

Supporting information

For

Highly Enantioselective Three-Component Povarov Reaction Catalyzed by SPINOL-Phosphoric Acids

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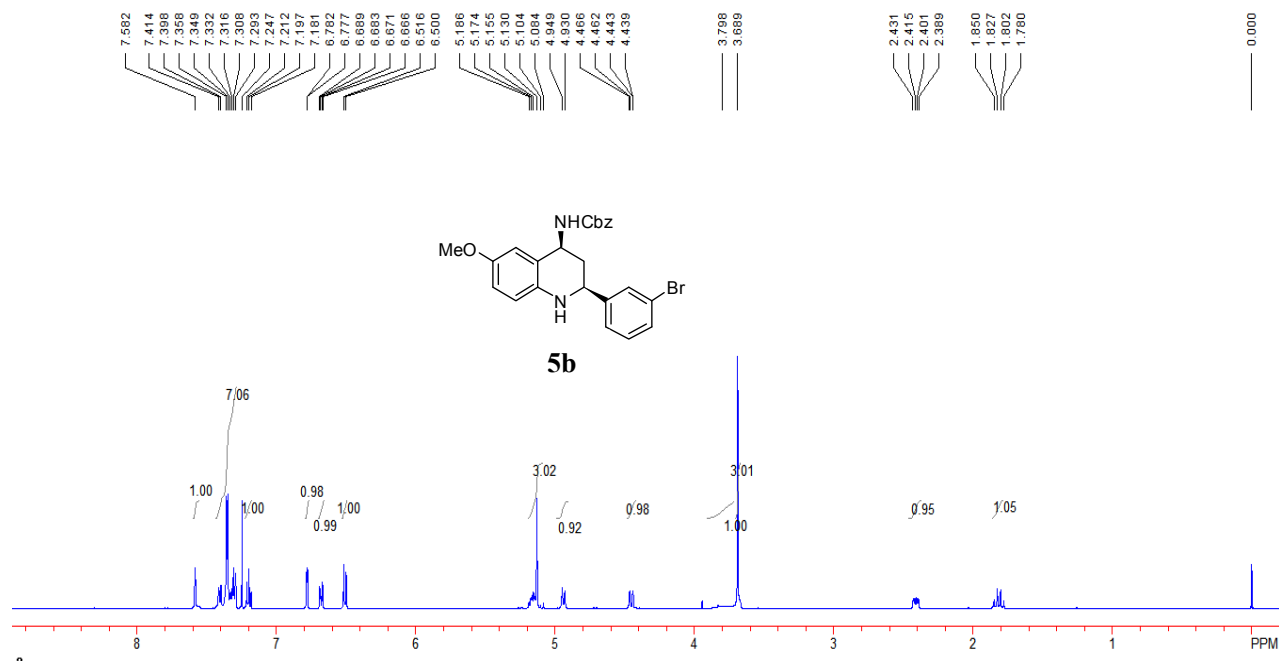
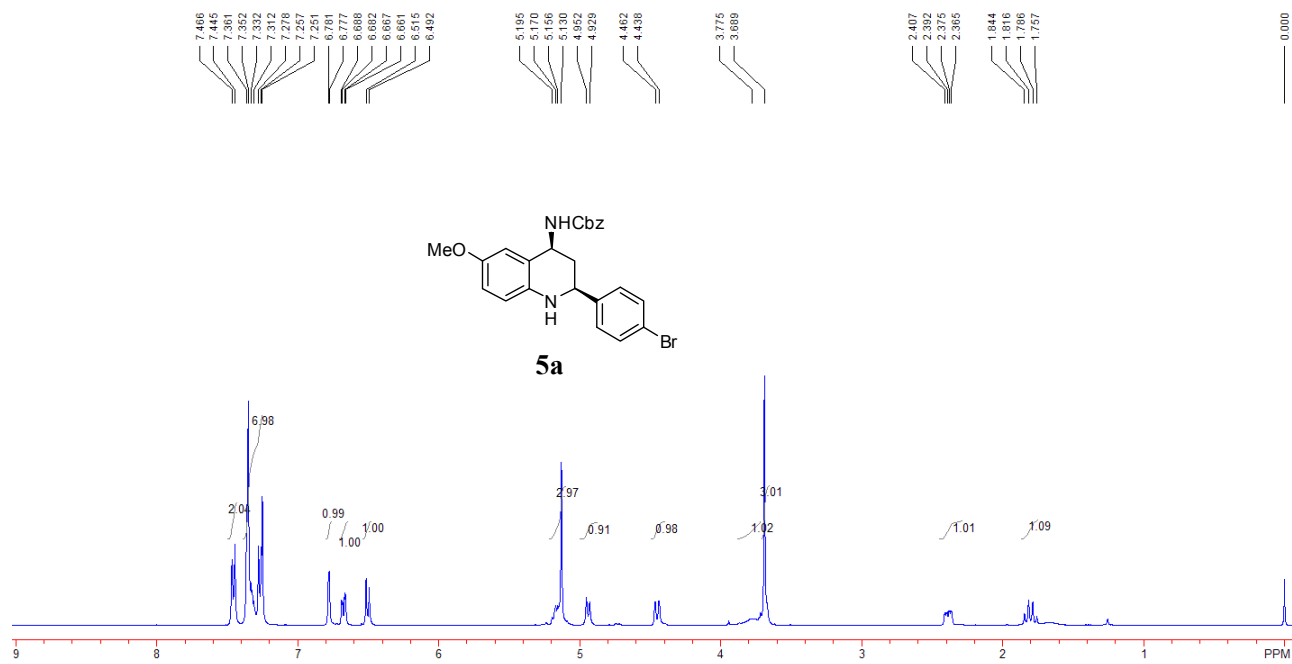
^a *Department of Chemistry, Zhejiang University, Hangzhou 310027, P. R of China; E-mail: lxfoke@zju.edu.cn*

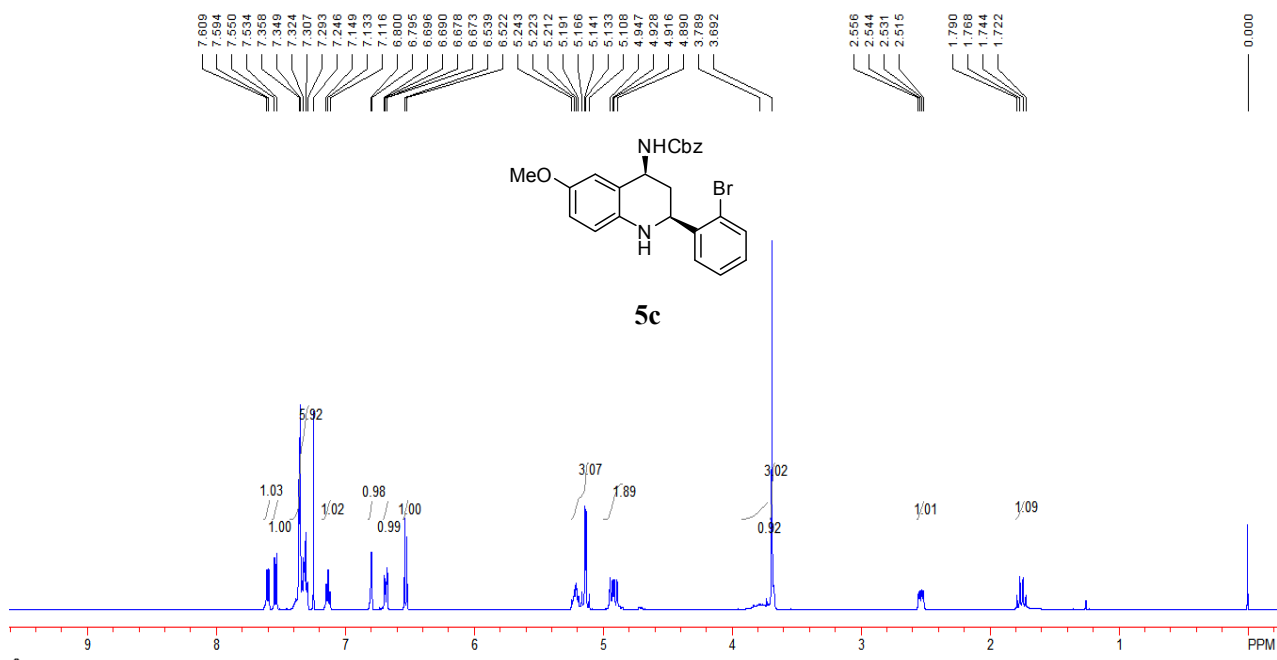
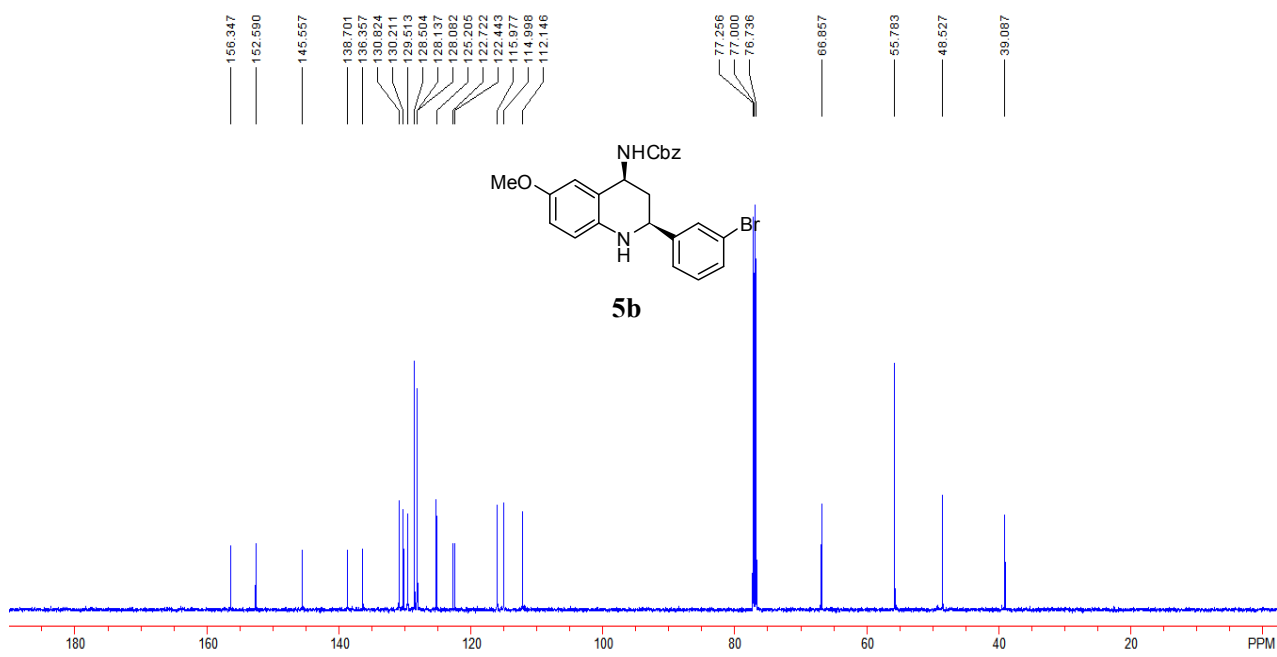
^b *School of Chemistry and Chemical Engineering, Yangzhou University, Yangzhou 225002, Jiangsu, P. R of China.*

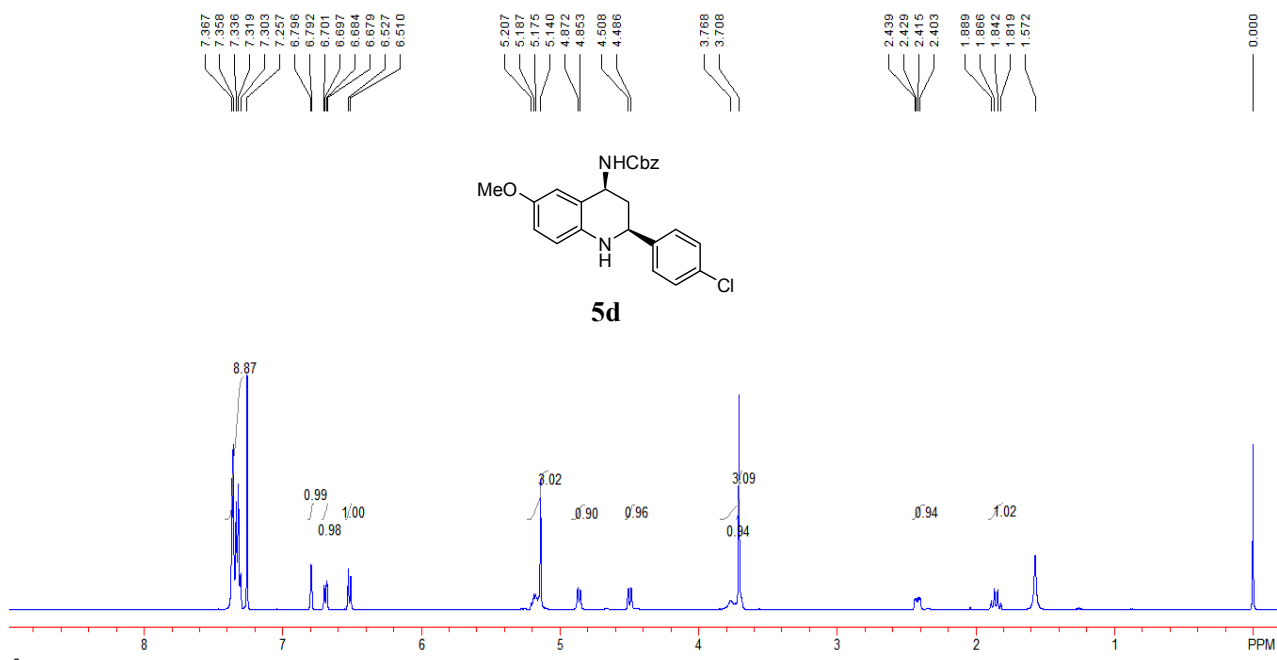
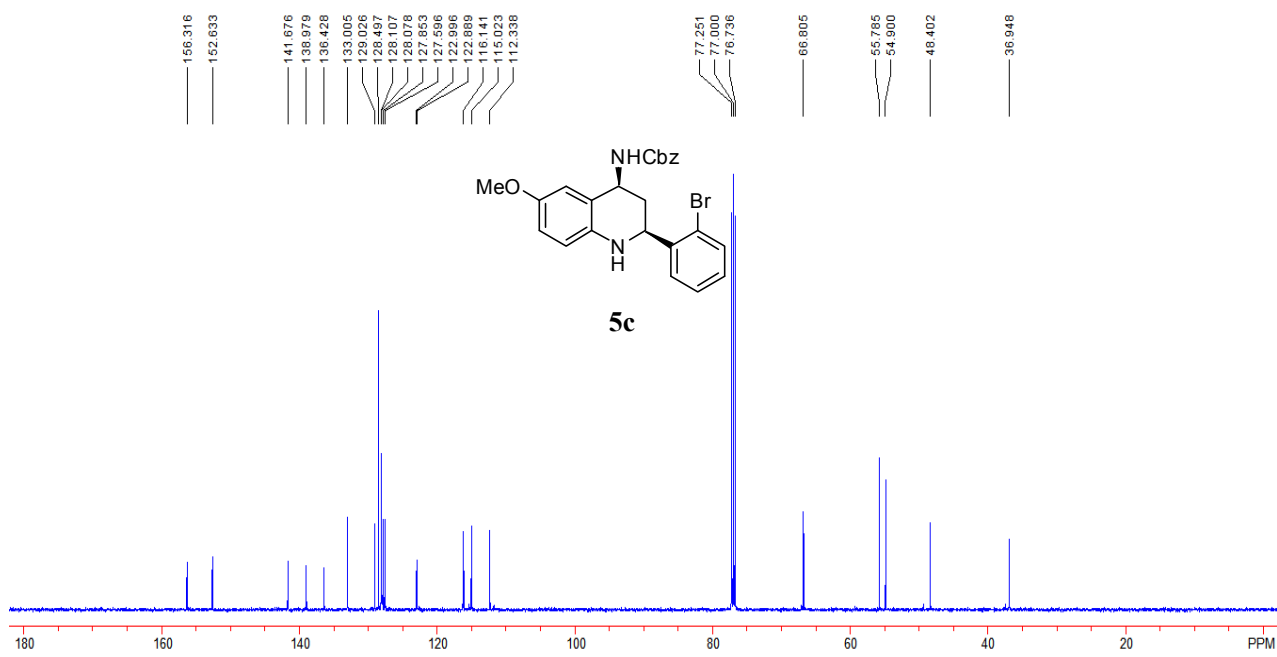
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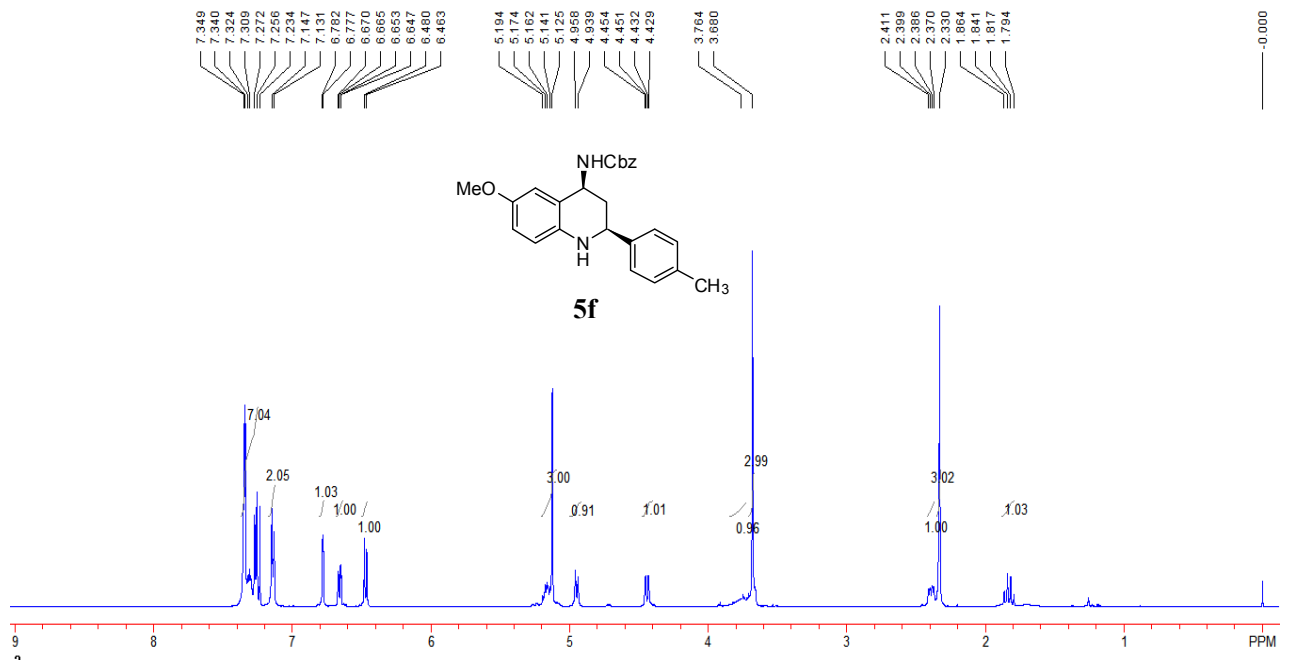
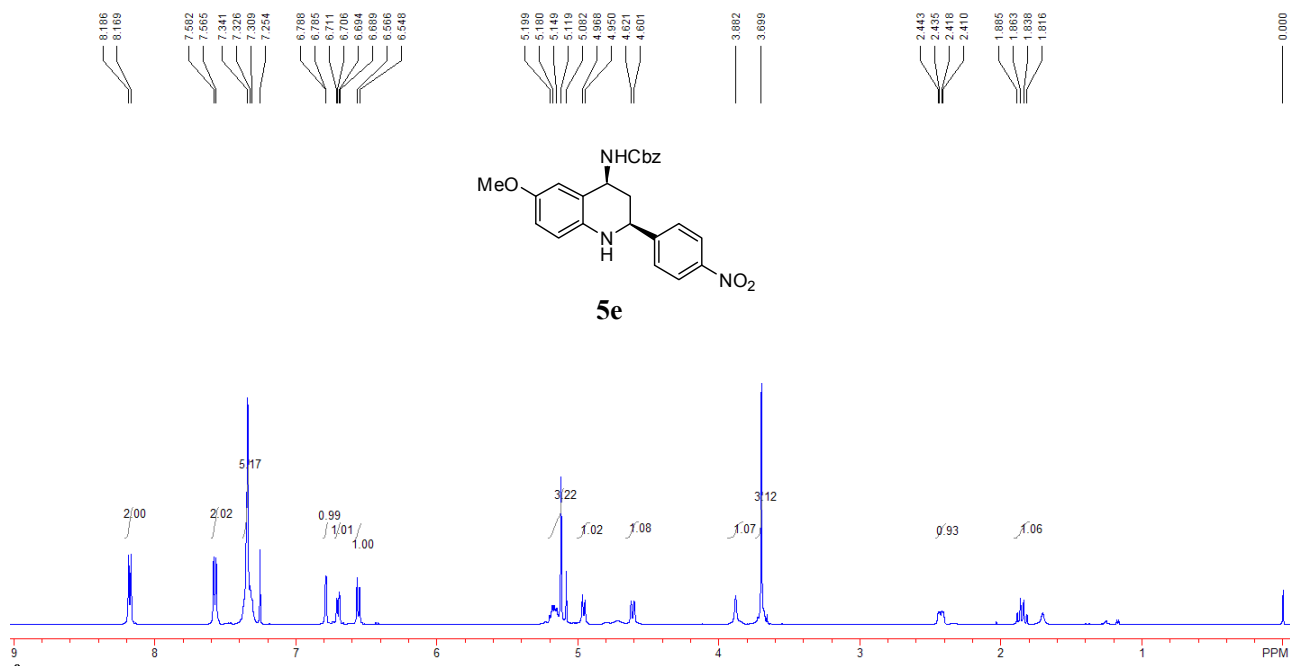
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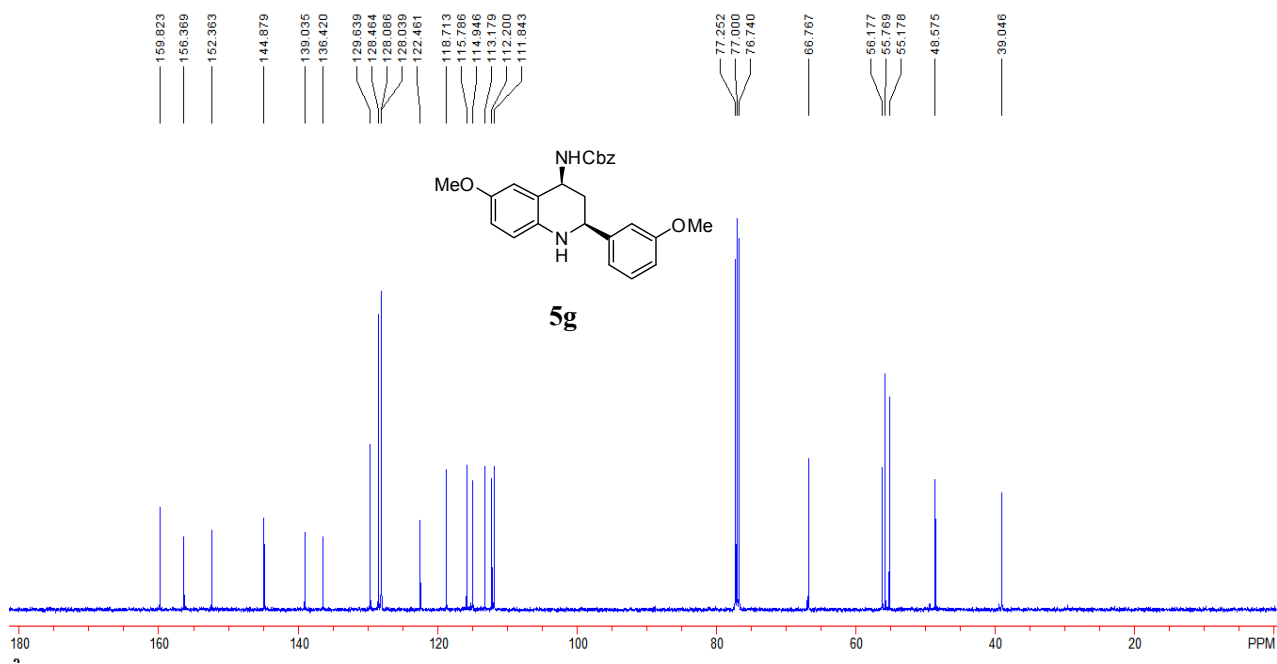
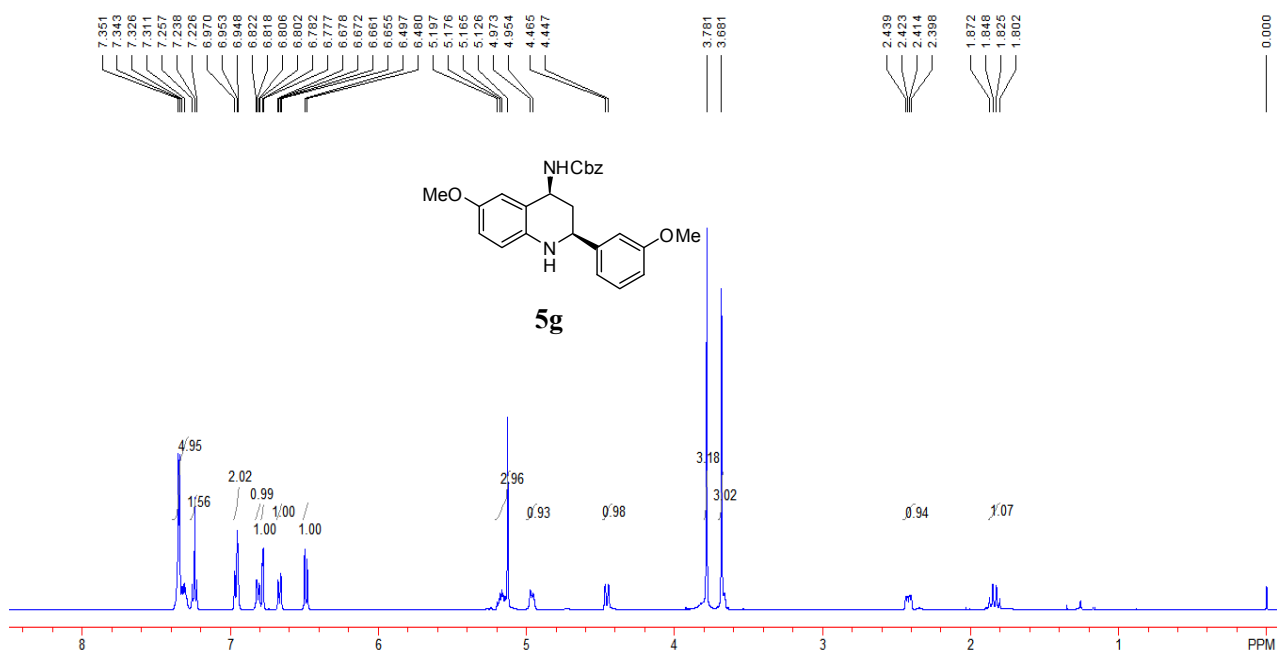
1. NMR spectra for all compounds

