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

Supporting information for

Design of primary amine functionalized polymer containing chiral isosorbide in the main chain for the asymmetric synthesis of isoquinuclidine derivatives

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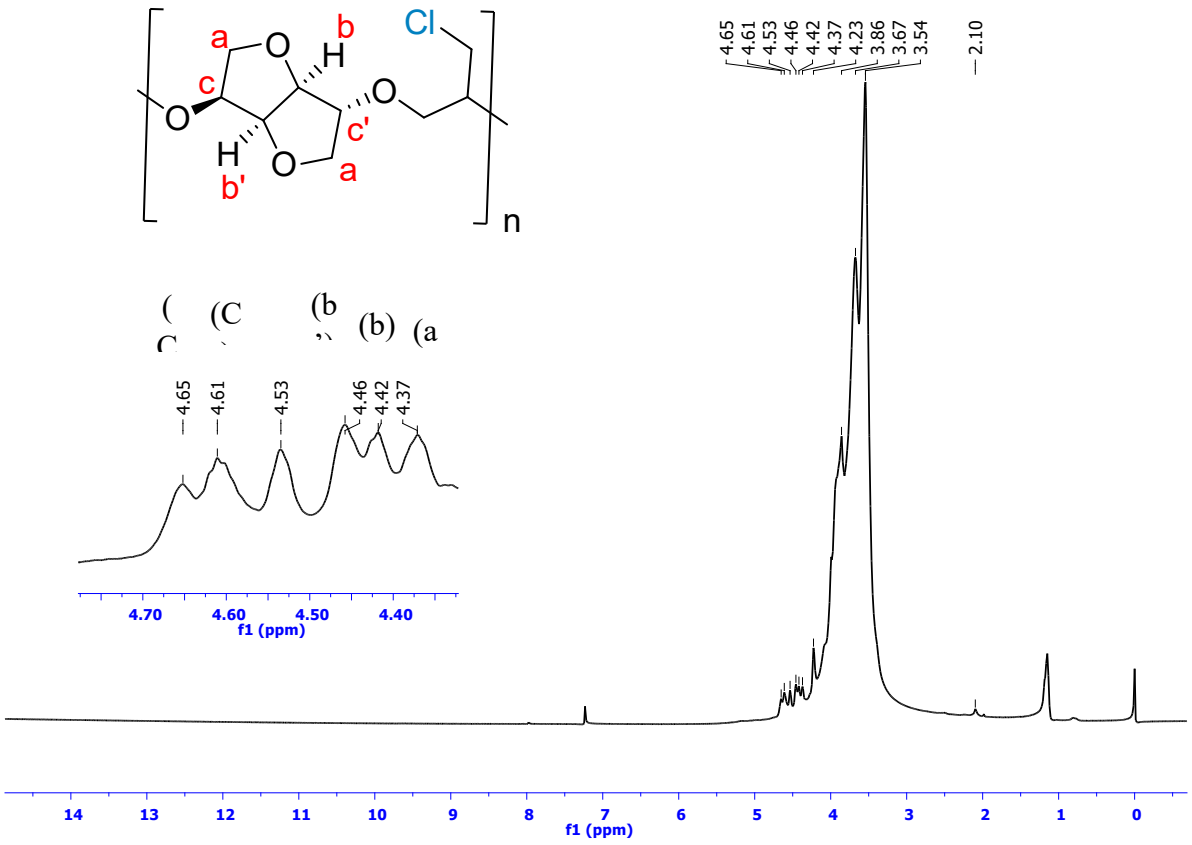


Figure S1 ^{1}H NMR spectrum of Chiral-ISO-PECH

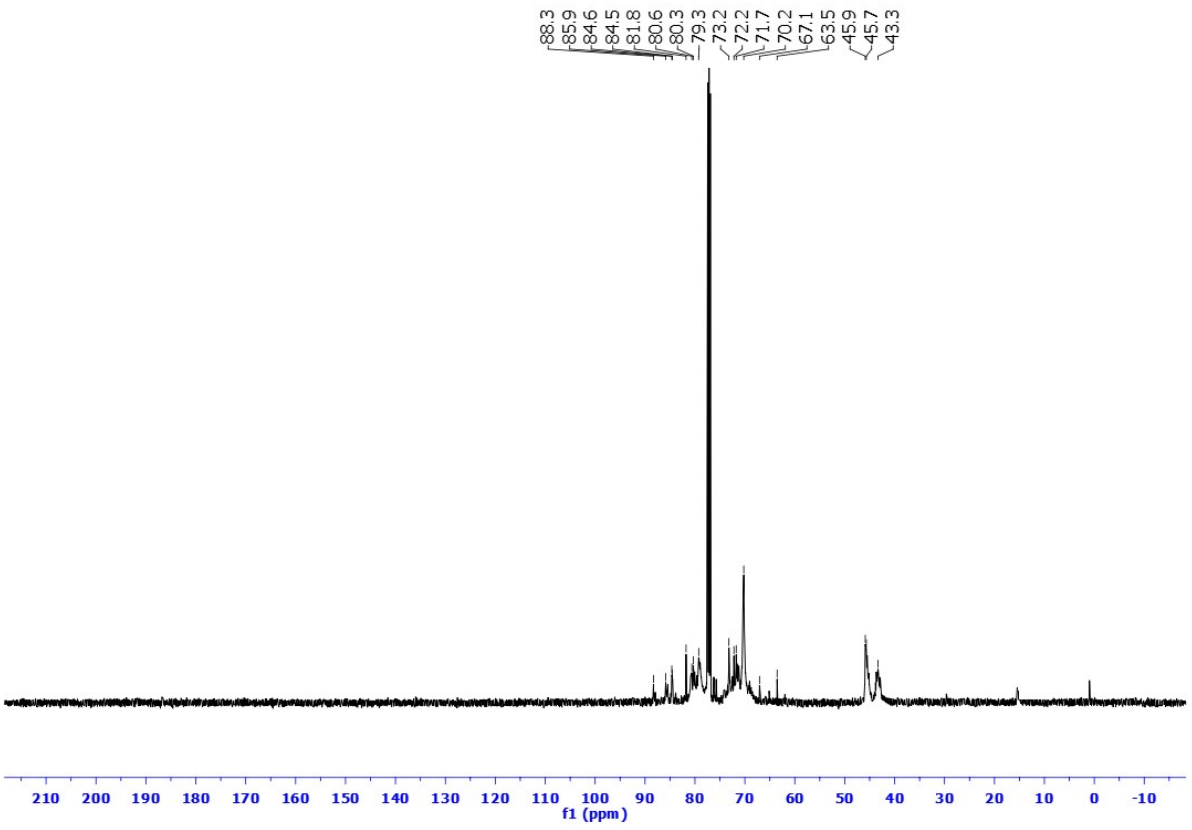


Figure S2 ^{13}C NMR spectrum of Chiral-ISO-PECH

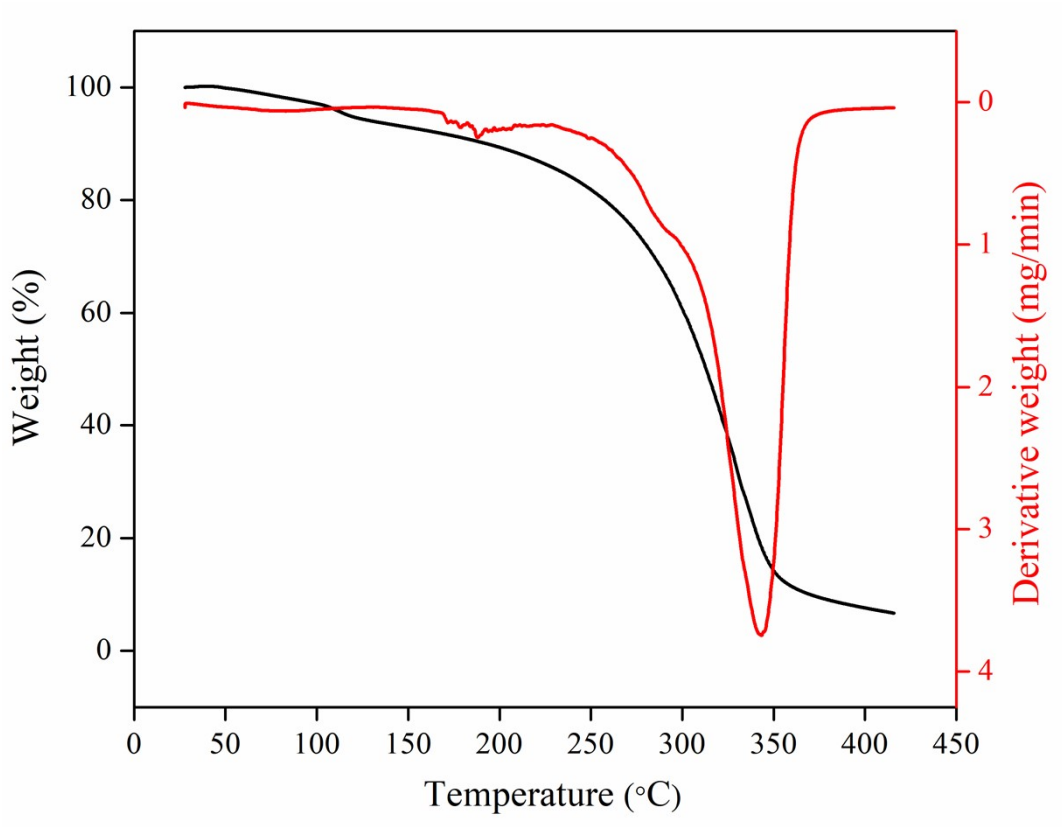


Figure S3 TG/DTG plot of Chiral-ISO-PECH

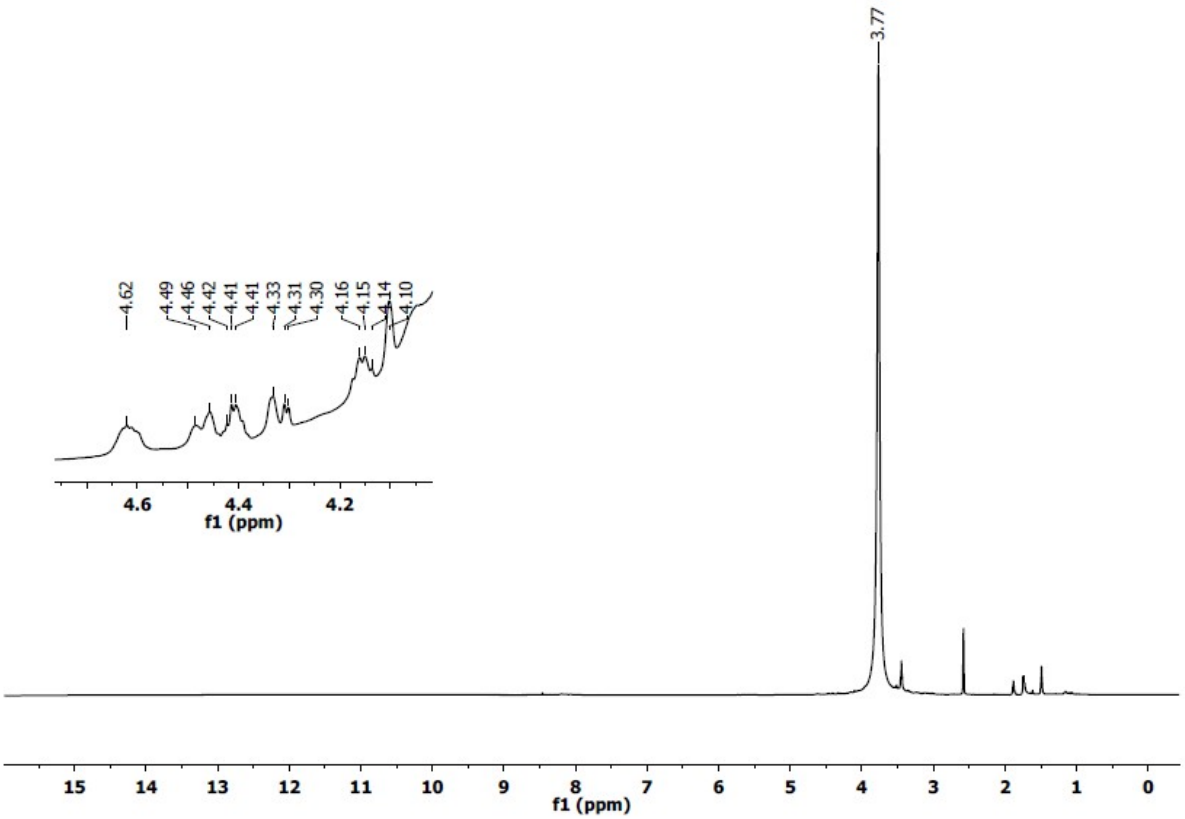


Figure S4 ^{1}H NMR spectrum of Chiral-ISO-PECH-Amine

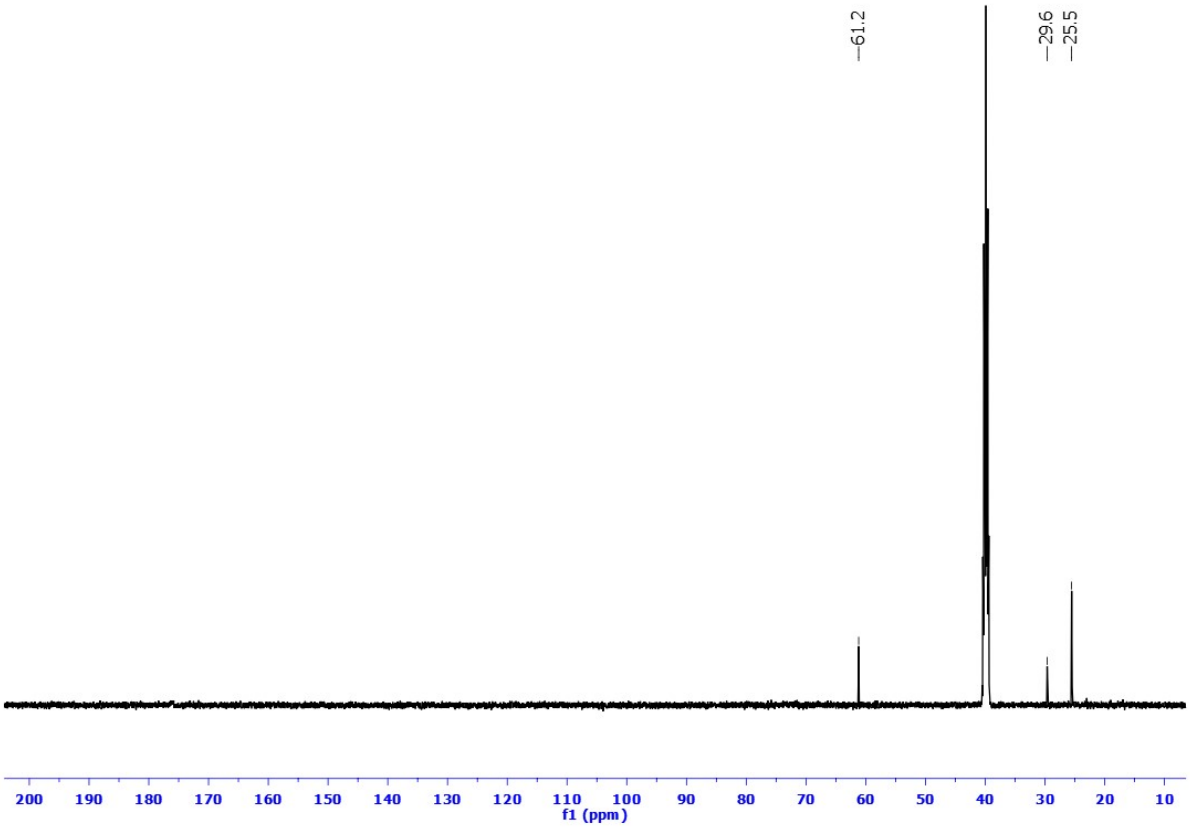
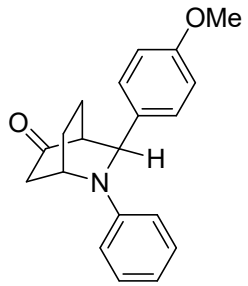


Figure S5 ^{13}C NMR spectrum of Chiral-ISO-PECH-Amine

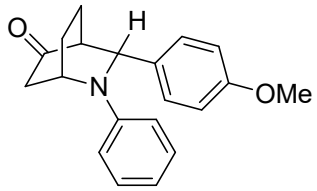
Analytical data of synthesized Isoquinuclidine derivatives

3-exo-(4-Methoxyphenyl)-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (4a)



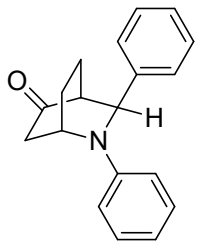
Brown waxy solid; GC-MS (M^+): 307; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.51-7.24 (m, 4H), 7.09-6.78 (m, 1H), 6.63 (d, *J* = 6.7 Hz, 2H), 6.54 (d, *J* = 8.2 Hz, 2H), 4.84-4.65 (m, 1H), 4.60-4.47 (m, 1H), 3.76 (s, 3H), 2.81-2.59 (m, 2H), 2.38-2.31 (m, 2H), 2.19-2.10 (m, 1H), 2.07-1.86 (m, 1H), 1.83-1.65 (m, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 193.1, 131.5, 129.1, 127.2, 117.7, 114.2, 113.1, 83.3, 61.9, 55.3, 51.2, 48.2, 42.3, 29.7, 26.0, 16.3.

3-endo-(4-Methoxyphenyl)-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (5a)[1]



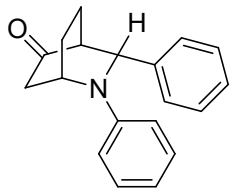
Brown waxy solid; GC-MS (M^+): 307; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.25-7.10 (m, 5H), 6.84 (d, *J* = 8.4, 2H), 6.67 (d, *J* = 8.4, 2H), 4.61-4.59 (m, 1H), 4.55-4.47 (m, 1H), 3.77 (s, 3H), 2.80-1.50 (m, 7H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 212.1, 158.9, 148.2, 133.7, 131.7, 129.3, 126.7, 117.7, 114.5, 114.3, 113.3, 65.4, 55.2, 52.3, 48.5, 45.9, 29.7, 22.7, 22.5; enantiomeric excess: 73 %, determined by HPLC (Chiralpak IB-3 column, hexane:isopropanol (90:10), flow rate 1.0 mL min^{-1}, 254 nm): major enantiomer R_t = 10.9 min, minor enantiomer R_t = 15.4 min.

3-exo-Phenyl-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (4b)[2]



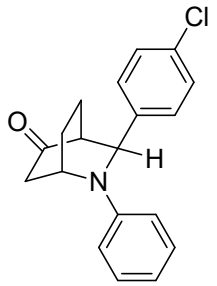
Brown solid; m. p. 112-113 °C (lit.[2] 112-113 °C); GC-MS (M^+): 277; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.39-7.33 m, 4H), 7.28-7.25 (m, 1H), 7.14-7.10 (m, 2H), 6.68 (t, *J* = 7.2 Hz, 1H), 6.57 (d, *J* = 8.4 Hz, 2H), 4.75 (d, *J* = 2.0 Hz, 1H), 4.53-4.52 (m, 1H), 2.77-2.68 (m, 2H), 2.42-2.37 (m, 1H), 2.29-2.19 (m, 1H), 1.95-1.84 (m, 1H), 1.74-1.60 (m, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 213.1, 147.9, 139.8, 129.1, 128.6, 127.2, 125.9, 117.5, 112.9, 62.3, 51.0, 48.2, 42.3, 26.0, 16.4.

3-endo-Phenyl-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (5b)[2]



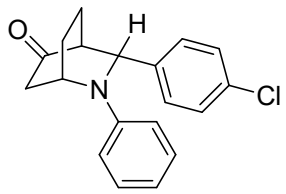
Brown solid; m. p. 121-122 °C (lit.[2] 120-121 °C); GC-MS (M^+): 277; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.27-7.25 (m, 4H), 7.18-7.15 (m, 1H), 7.15-7.08 (m, 2H), 6.69 (t, *J* = 7.4 Hz, 1H), 6.62-6.58 (m, 2H), 4.61 (d, *J* = 2.7 Hz, 1H), 4.47 (m, 1H), 2.75- 2.67 (m, 2H), 2.42-2.37 (m, 1H), 2.27-2.17 (m, 1H), 2.10-2.01 (m, 1H), 1.98-1.92 (m, 1H), 1.70-1.63 (m, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 211.3, 147.7, 141.4, 128.9, 128.6, 127.1, 125.2, 117.3, 112.9, 65.6, 52.0, 48.3, 45.6, 22.5, 22.4; enantiomeric excess: 22 %, determined by HPLC (Chiralpak IB-3 column, hexane:isopropanol (90:10), flow rate 1.0 mL min^{-1}, 254 nm): major enantiomer R_t = 7.6 min, minor enantiomer R_t = 7.1 min.

3-exo-(4-Chlorophenyl)-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (4c)[2]



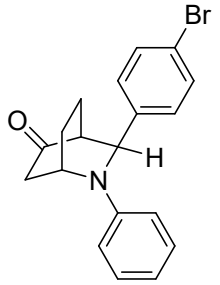
Brown solid; m. p. 138-140 °C (lit.[2] 138-139 °C); GC-MS (M^+): 311; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.32 (m, 4H), 7.14-7.10 (m, 2H), 6.70 (t, *J* = 7.4 Hz, 1H), 6.56-6.54 (m, 2H), 4.72 (d, *J* = 2.8 Hz, 1H), 4.52-4.51 (m, 1H), 2.76-2.70 (m, 1H), 2.66-2.64 (m, 1H), 2.39(dd, *J* = 18.8 Hz, 1.7 Hz, 1H), 2.25-2.16 (m, 1H), 1.93-1.85 (m, 1H), 1.70-1.59 (m, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 212.6, 147.6, 138.4, 132.9, 129.1, 128.8, 127.3, 117.8, 112.9, 61.8, 50.7, 48.1, 42.2, 26.0, 16.3.

3-endo-(4-Chlorophenyl)-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (5c)[2]



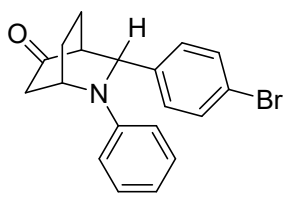
Brown solid; m. p. 154-155 °C (lit.[2] 156-157 °C); GC-MS (M^+): 311; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.27-7.22 (m, 4H), 7.20-7.14 (m, 2H), 6.76-6.72 (m, 1H), 6.62-6.60 (m, 2H), 4.61 (d, *J* = 2.8 Hz, 1H), 4.53-4.52 (m, 1H), 2.76-2.68 (m, 2H), 2.47 (dd, *J* = 18.8 Hz, 2.6 Hz, 1H), 2.31-2.22 (m, 1H), 2.16-2.00 (m, 2H), 1.78-1.70 (m, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 210.7, 147.3, 139.8, 132.7, 128.8, 128.7, 126.6, 117.6, 112.9, 64.9, 51.8, 48.3, 45.6, 22.4, 22.2; enantiomeric excess: 92 %, determined by HPLC (Chiralpak IB-3 column, hexane:isopropanol (90:10), flow rate 1.0 mL min^{-1}, 254 nm): major enantiomer R_t = 9.2 min, minor enantiomer R_t = 7.8 min.

3-exo-(4-Bromophenyl)-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (4d)[2]



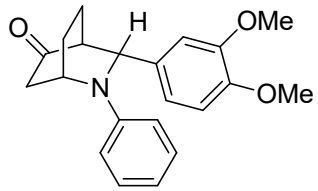
Brown solid; m. p. 123-124 °C (lit.[2] 125-126 °C); GC-MS (M^+): 356; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.47 (d, *J* = 8.4 Hz, 2H), 7.26 (d, *J* = 8.0 Hz, 2H), 7.14-7.10 (m, 2H), 6.70 (t, *J* = 7.4 Hz, 1H), 6.55 (d, *J* = 8.2 Hz, 2H), 4.70 (d, *J* = 2.6 Hz, 1H), 4.52-4.51 (m, 1H), 2.76-2.70 (m, 1H), 2.66-2.64 (m, 1H), 2.39 (dd, *J* = 18.8 Hz, 1.6 Hz, 1H), 2.24-2.15 (m, 1H), 1.94-1.86 (m, 1H), 1.68-1.60 (m, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 212.5, 147.6, 139.0, 131.7, 129.1, 127.7, 121.0, 117.8, 112.9, 61.8, 50.7, 48.2, 42.2, 26.0, 16.3.

3-endo-(4-Bromophenyl)-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (5d)[2]



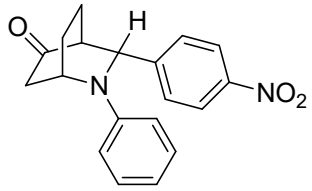
Brown solid; m. p. 158-159 °C (lit.[2] 157-158 °C); GC-MS (M^+): 356; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.41 (d, *J* = 8.3 Hz, 2H), 7.18-7.14 (m, 4H), 6.74 (t, *J* = 7.2 Hz, 1H), 6.61 (d, *J* = 8.2 Hz, 2H), 4.59 (d, *J* = 2.2 Hz, 1H), 4.53-4.52 (m, 1H), 2.75-2.68 (m, 2H), 2.46 (dd, *J* = 18.8 Hz, 1.6 Hz, 1H), 2.29-2.24 (m, 1H), 2.15-2.01 (m, 2H), 1.78-1.71 (m, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 210.9, 147.6, 140.6, 131.9, 129.2, 127.2, 121.2, 117.9, 113.2, 65.3, 52.0, 48.6, 45.9, 22.7, 22.6; enantiomeric excess: 41 %, determined by HPLC (Chiralpak IB-3 column, hexane:isopropanol (90:10), flow rate 1.0 mL min^{-1}, 254 nm): major enantiomer R_t = 9.9 min, minor enantiomer R_t = 9.6 min.

3-endo-(3,4-Dimethoxyphenyl)-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (5e)



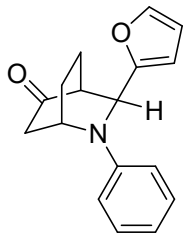
Brown waxy solid; GC-MS (M^+): 337; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.11 (t, *J* = 7.8 Hz, 2H), 6.79-6.60 (m, 6H), 4.52 (m, 1H), 4.47 (m, 1H), 3.77 (s, 3H), 3.76 (s, 3H), 2.71-2.67 (m, 2H), 2.42-2.10 (m, 1H), 1.99-1.94 (m, 1H), 1.69-1.65 (m, 2H), 1.38-1.34 (m, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 211.0, 148.3, 147.2, 133.3, 128.2, 116.8, 116.6, 112.4, 110.5, 107.6, 64.8, 54.9, 54.8, 51.3, 47.5, 44.9, 30.9, 28.7, 21.6, 21.5, 13.1; enantiomeric excess: 78 %, determined by HPLC (Chiralpak IB-3 column, hexane:isopropanol (90:10), flow rate 1.0 mL min^{-1}, 254 nm): major enantiomer R_t = 10.9 min, minor enantiomer R_t = 15.5 min.

3-endo-(4-Nitrophenyl)-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (5f)[3]



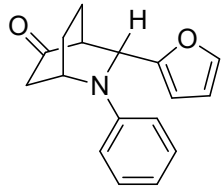
Yellow liquid; GC-MS (M^+): 322; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 8.19 (d, *J* = 8.4 Hz, 2H), 7.49 (d, *J* = 8.4 Hz, 2H), 7.20 (t, *J* = 7.5 Hz, 2H), 6.79 (t, *J* = 7.5 Hz, 1H), 6.61 (d, *J* = 7.5 Hz, 2H), 4.75 (d, *J* = 2.4 Hz, 1H), 4.60 (m, 1H), 2.81-2.70 (m, 2H), 2.52 (d, *J* = 18.9 Hz, 1H), 2.31-2.05 (m, 3H), 1.86-1.76 (m, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 210.6, 149.2, 147.3, 129.5, 126.7, 124.4, 123.8, 118.6, 113.5, 65.3, 51.9, 48.8, 45.9, 22.6, 22.4; enantiomeric excess: 34 %, determined by HPLC (Chiralpak IB-3 column, hexane:isopropanol (90:10), flow rate 1.0 mL min^{-1}, 254 nm): major enantiomer R_t = 7.3 min, minor enantiomer R_t = 8.1 min.

3-exo-(Furan-2-yl)-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (4g)



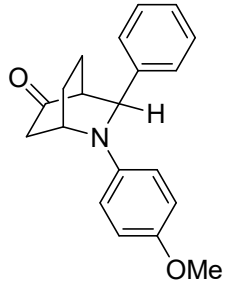
Brown waxy solid; GC-MS (M^+): 267; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.37-7.33 (m, 1H), 7.19-7.13 (m, 1H), 7.11-6.99 (m, 3H), 6.70-6.61 (m, 1H), 6.60-6.28 (m, 2H), 4.73 (m, 1H), 4.37 (m, 1H), 2.96-2.91 (m, 1H), 2.81-2.63 (m, 1H), 2.35-2.17 (m, 1H), 1.87-1.82 (m, 1H), 1.66-1.64 (m, 1H), 1.77-1.72 (m, 1H), 1.36-1.34 (m, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 212.8, 153.2, 148.1, 142.3, 129.4, 118.0, 113.0, 110.5, 108.0, 57.7, 48.1, 42.2, 29.7, 26.0, 17.3.

3-endo-(Furan-2-yl)-2-phenyl-2-azabicyclo[2.2.2]octan-5-one (5g)



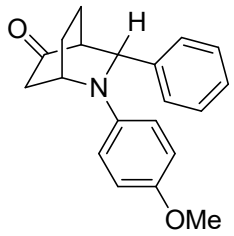
Brown waxy solid; GC-MS (M^+): 267; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.28 (s, 1H), 7.19-7.14 (m, 3H), 6.69-6.67 (m, 2H), 6.19 (s, 1H), 6.11 (s, 1H), 4.62 (m, 1H), 4.37 (m, 1H), 2.84-2.73 (m, 2H), 2.53-2.42 (m, 1H), 2.38-1.94 (m, 2H), 1.64-1.34 (m, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 211.9, 154.7, 148.1, 142.4, 129.3, 118.0, 113.1, 106.8, 60.3, 49.2, 48.4, 45.9, 29.7, 22.4, 21.9; enantiomeric excess: 62 %, determined by HPLC (Chiralpak IB-3 column, hexane:isopropanol (90:10), flow rate 1.0 mL min^{-1}, 254 nm): major enantiomer R_t = 6.1 min, minor enantiomer R_t = 5.6 min.

2-exo-(4-Methoxyphenyl)-3-phenyl-2-azabicyclo[2,2,2]octan-5-one (4h)[2]



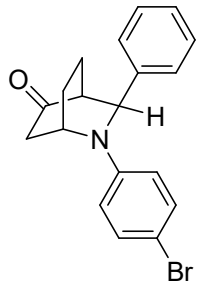
Yellow solid; m. p. 111-112 °C (lit.[2] 110-111 °C); GC-MS (M^+): 307; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.41-7.32 (m, 4H), 7.30-7.22 (m, 1H), 6.74-6.66 (m, 2H), 6.56-6.49 (m, 2H), 4.68 (d, *J* = 2.4 Hz, 1H), 4.42-4.40 (m, 1H), 3.67 (s, 3H), 2.77-2.71 (m, 1H), 2.66-2.63 (m, 1H), 2.38-2.33 (m, 1H), 2.30-2.18 (m, 1H), 1.92-1.80 (m, 1H), 1.75-1.67 (m, 1H), 1.65-1.54 (m, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 236.3, 174.5, 165.2, 163.0, 151.4, 149.9, 148.8, 137.4, 136.9, 85.4, 78.4, 73.8, 71.6, 64.7, 49.1, 39.2.

2-endo-(4-Methoxyphenyl)-3-phenyl-2-azabicyclo[2,2,2]octan-5-one (5h)[2]



Yellow solid; m. p. 201-202 °C (lit.[2] 200-201 °C); GC-MS (M^+): 307; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.26-7.25 (m, 4H), 7.18-7.16 (m, 1H), 6.71 (d, *J* = 8.8 Hz, 2H), 6.58 (d, *J* = 8.8 Hz, 2H), 4.54 (d, *J* = 2.4 Hz, 1H), 4.38-4.36 (m, 1H), 3.65 (s, 3H), 2.74- 2.72 (m, 2H), 2.43-2.38 (m, 1H), 2.20-2.17 (m, 1H), 2.08-2.00 (m, 1H), 1.99-1.93 (m, 1H), 1.70-1.65 (m, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 211.4, 151.6, 142.1, 141.9, 128.5, 127.1, 125.3, 114.4, 114.3, 66.0, 55.4, 52.1, 49.2, 45.9, 22.5, 22.2; enantiomeric excess: 70 %, determined by HPLC (Chiralpak IB-3 column, hexane:isopropanol (90:10), flow rate 1.0 mL min^{-1}, 254 nm): major enantiomer R_t = 8.9 min, minor enantiomer R_t = 11.3 min.

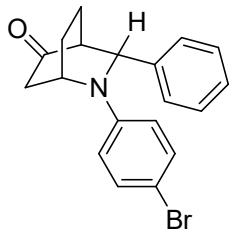
2-exo-(4-Bromophenyl)-3-phenyl-2-azabicyclo[2.2.2]octan-5-one (4i)[2]



Pale yellow solid; m. p. 158-160 °C (lit.[2] 158-159 °C); GC-MS (M^+): 356; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.39-7.32 (m, 4H), 7.30-7.28 (m, 1H), 7.18 (d, *J* = 9.0 Hz, 2H), 6.44 (d, *J* = 9.0 Hz, 2H), 4.70 (d, *J* = 2.0 Hz, 1H), 4.48-4.47 (m, 1H), 2.75- 2.65 (m, 2H), 2.43-2.39 (m, 1H), 2.29-2.21 (m, 1H), 1.94-1.86 (m, 1H), 1.70-1.62 (m, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz,):

δ (ppm) 212.7, 146.8, 139.1, 131.8, 128.7, 127.4, 125.8, 114.5, 109.5, 62.2, 50.9, 48.4, 42.3, 25.9, 16.3.

