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Supporting Information

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IBX-Mediated Oxidative Ugi-type Reaction: Application to the N- and C_1-functionalization of Tetrahydroisoquinoline

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General information

Melting points were recorded using Büchi B-540 melting point apparatus.

Mass spectra were obtained either from an AEI MS-9 using electron spray (ES), or from a MALDI-TOF type of instrument for the high resolution mass spectra (HRMS).

Proton NMR (^{1}H) spectra were at 500 MHz or 300 MHz spectrometer. Carbon NMR (^{13}C) spectra were similarly recorded at 125 or 75 MHz spectrometer, using a broadband decoupled mode with the multiplicities obtained using a JMOD or DEPT sequence.

Chemical shifts (δ) are reported in parts per million (ppm) from tetramethylsilane. NMR experiments were carried out in deuterochloroform ($CDCl_3$). The following abbreviations are used for the multiplicities: s: singlet, d: doublet, t: triplet, q: quartet, m: multiplet, brs: broad singlet for proton spectra. Coupling constants (*J*) are reported in Hertz (Hz).

Optical rotations were measured on a Jasco P-1010 polarimeter using 10 cm cells and the sodium D line (589 nm) at ambient temperature in the solvent and concentration indicated.

Infrared spectra were recorded on a Perkin Elmer Spectrum BX FT-IR spectrometer.

Flash chromatography was performed using Kieselgel Si 60, 40-63 μm particle sized silica gel (200-400 mesh). Visualization was achieved under a UVP mineralight UVGL-58 lamp.

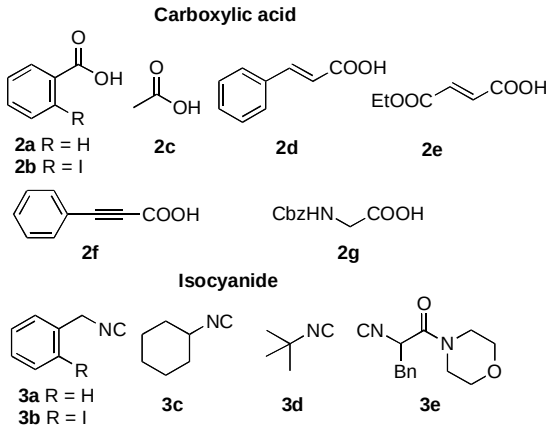
All reagents were obtained from commercial suppliers unless otherwise stated. *o*-Iodoxybenzoic acid (IBX) was prepared *via* the method of Santagostino.[1] *Caution!* IBX has been proven to be shock-sensitive, and explosive when subjected to elevated temperatures.[2] Therefore, appropriate precautions should be taken when working with IBX, especially when conducting procedures on large scale and/or when heating is employed. Where necessary, organic solvents were routinely dried and/or distilled prior to use and stored over molecular sieves under nitrogen. Tetrahydrofuran was dried by distillation from sodium/benzophenone. All reactions requiring anhydrous conditions were performed in flame-dried apparatus under a nitrogen atmosphere. Organic extracts were dried over anhydrous sodium sulfate (Na_2SO_4).

[1] M. Frigerio, M. Santagostino, S. Sputore, *J. Org. Chem.* **1999**, *64*, 4537-4538.
[2] (a) J. B. Plumb, D. J. Harper, *Chem. Eng. News* **1990**, *16*, 3-3; (b) D. B. Dess, J. C. Martin, *J. Am. Chem. Soc.* **1991**, *113*, 7277-7287.

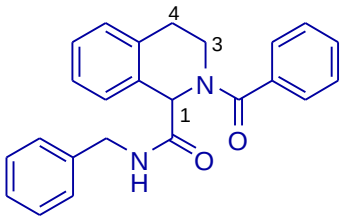
General procedure

Carboxylic acid (1.5 eq.), secondary amine (1.5 eq.) and isonitrile (1.0 eq.) were added successively to a suspension of IBX (2.0 eq.) in dry THF (0.5 M). The mixture was then heated at 60°C and followed by TLC (6-72h). When the reaction was completed, the reaction mixture was cooled to room temperature, hydrolyzed with HCl (1N) and stirred for 10 minutes. The reaction mixture was then diluted with dichloromethane, filtered on a short pad of Celite® and the filtrate was evaporated to dryness. The crude mixture was dissolved in sat. $Na_2S_2O_3$ and the aqueous phase was extracted with dichloromethane. The combined organic layers were washed with sat. $NaHCO_3$, water, dried over anhydrous Na_2SO_4, concentrated *in vacuo* and chromatographed on silica gel.

Carboxylic acids and isocyanides used for the N,C acylation of tetrahydroisoquinolines



Synthesis of 2-benzoyl-*N*-benzyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4a)



4a

According to the general procedure, *2-benzoyl-N-benzyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4a**) was obtained from benzoic acid, 1,2,3,4-tetrahydroisoquinoline and benzylisonitrile, as a white solid (166 mg, 87 %).

$C_{24}H_{22}N_2O_2$ (M = 370.44 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 7:3) = 0.20

Mp : 65°C

IR (neat, cm^{-1}) : 3302, 3062, 2924, 1666, 1614, 1538, 1495, 1424, 1241.

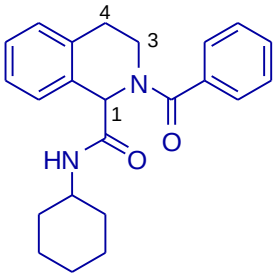
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7,47-7.18 (m, 15H, H_{Ar}, NH), 6.09 (s, 1H, H_1), 4,57 (dd, *J* = 6.2, 14.9 Hz, 1H, PhC$\underline{H}_2$N), 4.43 (dd, *J* = 5.5, 14.9 Hz, 1H, PhC$\underline{H}_2$N), 3.82-3.79 (m, 1H, H_3), 3.73-3.67 (m, 1H, H_3), 3.02-2.96 (m, 1H, H_4), 2.88 (m, 1H, H_4).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 171.5, 170.4, 138.5, 135.3, 134.3, 131.3, 130.0, 128.7, 128.5 (4C), 127.8, 127.5, 127.4 (2C), 127.1, 126 .7 (2C), 126.5, 57.4, 43.6, 43.4, 29.0.

Mass (ESI)(*m*/*z*) : 393.1 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{24}H_{22}N_2NaO_2$ $[M+Na]^+$: 393.1579, found 393.1562.

Synthesis of 2-benzoyl-*N*-cyclohexyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4b)



4b

According to the general procedure, *2-benzoyl-N-cyclohexyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4b**) was obtained from benzoic acid, 1,2,3,4-tetrahydroisoquinoline and cyclohexylisonitrile, as a white solid (162 mg, 97 %).

$C_{23}H_{26}N_2O_2$ (M = 362.46 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 8:2) = 0.12

Mp : 89°C

IR (neat, cm^{-1}) : 3308, 3061, 2928, 2853, 1620,1578, 1541, 1496, 1427.

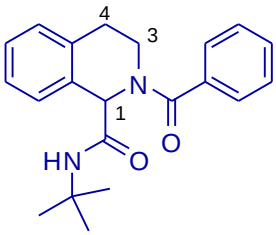
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.47-7.43 (m, 4H, H_{Ar}), 7.29-7.14 (m, 5H, H_{Ar}), 6.79 (brs, 1H, NH), 6.01 (s, 1H, H_1), 3.82-3.79 (m, 1H, H_3), 3.70-3.64 (m, 1H, H_3), 3.02-2.96 (m, 1H, H_4), 2.87-2.79 (m, 1H, H_4), 1.94-1.88 (m, 2H, $CH_{cyclo,}$), 1.73-1.69 (m, 2H, CH_{cyclo}), 1.61-1.58 (m, 2H, CH_{cyclo}), 1.39-1.34 (m, 2H, CH_{cyclo}), 1.29-1.22 (m, 3H, CH_{cyclo}).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 172.2, 169.2, 130.14, 128.8, 128.7 (3C), 128.0 (2C), 127.5, 126.7 (2C), 126.5 (2C), 57.4, 48.3, 43.5, 32.9, 32.8, 29.1, 25.6, 25.5, 24.6.

Mass (ESI)(*m*/*z*) : 385.2 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{23}H_{26}N_2NaO_2$ $[M+Na]^+$: 385.1892, found 385.1846.

Synthesis of 2-benzoyl-*N*-*tert*-butyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4c)



4c

According to the general procedure, *2-benzoyl-N-tert-butyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4c**) was obtained from benzoic acid, 1,2,3,4-tetrahydroisoquinoline and *tert*-butylisonitrile, as a white solid (160 mg, 99 %).

$C_{21}H_{24}N_2O_2$ (M = 336.43 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 8:2) = 0.17

Mp : 116°C

IR (neat, cm^{-1}) : 3329, 3061, 2965, 1681, 1616, 1578, 1541, 1495, 1427, 1224.

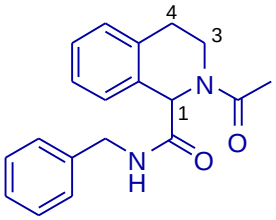
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.45 (m, 5H, H_{Ar}), 7.26-7.16 (m, 4H, H_{Ar}), 5.82 (brs, 1H, NH), 5.97 (s, 1H, H_1), 3.84-3.79 (m, 1H, H_3), 3.72-3.64 (m, 1H, H_3), 3.04-2.93 (m, 1H, H_4), 2.85-2.78 (m, 1H, H_4), 1.38 (s, 9H, $C(CH_3)_3$).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 171.4, 169.5, 130.1, 128.8, 128.6 (4C), 128.0, 127.4, 126.7 (2C), 126.5 (2C), 57.9, 51.4, 43.4, 28.7 (3C), 22.6.

Mass (ESI)(*m*/*z*) : 359.2 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{21}H_{25}N_2O_2$ $[M + H]^+$: 337.1916, found 337.1909.

Synthesis of 2-acetyl-*N*-benzyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4d)



4d

According to the general procedure, *2-acetyl-N-benzyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4d**) was obtained from acetic acid, 1,2,3,4-tetrahydroisoquinoline and benzylisonitrile, as a pale yellow solid (81 mg, 51 %).

$C_{19}H_{20}N_2O_2$ (M = 308.17 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 1:2) = 0.18

Mp : 154°C

IR (neat, cm^{-1}) : 3294, 3060, 2924, 1624, 1523, 1496, 1419, 1224, 746, 699.

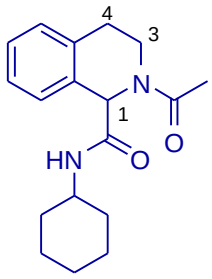
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.20-7.08 (m, 10H, H_{Ar}, NH), 5.87 (s, 1H, H_1), 4.34 (dd, *J* = 5.8, 15.2 Hz, 1H, PhC<u>H</u>N), 4.29 (dd, *J* = 5.8, 15.2 Hz, 1H, PhC<u>H</u>N), 3.82-3.73 (m, 1H, H_3), 3.62-3.54 (m, 1H, H_3), 3.05-2.96 (m, 1H, H_4), 2.85-2.75 (m, 1H, H_4), 2.07 (s, 3H, C<u>H</u>$_3$CO).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 170.7, 170.4, 138.2, 134.8, 131.9, 128.5 (2C), 128.2, 127.8, 127.7, 127.4 (2C), 127.2, 126.7, 57.3, 43.5, 43.0, 28.7, 21.8.

Mass (ESI)(*m*/*z*) : 331.1 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{19}H_{20}N_2NaO_2$ $[M+Na]^+$: 331.1422, found 331.1399.

Synthesis of 2-acetyl-*N*-cyclohexyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4e)



4e

According to the general procedure, *2-acetyl-N-cyclohexyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4e**) was obtained from acetic acid, 1,2,3,4-tetrahydroisoquinoline and cyclohexylisonitrile, as a pale yellow solid (95 mg, 69 %).

$C_{18}H_{24}N_2O_2$ (M = 300.40 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 8:2) = 0.28

Mp : 119°C

IR (neat, cm^{-1}) : 3299, 3059, 2929, 2853, 1626, 1537, 1417.

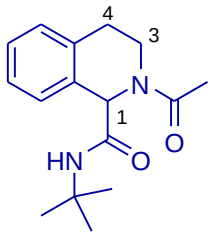
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.32-7.21 (m, 4H, H_{Ar}), 6.69 (d, *J* = 7.8 Hz, 1H, NH), 5.92 (s, 1H, H_1), 3.91 (ddd, *J* = 4.7, 8.5, 12.7 Hz, 1H, H_3), 3.80-3.73 (m, 1H, H_3), 3.10 (m, 1H, H_4), 2.98-2.88 (m, 1H, H_4), 2.25 (s, 3H, CH_3CO), 1.91-1.88 (m, 2H, CH_{cyclo}), 1.73-1.58 (m, 3H, CH_{cyclo}), 1.43-1.18 (m, 6H, CH_{cyclo}).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 170.4, 169.4, 134.6, 132.0, 128.2, 127.6, 127.4, 126.5, 57.1, 48.2, 42.8, 32.7 (2C), 28.8, 25.4, 24.6 (2C), 21.8.

Mass (ESI)(*m*/*z*) : 323.1 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{18}H_{24}N_2NaO_2$ $[M+Na]^+$: 323.1735, found 323.1695.

Synthesis of 2-acetyl-*N*-*tert*-butyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4f)



4f

According to the general procedure, *2-acetyl-N-tert-butyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4f**) was obtained from acetic acid, 1,2,3,4-tetrahydroisoquinoline and *tert*-butylisonitrile, as a pale yellow solid (70 mg, 53 %).

$C_{16}H_{22}N_2O_2$ (M = 274.36 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 1:2) = 0.26

Mp : 156°C

IR (neat, cm^{-1}) : 3318, 2965, 2926, 1681, 1624, 1544, 1450, 1421, 1225.

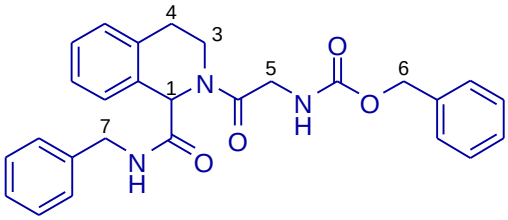
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.31-7.19 (m, 4H, H_{Ar}), 6.51 (brs, 1H, NH), 5.86 (s, 1H, H_1), 3.87 (ddd, *J* = 4.7, 8.4, 12.8 Hz, 1H, H_{3ax}), 3.79-3.71 (m, 1H, H_{3eq}), 3.06 (td, *J* = 4.7, 14.0 Hz, 1H, H_{4eq}), 2.92 (ddd, *J* = 5.2, 8.4, 14.0 Hz, 1H, H_{4ax}), 2.24 (s, 3H, CH_3CO), 1.35 (s, 9H, $C(CH_3)_3$).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 170.3, 169.6, 134.5, 132.1, 128.2, 127.5, 127.4, 126.5, 57.6, 51.2, 42.8, 28.7, 28.5, 21.7.

Mass (ESI)(*m*/*z*) : 297.1 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{16}H_{22}N_2NaO_2$ $[M+Na]^+$: 297.1579, found 297.1558.

Synthesis of benzyl 2-(1-(benzylcarbamoyl)-3,4-dihydroisoquinolin-2(*1H*)-yl)-2-oxoethylcarbamate (4g)



4g

According to the general procedure, *benzyl 2-(1-(benzylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-2-oxoethylcarbamate* (**4g**) was obtained from *N*-carbobenzyloxyglycine, 1,2,3,4-tetrahydroisoquinoline and benzylisonitrile , as a pale yellow solid (183 mg, 78 %).

$C_{27}H_{27}N_3O_4$ (M = 357.52 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 7:3) = 0.32

Mp : 82°C

IR (neat, cm^{-1}) : 3313, 3062, 2934, 2836, 1716, 1644, 1520, 1496, 1453, 1430, 1217.

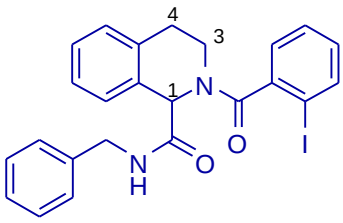
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm: 7.36-7.14 (m, 15H, H_{Ar}, NH), 5.87 (s, 1H, H_1), 5.83 (brs, 1H, NH), 5.11 (s, 2H, H_6), 4.35 (dd, *J* = 1.0, 5.8 Hz, 2H, H_7), 4.12 (dd, *J* = 4.2, 17.0 Hz, 1H, H_5), 4.00 (dd, *J* = 5.0, 17.0 Hz, 1H, H_5), 3.90-3.82 (m, 1H, H_3), 3.53-3.45 (m, 1H, H_3), 3.19-3.09 (m, 1H, H_4), 2.89-2.80 (m, 1H, H_4).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 169.8, 168.5, 156.2, 138.0, 136.2, 134.6, 131.5, 128.5 (2C), 128.4 (2C), 128.2, 128.1, 128.0 (2C), 127.9, 127.6, 127.4 (2C), 127.2, 126.9, 66.9, 58.0, 43.5, 42.9, 41.4, 28.3.

Mass (ESI)(*m*/*z*) : 480.2 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{27}H_{27}N_3NaO_4$ $[M+Na]^+$: 480.1899, found 480.1915.

Synthesis of *N*-benzyl-2-(2-iodobenzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4h)



4h

According to the general procedure, *N-benzyl-2-(2-iodobenzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4h)** obtained from 2-iodobenzoic acid, 1,2,3,4-tetrahydroisoquinoline and benzylisonitrile, as a white solid (222 mg, 88 %).

$C_{24}H_{21}IN_2O_2$ (M = 496.34 $g.mol^{-1}$)

***R*$_f$** (Heptane / Ethyl acetate 7:3) = 0.20

Mp : 80°C

IR (neat, cm^{-1}) : 3312, 2987, 2901, 1620, 1583, 1423, 1241.

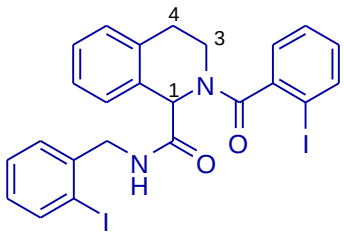
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm: 7.84-7.81 (m, 1H, H_{Ar}), 7.43-7.27 (m, 7H, H_{Ar}), 7.18-7.10 (m, 5H, H_{Ar}), 6.21 (s, 1H, H_1), 6.15 (brs, 1H, NH), 4.58-4.50 (m, 2H, $PhCH_2N$), 3.73-3.63 (m, 1H, H_3), 3.51-3.43 (m, 1H, H_3), 2.85-2.80 (m, 2H, H_4).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm: 170.4, 169.0, 141.3, 139.1, 133.6, 130.9, 130.5, 128.7, 128.6 (2C), 128.5 (2C), 128.4, 129.4 (2C), 127.6, 127.5, 126.6, 126.5, 92.5, 56.5, 44.0, 42.9, 28.6.

Mass (ESI)(*m*/*z*) : 519.0 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{24}H_{21}IN_2NaO_2$ $[M+Na]^+$: 519.0545, found 519.0560.

Synthesis of 2-(2-iodobenzoyl)-*N*-(2-iodobenzyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4i)



4i

According to the general procedure, *2-(2-iodobenzoyl)-N-(2-iodobenzyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4i**) was obtained from 2-iodobenzoic acid, 1,2,3,4-tetrahydroisoquinoline and 2-iodobenzylisonitrile[3], as a white solid (217 mg, 85 %).

$C_{24}H_{20}I_2N_2O_2$ (M = 622.24 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 7:3) = 0.24

Mp : 85°C

IR (neat, cm^{-1}) : 3667, 2987, 2900, 1622, 1407, 1393, 1241.

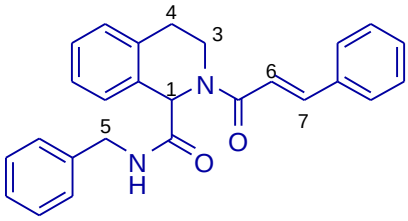
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.82-7.81 (m, 3H, H_{Ar}), 7.47-7.07 (m, 8H, H_{Ar}), 7.00-6.95 (m, 1H, H_{Ar}), 6.18 (s, 1H, H_1), 6.11 (brs, 1H, NH), 4.64-4.51 (m, 2H, $PhCH_2N$), 3.64-3.54 (m, 1H, H_3), 3.48-3.40 (m, 1H, H_3), 2.89-2.79 (m, 2H, H_4).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 170.6, 169.0, 141.3, 141.1, 139.4, 139.1, 133.7, 130.8, 130.6, 130.3, 129.4, 128.9, 128.6, 128.5, 128.4, 127.7, 126.7, 126.6, 99.8, 92.7, 56.6, 48.7, 43.1, 28.6.

Mass (ESI)(*m*/*z*) : 644.9 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{24}H_{20}I_2N_2NaO_2$ $[M+Na]^+$: 644.9512, found 644.9494.

Synthesis of *N*-benzyl-2-cinnamoyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4j)



4j

According to the general procedure, *N-benzyl-2-cinnamoyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4j**) was obtained from cinnamic acid, 1,2,3,4-tetrahydroisoquinoline and benzylisonitrile, as a pale yellow solid (176 mg, 87 %).

$C_{26}H_{24}N_2O_2$ (M = 396.48 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 7:3) = 0.18

[3] 2-iodobenzylisonitrile was prepared from 2-iodobenzylalcohol in five steps. See : Cuny Guylaine, PhD, Université Paris XI, **2004**, 153-190.

Mp : 71°C

IR (neat, cm^{-1}) : 3300, 3061, 2926, 2836, 1644, 1599, 1496, 1452, 1424, 1217.

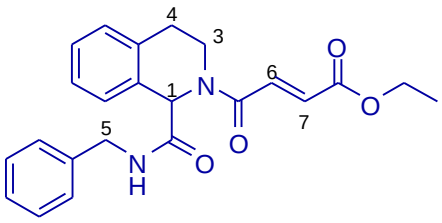
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm: 7.66 (d, *J* = 15.4 Hz, 1H, H_7), 7.50-7.47 (m, 2H, CH_{Ar}), 7.37-7.32 (m, 5H, CH_{Ar}), 7.24-7.13 (m, 7H, CH_{Ar}), 6.88 (d, *J* = 15.4 Hz, 1H, H_6), 6.15 (brs, 1H, NH), 6.06 (s, 1H, H_1), 4.40-4.38 (m, 2H, H_5), 3.97-3.86 (m, 2H, H_3), 3.09 (td, *J* = 5.5, 15.7 Hz, 1H, H_4), 2.86 (ddd, *J* = 5.2, 7.6, 15.7 Hz, 1H, H_4).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm: 170.4, 166.9, 143.8, 139.1, 138.3, 134.9, 134.8, 132.0, 129.9, 128.8, 128.6, 128.5, 128.4, 128.2, 128.0, 127.8, 127.7, 127.6, 127.4, 127.1, 126.6, 116.9, 58.0, 43.5, 43.6, 28.9.

