***Supporting Information for***

# Synergistic Cu/Pd-Catalyzed Asymmetric Allylation: A Facile Access to α-Quaternary Cysteine Derivatives

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## I. General remarks

$^1$H NMR spectra were recorded on a Bruker 400 MHz spectrometer in $CDCl_3$. Chemical shifts are reported in ppm with the internal TMS signal at 0.0 ppm as a standard. The data are reported as (s = single, d = double, t = triple, q = quarte, m = multiple or unresolved, brs = broad single, coupling constant(s) in Hz, integration). $^{13}$C NMR spectra were recorded on a Bruker 100 MHz spectrometer in $CDCl_3$. Chemical shifts are reported in ppm with the internal chloroform signal at 77.0 ppm as a standard. Commercially obtained reagents were used without further purification. Solvents were purified prior to use according to the standard methods. Unless otherwise noted, all reactions were carried out under nitrogen atmosphere. All reactions were monitored by TLC with silica gelcoated plates. Enantiomeric ratios were determined by chiral-phase HPLC analysis in comparison with authentic racemic materials using a chiralpak AD-H, chiralcel OD-H and IE column with hexane and *i*-PrOH as solvents. Cyclic imino ester,[1] allylcarbonates,[2] **L1-L4**[3] were prepared according to the literature procedure. The absolute configuration of **5e** was determined by X-ray analysis, and those of other adducts were deduced on the basis of this result.[4] The racemic products were obtained by running reactions with a racemic catalyst or blending equal amount of two enantiomers.

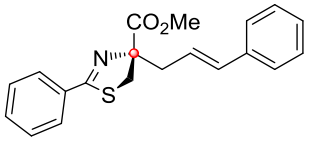
## II. General procedure for dual Cu/Pd-catalyzed allylic alkylation reaction of cyclic imino esters

The preparation of Cu catalyst: A flame dried Schlenk tube was cooled to rt and filled with $N_2$. To this flask were added ($S$,$S_p$)-$^t$Bu-Phosferrox **L2** (0.01 mmol, 5 mol %) and $Cu(OTf)_2$ (0.01 mmol, 5 mol %) were dissolved in 0.5 mL of THF, and stirred at room temperature for about 0.5 h.

The preparation of Pd catalyst: A flame dried Schlenk tube was cooled to rt and filled with $N_2$. To this flask were added ($S$,$S_p$)-$^t$Bu-Phosferrox **L2** (0.01 mmol, 5 mol %) and $[Pd(\eta^3\text{-allyl})Cl]_2$ (0.005 mmol, 2.5 mol %) were dissolved in 0.5 mL of THF, and stirred at room temperature for about 0.5 h.

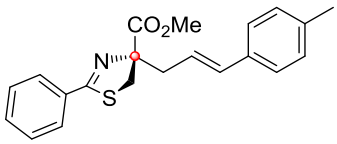
A flame dried Schlenk tube was cooled to rt and filled with $N_2$. To this flask were added cyclic imino esters (0.20 mmol, 1.0 equiv), base (0.20 mmol, 1.0 equiv), Cu catalyst (5 mol %), Pd catalyst (5 mol %). The methyl cinnamyl carbonate (0.30 mmol, 1.5 equiv) was then added. The reaction mixture was stirred at room temperature for 24 h. The organic solvent was removed by rotary evaporation. The dr value was determined by $^1$H NMR analysis of the crude mixture and the residue was purified by column chromatography on silica gel to give the allylation product, which was then directly analyzed by chiral HPLC to determine the enantiomeric excess.

**Methyl (*S, E*)-4-cinnamyl-2-phenyl-4,5-dihydrothiazole-4-carboxylate (5a):**



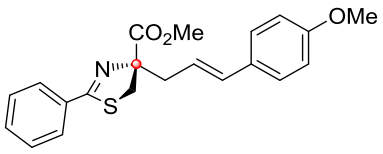

Yield (98%); 66.1 mg; yellow solid; m.p. 78-80 $^{o}$C; $[\alpha]_D^{20}$ = -38.7 (*c* 1.0, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.88 – 7.86 (m, 2H), 7.47 (t, *J* = 7.3 Hz, 1H), 7.40 (t, *J* = 7.4 Hz, 2H), 7.32 – 7.25 (m, 4H), 7.21 (t, *J* = 7.1 Hz, 1H), 6.52 (d, *J* = 15.8 Hz, 1H), 6.20 – 6.12 (m, 1H), 3.89 (d, *J* = 11.5 Hz, 1H), 3.81 (s, 3H), 3.45 (d, *J* = 11.5 Hz, 1H), 2.92 (dd, *J* = 7.3, 1.7 Hz, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.9, 169.1, 137.0, 134.4, 132.8, 131.6, 128.55, 128.46, 128.45, 127.4, 126.3, 123.6, 88.3, 52.9, 41.3, 38.8. HRMS (ESI-TOF) Calcd. For $C_{20}H_{20}N_2S^+$ ($[M+H]^+$): 338.1209, found: 338.1195. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 99% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 10.3 and 11.6 min.

**Methyl (*S, E*)-2-phenyl-4-(3-(p-tolyl) allyl)-4,5-dihydrothiazole-4-carboxylate (5b):**



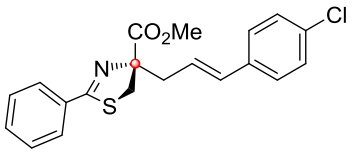

Yield (96%); 67.5 mg; yellow oil; $[\alpha]_D^{20}$ = -40.4 (*c* 1.0, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.3 Hz, 2H), 7.48 (t, *J* = 7.3 Hz, 1H), 7.41 (t, *J* = 7.5 Hz, 2H), 7.29 – 7.18 (m, 2H), 7.09 (d, *J* = 7.9 Hz, 2H), 6.49 (d, *J* = 15.7 Hz, 1H), 6.14 – 6.06 (m, 1H), 3.89 (d, *J* = 11.5 Hz, 1H), 3.81 (s, 3H), 3.45 (d, *J* = 11.5 Hz, 1H), 2.93 – 2.87 (m, 2H), 2.31 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.9, 169.1, 137.2, 134.2, 134.1, 132.8, 131.5, 129.1, 128.5, 128.4, 126.1, 122.4, 88.3, 52.9, 41.3, 38.6, 21.1. HRMS (ESI-TOF) Calcd. For $C_{21}H_{22}NO_2S^+$ ($[M+H]^+$): 352.1366, found: 352.1358. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 99% ee (Chiralpak IE, *i*-propanol /hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 9.6 and 10.8 min.

**Methyl (*S, E*)-4-(3-(4-methoxyphenyl) allyl)-2-phenyl-4,5-dihydrothiazole-4-Carboxylate (5c):**



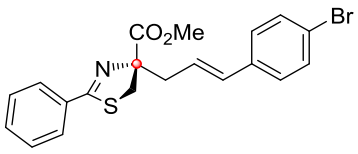

Yield (75%); 55.3 mg; brown solid; m.p. 60-62 ºC; $[\alpha]_D^{20}$ = -23.3 (*c* 1.0, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1H$ NMR (400 MHz, $CDCl_3$) δ 7.88 – 7.86 (m, 2H), 7.51 – 7.45 (m, 1H), 7.41 (t, *J* = 7.4 Hz, 2H), 7.28 – 7.25 (m, 2H), 6.82 (d, *J* = 8.7 Hz, 2H), 6.46 (d, *J* = 15.7 Hz, 1H), 6.05 – 5.97 (m, 1H), 3.89 (d, *J* = 11.5 Hz, 1H), 3.81 (s, 3H), 3.79 (s, 3H), 3.45 (d, *J* = 11.5 Hz, 1H), 2.94 – 2.84 (m, 2H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ 173.0, 169.1, 159.0, 133.8, 132.8, 131.5, 129.8, 128.5, 128.4, 127.4, 121.1, 113.8, 88.4, 55.2, 52.9, 41.3, 38.6. HRMS (ESI-TOF) Calcd. For $C_{21}H_{22}NO_3S^+$ ($[M+H]^+$): 368.1315, found: 368.1308. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 99% ee (Chiralpak AD-H, *i*-propanol/hexane = 5/95, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 20.4 and 23.1 min.

**Methyl (*S*, *E*)-4-(3-(4-chlorophenyl) allyl)-2-phenyl-4,5-dihydrothiazole-4-Carboxylate (5d):**



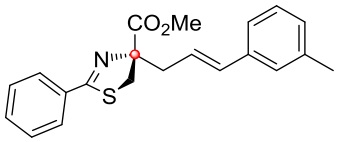

Yield (90%); 66.9 mg; yellow solid; m.p. 42-44 ºC; $[\alpha]_D^{20}$ = -28.5 (*c* 0.8, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1H$ NMR (400 MHz, $CDCl_3$) δ 7.88 (d, *J* = 7.3 Hz, 2H), 7.50 (t, *J* = 7.3 Hz, 1H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.25 (d, *J* = 4.0 Hz, 4H), 6.47 (d, *J* = 15.8 Hz, 1H), 6.19 – 6.11 (m, 1H), 3.89 (d, *J* = 11.5 Hz, 1H), 3.81 (s, 3H), 3.43 (d, *J* = 11.5 Hz, 1H), 2.91 (d, *J* = 7.2 Hz, 2H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ 172.9, 169.3, 135.4, 133.1, 133.0, 132.7, 131.6, 128.6, 128.51, 128.46, 127.4, 124.3, 88.1, 52.9, 41.3, 38.9. HRMS (ESI-TOF) Calcd. For $C_{20}H_{19}ClNO_2S^+$ ($[M+H]^+$): 372.0820, found: 372.0813. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 99% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 9.7 and 10.7 min.

**Methyl (*S*, *E*)-4-(3-(4-bromophenyl) allyl)-2-phenyl-4,5-dihydrothiazole-4-Carboxylate (5e):**



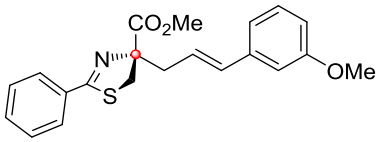

Yield (92%); 76.6 mg; white solid; m.p. 74-76 °C; $[\alpha]_D^{20}$ = -24.3 (*c* 1.1, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1H$ NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.4 Hz, 2H), 7.49 (t, *J* = 7.3 Hz, 1H), 7.41 (t, *J* = 8.7 Hz, 4H), 7.19 (d, *J* = 8.3 Hz, 2H), 6.45 (d, *J* = 15.8 Hz, 1H), 6.21 – 6.13 (m, 1H), 3.89 (d, *J* = 11.5 Hz, 1H), 3.82 (s, 3H), 3.43 (d, *J* = 11.5 Hz, 1H), 2.90 (d, *J* = 7.3 Hz, 2H). $^{13}C$ NMR (100 MHz, CDCl3) δ 172.9, 169.3, 135.8, 133.1, 132.7, 131.7, 131.5, 128.53, 128.48, 127.8, 124.4, 121.2, 88.1, 53.0, 41.3, 38.9. HRMS (ESI-TOF) Calcd. For $C_{20}H_{19}BrNO_2S$ ($[M+H]^+$): 416.0314, found: 416.0310. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 97% ee (Chiralpak IE, *i*-propanol / hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 10.5 and 11.6 min.

**Methyl (*S*, *E*)-2-phenyl-4-(3-(m-tolyl) allyl)-4,5-dihydrothiazole-4-carboxylate (5f):**



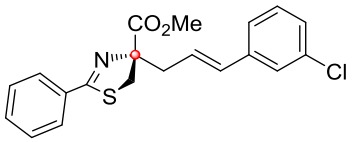

Yield (90%); 63.3 mg; white oil; $[\alpha]_D^{20}$ = -43.4 (*c* 0.53, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1H$ NMR (400 MHz, $CDCl_3$) δ 7.90 – 7.88 (m, 2H), 7.49 (t, *J* = 7.3 Hz, 1H), 7.42 (t, *J* = 7.4 Hz, 2H), 7.19 – 7.16 (m, 3H), 7.04 (d, *J* = 7.1 Hz, 1H), 6.50 (d, *J* = 15.7 Hz, 1H), 6.20 – 6.12 (m, 1H), 3.91 (d, *J* = 11.5 Hz, 1H), 3.83 (s, 3H), 3.46 (d, *J* = 11.5 Hz, 1H), 2.98 – 2.89 (m, 2H), 2.34 (s, 3H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ 173.0, 169.2, 138.1, 137.0, 134.6, 132.9, 131.6, 128.6, 128.5, 128.4, 128.3, 127.1, 123.5, 123.4, 88.4, 53.0, 41.4, 38.8, 21.4. HRMS (ESI-TOF) Calcd. For $C_{21}H_{22}NO_2S^+$ ($[M+H]^+$): 352.1366, found: 352.1359. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 99% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 9.3 and 10.6 min.

**Methyl (*S*, *E*)-4-(3-(3-methoxyphenyl) allyl)-2-phenyl-4,5-dihydrothiazole-4-Carboxylate (5g):**



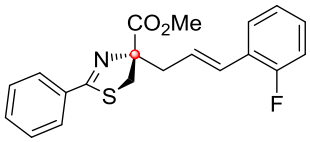

Yield (82%); 60.3 mg; white oil; $[\alpha]_D^{20}$ = -34.7 (*c* 0.5, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, $CDCl_3$) $^1$H NMR (400 MHz, $CDCl_3$) δ 7.89 – 7.86 (m, 2H), 7.52 – 7.45 (m, 1H), 7.43 – 7.40 (m, 2H), 7.22 (t, *J* = 7.9 Hz, 1H), 6.94 (d, *J* = 7.7 Hz, 1H), 6.87 – 6.86 (m, 1H), 6.78 (dd, *J* = 8.1, 2.4 Hz, 1H), 6.50 (d, *J* = 15.7 Hz, 1H), 6.18 – 6.14 (m, 1H), 3.90 (d, *J* = 11.5 Hz, 1H), 3.82 (s, 3H), 3.79 (s, 3H), 3.45 (d, *J* = 11.5 Hz, 1H), 2.93-2.91 (m, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.9, 169.2, 159.7, 138.5, 134.3, 132.8, 131.6, 129.4, 128.6, 128.5, 124.0, 119.0, 113.0, 111.7, 88.3, 55.2, 52.9, 41.3, 38.8. HRMS (ESI-TOF) Calcd. For $C_{21}H_{22}NO_3S^+$ ($[M+H]^+$): 368.1315, found: 368.1309. The product was analyzed by chiral HPLC to determine the enantiomeric excess: >99% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 15.3 and 18.2 min.

**Methyl (*S, E*)-4-(3-(3-chlorophenyl) allyl)-2-phenyl-4,5-dihydrothiazole-4-Carboxylate (5h):**



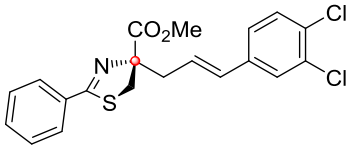

Yield (97%); 72.1 mg; white oil; $[\alpha]_D^{20}$ = -21.3 (*c* 0.4, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.89 – 7.86 (m, 2H), 7.52 – 7.46 (m, 1H), 7.43 – 7.41 (m, 2H), 7.31 (s, 1H), 7.20 – 7.19 (m, 3H), 6.46 (d, *J* = 15.8 Hz, 1H), 6.23 – 6.16 (m, 1H), 3.89 (d, *J* = 11.5 Hz, 1H), 3.82 (s, 3H), 3.42 (d, *J* = 11.5 Hz, 1H), 2.93 – 2.90 (m, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.9, 169.3, 138.8, 134.4, 133.0, 132.8, 131.7, 129.7, 128.6, 128.5, 127.4, 126.2, 125.3, 124.5, 88.2, 53.0, 41.3, 39.0. HRMS (ESI-TOF) Calcd. For $C_{20}H_{19}ClNO_2S^+$ ($[M+H]^+$): 372.0820, found: 372.0813. The product was analyzed by chiral HPLC to determine the enantiomeric excess: >99% ee (Chiralpak IE, *i*-propanol/ hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 9.6 and 10.5 min.

**Methyl (*S, E*)-4-(3-(2-fluorophenyl) allyl)-2-phenyl-4,5-dihydrothiazole-4-Carboxylate (5i):**




Yield (85%); 60.4 mg; brown oil; $[\alpha]_D^{20}$ = -18.0 (*c* 0.3, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.89 – 7.87 (m, 2H), 7.48 (t, *J* = 7.3 Hz, 1H), 7.41 (t, *J* = 7.5 Hz, 3H), 7.24-7.12 (m, 1H), 7.06-7.03 (m, 2H), 6.70 (d, *J* = 15.9 Hz, 1H), 6.29 – 6.21 (m, 1H), 3.91 (d, *J* = 11.5 Hz, 1H), 3.83 (s, 3H), 3.46 (d, *J* = 11.5 Hz, 1H), 2.95 (d, *J* = 7.4 Hz, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.8, 169.2, 159.9 (d, *J* = 249.9 Hz), 132.7, 131.6, 128.7 (d, *J* = 8.4 Hz), 128.5, 128.4, 127.2 (d, *J* = 3.7 Hz), 126.6 (d, *J* = 3.8 Hz), 126.2 (d, *J* = 4.2 Hz), 124.8 (d, *J* = 12.4 Hz), 124.0 (d, *J* = 3.5 Hz), 115.5 (d, *J* = 22.1 Hz), 88.2, 52.9, 41.6, 38.8. $^{19}$F NMR (376 MHz, $CDCl_3$) δ -118.64 (s). HRMS (ESI-TOF) Calcd. For $C_{20}H_{19}FNO_2S^+$ ($[M+H]^+$): 356.1115, found: 356.1111. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 98% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 9.9 and 12.2 min.

