Supporting Information

Organocatalytic Enantioselective Addition of Thiols to Ketimines Derived from Isatins

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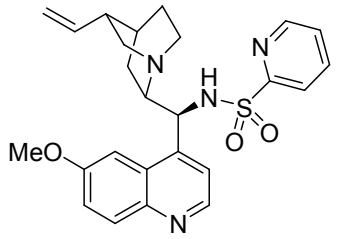
CONTENTS:

Experimental Section

General method: All reactions were performed in oven-dried glassware under a positive pressure of nitrogen. Solvents were transferred via syringe and were introduced into the reaction vessels through a rubber septum. All reactions were monitored by thin-layer chromatography (TLC) carried out on 0.25 mm Merck silica-gel (60-F254). The TLC plates were visualized with UV light and 7% phosphomolybdic acid or *p*-anisaldehyde in ethanol/heat. Column chromatography was carried out on a column packed with silica-gel 60N spherical neutral size 63-210 μm. The ^{1}H NMR (600 MHz, 300 MHz), ^{13}C NMR (150.9 MHz), spectra for solution in $CDCl_3$ were recorded on Bruker Avance 600 or Varian Mercury 300. Chemical shifts (δ) are expressed in ppm downfield from internal TMS. HPLC analyses were performed on a SHIMADZU LC-2010A HT using 4.6 x 250 mm CHIRALCEL® OD-3 and CHIRALPAK® IC column. ESI Mass spectra were recorded on a SHIMADZU LCMS-2050EV using positive mode. Optical rotations were measured on a HORIBA SEPA-300. Infrared spectra were recorded on a JASCO FT/IR-4100 spectrometer. The sulfonamide catalysts were synthesized by published procedures.[1)] The ketimines derived from isatins were prepared by use of aza-Wittig reaction.[2)]

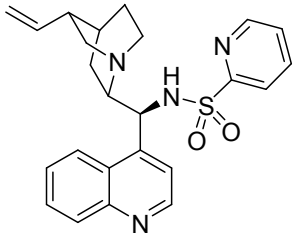
Typical Procedure for Synthesis of *N*-Heteroarenesulfonyl Cinchona Alkaloid Amides: Synthesis of (*S*)-*N*-(2-Pyridinesulfonyl)-(6-methoxyquinolin-4-yl)(8-vinylquinuclidin-2-yl)methanamine (3c)



To a solution of 9-amino(9-deoxy)-epi-quinine (323 mg, 1.00 mmol) and 2-pyridinesulfonyl chloride (355 mg, 2.00 mmol) in CH_2Cl_2 (12 mL) and Et_3N (0.278 mL, 2.00 mmol) was added at 0 ^oC. The mixture was stirred for 5 h at room temperature. After addition of water, the mixture was extracted with CH_2Cl_2. The organic extract was dried over Na_2SO_4, filtered, and then the filtrate was concentrated *in vacuo*. The residue was purified by a silica gel column chromatography (CH_2Cl_2:MeOH=95 : 5) to afford **3c** (372 mg, 80% yield) as a white solid.

$[\alpha]_D^{25}$ +57.3 (*c* 0.78, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 8.70-8.50 (m,2H) 8.48-8.40 (m, 1H), 8.37 (s, 1H), 7.97 (d, *J* = 9.6 Hz, 1H), 7.83 (d, *J* = 9.6 Hz, 1H), 7.60-7.06 (m, 10H), 7.17 (s, 1H), 5.75-5.50 (m, 2H), 5.19 (d, *J* = 10.8 Hz, 1H), 5.00-4.80 (m, 3H), 4.50 (d, *J* = 10.8 Hz, 1H), 4.48 (s, 3H), 3.98 (s, 2H), 3.40-3.10 (m, 4H), 3.05-2.80 (m, 3H), 2.80-2.55 (m, 4H), 1.75-1.40 (m, 6H), 1.35-1.10 (m, 3H), 1.00-0.78 (m, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 24.9, 27.1, 27.5, 39.1, 40.0, 52.8, 53.4, 54.9, 55.3, 60.0, 62.3, 100.7, 114.3, 120.2, 121.2, 121.6, 126.0, 128.2, 131.3, 136.9, 140.9, 142.9, 143.9, 147.0, 149.2, 157.2, 157.6; IR (KBr) 3523, 2937, 2866, 1621, 1509, 1475, 1427, 1327, 1241, 1174, 1121, 990, 920, 855, 775, 596 cm^{-1}; HRMS (ESI) calcd. for $[C_{25}H_{28}N_4O_3S+H]^+$: 465.1960, Found: 465.1960.

(*S*)-*N*-(2-Pyridinesulfonyl)-(quinolin-4-yl)(8-vinylquinuclidin-2-yl)methanamine (3g)

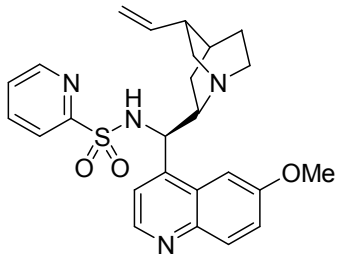


According to the typical procedure, the reaction using 9-amino(9-deoxy)-epi-cinchonidine (293 mg, 1.00 mmol) gave crude product, which was purified by silica gel column chromatography to give **3g** (365 mg, 84% yield) as a white solid.

$[\alpha]_D^{25}$ +37.2 (*c* 0.96, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 8.77 (s, 1H), 8.63 (s, 2H), 8.36 (d, *J* = 7.5 Hz, 1H), 8.28 (s, 1H), 8.16 (d, *J* = 8.4 Hz, 1H), 8.08 (d, *J* = 8.4 Hz, 1H), 7.96 (d, *J* = 7.5 Hz, 1H), 7.80-7.65 (m, 1H), 7.65-7.40 (m, 3H), 7.40-720 (m, 5H), 7.04 (s, 1H), 5.75-5.50 (m, 2H), 5.25 (d, *J* = 10.2 Hz,

1H), 5.00-4.80 (m, 3H), 4.48 (d, J = 10.2 Hz, 1H), 3.48-3.30 (m, 1H), 3.30-3.05 (m, 2H), 3.05-2.80 (m, 3H), 2.80-2.60 (m, 3H), 2.27 (s, 2H), 1.75-1.40 (m, 5H), 1.30-1.20 (m, 2H), 1.00-0.75 (m, 2H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 25.1, 27.3, 27.8, 39.5, 40.4, 52.8, 55.5, 61.4, 114.8, 120.2, 122.3, 122.5, 126.5, 127.0, 127.7, 129.3, 130.4, 136.8, 137.4, 141.2, 144.9, 148.2, 149.9, 157.2; IR (KBr) 3431, 3232, 2922, 2866, 1634, 1593, 1427, 1322, 1175, 1122, 1061, 991, 877, 765, 739, 595 cm^{-1}; HRMS (ESI) calcd. for $[C_{24}H_{26}N_4O_2S+H]^+$: 435.1855, Found: 435.1848.

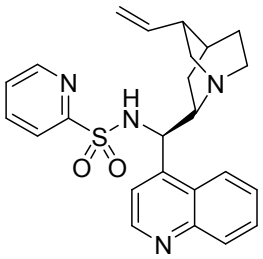
(*R*)-*N*-(2-Pyridineesulfonyl)-(6-methoxyquinolin-4-yl)((2*S*)-8-vinylquinuclidin-2-yl)methanamine (3h)



According to the typical procedure, the reaction using 9-amino(9-deoxy)-epi-quinidine (323 mg, 1.00 mmol) gave crude product, which was purified by silica gel column chromatography to give **3h** (362 mg, 78% yield) as a white solid.

$[\alpha]_D^{25}$ +32.3 (*c* 0.58, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.70-8.60 (m, 2H), 8.60-8.45 (m, 1H), 8.45-8.40 (m, 1H), 7.97 (d, J = 8.7 Hz, 1H), 7.86 (d, J = 10.2 Hz, 1H), 7.70-7.50 (m, 2H), 7.50-7.20 (m, 8H), 7.20 (s, 1H), 5.90-5.75 (m, 2H), 5.25-5.00 (m, 4H), 4.47 (d, J = 9.3 Hz, 1H), 3.95 (s, 3H), 3.90 (s, 2H), 3.40-3.20 (m, 2H), 3.00-2.80 (m, 7H), 2.80-2.55 (m, 3H), 2.40-2.25 (m, 2H), 2.20-2.05 (m, 1H), 1.70-1.40 (m, 5H), 1.30-1.10 (m, 2H), 1.00-0.80 (m, 2H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 24.3, 26.45, 27.2, 38.5, 38.9, 46.1, 48.8, 52.4, 55.4, 61.2, 100.3, 114.5, 120.2, 122.1, 122.4, 126.5, 128.6, 131.5, 137.5, 140.5, 143.6, 144.3, 147.2, 149.8, 149.8, 157.3, 158.0; IR (KBr) 3650, 2939, 2866, 1718, 1577, 1508, 1427, 1329, 1227, 1175, 918, 851, 737, 596, 516 cm^{-1}; HRMS (ESI) calcd. for $[C_{25}H_{28}N_4O_3S+H]^+$: 465.1960, Found: 465.1958.

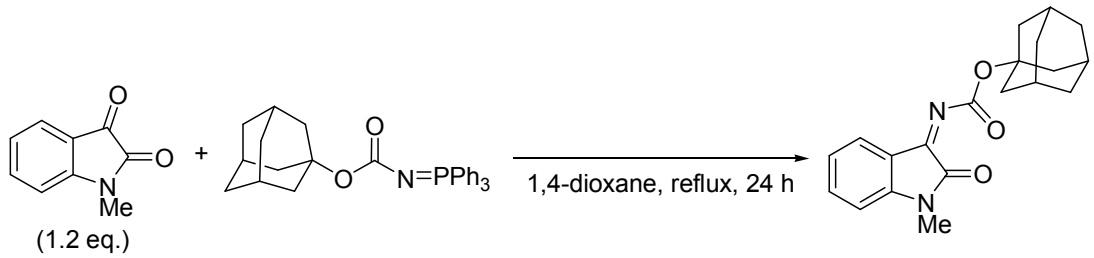
(*R*)-*N*-(2-Pyridinesulfonyl)-(quinolin-4-yl)[(2*S*)-8-vinylquinuclidin-2-yl]methanamine (3i)



According to the typical procedure, the reaction using 9-amino(9-deoxy)-epi-cinchonine (293 mg, 1.00 mmol) gave crude product, which was purified by silica gel column chromatography to give **3i** (369 mg, 85% yield) as a white solid.

$[\alpha]_D^{25}$ +56.8 (*c* 1.11, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 8.77 (s, 1H), 8.68 (s, 2H), 8.50-8.30 (m, 1H), 8.20-7.90 (m, 3H), 7.80-7.65 (m, 1H), 7.65-7.50 (m, 2H), 7.50-7.30 (m, 5H), 7.30-7.20 (m, 1H), 7.12 (s, 1H), 5.90-5.70 (m, 2H), 5.30-4.90 (m, 5H), 4.45 (d, *J* = 10.8 Hz, 1H), 3.40-3.23 (m, 1H), 3.00-2.70 (m, 6H), 2.70-2.50 (m, 2H), 2.40-2.15 (m, 2H), 1.70-1.40 (m, 5H), 1.30-1.00 (m, 2H), 1.00-0.80 (m, 2H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 24.2, 26.4, 27.4, 38.9, 46.4, 49.0, 52.3, 61.6, 114.8, 120.1, 122.4, 122.5, 126.6, 126.9, 127.7, 129.2, 130.4, 137.6, 140.3, 145.3, 148.2, 150.0, 157.2; IR (KBr) 3328, 3059, 2922, 2866, 1593, 1509, 1424, 1322, 1175, 1122, 1061, 991, 926, 877, 765, 627, 595 cm^{-1}; HRMS (ESI) calcd. for $[C_{24}H_{26}N_4O_2S+H]^+$: 435.1855, Found: 435.1857.

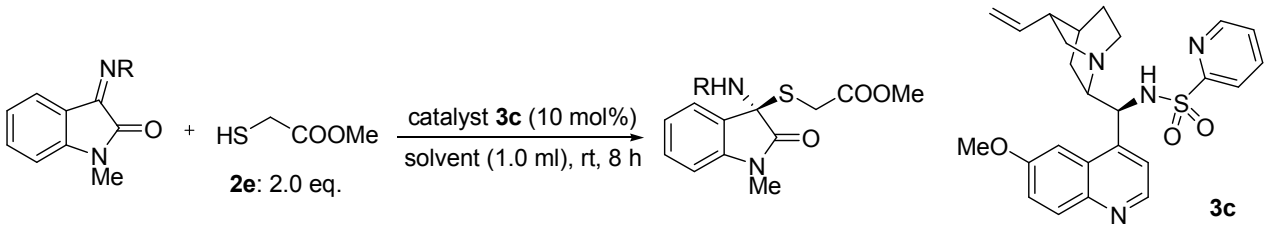
Typical procedure for synthesis of ketimines derived from isatins.[2)]



To a solution of *N*-methyl isatin (323 mg, 1.00 mmol) in 1,4-dioxane (2.0 mL), *N*-1-adamantyloxycarbonyl-phosphazene (355 mg, 2.00 mmol) was added. The mixture was stirred at reflux for 24 h. The reaction mixture was cooled to room temperature. The solvent was evaporated *in vacuo*. The residue was purified by silica gel column chromatography (Hex:AcOEt=90:10) to afford **1d** (227 mg, 67% yield) as a yellow solid.

^1H NMR (300 MHz, $CDCl_3$) δ 7.60-7.50 (m, 1H), 7.43 (dd, *J* = 7.5, 7.5 Hz, 1H), 7.03 (dd, *J* = 7.5, 7.5 Hz, 1H), 6.77 (d, *J* = 7.5 Hz, 1H), 3.16 (s, 3H), 2.30-2.15 (m, 8H), 1.75-1.45 (m, 7H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 26.2, 30.9, 31.1, 36.2, 41.3, 83.6, 109.3, 119.4, 123.6, 124.4, 135.4, 148.1, 153..1, 157.5, 160.1; IR (KBr) 3425, 2910, 1744, 1715, 1615, 1471, 1335, 1236, 1190, 1047, 747, 459 cm^{-1}; HRMS (ESI) calcd. for $[C_{20}H_{22}N_2O_3+Na]^+$: 361.1528, Found: 361.1532.

Optimization of Solvents:

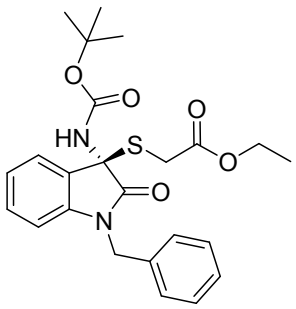


Run	R	Solvent	Yield (%)	Ee (%)
1	Boc	Toluene	94	89
2	Boc	CH_2Cl_2	85	68
3	Boc	AcOEt	82	68
4	Boc	THF	82	68
5	Adoc	Toluene	97	92

Typical procedure for the synthesis of 4, 7-18:

To a solution of ketimine **1d** (0.030 mmol, 10.0 mg) and catalyst **3c** (0.003 mmol, 1.4 mg) in toluene (1.0 mL) was cooled to -80 ^{o}C. Trimethylsilanol (0.059 mmol, 5.6 μL) and ethyl thioglycolate (**2a**) (0.059 mmol, 6.4 μL) was added and stirred for 8 h. After removal of solvent, the residue was purified by silica gel column chromatography (eluent: hexane/AcOEt, 90:10) to afford (*R*)-**7** (14.3 mg, 99%) as a white solid.

Ethyl 2-[1-benzyl-3-(*tert*-butoxylcarbonylamino)indolin-2-one-3-ylthio]acetate (4)

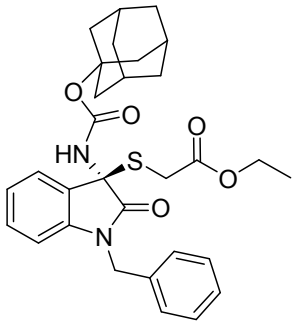


According to the typical procedure, the reaction using 3-(*tert*-butoxycarbonylamino)indolin-1-benzyl-2-one (**1a**) (10.1 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give **4** (14.2 mg, 99% yield) as a white solid.

$[\alpha]_D^{25}$ +90.7 (75% ee, *c* 3.85, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.41-7.10 (m, 8H), 7.04 (dd, *J* = 7.2, 7.2 Hz, 1H), 6.67 (d, *J* = 7.2 Hz, 1H), 5.20-5.05 (m, 1H), 4.95-4.80 (m, 1H), 4.59 (d, *J* = 17.1 Hz, 1H), 4.29 (q, *J* = 7.0 Hz, 2H), 3.26 (d, *J* = 17.1 Hz, 1H), 1.55-1.00 (m, 12H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.1, 28.2, 29.9, 43.8, 60.6, 62.4, 80.5, 109.7, 122.9, 123.2, 127.0, 127.5, 128.8, 129.9, 135.6, 141.4, 153.7, 171.1, 172.3, 173.9; IR (KBr) 3644, 3319, 2979, 2929, 1715, 1614, 1488, 1366, 1303, 1252,

1164, 1021, 908, 752, 697 cm^{-1}; HRMS (ESI) calcd. for $[C_{24}H_{28}N_2O_5S+Na]^+$: 479.1617, Found: 479.1615; HPLC (DAICEL CHIRALPAK IC, Hexane/^{i}PrOH = 70:30, 1.0 mL/min, 254 nm) t = 8.3 (major), t = 16.1 (minor) min.

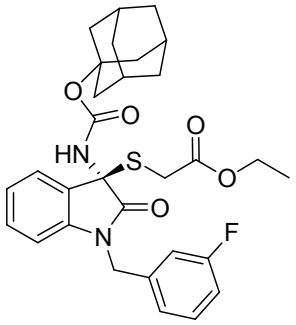
Ethyl 2-[1-benzyl-3-(1-adamantyloxylcarbonylamino)indolin-2-one-3-ylthio]acetate (5)



According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-1-benzyl-2-one (**1b**) (12.4 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give **5** (17.0 mg, 99% yield) as a white solid.

$[\alpha]_D^{25}$ +75.2 (91% ee, *c* 0.60, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.40-7.19 (m, 8H), 7.03 (dd, *J* = 7.5, 7.5 Hz, 1H), 6.67 (d, *J* = 6.6 Hz, 1H), 5.15 (d, *J* = 14.7 Hz, 1H), 4.90 (d, *J* = 14.7 Hz, 1H), 4.56 (d, *J* = 17.1 Hz, 1H), 4.29 (q, *J* = 7.1 Hz, 2H), 3.27 (d, *J* = 17.1 Hz, 1H), 2.30-1.80 (m, 8H), 1.70-1.42 (m, 7H), 1.35 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.3, 30.0, 30.9, 36.2, 41.5, 43.9, 60.7, 62.5, 80.5, 109.8, 123.0, 123.4, 127.1, 127.6, 128.9, 129.9, 135.7, 141.5, 153.4, 172.4, 173.9; IR (KBr) 3330, 2912, 2852, 1714, 1613, 1488, 1468, 1354, 1293, 1243, 1178, 1068, 921, 751 cm^{-1};~~;~~HRMS (ESI) calcd. for $[C_{30}H_{34}N_2O_5S+Na]^+$: 557.2086, Found: 557.2086; HPLC (DAICEL CHIRALPAK IC, Hexane/^{i}PrOH = 70:30, 1.0 mL/min, 254 nm) t = 11.8 (major), t = 26.5 (minor) min.

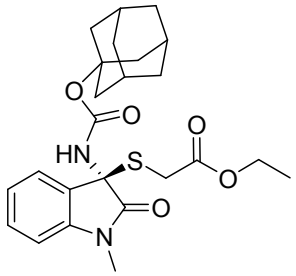
Ethyl 2-[1-3-fluorobenzyl-3-(1-adamantyloxylcarbonylamino)indolin-2-one-3-ylthio]acetate (6)



According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-1-3-fluorobenzyl -2-one (**1c**) (13.0 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give **6** (17.1 mg, 99% yield) as a white solid.

$[\alpha]_D^{25}$ +66.7 (86% ee, *c* 0.71, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.45-.03 (m, 7H), 7.03 (dd, *J* = 7.5, 7.5 Hz, 1H), 6.69-6.65 (m, 1H), 5.30-5.10 (m, 1H), 4.90-4.75 (m, 1H), 4.56 (d, *J* = 17.1 Hz, 1H), 4.29 (q, *J* = 6.9 Hz, 2H), 3.27 (d, *J* = 17.1 Hz, 1H), 2.20-1.80 (m, 8H), 1.75-1.40 (m, 7H), 1.35 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.2, 30.0, 30.9, 36.2, 41.5, 43.4, 60.7, 62.6, 80.6, 109.6, 114.2, 114.3, 114.7, 122.7, 123.2, 123.5, 130.0, 130.4, 138.3, 138.4, 141.2, 153.5, 172.4, 174.0; ^{19}F NMR (282 MHz, $CDCl_3$) δ -113.0; IR (KBr) 3852, 3734, 3648, 3566, 2904, 1716, 1507, 1489, 670, 512, 458, 438, 418 cm^{-1}; HRMS (ESI) calcd. for $[C_{30}H_{33}FN_2O_5S+Na]^+$: 575.1992, Found: 575.2003; HPLC (DAICEL CHIRALPAK IC, Hexane/^{i}PrOH = 70:30, 1.0 mL/min, 254 nm) t= 9.3 (major), t = 17.8 (minor) min.

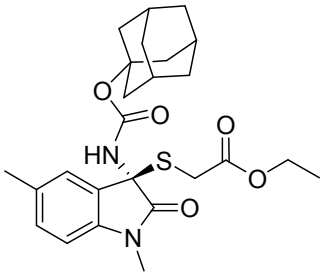
Ethyl 2-[1-methyl-3-(1-adamantyloxylcarbonylamino)indolin-2-one-3-ylthio]acetate (7)



According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-1-methyl-2-one (**1d**) (10.2 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give (*R*)-**7** (14.3 mg, 99% yield) as a white solid.

(*R*)-**7**: $[\alpha]_D^{25}$ +39.6 (97% ee, *c* 0.62, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.40-7.27 (m, 2H), 7.17 (s, 1H), 7.08 (dd, *J* = 7.2, 7.2 Hz, 1H), 6.85 (d, *J* = 7.5 Hz, 1H), 4.54 (d, *J* = 16.5 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 3.28 (s, 3H), 3.27-3.20 (m, 1H), 2.20-1.85 (m, 8H), 1.75-1.40 (m, 7H), 1.35 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.2, 26.7, 29.9, 30.8, 36.1, 41.5, 60.3, 62.5, 80.3, 108.7, 122.9, 123.3, 127.2, 130.0, 142.3, 153.3, 172.3, 173.8; IR (KBr) 3326, 2911, 1718, 1614, 1492, 1472, 1292, 1248, 1070, 751, 451 cm^{-1}; HRMS (ESI) calcd. for $[C_{24}H_{30}N_2O_5S+Na]^+$: 481.1773, Found: 481.1772; HPLC (DAICEL CHIRALPAK IC, Hexane/^{i}PrOH = 50:50, 1.0 mL/min, 254 nm) t = 12.3 (*R*), t = 22.9 (*S*) min.

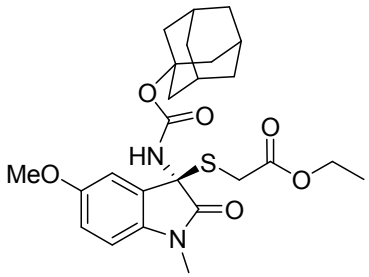
Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-methylindolin-2-one-3-ylthio]acetate (8)



According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-1,5-dimethyl-2-one (**1e**) (10.6 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give **8** (13.5 mg, 91% yield) as a white solid.

$[\alpha]_D^{25}$ +35.6 (97% ee, *c* 1.30, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.27 (s, 1H), 7.20 (s, 1H), 7.11 (dd, *J* = 7.5, 7.5 Hz, 1H), 6.73 (d, *J* = 7.5 Hz, 1H), 4.53 (d, *J* = 16.8 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 3.25 (s, 3H), 3.26-3.18 (m, 1H), 2.33 (s, 3H), 2.20-1.90 (m, 8H), 1.70-1.40 (m, 7H), 1.35 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.2, 26.8, 30.0, 30.8, 36.1, 41.5, 55.9, 60.6, 62.5, 80.3, 109.2, 110.3, 114.8, 128.4, 135.8, 153.3, 156.2, 172.4, 173.5; IR (KBr) 3330, 2975, 1728, 1704, 1615, 1356, 1252, 1172, 1023, 812, 755, 680 cm^{-1}; HRMS (ESI) calcd. for $[C_{25}H_{32}N_2O_5S+Na]^+$: 495.1930, Found: 495.1932; HPLC (DAICEL CHIRALPAK IC, Hexane/^{i}PrOH = 60:40, 1.0 mL/min, 225 nm) t = 17.2 (major), t = 32.6 (minor) min.

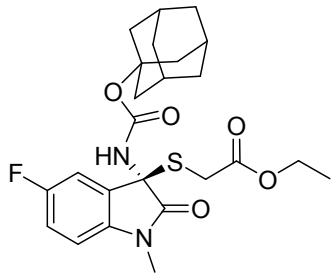
Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-methoxyindolin-2-one-3-ylthio]acetate (9)



According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-5-methoxy-1-methyl-2-one (**1f**) (11.1 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give (*R*)-**9** (14.7 mg, 96% yield) as a white solid

(*R*)-**9**: $[\alpha]_D^{25}$ +21.9 (97% ee, *c* 0.81, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.19 (s, 1H), 7.00 (s, 1H), 6.90-6.75 (m, 1H), 6.76 (d, *J* = 8.1 Hz, 1H), 4.56 (d, *J* = 17.1 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 3.80 (s, 3H), 3.25 (s, 3H), 3.25-3.19 (m, 1H), 2.20-1.80 (m, 8H), 1.75-1.40 (m, 7H), 1.35 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.2, 26.8, 30.0, 30.8, 36.1, 41.4, 55.9, 60.6, 62.5, 80.3, 109.2, 110.3, 114.8, 128.4, 135.8, 153.3, 156.2, 172.4, 173.4; IR (KBr) 3648, 3335, 2909, 2852, 1716, 1498, 1289, 1070, 783, 457 cm^{-1}; HRMS (ESI) calcd. for $[C_{25}H_{32}N_2O_5S+Na]^+$: 511.1879, Found: 511.1881; HPLC (DAICEL CHIRALPAK IC, hexane/ ^{i}PrOH = 60:40, 1.0 ml/min, 254 nm), *t* = 23.4 (*R*), *t* = 30.2 (*S*) min.

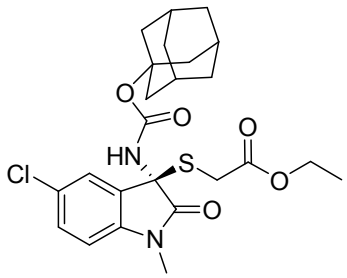
Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-fluoroindolin-2-one-3-ylthio]acetate (10)



According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-5-fluoro-1-methyl-2-one (**1g**) (10.7 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give (*R*)-**10** (14.8 mg, 99% yield) as a white solid.

