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# Direct, rapid, solvent-free conversion of unactivated esters to amides using lithium hydroxide as a catalyst

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## Key to Abbreviated Terms:

| | |
|---|---|
| $CDCl_3$: | deuterated chloroform |
| DCM: | dichloromethane |
| EtOAc: | ethyl acetate |
| Hex: | hexanes |

## General Considerations:

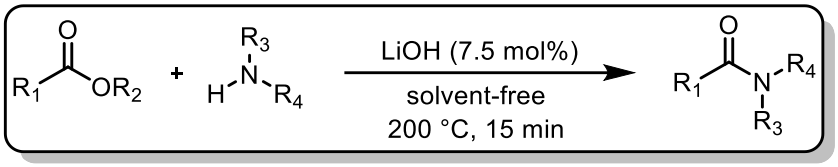
### General:

Reactions were performed using a CEM Discover microwave unit. NMR Spectra (1H, 13C) were performed at 298 K on either a Brüker Avance Ultra Shield 300 MHz NMR, Brüker DRX-400 400 MHz NMR, or Brüker Avance 500 MHz NMR. $^{1}$H-NMR Spectra obtained in $CDCl_3$ were referenced to residual non-deuterated chloroform (7.26 ppm) in the deuterated solvent. $^{13}$C- NMR Spectra obtained in $CDCl_3$ were referenced to chloroform (77.3 ppm). Flash chromatography and silica plugs utilized Dynamic Adsorbents Inc. Flash Silica Gel (60Å porosity, 32-63 μm).

### Chemicals:

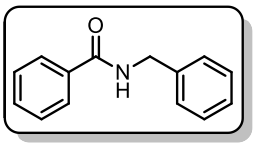
Deuterated chloroform was purchased from Cambridge Isotope Laboratories and stored over 4Å molecular sieves. Ethyl benzoate, benzylamine, pyrrolidine, and cyclohexylamine were purchased from Sigma-Aldrich. Lithium hydroxide and 1,2,3,4-tetrahydroisoquinoline were purchased from Acros Organic. Ethyl-*p*-nitrobenzoate, ethyl-4-bromobenzoate, *n*-octylamine, and δ-valerolactone were purchased from Alfa Aesar. Aniline was purchased from Fisher Scientific. Ethyl-4-(trifluoromethyl)benzoate and 4-methoxybenzylamine were purchased from Oakwood Chemicals. Ethyl hexanoate and benzyl benzoate were purchased from Chem Service.

# Synthesis of Amides



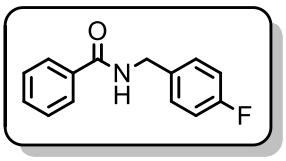

## TYPICAL PROCEDURE

### *N*-Benzylbenzamide (3a)



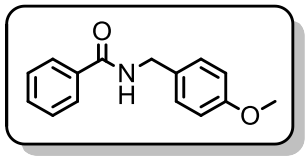
To a 10-mL capacity glass microwave tube equipped with a stir bar was added ethyl benzoate (0.75 g, 5 mmol, 1 equiv), benzylamine (0.80 g, 7.5 mmol, 1.5 equiv), and lithium hydroxide (0.009 g, 0.375 mmol, 0.075 equiv). The tube was sealed with a septum and placed into the microwave cavity. The reaction mixture was heating to 200 °C using an initial microwave power of 200 W and setting a pressure cut-off of 250 psi for safety purposes. Once at temperature, the contents of the tube were maintained at 200 °C for 30 min. After completion of the heating time, the reaction vessel was cooled to 50 °C before removing from the microwave unit. Product conversion was then determined by $^{1}$H NMR. To isolate the product, the contents of the tube were triturated with hexanes, filtered through a fritted funnel, and washed with more hexanes. The solid precipitate was dissolved in EtOAc and filtered through a pad of Celite. The ethyl acetate was removed *in vacuo* by rotary evaporation to afford the pure amide product, *N*-benzyl benzamide as a white solid (0.823 g, 78%).[1-6]

**$^{1}$H NMR** (400 MHz, $CDCl_3$) δ ppm 4.56 (d, *J*=5.84 Hz, 2 H) 7.26 - 7.32 (m, 5 H) 7.35 (t, *J*=7.59 Hz, 2 H) 7.46 (t, *J*=1.00 Hz, 1 H) 7.81 (d, *J*=7.79 Hz, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 44.01 ($CH_2$) 127.24 (CH) 127.45 (CH) 127.82 (CH) 128.56 (CH) 128.72 (CH) 131.52 (CH) 134.48 (C) 138.56 (C) 167.73 (C)



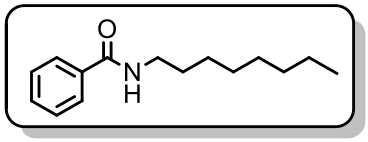
***N*-(4-Fluorobenzyl) benzamide (3b)** (0.915 g, 80%) was prepared from 4-fluorobenzylamine and ethyl benzoate using the typical procedure. The crude compound was filtered through a silica plug with a gradient of 9:1 Hex: EtOAc then 1:1 Hex: EtOAc basified with 10% triethylamine as the eluent to afford the product as a brown solid.[5]

**$^{1}$H NMR** (400 MHz, $CDCl_3$) δ ppm 4.56 (d, *J*=5.76 Hz, 2 H) 6.77 (br. s., 1 H) 6.99 (tt, *J*=1.00 Hz, 2 H) 7.26 - 7.33 (m, 2 H) 7.35 - 7.44 (m, 2 H) 7.49 (tt, *J*=1.00 Hz, 1 H) 7.74 - 7.82 (m, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 43.55 ($CH_2$) 115.61 - 115.96 (d, $J_{C\text{-}C\text{-}F}$=1.00 Hz, CH) 127.24 (CH) 128.82 (CH) 129.74 (d, $J_{C\text{-}C\text{-}C\text{-}F}$=8.09 Hz. CH) 131.85 (CH) 134.36 (d, $J_{C\text{-}C\text{-}C\text{-}C\text{-}F}$=8.09 Hz, C) 134.49 (C) 161.15 - 163.70 (d, $J_{C\text{-}F}$=1.00 Hz, C) 167.69 (C)



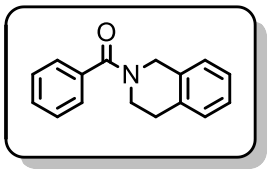
***N*-(4-Methoxybenzyl)-benzoylamide (3c)** (0.974 g, 81%) was prepared from 4-methoxybenzylamine and ethyl benzoate using the typical procedure. The crude compound was filtered through a silica plug with a gradient of 9:1 Hex: EtOAc then 1:1 Hex: EtOAc basified with 10% triethylamine as the eluent to afford the product as a white solid.[5]

**$^1$H NMR** (400 MHz, $CDCl_3$) δ ppm 3.79 (s, 3 H) 4.56 (d, *J*=5.21 Hz, 2 H) 6.75 (br. s., 1 H) 6.87 (d, *J*=8.42 Hz, 2 H) 7.27 (d, *J*=8.27 Hz, 2 H) 7.40 (t, *J*=1.00 Hz, 2 H) 7.49 (t, *J*=1.00 Hz, 1 H) 7.79 (q, *J*=1.00 Hz, 1 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 43.71 ($CH_2$) 55.41 ($CH_3$) 114.26 (2 x CH) 127.17 (CH) 128.67 (CH) 129.39 (CH) 130.53 (C) 131.60 (CH) 134.59 (C) 159.20 (C) 167.55 (C)



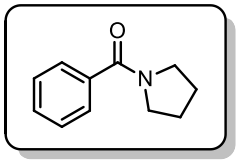
***N*-Octylbenzamide (3d)** (0.949 g, 81%) was prepared from *n*-octylamine and ethyl benzoate using the typical procedure. The crude compound was filtered through a silica plug with a gradient of 95:5 Hex: EtOAc then 1:1 Hex: EtOAc basified with 1% triethylamine as the eluent to afford the product as a white solid.[7]

**$^1$H NMR** (400 MHz, $CDCl_3$) δ ppm 0.79 - 0.94 (m, 3 H) 1.14 - 1.43 (m, 10 H) 1.52 - 1.66 (m, 2 H) 3.36 - 3.48 (m, 2 H) 6.34 (br. s., 1 H) 7.31 - 7.51 (m, 3 H) 7.69 - 7.82 (m, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 14.22 ($CH_3$) 22.78 ($CH_2$) 27.19 ($CH_2$) 29.37 ($CH_2$) 29.46 ($CH_2$) 29.81 ($CH_2$) 31.94 ($CH_2$) 40.31 ($CH_2$) 127.13 (CH) 128.52 (CH) 131.29 (CH) 135.03 (C) 167.78 (C)



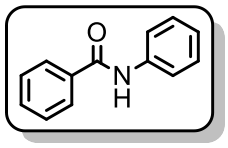
**2-Benzoyl-1,2,3,4-tetrahydroisoquinoline (3e)** (0.693 g, 58%) was prepared was prepared from 1,2,3,4-tetrahydroisoquinoline and ethyl benzoate using the typical procedure. The crude product was triturated with a 3:1 hex: EtOAc mixture, filtered through a fritted funnel, and washed with more hexanes. The solid precipitate was dissolved in EtOAc and filtered through a pad of Celite. The ethyl acetate was removed *in vacuo* by rotary evaporation to afford the pure amide product to afford 2-benzoyl-1,2,3,4-tetrahydro-isoquinoline as a white solid.[2]

**$^1$H NMR** (400 MHz, $CDCl_3$) δ ppm 3.05 (br. s., 2 H) 3.44 (br. s., 2 H) 4.34 (br. s., 2 H) 7.02 - 7.45 (m, 7 H) 7.84 (d, *J*=5.50 Hz, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 26.23 ($CH_2$) 41.51 ($CH_2$) 44.75 ($CH_2$) 126.96 (CH) 127.63 (CH) 127.96 (CH) 129.23 (CH) 129.48 (CH) 129.91 (CH) 130.85 (C) 132.57 (C) 136.26 (1 C) 173.92 (C)



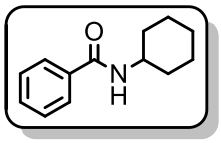
***N*-Benzoylpyrrolidine (3f)** (0.607 g, 70%) was prepared from pyrrolidine and ethyl benzoate using the typical procedure. The crude compound was filtered through a silica plug with a gradient of 9:1 Hex: EtOAc then 1:1 Hex: EtOAc basified with 10% triethylamine as the eluent to afford the product as a brown oil.[2]

**$^1$H NMR** (400 MHz, $CDCl_3$) δ ppm 1.72 (q, *J*=1.00 Hz, 2 H) 1.81 (q, *J*=1.00 Hz, 2 H) 3.28 (t, *J*=6.59 Hz, 2 H) 3.51 (t, *J*=6.93 Hz, 2 H) 7.26 - 7.31 (m, 3 H) 7.38 - 7.44 (m, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 24.31 ($CH_2$) 26.26 ($CH_2$) 46.01 ($CH_2$) 49.43 ($CH_2$) 126.94 (CH) 128.09 (CH) 129.60 (C) 137.18 (C)



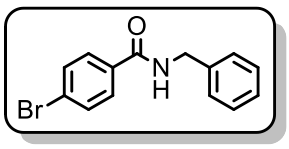
**Benzoylaminobenzene (3g)** (0.067 g, 7%) was prepared from aniline and ethyl benzoate using the typical procedure. The crude compound was triturated with hexanes, filtered through a fritted funnel, and washed with more hexanes. The solid precipitate was dissolved in EtOAc and filtered through a pad of Celite. The solvent was removed *in vacuo* by rotary evaporation to afford the product as a white solid.[7]

**$^1$H NMR** (400 MHz, $CDCl_3$) δ ppm 7.11 - 7.20 (m, 1 H) 7.38 (t, *J*=7.90 Hz, 2 H) 7.45 - 7.60 (m, 3 H) 7.65 (d, *J*=7.74 Hz, 2 H) 7.82 (br. s., 1 H) 7.84 - 7.92 (m, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 120.51 (CH) 124.84 (CH) 127.30 (CH) 129.05 (CH) 129.36 (CH) 132.10 (CH) 135.29 (C) 138.22 (C) 166.05 (C)



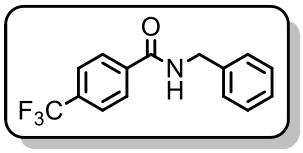
***N*-Cyclohexylbenzamide (3h)** (24% by $^1$H NMR) was prepared from cyclohexylamine and ethyl benzoate using the typical procedure. The crude compound was triturated with hexanes, filtered through a fritted funnel, and washed with more hexanes. The solid precipitate was dissolved in EtOAc and filtered through a pad of Celite. The solvent was removed *in vacuo* by rotary evaporation to afford the product as a tan solid.[7]

**$^1$H NMR** (400 MHz, $CDCl_3$) δ ppm 1.14 - 1.31 (m, 3 H) 1.36 - 1.50 (m, 2 H) 1.65 (dt, *J*=12.94, 3.80 Hz, 1 H) 1.75 (dt, *J*=13.66, 3.73 Hz, 2 H) 1.99 - 2.09 (m, 2 H) 3.91 - 4.04 (m, 1 H) 5.97 (br. s., 1 H) 7.33 - 7.52 (m, 3 H) 7.69 - 7.79 (m, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 25.01 - 25.32 ($CH_2$) 25.79 ($CH_2$) 33.42 ($CH_2$) 48.92 (CH) 127.09 (CH) 128.68 (CH) 131.40 (CH) 135.34 (C) 166.87 (C)



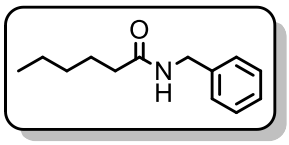
***N*-Benzyl-4-bromobenzamide (3j)** (0.906 g, 62%) was prepared from benzylamine and ethyl-4-bromobenzoate using the typical procedure. The crude compound was filtered through a silica plug with a gradient of 9:1 then 6:4 Hex: EtOAc as the eluent to afford the product as a white solid.[5]

**$^1$H NMR** (400 MHz, $CDCl_3$) δ ppm 4.60 (d, *J*=5.35 Hz, 2 H) 6.59 (br. s., 1 H) 7.29 - 7.40 (m, 5 H) 7.53 (d, *J*=8.08 Hz, 2 H) 7.65 (d, *J*=8.08 Hz, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 44.46 ($CH_2$) 127.96 (C) 128.17 (CH) 128.89 (CH) 129.07 (CH) 132.05 (CH) 133.45 (C) 138.21 (C) 166.70 (C)



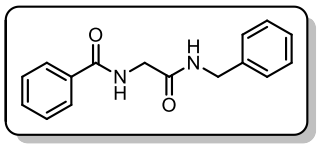
***N*-benzyl-4-(trifluoromethyl) benzamide (3k)** (1.082 g, 78%) was prepared from was prepared from benzylamine and ethyl-4-trifluoromethylbenzoate using the typical procedure.. The crude compound was triturated with hexanes, filtered through a fritted funnel, and washed with more hexanes. The solid precipitate was dissolved in EtOAc and filtered through a pad of Celite. The solvent was removed *in vacuo* by rotary evaporation to afford the product as a white solid.[5]

