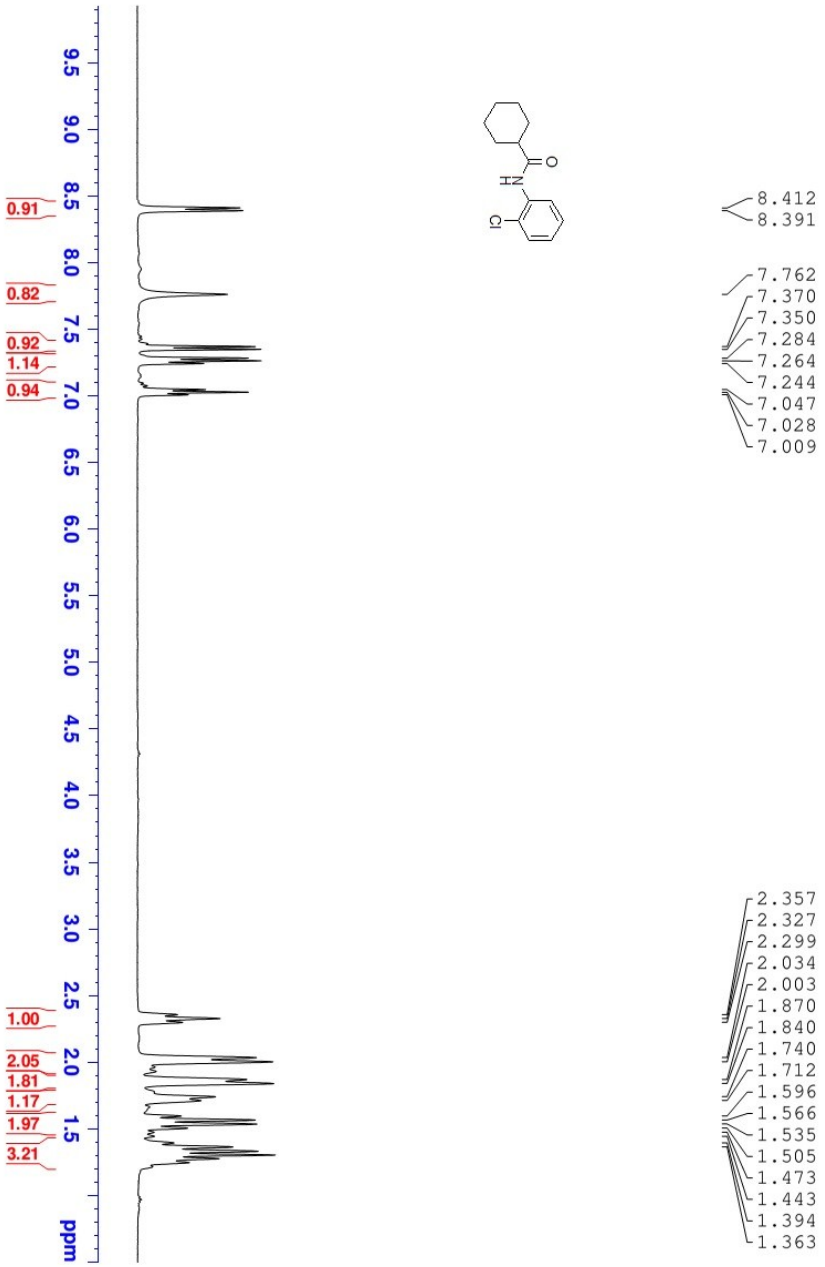
^{13}C NMR of Compound 3af



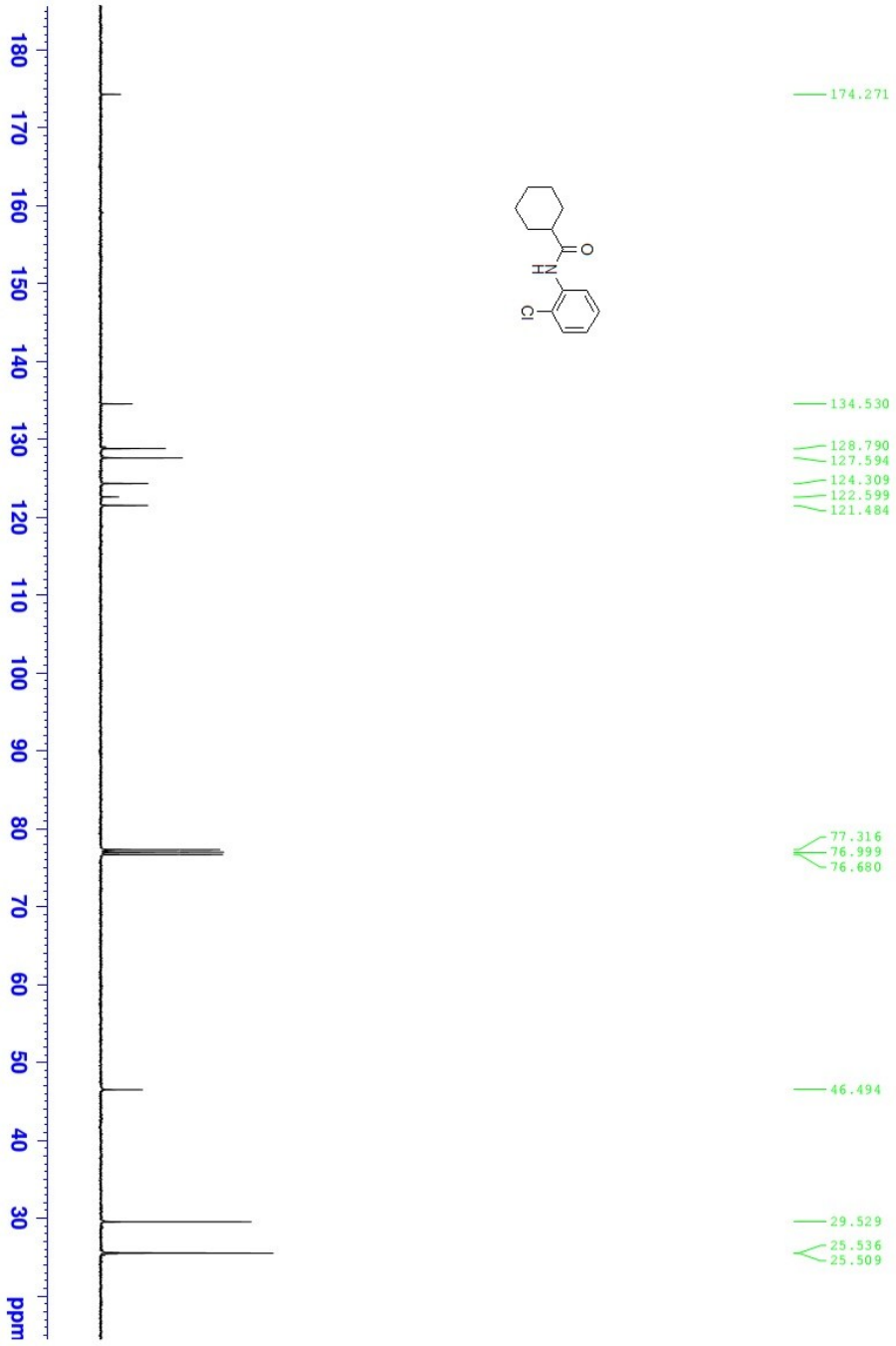
^{1}H NMR of Compound 3ag



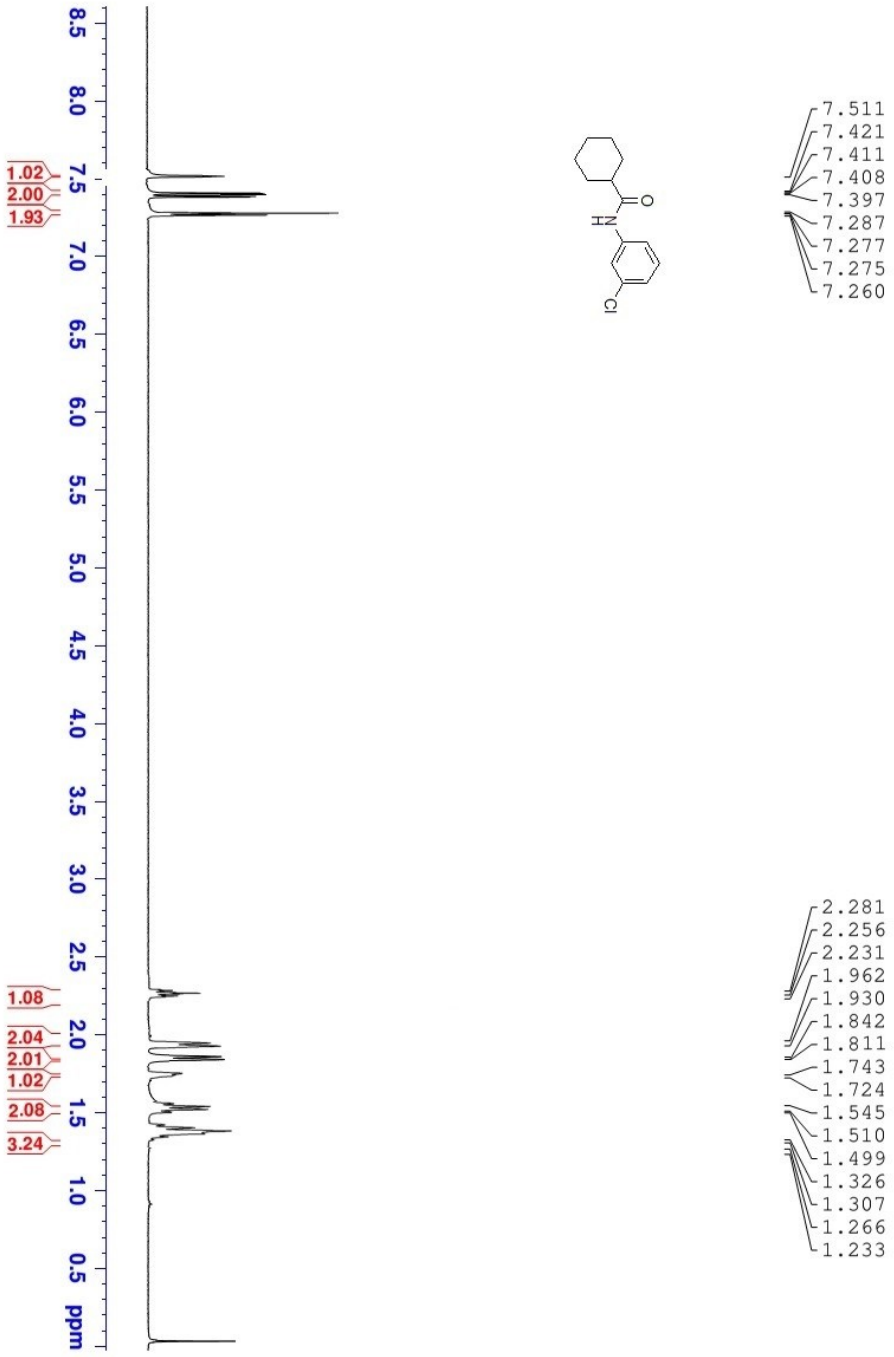
^{13}C NMR of Compound 3ag



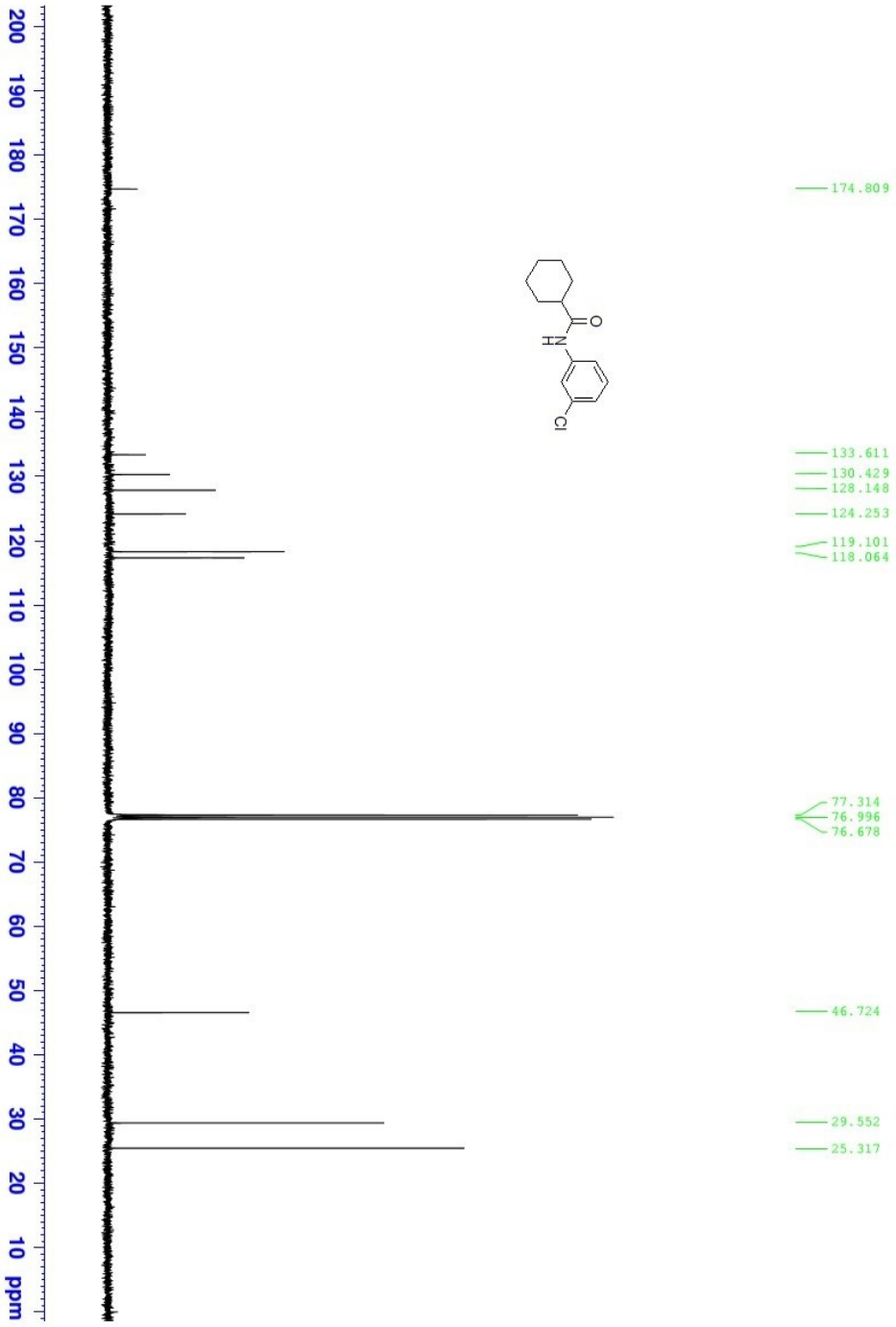
