Electronic Supplementary Material (ESI) for RSC Advances.

Highly efficient homogeneous and heterogenized ruthenium catalysts for transfer hydrogenation of carbonyl compounds

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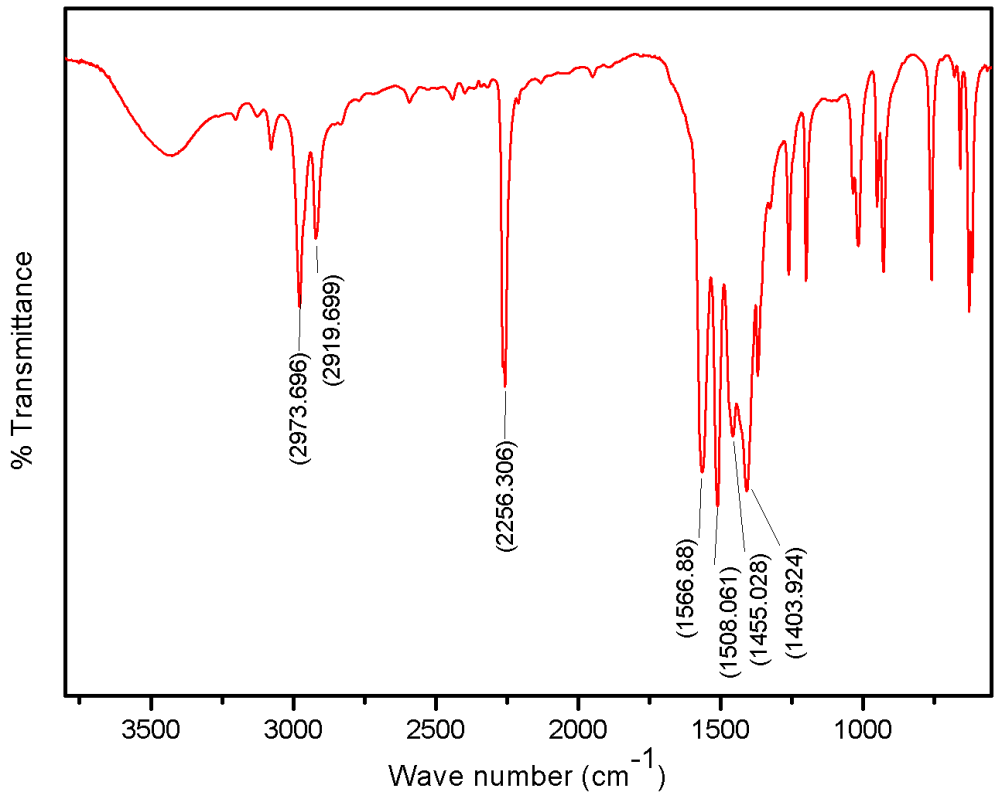


Figure S1. FT-IR spectrum of $[Ru(acac)_2(CH_3CN)_2]$

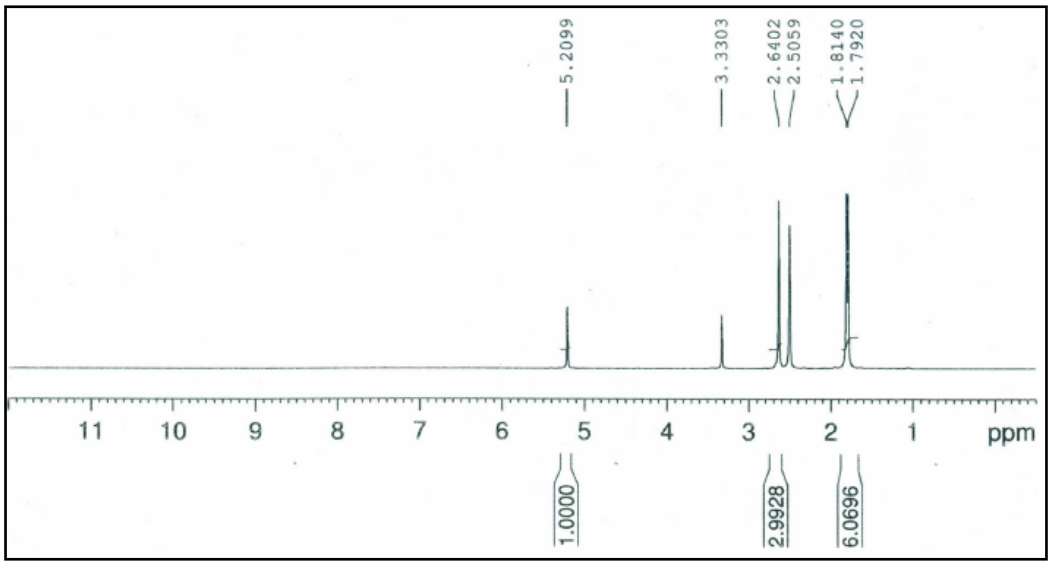


Figure S2. ^1H NMR spectrum of $[Ru(acac)_2(CH_3CN)_2]$

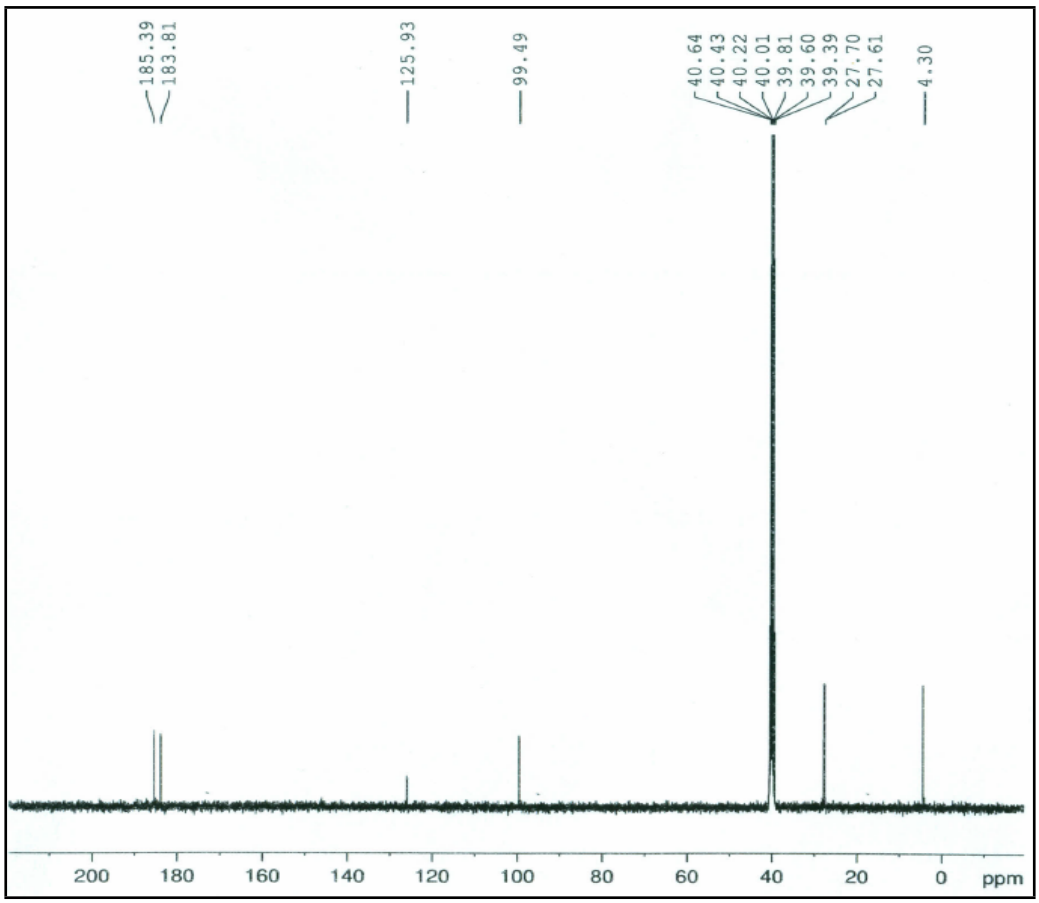
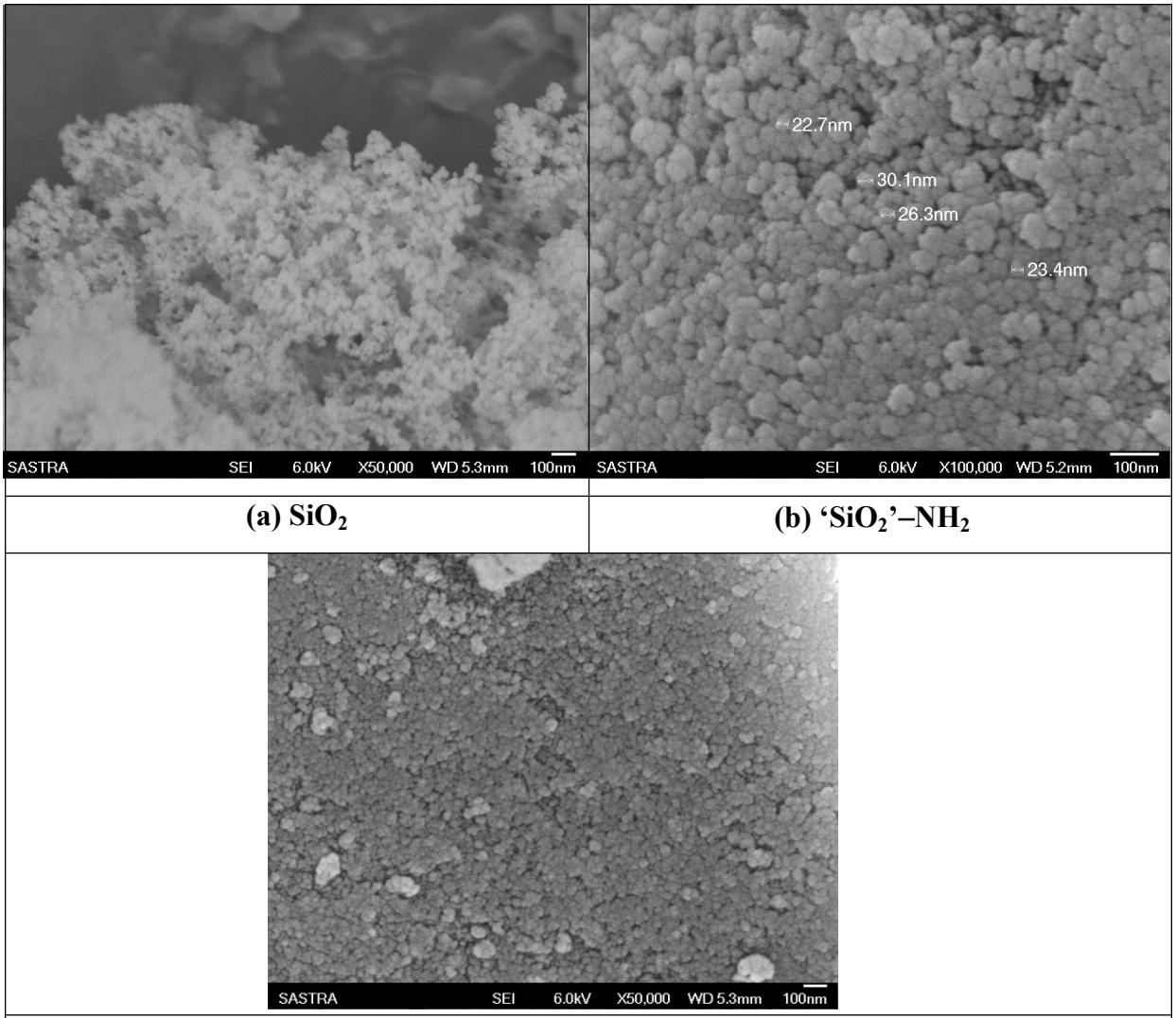


Figure S3. ^{13}C NMR spectrum of $[Ru(acac)_2(CH_3CN)_2]$



(a) SiO_2 **(b) 'SiO_2'–NH_2**

(c) 'SiO_2'–NH_2–Ru^{II}

Figure S4. SEM images of (a) SiO_2, (b) 'SiO_2'–NH_2 and (c) 'SiO_2'–NH_2–Ru^{II}

