Electronic Supplementary Material (ESI) for Organic & Biomolecular Chemistry

Supporting Information

Asymmetric hydrogenation of *β*-amino ketone with a bimetallic complex RuPHOX-Ru as the chiral catalyst

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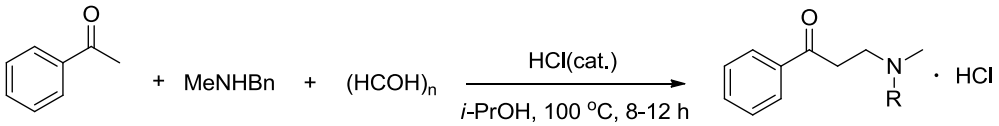
1. General Methods

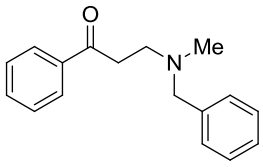
All reactions were performed under a nitrogen atmosphere, and workups were carried out in air. Toluene, MeOH, EtOH and *i*-PrOH were distilled over dehydrating reagents. Commercially available reagents were used without further purification. The substrates for allylic alkylation were prepared according to literature procedures.[1] ^{1}H NMR (400 MHz), ^{13C} NMR (100 MHz) and ^{31}P NMR (162 MHz) spectra were recorded on a Varian MERCURY plus-400 spectrometer with TMS as an internal standard. The enantioselectivity was measured by high performance liquid chromatography (HPLC) using Daicel Chiralcel OD-H, IC-3 columns with hexane / 2-propyl alcohol as eluent and 0.1% Et_2N as the additive. Column chromatography was performed using 100–200 mesh silica gel. All commercially available substrates were used as received. *β*-amino ketones were prepared through Mannich reaction according to literature procedures[1].

2. General procedure for the Synthesis of *β*-Amino Ketone



A mixture of substituted acetophenone (10.0 mmol), N-methylbenzylamine (1.54 mL, 12 mmol), paraformaldehyde (0.45 g, 15 mmol), and conc. HCl (1.2 mL) in 2-propyl alcohol (12.5 mL) was stirred and heated in a sealed tube at 100 ℃ for 8–12 h. After the solvent was cooled to room temperature, 2-propyl alcohol was removed as soon as possible and EtOAc (15 mL) was added. The mixture was strongly stired for 3 h at room temperature and then filtrated. The solid was washed with acetone to afford *β*-amino ketones hydrochloride (40~75% yield) which was alkalified and purified to afford the *β*-amino ketone.

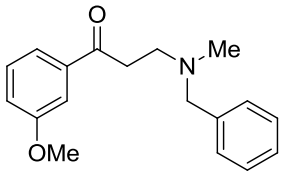
3-(Benzyl(methyl)amino)-1-phenylpropan-1-one (3a)[2]



3a

As a pale yellow liquid (81.2% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.91 (m, 2H), 7.60–7.20 (m, 8H), 3.55 (s, 2H), 3.19 (t, J = 6.8 Hz, 2H), 2.88 (t, J = 8 Hz, 2H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 199.9, 138.9, 137.2, 133.3, 129.2, 128.8, 128.5, 128.4, 127.3, 62.6, 52.7, 42.5, 37.1.

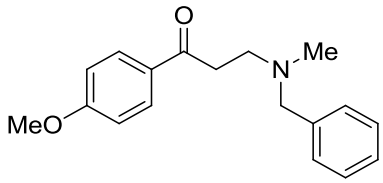
3-(Benzyl(methyl)amino)-1-(3-methoxyphenyl)propan-1-one (3b)[3]



3b

As a pale yellow liquid (59.6% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.54−7.46 (m, 2H), 7.35 (t, J = 8.0 Hz, 1H), 7.54−7.49 (m, 1H), 7.32−7.08 (m, 6H), 3.84 (s, 3H), 3.55 (s, 2H), 3.18 (t, J = 6.8 Hz, 2H), 2.88 (t, J = 7.2 Hz, 2H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 199.5, 160.1, 139.1, 138.6, 129.8, 129.2, 128.5, 127.3, 121, 119.8, 112.5, 62.7, 55.7, 52.8, 42.5, 37.3.

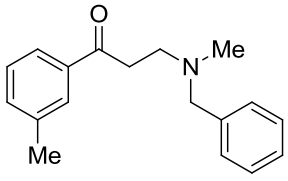
3-(Benzyl(methyl)amino)-1-(4-methoxyphenyl)propan-1-one (3c)[4]



3c

As a pale yellow liquid (64.2% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.97−7.91 (m, 2H), 7.35−7.15 (m, 5H), 6.96−6.90 (m, 2H), 3.86 (s, 3H), 3.58 (s, 2H), 3.16 (t, J = 7.6 Hz, 2H), 2.90 (t, J = 7.6 Hz, 2H), 2.28 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.3, 163.7, 139.1, 130.6, 129.3, 128.5, 127.3, 125.6 113.9, 62.7, 55.7, 52.9, 42.5, 36.8.

3-(Benzyl(methyl)amino)-1-(m-tolyl)propan-1-one (3d)

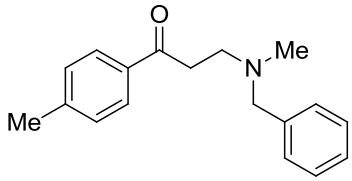


3d

As a pale yellow liquid (72.5% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.90−7.70 (m, 2H), 7.50−7.20 (m, 7H), 3.55 (s, 2H), 3.17 (t, J = 7.4 Hz, 2H), 2.89 (t, J = 8.0 Hz, 2H), 2.39 (s, 3H), 2.27 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 199.8, 139.1, 138.6, 137.3, 134.0, 129.2, 128.9,

128.7, 128.5, 127.3, 125.6, 62.6, 52.8, 42.5, 37.2, 21.6; HRMS (ESI-TOF) Calcd. For $C_{18}H_{22}NO$ $[M+H]^+$ 268.1677, Found: 268.1688.

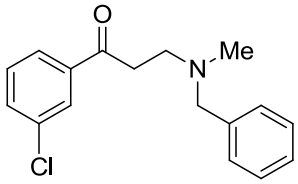
3-(Benzyl(methyl)amino)-1-(p-tolyl)propan-1-one (3e)



3e

As a pale yellow liquid (63.1% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.85 (d, J = 8.0 Hz,2H), 7.40−7.16 (m, 7H), 3.54 (s, 2H), 3.15 (t, J = 2.8 Hz, 2H), 2.89 (t, J = 7.6 Hz, 2H), 2.39 (s, 3H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 199.4, 144.1, 139.1, 134.7, 129.5, 129.2, 128.5, 128.4, 127.3, 62.6, 52.9, 42.5, 37.0, 21.9.

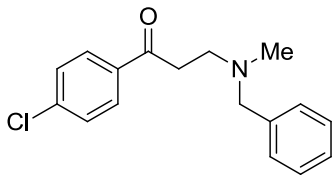
3-(Benzyl(methyl)amino)-1-(3-chlorophenyl)propan-1-one (3f)



3f

As a pale yellow liquid (74.4% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.90 (t, J = 2.0 Hz, 1H), 7.80 (t, J = 1.2 Hz, 1H), 7.78 (t, J = 1.2 Hz, 1H), 7.54−7.49 (m, 1H), 7.38 (t, J = 8.0 Hz, 1H), 7.33−7.15 (m, 5H), 3.55 (s, 2H), 3.14 (t, J = 6.8 Hz, 2H), 2.87 (t, J = 7.6 Hz, 2H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.4, 138.9, 138.7, 135.2, 133.2, 130.2, 129.2, 128.5, 128.4, 127.3, 126.4, 62.7, 52.5, 42.5, 37.3; HRMS (ESI-TOF) Calcd. For $C_{17}H_{19}ClNO$ [M+H] 288.1155, Found: 288.1122.

3-(Benzyl(methyl)amino)-1-(4-chlorophenyl)propan-1-one (3g)

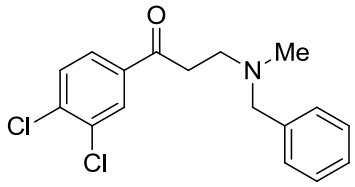


3g

As a colorless liquid (76.0% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.94−7.82 (m, 2H), 7.43–7.39 (m, 2H), 7.34−7.20 (m, 5H), 3.55 (s, 2H), 3.14 (t, J = 6.8 Hz, 2H), 2.86 (t, J = 8 Hz, 2H),

2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.7, 139.7, 138.9, 135.4, 129.7, 129.2, 129.1, 128.5, 127.3, 62.7, 52.6, 42.5, 37.2.

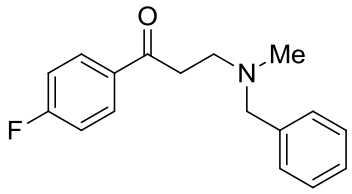
3-(Benzyl(methyl)amino)-1-(3,4-dichlorophenyl)propan-1-one (3h)



3h

As a pale yellow liquid (68.5% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.98−7.95 (m, 1H), 7.71−7.66 (m, 1H), 7.49−7.44 (m, 1H), 7.35−7.15 (m, 5H), 3.52 (s, 2H), 3.09 (t, J = 6.8 Hz, 2H), 2.84 (t, J = 7.2 Hz, 2H), 2.25 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 197.3, 138.9, 137.7, 136.7, 133.4, 130.9, 130.3, 129.2, 128.5, 127.3, 62.7, 56.3, 52.5, 42.6, 37.3.

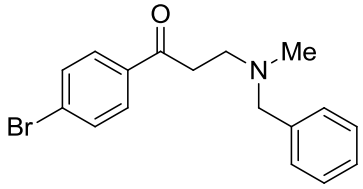
3-(Benzyl(methyl)amino)-1-(4-fluorophenyl)propan-1-one (3i)[5]



3i

As a pale yellow liquid (58.9% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.95 (m, 2H), 7.32−7.21 (m, 5H), 7.10 (m, 2H), 3.55 (s, 2H), 3.15 (t, J = 7.2 Hz, 2H), 2.87 (t, J = 7.6 Hz, 2H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.0, 139.1, 133.6, 130.9, 129.3, 128.5, 127.3, 125.6, 115.9, 62.7, 52.7, 42.5, 37.1.

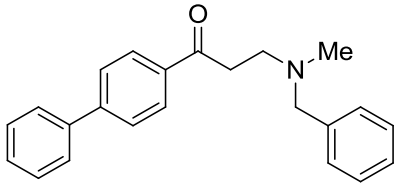
3-(Benzyl(methyl)amino)-1-(4-bromophenyl)propan-1-one (3j)



3j

As a pale yellow liquid (56.3% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.78 (d, J = 8.4 Hz, 2H), 7.58 (d, J = 8.4 Hz, 2H), 7.33−7.20 (m, 5H), 3.54 (s, 2H), 3.13 (t, J = 6.8 Hz, 2H), 2.85 (t, J = 7.2 Hz, 2H), 2.25 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.3, 139.1, 135.9, 132.1, 129.9, 129.2, 128.5, 128.2, 127.3, 62.6, 52.6, 42.5, 37.2.

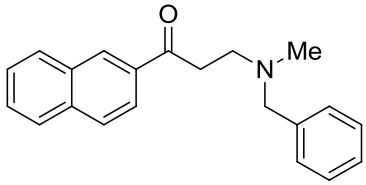
1-([1,1'-Biphenyl]-4-yl)-3-(benzyl(methyl)amino)propan-1-one (3k)



3k

As a white solid (62.8% yield). m.p. 61–62 ˚C ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.02–7.97 (m, 2H), 7.70–7.60 (m, 4H), 7.51–7.36 (m, 4H), 7.32–7.27 (m, 4H), 3.57 (s, 2H), 3.22 (t, J = 6.8 Hz, 2H), 2.90 (t, J = 8 Hz, 2H), 2.28 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 199.3, 145.9, 140.1, 139.1, 135.8, 129.3, 128.9, 128.5, 127.5, 127.3, 62.7, 52.9, 42.6, 37.2.

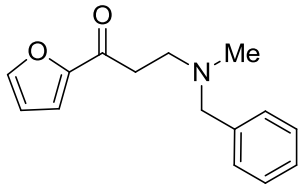
3-(Benzyl(methyl)amino)-1-(naphthalen-2-yl)propan-1-one (3l)[6]



3l

As a pale yellow liquid (42.9% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.44 (s, 1H), 8.05−8.02 (m, 1H), 7.94 (d, J= 7.6 Hz,1H), 7.87 (dd, J = 8.8, 3.6 Hz, 2H), 7.64−7.50 (m, 2H), 7.40−7.20 (m, 5H), 3.59 (s, 2H), 3.32 (t, J = 7.6 Hz, 2H), 2.96 (t, J = 8.0 Hz, 2H), 2.31 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 199.6, 139.1, 135.8, 134.5, 132.8, 130.0, 129.8, 129.3, 128.7, 128.5, 128.0, 127.3, 127.0, 124.1, 62.7, 52.9, 42.6, 37.3.

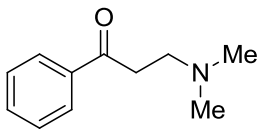
3-(Benzyl(methyl)amino)-1-(furan-2-yl)propan-1-one (3m)[7]



3m

As a pale yellow liquid (58.5% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.54−7.56 (m, 1H), 7.40−7.20 (m, 5H), 7.16 (dd, J = 3.6, 0.8 Hz, 1H),6.51 (dd, J = 3.6, 1.6 Hz, 1H), 3.53 (s, 2H), 3.03 (t, J = 7.2 Hz, 2H), 2.86 (t, J = 6.8 Hz, 2H), 2.24 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 188.9, 146.5, 139.2, 129.2, 128.5, 127.2, 117.3, 112.5, 62.4, 52.6, 42.3, 36.9.

3-(Dimethylamino)-1-phenylpropan-1-one (3n)[8]



3n

As a colorless liquid (78.3% yield). ^{1}H NMR (400 MHz, CD_3OD): δ 8.09–8.01 (m, 2H), 7.67–7.61 (m, 1H), 7.56–7.48 (m, 2H), 3.75–3.61 (m, 2H), 3.60–3.50 (m, 2H), 3.10–2.80 (m, 6H); ^{13}C (100 MHz, CD_3OD): δ 197.2, 136.1, 133.9, 128.8, 128.2, 53.2, 42.9, 33.3.

3. Reference

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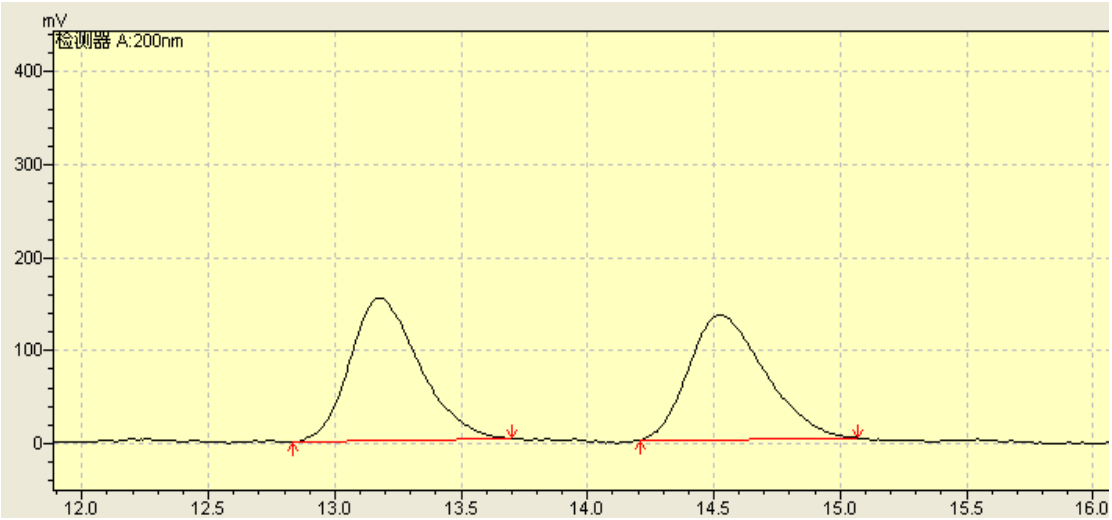
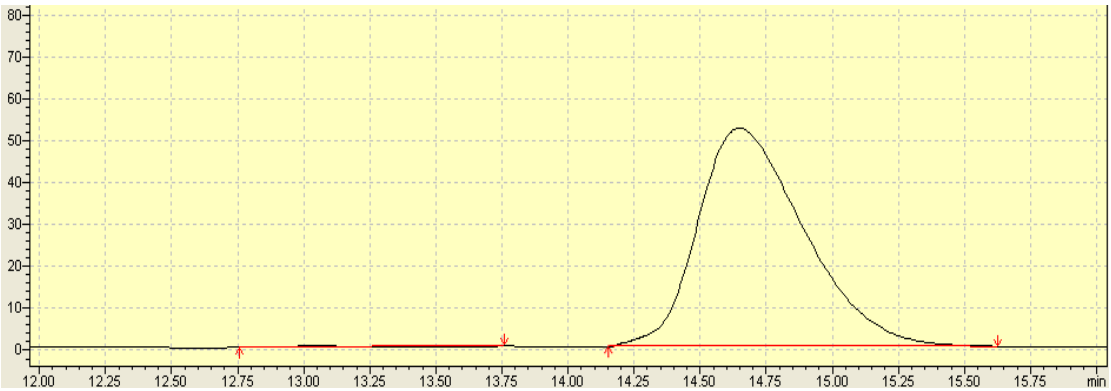
HPLC Spectra

Figure 1. Racemate of 3-(benzyl(methyl)amino)-1-phenylpropan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 0.8 mL /min, t_R = 14.52 min (major) and t_R = 13.16 min (minor).



Peak	Retention Time/min	Area %
1	13.175	50.861
2	14.521	49.139

Figure 2. (*R*)-3-(Benzyl(methyl)amino)-1-phenylpropan-1-ol (**4a**).