^{1}H NMR of Compound 3ah



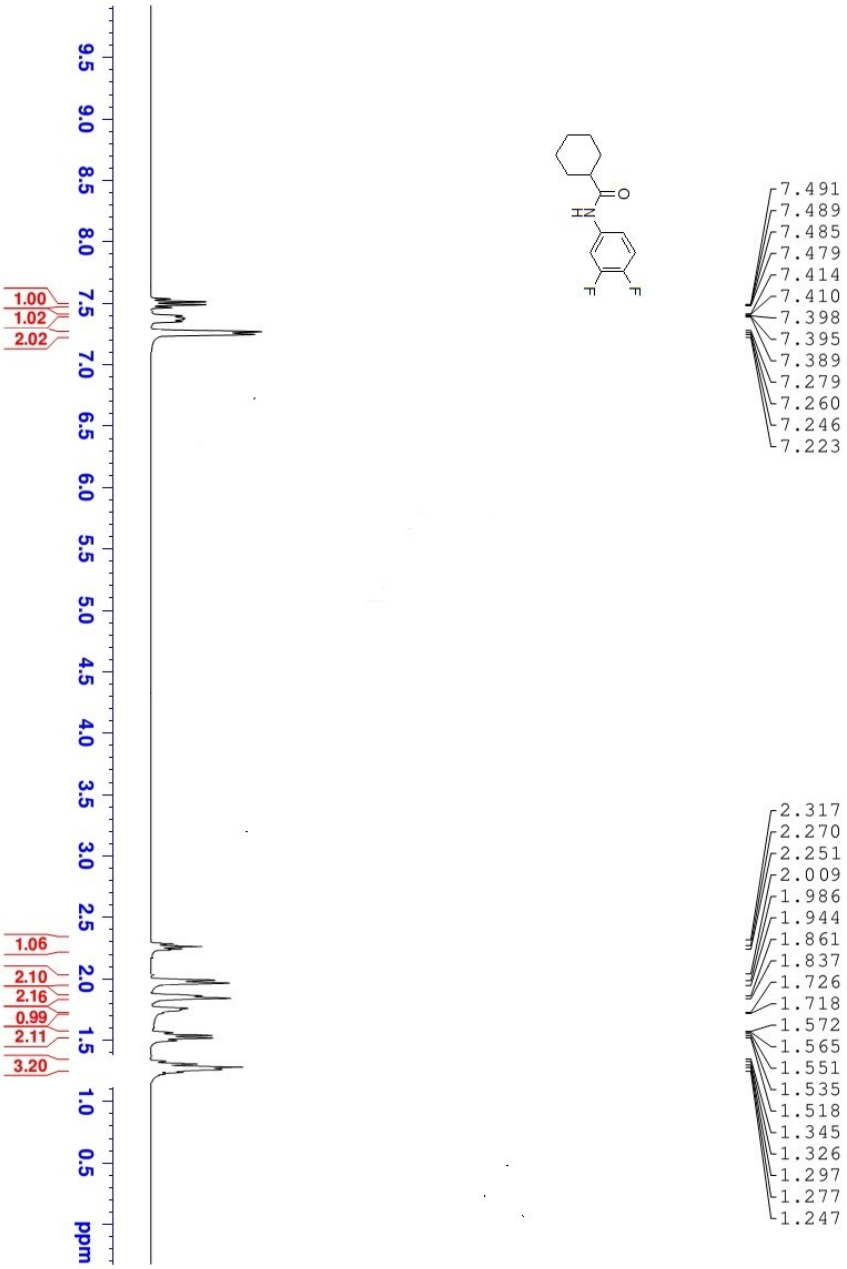
^{13}C NMR of Compound 3ah



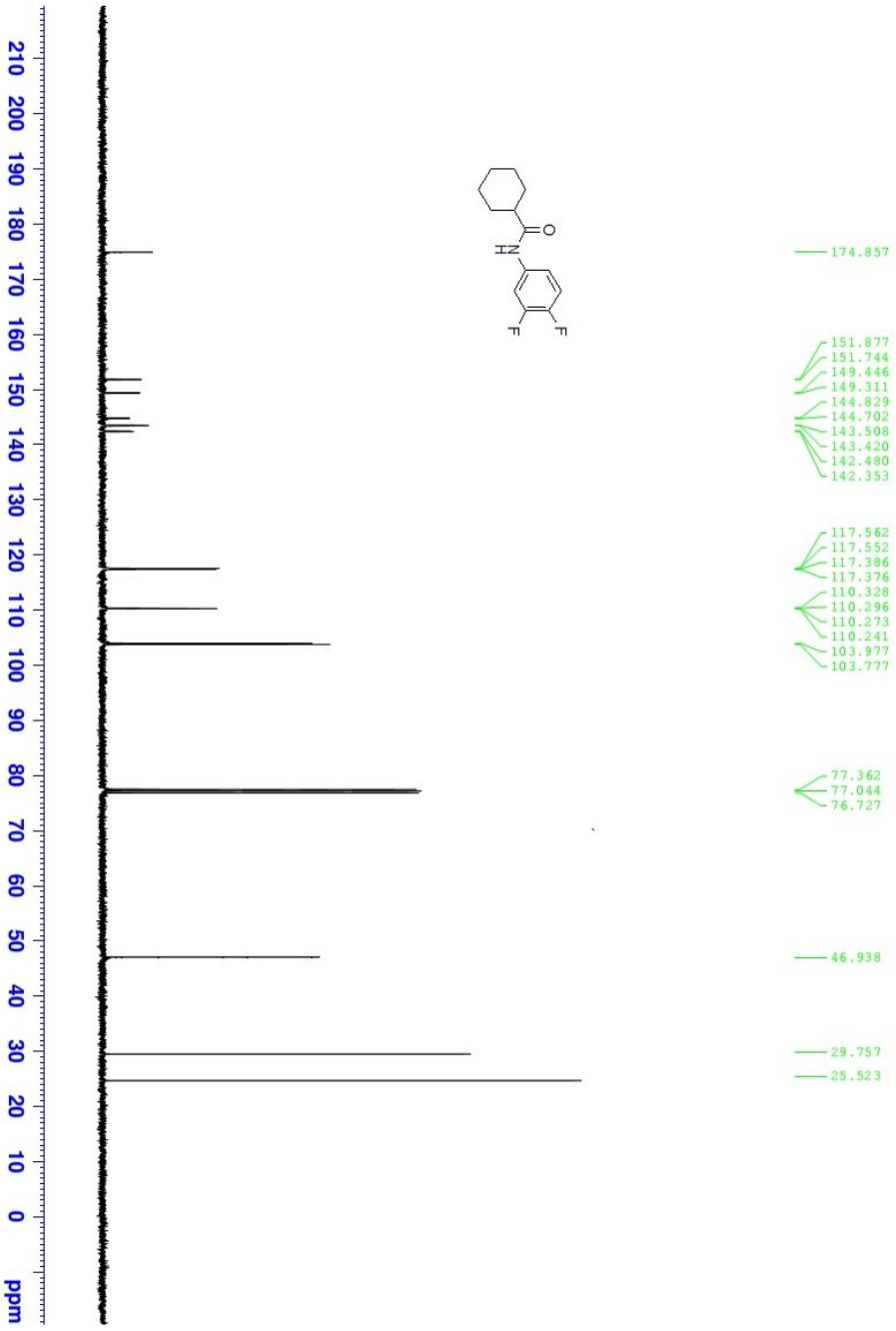
^{1}H NMR of Compound 3ai



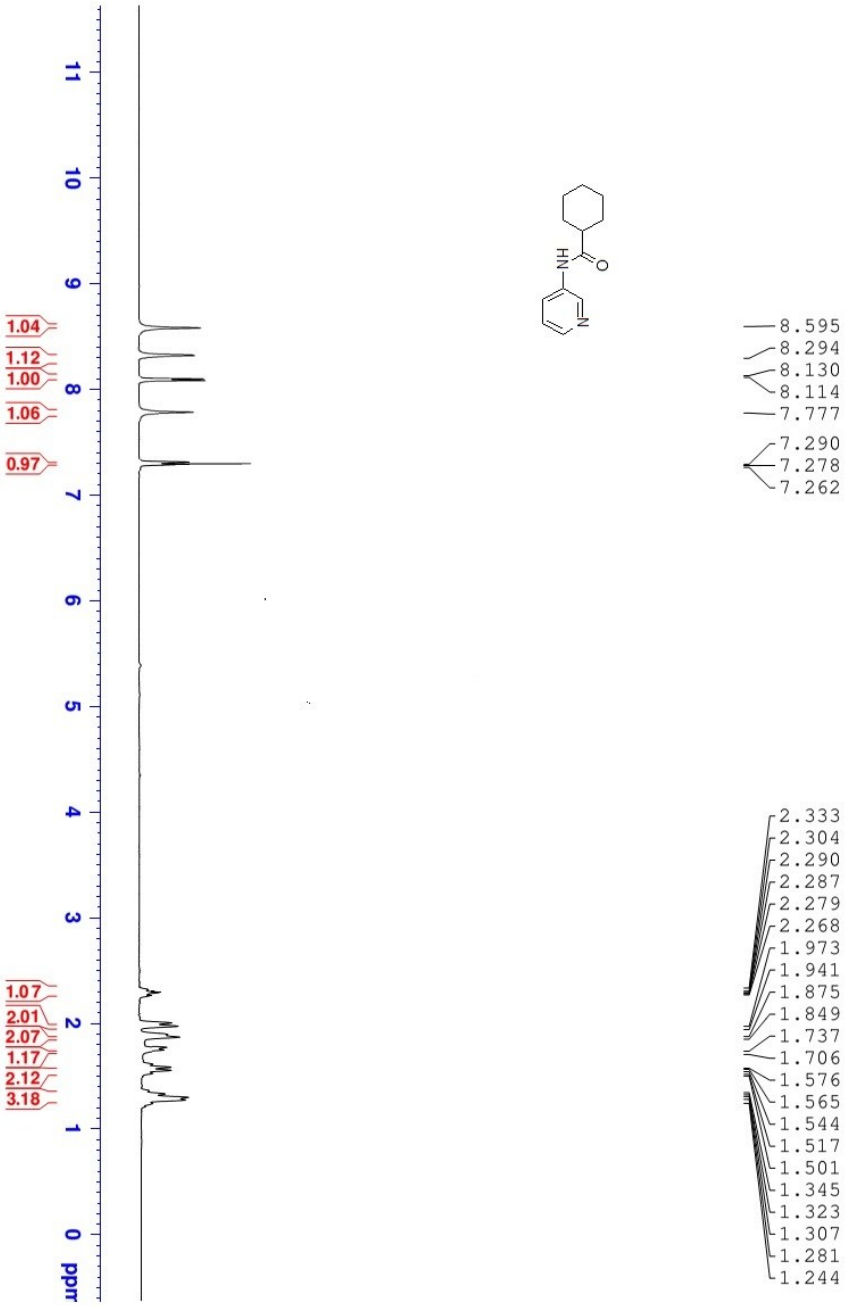
^{13}C NMR of Compound 3ai