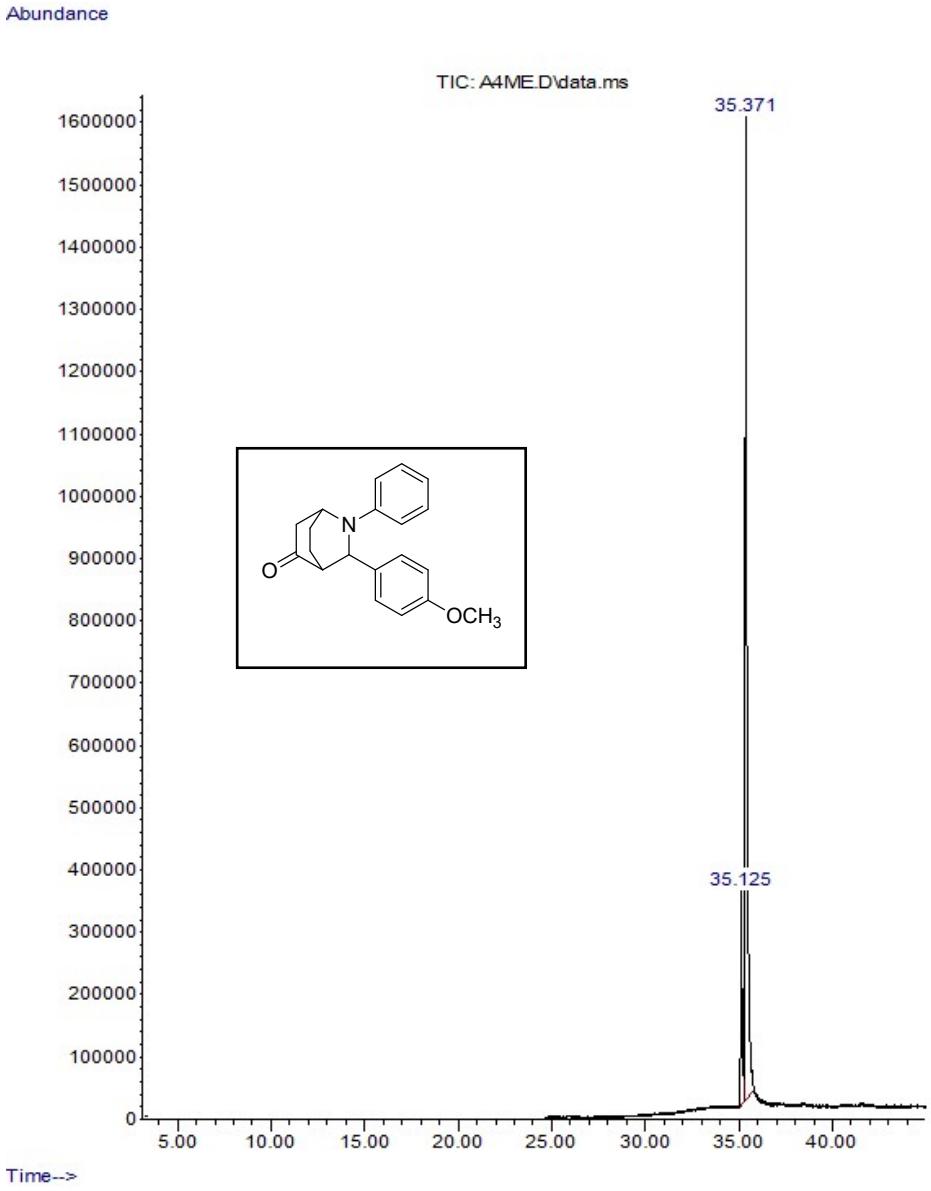
2-endo-(4-Bromophenyl)-3-phenyl-2-azabicyclo[2.2.2]octan-5-one (5i)[2]



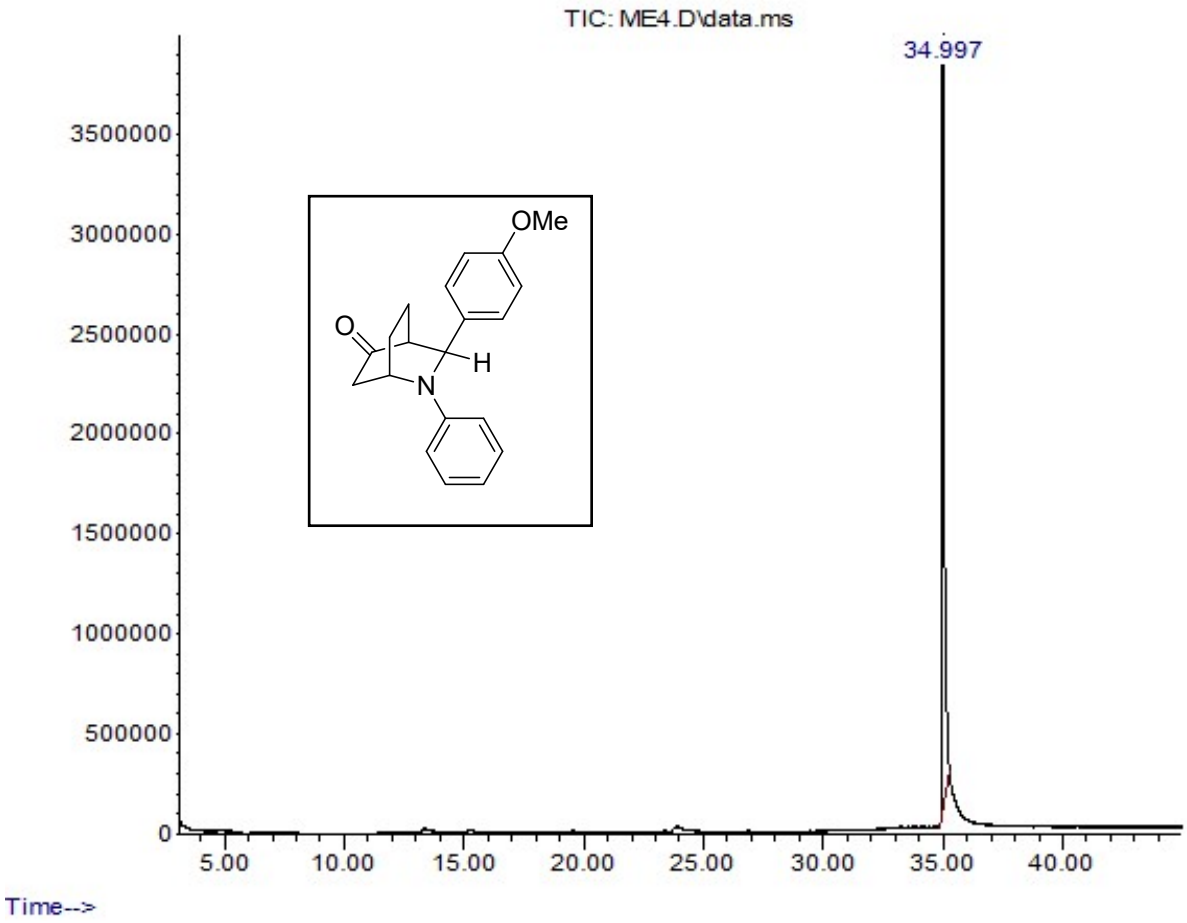
Pale yellow solid; m. p. 119-121 °C (lit.[2] 120-121 °C); GC-MS (M^+): 356; ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.30-7.26 (m, 2H), 7.23-7.17 (m, 5H), 6.51-6.47 (m, 2H), 4.58 (d, J = 2.4 Hz, 1H), 4.45-4.44 (m, 1H), 2.78-2.70 (m, 2H), 2.46-2.41 (m, 1H), 2.24-2.16 (m, 1H), 2.15-1.97 (m, 2H), 1.75-1.68 (m, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz,): δ (ppm) 210.8, 146.7, 140.8, 131.7, 128.8, 127.5, 125.7, 116.4, 114.8, 65.7, 52.0, 48.8, 45.7, 22.8, 22.5; enantiomeric excess: 21 %, determined by HPLC (Chiralpak IB-3 column, hexane:isopropanol (90:10), flow rate 1.0 mL min^{-1}, 254 nm): major enantiomer R_t = 9.3 min, minor enantiomer R_t = 10.5 min.

References

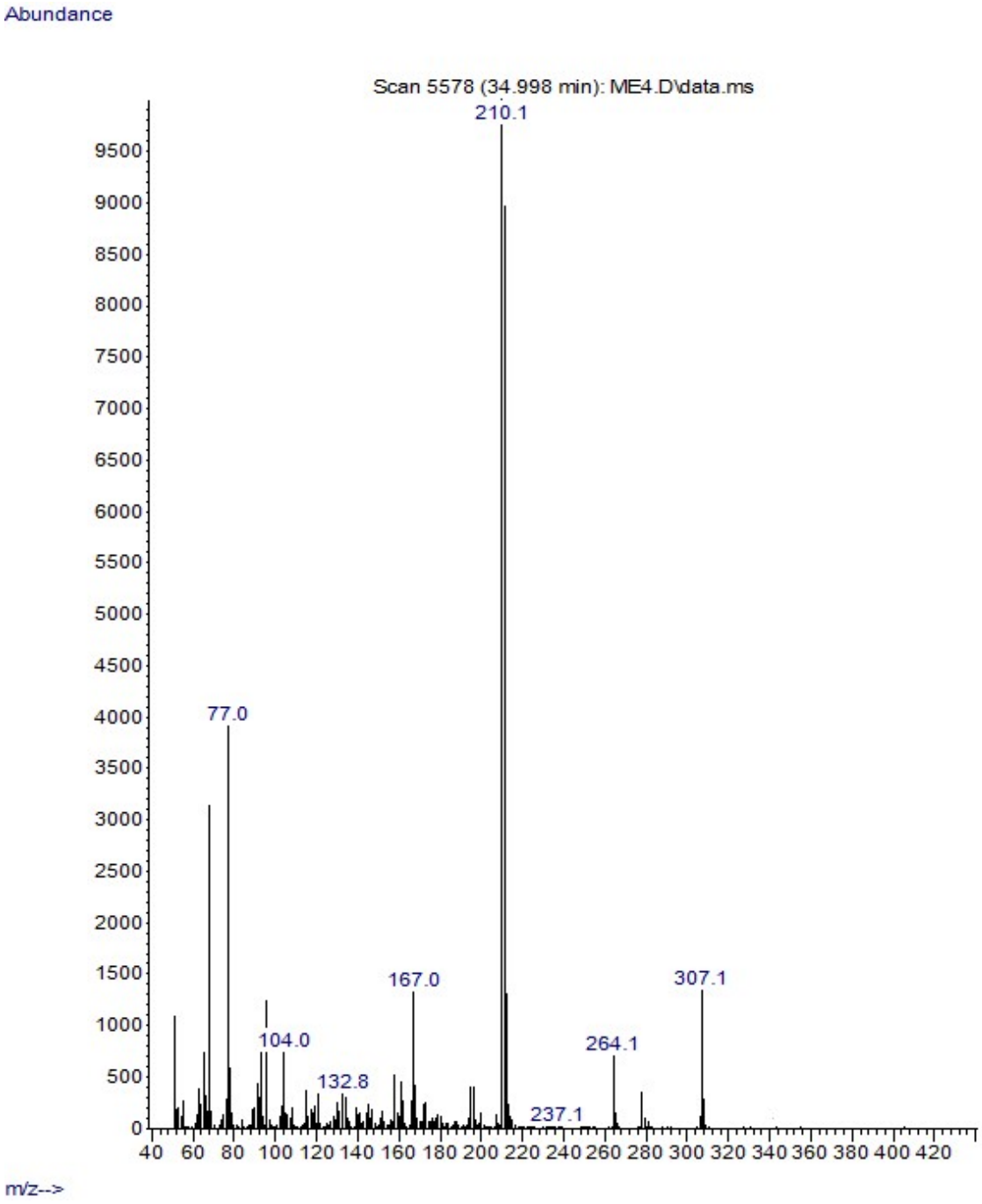
1. V. I. Maleev, V. S. Tat'yana, L. V. Yashkina, A. F. Mkrtchyan, A. S. Saghyan, M. M. Il'in and D. A. Chusov, *Tetrahedron: Asymmetry*, 2013, **24**, 178.
2. L. Huang, J. P. Chen, C. Jin and W. K. Su, *Chin. Chem. Lett.*, 2013, **24**, 347.
3. D. Borkin, E. Morzhina, S. Datta, A. Rudnitskaya, A., Sood, M. Török and B. Török, *Org. Biomol. Chem.*, 2011, **9**, 1394.