**$^1$H NMR** (400 MHz, $CDCl_3$) δ ppm 4.63 (d, *J*=5.69 Hz, 2 H) 6.64 (br. s., 1 H) 7.29 - 7.38 (m, 5 H) 7.66 (d, *J*=8.17 Hz, 2 H) 7.88 (d, *J*=8.08 Hz, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 44.58 ($CH_2$) 125.91 (q, *J*=3.70 Hz, 1 $CF_3$) 127.74 (CH) 128.09 (CH) 128.21 (CH) 129.15 (CH) 133.57 (d, $J_{C\text{-}C\text{-}F}$=1.00 Hz) 137.91 (C) 138.01 (C) 166.38 (C)



***N*-Benzylhexanamide (3l)** (0.593 g, 58%) was prepared from benzylamine and ethyl hexanoate using the typical procedure. The crude compound was filtered through a silica plug with a gradient of 9:1 Hex: EtOAc then 1:1 Hex: EtOAc basified with 1% triethylamine as the eluent to afford the product as a white solid.[6]

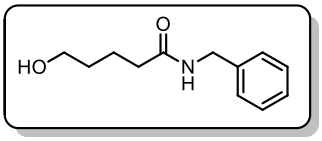
**$^1$H NMR** (400 MHz, $CDCl_3$) δ ppm 0.89 (t, *J*=6.69 Hz, 3 H) 1.23 - 1.37 (m, 4 H) 1.64 (quin, *J*=7.32 Hz, 2 H) 2.18 (t, *J*=7.61 Hz, 2 H) 4.40 (d, *J*=5.74 Hz, 2 H) 6.11 (br. s., 1 H) 7.24 (br. s., 1 H) 7.26 - 7.28 (m, 1 H) 7.28 - 7.35 (m, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 14.14 ($CH_3$) 22.60 ($CH_2$) 25.67 ($CH_2$) 31.69 ($CH_2$) 36.89 ($CH_2$) 43.69 ($CH_2$) 127.59 (CH) 127.95 (CH) 128.84 (CH) 138.74 (C) 173.33 (C)



**N-(2-(benzylamino)-2-oxoethyl)benzamide** (3o) (0.450 g, 76%) was prepared from the benzyl ester of benzoyl glycine and benzylamine using the typical procedure, but with modified conditions of 90 °C with 50 W for 30 min. The crude compound was triturated with chilled hexanes, filtered through a fritted funnel, and washed with more chilled hexanes. The solid precipitate was dissolved in DCM and filtered through a pad of Celite. The solvent was removed *in vacuo* by rotary evaporation to afford the product as a white solid.[8]

**$^1$H NMR** (400 MHz, $CDCl_3$) δ ppm 4.17 (d, *J*=5.06 Hz, 2 H) 4.43 (d, *J*=5.69 Hz, 2 H) 7.20 - 7.31 (m, 5 H) 7.38 (t, *J*=7.61 Hz, 3 H) 7.48 (t, *J*=7.37 Hz, 2 H) 7.75 (d, *J*=7.30 Hz, 2 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 43.90 ($CH_2$) 44.13 ($CH_2$) 127.43 (CH) 127.77 (CH) 127.99 (CH) 128.84 (CH) 128.94 (CH) 132.12 (CH) 133.63 (C) 138.09 (C) 168.16 (C) 169.32 (C)

**5-Hydroxy-*N*-(phenylmethyl)pentanamide (3o)** (5.404 g, 87%) was prepared from was prepared from benzylamine and δ-valerolactone using the typical procedure. The crude compound was triturated with hexanes, filtered through a fritted funnel, and washed with more hexanes. The solid precipitate was dissolved in EtOAc and filtered through a pad of Celite. The solvent was removed *in vacuo* by rotary evaporation to afford the product as a white solid.[8]




**$^{1}$H NMR** (400 MHz, $CDCl_3$) δ ppm 1.52 - 1.64 (m, 2 H) 1.69 - 1.81 (m, 2 H) 2.25 (t, *J*=7.20 Hz, 2 H) 3.62 (t, *J*=6.14 Hz, 2 H) 4.42 (d, *J*=5.70 Hz, 2 H) 6.02 (br. s., 1 H) 7.21 - 7.37 (m, 5 H)
**$^{13}$C NMR** ($CDCl_3$, 100 MHz) δ ppm 21.96 ($CH_2$) 32.26 ($CH_2$) 36.27 ($CH_2$) 43.88 ($CH_2$) 62.28 ($CH_2$) 127.78 (CH) 128.07 (CH) 128.97 (CH) 138.56 (C) 173.28 (C)

## References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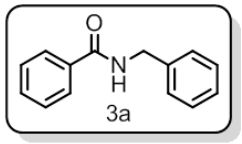
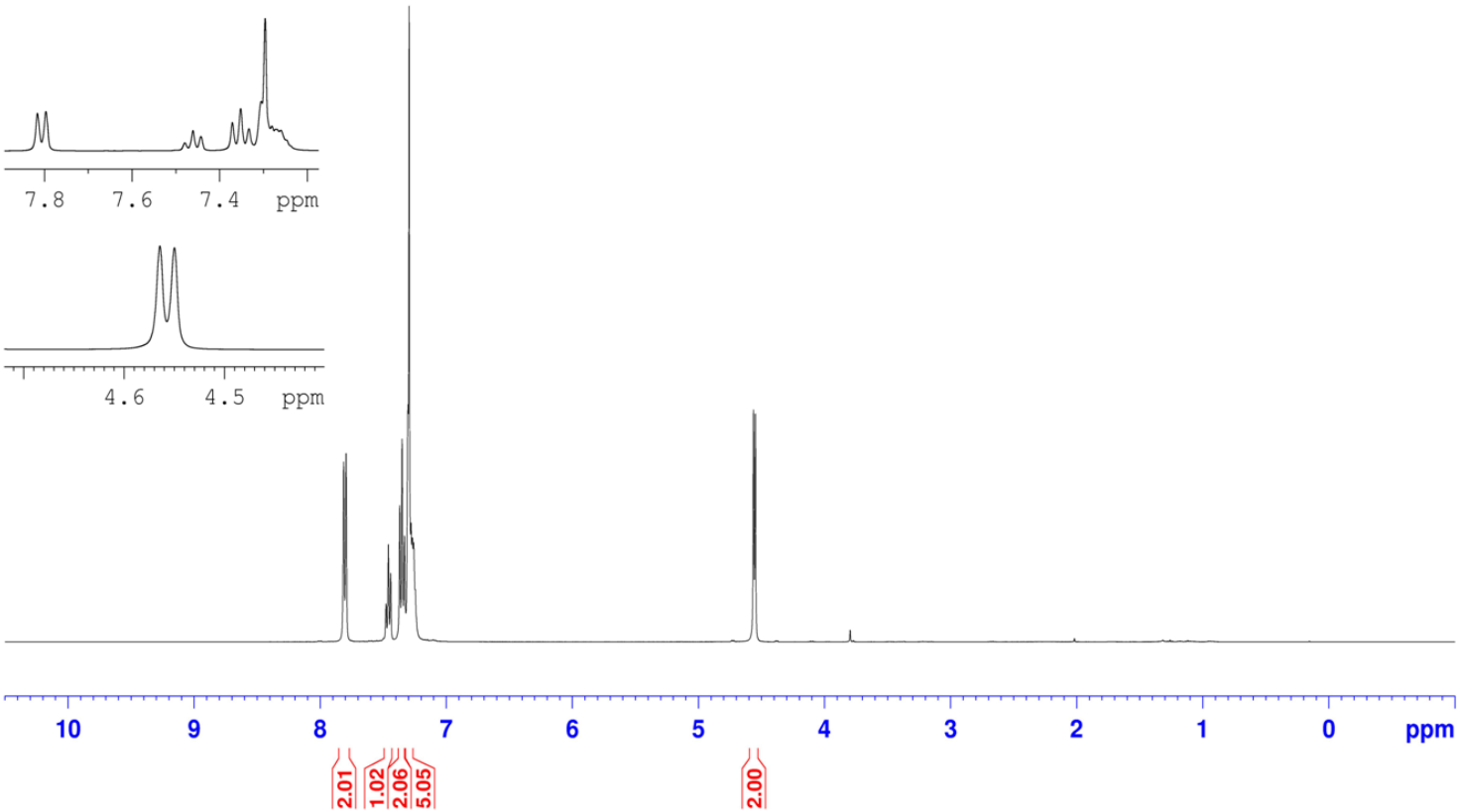
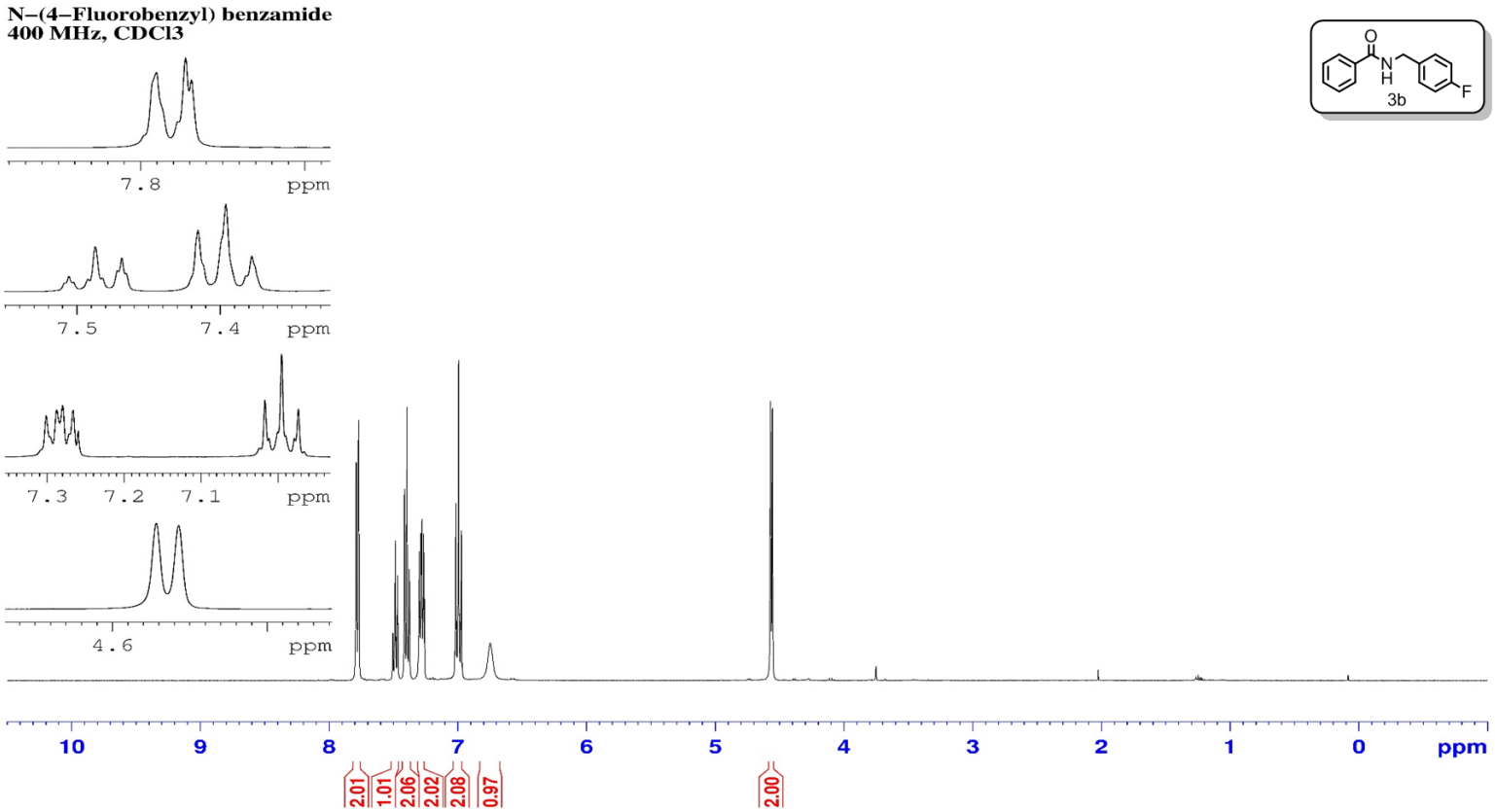
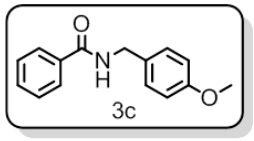
**N–Benzyl benzamide**
**400 MHz, CDCl3**