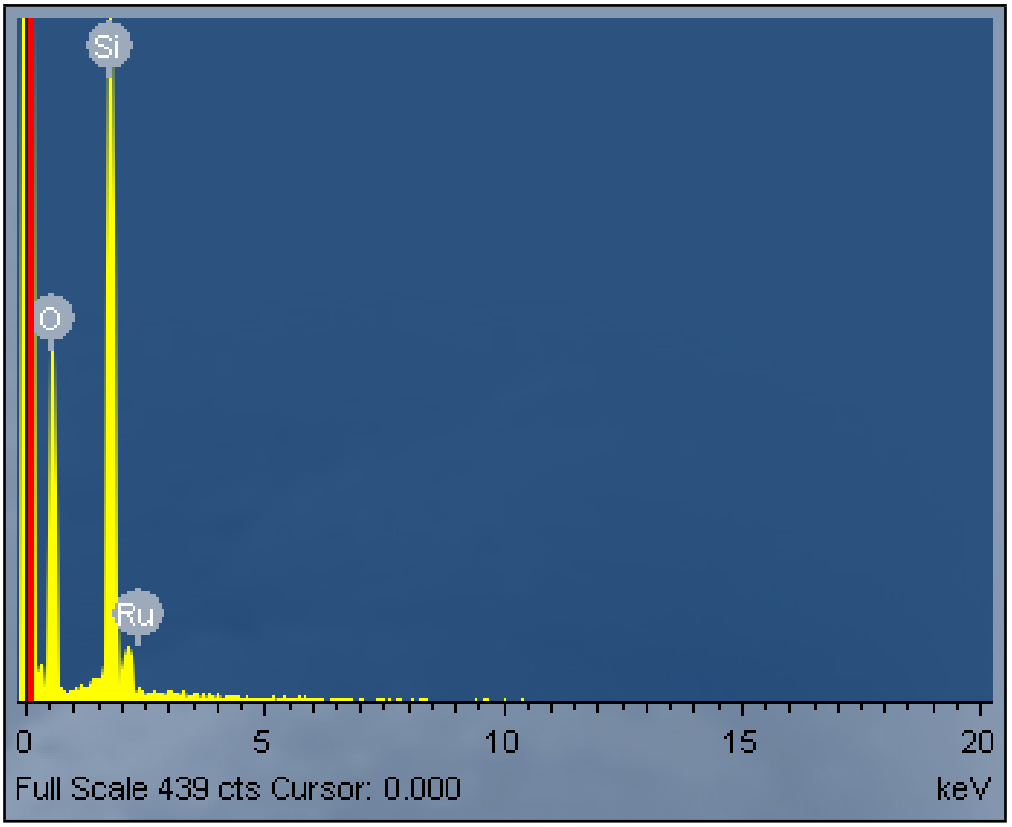
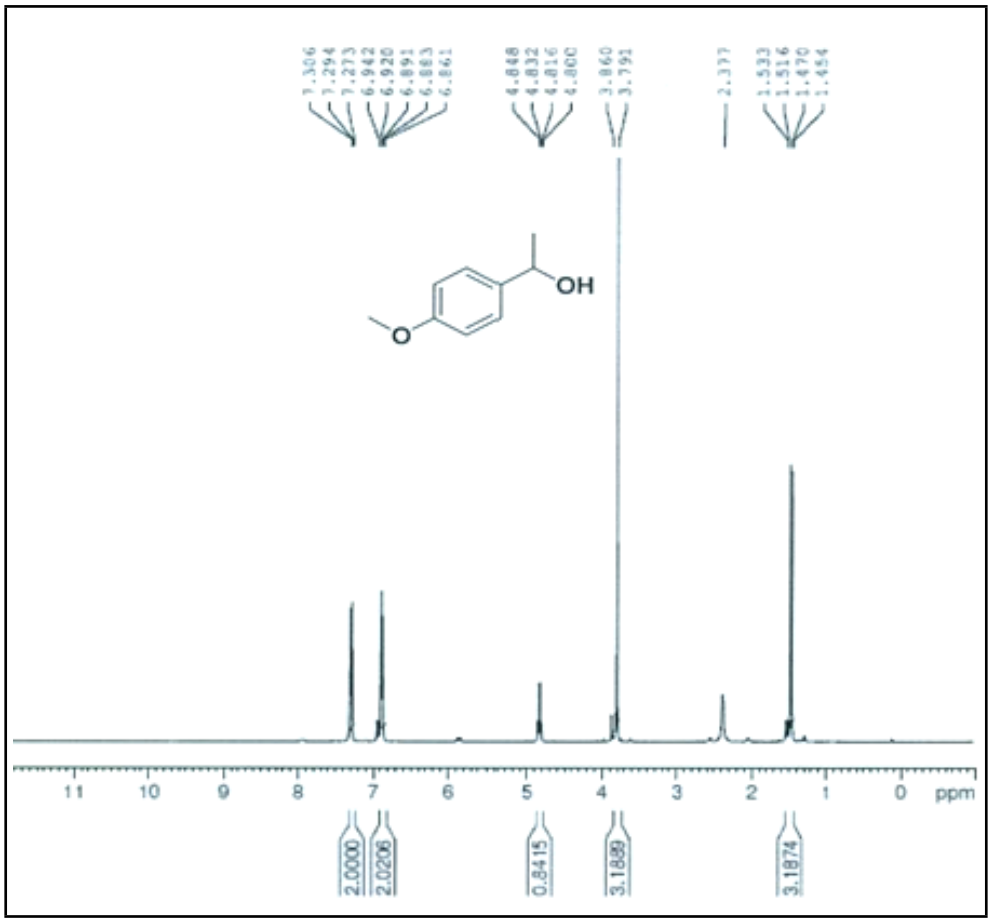


Figure S5. SEM-EDX of 'SiO_2'–NH_2–Ru^{II}

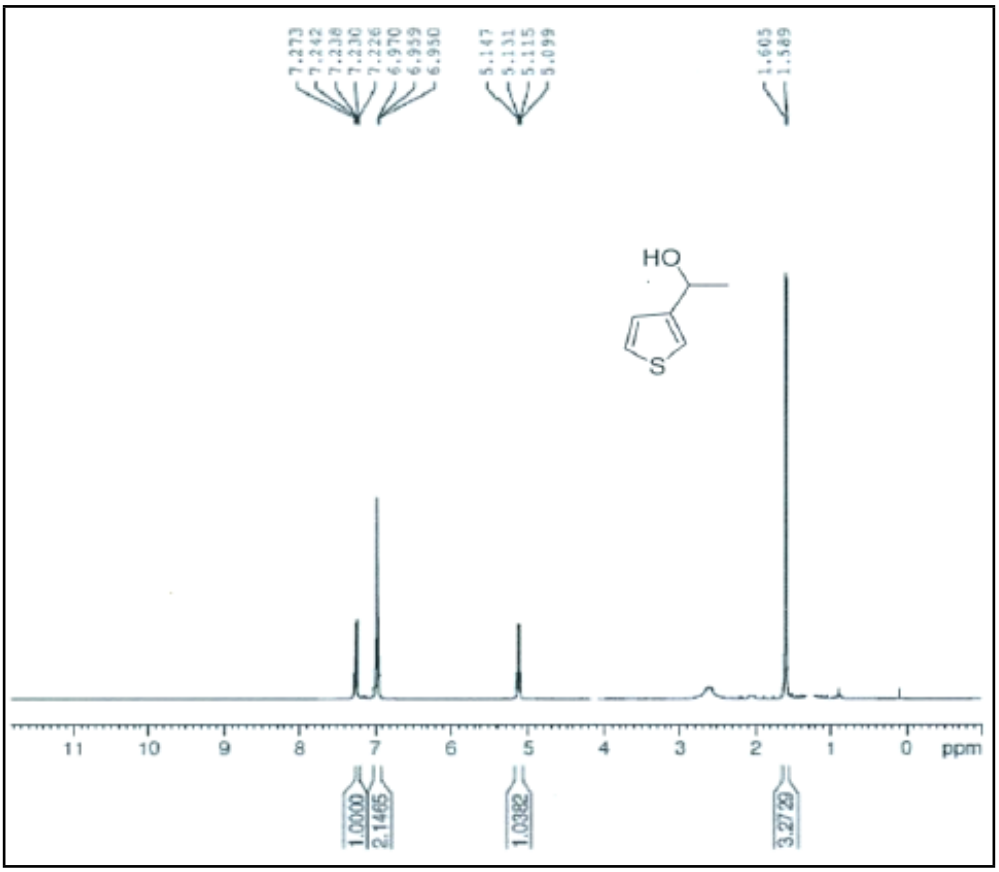
1. (Table 2, entry 7)

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) δ 1.46 (d, J = 6.40 Hz, 3H), 3.79 (s, 3H), 4.82 (q, J = 6.40 Hz, 1H), 6.88 (t, J = 8.80 Hz, 2H), 7.29 (t, J = 8.40 Hz, 2H).



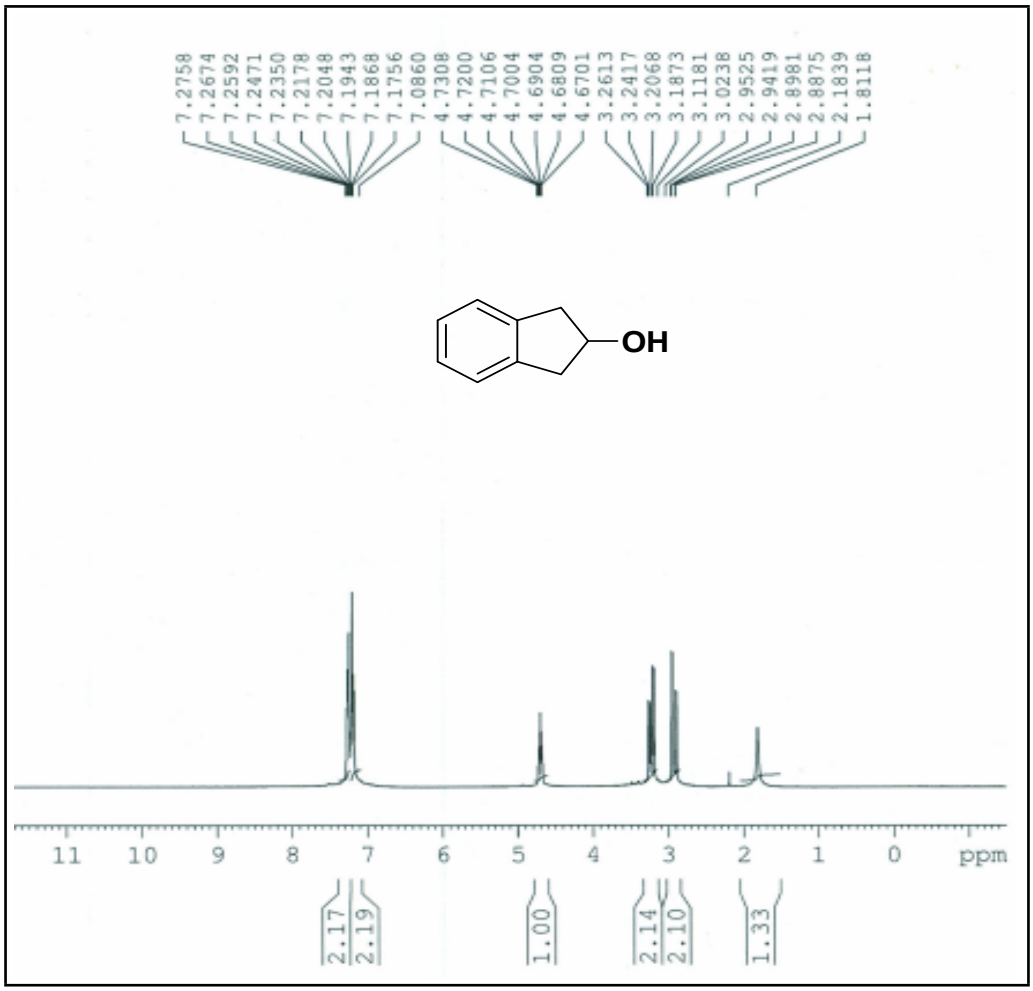
2. (Table 4, entry 6)

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 1.60 (d, *J* = 6.40 Hz, 3H), 5.12 (q, *J* = 6.40 Hz, 1H), 6.96 (d, *J* = 8.00 Hz, 2H), 7.22-7.24 (m, 1H)