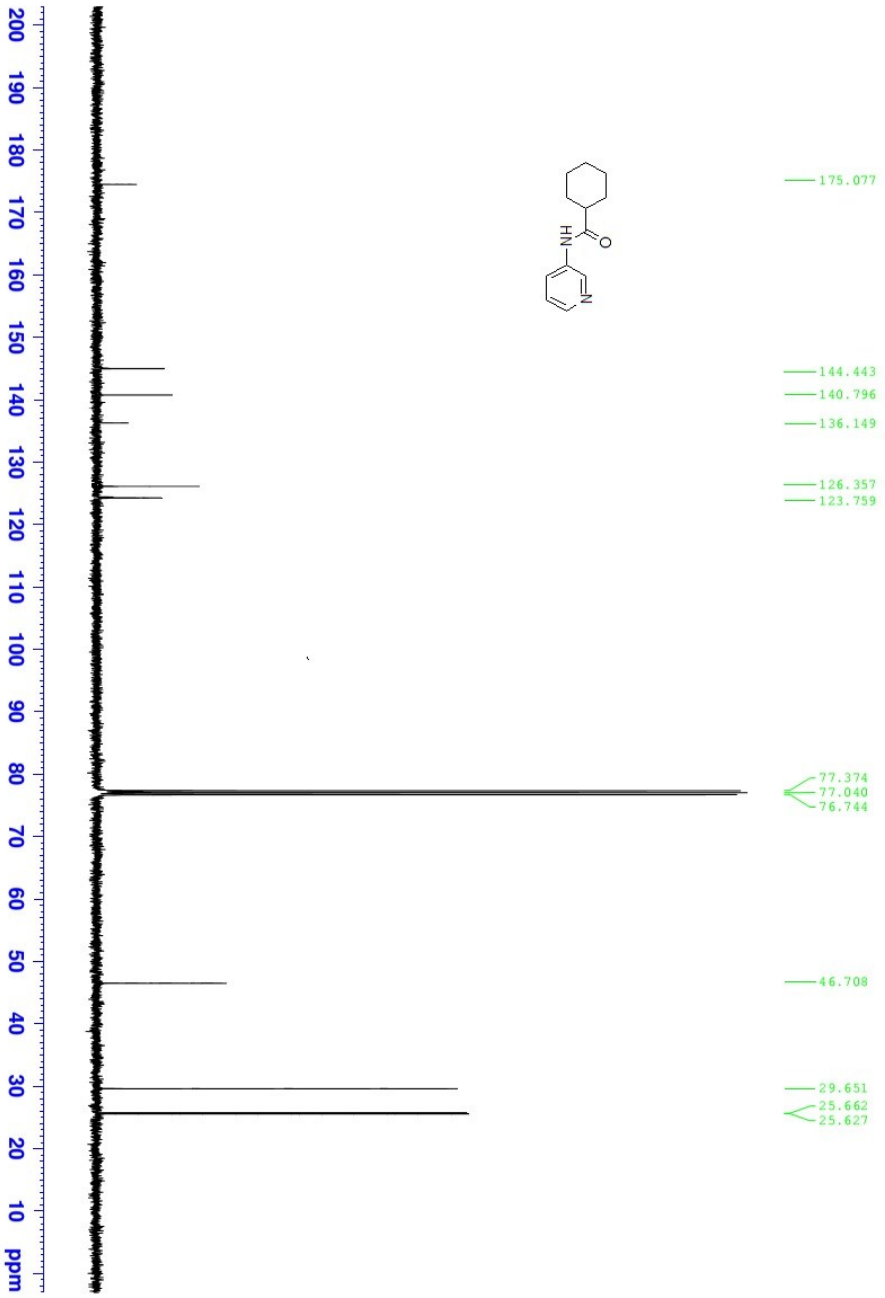
^{1}H NMR of Compound 3aj



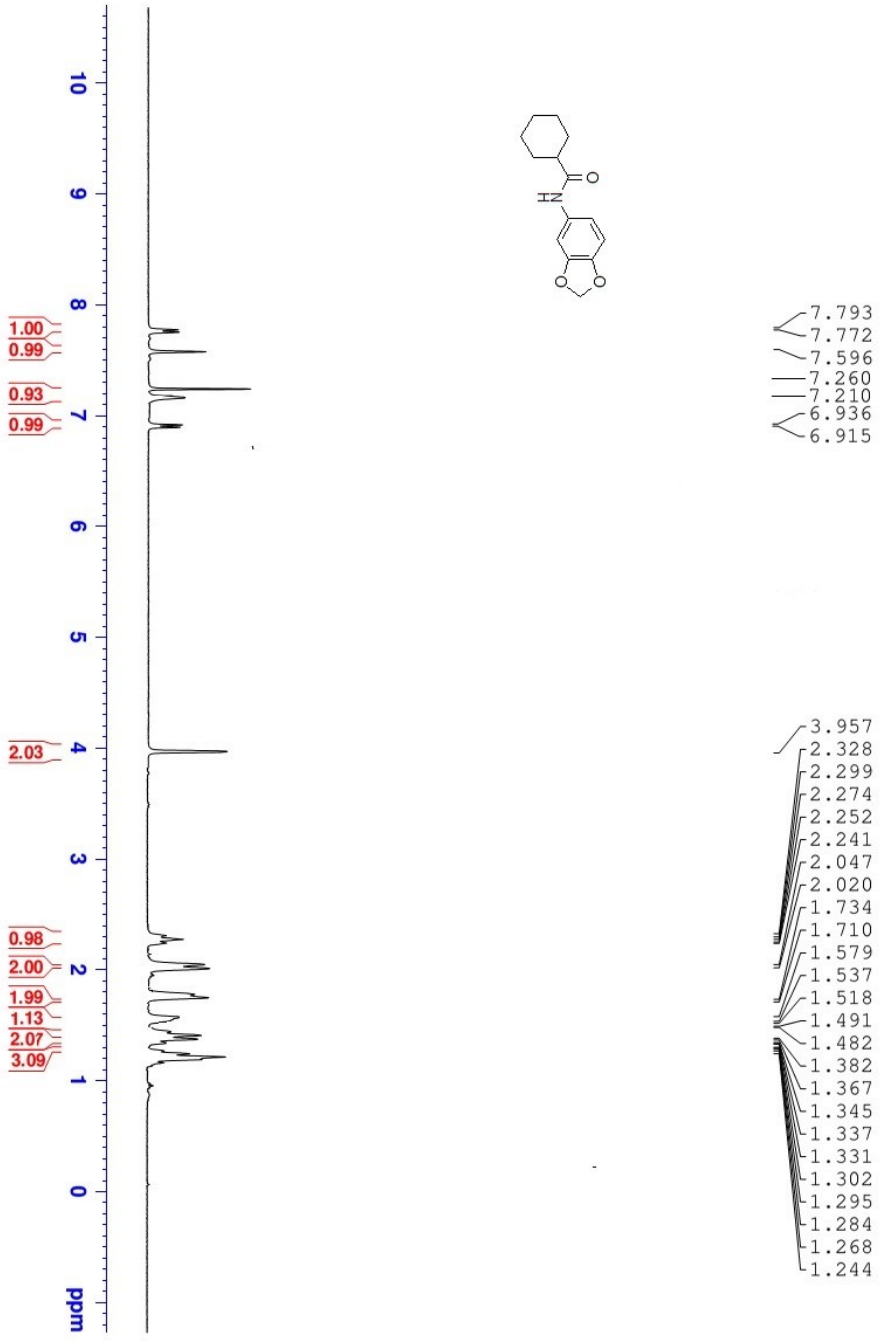
^{13}C NMR of Compound 3aj



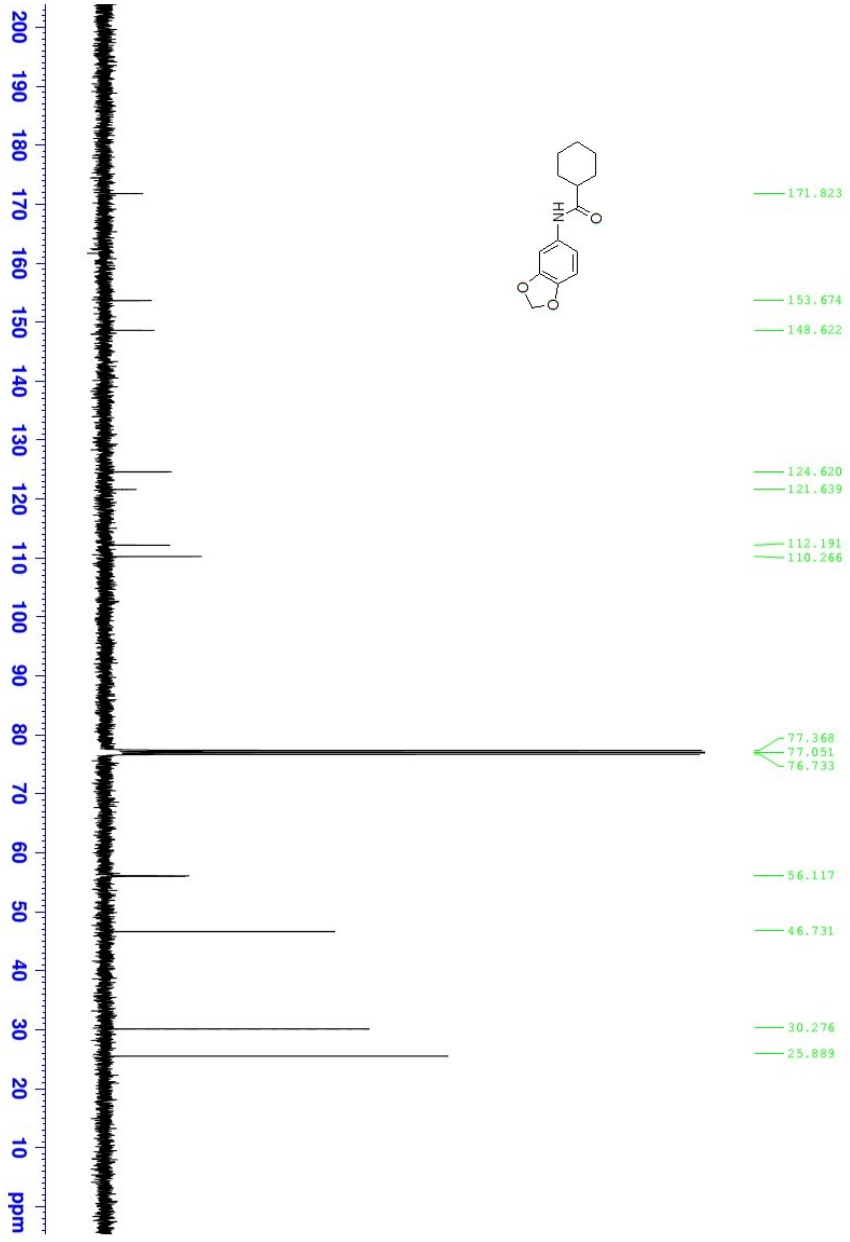
^{1}H NMR of Compound 3ak



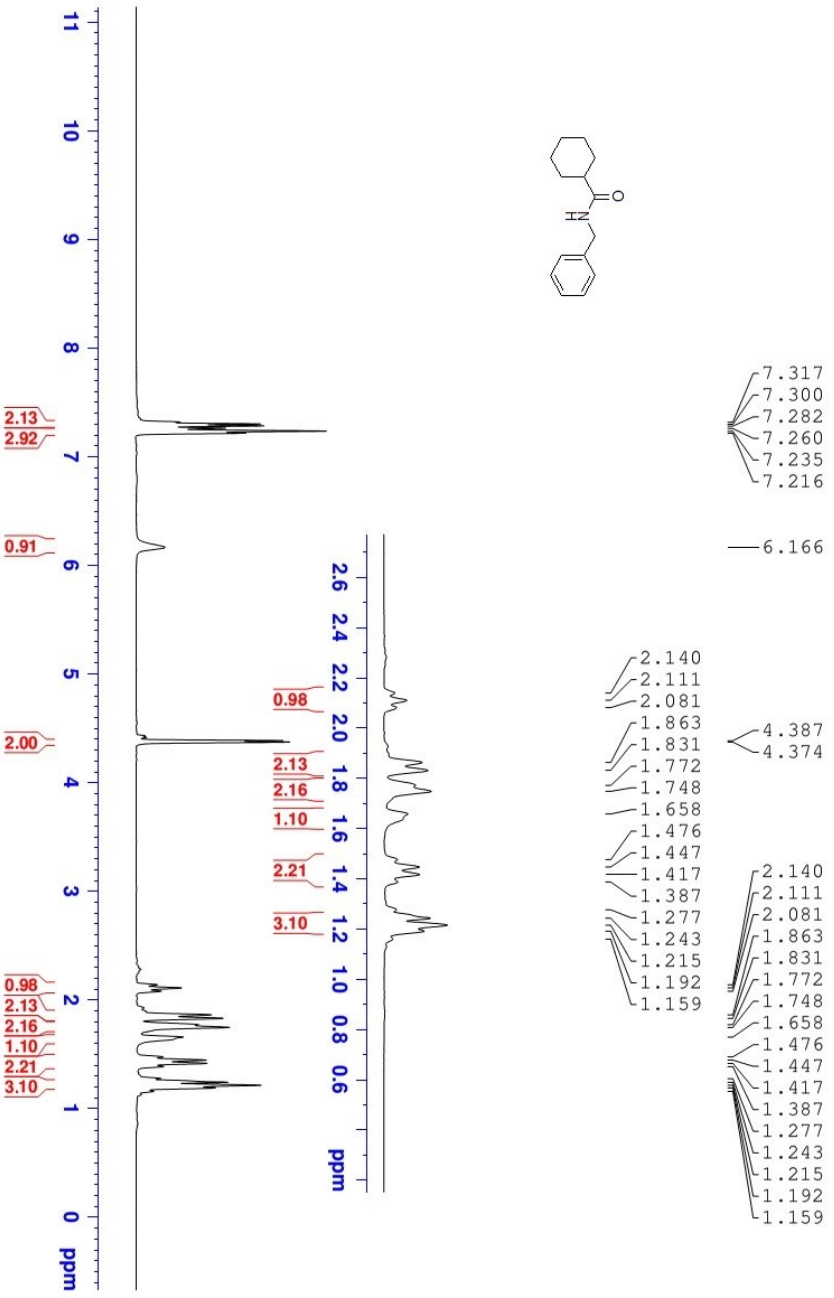