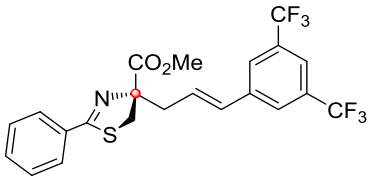
**Methyl (*S, E*)-4-(3-(3,4-dichlorophenyl) allyl)-2-phenyl-4,5-dihydrothiazole-4-Carboxylate (5j):**




Yield (95%); 77.2 mg; white oil; $[\alpha]_D^{20}$ = -15.6 (*c* 0.7, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.89 – 7.86 (m, 2H), 7.52 – 7.46 (m, 1H), 7.42 – 7.38 (m, 3H), 7.36 – 7.32 (m, 1H), 7.14 (dd, *J* = 8.3, 2.0 Hz, 1H), 6.41 (d, *J* = 15.8 Hz, 1H), 6.23 – 6.15 (m, 1H), 3.88 (d, *J* = 11.5 Hz, 1H), 3.82 (s, 3H), 3.41 (d, *J* = 11.5 Hz, 1H), 2.92-2.90 (m, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.8, 169.4, 137.1, 132.7, 132.6, 132.0, 131.7, 131.1, 130.4, 128.6, 128.5, 128.0, 125.9, 125.4, 88.1, 53.0, 41.3, 39.1. HRMS (ESI-TOF) Calcd. For $C_{20}H_{18}Cl_2NO_2S$ ($[M+H]^+$): 406.0430, found: 406.0424. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 97% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 11.0 and 12.3 min.

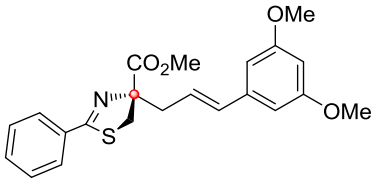
**Methyl (*S, E*)-4-(3-(3,5-bis(trifluoromethyl) phenyl) allyl)-2-phenyl-4,5-dihydrothiazole-4-**

**carboxylate (5k):**



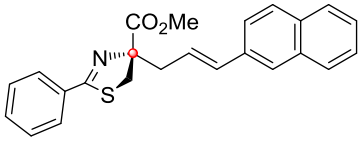

Yield (94%); 89.0 mg; brown soild; m.p. 50-52 $^{o}$C; $[\alpha]_D^{20}$ = +9.4 (*c* 1.2, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.89 – 7.86 (m, 2H), 7.72 (d, *J* = 8.9 Hz, 3H), 7.51 – 7.47 (m, 1H), 7.42 (t, *J* = 7.4 Hz, 2H), 6.60 – 6.56 (m, 1H), 6.43 – 6.36 (m, 1H), 3.90 (d, *J* = 11.5 Hz, 1H), 3.83 (s, 3H), 3.43 (d, *J* = 11.6 Hz, 1H), 2.96 (d, *J* = 7.3 Hz, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.7, 169.6, 139.0, 132.6, 131.8 (q, *J* = 33.3 Hz), 131.7, 131.6, 128.5, 128.3, 126.1 (d, *J* = 2.7 Hz), 123.3 (q, *J* = 273.8 Hz), 120.83, 120.80, 120.76, 120.7, 87.9, 53.0, 41.3, 39.4. $^{19}$F NMR (376 MHz, $CDCl_3$) δ -62.98 (s). HRMS (ESI-TOF) Calcd. For $C_{22}H_{18}F_6NO_2S^+$ ($[M+H]^+$): 474.0957, found: 474.0951. The product was analyzed by chiral HPLC to determine the enantiomeric excess: >99% ee (Chiralpak AS-H, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 4.4 and 5.0 min.

**Methyl (*S*, *E*)-4-(3-(3,5-dimethoxyphenyl) allyl)-2-phenyl-4,5-dihydrothiazole-4-carboxylate (5l):**



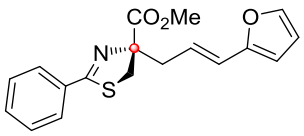

Yield (98%); 77.9 mg; brown oil; $[\alpha]_D^{20}$ = -27.6 (*c* 1.4, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.88 – 7.86 (m, 2H), 7.52 – 7.44 (m, 1H), 7.41 (t, *J* = 7.4 Hz, 2H), 6.49-6.44 (m, 3H), 6.35 (t, *J* = 2.2 Hz, 1H), 6.19 – 6.12 (m, 1H), 3.89 (d, *J* = 11.5 Hz, 1H), 3.82 (s, 3H), 3.77 (s, 6H), 3.44 (d, *J* = 11.5 Hz, 1H), 2.92-2.90 (m, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.9, 169.3, 160.9, 139.1, 134.4, 132.9, 131.7, 128.6, 128.5, 124.2, 104.5, 99.7, 88.3, 55.3, 53.0, 41.3, 38.9. HRMS (ESI-TOF) Calcd. For $C_{22}H_{24}NO_4S^+$ ($[M+H]^+$): 398.1421, found: 398.1416. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 99% ee (Chiralpak IE-H, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 30.8 and 40.9 min.

**Methyl (*S*, *E*)-4-(3-(naphthalen-2-yl) allyl)-2-phenyl-4,5-dihydrothiazole-4-carboxylate (5m):**



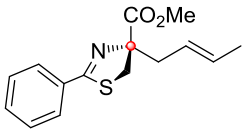

Yield (88%); 68.2 mg; brown soild; m.p. 98-100 ºC; $[\alpha]_D^{20}$ = -41.8 (*c* 1.3, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.90 – 7.87 (m, 2H), 7.76 (dd, *J* = 13.9, 5.4 Hz, 3H), 7.67 (s, 1H), 7.54 (dd, *J* = 8.5, 1.5 Hz, 1H), 7.47 – 7.38 (m, 5H), 6.67 (d, *J* = 15.8 Hz, 1H), 6.33 – 6.26 (m, 1H), 3.91 (d, *J* = 11.5 Hz, 1H), 3.82 (s, 3H), 3.47 (d, *J* = 11.5 Hz, 1H), 3.02 – 2.92 (m, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 173.0, 169.3, 134.6, 134.5, 133.6, 133.0, 132.9, 131.7, 128.7, 128.6, 128.2, 128.1, 128.0, 127.7, 126.3, 126.1, 125.8, 124.1, 123.7, 88.5, 53.0, 41.6, 39.0. HRMS (ESI-TOF) Calcd. For $C_{24}H_{22}NO_2S^+$ ($[M+H]^+$): 388.1366, found: 388.1363. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 99% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 13.8 and 16.5 min.

**Methyl (*S*, *E*)-4-(3-(furan-2-yl) allyl)-2-phenyl-4,5-dihydrothiazole-4-Carboxylate (5n):**



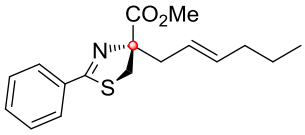

Yield (83%); 54.3 mg; white oil; $[\alpha]_D^{20}$ = -12.0 (*c* 0.7, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.88 – 7.86 (m, 2H), 7.51 – 7.45 (m, 1H), 7.43 – 7.41 (m, 2H), 7.31 (d, *J* = 1.4 Hz, 1H), 6.35 – 6.31 (m, 2H), 6.18 (d, *J* = 3.2 Hz, 1H), 6.14 – 6.06 (m, 1H), 3.90 (d, *J* = 11.5 Hz, 1H), 3.82 (s, 3H), 3.43 (d, *J* = 11.5 Hz, 1H), 2.95 – 2.82 (m, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.8, 169.2, 152.5, 141.8, 132.9, 131.6, 128.6, 128.5, 122.8, 122.3, 111.2, 107.4, 88.4, 53.0, 41.1, 38.8. HRMS (ESI-TOF) Calcd. For $C_{18}H_{18}NO_3S^+$ ($[M+H]^+$): 328.1002, found: 328.0997. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 96% ee (Chiralpak IE, *i*-propanol/ hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 10.7 and 12.3 min.

**Methyl (*S, E*)-4-(but-2-en-1-yl)-2-phenyl-4,5-dihydrothiazole-4-carboxylate (5o):**



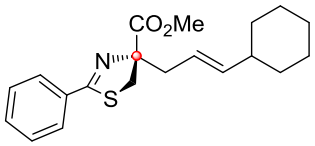

Yield (80%); 44.0 mg; white soild; m.p. 36-38 ºC; $[\alpha]_D^{20}$ = -32.3 (*c* 1.1, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 20/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.86 – 7.84 (m, 2H), 7.46 (t, *J* = 7.3 Hz, 1H), 7.39 (t, *J* = 7.4 Hz, 2H), 5.64-5.56 (m, 1H), 5.44 - 5.36 (m, 1H), 3.85 (d, *J* = 11.5 Hz, 1H), 3.80 (s, 3H), 3.38 (d, *J* = 11.4 Hz, 1H), 2.82 – 2.59 (m, 2H), 1.68 – 1.66 (m, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 173.1, 168.7, 133.0, 131.5, 130.4, 128.6, 128.5, 124.5, 88.6, 52.8, 41.0, 38.5, 18.1. HRMS (ESI-TOF) Calcd. For $C_{15}H_{18}NO_2S^+$ ($[M+H]^+$): 276.1053, found: 276.1049. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 84% ee (Chiralpak ID, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 220 nm); $t_r$ = 6.5 and 7.0 min.

**Methyl (*S, E*)-4-(hex-2-en-1-yl)-2-phenyl-4,5-dihydrothiazole-4-carboxylate (5q):**



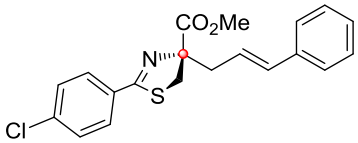

Yield (45%); 27.2 mg; white oil; $[\alpha]_D^{20}$ = -13.9 (*c* 0.6, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 20/1). $^1$H NMR (400 MHz, Chloroform-*d*) δ 7.91 – 7.78 (m, 2H), 7.50 – 7.44 (m, 1H), 7.42-7.38 (m, 2H), 5.60-5.55 (m, 1H), 5.41 – 5.36 (m, 1H), 3.87 (d, *J* = 11.5 Hz, 1H), 3.80 (s, 3H), 3.40 (d, *J* = 11.4 Hz, 1H), 2.75 – 2.67 (m, 2H), 2.01 – 1.95 (m, 2H), 1.38-1.33 (m, 2H), 0.86 (t, *J* = 7.4 Hz, 3H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 173.1, 168.7, 136.0, 133.0, 131.5, 128.6, 128.4, 123.4, 88.6, 52.8, 41.0, 38.5, 34.7, 22.5, 13.6. HRMS (ESI-TOF) Calcd. For $C_{17}H_{22}NO_2S^+$ ($[M+H]^+$): 304.1366, found: 304.1363. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 83% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 6.5 and 7.4 min.

**Methyl (*S, E*)-4-(3-cyclohexylallyl)-2-phenyl-4,5-dihydrothiazole-4-carboxylate (5r):**



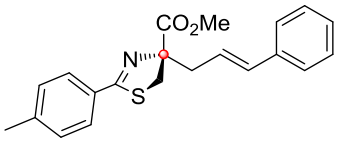

Yield (48%); 32.9 mg; white oil; $[\alpha]_D^{20}$ = -16.3 (*c* 0.8, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 20/1).$^1$H NMR (400 MHz, Chloroform-*d*) δ 7.86 – 7.84 (m, 2H), 7.47 – 7.45 (m, 1H), 7.42 – 7.38 (m, 2H), 5.52-5.49 (m, 1H), 5.35-5.33 (m, 1H), 3.86 (d, *J* = 11.5 Hz, 1H), 3.79 (s, 3H), 3.39 (d, *J* = 11.4 Hz, 1H), 2.70-2.64 (m, 2H), 1.93-1.90 (m, 1H), 1.70 – 1.63 (m, 5H), 1.26 – 1.01 (m, 5H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 173.1, 168.7, 142.1, 133.0, 131.5, 128.6, 128.4, 120.6, 88.7, 52.8, 41.1, 40.8, 38.3, 32.94, 32.93, 26.1, 25.9. HRMS (ESI-TOF) Calcd. For $C_{20}H_{26}NO_2S^+$ ($[M+H]^+$): 344.1679, found: 344.1678. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 69% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 220 nm); $t_r$ = 6.8 and 8.2 min.

**Methyl (*S, E*)-2-(4-chlorophenyl)-4-cinnamyl-4,5-dihydrothiazole-4-carboxylate (5s):**



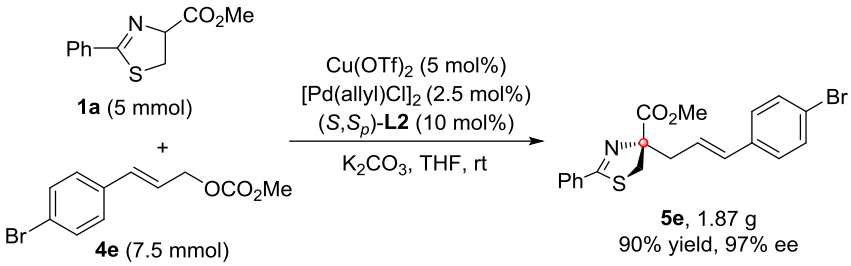

Yield (86%); 64.3 mg; yellow oil; $[\alpha]_D^{20}$ = -51.5 (*c* 0.8, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 15/1). $^1$H NMR (400 MHz, Chloroform-d) δ 7.83 – 7.80 (m, 2H), 7.41 – 7.37 (m, 2H), 7.34 – 7.27 (m, 4H), 7.25 – 7.20 (m, 1H), 6.52 (dd, *J* = 15.7, 1.4 Hz, 1H), 6.18-6.10 (m, 1H), 3.91 (d, *J* = 11.5 Hz, 1H), 3.82 (s, 3H), 3.47 (d, *J* = 11.5 Hz, 1H), 2.93-2.90 (m, 2H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 172.8, 168.0, 137.8, 137.0, 134.6, 131.3, 129.9, 128.8, 128.5, 127.5, 126.3, 123.4, 88.4, 53.0, 41.4, 39.1. HRMS (ESI-TOF) Calcd. For $C_{20}H_{19}ClNO_2S^+$ ($[M+H]^+$): 372.0820, found: 372.0820. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 97% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 8.5 and 9.1 min.

**Methyl (*S, E*)-4-cinnamyl-2-(p-tolyl)-4,5-dihydrothiazole-4-carboxylate (5t):**



Yield (96%); 67.5 mg; yellow oil; $[\alpha]_D^{20}$ = -41.2 (*c* 1.0, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 20/1). $^1$H NMR (400 MHz, Chloroform-*d*) δ 7.77 – 7.75 (m, 2H), 7.34 – 7.26 (m, 4H), 7.23 – 7.18 (m, 3H), 6.54 – 6.49 (m, 1H), 6.19 – 6.12 (m, 1H), 3.87 (d, *J* = 11.5 Hz, 1H), 3.81 (s, 3H), 3.43 (d, *J* = 11.4 Hz, 1H), 2.93-2.90 (m, 2H), 2.39 (s, 3H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 173.1, 169.1, 142.1, 137.1, 134.4, 130.2, 129.2, 128.6, 128.5, 127.5, 126.3, 123.7, 88.3, 52.9, 41.4, 38.7, 21.5. HRMS (ESI-TOF) Calcd. For $C_{20}H_{19}ClNO_2S^+$ ([M+H]$^+$): 352.1366, found: 352.1374. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 98% ee (Chiralpak IE, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 10.4 and 11.6 min.

## III. General procedures for gram-scale reaction and synthetic transformation

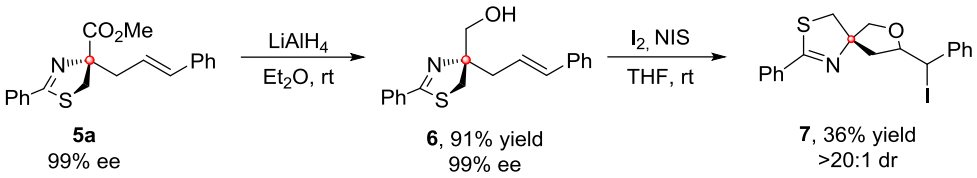



The preparation of Cu catalyst: A flame dried Schlenk tube was cooled to rt and filled with $N_2$. To this flask were added ($S$,$S_p$)-$^t$Bu-Phosferrox **L2** (0.25 mmol, 5 mol %) and $Cu(OTf)_2$ (0.25 mmol, 5 mol %) were dissolved in 5 mL THF, and stirred at room temperature for about 0.5 h.

The preparation of Pd catalyst: A flame dried Schlenk tube was cooled to rt and filled with $N_2$. To this flask were added ($S$,$S_p$)-$^t$Bu-Phosferrox **L2** (0.25 mmol, 5 mol %) and [Pd($\eta^3$-allyl)Cl]$_2$ (0.125 mmol, 2.5 mol %), which were dissolved in 5 mL THF, and stirred at room temperature for about 0.5 h.