(*R*)-**10**: $[\alpha]_D^{25}$ +50.8 (96% ee, *c* 1.71, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.26-7.10 (m, 2H), 7.10-7.00 (m, 1H), 6.85-6.76 (m, 1H), 4.52 (d, *J* = 17.1 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 3.27 (s, 1H), 3.26-3.19 (m, 1H), 2.07-2.01 (m, 8H), 1.80-1.45 (m, 7H), 1.35 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.2, 14.3, 26.9, 29.9, 30.9, 36.1, 41.5, 60.5, 62.6, 80.7, 109.4, 111.4, 111.6, 116.3, 116.4, 128.9, 138.4, 158.5, 160.1, 172.2, 173.6; ^{19}F NMR (282 MHz, $CDCl_3$) δ -119.9; IR (KBr) 3334, 2911, 1717, 1617, 1496, 1349, 1249, 1115, 1071, 794, 458, 431, 420 cm^{-1}; HRMS (ESI) calcd. for $[C_{24}H_{29}FN_2O_5S+Na]^+$: 499.1679, Found: 499.1684; HPLC (DAICEL CHIRALPAK IC, hexane/ ^{i}PrOH = 70:30, 1.0 ml/min, 254 nm), *t* = 13.8 (*R*), *t* = 25.6 (*S*) min.

Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-chloroindolin-2-one-3-ylthio]acetate (11)

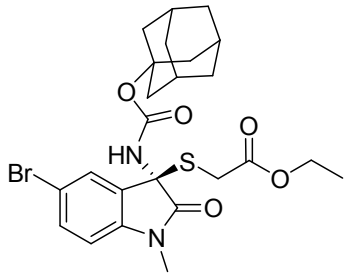


According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-5-chloro-1-methyl-2-one (**1h**) (11.2 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give **11** (14.0 mg, 96% yield) as a white solid.

$[\alpha]_D^{25}$ +32.2 (96% ee, *c* 0.70, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.40-7.20 (m, 4H), 6.78 (d, *J* = 8.1 Hz, 1H), 4.51 (d, *J* = 17.1 Hz, 1H), 4.28 (q, *J* = 7.2 Hz, 2H), 3.26 (s, 3H), 3.30-3.15 (m, 1H), 2.15-1.90 (m, 8H), 1.70-1.50 (m, 7H), 1.35 (t, *J* = 7.2 Hz, 3H) ; ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.2, 14.3, 26.9, 29.9, 30.9, 36.1, 41.5, 60.3, 62.6, 80.7, 109.8, 123.8, 128.4, 129.0, 130.0, 141.0, 153.4, 172.3, 173.4; IR

(KBr) 3467, 3321, 3257, 2908, 2851, 1717, 1698, 1603, 1375, 1352, 1069, 419 cm^{-1};-HRMS (ESI) calcd. for $[C_{24}H_{29}ClN_2O_5S+Na]^+$: 485.1511, Found: 485.1515; HPLC (DAICEL CHIRALPAK IC, Hexane/^{i}PrOH = 70:30, 1.0 mL/min, 254 nm), t = 12.1 (*R*), t = 20.3 (*S*) min.

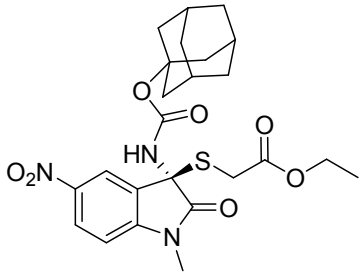
Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-bromoindolin-2-one-3-ylthio]acetate (12)



According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-5-bromo-1-methyl-2-one (**1i**) (12.5 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give (*R*)-**12** (15.6 mg, 93% yield) as a white solid.

(*R*)-**12**: $[\alpha]_D^{25}$ +24.1 (96% ee, *c* 0.70, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.50-7.43 (m, 2H), 7.27 (s, 1H), 6.74 (d, *J* = 8.1 Hz, 1H), 4.51 (d, *J* = 17.1 Hz, 1H), 4.29 (q, *J* = 7.1 Hz, 2H), 3.26 (s, 3H), 3.26-3.18 (m, 1H), 2.15-1.80 (m, 8H), 1.75-1.40 (m, 7H), 1.35 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.2, 14.3, 26.9, 29.9, 30.9, 36.1, 41.5, 60.2, 60.5, 62.7, 80.8, 110.3, 115.6, 126.5, 129.3, 132.9, 141.5, 153.4, 172.2, 173.3; IR (KBr) 3467, 3322, 3258, 2910, 1716, 1489, 1457, 1363, 1294, 1246, 1069, 459 cm^{-1}; HRMS (ESI) calcd. for $[C_{24}H_{29}BrN_2O_5S+Na]^+$: 559.0878, Found: 559.0885; HPLC (DAICEL CHIRALPAK IC, Hexane:^{i}PrOH = 60:40, 1.0 mL/min, 254 nm), t = 11.2 (*R*), t = 17.1 (*S*) min.

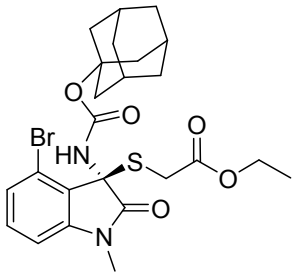
Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-nitoroindolin-2-one-3-ylthio]acetate (13)



According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-1-methyl-5-nitoro-2-one (**1j**) (11.5 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give **13** (14.8 mg, 94% yield) as a white solid.

$[\alpha]_D^{25}$ +35.9 (93% ee, *c* 0.96, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.35-8.25 (m, 2H), 7.38 (s, 1H), 6.94 (d, *J* = 8.7 Hz, 1H), 4.47 (d, *J* = 17.4 Hz, 1H), 4.31 (q, *J* = 7.1 Hz, 2H), 3.35 (s, 1H), 3.23 (d, *J* = 17.4 Hz, 1H), 2.09-1.90 (m, 8H), 1.70-1.50 (m, 7H), 1.36 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.2, 27.2, 29.9, 30.9, 36.1, 41.5, 59.9, 62.8, 81.2, 108.4, 119.2, 127.1, 128.5, 143.7, 147.9, 1583.5, 172.0, 174.1; IR (KBr) 3337, 2913, 2854, 1734, 1615, 1523, 1495, 1336, 1298, 1248, 1150, 1109, 1066, 1021, 907, 753, 732, 452, 408 cm^{-1}; HRMS (ESI) calcd. for $[C_{24}H_{29}N_3O_7S+Na]^+$: 526.1624, Found: 526.1628; HPLC (DAICEL CHIRALPAK IC, hexane/ ^{i}PrOH = 80:20, 1.0 ml/min, 254 nm), t = 17.7 (major), t = 27.0 (minor) min.

Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-4-bromoindolin-2-one-3-ylthio]acetate (14)

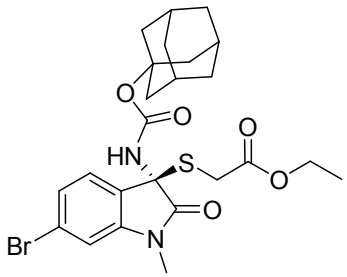


According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-4-bromo-1-methyl-2-one (**1k**) (12.5 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give (*R*)-**14** (16.1 mg, 96% yield) as a white solid.

(*R*)-**14**: $[\alpha]_D^{25}$ +63.4 (96% ee, *c* 1.00, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.27-7.10 (m, 2H), 7.068(s, 1H), 6.85-6.70 (m, 1H), 4.45 (d, *J* = 17.1 Hz, 1H), 4.28 (q, *J* = 6.9 Hz, 2H), 3.27 (s, 3H), 3.40-3.15 (m, 1H), 2.09-1.90 (m, 8H), 1.70-1.40 (m, 7H), 1.35 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.2, 26.9, 29.3, 30.9, 36.1, 41.5, 61.6, 62.4, 80.5, 107.8, 118.7, 124.7, 127.0, 131.2, 144.4, 153.4, 171.9, 172.9; IR (KBr) 3853, 3735, 3567, 3324, 2910, 2853, 1717, 1604, 1490, 1457, 1339, 1294, 1246, 1147,

1105, 1024, 778, 457, 442 cm^{-1} HRMS (ESI) calcd. for $[C_{24}H_{29}BrN_2OS+Na]^+$: 559.0878, Found: 559.0891; HPLC (DAICEL CHIRALPAK IC, Hexane:iPrOH = 80:20, 1.0 mL/min, 254 nm), t = 33.6 (*R*), t = 51.9 (*S*) min.

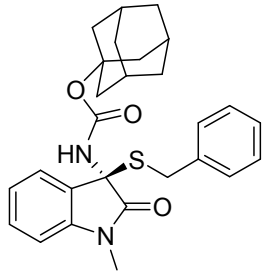
Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-6-bromoindolin-2-one-3-ylthio]acetate (15)



According to the typical procedure, the reaction using 3-(1-adamantoxycarbonylimino)indolin-6-bromo-1-methyl-2-one (**1l**) (12.5 mg, 0.03 mmol) gave crude product, which was purified by silica gel column chromatography to give (*R*)-**15** (16.6 mg, 99% yield) as a white solid.

(*R*)-**15**: $[\alpha]_D^{25}$ +56.9 (94% ee, *c* 1.20, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.27-7.15 (m, 3H), 7.01 (s, 1H), 4.49 (d, *J* = 16.8 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 3.25 (s, 3H), 3.30-3.16 (m, 1H), 2.18-1.83 (m, 8H), 1.67-1.50 (m, 7H), 1.34 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.2, 26.9, 29.9, 30.8, 36.1, 41.5, 60.1, 62.6, 80.6, 112.3, 123.8, 124.6, 125.8, 126.3, 143.7, 153.4, 172.3, 173.7 ; IR (KBr) 3735, 3435, 3303, 2906, 1718, 1701, 1607, 1496, 1457, 1364, 1299, 1252, 1163, 1091, 1073, 1022, 803, 703, 505, 421 cm^{-1}; HRMS (ESI) calcd. for $[C_{24}H_{29}BrN_2O_5S+Na]^+$: 559.0878, Found: 559.0889; HPLC (DAICEL CHIRALPAK IC, hexane/ ^{i}PrOH = 70:30, 1.0 ml/min, 254 nm), t = 13.5 (*R*), t = 24.2 (*S*) min.

1-Adamantyl 3-benzylthio-1-methyl-2-oxoindolin-3-ylcarbamate (16)

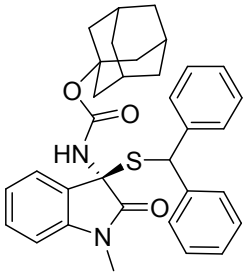


According to the typical procedure, the reaction using 1-adamantyl-1-methyl-2-oxoindolin-3-ylidencarbamate (**1d**) (10.2 mg, 0.03 mmol) and benzyl mercaptan (**2b**) (7.0 μl 0.06 mmol) gave crude product, which was purified by silica gel column chromatography to give **16** (13.1 mg, 90% yield) as a white solid.

$[\alpha]_D^{25}$ +46.7 (96% ee, *c* 0.70, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.45-7.20 (m, 7H), 7.04 (dd, *J* = 7.4, 7.4 Hz, 1H), 6.83 (d, *J* = 7.8 Hz, 1H), 5.30 (s, 1H), 4.29 (d, *J* = 12.6 Hz, 1H), 4.07 (d, *J* = 12.6 Hz, 1H), 3.28 (s, 3H), 2.20-1.60 (m, 8H), 1.80-1.50 (m, 7H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 26.7, 30.8, 32.8, 36.0, 41.3, 45.4, 62.6, 80.7, 108.4, 122.8, 123.6, 127.4, 128.8, 129.5, 129.8, 137.2, 142.2, 153.0, 173.1; IR (KBr) 3852, 3734, 3648, 3290, 2908, 2856, 1730, 1700, 1614, 1492, 1472, 1456, 1373, 1347, 1290,

1241, 1069, 750, 711, 418 cm^{-1}; HRMS (ESI) calcd. for $[C_{27}H_{30}N_2O_3S+Na]^+$: 485.1875, Found: 485.1885; HPLC (DAICEL CHIRALPAK IC, hexane/ ^{i}PrOH = 70:30, 1.0 ml/min, 254 nm), t = 9.7 (major), t = 18.9 (minor) min.

1-Adamantyl 3-diphenylmethylthio-1-methyl--2-oxoindolin-3-ylcarbamate (17)



According to the typical procedure, the reaction using 1-adamantyl-1-methyl-2-oxoindolin-3-ylidencarbamate (**1d**) (10.2 mg, 0.03 mmol) and diphenylmethanethiol (**2c**) (11.0 µl 0.06 mmol)gave crude product, which was purified by silica gel column chromatography to give **17** (15.2 mg, 90% yield) as a white solid.

$[\alpha]_D^{25}$ +46.3 (99% ee, *c* 1.01, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.70-7.60 (m, 2H), 7.50-7.10 (m, 10H), 7.07 (dd, *J* = 7.5, 7.5 Hz, 1H), 6.76 (d, *J* = 7.8 Hz, 1H), 6.06 (s, 1H), 4.97 (s, 1H), 3.20 (s, 3H), 2.20-1.60 (m, 8H), 1.70-1.40 (m, 7H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 26.6, 30.7, 36.0, 41.3, 63.5, 80.2, 108.5, 122.8, 123.8, 127.2, 127.6, 128.3, 128.4, 128.5, 128.6, 128.8, 129.0, 129.8, 140.6, 142.2, 142.4, 152.7, 173.1; IR (KBr) 3403, 3027, 2916, 2851, 1714, 1613, 1472, 1345, 1230, 1050, 1020, 755, 709 cm^{-1}; HRMS (ESI) calcd. for $[C_{33}H_{34}N_2O_3S+Na]^+$: 561.2188, Found: 561.2191; HPLC (DAICEL CHIRALCEL OD-3, hexane/ ^{i}PrOH = 95:5, 1.0 ml/min, 254 nm), t = 8.5 (major), t = 11.7 (minor) min.

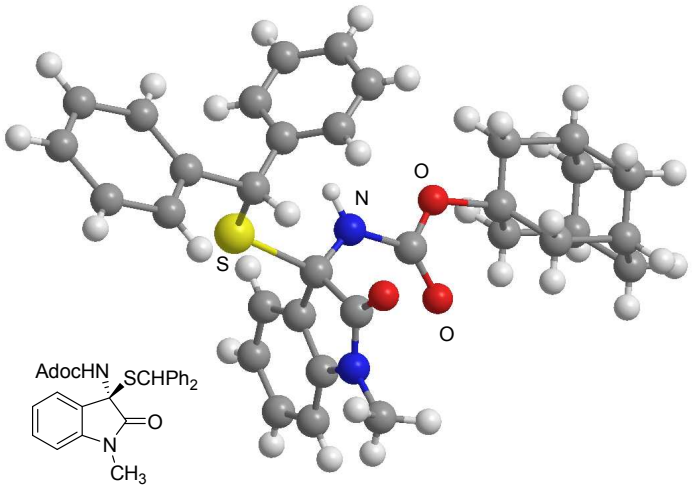
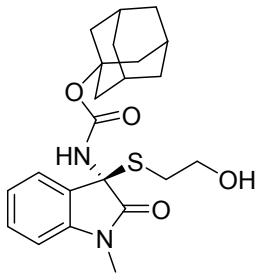


Figure S1. X-ray crystallography analysis for (*R*,)-**17**. Cambridge structure database: No. CCDC 986505

1-Adamantyl 3-(2-hydroxyethylthio)-1-methyl-2-oxoindolin-3-ylcarbamate (18)



According to the typical procedure, the reaction using 1-adamantyl-1-methyl-2-oxoindolin-3-ylidencarbamate (**1d**) (10.2 mg, 0.03 mmol) and 2-mercaptoethanol (**2d**) (4.2 μl 0.06 mmol) gave crude product, which was purified by silica gel column chromatography to give **18** (13.0 mg, 99% yield) as a white solid.

$[\alpha]_D^{25}$ +6.3 (78% ee, *c* 0.82, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.45-7.25 (m, 2H), 7.07 (dd, *J* = 7.5, 7.5 Hz, 1H), 6.84 (d, *J* = 7.5 Hz, 1H), 6.73 (s, 1H), 4.05-3.95 (m, 1H), 3.80-3.65 (m, 1H), 3.65-3.45 (m, 1H), 3.26 (s, 3H), 2.95-2.80 (m, 1H), 2.67 (s, 1H), 2.20-1.60 (m, 8H), 1.80-1.40 (m, 7H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 14.3 21.1, 26.7, 30.8, 36.1, 41.3, 60.5, 61.3, 80.6, 108.4, 122.9, 123.2, 129.6, 142.2, 153.6, 171.3, 174.8; IR (KBr) 3423, 3249, 2911, 2852, 1708, 1613, 1470, 1349, 1248, 1070, 751 cm^{-1}; HRMS (ESI) calcd. for $[C_{22}H_{28}N_2O_4S+Na]^+$: 439.1667, Found: 439.1666; HPLC (DAICEL CHIRALPAK IC, hexane/ ^{i}PrOH = 70:30, 1.0 ml/min, 254 nm), t = 14.3 (major), t = 19.7 (minor) min.

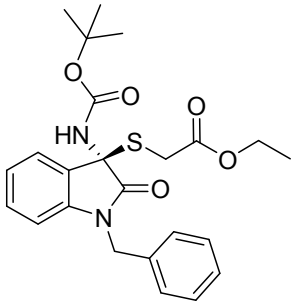
References

1) S. H. Oh, H. S. Rho, J. W. Lee, J. E. Lee, S. H. Youk, J. Chin, C. E. Song, *Angew. Chem. Int. Ed.* **2008**, *47*, 7872–7875.

2) W. Yan, D. Wang, J. Feng, P. Li, D. Zhao, R. Wang, *Org. Lett*. **2012**, *14*, 2512–2515.

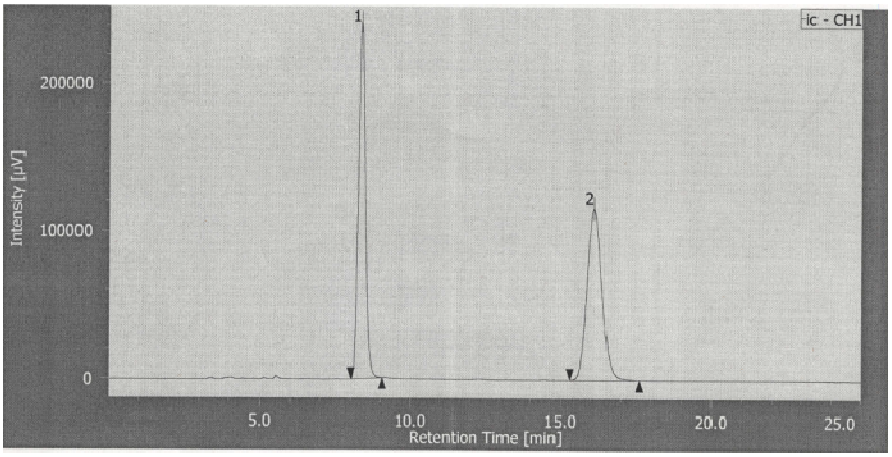
HPLC Data:

Ethyl 2-[1-benzyl-3-(tert-butoxylcarbonylamino)indolin-2-one-3-ylthio]acetate (4)

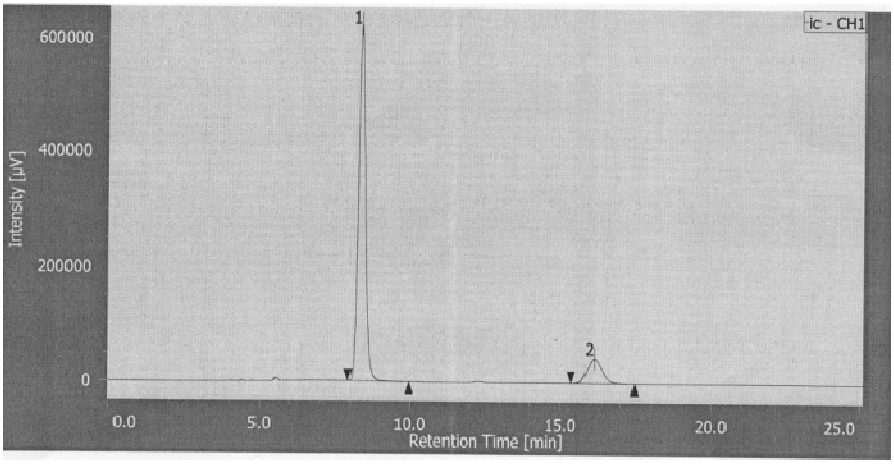


HPLC using an IC (*n*-Hexane/*i*PrOH = 70/30, flow rate 1.0 ml/min, 254 nm)

Racemic-**4**:



(*R*)-**4**:



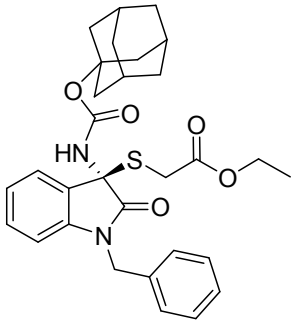
Racemic-**4**

Peak	tR (min)	Area (%)
1	8.350	49.764
2	16.100	50.236

(*R*)-**4**

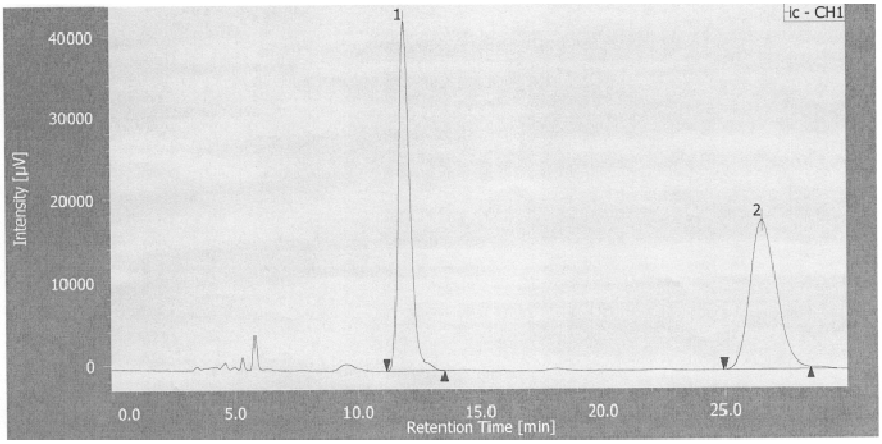
Peak	tR (min)	Area (%)
1	8.333	87.342
2	16.117	12.658

Ethyl 2-[1-benzyl-3-(1-adamantyloxylcarbonylamino)indolin-2-one-3-ylthio]acetate (5)

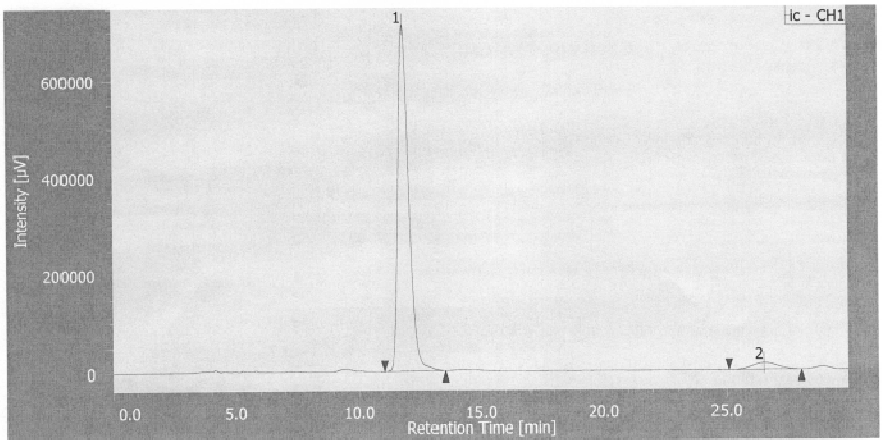


HPLC using an IC (*n*-Hexane/*i*PrOH = 70/30, flow rate 1.0 ml/min, 254 nm)

Racemic-**5**:



(*R*)-**5**:



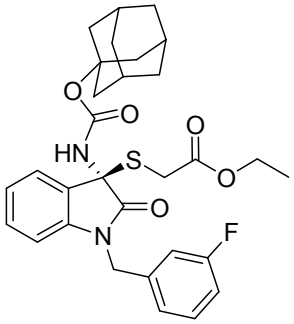
Racemic-**5**

Peak	tR (min)	Area (%)
1	11.917	50.482
2	26.525	49.518

(*R*)-**5**

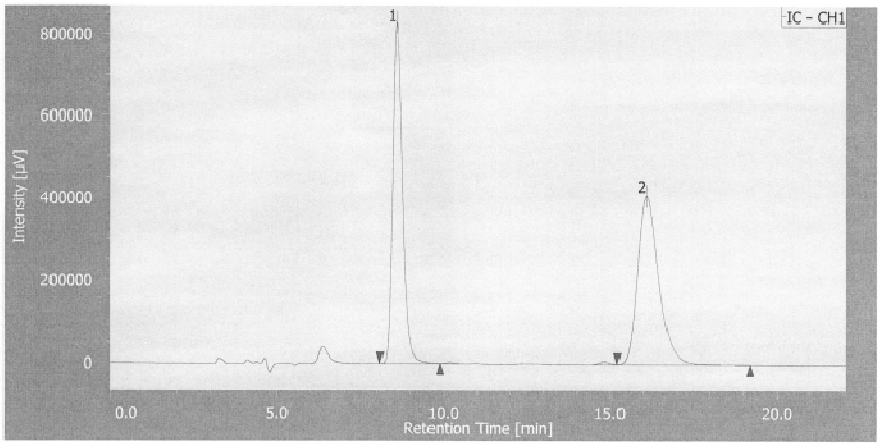
Peak	tR (min)	Area (%)
1	11.825	95.695
2	26.533	4.305

Ethyl 2-[1-3-fluorobenzyl-3-(1-adamantyloxylcarbonylamino)indolin-2-one-3-ylthio]acetate (6)

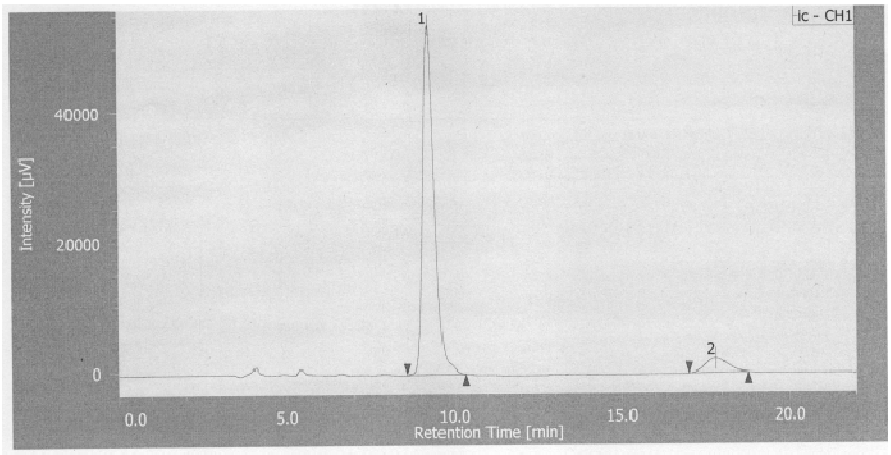


HPLC using an IC (*n*-Hexane/*i*PrOH = 70/30, flow rate 1.0 ml/min, 254 nm)

Racemic-**6**:



(*R*)-**6**:



