

Supporting Information

Asymmetric Aldol Reaction Organocatalyzed by (S)-Proline-Containing Dipeptides: Improved Stereoinduction under Solvent-Free Conditions

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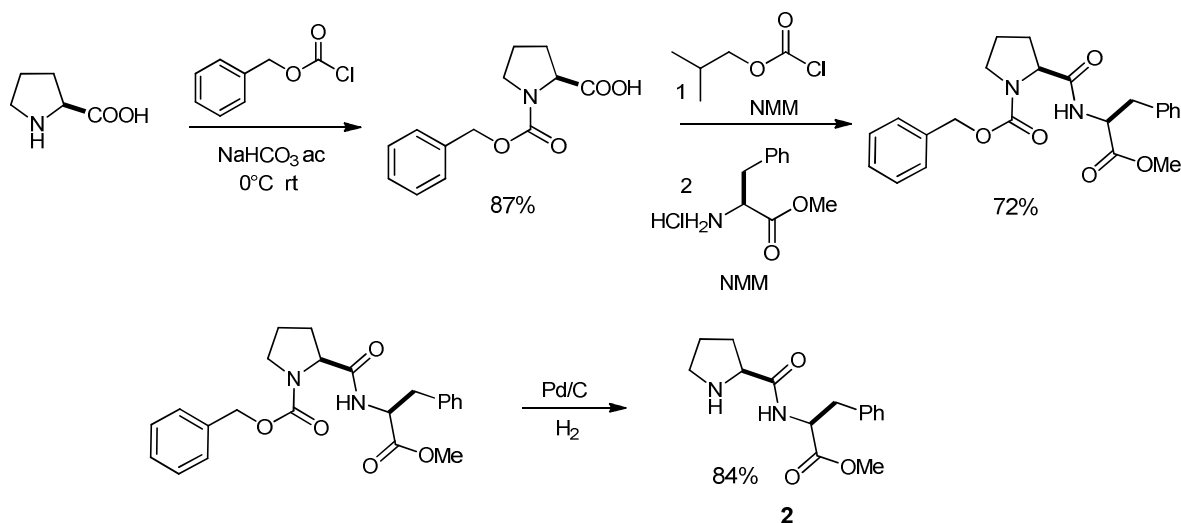
Experimental Section:

¹H and ¹³C NMR spectra were recorded on a 500 MHz spectrometer. Chemical shift (δ) are given in parts per million downfield from tetramethylsilane as an internal reference, coupling constants are given in *J* (Hertz). The molecular weight was determined using High-resolution mass spectra (HRMS). Infrared spectra (IR) were reported in reciprocal

centimeters. Enantiomeric excess was measured by chiral HPLC at room temperature using a Waters 600 E equipment fitted with a UV/Visible Waters 2487 detector at 220 or 254 nm with Chiralpak AD-H and Chiralcel OD-H columns. The reactions under ball-milling conditions were performed in a digital Amalgamator, used with a reactor (cylinder, 25 mm long and with a diameter 10 mm) containing one stainless steel ball with a 5 mm diameter.

Synthesis of dipeptide (*S,S*)-Proline-phenylalanine methyl ester **2**.

Dipeptide **2** was synthesized from the condensation of Cbz-Pro-OH with the phenylalanine methyl ester hydrochloride, following deprotection with hydrogen and palladium on carbon according to the general method for the preparation of dipeptides.



(*S,S*)-Proline-phenylalanine methyl ester **2**. (1.3 g, 84%). R_f = 0.35 [silica gel, DCM:MeOH 95:5]. (FT-IR/ATR cm^{-1}) ν_{max} 3324, 2951, 1740, 1667. $^1\text{H-NMR}$ (500 MHz, CDCl_3) δ 8.06 (1H, br-d, $J=8.3$ Hz), 7.29-7.18 (3H, m), 7.13-7.08 (2H, m), 4.83 (1H, m), 3.71 (3H, s), 3.67 (1H, m), 3.16 (1H, dd, $J=5.6$ Hz, $J=13.9$ Hz), 3.02 (1H, dd, $J=7.3$ Hz, $J=13.9$ Hz), 2.91 (1H, m), 2.72 (1H, m), 2.24 (1H, br-s), 2.03 (1H, m), 1.72 (1H, m), 1.64-1.45 (2H, m) ppm. $^{13}\text{C-NMR}$ (125 MHz, CDCl_3) δ 174.9, 172.0, 136.1, 129.2, 128.3, 126.9, 60.2, 52.4, 52.2, 47.1, 38.0, 30.6, 26.0 ppm. HR-ESI-TOF: Calculated for $\text{C}_{15}\text{H}_{21}\text{N}_2\text{O}_3$ $[\text{M}+\text{H}]^+$: 277.1546; found: 277.1551 (1.5 ppm error).

Typical procedure for the intermolecular aldol reaction. Ball mill method

A mixture of the catalyst **2** (7 mol %), cyclohexanone (20.56 mg, 0.22 mmol) and 4-nitrobenzaldehyde (30.2 mg, 0.2 mmol), was vigorously milled for 4 h at 2760 rpm at -20°C in a digital Mixer/Amalgamator used with a reactor made of Nylamid (cylinder, 25 mm long and with a diameter 10 mm) containing one stainless steel ball with a 5 mm diameter. Then the mixture was dissolved in AcOEt and extracted. The organic phase was dried over MgSO₄, and concentrate to give the crude reaction mixture that was purified by flash chromatography (silica gel, Hexane/EtOAc: 10:1-3:1) to afford aldol mixture (*syn-anti*).

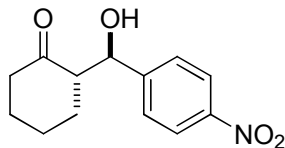
Spectroscopic data for compounds **5**

Compounds **5** have been previously described and spectroscopic data were in agreement with reported.¹⁻⁴

Diastereoselectivities were determined by ¹H NMR analysis in the crude reaction mixture. Purification by flash column chromatography gave the aldol products **5**.

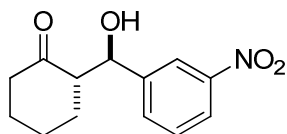
The absolute configuration of aldol products **5** was determined by comparison with reported HPLC data.

(*S*)-2-[(*R*)-Hydroxy(4-nitrophenyl)methyl]cyclohexanone **5a**



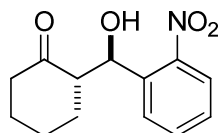
¹H-NMR (500 MHz, CDCl₃) δ 8.21 (2H, d, *J*=8.8 Hz), 7.51 (2H, d, *J*=8.8 Hz), 4.90 (1H, dd, *J*=8.4, 2.8 Hz), 4.08 (1H, m), 2.66-2.29 (3H, m), 2.17-2.04 (1H, m), 1.85-1.80 (1H, m), 1.75-1.15 (4H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 214.8, 148.4, 147.5, 127.8, 123.4, 73.9, 57.1, 42.6, 30.7, 27.6, 24.6 ppm.

(S)-2-[(R)-Hydroxy(3-nitrophenyl)methyl]cyclohexanone 5b



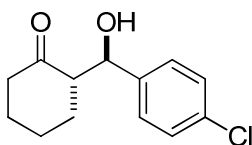
¹H-NMR (500 MHz, CDCl₃) δ 8.21 (1H, t, *J*=1.9 Hz), 8.17-8.12 (1H, m), 7.68 (1H, d, *J*=7.7 Hz), 7.53 (1H, t, *J*=7.9 Hz), 4.88 (1H, d, *J*=8.4 Hz), 4.16 (1H, s), 2.65-2.62 (1H, m), 2.51-2.48 (1H, m), 2.40-2.37 (1H, m), 2.13-2.10 (1H, m), 1.88-1.81 (1H, m), 1.76-1.54 (3H, m), 1.43-1.34 (1H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 214.9, 148.2, 143.2, 133.2, 129.3, 122.8, 122.0, 74.0, 57.1, 42.6, 30.7, 27.6, 24.6 ppm.

(S)-2-[(R)-Hydroxy(2-nitrophenyl)methyl]cyclohexanone 5c



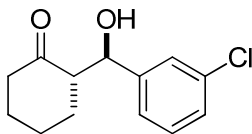
¹H-NMR (500 MHz, CDCl₃) δ 7.84 (1H, d, *J*=8.1 Hz), 7.77 (1H, d, *J*=7.8 Hz), 7.63 (1H, t, *J*=7.0 Hz), 7.43 (1H, t, *J*=7.3 Hz), 5.43 (1H, d, *J*=7.1 Hz), 4.20 (1H, s), 2.78-2.75 (1H, m), 2.51-2.43 (1H, m), 2.38-2.30 (1H, m), 2.12-2.04 (1H, m), 1.86-1.83 (1H, m), 1.83-1.60 (4H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 214.9, 148.7, 136.6, 133.1, 129.0, 128.4, 124.0, 69.7, 57.3, 42.8, 31.1, 27.7, 24.9 ppm.

(S)-2-[(R)-(4-Chlorophenyl)(hydroxy)methyl]cyclohexanone 5d



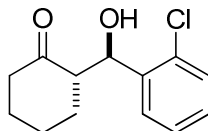
¹H-NMR (500 MHz, CDCl₃) δ 7.31 (2H, m), 7.25 (2H, m), 4.76 (1H, dd, *J*=8.8 Hz, *J*=2.3 Hz), 3.99 (1H, d, *J*=2.3 Hz), 2.58-2.52 (1H, m), 2.51-2.43 (1H, m), 2.40-2.30 (1H, m), 2.13-2.06 (1H, m), 1.85-1.73 (1H, m), 1.73-1.48 (3H, m), 1.33-1.26 (1H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 215.1, 139.3, 133.4, 128.3, 128.2, 74.1, 57.4, 42.7, 30.8, 27.6, 24.6 ppm.

(S)-2-[(R)-(3-Chlorophenyl)(hydroxy)methyl]cyclohexanone 5e



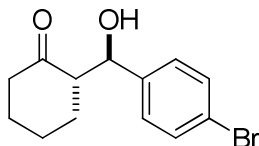
¹H-NMR (500 MHz, CDCl₃) δ 7.32 (1H, br-s), 7.28-7.24 (2H, m), 7.20-7.17 (1H, m), 4.75 (1H, d, *J*=8.7 Hz), 4.00 (1H, d, *J*=2.9 Hz), 2.62-2.55 (1H, m), 2.51-2.44 (1H, m), 2.40-2.30 (1H, m), 2.13-2.06 (1H, m), 1.85-1.73 (1H, m), 1.73-1.48 (3H, m), 1.34-1.24 (1H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 215.2, 143.0, 134.3, 129.6, 128.0, 127.1, 125.3, 74.2, 57.2, 42.6, 30.8, 27.7, 24.7 ppm.

(S)-2-[(R)-(2-Chlorophenyl)(hydroxy)methyl]cyclohexanone 5f



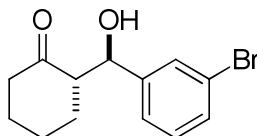
¹H-NMR (500 MHz, CDCl₃) δ 7.84 (1H, dd, *J*=7.8, *J*=1.5 Hz), 7.34-7.28 (2H, m), 7.21 (1H, m), 5.36 (1H, d, *J*=7.9 Hz), 4.03 (1H, d, *J*=3.7 Hz), 2.72-2.67 (1H, m), 2.48-2.44 (1H, m), 2.38-2.31 (1H, m), 2.11-2.04 (1H, m), 1.84-1.81 (1H, m), 1.70-1.54 (4H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 215.3, 139.0, 132.9, 129.2, 128.7, 128.2, 127.2, 70.4, 57.5, 42.7, 30.3, 27.8, 24.9 ppm.

(S)-2-[(R)-(4-Bromophenyl)(hydroxy)methyl]cyclohexanone 5g



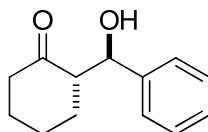
¹H-NMR (500 MHz, CDCl₃) δ 7.48-7.45 (2H, m), 7.21-7.18 (2H, m), 4.75 (1H, d, *J*=8.6 Hz), 3.99 (1H, d, *J*=2.7 Hz), 2.60-2.52 (1H, m), 2.51-2.43 (1H, m), 2.40-2.30 (1H, m), 2.13-2.06 (1H, m), 1.85-1.74 (1H, m), 1.73-1.49 (3H, m), 1.34-1.25 (1H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 215.3, 139.9, 131.4, 128.7, 121.7, 74.1, 57.3, 42.6, 30.7, 27.7, 24.7 ppm.

(S)-2-[(R)-(3-Bromophenyl)(hydroxy)methyl]cyclohexanone 5h



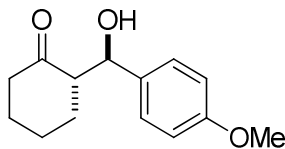
¹H-NMR (500 MHz, CDCl₃) δ 7.49-7.47 (1H, m), 7.40 (1H, dt, *J*=7.3 Hz, *J*=1.9 Hz), 7.24-7.17 (2H, m), 4.75 (1H, d, *J*=8.7 Hz), 4.00 (1H, d, *J*=2.7 Hz), 2.60-2.52 (1H, m), 2.51-2.42 (1H, m), 2.40-2.30 (1H, m), 2.13-2.06 (1H, m), 1.85-1.73 (1H, m), 1.73-1.48 (3H, m), 1.34-1.22 (1H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 215.2, 143.3, 130.9, 130.0, 129.8, 125.7, 122.5, 74.2, 57.2, 42.6, 30.7, 27.7, 24.6 ppm.