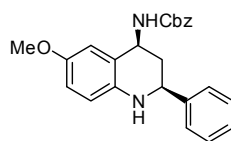
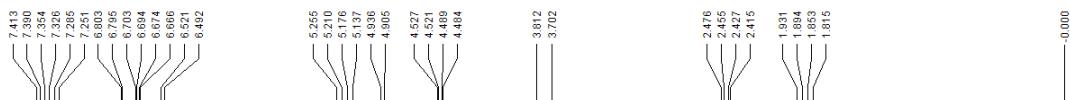




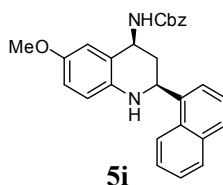
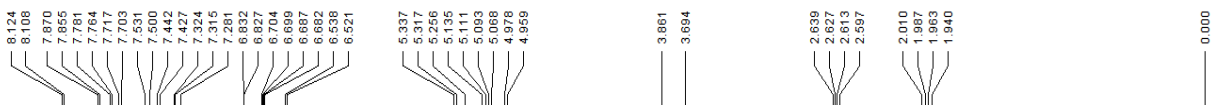
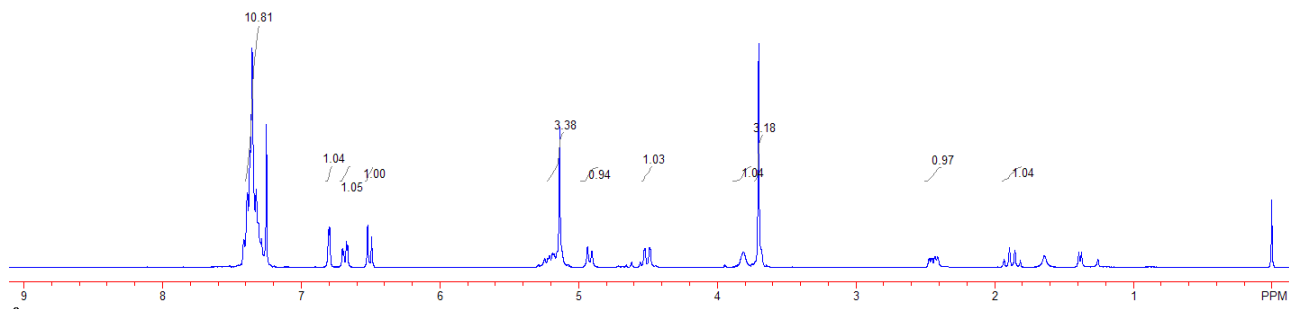




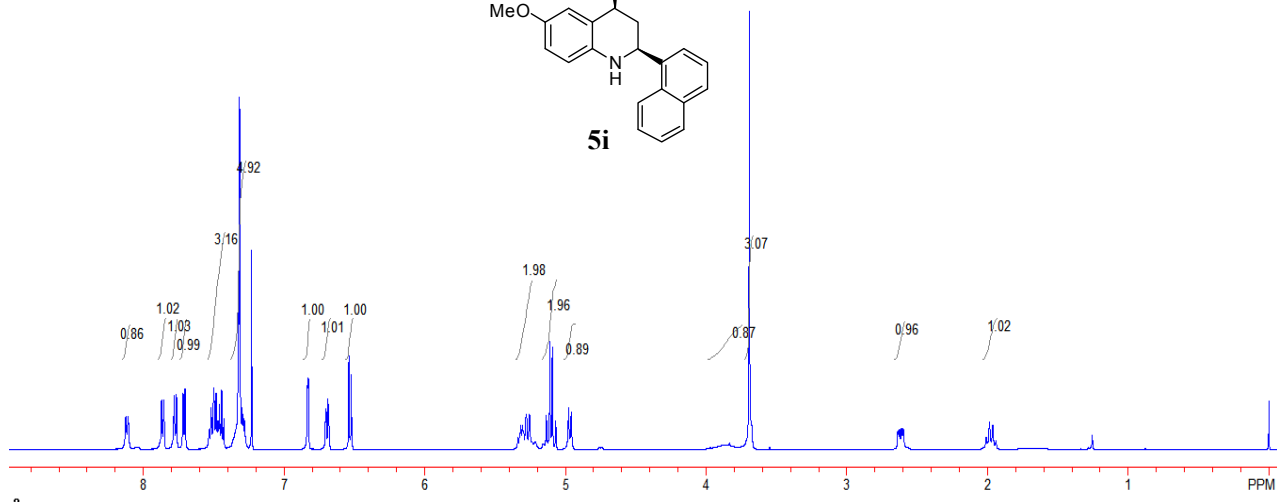


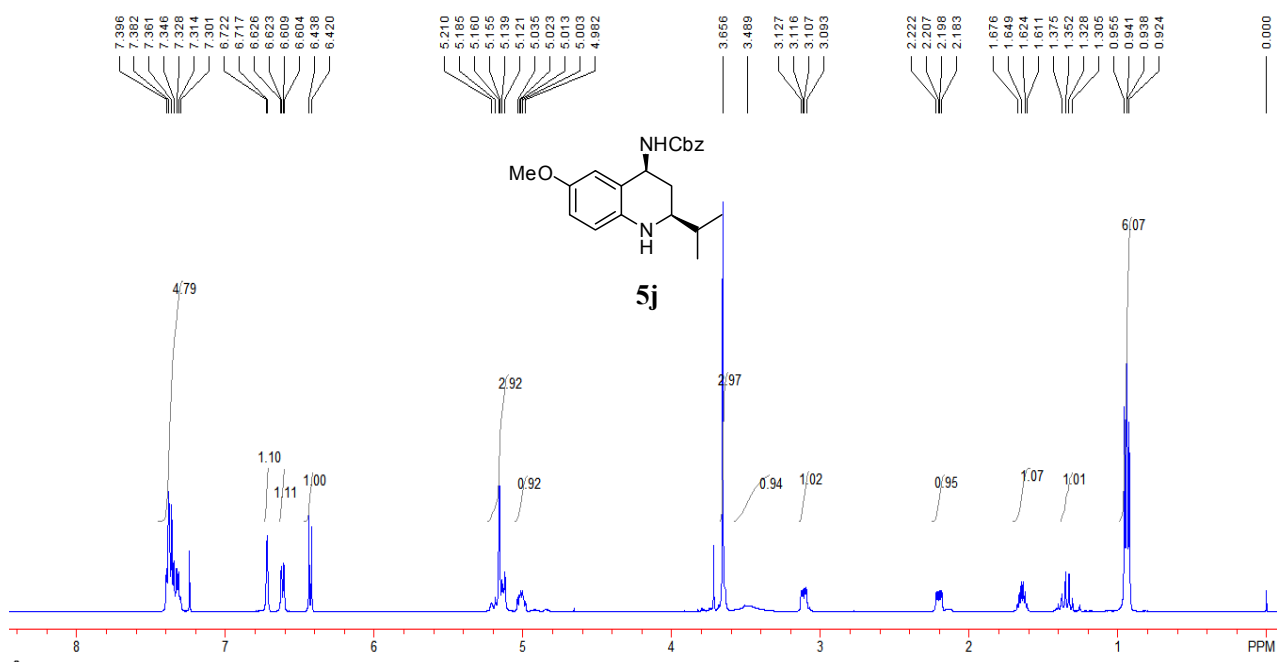
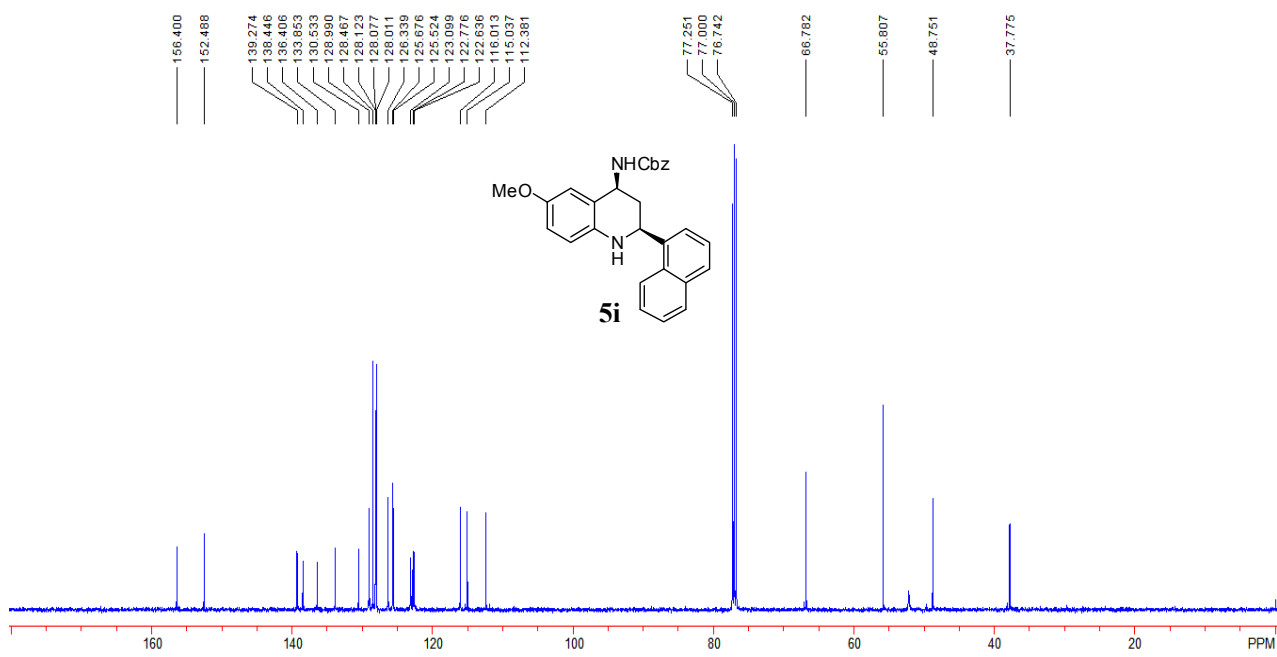


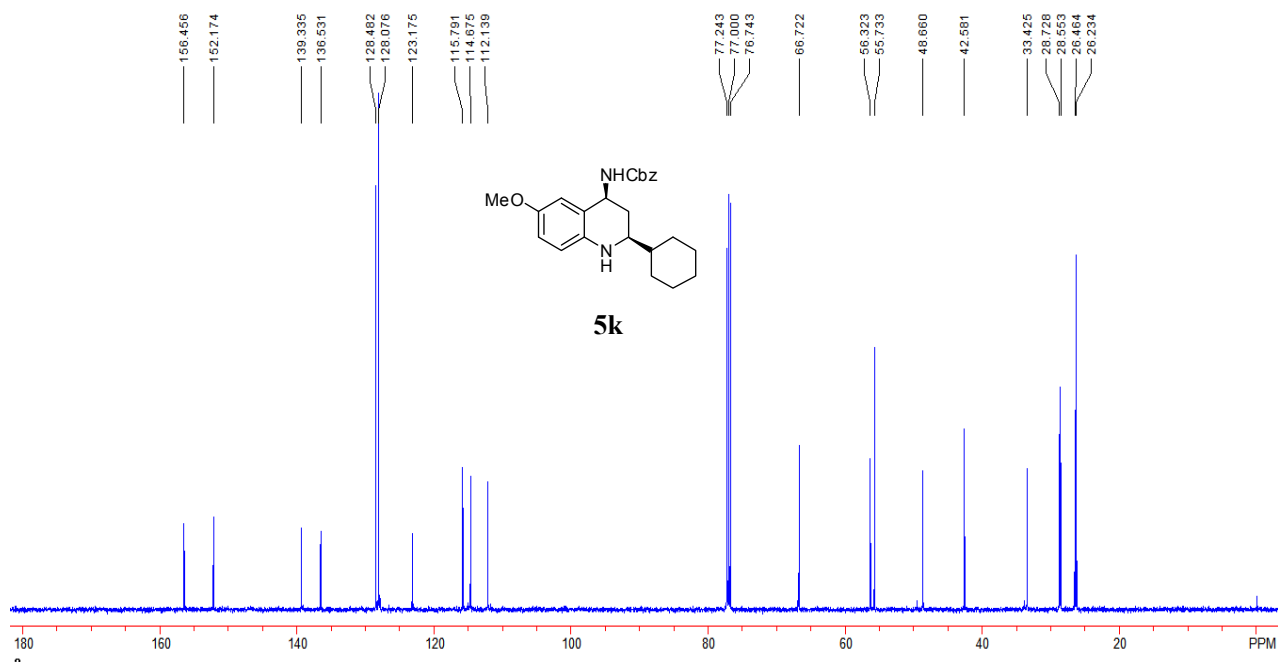
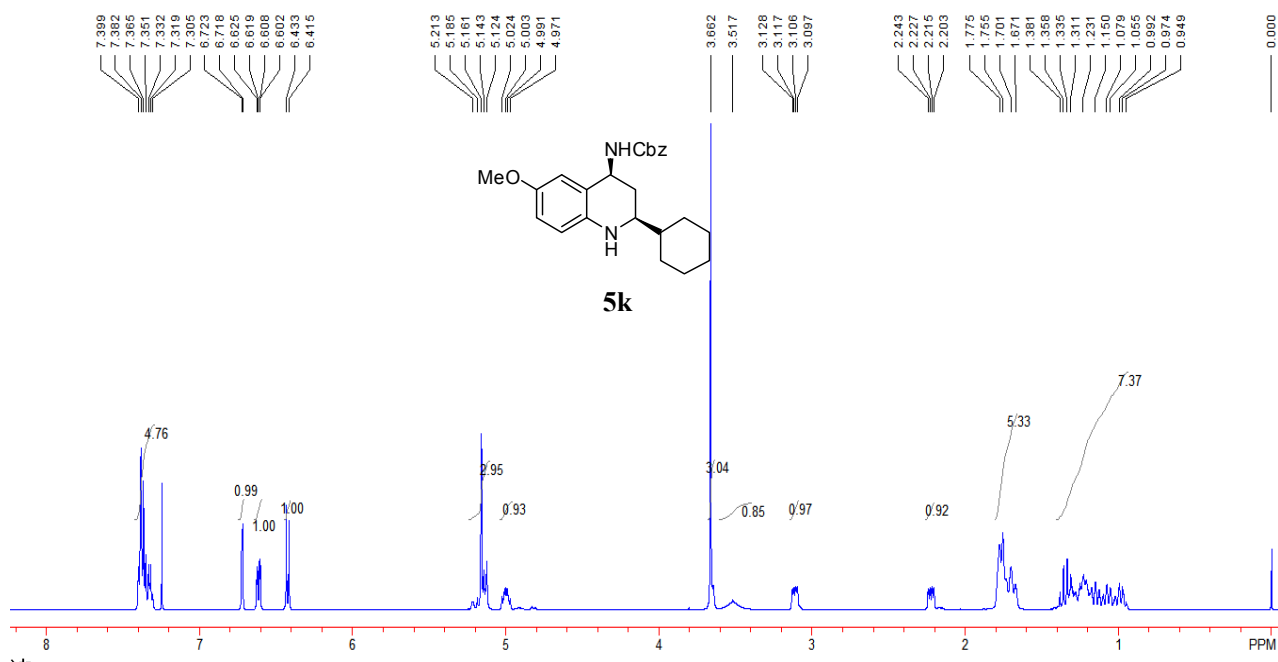
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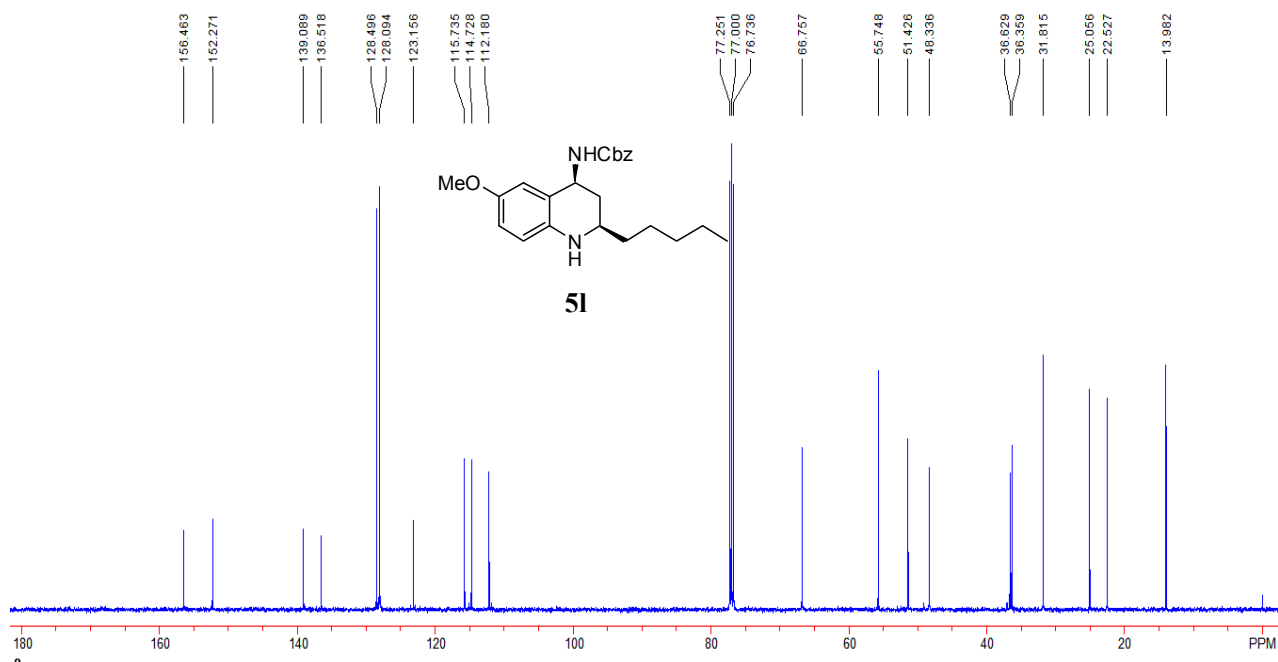
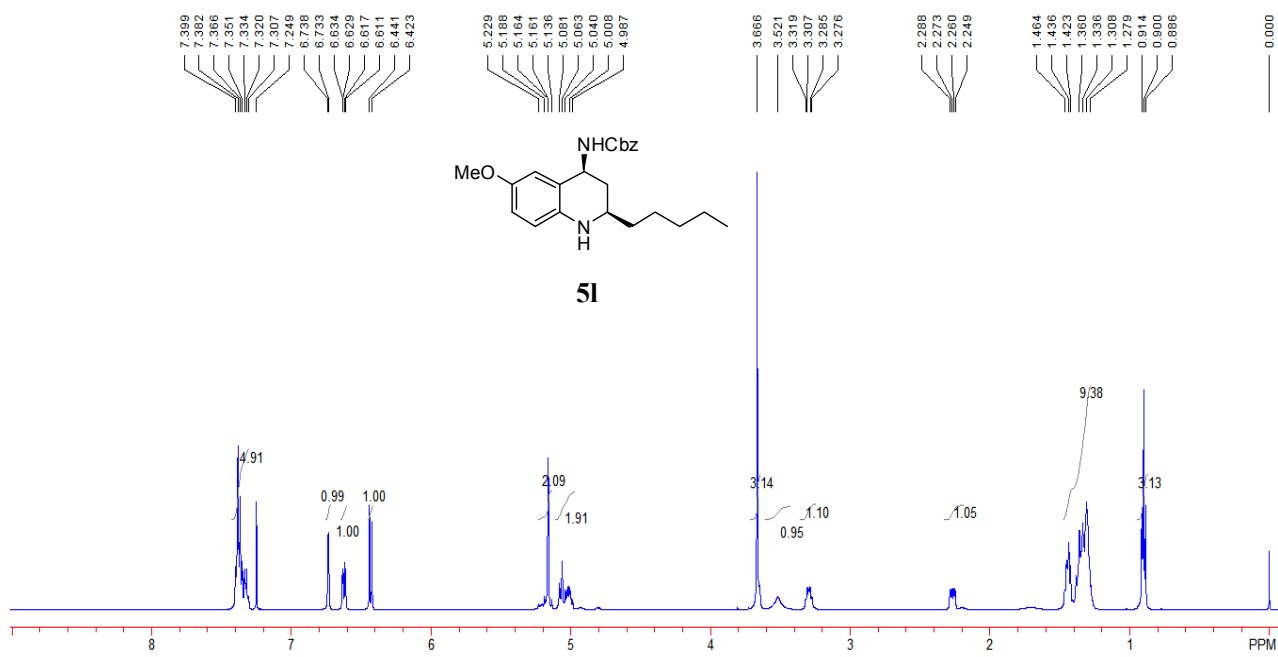