A flame dried Schlenk tube was cooled to rt and filled with $N_2$. To this flask were added methyl 2-phenyl-4,5-dihydrothiazole-4-carboxylate (5.0 mmol, 1.0 equiv), $K_2CO_3$ (5.0 mmol, 1.0 equiv), Cu catalyst (5 mol %) and Pd catalyst (5 mol %). The methyl cinnamyl carbonate (7.5 mmol, 1.5 equiv)

was then added. The reaction mixture was stirred at room temperature for 24 h. The organic solvent was removed by rotary evaporation. The dr value was determined by $^1$H NMR analysis of the crude mixture and the residue was purified by column chromatography on silica gel to give the allylation product **5e**, which was then directly analyzed by chiral HPLC to determine the enantiomeric excess.




**5a**
99% ee

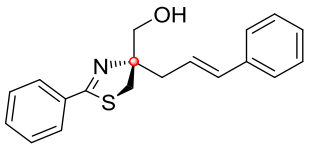
**6**, 91% yield
99% ee

**7**, 36% yield
>20:1 dr

$LiAlH_4$ (52.8 mg, 1.4 mmol) was added slowly in parts to a stirred solution of **5a** (1 mmol) in $Et_2O$ (10 mL). After 3 h, the reaction was completed (checked by TLC). Ethyl acetate was added, and then the mixture was washed with saturated aq. $NaHCO_3$ (2×5 mL), $H_2O$ (2×5 mL), saturated aq. NaCl (2×5 mL), and dried with anhydrous $Na_2SO_4$. The residue was purified by column chromatography (eluent: petroleum ether/ethyl acetate = 10/1) to give the product **6** (282.0 mg, 91 %), as a yellow oil.[5]

To a solution of compound **6** (76.4 mg, 0.247 mmol) in dry THF (20 mL) at 0 °C was added NIS (56 mg, 0.247 mmol) and $I_2$ (63 mg, 0.247 mmol) in four portions during 30 min. After stirring for an additional 24 h at room temperature, the reaction was completed (checked by TLC). 10% aqueous $Na_2S_2O_3$ (10 mL) was added to the reaction mixture and extracted with EtOAc (3×20 mL). The combined organic layer was dried over $Na_2SO_4$ and concentrated under reduced pressure to obtain a residue that was subjected to column chromatography (eluent: petroleum ether/ethyl acetate = 30/1) to afford compound **7** (38.7 mg, 36%) as a yellow solid.[6]

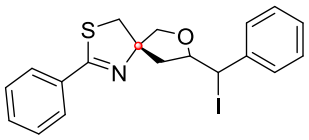
**(*S*)-(4-cinnamyl-2-phenyl-4,5-dihydrothiazol-4-yl)methanol (6):**



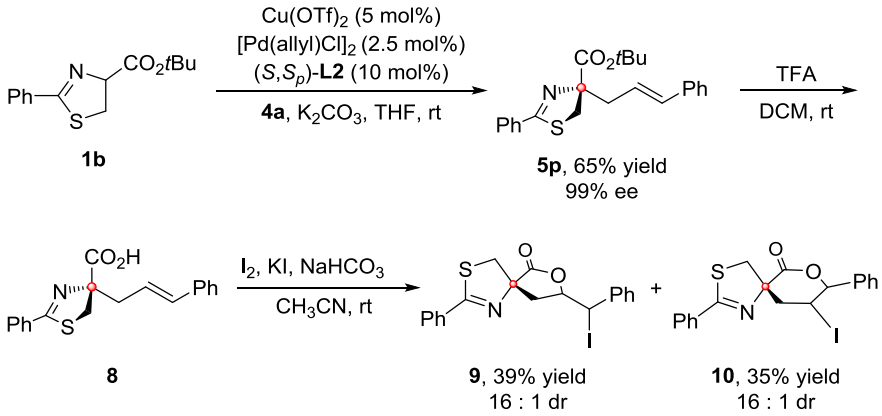

Yield (91%); 282 mg; yellow oil; $[\alpha]_D^{20}$ = -55.6 (*c* 0.5, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether: ethyl acetate = 10:1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.82 – 7.80 (m, 2H), 7.50 – 7.45 (m, 1H), 7.42 – 7.38 (m, 2H), 7.35 - 7.27 (m, 4H), 7.23 – 7.19 (m, 1H), 6.52 (d, *J* = 15.8 Hz, 1H), 6.25 – 6.17 (m, 1H), 3.97 (d, *J* = 11.1 Hz, 1H), 3.68 (d, *J* =

11.1 Hz, 1H), 3.42 (d, *J* = 11.0 Hz, 1H), 3.28 (d, *J* = 11.0 Hz, 1H), 2.72-2.59 (m, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 168.7, 137.3, 133.8, 133.0, 131.4, 128.54, 128.50, 128.4, 127.3, 126.2, 124.6, 86.6, 67.9, 39.6, 37.2. HRMS (ESI-TOF) Calcd. For $C_{19}H_{20}NOS^+$ ($[M+H]^+$): 310.1260, found: 310.1255. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 99% ee (Chiralpak ID, *i*-propanol/hexane = 2/98, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 15.2 and 24.1 min.

**(*S*)-8-(iodo(phenyl)methyl)-2-phenyl-7-oxa-3-thia-1-azaspiro[4.4]non-1-ene (7):**




Yield (36%); 38.7 mg; yellow solid; m.p. 42-44 °C; $[\alpha]_D^{20}$ = +14.0 (*c* 0.9, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 30/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 8.04 – 8.02 (m, 2H), 7.57 (t, *J* = 7.4 Hz, 1H), 7.47 -7.41 (m, 4H), 7.34 – 7.32 (m, 3H), 4.45 – 4.32 (m, 3H), 4.02 (dd, *J* = 9.9, 1.6 Hz, 1H), 3.39 (d, *J* = 13.2 Hz, 1H), 3.09 (d, *J* = 13.2 Hz, 1H), 2.80 – 2.78 (m, 1H), 2.38 (dd, *J* = 13.9, 10.3 Hz, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 166.2, 138.8, 133.4, 129.6, 129.5, 128.54, 128.52, 128.4, 127.4, 71.6, 68.9, 64.0, 49.9, 46.1, 27.1. HRMS (ESI-TOF) Calcd. For $C_{19}H_{18}NOS^+$ ($[M-I]^+$): 309.1181, found: 309.1149.




The preparation of Cu catalyst: A flame dried Schlenk tube was cooled to rt and filled with $N_2$. To this flask were added (*S*,*S*$_p$)-$^t$Bu-Phosferrox **L2** (0.05 mmol, 5 mol %) and $Cu(OTf)_2$ (0.05 mmol, 5 mol %) were dissolved in 5 mL THF, and stirred at room temperature for about 0.5 h.

The preparation of Pd catalyst: A flame dried Schlenk tube was cooled to rt and filled with $N_2$. To

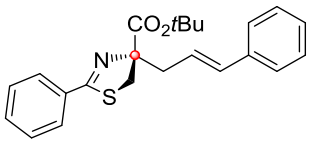
this flask were added ($S,S_p$)-$^t$Bu-Phosferrox **L2** (0.05 mmol, 5 mol %) and [Pd($\eta^3$-allyl)Cl]$_2$ (0.025 mmol, 2.5 mol %), which were dissolved in 5 mL THF, and stirred at room temperature for about 0.5 h.

A flame dried Schlenk tube was cooled to rt and filled with $N_2$. To this flask were added **1b** (1.0 mmol, 1.0 equiv), $K_2CO_3$ (1.0 mmol, 1.0 equiv), Cu catalyst (5 mol %) and Pd catalyst (5 mol %). The methyl cinnamyl carbonate (1.5 mmol, 1.5 equiv) was then added. The reaction mixture was stirred at room temperature for 24 h. The organic solvent was removed by rotary evaporation. The dr value was determined by $^1$H NMR analysis of the crude mixture and the residue was purified by column chromatography to give the allylation product **5p** (246.0 mg, 65%), which was then directly analyzed by HPLC to determine the enantiomeric excess.

**5p** (246 mg, 0.65 mmol, 1.0 equiv) was dissolved in DCM and TFA was added (3:1 v/v, 0.2 M). The reaction was stirred at 25 °C for 2 hours and concentrated under reduced pressure to obtain crude residue **8**, it was used in the next reaction without further purification.[7]

To a solution of **8** (0.65 mmol, 1.0 equiv) in MeCN (15 mL), were added $NaHCO_3$ (0.78 mmol, 1.2 equiv), $I_2$ (0.78 mmol, 1.2 equiv), KI (0.78 mmol, 1.2 equiv) at 0 °C, after stirring for 2 h, the reaction mixture was allowed to warm to room temperature and stirred for 10 h. The reaction was quenched with saturated aqueous $Na_2S_2O_3$ solution (20 mL) and diluted with EtOAc (25 mL). The organic layer was separated and the aqueous layer extracted with EtOAc (2×25 mL). The combined organic layers were dried over anhydrous $Na_2SO_4$ and concentrated under reduced pressure. The crude residue was purified by silica gel column chromatography (eluent: petroleum ether/ethyl acetate = 40/1) to obtain the **9** (113.0mg, 39%, dr = 16:1) and **10** (102.0 mg, 36%, dr = 16:1) as a yellow solid.[8]

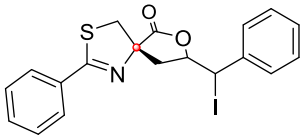
**Tert-butyl (*S*)-4-cinnamyl-2-phenyl-4,5-dihydrothiazole-4-carboxylate (5p):**




Yield (65%); 246.0 mg; yellow oil; $[\alpha]_D^{20}$ = -13.4 (*c* 1.4, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 50/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.89 – 7.87 (m, 2H), 7.48 – 7.42 (m, 1H), 7.41 – 7.36 (m, 2H), 7.35 – 7.30 (m, 2H), 7.30 – 7.25 (m, 2H), 7.22 – 7.15 (m, 1H), 6.52 (d, *J* = 15.8 Hz, 1H), 6.26 – 6.18 (m, 1H), 3.82 (d, *J* = 11.4 Hz,

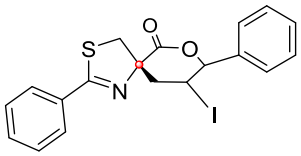
1H), 3.39 (d, *J* = 11.4 Hz, 1H), 2.93 – 2.84 (m, 2H), 1.49 (s, 9H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 171.3, 168.5, 137.2, 134.0, 133.1, 131.4, 128.6, 128.5, 128.4, 127.4, 126.3, 124.3, 88.7, 82.2, 41.4, 39.1, 28.1. HRMS (ESI-TOF) Calcd. For $C_{23}H_{26}NO_2S^+$ ($[M+H]^+$): 380.1679, found: 380.1672. The product was analyzed by chiral HPLC to determine the enantiomeric excess: 99% ee (Chiralpak ID, *i*-propanol/hexane = 1/99, flow rate 1.0 mL/min, λ = 254 nm); $t_r$ = 5.8 and 6.8 min.

**(*S*)-8-(iodo(phenyl)methyl)-2-phenyl-7-oxa-3-thia-1-azaspiro[4.4]non-1-en-6-one (9):**



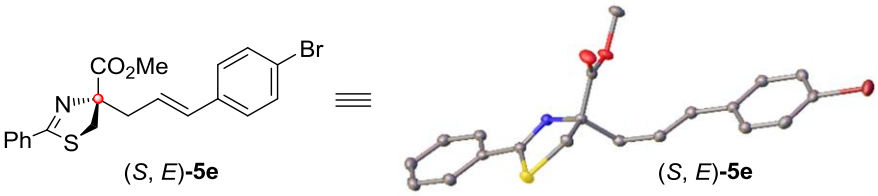

Yield (39%); 113.0 mg; yellow solid; m.p. 110-112 ºC; $[\alpha]_D^{20}$ = +38.4 (*c* 0.8, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 40/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.84 – 7.82 (m, 2H), 7.50 – 7.46 (m, 3H), 7.43 -7.40 (m, 2H), 7.36 – 7.29 (m, 3H), 5.24 – 5.16 (m, 2H), 4.01 (d, *J* = 11.2 Hz, 1H), 3.34 (d, *J* = 11.2 Hz, 1H), 2.98 – 2.94 (m, 1H), 2.20 – 2.15 (m, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 174.4, 170.7, 139.2, 132.2, 132.0, 129.0, 128.8, 128.7, 128.6, 128.2, 85.9, 80.6, 45.0, 38.4, 33.5. HRMS (ESI-TOF) Calcd. For $C_{19}H_{17}INO_2S^+$ ($[M+H]^+$): 450.0019, found: 450.0011.

**(*S*)-9-iodo-2,8-diphenyl-7-oxa-3-thia-1-azaspiro[4.5]dec-1-en-6-one (10):**




Yield (35%); 102.0 mg; yellow solid; m.p. 110-112 ºC; $[\alpha]_D^{20}$ = -94.4 (*c* 0.5, $CHCl_3$); it was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 40/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.88 – 7.86 (m, 2H), 7.53 – 7.51 (m, 1H), 7.49 – 7.45 (m, 4H), 7.35 – 7.29 (m, 3H), 5.52 (d, *J* = 10.0 Hz, 1H), 5.17 – 5.12 (m, 1H), 3.87 (d, *J* = 11.2 Hz, 1H), 3.44 (d, *J* = 11.6 Hz, 1H), 2.90 – 2.76 (m, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 175.2, 171.4, 139.5, 132.1, 128.9, 128.8, 128.7, 128.2, 84.2, 80.3, 42.2, 40.0, 33.8. HRMS (ESI-TOF) Calcd. For $C_{19}H_{17}INO_2S^+$ ($[M+H]^+$): 450.0019, found: 450.0014.

## IV. Absolute configuration determination of (*S, E*)-5e




In a 10 mL oven-dried glass sample vial, 10 mg pure **5e** and 0.1 mL $CH_3OH$ were added, and then 4 mL *n*-hexane was slowly added to the solution, which was sealed with perforated paper at room temperature to grow crystals.

| | | | |
|---|---|---|---|
| Bond precision: | C-C = 0.0041 A | | Wavelength = 1.54184 |
| Cell: | a = 7.6819 (1) | b = 5.8950 (1) | c = 20.1743 (1) |
| | alpha = 90 | beta = 91.416 (1) | gamma = 90 |
| Temperature: | 100 K | | |
| | | Calculated | Reported |
| Volume | | 913.31 (2) | 913.31 (2) |
| Space group | | P 21 | P 1 21 1 |
| Hall group | | P 2yb | P 2yb |
| Moiety formula | | C20 H18 Br N O2 S | C20 H18 Br N O2 S |
| Sum formula | | C20 H18 Br N O2 S | C20 H18 Br N O2 S |
| Mr | | 416.31 | 416.32 |
| Dx, g $cm^{-3}$ | | 1.514 | 1.514 |
| Z | | 2 | 2 |
| Mu ($mm^{-1}$) | | 4.240 | 4.240 |
| F000 | | 424.0 | 424.0 |
| F000’ | | 424.26 | |
| h,k,lmax | | 9,7,25 | 9,7,25 |
| Nref | | 3699[ 2039] | 3585 |
| Tmin,Tmax | | 0.489,0.809 | 0.548,1.000 |
| Tmin’ | | 0.267 | |

Correction method = # Reported T Limits: Tmin = 0.548 Tmax = 1.000

AbsCorr = MULTI-SCAN

Data completeness = 1.76/0.97 Theta(max) = 73.736

R(reflections) = 0.0213( 3567) wR2(reflections) = 0.0579( 3585)