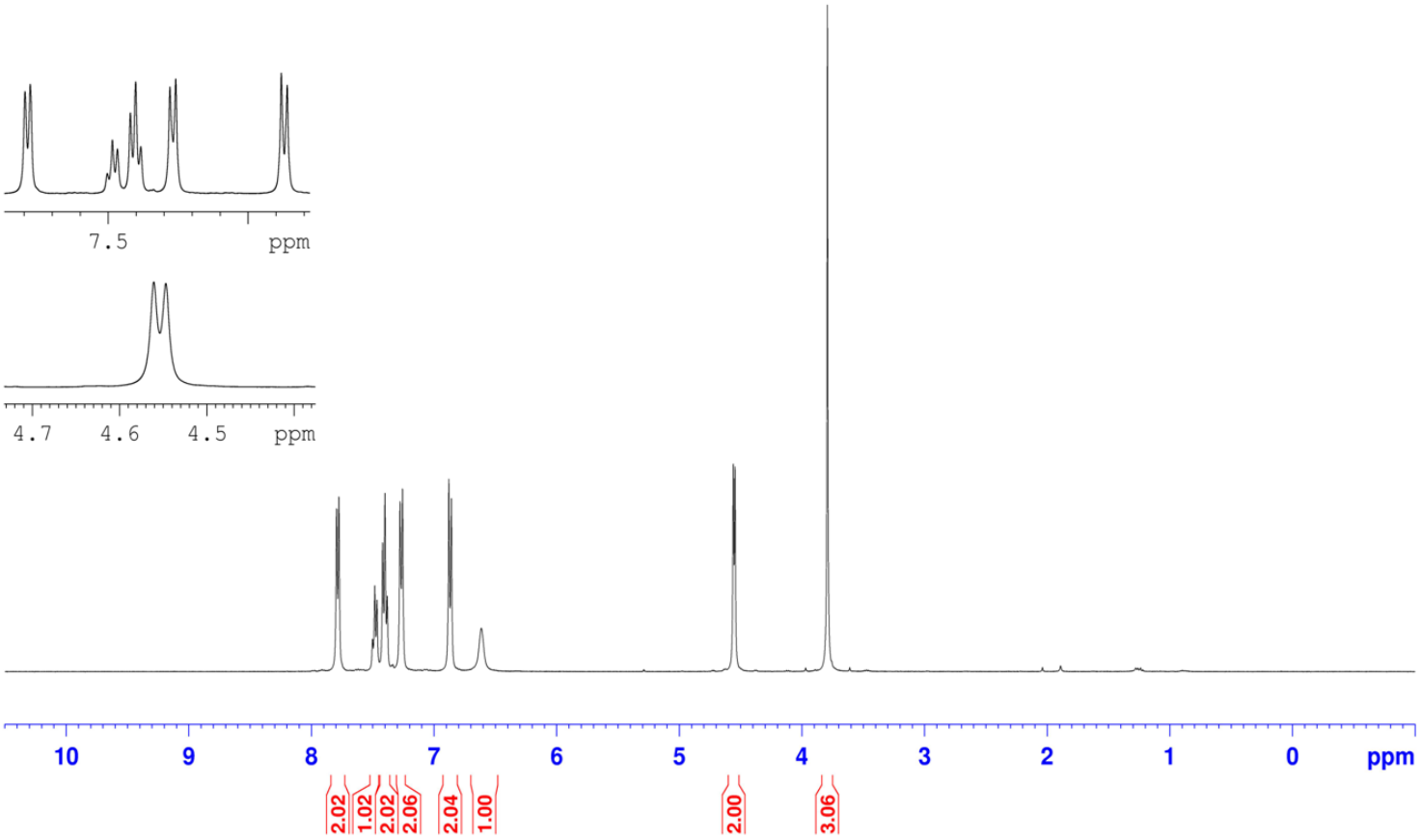


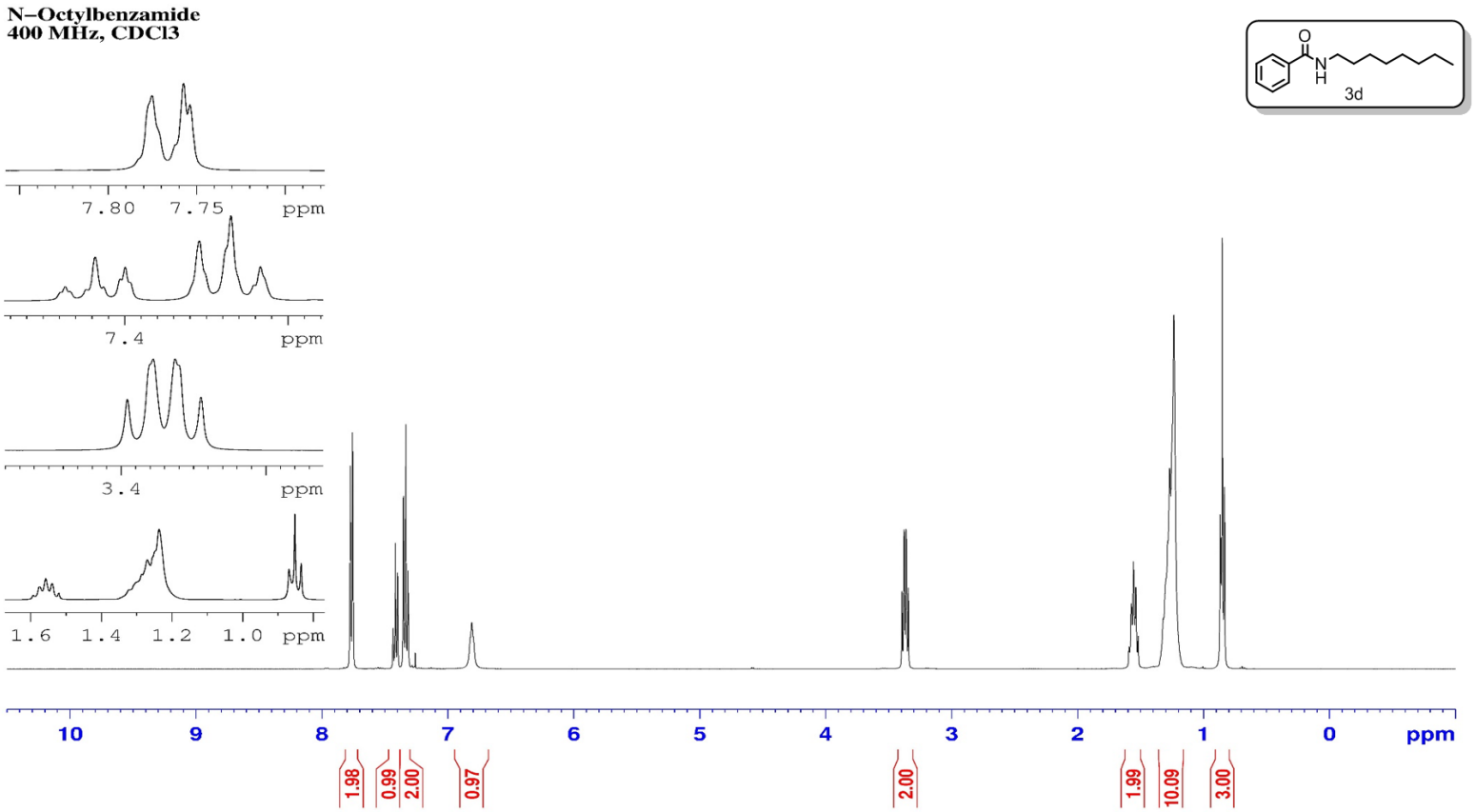




N–(4–Fluorobenzyl) benzamide
400 MHz, CDCl3
7.8
ppm
7.5
7.4
ppm
7.3
7.2
7.1
ppm
4.6
ppm
3b
10
9
8
7
6
5
4
3
2
1
0
ppm
2.01
1.01
2.06
2.02
2.08
0.97
2.00

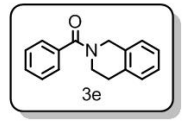
**N–(4–Methoxybenzyl)–benzoylamide**
**400 MHz, CDCl3**

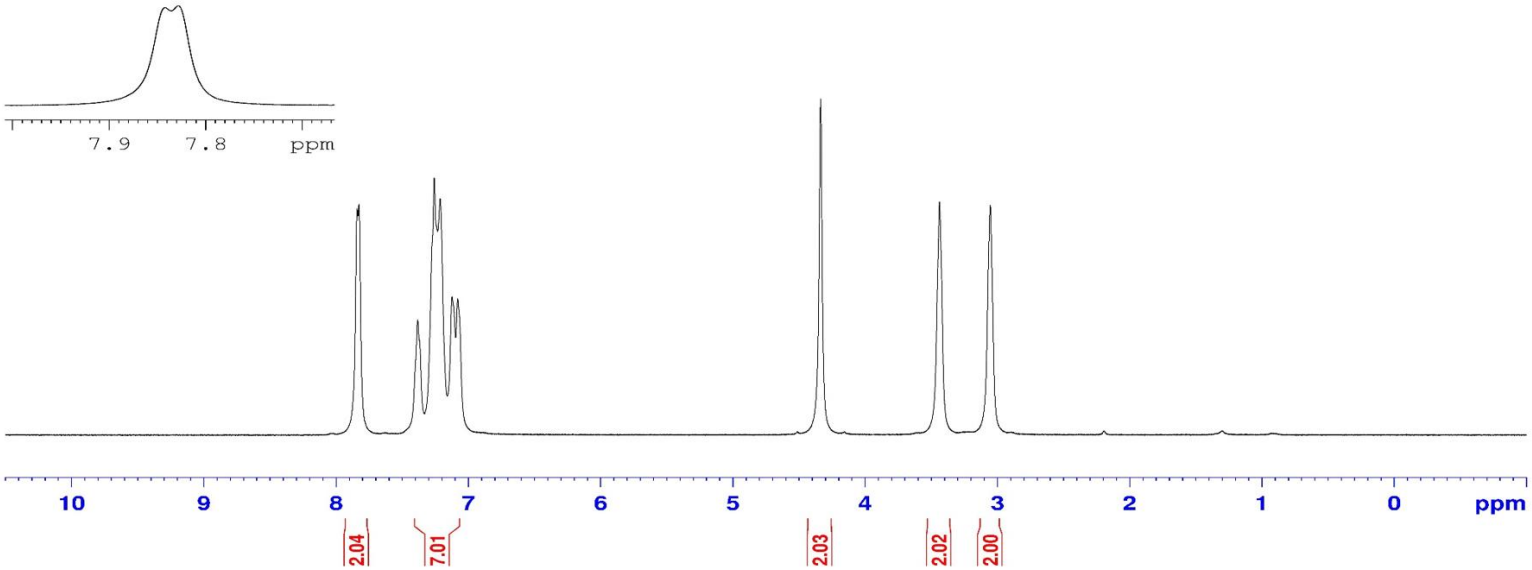


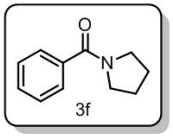

N–Octylbenzamide
400 MHz, CDCl3
3d
7.80
7.75
ppm
7.4
ppm
3.4
ppm
1.6
1.4
1.2
1.0
ppm
10
9
8
7
6
5
4
3
2
1
0
ppm
1.98
0.99
2.00
0.97
2.00
1.99
10.09
3.00

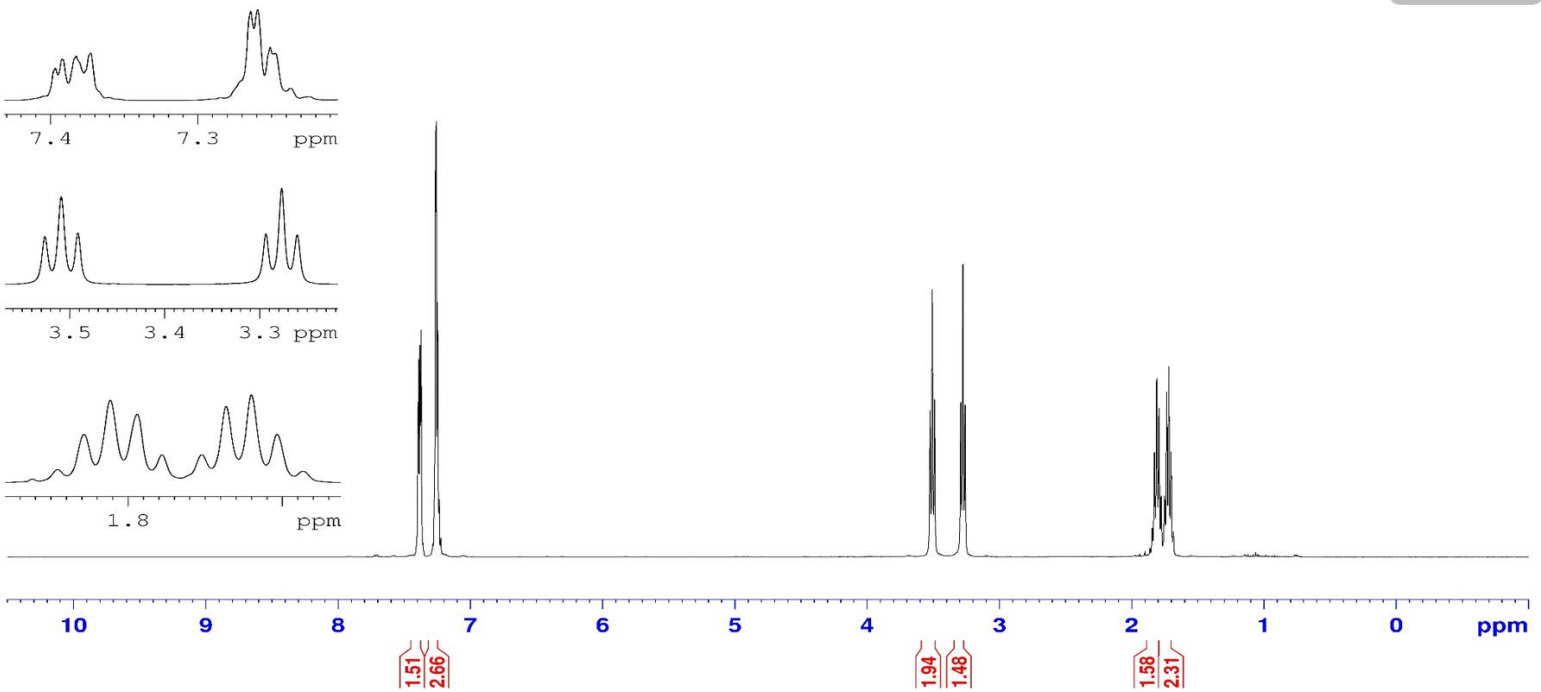
**2–Benzoyl–1,2,3,4–tetrahydroisoquinoline**
**400 MHz, CDCl3**



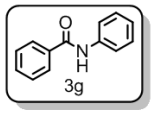



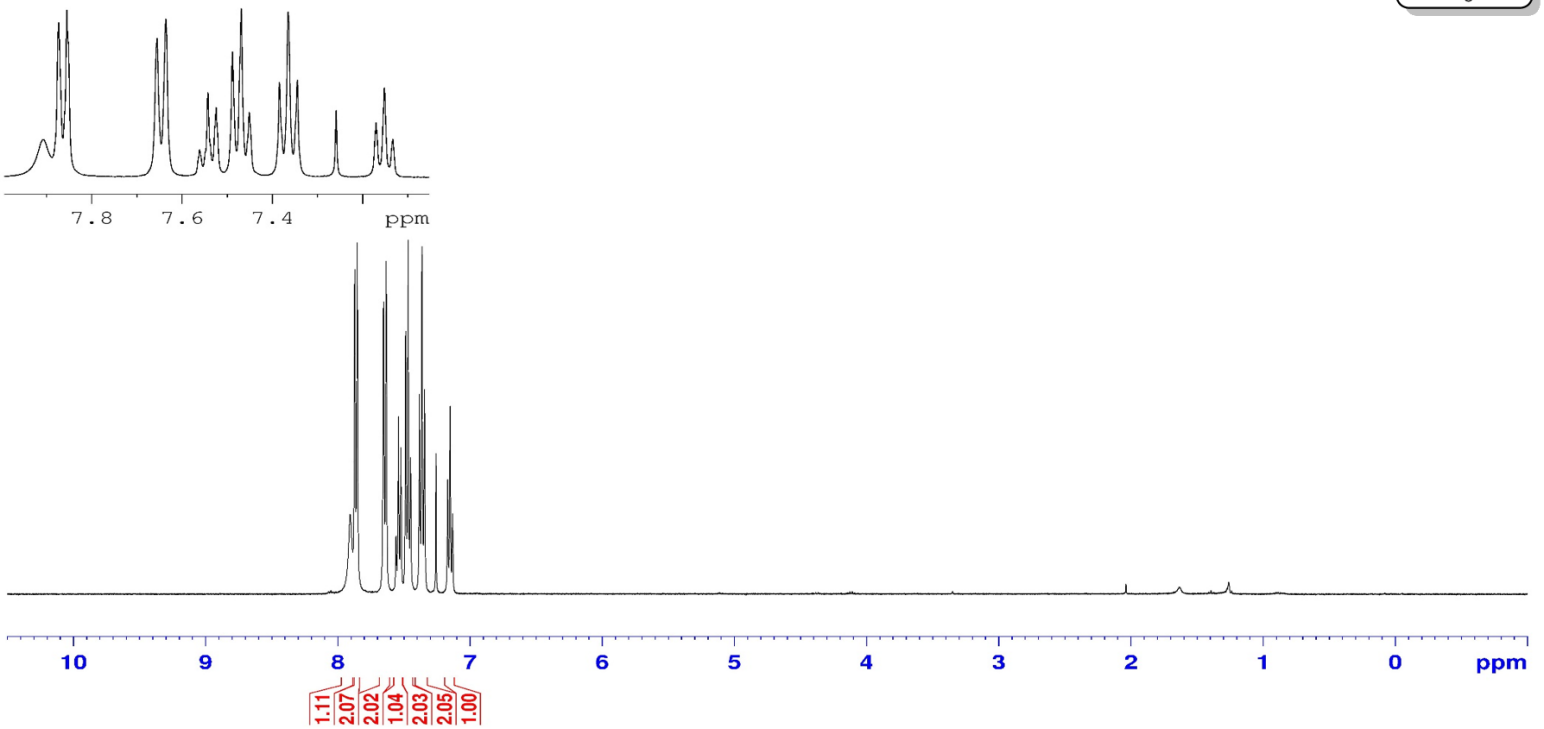
**N–Benzoylpyrrolidine**
**400 MHz, CDCl3**



