

One-pot synthesis of α,β -epoxy ketones through domino reaction between alkenes and aldehydes catalyzed by proline based chiral organocatalysts

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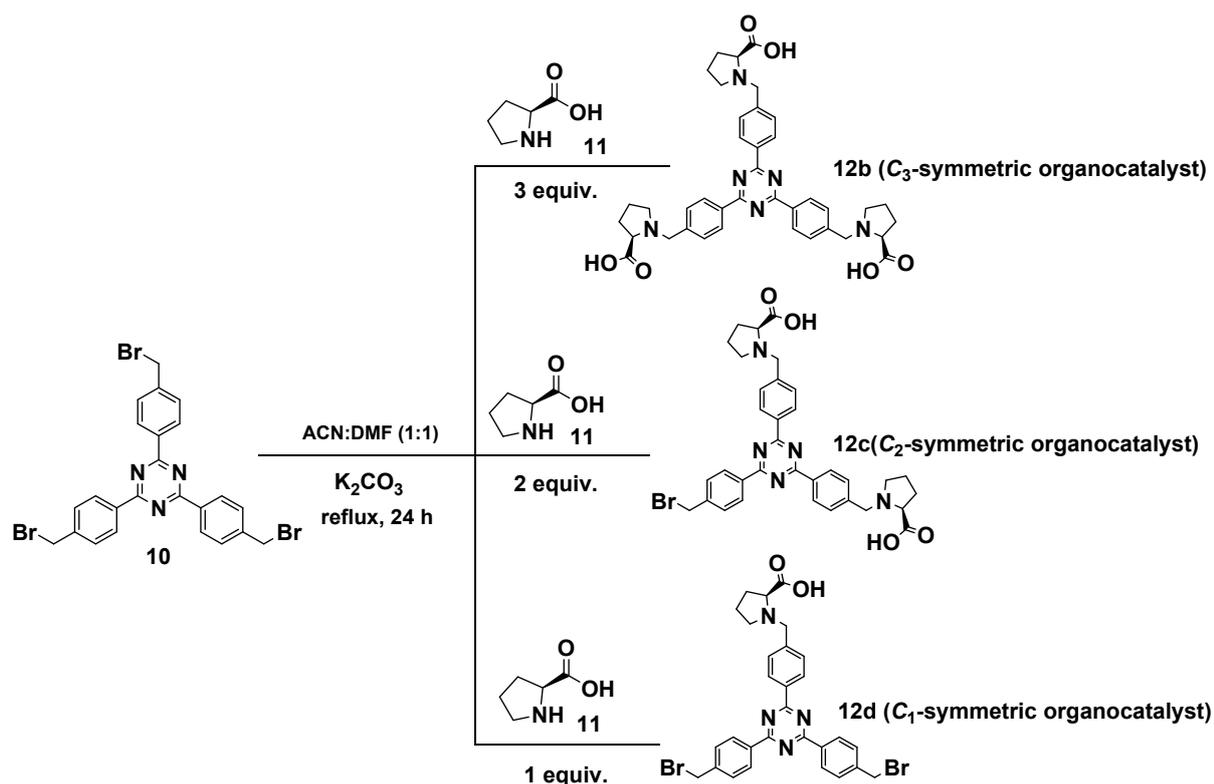
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Supporting Information

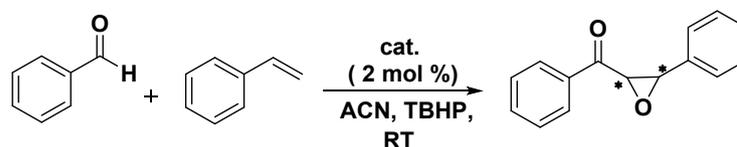
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Scheme S1 Synthesis of different symmetric proline based organocatalysts

Table S1 Catalyst optimization for the domino reaction (oxidative coupling) between benzaldehyde and styrene.



Entry	organocatalysts	Symmetry of the organocatalysts	Time (h) ^a	Yield (%) ^b	ee (%) ^c
1	12a	(C_3 -symmetry)	10	90	95
2	12b	(C_3 -symmetry)	10	95	99
3	12c	(C_2 -symmetry)	24	70	82
4	12d	(C_1 -symmetry)	36	57	73

^a The domino reaction was carried out between the benzaldehyde (1 mmol), styrene (1 mmol), TBHP (2 equiv.) and acetonitrile (2 mL) with different symmetric catalysts at room temperature with different time. ^b Isolated yield of purified material. ^c Enantiopurity was determined by HPLC analysis of epoxide product using a chiral column (Chiralcel OD-H) with hexane: IPA as an eluent. ^d Absolute configuration (2*R*,3*S*) was determined by comparison of the HPLC retention time using known literature data.¹⁻⁷

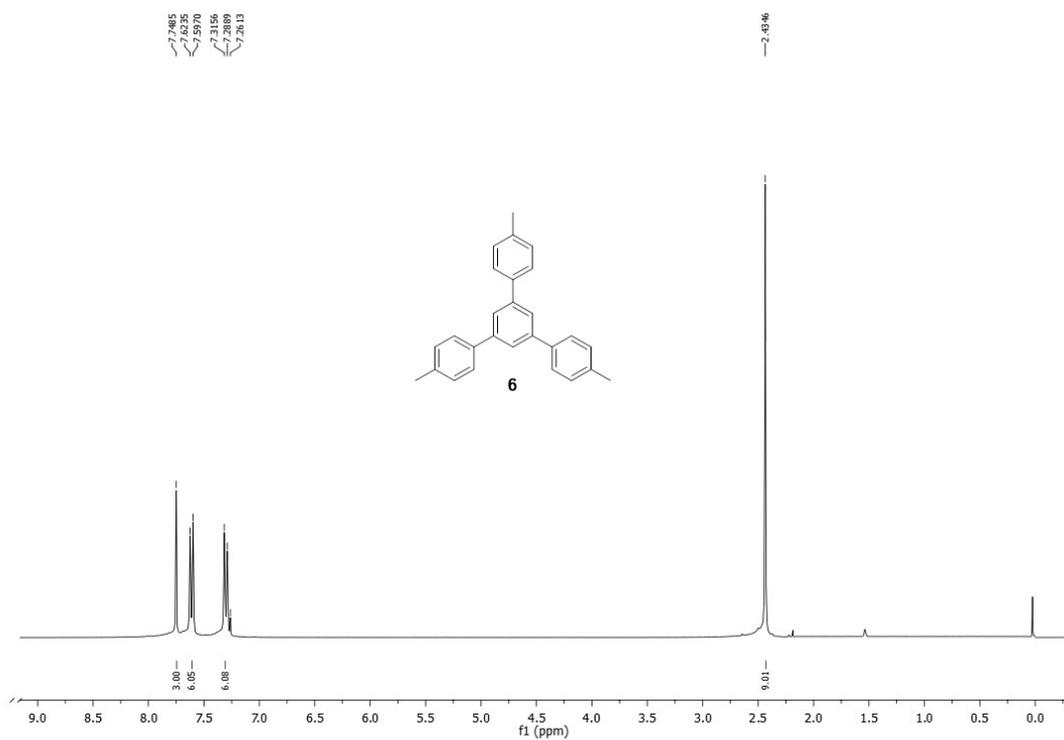


Figure S1: ¹H NMR Spectrum of compound 6.

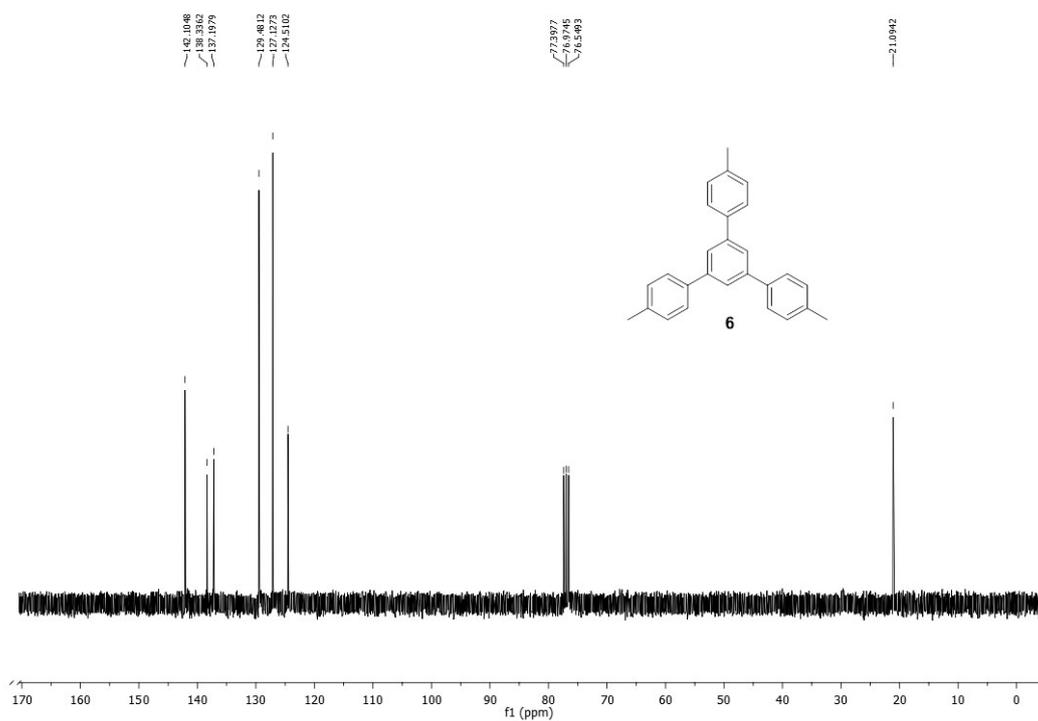
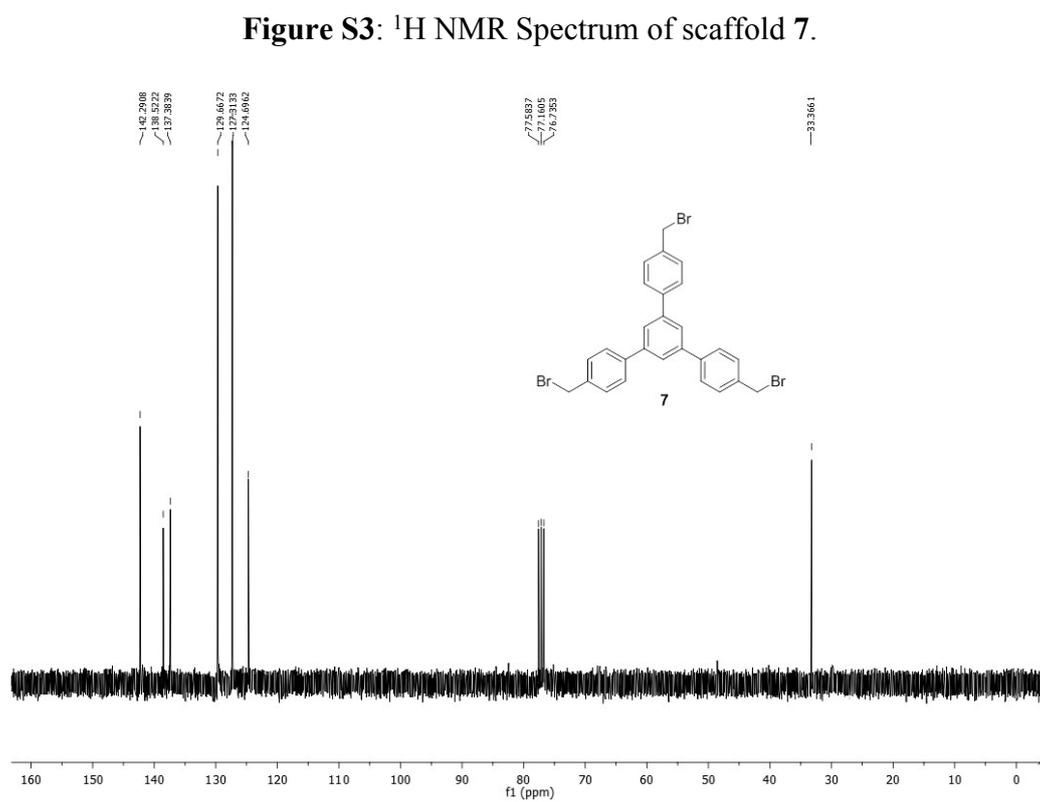
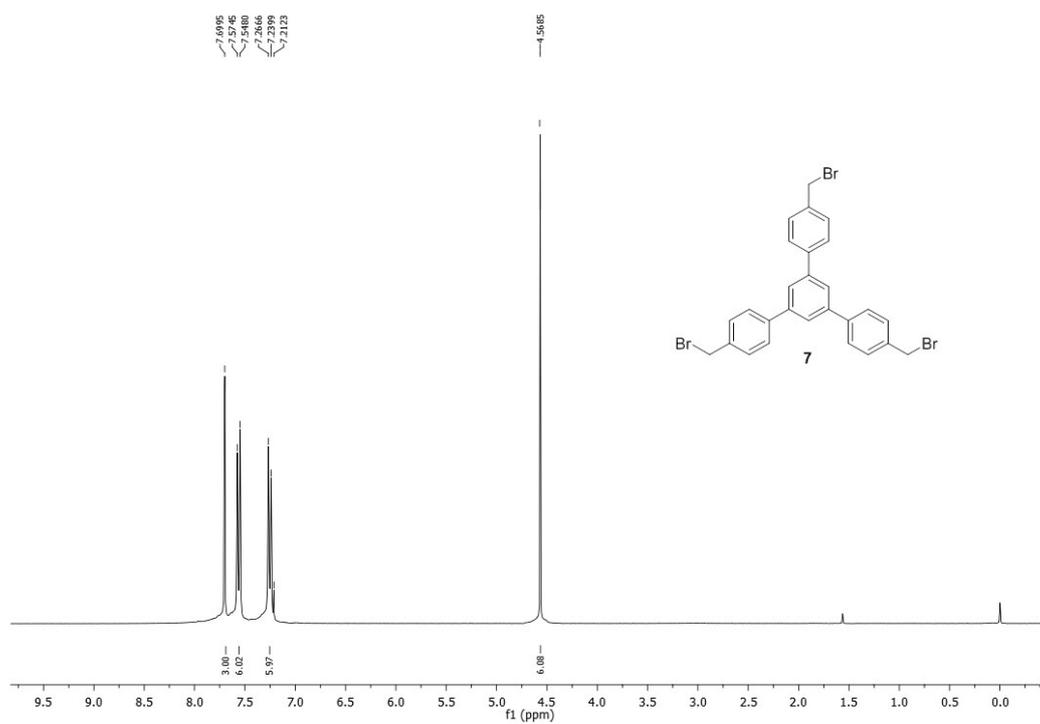


Figure S2: ¹³C NMR Spectrum of compound 6.



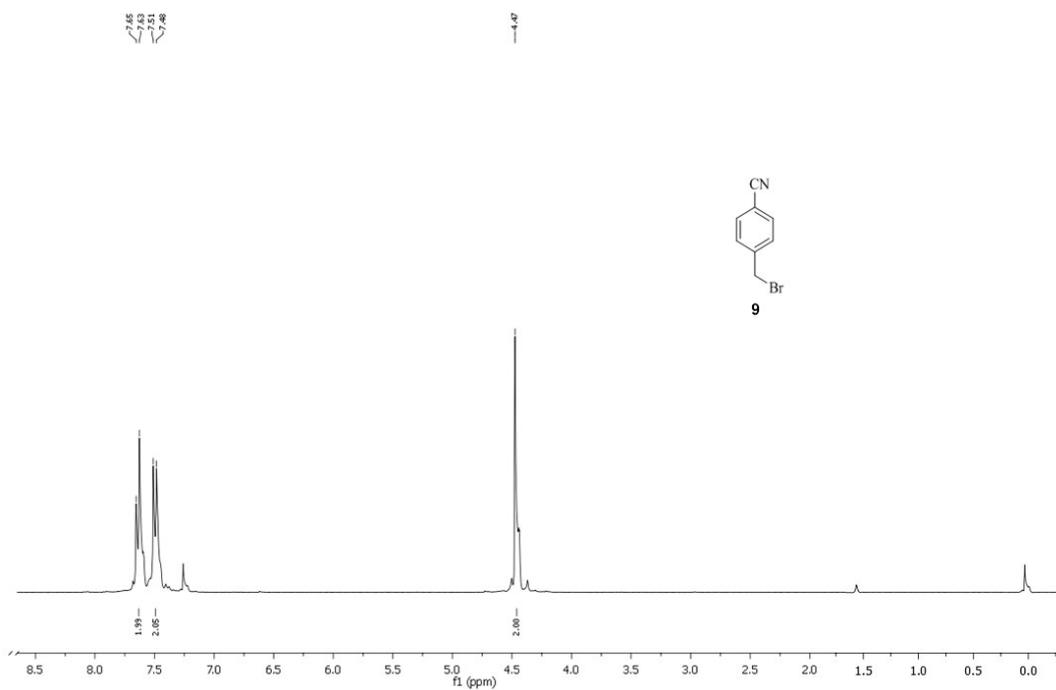


Figure S5: ^1H NMR Spectrum of scaffold 9.

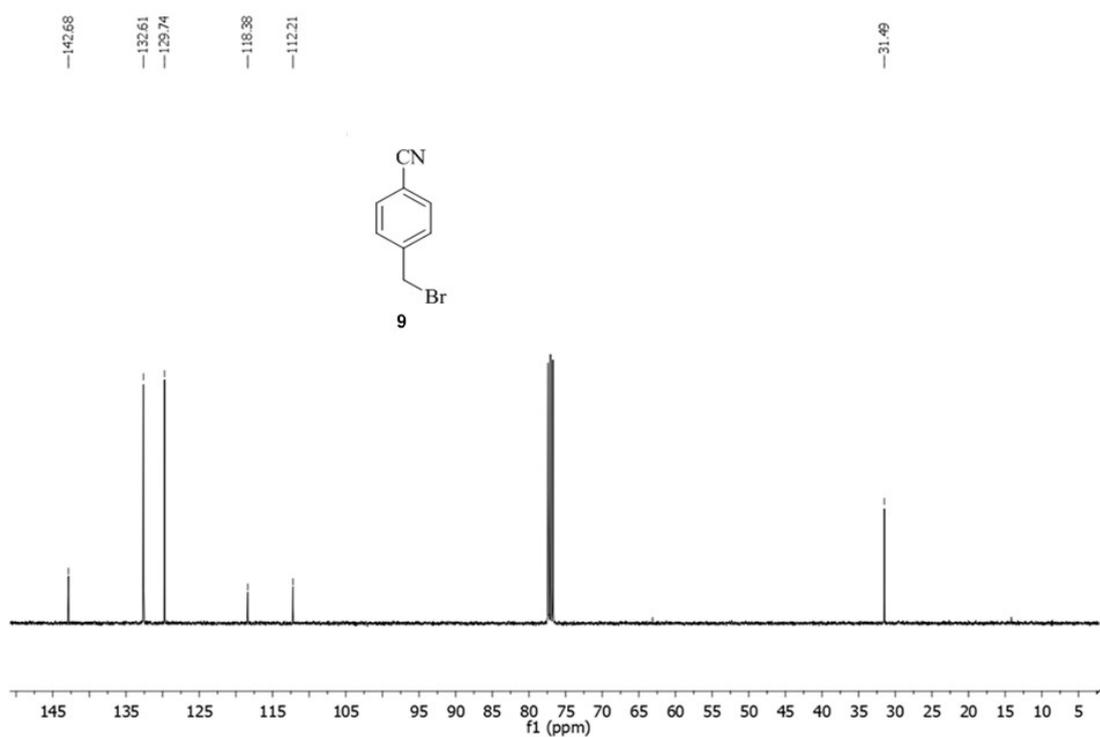


Figure S6: ^{13}C NMR Spectrum of compound 9.

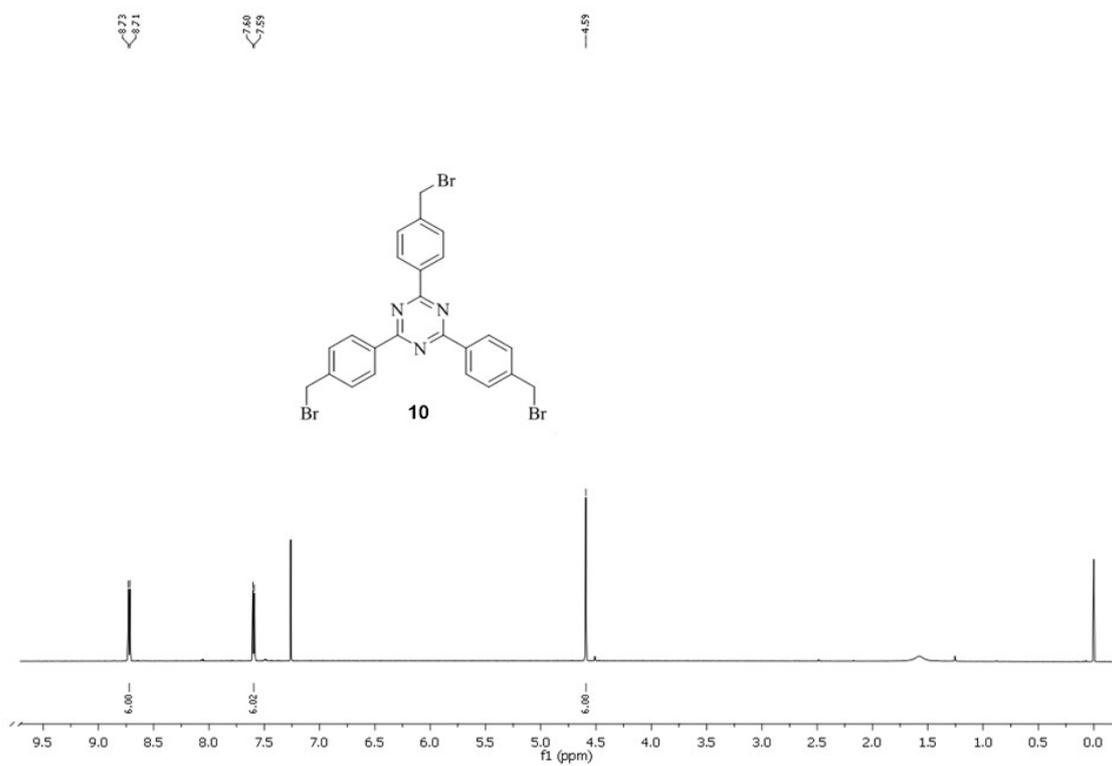


Figure S7: ¹H NMR Spectrum of scaffold 10.

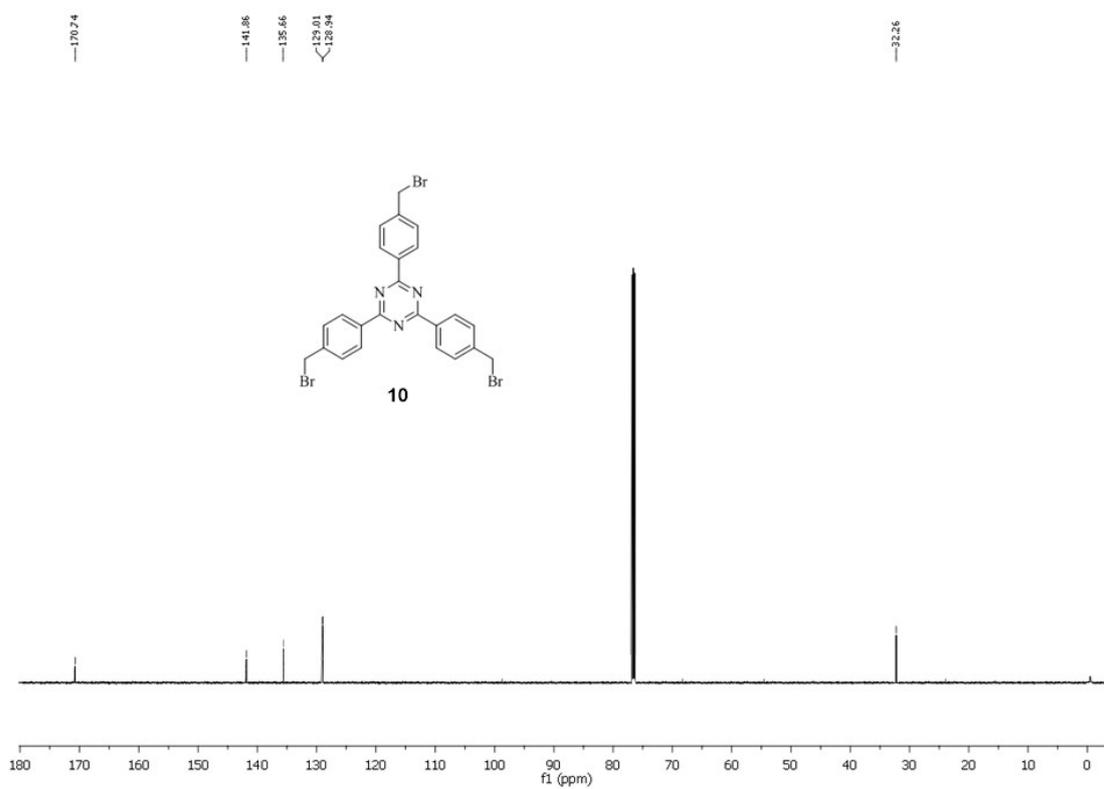


Figure S8: ¹³C NMR Spectrum of scaffold 10.

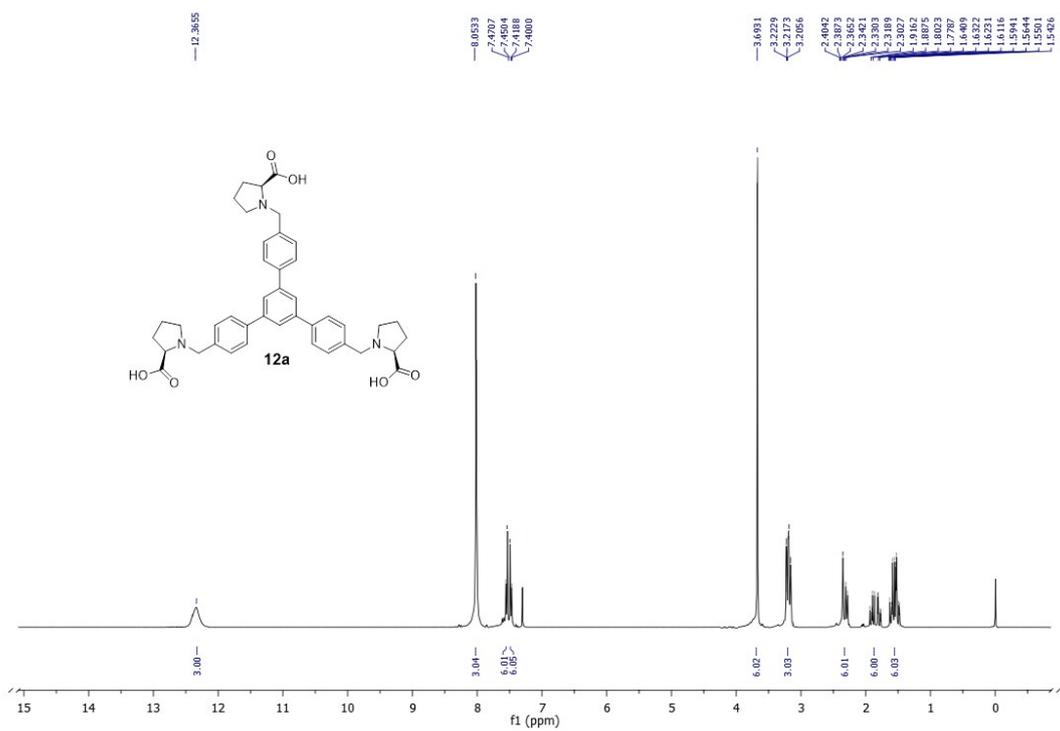


Figure S9: ^1H NMR Spectrum of organocatalyst **12a.**

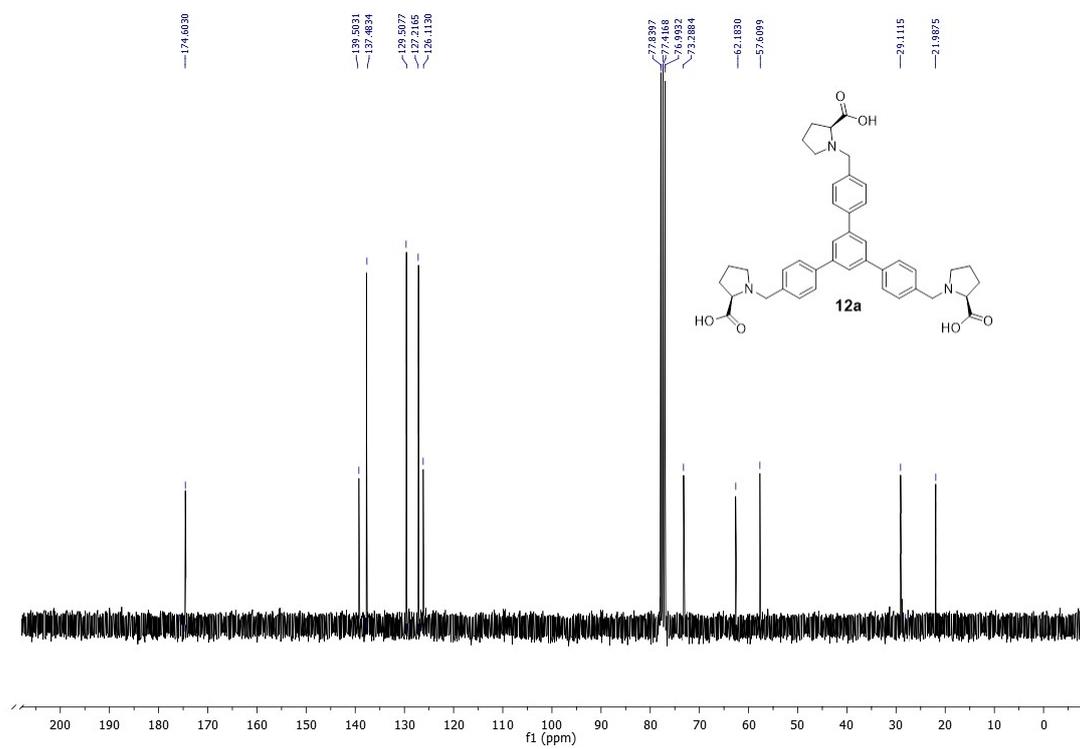


Figure S10: ^{13}C NMR Spectrum of organocatalyst **12a.**

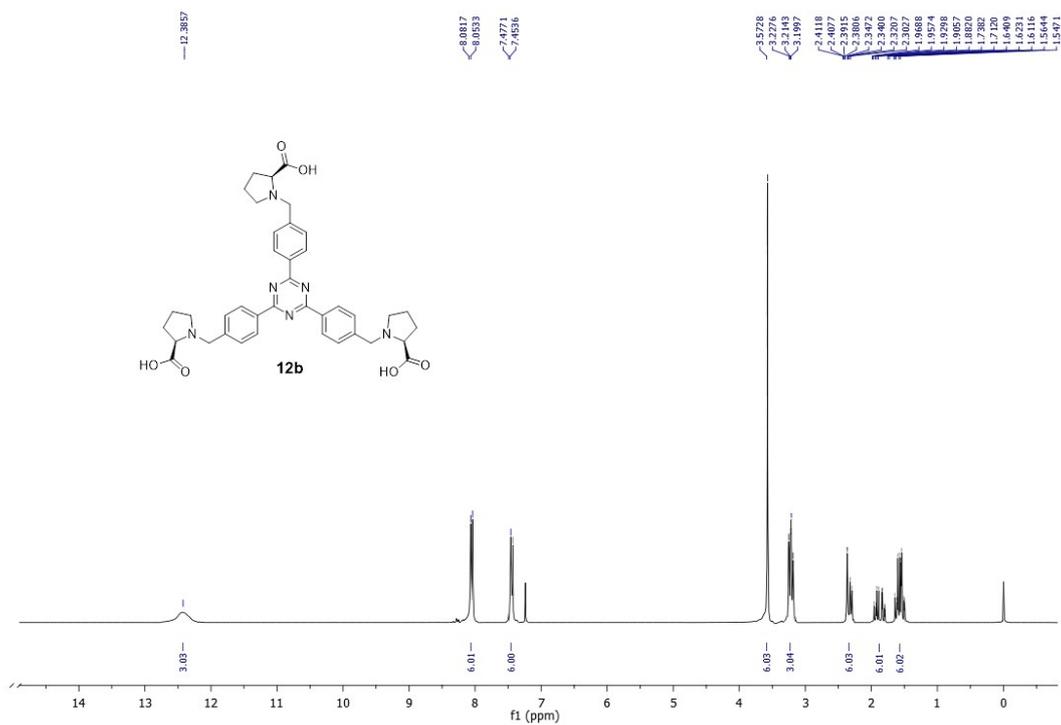


Figure S11: ¹H NMR Spectrum of organocatalyst 12b.

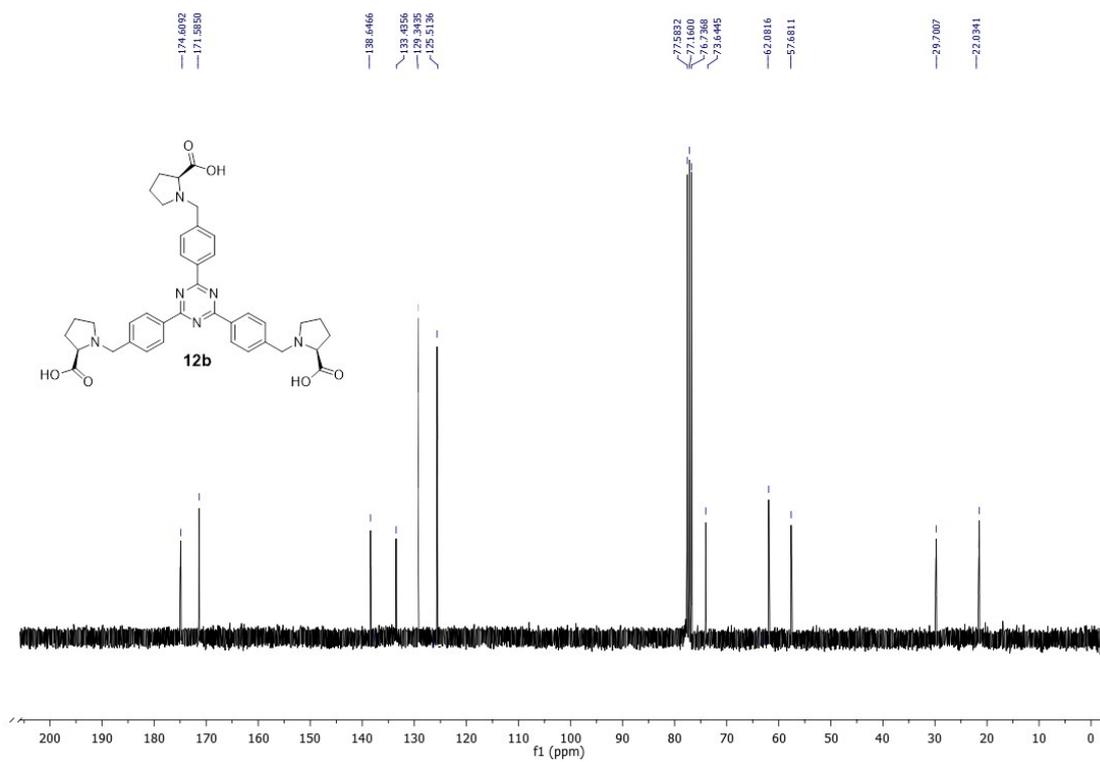


Figure S12: ¹³C NMR Spectrum of organocatalyst 12b.

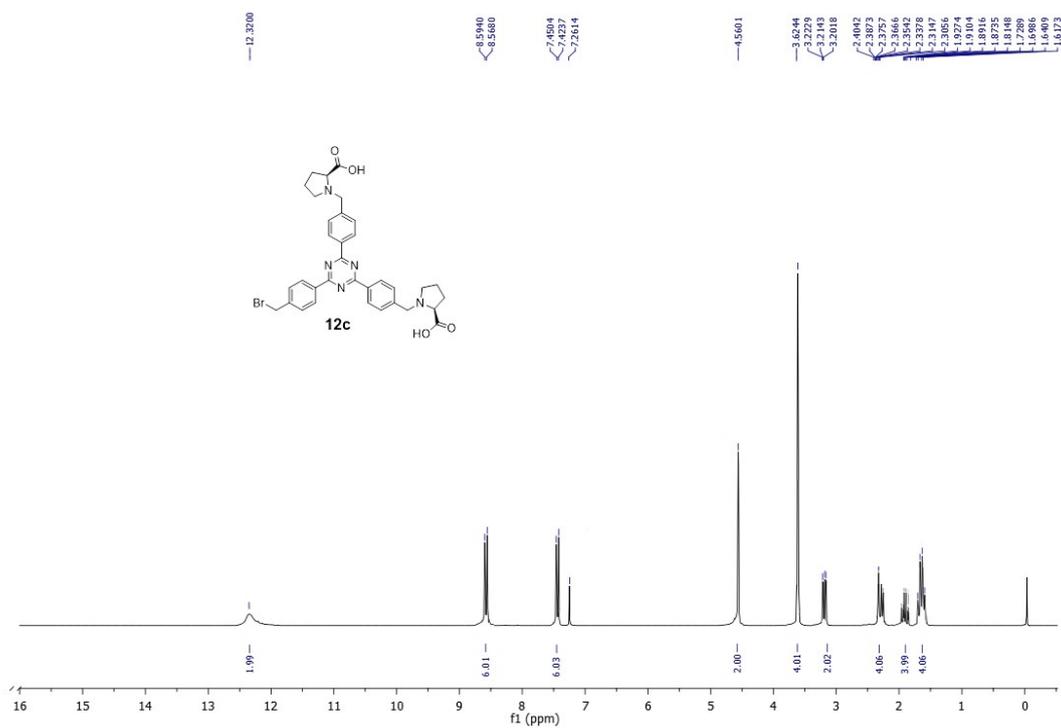


Figure S13: ¹H NMR Spectrum of C₂-symmetric organocatalyst 12c.