(S)-2-[(R)-Hydroxy(phenyl)methyl]cyclohexanone 5i



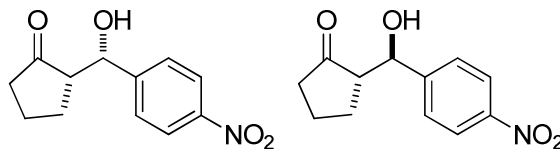
¹H-NMR (500 MHz, CDCl₃) δ 7.36-7.724 (5H, m), 4.79 (1H, d, *J*=8.8 Hz), 3.97 (1H, d, *J*=2.6 Hz), 2.65-2.58 (1H, m), 2.52-2.42 (1H, m), 2.42-2.31 (1H, m), 2.11-2.04 (1H, m), 1.84-1.75 (1H, m), 1.70-1.60 (1H, m), 1.60-1.48 (2H, m), 1.37-1.22 (1H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 215.6, 140.9, 128.3, 127.9, 127.0, 74.7, 57.4, 42.6, 30.8, 27.8, 24.7 ppm.

(S)-2-[(R)-Hydroxy(4-methoxyphenyl)methyl]cyclohexanone 5j



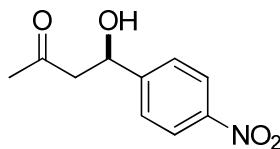
¹H-NMR (500 MHz, CDCl₃) δ 7.27-7.20 (2H, m), 6.89-6.87 (2H, m), 4.74 (1H, d, *J*=8.8 Hz), 3.99 (1H, d, *J*=2.6 Hz), 3.80 (3H, s), 2.62-2.54 (1H, m), 2.52-2.44 (1H, m), 2.42-2.30 (1H, m), 2.13-2.06 (1H, m), 1.85-1.73 (1H, m), 1.73-1.50 (3H, m), 1.32-1.25 (1H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 215.7, 159.2, 133.1, 128.1, 113.7, 74.2, 57.5, 55.2, 42.6, 30.8, 27.8, 24.7 ppm.

(S)-2-((R)-hydroxy(4-nitrophenyl)methyl)cyclopentanone 5k



¹H-NMR (500 MHz, CDCl₃) (Mixture of *syn/anti*: 69:31) δ 8.30-8.10 (3.0H, m), 7.60-7.40 (3.0H, m), 5.43 (1H, s, CH of *syn* diastereomer), 4.86 (0.45H, d, *J*=9.0 Hz, CH of *anti* diastereomer), 4.77 (0.45H, br-s), 3.09 (1H, br-s), 3.90-2.50 (1.45H, m), 2.39-2.30 (1.45H, m), 2.28-2.20 (0.45H, m), 2.18-2.04 (1H, m), 2.05-1.80 (2.9H, m), 1.80-1.60 (2.9H, m), 1.60-1.48 (0.45H, m) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 222.4, 219.9, 150.4, 148.7, 147.6, 147.1, 127.4, 126.4, 123.8, 123.7, 74.4, 70.4, 56.1, 55.1, 39.0, 38.7, 26.8, 22.4, 20.4 ppm.

(R)-4-Hydroxy-4-(4-nitrophenyl)butan-2-one 5l

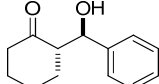
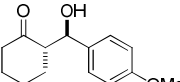
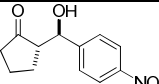
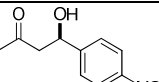


¹H-NMR (500 MHz, CDCl₃) δ 8.20 (2H, d, *J*=8.9 Hz), 7.54 (2H, d, *J*=8.3 Hz), 5.27 (1H, m), 3.68 (1H, br-s), 2.86 (2H, m), 2.23 (3H, s) ppm. **¹³C-NMR** (125 MHz, CDCl₃) δ 208.5, 149.9, 147.2, 126.3, 123.7, 68.8, 51.4, 30.6 ppm.

References:

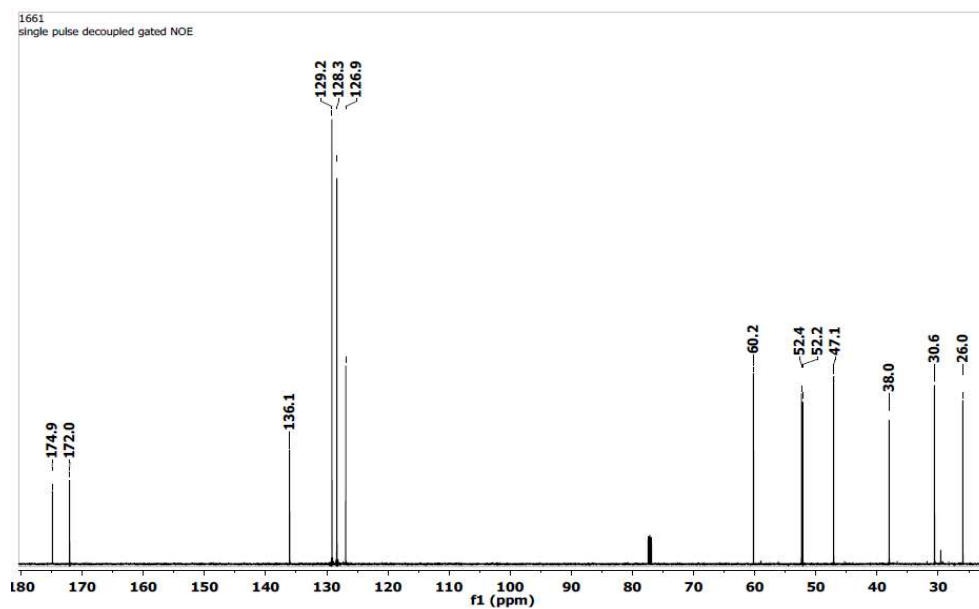
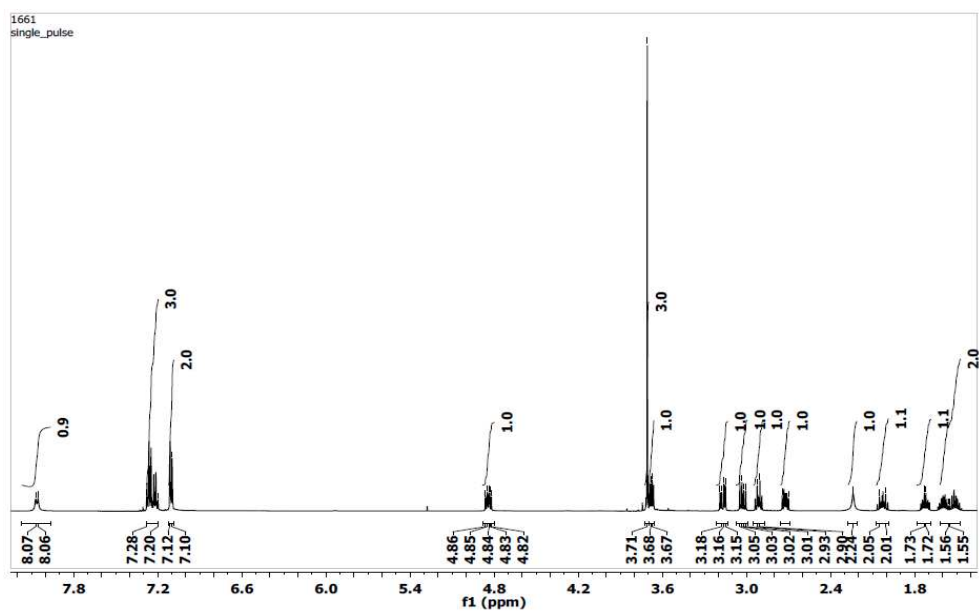
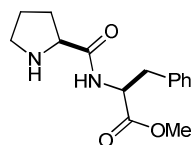
1. Rodríguez, B.; Bruckmann, A.; Bolm, C. *Chem. Eur. J.* **2007**, *13*, 4710-4722.
2. Lei, Meng.; Shi, L.; Chen, S.; Fang, W.; Ge, Z.; Cheng, T.; Li, R. Pecharsky, *Tetrahedron* **2007**, *63*, 7892-7898.
3. Lei, M.; Xia, S.; Wang, J.; Ge, Z.; Cheng, T.; Li, R. *Chirality*.**2010**, *22*,580-586.
4. An, Y-J.; Zhang, Y-X.; Wu, Y.; Liu, Z-M.; Pi, C.; Tao, C-J. *Tetrahedron: Asymmetry* **2010**, *21*, 688-694.

Table 1. ¹ H NMR <i>CHOH</i> (ppm) and HPLC conditions and retention times for compound 5							
	Structure	¹ H NMR (CDCl ₃ , - <i>CHOH</i> , d ppm, <i>J</i> Hz)		HPLC			
		<i>syn</i>	<i>anti</i>	Column	eluent (Hx/Pr ^o H) flow rate (mL/min)	<i>syn</i> t(min) ^a	<i>anti</i> t(min) ^a
5a		5.47 (br s)	4.90 (dd, <i>J</i> =8.4, 2.8 Hz)	Chiralpak AD-H	90:10 1 mL/min	18.350 20.783	23.283 (2 <i>R</i> ,1' <i>S</i>) 30.567 (2<i>S</i>,1'<i>R</i>)
5b		5.45 (br s)	4.88 (d, <i>J</i> =8.4 Hz)	Chiralpak AD-H	95:5 0.8 mL/min	28.750 31.133	35.117 (2<i>S</i>,1'<i>R</i>) 44.717 (2 <i>R</i> ,1' <i>S</i>)
5c		5.94 (br s)	5.43 (d, <i>J</i> =7.1 Hz)	Chiralpak AD-H	90:10 1 mL/min	n.d n.d	16.950 (2<i>S</i>,1'<i>R</i>) 18.483 (2 <i>R</i> ,1' <i>S</i>)
5d		5.36 (br s)	4.76 (dd, <i>J</i> =8.8, 2.3 Hz)	Chiralpak AD-H	90:10 0.5 mL/min	15.583 17.817	23.283 (2 <i>R</i> ,1' <i>S</i>) 26.367 (2<i>S</i>,1'<i>R</i>)
5e		5.36 (br s)	4.75 (d, <i>J</i> =8.7 Hz)	Chiralpak AD-H	90:10 0.5 mL/min	14.483 16.183	21.050 (2<i>S</i>,1'<i>R</i>) 23.050 (2 <i>R</i> ,1' <i>S</i>)
5f		5.71 (br s)	5.36 (d, <i>J</i> =7.9 Hz)	Chiralpak AD-H	95:5 0.5 mL/min	n.d n.d	24.683 (2<i>S</i>,1'<i>R</i>) 28.433 (2 <i>R</i> ,1' <i>S</i>)
5g		5.33 (br s)	4.75 (d, <i>J</i> =8.6 Hz)	Chiralpak AD-H	90:10 0.5 mL/min	15.933 18.483	24.533 (2 <i>R</i> ,1' <i>S</i>) 28.050 (2<i>S</i>,1'<i>R</i>)
5h		5.36 (br s)	4.75 (d, <i>J</i> =8.7 Hz)	Chiralpak AD-H	90:10 0.5 mL/min	15.067 16.367	22.200 (2<i>S</i>,1'<i>R</i>) 23.350 (2 <i>R</i> ,1' <i>S</i>)

