Supporting Information

Highly Enantioselective Michael Addition of Cyclopentanone with Chalcones Via Novel Di-imine Mechanism

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General Information

Unless otherwise stated, all reagents were purchased from commercial suppliers and were used without further purification. Reactions were monitored by thin layer chromatography (TLC) on GF_{254} silica gel plates. ^{1}H NMR spectra and ^{13}C NMR spectra were recorded on a JEOL JNM-AL300 (300 MHz) spectrometer in needful D-reagents with tetramethylsilane (TMS) as an internal reference. Data for ^{1}H NMR are reported as follows: chemical shift (ppm), and multiplicity (s = singlet, d = doublet, t = triplet, dd = double of doublet, br = broad, m = multiplet), coupling constants (Hz) and integration; Data for ^{13}C NMR are reported as ppm. Melting points were measured on an X_4-type micro-melting point apparatus and were uncorrected. HPLC analyses were performed using a Daicel ChiralPak AD or AS column purchased. Crystal structure determination of the Michael product **M-13b** was carried out on a Bruker Smart Apex-II CCD diffractometer. Optical rotations were measured on a AA-10R automatic polarimeter and are reported as follows: $[\alpha]_D^{25}$ (*c* in g per 100 mL of solvent).

General procedure for the Michael reactions:

To a mixture of cyclopentanone (1.0 mmol), a chalcone (0.5 mmol) and chiral catalyst 1,2-diaminocyclohexane **8** or **9** (0.1 mmol) in 0.6 ml of $CHCl_3$ was added the acid additive (0.1 mmol of hexanedioic acid prepared in 0.6 ml of anhydrous CH_3OH). The resulting mixture was stirred under room temperature in dark for 6 days and then directly purified by silica gel chromatography, and fractions were collected and concentrated in vacuo to provide a solid or clear oil.

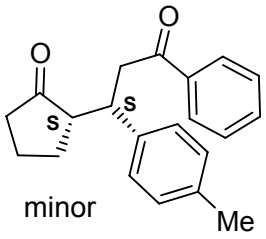
Scope of the Michael addition reaction:

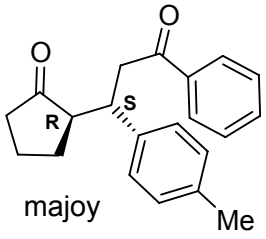
(S)-2-((S)-3-oxo-1,3-diphenylpropyl)cyclopentanone M-1: obtained in 69% yield; colorless oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.97 (d, J = 7.2 Hz, 2H), 7.54 (tri, J = 7.2 Hz, 1H), 7.44 (tri, J = 7.2 Hz, 2H), 7.27-7.19 (m, 5H), 3.85-3.73 (m, 2H), 3.47 (dd, J = 10.2 Hz, 20.1 Hz, 1H), 2.50 (m, 1H), 2.24 (dd, J = 7.5 Hz, 18.3 Hz, 1H), 2.20-2.09 (m, 1H), 1.99-1.86 (m, 1H), 1.81-1.65 (m, 3H); HPLC (AD, hexane:*i*-PrOH 50:50, 1.0 mL/min): t_R 6.22 min (major enantiomer), 7.02 min (minor enantiomer); ee 98.5%; $[\alpha]_D^{25}$ = +55 (c = 1.4, $CHCl_3$).

(R)-2-((S)-3-oxo-1,3-diphenylpropyl)cyclopentanone M-1: ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.91 (d, J = 7.2 Hz, 2H), 7.53 (tri, J = 7.2 Hz, 1H), 7.42 (tri, J = 7.5 Hz, 2H), 7.29-7.17 (m, 5H), 3.87 (dd, J = 6.3 Hz, 16.5 Hz, 1H), 3.70 (dd, J = 7.5 Hz, 14.4 Hz, 1H), 3.36 (dd, J = 7.5 Hz, 16.8 Hz, 1H), 2.46 (dd, J = 8.7 Hz, 17.1 Hz, 1H), 2.27-2.21 (m, 1H), 2.06 (dd, J = 9.0 Hz, 18.6 Hz, 1H), 1.90-1.87 (m, 2H), 1.75-1.65

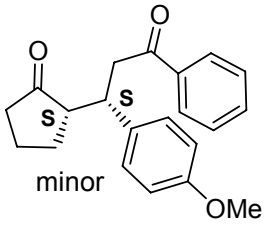
(m, 1H), 1.59-1.51 (m, 1H); HPLC (AD, hexane:*i*-PrOH 50:50, 1.0 mL/min): t_R 8.16 min (major enantiomer), 12.52 min (minor enantiomer); ee 97.4%; $[\alpha]_D^{25}$ = -46 (*c* = 1.2, $CHCl_3$).

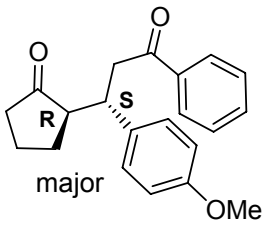
2-(3-Oxo-3-phenyl-1-p-tolylpropyl)cyclopentanone M-2: obtained in 73% yield; white solid; m.p. 56-57℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.92 (d, *J* = 8.4 Hz, 2H), 7.53 (tri, *J* = 7.5 Hz, 1H), 7.42 (tri, *J* = 7.5 Hz, 2H), 7.11-7.08 (m, 4H), 3.84 (dd, *J* = 6.0 Hz, 16.5 Hz, 1H), 3.66 (dd, *J* = 7.5 Hz, 15.0 Hz, 1H), 3.33 (dd, *J* = 7.5 Hz, 16.5 Hz, 1H), 2.43 (dd, *J* = 8.4 Hz, 16.8 Hz, 1H), 2.29 (s, 3H), 2.29-2.20 (m, 1H), 2.13-2.01 (m, 1H), 1.89-1.87 (m, 2H), 1.74-1.67 (m,1H), 1.58-1.52 (m, 1H); HPLC (AD, hexane:*i*-PrOH 50:50, 1.0 mL/min): dr 1:2; t_R 8.51 min (major enantiomer), 11.20 min (minor enantiomer); ee 98.3%; t_R 11.88 min (major enantiomer), 22.13 min (minor enantiomer); ee 97.2%; $[\alpha]_D^{25}$ = -23 (*c* = 1.2, $CHCl_3$).





2-(1-(4-Methoxyphenyl)-3-oxo-3-phenylpropyl)cyclopentanone M-3: Obtained in 43% yield; coloeless oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.98-7.89 (dd, *J* = 7.2 Hz, 15.6 Hz, 1.99H), 7.53-7.38 (m, 3.05H), 7.26-7.14 (m, 2.01H), 6.89-6.80 (m, 2.00H), 4.33(dd, *J* = 7.2 Hz, 12.0 Hz, 0.61H), 4.03 (dd, *J* = 4.8 Hz, 16.8 Hz, 0.38H), 3.79 (s, 3.42H), 3.66 (dd, *J* = 7.2 Hz, 16.8 Hz, 0.63H), 3.47-3.38 (m, 1.02H), 2.68-2.55 (m, 1.00H), 2.29-2.20 (m, 1.42H), 2.09-1.93 (m, 1.79H), 1.88-1.60 (m, 3.08H), 1.53-1.44 (m, 0.45H); HPLC (AS, hexane:*i*-PrOH 80:20, 1.0 mL/min): dr 2:1; t_R 6.97 min (minor enantiomer), 12.45 min (major enantiomer); ee 95.8%; t_R 8.37 min (major enantiomer), 8.98 min (minor enantiomer); ee 97.8%; $[\alpha]_D^{25}$ = +27 (*c* = 1.1, $CHCl_3$).





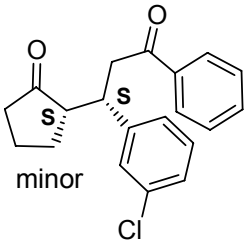
(S)-2-((S)-1-(4-fluorophenyl)-3-oxo-3-phenylpropyl)cyclopentanone M-4: obtained in 83% yield; white solid; m.p. 82-83℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.96 (d, J = 7.2 Hz, 2H), 7.55 (tri, J = 7.5 Hz, 1H), 7.45 (tri, J = 7.5 Hz, 2H), 7.21 (dd, J = 5.4 Hz, 8.4 Hz, 2H), 6.95 (tri, J = 8.4 Hz, 2H), 3.82-3.73 (m, 2H), 3.47 (dd, J = 9.6 Hz, 19.2 Hz, 1H), 2.53-2.48 (m, 1H), 2.30-2.12 (m, 2H), 1.98-1.58 (m, 4H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 220.5, 198.8, 163.2 (d, $^1J_{C\text{-}F}$ = 242.9 Hz), 160.0, 137.9, 136.9, 133.1, 130.0, 129.9, 128.6, 128.1, 115.4, 115.1, 53.1, 41.1, 40.3, 39.7, 27.2, 20.5; HPLC (AD, hexane:*i*-PrOH 50:50, 1.0 mL/min): t_R 6.44 min (major enantiomer), 7.96 min (minor enantiomer); ee >99%; $[\alpha]_D^{25}$ = +27 (c = 0.5, $CHCl_3$).

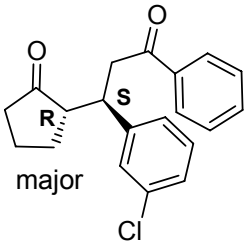
(R)-2-((S)-1-(4-fluorophenyl)-3-oxo-3-phenylpropyl)cyclopentanone M-4: ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.91 (d, J = 7.8 Hz, 2H), 7.54 (tri, J = 7.5 Hz, 1H), 7.43 (tri, J = 7.5 Hz, 2H), 7.18 (dd, J = 6.0 Hz, 7.5 Hz, 2H), 6.95 (tri, J = 8.4 Hz, 2H), 3.85 (dd, J = 6.0 Hz, 17.1 Hz, 1H), 3.69 (dd, J = 7.8 Hz, 16.5 Hz, 1H), 3.34 (dd, J = 7.5 Hz, 16.8 Hz, 1H), 2.43 (dd, J = 9.0 Hz, 17.1 Hz, 1H), 2.27 (dd, J = 7.5 Hz, 18.3 Hz, 1H), 2.05 (dd, J = 9.0 Hz, 18.3 Hz, 1H), 1.90 (m, 2H), 1.76-1.69 (m, 1H), 1.57-1.51 (m, 2H); HPLC (AD, hexane:*i*-PrOH 50:50, 1.0 mL/min): t_R 8.55 min (major enantiomer), 10.67 min (minor enantiomer); ee 98.2%; $[\alpha]_D^{25}$ = -75 (c = 1.7, $CHCl_3$).

4-(3-Oxo-1-(2-oxocyclopentyl)-3-phenylpropyl)benzonitrile M-5: obtained in 92% yield; white solid; m.p. 100-102℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.90 (d, J = 7.5 Hz, 2.00H), 7.56 (tri, J = 8.1 Hz, 2.97H), 7.43 (m, 1.99H), 7.36 (m, 2.01H), 3.94 (dd, J = 5.1 Hz, 17.1 Hz, 0.80H), 3.83-3.72 (m, 1.07H), 3.67-3.54 (m, 0.34H), 3.39 (dd, J = 8.4 Hz, 17.1 Hz, 0.80H), 2.47 (dd, J = 8.1 Hz, 18.0 Hz, 0.99H), 2.36-2.28 (m, 1.03H), 2.10 (dd, J = 9.0 Hz, 18.9 Hz, 1.12H), 1.99-1.88 (m, 2.01H), 1.80-1.68 (m, 1.24H), 1.55-1.38 (m, 0.87H); HPLC (AD, hexane:*i*-PrOH 50:50, 1.0 mL/min): dr 3:1; t_R

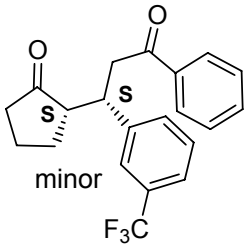
10.33 min (minor enantiomer), 24.40 min (major enantiomer); ee >99%; t_R 11.65 min (major enantiomer), 13.34 min (minor enantiomer); ee >99%; $[\alpha]_D^{25}$ = -32 (*c* = 1.0, $CHCl_3$).

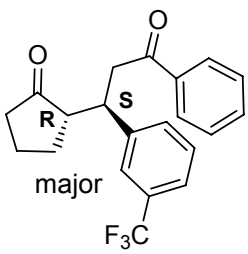
2-(1-(3-Chlorophenyl)-3-oxo-3-phenylpropyl)cyclopentanone M-6: obtained in 87% yield; colorless oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.94 (dd, *J* = 7.2 Hz, 14.1 Hz, 2.01H), 7.54 (dd, *J* = 2.4 Hz, 4.5 Hz, 1.00H), 7.52-7.41 (dd, *J* = 5.1 Hz, 7.8 Hz, 2.01H), 7.26-7.12 (m, 4.04H), 3.90 (dd, *J* = 5.7 Hz, 17.1 Hz, 0.55H), 3.76-3.69 (m, 1.34H), 3.49 (m, 0.40H), 3.34 (dd, *J* = 7.8 Hz, 17.1 Hz, 0.52H), 2.44 (m, 0.95H), 2.25 (m, 0.98H), 2.10 (m, 1.11H), 1.95-1.90 (m, 1.88H), 1.89-1.79 (m, 1.55H), 1.66 (m, 0.58H); ^{13}C NMR (75 MHz in $CDCl_3$): δ 219.8, 219.3, 198.4, 198.1, 144.7, 144.5, 136.8, 134.1, 133.1, 133.0, 129.6, 128.5, 128.2, 128.0, 127.9, 126.8, 126.7, 53.0, 52.6, 42.6, 40.5, 40.4, 40.4, 39.4, 38.7, 28.0, 27.0, 20.4, 20.1; HPLC (AD, hexane:*i*-PrOH 92:8, 1.0 mL/min): dr 2:3; t_R 12.09 min (minor enantiomer), 13.40 min (major enantiomer); ee 98.8%; t_R 18.24 min (minor enantiomer), 22.13 min (major enantiomer); ee 98.4%; $[\alpha]_D^{25}$ = +41 (*c* = 0.9, $CHCl_3$).





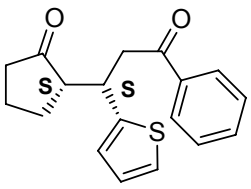
2-(3-Oxo-3-phenyl-1-(3-(trifluoromethyl)phenyl)propyl)cyclopentanone M-7: Obtained in 73% yield; colorless oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.93 (dd, *J* = 7.2 Hz, 14.4 Hz, 1.90H), 7.58-7.37 (m, 6.92H), 3.99-3.73 (m, 1.95H), 3.54-3.33 (m, 0.98H), 2.48 (dd, *J* = 8.4 Hz, 18.3 Hz, 1.00H), 2.30-2.25 (m, 0.99H), 2.11 (dd, *J* = 9.0 Hz, 18.0 Hz, 1.06H), 2.00-1.89 (m, 2.07H), 1.80-1.67 (m, 1.43H), 1.54-1.41 (m, 0.77H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 219.7, 219.2, 198.4, 198.1, 143.7, 143.4, 136.9, 136.8, 133.2, 133.1, 132.0, 131.9, 130.9, 130.5, 128.9, 128.9, 128.6, 128.6, 128.1, 128.0, 125.4, 125.2, 125.2, 124.8, 124.7, 124.7, 123.6, 123.6, 123.5, 122.7, 53.2, 52.6, 42.6, 40.7, 40.7, 40.6, 39.4, 38.7, 28.1, 27.1, 20.4,





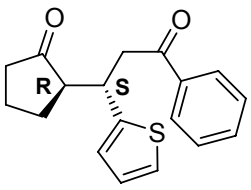
20.2; HPLC (AD, hexane:*i*-PrOH 97:3, 1.0 mL/min): dr 1:2; t_R 15.68 min (minor enantiomer), 18.12 min (major enantiomer); ee >99%; t_R 20.50 min (major enantiomer), 29.89 min (minor enantiomer); ee >99%; $[\alpha]_D^{25}$ = +51 (*c* = 4.5, $CHCl_3$).

(S)-2-((S)-3-oxo-3-phenyl-1-(thiophen-2-yl)propyl)cyclopentanone M-8: Obtained



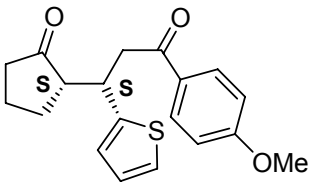
in 61% yield; colorless oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.98 (d, *J* = 7.8 Hz, 2H), 7.55 (tri, *J* = 7.5 Hz, 1H), 7.45 (tri, *J* = 7.5 Hz, 2H), 7.11 (d, *J* = 5.1 Hz, 1H), 6.91-6.87 (m, 2H), 4.10 (dd, *J* = 6.9 Hz, 10.5 Hz, 1H), 3.84 (dd, *J* = 6.9 Hz, 17.4 Hz, 1H), 3.49 (dd, *J* = 6.9 Hz, 17.4 Hz, 1H), 2.56 (m, 1H), 2.27 (dd, *J* = 7.5 Hz, 18.0 Hz, 1H) overlapping with 2.23-2.17 (m, 1H), 2.06-1.65 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 220.3, 198.6, 145.2, 136.9, 133.1, 128.6, 128.2, 126.6, 125.5, 123.7, 52.9, 42.6, 39.7, 36.5, 27.4, 20.5; HPLC (AD, hexane:*i*-PrOH 50:50, 1.0 mL/min): t_R 6.97 min (major enantiomer), 7.42 min (minor enantiomer); ee 98.2%; $[\alpha]_D^{25}$ = +55 (*c* = 0.9, $CHCl_3$).

(R)-2-((S)-3-oxo-3-phenyl-1-(thiophen-2-yl)propyl)cyclopentanone M-8: ^{1}H NMR



(300 MHz, $CDCl_3$): δ 7.94 (d, *J* = 6.9 Hz, 2H), 7.55 (tri, *J* = 7.5 Hz, 1H), 7.44 (tri, *J* = 7.5 Hz, 2H), 7.11 (d, *J* = 4.8 Hz, 1H), 6.90-6.86 (m, 2H), 4.17 (dd, *J* = 6.9 Hz, 13.8 Hz, 1H), 3.68 (dd, *J* = 6.9 Hz, 16.8 Hz, 1H), 3.45 (dd, *J* = 6.9 Hz, 16.8 Hz, 1H), 2.47 (dd, *J* = 7.8 Hz, 18.6 Hz, 1H), 2.26 (dd, *J* = 7.5 Hz, 18.0 Hz, 1H), 2.08-1.84 (m, 3H), 1.79-1.61 (m, 2H); HPLC (AD, hexane:*i*-PrOH 50:50, 1.0 mL/min): t_R 8.59 min (major enantiomer), 13.27 min (minor enantiomer); ee 95%; $[\alpha]_D^{25}$ = -57 (*c* = 1.2, $CHCl_3$).

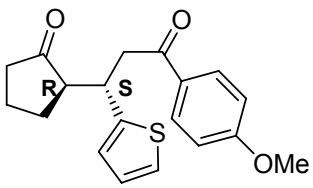
(S)-2-((S)-3-(4-methoxyphenyl)-3-oxo-1-(thiophen-2-yl)propyl)cyclopentanone



M-9: Obtained in 51% yield; colorless oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.98 (d, *J* = 8.7 Hz, 2H), 7.11 (d, *J* = 4.8 Hz, 1H), 6.94-6.88 (m, 4H), 4.08 (dd, *J* = 6.9 Hz, 10.5 Hz, 1H), 3.86 (s, 3H), 3.79 (dd, *J* = 7.2 Hz, 16.8 Hz, 1H), 3.42 (dd, *J* = 6.9 Hz, 16.8 Hz, 1H), 2.53 (m, 1H), 2.26 (dd, *J* = 6.9 Hz, 18.3 Hz, 1H), 2.20

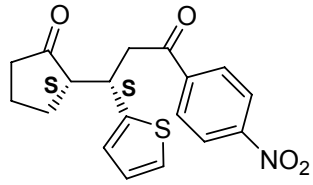
(dd, *J* = 7.2 Hz, 16.8 Hz, 1H), 1.97 (dd, *J* = 8.4 Hz, 18.0 Hz, 1H), 1.86-1.64 (m, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 220.3, 197.0, 163.5, 145.2, 130.5, 130.0, 126.6, 125.4, 123.6, 113.6, 55.4, 52.9, 42.1, 39.6, 36.6, 27.4, 20.4; HPLC (AD, hexane:*i*-PrOH 65:35, 1.0 mL/min): t_R 13.71 min (major enantiomer), 16.73 min (minor enantiomer); ee >98.8%; $[\alpha]_D^{25}$ = +41 (*c* = 0.9, $CHCl_3$).

(R)-2-((S)-3-(4-methoxyphenyl)-3-oxo-1-(thiophen-2-yl)propyl)cyclopentanone



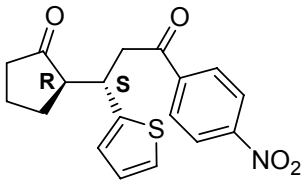
M-9: ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.93 (d, *J* = 9.0 Hz, 2H), 7.11 (d, *J* = 5.1 Hz, 1H), 6.93-6.84 (m, 4H), 4.17 (dd, *J* = 6.9 Hz, 13.5 Hz, 1H), 3.86 (s, 3H), 3.58 (dd, *J* = 7.2 Hz, 16.8 Hz, 1H), 3.40 (dd, *J* = 6.9 Hz, 16.5 Hz, 1H), 2.47 (dd, *J* = 7.8 Hz, 18.0 Hz, 1H), 2.25 (dd, *J* = 6.9 Hz, 17.1 Hz, 1H), 2.07-1.84 (m, 3H), 1.78-1.64 (m, 2H); HPLC (AD, hexane:*i*-PrOH 65:35, 1.0 mL/min): t_R 19.32 min (major enantiomer), 32.24 min (minor enantiomer); ee >97.5%; $[\alpha]_D^{25}$ = -53 (*c* = 1.2, $CHCl_3$).

(R)-2-((R)-3-(4-Nitrophenyl)-3-oxo-1-(thiophen-2-yl)propyl)cyclopentanone M-10:



Obtained in 29% yield; colorless oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.30 (d, *J* = 8.1 Hz, 2H), 8.12 (d, *J* = 8.1 Hz, 2H), 7.13 (d, *J* = 5.4 Hz, 1H), 6.89 (m, 2H), 4.08 (m, 1H), 3.86 (dd, *J* = 6.6 Hz, 17.4 Hz, 1H), 3.55 (dd, *J* = 7.2 Hz, 17.1 Hz, 1H), 2.56 (m, 1H), 2.34-2.21 (m, 2H), 2.08-1.95 (m, 1H), 1.86-1.76 (m, 3H); HPLC (AD, hexane:*i*-PrOH 60:40, 1.0 mL/min): t_R 14.85 min (major enantiomer), 16.06 min (minor enantiomer); ee 98%; $[\alpha]_D^{25}$ = +55 (*c* = 1.0, $CHCl_3$).

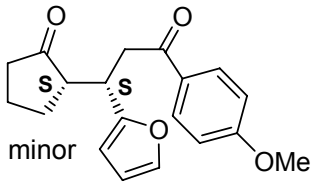
(R)-2-((S)-3-(4-Nitrophenyl)-3-oxo-1-(thiophen-2-yl)propyl)cyclopentanone M-10:

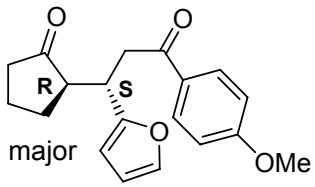


^{1}H NMR (300 MHz, $CDCl_3$): δ 8.30 (d, *J* = 7.8 Hz, 2H), 8.07 (d, *J* = 8.1 Hz, 2H), 7.14 (d, *J* = 4.8 Hz, 1H), 6.88 (m, 2H), 4.04 (m, 1H), 3.86 (dd, *J* = 6.0 Hz, 17.4 Hz, 1H), 3.43 (dd, *J* = 7.2 Hz, 16.8 Hz, 1H), 2.45 (dd, *J* = 8.7 Hz, 17.1 Hz, 1H), 2.33-2.27 (m, 1H), 2.17-1.94 (m, 3H), 1.79-1.58 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 219.2, 196.6, 150.2, 145.2, 141.3, 129.0, 126.7, 125.3, 123.8, 53.3, 44.4,

38.8, 36.4, 27.7, 20.1; HPLC (AD, hexane:*i*-PrOH 60:40, 1.0 mL/min): t_R 23.38 min (major enantiomer), 32.97 min (minor enantiomer); ee >99%; $[\alpha]_D^{25}$ = -59 (*c* = 1.4, $CHCl_3$).

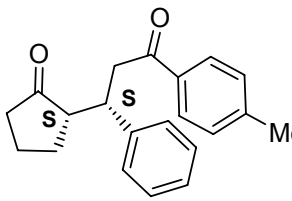
2-(1-(Furan-2-yl)-3-(4-methoxyphenyl)-3-oxopropyl)cyclopentanone M-11:



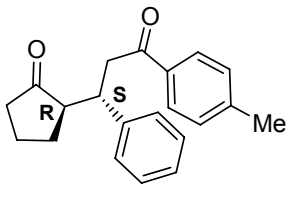


Obtained in 56% yield; colorless oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.95 (d, *J* = 8.7 Hz, 2.24H), 6.93 (d, *J* = 8.7 Hz, 2.65H), 6.23 (m, 1.03H), 6.04 (m, 1.00H), 3.96 (dd, *J* = 6.9 Hz, 13.5 Hz, 1.12H), 3.86 (s, 3.92H), 3.58 (dd, *J* = 6.9 Hz, 16.5 Hz, 0.59H), 3.44-3.36 (dd, *J* = 3.0 Hz, 6.9 Hz, 1.95H), 2.45 (dd, *J* = 9.6 Hz, 17.1 Hz, 1.37H), 2.28-2.16 (m, 1.82H), 2.11-1.99 (m, 2.25H), 1.89-1.54 (m, 4.85H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 220.1, 219.4, 197.1, 196.6, 163.5, 155.7, 155.3, 141.3, 141.2, 130.4, 129.9, 129.6, 115.3, 113.7, 110.2, 110.1, 106.6, 106.4, 55.4, 51.8, 50.9, 39.8, 39.4, 39.2, 38.5, 35.0, 34.5, 27.5, 26.6, 20.5, 20.3; HPLC (AD, hexane:*i*-PrOH 60:40, 1.0 mL/min): dr 1:3; t_R 11.94 min (major enantiomer), 15.91 min (minor enantiomer); ee 98.2%; t_R 13.54 min (minor enantiomer), 18.76 min (major enantiomer); ee 97.1%; $[\alpha]_D^{25}$ = -28 (*c* = 0.9, $CHCl_3$).