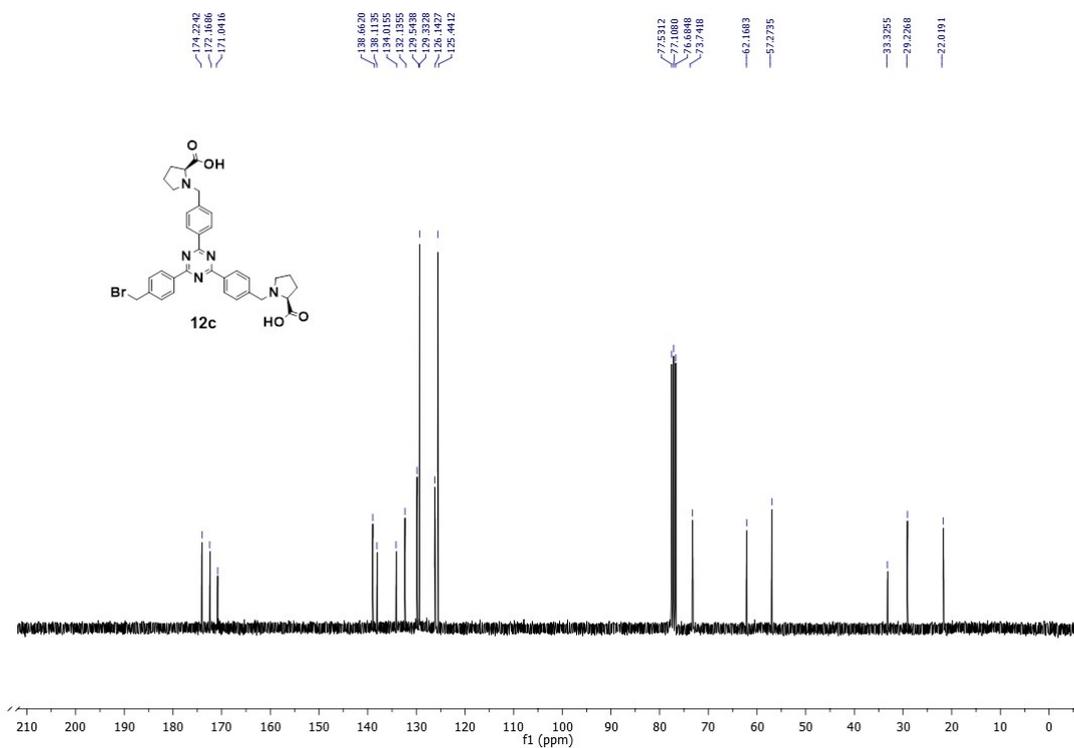


Figure S14: ¹³C NMR Spectrum of C₂-symmetric organocatalyst 12c.

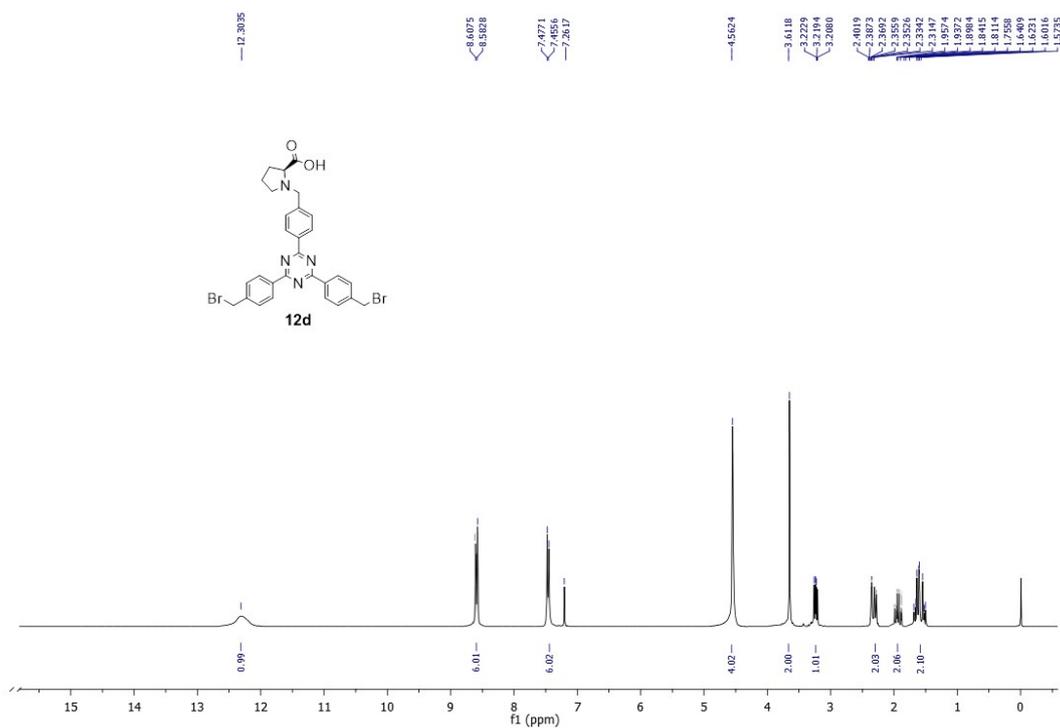


Figure S15: ^1H NMR Spectrum of C_1 -symmetric organocatalyst **12d**.

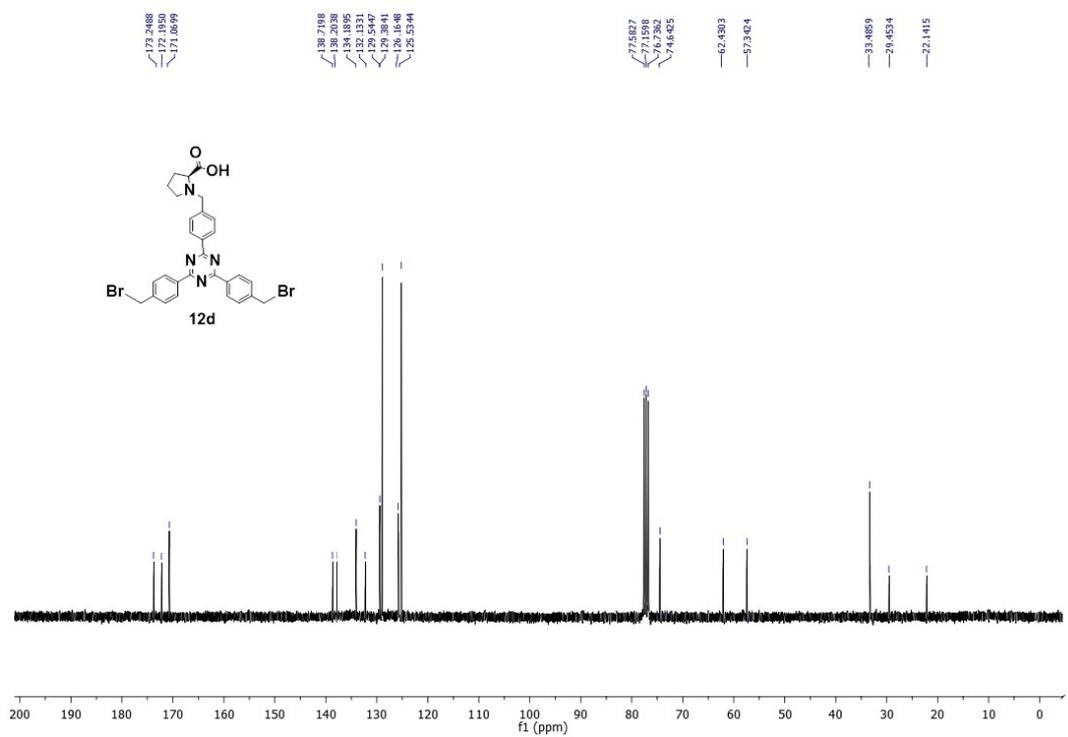


Figure S16: ^{13}C NMR Spectrum of C_1 -symmetric organocatalyst **12d**.

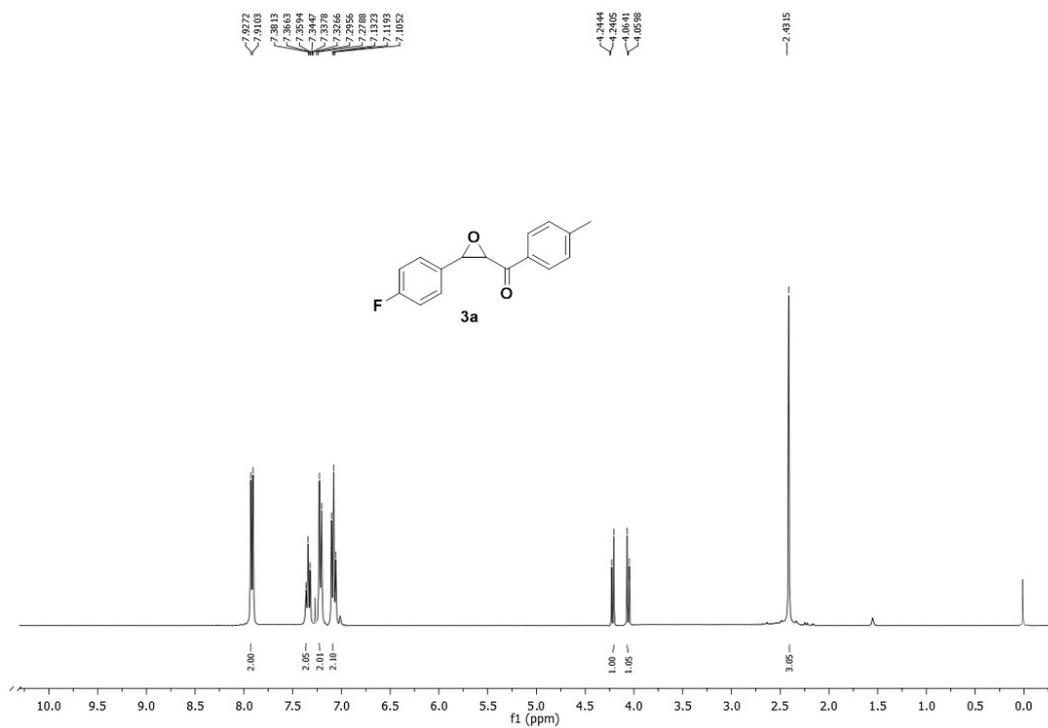


Figure S19: ¹H NMR Spectrum of α , β -epoxy ketone **3a.**

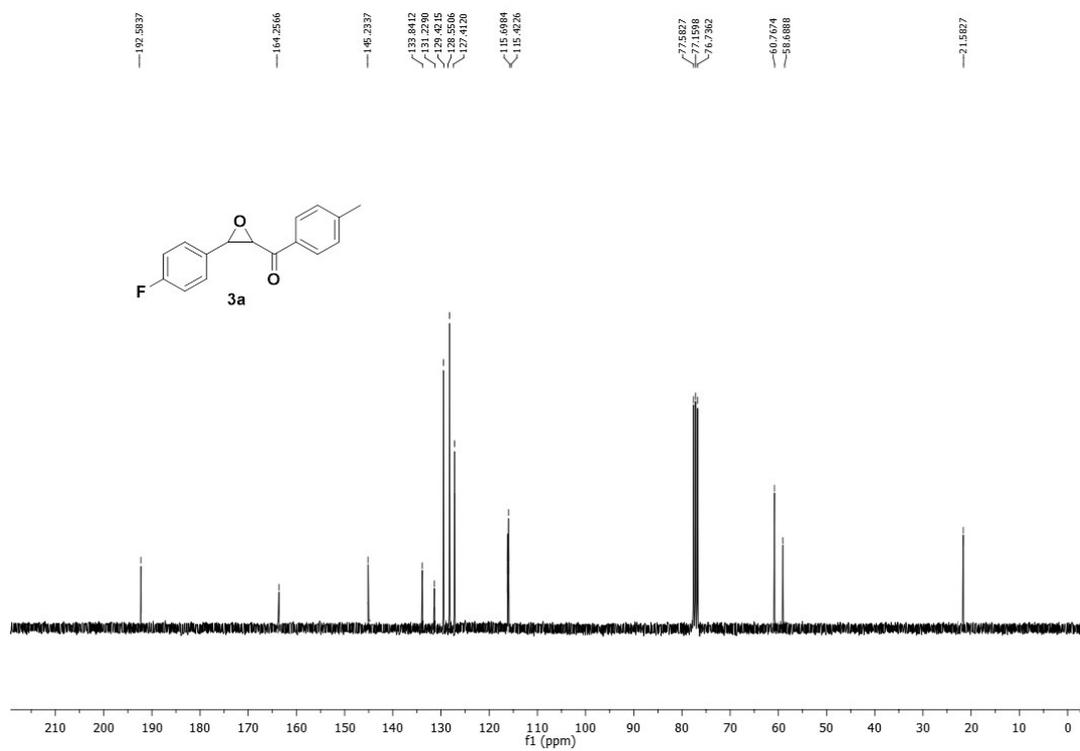


Figure S20: ¹³C NMR Spectrum of α , β -epoxy ketone **3a.**

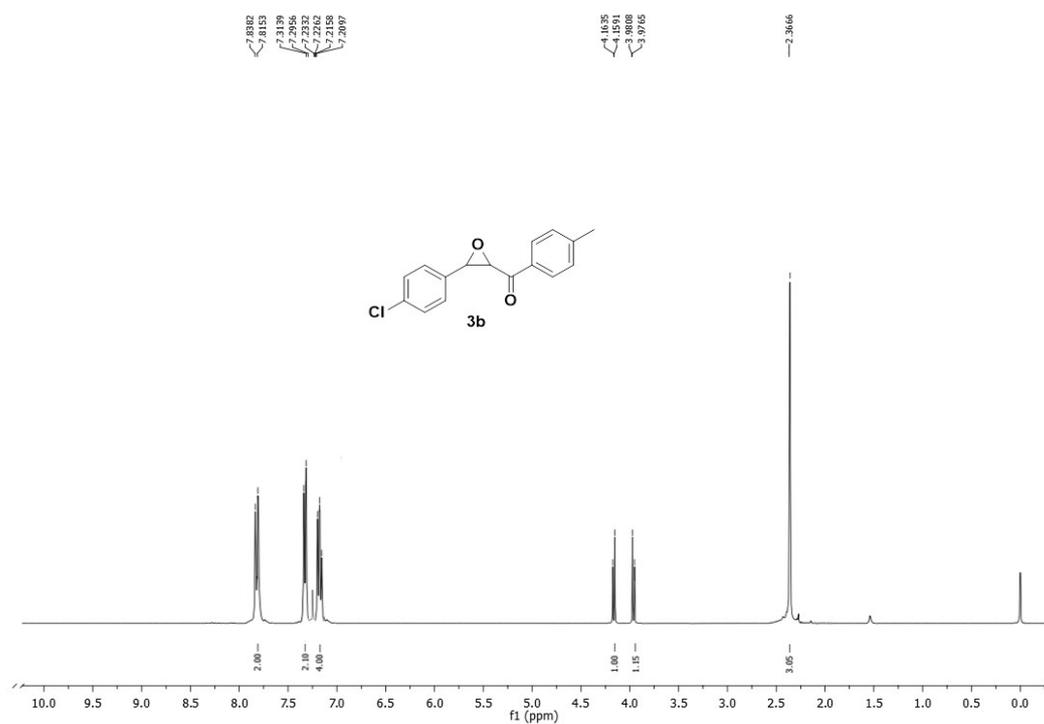


Figure S21: ¹H NMR Spectrum of α , β -epoxy ketone **3b**.

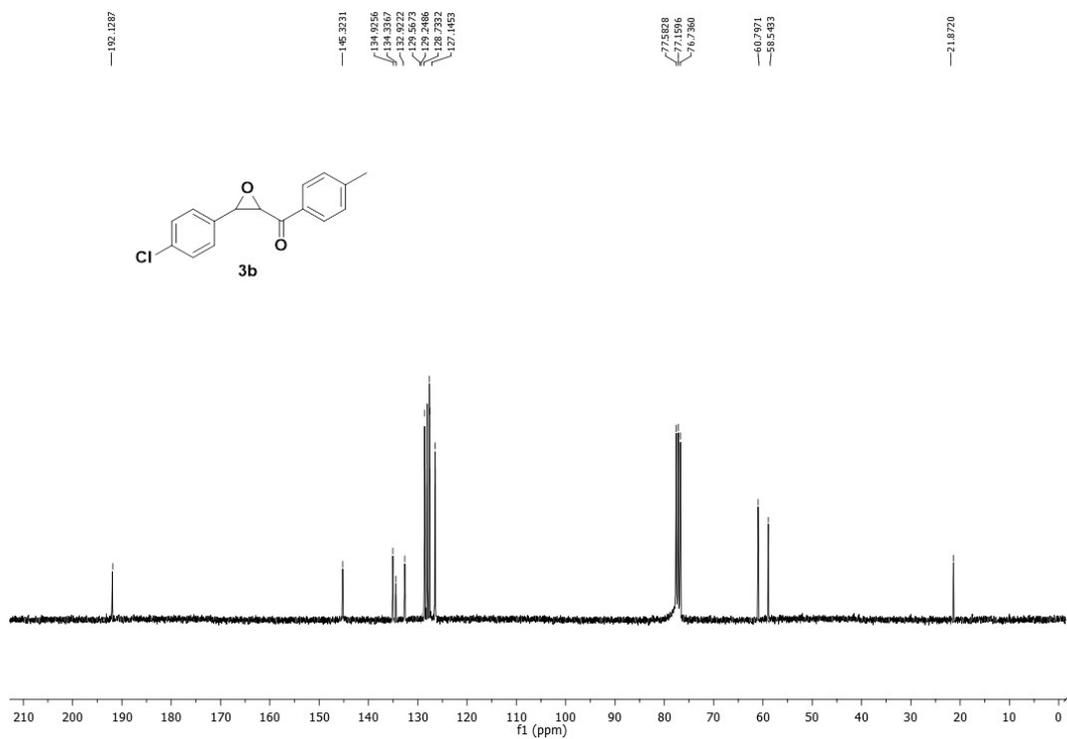


Figure S22: ¹³C NMR Spectrum of α , β -epoxy ketone **3b**.

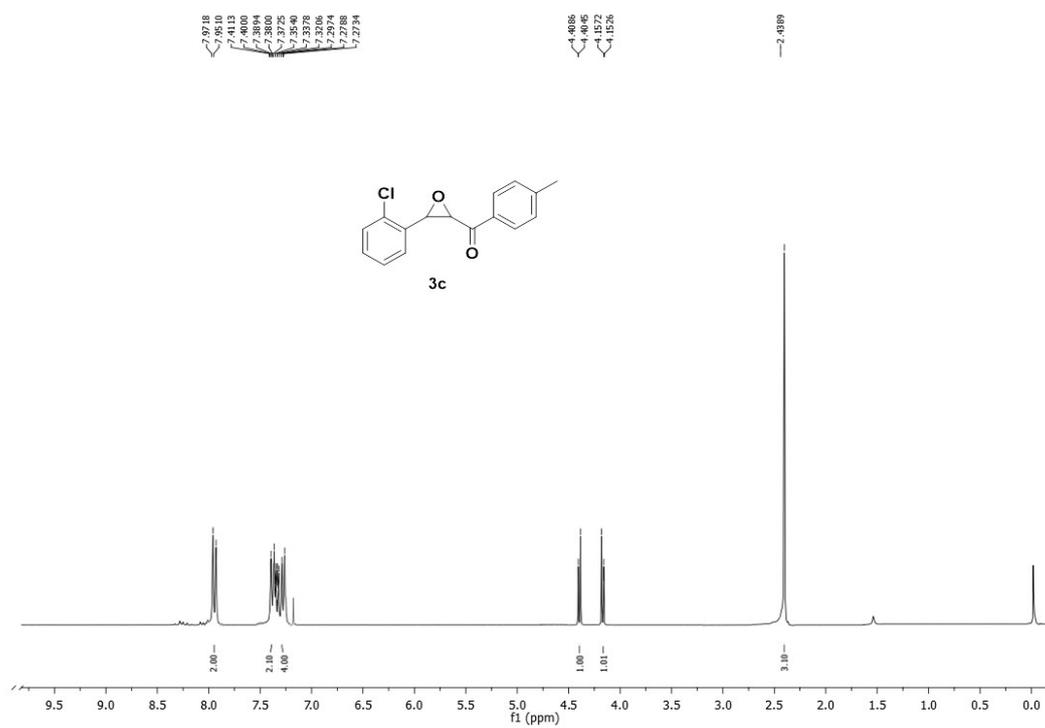


Figure S23: ¹H NMR Spectrum of α , β -epoxy ketone **3c**.

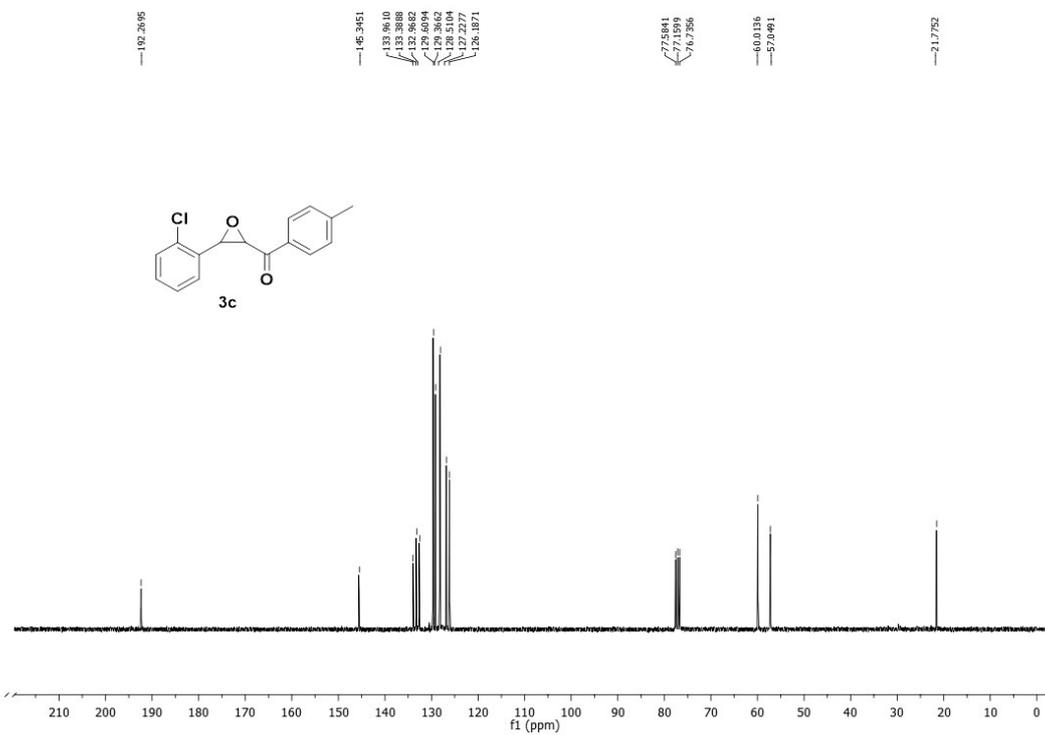


Figure S24: ¹³C NMR Spectrum of α , β -epoxy ketone **3c**.

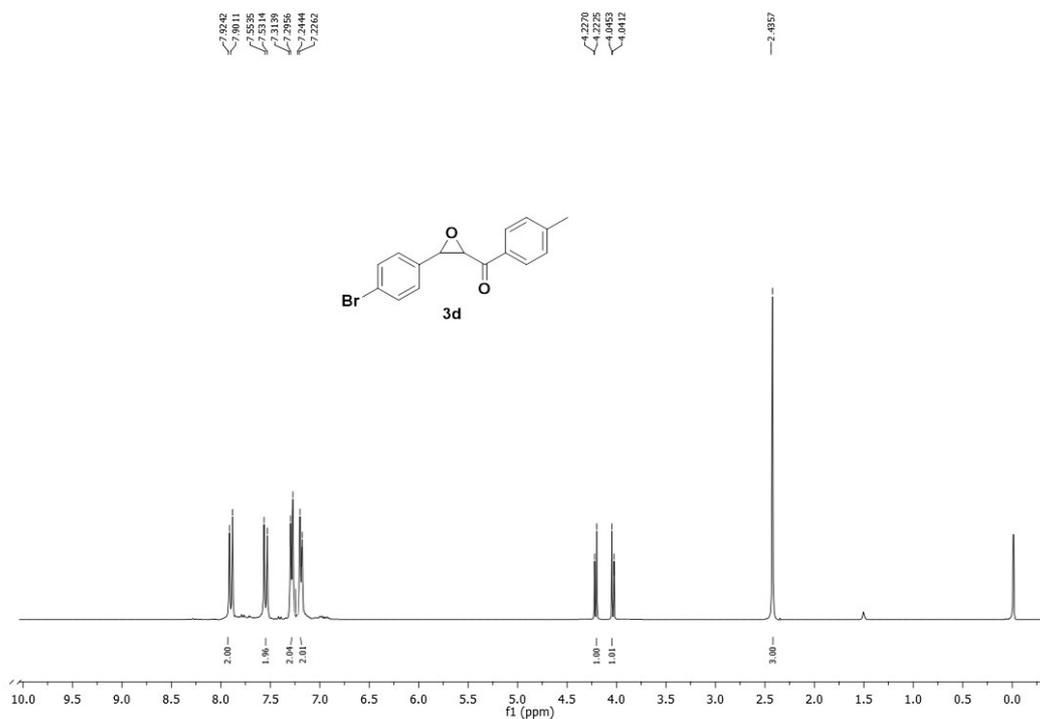


Figure S25: ¹H NMR Spectrum of α , β -epoxy ketone **3d**.

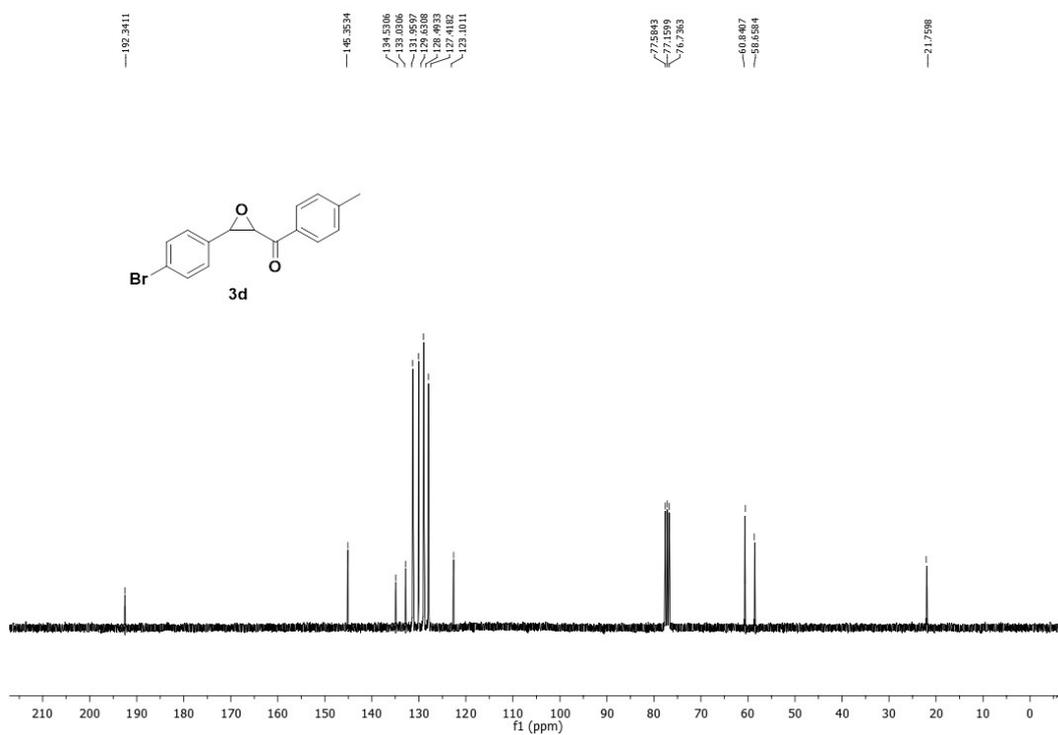


Figure S26: ¹³C NMR Spectrum of α , β -epoxy ketone **3d**.

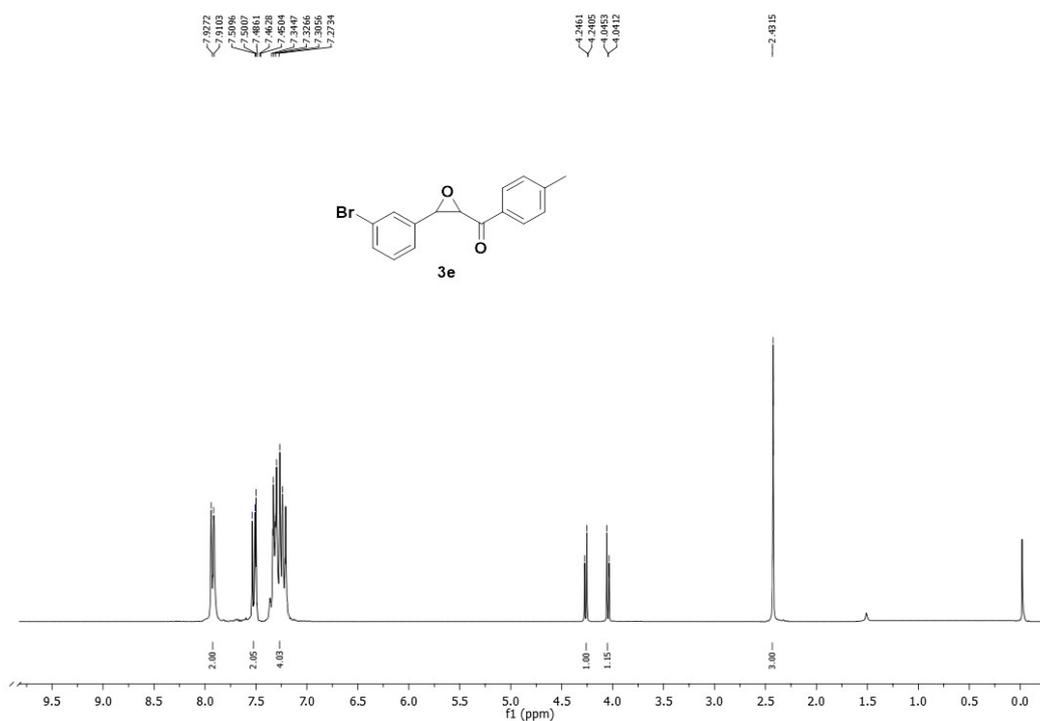


Figure S27: ¹H NMR Spectrum of α , β -epoxy ketone **3e**.

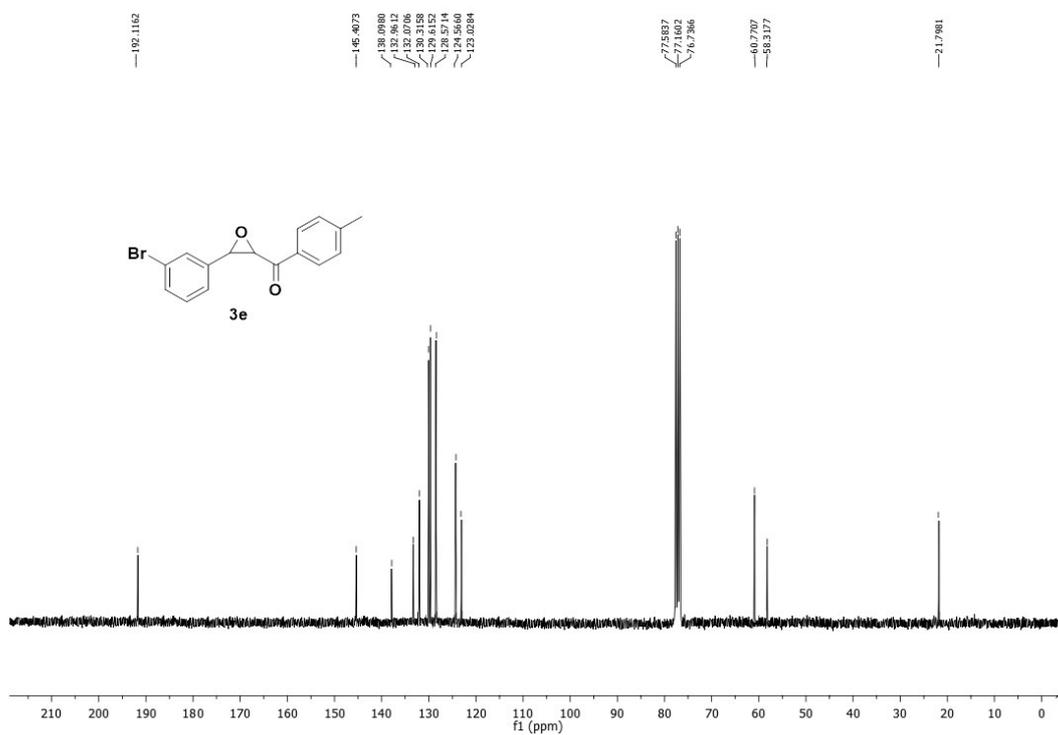


Figure S28: ¹³C NMR Spectrum of α , β -epoxy ketone **3e**.

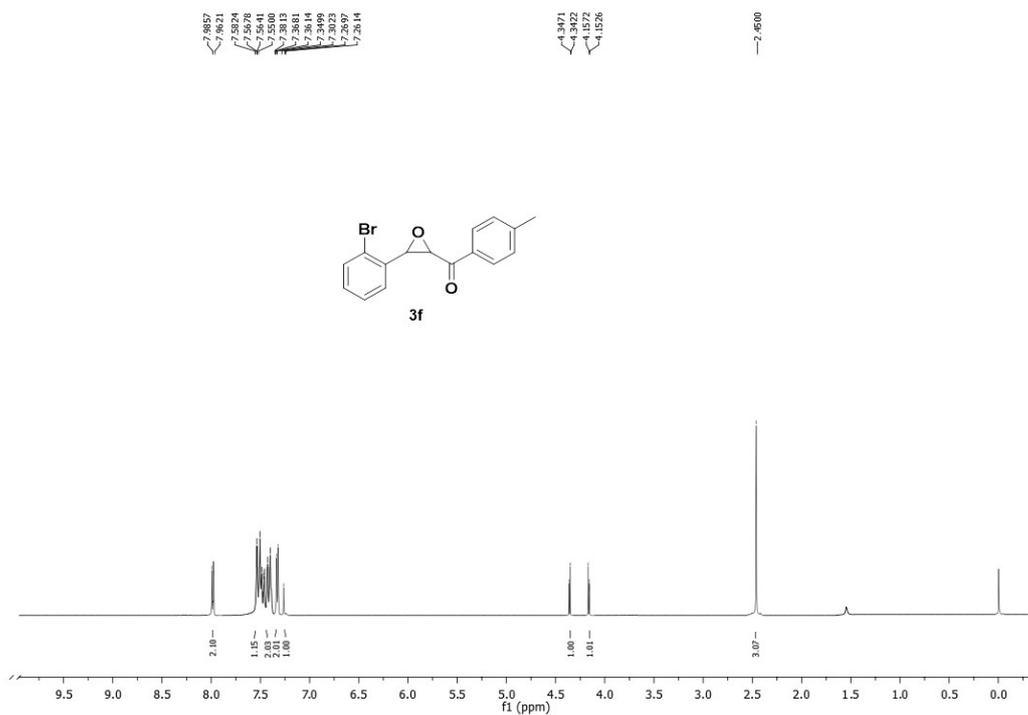


Figure S29: ¹H NMR Spectrum of α , β -epoxy ketone **3f**.