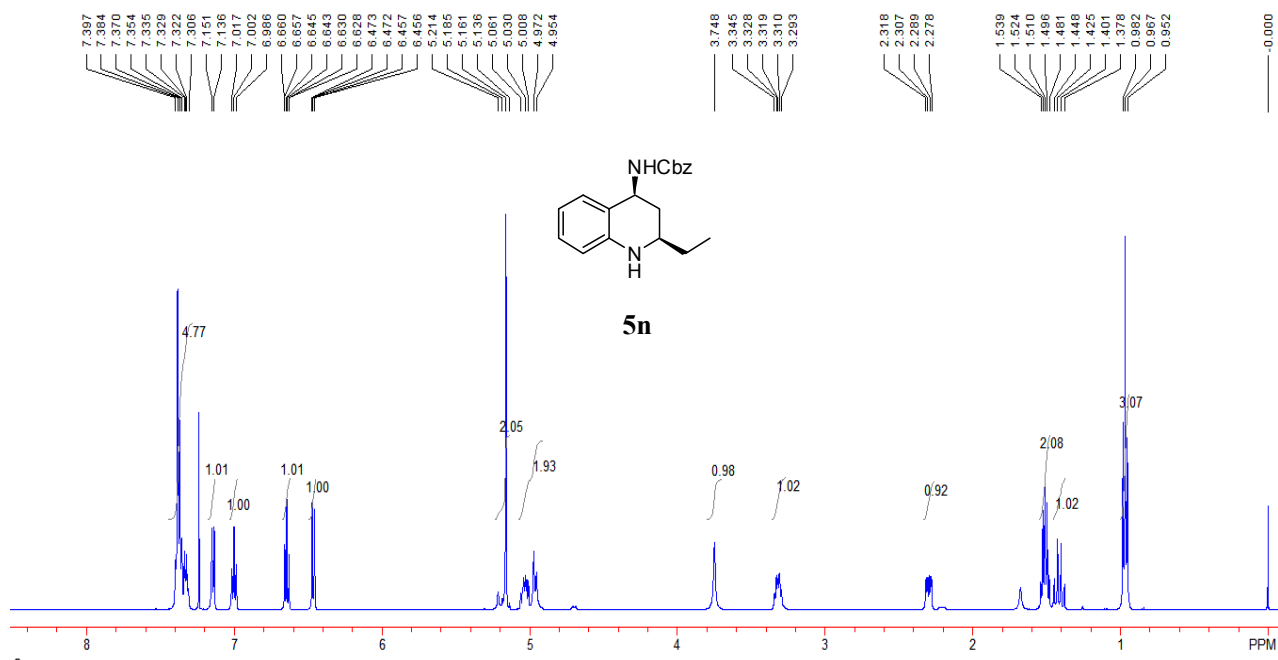
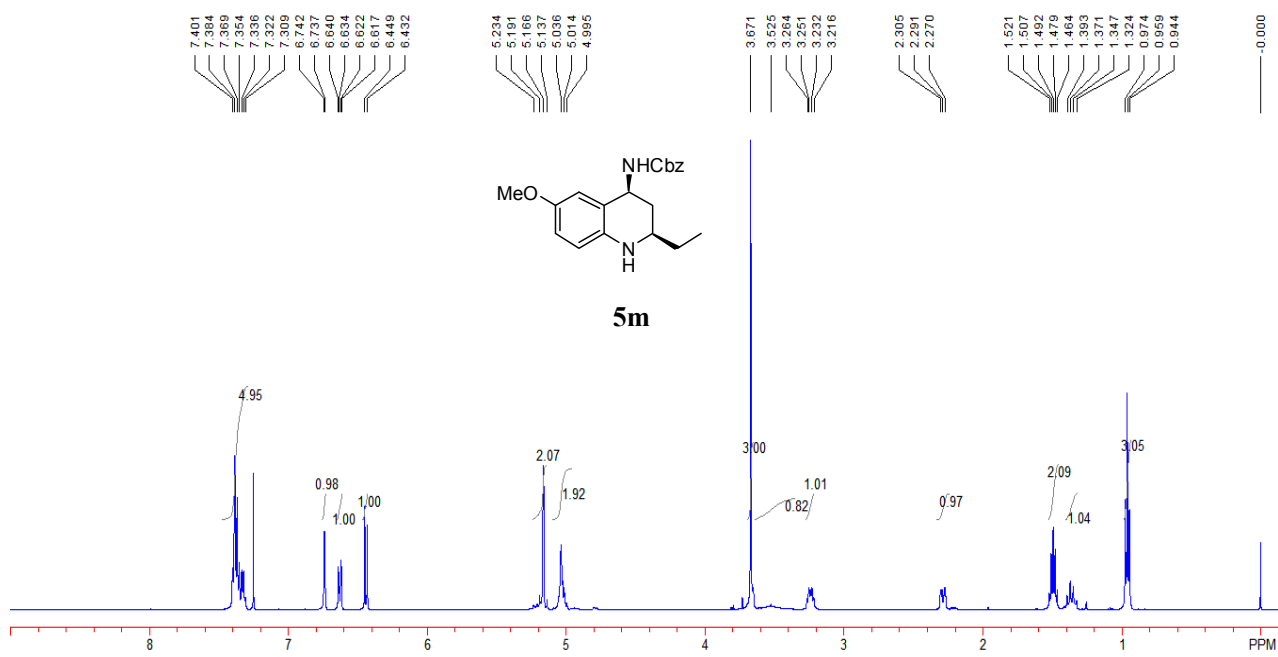
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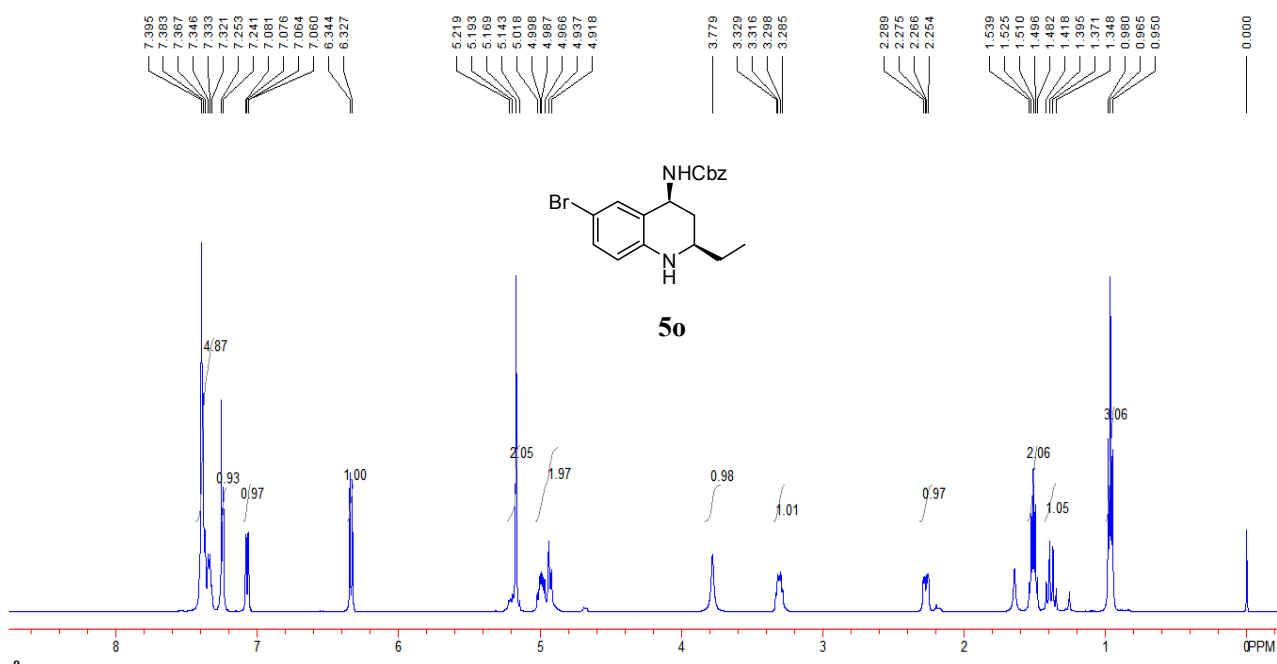
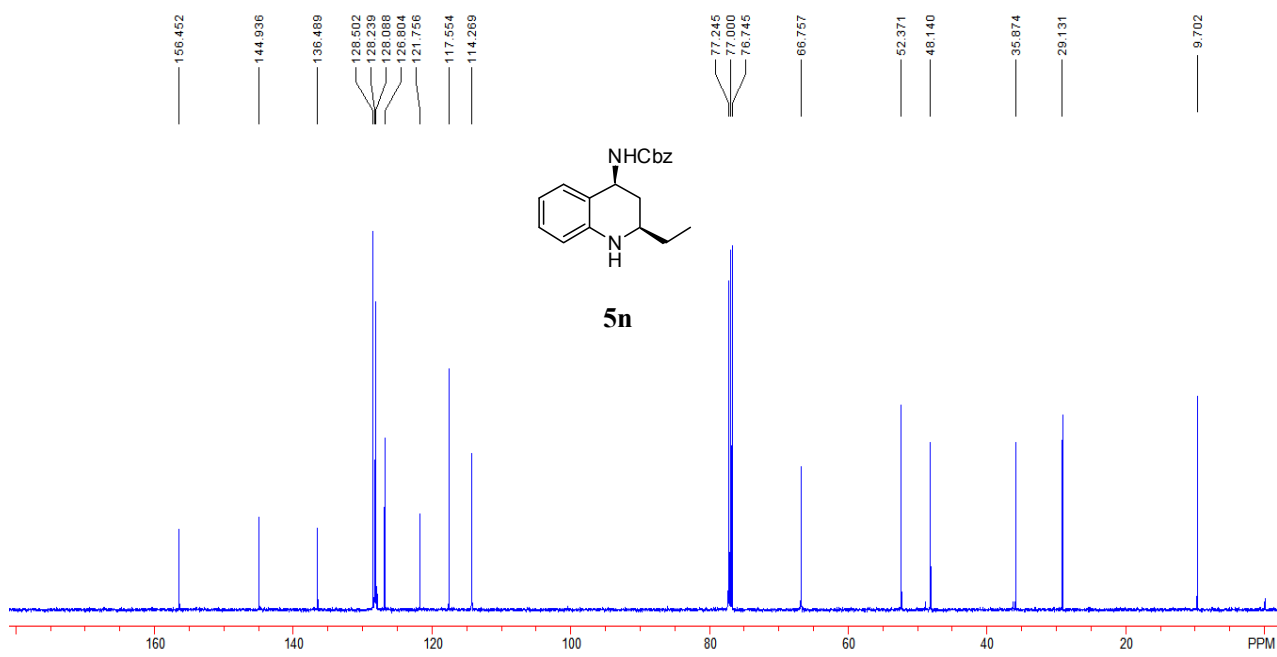


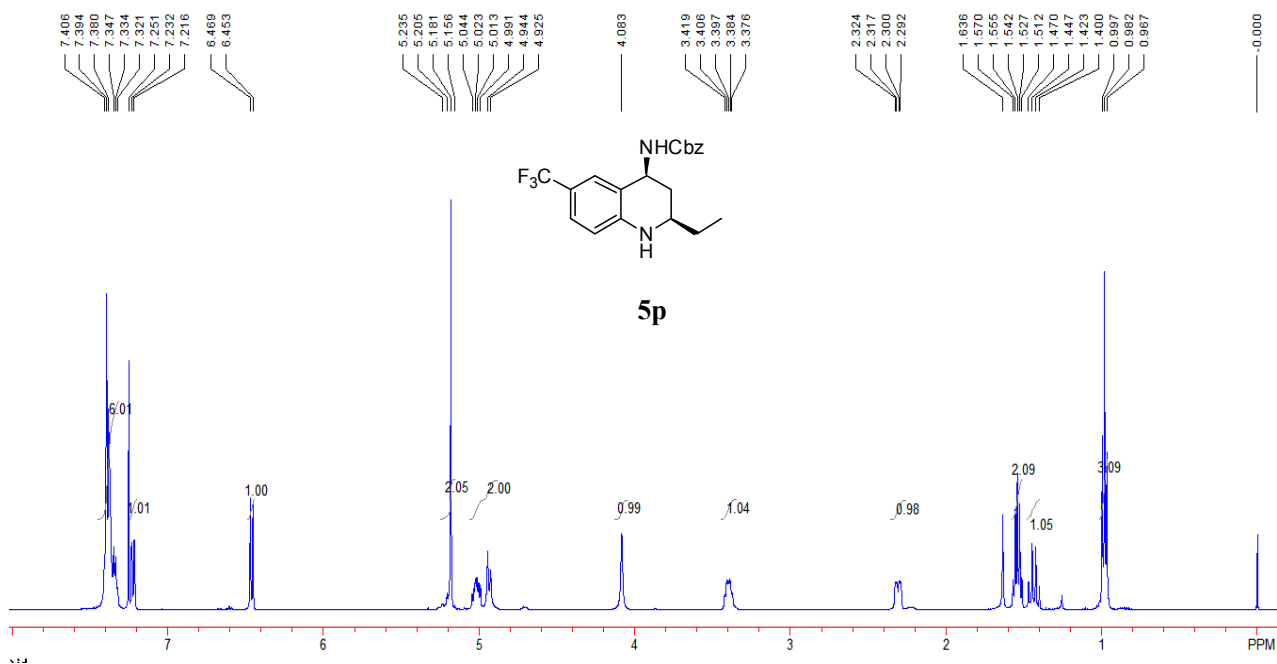
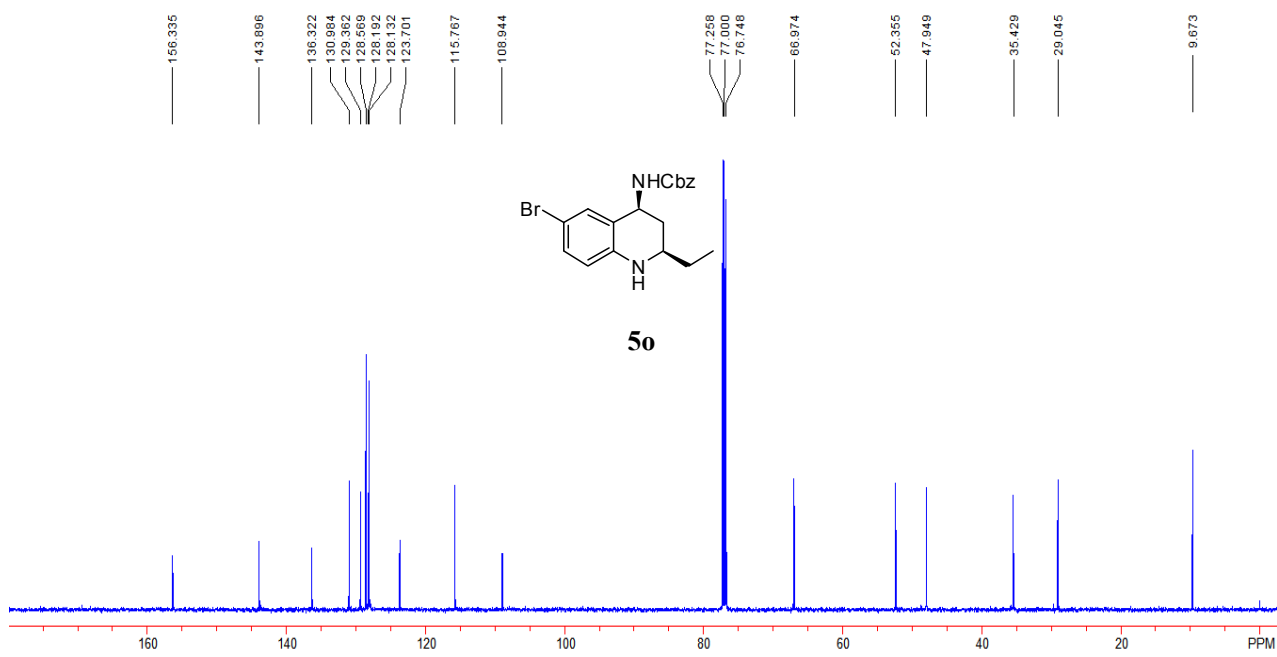