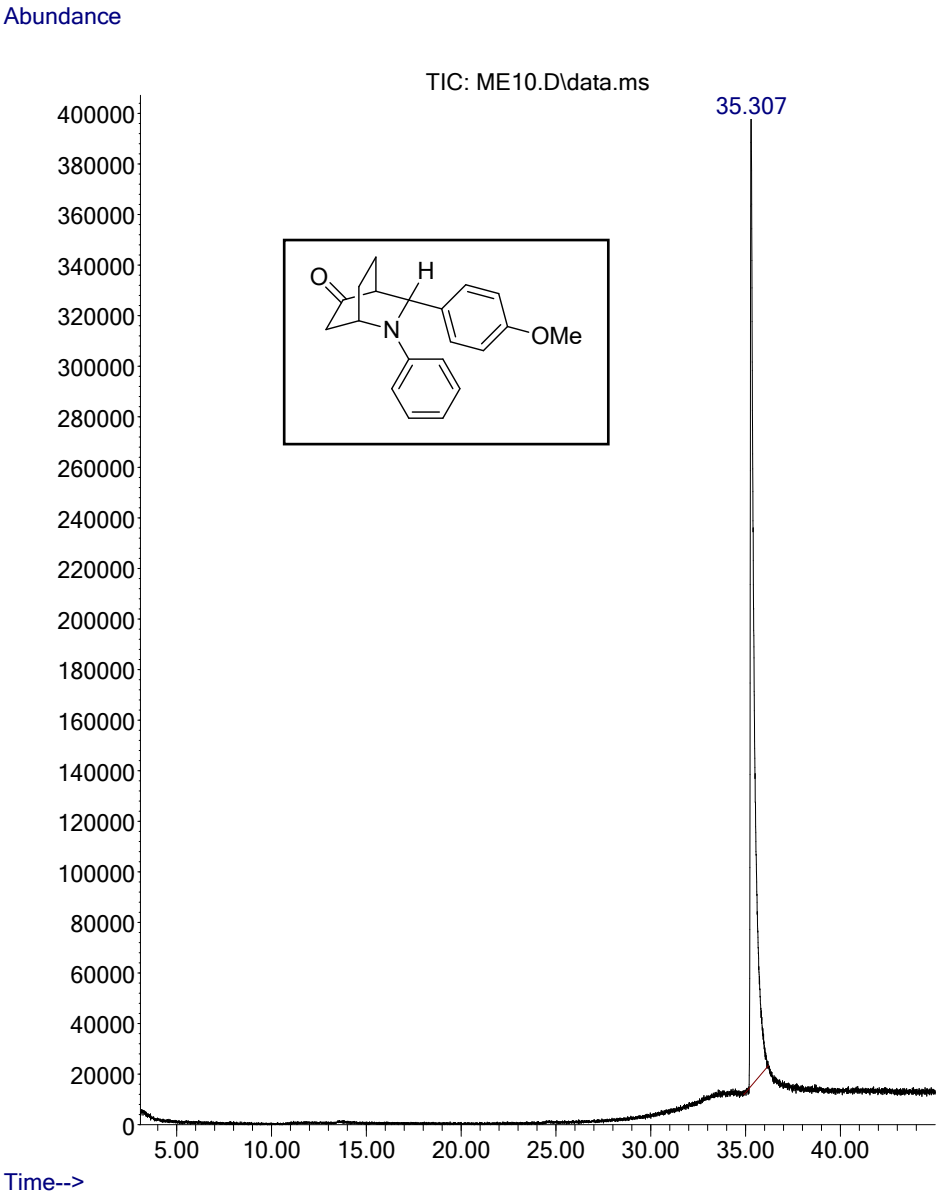
Gas chromatogram of 4a and 5a mixture



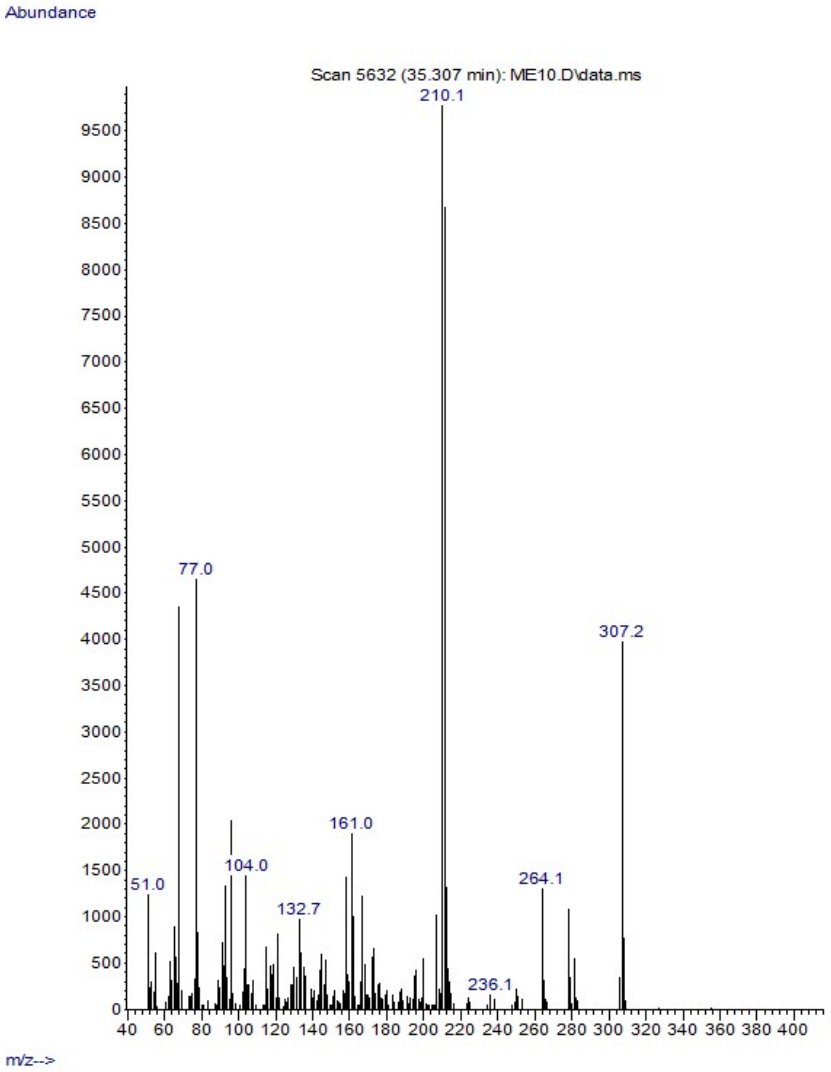
Gas chromatogram of 4a



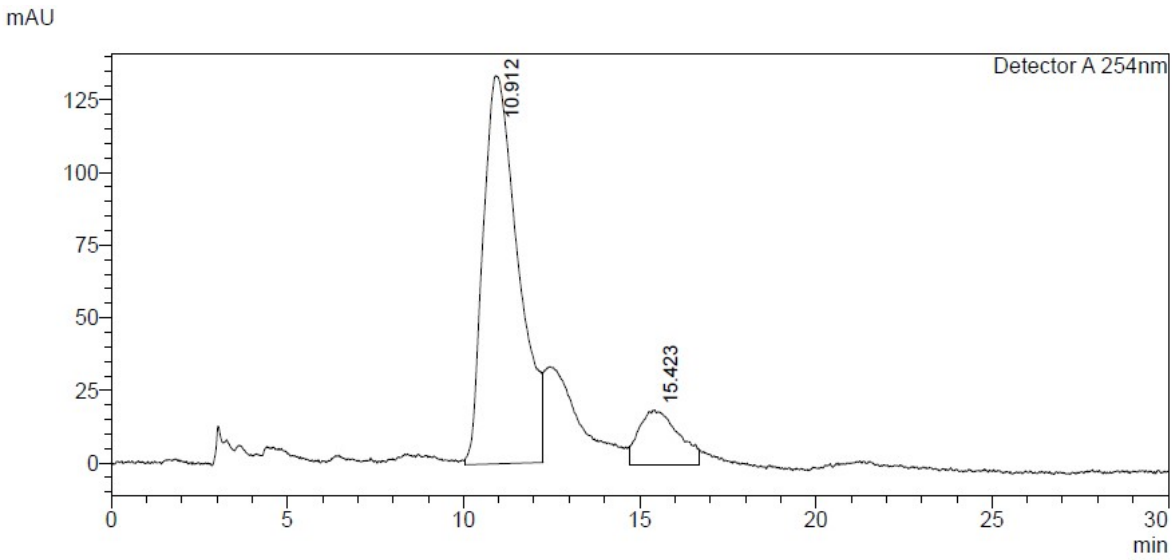
Mass spectrum of 4a



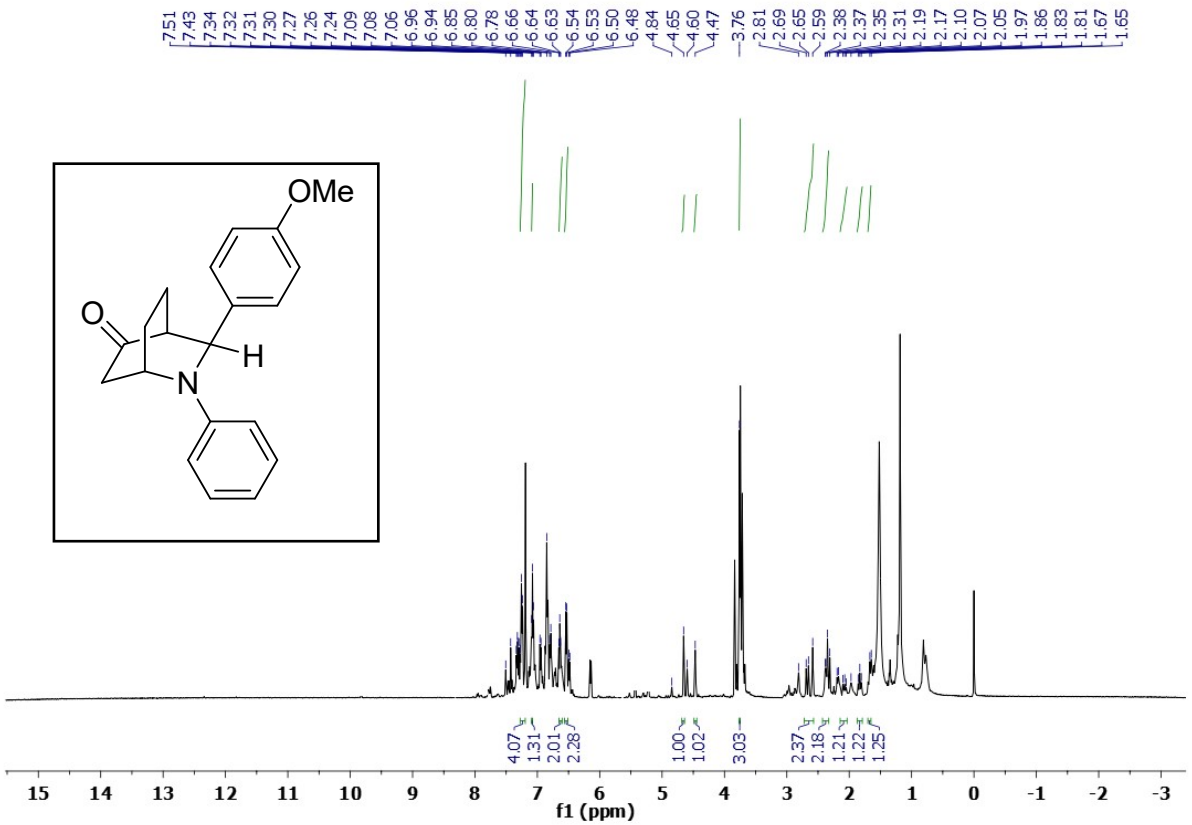
Gas chromatogram of 5a



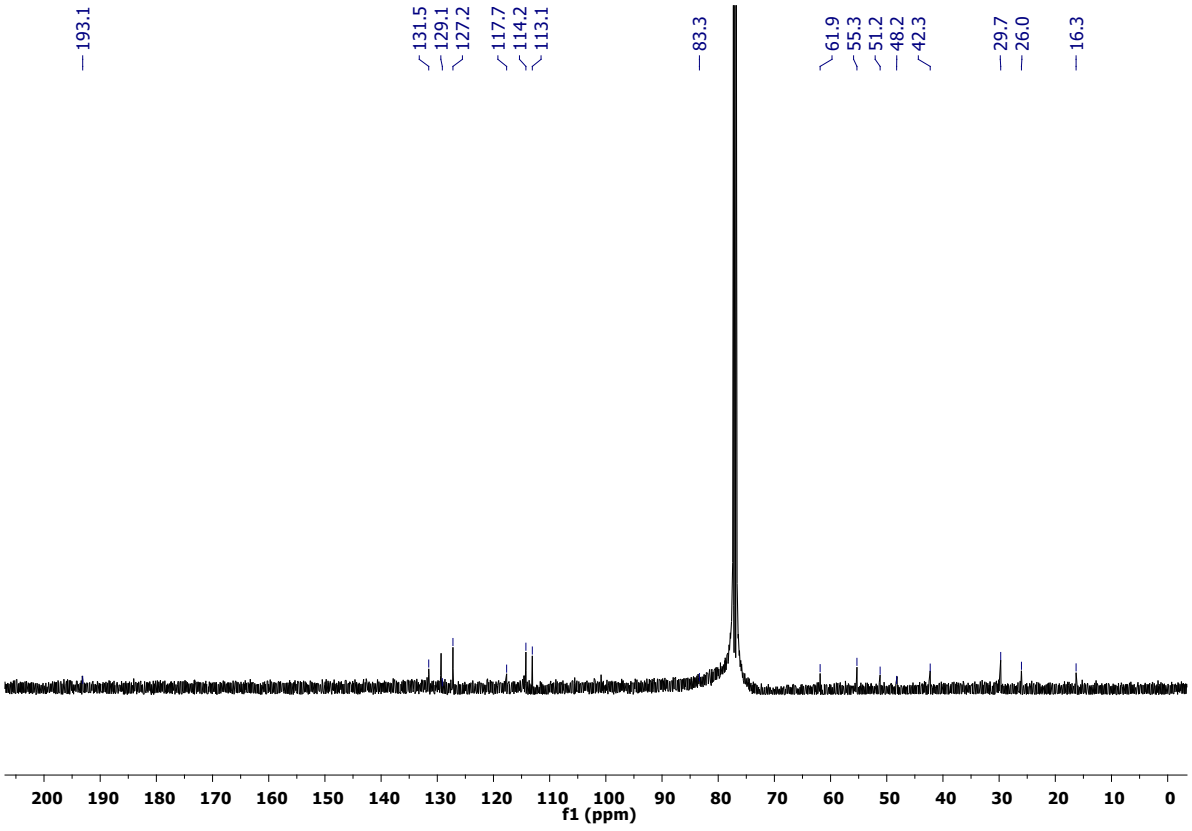
Mass spectrum of 5a



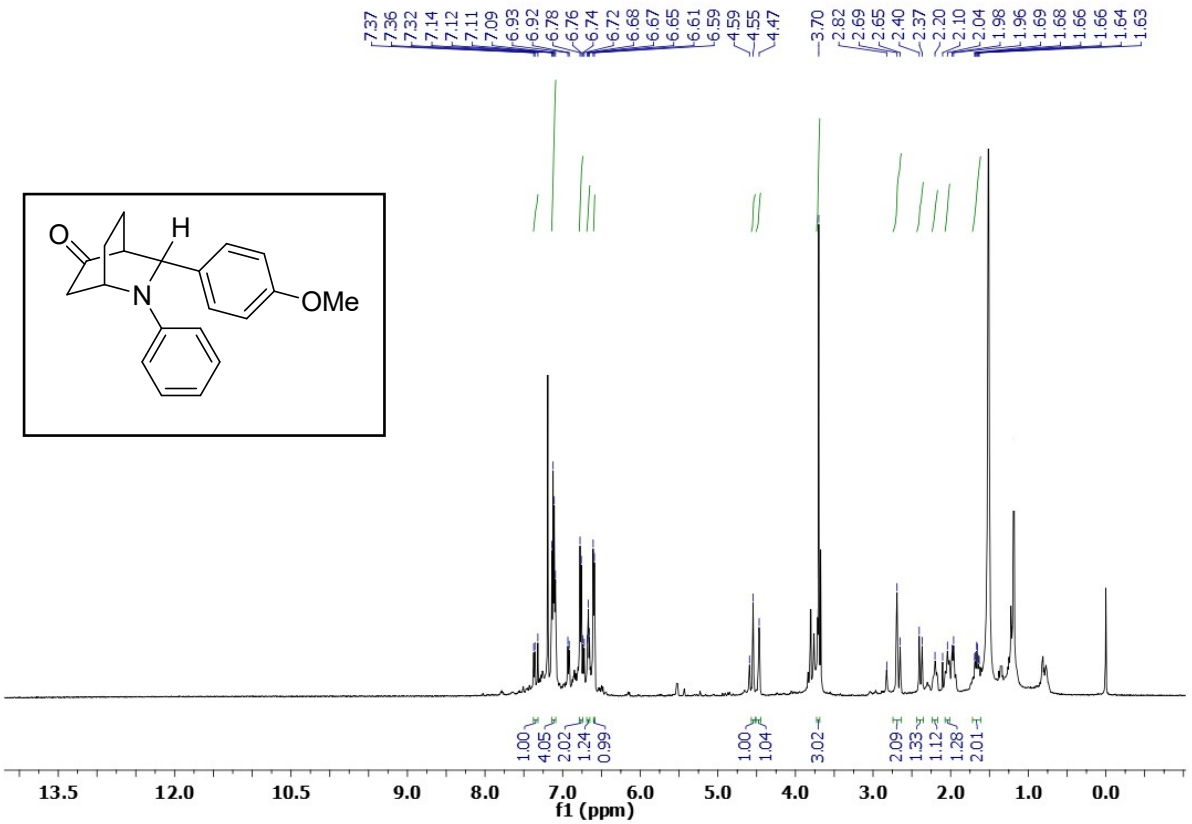
HPLC profile of 5a



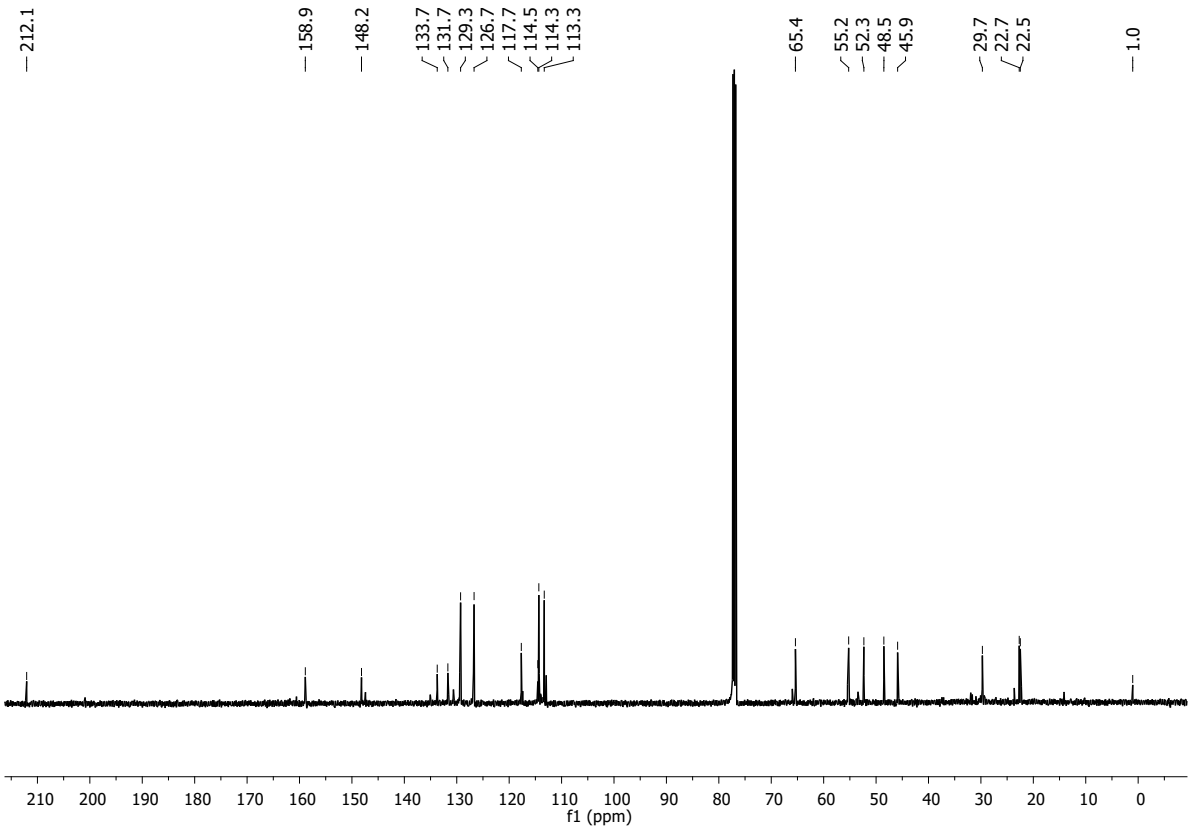
^{1}H NMR spectrum of 4a



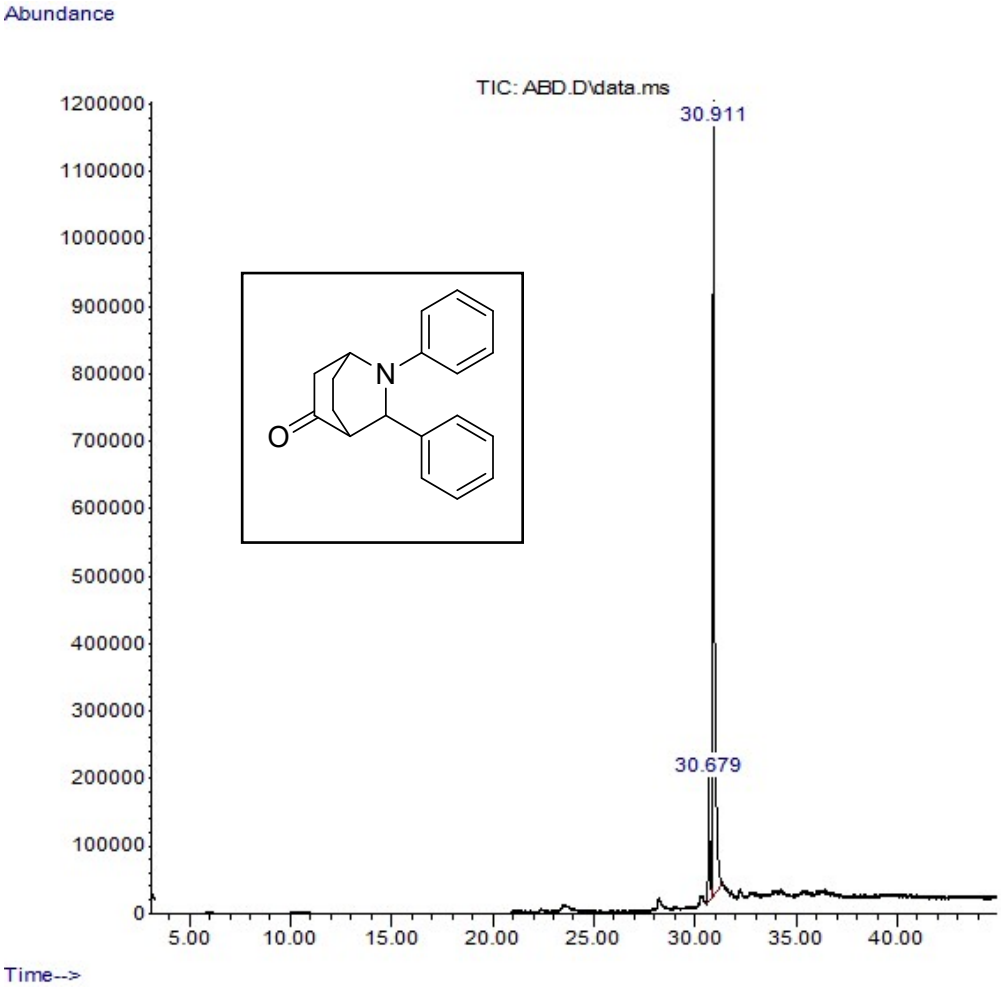
^{13}C NMR spectrum of 4a



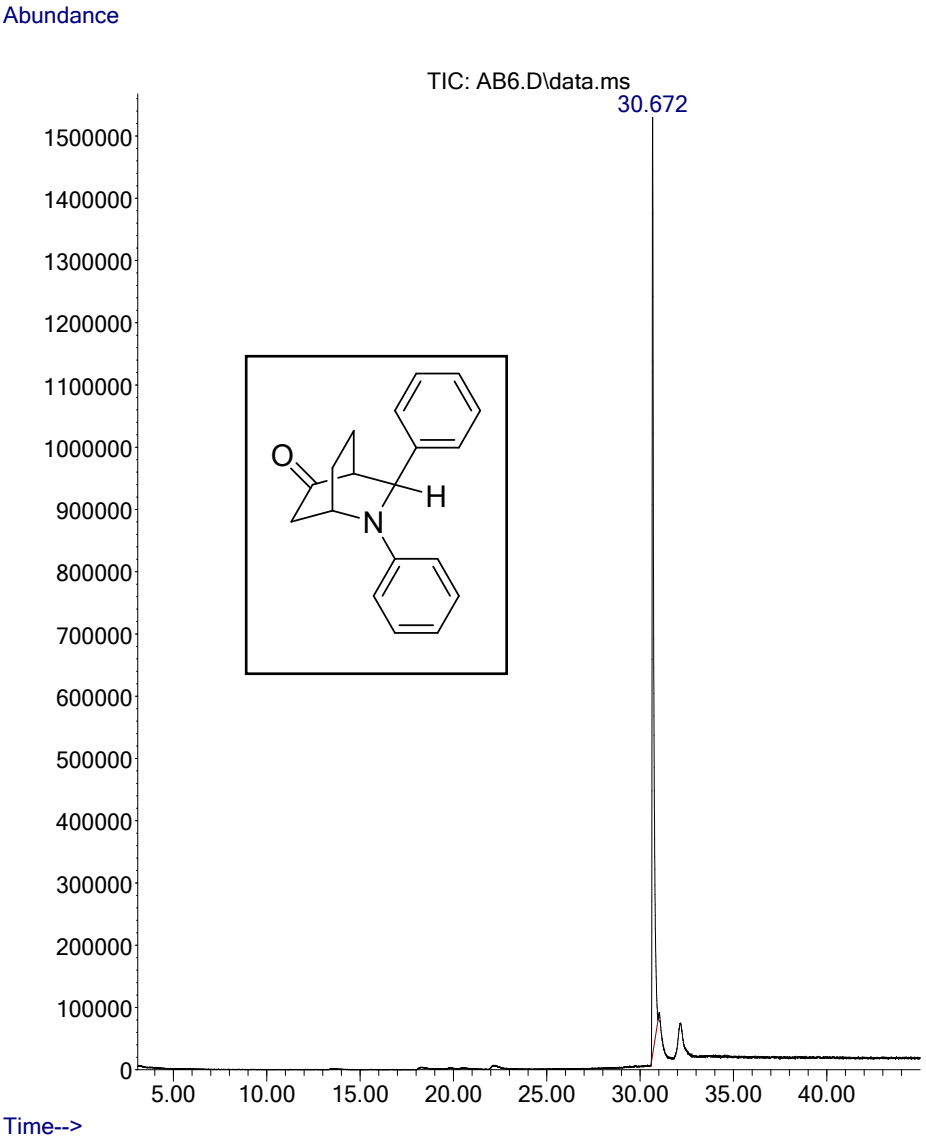
^{1}H NMR spectrum of 5a



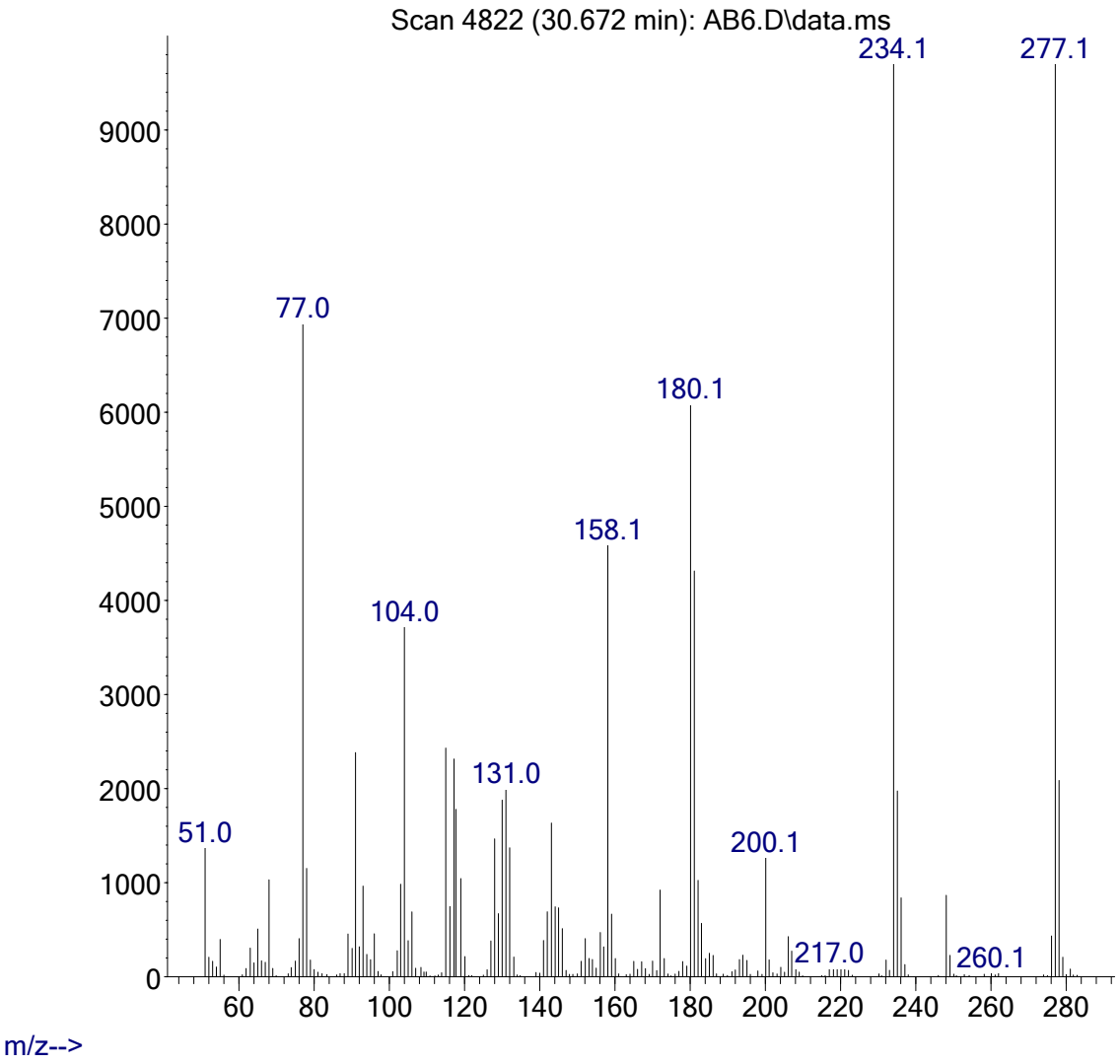
^{13}C NMR spectrum of 5a



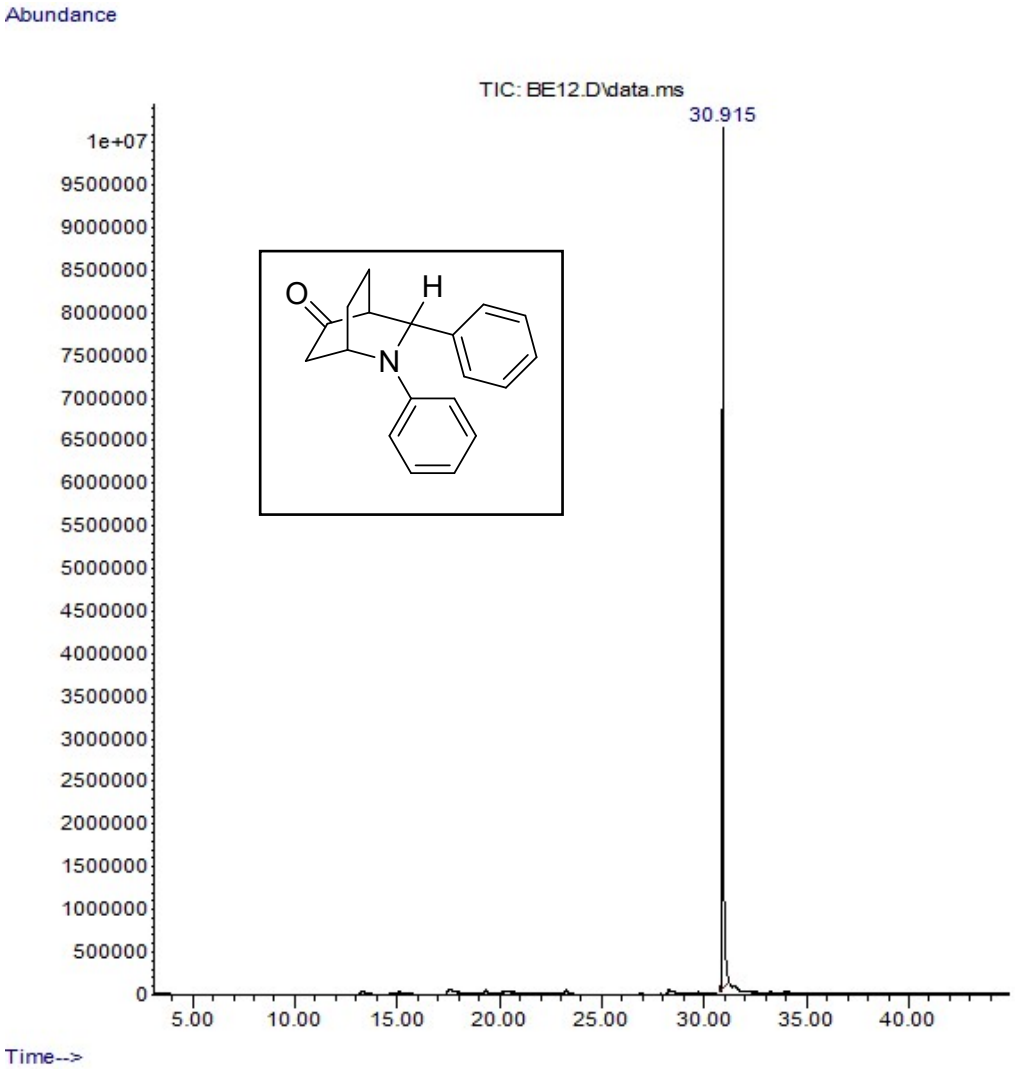
Gas chromatogram of 4b and 5b mixture



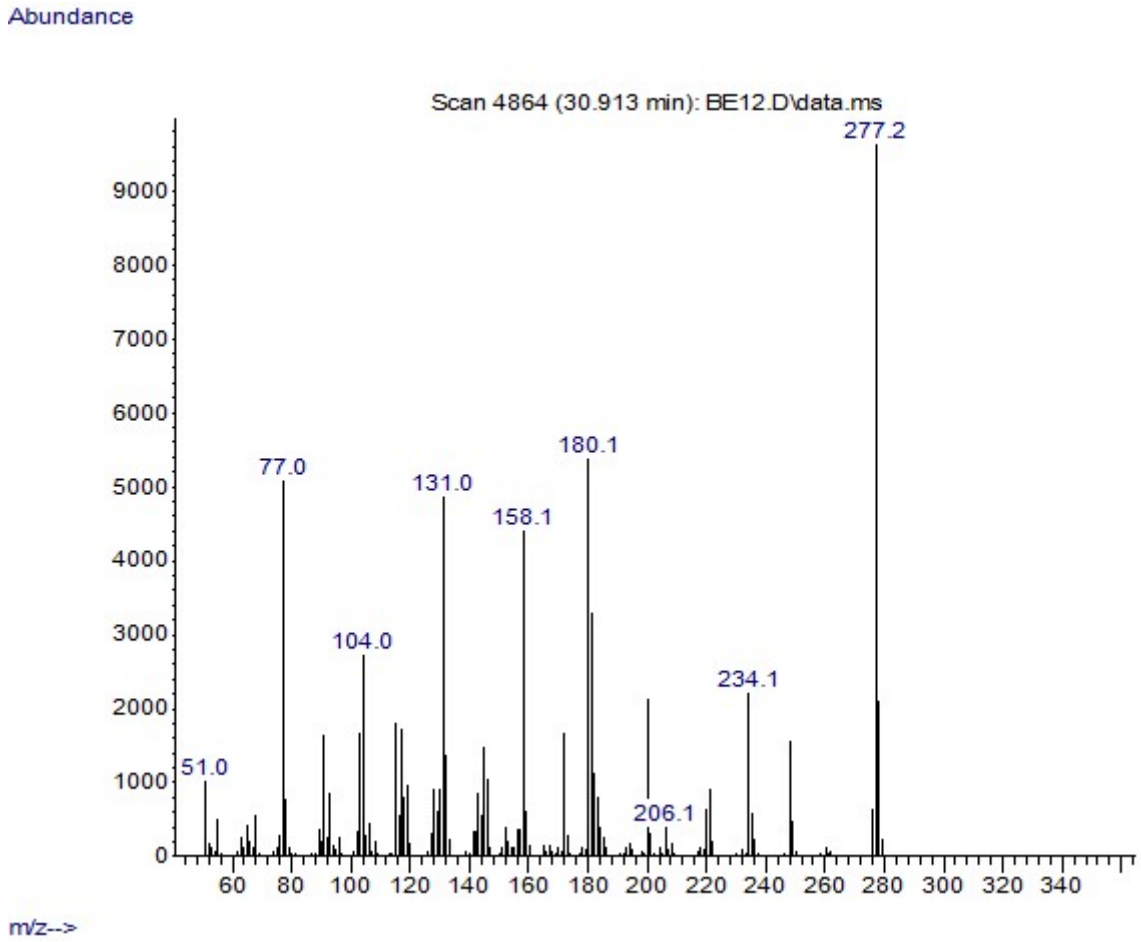
Gas chromatogram of 4b