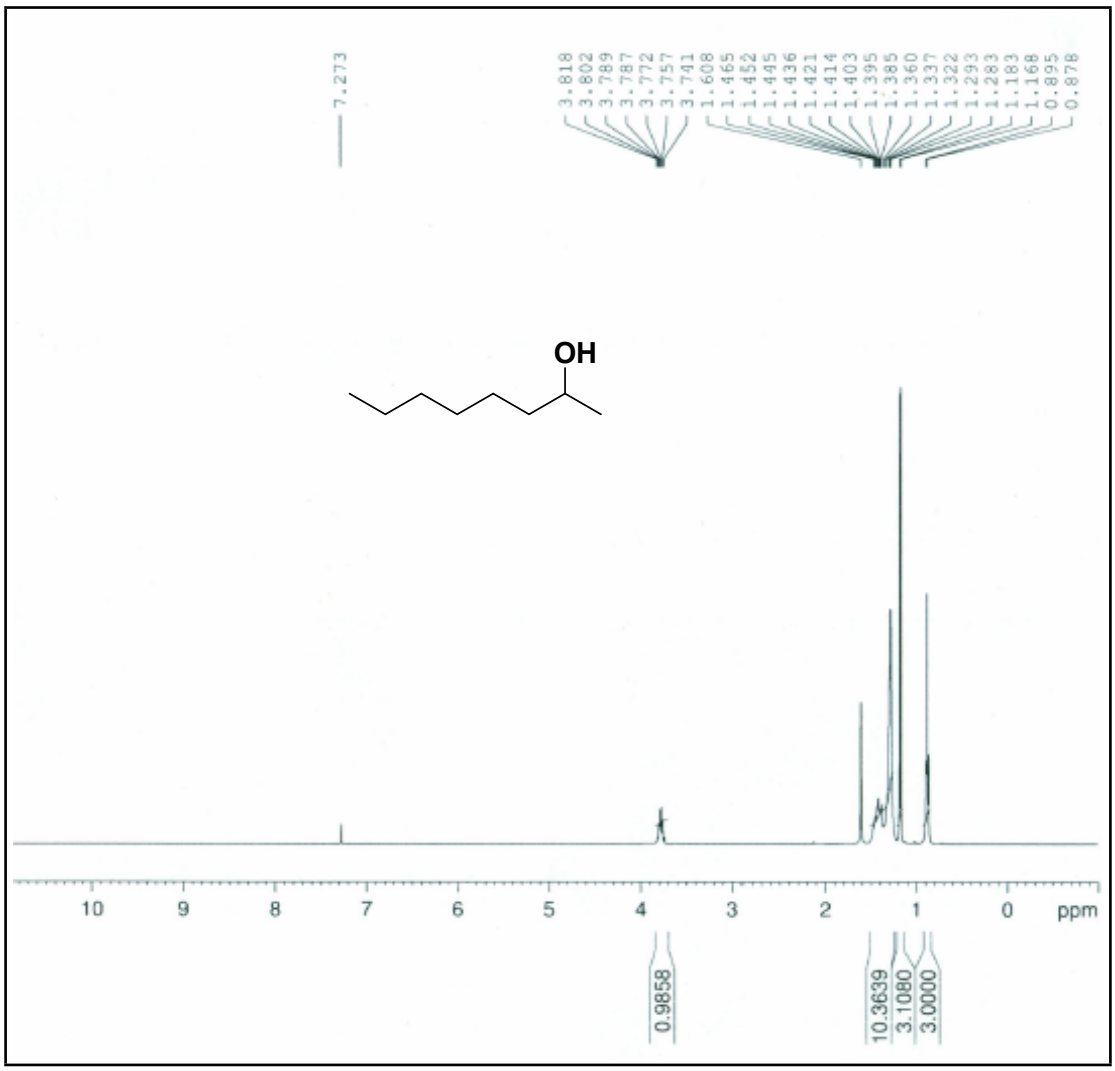
3. (Table 3, entry 6)

^{1}H NMR (300 MHz, $CDCl_3$): δ (ppm) 1.81 (bs, 1H), 2.92 (dd, *J* = 3.18, 16.32 Hz, 2H), 3.22 (dd, *J* = 5.85, 16.34 Hz, 2H), 4.67-4.73 (m, 1H), 7.18-7.19 (m, 2H), 7.25-7.28 (m, 2H)



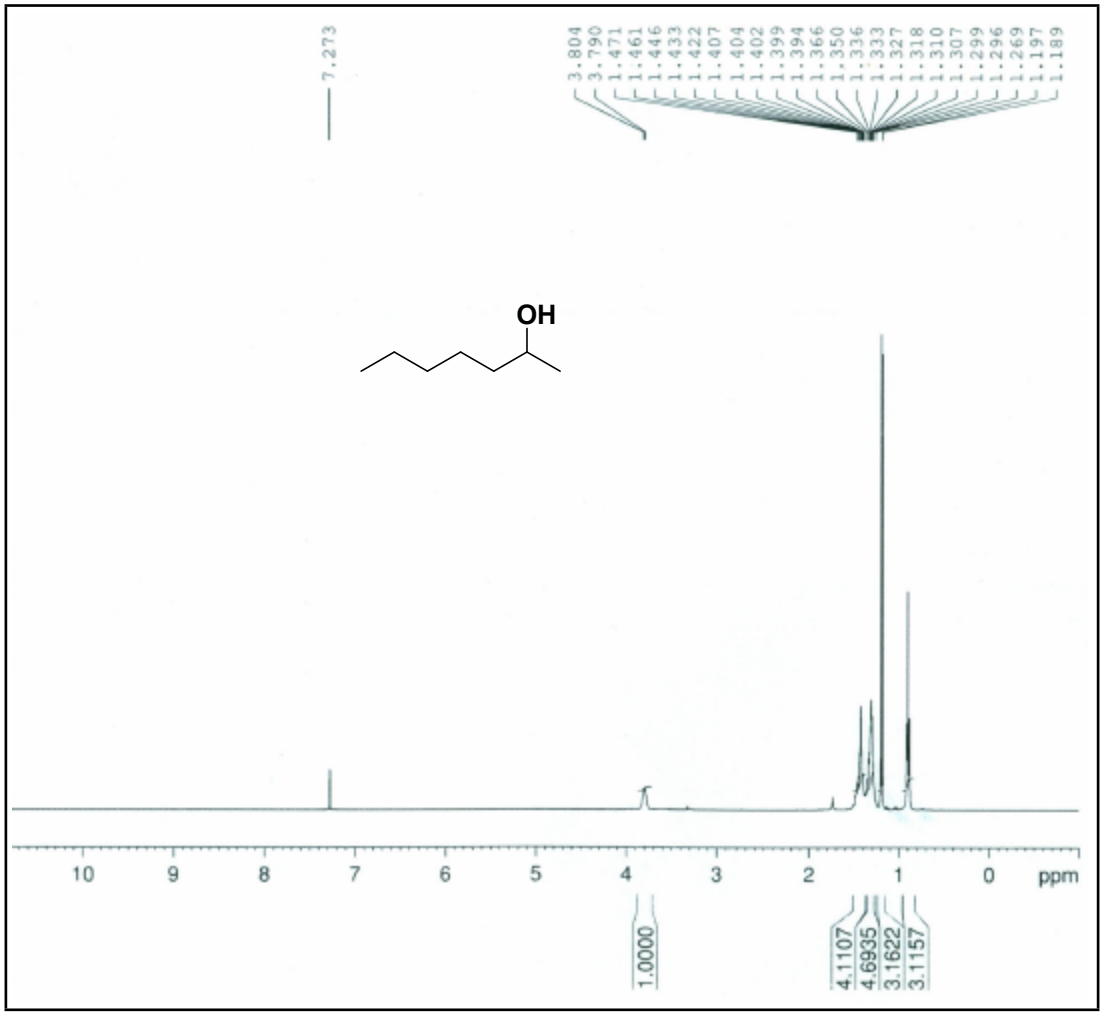
4. (Table 3, entry 7)

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 0.88 (t, *J* = 6.80 Hz, 3H), 1.18 (d, *J* = 6.00 Hz, 3H), 1.30-1.45 (m, 10H), 3.74-3.82 (m, 1H).



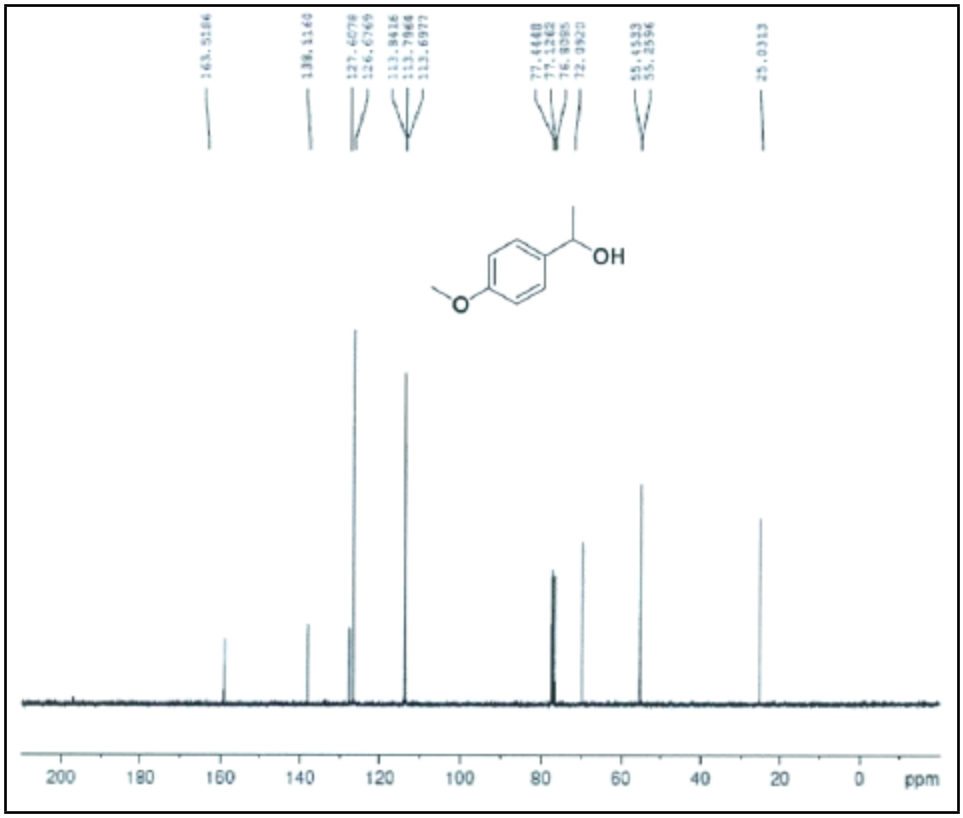
5. (Table 3, entry 8)

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 0.90 (t, *J* = 6.80 Hz, 3H), 1.19 (d, *J* = 6.40 Hz, 3H), 1.29-1.36 (m, 4H), 1.39-1.47 (m, 4H), 3.76-3.85 (m, 1H)



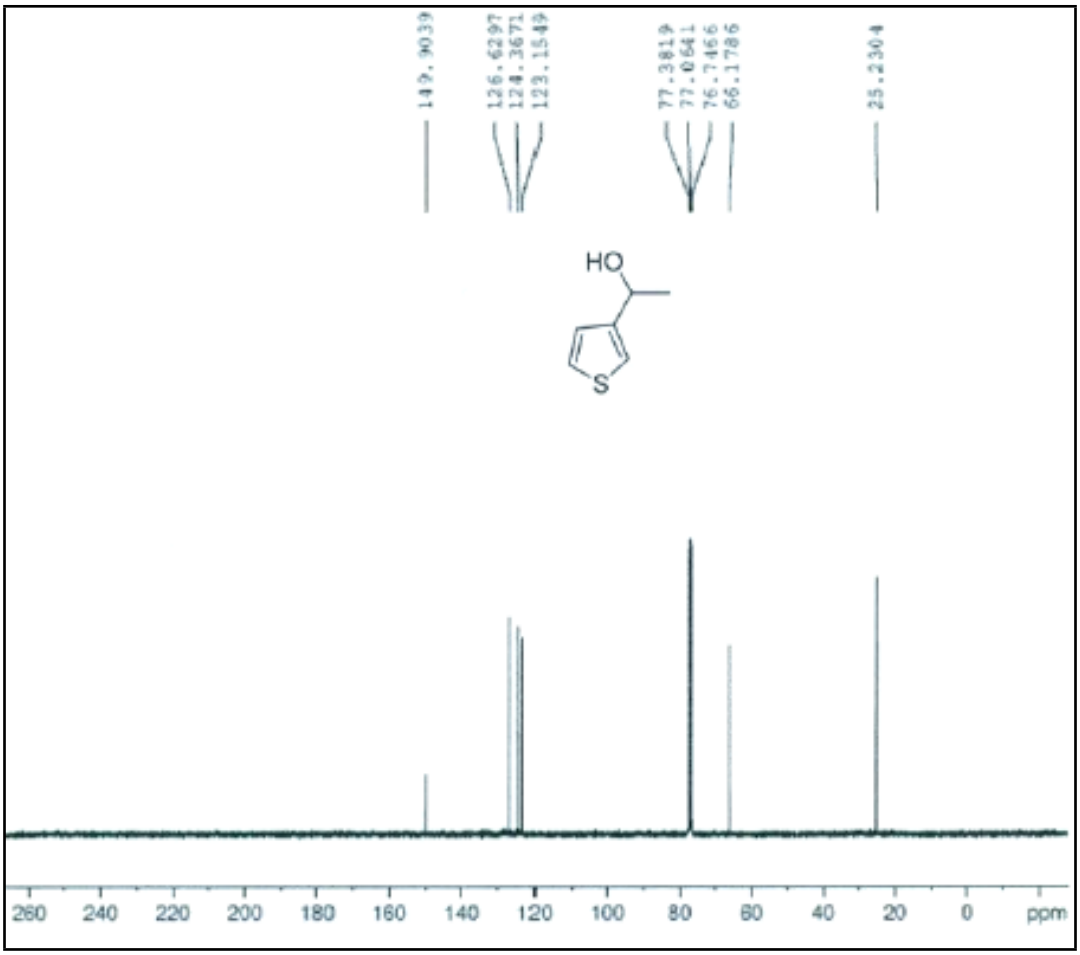
6. (Table 2, entry 7)