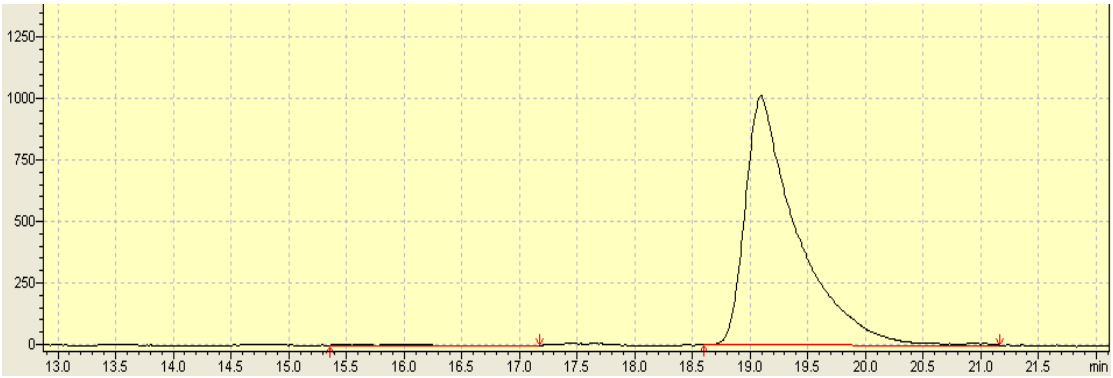


Peak	Retention Time/min	Area %
1	13.042	0.037
2	14.645	99.963

Figure 3. Racemate of 3-(benzyl(methyl)amino)-1-(3-methoxyphenyl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 1.0 mL /min, t_R = 19.25 min (major) and t_R = 15.44 min (minor).

Peak	Retention Time/min	Area %
1	15.444	50.632
2	19.252	49.368

Figure 4. (*R*)-3-(Benzyl(methyl)amino)-1-(3-methoxyphenyl)propan-1-ol (**4b**).



Peak	Retention Time/min	Area %
1	15.424	0.050
2	19.092	99.950

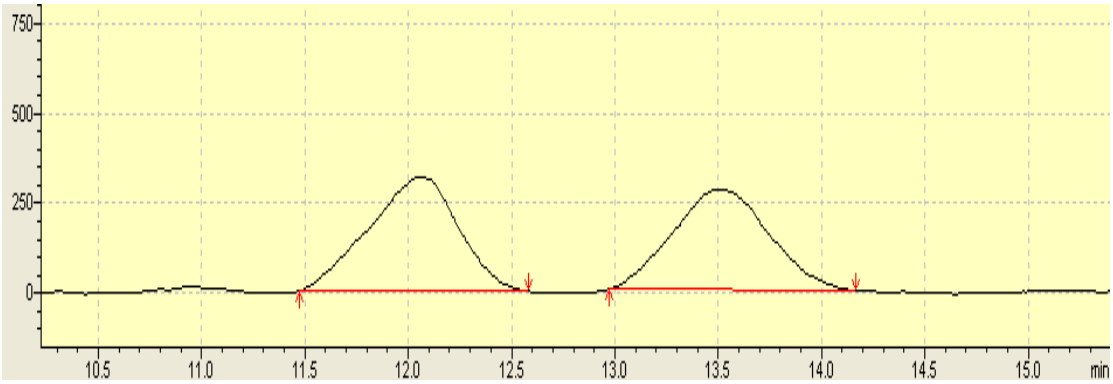
Figure 5. Racemate of 3-(benzyl(methyl)amino)-1-(4-methoxyphenyl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 1.0 mL /min, t_R = 19.38 min (major) and t_R = 14.84 min (minor).

Peak	Retention Time/min	Area %
1	14.840	50.453
2	19.379	49.547

Figure 6. (*R*)-3-(Benzyl(methyl)amino)-1-(4-methoxyphenyl)propan-1-ol (**4c**).

Peak	Retention Time/min	Area %
1	15.011	0.217
2	19.041	99.783

Figure 7. Racemate of 3-(benzyl(methyl)amino)-1-(m-tolyl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 0.8 mL /min, t_R = 13.51 min major) and t_R = 12.05 min (minor).



Peak	Retention Time/min	Area %
1	12.045	49.774
2	13.514	50.226

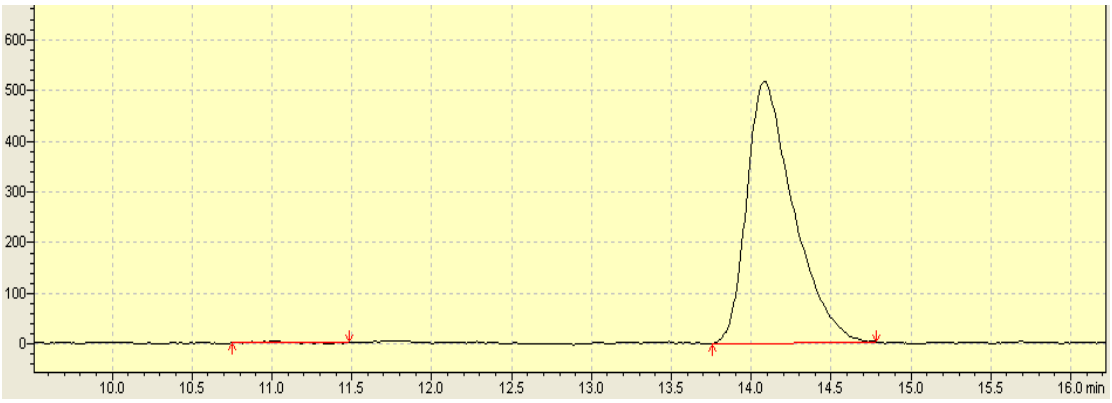
Figure 8. (*R*)-3-(Benzyl(methyl)amino)-1-(m-tolyl)propan-1-ol (**4d**).

Peak	Retention Time/min	Area %
1	11.929	0.043
2	13.470	99.957

Figure 9. Racemate of 3-(benzyl(methyl)amino)-1-(p-tolyl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 0.8 mL /min, t_R = 14.19 min (major) and t_R = 11.07 min (minor).

Peak	Retention Time/min	Area %
1	11.066	50.045
2	14.192	49.955

Figure 10. (*R*)-3-(Benzyl(methyl)amino)-1-(p-tolyl)propan-1-ol (**4e**).



Peak	Retention Time/min	Area %
1	11.030	0.012
2	14.080	99.988

Figure 11. Racemate of 3-(benzyl(methyl)amino)-1-(3-chlorophenyl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 1.0 mL /min, t_R = 12.08 min (major) and t_R = 9.19 min (minor).

Peak	Retention Time/min	Area %
1	9.197	49.787
2	12.084	50.213

Figure 12. (*R*)-3-(Benzyl(methyl)amino)-1-(3-chlorophenyl)propan-1-ol (**4f**).

Peak	Retention Time/min	Area %
1	9.454	0.361
2	12.075	99.639

Figure 13. Racemate of 3-(benzyl(methyl)amino)-1-(4-chlorophenyl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 210 nm, 0.6 mL /min, t_R = 21.47 min (major) and t_R = 16.09 min (minor).

Peak	Retention Time/min	Area %
1	16.088	49.320
2	21.470	50.680

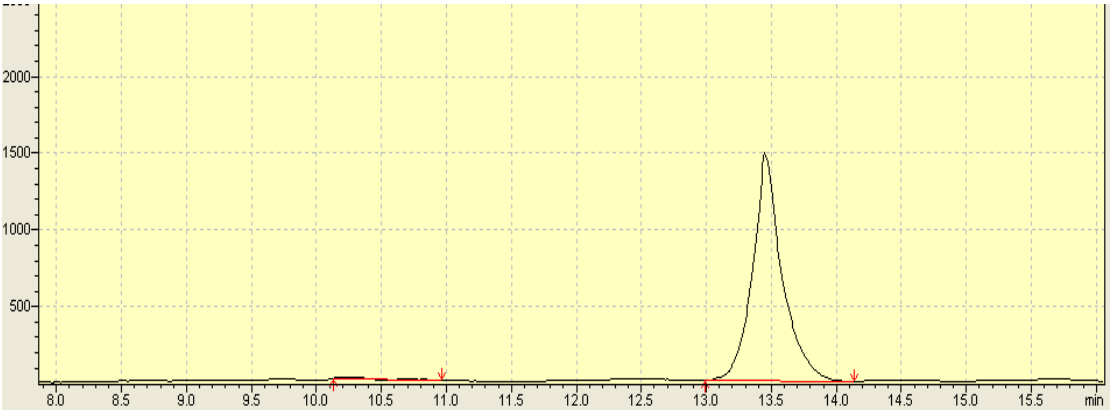
Figure 14. (*R*)-3-(Benzyl(methyl)amino)-1-(4-chlorophenyl)propan-1-ol (**4g**).

Peak	Retention Time/min	Area %
1	16.165	0.032
2	21.138	99.968

Figure 15. Racemate of 3-(benzyl(methyl)amino)-1-(3,4-dichlorophenyl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 1.0 mL /min, t_R = 13.56 min (major) and t_R = 10.39 min (minor).

Peak	Retention Time/min	Area %
1	10.390	50.248
2	13.557	49.752

Figure 16. (*R*)-3-(Benzyl(methyl)amino)-1-(3,4-dichlorophenyl)propan-1-ol (**4h**).



Peak	Retention Time/min	Area %
1	10.231	0.014
2	13.446	99.986

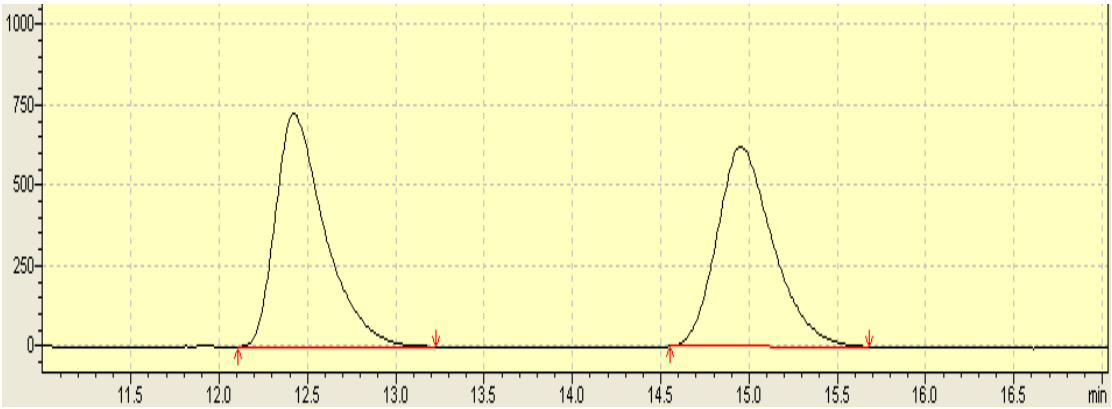
Figure 17. Racemate of 3-(benzyl(methyl)amino)-1-(4-fluorophenyl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 0.8 mL /min, t_R = 14.26 min (major) and t_R = 11.12 min (minor).

Peak	Retention Time/min	Area %
1	11.119	50.173
2	14.257	49.827

Figure 18. (*R*)-3-(Benzyl(methyl)amino)-1-(4-fluorophenyl)propan-1-ol (**4i**).

Peak	Retention Time/min	Area %
1	10.940	0.353
2	14.348	99.647

Figure 19. Racemate of 3-(benzyl(methyl)amino)-1-(4-bromophenyl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 0.6 mL /min, t_R = 14.94 min (major) and t_R = 12.41 min (minor).



Peak	Retention Time/min	Area %
1	12.414	50.730
2	14.944	49.270

Figure 20. (*R*)-3-(Benzyl(methyl)amino)-1-(4-bromophenyl)propan-1-ol (**4j**).

Peak	Retention Time/min	Area %
1	12.202	1.353
2	14.720	98.647

Figure 21. Racemate of 1-([1,1'-biphenyl]-4-yl)-3-(benzyl(methyl)amino)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel IC-3), Hex : *i*-PrOH 90 : 10, UV 230 nm, 0.8 mL /min, t_R = 31.48 min (major) and t_R = 16.94 min (minor).

Peak	Retention Time/min	Area %
1	16.937	49.019
2	31.483	50.981

Figure 22. (*R*)-1-([1,1'-Biphenyl]-4-yl)-3-(benzyl(methyl)amino)propan-1-ol (**4k**).

Peak	Retention Time/min	Area %
1	17.442	0.395
2	32.552	99.605

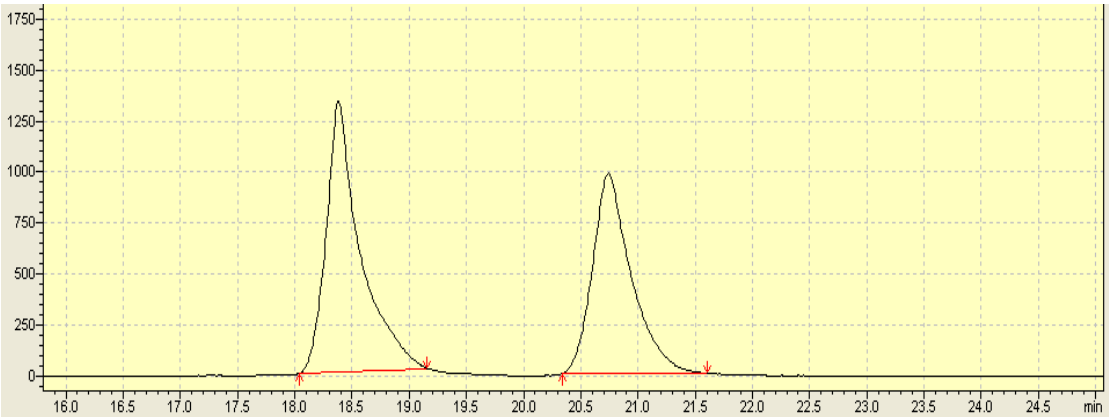
Figure 23. Racemate of 3-(benzyl(methyl)amino)-1-(naphthalen-2-yl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 1.0 mL /min, t_R = 24.65 min (major) and t_R = 17.84 min (minor).

Peak	Retention Time/min	Area %
1	17.835	50.146
2	24.649	49.854

Figure 24. (*R*)-3-(Benzyl(methyl)amino)-1-(naphthalen-2-yl)propan-1-ol **(4l)**.

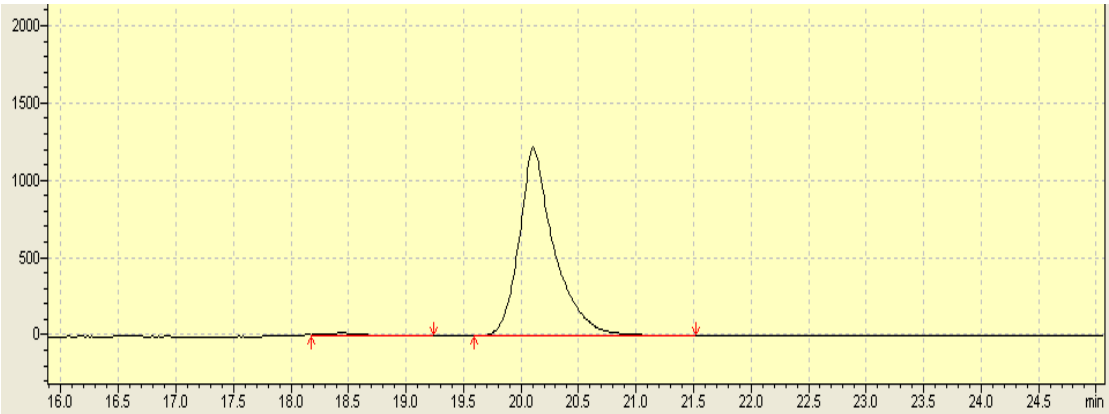
Peak	Retention Time/min	Area %
1	18.392	0.060
2	24.787	99.940

Figure 25. Racemate of (benzyl(methyl)amino)-1-(furan-2-yl)propan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 200 nm, 0.5 mL /min, t_R = 20.74 min (major) and t_R = 18.38 min (minor).



Peak	Retention Time/min	Area %
1	18.376	50.049
2	20.739	49.951

Figure 26. (*R*)-(Benzyl(methyl)amino)-1-(furan-2-yl)propan-1-ol (**4m**).

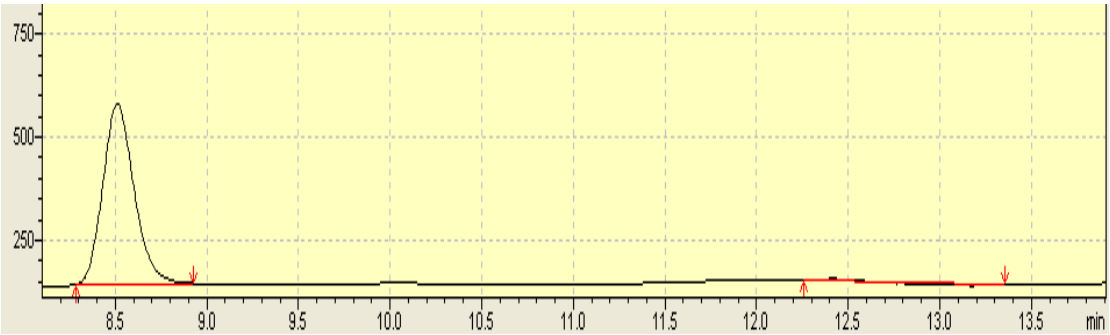


Peak	Retention Time/min	Area %
1	18.459	0.650
2	20.101	99.350

Figure 27. Racemate of 3-(dimethylamino)-1-phenylpropan-1-ol, the enantiomeric excess was determined by HPLC (Chiralcel OD-H), Hex : *i*-PrOH 95 : 5, UV 254 nm, 1.0 mL /min, t_R = 8.61 min (major) and t_R = 12.49 min (minor).

Peak	Retention Time/min	Area %
1	8.610	49.917
2	12.488	50.083

Figure 28. (*S*)-3-(Dimethylamino)-1-phenylpropan-1-ol (**4n**).