Mass (ESI)(*m*/*z*) : 419.2 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{26}H_{24}N_2NaO_2$ $[M+Na]^+$: 419.1735, found 419.1719.

Synthesis of (*E*)-ethyl 4-(1-(benzylcarbamoyl)-3,4-dihydroisoquinolin-2(*1H*)-yl)-4-oxobut-2-enoate (4k)



4k

According to the general procedure, *(E)-ethyl 4-(1-(benzylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-4-oxobut-2-enoate* (**4k**) was obtained from (*E*)-4-ethoxy-4-oxobut-2-enoic acid, 1,2,3,4-tetrahydroisoquinoline and benzylisonitrile, as a pale yellow solid (123 mg, 61 %).

$C_{23}H_{24}N_2O_4$ (M = 392.45 $g.mol^{-1}$)

R_f (Heptane / Ethyl acetate 6:4) = 0.32

Mp : 51°C

IR (neat, cm^{-1}) : 3308, 3063, 1719, 1650, 1620, 1530, 1496, 1426, 1300, 1268, 1173.

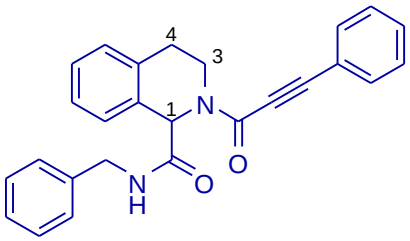
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.42 (d, *J* = 15.3 Hz, 1H, H_6), 7.28-7.19 (m, 9H, H_{Ar}), 7.07 (brs, 1H, NH), 6.80 (d, *J* = 15.3 Hz, 1H, H_7), 5.97 (s, 1H, H_1), 4.41 (d, *J* = 5.9 Hz, 2H, H_5), 4.29 (q, *J* = 7.1 Hz, 2H, OCH_2), 4.02-3.94 (m, 1H, H_3), 3.89-3.81 (m, 1H, H_3), 3.13-3.07 (m, 1H, H_4), 2.98-2.88 (m, 1H, H_4), 1.35 (t, *J* = 7.1 Hz, 3H, CH_3).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 169.7, 165.4, 164.9, 138.0, 134.6, 133.4, 132.2, 131.4, 128.6 (2C), 128.4, 127.9, 127.7, 127.5 (2C), 127.3, 126.9, 61.2, 58.0, 43.7, 42.7, 28.8, 14.1.

Mass (ESI)(*m*/*z*) : 415.1 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{23}H_{24}N_2NaO_4$ $[M+Na]^+$: 415.1634, found 415.1608.

Synthesis of *N*-benzyl-2-(3-phenylpropioloyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4l)



4l

According to the general procedure, *N-benzyl-2-(3-phenylpropioloyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4l**) was obtained from 3-phenylpropiolic acid, 1,2,3,4-tetrahydroisoquinoline and benzylisonitrile, as a pale yellow solid (147 mg, 73 %).

$C_{26}H_{22}N_2O_4$ (M = 394.47 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 7:3) = 0.33

Mp : 71°C

IR (neat, cm^{-1}) : 3305, 3061, 2930, 2835, 2213, 1666, 1613, 1599, 1490, 1453, 1423, 1195.

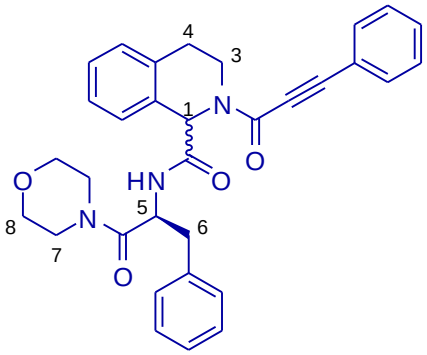
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.46-7.43 (m, 2H, H_{Ar}), 7.36-7.23 (m, 4H, H_{Ar}), 7.18-7.11 (m, 6H, H_{Ar}),7.08-7.05 (m, 3H, H_{Ar}, NH), 5.83 (s, 1H, H_1), 4.36 (dd, *J* = 5.9, 15.0 Hz, 1H, $PhCH_2N$), 4.29 (dd, *J* = 5.9, 15.0 Hz, 1H, $PhCH_2N$), 4.20 (td, *J* = 5.2, 12.8 Hz, 1H, H_3), 3.99-3.90 (m, 1H, H_3), 2.94-2.78 (m, 2H, H_4).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 169.6, 154.5, 138.0, 134.5, 132.6, 132.4, 130.8, 130.3, 128.6 (3C), 128.5 (2C), 127.7, 127.5 (2C), 127.3 (2C), 127.0, 120.1, 92.8, 80.9, 57.1, 43.6, 43.5, 28.8.

Mass (ESI)(*m*/*z*) : 417.2 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{26}H_{22}N_2NaO_4$ $[M+Na]^+$: 417.1579, found 417.1599.

Synthesis of (S)-*N*-(1-morpholino-1-oxo-3-phenylpropan-2-yl)-2-(3-phenylpropioloyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4m)



4m

According to the general procedure, an inseparable mixture of diastereomers of *(S)-N-(1-morpholino-1-oxo-3-phenylpropan-2-yl)-2-(3-phenylpropioloyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide* (**4m**) was obtained from 3-phenylpropiolic acid, 1,2,3,4-tetrahydroisoquinoline and (*S*)-4-(2-isocyano-3-phenylpropanoyl)morpholine[4], as a yellow oil (53 mg, 62 %).

$C_{32}H_{31}N_3O_4$ (M = 521.61 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 1:1) = 0.15

IR (neat, cm^{-1}) : 3294, 3056, 2856, 2212, 1621, 1490, 1433, 1300, 1264, 1113.

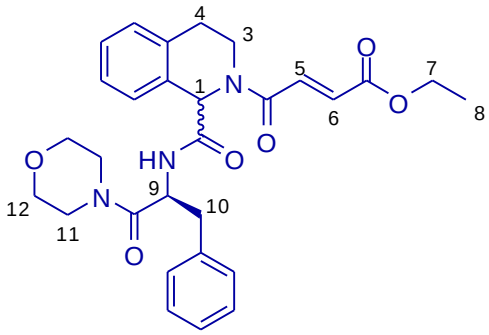
NMR ^{1}H ($CDCl_3$, 300MHz, 293K) *d* ppm, mixture of diastereomers : 7.63-7.58 (m, 2H, H_{Ar}), 7.47-7.38 (m, 3H, H_{Ar}), 7.30-7.17 (m, 10H, H_{Ar}, NH), 5.94 (s, 0.5H, H_1, one diastereomer), 5.92 (s, 0.5H, H_1, one diastereomer), 5.13-5.04 (m, 1H, H_5), 4.27-4.17 (m, 1H, H_3), 4.15-4.04 (m, 0.5H, H_3, one diastereomer), 3.92-3.86 (m, 0.5H, H_3, one diastereomer), 3.63-3.42 (m, 5H, H_4, H_8), 3.38-3.28 (m, 1H, H_4), 3.05-2.95 (m, 6H, H_6, H_7).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm, mixture of diastereomers : 169.3, 169.0 (one diastereoisomer), 168.7 (one diastereoisomer), 154.5, 135.9, 134.4, 134.4, 132.6, 130.5, 130.3, 129.5 (2C), 129.4, 128.6 (2C), 128.5, 127.9, 127.8, 127.0, 126.9, 126.8, 120.2, 91.6, 81.0, 66.4, 66.1, 57.1, 49.9, 43.6 (one diastereomer), 43.4 (one diastereomer), 42.3, 39.5 (2C), 28.8.

Mass (ESI)(*m*/*z*) : 544.2 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{32}H_{31}N_3NaO_4$ $[M+Na]^+$: 544.2212, found 544.2193.

Synthesis of (*S,E*)-ethyl 4-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(*1H*)-yl)-4-oxobut-2-enoate (4n)



4n, two separable diastereomers

According to the general procedure, *(S,E)-ethyl 4-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-4-oxobut-2-enoate* (**4n**) was obtained from (*E*)-4-ethoxy-4-oxobut-2-enoic acid, 1,2,3,4-tetrahydroisoquinoline and (*S*)-4-(2-isocyano-3-phenylpropanoyl)morpholine.

[4] Fayol, A.; Zhu, J. *Tetrahedron* **2005**, *48*, 11511-11519.

Diastereomer **A** : Yellow oil (22 mg, 26%).

$C_{29}H_{33}N_3O_6$ (M = 519.59 g.mol^{-1})

R_f (Diethyl ether / Toluene 9:1) = 0.14

IR (neat, cm^{-1}) : 3282, 2924, 1721, 1643, 1440, 1274, 1114.

[α]$_D$: - 2 (c = 1.2, $CHCl_3$, 23°C)

NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.31 (d, *J* = 15.3 Hz, 1H, H_5), 7.16-7.00 (m, 9H, H_{Ar}), 6.77 (d, *J* = 15.3 Hz, 1H, H_6), 6.00 (brs, 1H, NH), 5.81 (s, 1H, H_1), 4.95 (q, *J* = 7.6 Hz, 1H, H_9), 4.17 (q, *J* = 7.1 Hz, 2H, H_7), 3.66-3.60 (m, 2H, H_3), 3.48-3.20 (m, 6H, H_{10}, H_{12}), 2.96-2.80 (m, 6H, H_4, H_{11}), 1.23 (t, *J* = 7.1 Hz, 3H, H_8).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 169.4, 169.2, 165.5, 164.8, 136.0, 134.4, 133.0, 132.4, 131.0, 129.5, 128.6 (2C), 128.5, 128.3, 128.0, 127.9, 127.4, 126.9, 66.5, 66.1, 61.2, 57.8, 49.8, 42.6, 42.3, 39.3 (2C), 29.2, 14.1.

Mass (ESI)(*m*/*z*) : 542.2 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{29}H_{33}N_3NaO_6$ $[M+Na]^+$: 542.2267, found 542.2256.

Diastereomer **B** : Yellow oil (20 mg, 24%).

$C_{29}H_{33}N_3O_6$ (M = 519.59 g.mol^{-1})

R_f (Diethyl ether / Toluene 9:1) = 0.10

IR (neat, cm^{-1}) : 3282, 2924, 1720, 1643, 1440, 1275, 1114.

[α]$_D$: + 2 (c = 1.1, $CHCl_3$, 23°C)

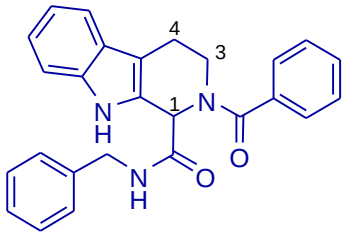
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* (rotamers) ppm : 7.35 (d, *J* = 15.3 Hz, 1H, H_5), 7.22-7.09 (m, 7H, H_{Ar}), 6.98-6.95 (m, 3H, H_{Ar}, NH), 6.78 (d, *J* = 15.3 Hz, 1H, H_6), 5.86 (s, 1H, H_1), 4.98-4.88 (m, 1H, H_9), 4.16 (q, *J* = 7.1 Hz, 2H, H_7), 3.87-3.79 (m, 1H, H_3), 3.74-3.66 (m, 1H, H_3), 3.51-3.46 (m, 1H, H_{12}), 3.43-3.30 (m, 4H, H_{10}, H_{12}), 3.24-3.16 (m, 1H, H_{12}), 2.93-2.73 (m, 6H, H_{11}, H_4), 1.22 (t, *J* = 7.1 Hz, 3H, H_8).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 169.4, 169.0, 165.5, 164.9, 135.8, 134.6, 133.1, 132.4, 131.3, 129.4 (2C), 129.3, 128.6, 128.5, 128.3, 128.1, 127.9, 127.1, 66.4, 66.0, 61.2, 58.0, 50.0, 42.9, 42.3, 39.4 (2C), 29.2, 14.1.

Mass (ESI)(*m*/*z*) : 542.2 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{29}H_{33}N_3NaO_6$ $[M+Na]^+$: 542.2267, found 542.2278.

Synthesis of 2-benzoyl-*N*-benzyl-2,3,4,9-tetrahydro-1H-pyrido[3,4-b]indole-1-carboxamide (4o)



4o

According to the general procedure, *2-benzoyl-N-benzyl-2,3,4,9-tetrahydro-1H-pyrido[3,4-b]indole-1-carboxamide* (**4o**) was obtained from benzoic acid, 1,2,3,4-tetrahydro-*9H*-pyrido[3,4-b]indole and benzylisonitrile, as a yellow solid (98 mg, 47 %).

$C_{26}H_{23}N_3O_2$ (M = 409.48 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 7:3) = 0.21

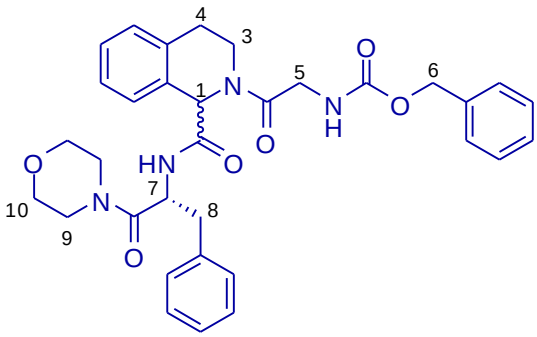
Mp : 68°C

IR (neat, cm^{-1}) : 3359, 2931, 1637, 1507, 1436.

NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm: 11.31 (brs, 1H, NH), 7.90-7.77 (m, 2H, H_{Ar}), 7.66-7.63 (m, 1H, H_{Ar}), 7.44-7.14 (m, 12H, H_{Ar}, H_1), 6.67 (brs, 1H, NH), 4.61-4.58 (m, 2H, PhC$\underline{H_2}$N), 3.86-3.80 (m, 2H, H_3), 3.60-3.54 (m, 2H, H_4).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm: 175.6, 167.5, 162.7, 139.7, 137.6, 136.7, 134.5, 131.1, 130.8, 129.3, 128.9 (2C), 128.4 (2C), 127.9, 127.8, 126.9 (2C), 126.8, 121.2 (2C), 112.9, 76.1, 43.5, 41.0, 25.0.

Synthesis of (*R*)-benzyl 2-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-2-oxoethylcarbamate (4p)



4p, two separable diastereomers

According to the general procedure, *(R)-benzyl 2-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-2-oxoethylcarbamate* (**4p**) was obtained from *N*-carbobenzyloxyglycine, 1,2,3,4-tetrahydroisoquinoline and (*S*)-4-(2-isocyano-3-phenylpropanoyl)morpholine.

Diastereomer **A** : pale yellow solid (85 mg, 36%).

$C_{33}H_{36}N_4O_6$ (M = 584.66 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl Acetate 9:1) = 0.36

IR (neat, cm^{-1}) : 3299, 3030, 2926, 2856, 1715, 1632, 1495, 1435, 1221, 1113.

[*a*]$_D$: - 25.7 (c = 1.1, $CHCl_3$, 25°C)

NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.84 (d, *J* = 8.2 Hz, 1H, NH), 7.28-7.05 (m, 14H, H_{Ar}), 6.28 (brs, 1H, NH), 6.00 (s, 1H, H_1), 5.06 (s, 2H, H_6), 5.00 (dd, *J* = 7.5, 15.4 Hz, 1H, H_7), 4.13-4.04 (m, 2H, H_5), 3.81-3.75 (m, 1H, H_3), 3.49-3.33 (m, 5H, H_3, H_{10}), 3.25-3.20 (m, 1H, H_9), 3.17-3.15 (m, 1H, H_9), 3.07-2.96 (m, 1H, H_4), 2.94-2.90 (m, 2H, H_8), 2.86-2.78 (m, 3H, H_4, H_9).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 169.7, 169.4, 168.4, 156.4, 136.4, 136.0, 135.0, 131.4, 129.4 (2C), 128.4 (6C), 128.2, 127.9 (2C), 127.8, 127.6, 126.9, 66.8, 66.3, 65.9, 57.5, 49.6, 45.9, 43.1, 42.2, 41.2, 39.4, 28.3.

Mass (ESI)(*m*/*z*) : 607.3 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{33}H_{36}N_4NaO_6$ $[M+Na]^+$: 607.2533, found 607.2562.

Diastereomer **B** : Yellow oil (66 mg, 28%).

$C_{33}H_{36}N_4O_6$ (M = 584.66 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl Acetate 9:1) = 0.21

IR (neat, cm^{-1}) : 3398, 3029, 2924, 2857, 1716, 1629, 1435, 1221, 1113.

[*a*]$_D$: + 15.0 (c = 1.0, $CHCl_3$, 25°C)

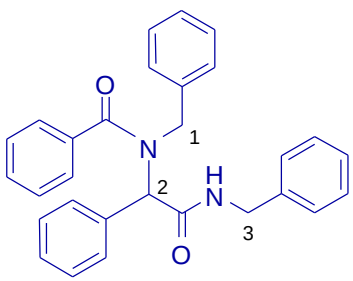
NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm : 7.32-7.16 (m, 12H, H_{Ar}), 7.01-6.98 (m, 2H, H_{Ar}), 6.03 (brs, 1H, NH), 5.93 (s, 1H, H_1), 5.10 (s, 2H, H_6), 4.98 (dd, *J* = 7.3, 15.0 Hz, 1H, H_7), 4.15-4.11 (m, 2H, H_5), 3.82-3.77 (m, 1H, H_3), 3.54-3.36 (m, 6H, H_3, H_{10}, H_9), 3.30-3.22 (m, 1H, H_9), 2.98-2.92 (m, 3H, H_9, H_4), 2.87-2.81 (m, 3H, H_4, H_8).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm : 169.4, 169.1, 168.5, 156.3, 136.4, 135.9, 134.6, 131.4, 129.4 (2C), 129.3 (4C), 128.6, 128.5 (2C), 128.3, 128.0, 127.7, 127.1, 127.0, 66.9, 66.4, 66.0, 57.6, 50.0, 45.9, 43.1, 42.3, 41.3, 39.3, 28.3.

Mass (ESI)(*m*/*z*) : 607.3 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{33}H_{36}N_4NaO_6$ $[M+Na]^+$: 607.2533, found 607.2559.

Synthesis of *N*-benzyl-*N*-[2-(benzylamino)-2-oxo-1-phenylethyl]benzamide (4q)



4q

According to the general procedure, *N-benzyl-N-[2-(benzylamino)-2-oxo-1-phenylethyl]benzamide* (**4q**) was obtained from benzoic acid, dibenzylamine and benzylisonitrile, as a white solid (71 mg, 32 %).

$C_{29}H_{26}N_2O_2$ (M = 434.53 g.mol^{-1})

***R*$_f$** (Heptane / Ethyl acetate 7:3) = 0.38

Mp : 58°C

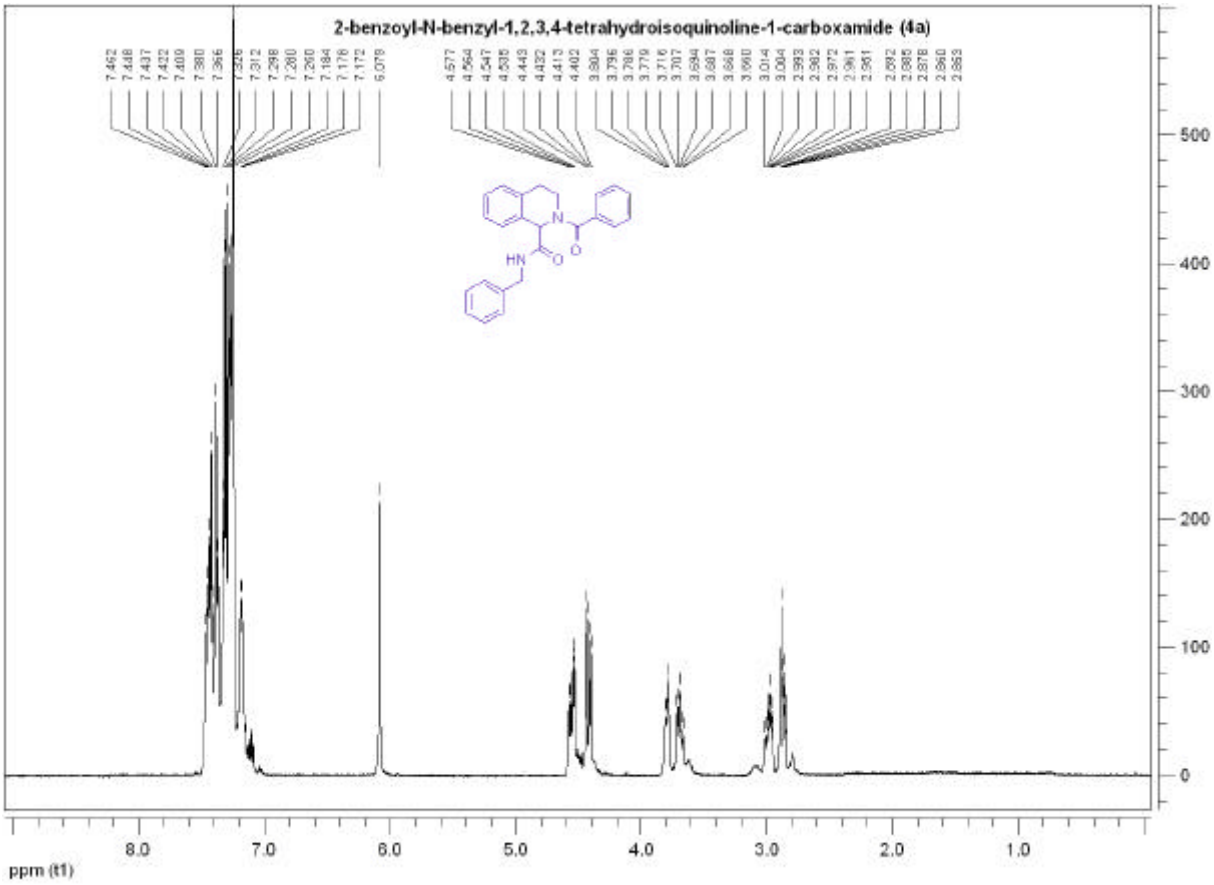
IR (neat, cm^{-1}) : 3286, 3061, 2987, 2901, 1626, 1520, 1495, 1453, 1407, 1250.