^{13}C-NMR (100 MHz, $CDCl_3$): δ (ppm) 25.03, 55.26, 55.45, 72.09, 113.70, 113.80, 113.84, 126.68, 127.61, 138.12, 163.52



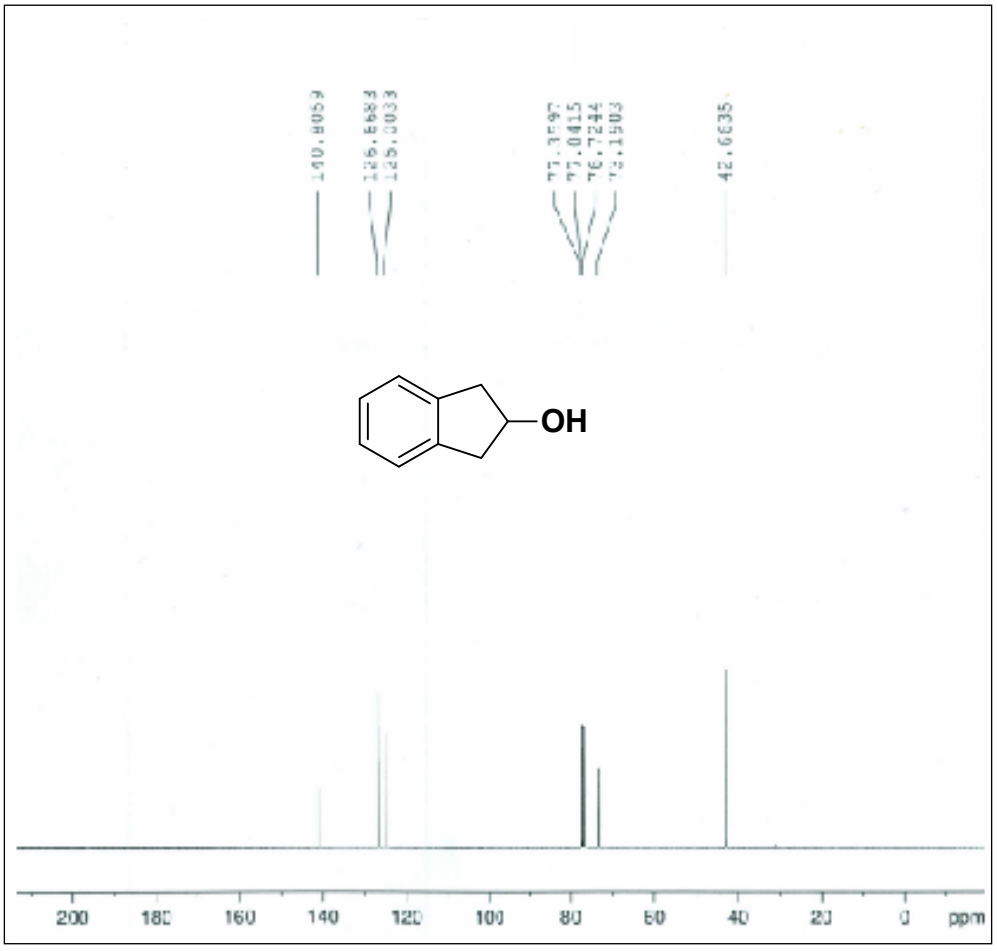
7. (Table 3, entry 6)

^{13}C-NMR (100 MHz, $CDCl_3$): δ (ppm) 25.23, 66.18, 123.15, 124.37, 126.63, 149.90



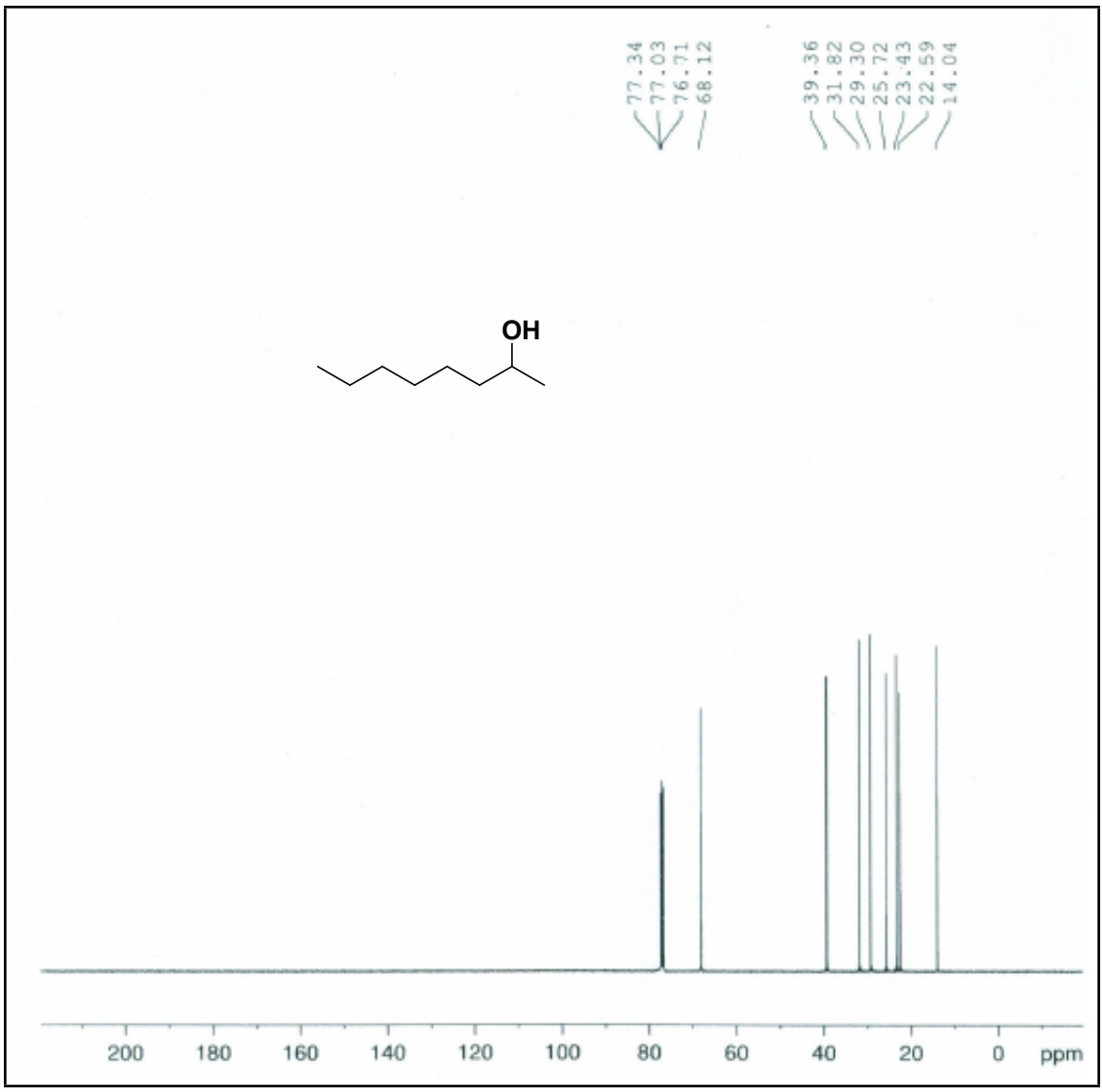
8. (Table 2, entry 6)

^{13}C-NMR (100 MHz, $CDCl_3$): δ (ppm) 42.66, 73.19, 125.00, 126.67, 140.81



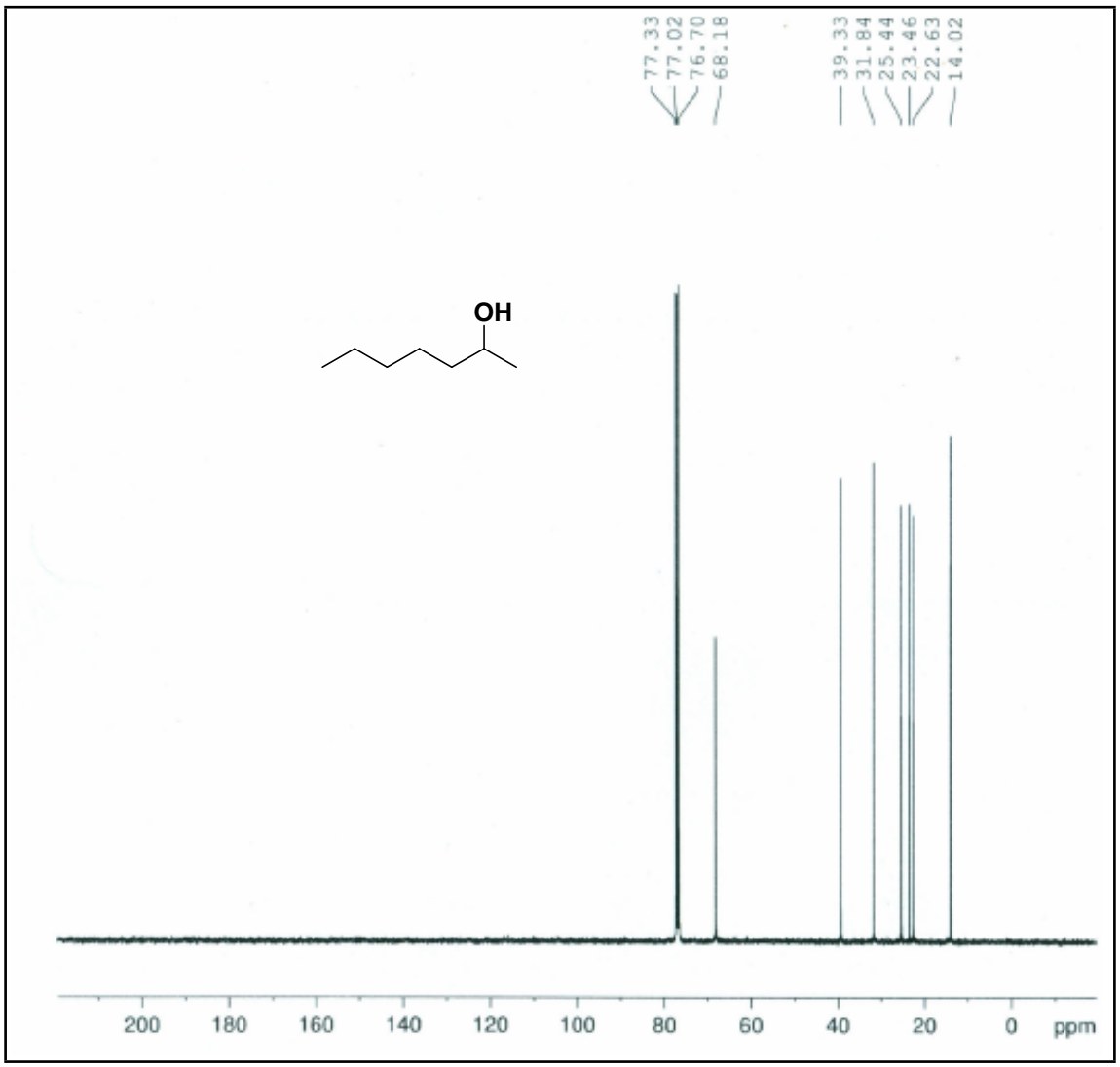
9. (Table 3, entry 7)

^{13}C-NMR (100 MHz, $CDCl_3$): δ (ppm) 14.04, 22.59, 23.43, 25.72, 29.30, 31.82, 39.36, 68.12



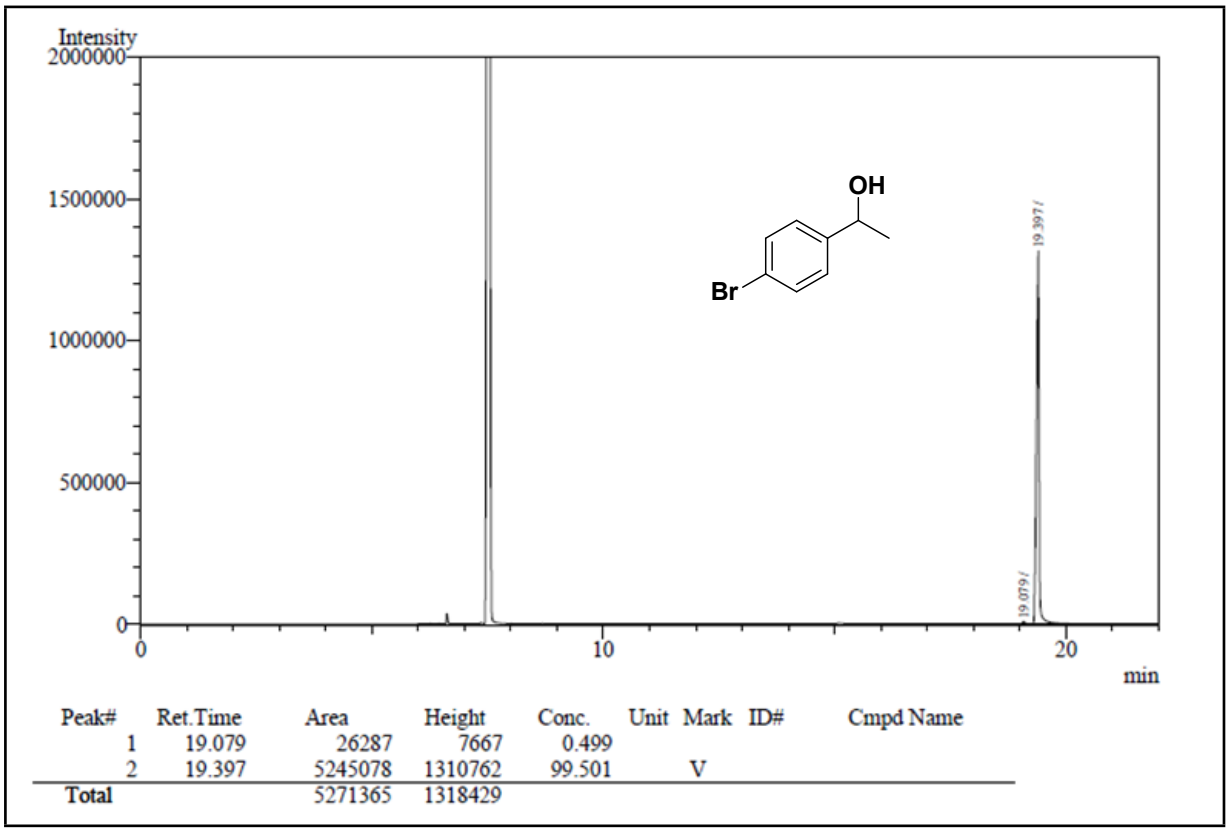
10. (Table 3, entry 8)