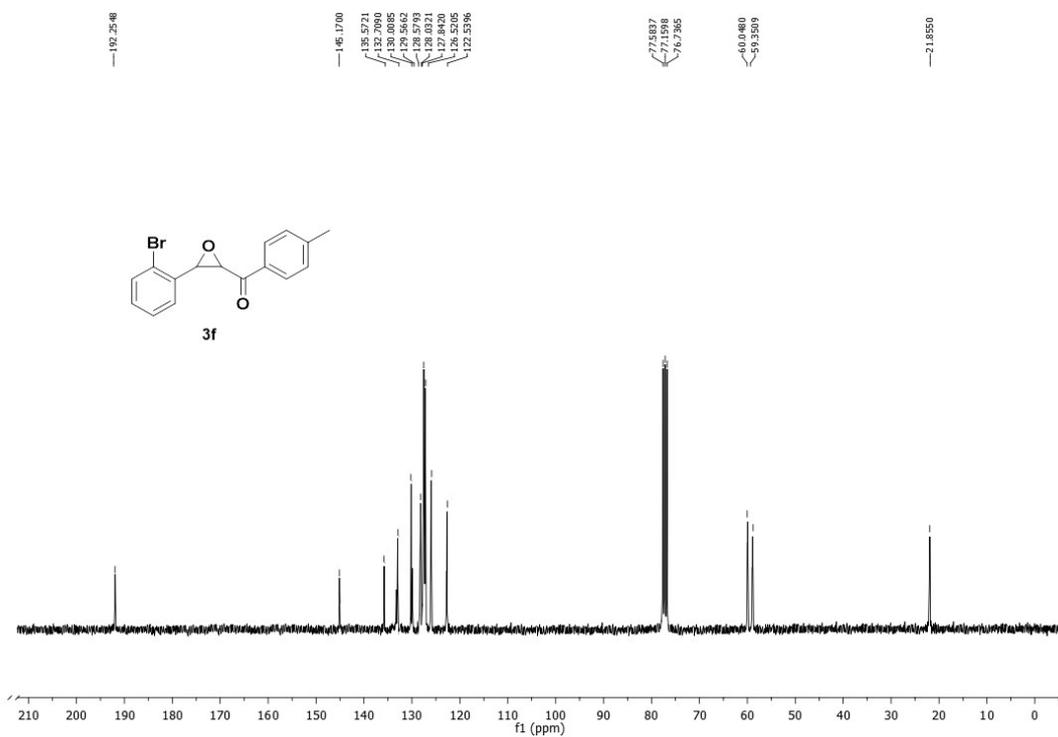


Figure S30: ¹³C NMR Spectrum of α , β -epoxy ketone **3f**.

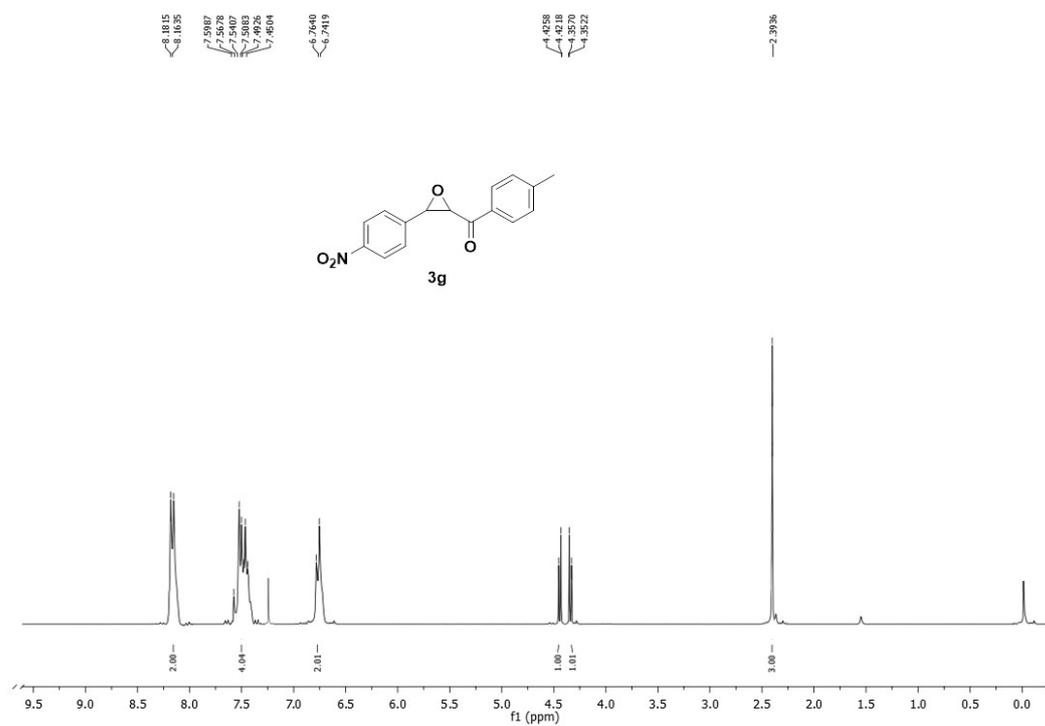


Figure S31: ¹H NMR Spectrum of α , β -epoxy ketone **3g**.

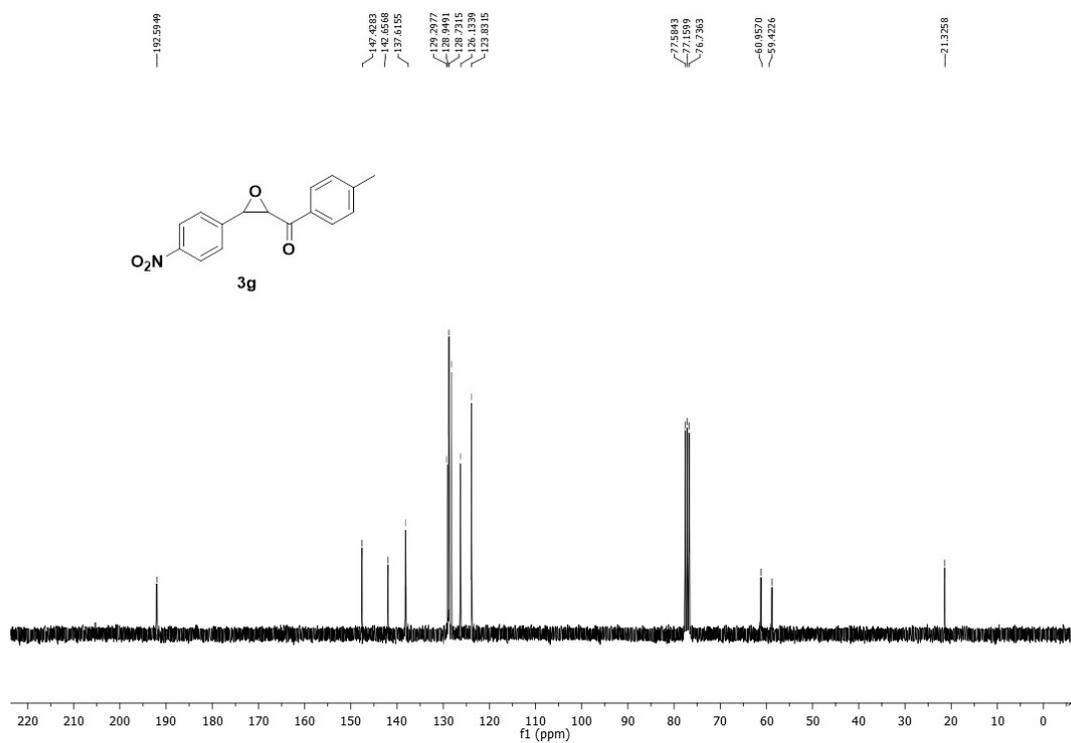


Figure S32: ¹³C NMR Spectrum of α , β -epoxy ketone **3g**.

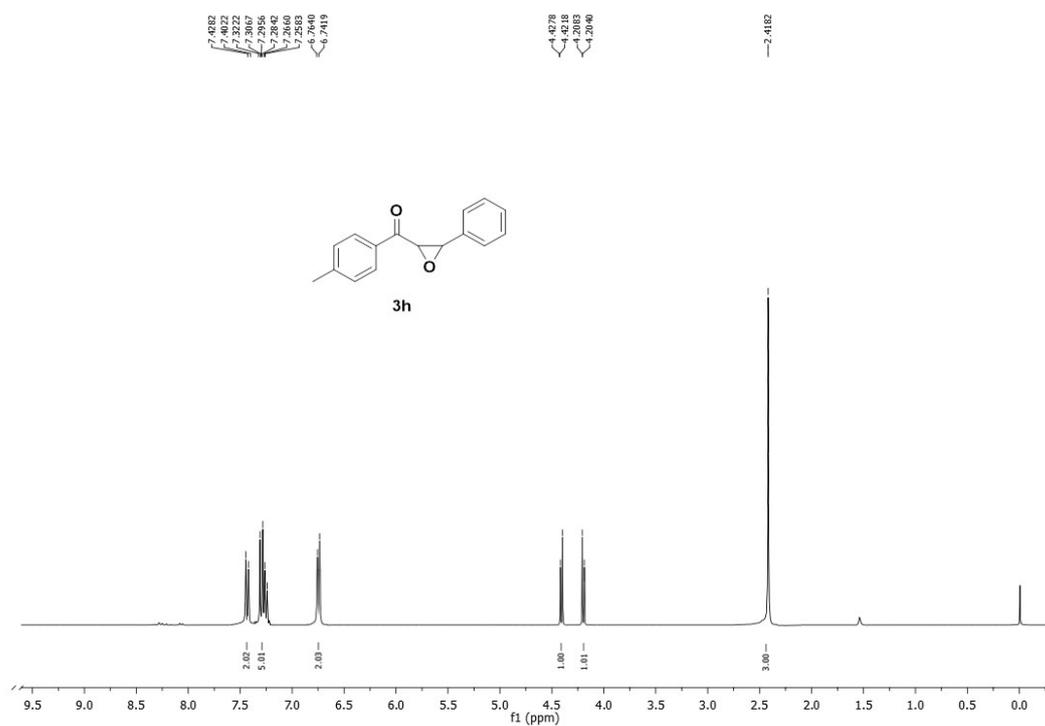


Figure S33: ¹H NMR Spectrum of α , β -epoxy ketone **3h.**

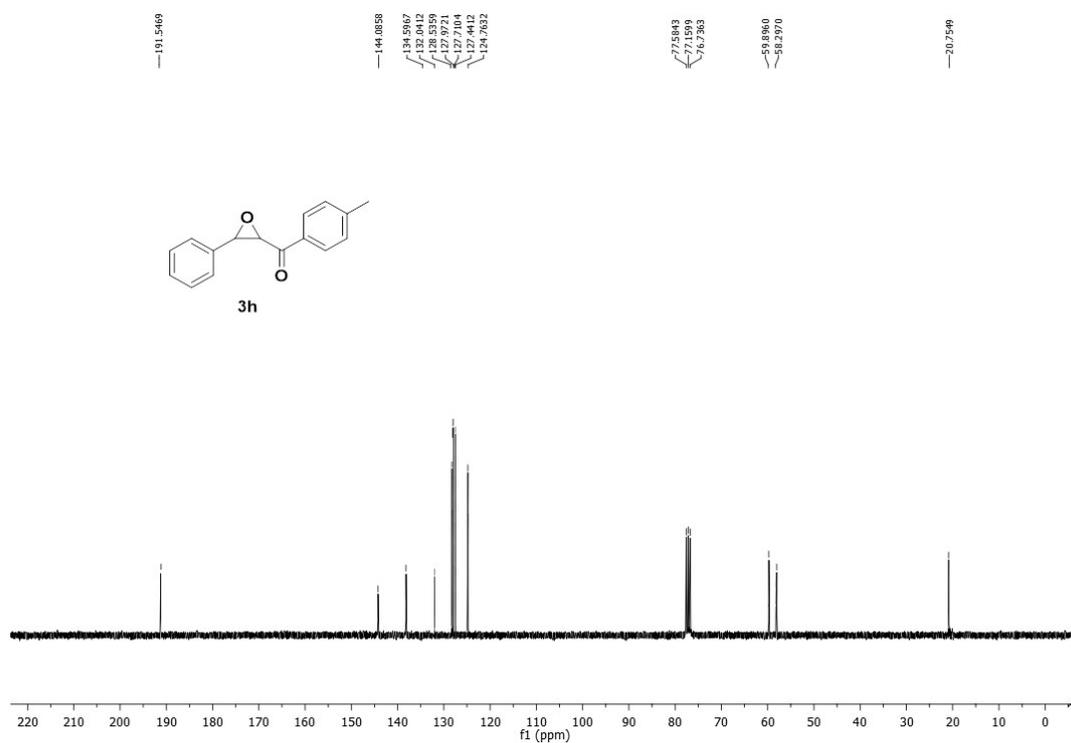


Figure S34: ¹³C NMR Spectrum of α , β -epoxy ketone **3h.**

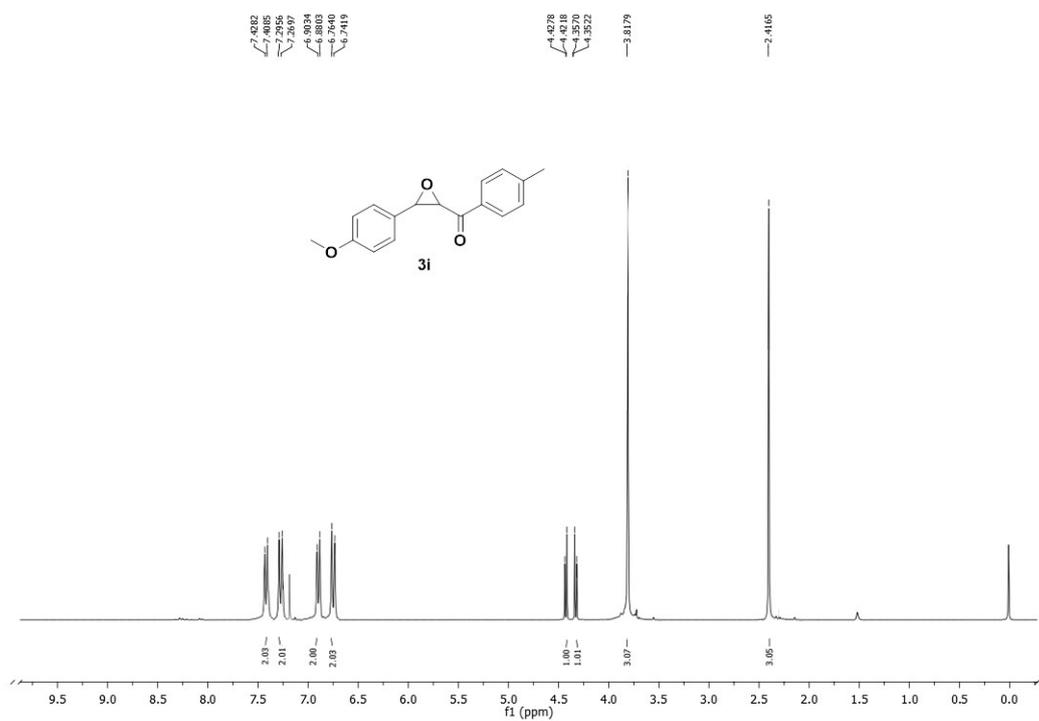


Figure S35: ¹H NMR Spectrum of α, β -epoxy ketone **3i**.

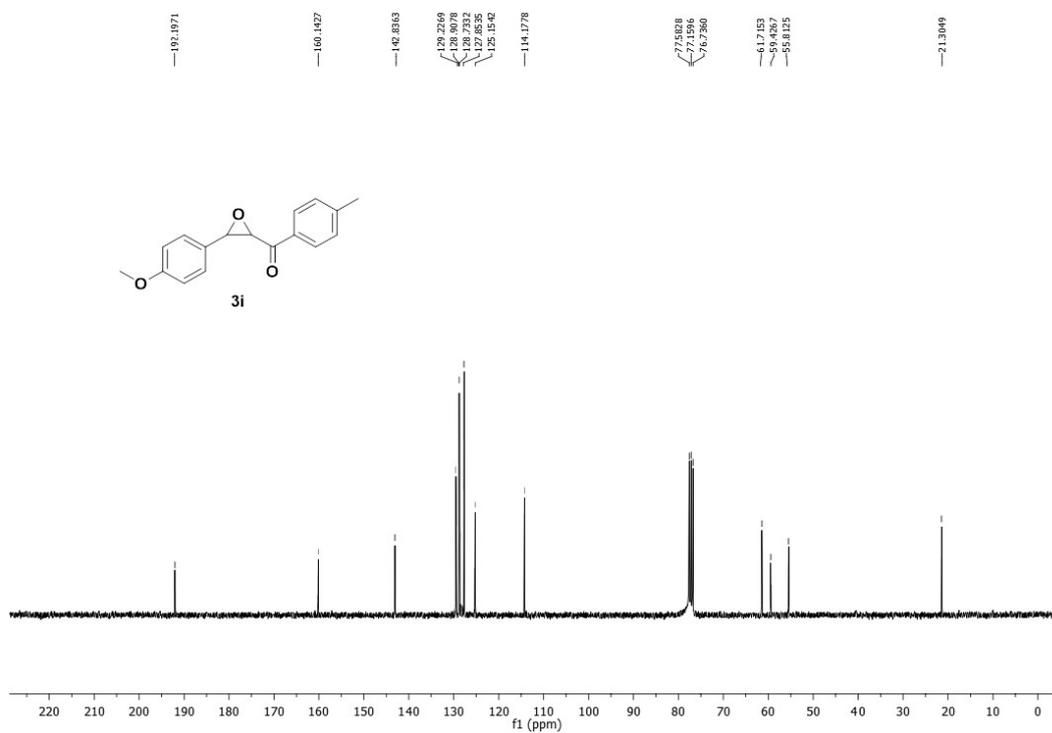


Figure S36: ¹³C NMR Spectrum of α, β -epoxy ketone **3i**.

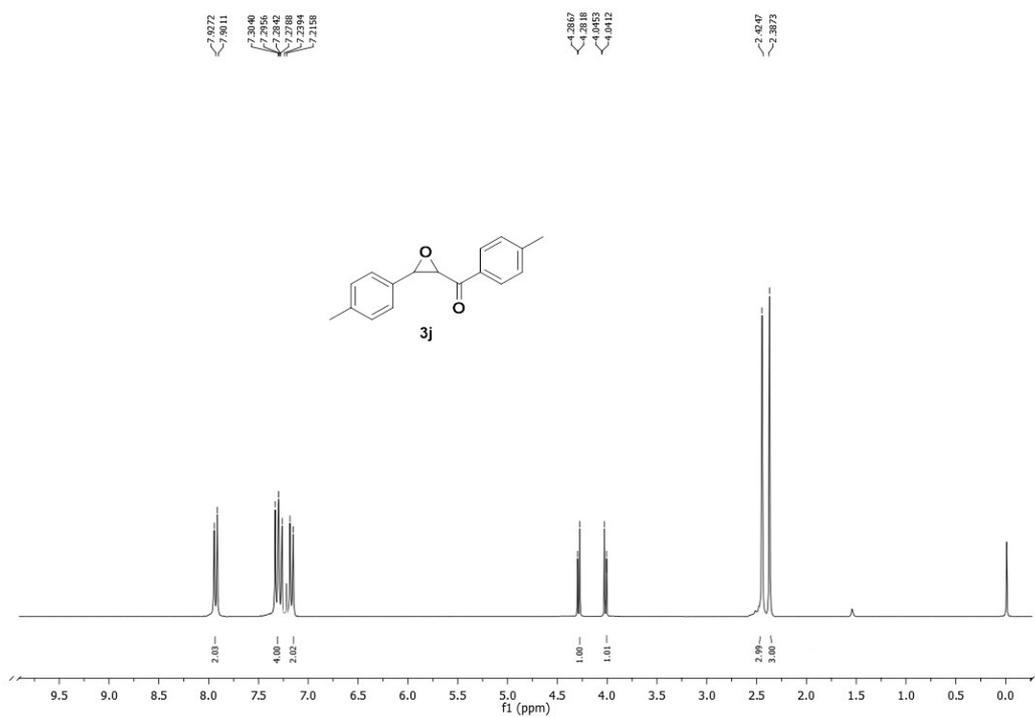


Figure S37: ¹H NMR Spectrum of α, β -epoxy ketone **3j**.

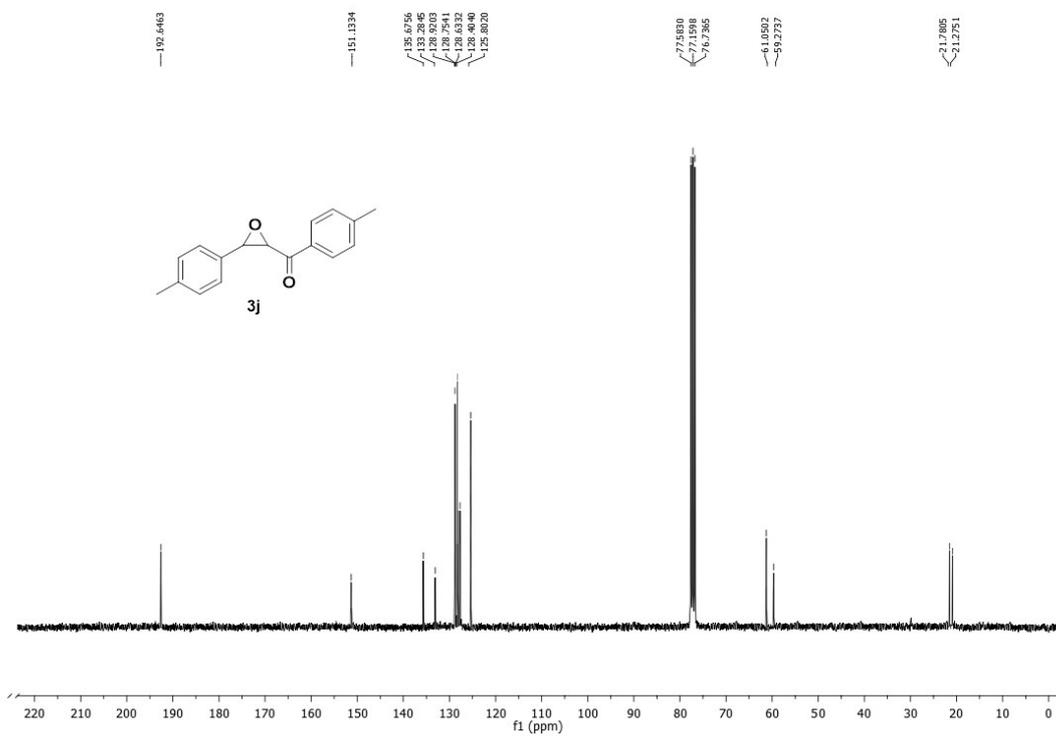


Figure S38: ¹³C NMR Spectrum of α, β -epoxy ketone **3j**.

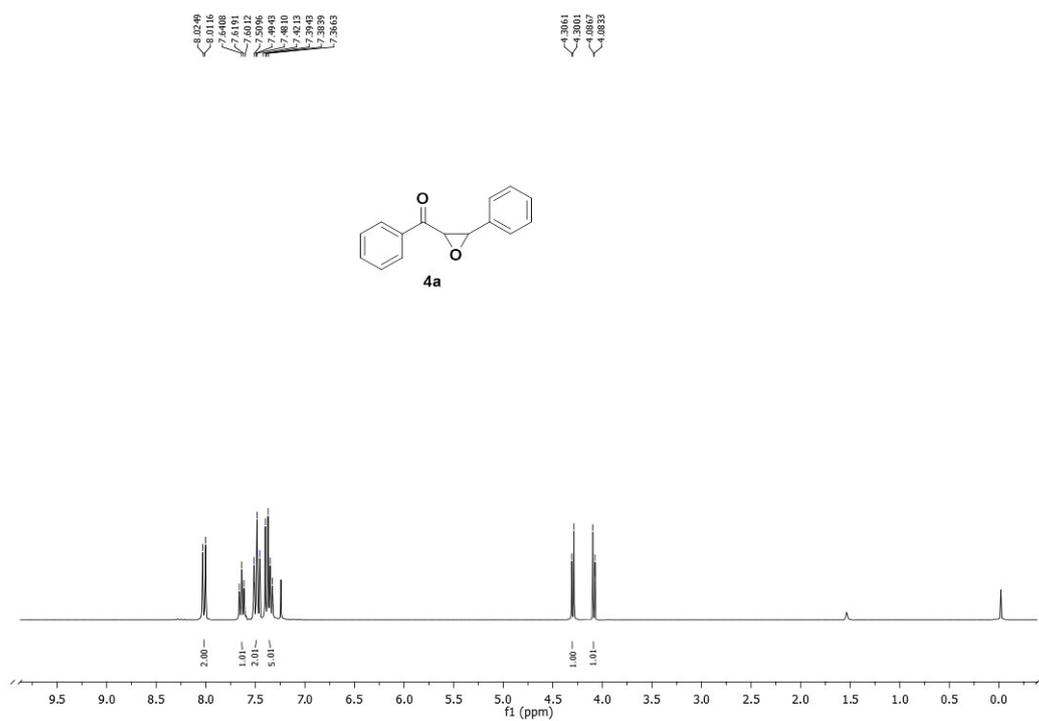


Figure S39: $^1\text{H NMR}$ Spectrum of α, β -epoxy ketone **4a**.

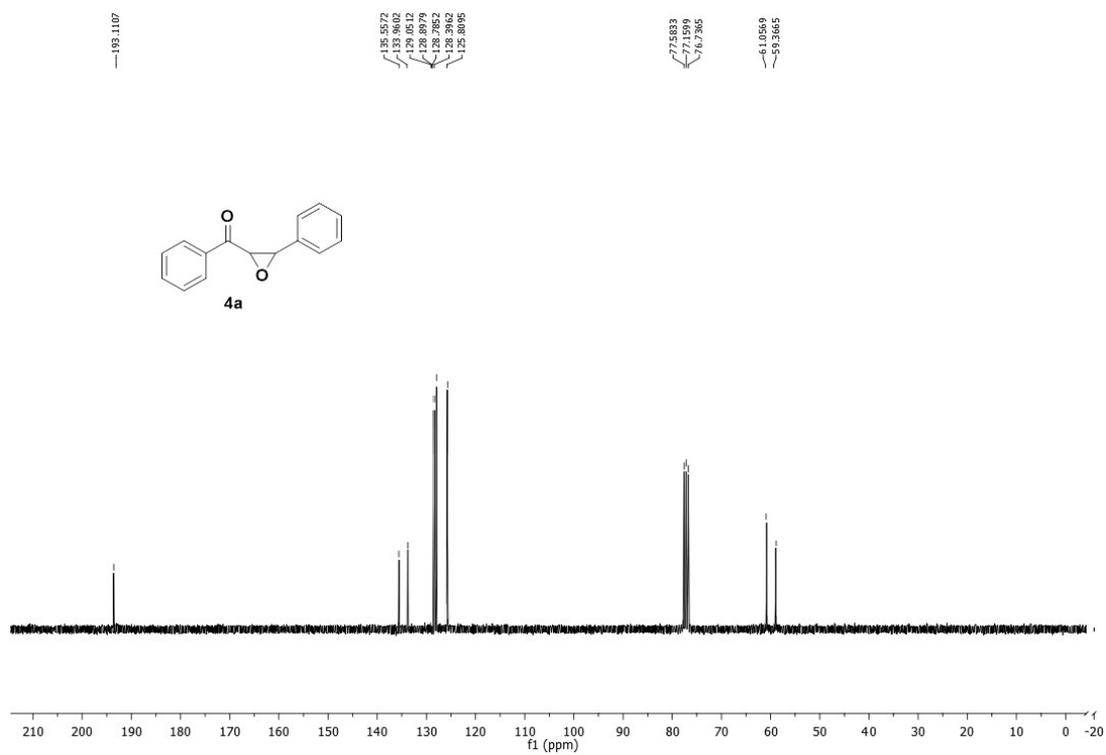


Figure S40: $^{13}\text{C NMR}$ Spectrum of α, β -epoxy ketone **4a**.

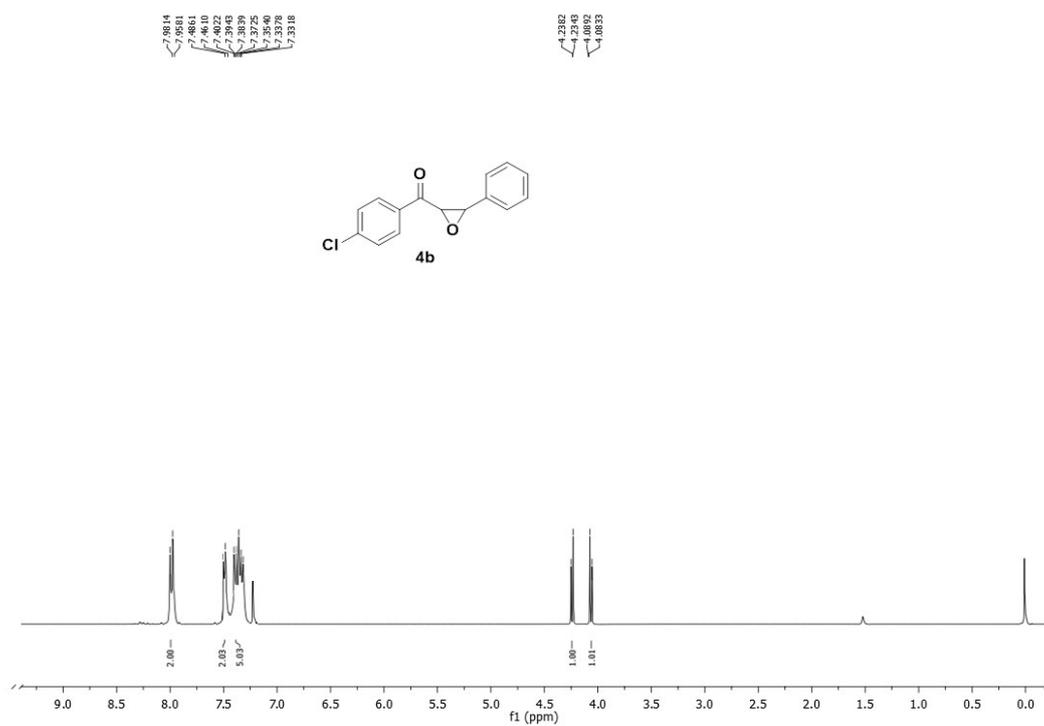


Figure S41: ¹H NMR Spectrum of α , β -epoxy ketone **4b**.

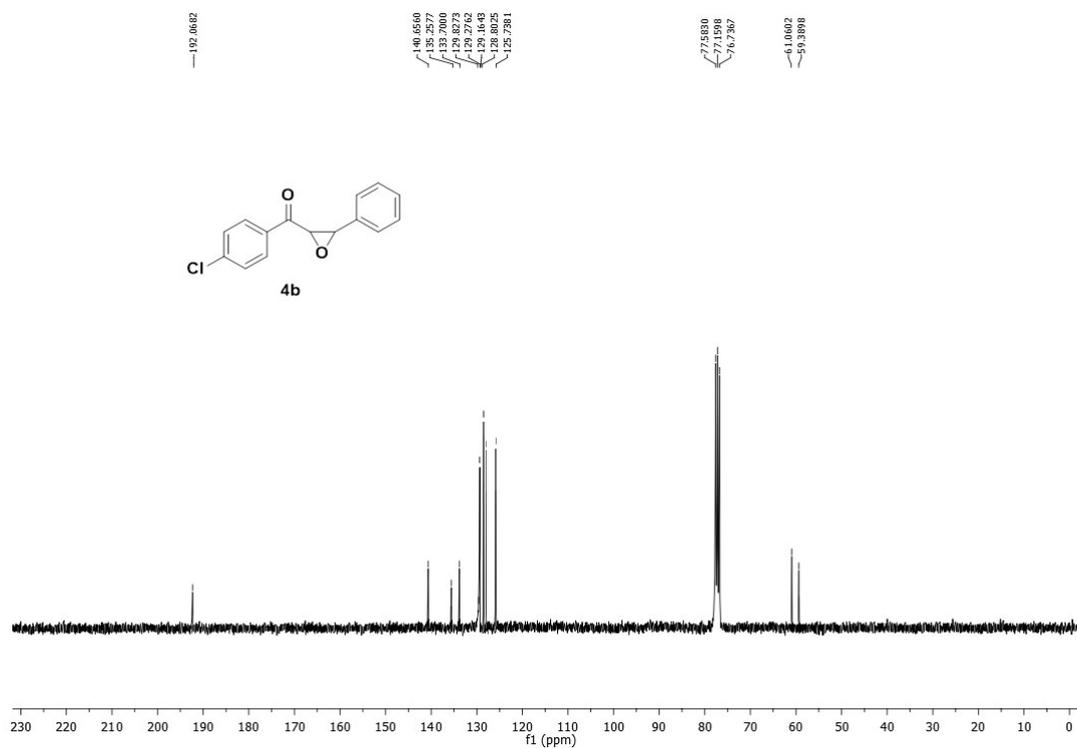


Figure S42: ¹³C NMR Spectrum of α , β -epoxy ketone **4b**.

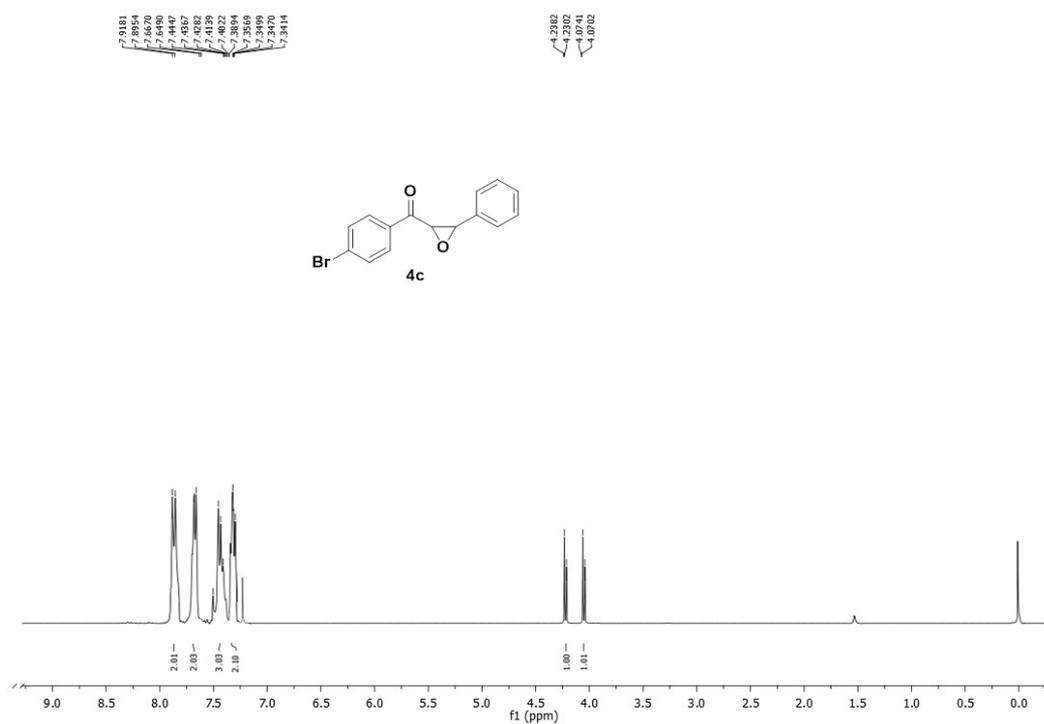


Figure S43: $^1\text{H NMR}$ Spectrum of α, β -epoxy ketone **4c**.

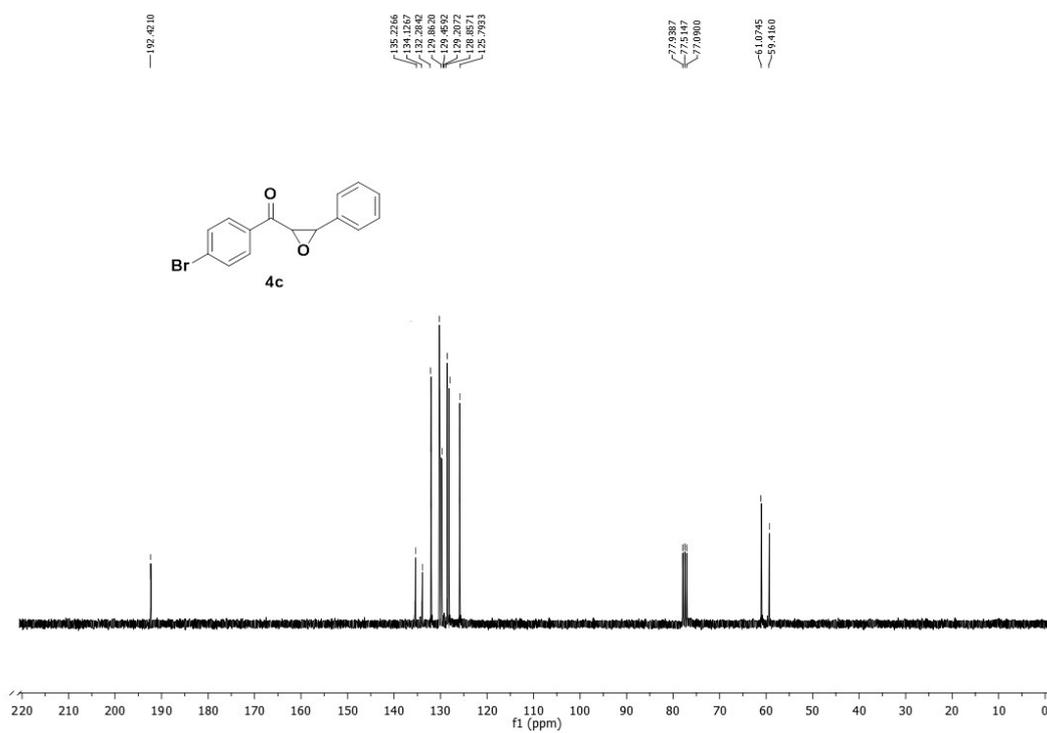


Figure S44: $^{13}\text{C NMR}$ Spectrum of α, β -epoxy ketone **4c**.