^{13}C NMR of Compound 3ak



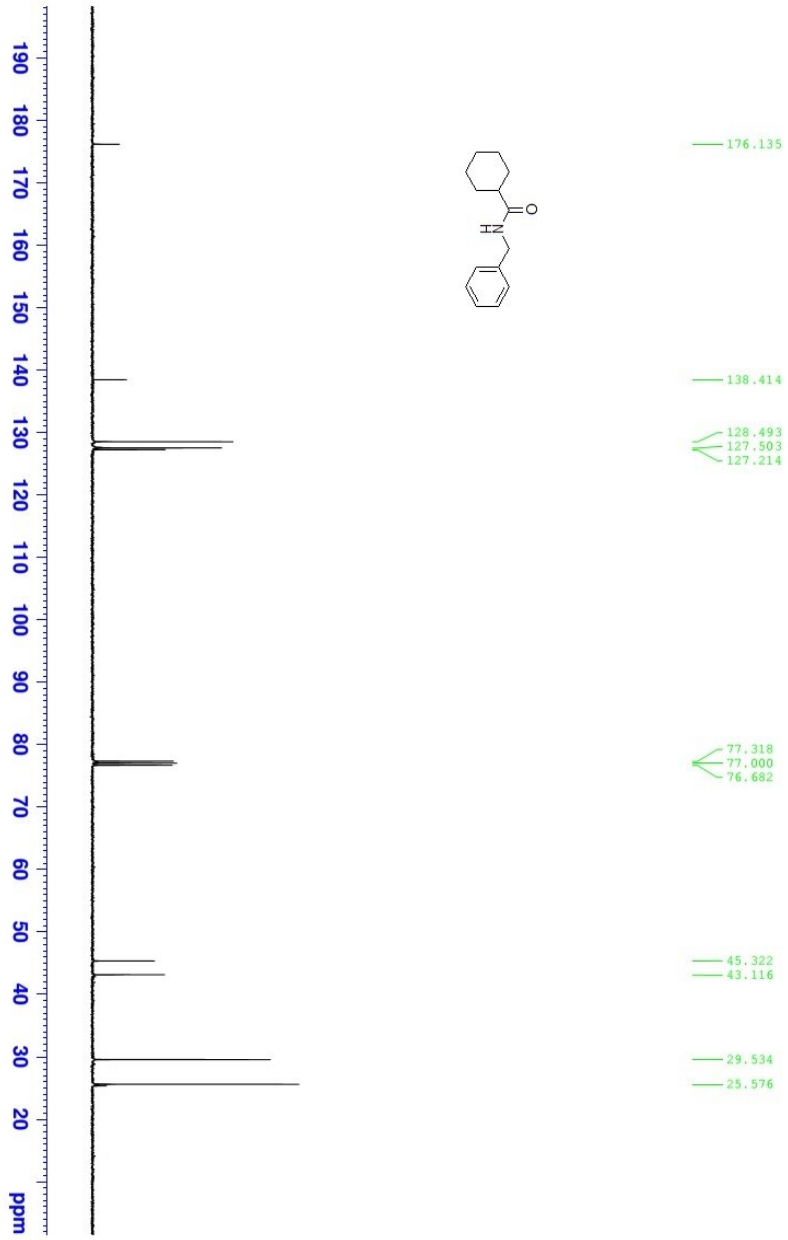
^{1}H NMR of Compound 3al



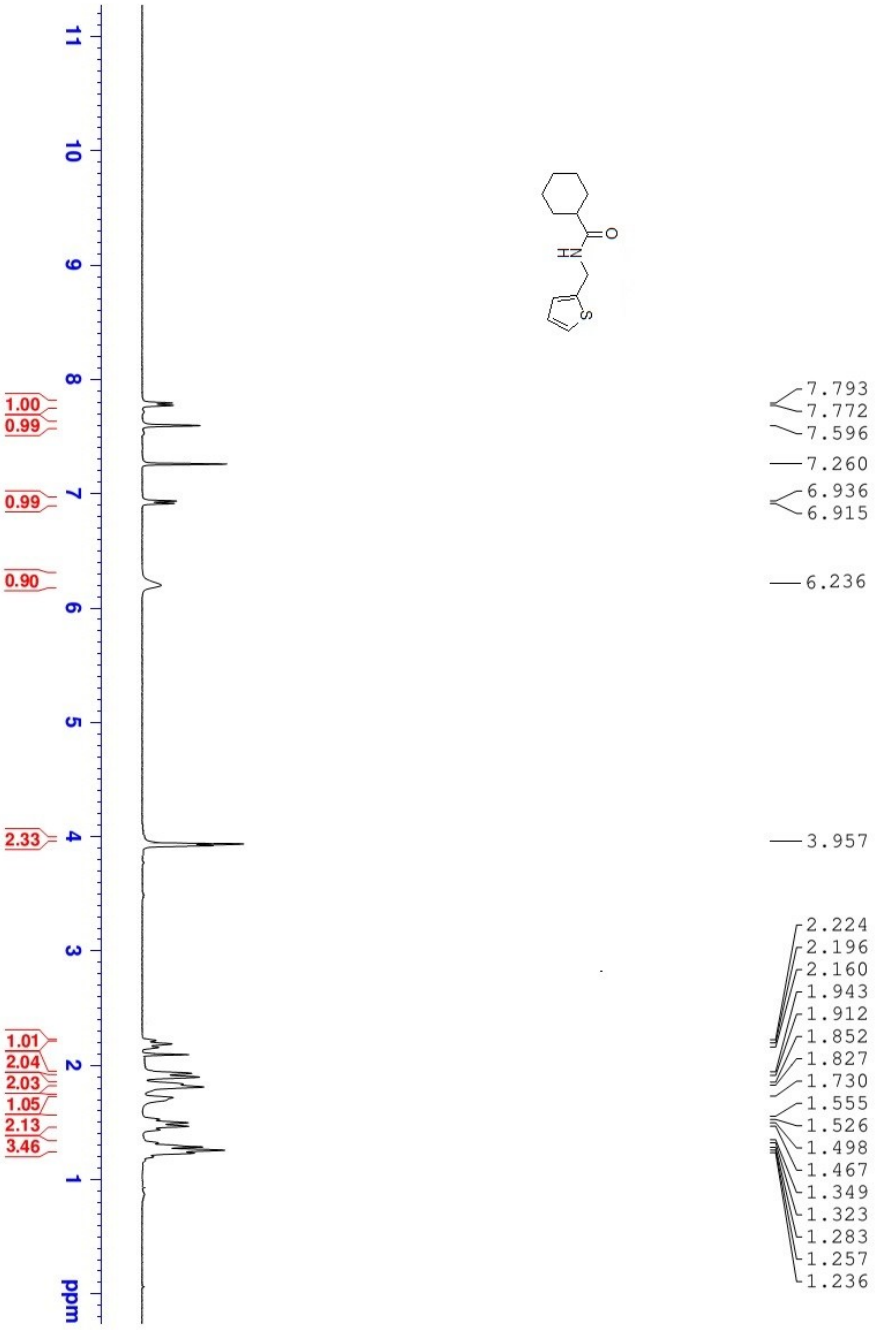
^{13}C NMR of Compound 3al



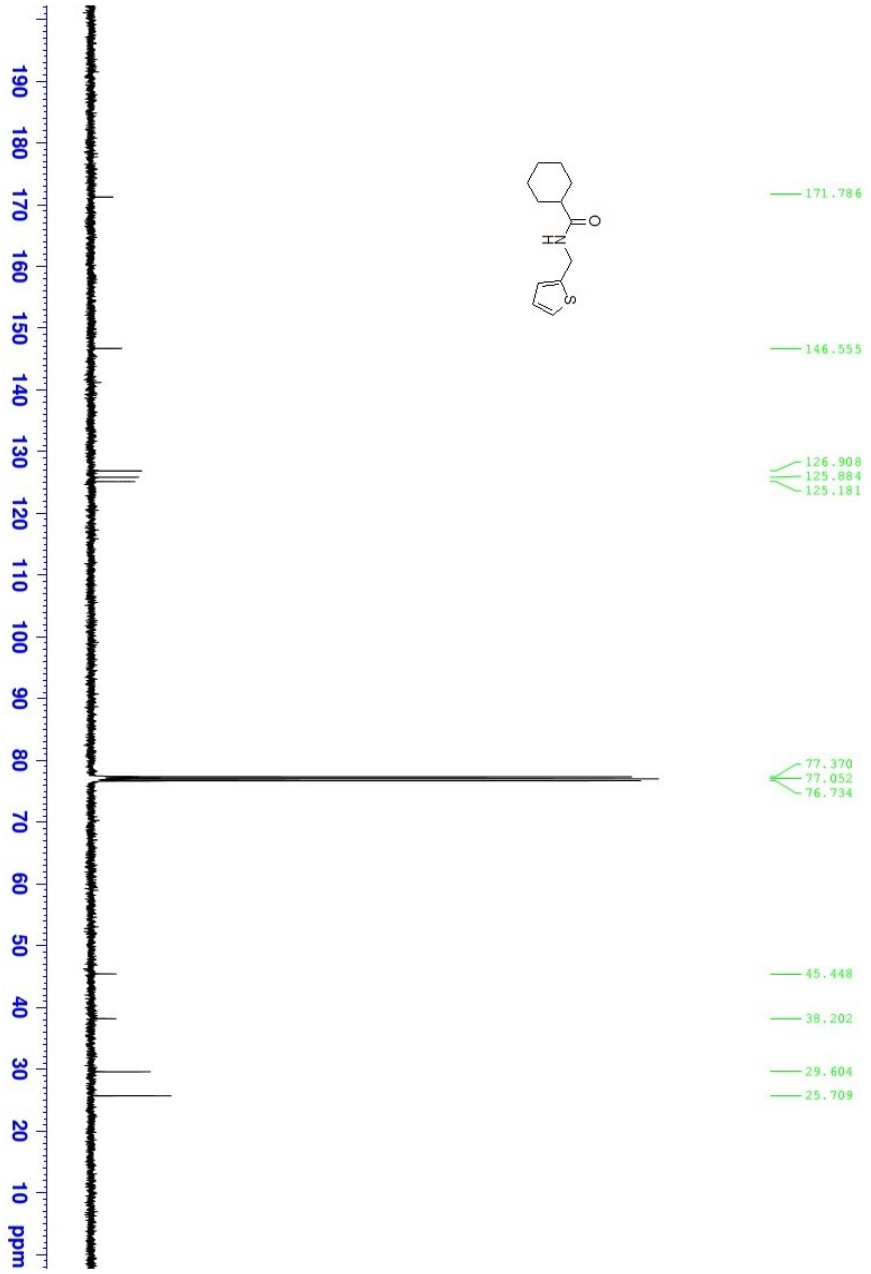
^{1}H NMR of Compound 3am