^{13}C-NMR (100 MHz, $CDCl_3$): δ (ppm) 14.02, 22.63, 23.46, 25.44, 31.84, 39.33, 68.18



GC Reports

1. (Table 2, entry 4)



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1	19.079	26287	7667	0.499				
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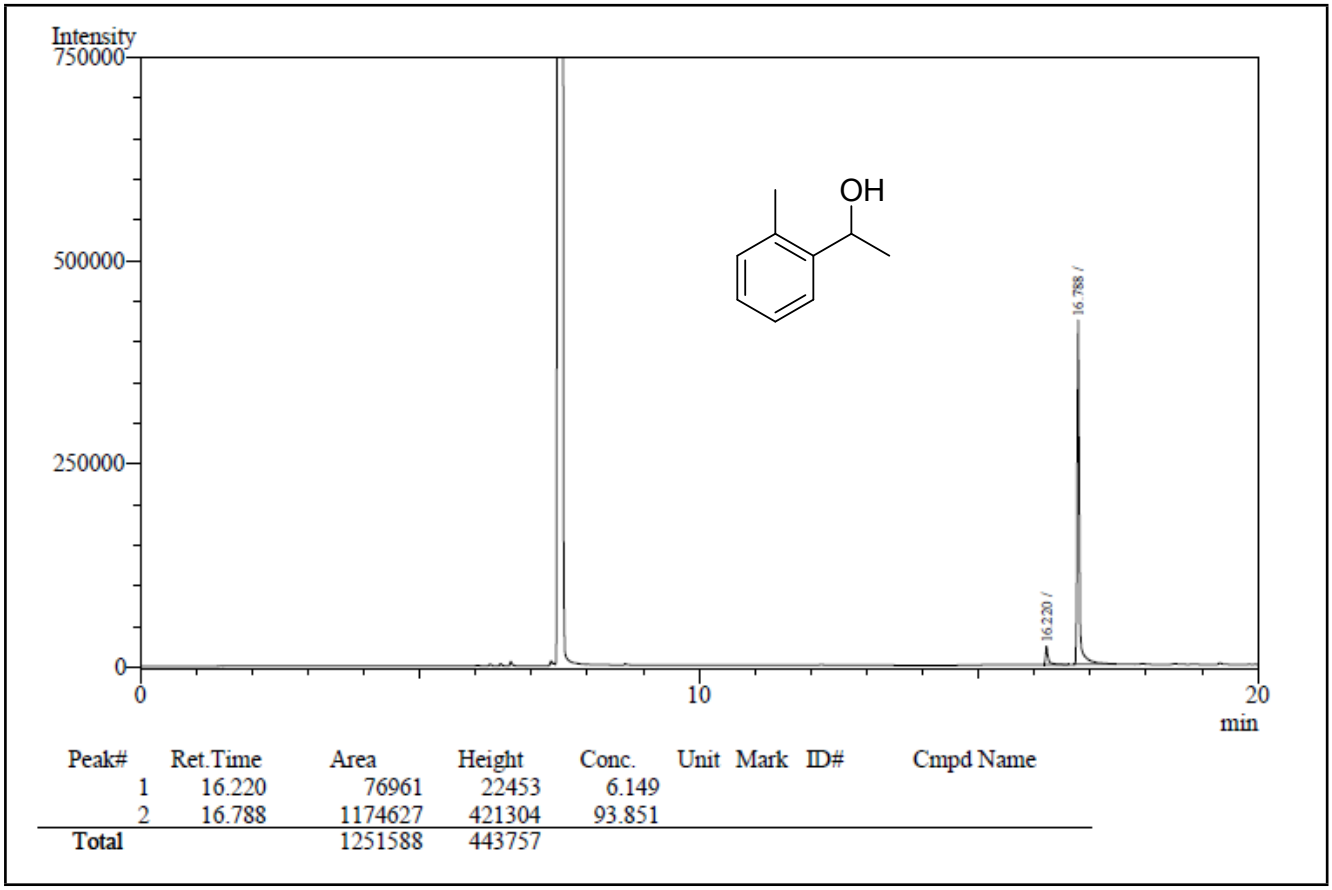
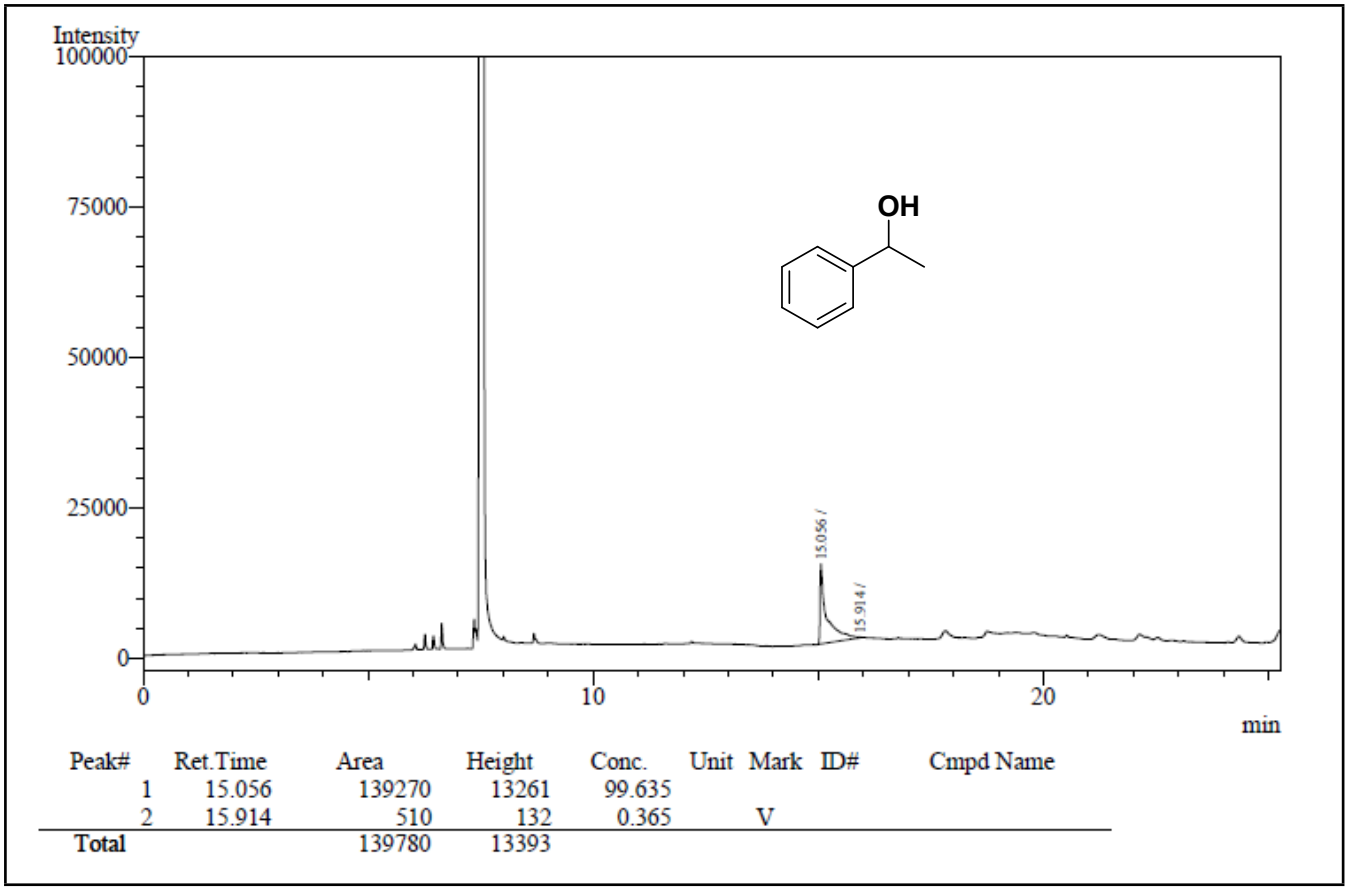
2. (Table 2, entry 2)



Peak#	Ret.Time	Area	Height	Conc.	Unit	Mark	ID#	Cmpd Name
1	16.220	76961	22453	6.149				
2	16.788	1174627	421304	93.851				
Total		1251588	443757					

3. (Table 2, entry 1)



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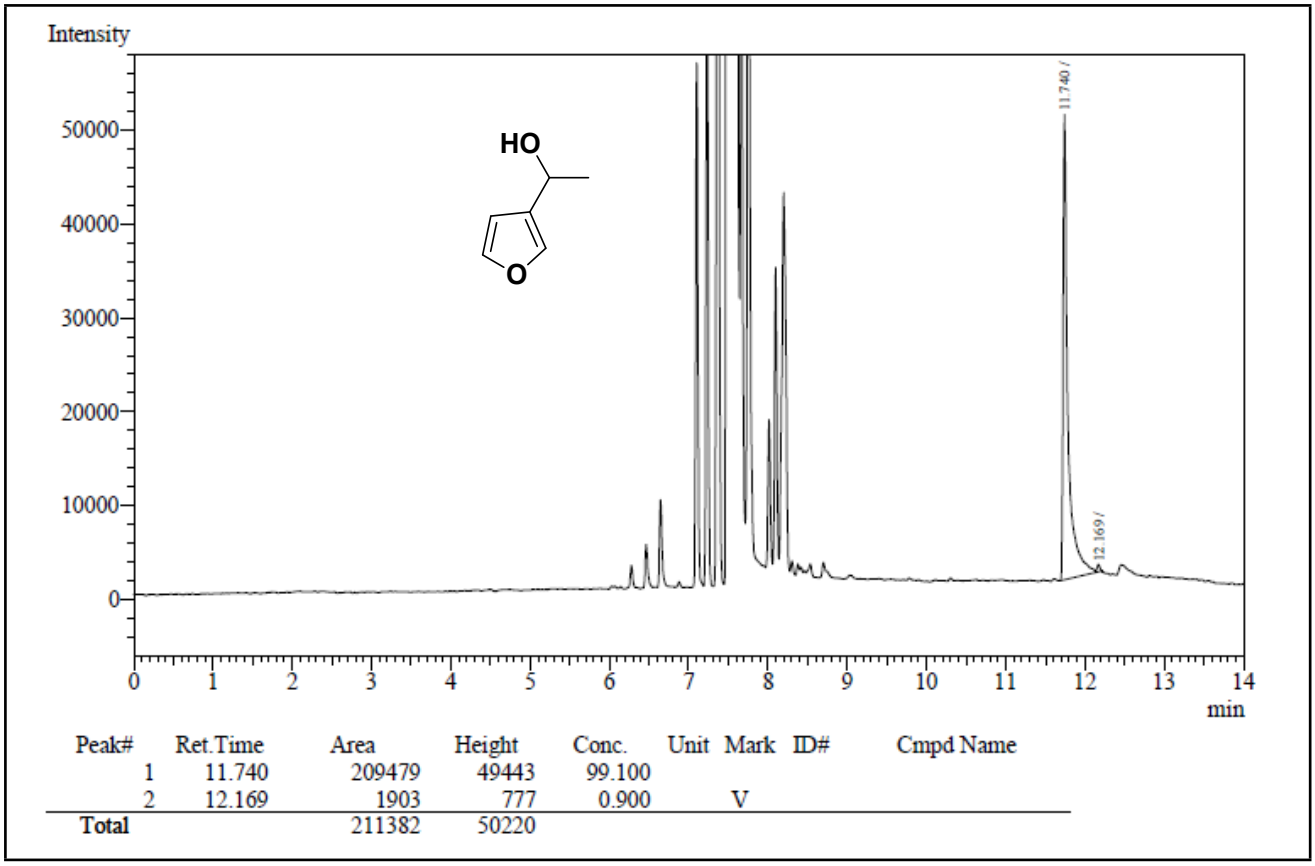
4. (Table 2, entry 8)