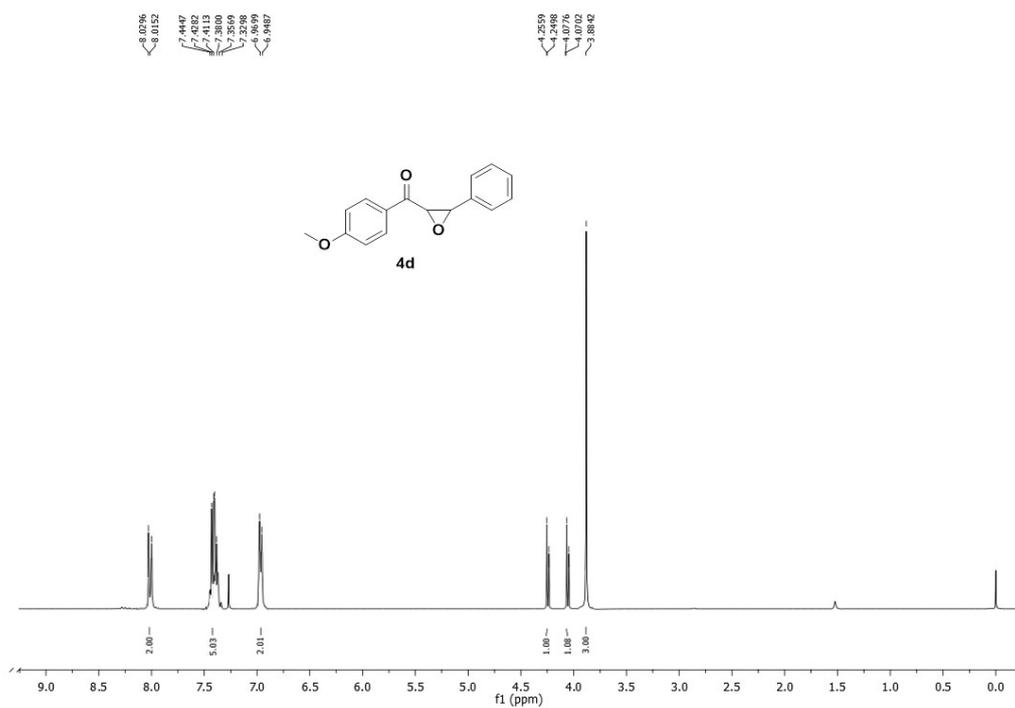


Figure S45: ¹H NMR Spectrum of α, β -epoxy ketone **4d**.

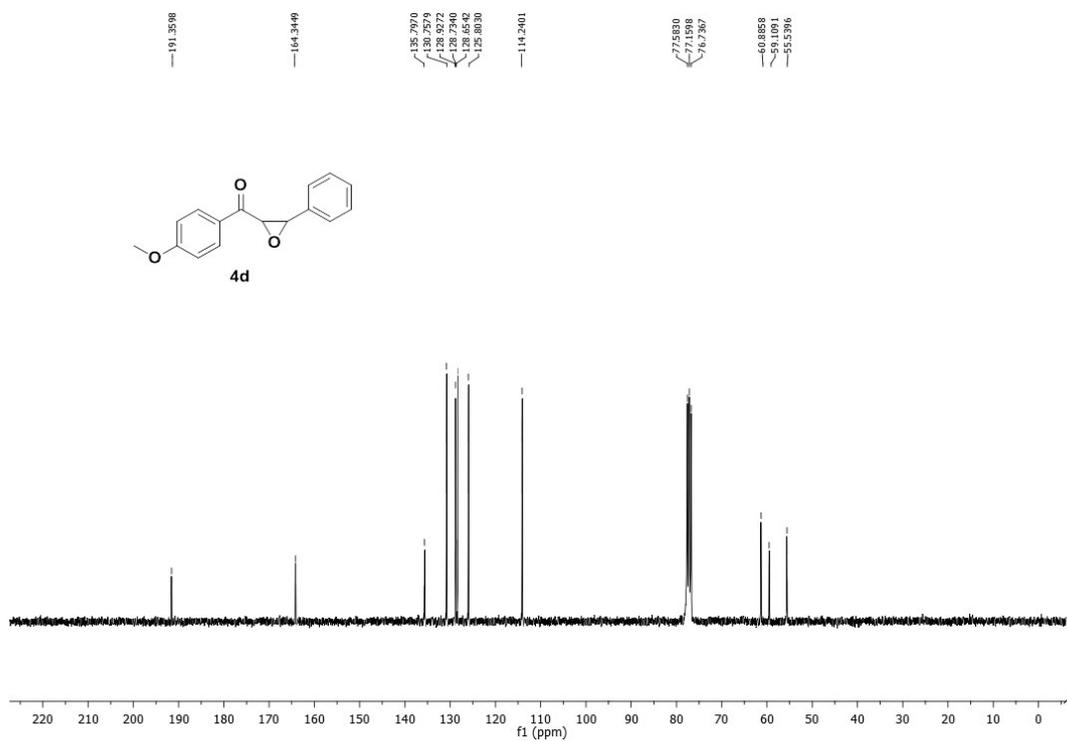


Figure S46: ¹³C NMR Spectrum of α, β -epoxy ketone **4d**.

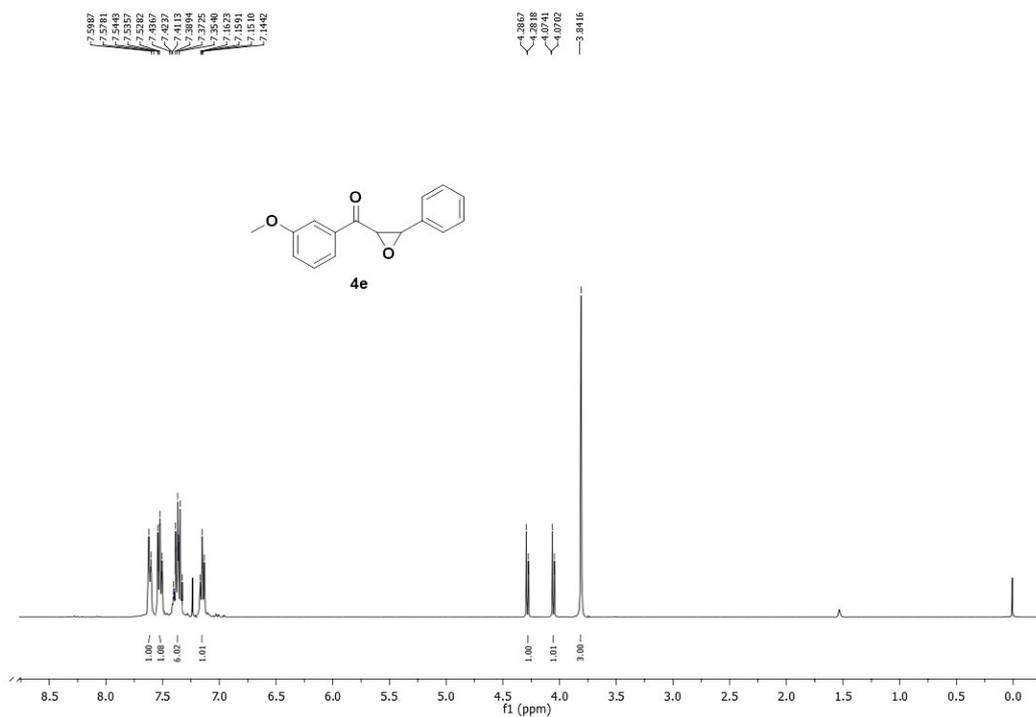


Figure S47: ¹H NMR Spectrum of α , β -epoxy ketone **4e**.

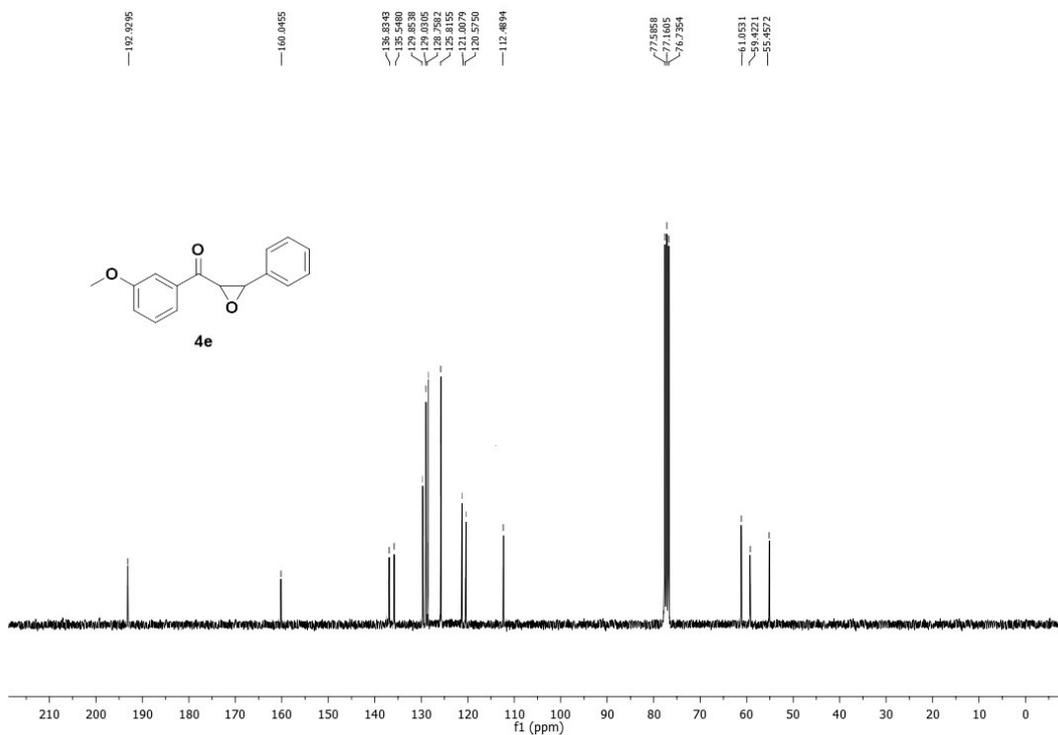


Figure S48: ¹³C NMR Spectrum of α , β -epoxy ketone **4e**.

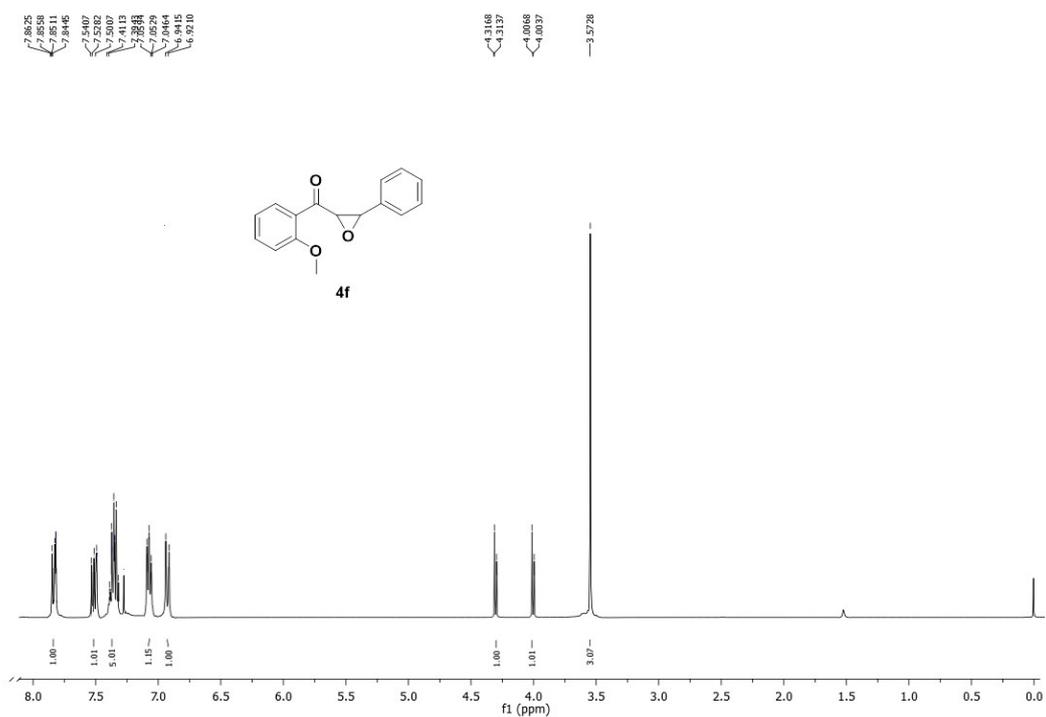


Figure S49: ¹H NMR Spectrum of α , β -epoxy ketone **4f.**

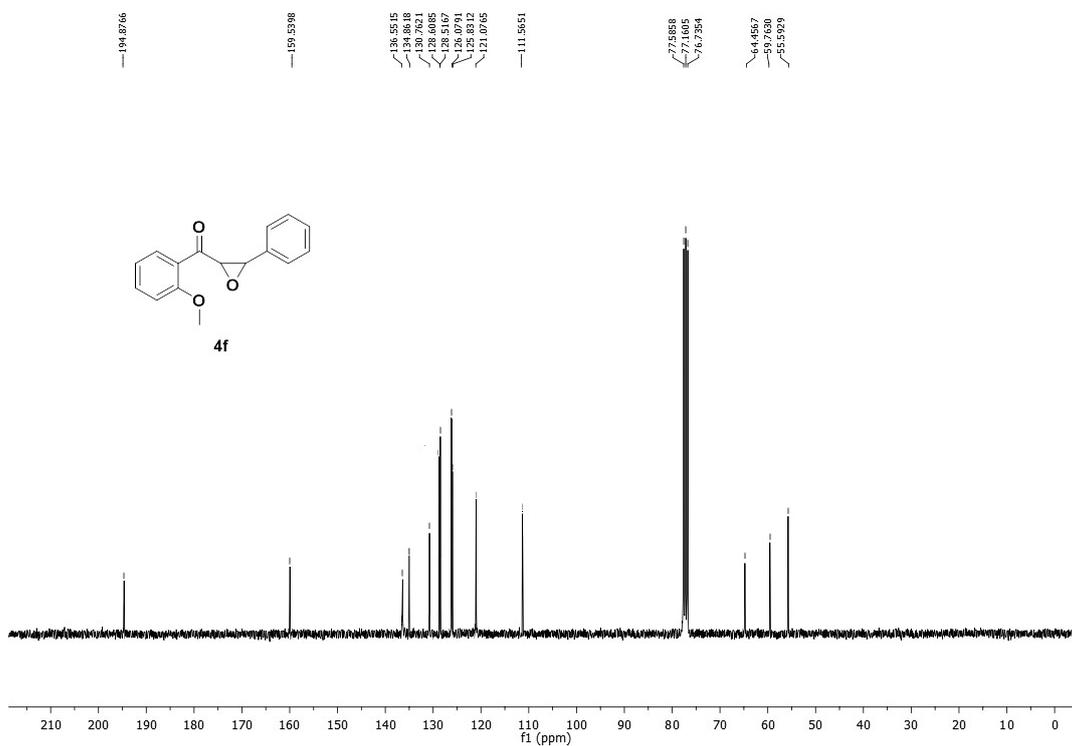


Figure S50: ¹³C NMR Spectrum of α , β -epoxy ketone **4f.**

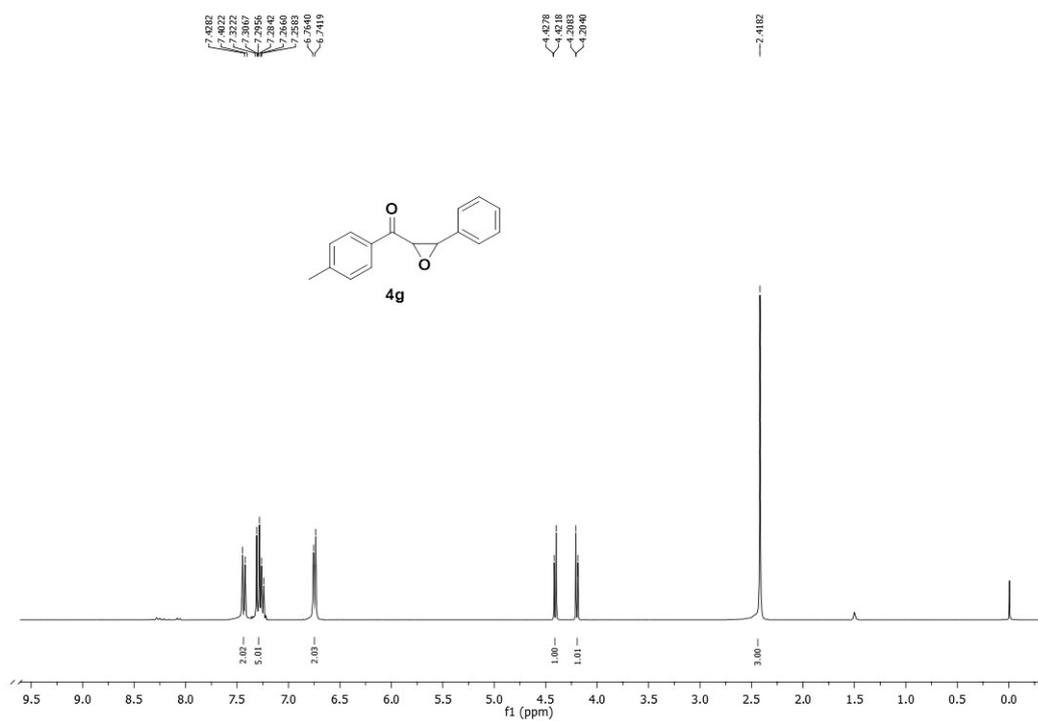


Figure S51: ¹H NMR Spectrum of α , β -epoxy ketone **4g**.

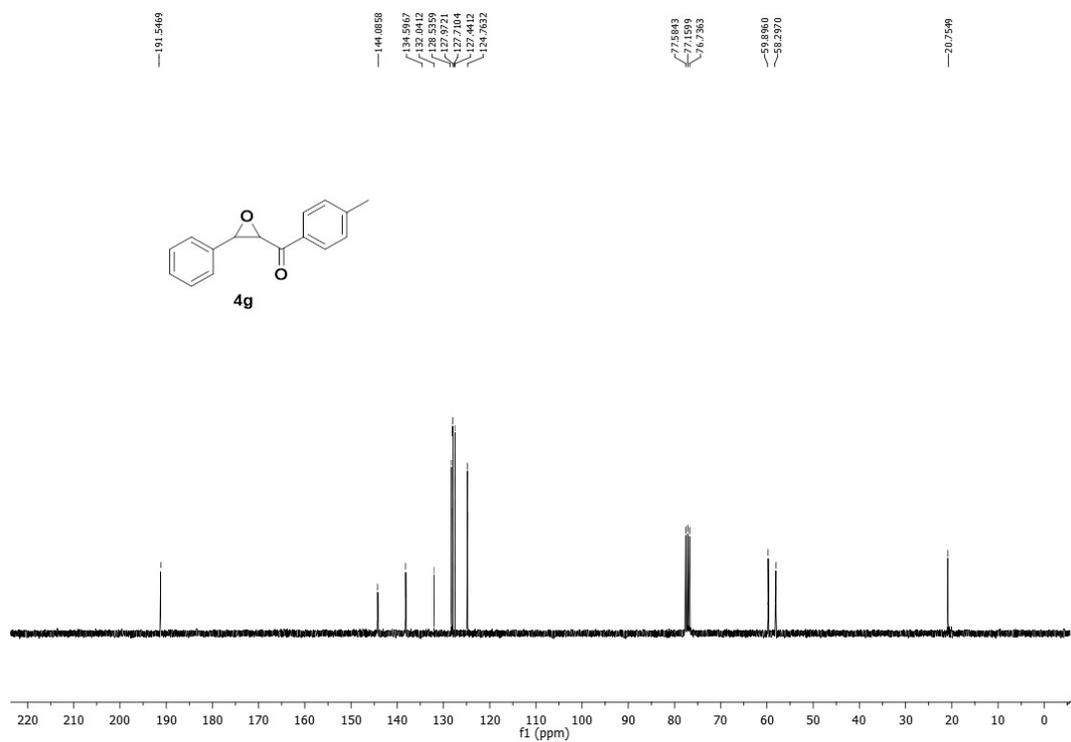


Figure S52: ¹³C NMR Spectrum of α , β -epoxy ketone **4g**.

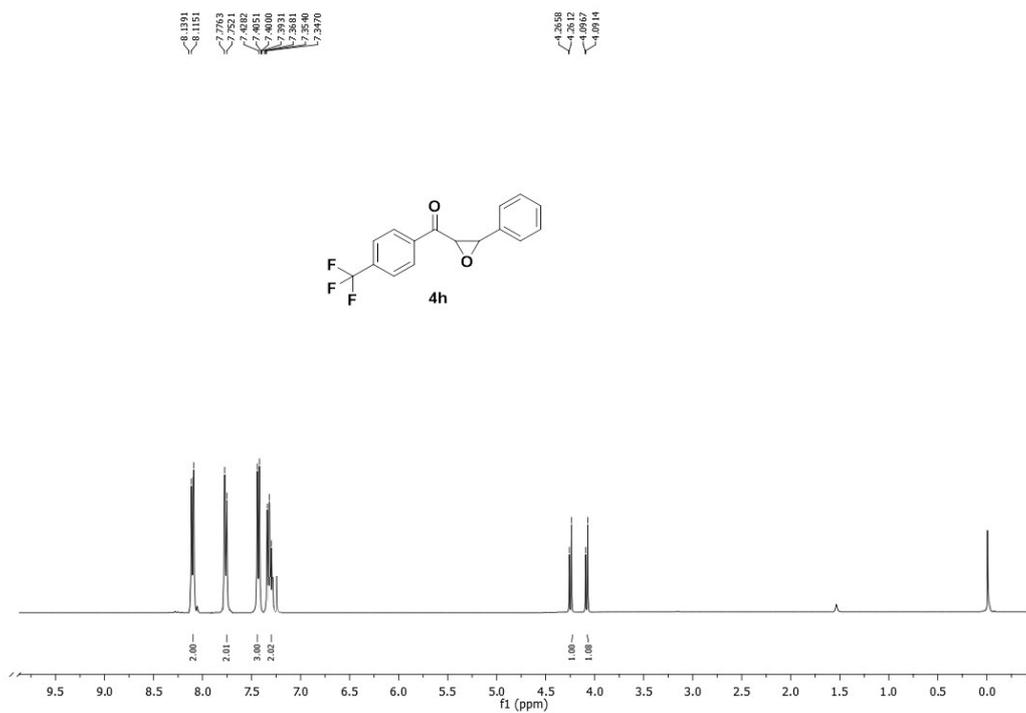


Figure S53: $^1\text{H NMR}$ Spectrum of α, β -epoxy ketone **4h**.

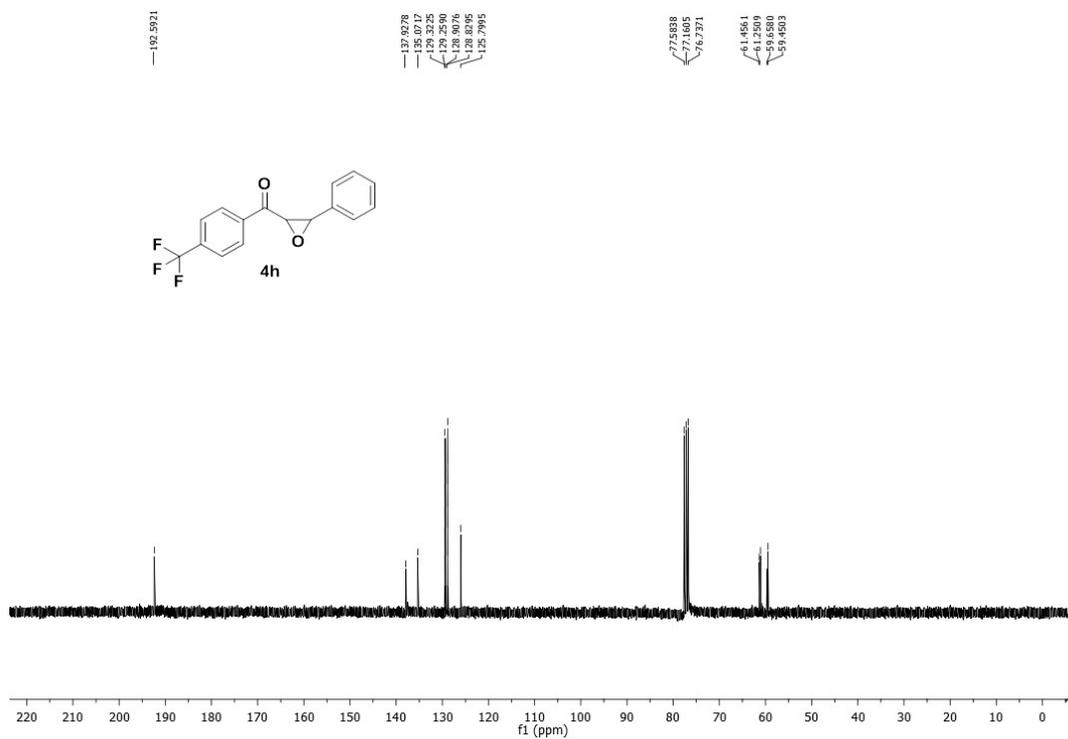


Figure S54: $^{13}\text{C NMR}$ Spectrum of α, β -epoxy ketone **4h**.

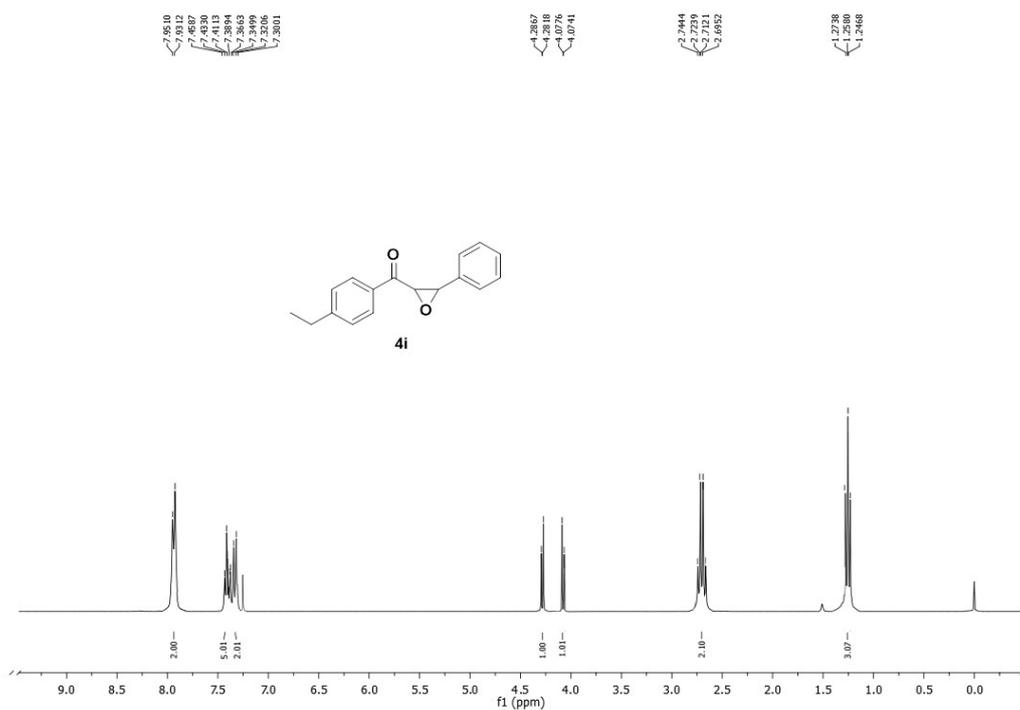


Figure S55: ¹H NMR Spectrum of α , β -epoxy ketone **4i**.

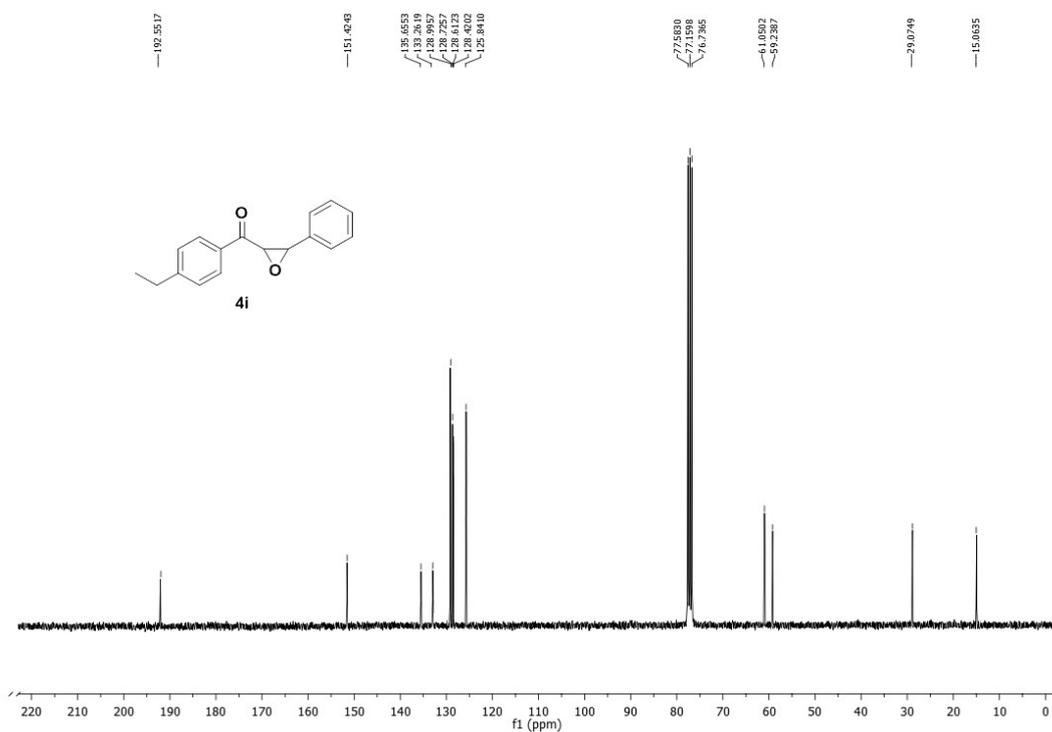


Figure S56: ¹³C NMR Spectrum of α , β -epoxy ketone **4i**.

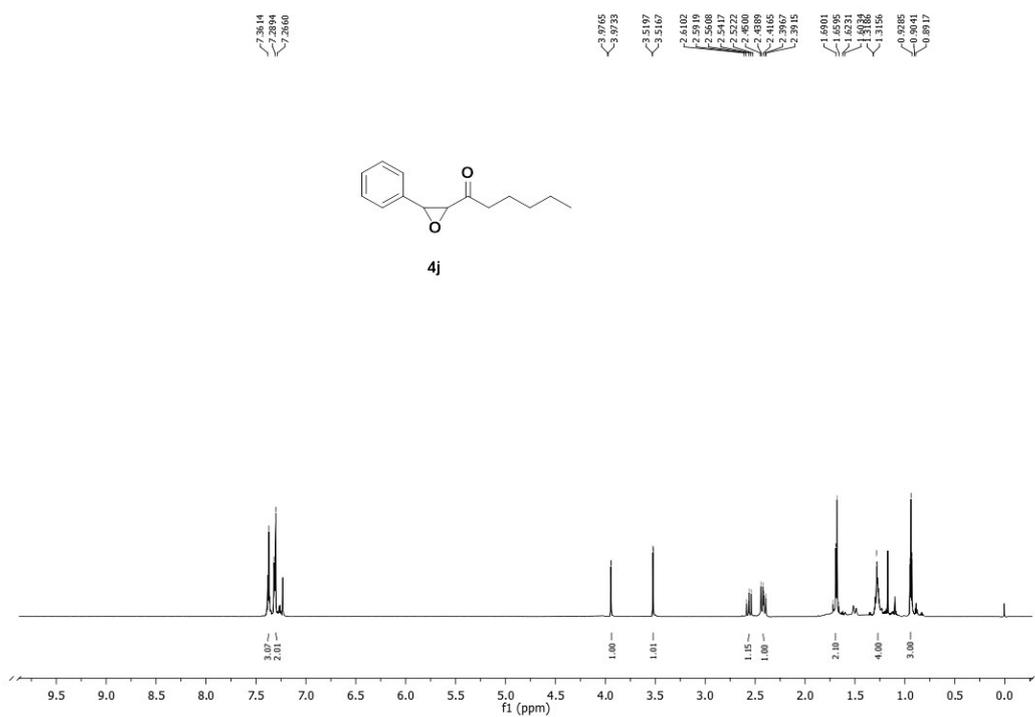


Figure S57: ^1H NMR Spectrum of α, β -epoxy ketone **4j**.

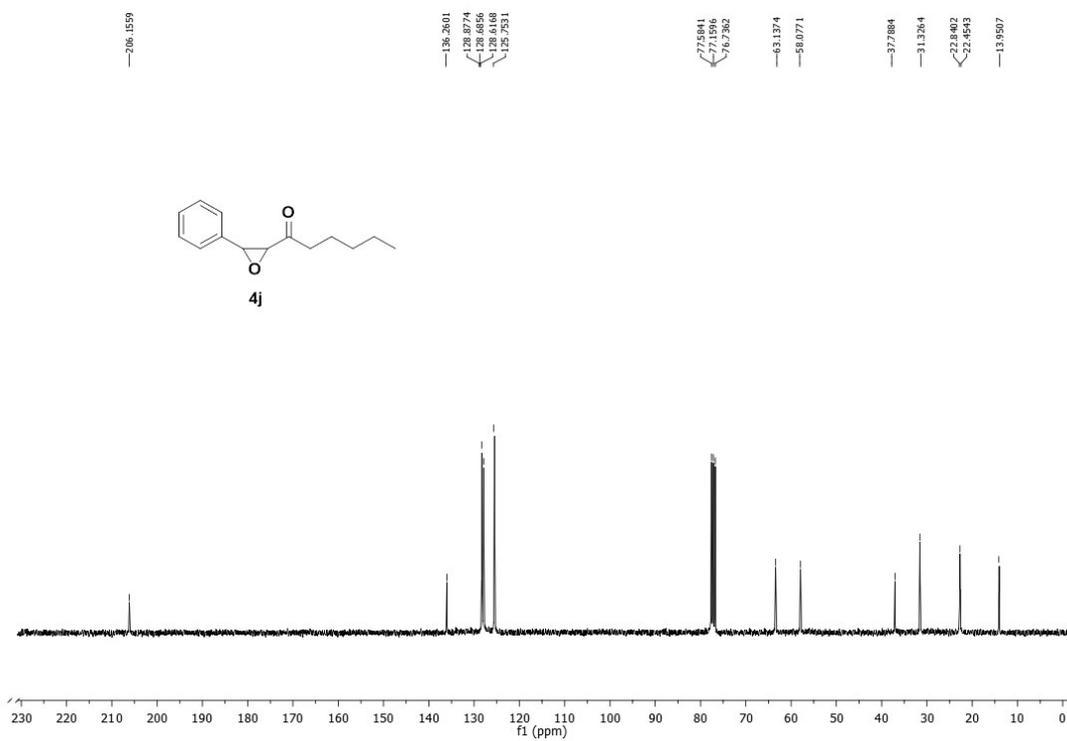
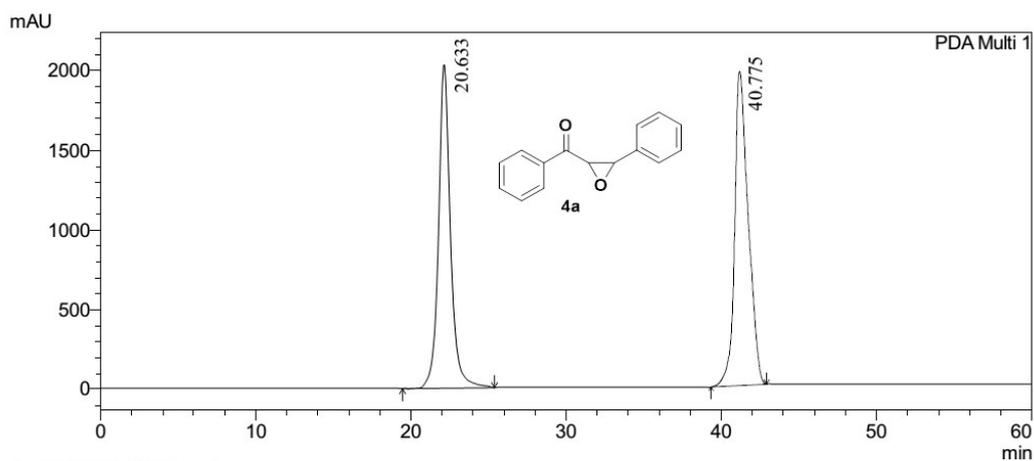


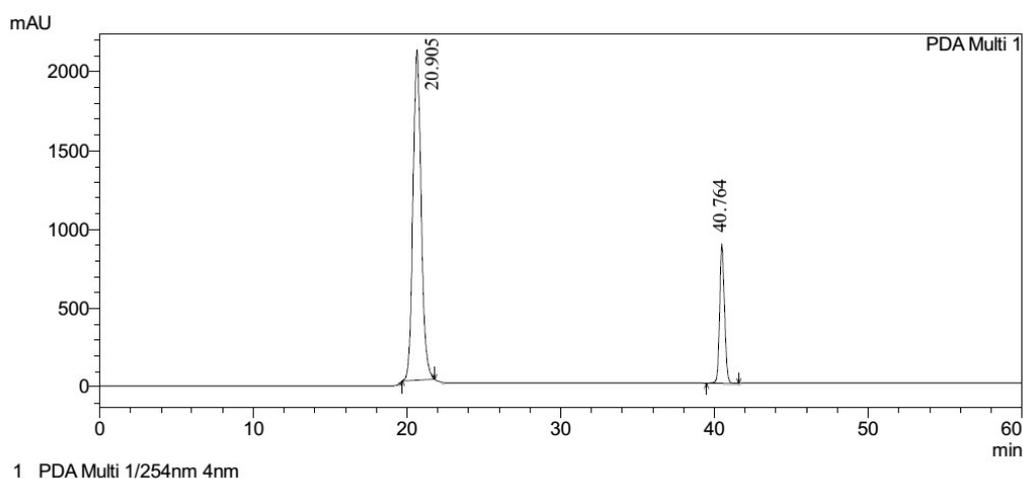
Figure S58: ^{13}C NMR Spectrum of α, β -epoxy ketone **4j**.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.633	1973568	8839	50.216	51.640
2	40.775	1877623	8633	49.784	48.360
Total		3851191	17472	100.000	100.000

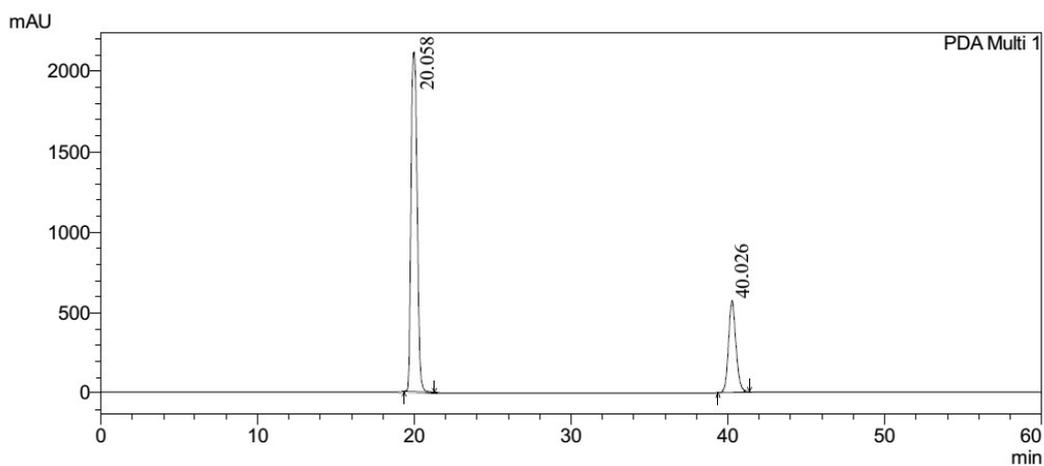
Figure S59: HPLC chromatogram of (**4a**) Racemic mixture.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.905	3986453	97339	73.611	85.579
2	40.764	1659166	16403	26.389	14.421
Total		5645619	113742	100.000	100.000

Figure S60: HPLC chromatogram of (**4a**) in the presence 2 mol % of organocatalyst (**12a**) and TBHP/**Ethanol** in room temperature condition.