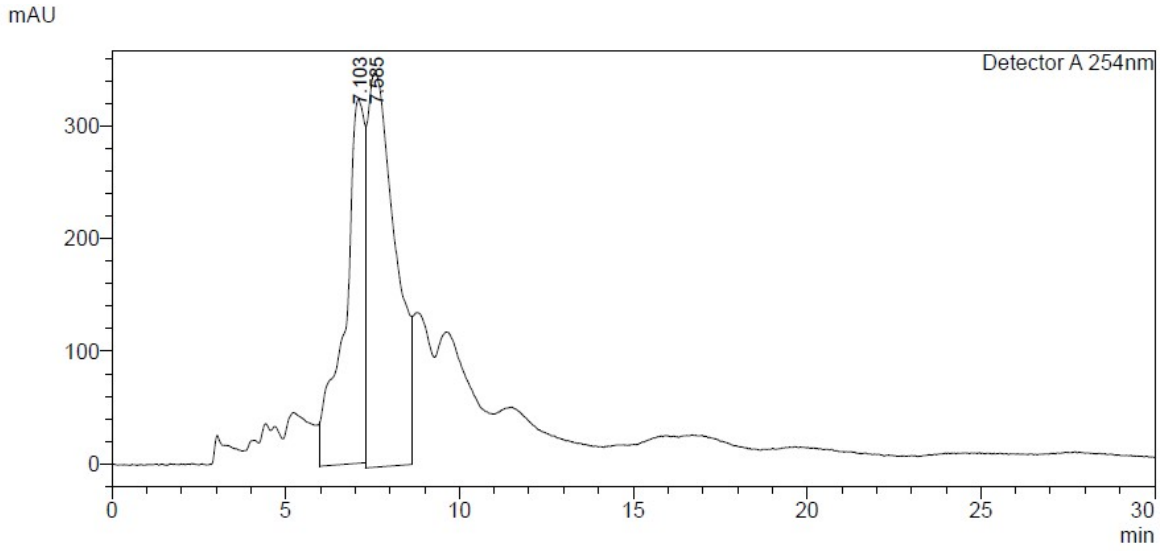
Mass spectrum of 4b



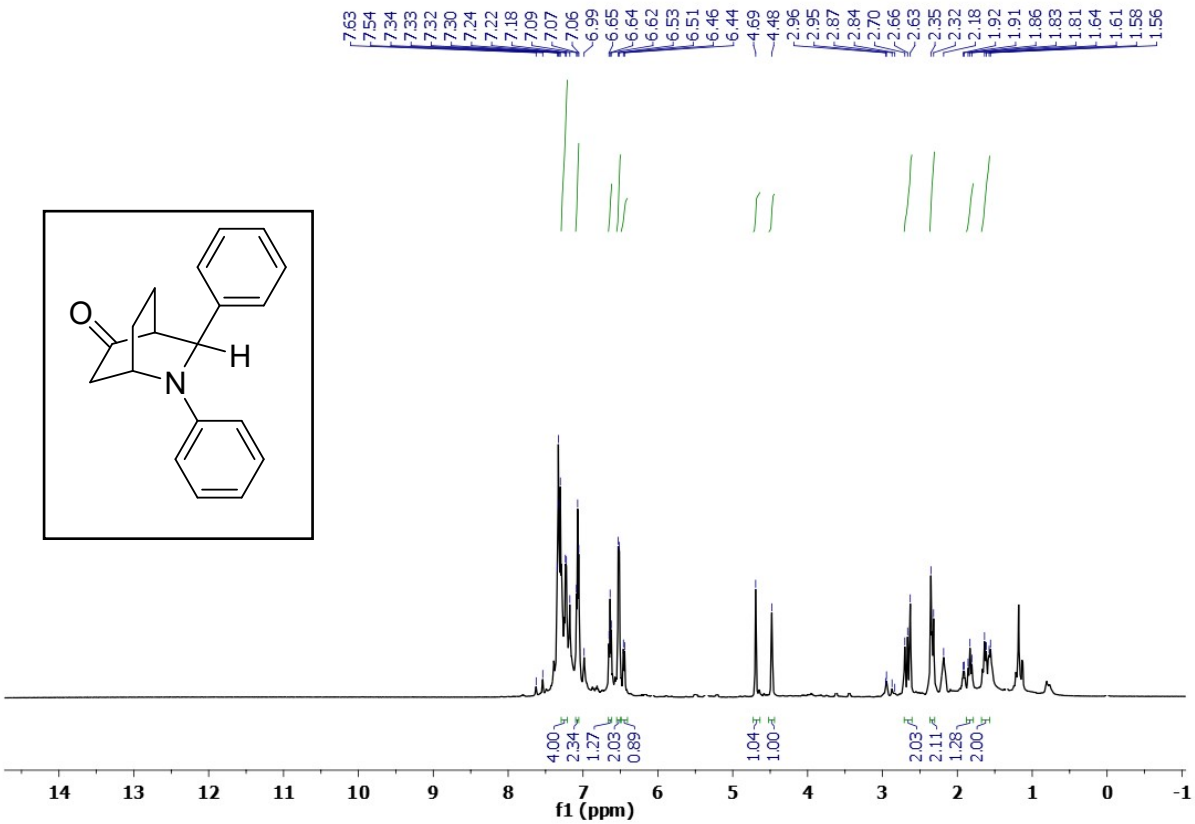
Gas chromatogram of 5b



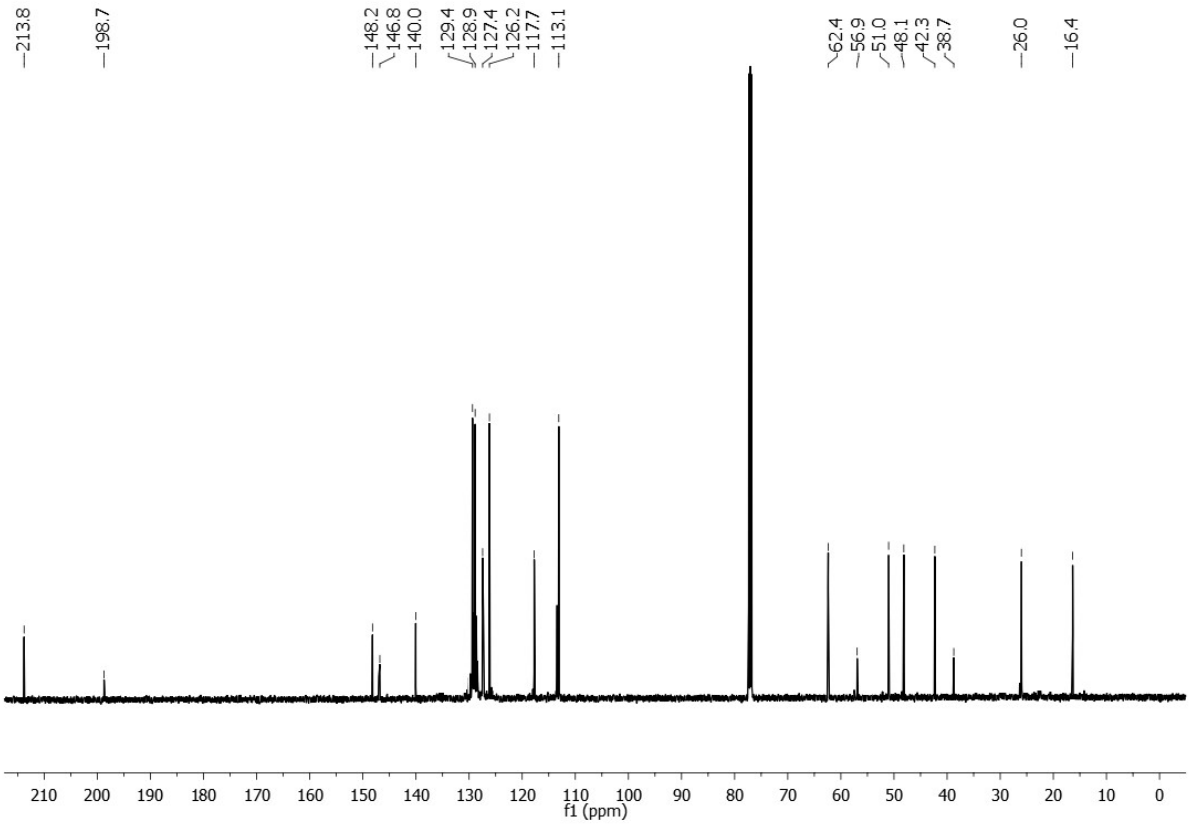
Mass spectrum of 5b



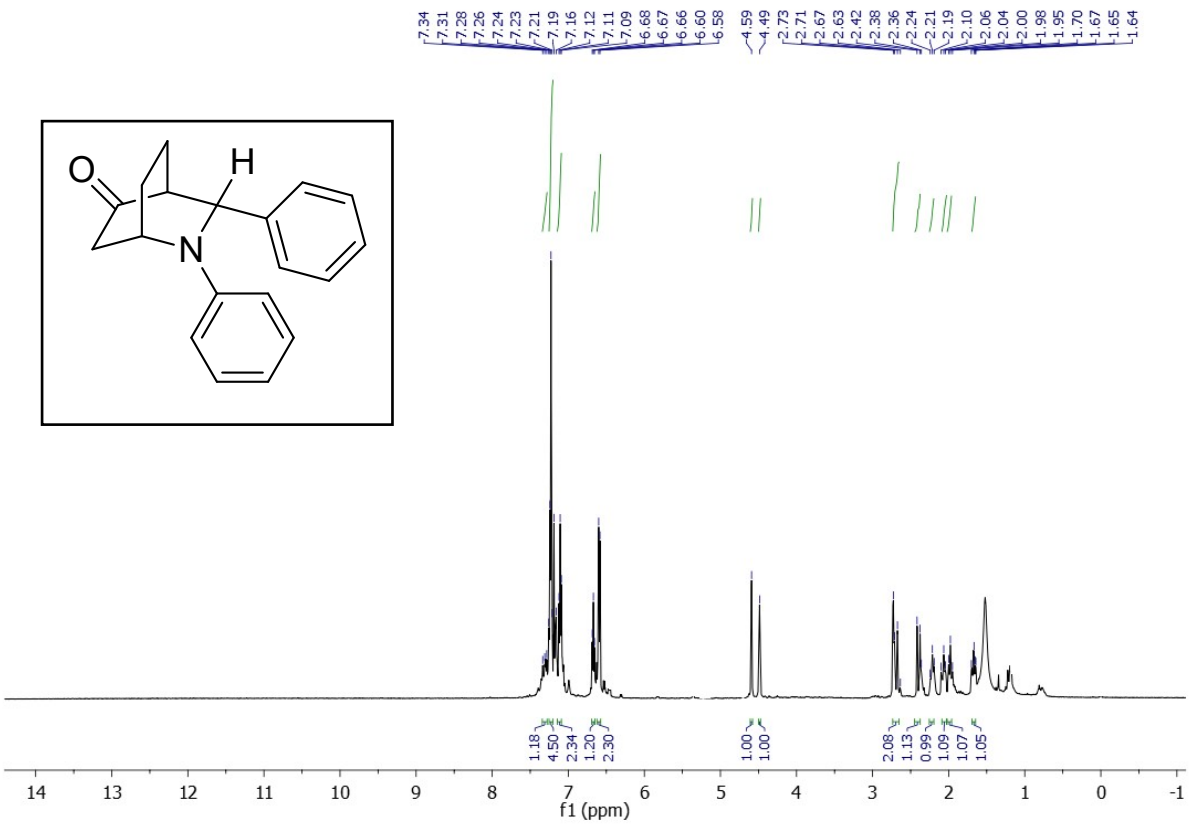
HPLC profile of 5b



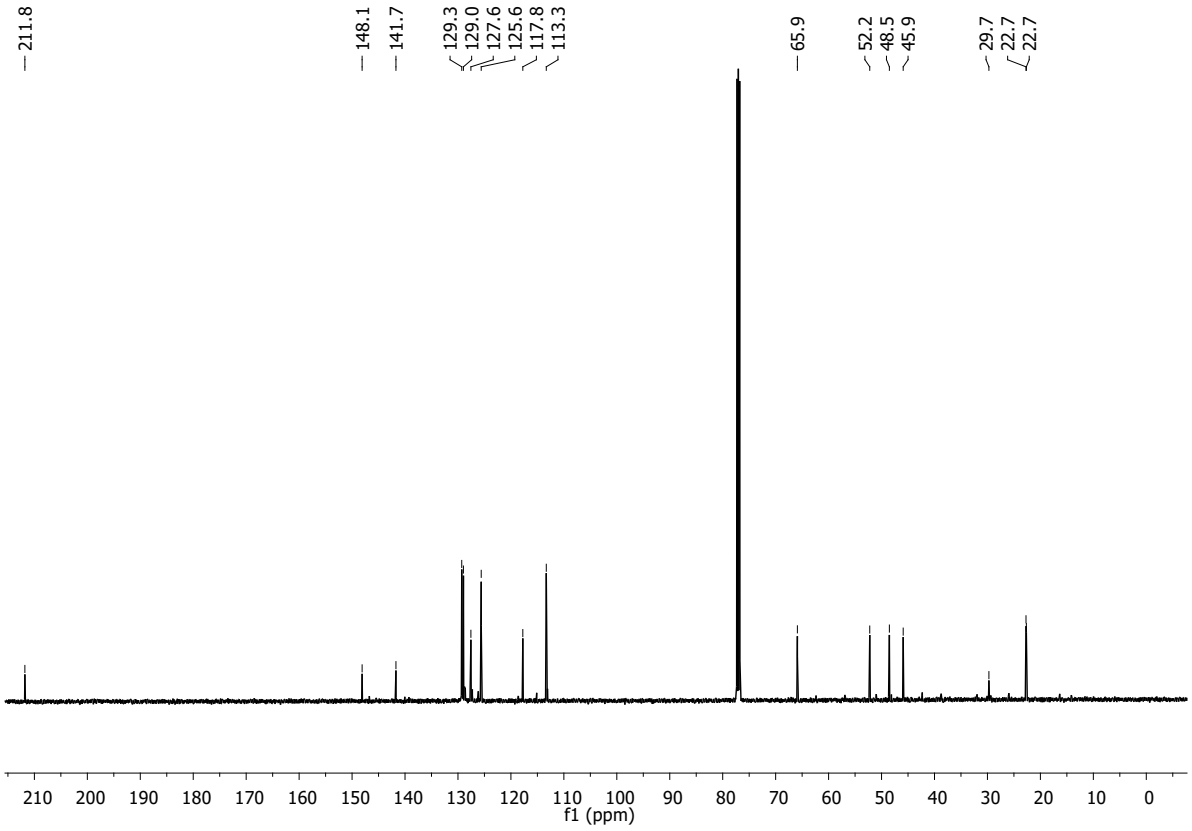
^{1}H NMR spectrum of 4b



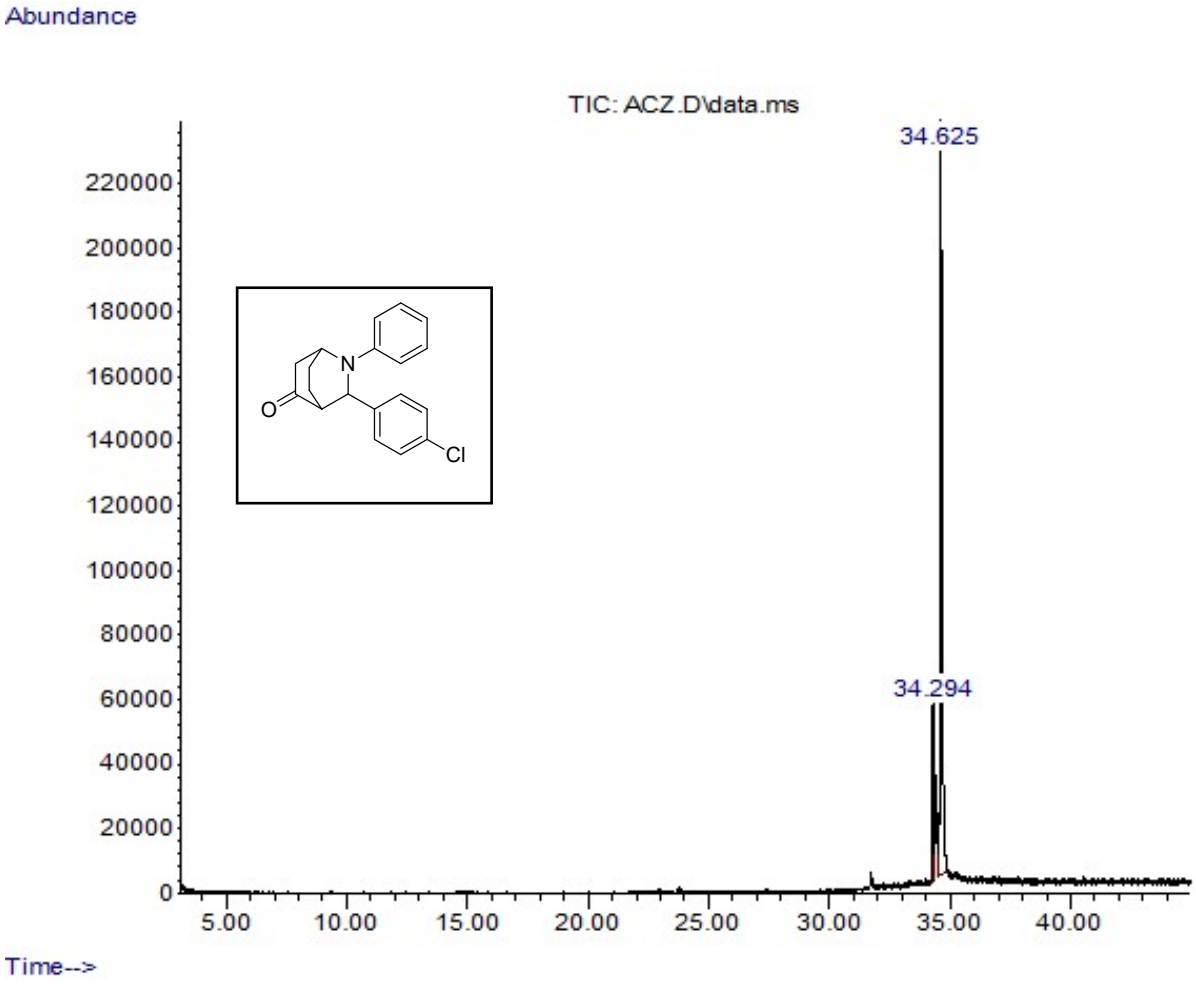
^{13}C NMR spectrum of 4b



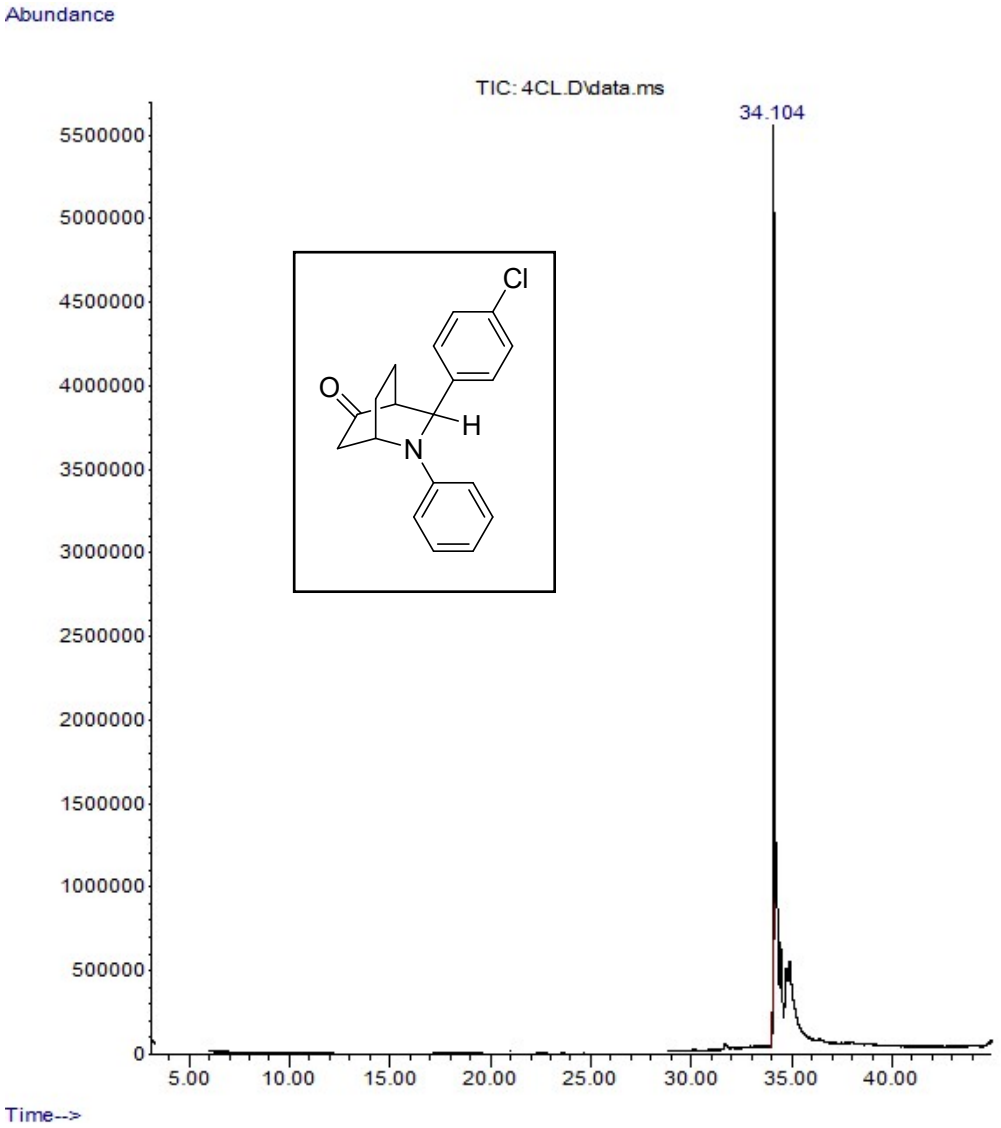
^{1}H NMR spectrum of 5b



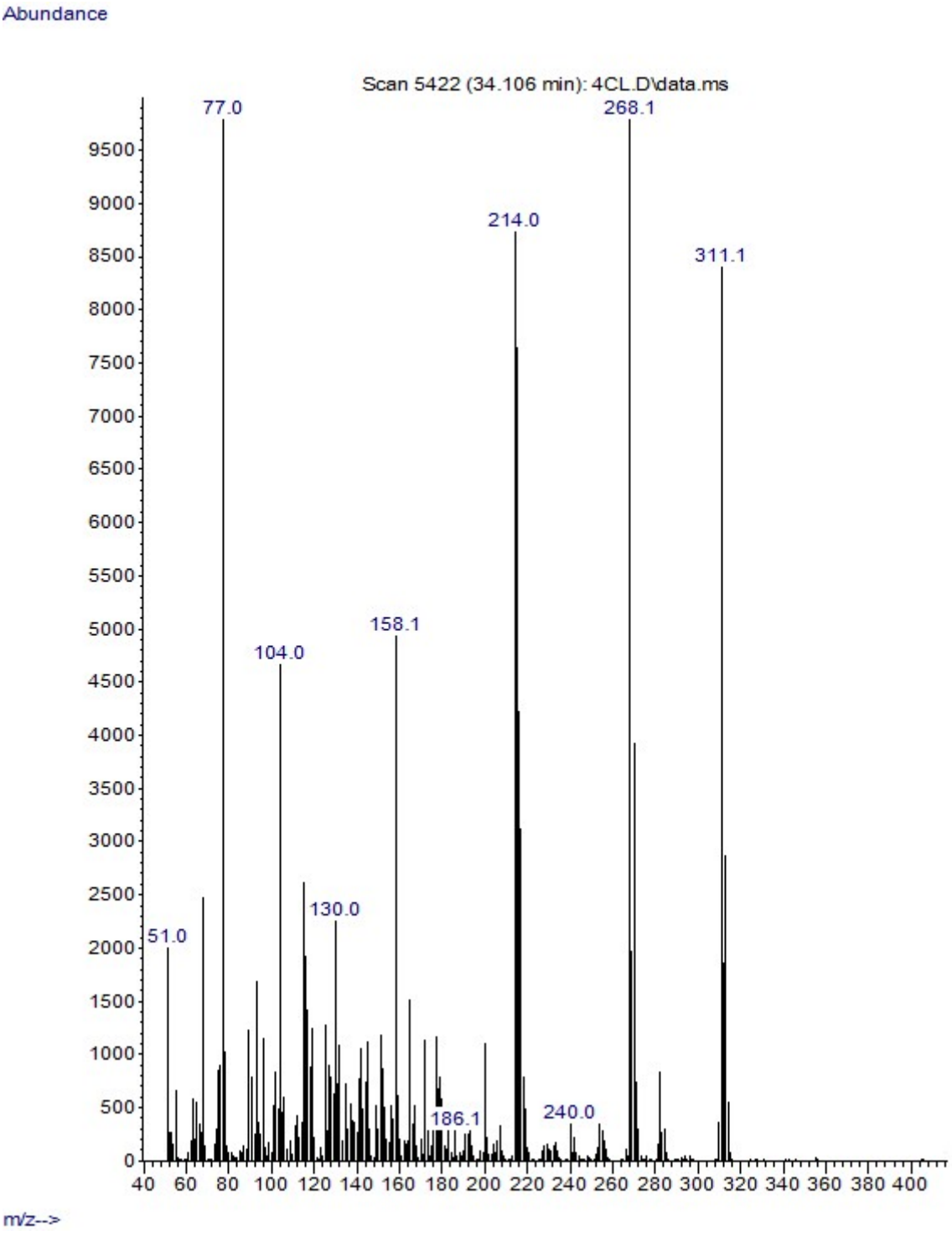
^{13}C NMR spectrum of 5b



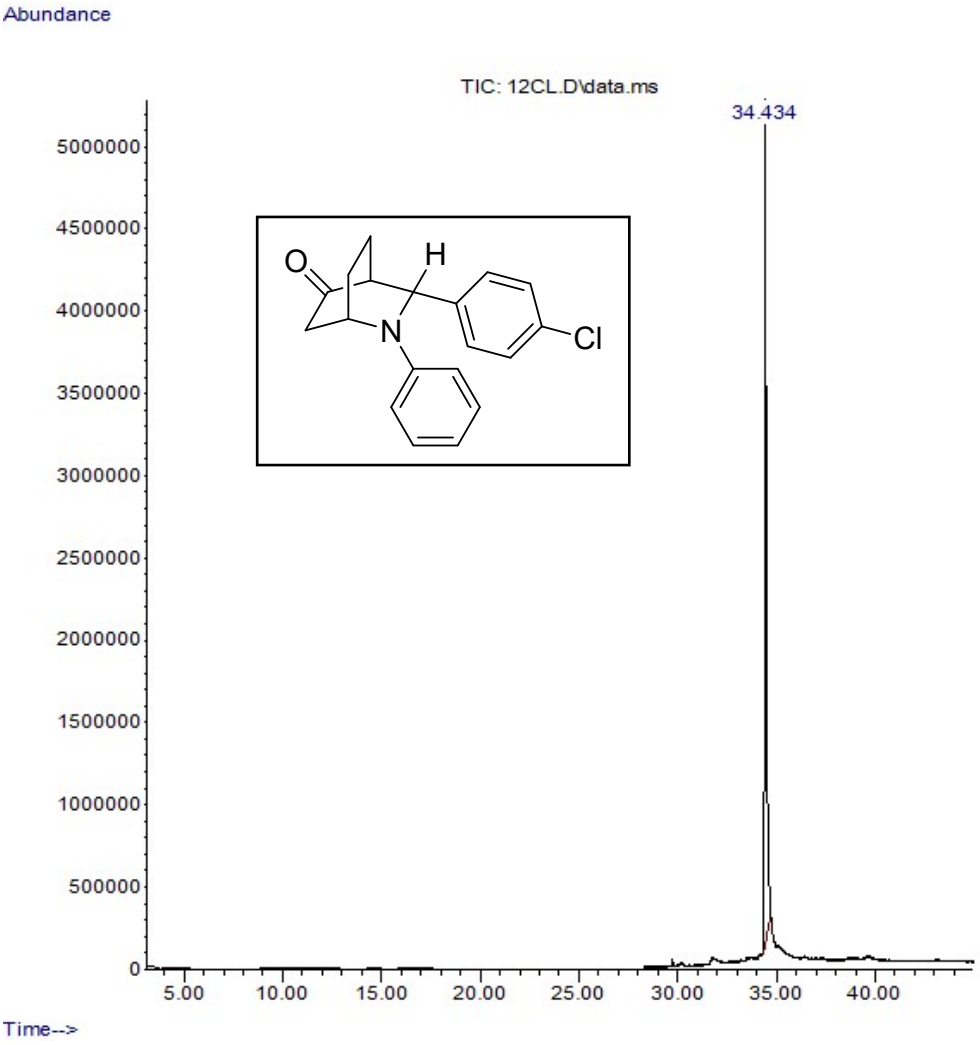
Gas chromatogram of 4c and 5c mixture



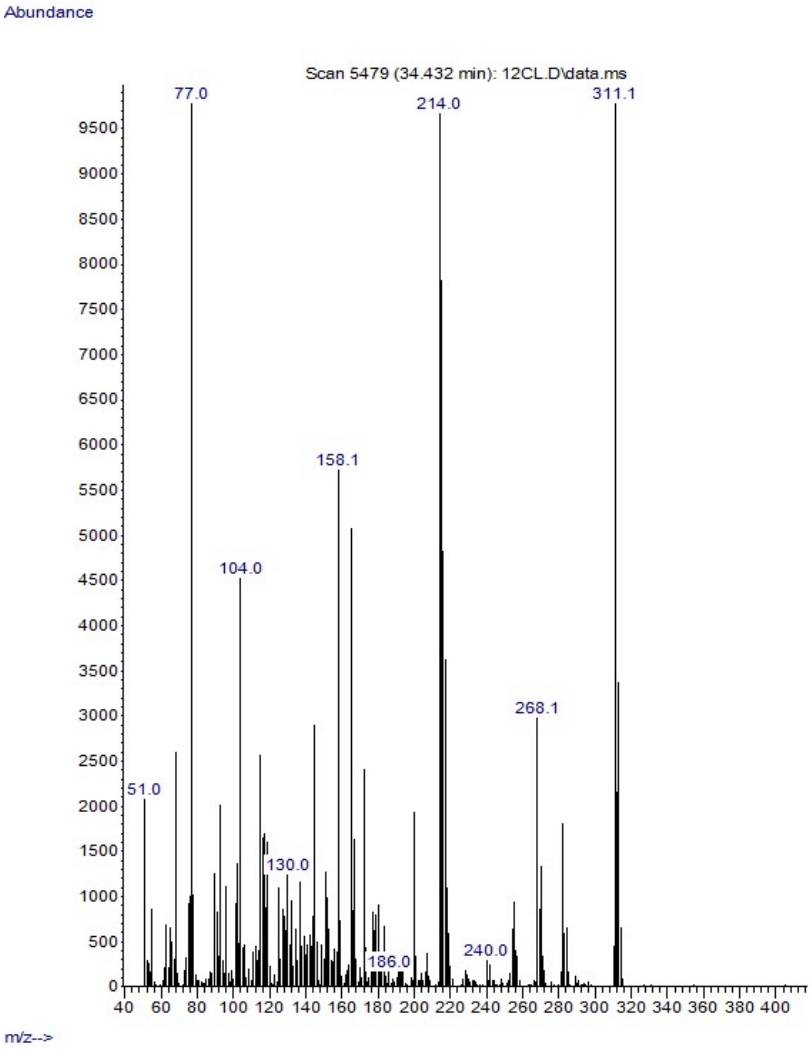
Gas chromatogram of 4c



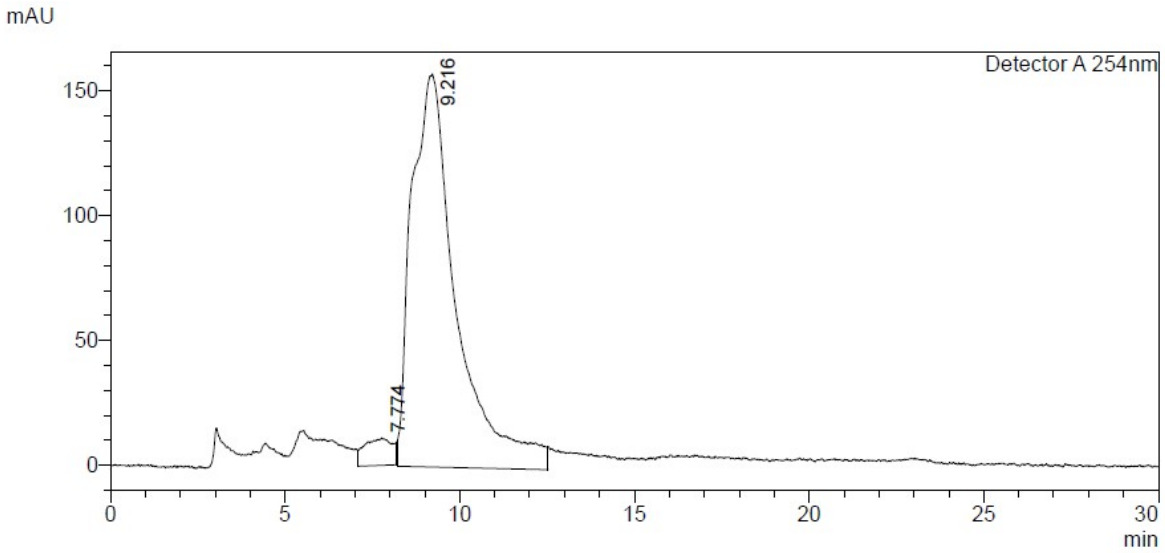
Mass spectrum of 4c



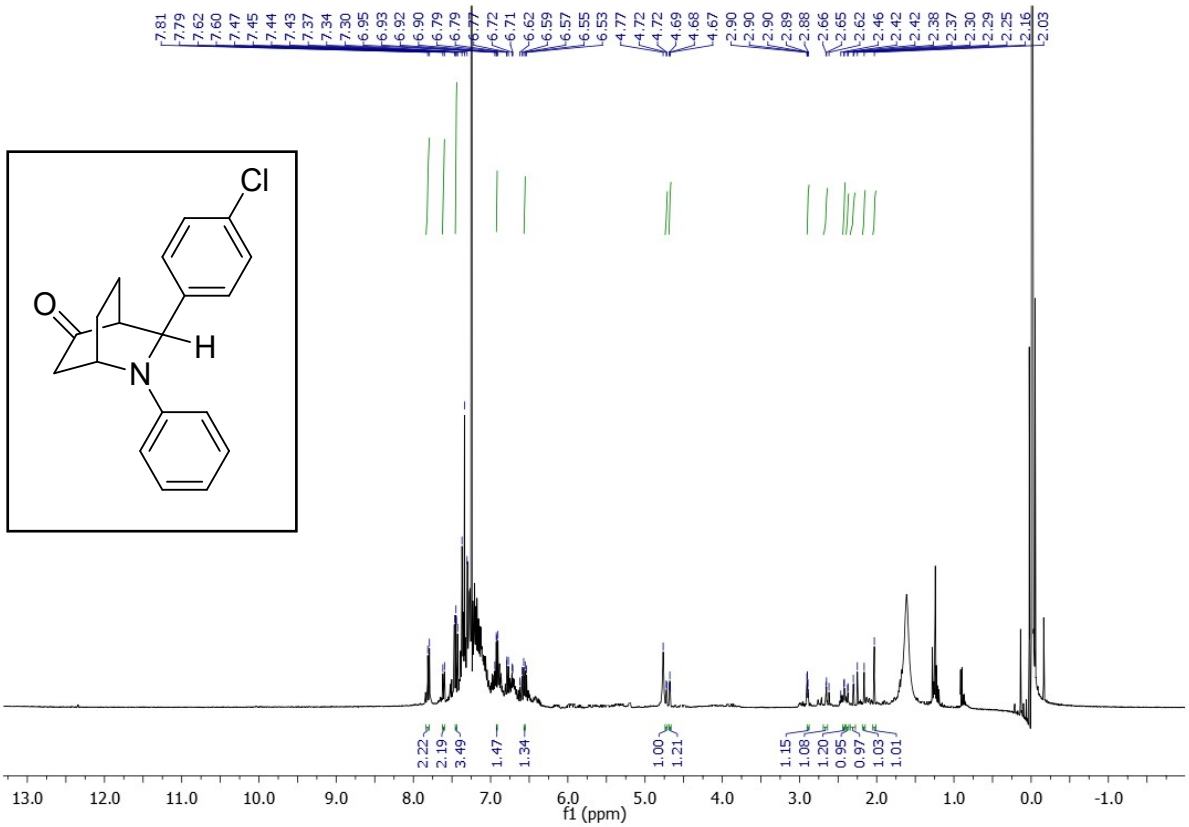
Gas chromatogram of 5c



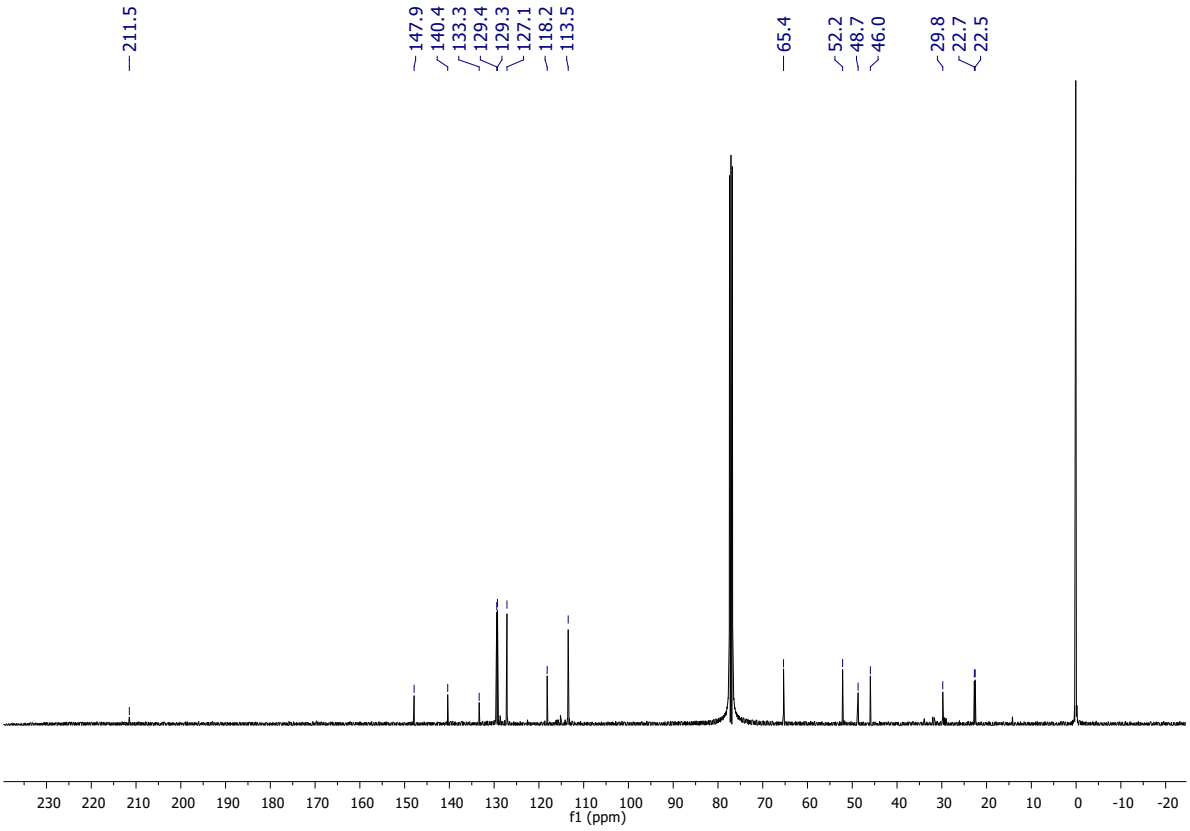
Mass spectrum of 5c