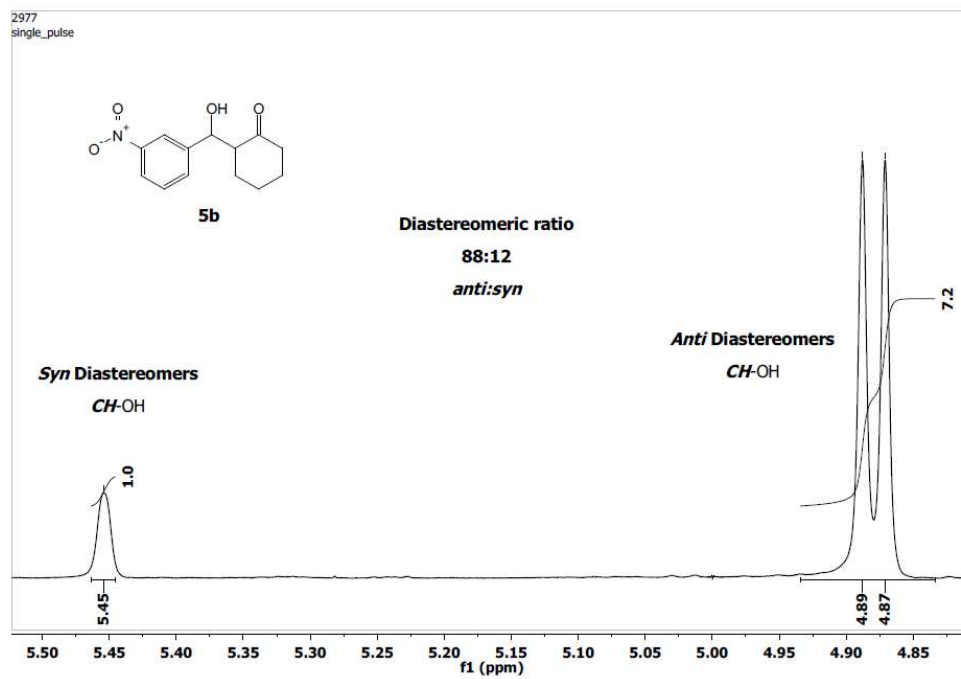
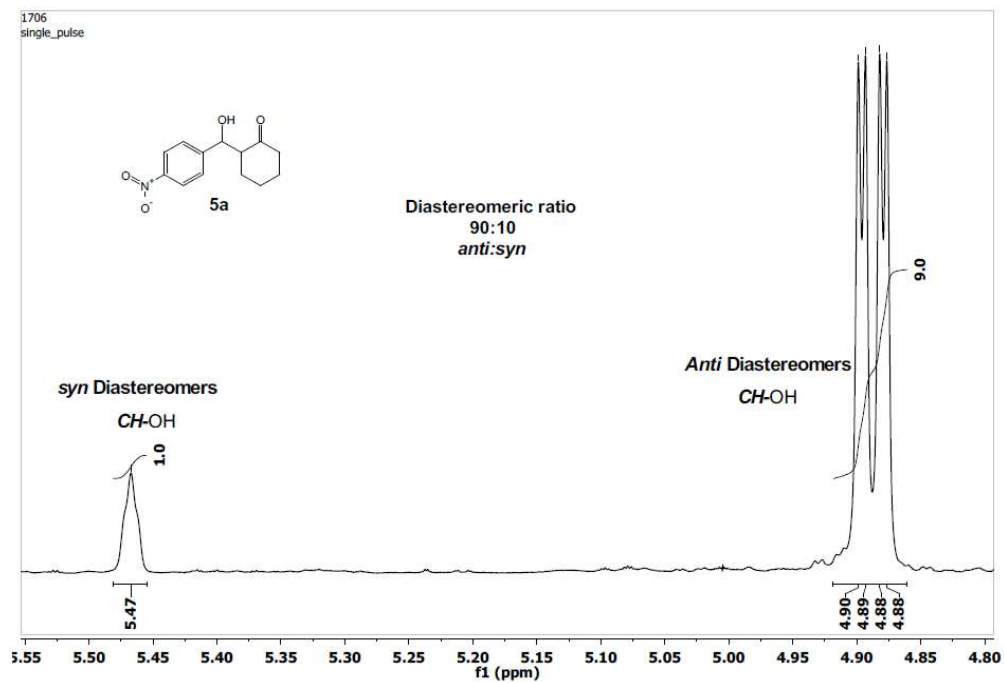
Table 1. (continuation) ¹ H NMR <i>CHOH</i> (d ppm) and HPLC conditions and retention times for compound 5							
	Structure	¹ H NMR (CDCl ₃ , - <i>CHOH</i> , d ppm, <i>J</i> Hz)		HPLC			
		<i>syn</i>	<i>anti</i>	Column	eluent (Hx/Pr ^o OH) flow rate (mL/min)	<i>syn</i> t(min) ^a	<i>anti</i> t(min) ^a
5i		5.39 (br-d, <i>J</i> =2.2 Hz)	4.79 (d, <i>J</i> =8.8 Hz)	Chiralcel OD-H	95:5(Hx/EtOH) 0.5 mL/min	14.267 14.683	16.317 (2<i>S</i>,1'<i>R</i>) 20.433 (2 <i>R</i> ,1' <i>S</i>)
5j		5.32 (br-d, <i>J</i> =2.4 Hz)	4.74 (d, <i>J</i> =8.8 Hz)	Chiralcel OD-H	95:5(Hx/EtOH) 0.5 mL/min	18.217 19.217	21.333 (2<i>S</i>,1'<i>R</i>) 26.533 (2 <i>R</i> ,1' <i>S</i>)
5k		5.43 (br s)	4.86 (d, <i>J</i> =9.0 Hz)	Chiralpak AD-H	95:5 1.0 mL/min	21.450 28.733	36.550 (2 <i>R</i> ,1' <i>S</i>) 38.017 (2<i>S</i>,1'<i>R</i>)
5l		---	---	Chiralpak AD-H	95:5 0.5 mL/min	49.717 (<i>S</i>) 51.600 (<i>R</i>)	

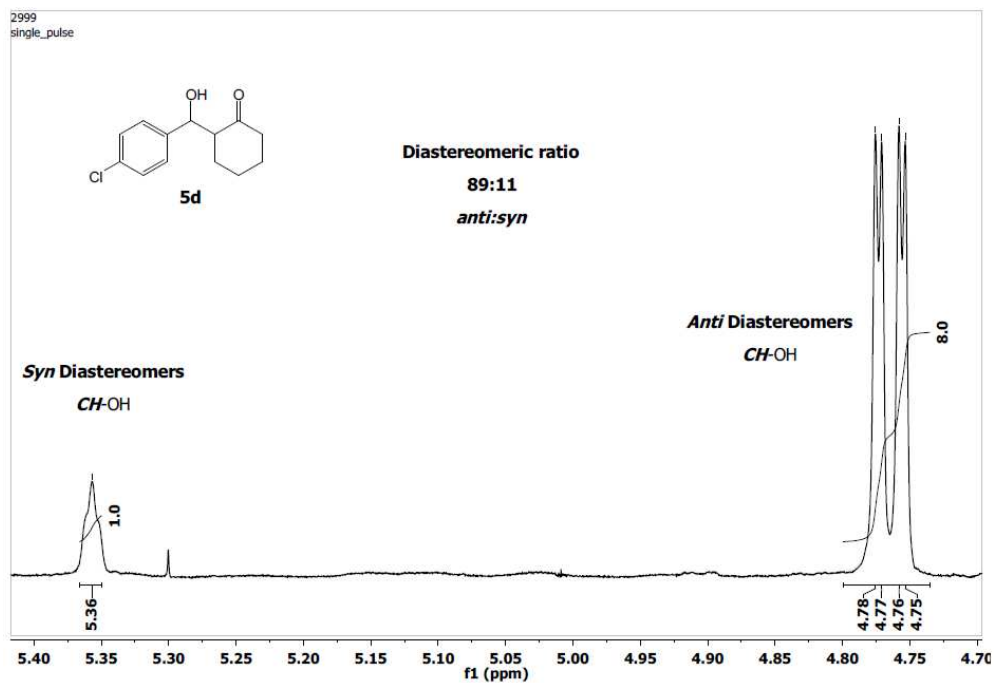
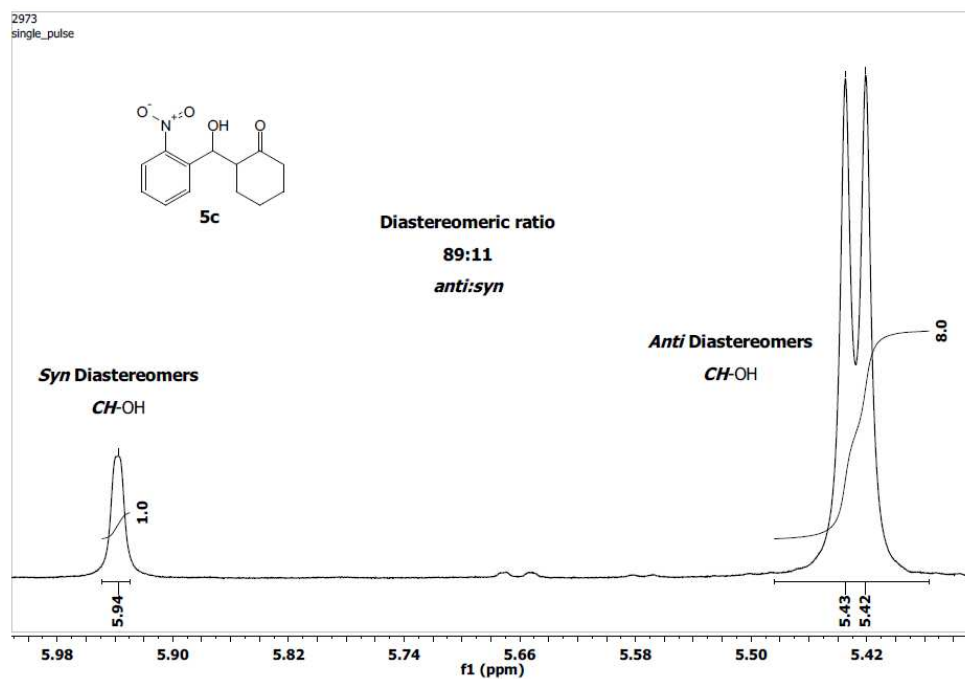
NMR Spectra ^1H , ^{13}C -NMR

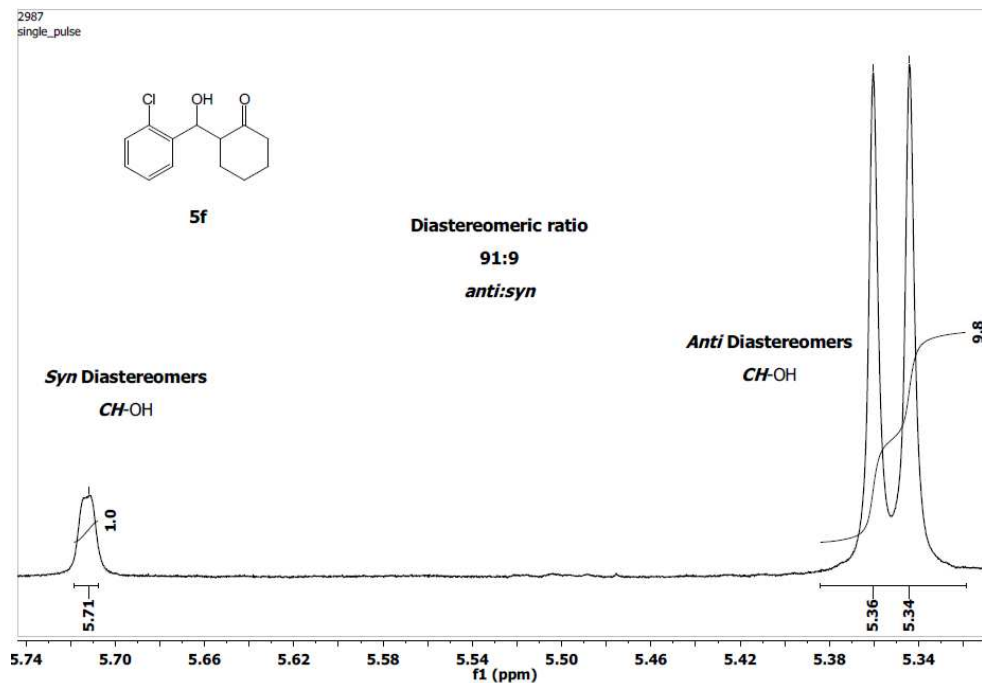
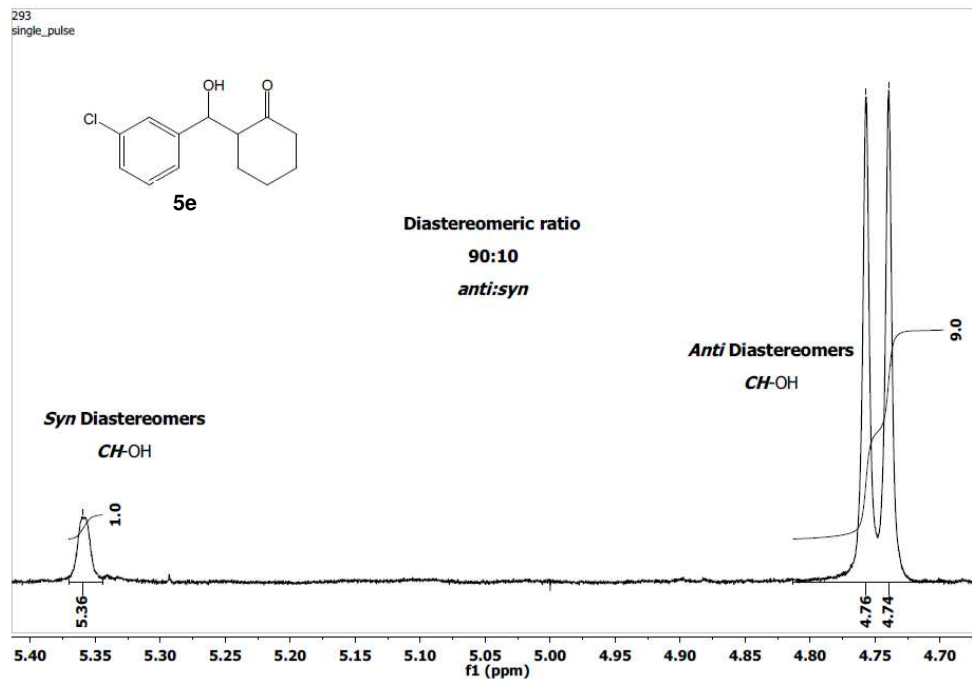
NH-Pro-Phe-COOMe (2)