(S)-2-((S)-3-oxo-1-phenyl-3-p-tolylpropyl)cyclopentanone M-12: Obtained in 85% yield; white solid; m.p. 80-81℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.87 (d, J = 8.1 Hz, 2H), 7.29-7.19 (m, 7H), 3.78 (m, 2H), 3.44 (dd, *J* = 9.3 Hz, 19.5 Hz, 1H), 2.52-2.49 (m, 1H), 2.39 (s, 3H), 2.24 (dd, *J* = 6.0 Hz, 18.0 Hz, 1H), 2.19-2.09 (m, 1H), 1.91 (dd, *J* = 8.7 Hz, 18.0 Hz, 1H), 1.83-1.61 (m, 3H); HPLC (AD, hexane:*i*-PrOH 60:40, 1.0 mL/min): t_R 8.96 min (major enantiomer), 11.87 min (minor enantiomer); ee >99%; $[\alpha]_D^{25}$ = +61 (*c* = 0.8, $CHCl_3$).

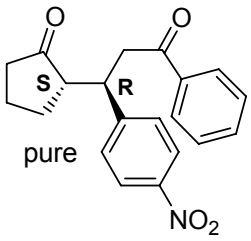


(R)-2-((S)-3-oxo-1-phenyl-3-p-tolylpropyl)cyclopentanone M-12: ^{1}H NMR (300 MHz in $CDCl_3$): δ 7.81 (d, *J* = 8.1 Hz, 2H), 7.29-7.15 (m, 7H), 3.82 (dd, *J* = 6.3 Hz, 16.5 Hz, 1H),



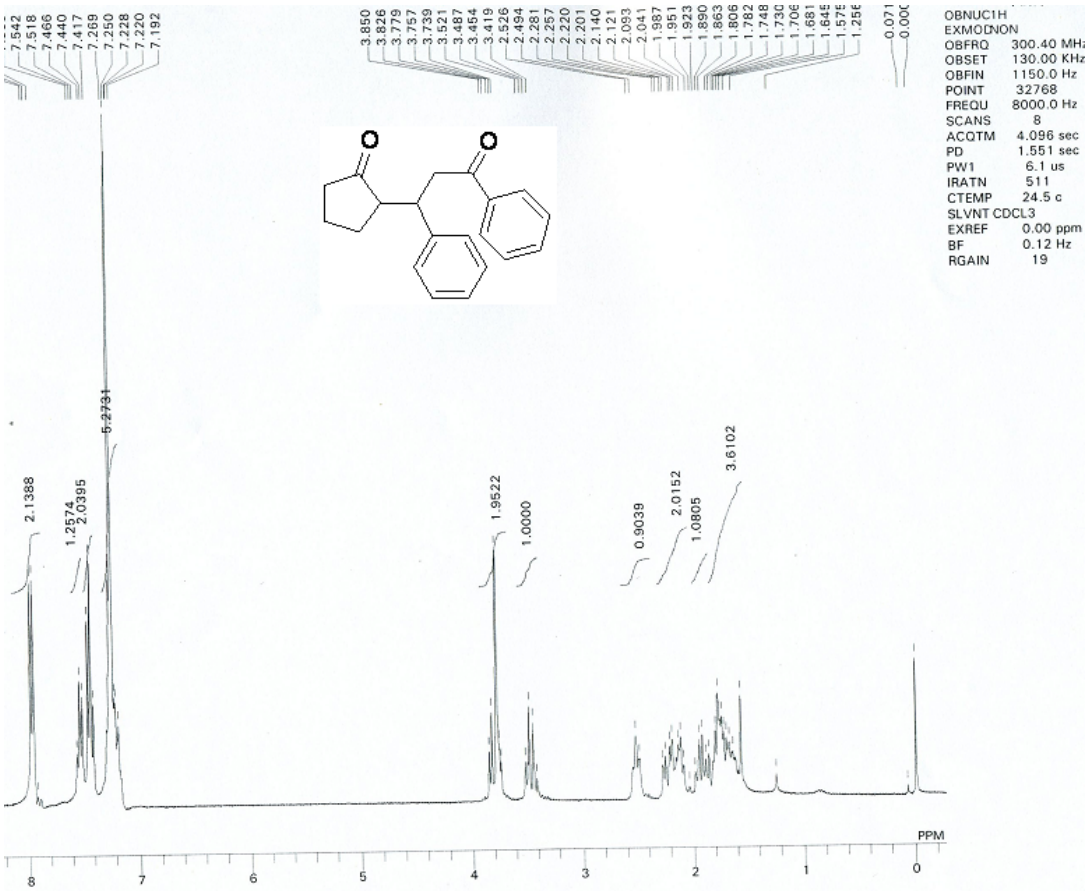
3.70 (dd, *J* = 7.5 Hz, 15.0 Hz, 1H), 3.35 (dd, *J* = 7.5 Hz, 16.5 Hz, 1H), 2.45 (dd, *J* = 7.5 Hz, 16.5 Hz, 1H), 2.39 (s, 3H), 2.29-2.19 (m, 1H), 2.04 (dd, *J* = 9.0 Hz, 18.0 Hz, 1H), 1.94-1.85 (m, 2H), 1.74-1.51 (m, 3H); HPLC (AD, hexane:*i*-PrOH 60:40, 1.0 mL/min): t_R 12.89 min (major enantiomer), 24.38 min (minor enantiomer); ee 97.4%; $[\alpha]_D^{25}$ = -57 (*c* = 1.2, $CHCl_3$).

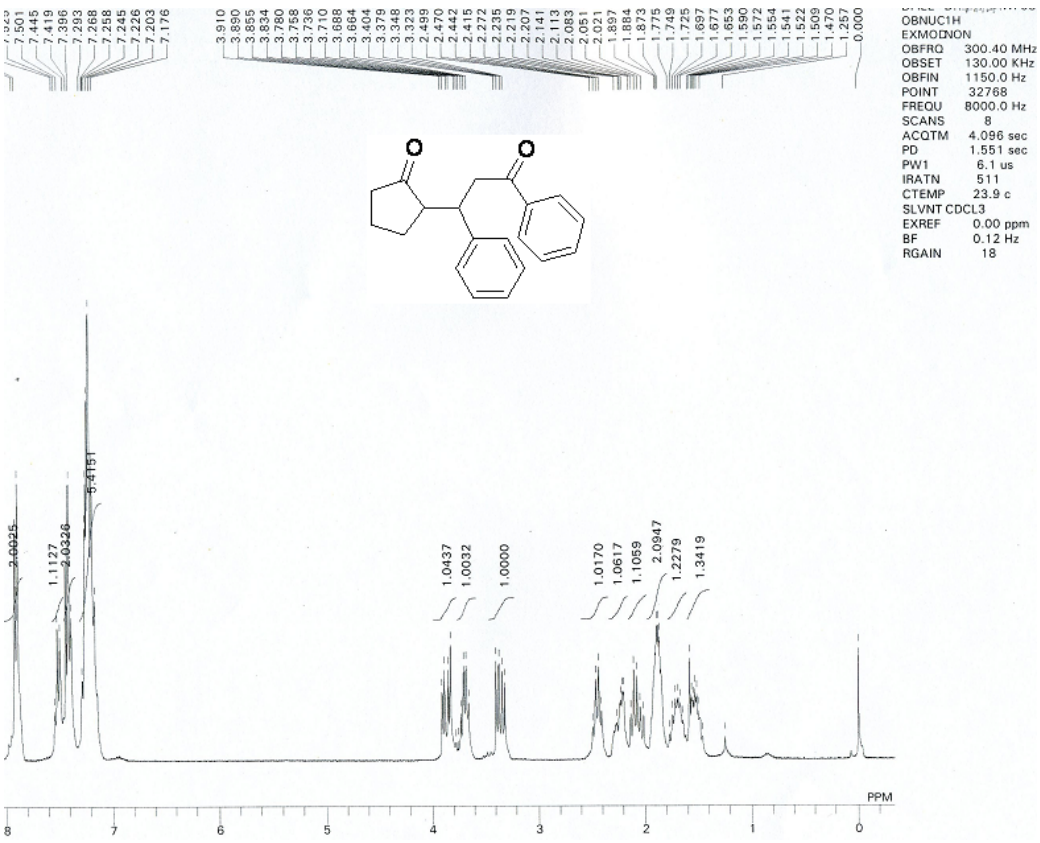
(S)-2-((R)-1-(4-nitrophenyl)-3-oxo-3-phenylpropyl)cyclopentanone M-13:



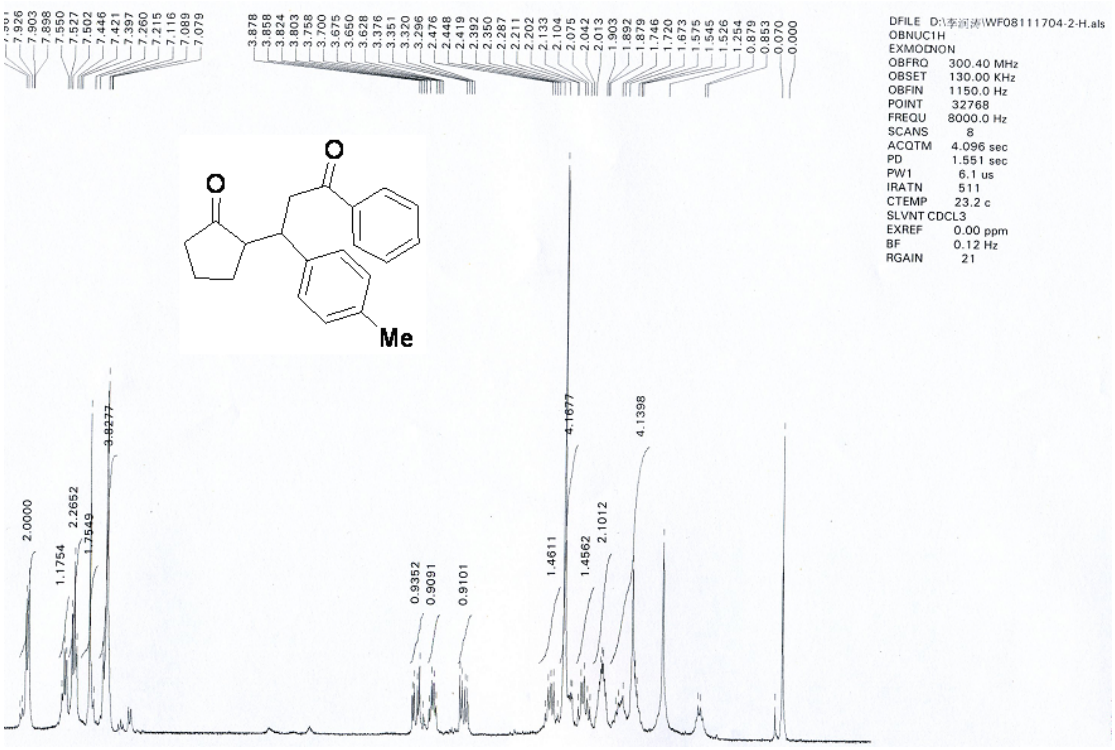
Obtained in 76% yield; light yellow crystal; m.p. 131-132℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.15 (d, *J* = 8.4 Hz, 2H), 7.92 (d, *J* = 7.5 Hz, 2H), 7.59-7.54 (m, 1H), 7.47-7.41 (m, 4H), 4.01 (dd, *J* = 5.1 Hz, 17.1 Hz, 1H), 3.80 (dd, *J* = 4.8 Hz, 8.4 Hz, 1H), 3.42 (dd, *J* = 8.7 Hz, 17.4 Hz, 1H), 2.50 (dd, *J* = 8.7 Hz, 18.3 Hz, 1H), 2.34 (dd, *J* = 7.8 Hz, 19.2 Hz, 1H), 2.12 (dd, *J* = 8.4 Hz, 18.6 Hz, 1H), 1.99-1.87 (m, 2H), 1.81-1.71 (m, 1H), 1.53-1.39 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 218.8, 197.7, 150.3, 146.7, 136.6, 133.3, 129.2, 128.6, 127.9, 123.7, 52.4, 42.4, 40.7, 38.7, 28.1, 20.2; HPLC (AS, hexane:*i*-PrOH 50:50, 1.0 mL/min): dr 3:2; t_R 10.02 min (major enantiomer), 11.53 min (minor enantiomer); ee >96.4%; t_R 11.65 min (major enantiomer), 13.34 min (minor enantiomer); ee >99%; $[\alpha]_D^{25}$ = +25 (*c* = 1.5, $CHCl_3$); recrystallization: dr >99:1; ee >99.9%; $[\alpha]_D^{25}$ = +120 (*c* = 1.5, $CHCl_3$).