S = 1.080 Npar= 227

**V. Reference**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3. Richards, C. J.; Mulvaney, A. W.; *Tetrahedron: Asymmetry* **1996**, *7*, 1419.
4. The X-ray crystal data of compound **5e** has been deposited with the Cambridge Crystallographic Data Centre as supplementary publication no. CCDC 2074630. Copies of the data can be obtained, free of charge, on application to the CCDC, 12 Union Road, Cambridge CB21EZ, UK [Fax: +44 (1223)336033 or E-mail: deposit@ccdc.cam.ac.uk].
5. Einsiedel, J.; Hubner, H.; Gmeiner, P. *Bioorg. Med. Chem. Lett.* **2001**, *11*, 2533.
6. Ghosal, P.; Ajay, S.; Meena, S.; Sinha, S.; Shaw, A.-K. *Tetrahedron: Asymmetry* **2013**, *24*, 903.
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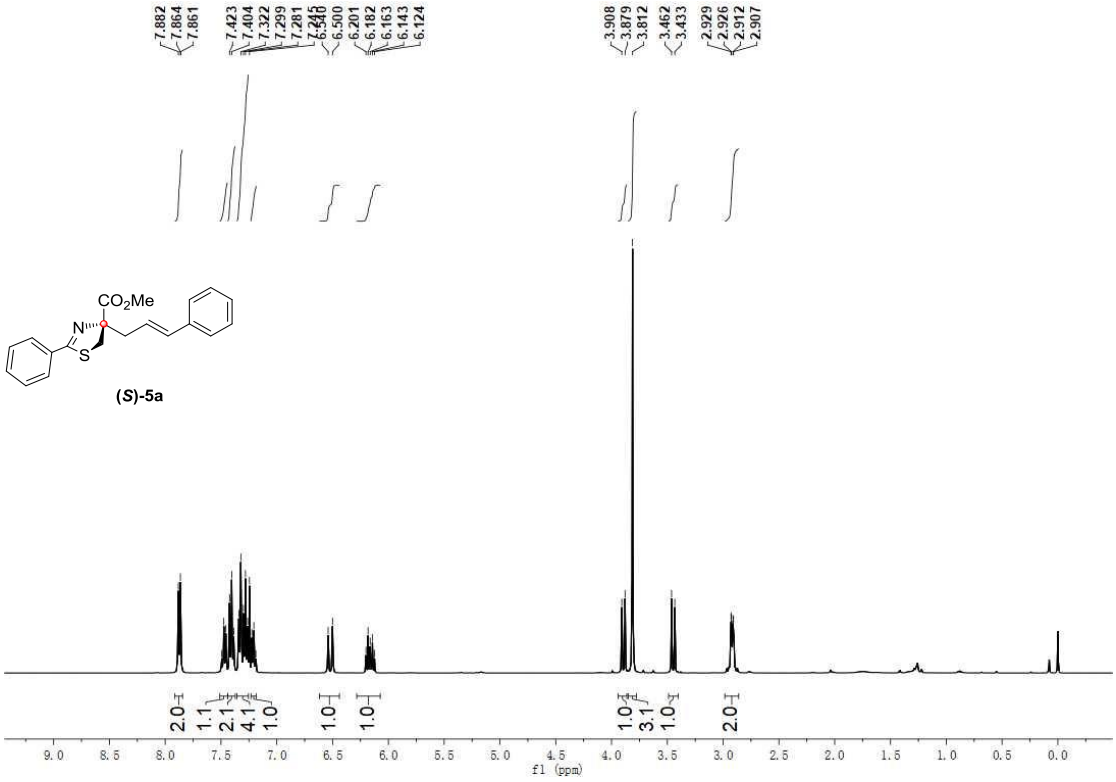
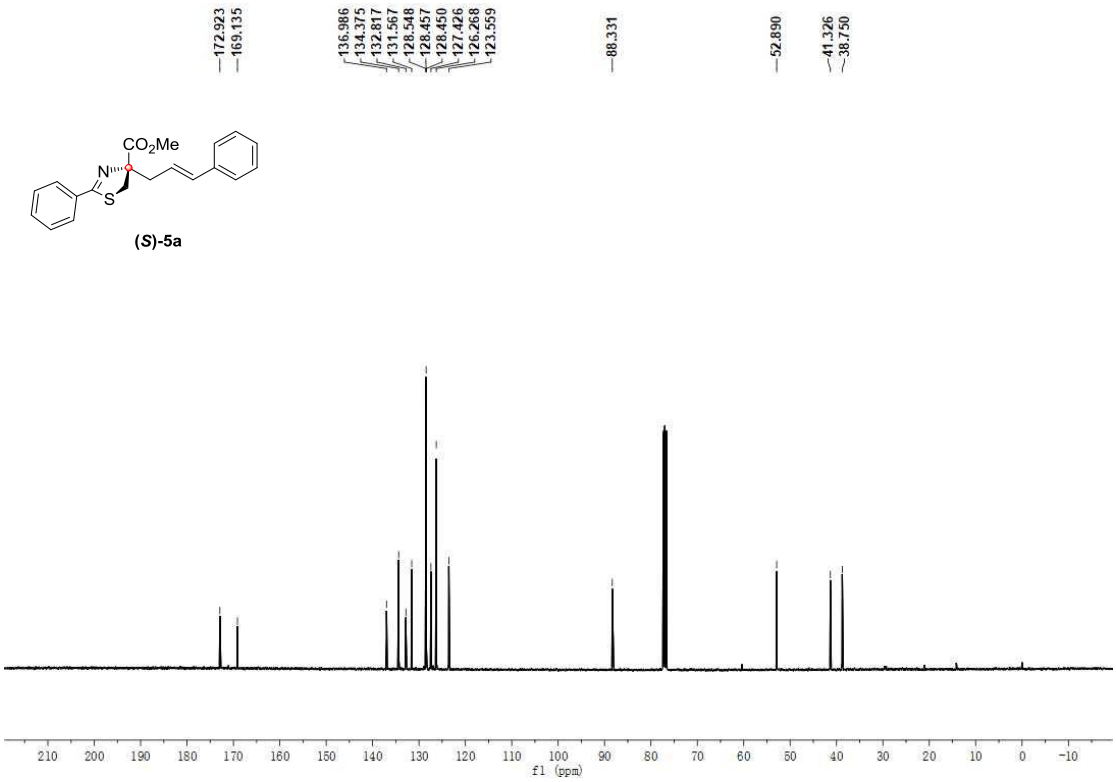
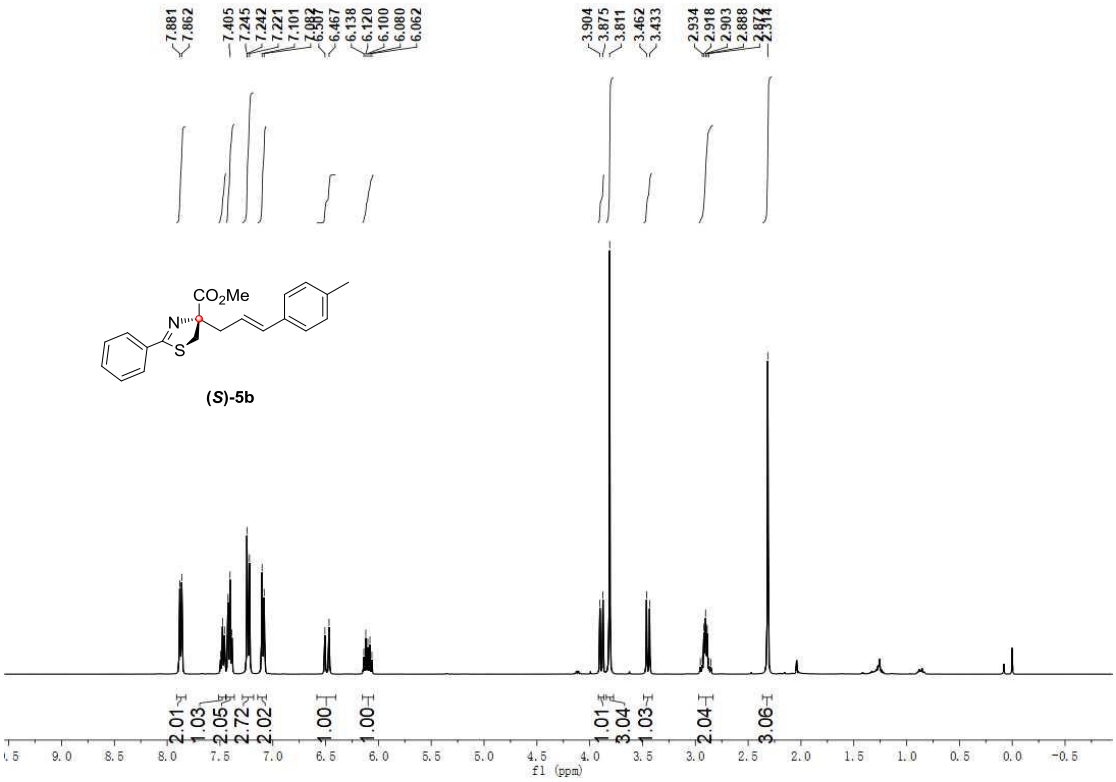
## VI. $^{1}$H NMR and $^{13}$C NMR spectra



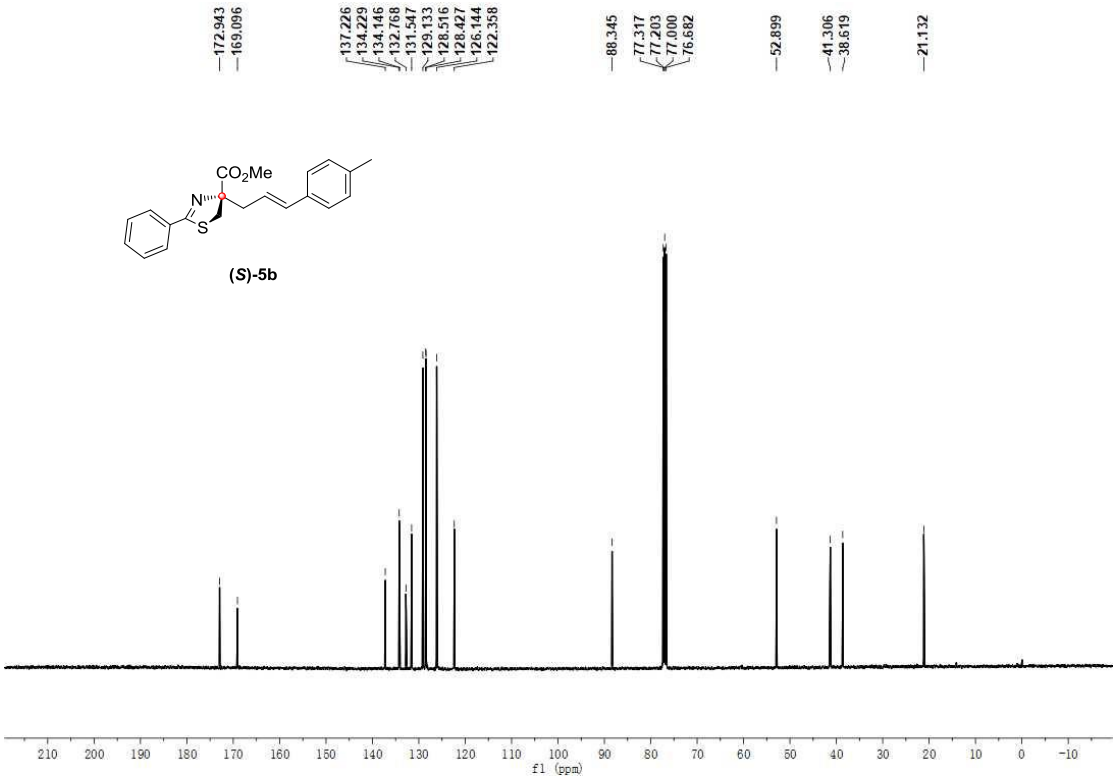

**$^{1}$H NMR** (400 MHz, $CDCl_3$)



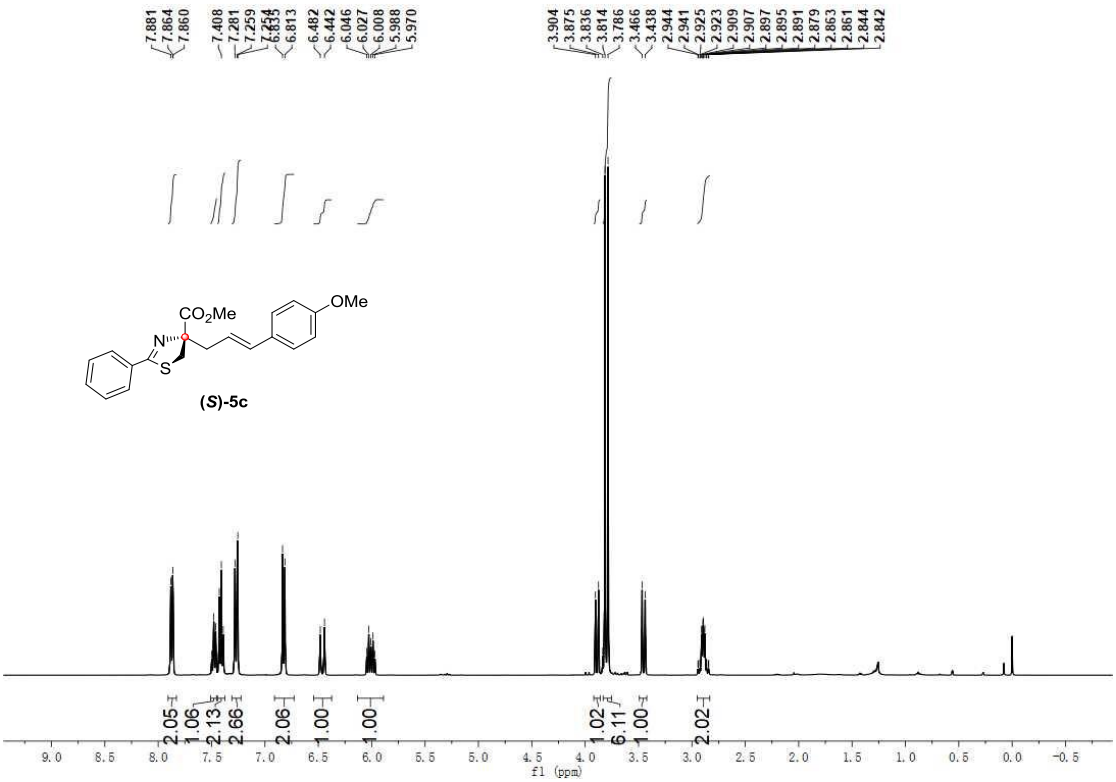

**$^{13}$C NMR** (100 MHz, $CDCl_3$)




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




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

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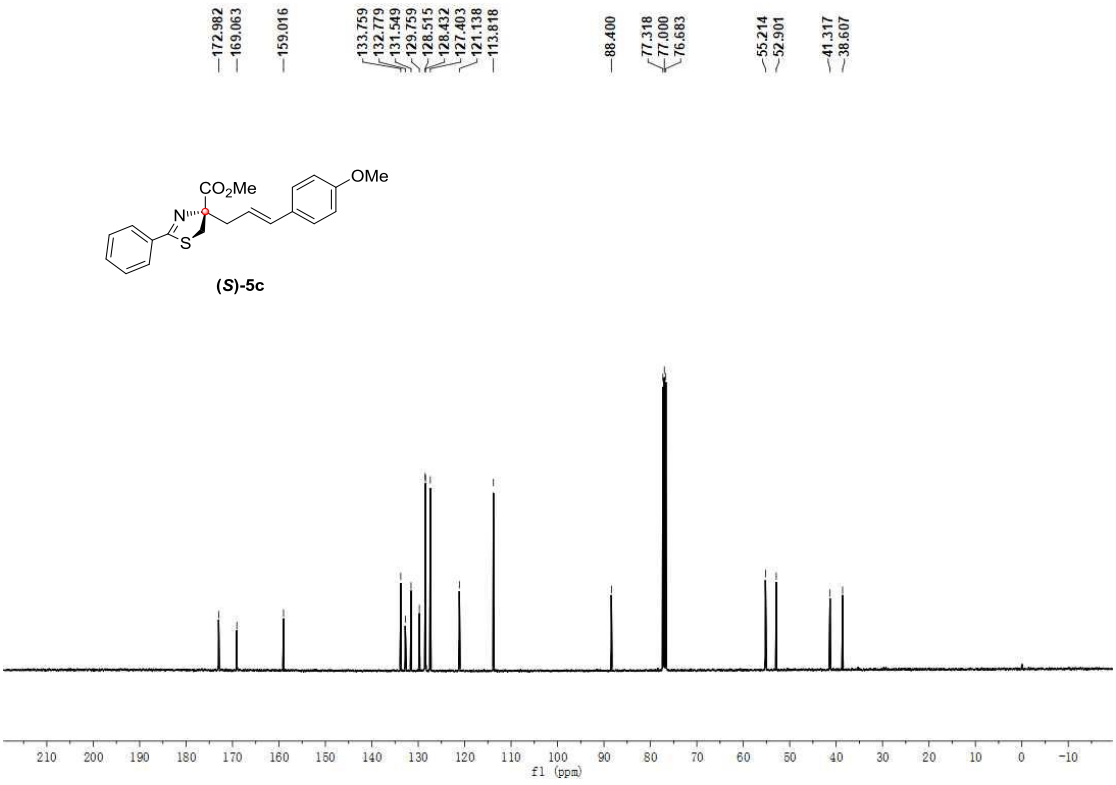
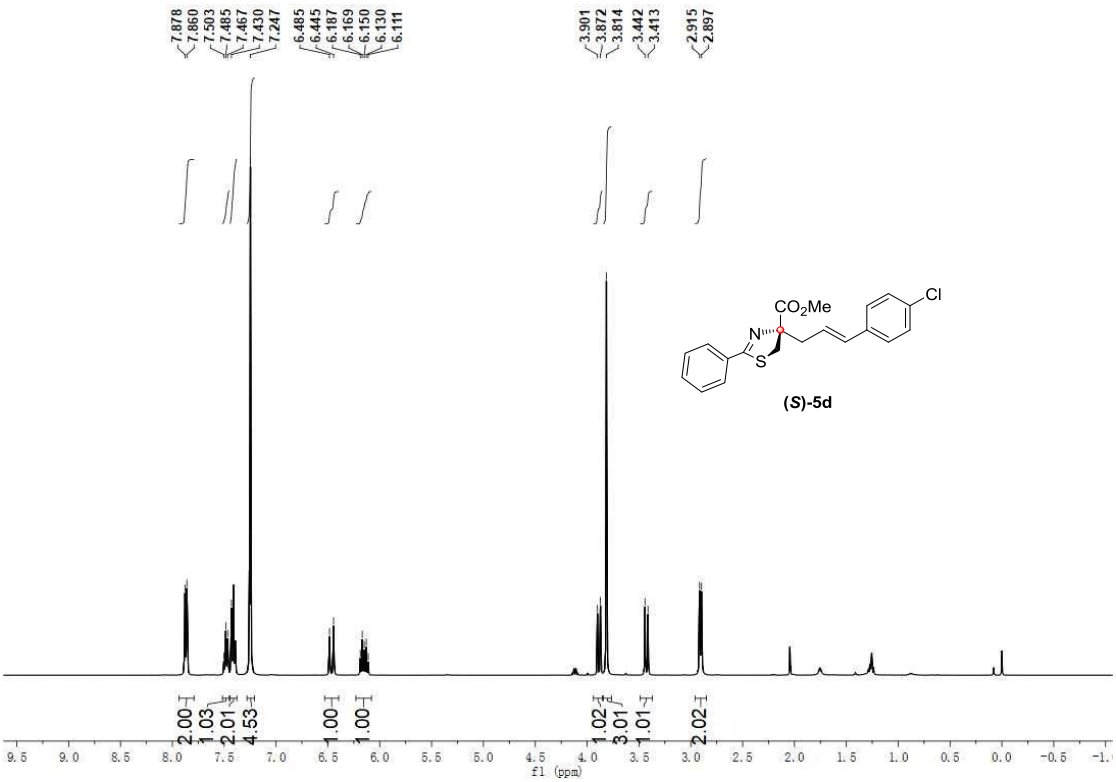