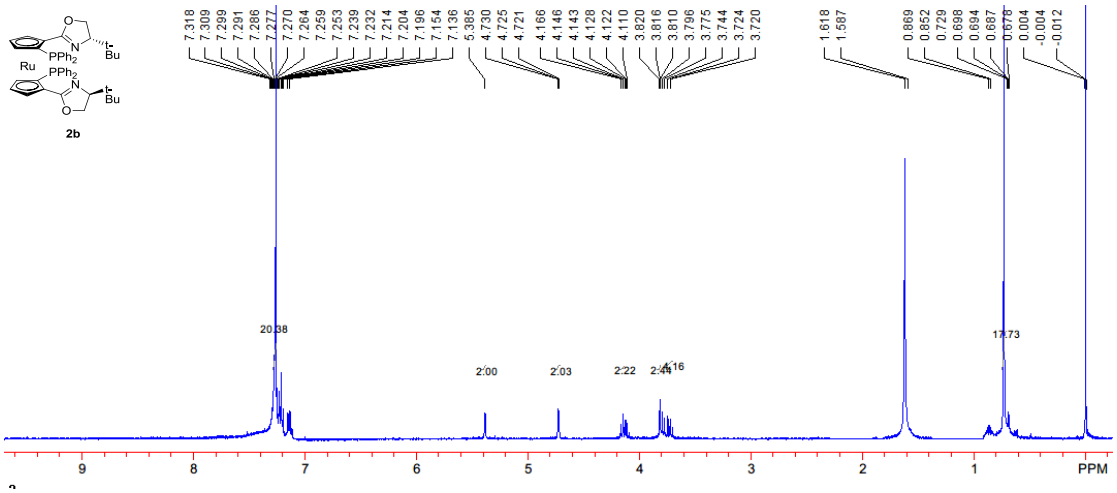


Peak	Retention Time/min	Area %
1	8.507	99.792
2	12.411	0.208

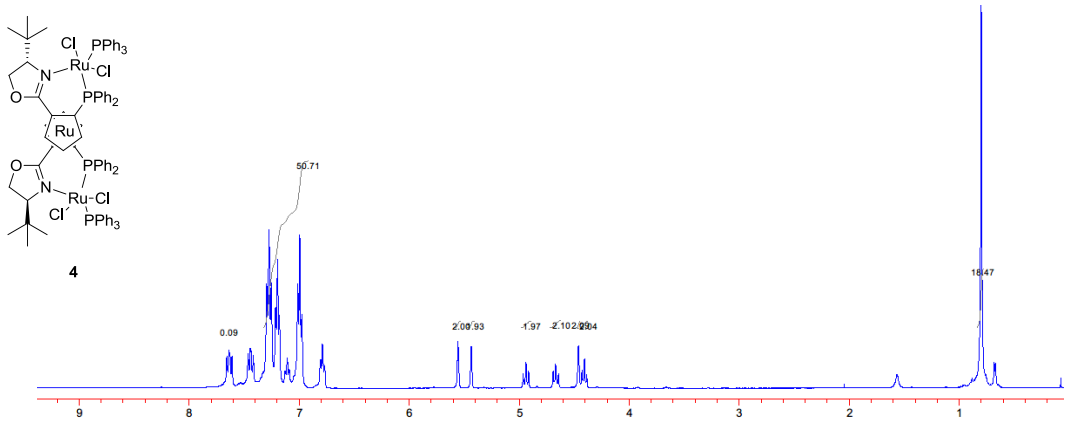
4. NMR Spectra

2,2'-Bis[(*S*)-4-tertyloxazolin-2-yl]-(*S*)-(*S*)-1,1'-bis(diphenylphosphino)-ruthenocene (1b)

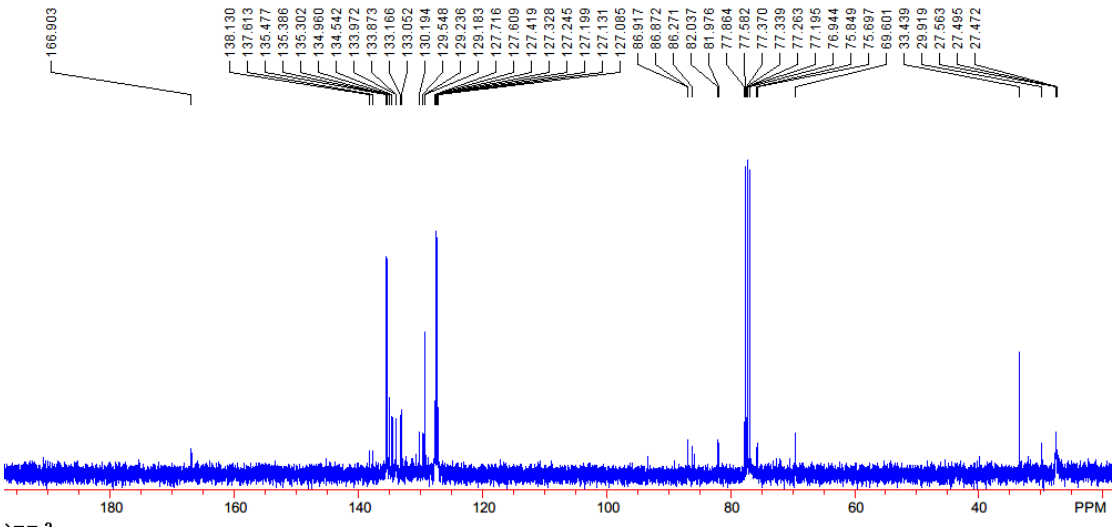
^{1}H NMR (400 MHz, $CDCl_3$)



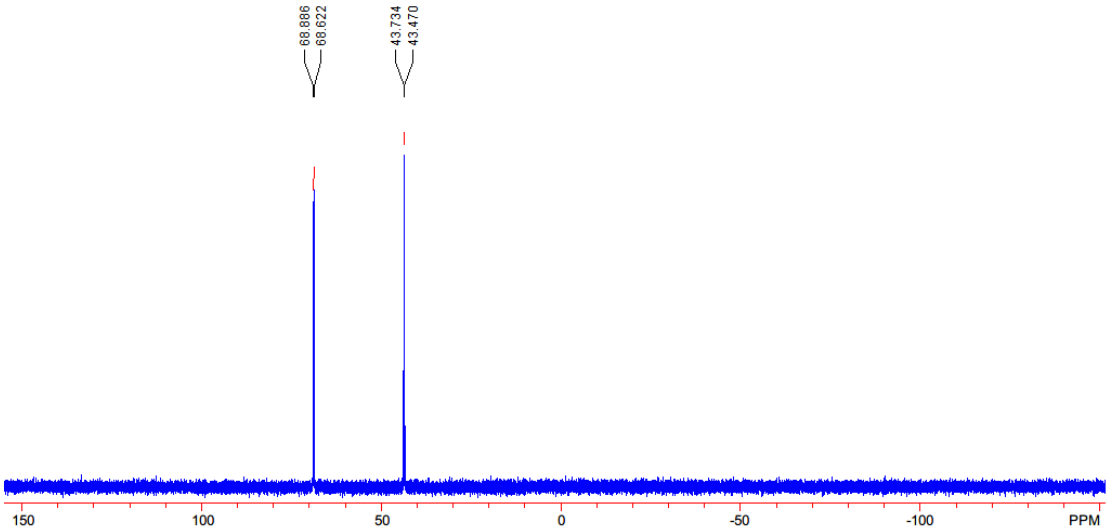
^{1}H NMR (400 MHz, $CDCl_3$) **2**



^{13}C NMR (100 MHz, $CDCl_3$) **2**

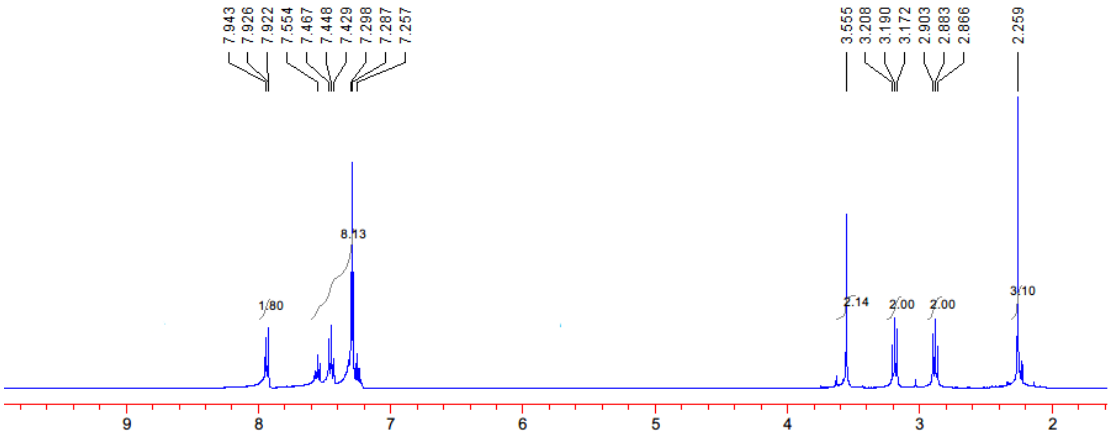


^{31}P NMR (126 MHz, $CDCl_3$) **2**

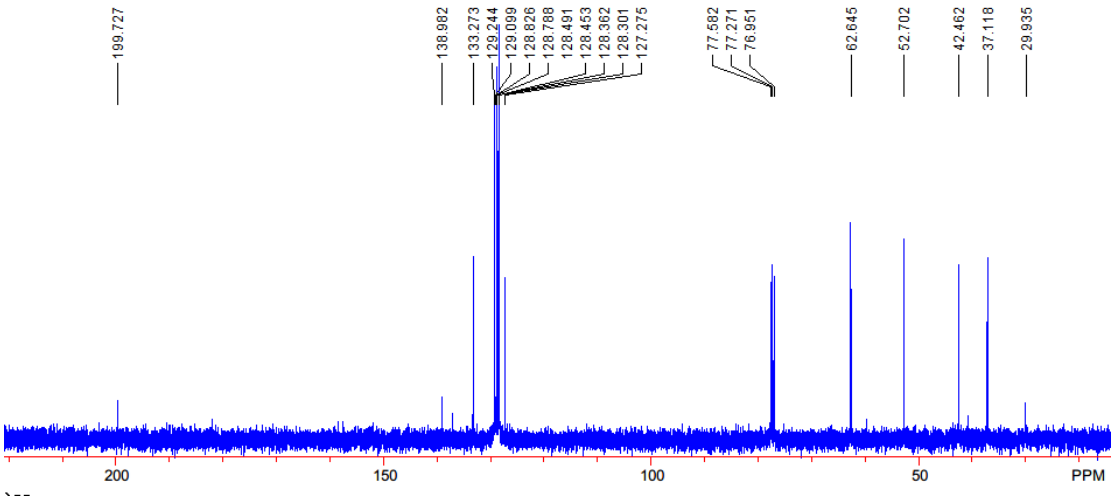


3-(Benzyl(methyl)amino)-1-phenylpropan-1-one (3a)

^{1}H NMR (400 MHz, $CDCl_3$)

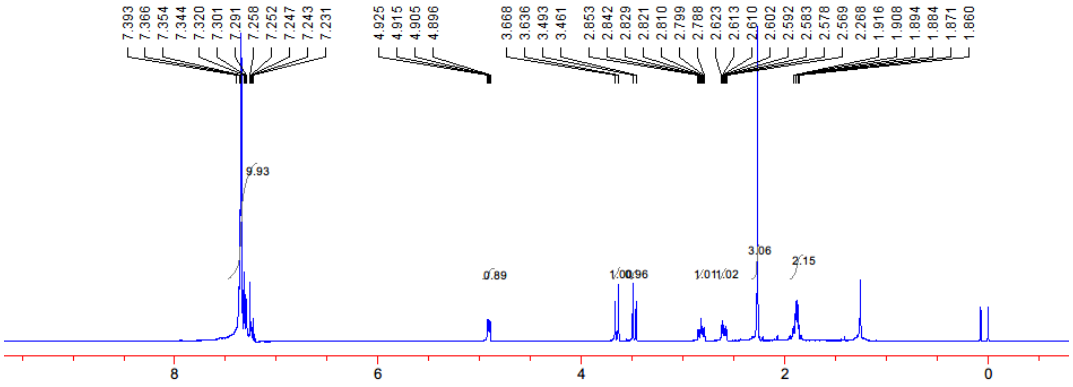


^{13}C NMR (100 MHz, $CDCl_3$) **3a**

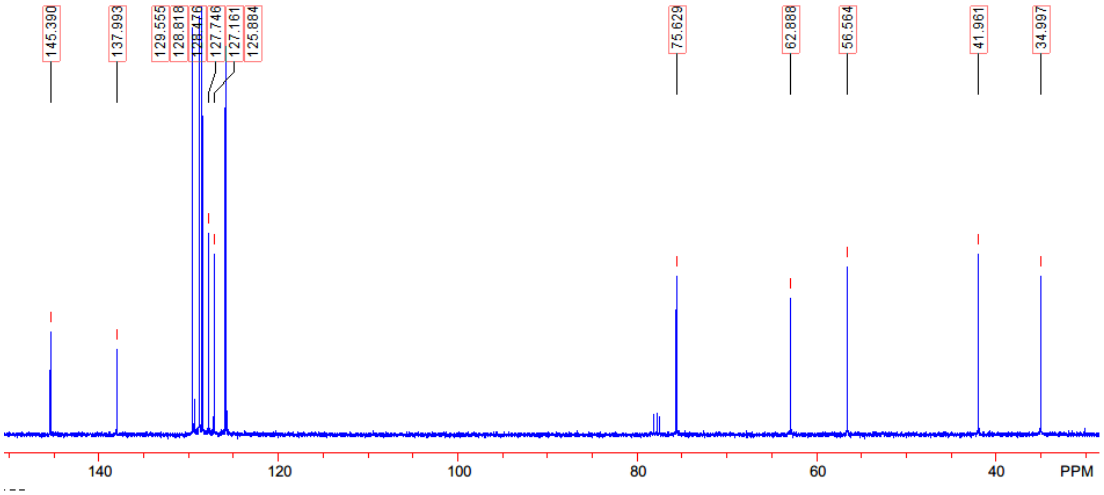


(*R*)-3-(Benzyl(methyl)amino)-1-phenylpropan-1-ol (4a)

^{1}H NMR (400 MHz, $CDCl_3$)

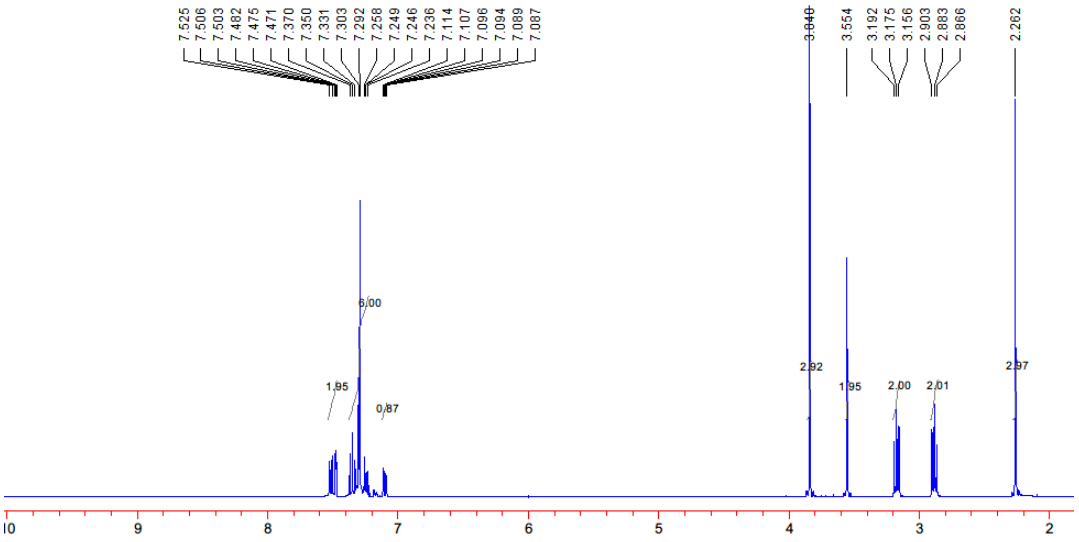


^{13}C NMR (100 MHz, $CDCl_3$) **4a**

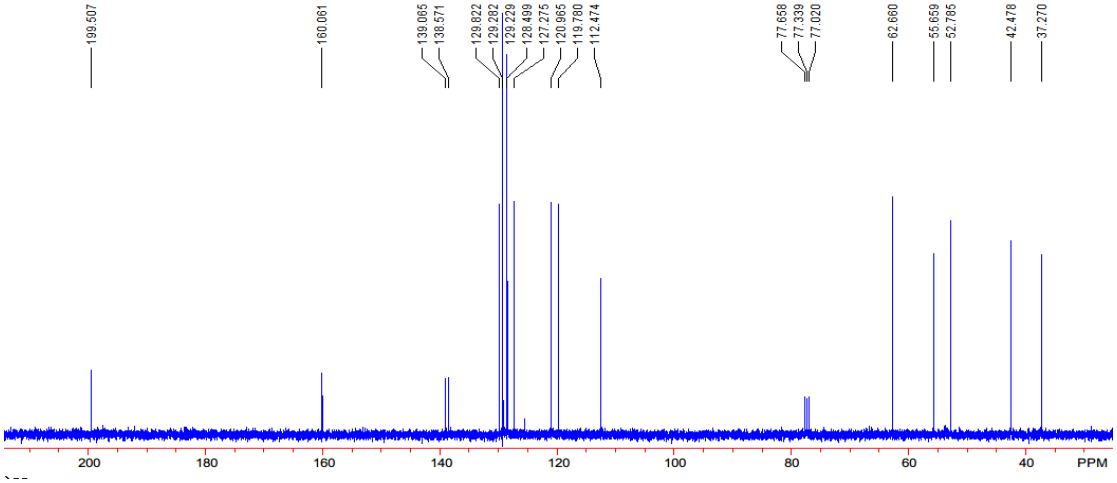


3-(Benzyl(methyl)amino)-1-(3-methoxyphenyl)propan-1-one (3b)

^{1}H NMR (400 MHz, $CDCl_3$)