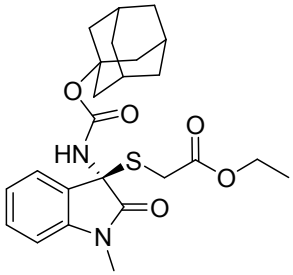
Racemic-**6**

Peak	tR (min)	Area (%)
1	8.583	49.596
2	16.092	50.404

(*R*)-**6**

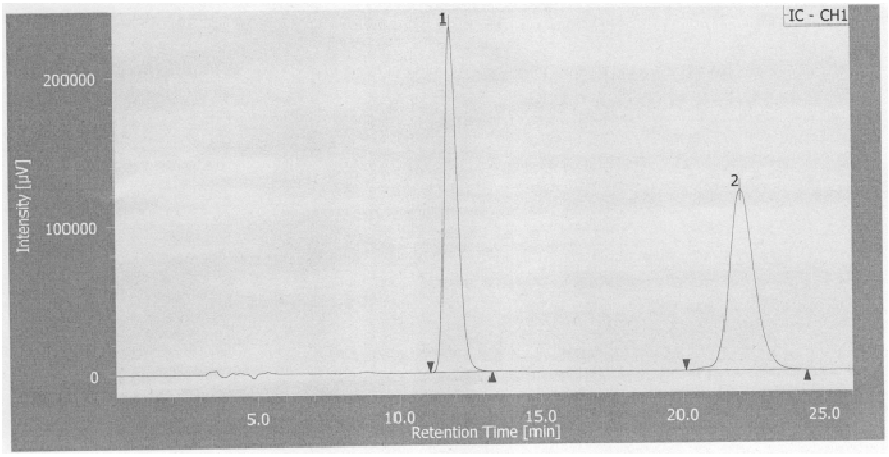
Peak	tR (min)	Area (%)
1	9.258	92.762
2	17.808	7.238

Ethyl 2-[1-methyl-3-(1-adamantyloxylcarbonylamino)indolin-2-one-3-ylthio]acetate (7)

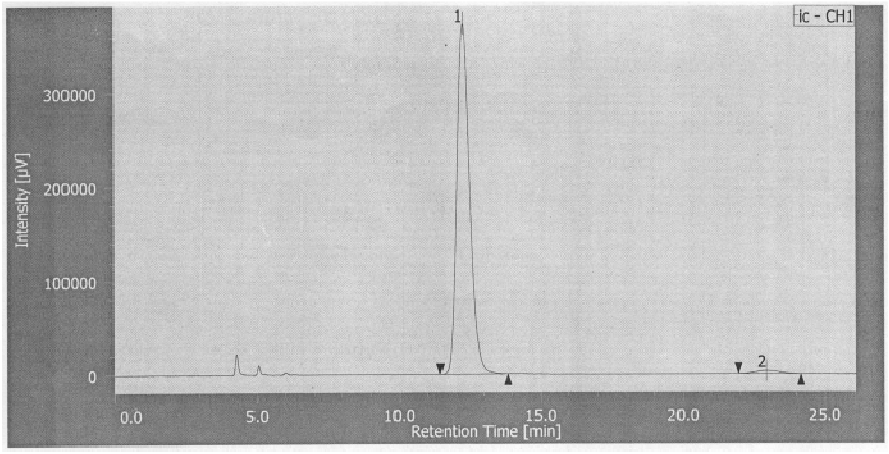


HPLC using an IC (*n*-Hexane/*i*PrOH = 50/50, flow rate 1.0 ml/min, 254 nm)

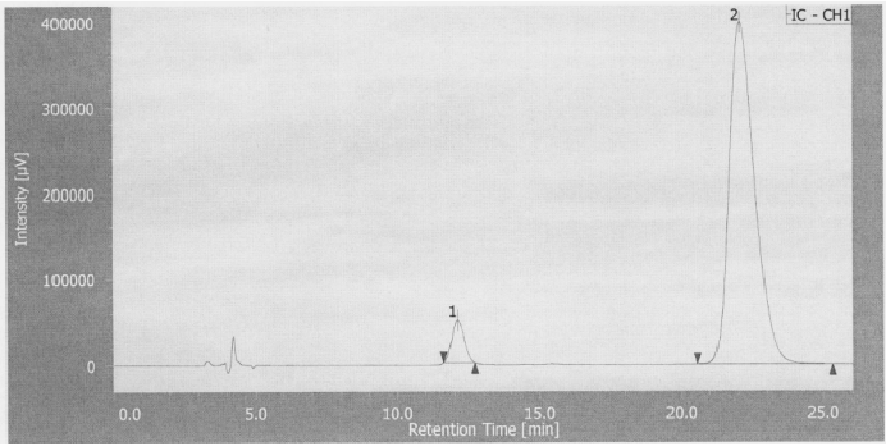
Racemic-**7**:



(*R*)-7:



(*S*)-7:



Racemic-**7**

Peak	tR (min)	Area (%)
1	11.858	49.755
2	22.067	50.245

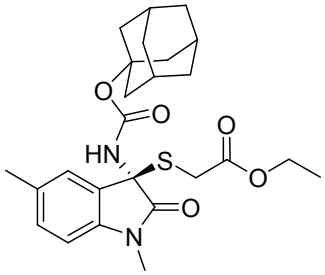
(*R*)-**7**

Peak	tR (min)	Area (%)
1	12.250	98.294
2	22.942	1.706

(*S*)-**7**

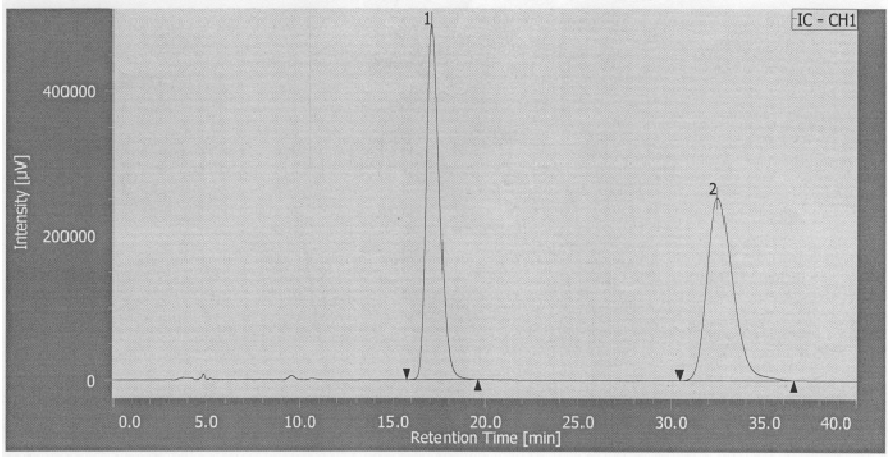
Peak	tR (min)	Area (%)
1	12.108	5.585
2	22.075	94.415

Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-methylindolin-2-one-3-ylthio]acetate (8)

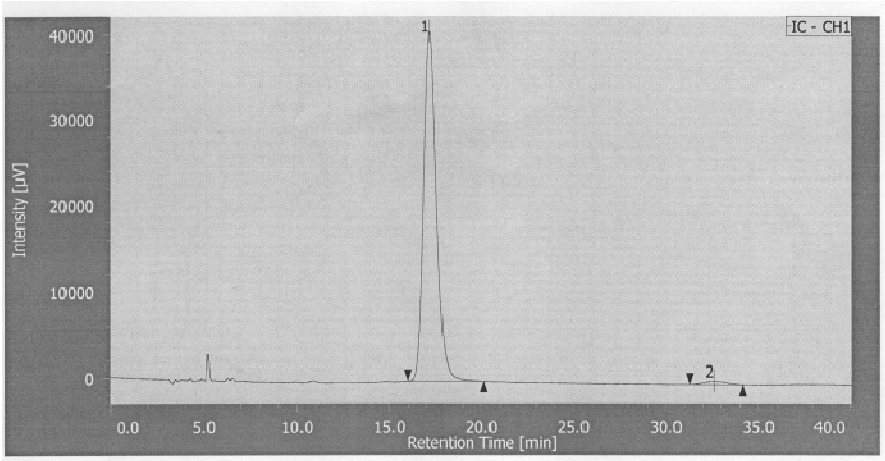


HPLC using an IC (*n*-Hexane/*i*PrOH = 60/40, flow rate 1.0 ml/min, 254 nm)

Racemic-**8**:



(*R*)-**8**:



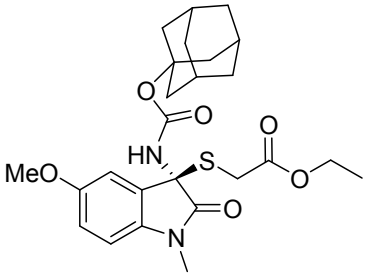
Racemic-**8**

Peak	tR (min)	Area (%)
1	17.083	50.063
2	32.467	49.937

(*R*)-**8**

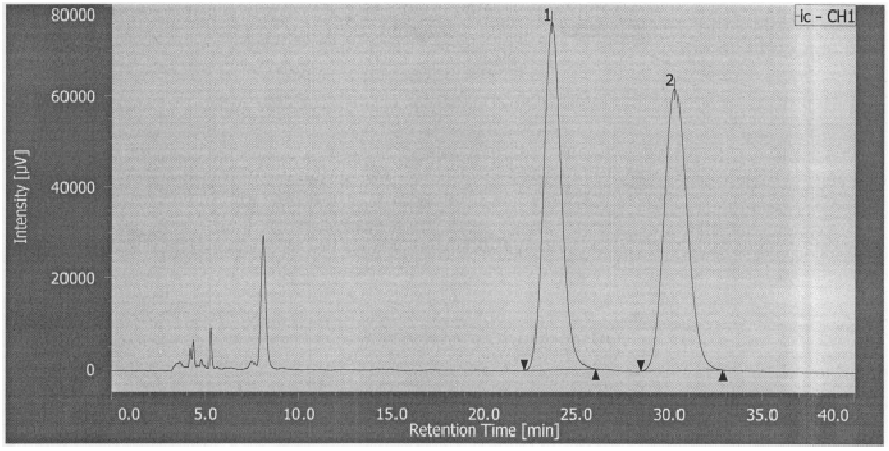
Peak	tR (min)	Area (%)
1	17.183	98.326
2	32.600	1.647

Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-methoxyindolin-2-one-3-ylthio]acetate (9)

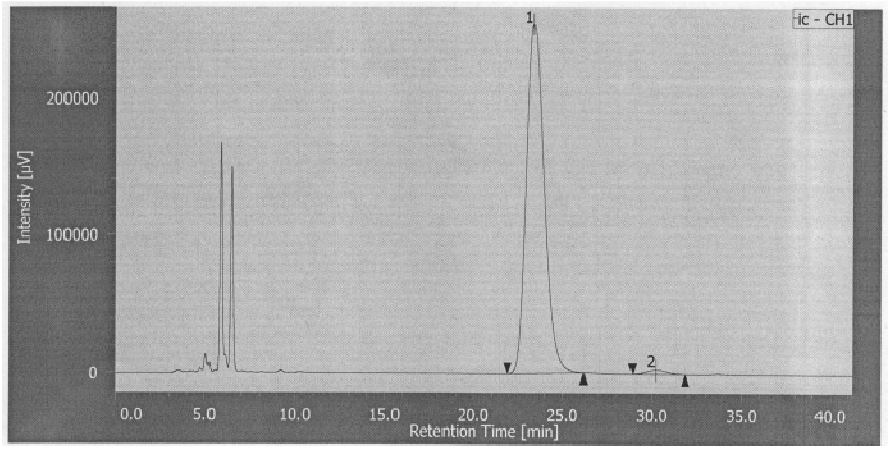


HPLC using an IC (*n*-Hexane/*i*PrOH = 60/40, flow rate 1.0 ml/min, 254 nm)

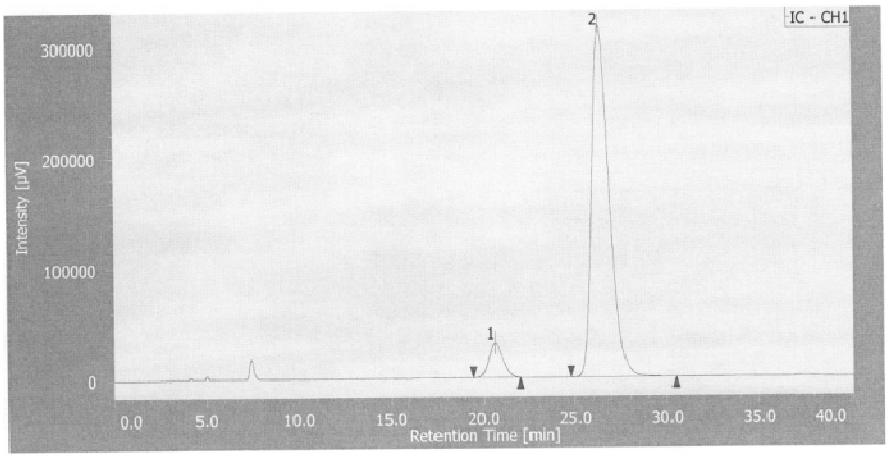
Racemic-**9**:



(*R*)-**9**:



(*S*)-**9**:



Racemic-**9**

Peak	tR (min)	Area (%)
1	23.642	49.765
2	30.258	50.235

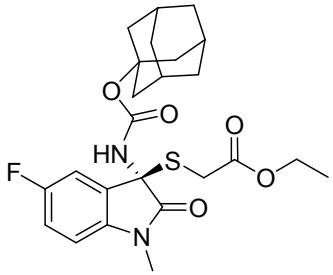
(*R*)-**9**

Peak	tR (min)	Area (%)
1	23.367	98.585
2	30.208	1.199

(*S*)-**9**

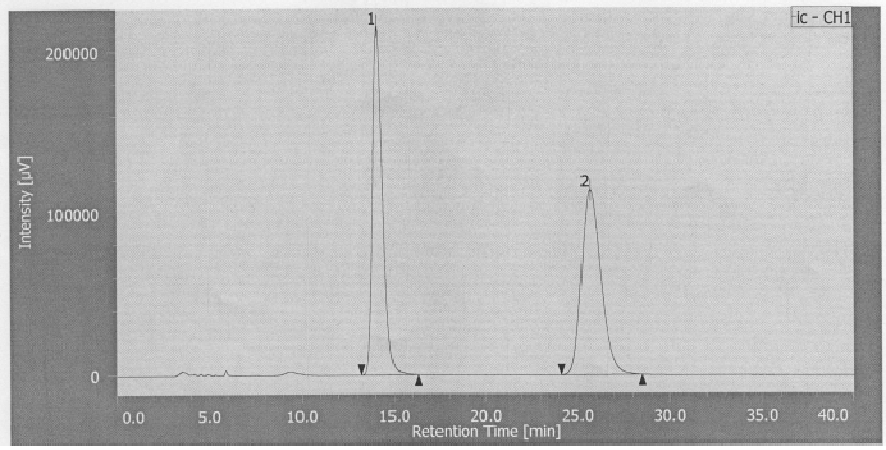
Peak	tR (min)	Area (%)
1	20.642	7.376
2	26.384	92.624

Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-fluoroindolin-2-one-3-ylthio]acetate (10)

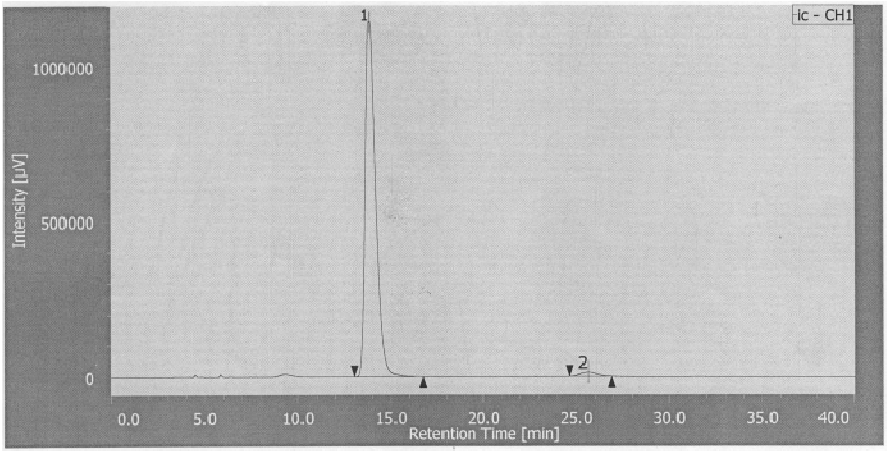


HPLC using an IC (*n*-Hexane/*i*PrOH = 70/30, flow rate 1.0 ml/min, 254 nm)

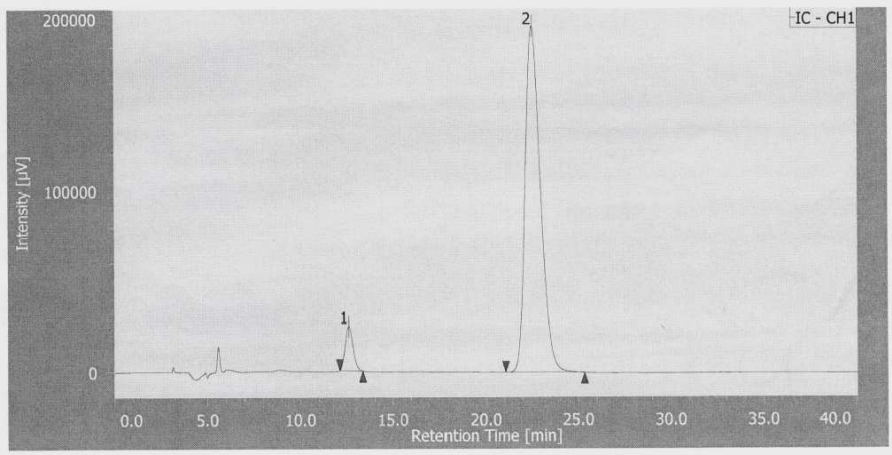
Racemic-**10**:



(*R*)-**10**:



(*S*)-**10**:



Racemic-**10**

Peak	tR (min)	Area (%)
1	14.100	49.916
2	25.683	50.084

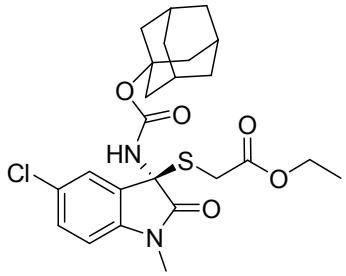
(*R*)-**10**

Peak	tR (min)	Area (%)
1	13.842	98.267
2	30.208	1.199

(*S*)-**10**

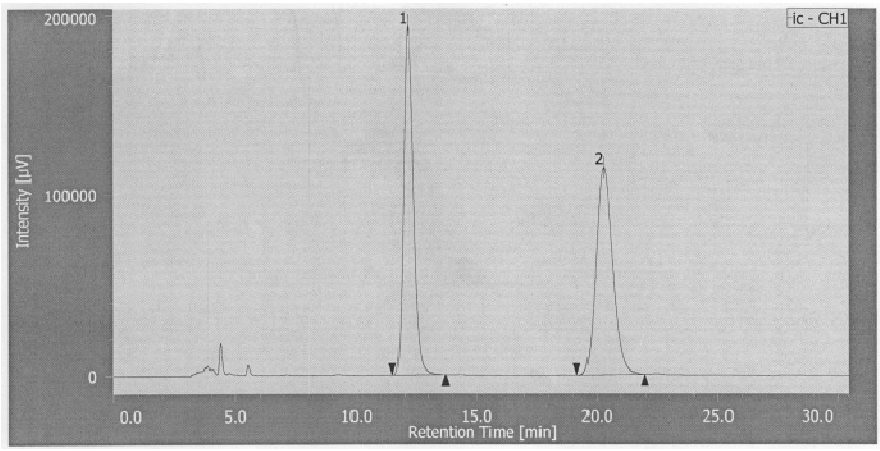
Peak	tR (min)	Area (%)
1	12.608	6.088
2	22.517	93.912

Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-chloroindolin-2-one-3-ylthio]acetate (11)

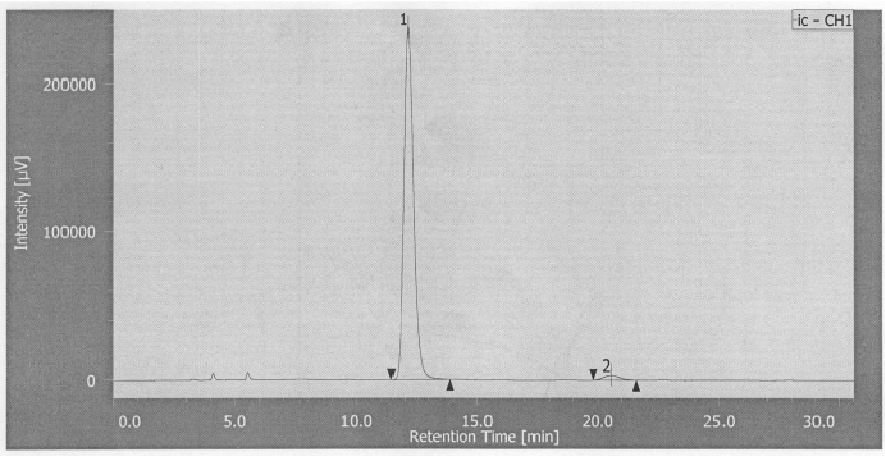


HPLC using an IC (*n*-Hexane/*i*PrOH = 70/30, flow rate 1.0 ml/min, 254 nm)

Racemic-**11**:



(*R*)-**11**:



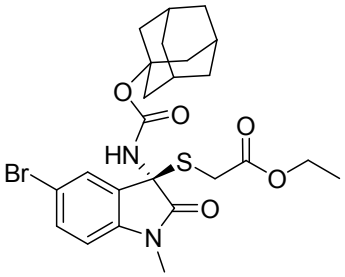
Racemic-**11**

Peak	tR (min)	Area (%)
1	12.133	50.128
2	20.283	49.872

(*R*)-**11**

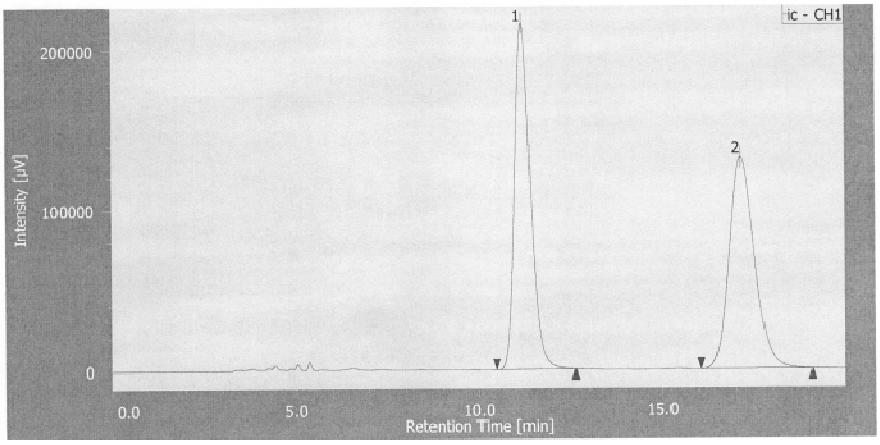
Peak	tR (min)	Area (%)
1	12.142	97.814
2	20.567	2.186

Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-bromoindolin-2-one-3-ylthio]acetate (12)

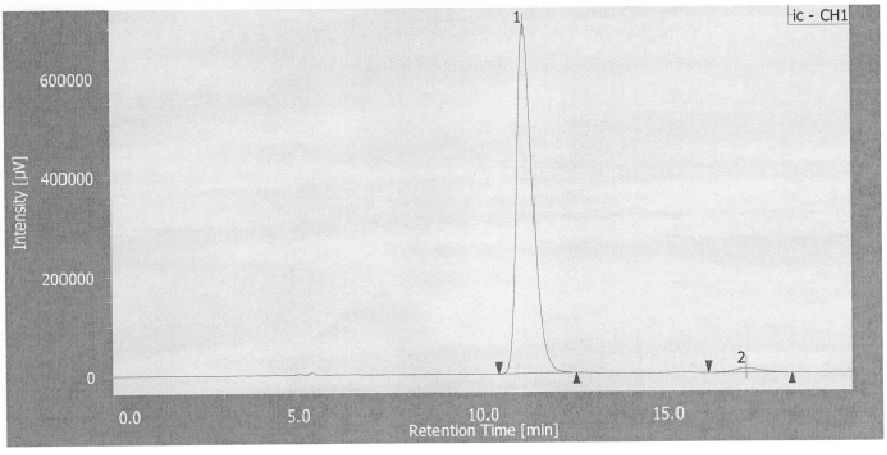


HPLC using an OD-3 (*n*-Hexane/*i*PrOH = 60/40, flow rate 1.0 ml/min, 254 nm)

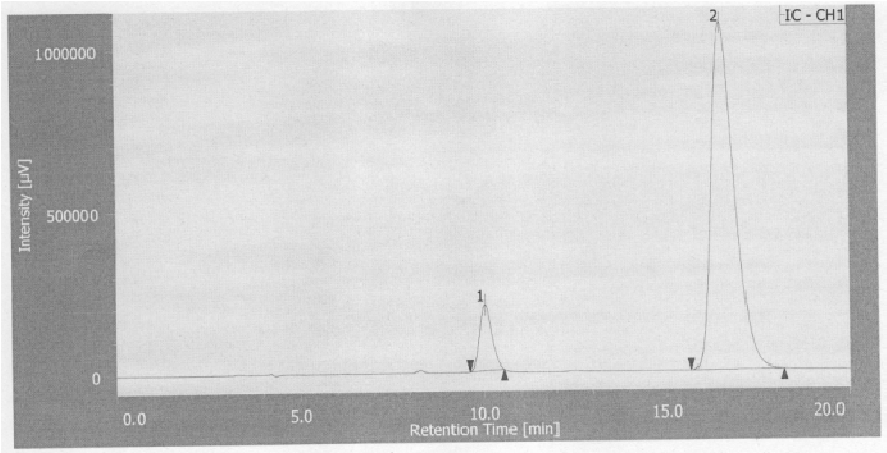
Racemic-**12**:



(*R*)-**12**:



(*S*)-**12**:



Racemic-**12**

Peak	tR (min)	Area (%)
1	11.200	49.930
2	17.142	50.070

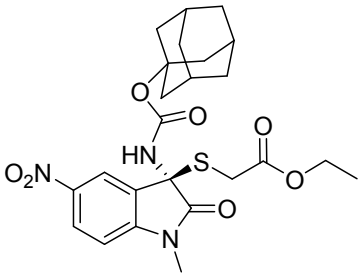
(*R*)-**12**

Peak	tR (min)	Area (%)
1	11.150	97.878
2	17.108	2.122

(*S*)-**12**

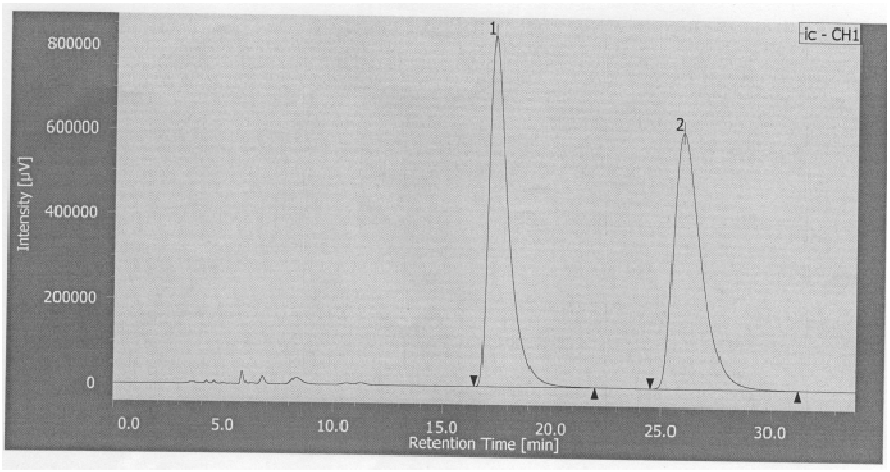
Peak	tR (min)	Area (%)
1	10.042	9.168
2	16.517	90.832

Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-5-nitoroindolin-2-one-3-ylthio]acetate (13)

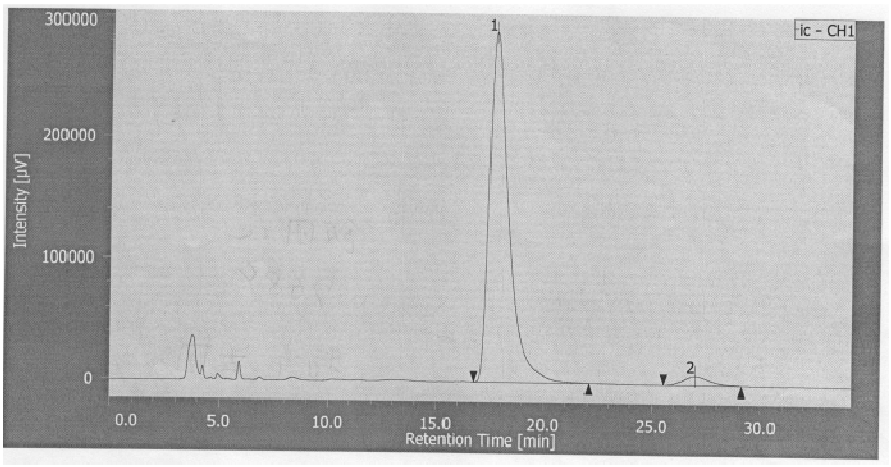


HPLC using an IC (*n*-Hexane/*i*PrOH = 70/30, flow rate 1.0 ml/min, 254 nm)

Racemic-**13**:



(*R*)-**13**:



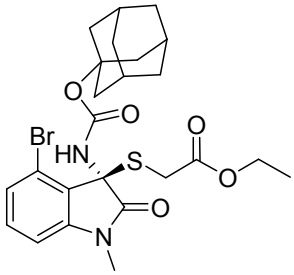
Racemic-**13**

Peak	tR (min)	Area (%)
1	17.275	49.885
2	25.892	50.115

(*R*)-**13**

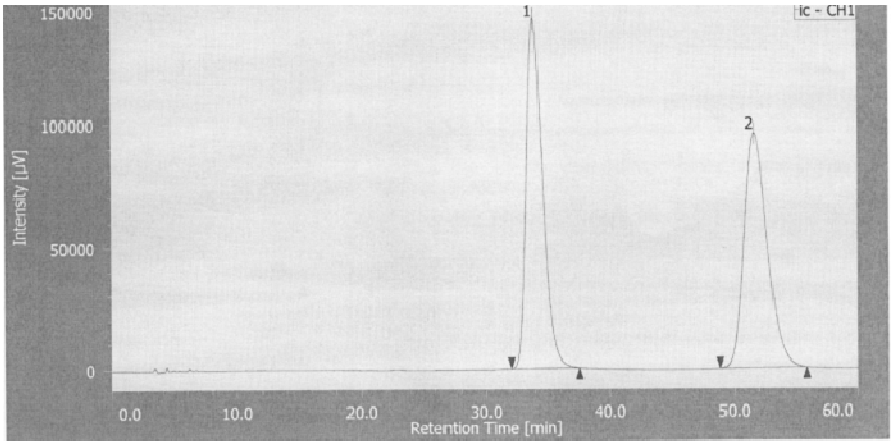
Peak	tR (min)	Area (%)
1	12.142	96.449
2	20.567	3.551

Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-4-bromoindolin-2-one-3-ylthio]acetate (14)

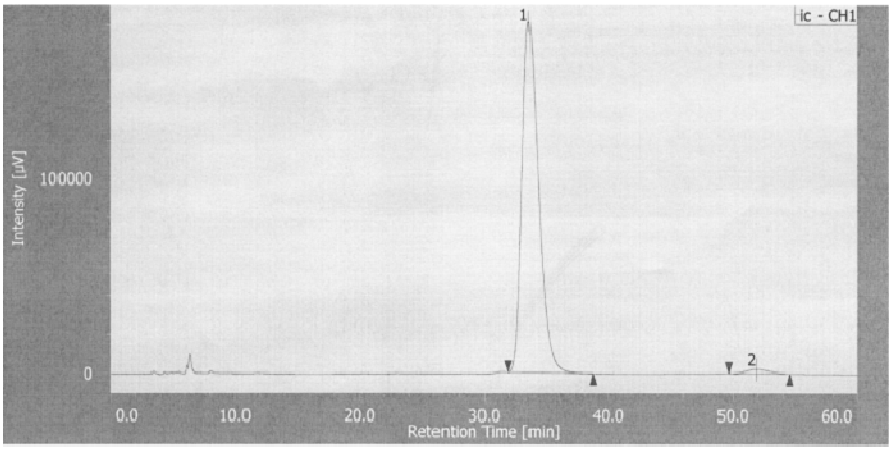


HPLC using an IC (*n*-Hexane/*i*PrOH = 80/20, flow rate 1.0 ml/min, 254 nm)

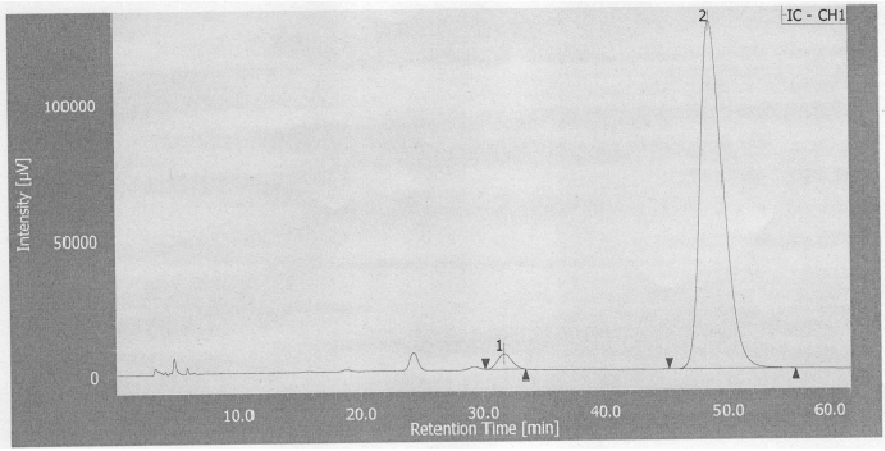
Racemic-**14**:



(*R*)-**14**:



(*S*)-14:



Racemic-**14**

Peak	tR (min)	Area (%)
1	33.867	50.338
2	51.617	49.662

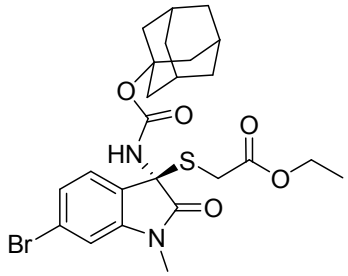
(*R*)-**14**

Peak	tR (min)	Area (%)
1	33.567	98.212
2	51.883	1.788

(*S*)-**14**

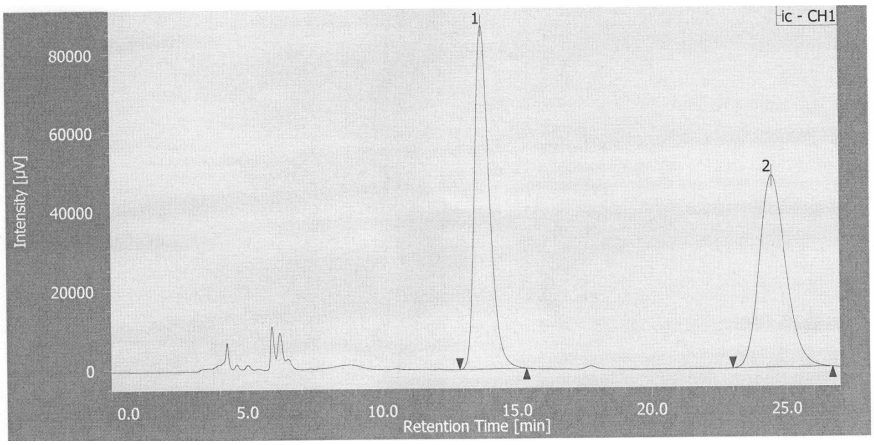
Peak	tR (min)	Area (%)
1	31.708	2.834
2	48.658	97.166

Ethyl 2-[1-methyl-3-(1-adamantyloxycarbonylamino)-6-bromoindolin-2-one-3-ylthio]acetate (15)

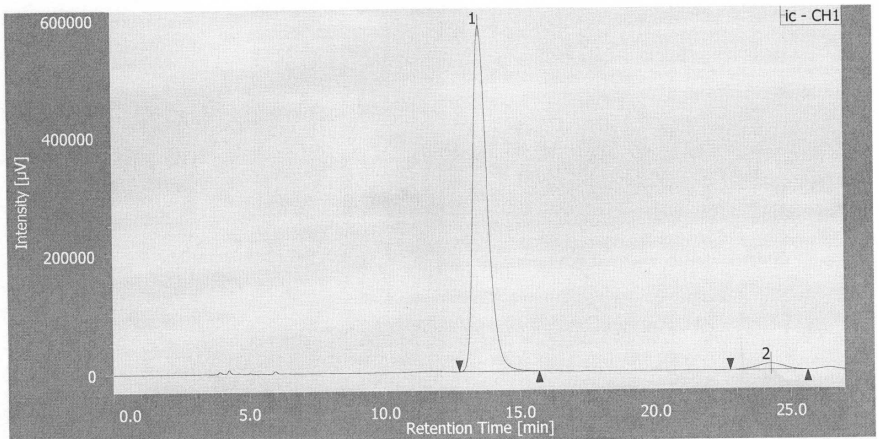


HPLC using an IC (*n*-Hexane/*i*PrOH = 70/30, flow rate 1.0 ml/min, 254 nm)

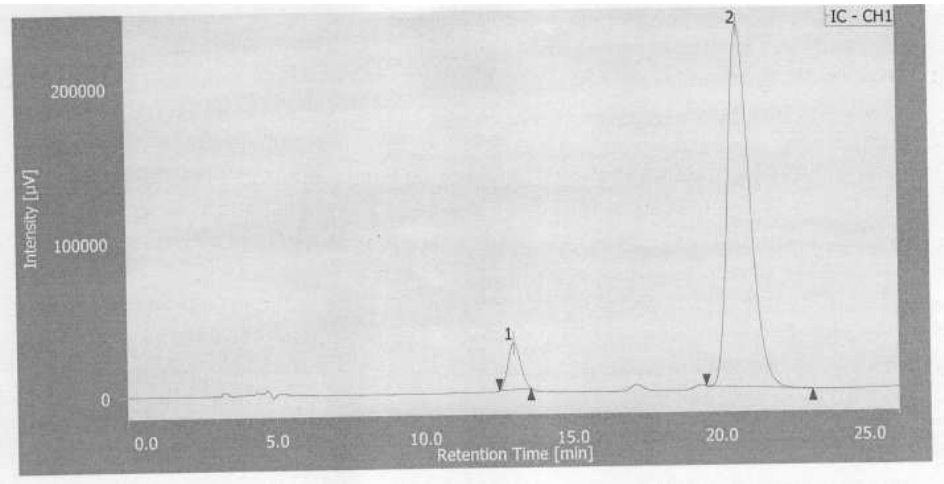
Racemic-**15**:



(*R*)-**15**:



(*S*)-**15**:



Racemic-**15**

Peak	tR (min)	Area (%)
1	13.733	50.076
2	24.458	49.924

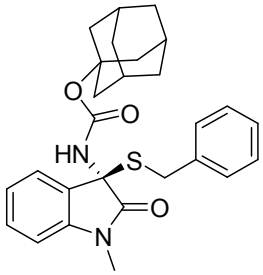
(*R*)-**15**

Peak	tR (min)	Area (%)
1	13.533	96.782
2	24.233	3.218

(*S*)-**15**

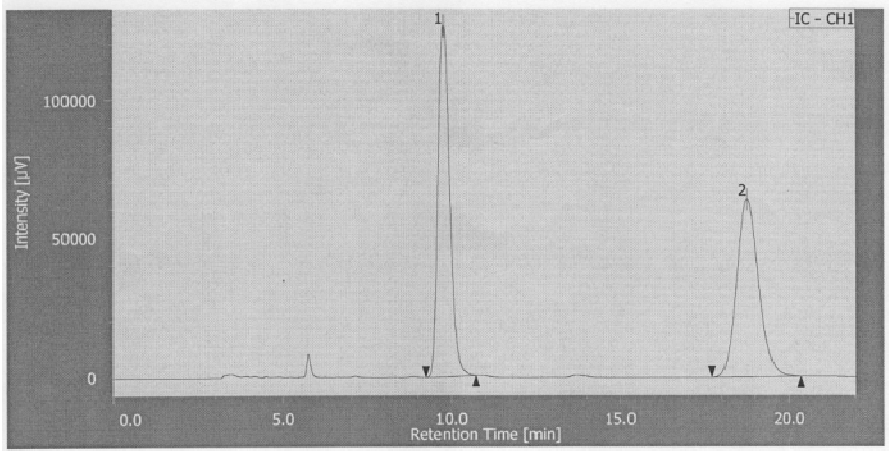
Peak	tR (min)	Area (%)
1	13.008	6.819
2	20.625	93.181

1-Adamantyl 3-(benzylthio)-1-methyl-2-oxoindolin-3-ylcarbamate (16)

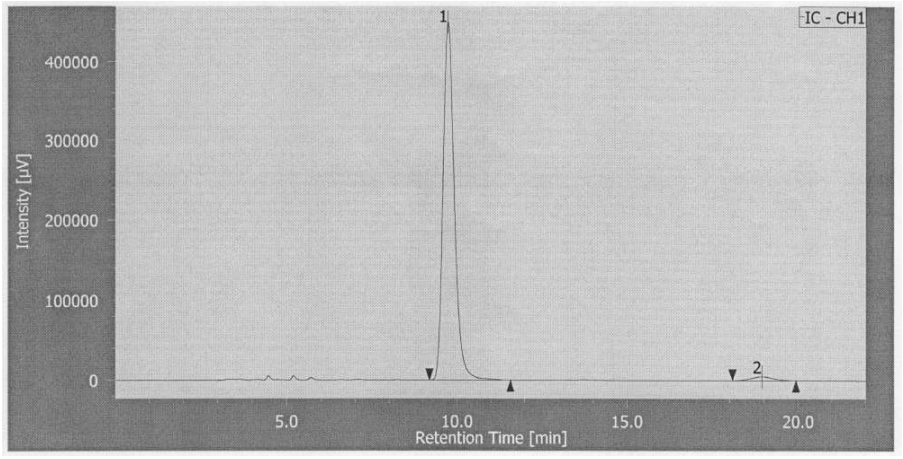


HPLC using an IC (*n*-Hexane/*i*PrOH = 70/30, flow rate 1.0 ml/min, 254 nm)

Racemic-**16**:



(*R*)-**16**:



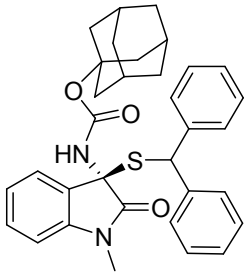
Racemic-**16**

Peak	tR (min)	Area (%)
1	9.755	49.760
2	18.750	50.240

(*R*)-**16**

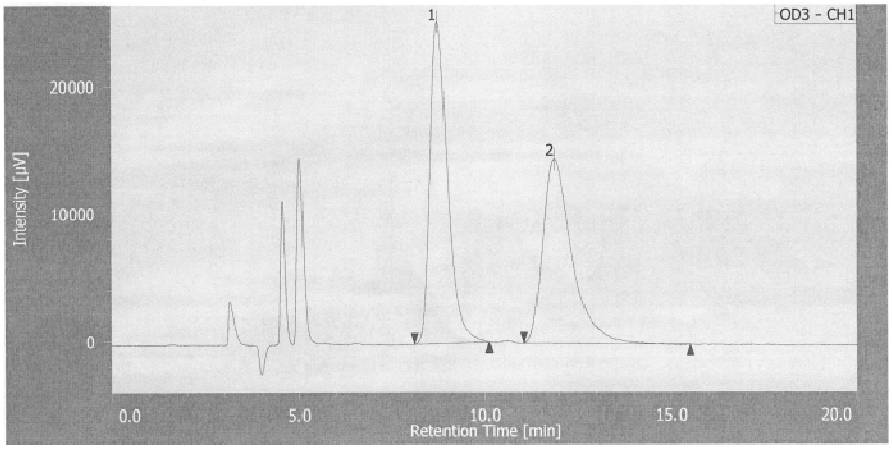
Peak	tR (min)	Area (%)
1	9.725	97.883
2	18.933	2.117

1-Adamantyl 3-(benzhydrylthio)-1-methyl-2-oxoindolin-3-ylcarbamate (17)

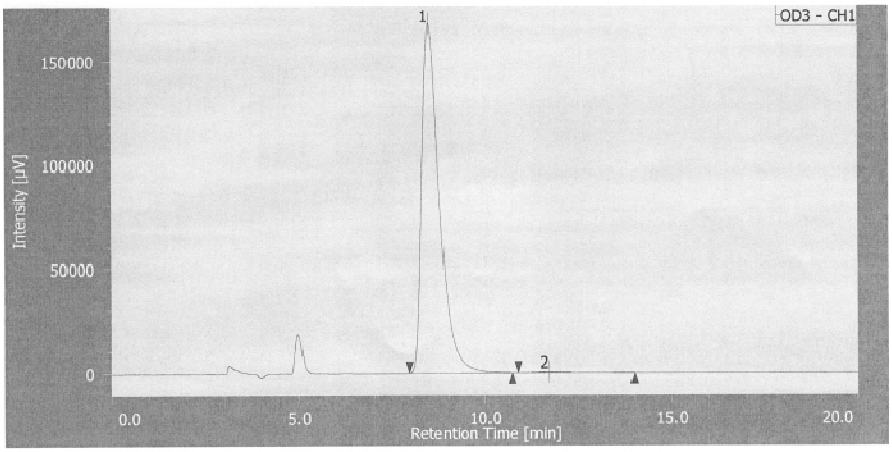


HPLC using an OD-3 (*n*-Hexane/*i*PrOH = 95/5, flow rate 1.0 ml/min, 254 nm)

Racemic-**17**:



(*R*)-**17**:



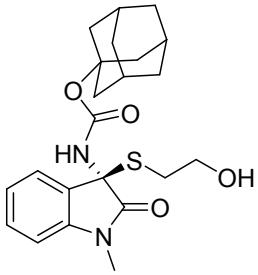
Racemic-**17**

Peak	tR (min)	Area (%)
1	8.733	50.902
2	11.875	49.098

(*R*)-**17**

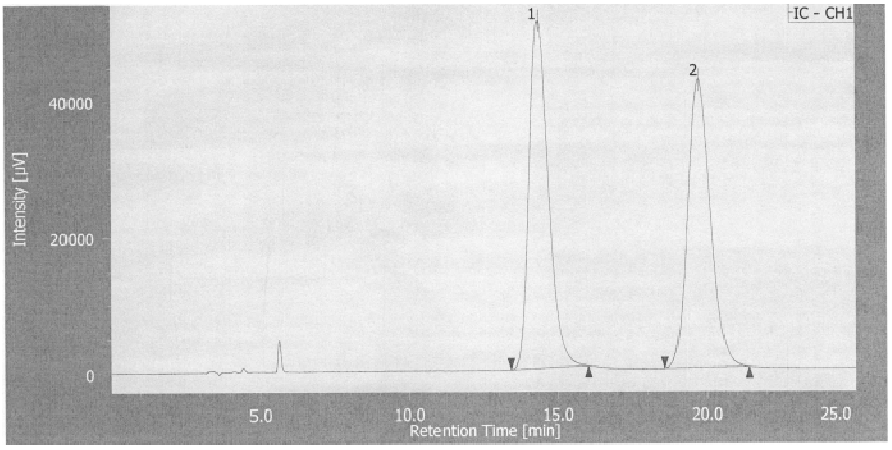
Peak	tR (min)	Area (%)
1	8.483	99.259
2	11.700	0.471

1-Adamantyl 3-(2-hydroxyethylthio)-1-methyl-2-oxoindolin-3-ylcarbamate (18)

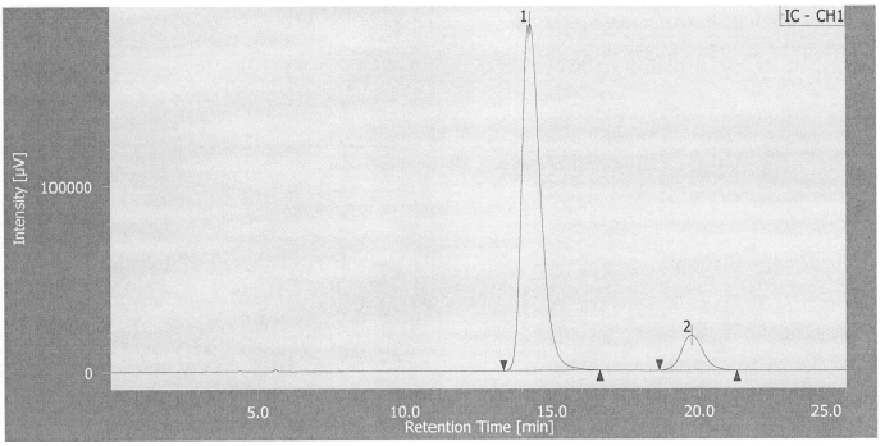


HPLC using an IC (*n*-Hexane/*i*PrOH = 70/30, flow rate 1.0 ml/min, 254 nm)

Racemic-**18**:



(*R*)-**18**:



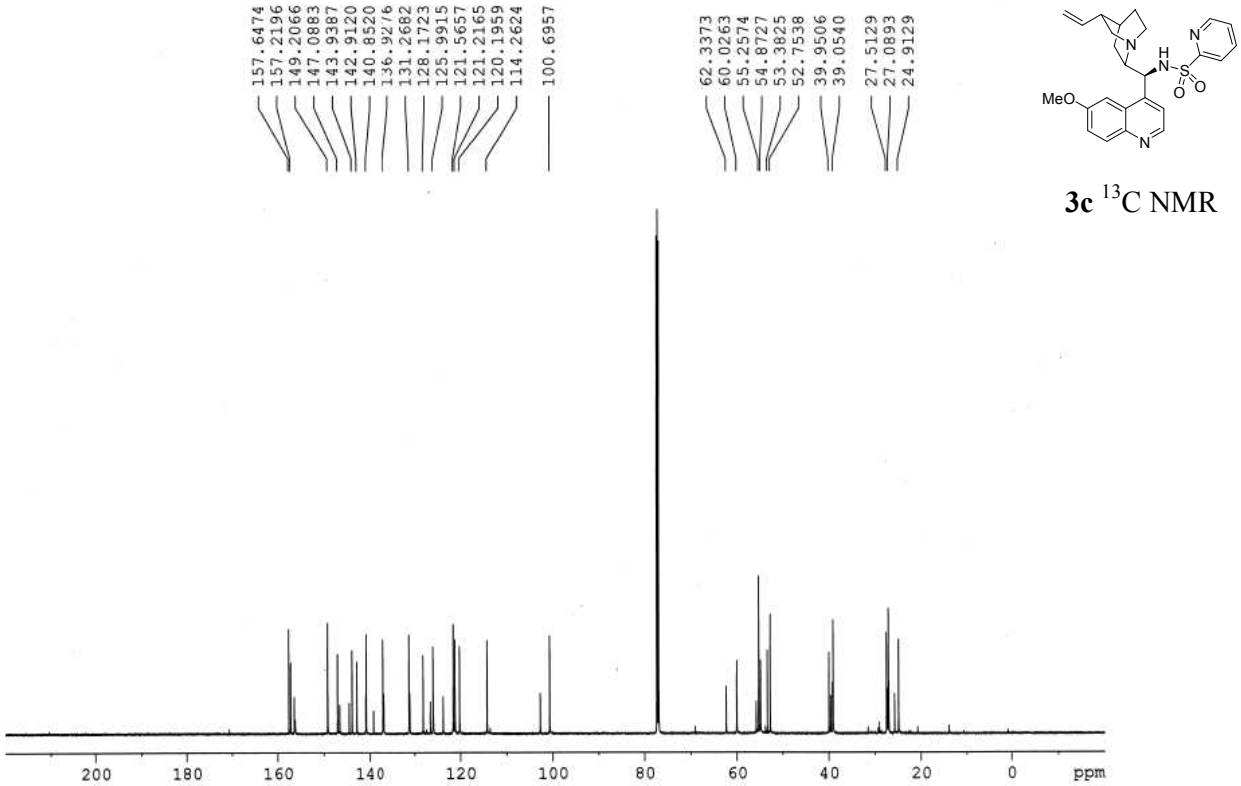
Racemic-**18**

Peak	tR (min)	Area (%)
1	14.432	49.739
2	19.725	50.261

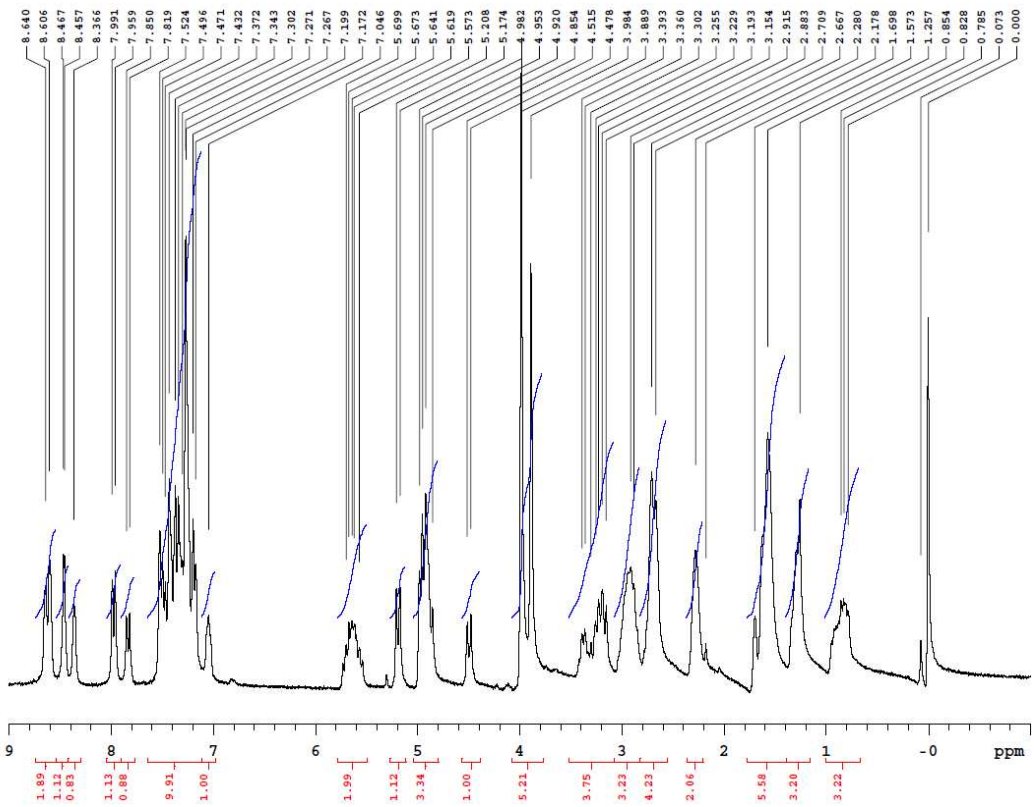
(*R*)-**18**

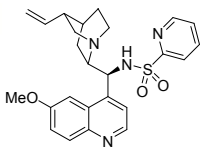
Peak	tR (min)	Area (%)
1	14.283	89.049
2	19.733	10.951