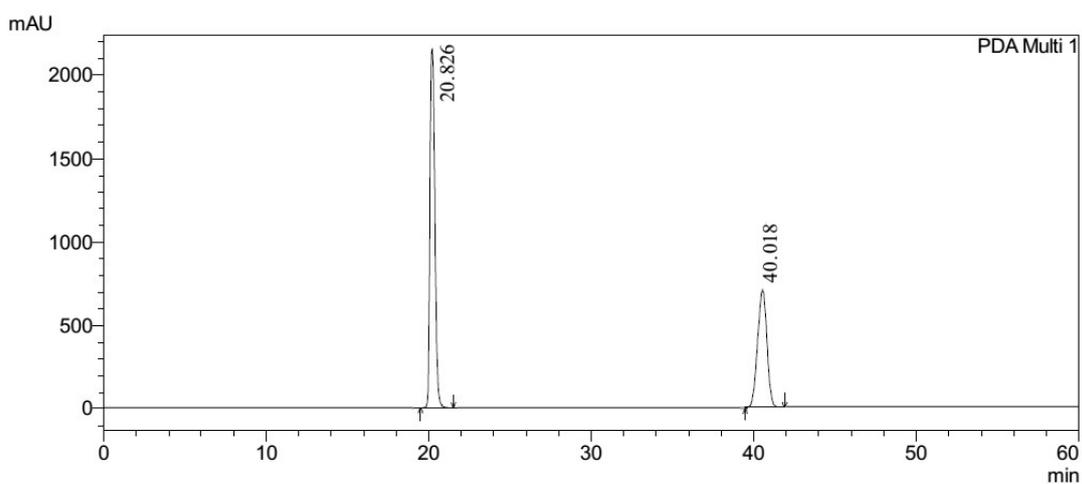
1 PDA Multi 1/254nm 4nm

PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.058	14023952	105826	79.379	69.896
2	40.026	3643082	70856	20.621	30.104
Total		17667034	176683	100.000	100.000

Figure S61: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12b) and TBHP/Ethanol in room temperature condition.



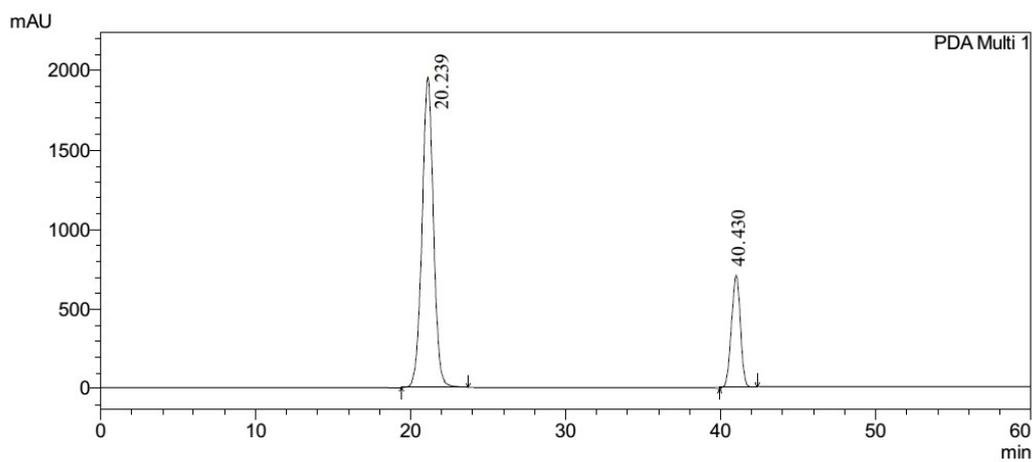
1 PDA Multi 1/254nm 4nm

PeakTable

PDA Ch1 240nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.826	179449516	2323261	65.208	63.542
2	40.018	83641572	1791754	34.792	36.458
Total		263091088	4115015	100.000	100.000

Figure S62: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12a) and TBHP/1-butanol in room temperature condition.

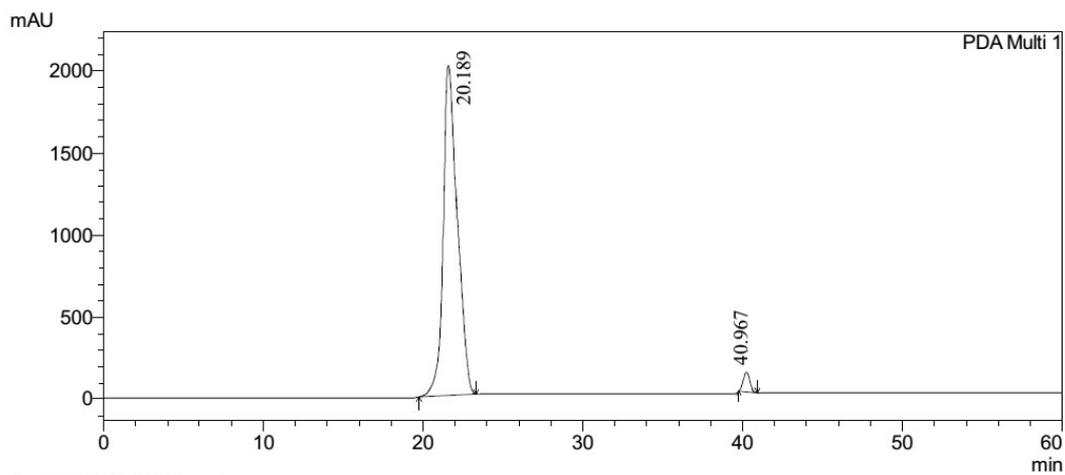


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.239	16023952	101826	70.379	59.796
2	40.430	13643082	70856	29.621	40.204
Total		19667034	172683	100.000	100.000

Figure S63: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12b) and TBHP/1-butanol in room temperature condition.

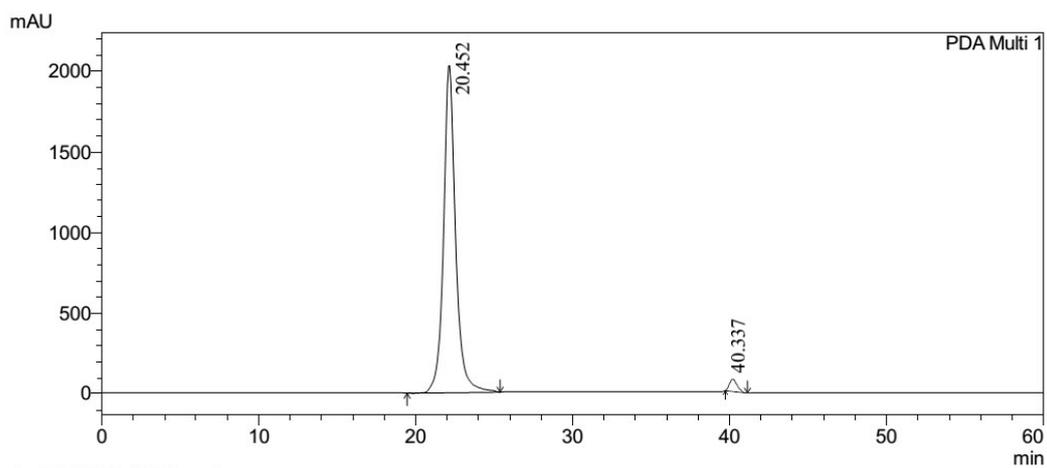


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.189	59989641	2024905	97.580	95.203
2	40.967	1487822	102027	2.420	4.797
Total		61477464	2126932	100.000	100.000

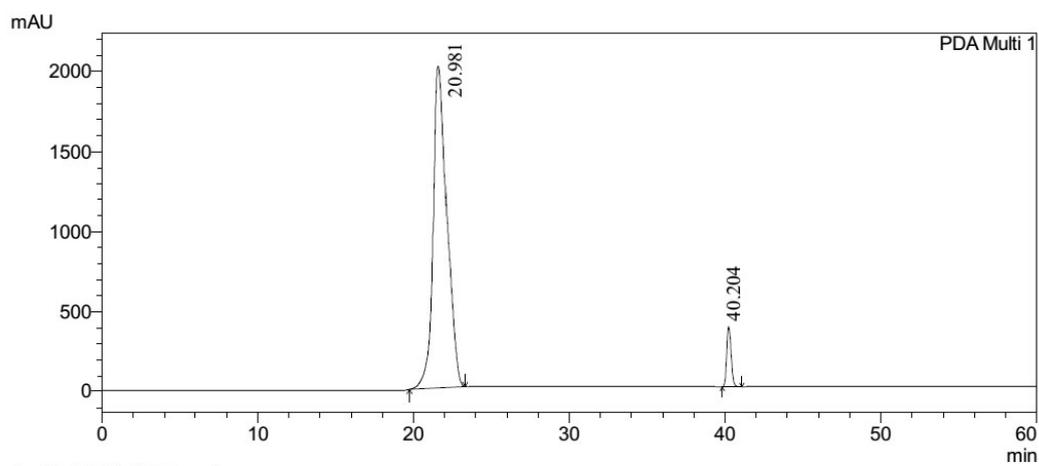
Figure S64: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.452	331381981	389212	99.687	98.851
2	40.337	44433	4523	0.313	1.149
Total		331426414	393735	100.000	100.000

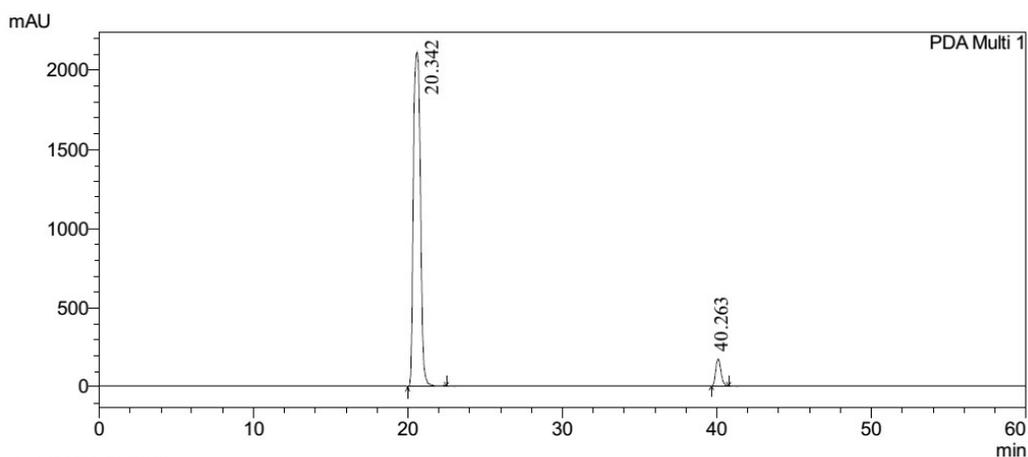
Figure S65: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12b) and TBHP/Acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.981	27802899	398992	94.885	93.769
2	40.204	1498877	26514	5.115	6.231
Total		29301776	425507	100.000	100.000

Figure S66: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12a) and TBHP/DMSO in room temperature condition.



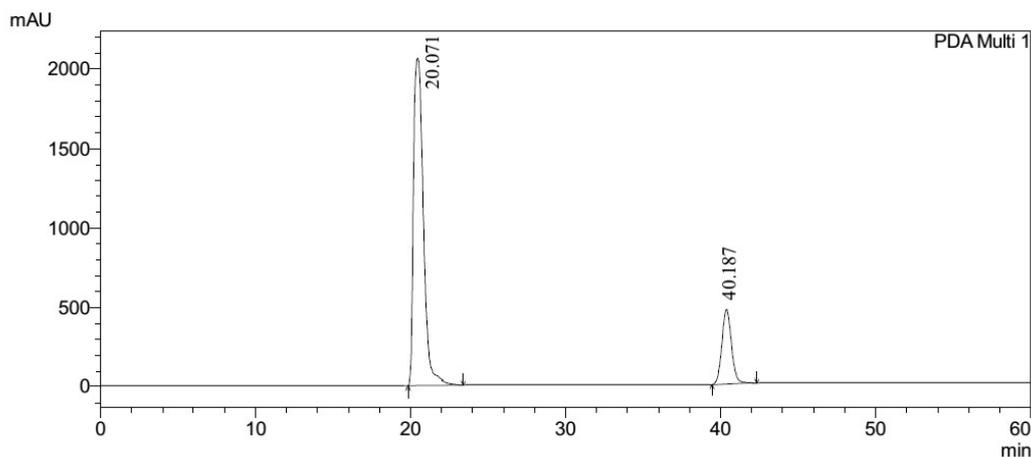
1 PDA Multi 1/254nm 4nm

PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.342	82677818	834234	96.067	92.270
2	40.263	3384812	69886	3.933	7.730
Total		86062630	904119	100.000	100.000

Figure S67: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12b) and TBHP/DMSO in room temperature condition.



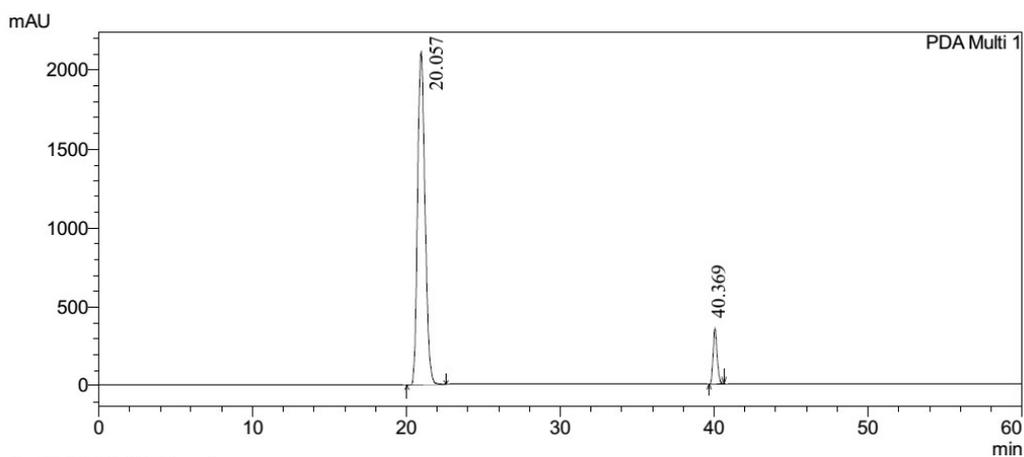
1 PDA Multi 1/254nm 4nm

PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.071	6412071	85516	89.674	73.910
2	40.187	738383	30187	10.326	26.090
Total		7150455	115703	100.000	100.000

Figure S68: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12a) and TBHP/THF in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.057	16288090	453694	93.044	88.009
2	40.369	1217689	61815	6.956	11.991
Total		17505779	515509	100.000	100.000

Figure S69: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12b) and TBHP/THF in room temperature condition.

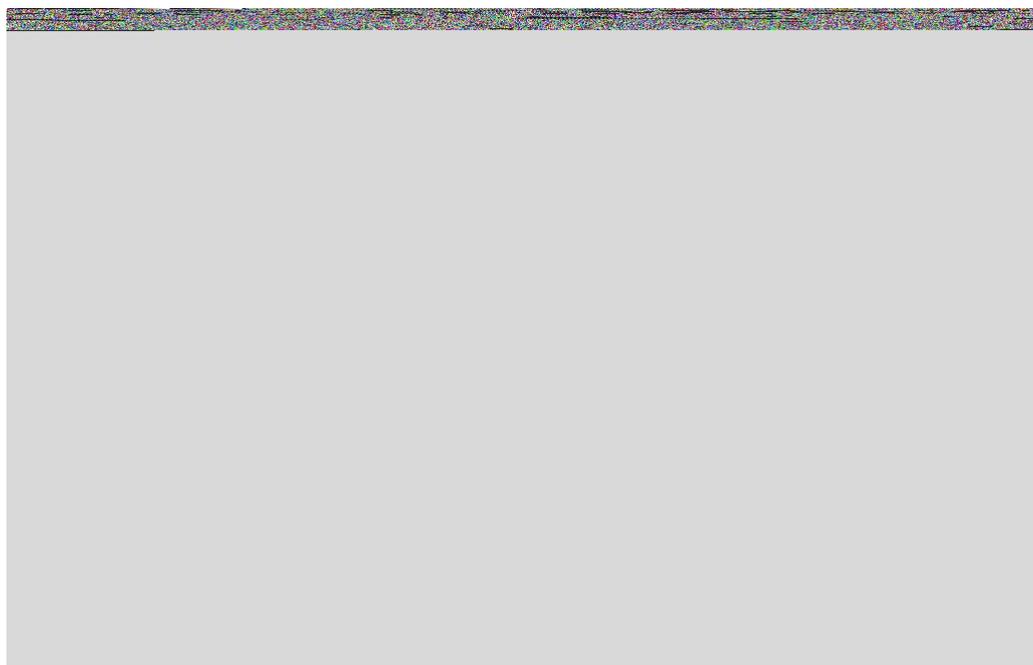


Figure S70: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12b) and H₂O₂/TEA/Acetonitrile in room temperature condition.

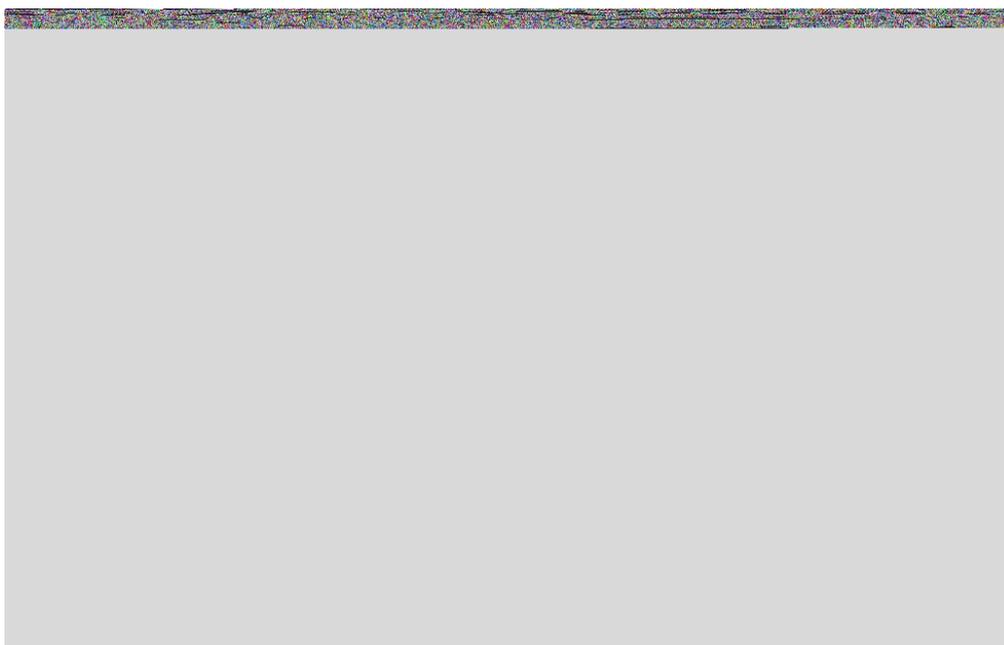
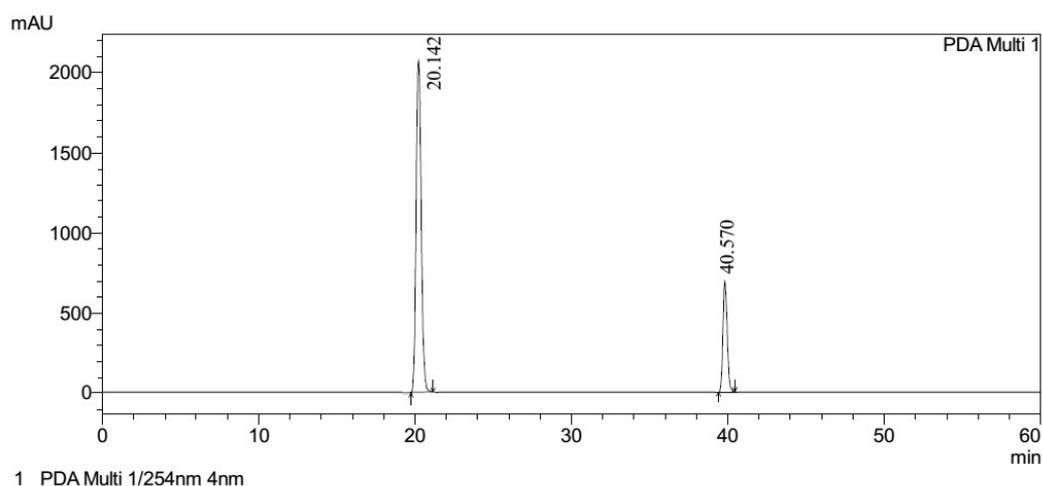


Figure S71: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12b) and H₂O₂/without base/Acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.142	9227796	104252	79.483	73.552
2	40.570	2042474	36487	17.517	26.448
Total		11370271	141740	100.000	100.000

Figure S72: HPLC chromatogram of (4a) in the presence 2 mol % of organocatalyst (12b) and TBHP/TEA/Acetonitrile in room temperature condition.



Figure S73: HPLC chromatogram of **(4a)** in the presence 2 mol % of organocatalyst **(12b)** and **TBHP/Pyridine/Acetonitrile** in room temperature condition.



Figure S74: HPLC chromatogram of **(4a)** in the presence 2 mol % of organocatalyst **(12b)** and **TBHP/without base/Acetonitrile** in room temperature condition.

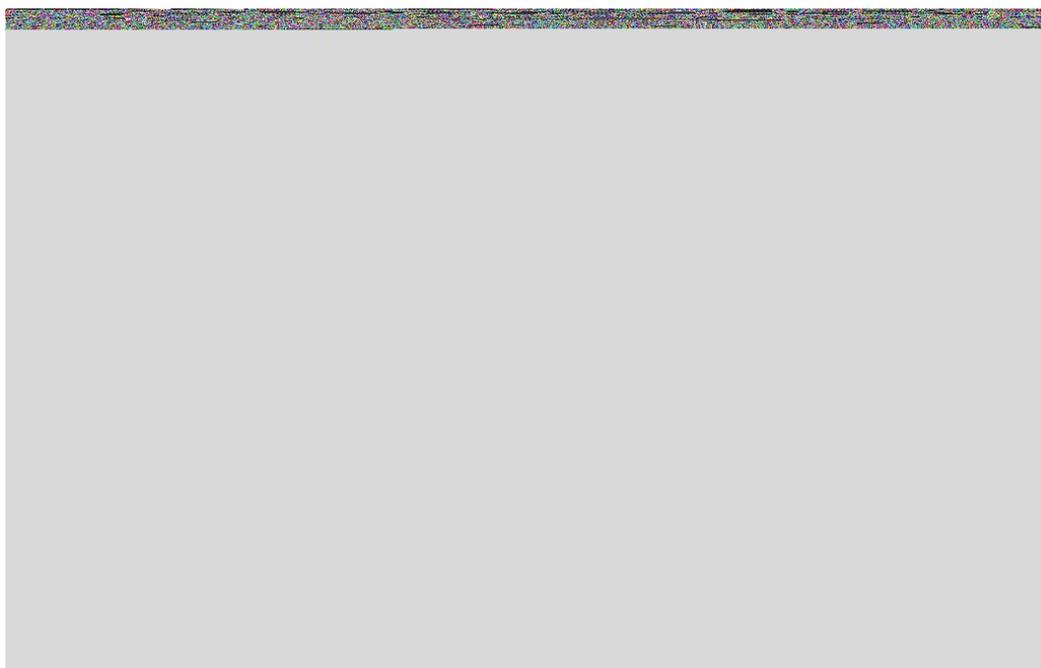
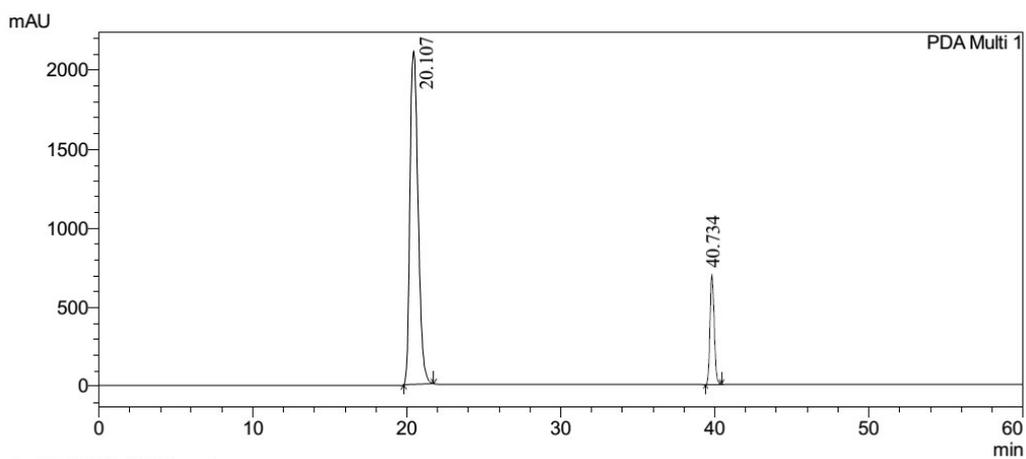


Figure S75: HPLC chromatogram of (4a) in the presence **2 mol %** of organocatalyst (12b) and TBHP /Acetonitrile in **65 °C temperature** conditions.



Figure S76: HPLC chromatogram of (4a) in the presence **5 mol %** of organocatalyst (12b) and TBHP /Acetonitrile in **65 °C temperature** conditions.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.107	8473498	108659	83.721	74.717
2	40.734	1647576	36770	16.279	25.283
Total		10121074	145429	100.000	100.000

Figure S77: HPLC chromatogram of (4a) in the presence **15 mol %** of organocatalyst (12b) and TBHP /Acetonitrile in **65 °C temperature** conditions.

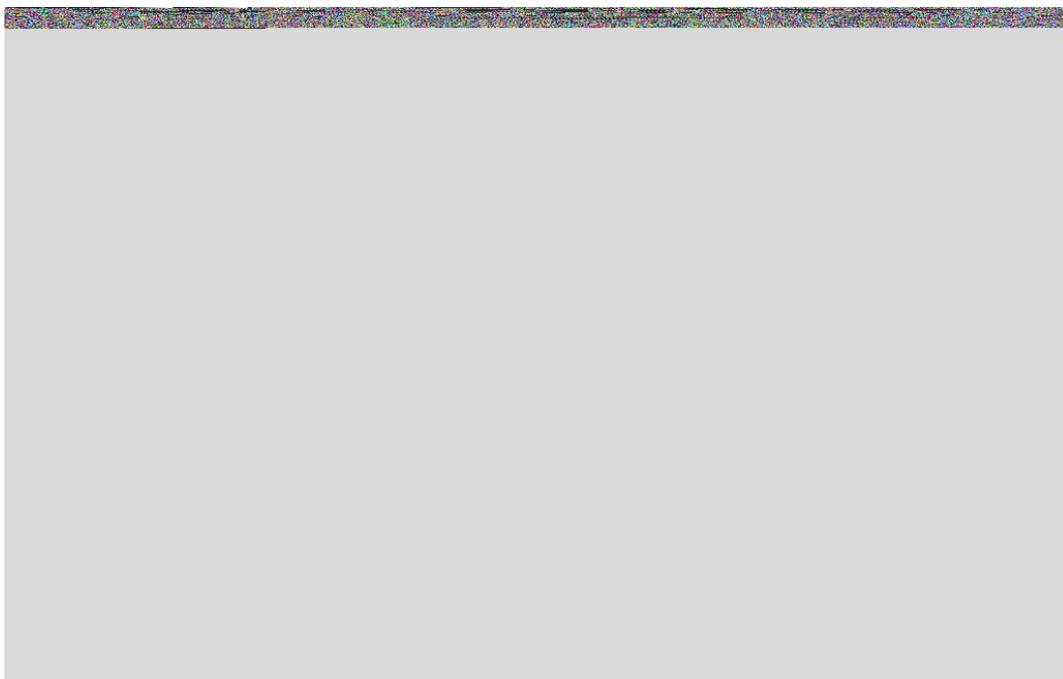


Figure S78: HPLC chromatogram of (4a) in the presence **2 mol %** of organocatalyst (12b) and TBHP /Acetonitrile in **30 °C temperature (RT)** conditions.

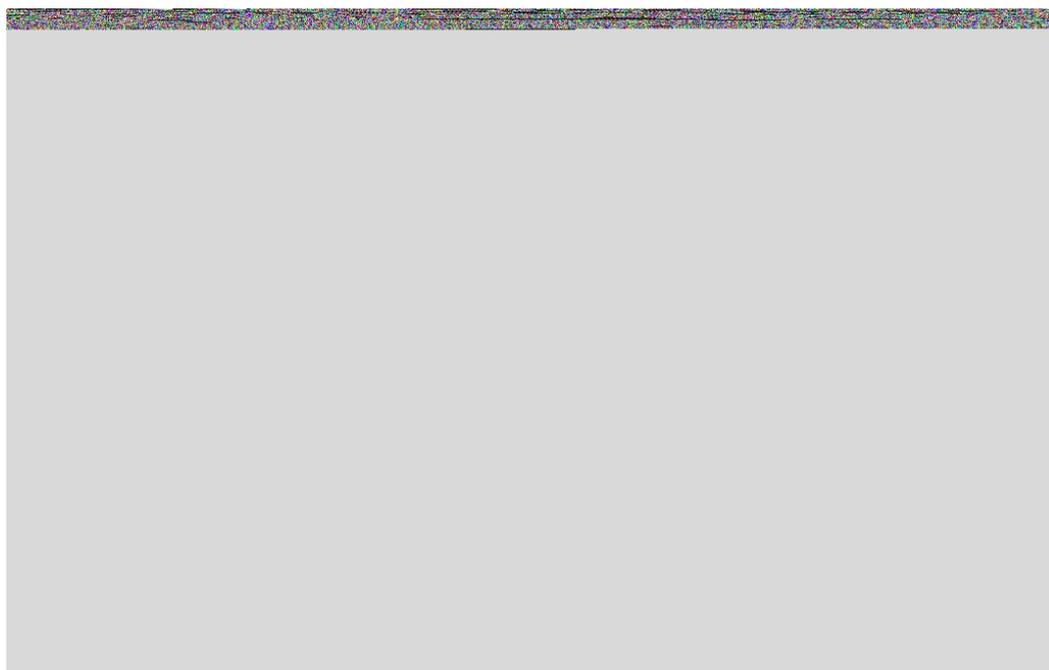
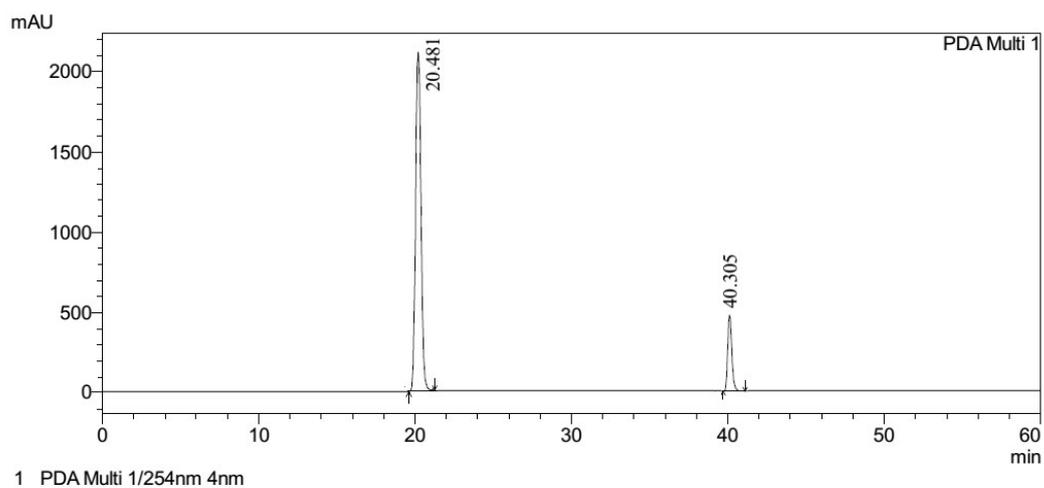


Figure S79: HPLC chromatogram of (4a) in the presence 5 mol % of organocatalyst (12b) and TBHP /Acetonitrile in 30 °C temperature (RT) conditions.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.481	62187860	2088838	89.957	84.178
2	40.305	6943057	392620	10.043	15.822
Total		69130916	2481458	100.000	100.000

Figure S80: HPLC chromatogram of (4a) in the presence 15 mol % of organocatalyst (12b) and TBHP /Acetonitrile in 30 °C temperature (RT) conditions.

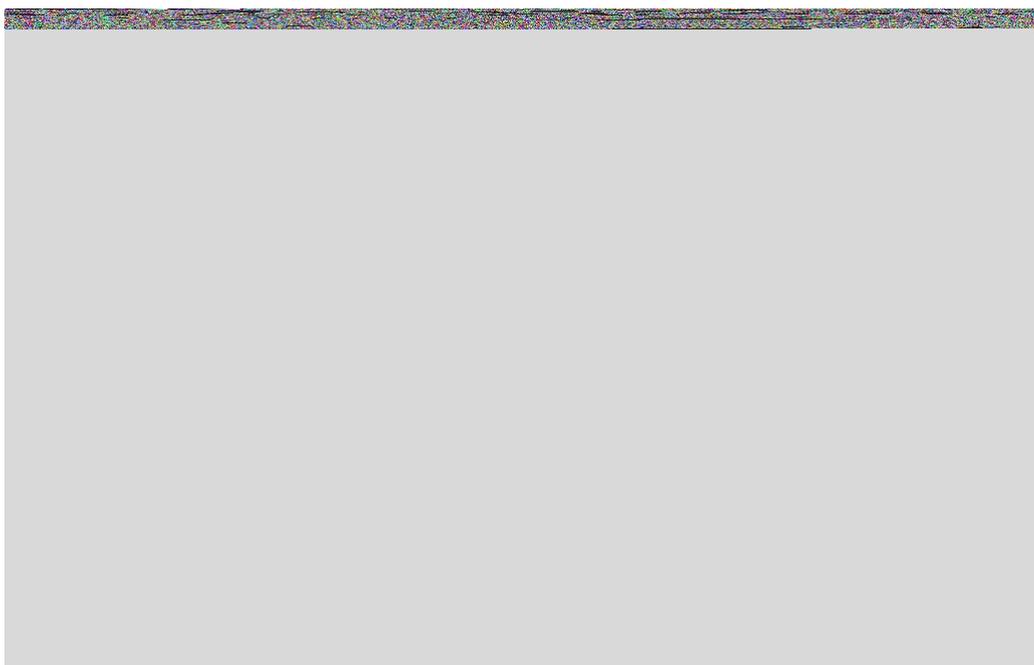


Figure S81: HPLC chromatogram of (4a) in the presence **2 mol %** of organocatalyst (12b) and TBHP /Acetonitrile in **0 °C temperature** conditions.