**$^{13}$C NMR** (100 MHz, $CDCl_3$)

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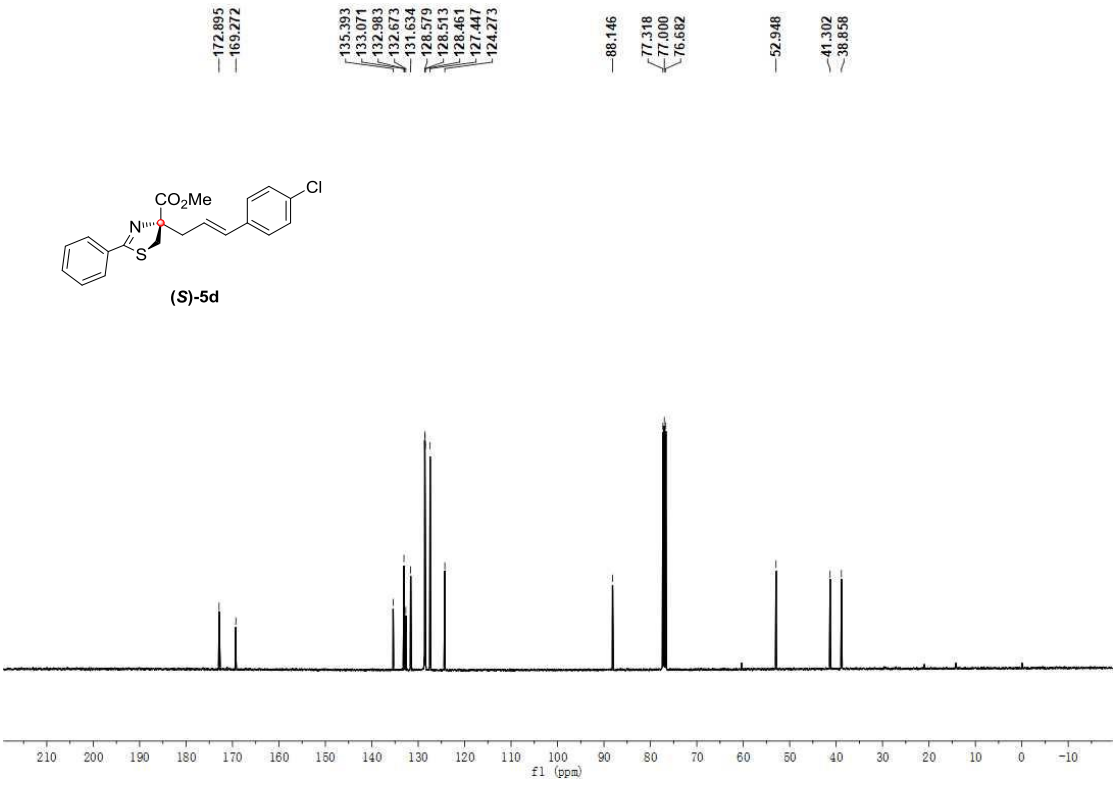
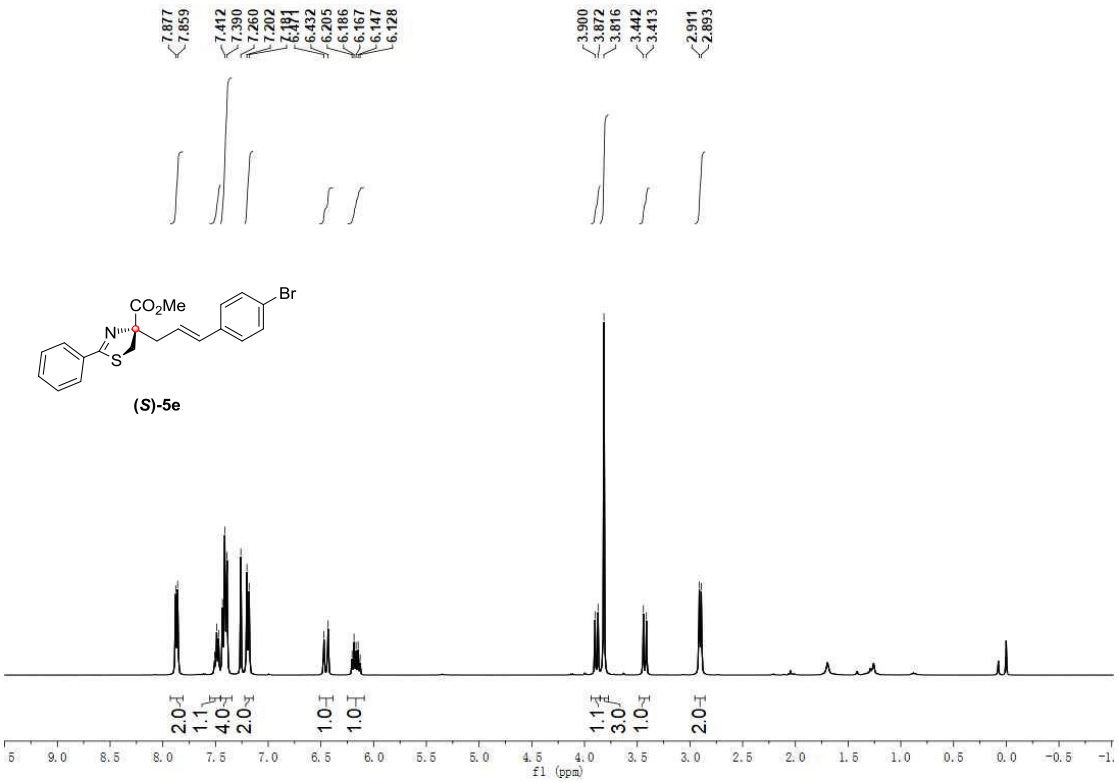



**$^{13}$C NMR** (100 MHz, $CDCl_3$)

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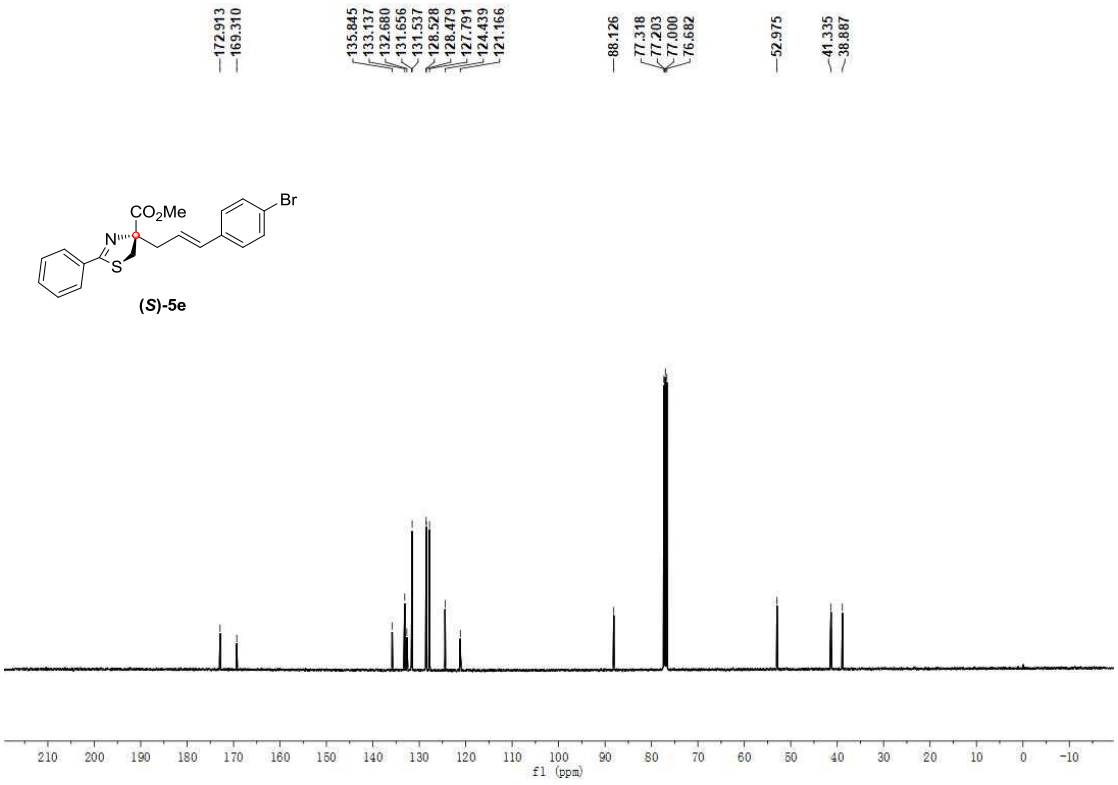
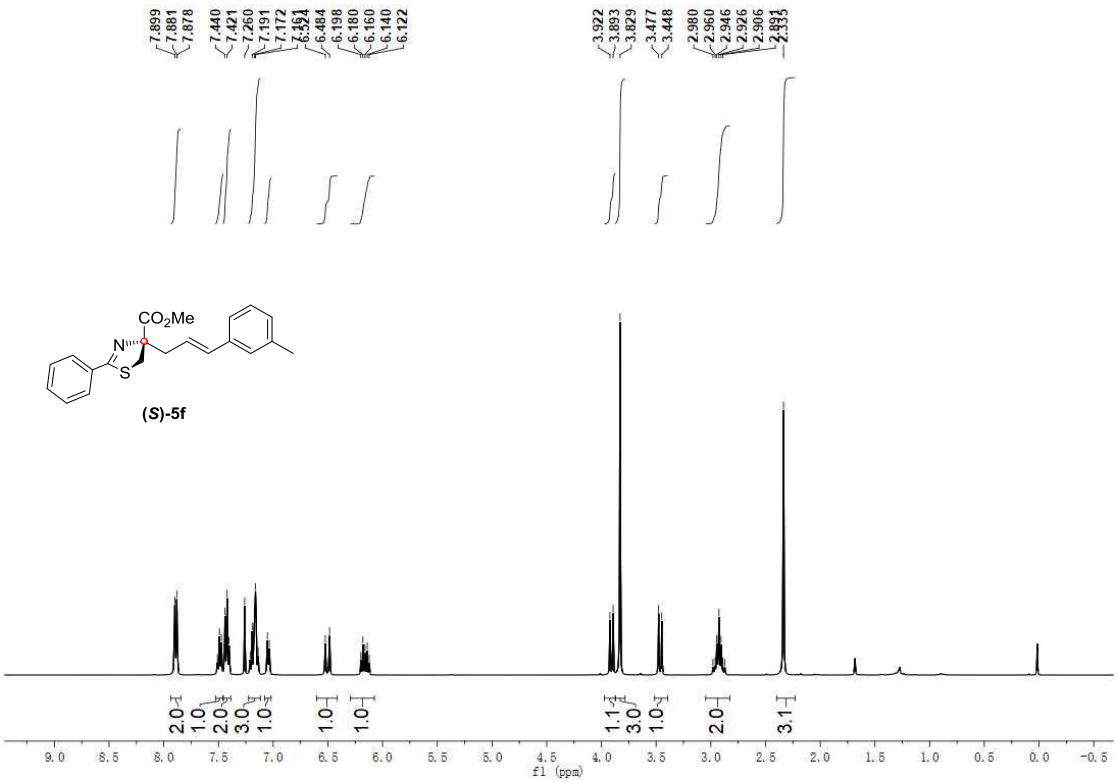



**$^{13}$C NMR** (100 MHz, $CDCl_3$)

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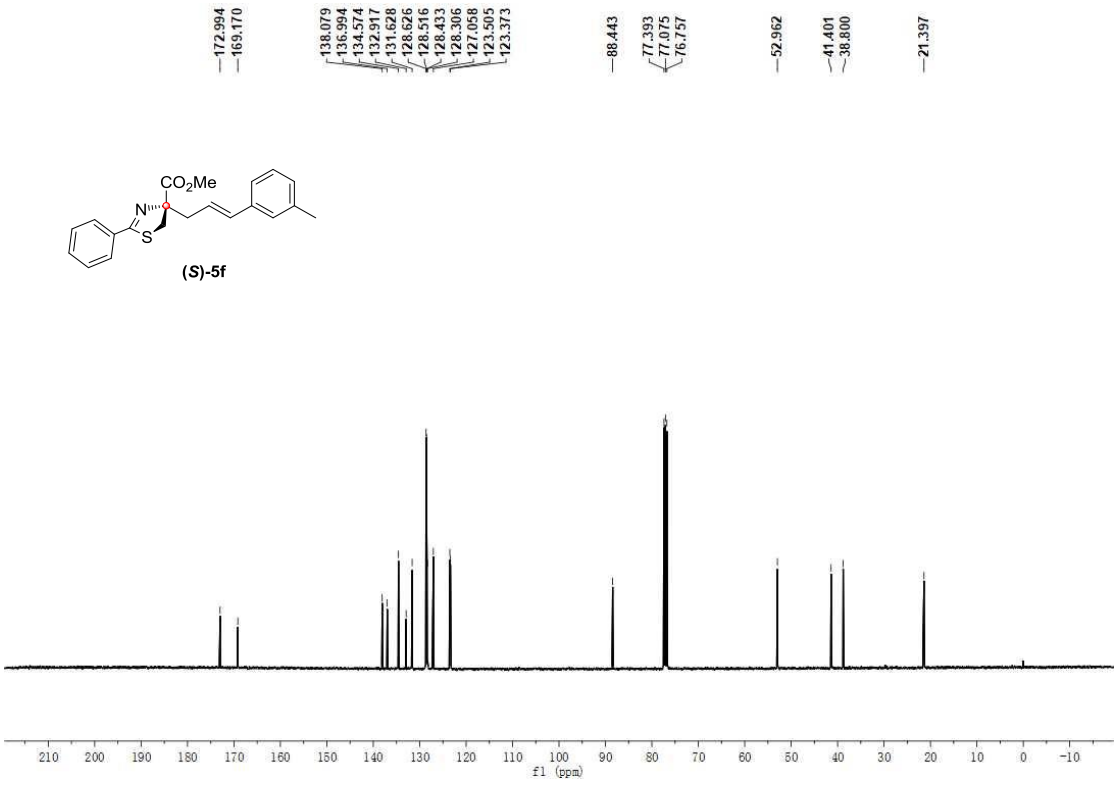


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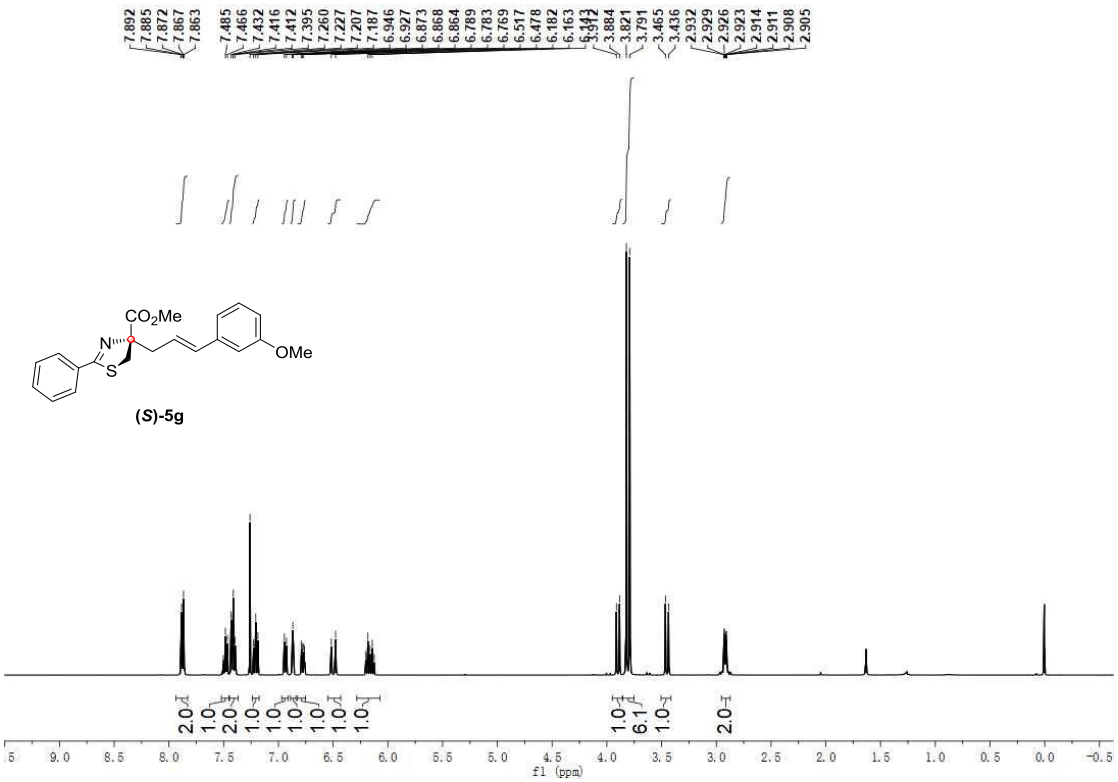