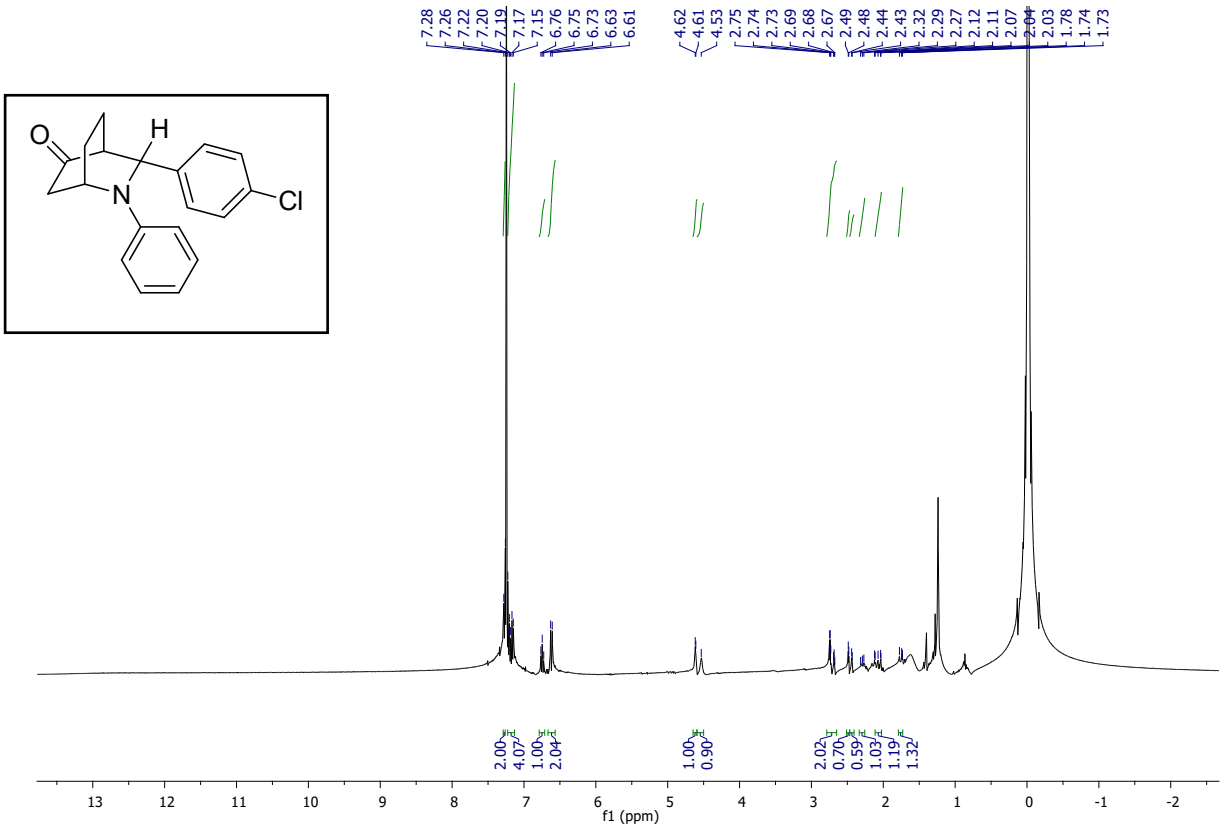
HPLC profile of 5c



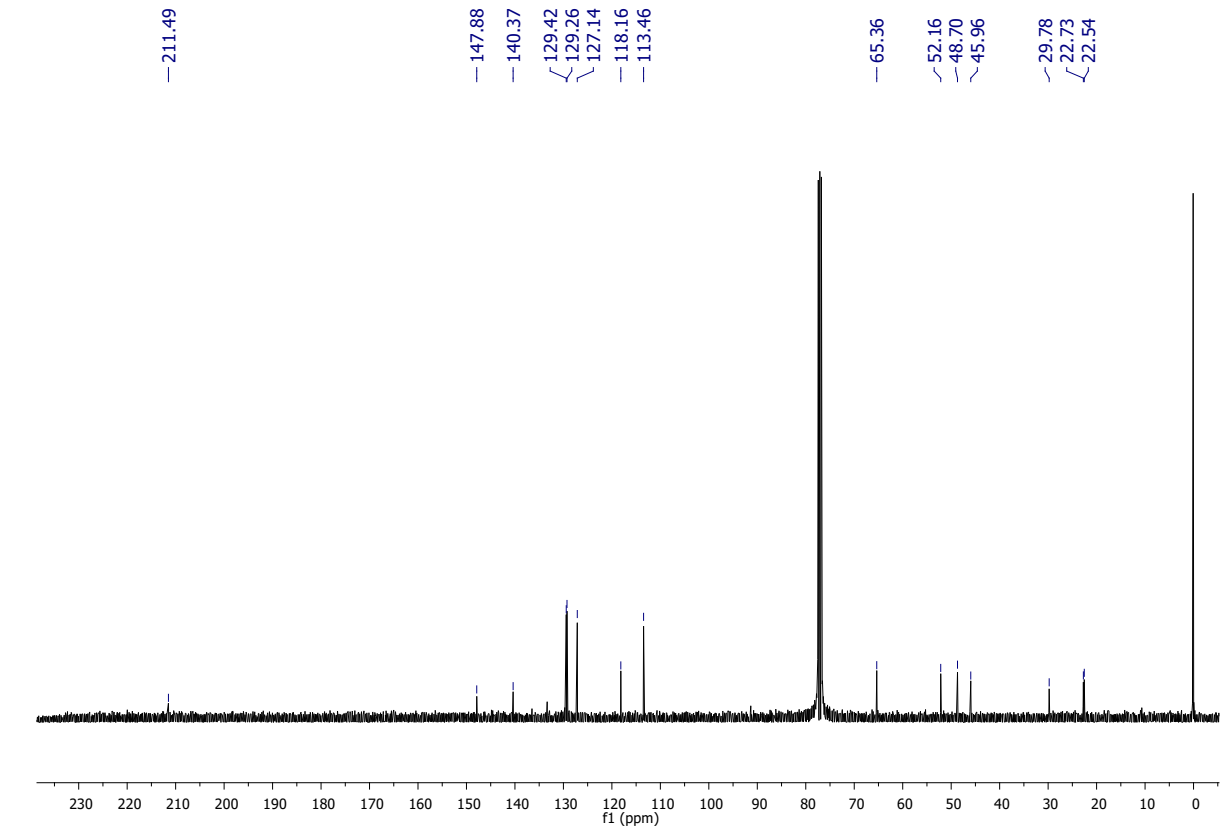
^{1}H NMR spectrum of 4c



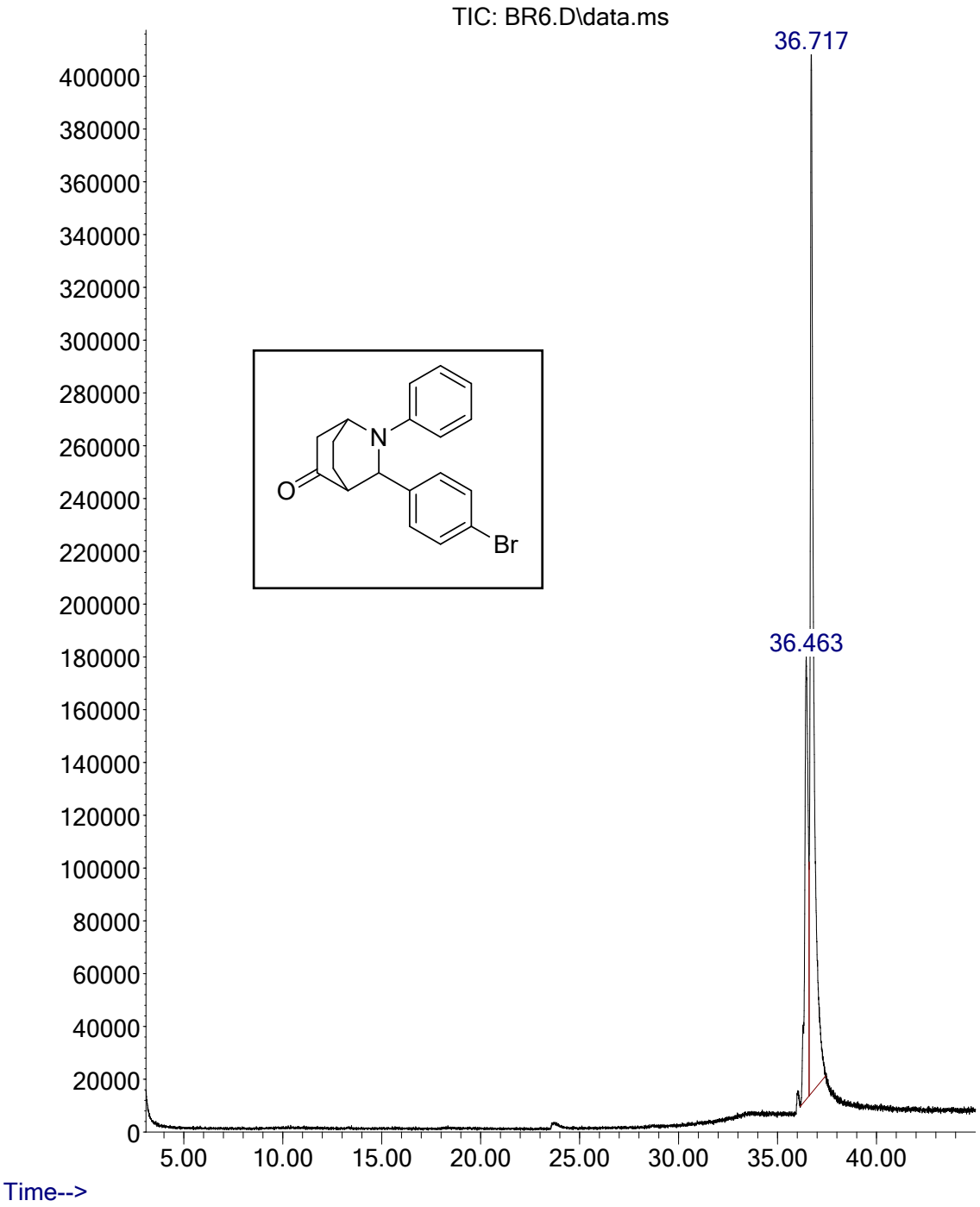
^{1}C NMR spectrum of 4c



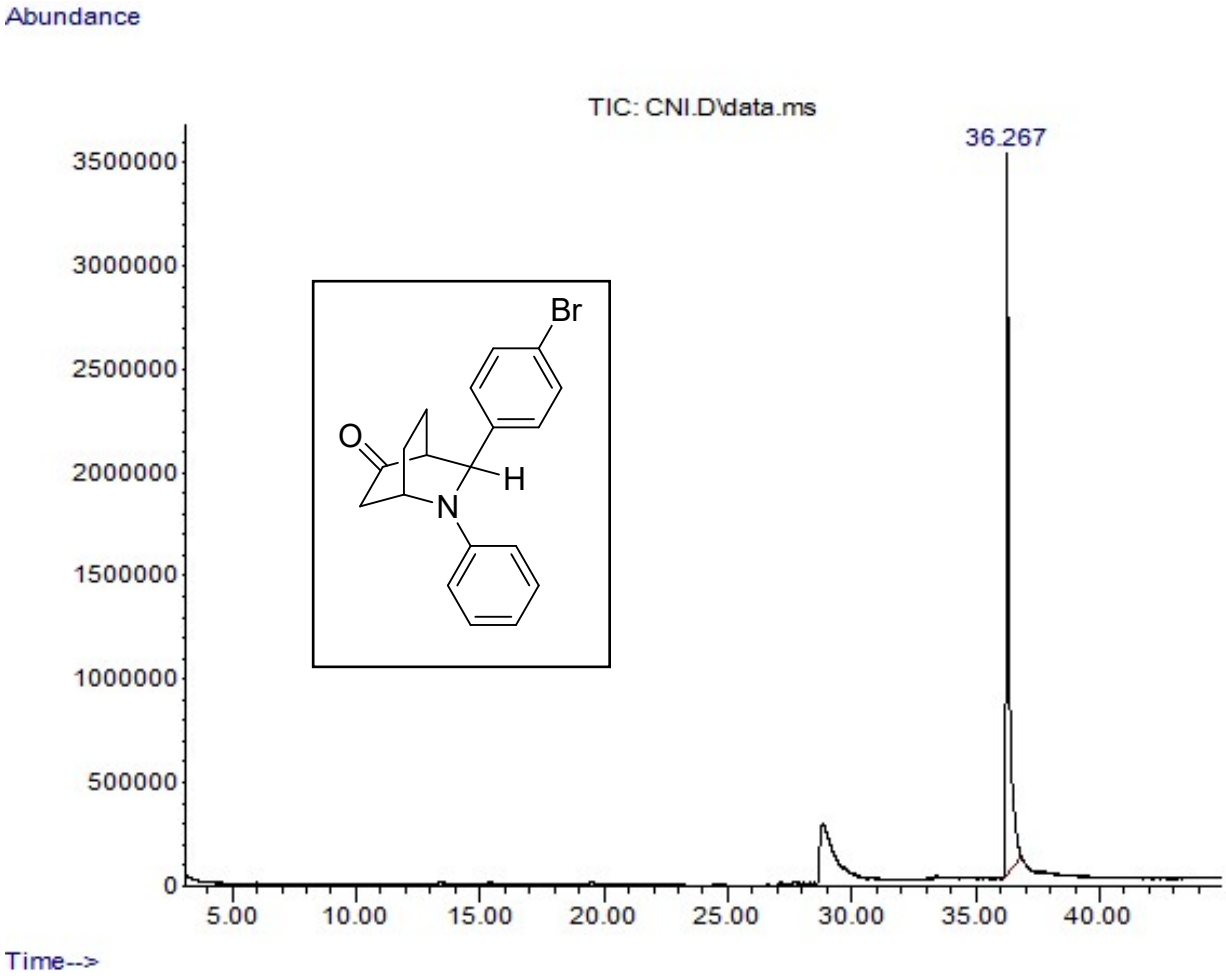
^{1}H NMR spectrum of 5c



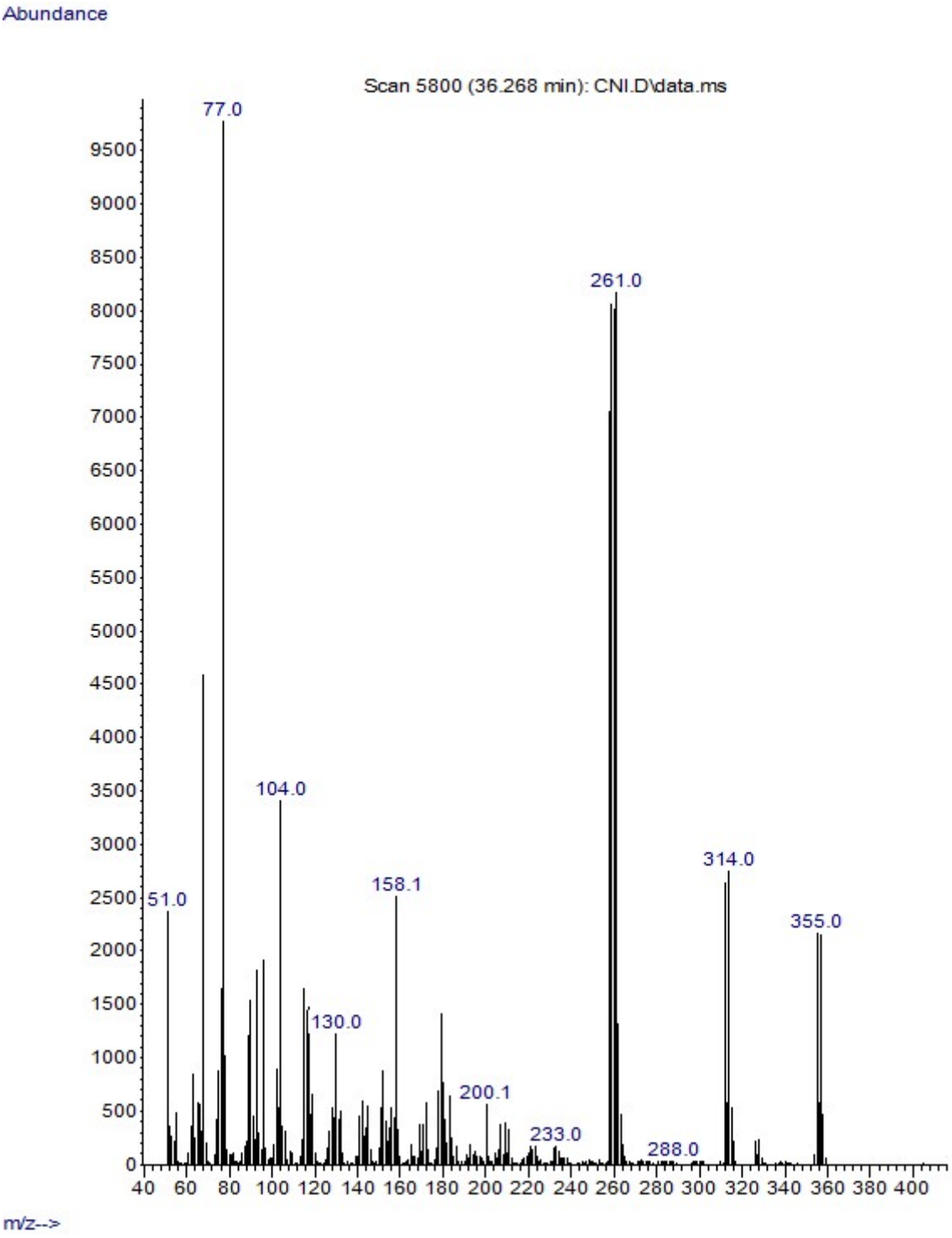
^{13}C NMR spectrum of 5c



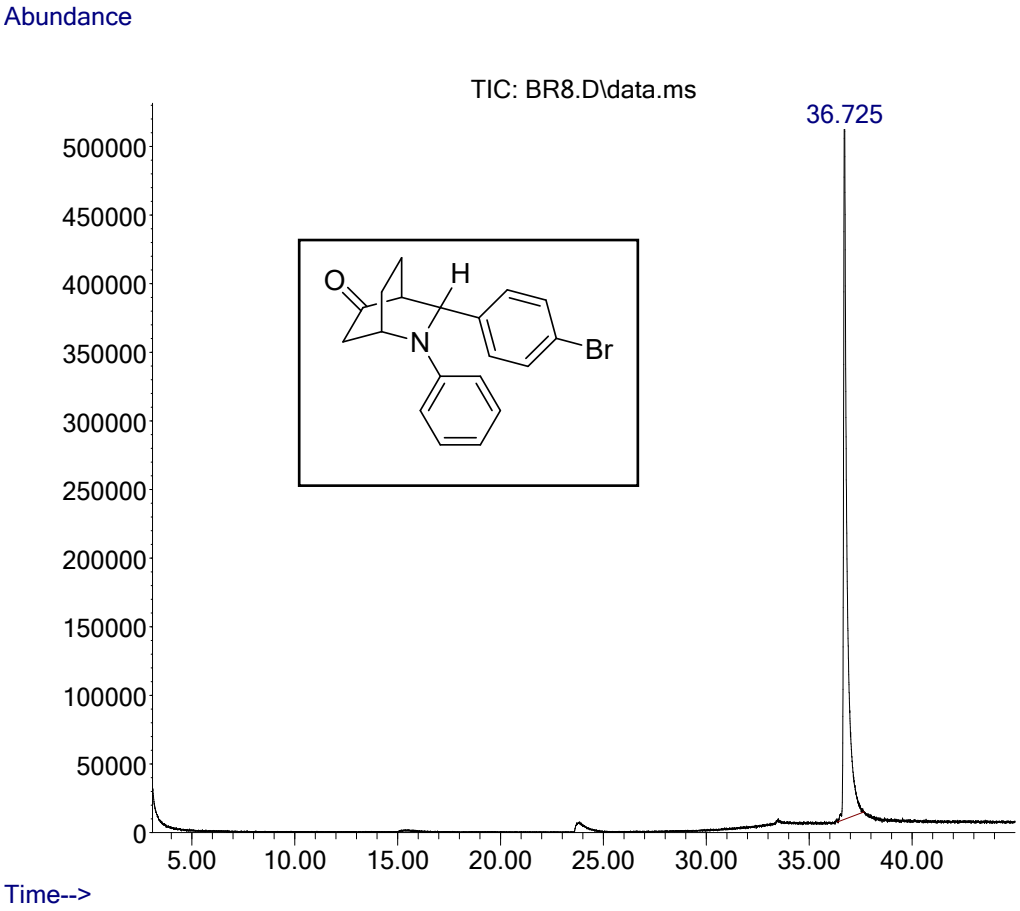
Gas chromatogram of 4d and 5d mixture



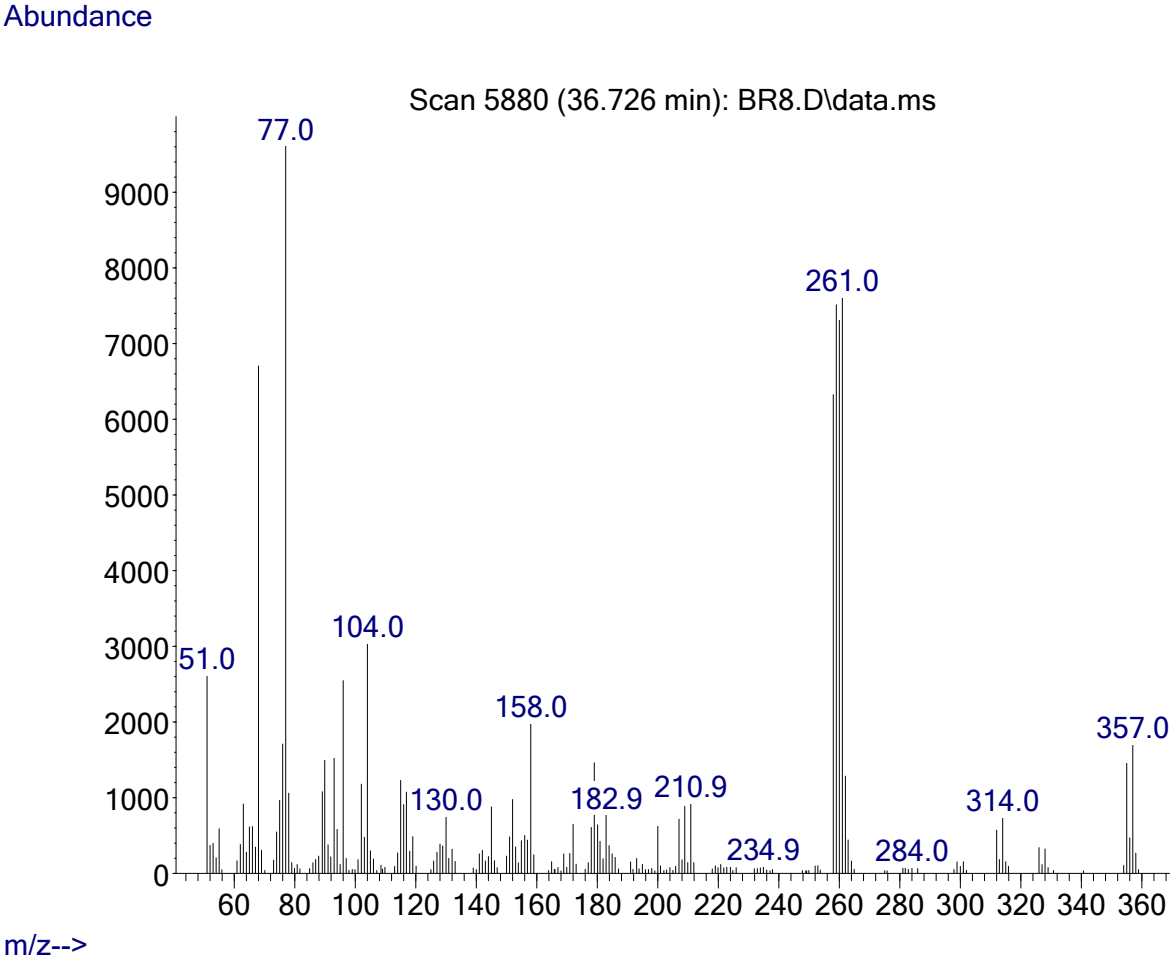
Gas chromatogram of 4d



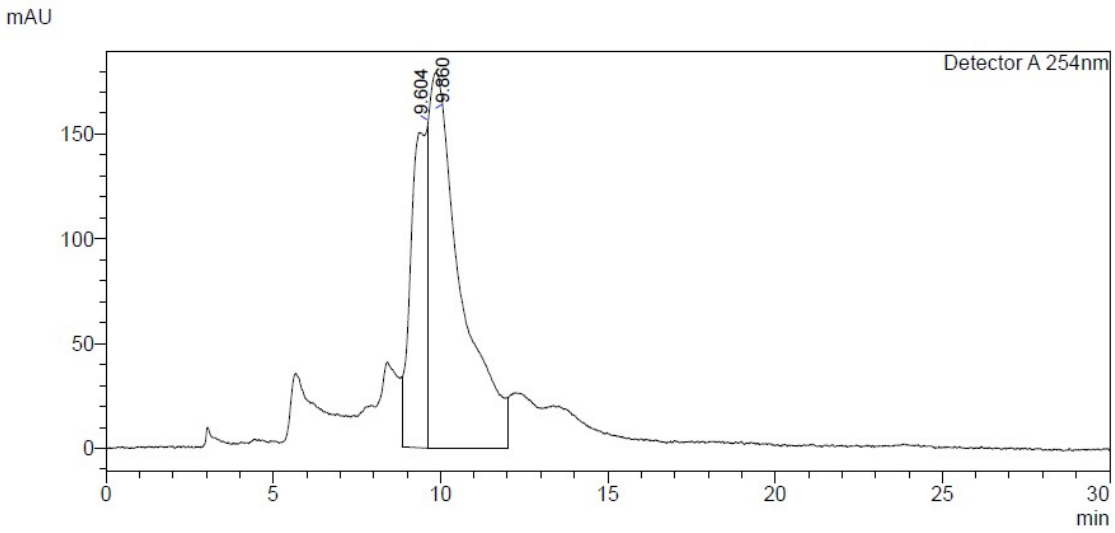
Mass spectrum of 4d



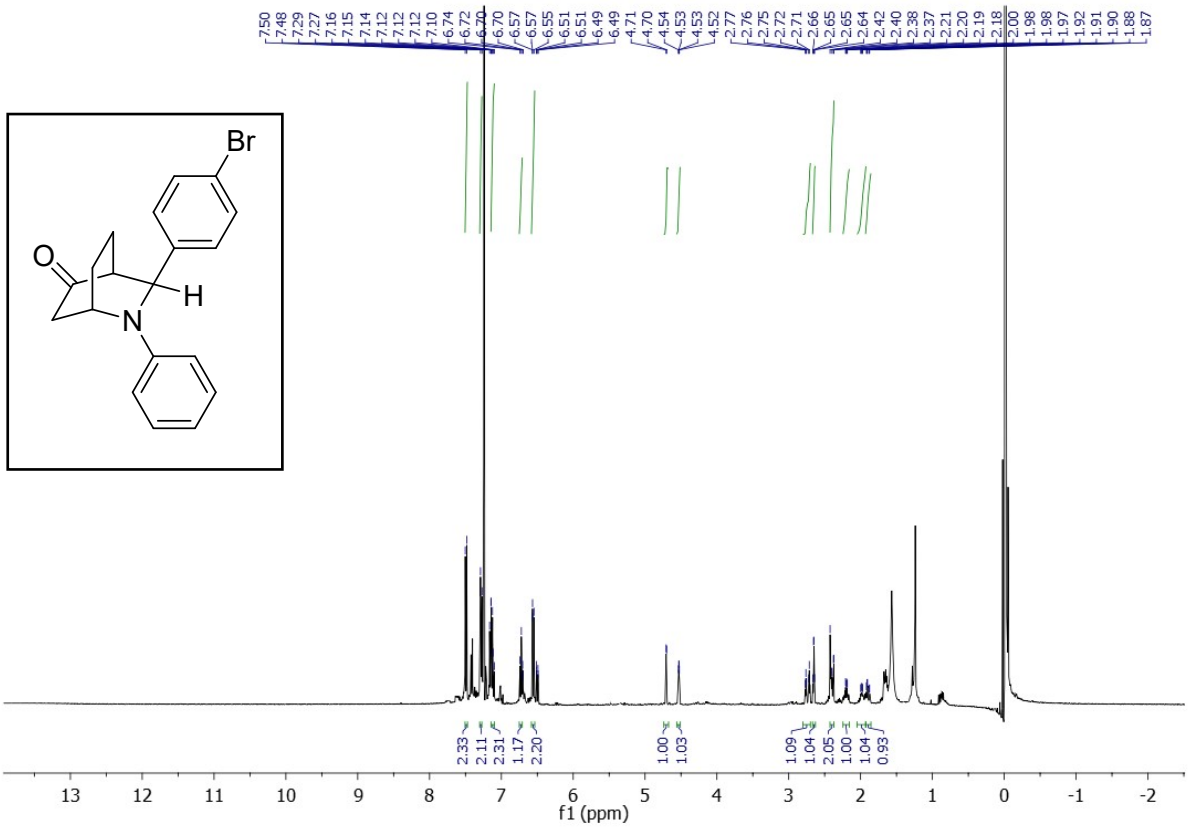
Gas chromatogram of 5d



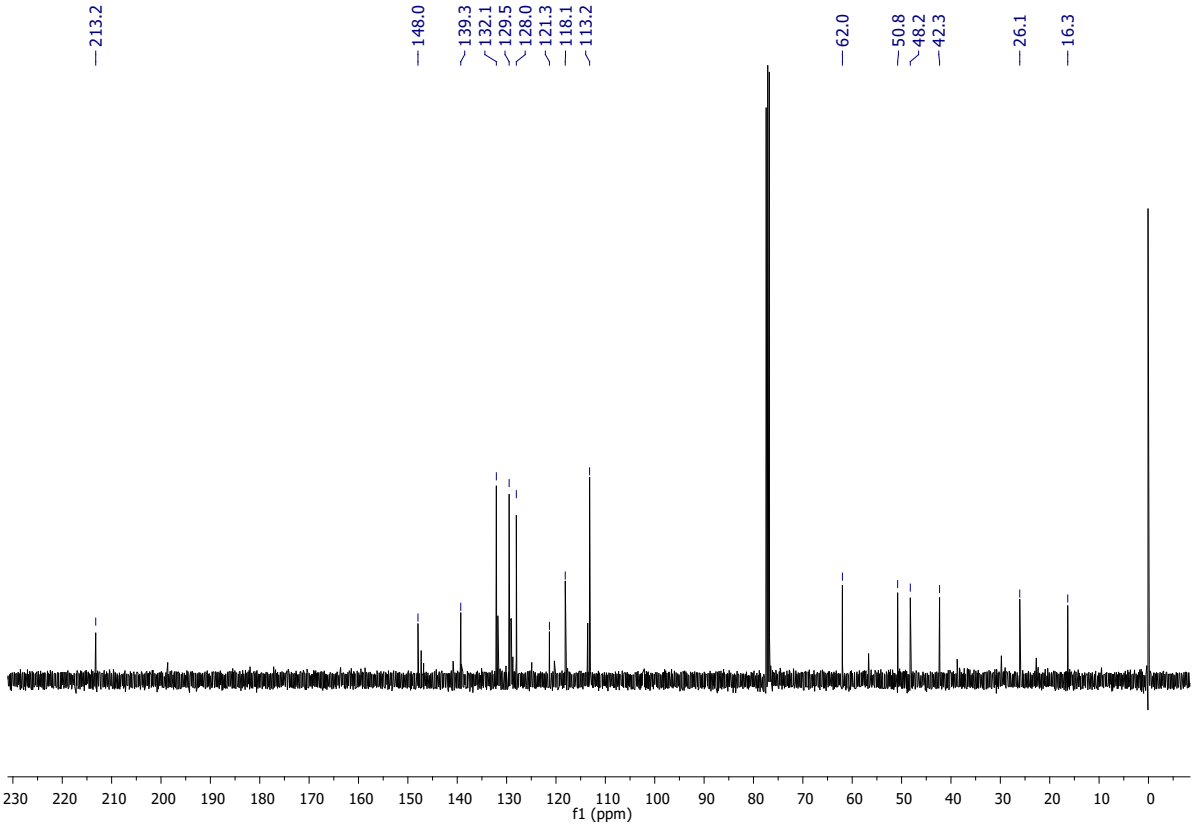
Mass spectrum of 5d



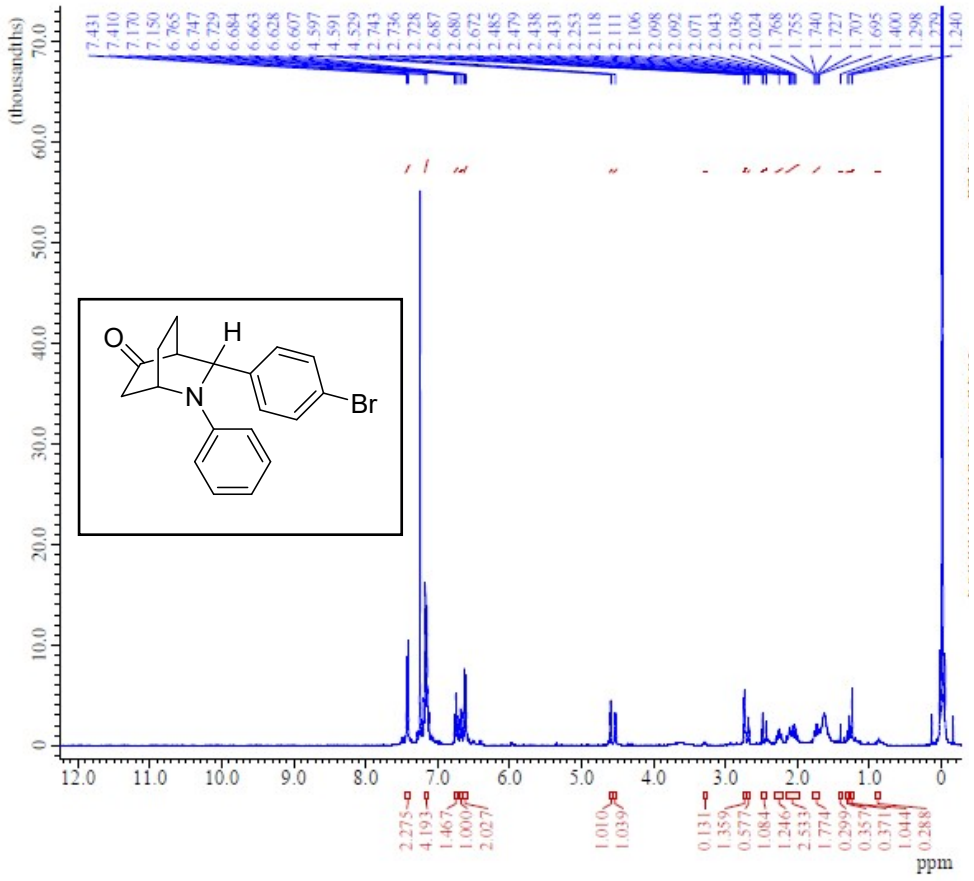
HPLC profile of 5d



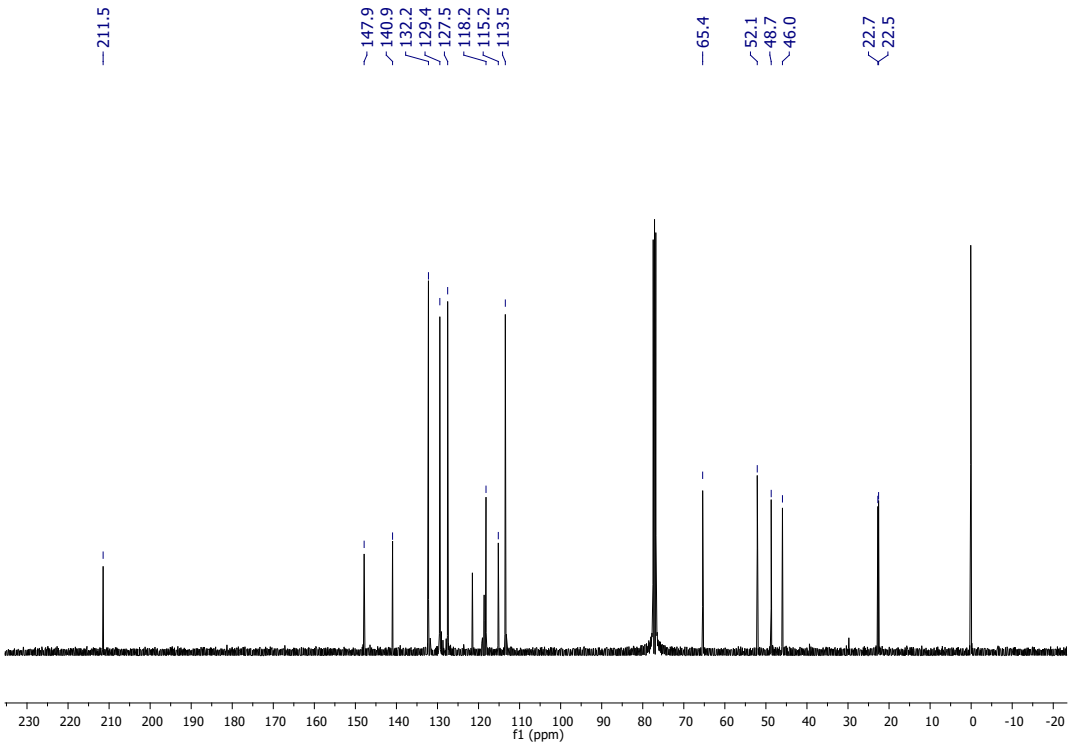
^{1}H NMR spectrum of 4d



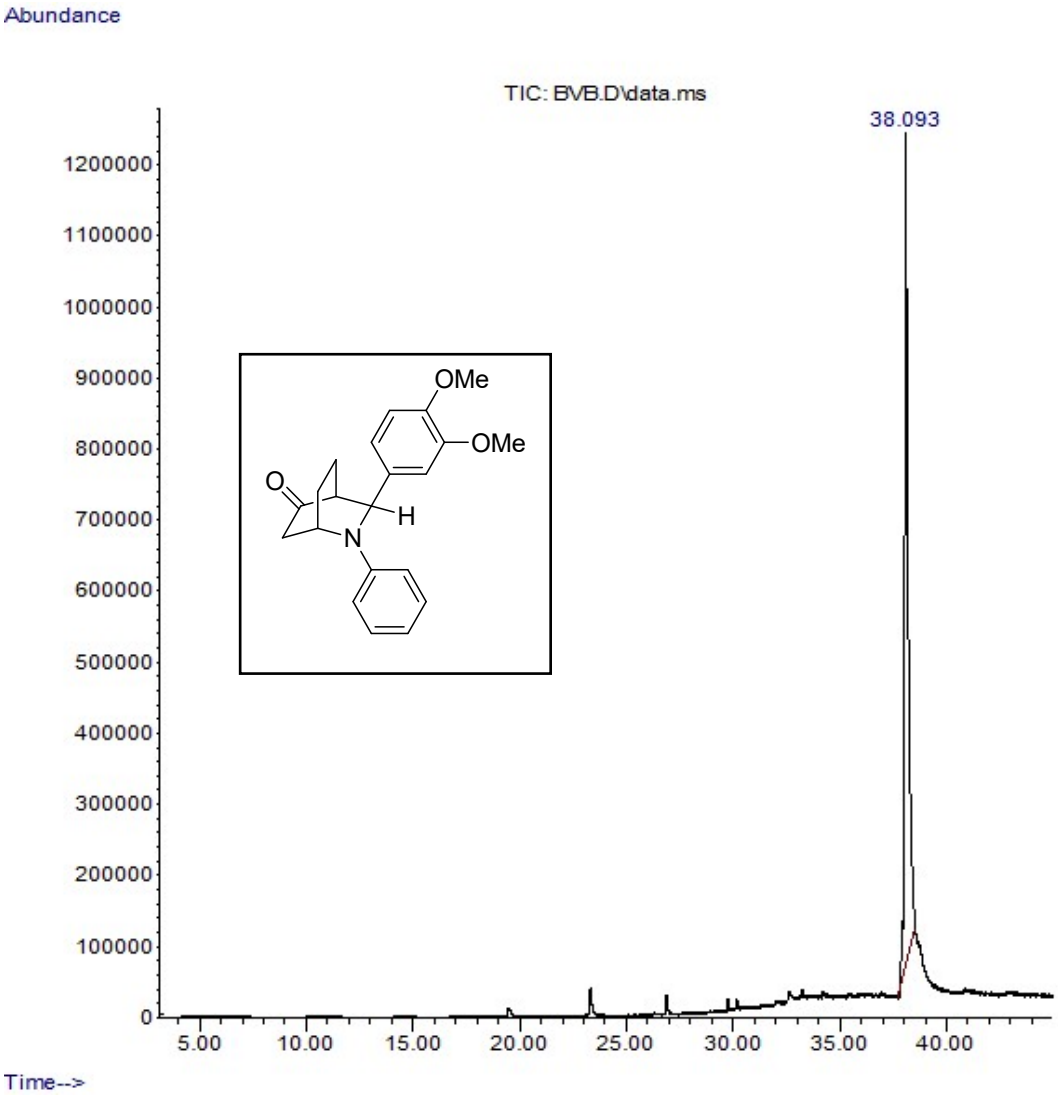