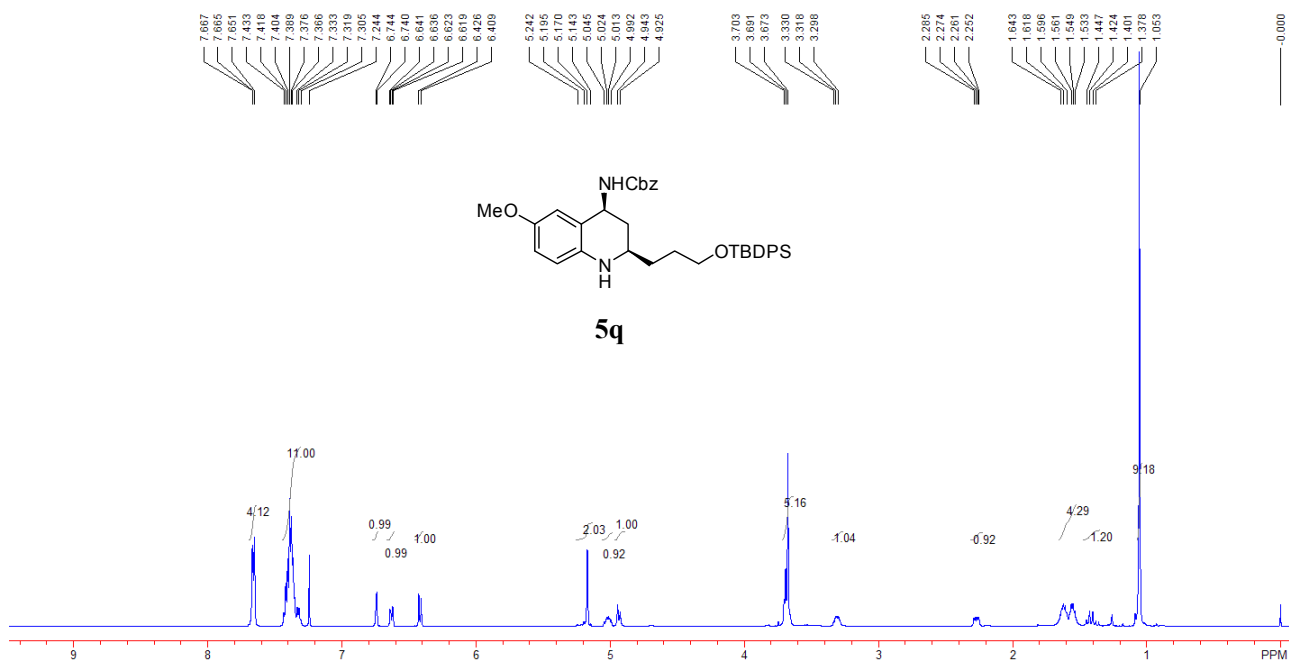
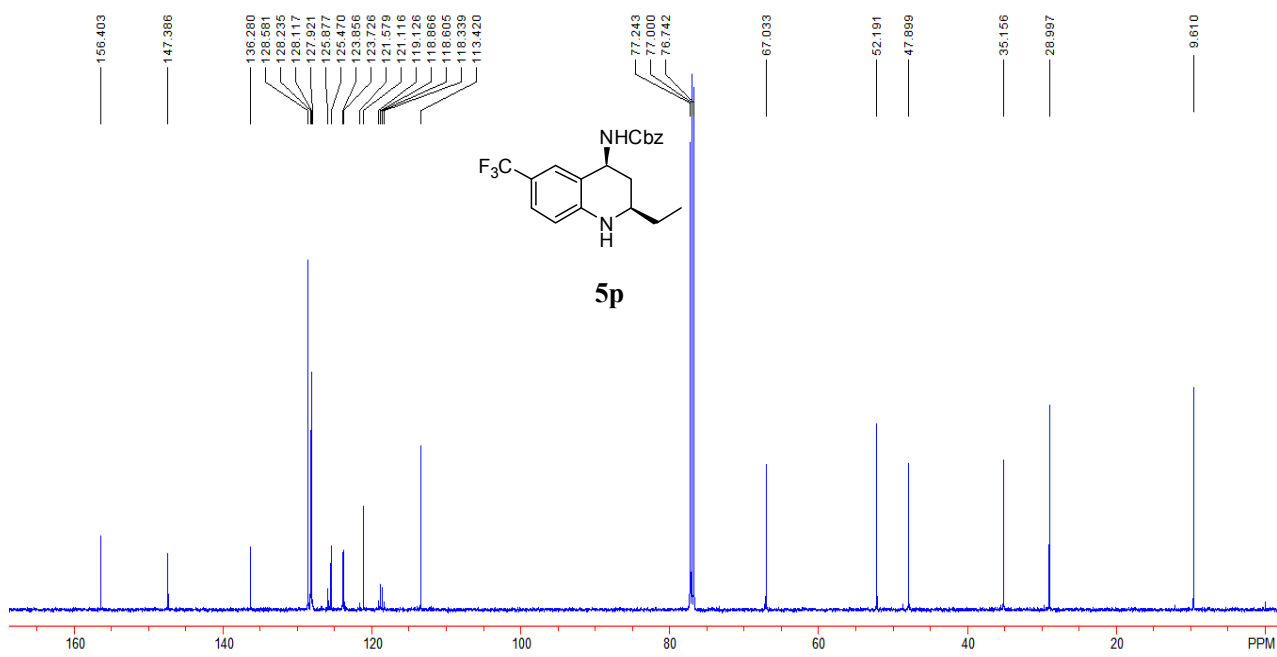


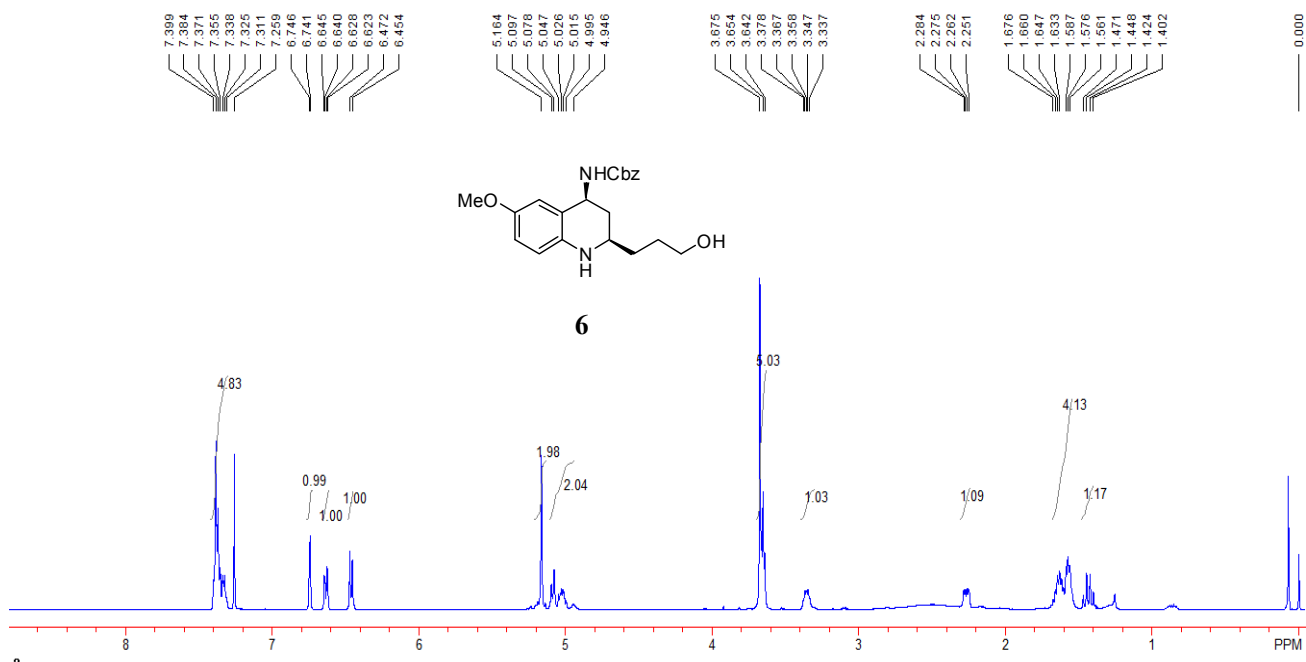
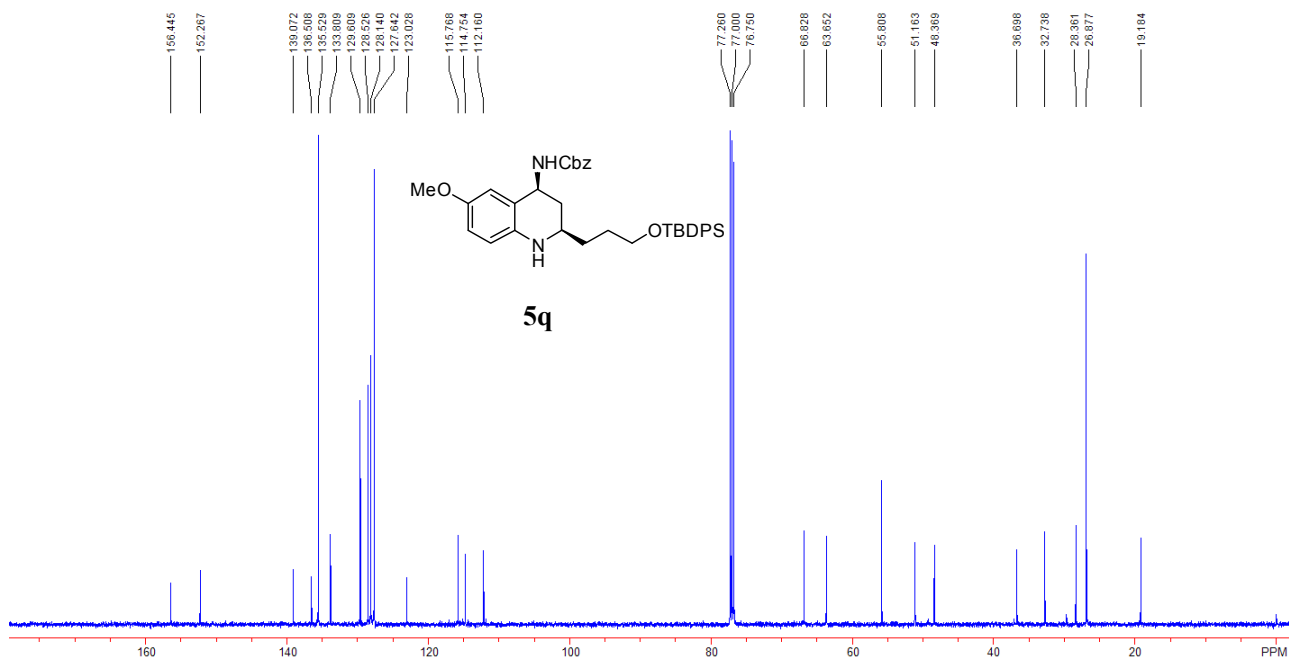


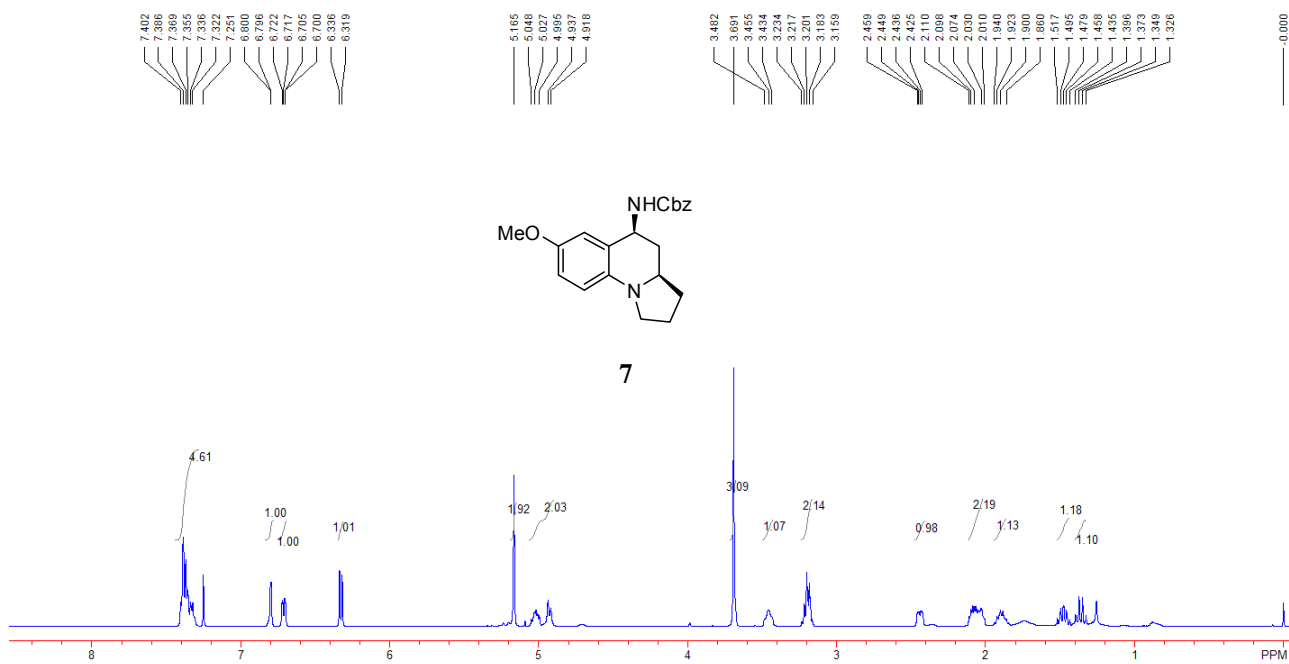
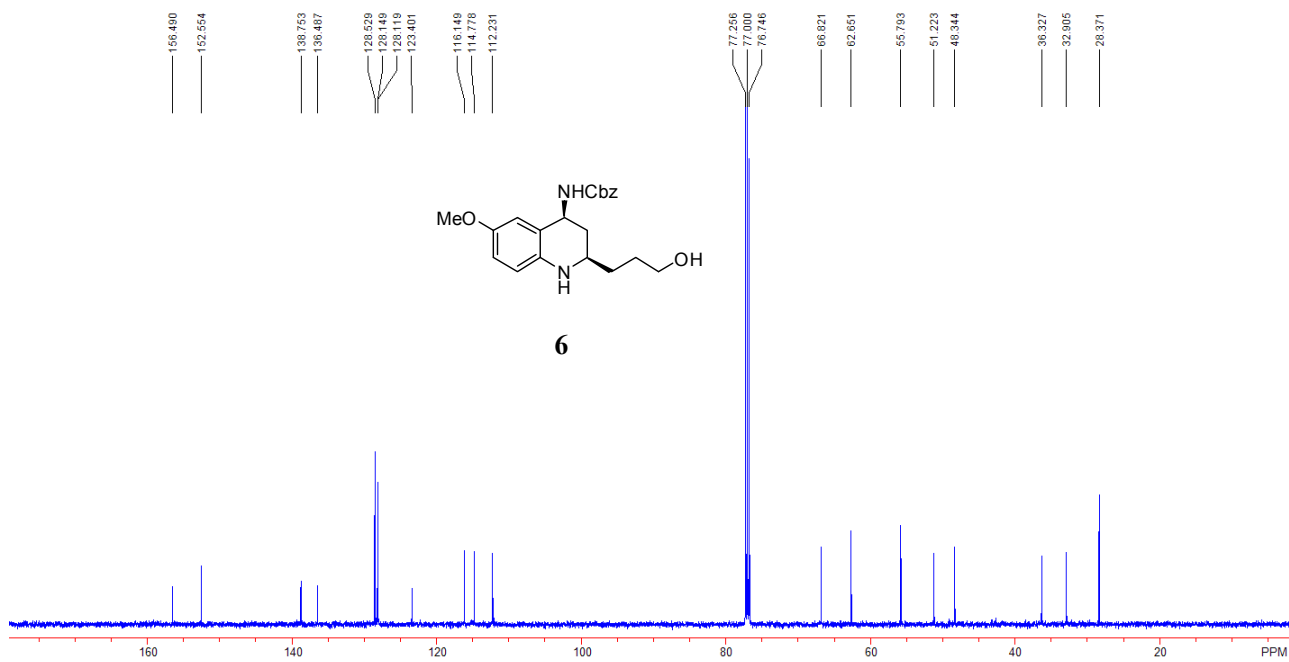


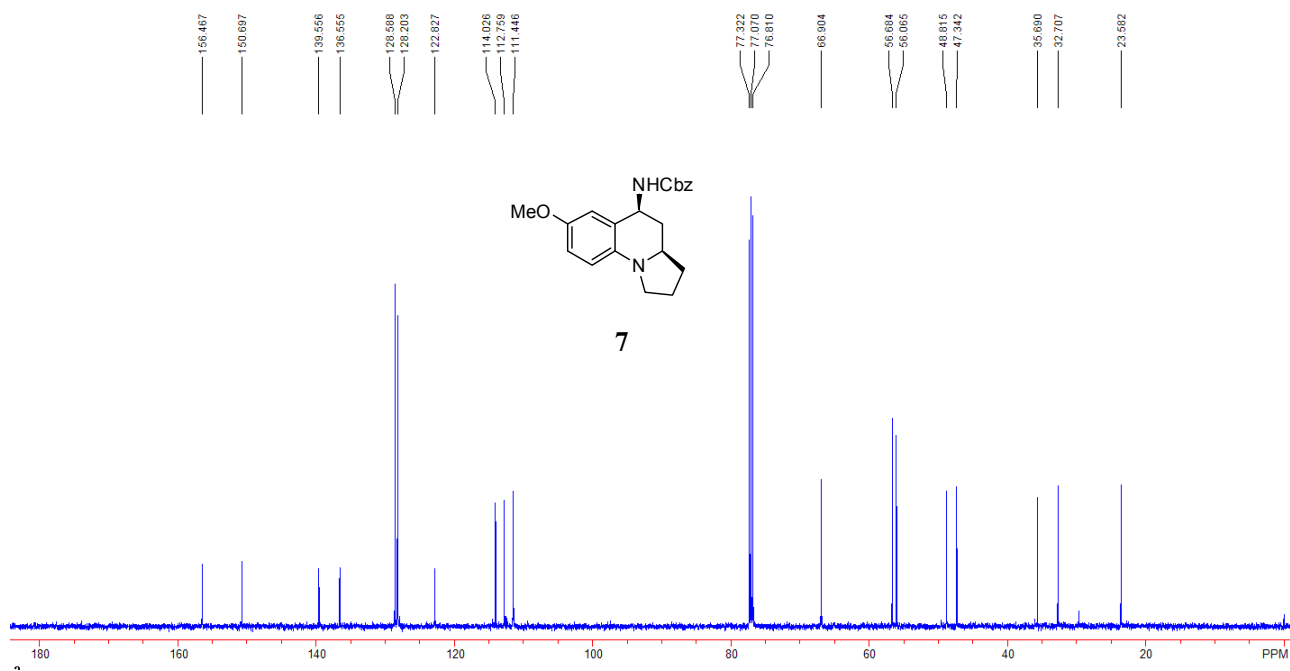




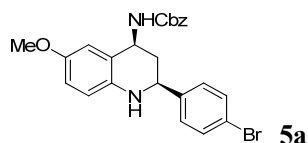




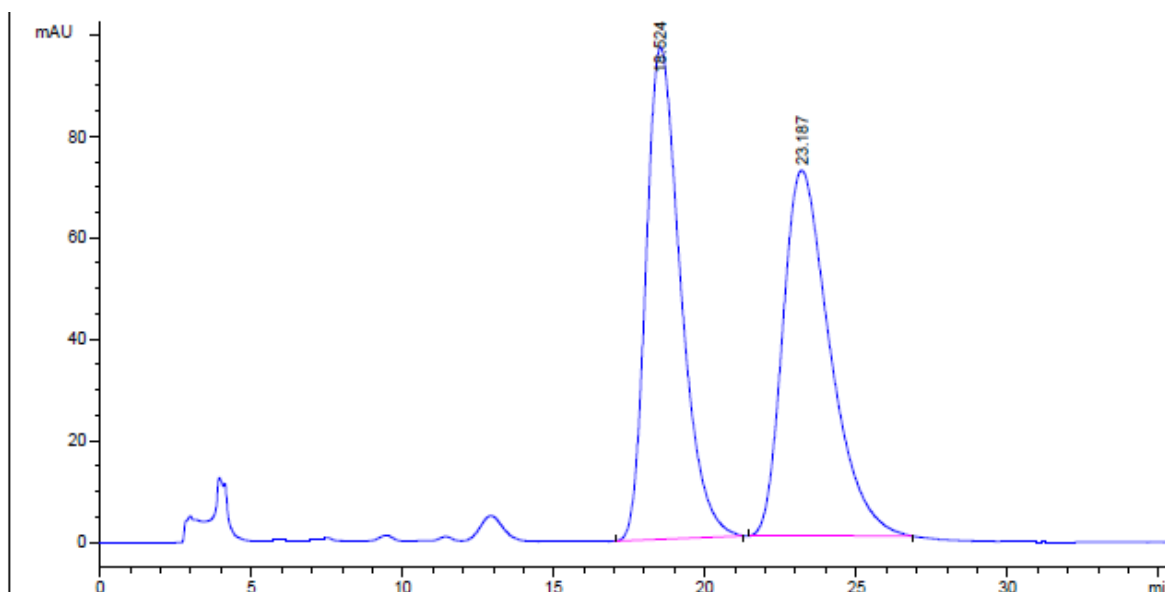




2. HPLC spectra for compounds 5a-5p, 6 and 7

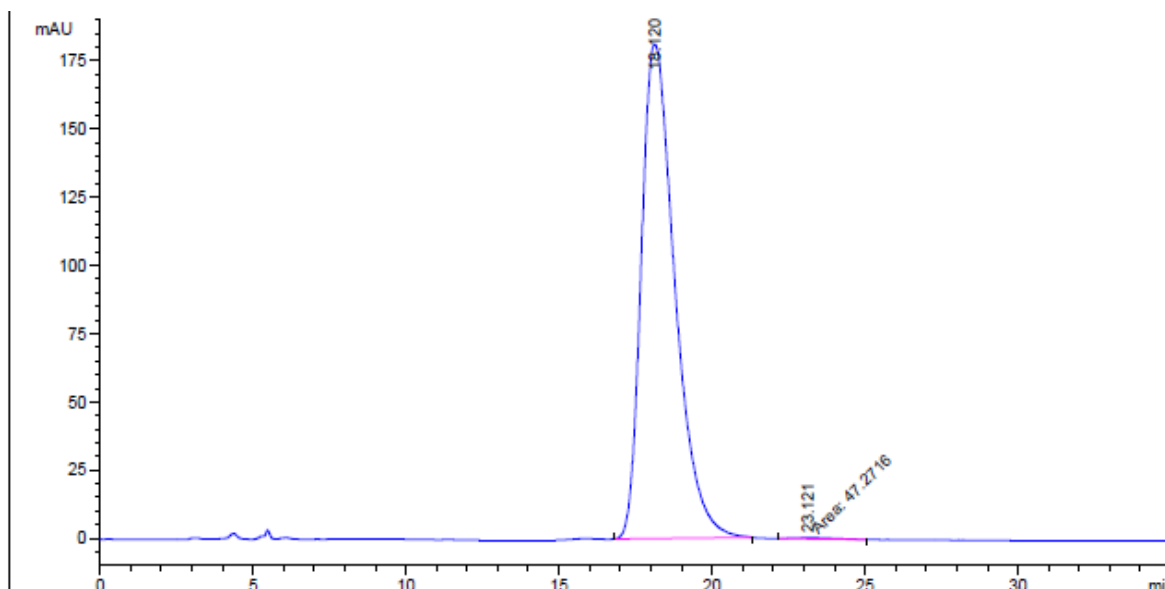


>99% ee. [Daicel Chiralcel OD-H, *n*-hexane / *i*-propanol = 70 / 30, 1.0 mL/min, λ = 254 nm]