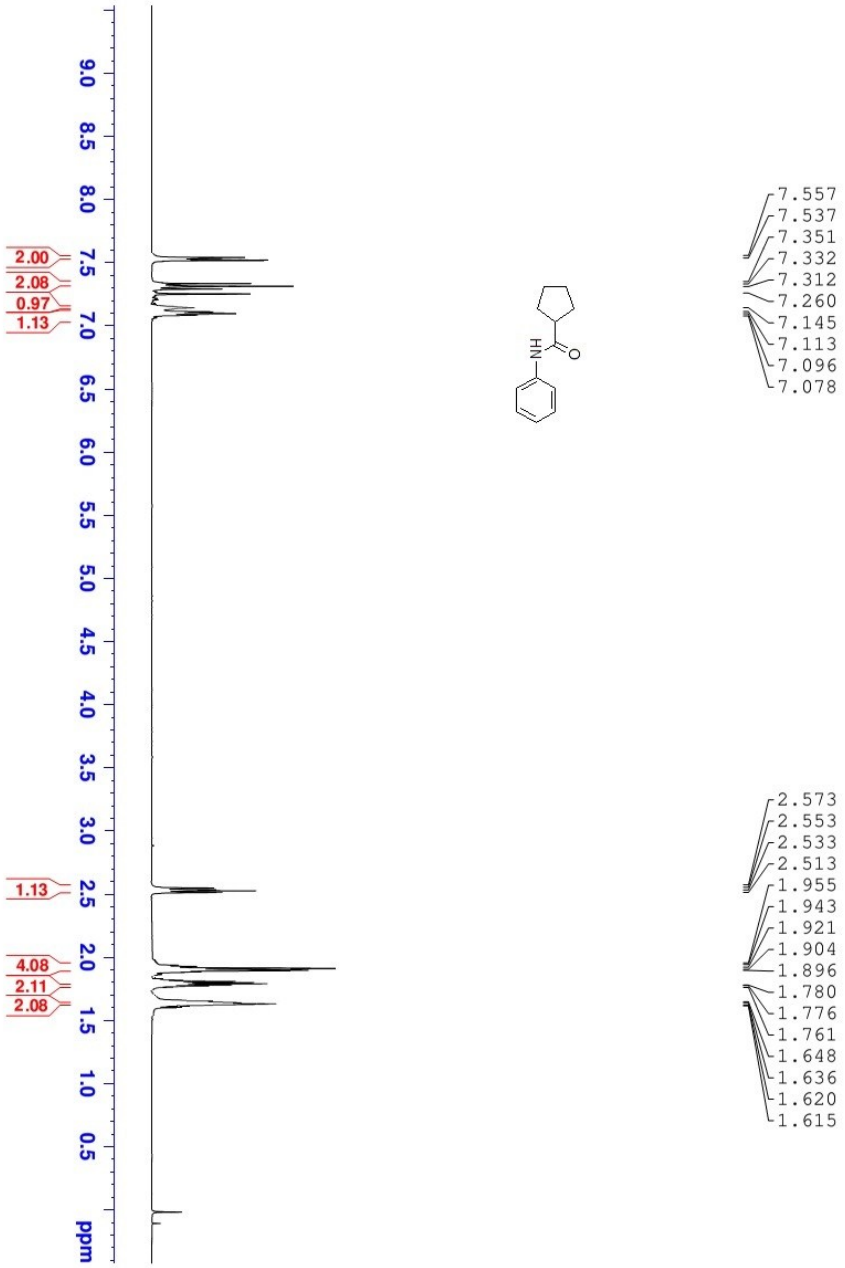
^{13}C NMR of Compound 3am



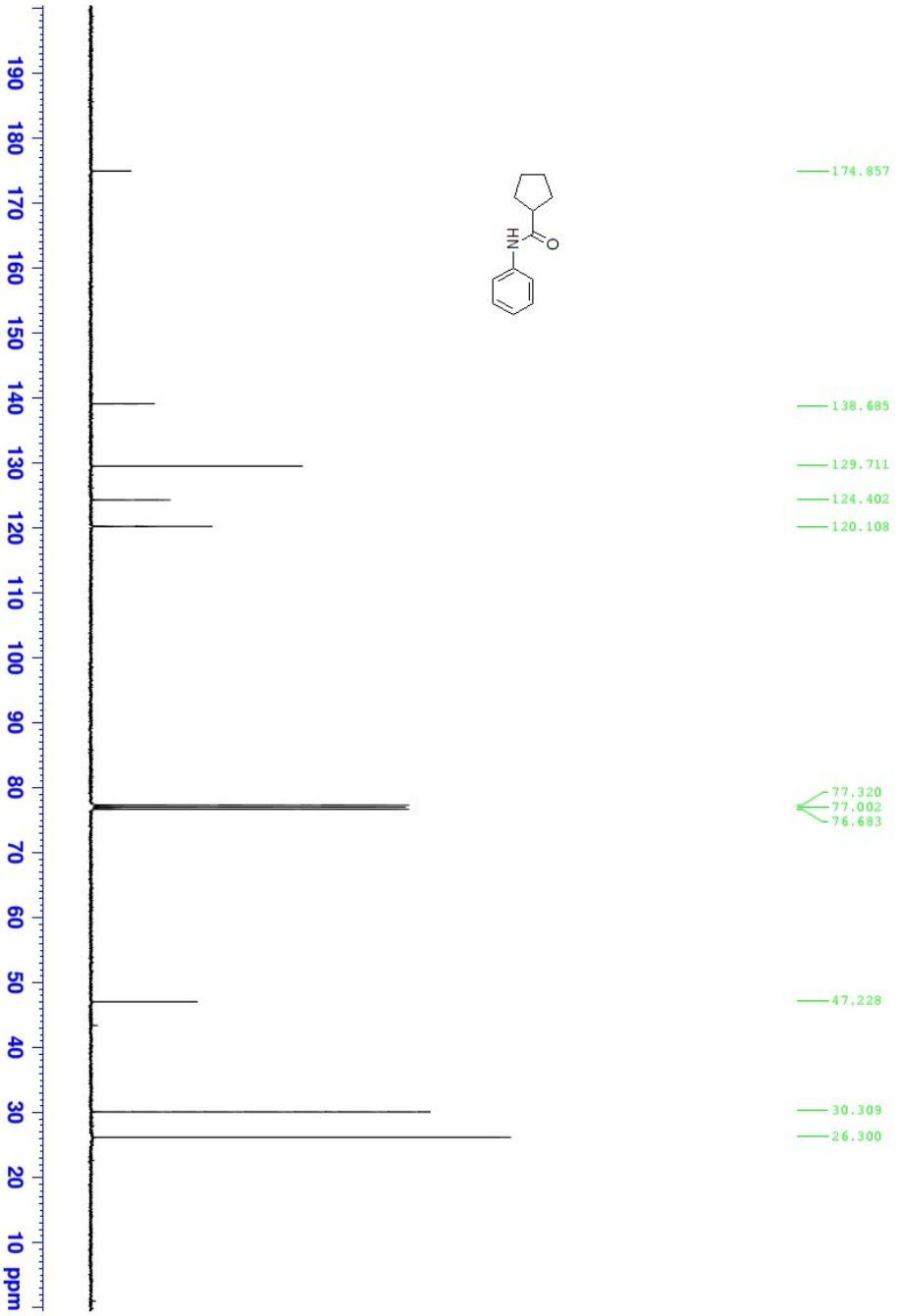
^{1}H NMR of Compound 3an



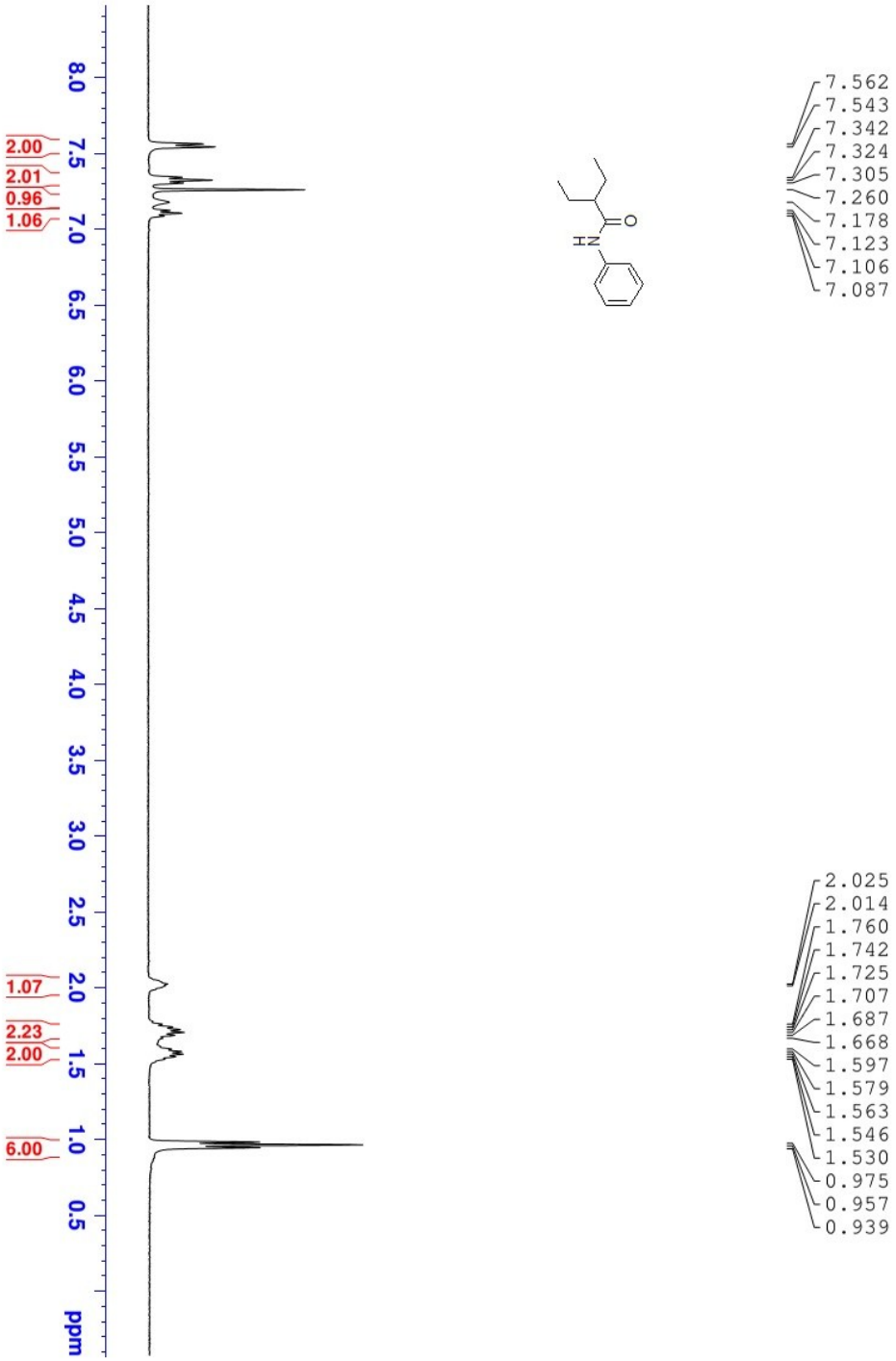
^{13}C NMR of Compound 3an



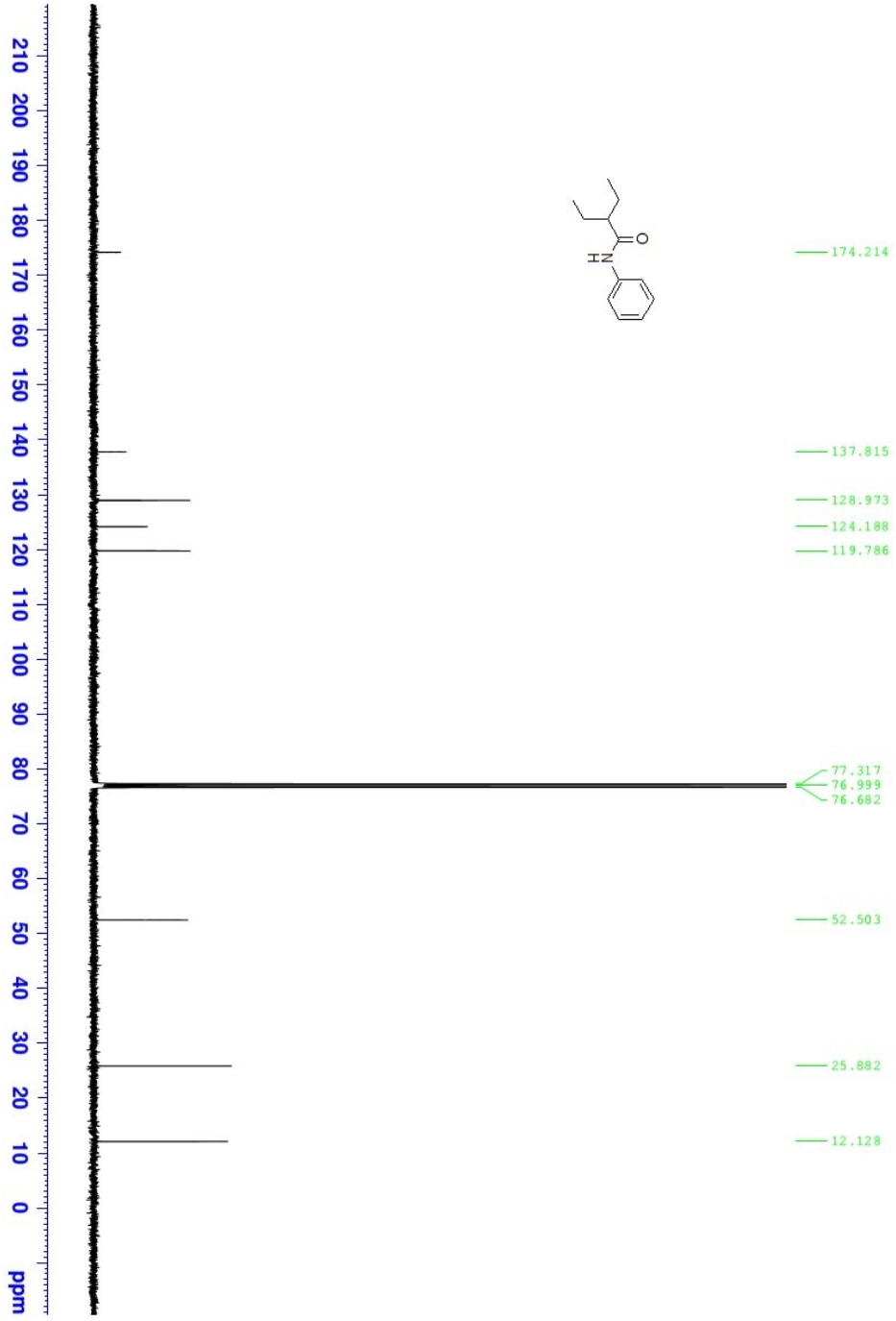
