

Enantio- and chemoselective, Brønsted-acid catalysed reduction of α -keto esters with catecholborane

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General Remarks

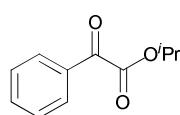
Unless otherwise stated, all reactions were performed in oven-dried glassware under a slightly positive pressure of argon. Starting materials and reagents were purchased from common suppliers and used without further purification unless otherwise stated. Ethylbenzoylformate (**1a**) was purchased from *Aldrich* and was used as received. Catecholborane was purchased from *Acros* and was stored in a Schlenk tube under argon. Unsubstituted keto esters were synthesized in a two-step procedure starting from mandelic acid.¹ All solvents were dried by conventional methods. Preparative column chromatography: *Merck* silica gel 60, particle size 0.040-0.063 mm (230-240 mesh, flash). Analytical TLC: silica gel 60 F₂₅₄ plates from *Macherey & Nagel*. Visualization of the developed TLC plates was performed with ultraviolet irradiation (254 nm) or by staining with a solution of potassium permanganate or mostain. ¹H-, ¹³C- and ¹⁹F-NMR spectra were recorded at ambient temperature on *Varian* Mercury 300, *Varian* Inova 400 and *Varian* VNMRS 600 instruments with tetramethylsilane as internal standard. Chemical shifts for ¹H-NMR, ¹³C-NMR and ¹⁹F-NMR are reported in parts per million (ppm), with coupling constants reported in Hertz (Hz). The following abbreviations are used for spin multiplicity: s = singlet, d = doublet, dd = doublet of doublet, ddd = doublet of doublet of doublet, td = triplet of doublet, tdd = triplet of doublet of doublet, t = triplet, dt = doublet of triplet, tt = triplet of triplet, q = quartet, dq = doublet of quartet, dqint = doublet of quintet, sept = septet, m = multiplet and br = broad. Mass spectra were acquired on a *Finnigan* SSQ 7000 (EI, 70 eV) spectrometer and on a *ThermoFinnigan* LCQ Deca XP plus (ESI) spectrometer, as well as high resolution ESI spectra on a *ThermoFisher* Scientific LTQ-Orbitrap XL. IR spectra were taken on a *PerkinElmer* Spectrum 100 FT-IR spectrometer. The following abbreviations are used: vw = very weak, w = weak, m = medium, s = strong and vs = very strong. Microanalyses were performed with a *Vario* EL Cube element analyser. Melting points were measured on a *Büchi* MeltingPoint B-540 instrument. Analytical HPLC was carried out on a *Hewlett-Packard* 110 Series instrument using chiral stationary phases. Optical rotation values were measured on a *Perkin-Elmer* 241 polarimeter.

General procedure for the synthesis of α -keto esters:¹

Substituted ethyl α -keto esters have been prepared according to literature procedures and the analytical data were consistent with those reported. After hydrolysis of the ethyl esters with 2N NaOH (quantitative) the corresponding α -keto acids (17.2 mmol, 1.0 eq) were dissolved in dry DCM (17.5 mL) and oxalyl chloride (2.48 g, 1.7 mL, 19.5 mmol, 1.1 eq) and one drop of DMF were subsequently added. The suspension was stirred at room temperature until the evolution of gasses has ceased (3-4 hours). After removal of all volatiles under reduced pressure the residue was redissolved in dry DCM (17.5 mL) under argon and *iso*-propanol (1.24 g, 1.59 mL, 20.6 mmol, 1.2 eq) was added. After the drop-wise addition of NEt₃ (5.22 g, 6.7 mL, 51.6 mmol, 3.0 eq) the reaction was stirred at room temperature over night. The reaction was quenched by the addition of water and after separation of the phases the aqueous phase was extracted with diethyl ether. The combined extracts were dried over Na₂SO₄ and after removal of the solvent in vacuum the α -keto esters were obtained after purification by flash column chromatography over silica gel (diethyl ether:*n*-pentane, 1:50 to 1:10).

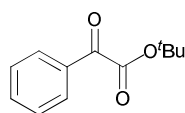
Analytical Data

iso-Propyl-2-oxo-2-phenylacetate (**1b**)²



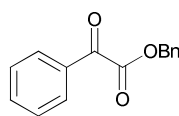
Compound **1b** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (2.22 g, 45%); ¹H-NMR (300 MHz, CDCl₃): δ = 1.41 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 5.33 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 7.47-7.55 (m, 2H, CH_{ar}), 7.62-7.69 (m, 1H, CH_{ar}), 7.97-8.03 (m, 2H, CH_{ar}) ppm; ¹³C-NMR (75 MHz, CDCl₃): δ = 21.7 (CH(CH₃)₂), 70.7 (CH(CH₃)₂), 128.9 (CH_{ar}, 2C), 129.9 (CH_{ar}, 2C), 132.5 (C_{ar}), 134.8 (CH_{ar}), 163.6 (OC=O), 186.7 (C=O) ppm; MS (EI, 70 eV): *m/z* (%) = 192 (4) [M⁺], 105 (100), 77 (25).

tert-Butyl-2-oxo-2-phenylacetate (**1c**)³



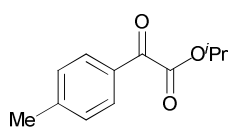
Compound **1c** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (1.41 g, 27%); ¹H-NMR (300 MHz, CDCl₃): δ = 1.63 (s, *J* = 6.3 Hz, 9H, C(CH₃)₃), 7.47-7.55 (m, 2H, CH_{ar}), 7.61-7.68 (m, 1H, CH_{ar}), 7.95-8.00 (m, 2H, CH_{ar}) ppm; ¹³C-NMR (75 MHz, CDCl₃): δ = 28.1 (C(CH₃)₃), 84.8 (C(CH₃)₃), 128.8 (CH_{ar}, 2C), 129.9 (CH_{ar}, 2C), 132.5 (C_{ar}), 134.6 (CH_{ar}), 163.7 (OC=O), 186.8 (C=O) ppm; MS (EI, 70 eV): *m/z* (%) = 105 (28) [M⁺-CO₂^tBu], 77 (22), 57 (100), 51 (13).

Benzyl-2-oxo-2-phenylacetate (**1d**)⁴



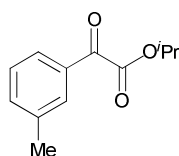
Compound **1d** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a yellow oil (5.83 g, 70%); ¹H-NMR (300 MHz, CDCl₃): δ = 5.42 (s, 2H, CH₂), 7.32-7.53 (m, 7H, CH_{ar}), 7.60-7.68 (m, 1H, CH_{ar}), 7.94-7.99 (m, 2H, CH_{ar}) ppm; ¹³C-NMR (75 MHz, CDCl₃): δ = 67.7 (CH₂), 128.6 (CH_{ar}, 2C), 128.8 (CH_{ar}), 128.8 (CH_{ar}, 2C), 128.9 (CH_{ar}, 2C), 130.0 (CH_{ar}, 2C), 132.4 (C_{ar}), 134.5 (C_{ar}), 135.0 (CH_{ar}), 163.6 (OC=O), 186.0 (C=O) ppm; MS (EI, 70 eV): *m/z* (%) = 105 (100) [M⁺-CO₂Bn], 91 (88), 77 (29), 51 (21).

iso-Propyl-2-oxo-2-(4-tolyl)acetate (**1e**)²



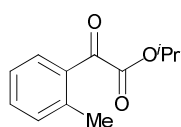
Compound **1e** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (0.32 g, 48%); ¹H-NMR (400 MHz, CDCl₃): δ = 1.39 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 2.42 (s, 3H, CH₃), 5.30 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 7.29 (d, *J* = 8.1 Hz, 2H, CH_{ar}), 7.87 (d, *J* = 8.1 Hz, 2H, CH_{ar}) ppm; ¹³C-NMR (100 MHz, CDCl₃): δ = 21.7 (CH(CH₃)₂, 2C), 21.9 (CH₃), 70.4 (CH(CH₃)₂), 129.6 (CH_{ar}, 2C), 130.1 (CH_{ar}, 2C), 130.1 (C_{ar}), 146.1 (C_{ar}), 163.8 (OC=O), 186.4 (C=O) ppm; MS (EI, 70 eV): *m/z* (%) = 207 (6) [M⁺+H], 206 (23) [M⁺], 178 (14), 119 (100), 91 (19).

iso-Propyl-2-oxo-2-(3-tolyl)acetate (**1f**)



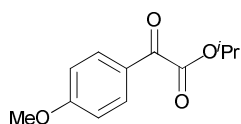
Compound **1f** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (2.79 g, 68%); IR (ATR): ν (cm⁻¹) = 2983 (m), 2935 (w), 2321 (vw), 2096 (w), 1915 (vw), 1732 (vs), 1686 (vs), 1590 (m), 1457 (m), 1377 (m), 1305 (s), 1232 (vs), 1158 (vs), 1100 (vs), 1027 (s), 908 (m), 834 (w), 789 (w), 676 (s), 528 (m); ¹H-NMR (400 MHz, CDCl₃): δ = 1.39 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 2.40 (s, 3H, CH₃), 5.31 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 7.37 (t, *J* = 7.6 Hz, 1H, CH_{ar}), 7.44 (d, *J* = 7.6 Hz, 1H, CH_{ar}), 7.72-7.81 (m, 2H, CH_{ar}) ppm; ¹³C-NMR (100 MHz, CDCl₃): δ = 21.2 (CH₃), 21.7 (CH(CH₃)₂, 2C), 70.4 (CH(CH₃)₂), 127.3 (CH_{ar}), 128.7 (CH_{ar}), 130.2 (CH_{ar}), 132.5 (C_{ar}), 135.6 (CH_{ar}), 138.8 (C_{ar}), 163.8 (OC=O), 186.9 (C=O) ppm; MS (ESI, pos): *m/z* (%) = 207 (8) [M⁺+H], 229 (33) [M⁺+Na]; EA (CHN): calcd. for [C₁₁H₁₄O₃]: C = 69.88%, H = 6.84%, found C = 69.53%, H = 6.80%.

iso-Propyl-2-oxo-2-(2-tolyl)acetate (1g)



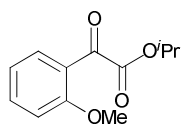
Compound **1g** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (2.36 g, 57%); **IR** (ATR): ν (cm⁻¹) = 3067 (vw), 2982 (m), 2936 (w), 2324 (vw), 2095 (vw), 1921 (vw), 1729 (vs), 1684 (vs), 1600 (w), 1571 (w), 1456 (s), 1378 (m), 1279 (s), 1191 (vs), 1099 (vs), 980 (vs), 908 (w), 843 (m), 729 (vs), 666 (m), 531 (m); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.38 (d, J = 6.3 Hz, 6H, CH(CH₃)₂), 2.59 (s, 3H, CH₃), 5.28 (sept., J = 6.3 Hz, 1H, CH(CH₃)₂), 7.26-7.37 (m, 2H, CH_{ar}), 7.47 (t, J = 7.5 Hz, 1H, CH_{ar}), 7.66 (d, J = 6.9 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.4 (CH₃), 21.7 (CH(CH₃)₂, 2C), 70.5 (CH(CH₃)₂), 125.9 (CH_{ar}), 131.2 (C_{ar}), 132.2 (CH_{ar}), 132.3 (CH_{ar}), 133.6 (CH_{ar}), 141.3 (C_{ar}), 163.8 (OC=O), 186.9 (C=O) ppm; **MS** (EI, 70 eV): m/z (%) = 206 (18) [M⁺], 119 (100), 91 (29), 65 (10); **HRMS** (ESI): calcd. for [C₁₂H₁₄O₃Na]: 229.0835, found: 229.0828.

iso-Propyl 2-(4-methoxyphenyl)-2-oxoacetate (1h)²



Compound **1h** was isolated by flash column chromatography (10:1 *n*-pentane:Et₂O) to yield a light yellow oil (1.91 g, 85%); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.38 (d, J = 6.3 Hz, 6H, CH(CH₃)₂), 3.87 (s, 3H, OCH₃), 5.28 (sept., J = 6.3 Hz, 1H, CH(CH₃)₂), 6.95 (d, J = 9.0 Hz, 2H, CH_{ar}), 7.96 (d, J = 9.0 Hz, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.7 (CH(CH₃)₂, 2C), 55.6 (OCH₃), 70.4 (CH(CH₃)₂), 114.2 (CH_{ar}, 2C), 125.6 (C_{ar}), 132.4 (CH_{ar}, 2C), 163.8 (OC=O), 164.9 (C_{ar}), 186.9 (C=O) ppm; **MS** (EI, 70 eV): m/z (%) = 223 (9) [M⁺+H], 222 (14) [M⁺], 135 (100).

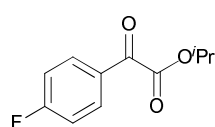
iso-Propyl-2-(2-methoxyphenyl)-2-oxoacetate (1i)



Compound **1i** was isolated by flash column chromatography (10:1 *n*-pentane:Et₂O) to yield an orange oil (3.78 g, 85%); **IR** (ATR): ν (cm⁻¹) = 2982 (m), 2941 (w), 2844 (vw), 2321 (vw), 2085 (vw), 1923 (vw), 1734 (vs), 1669 (vs), 1595 (vs), 1473 (vs), 1374 (m), 1271 (vs), 1192 (vs), 1102 (vs), 990 (vs), 907 (w), 845 (s), 756 (vs), 663 (s), 585 (w), 539 (vw); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.35 (d, J = 6.3 Hz, 6H, CH(CH₃)₂), 3.84 (s, 3H, OCH₃), 5.21 (sept., J = 6.3 Hz, 1H, CH(CH₃)₂), 6.96 (d, J = 8.4 Hz, 1H, CH_{ar}), 7.04 (td, J = 0.9/7.7 Hz, 1H, CH_{ar}), 7.56 (ddd, J = 1.8/7.3/8.4 Hz, 1H, CH_{ar}), 7.86 (dd, J = 1.8/7.7 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.7 (CH(CH₃)₂, 2C), 55.7 (OCH₃), 69.8 (CH(CH₃)₂), 111.9 (CH_{ar}), 121.2 (CH_{ar}), 122.8 (C_{ar}), 130.8 (CH_{ar}), 136.2 (CH_{ar}), 160.2 (C_{ar}), 164.9 (OC=O), 186.8 (C=O) ppm; **MS** (EI, 70 eV):

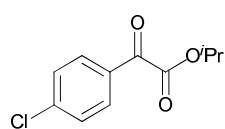
m/z (%) = 223 (13) [$M^+ + H$], 222 (32) [M^+], 135 (100); **EA** (CHN): calcd. for [$C_{12}H_{14}O_4$]: C = 64.85%, H = 6.35%, found C = 64.37%, H = 6.41%.

iso-Propyl-2-(4-fluorophenyl)-2-oxoacetate (1j)



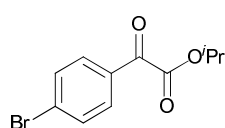
Compound **1j** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (2.22 g, 67%); **IR** (ATR): ν (cm⁻¹) = 2986 (m), 2940 (vw), 2085 (vw), 1730 (vs), 1687 (vs), 1596 (vs), 1506 (m), 1458 (w), 1414 (w), 1377 (w), 1305 (s), 1232 (s), 1199 (vs), 1153 (vs), 1101 (vs), 988 (vs), 905 (w), 854 (vs), 812 (s), 731 (w), 678 (w); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.39 (d, J = 6.3 Hz, 6H, CH(CH₃)₂), 5.29 (sept., J = 6.3 Hz, 1H, CH(CH₃)₂), 7.17 (t, J = 8.6 Hz, 2H, CH_{ar}), 8.04 (dd, J = 5.3/9.0 Hz, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.7 (CH(CH₃)₂, 2C), 70.8 (CH(CH₃)₂), 116.2 (d, J = 22.2 Hz, CH_{ar}, 2C), 129.0 (d, J = 2.8 Hz, C_{ar}), 132.8 (d, J = 9.7 Hz, CH_{ar}, 2C), 163.2 (OC=O), 166.7 (d, J = 258.1 Hz, C_{ar}), 184.8 (C=O) ppm; **¹⁹F-NMR** (376 MHz, CDCl₃): δ = -101.5 (s, 1F, CF) ppm; **MS** (ESI, pos): m/z (%) = 249 (5) [$M^+ + K$], 233 (100) [$M^+ + Na$]; **EA** (CHN): calcd. for [$C_{11}H_{11}FO_3$]: C = 62.85%, H = 5.27%, found C = 63.03%, H = 5.68%.

iso-Propyl-2-(4-chlorophenyl)-2-oxoacetate (1k)²



Compound **1k** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (2.82 g, 71%); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.39 (d, J = 6.3 Hz, 6H, CH(CH₃)₂), 5.29 (sept., J = 6.3 Hz, 1H, CH(CH₃)₂), 7.47 (d, J = 8.7 Hz, 2H, CH_{ar}), 7.94 (d, J = 8.7 Hz, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.7 (CH(CH₃)₂, 2C), 70.9 (CH(CH₃)₂), 129.3 (CH_{ar}, 2C), 130.9 (C_{ar}), 131.3 (CH_{ar}, 2C), 141.5 (C_{ar}), 162.9 (OC=O), 185.2 (C=O) ppm; **MS** (EI, 70 eV): m/z (%) = 229 (10) [$M^+ + H$, ³⁷Cl], 227 (31) [$M^+ + H$, ³⁵Cl], 185 (12), 141 (33), 139 (100).

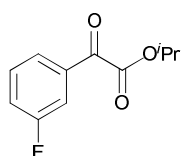
iso-Propyl-2-(4-bromophenyl)-2-oxoacetate (1l)



Compound **1l** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (2.12 g, 39%); **IR** (ATR): ν (cm⁻¹) = 2983 (m), 2937 (w), 2299 (vw), 2089 (vw), 1924 (vw), 1729 (vs), 1690 (vs), 1581 (vs), 1469 (m), 1385 (m), 1300 (s), 1198 (vs), 1100 (vs), 1071 (s), 985 (vs), 903 (vw), 847 (s), 804 (w), 764 (w), 667 (vw), 619 (vw); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.39 (d, J = 6.3 Hz, 6H, CH(CH₃)₂), 5.29 (sept., J = 6.3 Hz, 1H, CH(CH₃)₂), 7.64 (d, J = 8.7 Hz, 2H, CH_{ar}), 7.86 (d, J = 8.7 Hz, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.7

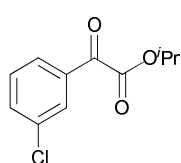
(CH(CH₃)₂, 2C), 70.9 (CH(CH₃)₂), 128.9 (C_{ar}), 129.9 (C_{ar}), 131.3 (CH_{ar}, 2C), 132.3 (CH_{ar}, 2C), 162.9 (OC=O), 185.4 (C=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 273 (12) [M⁺+H, ⁸¹Br], 272 (12) [M⁺, ⁸¹Br], 271 (12) [M⁺+H, ⁷⁹Br], 270 (11) [M⁺, ⁷⁹Br], 231 (10), 229 (10), 185 (100), 183 (100), 157 (16), 155 (17); **HRMS** (ESI): calcd. for [C₁₁H₁₁O₃BrNa]: 292.9784, found: 292.9770.

iso-Propyl-2-(3-fluorophenyl)-2-oxoacetate (1m)



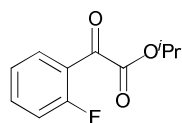
Compound **1m** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a yellow oil (2.81 g, 88%); **IR** (ATR): ν (cm⁻¹) = 2986 (w), 2940 (vw), 1731 (vs), 1692 (vs), 1588 (s), 1482 (m), 1446 (s), 1378 (w), 1308 (s), 1235 (vs), 1146 (s), 1099 (vs), 1006 (s), 907 (s), 833 (m), 790 (m), 748 (w), 671 (m); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.40 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 5.30 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 7.34 (tdd, *J* = 0.9/2.6/8.2 Hz, 1H, CH_{ar}), 7.48 (td, *J* = 5.4/8.0 Hz, 1H, CH_{ar}), 7.69 (ddd, *J* = 1.7/2.3/9.1 Hz, 1H, CH_{ar}), 7.78 (d, *J* = 7.8 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.7 (CH(CH₃)₂, 2C), 71.0 (CH(CH₃)₂), 116.4 (d, *J* = 22.9 Hz, CH_{ar}), 121.9 (d, *J* = 21.6 Hz, CH_{ar}), 125.9 (d, *J* = 3.0 Hz, CH_{ar}), 130.6 (d, *J* = 7.6 Hz, CH_{ar}), 134.5 (d, *J* = 6.6 Hz, C_{ar}), 162.7 (d, *J* = 249.1 Hz, C_{ar}), 162.9 (OC=O), 185.2 (C=O) ppm; **¹⁹F-NMR** (376 MHz, CDCl₃): δ = -110.9 (s, 1F, CF) ppm; **MS** (EI, 70 eV): *m/z* (%) = 211 (10) [M⁺+H], 210 (3) [M⁺], 169 (16), 123 (100), 95 (21); **EA** (CHN): calcd. for [C₁₁H₁₁FO₃]: C = 62.85%, H = 5.27%, found C = 62.79%, H = 5.30%.

iso-Propyl-2-(3-chlorophenyl)-2-oxoacetate (1n)



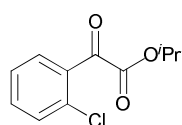
Compound **1n** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (0.69 g, 61%); **IR** (ATR): ν (cm⁻¹) = 2984 (w), 2938 (vw), 2086 (vw), 1730 (vs), 1692 (vs), 1571 (m), 1468 (w), 1422 (vw), 1376 (w), 1303 (s), 1192 (vs), 1099 (vs), 1001 (vs), 903 (m), 849 (w), 792 (m), 733 (m), 699 (m), 537 (vw); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.40 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 5.30 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 7.44 (t, *J* = 7.9 Hz, 1H, CH_{ar}), 7.60 (ddd, *J* = 1.1/2.0/7.9 Hz, 1H, CH_{ar}), 7.87 (ddd, *J* = 1.1/1.5/7.9 Hz, 1H, CH_{ar}), 7.98 (t, *J* = 2.0 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.7 (CH(CH₃)₂, 2C), 71.1 (CH(CH₃)₂), 128.1 (CH_{ar}), 129.8 (CH_{ar}), 130.2 (CH_{ar}), 134.1 (C_{ar}), 134.7 (CH_{ar}), 135.2 (C_{ar}), 162.8 (OC=O), 185.1 (C=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 229 (9) [M⁺+H, ³⁷Cl], 227 (30) [M⁺+H, ³⁵Cl], 185 (22), 141 (33), 139 (100), 111 (10); **HRMS** (ESI): calcd for [C₁₁H₁₁ClO₃Na]: 249.0289, found: 249.0279.

***iso*-Propyl-2-(2-fluorophenyl)-2-oxoacetate (1o)**



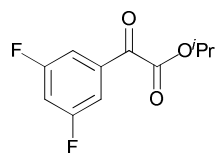
Compound **1o** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (0.58 g, 78%); **IR** (ATR): ν (cm⁻¹) = 2985 (m), 2940 (vw), 2320 (vw), 2101 (vw), 1735 (vs), 1688 (vs), 1608 (vs), 1458 (vs), 1376 (m), 1310 (s), 1260 (vs), 1199 (vs), 1153 (s), 1099 (vs), 1034 (vw), 906 (w), 847 (s), 759 (vs), 681 (w); **¹H-NMR** (600 MHz, CDCl₃): δ = 1.38 (d, J = 6.3 Hz, 6H, CH(CH₃)₂), 5.28 (sept., J = 6.3 Hz, 1H, CH(CH₃)₂), 7.13-7.18 (m, 1H, CH_{ar}), 7.29 (t, J = 7.5 Hz, 1H, CH_{ar}), 7.63 (dd, J = 7.0/13.9 Hz, 1H, CH_{ar}), 7.92 (t, J = 7.5 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (150 MHz, CDCl₃): δ = 21.5 (CH(CH₃)₂, 2C), 70.8 (CH(CH₃)₂), 116.5 (d, J = 21.7 Hz, CH_{ar}), 121.7 (d, J = 10.7 Hz, C_{ar}), 124.8 (d, J = 3.5 Hz, CH_{ar}), 130.8 (CH_{ar}), 136.6 (d, J = 9.2 Hz, CH_{ar}), 162.7 (d, J = 257.7 Hz, C_{ar}), 163.8 (OC=O), 184.3 (C=O) ppm; **¹⁹F-NMR** (564 MHz, CDCl₃): δ = -110.9 (s, 1F, CF) ppm; **MS** (EI, 70 eV): m/z (%) = 211 (18) [M⁺+H], 169 (18), 123 (100), 95 (10); **EA** (CHN): calcd. for [C₁₁H₁₁FO₃]: C = 62.85%, H = 5.27%, found C = 62.54%, H = 5.65%.

***iso*-Propyl-2-(2-chlorophenyl)-2-oxoacetate (1p)**



Compound **1p** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (0.87 g, 99%); **IR** (ATR): ν (cm⁻¹) = 2984 (m), 2938 (w), 2323 (vw), 2108 (vw), 1920 (vw), 1728 (vs), 1588 (s), 1463 (m), 1439 (s), 1376 (m), 1300 (s), 1254 (vs), 1199 (vs), 1102 (vs), 1062 (s), 985 (vs), 906 (w), 842 (s), 759 (vs), 736 (vs), 671 (vw); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.36 (d, J = 6.3 Hz, 6H, CH(CH₃)₂), 5.24 (sept., J = 6.3 Hz, 1H, CH(CH₃)₂), 7.36-7.44 (m, 2H, CH_{ar}), 7.50 (ddd, J = 1.7/7.4/8.0 Hz, 1H, CH_{ar}), 7.74 (dd, J = 1.7/7.7 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂, 2C), 71.0 (CH(CH₃)₂), 127.2 (CH_{ar}), 130.5 (CH_{ar}), 131.6 (CH_{ar}), 133.4 (C_{ar}), 133.7 (C_{ar}), 134.1 (CH_{ar}), 162.7 (OC=O), 186.9 (C=O) ppm; **MS** (EI, 70 eV): m/z (%) = 229 (2) [M⁺+H, ³⁷Cl], 227 (4) [M⁺+H, ³⁵Cl], 185 (15), 141 (32), 139 (100), 111 (18), 75 (11); **EA** (CHN): calcd. for [C₁₁H₁₁ClO₃]: C = 58.29%, H = 4.89%, found C = 58.63%, H = 5.26%.

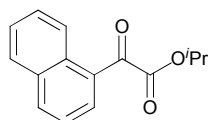
***iso*-Propyl-2-(3,5-difluorophenyl)-2-oxoacetate (1q)**



Compound **1q** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (1.87 g, 71%); **IR** (ATR): ν (cm⁻¹) = 3093 (w), 2986 (w), 2940 (vw), 2107 (vw), 1730 (vs), 1699 (vs), 1594 (vs), 1443 (vs), 1328 (vs), 1278 (vs), 1143 (vs), 1101 (vs), 1041 (s),

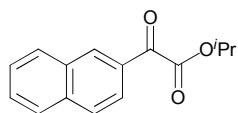
988 (s), 913 (m), 871 (s), 825 (m), 768 (w), 732 (m), 661 (w), 552 (m); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.40 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 5.29 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 7.09 (tt, *J* = 2.3/8.3 Hz, 1H, CH_{ar}), 7.53-7.56 (m, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.6 (CH(CH₃)₂, 2C), 71.4 (CH(CH₃)₂), 110.1 (t, *J* = 25.3 Hz, CH_{ar}), 112.7-113.1 (m, CH_{ar}, 2C), 135.3 (t, *J* = 8.2 Hz, C_{ar}), 162.2 (OC=O), 162.9 (d, *J* = 252.0 Hz, C_{ar}), 163.0 (d, *J* = 252.0 Hz, C_{ar}), 185.2 (C=O) ppm; **¹⁹F-NMR** (376 MHz, CDCl₃): δ = -107.1 (s, 2F, CF) ppm; **MS** (ESI, pos): *m/z* (%) = 229 (3) [M⁺+H], 251 (7) [M⁺+Na]; **EA** (CHN): calcd. for [C₁₁H₁₀F₂O₃]: C = 57.90%, H = 4.42%, found C = 58.00%, H = 4.33%.

***iso*-Propyl-2-(naphthalen-1-yl)-2-oxoacetate (1r)**



Compound **1r** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a yellow oil (1.47 g, 99%); **IR** (ATR): *v* (cm⁻¹) = 2978 (s), 2878 (w), 2321 (vw), 2088 (vw), 1811 (vw), 1723 (vs), 1466 (s), 1374 (s), 1291 (vs), 1242 (s), 1186 (m), 1145 (w), 1103 (s), 1049 (vs), 1004 (vs), 941 (vw), 907 (w), 850 (m), 731 (w); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.46 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 5.34 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 7.51-7.60 (m, 2H, CH_{ar}), 7.67 (ddd, *J* = 1.4/6.9/8.5 Hz, 1H, CH_{ar}), 7.90 (d, *J* = 8.2 Hz, 1H, CH_{ar}), 7.96 (dd, *J* = 1.1/7.3 Hz, 1H, CH_{ar}), 8.10 (d, *J* = 8.2 Hz, 1H, CH_{ar}), 9.03 (d, *J* = 8.7 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.7 (CH(CH₃)₂, 2C), 70.7 (CH(CH₃)₂), 124.3 (CH_{ar}), 125.6 (CH_{ar}), 127.0 (CH_{ar}), 128.3 (C_{ar}), 128.7 (CH_{ar}), 129.2 (CH_{ar}), 131.0 (C_{ar}), 133.8 (CH_{ar}), 133.9 (C_{ar}), 135.7 (CH_{ar}), 164.3 (OC=O), 189.1 (C=O) ppm; **MS** (+ESI): *m/z* (%) = 243 (12) [M⁺+H], 242 (18) [M⁺], 156 (13), 155 (100), 127 (18); **HRMS** (ESI): calcd. for [C₁₅H₁₄O₃Na]: 265.0835, found: 265.0827.

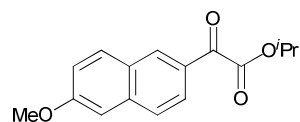
***iso*-Propyl-2-(naphthalen-2-yl)-2-oxoacetate (1s)**



Compound **1s** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a yellow oil (0.79 g, 90%); **IR** (ATR): *v* (cm⁻¹) = 3061 (vw), 2983 (m), 2937 (vw), 2325 (vw), 2110 (vw), 1918 (vw), 1729 (vs), 1679 (vs), 1626 (m), 1594 (w), 1463 (s), 1374 (s), 1306 (s), 1247 (m), 1208 (m), 1172 (vs), 1098 (vs), 1020 (s), 994 (s), 942 (m), 906 (w), 868 (w), 814 (s), 748 (s); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.44 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 5.37 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 7.54-7.59 (m, 1H, CH_{ar}), 7.61-7.66 (m, 1H, CH_{ar}), 7.88 (d, *J* = 8.2 Hz, 1H, CH_{ar}), 7.92 (d, *J* = 8.7 Hz, 1H, CH_{ar}), 7.96 (d, *J* = 8.2 Hz, 1H, CH_{ar}), 8.02 (dd, *J* = 1.7/8.7 Hz, 1H, CH_{ar}), 8.52 (br. s, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.8 (CH(CH₃)₂, 2C),

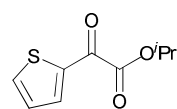
70.7 (CH(CH₃)₂), 124.0 (CH_{ar}), 127.1 (CH_{ar}), 127.9 (CH_{ar}), 128.9 (CH_{ar}), 129.5 (C_{ar}), 129.9 (CH_{ar}), 130.0 (CH_{ar}), 132.3 (C_{ar}), 133.3 (CH_{ar}), 136.3 (C_{ar}), 163.7 (OC=O), 186.6 (C=O) ppm; **MS** (ESI, pos): *m/z* (%) = 243 (13) [M⁺+H], 265 (100) [M⁺+Na], 281 (21) [M⁺+K]; **HRMS** (ESI): calcd. for [C₁₅H₁₄O₃Na]: 265.0835, found: 265.0835.

iso-Propyl-2-(6-methoxynaphthalen-2-yl)-2-oxoacetate (**1t**)



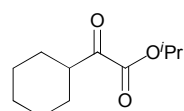
Compound **1t** was isolated by flash column chromatography (10:1 *n*-pentane:Et₂O) to yield a light yellow solid (2.20 g, 80%); Mp = 59 °C; **IR** (ATR): ν (cm⁻¹) = 2982 (m), 2941 (w), 2701 (vw), 2469 (vw), 2302 (vw), 2096 (vw), 1722 (vs), 1676 (vs), 1615 (vs), 1481 (vs), 1383 (vs), 1304 (s), 1265 (vs), 1158 (vs), 1092 (vs), 1017 (vs), 955 (w), 916 (vs), 835 (vs), 723 (s), 692 (s), 652 (vw), 605 (vw), 565 (vw), 539 (m); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.43 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 3.94 (s, 3H, OCH₃), 5.36 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 7.14 (d, *J* = 2.5 Hz, 1H, CH_{ar}), 7.20 (dd, *J* = 2.5/9.0 Hz, 1H, CH_{ar}), 7.78 (d, *J* = 8.7 Hz, 1H, CH_{ar}), 7.84 (d, *J* = 9.0 Hz, 1H, CH_{ar}), 7.98 (dd, *J* = 1.8/8.7 Hz, 1H, CH_{ar}), 8.43 (br. s, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.8 (CH(CH₃)₂, 2C), 55.5 (OCH₃), 70.5 (CH(CH₃)₂), 105.92 (CH_{ar}), 120.1 (CH_{ar}), 124.8 (CH_{ar}), 127.6 (CH_{ar}), 127.6 (C_{ar}), 127.9 (C_{ar}), 131.6 (CH_{ar}), 133.1 (CH_{ar}), 138.2 (C_{ar}), 160.6 (C_{ar}), 163.9 (OC=O), 186.3 (C=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 273 (9) [M⁺+H], 272 (39) [M⁺], 186 (13), 185 (100), 157 (14); **EA** (CHN): calcd. for [C₁₆H₁₆O₄]: C = 70.57%, H = 5.92%, found C = 70.42%, H = 6.11%.

iso-Propyl-2-oxo-2-(thiophen-2-yl)acetate (**1u**)²



Compound **1u** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a red oil (3.00 g, 95%); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.39 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 5.25 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 7.17 (dt, *J* = 6.0/12.0 Hz, 1H, CH_{ar}), 7.79 (dd, *J* = 1.1/4.9 Hz, 1H, CH_{ar}), 8.08 (dd, *J* = 1.1/3.9 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.6 (CH(CH₃)₂, 2C), 71.1 (CH(CH₃)₂), 128.6 (CH_{ar}), 137.0 (CH_{ar}), 137.2 (CH_{ar}), 139.1 (C_{ar}), 161.3 (OC=O), 176.8 (C=O) ppm; **MS** (ESI, pos): *m/z* (%) = 199 (2) [M⁺+H], 221 (100) [M⁺+Na], 237 (2) [M⁺+K].

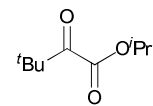
iso-Propyl-2-cyclohexyl-2-oxoacetate (**1v**)



Compound **1v** was isolated by flash column chromatography (50:1 *n*-pentane:Et₂O) to yield a light yellow oil (0.59 g, 59%); **IR** (ATR): ν (cm⁻¹) = 2931 (s), 2855 (w), 2079 (vw), 1725 (vs), 1451 (w), 1376 (w), 1259 (vs),

1179 (vw), 1015 (vs), 869 (w), 798 (vs), 697 (w); **¹H-NMR** (600 MHz, CDCl₃): δ = 1.16-1.26 (m, 1H, CH₂), 1.26-1.37 (m, 10H, CH₂ & CH(CH₃)₂), 1.67 (d, *J* = 12.7 Hz, 1H, CH₂), 1.73-1.82 (m, 2H, CH₂), 1.83-1.92 (m, 2H, CH₂), 2.93-3.04 (m, 1H, CH), 5.13 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂) ppm; **¹³C-NMR** (150 MHz, CDCl₃): δ = 21.6 (CH(CH₃)₂), 21.8 (CH(CH₃)₂), 25.3 (CH₂, 2C), 25.7 (CH₂), 27.4 (CH₂, 2C), 43.4 (CH), 70.3 (CH(CH₃)₂), 161.8 (OC=O), 198.0 (C=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 199 (100) [M⁺+H], 198 (6) [M⁺], 171 (24), 157 (60), 139 (40), 111 (70), 83 (68), 55 (51), 53 (19), 50 (22), 49 (20), 48 (76), 47 (74); **HRMS** (ESI): calcd. for [C₁₁H₁₈O₃Na]: 221.1148, found: 221.1147.

iso-Propyl-3,3-dimethyl-2-oxobutanoate (**1w**)⁵

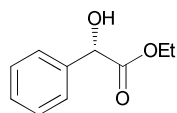
 Compound **1b** was isolated by Kugelrohr distillation to yield a colourless liquid (4.23 g, 59%). bp.= 75 °C (24 mbar); **¹H-NMR** (600 MHz, CDCl₃): δ = 1.23 (s, 9H, (C(CH₃)₃), 1.32 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 5.17 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂) ppm; **¹³C-NMR** (150 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂, 2C), 25.7 (C(CH₃)₃, 3C), 42.6 (C(CH₃)₃), 69.9 (CH(CH₃)₂), 163.7 (OC=O), 202.4 (C=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 173 (19) [M⁺+H], 172 (2) [M⁺], 131 (29), 113 (14), 85 (23), 57 (100).

General procedure for the reduction of α-keto esters:

In a dry argon-flushed Schlenk tube chiral phosphoric acid **4f** (5.3 mg, 0.0075 mmol, 5 mol%) was dissolved in dry mesitylene (1.5 mL) and 22.8 μL MgBu₂ (0.125 M in toluene, 0.00285 mmol, 1.9 mol%) were added *via* syringe. After stirring for 10 min at room temperature 25.4 μL catecholborane **3** (28.7 mg, 0.24 mmol, 1.6 equiv.) and the corresponding α-keto ester (0.15 mmol, 1.0 equiv.) were added subsequently *via* syringe. The mixture was stirred for 24 hours at room temperature and then the reaction was stopped by adding 0.9 mL sat. aqueous ammonium chloride solution. The mixture was extracted three times with diethyl ether and the combined organic phase was washed twice with 1N NaOH (3.0 mL). The organic phase was dried over Na₂SO₄ and filtrated. After evaporation of the solvent the residue was purified *via* flash column chromatography over silica gel (diethyl ether:*n*-pentane = 10:1 to 1:2) to furnish the corresponding α-hydroxy esters. Racemic samples were prepared using sodium borohydride in THF for 10 min at room temperature.

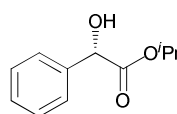
Analytical Data

(S)-Ethyl-2-hydroxy-2-phenylacetate (**2a**)⁶



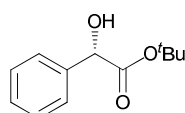
Compound **2a** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless oil (17 mg, 94%); $[\alpha]_{\text{D}}^{24} = +111.7$ (c=1.0, CHCl₃, Lit.: $[\alpha]_{\text{D}}^{24} = +118.6$ (S)); 87% *ee*; **¹H-NMR** (400 MHz, CDCl₃): $\delta = 1.21$ (t, $J = 7.1$ Hz, 3H, CH₃), 3.13 (br. s, 1H, OH), 4.09-4.30 (m, 2H, CH₂), 5.14 (s, 1H, CH), 7.27-7.37 (m, 3H, CH_{ar}), 7.38-7.41 (m, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): $\delta = 14.0$ (CH₃), 62.2 (CH₂), 72.9 (CH), 126.5 (CH_{ar}, 2C), 128.4 (CH_{ar}), 128.5 (CH_{ar}, 2C), 138.4 (C_{ar}), 173.7 (OC=O) ppm; **MS** (EI, 70 eV): m/z (%) = 181 (44) [M⁺+H], 180 (62) [M⁺], 163 (70), 108 (16), 107 (100), 105 (17), 79 (89), 77 (55), 51 (10); **HPLC**: t_{R} 11.05 min (major) 11.87 min (minor), *n*-heptane/*i*-propanol 90:10, 0.70 mL/min, Daicel Chiralpak-IA column.

(S)-iso-Propyl-2-hydroxy-2-phenylacetate (**2b**)⁷



Compound **2b** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (27 mg, 93%); Mp = 31 °C; $[\alpha]_{\text{D}}^{24} = +98.9$ (c=1.0, CHCl₃, Lit.: $[\alpha]_{\text{D}}^{24} = -91.6$ (R)); 91% *ee*; **¹H-NMR** (400 MHz, CDCl₃): $\delta = 1.09$ (d, $J = 6.3$ Hz, 3H, CH(CH₃)₂), 1.27 (d, $J = 6.3$ Hz, 3H, CH(CH₃)₂), 3.48 (d, $J = 6.0$ Hz, 1H, OH), 5.04 (sept, $J = 6.3$ Hz, 1H, CH(CH₃)₂), 5.10 (d, $J = 5.6$ Hz, 1H, CH), 7.26-7.37 (m, 3H, CH_{ar}), 7.37-7.43 (m, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): $\delta = 21.4$ (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 70.1 (CH(CH₃)₂), 72.9 (CH), 126.4 (CH_{ar}, 2C), 128.3 (CH_{ar}), 128.5 (CH_{ar}, 2C), 138.5 (C_{ar}), 173.2 (OC=O) ppm; **MS** (EI, 70 eV): m/z (%) = 194 (6) [M⁺], 107 (100), 105 (10), 85 (18), 83 (23), 79 (48), 77 (31); **HPLC**: t_{R} 5.52 min (major) 8.67 min (minor), *n*-heptane/*i*-propanol 90:10, 1.00 mL/min, Daicel Chiralpak-OD column.

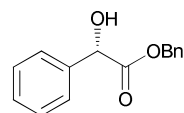
(S)-tert-Butyl 2-hydroxy-2-phenylacetate (**2c**)⁸



The reaction was conducted at 0 °C. Compound **2c** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (10 mg, 32%); Mp = 63 °C; $[\alpha]_{\text{D}}^{24} = +30.5$ (c=1.0, CHCl₃, Lit.: $[\alpha]_{\text{D}}^{24} = +108.0$ (S)); 81% *ee*; **¹H-NMR** (400 MHz, CDCl₃): $\delta = 1.39$ (s, 9H, C(CH₃)₃), 3.50 (d, $J = 6.0$ Hz, 1H, OH), 5.02 (d, $J = 6.0$ Hz, 1H, CH), 7.25-7.43 (m, 5H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): $\delta = 27.8$ (C(CH₃)₃), 73.0 (CH), 83.1 (C(CH₃)₃), 126.3 (CH_{ar}, 2C), 128.1 (CH_{ar}), 128.4 (CH_{ar}, 2C), 138.9 (C_{ar}), 172.9 (OC=O) ppm; **MS** (EI, 70 eV): m/z (%) = 107 (100)

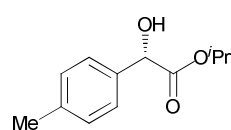
[M⁺-CO₂^tBu], 79 (37), 77 (23), 57 (86); **HPLC**: t_R 4.47 min (major) 7.02 min (minor), *n*-heptane/ethanol 90:10, 1.00 mL/min, Daicel Chiralpak OD-column.

(*S*)-Benzyl-2-hydroxy-2-phenylacetate (**2d**)⁹



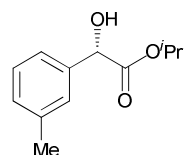
Compound **2d** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (35 mg, 97%); Mp = 90 °C; [α]_D²⁴ = +34.5 (c=1.0, CHCl₃, Lit.: [α]_D²⁴ = +53.7 (*S*)); 66% *ee*; **¹H-NMR** (400 MHz, CDCl₃): δ = 3.42 (d, *J* = 5.9 Hz, 1H, OH), 5.13 (d, *J* = 12.3 Hz, 1H, CH), 5.19-5.25 (m, 2H, CH₂), 7.13-7.22 (m, 2H, CH_{ar}), 7.26-7.46 (m, 8H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 67.7 (CH₂), 72.9 (CH), 126.6 (CH_{ar}, 2C), 127.9 (CH_{ar}, 2C), 128.4 (CH_{ar}), 128.5 (CH_{ar}, 2C), 128.6 (CH_{ar}, 2C), 135.0 (C_{ar}), 138.2 (C_{ar}), 173.5 (OC=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 107 (100) [M⁺-CO₂Bn], 91 (54), 79 (56), 77 (38), 65 (14); **HPLC**: t_R 8.22 min (major), 9.39 min (minor), *n*-heptane/*i*-propanol 70:30, 0.70 mL/min, Daicel Chiralpak AD column.

(*S*)-*iso*-Propyl-2-hydroxy-2-(4-tolyl)acetate (**2e**)



Compound **2e** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (29 mg, 94%); Mp = 51 °C; [α]_D²⁴ = + 70.2 (c=1.0, CHCl₃); 97% *ee*; **IR** (ATR): ν (cm⁻¹) = 3450 (s), 3031 (vw), 2983 (w), 2923 (w), 1724 (vs), 1513 (w), 1460 (w), 1377 (s), 1266 (m), 1188 (vs), 1143 (m), 1106 (vs), 1075 (vs), 954 (m), 930 (s), 906 (m), 866 (vw), 814 (vs), 753 (vs), 663 (s); **¹H-NMR** (600 MHz, CDCl₃): δ = 1.11 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.27 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 2.34 (s, 3H, CH₃), 3.42 (br. s, 1H, OH), 4.99-5.12 (m, 2H, CHOH & CH(CH₃)₂), 7.15 (d, *J* = 8.0 Hz, 2H, CH_{ar}), 7.29 (d, *J* = 8.0 Hz, 2H, CH_{ar}) ppm; **¹³C-NMR** (150 MHz, CDCl₃): δ = 21.1 (CH₃), 21.4 (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 70.0 (CH(CH₃)₂), 72.7 (CHOH), 126.3 (CH_{ar}, 2C), 129.2 (CH_{ar}, 2C), 135.6 (C_{ar}), 138.0 (C_{ar}), 173.4 (OC=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 209 (3) [M⁺+H], 208 (11) [M⁺], 121 (100), 93 (29), 91 (17), 77 (11); **EA** (CHN): calcd. for [C₁₂H₁₆O₃]: C = 69.21%, H = 7.74%, found C = 69.11%, H = 7.57%; **HPLC**: t_R 9.93 min (major) 11.28 min (minor), *n*-heptane:*i*-propanol 90:10, 0.70 mL/min, Daicel Chiralpak-IA column.

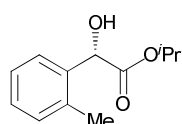
(*S*)-*iso*-Propyl-2-hydroxy-2-(3-tolyl)acetate (**2f**)



Compound **2f** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless oil (31 mg, >99%); [α]_D²⁴ = +84.1

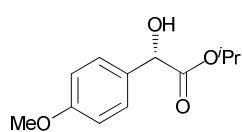
($c=1.0$, CHCl_3); 95% *ee*; **IR** (ATR): ν (cm^{-1}) = 3469 (m), 2980 (m), 2932 (m), 2322 (w), 2098 (w), 1912 (vw), 1727 (vs), 1605 (w), 1458 (m), 1377 (m), 1205 (vs), 1151 (s), 1097 (vs), 960 (w), 907 (m), 775 (s), 697 (m); **$^1\text{H-NMR}$** (400 MHz, CDCl_3): δ = 1.11 (d, J = 6.3 Hz, 3H, $\text{CH}(\text{CH}_3)_2$), 1.27 (d, J = 6.3 Hz, 3H, $\text{CH}(\text{CH}_3)_2$), 2.34 (s, 3H, CH_3), 3.43 (d, J = 6.1 Hz, 1H, OH), 4.98-5.12 (m, 2H, CHOH & $\text{CH}(\text{CH}_3)_2$), 7.11 (d, J = 7.2 Hz, 1H, CH_{ar}), 7.15-7.26 (m, 3H, CH_{ar}) ppm; **$^{13}\text{C-NMR}$** (100 MHz, CDCl_3): δ = 21.4 (CH_3), 21.4 ($\text{CH}(\text{CH}_3)_2$), 21.7 ($\text{CH}(\text{CH}_3)_2$), 70.1 ($\text{CH}(\text{CH}_3)_2$), 72.9 (CHOH), 123.6 (CH_{ar}), 127.0 (CH_{ar}), 128.4 (CH_{ar}), 129.0 (CH_{ar}), 138.2 (C_{ar}), 138.5 (C_{ar}), 173.3 (OC=O) ppm; **MS** (EI, 70 eV): m/z (%) = 209 (48) [$\text{M}^+ + \text{H}$], 208 (54) [M^+], 192 (12), 191 (95), 121 (100), 119 (12), 93 (42), 91 (28), 77 (14); **EA** (CHN): calcd. for $[\text{C}_{12}\text{H}_{16}\text{O}_3]$: C = 69.21%, H = 7.74%, found C = 69.01%, H = 7.85%; **HPLC**: t_{R} 9.26 min (major) 13.39 min (minor), *n*-heptane:ethanol 90:10, 0.50 mL/min, Daicel Chiralcel-OD column.

(*S*)-*iso*-Propyl-2-hydroxy-2-(2-tolyl)acetate (**2g**)



Compound **2g** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless oil (30 mg, 97%); $[\alpha]_{\text{D}}^{24} = +99.0$ ($c=1.0$, CHCl_3); 97% *ee*; **IR** (ATR): ν (cm^{-1}) = 3465 (m), 2981 (m), 2936 (w), 2324 (w), 2108 (w), 1918 (vw), 1726 (vs), 1461 (m), 1377 (m), 1257 (s), 1215 (vs), 1177 (s), 1103 (vs), 1069 (vs), 953 (m), 903 (w), 822 (w), 746 (vs); **$^1\text{H-NMR}$** (600 MHz, CDCl_3): δ = 1.10 (d, J = 6.3 Hz, 3H, $\text{CH}(\text{CH}_3)_2$), 1.26 (d, J = 6.3 Hz, 3H, $\text{CH}(\text{CH}_3)_2$), 2.43 (s, 3H, CH_3), 3.44 (br. s, 1H, OH), 5.07 (sept., J = 6.3 Hz, 1H, $\text{CH}(\text{CH}_3)_2$), 5.32 (s, 1H, CHOH), 7.17-7.23 (m, 3H, CH_{ar}), 7.24-7.31 (m, 1H, CH_{ar}) ppm; **$^{13}\text{C-NMR}$** (150 MHz, CDCl_3): δ = 19.3 (CH_3), 21.4 ($\text{CH}(\text{CH}_3)_2$), 21.7 ($\text{CH}(\text{CH}_3)_2$), 70.1 ($\text{CH}(\text{CH}_3)_2$), 70.4 (CHOH), 126.2 (CH_{ar}), 126.5 (CH_{ar}), 128.2 (CH_{ar}), 130.7 (CH_{ar}), 136.3 (C_{ar}), 136.9 (C_{ar}), 173.7 (OC=O) ppm; **MS** (EI, 70 eV): m/z (%) = 209 (3) [$\text{M}^+ + \text{H}$], 208 (6) [M^+], 191 (23), 190 (33), 121 (100), 93 (39), 91 (23), 77 (14); **EA** (CHN): calcd. for $[\text{C}_{12}\text{H}_{16}\text{O}_3]$: C = 69.21%, H = 7.74%, found C = 69.06%, H = 7.28%; **HPLC**: t_{R} 9.33 min (major) 10.74 min (minor), *n*-heptane:*i*-propanol 90:10, 0.70 mL/min, Daicel Chiralpak-IA column.

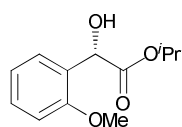
(*S*)-*iso*-Propyl-2-hydroxy-2-(4-methoxyphenyl)acetate (**2h**)



Compound **2h** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (190 mg, 85%); $\text{Mp} = 56$ °C; $[\alpha]_{\text{D}}^{24} = +94.2$ ($c=1.0$, CHCl_3); 97% *ee*; **IR** (ATR): ν (cm^{-1}) = 3440 (m), 2969 (m), 2838 (vw), 2325 (vw), 2049 (vw), 1728 (vs), 1608 (m), 1510 (s), 1456 (m), 1373

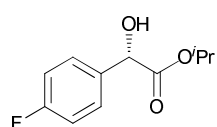
(s), 1246 (vs), 1186 (vs), 1105 (vs), 1065 (vs), 951 (w), 820 (vs), 754 (s); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.10 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.26 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 3.41 (d, *J* = 5.8 Hz, 1H, OH), 3.78 (s, 3H, OCH₃), 4.97-5.11 (m, 2H, CHOH & CH(CH₃)₂), 6.86 (d, *J* = 8.7 Hz, 2H, CH_{ar}), 7.30 (d, *J* = 8.7 Hz, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 55.2 (OCH₃), 70.0 (CH(CH₃)₂), 72.5 (CHOH), 113.9 (CH_{ar}, 2C), 127.7 (CH_{ar}, 2C), 130.8 (C_{ar}), 159.6 (C_{ar}), 173.4 (OC=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 225 (13) [M⁺+H], 224 (92) [M⁺], 207 (61), 137 (100); **EA** (CHN): calcd. for [C₁₂H₁₆O₄]: C = 64.27%, H = 7.19%, found C = 64.13%, H = 6.90%; **HPLC**: t_R 8.18 min (major) 12.42 min (minor), *n*-heptane:ethanol 90:10, 0.70 mL/min, Daicel Chiralcel-OD column.

(S)-*iso*-Propyl-2-hydroxy-2-(2-methoxyphenyl)acetate (**2i**)



Compound **2i** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a light yellow oil (33 mg, >99%); [α]_D²⁴ = +70.3 (c=1.0, CHCl₃); 96% *ee*; **IR** (ATR): ν (cm⁻¹) = 3482 (m), 2981 (m), 2939 (w), 2839 (vw), 2323 (w), 2109 (w), 1910 (vw), 1727 (vs), 1597 (s), 1493 (vs), 1462 (s), 1377 (m), 1246 (vs), 1105 (vs), 1068 (vs), 1027 (vs), 957 (m), 904 (w), 868 (vw), 823 (w), 755 (vs); **¹H-NMR** (600 MHz, CDCl₃): δ = 1.12 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.23 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 3.55 (br. s, 1H, OH), 3.82 (s, 3H, OCH₃), 5.09 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 5.21 (s, 1H, CHOH), 6.88 (d, *J* = 8.2 Hz, 1H, CH_{ar}), 6.94 (t, *J* = 7.4 Hz, 1H, CH_{ar}), 7.25 (d, *J* = 6.7 Hz, 1H, CH_{ar}), 7.30 (t, *J* = 7.8 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (150 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 55.4 (OCH₃), 69.4 (CH(CH₃)₂), 70.5 (CHOH), 111.0 (CH_{ar}), 120.7 (CH_{ar}), 127.3 (C_{ar}), 129.5 (CH_{ar}), 129.8 (CH_{ar}), 157.1 (C_{ar}), 173.3 (OC=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 225 (3) [M⁺+H], 224 (12) [M⁺], 137 (100), 107 (22), 83 (14); **EA** (CHN): calcd. for [C₁₂H₁₆O₄]: C = 64.27%, H = 7.19%, found C = 64.20%, H = 7.36%; **HPLC**: t_R 12.55 min (major) 15.25 min (minor), *n*-heptane:ethanol 90:10, 0.50 mL/min, Daicel Chiralcel-OD column.

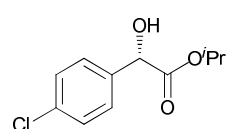
(S)-*iso*-Propyl-2-(4-fluorophenyl)-2-hydroxyacetate (**2j**)



Compound **2j** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a light yellow solid (30 mg, 95%); Mp = 40 °C; [α]_D²⁴ = +100.7 (c=1.0, CHCl₃); 97% *ee*; **IR** (ATR): ν (cm⁻¹) = 3439 (s), 2989 (m), 2941 (w), 2598 (vw), 2323 (vw), 2198 (vw), 2160 (vw), 1989 (vw), 1724 (vs), 1605 (m), 1508 (s), 1459 (w), 1374 (s), 1210 (vs), 1074 (vs), 939 (m), 815 (vs), 759 (s), 673

(m); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.09 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.26 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 3.51 (d, *J* = 5.6 Hz, 1H, OH), 4.99-5.13 (m, 2H, CHOH & CH(CH₃)₂), 6.99-7.06 (m, 2H, CH_{ar}), 7.34-7.41 (m, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 70.3 (CH(CH₃)₂), 72.2 (CHOH), 115.4 (d, *J* = 21.6 Hz, CH_{ar}, 2C), 128.1 (d, *J* = 8.2 Hz, CH_{ar}, 2C), 134.3 (C_{ar}), 162.6 (d, *J* = 246.6 Hz, C_{ar}), 173.0 (OC=O) ppm; **¹⁹F-NMR** (376 MHz, CDCl₃): δ = -114.0 (s, 1F, CF) ppm; **MS** (EI, 70 eV): *m/z* (%) = 213 (28) [M⁺+H], 212 (44) [M⁺], 195 (49), 125 (100), 123 (16), 97 (29), 95 (14), 77 (10); **EA** (CHN): calcd. for [C₁₁H₁₃F₁O₃]: C = 62.26%, H = 6.17%, found C = 62.23%, H = 6.32%; **HPLC**: t_R 9.58 min (major) 10.27 min (minor), *n*-heptane:*i*-propanol 90:10, 0.70 mL/min, Daicel Chiralpak-IA column.

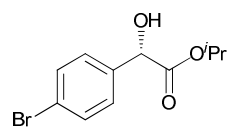
(S)-iso-Propyl-2-(4-chlorophenyl)-2-hydroxyacetate (2k)¹⁰



Compound **2k** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (33 mg, 97%); Mp = 50 °C; [α]_D²⁴ = +87.8 (c=1.0, CHCl₃); 95% *ee*; **¹H-NMR** (400 MHz, CDCl₃): δ =

1.10 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.27 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 3.50 (d, *J* = 5.6 Hz, 1H, OH), 4.98-5.11 (m, 2H, CHOH & CH(CH₃)₂), 7.31 (d, *J* = 8.6 Hz, 2H, CH_{ar}), 7.35 (d, *J* = 8.6 Hz, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 70.5 (CH(CH₃)₂), 72.2 (CHOH), 127.8 (CH_{ar}, 2C), 128.6 (CH_{ar}, 2C), 134.3 (C_{ar}), 137.0 (C_{ar}), 172.8 (OC=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 231 (22) [M⁺+H, ³⁷Cl], 230 (21) [M⁺, ³⁷Cl], 229 (66) [M⁺+H, ³⁵Cl], 228 (41) [M⁺, ³⁵Cl], 213 (33), 212 (11), 211 (100), 143 (21), 141 (65), 77 (15); **HPLC**: R_t = 8.54 min (major) 9.75 min (minor), *n*-heptane:ethanol 95:5, 0.70 mL/min, Daicel Chiralpak-AS column.

(S)-iso-Propyl-2-(4-bromophenyl)-2-hydroxyacetate (2l)

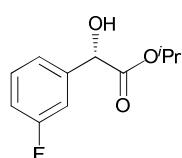


Compound **2l** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (41 mg, >99%); Mp = 69 °C; [α]_D²⁴ = +71.2 (c=1.0, CHCl₃); 91% *ee*; **IR** (ATR): ν (cm⁻¹) = 3438 (s),

2980 (w), 2936 (w), 1731 (vs), 1480 (m), 1379 (s), 1194 (vs), 1079 (vs), 1010 (s), 943 (m), 821 (vs), 776 (s), 698 (m); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.10 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.27 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 3.50 (d, *J* = 5.6 Hz, 1H, OH), 4.97-5.09 (m, 2H, CHOH & CH(CH₃)₂), 7.29 (d, *J* = 8.4 Hz, 2H, CH_{ar}), 7.47 (d, *J* = 8.4 Hz, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 70.5 (CH(CH₃)₂), 72.2 (CHOH), 122.3 (C_{ar}), 128.1 (CH_{ar}, 2C), 131.6 (CH_{ar}, 2C), 137.5 (C_{ar}), 172.7 (OC=O) ppm;

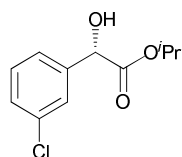
MS (EI, 70 eV): m/z (%) = 275 (15) [$M^+ + H$, ^{81}Br], 274 (44) [M^+ , ^{81}Br], 273 (15) [$M^+ + H$, ^{79}Br], 272 (43) [M^+ , ^{79}Br], 257 (21), 255 (21), 187 (93), 185 (100), 157 (11). **EA** (CHN): calcd. for $[\text{C}_{11}\text{H}_{13}\text{Br}_1\text{O}_3]$: C = 48.37%, H = 4.80%, found C = 48.84%, H = 5.08%; **HPLC**: t_R 10.37 min (major) 11.37 min (minor), *n*-heptane:*i*-propanol 90:10, 0.70 mL/min, Daicel Chiralpak-IA column.

(S)-iso-Propyl-2-(3-fluorophenyl)-2-hydroxyacetate (2m)



Compound **2m** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (32 mg, >99%); Mp = 34 °C; $[\alpha]_D^{24} = +84.3$ (c=1.0, CHCl₃); 93% *ee*; **IR** (ATR): ν (cm⁻¹) = 3434 (s), 2984 (w), 1725 (vs), 1595 (s), 1452 (m), 1383 (m), 1206 (vs), 1095 (vs), 916 (s), 822 (m), 753 (s), 683 (s); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.11 (d, J = 6.3 Hz, 3H, CH(CH₃)₂), 1.28 (d, J = 6.3 Hz, 3H, CH(CH₃)₂), 3.54 (d, J = 5.8 Hz, 1H, OH), 5.00-5.11 (m, 2H, CHOH & CH(CH₃)₂), 6.99 (td, J = 8.3 Hz, 1H, CH_{ar}), 7.10-7.16 (m, 1H, CH_{ar}), 7.20 (d, J = 7.8 Hz, 1H, CH_{ar}), 7.30 (td, J = 7.8/5.8 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 70.5 (CH(CH₃)₂), 72.2 (CHOH), 113.4 (d, J = 22.8 Hz, CH_{ar}), 115.1 (d, J = 21.2 Hz, CH_{ar}), 122.0 (d, J = 2.9 Hz, CH_{ar}), 129.9 (d, J = 8.1 Hz, CH_{ar}), 140.9 (d, J = 7.2 Hz, C_{ar}), 162.8 (d, J = 246.2 Hz, C_{ar}), 172.7 (OC=O) ppm; **¹⁹F-NMR** (376 MHz, CDCl₃): δ = -112.8 (s, 1F, CF) ppm. **MS** (EI, 70 eV): m/z (%) = 213 (30) [$M^+ + H$], 212 (33) [M^+], 195 (10), 171 (16), 125 (100), 97 (39), 95 (10); **EA** (CHN): calcd. for $[\text{C}_{11}\text{H}_{13}\text{F}_1\text{O}_3]$: C = 62.26%, H = 6.17%, found C = 61.81%, H = 6.39%; **Chiral GC**: t_R 20.05 min (major) 22.34 min (minor), 11.6 psi H₂, Lipodex E, 100-10iso-1-120-3-180-20iso.

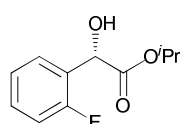
(S)-iso-Propyl-2-(3-chlorophenyl)-2-hydroxyacetate (2n)



Compound **2n** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a light yellow oil (30 mg, 88%); $[\alpha]_D^{24} = +74.6$ (c=1.0, CHCl₃); 89% *ee*; **IR** (ATR): ν (cm⁻¹) = 3456 (m), 2983 (m), 2937 (w), 2326 (w), 2085 (vw), 1728 (vs), 1576 (m), 1473 (m), 1429 (w), 1377 (m), 1274 (s), 1184 (vs), 1101 (vs), 959 (w), 902 (s), 773 (s), 689 (s); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.12 (d, J = 6.3 Hz, 3H, CH(CH₃)₂), 1.29 (d, J = 6.3 Hz, 3H, CH(CH₃)₂), 3.52 (br. s, 1H, OH), 5.02-5.14 (m, 2H, CHOH & CH(CH₃)₂), 7.26-7.34 (m, 3H, CH_{ar}), 7.44 (s, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 70.6 (CH(CH₃)₂), 72.2 (CHOH), 124.6 (CH_{ar}), 126.6 (CH_{ar}), 128.4 (CH_{ar}), 129.7 (CH_{ar}), 134.4 (C_{ar}), 140.4 (C_{ar}), 172.6 (OC=O) ppm; **MS** (EI, 70 eV): m/z (%) = 231 (6) [$M^+ + H$, ^{37}Cl], 230

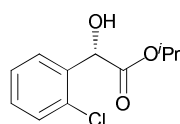
(10) $[M^+, ^{37}\text{Cl}]$, 229 (16) $[M^++H, ^{35}\text{Cl}]$, 228 (24) $[M^+, ^{35}\text{Cl}]$, 187 (11), 143 (31), 141 (100), 113 (25), 77 (32); **EA** (CHN): calcd. for $[\text{C}_{11}\text{H}_{13}\text{Cl}_2\text{O}_3]$: C = 57.78%, H = 5.73%, found C = 58.03%, H = 6.06%; **HPLC**: t_R 9.37 min (major) 10.09 min (minor), *n*-heptane:*i*-propanol 90:10, 0.70 mL/min, Daicel Chiralpak-IA column.

(S)-iso-Propyl-2-(2-fluorophenyl)-2-hydroxyacetate (2o)



Compound **2o** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a yellow oil (28 mg, 90%); $[\alpha]_D^{24} = +85.5$ (c=1.0, CHCl₃); 95% *ee*; **IR** (ATR): ν (cm⁻¹) = 3461 (m), 2983 (m), 2319 (vw), 2098 (vw), 1729 (vs), 1590 (m), 1489 (s), 1458 (s), 1378 (m), 1228 (vs), 1098 (vs), 951 (m), 903 (w), 822 (m), 759 (vs); **¹H-NMR** (400 MHz, CDCl₃): δ = 1.10 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.25 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 3.55 (d, *J* = 5.5 Hz, 1H, OH), 5.08 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 5.32 (d, *J* = 5.5 Hz, 1H, CHOH), 7.01-7.08 (m, 1H, CH_{ar}), 7.09-7.16 (m, 1H, CH_{ar}), 7.25-7.38 (m, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.3 (CH(CH₃)₂), 21.6 (CH(CH₃)₂), 67.7 (CH(CH₃)₂), 70.4 (CHOH), 115.6 (d, *J* = 21.6 Hz, CH_{ar}), 124.2 (d, *J* = 3.5 Hz, CH_{ar}), 126.0 (d, *J* = 14.0 Hz, C_{ar}), 128.6 (d, *J* = 3.8 Hz, CH_{ar}), 130.1 (d, *J* = 8.2 Hz, CH_{ar}), 160.5 (d, *J* = 248.5 Hz, C_{ar}), 172.7 (OC=O) ppm; **¹⁹F-NMR** (376 MHz, CDCl₃): δ = -118.3 (s, 1F, CF) ppm. **MS** (EI, 70 eV): *m/z* (%) = 213 (42) $[M^++H]$, 212 (56) $[M^+]$, 195 (16), 187 (25), 185 (29), 125 (100), 123 (23), 97 (29), 95 (13), 77 (16), 45 (11); **EA** (CHN): calcd. for $[\text{C}_{11}\text{H}_{13}\text{FO}_3]$: C = 62.26%, H = 6.17%, found C = 62.48%, H = 6.41%; **Chiral GC**: R_t = 46.66 min (major) 47.26 min (minor), 11.6 psi H₂, CP-Chirasil-dex CB, 60-10iso-1-80-3-180-30iso.

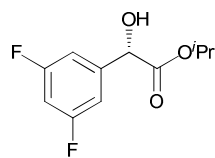
(S)-iso-Propyl-2-(2-chlorophenyl)-2-hydroxyacetate (2p)¹¹



Compound **2p** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a yellow oil (32 mg, 94%); $[\alpha]_D^{24} = +103.8$ (c=1.0, CHCl₃, Lit.: $[\alpha]_D^{24} = +56.7$ (S)); 83% *ee*; **¹H-NMR** (400 MHz, CDCl₃): δ = 1.11 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.26 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 3.59 (br. s, 1H, OH), 5.08 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 5.50 (s, 1H, CHOH), 7.23-7.28 (m, 2H, CH_{ar}), 7.34-7.40 (m, 2H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂), 21.6 (CH(CH₃)₂), 70.4 (CH(CH₃)₂), 70.5 (CHOH), 127.0 (CH_{ar}), 128.6 (CH_{ar}), 129.6 (CH_{ar}), 129.9 (CH_{ar}), 133.6 (C_{ar}), 136.3 (C_{ar}), 172.7 (OC=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 231 (3) $[M^++H, ^{37}\text{Cl}]$, 230 (4) $[M^+, ^{37}\text{Cl}]$, 229 (6) $[M^++H, ^{35}\text{Cl}]$, 228 (9) $[M^+, ^{35}\text{Cl}]$, 187 (13), 185

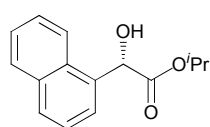
(11), 143 (31), 141 (100), 113 (13), 77 (28); **HPLC**: t_R 11.76 min (major) 13.80 min (minor), *n*-heptane:*i*-propanol 97:3, 1.00 mL/min, Daicel Chiralpak-AD column.

(S)-iso-Propyl-2-(3,5-difluorophenyl)-2-hydroxyacetate (2q)



Compound **2q** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (34 mg, >99%); Mp = 46 °C; $[\alpha]_D^{24} = +69.6$ (c=1.0, CHCl₃); 88% *ee*; **IR** (ATR): ν (cm⁻¹) = 3440 (s), 3102 (vw), 2988 (w), 1727 (vs), 1598 (s), 1459 (s), 1381 (m), 1293 (s), 1214 (vs), 1098 (vs), 977 (s), 932 (w), 905 (vw), 853 (s), 815 (s), 723 (w), 684 (w); **¹H-NMR** (600 MHz, CDCl₃): δ = 1.15 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.30 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 3.57 (br. s, 1H, OH), 5.03-5.12 (m, 2H, CH(CH₃)₂ & CHOH), 6.74 (t, *J* = 8.8 Hz, 1H, CH_{ar}), 6.99 (d, *J* = 6.1 Hz, 2H, CH_{ar}) ppm; **¹³C-NMR** (150 MHz, CDCl₃): δ = 21.4 (CH(CH₃)₂), 21.6 (CH(CH₃)₂), 71.0 (CH(CH₃)₂), 71.7 (CHOH), 103.6 (t, *J* = 25.4 Hz, CH_{ar}), 109.3 (dd, *J* = 21.0/5.5 Hz, CH_{ar}, 2C), 142.3 (t, *J* = 8.9 Hz, C_{ar}), 162.9 (d, *J* = 248.9 Hz, C_{ar}), 163.0 (d, *J* = 248.9 Hz, C_{ar}), 172.1 (OC=O) ppm; **¹⁹F-NMR** (564 MHz, CDCl₃): δ = -109.3 (s, 2F, CF) ppm; **MS** (EI, 70 eV): *m/z* (%) = 231 (21) [M⁺+H], 230 (8) [M⁺], 189 (22), 143 (100), 115 (33), 95 (10); **EA** (CHN): calcd. for [C₁₁H₁₂F₂O₃]: C = 57.39%, H = 5.25%, found C = 57.88%, H = 5.18%; **HPLC**: t_R 8.27 min (major) 9.041 min (minor), *n*-heptane:*i*-propanol 90:10, 0.70 mL/min, Daicel Chiralpak-IA column.

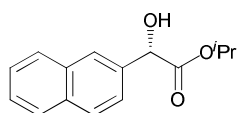
(S)-iso-Propyl-2-(naphthalen-1-yl)-2-oxoacetate (2r)



Compound **2r** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a light yellow oil (36 mg, >99%); $[\alpha]_D^{24} = +87.7$ (c=1.0, CHCl₃); 90% *ee*; **IR** (ATR): ν (cm⁻¹) = 3458 (m), 3052 (w), 2980 (m), 2323 (w), 2091 (w), 1925 (vw), 1724 (vs), 1598 (w), 1512 (w), 1458 (w), 1376 (m), 1221 (vs), 1097 (vs), 949 (m), 905 (w), 785 (vs); **¹H-NMR** (400 MHz, CDCl₃): δ = 0.99 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.23 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 3.56 (d, *J* = 5.1 Hz, 1H, OH), 5.09 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 5.76 (d, *J* = 5.1 Hz, 1H, CHOH), 7.39-7.56 (m, 4H, CH_{ar}), 7.80-7.88 (m, 2H, CH_{ar}), 8.16 (d, *J* = 8.3 Hz, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): δ = 21.3 (CH(CH₃)₂), 21.6 (CH(CH₃)₂), 70.3 (CH(CH₃)₂), 71.4 (CHOH), 123.8 (CH_{ar}), 125.2 (CH_{ar}), 125.6 (CH_{ar}), 125.8 (CH_{ar}), 126.4 (CH_{ar}), 128.7 (CH_{ar}), 129.3 (CH_{ar}), 131.1 (C_{ar}), 134.0 (C_{ar}), 134.3 (C_{ar}), 173.7 (OC=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 245 (11) [M⁺+H], 244 (57) [M⁺], 228 (16), 227 (100), 157 (12); **EA** (CHN): calcd. for [C₁₅H₁₆O₃]: C = 73.75%,

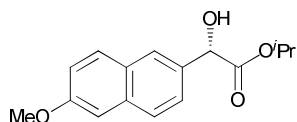
H = 6.60%, found C = 73.53%, H = 6.92%; **HPLC**: t_R 13.35 min (major) 14.79 min (minor), *n*-heptane:*i*-propanol 90:10, 0.70 mL/min, Daicel Chiralpak-IA column.

(S)-iso-Propyl-2-(naphthalen-2-yl)-2-oxoacetate (2s)¹⁰



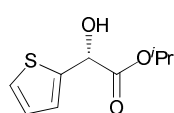
Compound **2s** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (35 mg, 97%); Mp = 74 °C; $[\alpha]_D^{24} = +86.2$ (c=1.0, CHCl₃); 94% *ee*; **¹H-NMR** (400 MHz, CDCl₃): $\delta = 1.08$ (d, $J = 6.3$ Hz, 3H, CH(CH₃)₂), 1.28 (d, $J = 6.3$ Hz, 3H, CH(CH₃)₂), 3.61 (d, $J = 5.8$ Hz, 1H, OH), 5.07 (sept., $J = 6.3$ Hz, 1H, CH(CH₃)₂), 5.28 (d, $J = 5.8$ Hz, 1H, CHOH), 7.41-7.56 (m, 3H, CH_{ar}), 7.78-7.87 (m, 3H, CH_{ar}), 7.90 (s, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): $\delta = 21.4$ (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 70.3 (CH(CH₃)₂), 73.0 (CHOH), 124.1 (CH_{ar}), 125.7 (CH_{ar}), 126.2 (CH_{ar}, 2C), 127.7 (CH_{ar}), 128.1 (CH_{ar}), 128.3 (CH_{ar}), 133.2 (C_{ar}), 133.2 (C_{ar}), 135.9 (C_{ar}), 173.2 (OC=O) ppm; **MS** (EI, 70 eV): m/z (%) = 245 (12) [M⁺+H], 244 (60) [M⁺], 228 (10), 227 (63), 158 (11), 157 (100), 155 (10), 129 (65), 128 (10), 127 (18); **HPLC**: t_R 14.61 min (major) 18.06 min (minor), *n*-heptane:ethanol 95:5, 0.50 mL/min, Daicel Chiralpak-AS column.

(S)-iso-Propyl-2-(6-methoxynaphthalen-2-yl)-2-oxoacetate (2t)



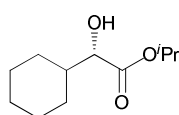
Compound **2t** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (41 mg, >99%); Mp = 98 °C; $[\alpha]_D^{24} = +80.2$ (c=1.0, CHCl₃); 97% *ee*; **IR** (ATR): δ (cm⁻¹) = 3482 (m), 2981 (m), 2322 (vw), 1726 (vs), 1607 (s), 1469 (s), 1383 (s), 1271 (vs), 1206 (vs), 1104 (vs), 1057 (vs), 967 (w), 908 (s), 857 (vs), 819 (vs), 756 (m), 685 (m); **¹H-NMR** (400 MHz, CDCl₃): $\delta = 1.07$ (d, $J = 6.3$ Hz, 3H, CH(CH₃)₂), 1.27 (d, $J = 6.3$ Hz, 3H, CH(CH₃)₂), 3.57 (d, $J = 5.8$ Hz, 1H, OH), 3.90 (s, 3H, OCH₃), 5.07 (sept., $J = 6.3$ Hz, 1H, CH(CH₃)₂), 5.23 (d, $J = 5.8$ Hz, 1H, CHOH), 7.09-7.17 (m, 2H, CH_{ar}), 7.45 (dd, $J = 1.7/8.5$ Hz, 1H, CH_{ar}), 7.71 (d, $J = 4.3$ Hz, 1H, CH_{ar}), 7.73 (d, $J = 4.3$ Hz, 1H, CH_{ar}), 7.80 (s, 1H, CH_{ar}) ppm; **¹³C-NMR** (100 MHz, CDCl₃): $\delta = 21.4$ (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 55.3 (OCH₃), 70.2 (CH(CH₃)₂), 73.0 (CHOH), 105.6 (CH_{ar}), 119.1 (CH_{ar}), 124.6 (CH_{ar}), 125.6 (CH_{ar}), 127.1 (CH_{ar}), 128.6 (C_{ar}), 129.6 (CH_{ar}), 133.7 (C_{ar}), 134.4 (C_{ar}), 157.9 (C_{ar}), 173.3 (OC=O) ppm; **MS** (EI, 70 eV): m/z (%) = 275 (11) [M⁺+H], 274 (60) [M⁺], 257 (27), 188 (13), 187 (100), 159 (18), 144 (16); **EA** (CHN): calcd. for [C₁₆H₁₈O₄]: C = 70.06%, H = 6.61%, found C = 69.67%, H = 6.68%; **HPLC**: $R_t = 17.03$ min (major) 21.91 min (minor), *n*-heptane:*i*-propanol 90:10, 0.7 mL/min, Daicel Chiralpak-IA column.

(S)-iso-Propyl-2-hydroxy-2-(thiophen-2-yl)acetate (2u)¹⁰



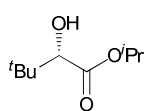
Compound **2u** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a yellow oil (29 mg, 97%); $[\alpha]_{\text{D}}^{24} = +58.5$ (c=1.0, CHCl₃); 96% *ee*; **¹H-NMR** (600 MHz, CDCl₃): $\delta = 1.22$ (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 1.31 (d, *J* = 6.3 Hz, 3H, CH(CH₃)₂), 3.51 (br. s, 1H, OH), 5.12 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂), 5.35 (s, 1H, CHOH), 6.96-7.00 (m, 1H, CH_{ar}), 7.09 (d, *J* = 2.8 Hz, 1H, CH_{ar}), 7.24-7.28 (m, 1H, CH_{ar}) ppm; **¹³C-NMR** (150 MHz, CDCl₃): $\delta = 21.4$ (CH(CH₃)₂), 21.7 (CH(CH₃)₂), 69.1 (CH(CH₃)₂), 70.6 (CHOH), 125.1 (CH_{ar}), 125.5 (CH_{ar}), 126.9 (CH_{ar}), 141.7 (C_{ar}), 172.0 (OC=O) ppm; **MS** (ESI, pos): *m/z* (%) = 223 (100) [M⁺+Na], 239 (4) [M⁺+K]; **HPLC**: *t_R* 7.54 min (minor) 8.06 min (major), *n*-heptan:*i*-propanol 80:20, 0.50 mL/min, Daicel Chiralpak-IC column.

(S)-iso-Propyl-2-cyclohexyl-2-hydroxyacetate (2v)



Compound **2v** was isolated by flash column chromatography (4:1 *n*-pentane:Et₂O) to yield a colourless solid (29 mg, 97%); Mp = 39 °C; $[\alpha]_{\text{D}}^{24} = +5.7$ (c=1.0, CHCl₃); 70% *ee*; **IR** (ATR): ν (cm⁻¹) = 3512 (m), 2980 (m), 2926 (vs), 2855 (s), 2320 (w), 2106 (w), 1913 (vw), 1724 (vs), 1451 (s), 1376 (m), 1260 (vs), 1219 (vs), 1142 (m), 1104 (vs), 1002 (vw), 976 (m), 903 (m), 823 (w), 708 (w); **¹H-NMR** (600 MHz, CDCl₃): $\delta = 1.05$ (m, 11H, CH(CH₃)₂ & CH₂), 1.43 (d, *J* = 6.6 Hz, 1H, CH), 1.60-1.82 (m, 5H, CH₂), 2.69 (br. s, 1H, OH), 3.95 (d, *J* = 3.0 Hz, 1H, CHOH), 5.10 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂) ppm; **¹³C-NMR** (150 MHz, CDCl₃): $\delta = 21.8$ (CH(CH₃)₂), 21.8 (CH(CH₃)₂), 26.0 (CH₂), 26.1 (CH₂), 26.2 (CH₂), 26.3 (CH₂), 29.1 (CH₂), 42.0 (CH), 69.4 (CH(CH₃)₂), 74.7 (CHOH), 174.4 (OC=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 201 (4) [M⁺+H], 118 (23), 113 (46), 95 (100), 76 (22), 55 (14); **EA** (HRMS, ESI): calcd. for [C₁₁H₂₀O₃Na; M⁺+Na]: *m/z* (+) = 223.1305 found *m/z* (+) = 223.1305; **Chiral GC**: *t_R* 45.97 min (major) 47.04 min (minor), 11.6 psi H₂, CP-Chirasil-dex CB, 60-10iso-1-80-3-180-30iso.

(S)-iso-Propyl-2-hydroxy-3,3-dimethylbutanoate (2w)¹²



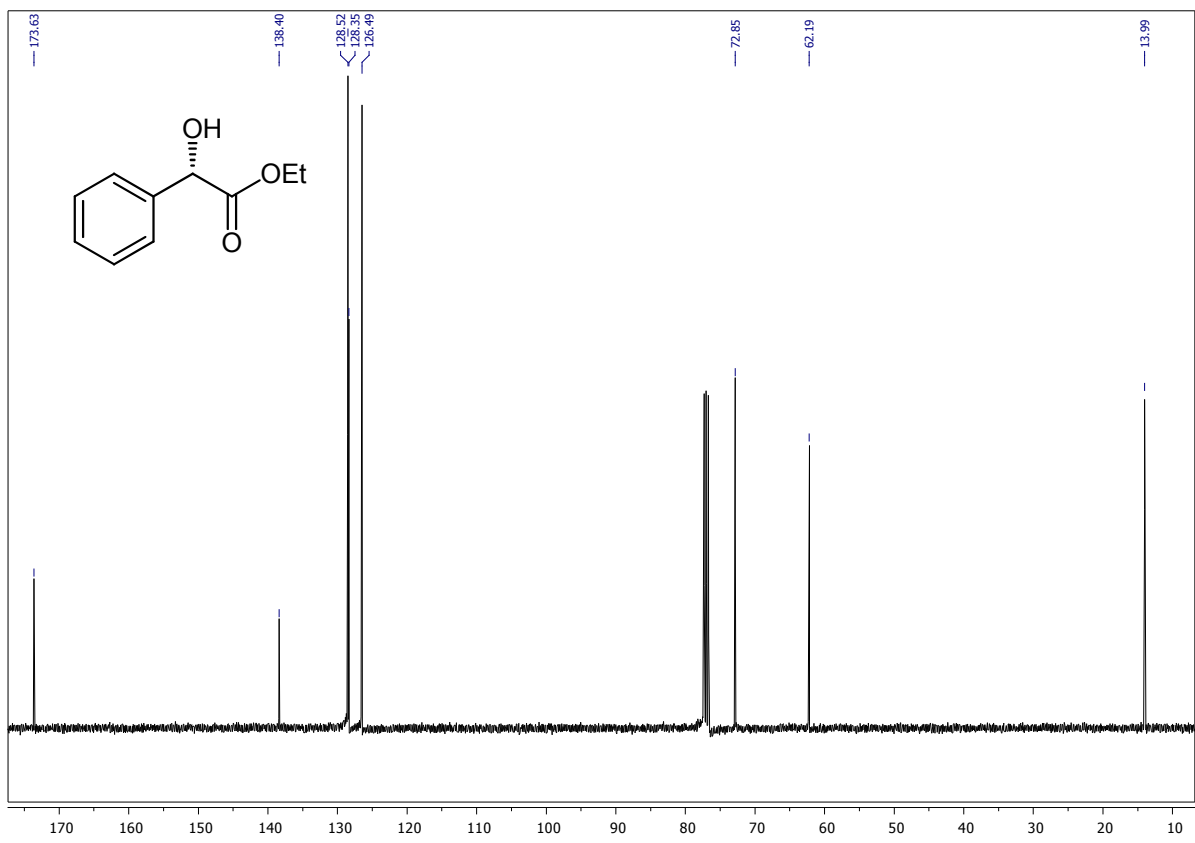
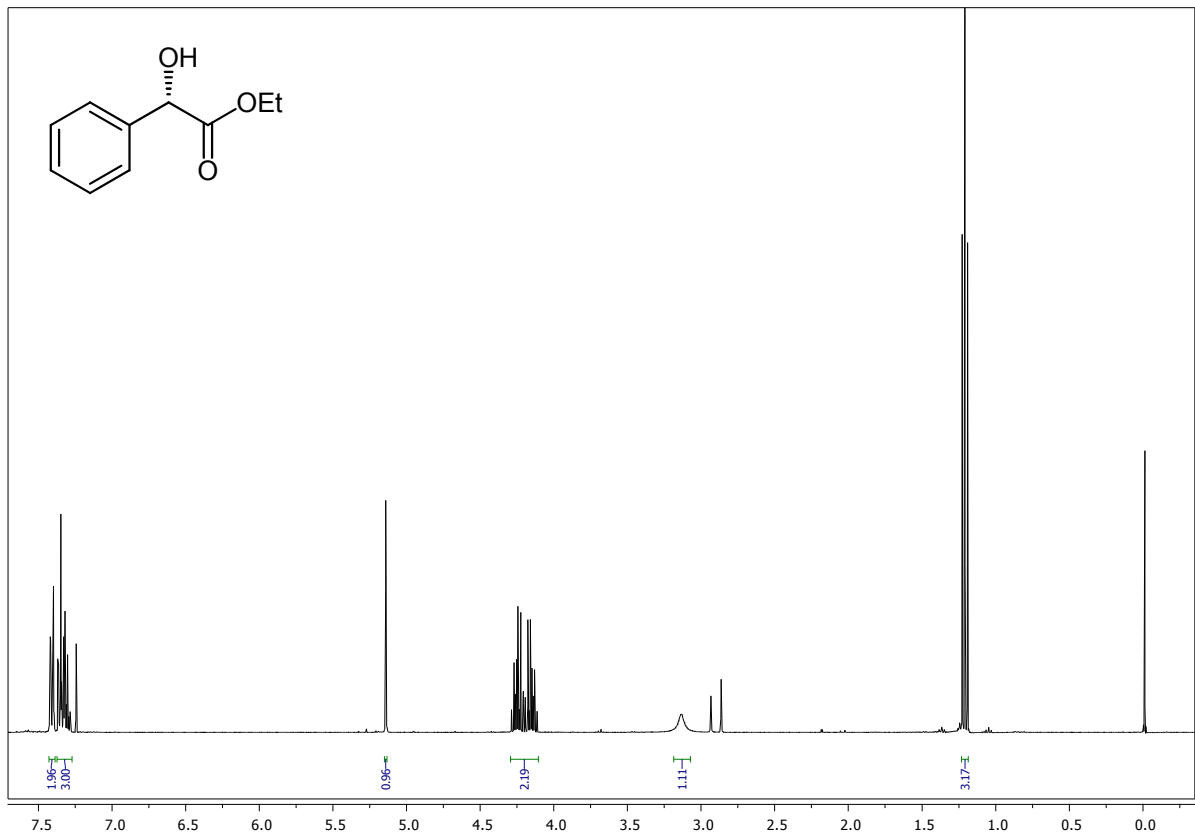
Compound **2w** was isolated by flash column chromatography (10:1 *n*-pentane:Et₂O) to yield a yellow oil (26 mg, >99%); $[\alpha]_{\text{D}}^{24} = +13.3$ (c=1.0, CHCl₃, Lit.: $[\alpha]_{\text{D}}^{24} = -24.4$ (*R*)); 73.5% *ee*; **¹H-NMR** (600 MHz, CDCl₃): $\delta = 0.97$ (s, 9H, C(CH₃)₃), 1.29 (d, *J* = 6.3 Hz, 6H, CH(CH₃)₂), 2.82 (d, *J* = 6.2 Hz, 1H, OH), 3.74 (d, *J* = 5.1 Hz, 1H, CHOH), 5.12 (sept., *J* = 6.3 Hz, 1H, CH(CH₃)₂) ppm; **¹³C-NMR** (150 MHz, CDCl₃): $\delta = 21.4$ (CH(CH₃)₂), 21.4 (CH(CH₃)₂), 25.8 (C(CH₃)₃, 3C), 35.3 (C(CH₃)₃),

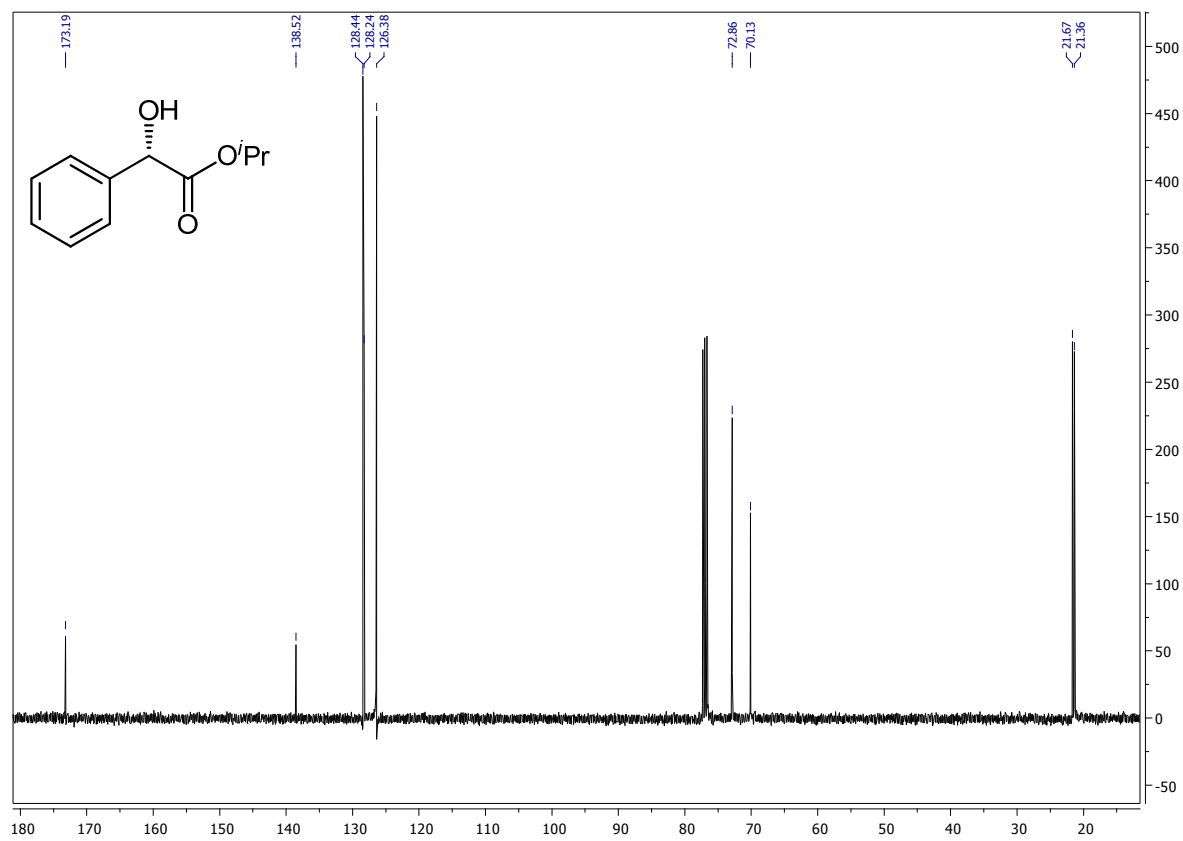
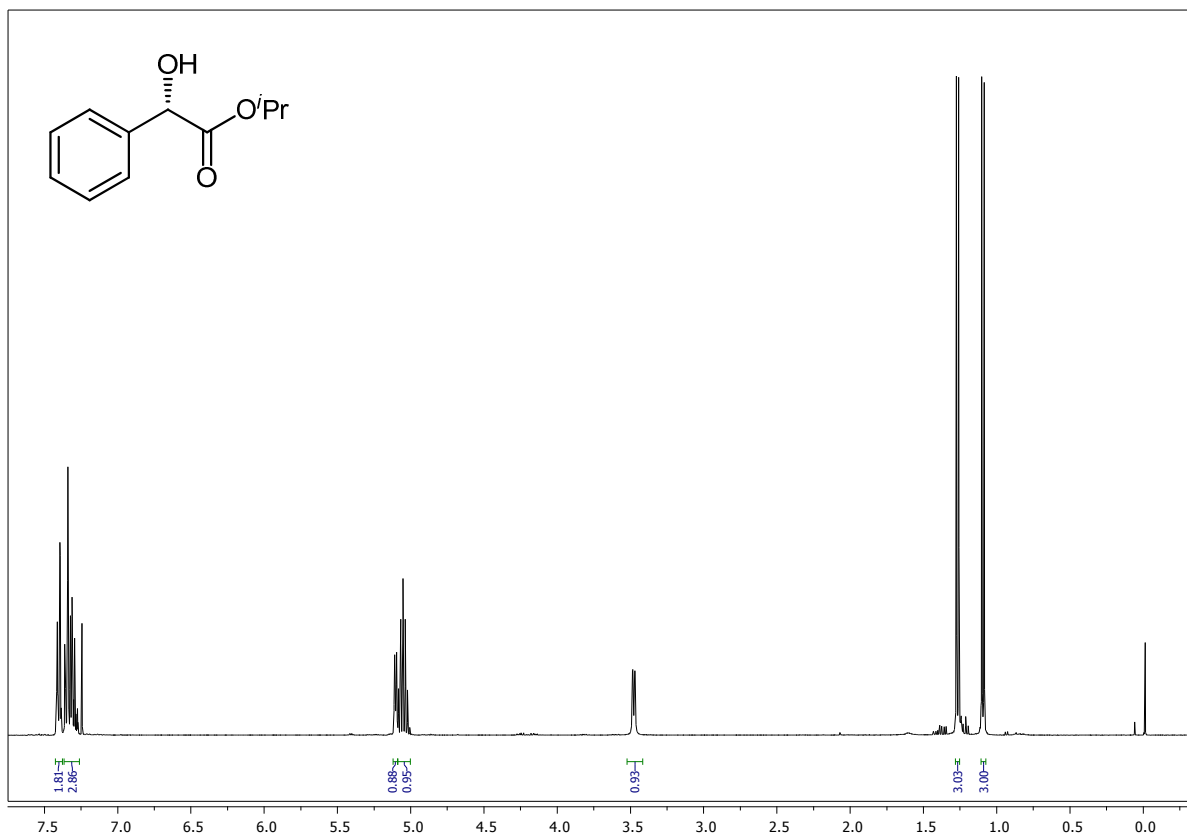
69.4 (CH(CH₃)₂), 78.3 (CHOH), 174.0 (OC=O) ppm; **MS** (EI, 70 eV): *m/z* (%) = 175 (98) [M⁺+H], 133 (55), 118 (67), 117 (11), 87 (75), 76 (100), 69 (16), 57 (52), 46 (15); **Chiral GC**: t_R 25.06 min (major) 26.17 min (minor), 11.6 psi H₂, CP-Chirasil-dex CB, 60-10iso-1-80-3-180-30iso.

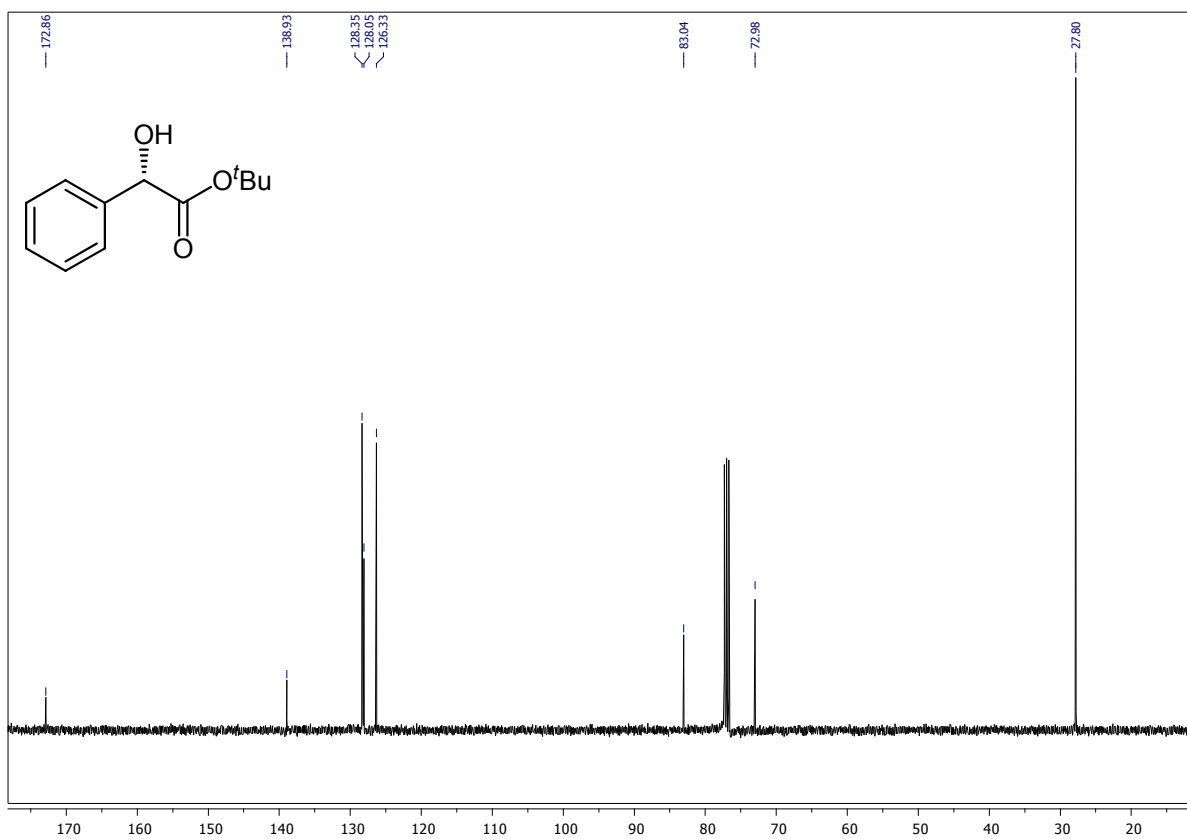
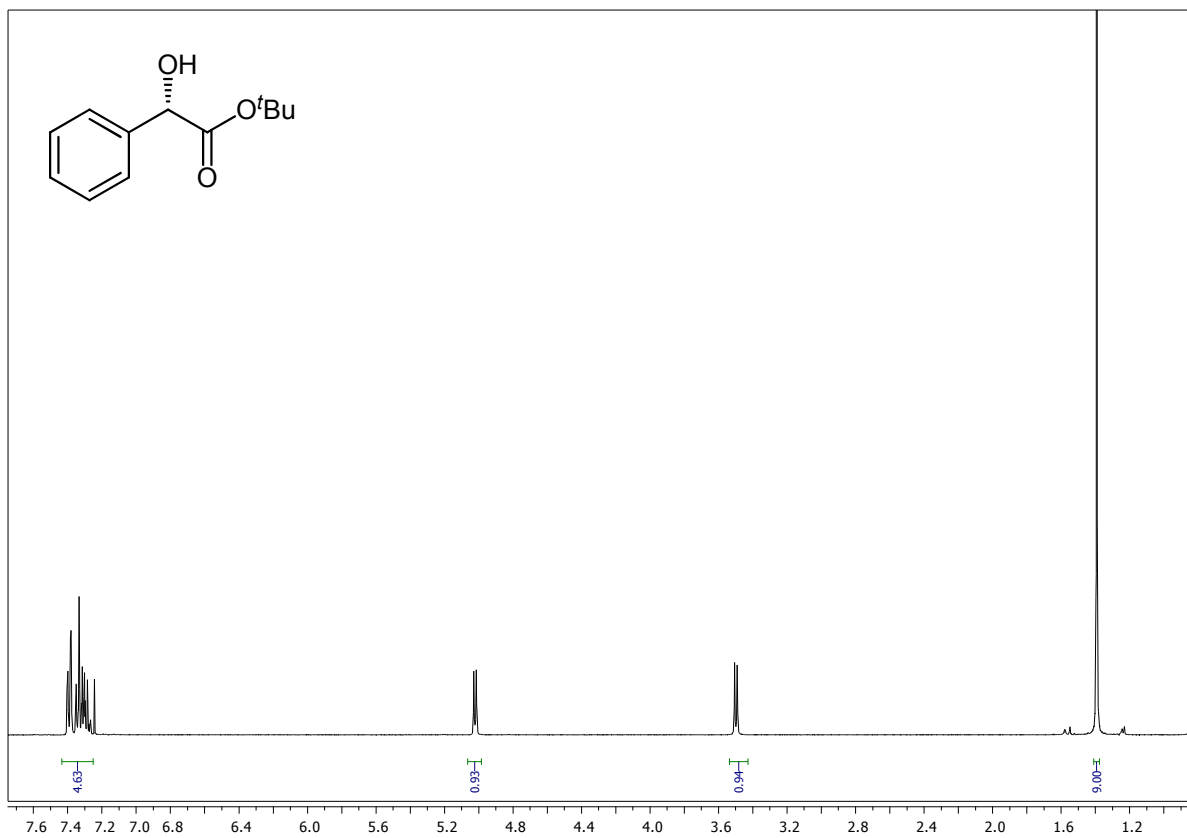
Literatur

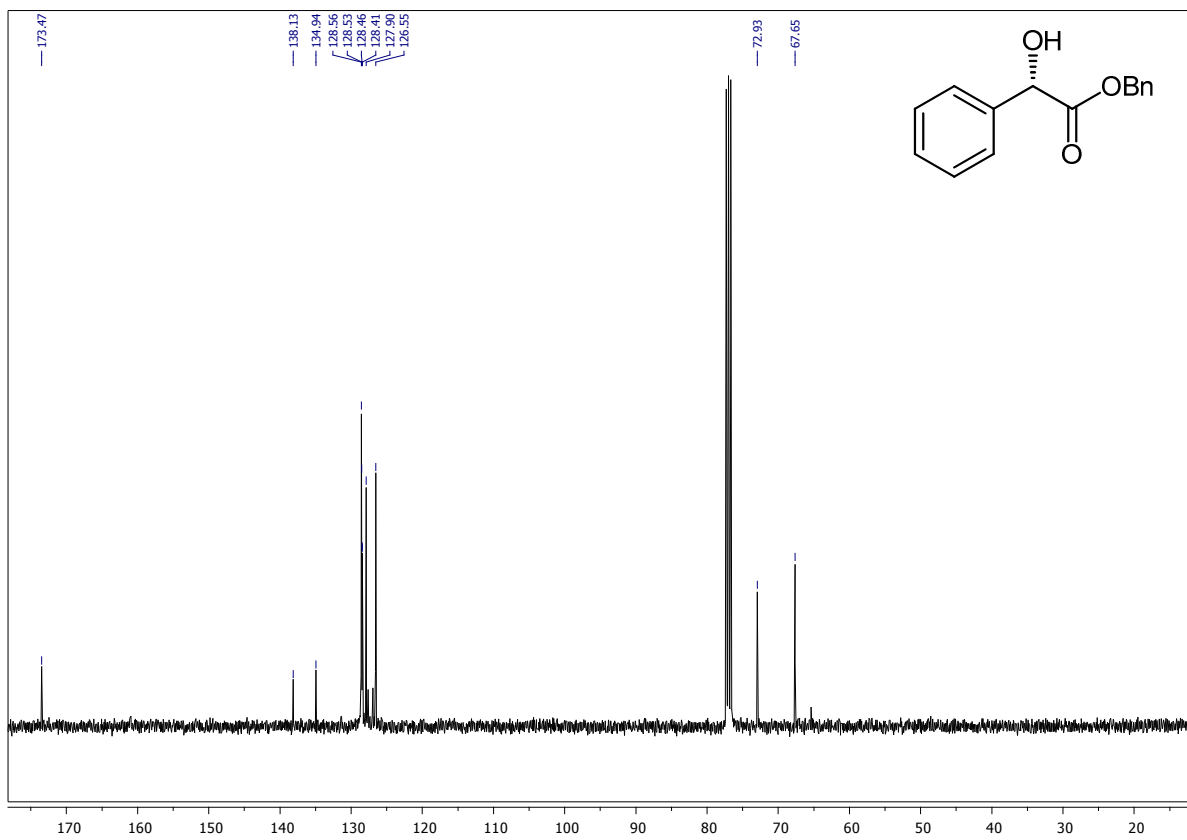
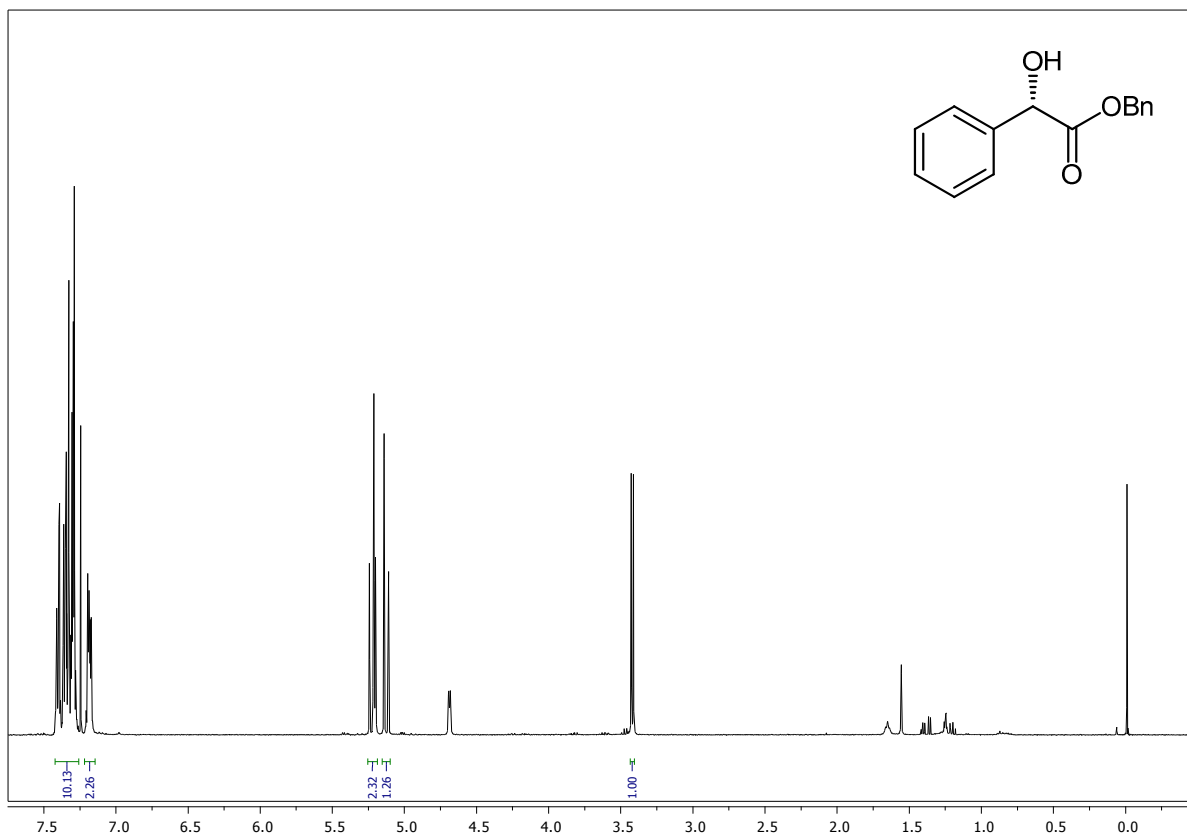
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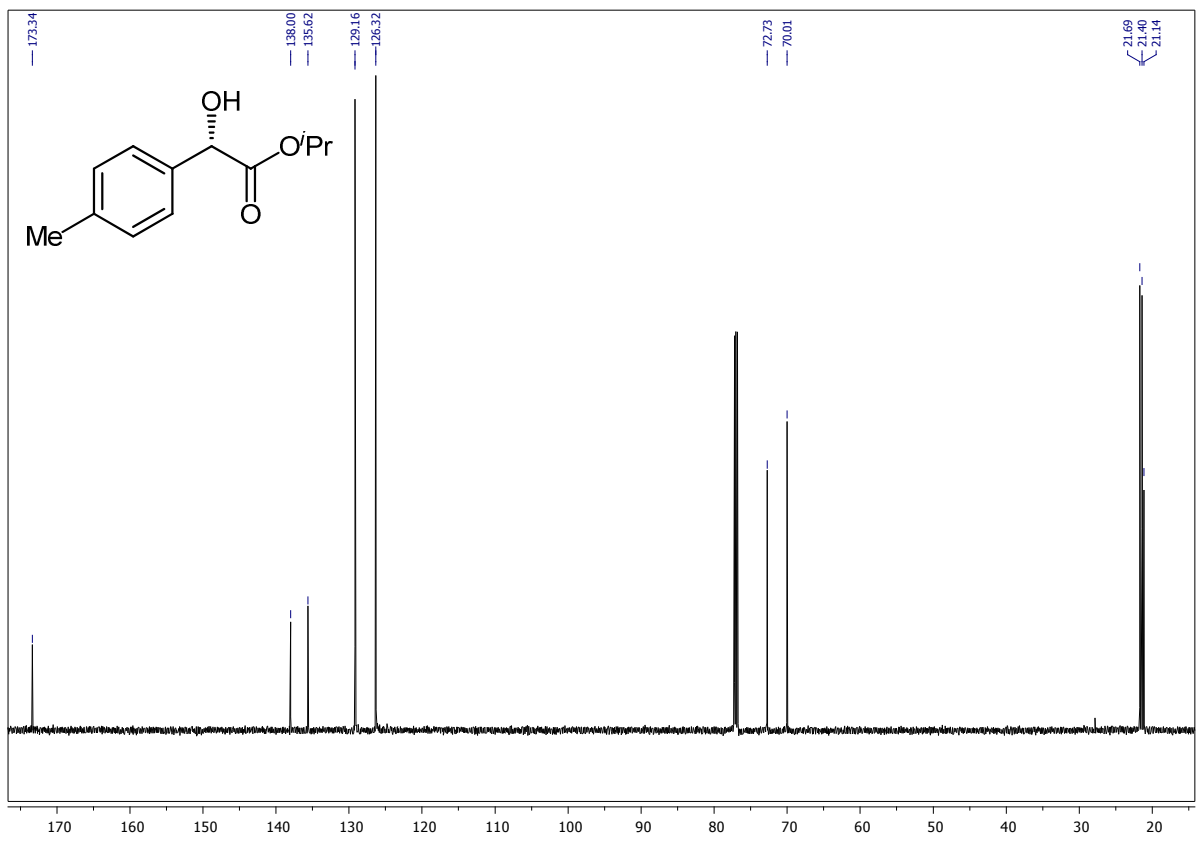
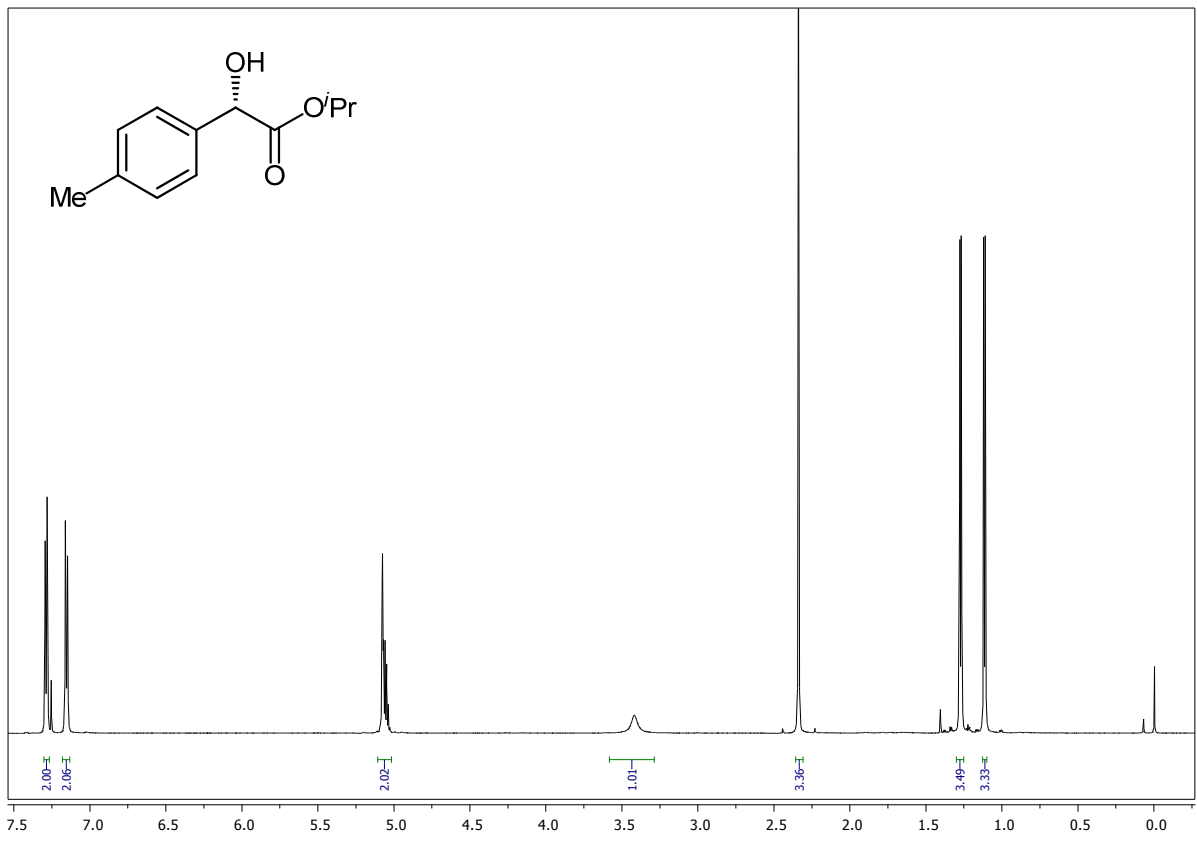
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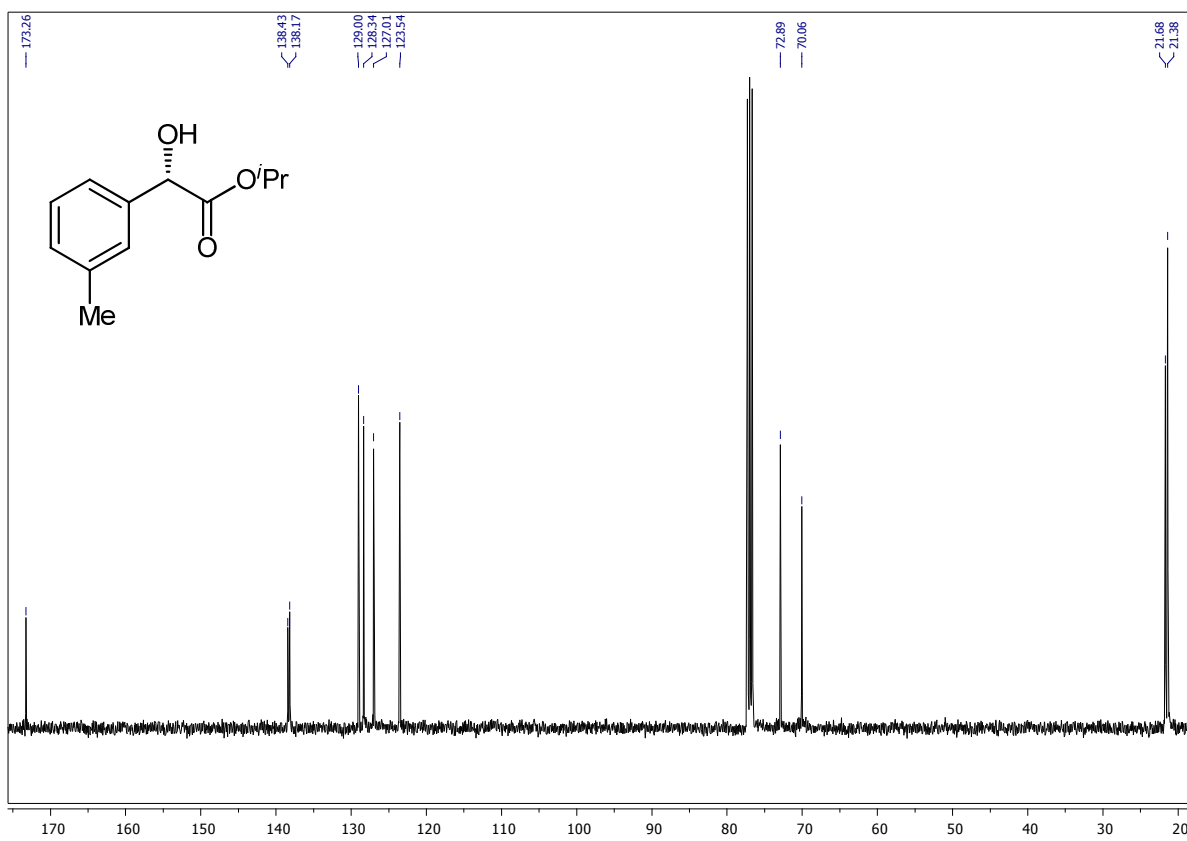
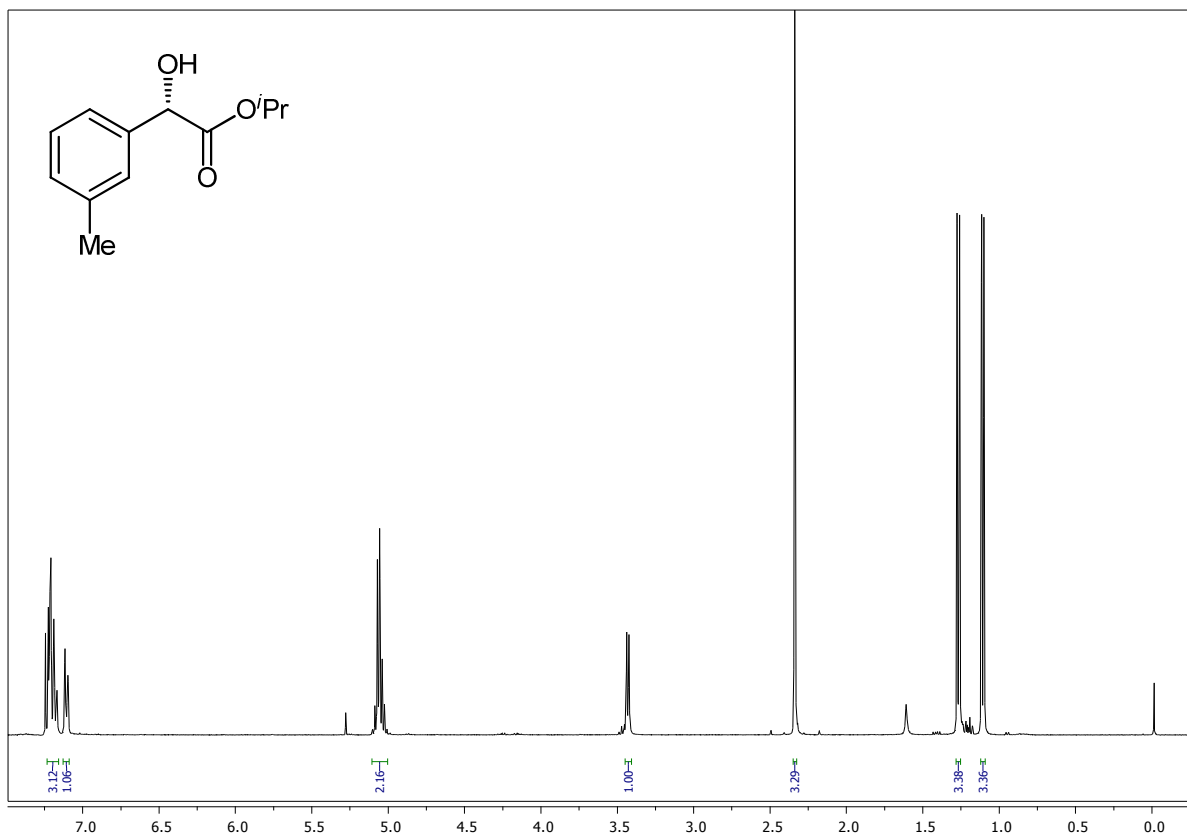


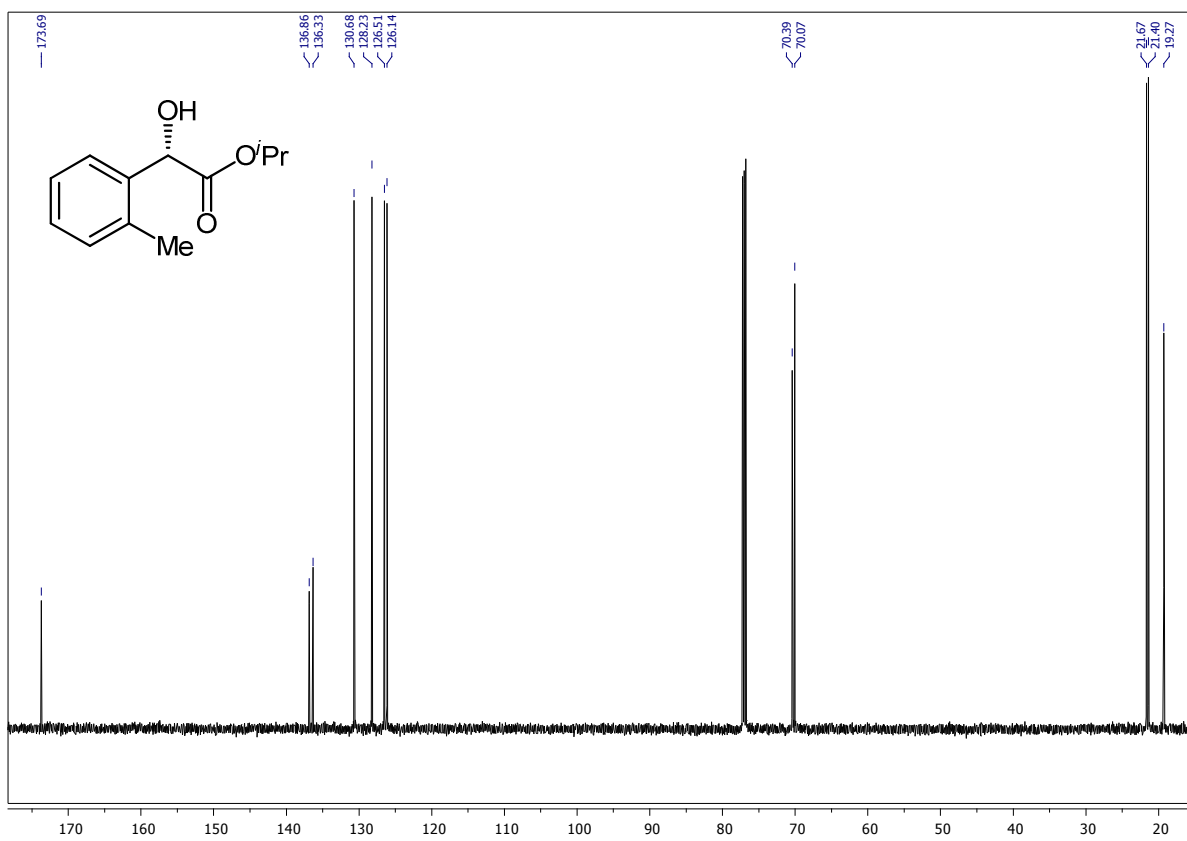
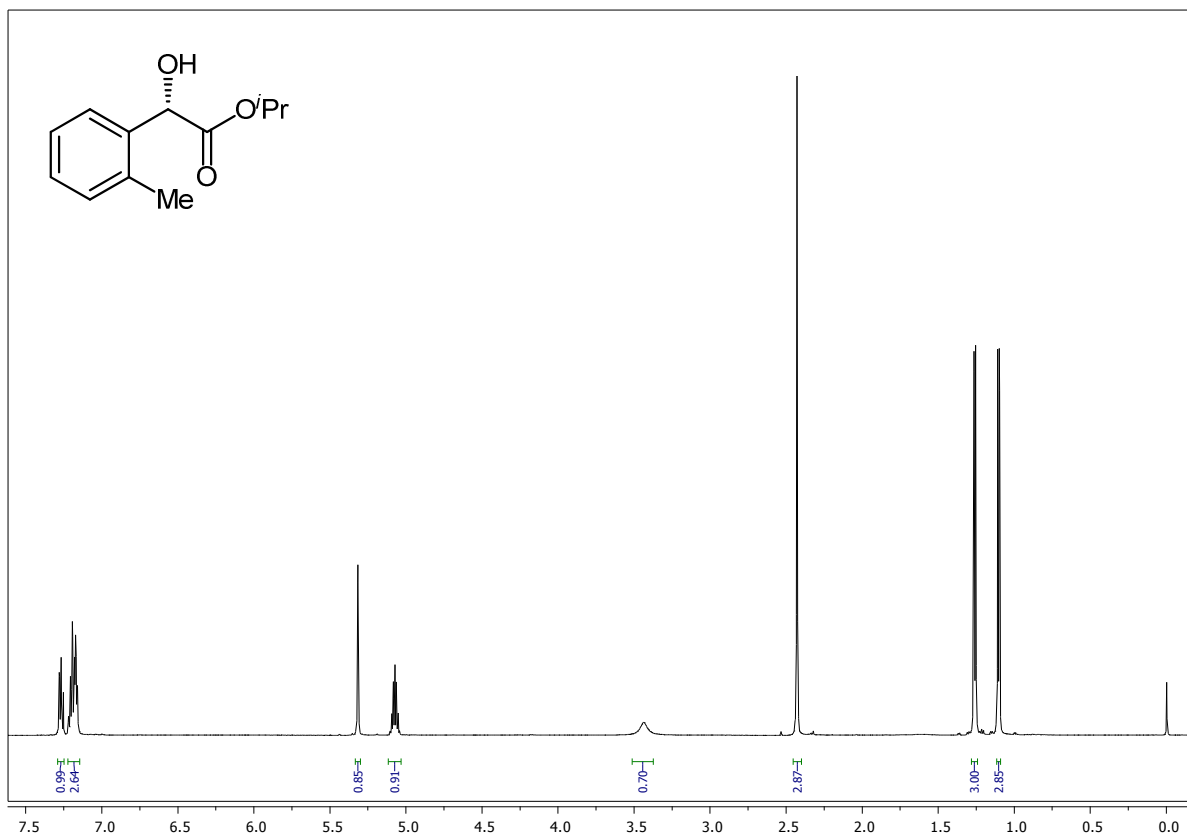


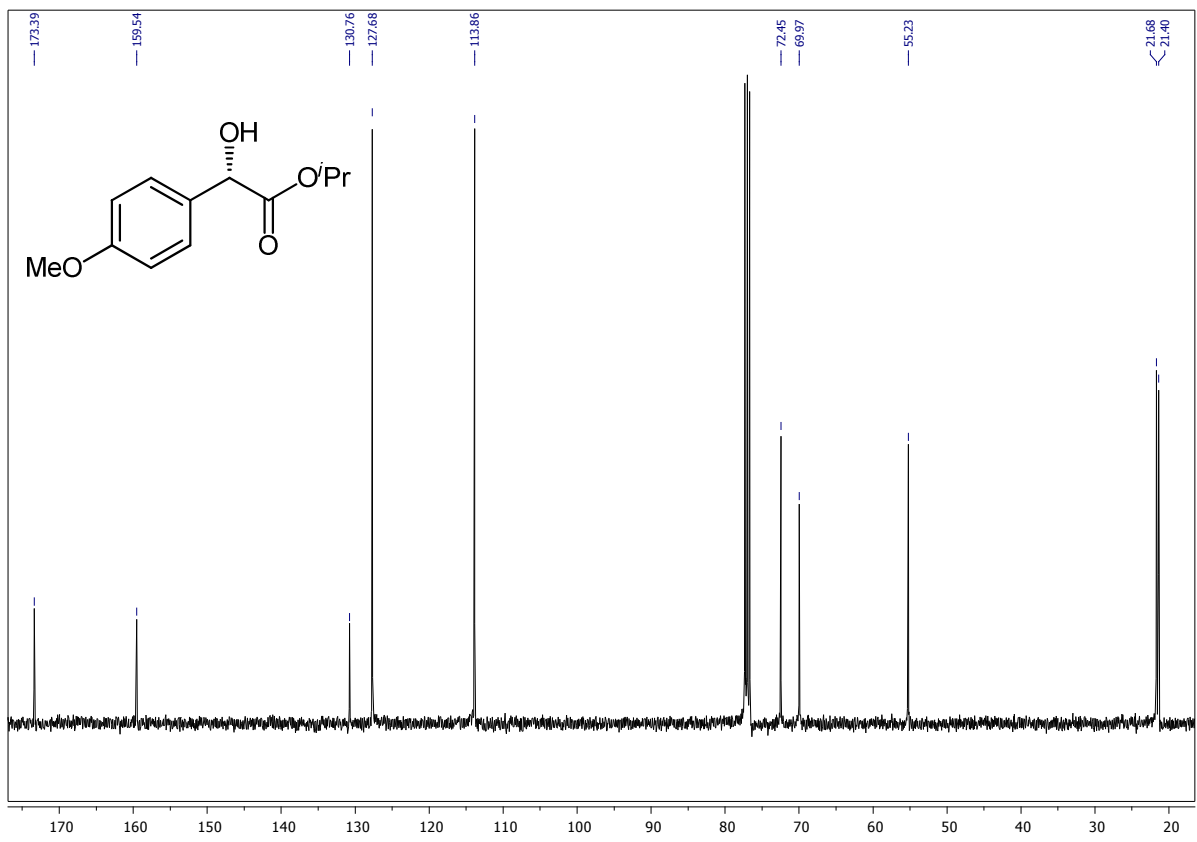
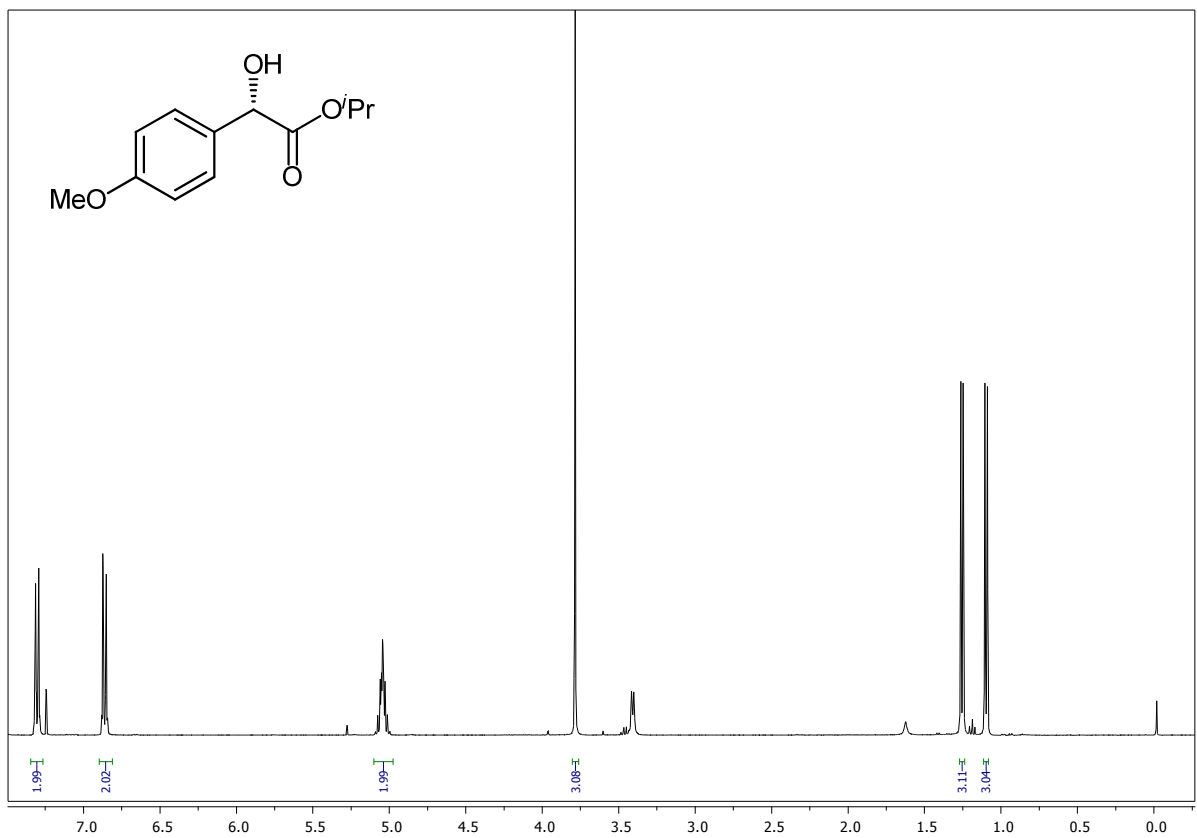


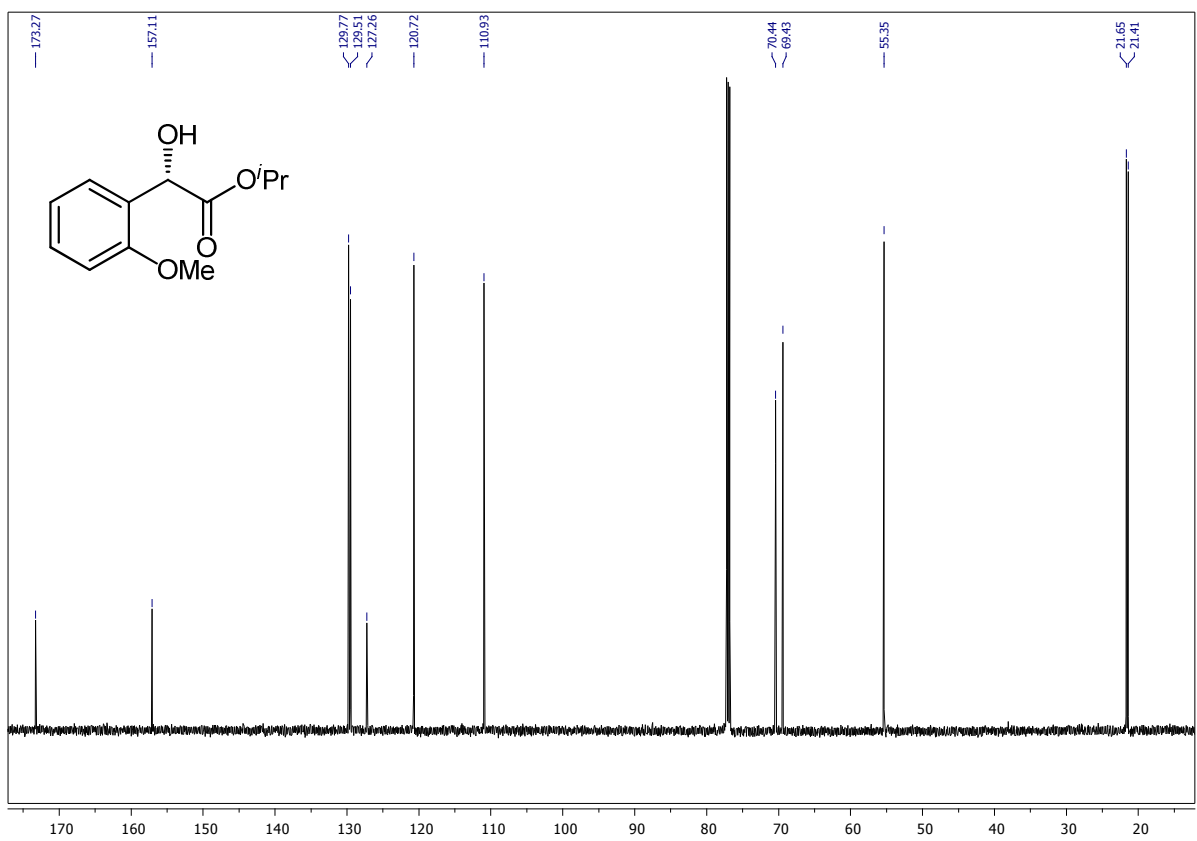
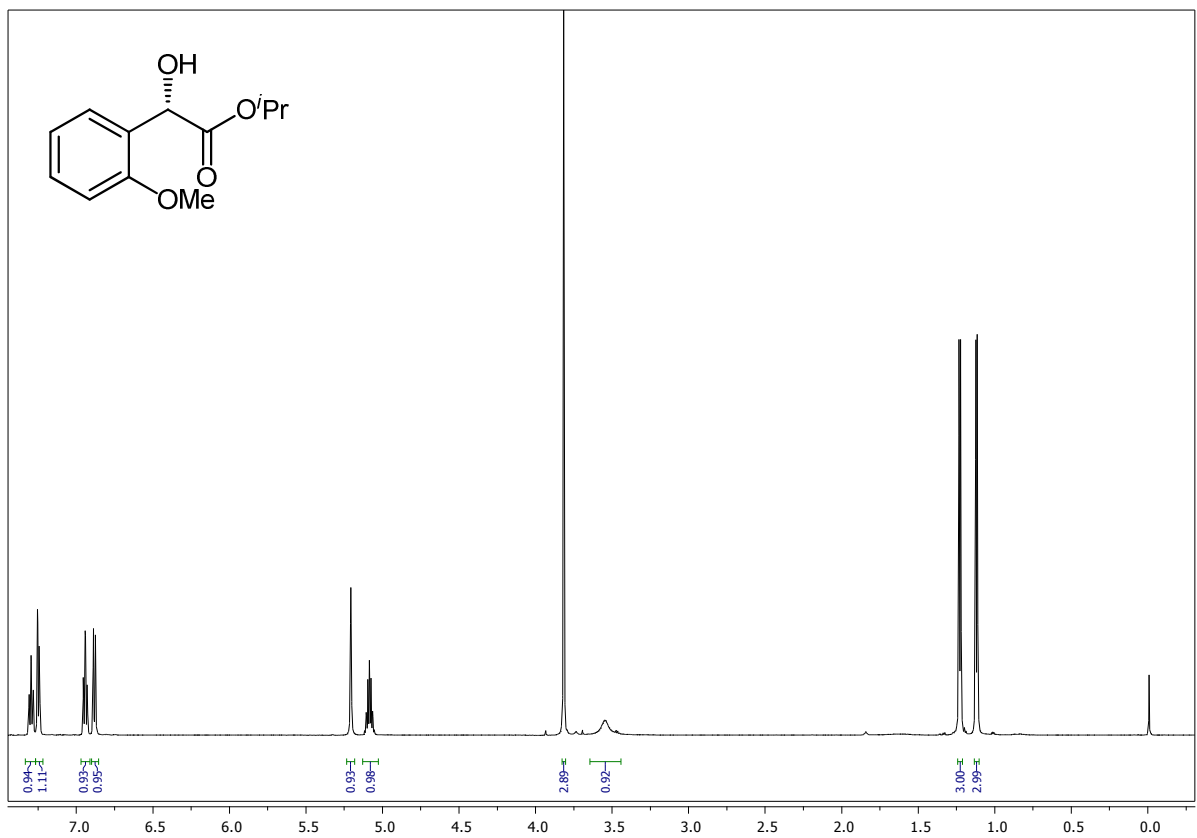


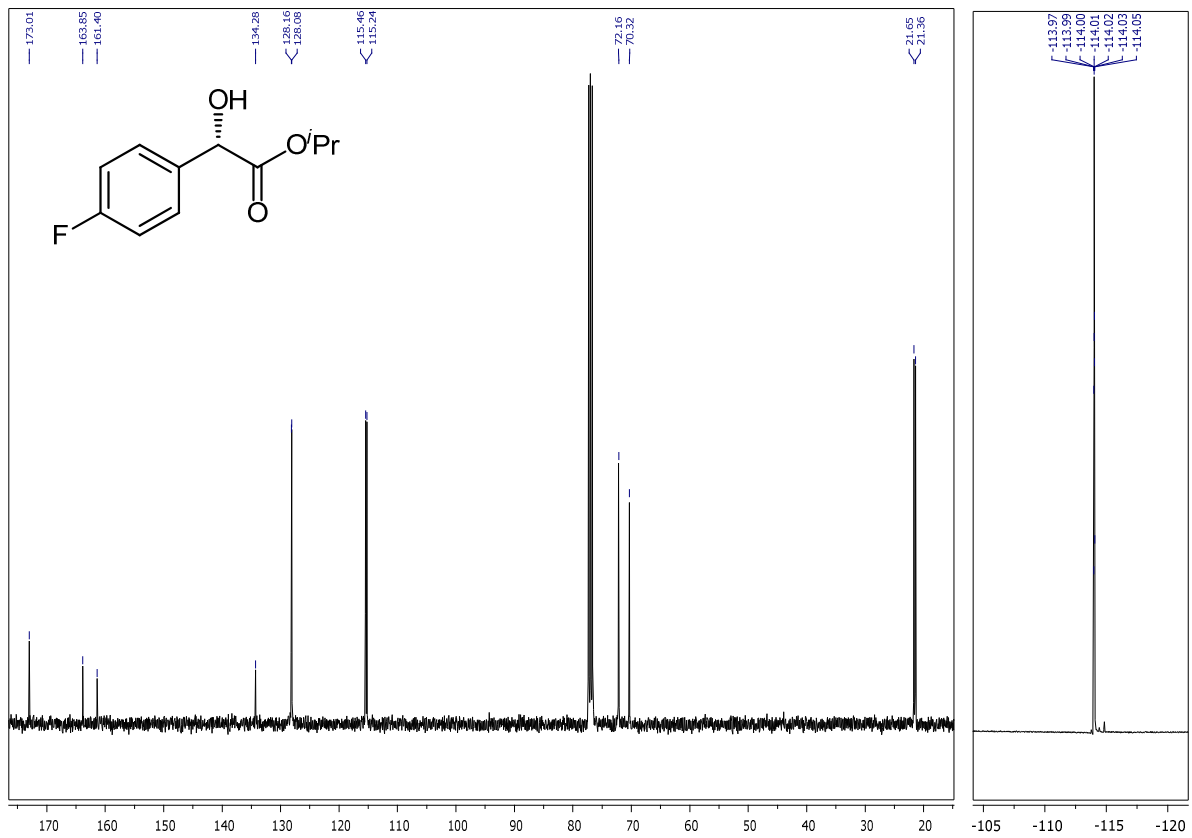
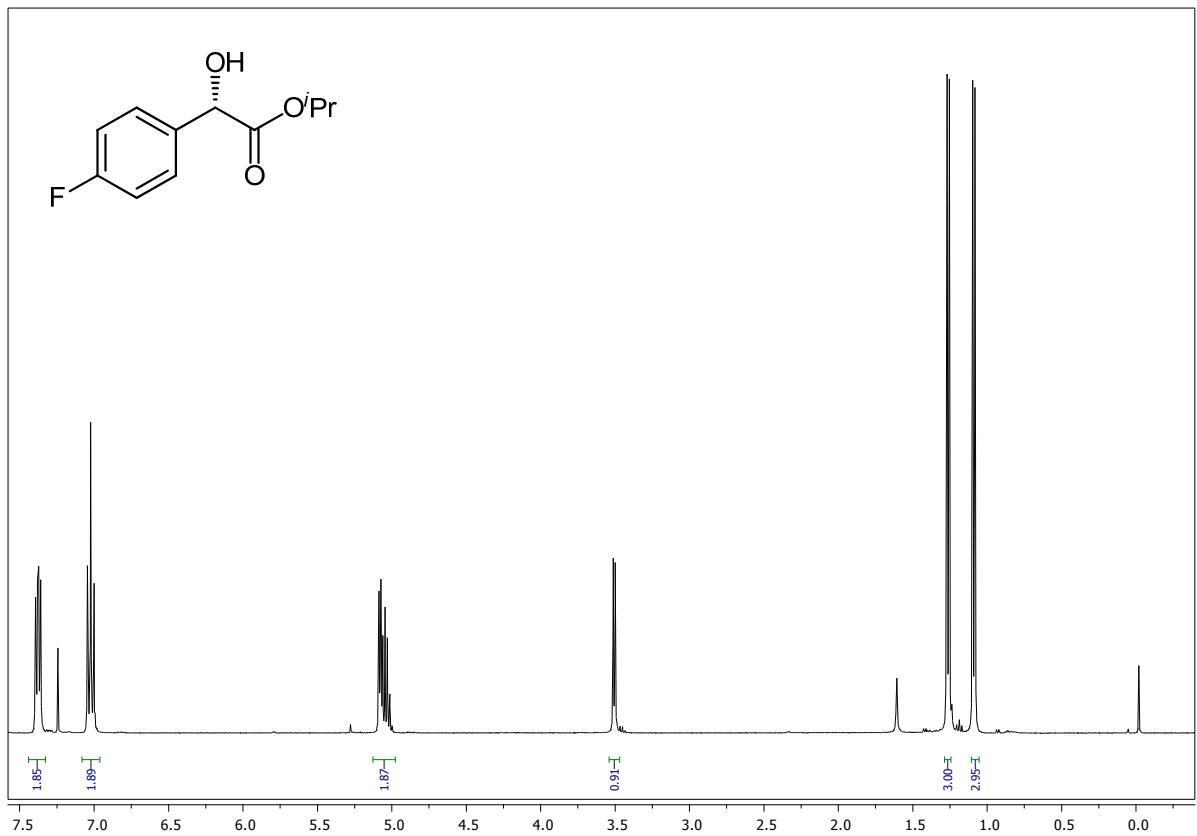


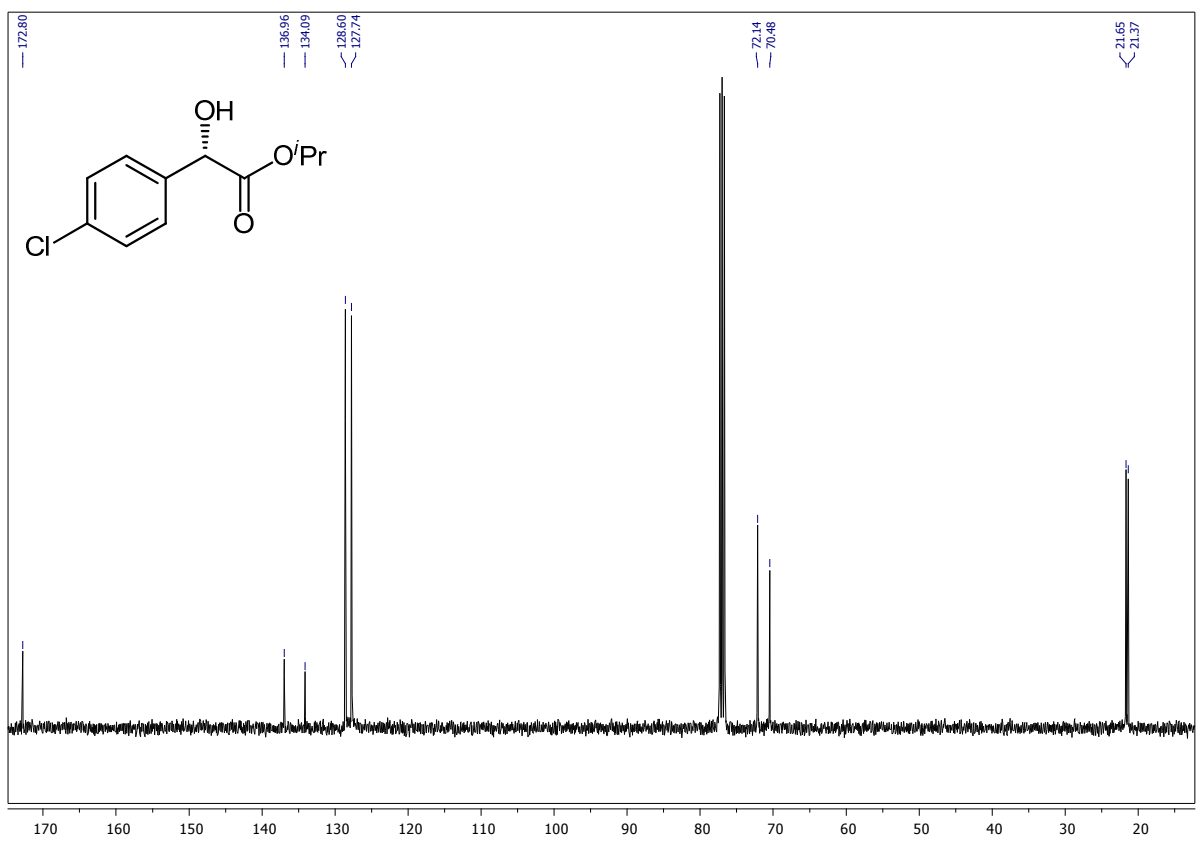
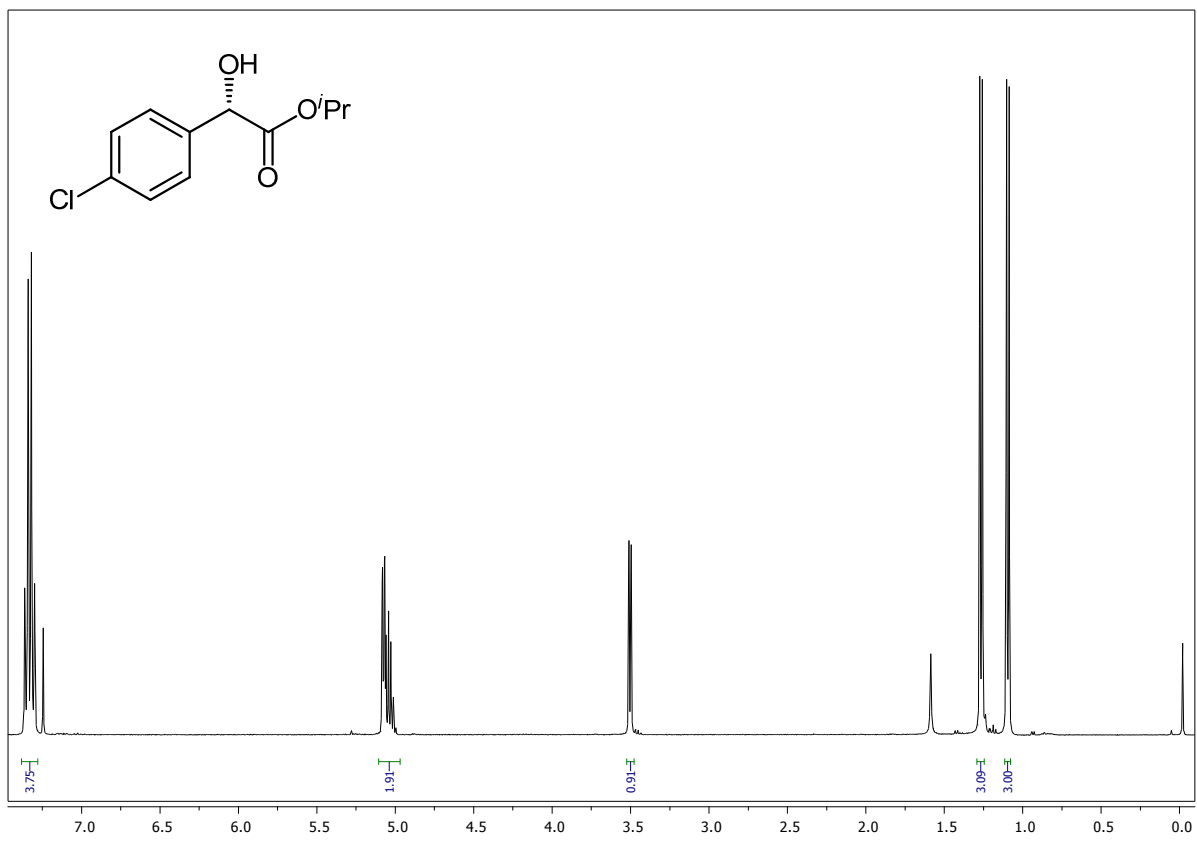


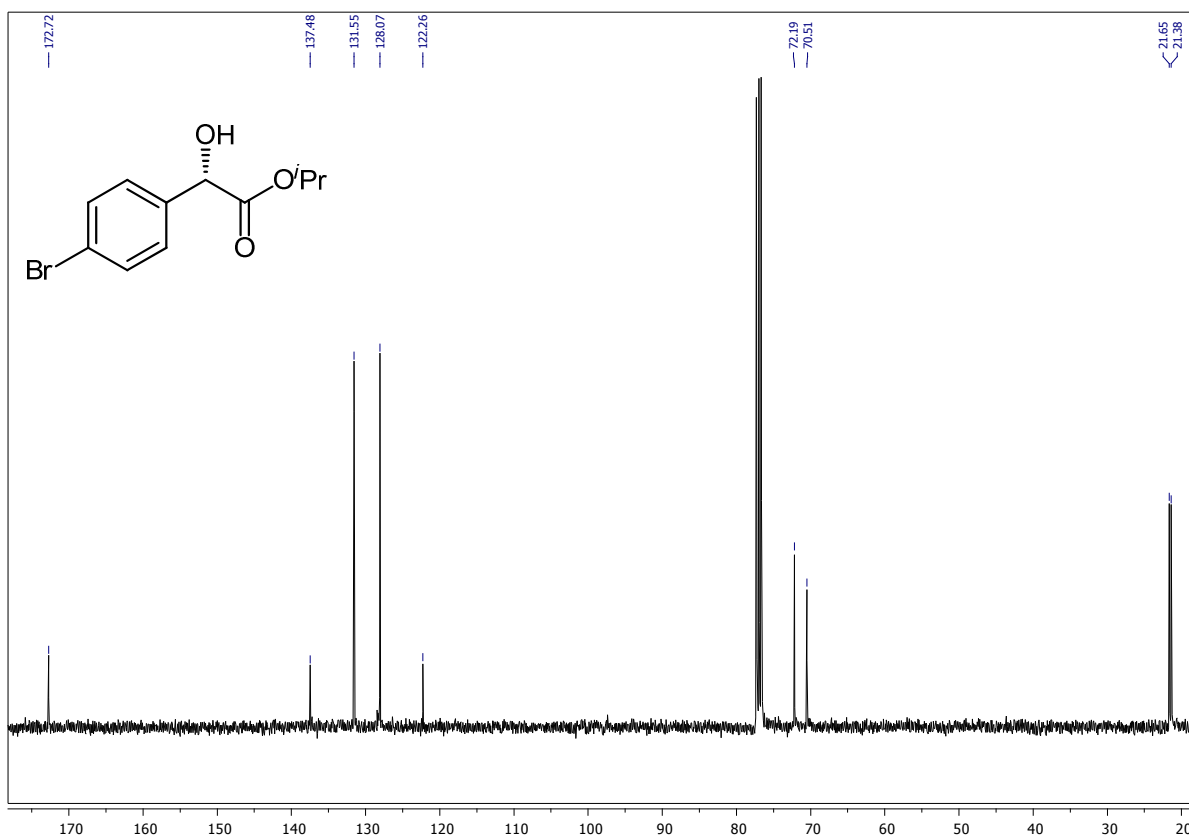
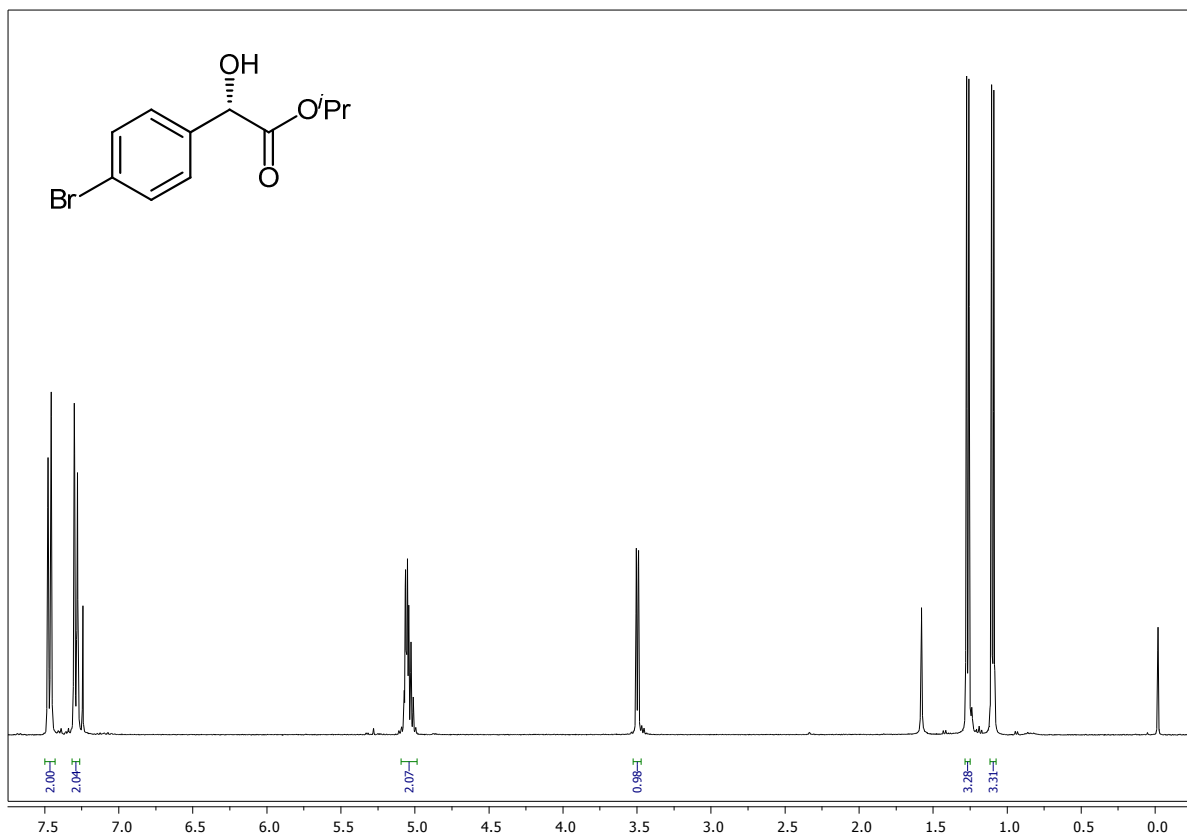


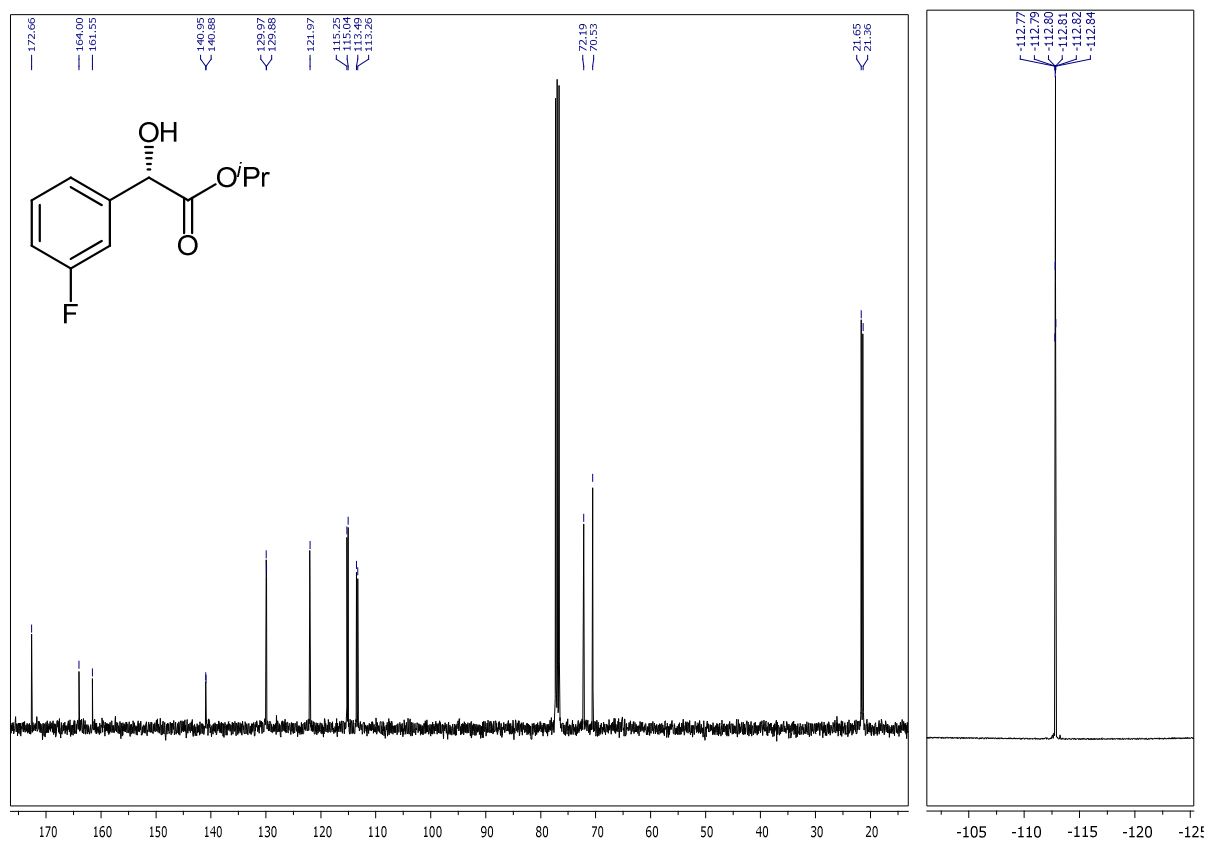
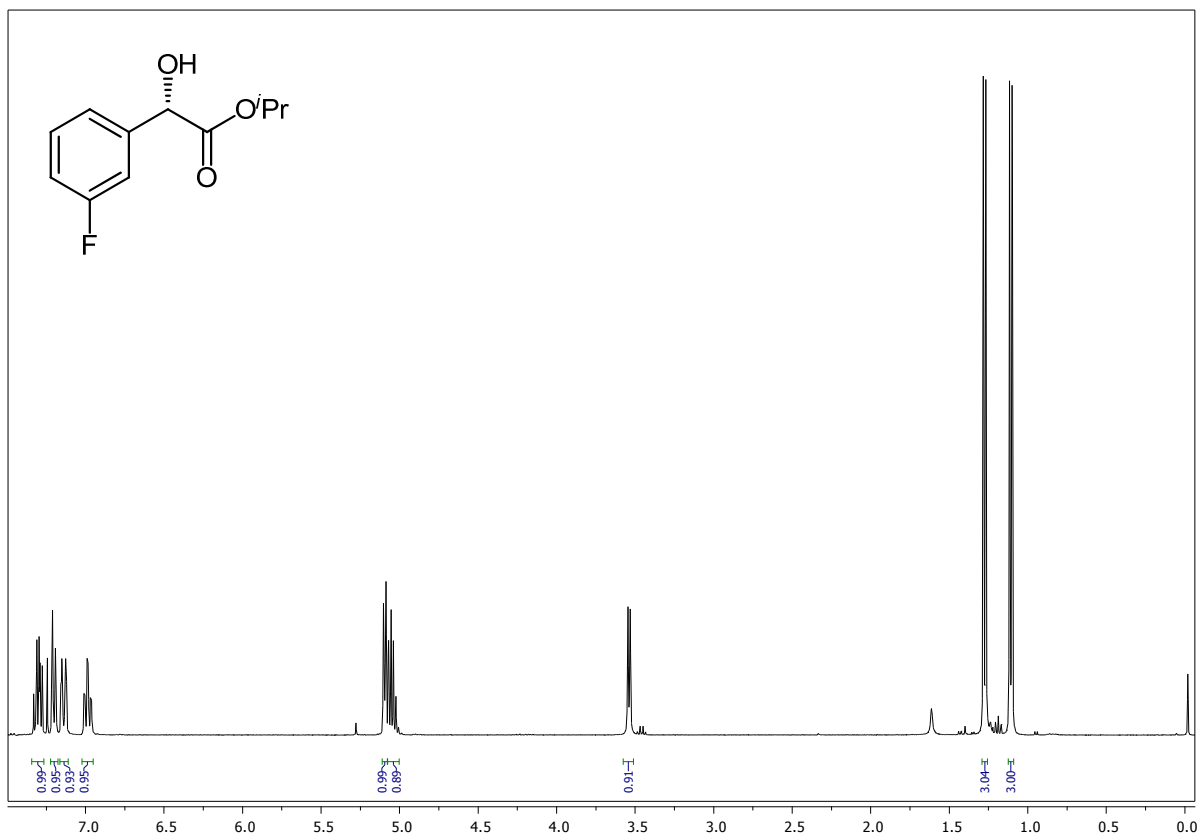


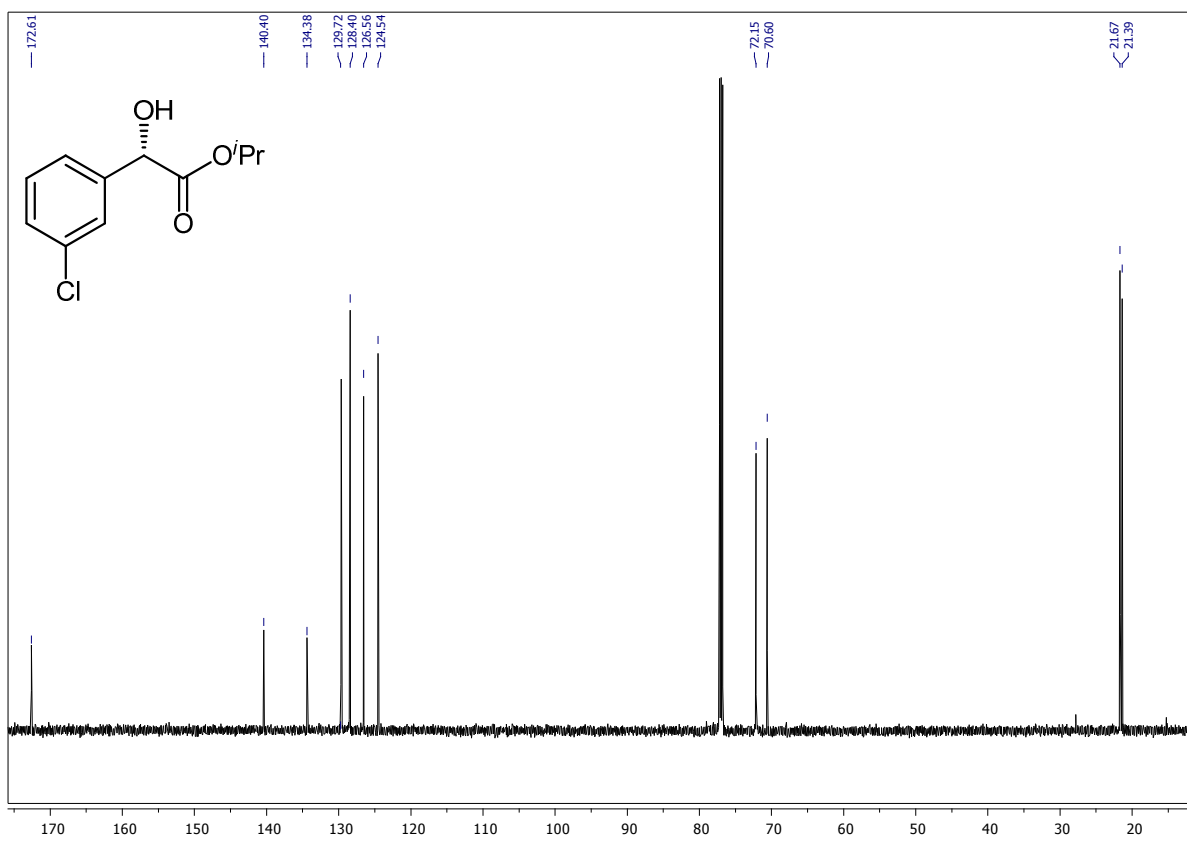
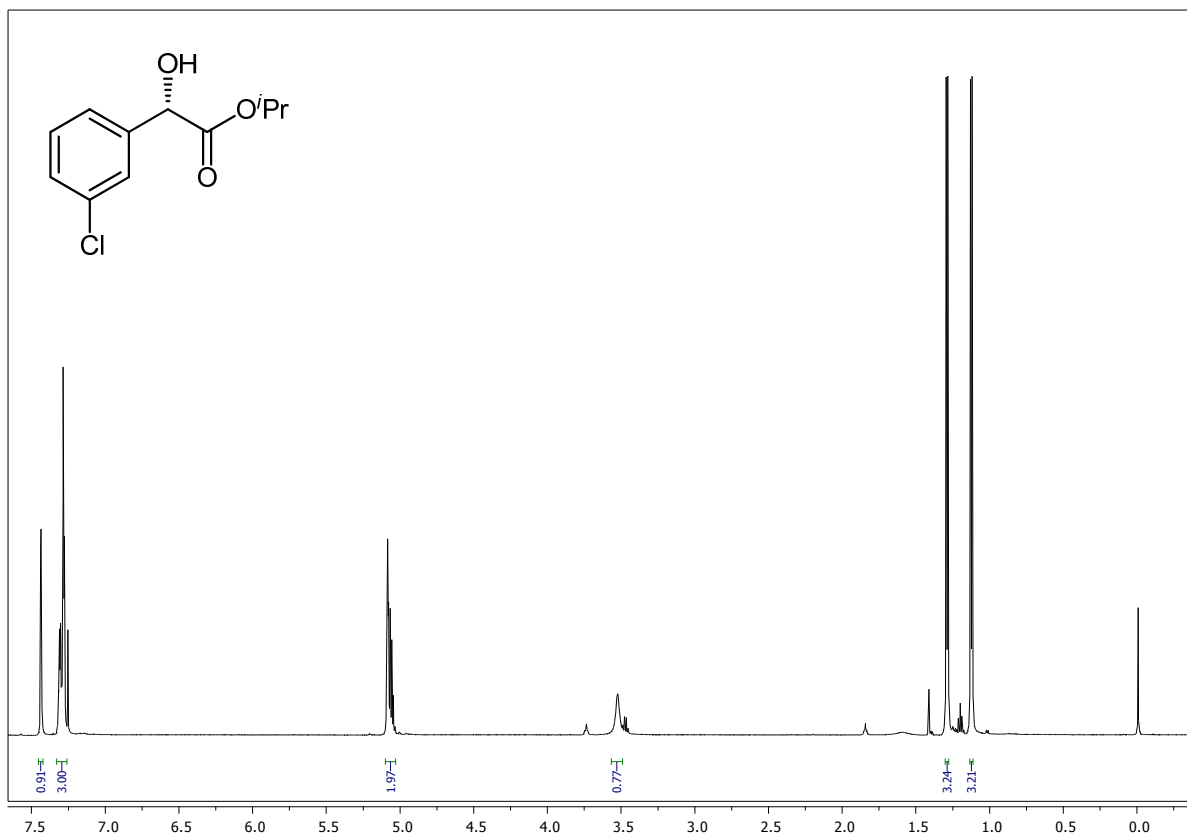


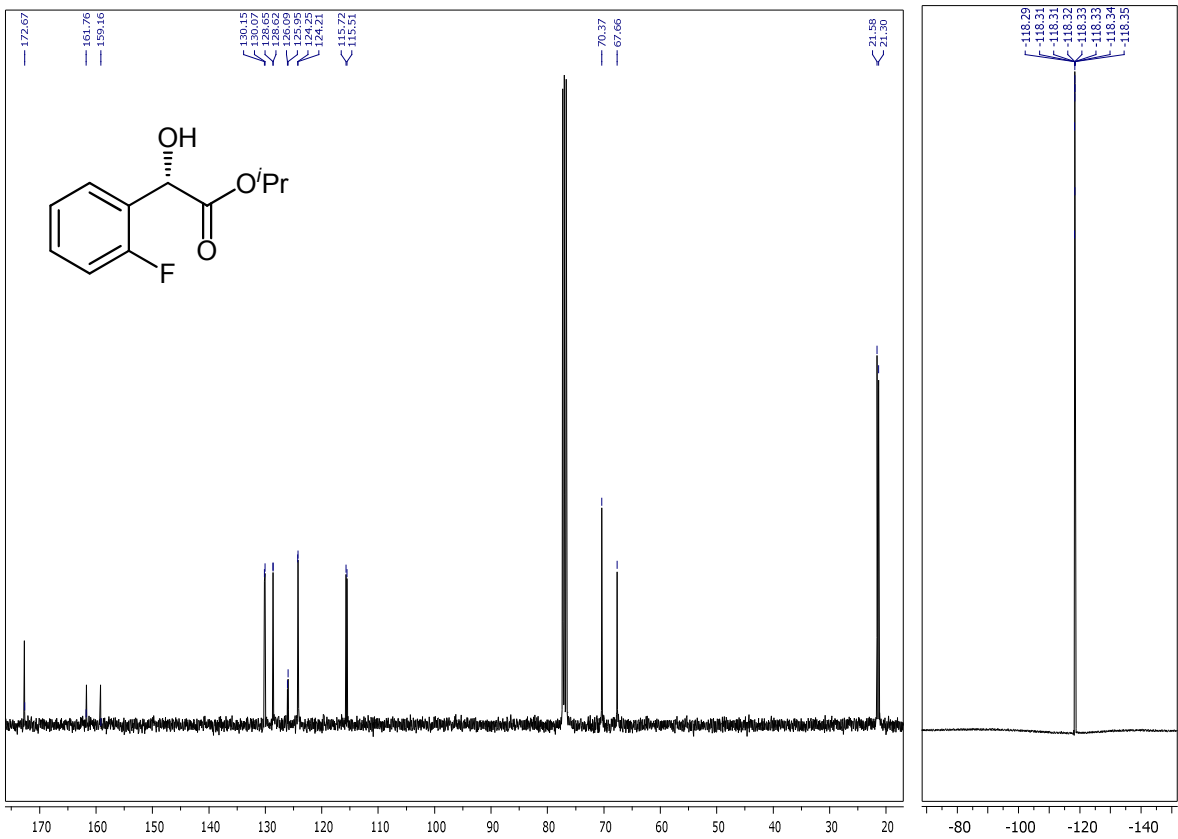
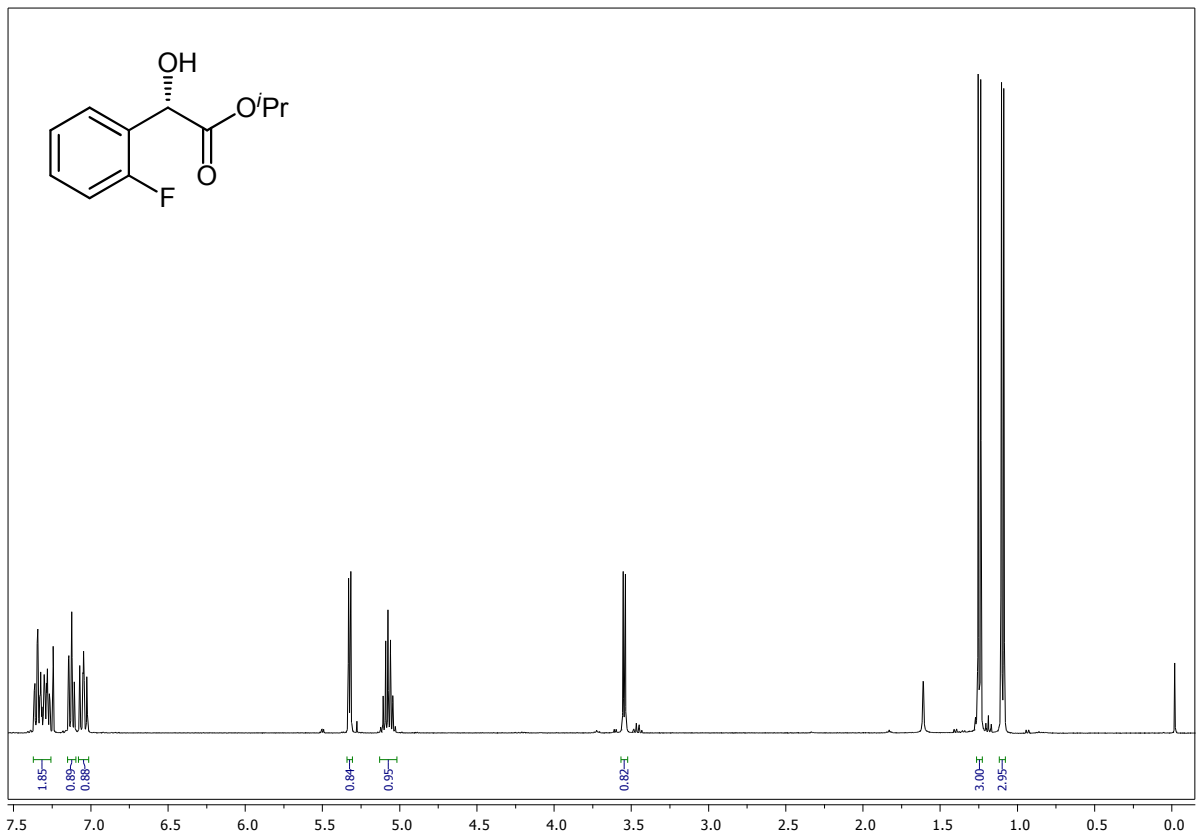


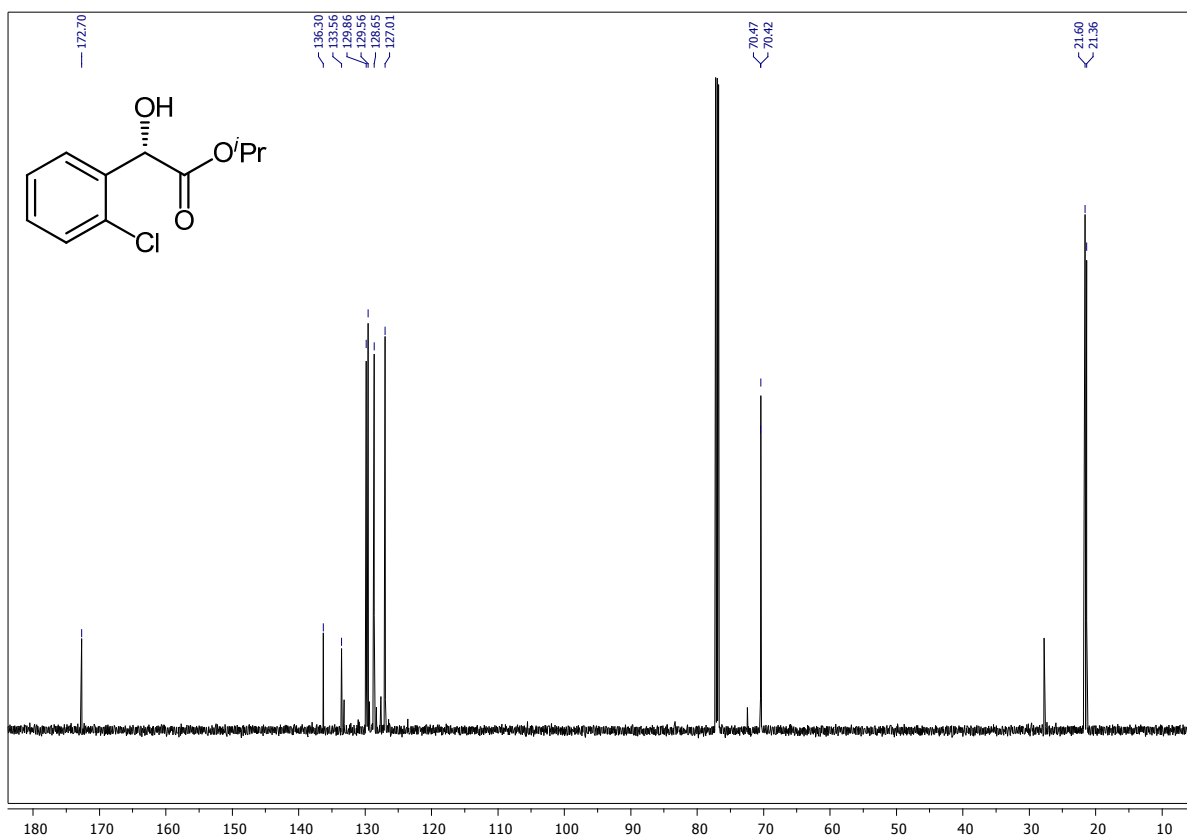
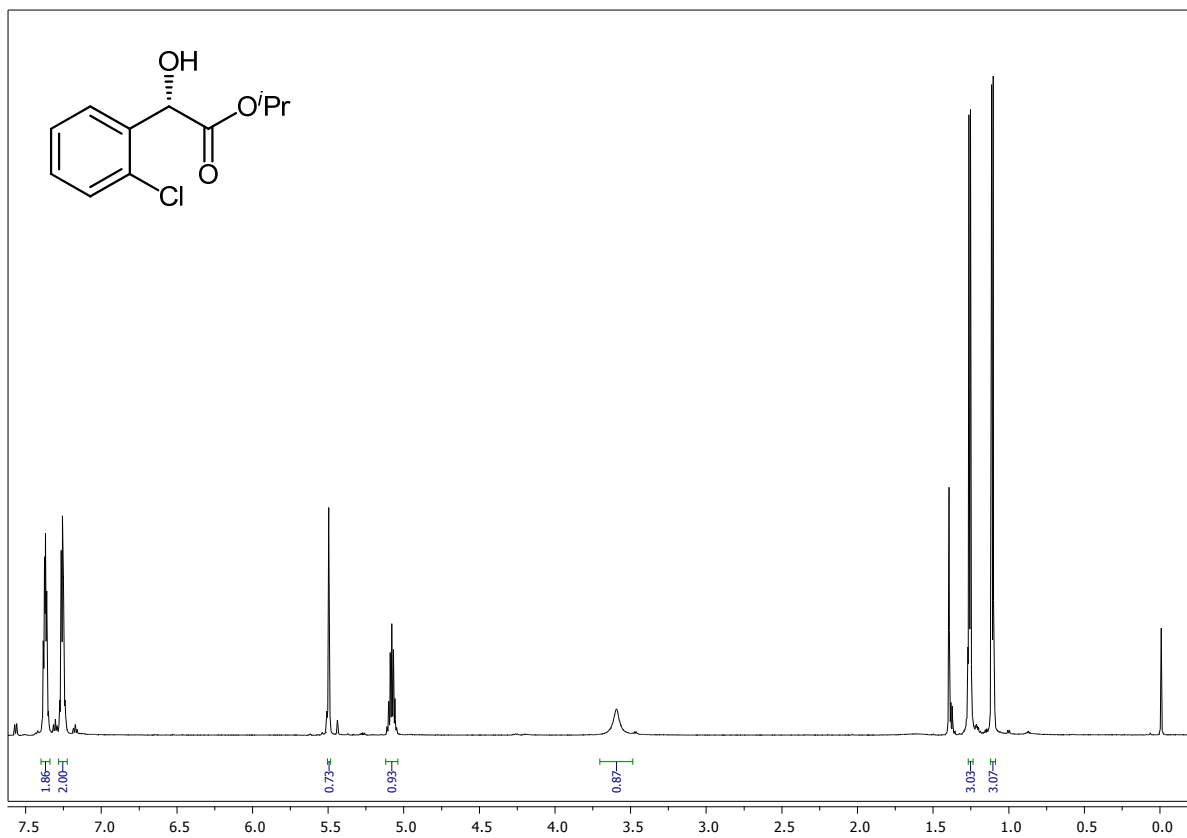


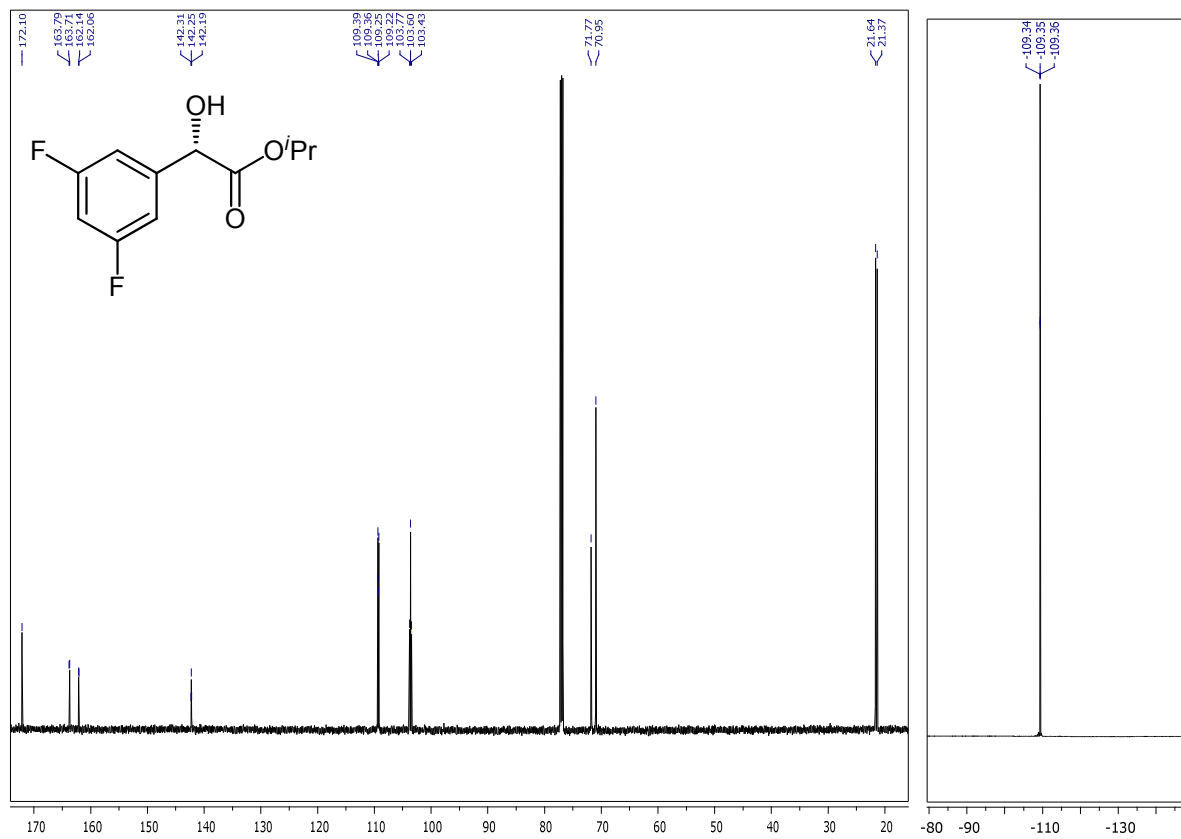
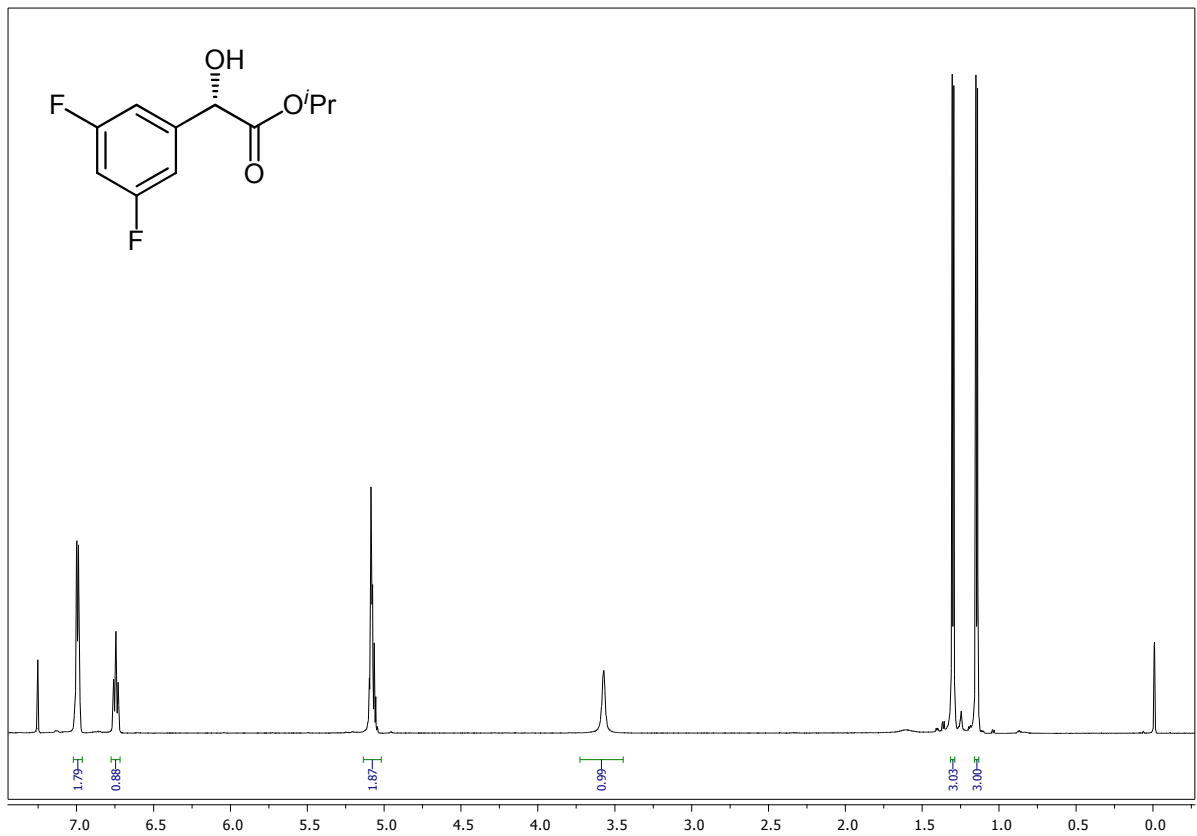


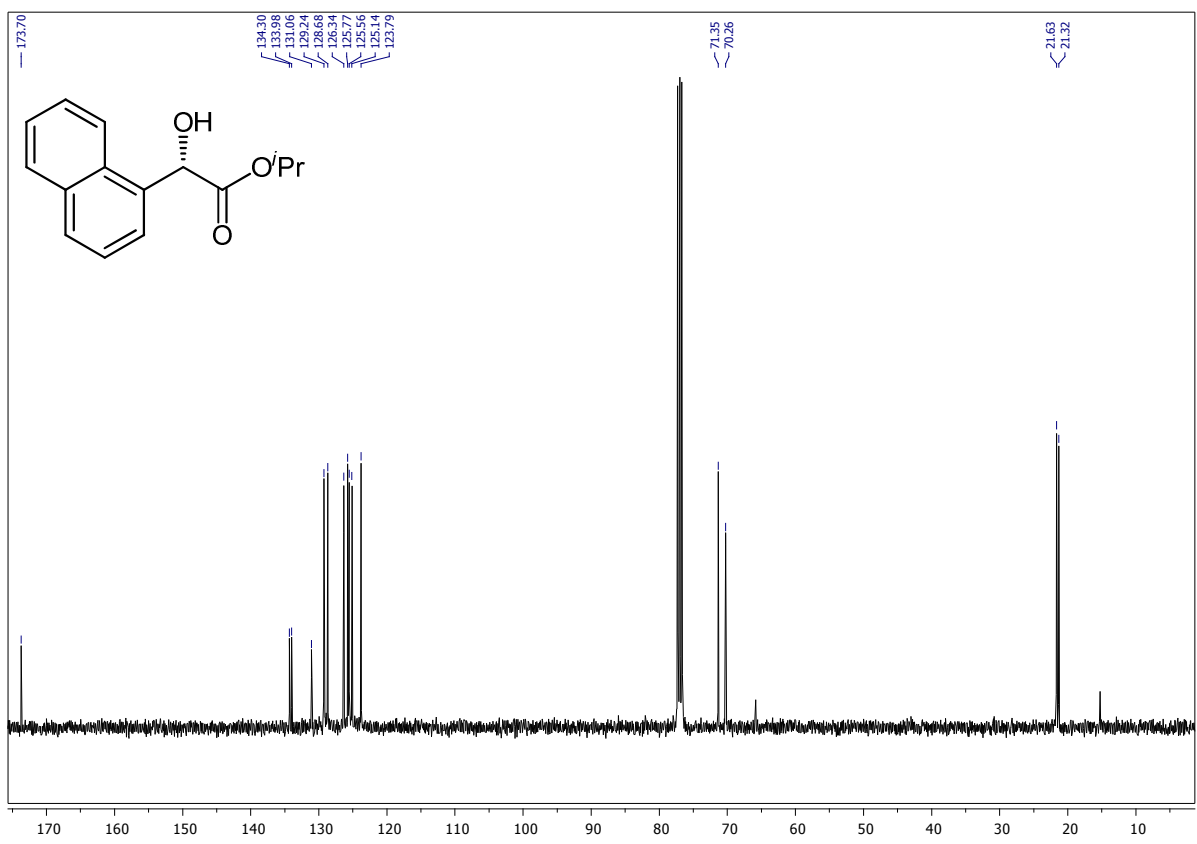
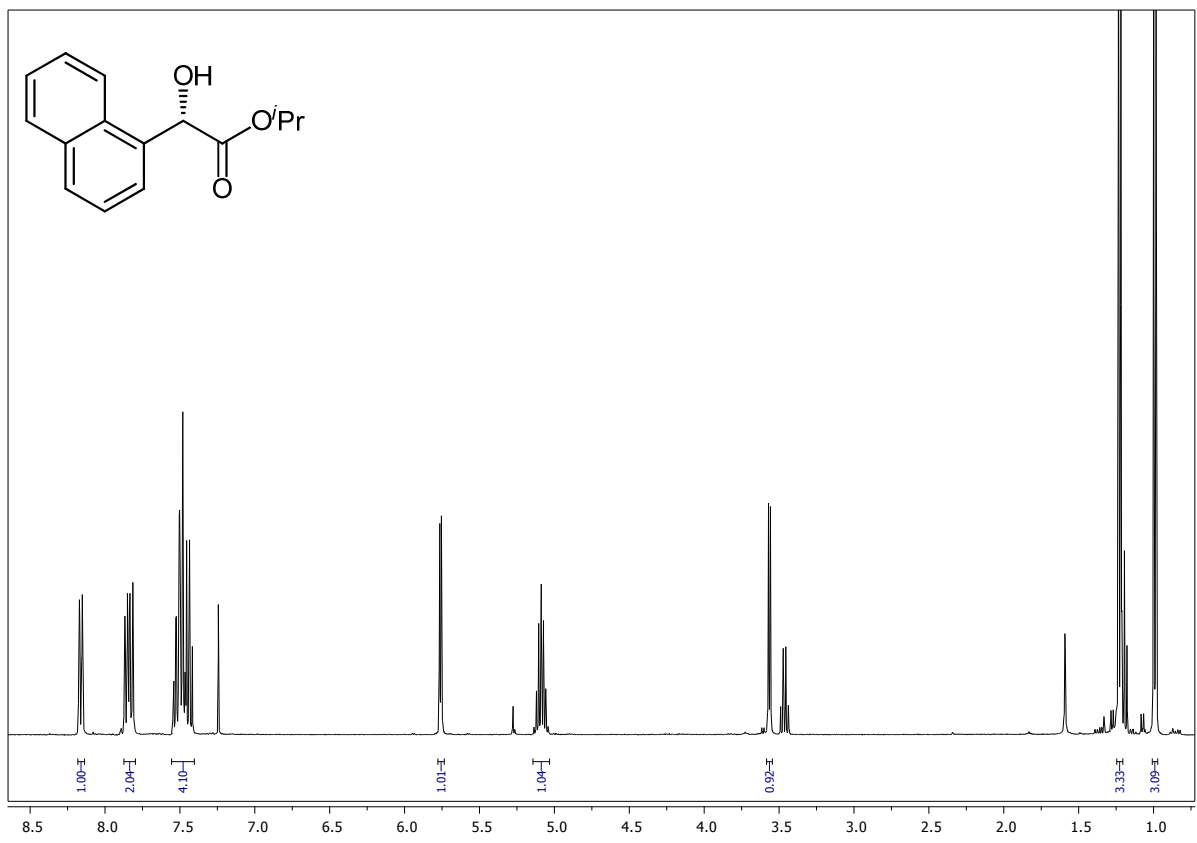


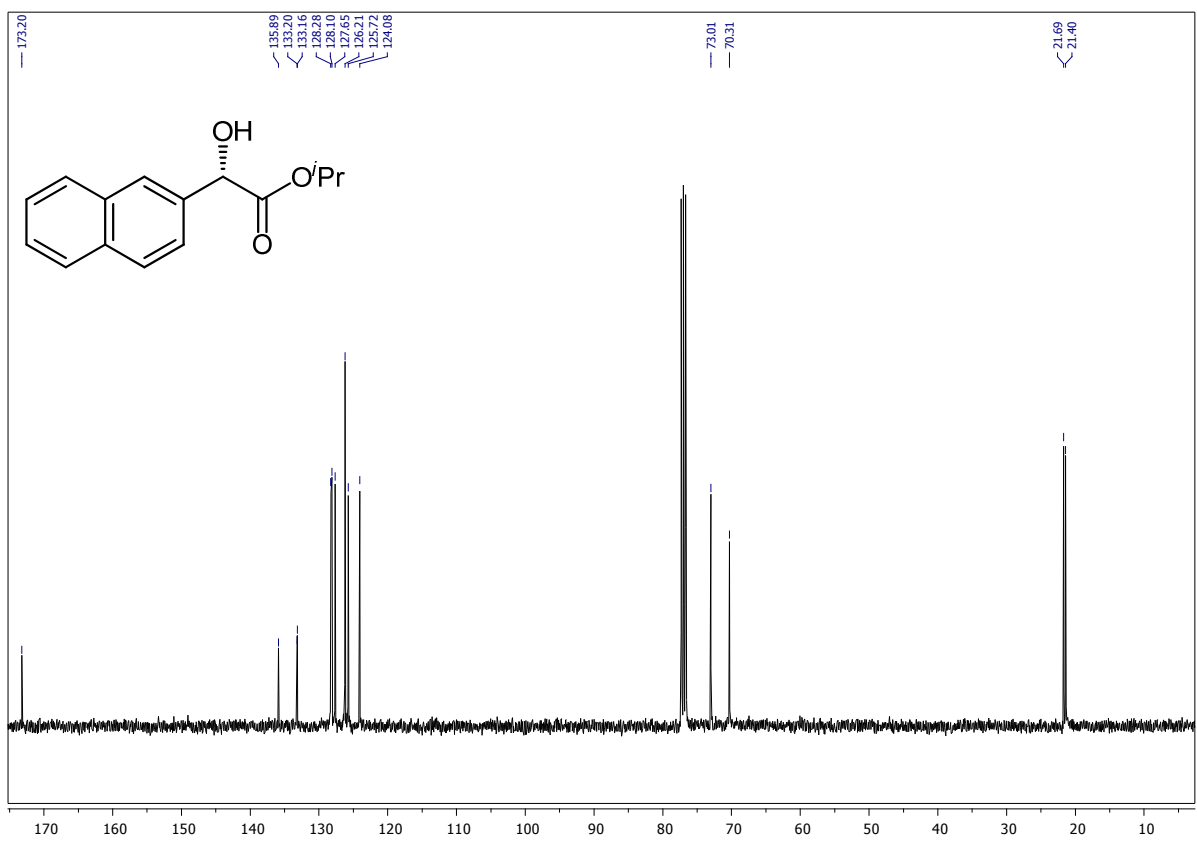
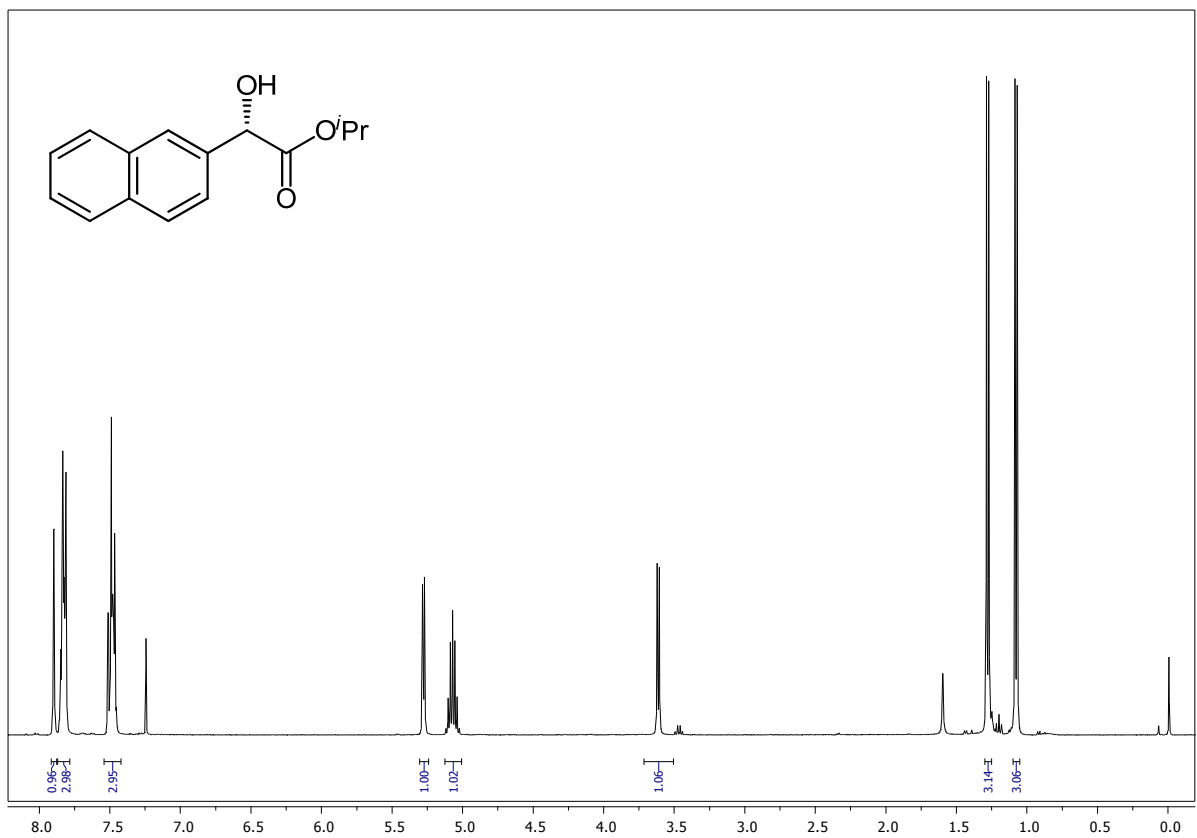


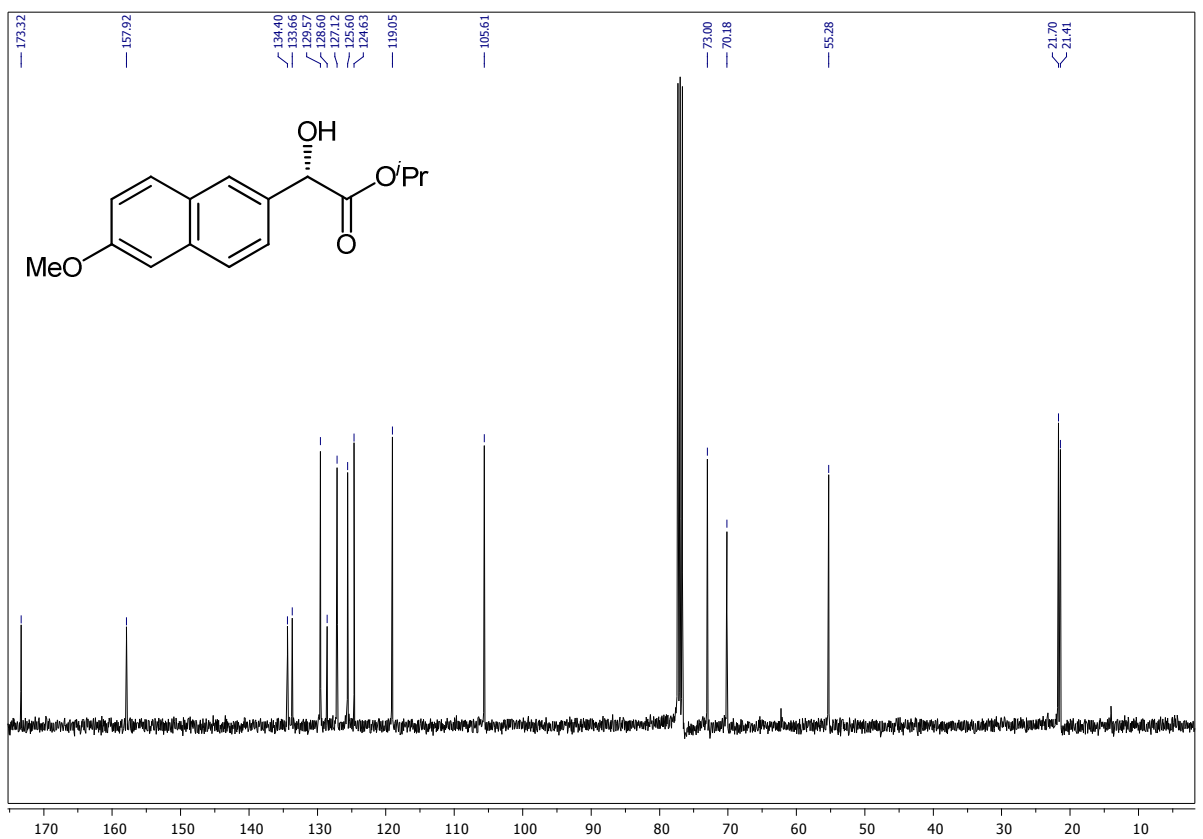
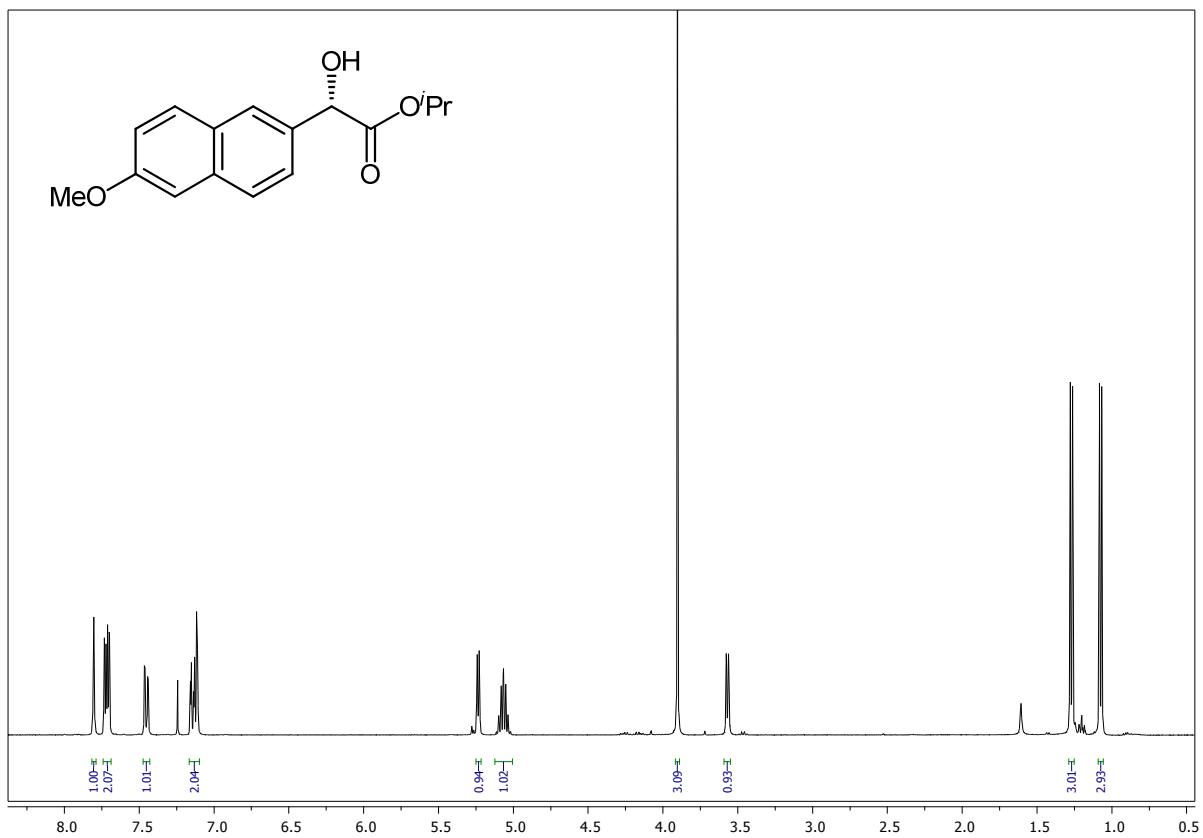


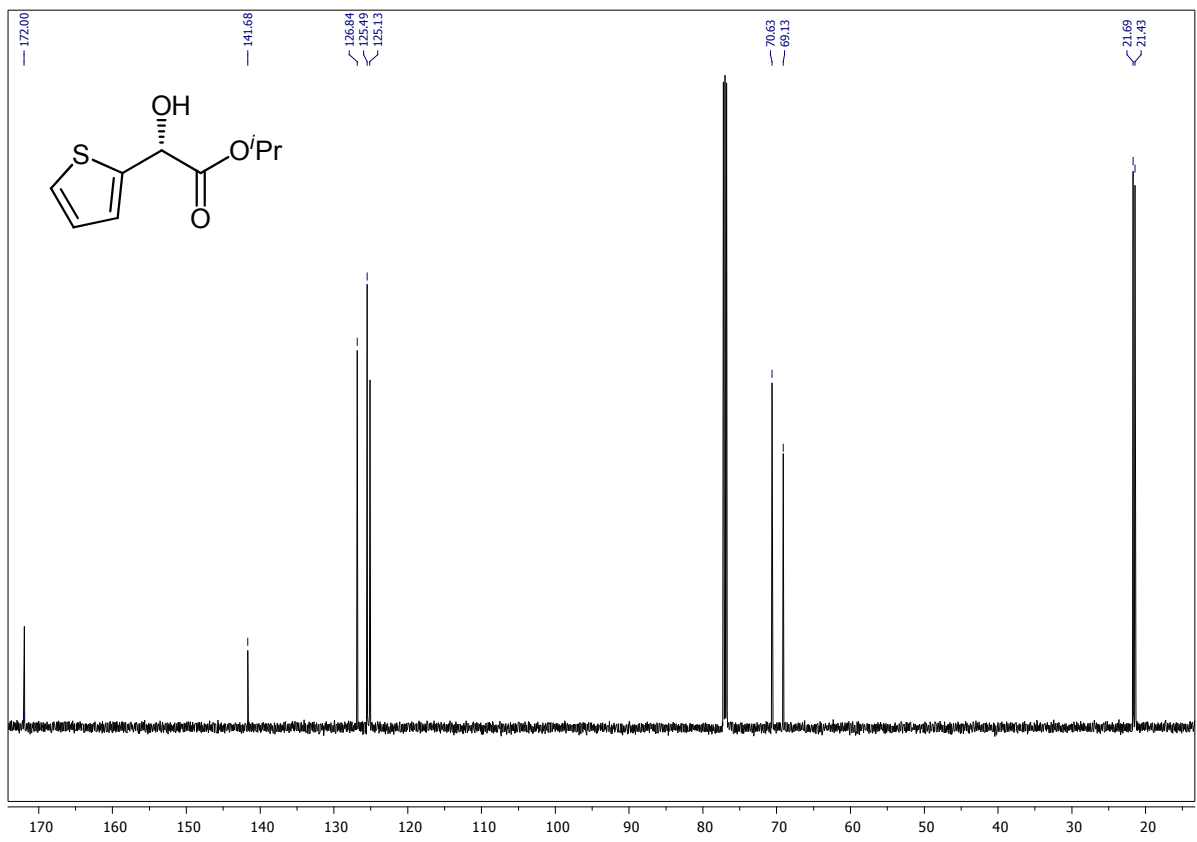
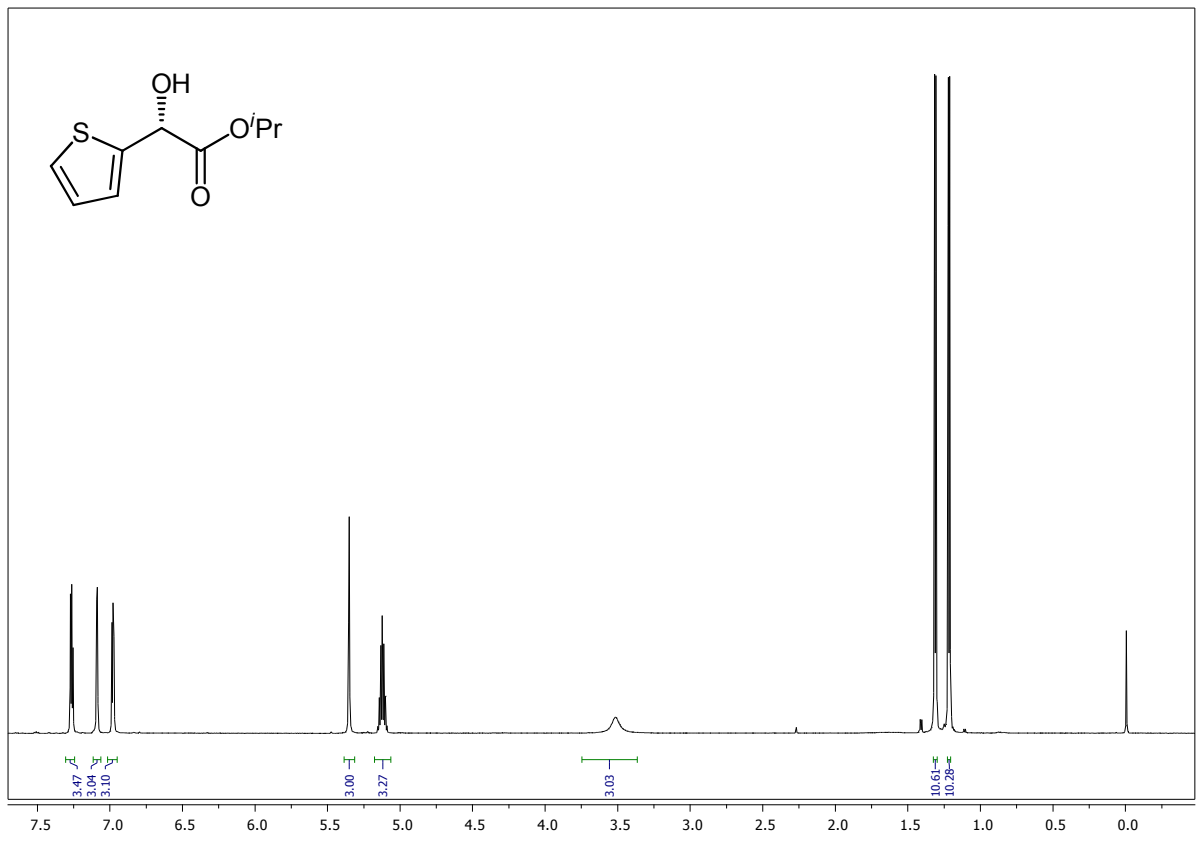


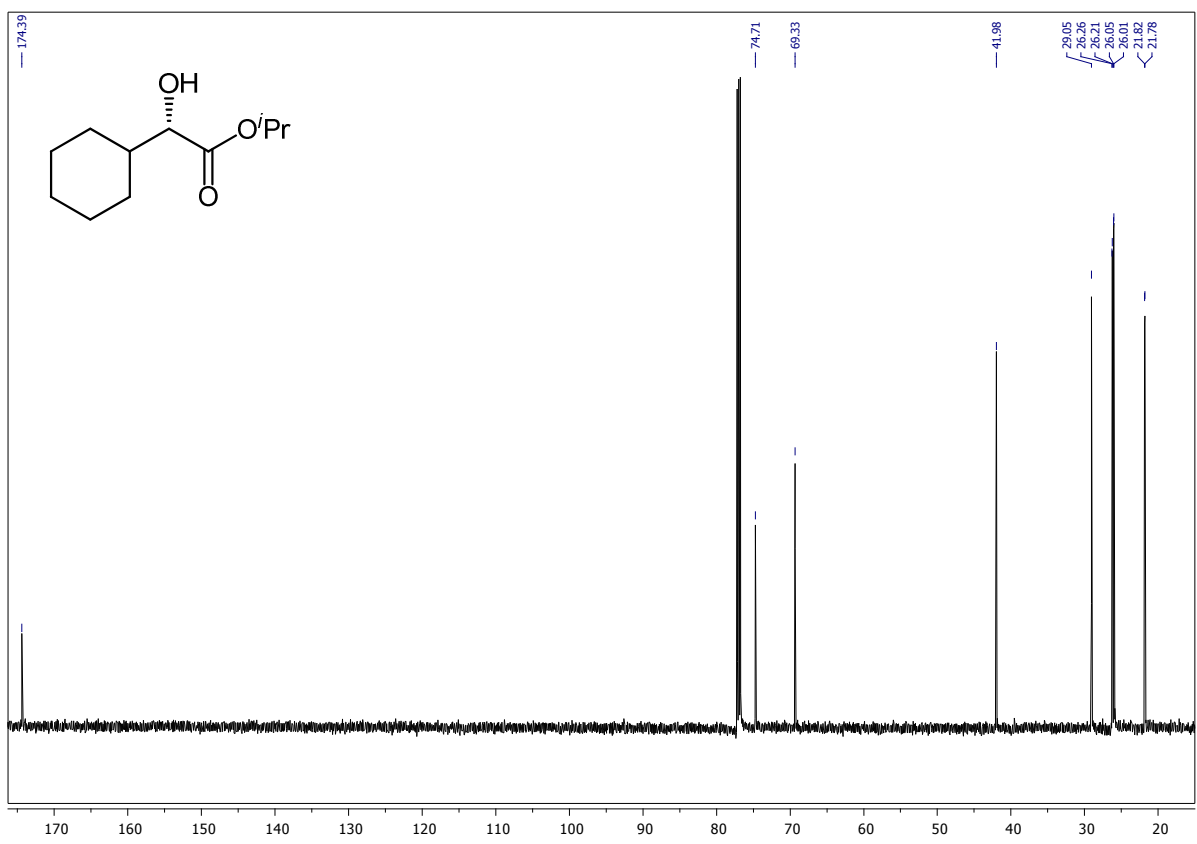
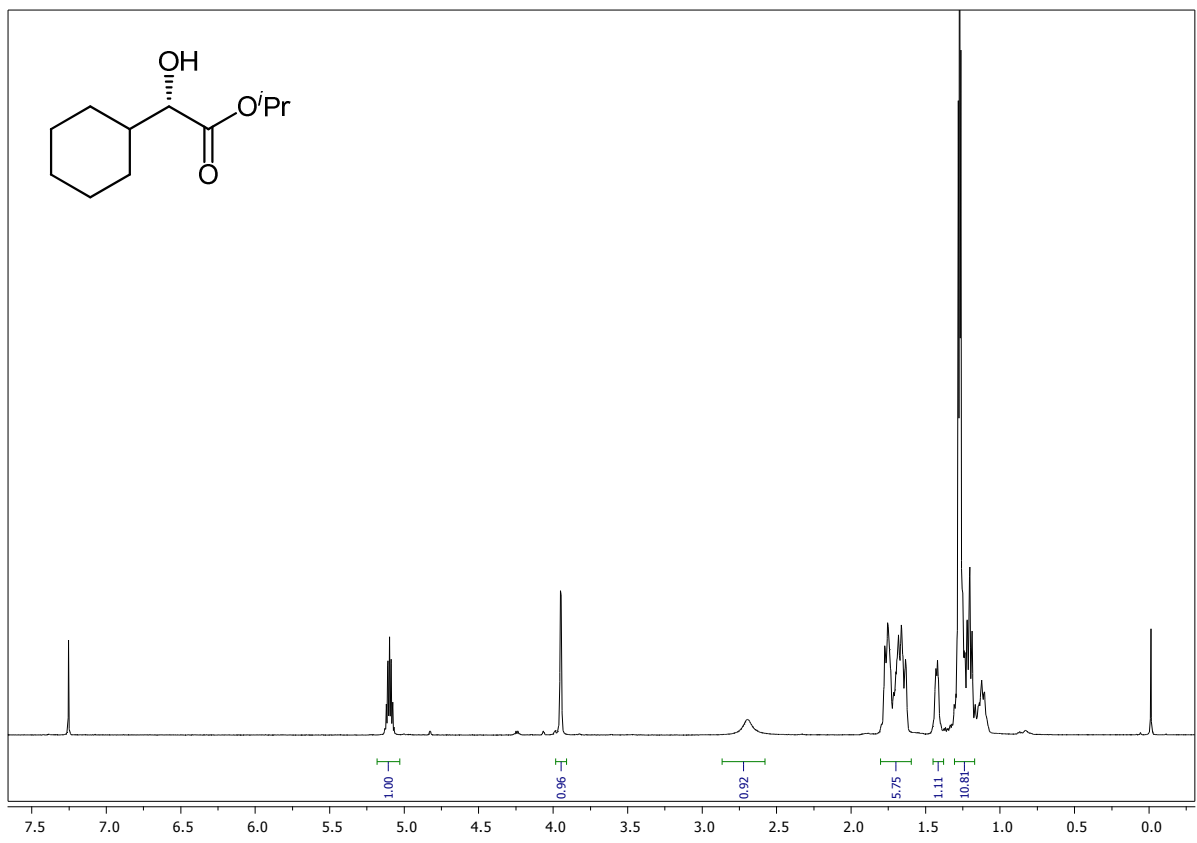


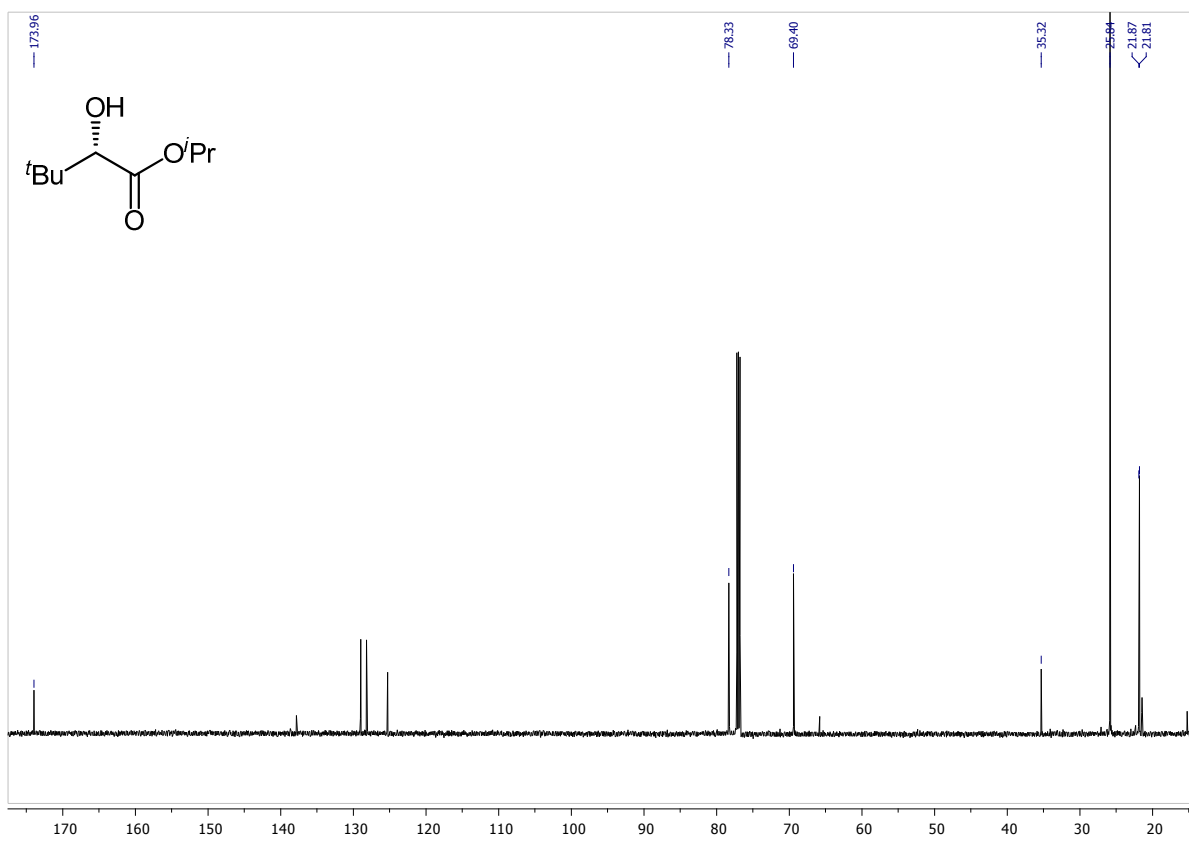
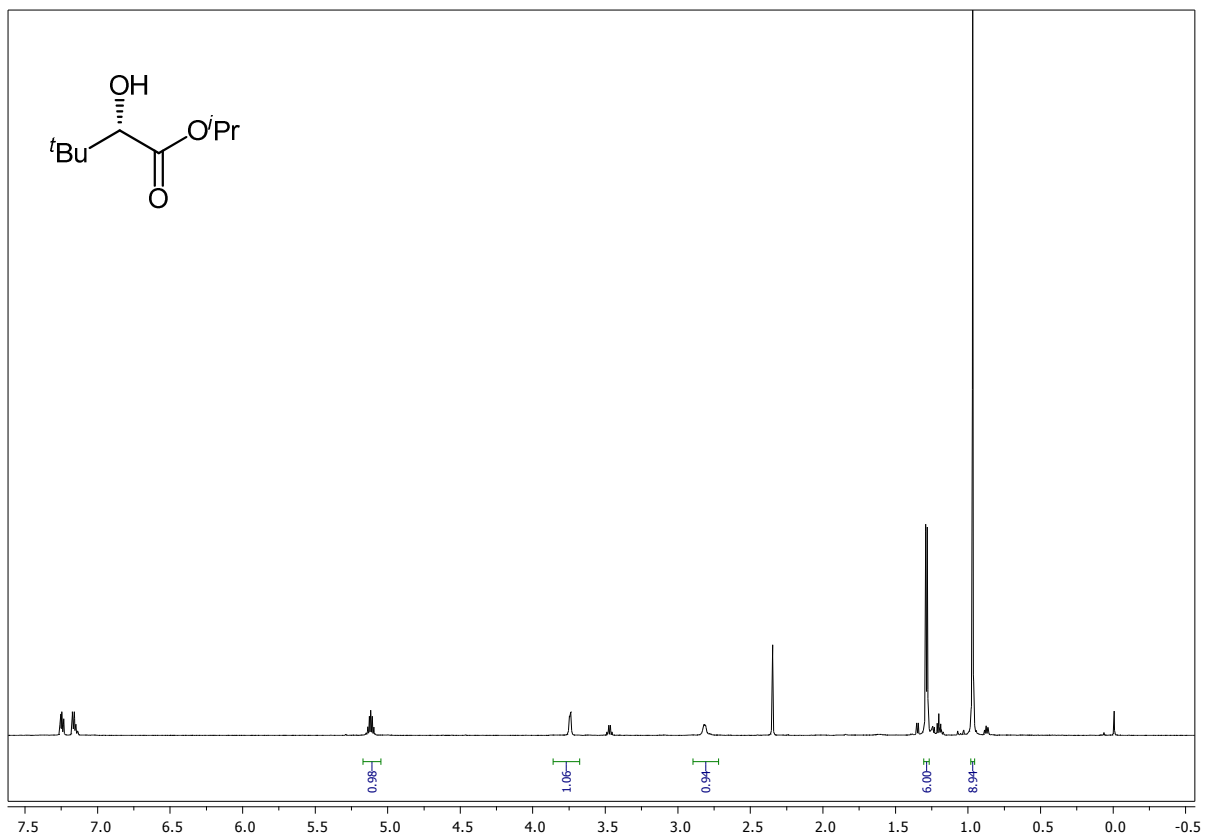












HPLC-Data