NMR Spectrum

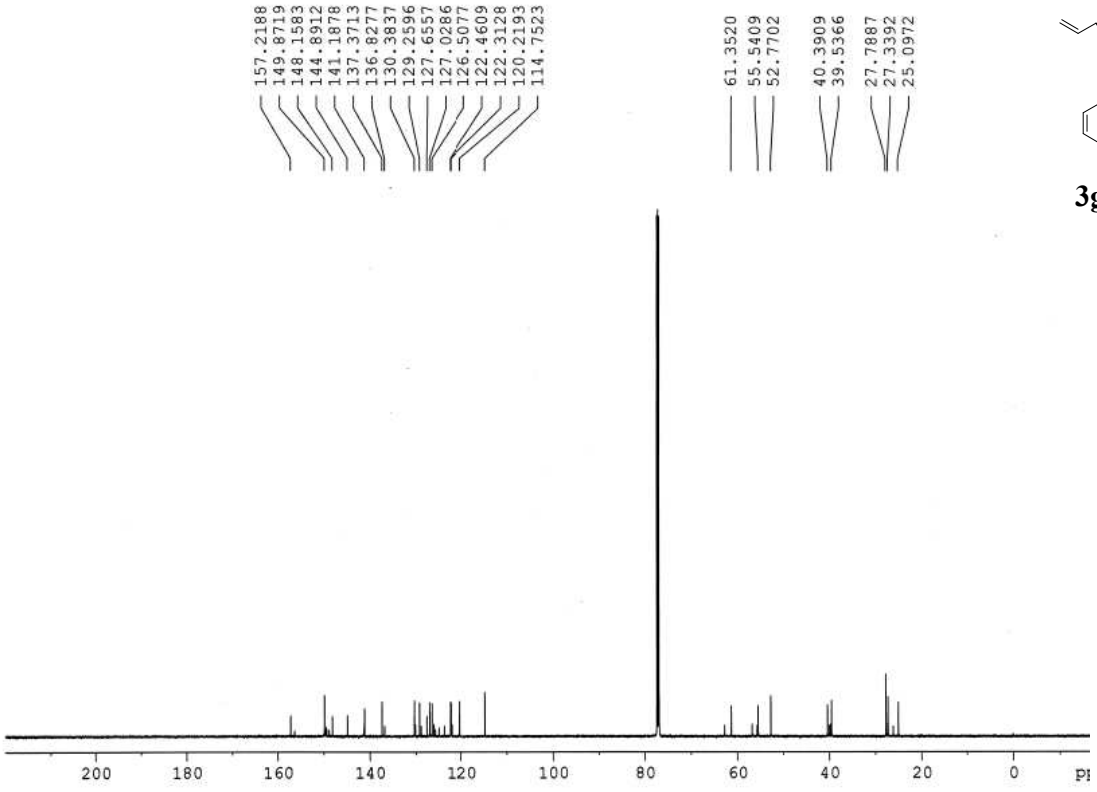


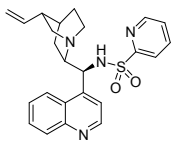
3c ^{13}C NMR



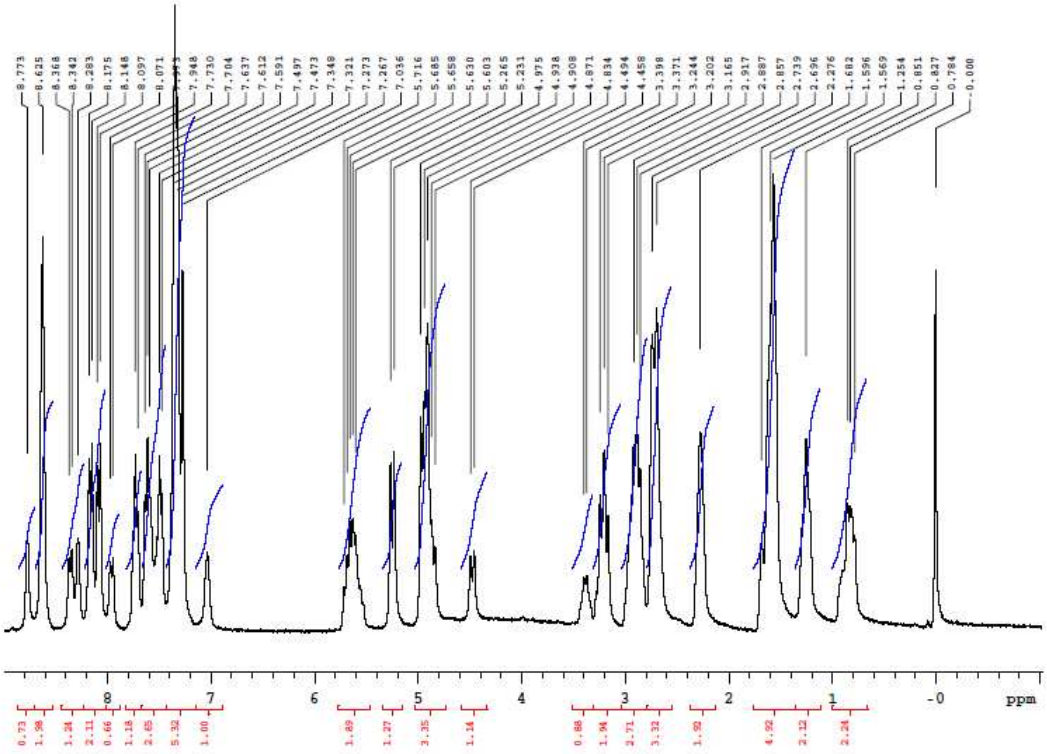


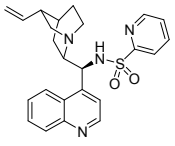
3c ^{1}H NMR



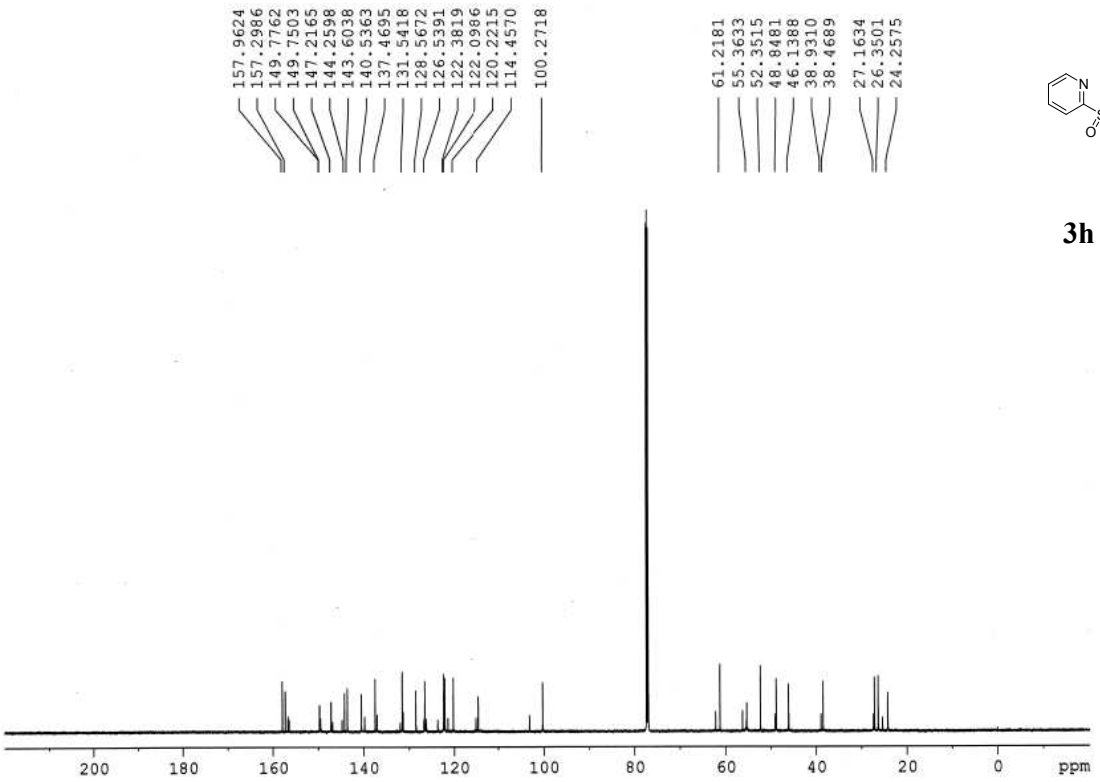


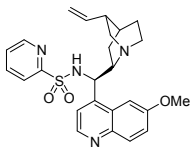
3g ^{13}C NMR



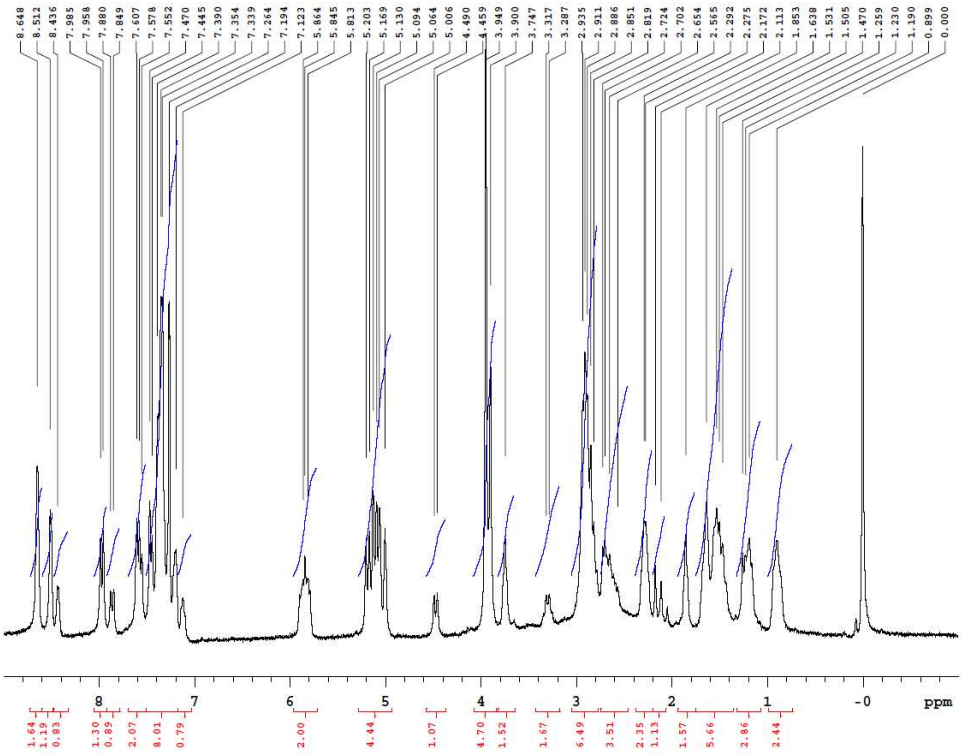


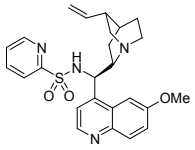
3g ^{1}H NMR



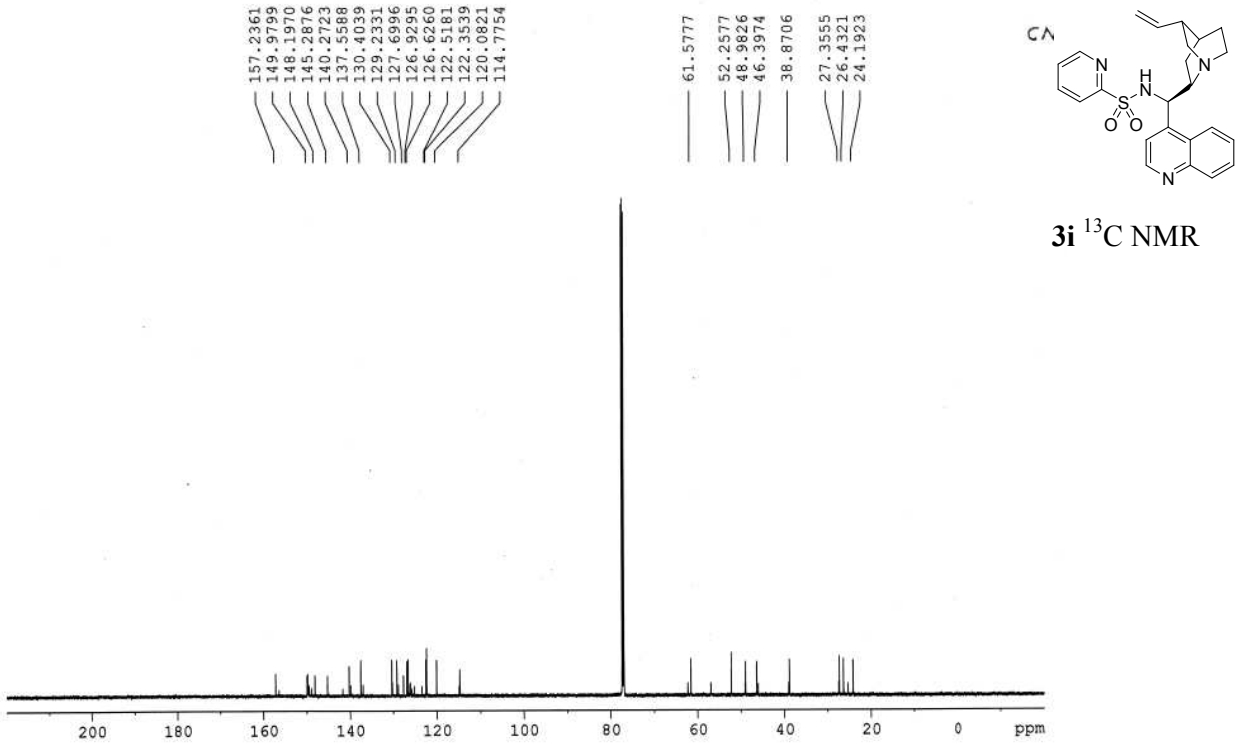


3h ^{13}C NMR

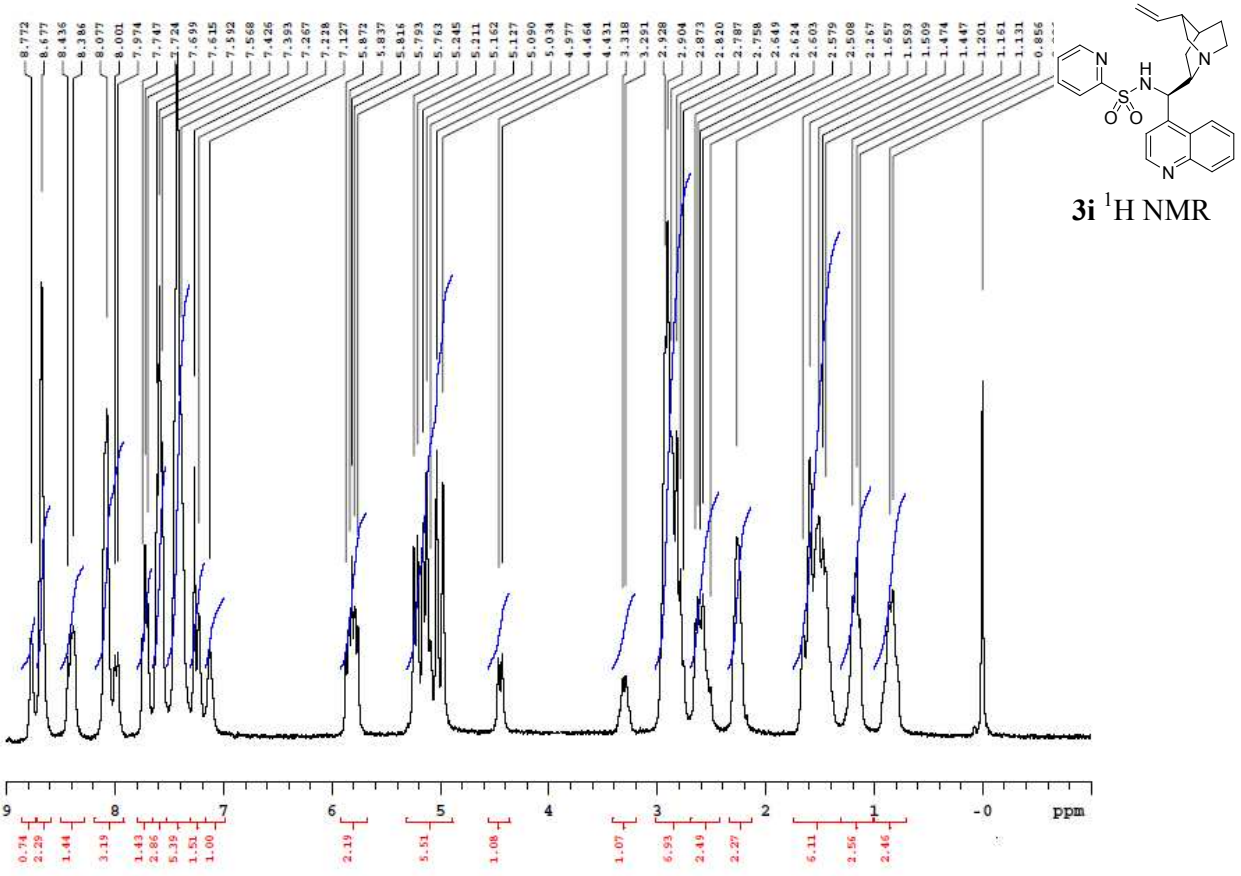




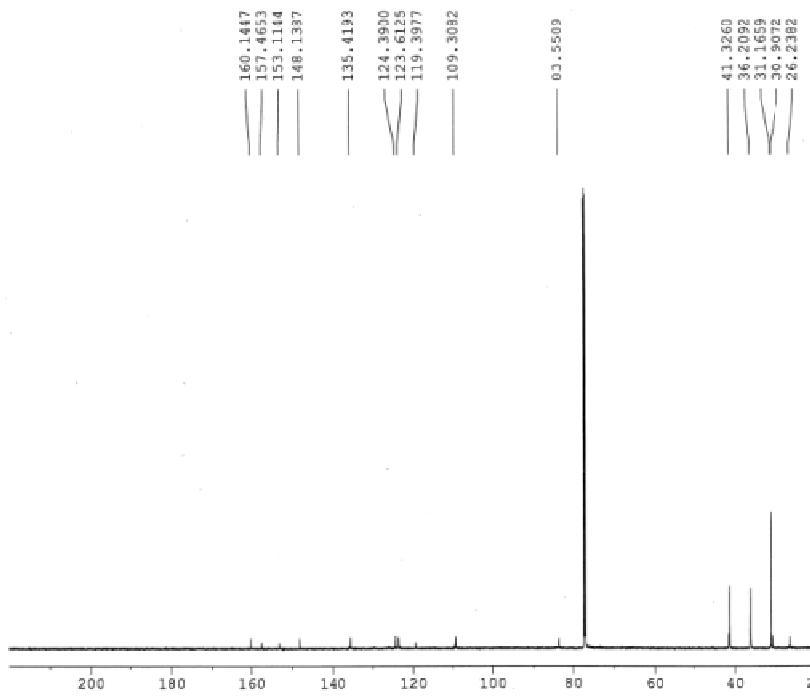
3h ^{1}H NMR

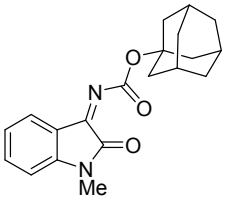


3i ^{13}C NMR

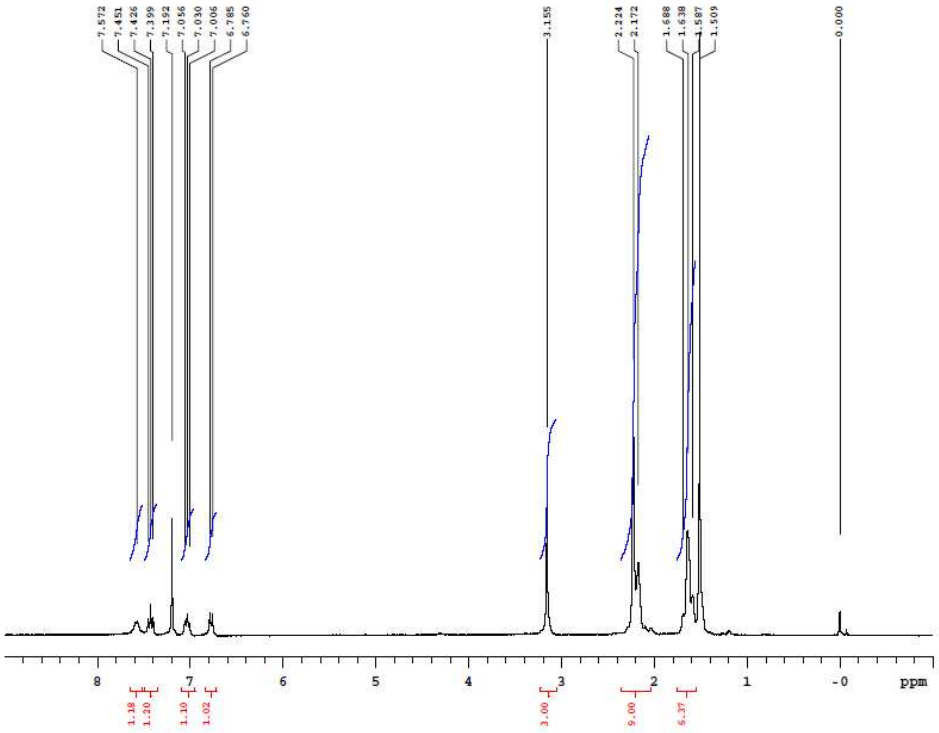


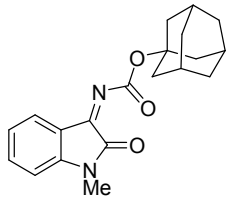
3i ^{1}H NMR



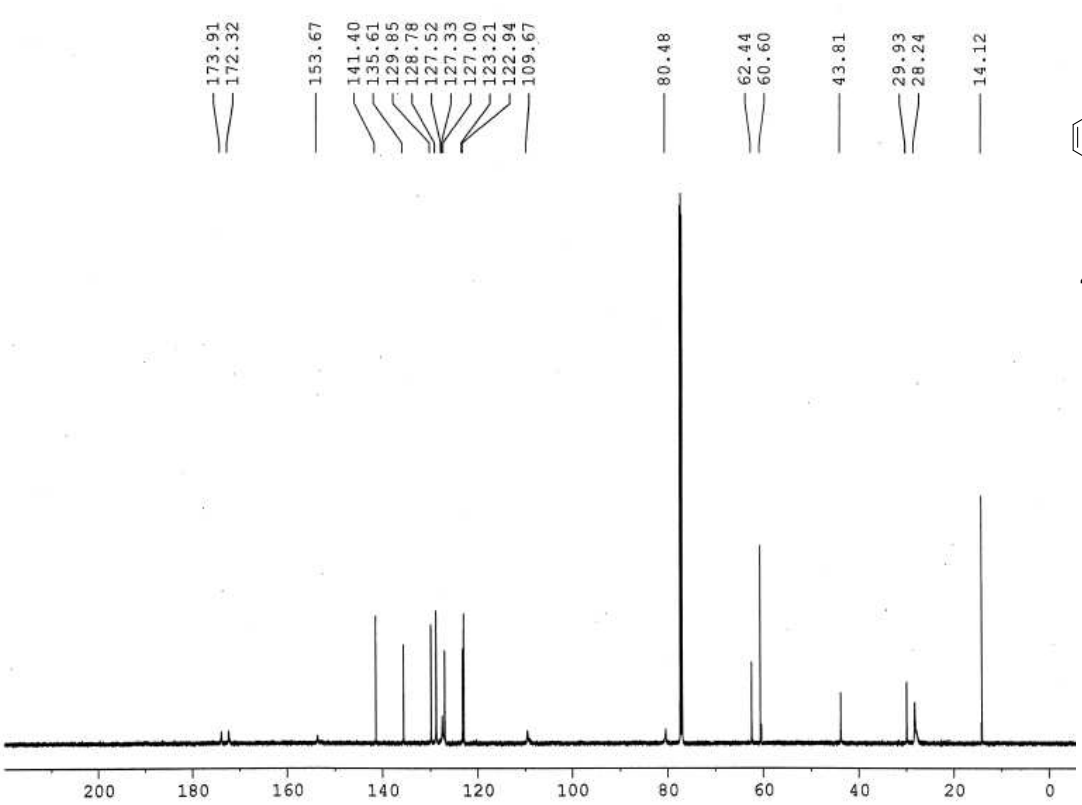


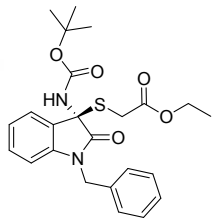
1d ^{13}C NMR



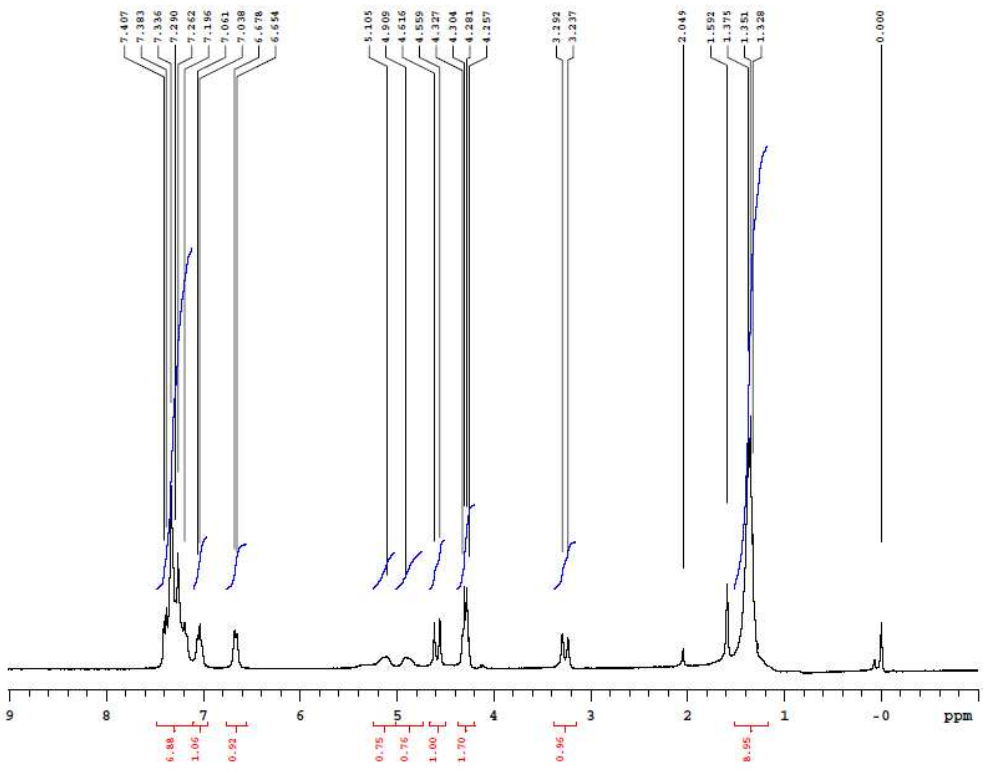


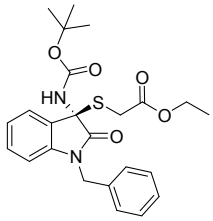
1d ^{1}H NMR



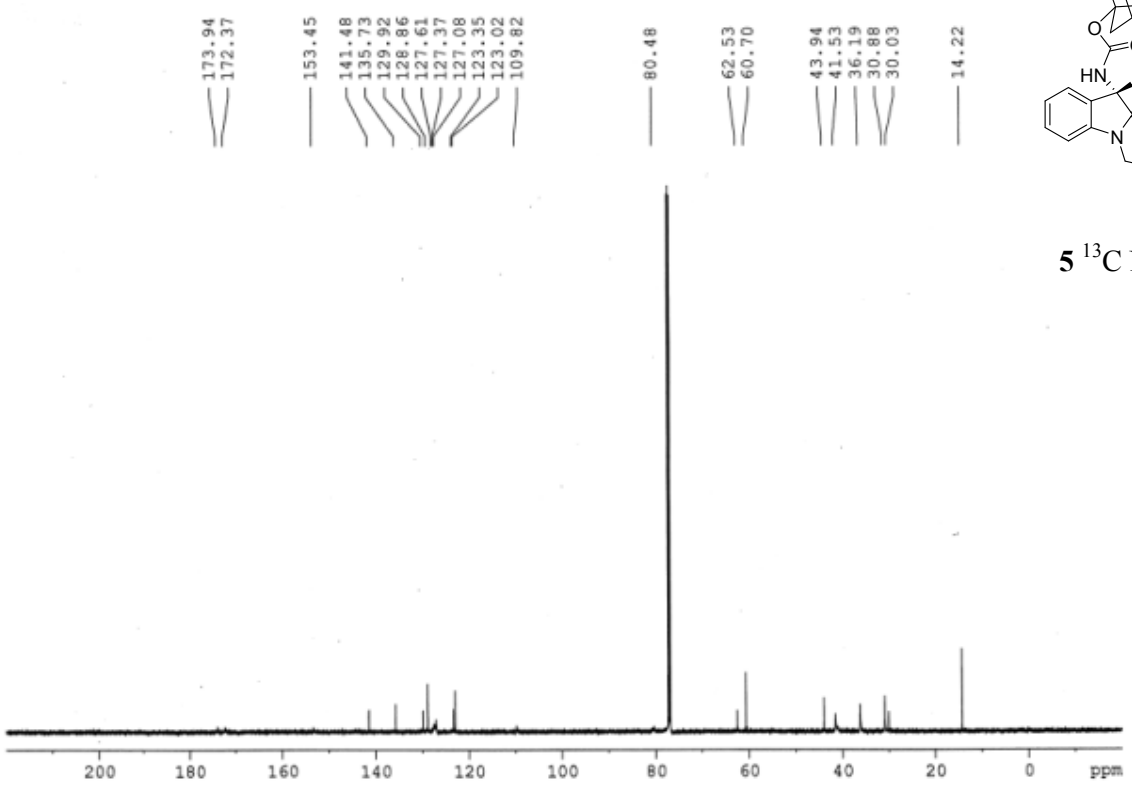