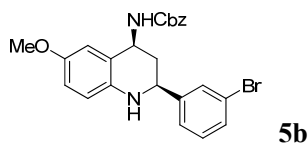
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1	18.524	BB	1.1780	7709.13281	97.11187	49.6647
2	23.187	BB	1.5739	7813.23535	72.13058	50.3353

Totals : 1.55224e4 169.24245

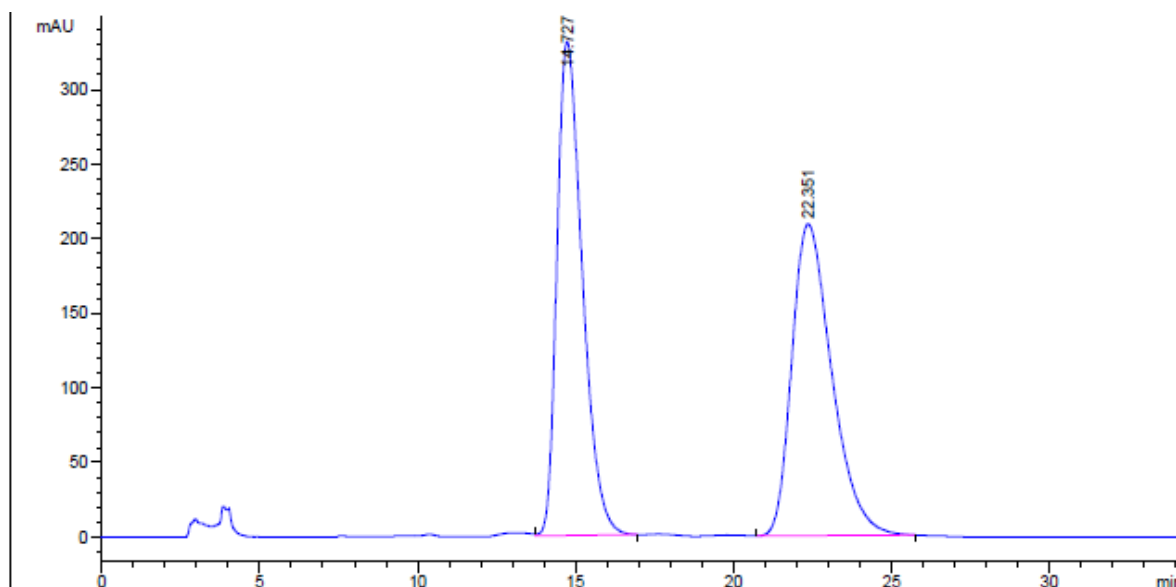


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	18.120	BB	1.1022	1.38335e4	181.40642	99.6594
2	23.121	MM	1.4965	47.27156	5.26473e-1	0.3406

Totals : 1.38808e4 181.93289

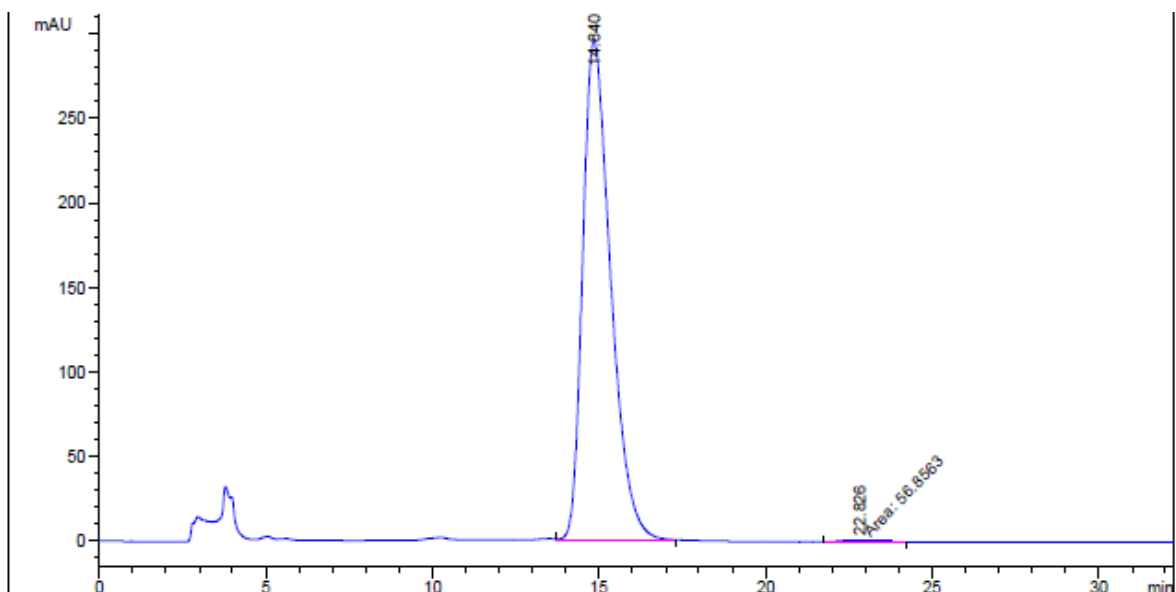


>99% ee. [Daicel Chiralcel OD-H, *n*-hexane / *i*-propanol = 70 / 30, 1.0 mL/min, λ = 254 nm]



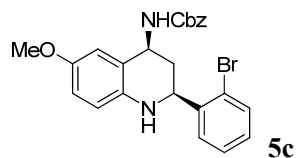
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	14.727	VB	0.8473	1.85198e4	331.27155	50.1666
2	22.351	VB	1.3147	1.83968e4	209.10194	49.8334

Totals : 3.69166e4 540.37349

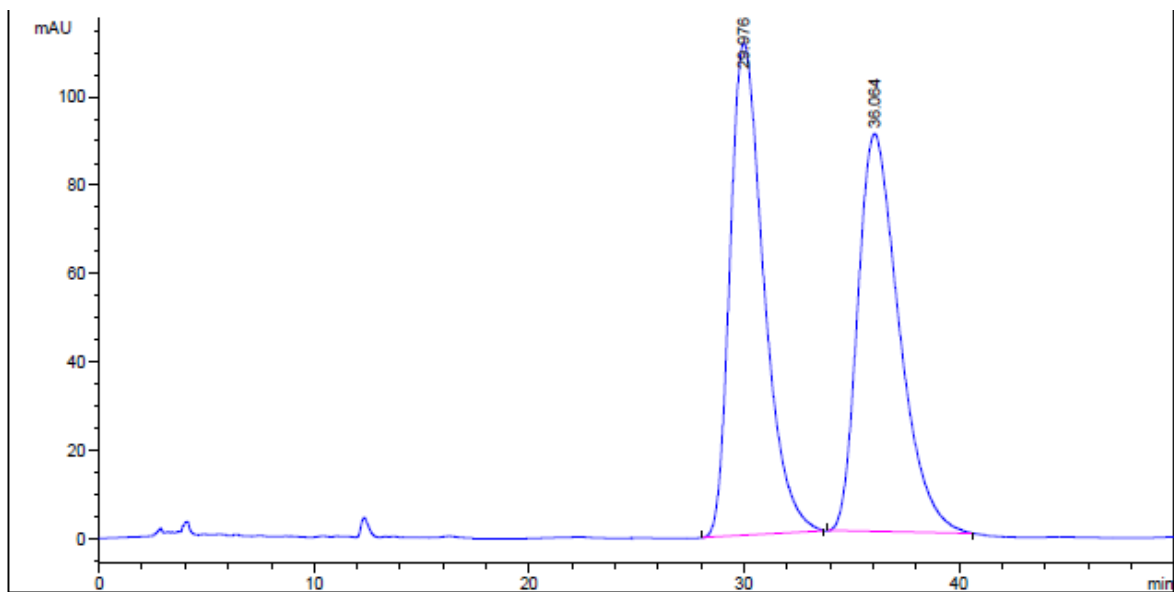


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	14.840	VB	0.8960	1.72558e4	295.83575	99.6716
2	22.826	MM	1.3087	56.85627	7.24070e-1	0.3284

Totals : 1.73126e4 296.55982

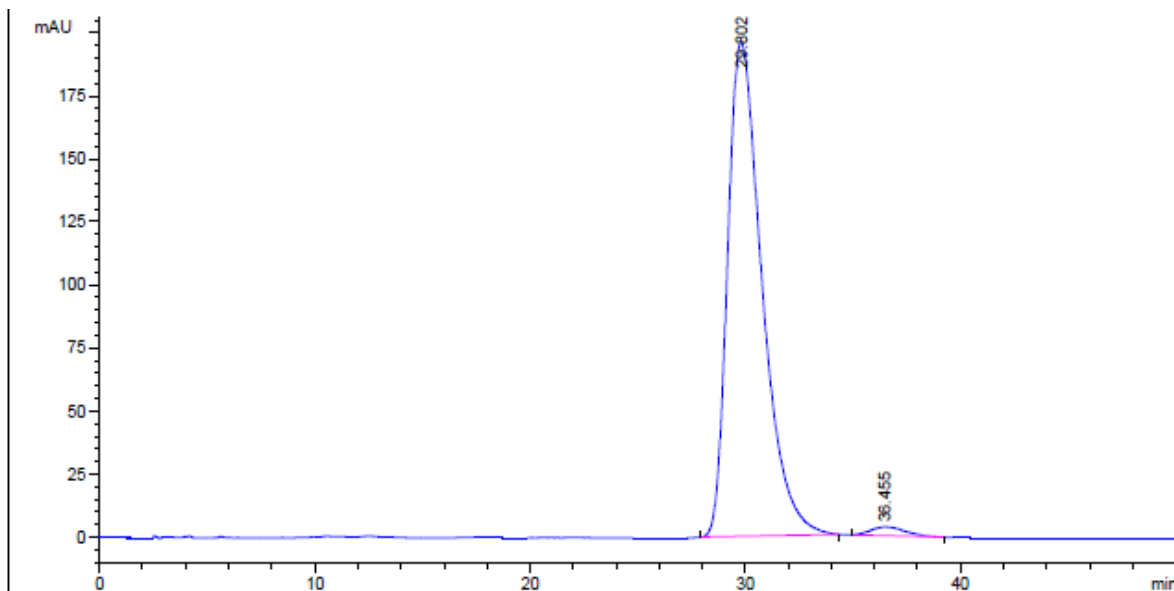


96% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH = 70 / 30, 1.2 mL/min, λ = 254 nm]



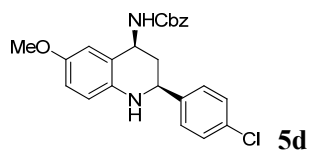
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1	29.976	BB	1.6036	1.21605e4	111.56923	50.2512
2	36.064	BB	1.9793	1.20389e4	90.11979	49.7488

Totals : 2.41994e4 201.68902

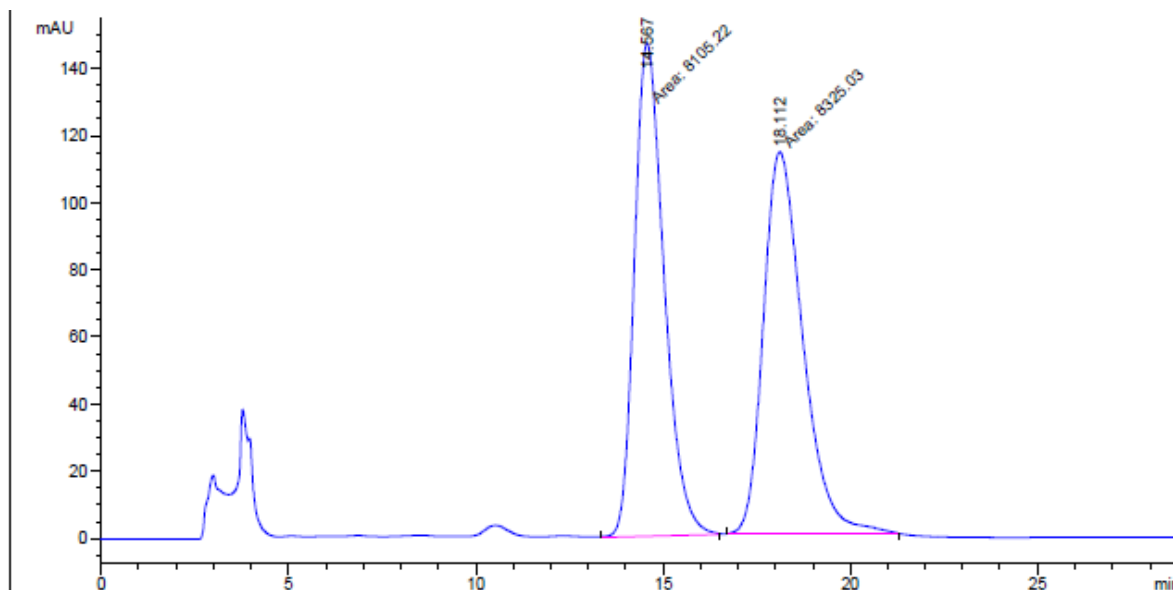


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1	29.802	BB	1.6541	2.17963e4	196.22585	98.2123
2	36.455	BP	1.3405	396.73459	3.51383	1.7877

Totals : 2.21931e4 199.73967

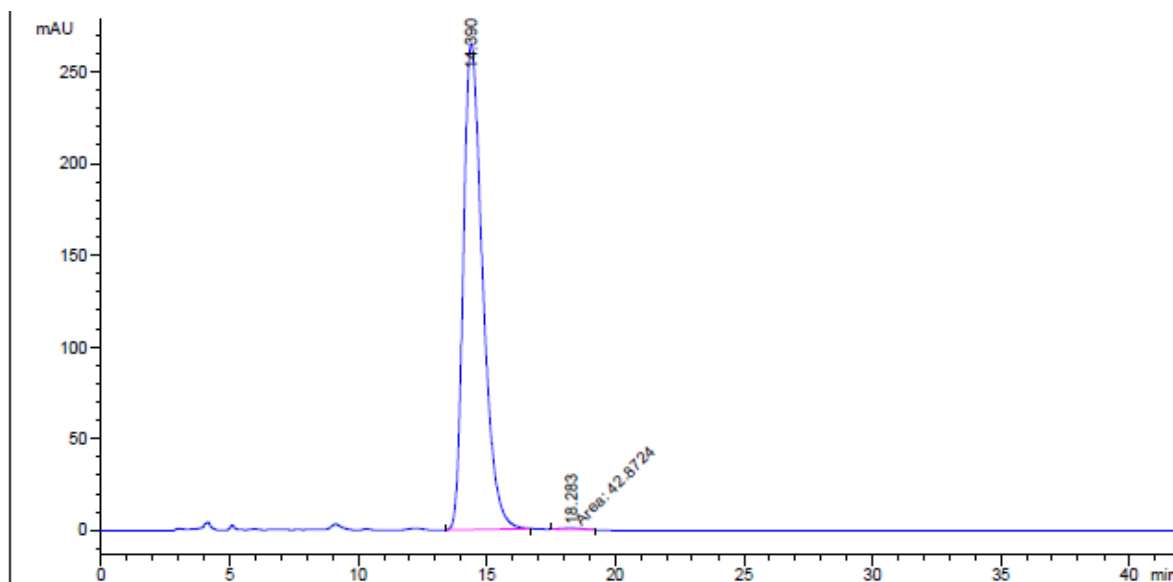


>99% ee. [Daicel Chiralcel OD-H, *n*-hexane / *i*-propanol = 70 / 30, 1.0 mL/min, λ = 254 nm]



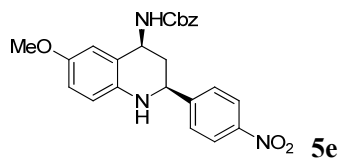
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1	14.567	MM	0.9198	8105.22412	146.86246	49.3311
2	18.112	MM	1.2213	8325.03320	113.60770	50.6689

Totals : 1.64303e4 260.47016

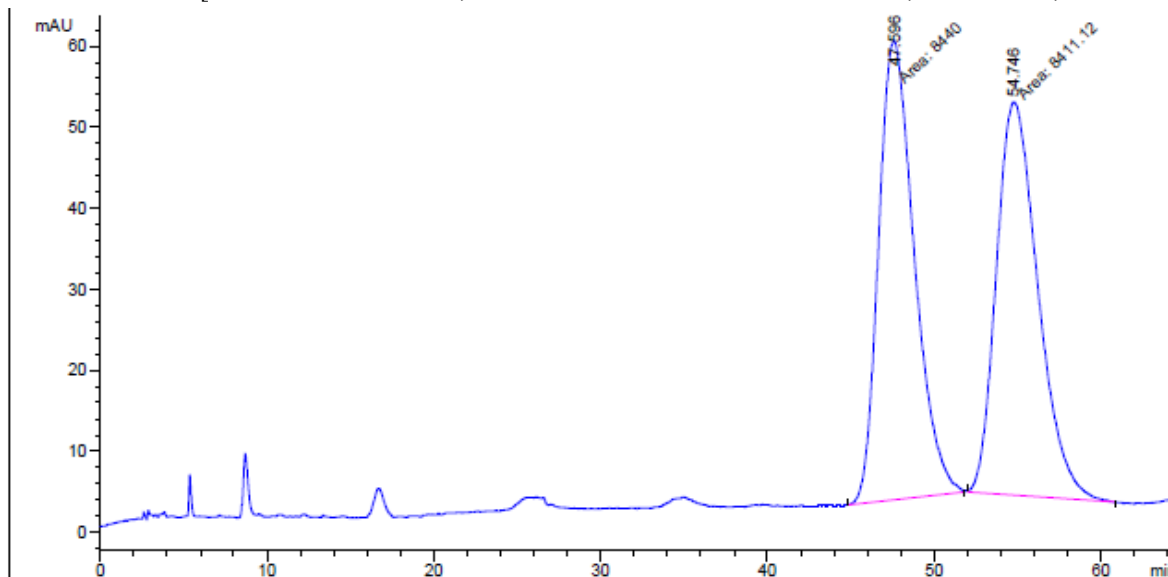


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	14.390	BB	0.7989	1.38147e4	265.02502	99.6906
2	18.283	MM	0.9478	42.87241	7.53876e-1	0.3094

Totals : 1.38575e4 265.77890

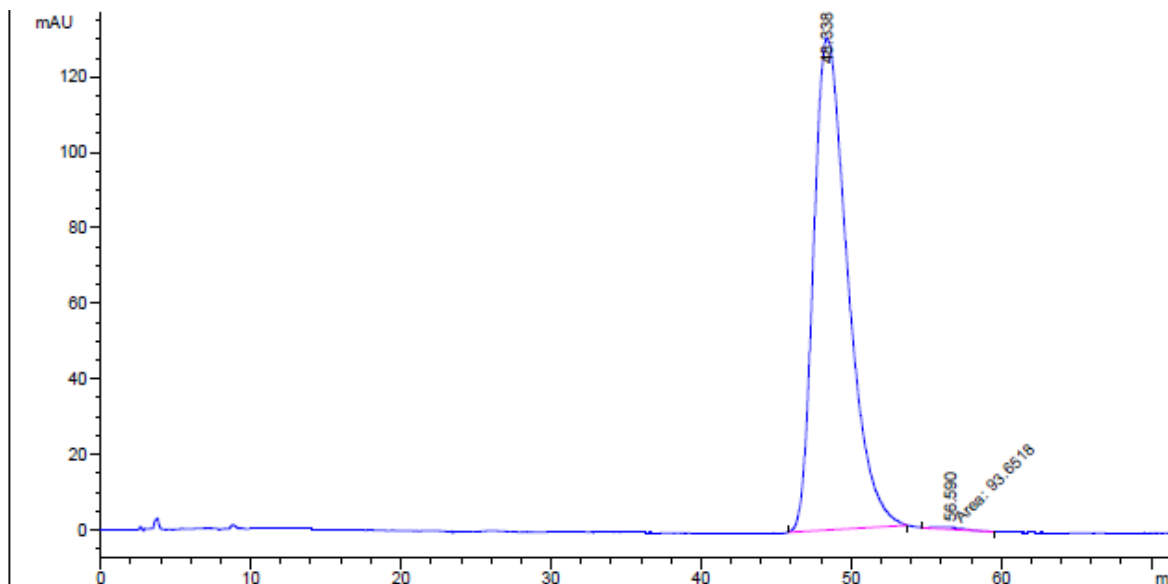


>99% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH / DEA = 60 / 40 / 0.1, 1.2 mL/min, λ = 254 nm]