^{1}H NMR of Compound 3ab



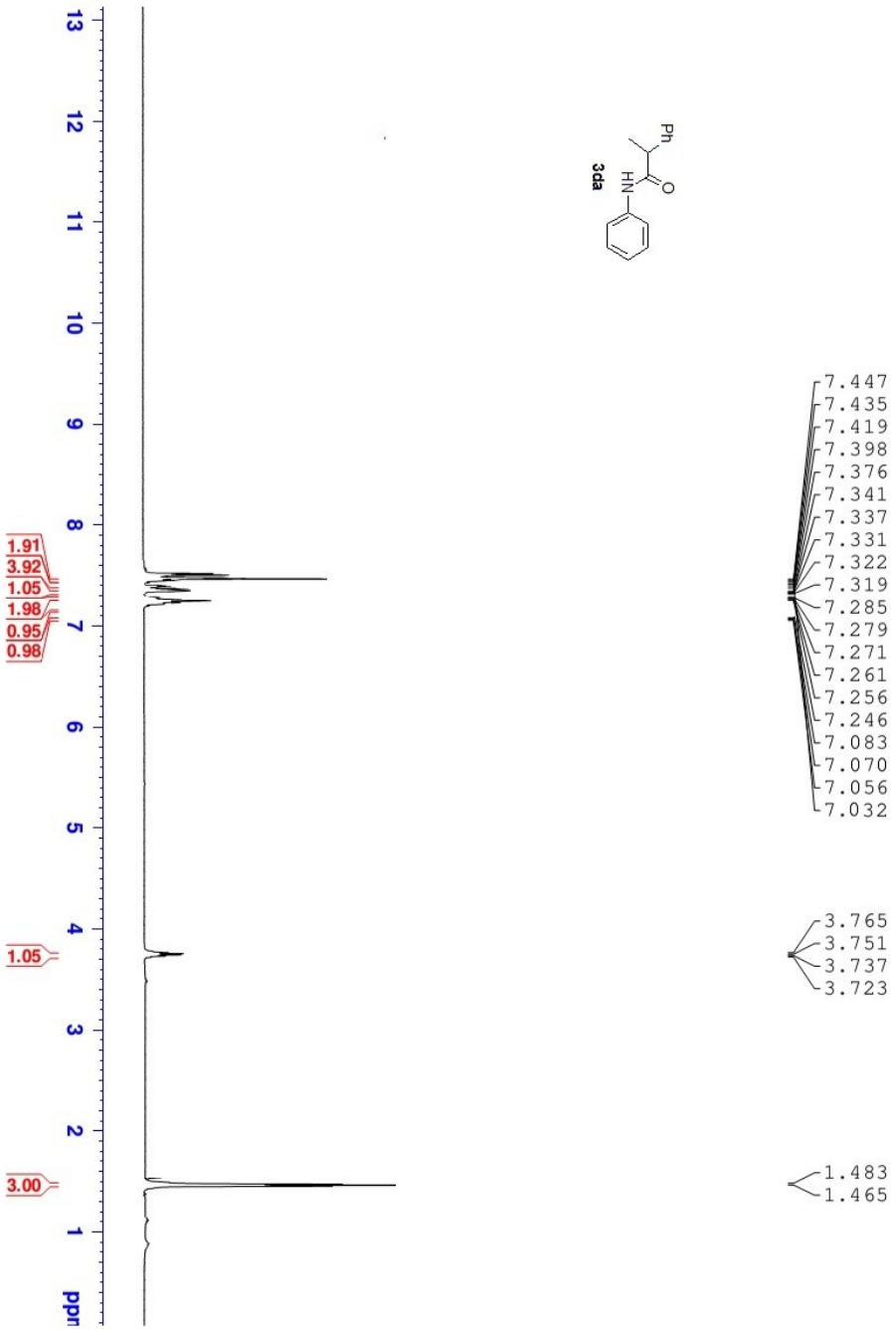
^{13}C NMR of Compound 3ba



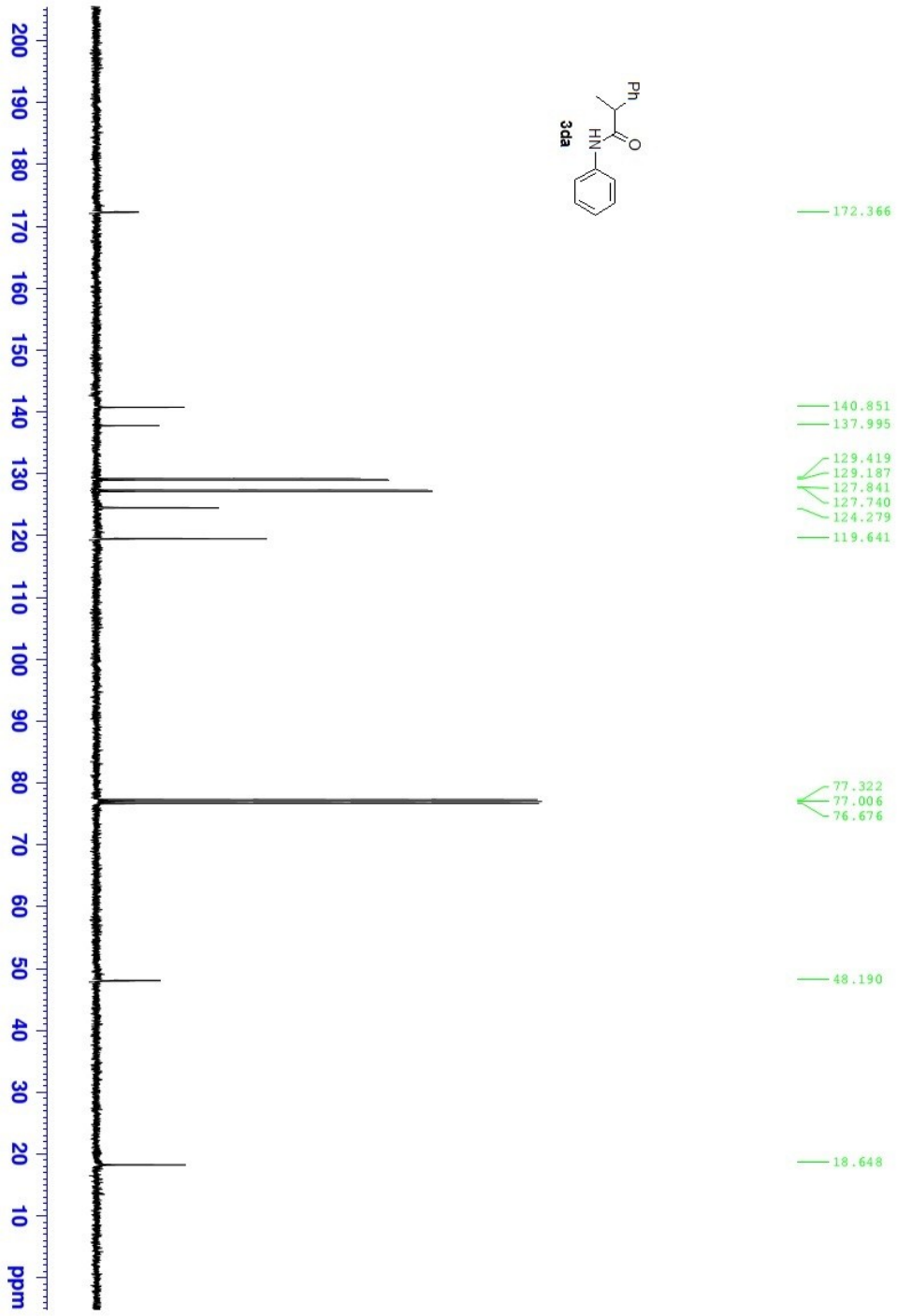
^{1}H NMR of Compound 3ca



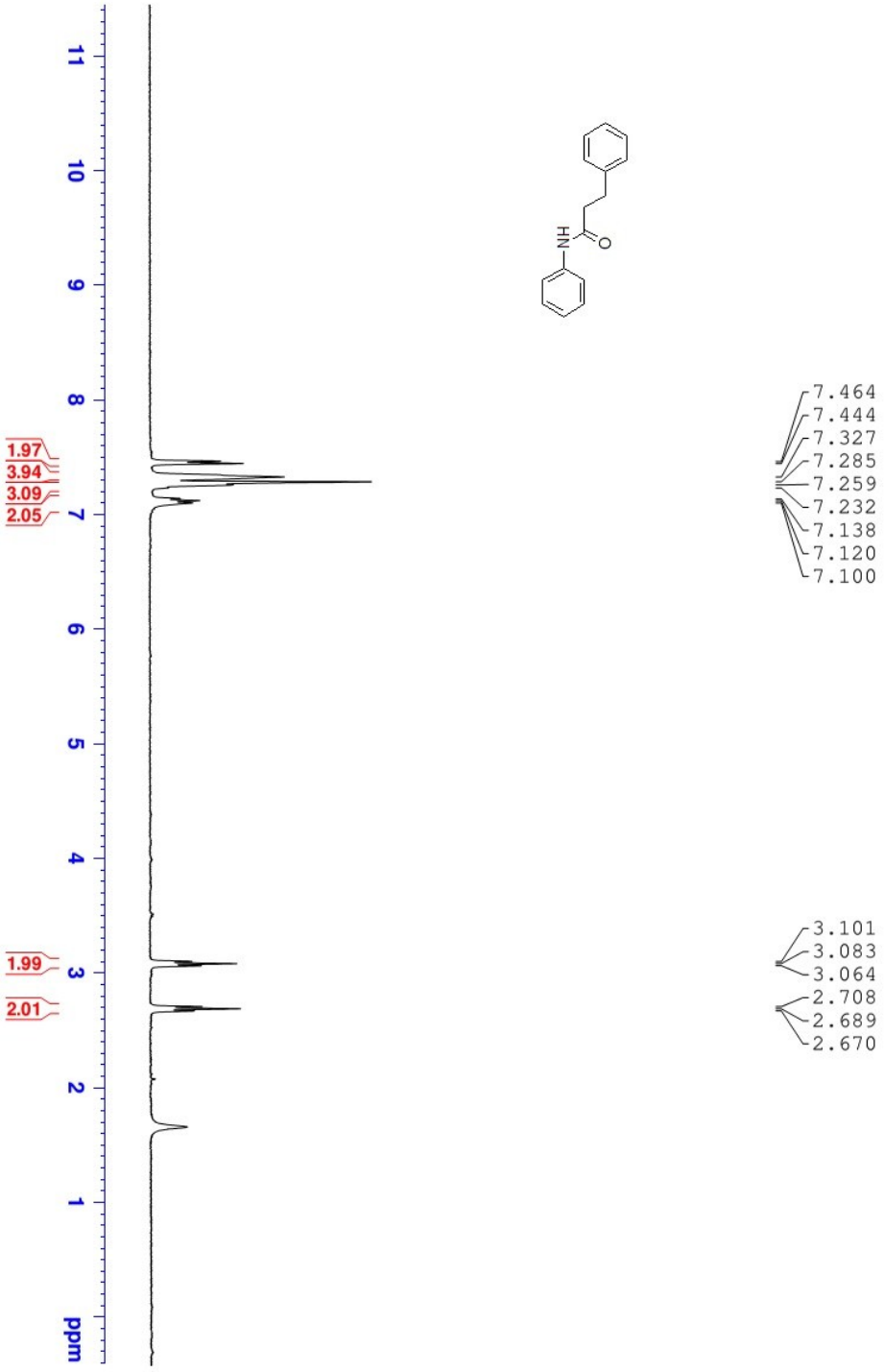
^{13}C NMR of Compound 3ca