^{13}C NMR spectrum of 4d



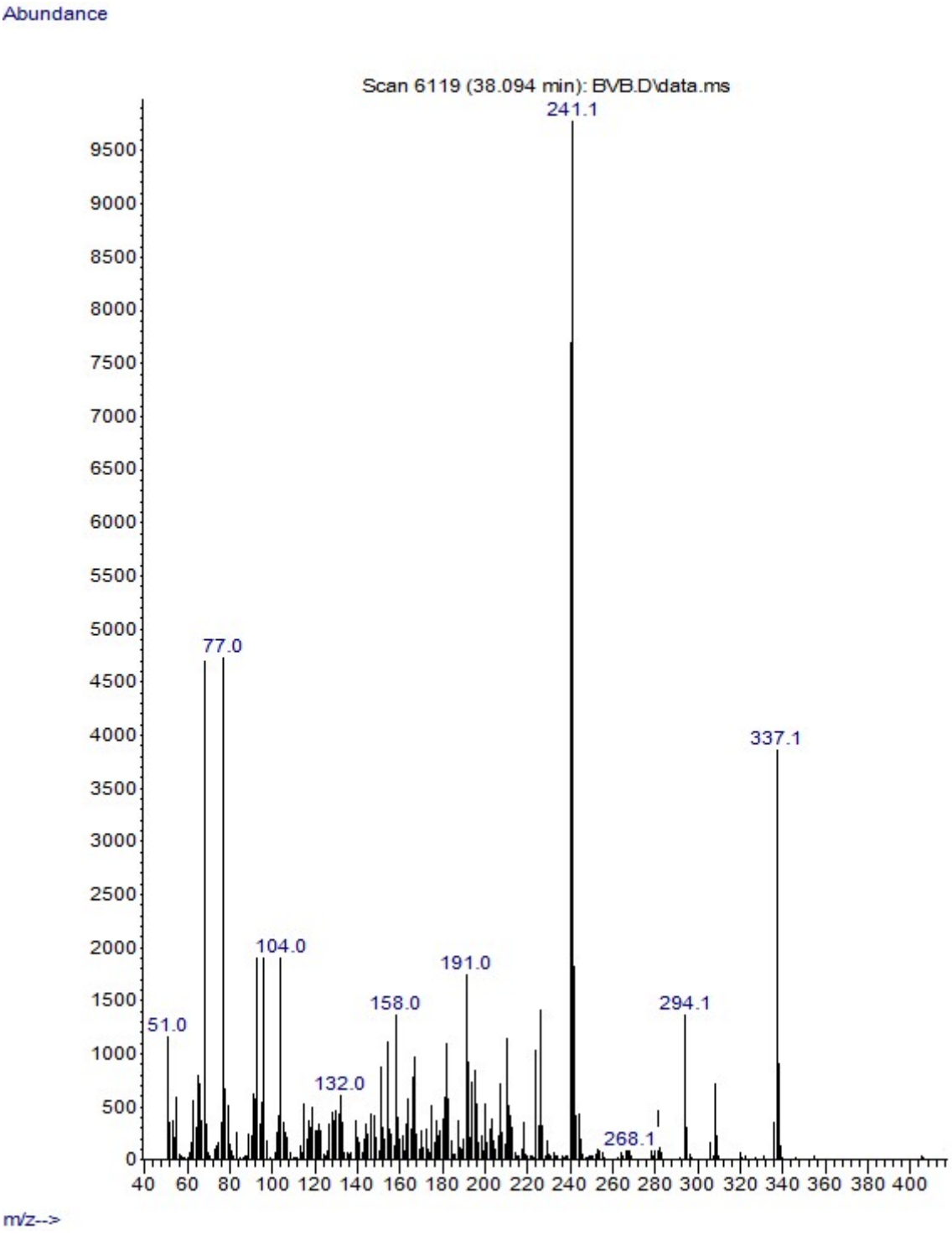
^{1}H NMR spectrum of 5d



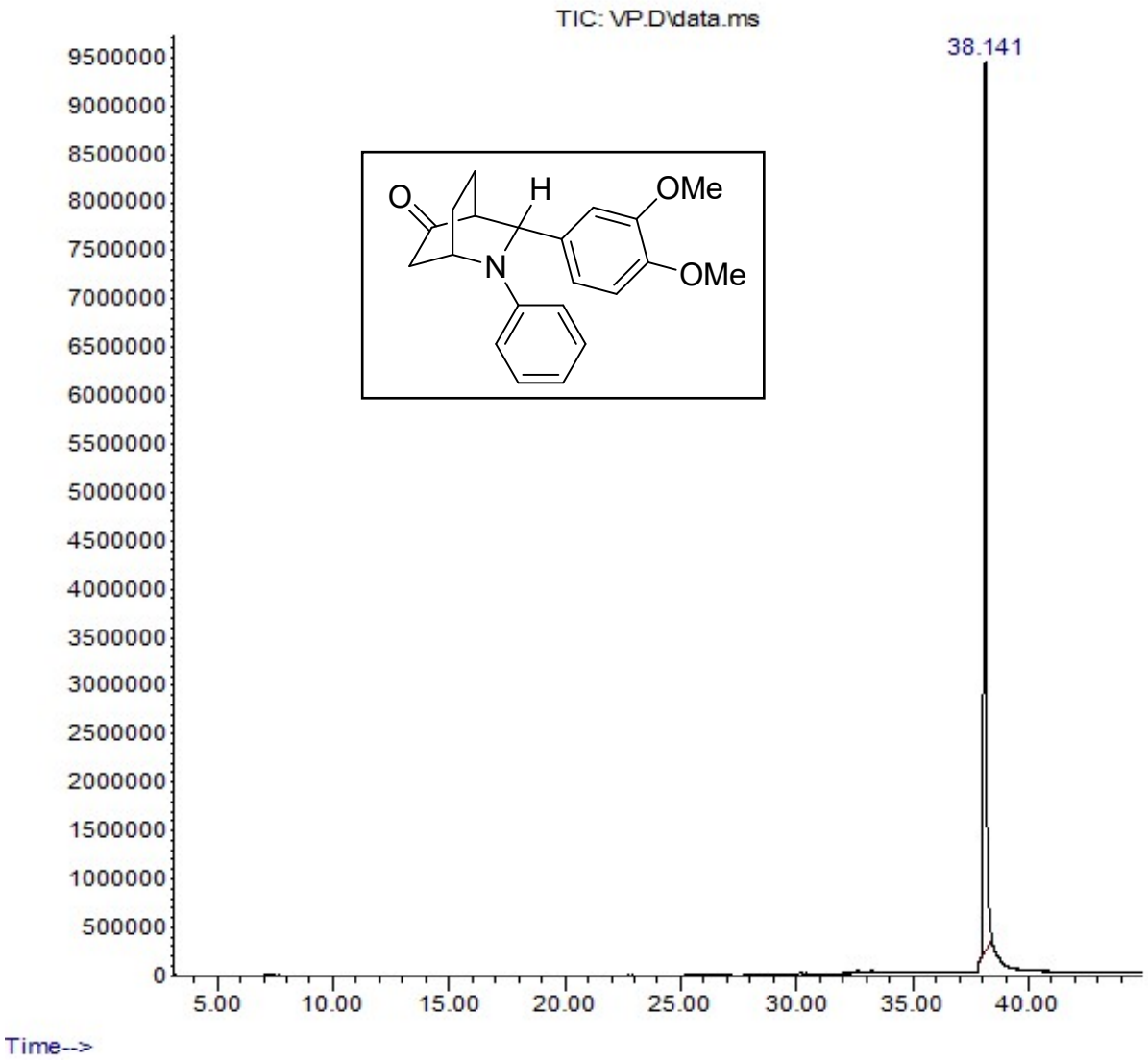
^{13}C NMR spectrum of 5d



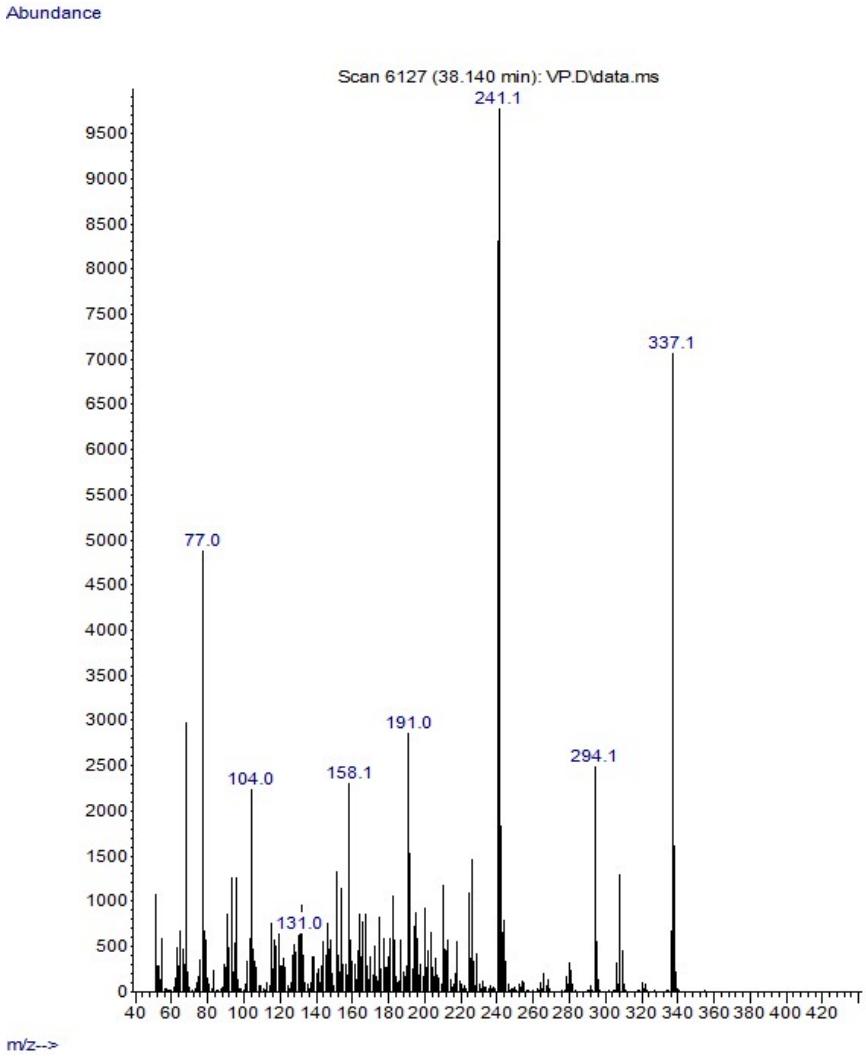
Gas chromatogram of 4e



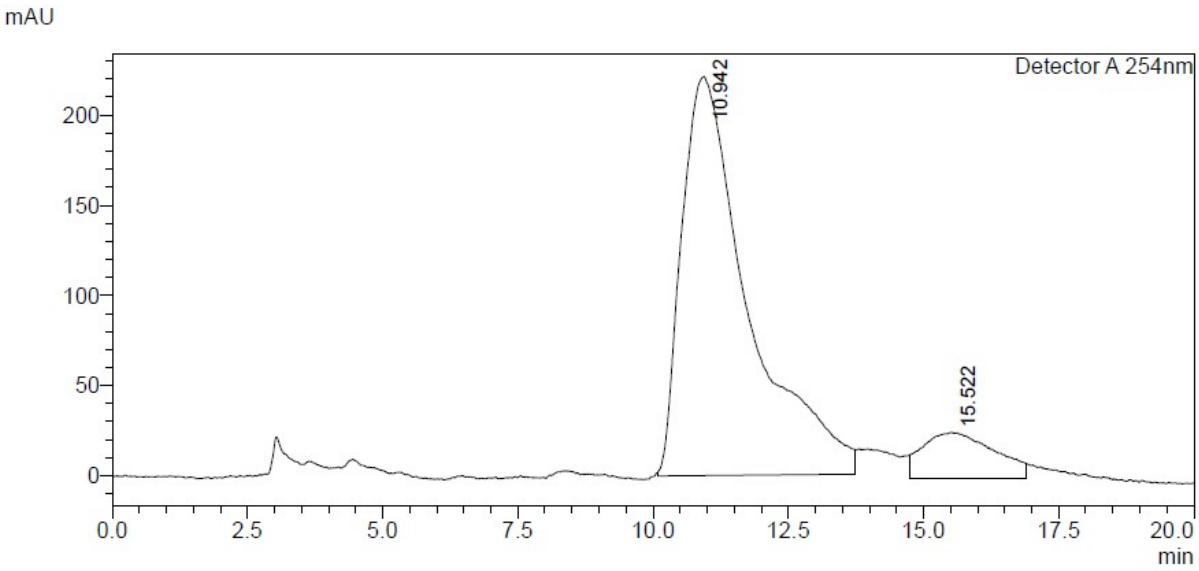
Mass spectrum of 4e



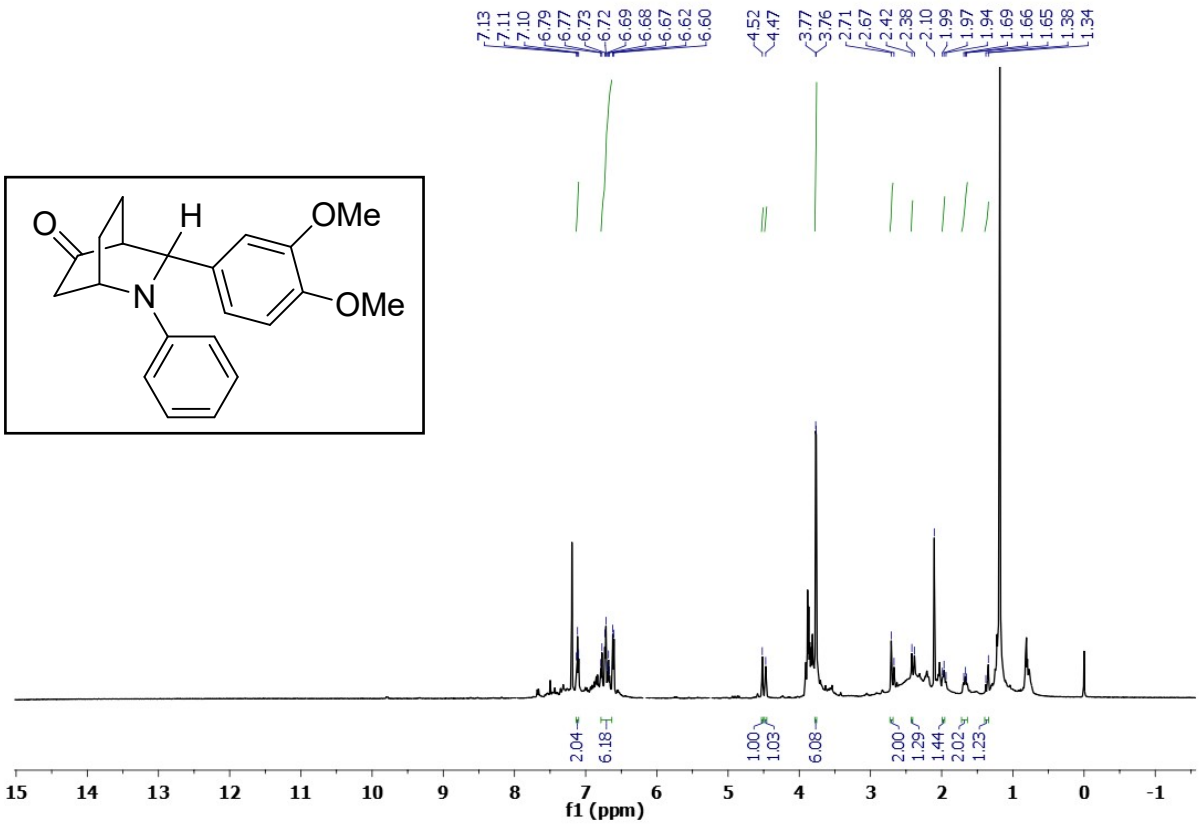
Gas chromatogram of 5e



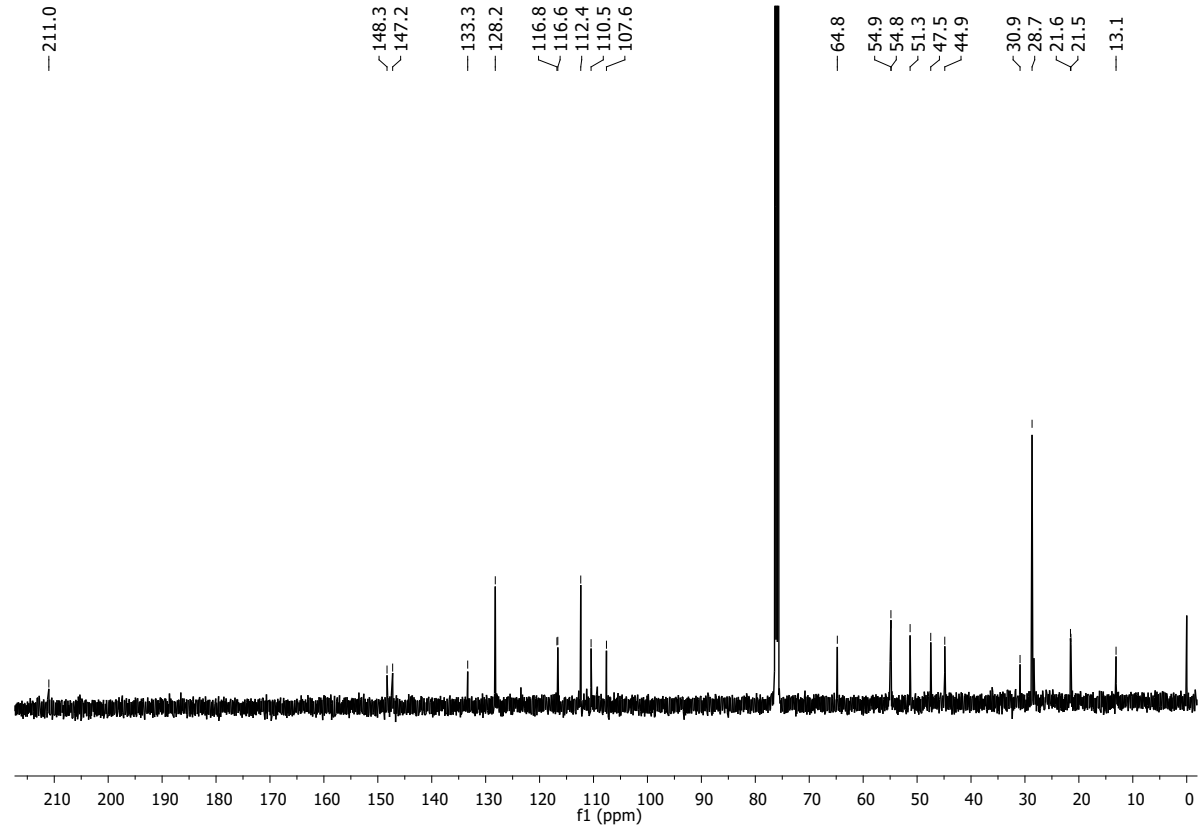
Mass spectrum of 5e



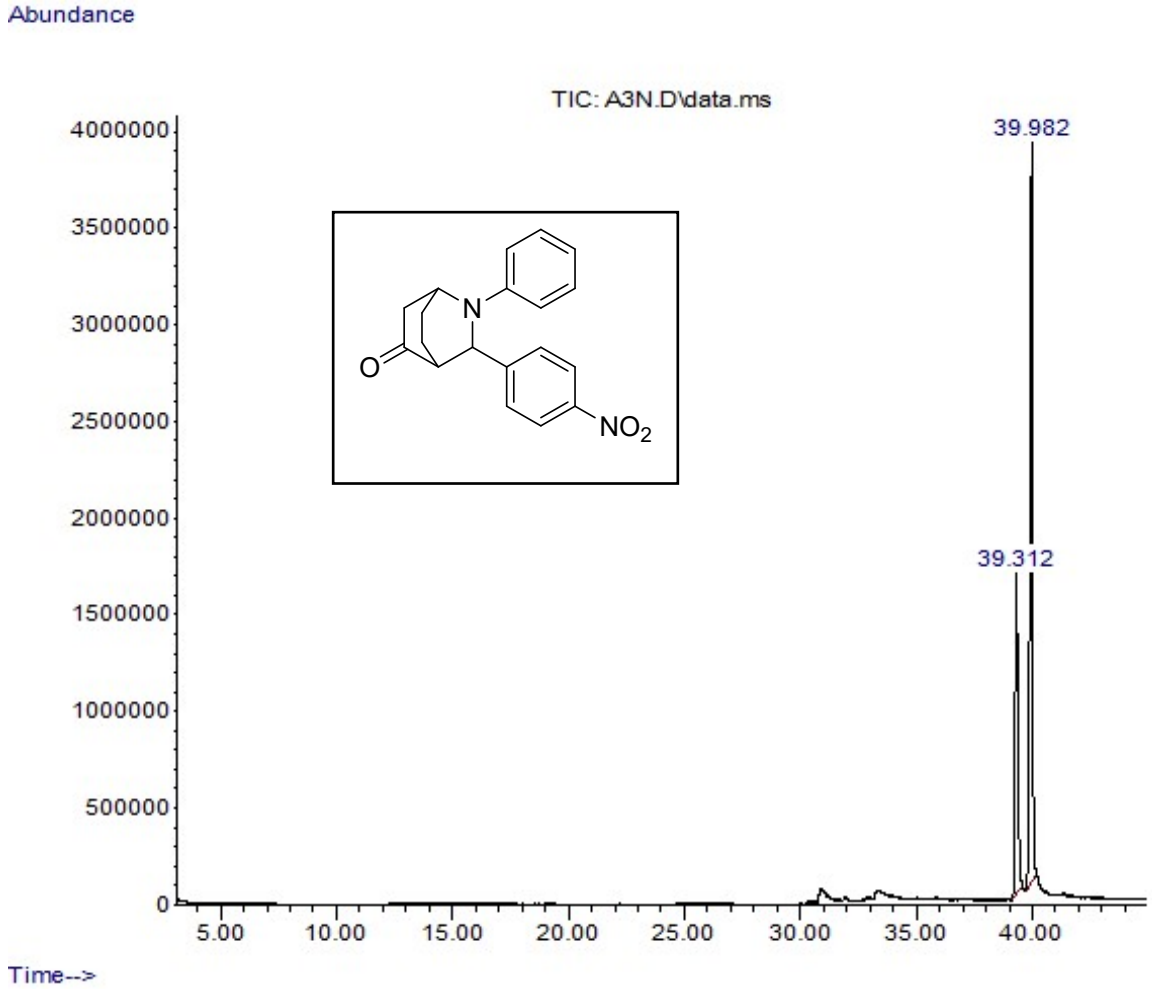
HPLC profile of 5e



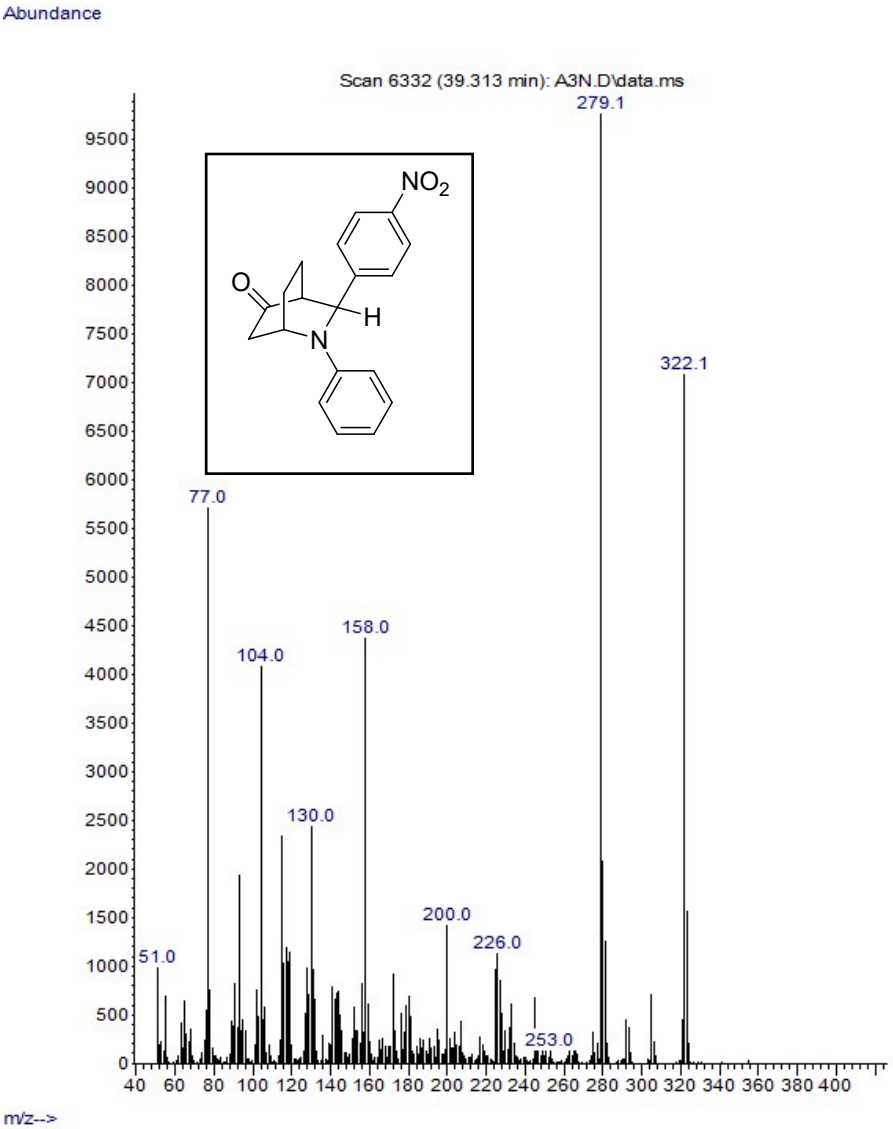
^{1}H NMR spectrum of 5e



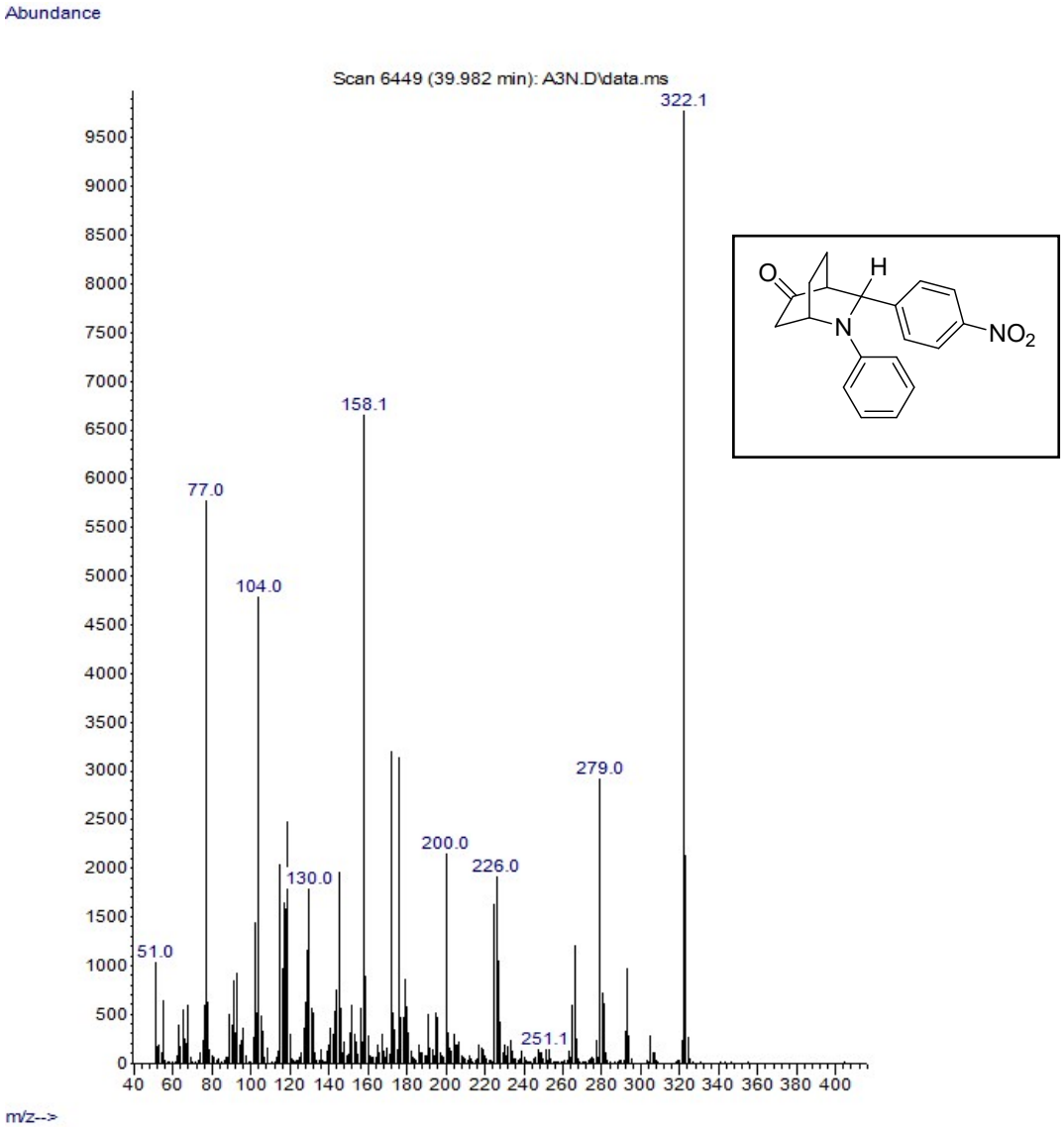
^{13}C NMR spectrum of 5e



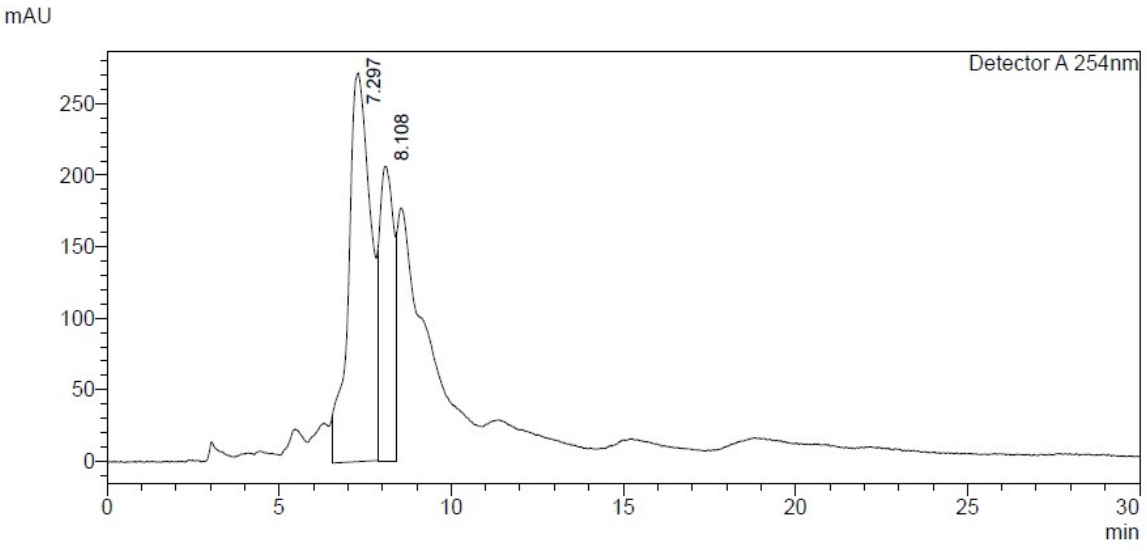
Gas chromatogram of 4f and 5f mixture



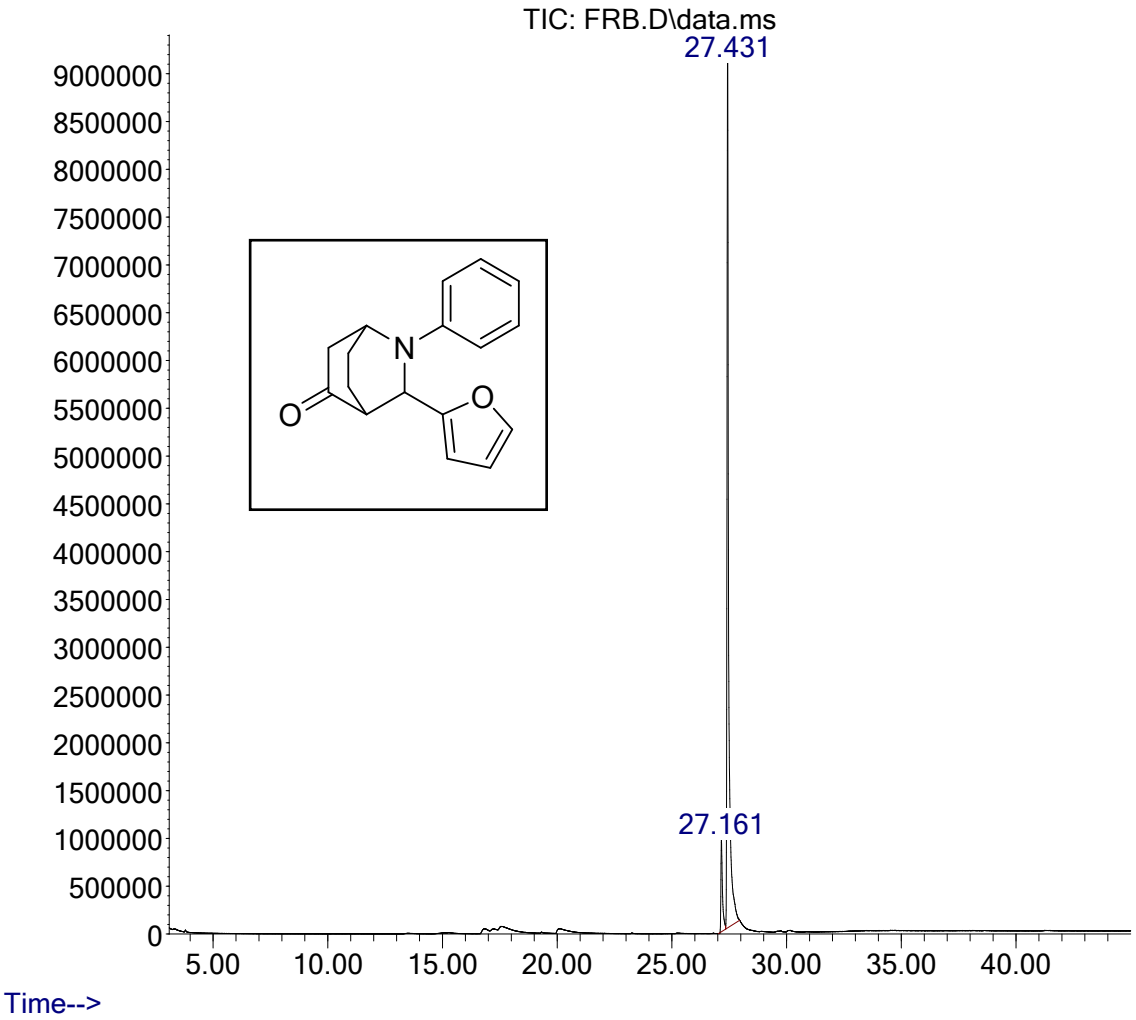
Mass spectrum of 4f



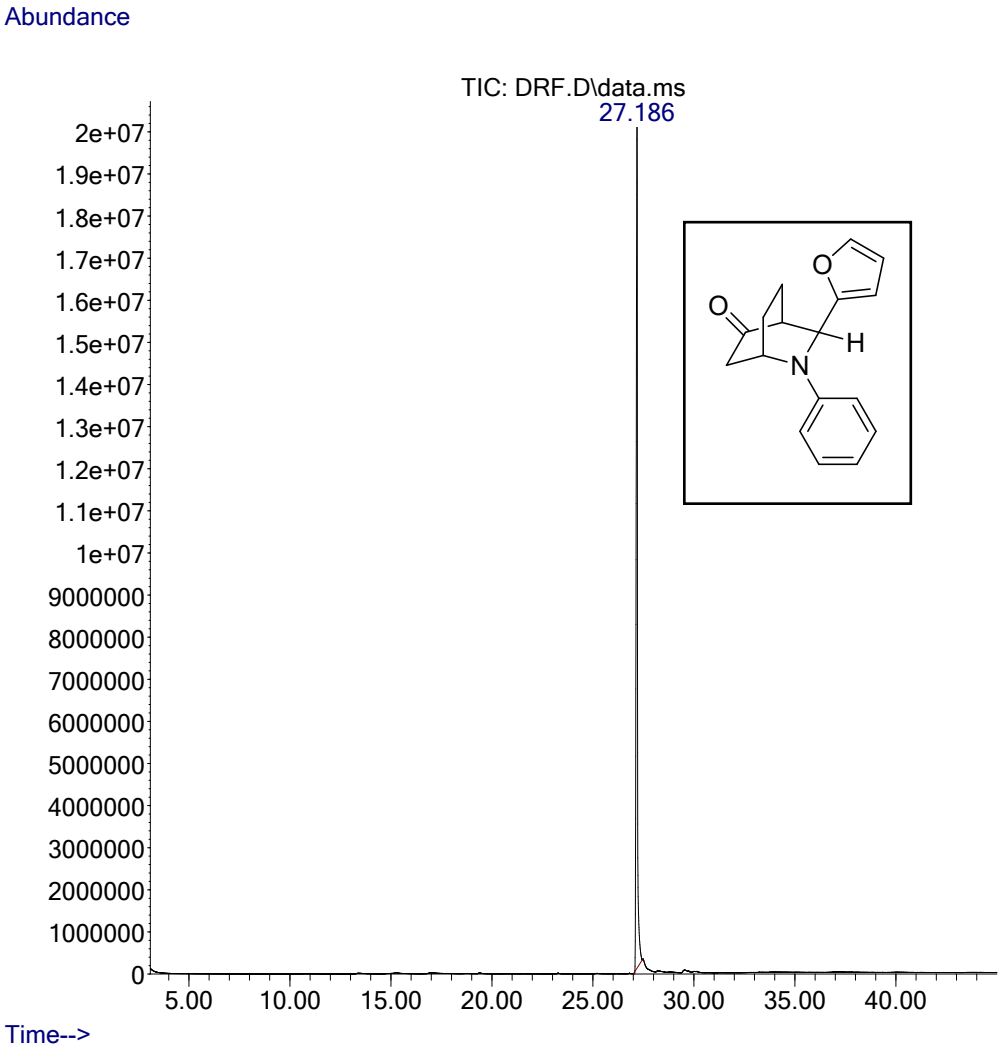
Mass spectrum of 5f