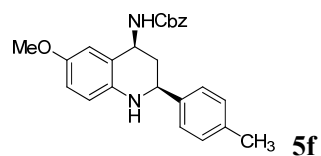
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1	47.596	MM	2.4803	8440.00195	56.71302	50.0857
2	54.746	MM	2.8893	8411.11719	48.51919	49.9143

Totals : 1.68511e4 105.23221

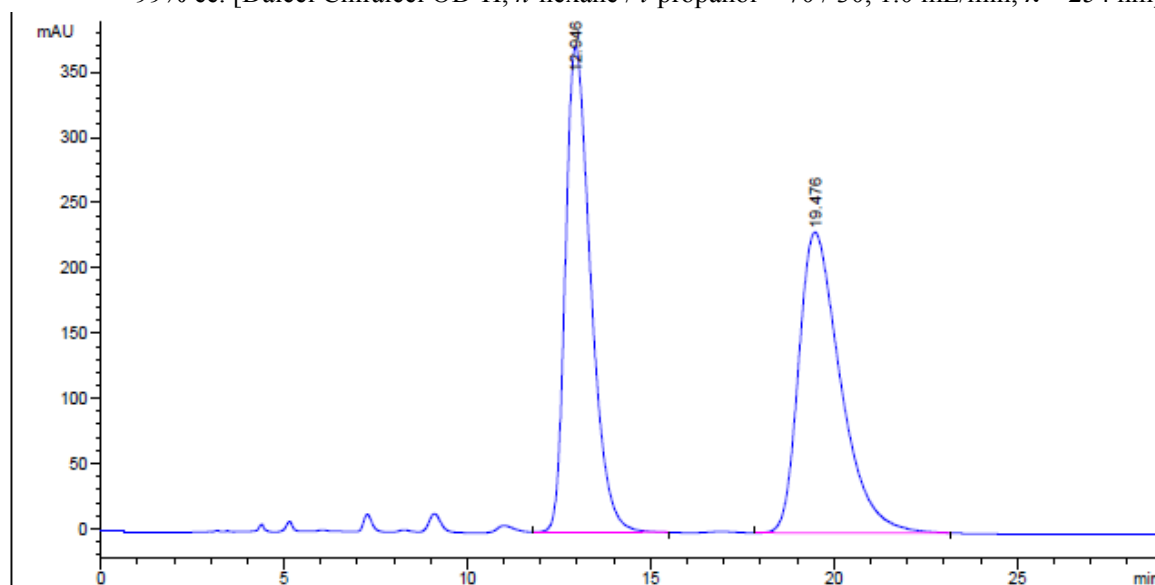


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1	48.338	BB	1.9123	2.05911e4	130.48953	99.5472
2	56.590	MM	2.4059	93.65184	6.48753e-1	0.4528

Totals : 2.06848e4 131.13829

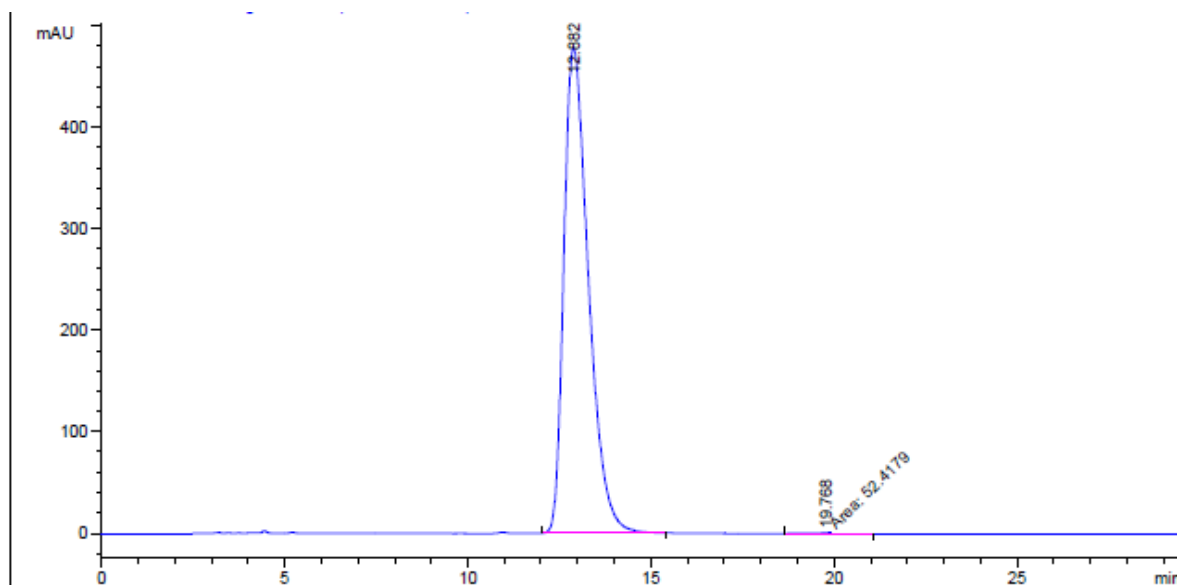


>99% ee. [Daicel Chiralcel OD-H, *n*-hexane / *i*-propanol = 70 / 30, 1.0 mL/min, λ = 254 nm]



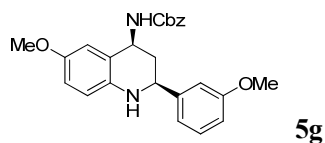
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1	12.946	VB	0.7297	1.79349e4	373.09683	49.4918
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Totals : 3.62382e4 603.80092

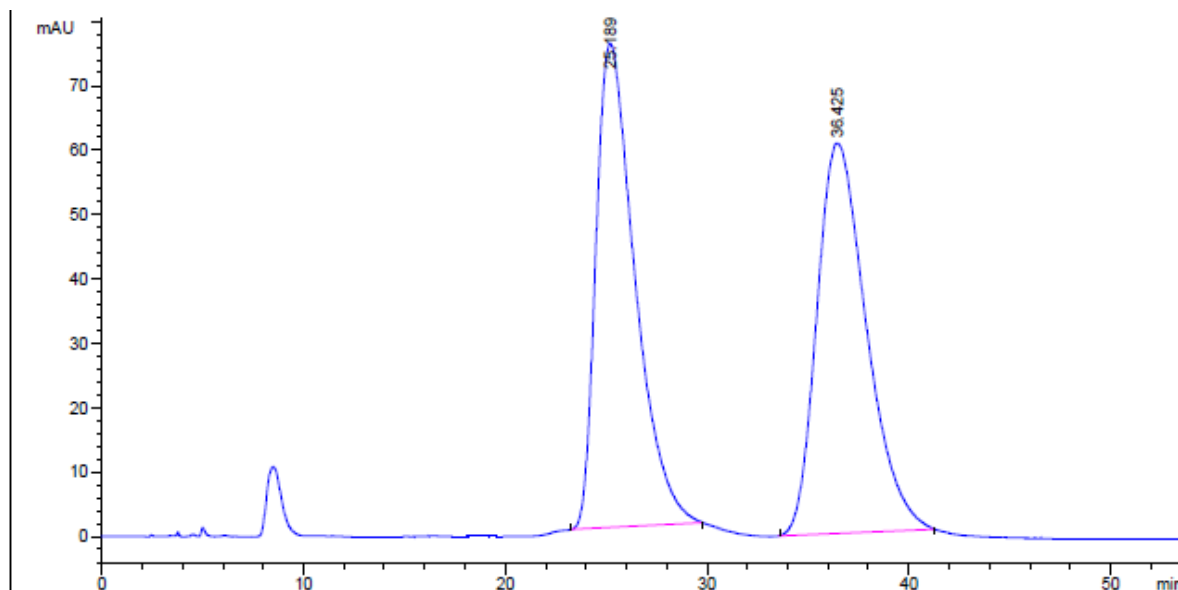


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1	12.882	BB	0.7098	2.23461e4	478.15759	99.7660
2	19.768	MM	1.3196	52.41792	6.62046e-1	0.2340

Totals : 2.23985e4 478.81964

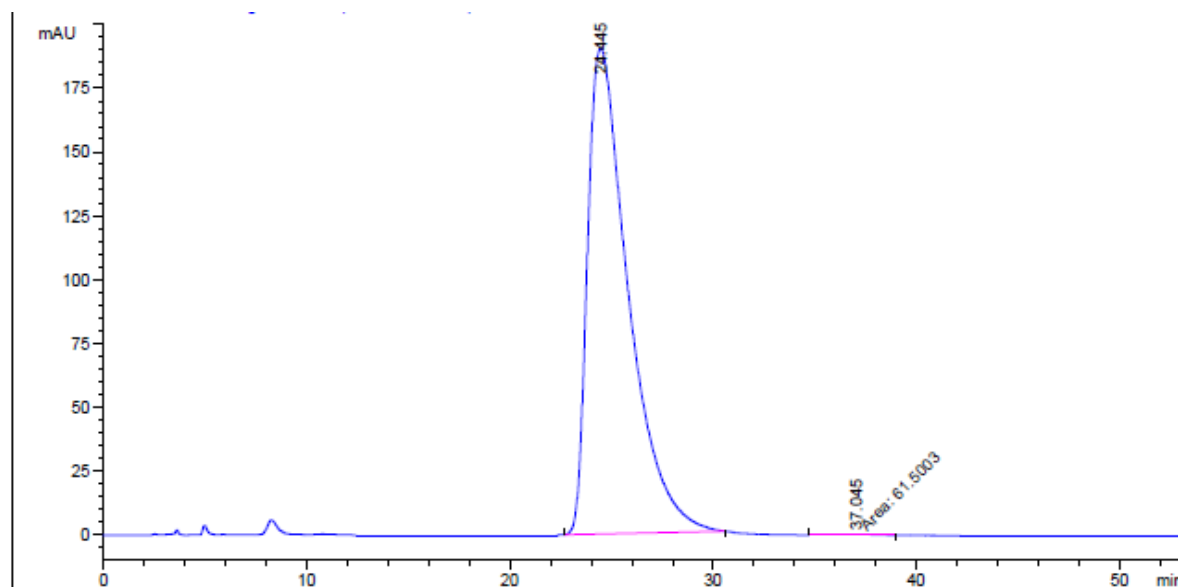


>99% ee. [Daicel Chiralcel OD-H, *n*-hexane / *i*-propanol = 70 / 30, 1.2 mL/min, λ = 254 nm]



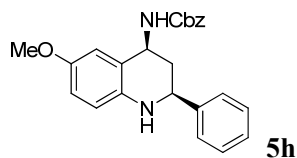
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1	25.189	BB	1.9108	1.01109e4	75.26900	49.4095
2	36.425	BB	2.0956	1.03526e4	60.67082	50.5905

Totals : 2.04635e4 135.93982

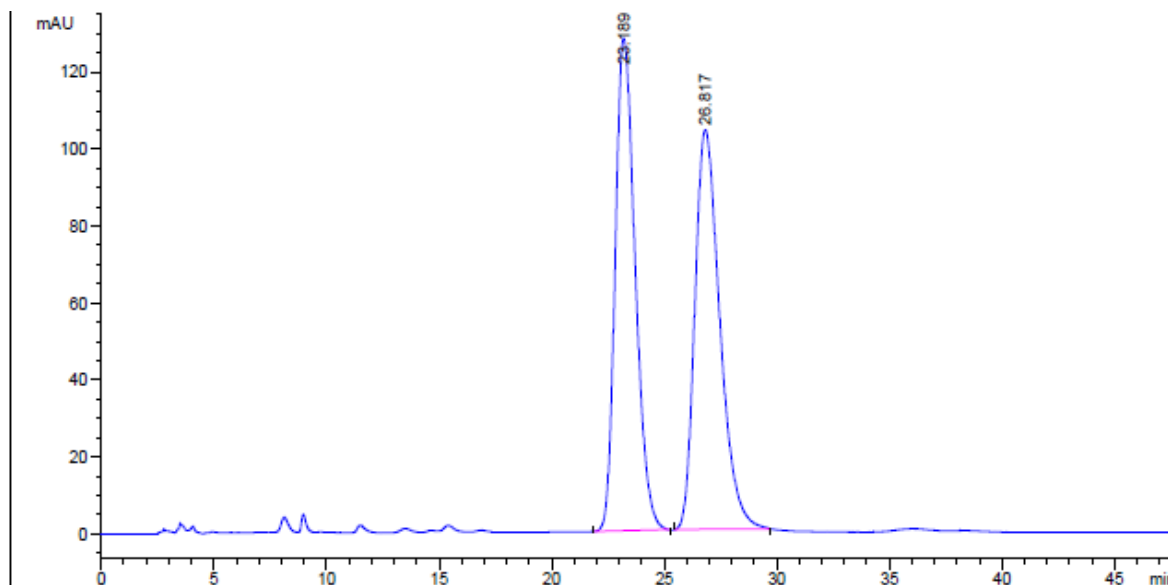


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1	24.445	BB	2.0176	2.65253e4	190.33356	99.7687
2	37.045	MM	2.4153	61.50032	4.24375e-1	0.2313

Totals : 2.65868e4 190.75793

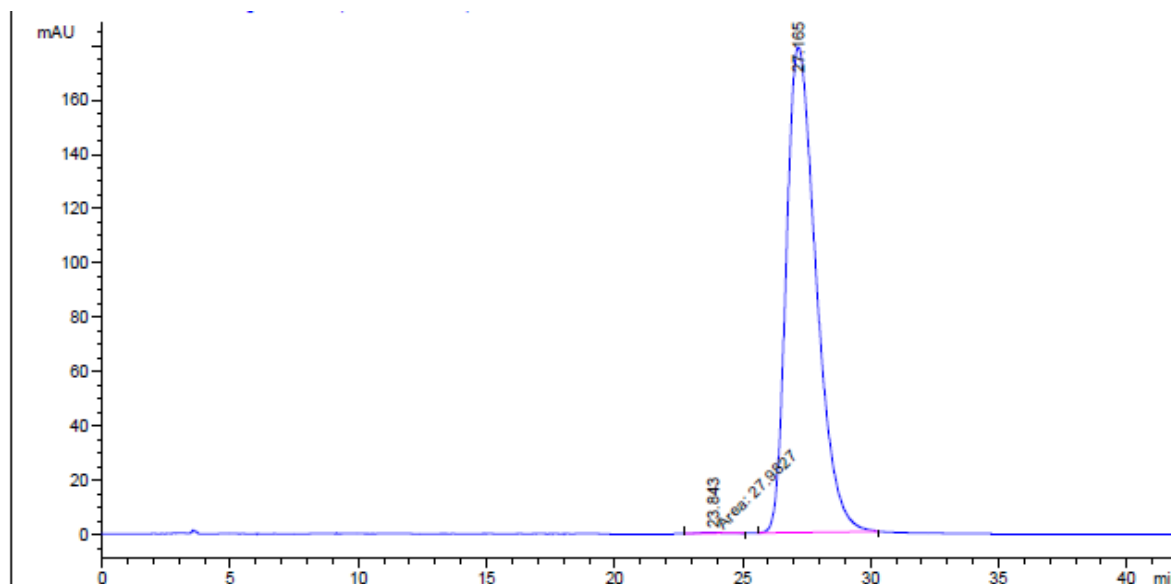


>99% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH = 60 / 40, 1.2 mL/min, λ = 254 nm]



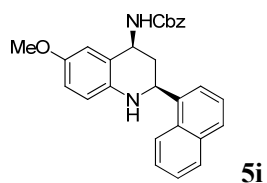
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1	23.189	BB	0.9348	7889.86035	127.97105	49.6421
2	26.817	BB	1.1608	8003.62109	103.89879	50.3579

Totals : 1.58935e4 231.86983

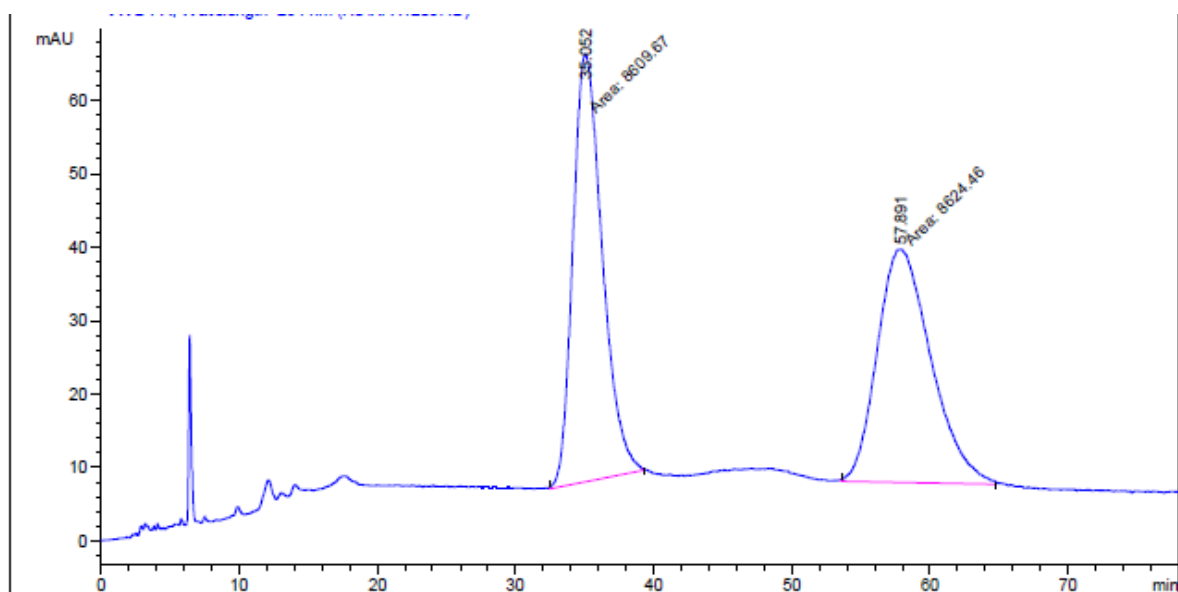


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	23.843	MM	1.0784	27.98271	4.32466e-1	0.1936
2	27.165	BB	1.2255	1.44259e4	178.73514	99.8064

Totals : 1.44538e4 179.16760

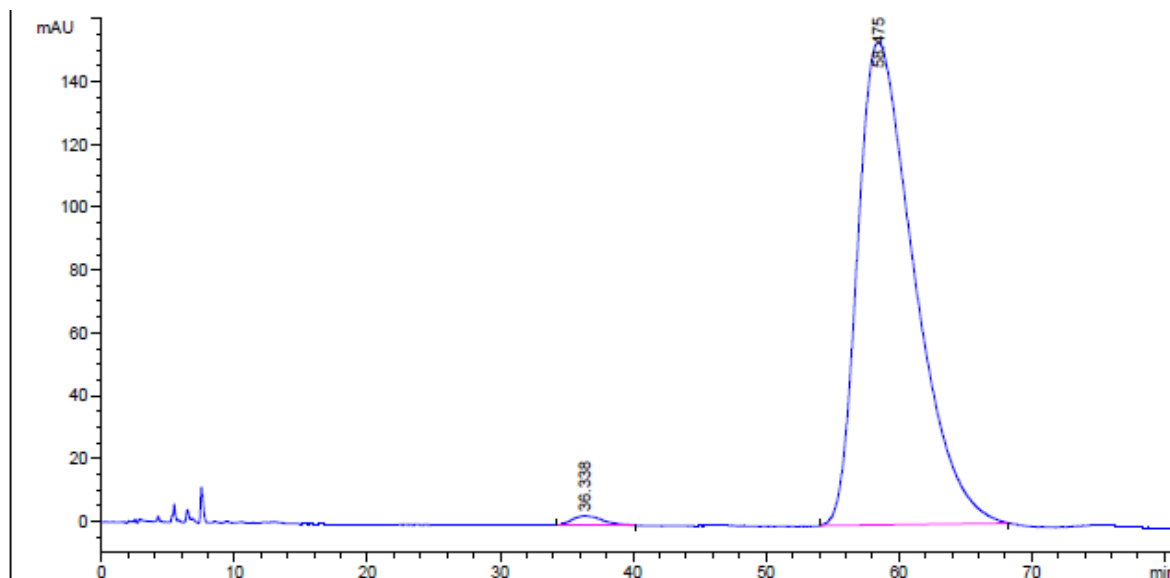


98% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH / DEA = 45 / 55 / 0.1, 1.2 mL/min, λ = 254 nm]



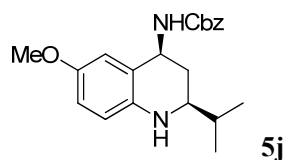
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1	35.052	MM	2.4602	8609.67090		58.32669	49.9571
2	57.891	MM	4.5201	8624.45703		31.80056	50.0429