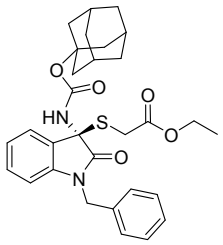
4 ^{13}C NMR



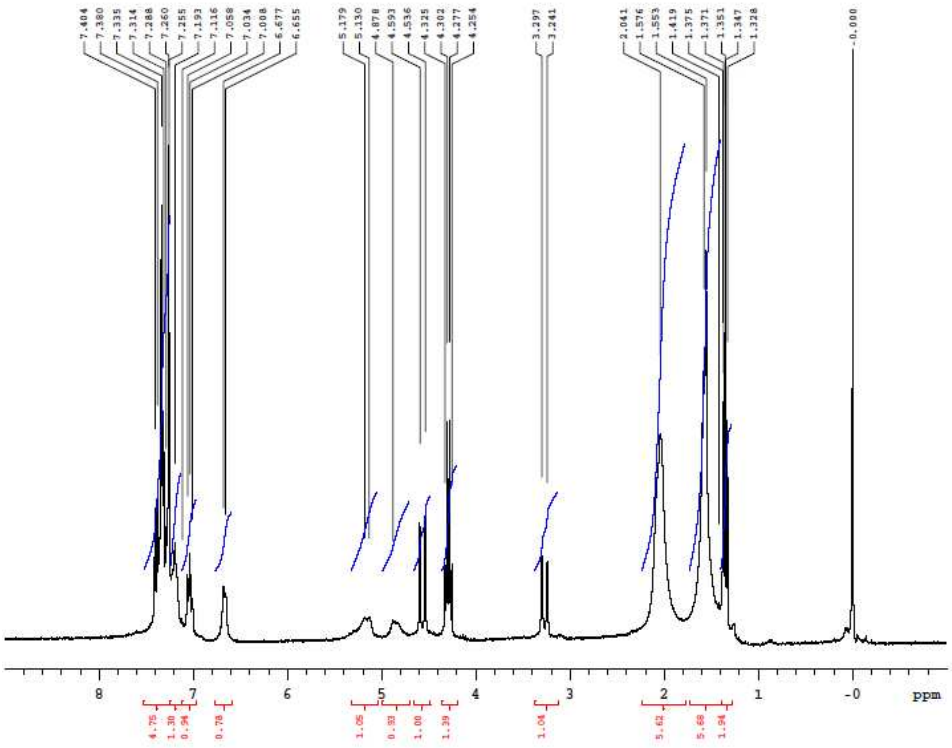


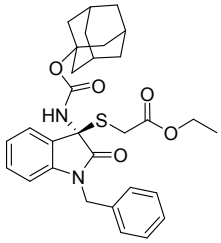
4 ^{1}H NMR



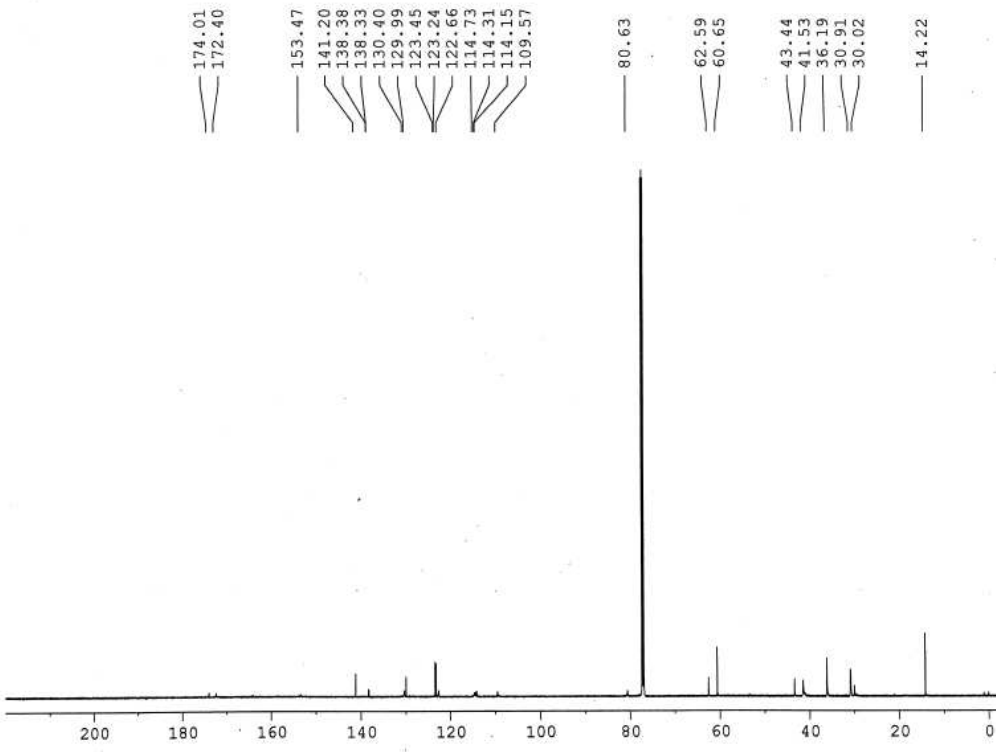


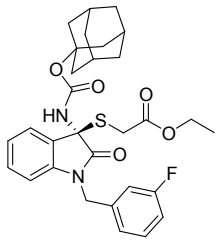
5 ^{13}C NMR



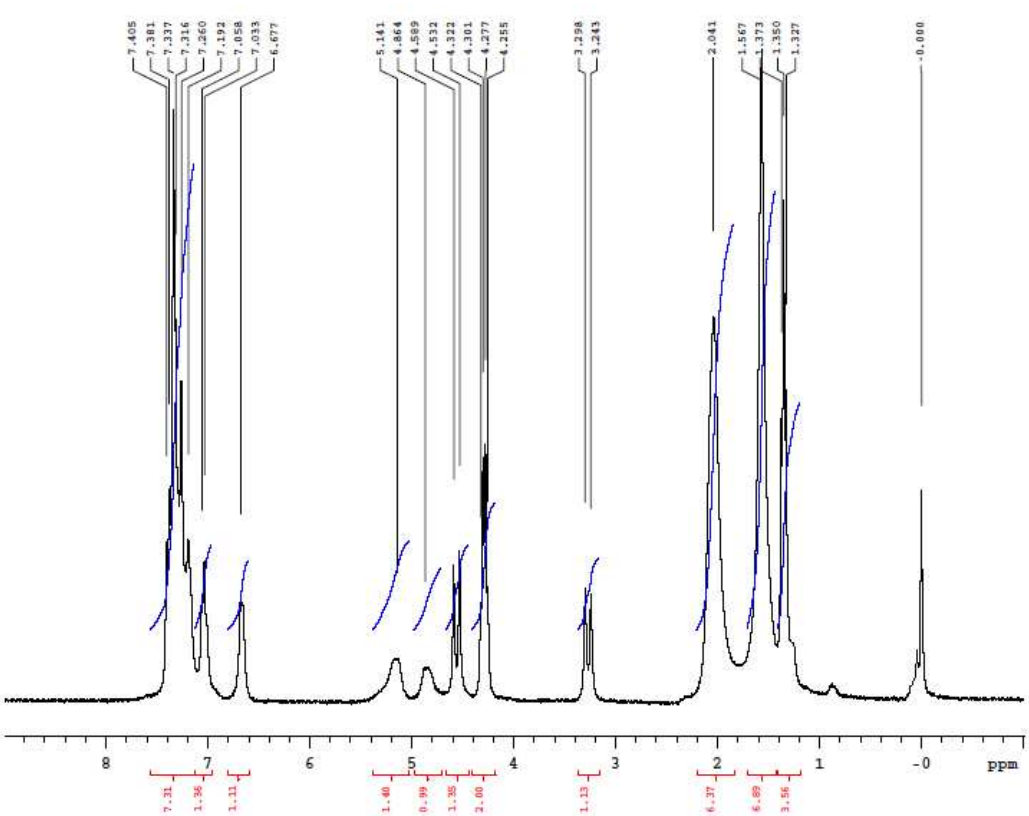


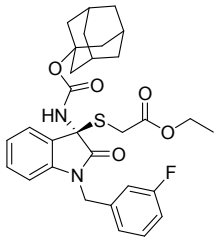
5 ^{1}H NMR



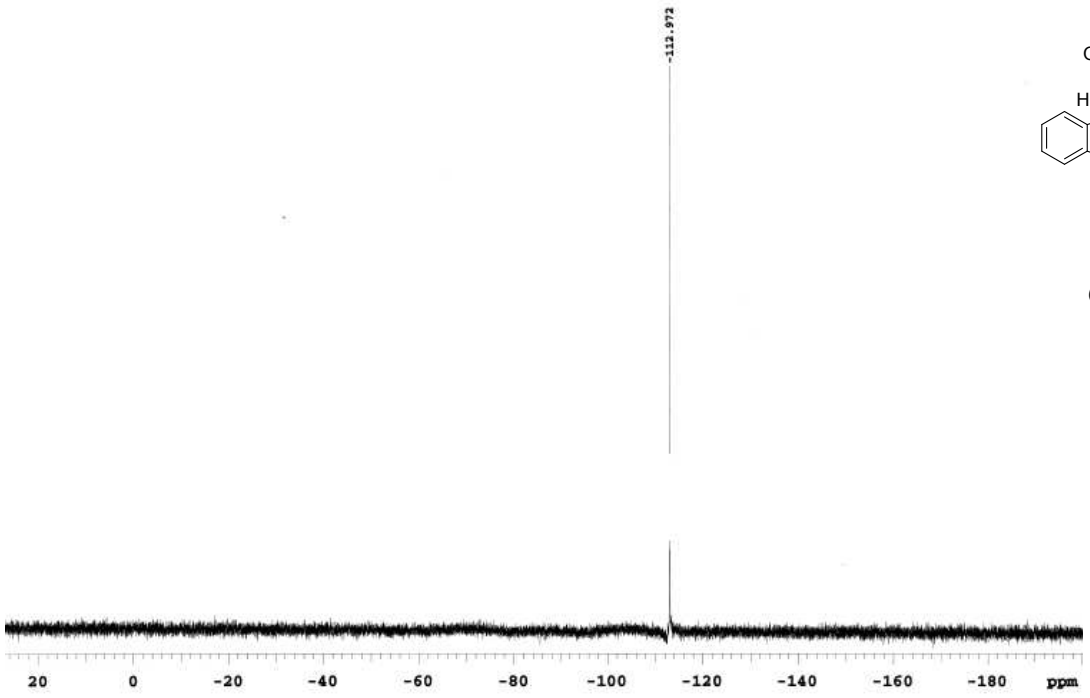


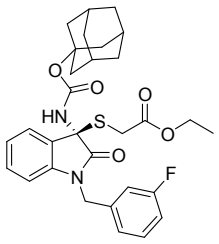
6 ^{13}C NMR



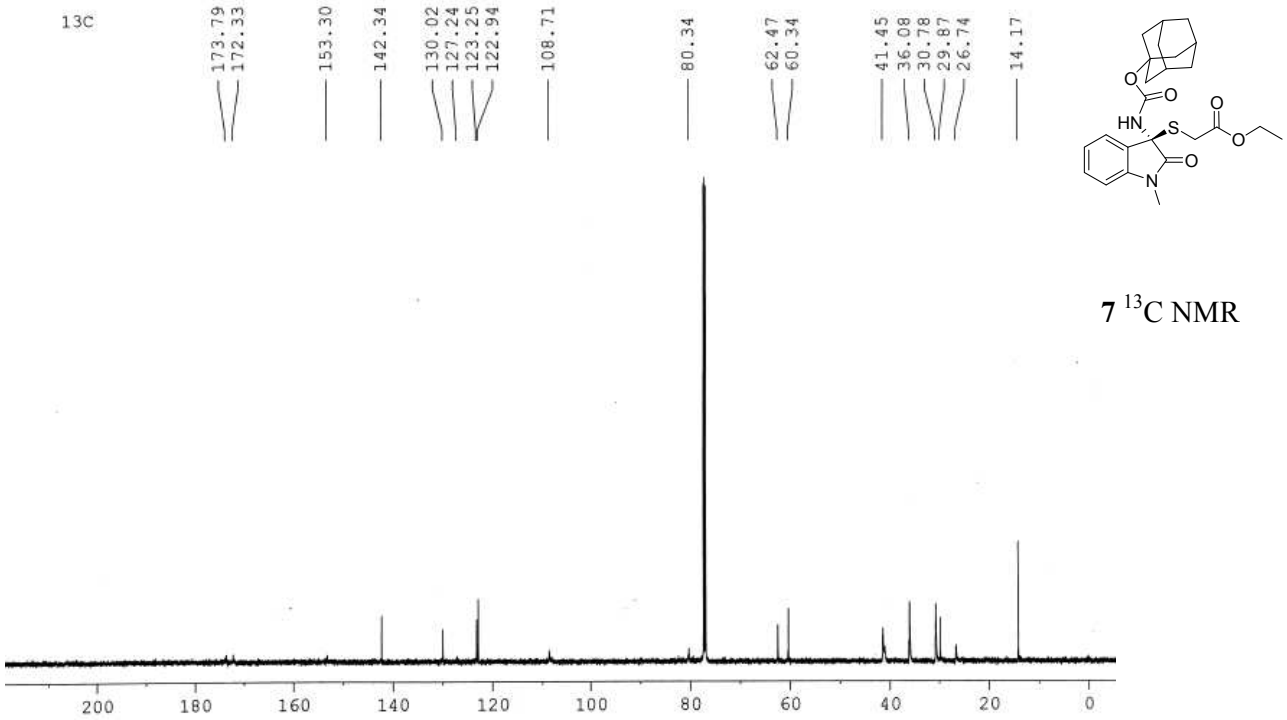


6 ^{1}H NMR

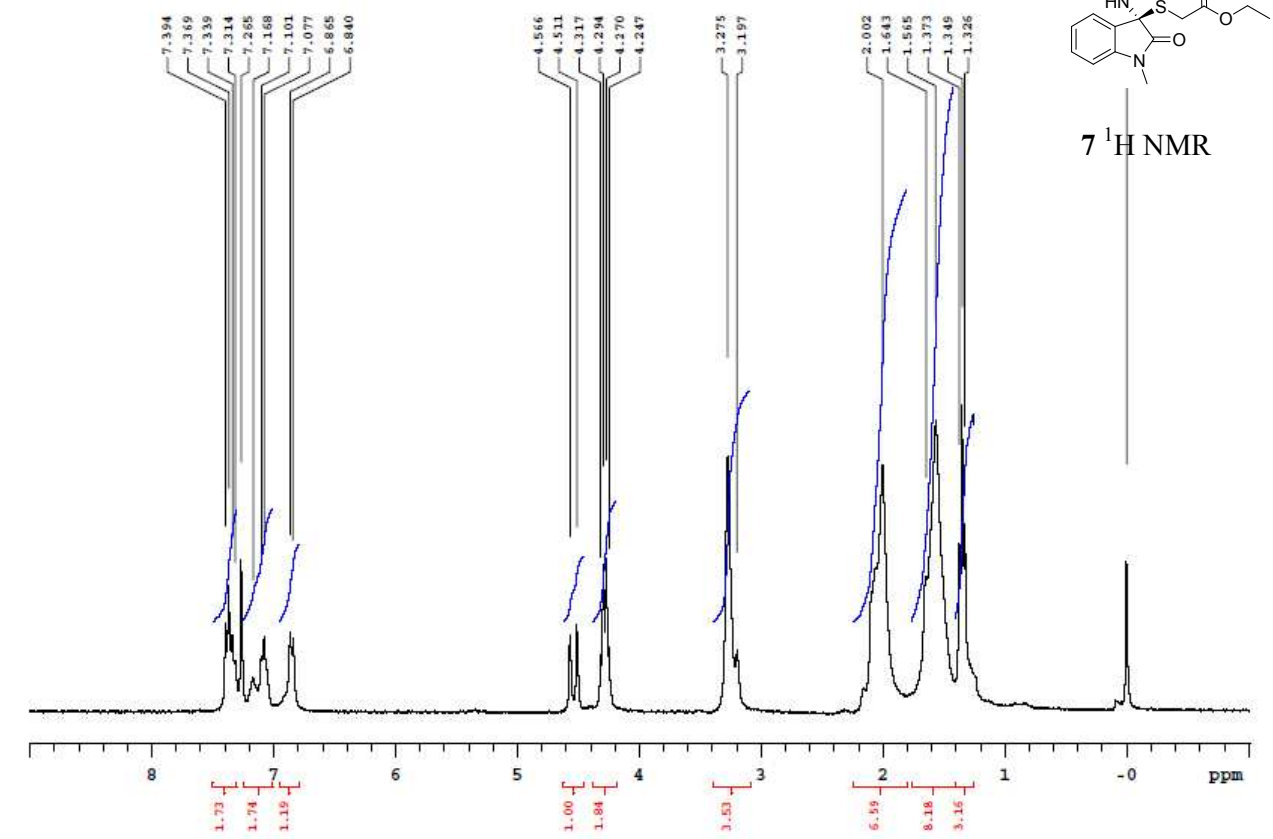




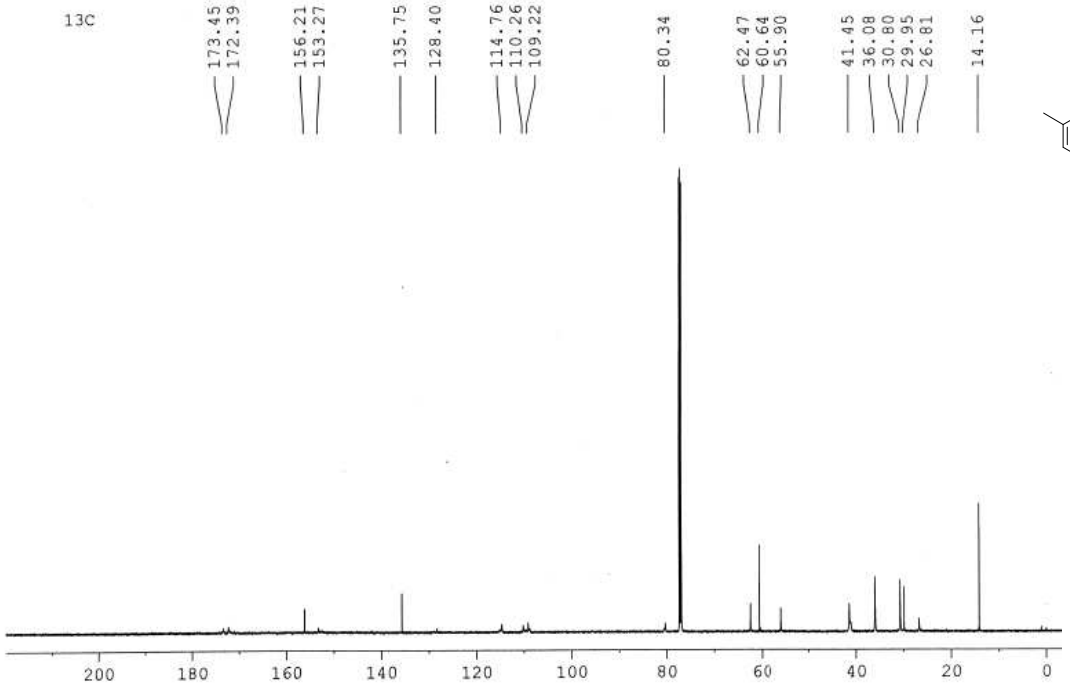
6 ^{19}F NMR

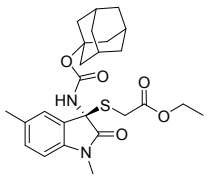


7 ^{13}C NMR

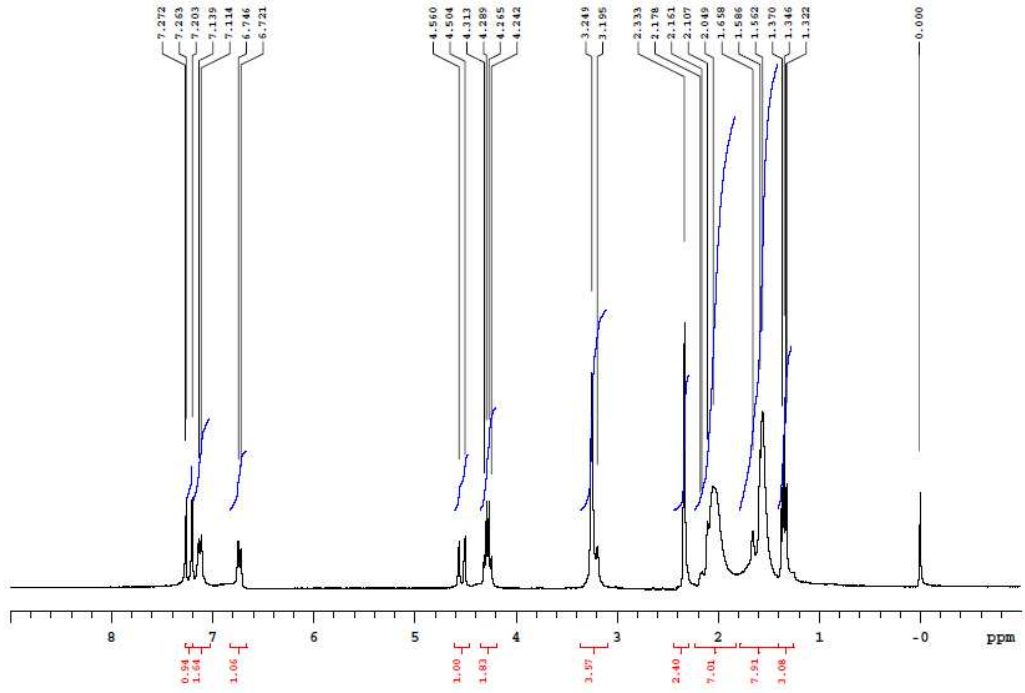


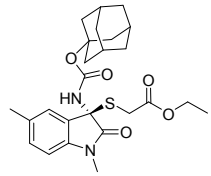
7 ^{1}H NMR



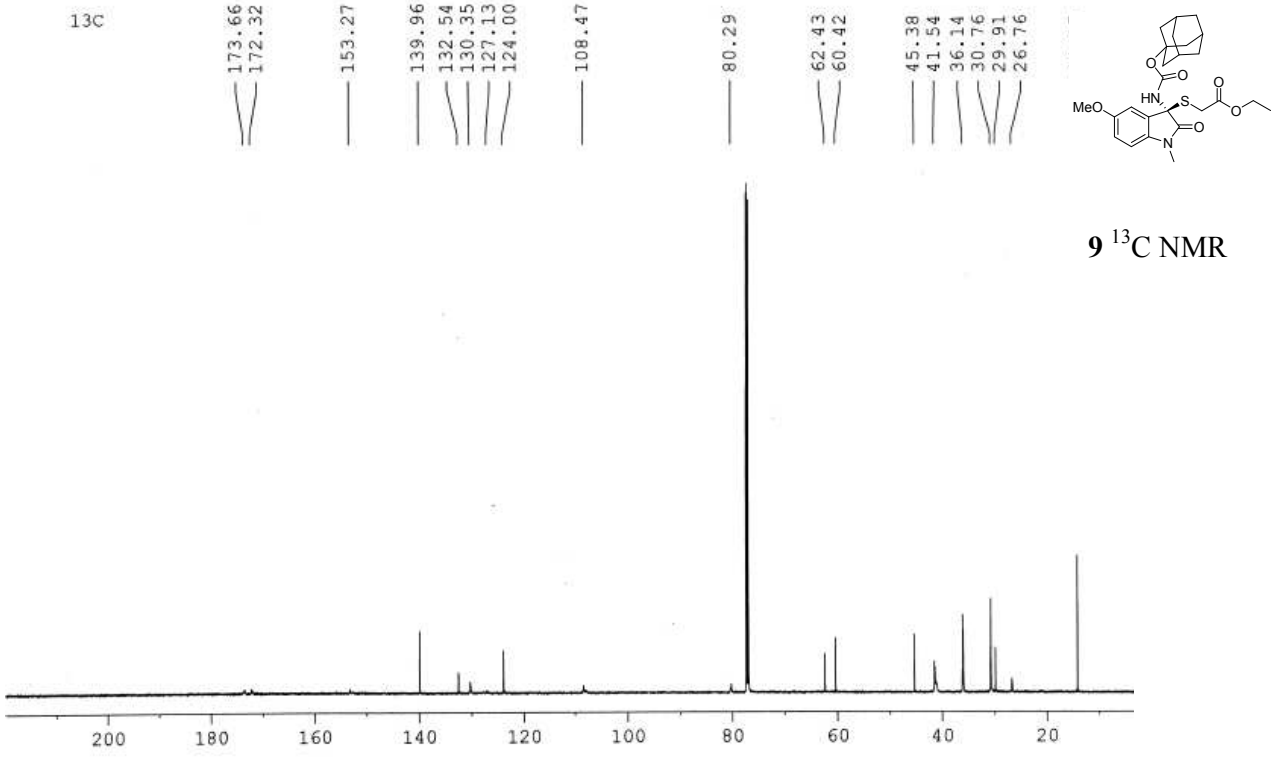


8 ^{13}C NMR

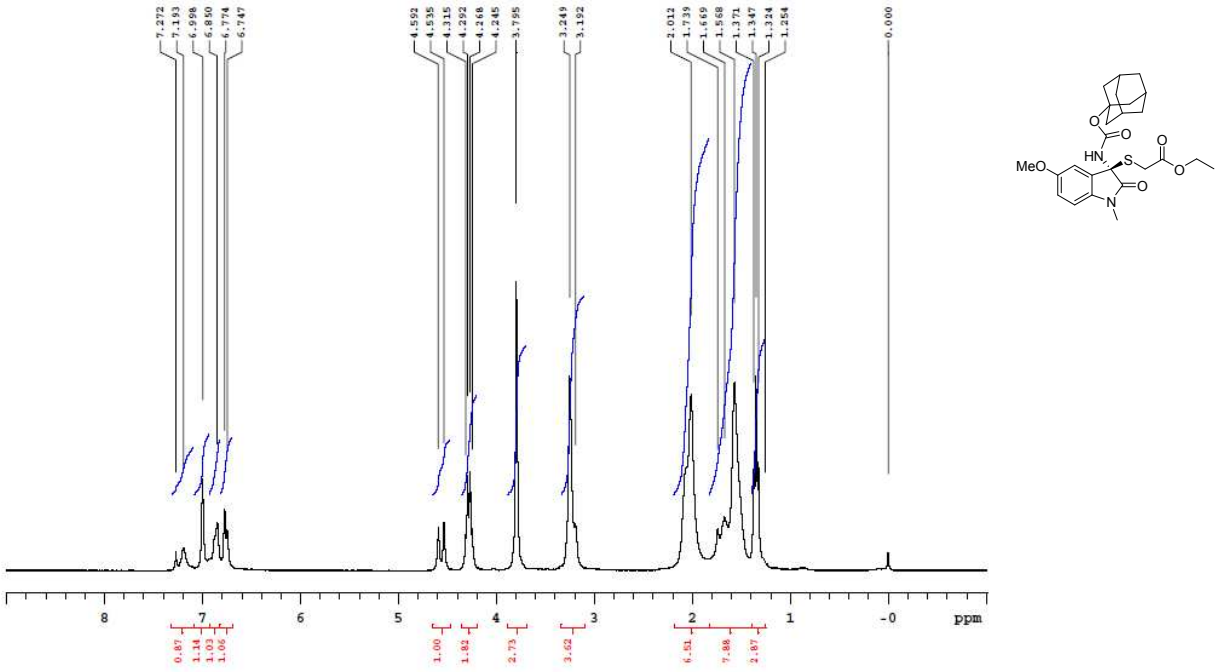




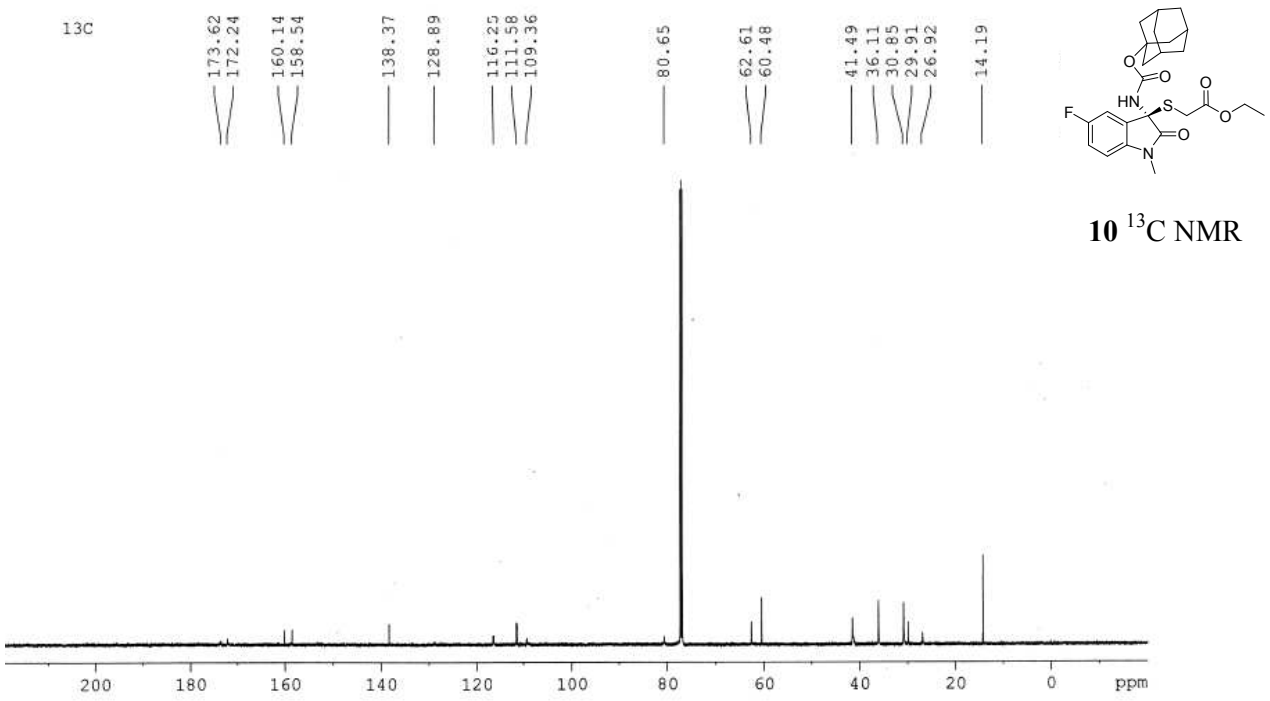
8 ^{1}H NMR