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2	12.169	1903	777	0.900		V		
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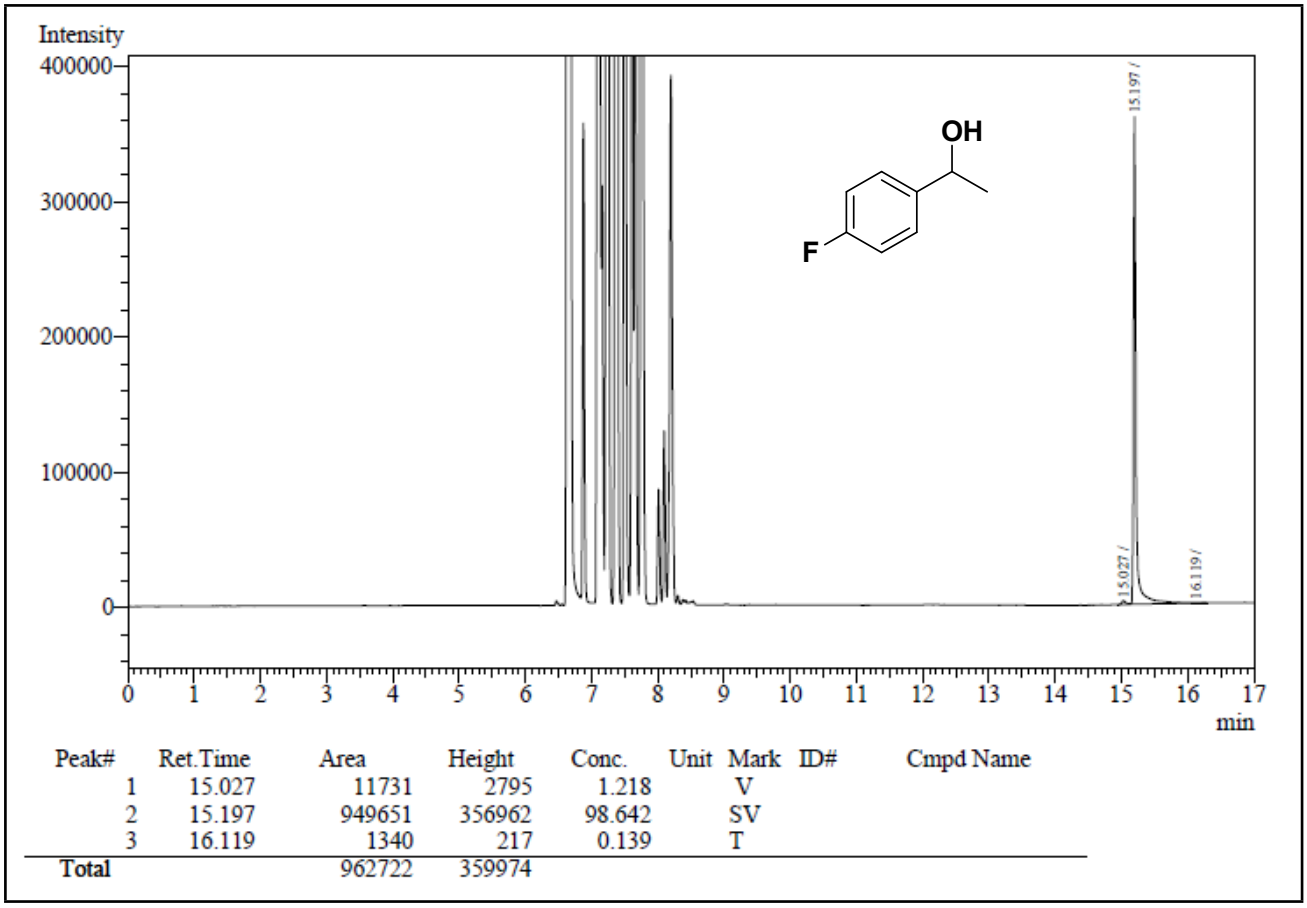
5. (Table 2, entry 6)



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1	15.027	11731	2795	1.218		V		
2	15.197	949651	356962	98.642		SV		
3	16.119	1340	217	0.139		T		
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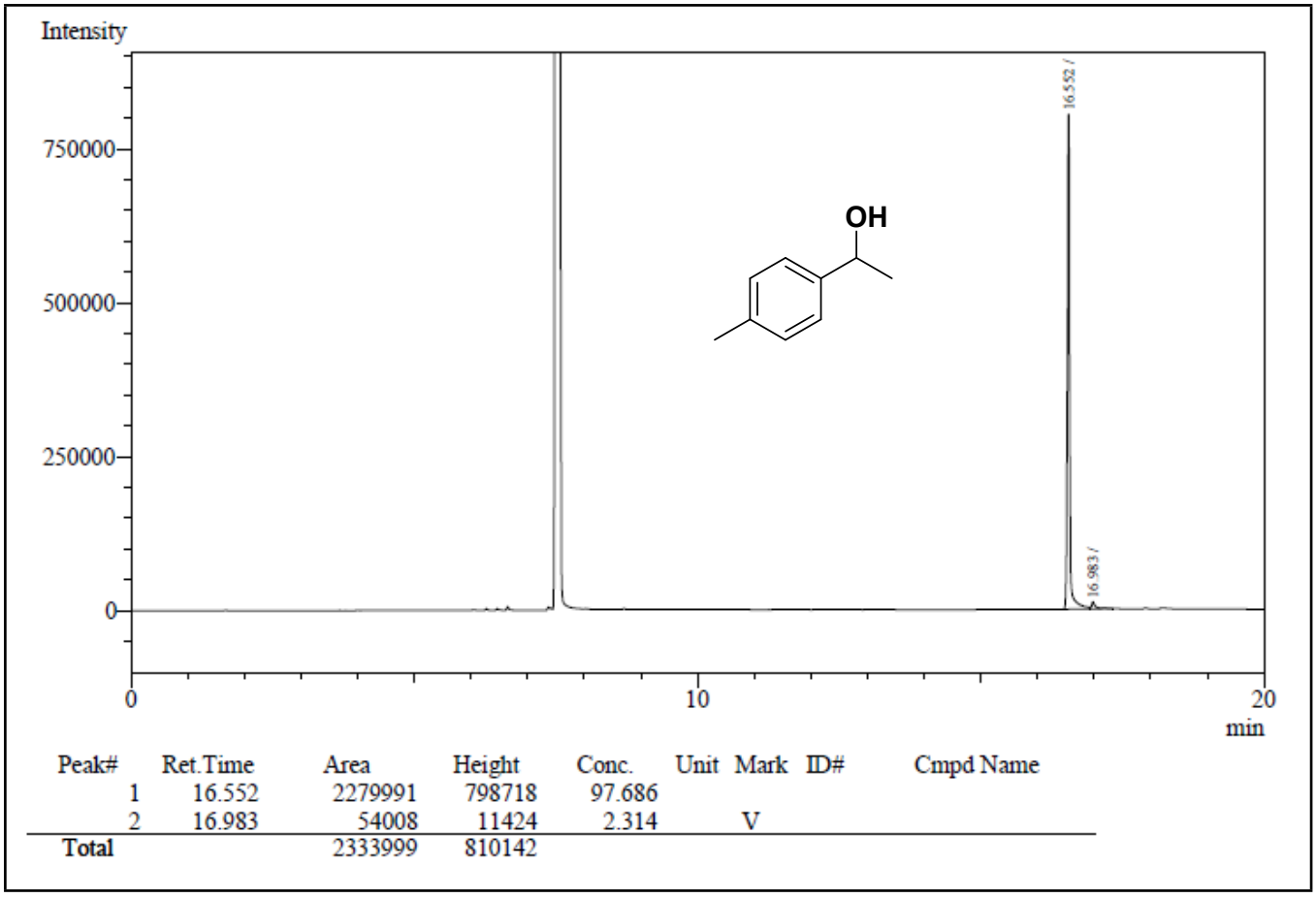
6. (Table 2, entry 3)



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1	16.552	2279991	798718	97.686				
2	16.983	54008	11424	2.314		V		
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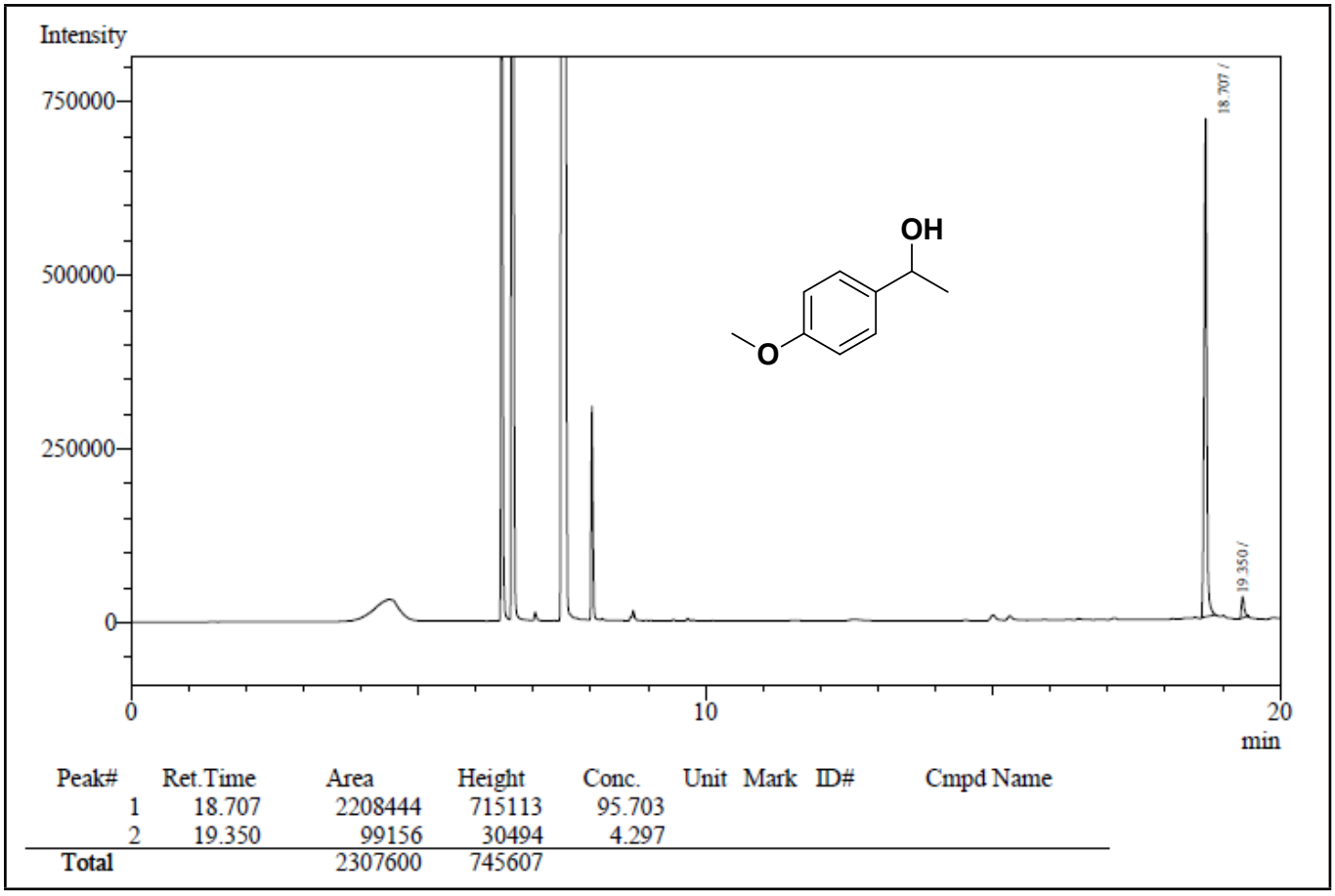
7. (Table 2, entry 7)