Totals : 1.72341e4 90.12725

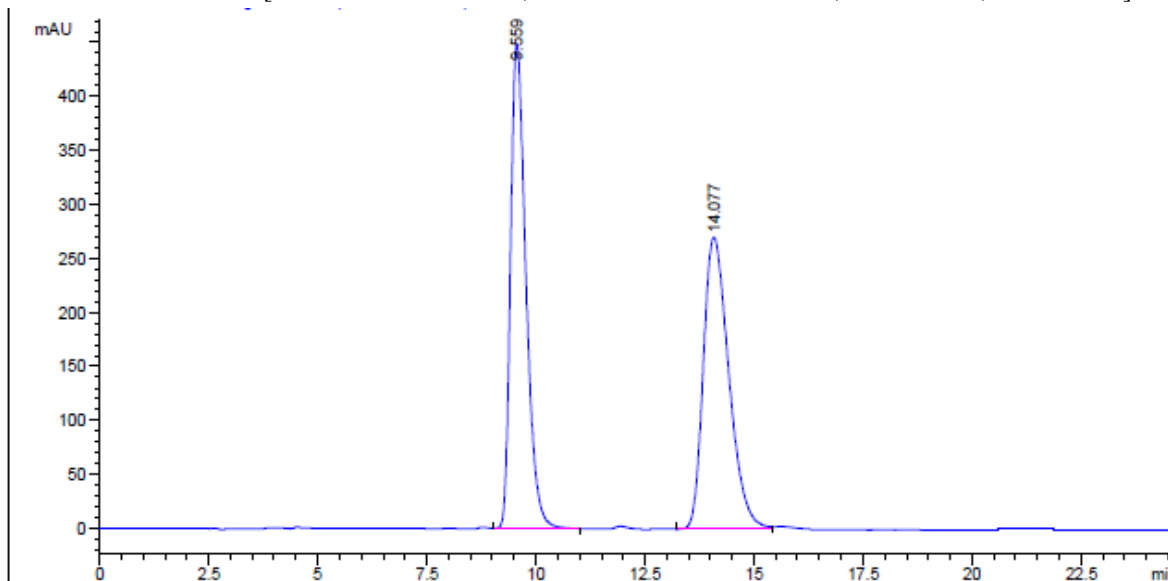


Peak #	RetTime [min]	Type	Width [min]	Area mAU	Area *s	Height [mAU]	Area %
1	36.338	VB	1.8923	491.55206		3.07076	1.0736
2	58.475	BB	3.4996	4.52939e4		153.55031	98.9264

Totals : 4.57854e4 156.62107

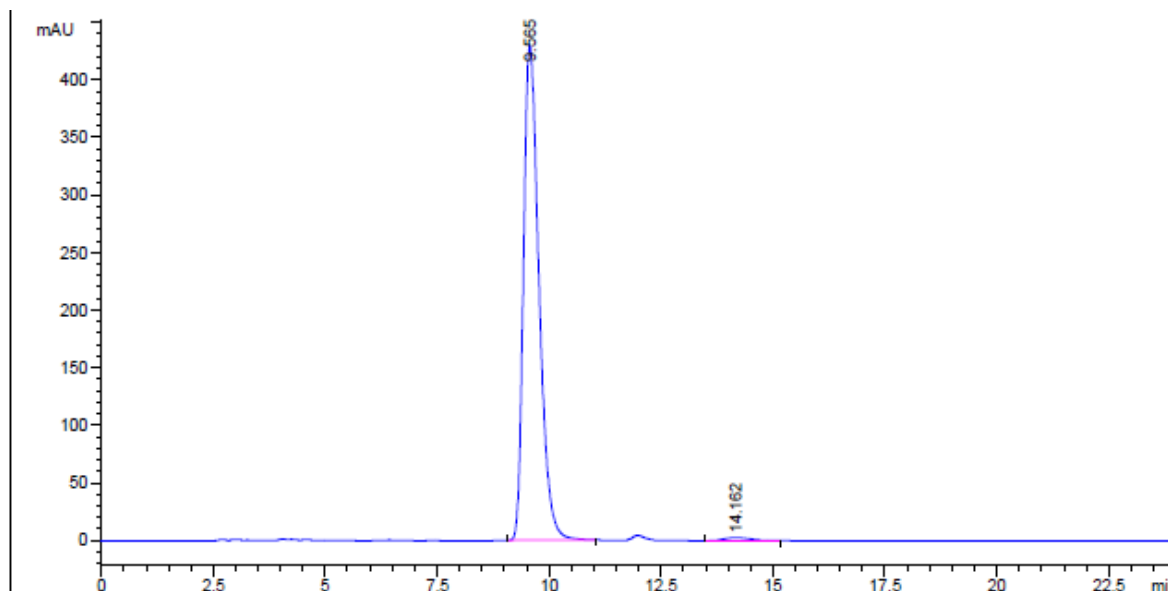


98% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH = 70 / 30, 1.2 mL/min, λ = 254 nm]



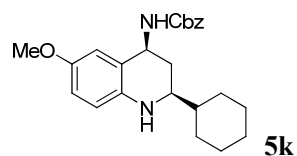
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	9.559	VB	0.3769	1.10303e4	448.92267	50.0405
2	14.077	VB	0.6309	1.10124e4	270.41623	49.9595

Totals : 2.20427e4 719.33890

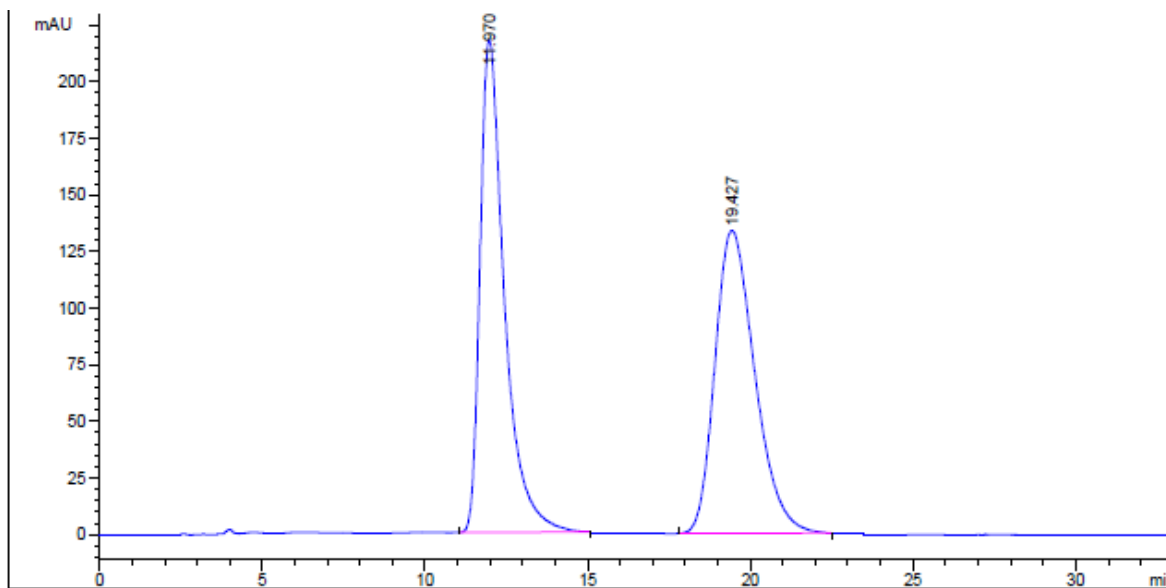


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	9.565	BB	0.3727	1.03621e4	430.22601	99.0893
2	14.162	PP	0.5024	95.23485	2.50989	0.9107

Totals : 1.04573e4 432.73590

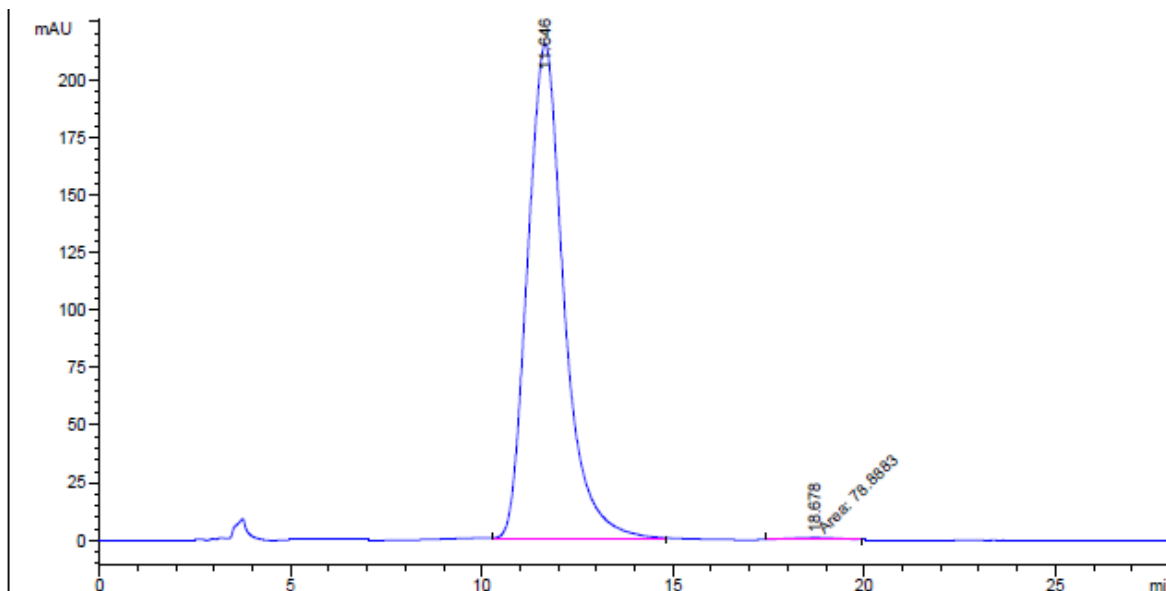


99% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH = 70 / 30, 1.2 mL/min, λ = 254 nm]



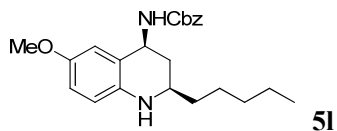
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	11.970	BB	0.7792	1.13692e4	217.87202	49.8708
2	19.427	BB	1.3015	1.14281e4	133.89738	50.1292

Totals : 2.27972e4 351.76941

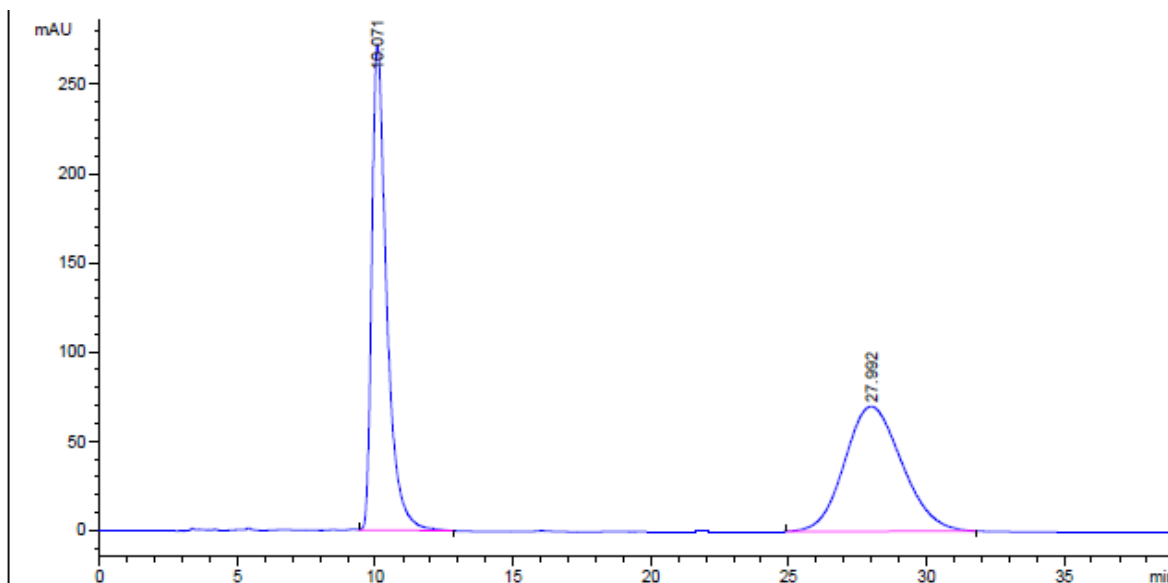


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	11.646	BB	1.0335	1.41800e4	214.45995	99.4467
2	18.678	MM	1.4728	78.88827	8.92705e-1	0.5533

Totals : 1.42589e4 215.35265

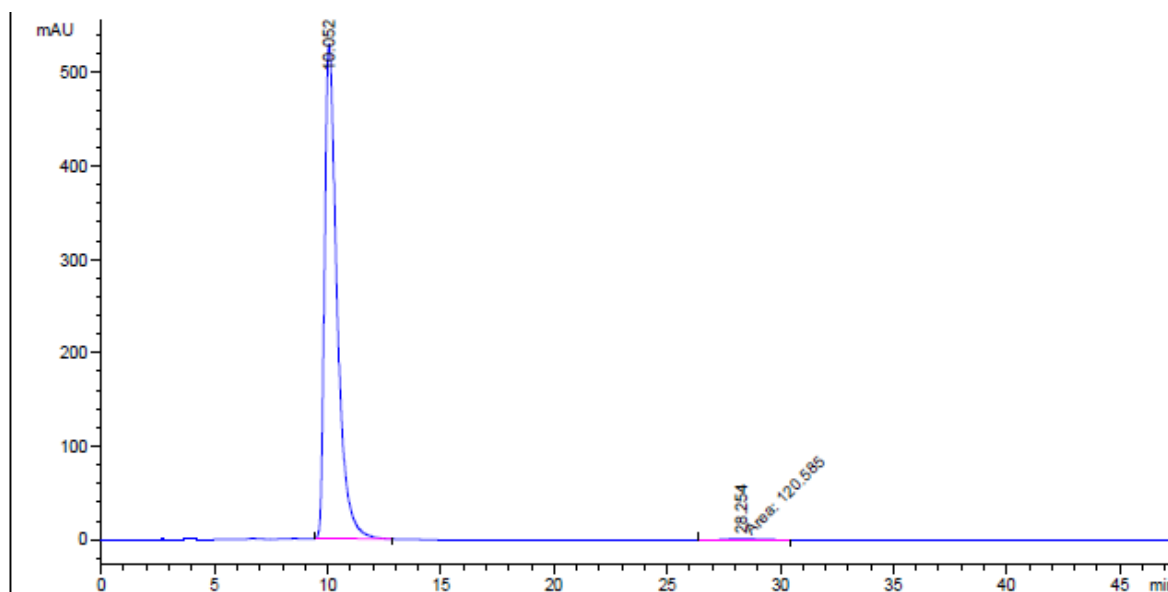


99% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH = 70 / 30, 1.2 mL/min, λ = 254 nm]



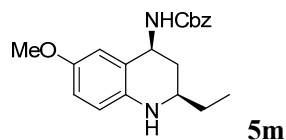
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	10.071	VB	0.5632	1.02365e4	272.66724	50.2075
2	27.992	BB	2.0759	1.01518e4	70.02055	49.7925

Totals : 2.03883e4 342.68778

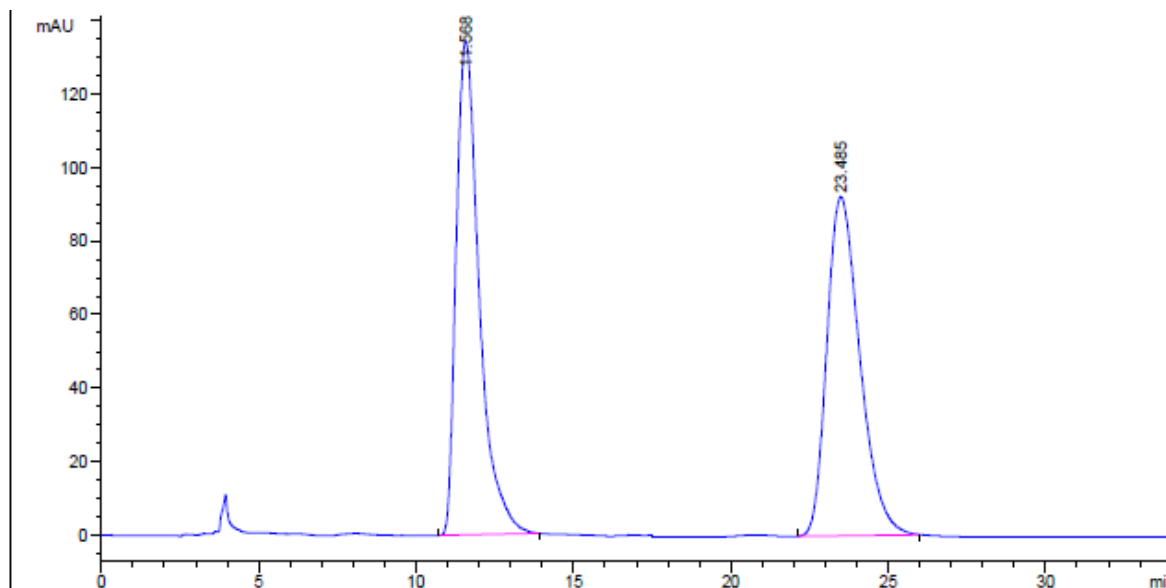


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	10.052	BB	0.5787	2.02792e4	528.48950	99.4089
2	28.254	MM	2.1744	120.58539	9.24302e-1	0.5911

Totals : 2.03998e4 529.41380



98% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH = 75 / 25, 1.2 mL/min, λ = 254 nm]



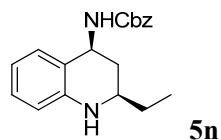
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	11.568	BB	0.7879	6864.11377	134.43452	50.4847
2	23.485	BB	1.1178	6732.29980	92.25476	49.5153

Totals : 1.35964e4 226.68929

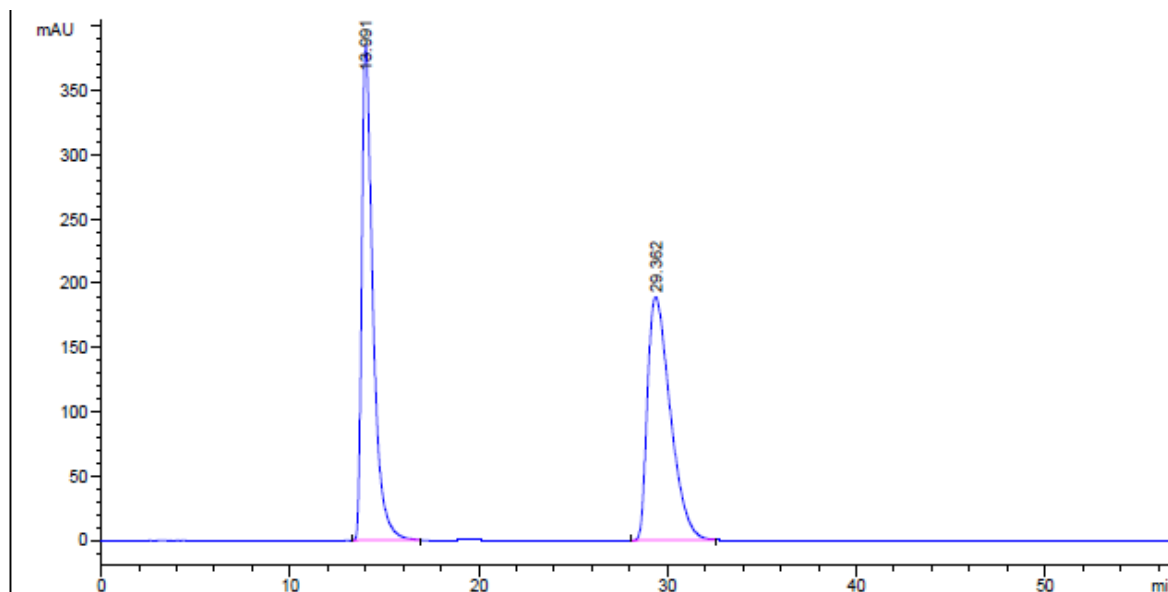


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	11.491	BB	0.7445	1.27270e4	266.01215	98.8956
2	23.730	BB	0.8159	142.12759	2.08047	1.1044

Totals : 1.28692e4 268.09262

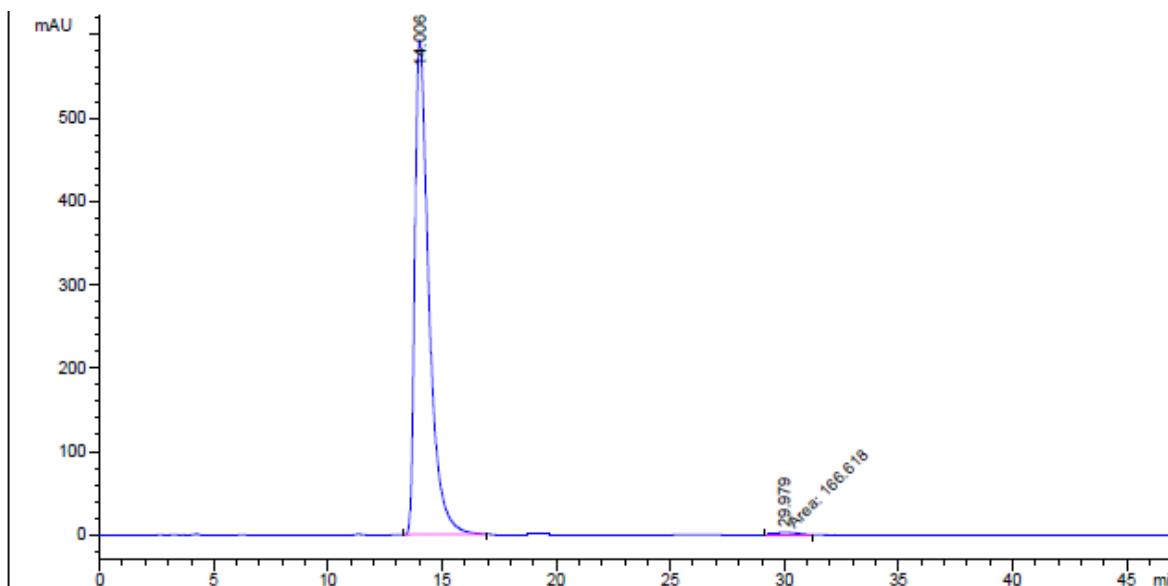


99% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH = 75 / 25, 1.2 mL/min, λ = 254 nm]