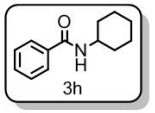



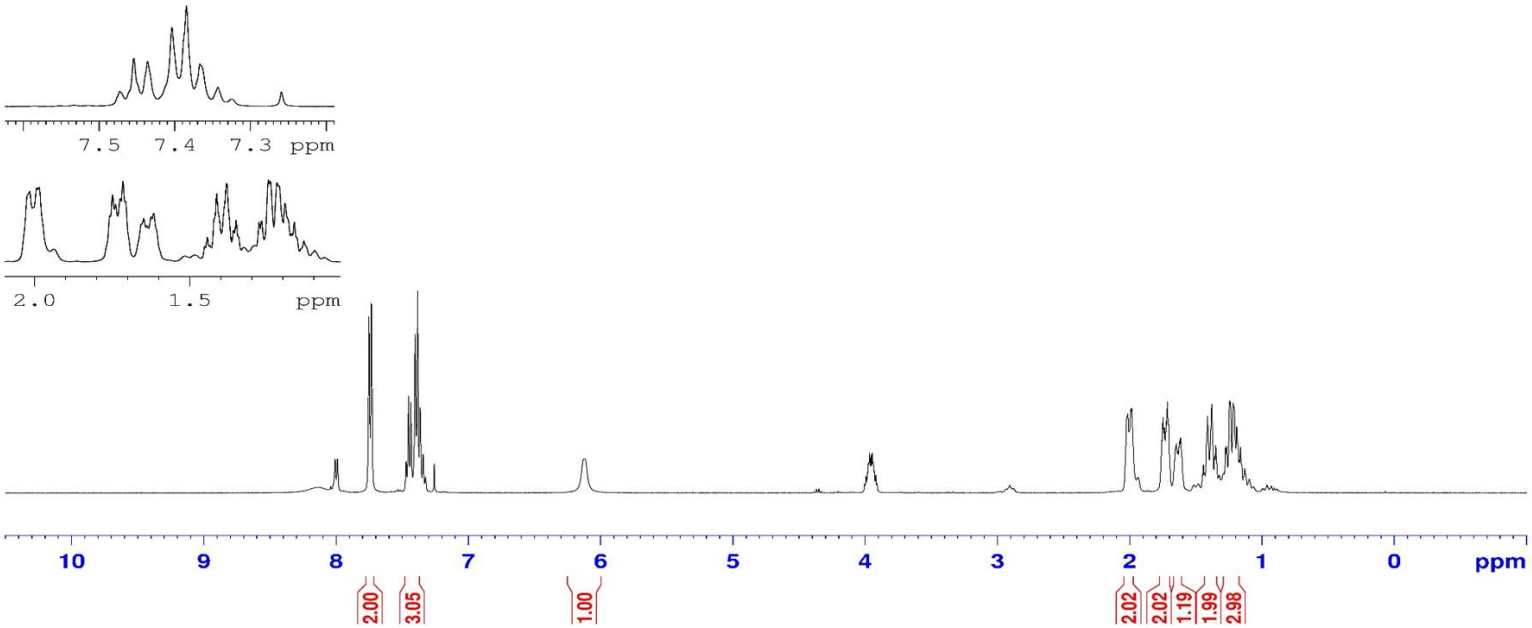
**Benzoylaminobenzene**
**400 MHz, CDCl3**



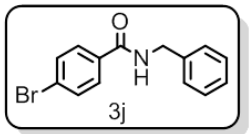



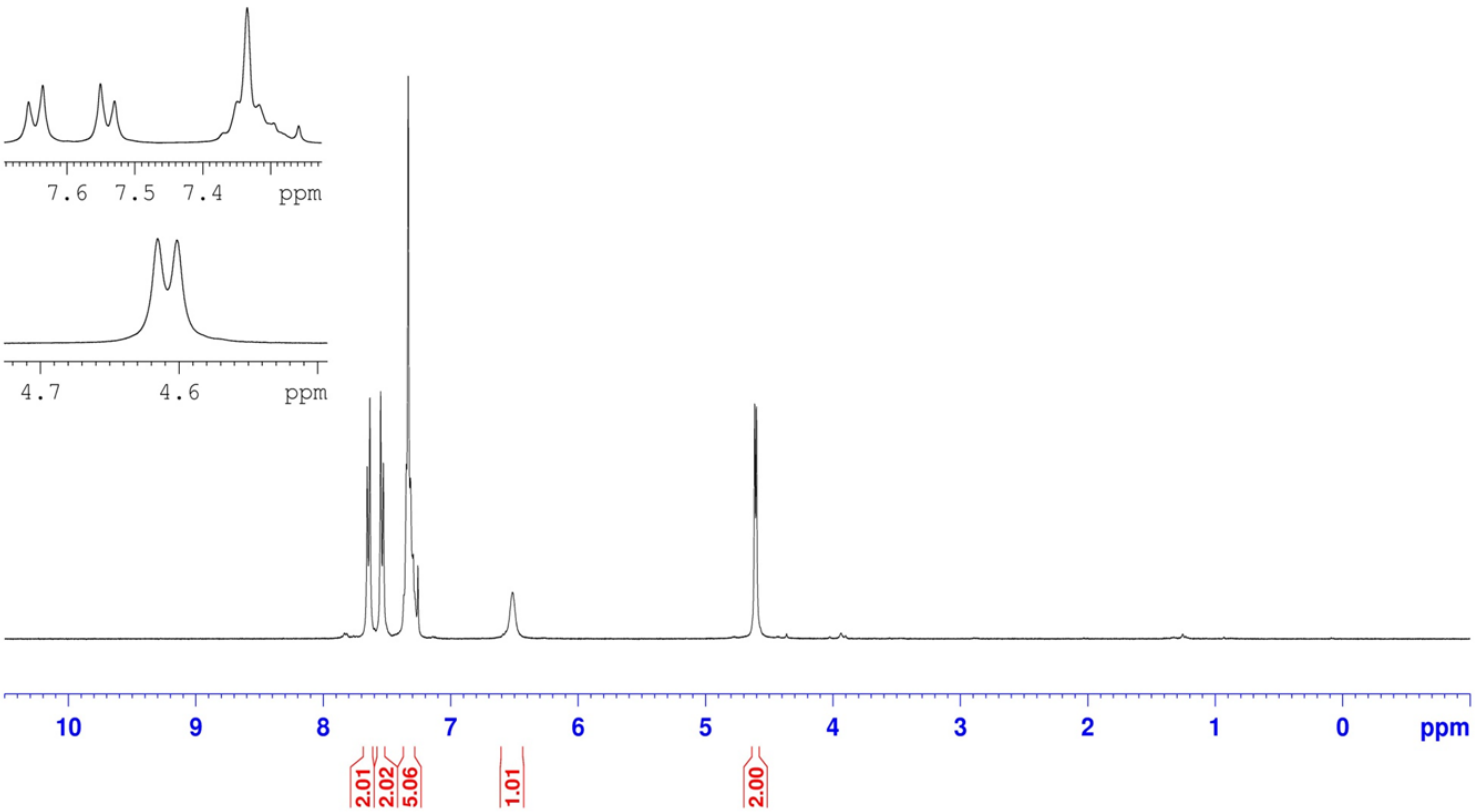
**N–Cyclohexylbenzamide**
**400 MHz, CDCl3**



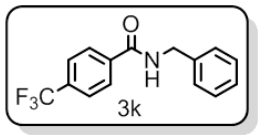



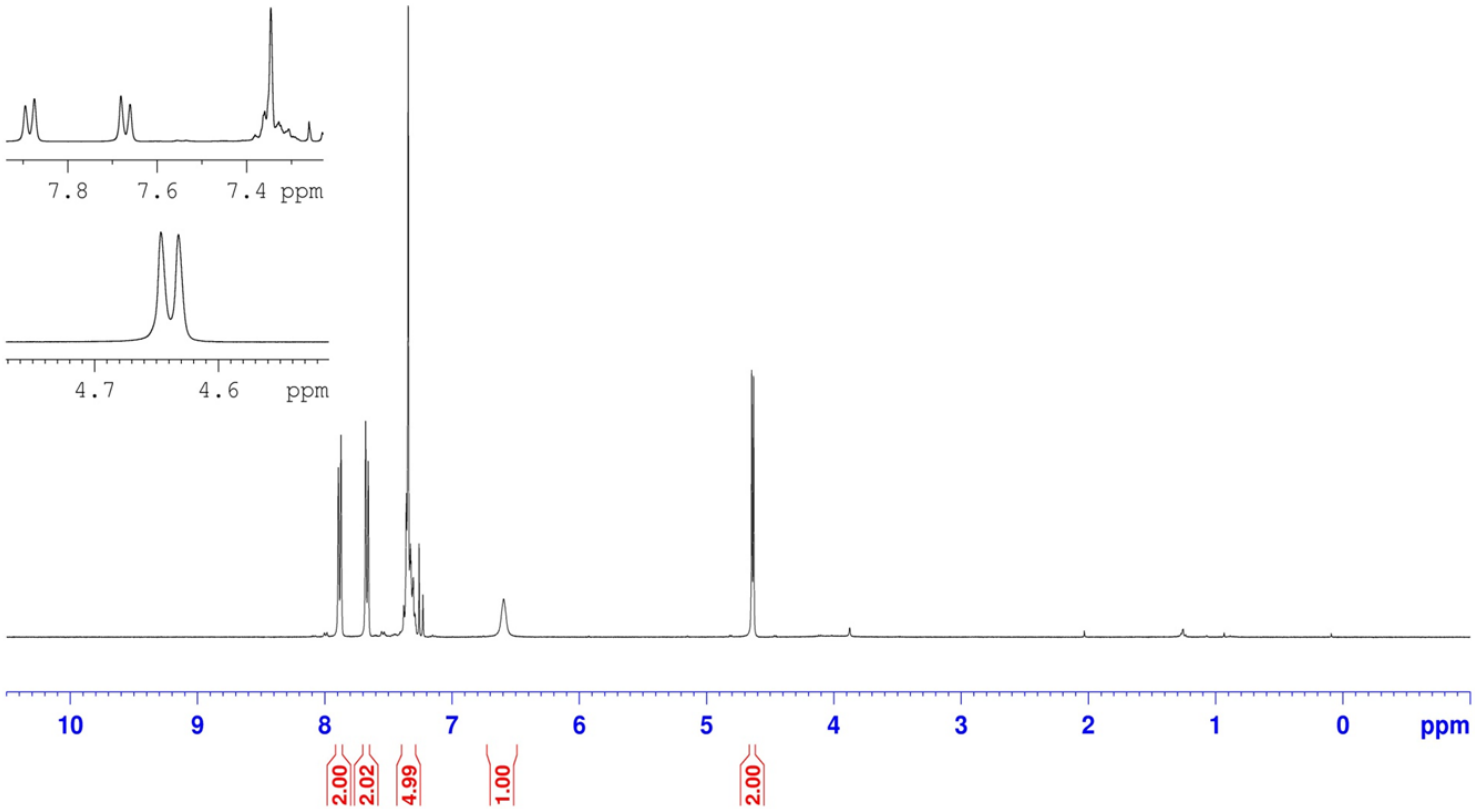
**N–Benzyl–4–bromo–benzamide**
**400 MHz, CDCl3**