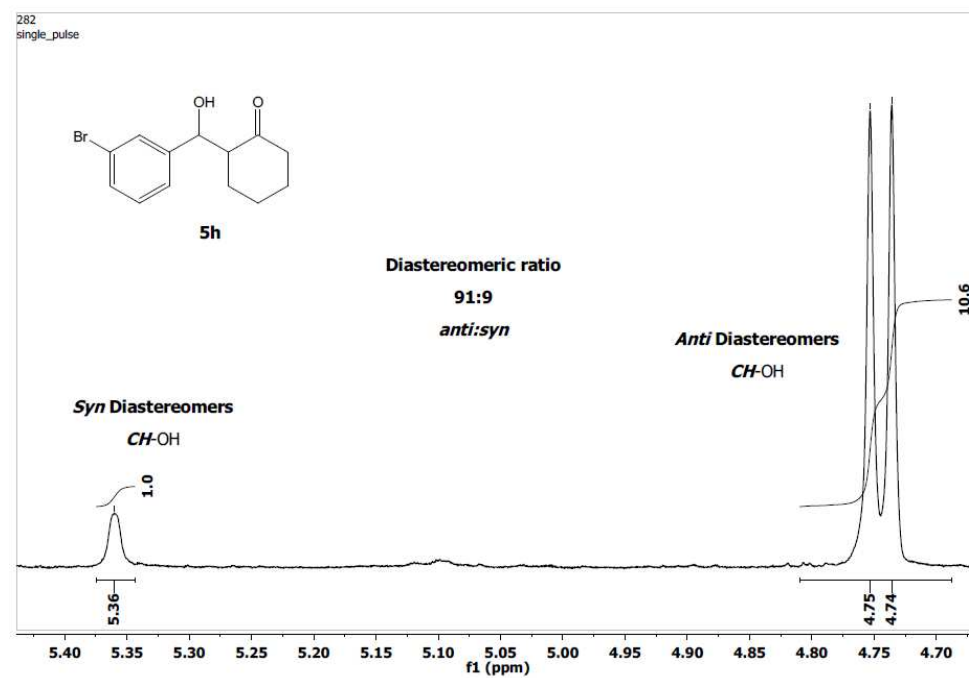
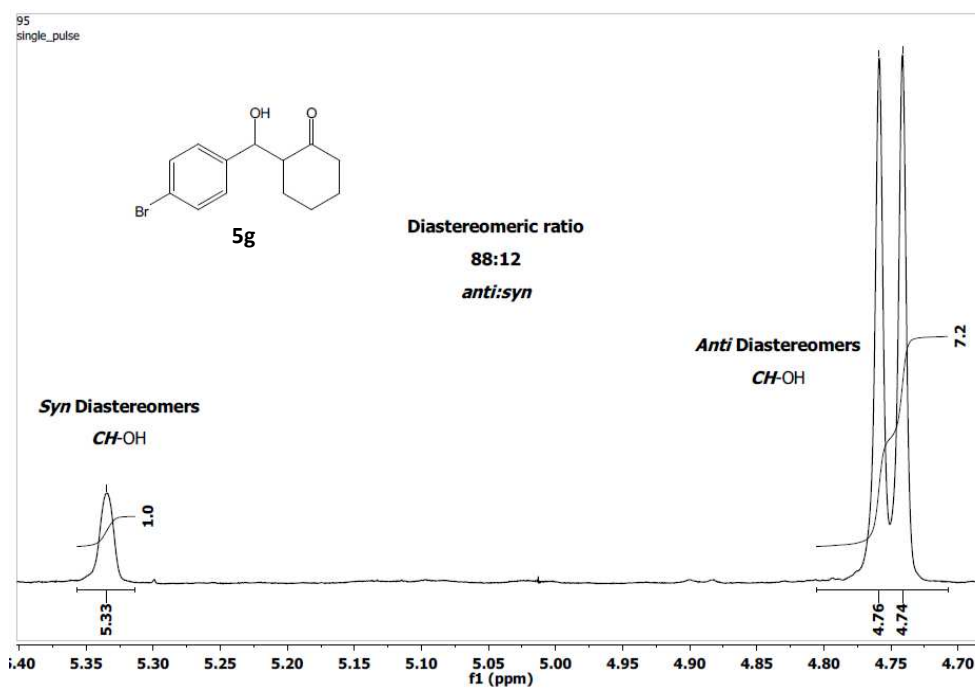


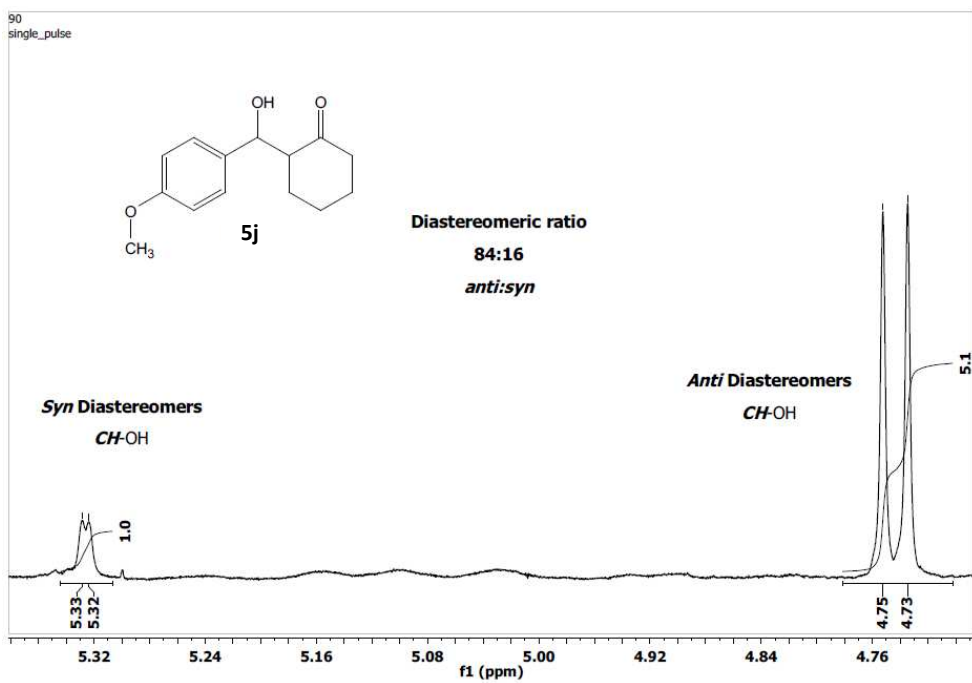
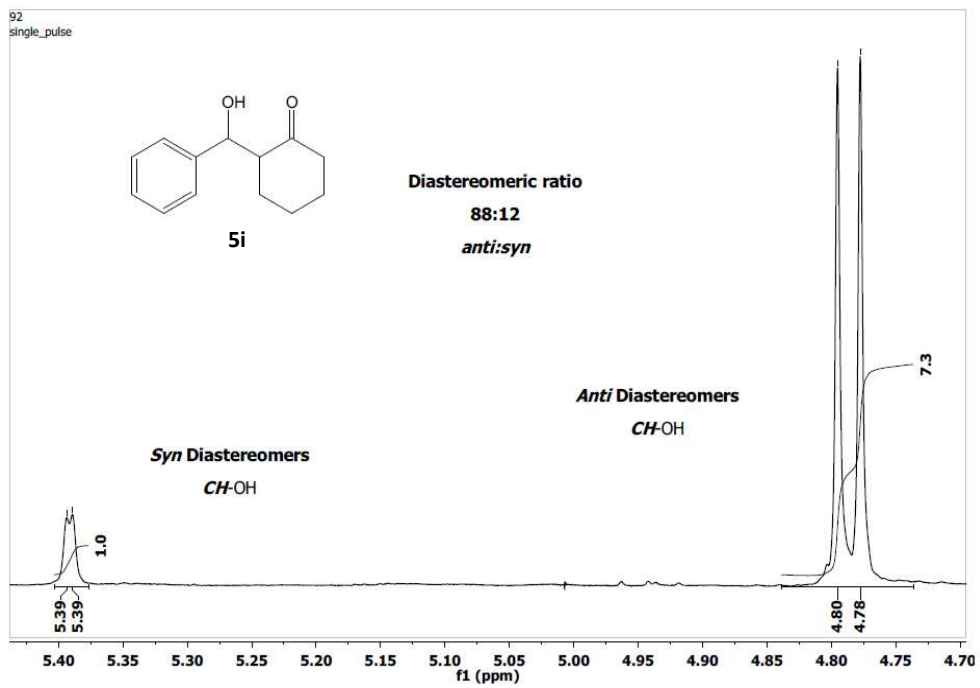
Diastereomeric ratio of 5a-k determined by ^1H NMR spectroscopic analysis.

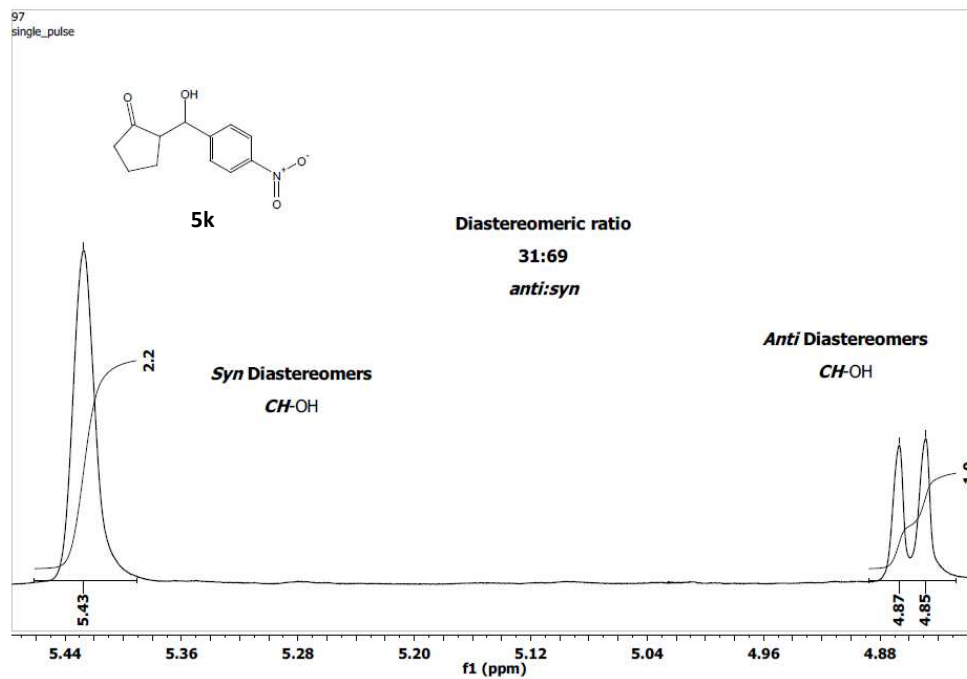




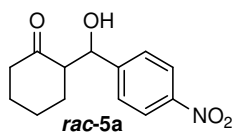






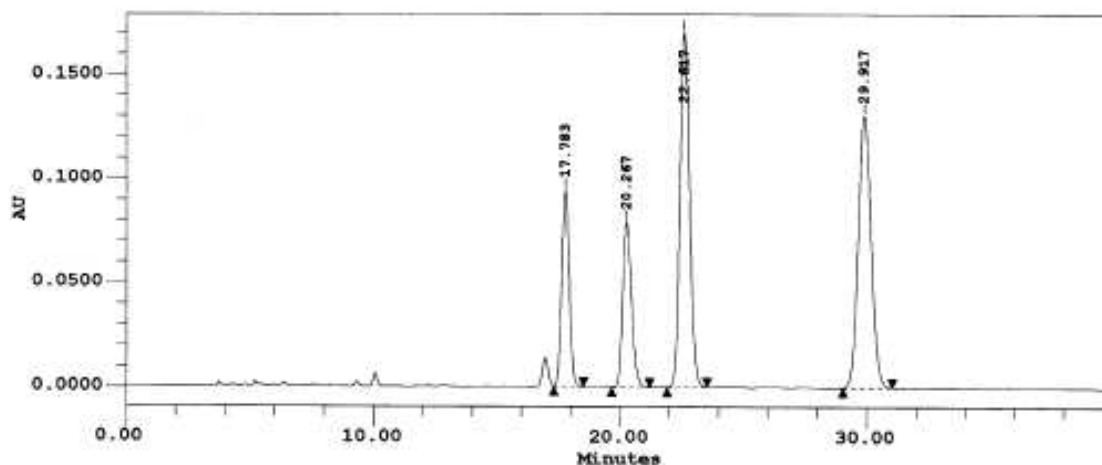


Enantiomeric excess of 5a-I Determined by chiral-phase HPLC analysis



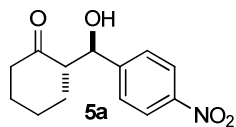
Millennium Sample Information

Project Name:	Gregorio	Flujo : 1.0 ml/min Unknown
Sample Name:	Rac-Aldol	Fase : 90:10 Hexano-IPA 1.00000
Vial:	3	Longitud: 254 nm UV 486
Injection:	1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired:	06/14/10 06:31:48 PM	Run Time: 40.0 min
Acq Meth Set:	alcoholes	Volume: 20.00
Processing Method:	Default	
Column:	Columna Chiralpak AD-H 06/14/10 07:28:38 PM	



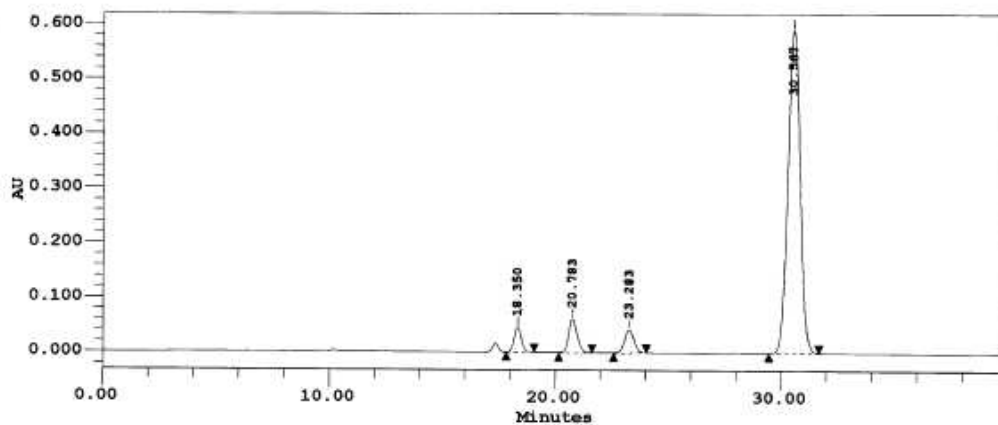
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		17.783	17.317	18.533	1941342	93930	14.70
2		20.267	19.667	21.200	1948428	79008	14.75
3		22.617	21.900	23.533	4603826	170446	34.86
4		29.917	29.050	31.033	4714081	130265	35.69



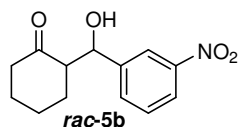
Millennium Sample Information

Project Name: Gregorio	Flujo : 1.0 ml/min Unknown
Sample Name: JG137	Fase : 90:10 Hexano-IPA 1.00000
Vial: 2	Longitud: 254 nm UV 486
Injection: 1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired: 06/15/10 01:33:53 PM	Run Time: 40.0 min
Acq Meth Set: alcoholes	Volume: 20.00
Processing Method: Default	
Column: Columna Chiralpak AD-H 06/15/10 02:18:56 PM	