NMR ^{1}H ($CDCl_3$, 300 MHz, 293K) *d* ppm: 7.51-7.49 (m, 2H, H_{Ar}), 7.40-7.26 (m, 14H, H_{Ar}), 7.20-7.09 (m, 4H, H_{Ar}), 6.08 (brs, 1H, NH), 5.51 (s, 1H, H_2), 4.78 (d, *J* = 16.5 Hz, 1H, H_1), 4.50-4.46 (m, 3H, H_1, H_3).

NMR ^{13}C ($CDCl_3$, 75 MHz, 293K) *d* ppm: 173.1, 169.2, 134.7, 129.9 (2C), 129.7 (2C), 128.9 (3C), 128.7 (2C), 128.6 (2C), 128.5, 128.4, 128.3 (2C), 128.2, 127.6 (2C), 127.5, 127.4, 127.3, 127.0, 126.7, 77.2, 43.7 (2C).

Mass (ESI)(*m*/*z*) : 457.1 $[M+Na]^+$

HRMS (ESI) : calculated for $C_{29}H_{26}N_2NaO_2$ $[M+Na]^+$: 457.1892, found 457.1898.


2-benzoyl-N-benzyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4a)
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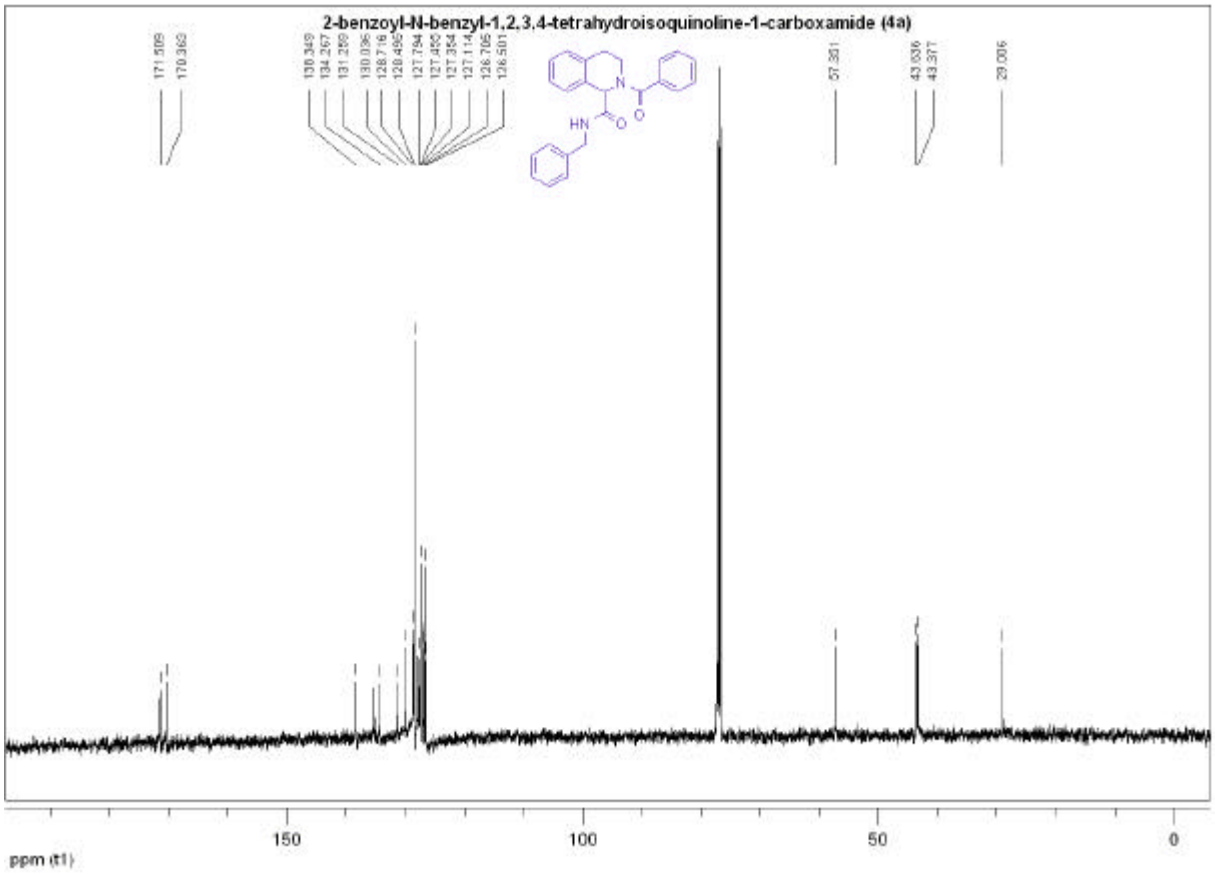
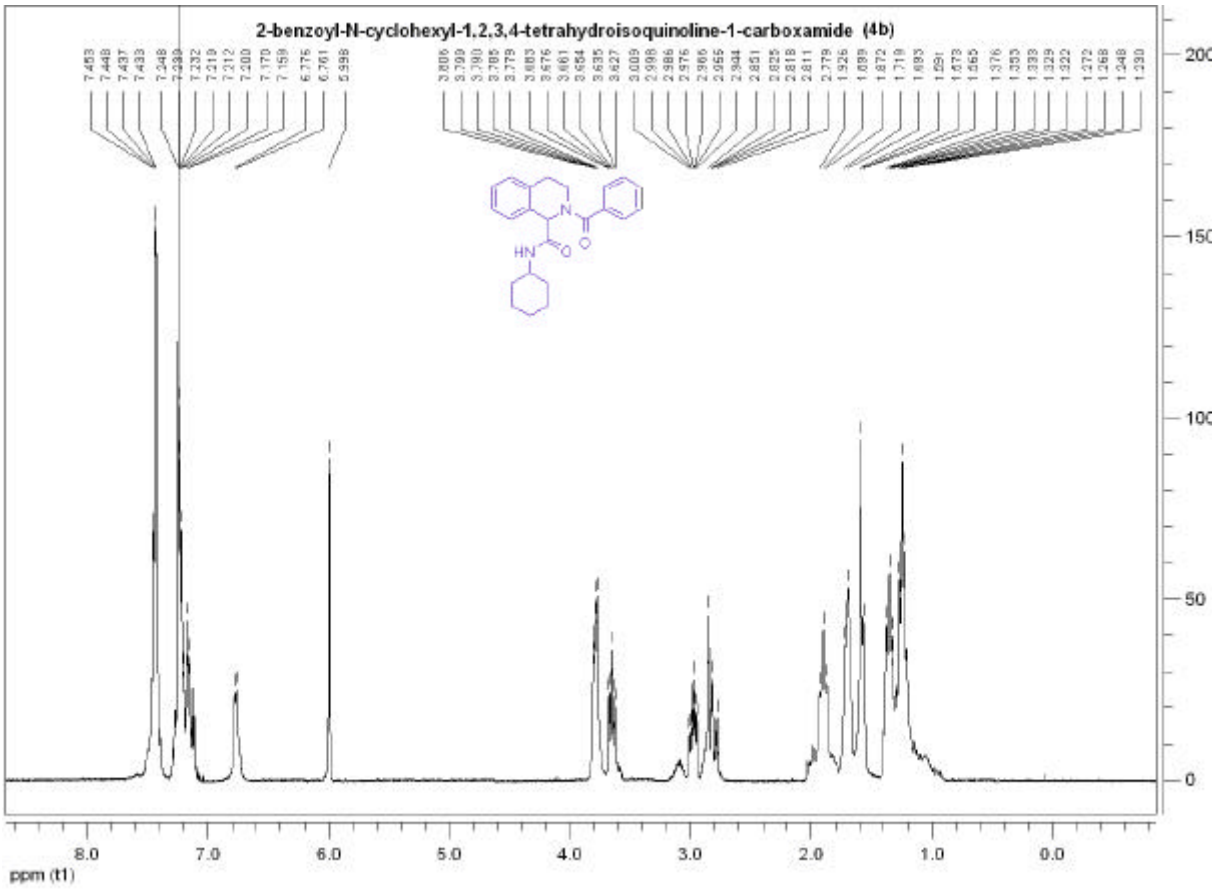
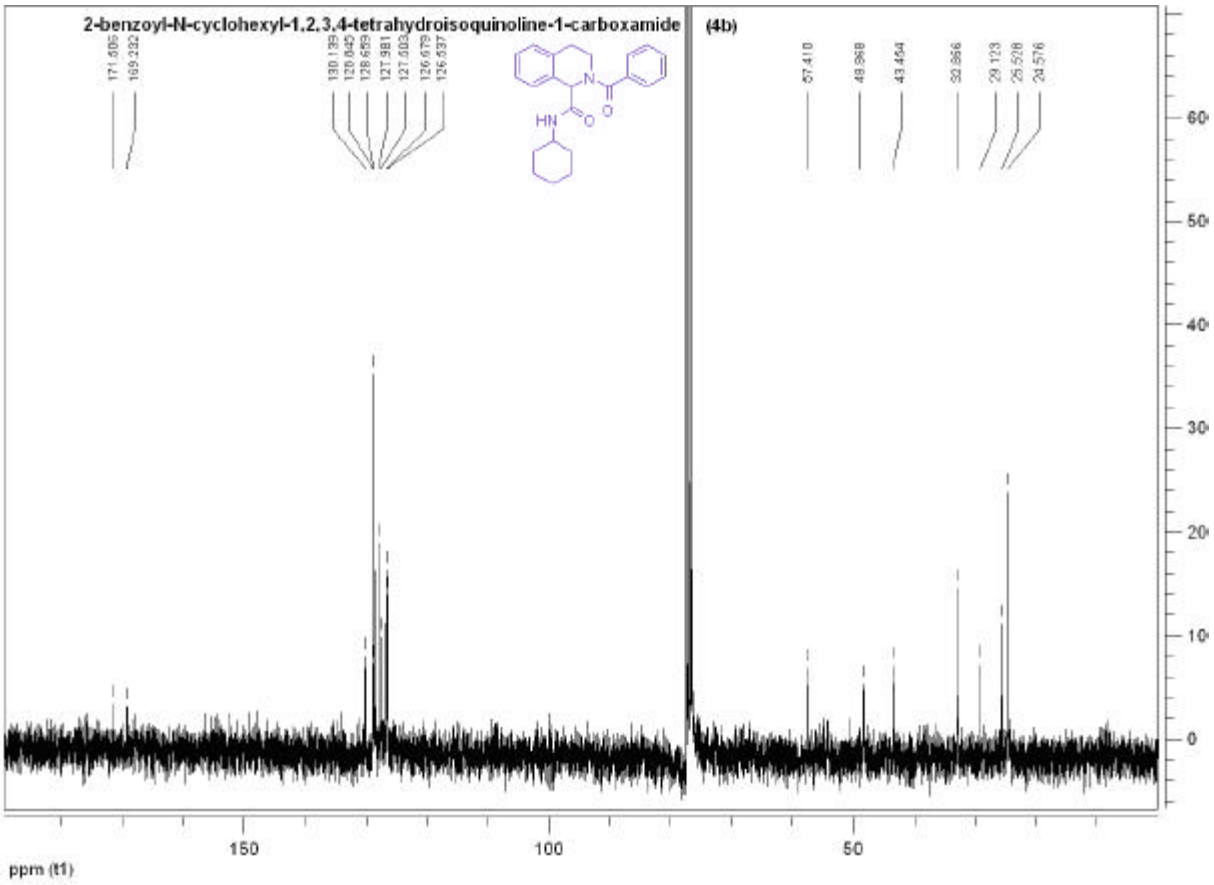
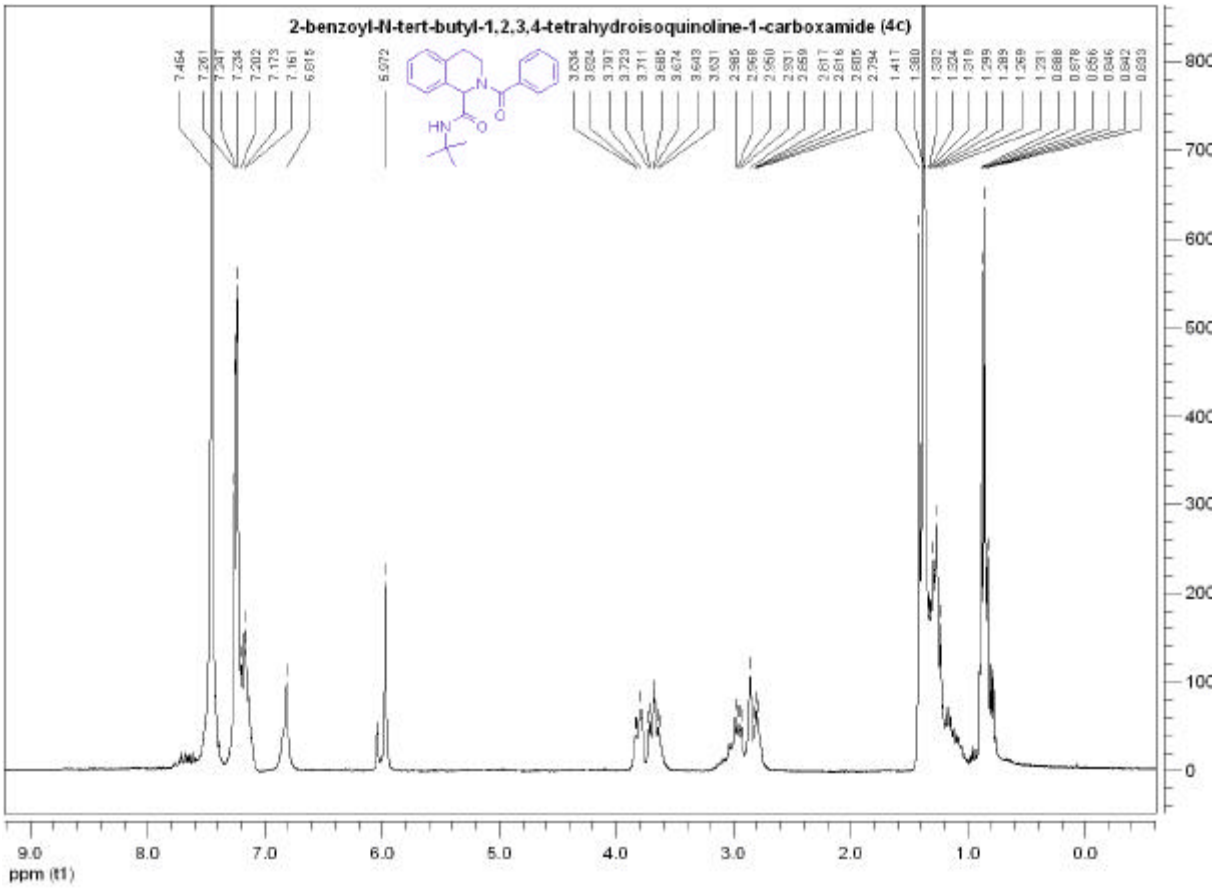
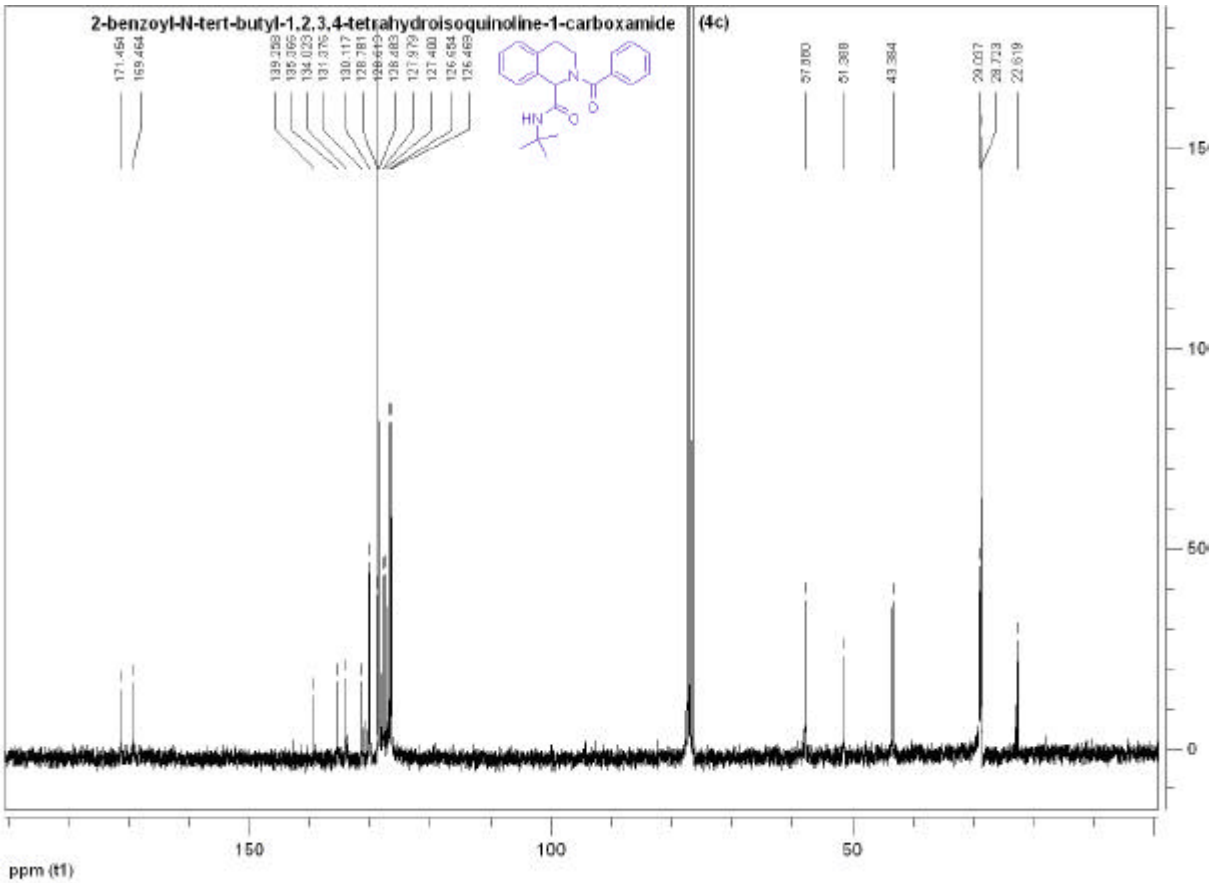
7.448
7.437
7.422
7.409
7.380
7.366
7.326
7.312
7.298
7.260
7.184
7.176
7.172
6.078
4.577
4.564
4.547
4.535
4.443
4.432
4.413
4.402
3.804
3.796
3.786
3.779
3.716
3.707
3.694
3.687
3.668
3.660
3.014
3.004
2.993
2.982
2.972
2.961
2.951
2.892
2.885
2.878
2.860
2.853
HN
O
N
O
500
400
300
200
100
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
ppm (t1)

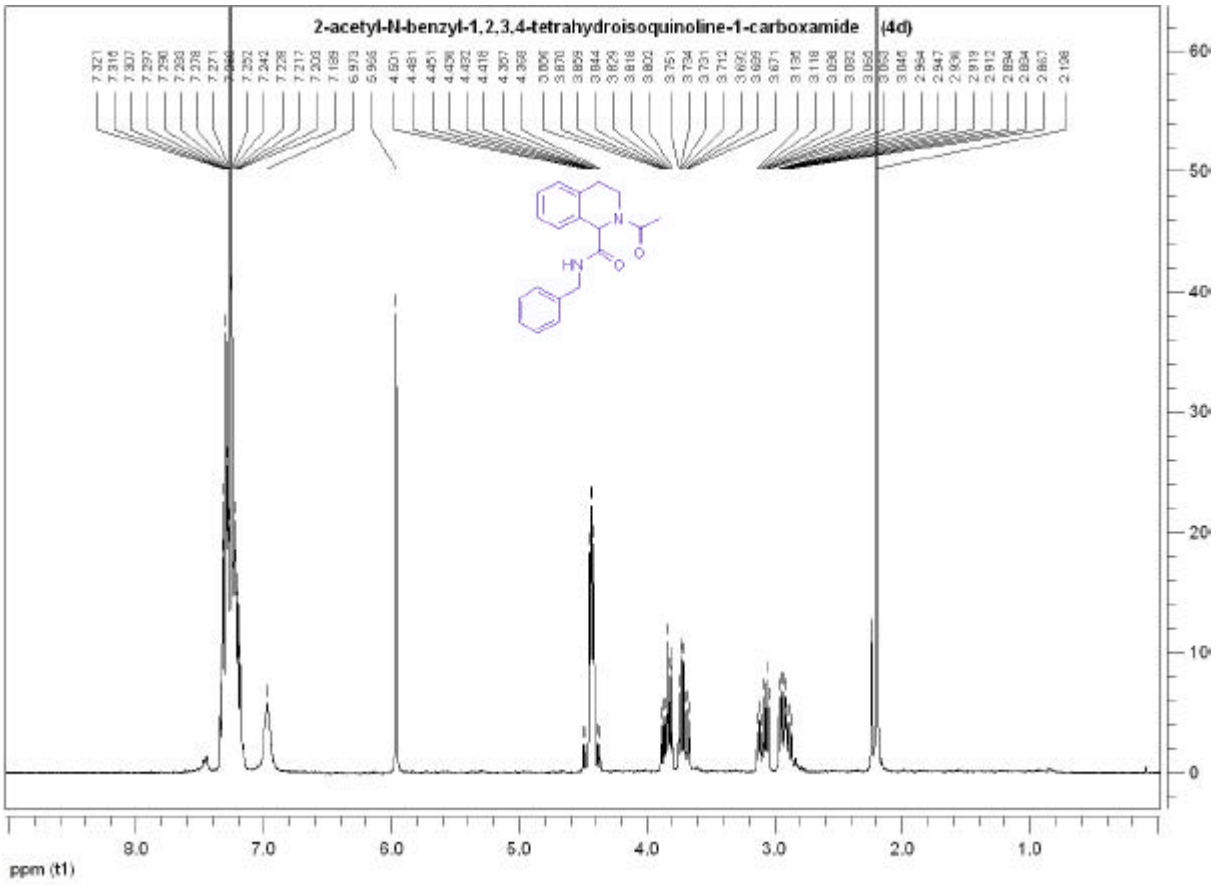

2-benzoyl-N-benzyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4a)
171.509
170.362
136.349
134.257
131.259
130.036
128.716
128.495
127.794
127.450
127.354
127.114
126.705
126.501
57.331
43.936
43.377
29.006
HN
O
N
O
150
100
50
0
ppm (t1)