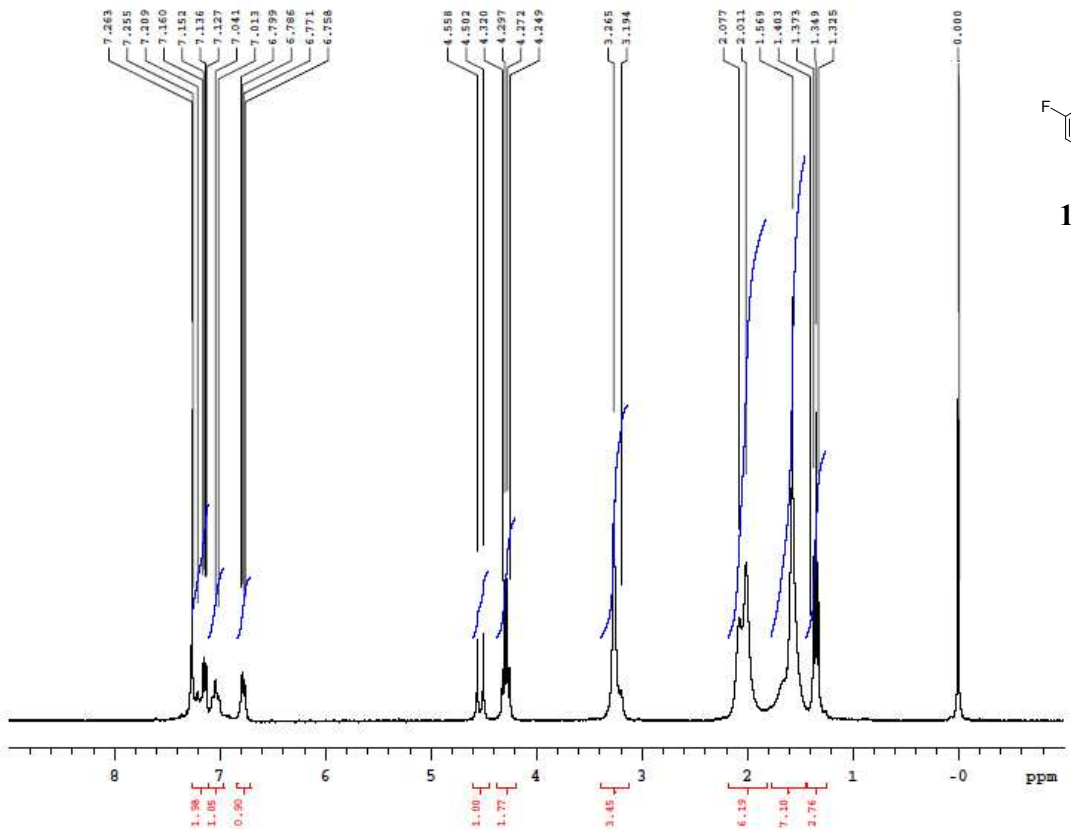
9 ^{13}C NMR



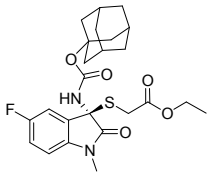
9 ^{13}C NMR



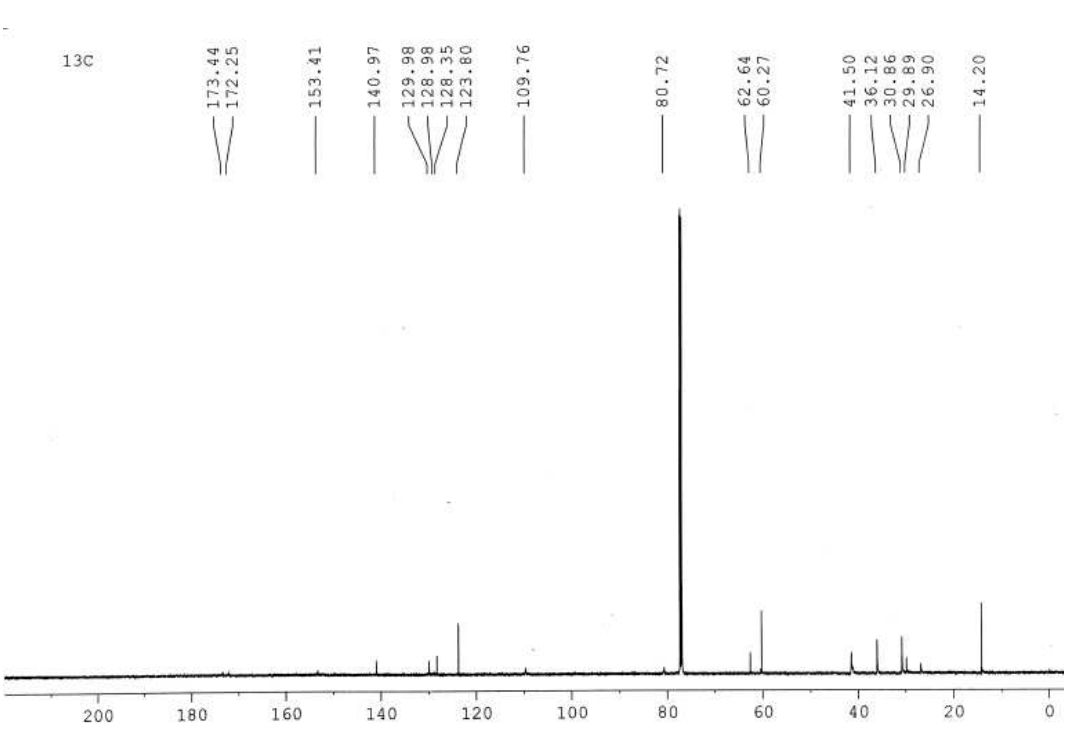
10 ^{13}C NMR

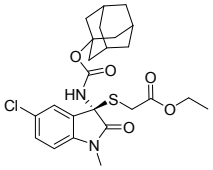


10 ^{1}H NMR

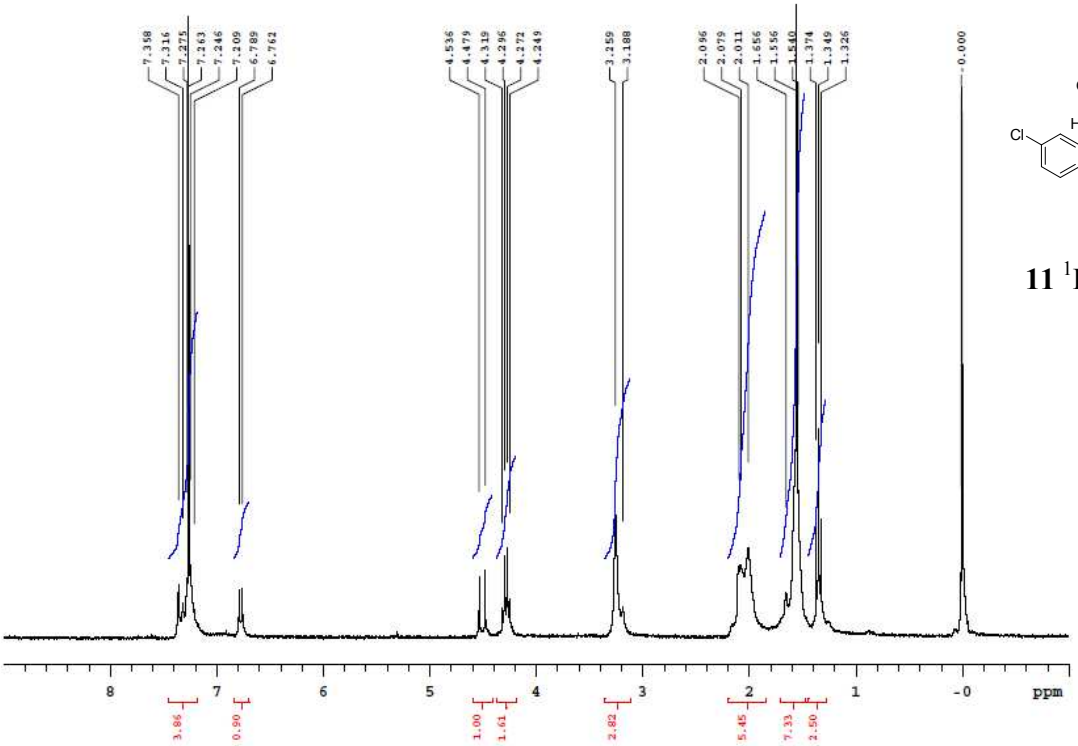


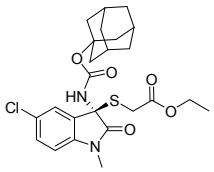
10 ^{19}F NMR



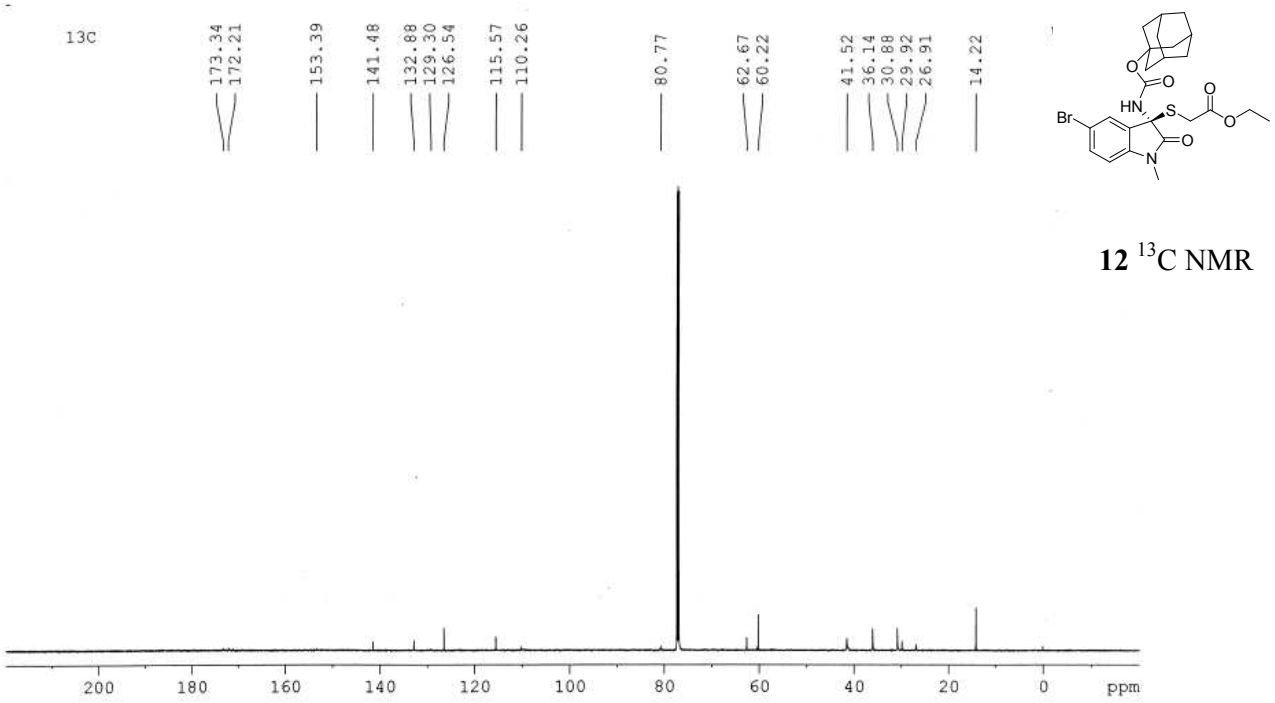


11 ^{13}C NMR

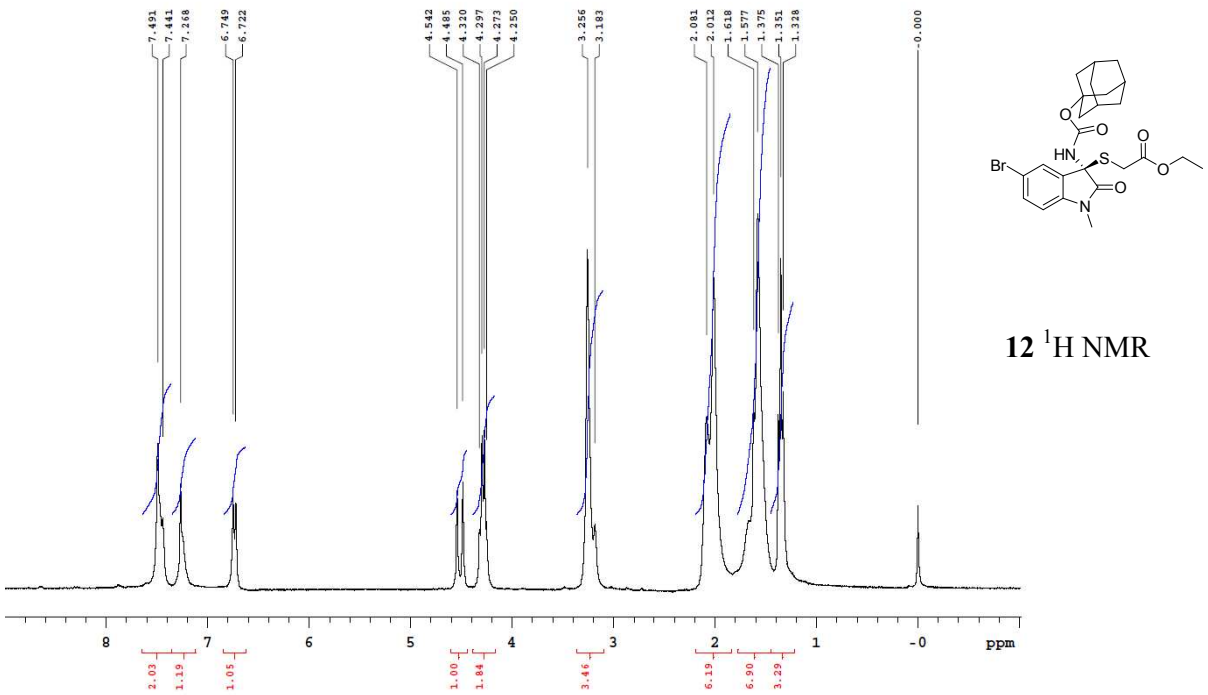




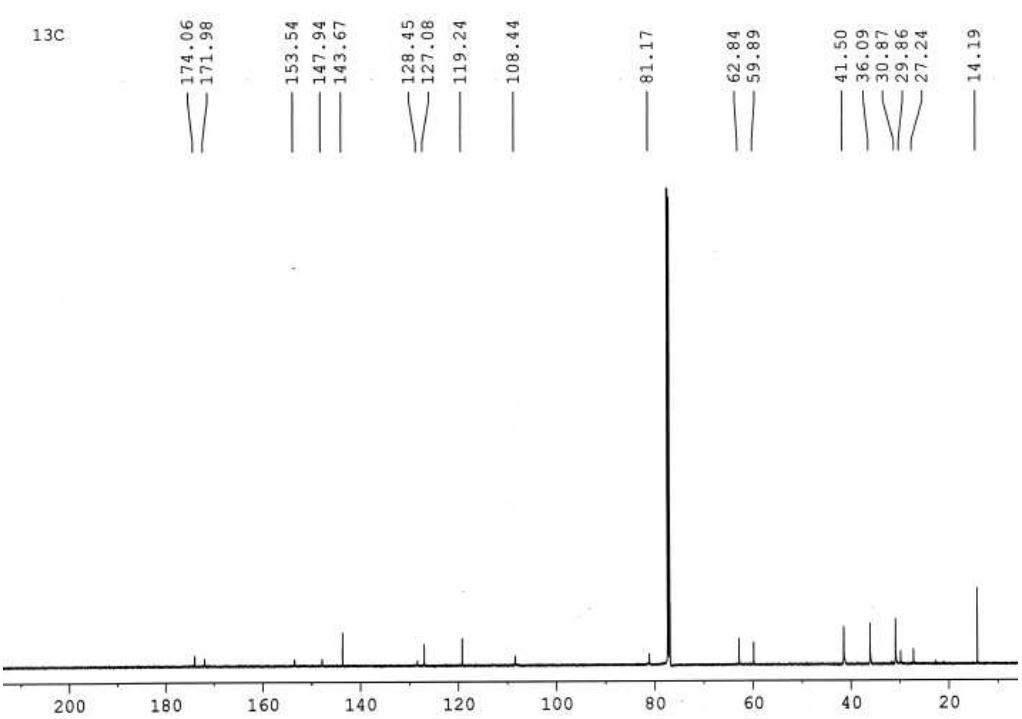
11 ^{1}H NMR

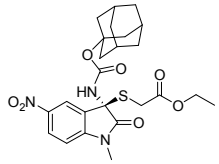


12 ^{13}C NMR

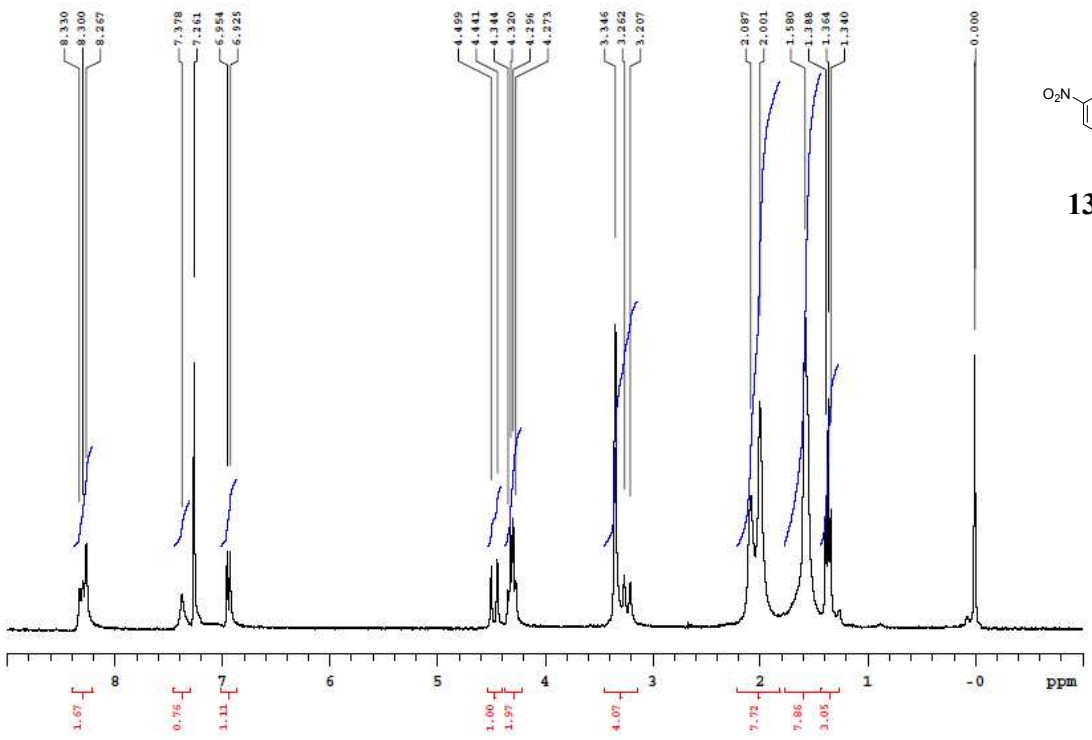


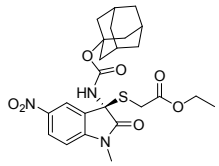
12 ^{1}H NMR



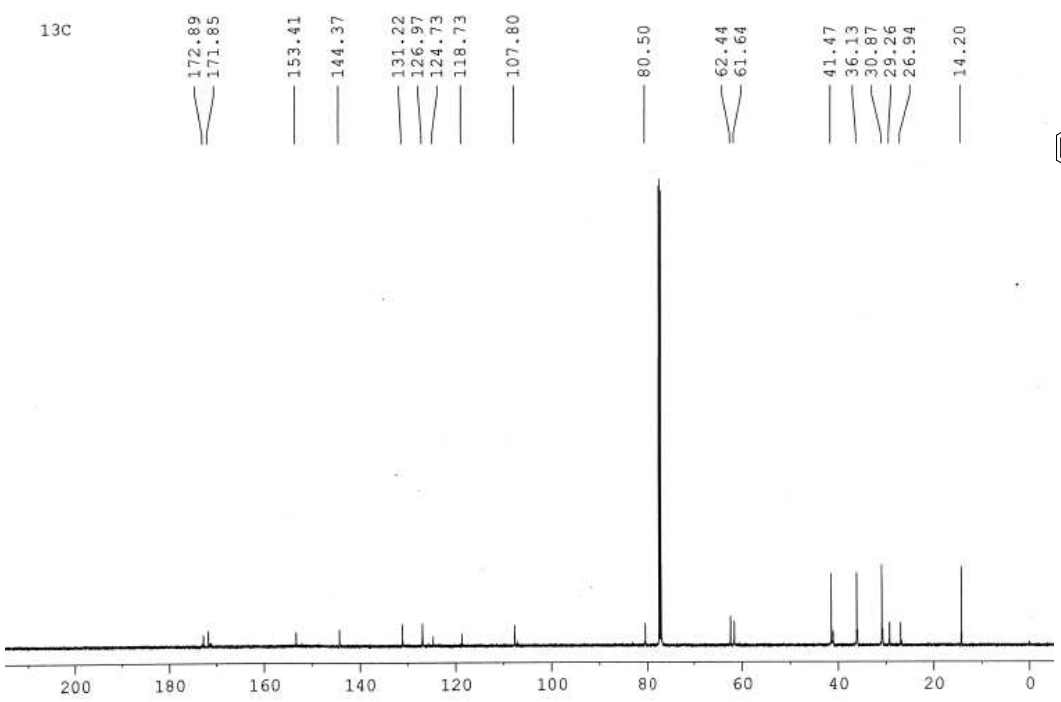


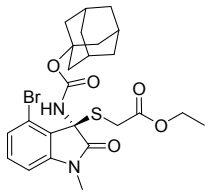
13 ^{13}C NMR



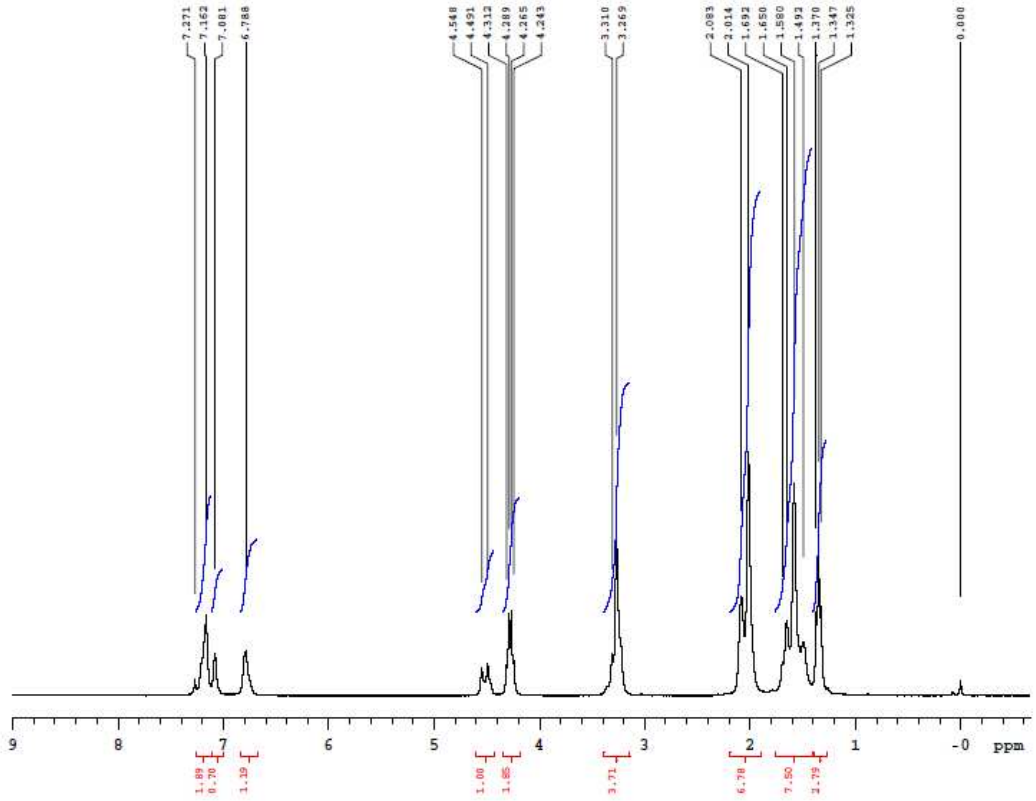


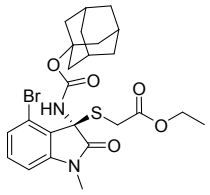
13 ^{1}H NMR



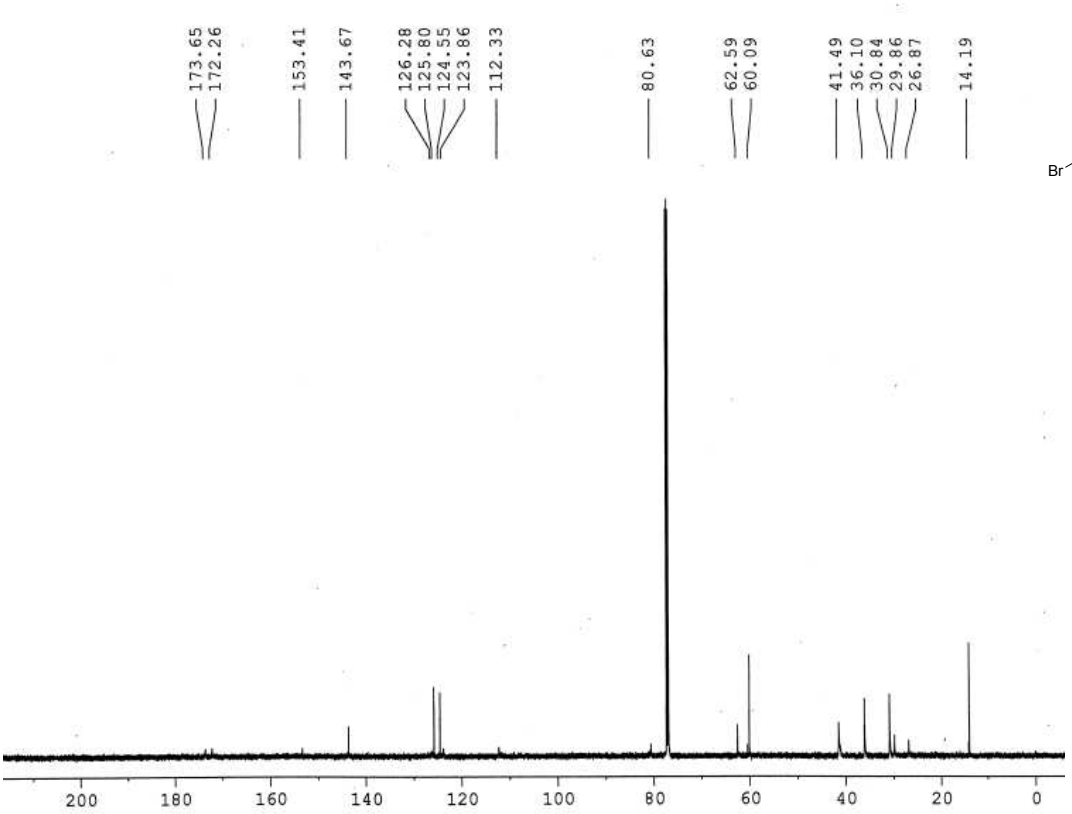


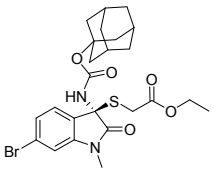
14 ^{13}C NMR



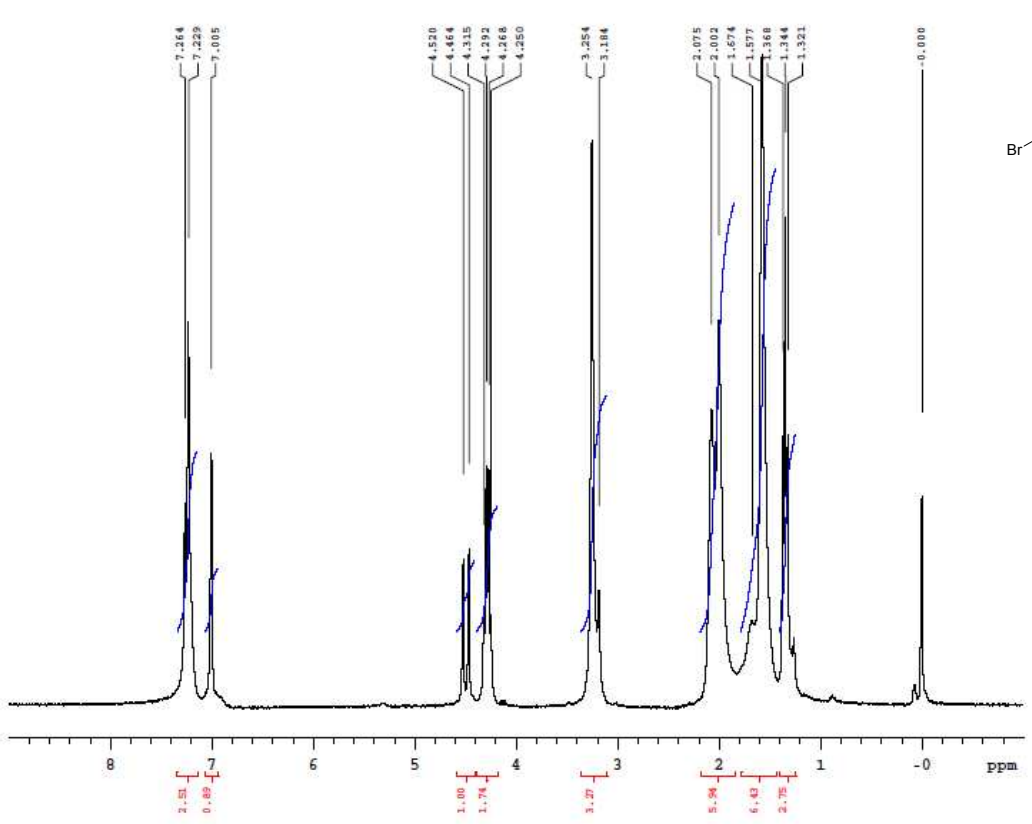