NMR Spectra for Michael Product M-1

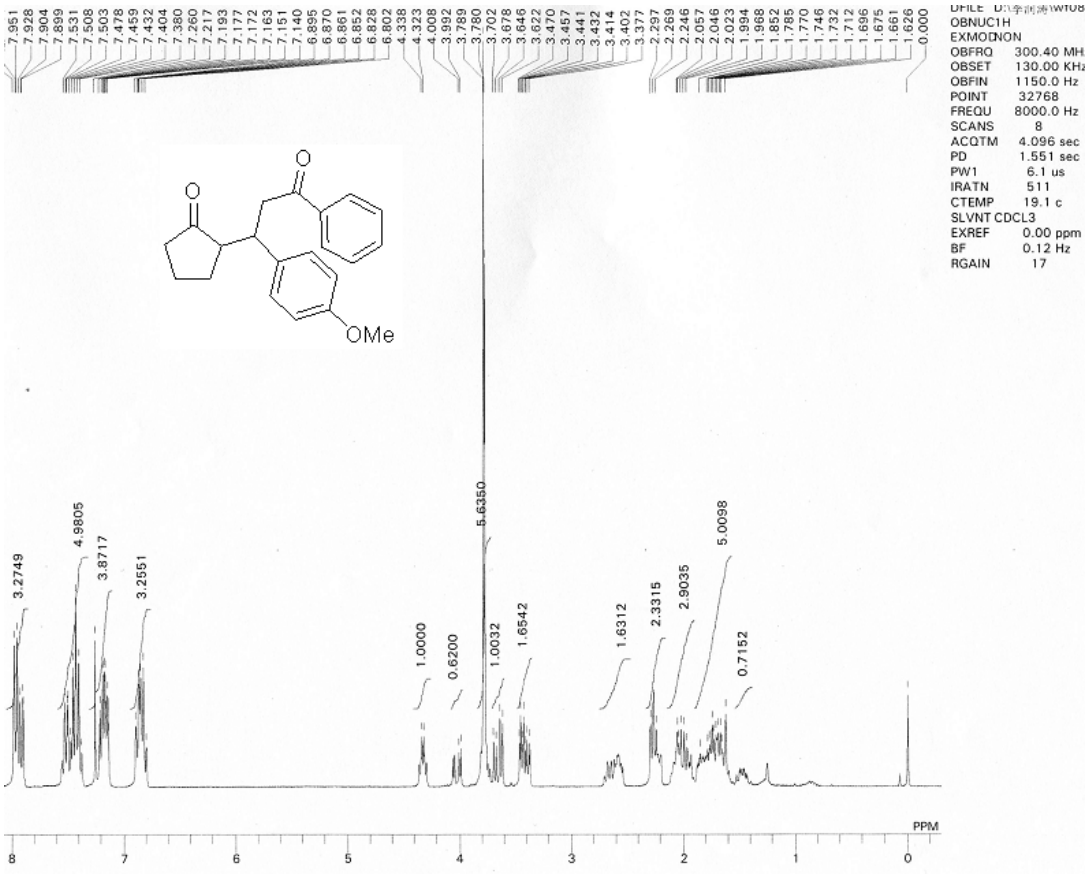




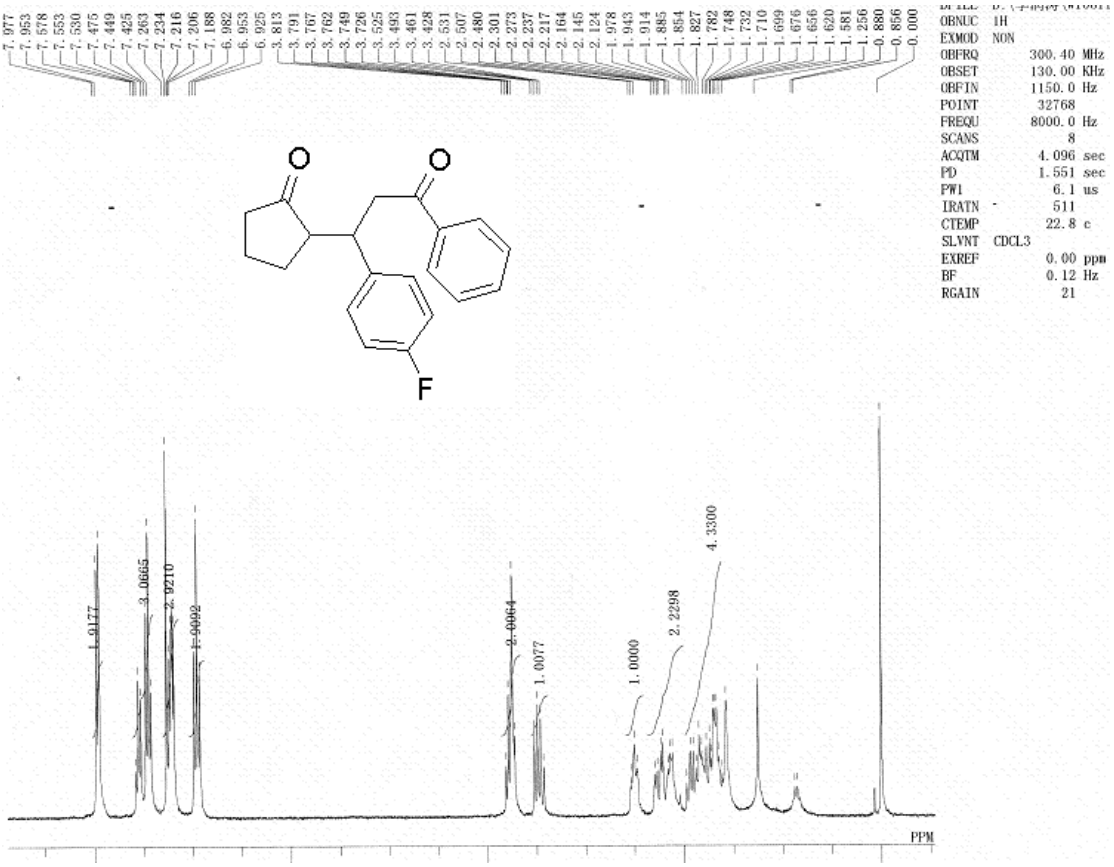
NMR Spectra for Michael Product M-2

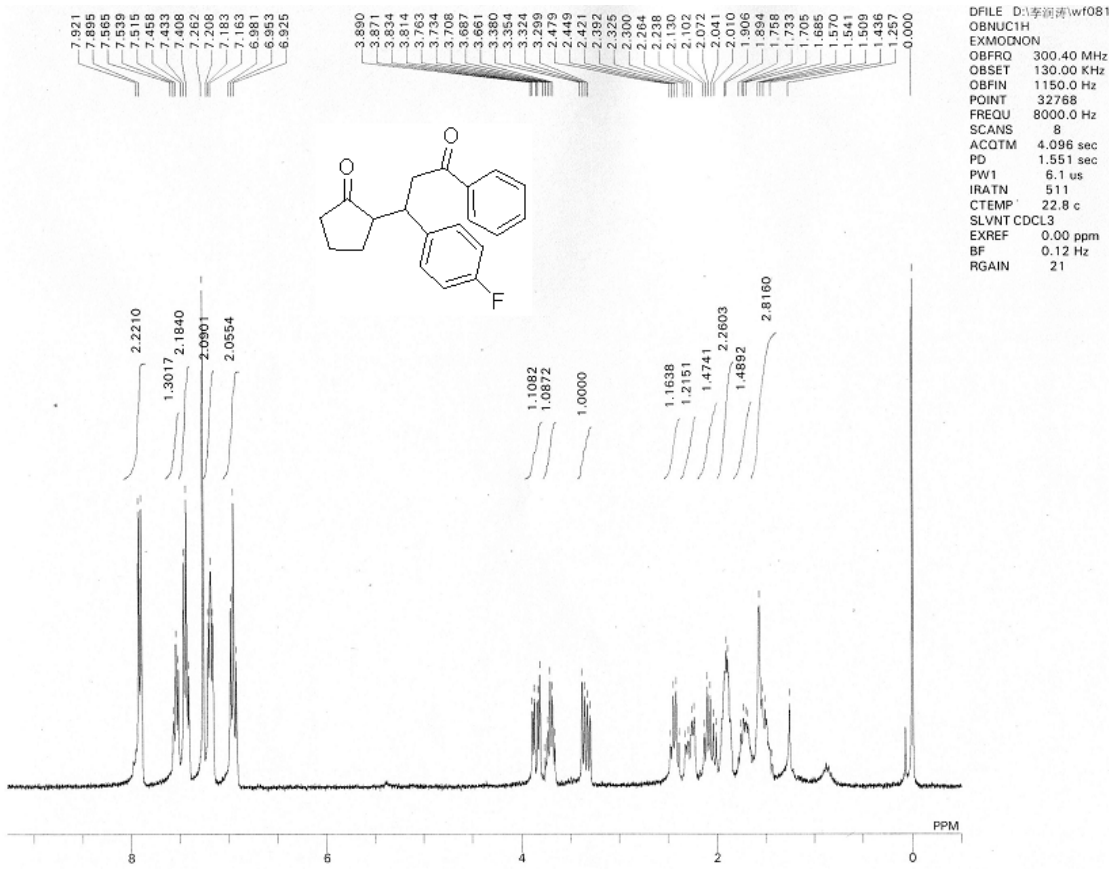


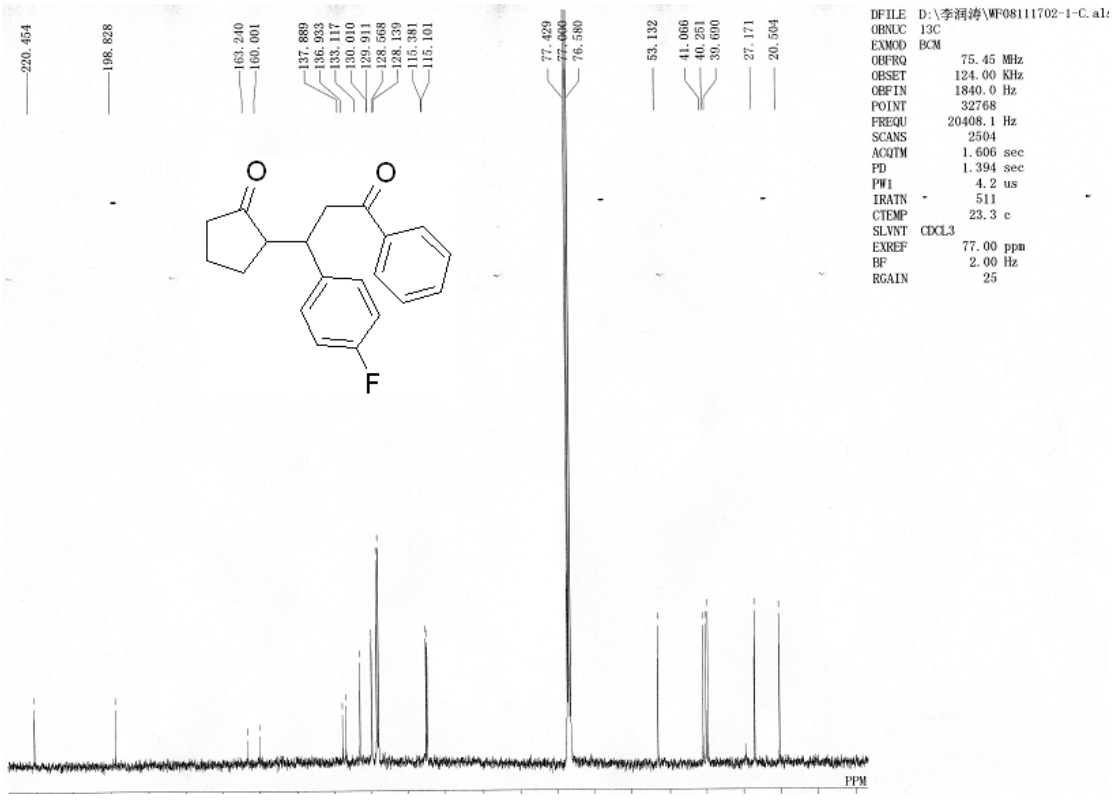
NMR Spectra for Michael Product M-3



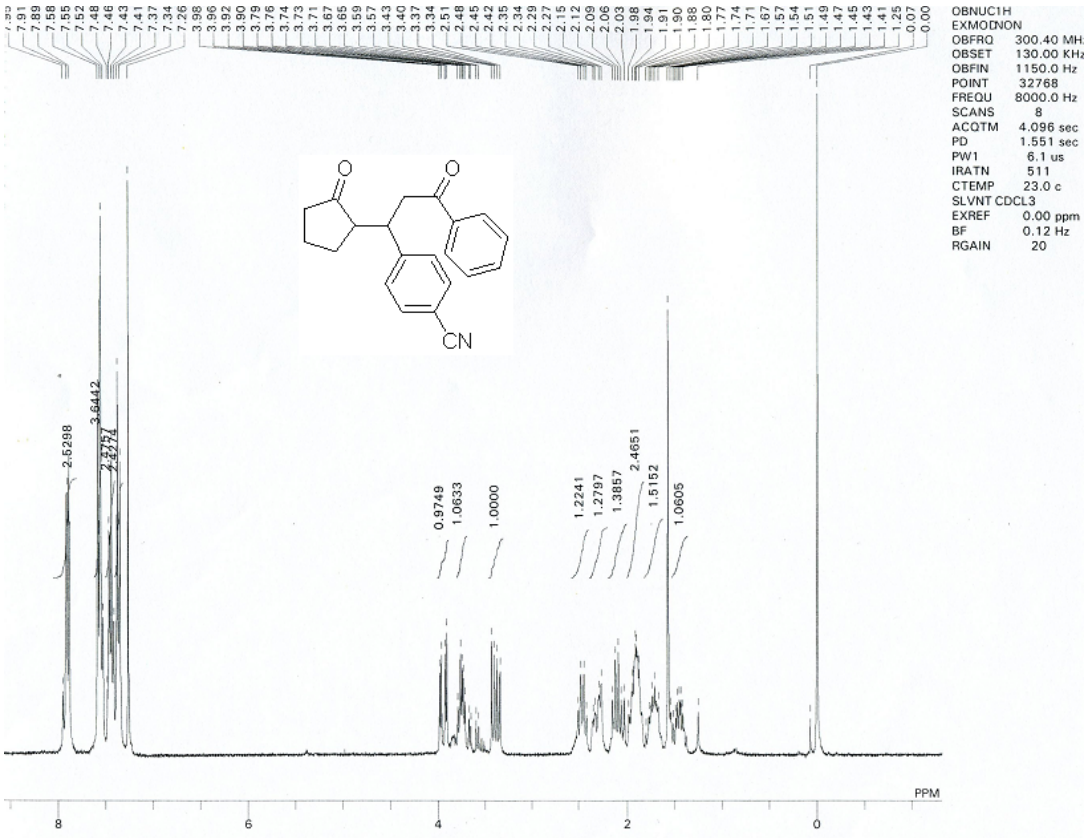
NMR Spectra for Michael Product M-4



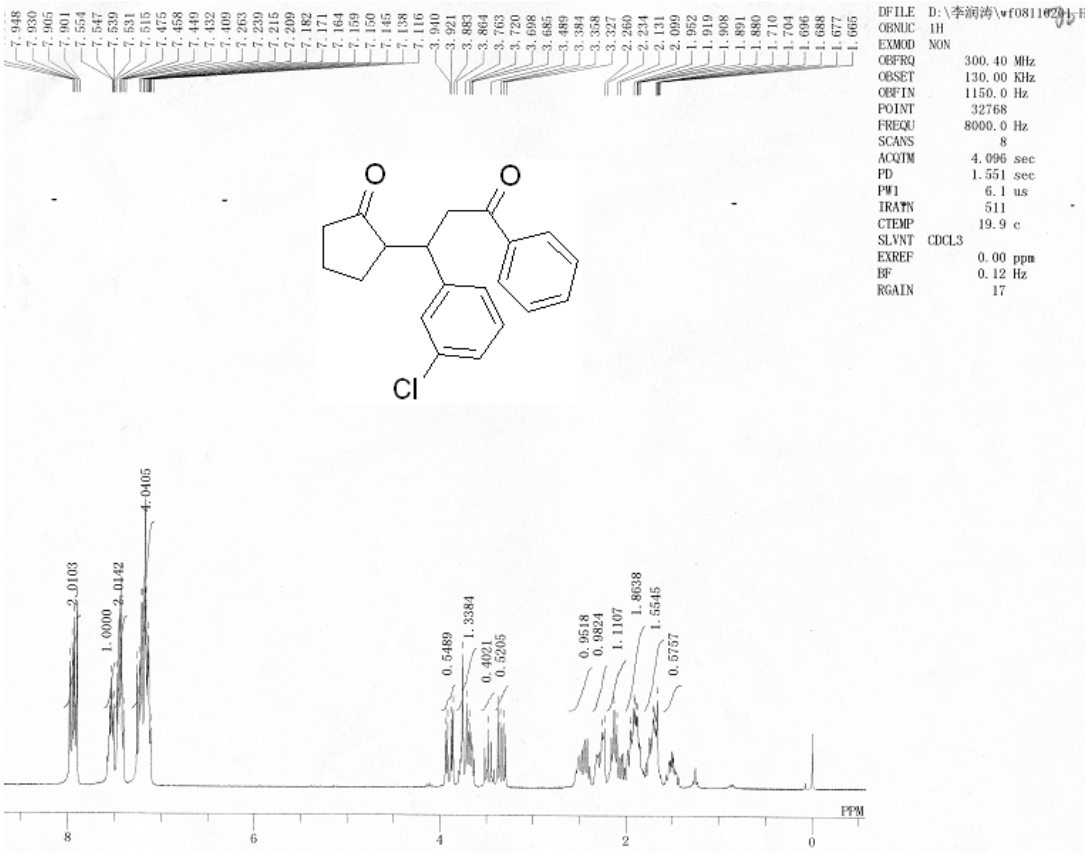


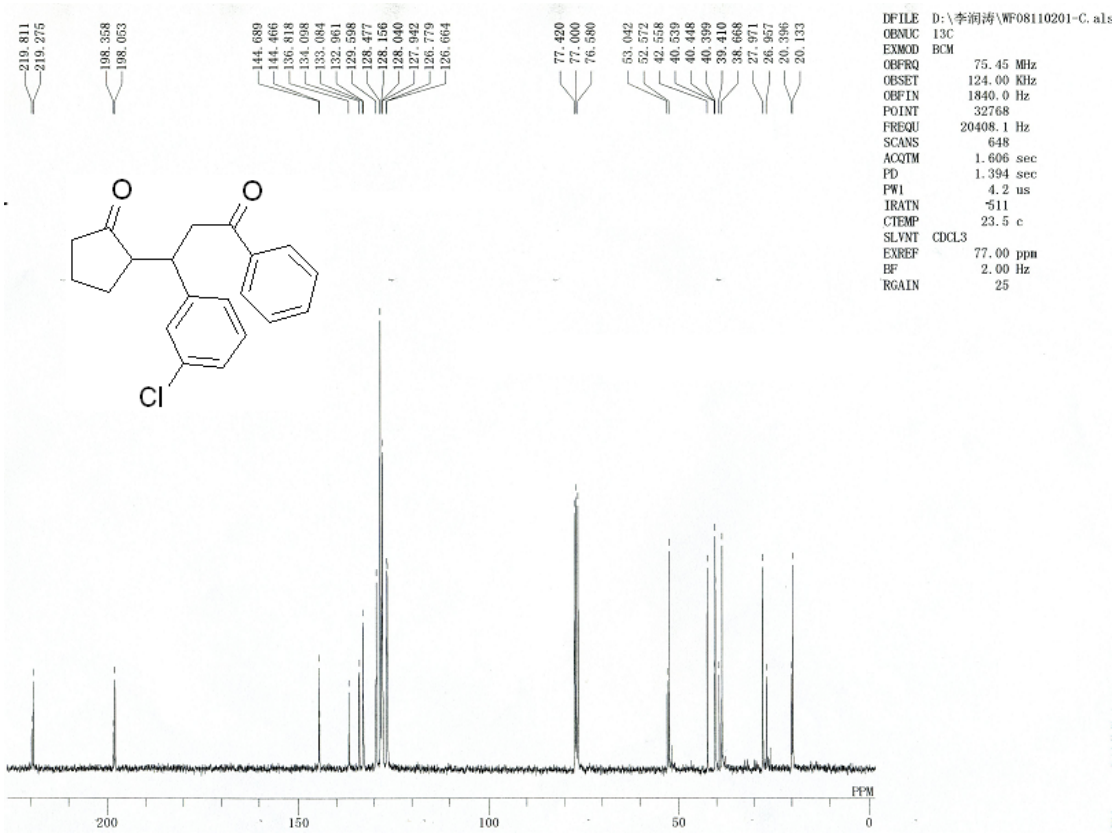


NMR Spectra for Michael Product M-5

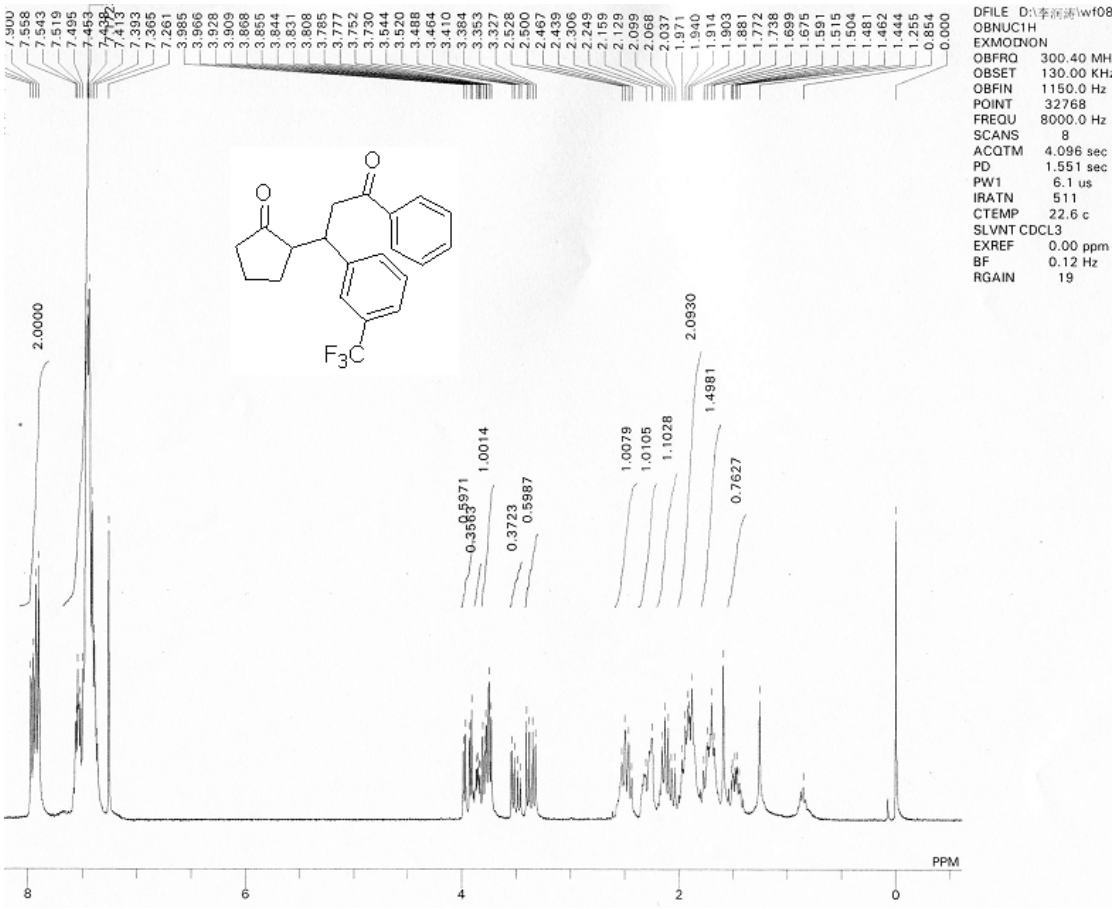


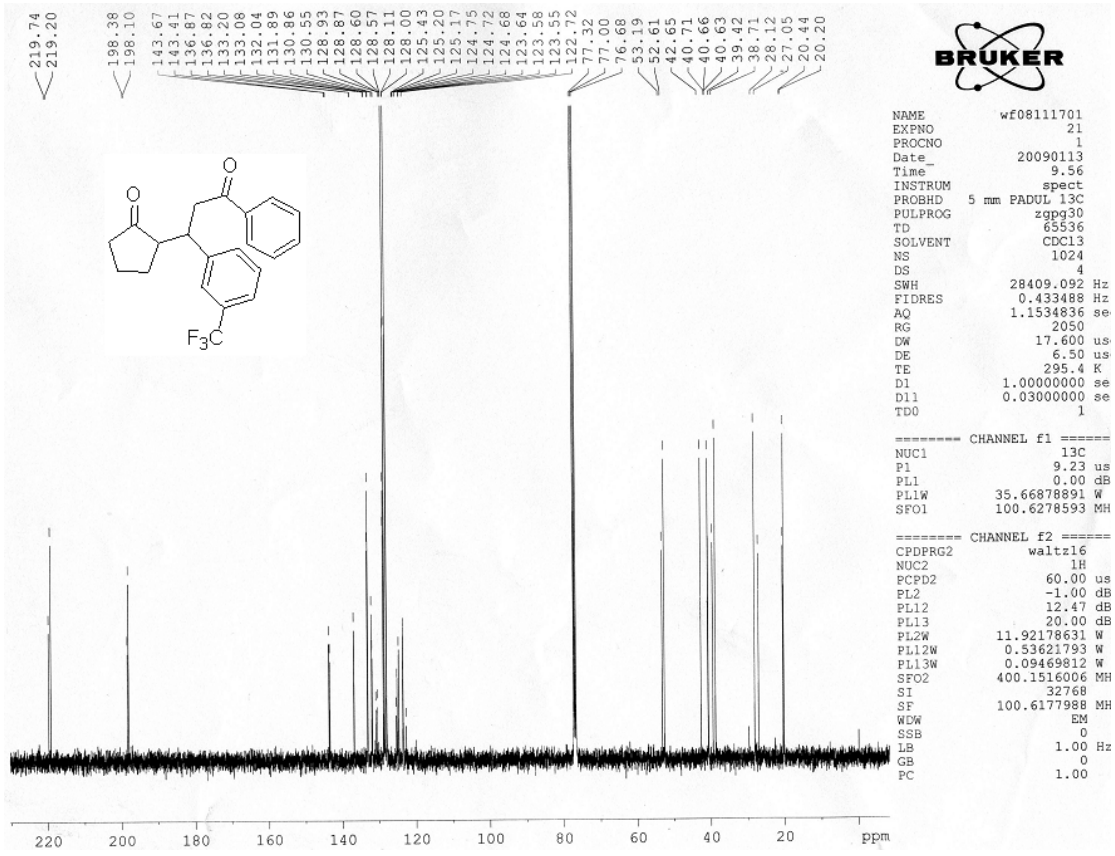
NMR Spectra for Michael Product M-6



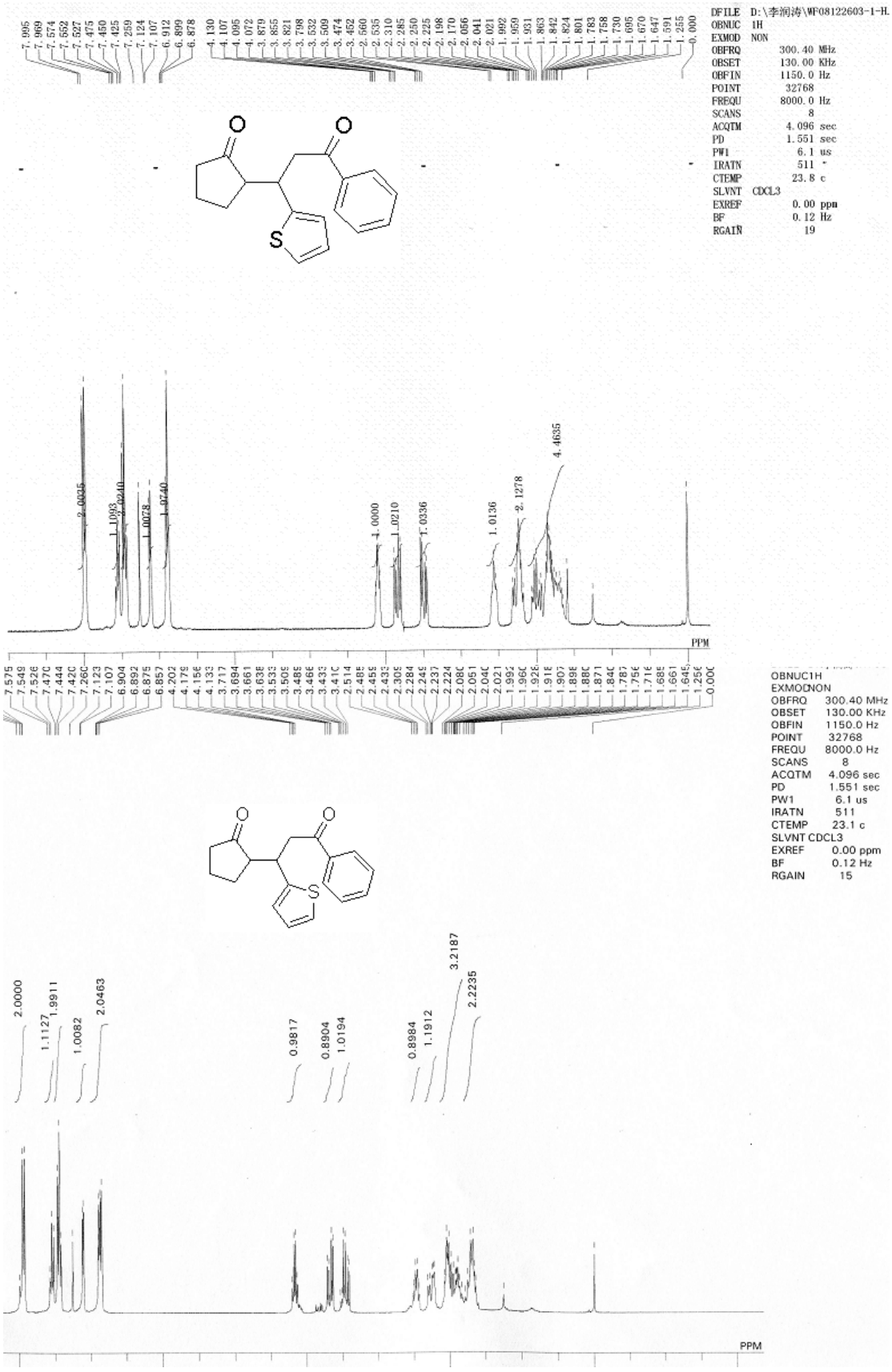


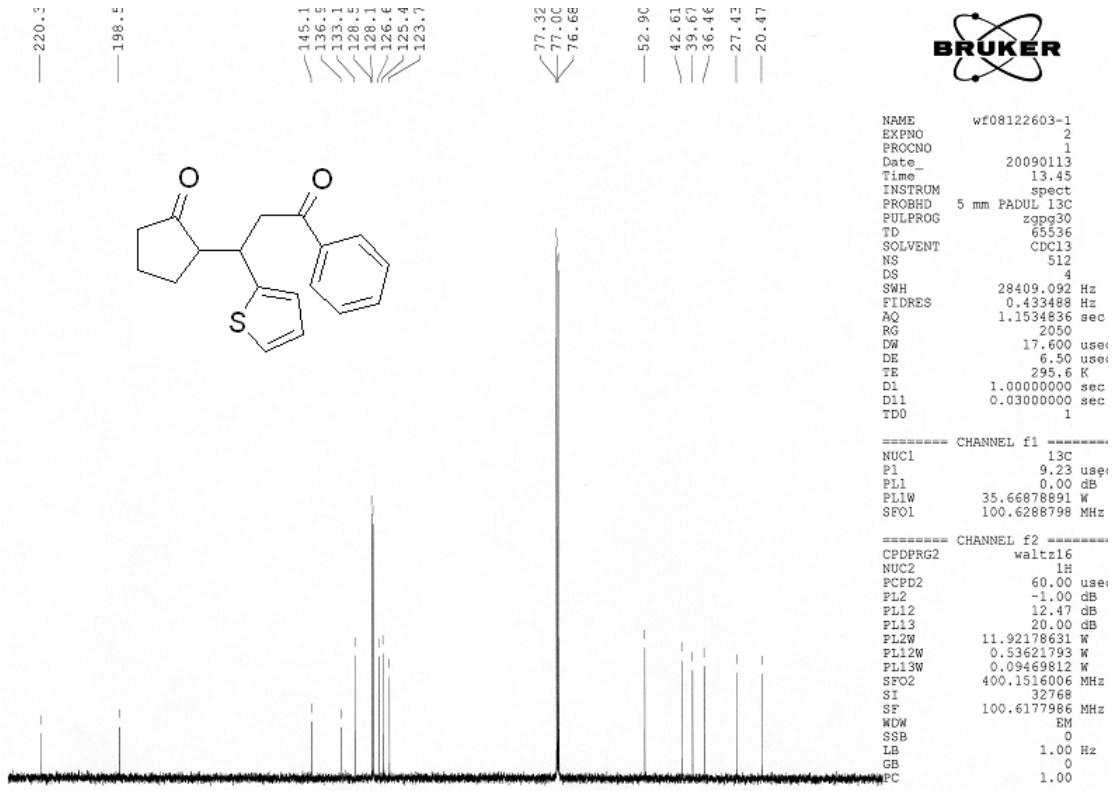
NMR Spectra for Michael Product M-7



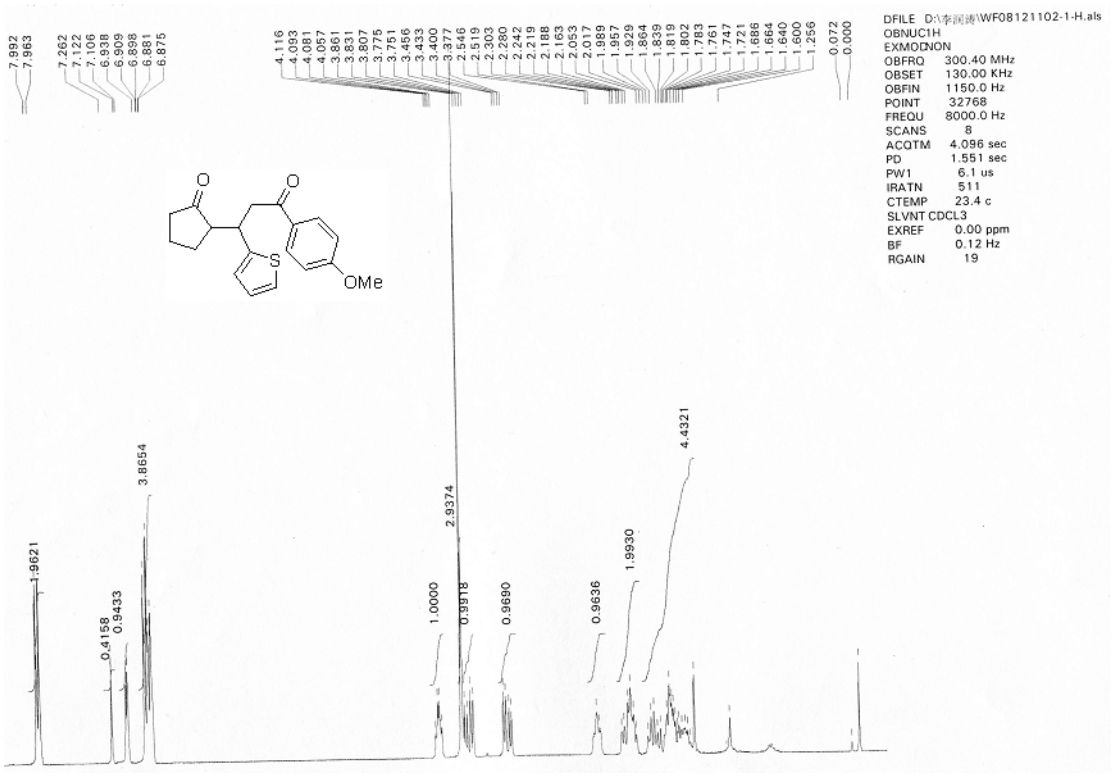


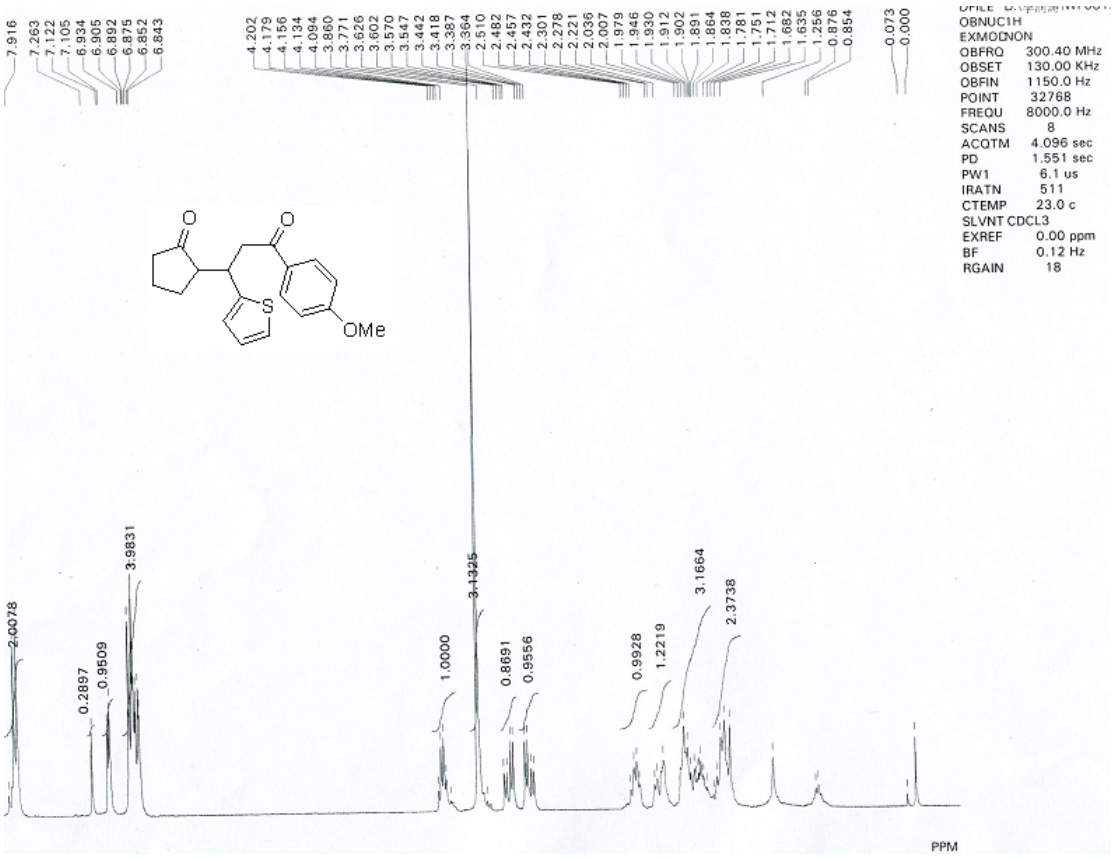
NMR Spectra for Michael Product M-8





NMR Spectra for Michael Product M-9

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4.156
4.134
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3.860
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3.387
3.364
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2.221