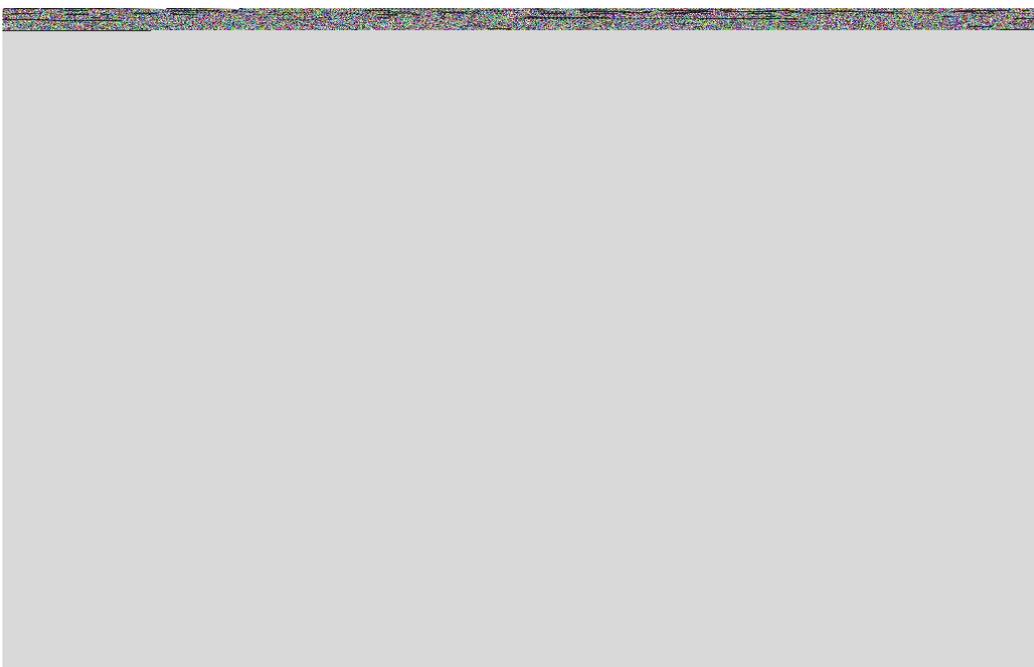
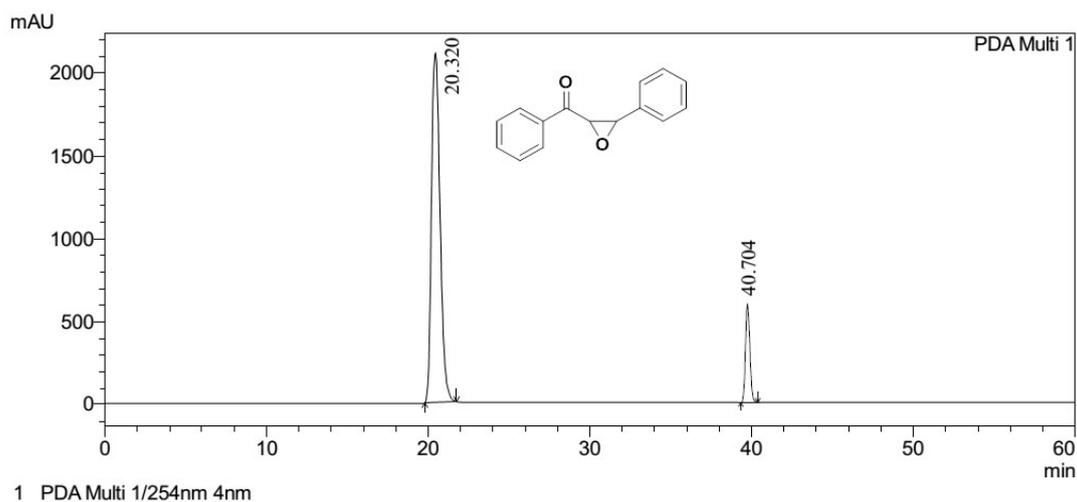


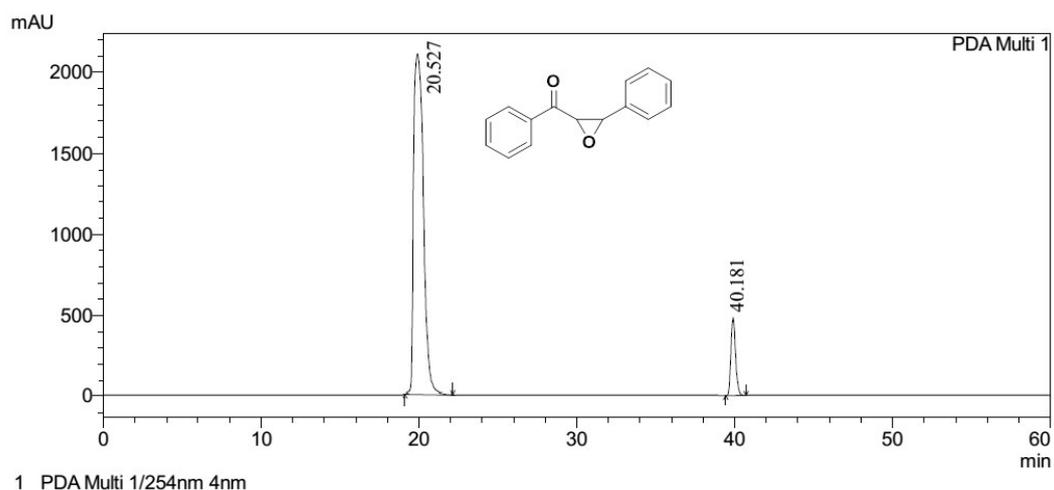
Figure S82: HPLC chromatogram of (4a) in the presence **5 mol %** of organocatalyst (12b) and TBHP /Acetonitrile in **0 °C temperature** conditions.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.320	24206970	377437	86.330	93.313
2	40.704	3833205	27046	13.670	6.687
Total		28040175	404483	100.000	100.000

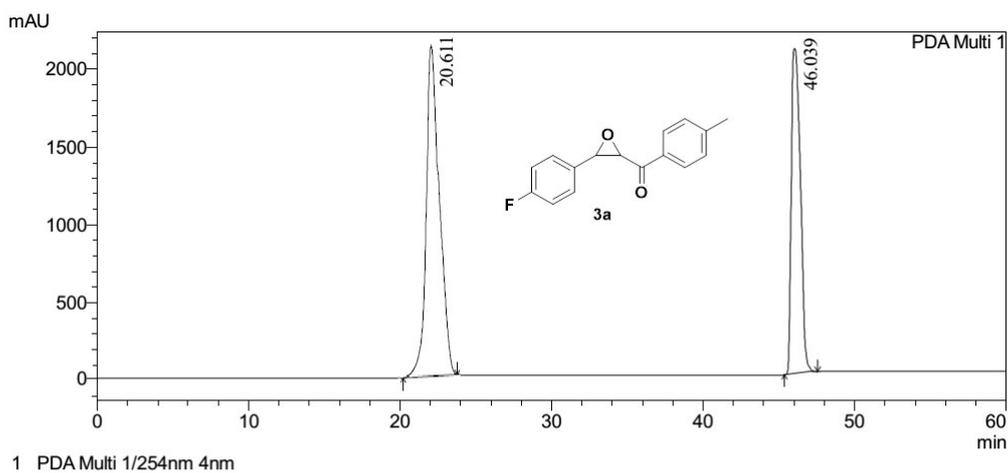
Figure S83: HPLC chromatogram of (4a) in the presence 2 mol % of C_2 -symmetric organocatalyst (12c) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.527	14728497	1273402	91.022	94.372
2	40.181	1452704	21071	8.978	5.628
Total		16181201	1294473	100.000	100.000

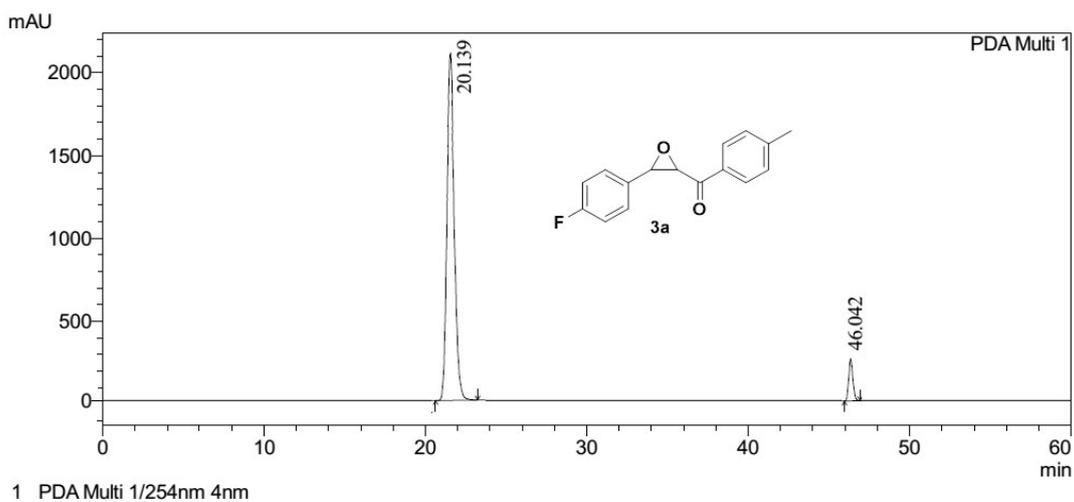
Figure S84: HPLC chromatogram of (4a) in the presence 2 mol % of C_1 -symmetric organocatalyst (12d) and TBHP/acetonitrile in room temperature condition.



PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.611	2753234	112968	50.961	51.633
2	46.039	2615892	111219	49.039	48.367
Total		5369127	224187	100.000	100.000

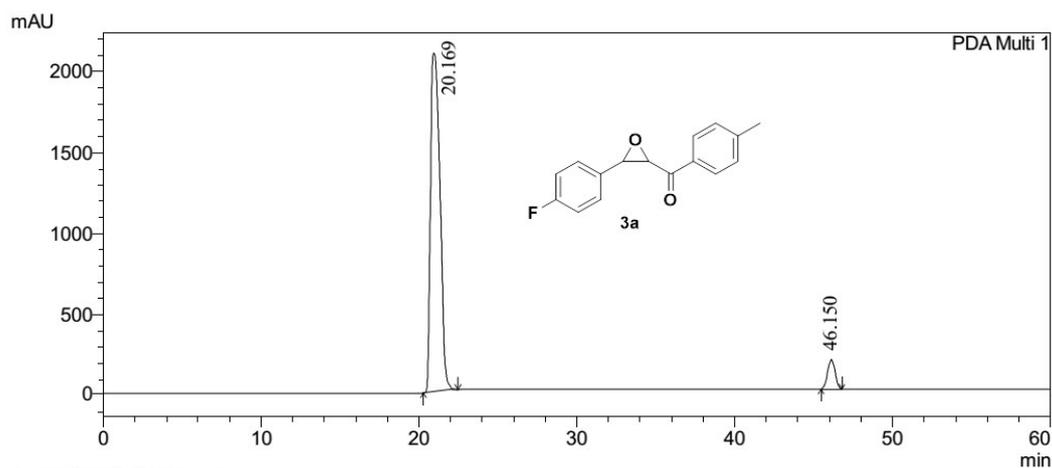
Figure S85: HPLC chromatogram of (3a) Racemic mixture.



PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.139	63163666	2142740	94.133	90.976
2	46.042	3936965	212532	5.867	9.024
Total		67100631	2355272	100.000	100.000

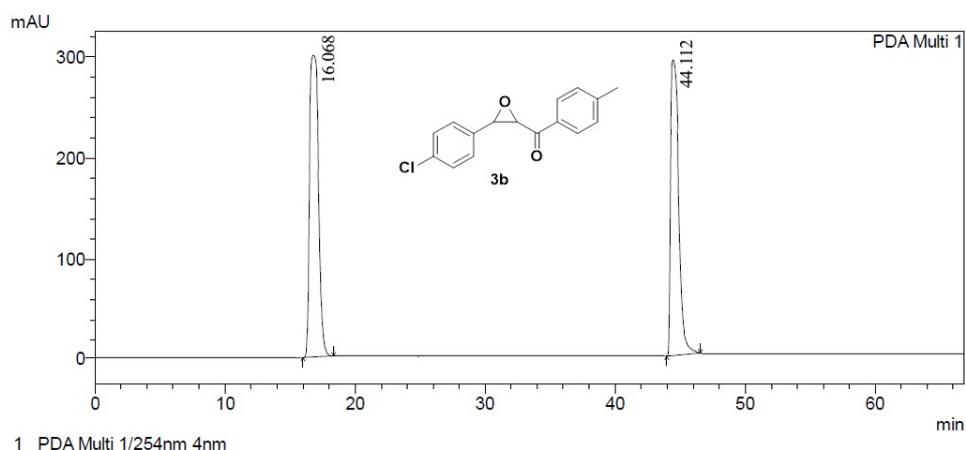
Figure S86: HPLC chromatogram of (3a) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.



PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.169	61357098	746211	97.057	93.606
2	46.150	61860393	50970	2.943	6.394
Total		63217491	797180	100.000	100.000

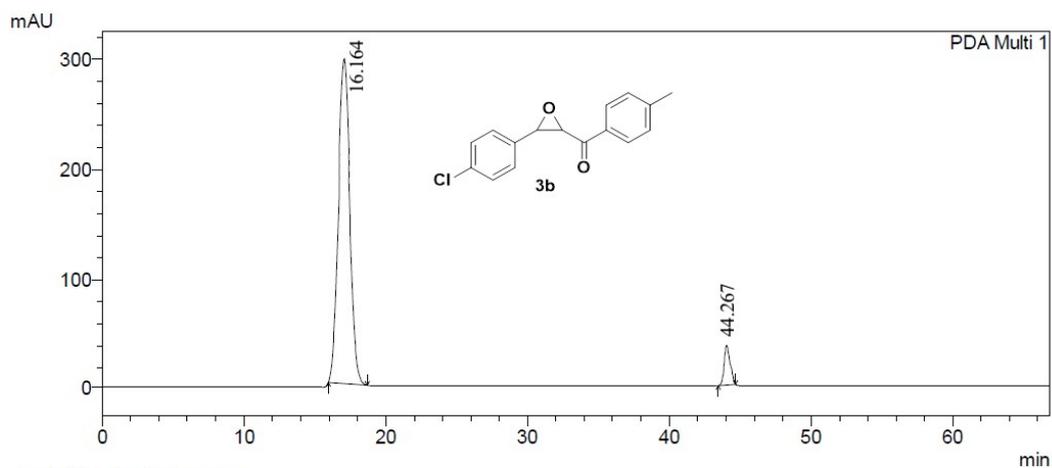
Figure S87: HPLC chromatogram of (**3a**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.



PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	16.068	9427796	104252	50.483	51.552
2	44.112	9342474	97487	49.517	48.448
Total		18770271	201740	100.000	100.000

Figure S88: HPLC chromatogram of (**3b**) Racemic mixture.

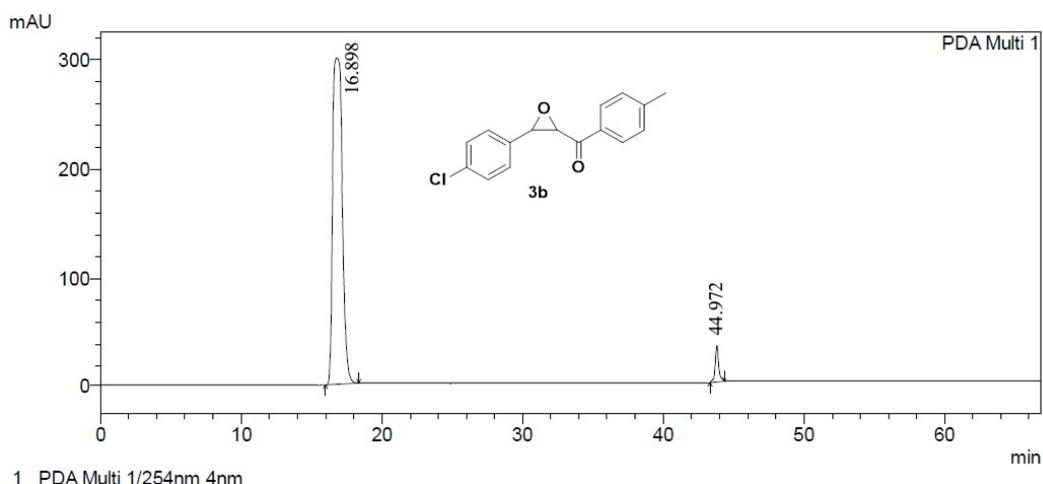


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	16.164	36665482	376897	93.816	85.381
2	44.267	2416824	64531	6.184	14.619
Total		39082306	441428	100.000	100.000

Figure S89: HPLC chromatogram of (**3b**) in the presence 2 mol % of organocatalyst (**12a**) and TBHP/acetonitrile in room temperature condition.

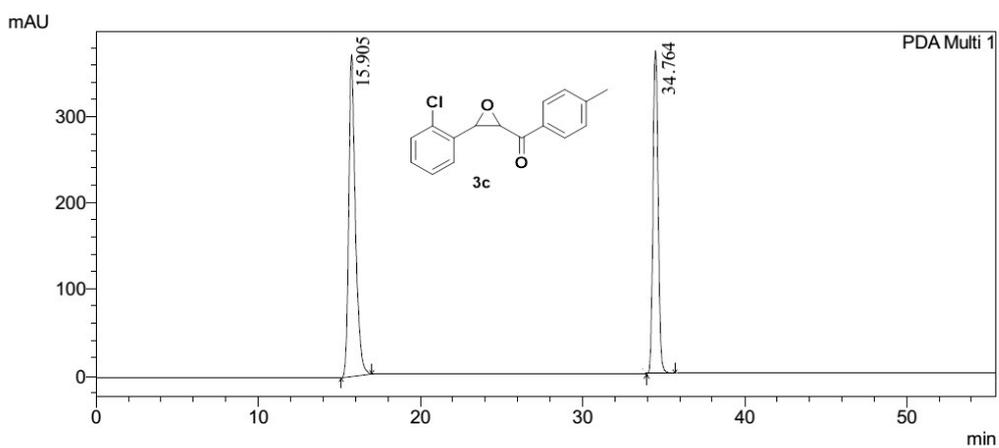


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	16.898	56742198	813778	97.469	97.488
2	44.972	4621317	20965	2.531	2.512
Total		61363515	834744	100.000	100.000

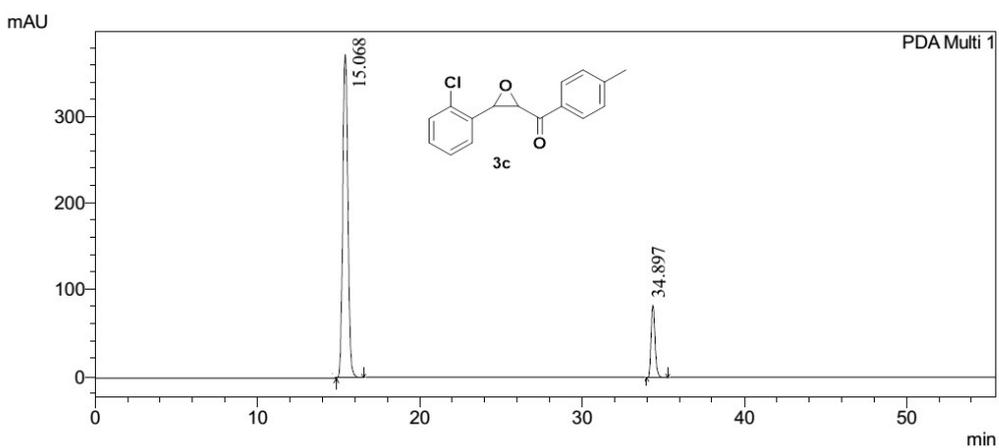
Figure S90: HPLC chromatogram of (**3b**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.



PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	15.905	3986453	97339	50.611	51.579
2	34.764	3859166	95403	49.389	48.421
Total		7845619	192742	100.000	100.000

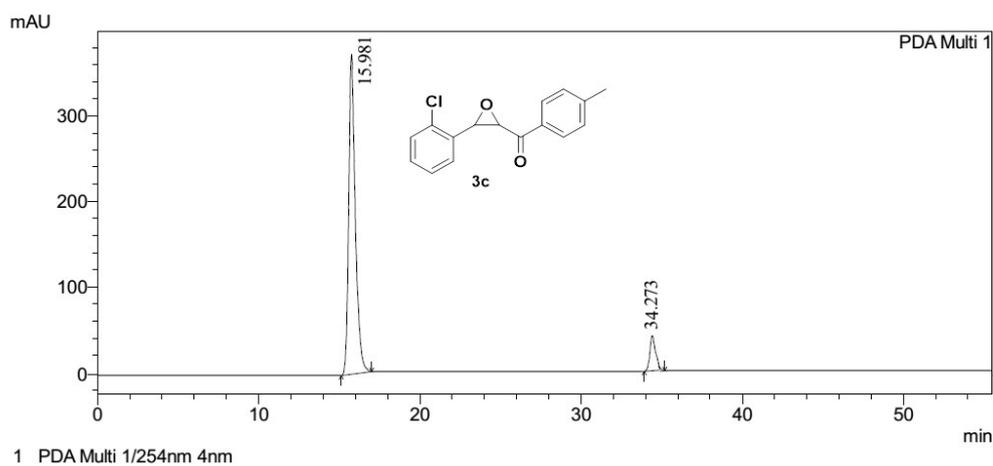
Figure S91: HPLC chromatogram of (3c) Racemic mixture.



PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	15.068	62187860	2088838	89.957	84.178
2	34.897	6943057	392620	10.043	15.822
Total		69130916	2481458	100.000	100.000

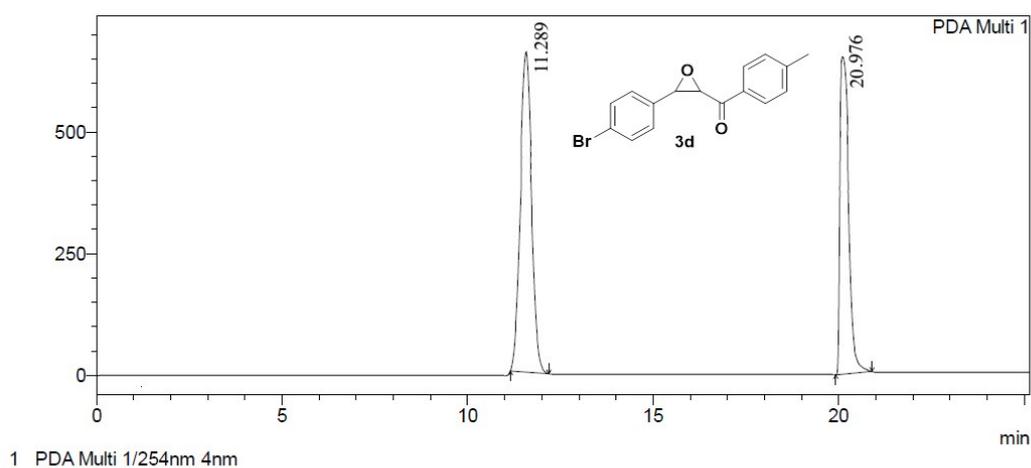
Figure S92: HPLC chromatogram of (3c) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	15.981	27802899	398992	94.885	93.769
2	34.273	1498877	26514	5.115	6.231
Total		29301776	425507	100.000	100.000

Figure S93: HPLC chromatogram of (3c) in the presence 2 mol % of organocatalyst (12b) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	11.289	2317152	11569	50.713	52.819
2	20.976	2151471	10896	49.287	47.181
Total		4468624	22465	100.000	100.000

Figure S94: HPLC chromatogram of (3d) Racemic mixture.

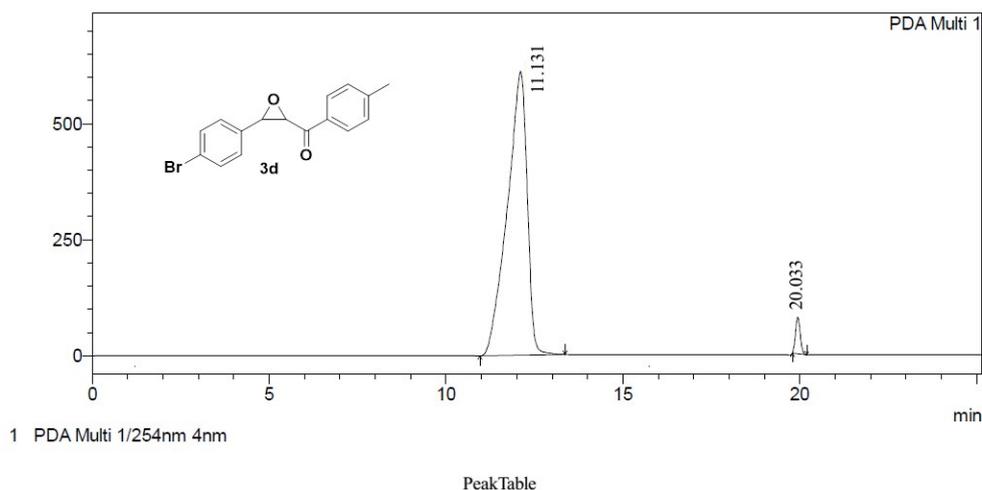


Figure S95: HPLC chromatogram of (**3d**) in the presence 2 mol % of organocatalyst (**12a**) and TBHP/acetonitrile in room temperature condition.

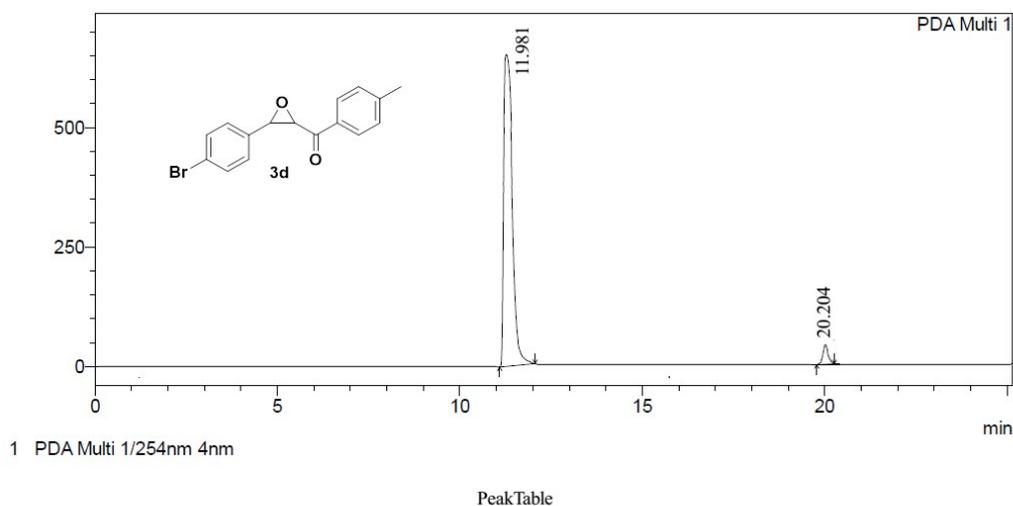
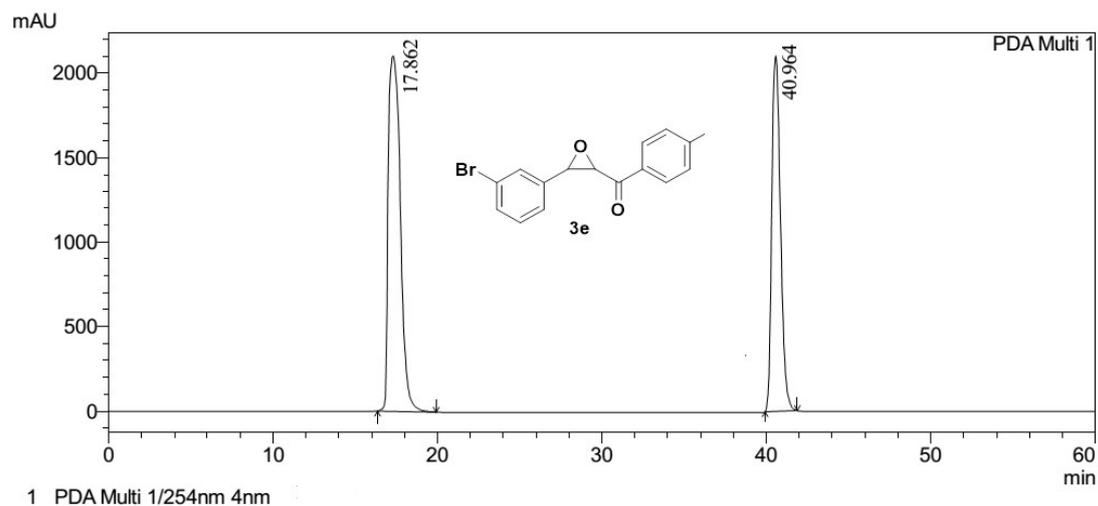


Figure S96: HPLC chromatogram of (**3d**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.

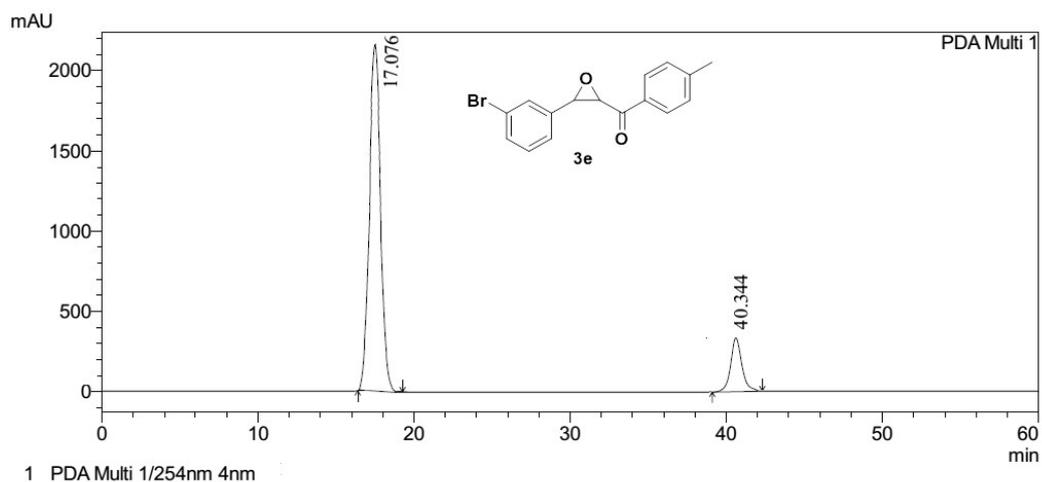


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	17.862	143622513	1483220	50.741	51.794
2	40.964	142638897	1365126	49.259	48.206
Total		286261409	2848346	100.000	100.000

Figure S97: HPLC chromatogram of (3e) Racemic mixture.

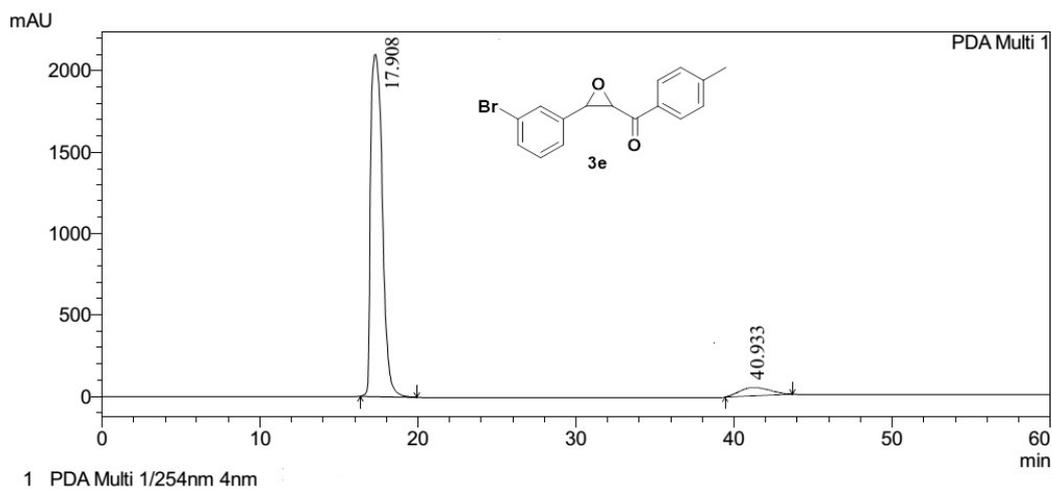


PeakTable

PDA Ch1 240nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	17.076	14690360	1273254	91.885	96.459
2	40.344	1297389	19932	8.115	3.541
Total		15987749	1293185	100.000	100.000

Figure S98: HPLC chromatogram of (3e) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.

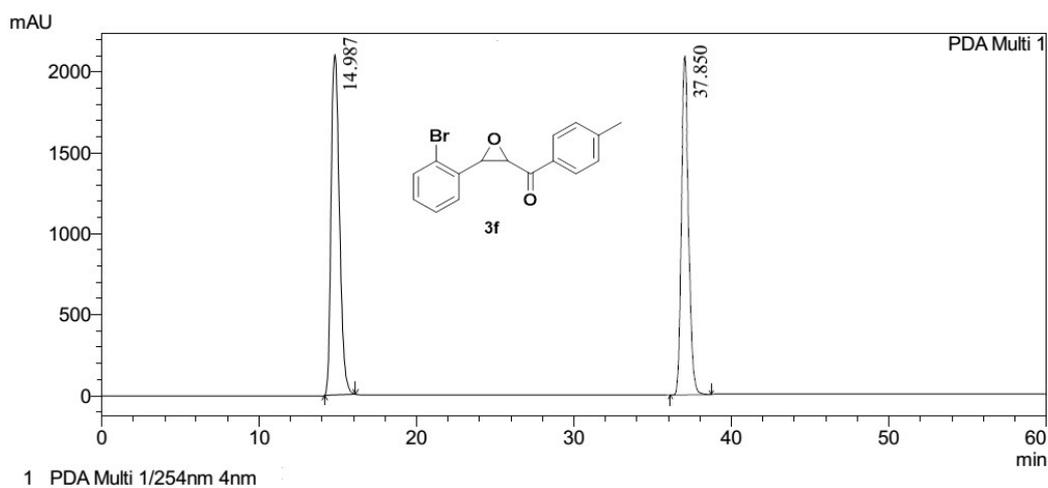


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	17.908	76821577	1226754	93.021	95.364
2	40.933	5711609	146005	2.979	4.636
Total		82533186	1372758	100.000	100.000

Figure S99: HPLC chromatogram of (**3e**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.

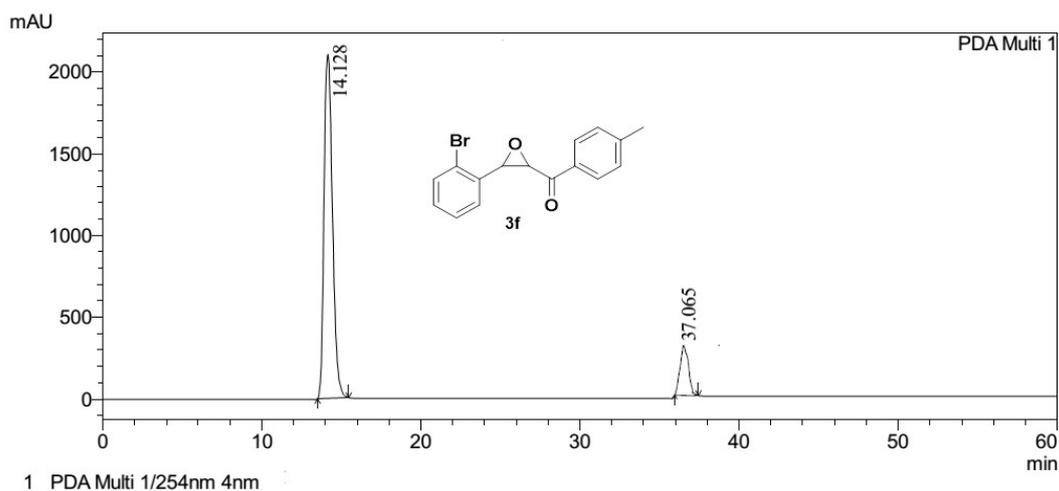


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	14.987	5653681	104342	50.162	51.369
2	37.850	5517457	97410	49.838	48.631
Total		11171138	201752	100.000	100.000

Figure S100: HPLC chromatogram of (**3f**) Racemic mixture.