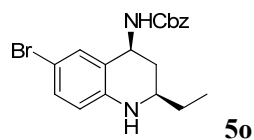
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	13.991	PB	0.6236	1.59421e4	385.55374	50.0574
2	29.362	BB	1.2466	1.59055e4	189.59758	49.9426

Totals : 3.18476e4 575.15132

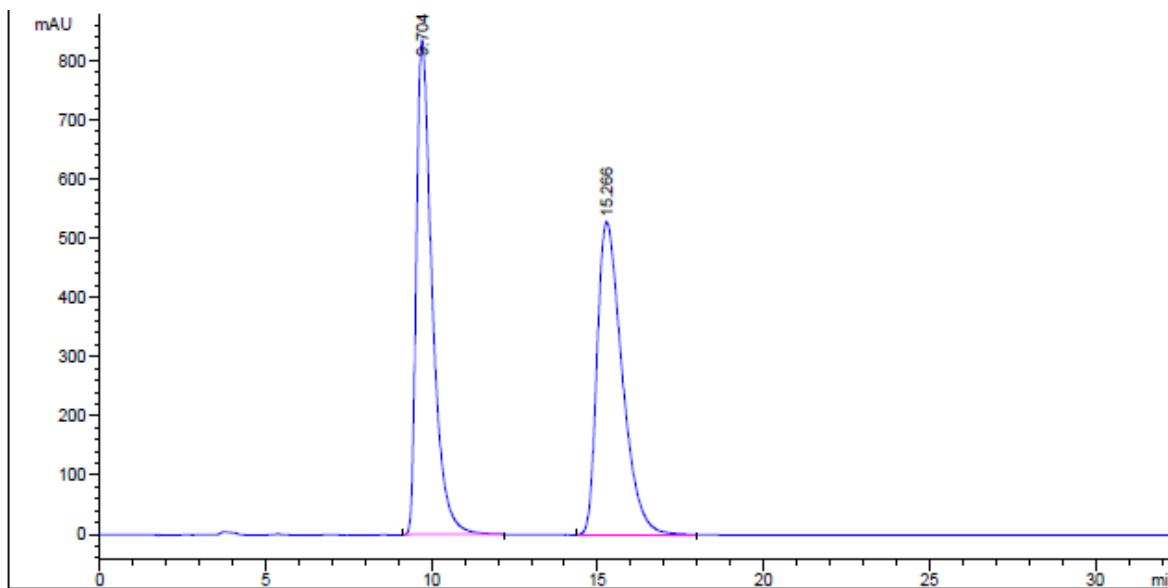


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	14.006	PB	0.6476	2.55111e4	592.87854	99.3511
2	29.979	MM	1.0520	166.61804	2.63979	0.6489

Totals : 2.56777e4 595.51833

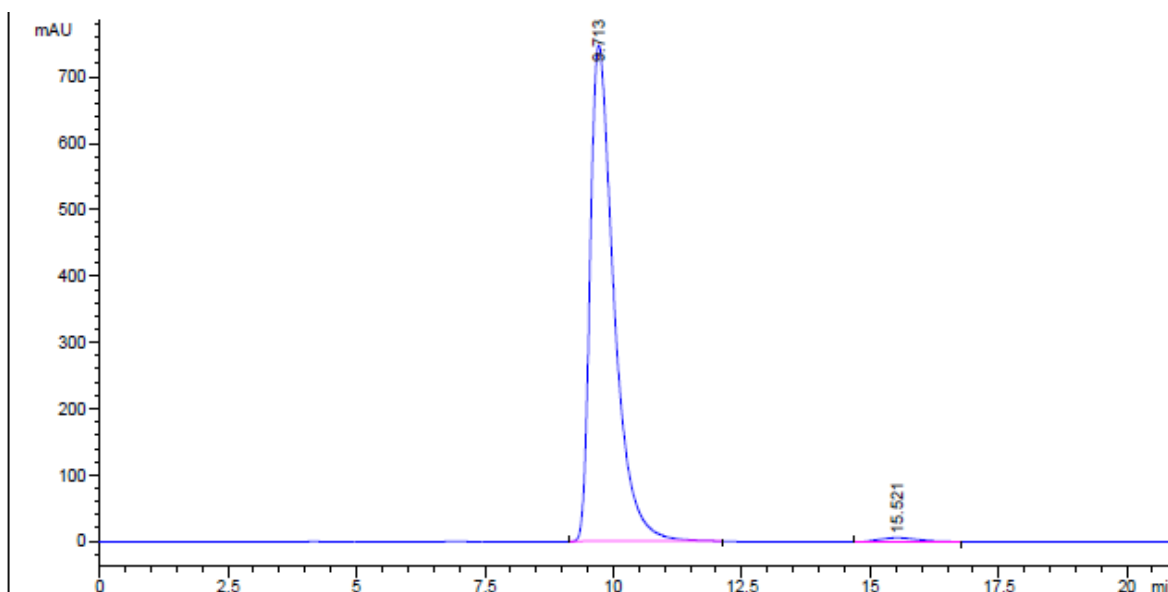


98% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH = 70 / 30, 1.2 mL/min, λ = 254 nm]



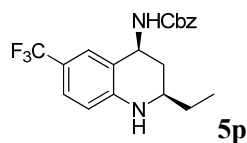
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	9.704	PB	0.4961	2.77391e4	836.45642	50.0940
2	15.266	BB	0.7998	2.76350e4	528.08911	49.9060

Totals : 5.53741e4 1364.54553

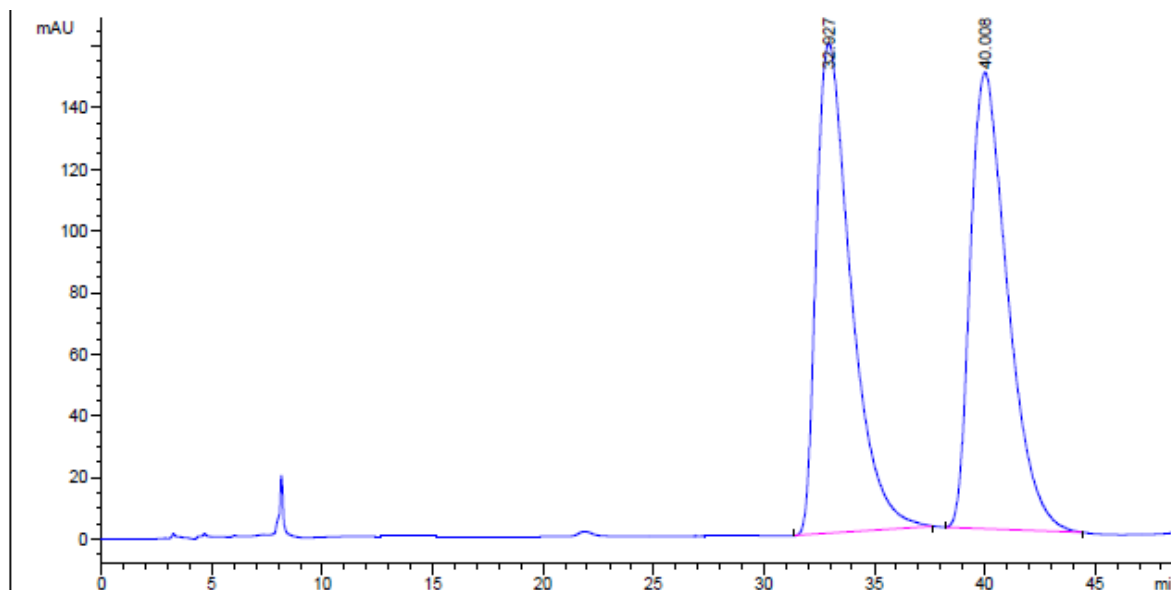


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	9.713	PB	0.4834	2.40865e4	748.06439	98.8792
2	15.521	BB	0.6424	273.02325	5.69431	1.1208

Totals : 2.43596e4 753.75870

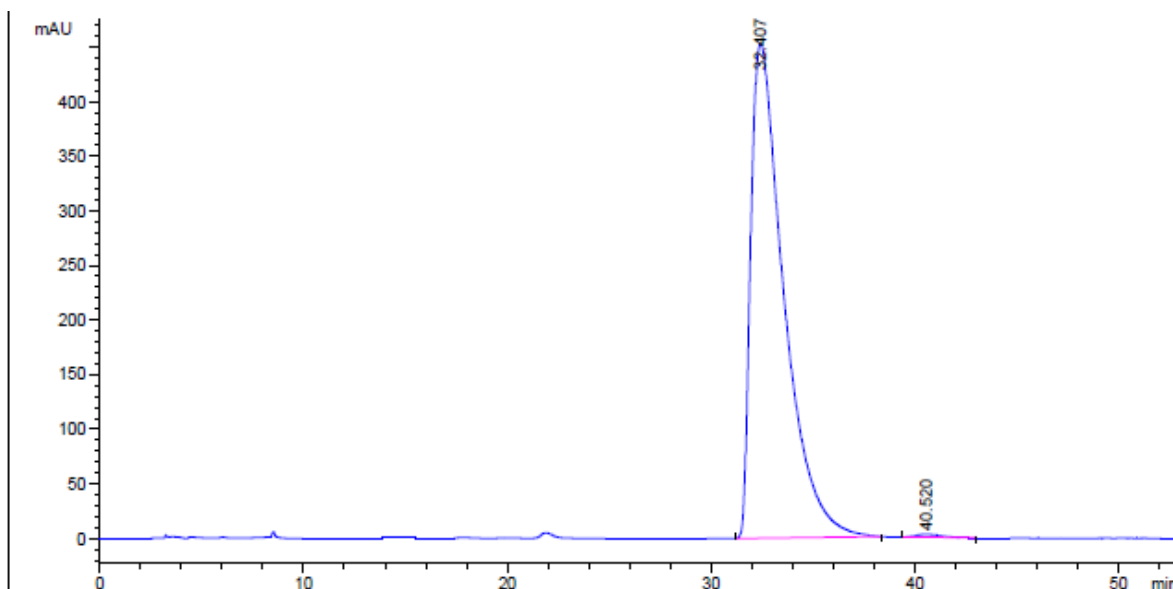


98% ee. [Daicel Chiralcel OJ-H, *n*-hexane / EtOH = 93 / 7, 1.0 mL/min, λ = 254 nm]



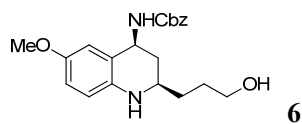
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	32.927	BB	1.6296	1.74106e4	159.21217	49.9936
2	40.008	BB	1.7236	1.74150e4	148.33064	50.0064

Totals : 3.48256e4 307.54282

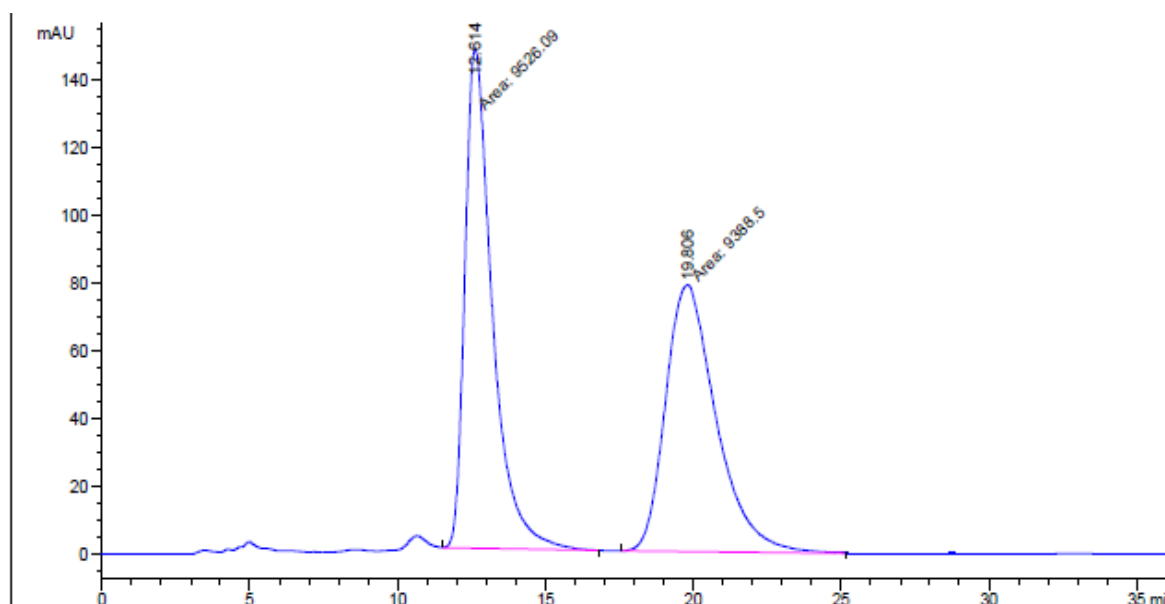


Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	32.407	BB	1.6654	5.10238e4	452.84146	99.5183
2	40.520	BP	1.1422	246.94986	2.54838	0.4817

Totals : 5.12707e4 455.38984

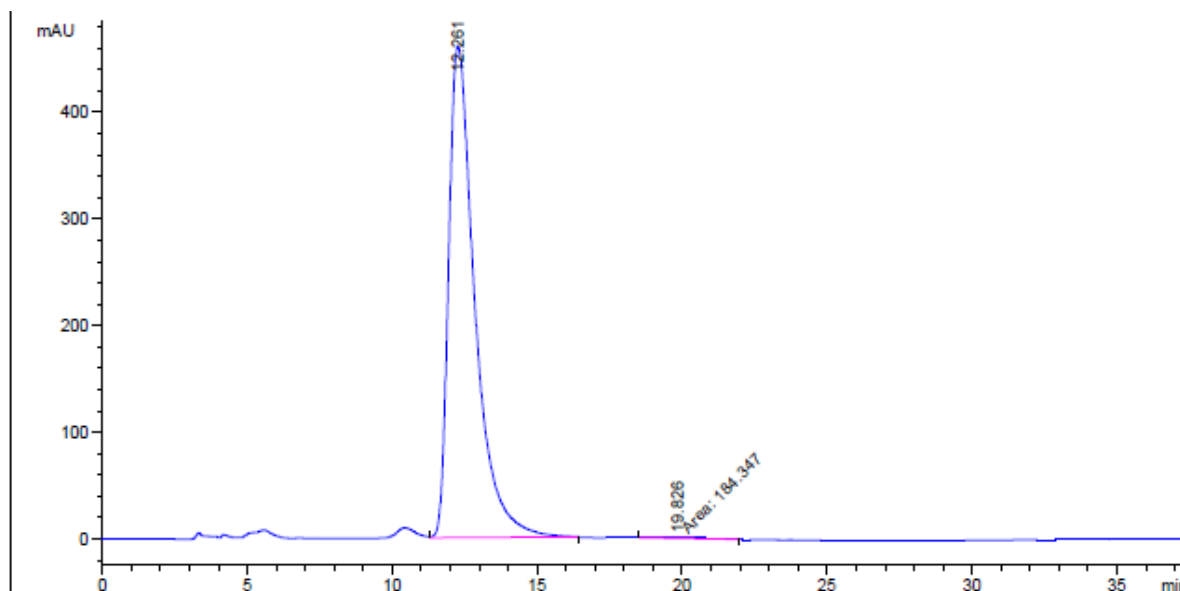


99% ee. [Daicel Chiralcel OJ-H, *n*-hexane / *i*-propanol = 60 / 40, 1.0 mL/min, λ = 254 nm]



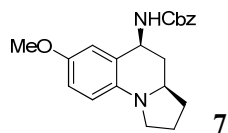
Peak #	RetTime [min]	Type	Width [min]	Area mAU	Area *s	Height [mAU]	Area %
1	12.614	MM	1.0761	9526.09473		147.53679	50.3637
2	19.806	MM	1.9853	9388.50488		78.81802	49.6363

Totals : 1.89146e4 226.35480

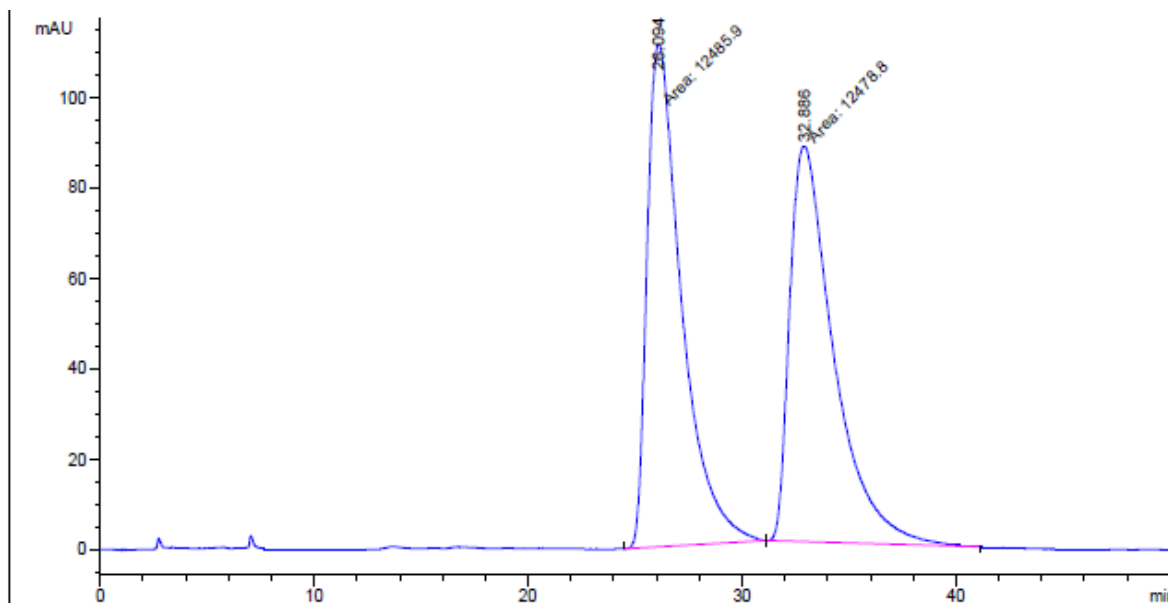


Peak #	RetTime [min]	Type	Width [min]	Area mAU	Area *s	Height [mAU]	Area %
1	12.261	VB	0.9487	2.90029e4		461.49316	99.3684
2	19.826	MM	1.7810	184.34737		1.72510	0.6316

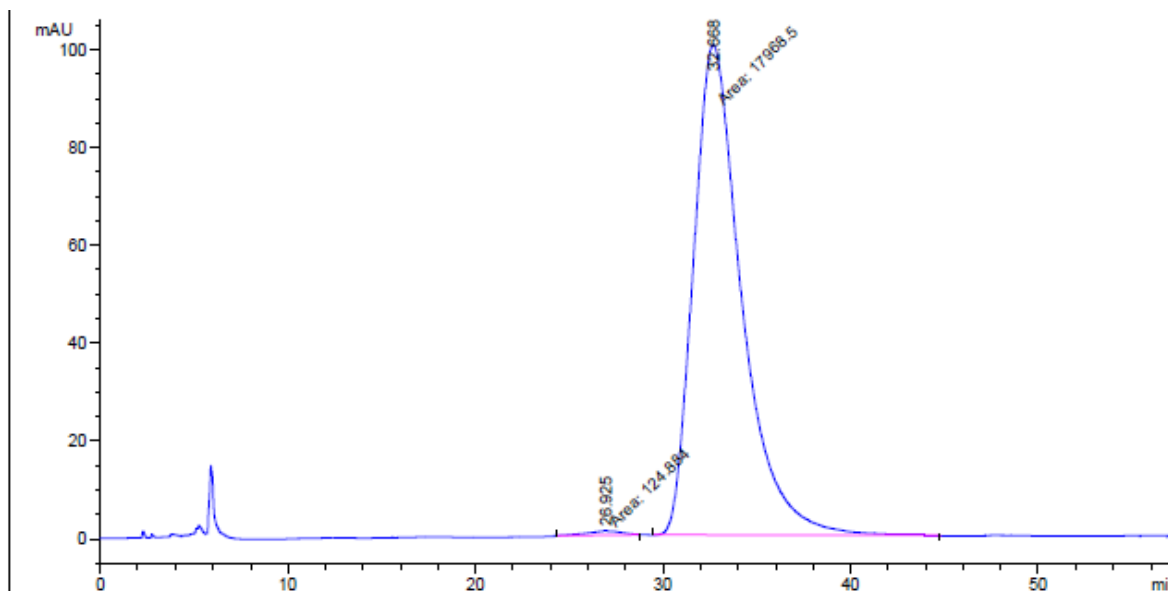
Totals : 2.91872e4 463.21826



99% ee. [Daicel Chiralcel OJ-H, *n*-hexane / *i*-propanol = 90 / 10, 1.2 mL/min, λ = 254 nm]



Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	26.094	MM	1.8707	1.24859e4	111.24030	50.0141
2	32.886	MM	2.3783	1.24788e4	87.44910	49.9859
Totals :				2.49647e4	198.68939	



Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	26.925	MM	2.2802	124.88423	9.12814e-1	0.6902
2	32.668	MM	2.9848	1.79685e4	100.33331	99.3098
Totals :				1.80933e4	101.24613	