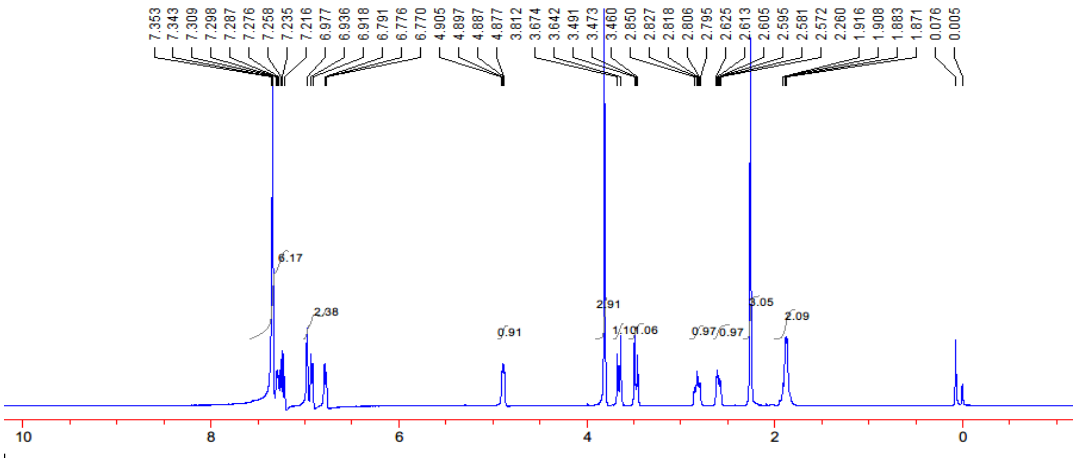


^{13}C NMR (100 MHz, $CDCl_3$) **3b**

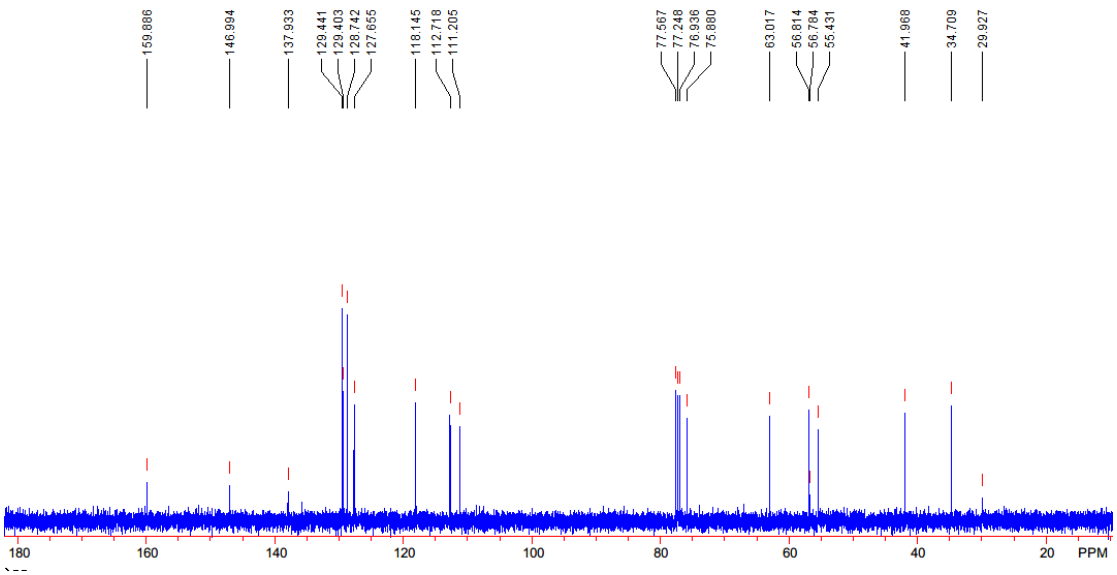


(*R*)-3-(Benzyl(methyl)amino)-1-(3-methoxyphenyl)propan-1-ol (4b)

^{1}H NMR (400 MHz, $CDCl_3$)

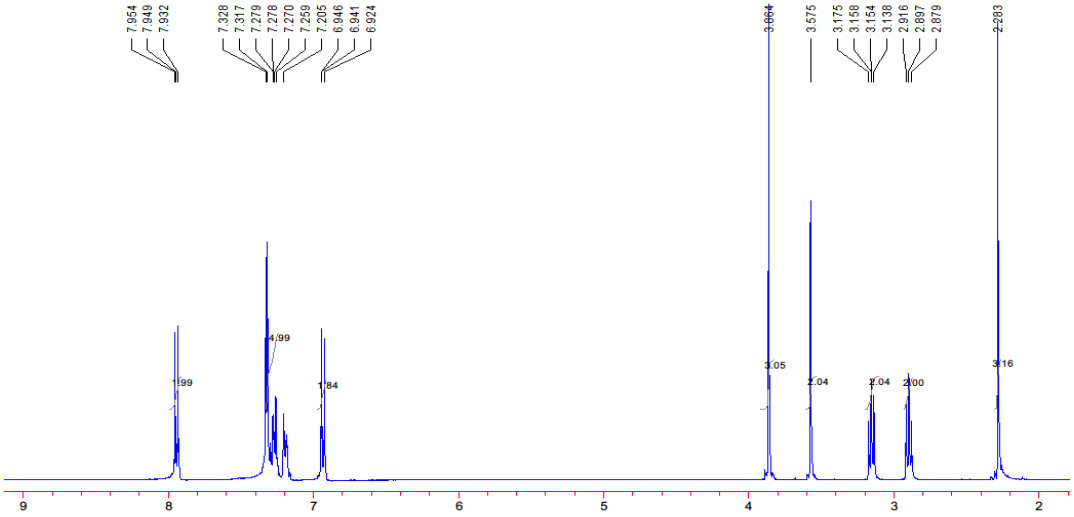


^{13}C NMR (100 MHz, $CDCl_3$) **4b**

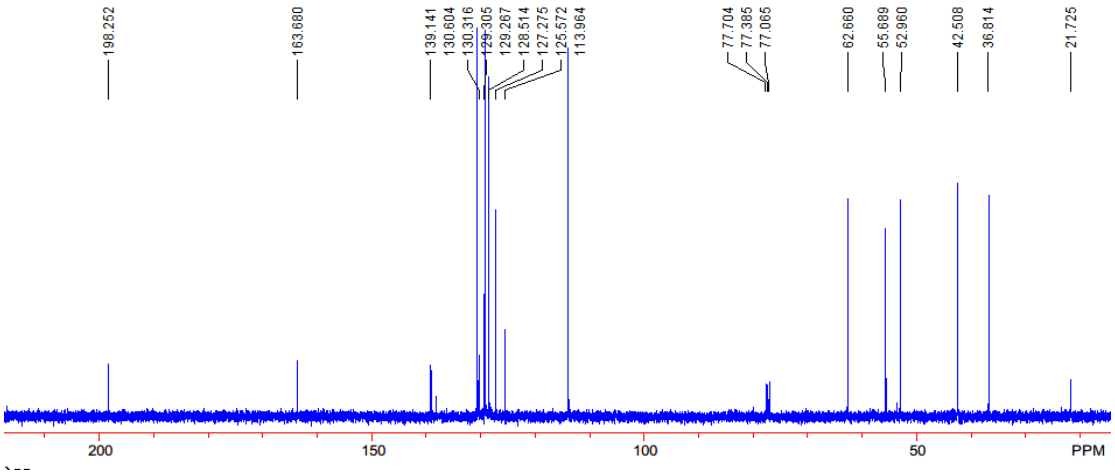


3-(Benzyl(methyl)amino)-1-(4-methoxyphenyl)propan-1-one (3c)

^{1}H NMR (400 MHz, $CDCl_3$)

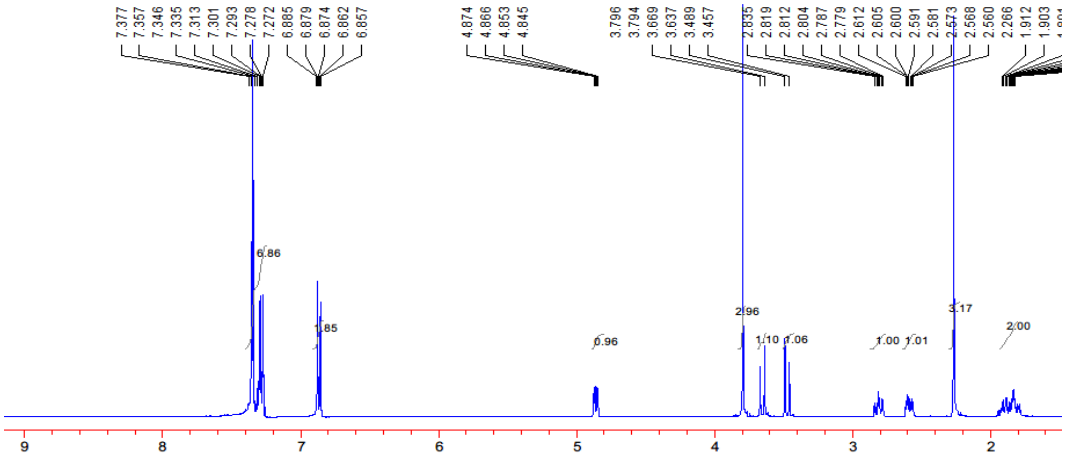


^{13}C NMR (100 MHz, $CDCl_3$) **3c**

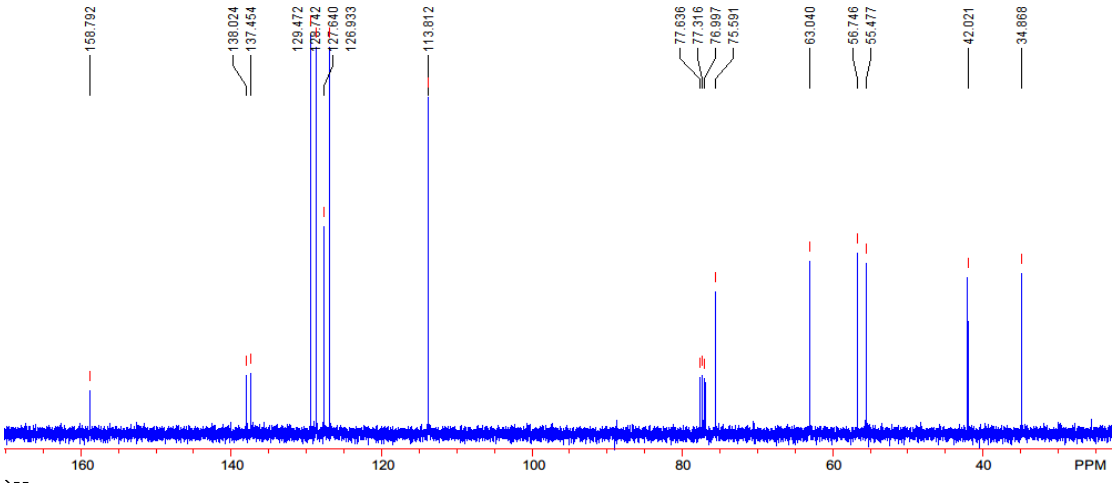


(*R*)-3-(Benzyl(methyl)amino)-1-(4-methoxyphenyl)propan-1-ol (4c)

^{1}H NMR (400 MHz, $CDCl_3$)

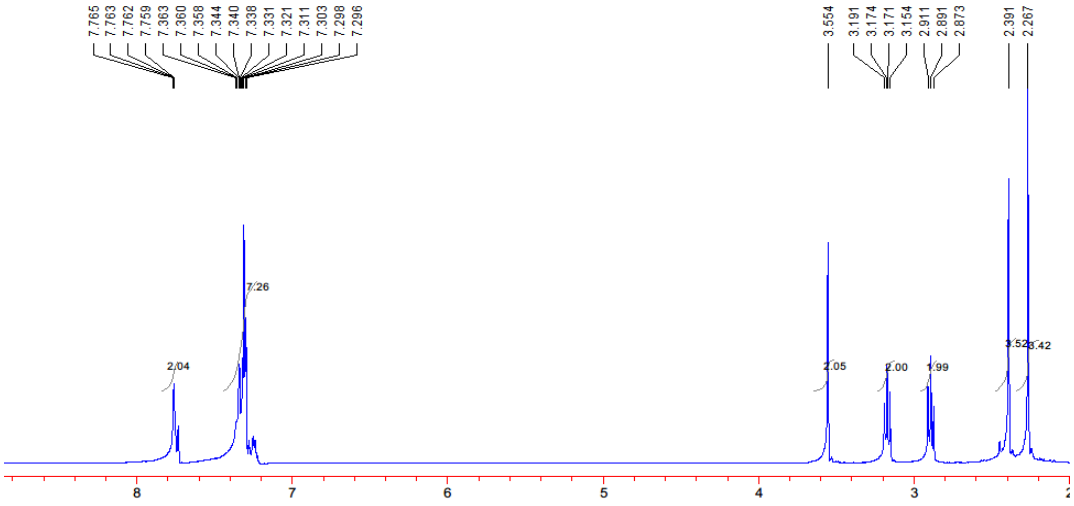


^{13}C NMR (100 MHz, $CDCl_3$) **4c**

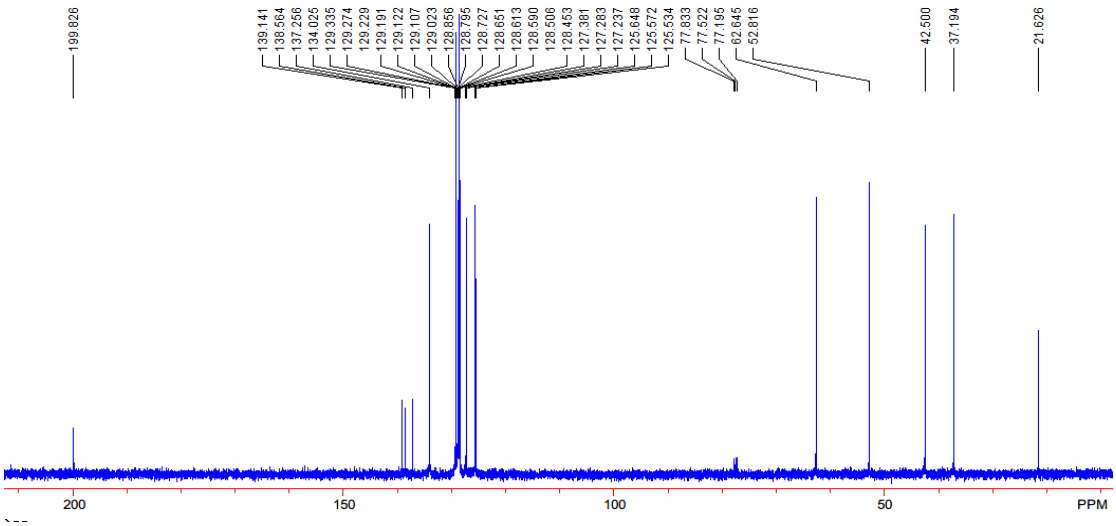


3-(Benzyl(methyl)amino)-1-(*m*-tolyl)propan-1-one (3d)

^{1}H NMR (400 MHz, $CDCl_3$)

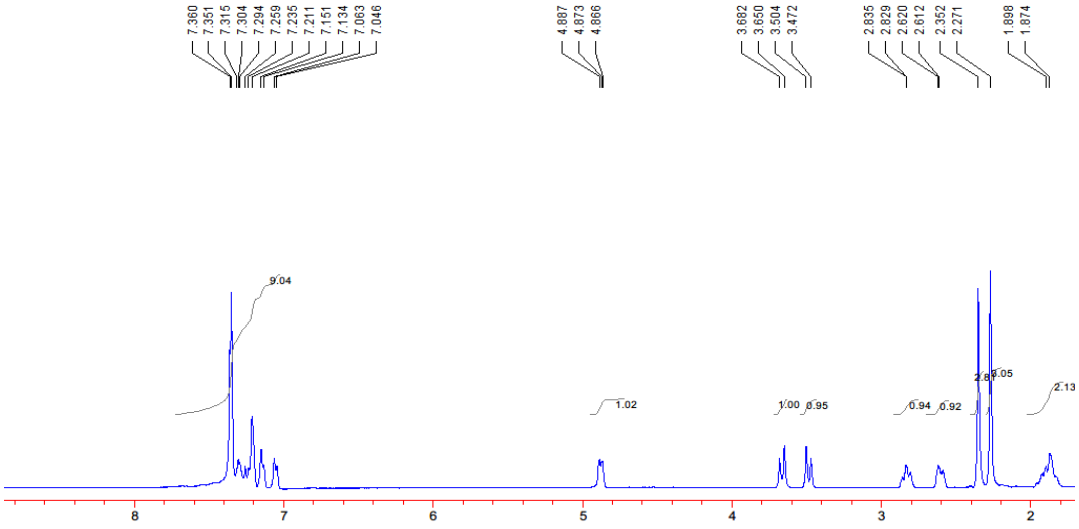


^{13}C NMR (100 MHz, $CDCl_3$) **3d**

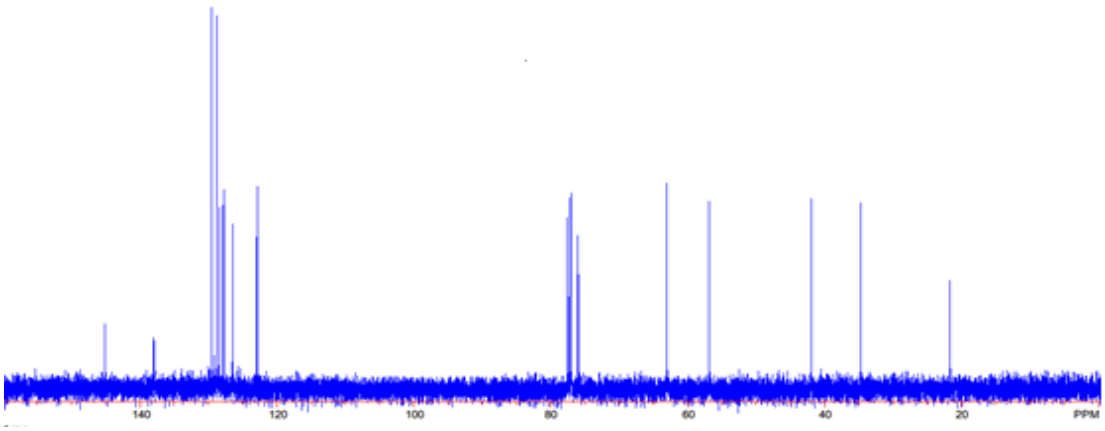


(*R*)-3-(Benzyl(methyl)amino)-1-(*m*-tolyl)propan-1-ol (4d)

^{1}H NMR (400 MHz, $CDCl_3$)