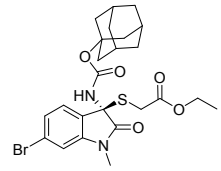
14 ^{1}H NMR



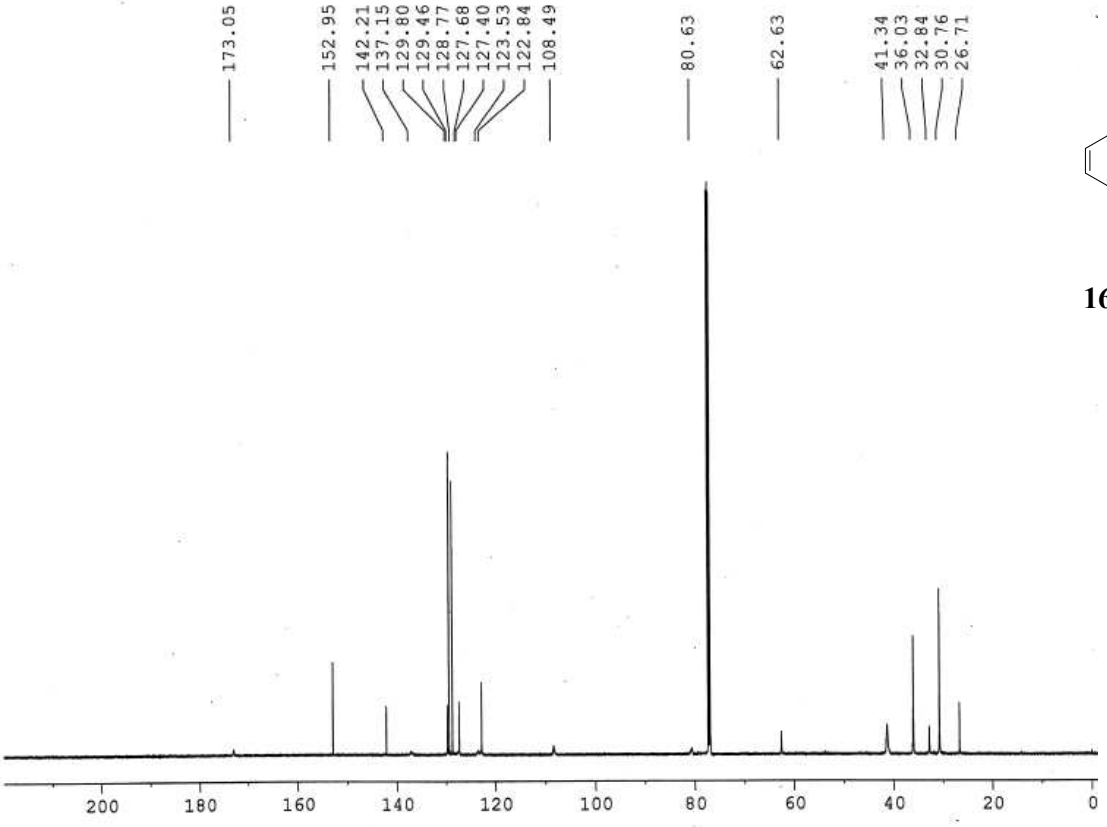


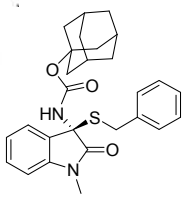
15 ^{13}C NMR



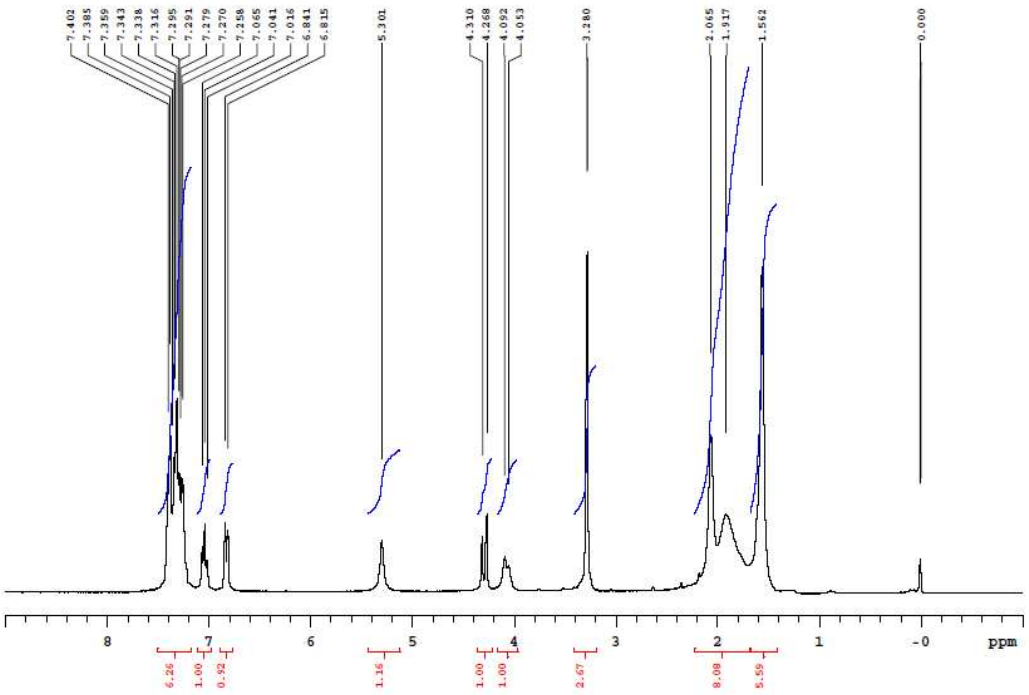


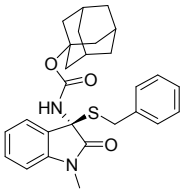
15 ^{1}H NMR



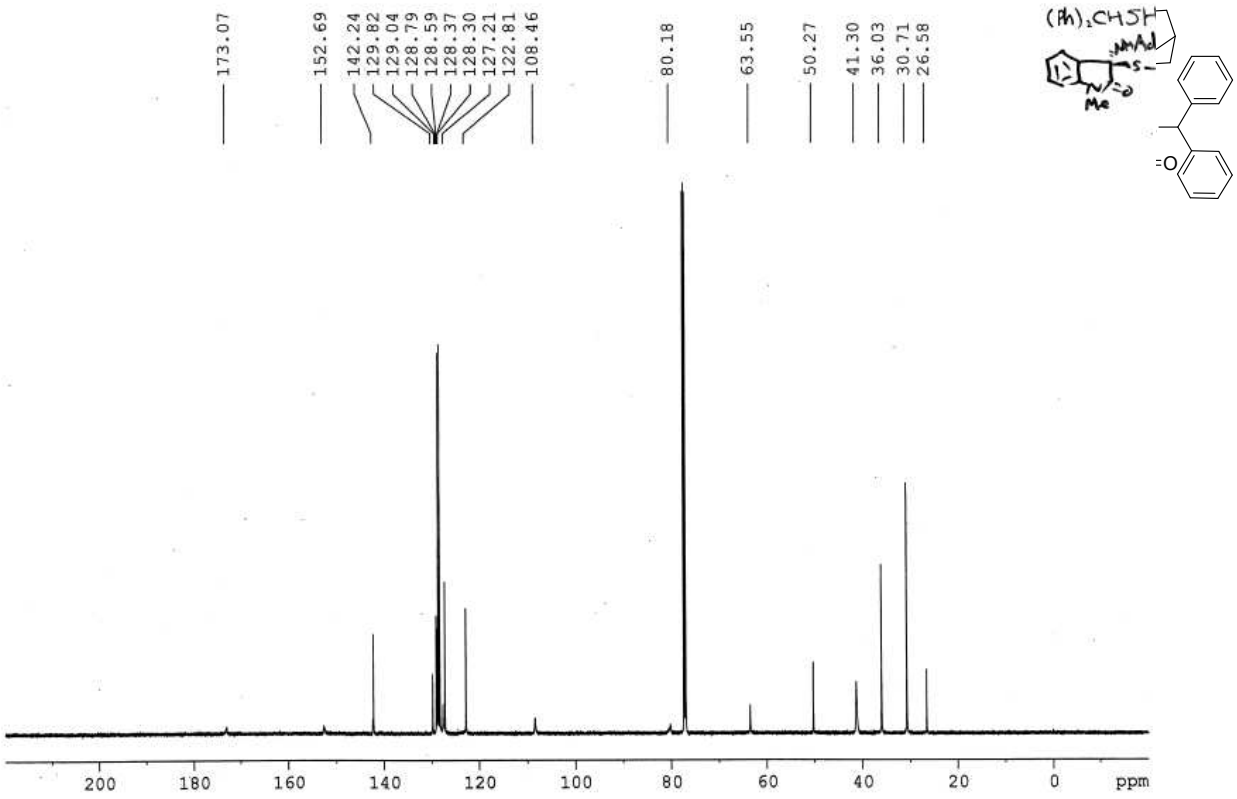


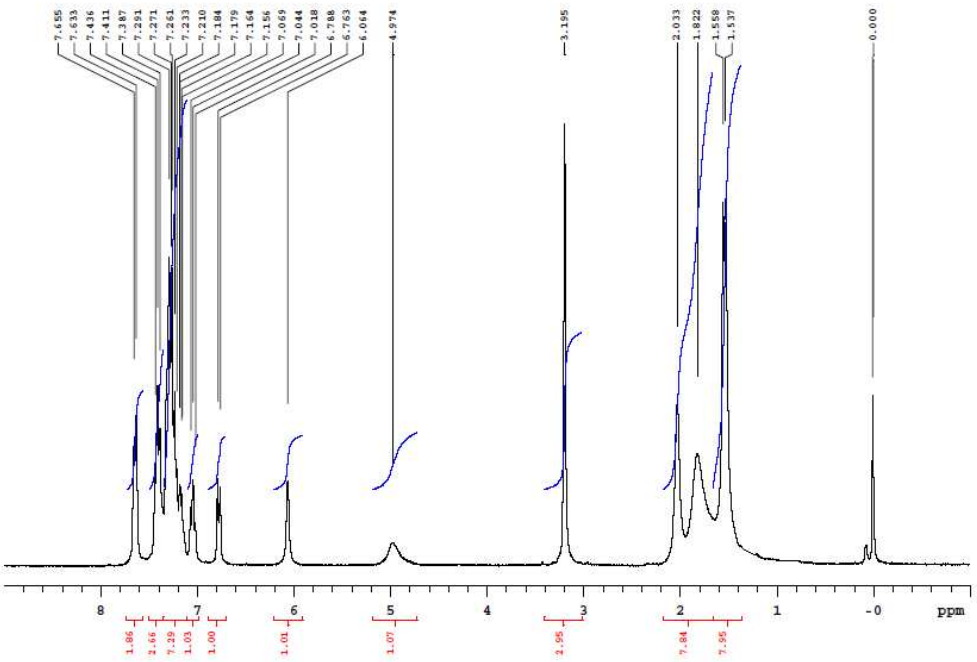
16 ^{13}C NMR

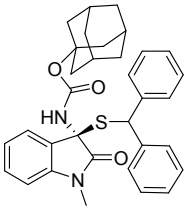




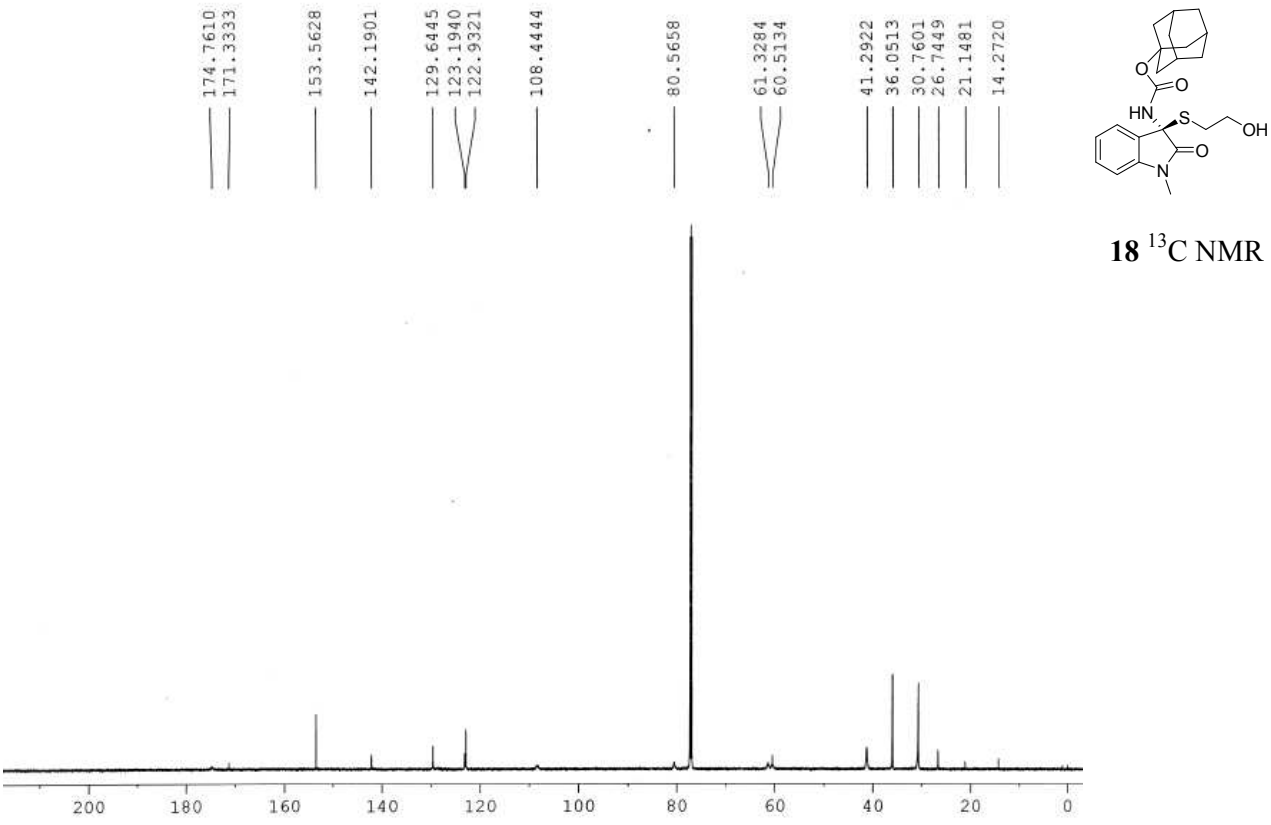
16 ^{1}H NMR


173.07
152.69
142.24
129.82
129.04
128.79
128.59
128.37
128.30
127.21
122.81
108.46
80.18
63.55
50.27
41.30
36.03
30.71
26.58
200
180
160
140
120
100
80
60
40
20
0
ppm

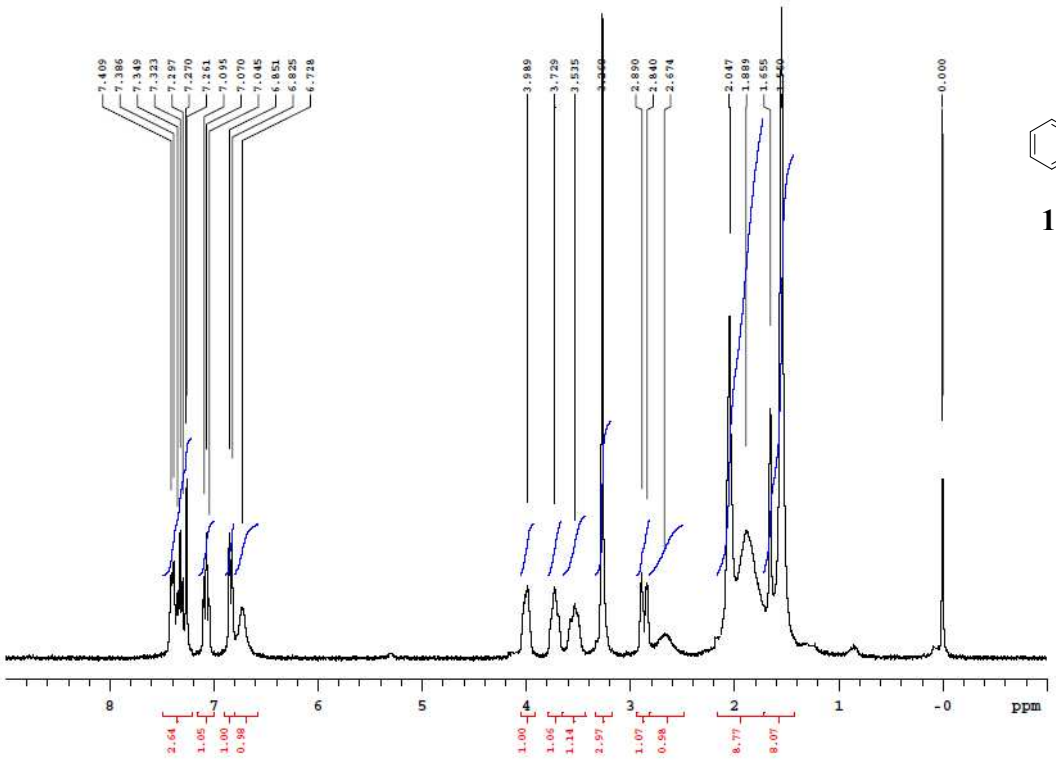

7.655
7.633
7.436
7.411
7.387
7.291
7.271
7.261
7.233
7.210
7.184
7.179
7.164
7.156
7.069
7.044
7.018
6.788
6.763
6.064
4.974
3.195
2.033
1.822
1.558
1.537
0.000
8
7
6
5
4
3
2
1
-0
ppm

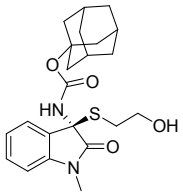


17 ^{1}H NMR



18 ^{13}C NMR





18 ^{1}H NMR