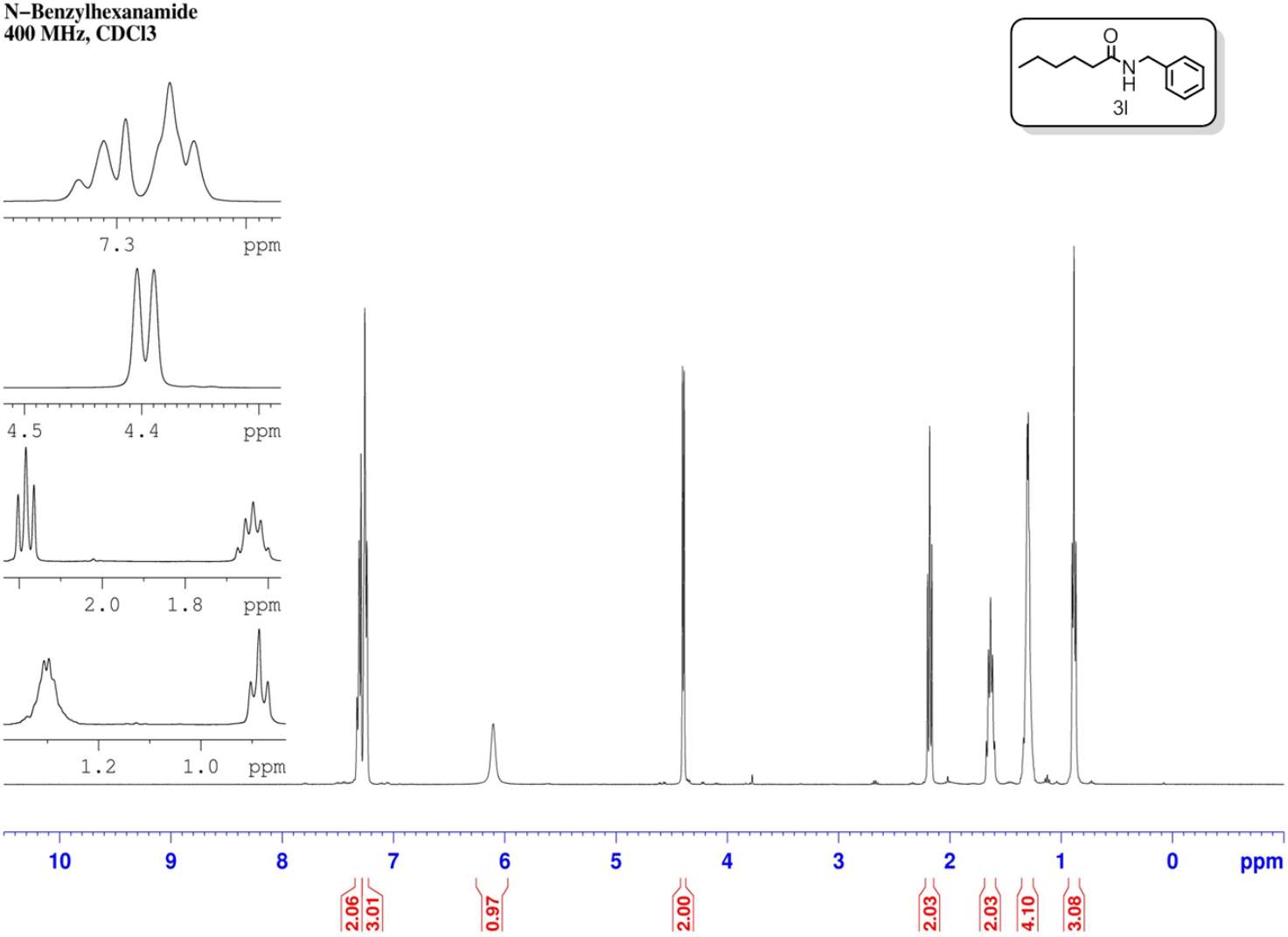



**N–Benzyl–4–(trifluoromethyl) benzamide**
**400 MHz, CDCl3**



**N–Benzylhexanamide**
**400 MHz, CDCl3**

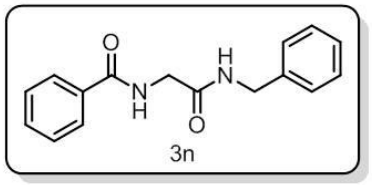


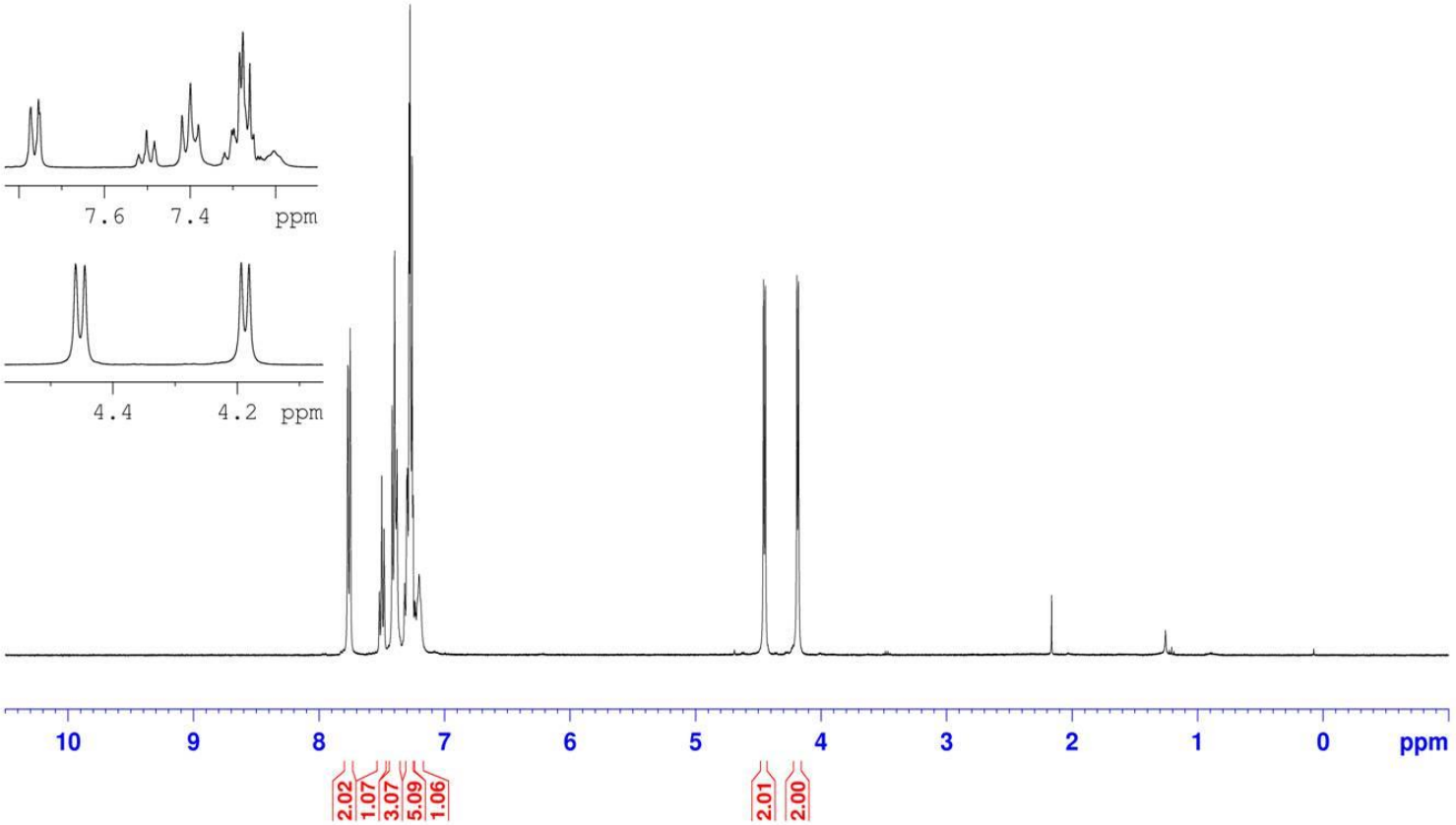




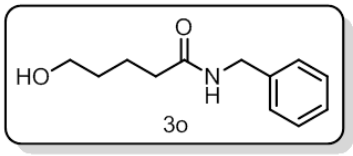
3l

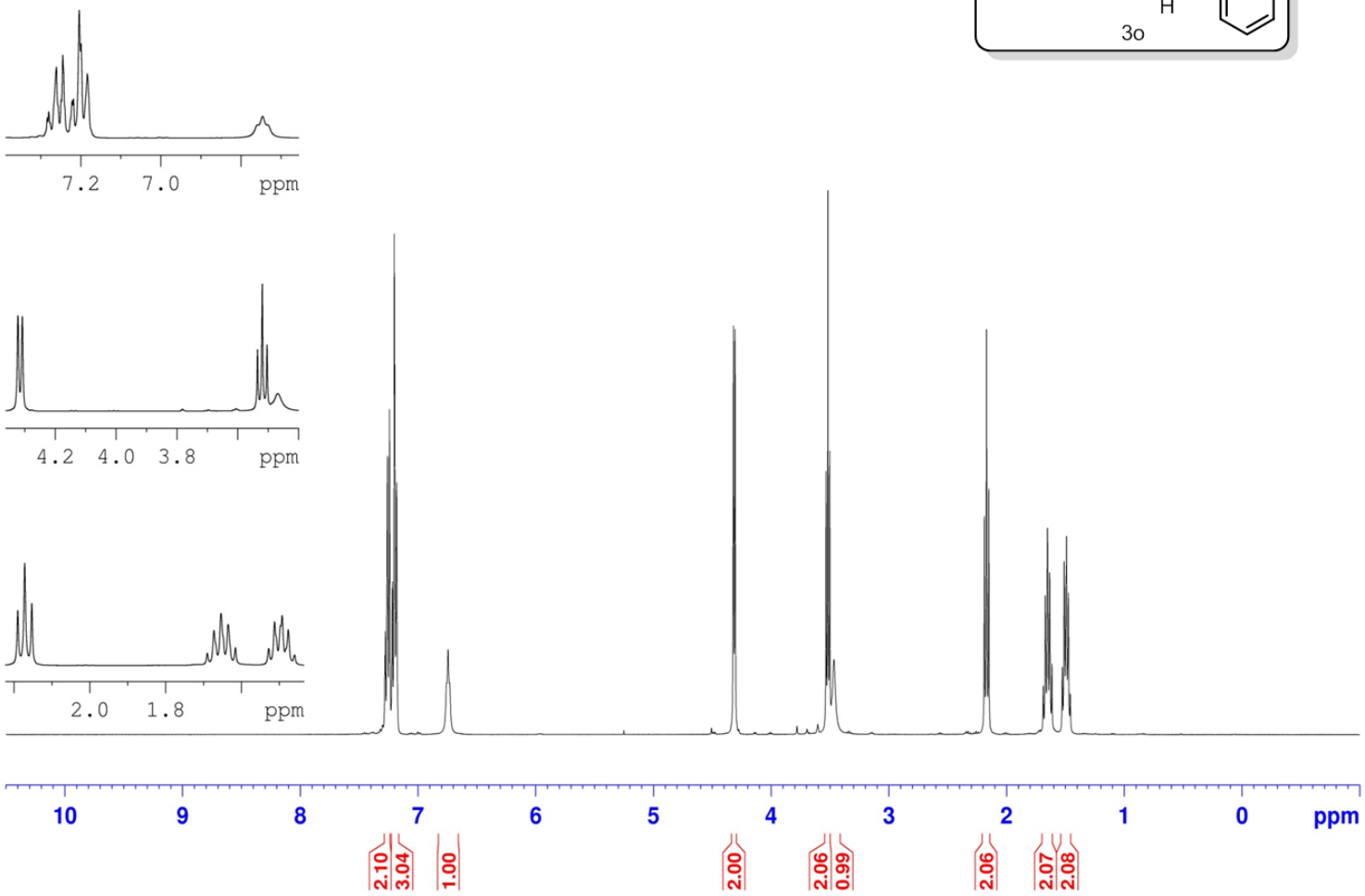
**N–(2–(benzylamino)–2–oxoethyl)benzamide**
**400MHz, CDCl3**