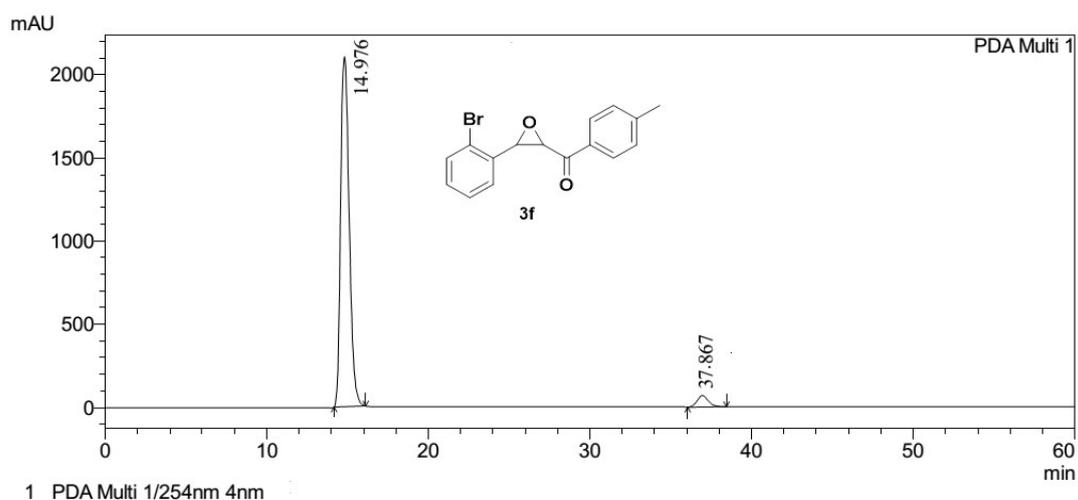


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	14.128	66414870	2381620	92.586	89.713
2	37.065	5317969	273094	7.414	10.287
Total		71732839	2654714	100.000	100.000

Figure S101: HPLC chromatogram of (3f) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.

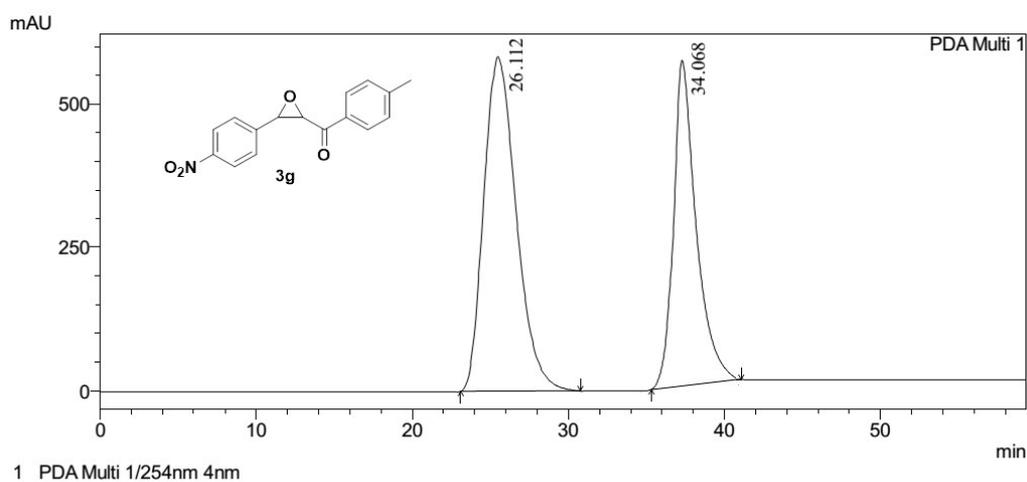


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	14.976	56645792	920867	96.524	97.197
2	37.867	3929714	26560	3.476	2.803
Total		60575506	947427	100.000	100.000

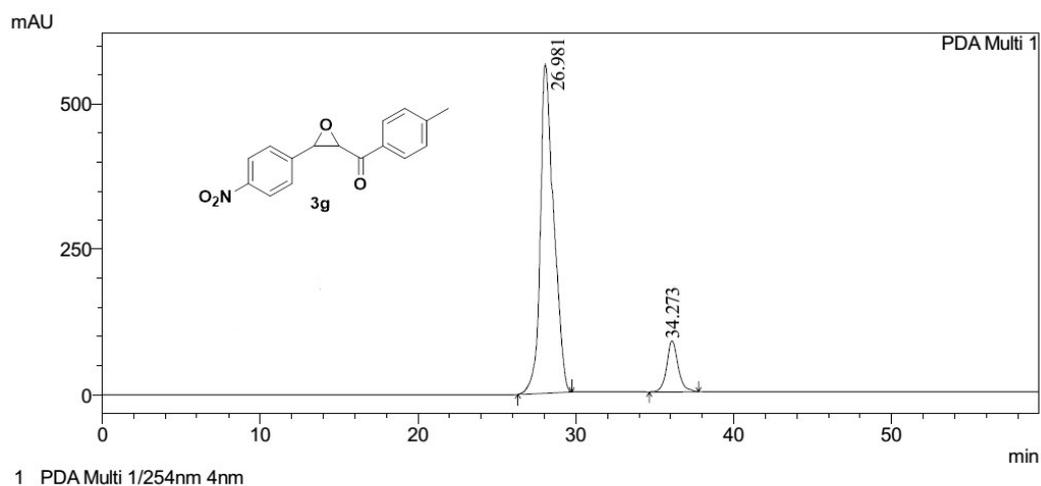
Figure S102: HPLC chromatogram of (3f) in the presence 2 mol % of organocatalyst (12b) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	26.112	9236738	103209	50.607	51.001
2	34.068	9187611	102591	49.393	48.999
Total		18424349	205800	100.000	100.000

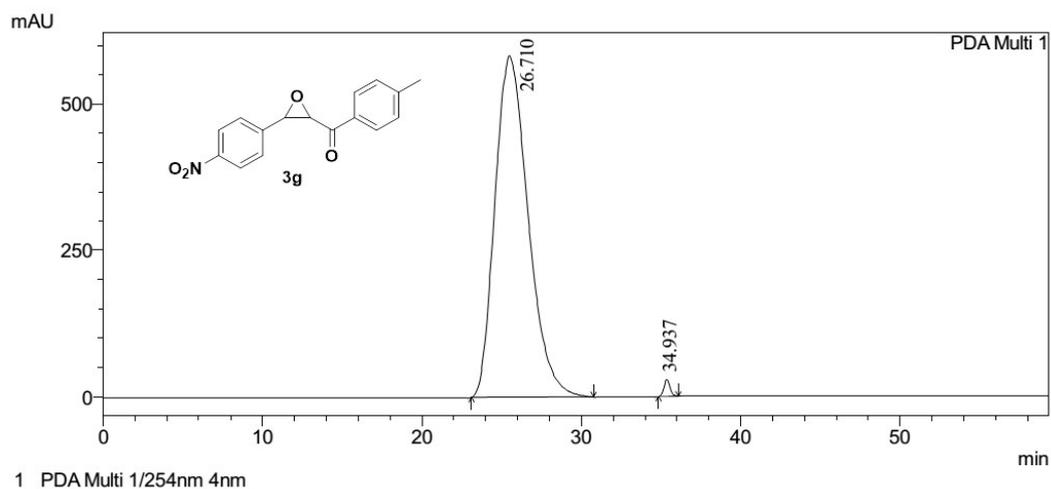
Figure S103: HPLC chromatogram of **(3g)** Racemic mixture.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	26.981	27802899	398992	94.885	93.769
2	34.273	1498877	26514	5.115	6.231
Total		29301776	425507	100.000	100.000

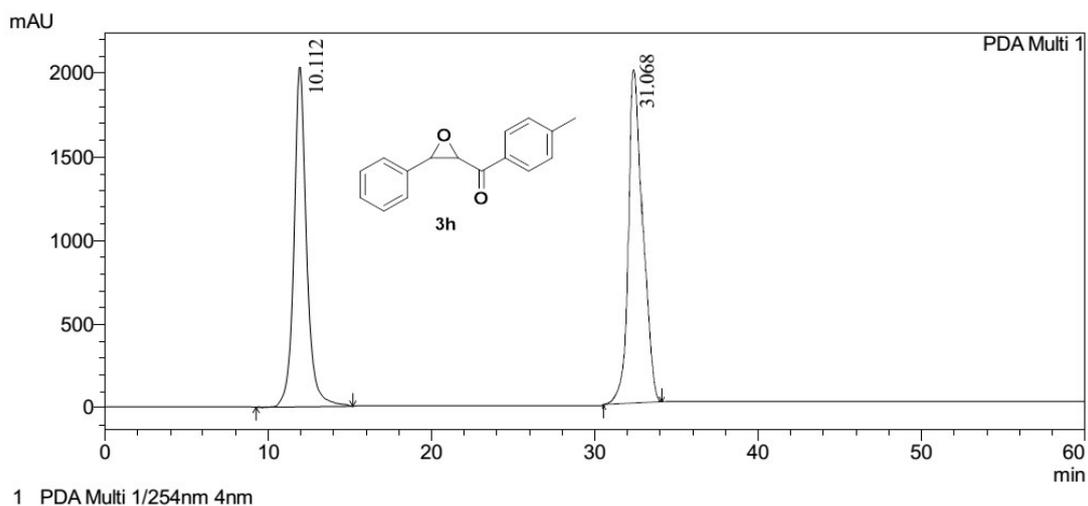
Figure S104: HPLC chromatogram of **(3g)** in the presence 2 mol % of organocatalyst **(12a)** and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	26.710	72949890	507459	99.113	98.604
2	34.937	652804	7184	0.887	1.396
Total		73602695	514642	100.000	100.000

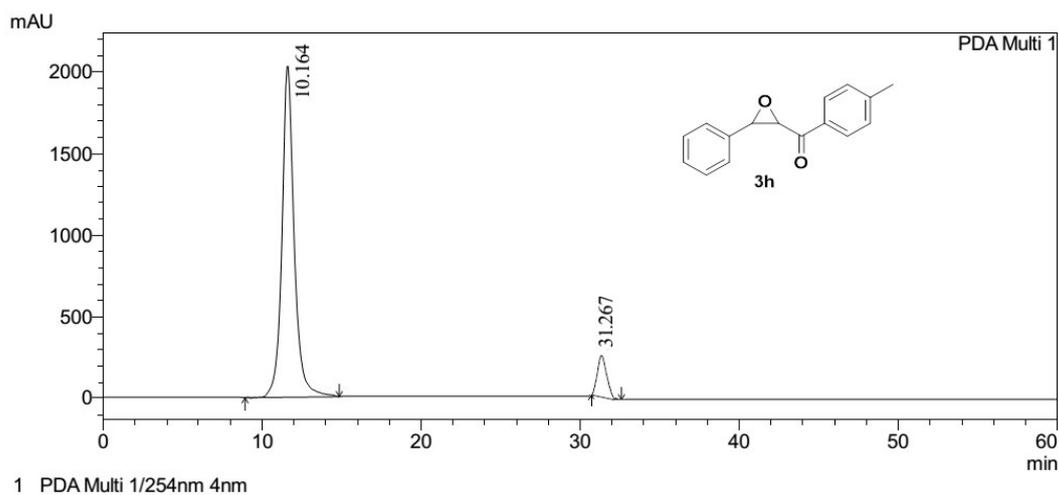
Figure S105: HPLC chromatogram of (**3g**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	10.112	9151863	102571	50.394	51.420
2	31.068	9065393	95256	49.606	48.580
Total		18217256	197826	100.000	100.000

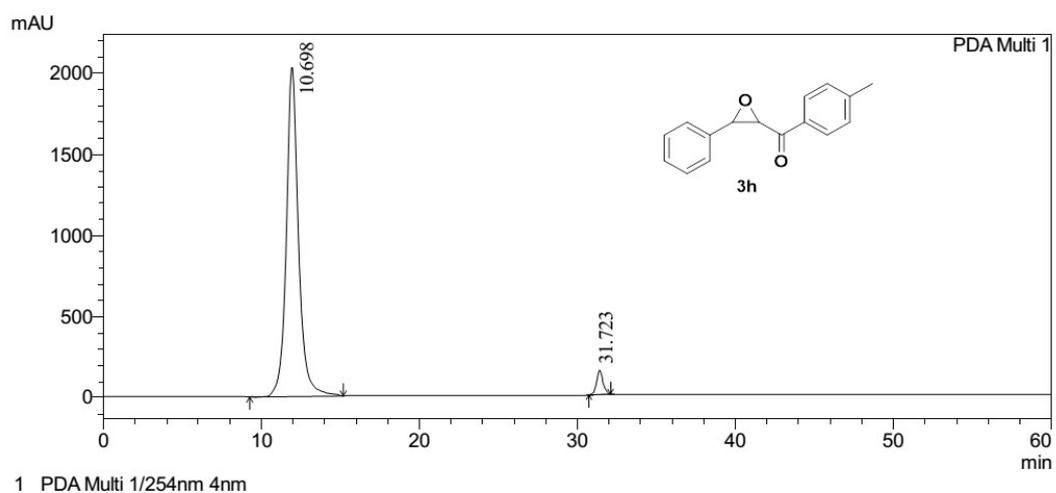
Figure S106: HPLC chromatogram of (**3h**) Racemic mixture.



PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	10.164	36665482	376897	93.816	85.381
2	31.267	2416824	64531	6.184	14.619
Total		39082306	441428	100.000	100.000

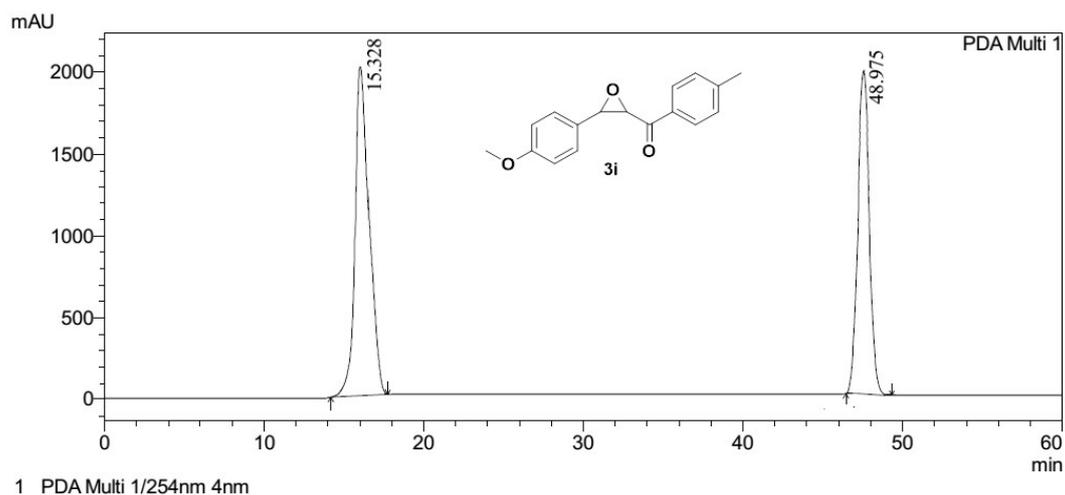
Figure S107: HPLC chromatogram of (**3h**) in the presence 2 mol % of organocatalyst (**12a**) and TBHP/acetonitrile in room temperature condition.



PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	10.698	59989641	2024905	97.580	95.203
2	31.723	1487822	102027	2.420	4.797
Total		61477464	2126932	100.000	100.000

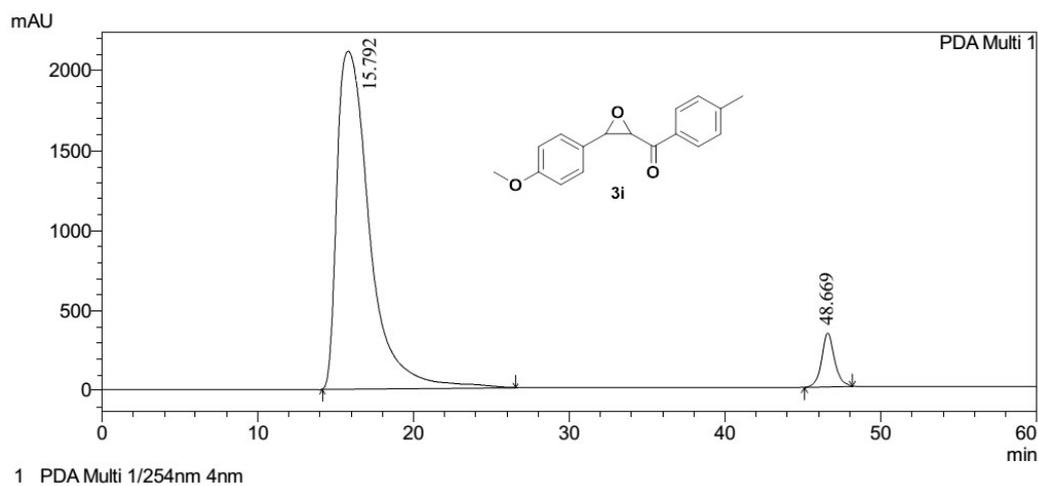
Figure S108: HPLC chromatogram of (**3h**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	15.328	4120354	196930	50.914	52.714
2	48.975	4011796	185535	49.086	47.286
Total		8132150	382465	100.000	100.000

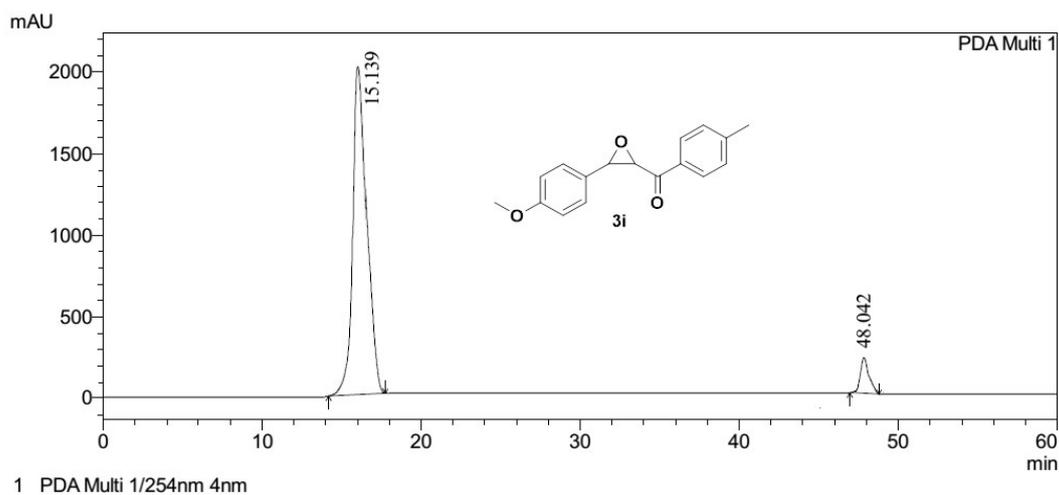
Figure S109: HPLC chromatogram of **(3i)** Racemic mixture.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	15.792	14690360	1273254	91.885	96.459
2	48.669	1297389	19932	8.115	3.541
Total		15987749	1293185	100.000	100.000

Figure S110: HPLC chromatogram of **(3i)** in the presence 2 mol % of organocatalyst **(12a)** and TBHP/acetonitrile in room temperature condition.

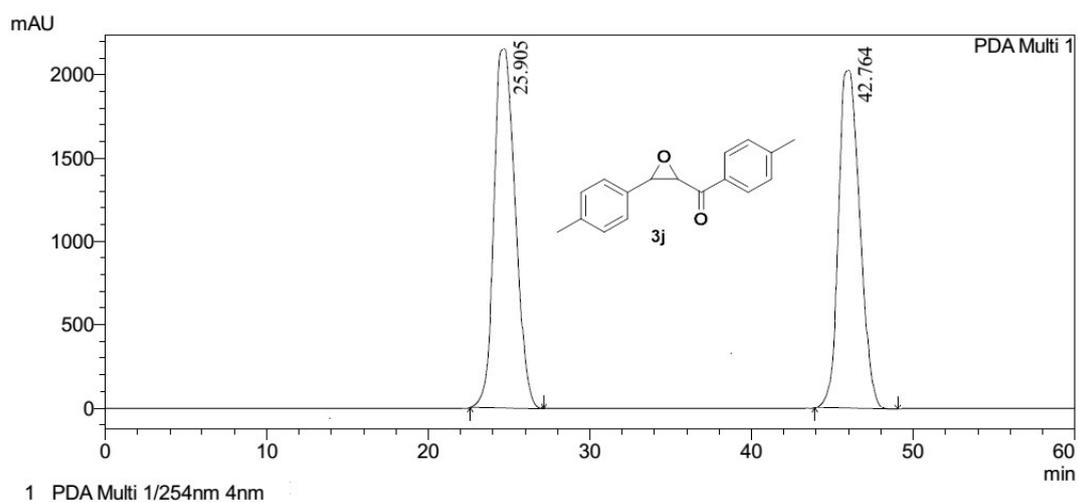


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	15.139	63163666	2142740	96.133	90.976
2	48.042	3936965	212532	4.867	9.024
Total		67100631	2355272	100.000	100.000

Figure S111: HPLC chromatogram of (**3i**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.



PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	25.905	3986453	97339	50.611	51.579
2	42.764	3859166	95403	49.389	48.421
Total		7845619	192742	100.000	100.000

Figure S112: HPLC chromatogram of (**3j**) Racemic mixture.

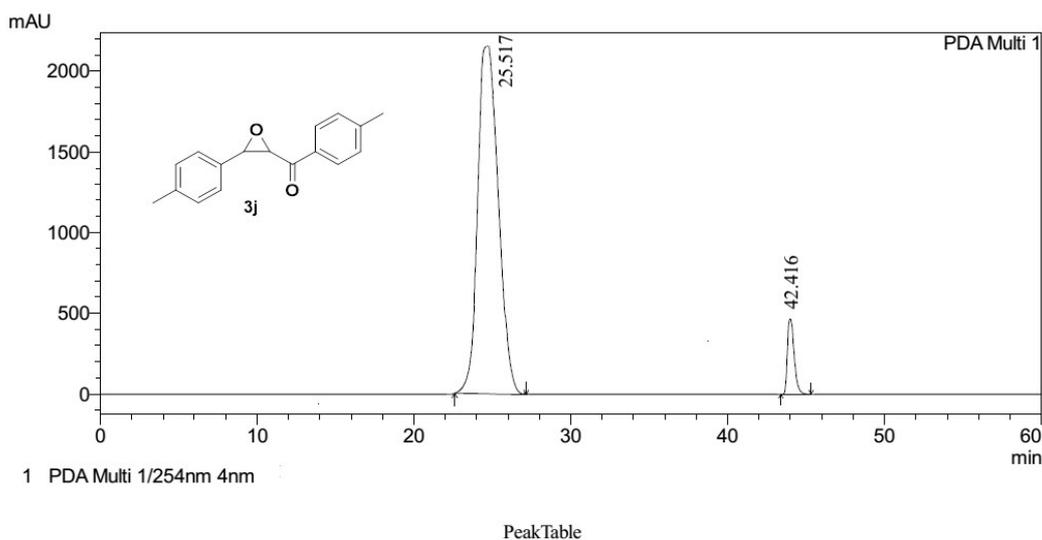


Figure S113: HPLC chromatogram of (3j) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.

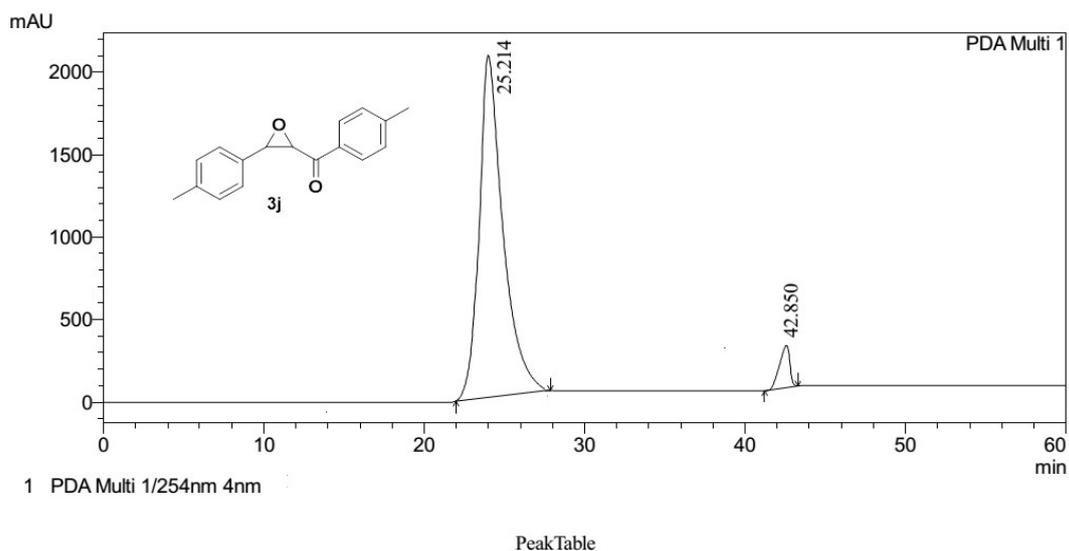
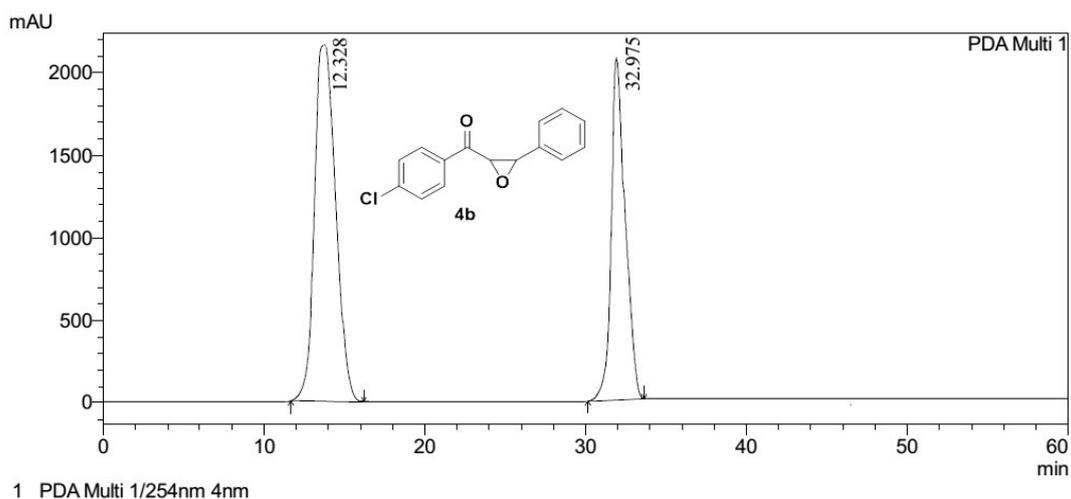


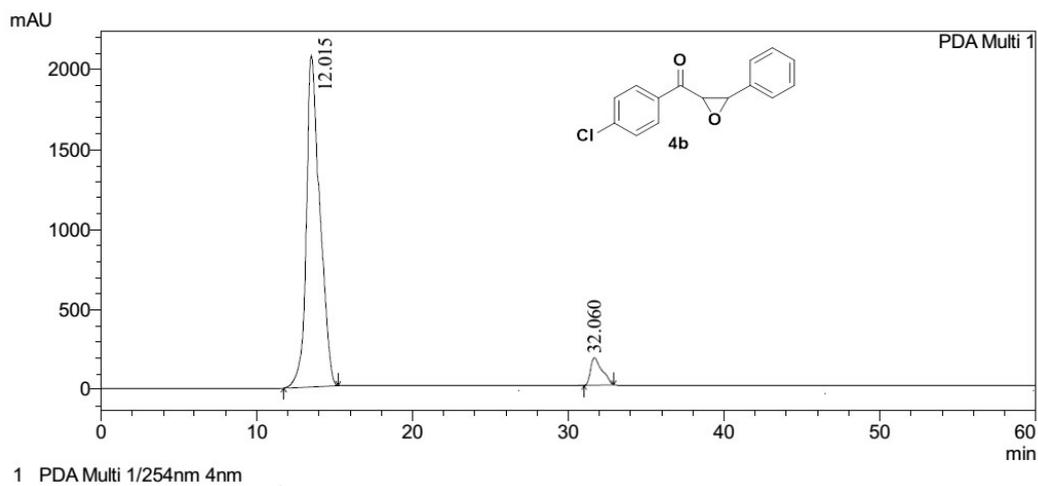
Figure S114: HPLC chromatogram of (3j) in the presence 2 mol % of organocatalyst (12b) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	12.328	4120354	196930	50.914	52.714
2	32.975	4011796	185535	49.086	47.286
Total		8132150	382465	100.000	100.000

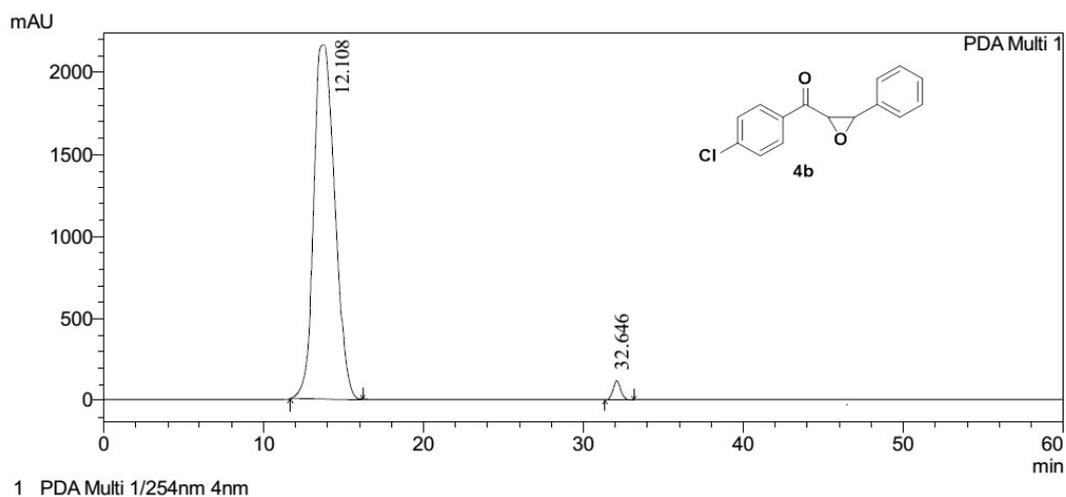
Figure S115: HPLC chromatogram of **(4b)** Racemic mixture.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	12.015	61357098	746211	96.057	93.606
2	32.060	61860393	50970	3.943	6.394
Total		63217491	797180	100.000	100.000

Figure S116: HPLC chromatogram of **(4b)** in the presence 2 mol % of organocatalyst **(12a)** and TBHP/acetonitrile in room temperature condition.

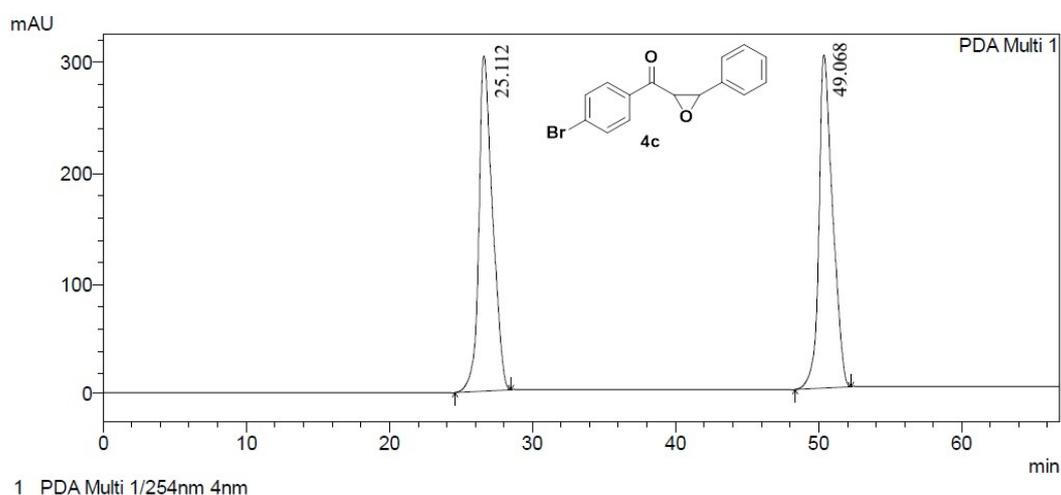


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	12.108	68931819	2182365	98.584	98.087
2	32.646	989860	42564	1.416	1.913
Total		69921680	2224929	100.000	100.000

Figure S117: HPLC chromatogram of (**4b**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.

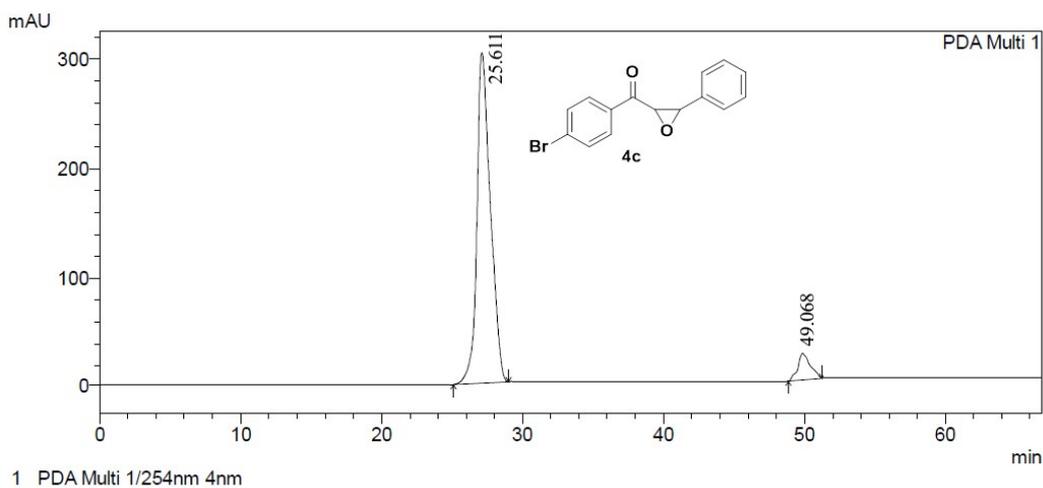


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	25.112	9236738	103209	50.607	51.001
2	49.068	9187611	102591	49.393	48.999
Total		18424349	205800	100.000	100.000

Figure S118: HPLC chromatogram of (**4c**) Racemic mixture.

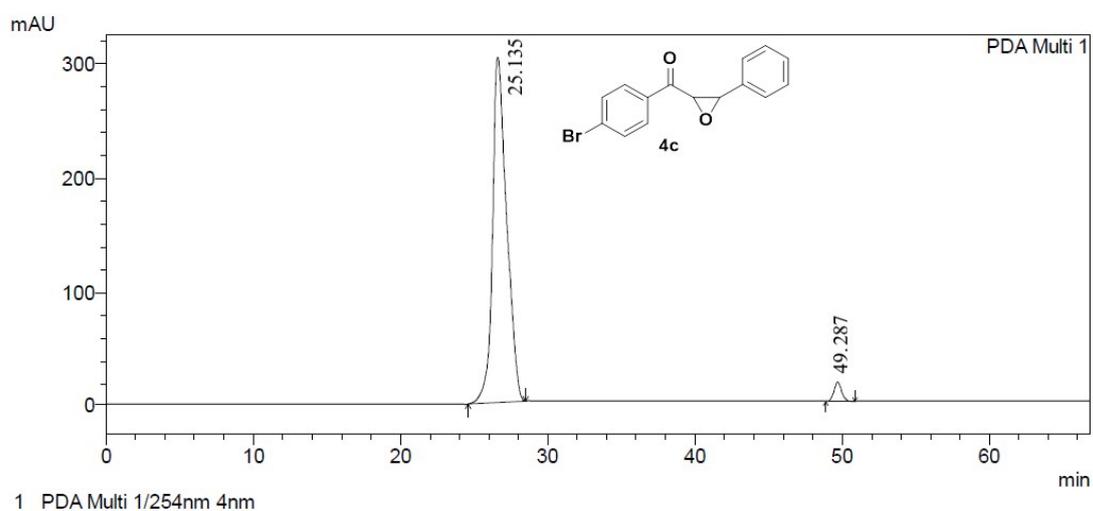


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	25.611	2753234	112968	95.961	98.933
2	49.068	115892	1219	4.039	1.067
Total		2869127	114187	100.000	100.000

Figure S119: HPLC chromatogram of (**4c**) in the presence 2 mol % of organocatalyst (**12a**) and TBHP/acetonitrile in room temperature condition.