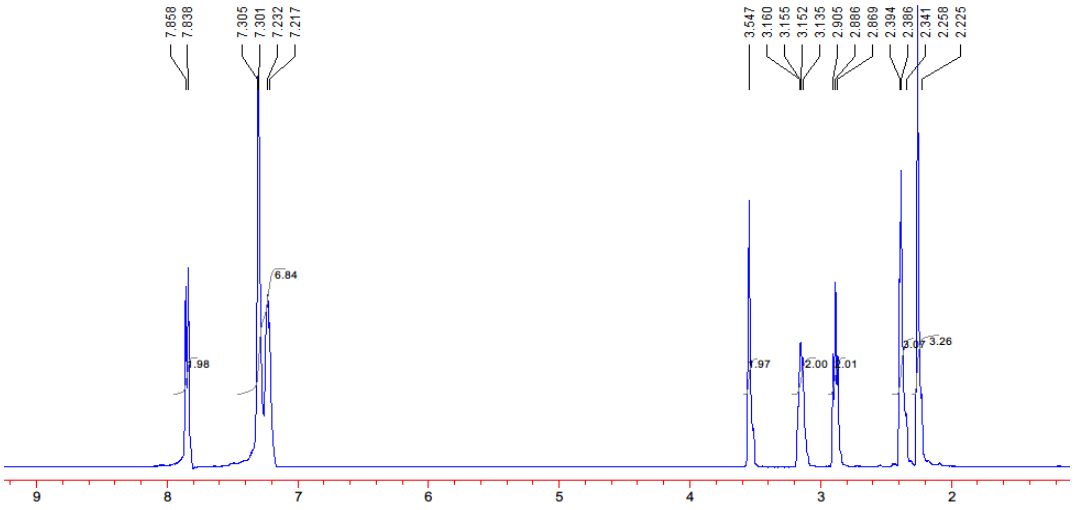


^{13}C NMR (100 MHz, $CDCl_3$) **4d**

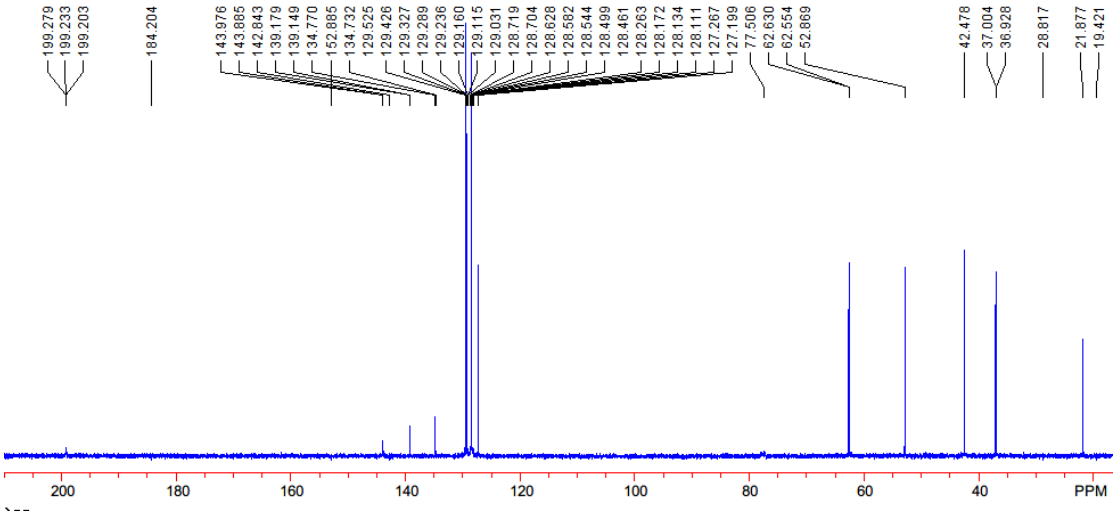


3-(Benzyl(methyl)amino)-1-(*p*-tolyl)propan-1-one (3e)

^{1}H NMR (400 MHz, $CDCl_3$)

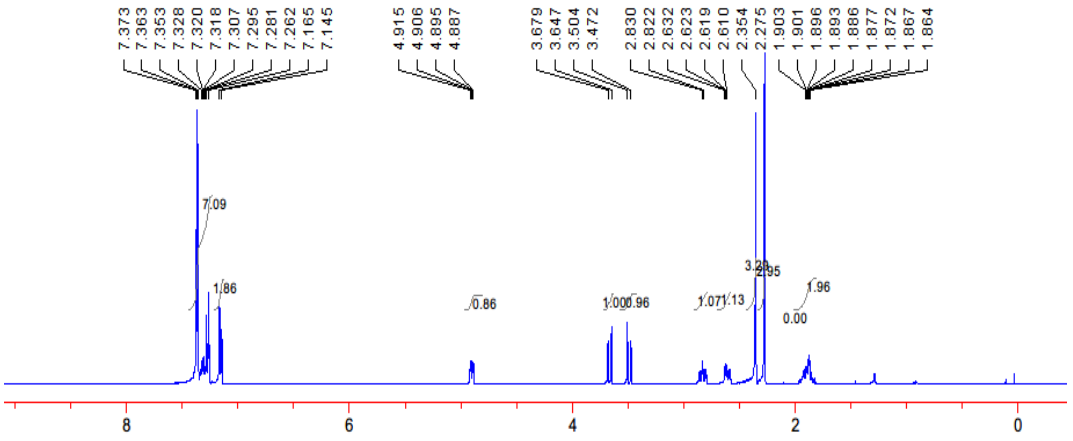


^{13}C NMR (100 MHz, $CDCl_3$) **3e**

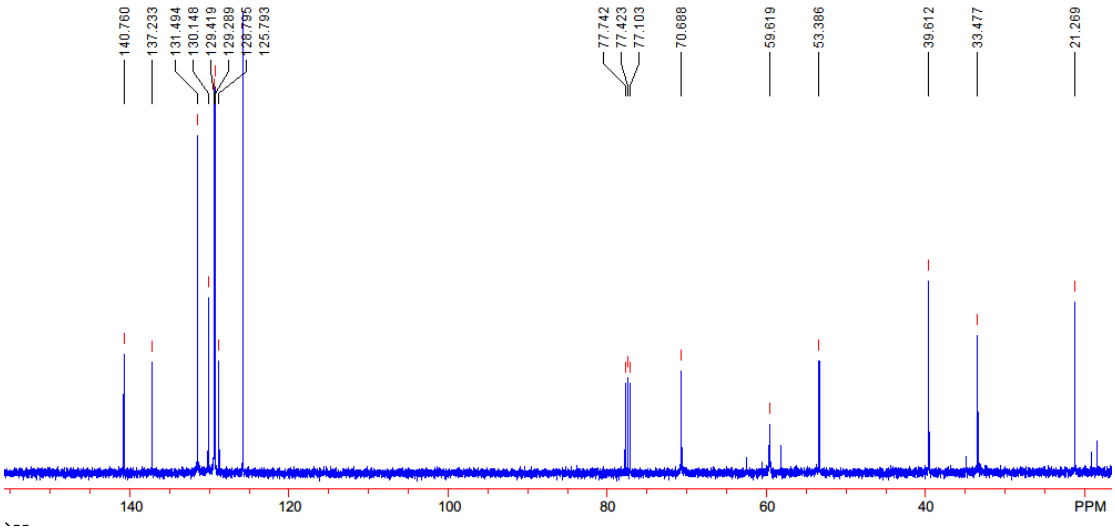


(*R*)-3-(Benzyl(methyl)amino)-1-(*p*-tolyl)propan-1-ol (4e)

^{1}H NMR (400 MHz, $CDCl_3$)

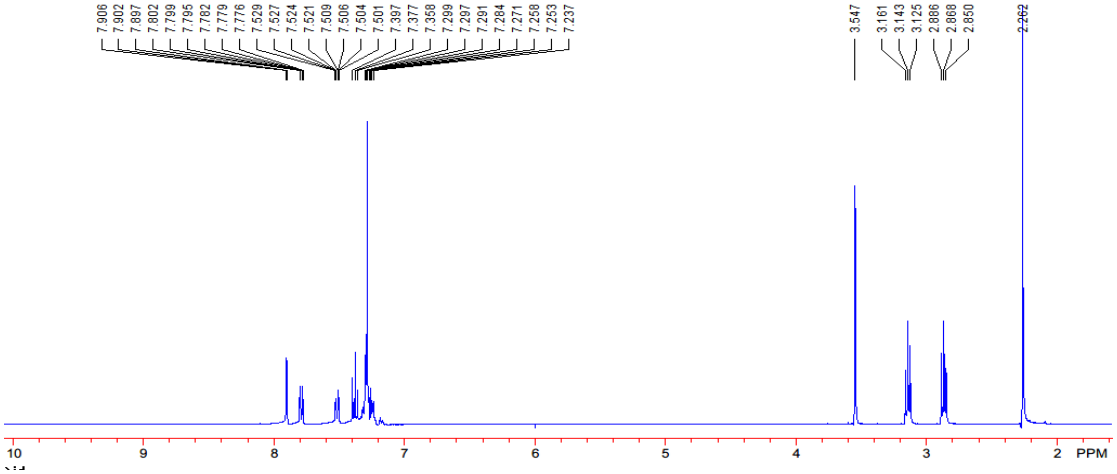


^{13C} NMR (100 MHz, $CDCl_3$) **4e**

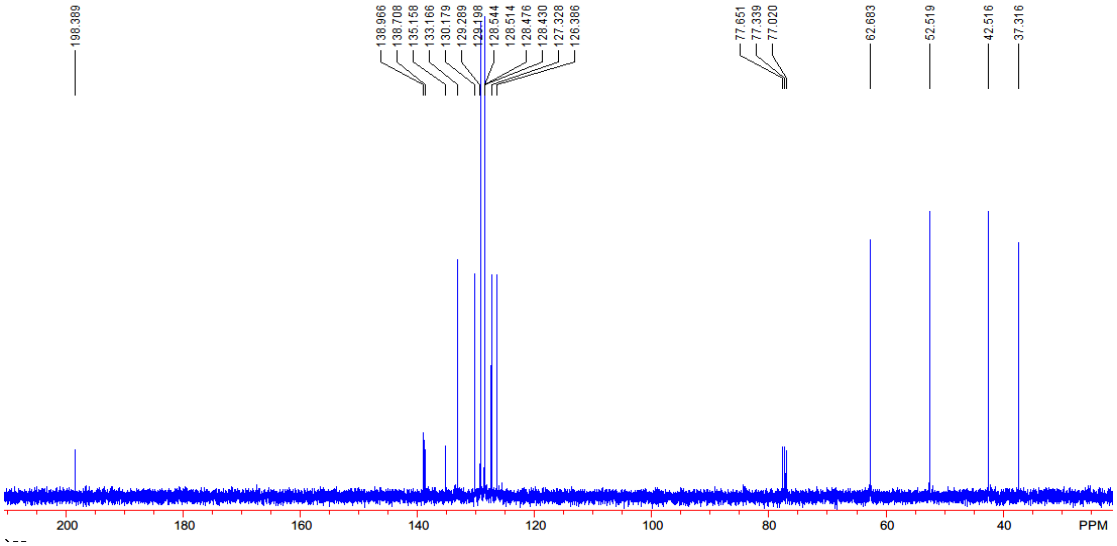


3-(Benzyl(methyl)amino)-1-(3-chlorophenyl)propan-1-one (3f)

^{1}H NMR (400 MHz, $CDCl_3$)

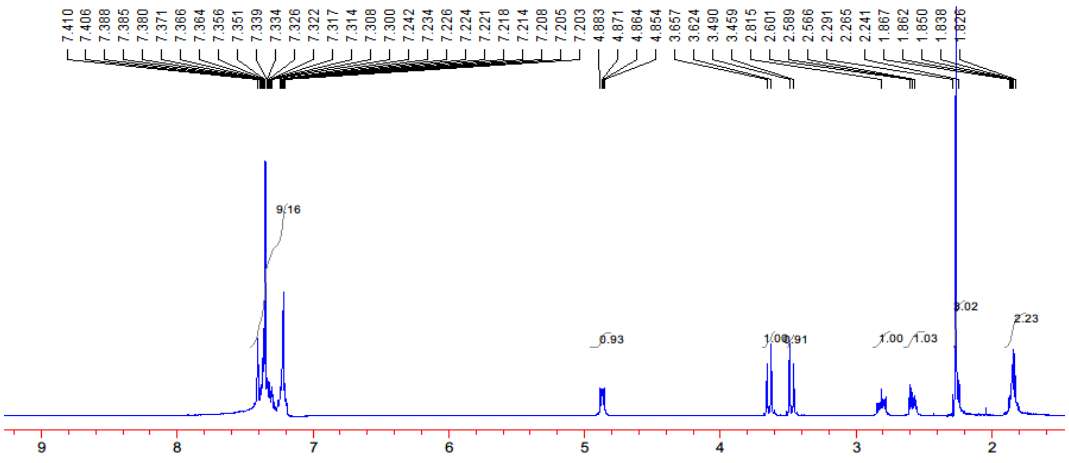


^{13}C NMR (100 MHz, $CDCl_3$) **3f**

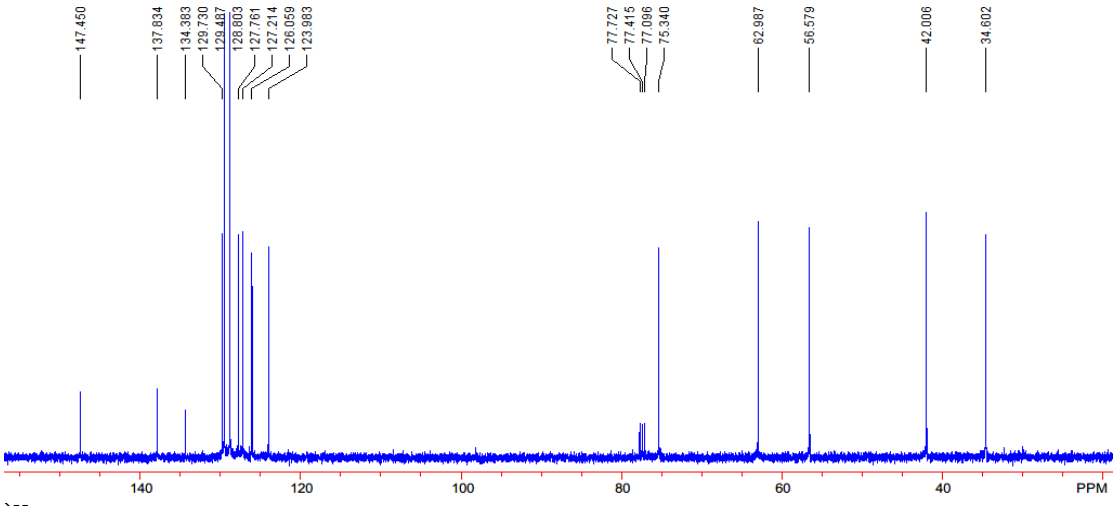


(*R*)-3-(Benzyl(methyl)amino)-1-(3-chlorophenyl)propan-1-ol (4f)

^{1}H NMR (400 MHz, $CDCl_3$)

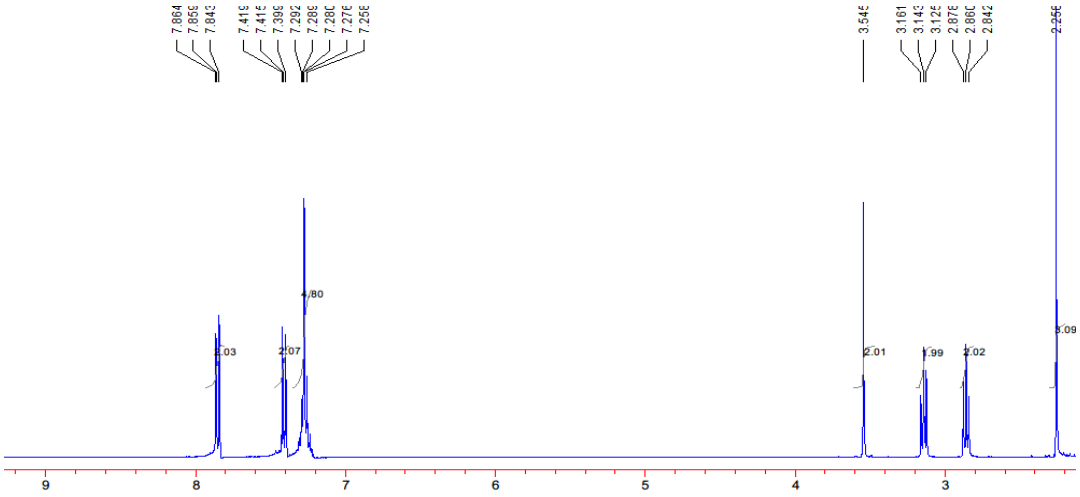


^{13}C NMR (100 MHz, $CDCl_3$) **4f**

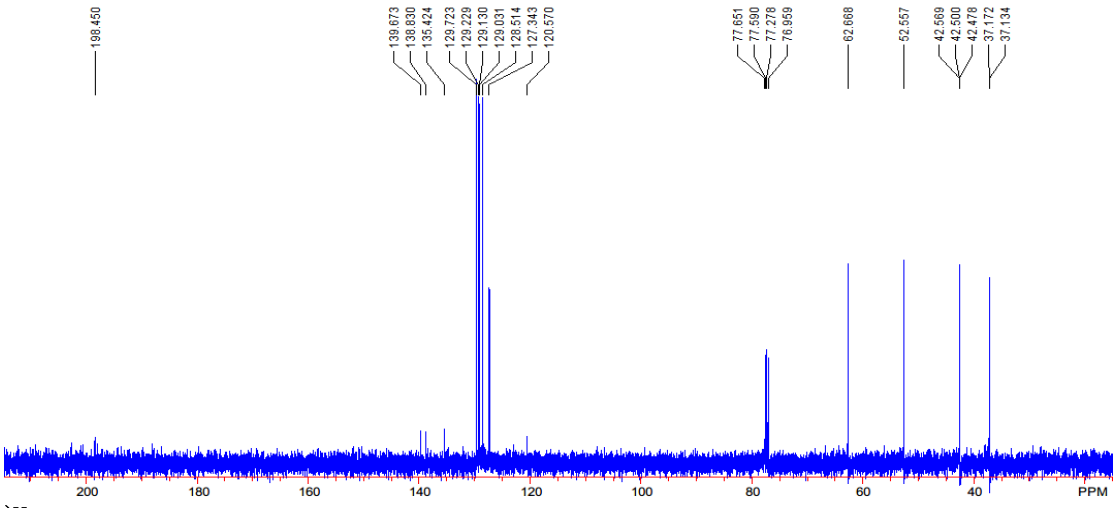


3-(Benzyl(methyl)amino)-1-(4-chlorophenyl)propan-1-one (3g)

