Supporting Information

Cinchona alkaloids derived NN ligand for ruthenium catalyzed asymmetric hydrogenation of aromatic and α, β-unsaturated ketones

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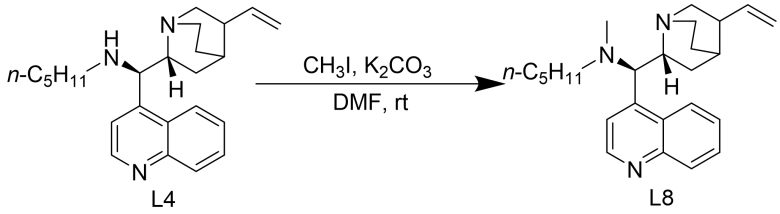
Table of contents

1. General experimental details

Unless otherwise mentioned, all experiments were carried out under an atmosphere of argon or using standard Schlenk techniques. All the reagents and solvents were used as supplied commercially without further purification. Solvents were dried with standard procedures and degassed with N_2. NMR spectra were recorded on a Bruker AVANCE 400 or 600 spectrometer. Chemical shifts are reported in ppm and coupling constants are given in Hz. HRMS was performed on a Waters Xevo G2-S Qtof instrument using electrospray ionization (ESI) techniques.

2.Synthesis of L8



To a solution of **L4** (90mg, 0.25mmol) in DMF (3mL) were added CH_3I (43mg, 0.3mmol) and K_2CO_3 (69mg, 0.5mmol) at room temperature. After stirring for 30min, the reaction was quenched with water (5 mL) and the aqueous layer was extracted with CH_2Cl_2 (5 mL x 3). The combined organic layers were dried over anhydrous sodium sulfate and filtered. The solvent was concentrated and the crude product was further purified by column chromatography on silica gel (CH_2Cl_2/MeOH/ammonia water=20/1/0.1) to give the corresponding compound **L8** (81mg, 85.5% yield). Yellow solid, ^{1}H NMR (600 MHz, MeOD) δ 8.90 (d, J = 3.0 Hz, 1H), 8.49 – 8.59 (m, 1H), 8.12 (d, J = 3.0 Hz, 1H), 7.74 – 7.87 (m, 3H), 5.62 – 5.68 (m, 1H), 5.24 (d, J = 6.0 Hz, 1H), 5.14 (d, J = 3.0 Hz, 1H) 3.94 – 3.98(m, 1H), 3.59 – 3.76 (m, 3H), 3.45 – 3.47 (m, 3H), 2.82 – 2.87 (m, 1H), 2.36 – 2.40 (m, 1H), 2.02 – 2.14 (m, 3H), 1.82 (s, 1H), 1.23 – 1.44 (m, 8H), 1.07 – 1.16 (m, 1H), 0.80 – 0.91 (m, 4H). ^{13}C NMR (150 MHz, MeOD) δ 149.86, 135.75, 130.02, 129.21, 127.63, 123.77, 123.20, 121.28, 116.46, 69.61, 60.52, 46.29, 37.47, 29.38, 29.17, 26.40, 23.40, 22.04, 12.88. HRMS (ESI) calcd. for $C_{24}H_{33}N_3$ $[M+H]^+$:378.2904, found：378.2903.

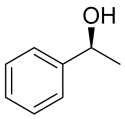
3. Details of catalytic study

3.1 General procedure for asymmetric hydrogenation

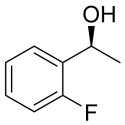
All reagents were of analytical grade and used as-received without further purification. The purity of hydrogen was over 99.99%. For asymmetric hydrogenation of acetophenone: Required amount of benzylidene-bis(tricyclohexylphosphine)-dichlororuthenium (3.7 mg, 0.0044 mmol), acetophenone (1.1144 mmol, 133.9 mg), **L4**(5.3 mg, 0.0145 mmol), $Ba(OH)_2$ (56.8 mg, 0.15 mmol) and ethanol (2 mL) were added to a 25 mL stainless autoclave and purged by three cycles of pressurization/venting with H_2 . The required H_2 pressure (6.0 MPa) was then installed and the autoclave was wormed to the indicated temperature. The autoclave was cooled down after the indicated reaction time and the pressure was slowly released. The product was purified by silica gel chromatography using petroleum ether/ethylacetate (10/1) as eluent. The asymmetric hydrogenation of other substrates was similar to that of acetophenone.

The enantioselectivity values were analyzed by GC-9790 with a Beta-DEX TM 120 capillary column (df = 0.25 μm, 0.25 mm i.d.×30 m) and LC-16 with Chirasil OD-H column (25 cm × 4.6 mm), Chirasil IA column (25 cm × 4.6 mm) and Chirasil IB column (25 cm × 4.6 mm). The ee values of chiral alcohols were calculated from the equations enantioselectivity values (ee, %) = | R - S| / |R + S|. Optical rotation was measured on the Rudolph Autopol Ⅰ with $[\alpha]_D^{25}$ values reported in degrees at 25°C； concentration (c) is in g/100ml.

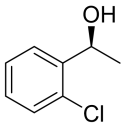
3.2 Characterization data of compounds



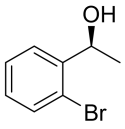
(S)-1-Phenyl-ethanol (P1): Colorless oil; known compound[3]; purified by silica gel chromatography (petroleum ether/ethylacetate = 10:1),97.7% yield, 40 mg, 93.1% ee, *S* isomer; $[a]_D^{25}$ = - 40.5 (c=1.00 in $CHCl_3$) (lit. 3 $[a]_D^{20}$ = - 42.6 (c=1.0, $CHCl_3$)); ^{1}H NMR (600 MHZ, DMSO-d_6) δ 7.13 – 7.20 (m, 4H), 7.03 – 7.06 (m, 1H), 5.00 (d, *J* = 3.0 Hz, 1H), 4.55 – 4.59 (m, 1H), 1.17 (d, *J* = 3.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 147.88, 128.43, 126.95, 125.76, 68.60, 26.46.



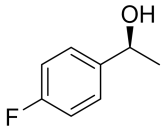
(S)-1-(2-Fluoro-Phenyl)-ethanol (P2): Colorless oil; known compound[4]; purified by silica gel chromatography (petroleum ether/ethylacetate = 10:1),47.6% yield, 43 mg, 88.0% ee, *S* isomer; $[a]_D^{25}$ = - 35.3 (c=1.00 in $CHCl_3$) (lit. 4 $[a]_D^{20}$ = - 43.4 (c=0.9, $CHCl_3$)); ^{1}H NMR (400 MHZ, DMSO-d_6) δ 7.55 – 7.60 (m, 1H), 7.07 – 7.29 (m, 3H), 5.32 (s, 1H), 5.04 – 5.06 (m, 1H), 1.35 – 1.38 (m, 3H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 160.58, 158.16, 134.59, 128.62, 127.38, 124.66, 115.32, 62.54, 25.12.



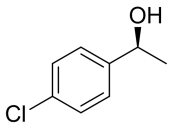
(S)-1-(2-Chloro-phenyl)-ethan-1-ol (P3): Colorless oil; known compound[5]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 40.2% yield, 39 mg, 93.9% ee, *S* isomer; $[a]_D^{25}$ = - 40.9 (c = 1.00 in $CHCl_3$) (lit.5 $[a]_D^{20}$ = - 56.8 (c = 1.0, $CHCl_3$)); ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.65 (d, *J* = 6.0 Hz, 1H), 7.34 – 7.37 (m, 2H), 7.23 – 7.26 (m, 1H), 5.38 (d, *J* = 2.0 Hz, 1H), 5.04– 5.08 (m, 1H), 1.33 (d, *J* = 3.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 145.05, 130.76, 129.30, 128.59, 127.71, 127.36, 65.47, 24.77.



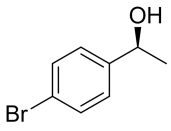
(S)-1-(2-Bromophenyl)-ethan-1-ol (P4): Colorless oil; known compound[5]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 54.5% yield, 54mg, 84.2% ee, *S* isomer; $[a]_D^{25}$ = - 31.9 (c = 1.00 in $CHCl_3$) (lit.5 $[a]_D^{20}$ = - 40.4 (c = 1.0, $CHCl_3$)); ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.65 – 7.69 (m, 1H), 7.53 (d , *J* = 6.0 Hz, 1H), 7.38 – 7.41 (m, 1H), 7.15 – 7.18 (m, 1H), 5.42 – 5.45 (m, 1H), 5.00 – 5.06 (m, 1H), 1.33 – 1.37 (m, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 146.61, 132.53, 128.95, 128.27, 127.65, 121.21, 67.88, 24.88.



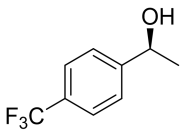
(S)-1-1-(4-Fluoro-phenyl)-ethanol (P5): Colorless oil; known compound[7]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 96.2% yield, 43mg, 96.2% ee, *S* isomer;$[a]_D^{25}$ = - 29.0 (c = 1.00 in $CHCl_3$) (lit.7 $[a]_D^{20}$= - 44.8 (c = 1.4, $CHCl_3$)); ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.36 – 7.38 (m, 2H), 7.10 – 7.14 (m, 2H), 5.20 (d, *J* = 3.0 Hz, 1H), 4.70 – 4.74 (m, 1H), 1.31 (d, *J* = 6.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 162.23, 160.63, 143.99, 127.64, 127.59, 115.14, 115.00, 67.91, 26.43.



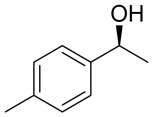
(S)-1-(4-chloro-phenyl)-ethan-1-ol(P6): Colorless oil; known compound[9]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 96.6% yield, 64mg, 96.8% ee, *S* isomer;$[a]_D^{25}$ = - 46.3 (c = 1.00 in $CHCl_3$) (lit.9 $[a]_D^{20}$ = - 49.3 (c 1.0 (c = 1.0, $CHCl_3$)); ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.36 (s, 4H), 5.29 (d, *J* = 3.0 Hz, 1H), 4.70 – 4.74 (m, 1H), 1.30 (d, *J* = 6.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 146.82, 131.39, 128.39, 127.65, 67.89, 26.29.



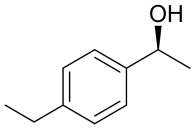
(S)-1-(4-bromo-phenyl)-ethan-1-ol(P7): Colorless oil; known compound[10]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 87.1% yield, 77mg, 87.6% ee, *S* isomer;$[a]_D^{25}$ = - 32.1 (c = 1.00 in $CHCl_3$) (lit.10 $[a]_D^{24}$ = - 33.4 (c=0.60, $CHCl_3$)).^{1}H NMR (600 MHz, DMSO-d_6) δ 7.48 – 7.51 (m, 4H), 7.29 – 7.32 (m, 2H), 5.29 (d, *J* = 3.0 Hz, 1H), 4.68 – 4.72 (m, 1H), 1.30 (d, *J* = 3.0 Hz, 1H). ^{13}C NMR (150 MHz, DMSO) δ 147.25, 131.31, 128.06, 119.86, 67.92, 26.27.



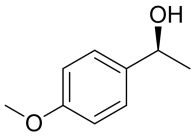
(S)-1-(4-(trifluoromethyl)phenyl)ethan-1-ol (P8): Colorless oil; known compound[9]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 20:1), 97.5% yield, 80mg, 97.4% ee, S isomer; $[a]_D^{25}$ = - 27.0 (c = 1.00 in $CHCl_3$) (lit.9 $[a]_D^{20}$ = - 25.2 (c = 1.0, $CHCl_3$)).^{1}H NMR (600 MHz, DMSO-d_6) δ 7.68 (d, J = 6.0 Hz, 2H), δ 7.58 (d, J = 3.0 Hz, 2H), 5.41 (d, J = 3.0 Hz, 1H), 4.81 – 4.85 (m, 1H), 1.35 (d, J = 6.0 Hz, 3H).^{13}C NMR (150 MHz, DMSO-d_6) δ 152.61, 127.80, 127.59, 126.48, 125.78, 125.34, 124.98, 68.03, 26.22.



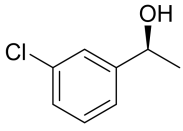
(S)-1-1-p-Tolyl-ethanol (P9): Colorless oil; known compound[5]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 20:1), 97.3% yield, 50mg, 92.8% ee, S isomer;$[a]_D^{25}$ = - 46.7 (c = 1.00 in $CHCl_3$) (lit.5 $[a]_D^{20}$ = - 52.1 (c = 1.0, $CHCl_3$)). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.23 (d, J = 3.0 Hz, 2H), 7.12 (d, J = 3.0 Hz, 2H), 5.07 (d, J = 3.0 Hz, 1H), 4.66 – 4.70 (m, 1H), 2.28 (s, 3H), 1.31 (d, J = 3.0 Hz, 3H) . ^{13}C NMR (150 MHz, DMSO-d_6) δ 144.91, 135.87, 129.00, 128.98, 125.76, 125.73, 68.50, 26.43, 21.12.



(S)-1-(4-ethylphenyl)ethan-1-ol (P10): Colorless oil; known compound[4]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 73.1% yield, 83mg, 98.8% ee, *S* isomer; $[a]_D^{25}$ = - 40.8(c = 1.00 in $CHCl_3$) (lit.4 $[a]_D^{20}$ = - 50.1 (c = 1.0, $CHCl_3$)). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.25 (d, J = 3.0 Hz, 2H), 7.13 (d, J = 6.0 Hz, 2H), 5.07 (d, J = 3.0 Hz, 1H), 4.68 - 4.70 (m, 1H), 2.55 – 2.58 (m, 2H), 1.31 (d, J = 3.0 Hz, 3H), 1.15 – 1.17 (m, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 145.15, 142.35, 127.78, 125.77, 68.45, 28.36, 26.41, 16.23.

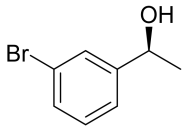


(S)-1-(4-Methoxy-phenyl)-ethanol (P11): Colorless oil; known compound[5]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 89.7% yield, 52mg, 96.2% ee, *S* isomer; $[a]_D^{25}$ = - 35.8 (c = 1.00 in $CHCl_3$) (lit.5 $[a]_D^{20}$ = - 41.7 (c = 1.0, $CHCl_3$)). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.31 – 7.35 (m, 2H), 6.90 – 6.94 (m, 2H), 5.12 – 5.14 (m, 1H), 4.74 – 4.78 (m, 1H), 3.75 – 3.76 (m, 3H)，1.37 – 1.41 (m, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 158.52, 139.89, 126.95, 126.94, 113.79, 68.28, 55.37, 55.35, 26.37, 26.35.

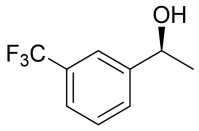


(S)-1-(3-chlorophenyl)ethan-1-ol (P12): Colorless oil; known compound[5]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 96.7% yield, 118mg, 89.8% ee, *S* isomer; $[a]_D^{25}$ = - 31.0 (c = 1.00 in $CHCl_3$) (lit.5 $[a]_D^{20}$ = - 40.4 (c = 1.0, $CHCl_3$)); ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.42 (s, 1H), 7.25 – 7.35 (m, 3H), 5.35 (d, J = 3 Hz, 1H), 4.74 – 4.78 (m, 1H),

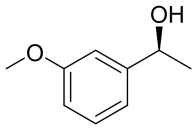
1.35 (d, *J* = 3.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 150.49, 133.36, 130.30, 126.83, 125.65, 124.43, 68.03, 26.21.



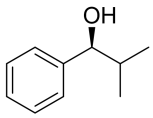
(S)-1-(3-bromophenyl)ethan-1-ol (P13)： Colorless oil; known compound[6]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 73.0% yield, 107mg, 84.9% ee, *S* isomer; $[a]_D^{25}$ = - 25.8 (c = 1.00 in $CHCl_3$)(lit.6 $[a]_D^{20}$ = - 28.87 (c = 2.8, $CHCl_3$)); ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.65 – 7.68 (m, 1H), 7.26 – 7.45 (m, 3H), 5.42 (s, 1H), 4.84 (s, 1H), 1.41 – 1.46 (m, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 150.57, 130.52, 129.82, 128.68, 124.80, 122.25, 68.28, 26.21.



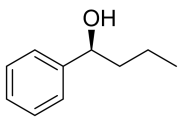
(S)-1-(3-(trifluoromethyl)phenyl)ethan-1-ol (P14): Colorless oil; known compound[7]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 95.0% yield, 65mg, 91.4% ee, *S* isomer; $[a]_D^{25}$ = - 19.7 (c = 1.00 in $CHCl_3$) (lit.7 $[a]_D^{20}$ = - 31 (c = 1.95, $CHCl_3$)); ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.71 (s, 1H), 7.65 (d, *J* = 3.0 Hz, 1H), 7.55 – 7.60 (m, 2H), 5.41 (d, *J* = 3.0 Hz, 1H), 4.82 – 4.86 (m, 1H), 1.37 (d, *J* = 3.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 149.31, 129.96, 129.49, 129.20, 125.77, 123.67, 122.14, 67.92, 26.24.



(S)-1-(3-methoxyphenyl)ethan-1-ol (P15): Colorless oil; known compound[8]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 96.6% yield, 63mg, 98.7% ee, *S* isomer; $[a]_D^{25}$ = - 30.4 (c = 1.00 in $CHCl_3$) (lit.8 $[a]_D^{20}$ = - 42.1 (c = 1.0, $CHCl_3$)); ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.22 – 7.26 (m, 1H), 6.93 – 7.00 (m, 2H), 6.78 – 6.82 (m, 1H), 5.18 – 5.23 (m, 1H), 4.72 – 4.78 (m, 1H), 3.76 – 3.77 (m, 3H), 1.34 – 1.38 (m, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 159.68, 149.66, 129.47, 118.02, 112.31, 111.33, 68.60, 55.30, 26.39.

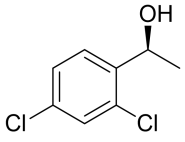


(S)-2-methyl-1-phenylpropan-1-ol (P16): Colorless oil; known compound[10]; 85.2% yield, 50mg, 98.2% ee, *S* isomer; $[a]_D^{25}$ = - 39.8 (c = 1.00 in $CHCl_3$) (lit.10 $[a]_D^{24}$ = - 41.1 (c =1.24, $CHCl_3$)). ^{1}H NMR (600 MHz, DMSO) δ 7.06 – 7.09 (m, 4H), 6.96 – 7.00 (m, 1H), 4.86 – 4.87 (m, 1H), 4.01 – 4.04 (m, 1H), 1.56 – 1.61 (m, 1H), 0.63 – 0.65 (m, 3H), 0.52 – 0.53 (m, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 145.55, 128.08, 126.97, 126.95, 78.04, 35.49, 19.54, 18.41.

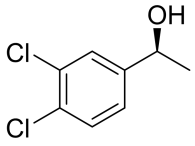


(S)-1-Phenyl-butan-1-ol (P17): Colorless oil; known compound[7]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 20:1), 93.4% yield, 28mg, 90.7% ee, *S* isomer; $[a]_D^{25}$ = - 40.0 (c = 1.00 in $CHCl_3$) (lit.7 $[a]_D^{20}$ = - 44.2 (c = 0.99, $CHCl_3$)). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.29 – 7.32 (m, 4H), 7.20 – 7.22 (m, 1H), 5.10 (d, *J* = 3.0 Hz, 1H), 1.50 – 1.64 (m, 2H),

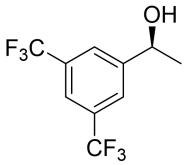
1.22 – 1.38 (m, 2H), 0.86 – 0.88 (m, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 146.99, 128.35, 126.97, 126.24, 72.50, 42.08, 19.02, 14.37.



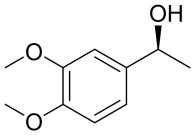
(S)-1-(2,4-dichlorophenyl)ethan-1-ol (P18): Colorless oil; known compound[13]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 20:1), 58.2% yield, 49mg, 84.4 % ee, *S* isomer; $[a]_D^{25}$ = - 46.0 (c = 1.00 in $CHCl_3$) (lit.13 $[a]_D^{20}$ = - 21.6 (c = 0.5, $CHCl_3$)). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.67 (d, *J* = 3.0 Hz, 1H), 7.46 (d, *J* = 1.2 Hz, 1H), 7.41 – 7.42 (m, 1H), 5.49 (d, *J* = 2.1 Hz, 1H), 5.03 – 5.07 (m, 1H), 1.34 (d, *J* = 6.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 144.14, 132.21, 131.57, 128.75, 128.62, 127.83, 65.21, 24.49.



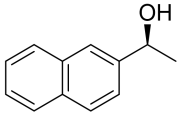
(S)-1-(3,4-dichlorophenyl)ethan-1-ol (P19): Colorless oil; known compound[12]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 96.8% yield, 98mg, 83.4 % ee, *S* isomer; $[a]_D^{25}$ = - 37.2 (c = 1.00 in CHCl3) (lit.12 $[a]_D^{20}$ = - 33.0 (c=0.30, $CHCl_3$)). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.55 – 7.57 (m, 2H), 7.32 – 7.34 (m, 1H), 5.39 (d, *J* = 3.0 Hz, 1H), 4.71 – 4.75 (m, 1H), 1.32 (d, *J* = 3.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 149.12, 131.15, 130.70, 129.30, 127.81, 126.19, 67.40, 26.07.



(S)-1-(3,5-Bis-trifluoromethyl-phenyl)-ethanol (P20): White solid, mp: 53.4-54.8°C; known compound[16]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 84.5% yield, 99mg, 75.8% ee, *S* isomer; $[a]_D^{25}$ = - 12.8 (c = 1.00 in $CHCl_3$) (lit.16 $[a]_D^{20}$ = - 20.4 (c =1.0, $CHCl_3$)). ^{1}H NMR (600 MHz, DMSO-d_6) δ 8.02 (s, 2H), 7.91 (s, 1H), 5.61 (d, *J* = 2.3 Hz, 1H), 4.92 – 4.96 (m, 1H), 1.38 (d, *J* = 3.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 151.39, 130.82, 130.60, 130.38, 130.17, 126.50, 124.82, 123.01, 121.21, 120.61, 67.44, 25.99.

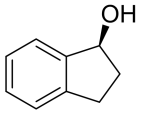


(S)-1-(3,4-dimethoxyphenyl)ethan-1-ol (P21): Colorless oil; known compound[11]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 5:1), 50.0% yield, 28mg, 81.1% ee, *S* isomer; $[a]_D^{25}$ = - 42.7 (c = 1.00 in $CHCl_3$) (lit.11 $[a]_D^{20}$ = - 37.3 (c = 1.09, $CHCl_3$)). ^{1}H NMR (600 MHz, DMSO-d_6) δ 6.98 (s, 1H), 6.85 – 6.88 (m, 2H), 5.09 (d, *J* = 3.0 Hz, 1H), 4.68 – 4.72 (m, 1H), 3.74 (d, *J* = 9.0 Hz, 6H), 1.34 (d, *J* = 3.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 149.04, 148.02, 140.55, 117.69, 111.96, 109.79, 68.47, 55.96, 55.79, 26.39.

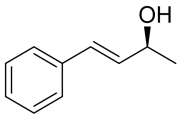


(S)-1-(naphthalen-2-yl)ethan-1-ol (P22): White solid ,Mp: 70.6-71.4°C; known compound[14]; purified by silica gel chromatography (petroleum ethe/ethylacetate = 10:1), 96.9%

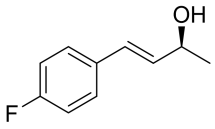
yield, 68mg, 91.1% ee, *S* isomer; $[a]_D^{25}$ = - 43.5 (c = 1.00 in $CHCl_3$) (lit.14 $[a]_D^{20}$ = - 38.5 (c =1.0, $CHCl_3$)). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.87 – 7.92 (m, 4H), 7.48 – 7.56 (m, 3H), 5.34 (d, *J* = 3.0 Hz, 1H), 4.91 – 4.95 (m, 1H), 1.45 (d, *J* = 3.0 Hz, 3H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 145.43, 133.37, 132.61, 128.16, 128.00, 127.94, 126.41, 125.86, 124.86, 123.68, 68.65, 26.32.



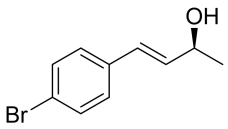
(S)-2,3-dihydro-1H-inden-1-ol (P23): White solid, known compound[17]; 51.4 % yield, 26mg, 63.9 % ee, S isomer; $[a]_D^{25}$ = - 14.0 (c = 1.00 in $CHCl_3$) (lit.17 $[a]_D^{25}$ = -16.1 (c = 0.88, $CHCl_3$)). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.32 – 7.33 (m, 1H), 7.17 – 7.22 (m, 3H), 5.21 (d, *J* = 3 Hz, 1H), 5.02 – 5.05 (m, 1H), 2.88 – 2.92 (m, 1H), 2.67 – 2.73 (m, 1H), 2.29 – 2.34 (m, 1H), 1.73 – 1.79 (m, 1H). ^{13}C NMR (150 MHz, DMSO-d_6) δ 146.87, 142.98, 127.78, 126.59, 124.87, 124.63, 74.84, 35.95, 29.73.



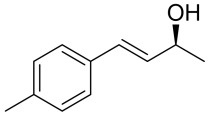
(S)-4-phenylbut-3-en-2-ol (P24): Light yellow oil, known compound[18]; 98.0 % yield, 64mg, 68.9 % ee, *S* isomer; $[a]_D^{20}$ = - 12.2 (c = 1.00 in $CHCl_3$).^{1}H NMR (400 MHz, DMSO-d_6) δ 7.41(d, *J* = 4 Hz, 2H), 7.30 – 7.34 (m, 2H), 7.20 – 7.24 (m, 1H), 6.51 (d, *J* = 8 Hz, 1H), 6.29 – 6.34 (m, 1H), 4.91 (d, *J* = 2 Hz, 1H), 4.29 – 4.33 (m, 1H), 1.22 (d, *J* = 4 Hz, 3H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 137.41, 136.02, 129.11, 127.69, 127.65, 126.66, 67.15, 24.35.



(S)-4-(4-fluorophenyl)but-3-en-2-ol (P25): Colorless oil; known compound[18]; 97.5% yield, 71mg, 66.3% ee, *S* isomer; $[a]_D^{20}$ = - 9.833 (c = 1.00 in $CHCl_3$). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.46 (s, 2H), 7.13 – 7.17 (m, 2H), 6.51 (d, *J* = 8 Hz, 1H), 6.26 (d, *J* = 8 Hz, 1H), 4.91 (s, 1H), 4.30 (s, 1H), 1.22 (d, *J* = 4 Hz, 3H).^{13}C NMR (100 MHz, DMSO-d_6) δ 163.02, 160.63, 135.93, 135.90, 133.99, 133.95, 128.51, 128.43, 126.43, 115.97, 115.61, 67.10, 24.30.

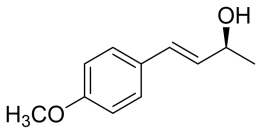


(S)-4-(4-bromophenyl)but-3-en-2-ol (P26): Light yellow solid, known compound[18]; 90.5 % yield, 90.0mg, 65.1 % ee, *S* isomer; $[a]_D^{20}$ = - 7.7 (c = 1.00 in $CHCl_3$). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.50 (d, *J* = 4 Hz, 2H), 7.38 (d, *J* = 4 Hz, 2H), 6.49 (d, *J* = 8 Hz, 1H), 6.33 – 6.38 (m, 1H), 4.94 (d, *J* = 2 Hz, 1H), 4.28 – 4.32 (m, 1H), 1.21 (d, *J* = 4 Hz, 3H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 137.12, 136.71, 131.95, 128.71, 126.40, 120.56, 67.00, 24.21.



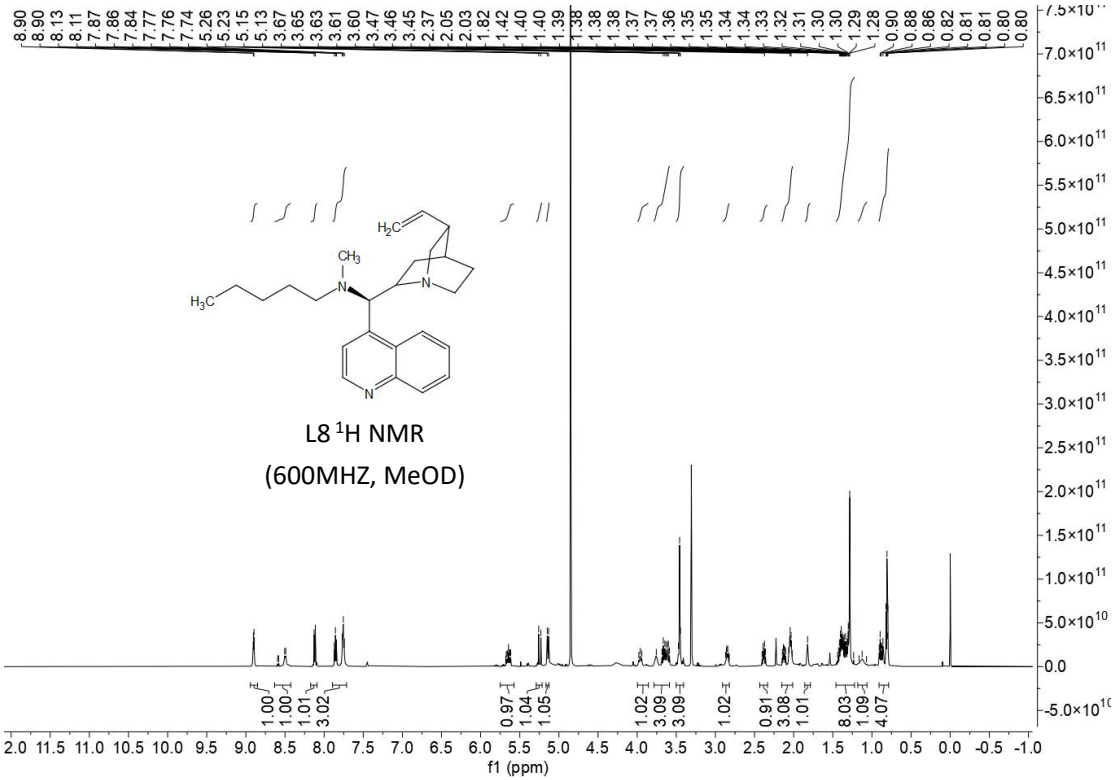
(S)-4-(p-tolyl)but-3-en-2-ol (P27): Light yellow solid, known compound[18]; 71.5 % yield, 51mg, 69.0 % ee, *S* isomer; $[a]_D^{20}$ = -6.2 (c = 1.00 in $CHCl_3$). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.25 (d, *J* = 4 Hz, 2H), 7.08 (d, *J* = 4 Hz, 2H), 6.41 (d, *J* = 8 Hz, 1H), 6.16 – 6.22 (m, 1H),

4.81 – 4.83 (m, 1H), 4.22 – 4.27 (m, 1H), 2.23 (s, 3H) 1.16 (d, *J* = 2 Hz, 3H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 136.90, 134.93, 134.61, 129.69, 127.58, 126.58, 67.21, 24.37, 21.27.

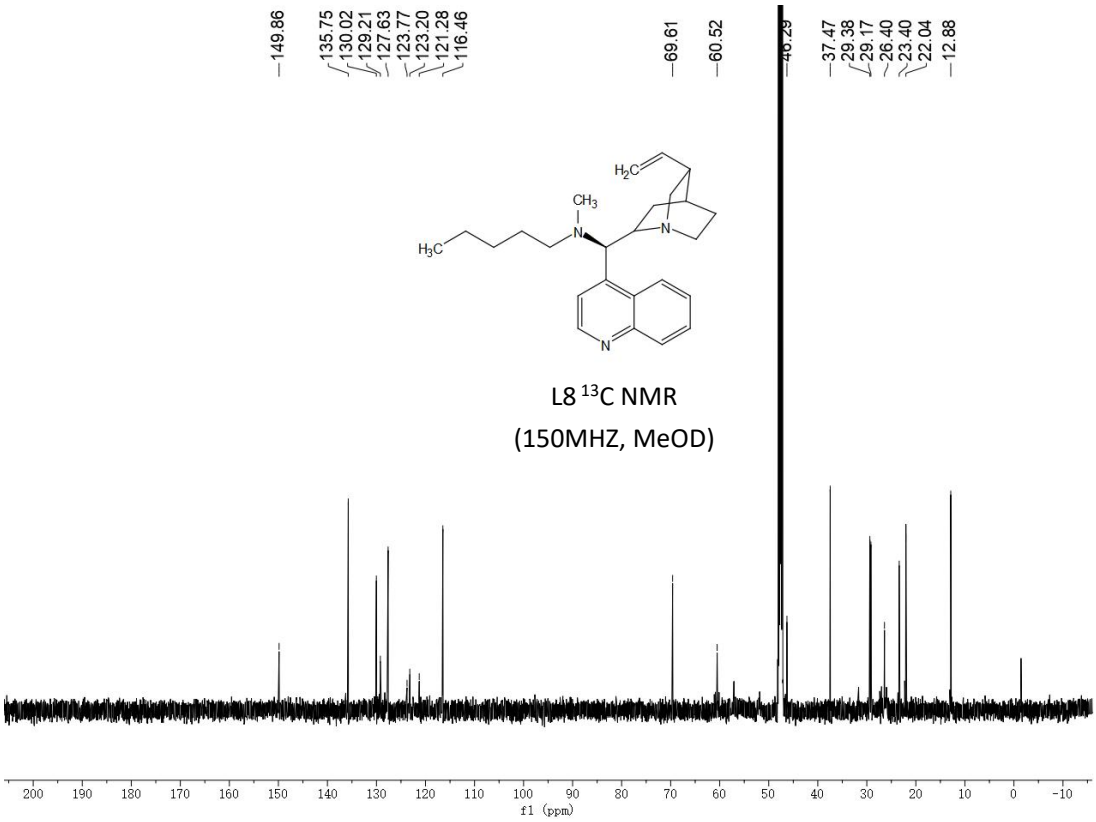


(S)-4-(4-methoxyphenyl)but-3-en-2-ol (P28): White solid, known compound[18]; 54.0 % yield, 42mg, 70.5 % ee, S isomer; $[a]_D^{20}$ = -18.5 (c = 1.00 in $CHCl_3$). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.34 (d, *J* = 4 Hz, 2H), 6.88 (d, *J* = 4 Hz, 2H), 6.43 (d, *J* = 8 Hz, 1H), 6.11 – 6.17 (m, 1H), 4.82 (d, *J* = 2 Hz, 1H), 4.25 – 4.29 (m, 1H), 3.74 (s, 3H) 1.20 (d, *J* = 2 Hz, 3H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 159.07, 133.64, 129.98, 127.86, 127.27, 114.50, 67.28, 55.58, 24.36.

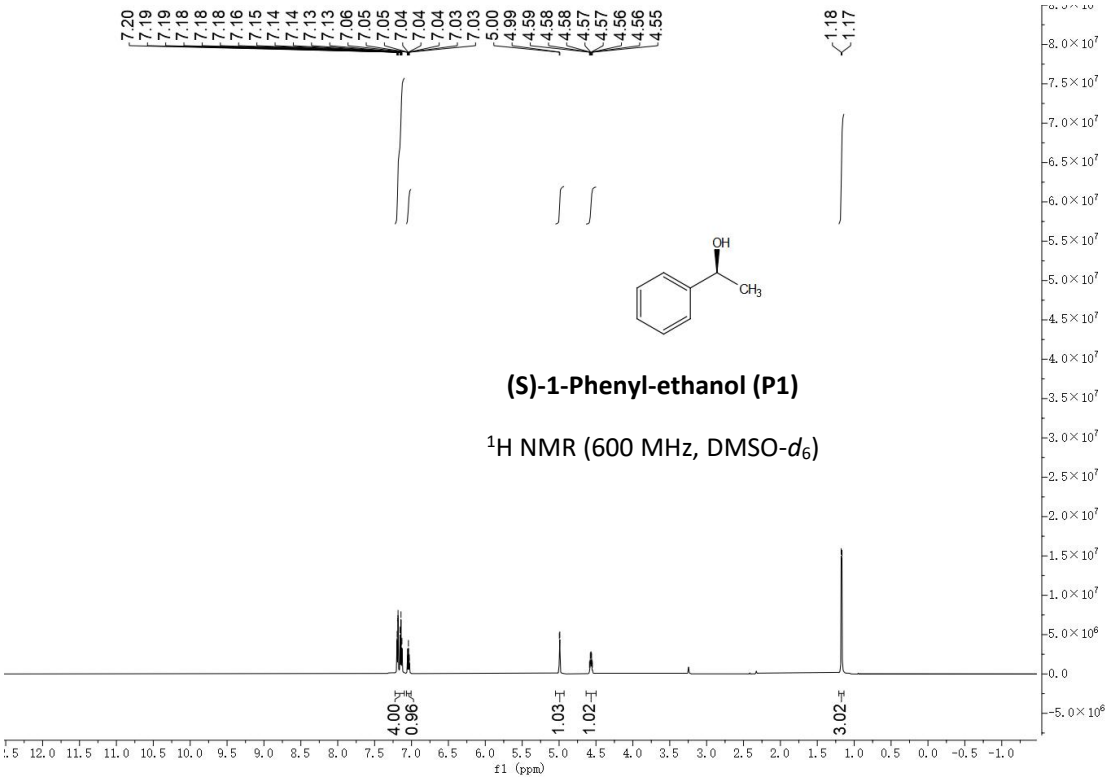
4. NMR spectra



L8 ^{1}H NMR
(600MHZ, MeOD)

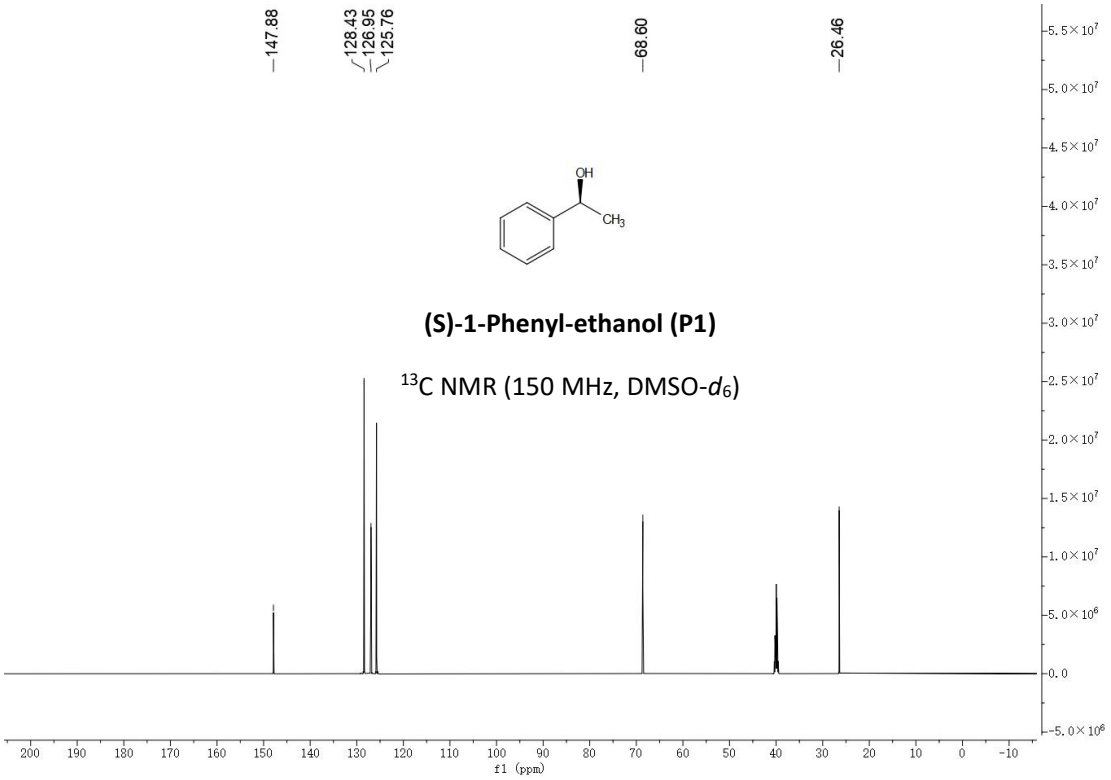


L8 ^{13}C NMR
(150MHZ, MeOD)



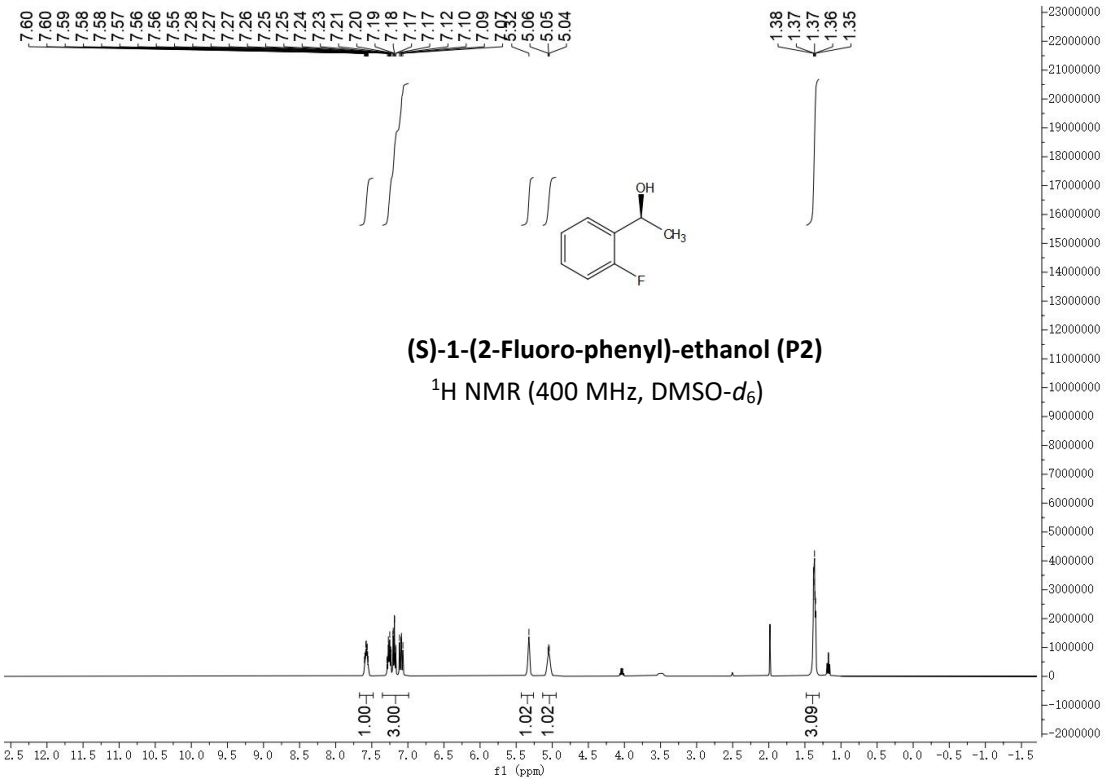
(S)-1-Phenyl-ethanol (P1)

^{1}H NMR (600 MHz, DMSO-d_6)



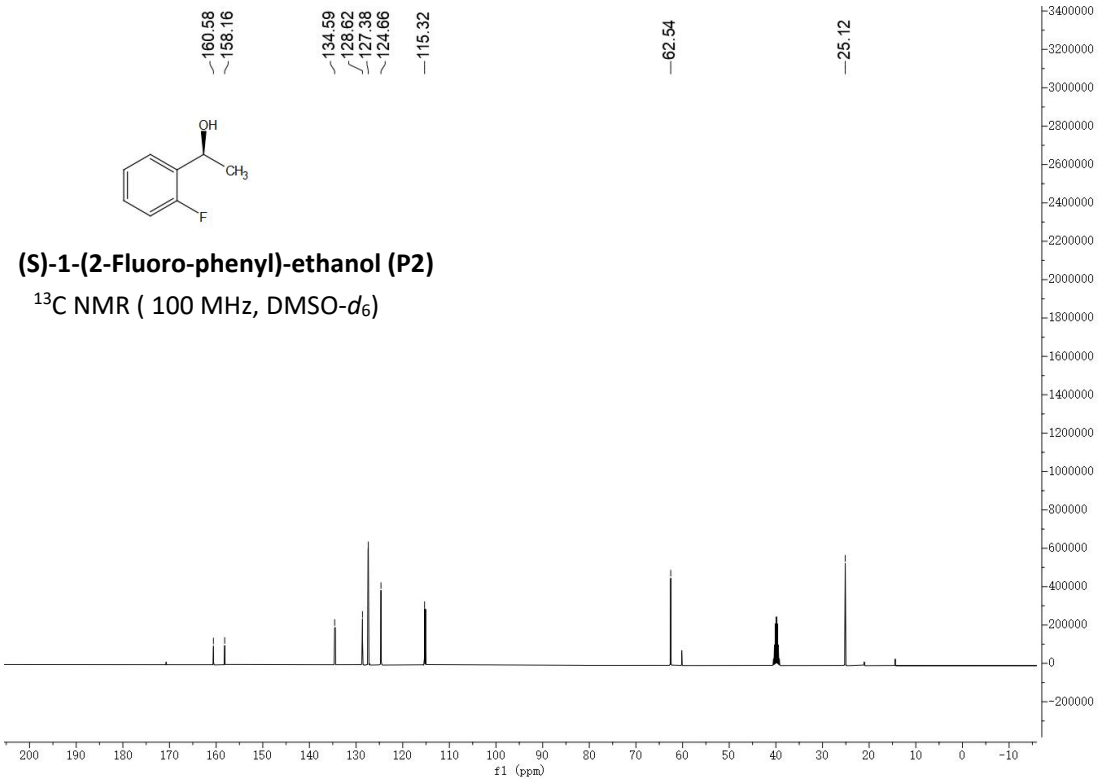
(S)-1-Phenyl-ethanol (P1)

^{13}C NMR (150 MHz, DMSO-d_6)



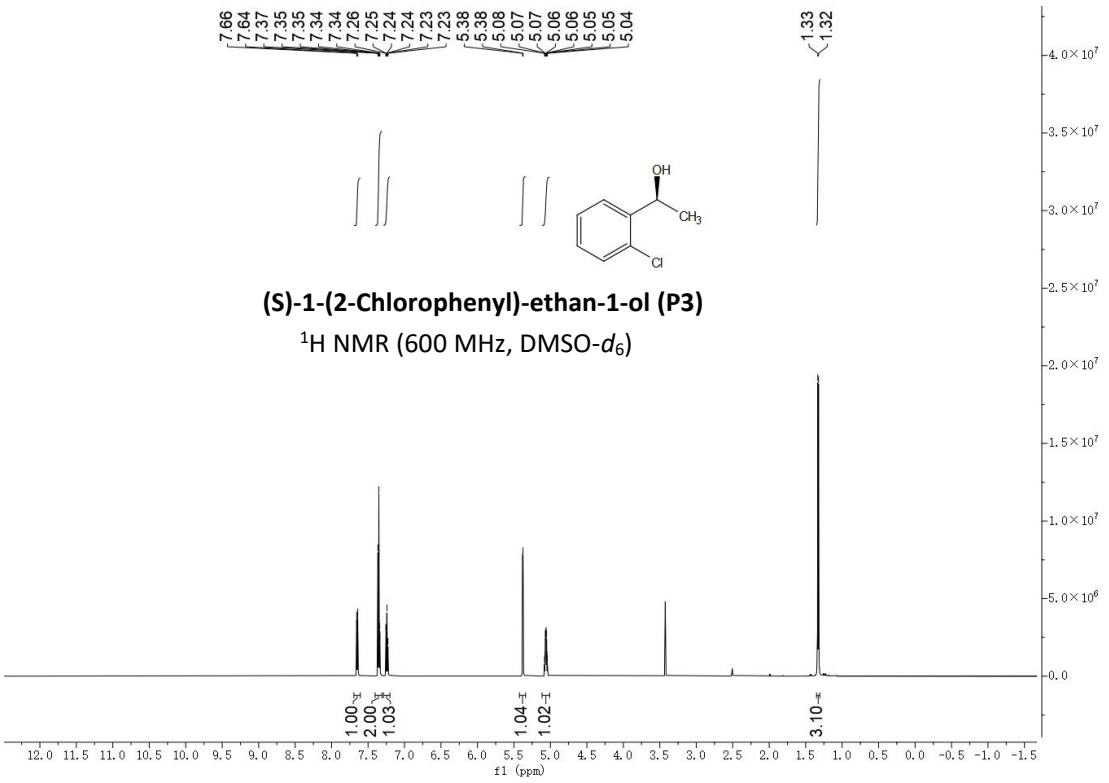
(S)-1-(2-Fluoro-phenyl)-ethanol (P2)

^{1}H NMR (400 MHz, DMSO-d_6)



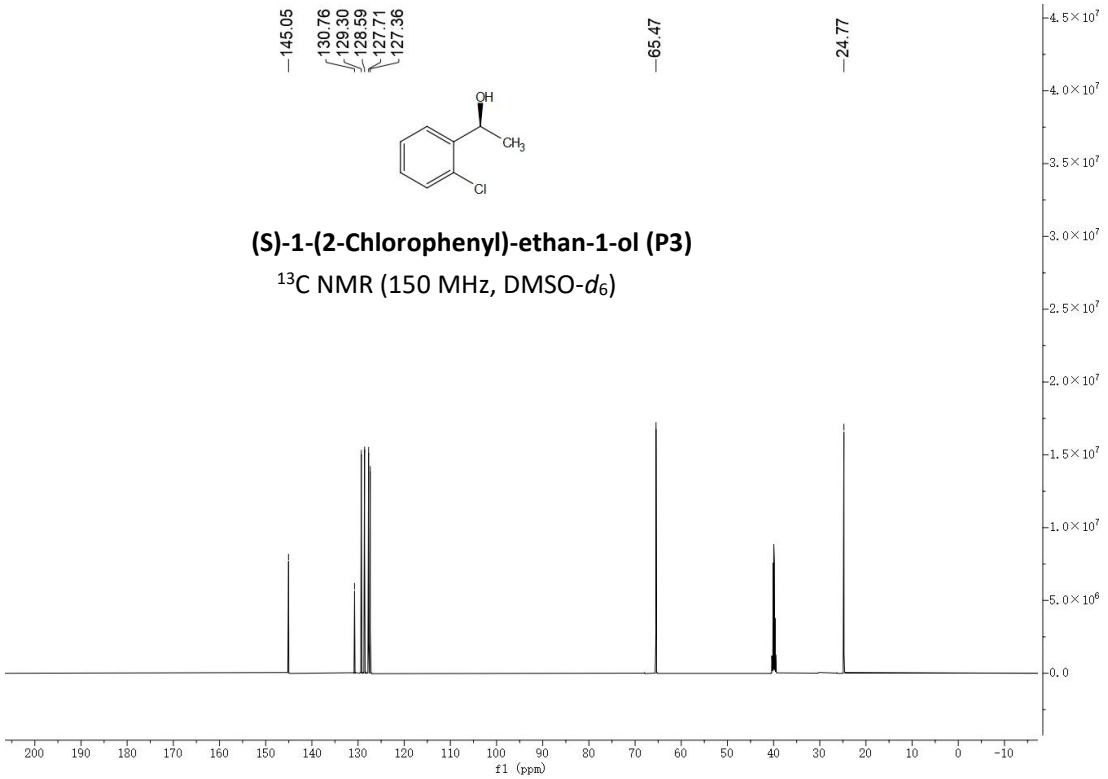
(S)-1-(2-Fluoro-phenyl)-ethanol (P2)

^{13}C NMR (100 MHz, DMSO-d_6)



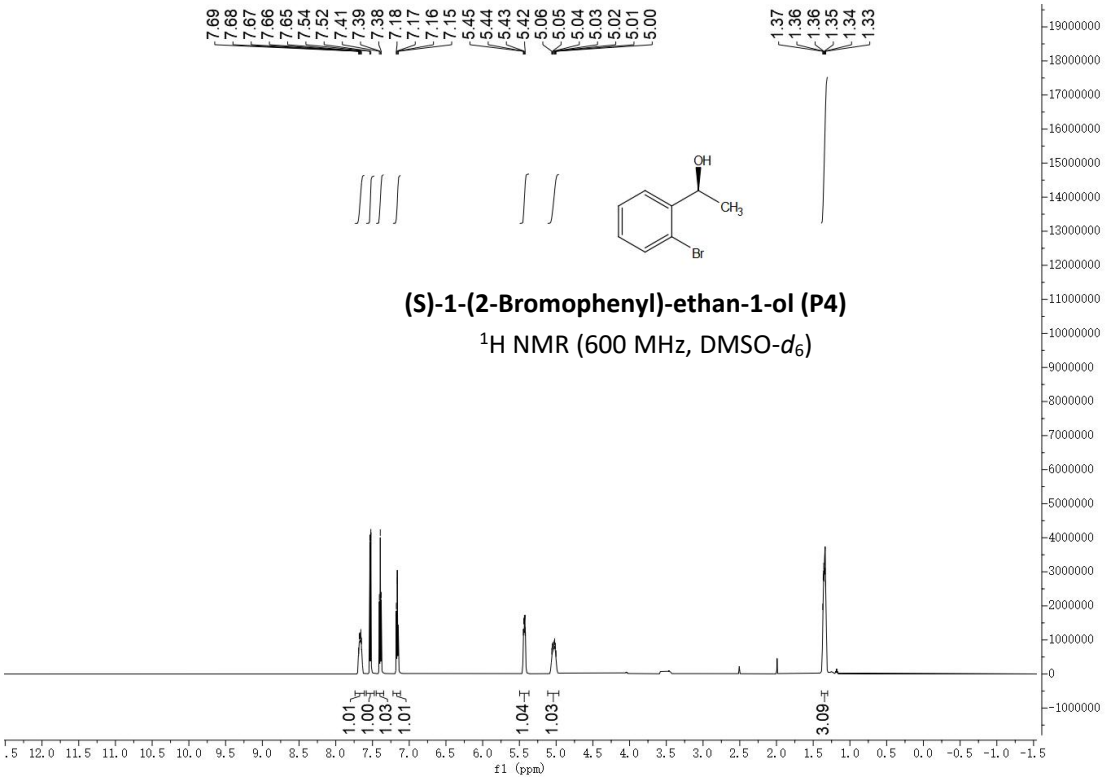
(S)-1-(2-Chlorophenyl)-ethan-1-ol (P3)

^{1}H NMR (600 MHz, DMSO-d_6)



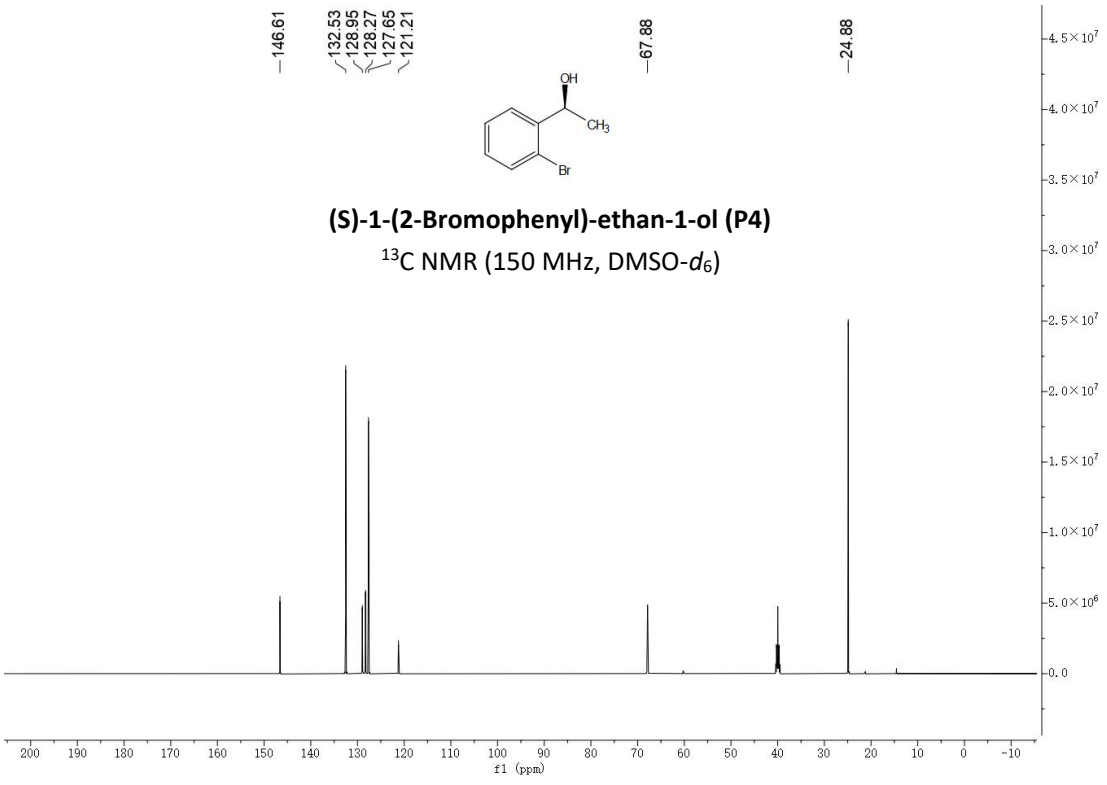
(S)-1-(2-Chlorophenyl)-ethan-1-ol (P3)

^{13}C NMR (150 MHz, DMSO-d_6)



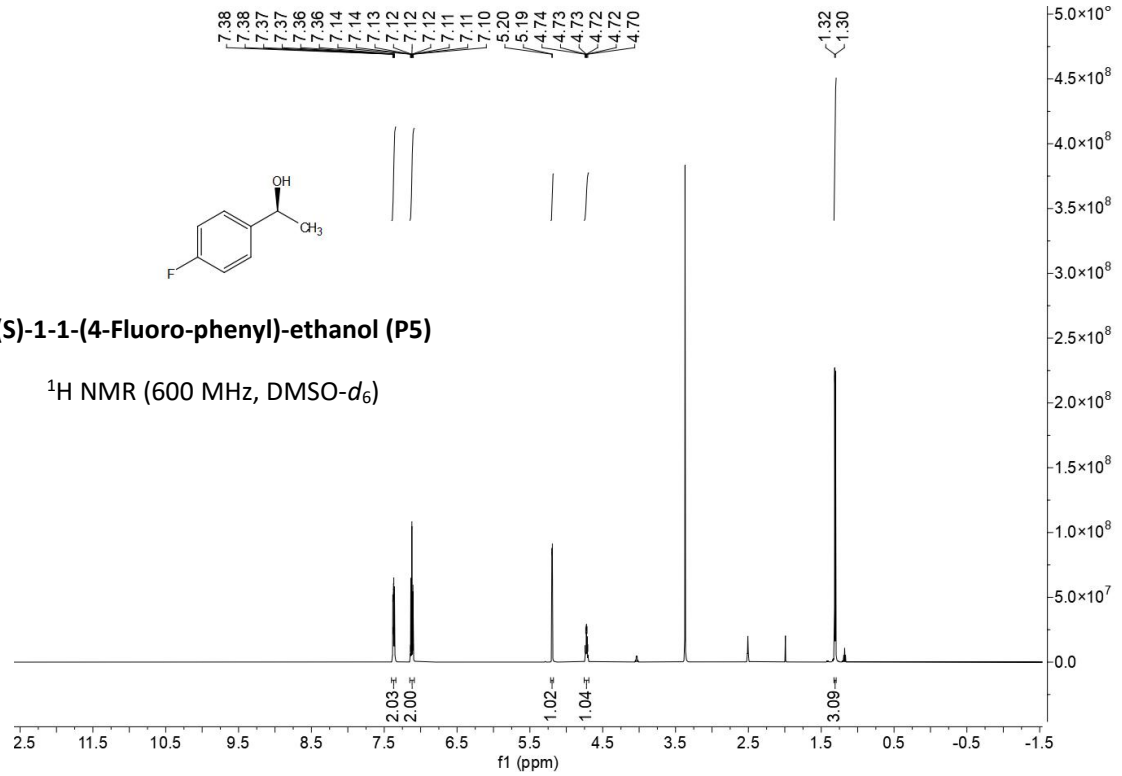
(S)-1-(2-Bromophenyl)-ethan-1-ol (P4)

^{1}H NMR (600 MHz, DMSO-d_6)



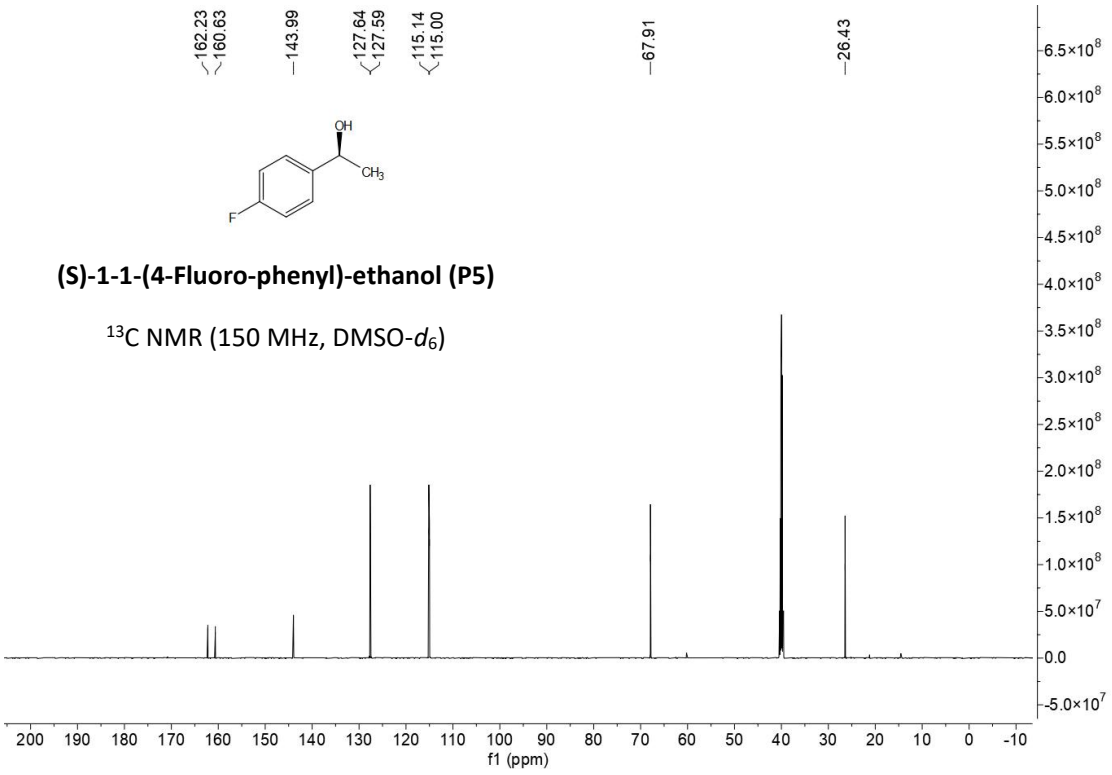
(S)-1-(2-Bromophenyl)-ethan-1-ol (P4)

^{13}C NMR (150 MHz, DMSO-d_6)



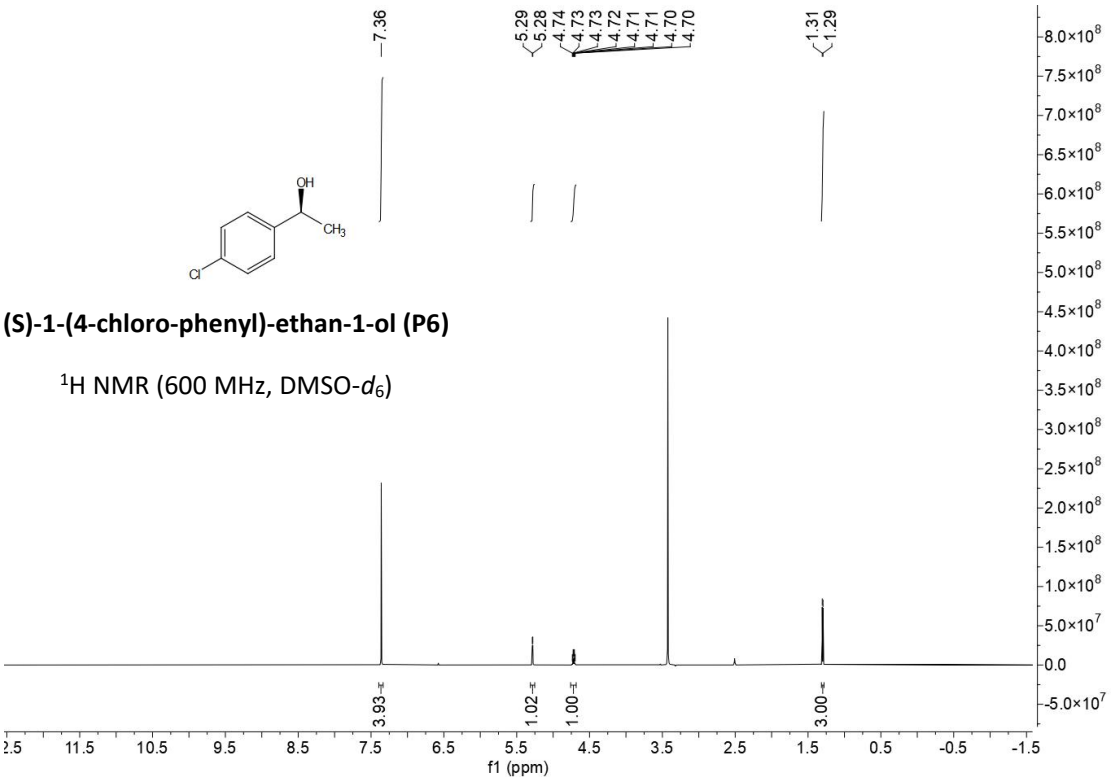
(S)-1-1-(4-Fluoro-phenyl)-ethanol (P5)

^{1}H NMR (600 MHz, DMSO-d_6)



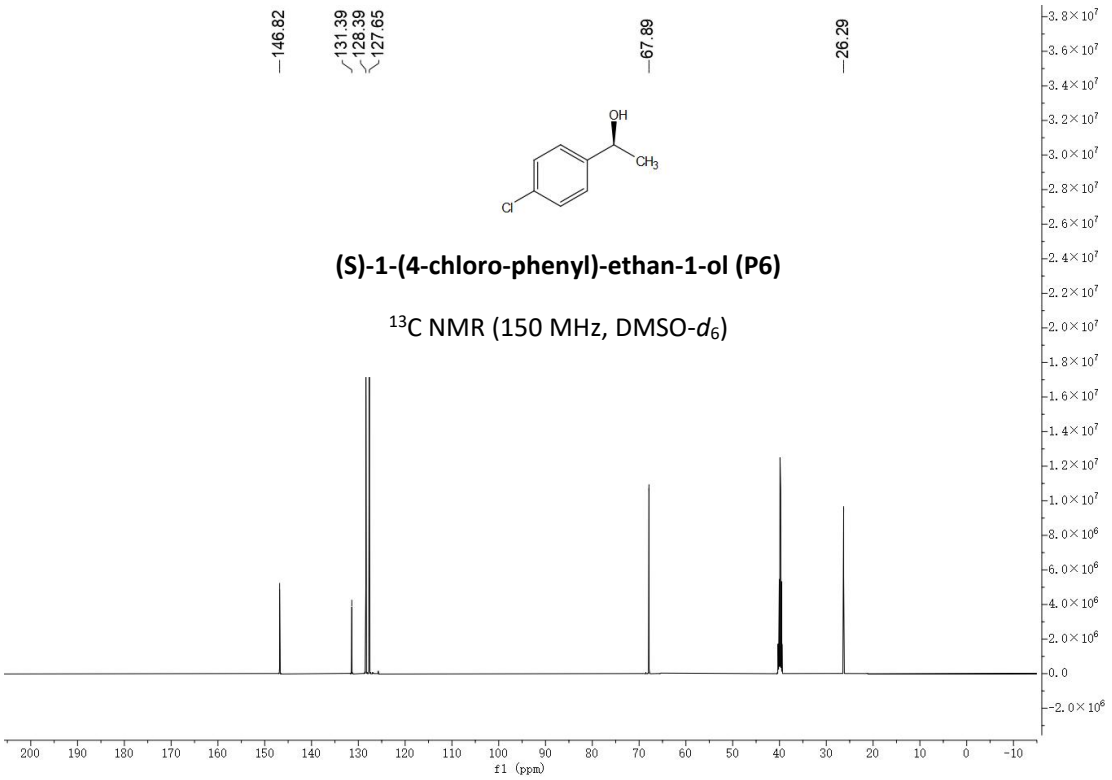
(S)-1-1-(4-Fluoro-phenyl)-ethanol (P5)

^{13}C NMR (150 MHz, DMSO-d_6)



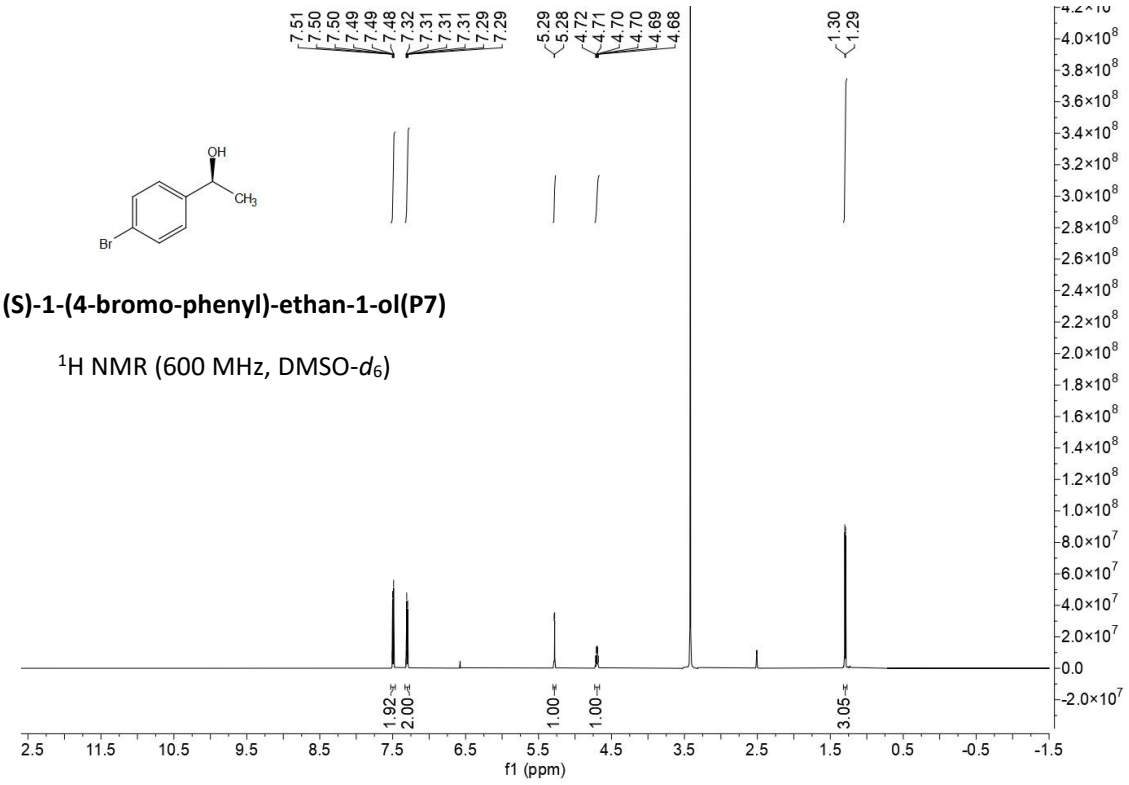
(S)-1-(4-chloro-phenyl)-ethan-1-ol (P6)

^{1}H NMR (600 MHz, DMSO-d_6)



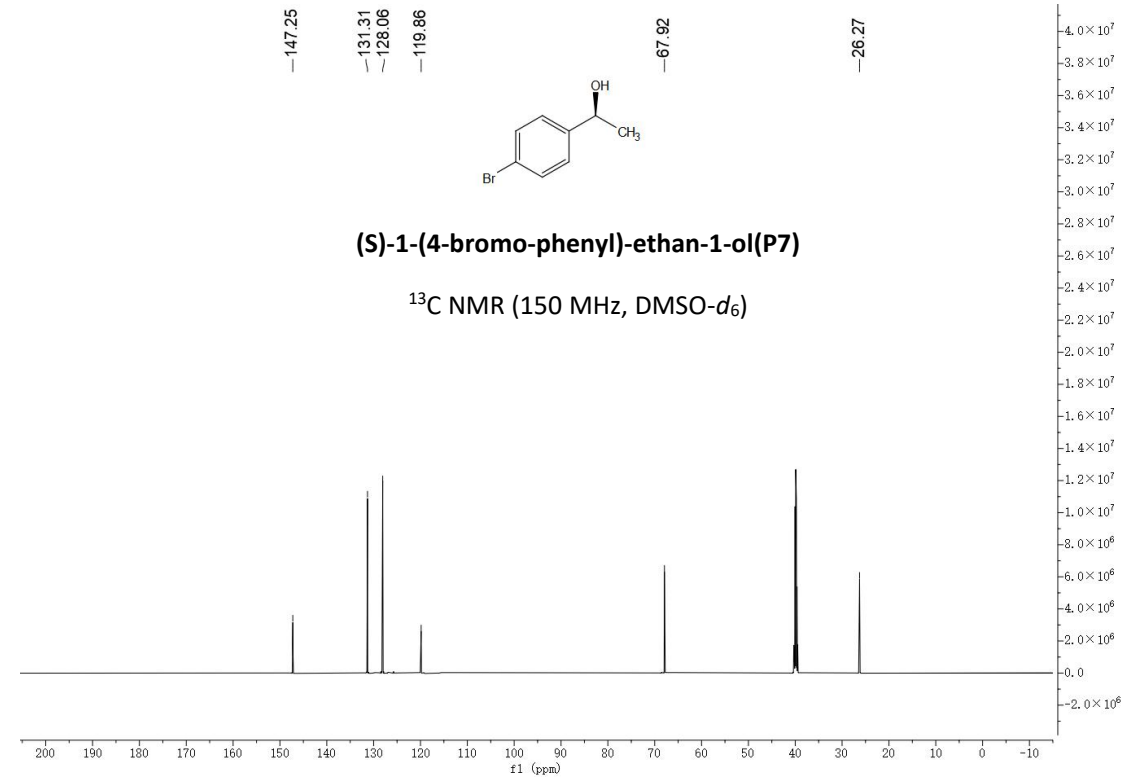
(S)-1-(4-chloro-phenyl)-ethan-1-ol (P6)

^{13}C NMR (150 MHz, DMSO-d_6)



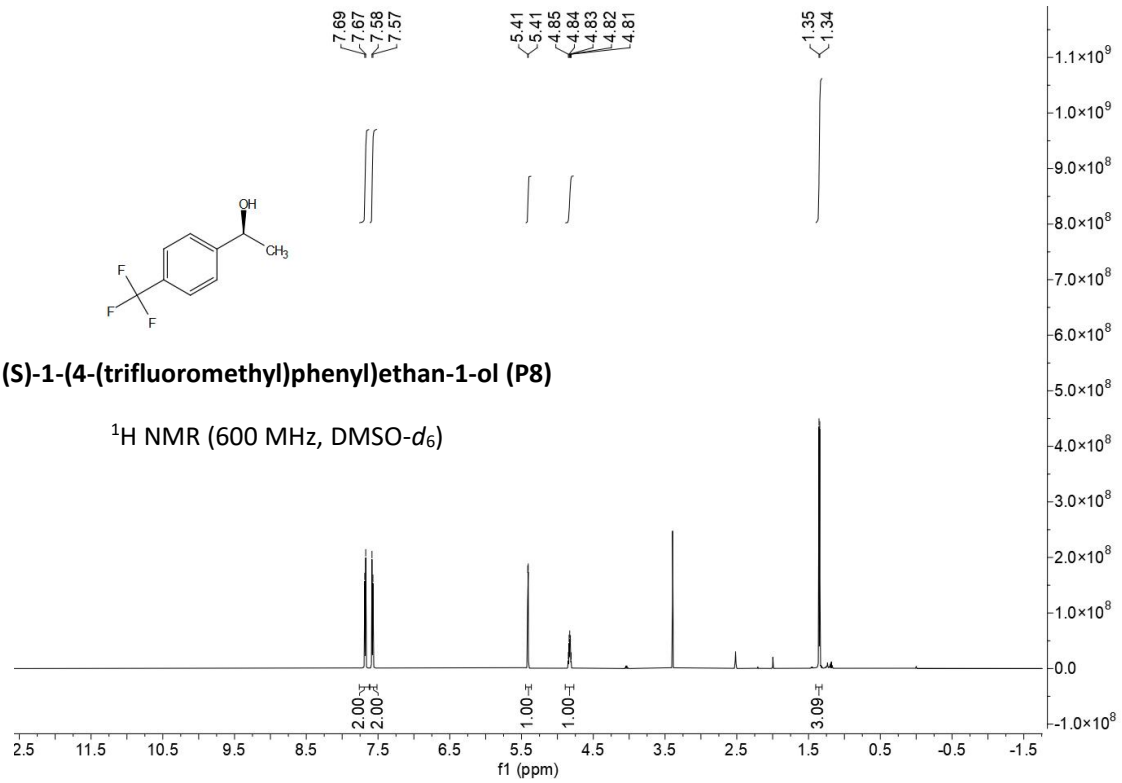
(S)-1-(4-bromo-phenyl)-ethan-1-ol(P7)

^{1}H NMR (600 MHz, DMSO-d_6)



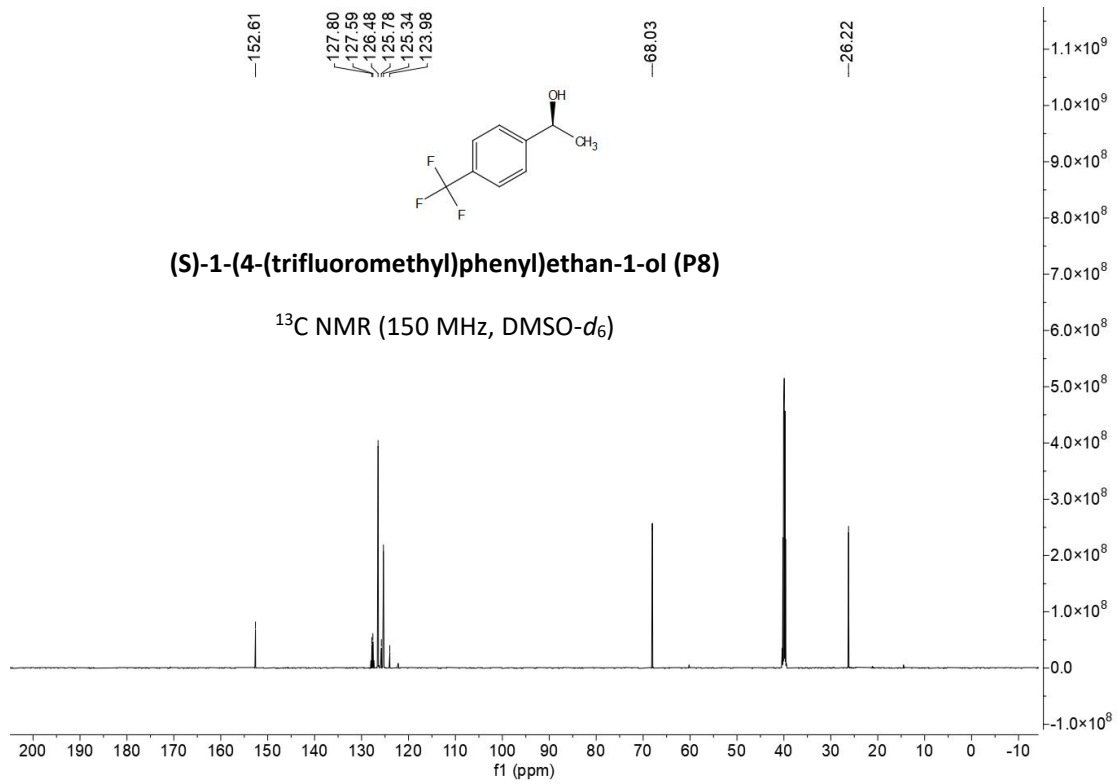
(S)-1-(4-bromo-phenyl)-ethan-1-ol(P7)

^{13}C NMR (150 MHz, DMSO-d_6)



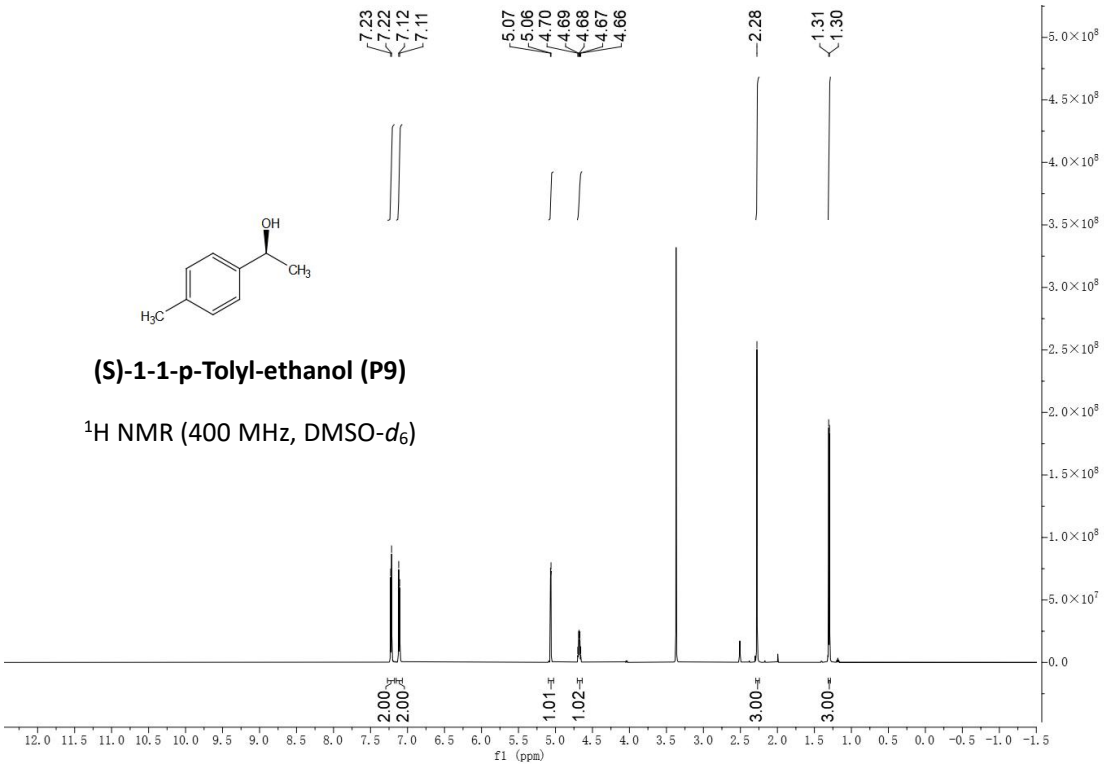
(S)-1-(4-(trifluoromethyl)phenyl)ethan-1-ol (P8)

^{1}H NMR (600 MHz, DMSO-d_6)



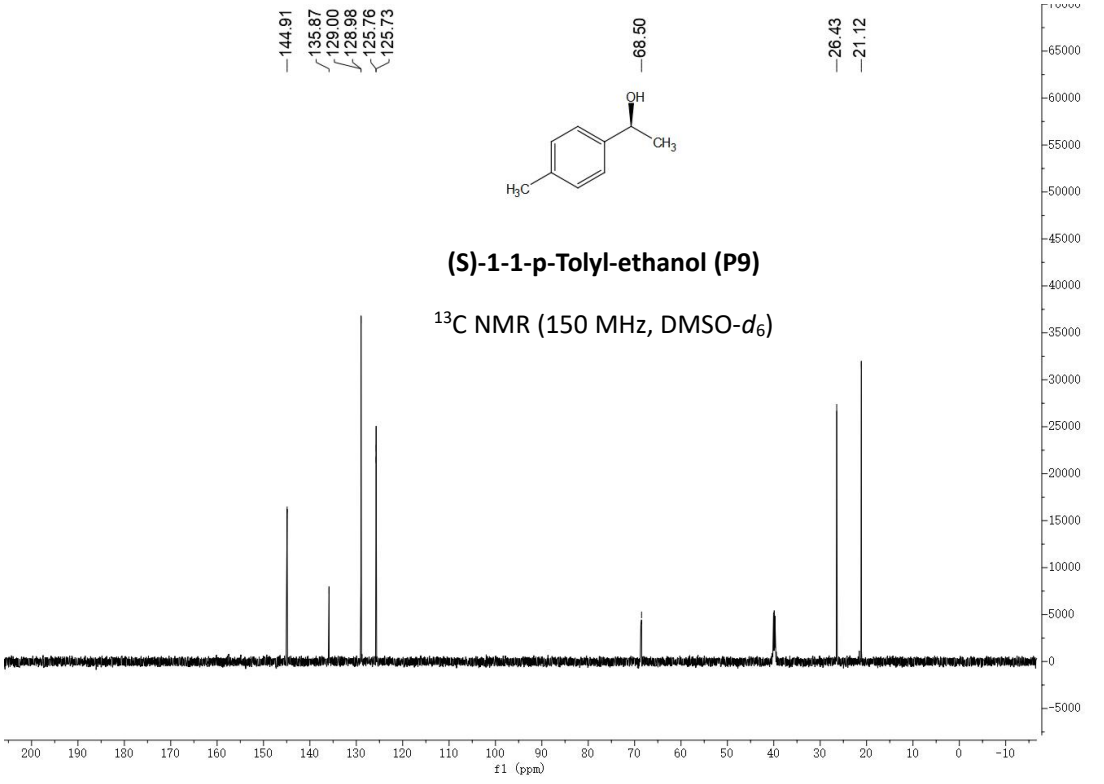
(S)-1-(4-(trifluoromethyl)phenyl)ethan-1-ol (P8)

^{13}C NMR (150 MHz, DMSO-d_6)



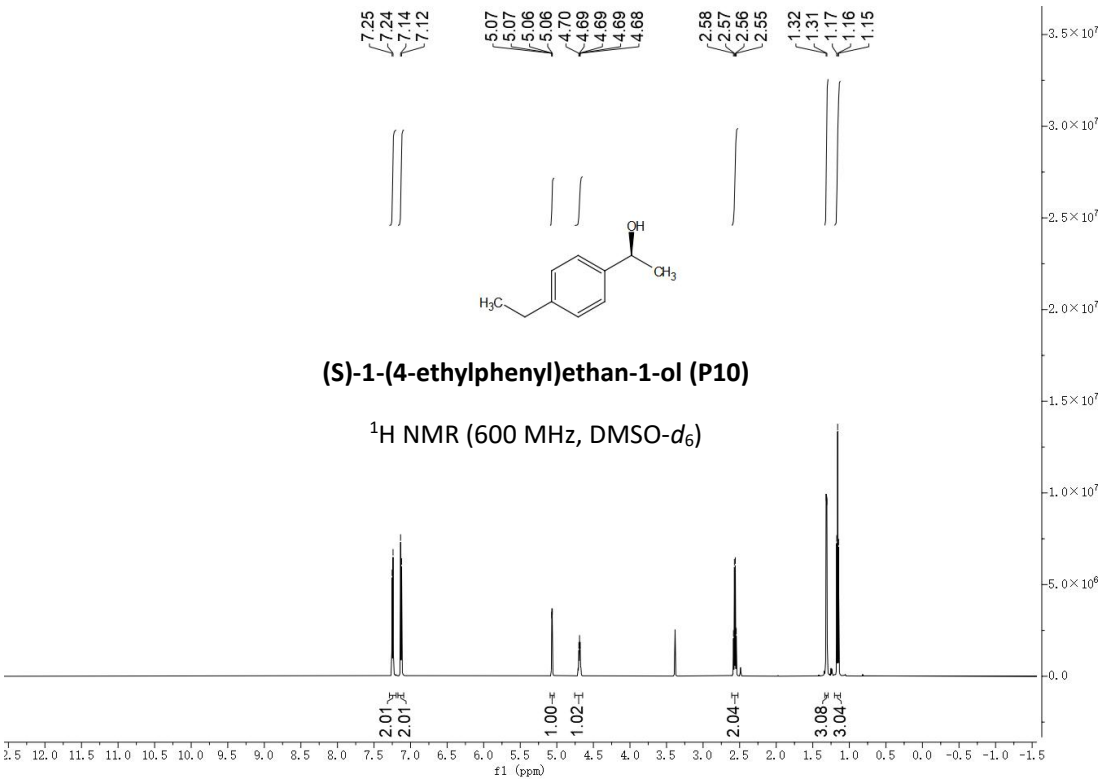
(S)-1-1-p-Tolyl-ethanol (P9)

^{1}H NMR (400 MHz, DMSO-d_6)



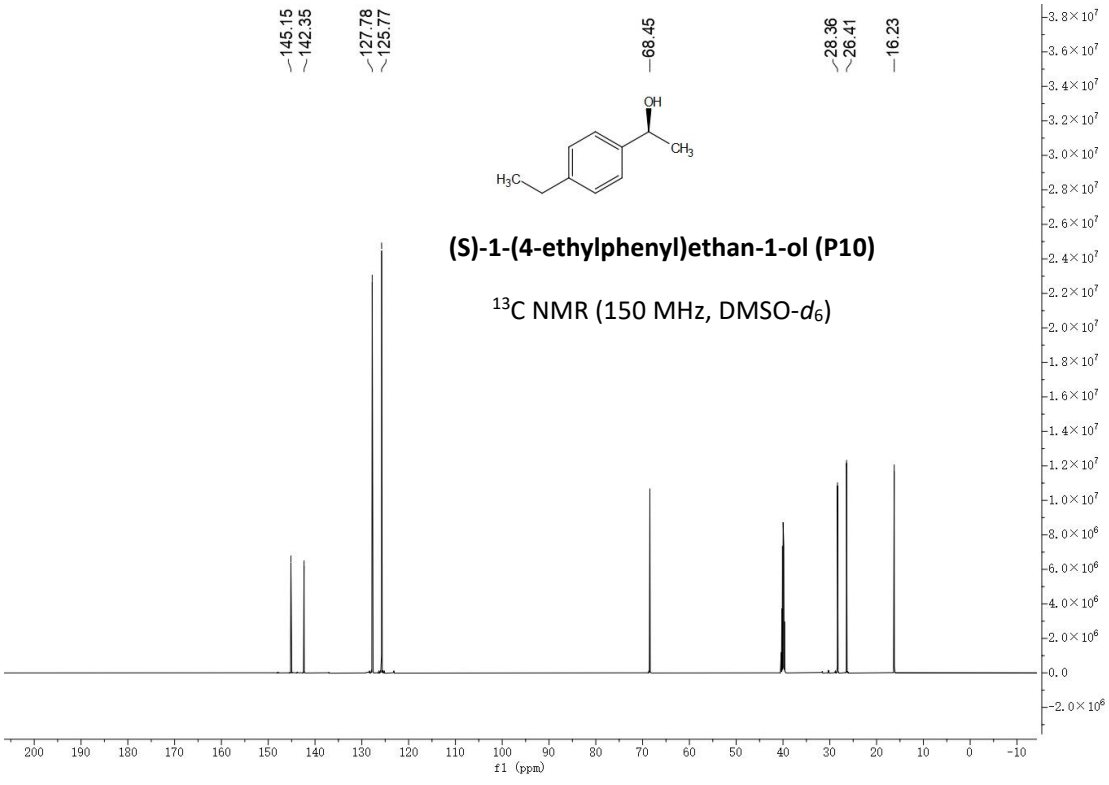
(S)-1-1-p-Tolyl-ethanol (P9)

^{13}C NMR (150 MHz, DMSO-d_6)



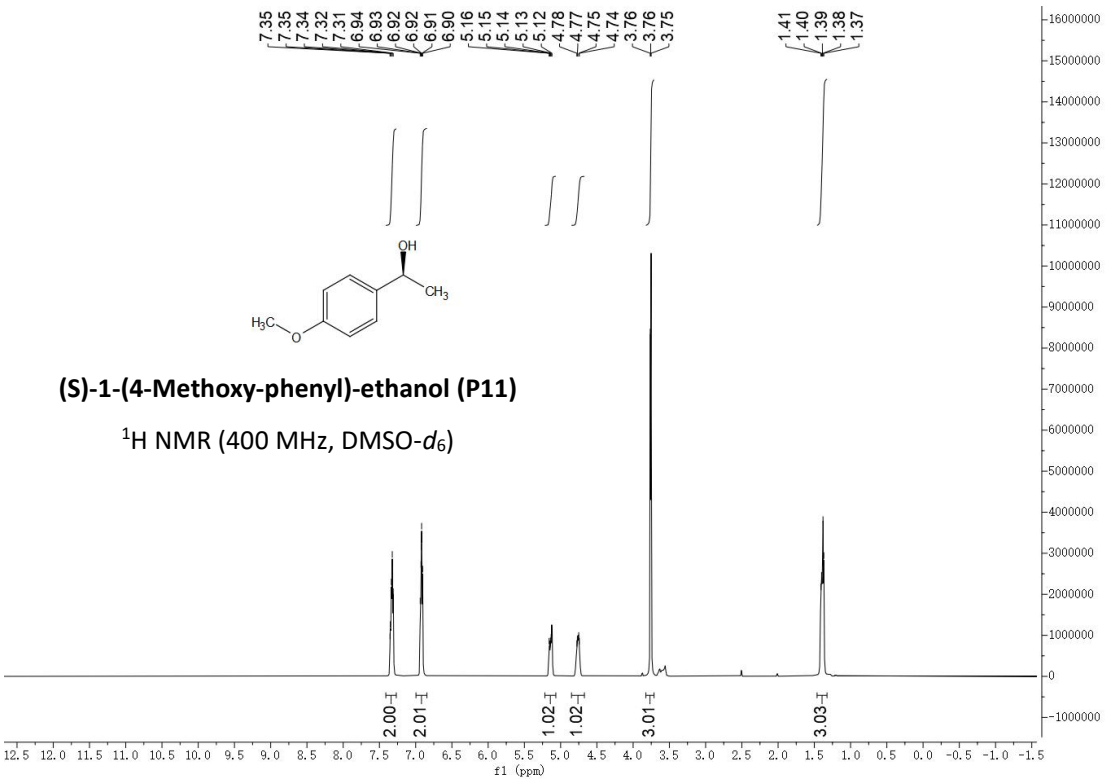
(S)-1-(4-ethylphenyl)ethan-1-ol (P10)

^{1}H NMR (600 MHz, DMSO-d_6)



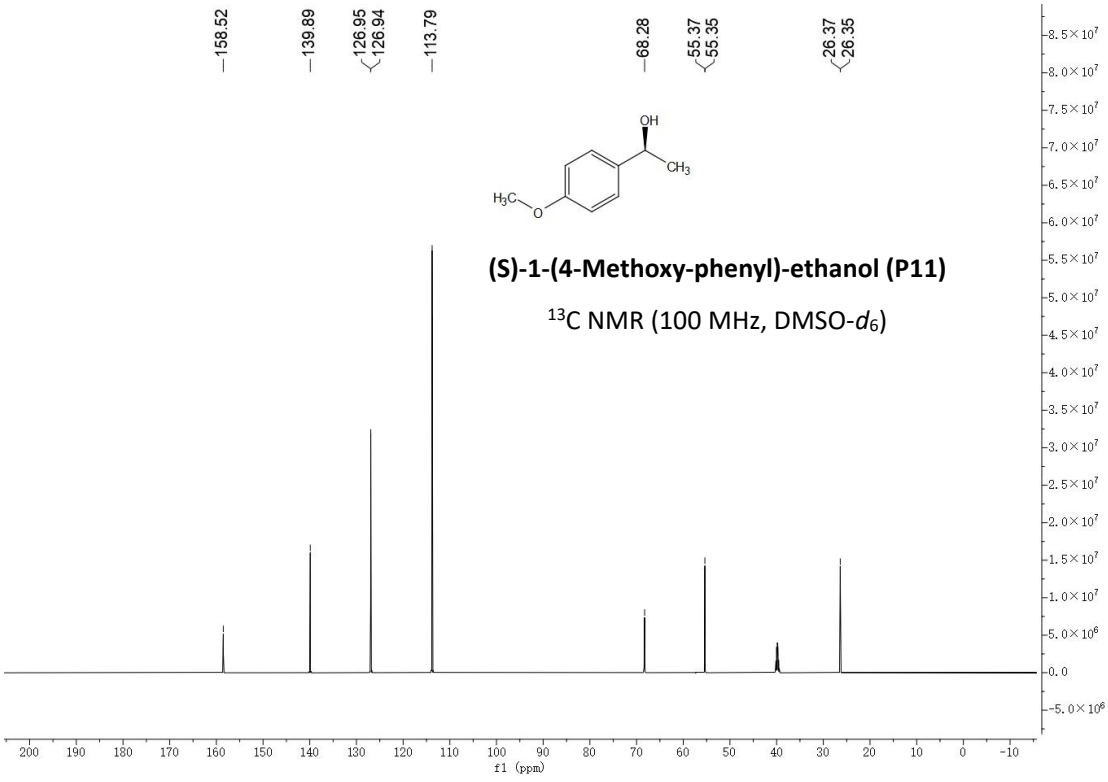
(S)-1-(4-ethylphenyl)ethan-1-ol (P10)

^{13}C NMR (150 MHz, DMSO-d_6)



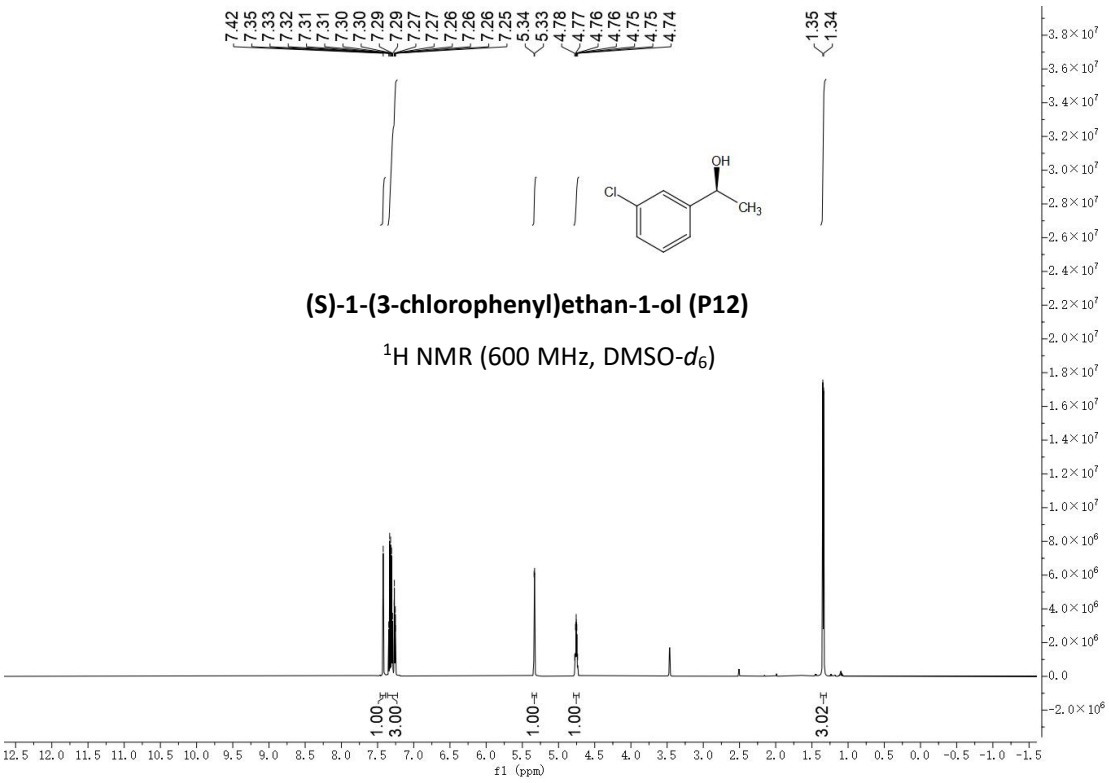
(S)-1-(4-Methoxy-phenyl)-ethanol (P11)

^{1}H NMR (400 MHz, DMSO-d_6)



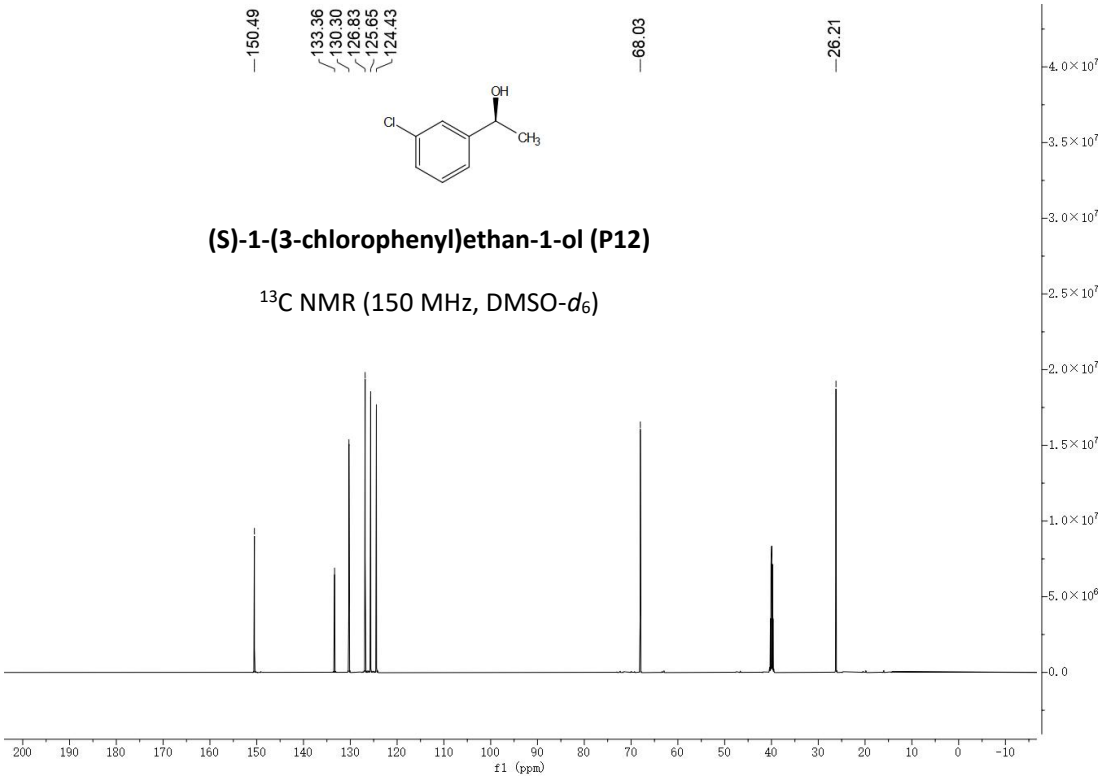
(S)-1-(4-Methoxy-phenyl)-ethanol (P11)

^{13}C NMR (100 MHz, DMSO-d_6)



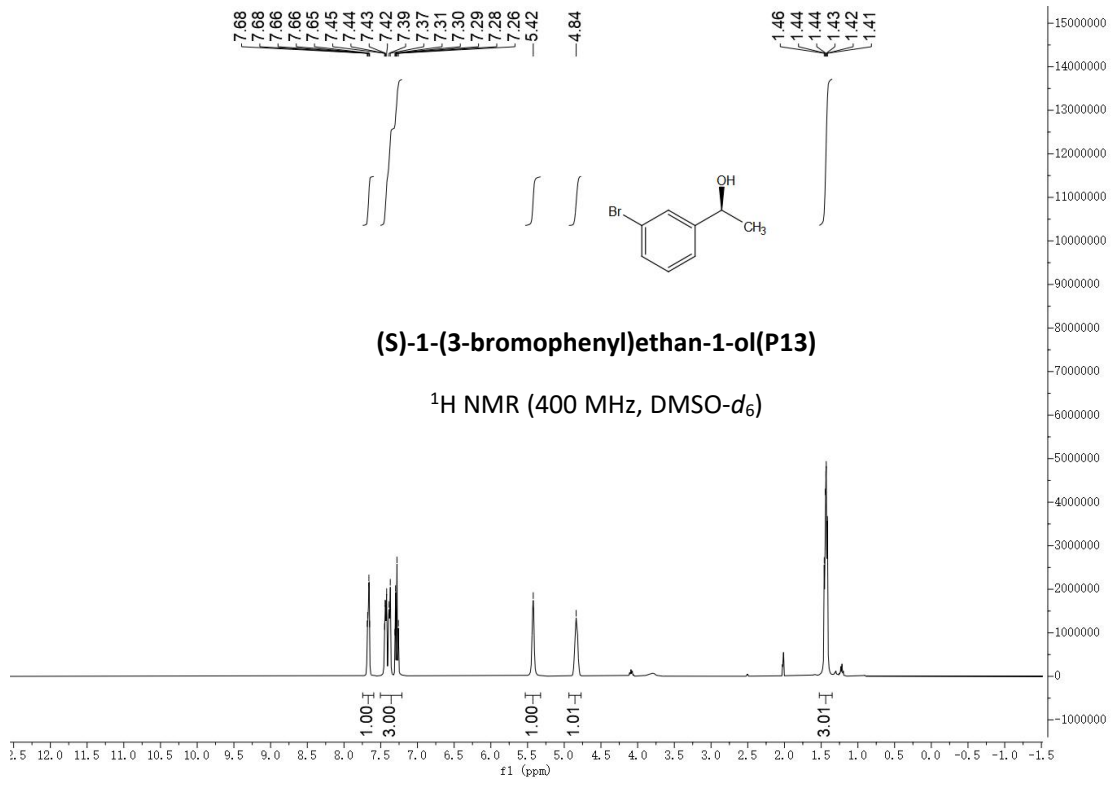
(S)-1-(3-chlorophenyl)ethan-1-ol (P12)

^{1}H NMR (600 MHz, DMSO-d_6)



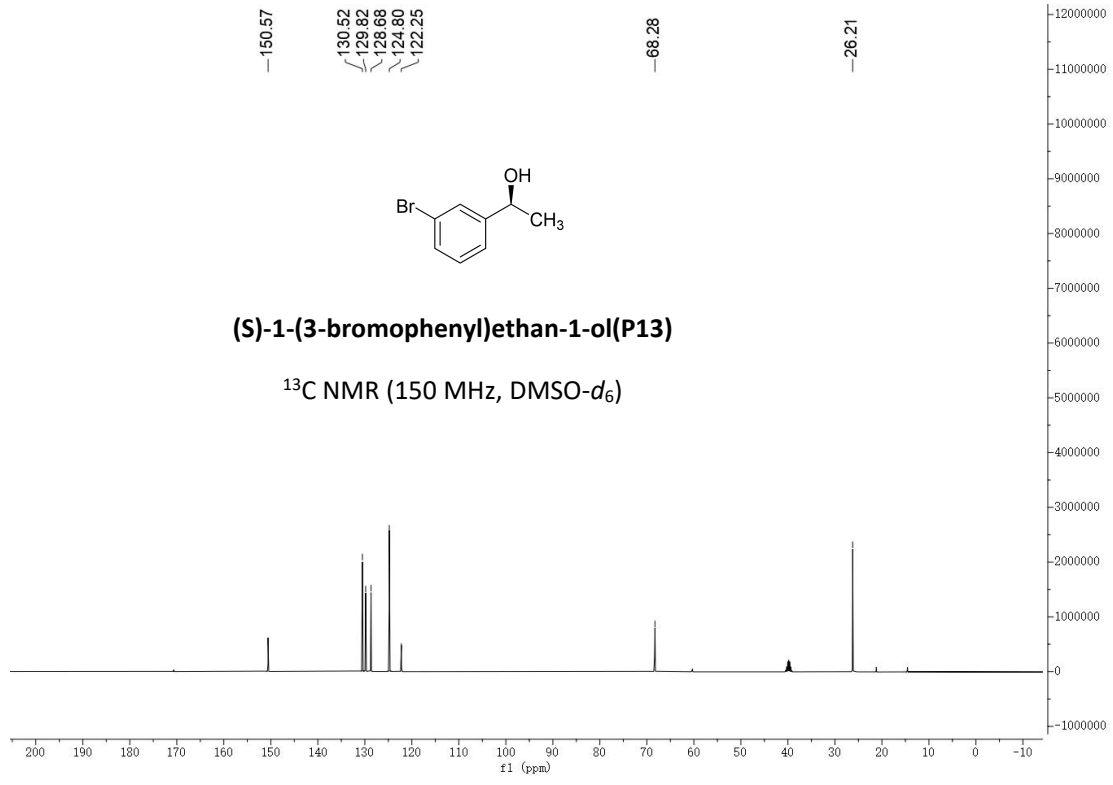
(S)-1-(3-chlorophenyl)ethan-1-ol (P12)

^{13}C NMR (150 MHz, DMSO-d_6)



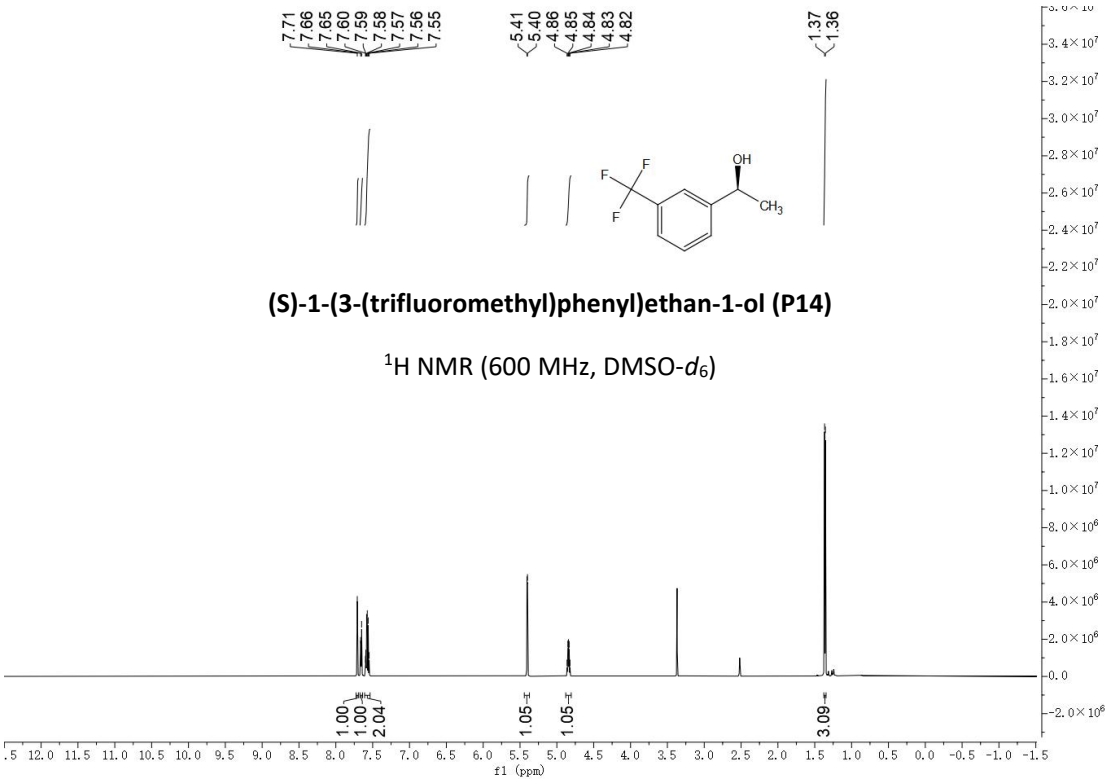
(S)-1-(3-bromophenyl)ethan-1-ol(P13)

^{1}H NMR (400 MHz, DMSO-d_6)



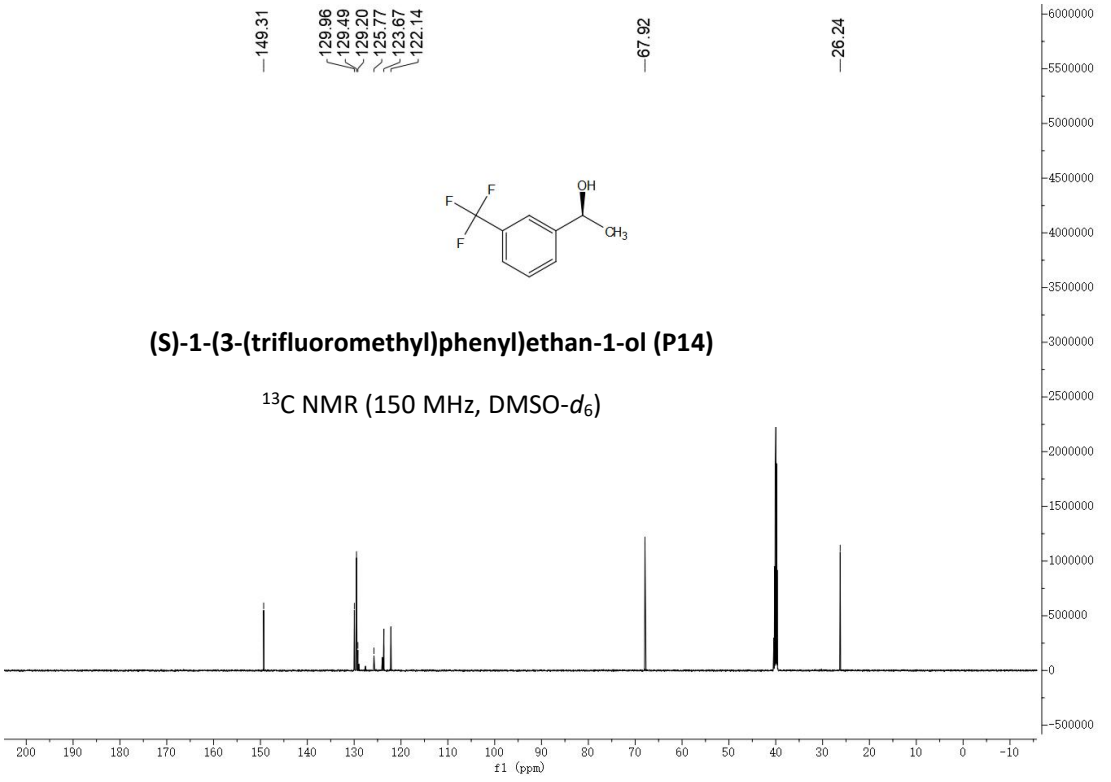
(S)-1-(3-bromophenyl)ethan-1-ol(P13)

^{13}C NMR (150 MHz, DMSO-d_6)



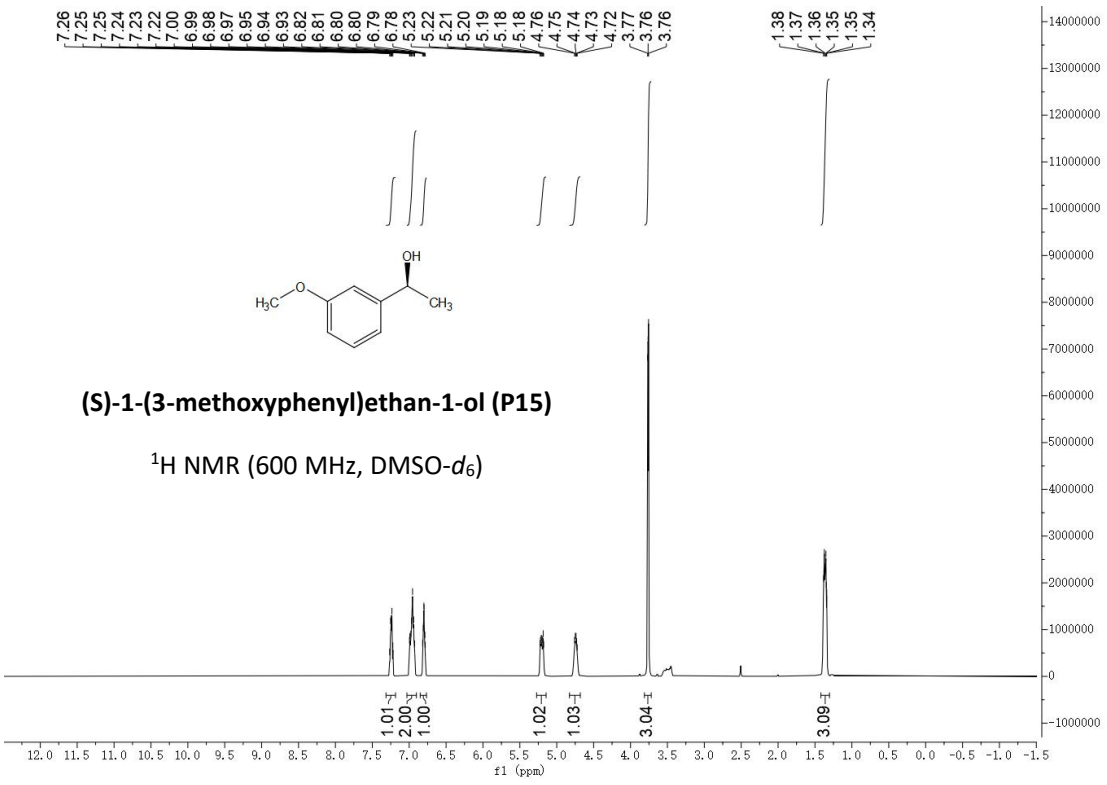
(S)-1-(3-(trifluoromethyl)phenyl)ethan-1-ol (P14)

^{1}H NMR (600 MHz, DMSO-d_6)



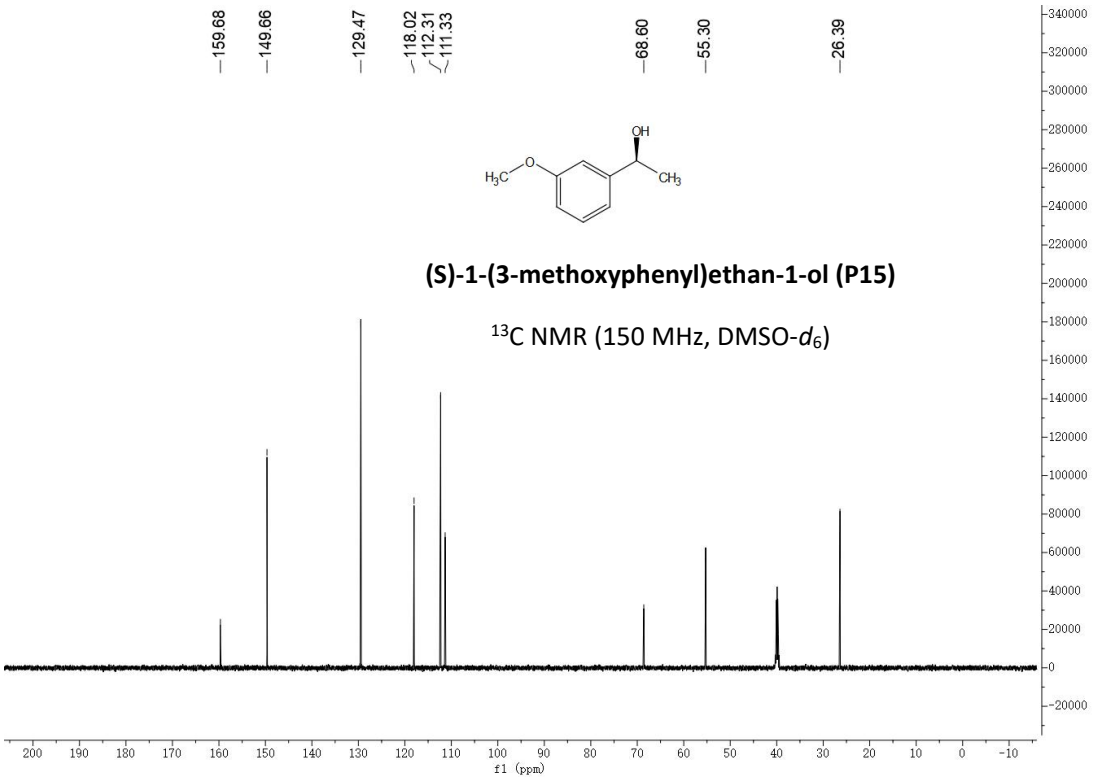
(S)-1-(3-(trifluoromethyl)phenyl)ethan-1-ol (P14)

^{13}C NMR (150 MHz, DMSO-d_6)



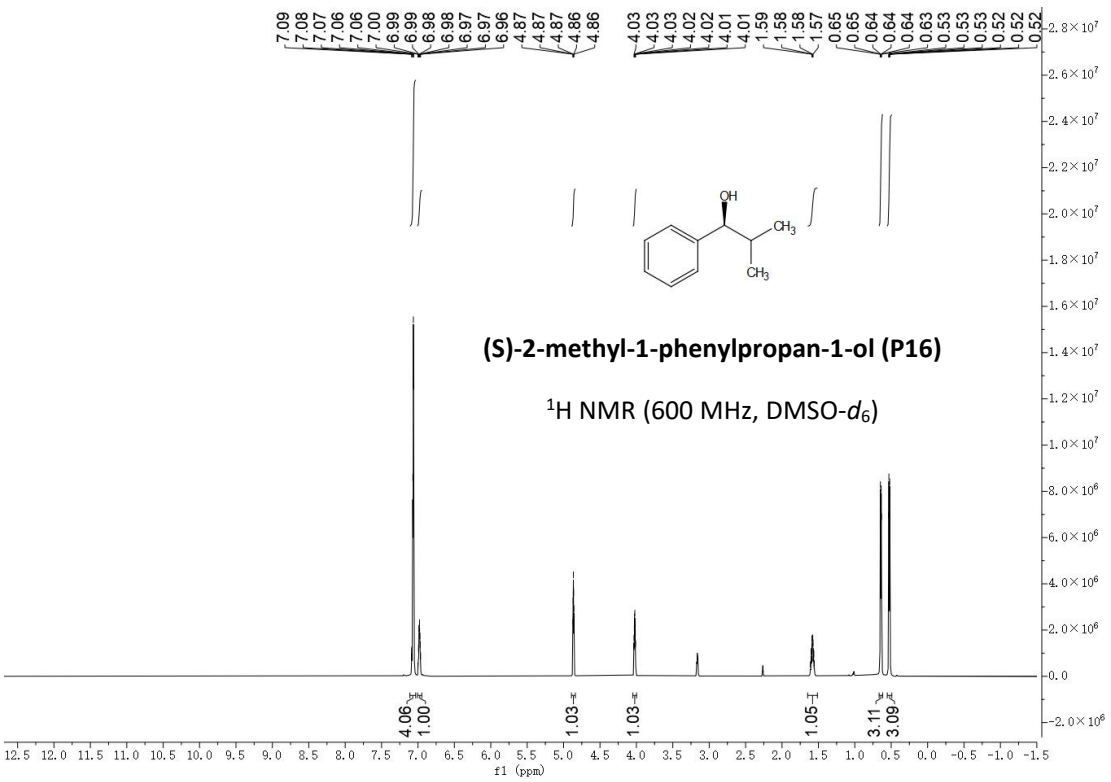
(S)-1-(3-methoxyphenyl)ethan-1-ol (P15)

^{1}H NMR (600 MHz, DMSO-d_6)



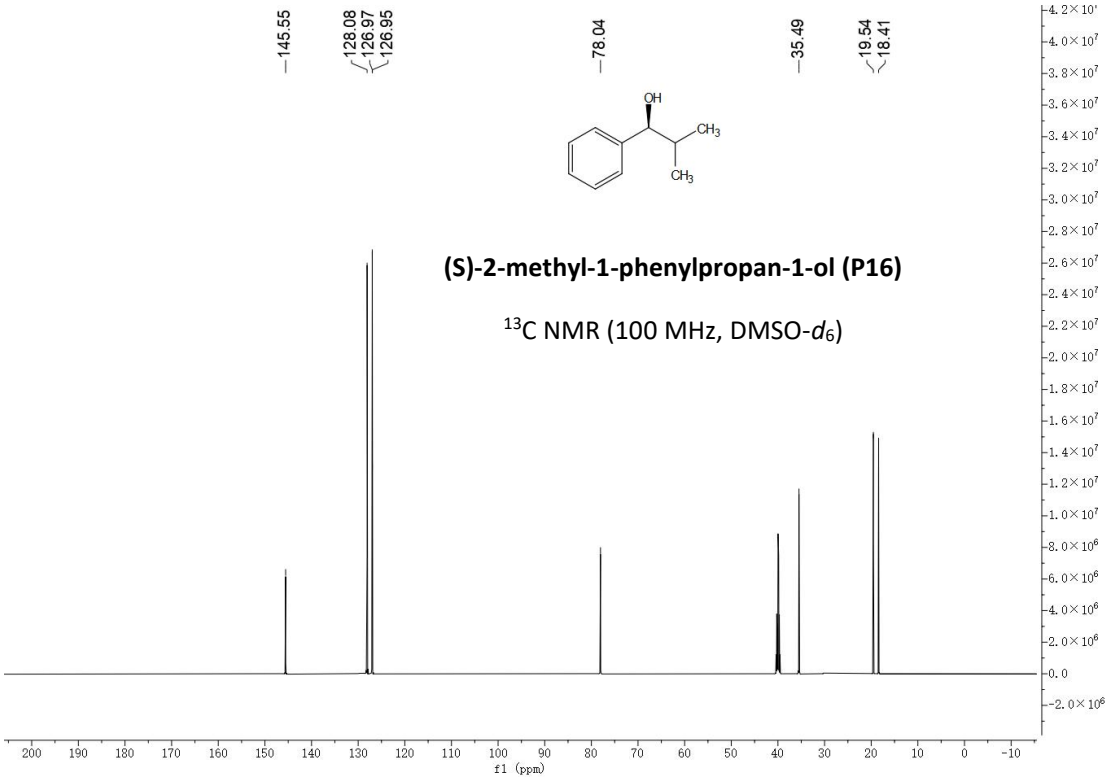
(S)-1-(3-methoxyphenyl)ethan-1-ol (P15)

^{13}C NMR (150 MHz, DMSO-d_6)



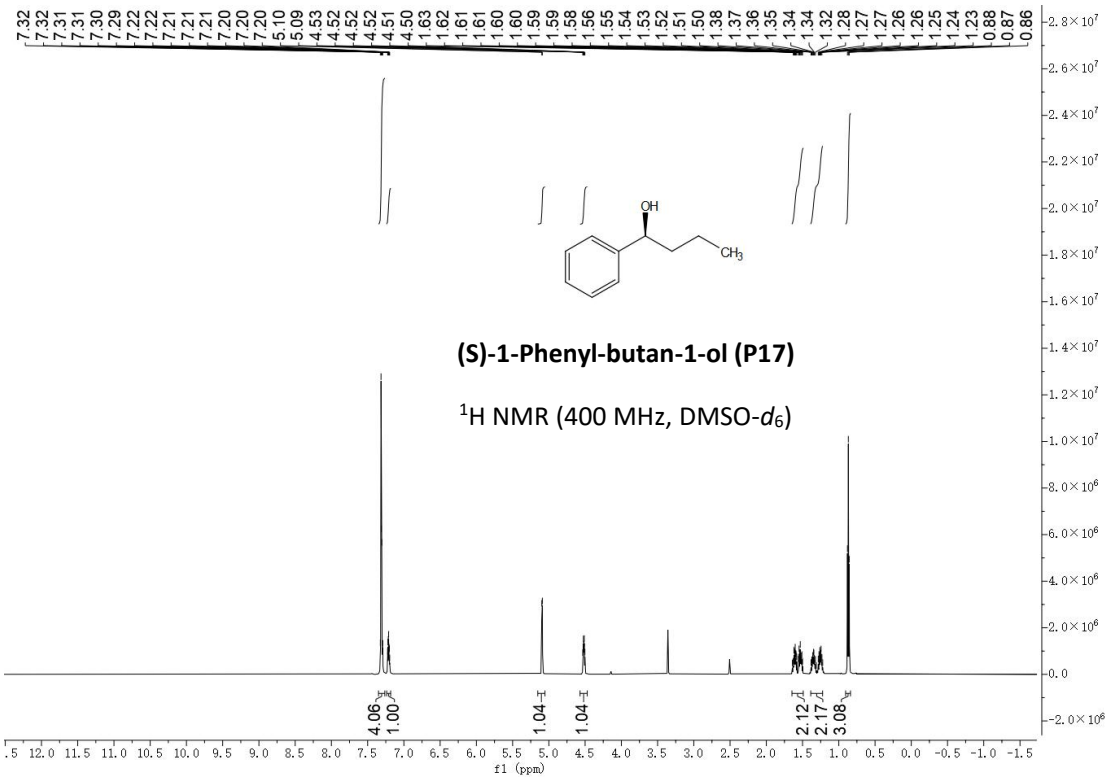
(S)-2-methyl-1-phenylpropan-1-ol (P16)

^{1}H NMR (600 MHz, DMSO-d_6)



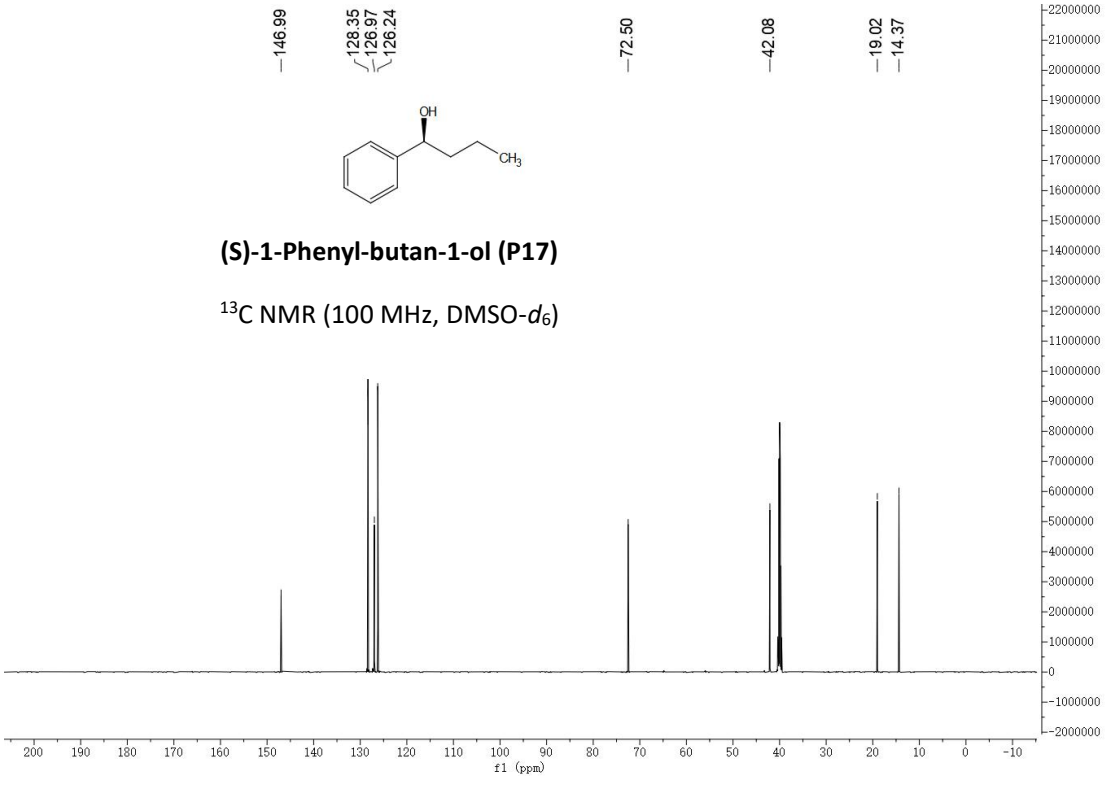
(S)-2-methyl-1-phenylpropan-1-ol (P16)

^{13}C NMR (100 MHz, DMSO-d_6)



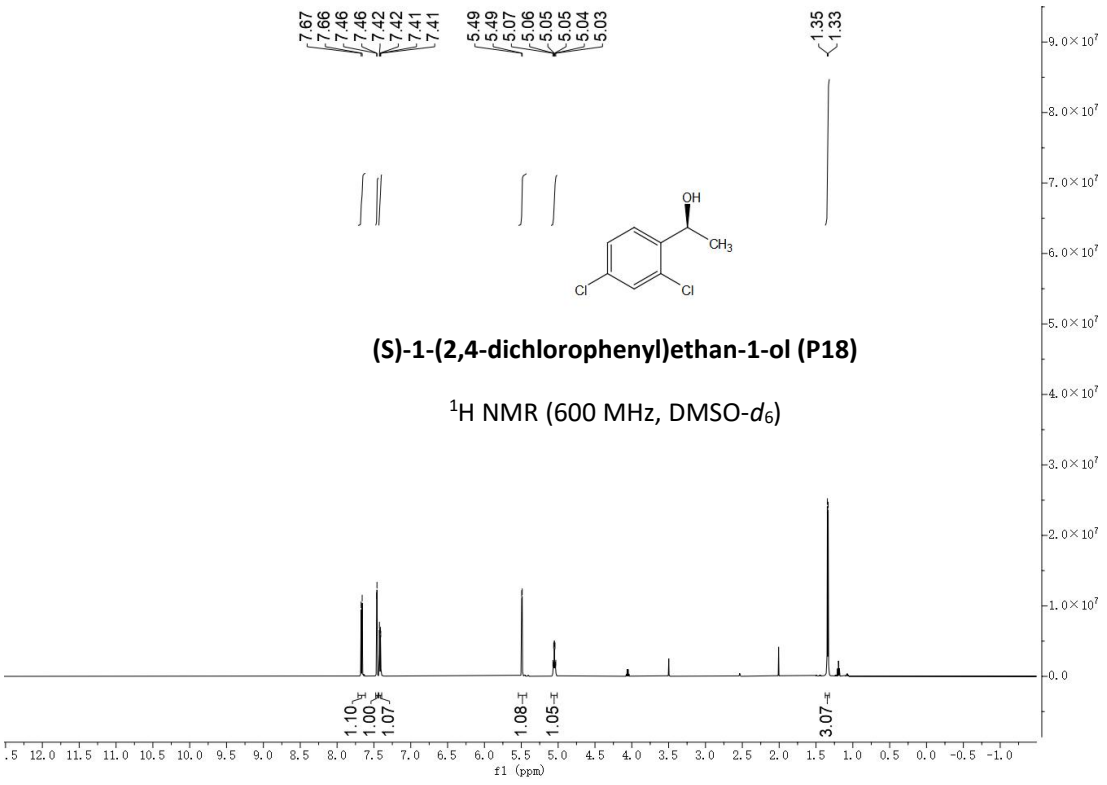
(S)-1-Phenyl-butan-1-ol (P17)

^{1}H NMR (400 MHz, DMSO-d_6)



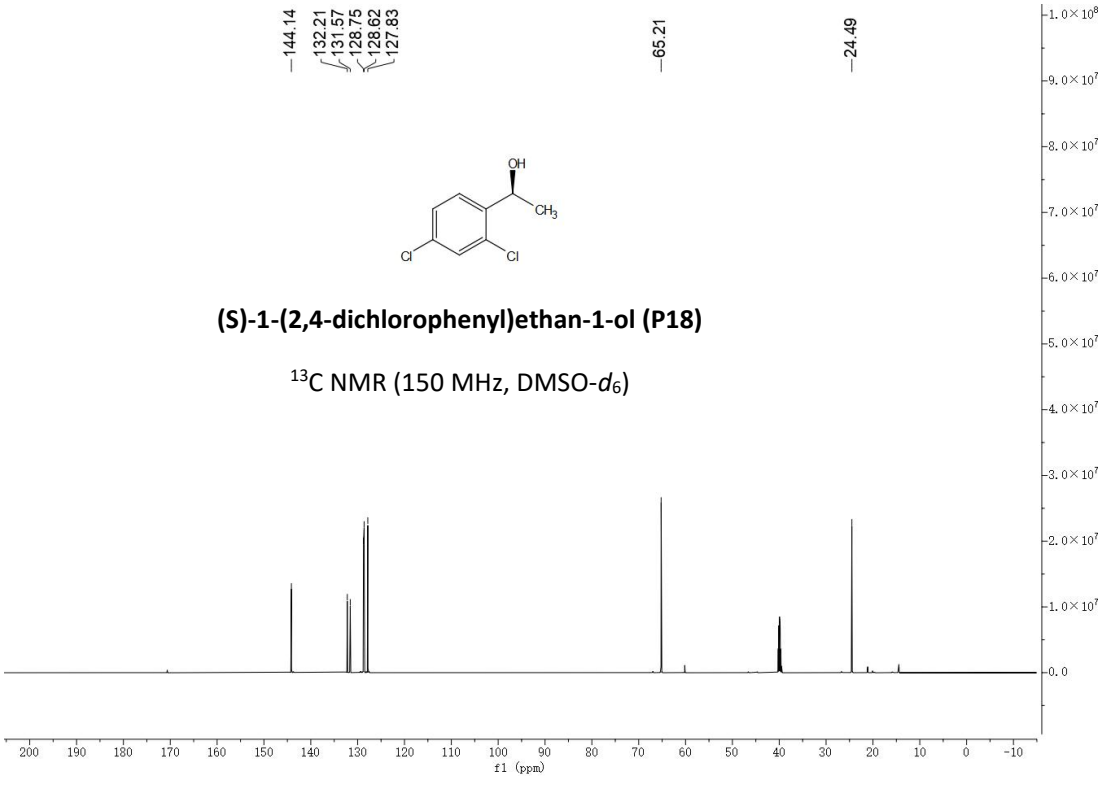
(S)-1-Phenyl-butan-1-ol (P17)

^{13}C NMR (100 MHz, DMSO-d_6)



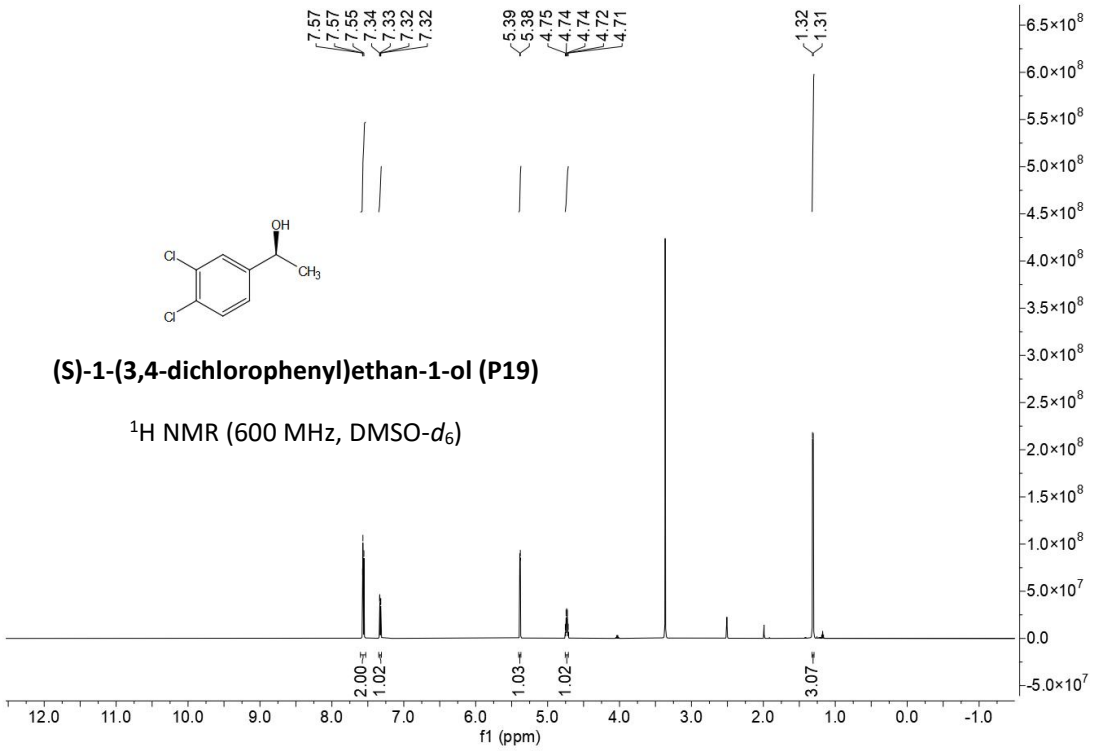
(S)-1-(2,4-dichlorophenyl)ethan-1-ol (P18)

^{1}H NMR (600 MHz, DMSO-d_6)



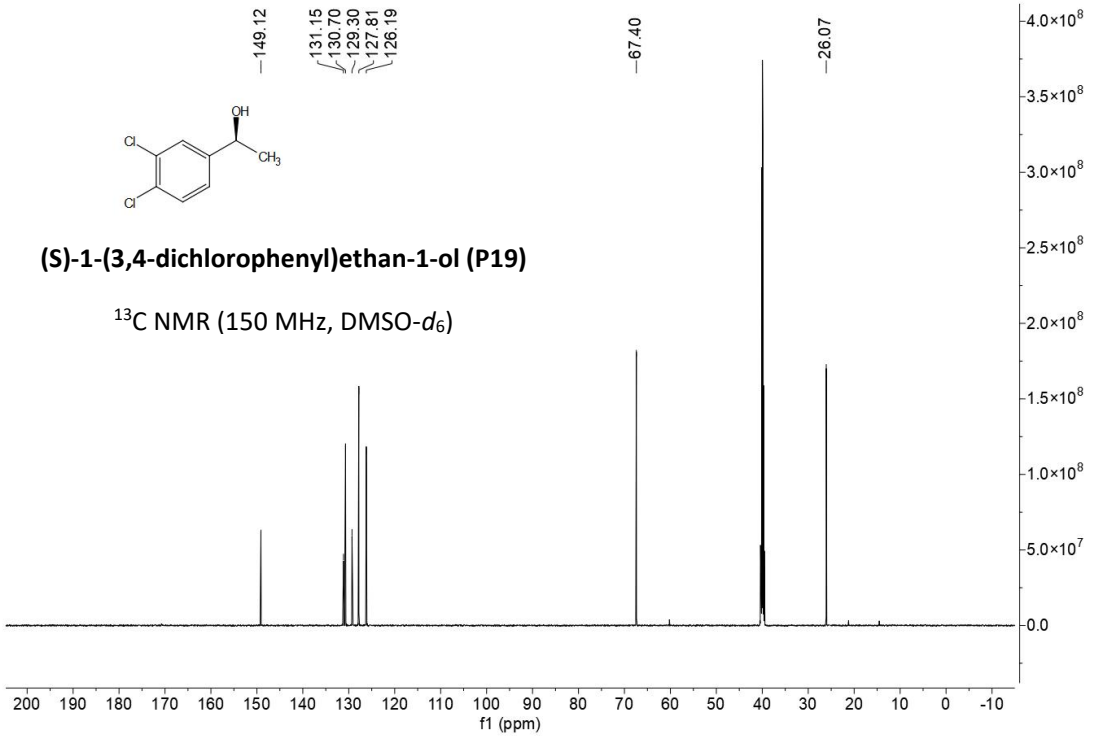
(S)-1-(2,4-dichlorophenyl)ethan-1-ol (P18)

^{13}C NMR (150 MHz, DMSO-d_6)



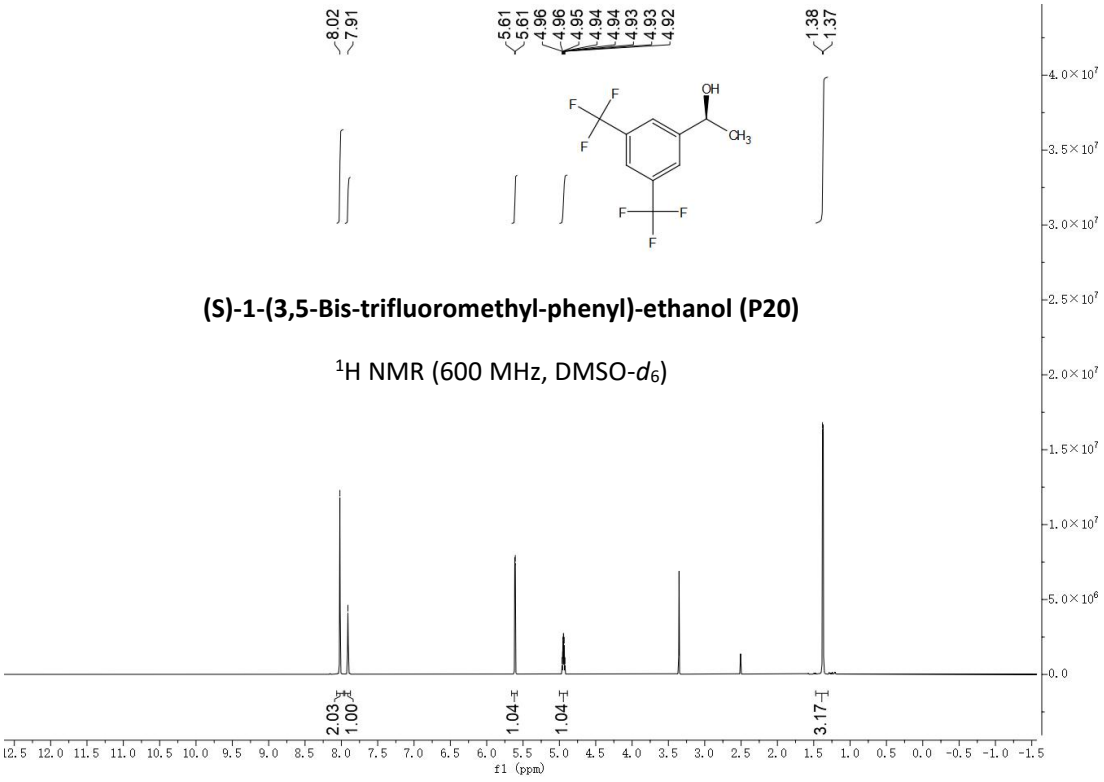
(S)-1-(3,4-dichlorophenyl)ethan-1-ol (P19)

^{1}H NMR (600 MHz, DMSO-d_6)



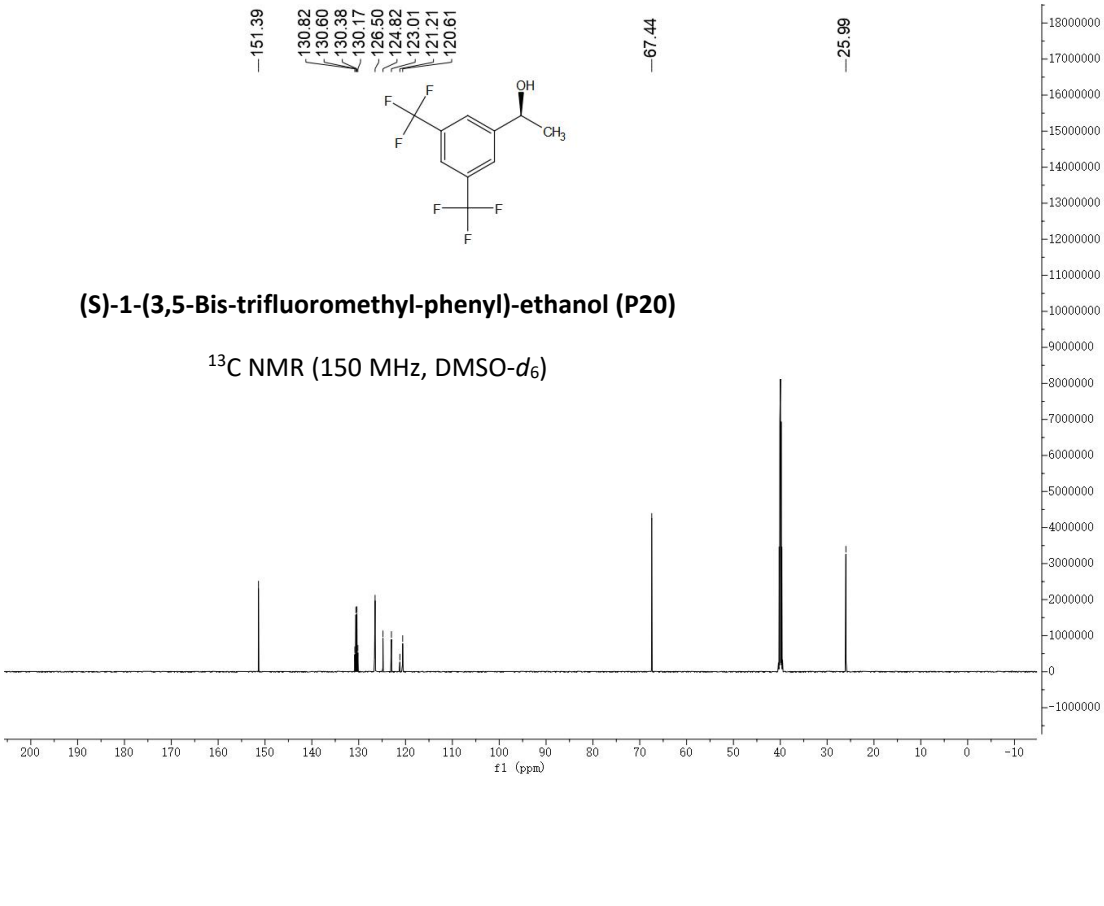
(S)-1-(3,4-dichlorophenyl)ethan-1-ol (P19)

^{13}C NMR (150 MHz, DMSO-d_6)



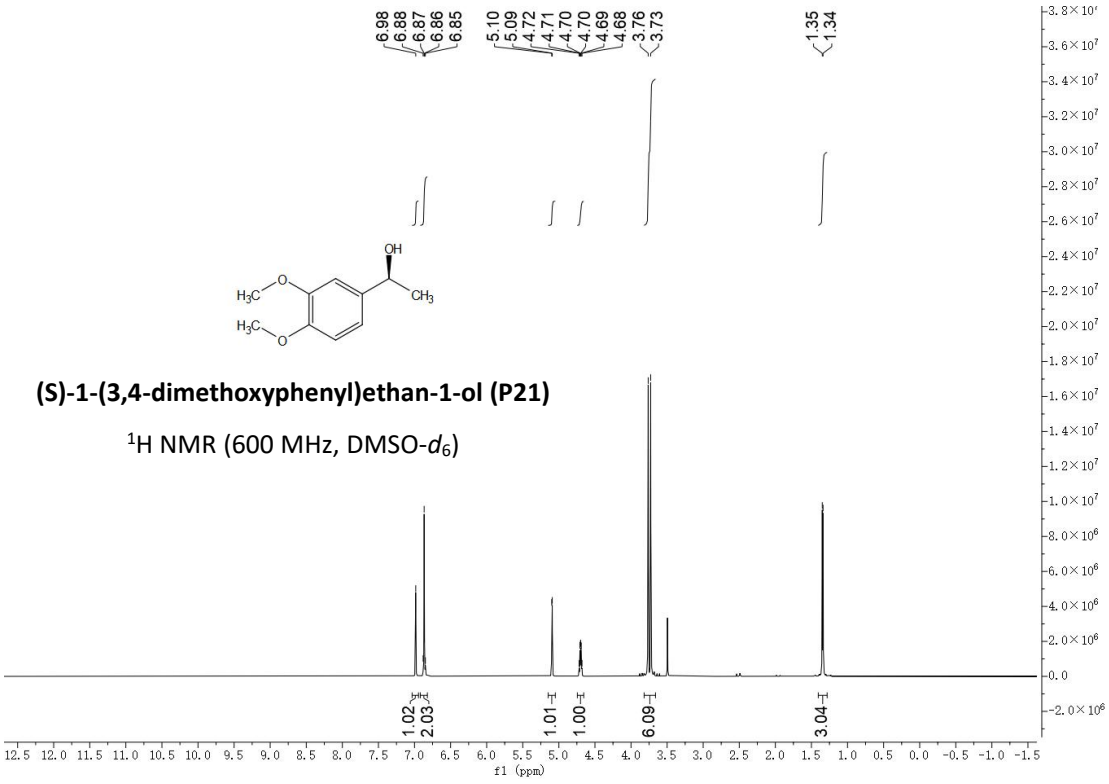
(S)-1-(3,5-Bis-trifluoromethyl-phenyl)-ethanol (P20)

^{1}H NMR (600 MHz, DMSO-d_6)



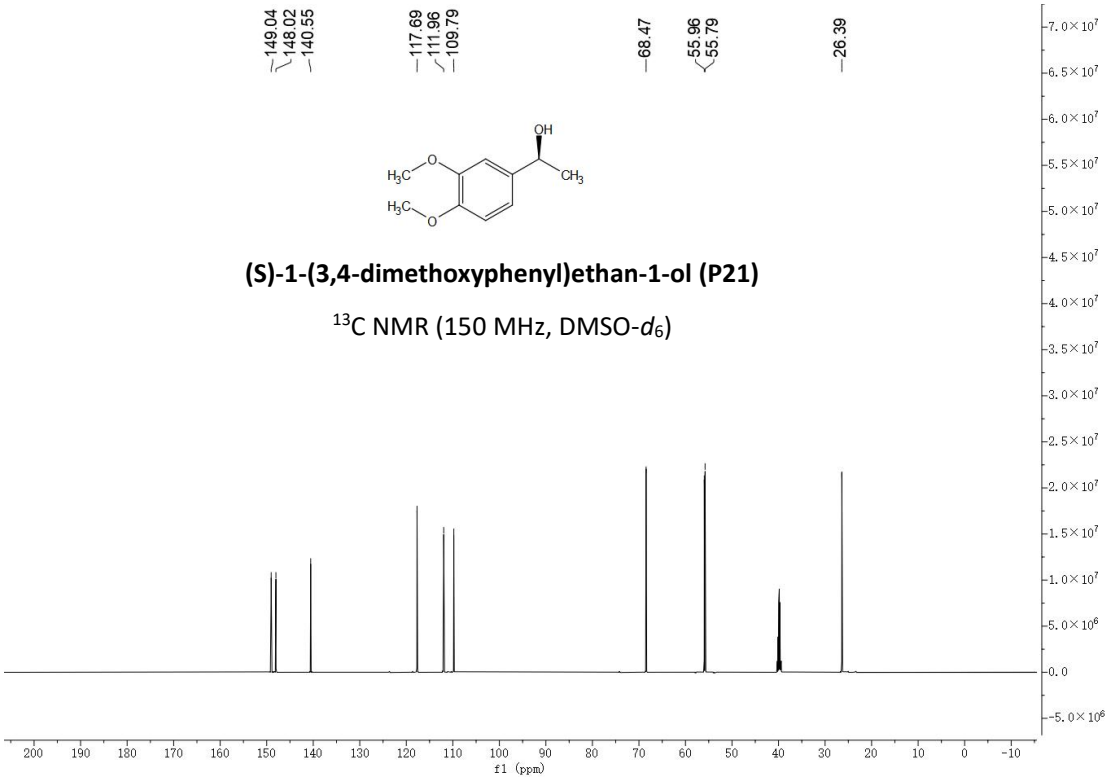
(S)-1-(3,5-Bis-trifluoromethyl-phenyl)-ethanol (P20)

^{13}C NMR (150 MHz, DMSO-d_6)



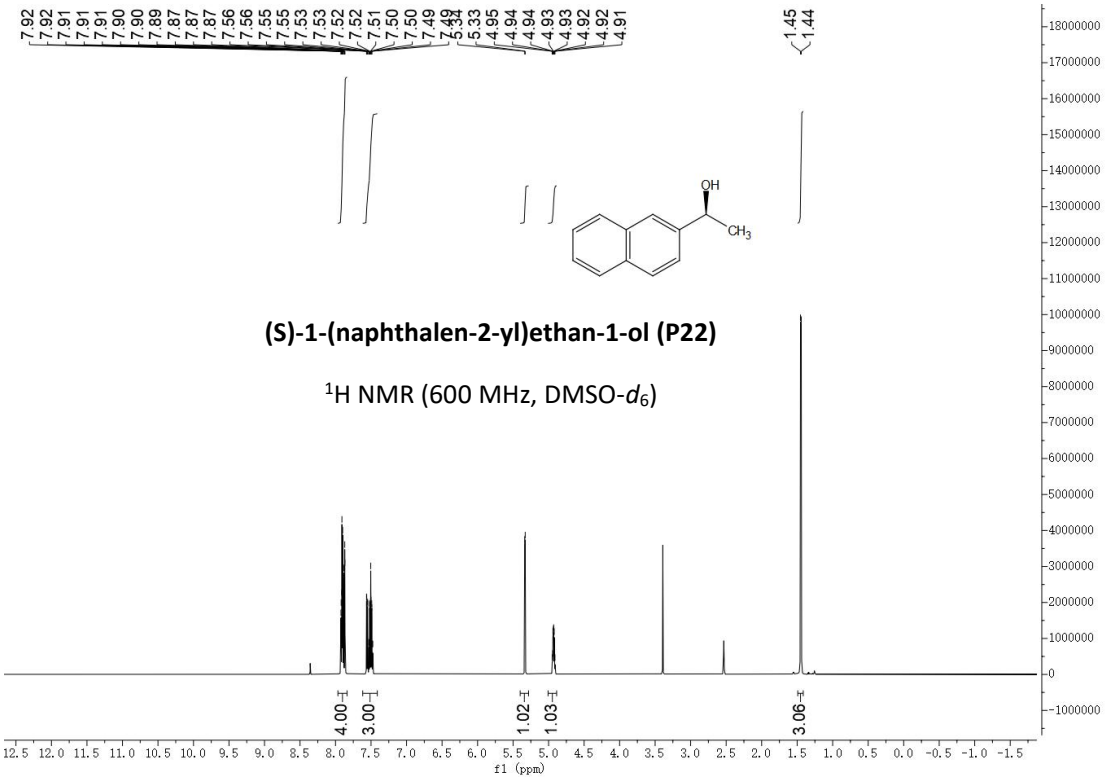
(S)-1-(3,4-dimethoxyphenyl)ethan-1-ol (P21)

^{1}H NMR (600 MHz, DMSO-d_6)



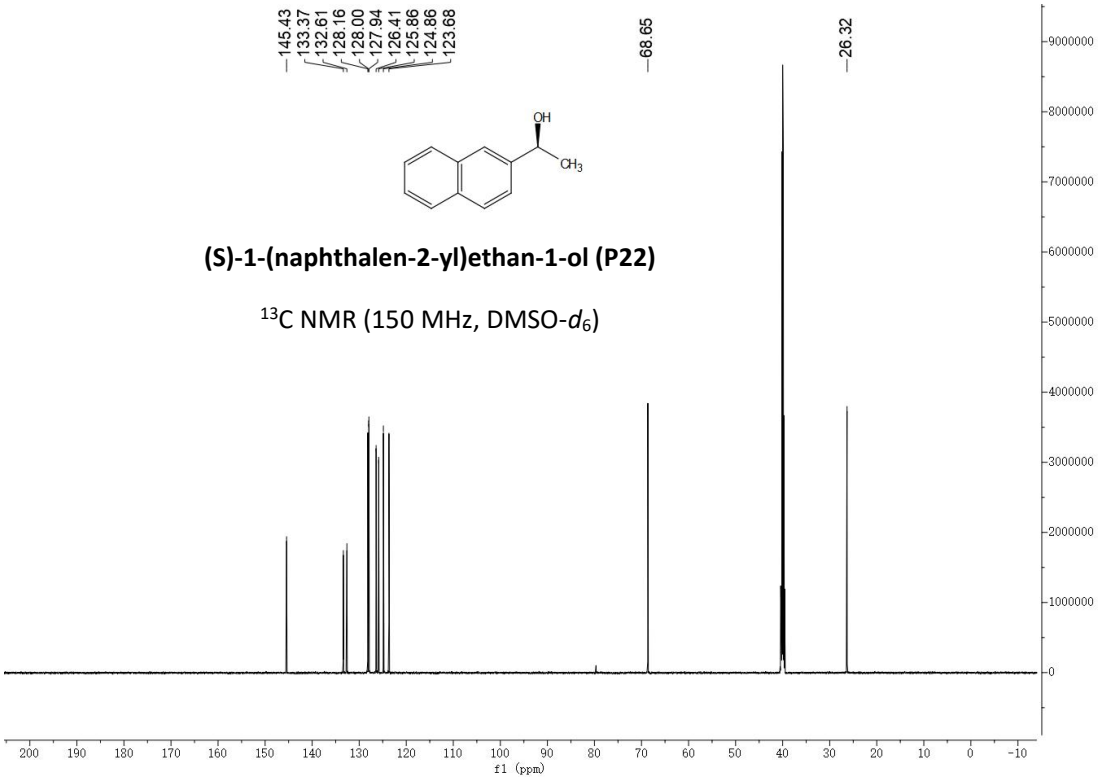
(S)-1-(3,4-dimethoxyphenyl)ethan-1-ol (P21)

^{13}C NMR (150 MHz, DMSO-d_6)



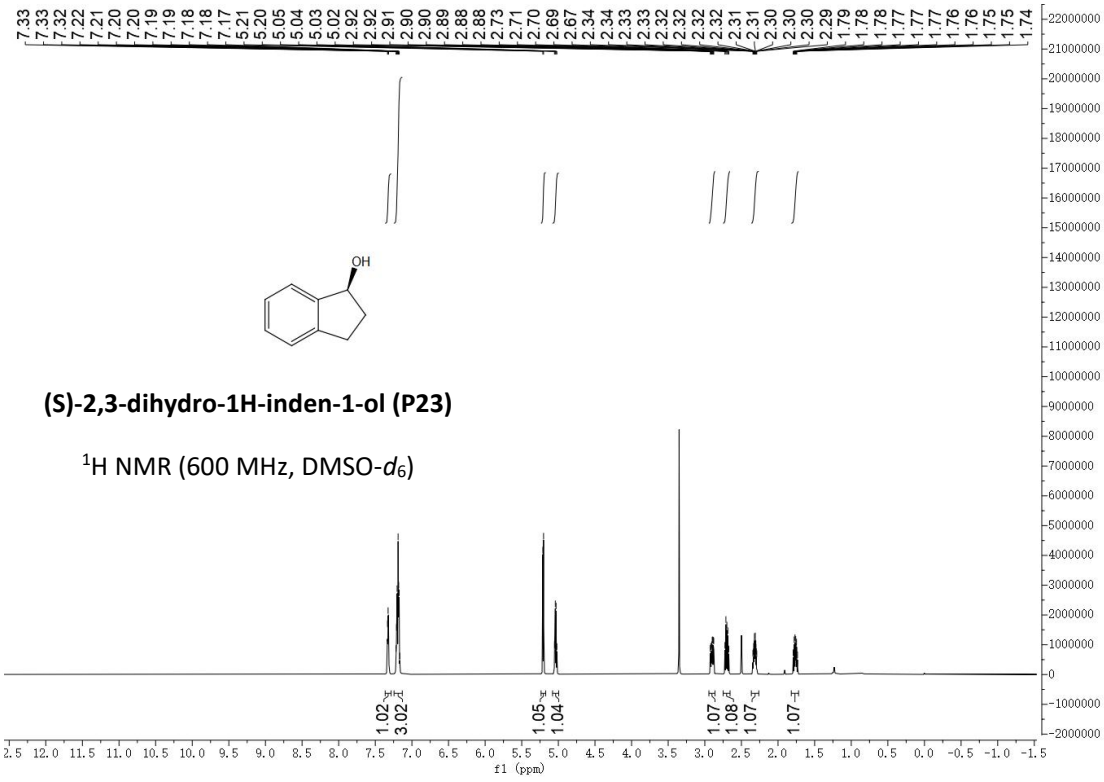
(S)-1-(naphthalen-2-yl)ethan-1-ol (P22)

^{1}H NMR (600 MHz, DMSO-d_6)



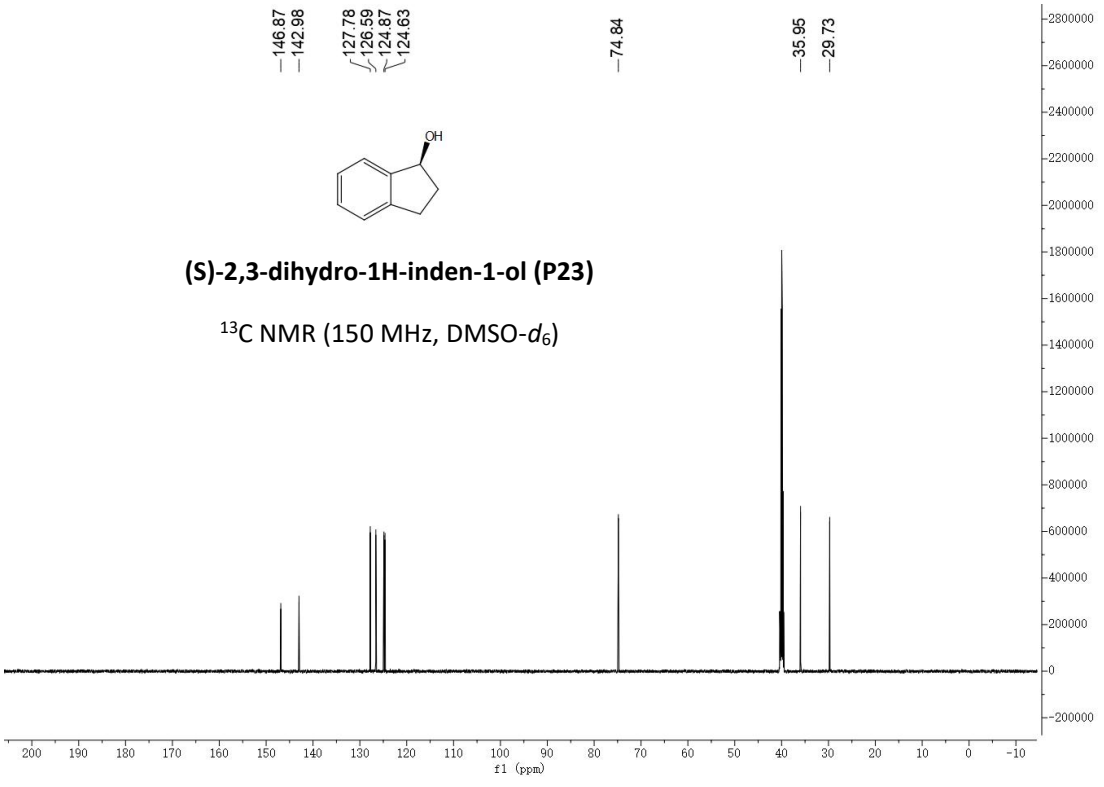
(S)-1-(naphthalen-2-yl)ethan-1-ol (P22)

^{13}C NMR (150 MHz, DMSO-d_6)



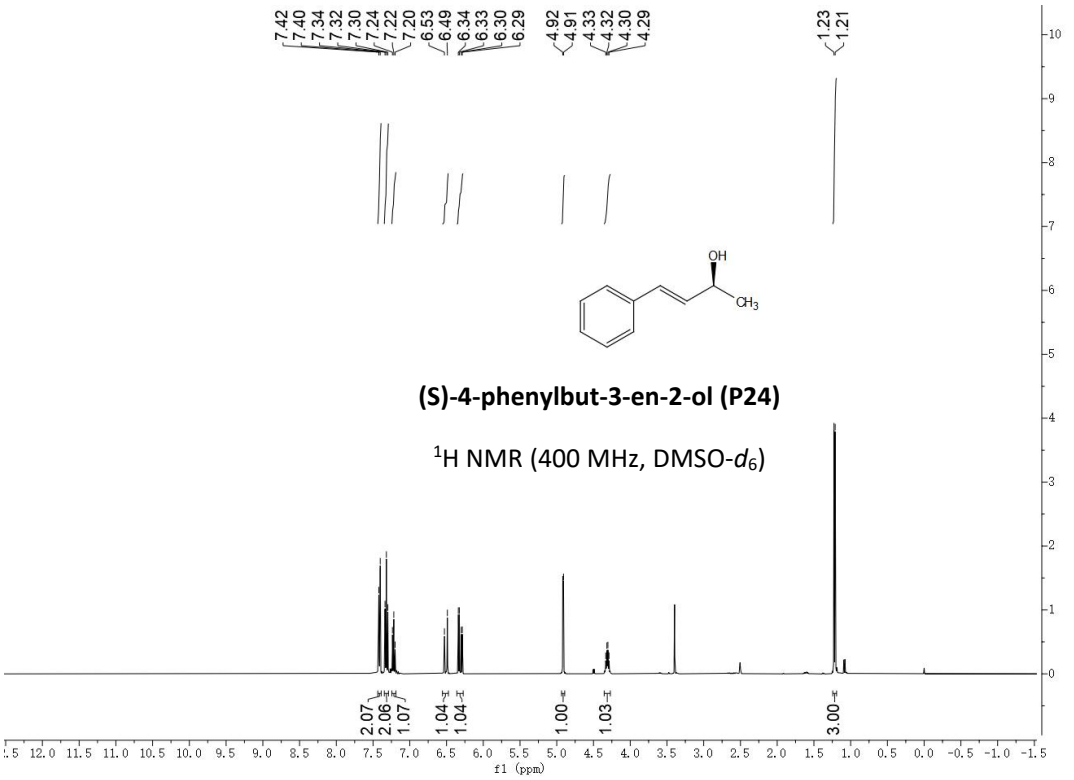
(S)-2,3-dihydro-1H-inden-1-ol (P23)

^{1}H NMR (600 MHz, DMSO-d_6)



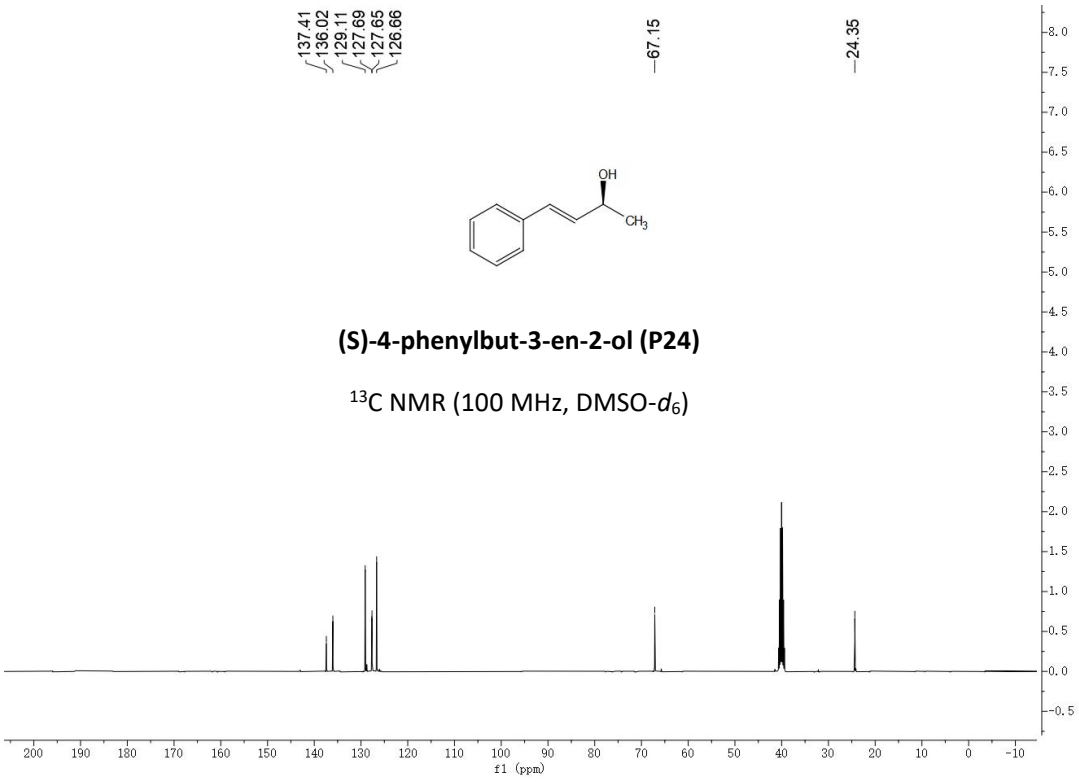
(S)-2,3-dihydro-1H-inden-1-ol (P23)

^{13}C NMR (150 MHz, DMSO-d_6)



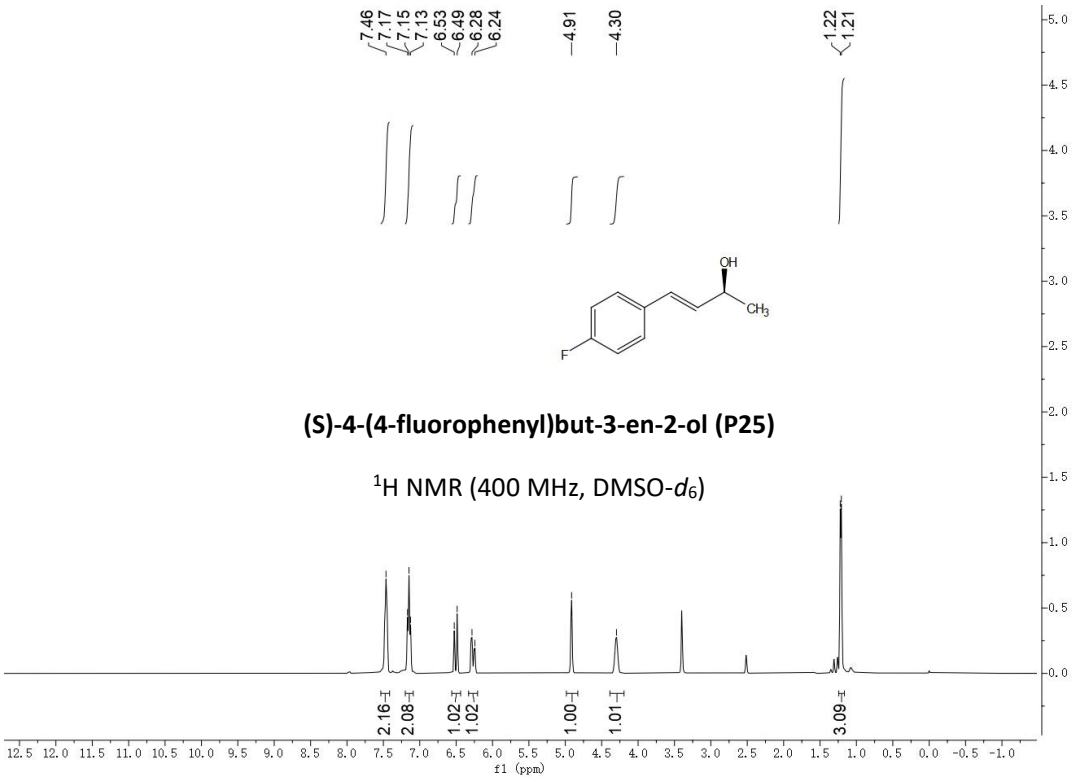
(S)-4-phenylbut-3-en-2-ol (P24)

^{1}H NMR (400 MHz, DMSO-d_6)



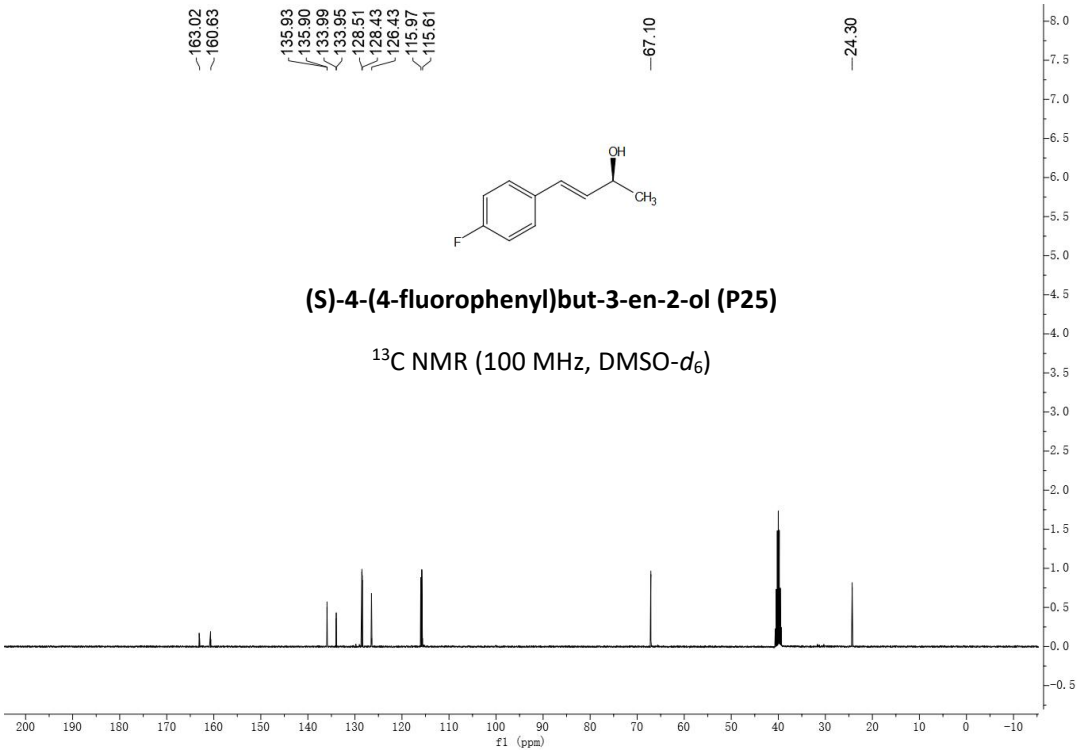
(S)-4-phenylbut-3-en-2-ol (P24)

^{13}C NMR (100 MHz, DMSO-d_6)



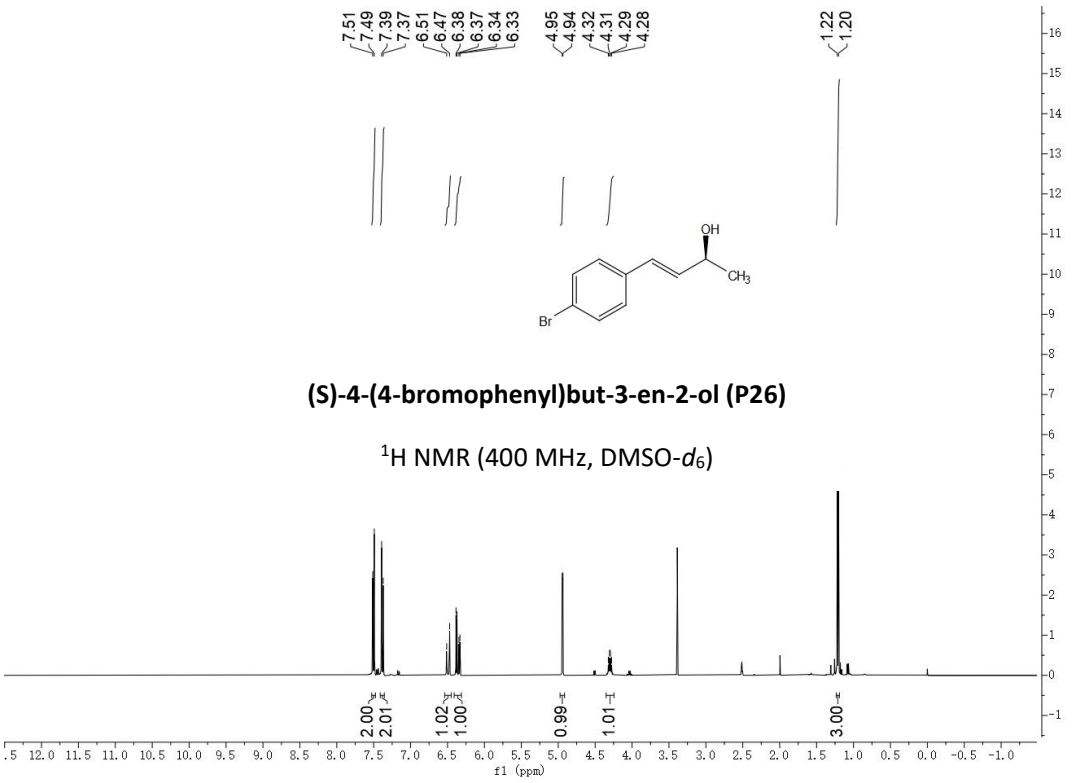
(S)-4-(4-fluorophenyl)but-3-en-2-ol (P25)

^{1}H NMR (400 MHz, DMSO-d_6)



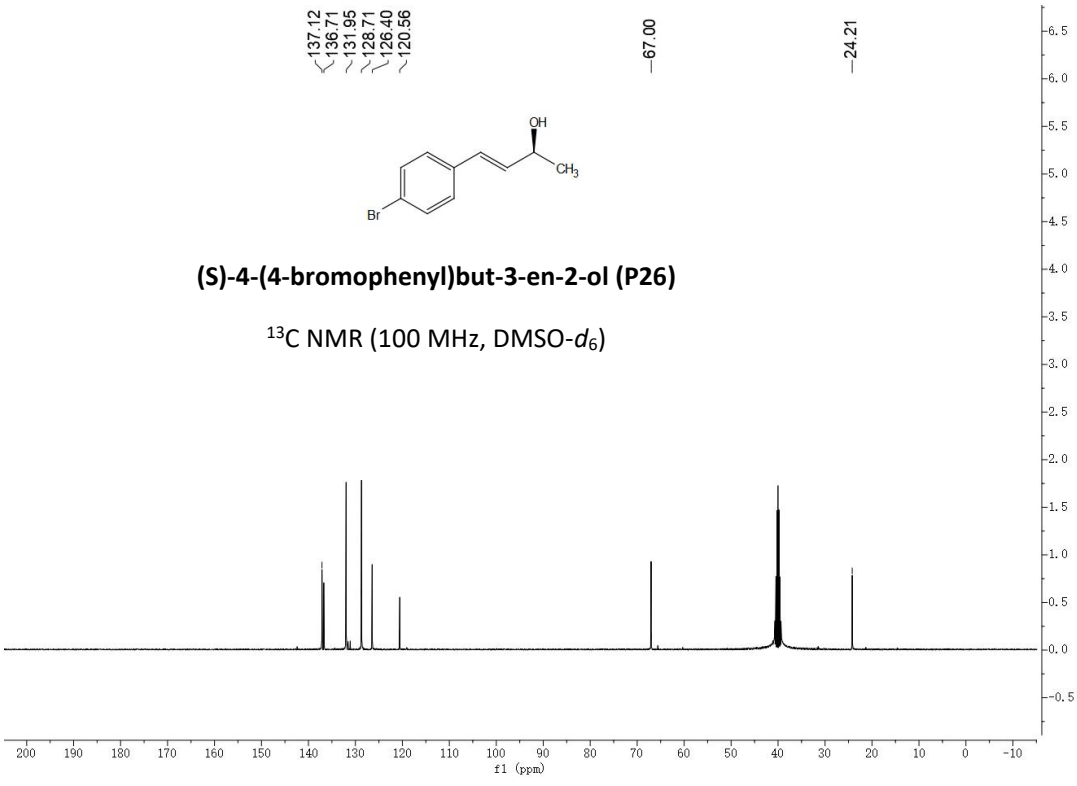
(S)-4-(4-fluorophenyl)but-3-en-2-ol (P25)

^{13}C NMR (100 MHz, DMSO-d_6)



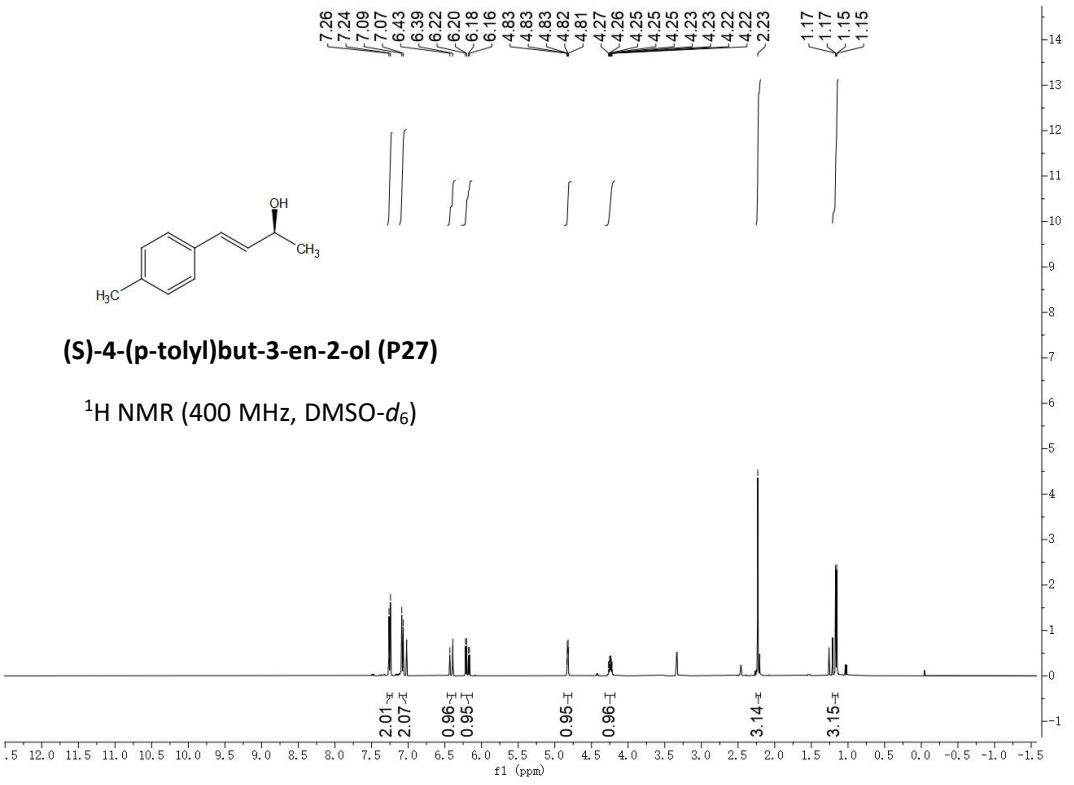
(S)-4-(4-bromophenyl)but-3-en-2-ol (P26)

^{1}H NMR (400 MHz, DMSO-d_6)



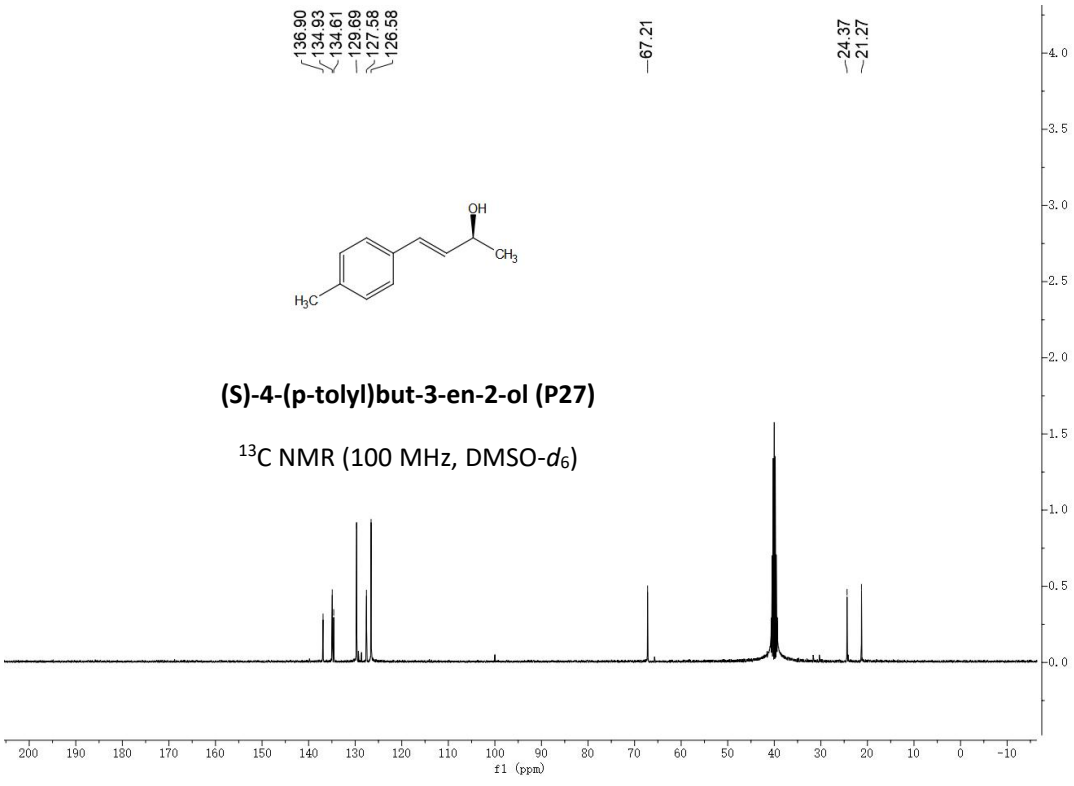
(S)-4-(4-bromophenyl)but-3-en-2-ol (P26)

^{13}C NMR (100 MHz, DMSO-d_6)



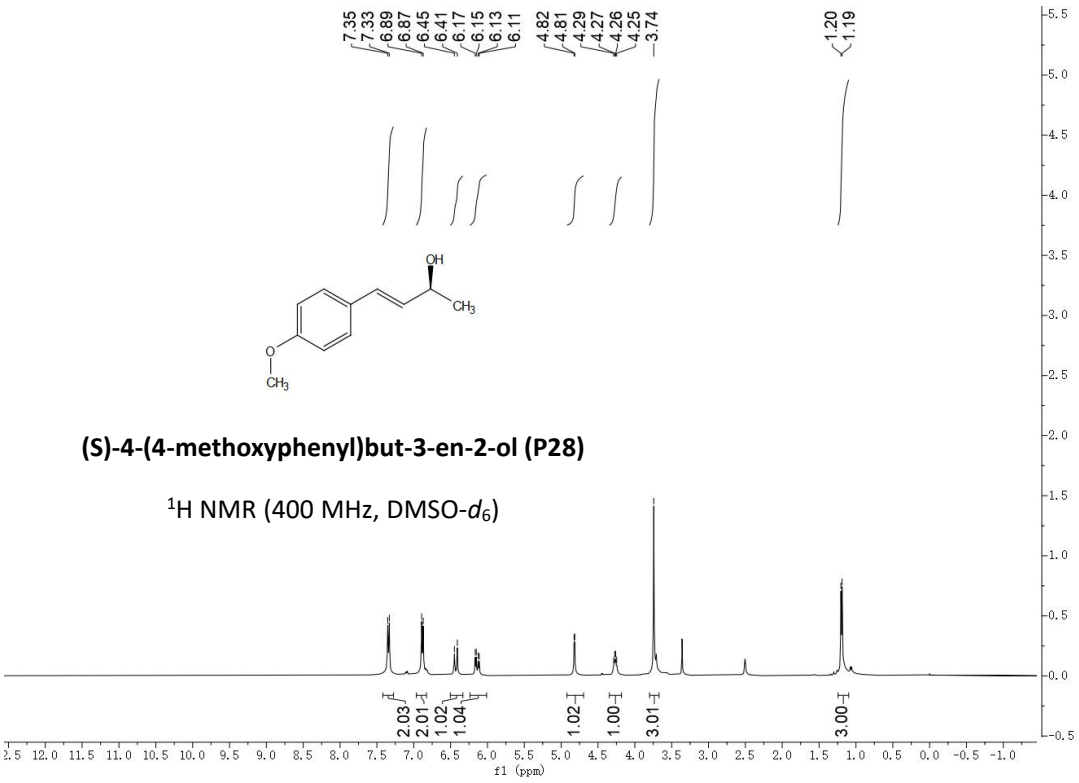
(S)-4-(p-tolyl)but-3-en-2-ol (P27)

^{1}H NMR (400 MHz, DMSO-d_6)



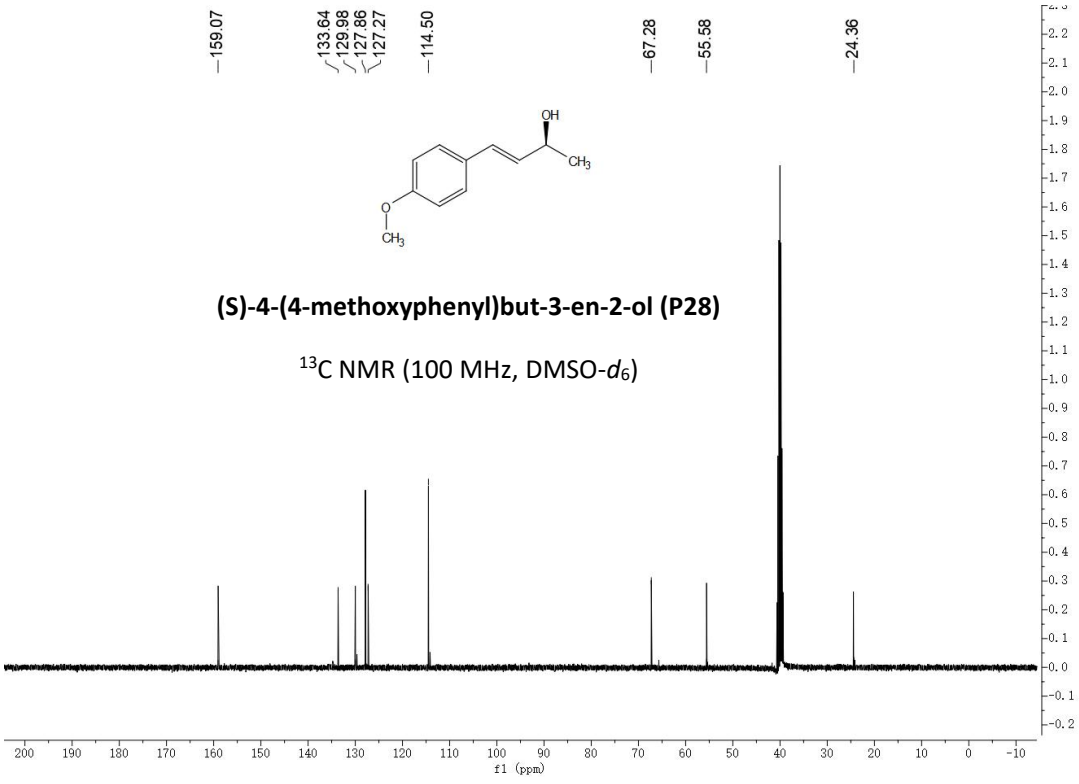
(S)-4-(p-tolyl)but-3-en-2-ol (P27)

^{13}C NMR (100 MHz, DMSO-d_6)



(S)-4-(4-methoxyphenyl)but-3-en-2-ol (P28)

^{1}H NMR (400 MHz, DMSO-d_6)

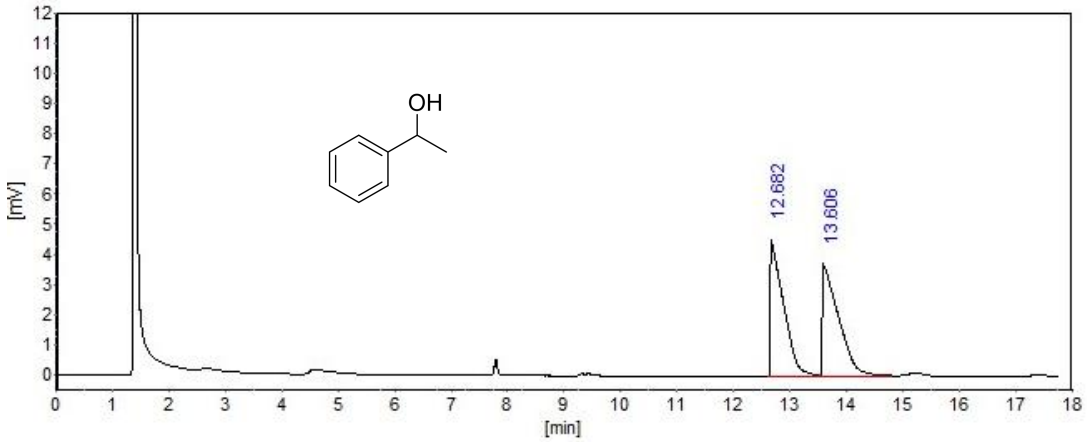


(S)-4-(4-methoxyphenyl)but-3-en-2-ol (P28)

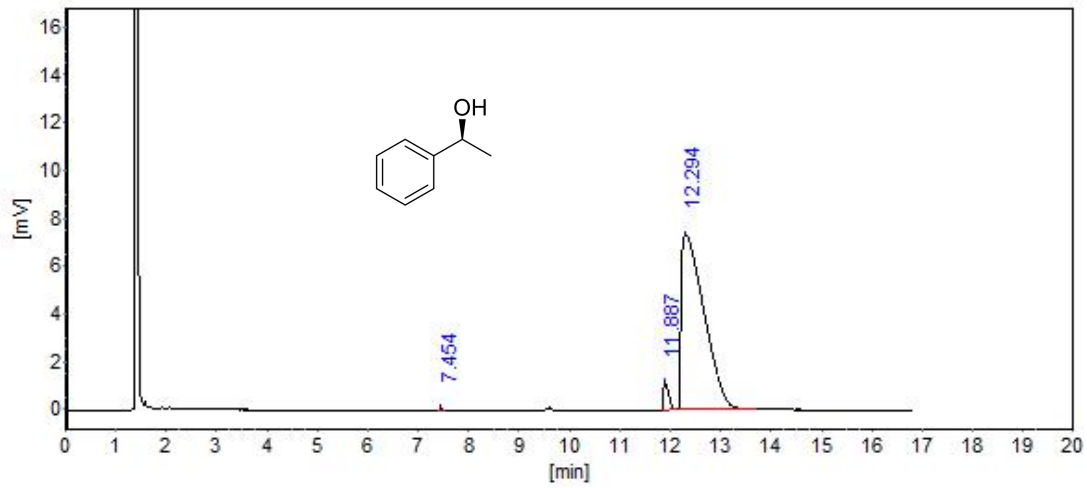
^{13}C NMR (100 MHz, DMSO-d_6)

5. HPLC and GC chromatograms of alcohol products

(±)-1-Phenylethanol: The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; injector temprature: 250 °C; detector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.08 MPa.

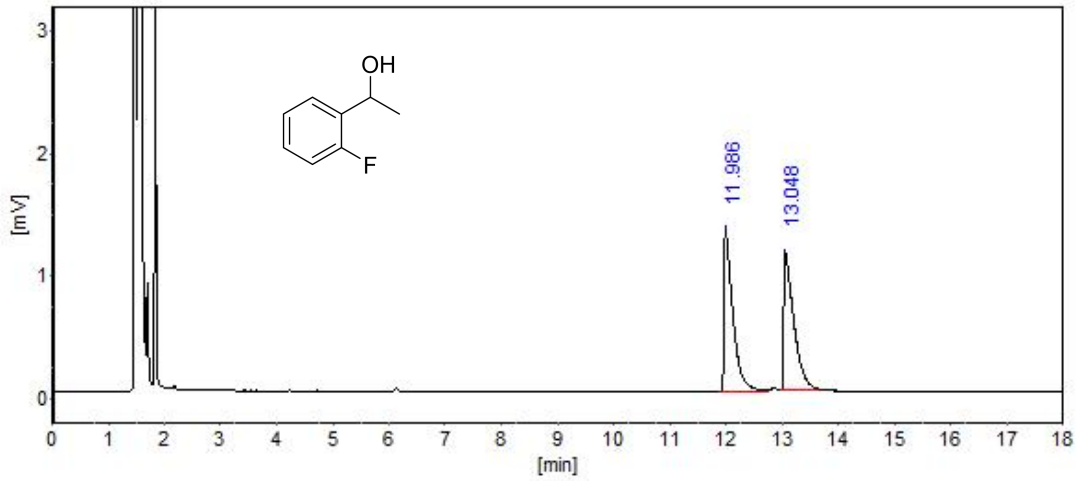


(*S*)-1-Phenylethanol(P1): Colorless oil; 89.2% yield, 93.1 % ee, S isomer; $[a]_D^{25}$ = - 40.5 (c = 1.00 in $CHCl_3$). The enantiomeric excess was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250°C; injector temperature: 250 °C; column temperature: 115°C; inlet pressure = 0.08 MPa.

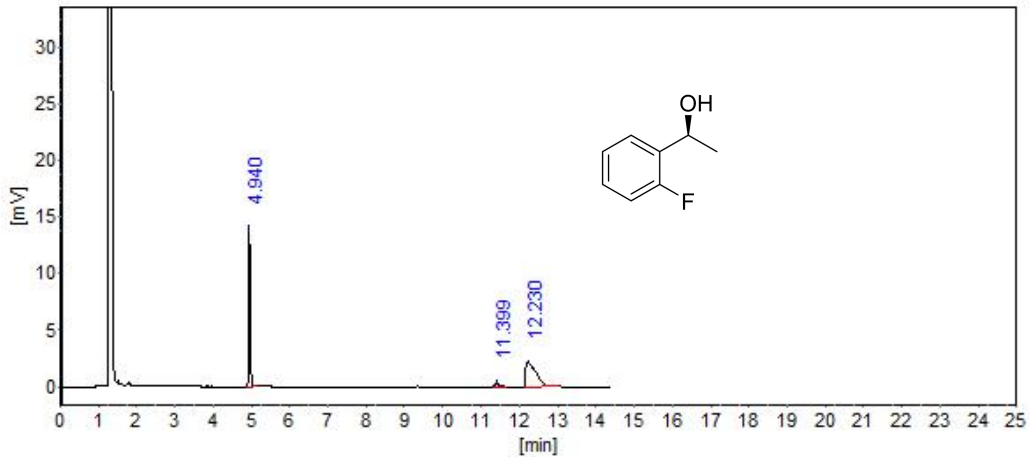


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	11.887	8190	3.462
2	12.294	228338	96.538

(±)-1-(2-Fluoro-phenyl)-ethanol(P2): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.08 MPa.

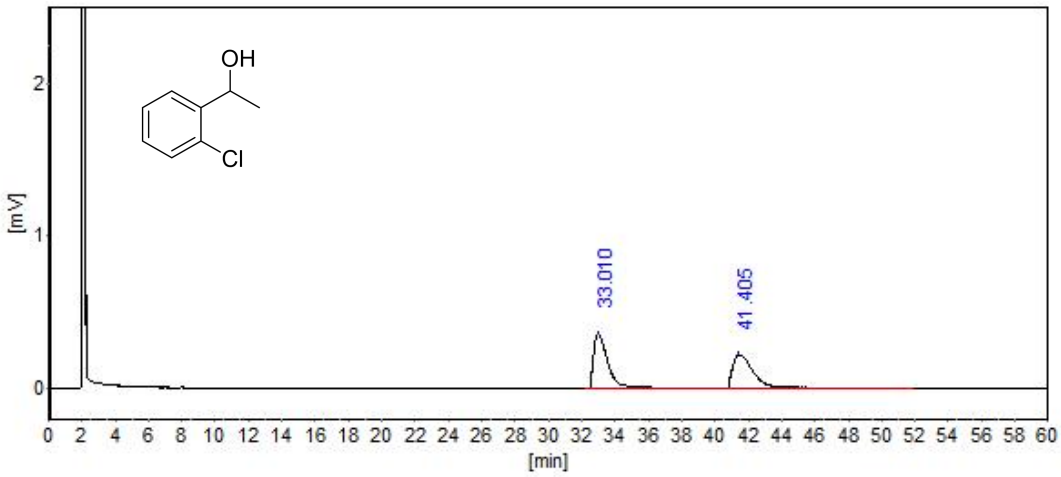


(*S*)-1-(2-Fluoro-phenyl)-ethanol(P2): Colorless oil; 47.6 % yield, 88.0 % ee, S isomer; $[a]_D^{25}$ = -35.3 (c = 1.00 in $CHCl_3$). The enantiomeric excess was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.08 MPa.

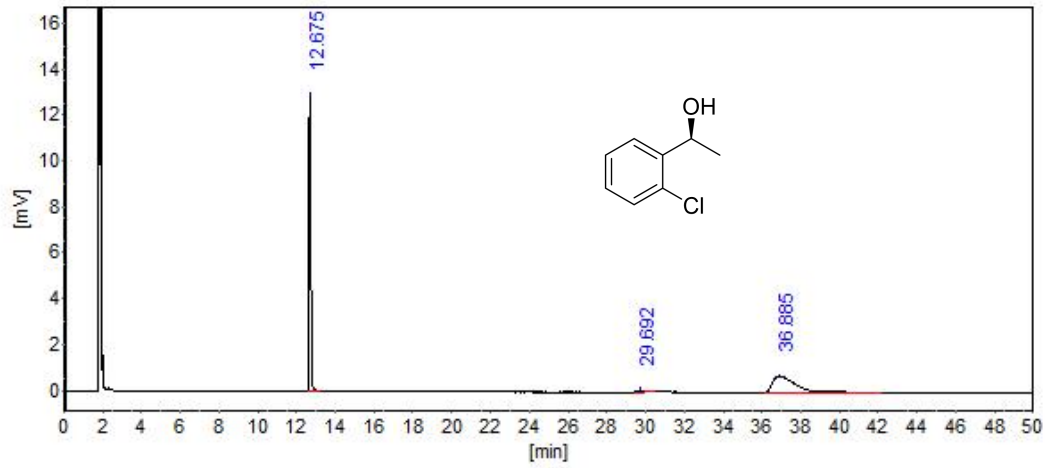


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	11.399	2499	5.979
2	12.230	39299	94.021

(±)-1-(2-Chlorophenyl)-ethan-1-ol(P3): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 125 °C; inlet pressure = 0.06 MPa.

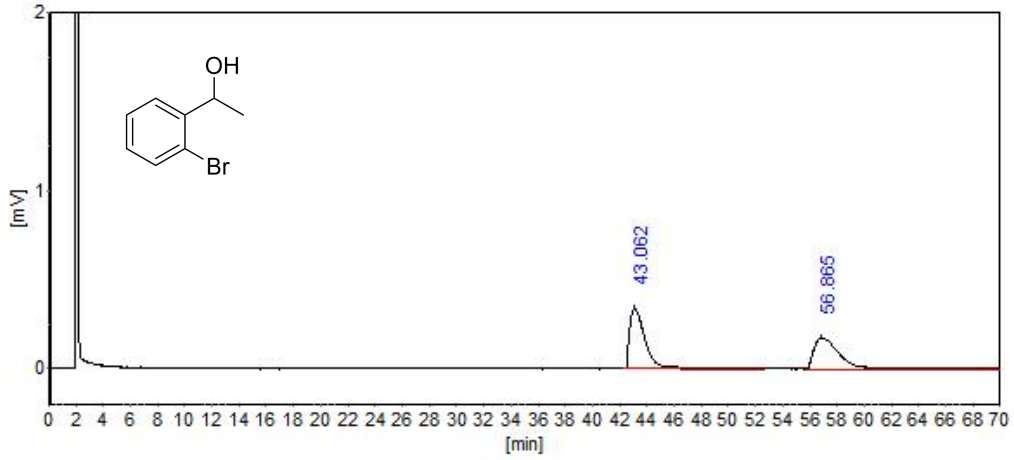


(*S*)-1-(2-Chlorophenyl)-ethan-1-ol(P3): Colorless oil; 40.2 % yield, 93.9 % ee, S isomer; $[a]_D^{25}$ = -40.9 (c = 1.00 in $CHCl_3$). The enantiomeric excess was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250°C; injector temperature: 250 °C; column temperature: 125°C; inlet pressure = 0.06 MPa.

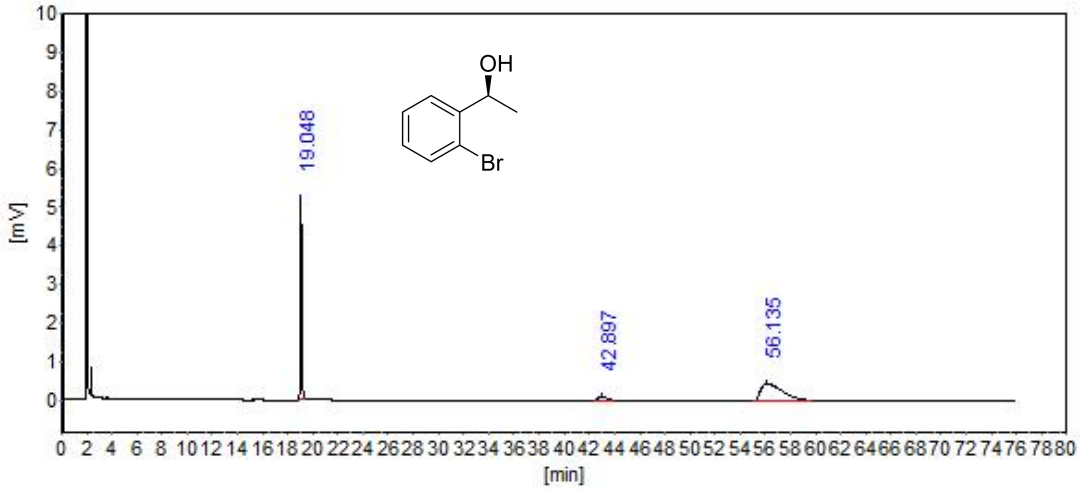


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	29.692	1720	3.038
2	36.885	54902	96.962

(±)-1-(2-Bromophenyl)-ethan-1-ol(P4): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 130 °C; inlet pressure = 0.06 MPa.

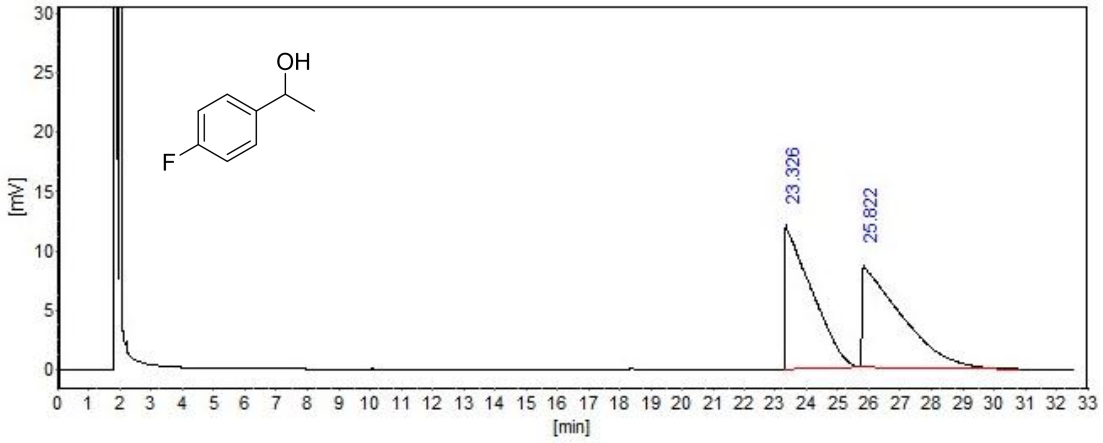


(*S*)-1-(2-Bromophenyl)-ethan-1-ol(P4): Colorless oil; 54.5 % yield, 84.2 % ee, S isomer; $[a]_D^{25}$ = -31.9 (c = 1.00 in $CHCl_3$). The enantiomeric excess was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 130°C; inlet pressure = 0.06 MPa.

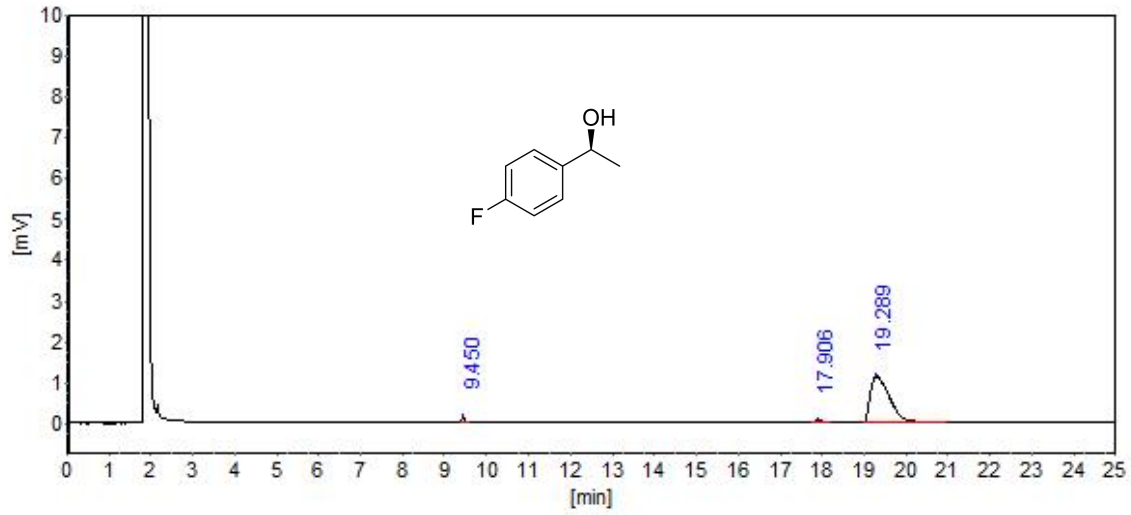


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	42.897	4522	7.906
2	56.135	52673	92.094

(±)-1-(4-Fluoro-phenyl)-ethanol(P5): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.06 MPa.

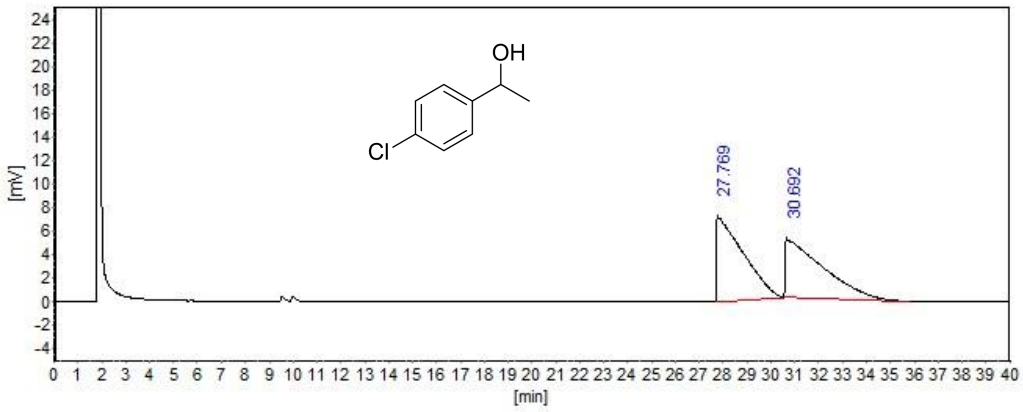


(*S*)-1-(4-Fluoro-phenyl)-ethanol(P5): Colorless oil; 82.7 % yield, 96.1 % ee, S isomer; $[a]_D^{25}$ = -29.0 (c = 1.00 in $CHCl_3$). The enantiomeric excess was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.06 MPa.

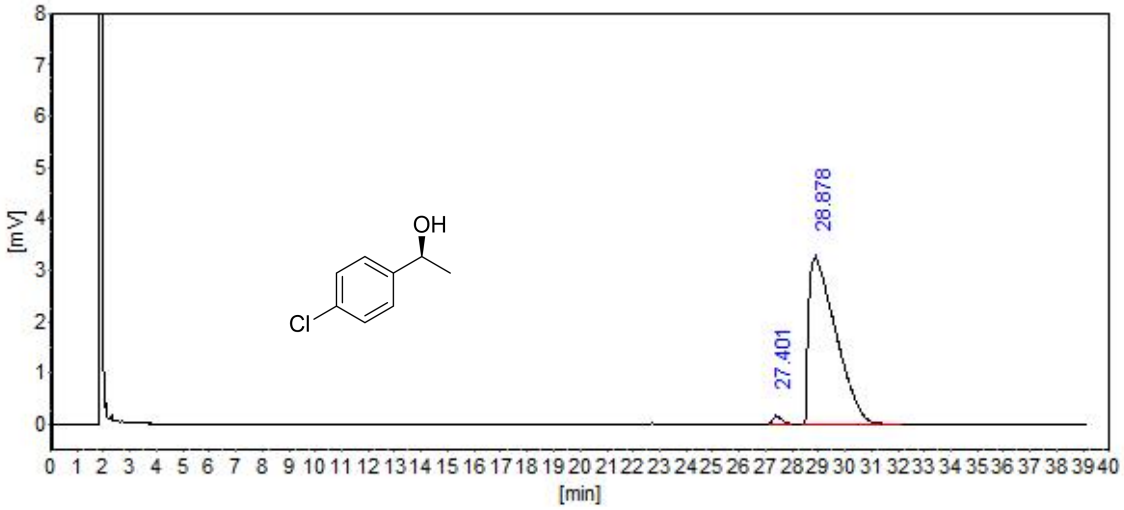


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	17.906	732	1.957
2	19.289	36682	98.043

(±)-1-(4-chloro-phenyl)-ethan-1-ol(P6): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 μm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 130 °C; inlet pressure = 0.06 MPa.

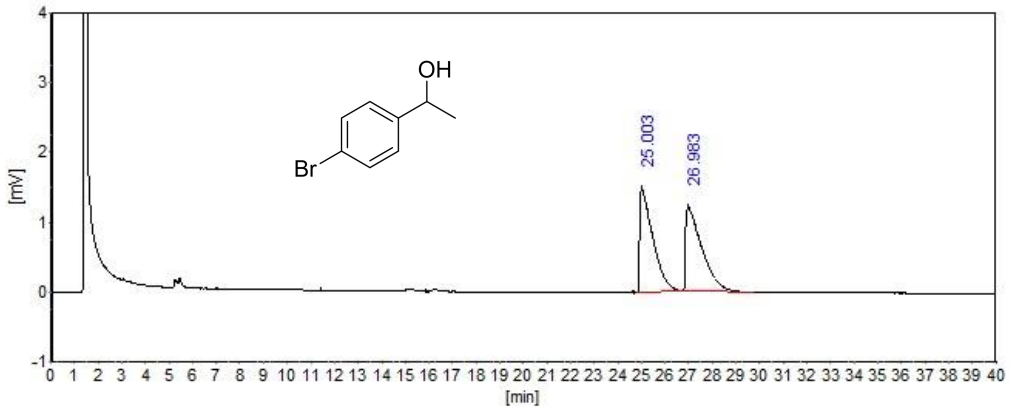


(*S*)-1-(4-chloro-phenyl)-ethan-1-ol(P6): Colorless oil; 96.6% yield, 96.8% ee, S isomer;$[a]_D^{25}$ = -46.3 (c = 1.00 in $CHCl_3$) . The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 μm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 130 °C; inlet pressure = 0.06MPa

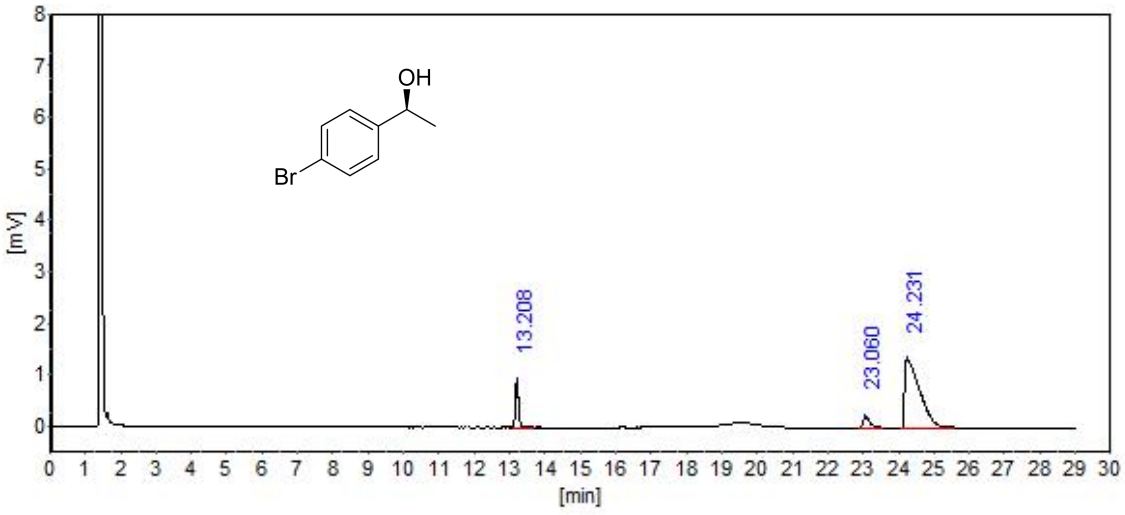


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	27.401	3924	1.641
2	28.878	232302	98.359

(±)-1-(4-bromo-phenyl)-ethan-1-ol(P7): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 140 °C; inlet pressure = 0.08 MPa.

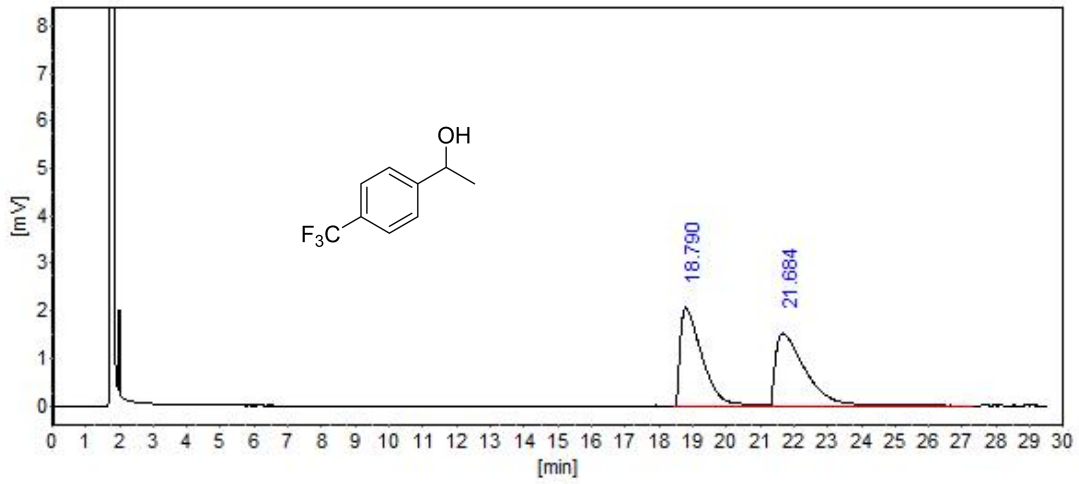


(S)-1-(4-bromo-phenyl)-ethan-1-ol(P7): Colorless oil; 87.1% yield, 87.6% ee, S isomer;$[a]_D^{25}$ = -32.1 (c = 1.00 in $CHCl_3$); The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 140 °C; inlet pressure = 0.08 MPa.

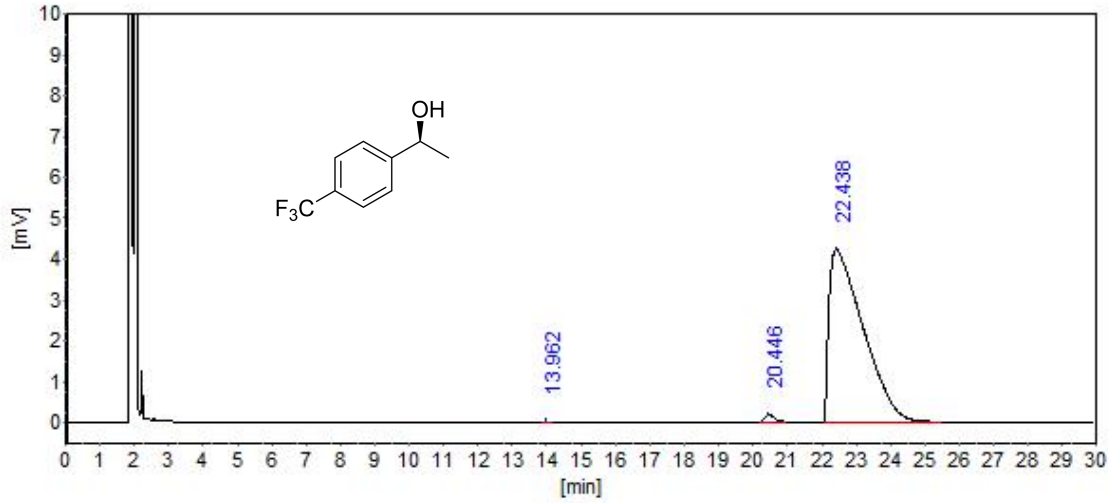


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	23.060	2597	6.208
2	24.231	39236	93.792

(±)-1-(4-(trifluoromethyl)phenyl)ethan-1-ol (P8): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 μm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 ℃; inlet pressure = 0.06 MPa.

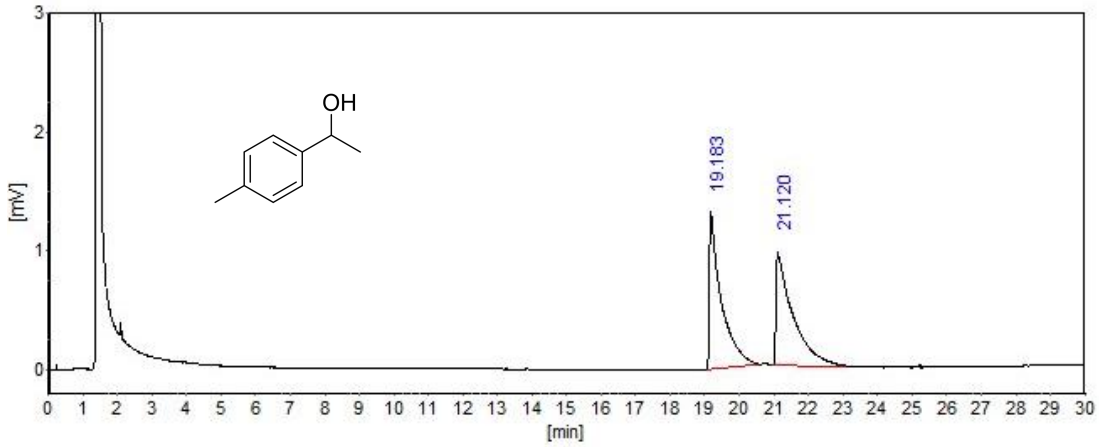


(S)-1-(4-(trifluoromethyl)phenyl)ethan-1-ol (P8): Colorless oil; 97.5% yield, 97.4% ee, S isomer; $[a]_D^{25}$ = - 27.0 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 μm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.06 MPa.

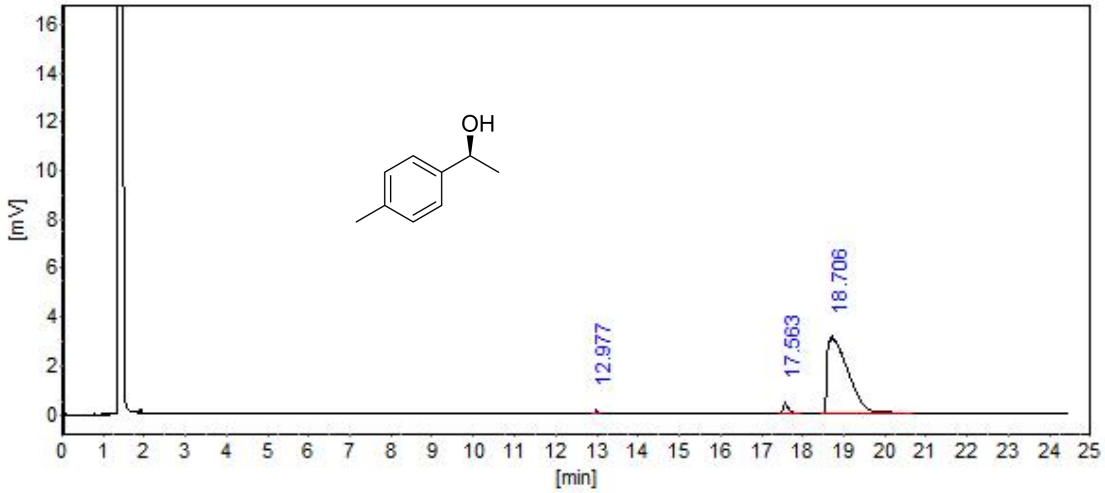


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	20.446	3854	1.298
2	22.438	293026	98.702

(±)-1-p-Tolyl-ethanol(P9): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.08 MPa.

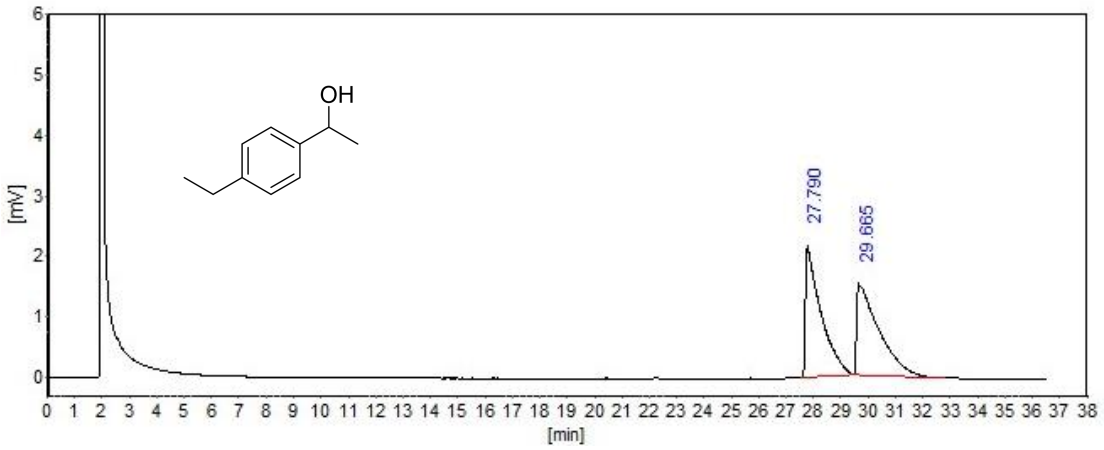


(S) -1-p-Tolyl-ethanol(P9): Colorless oil; 90.3 % yield, 92.8% ee, S isomer; $[a]_D^{25}$ = - 46.7 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.08 MPa.

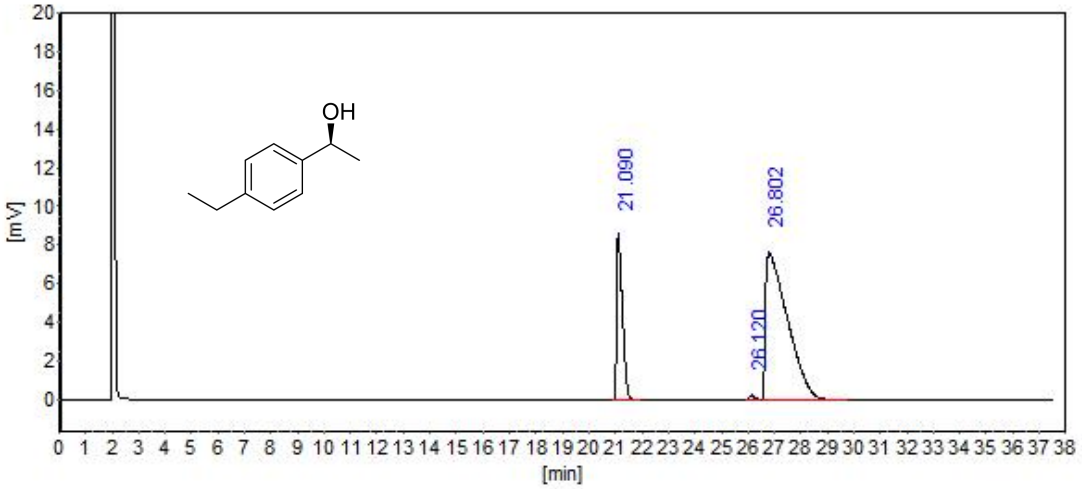


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	17.563	4164	3.583
2	18.706	112058	96.417

(±)-1-(4-ethylphenyl)ethan-1-ol(10): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 125 °C; inlet pressure = 0.06 MPa.

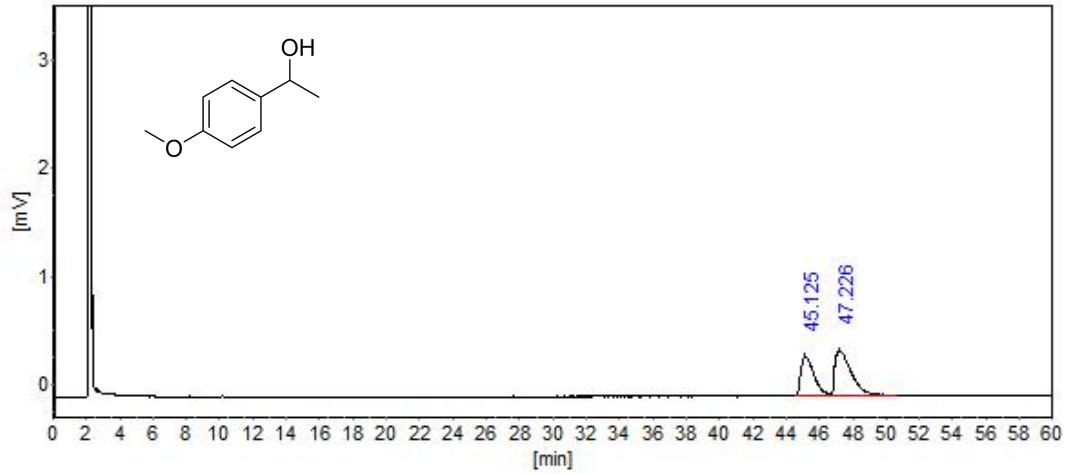


(*S*)-1-(4-ethylphenyl)ethan-1-ol(P10): Colorless oil; 73.1 % yield, 98.8 % ee, S isomer; $[a]_D^{25}$ = -40.8 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 125 °C; inlet pressure = 0.06 MPa.

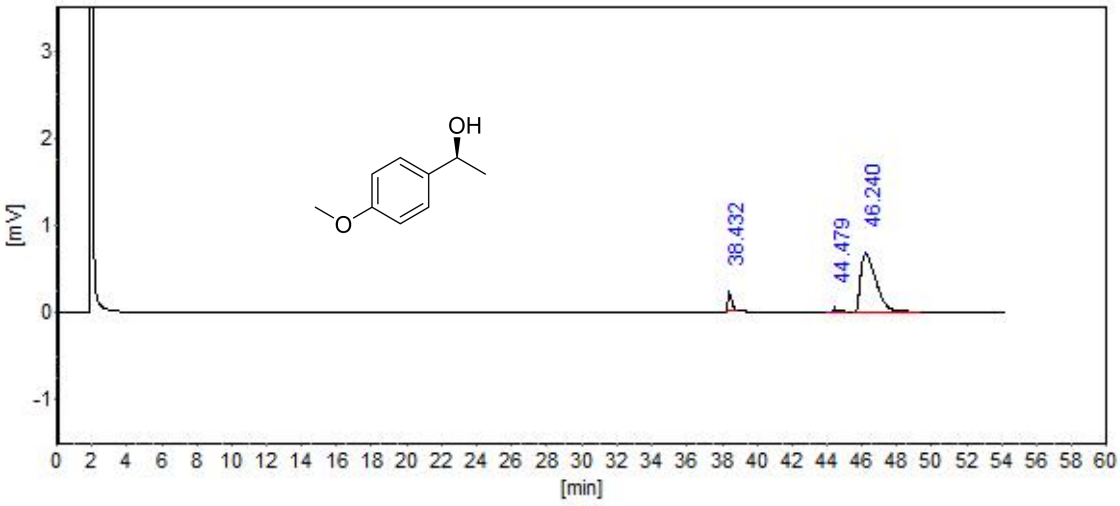


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	26.120	2661	0.605
2	26.802	437151	99.395

(±)-1-(4-Methoxy-phenyl)-ethanol(P11): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 125 °C; inlet pressure = 0.06 MPa.

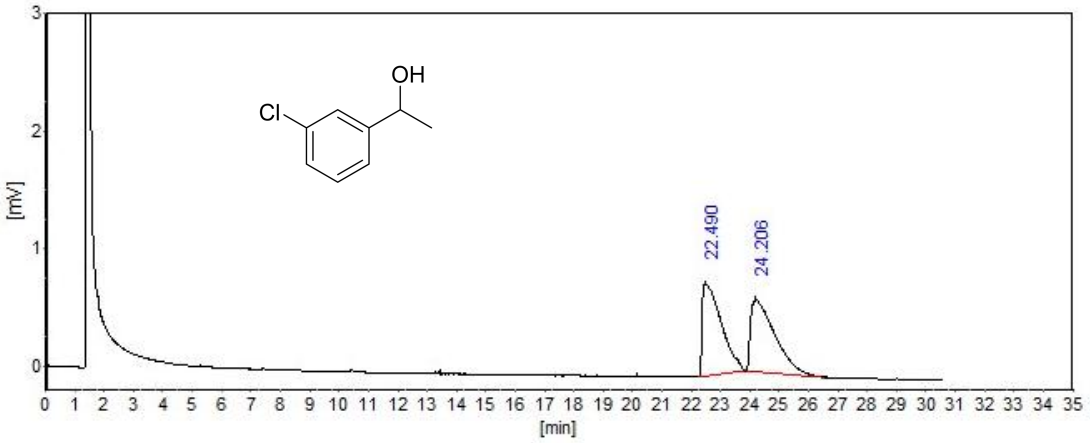


(*S*)-1-(4-Methoxy-phenyl)-ethanol(P11): Colorless oil; 86.7 % yield, 95.3% ee, S isomer; $[a]_D^{25}$ = -35.8(c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 125 °C; inlet pressure = 0.06 MPa.

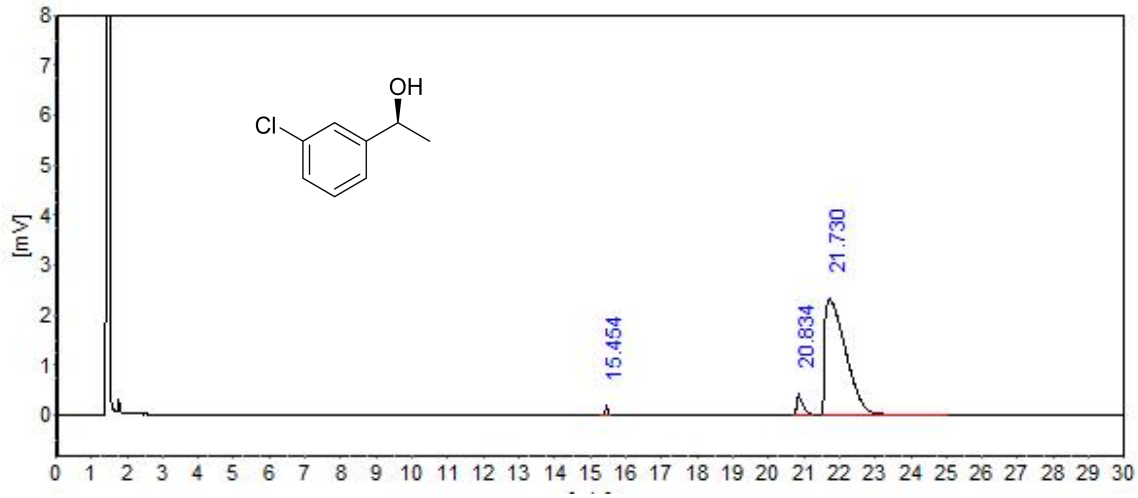


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	44.479	996	2.356
2	46.240	41259	97.644

(±)-1-(3-chlorophenyl)ethan-1-ol (P12): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 130 °C; inlet pressure = 0.08 MPa.

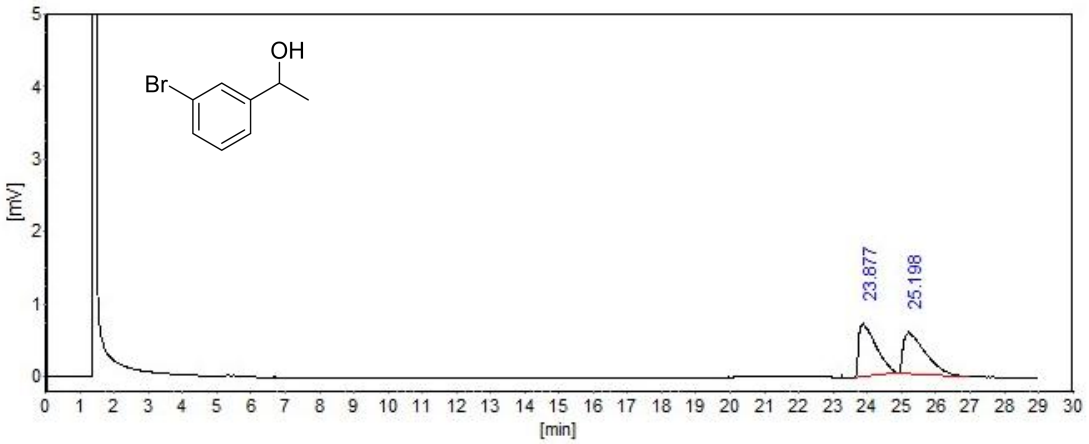


(S)-1-(3-chlorophenyl)ethan-1-ol (P12): Colorless oil; 96.7% yield, 89.8% ee, S isomer; $[a]_D^{25}$ = -31.0 (c = 1.00 in $CHCl_3$);The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 130 °C; inlet pressure = 0.08 MPa

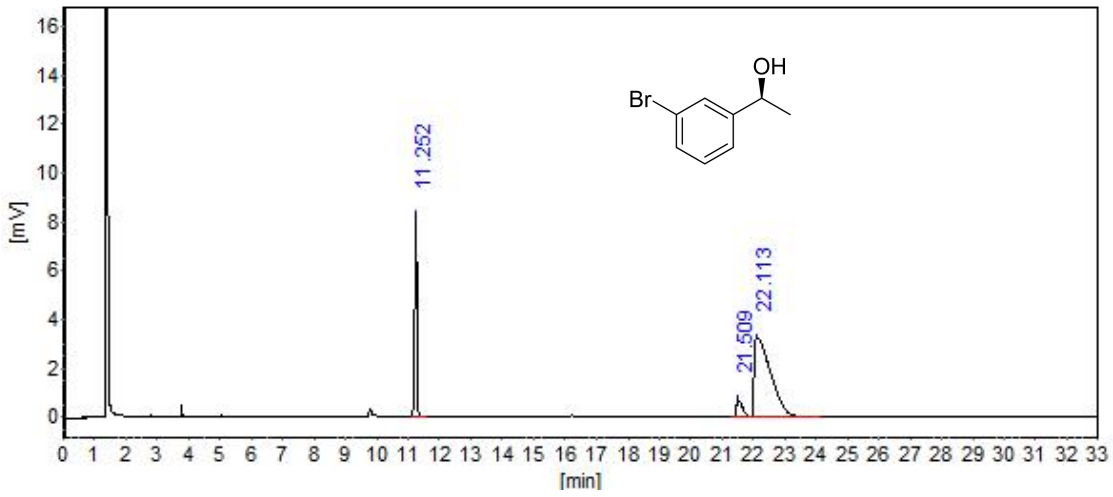


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	20.834	5093	5.070
2	21.730	95352	94.930

(±)-1-(3-bromophenyl)ethan-1-ol（P13）： The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 μm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 140 °C; inlet pressure = 0.08 MPa.

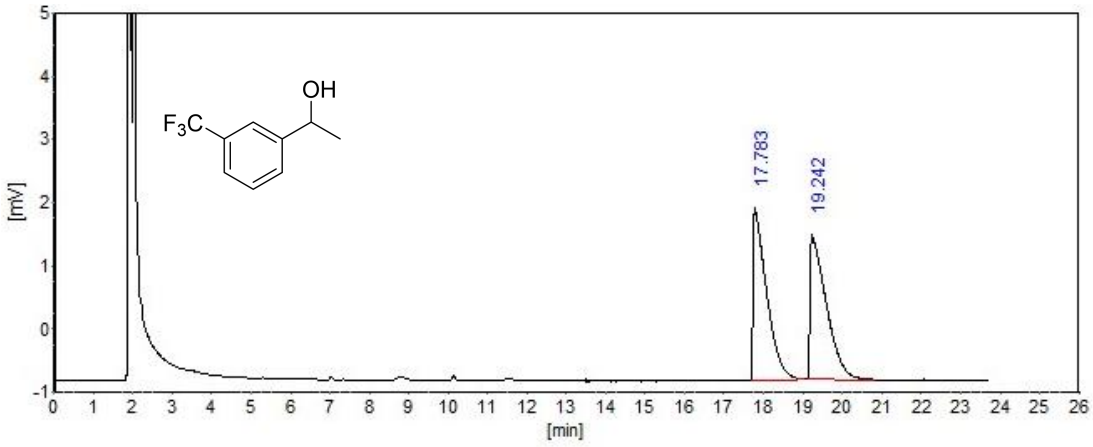


(*S*)-1-(3-bromophenyl)ethan-1-ol(P13): Colorless oil; 73.0 % yield, 84.8 % ee, S isomer; $[a]_D^{25}$ = -25.8 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 μm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 140 °C; inlet pressure = 0.08 MPa.

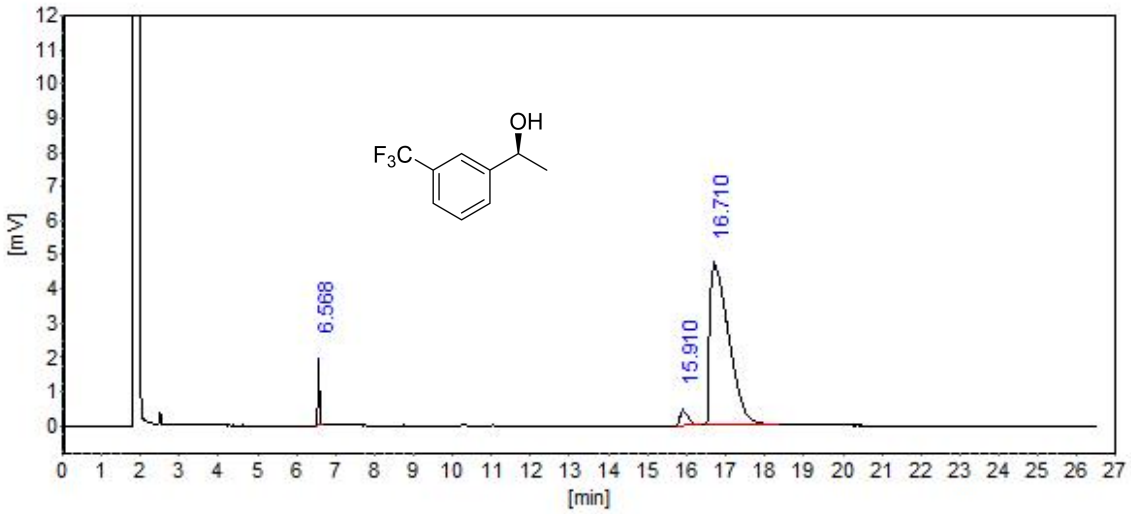


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	21.509	9649	7.580
2	22.113	117652	92.420

(±)-1-(3-(trifluoromethyl)phenyl)ethan-1-ol(P14): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.06 MPa.

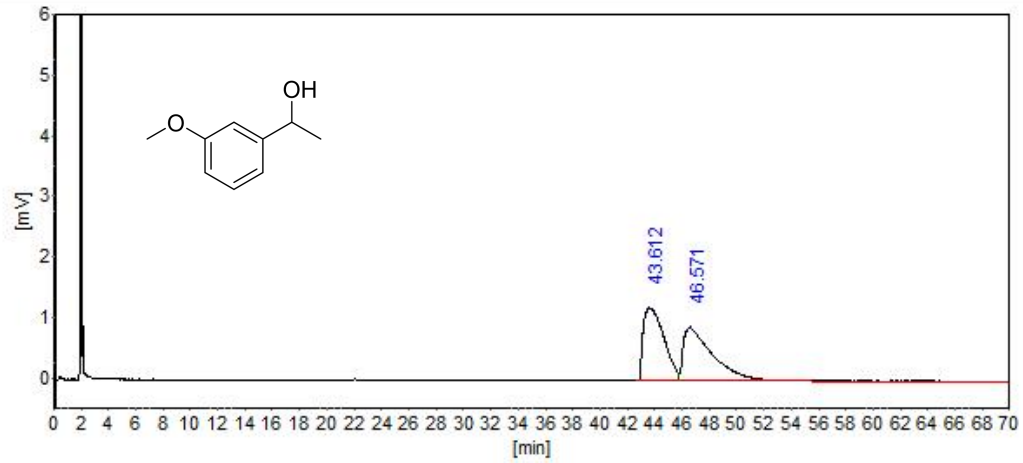


(*S*)-1-(3-(trifluoromethyl)phenyl)ethan-1-ol(P14): Colorless oil; 95.0 % yield, 92.2 % ee, S isomer; $[a]_D^{25}$ = - 19.7 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.06 MPa.

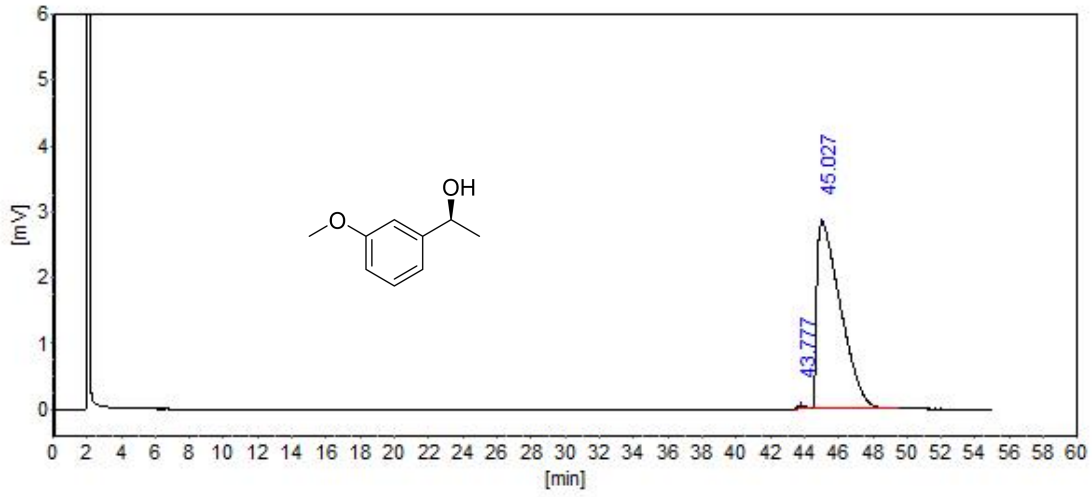


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	15.910	6467	3.891
2	16.710	159724	96.109

(±)-1-(3-methoxyphenyl)ethan-1-ol(P15): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 125 °C; inlet pressure = 0.06 MPa.

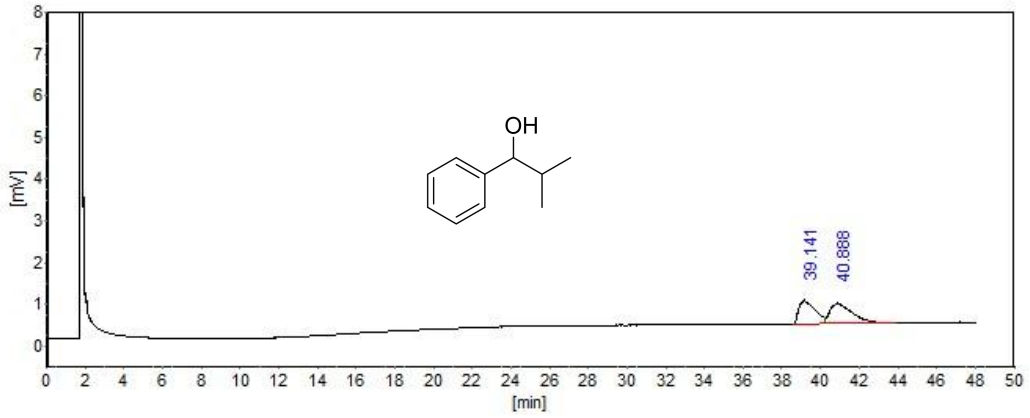


(*S*)-1-(3-methoxyphenyl)ethan-1-ol(P15): Colorless oil; 96.6 % yield, 98.8 % ee, S isomer; $[a]_D^{25}$ = - 30.4 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 125 °C; inlet pressure = 0.06 MPa.

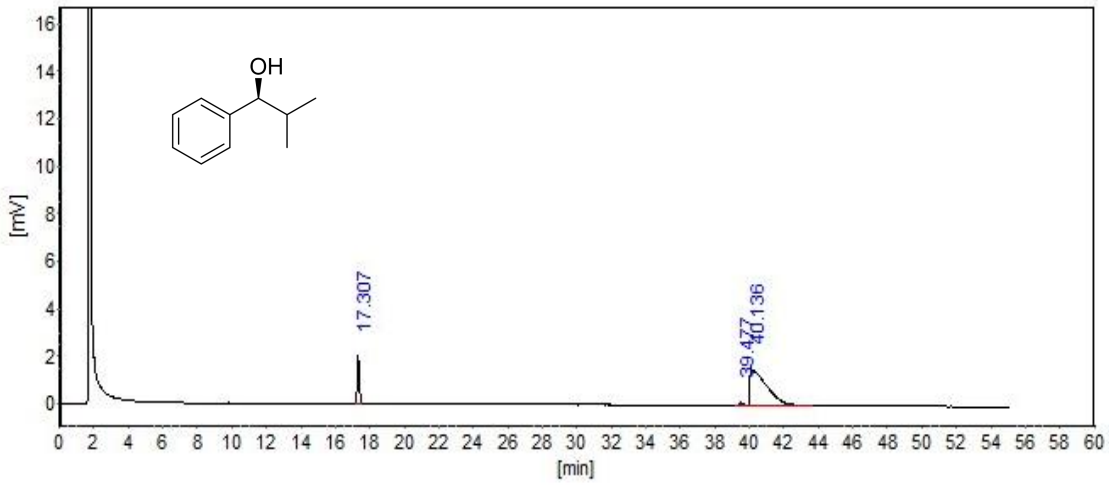


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	43.777	1706	0.624
2	45.027	271609	99.376

(±)-2-methyl-1-phenylpropan-1-ol (P16): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.06 MPa.

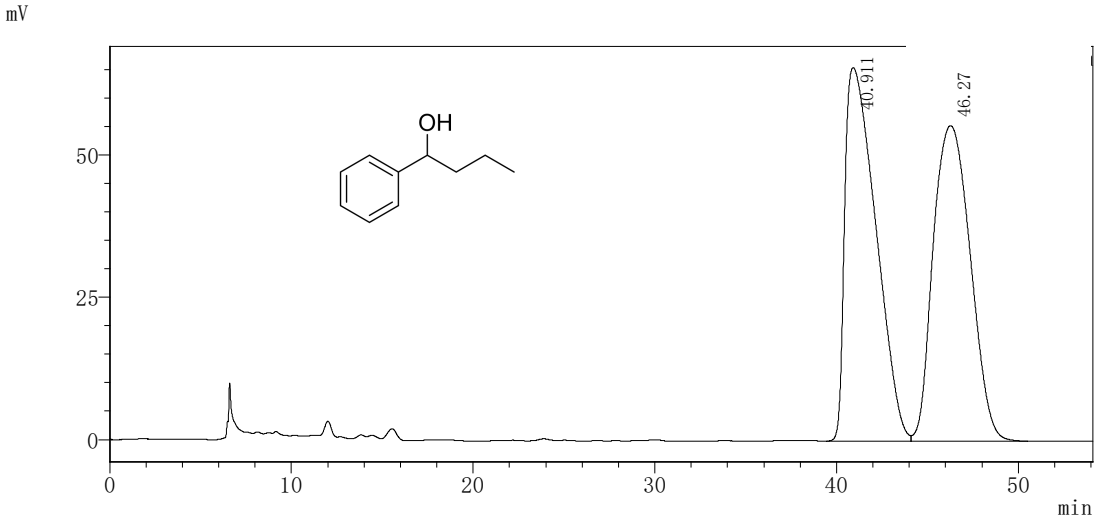


(S)-2-methyl-1-phenylpropan-1-ol (P16): Colorless oil; 85.2% yield, 98.2% ee, S isomer; $[a]_D^{25}$ = -39.8 (c = 1.00 in $CHCl_3$) . The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.06 MPa.

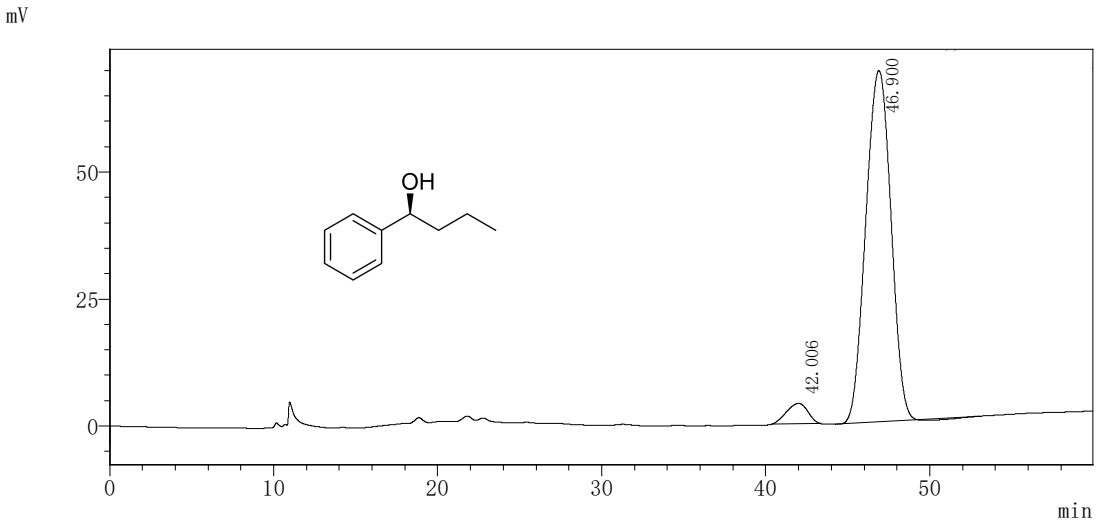


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	39.477	932	0.917
2	40.136	100704	99.083

(±)-1-Phenyl-butan-1-ol(P17): The racemate was determined by HPLC on Chiralcel OD-H column, hexane: isopropanol = 99:1; flow rate = 0.5 mL/min; UV detection at 254 nm.

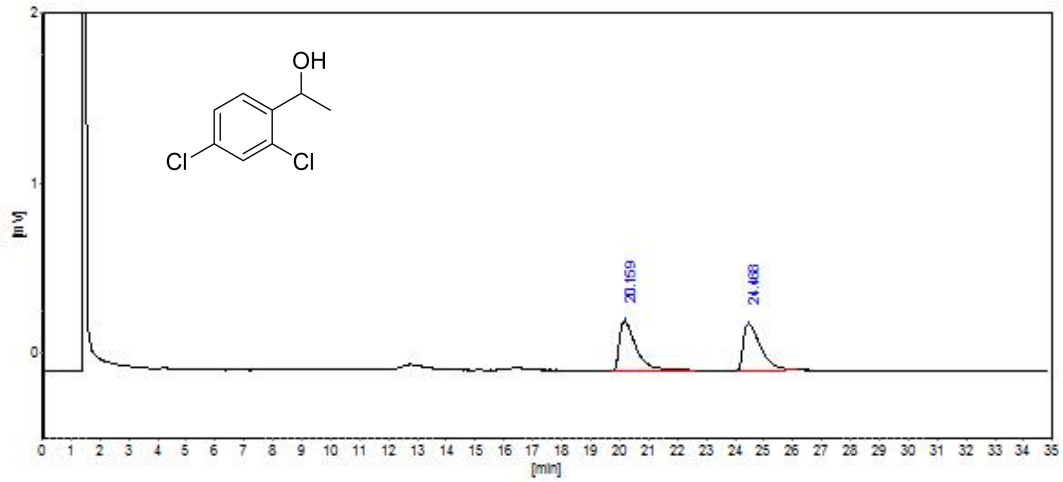


(*S*)-1-Phenyl-butan-1-ol(P17): Colorless oil; 93.4 % yield, 90.7% ee, S isomer; $[a]_D^{25}$ = - 40.5 (c = 1.00 in $CHCl_3$). The enantiomeric excess was determined by HPLC on Chiralcel OD-H column, hexane: isopropanol = 95:5; flow rate = 0.5 mL/min; UV detection at 254 nm.

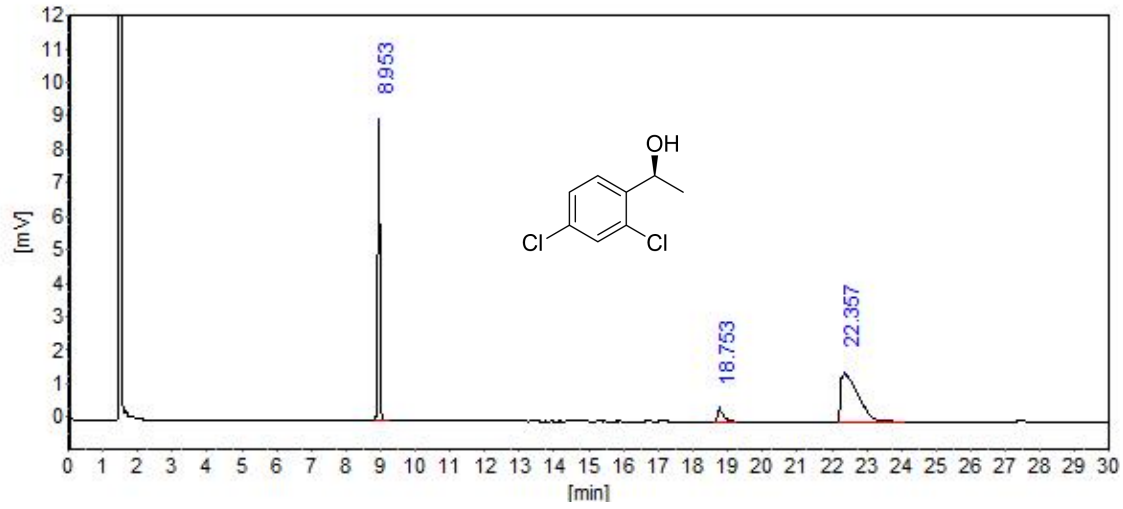


Peak	Processed Channel	Retention Time (min)	Peak Area (mAU*s)	Peak Hight (mAU)	Peak Area (%)
1	PDA 254 nm	42.006	360322	4018	4.669
2	PDA 254 nm	46.900	7356467	69195	95.331

(±)-1-(2,4-dichlorophenyl)ethan-1-ol(P18): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 150 °C; inlet pressure = 0.08 MPa.

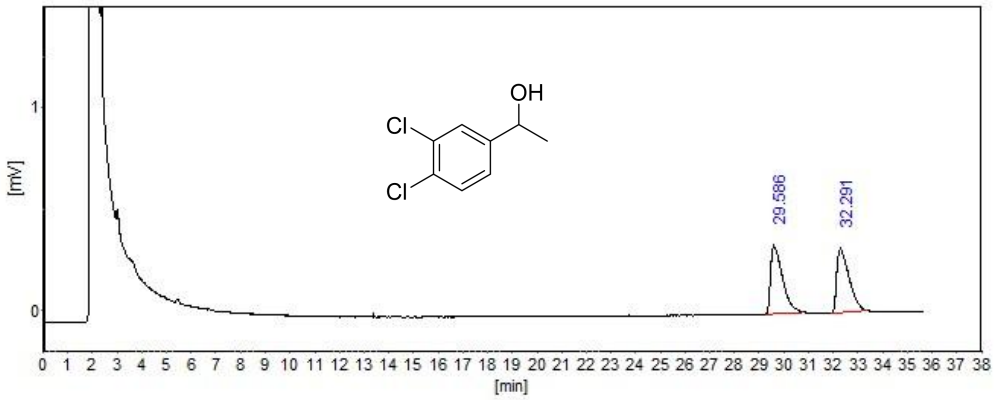


(*S*)-1-(2,4-dichlorophenyl)ethan-1-ol(P18): Colorless oil; 99 % yield,84.3 % ee, S isomer; $[a]_D^{25}$ = -46.0 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 150 °C; inlet pressure = 0.08 MPa.

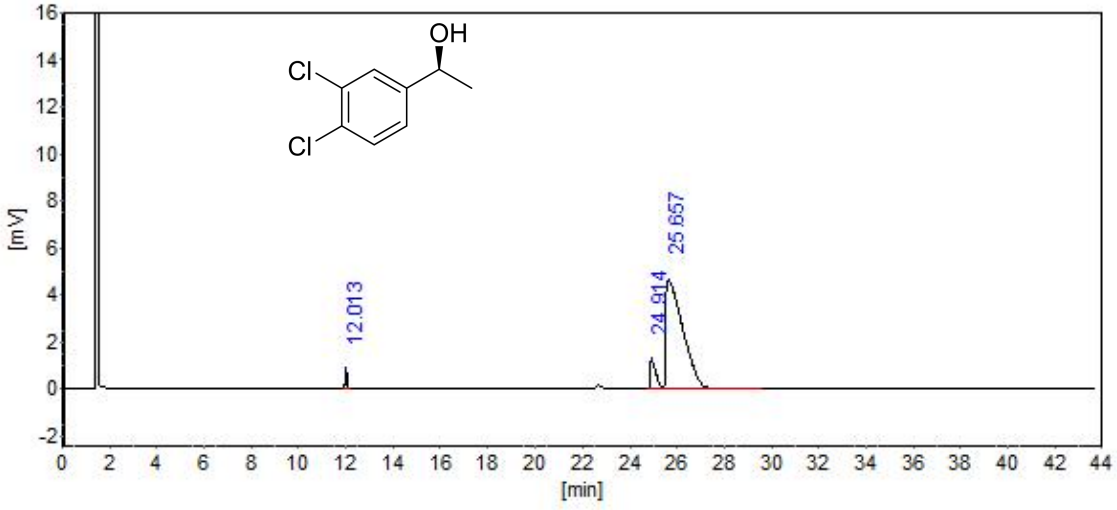


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	18.753	4250	7.831
2	54.464	50025	92.169

(±)-1-(3,4-dichlorophenyl)ethan-1-ol (P19): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 150 °C; inlet pressure = 0.08 MPa.

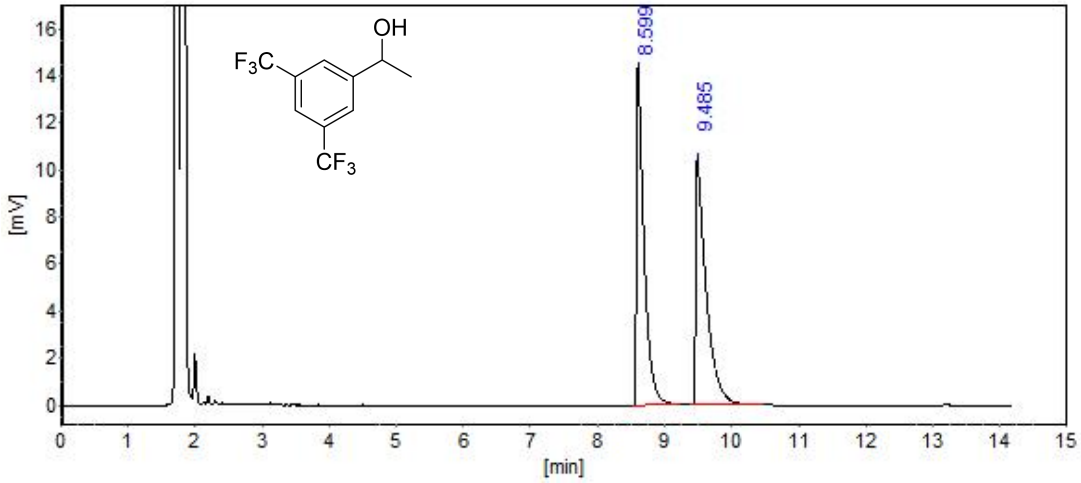


(S)-1-(3,4-dichlorophenyl)ethan-1-ol (P19): Colorless oil; 96.8% yield, 83.4 % ee, S isomer; $[a]_D^{25}$ = - 37.2 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 150 °C; inlet pressure = 0.08 MPa.

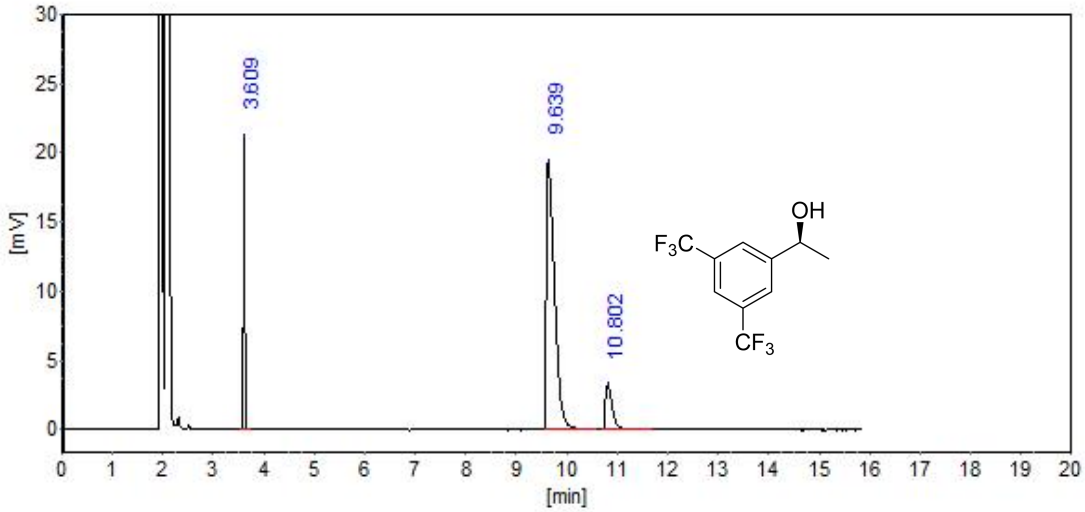


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	24.914	21425	8.308
2	25.657	236464	91.692

(±)-1-(3,5-bis(trifluoromethyl)phenyl)ethan-1-ol(P20): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.06 MPa.

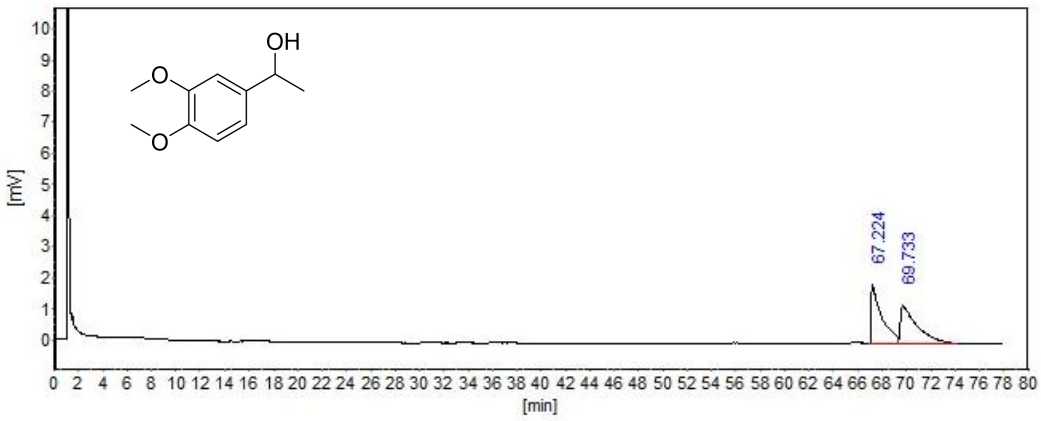


(*S*)-1-(3,5-bis(trifluoromethyl)phenyl)ethan-1-ol(P20): White solid, Mp: 53.4 - 54.8 °C ; 84.5 % yield, 75.8 % ee, S isomer; $[a]_D^{25}$ = - 12.797 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 115 °C; inlet pressure = 0.06 MPa.

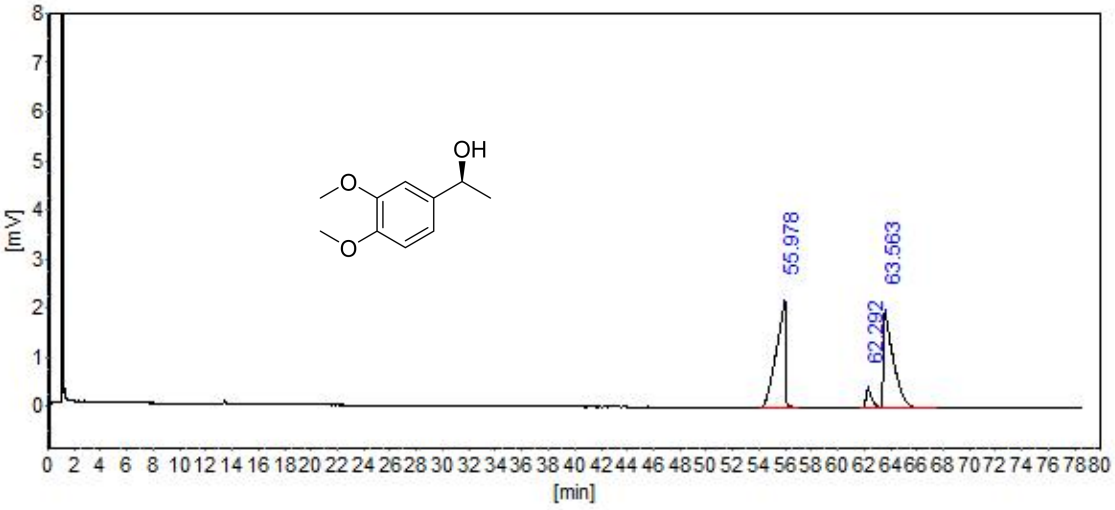


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	9.639	217798	87.897
2	10.802	29990	12.103

(±)-1-(3,4-dimethoxyphenyl)ethan-1-ol(P21): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 C; injector temperature: 250 C; column temperature: 130 C; inlet pressure = 0.1 MPa.

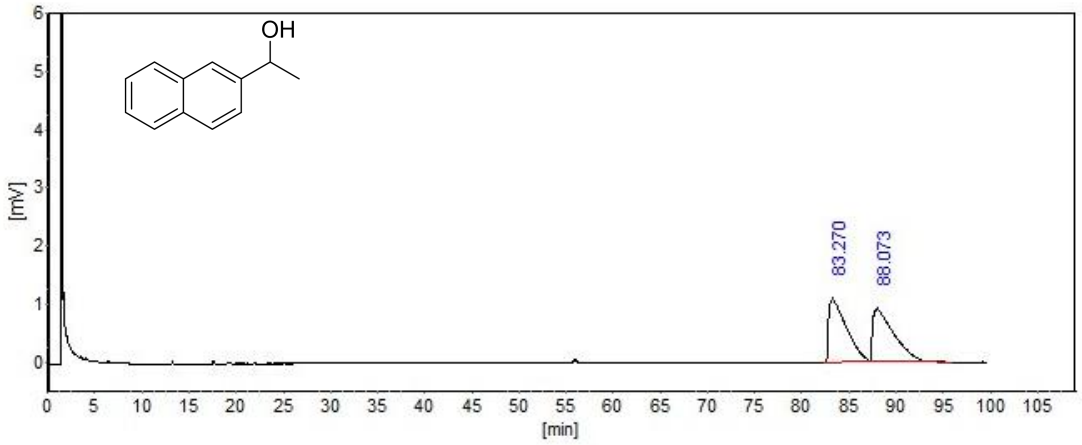


(*S*)-1-(3,4-dimethoxyphenyl)ethan-1-ol(P21): Colorless oil; 50 % yield, 81.1 % ee, S isomer; $[a]_D^{25}$ = - 42.7 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 130 °C; inlet pressure = 0.1 MPa.

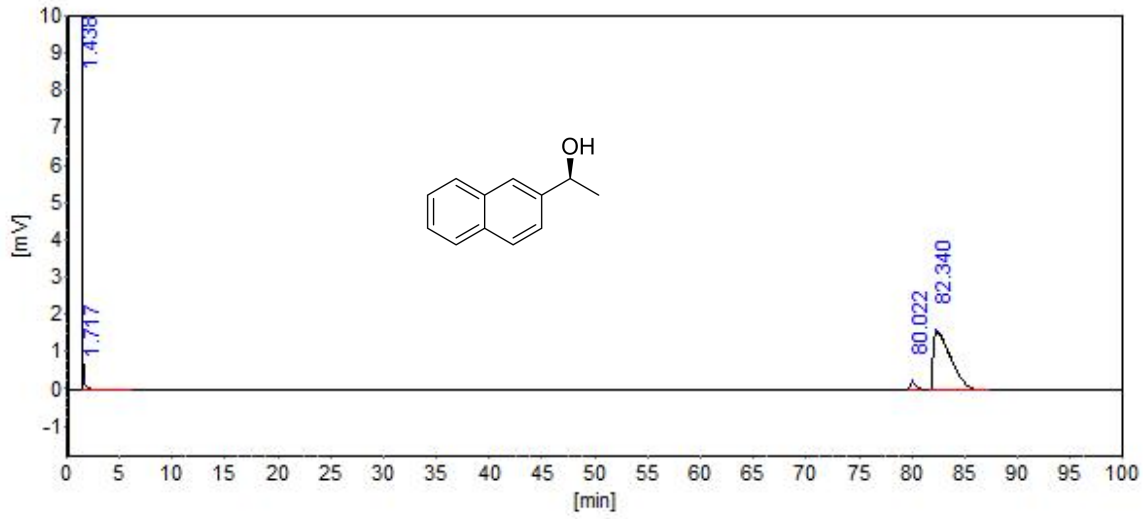


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	62.292	11849	9.464
2	63.563	104456	90.536

(±)-1-(naphthalen-2-yl)ethan-1-ol(P22): The racemate was determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 140 °C; inlet pressure = 0.08 MPa.

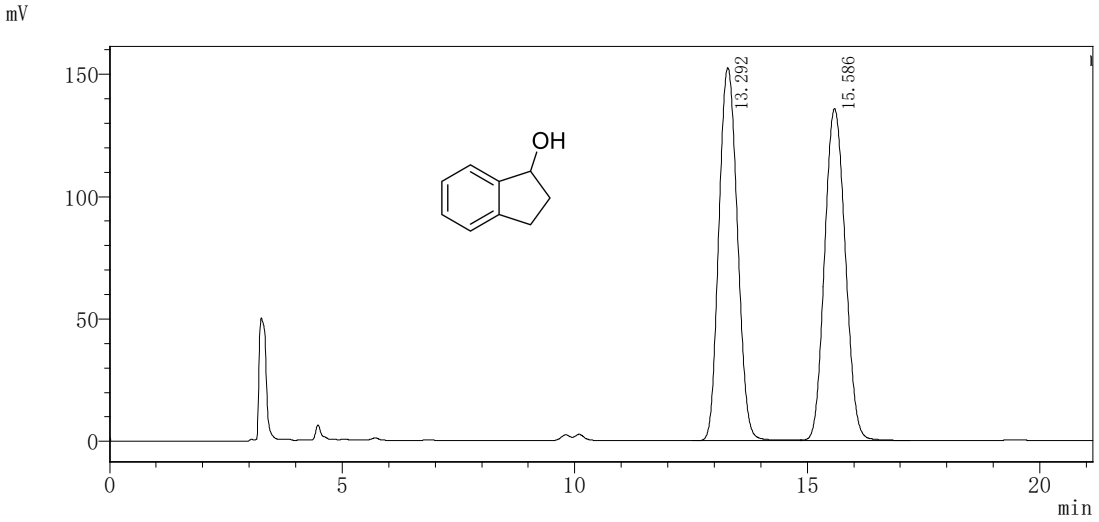


(*S*)-1-(naphthalen-2-yl)ethan-1-ol(P22): White solid Mp: 70.6 - 71.4 ℃; 99 % yield, 91.1 % ee, S isomer; $[a]_D^{25}$ = - 43.5 (c = 1.00 in $CHCl_3$). The enantiomeric excess were determined by GC equipped with a chiral *β*-DEX^{TM}120 (df = 0.25 µm, 0.25 mm i.d.×30 m, fused silica capillary column); carrier gas: H_2; detector temperature: 250 °C; injector temperature: 250 °C; column temperature: 140 °C; inlet pressure = 0.08 MPa.

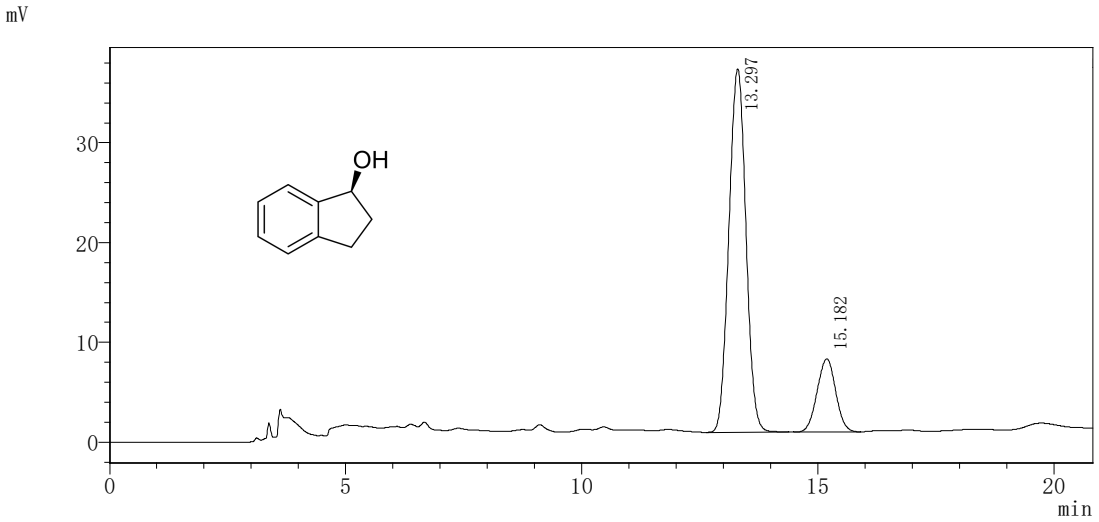


Peak	Retention time [min]	Area [uv*s]	Area [%]
1	80.022	8409	4.428
2	82.340	181517	95.572

(±)-2,3-dihydro-1H-inden-1-ol (P23): The racemate was determined by HPLC on Chiralcel OD-H column, hexane: isopropanol = 97:3; flow rate = 1.0 mL/min; UV detection at 254nm.

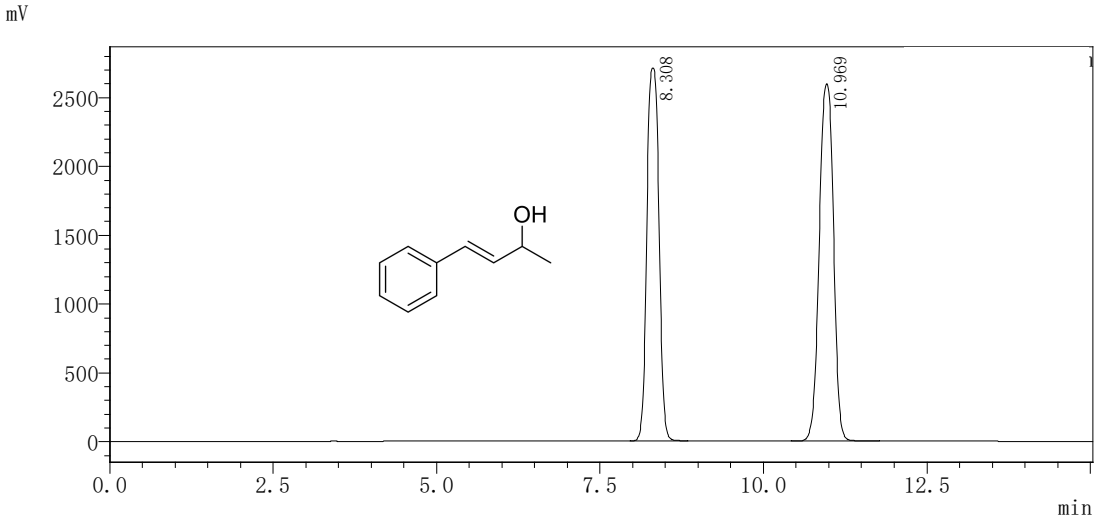


(S)-2,3-dihydro-1H-inden-1-ol (P23): White solid, Mp: 53.4 - 54.8 °C ; 51.4 % yield, 63.9 % ee, S isomer; $[a]_D^{25}$ = - 14.0 (c = 1.00 in $CHCl_3$). The enantiomeric excess was determined by HPLC on Chiralcel OD-H column, hexane: isopropanol = 97:3; flow rate = 1.0 mL/min; UV detection at 254nm.

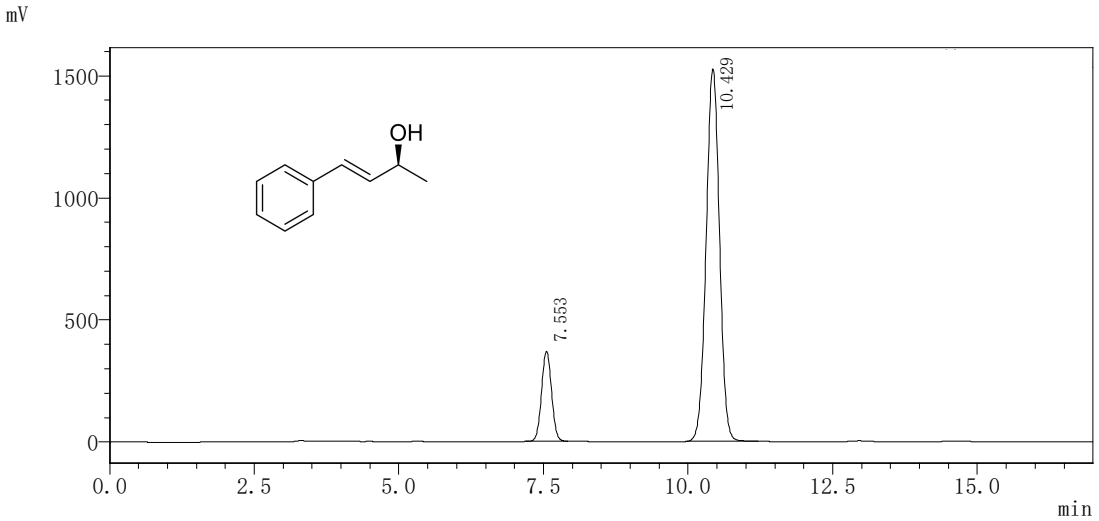


Peak	Processed Channel	Retention Time (min)	Peak Area (mAU*s)	Peak Hight (mAU)	Peak Area (%)
1	PDA 254 nm	13.297	913124	36451	81.974
2	PDA 254 nm	15.182	200791	7331	18.026

(±)-4-phenylbut-3-en-2-ol (P24): The racemate was determined by HPLC on Chiralcel IB-H column, hexane: isopropanol = 90:10; flow rate = 1.0 mL/min; UV detection at 254nm.

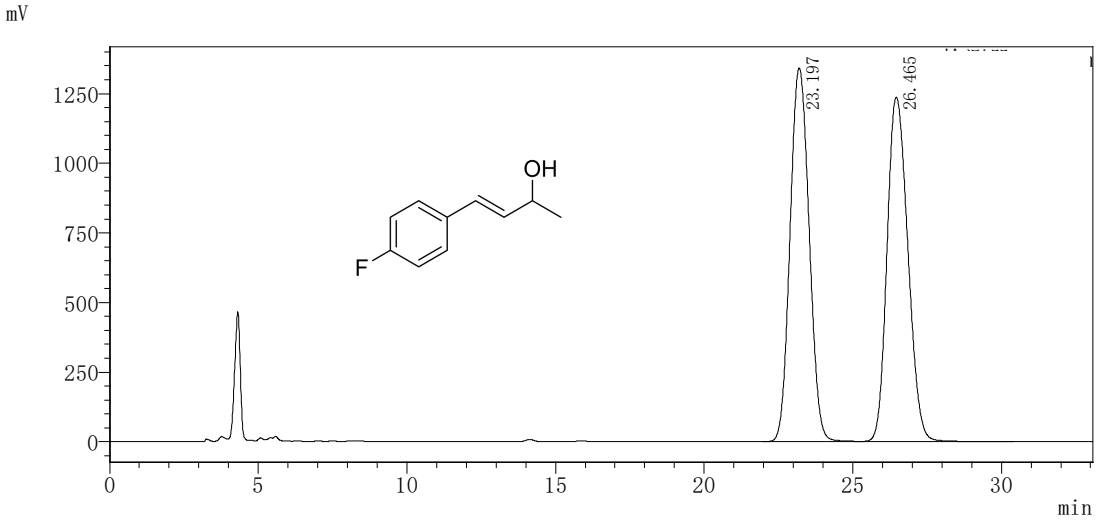


(S)-4-phenylbut-3-en-2-ol (P24): Yellowish oil; 98.0 % yield, 68.9 % ee, S isomer; $[a]_D^{20}$ = - 12.2 (c = 1.00 in $CHCl_3$). The racemate was determined by HPLC on Chiralcel IB-H column, hexane: isopropanol = 90:10; flow rate = 1.0 mL/min; UV detection at 254nm.

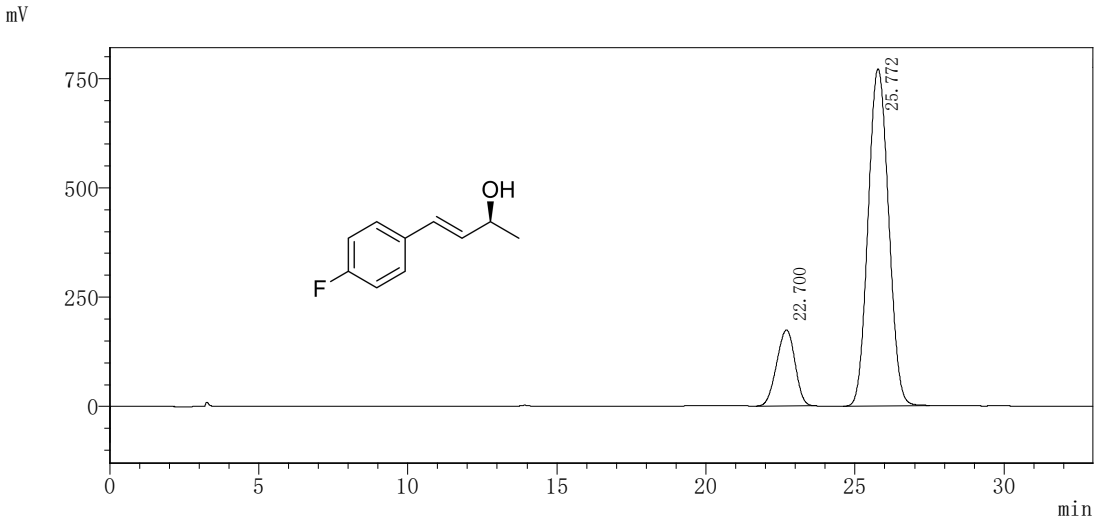


Peak	Processed Channel	Retention Time (min)	Peak Area (mAU*s)	Peak Hight (mAU)	Peak Area (%)
1	PDA 254 nm	7.553	4445060	369485	15.337
2	PDA 254 nm	10.429	24537728	1525885	84.663

(±)-4-(4-fluorophenyl)but-3-en-2-ol (P25): The racemate was determined by HPLC on Chiralcel OD-H column, hexane: isopropanol = 98:2; flow rate = 1.0 mL/min; UV detection at 254nm.

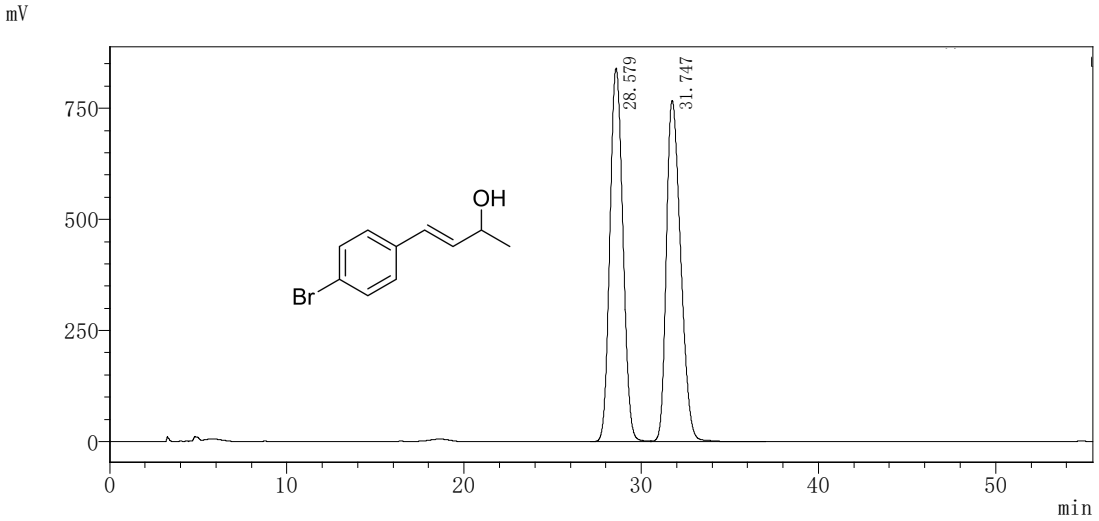


(S)-4-(4-fluorophenyl)but-3-en-2-ol (P25): Colorless oil; 97.5% yield, 66.3% ee, S isomer; $[a]_D^{20}$ = -9.833 (c = 1.00 in $CHCl_3$). The racemate was determined by HPLC on Chiralcel OD-H column, hexane: isopropanol = 98:2; flow rate = 1.0 mL/min; UV detection at 254 nm.

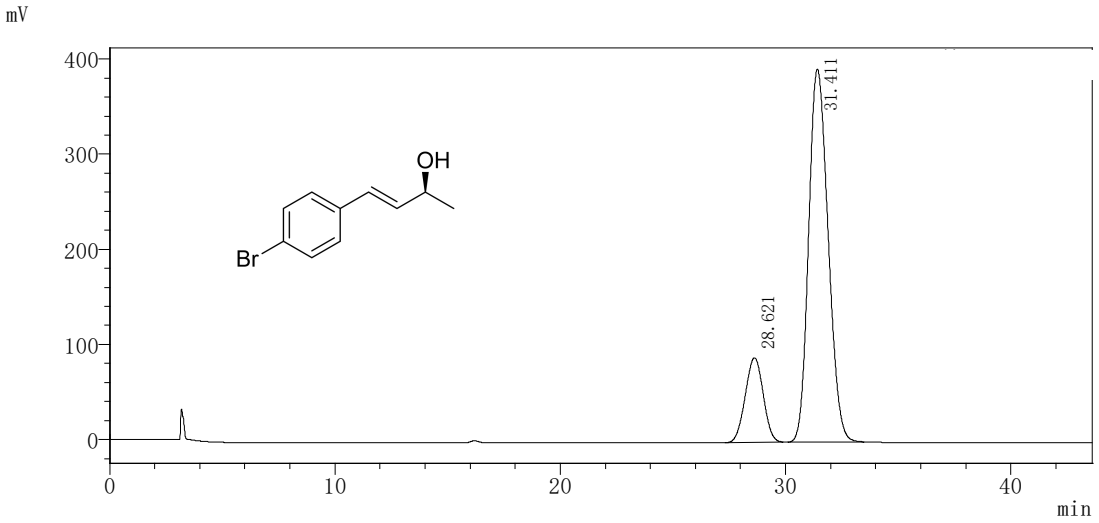


Peak	Processed Channel	Retention Time (min)	Peak Area (mAU*s)	Peak Hight (mAU)	Peak Area (%)
1	PDA 254 nm	22.700	7417301	173383	16.750
2	PDA 254 nm	25.772	36864247	770765	83.250

(±)-4-(4-bromophenyl)but-3-en-2-ol (P26): The racemate was determined by HPLC on Chiralcel OD-H column, hexane: isopropanol = 98:2; flow rate = 1.0 mL/min; UV detection at 254 nm.

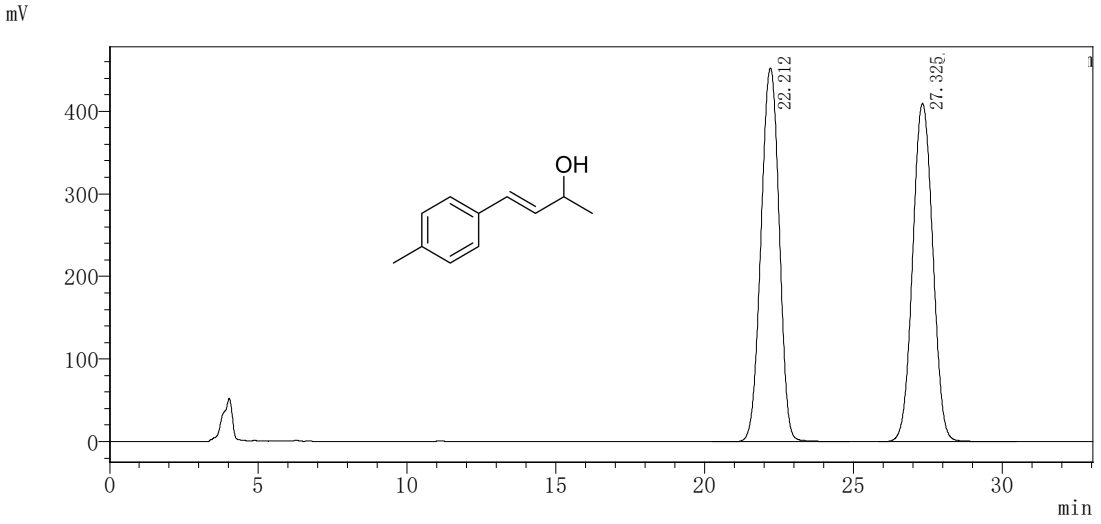


(S)-4-(4-bromophenyl)but-3-en-2-ol (P26): Yellowish solid, 90.5 % yield, 65.1 % ee, S isomer; $[a]_D^{20}$ = - 7.7 (c = 1.00 in $CHCl_3$). The racemate was determined by HPLC on Chiralcel OD-H column, hexane: isopropanol = 98:2; flow rate = 1.0 mL/min; UV detection at 254nm.

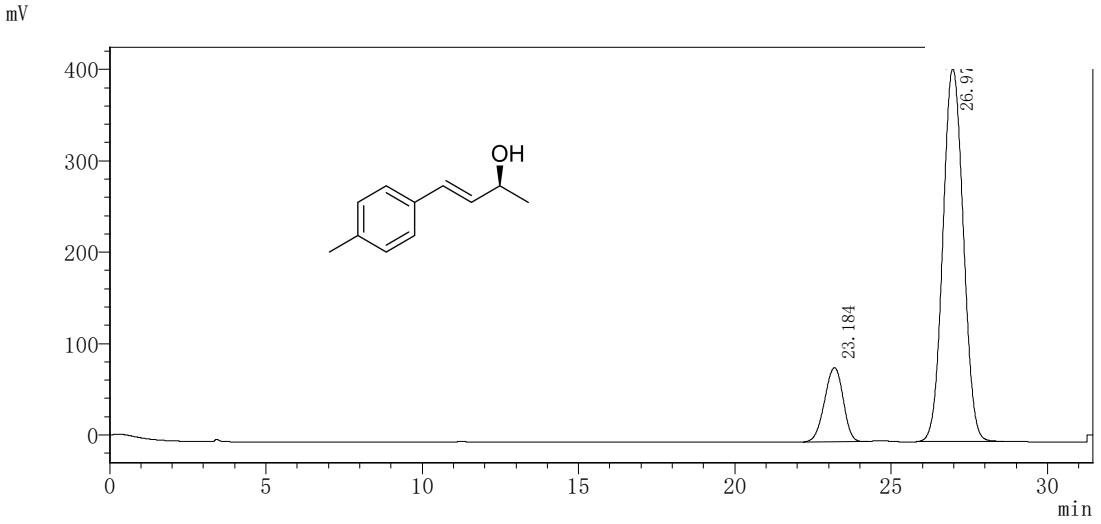


Peak	Processed Channel	Retention Time (min)	Peak Area (mAU*s)	Peak Hight (mAU)	Peak Area (%)
1	PDA 254 nm	28.621	4897254	88668	17.195
2	PDA 254 nm	31.411	23584261	392302	82.805

(±)-4-(p-tolyl)but-3-en-2-ol (P27): The racemate was determined by HPLC on Chiralcel IB-H column, hexane: isopropanol = 98:2; flow rate = 1.0 mL/min; UV detection at 254nm.

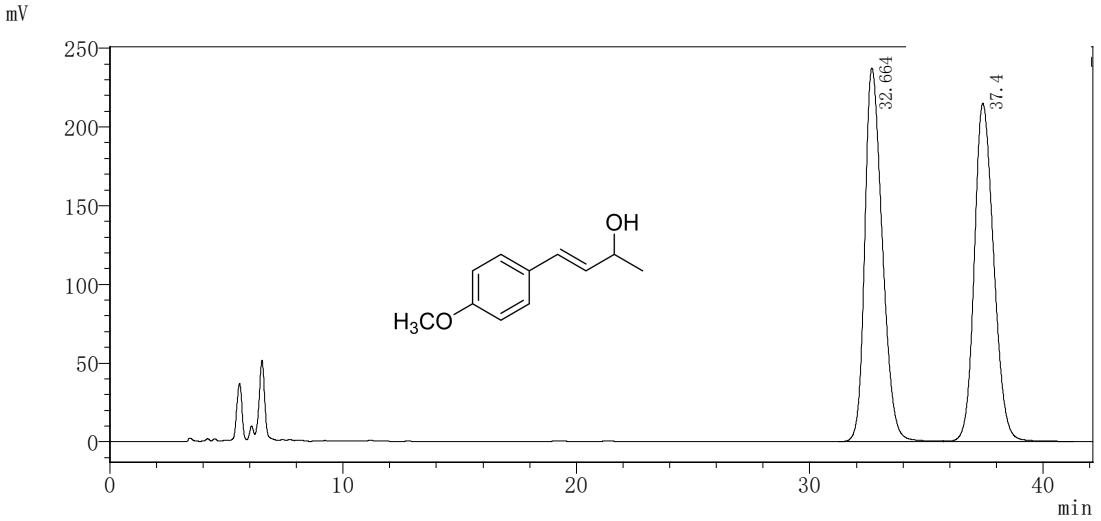


(S)-4-(p-tolyl)but-3-en-2-ol (P27): Yellowish solid, 71.5 % yield, 69.0 % ee, S isomer; $[a]_D^{20}$ = -6.2 (c = 1.00 in $CHCl_3$). The racemate was determined by HPLC on Chiralcel IB-H column, hexane: isopropanol = 98:2; flow rate = 1.0 mL/min; UV detection at 254nm.

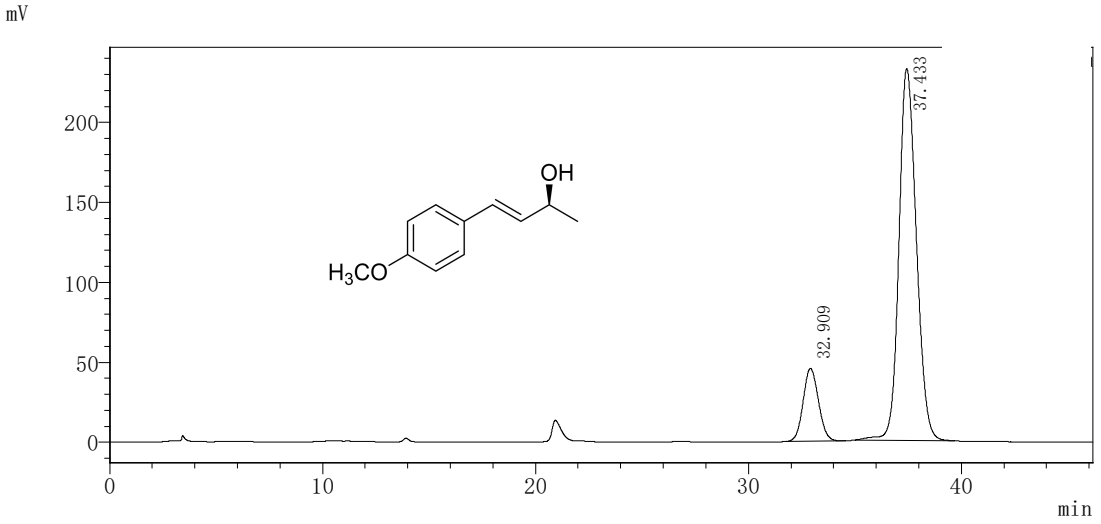


Peak	Processed Channel	Retention Time (min)	Peak Area (mAU*s)	Peak Hight (mAU)	Peak Area (%)
1	PDA 254 nm	23.184	3355537	81076	15.325
2	PDA 254 nm	26.971	18540835	408344	84.675

(±)-4-(4-methoxyphenyl)but-3-en-2-ol (P28): The racemate was determined by HPLC on Chiralcel IB-H column, hexane: isopropanol = 98:2; flow rate = 1.0 mL/min; UV detection at 254nm.



(S)-4-(4-methoxyphenyl)but-3-en-2-ol (P28): White solid, 54.0 % yield, 70.5 % ee, S isomer; $[a]_D^{20}$ = -18.5 (c = 1.00 in $CHCl_3$). The racemate was determined by HPLC on Chiralcel IB-H column, hexane: isopropanol = 98:2; flow rate = 1.0 mL/min; UV detection at 254nm.



Peak	Processed Channel	Retention Time (min)	Peak Area (mAU*s)	Peak Hight (mAU)	Peak Area (%)
1	PDA 254 nm	32.909	2338908	45892	14.748
2	PDA 254 nm	37.433	13520603	233418	85.252

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