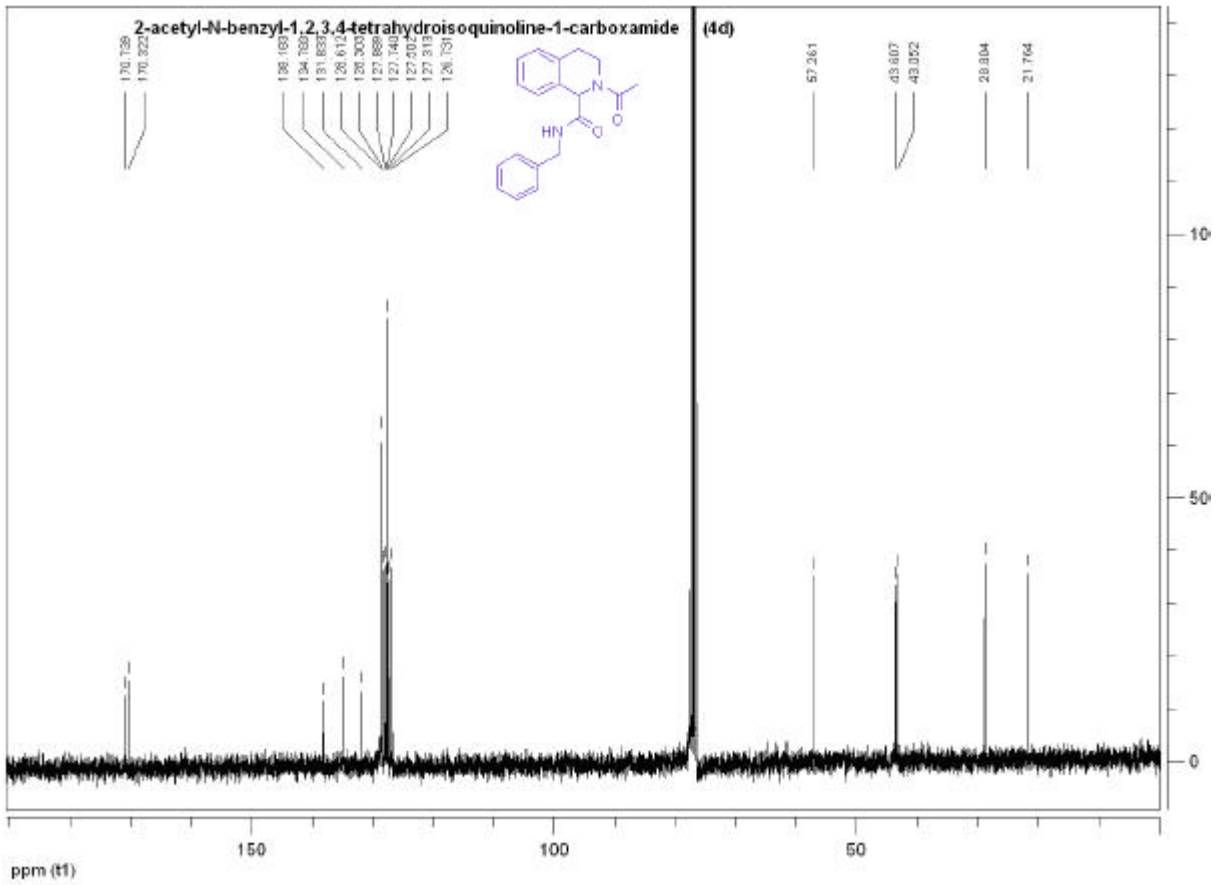

2-benzoyl-N-cyclohexyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4b)
ppm (t1)

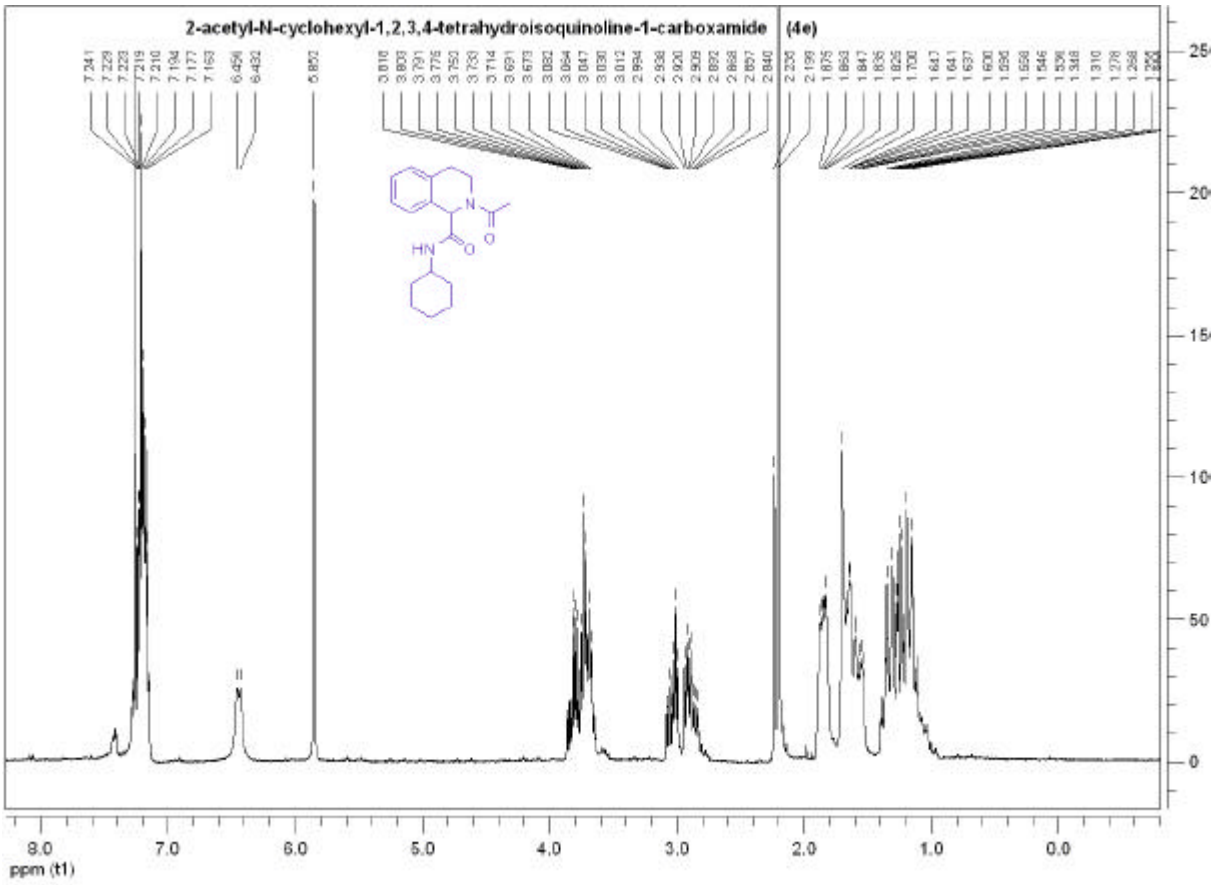

2-benzoyl-N-cyclohexyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide
(4b)
ppm (t1)

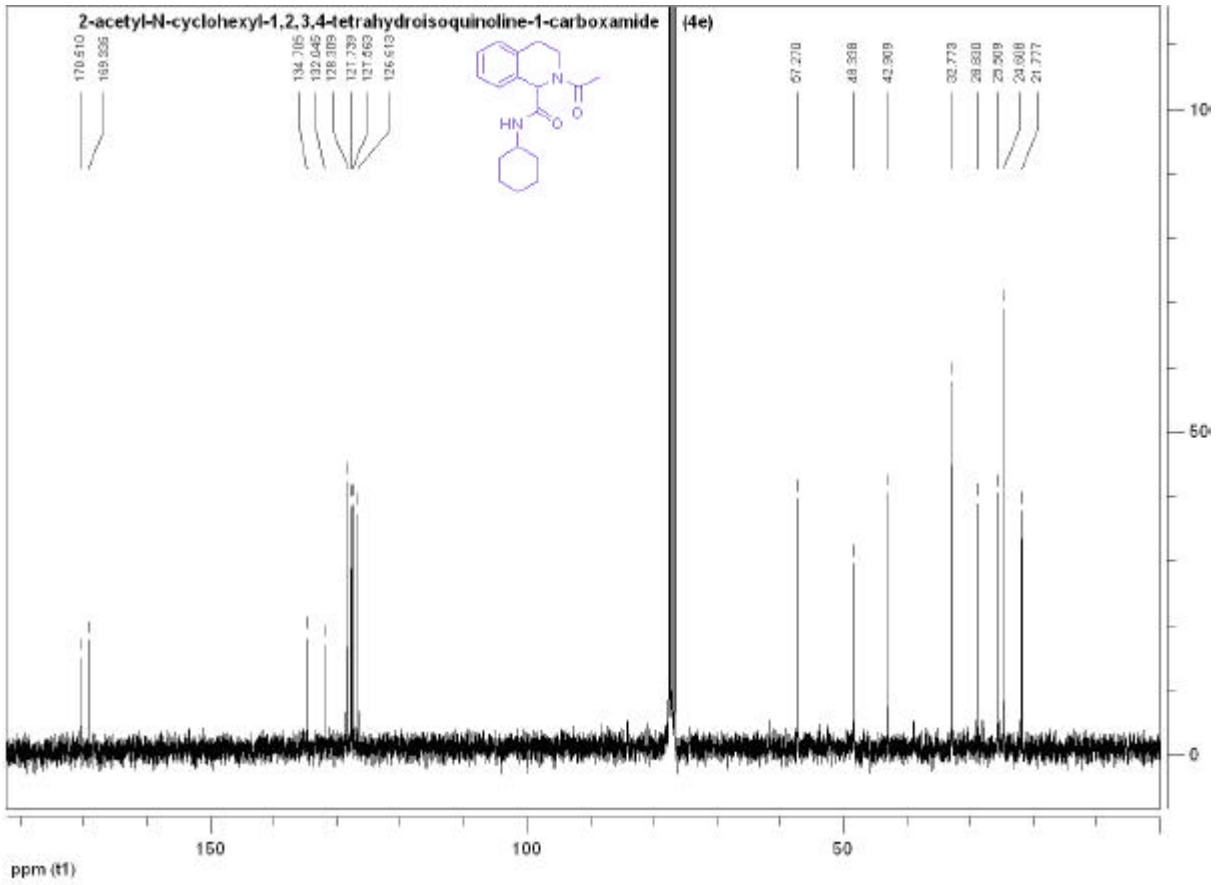

2-benzoyl-N-tert-butyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4c)
ppm (t1)

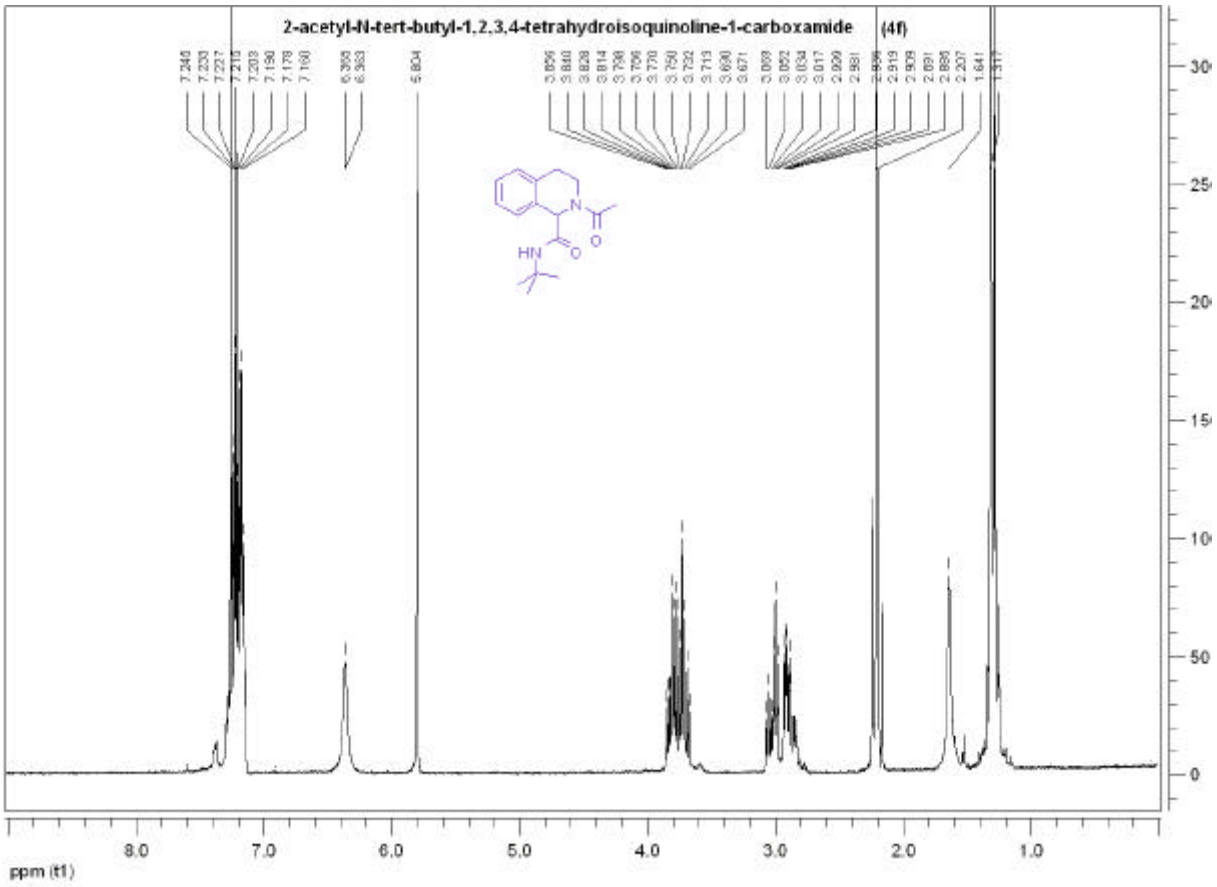

2-benzoyl-N-tert-butyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide
(4c)
ppm (t1)

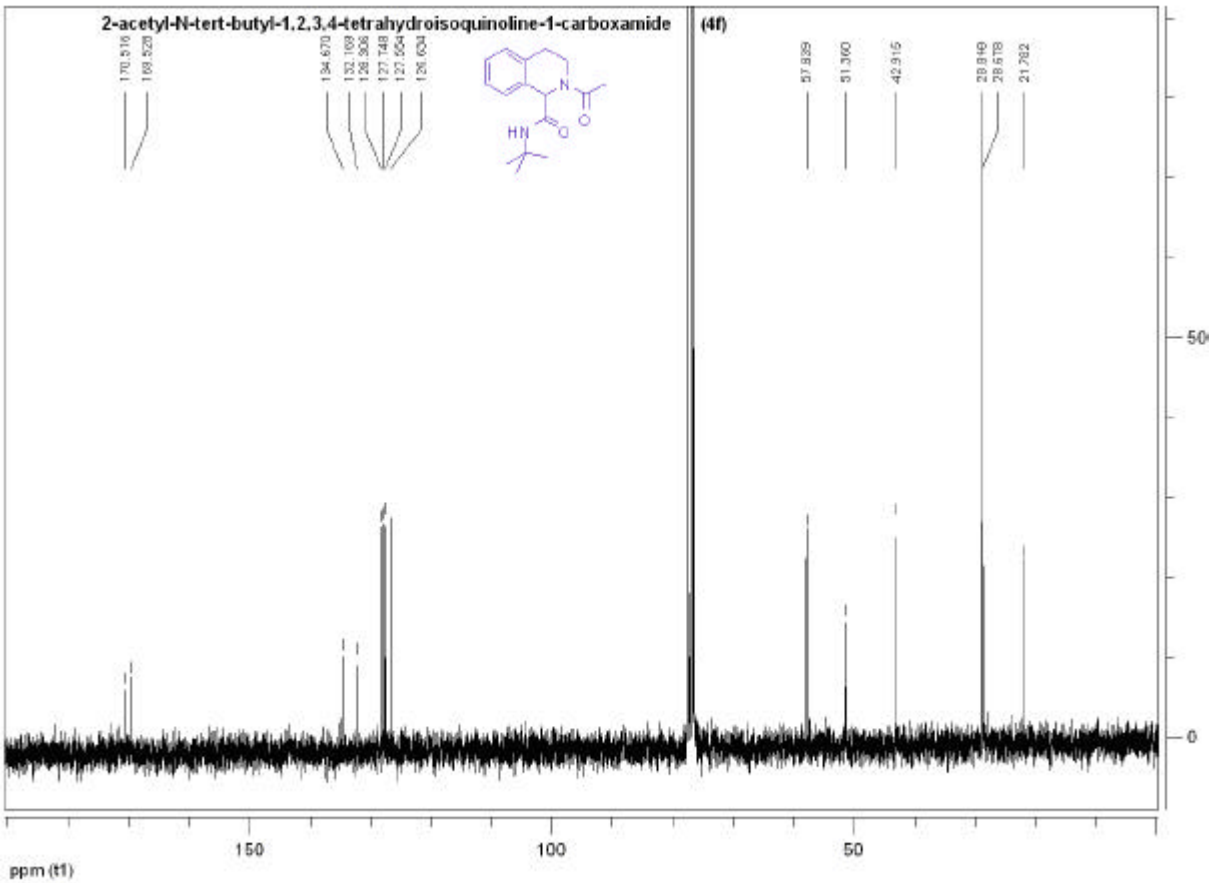

2-acetyl-N-benzyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4d)
ppm (t1)

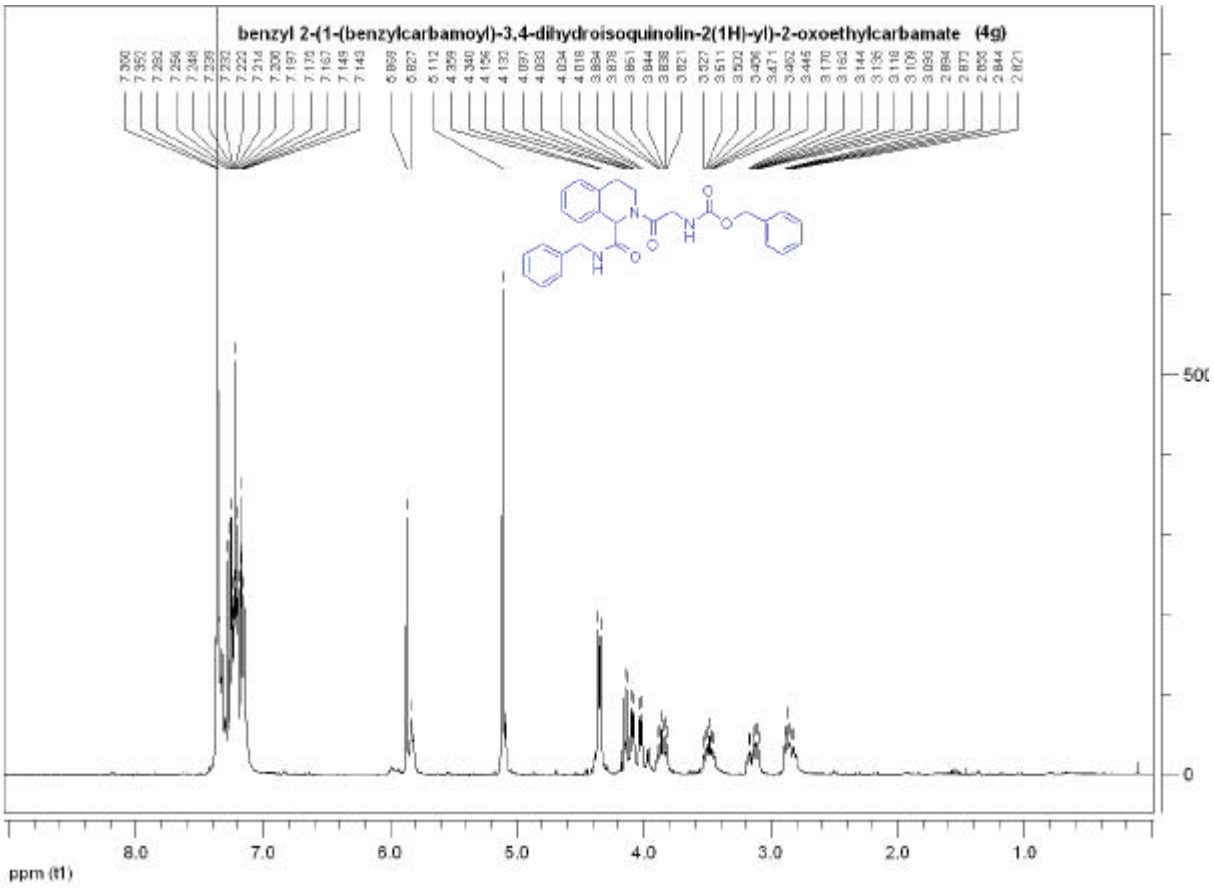

2-acetyl-N-benzyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4d)
ppm (t1)