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1.751
1.712
1.682
1.635
1.256
0.876
0.854
0.073
0.000
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EXMOD NON
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OBSET 130.00 KHz
OBFIN 1150.0 Hz
POINT 32768
FREQU 8000.0 Hz
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PD 1.551 sec
PW1 6.1 us
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SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 18
O
O
S
OMe
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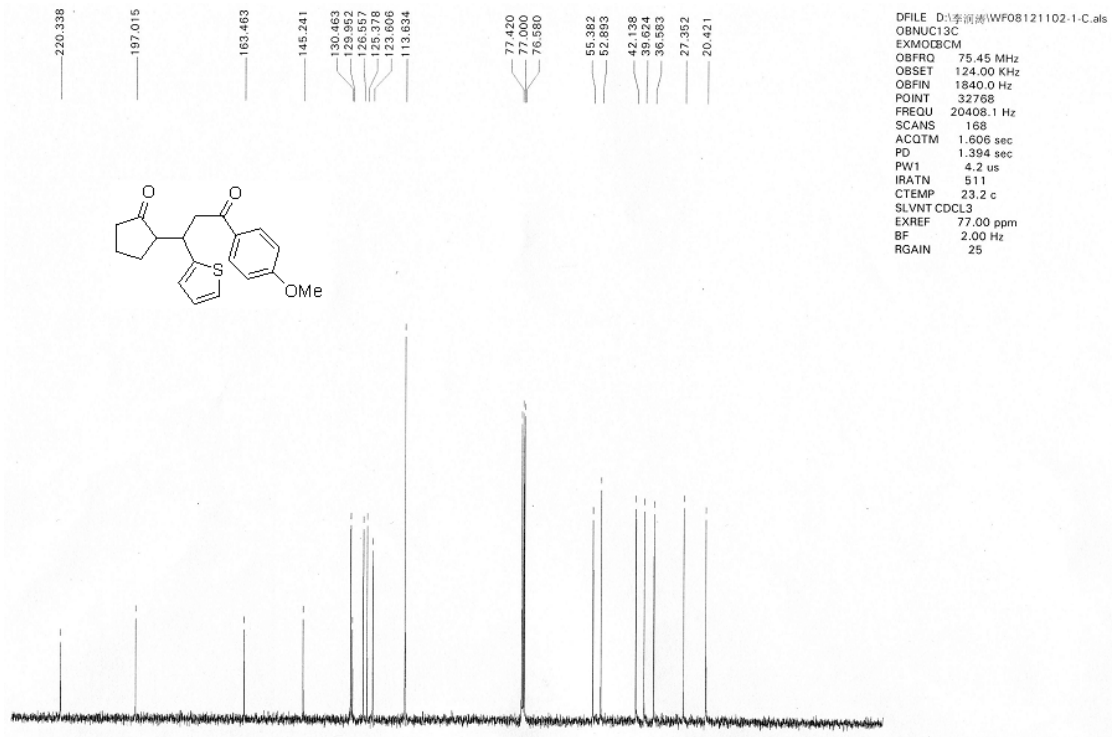
2.3738
PPM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125.378
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113.634
77.420
77.000
76.580
55.382
52.893
42.138
39.624
36.583
27.352
20.421
DFILE D:\李河涛\WF08121102-1-C.als
OBNUC13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 168
ACQTM 1.606 sec
PD 1.394 sec
PW1 4.2 us
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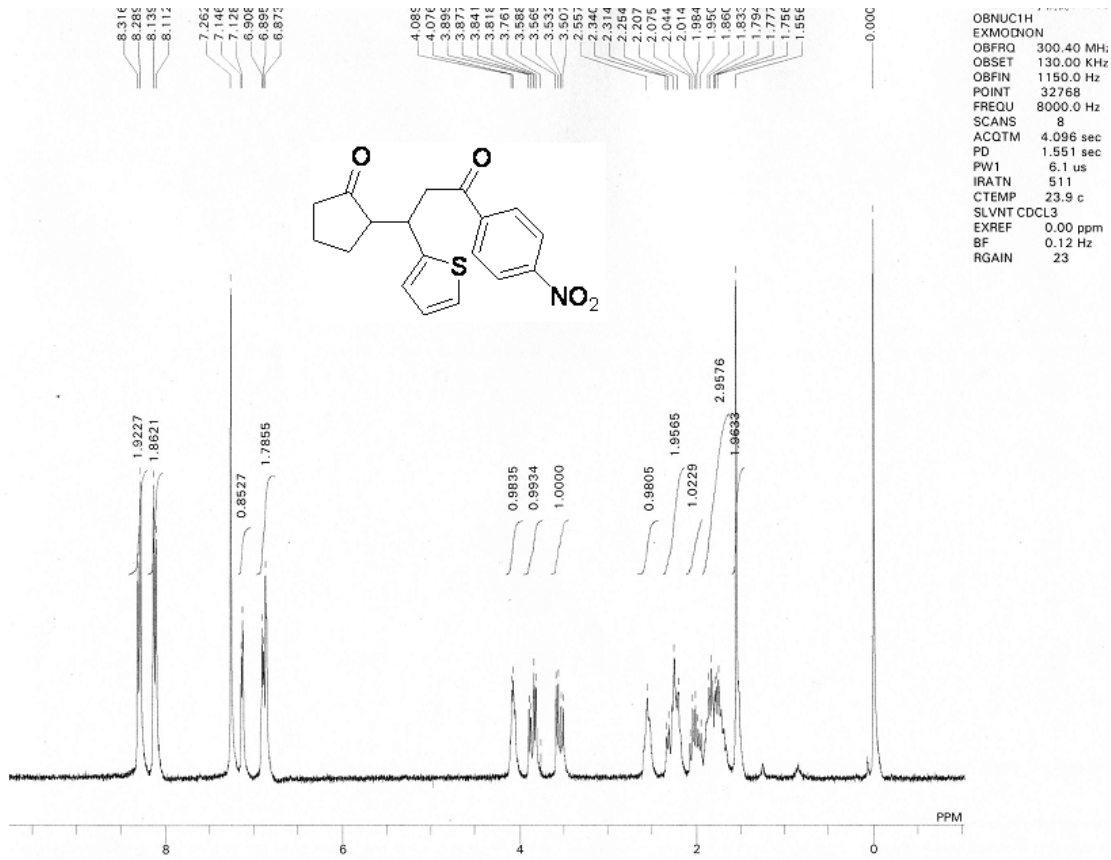
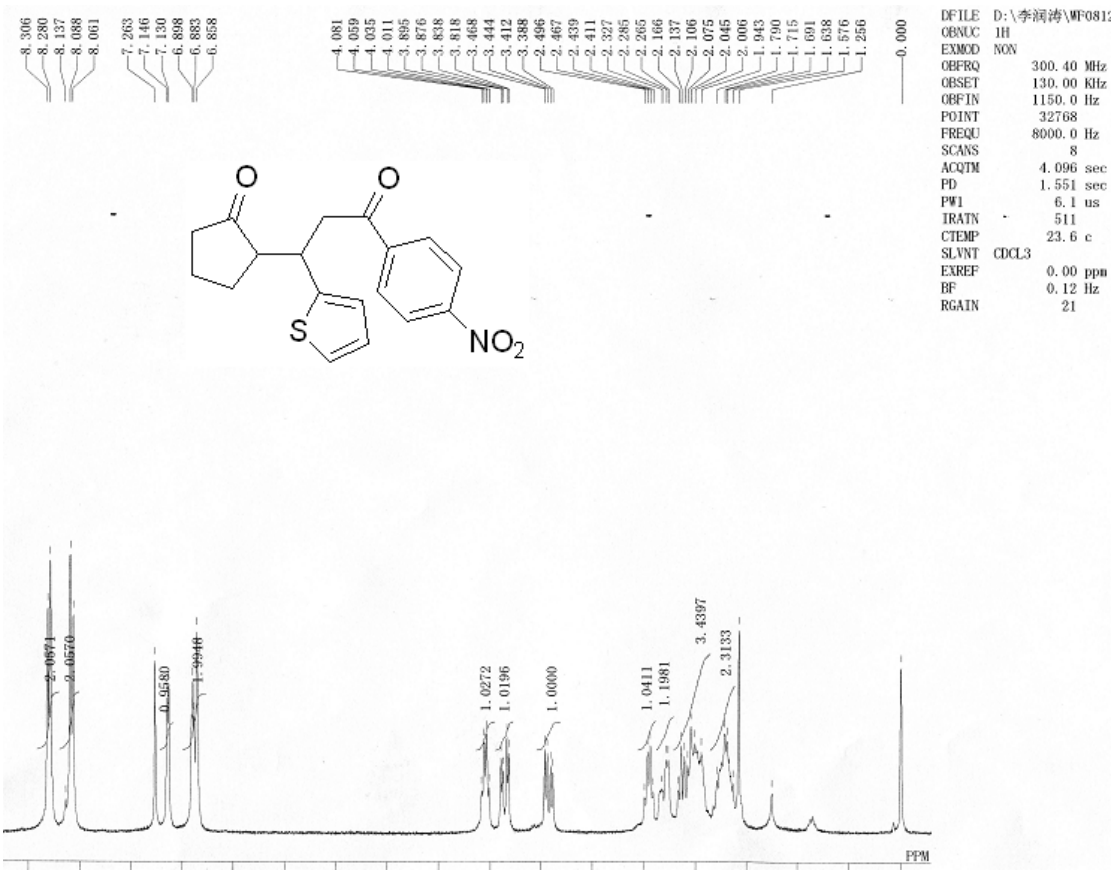
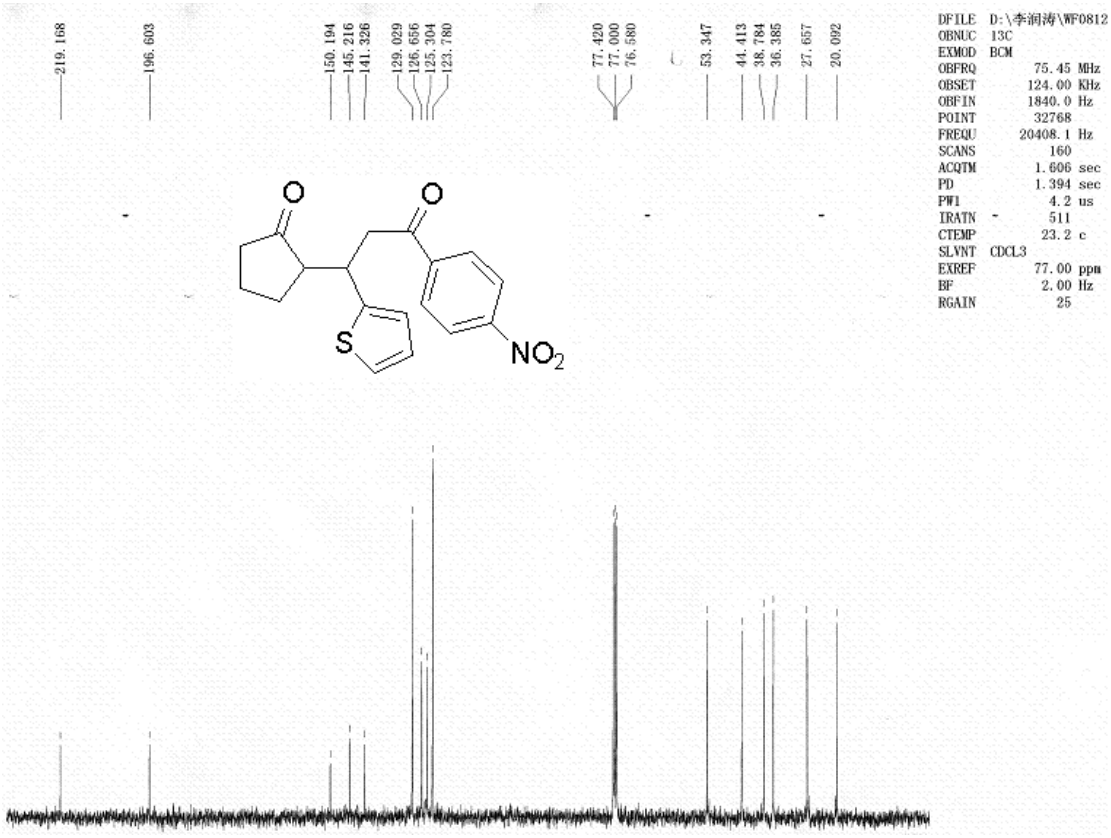
O
O
S
OMe