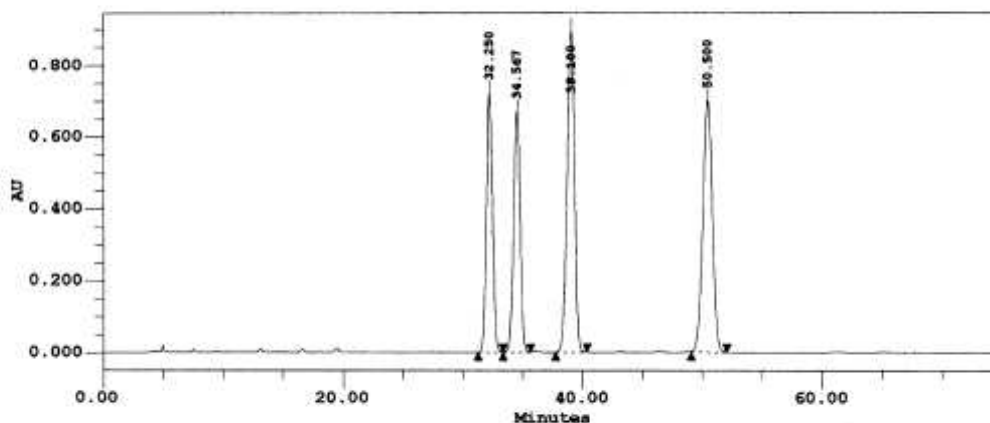
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		18.350	17.833	19.083	987215	45628	3.84
2		20.783	20.150	21.633	1563703	61641	6.08
3		23.283	22.583	24.033	1158578	41856	4.50
4		30.567	29.450	31.683	22010172	589840	85.58



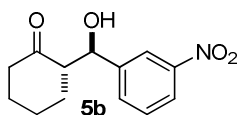
Millennium Sample Information

Project Name:	Gregorio	Flujo : 0.8 mL/min Unknown
Sample Name:	JG156-Rac	Fase : 95:5 Hexano-IPA 1.00000
Vial:	1	Longitud: 254 nm UV 486
Injection:	1	Operator: Rodrigo Gonzalez 1.00000
Date Acquired:	08/11/10 11:50:33 AM	Run Time: 75.0 min
Acq Meth Set:	alcoholes	Volume: 20.00
Processing Method:	Default	
Column:	Chiralpak AD-H 08/11/10 02:29:17 PM	



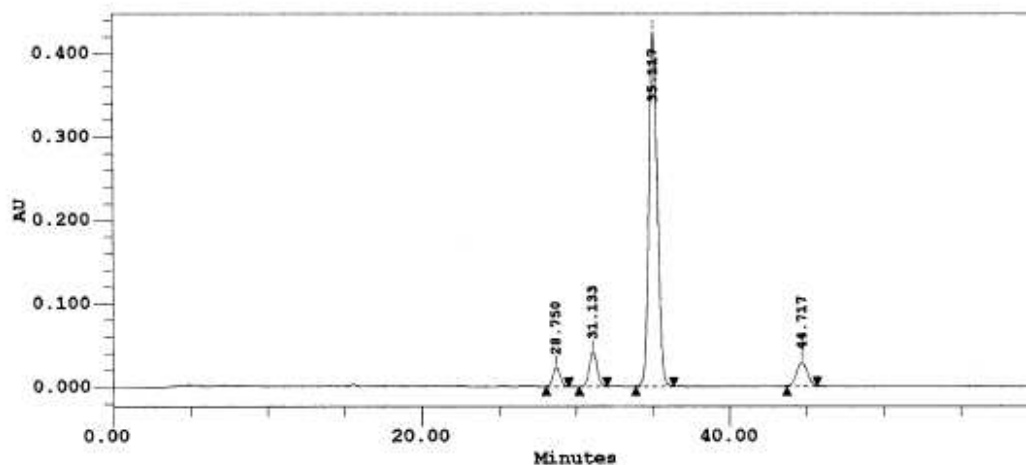
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		32.250	31.250	33.350	25589610	724684	19.98
2		34.567	33.350	35.650	25579337	672836	19.97
3		39.100	37.717	40.367	38596521	899829	30.14
4		50.500	49.050	52.033	38303885	701853	29.91



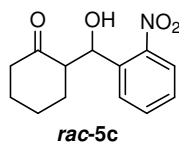
Millennium Sample Information

Project Name: Gregorio	Flujo : 0.8 mL/min Unknown
Sample Name: JG197-3NO2	Fase : Hexano-IPA (95:5) 1.00000
Vial: 1	Longitud: 254 nm UV 486
Injection: 1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired: 09/13/10 05:14:12 PM	Run Time: 60.0 min
Acq Meth Set: alcoholes	Volume: 20.00
Processing Method: Default	
Column: Chiralpak AD-H 09/13/10 06:16:55 PM	



Peak Results

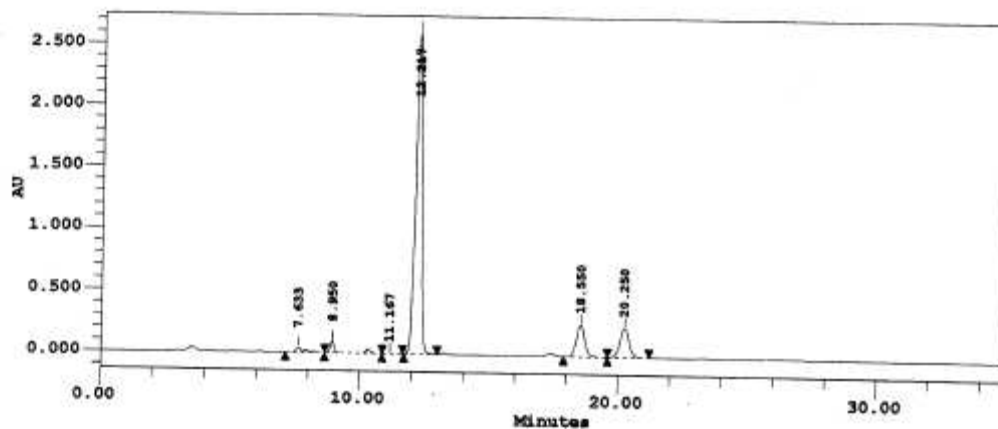
#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		28.750	28.050	29.533	709507	22845	3.58
2		31.133	30.217	32.033	1403302	41356	7.07
3		35.117	33.883	36.367	16372095	425588	82.54
4		44.717	43.717	45.700	1350461	28421	6.81



Millennium Sample Information

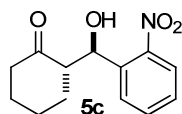
Project Name: Gregorio
Sample Name: JG155-rac
Vial: 1
Injection: 1
Date Acquired: 08/10/10 11:59:20 AM
Acq Meth Set: alcoholes
Processing Method: Default
Column: Columna Chiralpak AD-H 08/10/10 01:11:05 PM

Flujo : 1.0 ml/min Unknown
Fase : 90:10 Hexano-IPA 1.00000
Longitud: 254 nm UV 486
Operador: Rodrigo Gonzalez 1.00000
Run Time: 35.0 min
Volume: 20.00



Peak Results

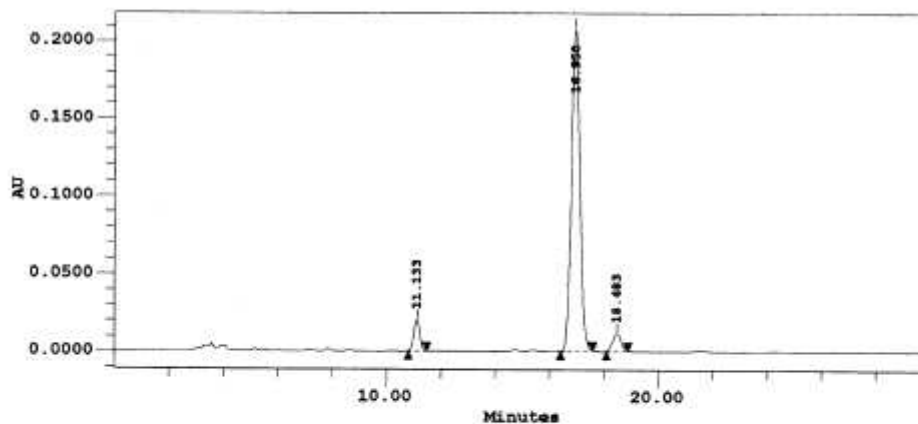
#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		7.633	7.133	8.650	744735	37526	1.34
2		8.950	8.650	10.867	1421393	96336	2.55
3		11.167	10.867	11.667	21183	955	0.04
4		12.217	11.700	13.000	42044771	2609694	75.38
5		18.550	17.883	19.600	5848407	258947	10.49
6		20.250	19.600	21.200	5694059	236834	10.21



Millennium Results Report		September 24, 2010		Page: 1 of 1	
Report Method: Default		Version: 2.15.01			
For Sample:	JG-198-2NO2	Vial: 1	Injection: 1	Channel: 486	
Proc Chan:	486	Processed: 09/24/10 06:51:00 PM			
Channel Descr:					

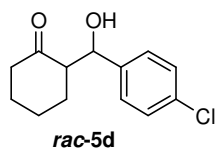
Millennium Sample Information

Project Name:	Gregorio	Flujo : 1.0 mL/min Unknown
Sample Name:	JG-198-2NO2	Fase : Hexano-IPA (90:10) 1.00000
Vial:	1	Longitud: 254 nm UV 486
Injection:	1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired:	09/24/10 03:57:10 PM	Run Time: 30.0 min
Acq Meth Set:	alcoholes	Volume: 20.00
Processing Method:	Default	
Column:	Chiralpak AD-H 09/24/10 06:51:00 PM	



Peak Results

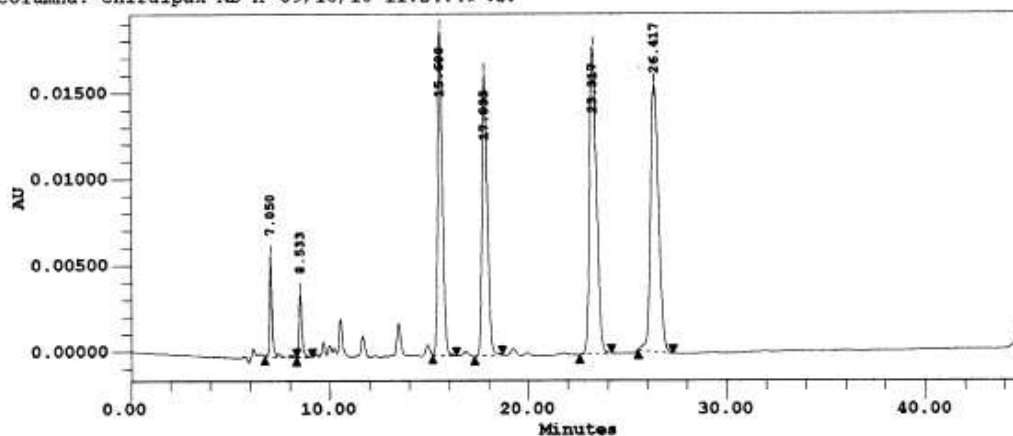
#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		11.133	10.800	11.483	302282	19836	6.05
2		16.950	16.400	17.583	4456795	207092	89.26
3		18.483	18.100	18.883	234211	11096	4.69



Millennium Sample Information

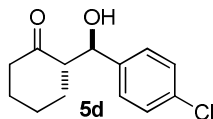
Project Name: Gregorio
Sample Name: JG-176-rac-Cl
Vial: 1
Injection: 1
Date Acquired: 09/01/10 01:27:17 PM
Acq Meth Set: alcoholes
Processing Method: Default
Column: Chiralpak AD-H 09/10/10 11:24:49 AM

Flujo : 0.5 mL/min Unknown
Fase : Hexano-IPA (90:10) 1.00000
Longitud: 254 nm UV 486
Operador: Rodrigo Gonzalez 1.00000
Run Time: 45.0 min
Volume: 20.00



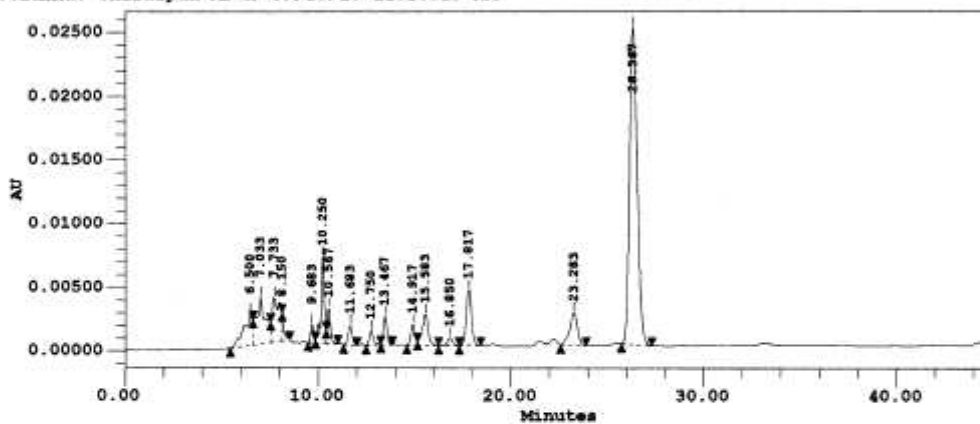
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		7.050	6.717	8.333	50028	5808	3.25
2		8.533	8.333	9.133	35655	3666	2.31
3		15.600	15.183	16.367	300367	18798	19.50
4		17.833	17.300	18.700	299392	16309	19.43
5		23.317	22.583	24.200	426009	17743	27.65
6		26.417	25.550	27.283	429028	15436	27.85