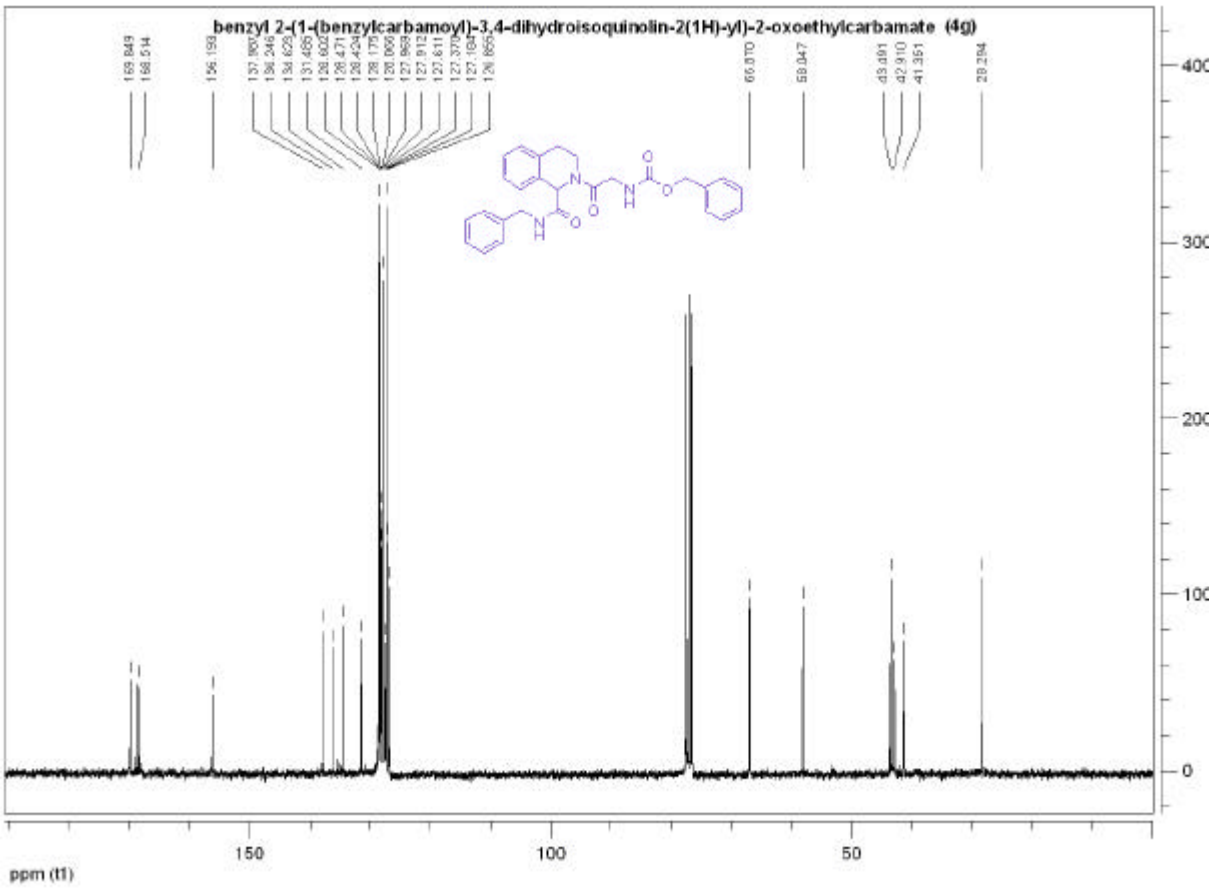

2-acetyl-N-cyclohexyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide
(4e)
ppm (t1)

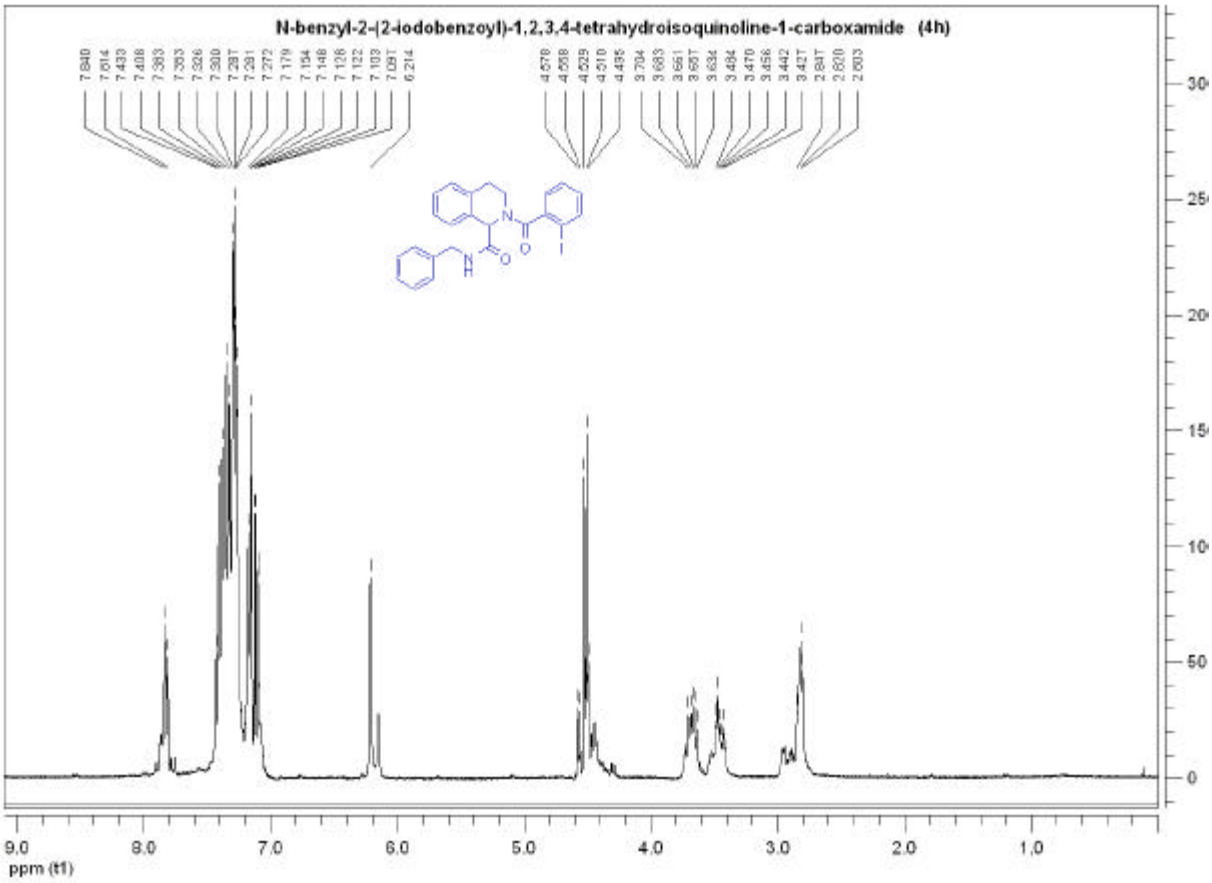

2-acetyl-N-cyclohexyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide
(4e)
ppm (t1)

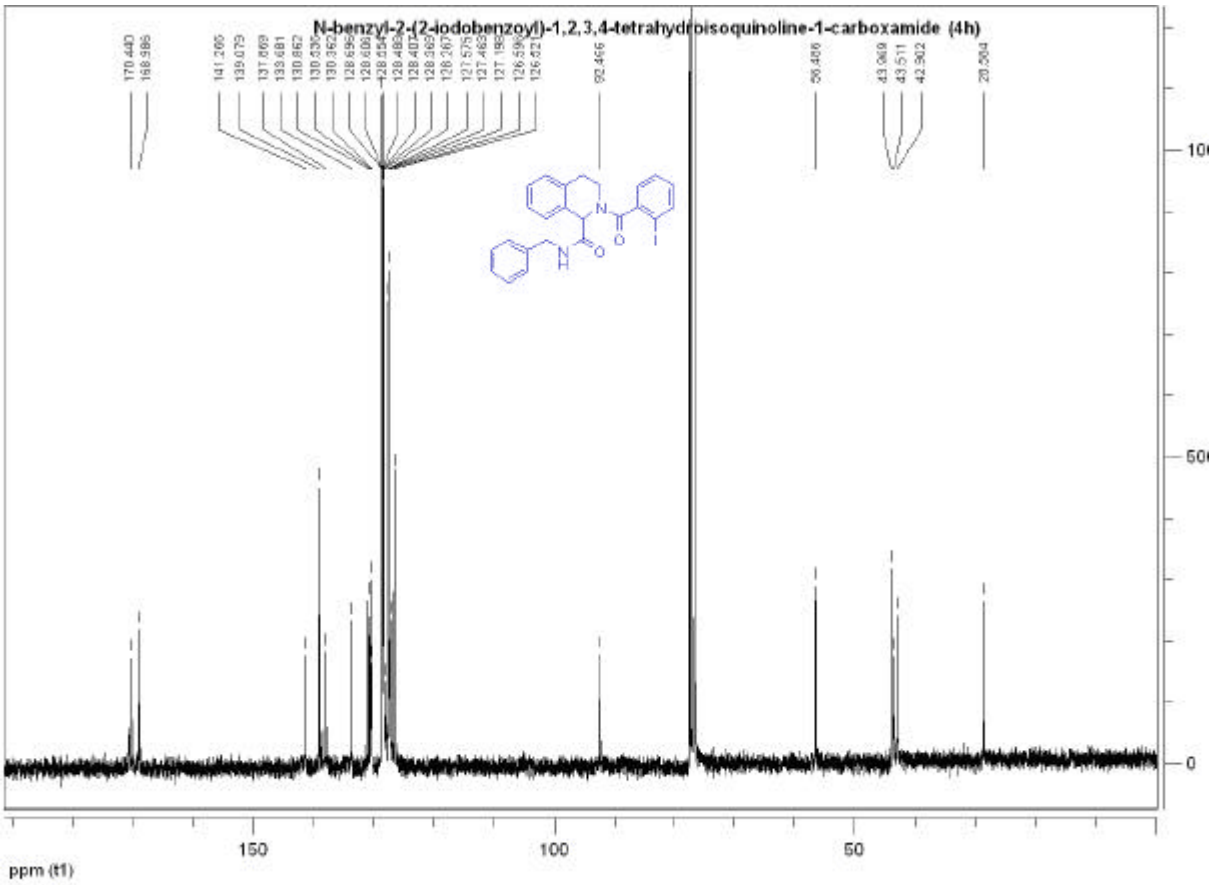

2-acetyl-N-tert-butyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide
(4f)
ppm (t1)

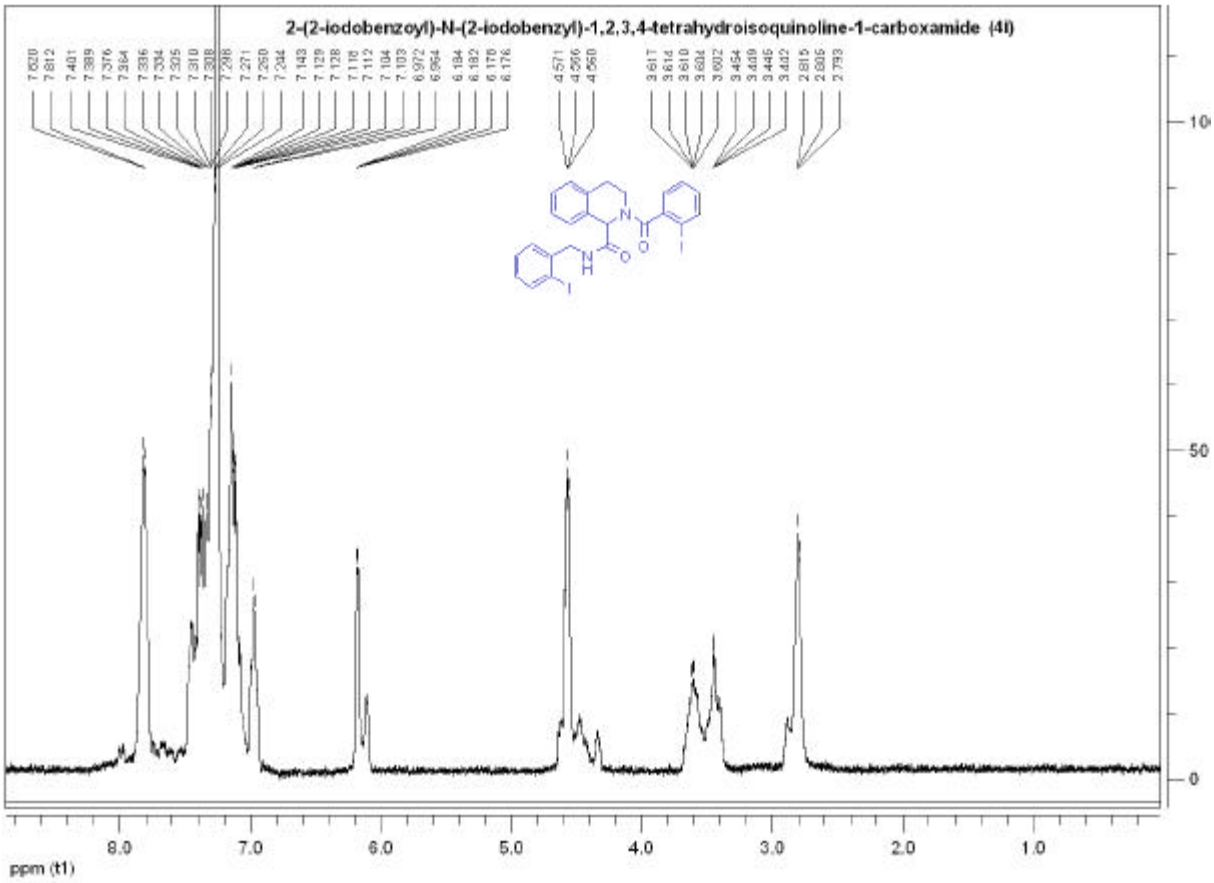

2-acetyl-N-tert-butyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide
(4f)
ppm (t1)

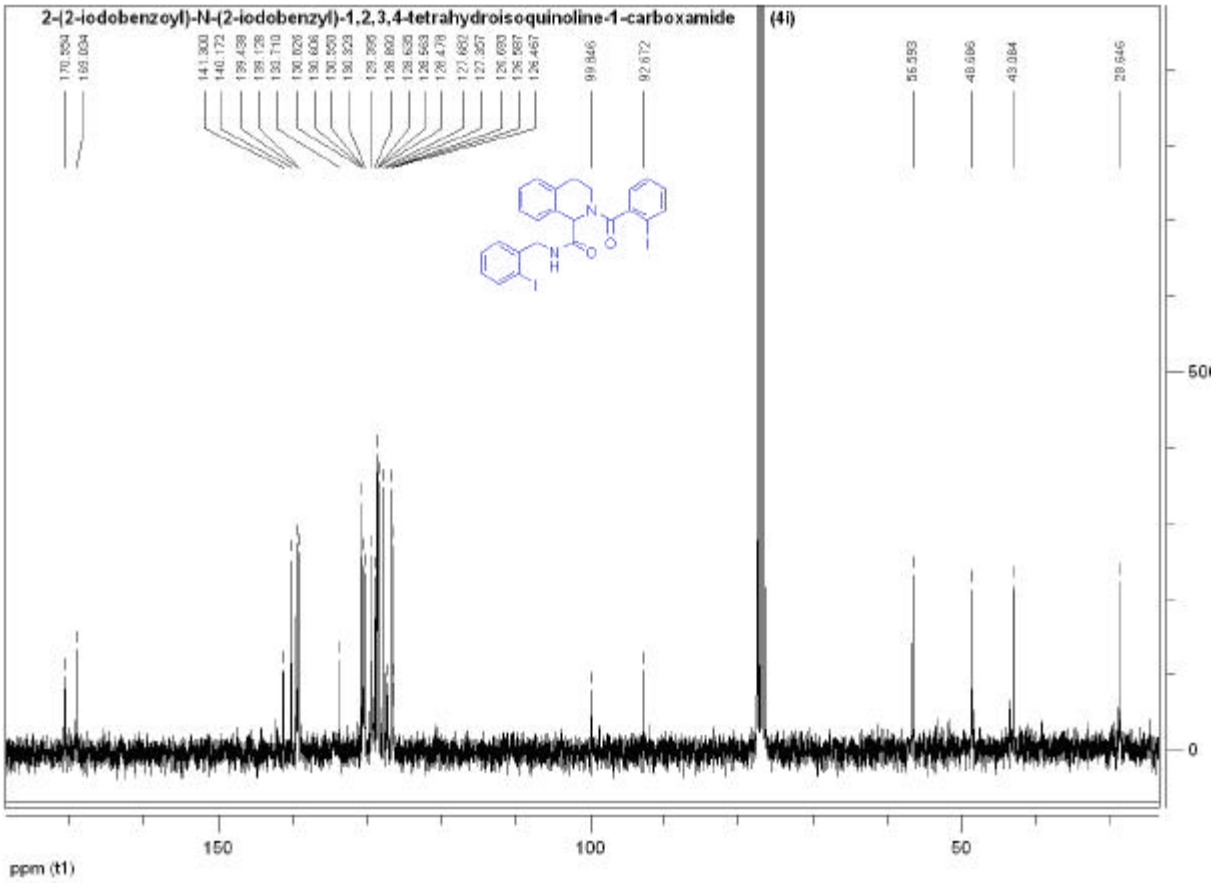

benzyl 2-(1-(benzylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-2-oxoethylcarbamate (4g)
ppm (t1)

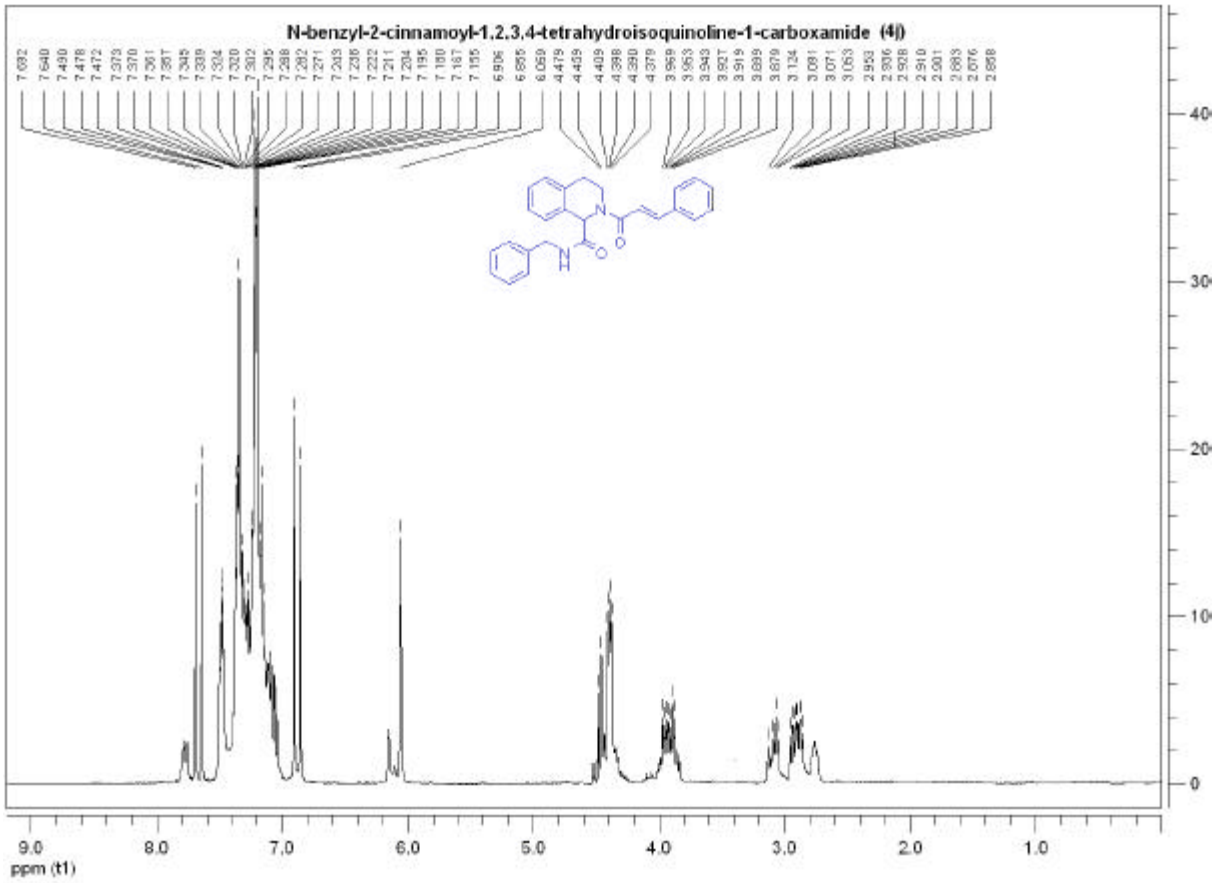

benzyl 2-(1-(benzylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-2-oxoethylcarbamate (4g)
ppm (t1)