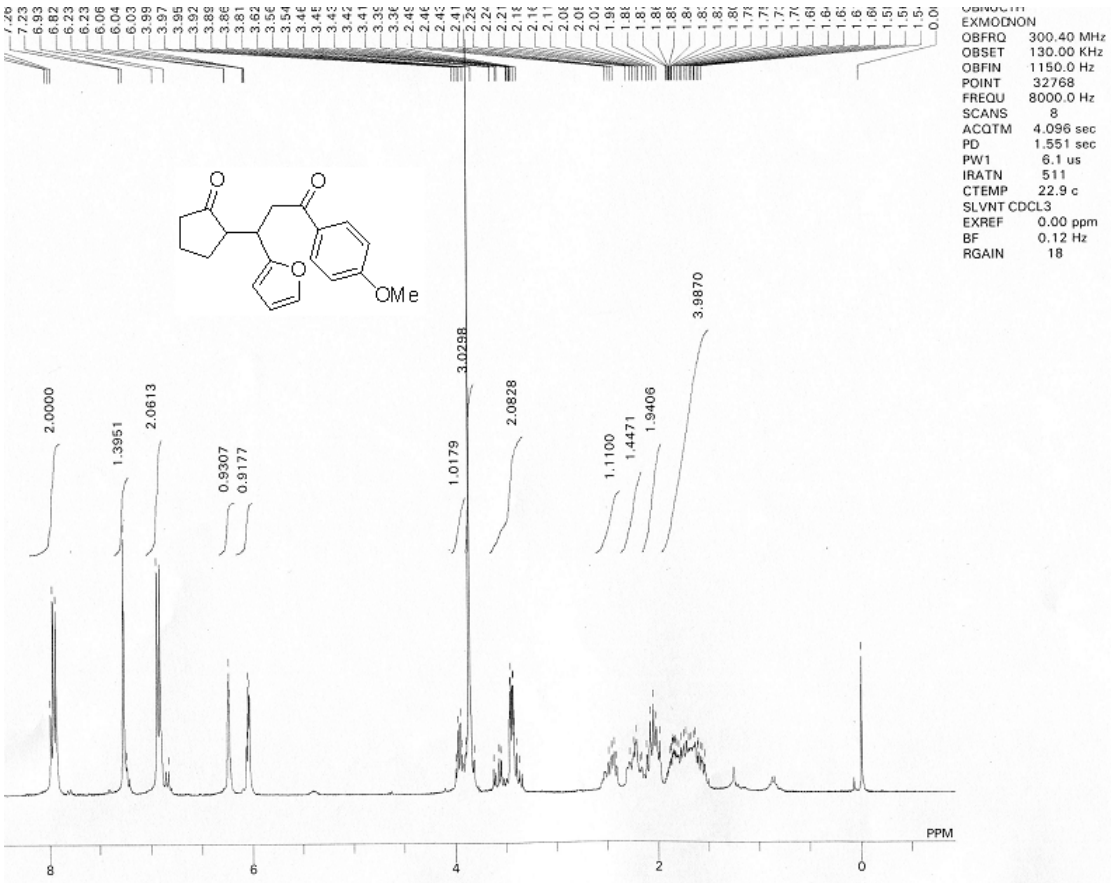
NMR Spectra for Michael Product M-10

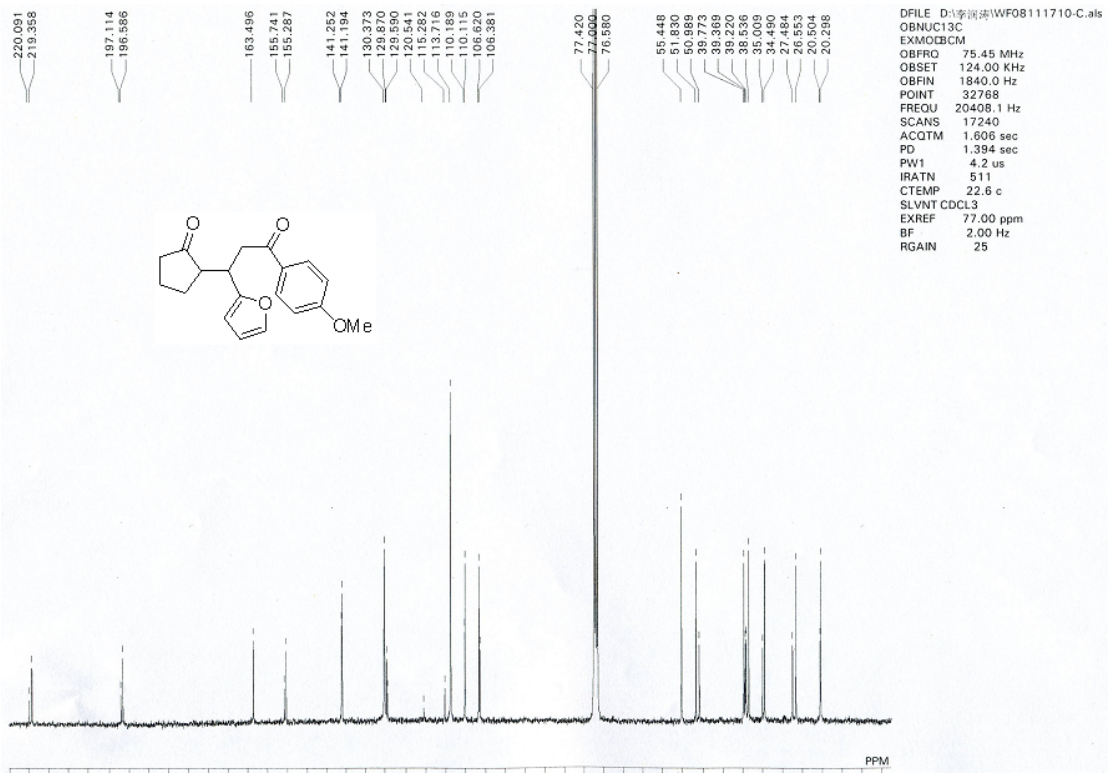




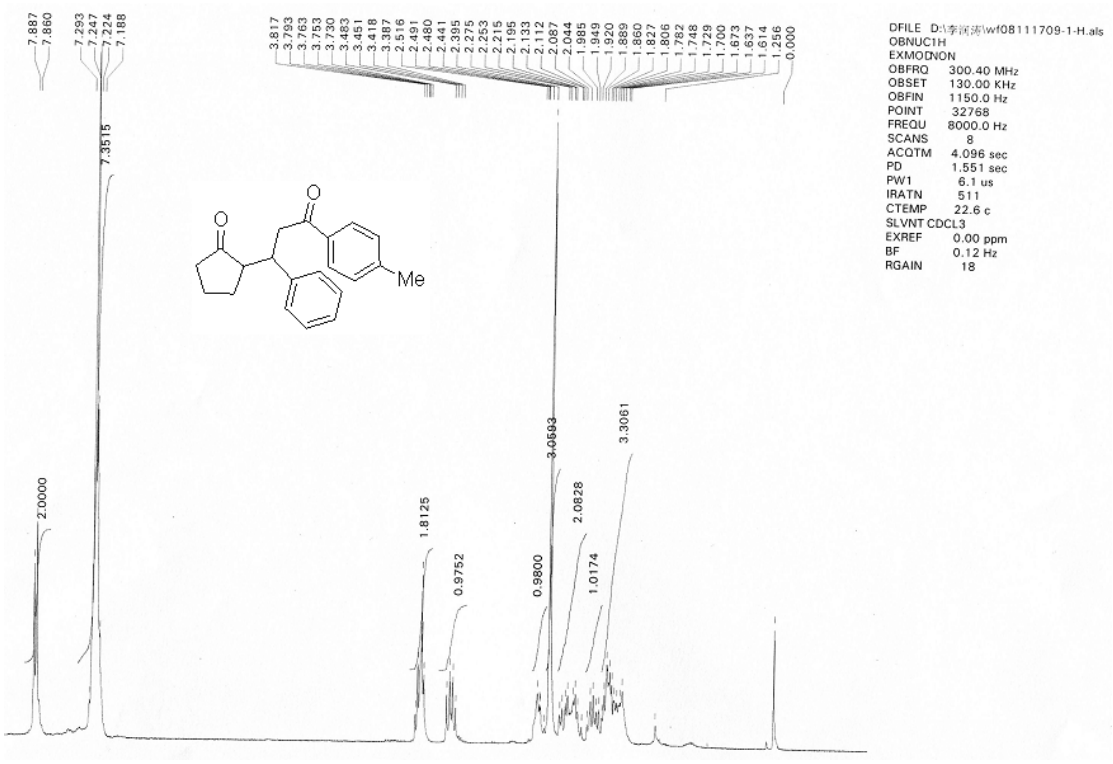


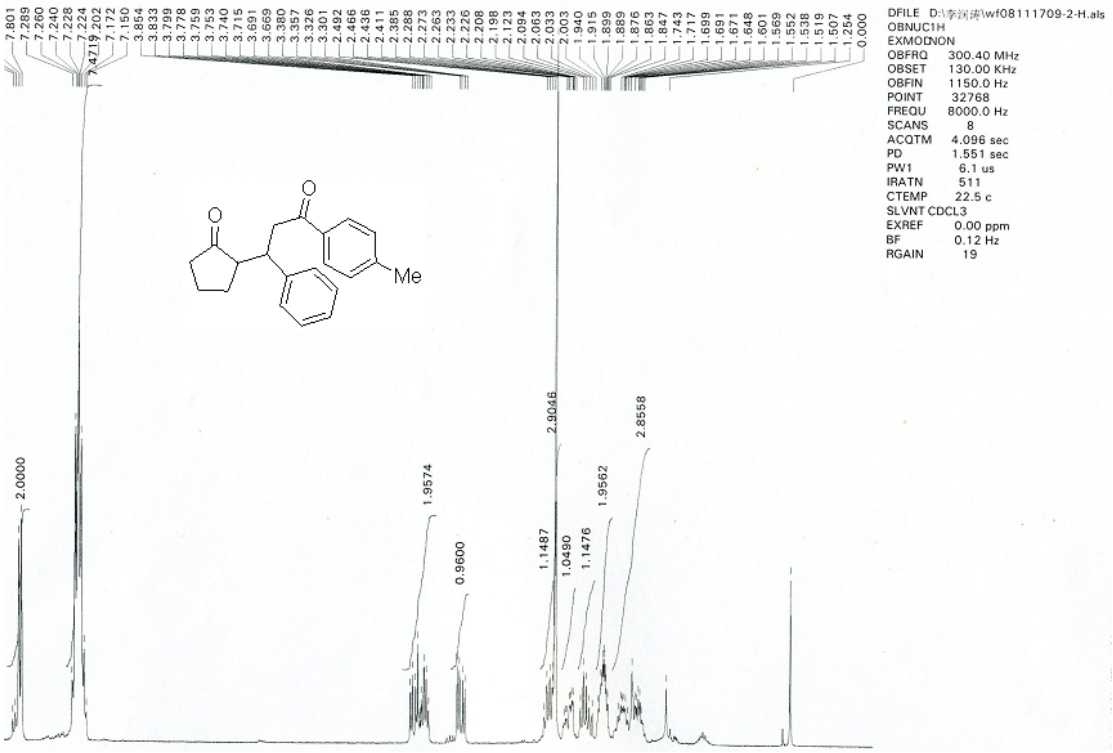
NMR Spectra for Michael Product M-11



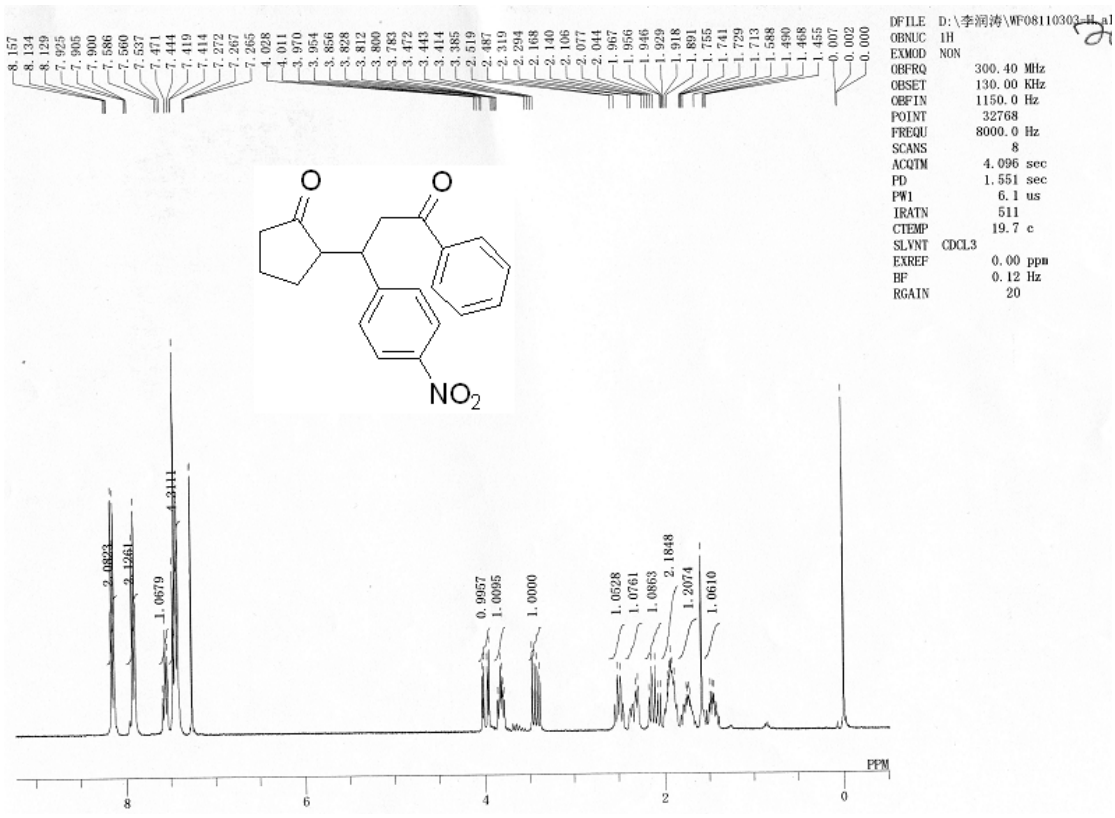


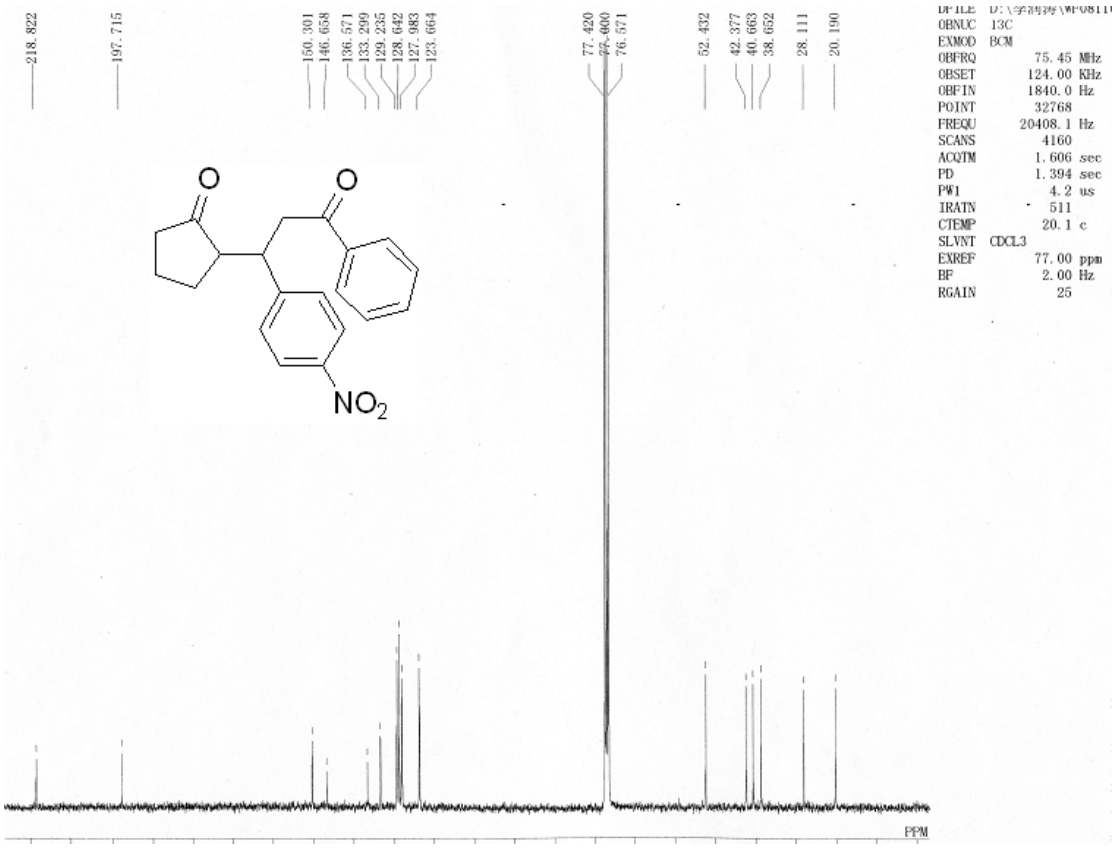
NMR Spectra for Michael Product M-12





NMR Spectra for Michael Product M-13

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123.664
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77.000
76.571
52.432
42.377
40.663
38.652
28.111
20.190
O
O
NO2
PPM
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 4160
ACQTM 1.606 sec
PD 1.394 sec
PW1 4.2 us
IRATN 511
CTEMP 20.1 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 2.00 Hz
RGAIN 25

HPLC analysis for compounds M-1 to M-13

M-1

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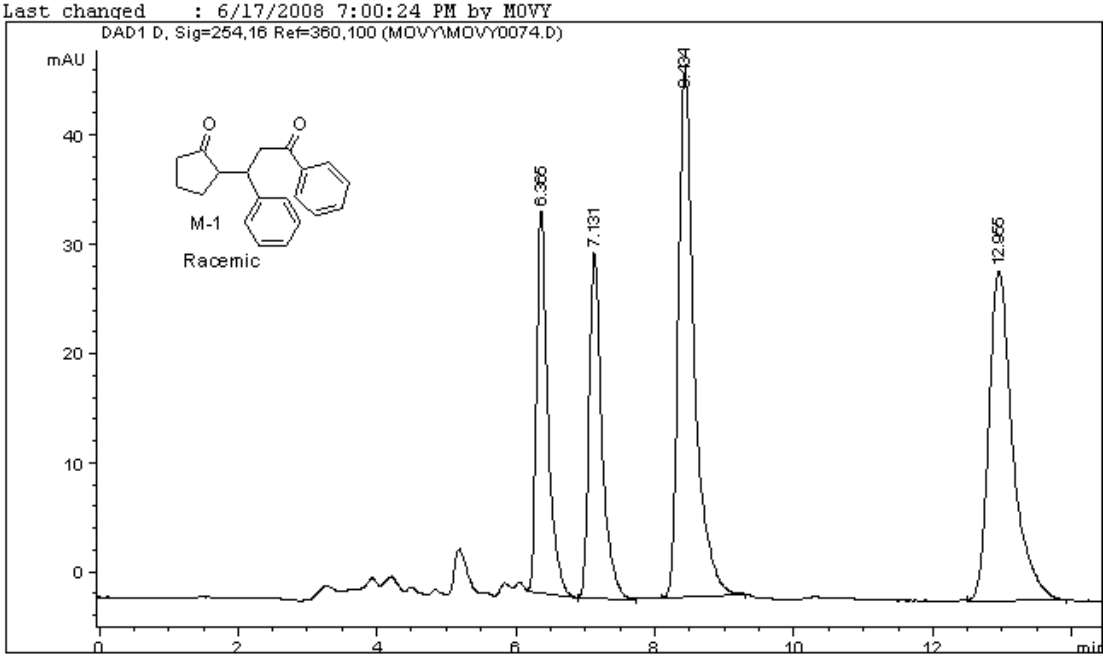

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4	12.955	BBA	0.3549	716.78088	30.20444	31.4084

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Injection Date  : 7/18/2008 9:31:57 AM
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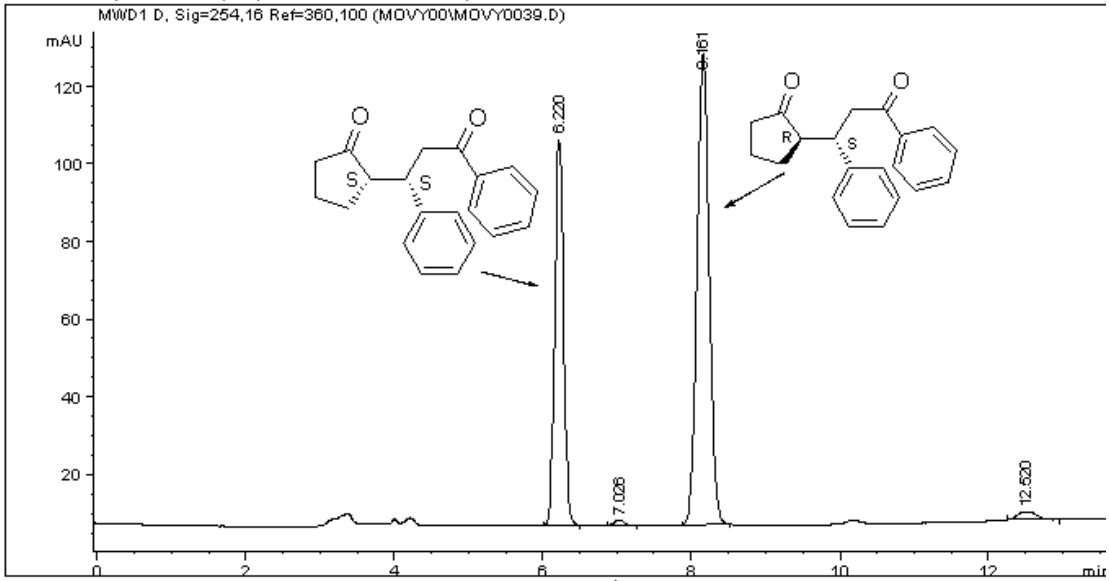

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M-2

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Injection Date  : 7/18/2008 10:34:36 AM
Sample Name     : wf08070801
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/18/2008 9:30:00 AM by MOVY
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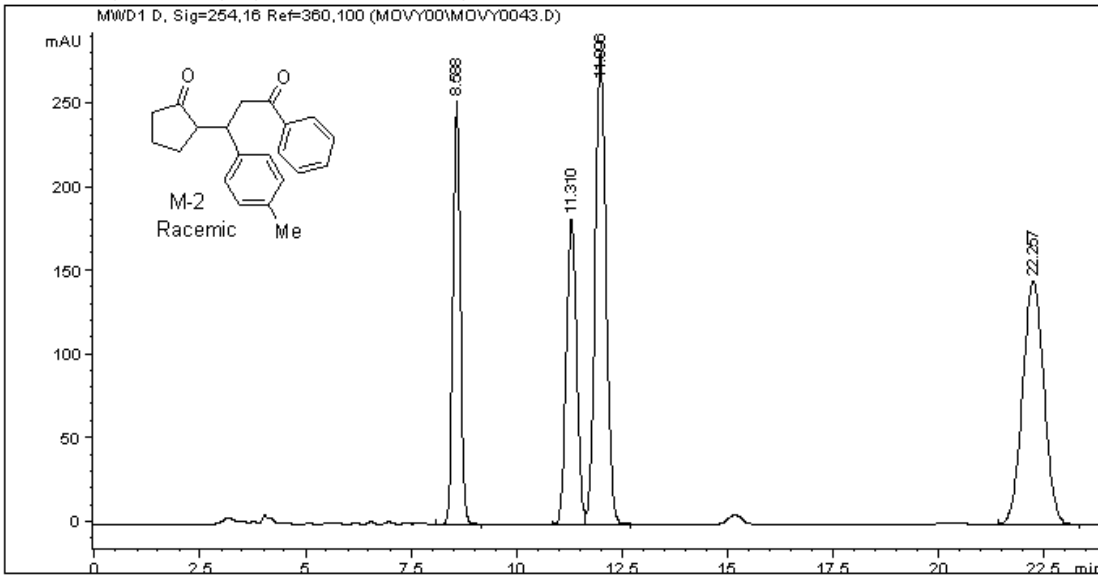

1	8.588	BB	0.1933	3149.16650	252.94379	19.1007
2	11.310	BV	0.2625	3100.83984	182.28928	18.8076
3	11.996	VB	0.2813	5118.98730	280.02710	31.0483
4	22.257	BB	0.5582	5118.15430	145.55338	31.0433

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Injection Date  : 7/18/2008 10:58:57 AM
Sample Name     : wf08070916
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/18/2008 9:30:00 AM by MOVY
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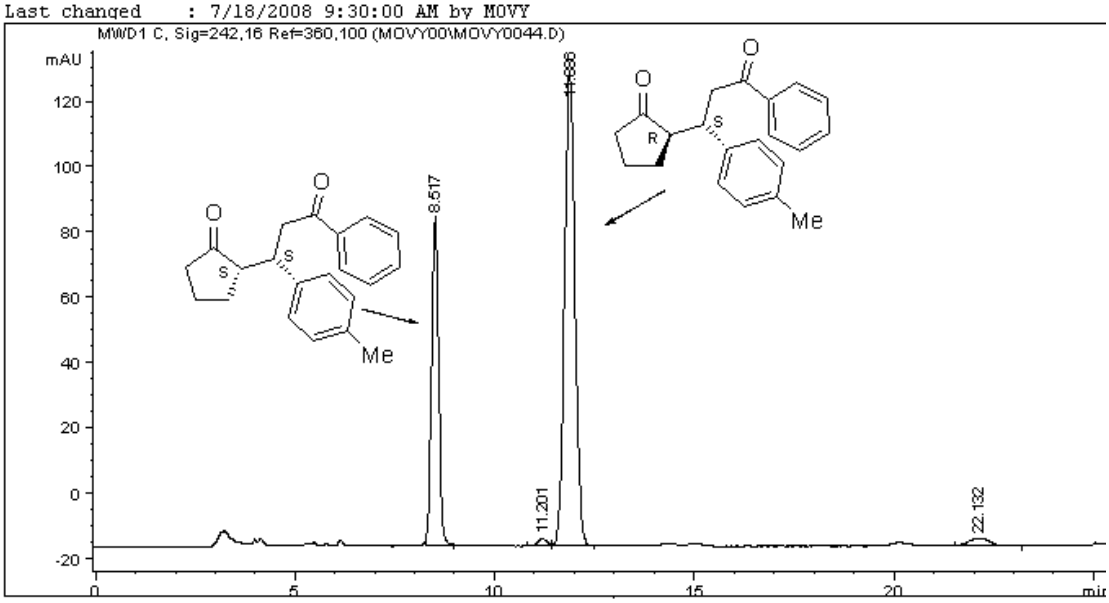

1	8.517	BB	0.2016	1255.22168	100.60606	31.2776
2	11.201	PV	0.2669	36.44593	2.18164	0.9082
3	11.886	VB	0.2928	2635.27832	144.45715	65.6658
4	22.132	PP	0.5760	86.22055	2.41817	2.1484

M-3

```
Injection Date  : 7/19/2008 1:19:03 PM
Sample Name     : wf08071909
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/19/2008 1:17:30 PM by MOVY
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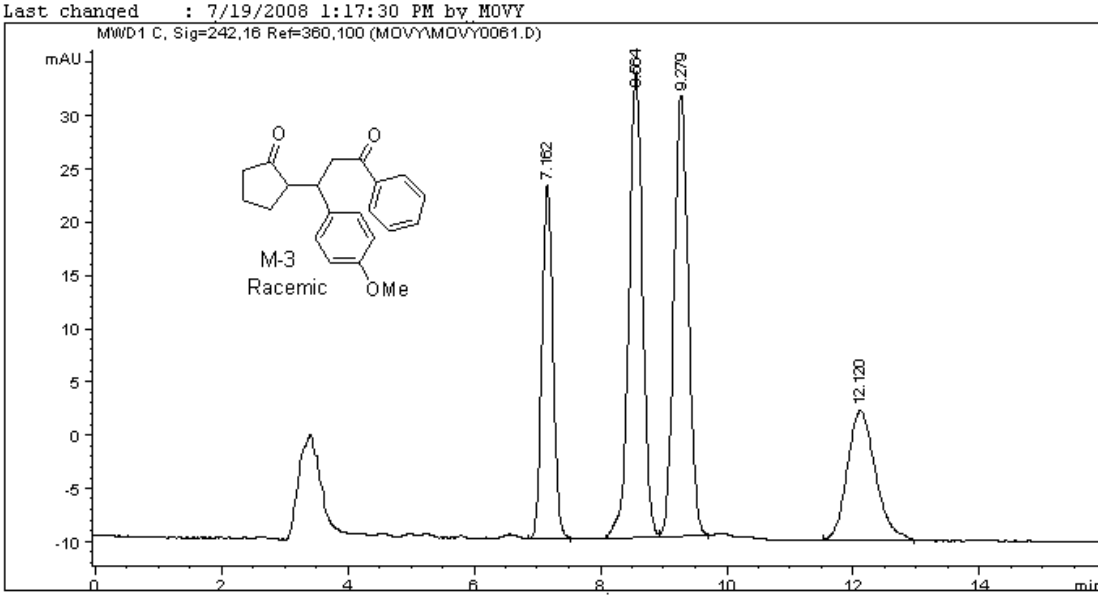

1	7.162	VB	0.1860	398.33493	33.19232	19.0897
2	8.564	BV	0.2324	659.95209	43.64772	31.6274
3	9.279	VB	0.2477	657.66217	41.31667	31.5176
4	12.120	BP	0.4395	370.69931	12.09664	17.7653

```
Injection Date  : 7/22/2008 7:20:51 PM
Sample Name     : wf08072013
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/22/2008 7:11:48 PM by MOVY
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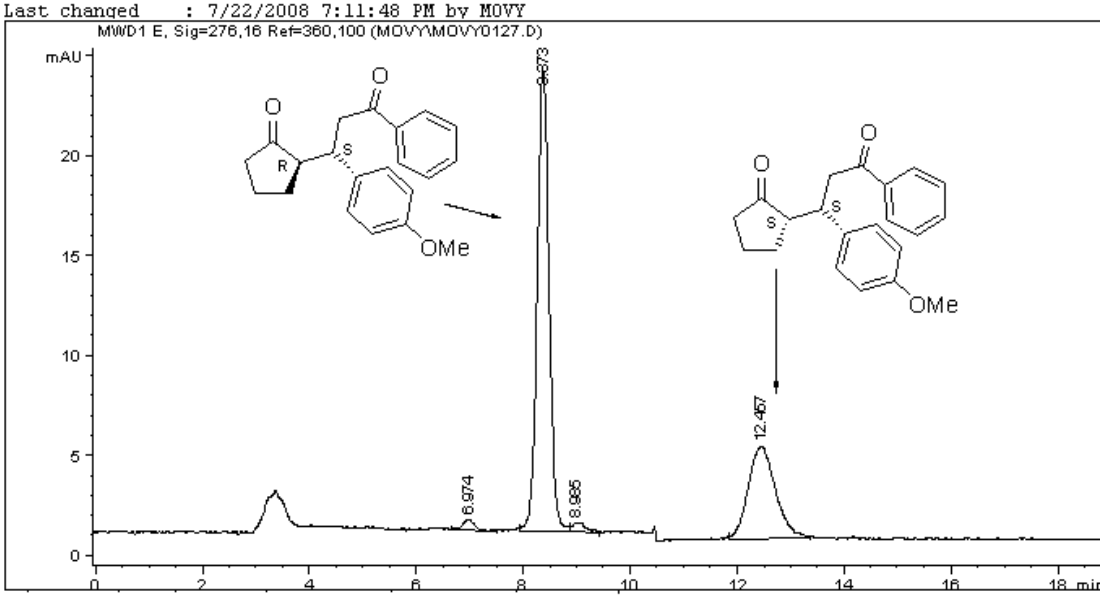

1	6.974	BB	0.1920	7.29336	5.31693e-1	1.3642
2	8.373	BB	0.2400	355.03461	23.01093	66.4082
3	8.985	BP	0.2266	7.75413	4.29592e-1	1.4504
4	12.457	BB	0.4863	164.54253	4.63296	30.7772

M-4

```
Injection Date  : 7/7/2008 11:52:22 AM
Sample Name     : wf08070602
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\YG.M
Last changed    : 7/7/2008 9:26:44 AM by MOVY
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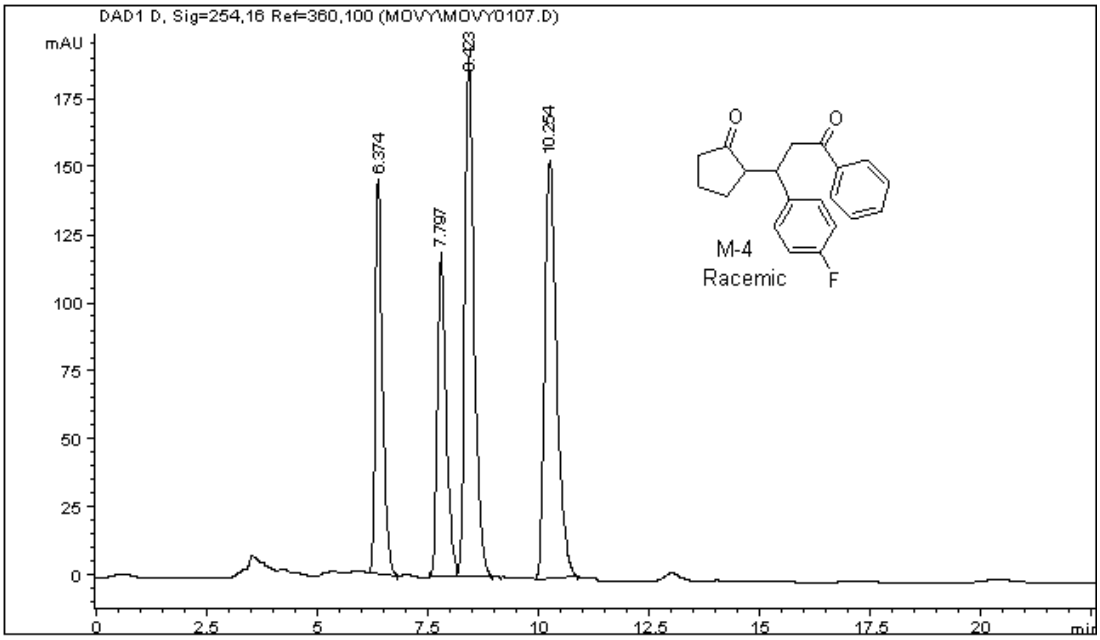

1	6.374	BB	0.1687	1650.22595	145.05287	18.4777
2	7.797	BV	0.2060	1637.84204	119.43837	18.3391
3	8.423	VP	0.2222	2814.88550	190.66075	31.5185
4	10.254	BB	0.2768	2827.94482	153.59642	31.6647

M-4a

```
Injection Date  : 7/19/2008 3:37:10 PM
Sample Name     : wf08071717
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/19/2008 3:26:37 PM by MOVY
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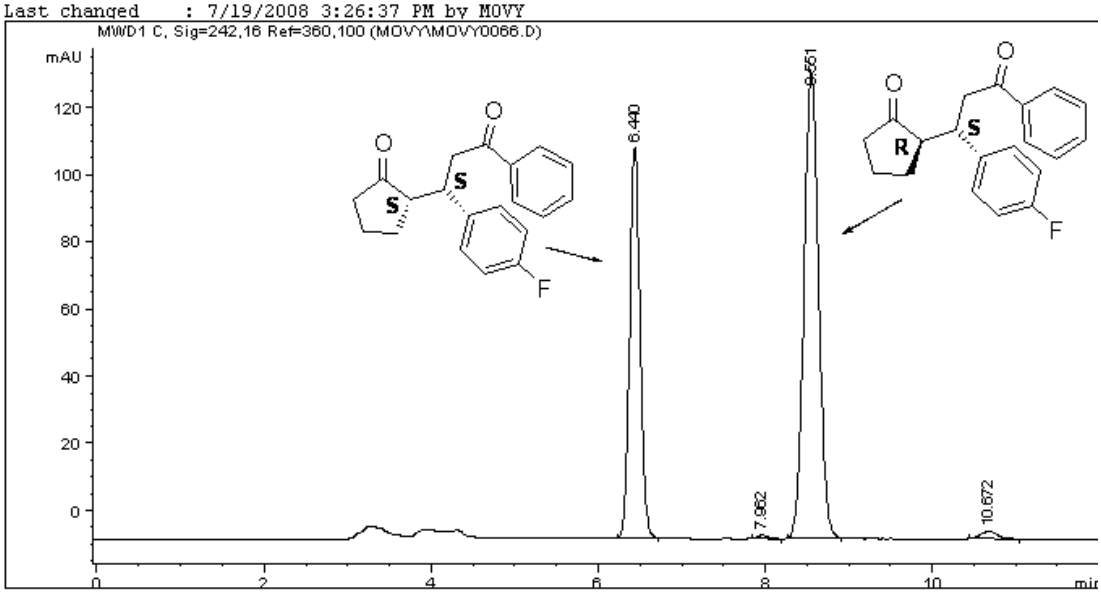