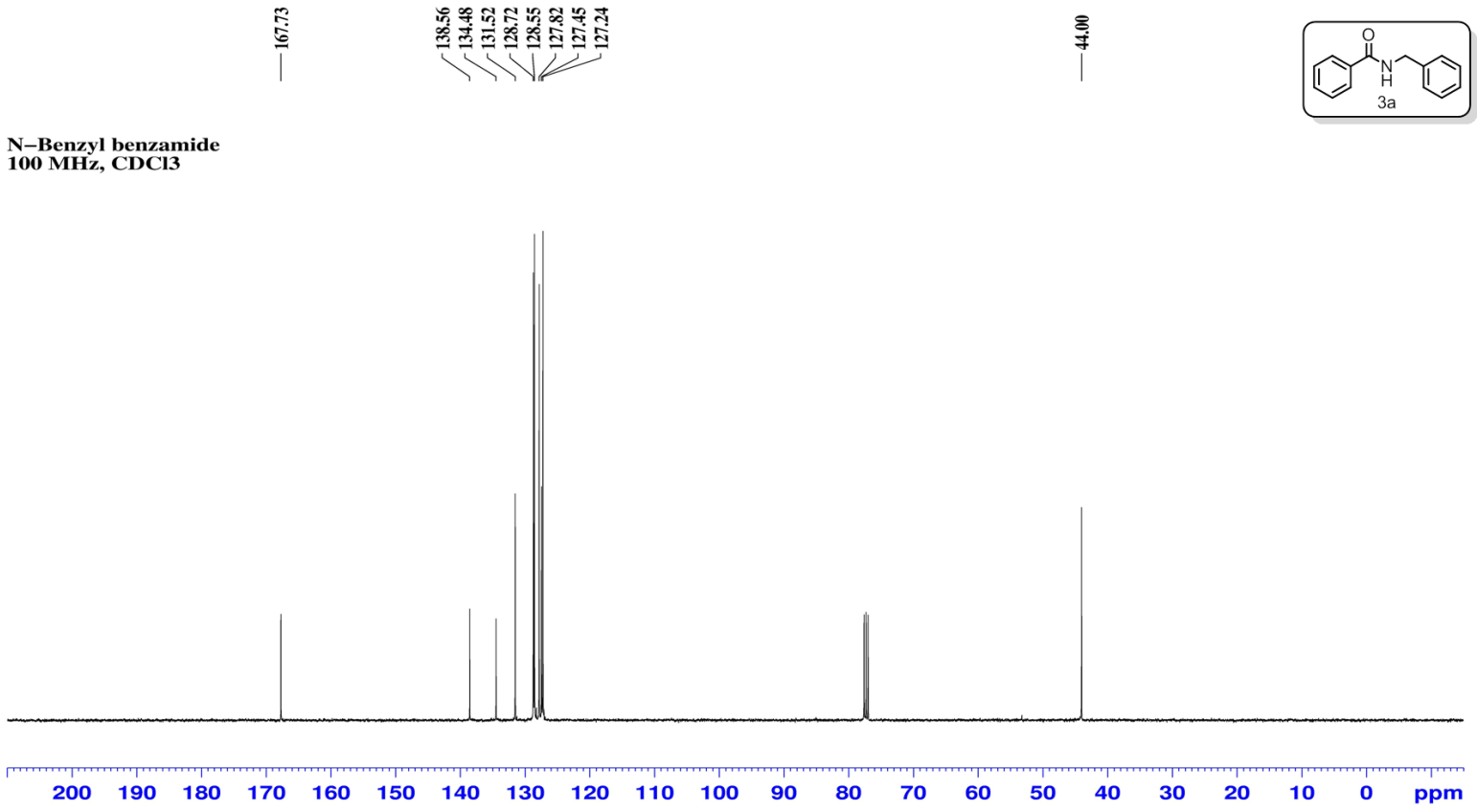


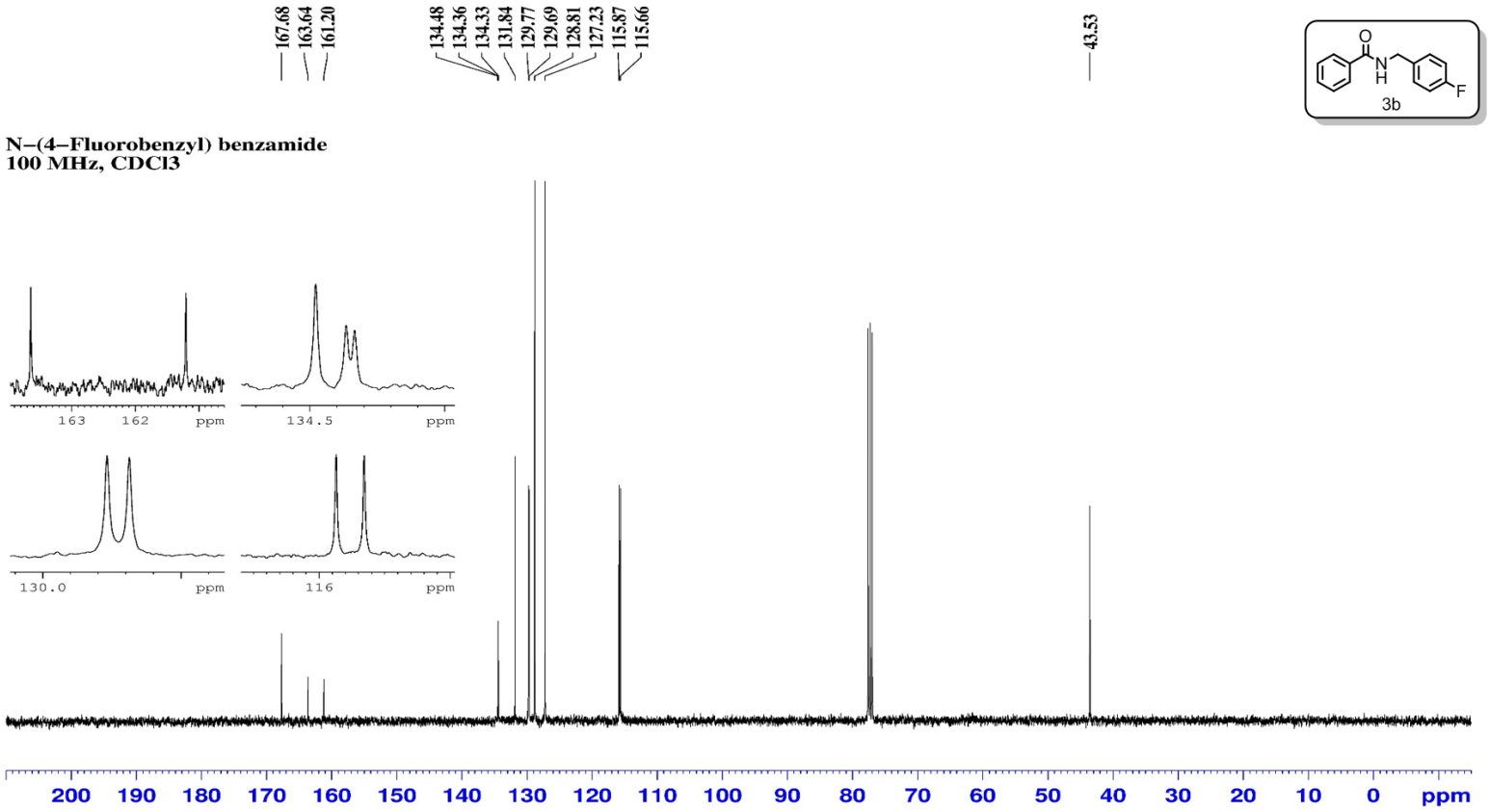



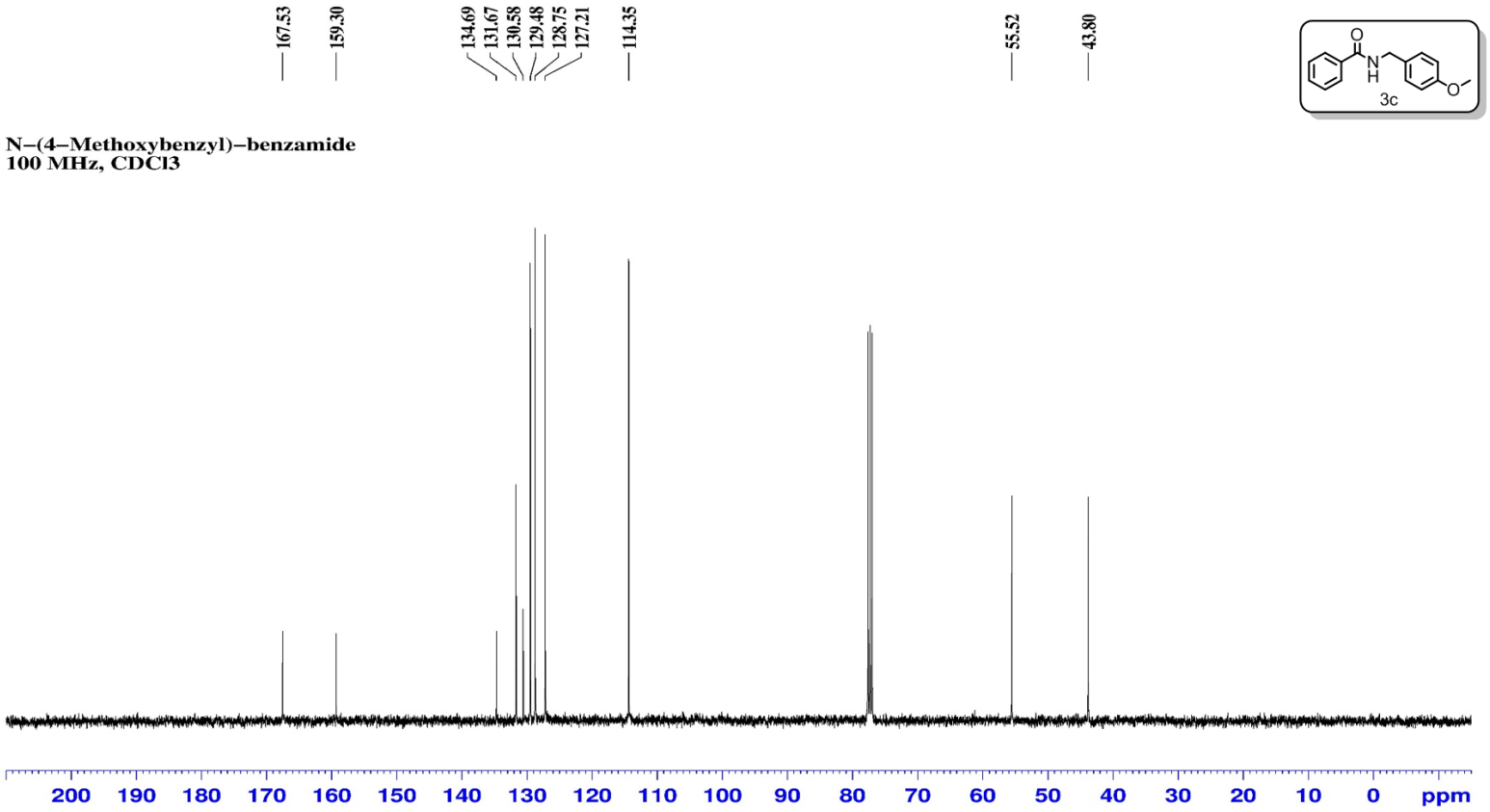
**5–Hydroxy–N–(phenylmethyl)pentanamide**
**400 MHz, CDCl3**

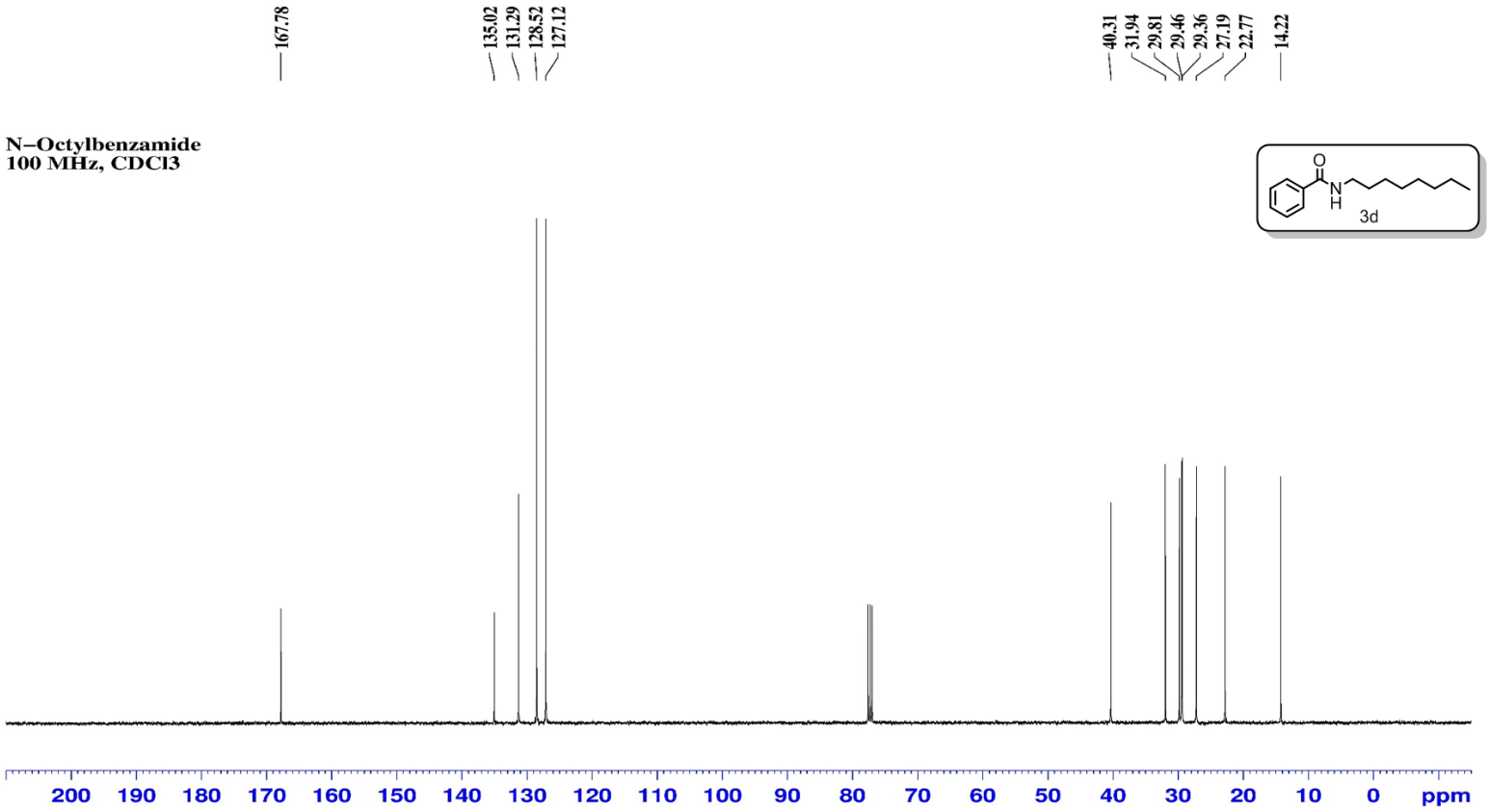


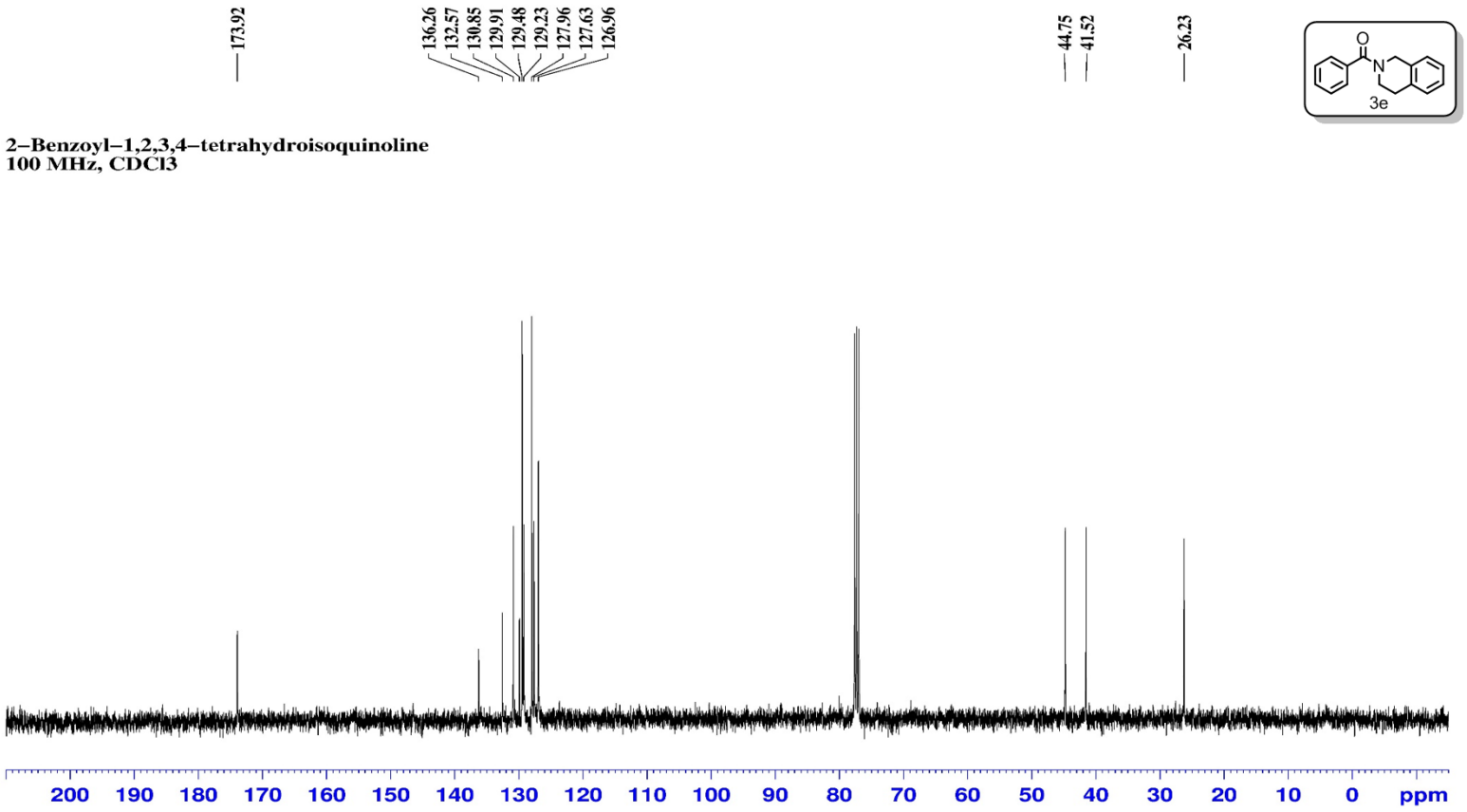



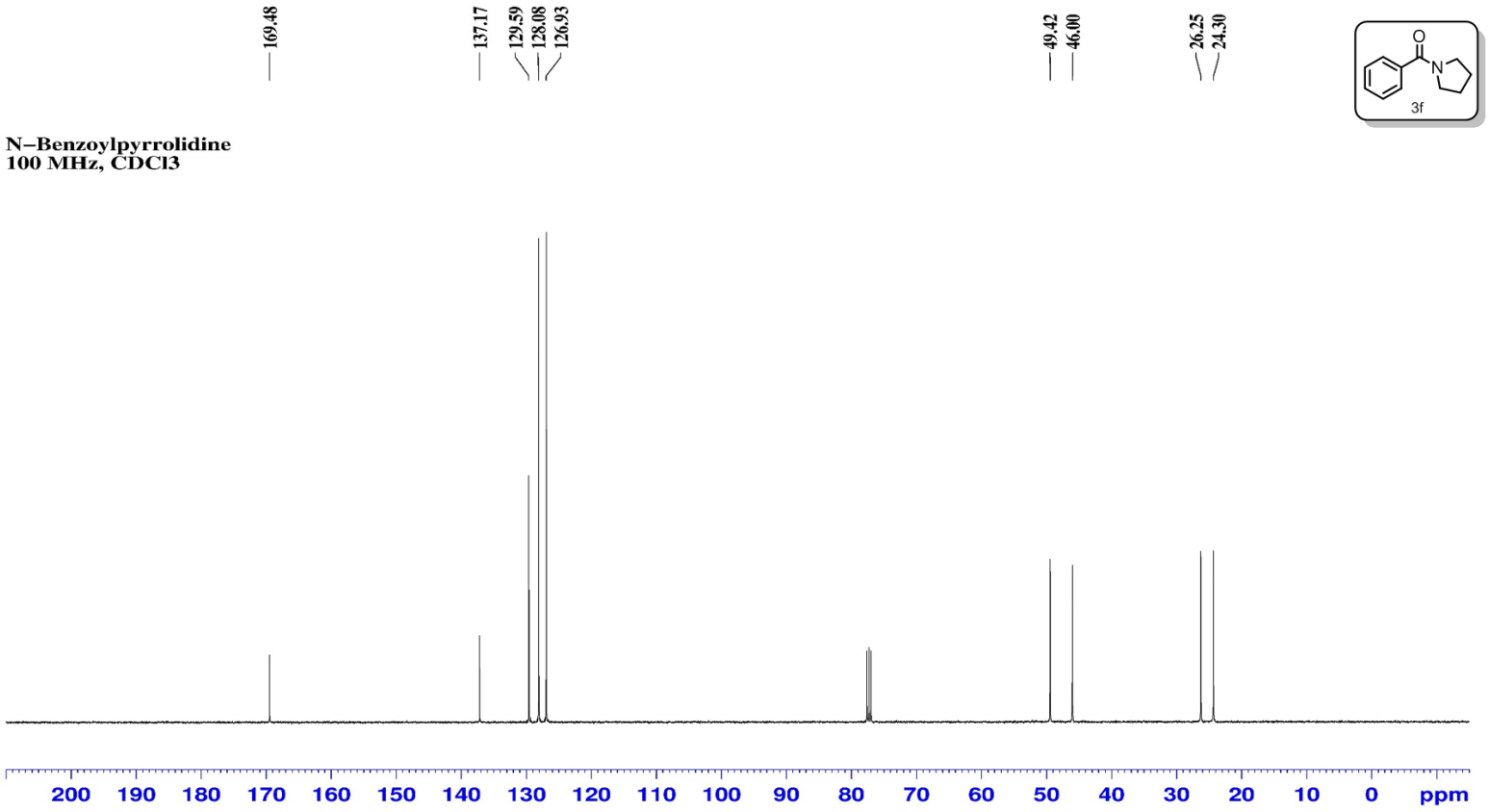

167.73
138.56
134.48
131.52
128.72
128.55
127.82
127.45
127.24
44.00
O
N
H
3a
N–Benzyl benzamide
100 MHz, CDCl3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