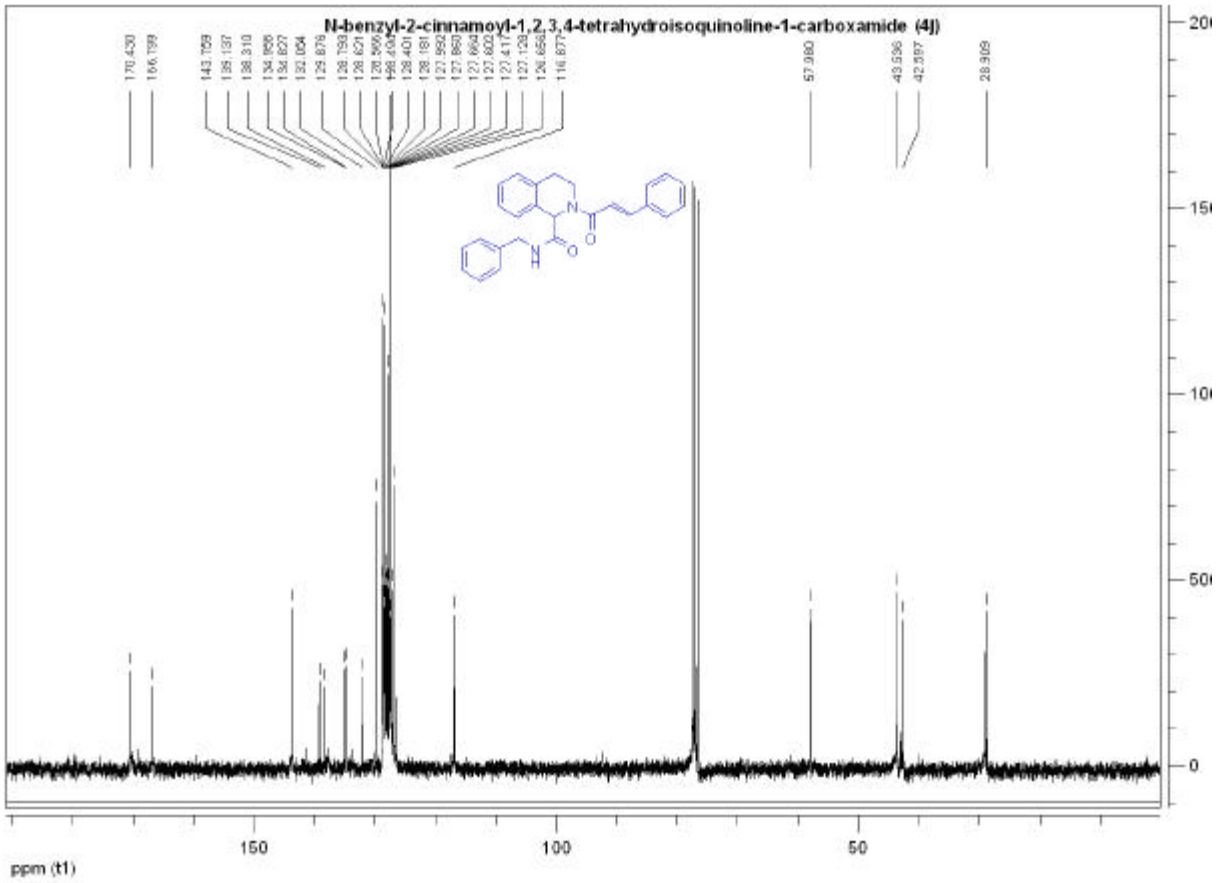

N-benzyl-2-(2-iodobenzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4h)
ppm (t1)

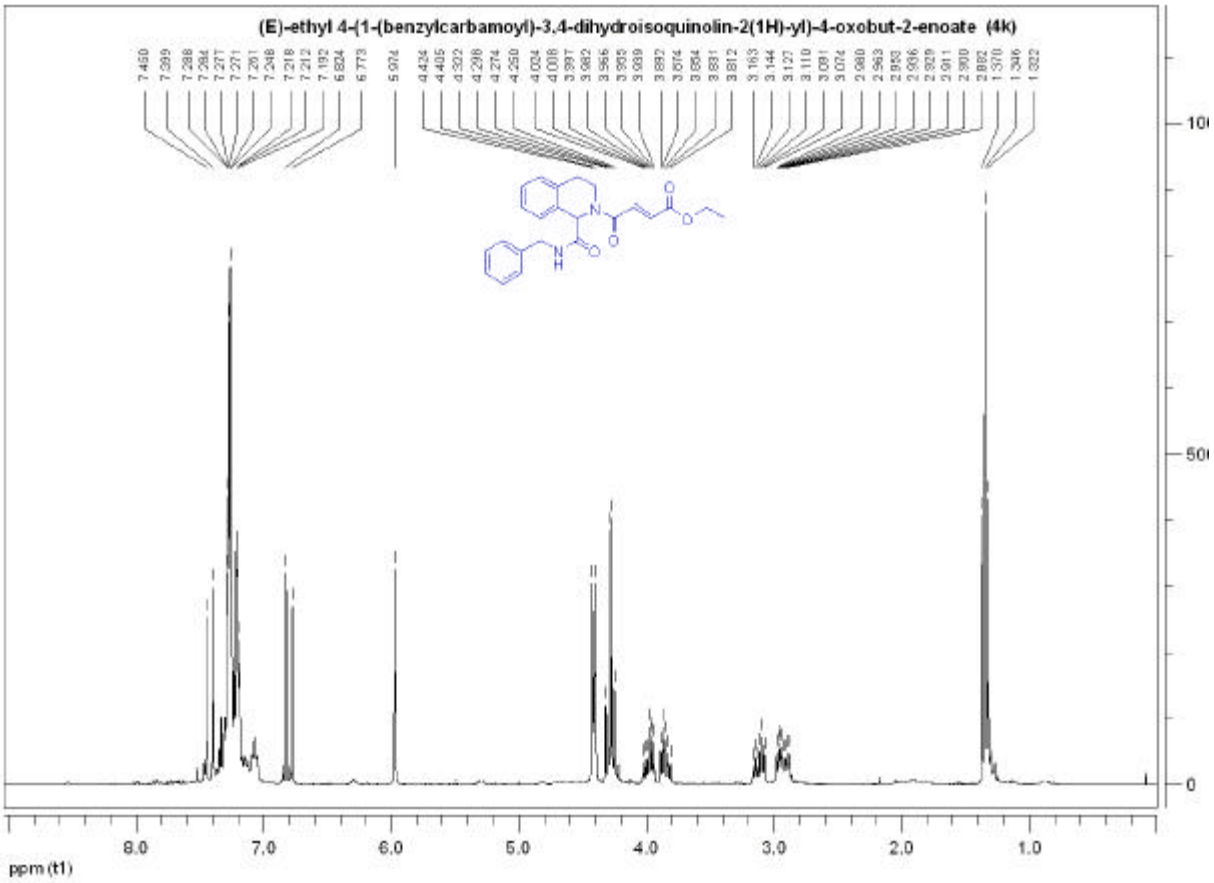

N-benzyl-2-(2-iodobenzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4h)
ppm (t1)

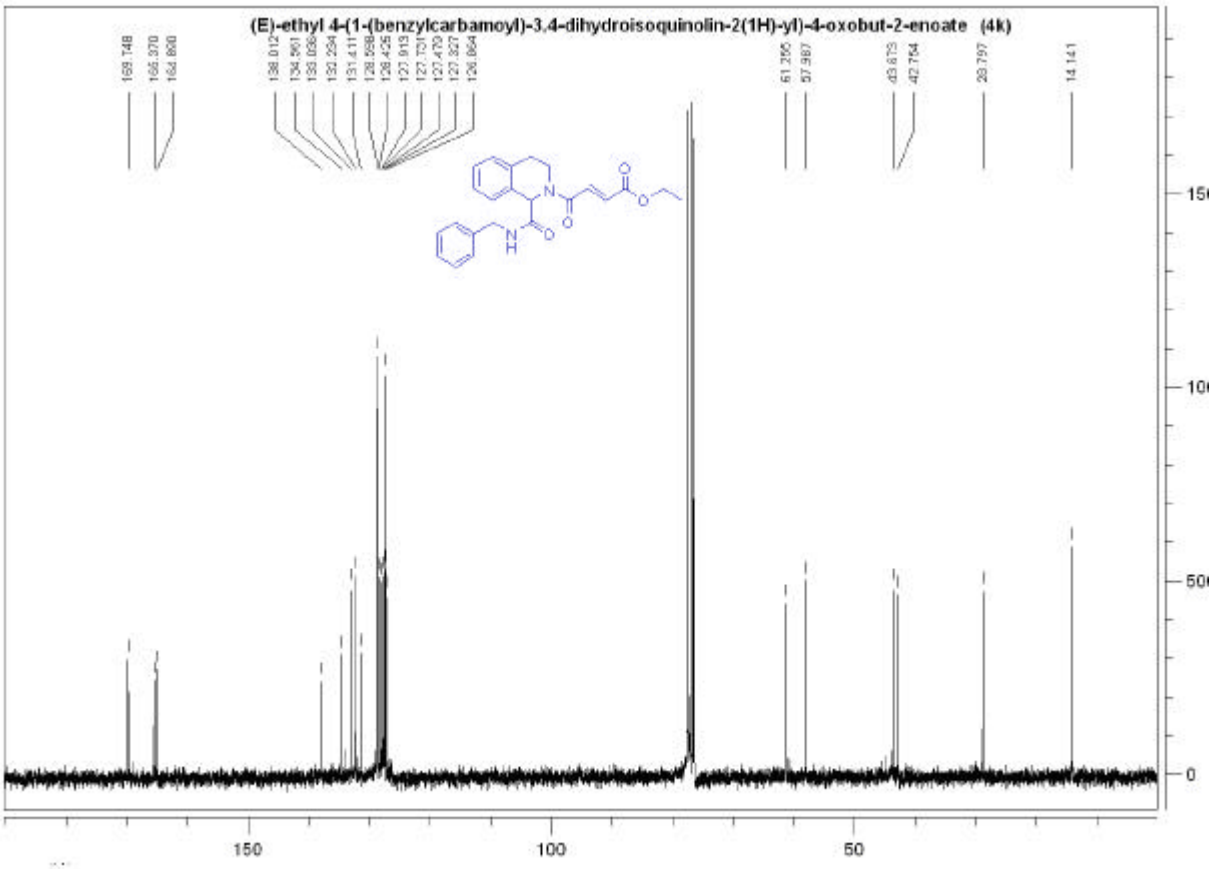

2-(2-iodobenzoyl)-N-(2-iodobenzyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4i)
ppm (t1)

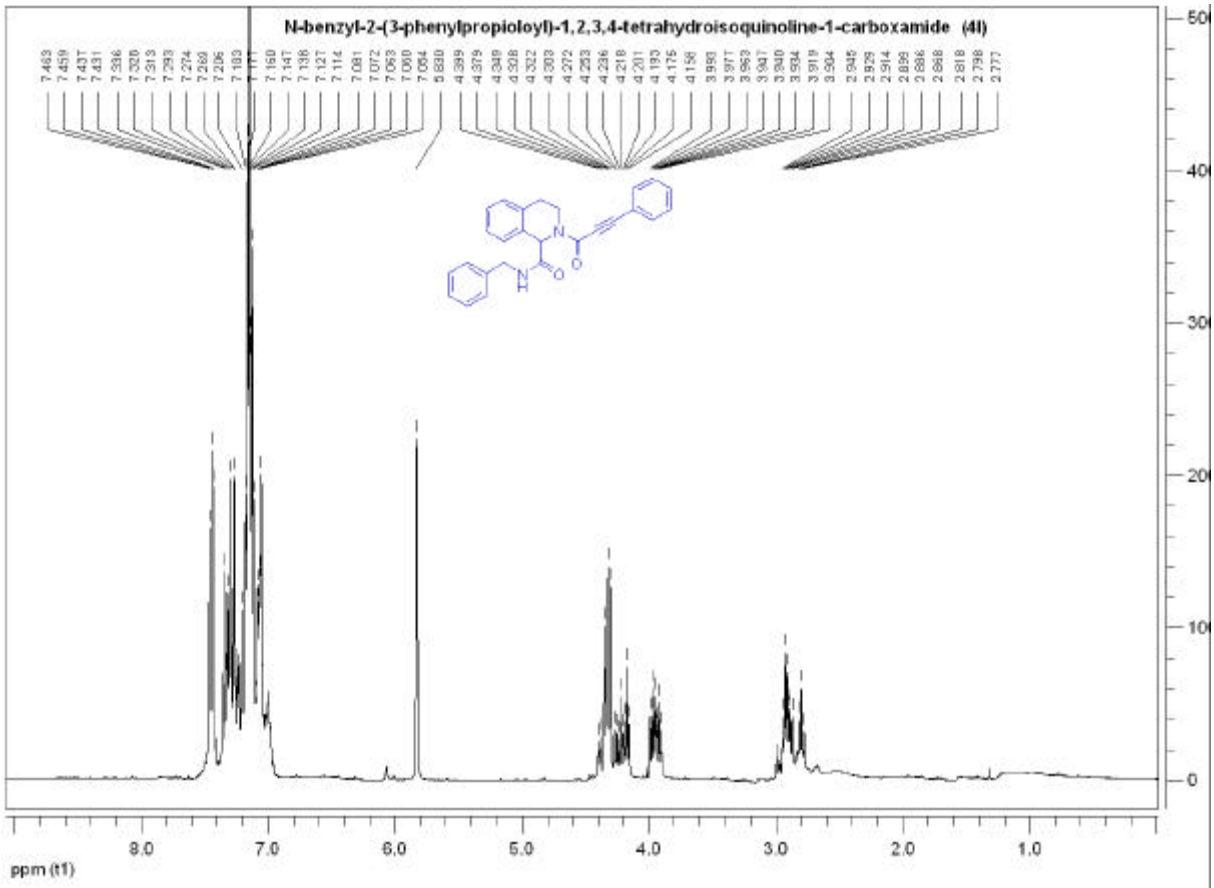

2-(2-iodobenzoyl)-N-(2-iodobenzyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide
(4i)
ppm (t1)

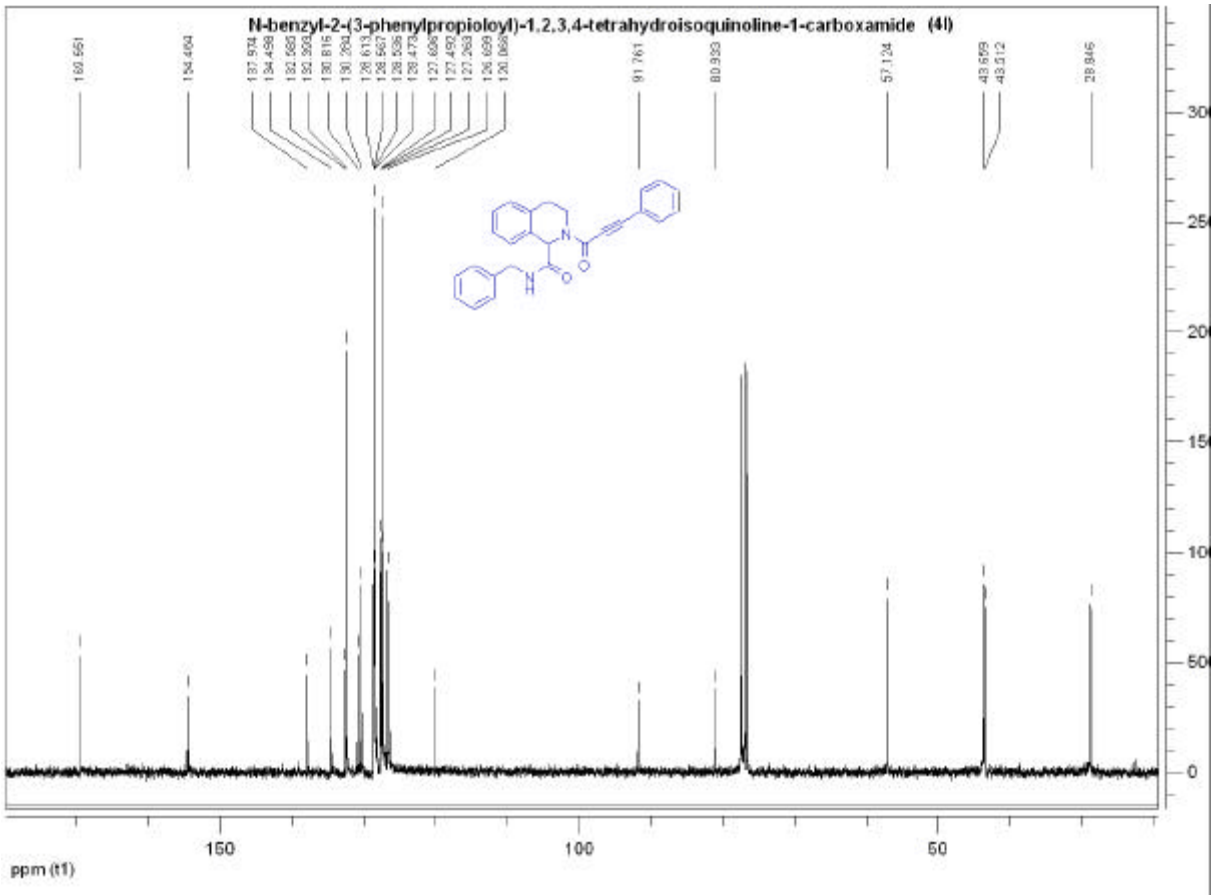

N-benzyl-2-cinnamoyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4j)
ppm (t1)

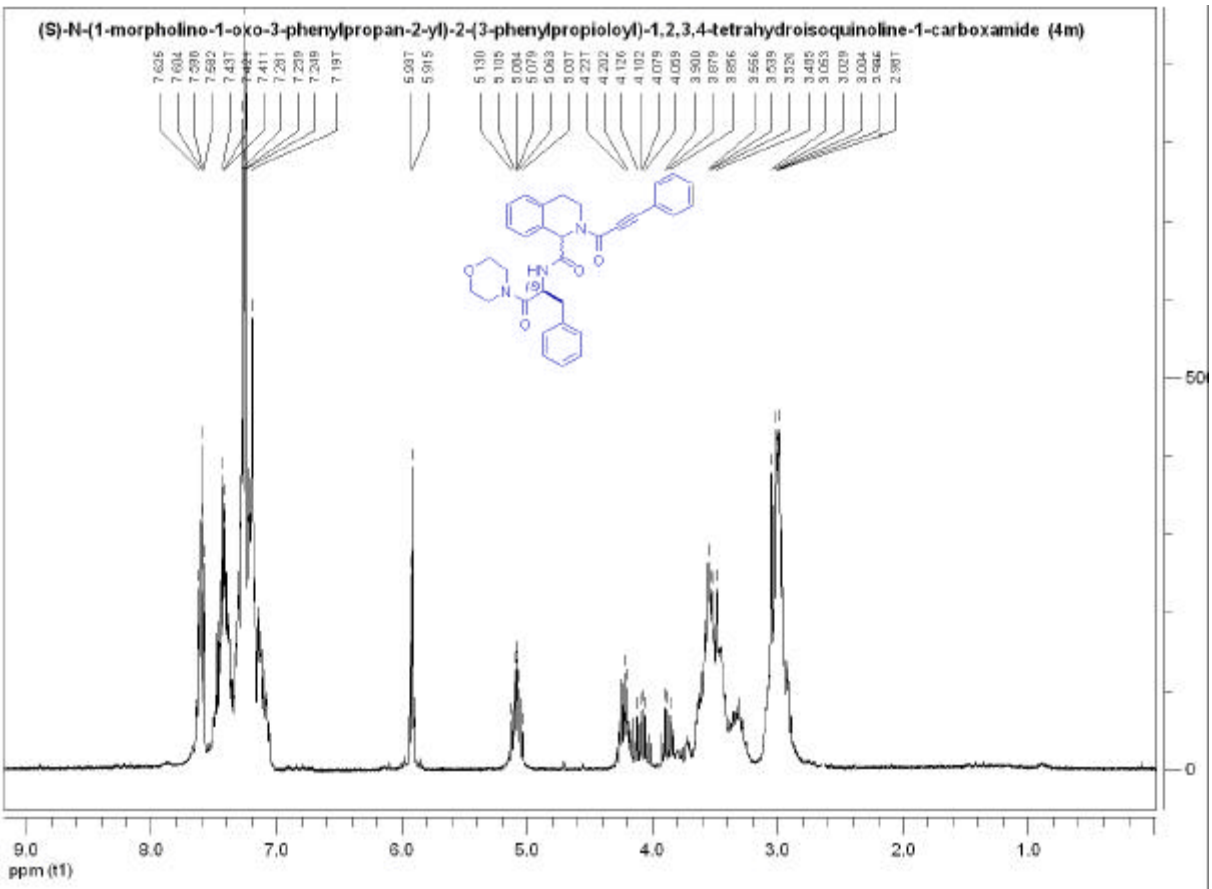

N-benzyl-2-cinnamoyl-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4j)
ppm (t1)

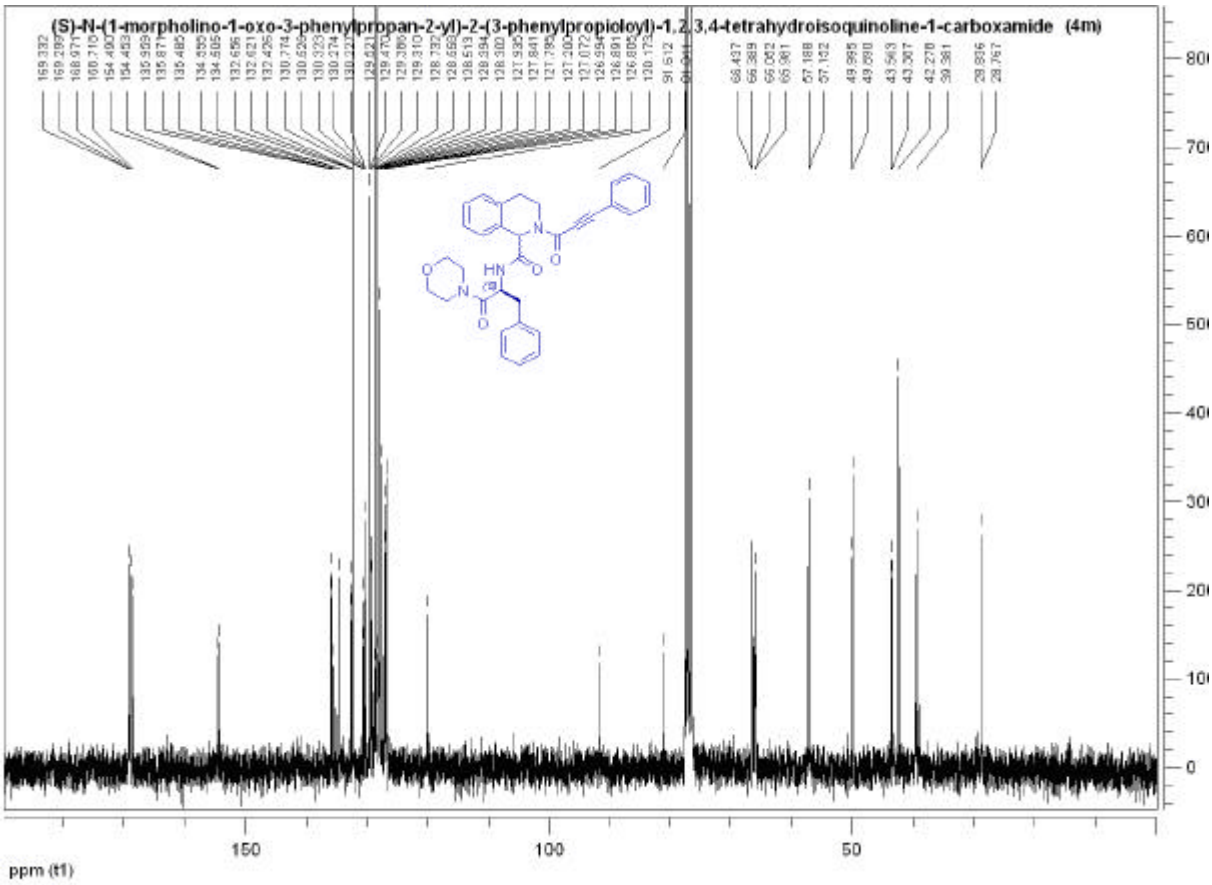

(E)-ethyl 4-(1-(benzylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-4-oxobut-2-enoate (4k)
7.460
7.399
7.288
7.284
7.277
7.271
7.261
7.248
7.218
7.212
7.192
6.824
6.773
5.974
4.434
4.405
4.322
4.296
4.274
4.250
4.024
4.008
3.997
3.982
3.956
3.935
3.909
3.892
3.874
3.854
3.831
3.812
3.163
3.144
3.127
3.110
3.091
3.074
2.980
2.963
2.953
2.936
2.929
2.911
2.900
2.882
1.370
1.346
1.322
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
ppm (t1)