^{1}H NMR (400 MHz, $CDCl_3$)

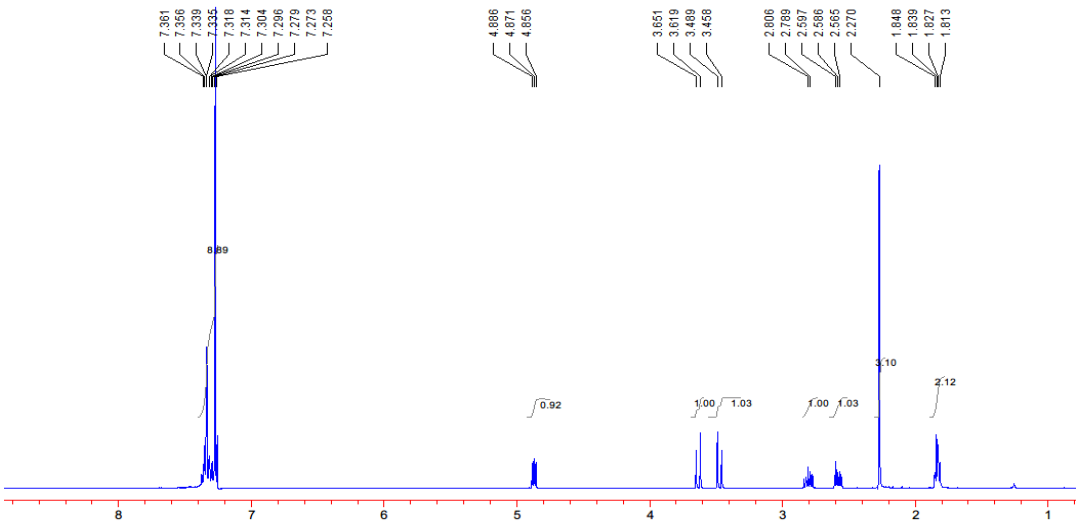


^{13}C NMR (100 MHz, $CDCl_3$) **3g**

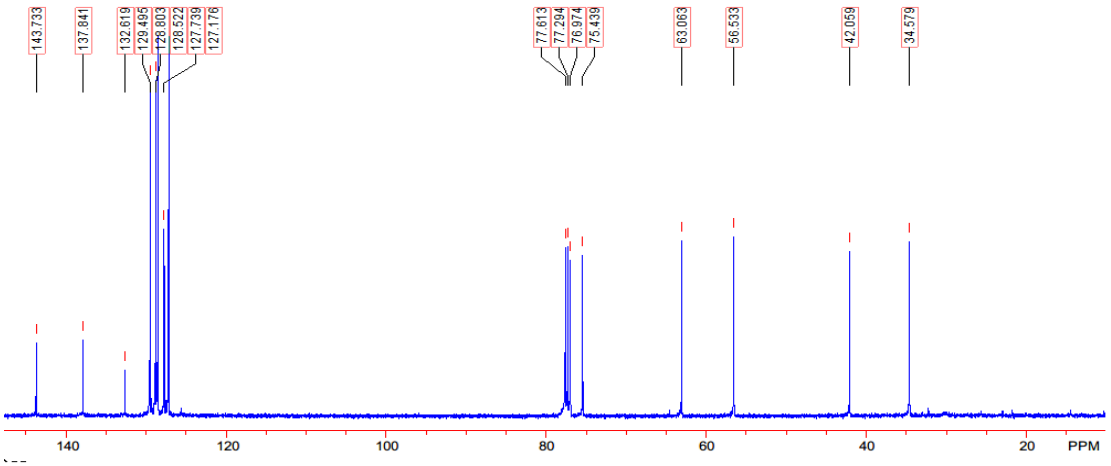


(*R*)-3-(Benzyl(methyl)amino)-1-(4-chlorophenyl)propan-1-ol (4g)

^{1}H NMR (400 MHz, $CDCl_3$)

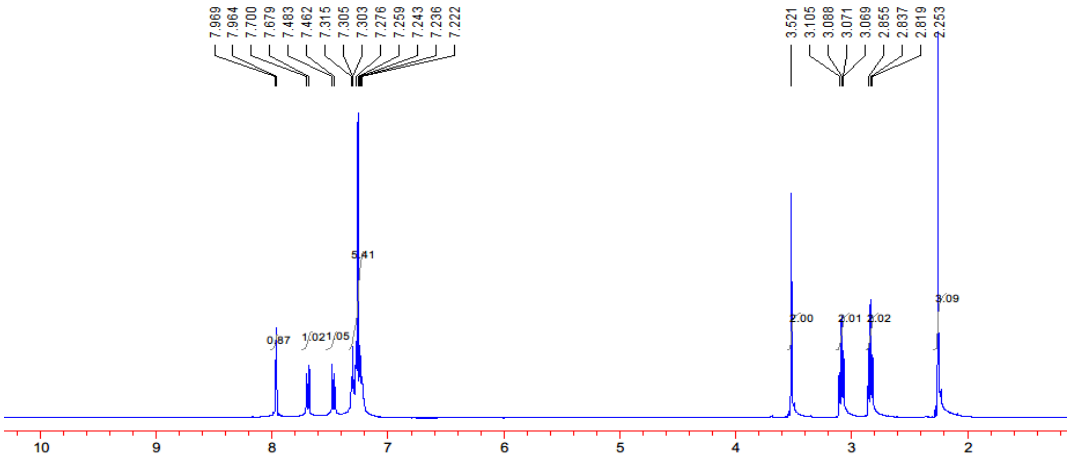


^{13}C NMR (100 MHz, $CDCl_3$) **4g**

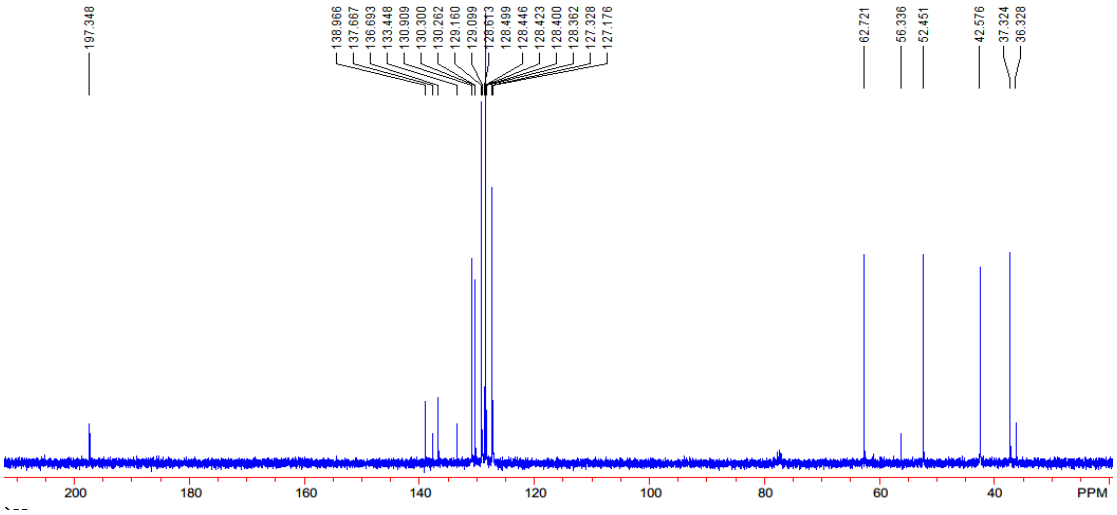


3-(Benzyl(methyl)amino)-1-(3,4-dichlorophenyl)propan-1-one (3h)

^{1}H NMR (400 MHz, $CDCl_3$)

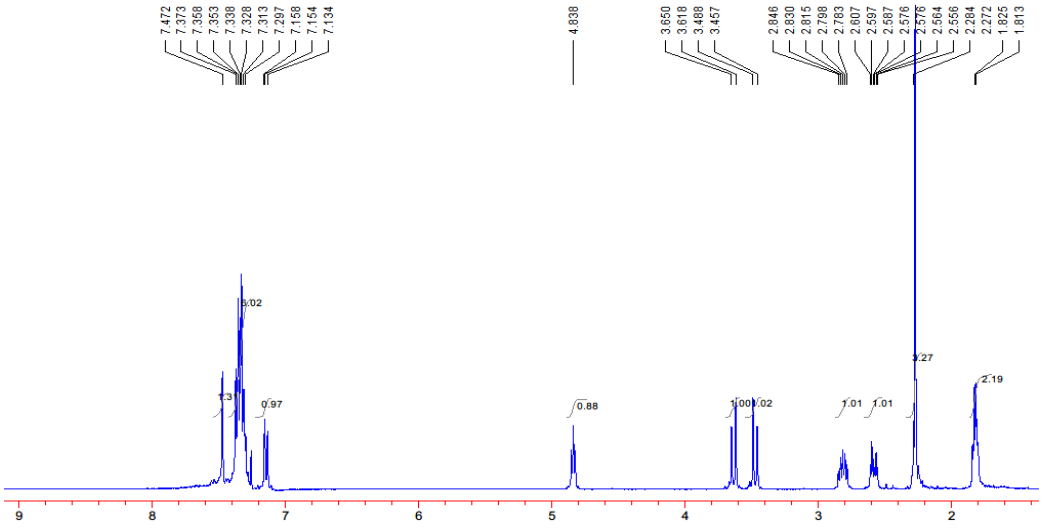


^{13}C NMR (100 MHz, $CDCl_3$) **3h**

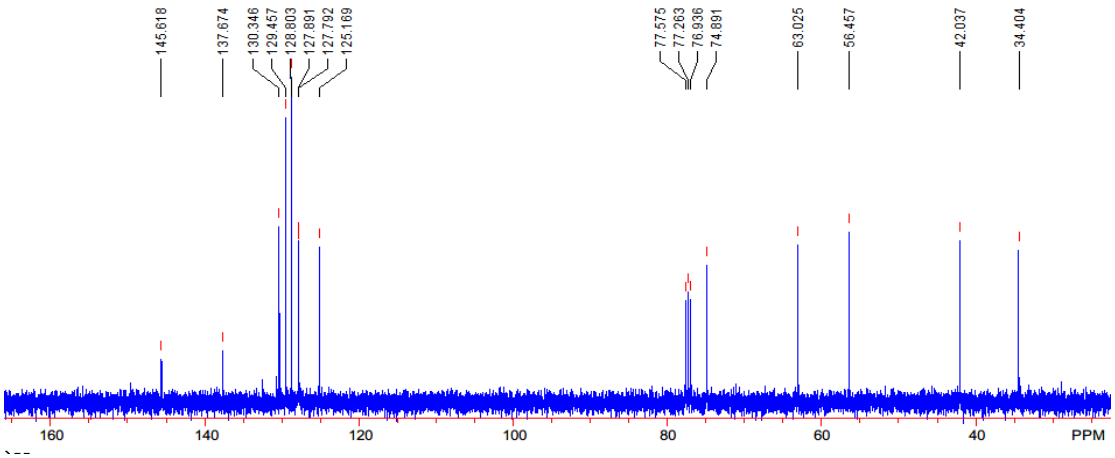


(*R*)-3-(Benzyl(methyl)amino)-1-(3,4-dichlorophenyl)propan-1-ol (4h)

^{1}H NMR (400 MHz, $CDCl_3$)

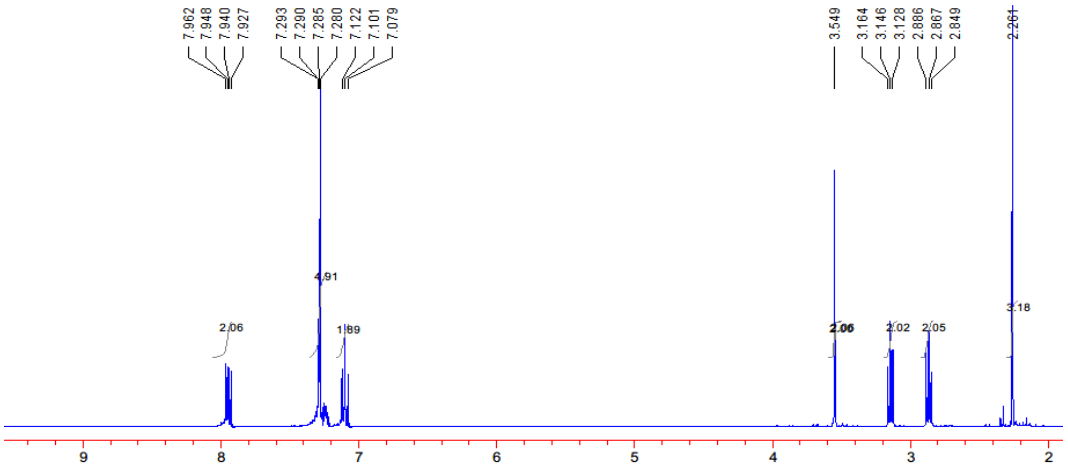


^{13}C NMR (100 MHz, $CDCl_3$) **4h**

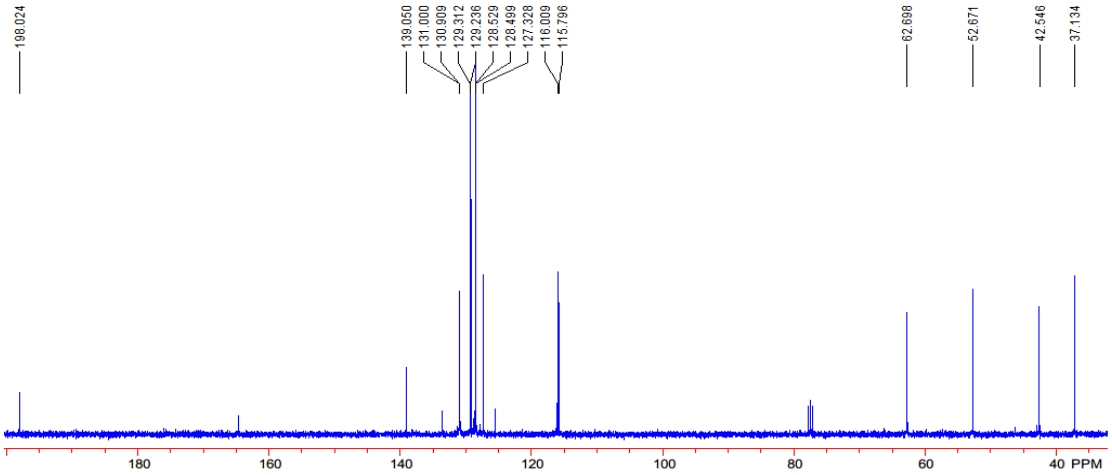


3-(Benzyl(methyl)amino)-1-(4-fluorophenyl)propan-1-one (3i)

^{1}H NMR (400 MHz, $CDCl_3$)

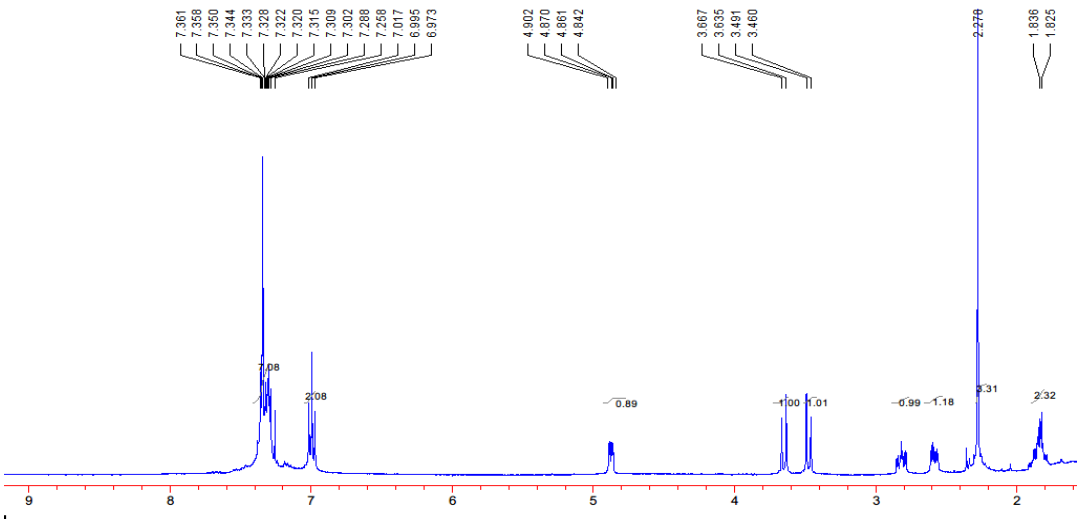


^{13}C NMR (100 MHz, $CDCl_3$) **3i**

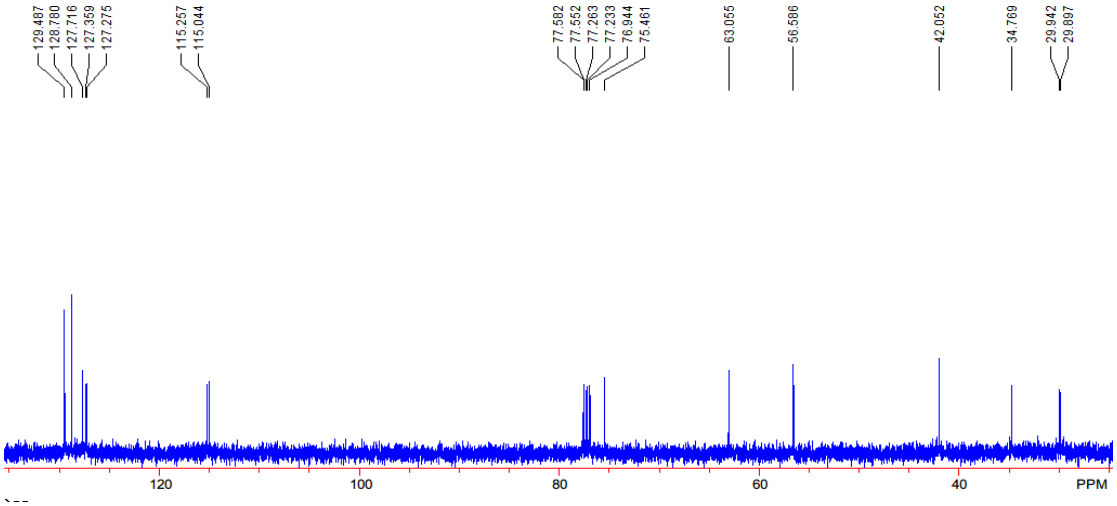


(*R*)-3-(Benzyl(methyl)amino)-1-(4-fluorophenyl)propan-1-ol (4i)