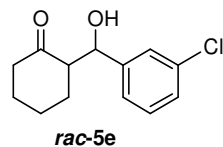
Millennium Sample Information

Project Name: Gregorio	Flujo : 0.5 mL/min Unknown
Sample Name: JG-179-Cl	Fase : Hexano-IPA (90:10) 1.00000
Vial: 2	Longitud: 254 nm UV 486
Injection: 1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired: 09/01/10 02:14:20 PM	Run Time: 45.0 min
Acq Meth Set: alcoholes	Volume: 20.00
Processing Method: Default	
Column: Chiralpak AD-H 09/10/10 11:28:19 AM	



Peak Results

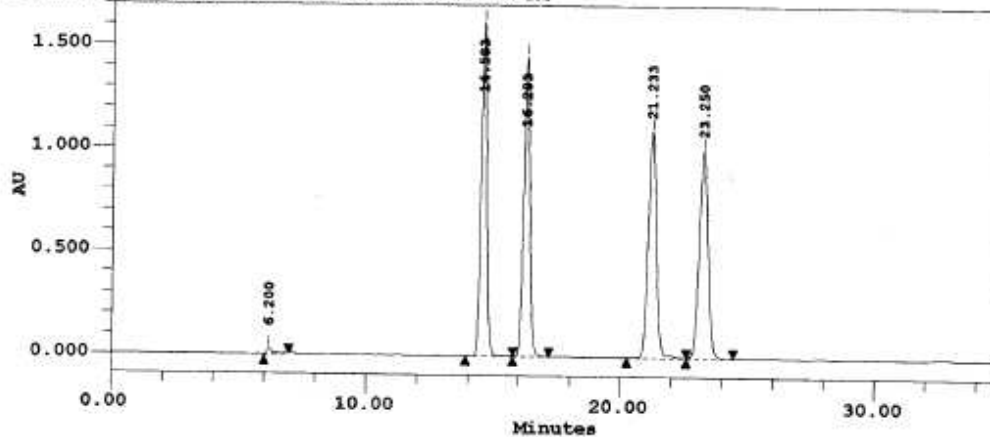
#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		6.500	5.450	6.617	72790	2468	5.12
2		7.033	6.617	7.533	119620	3650	8.41
3		7.733	7.533	8.133	98935	3494	6.95
4		8.150	8.133	8.533	12581	1909	0.88
5		9.683	9.467	9.850	14683	1474	1.03
6		10.250	9.850	10.433	85675	6767	6.02
7		10.567	10.433	11.033	31301	2768	2.20
8		11.683	11.300	12.033	20759	1554	1.46
9		12.750	12.483	13.233	16579	1136	1.17
10		13.467	13.233	13.867	29663	2186	2.08
11		14.917	14.600	15.167	24295	1628	1.71
12		15.583	15.167	16.250	51298	2463	3.60
13		16.850	16.250	17.317	10378	596	0.73
14		17.817	17.317	18.433	80880	4412	5.68
15		23.283	22.583	23.917	69166	2558	4.86
16		26.367	25.733	27.333	684402	24852	48.10



Millennium Sample Information

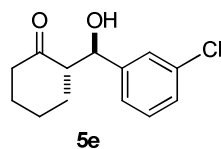
Project Name: Gregorio
Sample Name: JG221-3Cl-ra
Vial: 2
Injection: 1
Date Acquired: 10/28/10 12:57:59 PM
Acq Meth Set: alcoholes
Processing Method: Default
Column: Chiralcel AD-H 10/28/10 05:17:59 PM

Flujo : 0.5 mL/min Unknown
Fase : Hexano-IPA (90:10) 1.00000
Longitud: 210 nm UV 486
Operador: Rodrigo Gonzalez 1.00000
Run Time: 35.0 min
Volume: 20.00



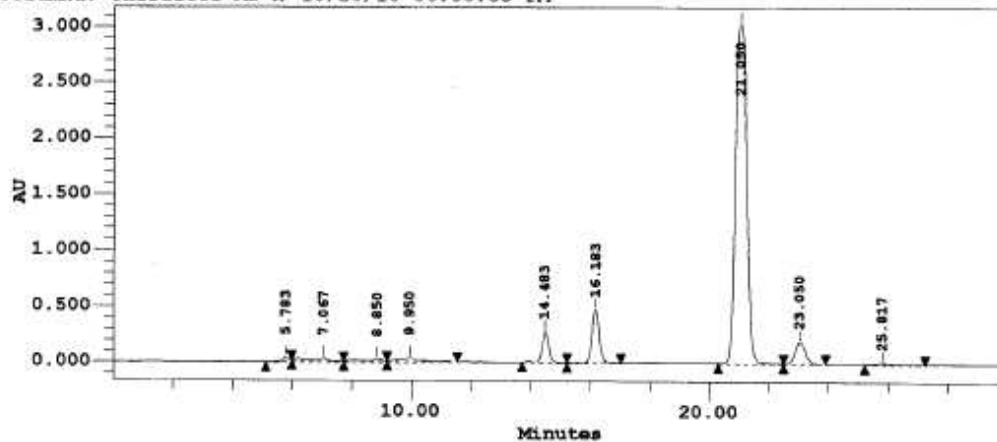
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		6.200	5.983	6.950	457984	29114	0.47
2		14.583	13.883	15.767	24249198	1619583	24.94
3		16.283	15.767	17.167	24228434	1455461	24.92
4		21.233	20.250	22.583	24257415	1099960	24.95
5		23.250	22.583	24.433	24023129	1008739	24.71



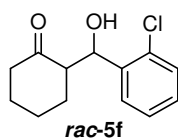
Millennium Sample Information

Project Name: Gregorio	Flujo : 0.5 mL/min Unknown
Sample Name: JG224-3Cl	Fase : Hexano-IPA (90:10) 1.00000
Vial: 4	Longitud: 210 nm UV 486
Injection: 1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired: 10/28/10 02:11:00 PM	Run Time: 30.0 min
Acq Meth Set: alcoholes	Volume: 20.00
Processing Method: Default	
Column: Chiralcel AD-H 10/28/10 06:08:55 PM	



Peak Results

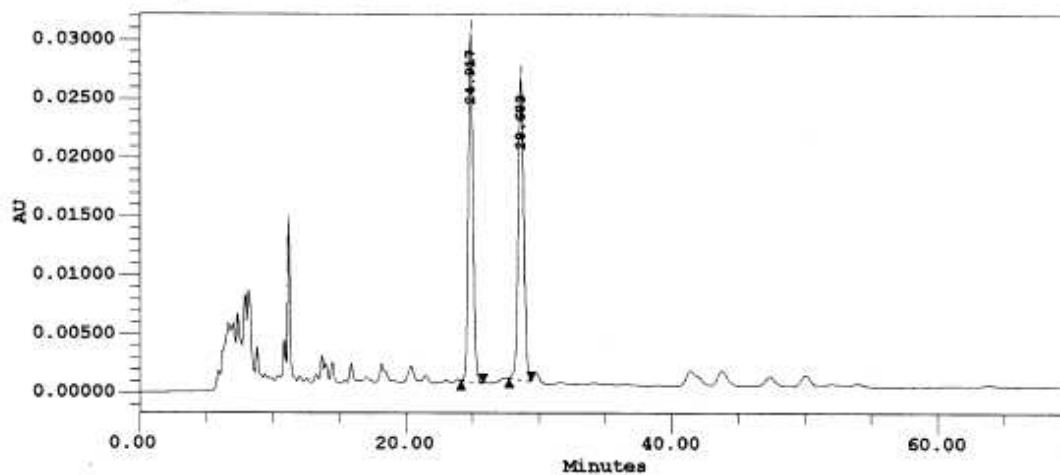
#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		5.783	5.100	5.983	584528	42431	0.58
2		7.067	5.983	7.717	1681456	37339	1.66
3		8.850	7.717	9.167	1123335	28029	1.11
4		9.950	9.167	11.533	1598513	37319	1.58
5		14.483	13.700	15.217	4209784	274301	4.16
6		16.183	15.217	17.017	7911686	475848	7.82
7		21.050	20.283	22.483	79068940	3027693	78.20
8		23.050	22.483	23.900	4600881	195661	4.55
9		25.817	25.217	27.233	331154	12129	0.33



Millennium Sample Information

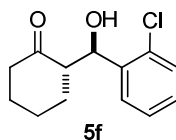
Project Name: Gregorio
Sample Name: JG177-Rac2Cl
Vial: 1
Injection: 1
Date Acquired: 09/13/10 12:21:29 PM
Acq Meth Set: alcoholes
Processing Method: Default
Column: Chiralpak AD-H 09/13/10 04:06:17 PM

Flujo : 0.5 mL/min Unknown
Fase : Hexano-IPA (95:5) 1.00000
Longitud: 254 nm UV 486
Operador: Rodrigo Gonzalez 1.00000
Run Time: 70.0 min
Volume: 20.00



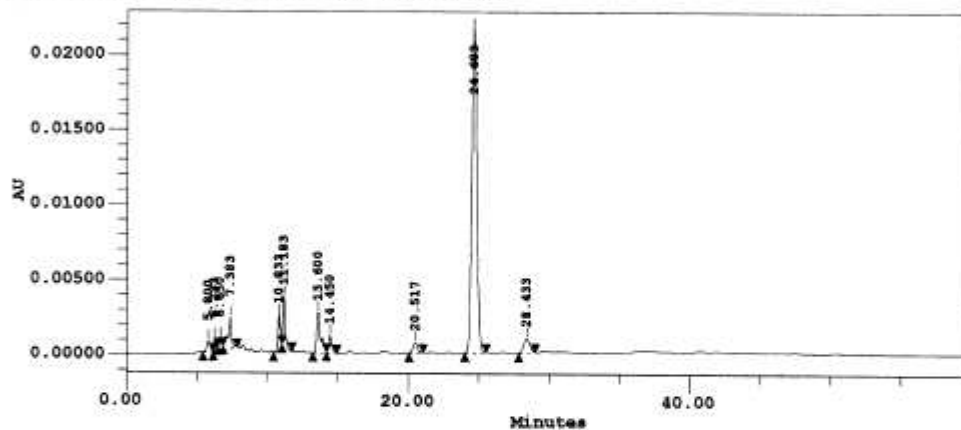
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		24.917	24.133	25.817	747054	29699	49.98
2		28.683	27.783	29.417	747615	25778	50.02



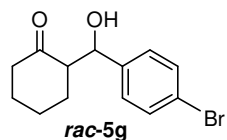
Millennium Sample Information

Project Name: Gregorio	Flujo : 0.5 mL/min Unknown
Sample Name: JG178-2C1	Fase : Hexano-IPA (95:5) 1.00000
Vial: 2	Longitud: 254 nm UV 486
Injection: 1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired: 09/13/10 01:32:46 PM	Run Time: 60.0 min
Acq Meth Set: alcoholes	Volume: 20.00
Processing Method: Default	
Column: Chiralpak AD-H 09/13/10 04:09:05 PM	



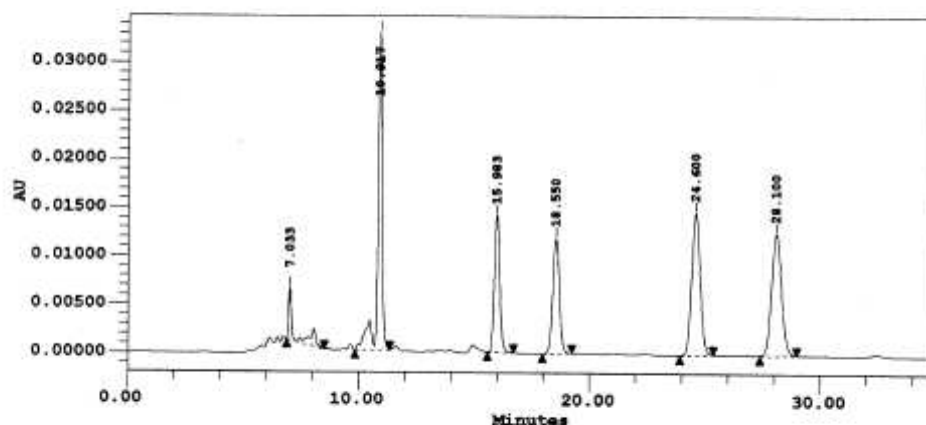
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		5.800	5.417	6.133	13798	767	1.70
2		6.233	6.133	6.467	9857	905	1.09
3		6.650	6.467	6.833	11053	872	1.36
4		7.383	6.833	7.833	39508	2115	4.87
5		10.833	10.433	11.000	27745	2500	3.42
6		11.183	11.000	11.733	47306	3683	5.83
7		13.600	13.200	14.200	51698	2739	6.37
8		14.450	14.200	14.933	17467	1177	2.15
9		20.517	20.050	21.033	14303	689	1.76
10		24.683	24.017	25.533	551830	21663	68.04
11		28.433	27.850	29.033	27501	959	3.39



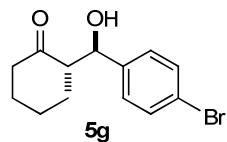
Millennium Sample Information

Project Name: Gregorio	Flujo : 1.0 mL/min Unknown	
Sample Name: JG191-rac-4Br	Fase : Hexano-IPA (90:10) 1.00000	
Vial: 2	Longitud: 254 nm UV 486	
Injection: 1	Operador: Rodrigo Gonzalez 1.00000	
Date Acquired: 09/24/10 05:31:27 PM	Run Time: 35.0 min	
Acq Meth Set: alcoholes	Volume: 20.00	
Processing Method: Default		
Column: Chiralpak AD-H 09/24/10 07:03:42 PM		