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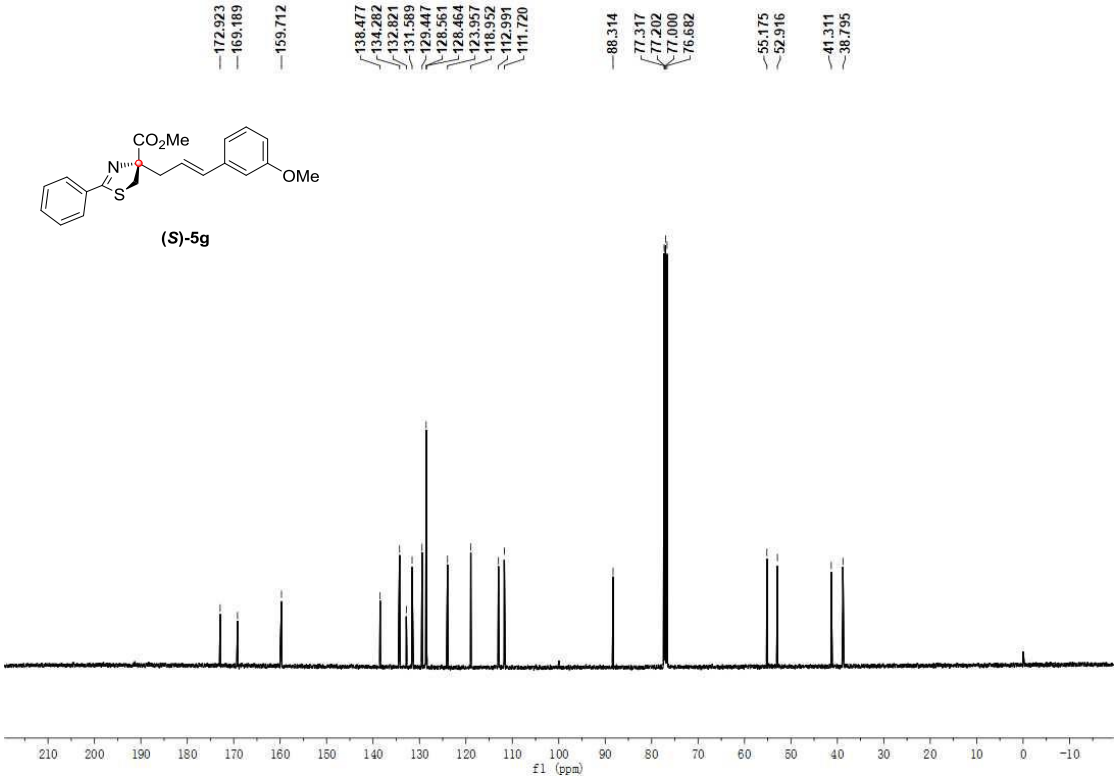


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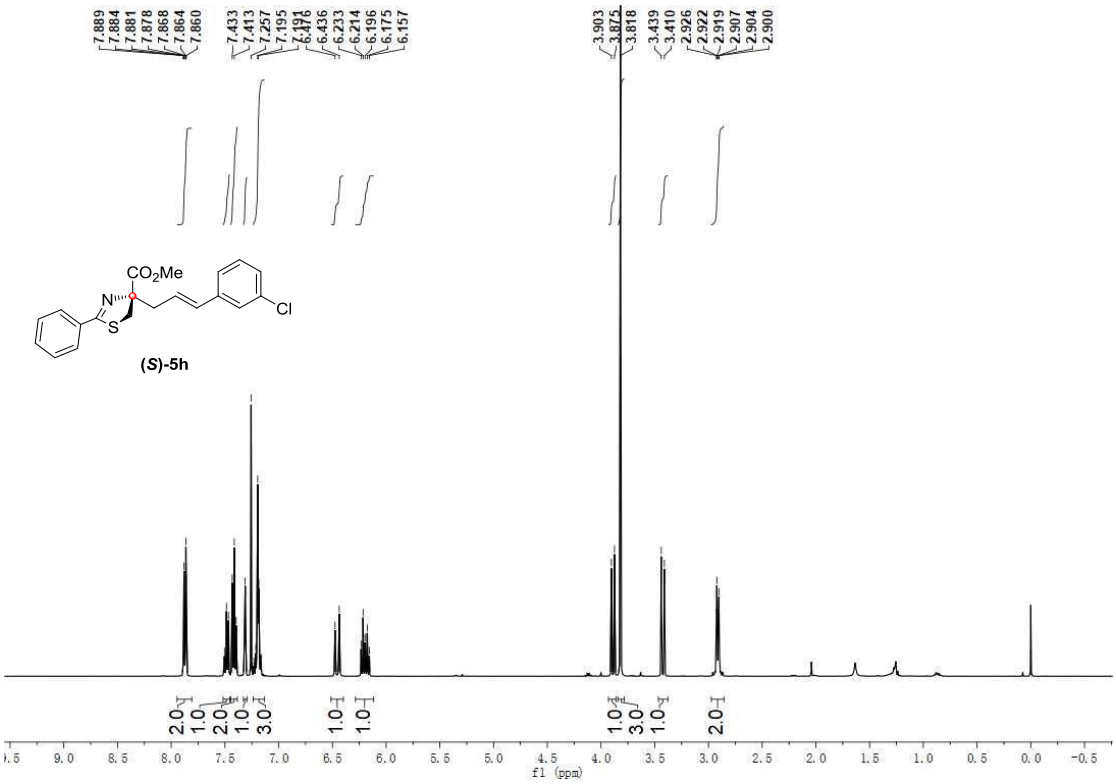
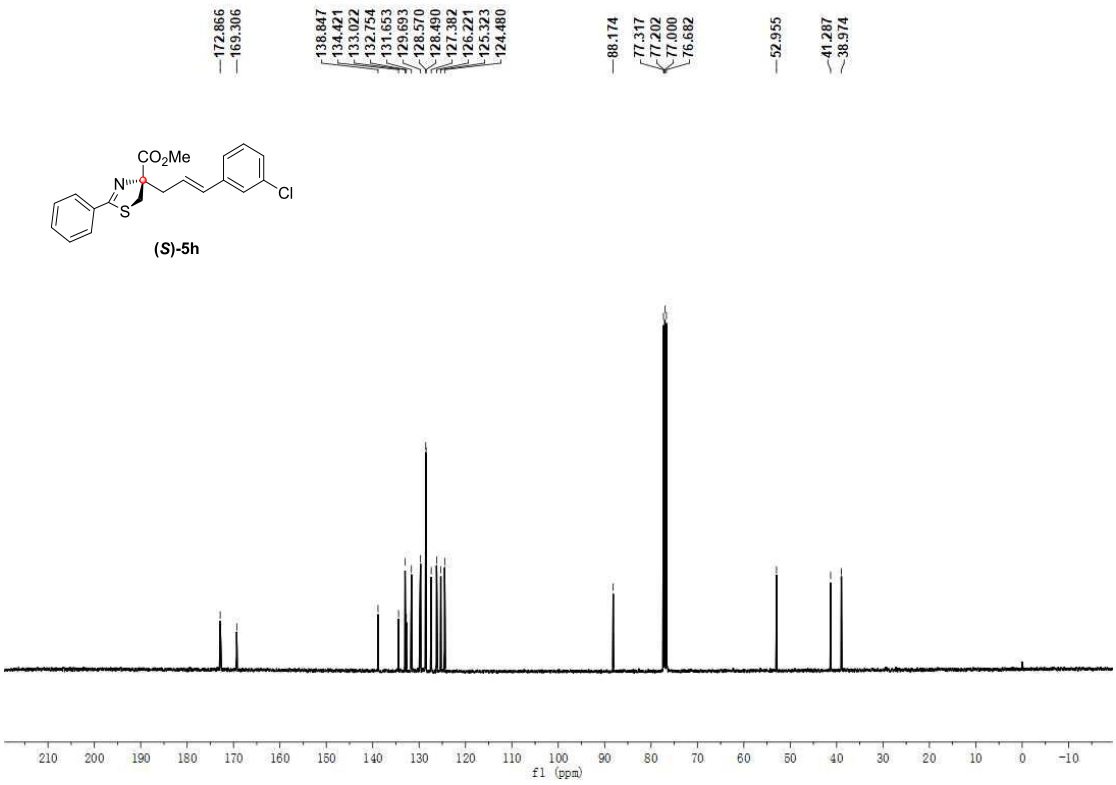



**$^{1}$H NMR** (400 MHz, $CDCl_3$)

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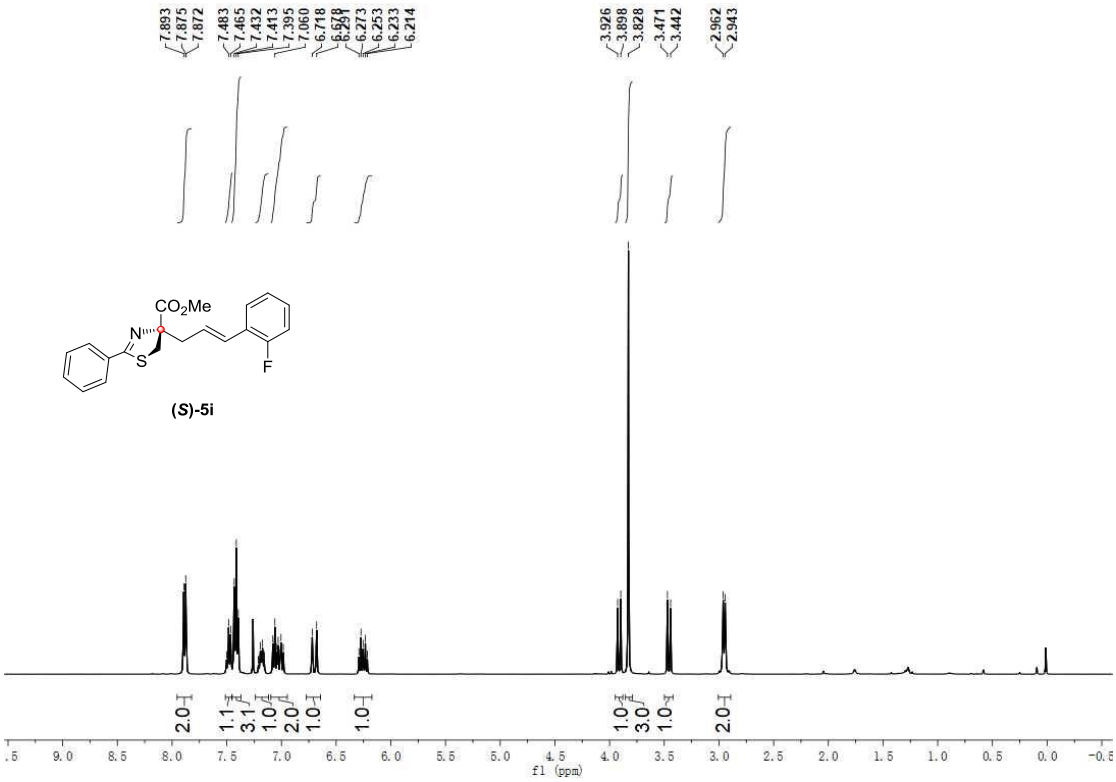
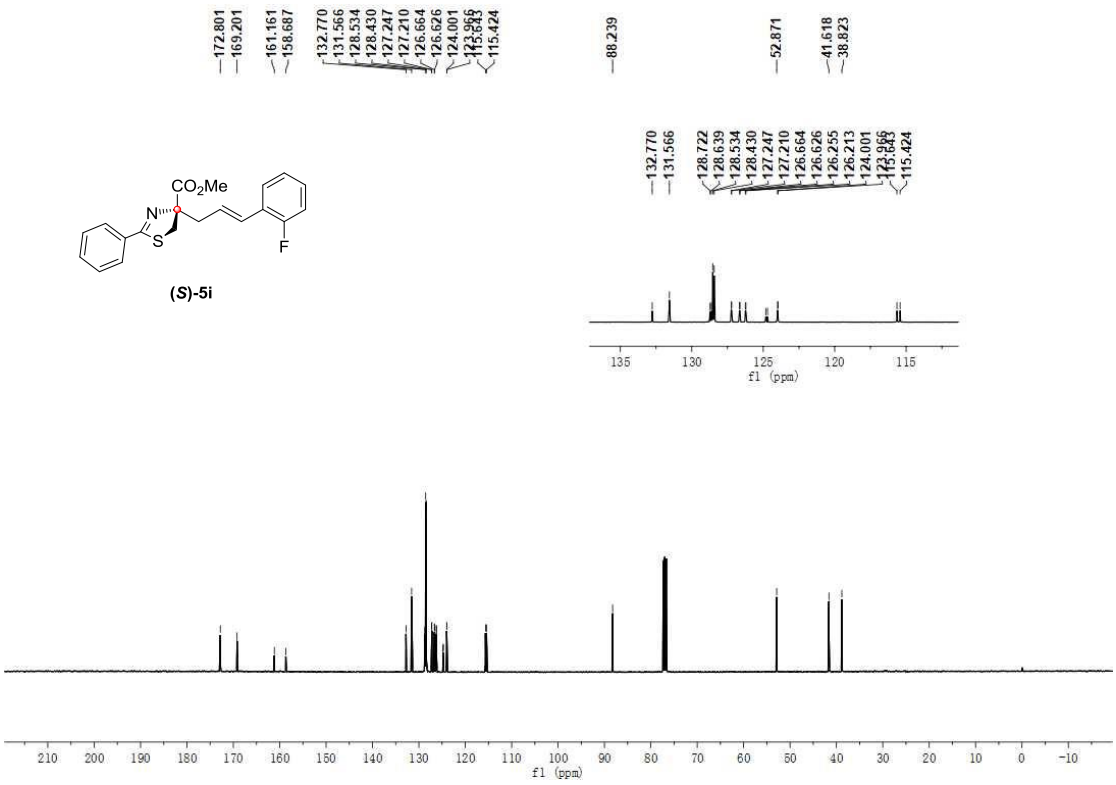
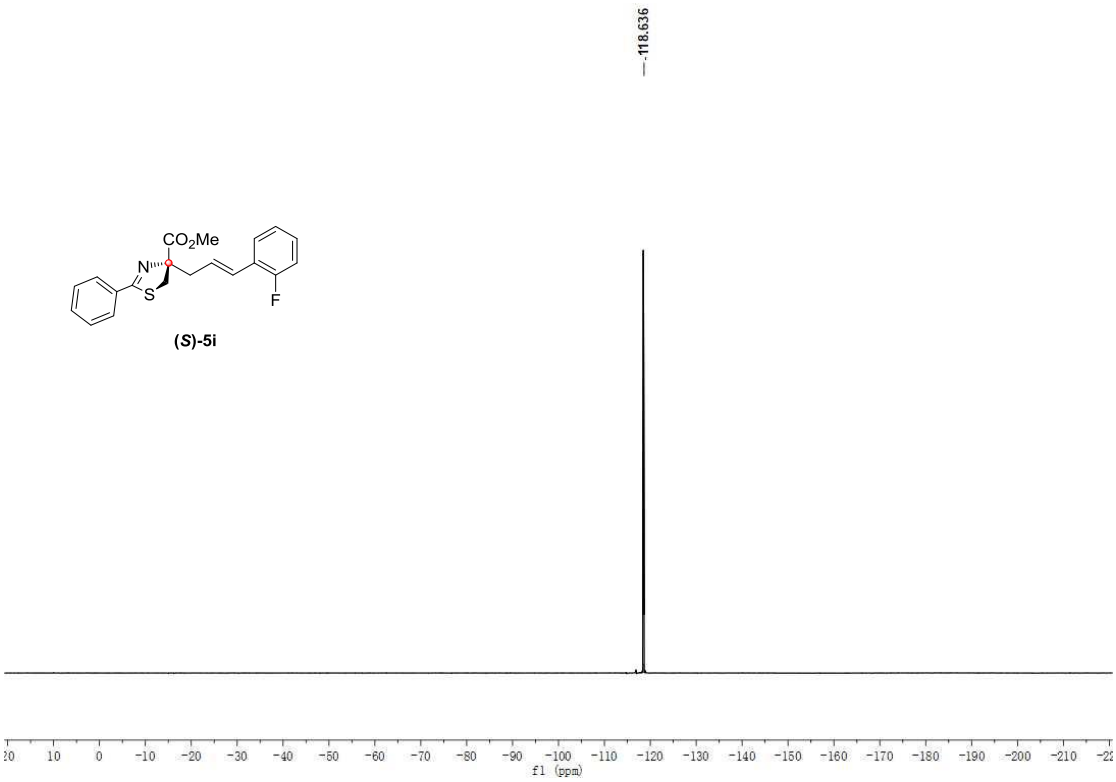