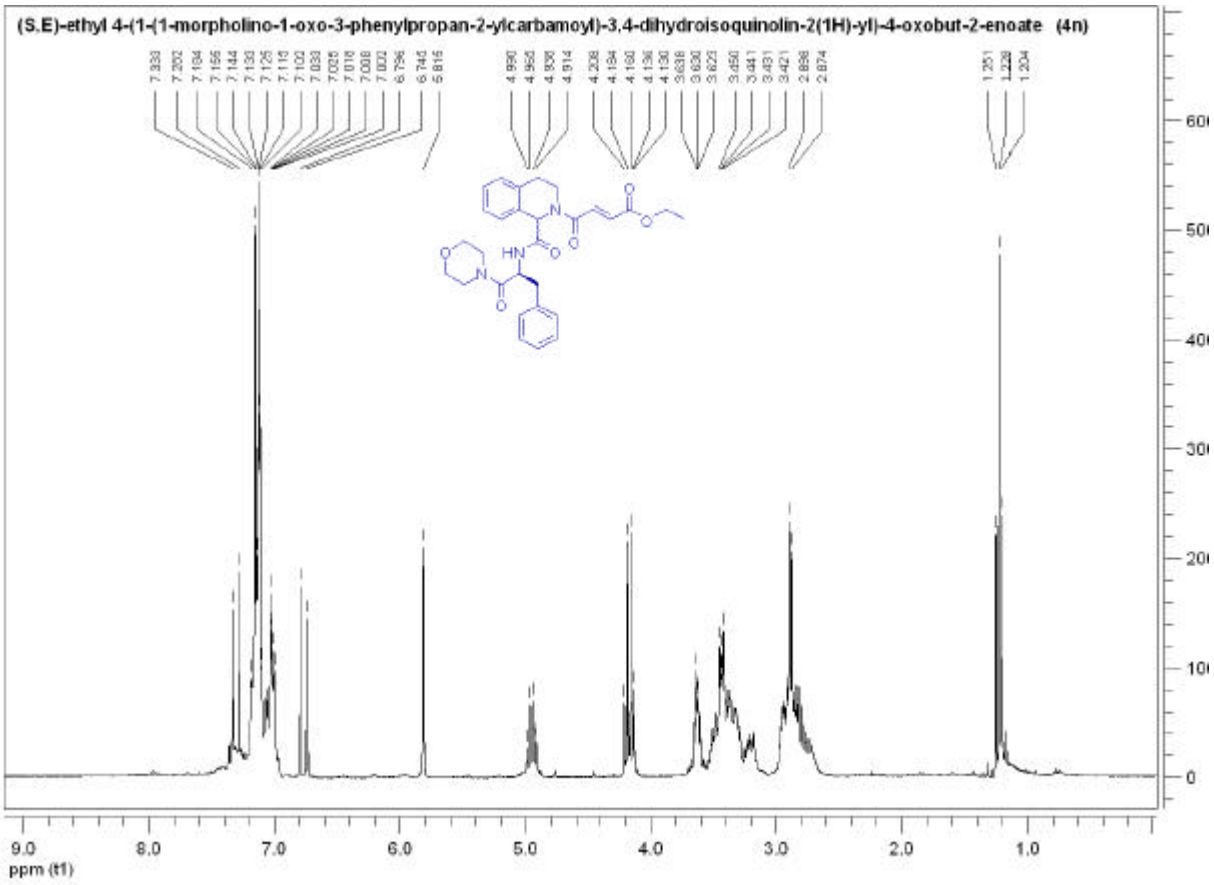

(E)-ethyl 4-(1-(benzylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-4-oxobut-2-enoate (4k)
169.748
165.370
164.800
136.012
134.961
133.036
132.254
131.411
128.598
128.425
127.913
127.731
127.479
127.327
126.864
61.395
57.987
43.673
42.754
28.797
14.141
150
100
50

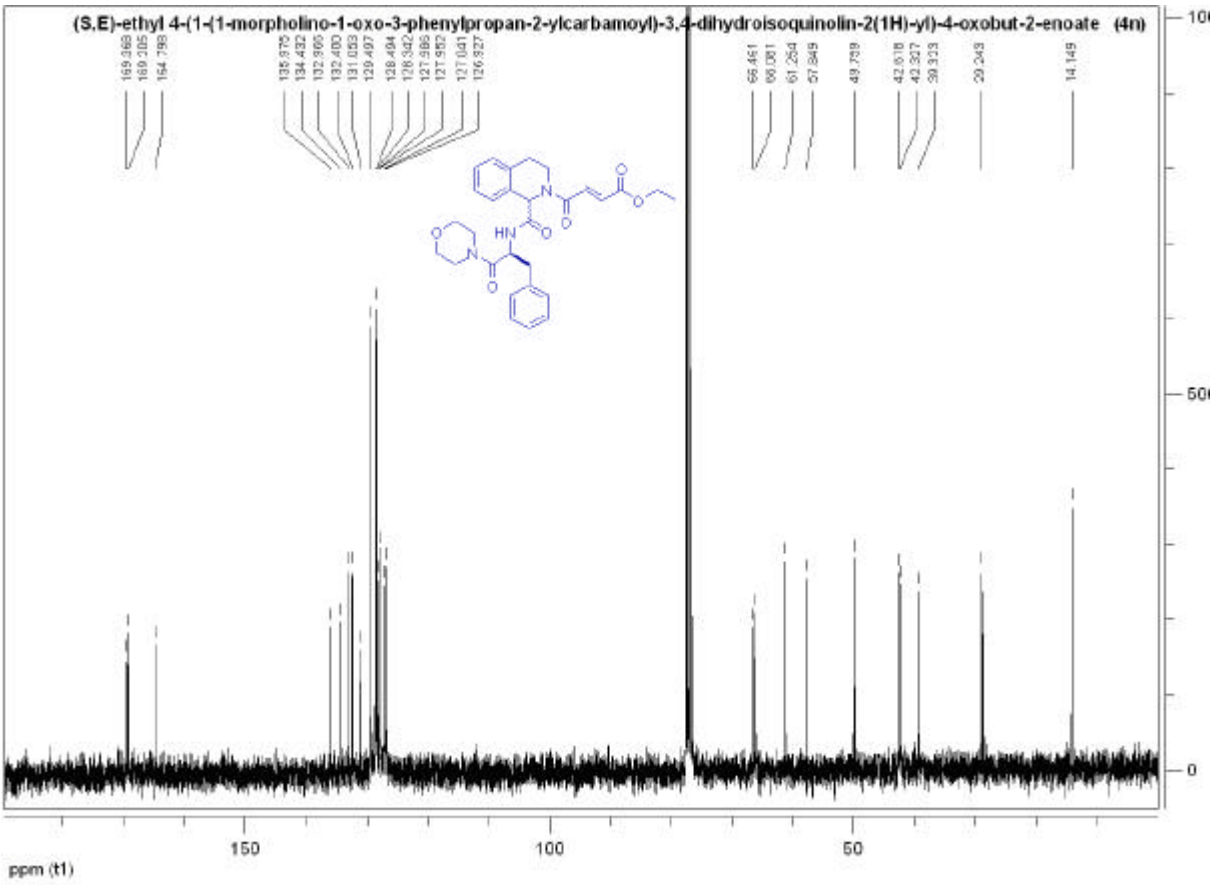

N-benzyl-2-(3-phenylpropioloyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4l)
ppm (t1)

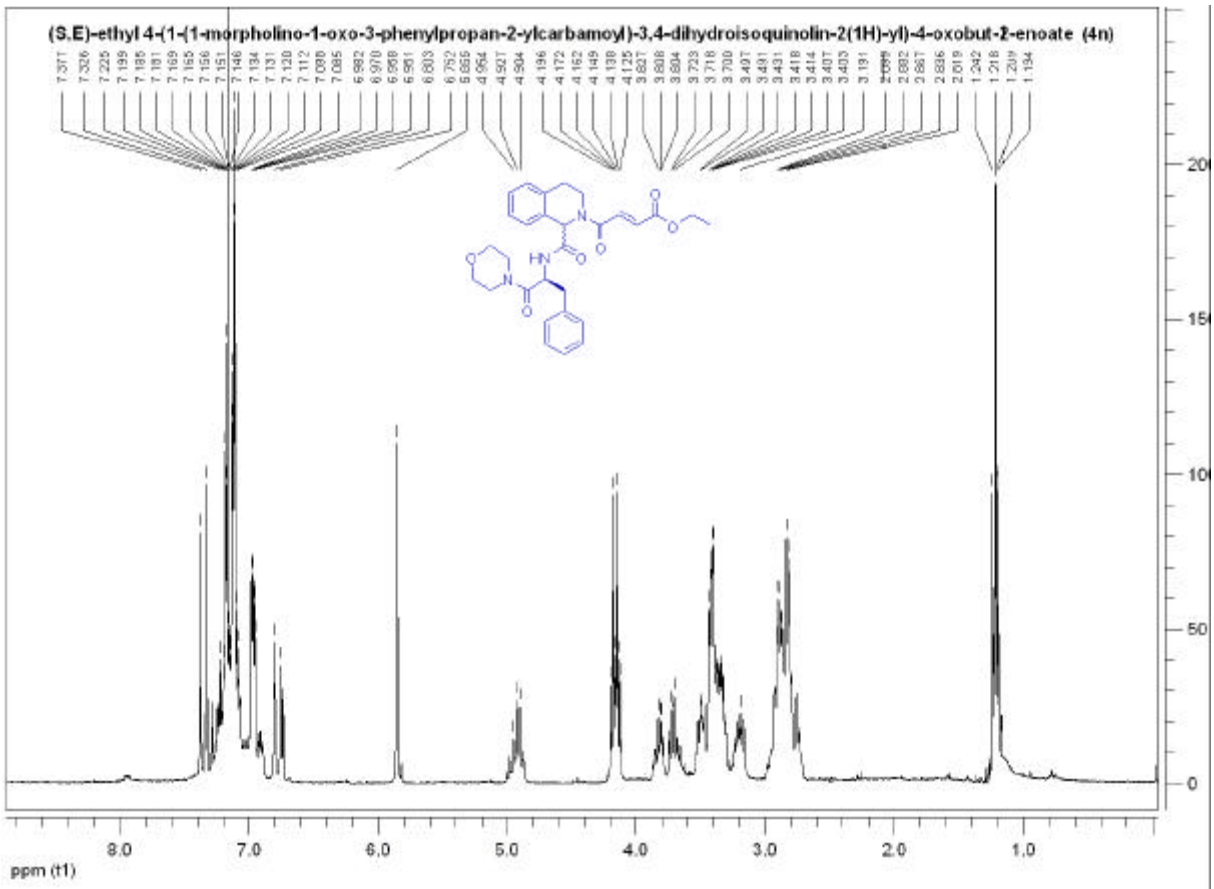

N-benzyl-2-(3-phenylpropioloyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4l)
ppm (t1)

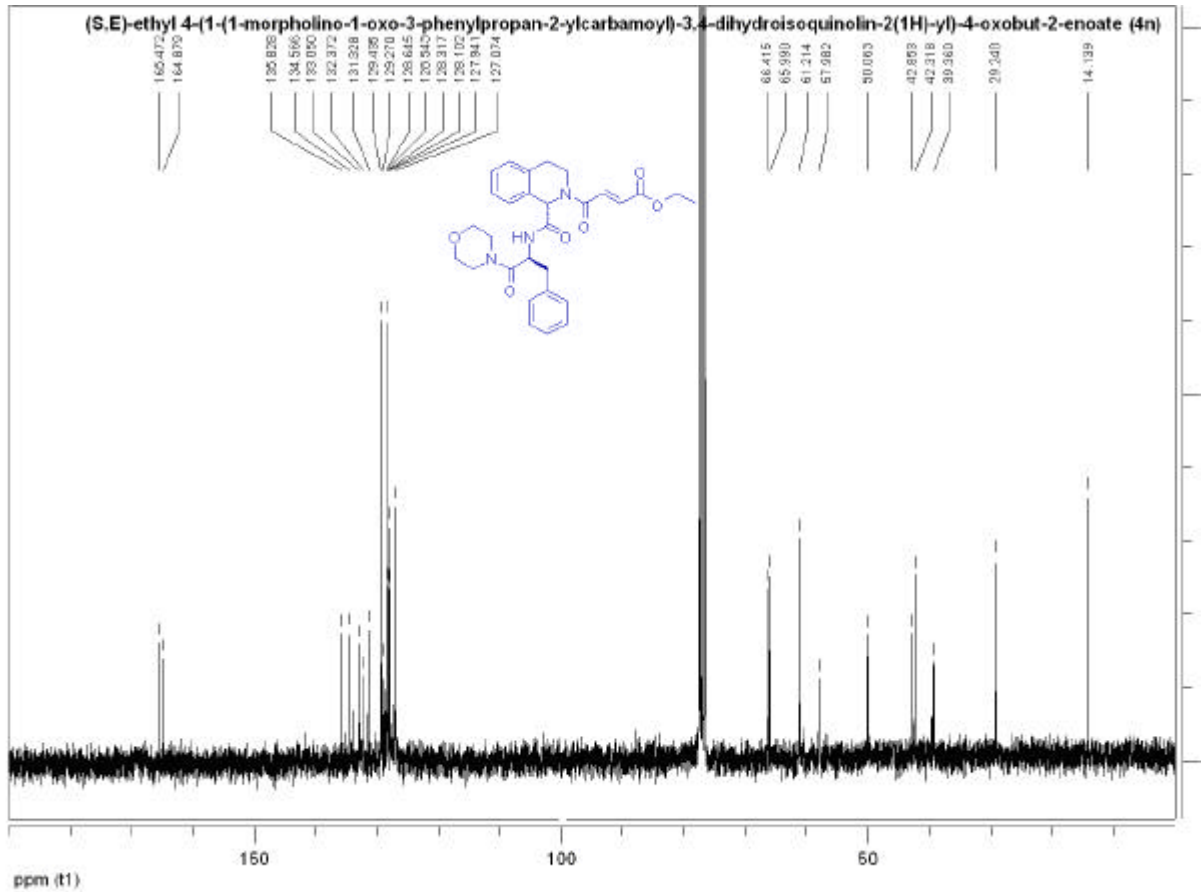

(S)-N-(1-morpholino-1-oxo-3-phenylpropan-2-yl)-2-(3-phenylpropioloyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4m)
ppm (t1)

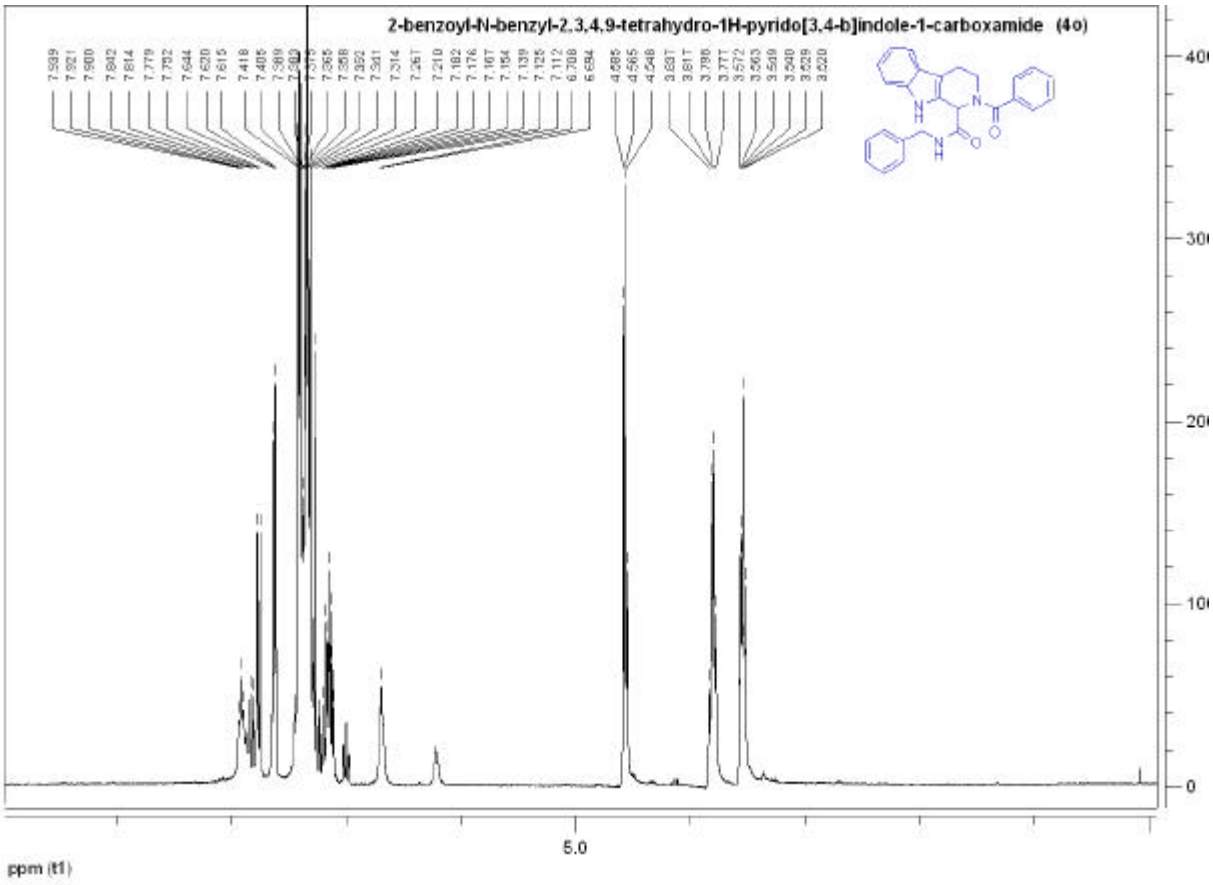

(S)-N-(1-morpholino-1-oxo-3-phenylpropan-2-yl)-2-(3-phenylpropioloyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (4m)
ppm (t1)

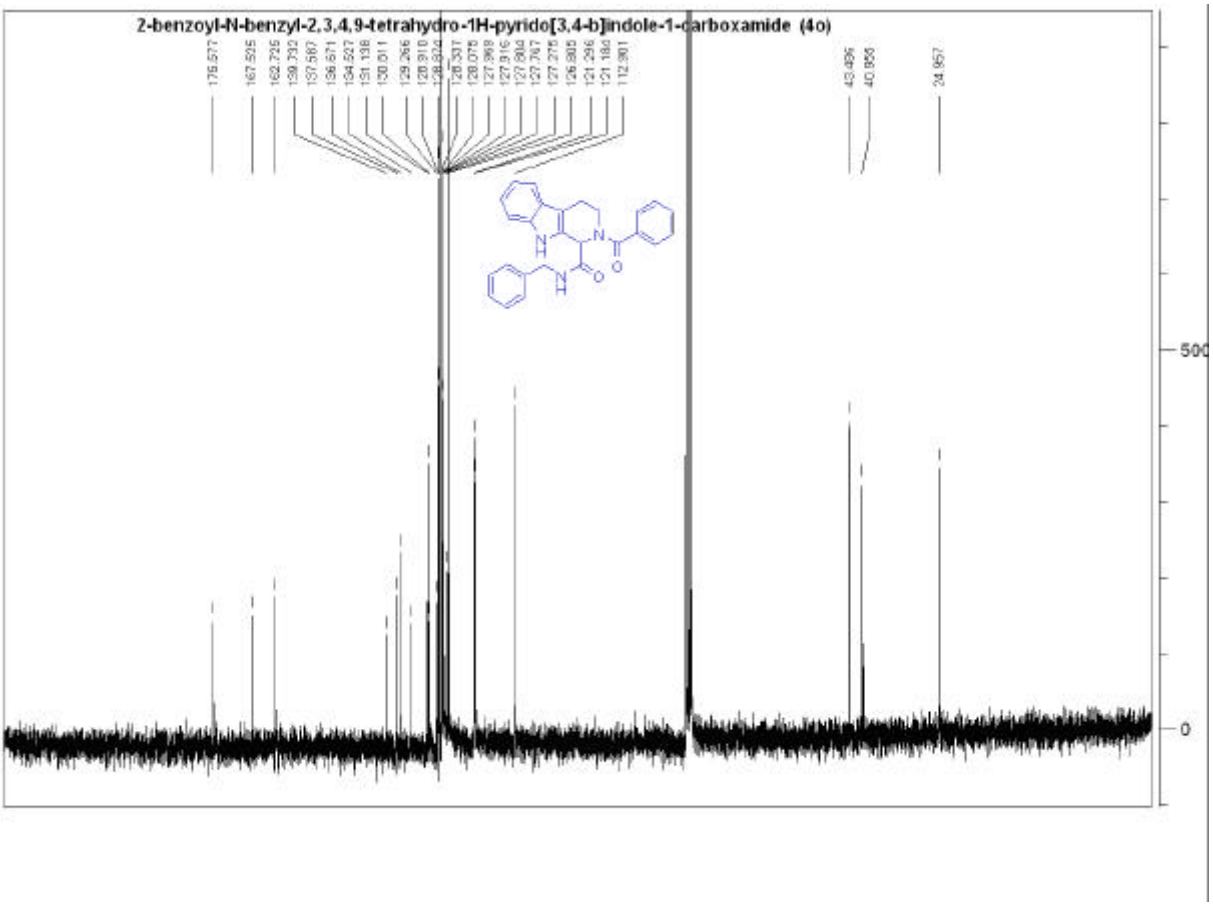

(S.E)-ethyl 4-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-4-oxobut-2-enoate (4n)
ppm (t1)