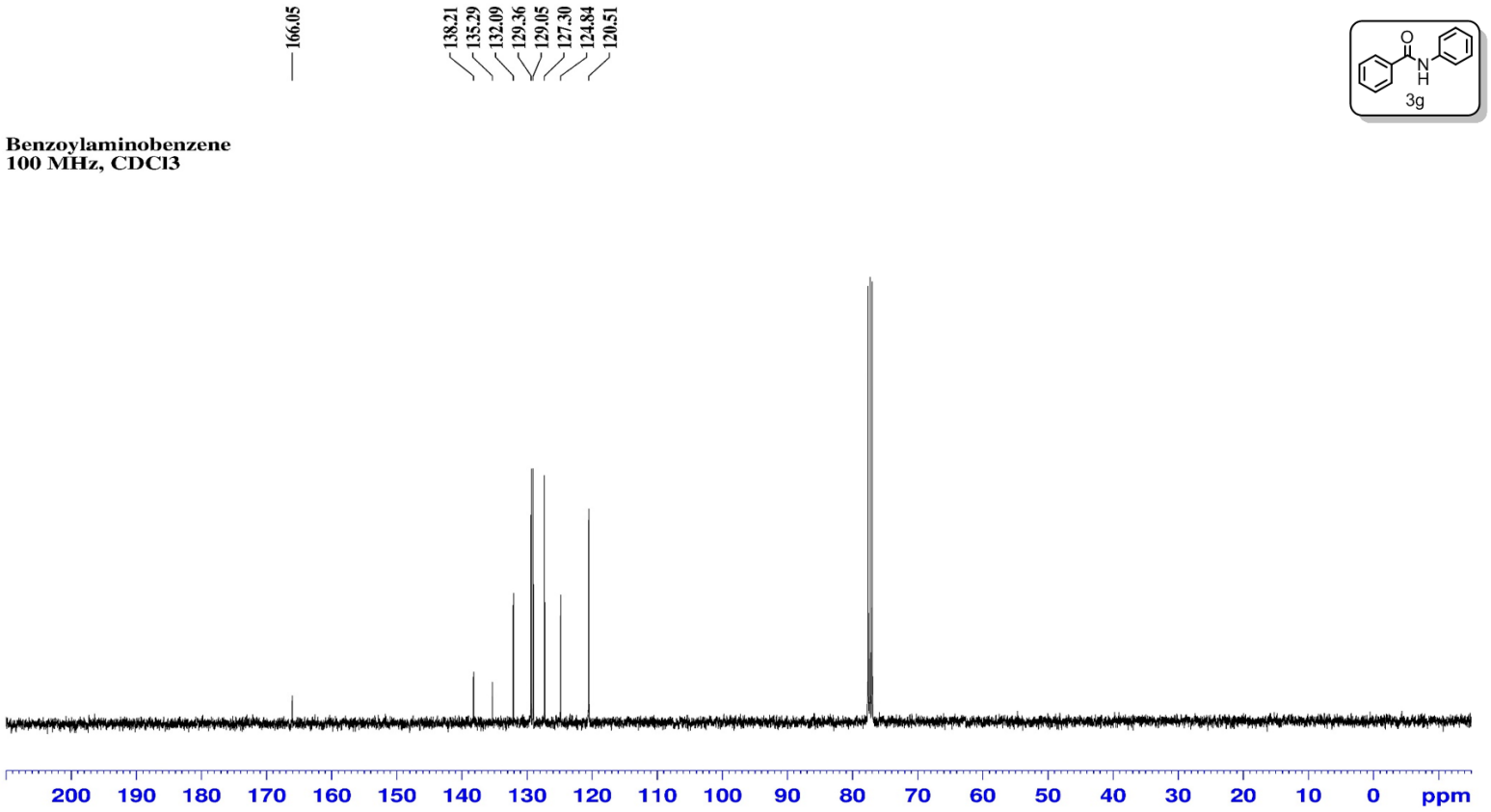

167.68
163.64
161.20
134.48
134.36
134.33
131.84
129.77
129.69
128.81
127.23
115.87
115.66
43.53
3b
N–(4–Fluorobenzyl) benzamide
100 MHz, CDCl3
163
162
ppm
134.5
ppm
130.0
ppm
116
ppm
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

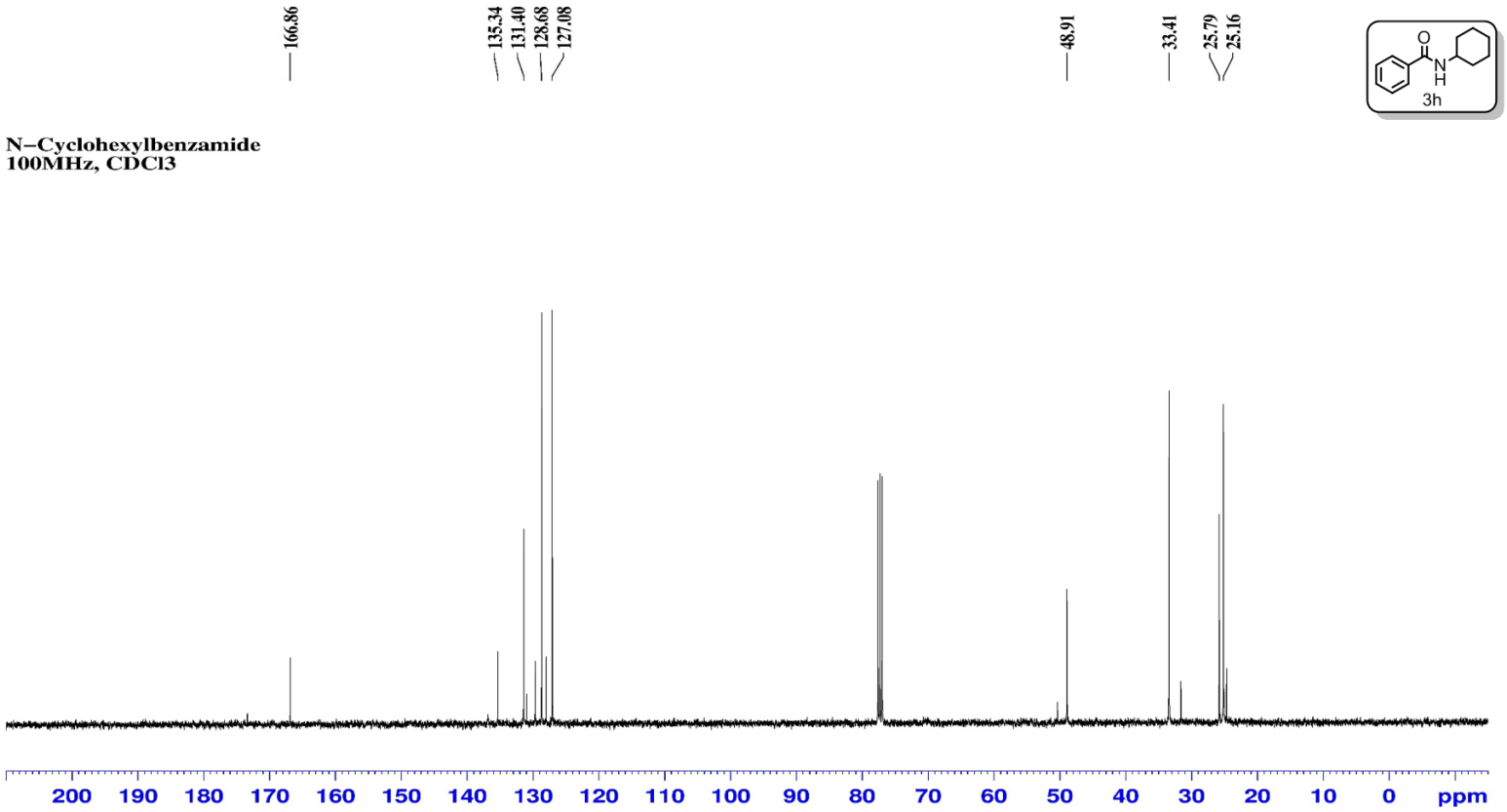

167.53
159.30
134.69
131.67
130.58
129.48
128.75
127.21
114.35
55.52
43.80
3c
N–(4–Methoxybenzyl)–benzamide
100 MHz, CDCl3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

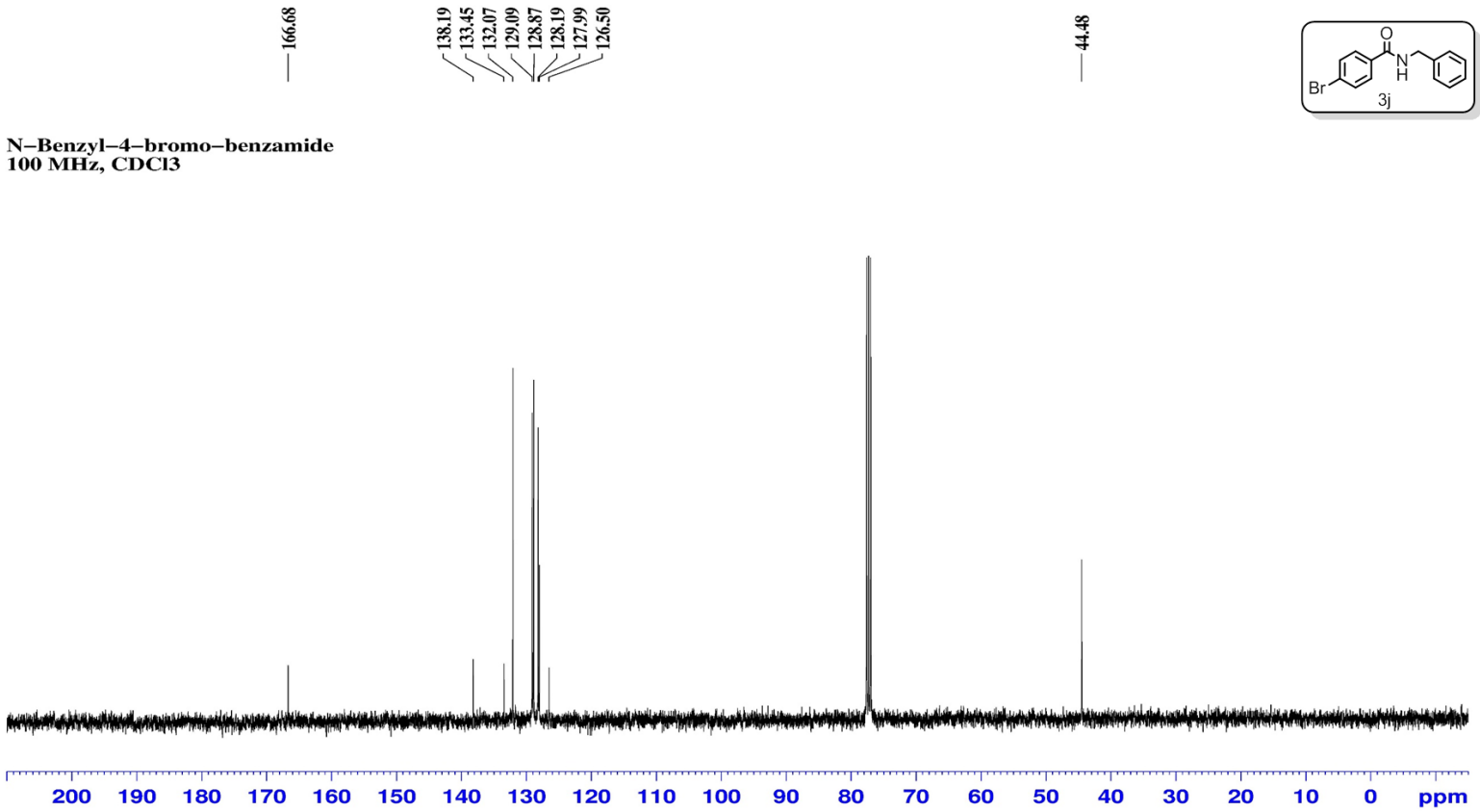

167.78
135.02
131.29
128.52
127.12
40.31
31.94
29.81
29.46
29.36
27.19
22.77
14.22
N–Octylbenzamide
100 MHz, CDCl3
3d
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