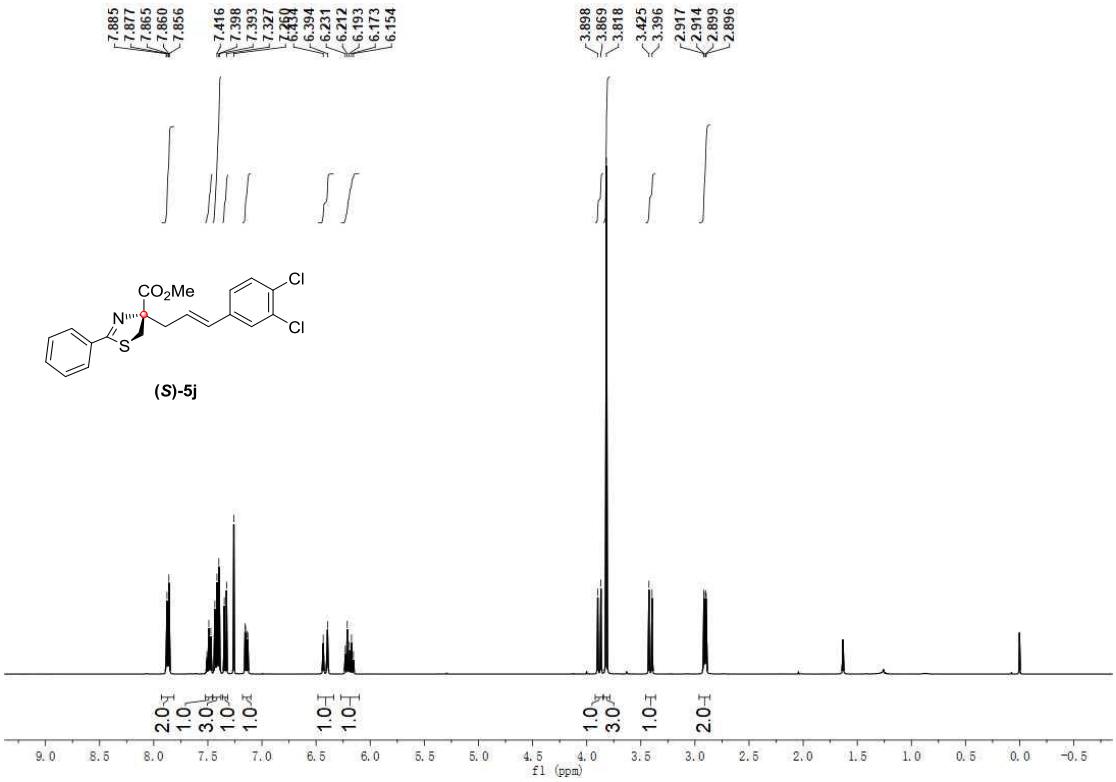

**$^{1}$H NMR** (400 MHz, $CDCl_3$)



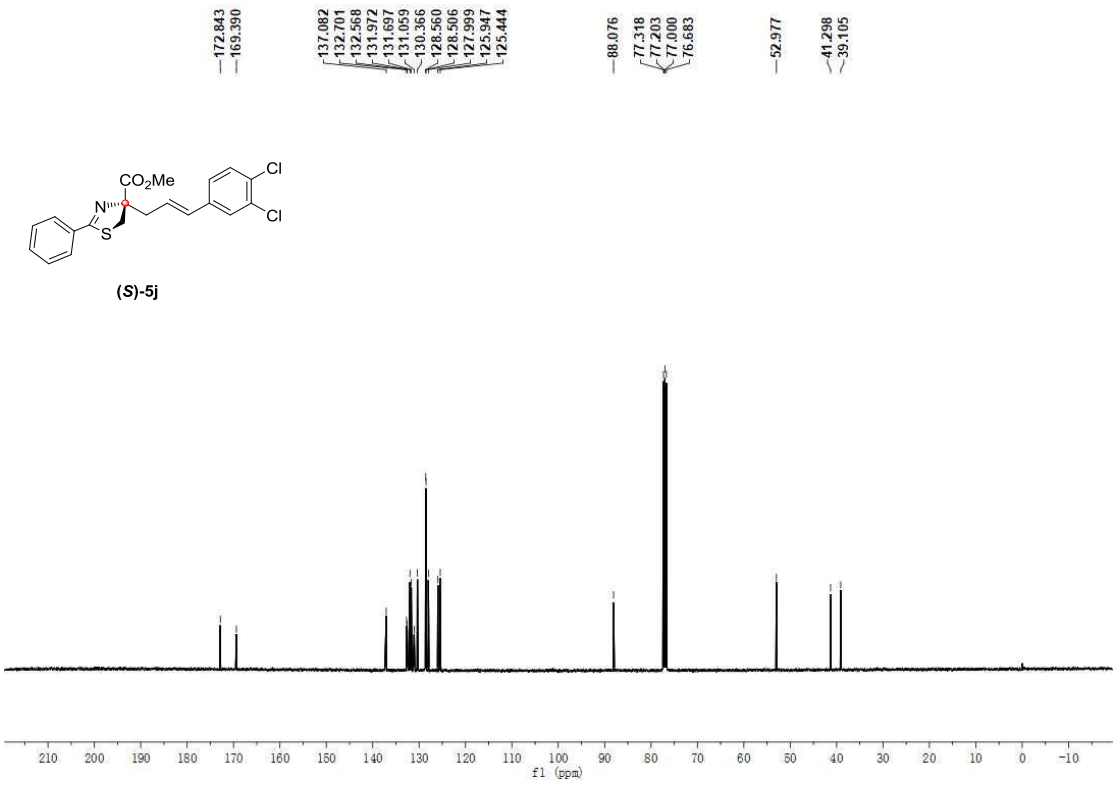

**$^{13}$C NMR** (100 MHz, $CDCl_3$)




**$^{19}$F NMR** (376 MHz, $CDCl_3$)




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

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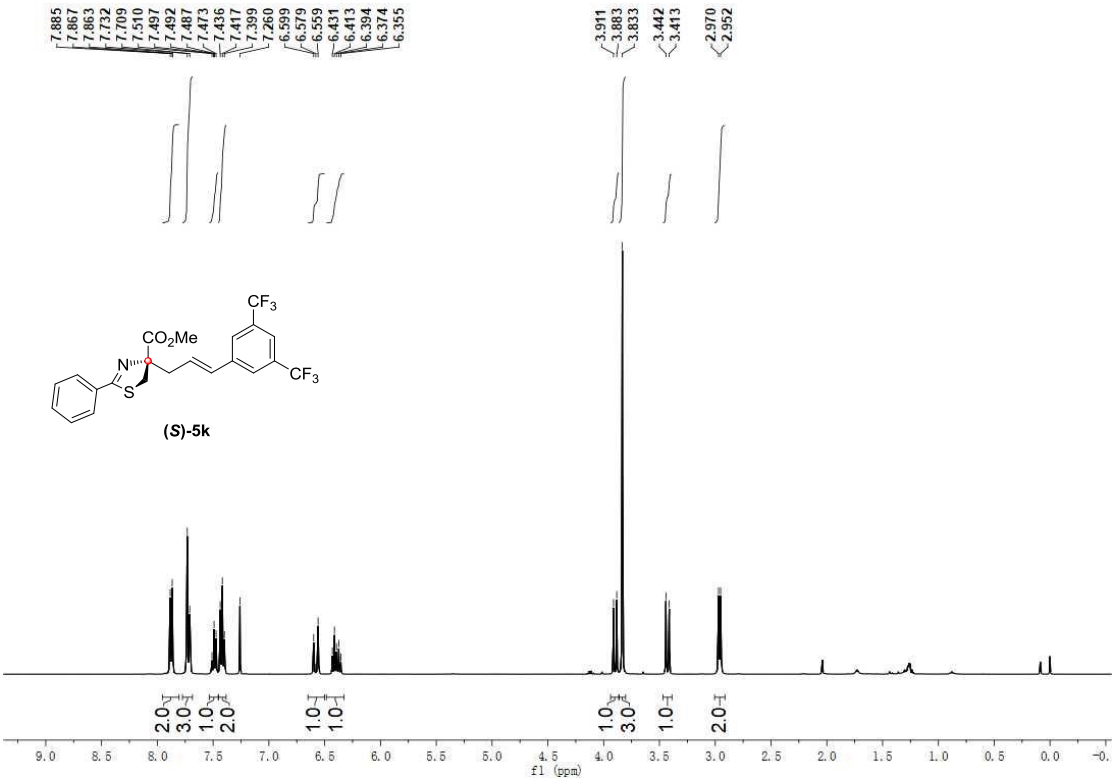


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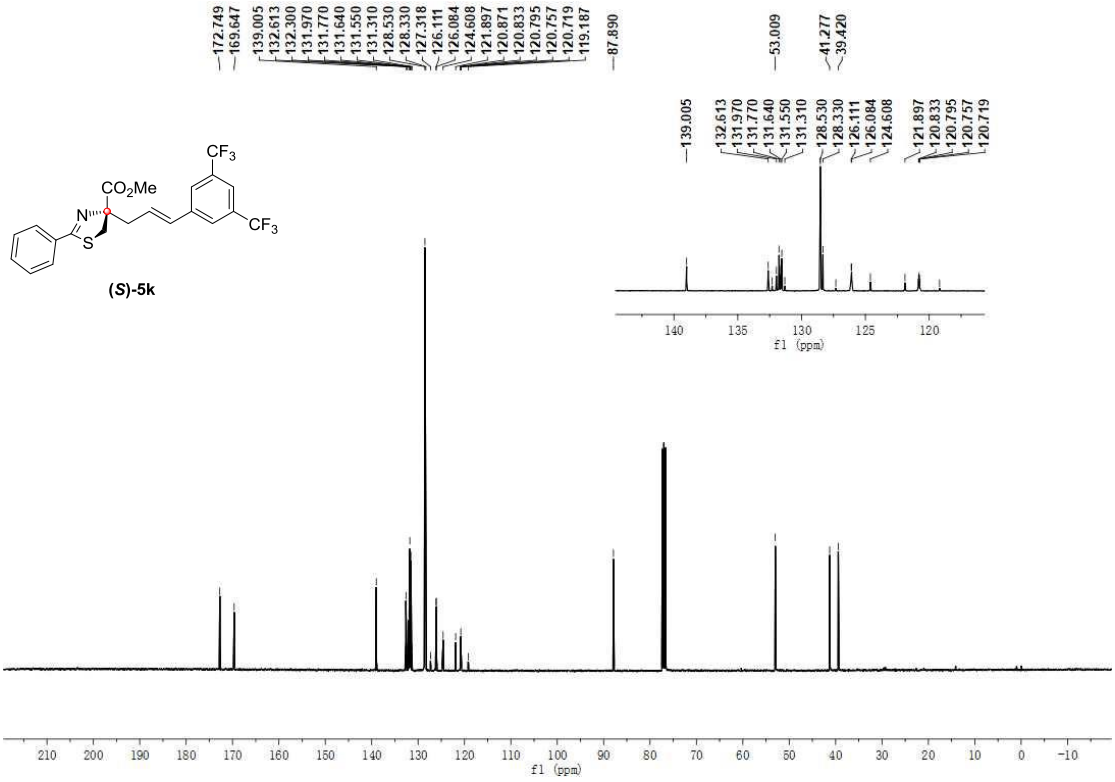
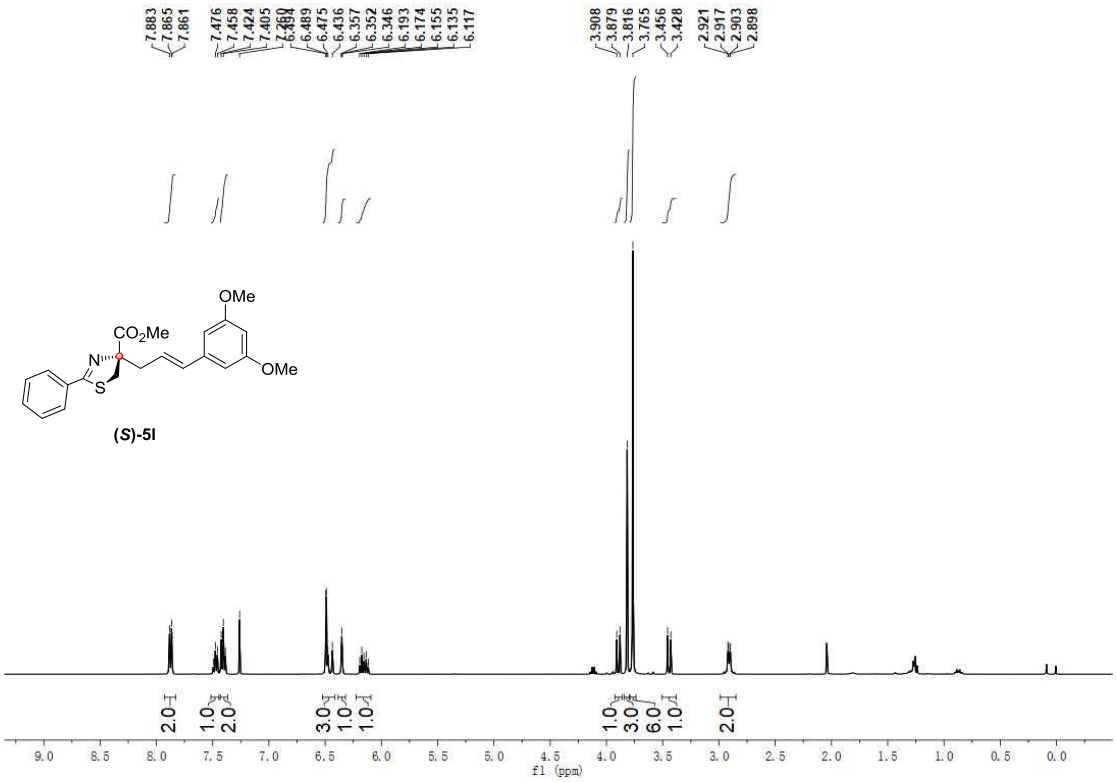
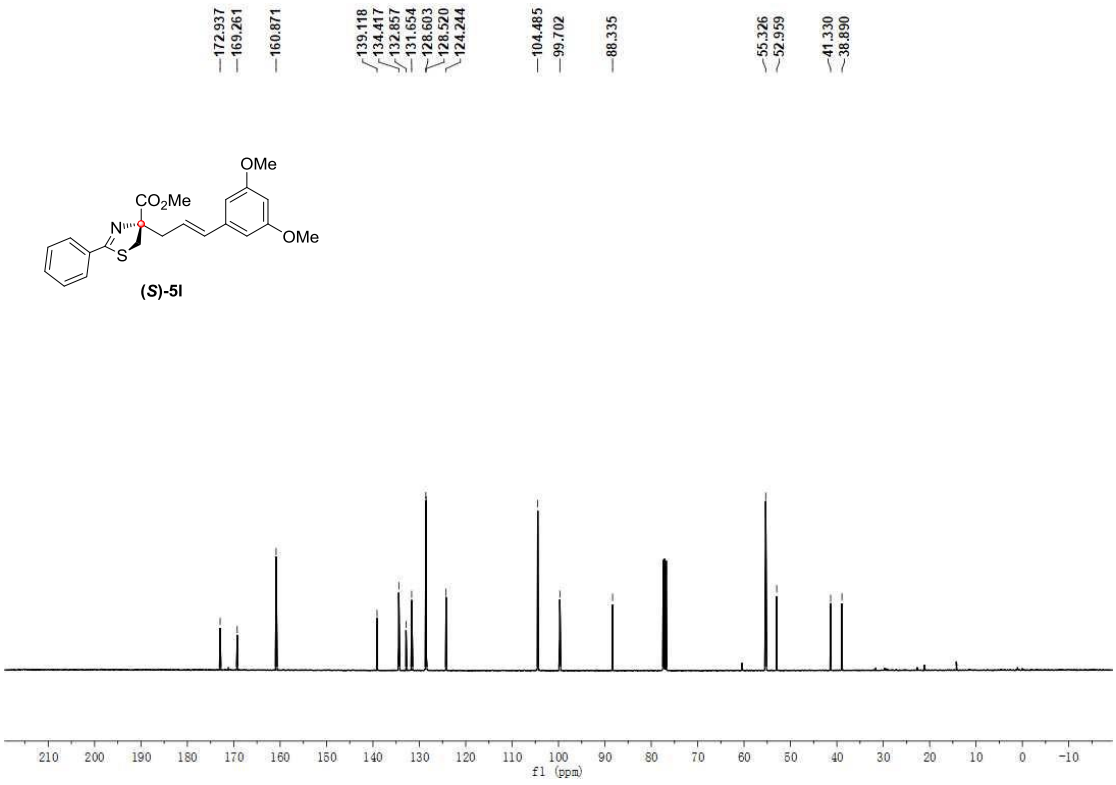