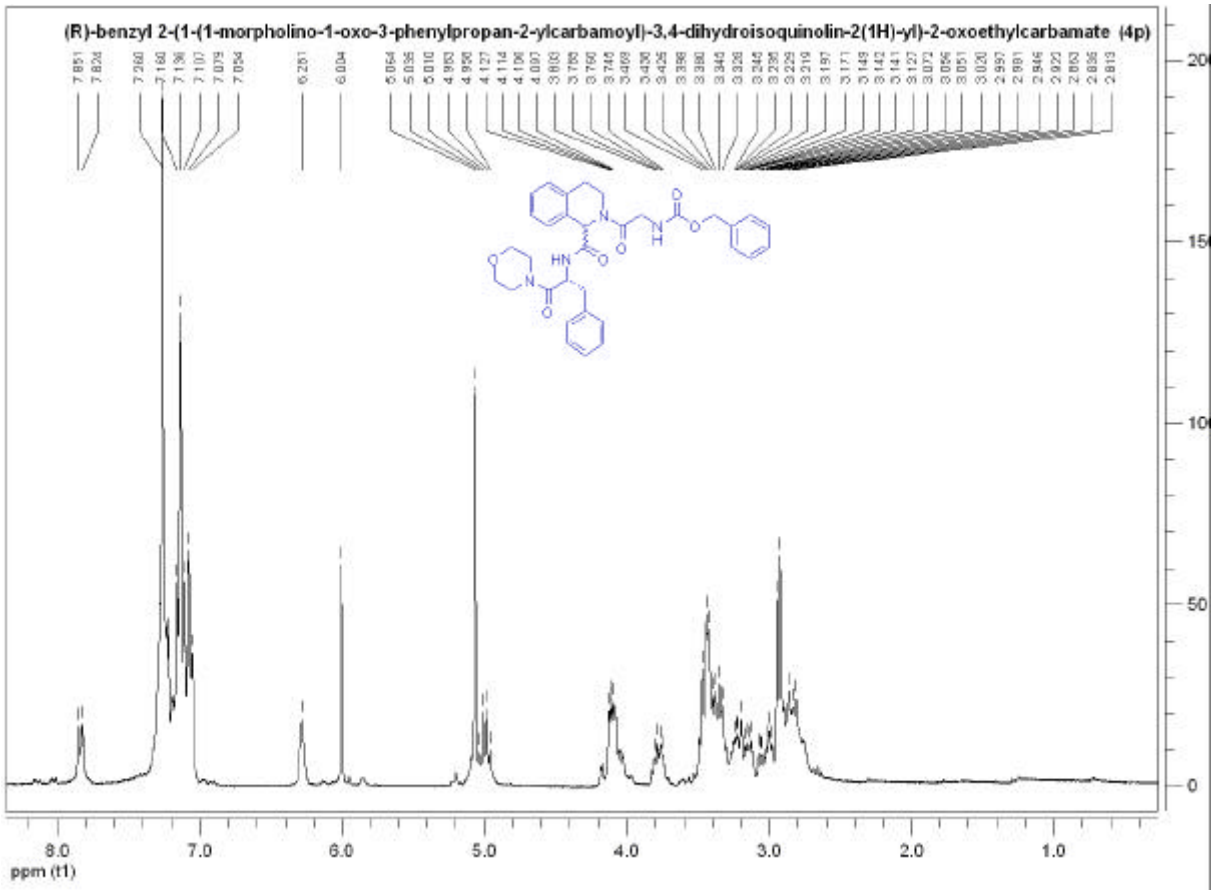

(S.E)-ethyl 4-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-4-oxobut-2-enoate (4n)
ppm (t1)

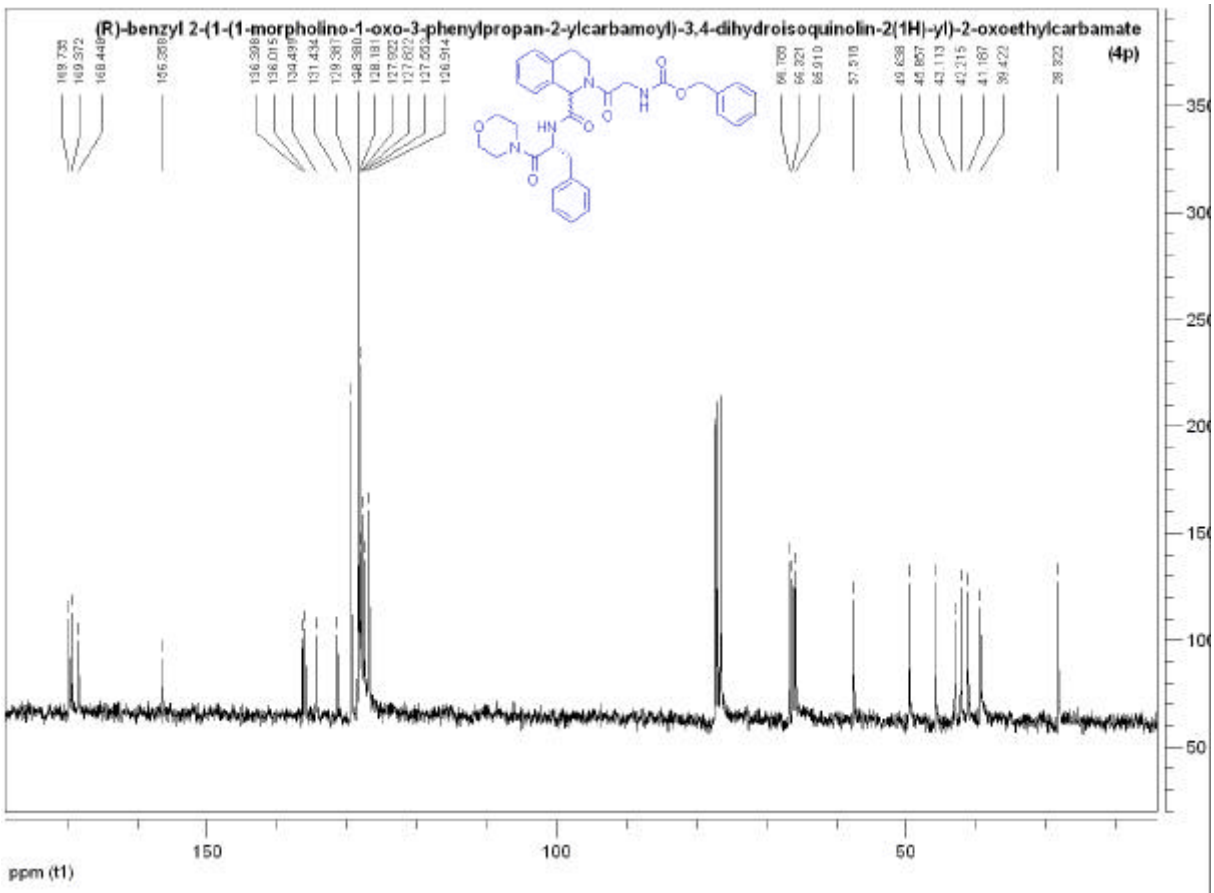

(S.E)-ethyl 4-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-4-oxobut-2-enoate (4n)
ppm (t1)

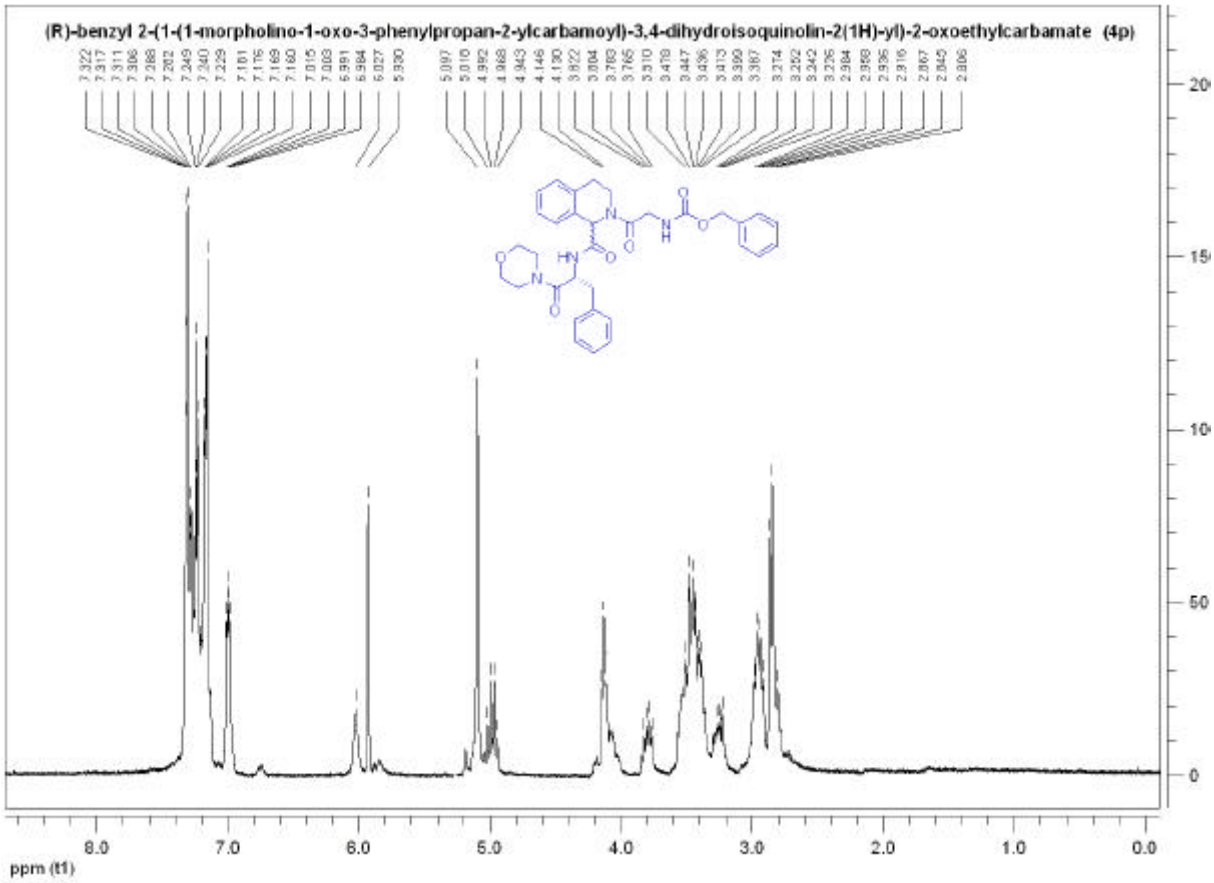

(S.E)-ethyl 4-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-4-oxobut-2-enoate (4n)
ppm (t1)

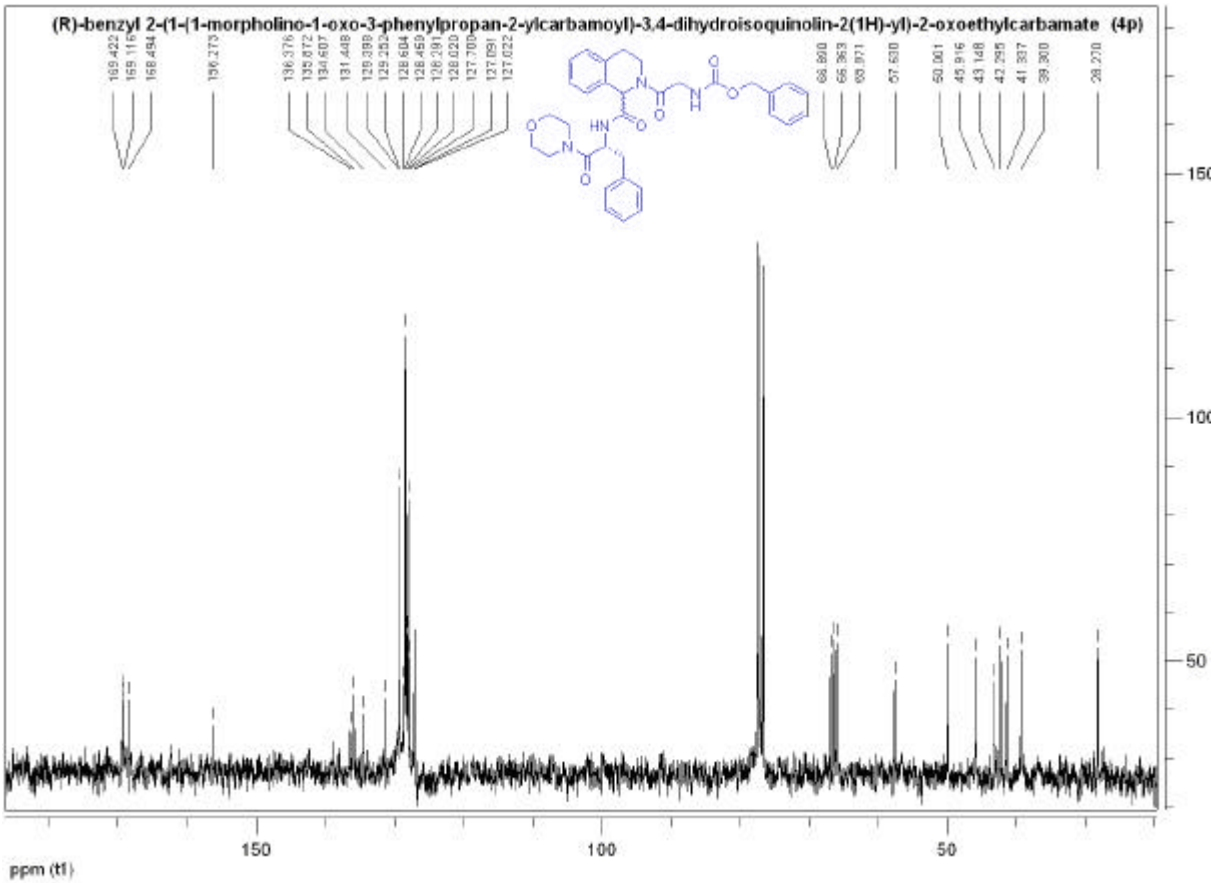

2-benzoyl-N-benzyl-2,3,4,9-tetrahydro-1H-pyrido[3,4-b]indole-1-carboxamide (4o)
7.939
7.921
7.900
7.842
7.814
7.779
7.752
7.644
7.620
7.615
7.418
7.405
7.389
7.380
7.375
7.365
7.358
7.352
7.341
7.314
7.267
7.210
7.182
7.176
7.167
7.154
7.139
7.125
7.112
6.708
6.694
4.585
4.565
4.548
3.837
3.817
3.786
3.777
3.572
3.563
3.549
3.540
3.529
3.520
40
30
20
10
0
5.0
ppm (t1)

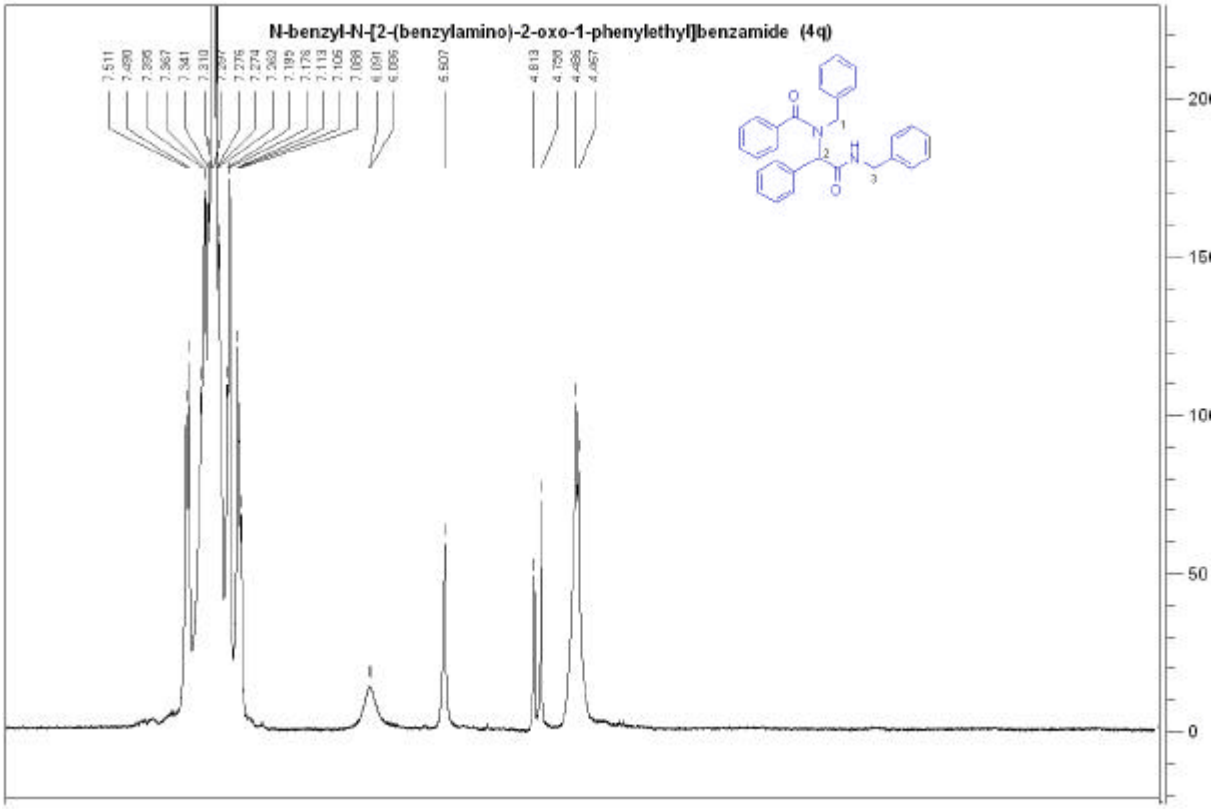

2-benzoyl-N-benzyl-2,3,4,9-tetrahydro-1H-pyrido[3,4-b]indole-1-carboxamide (4o)
175.577
167.525
162.725
139.732
137.567
136.571
134.527
131.138
130.011
129.266
128.910
128.824
128.537
128.078
127.968
127.916
127.800
127.767
127.275
126.985
121.296
121.180
112.901
43.496
40.958
24.957
500
0

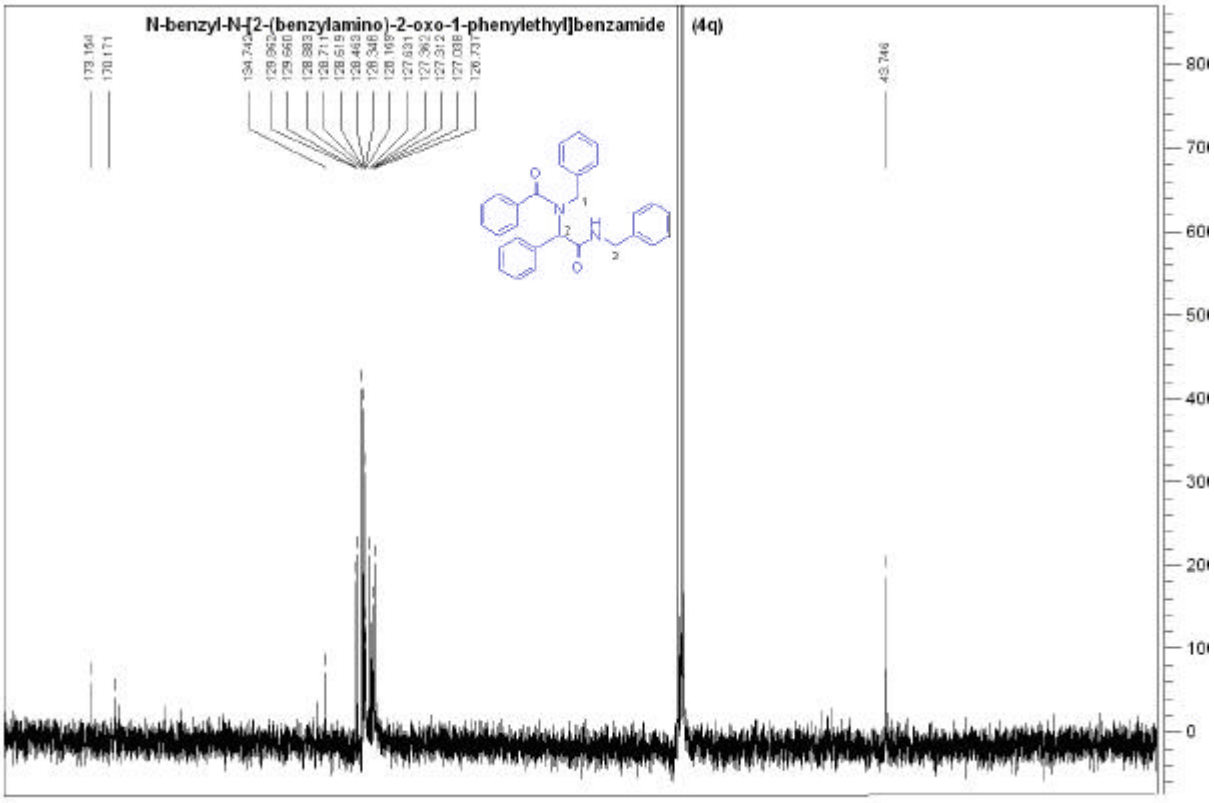

(R)-benzyl 2-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-2-oxoethylcarbamate (4p)
ppm (t1)


(R)-benzyl 2-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-2-oxoethylcarbamate (4p)
ppm (t1)


(R)-benzyl 2-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-2-oxoethylcarbamate (4p)
ppm (t1)


(R)-benzyl 2-(1-(1-morpholino-1-oxo-3-phenylpropan-2-ylcarbamoyl)-3,4-dihydroisoquinolin-2(1H)-yl)-2-oxoethylcarbamate (4p)
ppm (t1)


N-benzyl-N-[2-(benzylamino)-2-oxo-1-phenylethyl]benzamide (4q)


N-benzyl-N-[2-(benzylamino)-2-oxo-1-phenylethyl]benzamide (4q)