1	6.440	BB	0.1357	1016.90356	116.65658	37.0043
2	7.962	BP	0.1420	9.31680	9.87708e-1	0.3390
3	8.551	BB	0.1877	1690.85022	139.24857	61.5288
4	10.672	BP	0.2106	30.99444	2.11954	1.1279

M-4b

```
Injection Date  : 7/19/2008 3:49:34 PM
Sample Name     : wf08071718
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/19/2008 3:26:37 PM by MOVY
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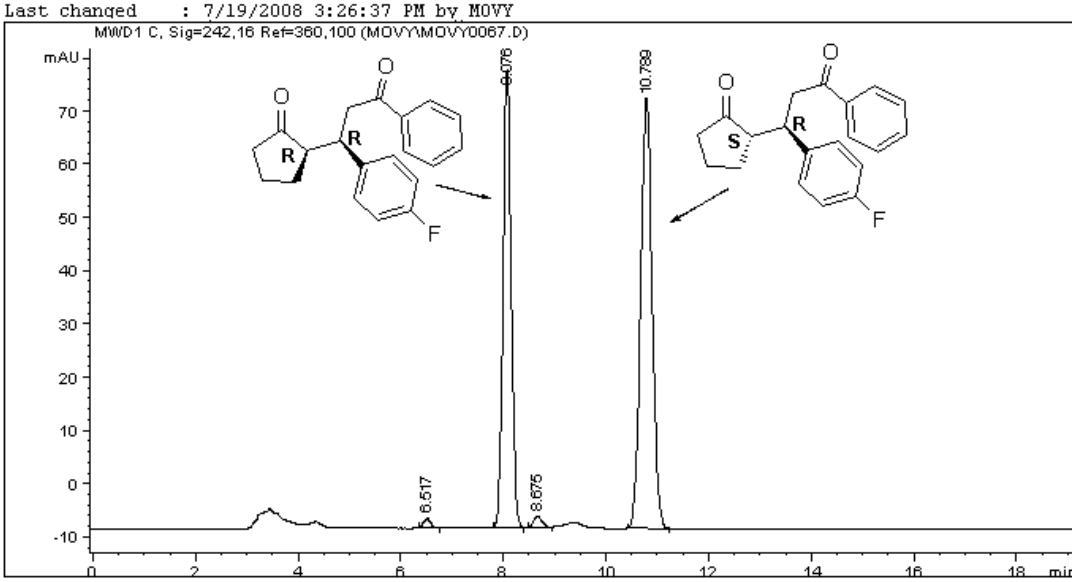
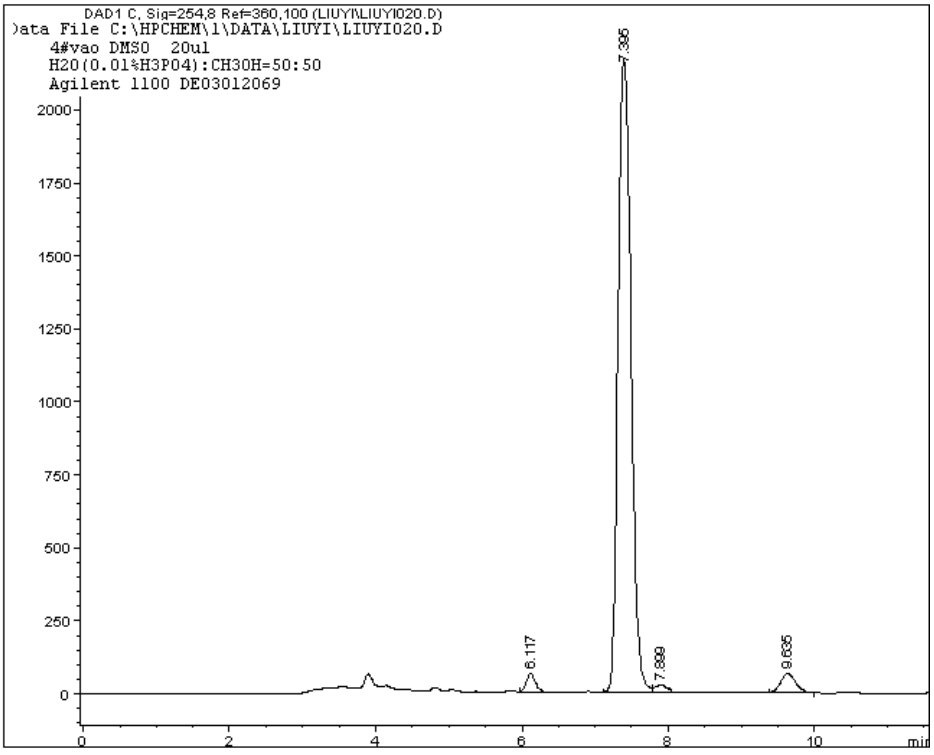


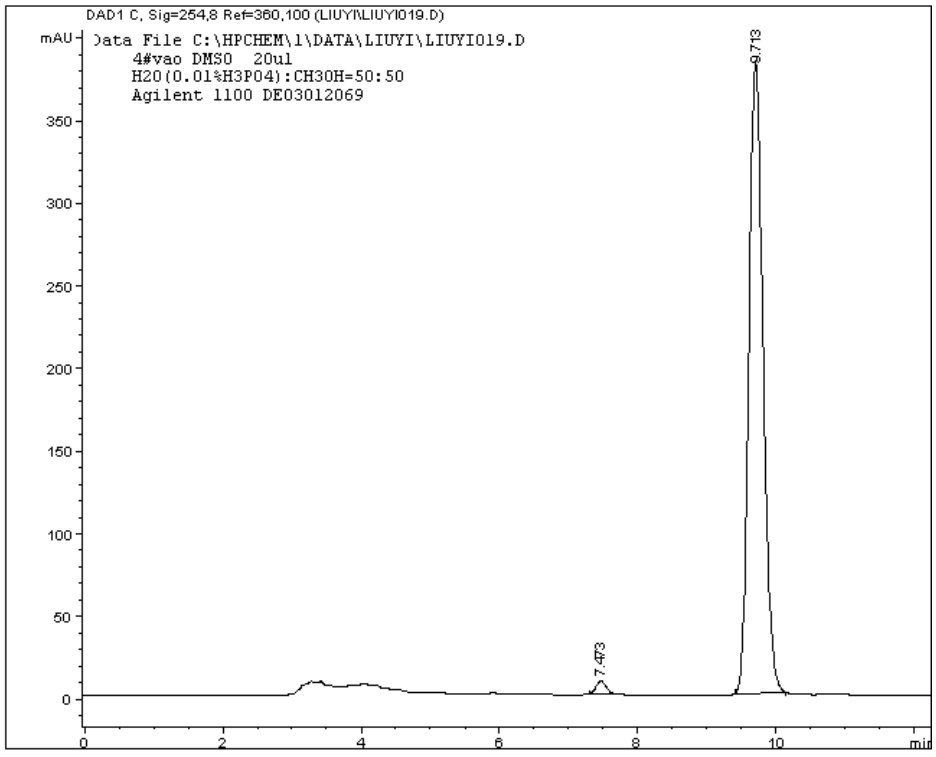
1	6.517	BB	0.1346	15.46282	1.72522	0.6831
2	8.076	BB	0.1745	960.30750	85.85493	42.4227
3	8.675	BP	0.1681	21.56010	1.99531	0.9524
4	10.789	BB	0.2448	1266.33362	80.83439	55.9418

M-4b1



1	6.117	BB	0.1318	538.12317	62.90105	1.9008
2	7.395	BV	0.1953	2.66119e4	2166.48145	94.0000
3	7.899	VV	0.1809	273.73846	22.66899	0.9669
4	9.635	BB	0.2162	886.76147	63.79070	3.1323

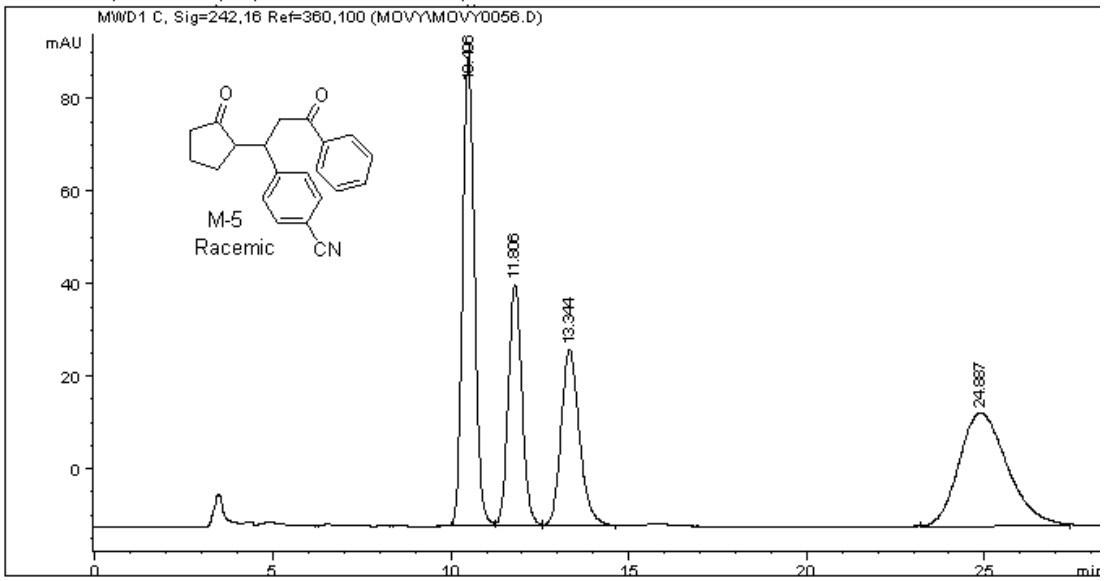
M-4b2



1	7.473	BB	0.1547	76.16589	7.61683	1.3728
2	9.713	BB	0.2206	5471.90625	383.17245	98.6272

M-5

Injection Date : 7/18/2008 6:23:37 PM
Sample Name : wf08071301
Acq. Operator : MOVY
Acq. Method : C:\HPCHEM\1\METHODS\LEIM.M
Last changed : 7/18/2008 4:47:56 PM by MOVY



1	10.496	BV	0.3625	2351.23657	101.40080	31.6914
2	11.806	VV	0.4166	1393.09534	51.99088	18.7770
3	13.344	VB	0.5527	1366.48376	37.89492	18.4183
4	24.887	BB	1.3866	2308.34326	24.51261	31.1133

```
Injection Date  : 7/19/2008 2:20:50 PM
Sample Name     : wf08071721
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/19/2008 1:48:43 PM by MOVY
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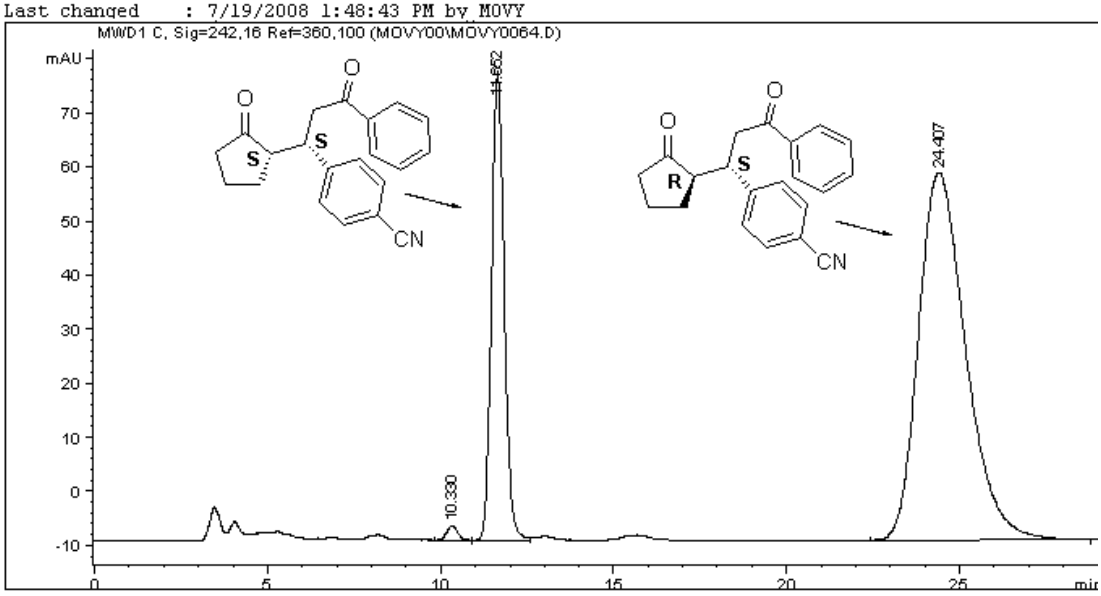

1	10.330	VV	0.3657	65.83926	2.76634	0.7540
2	11.652	VV	0.4030	2218.57275	86.55634	25.4088
3	24.407	BB	1.4663	6447.09180	67.98916	73.8371

M-6

```
Injection Date  : 7/12/2008 1:18:16 PM
Sample Name     : wf08071206
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\YG.M
Last changed    : 7/12/2008 1:43:43 PM by MOVY
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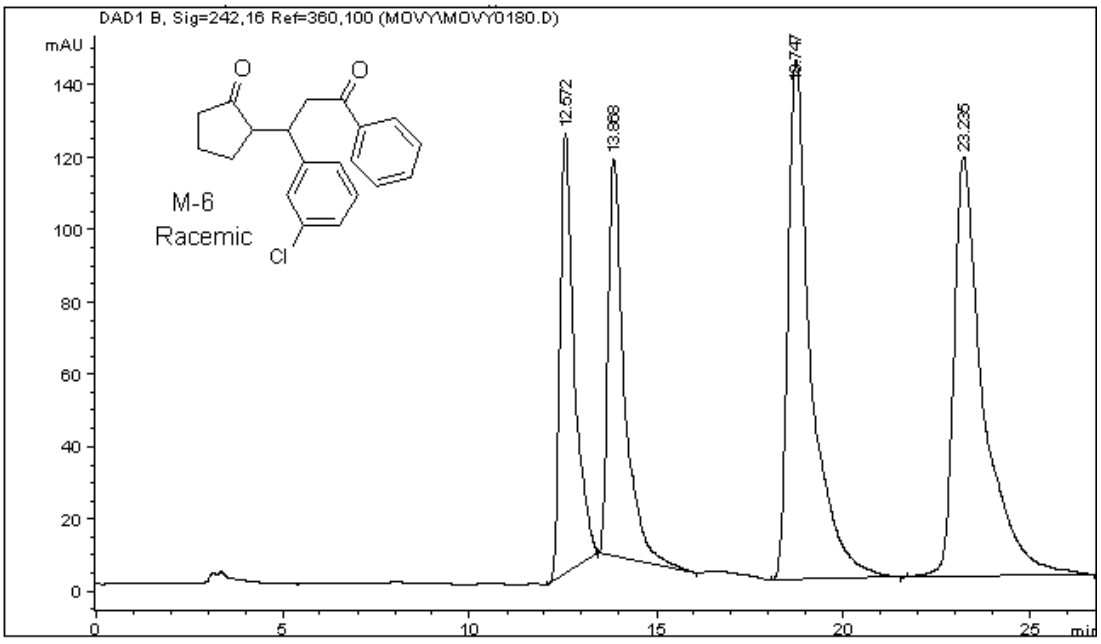

1	12.572	BB	0.3908	3223.78174	121.78127	16.9707
2	13.868	BBA	0.4408	3316.75854	109.68959	17.4602
3	18.747	BBA	0.6122	6117.53027	143.82243	32.2041
4	23.235	BBA	0.7834	6338.07568	116.00311	33.3651

M-6a

```
Injection Date  : 7/22/2008 12:07:35 PM
Sample Name     : wf08072015
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/22/2008 10:50:02 AM by MOVY
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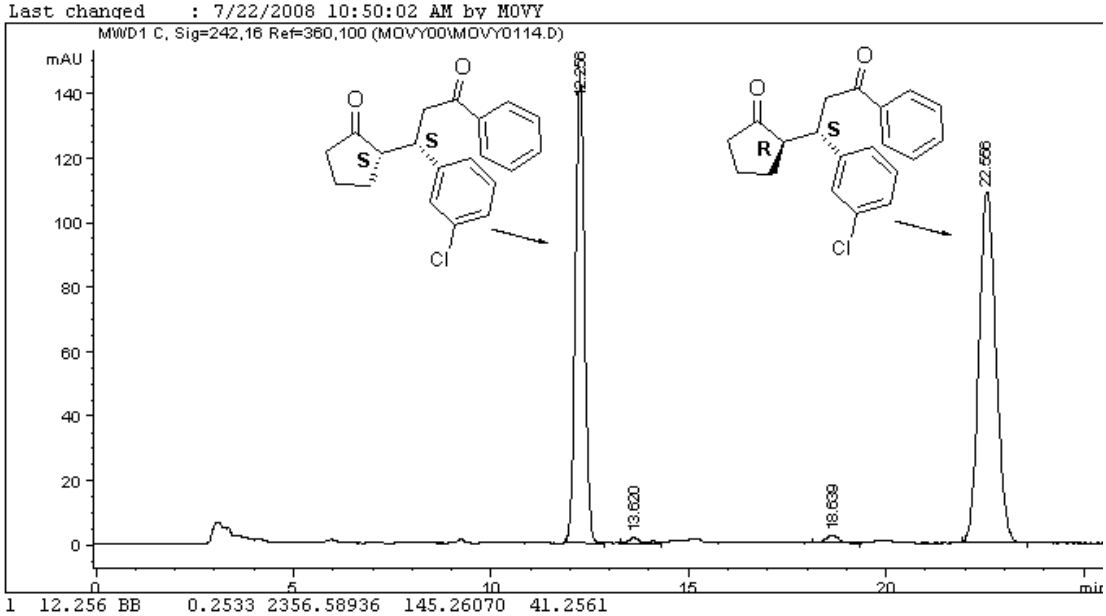

1	12.256	BB	0.2533	2356.58936	145.26070	41.2561
2	13.620	PB	0.3724	41.95068	1.67365	0.7344
3	18.639	BP	0.3689	52.70345	2.25350	0.9227
4	22.556	BB	0.4694	3260.84912	108.86797	57.0868

M-6b

```
Injection Date  : 7/21/2008 10:47:18 PM
Sample Name     : wf08072016
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/21/2008 10:18:17 PM by MOVY
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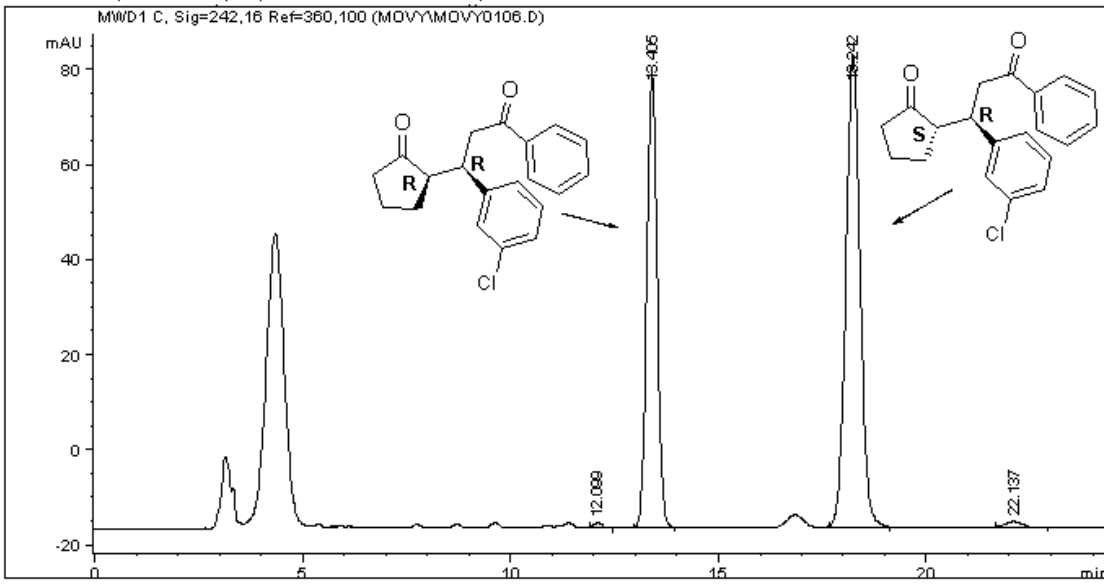

1	12.099	BB	0.2115	15.34927	1.03200	0.3753
2	13.405	BB	0.2688	1656.40344	96.23329	40.4996
3	18.242	BB	0.3730	2383.17822	98.94910	58.2694
4	22.137	BB	0.4036	34.99836	1.14811	0.8557

M-7

```
Injection Date  : 7/12/2008 1:50:00 PM
Sample Name     : wf08071101
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\YG.M
Last changed    : 7/12/2008 2:23:41 PM by MOVY
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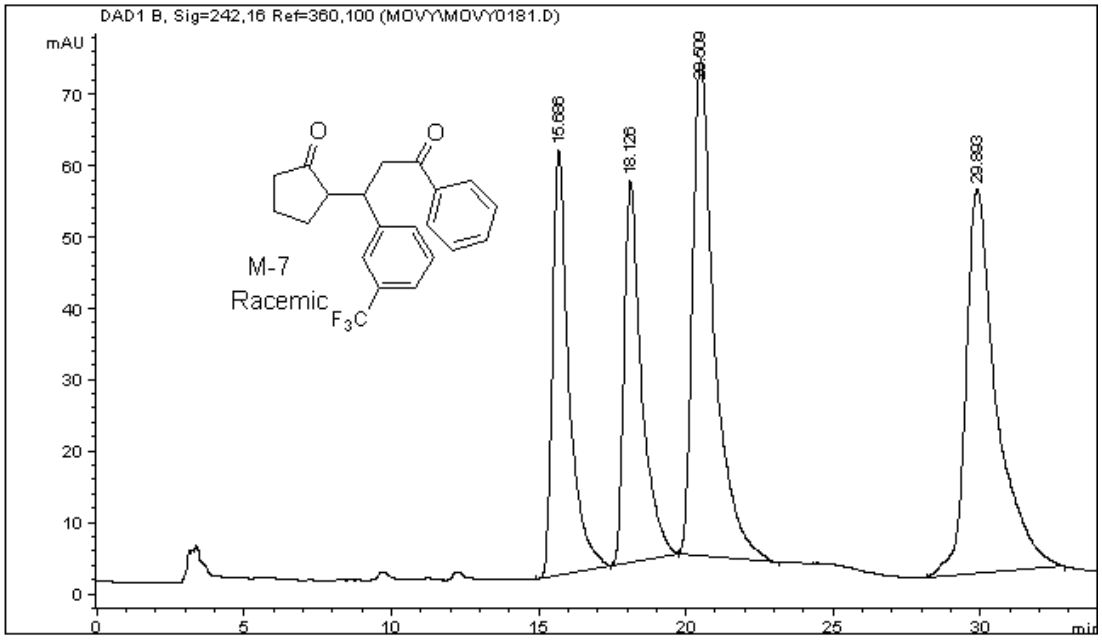

1	15.686	PBA	0.5685	2322.53687	59.62217	19.3889
2	18.126	PB	0.6067	2214.83911	53.30948	18.4898
3	20.509	BBA	0.7562	3589.81396	69.78153	29.9683
4	29.893	BBA	1.0340	3851.51660	53.74982	32.1530

M-7a

```
Injection Date  : 7/19/2008 9:37:09 PM
Sample Name     : wf08071719
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/19/2008 9:26:48 PM by MOVY
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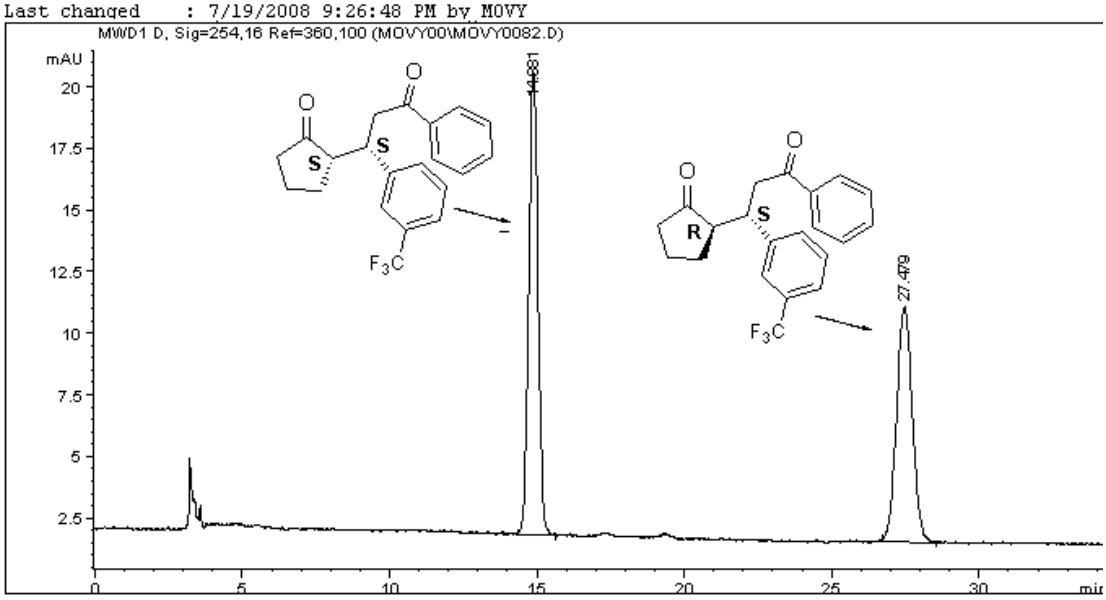

1	14.881	BP	0.3428	409.72147	18.75867	53.7827
2	27.479	BB	0.5747	352.08710	9.53650	46.2173

M-7b