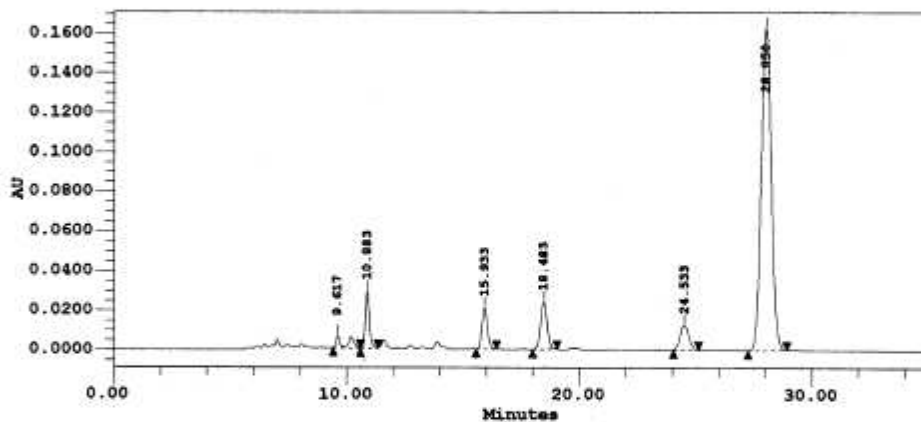
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		7.033	6.883	8.517	76306	5365	4.45
2		10.917	9.833	11.350	437005	32821	25.47
3		15.983	15.583	16.700	229835	14128	13.40
4		18.550	17.967	19.233	230326	11897	13.42
5		24.600	23.917	25.367	372235	14665	21.69
6		28.100	27.383	28.967	370090	12536	21.57



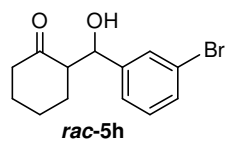
Millennium Sample Information

Project Name: Gregorio	Flujo : 1.0 mL/min Unknown
Sample Name: JG195-4Br	Fase : Hexano-IPA (90:10) 1.00000
Vial: 3	Longitud: 254 nm UV 486
Injection: 1	Operator: Rodrigo Gonzalez 1.00000
Date Acquired: 09/24/10 06:11:08 PM	Run Time: 35.0 min
Acq Meth Set: alcohols	Volume: 20.00
Processing Method: Default	
Column: Chiralpak AD-H 09/24/10 07:19:52 PM	



Peak Results

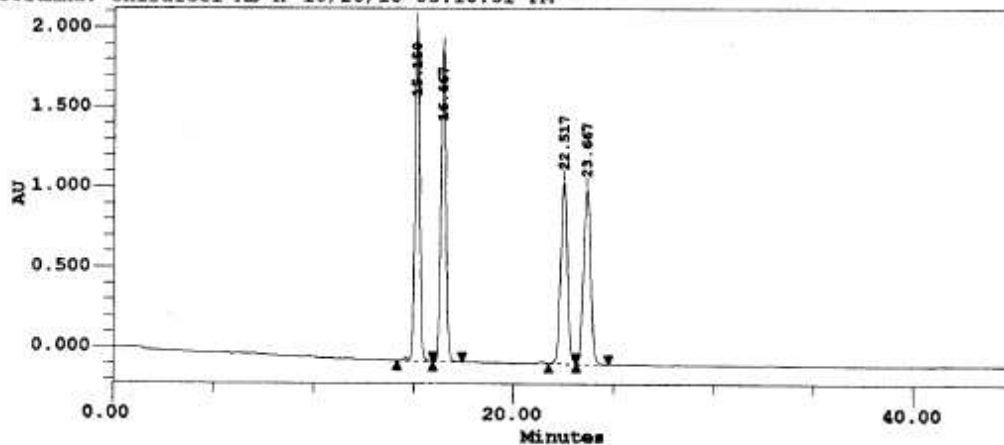
#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		9.617	9.400	10.583	144536	6078	2.24
2		10.883	10.583	11.333	337164	28979	5.22
3		15.933	15.550	16.433	338449	20963	5.24
4		18.483	17.983	19.033	462907	24043	7.17
5		24.533	24.050	25.133	318293	12734	4.93
6		28.050	27.250	28.933	4852665	162608	75.19



Millennium Sample Information

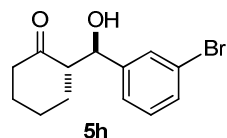
Project Name: Gregorio
Sample Name: JG220-3Br-ra
Vial: 1
Injection: 1
Date Acquired: 10/28/10 11:59:01 AM
Acq Meth Set: alcoholes
Processing Method: Default
Column: Chiralcel AD-H 10/28/10 05:10:51 PM

Flujo : 0.5 mL/min Unknown
Fase : Hexano-IPA (90:10) 1.00000
Longitud: 210 nm UV 486
Operador: Rodrigo Gonzalez 1.00000
Run Time: 45.0 min
Volume: 20.00



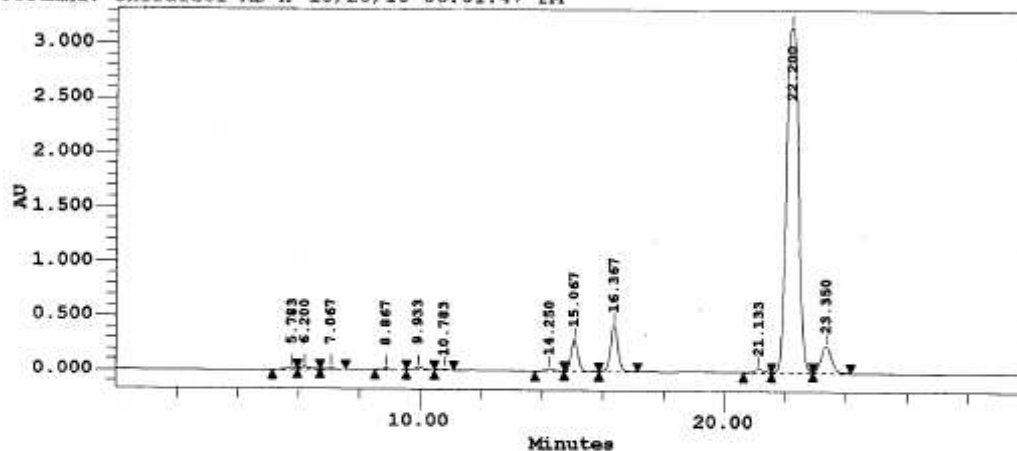
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		15.150	14.167	15.967	33754714	2100934	27.83
2		16.467	15.967	17.417	33870399	1963715	27.93
3		22.517	21.750	23.133	26738702	1132590	22.05
4		23.667	23.133	24.750	26910833	1089957	22.19



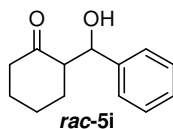
Millennium Sample Information

Project Name: Gregorio	Flujo : 0.5 mL/min Unknown
Sample Name: JG223-3Br	Fase : Hexano-IPA (90:10) 1.00000
Vial: 3	Longitud: 210 nm UV 486
Injection: 1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired: 10/28/10 01:39:46 PM	Run Time: 30.0 min
Acq Meth Set: alcoholes	Volume: 20.00
Processing Method: Default	
Column: Chiralcel AD-H 10/28/10 06:01:47 PM	



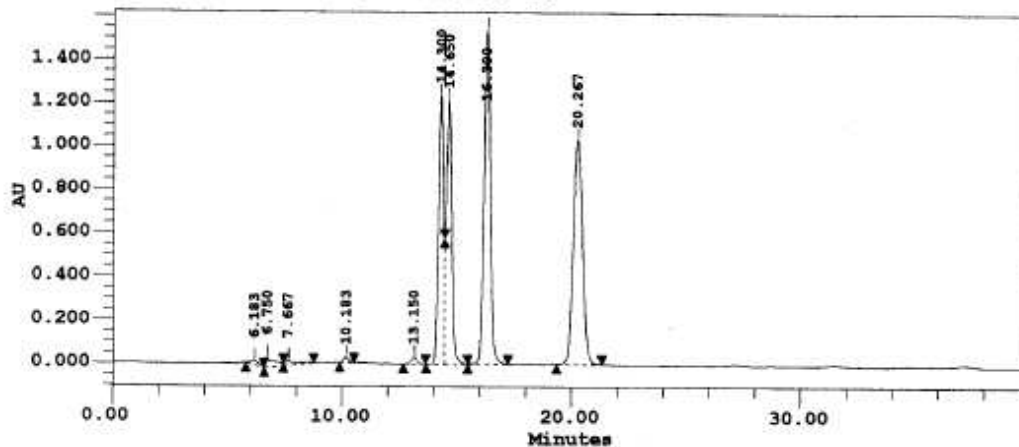
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		5.783	5.150	5.967	500151	28760	0.46
2		6.200	5.967	6.700	637995	29260	0.58
3		7.067	6.700	7.533	361713	26004	0.33
4		8.867	8.500	9.533	250014	16239	0.23
5		9.933	9.533	10.467	525031	28174	0.48
6		10.783	10.467	11.100	178934	12121	0.16
7		14.250	13.767	14.717	575665	26667	0.53
8		15.067	14.717	15.867	4534568	291919	4.14
9		16.367	15.867	17.133	7228462	426578	6.60
10		21.133	20.617	21.550	748962	33639	0.68
11		22.200	21.550	22.900	87929969	3163307	80.33
12		23.350	22.900	24.133	5991509	247328	5.47



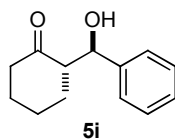
M i l l e n n i u m S a m p l e I n f o r m a t i o n

Project Name:	Gregorio	Flujo : 0.5 mL/min Unknown
Sample Name:	JG186-Benz-ra	Fase : Hexano-EtOH (95:5) 1.00000
Vial:	1	Longitud: 215 nm UV 486
Injection:	1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired:	09/30/10 04:11:39 PM	Run Time: 40.0 min
Acq Meth Set:	alcoholes	Volume: 20.00
Processing Method:	Default	
Column:	Chiralcel OD-H 09/30/10 05:37:18 PM	



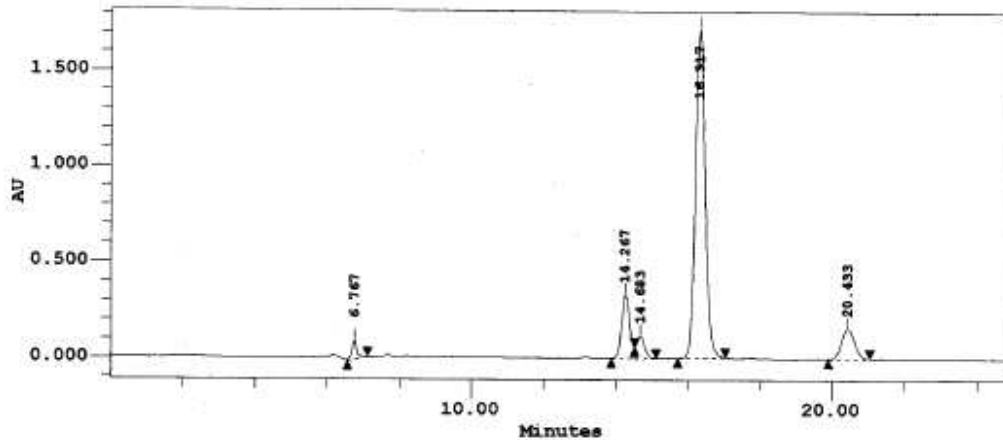
P e a k R e s u l t s

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		6.183	5.800	6.583	445091	21311	0.44
2		6.750	6.600	7.433	1093744	44569	1.09
3		7.667	7.433	8.750	683513	23334	0.68
4		10.183	9.883	10.517	332649	25714	0.33
5		13.150	12.650	13.633	503164	31979	0.50
6		14.300	13.650	14.467	18570991	1240130	18.55
7		14.650	14.467	15.483	20261860	1216480	20.24
8		16.300	15.483	17.233	29092309	1545021	29.06
9		20.267	19.350	21.333	29135230	1037545	29.10



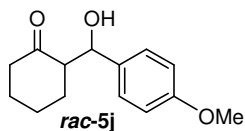
M i l l e n n i u m S a m p l e I n f o r m a t i o n

Project Name:	Gregorio	Flujo : 0.5 mL/min Unknown
Sample Name:	JG193-Benz	Fase : Hexano-EtOH (95:5) 1.00000
Vial:	2	Longitud: 215 nm UV 486
Injection:	1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired:	09/30/10 04:54:17 PM	Run Time: 25.0 min
Acq Meth Set:	alcoholes	Volume: 20.00
Processing Method:	Default	
Column:	Chiralcel OD-H 09/30/10 05:28:16 PM	



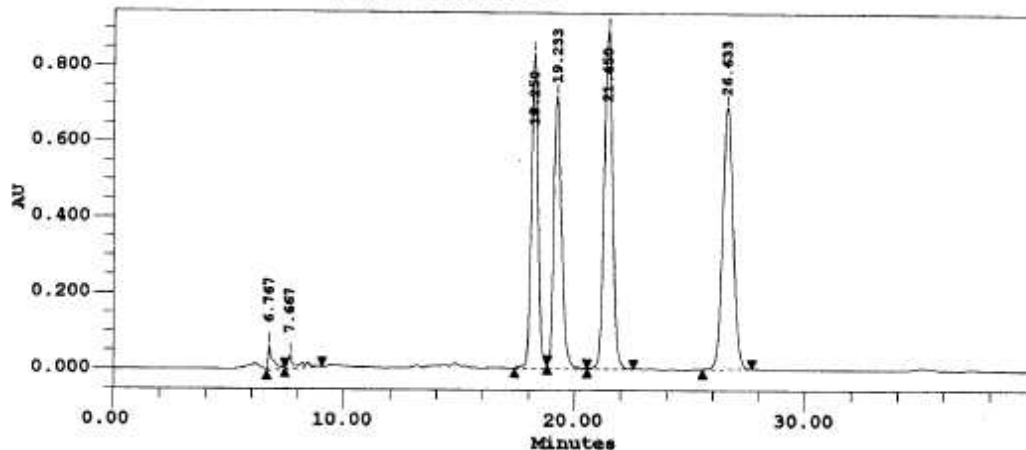
P e a k R e s u l t s

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		6.767	6.567	7.117	875713	99906	1.98
2		14.267	13.867	14.517	5124772	332207	11.56
3		14.683	14.517	15.117	1872090	117746	4.22
4		16.317	15.717	17.033	32603842	1726802	73.56
5		20.433	19.883	21.033	3849234	155949	8.68