^{1}H NMR of Compound 3da



^{13}C NMR of Compound 3da



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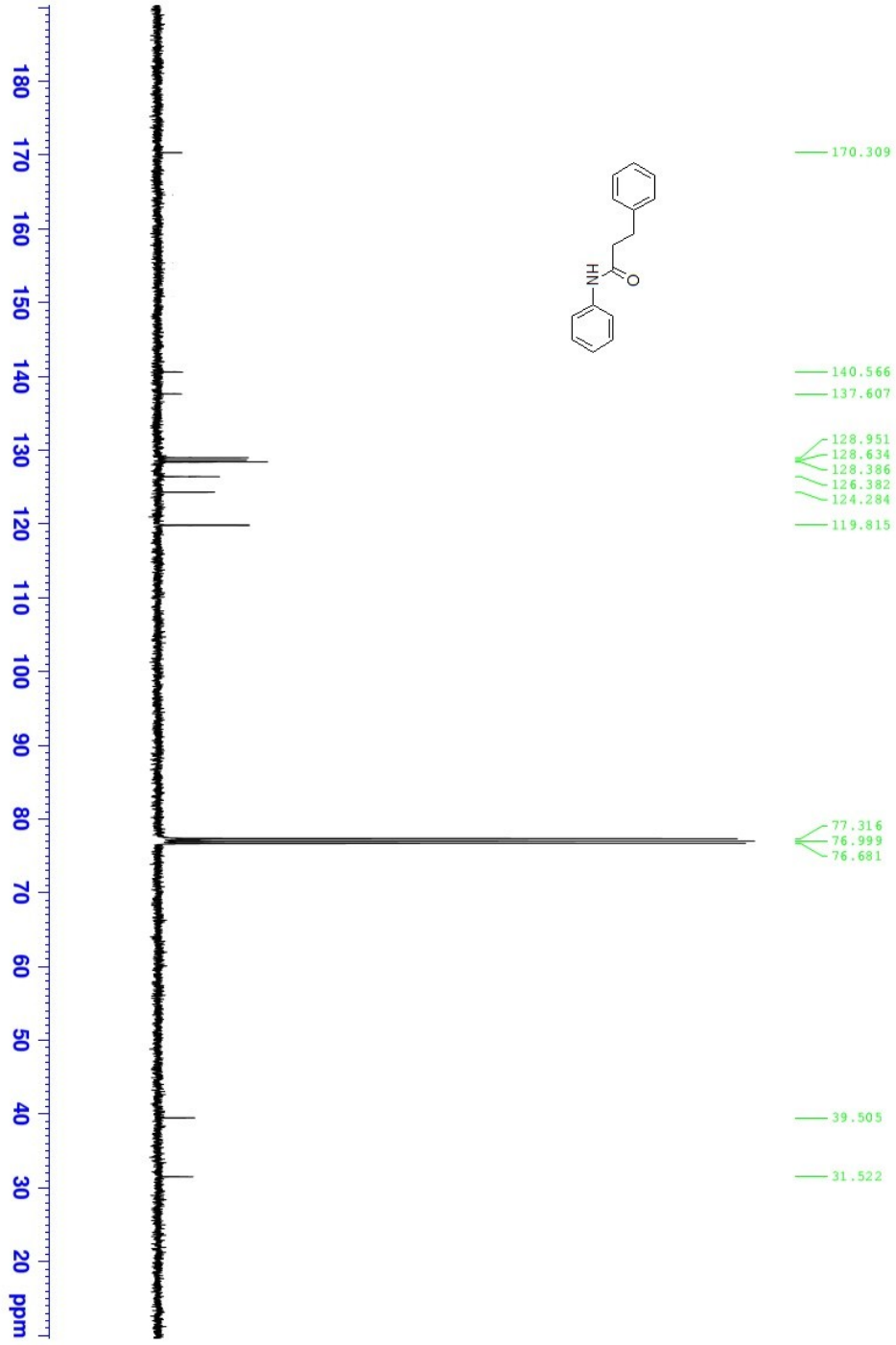
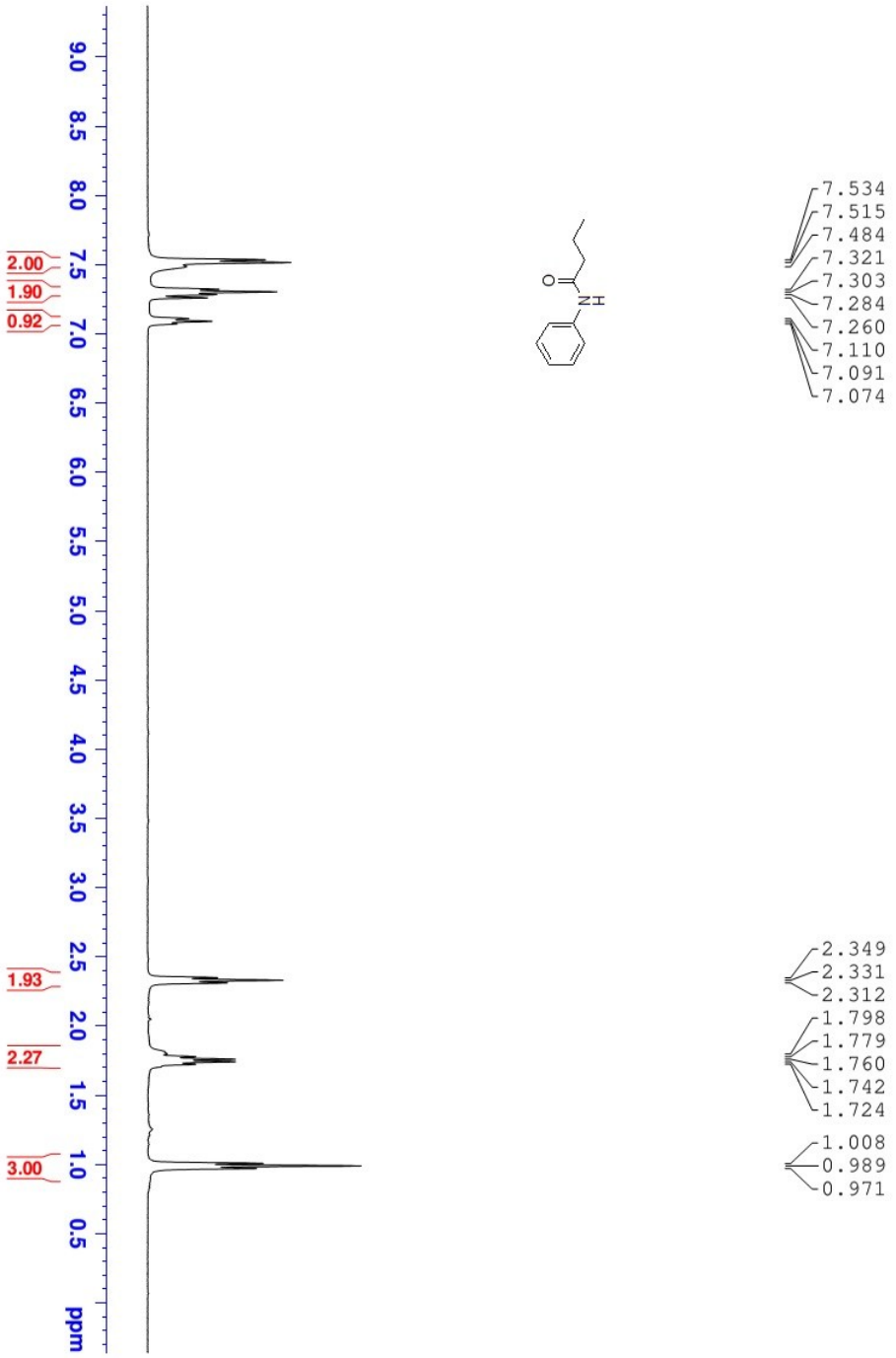
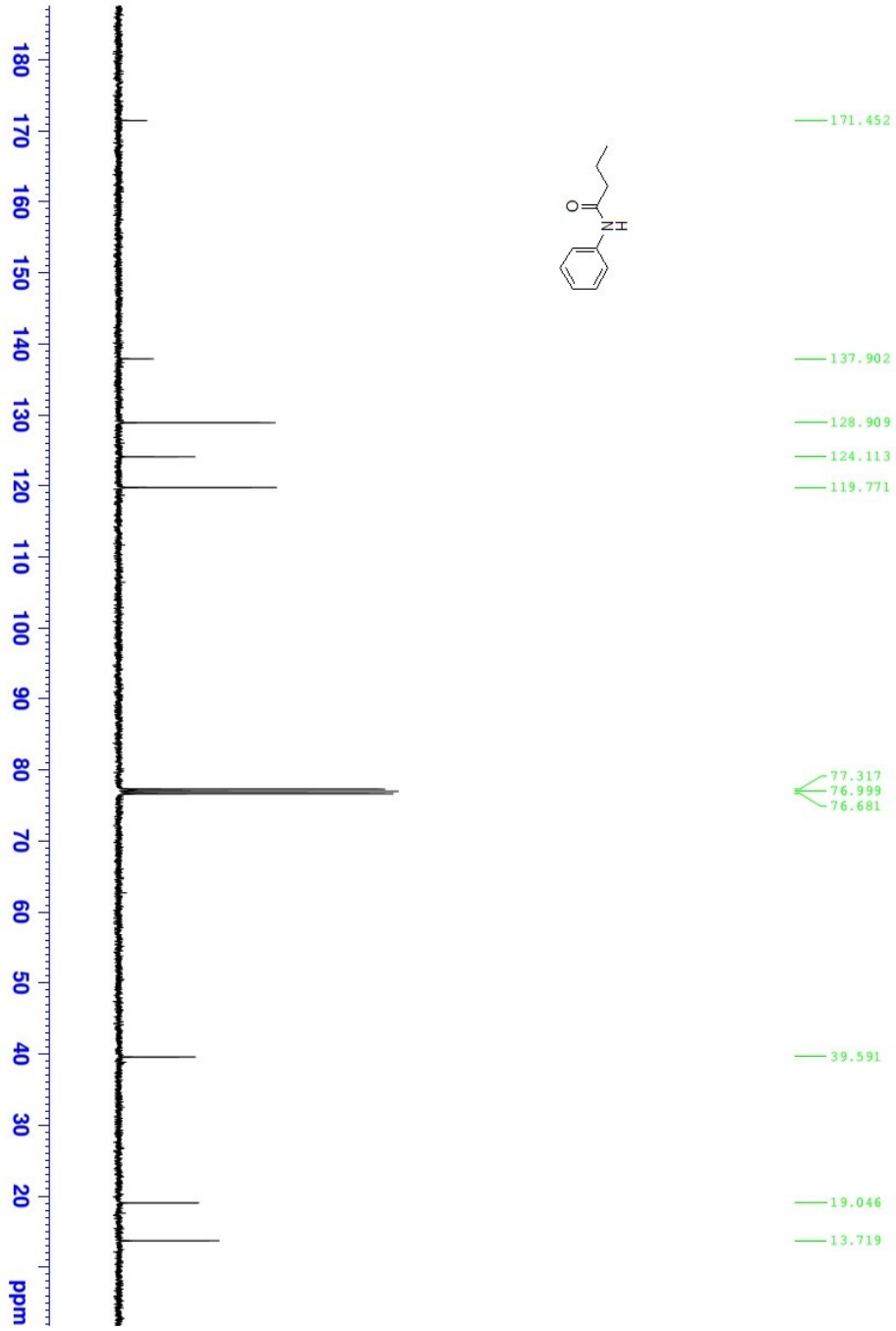