```
Injection Date  : 7/19/2008 10:14:29 PM
Sample Name     : wf08071720
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/19/2008 9:26:48 PM by MOVY
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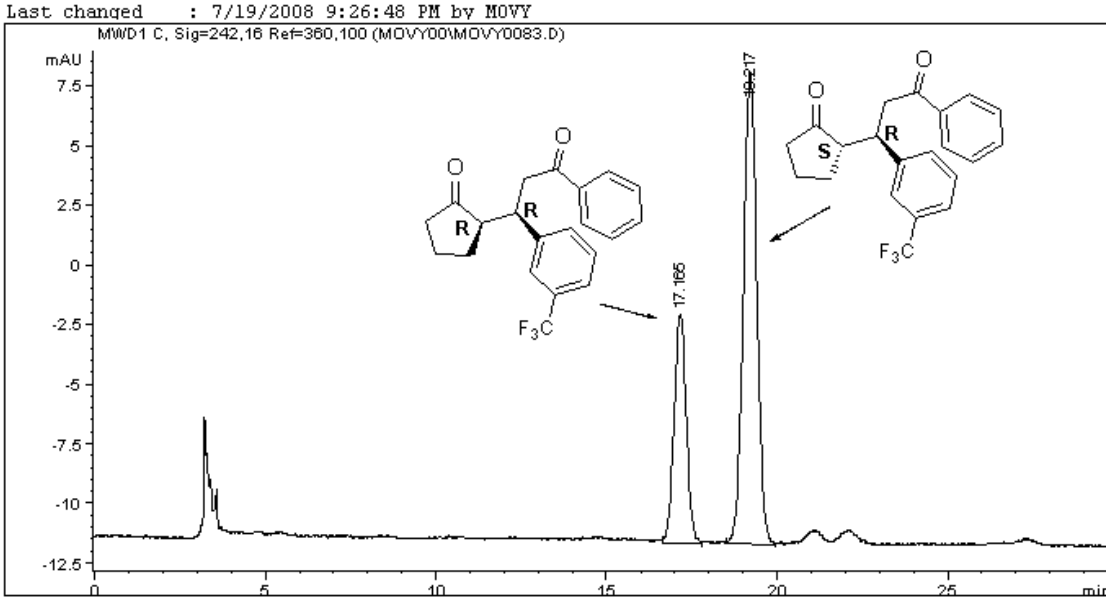

1	17.165	VV	0.3877	239.33287	9.57144	30.6641
2	19.217	VV	0.4247	541.16534	19.68902	69.3359

M-8

```
Injection Date  : 7/9/2008 11:43:50 AM
Sample Name     : wf08070902
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\YG.M
Last changed    : 7/9/2008 9:48:35 AM by liujm
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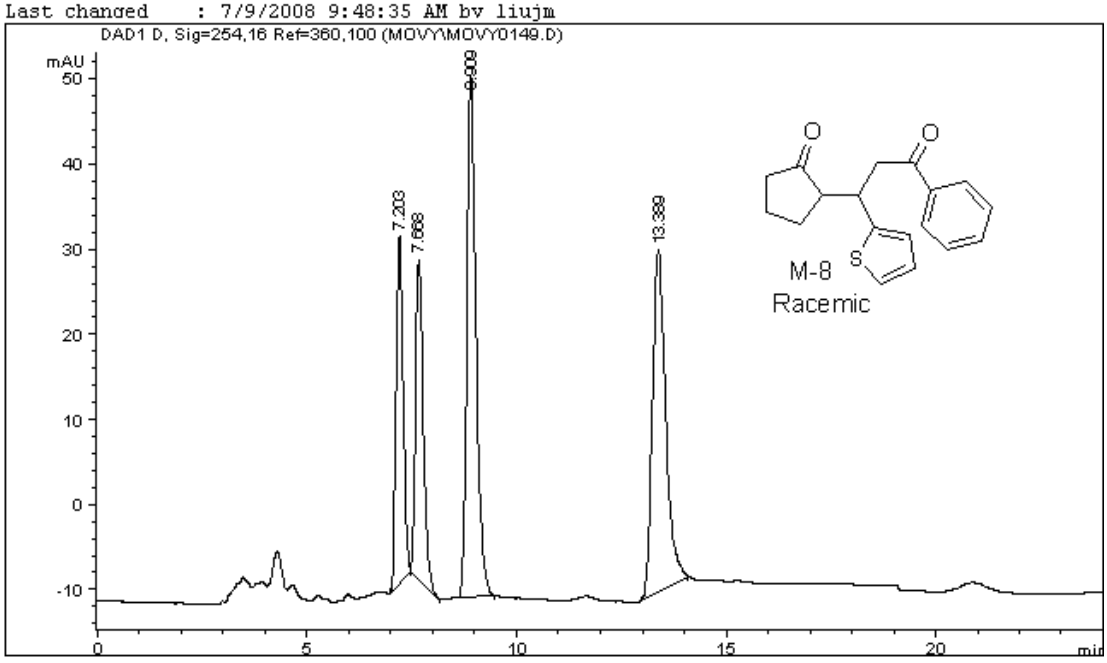

1	7.203	PB	0.1769	464.62149	40.79439	16.9335
2	7.668	BBA	0.1949	473.21408	37.57124	17.2467
3	8.909	BBA	0.2290	926.72363	61.07872	33.7753
4	13.389	PBA	0.3361	879.23499	40.04784	32.0445

```
Injection Date  : 7/21/2008 7:27:58 PM
Sample Name     : wf08072011
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/19/2008 11:16:59 PM by MOVY
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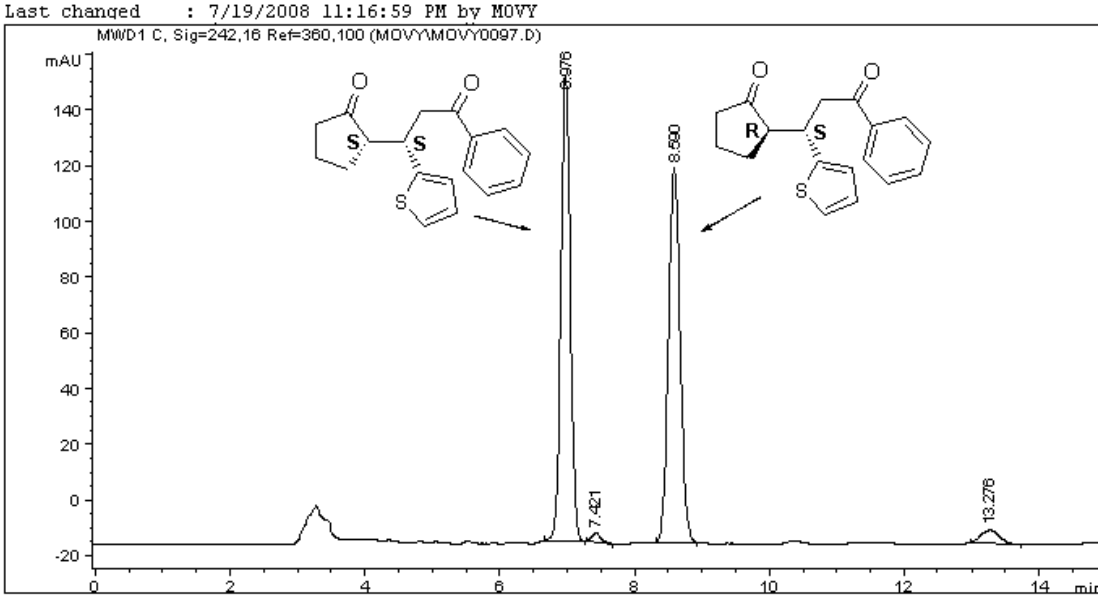

1	6.976	BP	0.1479	1609.06738	167.72656	48.0229
2	7.421	BB	0.1492	29.64243	3.05543	0.8847
3	8.590	BB	0.1892	1627.60229	134.52550	48.5761
4	13.276	BP	0.2789	84.31435	4.62118	2.5164

M-9

```
Injection Date  : 7/12/2008 11:28:59 AM
Sample Name     : wf08071116
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\YG.M
Last changed    : 7/12/2008 11:19:35 AM by MOVY
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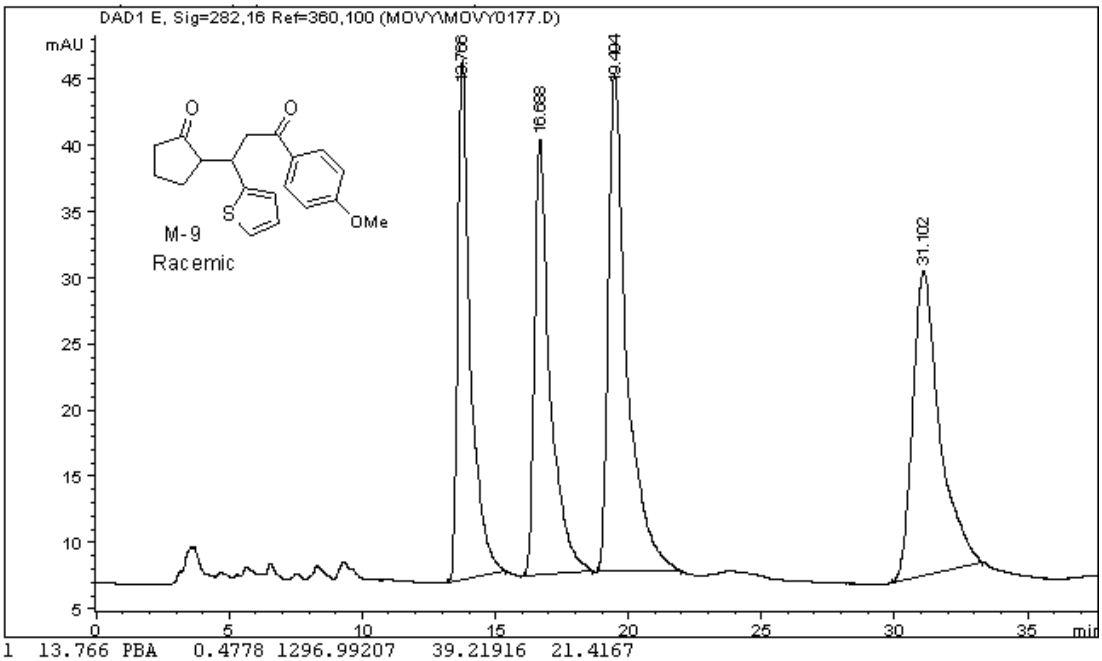

1	13.766	PBA	0.4778	1296.99207	39.21916	21.4167
2	16.688	PBA	0.5882	1340.45959	32.84082	22.1345
3	19.494	BBA	0.6924	1810.93030	37.43369	29.9032
4	31.102	BBA	0.9464	1607.58997	22.91675	26.5455

M-9a

```
Injection Date  : 7/21/2008 9:30:02 PM
Sample Name     : wf08072017
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/21/2008 9:19:04 PM by MOVY
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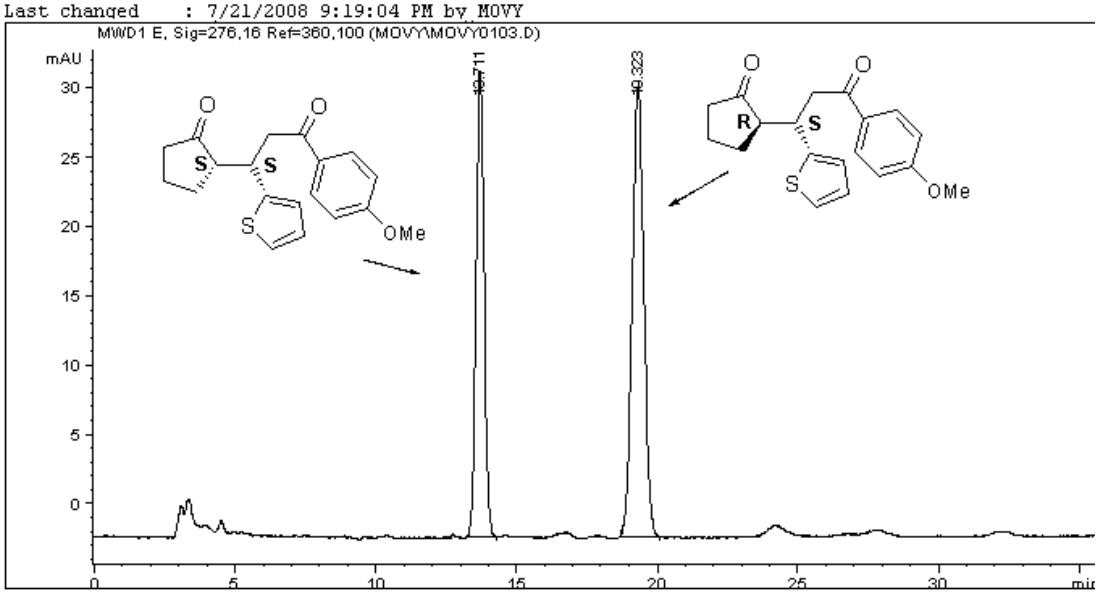

1	13.711	BB	0.3121	665.79547	33.46187	41.5930
2	19.323	BB	0.4447	934.94354	32.39587	58.4070

M-9a1

```
Injection Date  : 7/23/2008 3:04:35 PM
Sample Name     : wf08072017up
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/23/2008 2:53:08 PM by MOVY
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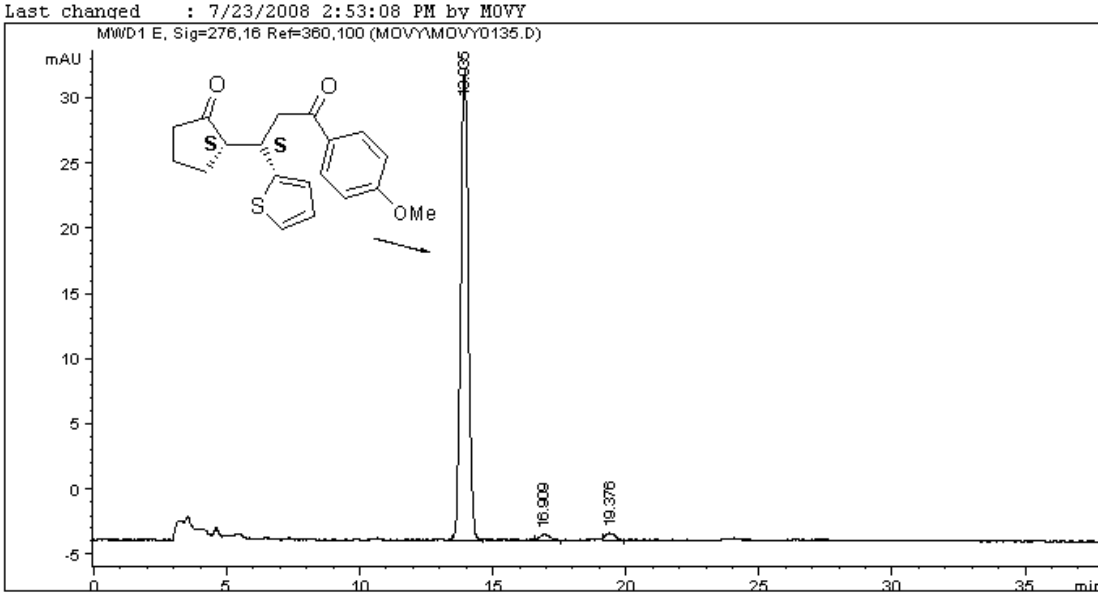

1	13.935	BB	0.3107	706.65363	35.73158	96.8891
2	16.909	BB	0.3031	9.66378	3.87344e-1	1.3250
3	19.376	BP	0.2897	13.02500	5.47122e-1	1.7859

M-9a2

```
Injection Date  : 7/23/2008 3:43:29 PM
Sample Name     : wf08072017down
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/23/2008 2:53:08 PM by MOVY
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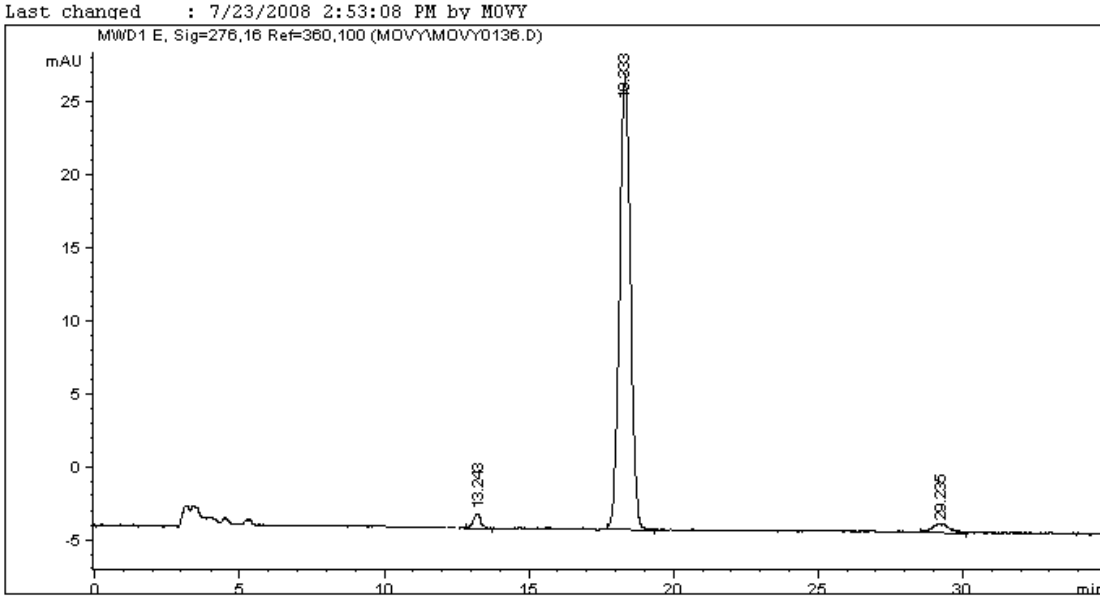

1	13.243	BP	0.2608	17.87313	9.44178e-1	2.0545
2	18.333	BB	0.4178	826.43488	31.11989	95.0000
3	29.235	BP	0.5363	25.62372	5.70191e-1	2.9455

M-10

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Injection Date  : 7/18/2008 2:43:56 PM
Sample Name     : wf08071805
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/18/2008 12:46:22 PM by MOVY
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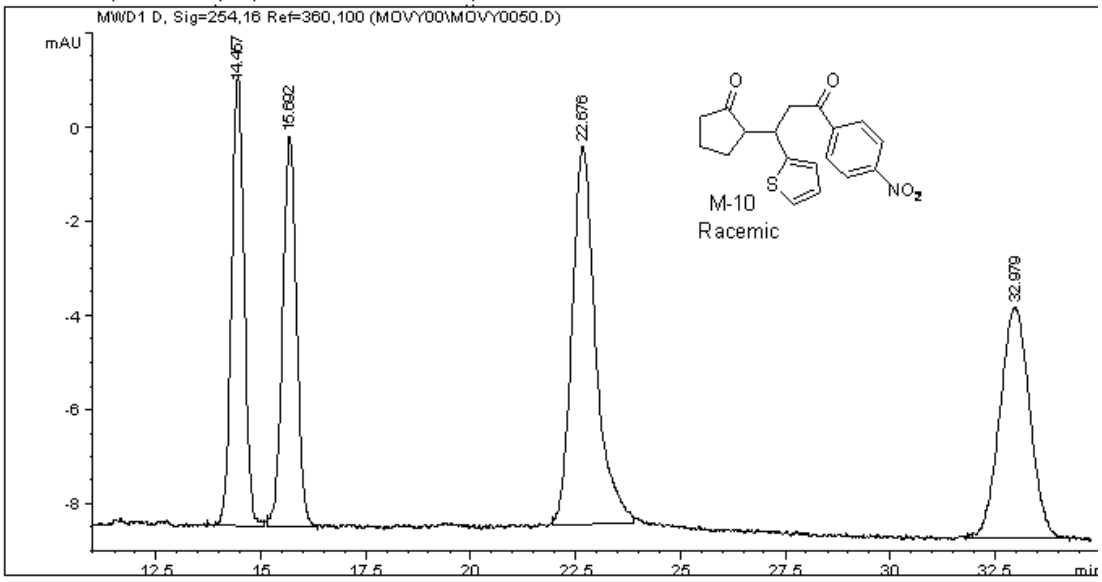

1	14.457	BB	0.3236	199.73701	9.56646	21.0242
2	15.692	BB	0.3574	191.21831	8.27995	20.1275
3	22.676	BB	0.5546	315.76495	8.03335	33.2372
4	32.979	BB	0.6493	243.31308	4.91734	25.6110

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Injection Date  : 7/22/2008 2:50:10 PM
Sample Name     : wf08072029
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/22/2008 2:40:02 PM by MOVY
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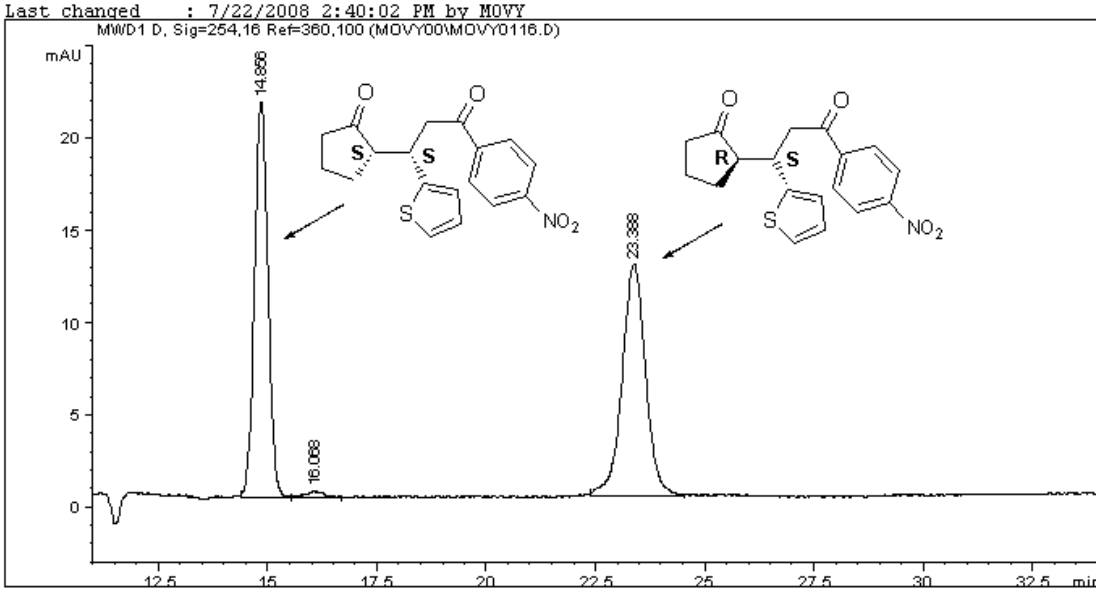

1	14.856	BV	0.3390	460.32651	21.39997	48.9789
2	16.068	VP	0.3348	9.30405	3.40440e-1	0.9900
3	23.388	BB	0.5767	470.21585	12.56286	50.0311

M-11

```
Injection Date  : 7/12/2008 10:44:09 AM
Sample Name     : wf08071121
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\YG.M
Last changed    : 7/12/2008 10:38:49 AM by MOVY
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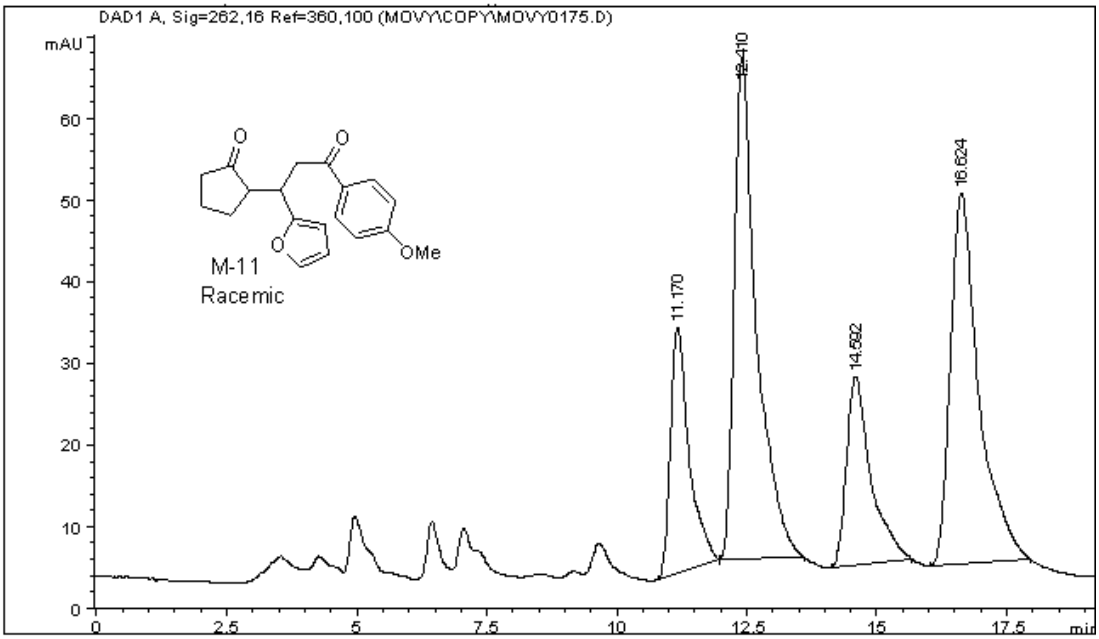

1	11.170	PBA	0.3682	748.47223	30.08860	14.7355
2	12.410	BBA	0.4360	1849.64063	61.30045	36.4146
3	14.592	PBA	0.4767	752.26678	23.05335	14.8102
4	16.624	PBA	0.5626	1729.01453	45.37075	34.0398

M-11a