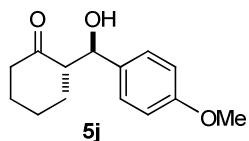
M i l l e n n i u m S a m p l e I n f o r m a t i o n

Project Name:	Gregorio	Flujo : 0.5 mL/min Unknown
Sample Name:	JG-187-4OMe-ra	Fase : Hexano-EtOH (95:5) 1.00000
Vial:	1	Longitud: 215 nm UV 486
Injection:	1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired:	09/30/10 02:33:21 PM	Run Time: 40.0 min
Acq Meth Set:	alcoholes	Volume: 20.00
Processing Method:	Default	
Column:	Chiralcel OD-H 09/30/10 05:40:40 PM	



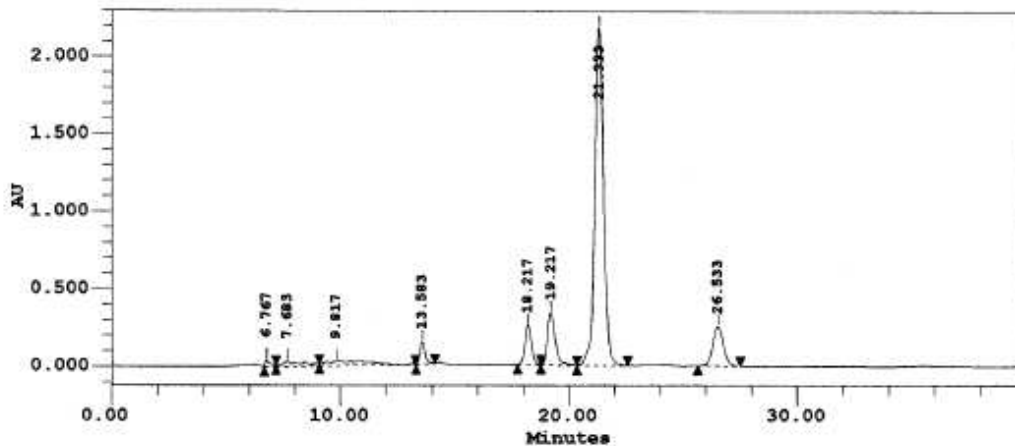
P e a k R e s u l t s

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		6.767	6.650	7.433	836269	65029	1.04
2		7.667	7.433	9.033	807873	34787	1.01
3		18.250	17.383	18.817	17052060	834497	21.31
4		19.233	18.817	20.533	17129877	721555	21.40
5		21.450	20.533	22.550	22293012	897174	27.85
6		26.633	25.550	27.700	21917289	692918	27.38



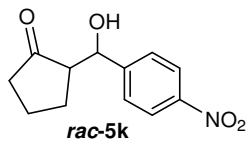
Millennium Sample Information

Project Name: Gregorio	Flujo : 0.5 mL/min Unknown
Sample Name: JG-194-4OMe	Fase : Hexano-EtOH (95:5) 1.00000
Vial: 2	Longitud: 215 nm UV 486
Injection: 1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired: 09/30/10 03:15:10 PM	Run Time: 40.0 min
Acq Meth Set: alcoholes	Volume: 20.00
Processing Method: Default	
Column: Chiralcel OD-H 09/30/10 05:44:54 PM	



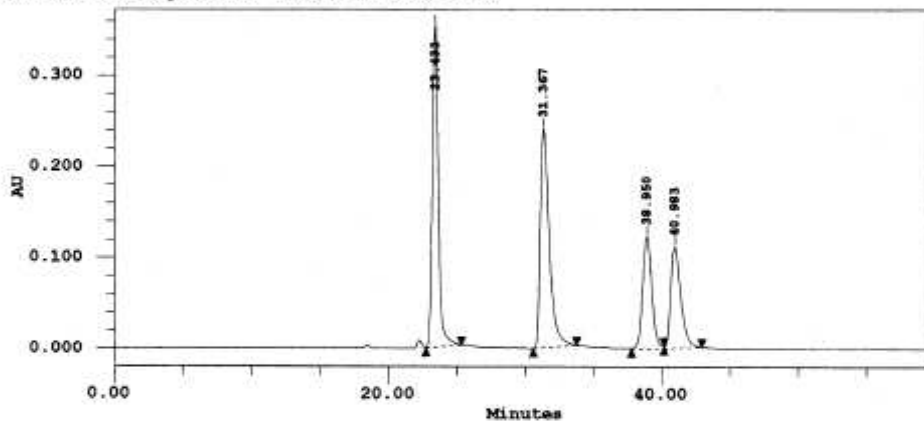
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		6.767	6.650	7.167	547109	44818	0.63
2		7.683	7.167	9.067	1837021	34309	2.12
3		9.817	9.067	13.283	3698318	27220	4.28
4		13.583	13.300	14.133	2187588	145669	2.53
5		18.217	17.750	18.750	4968706	251506	5.74
6		19.217	18.750	20.350	7895316	335321	9.13
7		21.333	20.350	22.567	57386090	2182876	66.35
8		26.533	25.650	27.500	7971149	253470	9.22



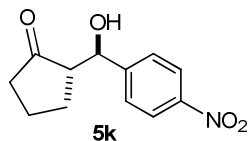
Millennium Sample Information

Project Name:	Gregorio	Flujo : 1.0 mL/min Unknown
Sample Name:	JG188cypen4NO2	Fase : Hexano-IEA (95:5) 1.00000
Vial:	3	Longitud: 254 nm UV 486
Injection:	1	Operator: Rodrigo Gonzalez 1.00000
Date Acquired:	09/27/10 02:52:27 PM	Run Time: 60.0 min
Acq Meth Set:	alcoholes	Volume: 20.00
Processing Method:	Default	
Column:	Chiralpak AD-H 09/27/10 05:58:11 PM	



Peak Results

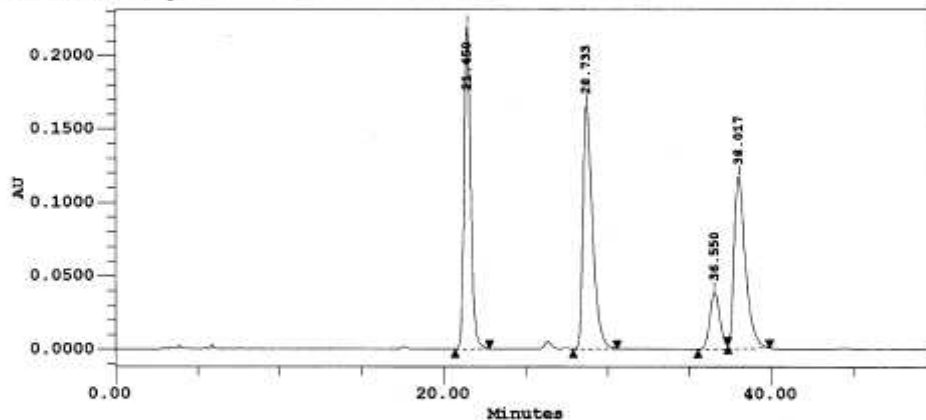
#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		23.433	22.717	25.333	10896253	353668	32.87
2		31.367	30.600	33.767	10936286	240694	32.99
3		38.950	37.800	40.183	5664386	123108	17.09
4		40.983	40.183	42.933	5654014	110309	17.06



Millennium Sample Information

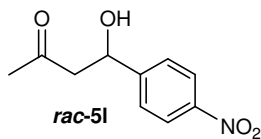
Project Name: Gregorio
Sample Name: JG196cypen4NO2
Vial: 4
Injection: 1
Date Acquired: 09/27/10 04:22:05 PM
Acq Meth Set: alcoholes
Processing Method: Default
Column: Chiralpak AD-H 09/27/10 06:26:06 PM

Flujo : 1.0 mL/min Unknown
Fase : Hexano-IPA (95:5) 1.00000
Longitud: 254 nm UV 486
Operador: Rodrigo Gonzalez 1.00000
Run Time: 50.0 min
Volume: 20.00



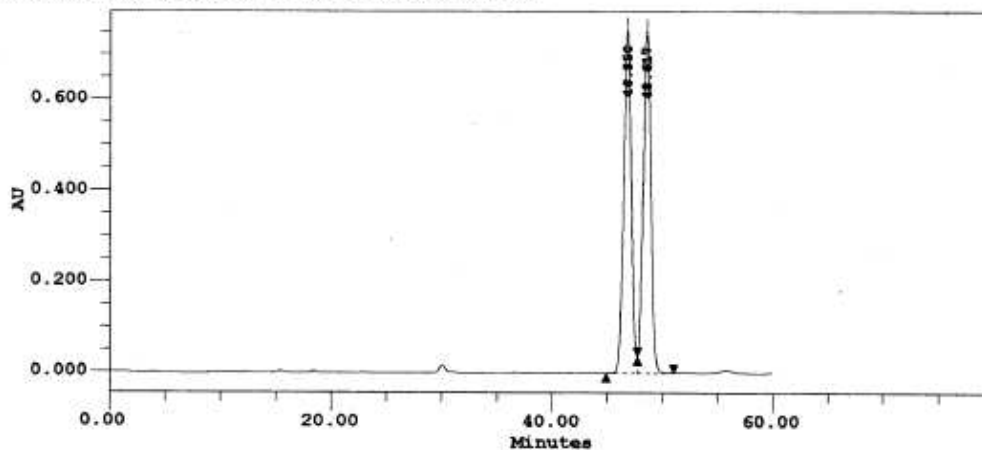
Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		21.450	20.683	22.783	6149254	219714	30.50
2		28.733	27.917	30.583	6733995	165444	33.40
3		36.550	35.500	37.350	1639830	38517	8.13
4		38.017	37.350	39.900	5640965	116868	27.98



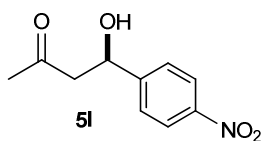
Millennium Sample Information

Project Name:	Gregorio	Flujo : 0.5 mL/min Unknown
Sample Name:	JG170Ac4NO2ra	Fase : Hexano-IPA (95:5) 1.00000
Vial:	1	Longitud: 254 nm UV 486
Injection:	1	Operador: Rodrigo Gonzalez 1.00000
Date Acquired:	09/28/10 11:44:05 AM	Run Time: 80.0 min
Acq Meth Set:	alcoholes	Volume: 20.00
Processing Method:	Default	
Column:	Chiralpak AD-H 09/28/10 06:30:17 PM	



Peak Results

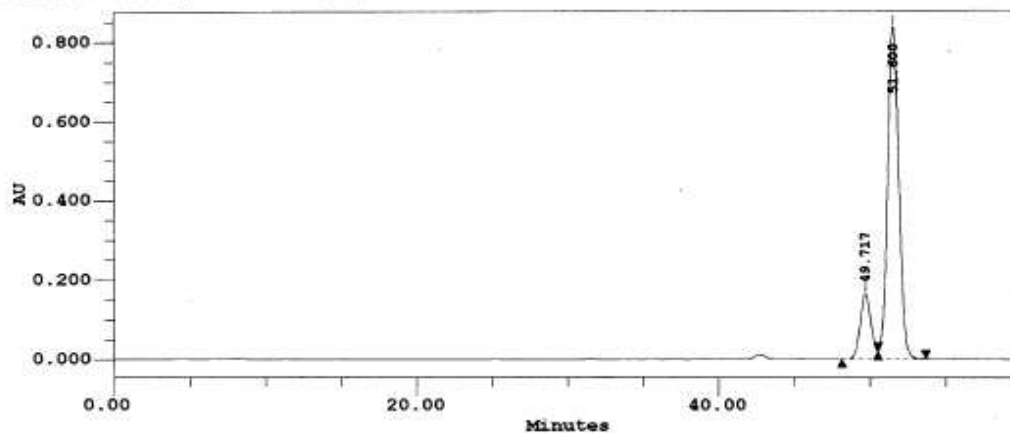
#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		46.850	44.900	47.733	36717066	759726	49.81
2		48.617	47.733	51.017	36996360	754755	50.19



Millennium Sample Information

Project Name: Gregorio
Sample Name: JG204Ac4NO2
Vial: 2
Injection: 1
Date Acquired: 09/28/10 12:51:35 PM
Acq Meth Set: alcoholes
Processing Method: Default
Column: Chiralpak AD-H 09/28/10 06:34:14 PM

Flujo : 0.5 mL/min Unknown
Fase : Hexano-IPA (95:5) 1.00000
Longitud: 254 nm UV 486
Operador: Rodrigo Gonzalez 1.00000
Run Time: 60.0 min
Volume: 20.00



Peak Results

#	Name	Ret Time (min)	Start Time (min)	End Time (min)	Area (uV*sec)	Height (uV)	% Area
1		49.717	48.150	50.550	8050634	161272	15.79
2		51.600	50.550	53.700	42921204	834793	84.21