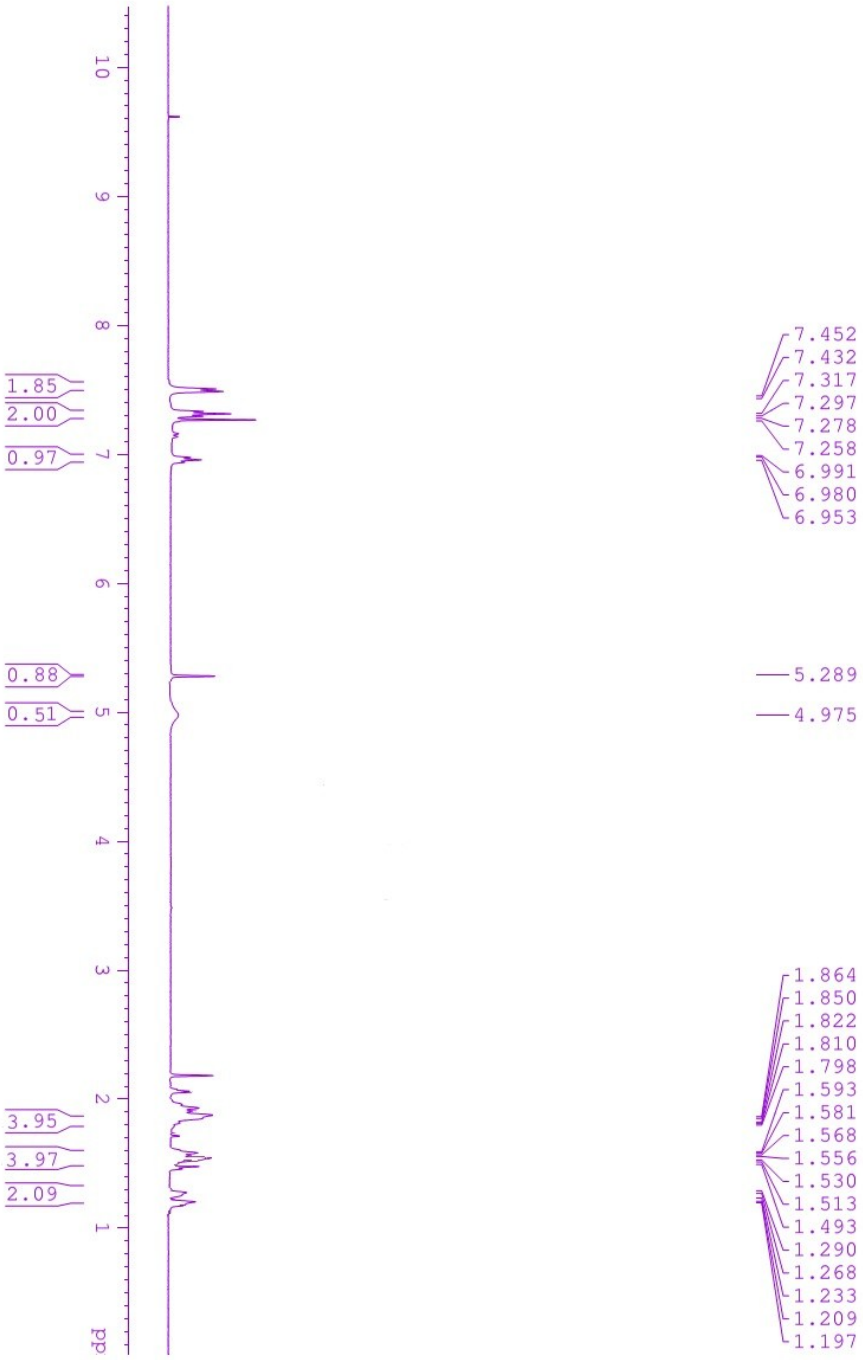
^{13}C NMR of Compound 3ea



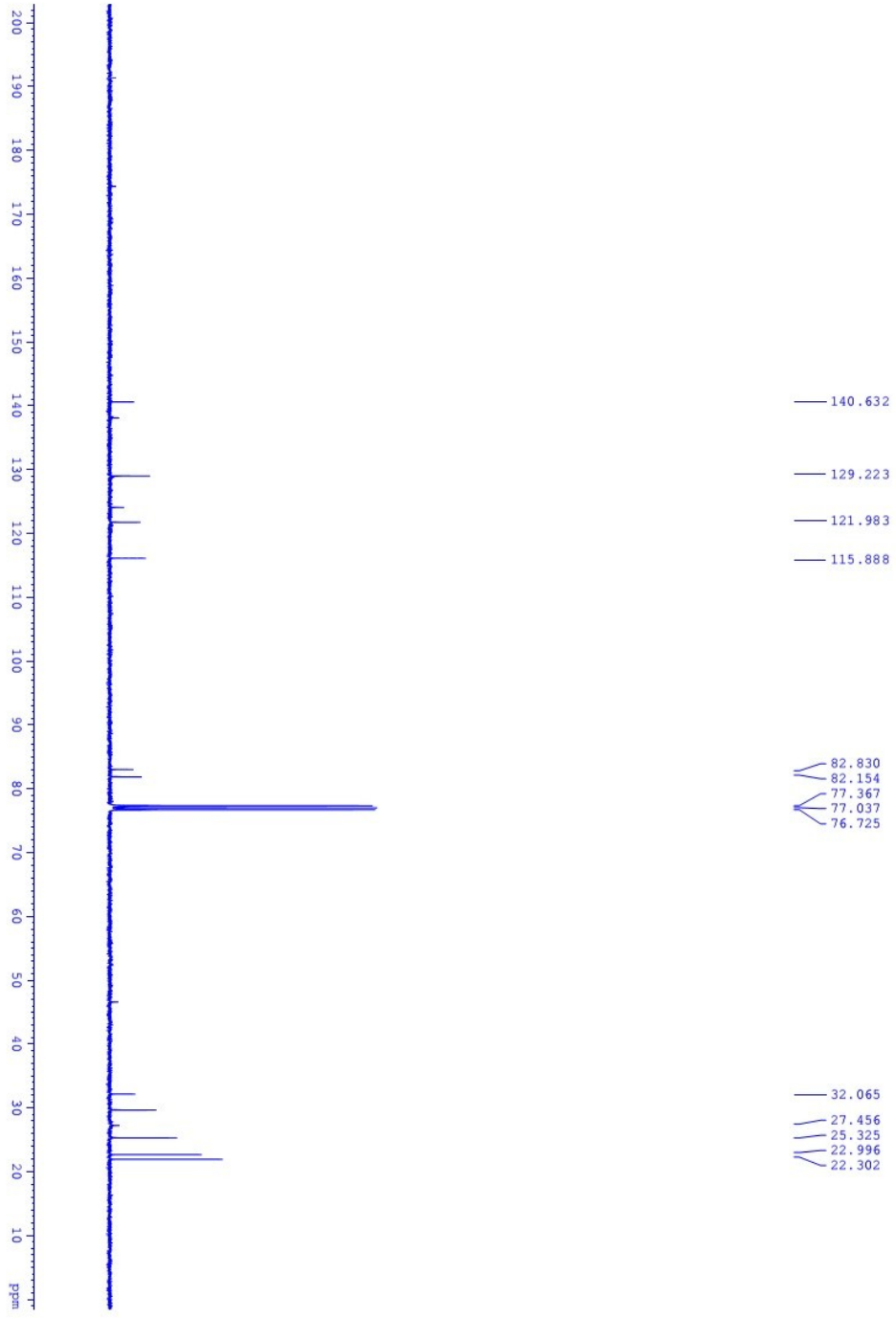
^{1}H NMR of Compound 3fa



^{13}C NMR of Compound 3fa



^{1}H NMR of Compound 4



^{13}C NMR of Compound 4