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2	19.350	99156	30494	4.297				
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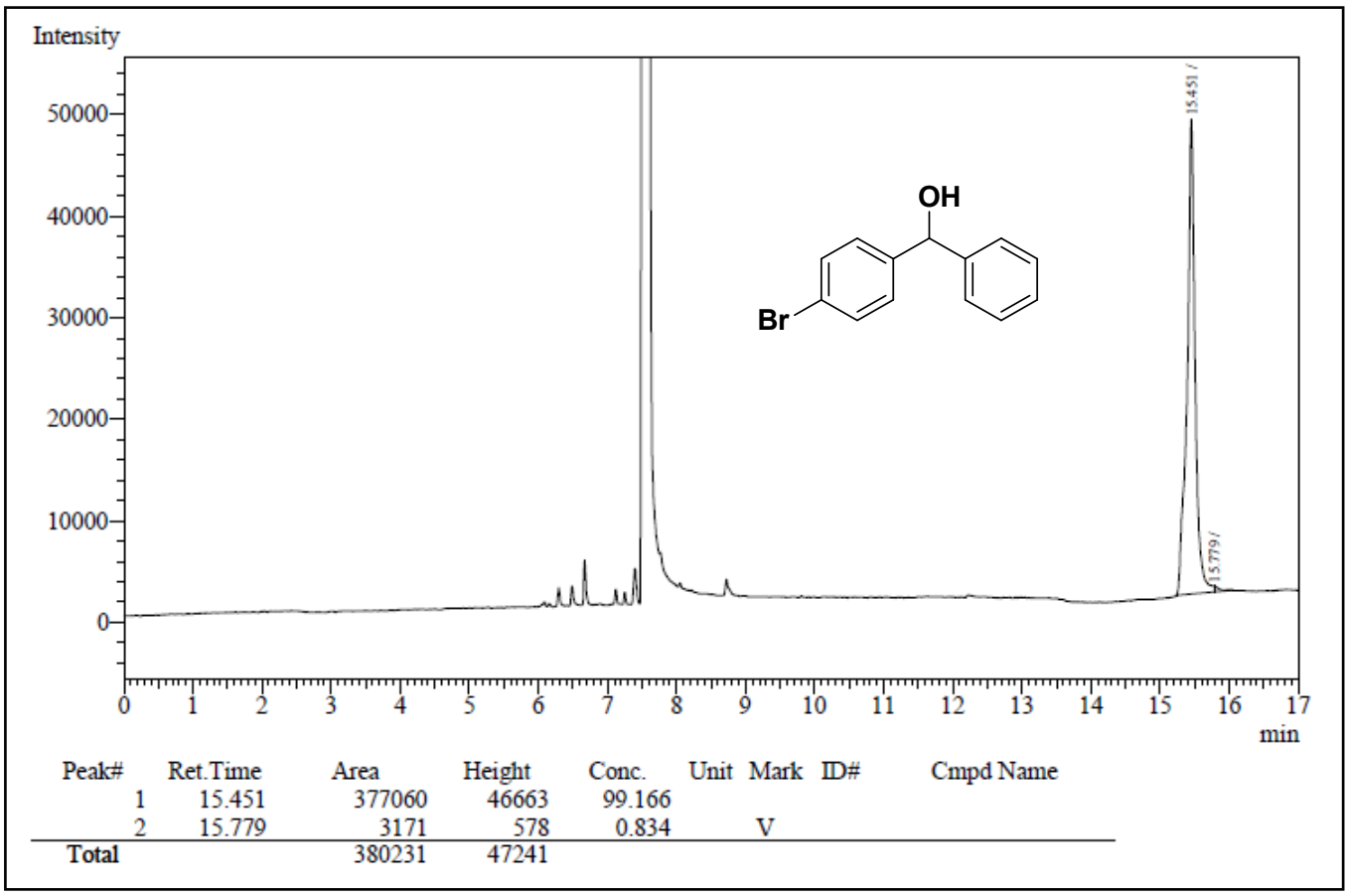

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2	15.779	3171	578	0.834		V		
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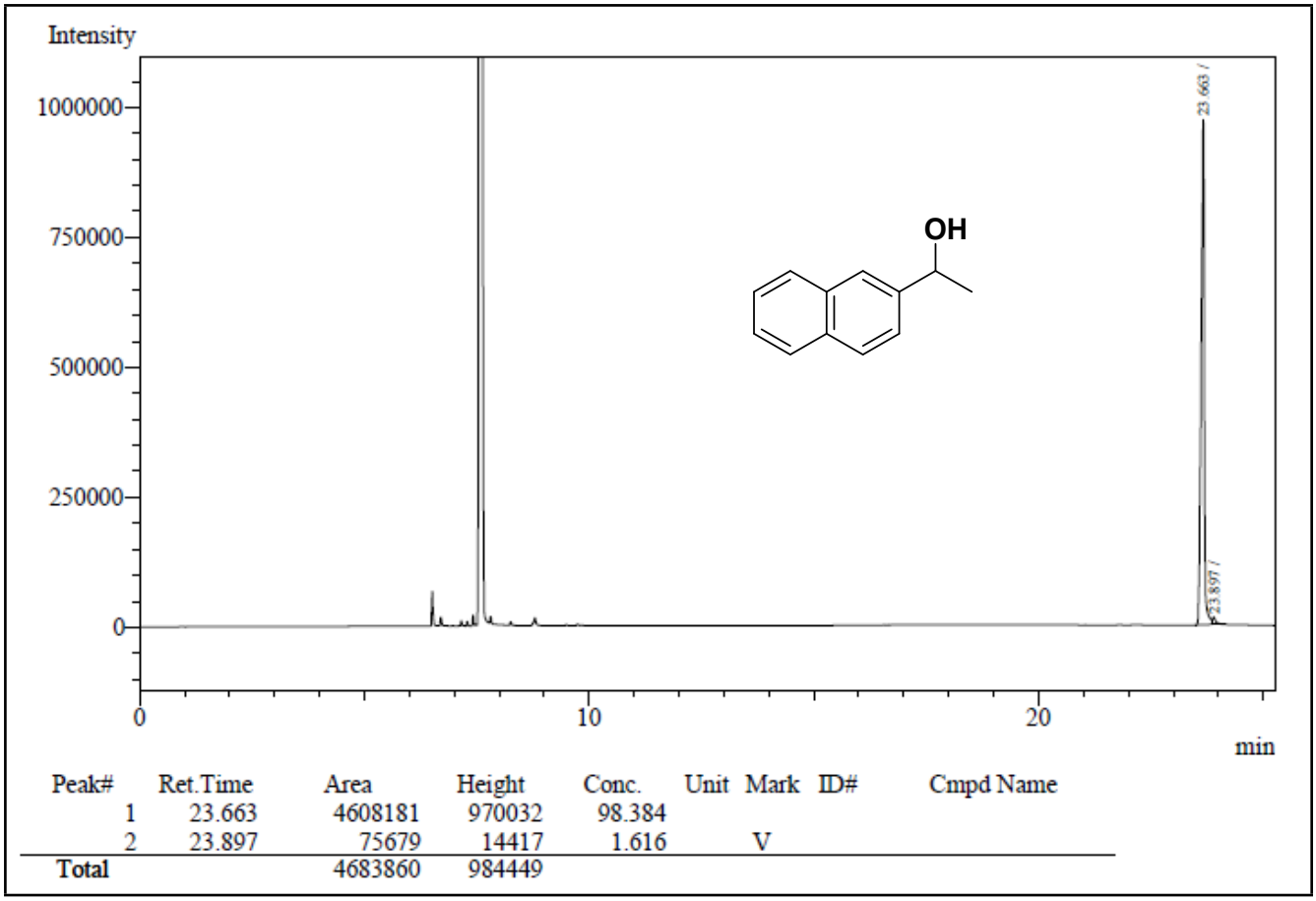
9. (Table 3, entry 1)



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1	23.663	4608181	970032	98.384				
2	23.897	75679	14417	1.616		V		
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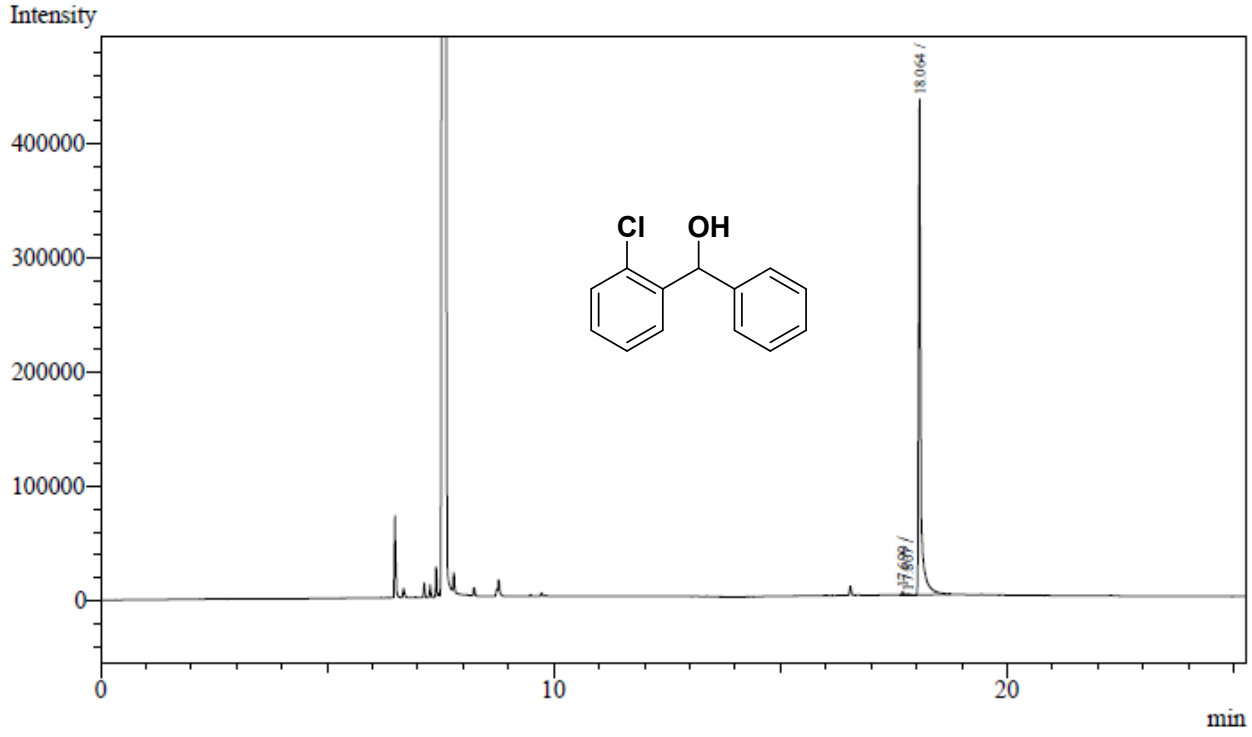
10. (Table 3, entry 2)



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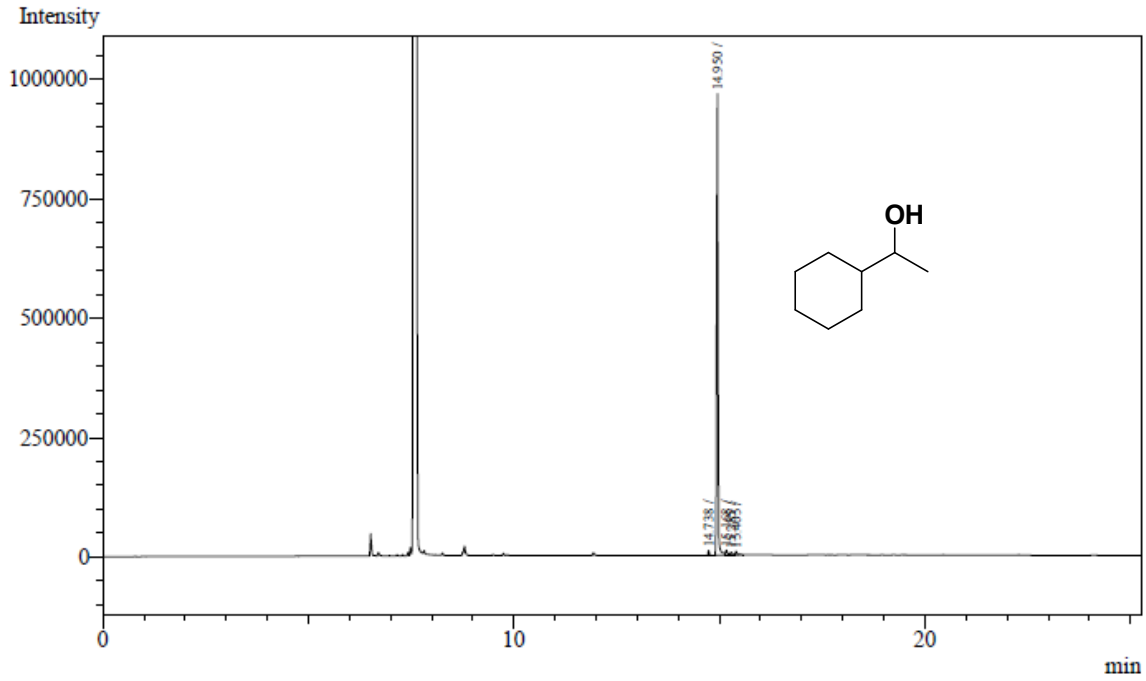
1	17.690	8514	2532	0.601				
2	17.807	3461	907	0.244		V		
3	18.064	1405458	431603	99.155				
Total		1417433	435042					

11. (Table 3, entry 5)