^{1}H NMR (400 MHz, $CDCl_3$)

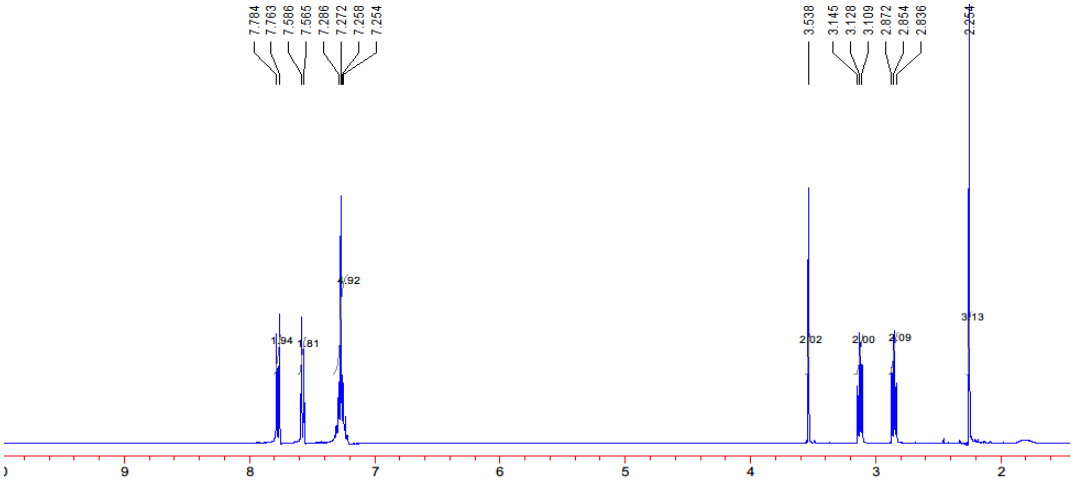


^{13}C NMR (100 MHz, $CDCl_3$) **4i**

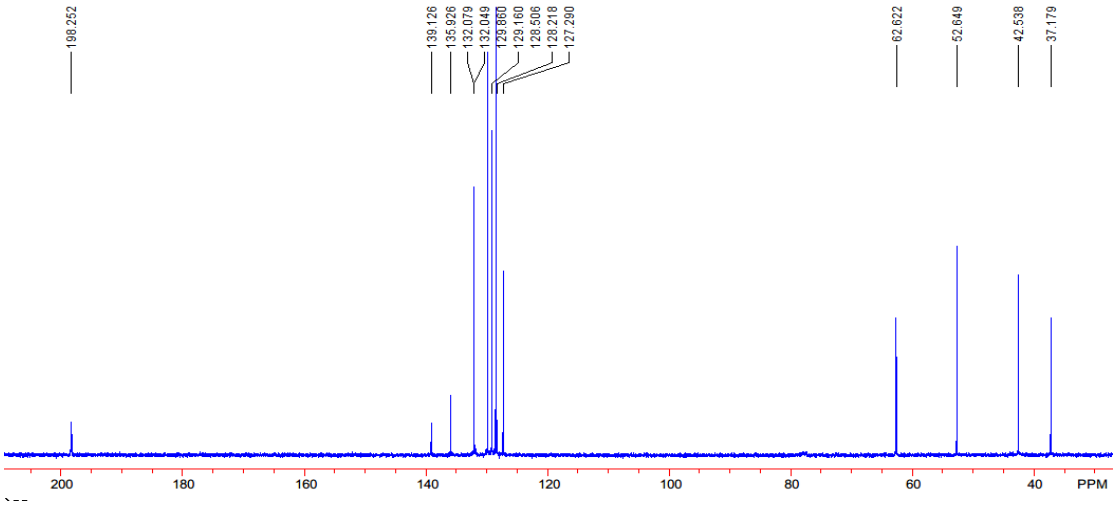


3-(Benzyl(methyl)amino)-1-(4-bromophenyl)propan-1-one (3j)

^{1}H NMR (400 MHz, $CDCl_3$)

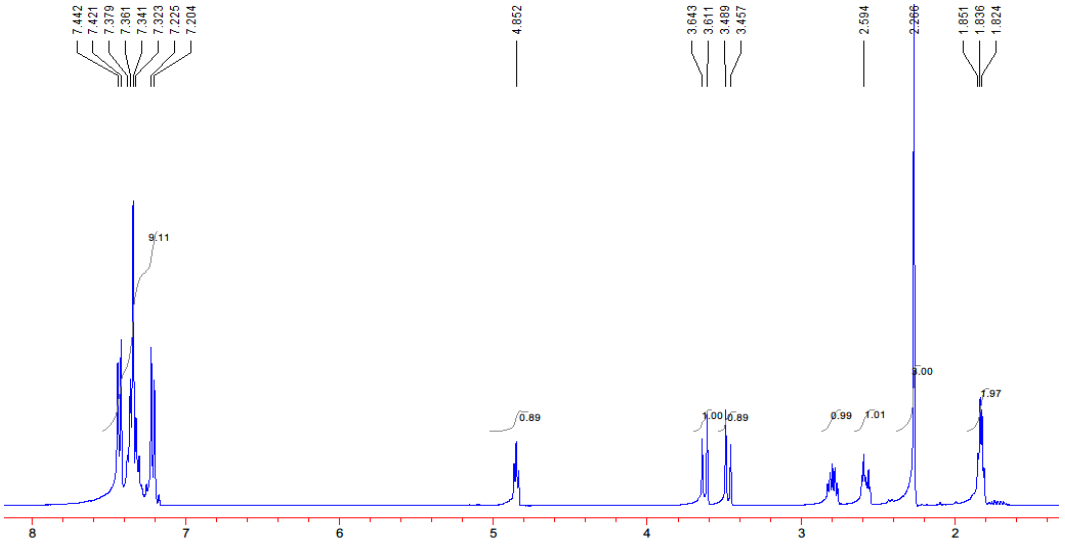


^{13}C NMR (100 MHz, $CDCl_3$) **3j**

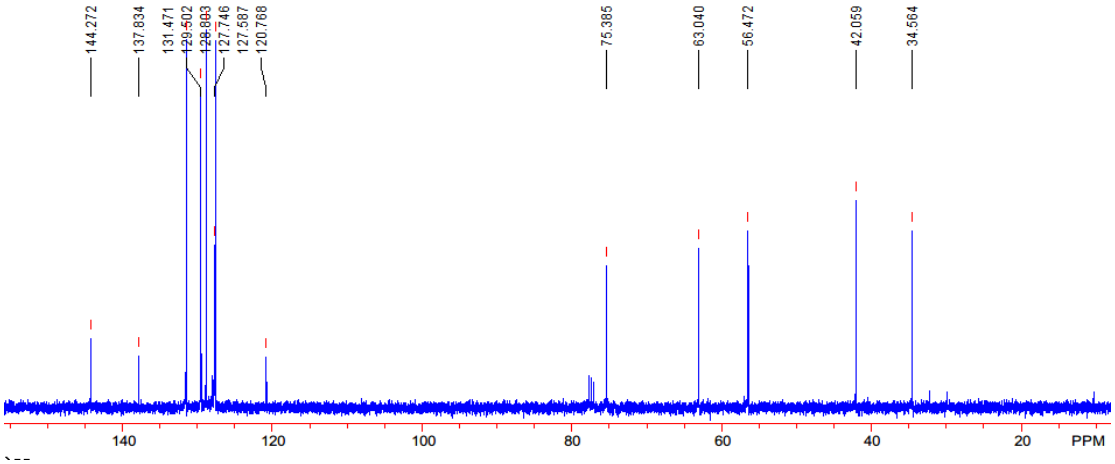


(*R*)-3-(Benzyl(methyl)amino)-1-(4-bromophenyl)propan-1-ol (4j)

^{1}H NMR (400 MHz, $CDCl_3$)

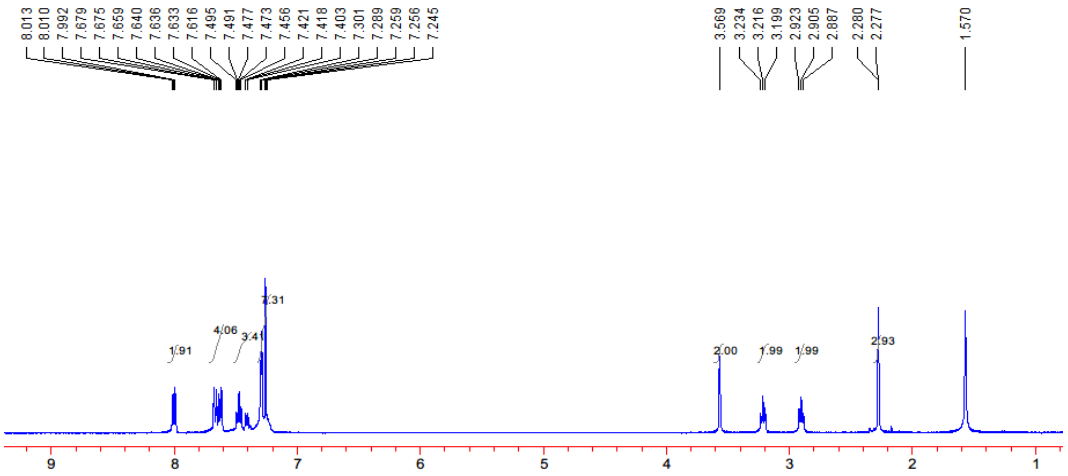


^{13}C NMR (100 MHz, $CDCl_3$) **4j**

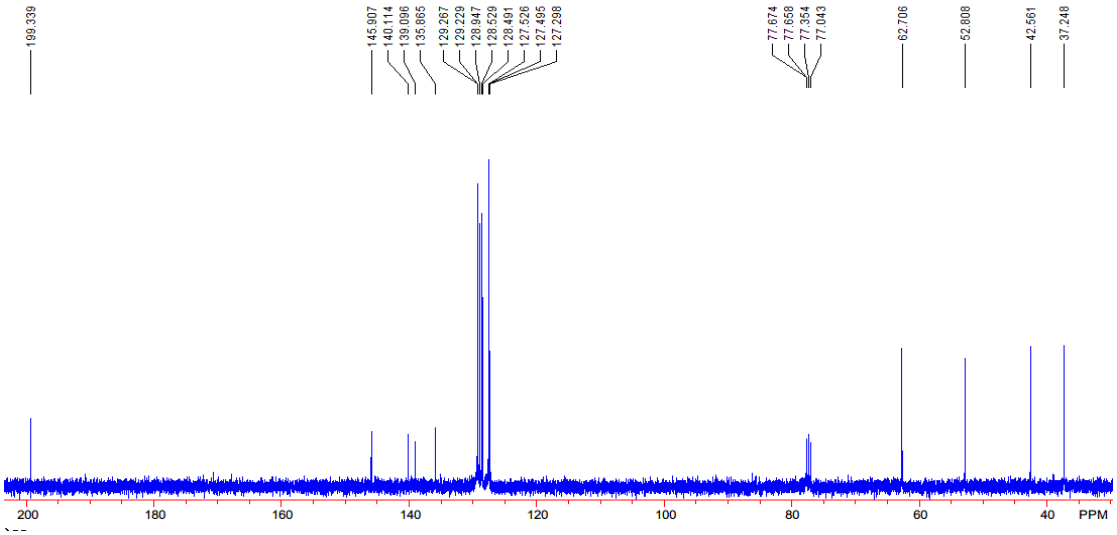


1-([1,1'-biphenyl]-4-yl)-3-(Benzyl(methyl)amino)propan-1-one (3k)

^{1}H NMR (400 MHz, $CDCl_3$)

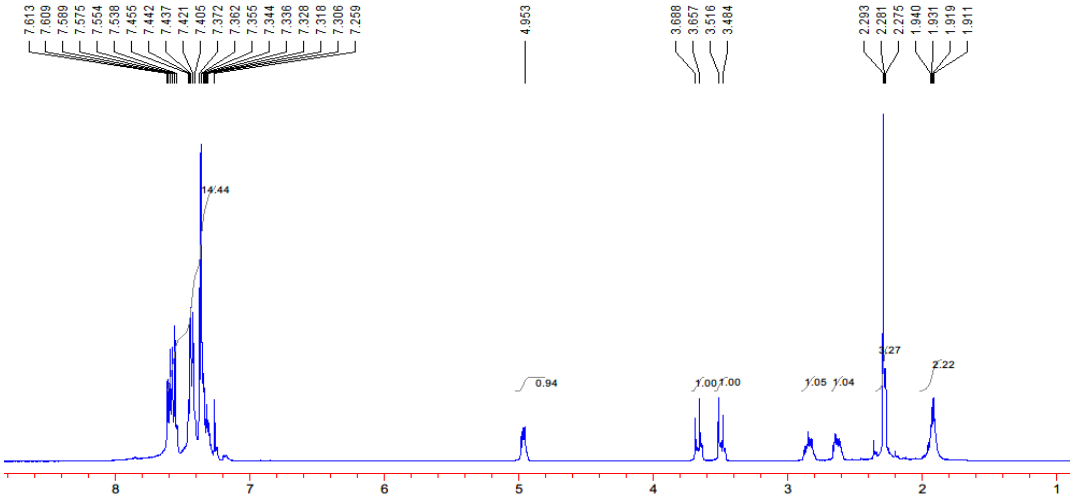


^{13}C NMR (100 MHz, $CDCl_3$) **3k**

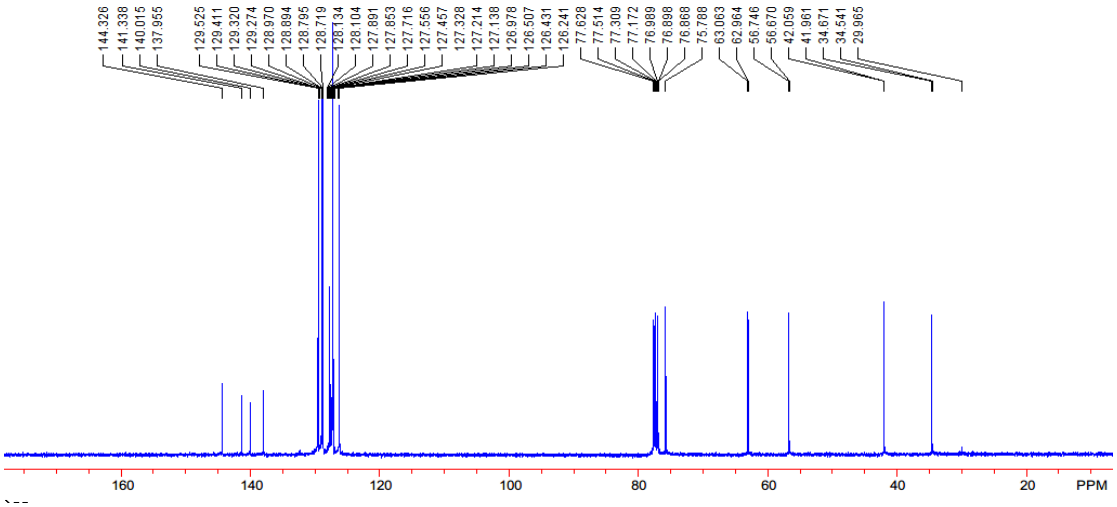


(*R*)-1-([1,1'-Biphenyl]-4-yl)-3-(benzyl(methyl)amino)propan-1-ol (4k)

^{1}H NMR (400 MHz, $CDCl_3$)

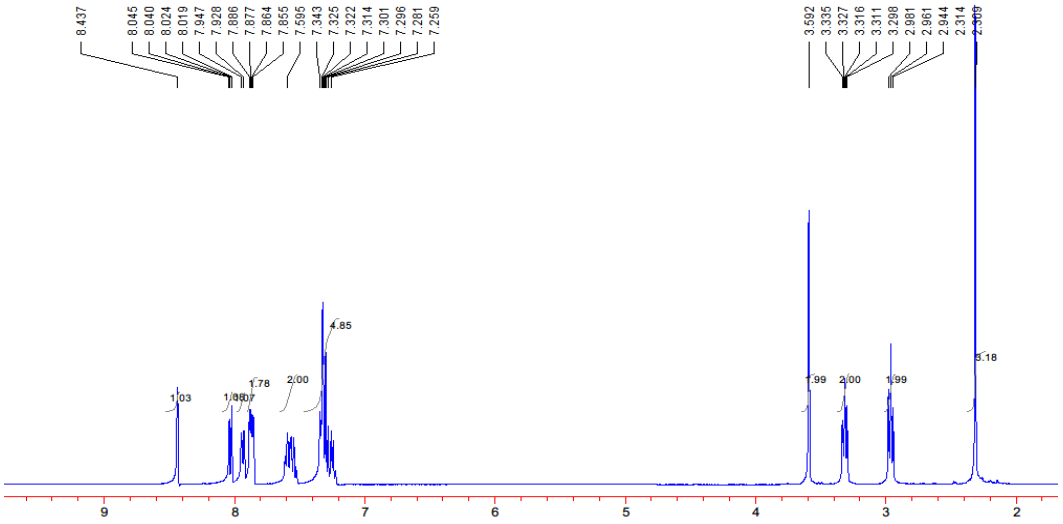


^{13}C NMR (100 MHz, $CDCl_3$) **4k**

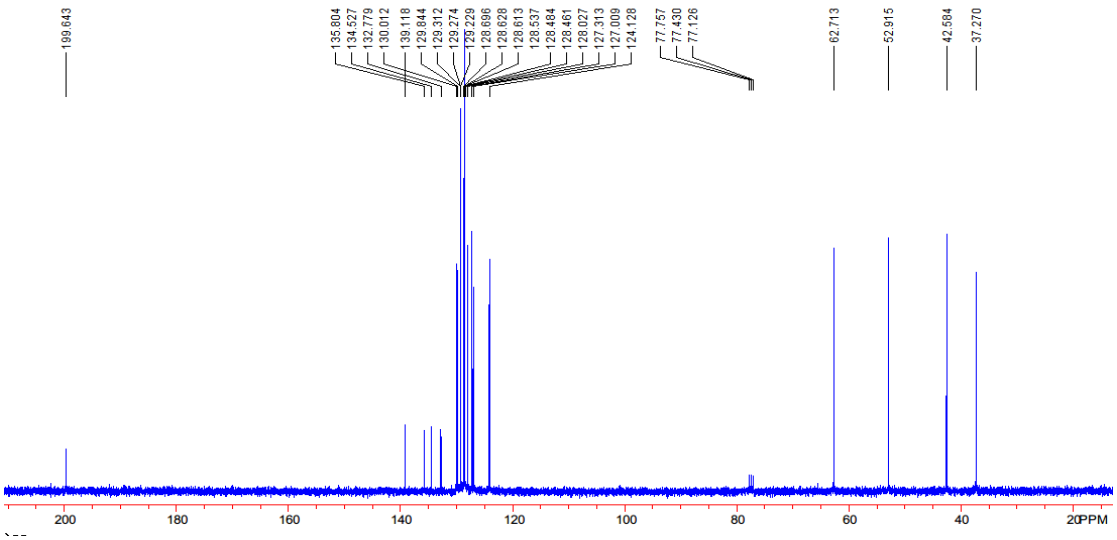


3-(Benzyl(methyl)amino)-1-(naphthalen-2-yl)propan-1-one (3l)

^{1}H NMR (400 MHz, $CDCl_3$)

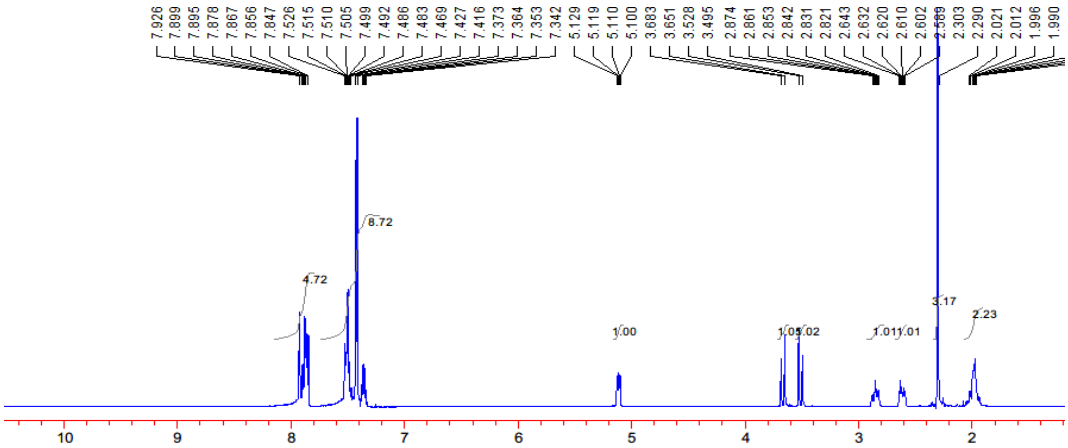


^{13}C NMR (100 MHz, $CDCl_3$) **3l**

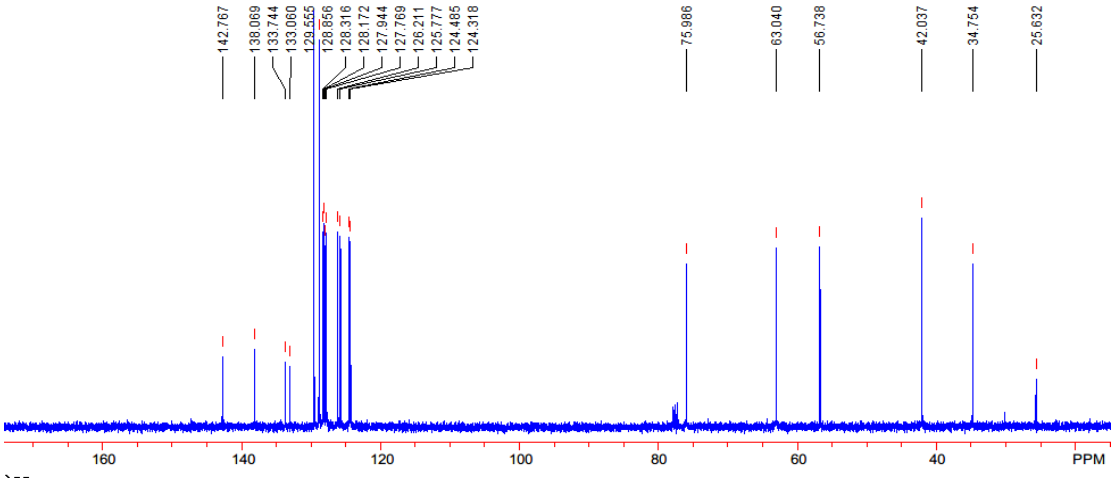


(*R*)-3-(Benzyl(methyl)amino)-1-(naphthalen-2-yl)propan-1-ol (4l)

^{1}H NMR (400 MHz, $CDCl_3$)

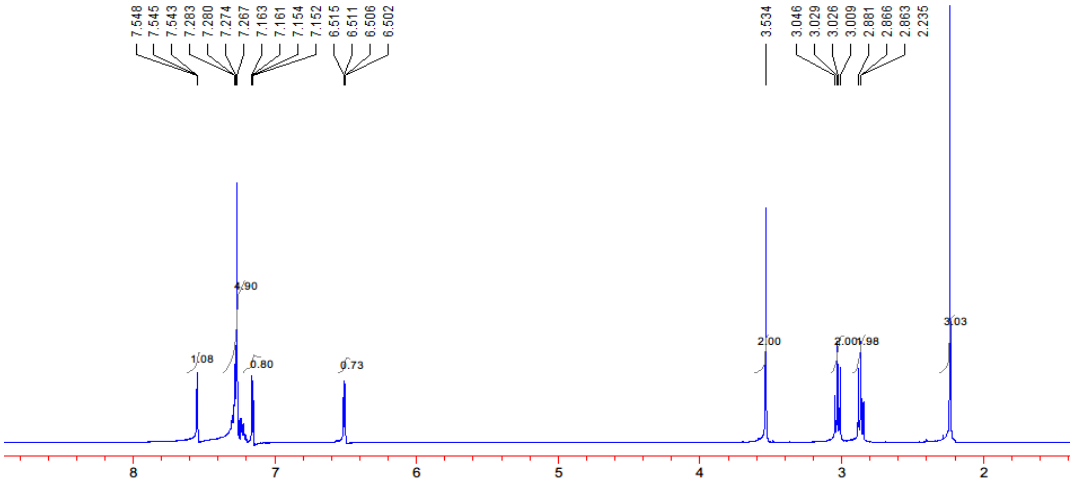


^{13}C NMR (100 MHz, $CDCl_3$) **4l**

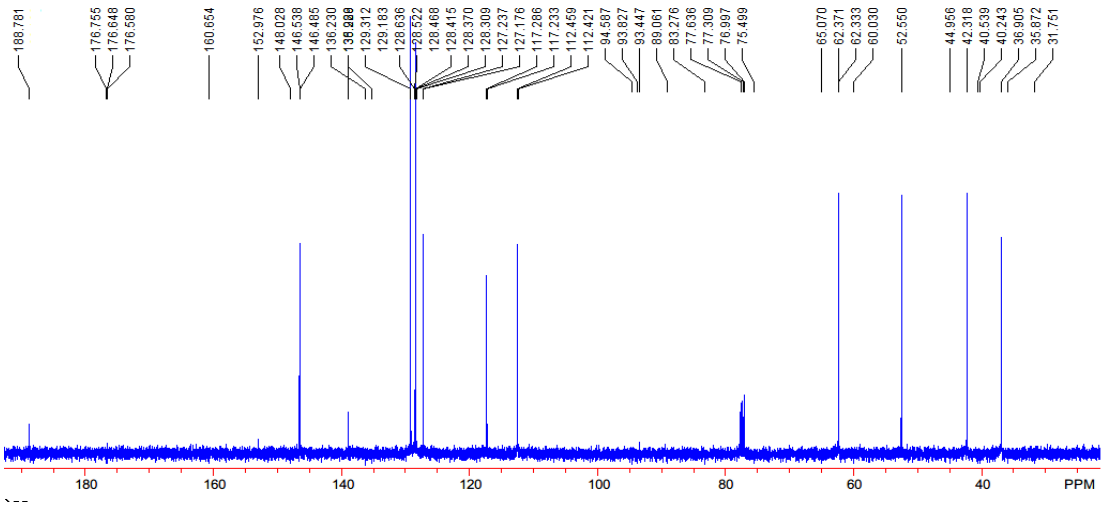


3-(Benzyl(methyl)amino)-1-(furan-2-yl)propan-1-one (3m)

^{1}H NMR (400 MHz, $CDCl_3$)

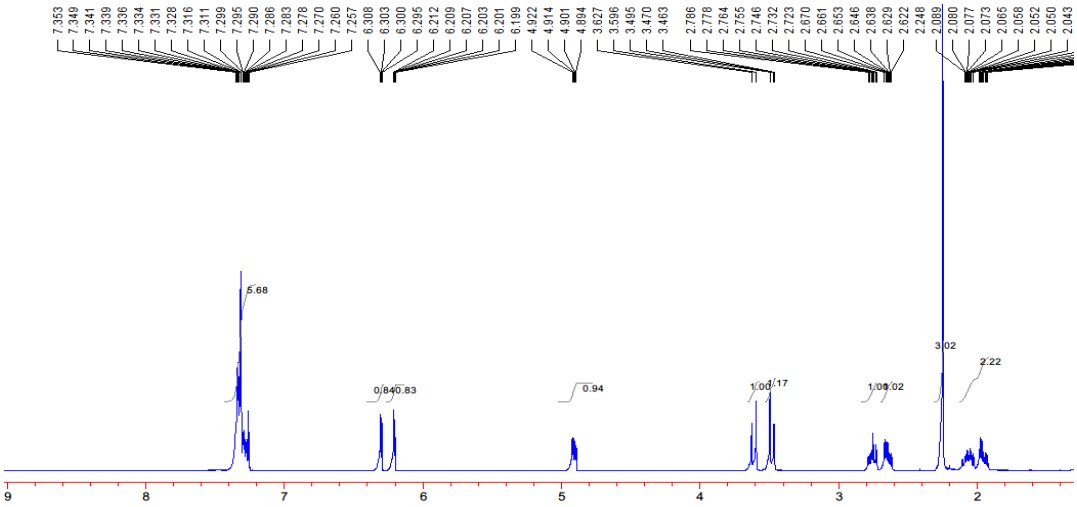


^{13}C NMR (100 MHz, $CDCl_3$) **3m**

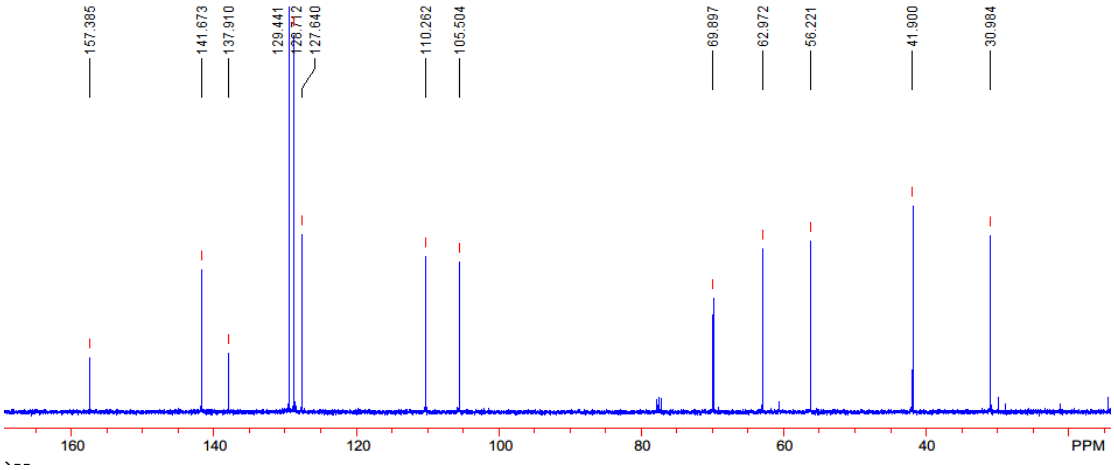


(*R*)-(Benzyl(methyl)amino)-1-(furan-2-yl)propan-1-ol (4m)

^{1}H NMR (400 MHz, $CDCl_3$)

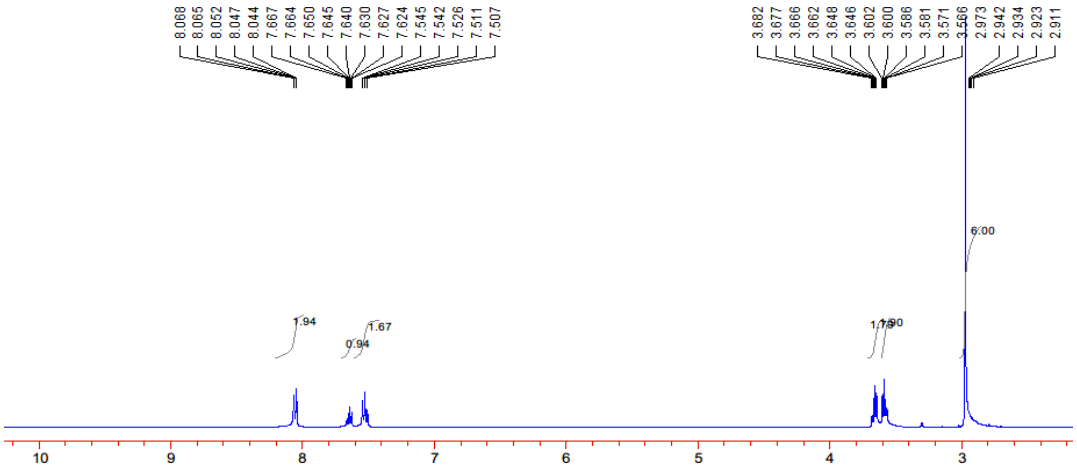


^{13}C NMR (100 MHz, $CDCl_3$) **4m**

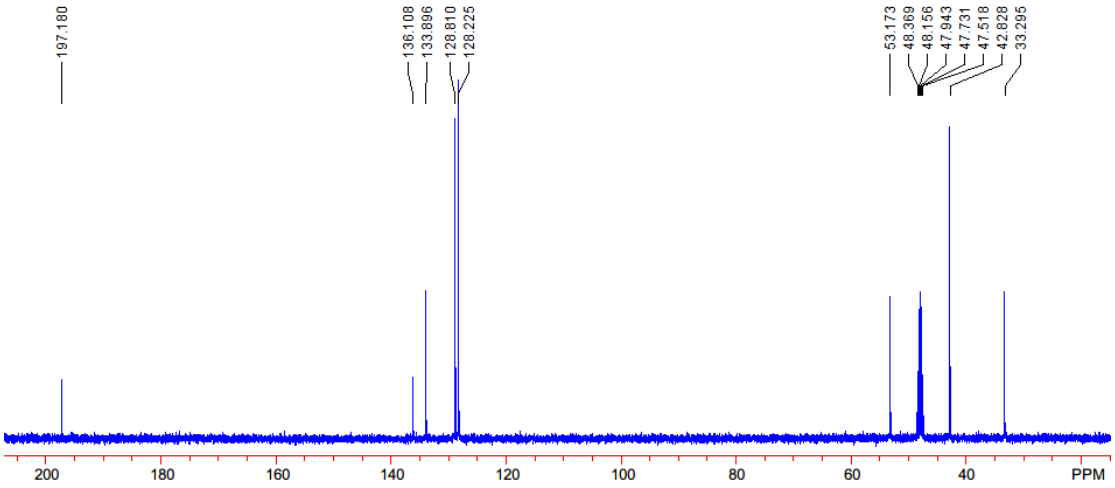


3-(Dimethylamino)-1-phenylpropan-1-one (3n)

^{1}H NMR (400 MHz, CD_3OD)

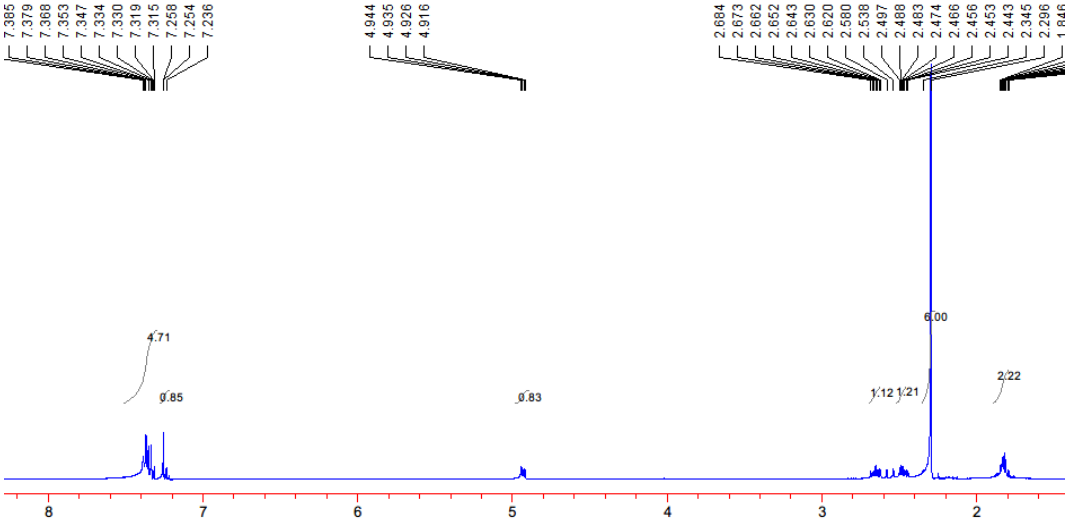


^{13}C NMR (100 MHz, CD_3OD) **3n**



(*S*)-3-(dimethylamino)-1-phenylpropan-1-ol (4n)

^{1}H NMR (400 MHz, $CDCl_3$)



^{13}C NMR (100 MHz, $CDCl_3$) **4n**