```
Injection Date  : 7/21/2008 8:17:48 PM
Sample Name     : wf08072019
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/21/2008 8:08:43 PM by MOVY
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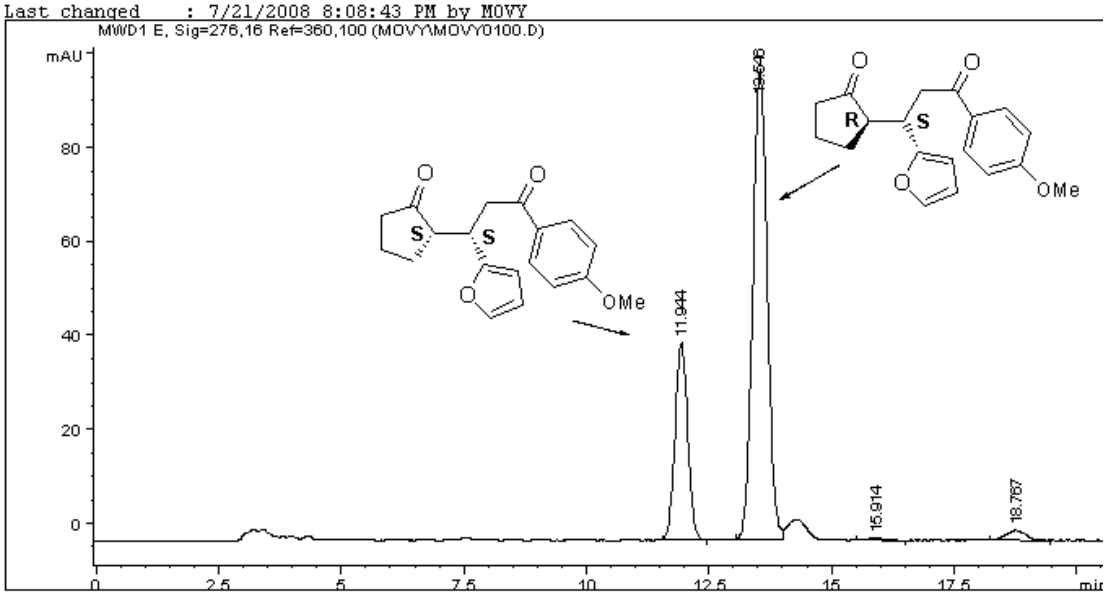

1	11.944	BB	0.2825	756.55334	41.92402	26.2455
2	13.546	BV	0.3233	2051.56665	100.02622	71.1705
3	15.914	BP	0.2646	14.06579	6.49691e-1	0.4880
4	18.767	BP	0.3902	60.42043	2.10933	2.0960

M-11b

```
Injection Date  : 7/21/2008 8:38:49 PM
Sample Name     : wf08072020
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
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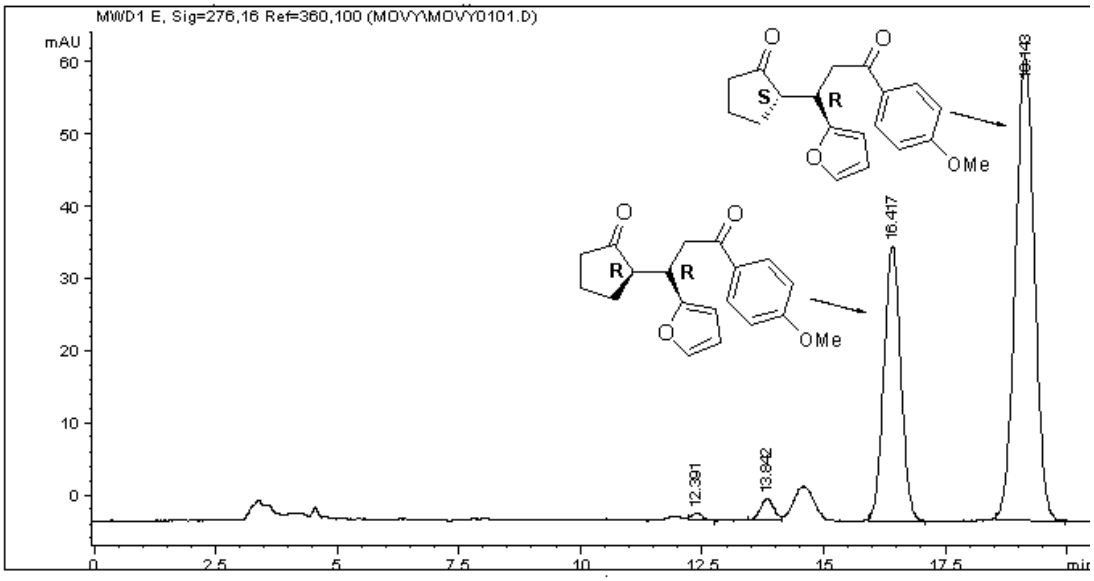

1	12.391	BP	0.2260	14.44131	8.86584e-1	0.5230
2	13.842	BV	0.2997	59.84446	2.96158	2.1671
3	16.417	BB	0.3834	924.00073	38.03297	33.4608
4	19.143	BB	0.4272	1763.15759	64.44792	63.8491

M-12

```
Injection Date  : 7/18/2008 1:16:31 PM
Sample Name     : wf08071217
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/18/2008 12:46:22 PM by MOVY
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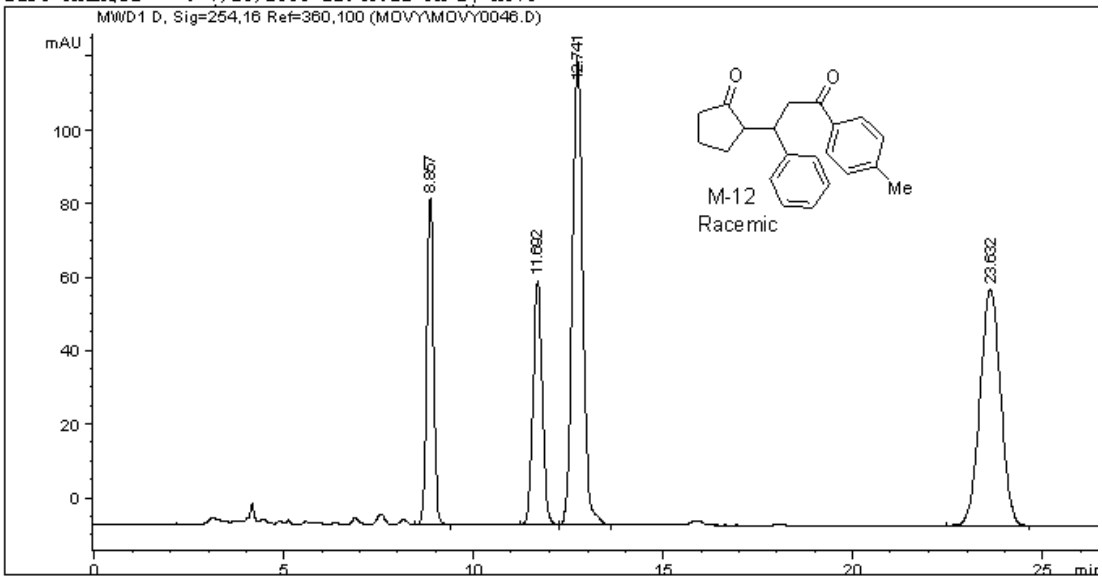

1	8.857	VP	0.1971	1117.95496	88.69008	15.6178
2	11.692	VV	0.2666	1139.65247	66.27001	15.9209
3	12.741	VV	0.2972	2461.10400	127.48241	34.3815
4	23.632	BV	0.5752	2439.51099	64.50632	34.0798

M-12a

```
Injection Date  : 7/19/2008 5:18:45 PM
Sample Name     : wf08071705
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/19/2008 5:06:10 PM by MOVY
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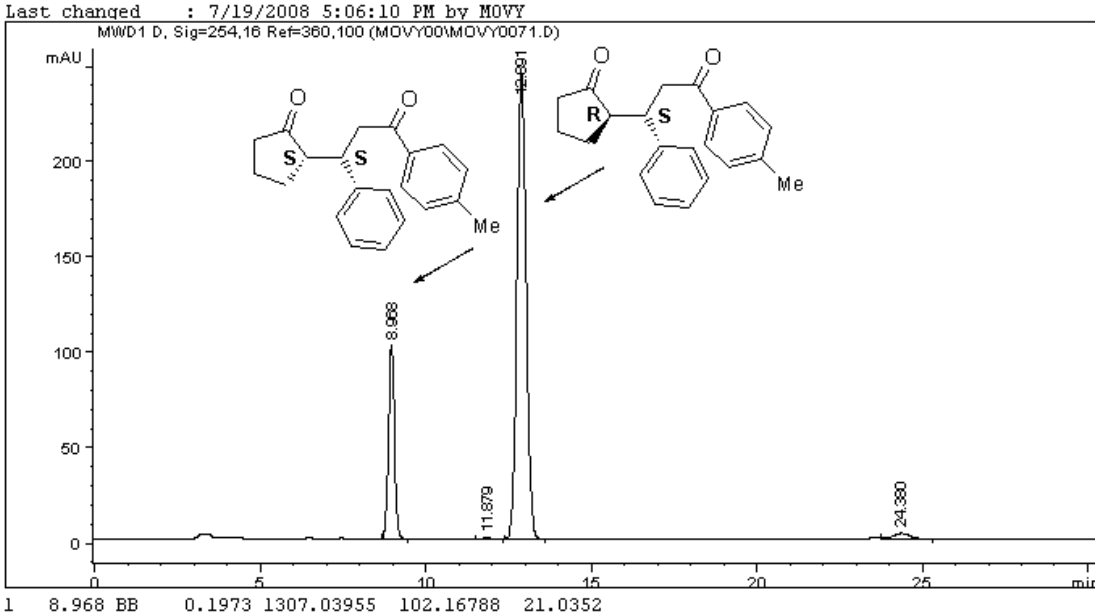

1	8.968	BB	0.1973	1307.03955	102.16788	21.0352
2	11.879	PP	0.2077	12.90287	8.02103e-1	0.2077
3	12.891	BB	0.3027	4768.29004	245.34819	76.7397
4	24.380	BB	0.5253	125.35735	3.14314	2.0175

M-12b

```
Injection Date  : 7/18/2008 3:45:20 PM
Sample Name     : wf08071723
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\LEIM.M
Last changed    : 7/18/2008 12:46:22 PM by MOVY
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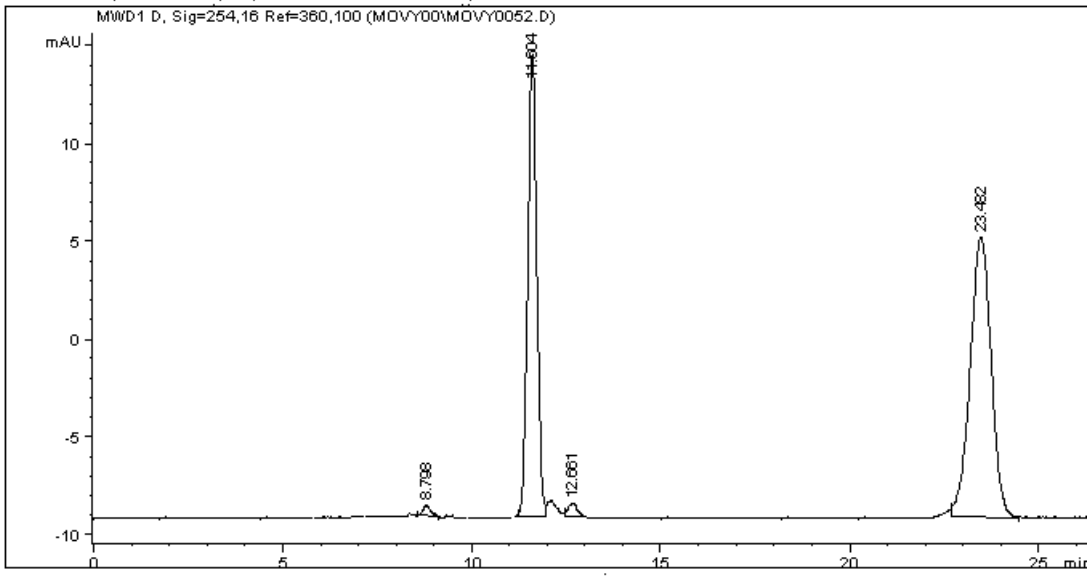
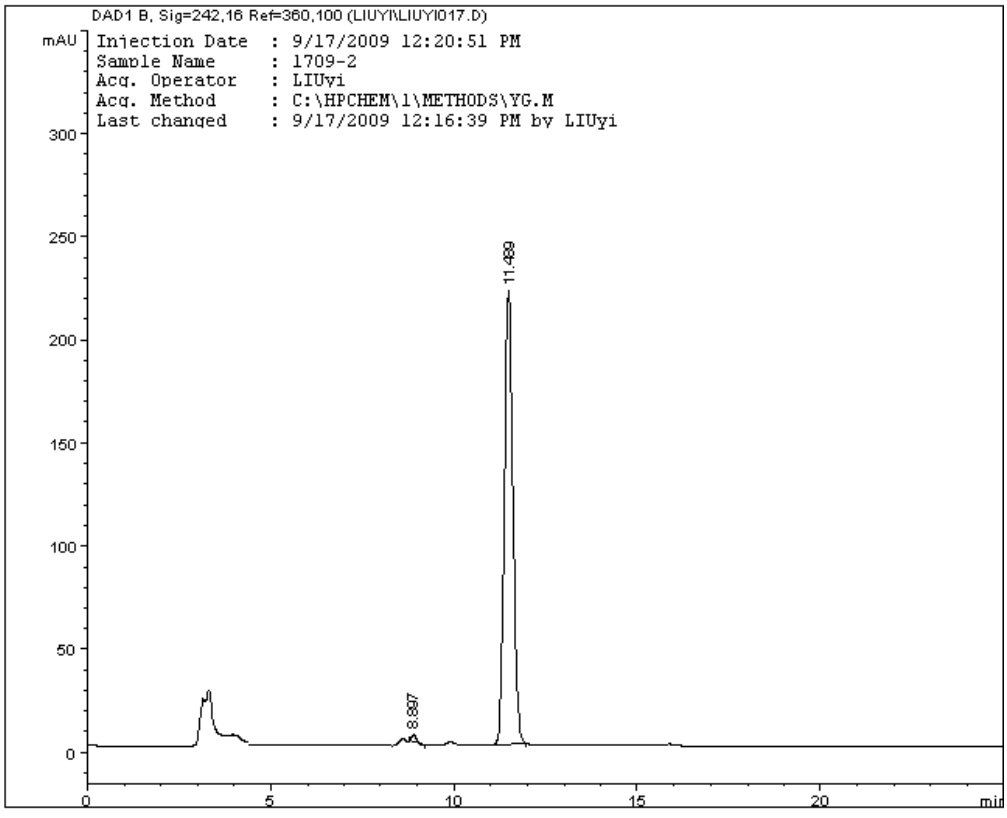


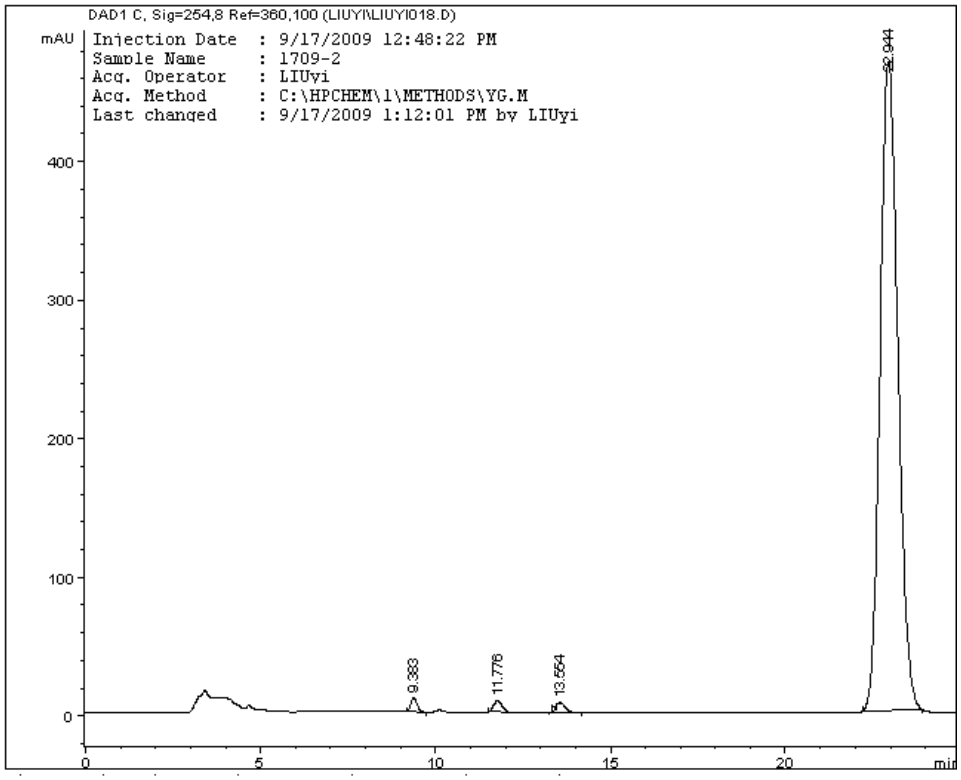
1	8.798	BP	0.1981	6.82550	4.91179e-1	0.7048
2	11.604	BV	0.2664	400.67685	23.56026	41.3757
3	12.661	BB	0.2246	12.15975	6.67413e-1	1.2557
4	23.482	BB	0.5881	548.72510	14.28757	56.6638

M-12b1



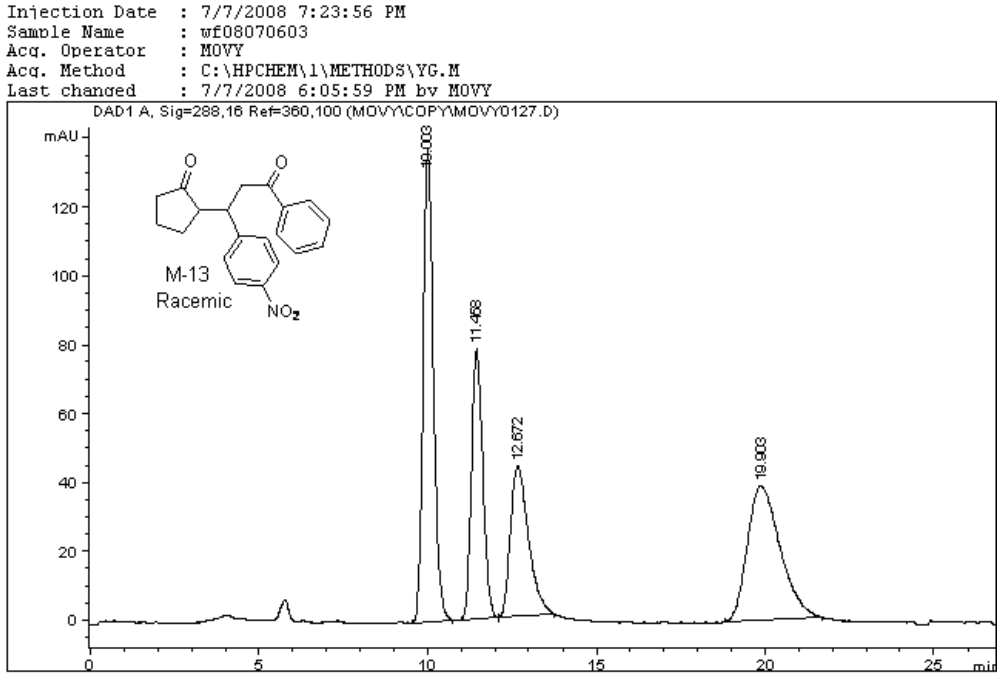
1	8.897	BP	0.1605	35.32785	3.60077	0.9796
2	11.489	BB	0.2516	3570.90454	219.67505	99.0204

M-12b2



1	9.383	BB	0.1919	122.36016	10.06201	0.7212
2	11.776	BP	0.2559	131.60416	8.08631	0.7757
3	13.554	VB	0.2765	123.34281	6.90164	0.7270
4	22.944	BB	0.5512	1.65895e4	468.35098	97.7762

M-13



1	10.003	BBA	0.3336	2936.10156	137.23839	32.5529
2	11.458	BBA	0.3567	1819.70874	78.41880	20.1753
3	12.672	BBA	0.5150	1619.08594	43.62408	17.9510
4	19.903	BBA	0.8200	2644.57227	39.05539	29.3207

M-13b

```
Injection Date  : 11/20/2008 11:06:12 AM
Sample Name     : wf08110303
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\YG.M
Last changed    : 11/20/2008 10:41:36 AM by MOVY
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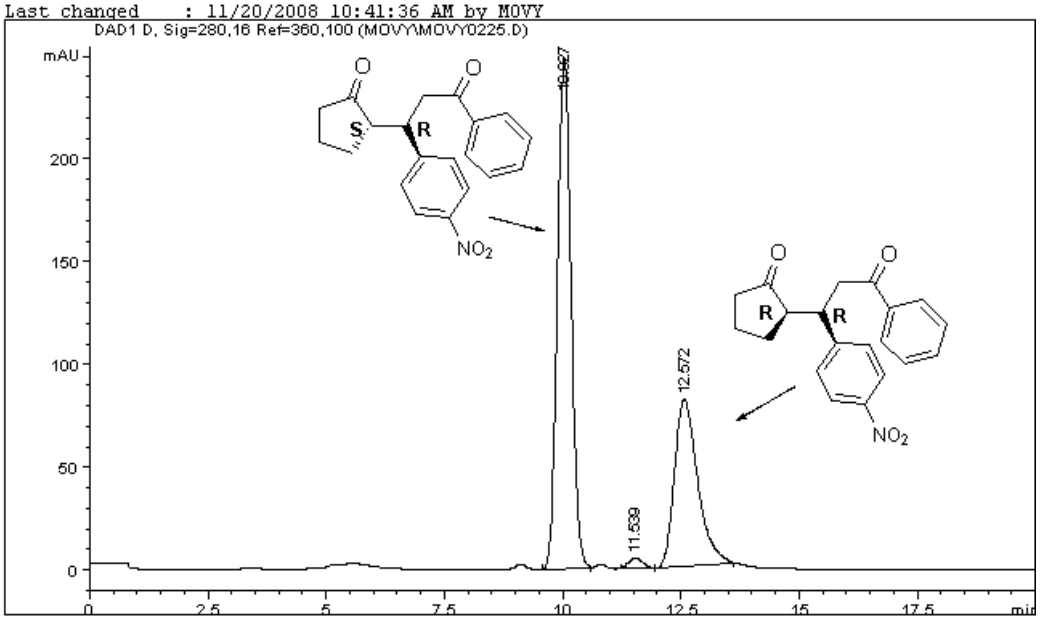

1	10.027	BBA	0.3116	4986.48437	249.00954	63.6050
2	11.539	BB	0.3431	102.84580	4.73997	1.3118
3	12.572	BBA	0.5131	2750.43262	81.21510	35.0831

M-13b2

```
Injection Date  : 3/9/2009 4:27:35 PM
Sample Name     : wf08110303
Acq. Operator   : MOVY
Acq. Method     : C:\HPCHEM\1\METHODS\YG.M
Last changed    : 3/9/2009 4:19:53 PM by MOVY
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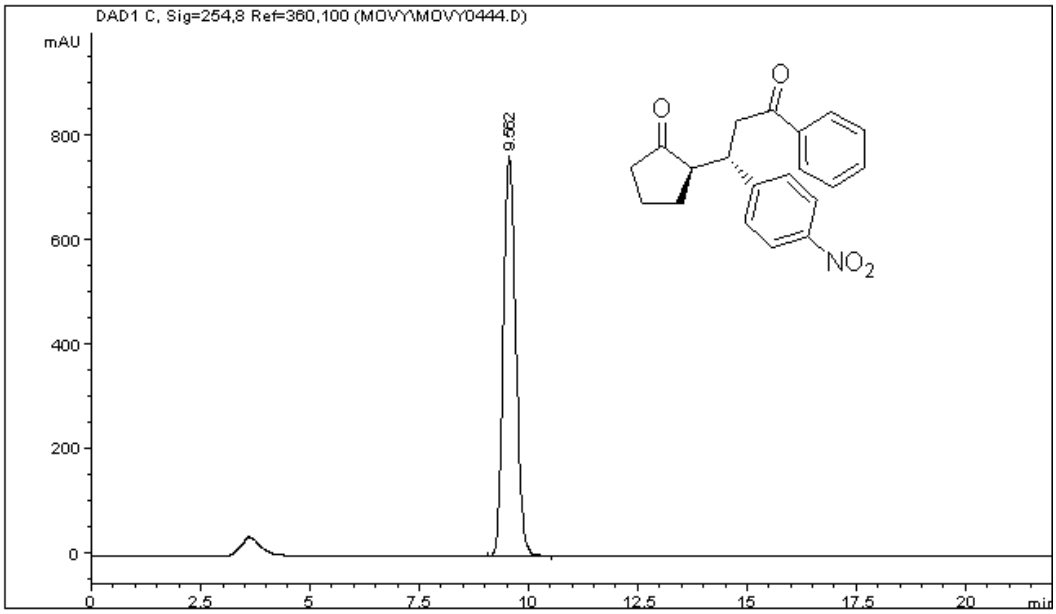

1	9.562	BBA	0.3115	1.52304e4	767.51489	100.0000