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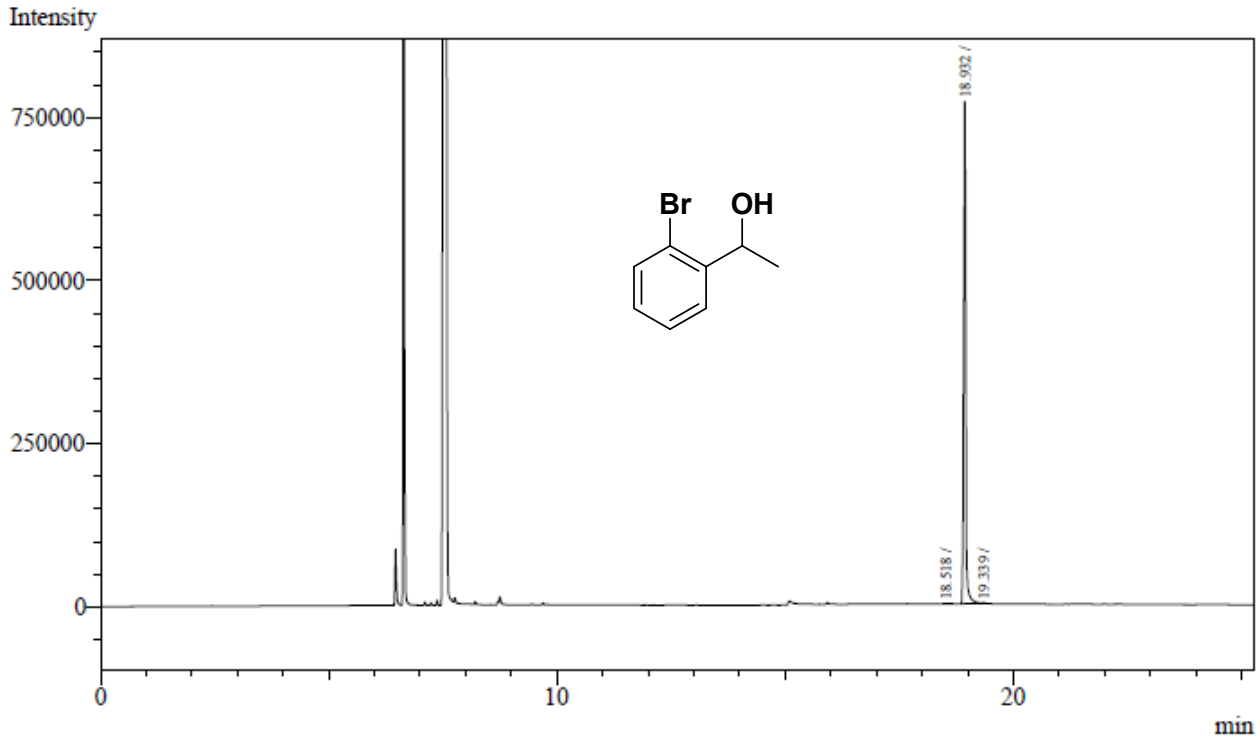
1	14.738	22956	9751	0.969				
2	14.950	2268485	962317	95.716				
3	15.168	35544	10065	1.500		V		
4	15.285	20782	5824	0.877		V		
5	15.405	22260	7347	0.939		V		
Total		2370027	995304					

12. (Table 4, entry 2)



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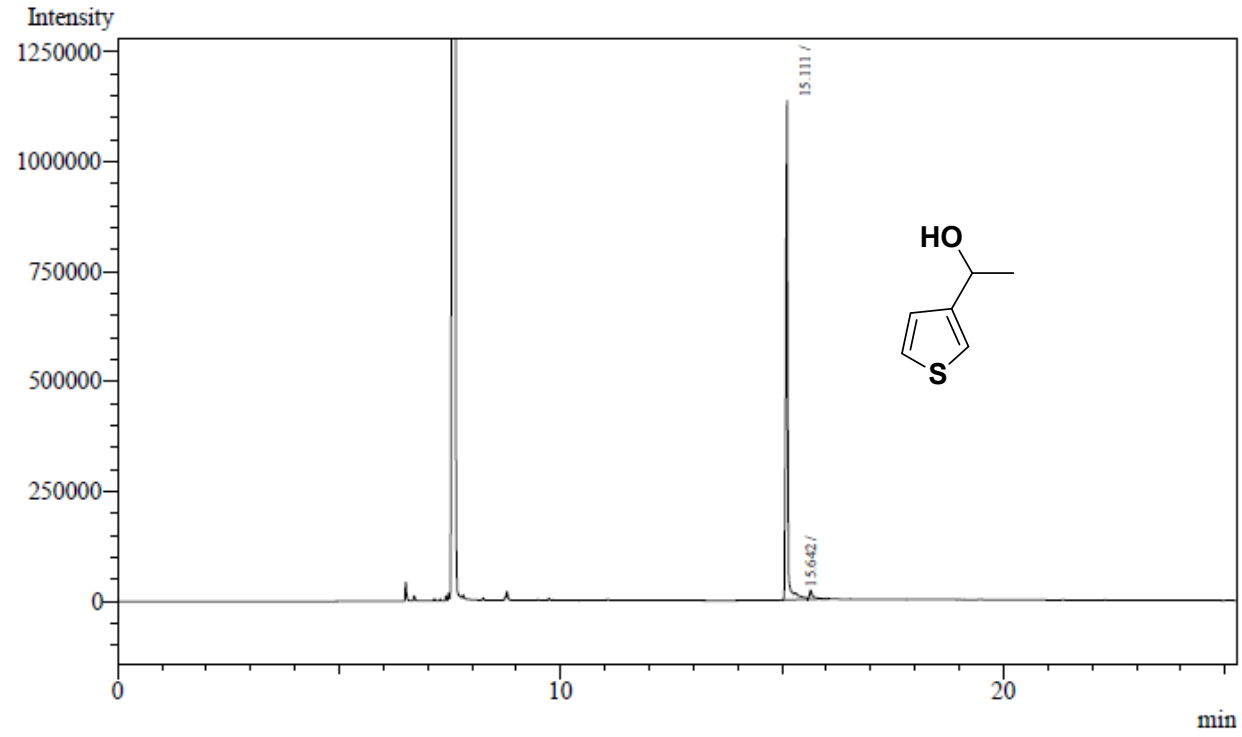
1	18.518	4218	1085	0.176				
2	18.932	2390775	765521	99.598				
3	19.339	5434	1223	0.226		V		
Total		2400427	767829					

13. (Table 4, entry 6)



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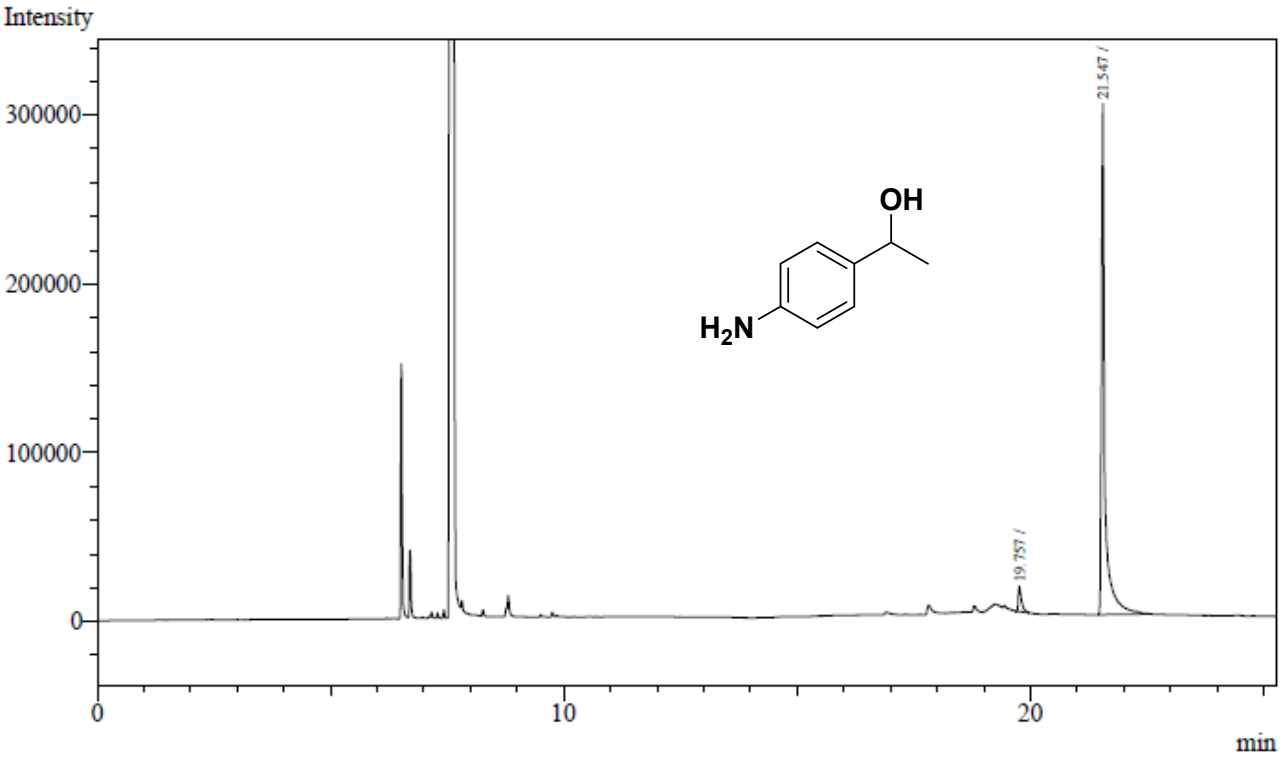
1	15.111	3549000	1127134	97.006				
2	15.642	109541	20520	2.994		V		
Total		3658541	1147654					

14. (Table 4, entry 4)

Peak#	Ret.Time	Area	Height	Conc.	Unit	Mark	ID#	Cmpd Name
1	18.429	78617	5068	0.989				
2	18.796	6952141	1584507	87.419		V		
3	19.400	921927	308679	11.593		V		
Total		7952685	1898254					

15. (Table 4, entry 3)



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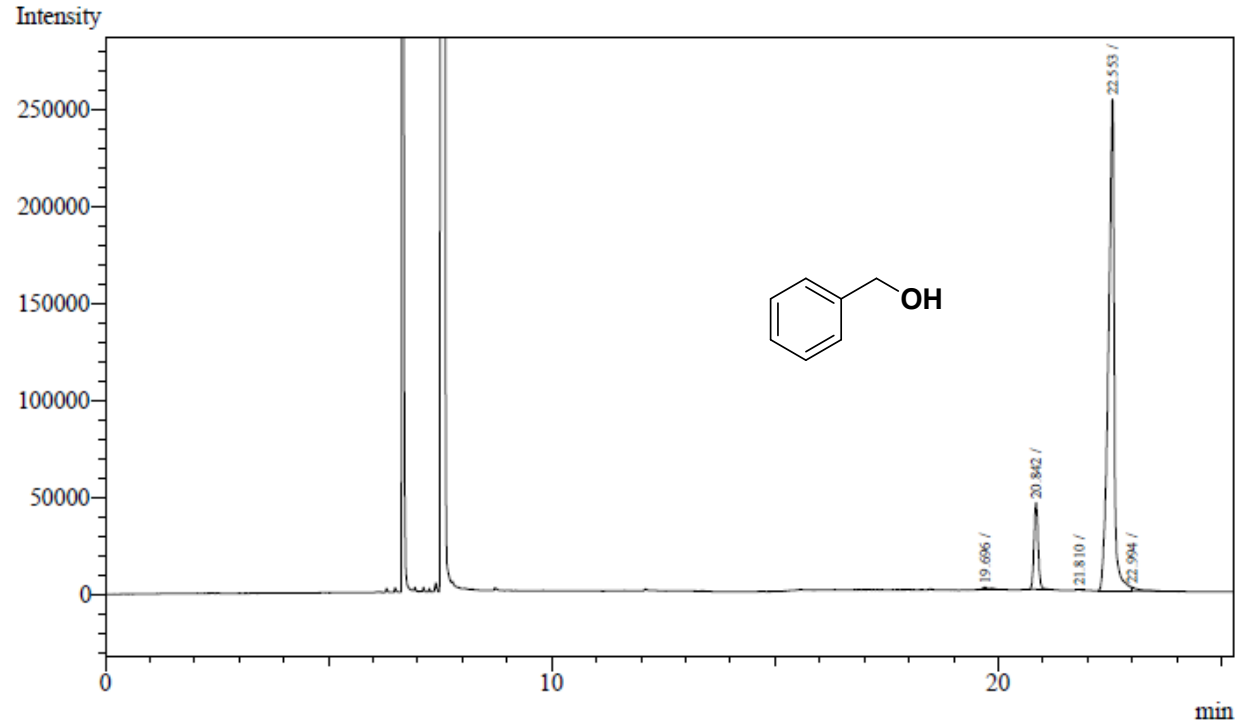
16. (Table 4, entry 1)



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1	19.696	11424	1054	0.435				
2	20.842	286059	44428	10.902				
3	21.810	2396	361	0.091				
4	22.553	2303437	252917	87.784				
5	22.994	20675	1882	0.788		V		
Total		2623991	300642					