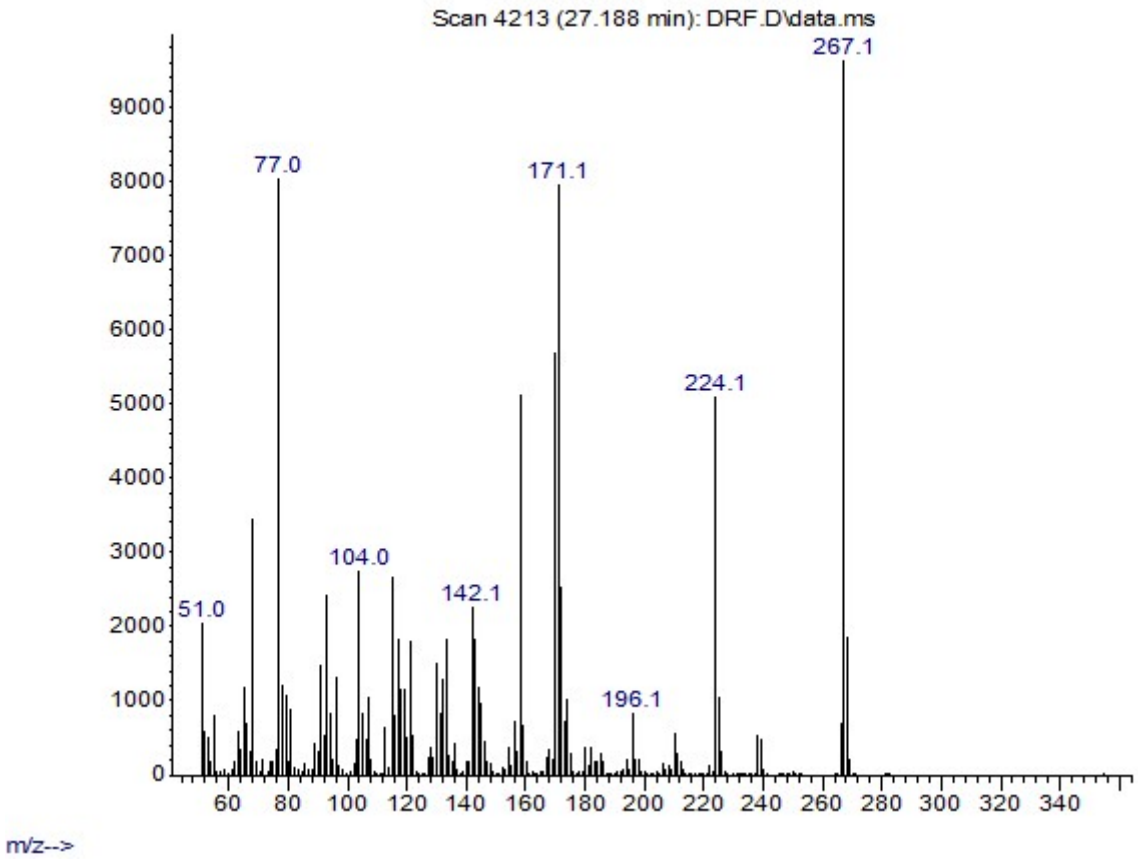
HPLC profile of 5f



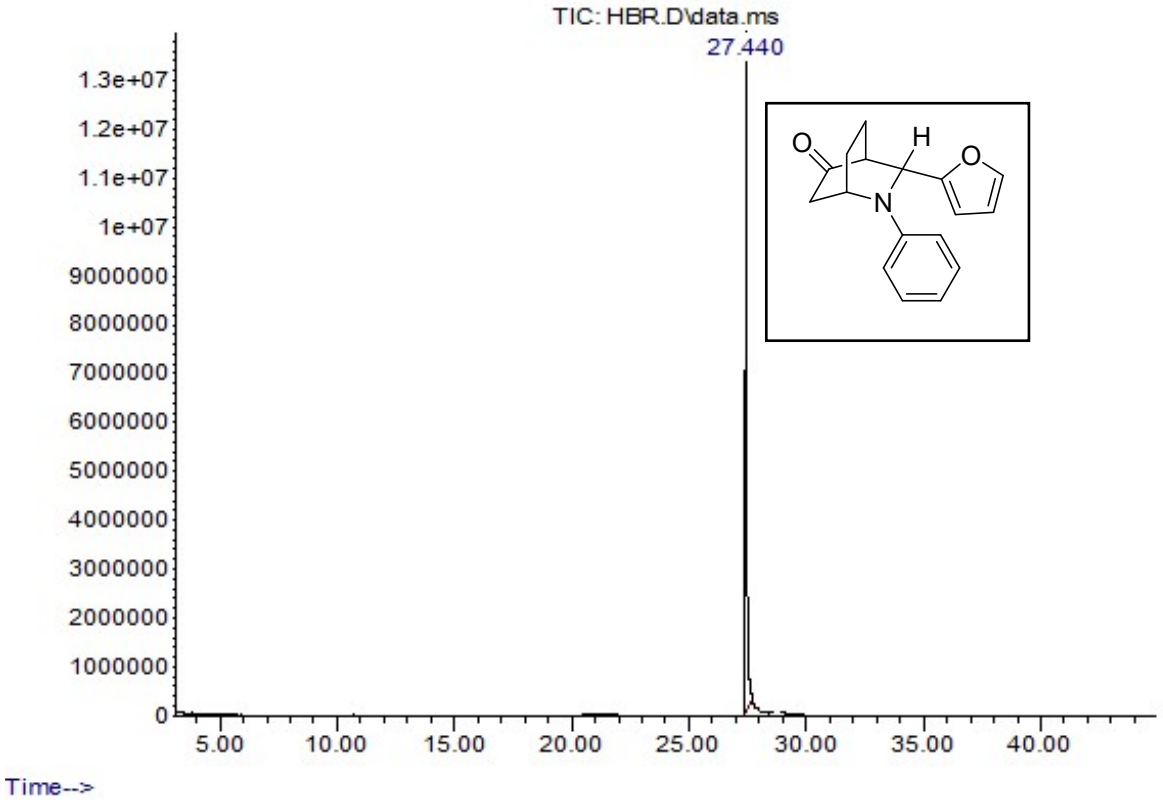
Gas chromatogram of 4g and 5g mixture



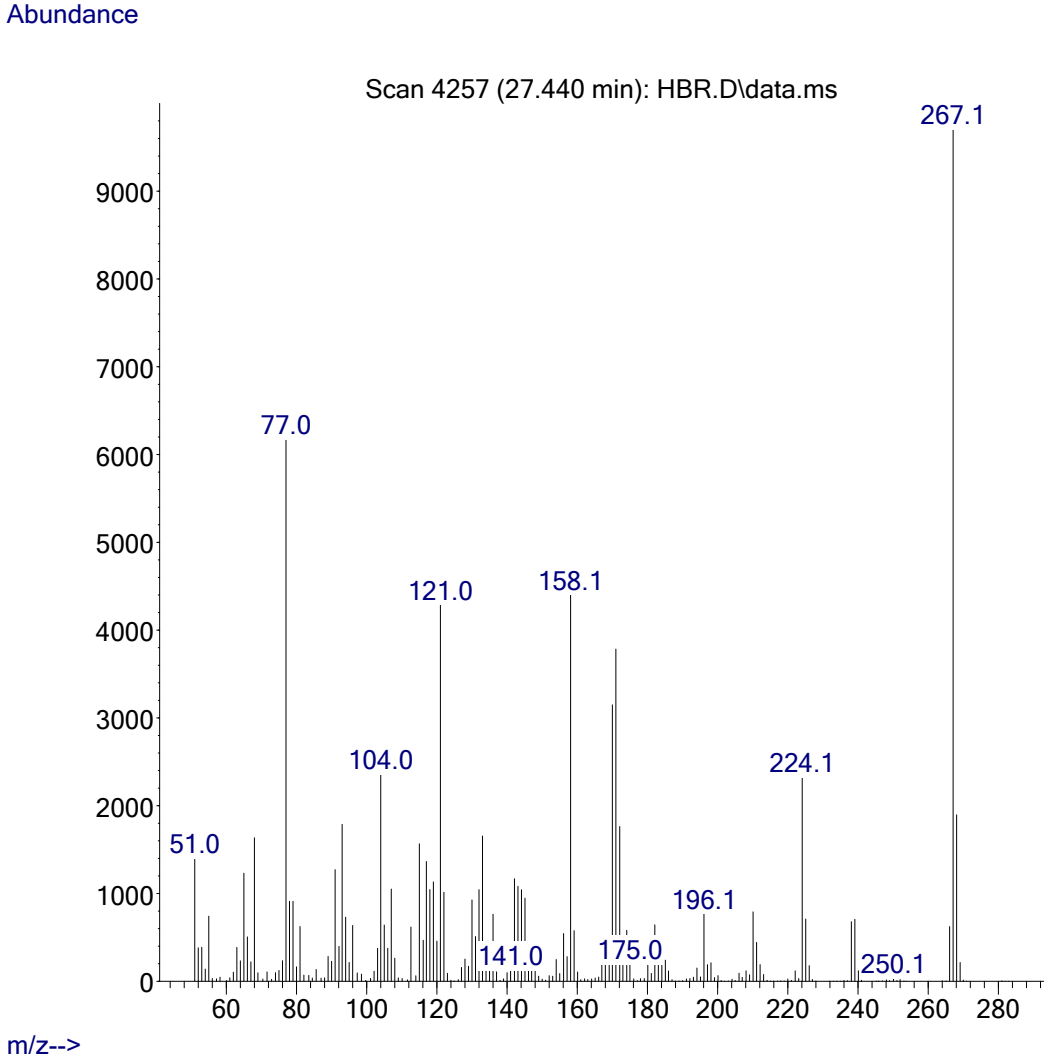
Gas chromatogram of 4g



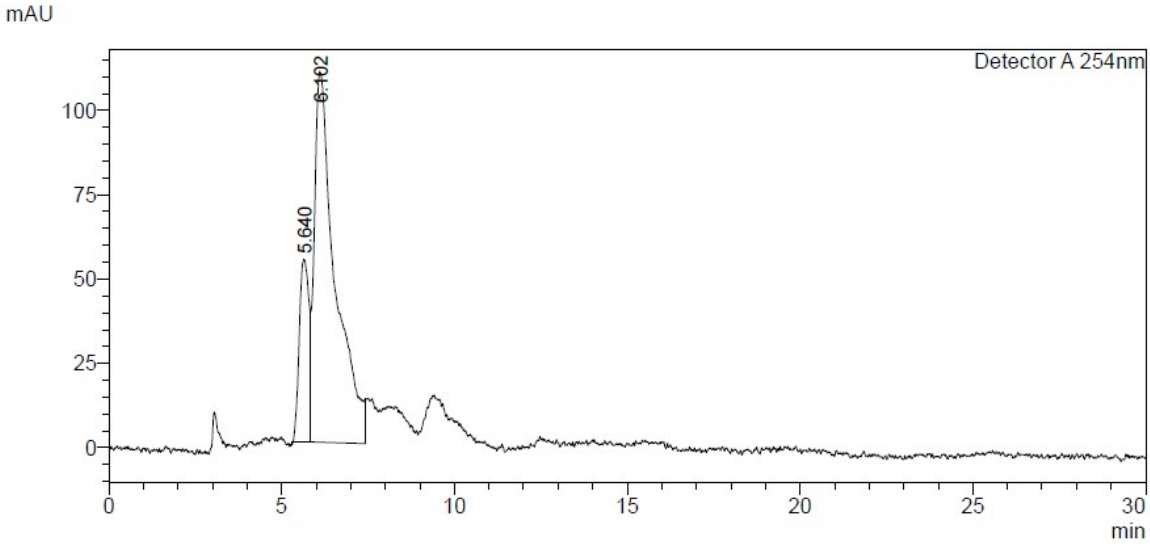
Mass spectrum of 4g



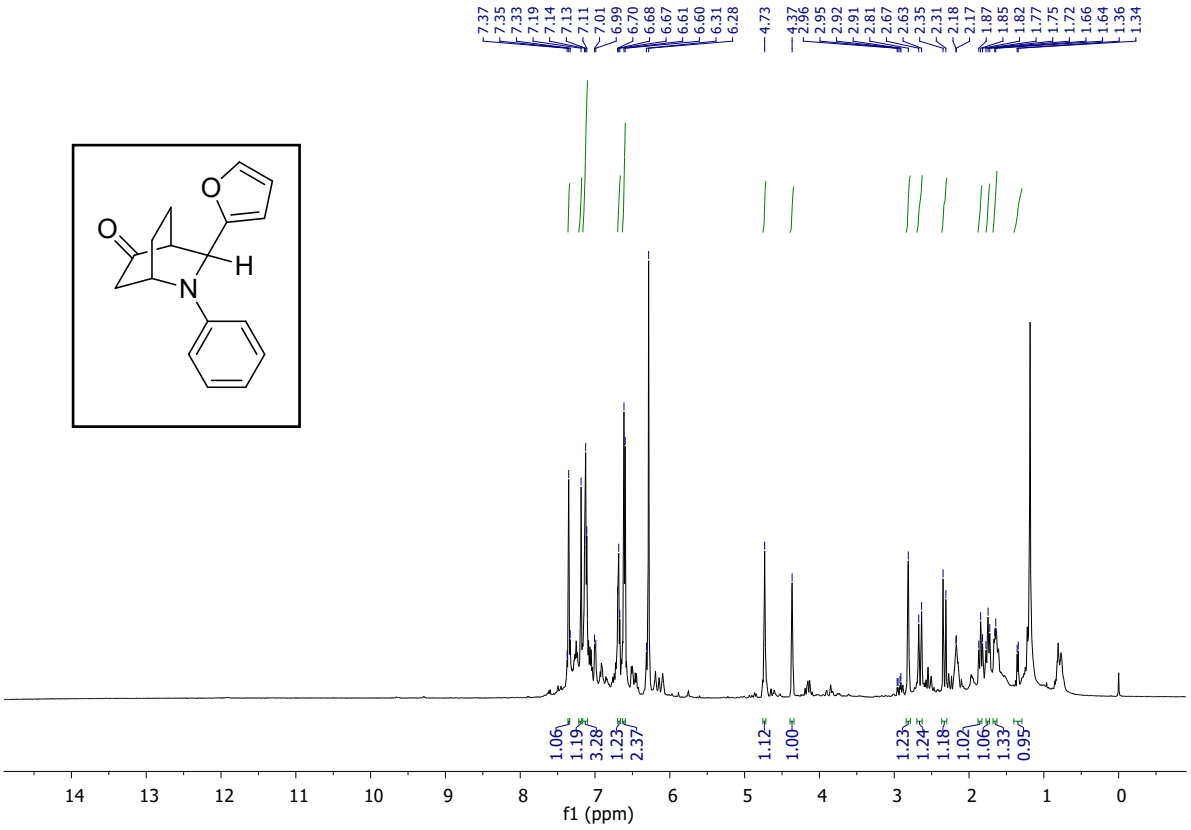
Gas chromatogram of 5g



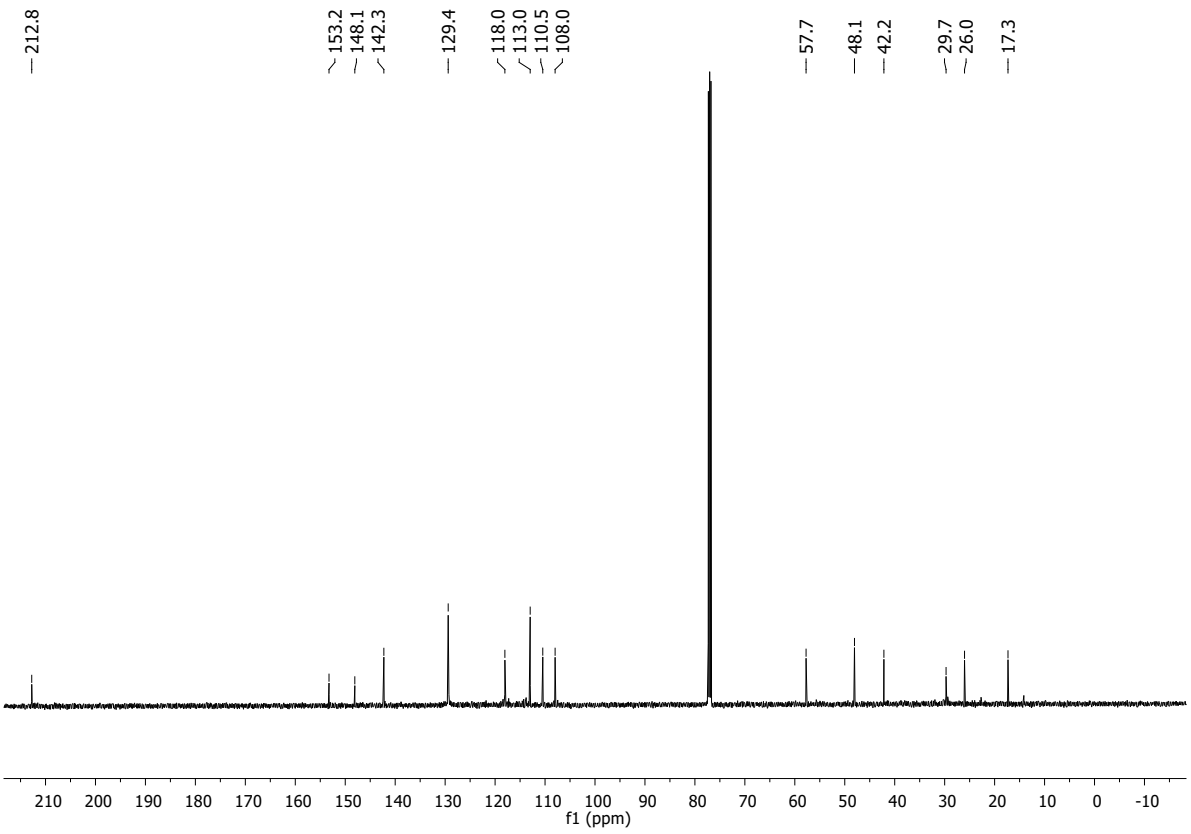
Mass spectrum of 5g



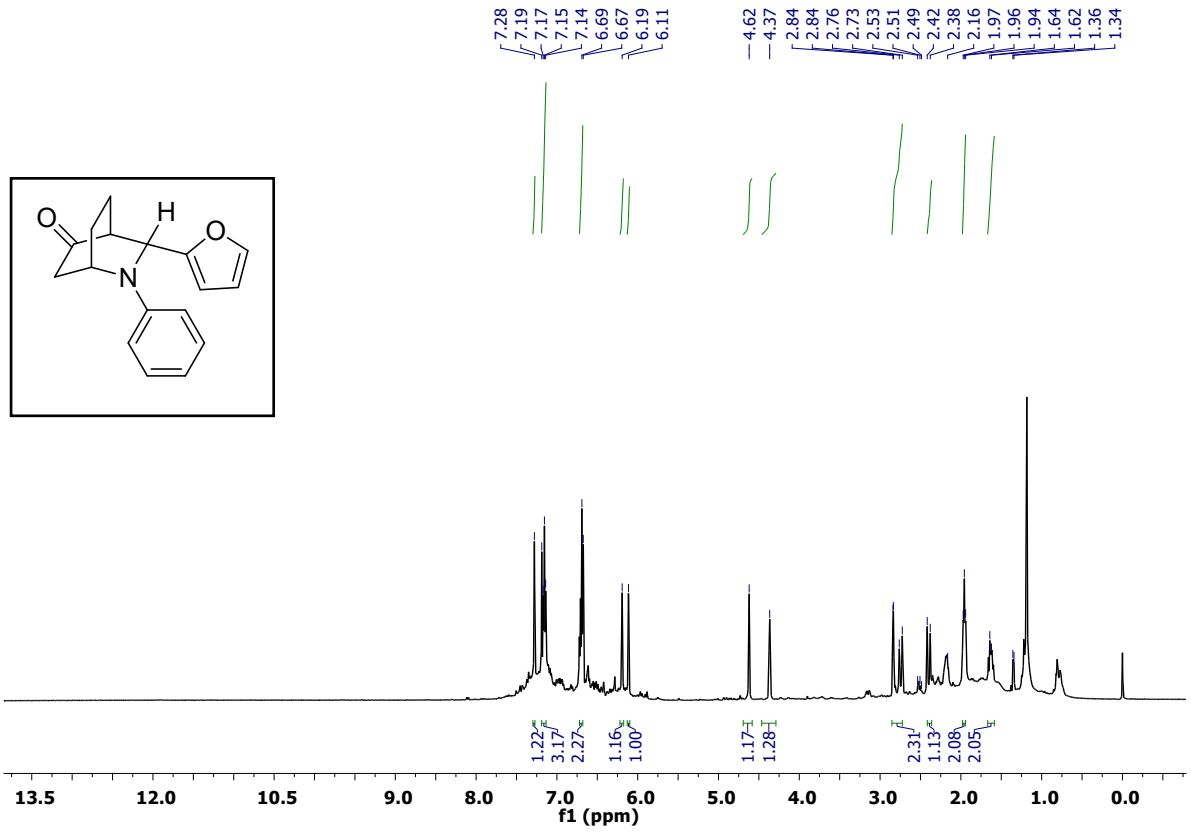
HPLC profile of 5g



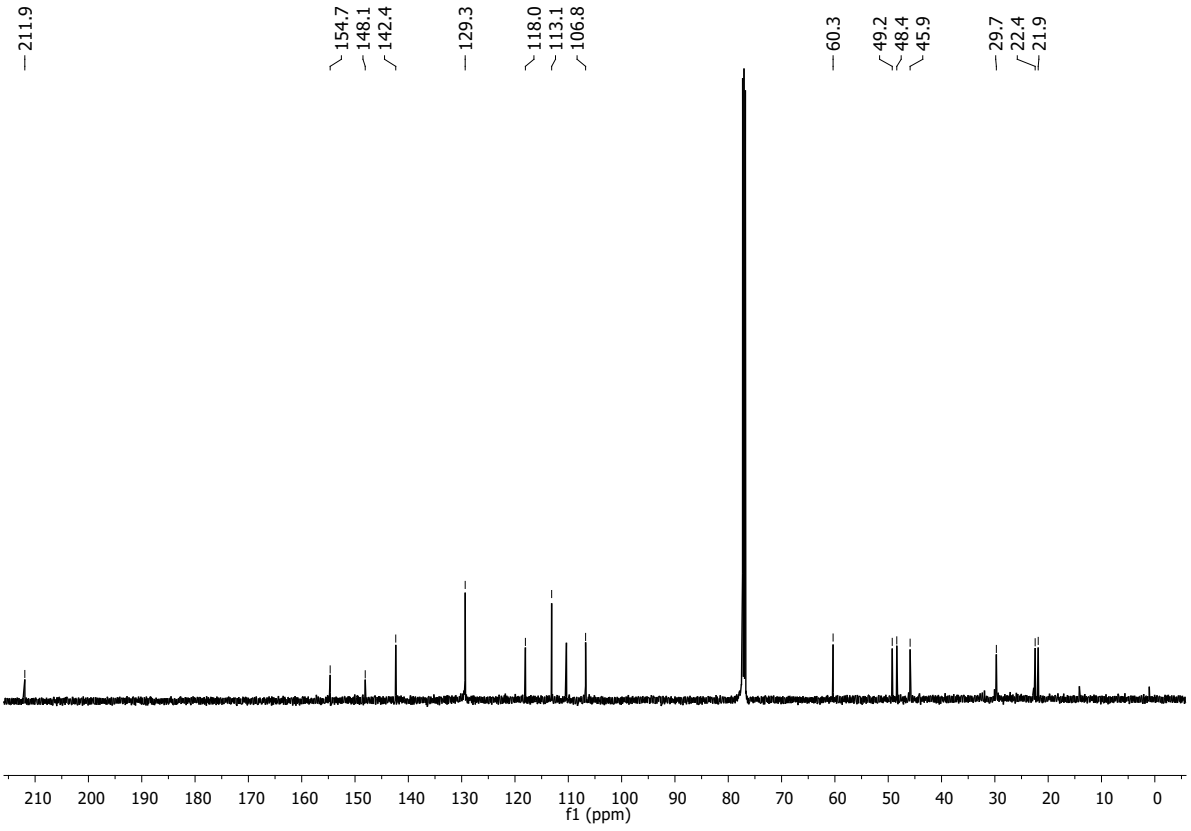
^{1}H NMR spectrum of 4g



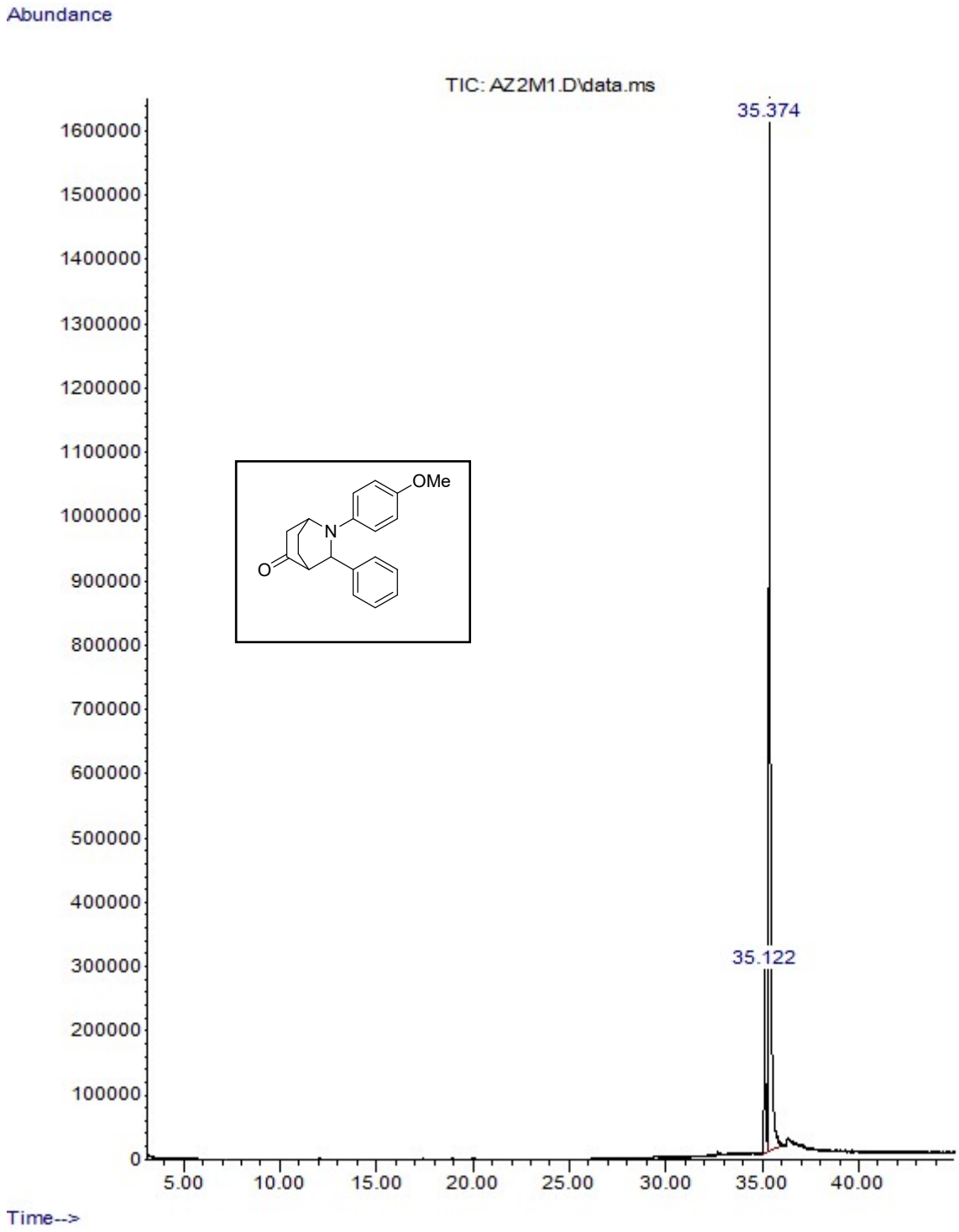
^{13}C NMR spectrum of 4g



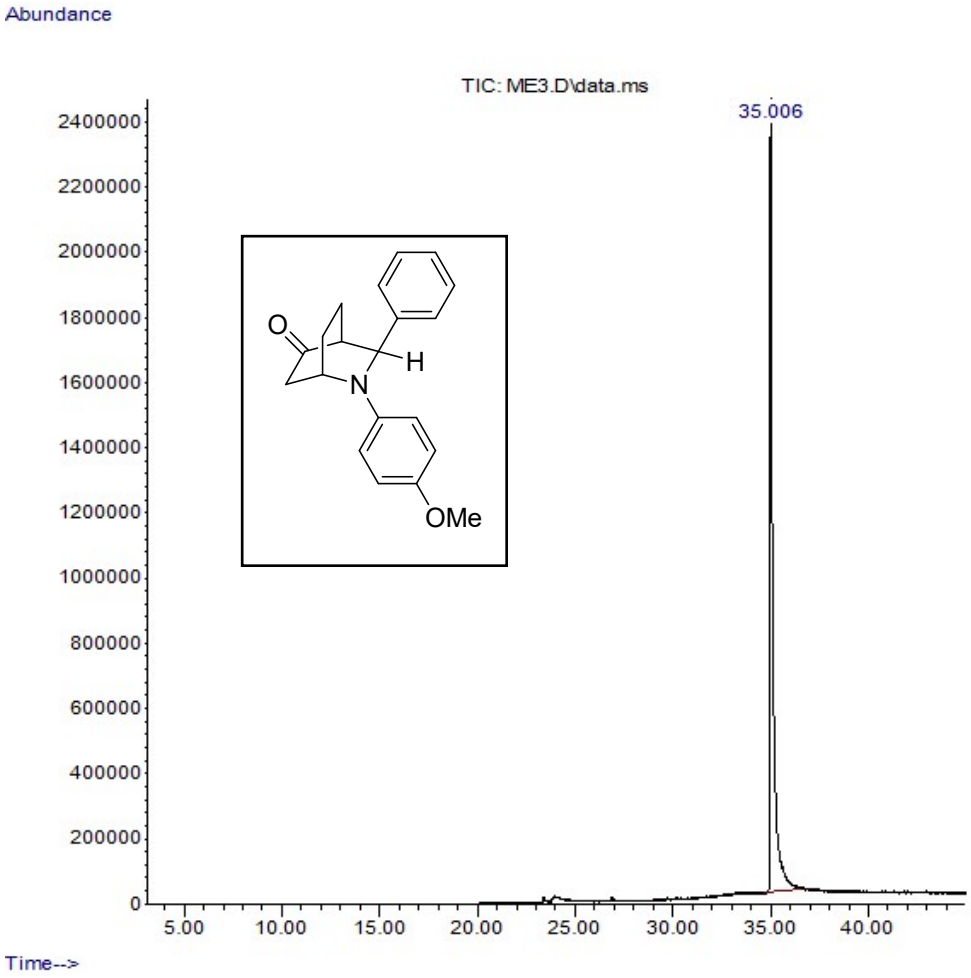
^{1}H NMR spectrum of 5g



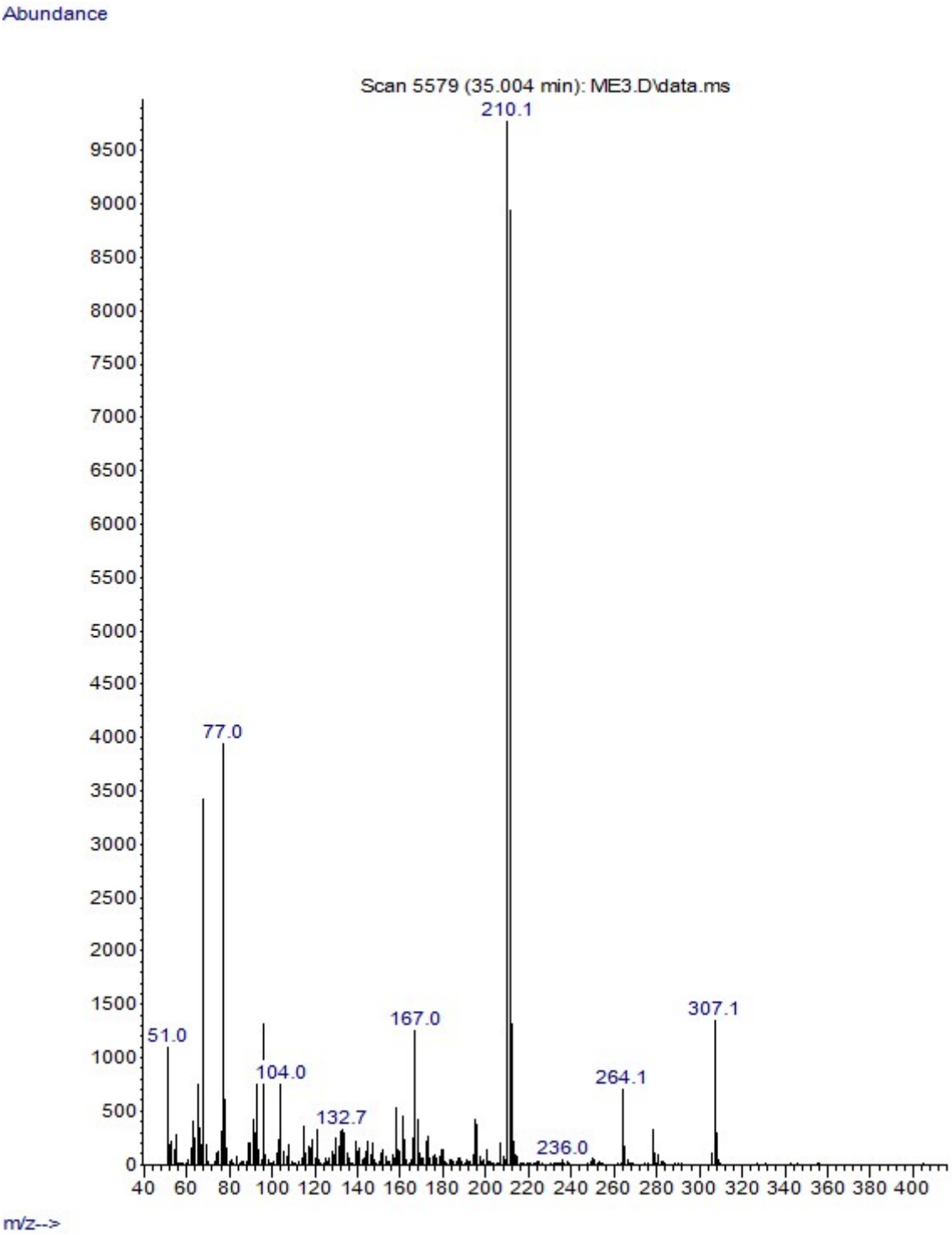
^{13}C NMR spectrum of 5g



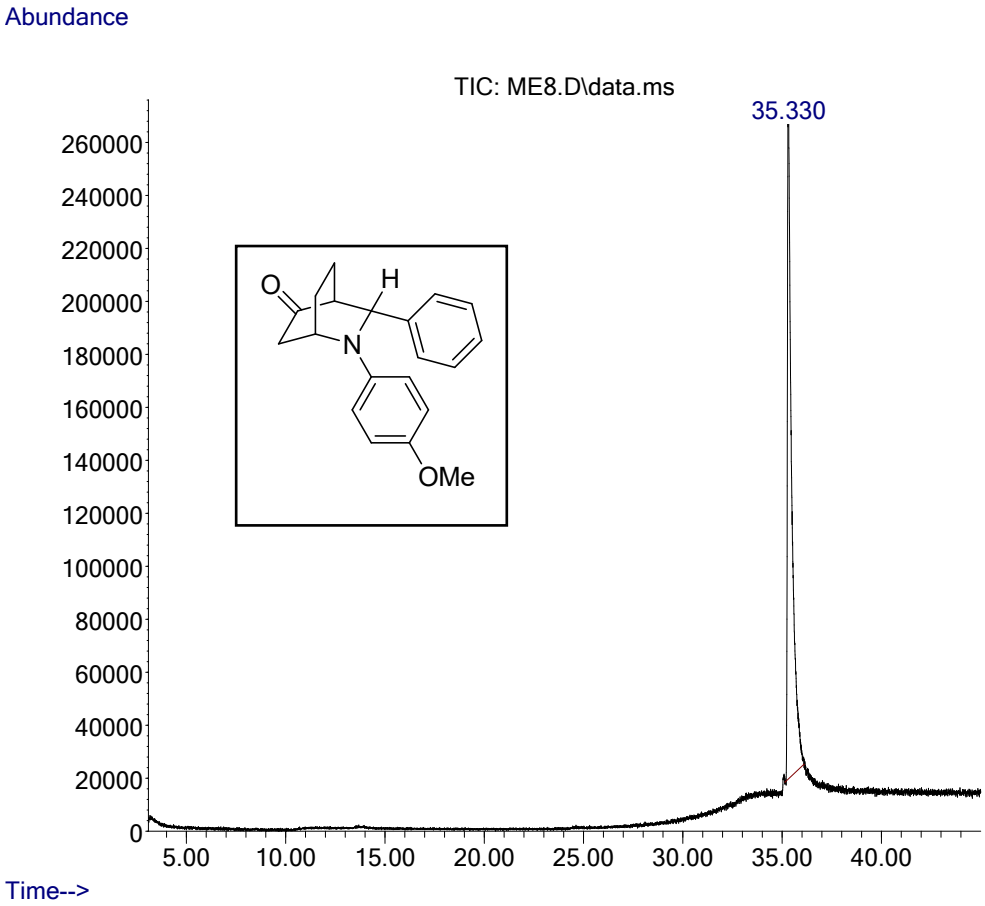
Gas chromatogram of 4h and 5h mixture



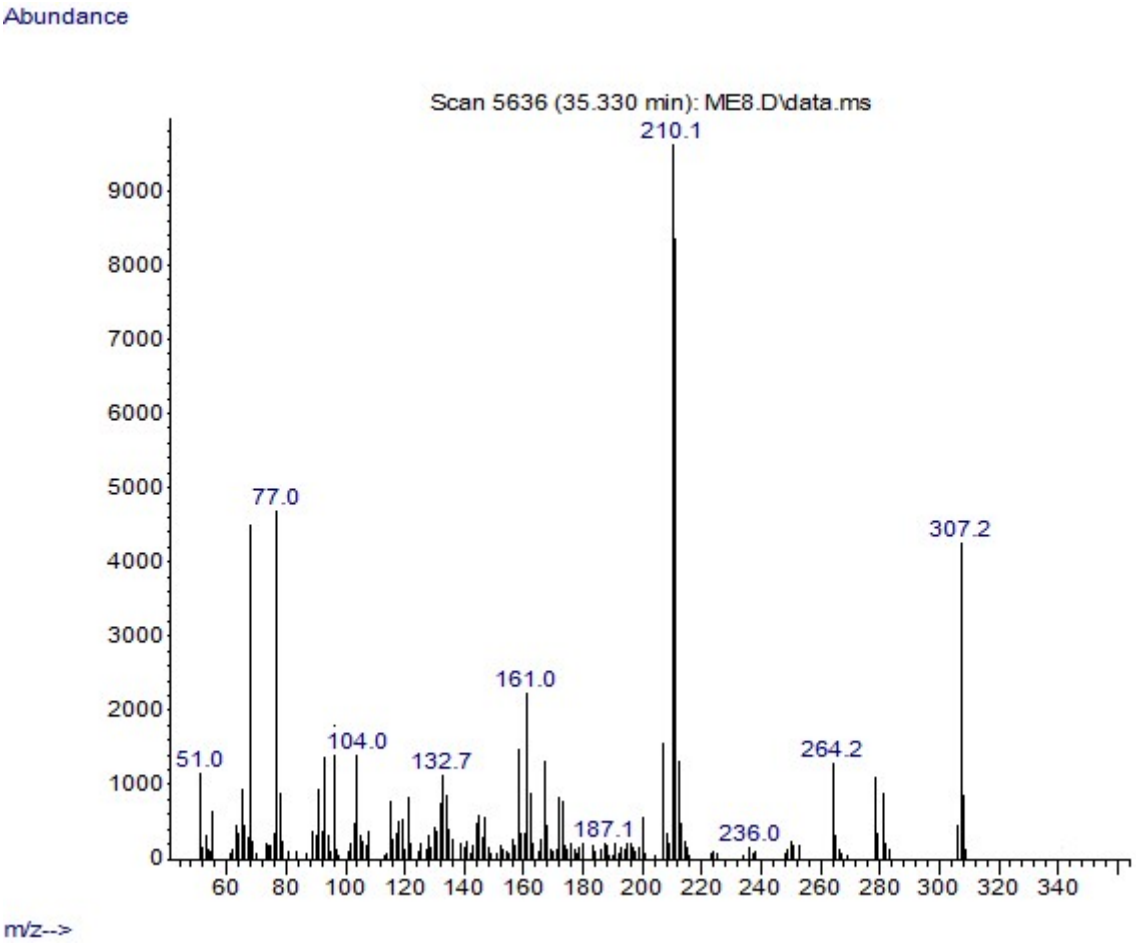
Gas chromatogram of 4h



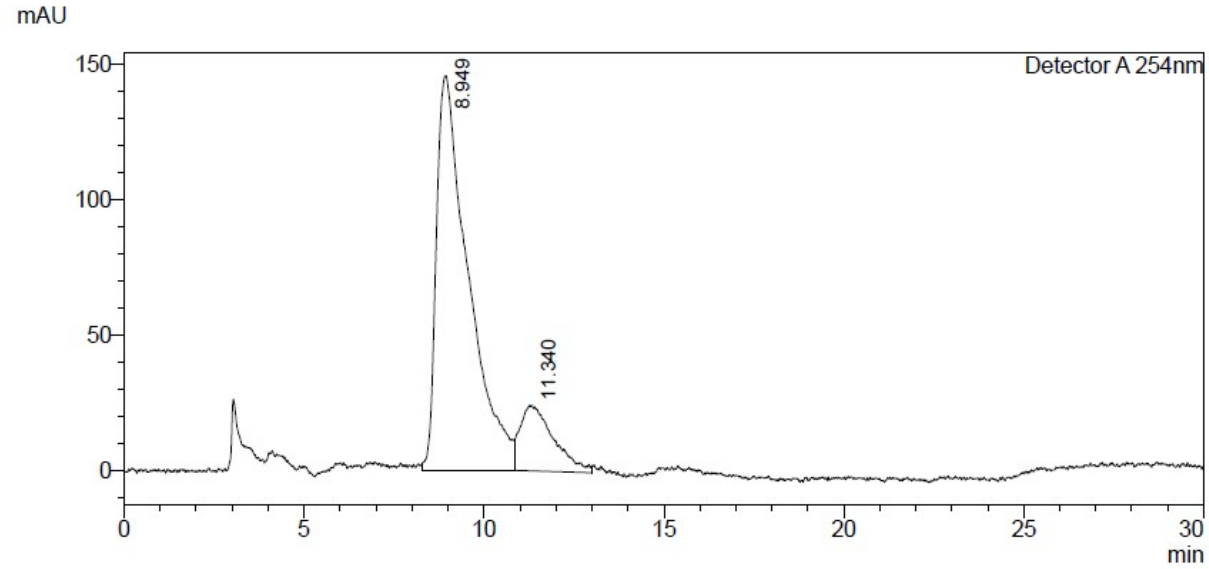
Mass spectrum of 4h



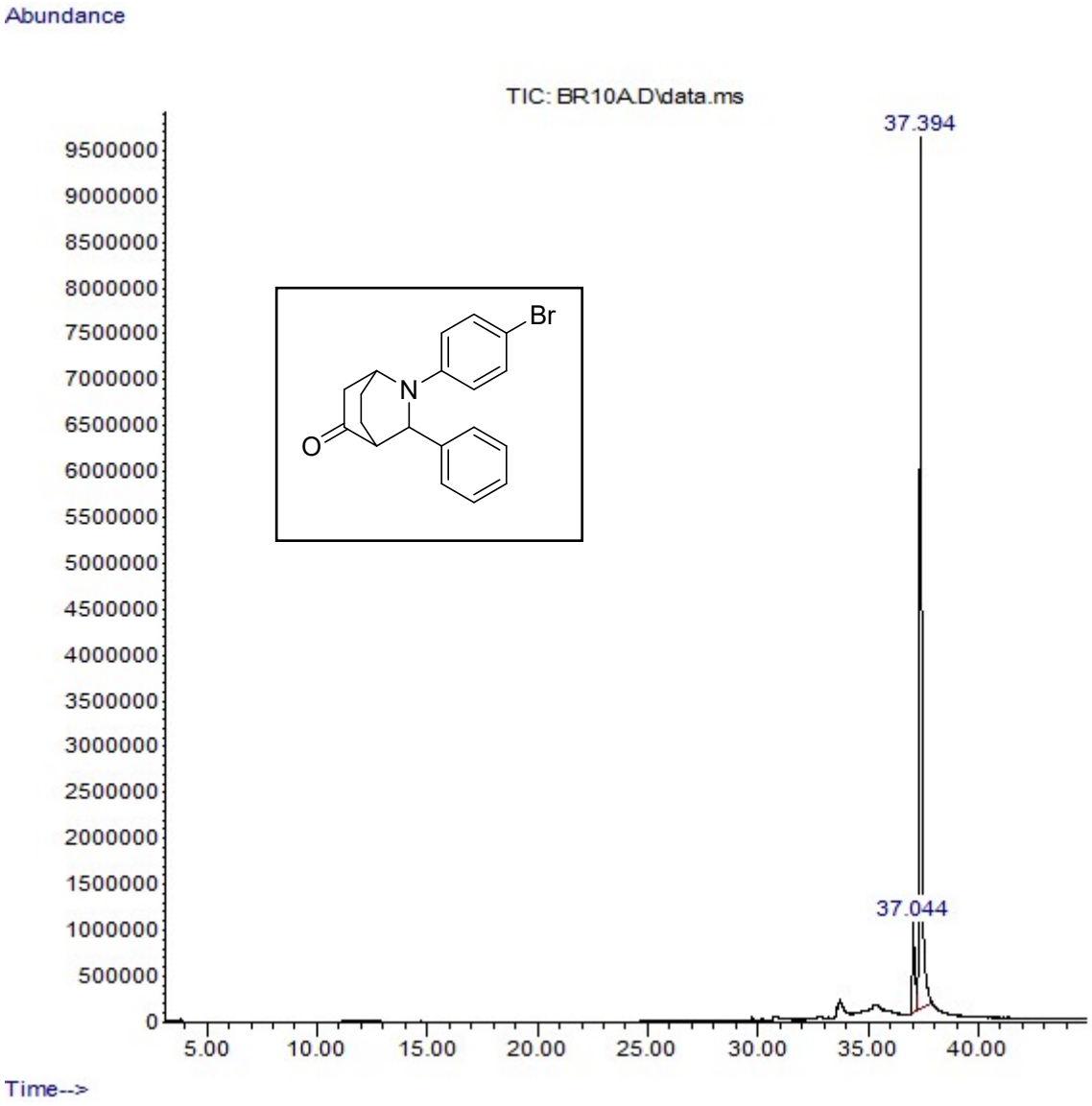
Gas chromatogram of 5h



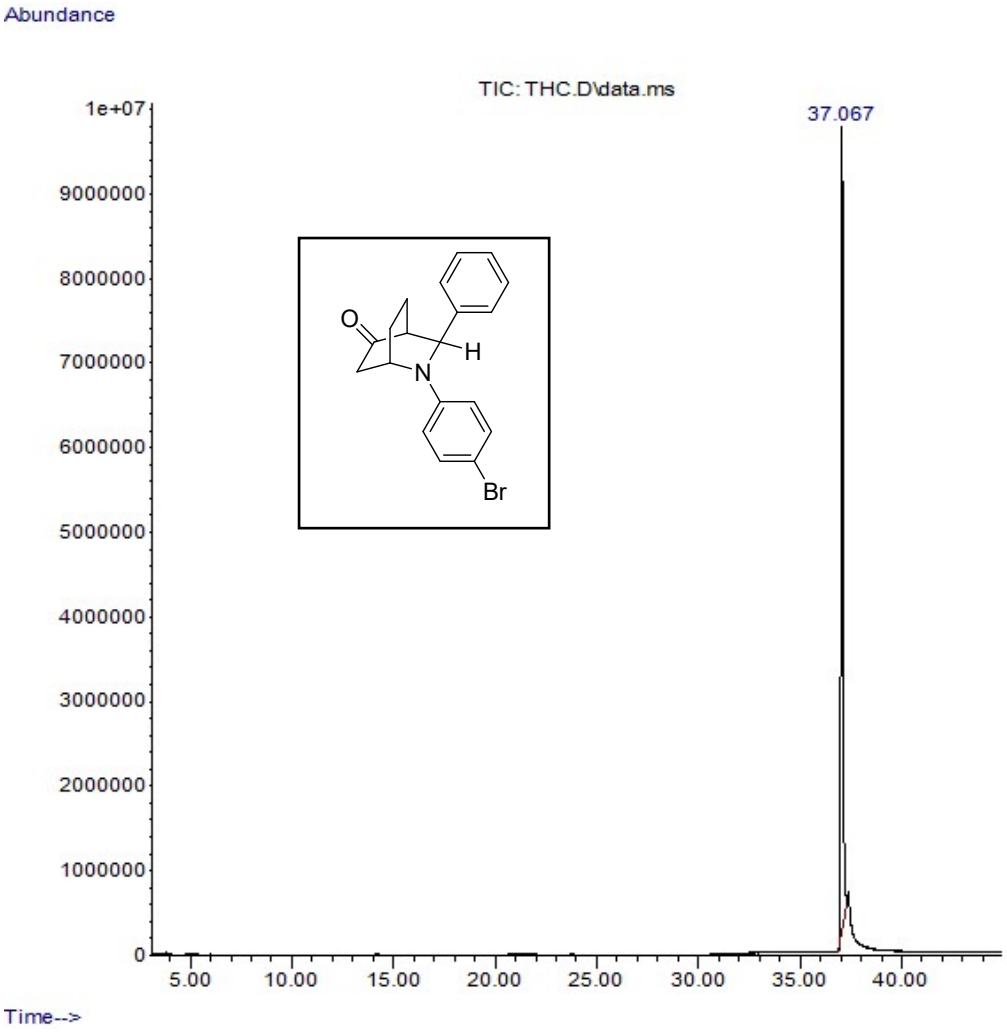
Mass spectrum of 5h



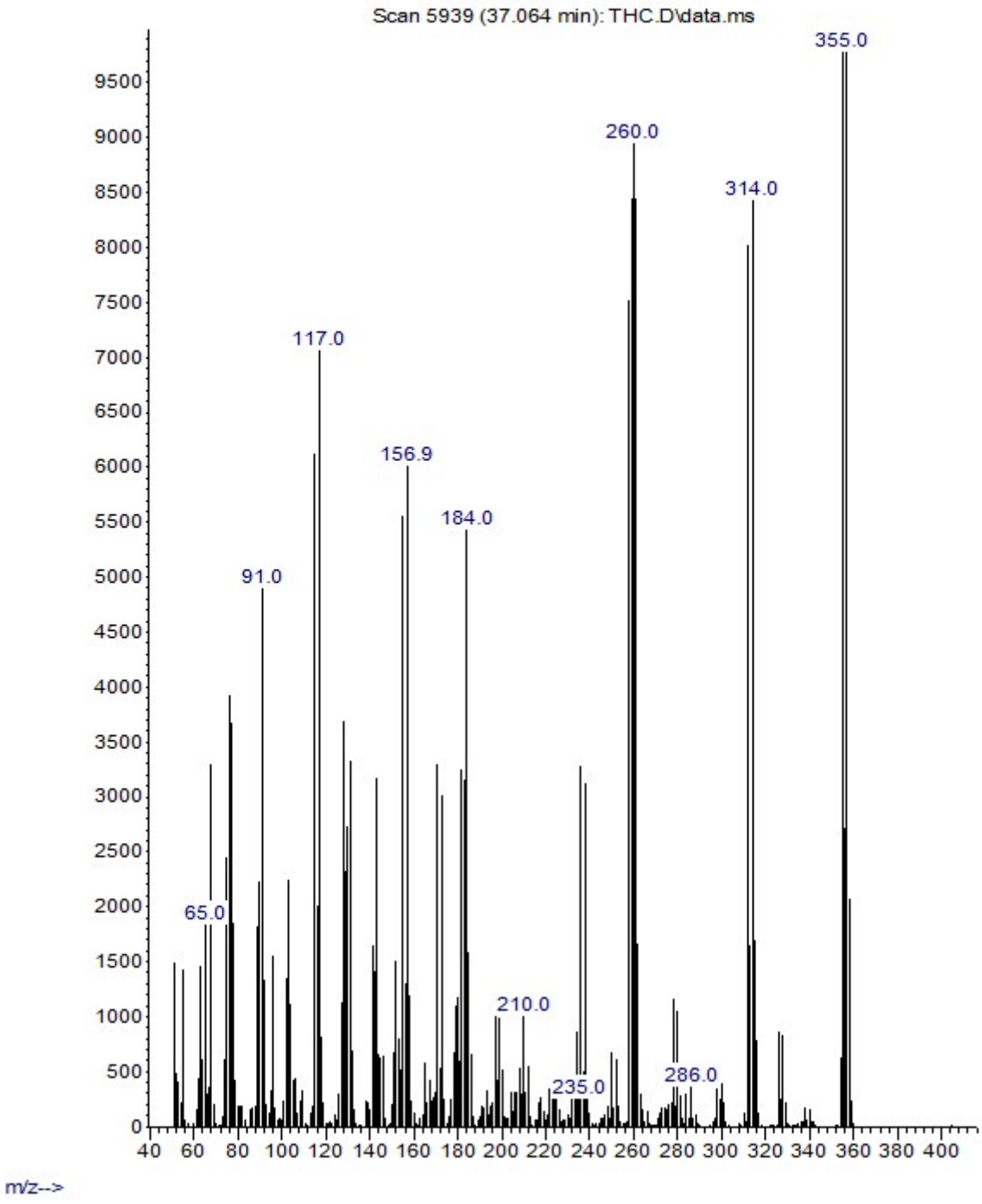
HPLC profile of 5h



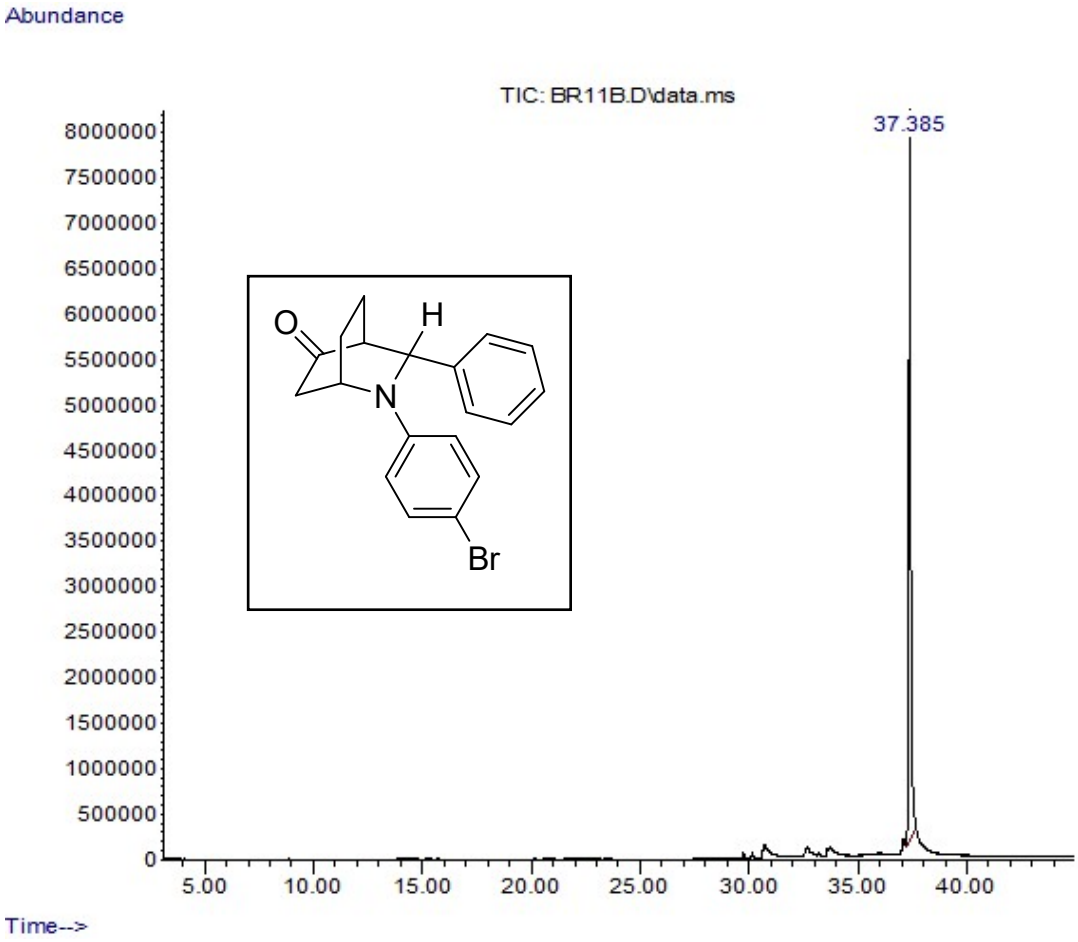
Gas chromatogram of 4i and 5i mixture



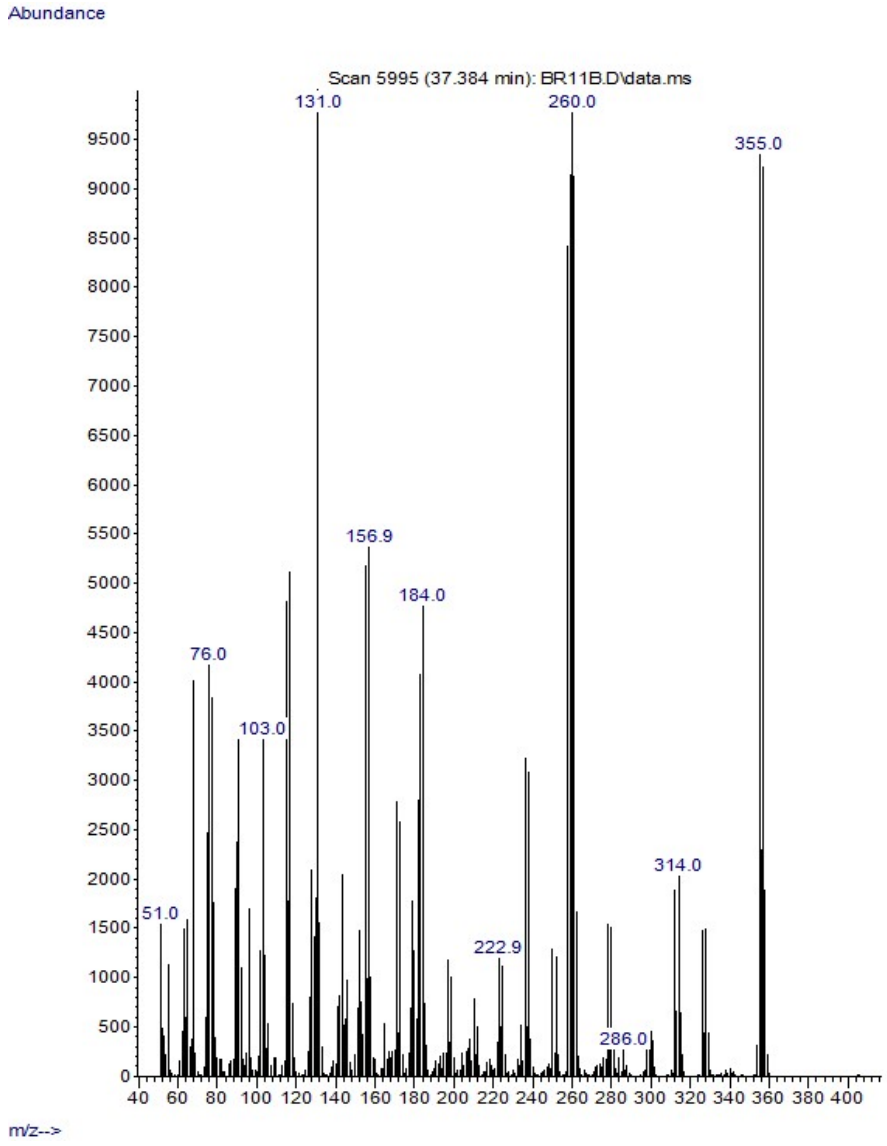
Gas chromatogram of 4i



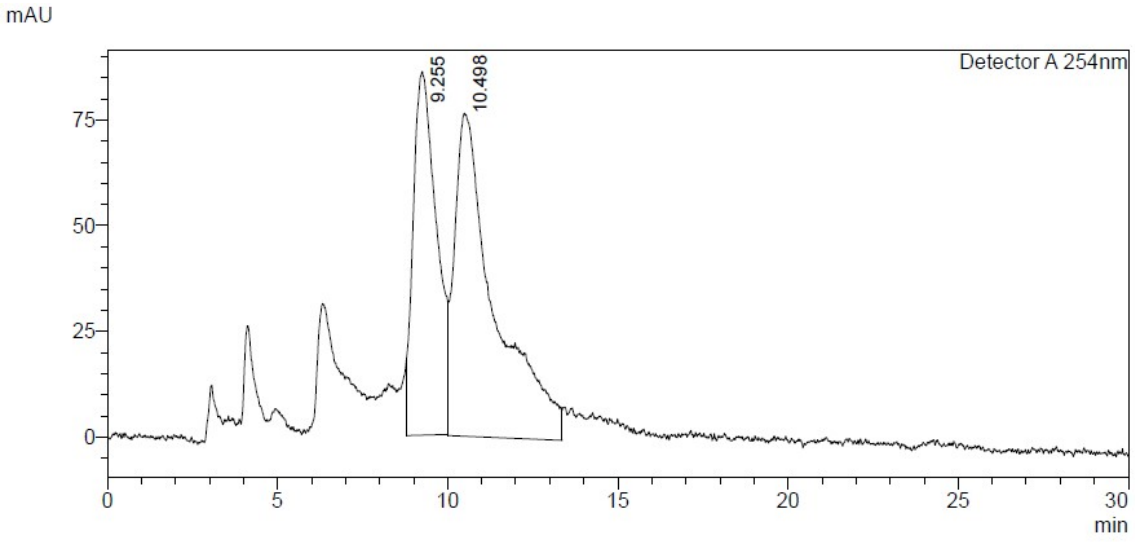
Mass spectrum of 4i



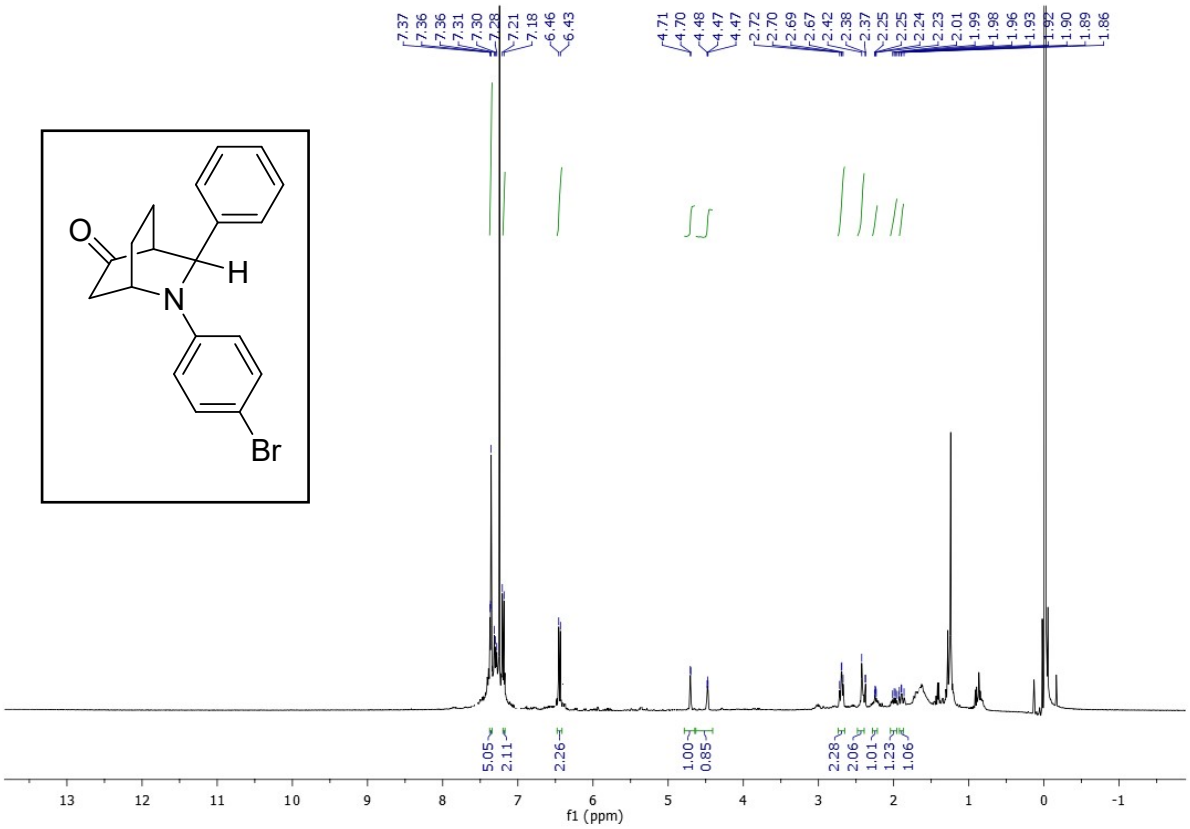
Gas chromatogram of 5i



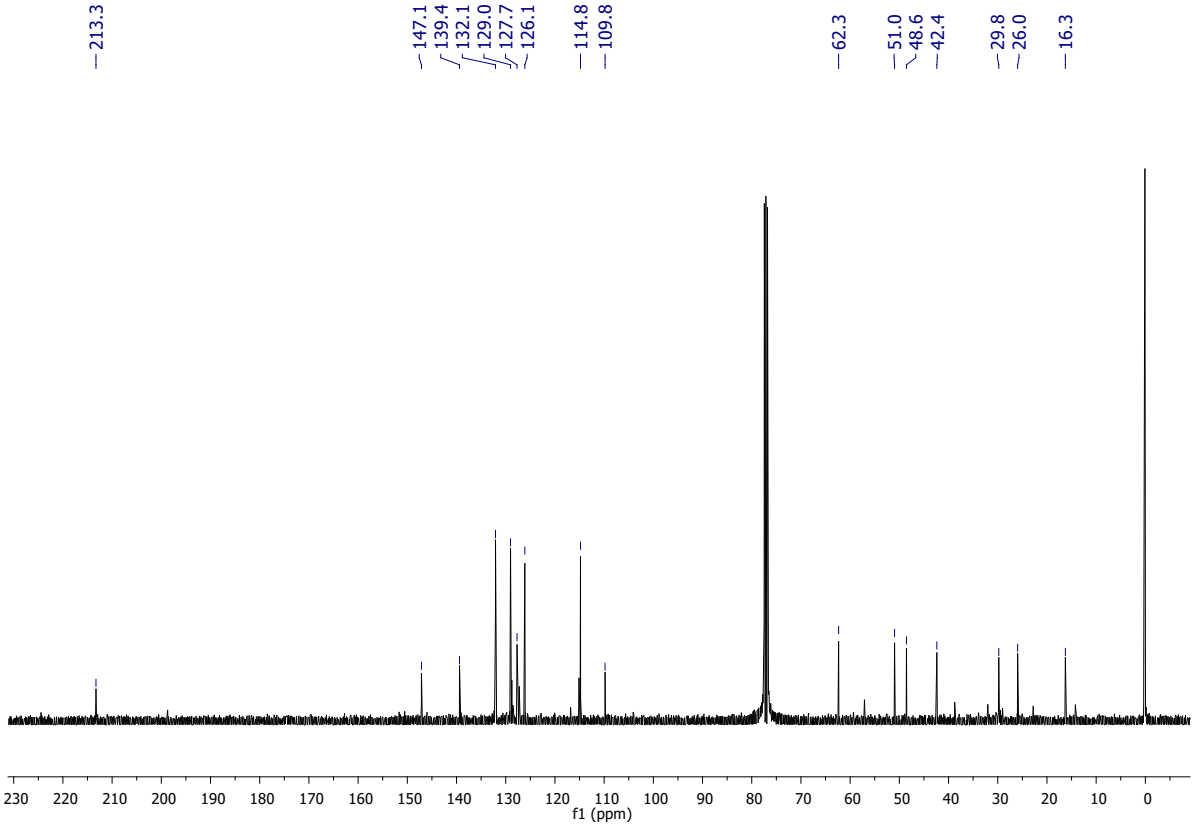
Mass spectrum of 5i



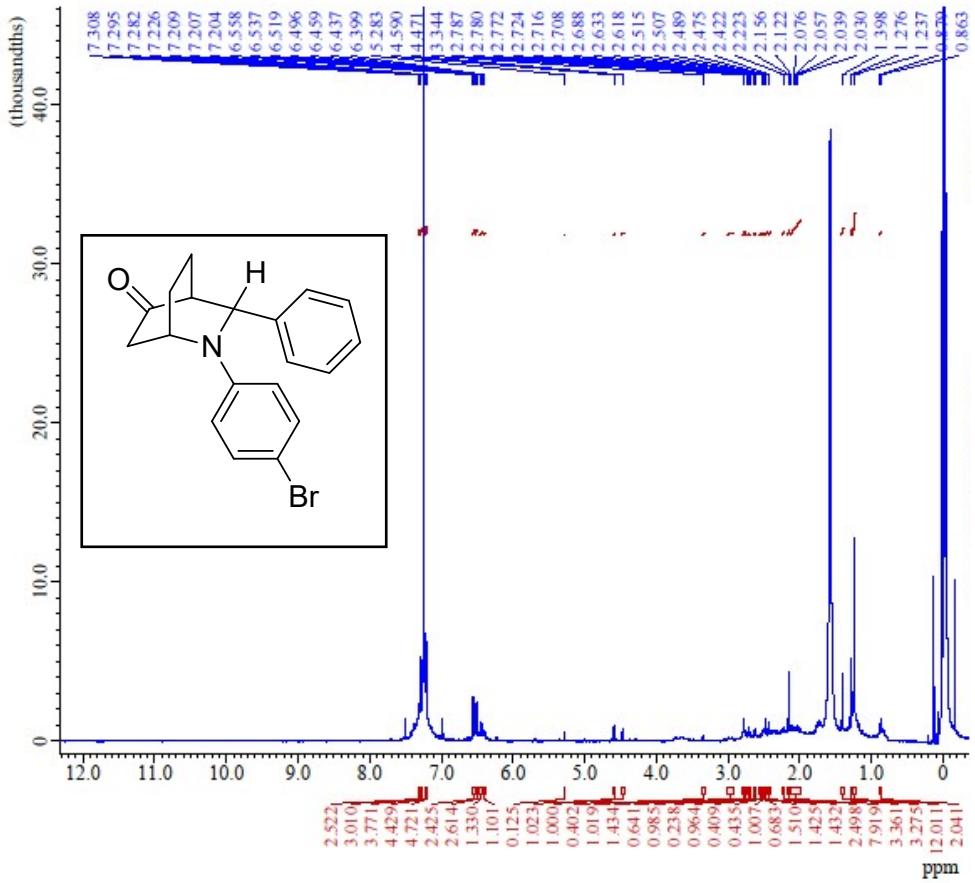
HPLC profile of 5i



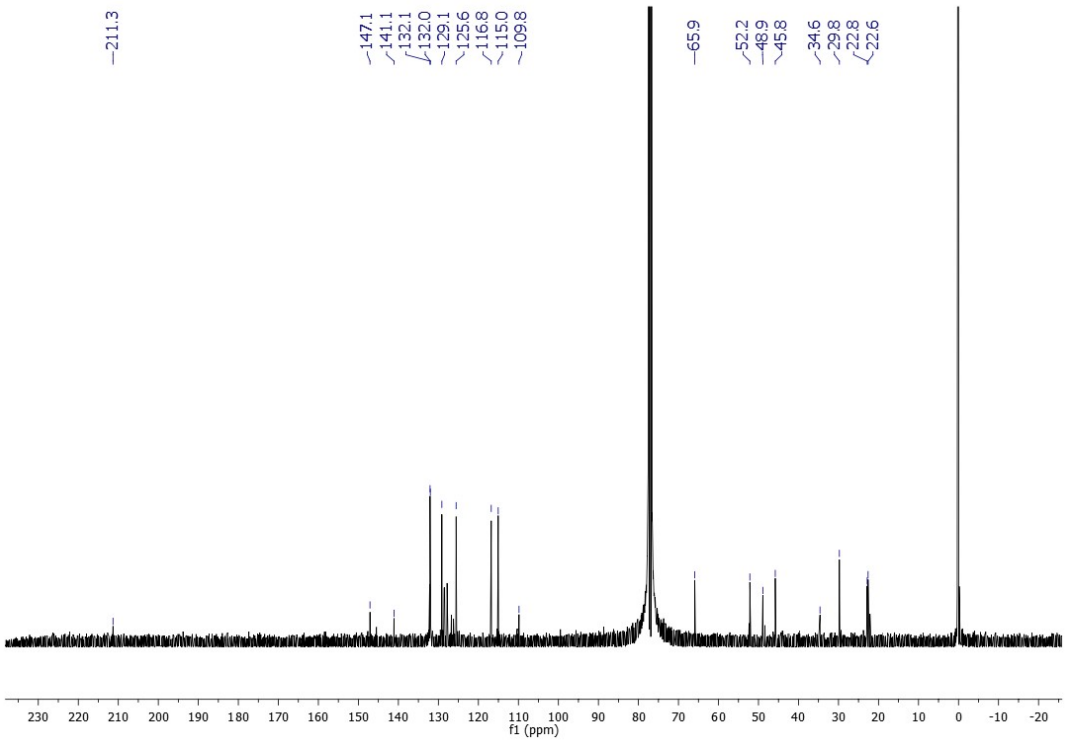
^{1}H NMR spectrum of 4i



^{13}C NMR spectrum of 4i



^{1}H NMR spectrum of 5i



^{13}C NMR spectrum of 5i