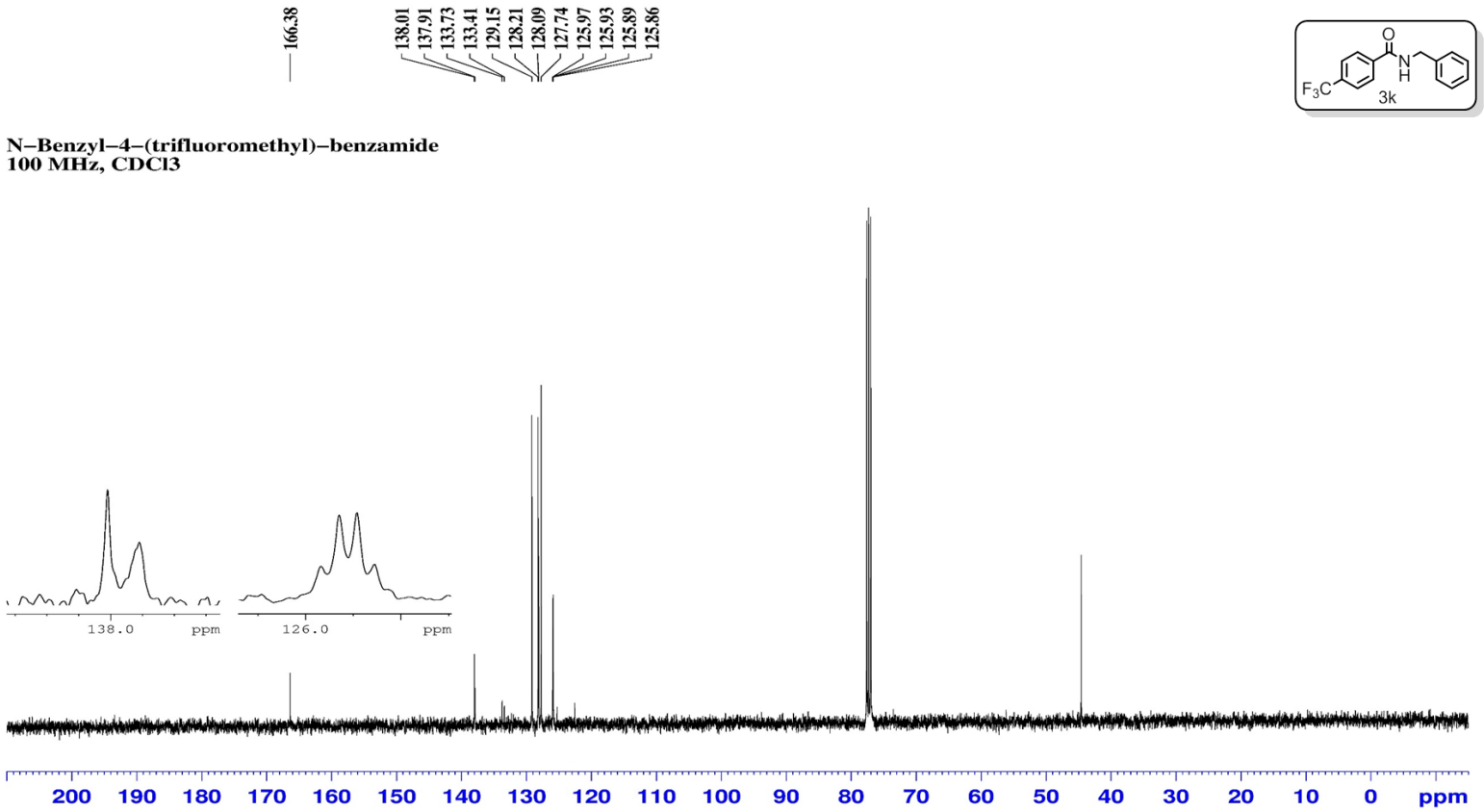

173.92
136.26
132.57
130.85
129.91
129.48
129.23
127.96
127.63
126.96
44.75
41.52
26.23
O
N
3e
2–Benzoyl–1,2,3,4–tetrahydroisoquinoline
100 MHz, CDCl3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

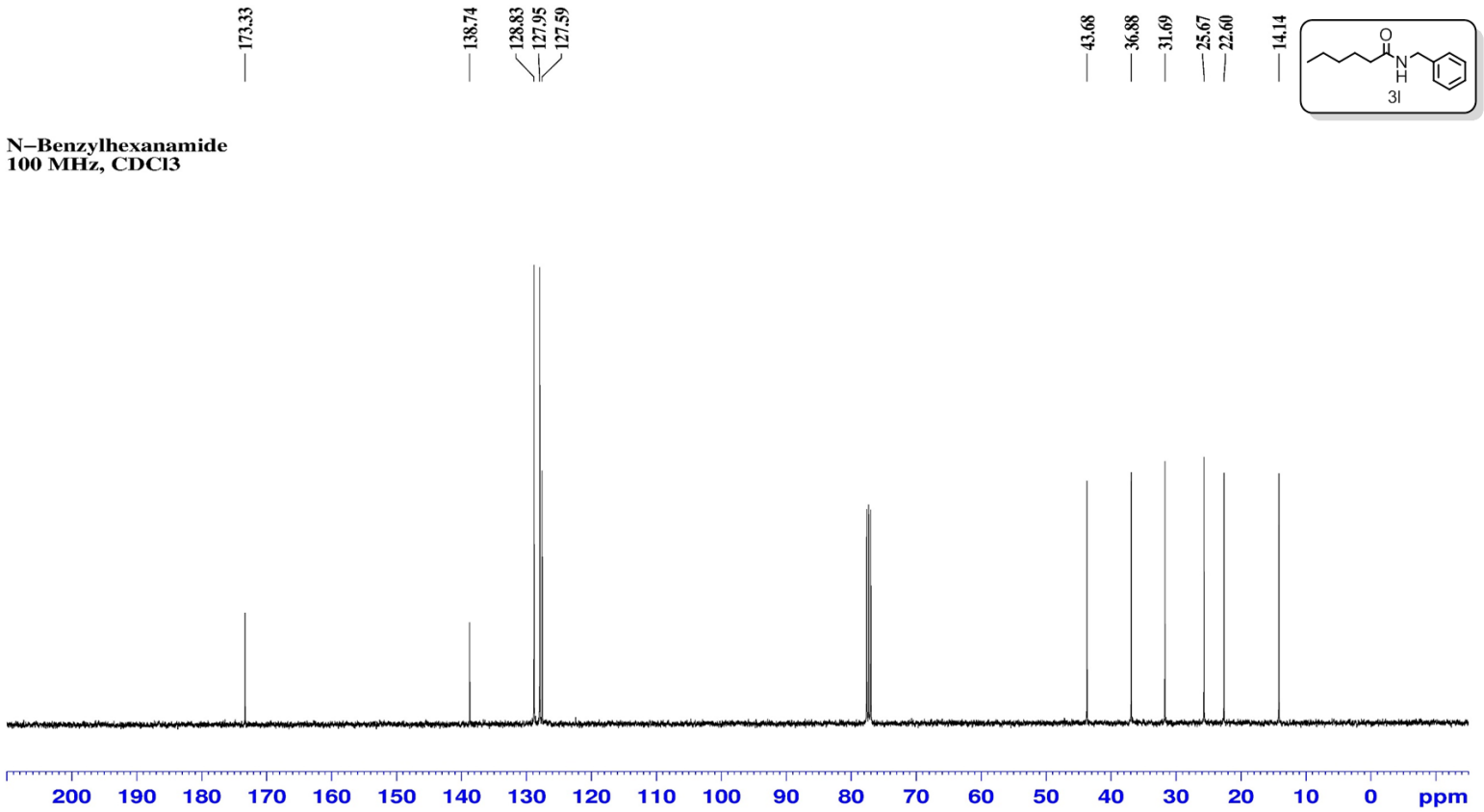

169.48
137.17
129.59
128.08
126.93
49.42
46.00
26.25
24.30
3f
N–Benzoylpyrrolidine
100 MHz, CDCl3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

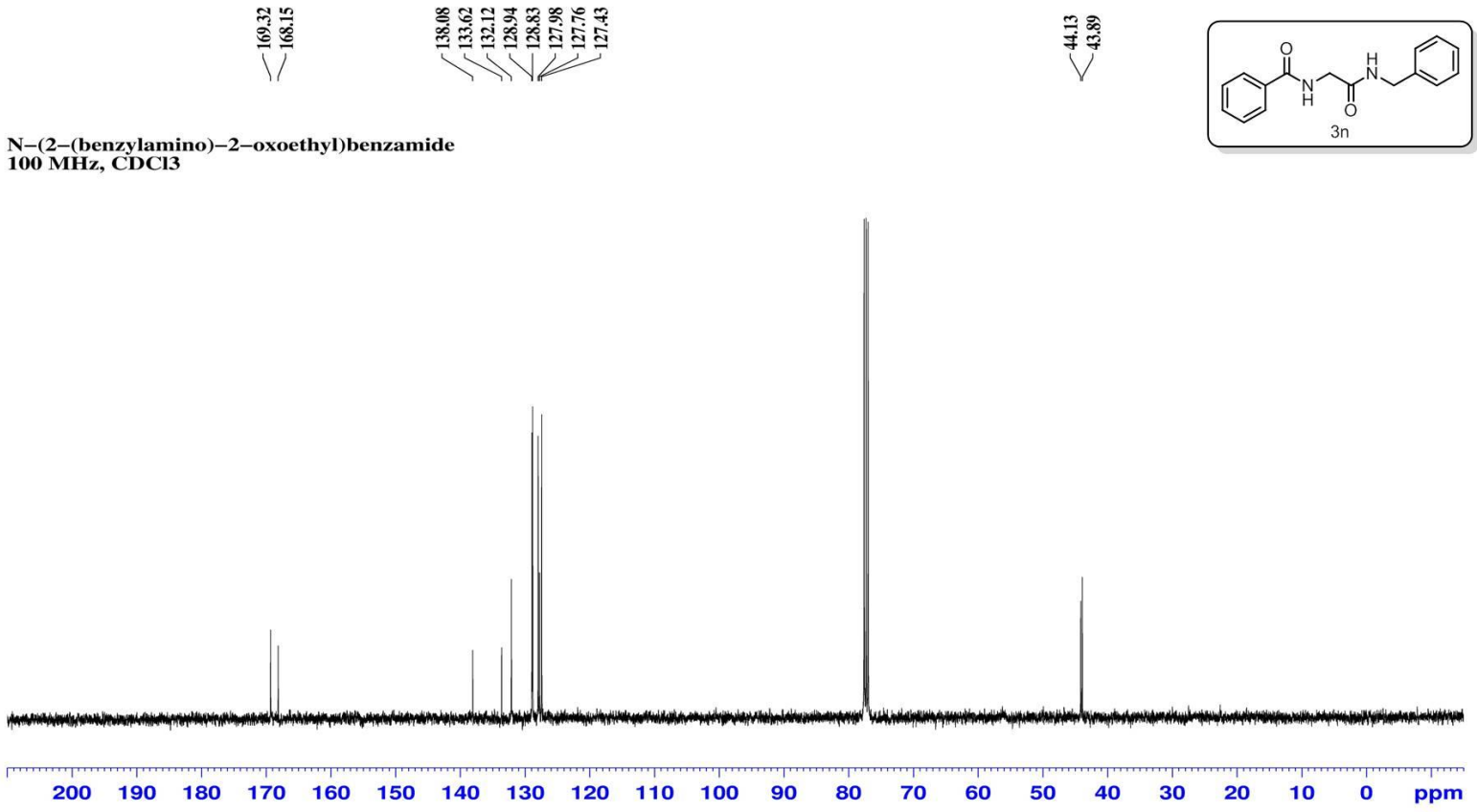

166.05
138.21
135.29
132.09
129.36
129.05
127.30
124.84
120.51
O
N
H
3g
Benzoylaminobenzene
100 MHz, CDCl3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

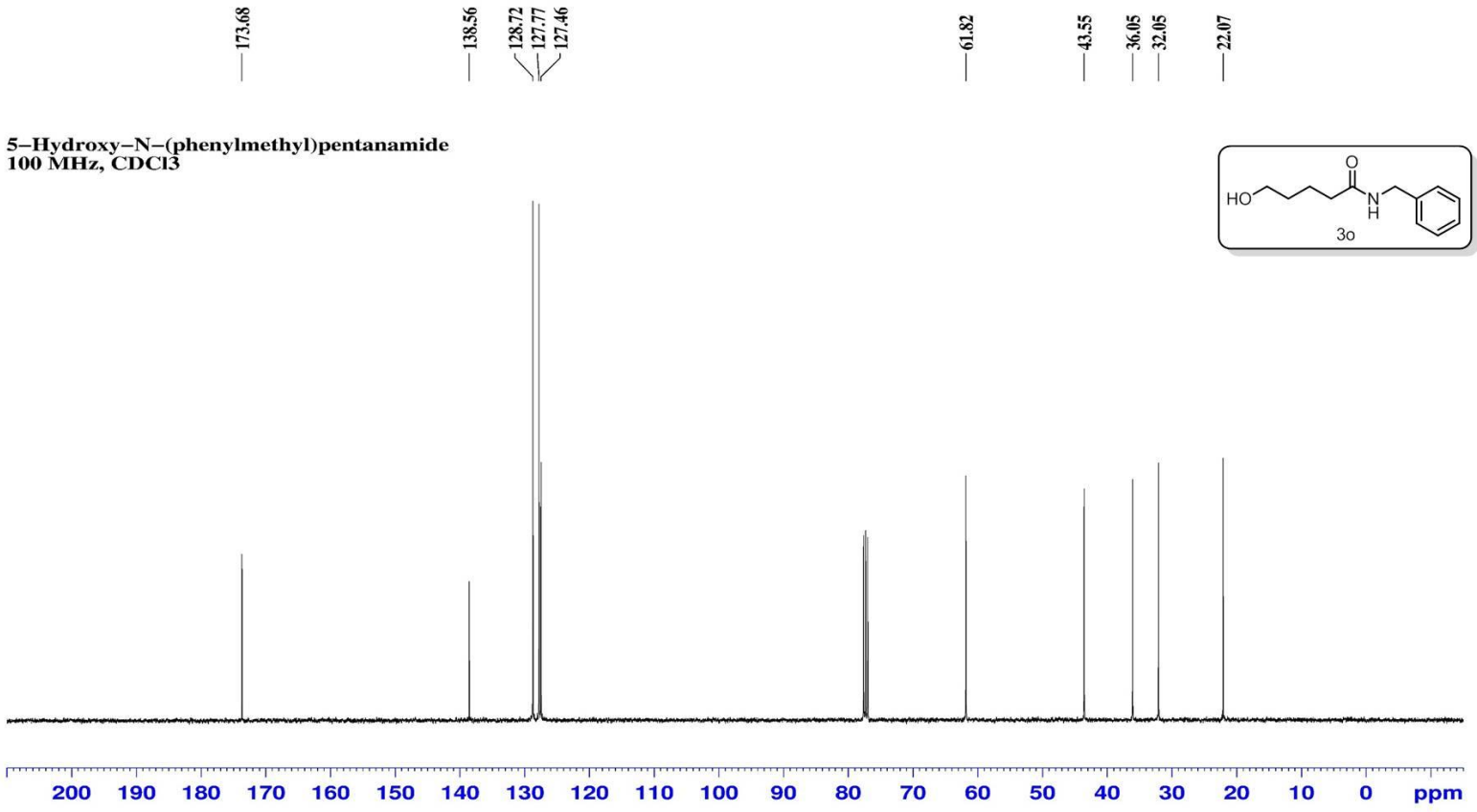

166.86
135.34
131.40
128.68
127.08
48.91
33.41
25.79
25.16
3h
N–Cyclohexylbenzamide
100MHz, CDCl3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


166.68
138.19
133.45
132.07
129.09
128.87
128.19
127.99
126.50
44.48
Br
O
N
H
3j
N–Benzyl–4–bromo–benzamide
100 MHz, CDCl3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


166.38
138.01
137.91
133.73
133.41
129.15
128.21
128.09
127.74
125.97
125.93
125.89
125.86
F3C
O
N
H
3k
N–Benzyl–4–(trifluoromethyl)–benzamide
100 MHz, CDCl3
138.0
ppm
126.0
ppm
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm


173.33
138.74
128.83
127.95
127.59
43.68
36.88
31.69
25.67
22.60
14.14
O
N
H
3l
N–Benzylhexanamide
100 MHz, CDCl3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


169.32
168.15
138.08
133.62
132.12
128.94
128.83
127.98
127.76
127.43
44.13
43.89
3n
N–(2–(benzylamino)–2–oxoethyl)benzamide
100 MHz, CDCl3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


173.68
138.56
128.72
127.77
127.46
61.82
43.55
36.05
32.05
22.07
5–Hydroxy–N–(phenylmethyl)pentanamide
100 MHz, CDCl3
HO
O
N
H
3o
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm