Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Organocatalytic Enantioselective Decarboxylative Protonation of α-Alkyl-α-Aryl Malonate Monoesters

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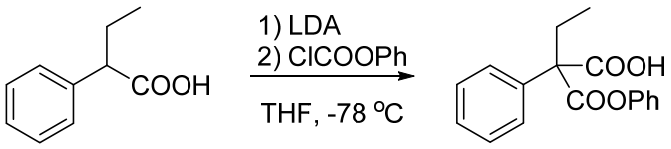
Contents

1. General information

All reagents and organic solvents were purchased from TCI, Sigma-Aldrich, Adamas-beta and Energy Chemical of the highest purity grade and used without further purification unless otherwise noted. ^{1}H and ^{13}C NMR spectra were recorded in $CDCl_3$ on Bruker Avance or Joel 400 MHz spectrometers. The chemical shifts (δ) are reported in ppm and coupling constants (*J*) in Hz. HRMS-ESI spectra were recorded on Waters Micromass GCT Premier. IR spectra were recorded on a FT-IR spectrophotometer using KBr optics. Melting points were measured without correction. HPLC spectra were measured using a Thermo 3000. The **C1** and **C6** catalysts were purchased from Adamas-beta and used without further purification. The known Cinchona alkaloid catalysts **C2**-**C5** were prepared according to literature method.[1] The chiral 1,2-*trans*-diaminocyclohexane derived organocatalysts **C7**-**C14** were synthesized based on the literature method.[2]

2. The procedure of preparation and corresponding spectral characterizations of α-alkyl-α-aryl malonate monoesters 1



1a

LDA (23 mL, 45.8 mmol, 2 M in hexanes) was added to a flame-dried round bottom flask containing anhydrous THF (60 mL) at -78 °C under argon. A solution of 2-phenylbutanoic acid (3 g, 18.3 mmol) dissolved in THF (10 mL) was added dropwise to the LDA solution. The solution was allowed to warm to room temperature and stir for four hours. The solution was then cooled to -78 °C and the dianion was allowed to react with phenylchloroformate (3.4 g, 22 mmol). The reaction was stirred overnight and quenched with HCl (3 M). Diethyl ether (25 mL) was added to the reaction mixture and two resulting phases were separated. The aqueous phase was acidified with 3 M HCl to pH = 3 and extracted three times with diethyl ether (20 mL) and the combined organic phases were washed three times with brine, and dried over anhydrous sodium sulfate. The solvent was removed in vacuo at -20 °C. The remaining residue was purified by silica gel column chromatography (hexane/ethyl acetate =10/1) to afford the desired product **1a** as a white solid (2.3 g, 44%). (Note: α-Alkyl-α-aryl substituted malonate phenyl monoesters demonstrate stability at -30°C when stored in a refrigerator. However, after a period of three weeks, less than 5% of the decarboxylative protonation product was observed. The racemic decarboxylative protonation product could be removed by washing the crude mixture with petroleum ether.)

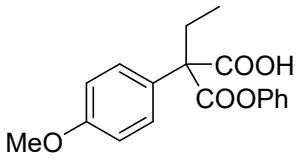
2-(phenoxycarbonyl)-2-phenylbutanoic acid (1a): white solid, Mp: 82–83 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.56 – 7.53 (m, 2H), 7.43 – 7.33 (m, 5H), 7.26 – 7.22 (m, 1H), 7.04 – 7.01 (m, 2H), 2.68 – 2.52 (m, 2H), 1.09 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 175.3, 170.7, 150.5, 136.1, 129.7, 128.8, 128.4, 127.8, 126.5, 121.3, 63.2, 28.6, 9.7.

HRMS-ESI (m/z) Calcd for $C_{17}H_{17}O_4$ [(M + H) $^+$] 285.1121, Found: 285.1130.

IR (KBr): ν (cm^{-1}) 2980, 1744, 1618, 1592, 1492, 1457, 747, 589.



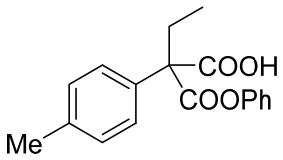
2-(4-methoxyphenyl)-2-(phenoxycarbonyl)butanoic acid (1d)

Compound **1d** was prepared according to the same procedure as the one used for **1a**.

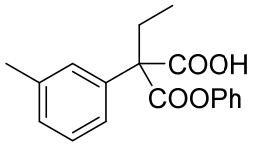
Yield: 81%, white solid, Mp: 81–83 °C.

^{1}H NMR (400MHz, $CDCl_3$): δ 7.46 – 7.43 (m, 2H), 7.38 (t, *J* = 7.9 Hz, 2H), 7.28 - 7.24 (m, 1H), 7.01 (d, *J* = 7.8 Hz, 2H), 6.95 – 6.92 (m, 2H), 3.82 (s, 3H), 2.71 – 2.51 (m, 2H), 1.11 (t, *J* = 7.4 Hz, 3H).

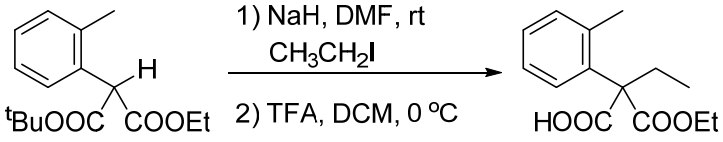
^{13}C NMR (100MHz, $CDCl_3$): δ 175.6, 170.8, 159.4, 150.5, 129.7, 129.2, 127.8, 126.4, 121.3, 114.1, 62.4, 55.4, 28.4, 9.7.
HRMS-ESI (m/z) Calcd for $C_{18}H_{19}O_5$ [(M + H) $^+$] 315.1227, Found: 315.1238.
IR (KBr): ν (cm^{-1}) 3474, 2938, 1742, 1713, 1591, 1254, 829, 799.



2-(phenoxycarbonyl)-2-(p-tolyl)butanoic acid (1e)
Compound **1e** was prepared according to the same procedure as the one used for **1a**. Yield: 78%, white solid, Mp: 90–91 ºC.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 – 7.36 (m, 4H), 7.28 – 7.21 (m, 3H), 7.03 – 7.00 (m, 2H), 2.71 – 2.51 (m, 2H), 2.36 (s, 3H), 1.11 (t, J = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 175.3, 171.0, 150.5, 138.2, 133.0, 129.6, 129.5, 127.7, 126.5, 121.3, 62.8, 28.5, 21.2, 9.7.
HRMS-ESI (m/z) Calcd for $C_{18}H_{19}O_4$ [(M + H) $^+$] 299.1278, Found: 299.1284.
IR (KBr): ν (cm^{-1}) 3446, 1706, 1650, 1630, 1592, 815, 764, 749.



2-(phenoxycarbonyl)-2-(m-tolyl)butanoic acid (1f)
Compound **1f** was prepared according to the same procedure as the one used for **1a**. Yield: 57%, white solid, Mp: 66–67 ºC.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37 – 7.21 (m, 6H), 7.15 (d, J = 7.3 Hz, 1H), 7.03 (d, J = 8.5 Hz, 2H), 2.63 – 2.52 (m, 2H), 2.37 (s, 3H), 1.08 (t, J = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 175.1, 170.9, 150.5, 138.4, 136.0, 129.6, 129.1, 128.6, 128.4, 126.5, 124.8, 121.3, 63.1, 28.6, 21.8, 9.8.
HRMS-ESI (m/z) Calcd for $C_{18}H_{19}O_4$ [(M + H) $^+$] 299.1278, Found: 299.1283.
IR (KBr): ν (cm^{-1}) 3473, 2979, 1743, 1710, 1591, 1491, 782, 748.



1g

1-(*tert*-butyl) 3-ethyl 2-(o-tolyl) malonate (583 mg, 3.1 mmol) was slowly added to a suspension of NaH (126 mg, 3.15 mmol) in 10 mL of DMF at 0 ºC. After the solution was stirred for 0.5 h at room temperature, ethyl iodide (983 mg, 6.3 mmol) was added and the mixture was stirred at rt overnight. Then the solution was quenched with saturated NH_4Cl solution. Diethyl ether (25 mL) was added to the reaction mixture and extracted three times with diethyl ether (20 mL) and the combined organic phases were washed three times with brine, and dried over anhydrous sodium sulfate. The

solvent was removed in vacuo. The remaining residue was purified by silica gel column chromatography (hexane/ethyl acetate = 20/1) to afford the alkylated product. A solution of the alkylated product in dry CH_2Cl_2 (1.5 mL) was treated with TFA (0.98 mL, 12.7 mmol), and the reaction was stirred at 0 ºC for 10 h. The reaction was concentrated in vacuo, the remaining residue was purified by column chromatography with 5% MeOH in CH_2Cl_2 to afford the desired product **1g** (180 mg, 34%, Colorless oil).

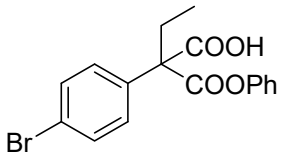
2-(ethoxycarbonyl)-2-(o-tolyl)butanoic acid (1g)

^{1}H NMR (400MHz, $CDCl_3$): δ 7.49 – 7.47 (m, 1H), 7.28 – 7.21 (m, 2H), 7.15 – 7.13 (m, 1H), 4.33 – 4.15 (m, 2H), 2.62 – 2.53 (m, 1H), 2.47 – 2.38 (m, 1H), 2.17 (s, 3H), 1.18 (t, *J* = 7.1 Hz, 3H), 1.08 (t, *J* = 7.5 Hz, 3H).

^{13}C NMR (100MHz, $CDCl_3$): δ 177.8, 172.1, 136.7, 136.0, 131.6, 128.1, 126.7, 126.5, 63.5, 60.1, 30.9, 20.0, 13.8, 9.6.

HRMS-ESI (m/z) Calcd for $C_{14}H_{19}O_4$ [(M + H) $^+$] 251.1278, Found: 251.1285.

IR (KBr): ν (cm^{-1}) 3473, 2985, 1737, 1637, 1488, 1456, 765, 749.



2-(4-bromophenyl)-2-(phenoxycarbonyl)butanoic acid (1h)

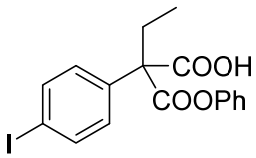
Compound **1h** was prepared according to the same procedure as the one used for **1a**. Yield: 53%, white solid, Mp: 87–89 ºC.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.55 (dd, *J* = 8.7, 2.0 Hz, 2H), 7.44 – 7.37 (m, 4H), 7.29 – 7.25(m,1H), 7.01 – 7.00 (m, 2H), 2.65 – 2.50 (m, 2H), 1.10 – 1.06 (m, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 175.3, 169.7, 150.4, 134.8, 131.9, 129.8, 129.7, 126.6, 122.7, 121.2, 62.8, 28.5, 9.5.

HRMS-ESI (m/z) Calcd for $C_{17}H_{16}BrO_4$ [(M + H) $^+$] 363.0226, Found: 363.0232.

IR (KBr): ν (cm^{-1}) 3063, 1744, 1713, 1592, 1492, 1457, 1387, 747, 689.



2-(4-iodophenyl)-2-(phenoxycarbonyl)butanoic acid (1i)

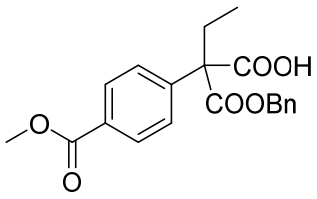
Compound **1i** was prepared according to the same procedure as the one used for **1a**. Yield: 65%, white solid, Mp: 92–94 ºC.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.76 – 7.72 (m, 2H), 7.40 – 7.35 (m, 2H), 7.31 – 7.24 (m, 3H), 7.03 – 7.01 (m, 2H), 2.63 – 2.48 (m, 2H), 1.07 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 175.1, 169.7, 150.4, 137.8, 135.6, 129.9, 129.7, 126.6, 121.2, 94.4, 62.9, 28.4, 9.5.

HRMS-ESI (m/z) Calcd for $C_{17}H_{16}IO_4$ [(M + H) $^+$] 411.0088, Found: 411.0089.

IR (KBr): ν (cm^{-1}) 3447, 1739, 1713, 1592, 1489, 817, 745, 687.



2-((benzyloxy)carbonyl)-2-(4-(methoxycarbonyl)phenyl)butanoic acid (1j)

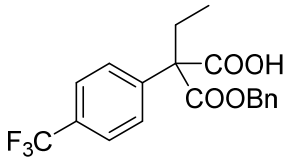
Compound **1j** was prepared according to the same procedure as the one used for **1g**. Yield: 81%, colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.02 – 7.96 (m, 2H), 7.45 – 7.39 (m, 2H), 7.32 (dd, *J* = 4.8, 2.0 Hz, 3H), 7.23 (dd, *J* = 6.5, 3.1 Hz, 2H), 5.28 – 5.18 (m, 2H), 3.92 (s, 3H), 2.60 – 2.48 (m, 1H), 2.45 – 2.36 (m, 1H), 0.91 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 173.7, 172.0, 166.7, 141.3, 134.4, 129.7, 129.6, 128.6, 128.6, 128.2, 127.6, 68.2, 62.8, 52.3, 28.5, 9.4.

HRMS-ESI (m/z) Calcd for $C_{20}H_{20}O_6$ [(M + Na) $^+$] 379.1152, Found: 379.1152.

IR (KBr): ν (cm^{-1}) 3676, 2953 1725 1610, 1438, 1282, 745, 597.



2-((benzyloxy)carbonyl)-2-(4-(trifluoromethyl)phenyl)butanoic acid (1k)

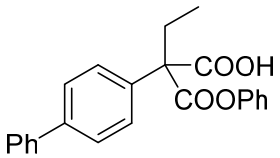
Compound **1k** was prepared according to the same procedure as the one used for **1g**. Yield: 82%, white solid.

^{1}H NMR (400MHz, $CDCl_3$): δ 7.58 (d, *J* = 8.3 Hz, 2H), 7.49 (d, *J* = 8.4 Hz, 2H), 7.31 (dd, *J* = 5.0, 2.1 Hz, 3H), 7.22 (dd, *J* = 6.7, 2.9 Hz, 2H), 5.27 – 5.11 (m, 2H), 2.50 – 2.40 (m, 2H), 0.90 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (100MHz, $CDCl_3$): δ 173.9, 171.7, 140.2, 134.5, 130.2 (q, *J* = 32.8), 128.7, 128.6, 128.2, 128.1, 125.4, 125.4, 123.8 (q, *J* = 272.3), 68.1, 62.7, 28.5, 9.4.

HRMS-ESI (m/z) Calcd for $C_{19}H_{17}F_3O_4$ [(M + Na) $^+$] 389.0971, Found: 389.0970.

IR (KBr): ν (cm^{-1}) 2979, 1741, 1705, 1327, 1218, 1126, 887, 749.



2-([1,1'-biphenyl]-4-yl)-2-(phenoxycarbonyl)butanoic acid (1l)

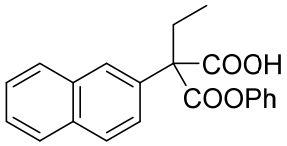
Compound **1l** was prepared according to the same procedure as the one used for **1a**. Yield: 66%, white solid, Mp: 93–94 ºC.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.65 – 7.59 (m, 6H), 7.45 (t, *J* = 7.5 Hz, 2H), 7.37 (q, *J* = 8.1 Hz, 3H), 7.28 – 7.24 (m, 1H), 7.06 (d, *J* = 8.0 Hz, 2H), 2.74 – 2.57 (m, 2H), 1.14 (t, *J* = 4.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 175.0, 170.8, 150.5, 141.2, 140.4, 135.0, 129.7, 129.0, 128.3, 127.7, 127.5, 127.3, 126.6, 121.3, 62.9, 28.6, 9.8.

HRMS-ESI (m/z) Calcd for $C_{23}H_{21}O_4$ [(M + H) $^+$] 361.1434, Found: 361.1446.

IR (KBr): ν (cm^{-1}) 3474, 2979, 1743, 1710, 1618, 1591, 1488, 834, 764, 749.



2-(naphthalen-2-yl)-2-(phenoxycarbonyl)butanoic acid (1m)

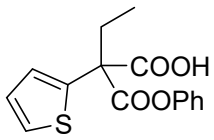
Compound **1m** was prepared according to the same procedure as the one used for **1a**. Yield: 73%, white solid, Mp: 79–81 ºC.

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.02 (d, *J* = 1.3 Hz, 1H), 7.89 – 7.83 (m, 3H), 7.61 (dd, *J* = 8.7, 1.9 Hz, 1H), 7.53 – 7.50 (m, 2H), 7.37 (t, *J* = 7.9 Hz, 2H), 7.25 (t, *J* = 7.4 Hz, 1H), 7.02 (d, *J* = 7.9 Hz, 2H), 2.82 – 2.65 (m, 2H), 1.16 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 174.6, 170.9, 150.5, 133.5, 133.2, 132.9, 129.7, 128.5, 128.4, 127.6, 127.0, 126.8, 126.6, 126.5, 125.6, 121.3, 63.2, 28.7, 9.8.

HRMS-ESI (m/z) Calcd for $C_{21}H_{19}O_4$ [(M + H) $^+$] 335.1278, Found: 335.1287.

IR (KBr): ν (cm^{-1}) 3454, 1647, 1632, 1492, 1457, 815, 745, 688.



2-(phenoxycarbonyl)-2-(thiophen-2-yl)butanoic acid (1n)

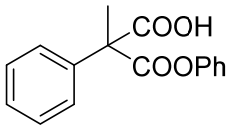
Compound **1n** was prepared according to the same procedure as the one used for **1a**. Yield: 59%, white solid, Mp: 72–73 ºC.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.40 – 7.35 (m, 3H), 7.27 – 7.24 (m, 2H), 7.09 – 7.04 (m, 3H), 2.68 – 2.53 (m, 2H), 1.05 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 174.3, 168.9, 150.5, 138.1, 129.6, 127.2, 126.6, 126.5, 126.5, 121.2, 60.7, 31.0, 9.4.

HRMS-ESI (m/z) Calcd for $C_{15}H_{15}SO_4$ [(M + H) $^+$] 291.0686, Found: 291.0688.

IR (KBr): ν (cm^{-1}) 3474, 2977, 1719, 1592, 1491, 1457, 747, 703.



2-methyl-3-oxo-3-phenoxy-2-phenylpropanoic acid (1o)

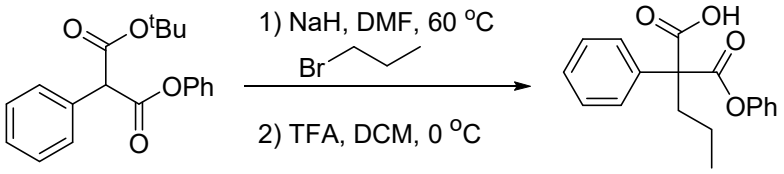
Compound **1o** was prepared according to the same procedure as the one used for **1a**. Yield: 75%, white solid, Mp: 76–77 ºC.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.54 – 7.51 (m, 2H), 7.42 – 7.33 (m, 5H), 7.24 – 7.20 (m, 1H), 7.08 – 7.06 (m, 2H), 2.06 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 177.3, 170.1, 150.7, 137.0, 129.6, 128.6, 128.4, 127.6, 126.4, 121.3, 58.9, 22.0.

HRMS-ESI (m/z) Calcd for $C_{16}H_{15}O_4$ [(M + H) $^+$] 271.0965, Found: 271.0973.

IR (KBr): ν (cm^{-1}) 3271, 1747, 1713, 1591, 1492, 1457, 745, 694.



1p

2-(phenoxycarbonyl)-2-phenylpentanoic acid (1p)

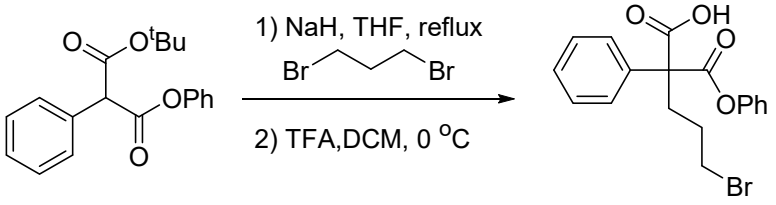
Compound **1p** was prepared according to the same procedure as the one used for **1g**. Yield: 31%, white solid, Mp: 66–67 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.54 (d, *J* = 7.8 Hz, 2H), 7.42 – 7.33 (m, 5H), 7.26 – 7.22 (m, 1H), 7.02 (d, *J* = 8.0 Hz, 2H), 2.54 – 2.46 (m, 2H), 1.47 – 1.44 (m, 2H), 1.03 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 174.7, 171.2, 150.4, 136.4, 129.7, 128.8, 128.3, 127.6, 126.5, 121.2, 62.5, 37.5, 18.7, 14.5.

HRMS-ESI (m/z) Calcd for $C_{18}H_{19}O_4$ [(M + H) $^+$] 299.1278, Found: 299.1284.

IR (KBr): ν (cm^{-1}) 3412, 2965, 1743, 1710, 1591, 1492, 1448, 744, 689.



1q

5-bromo-2-(phenoxycarbonyl)-2-phenylpentanoic acid (1q)

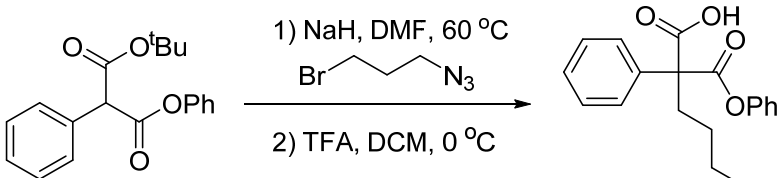
Compound **1q** was prepared according to the same procedure as the one used for **1g**. Yield: 30%, white solid, Mp: 117–119 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.55 – 7.52 (m, 2H), 7.44 – 7.34 (m, 5H), 7.26 – 7.23 (m, 1H), 7.07 – 7.04 (m, 2H), 3.50 – 3.41 (m, 2H), 2.69 – 2.65 (m, 2H), 2.07 – 1.90 (m, 2H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 174.6, 170.1, 150.4, 135.8, 129.7, 128.9, 128.5, 127.7, 126.5, 121.2, 62.2, 34.3, 33.3, 28.3.

HRMS-ESI (m/z) Calcd for $C_{18}H_{18}B_rO_4$ [(M + H) $^+$] 377.0383, Found: 377.0390.

IR (KBr): ν (cm^{-1}) 3413, 3063, 1743, 1715, 1590, 1491, 1447, 766, 748.

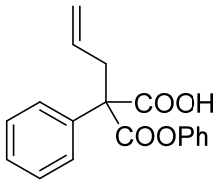


1r

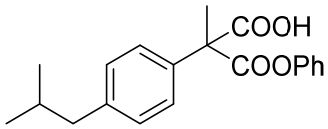
5-azido-2-(phenoxycarbonyl)-2-phenylpentanoic acid (1r)

Compound **1r** was prepared according to the same procedure as the one used for **1g**. Yield: 35%, white solid, Mp: 55–57 °C.

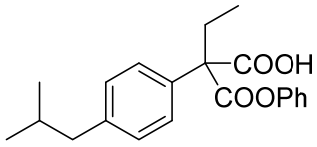
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.51 (d, *J* = 7.5 Hz, 2H), 7.45 – 7.37 (m, 5H), 7.28 – 7.25 (m, 1H), 7.05 – 7.03 (m, 2H), 3.46 – 3.34 (m, 2H), 2.64 – 2.57 (m, 2H), 1.77 – 1.68 (m, 2H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 174.7, 170.2, 150.4, 135.7, 129.7, 128.9, 128.5, 127.6, 126.6, 121.2, 62.3, 51.4, 32.8, 24.8.
HRMS-ESI (m/z) Calcd for $C_{18}H_{18}N_3O_4$ [(M + H) $^+$] 340.1292, Found: 340.1291.
IR (KBr): ν (cm^{-1}) 2936, 2098, 1744, 1591, 1492, 1448, 746, 689.



2-(phenoxycarbonyl)-2-phenylpent-4-enoic acid (1s)
Compound **1s** was prepared according to the same procedure as the one used for **1g**. Yield: 44%, white solid, Mp: 76–77 ºC.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.55 – 7.53 (m, 2H), 7.44 – 7.35 (m, 5H), 7.27 – 7.23 (m, 1H), 7.01 (d, *J* = 8.2 Hz, 2H), 5.96 – 5.85 (m, 1H), 5.31 – 5.20 (m, 2H), 3.37 (dd, *J* = 14.1, 6.7 Hz, 1H), 3.25 (dd, *J* = 14.0, 7.6 Hz, 1H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 173.4, 171.2, 150.4, 136.0, 132.2, 129.7, 128.9, 128.5, 127.5, 126.6, 121.2, 120.2, 62.4, 39.9.
HRMS-ESI (m/z) Calcd for $C_{18}H_{17}O_4$ [(M + H) $^+$] 297.1121, Found: 297.1126.
IR (KBr): ν (cm^{-1}) 3063, 1747, 1713, 1629, 1591, 1492, 796, 746.

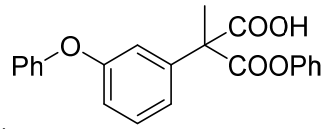


2-(4-isobutylphenyl)-2-methyl-3-oxo-3-phenoxypropanoic acid (1t)
Compound **1t** was prepared according to the same procedure as the one used for **1a.** Yield: 53%, white solid, Mp: 60–62 ºC.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, *J* = 8.2 Hz, 2H), 7.35 (t, *J* = 7.9 Hz, 2H), 7.24 – 7.16 (m, 3H), 7.07 (d, *J* = 7.6 Hz, 2H), 2.48 (d, *J* = 7.2 Hz, 2H), 2.05 (s, 3H), 1.92 – 1.82 (m, 1H), 0.91 (d, *J* = 7.6 Hz, 6H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 177.2, 170.4, 150.8, 141.9, 134.2, 129.6, 129.4, 127.3, 126.3, 121.3, 58.6, 45.1, 30.2, 22.6, 22.1.
HRMS-ESI (m/z) Calcd for $C_{20}H_{23}O_4$ [(M + H) $^+$] 327.1591, Found: 327.1604.
IR (KBr): ν (cm^{-1}) 3412, 2954, 1748, 1713, 1592, 1514, 1383, 739, 687.

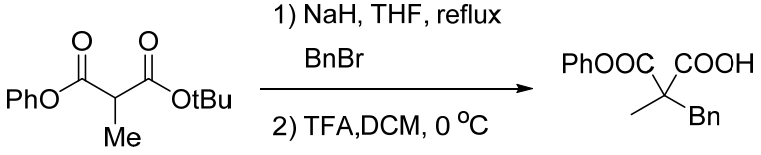


2-(4-isobutylphenyl)-2-(phenoxycarbonyl)butanoic acid (1u)
Compound **1u** was prepared according to the same procedure as the one used for **1a.** Yield: 56%, white solid, Mp: 68–70 ºC.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, *J* = 8.2 Hz, 2H), 7.38 – 7.34 (m, 2H), 7.25 – 7.22 (m, 1H), 7.17 (d, *J* = 8.3 Hz, 2H), 7.02 (d, *J* = 7.9 Hz, 2H), 2.66 – 2.50 (m, 2H), 2.47 (d, *J* = 7.2 Hz, 2H), 1.90 – 1.82 (m, 1H), 1.08 (t, *J* = 7.4 Hz, 3H), 0.90 (d, *J* = 6.6 Hz, 6H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 174.5, 171.4, 150.4, 141.9, 133.4, 129.6, 129.5, 127.3, 126.5, 121.2, 62.8, 45.1, 30.2, 28.6, 22.5, 9.8.
HRMS-ESI (m/z) Calcd for $C_{21}H_{25}O_4$ [(M + H) $^+$] 341.1747, Found: 341.1758.
IR (KBr): ν (cm^{-1}) 3414, 1746, 1710, 1638, 1618, 1492, 764, 749.

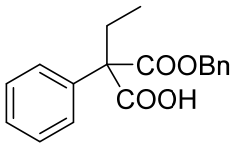


2-methyl-3-oxo-3-phenoxy-2-(3-phenoxyphenyl)propanoic acid (1v)
Compound **1v** was prepared according to the same procedure as the one used for **1a.**
Yield: 56%, white solid, Mp: 116–117 °C.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37 – 7.30 (m, 5H), 7.27 – 7.20 (m, 3H), 7.09 (t, *J* = 7.4 Hz, 1H), 7.02 (d, *J* = 8.4 Hz, 4H), 6.98 (dd, *J* = 8.0, 2.1 Hz, 1H), 2.04 (s, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 176.7, 169.8, 157.4, 157.0, 150.6, 138.9, 130.0, 129.9, 129.6, 126.4, 123.6, 122.4, 121.3, 119.1, 118.5, 118.5, 58.8, 22.1.
HRMS-ESI (m/z) Calcd for $C_{22}H_{19}O_5$ [(M + H) $^+$] 363.1227, Found: 363.1232.
IR (KBr): ν (cm^{-1}) 3451, 1747, 1714, 1592, 1488, 1223, 750, 689.



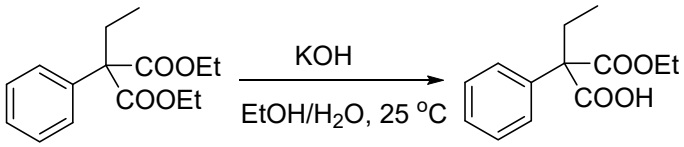
1w

2-benzyl-2-methyl-3-oxo-3-phenoxypropanoic acid (1w)
Compound **1w** was prepared according to the same procedure as the one used for **1g**.
Yield: 52%, white solid.
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 (t, *J* = 7.9 Hz, 2H), 7.33 – 7.26 (m, 6H), 7.06 (d, *J* = 7.8 Hz, 2H), 3.47 (d, *J* = 13.7 Hz, 1H), 3.32 (d, *J* = 13.7 Hz, 1H), 1.57 (s, 3H).
^{13}C NMR (100 MHz, $CDCl_3$) δ 178.0, 170.2, 150.6, 135.5, 130.5, 129.6, 128.5, 127.4, 126.3, 121.4, 55.3, 41.2, 20.1.
HRMS-ESI (m/z) calcd for C17H16O4Na [(M + Na) $^+$] 309.0941, found 309.0947.



2-((benzyloxy)carbonyl)-2-phenylbutanoic acid (1b)
Compound **1b** was prepared according to the same procedure as the one used for **1a.**
Yield: 88%, white solid, Mp: 79–80 °C.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36 – 7.30 (m, 8H), 7.23 – 7.21 (m, 2H), 5.22 (q, *J* = 12.3 Hz, 2H), 2.57 – 2.35 (m, 2H), 0.91 (t, *J* = 7.3 Hz, 3H);

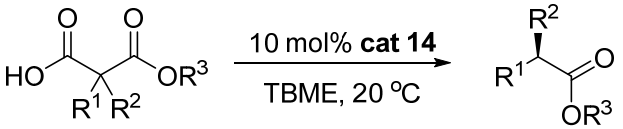
^{13}C NMR (100 MHz, $CDCl_3$): δ 173.8, 173.4, 136.8, 134.7, 128.7, 128.7, 128.3, 128.2, 127.2, 68.2, 62.7, 28.6, 9.8.
HRMS-ESI (m/z) Calcd for $C_{18}H_{18}O_4Na$ [(M + Na) $^+$] 321.1097, Found: 321.1103.
IR (KBr): ν (cm^{-1}) 3446, 2977, 1735, 1711, 1601, 1498, 1455, 735, 696.



1c

A solution of 1.27 g (22.7 mmol) of KOH in 11 mL of H_2O is added dropwise to a solution of 3.0 g (11.4 mmol) of diethyl 2-ethyl-2-phenylmalonate in 26 mL of cold ethanol (0-5 °C). Agitation is continued for 24 hours at 25 °C and the solvent is evaporated off. The residue is separated with H_2O and diethylether. After decantation, the aqueous layer is acidified at 0 °C with 3N HCl and extracted with diethylether (50 mL × 2). The solution was evaporated in vacuo, the remaining residue was purified by recrystallization with PE and DCM to afford the desired product **1c** as a white solid (2 g, 74%).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.40 – 7.31 (m, 5H), 4.36 – 4.22 (m, 2H), 2.61 – 2.52 (m, 1H), 2.43 – 2.34 (m, 1H), 1.26 (t, J = 7.1 Hz, 3H), 0.98 (t, J = 7.3 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 174.8, 173.0, 137.2, 128.8, 128.2, 126.9, 62.9, 62.5, 28.7, 13.9, 9.9.
HRMS-ESI (m/z) Calcd for $C_{13}H_{17}O_4$ [(M + H) $^+$] 237.1121, Found: 237.1123.
IR (KBr): ν (cm^{-1}) 3509, 2981, 1708, 1601, 1498, 1447, 760, 697.

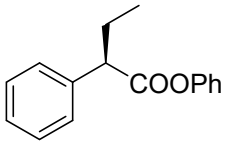
3. Representative procedure for the enantioselective decarboxylative protonation and spectral characterizations of the products 2



1 **2**

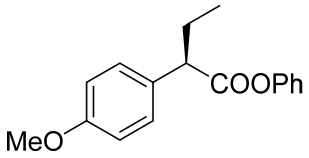
To a mixture of catalyst **C14** (0.01 mmol), disubstituted malonic acid half-esters **1** (0.1 mmol) in a vial (4.0 mL) were added TBME (1.0 mL). Then the reaction mixture was stirred at 20 ºC and was monitored by TLC. After completion, the reaction mixture was concentrated in vacuo, and the remaining residue was purified by silica gel column chromatography (hexane/ethyl acetate) to afford the desired product **2**.

(*R*)-phenyl-2-phenylbutanoate (2a):



Yield: 98%; ee: 91%.
Colorless oil, $[\alpha]_D^{20}$ = -68º (0.44, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 – 7.28 (m, 7H), 7.19 (t, *J* = 7.5 Hz, 1H), 7.00 – 6.98 (m, 2H), 3.70 (t, *J* = 7.7 Hz, 1H), 2.28 – 2.17 (m, 1H), 1.96 – 1.85 (m, 1H), 1.00 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.7, 150.9, 138.7, 129.5, 128.9, 128.2, 127.5, 125.9, 121.6, 53.6, 26.9, 12.3.
HRMS-ESI (m/z) Calcd for $C_{16}H_{17}O_2$ [(M + H) $^+$] 241.1223, Found: 241.1229.
IR (KBr): ν (cm^{-1}) 3478, 2966, 1754, 1618, 1592, 1491, 764, 748.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 90/10, 1.0 mL/min, 210 nm, 25 °C, t_R = 8.72 min (minor), 10.09 min (major).

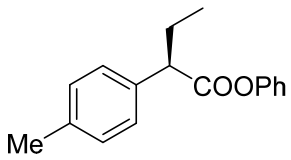
(*R*)-phenyl -2-(4-methoxyphenyl) butanoate (2d):



Yield: 96%; ee: 91%.
Colorless oil, $[\alpha]_D^{20}$ = -65º (0.23, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35 – 7.31 (m, 4H), 7.21 – 7.17 (m, 1H), 6.99 – 6.97 (m, 2H), 6.91 – 6.89 (m, 2H), 3.81 (s, 3H), 3.64 (t, *J* = 7.7 Hz, 1H), 2.25 – 2.14 (m, 1H), 1.93 – 1.82 (m, 1H), 0.99 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.9, 159.0, 150.9, 130.7, 129.4, 129.1, 125.8, 121.6, 114.2, 55.4, 52.7, 26.8, 12.2.
HRMS-ESI (m/z) Calcd for $C_{17}H_{19}O_3$ [(M + H) $^+$] 271.1329, Found: 271.1338.
IR (KBr): ν (cm^{-1}) 3414, 2932, 1753, 1610, 1592, 1511, 1252, 816, 750.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 90/10, 1.0 mL/min,

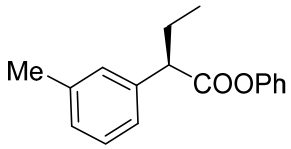
204 nm, 25 °C, t_R = 27.54 min (minor), 38.92 min (major).

(*R*)-phenyl -2-(p-tolyl) butanoate (2e):



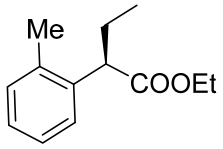
Yield: 91%; ee: 91%.
Colorless oil, $[\alpha]_D^{20}$ = -74º (0.39, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34 – 7.27 (m, 4H), 7.20 – 7.16 (m, 3H), 7.00 – 6.97 (m, 2H), 3.66 (t, *J* = 7.7 Hz, 1H), 2.35 (s, 3H), 2.26 – 2.15 (m, 1H), 1.93 – 1.83 (m, 1H), 0.99 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.8, 151.0, 137.2, 135.7, 129.5, 129.4, 128.0, 125.8, 121.6, 53.2, 26.9, 21.2, 12.3.
HRMS-ESI (m/z) Calcd for $C_{17}H_{19}O_2$ [(M + H) $^+$] 255.1380, Found: 255.1388.
IR (KBr): ν (cm^{-1}) 3450, 2964, 1754, 1646, 1513, 1491, 749, 687.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 90/10, 1.0 mL/min, 204 nm, 25 °C, t_R = 15.59 min (major), 18.64 min (minor).

(*R*)-phenyl -2-(m-tolyl) butanoate (2f):



Yield: 91%; ee: 90%.
Colorless oil, $[\alpha]_D^{20}$ = -65º (0.24, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35 – 7.31 (m, 2H), 7.27 – 7.23 (m, 1H), 7.20 – 7.16 (m, 3H), 7.10 (d, *J* = 7.2 Hz, 1H), 7.00 – 6.98 (m, 2H), 3.65 (t, *J* = 7.7 Hz, 1H), 2.36 (s, 3H), 2.26 – 2.16 (m, 1H), 1.94 – 1.83 (m, 1H), 0.99 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.8, 150.9, 138.7, 138.5, 129.4, 128.9, 128.7, 128.3, 125.8, 125.1, 121.6, 53.6, 26.9, 21.6, 12.3.
HRMS-ESI (m/z) Calcd for $C_{17}H_{19}O_2$ [(M + H) $^+$] 255.1380, Found: 255.1385.
IR (KBr): ν (cm^{-1}) 3451, 2965, 1755, 1630, 1592, 1491, 767, 749.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 90/10, 1.0 mL/min, 204 nm, 25 °C, t_R = 12.10 min (minor), 13.76 min (major).

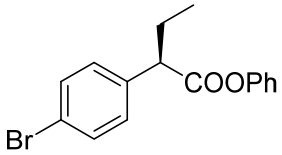
(*R*)-ethyl-2-(o-tolyl) butanoate (2g):



Yield: 90%; ee: 89%.
Colorless oil, $[\alpha]_D^{20}$ = -60º (0.13, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 (d, *J* = 7.2 Hz, 1H), 7.19 – 7.13 (m, 3H), 4.16 – 4.05 (m, 2H), 3.73 (t, *J* = 8 Hz, 1H), 2.38 (s, 3H), 2.17 – 2.06 (m, 1H), 1.81 – 1.70 (m, 1H), 1.20 (t, *J* = 7.1 Hz, 3H), 0.91 (t, *J* = 7.4 Hz, 3H).

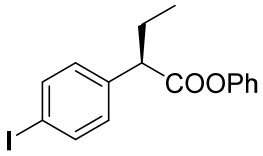
^{13}C NMR (100 MHz, $CDCl_3$): δ 174.4, 137.9, 136.3, 130.5, 126.9, 126.8, 126.4, 60.7, 48.8, 26.4, 20.0, 14.3, 12.4.
HRMS-ESI (m/z) Calcd for $C_{13}H_{19}O_2$ [(M + H) $^+$] 207.1380, Found: 207.1383.
IR (KBr): ν (cm^{-1}) 3415, 2965, 1733, 1636, 1490, 1463, 750, 732.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 99.8/0.2, 0.6 mL/min, 204 nm, 25 °C, t_R = 11.24 min (major), 12.21 min (minor).

(*R*)-phenyl-2-(4-bromophenyl) butanoate (2h):



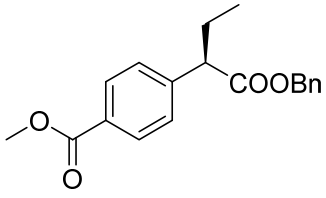
Yield: 99%; ee: 86%.
Colorless oil, $[\alpha]_D^{20}$ = -64° (0.18, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): 7.50 – 7.47 (m, 2H), 7.36 – 7.32 (m, 2H), 7.29 – 7.27 (m, 2H), 7.22 – 7.18 (m, 1H), 6.99 – 6.97 (m, 2H), 3.66 (t, *J* = 7.7 Hz, 1H), 2.26 – 2.15 (m, 1H), 1.93 - 1.82 (m, 1H), 0.99 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.2, 150.7, 137.7, 132.0, 129.9, 129.5, 126.0, 121.5, 121.5, 53.0, 26.8, 12.2.
HRMS-ESI (m/z) Calcd for $C_{16}H_{16}BrO_2$ [(M + H) $^+$] 319.0328, Found: 319.0337.
IR (KBr): ν (cm^{-1}) 3461, 2965, 1754, 1592, 1489, 1456, 815, 749.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 95/5, 1.0 mL/min, 204 nm, 25 °C, t_R = 16.46 min (minor), 23.39 min (major).

(*R*)-phenyl-2-(4-iodophenyl) butanoate (2i):



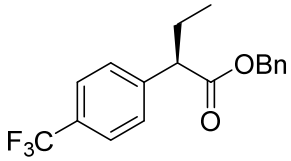
Yield: 94%; ee: 85%.
Colorless oil, $[\alpha]_D^{20}$ = -59° (0.13, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.71 – 7.68 (m, 2H), 7.36 – 7.32 (m, 2H), 7.22 – 7.18 (t, *J* = 7.7 Hz, 1H), 7.17 – 7.14 (m, 2H), 6.98 (d, *J* = 7.7 Hz, 2H), 3.64 (t, *J* = 7.7 Hz, 1H), 2.26 – 2.15 (m, 1H), 1.93 – 1.82 (m, 1H), 0.99 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.2, 150.8, 138.4, 137.9, 130.2, 129.5, 126.0, 121.5, 93.1, 53.1, 26.8, 12.2.
HRMS-ESI (m/z) Calcd for $C_{16}H_{16}IO_2$ [(M + H) $^+$] 367.0189, Found: 367.0195.
IR (KBr): ν (cm^{-1}) 3477, 2964, 1755, 1638, 1592, 1485, 814, 750.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 95/5, 1.0 mL/min, 204 nm, 25 °C, t_R = 17.77 min (minor), 31.39 min (major).

(*R*)-methyl-4-(1-(benzyloxy)-1-oxobutan-2-yl)benzoate (2j):



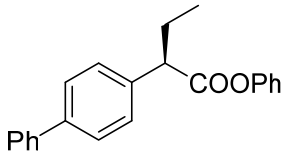
Yield: 97%; ee: 84%.
Colorless oil, $[\alpha]_D^{20}$ = -6º (0.21, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.98 (d, *J* = 8.2 Hz, 2H), 7.38 (d, *J* = 8.2 Hz, 2H), 7.34 – 7.28 (m, 3H), 7.24 (m, 2H), 5.26 – 4.97 (m, 2H), 3.91 (s, 3H), 3.57 (t, *J* = 7.7 Hz, 1H), 2.19 – 2.08 (m, 1H), 1.88 – 1.77 (m, 1H), 0.88 (t, *J* = 7.3 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 173.2, 166.9, 144.0, 135.7, 129.8, 129.1, 128.5, 128.2, 128.1, 128.0, 66.6, 53.4, 52.1, 26.6, 12.0.
HRMS-ESI (m/z) Calcd for $C_{19}H_{20}O_4$ [(M + H) $^+$] 313.1434, Found: 313.1437.
IR (KBr): ν (cm^{-1}) 2966, 2406, 1725, 1559, 1281, 1162, 921, 746.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 80/20, 1.0 mL/min, 254 nm, 25 °C, t_R =12.56 min (minor), 17.99 min (major).

(*R*)-benzyl -2-(4-(trifluoromethyl)phenyl)butanoate (2k)



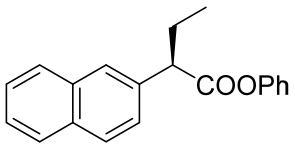
Yield: 99%; ee: 78%.
Colorless oil, $[\alpha]_D^{20}$ = -4º (0.11, $CHCl_3$).
^{1}H NMR (400MHz, $CDCl_3$): δ 7.57 (d, *J* = 8.2 Hz, 2H), 7.42 (d, *J* = 8.1 Hz, 2H), 7.36 – 7.29 (m, 3H), 7.26 – 7.22 (m, 2H), 5.46 – 4.85 (m, 2H), 3.57 (t, *J* = 7.7 Hz, 1H), 2.20 – 2.09 (m, 1H), 1.88 – 1.77 (m, 1H), 0.89 (t, *J* = 7.3 Hz, 3H).
^{13}C NMR (100MHz, $CDCl_3$): δ 173.1, 142.8, 135.7, 129.5 (q, *J* = 32.8), 128.5, 128.4, 128.2, 128.0, 125.5, 125.5, 122.8, 66.6, 53.2, 26.6, 12.0.
HRMS-ESI (m/z) Calcd for $C_{18}H_{17}F_3O_2$ [(M + Na) $^+$] 345.1073, Found: 345.1083.
IR (KBr): ν (cm^{-1}) 3662, 2966, 2235, 1736, 1261, 1123, 801, 751.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 98/2, 1.0 mL/min, 210 nm, 25 °C, t_R = 9.08 min (minor), 11.53 min (major).

(*R*)-phenyl-2-([1,1'-biphenyl]-4-yl) butanoate (2l):



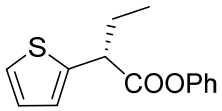
Yield: 98%; ee: 90%.
Colorless oil, $[\alpha]_D^{20}$ = -69º (0.44, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.61 – 7.58 (m, 4H), 7.49 – 7.42 (m, 4H), 7.36 – 7.32 (m, 3H), 7.21 – 7.17 (m, 1H), 7.02 – 7.00 (m, 2H), 3.74 (t, *J* = 7.7 Hz, 1H), 2.32 – 2.21 (m, 1H), 2.00 – 1.89 (m, 1H), 1.03 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.7, 150.9, 140.8, 140.5, 137.8, 129.5, 128.9, 128.6, 127.6, 127.5, 127.2, 125.9, 121.6, 53.3, 26.9, 12.3.
HRMS-ESI (m/z) Calcd for $C_{22}H_{21}O_2$ [(M + H) $^+$] 317.1536, Found: 317.1539.
IR (KBr): ν (cm^{-1}) 3476, 2965, 1753, 1619, 1592, 1486, 816, 748.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 85/15, 1.0 mL/min, 204 nm, 35 °C, t_R = 19.86 min (minor), 23.97 min (major).

(*R*)-phenyl-2-(naphthalen-2-yl) butanoate (2m):



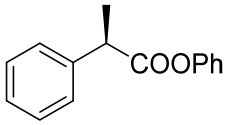
Yield: 99%; ee: 91%.
Colorless oil, $[\alpha]_D^{20}$ = -91° (0.26, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.87 – 7.83 (m, 4H), 7.56 – 7.47 (m, 3H), 7.34 – 7.30 (m, 2H), 7.20 – 7.16 (m, 1H), 6.99 – 6.97 (m, 2H), 3.87 (t, *J* = 7.7 Hz, 1H), 2.38 – 2.27 (m, 1H), 2.07 – 1.96 (m, 1H), 1.03 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.7, 150.9, 136.1, 133.6, 132.8, 129.4, 128.6, 128.0, 127.8, 127.2, 126.3, 126.0, 126.0, 125.9, 121.5, 53.7, 26.8, 12.3.
HRMS-ESI (m/z) Calcd for $C_{20}H_{19}O_2$ [(M + H) $^+$] 291.1380, Found: 291.1386.
IR (KBr): ν (cm^{-1}) 3472, 2965, 1752, 1630, 1592, 1491, 764, 749.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 85/15, 1.0 mL/min, 204 nm, 25 °C, t_R = 20.06 min (minor), 25.87 min (major).

(*R*)-phenyl-2-(thiophen-2-yl) butanoate (2n):



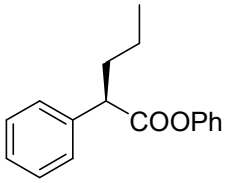
Yield: 99%; ee: 88%.
Colorless oil, $[\alpha]_D^{20}$ = -26° (0.29, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37 – 7.33 (m, 2H), 7.25 – 7.19 (m, 2H), 7.05 – 7.03 (m, 3H), 7.00 – 6.98 (m, 1H), 4.01 (t, *J* = 7.6 Hz, 1H), 2.30 – 2.20 (m, 1H), 2.05 – 1.94 (m, 1H), 1.05 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 171.7, 150.8, 140.9, 129.5, 126.9, 126.0, 125.8, 124.9, 121.5, 48.8, 28.1, 12.2.
HRMS-ESI (m/z) Calcd for $C_{14}H_{15}SO_2$ [(M + H) $^+$] 247.0787, Found: 247.0788.
IR (KBr): ν (cm^{-1}) 3414, 2931, 1757, 1592, 1491, 1456, 750, 700.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 85/15, 1.0 mL/min, 204 nm, 25 °C, t_R = 21.53 min (major), 24.38 min (minor).

(*R*)-phenyl-2-phenylpropanoate (2o):



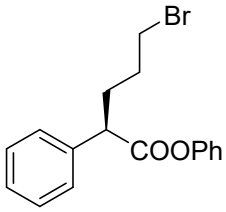
Yield: 92%; ee: 86%.
Colorless oil, $[\alpha]_D^{20}$ = -83° (0.2, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 – 7.28 (m, 7H), 7.21 – 7.17 (m, 1H), 7.00 – 6.97 (m, 2H), 3.96 (q, *J* = 7.2 Hz, 1H), 1.62 (d, *J* = 7.2 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 173.2, 150.9, 140.2, 129.4, 128.9, 127.6, 127.5, 125.9, 121.5, 45.8, 18.6.
HRMS-ESI (m/z) Calcd for $C_{15}H_{15}O_2$ [(M + H) $^+$] 227.1067, Found: 227.1078.
IR (KBr): ν (cm^{-1}) 3414, 2979, 1757, 1638, 1592, 1491, 749, 732.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 90/10, 1.0 mL/min, 204 nm, 25 °C, t_R = 32.89 min (major), 36.80 min (minor).

(*R*)-phenyl-2-phenylpentanoate (2p):



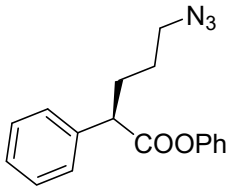
Yield: 91%; ee: 92%.
Colorless oil, $[\alpha]_D^{20}$ = -60° (0.13, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 – 7.27 (m, 7H), 7.21 – 7.17 (m, 1H), 7.00 – 6.97 (m, 2H), 3.80 (t, *J* = 7.7 Hz, 1H), 2.20 – 2.13 (m, 1H), 1.89 – 1.81 (m, 1H), 1.39 (ddd, *J* = 14.2, 9.3, 7.6 Hz, 2H), 0.97 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.8, 150.9, 138.9, 129.4, 128.8, 128.1, 127.5, 125.9, 121.5, 51.7, 35.7, 20.9, 14.0.
HRMS-ESI (m/z) Calcd for $C_{17}H_{19}O_2$ [(M + H) $^+$] 255.1380, Found: 255.1387.
IR (KBr): ν (cm^{-1}) 3415, 2929, 1755, 1618, 1592, 1491, 750, 697.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 90/10, 1.0 mL/min, 204 nm, 25 °C, t_R = 12.84 min (minor), 15.07 min (major).

(*R*)-phenyl-5-bromo-2-phenylpentanoate (2q):



Yield: 91%; ee: 91%.
Colorless oil, $[\alpha]_D^{20}$ = -46° (0.14, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.41 – 7.25 (m, 7H), 7.22 – 7.18 (m, 1H), 6.99 – 6.96 (m, 2H), 3.81 (td, *J* = 7.7, 1.8 Hz, 1H), 3.43 (t, *J* = 6.5 Hz, 2H), 2.36 – 2.30 (m, 1H), 2.09 – 1.97 (m, 1H), 1.96 – 1.81 (m, 2H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.2, 150.8, 138.1, 129.5, 129.1, 128.1, 127.8, 126.0, 121.5, 51.1, 33.1, 32.0, 30.7.
HRMS-ESI (m/z) Calcd for $C_{16}H_{16}BrO_2$ [(M + H) $^+$] 333.0485, Found: 333.0488.
IR (KBr): ν (cm^{-1}) 3451, 2921, 1752, 1630, 1491, 1454, 764, 749.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 85/15, 1.0 mL/min, 204 nm, 25 °C, t_R = 29.49 min (minor), 42.53 min (major).

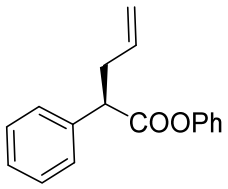
(*R*)-phenyl-5-azido-2-phenylpentanoate (2r):



Yield: 99%; ee: 90%.
Colorless oil, $[\alpha]_D^{20}$ = -75° (0.15, $CHCl_3$).

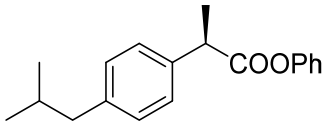
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.41 – 7.30 (m, 7H), 7.20 (t, *J* = 7.4 Hz, 1H), 6.98 (dd, *J* = 8.5, 0.9 Hz, 2H), 3.80 (t, *J* = 7.7 Hz, 1H), 3.34 – 3.30 (m, 2H), 2.27 – 2.23 (m, 1H), 1.99 – 1.96 (m, 1H), 1.69 – 1.60 (m, 2H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.3, 150.7, 138.1, 129.5, 129.1, 128.0, 127.8, 126.0, 121.4, 51.4, 51.2, 30.6, 27.0.
HRMS-ESI (m/z) Calcd for $C_{17}H_{17}N_3O_2$ [(M + H) $^+$] 296.1394, Found: 296.1398.
IR (KBr): ν (cm^{-1}) 2961, 2096, 1754, 1592, 1491, 1452, 729, 689.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 70/30, 1.0 mL/min, 204 nm, 35 °C, t_R = 14.00 min (minor), 21.90 min (major).

(*R*)-phenyl-2-phenylpent-4-enoate (2s):



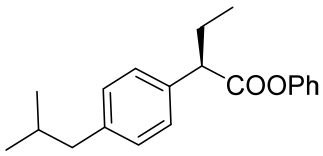
Yield: 99%; ee: 90%.
Colorless oil, $[\alpha]_D^{20}$ = -54° (0.13, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 – 7.28 (m, 7H), 7.18 (t, *J* = 7.4 Hz, 1H), 6.98 (d, *J* = 8.1 Hz, 2H), 5.86 – 5.78 (m, 1H), 5.12 (dd, *J* = 33.8, 13.6 Hz, 2H), 3.96 – 3.79 (m, 1H), 2.98 – 2.91 (m, 1H), 2.65 – 2.58 (m, 1H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.1, 150.9, 138.2, 135.1, 129.5, 128.9, 128.1, 127.7, 126.0, 121.5, 117.5, 51.6, 37.7.
HRMS-ESI (m/z) Calcd for $C_{17}H_{17}O_2$ [(M + H) $^+$] 253.1223, Found: 253.1229.
IR (KBr): ν (cm^{-1}) 3472, 3078, 2921, 1756, 1644, 1592, 1491, 749.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 95/5, 1.0 mL/min, 204 nm, 25 °C, t_R = 17.61 min (major), 18.72 min (minor).

(*R*)-phenyl-2-(4-isobutylphenyl) propanoate (2t):



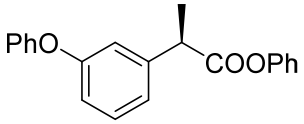
Yield: 92%; ee: 86%.
Colorless oil, $[\alpha]_D^{20}$ = -67° (0.22, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34 – 7.29 (m, 4H), 7.20 – 7.13 (m, 3H), 7.00 – 6.98 (m, 2H), 3.93 (q, *J* = 7.1 Hz, 1H), 2.47 (d, *J* = 7.2 Hz, 2H), 1.91 – 1.81 (m, 1H), 1.60 (d, *J* = 7.1 Hz, 3H), 0.91 (d, *J* = 6.6 Hz, 6H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 173.4, 151.0, 140.9, 137.4, 129.6, 129.4, 127.3, 125.8, 121.5, 45.4, 45.2, 30.3, 22.5, 18.7.
HRMS-ESI (m/z) Calcd for $C_{19}H_{23}O_2$ [(M + H) $^+$] 283.1693, Found: 283.1701.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 99/1, 1.0 mL/min, 210 nm, 25 °C, t_R = 23.03 min (major), 35.55 min (minor).

(*R*)-phenyl-2-(4-isobutylphenyl) butanoate (2u):



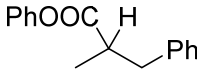
Yield: 99%; ee: 90%.
Colorless oil, $[\alpha]_D^{20}$ = -44° (0.11, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35 – 7.28 (m, 4H), 7.21 – 7.17 (m, 1H), 7.13 (d, *J* = 8.1 Hz, 2H), 7.00 – 6.98 (m, 2H), 3.67 (t, *J* = 7.7 Hz, 1H), 2.47 (d, *J* = 7.2 Hz, 2H), 2.25 – 2.17 (m, 1H), 1.92 – 1.85 (m, 2H), 1.00 (t, *J* = 7.4 Hz, 3H), 0.91 (d, *J* = 6.6 Hz, 6H).
^{13}C NMR (100MHz, $CDCl_3$): δ 172.9, 151.0, 141.0, 135.9, 129.5, 129.4, 127.8, 125.8, 121.6, 53.3, 45.2, 30.3, 26.9, 22.5, 12.3.
HRMS-ESI (m/z) Calcd for $C_{20}H_{25}O_2$ [(M + H) $^+$] 297.1849, Found: 297.1854.
IR (KBr): ν (cm^{-1}) 3473, 2960, 1756, 1632, 1511, 1492, 1382, 749.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 98/2, 1.0 mL/min, 204 nm, 25 °C, t_R = 11.39 min (minor), 12.77 min (major).

(*R*)-phenyl-2-(3-phenoxyphenyl) propanoate (2v):



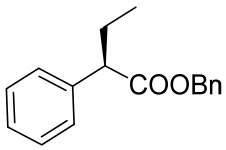
Yield: 99%; ee: 87%.
Colorless oil, $[\alpha]_D^{20}$ = -62° (0.18, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36 – 7.30 (m, 5H), 7.20 (t, *J* = 7.4 Hz, 1H), 7.14 – 7.07 (m, 3H), 7.04 – 6.92 (m, 5H), 3.93 (q, *J* = 7.1 Hz, 1H), 1.60 (d, *J* = 7.2 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 172.8, 157.7, 157.1, 150.9, 142.1, 130.2, 129.9, 129.5, 125.9, 123.5, 122.5, 121.5, 119.1, 118.2, 117.8, 45.6, 18.5.
HRMS-ESI (m/z) Calcd for $C_{21}H_{19}O_3$ [(M + H) $^+$] 319.1329, Found: 319.1332.
IR (KBr): ν (cm^{-1}) 3473, 2963, 1757, 1583, 1487, 1260, 764, 750.
HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol = 80/20, 1.0 mL/min, 204 nm, 25 °C, t_R = 32.36 min (major), 38.65 min (minor).

phenyl 2-methyl-3-phenylpropanoate (2w)



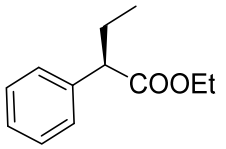
Yield: 30%; ee: 8%.
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 (dd, *J* = 15.0, 7.1 Hz, 4H), 7.24 (dd, *J* = 7.6, 6.1 Hz, 3H), 7.19 (t, *J* = 7.4 Hz, 1H), 6.92 (d, *J* = 7.8 Hz, 2H), 3.13 (dd, *J* = 13.3, 7.6 Hz, 1H), 3.05 – 2.94 (m, 1H), 2.83 (dd, *J* = 13.3, 7.2 Hz, 1H), 1.32 (d, *J* = 6.9 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$) δ 174.7, 150.8, 139.1, 129.5, 129.2, 128.6, 126.6, 125.8, 121.6, 41.8, 39.9, 17.1.
HRMS-ESI (m/z) calcd for $C_{16}H_{16}O_2Na$ [(M + Na) $^+$] 263.1043, found 263.1053.
HPLC: Chiralcel OD-H (25 cm × 0.46 cm), hexane/2-propanol = 98/2, 1.0 mL/min, 204 nm, 25 °C, t_R = 21.93 min (major), 23.12 min (minor).

(*R*)-benzyl-2-phenylbutanoate (2b)[3]



Yield: 47%; ee: 88%.
Colorless oil, $[\alpha]_D^{20}$ = -12º (0.11, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31 – 7.28 (m, 7H), 7.26 –7.23 (m, 3H), 5.10 (dd, *J* = 33.2, 12.5 Hz, 2H), 3.51 (t, *J* = 7.7 Hz, 1H), 2.18 – 2.07 (m, 1H), 1.87 – 1.77 (m, 1H), 0.88 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 174.0, 139.0, 136.1, 128.7, 128.6, 128.2, 128.1, 128.0, 127.3, 66.4, 53.6, 26.8, 12.3.
HPLC: Chiralcel OD-H (25 cm × 0.46 cm), hexane/2-propanol = 98/2, 1.0 mL/min, 204 nm, 25 °C, t_R = 22.23 min (major), 24.90 min (minor).

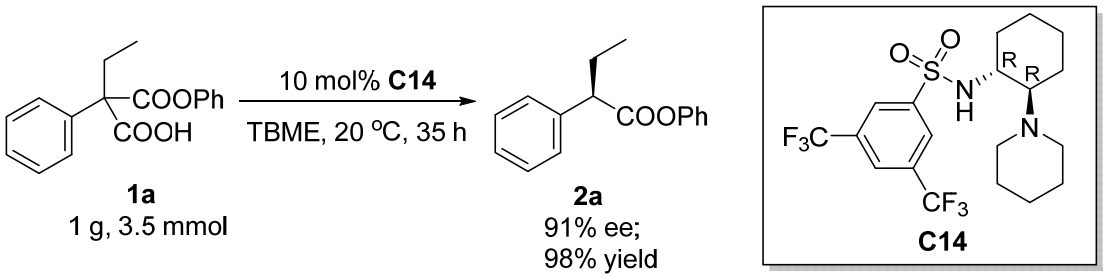
(*R*)-ethyl-2-phenylbutanoate (2c)[4]



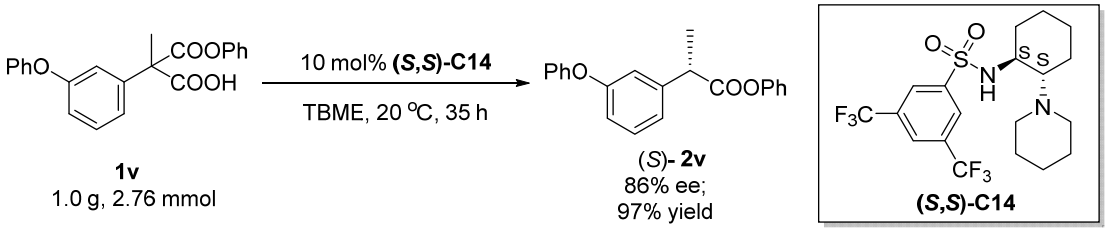
Yield: 50%; ee: 90%.
Colorless oil, $[\alpha]_D^{20}$ = -56º (0.05, $CHCl_3$).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35 – 7.24 (m, 5H), 4.18 – 4.06 (m, 2H), 3.43 (t, *J* = 7.7 Hz, 1H), 2.13 – 2.06 (m, 1H), 1.83 – 1.75 (m, 1H), 1.21 (t, *J* = 7.1 Hz, 3H), 0.89 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 174.2, 139.3, 128.6, 128.0, 127.2, 60.7, 53.6, 26.9, 14.3, 12.3.
HPLC: Chiralcel OD-H (25 cm × 0.46 cm), hexane/2-propanol = 99.8/0.2, 1.0 mL/min, 204 nm, 25 °C, t_R = 14.18 min (major), 28.64 min (minor).

4. Synthetic Applications

4.1 Gram-Scale Synthesis of 2a and (*S*)-2v

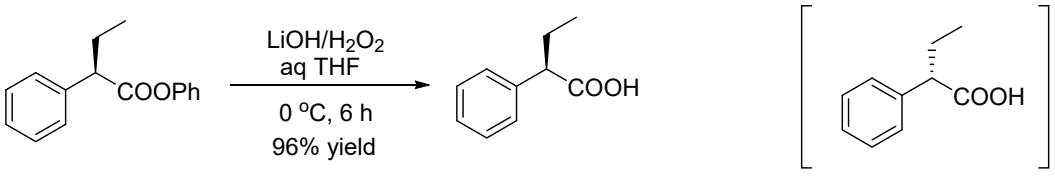


To a mixture of catalyst **C14** (10 mol%) and 2-(phenoxycarbonyl)-2-phenylbutanoic acid **1a** (1.0 g, 3.5 mmol) in a vial were added TBME (35.0 mL), then the reaction mixture was stirred at 20 °C for 35 h. The mixture was concentrated in vacuo. The remaining residue was purified by silica gel column chromatography (hexane/ethyl acetate) to afford the desired product **2a**（828 mg, 98%）in 91% ee.



To a mixture of catalyst **(*S*, *S*)-C14** (10 mol%) and 2-methyl-3-oxo-3-phenoxy-2-(3-phenoxyphenyl) propanoic acid **1v** (1.0 g, 2.76 mmol) in a vial were added TBME (28.0 mL), then the reaction mixture was stirred at 20 °C for 35 h. The mixture was concentrated in vacuo, and the remaining residue was purified by silica gel column chromatography (hexane/ethyl acetate) to afford the desired product (*S*)-**2v**（878 mg, 97%）in 86% ee.

4.2 The Transformations of Compound 2a and enantiomer (*S*)-2v



2a
92% ee

3a
91% ee
$[\alpha]_D^{20}$ = -63° (*c* 0.21, $CHCl_3$)

(*S*)-(-)-96% ee
$[\alpha]_D^{23}$ = 70.7° (*c* 1.0, $CHCl_3$)[ref. 5]

30% H_2O_2 (0.48 mL) and aq. LiOH (1.22 mL, 2.0 M) were added to a solution of **2a** (0.200 g, 0.83 mmol) in THF (4.88 mL) and water (0.73 mL) at 0 °C. The reaction mixture was stirred at 0 °C for 6 h, quenched with NaS_2O_3 (4.9 mL, 0.7 M) and $NaHCO_3$ (9.8 mL, 0.5 M), stirred for another 15 min, acidified with 20% HCl, extracted with EtOAc (5 mL × 3), dried over Na_2SO_4, filtered, concentrated, and purified by flash chromatography (petroleum ether/ethyl acetate = 10/1) to give acid **3a** as a colorless oil (0.13 g, 96% yield, 91% ee).

(*R*)-2-phenylbutanoic acid (*R*)-3a[5]

$[\alpha]_D^{20}$ = -63° (*c* 0.21, $CHCl_3$).

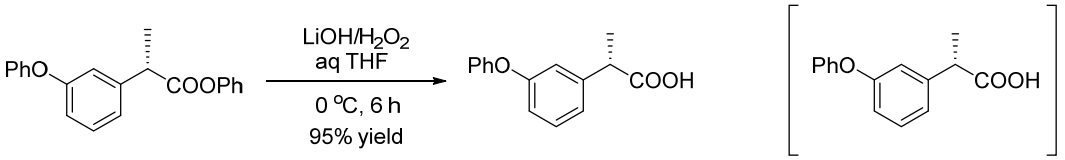
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35 – 7.28 (m, 5H), 3.50 – 3.45 (m, 1H), 2.15 – 2.08 (m, 1H), 1.88 – 1.80 (m, 1H), 0.96 – 0.90 (m, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 180.9, 138.5, 128.8, 128.2, 127.6, 53.5, 26.4, 12.2.

IR (KBr): ν (cm^{-1}) 3468, 2966, 1706, 1601, 1495, 1455, 748, 697.

HPLC: Chiralcel OJ-H (25 cm × 0.46 cm), hexane/2-propanol/CF_3COOH = 95/4/1, 1.0 mL/min, 204 nm, 25 °C, t_R = 16.61 min (major), 17.74 min (minor).

The optical rotation of compound **3a** was $[\alpha]_D^{20}$ = -63° (*c* 0.21, $CHCl_3$), and the absolute configuration of **3a** was determined to be *R* by comparing the reported optical rotation of (-)-(*S*)-**3a** $[\alpha]_D^{23}$ = 70.7 (*c* 1.0 $CHCl_3$).[5]



(*S*)-**2v**
86% ee

(*S*)-fenoprofen
86% ee
$[\alpha]_D^{20}$ = 41° (*c* 0.41, $CHCl_3$)

(*S*)-88% ee
$[\alpha]_D^{26}$ = 41.2° (*c* 1.0, $CHCl_3$)[ref. 5]

30% H_2O_2 (0.36 mL) and aq. LiOH (0.93 mL, 2.0 M) were added to a solution of (*S*)-**2v** (0.200 g, 0.63 mmol) in THF (3.7 mL) and water (0.56 mL) at 0 °C. The reaction mixture was stirred at 0 °C for 6 h, quenched with NaS_2O_3 (3.7 mL, 0.7 M) and $NaHCO_3$ (7.4 mL, 0.5 M), stirred for another 15 min, acidified with 20% HCl, extracted with EtOAc (5 mL × 3), dried over Na_2SO_4, filtered, concentrated, and purified by flash chromatography (petroleum ether/ethyl acetate = 10/1) to give (*s*)-fenoprofen[5] as a colorless oil (0.14 g, 95% yield, 86% ee).

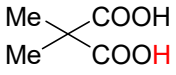
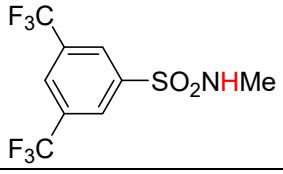
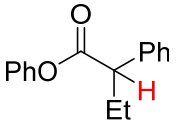
$[\alpha]_D^{20}$ = 41° (0.41, $CHCl_3$).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36 – 7.25 (m, 3H), 7.13 – 7.03 (m, 2H), 7.02 – 7.01 (m, 3H), 6.89 (dd, *J* = 7.9, 2.2 Hz, 1H), 3.72 (q, *J* = 7.2 Hz, 1H), 1.50 (d, *J* = 7.2 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 180.6, 157.6, 157.0, 141.8, 130.0, 129.9, 123.5, 122.5, 119.1, 118.3, 117.6, 45.3, 18.2.

IR (KBr): ν (cm^{-1}) 3473, 2930, 1708, 1583, 1488, 1245, 752, 691.
HPLC: Chiralcel AD-H (25 cm × 0.46 cm), hexane/2-propanol/CF_3COOH = 90/10/0.1, 1.0 mL/min, 204 nm, 25 °C, t_R = 24.42 min (minor), 28.20 min (major).

5. Some p*k*a values of our reaction related compounds

Entry	Compounds	p*K*a (H_2O)	p*K*a (DMSO)
1[6]		3.15	-
2[7]		10.72	9.07
3[8]		5.50	11.11
4[8]		9.14	17.96

6. Reference

1). (a) A. Nakano, S. Kawahara, S. Akamatsu, K. Morokuma, M. Nakatani, Y. Iwabuchi, K. Takahashi, J. Ishihara and S. Hatakeyama, *Tetrahedron* 2006, **62**, 381; (b) B. Hu and L. Deng, *Angew. Chem. Int. Ed.* 2018, **57**, 2233; (c) J. Luo, L.-W. Xu, R. A. S. Hay and Y. Lu, *Org. Lett.* 2009, **11**, 437; (d) B. Vakulya, S. Varga, A. Csámpai and T. Soós, *Org. Lett.* 2005, **7**, 1967.

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3). X.-N. Wang, H. Lv, X.-L. Huang and S. Ye, *Org. Biomol. Chem.*, 2009, **7**, 346.

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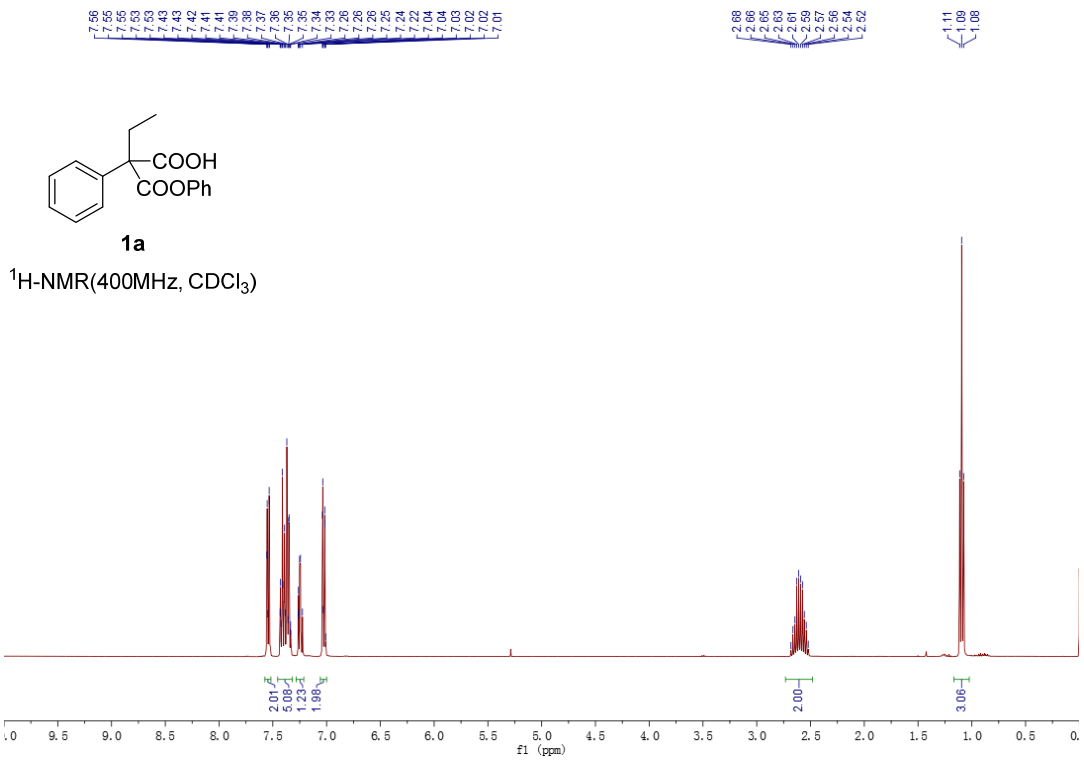
5). C. E. Stivala and A. Zakarian, *J. Am. Chem. Soc.* 2011, **133**, 11936.

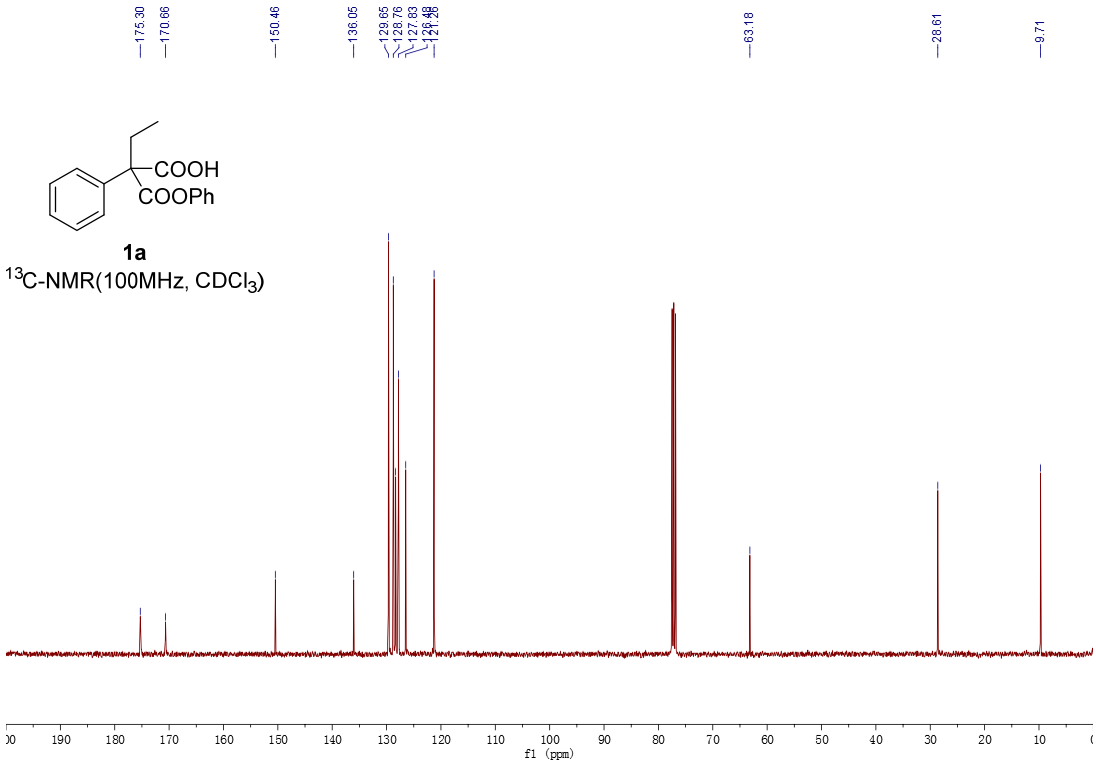
6). *CRC Handbook of Chemistry and Physics*, ed. W. M. Haynes, CRC Press, Boca Raton, FL, 97th edn, 2016–2017, pp. 5–91.

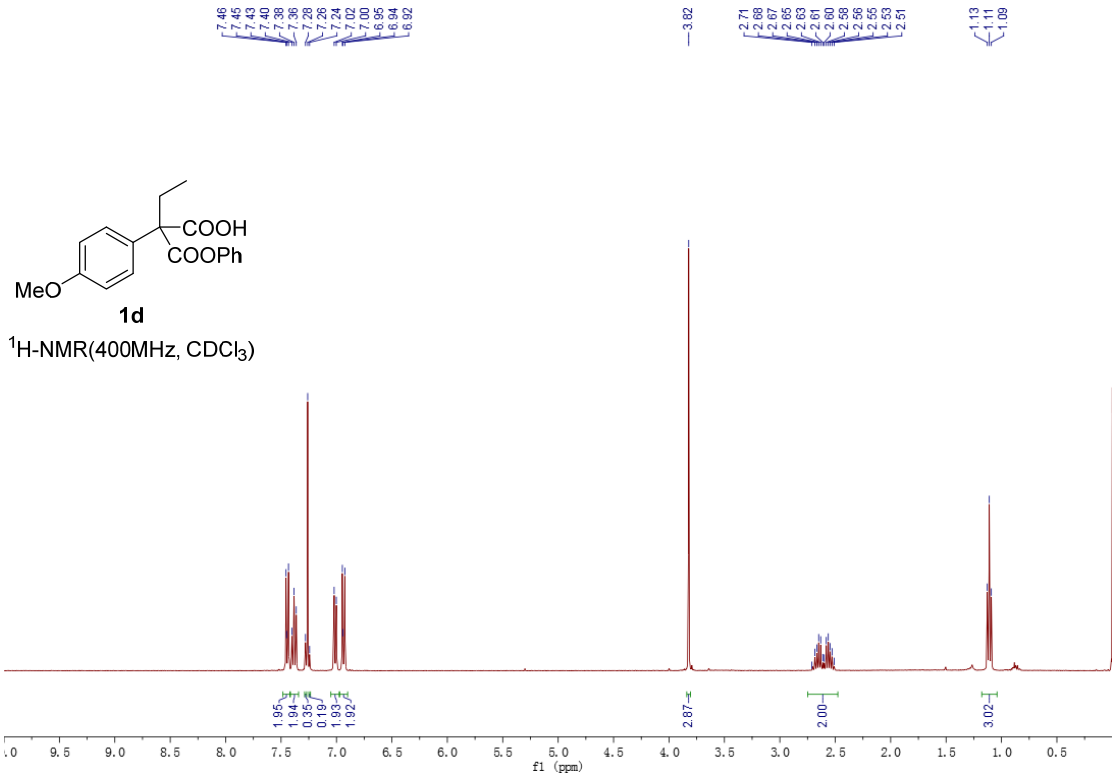
7). M. R. Crampton and I. A. Robotham, *J. Chem. Res. (S)* 1997, 22.

8). Corresponding p*K*a value was predicted by the approach developed by Luo and Zhang, see: Q. Yang, Y. Li, J.-D. Yang, Y. Liu, L. Zhang, S. Luo and J.-P. Cheng, *Angew. Chem. Int. Ed.* 2020, **59**, 19282.

7. ^{1}H NMR, ^{13}C NMR and HPLC Spectra Data

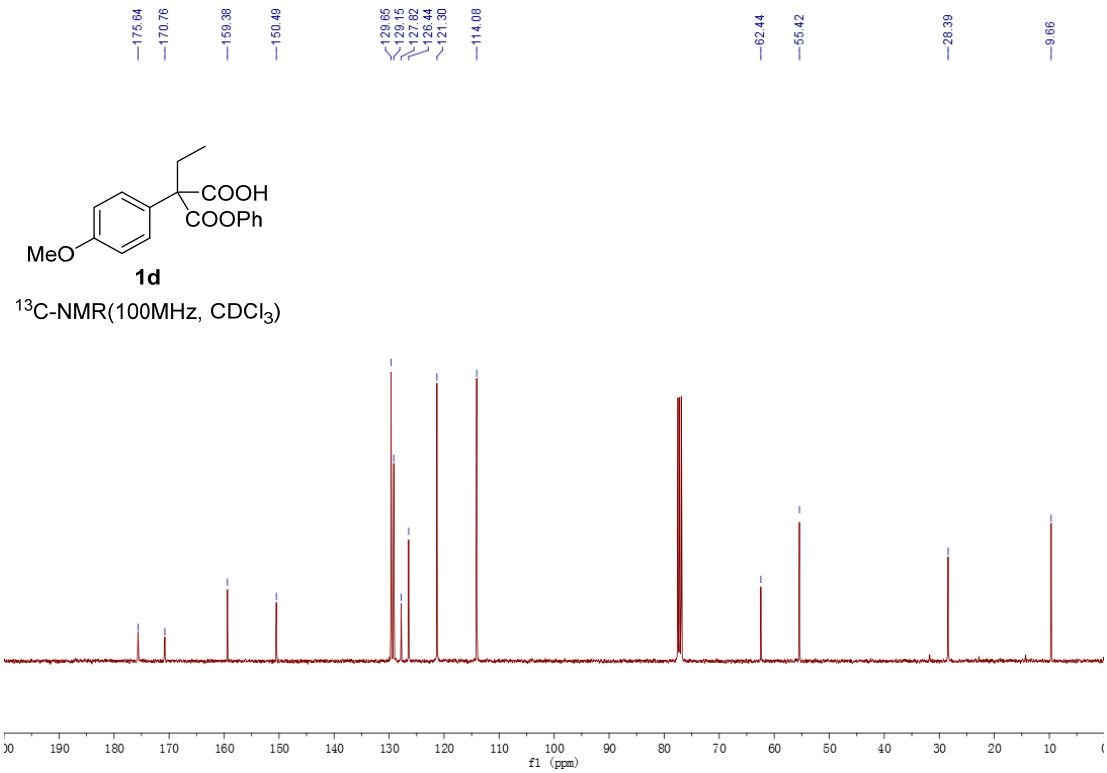






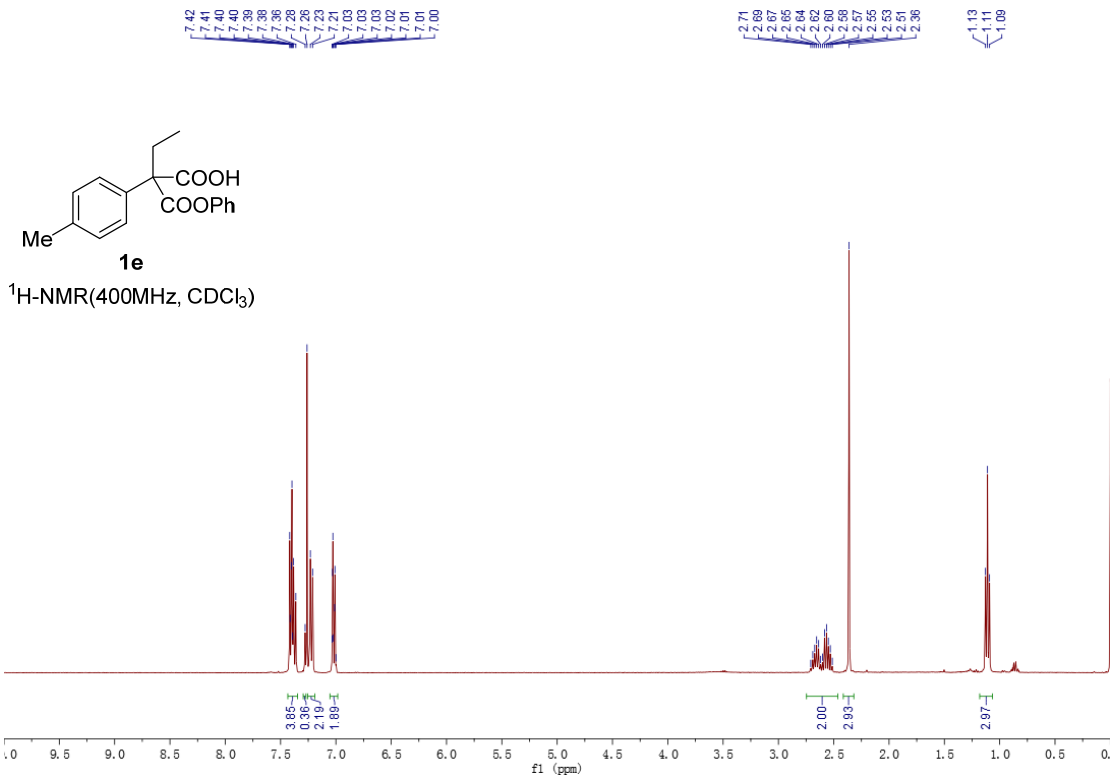
1d

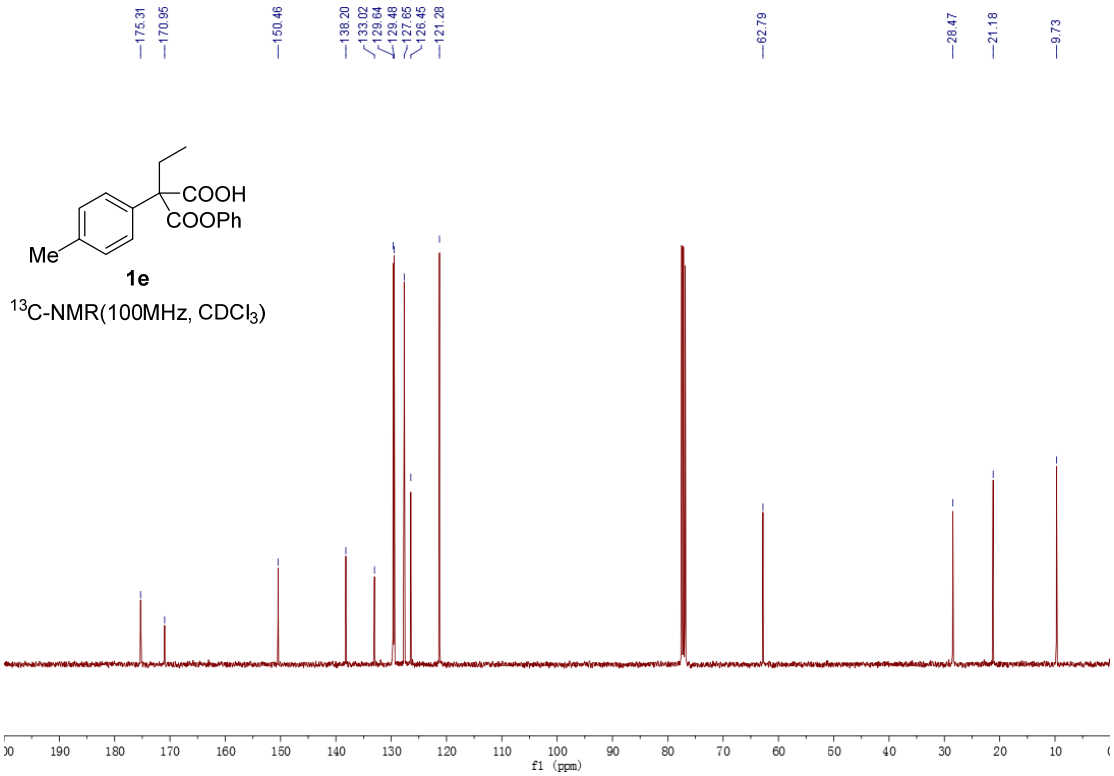
^{1}H-NMR(400MHz, $CDCl_3$)

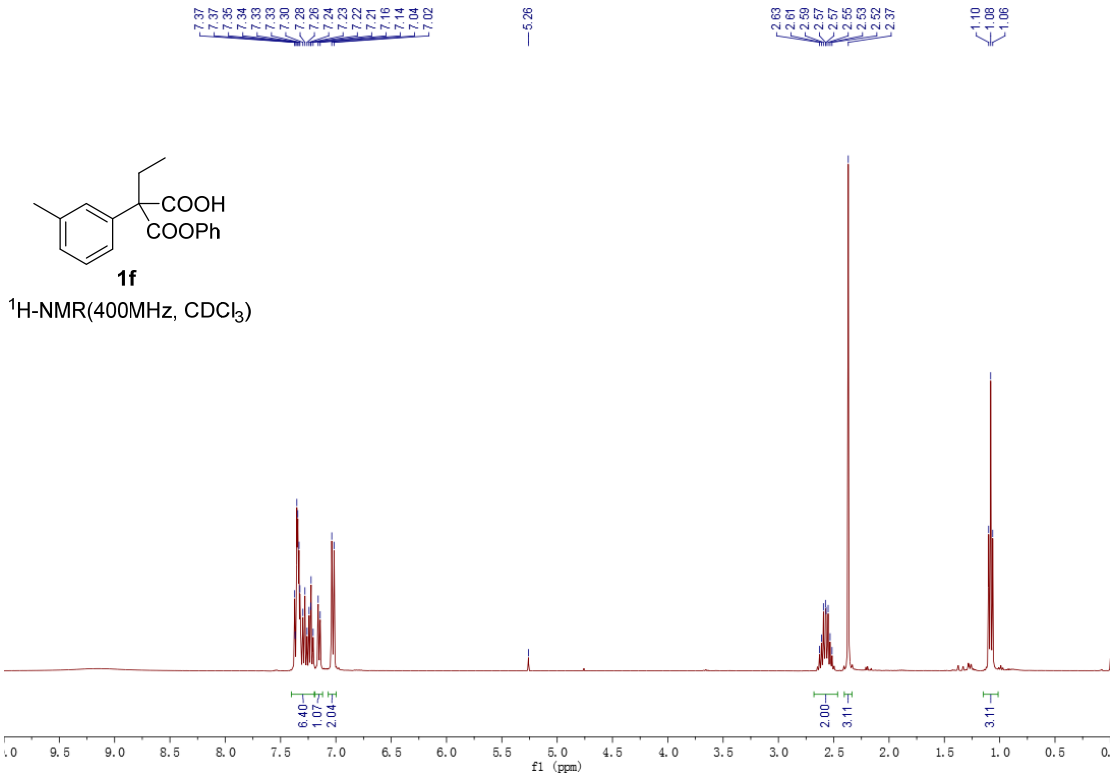


1d

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

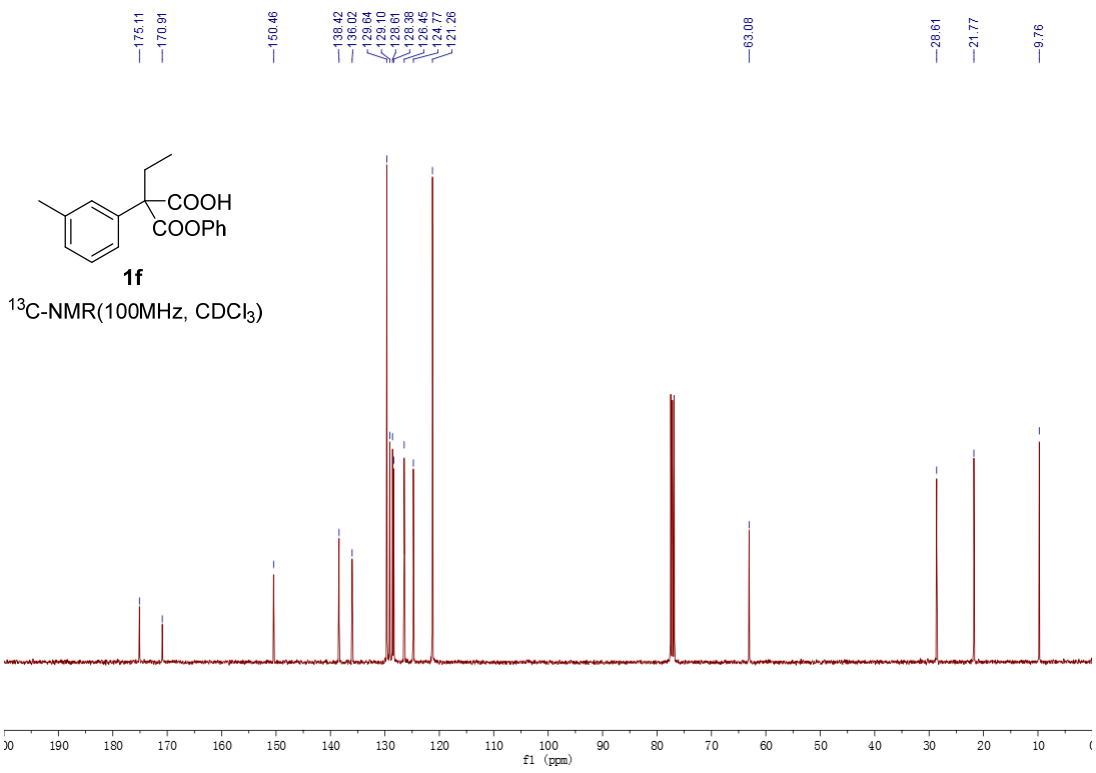

7.42
7.41
7.40
7.40
7.39
7.38
7.36
7.28
7.26
7.23
7.21
7.03
7.03
7.03
7.02
7.01
7.01
7.00
2.71
2.69
2.67
2.65
2.64
2.62
2.60
2.58
2.57
2.55
2.53
2.51
2.36
1.13
1.11
1.09
COOH
COOPh
Me
1e
1H-NMR(400MHz, CDCl3)
3.85
0.36
2.19
1.89
2.00
2.93
2.97
f1 (ppm)


175.31
170.95
150.46
138.20
133.02
129.64
129.48
127.65
126.45
121.28
62.79
28.47
21.18
9.73
COOH
COOPh
Me
1e
13C-NMR(100MHz, CDCl3)
f1 (ppm)



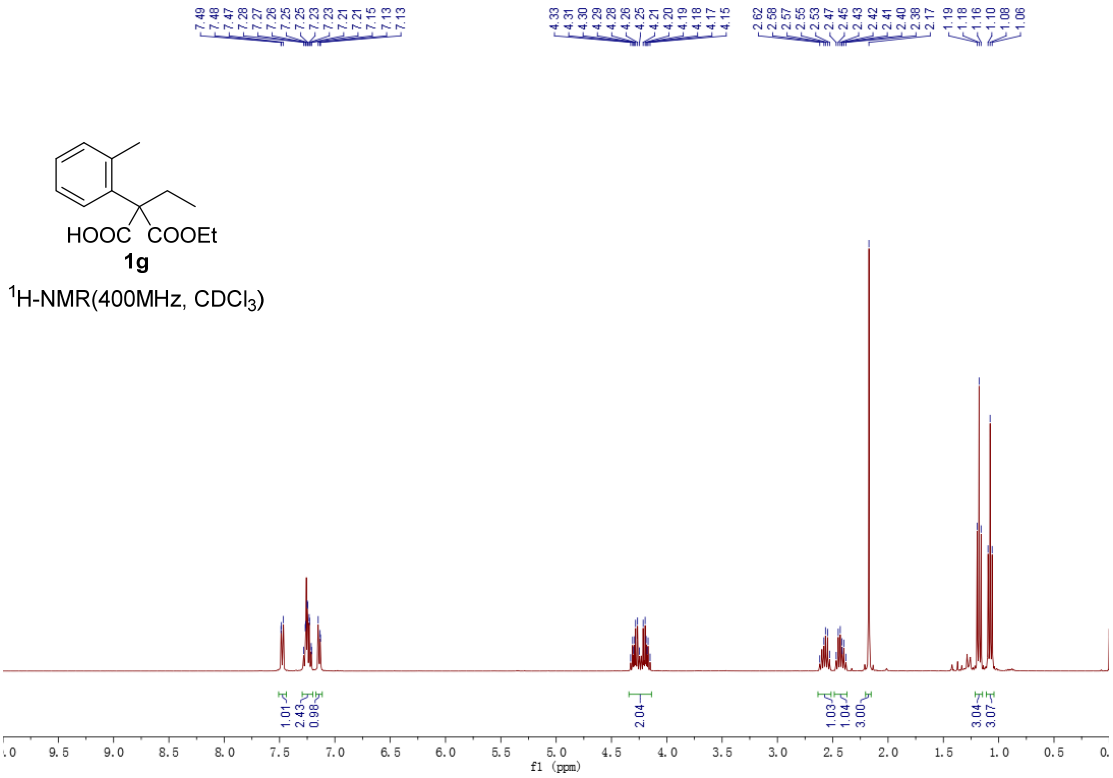
1f

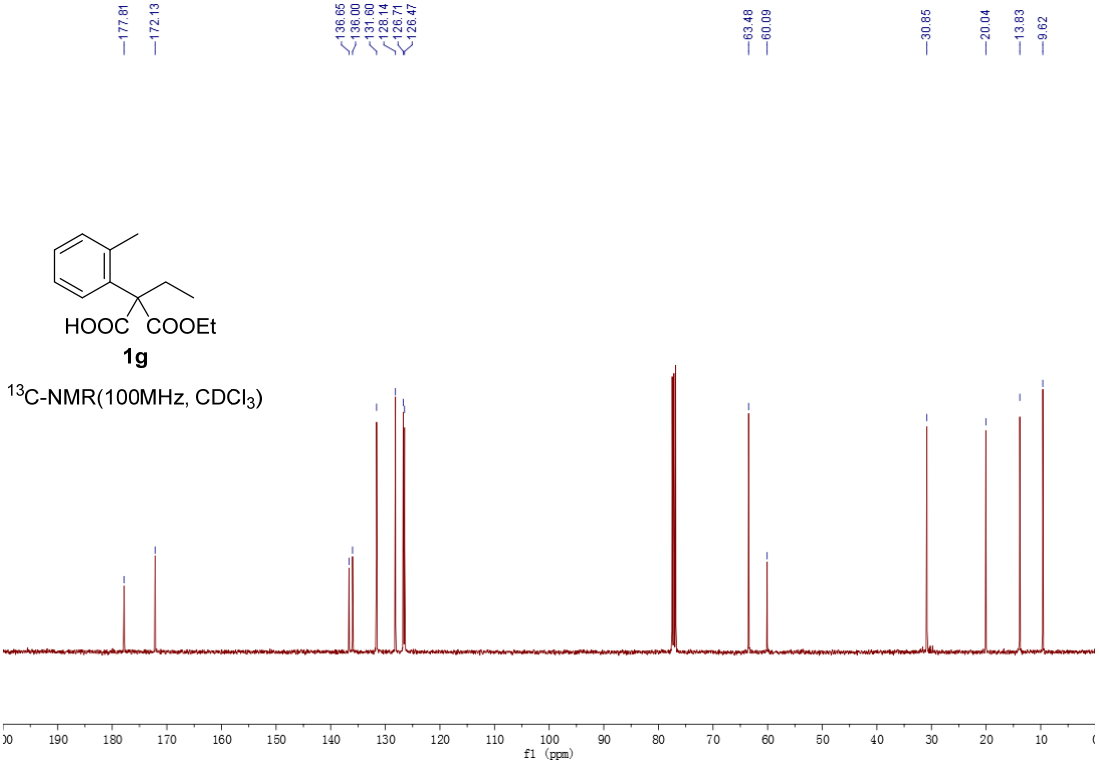
^{1}H-NMR(400MHz, $CDCl_3$)

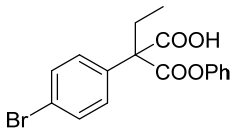


1f

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

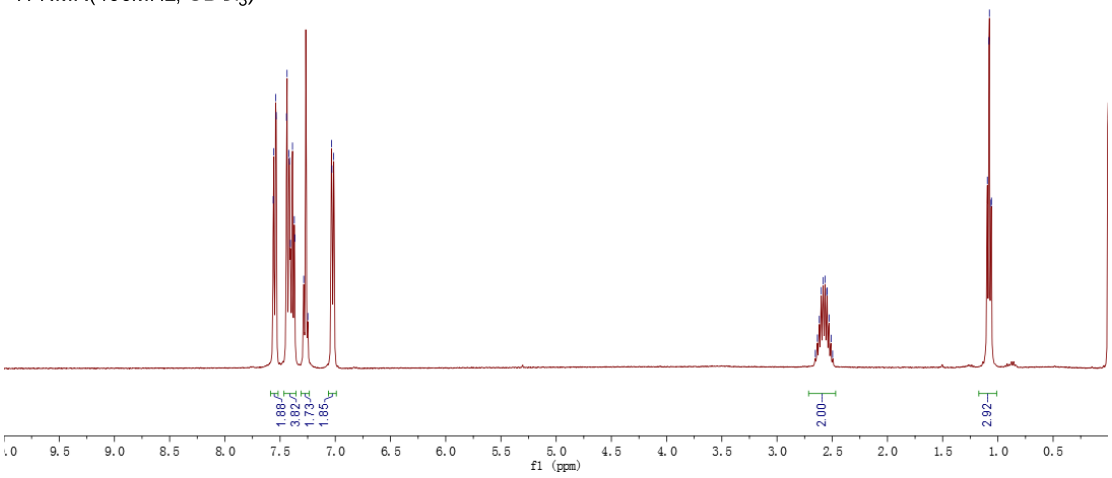

HOOC COOEt
1g
1H-NMR(400MHz, CDCl3)
f1 (ppm)

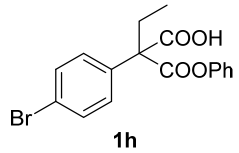

HOOC COOEt
1g
13C-NMR(100MHz, CDCl3)
f1 (ppm)



1h

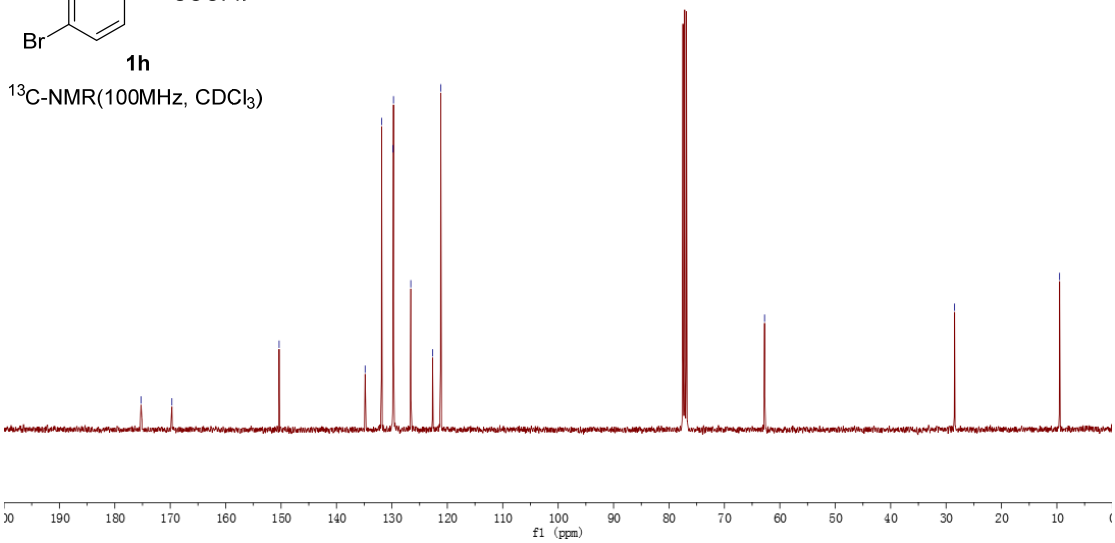
^{1}H-NMR(400MHz, $CDCl_3$)

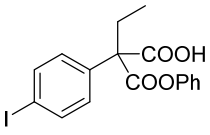




1h

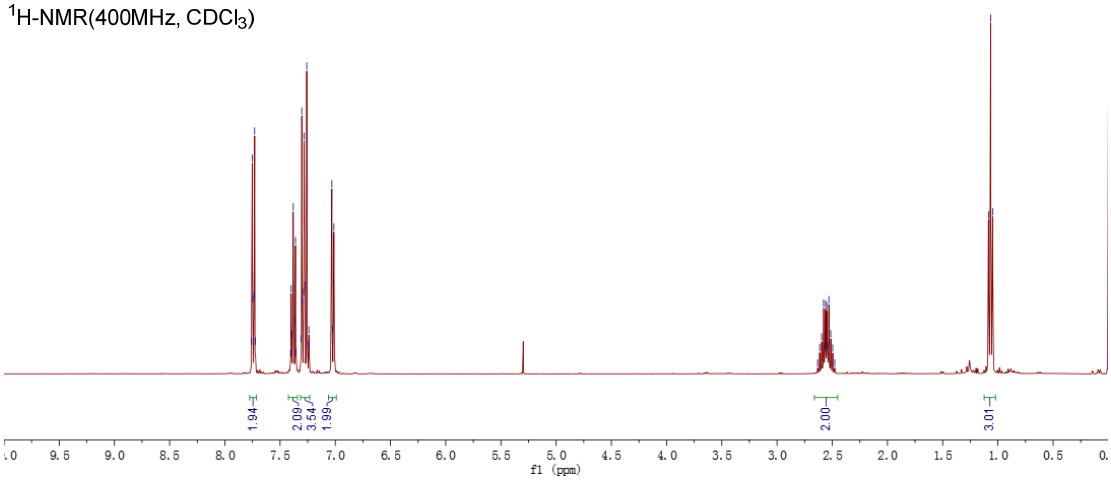
^{13}C-NMR(100MHz, $CDCl_3$)

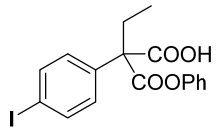




1i

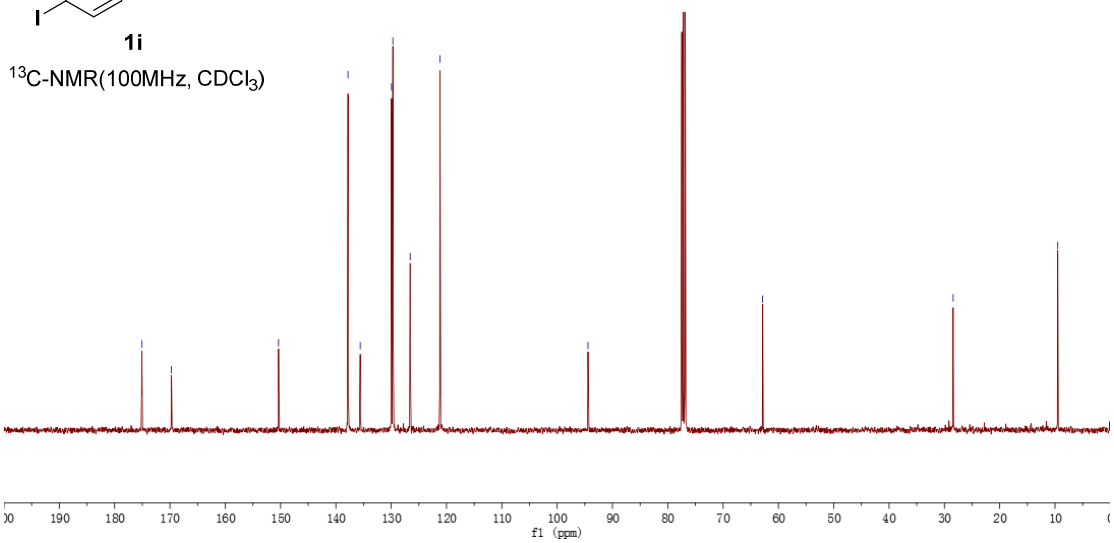
^{1}H-NMR(400MHz, $CDCl_3$)

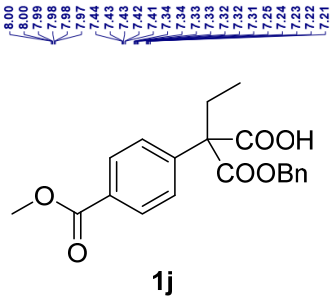




1i

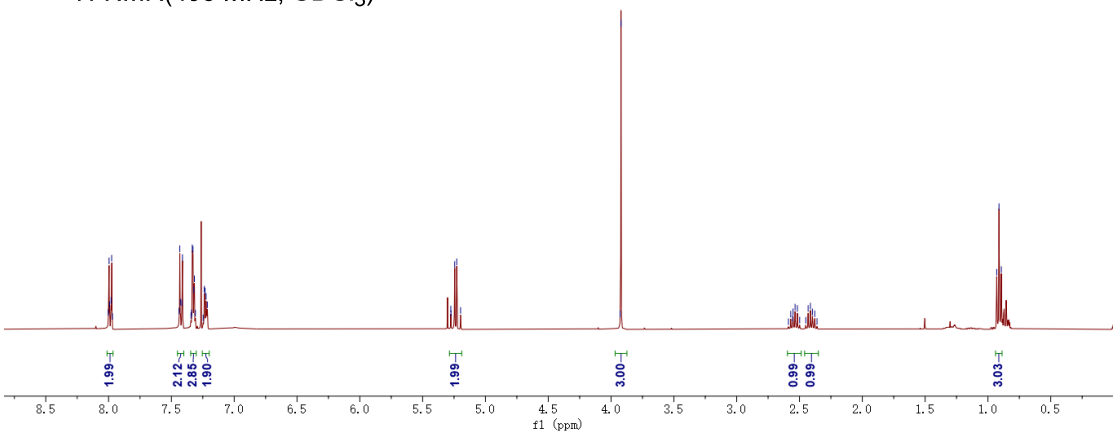
^{13}C-NMR(100MHz, $CDCl_3$)

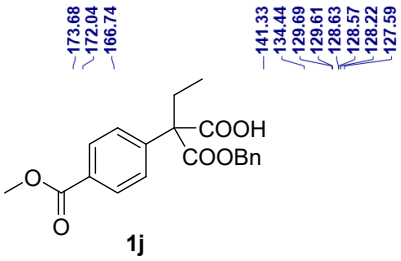




1j

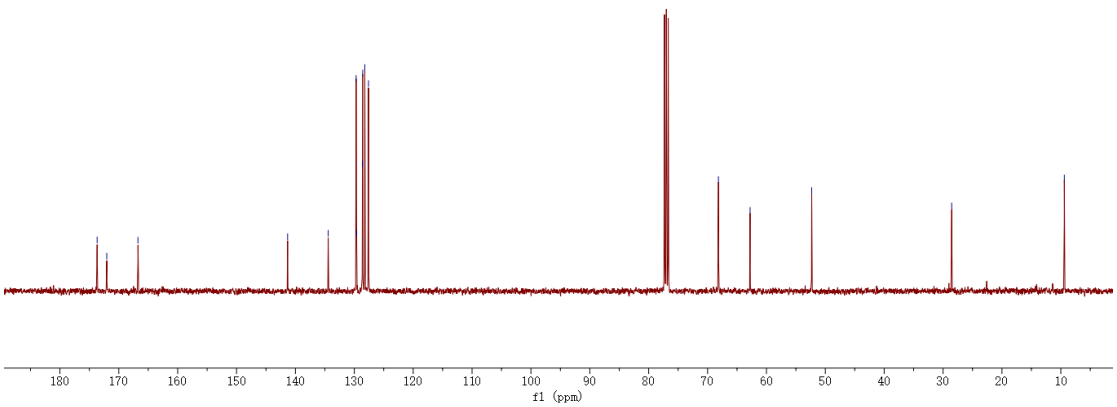
^{1}H-NMR(400 MHz, $CDCl_3$)

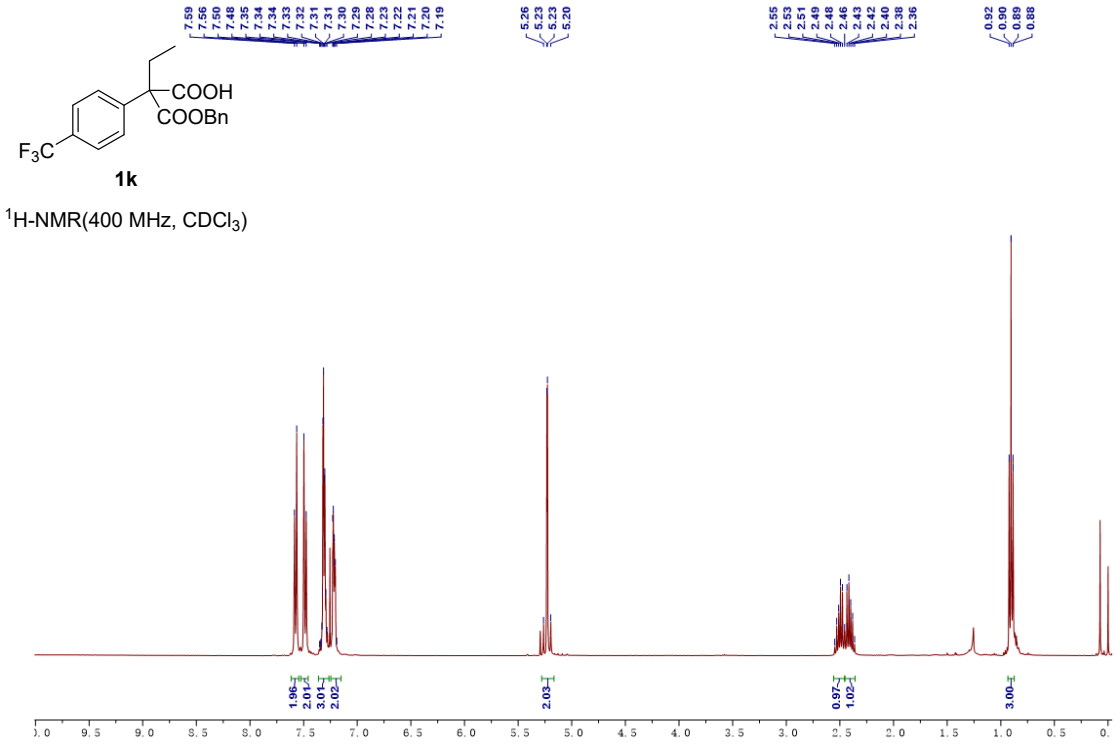


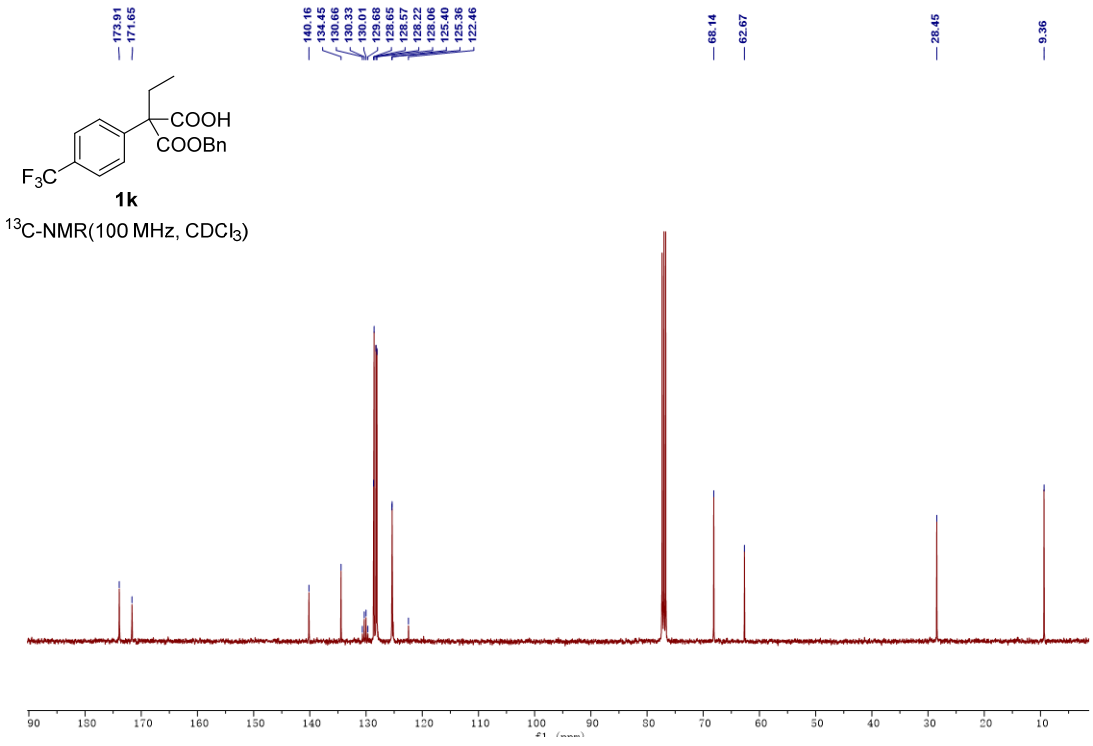


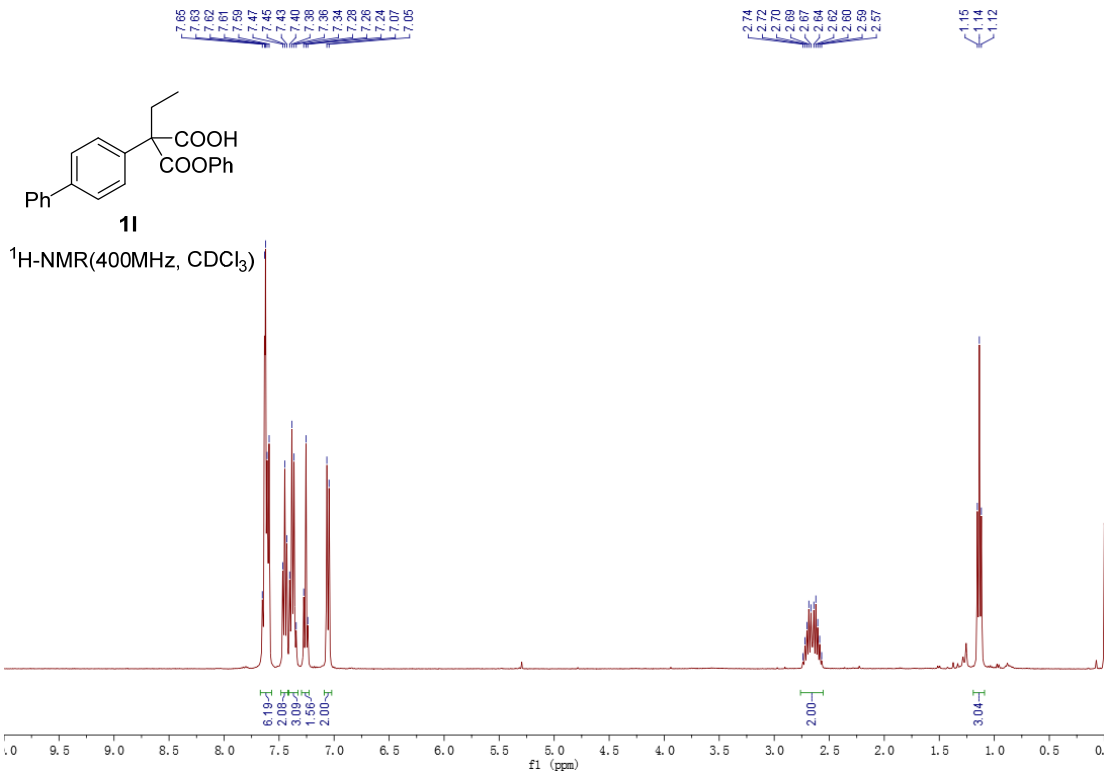
1j

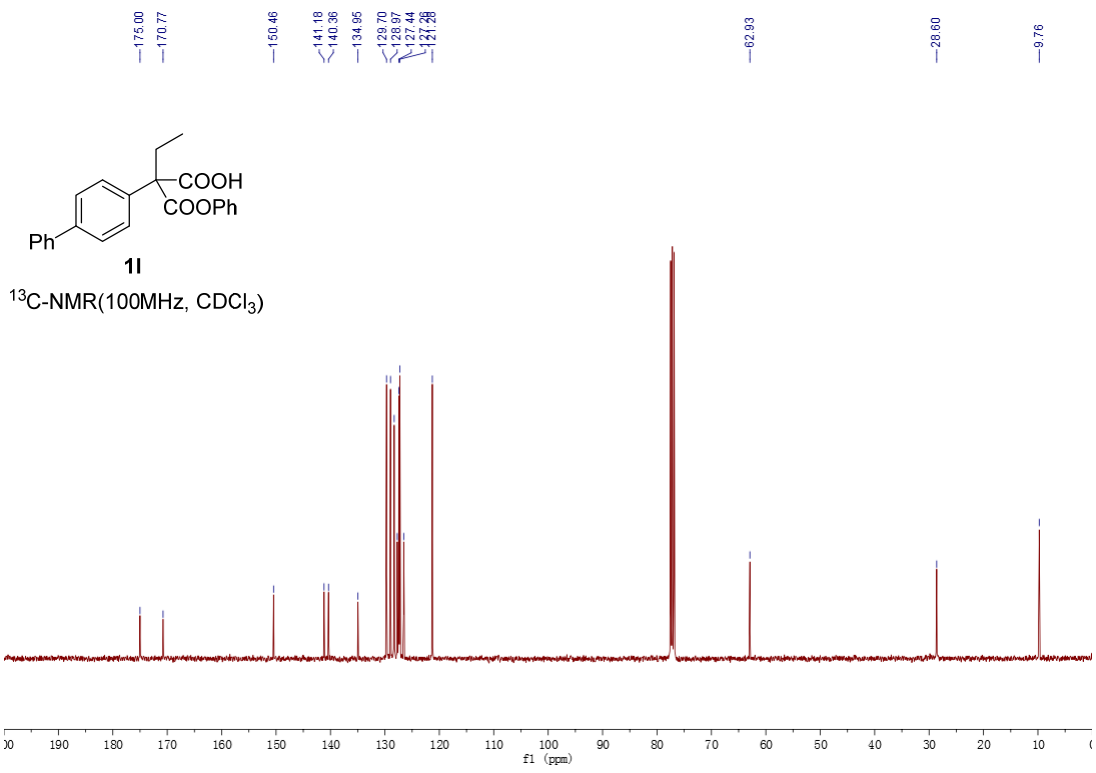
^{13}C-NMR(100 MHz, $CDCl_3$)

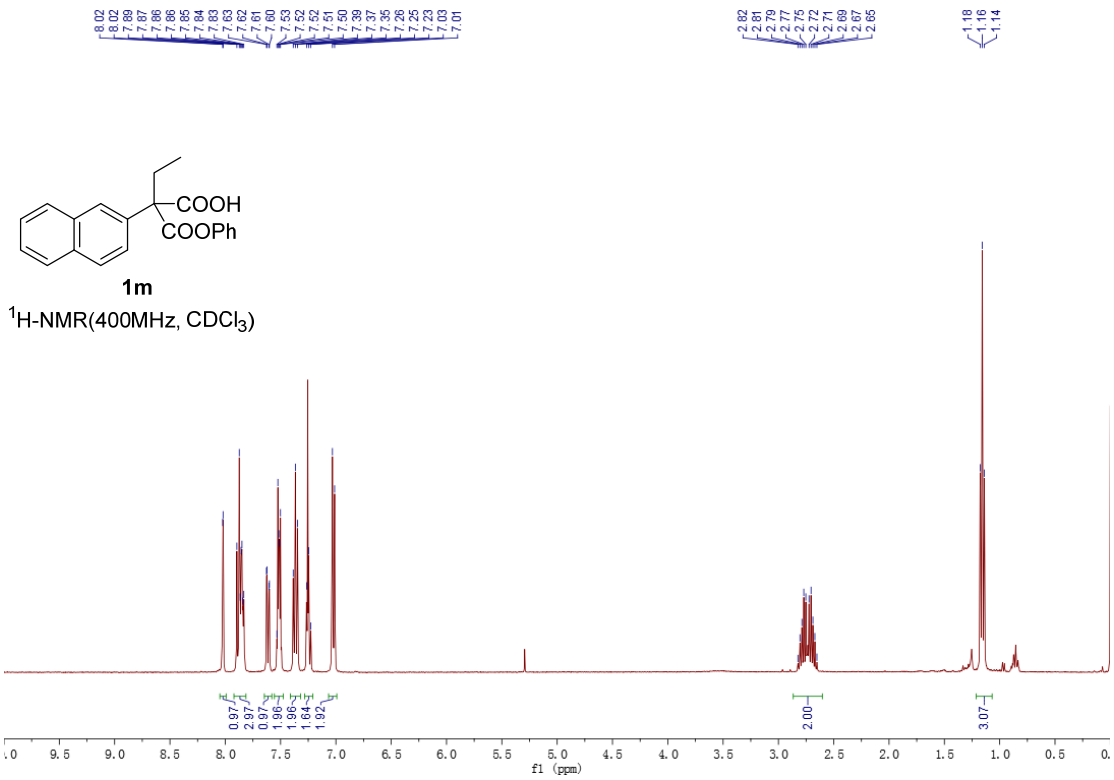


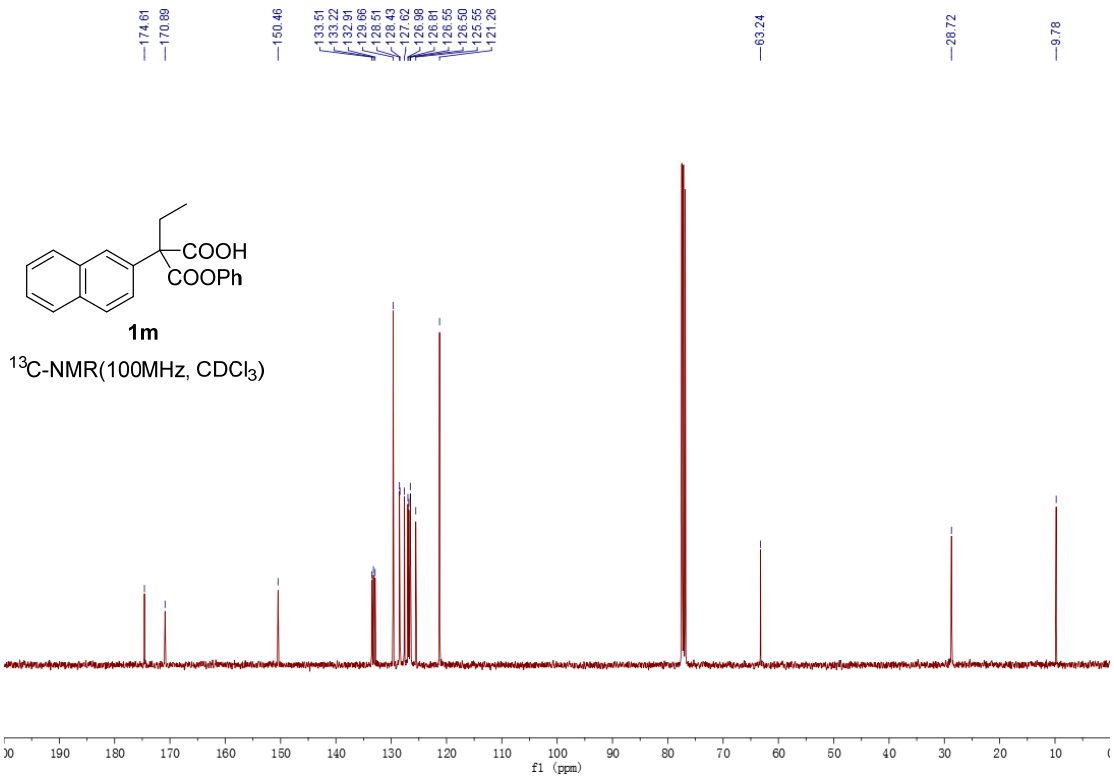

7.59
7.56
7.50
7.48
7.35
7.34
7.33
7.32
7.31
7.31
7.30
7.29
7.28
7.23
7.22
7.21
7.20
7.19
5.26
5.23
5.23
5.20
2.55
2.53
2.51
2.49
2.48
2.46
2.43
2.42
2.40
2.38
2.36
0.92
0.90
0.89
0.88
COOH
COOBn
F3C
1k
1H-NMR(400 MHz, CDCl3)
1.96
2.01
3.01
2.02
2.03
0.97
1.02
3.00

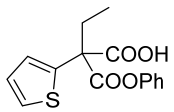

173.91
171.65
140.16
134.45
130.66
130.33
130.01
129.68
128.65
128.57
128.22
128.06
125.40
125.36
122.46
68.14
62.67
28.45
9.36
COOH
COOBn
F3C
1k
13C-NMR(100 MHz, CDCl3)


7.65
7.63
7.62
7.61
7.59
7.47
7.45
7.43
7.40
7.38
7.36
7.34
7.28
7.26
7.24
7.07
7.05
2.74
2.72
2.70
2.69
2.67
2.64
2.62
2.60
2.59
2.57
1.15
1.14
1.12
COOH
COOPh
Ph
1l
1H-NMR(400MHz, CDCl3)
6.19
2.08
3.09
1.58
2.00
2.00
3.04
f1 (ppm)


175.00
170.77
150.46
141.18
140.36
134.95
129.70
128.97
127.44
62.93
28.60
9.76
COOH
COOPh
Ph
1l
13C-NMR(100MHz, CDCl3)
f1 (ppm)

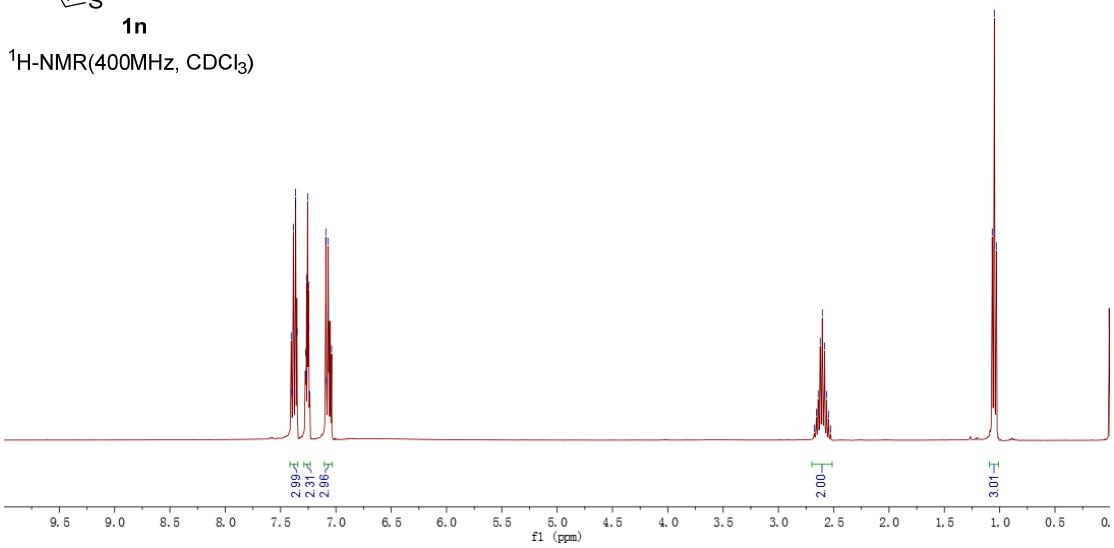

COOH
COOPh
1m
1H-NMR(400MHz, CDCl3)
f1 (ppm)

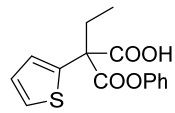

COOH
COOPh
1m
13C-NMR(100MHz, CDCl3)
f1 (ppm)



1n

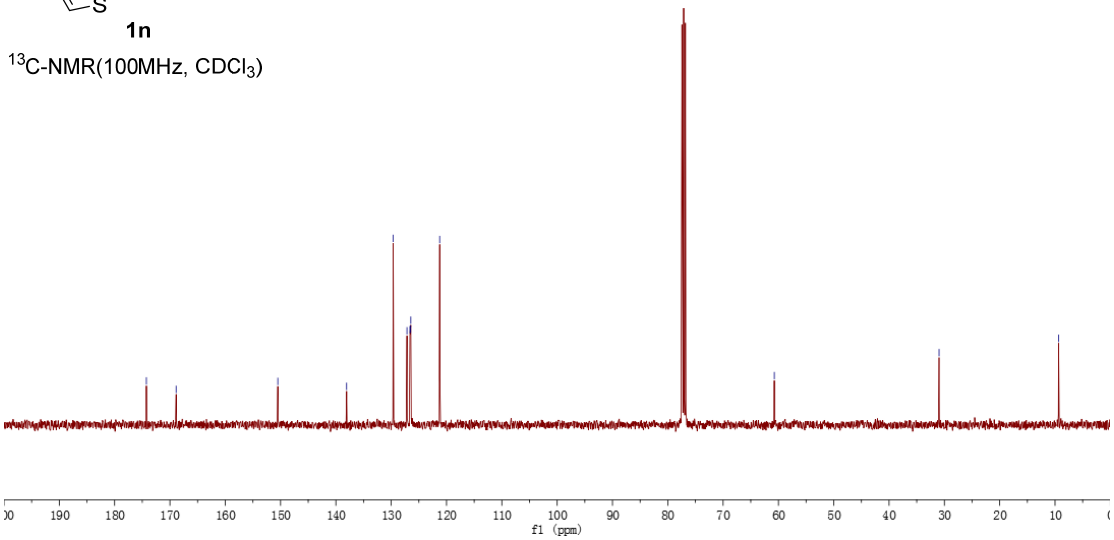
^{1}H-NMR(400MHz, $CDCl_3$)

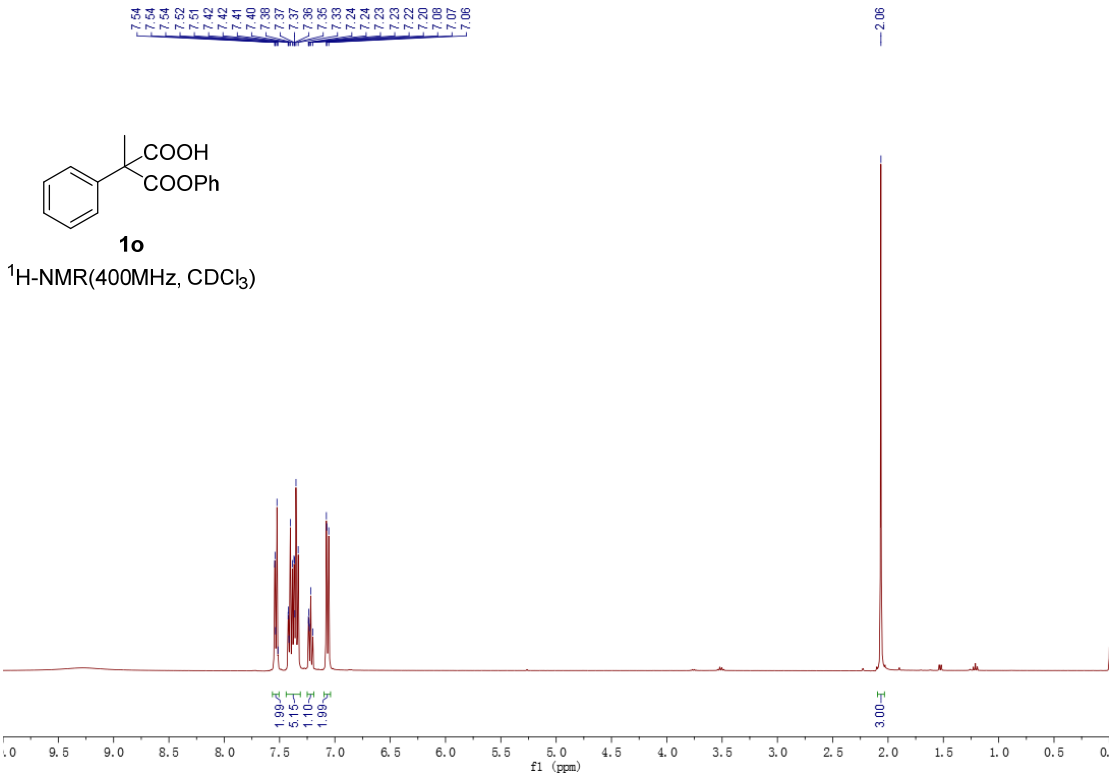




1n

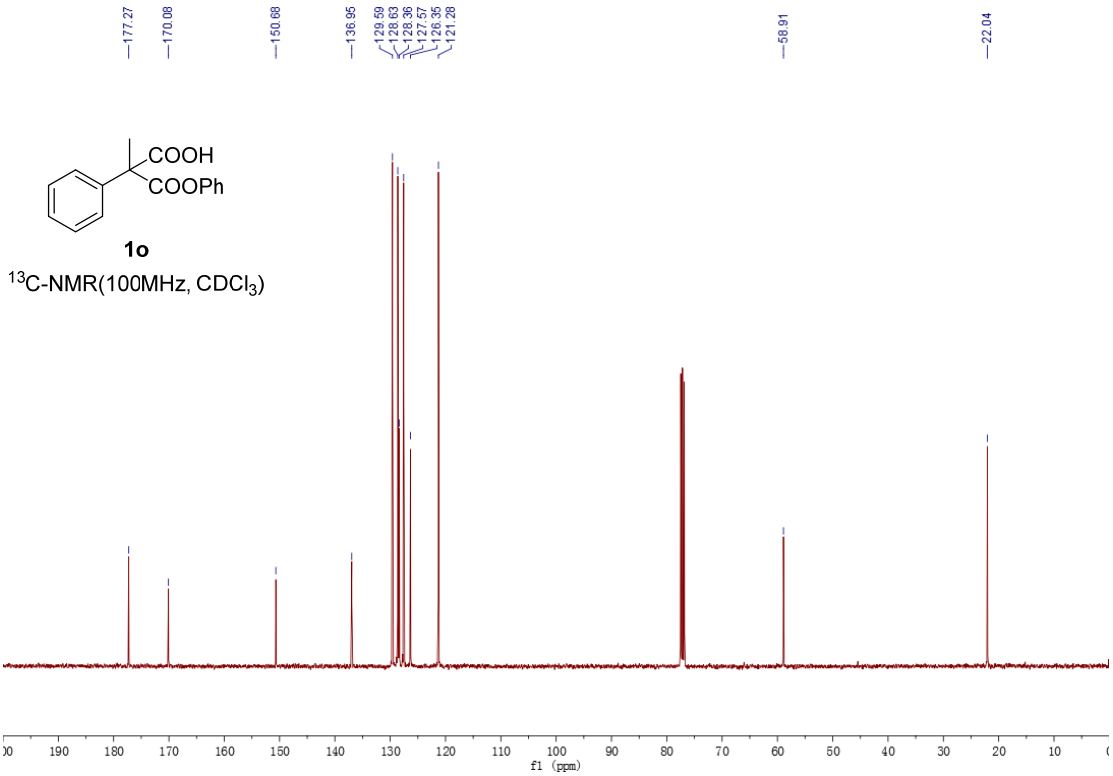
^{13}C-NMR(100MHz, $CDCl_3$)





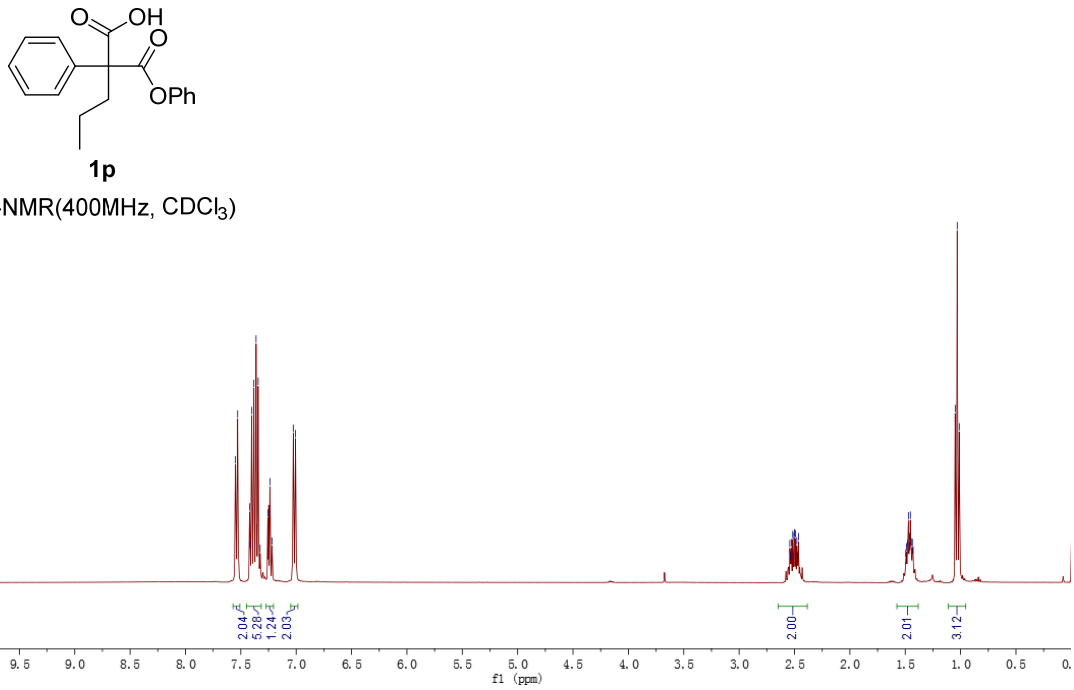
1o

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



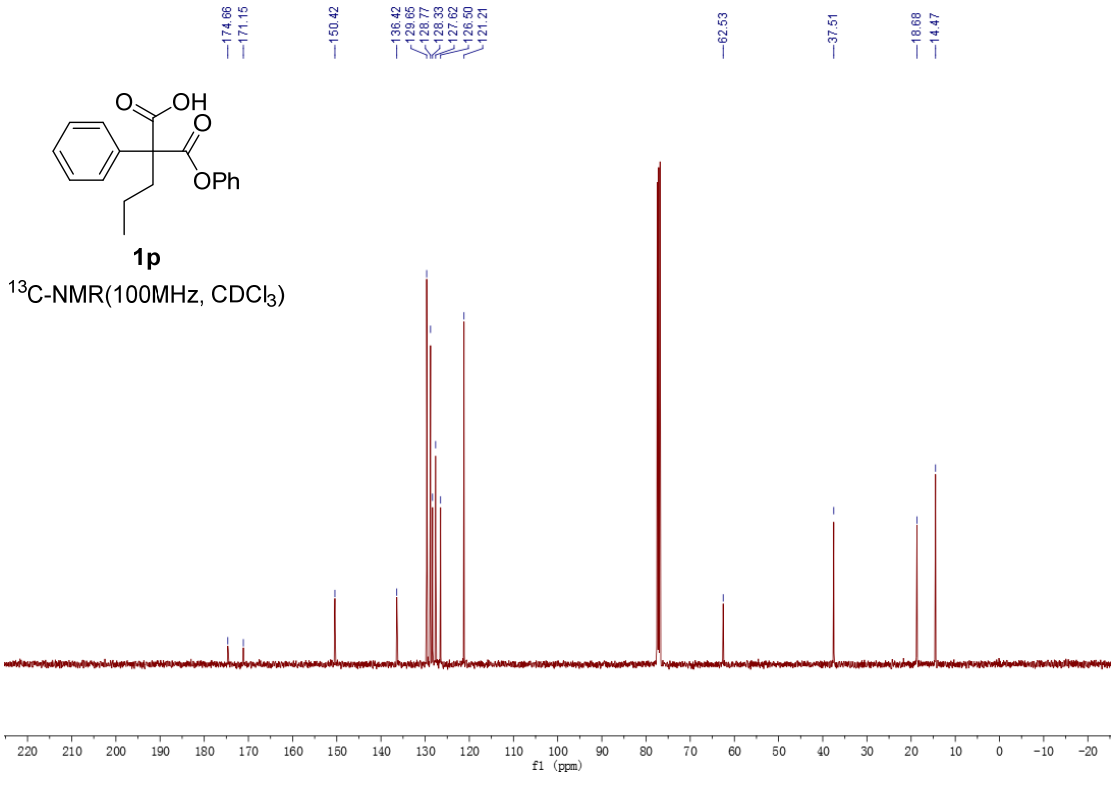
1o

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



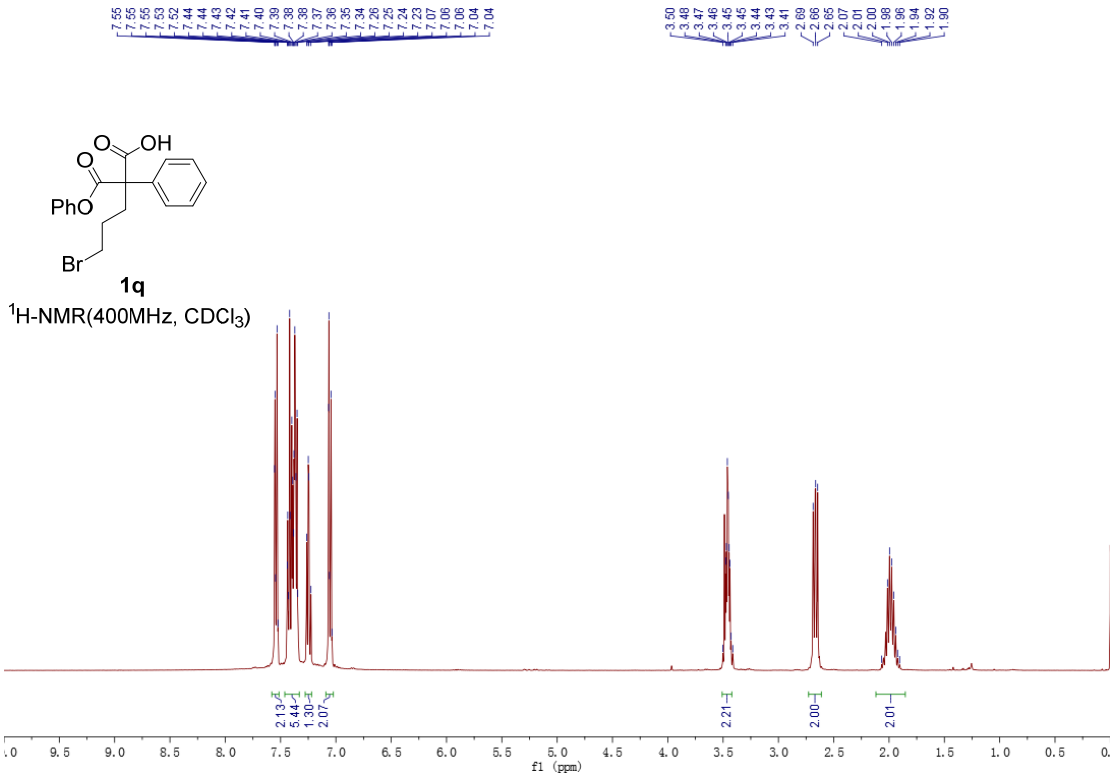
1p

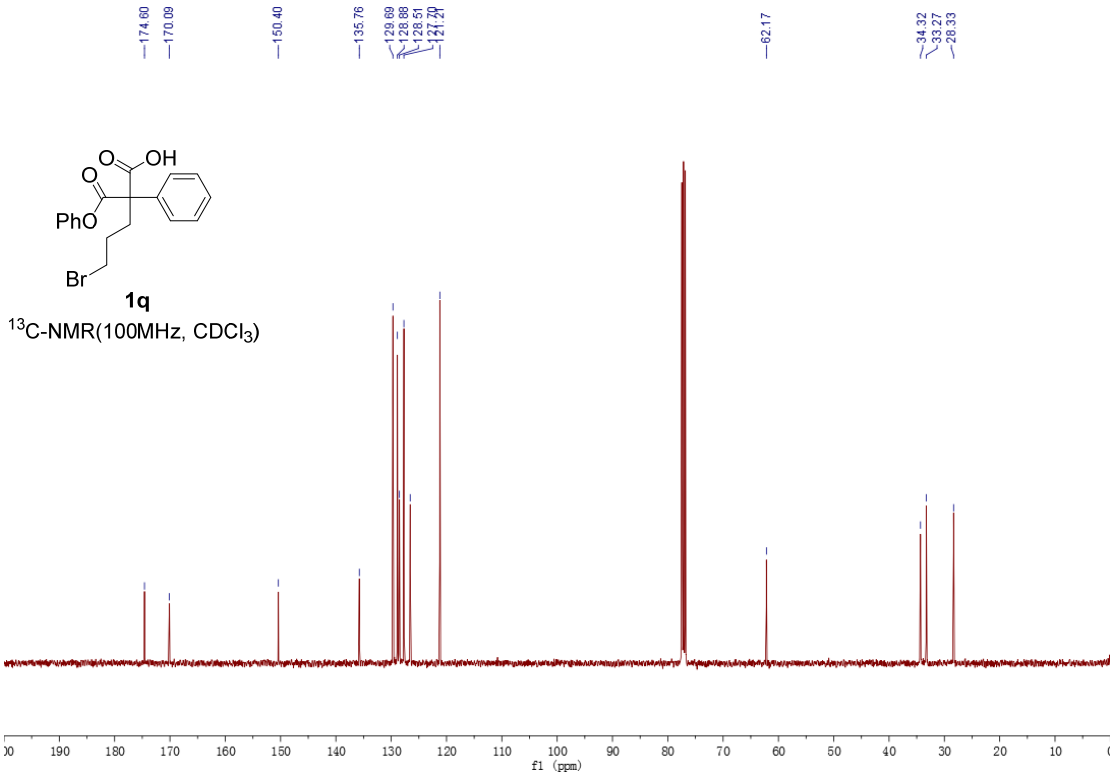
^{1}H-NMR(400MHz, $CDCl_3$)

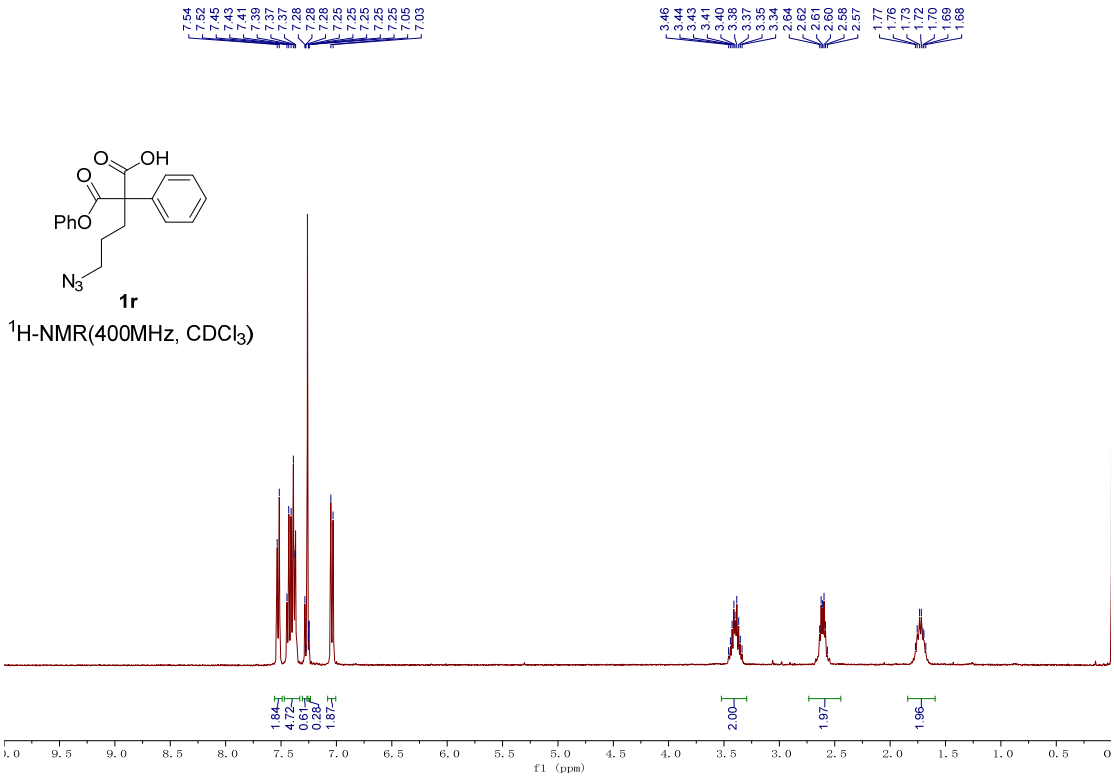


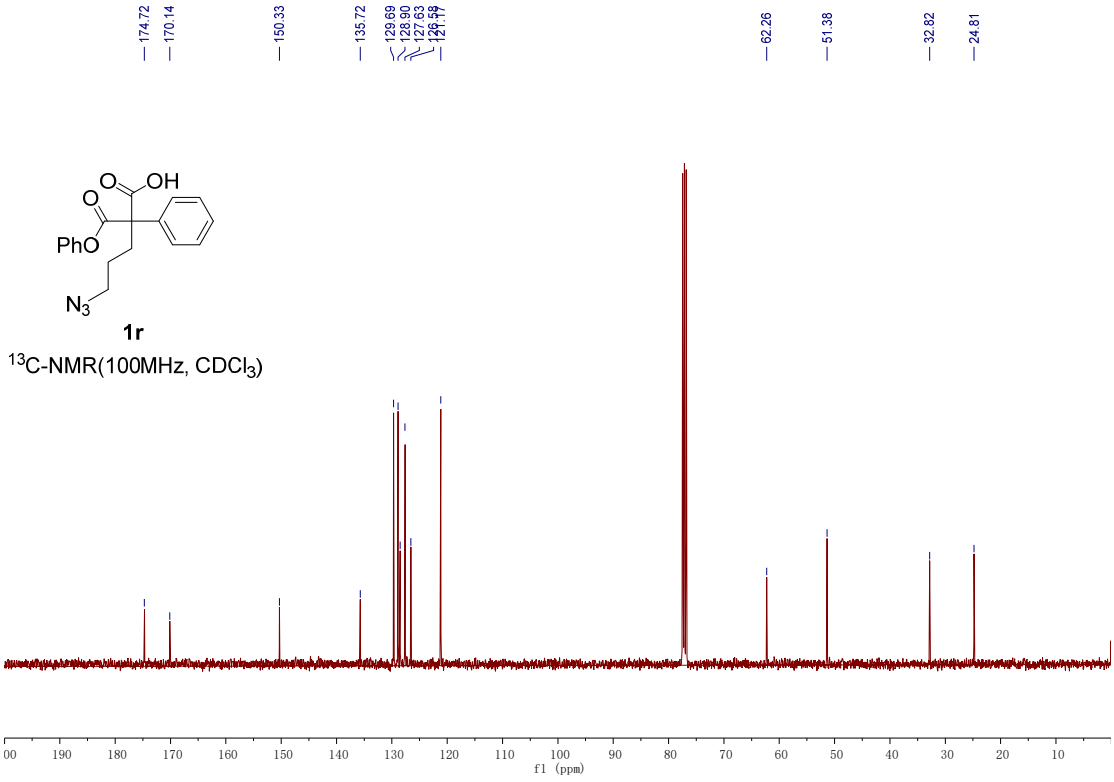
1p

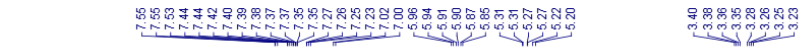
^{13}C-NMR(100MHz, $CDCl_3$)

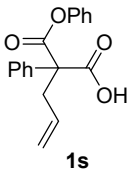

7.55
7.55
7.55
7.53
7.52
7.44
7.44
7.43
7.42
7.41
7.40
7.39
7.38
7.38
7.37
7.36
7.35
7.34
7.26
7.25
7.24
7.23
7.07
7.06
7.06
7.04
7.04
3.50
3.48
3.47
3.46
3.45
3.45
3.44
3.43
3.41
2.69
2.66
2.65
2.07
2.01
2.00
1.98
1.96
1.94
1.92
1.90
O
OH
O
PhO
Br
1q
1H-NMR(400MHz, CDCl3)
2.13
5.44
1.30
2.07
2.21
2.00
2.01
f1 (ppm)


174.60
170.09
150.40
135.76
129.69
128.88
128.51
127.70
121.21
62.17
34.32
33.27
28.33
O
OH
O
PhO
Br
1q
13C-NMR(100MHz, CDCl3)
f1 (ppm)


7.54
7.52
7.45
7.43
7.41
7.39
7.37
7.37
7.28
7.28
7.25
7.25
7.25
7.25
7.05
7.03
3.46
3.44
3.43
3.41
3.40
3.38
3.37
3.35
3.34
2.64
2.62
2.61
2.60
2.58
2.57
1.77
1.76
1.73
1.72
1.70
1.69
1.68
O
OH
O
PhO
N3
1r
1H-NMR(400MHz, CDCl3)
1.84
4.72
0.61
0.28
1.87
2.00
1.97
1.96
f1 (ppm)

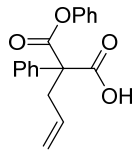

174.72
170.14
150.33
135.72
129.69
128.90
127.63
126.58
121.17
62.26
51.38
32.82
24.81
O
OH
O
PhO
N3
1r
13C-NMR(100MHz, CDCl3)
f1 (ppm)





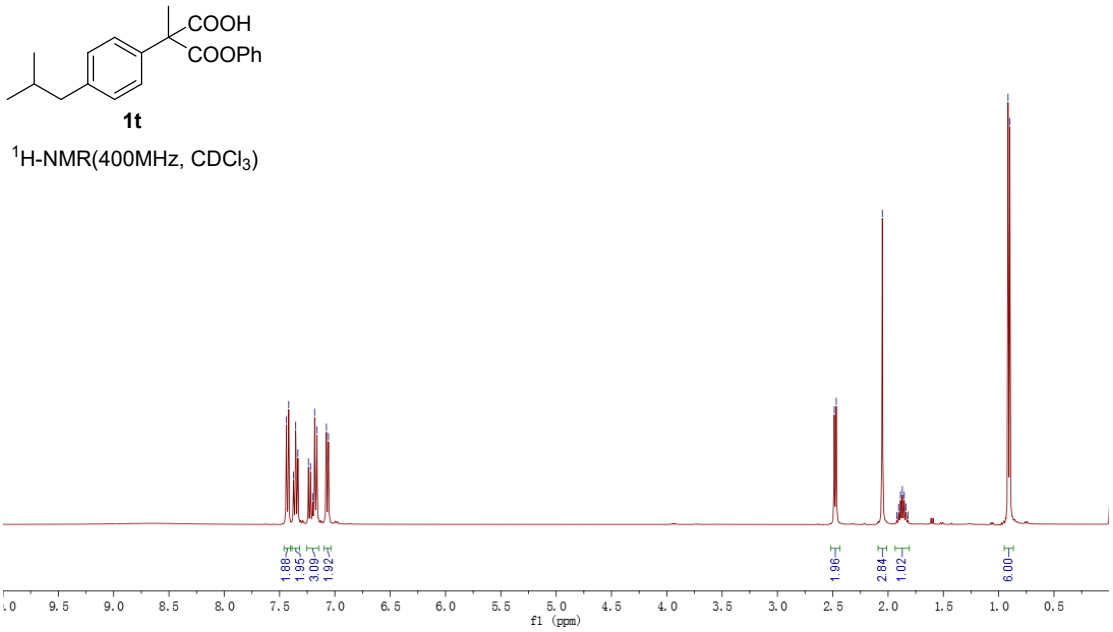
1s

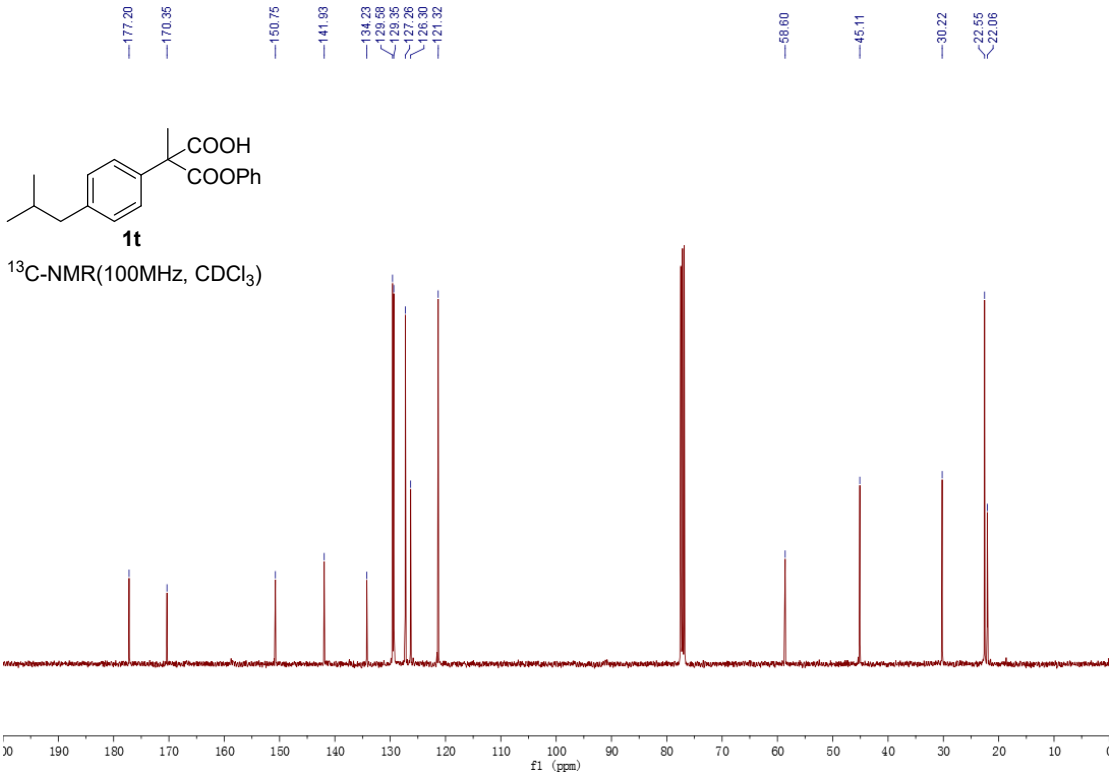
^{1}H-NMR(400MHz, $CDCl_3$)

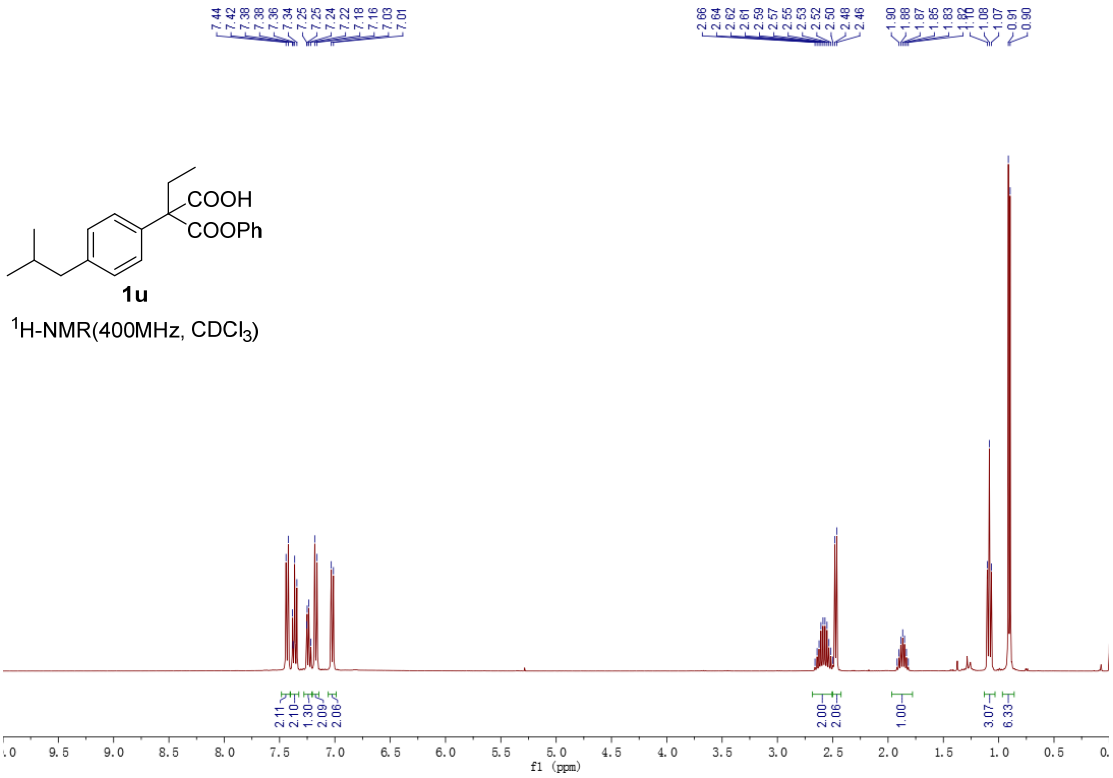


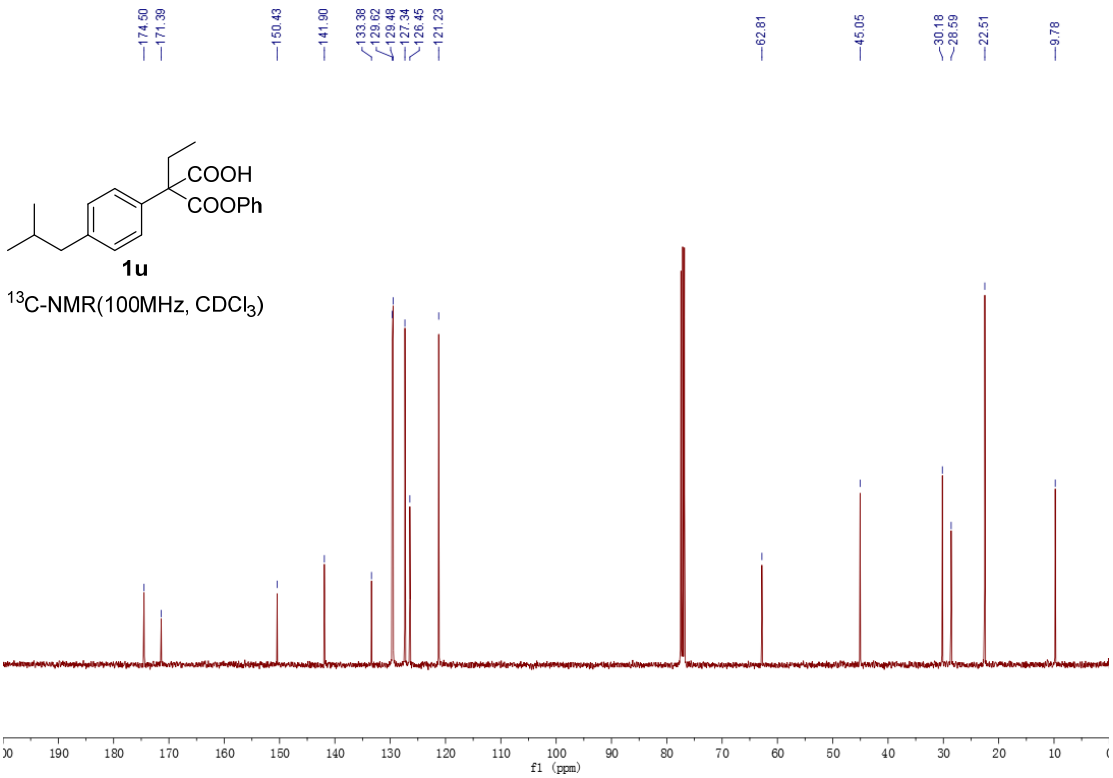
1s

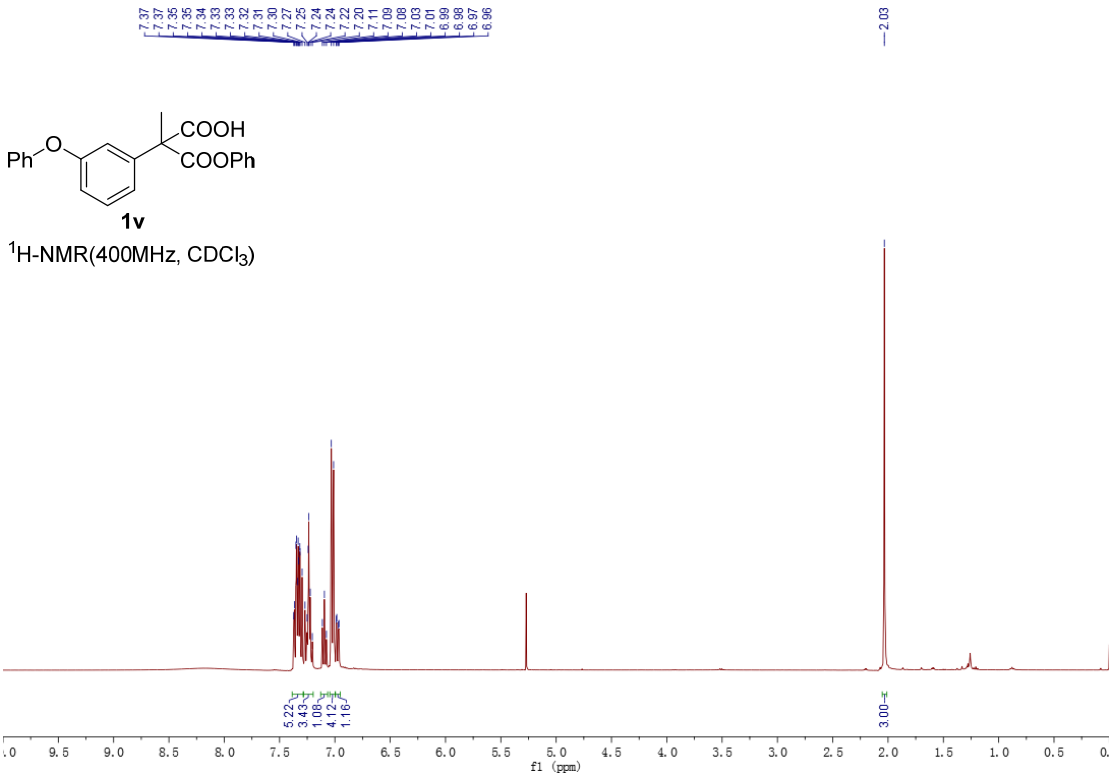
^{13}C-NMR(100MHz, $CDCl_3$)


7.44
7.42
7.37
7.35
7.33
7.24
7.22
7.20
7.18
7.16
7.08
7.06
2.49
2.47
2.05
1.92
1.90
1.89
1.87
1.85
1.84
1.82
0.92
0.90
COOH
COOPh
1t
1H-NMR(400MHz, CDCl3)
1.88
1.95
3.09
1.92
1.96
2.84
1.02
6.00
f1 (ppm)


177.20
170.35
150.75
141.93
134.23
129.58
129.35
127.26
126.30
121.32
58.60
45.11
30.22
22.55
22.06
COOH
COOPh
1t
13C-NMR(100MHz, CDCl3)
f1 (ppm)


COOH
COOPh
1u
1H-NMR(400MHz, CDCl3)
f1 (ppm)


COOH
COOPh
1u
13C-NMR(100MHz, CDCl3)
f1 (ppm)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7.37
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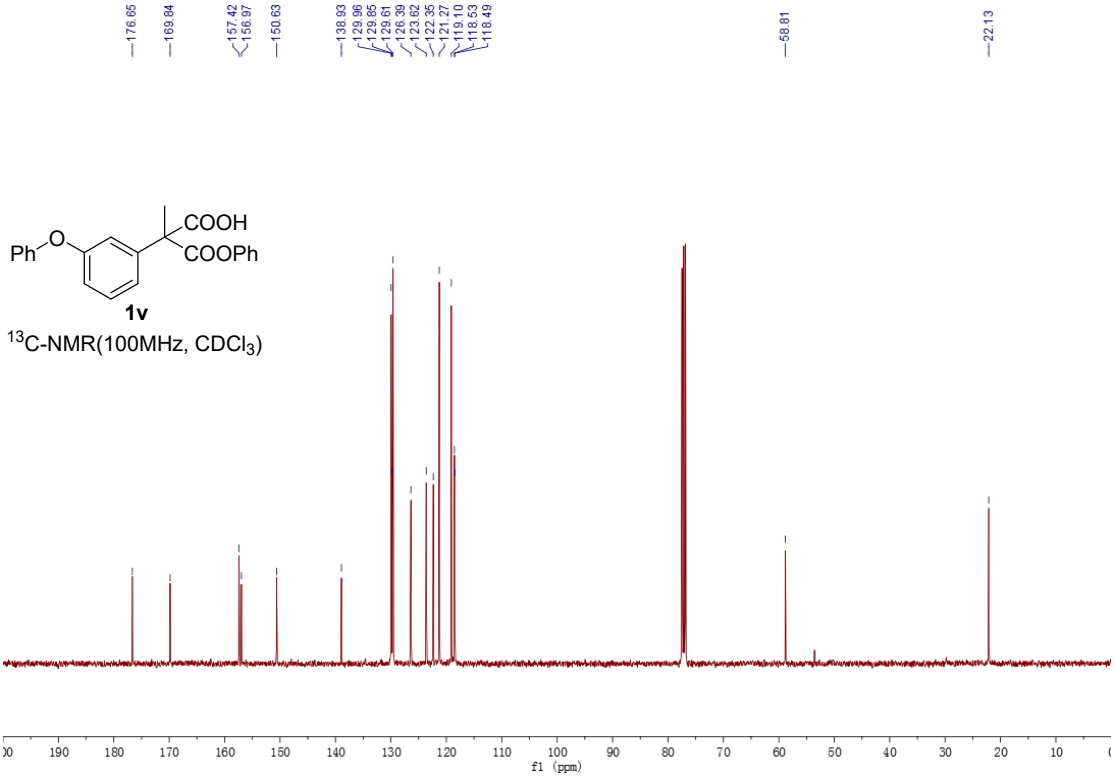
7.35
7.34
7.33
7.33
7.32
7.31
7.30
7.27
7.25
7.24
7.24
7.22
7.20
7.11
7.09
7.08
7.03
7.01
6.99
6.98
6.97
6.96
2.03
COOH
COOPh
Ph
O
1v
1H-NMR(400MHz, CDCl3)
5.22
3.43
1.08
4.12
1.16
3.00
f1 (ppm)

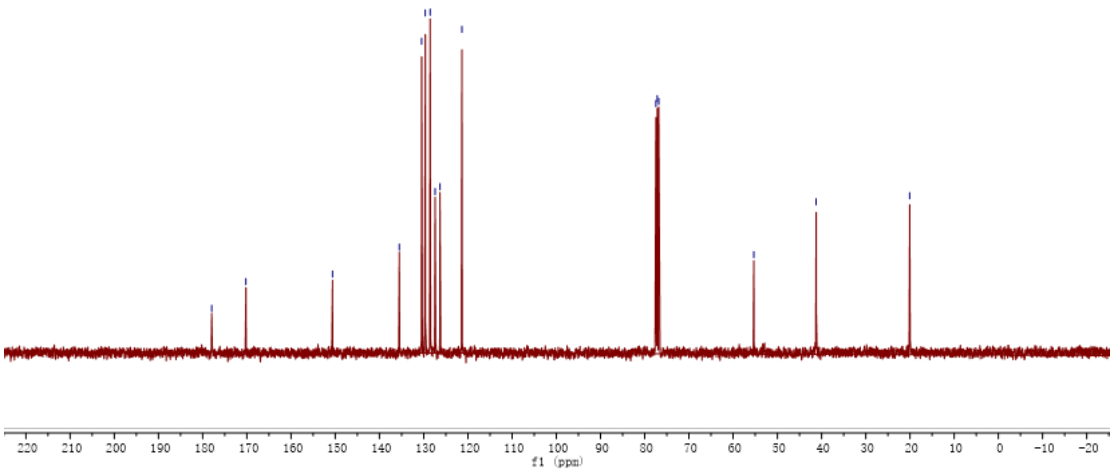

176.65
169.84
157.42
156.97
150.63
138.93
129.96
129.85
129.61
126.39
123.62
122.35
121.27
119.10
118.53
118.49
58.81
22.13
COOH
COOPh
Ph
O
1v
13C-NMR(100MHz, CDCl3)
f1 (ppm)

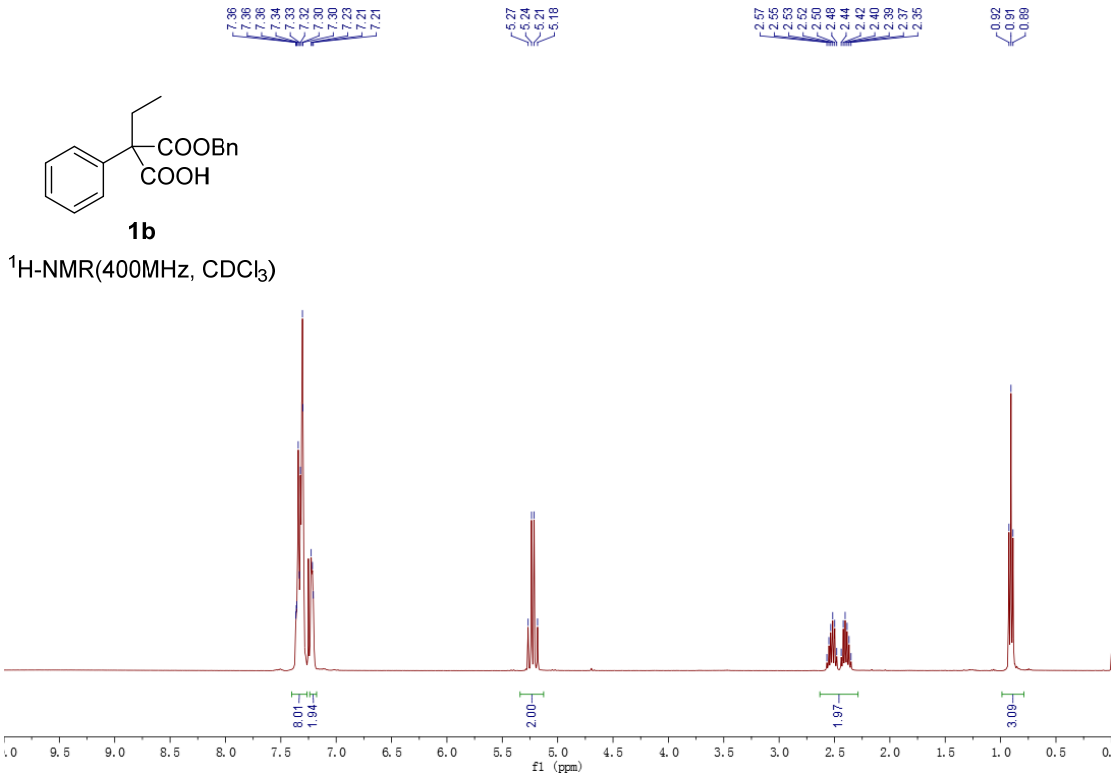
1w

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

1w

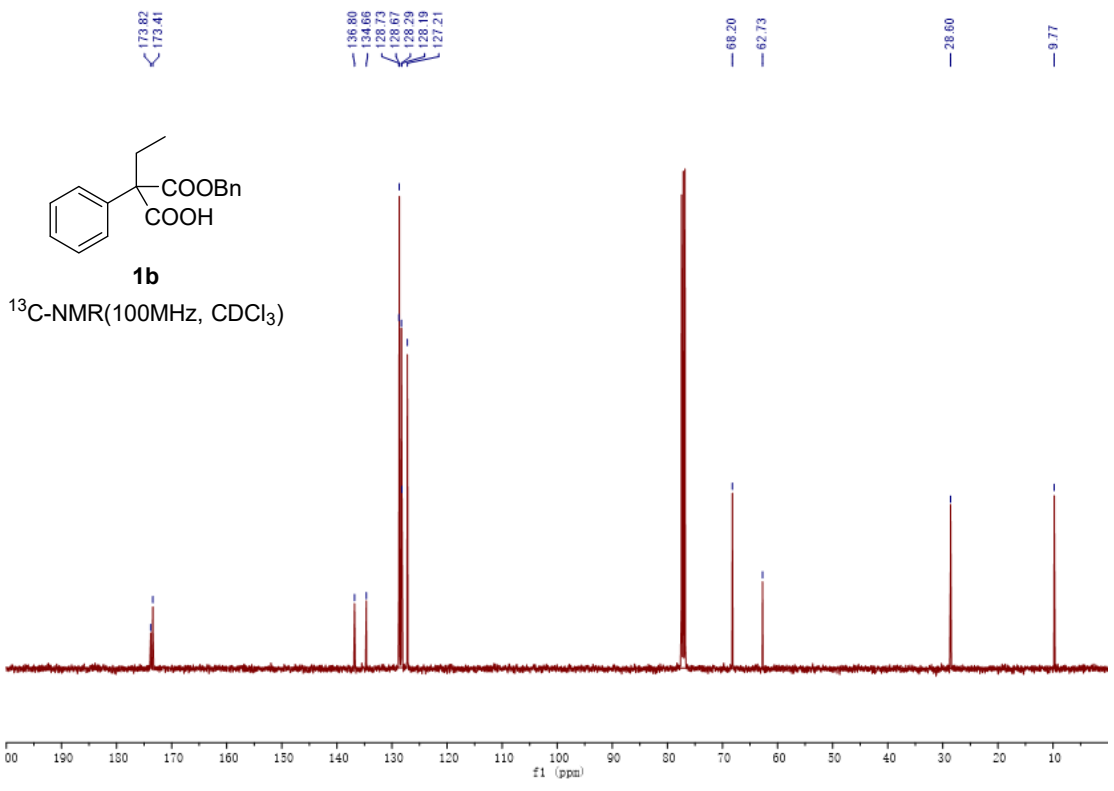
^{13}C-NMR(100MHz, $CDCl_3$)





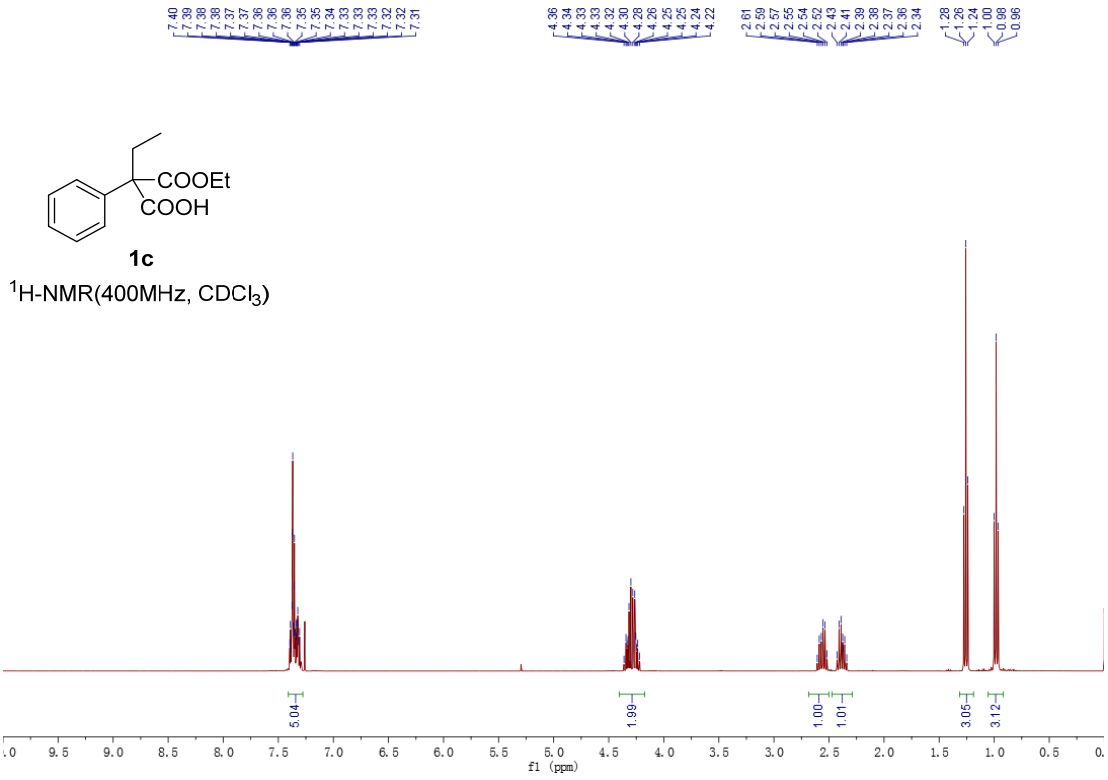
1b

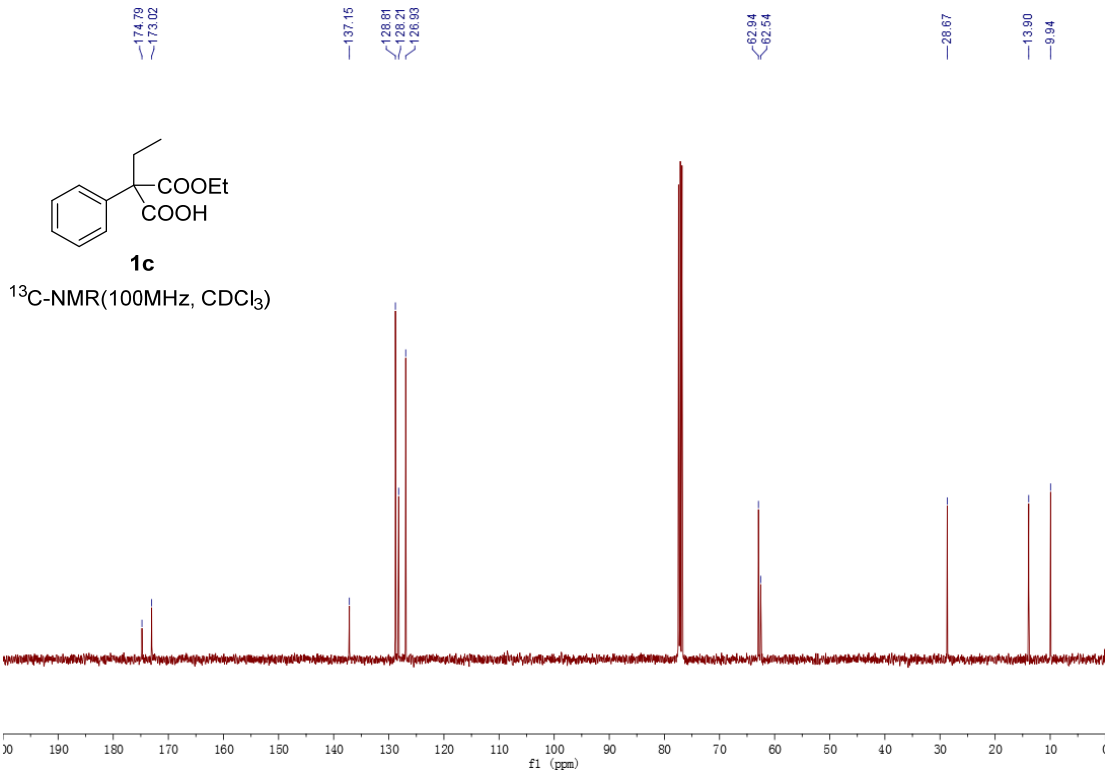
^{1}H-NMR(400MHz, $CDCl_3$)

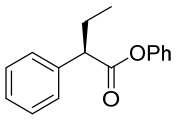


1b

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

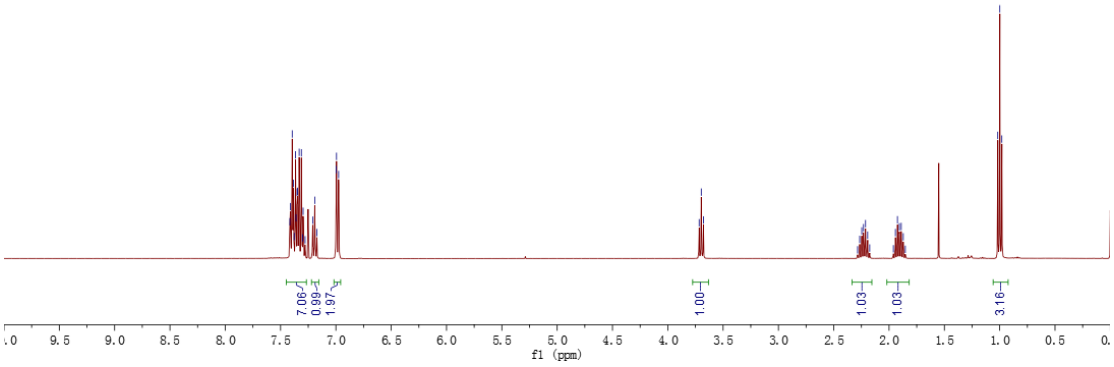

COOEt
COOH
1c
1H-NMR(400MHz, CDCl3)
f1 (ppm)

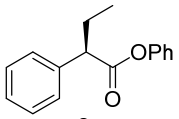

COOEt
COOH
1c
13C-NMR(100MHz, CDCl3)
f1 (ppm)



2a

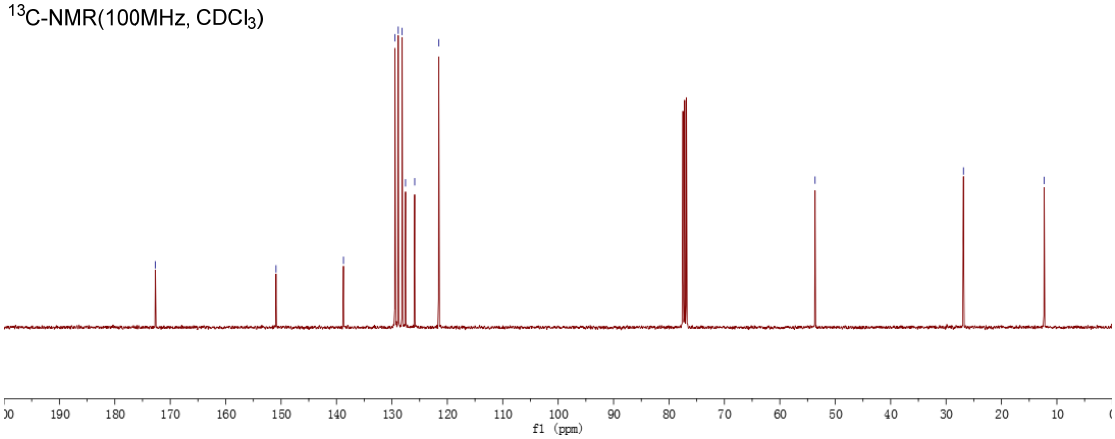
^{1}H-NMR(400MHz, $CDCl_3$)





2a

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



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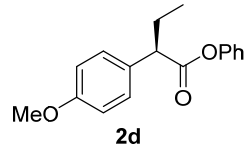
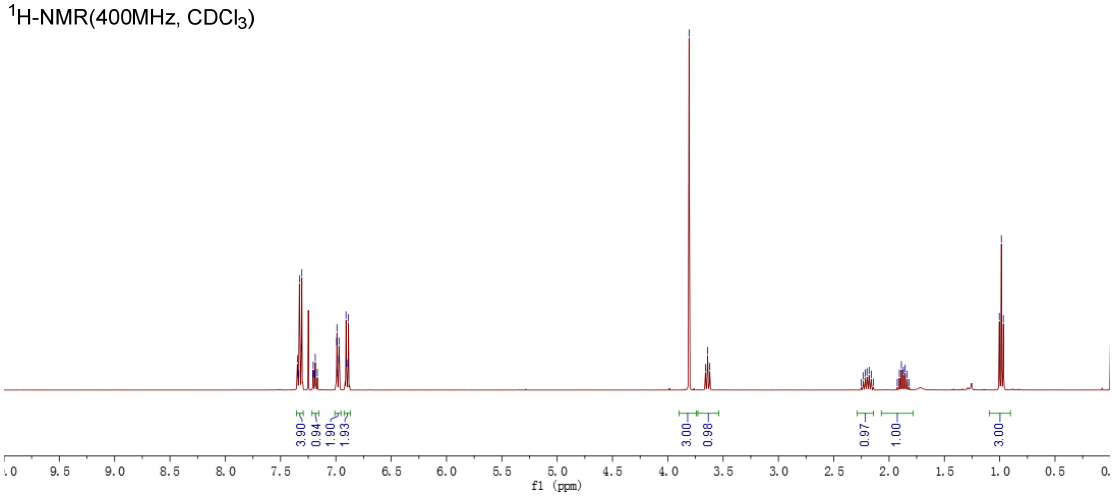
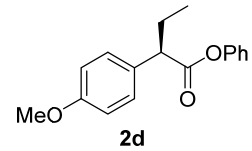


2d

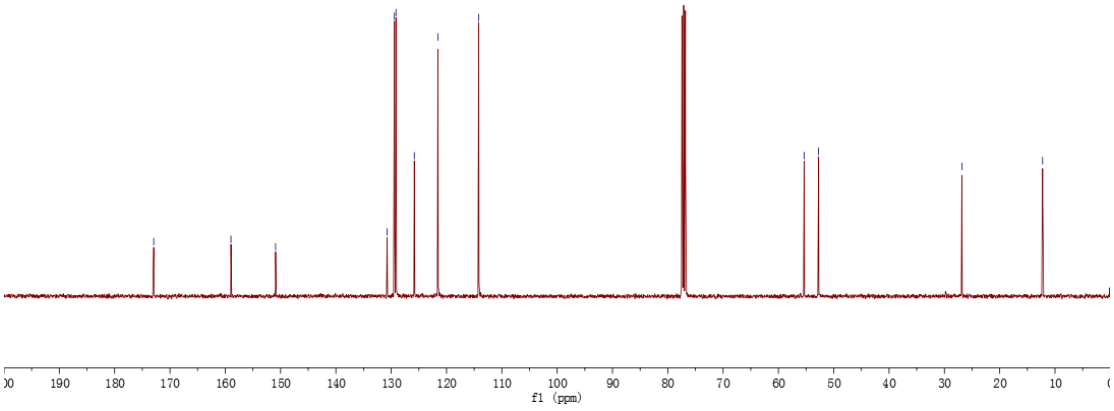
^{1}H-NMR(400MHz, $CDCl_3$)

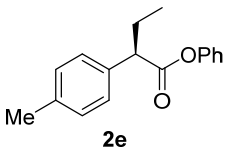




2d

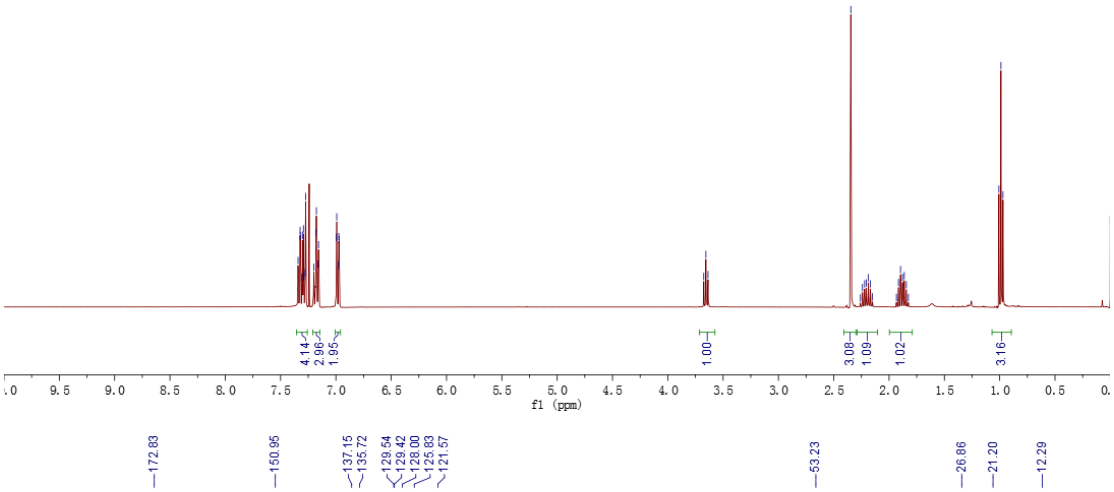
^{13}C-NMR(100MHz, $CDCl_3$)

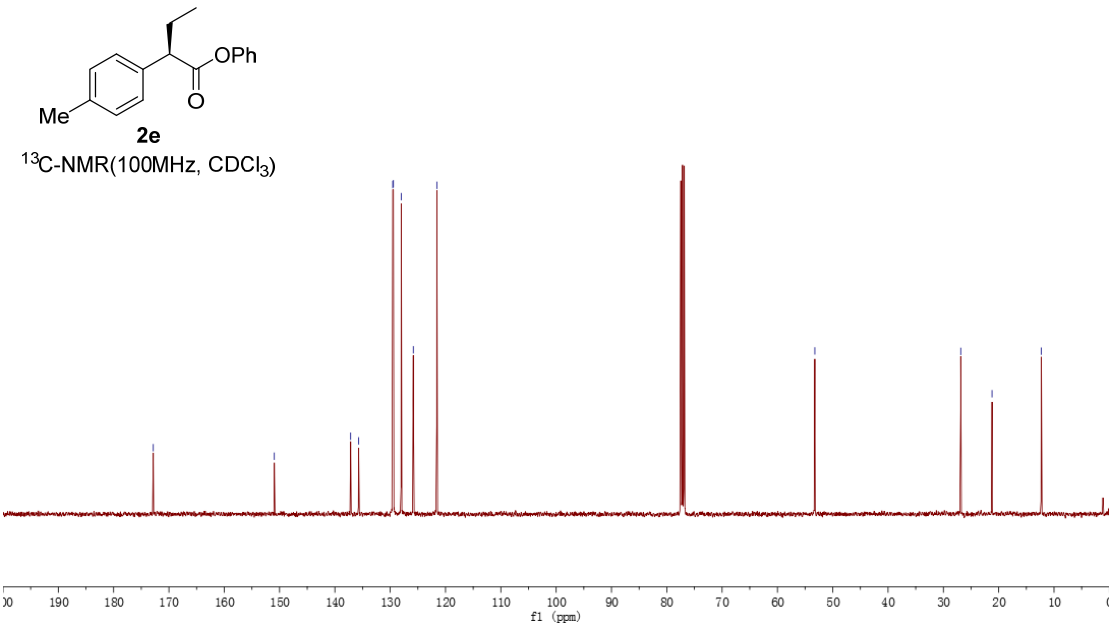




2e

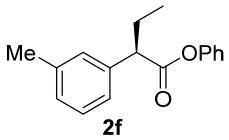
^{1}H-NMR(400MHz, $CDCl_3$)





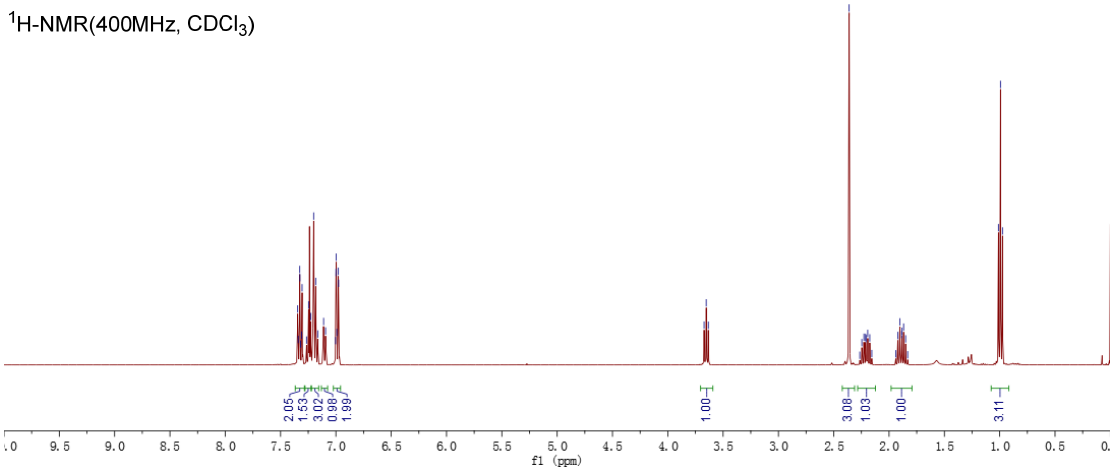
2e

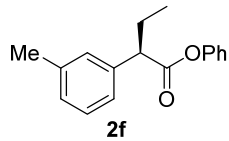
^{13}C-NMR(100MHz, $CDCl_3$)



2f

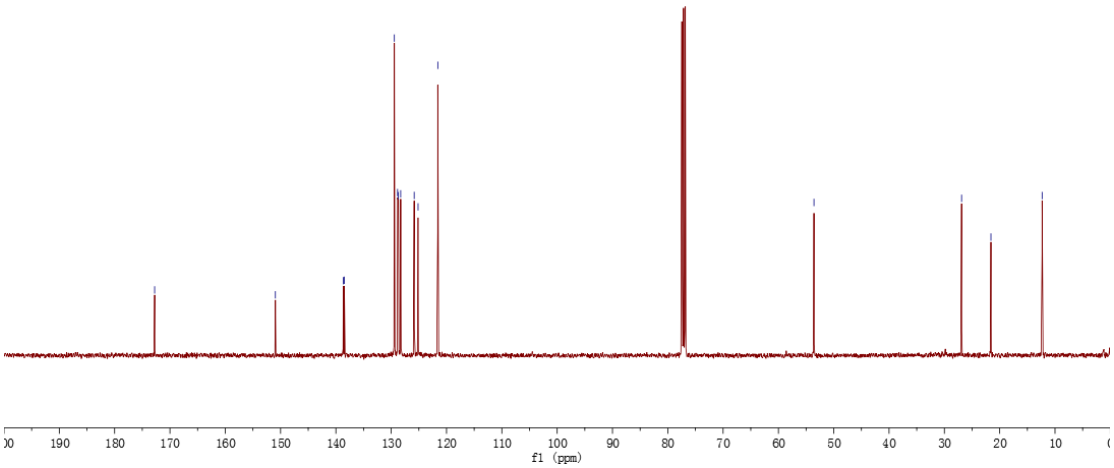
^{1}H-NMR(400MHz, $CDCl_3$)

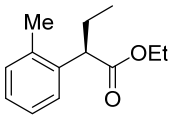




2f

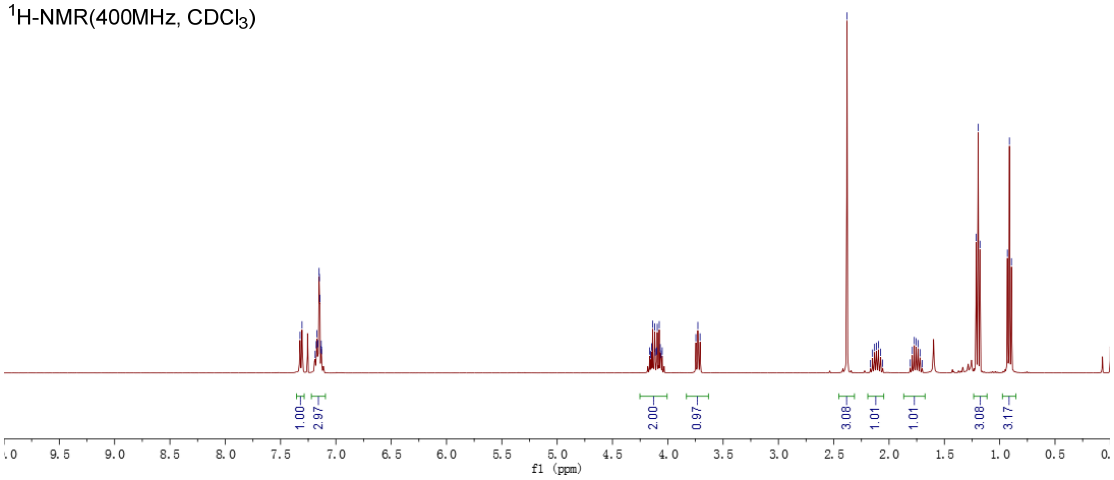
^{13}C-NMR(100MHz, $CDCl_3$)

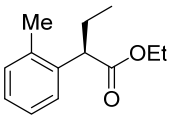




2g

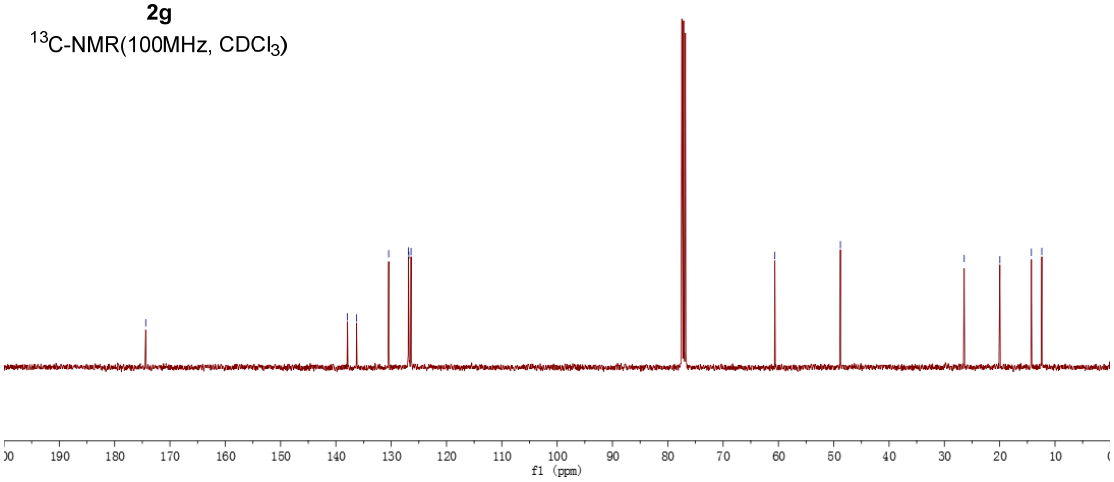
^{1}H-NMR(400MHz, $CDCl_3$)

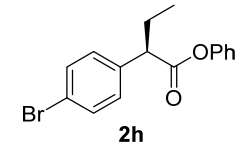




2g

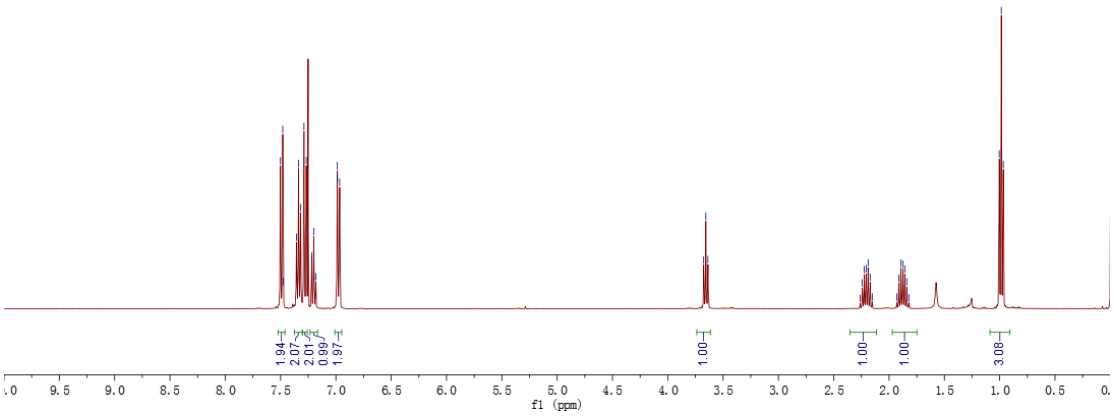
^{13}C-NMR(100MHz, $CDCl_3$)

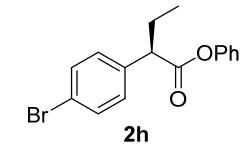




2h

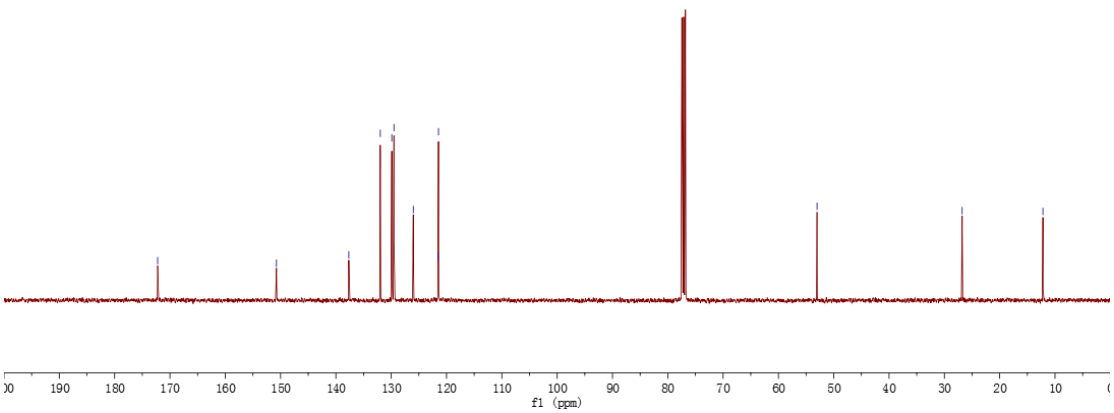
^{1}H-NMR(400MHz, $CDCl_3$)

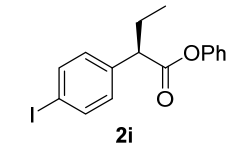




2h

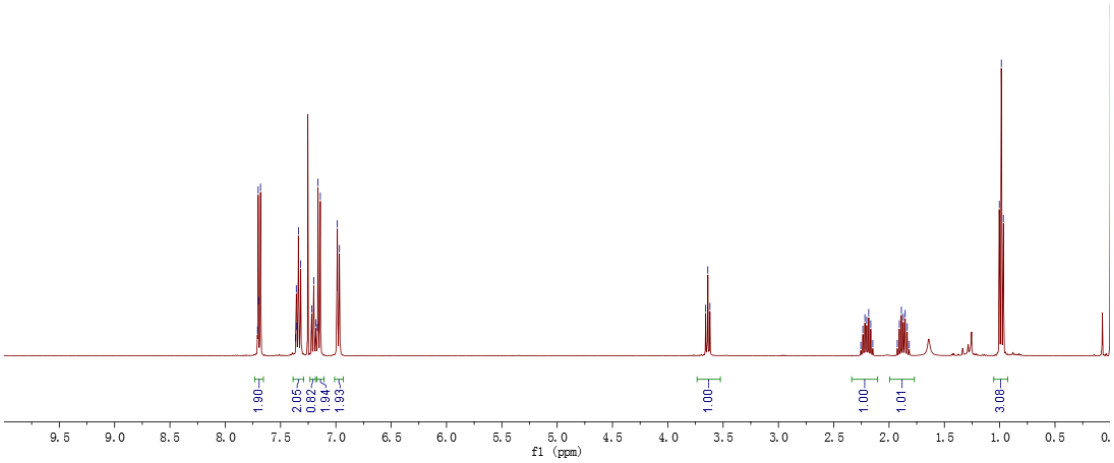
^{13}C-NMR(100MHz, $CDCl_3$)

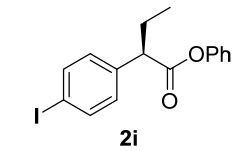




2i

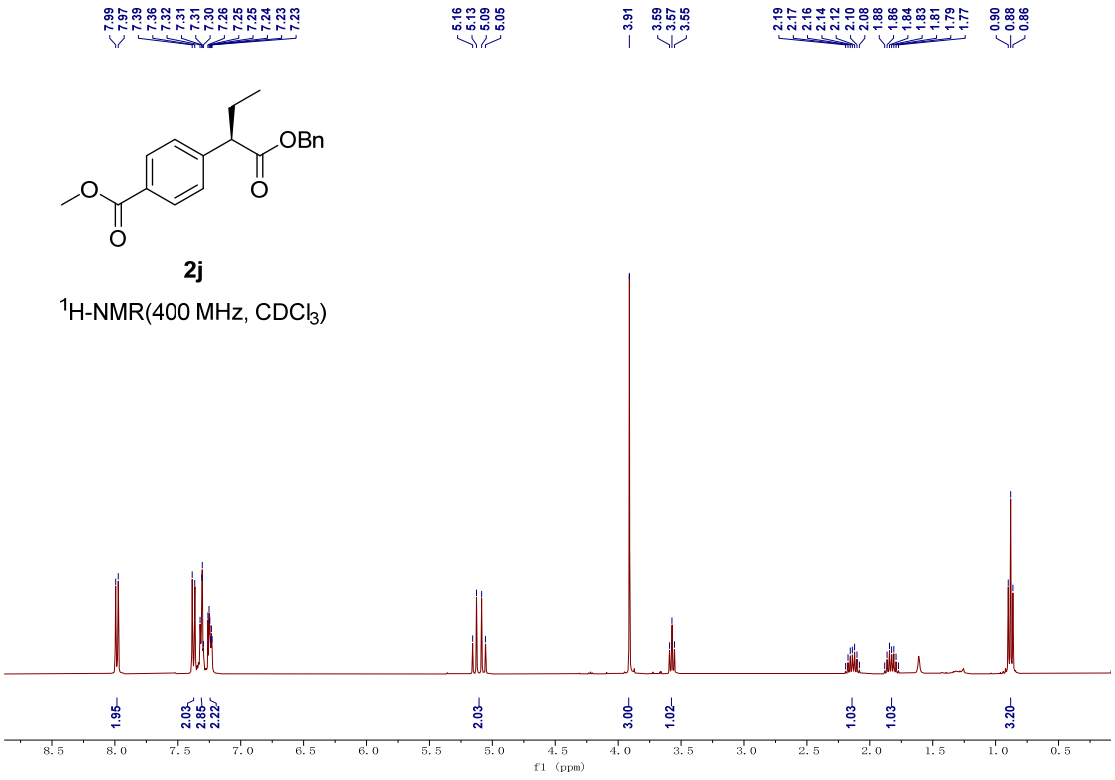
^{1}H-NMR(400MHz, $CDCl_3$)

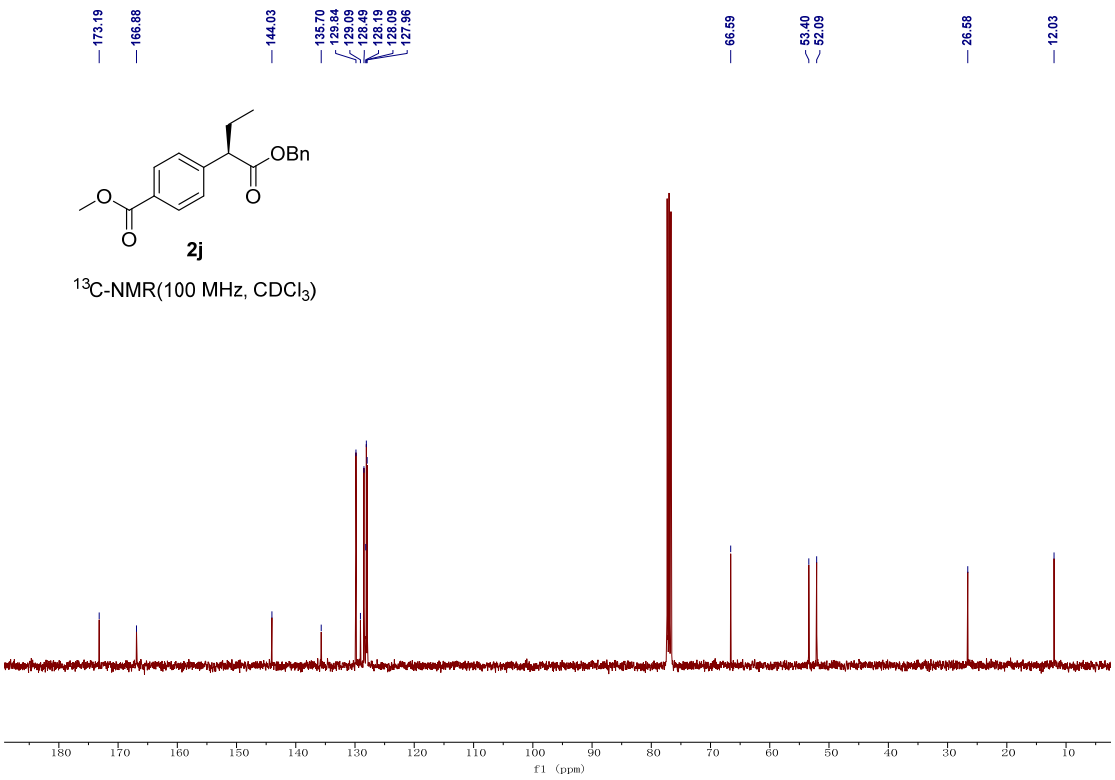


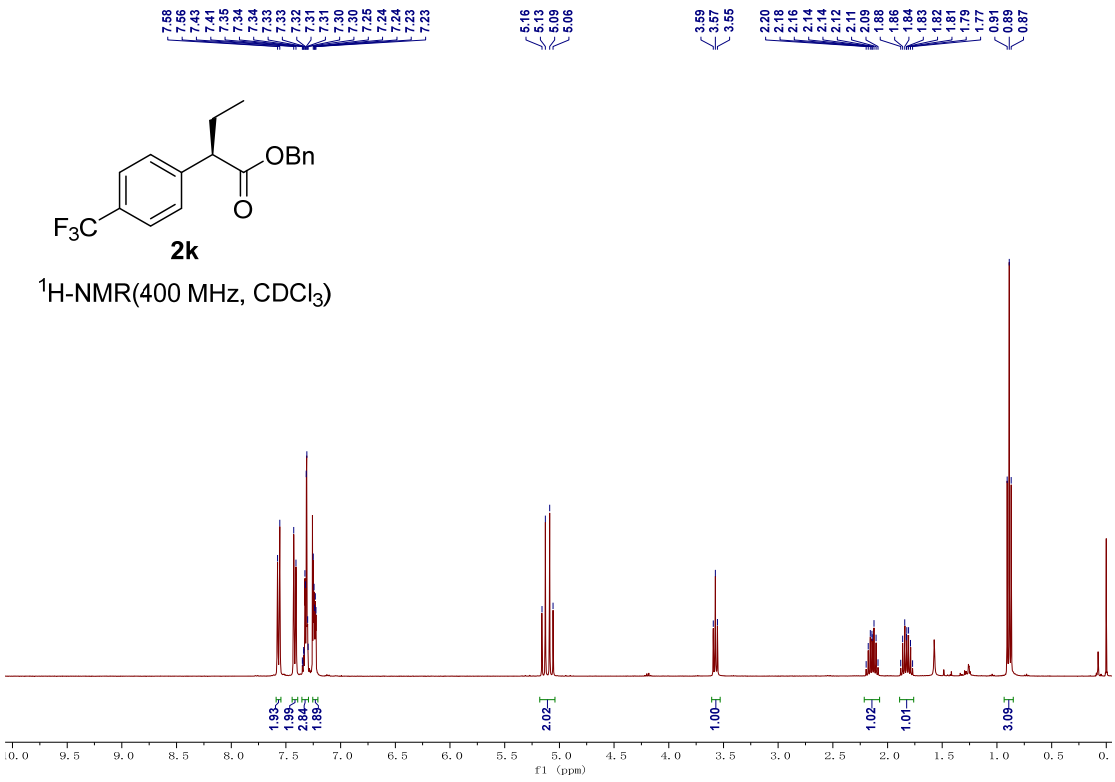


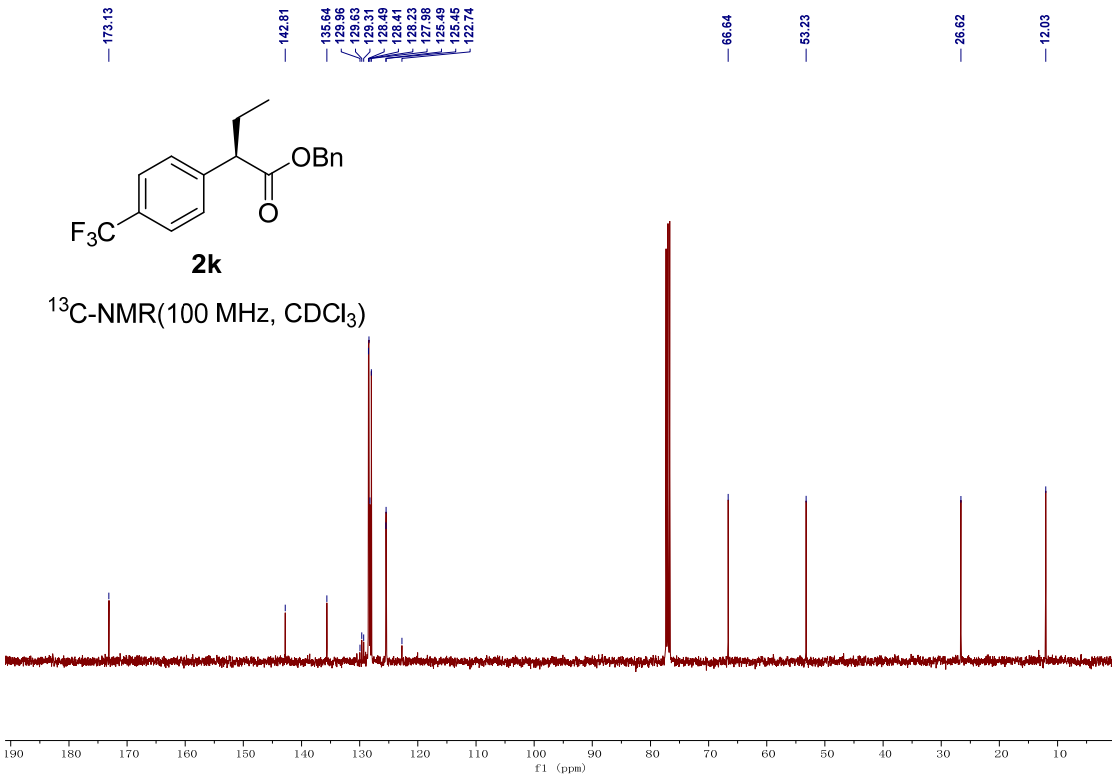
2i

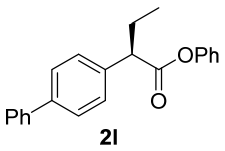
^{13}C-NMR(100MHz, $CDCl_3$)


7.99
7.97
7.39
7.36
7.32
7.31
7.31
7.30
7.26
7.25
7.25
7.24
7.23
7.23
5.16
5.13
5.09
5.05
3.91
3.59
3.57
3.55
2.19
2.17
2.16
2.14
2.12
2.10
2.08
1.88
1.86
1.84
1.83
1.81
1.79
1.77
0.90
0.88
0.86
OBn
O
O
O
2j
1H-NMR(400 MHz, CDCl3)
1.95
2.03
2.85
2.22
2.03
3.00
1.02
1.03
1.03
3.20
f1 (ppm)


173.19
166.88
144.03
135.70
129.84
129.09
128.49
128.19
128.09
127.96
66.59
53.40
52.09
26.58
12.03
OBn
O
O
O
2j
13C-NMR(100 MHz, CDCl3)
f1 (ppm)

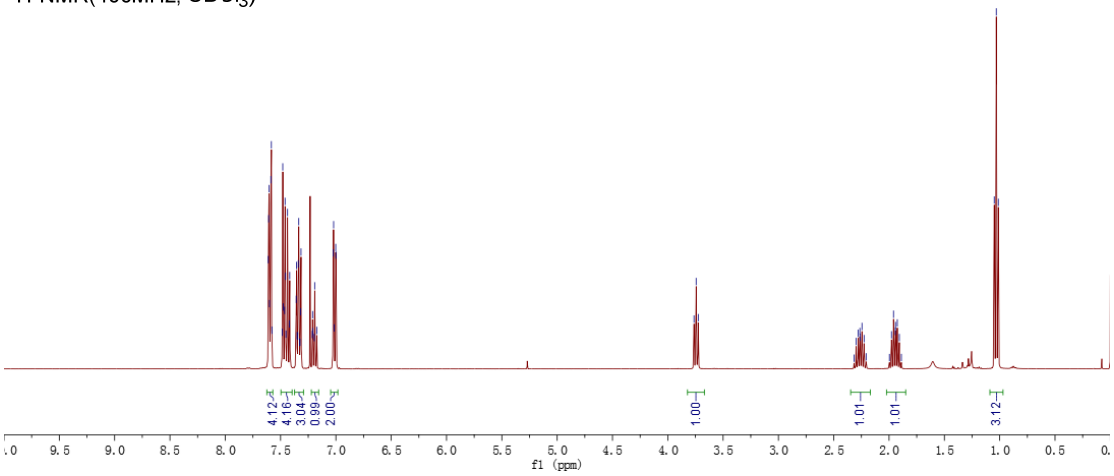

OBn
O
F3C
2k
1H-NMR(400 MHz, CDCl3)
f1 (ppm)

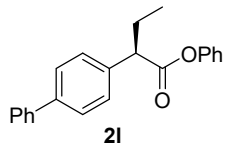

OBn
O
F3C
2k
13C-NMR(100 MHz, CDCl3)
f1 (ppm)



2l

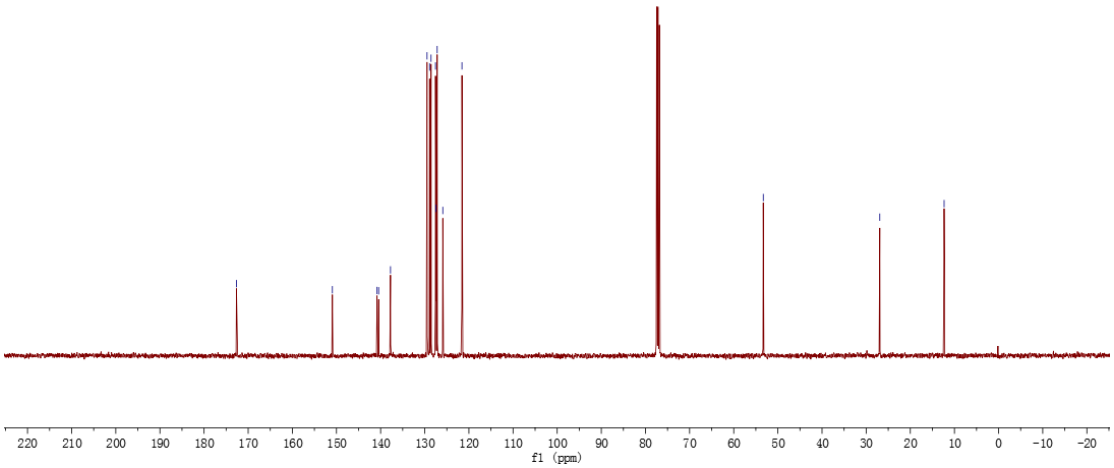
^{1}H-NMR(400MHz, $CDCl_3$)

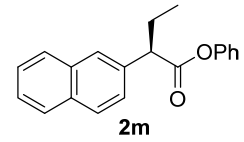




2l

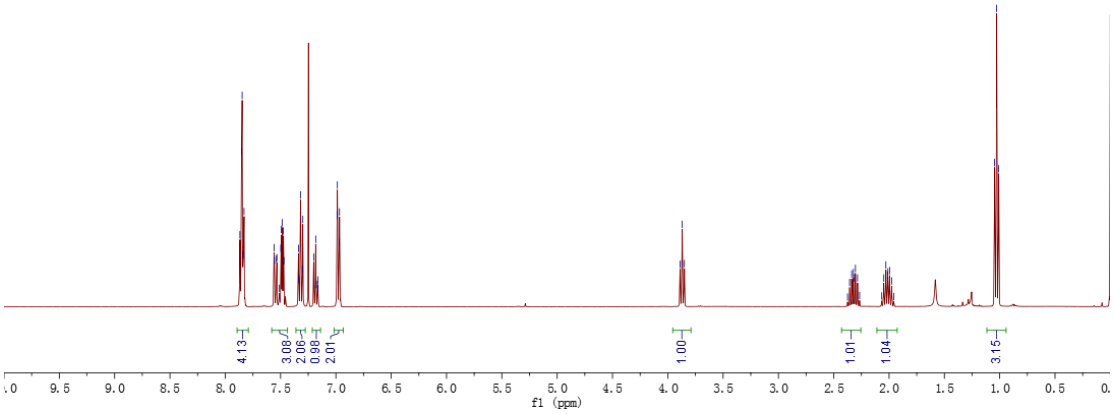
^{13}C-NMR(100MHz, $CDCl_3$)

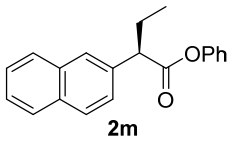




2m

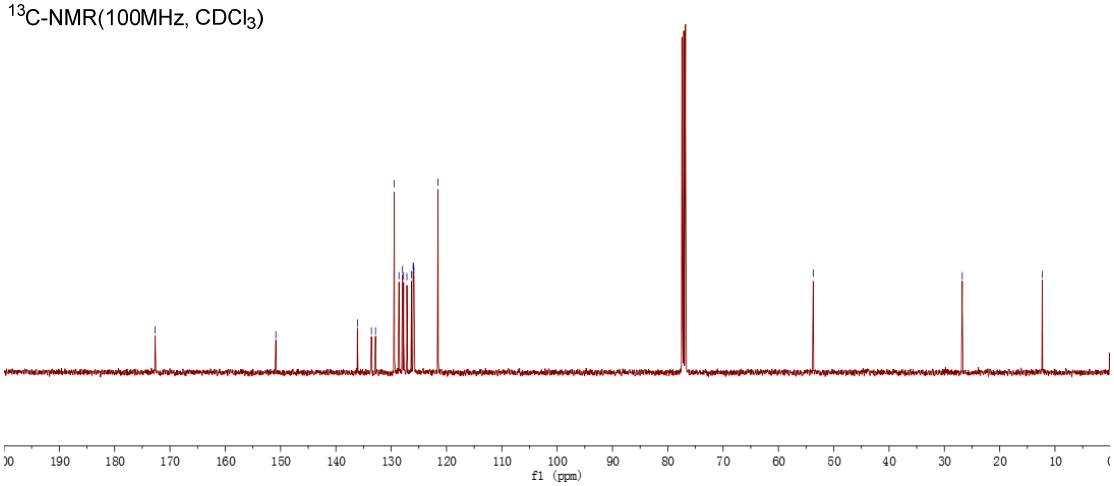
^{1}H-NMR(400MHz, $CDCl_3$)

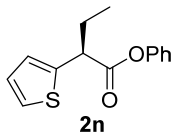




2m

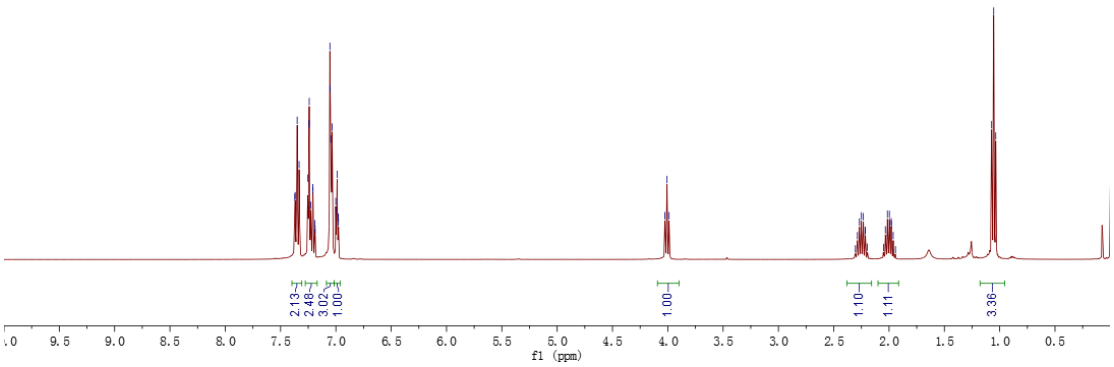
^{13}C-NMR(100MHz, $CDCl_3$)

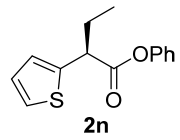




2n

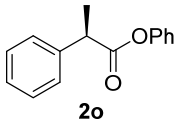
^{1}H-NMR(400MHz, $CDCl_3$)





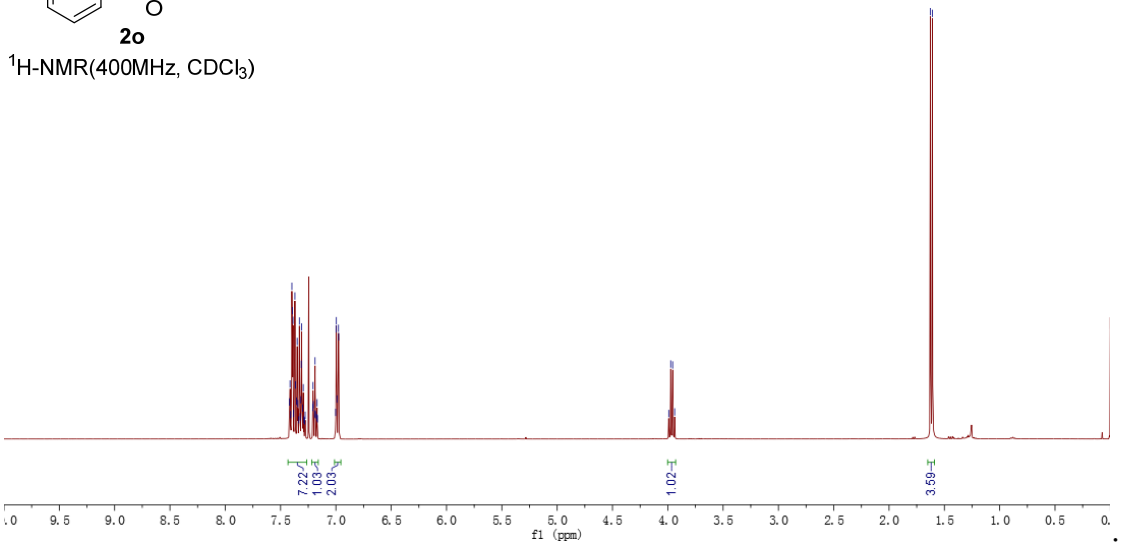
2n

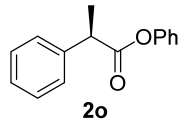
^{13}C-NMR(100MHz, $CDCl_3$)



2o

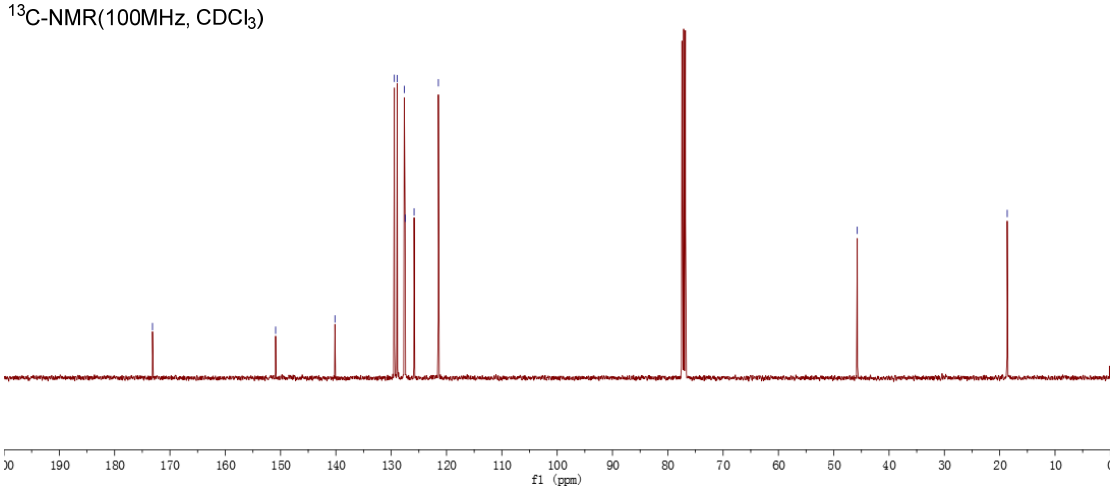
^{1}H-NMR(400MHz, $CDCl_3$)

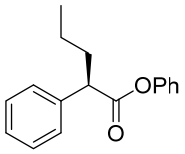




2o

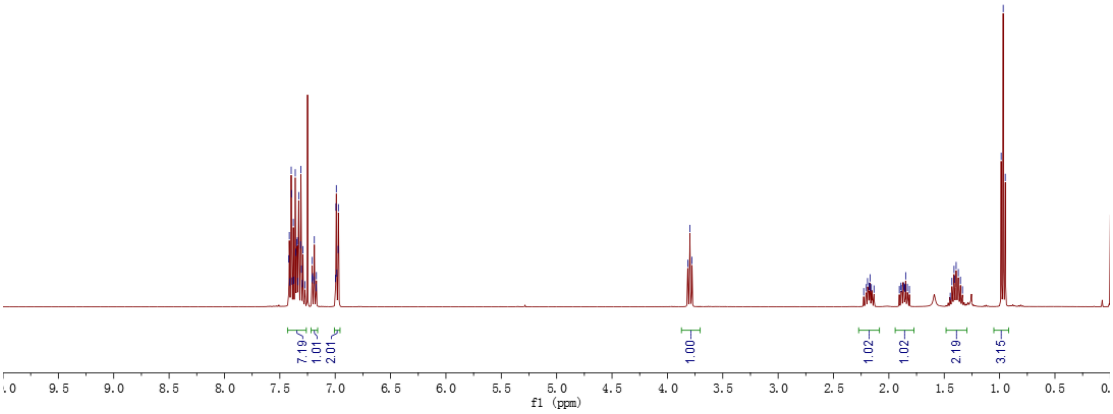
^{13}C-NMR(100MHz, $CDCl_3$)

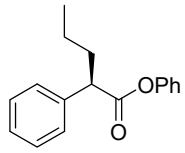




2p

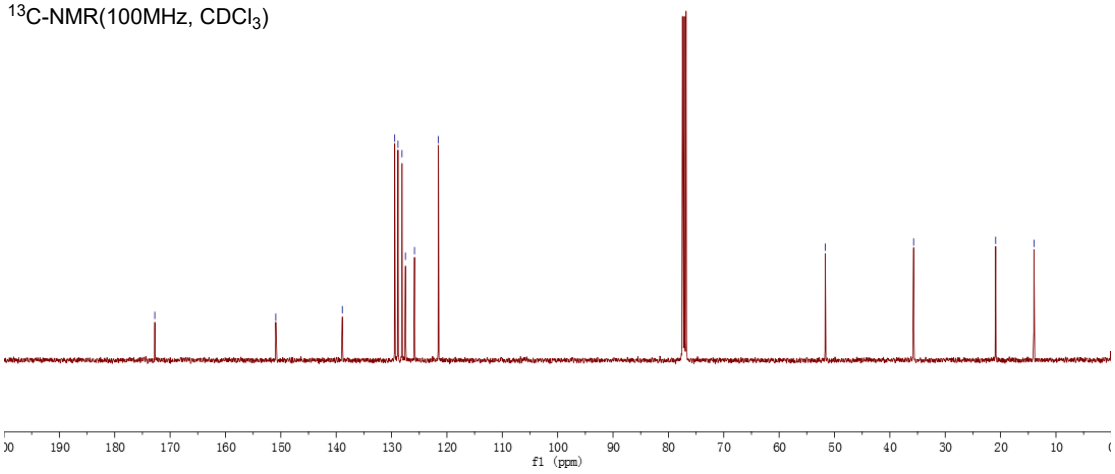
^{1}H-NMR(400MHz, $CDCl_3$)

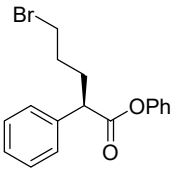




2p

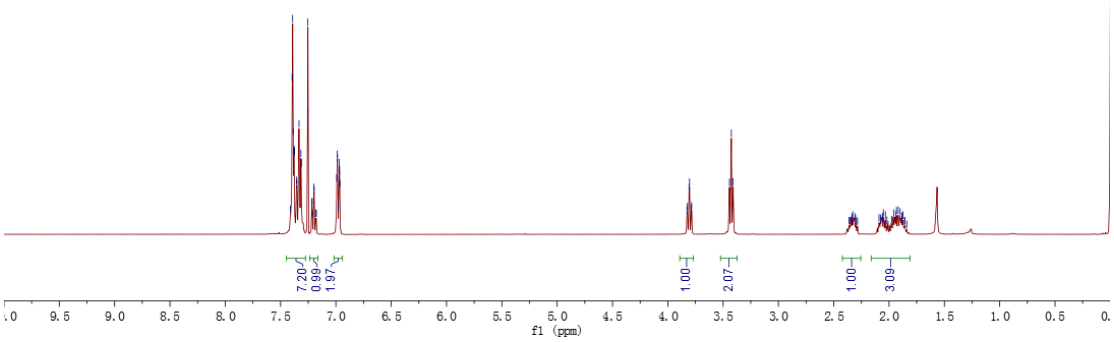
^{13}C-NMR(100MHz, $CDCl_3$)

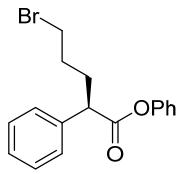




2q

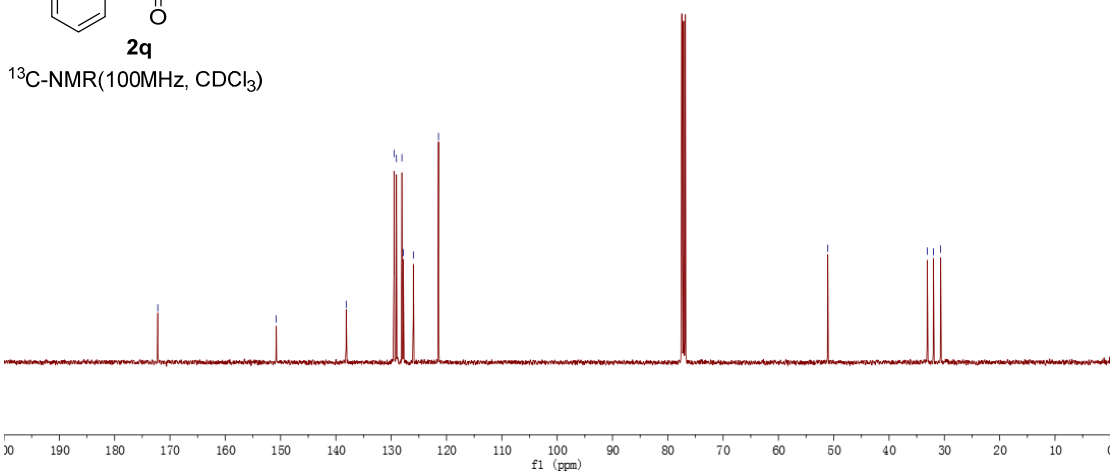
^{1}H-NMR(400MHz, $CDCl_3$)

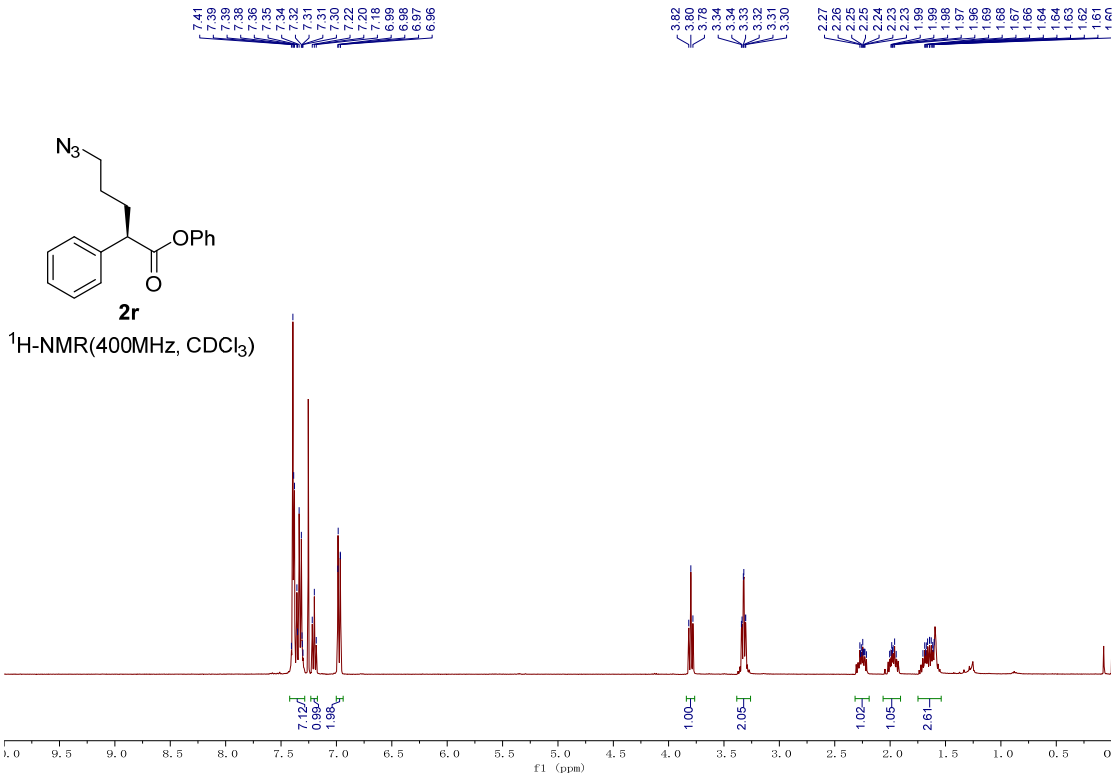


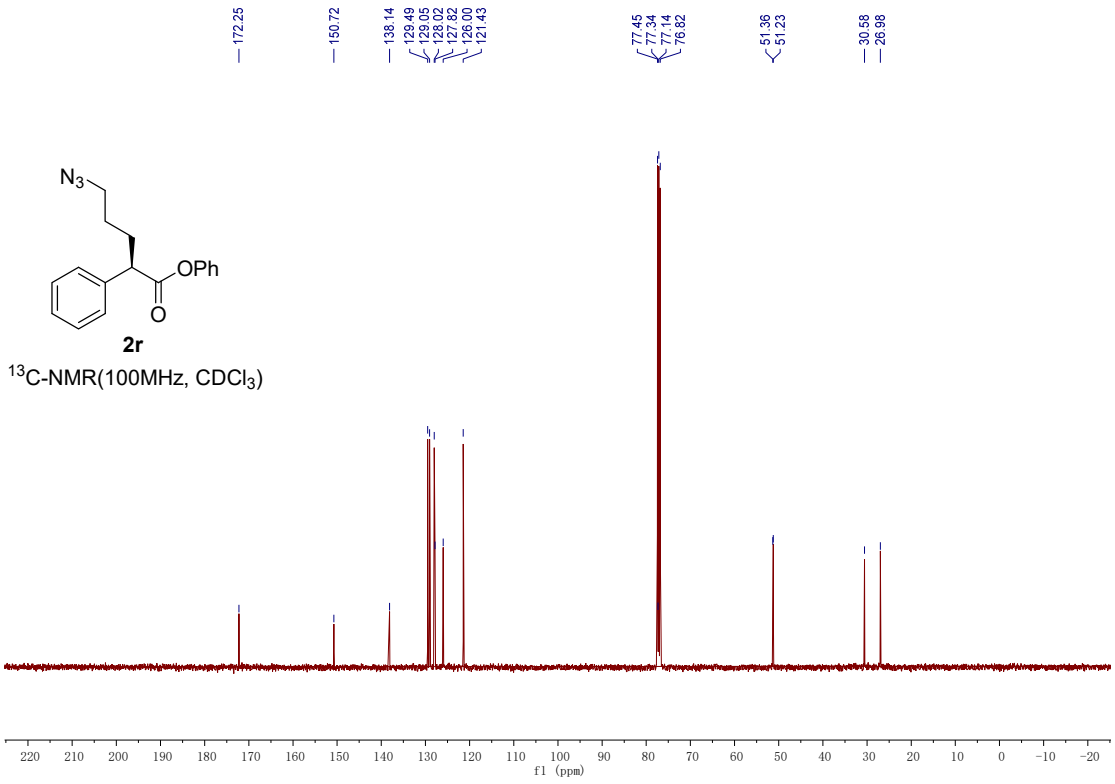


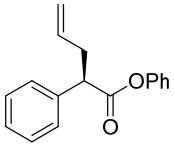
2q

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



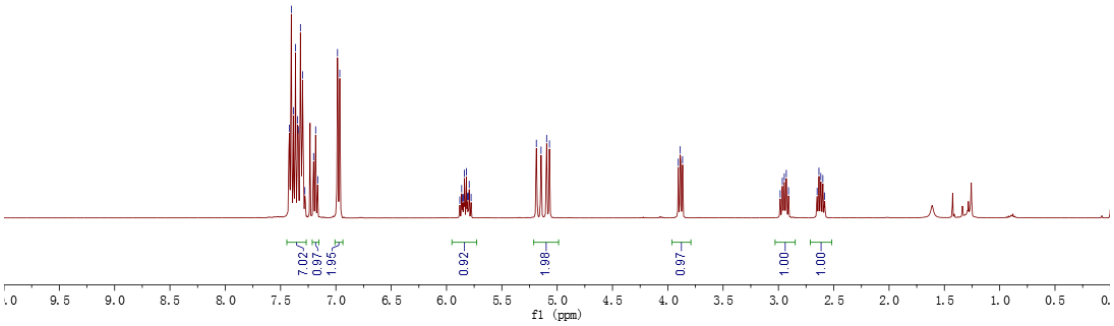

N3
OPh
O
2r
1H-NMR(400MHz, CDCl3)
7.41 7.39 7.38 7.36 7.35 7.34 7.32 7.31 7.31 7.30 7.22 7.20 7.18 6.99 6.98 6.97 6.96
3.82 3.80 3.78 3.34 3.34 3.33 3.32 3.31 3.30
2.27 2.26 2.25 2.25 2.24 2.23 2.23 1.99 1.99 1.98 1.97 1.96 1.69 1.68 1.67 1.66 1.64 1.64 1.63 1.62 1.61
7.12 0.99 1.98 1.00 2.05 1.02 1.05 2.61
f1 (ppm)

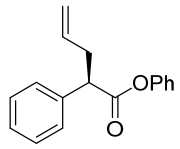

N3
OPh
O
2r
13C-NMR(100MHz, CDCl3)
172.25 150.72 138.14 129.49 129.05 128.02 127.82 126.00 121.43
77.45 77.34 77.14 76.82 51.36 51.23 30.58 26.98
f1 (ppm)



2s

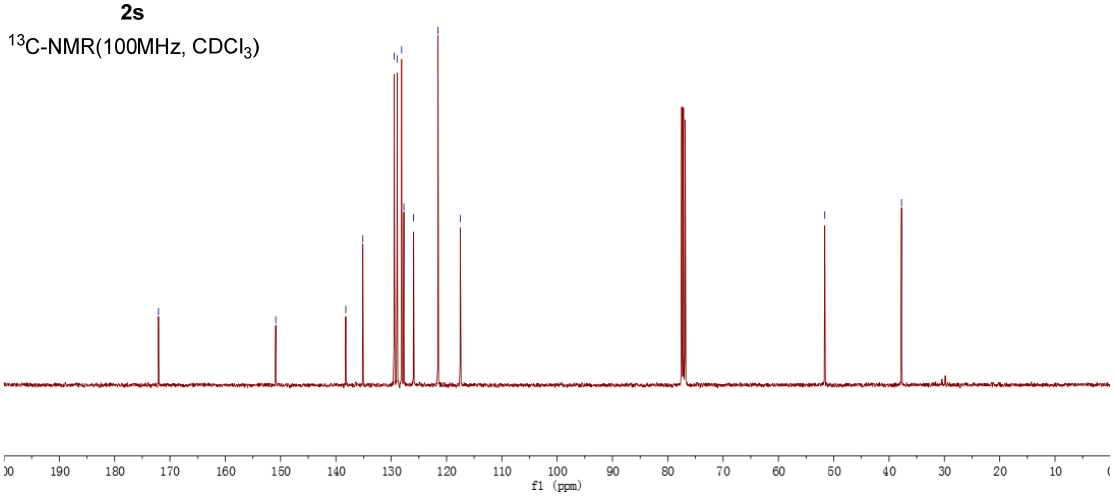
^{1}H-NMR(400MHz, $CDCl_3$)

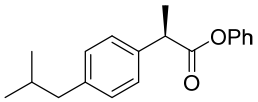




2s

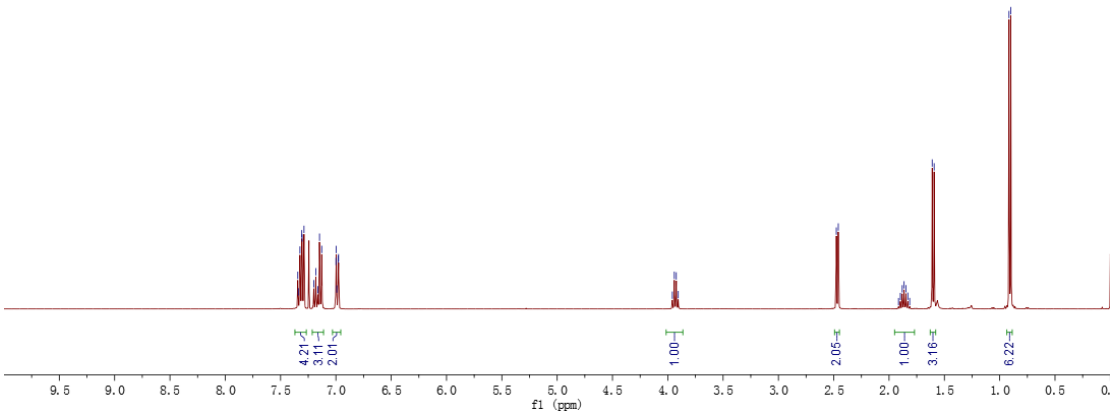
^{13}C-NMR(100MHz, $CDCl_3$)

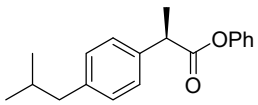




2t

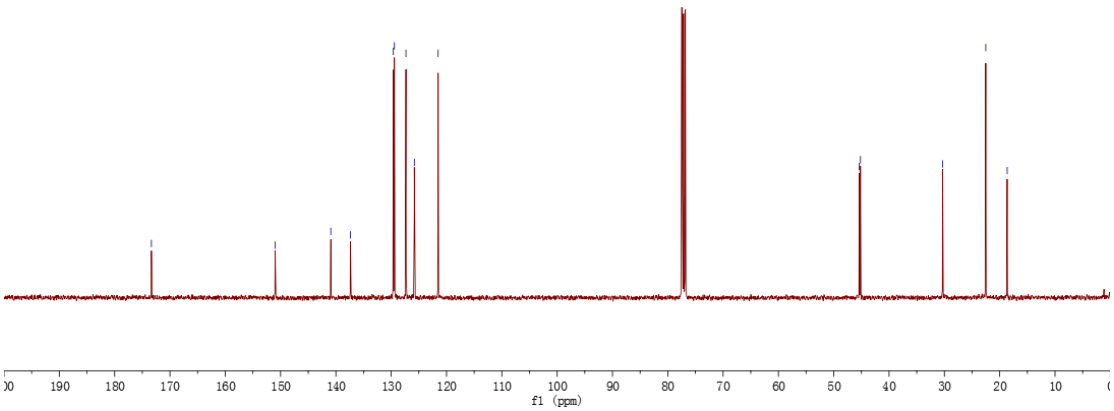
^{1}H-NMR(400MHz, $CDCl_3$)

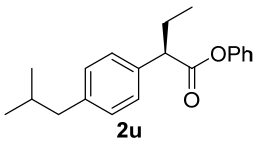




2t

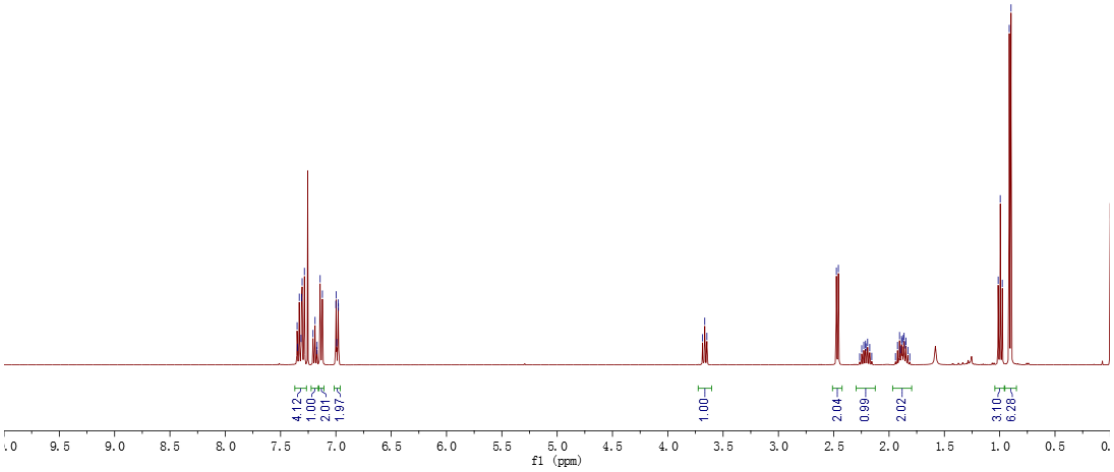
^{13}C-NMR(100MHz, $CDCl_3$)

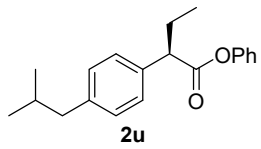




2u

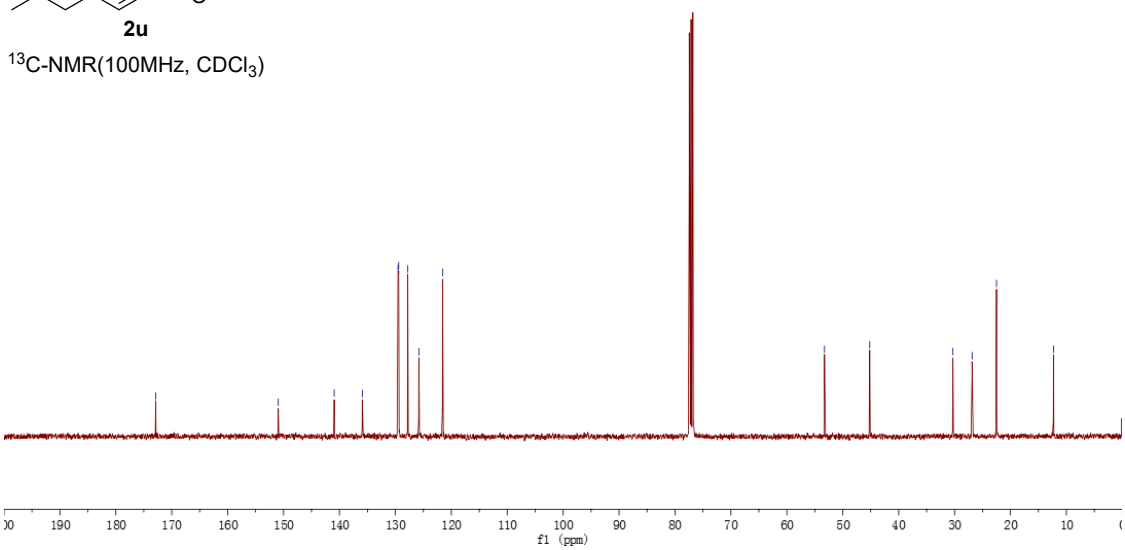
^{1}H-NMR(400MHz, $CDCl_3$)

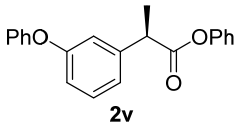




2u

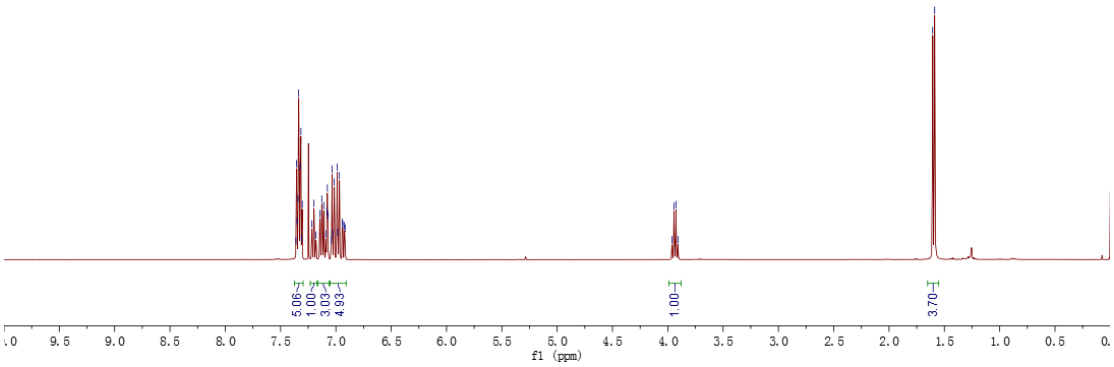
^{13}C-NMR(100MHz, $CDCl_3$)

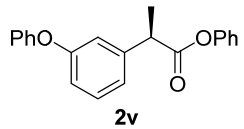




2v

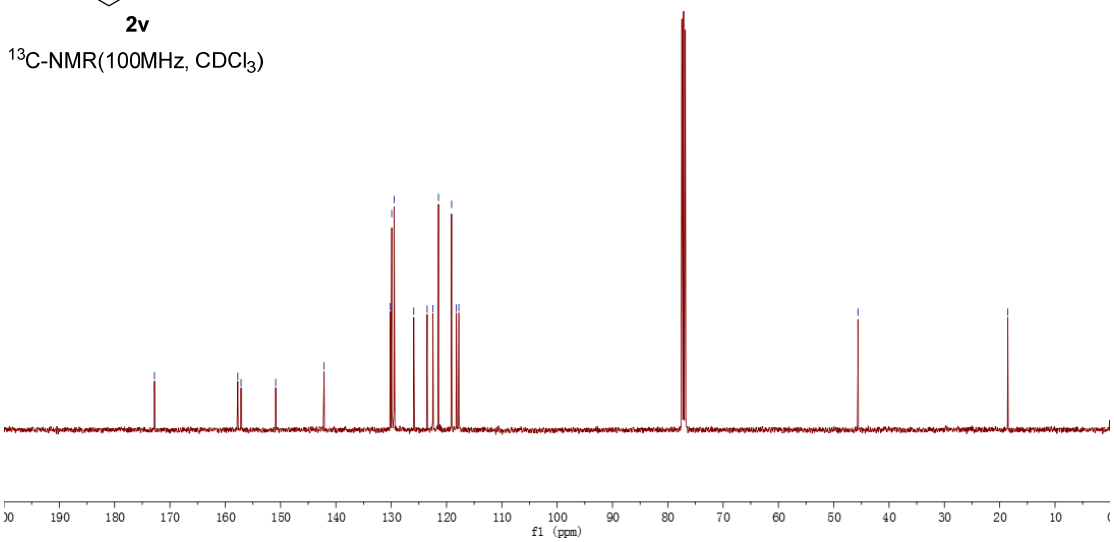
^{1}H-NMR(400MHz, $CDCl_3$)

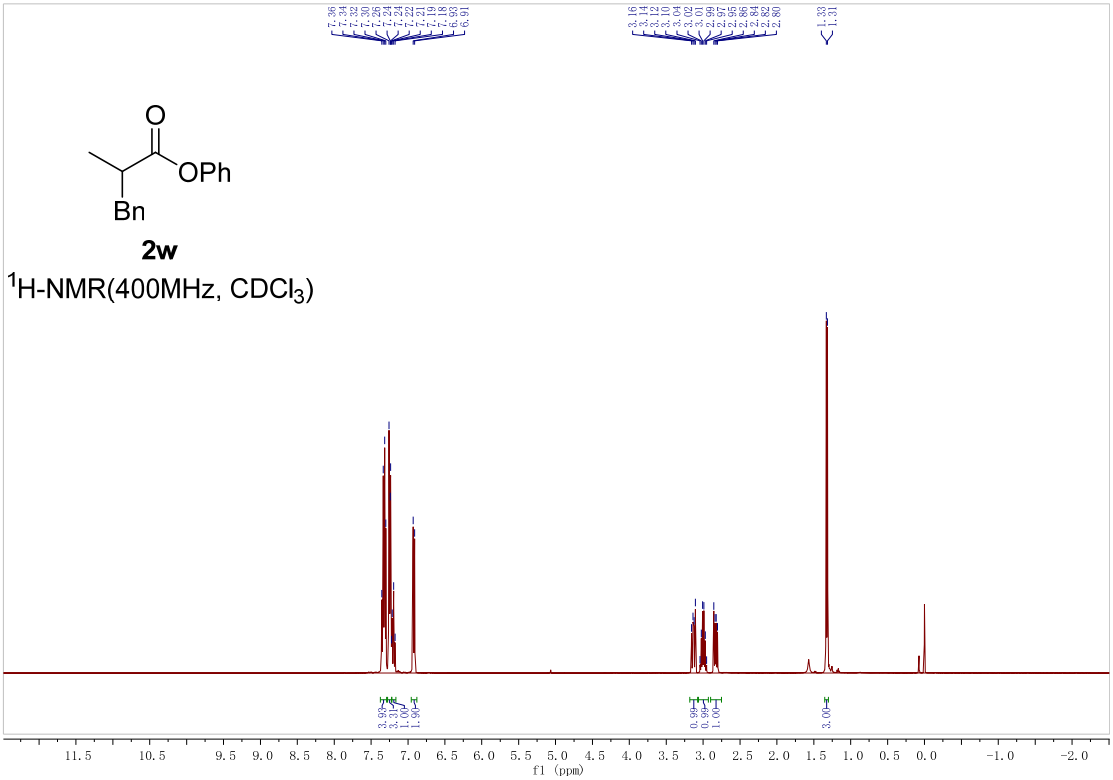




2v

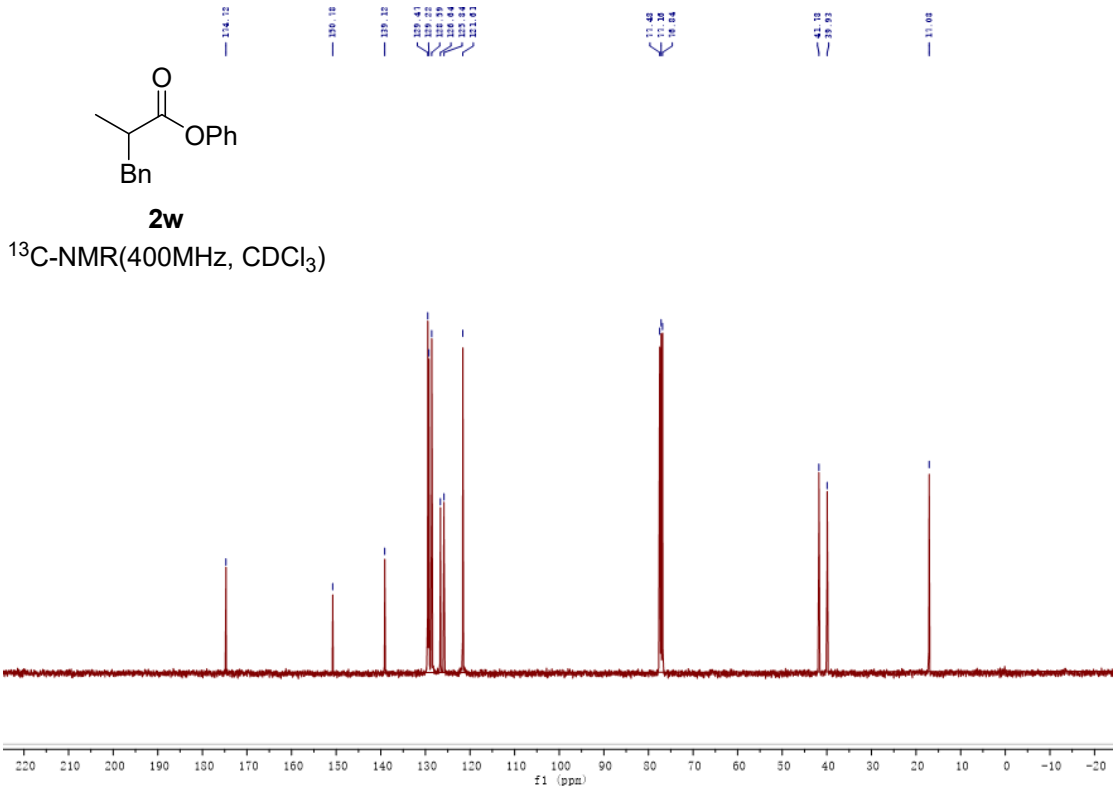
^{13}C-NMR(100MHz, $CDCl_3$)





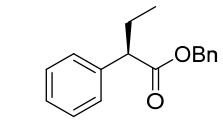
2w

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



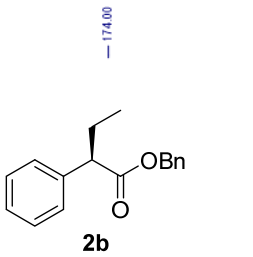
2w

^{13}C-NMR(400MHz, $CDCl_3$)



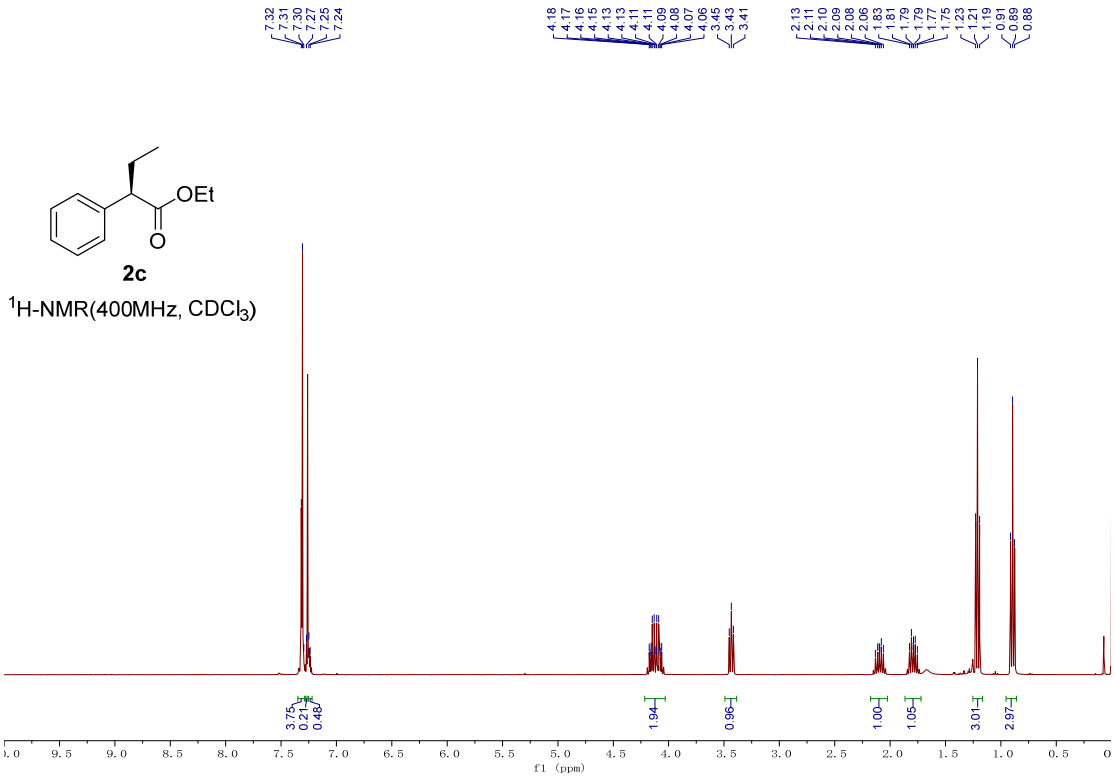
2b

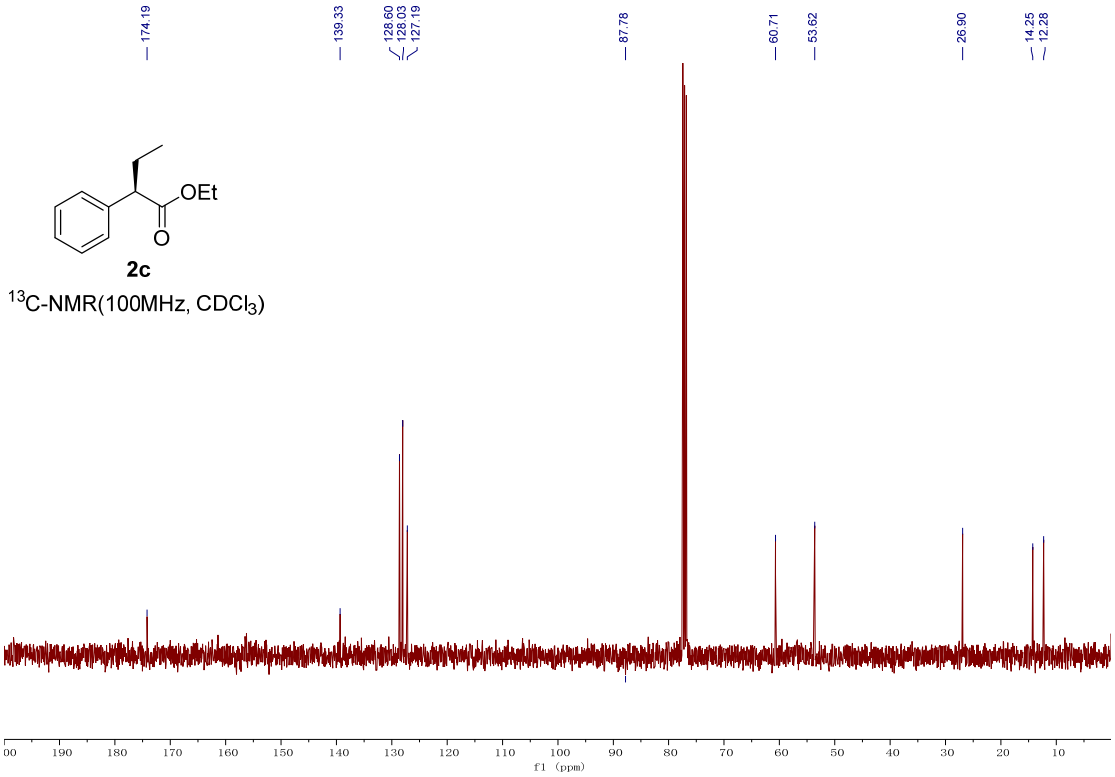
^{1}H-NMR(400MHz, $CDCl_3$)

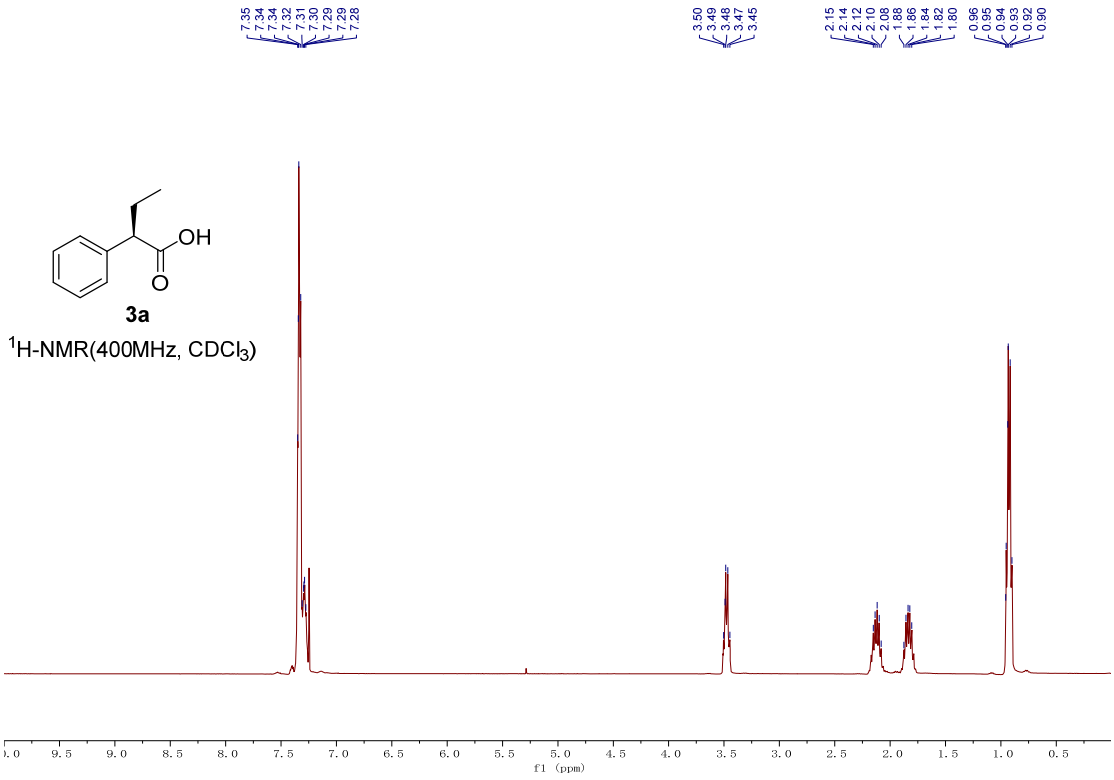


2b

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

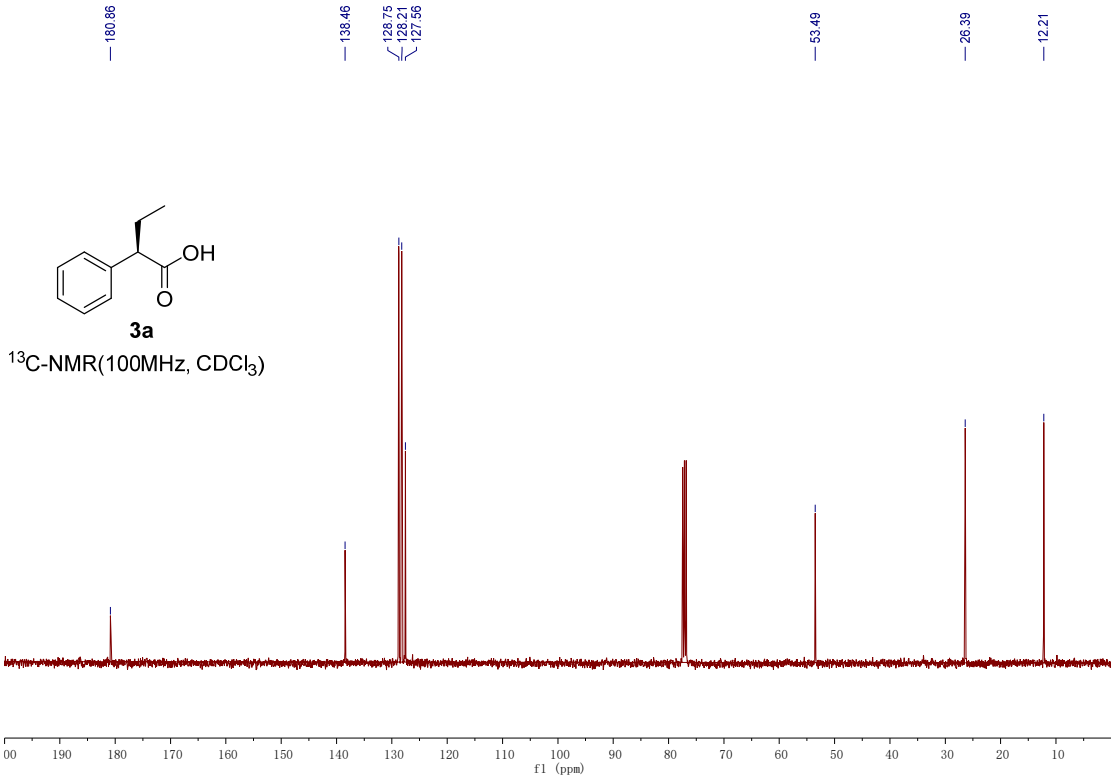

OEt
O
2c
1H-NMR(400MHz, CDCl3)
f1 (ppm)


OEt
O
2c
13C-NMR(100MHz, CDCl3)
f1 (ppm)



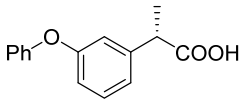
3a

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



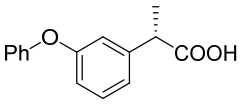
3a

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



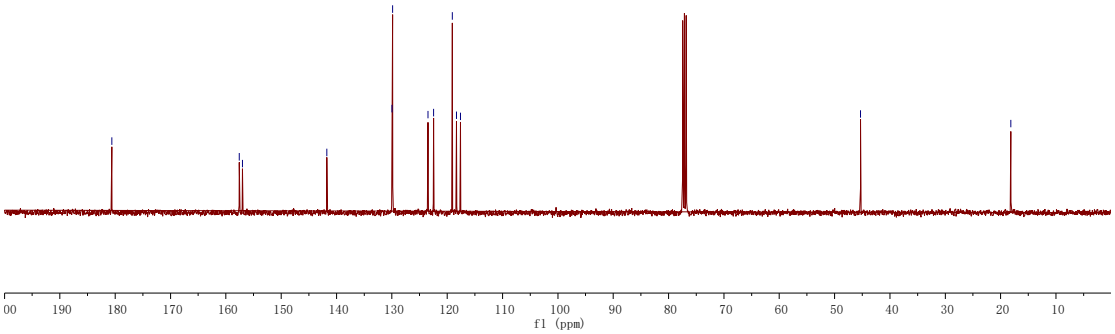
(*S*)-**fenoprofen**

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



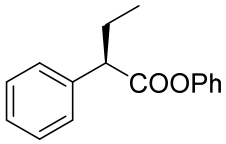
(*S*)-**fenoprofen**

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

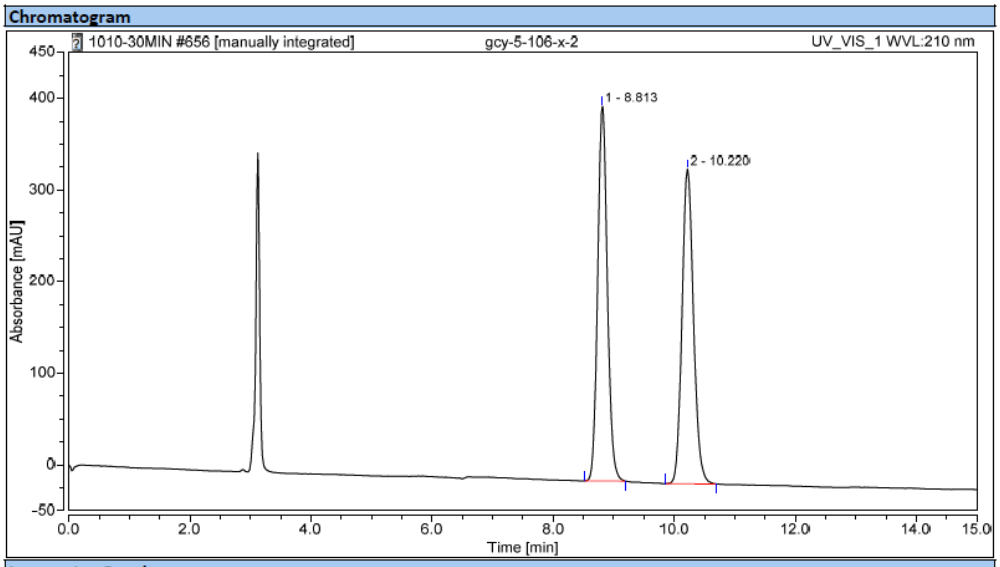


HPLC Spectra Data:

(R)-phenyl-2-phenylbutanoate (2a):

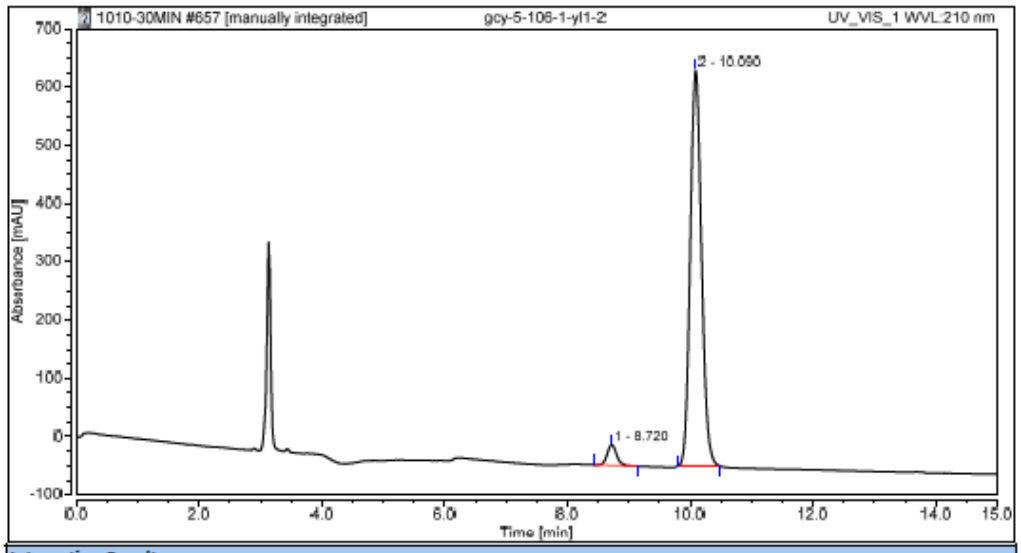


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 90:10, flow rate 1 mL/min, 25 °C, UV 210 nm



Integration Results

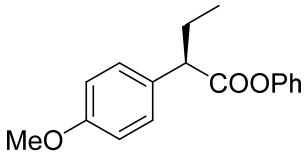
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.813	75.321	408.952	49.98	54.34	n.a.
2		10.220	75.380	343.574	50.02	45.66	n.a.
Total:			**150.701**	**752.525**	**100.00**	**100.00**	



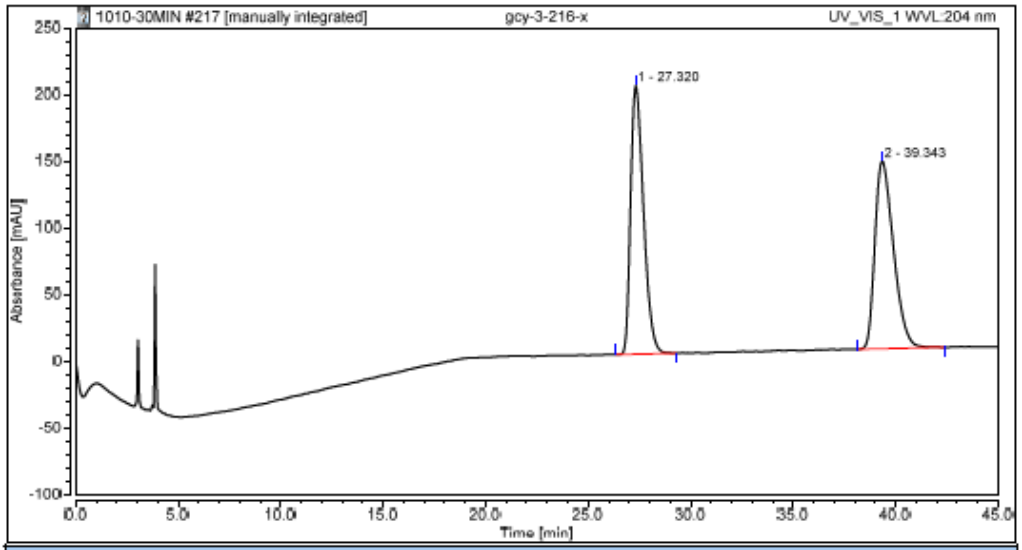
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.720	6.370	35.634	4.24	4.98	n.a.
2		10.090	143.848	679.848	95.76	95.02	n.a.
Total:			**150.218**	**715.482**	**100.00**	**100.00**	

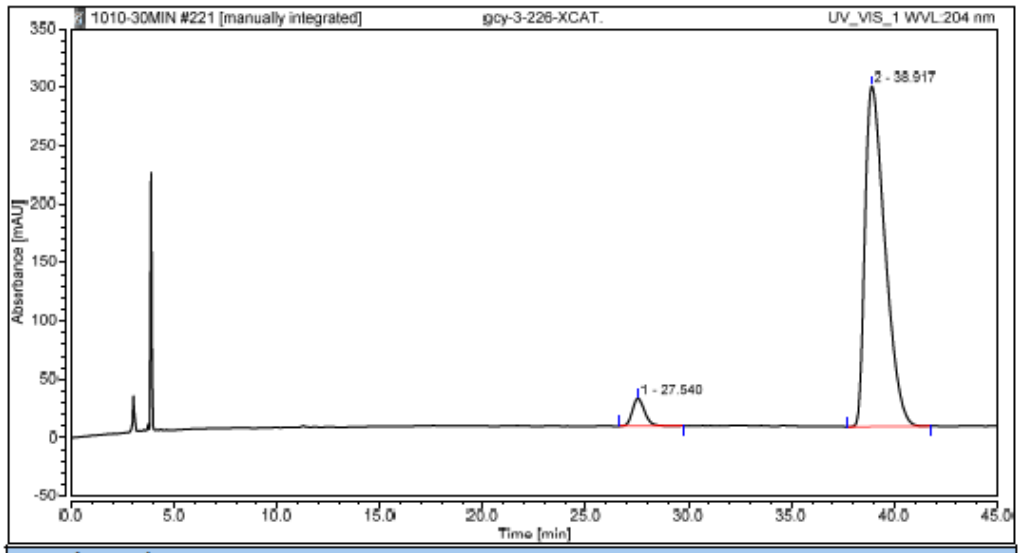
(R)-phenyl -2-(4-methoxyphenyl) butanoate (2d):



Column DAICEL Chiralcel OJ-H 5µm, heptane/i-PrOH 90:10, flow rate 1 mL/min, 25 °C, UV 204 nm

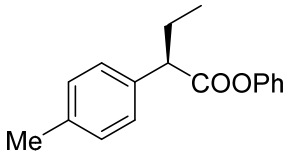


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		27.320	146.641	201.031	49.82	58.88	n.a.
2		39.343	147.689	140.369	50.18	41.12	n.a.
Total:			294.330	341.400	100.00	100.00	

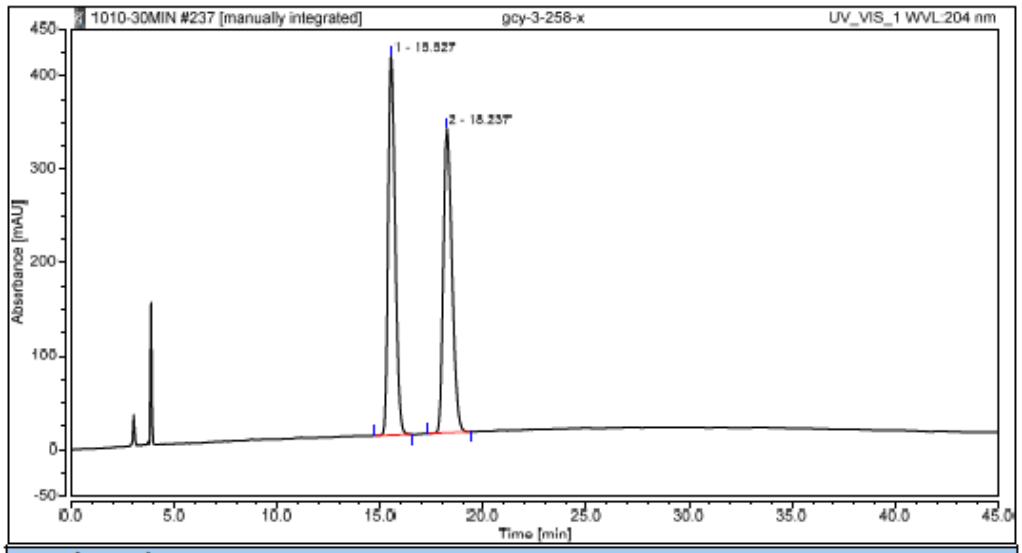


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		27.540	16.115	23.689	4.69	7.51	n.a.
2		38.917	327.580	291.953	95.31	92.49	n.a.
Total:			343.695	315.642	100.00	100.00	

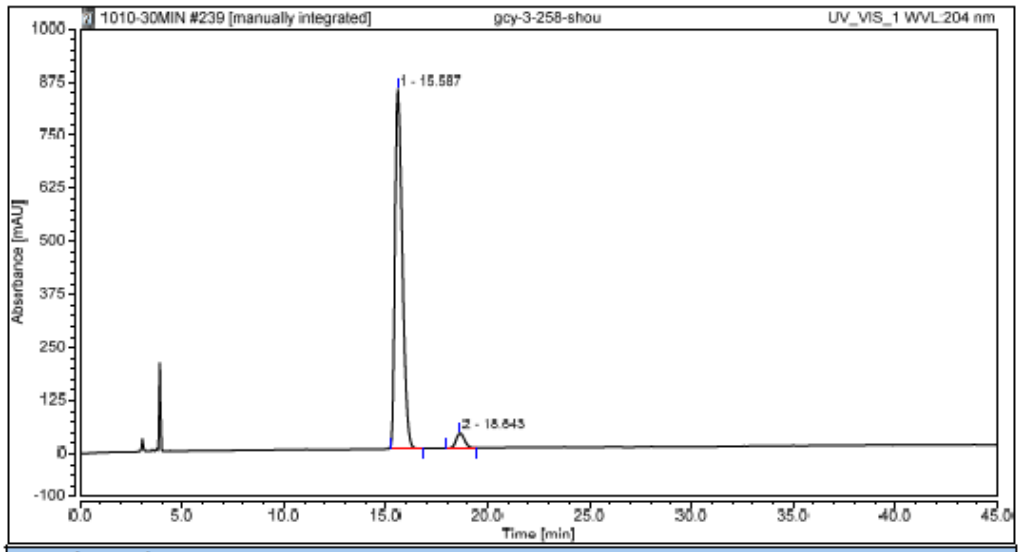
(R)-phenyl -2-(p-tolyl) butanoate (2e):



Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 90:10, flow rate 1 mL/min, 25 °C, UV 204 nm

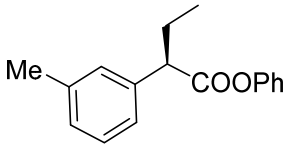


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		15.527	159.284	405.226	50.10	55.47	n.a.
2		18.237	158.655	325.326	49.90	44.53	n.a.
Total:			**317.939**	**730.552**	**100.00**	**100.00**	

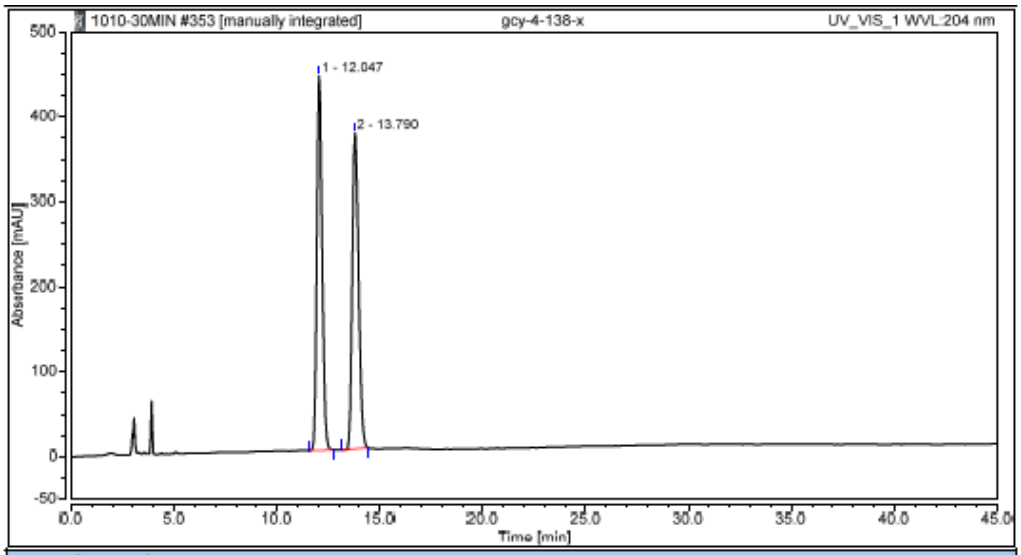


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		15.587	352.955	845.801	95.42	96.00	n.a.
2		18.643	16.940	35.228	4.58	4.00	n.a.
Total:			**369.895**	**881.029**	**100.00**	**100.00**	

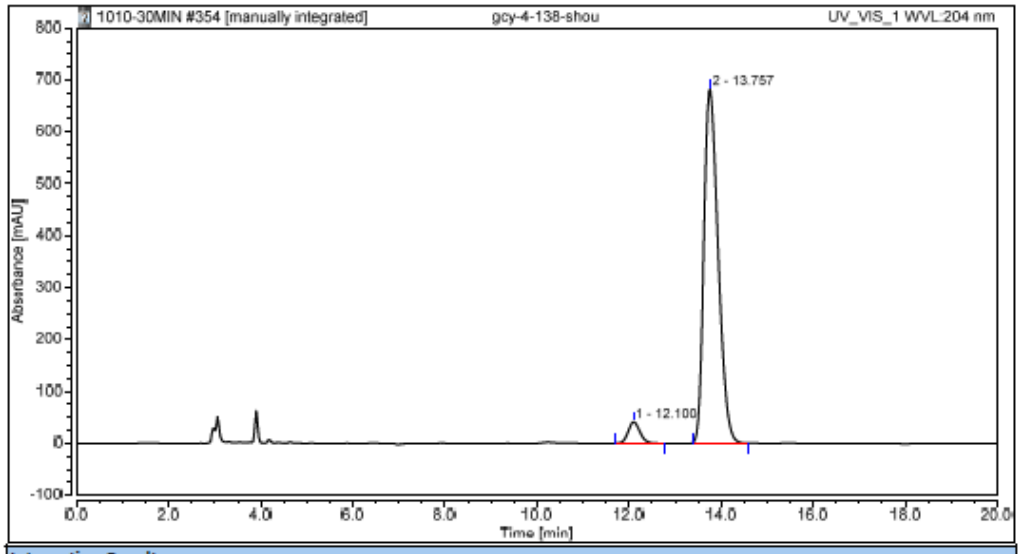
(R)-phenyl -2-(m-tolyl) butanoate (2f):



Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 90:10, flow rate 1 mL/min, 25 °C, UV 204 nm

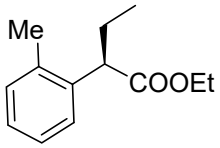


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		12.047	131.384	440.721	50.23	54.22	n.a.
2		13.790	130.188	372.094	49.77	45.78	n.a.
Total:			261.572	812.815	100.00	100.00	

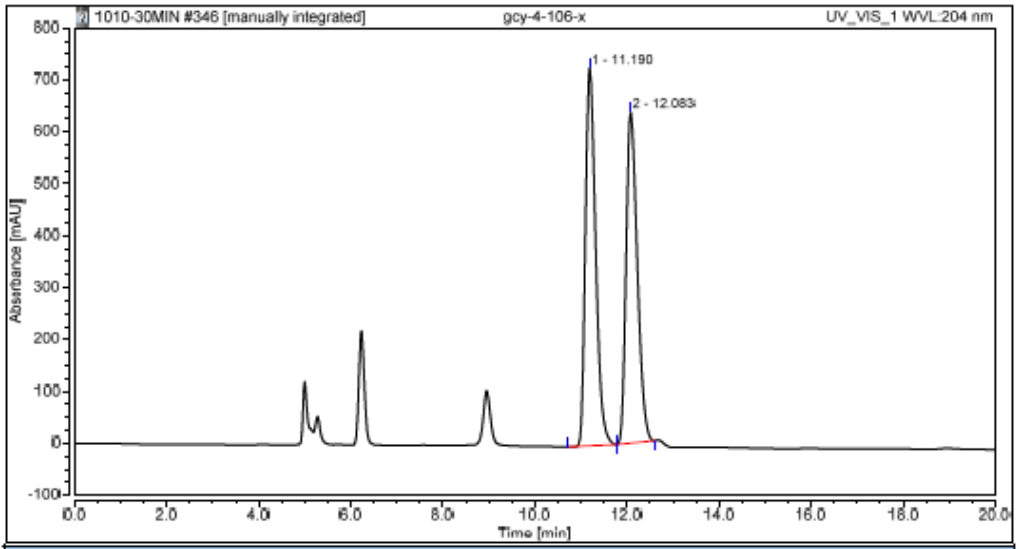


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		12.100	12.230	41.157	4.78	5.70	n.a.
2		13.757	243.751	681.531	95.22	94.30	n.a.
Total:			255.981	722.689	100.00	100.00	

(*R*)-ethyl-2-(o-tolyl) butanoate (2g):

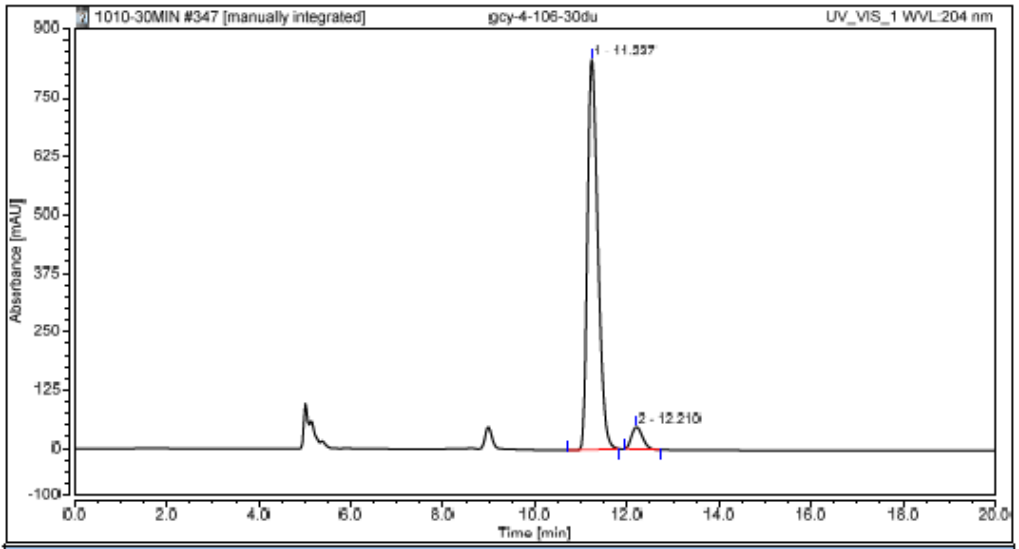


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 99.8:0.2, flow rate 0.6 mL/min, 25 °C, UV 204 nm



Integration Results

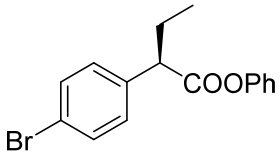
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		11.190	186.173	727.831	50.86	53.31	n.a.
2		12.083	179.908	637.523	49.14	46.69	n.a.
Total:			**366.080**	**1365.354**	**100.00**	**100.00**	



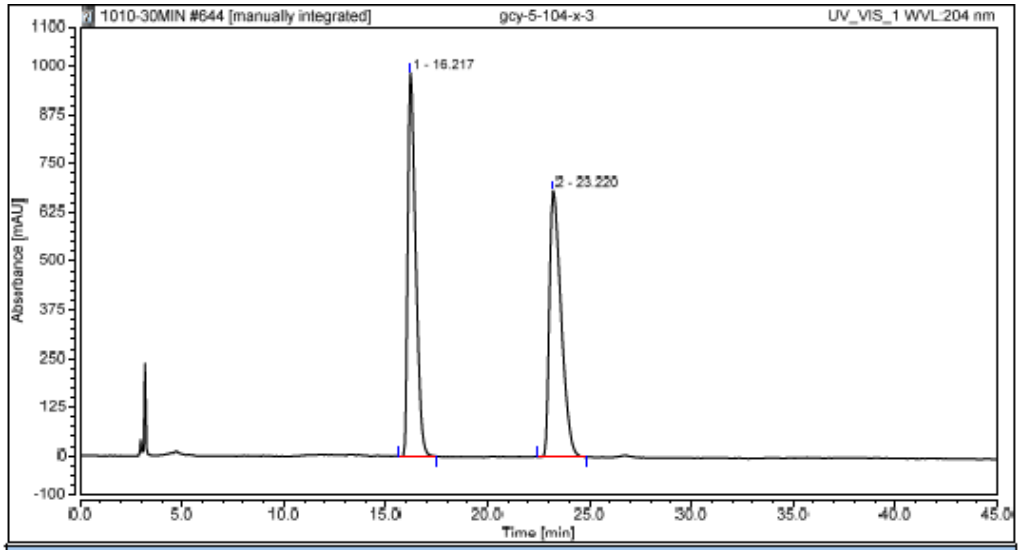
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		11.237	217.610	835.010	94.39	94.61	n.a.
2		12.210	12.925	47.588	5.61	5.39	n.a.
Total:			**230.534**	**882.598**	**100.00**	**100.00**	

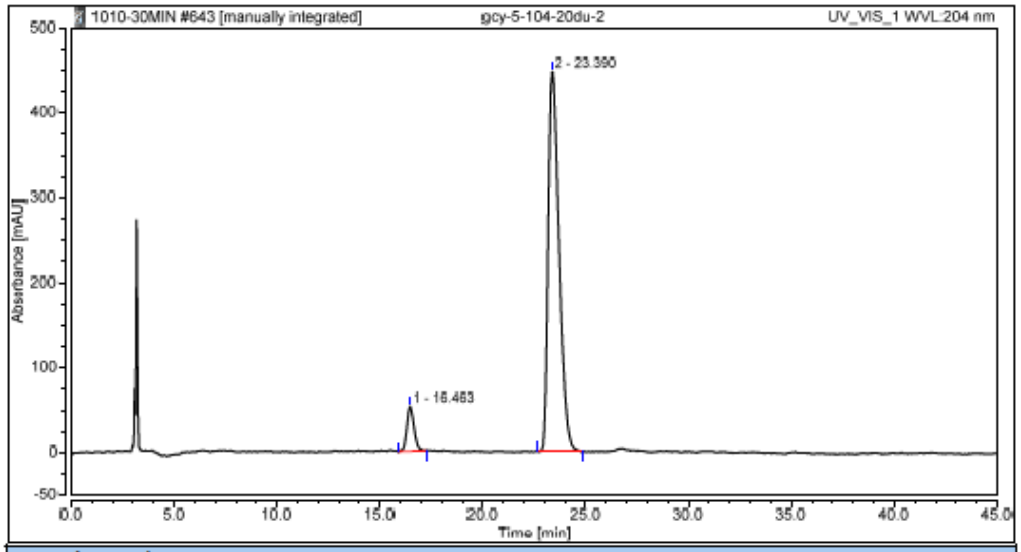
(*R*)-phenyl-2-(4-bromophenyl) butanoate (2h):



Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 95:5, flow rate 1.0 mL/min, 25 °C, UV 204 nm

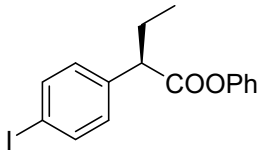


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		16.217	440.221	983.394	49.22	59.02	n.a.
2		23.220	454.202	682.753	50.78	40.98	n.a.
Total:			894.423	1666.146	100.00	100.00	

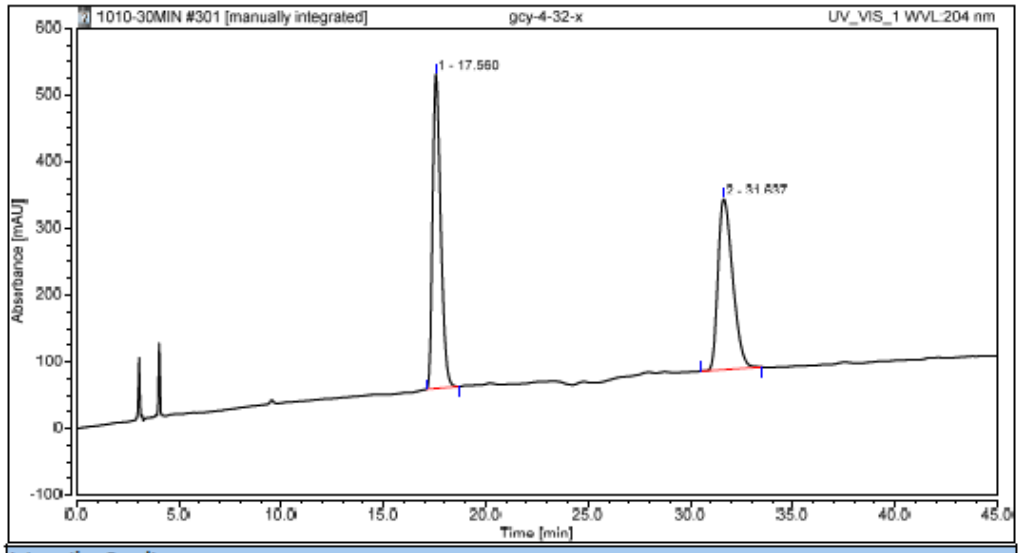


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		16.463	21.185	53.150	7.19	10.62	n.a.
2		23.390	273.313	447.246	92.81	89.38	n.a.
Total:			294.497	500.396	100.00	100.00	

(R)-phenyl-2-(4-iodophenyl) butanoate (2i):

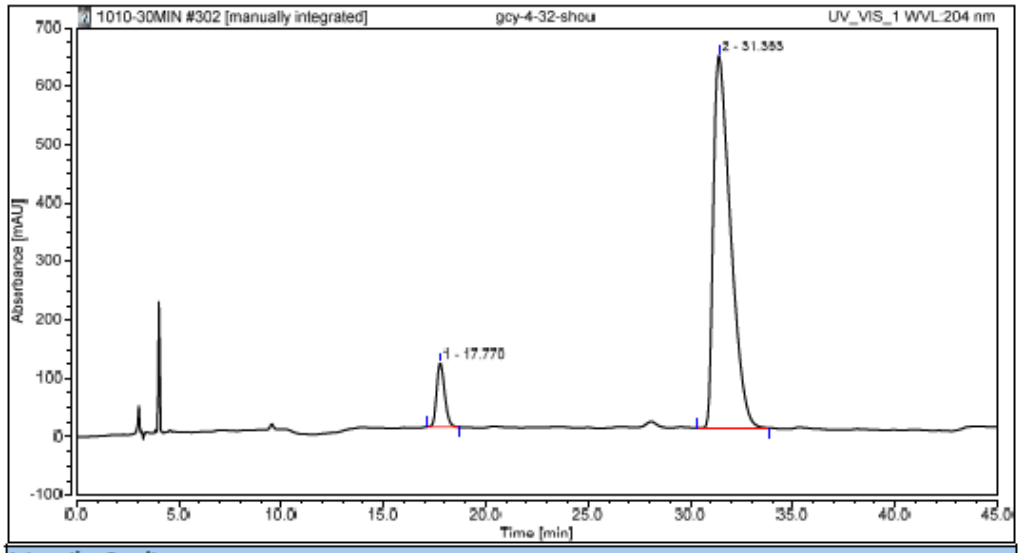


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 95:5, flow rate 1.0 mL/min, 25 °C, UV 204 nm



Integration Results

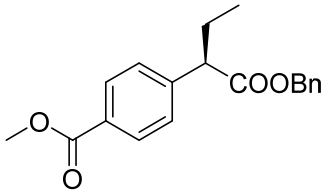
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		17.560	215.180	470.846	50.29	64.74	n.a.
2		31.637	212.736	256.459	49.71	35.26	n.a.
Total:			**427.916**	**727.305**	**100.00**	**100.00**	



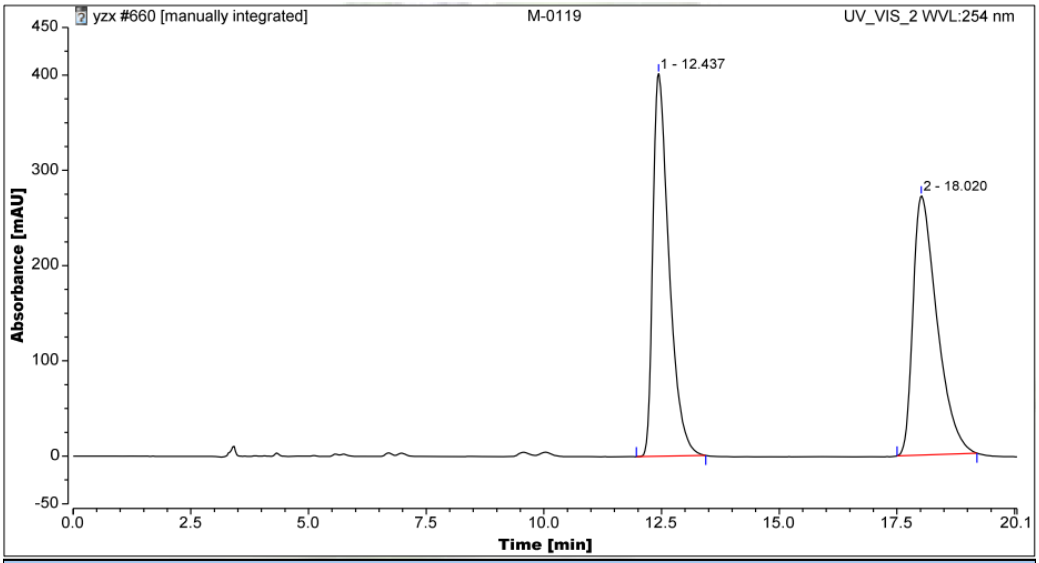
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		17.770	49.586	110.094	7.39	14.72	n.a.
2		31.393	621.022	637.648	92.61	85.28	n.a.
Total:			**670.608**	**747.742**	**100.00**	**100.00**	

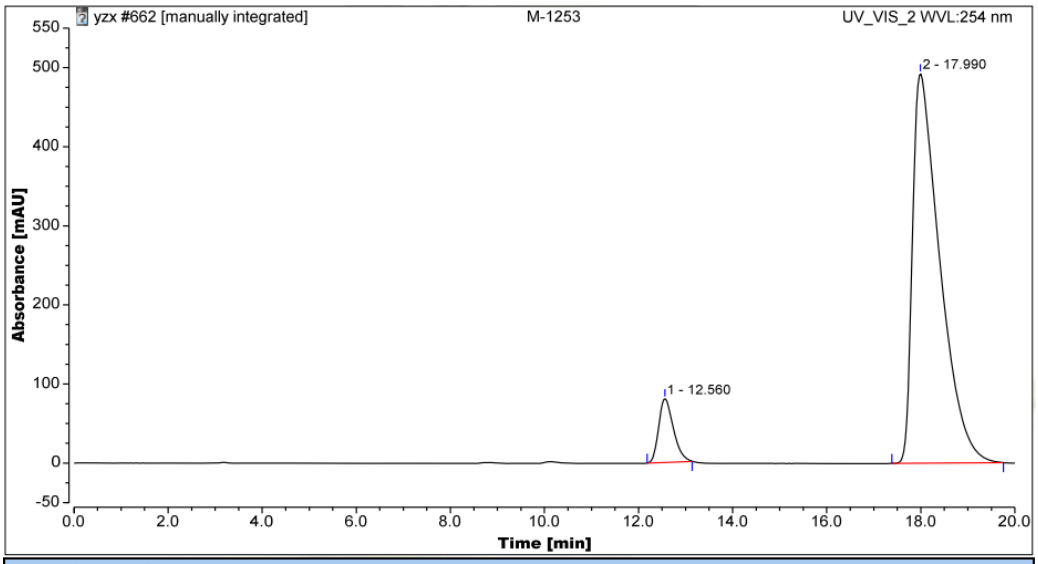
(*R*)-methyl-4-(1-(benzyloxy)-1-oxobutan-2-yl)benzoate (2j):



Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 80:20, flow rate 1.0 mL/min, 25 °C, UV 254 nm

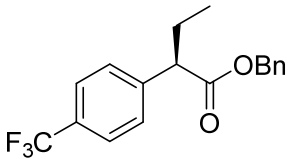


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		12.437	159.669	401.560	49.82	59.61	n.a.
2		18.020	160.803	272.089	50.18	40.39	n.a.
Total:			**320.472**	**673.649**	**100.00**	**100.00**	

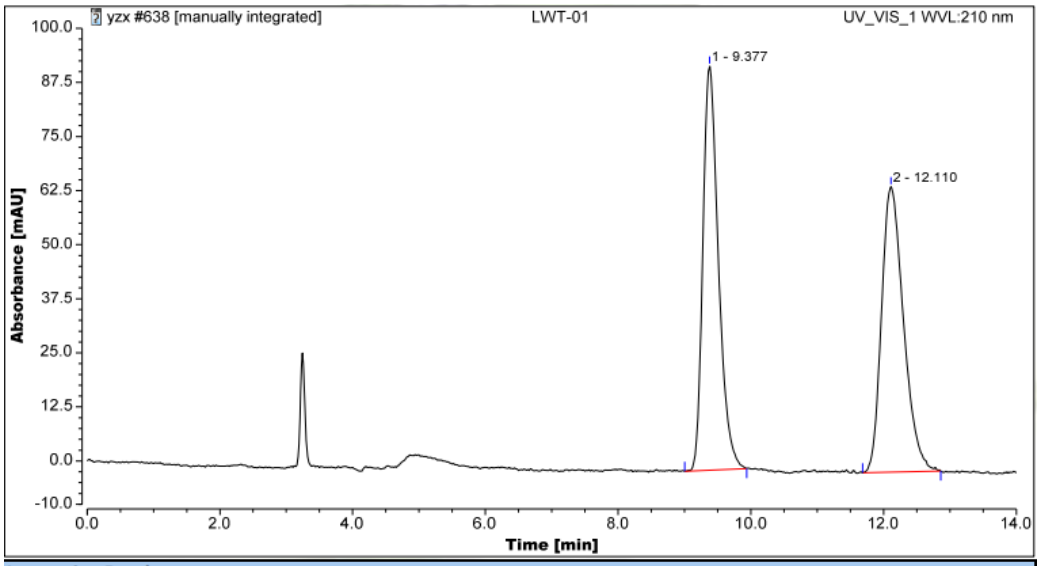


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		12.560	29.049	80.555	8.04	14.05	n.a.
2		17.990	332.370	492.770	91.96	85.95	n.a.
Total:			**361.419**	**573.326**	**100.00**	**100.00**	

(*R*)-benzyl -2-(4-(trifluoromethyl)phenyl)butanoate (2k):

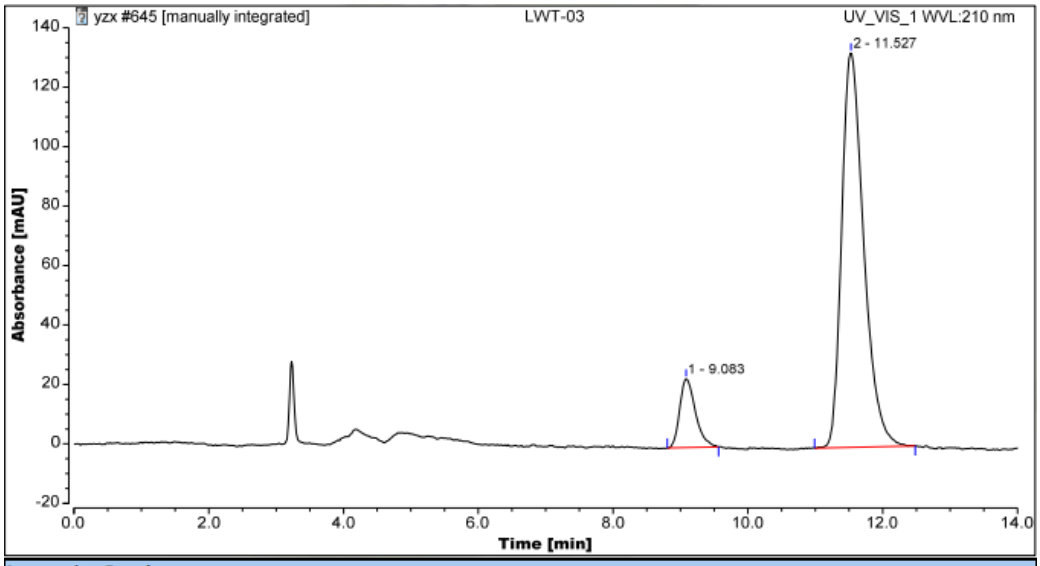


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 98:2, flow rate 1.0 mL/min, 25 °C, UV 210 nm



Integration Results

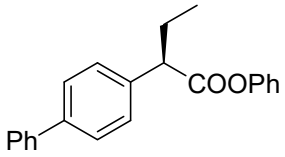
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		9.377	25.302	93.428	50.00	58.61	n.a.
2		12.110	25.302	65.983	50.00	41.39	n.a.
Total:			**50.604**	**159.411**	**100.00**	**100.00**	



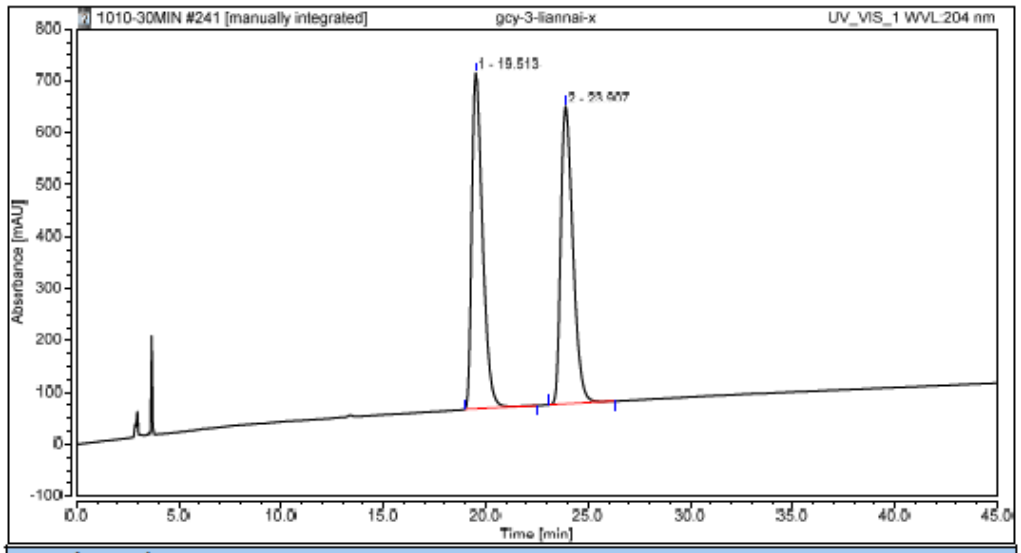
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		9.083	6.222	23.127	10.98	14.84	n.a.
2		11.527	50.451	132.761	89.02	85.16	n.a.
Total:			**56.672**	**155.888**	**100.00**	**100.00**	

(*R*)-phenyl-2-([1,1'-biphenyl]-4-yl) butanoate (2l):

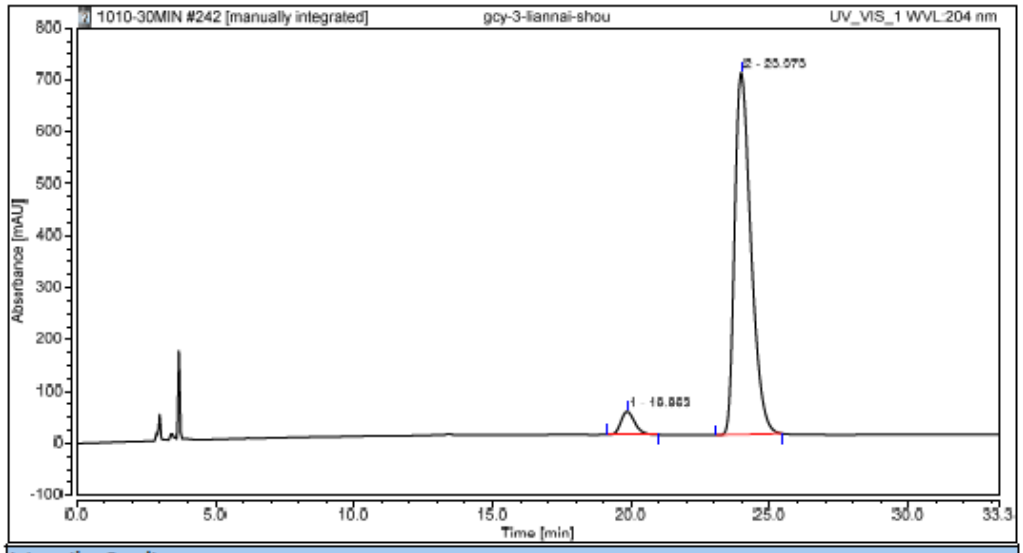


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 85:15, flow rate 1.0 mL/min, 35 °C, UV 204 nm



Integration Results

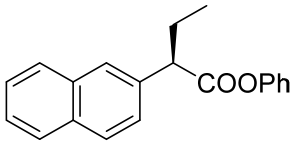
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		19.513	393.663	647.320	50.04	53.03	n.a.
2		23.907	392.956	573.395	49.96	46.97	n.a.
Total:			**786.619**	**1220.715**	**100.00**	**100.00**	



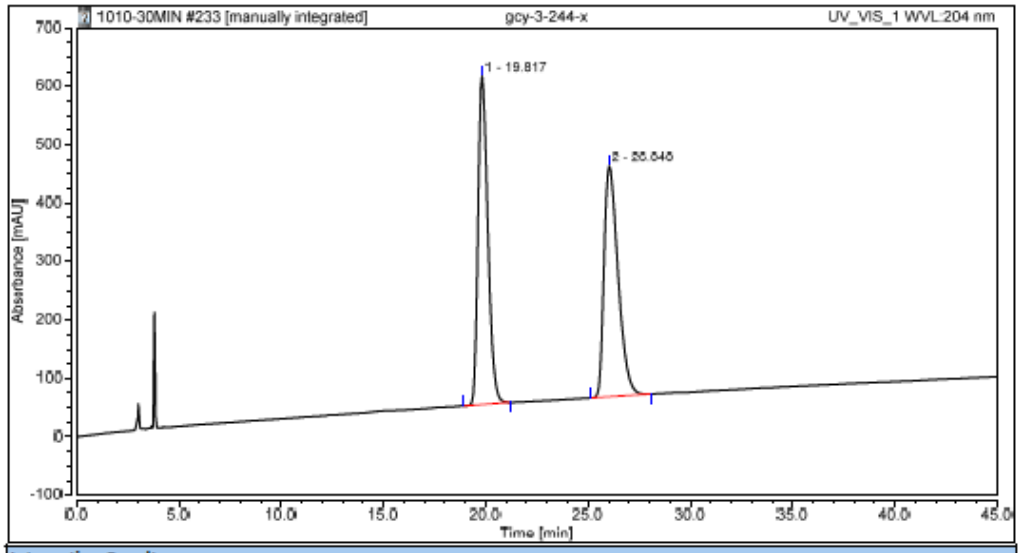
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		19.863	25.959	44.592	5.17	6.01	n.a.
2		23.973	476.373	697.155	94.83	93.99	n.a.
Total:			**502.332**	**741.746**	**100.00**	**100.00**	

(R)-phenyl-2-(naphthalen-2-yl) butanoate (2m):

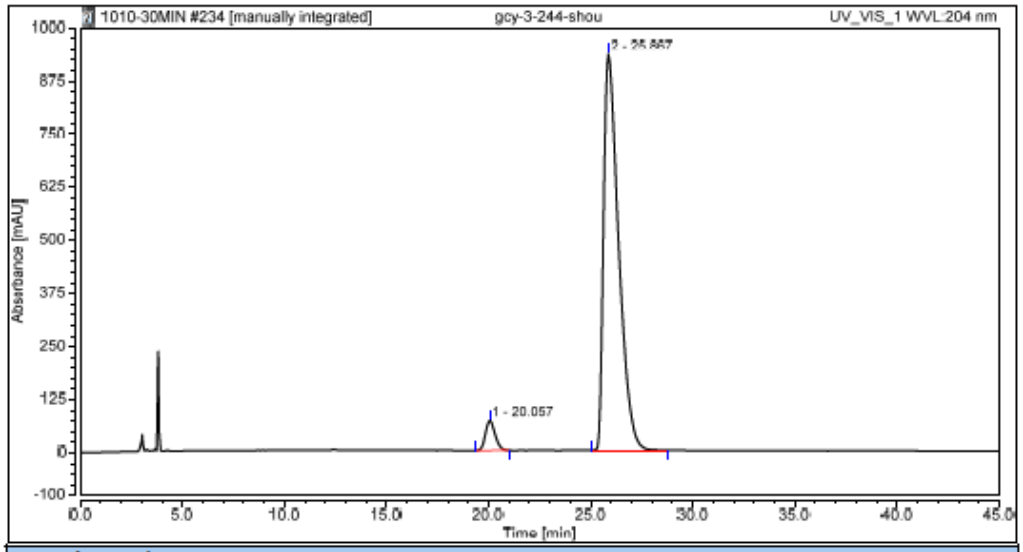


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 85:15, flow rate 1.0 mL/min, 25 °C, UV 204 nm



Integration Results

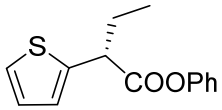
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		19.817	312.943	562.180	50.01	58.71	n.a.
2		26.040	312.787	395.434	49.99	41.29	n.a.
Total:			**625.730**	**957.614**	**100.00**	**100.00**	



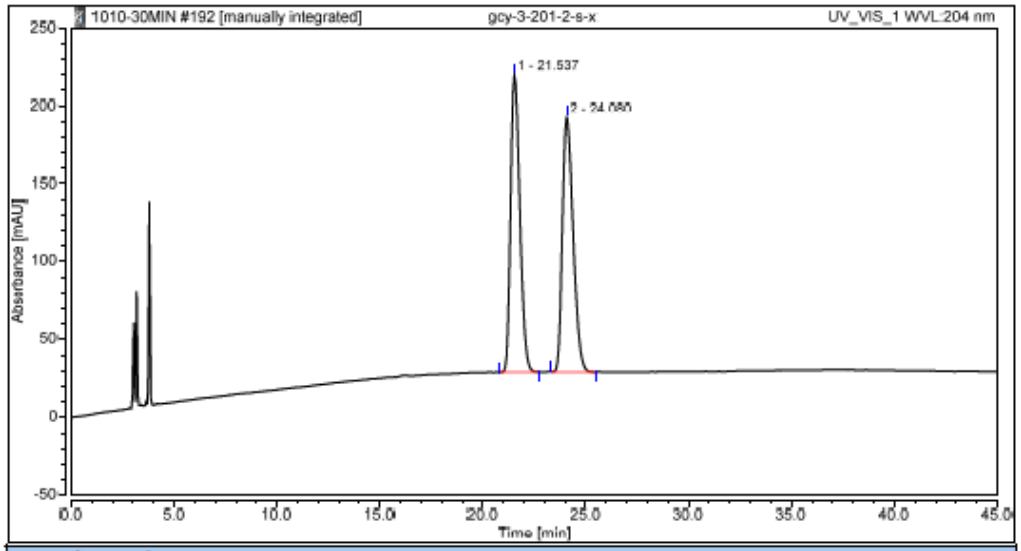
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		20.057	38.336	70.234	4.61	7.00	n.a.
2		25.867	793.563	933.324	95.39	93.00	n.a.
Total:			**831.899**	**1003.558**	**100.00**	**100.00**	

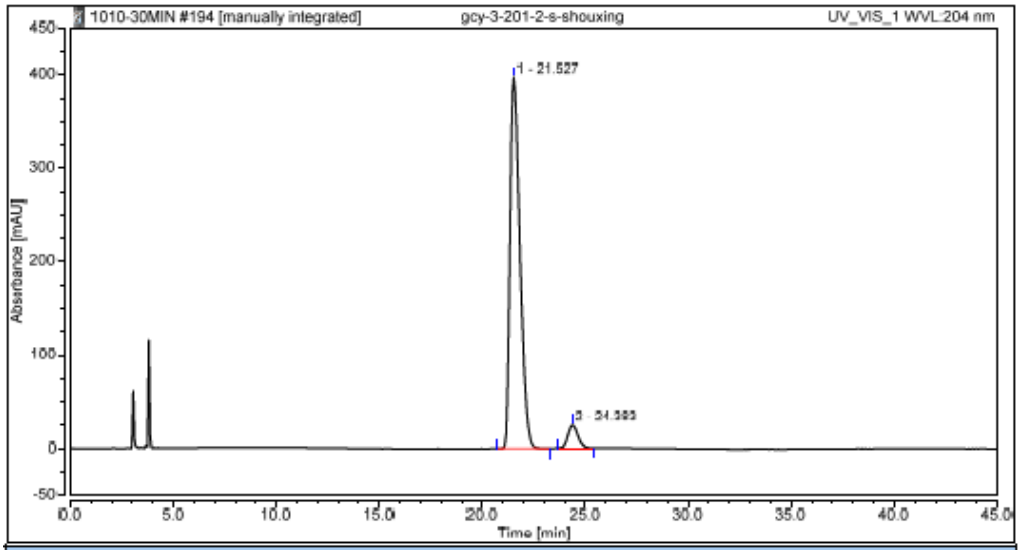
(R)-phenyl-2-(thiophen-2-yl) butanoate (2n):



Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 85:15, flow rate 1.0 mL/min, 25 °C, UV 204 nm

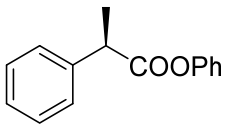


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		21.537	99.393	191.368	50.08	53.87	n.a.
2		24.080	99.057	163.887	49.92	46.13	n.a.
Total:			198.450	355.255	100.00	100.00	

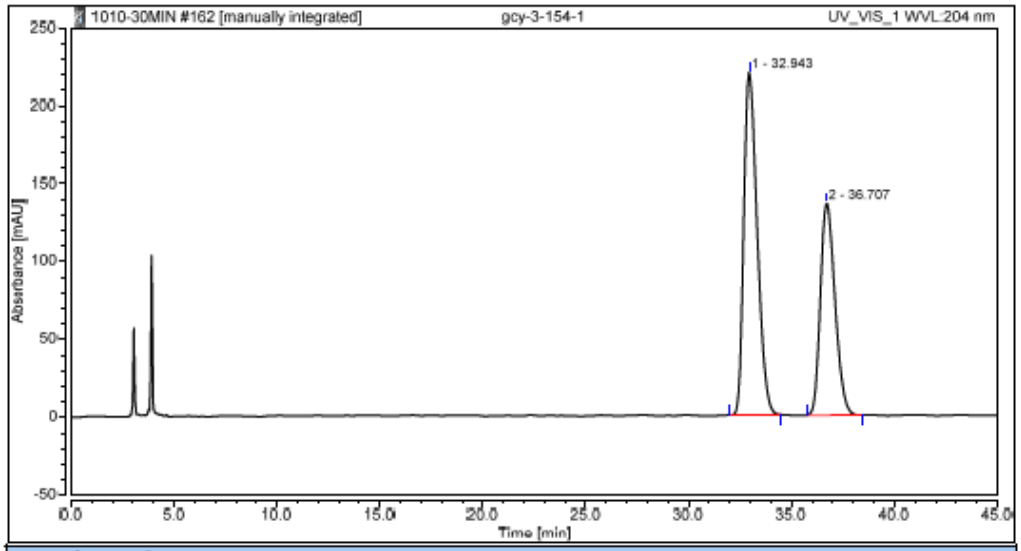


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		21.527	223.831	398.088	93.95	94.03	n.a.
2		24.383	14.413	25.267	6.05	5.97	n.a.
Total:			238.244	423.355	100.00	100.00	

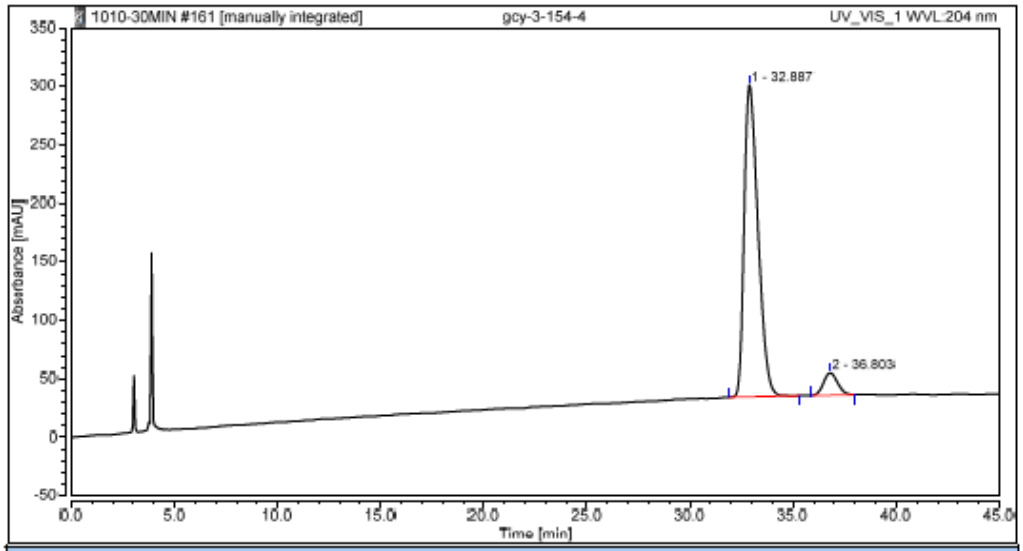
(R)-phenyl-2-phenylpropanoate (2o):



Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 90:10, flow rate 1.0 mL/min, 25 °C, UV 204 nm

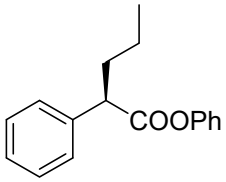


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		32.943	165.515	220.155	59.65	61.75	n.a.
2		36.707	111.964	136.365	40.35	38.25	n.a.
Total:			**277.479**	**356.520**	**100.00**	**100.00**	

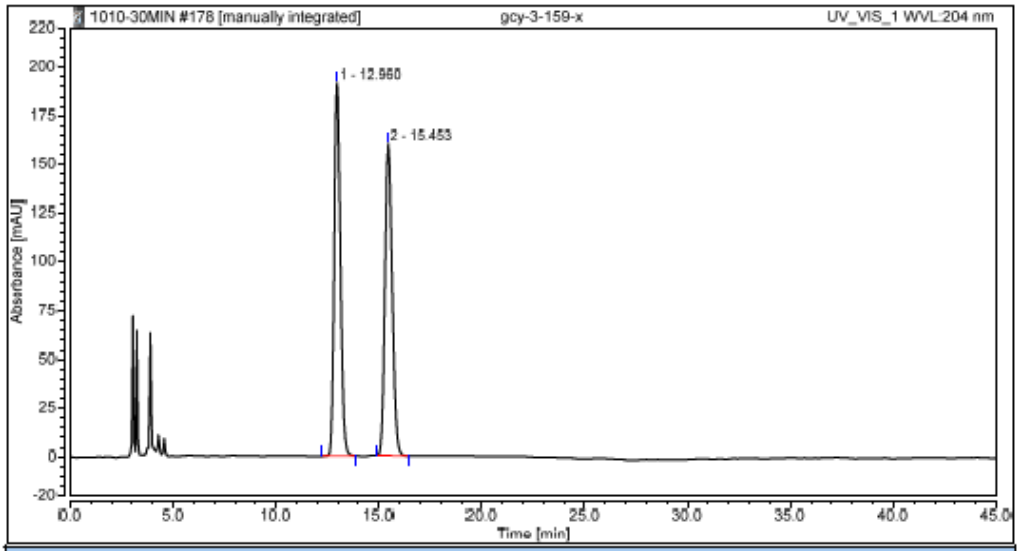


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		32.887	206.965	266.568	93.22	93.31	n.a.
2		36.803	15.057	19.097	6.78	6.69	n.a.
Total:			**222.022**	**285.665**	**100.00**	**100.00**	

(R)-phenyl-2-phenylpentanoate (2p):

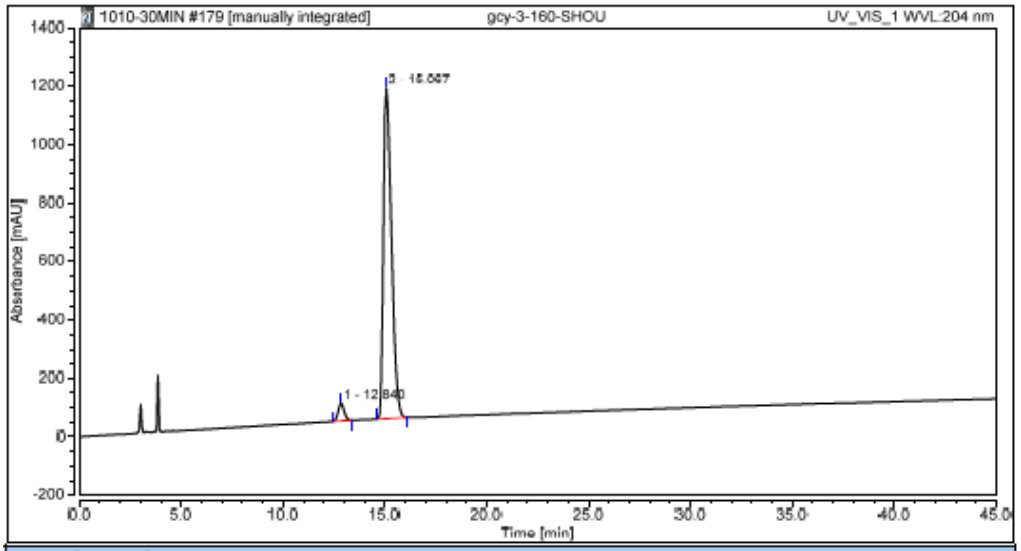


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 90:10, flow rate 1.0 mL/min, 25 °C, UV 204 nm



Integration Results

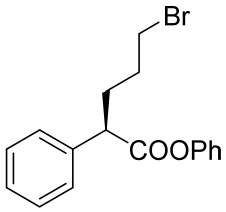
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		12.960	65.946	191.574	50.19	54.46	n.a.
2		15.453	65.458	160.182	49.81	45.54	n.a.
Total:			**131.404**	**351.755**	**100.00**	**100.00**	



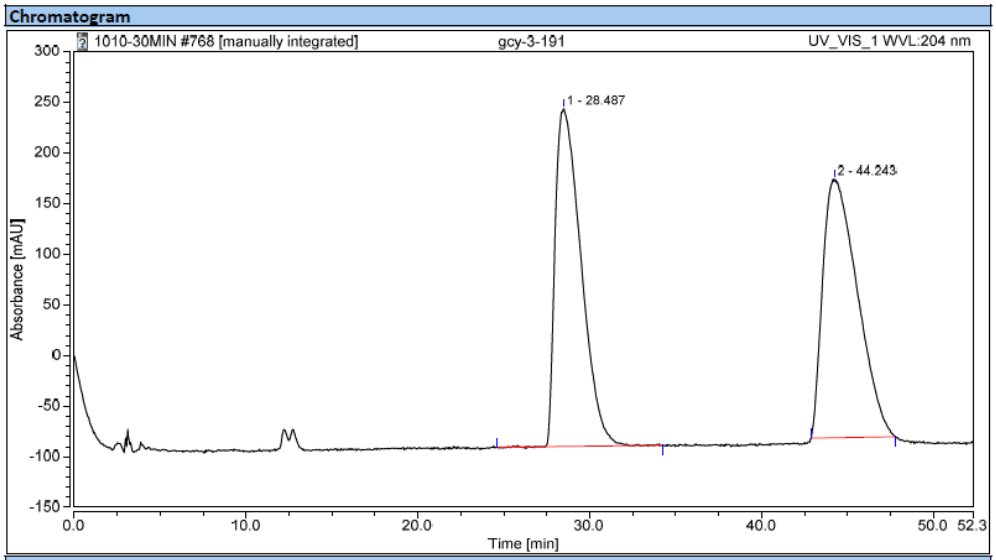
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		12.840	20.742	61.491	3.83	5.15	n.a.
2		15.067	520.810	1132.366	96.17	94.85	n.a.
Total:			**541.552**	**1193.857**	**100.00**	**100.00**	

(R)-phenyl-5-bromo-2-phenylpentanoate (2q):

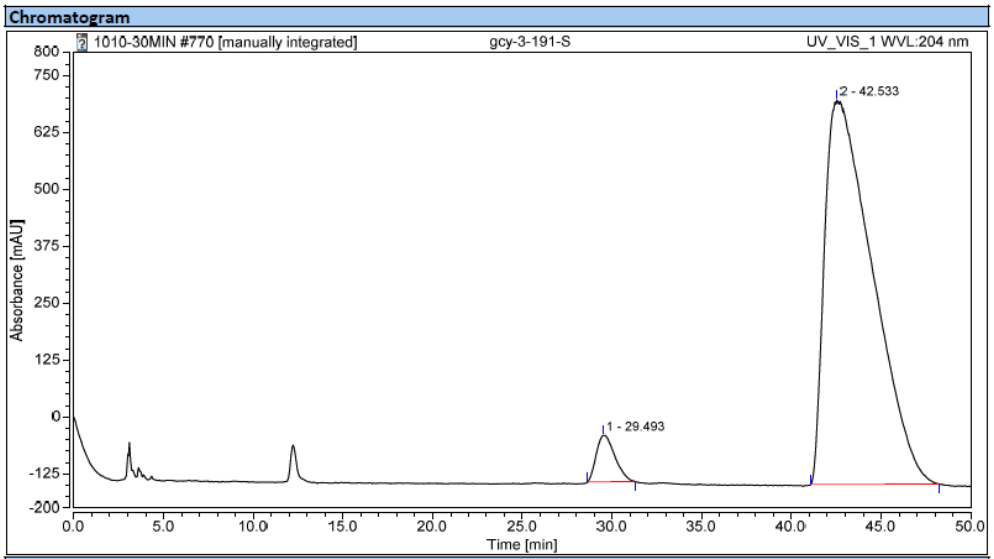


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 85:15, flow rate 1.0 mL/min, 25 °C, UV 204 nm



Integration Results

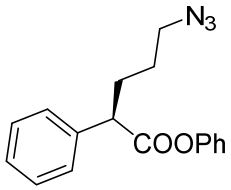
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		28.487	581.444	333.788	49.40	56.62	n.a.
2		44.243	595.480	255.763	50.60	43.38	n.a.
Total:			**1176.924**	**589.551**	**100.00**	**100.00**	



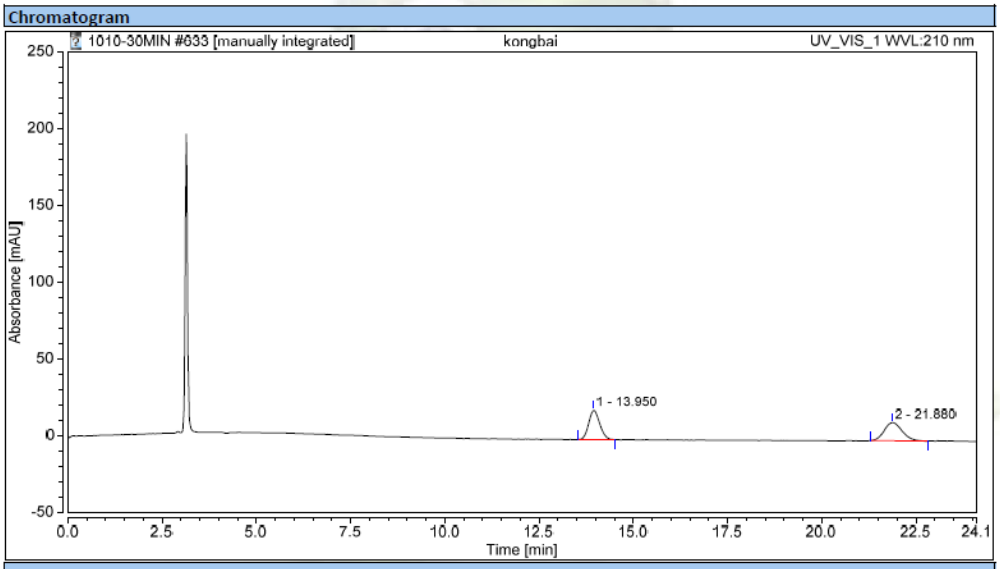
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		29.493	122.295	102.394	4.48	10.82	n.a.
2		42.533	2604.871	844.132	95.52	89.18	n.a.
Total:			**2727.166**	**946.526**	**100.00**	**100.00**	

(R)-phenyl-5-azido-2-phenylpentanoate (2r):

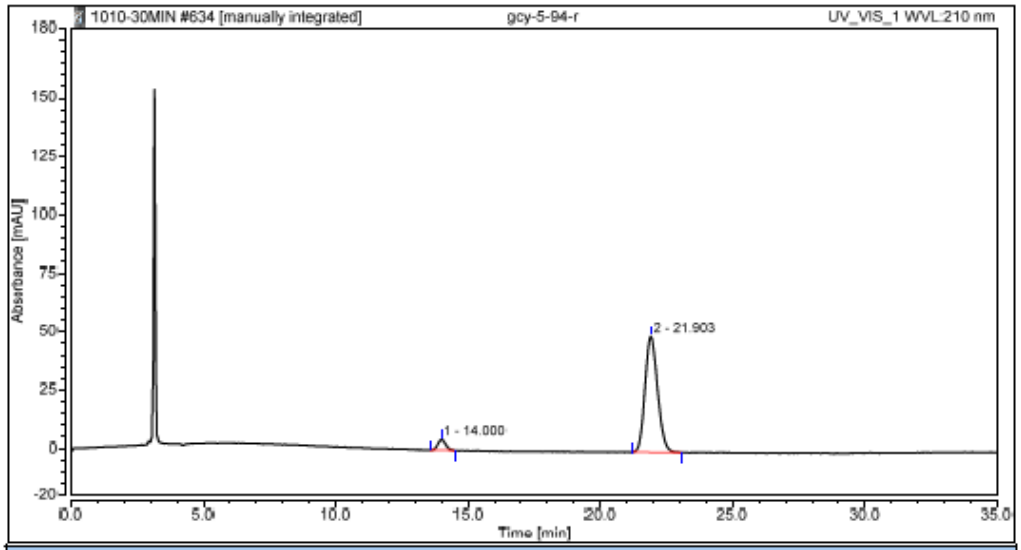


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 70:30, flow rate 1.0 mL/min, 35 °C, UV 204 nm



Integration Results

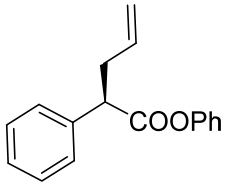
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		13.950	6.452	19.151	49.85	61.69	n.a.
2		21.880	6.492	11.894	50.15	38.31	n.a.
Total:			12.944	31.044	100.00	100.00	



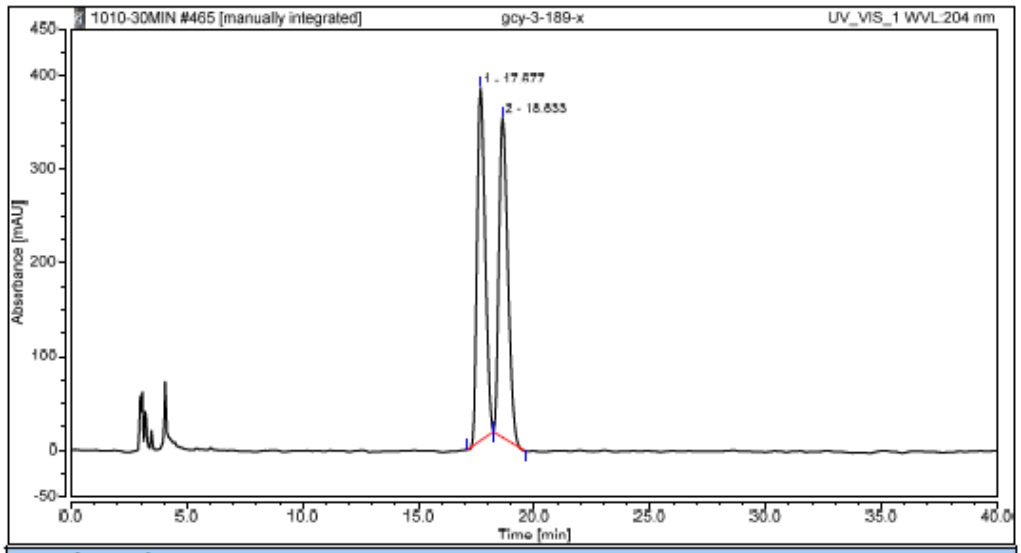
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		14.000	1.512	4.573	5.24	8.43	n.a.
2		21.903	27.352	49.690	94.76	91.57	n.a.
Total:			28.864	54.263	100.00	100.00	

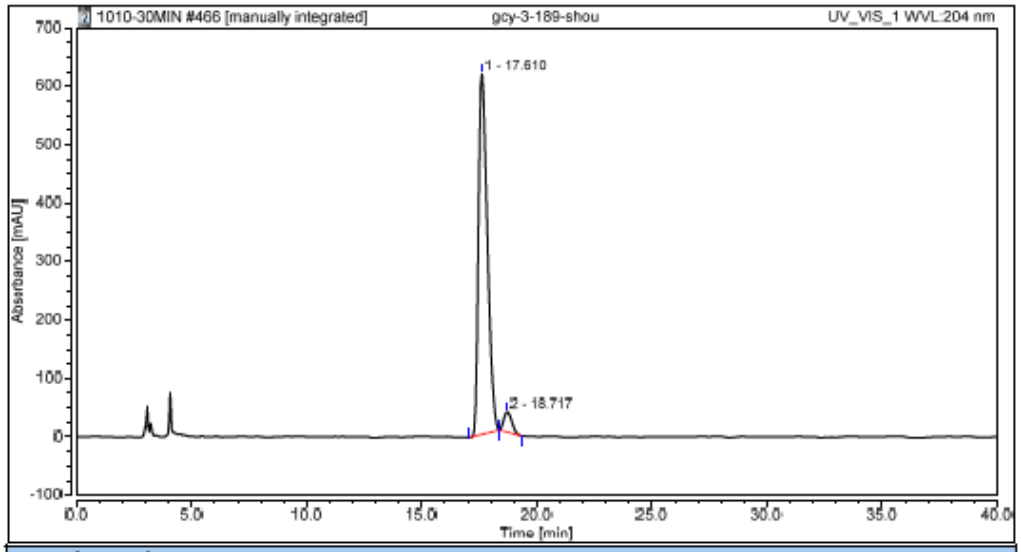
(R)-phenyl-2-phenylpent-4-enoate (2s):



Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 95:5, flow rate 1.0 mL/min, 25 °C, UV 204 nm

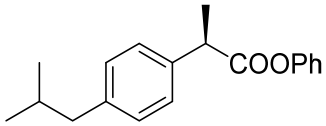


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		17.677	152.734	377.735	50.07	52.51	n.a.
2		18.633	152.321	341.635	49.93	47.49	n.a.
Total:			305.055	719.369	100.00	100.00	

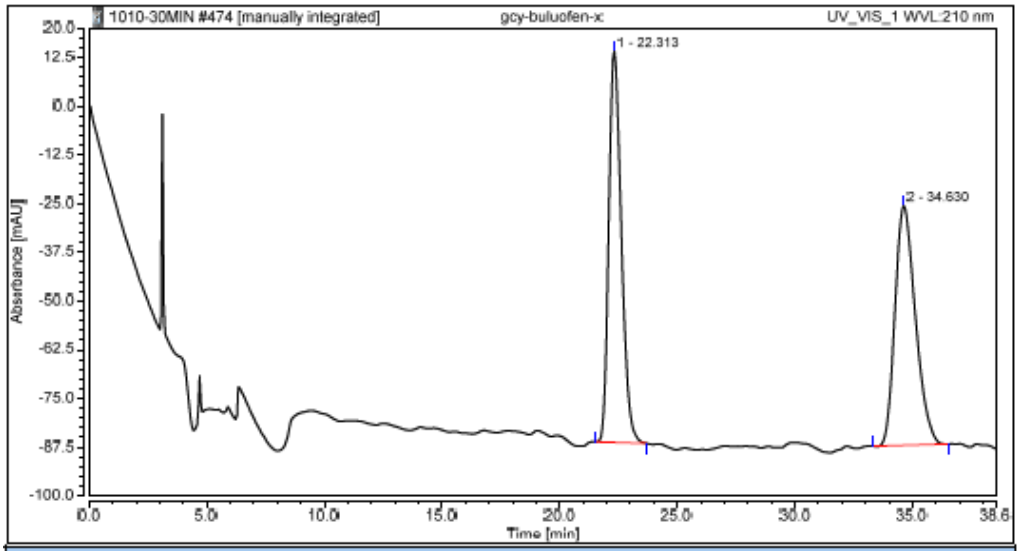


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		17.610	275.638	617.651	95.23	94.69	n.a.
2		18.717	13.810	34.614	4.77	5.31	n.a.
Total:			289.448	652.265	100.00	100.00	

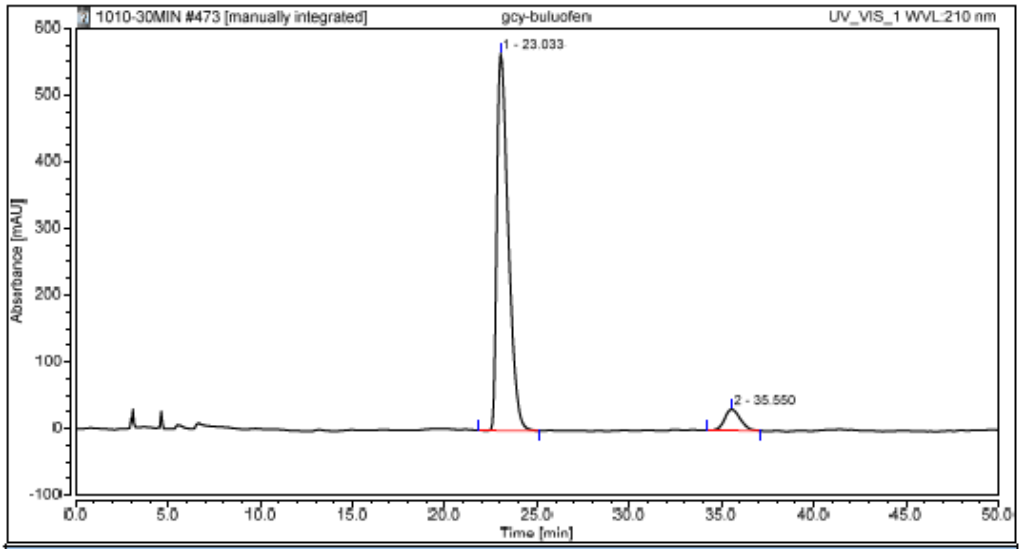
(R)-phenyl-2-(4-isobutylphenyl) propanoate (2t):



Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 99:1, flow rate 1.0 mL/min, 25 °C, UV 210 nm

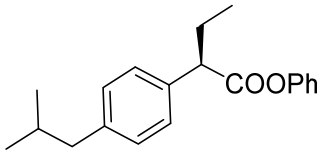


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		22.313	62.222	100.285	50.22	62.02	n.a.
2		34.630	61.669	61.412	49.78	37.98	n.a.
Total:			**123.891**	**161.697**	**100.00**	**100.00**	

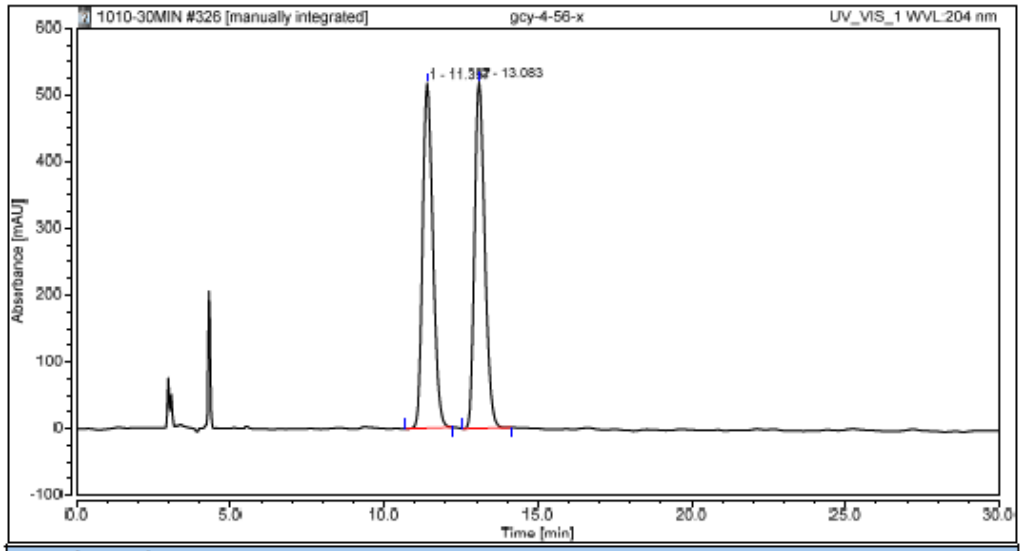


Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		23.033	404.214	565.013	92.88	94.68	n.a.
2		35.550	30.975	31.747	7.12	5.32	n.a.
Total:			**435.189**	**596.760**	**100.00**	**100.00**	

(R)-phenyl-2-(4-isobutylphenyl) butanoate (2u):

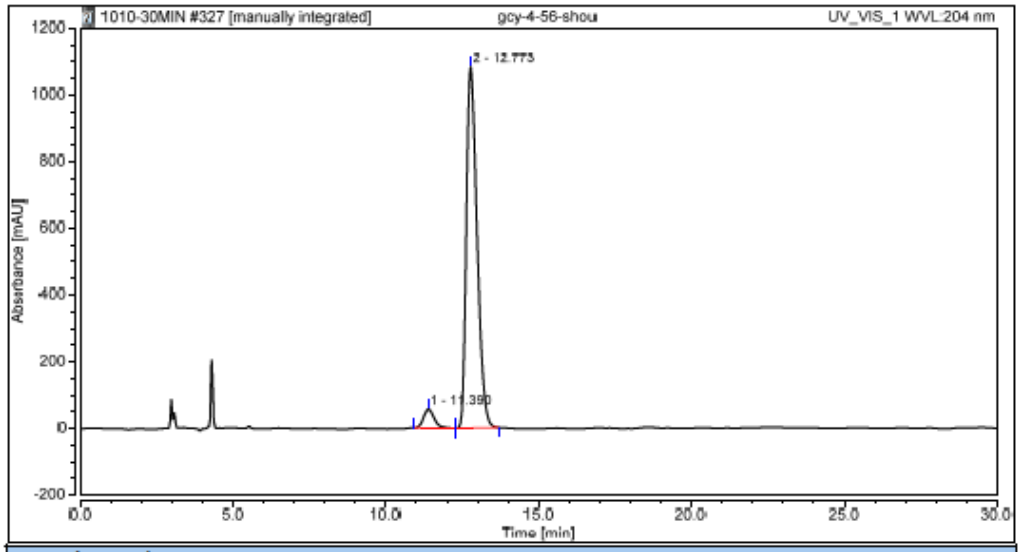


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 98:2, flow rate 1.0 mL/min, 25 °C, UV 204 nm



Integration Results

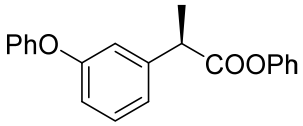
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		11.397	199.212	516.949	49.98	49.89	n.a.
2		13.083	199.356	519.218	50.02	50.11	n.a.
Total:			**398.567**	**1036.167**	**100.00**	**100.00**	



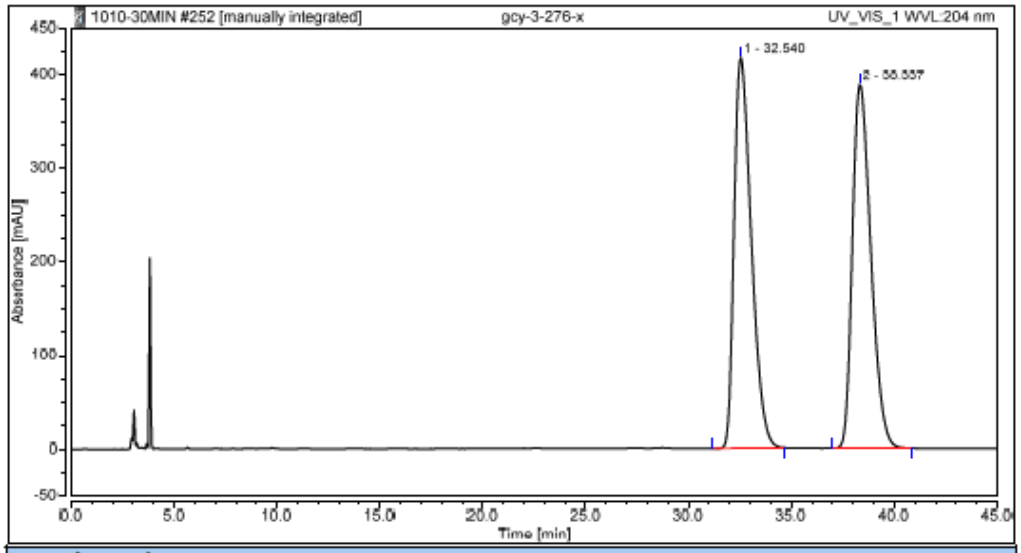
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		11.390	22.919	56.252	4.99	4.94	n.a.
2		12.773	436.432	1082.256	95.01	95.06	n.a.
Total:			**459.351**	**1138.508**	**100.00**	**100.00**	

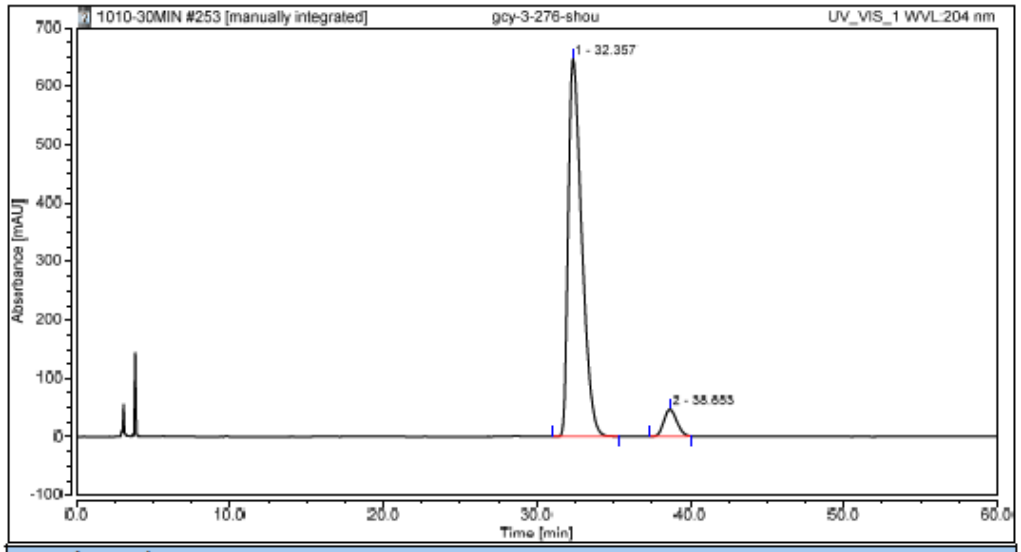
(R)-phenyl-2-(3-phenoxyphenyl) propanoate (2v):



Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH 80:20, flow rate 1.0 mL/min, 25 °C, UV 204 nm

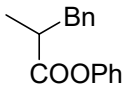


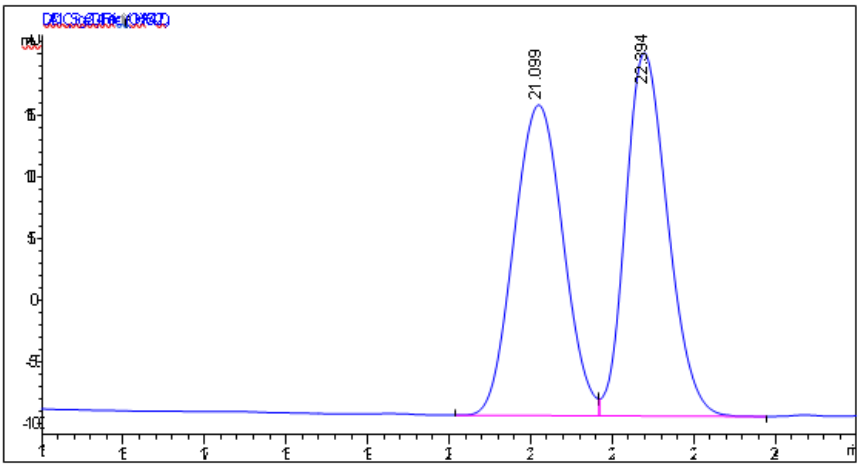
Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		32.540	403.407	417.520	49.92	51.76	n.a.
2		38.337	404.647	389.095	50.08	48.24	n.a.
Total:			808.054	806.614	100.00	100.00	



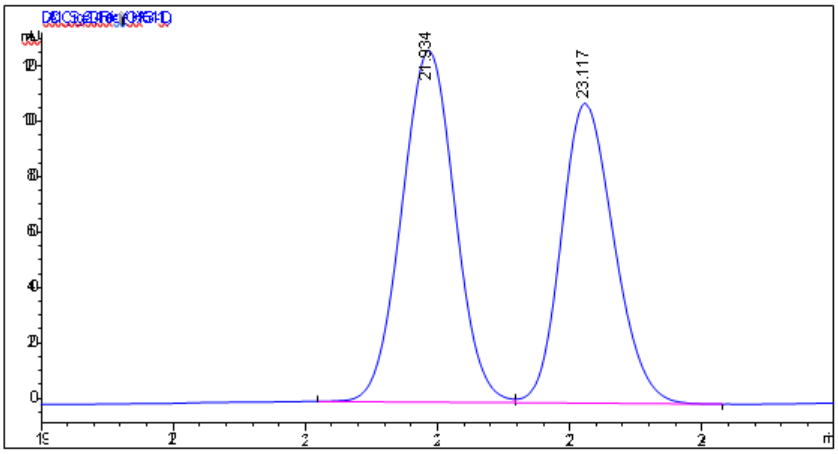
Integration Results							
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		32.357	657.526	646.145	93.56	93.34	n.a.
2		38.653	45.260	46.094	6.44	6.66	n.a.
Total:			702.786	692.238	100.00	100.00	

phenyl 2-methyl-3-phenylpropanoate (2w):



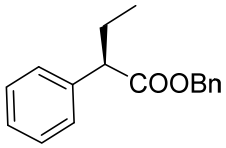


No	Peak Name	Retention Time min	Area mAU*mi	Height mAU	Relative Area %	Relative Height %	Amount n.a
1		21.099	501.5	251.9	49.971	49.971	n.a
2		22.394	473.1	294.6	50.029	50.029	n.a

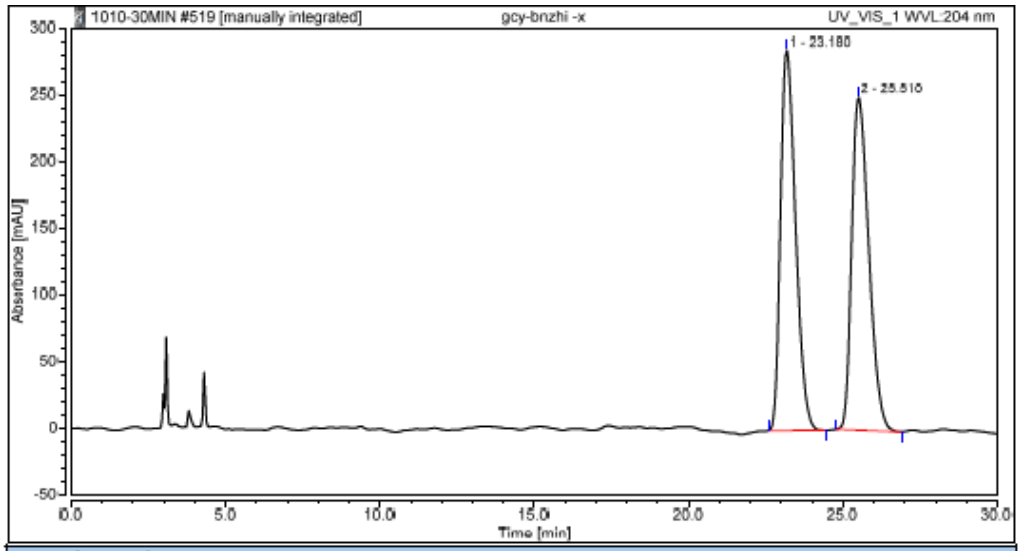


No	Peak Name	Retention Time min	Area mAU*mi	Height mAU	Relative Area %	Relative Height %	Amount n.a
1		21.934	161.6	127.1	54.117	54.117	n.a
2		23.117	130.1	108.4	45.883	45.883	n.a

(R)-benzyl-2-phenylbutanoate (2b):

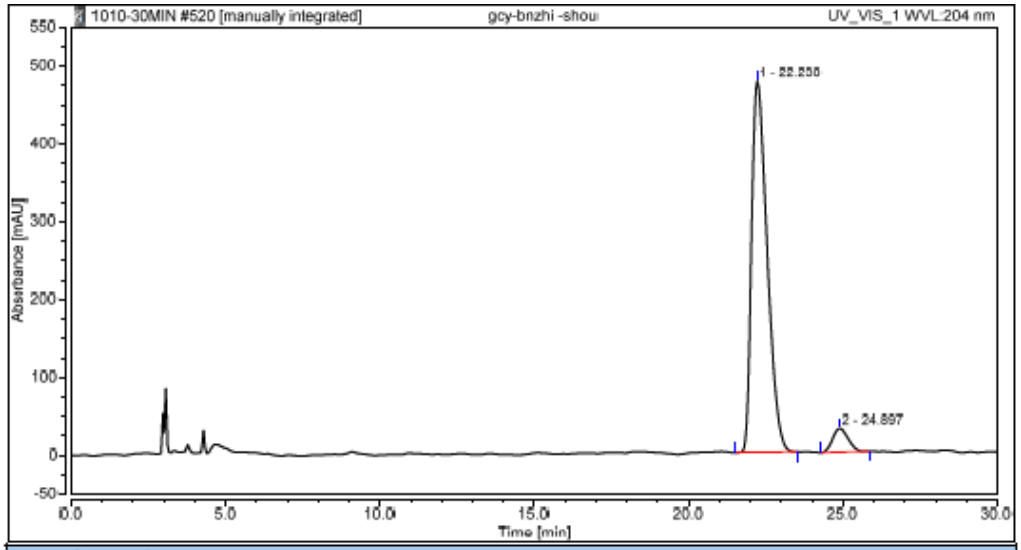


Column DAICEL Chiralcel OD-H 5μm, heptane/i-PrOH 98:2, flow rate 1.0 mL/min, 25 °C, UV 204 nm



Integration Results

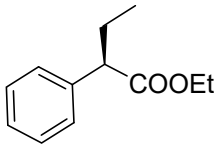
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		23.180	160.943	284.763	50.12	53.32	n.a.
2		25.510	160.143	249.306	49.88	46.68	n.a.
Total:			**321.086**	**534.069**	**100.00**	**100.00**	



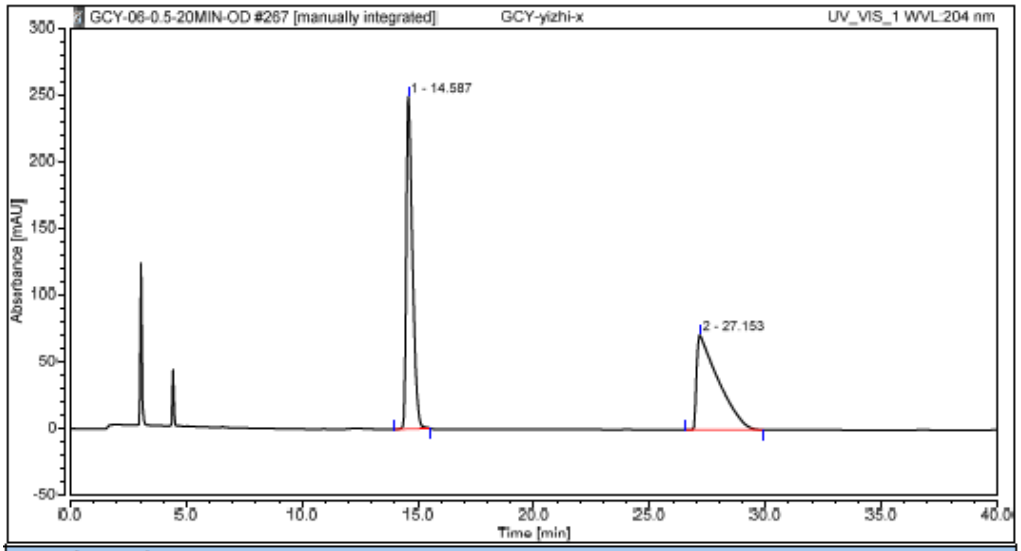
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		22.230	278.580	476.467	94.06	93.98	n.a.
2		24.897	17.600	30.530	5.94	6.02	n.a.
Total:			**296.180**	**506.997**	**100.00**	**100.00**	

(R)-ethyl-2-phenylbutanoate (2c):

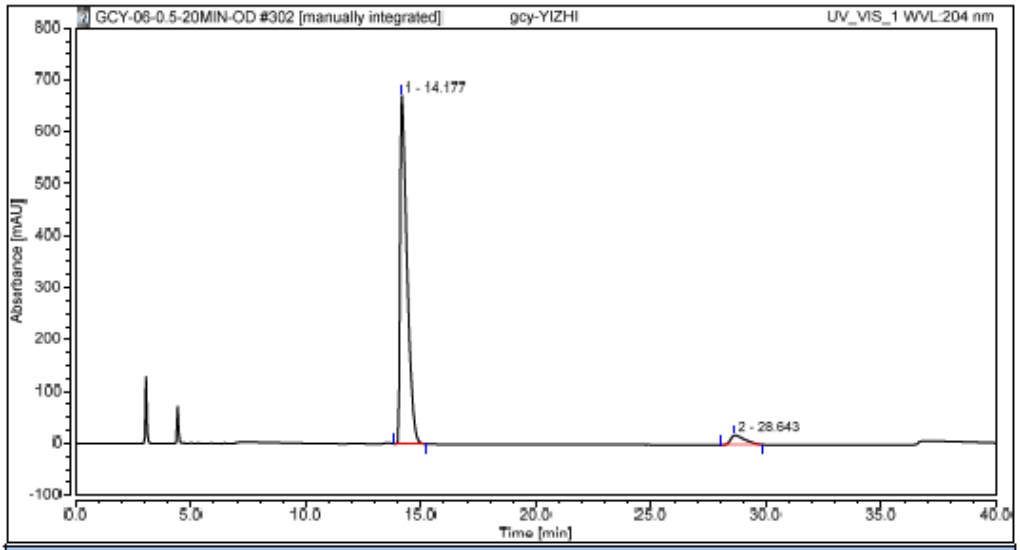


Column DAICEL Chiralcel OD-H 5μm, heptane/i-PrOH 99.8:0.2, flow rate 1.0 mL/min, 25 °C, UV 204 nm



Integration Results

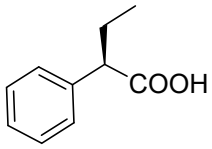
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		14.587	77.151	248.869	50.22	77.83	n.a.
2		27.153	76.475	70.894	49.78	22.17	n.a.
Total:			**153.626**	**319.763**	**100.00**	**100.00**	



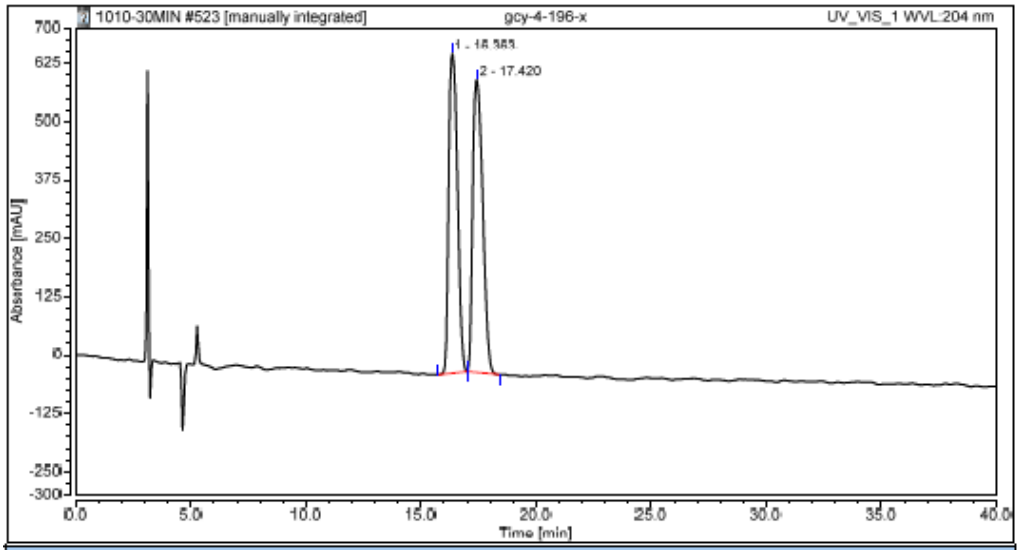
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		14.177	232.221	670.064	94.87	97.37	n.a.
2		28.643	12.550	18.087	5.13	2.63	n.a.
Total:			**244.770**	**688.151**	**100.00**	**100.00**	

(R)-2-phenylbutanoic acid (3a):

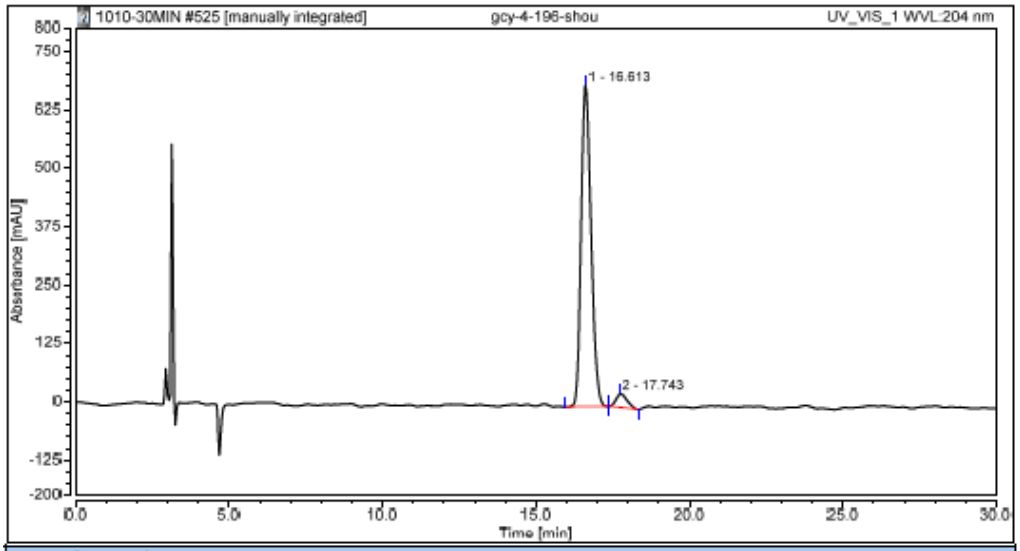


Column DAICEL Chiralcel OJ-H 5μm, heptane/i-PrOH/CF_3COOH 95:4:1, flow rate 1.0 mL/min, 25 °C, UV 204 nm



Integration Results

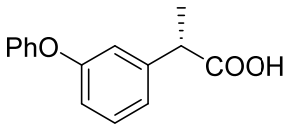
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		16.383	302.143	683.458	49.01	52.21	n.a.
2		17.420	314.412	625.622	50.99	47.79	n.a.
Total:			**616.554**	**1309.080**	**100.00**	**100.00**	



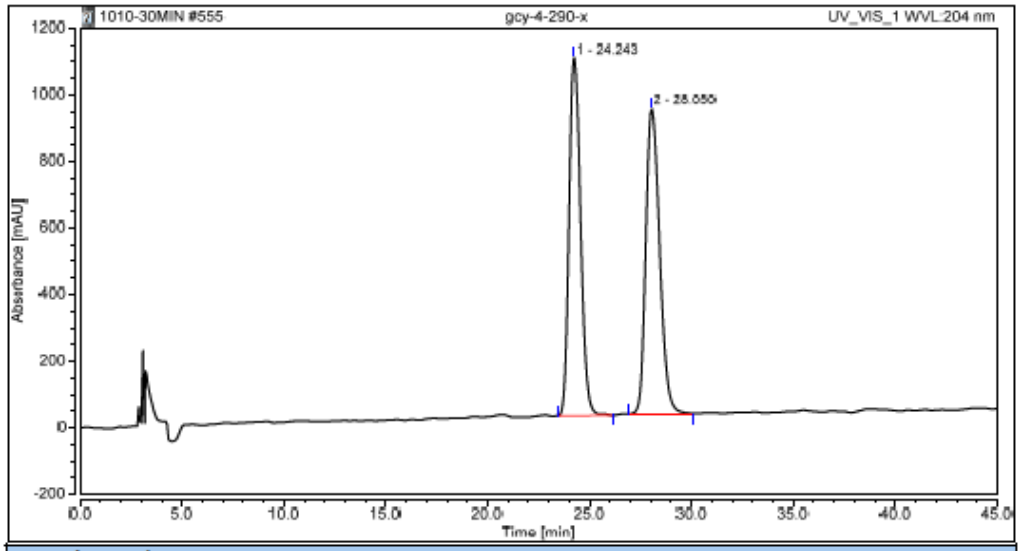
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		16.613	258.042	687.405	95.56	95.99	n.a.
2		17.743	12.002	28.702	4.44	4.01	n.a.
Total:			**270.044**	**716.107**	**100.00**	**100.00**	

(S)-phenyl-2-(3-phenoxyphenyl)propanoate:

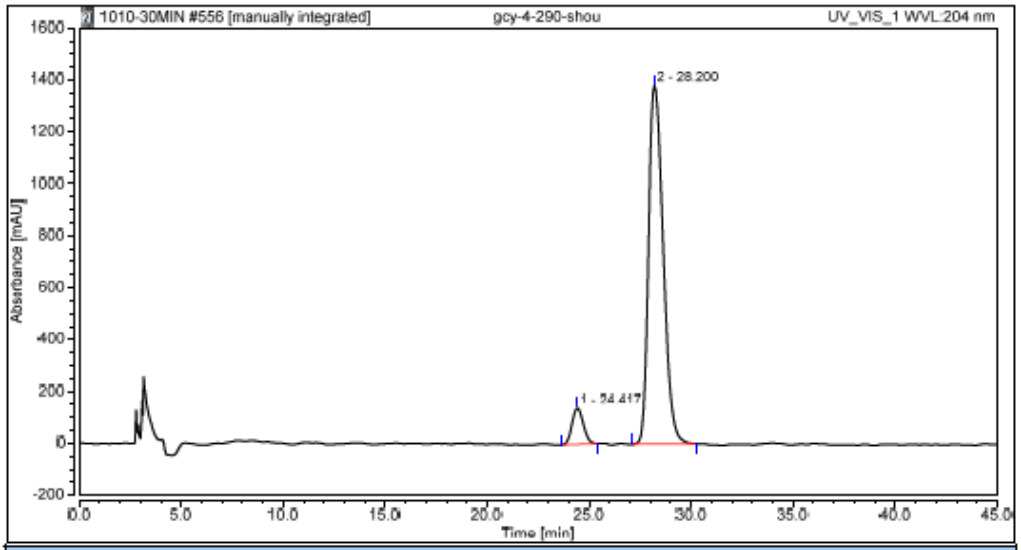


Column DAICEL Chiralcel AD-H 5μm, heptane/i-PrOH/CF_3COOH 90:10:0.1, flow rate 1.0 mL/min, 25 °C, UV 204 nm



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		24.243	704.267	1074.526	49.39	53.97	n.a.
2		28.050	721.704	916.399	50.61	46.03	n.a.
Total:			**1425.971**	**1990.925**	**100.00**	**100.00**	



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		24.417	89.259	140.355	7.22	9.22	n.a.
2		28.200	1146.745	1382.495	92.78	90.78	n.a.
Total:			**1236.004**	**1522.850**	**100.00**	**100.00**	