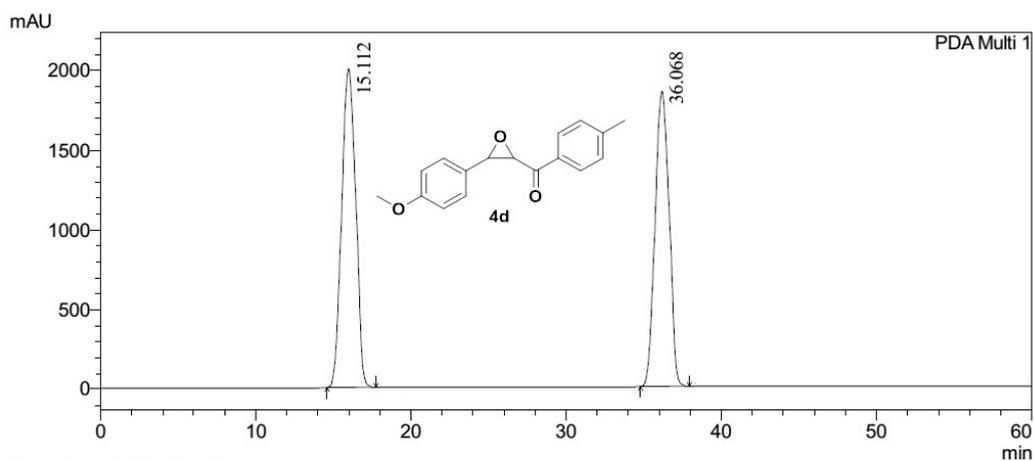


PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	25.135	27835219	399135	98.489	94.977
2	49.287	427069	21110	1.511	5.023
Total		28262287	420246	100.000	100.000

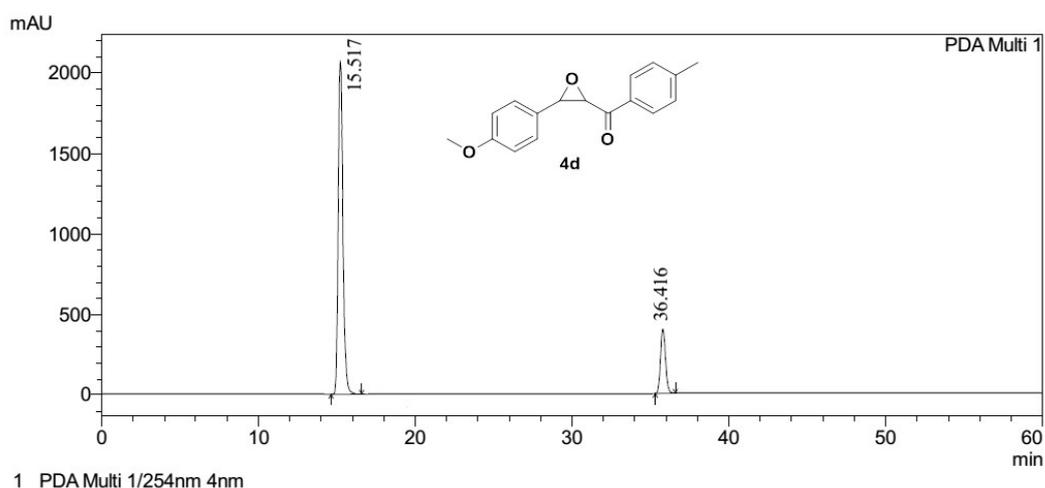
Figure S120: HPLC chromatogram of (**4c**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	15.112	9151863	102571	50.394	51.420
2	36.068	9065393	95256	49.606	48.580
Total		18217256	197826	100.000	100.000

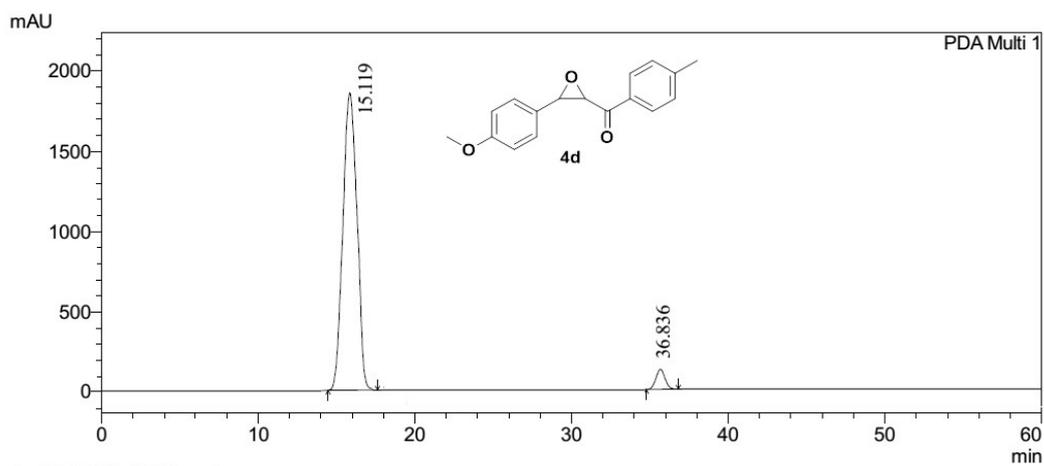
Figure S121: HPLC chromatogram of **(4d)** Racemic mixture.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	15.517	16288090	453694	93.044	88.009
2	36.416	1217689	61815	6.956	11.991
Total		17505779	515509	100.000	100.000

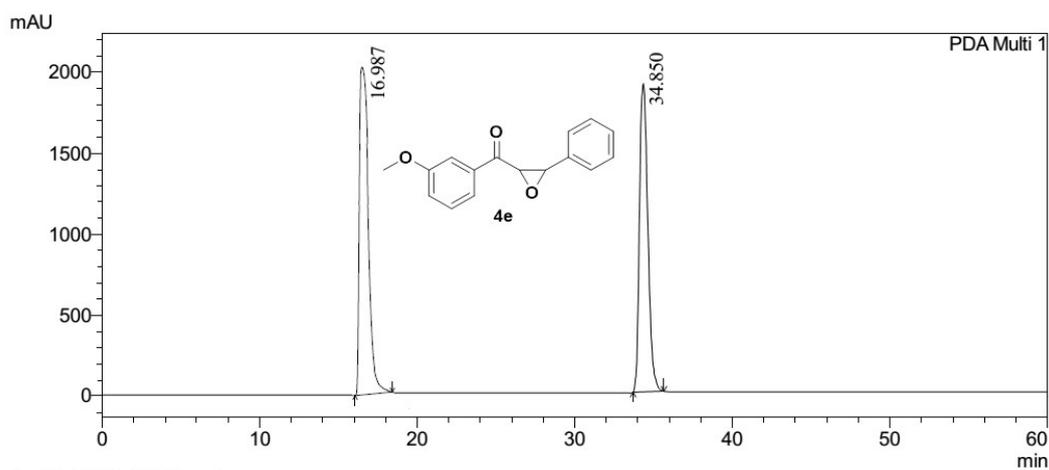
Figure S122: HPLC chromatogram of **(4d)** in the presence 2 mol % of organocatalyst **(12a)** and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	15.119	1973568	8839	96.216	88.640
2	36.836	77623	1133	3.784	11.360
Total		2051191	9971	100.000	100.000

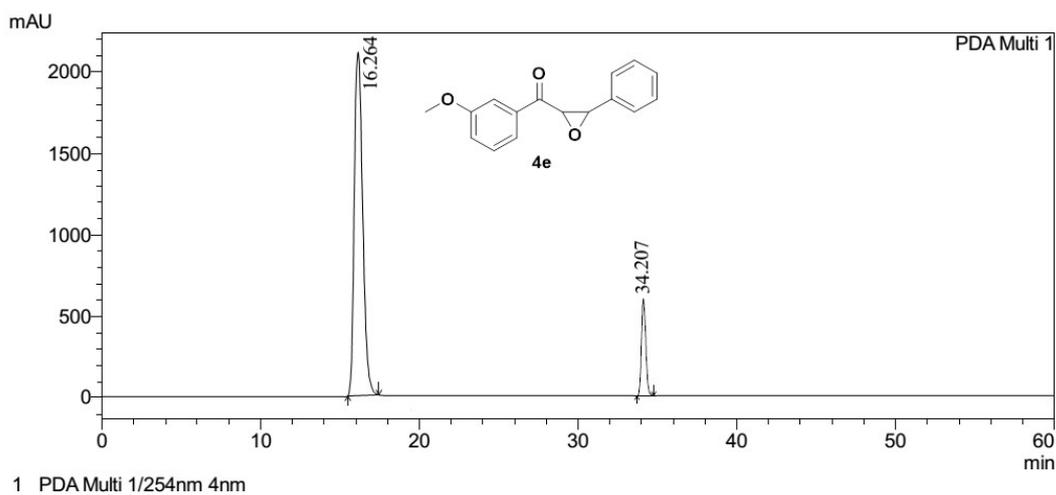
Figure S123: HPLC chromatogram of (**4d**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	16.987	5653681	104342	50.162	51.369
2	34.850	5517457	97410	49.838	48.631
Total		11171138	201752	100.000	100.000

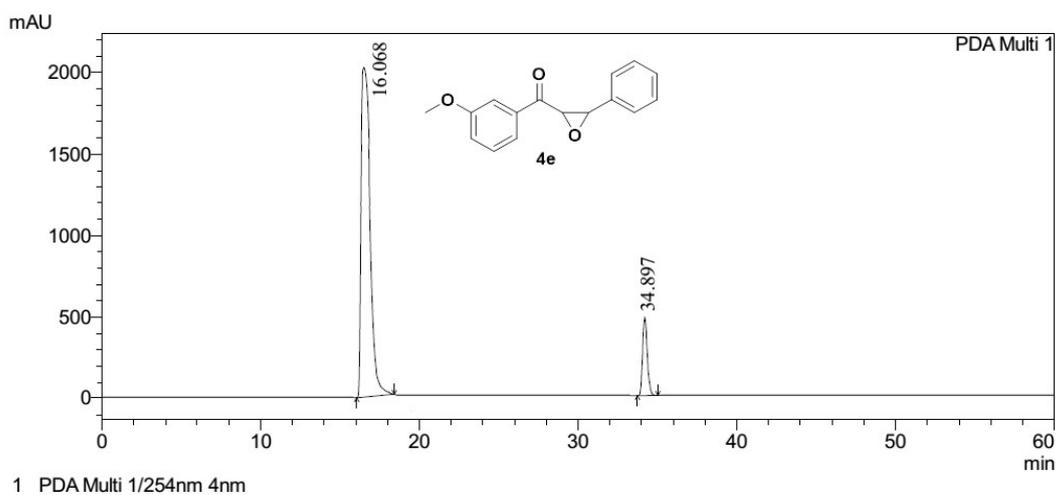
Figure S124: HPLC chromatogram of (**4e**) Racemic mixture.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	16.264	8473498	108659	83.721	74.717
2	34.207	1647576	36770	16.279	25.283
Total		10121074	145429	100.000	100.000

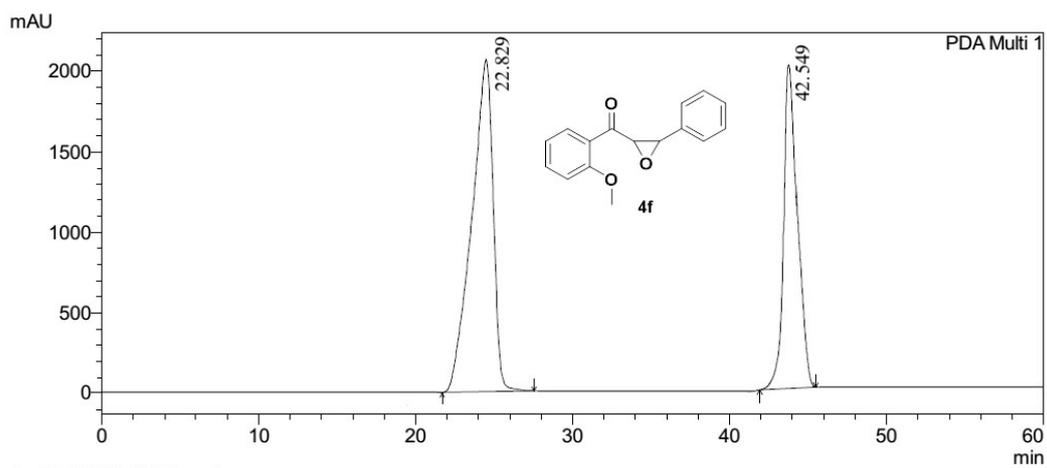
Figure S125: HPLC chromatogram of (**4e**) in the presence 2 mol % of organocatalyst (**12a**) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	16.068	62187860	2088838	87.957	84.178
2	34.897	6943057	392620	12.043	15.822
Total		69130916	2481458	100.000	100.000

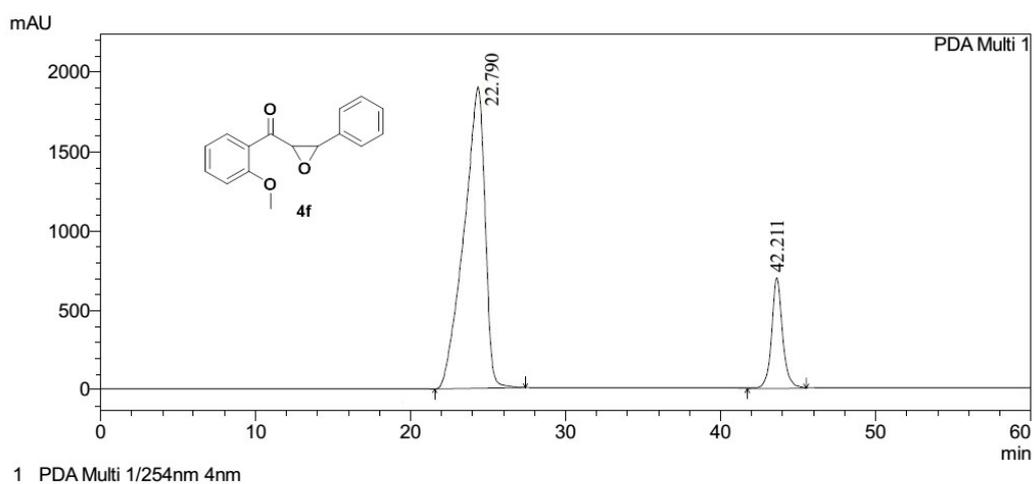
Figure S126: HPLC chromatogram of (**4e**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	22.829	1973568	8839	50.216	51.640
2	42.549	1877623	8433	49.784	48.360
Total		3851191	17272	100.000	100.000

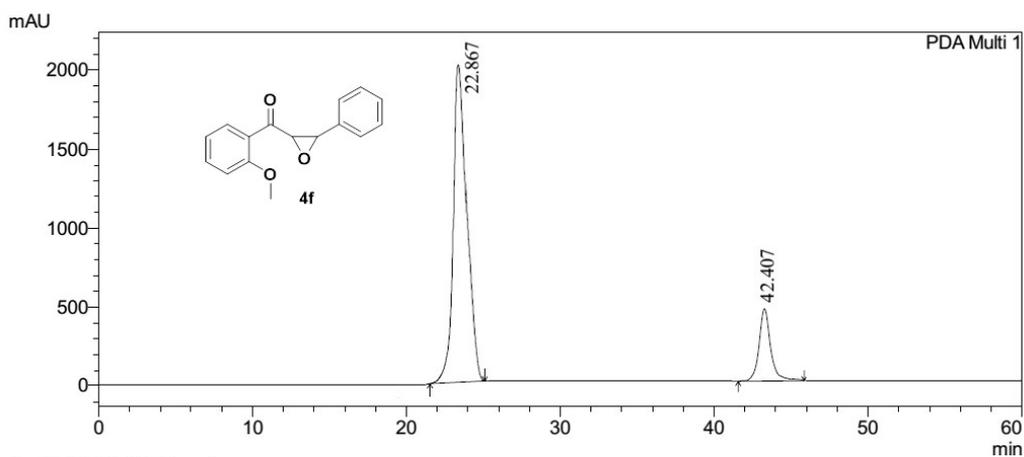
Figure S127: HPLC chromatogram of (4f) Racemic mixture.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	22.790	94686876	1249027	80.058	89.034
2	42.211	23585725	153840	19.942	10.966
Total		118272601	1402868	100.000	100.000

Figure S128: HPLC chromatogram of (4f) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.

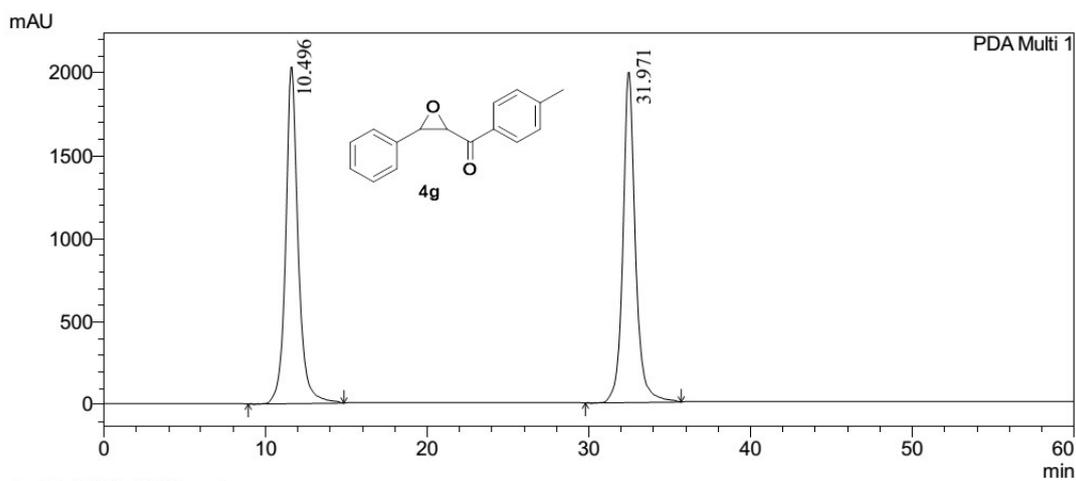


PDA Ch1 254nm 4nm

PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	22.867	24206970	377437	86.330	93.313
2	42.407	3833205	27046	13.670	6.687
Total		28040175	404483	100.000	100.000

Figure S129: HPLC chromatogram of (4f) in the presence 2 mol % of organocatalyst (12b) and TBHP/acetonitrile in room temperature condition.

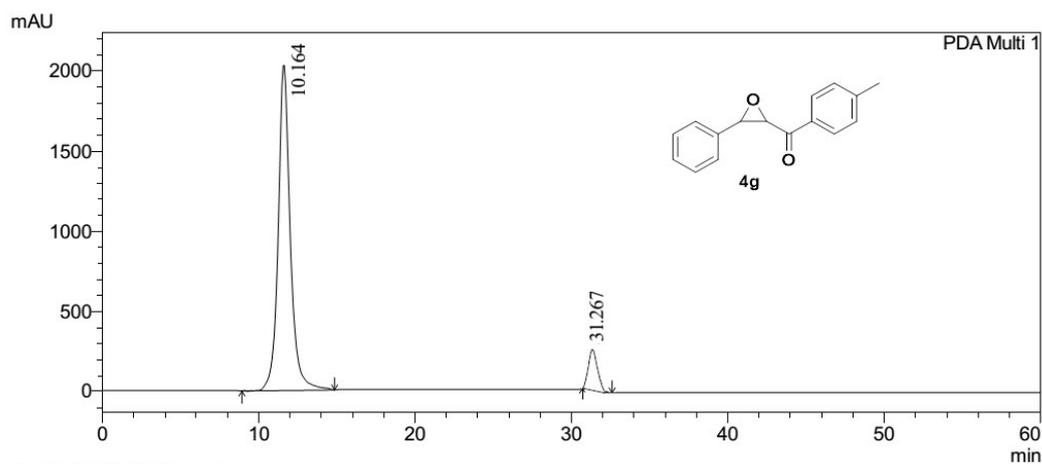


PDA Ch1 254nm 4nm

PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	10.496	20622334	254758	50.214	51.370
2	31.971	19741162	230817	49.786	48.630
Total		40363496	485575	100.000	100.000

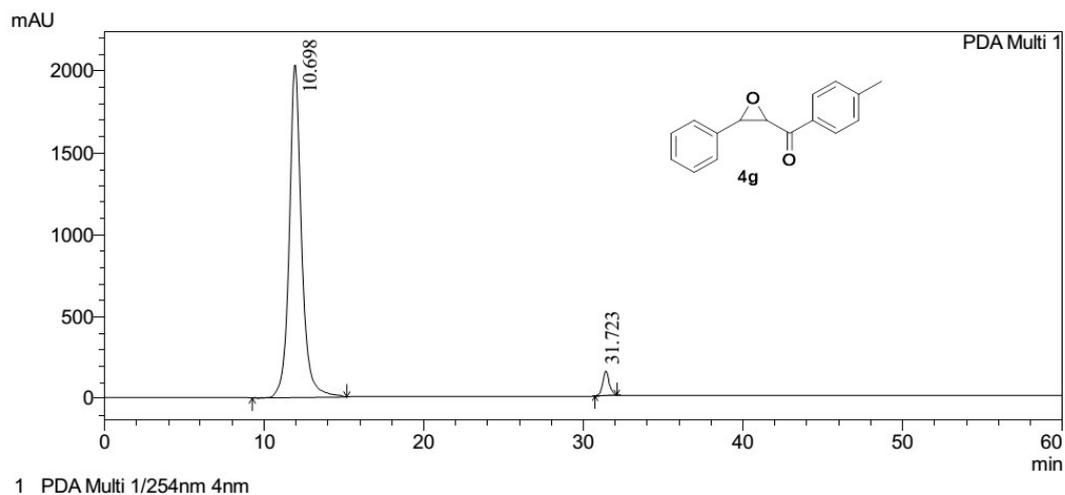
Figure S130: HPLC chromatogram of (4g) Racemic mixture.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	10.164	36665482	376897	93.816	85.381
2	31.267	2416824	64531	6.184	14.619
Total		39082306	441428	100.000	100.000

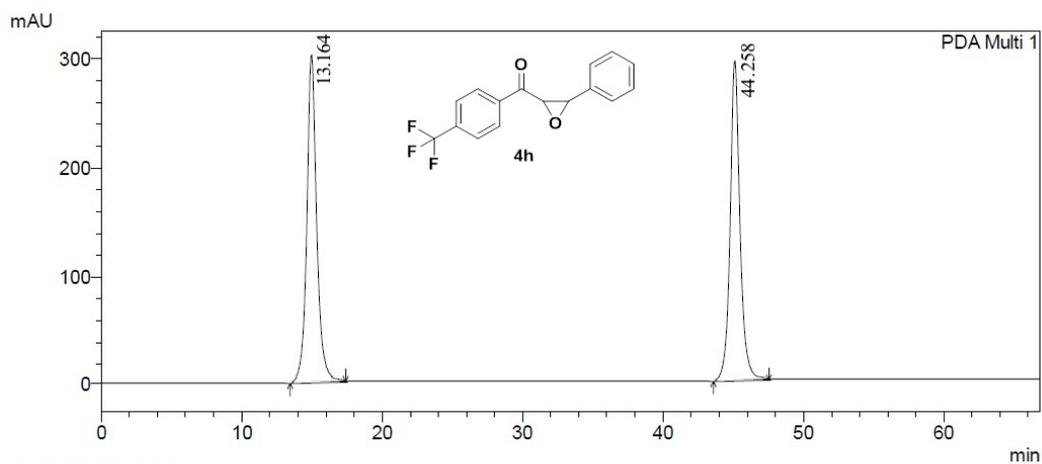
Figure S131: HPLC chromatogram of (4g) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	10.698	59989641	2024905	97.580	95.203
2	31.723	1487822	102027	2.420	4.797
Total		61477464	2126932	100.000	100.000

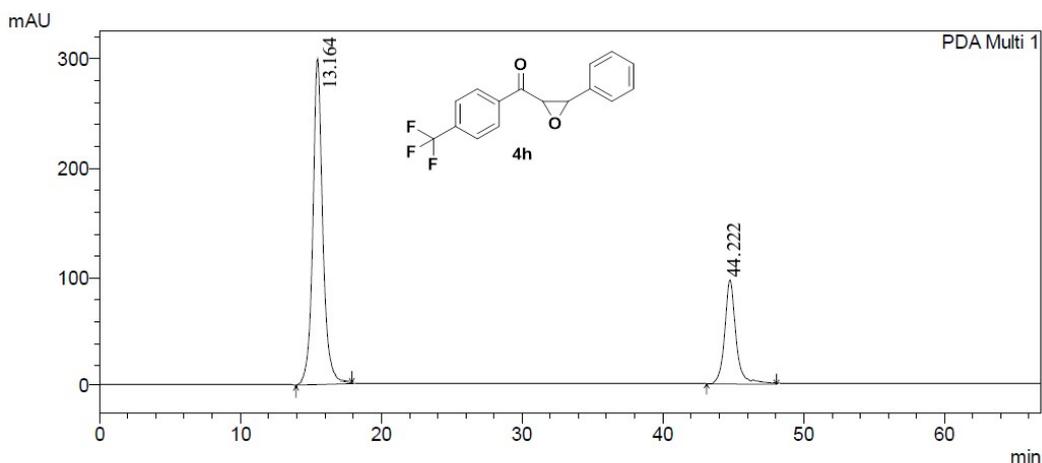
Figure S132: HPLC chromatogram of (4g) in the presence 2 mol % of organocatalyst (12b) and TBHP/acetonitrile in room temperature condition.



Peak Table

Peak#	Ret. Time	Area	Height	Area %	Height %
1	13.164	36525852	399404	50.753	51.826
2	44.258	35721829	371448	49.247	48.174
Total		72247681	770851	100.000	100.000

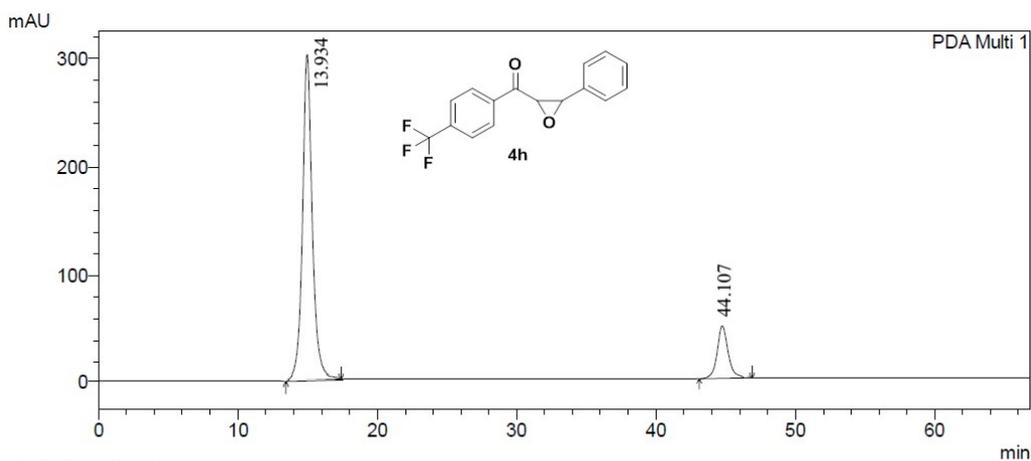
Figure S133: HPLC chromatogram of (4h) Racemic mixture.



Peak Table

Peak#	Ret. Time	Area	Height	Area %	Height %
1	13.164	36525852	399404	90.753	84.826
2	44.222	3721829	71448	9.247	15.174
Total		40247681	470851	100.000	100.000

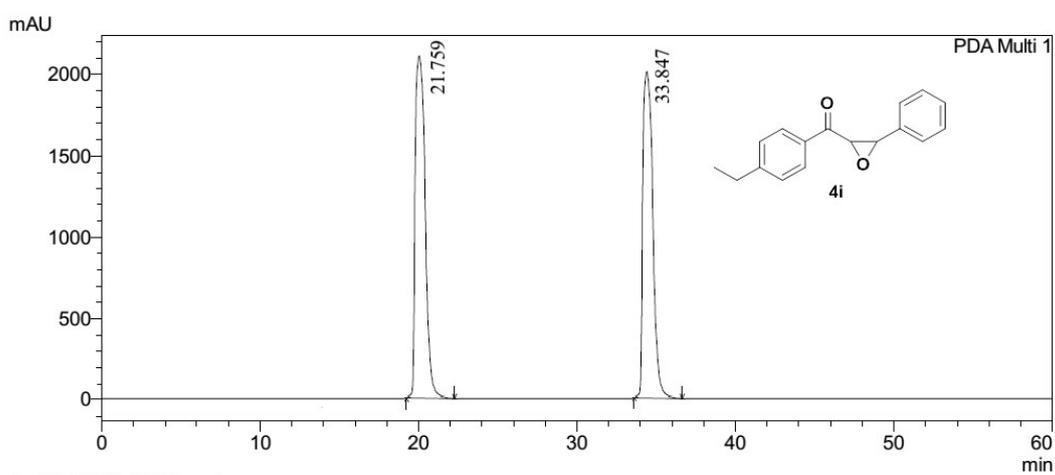
Figure S134: HPLC chromatogram of (4h) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	13.934	3904352	75789	96.378	95.441
2	44.107	146742	3620	3.622	4.559
Total		4051094	79409	100.000	100.000

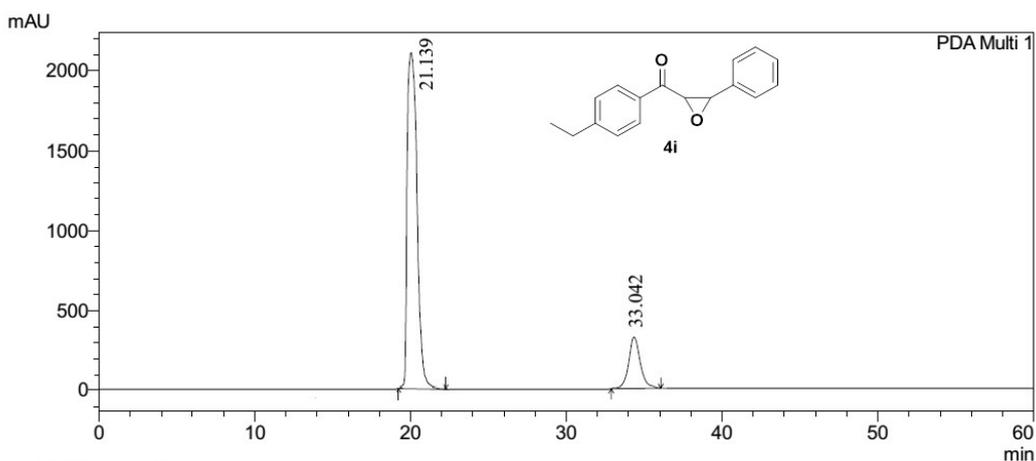
Figure S135: HPLC chromatogram of (**4h**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	21.759	1362622	9131	50.357	51.296
2	33.847	1222762	8981	49.643	48.704
Total		2585384	18112	100.000	100.000

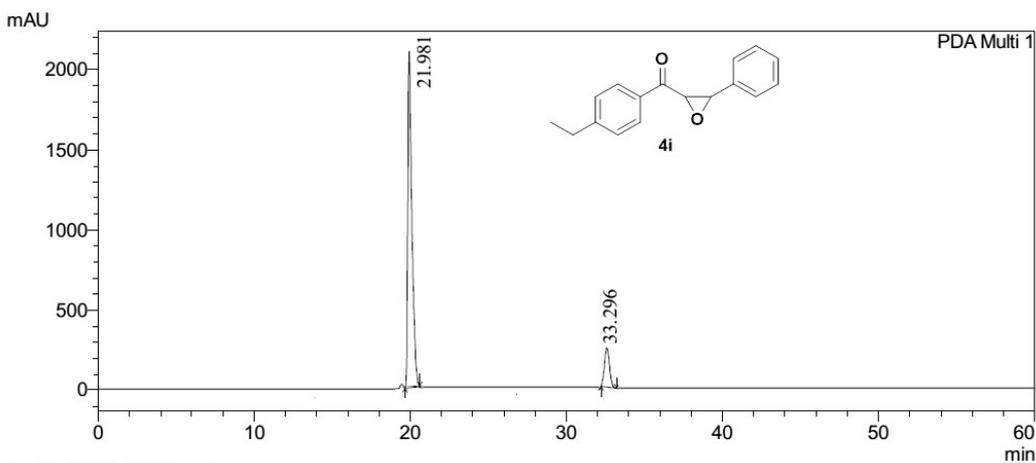
Figure S136: HPLC chromatogram of (**4i**) Racemic mixture.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	21.139	63163666	2142740	94.133	90.976
2	33.042	3936965	212532	5.867	9.024
Total		67100631	2355272	100.000	100.000

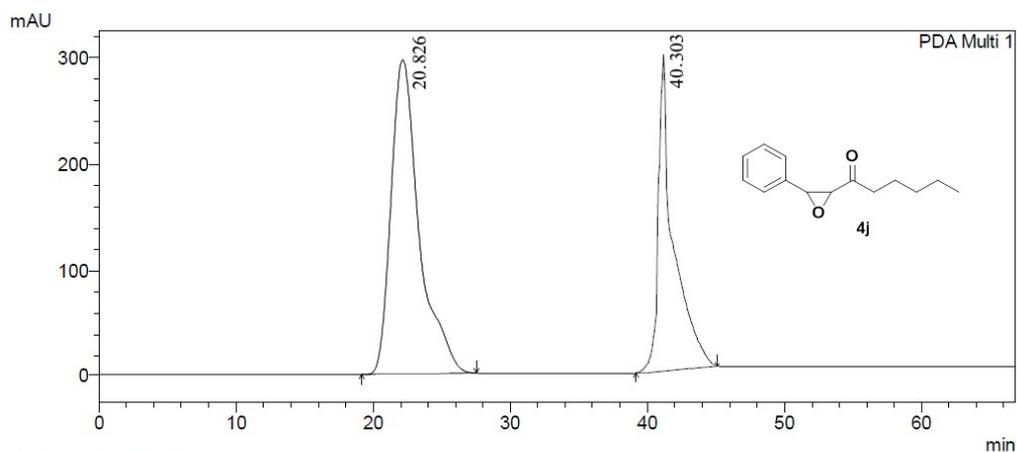
Figure S137: HPLC chromatogram of (4i) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	21.981	27835219	399135	98.489	94.977
2	33.296	427069	21110	1.511	5.023
Total		28262287	420246	100.000	100.000

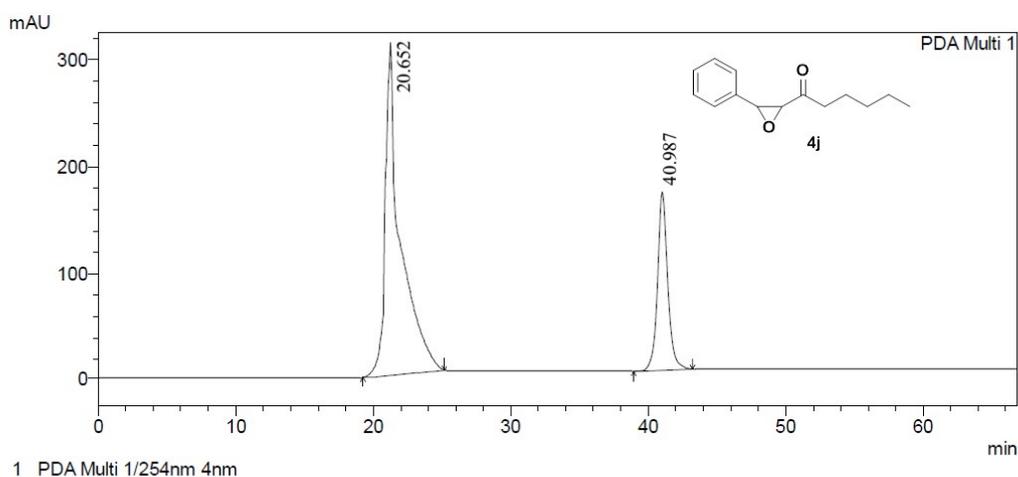
Figure S138: HPLC chromatogram of (4i) in the presence 2 mol % of organocatalyst (12b) and TBHP/acetonitrile in room temperature condition.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.826	6412071	85516	50.674	51.910
2	40.303	6338383	83187	49.326	48.090
Total		12750455	168703	100.000	100.000

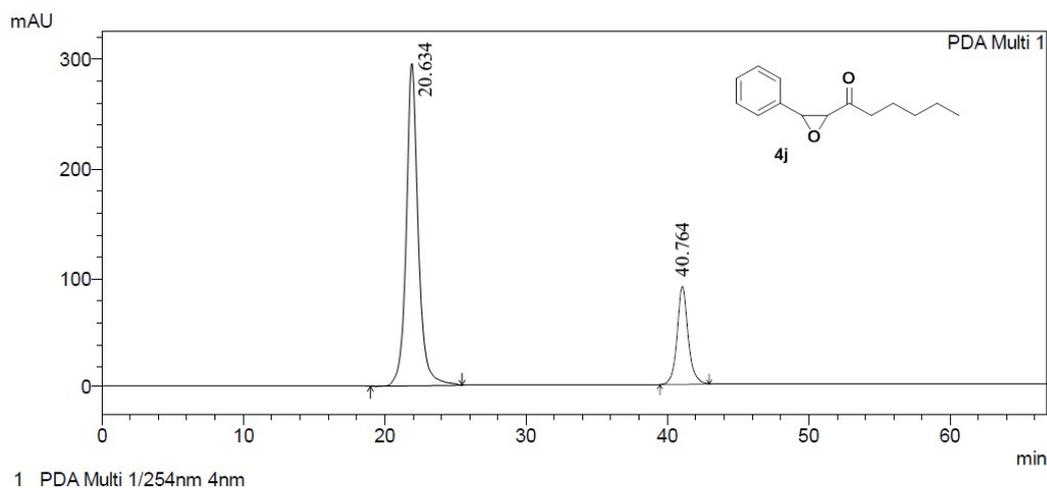
Figure S139: HPLC chromatogram of (4i) Racemic mixture.



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.652	1677846	72754	82.584	80.046
2	40.987	353831	8042	17.416	19.954
Total		2031677	80797	100.000	100.000

Figure S140: HPLC chromatogram of (4j) in the presence 2 mol % of organocatalyst (12a) and TBHP/acetonitrile in room temperature condition.



PeakTable

PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	20.634	6770649	261063	85.713	94.819
2	40.764	1128573	14265	14.287	5.181
Total		7899222	275328	100.000	100.000

Figure S141: HPLC chromatogram of (**4j**) in the presence 2 mol % of organocatalyst (**12b**) and TBHP/acetonitrile in room temperature condition.

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