**$^{13}$C NMR** (100 MHz, $CDCl_3$)


**$^{19}$F NMR** (376 MHz, $CDCl_3$)




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

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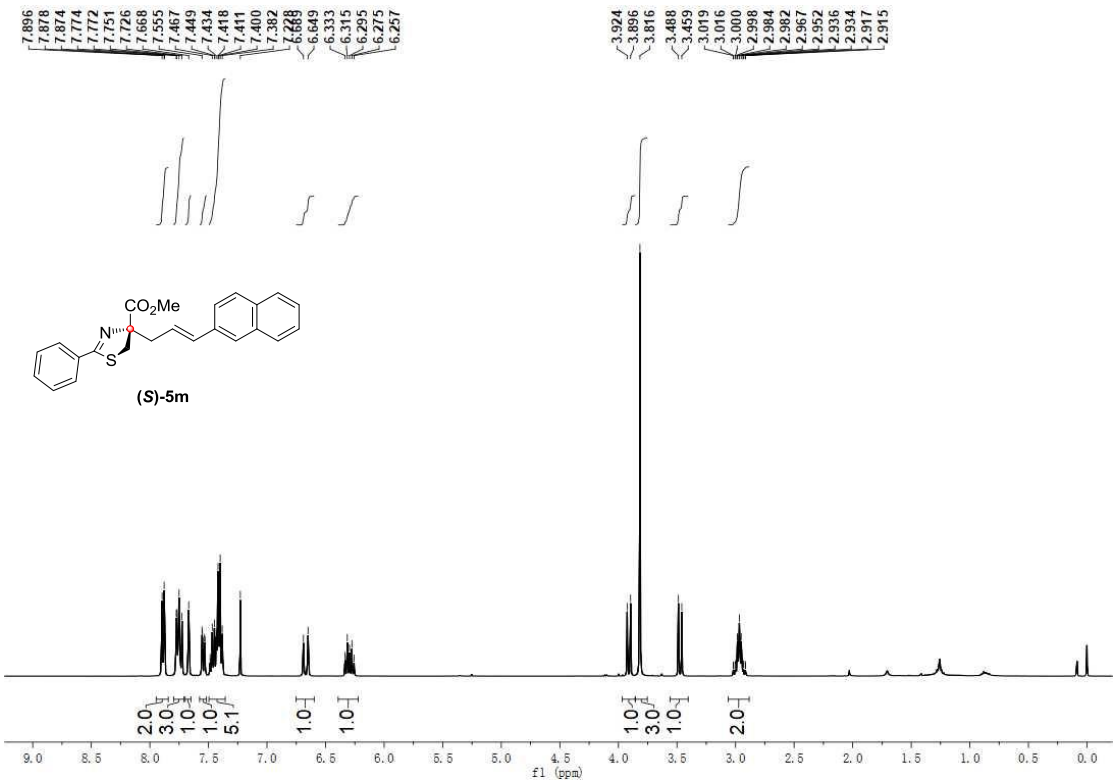


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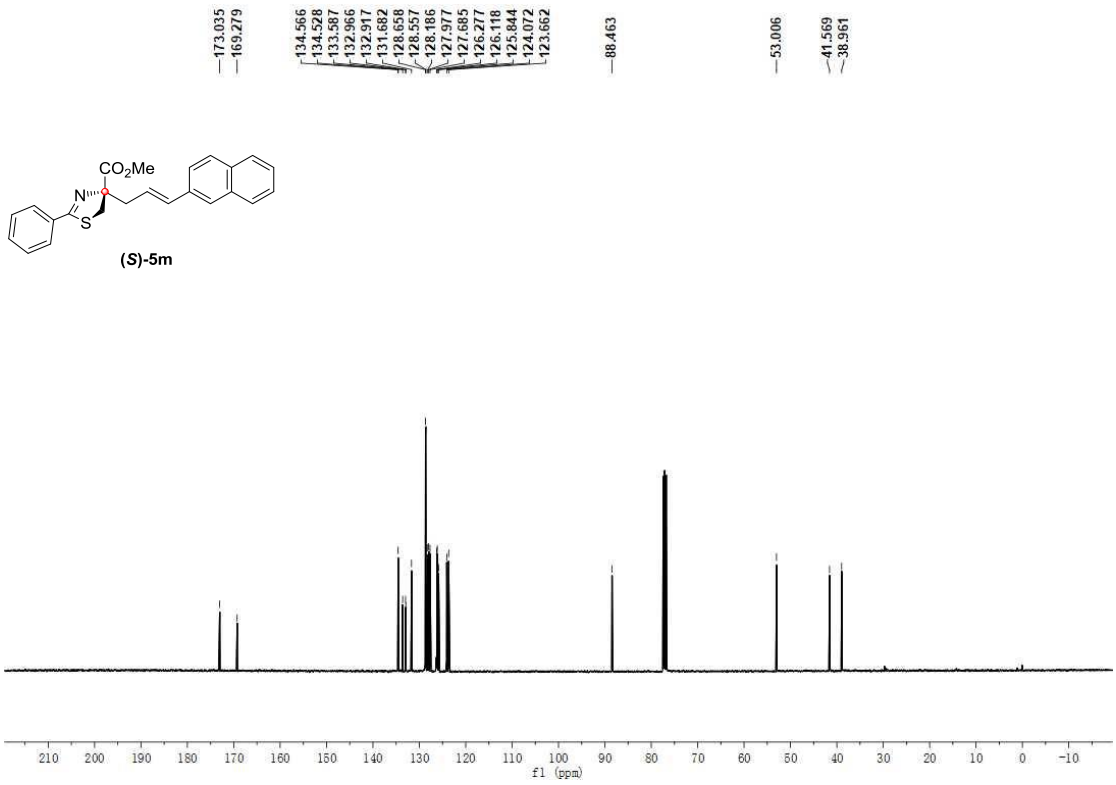


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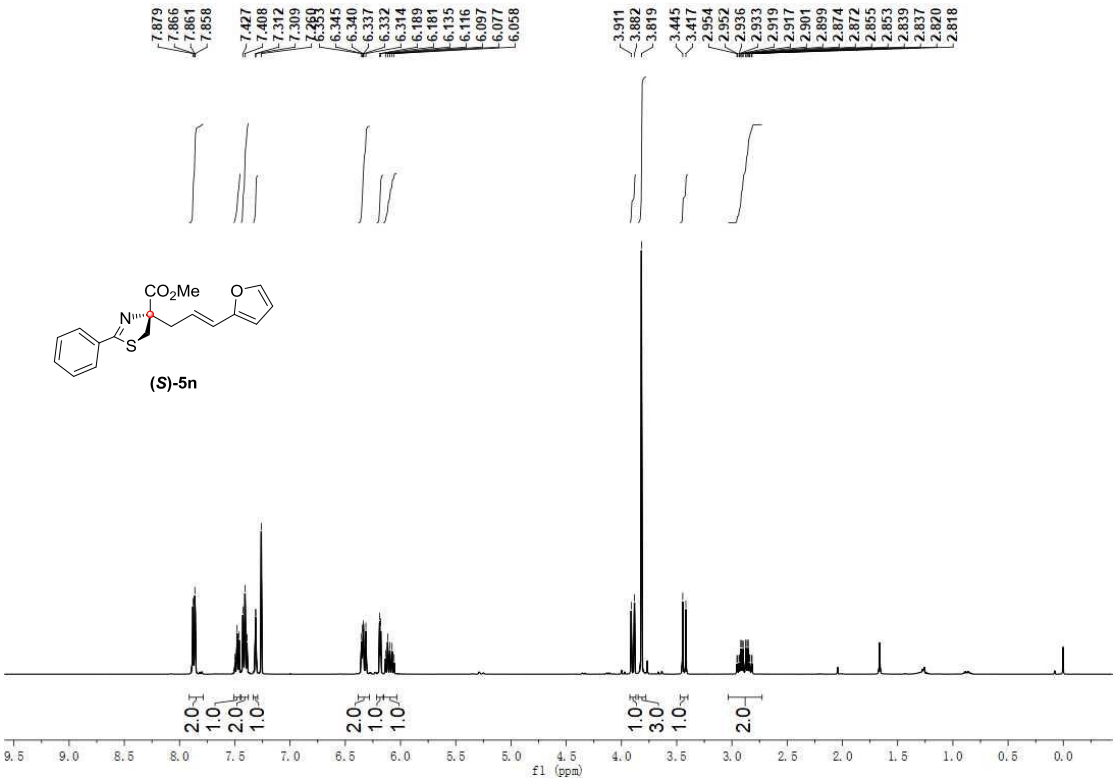


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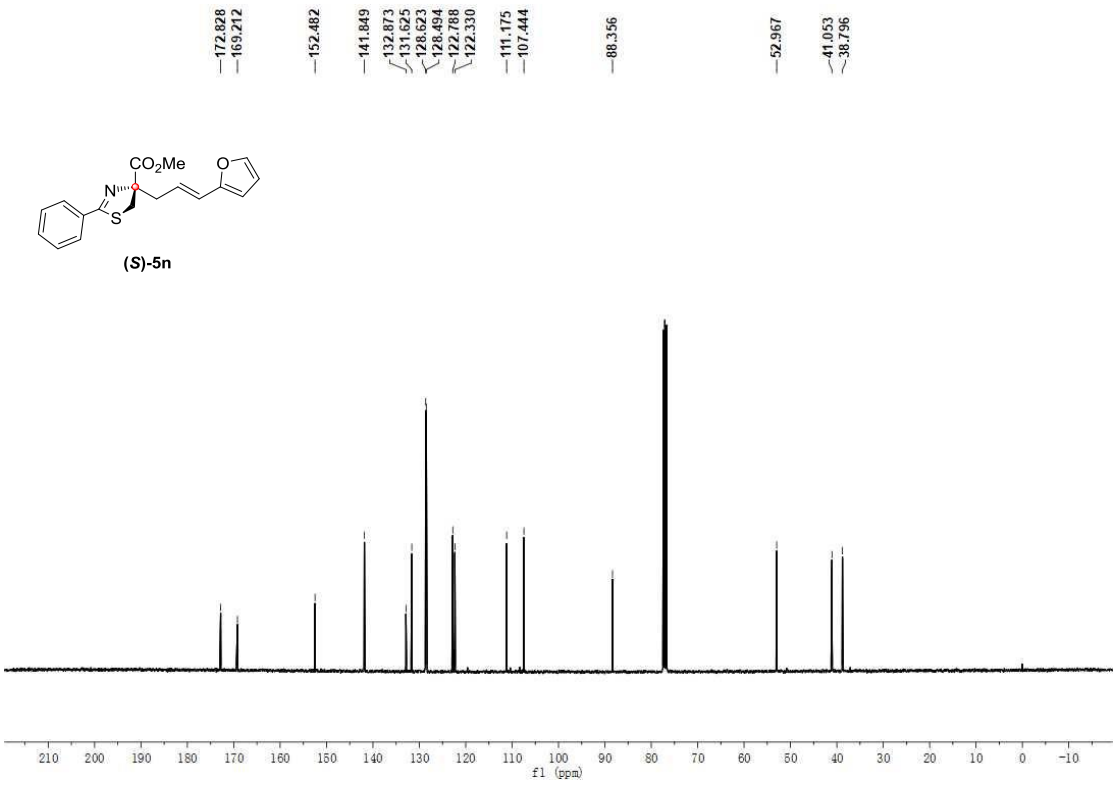
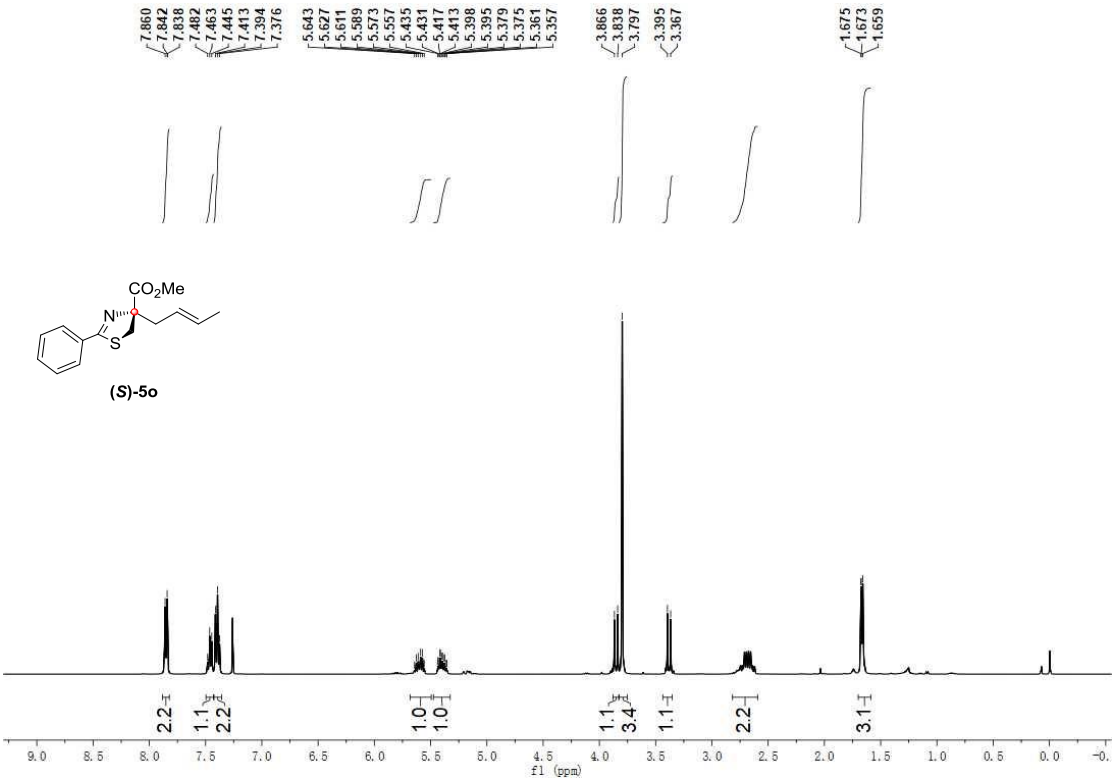
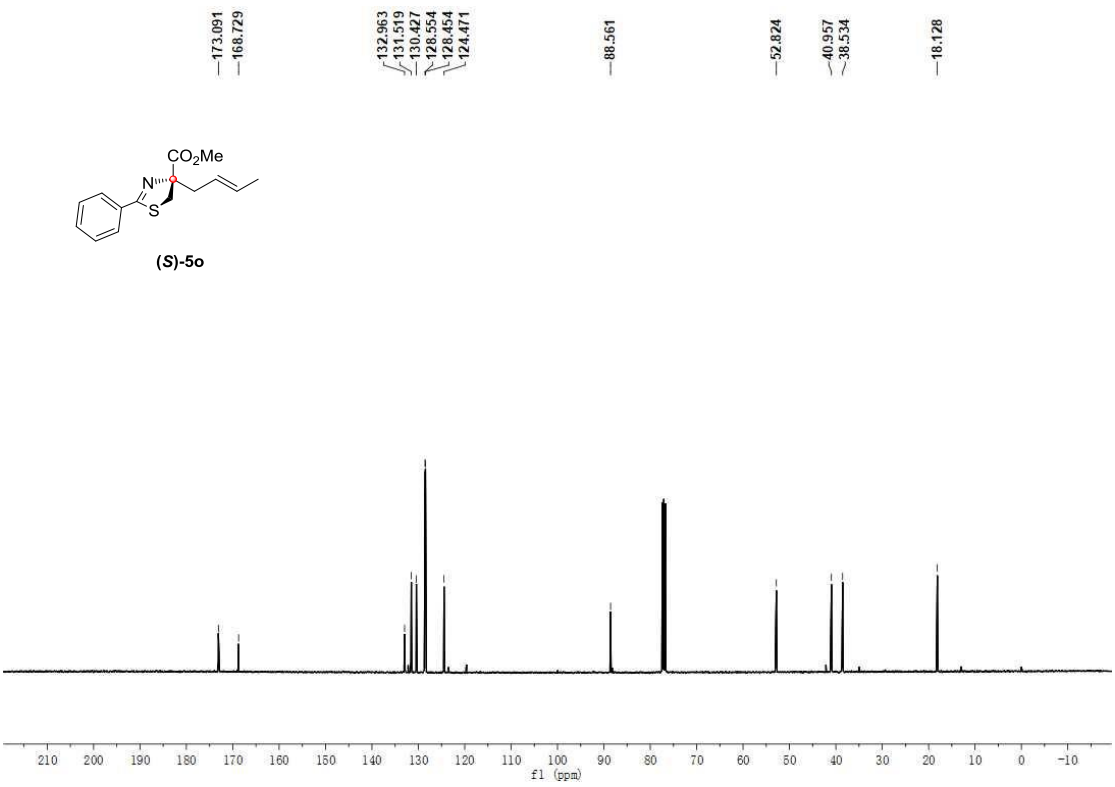



**$^{13}$C NMR** (100 MHz, $CDCl_3$)




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

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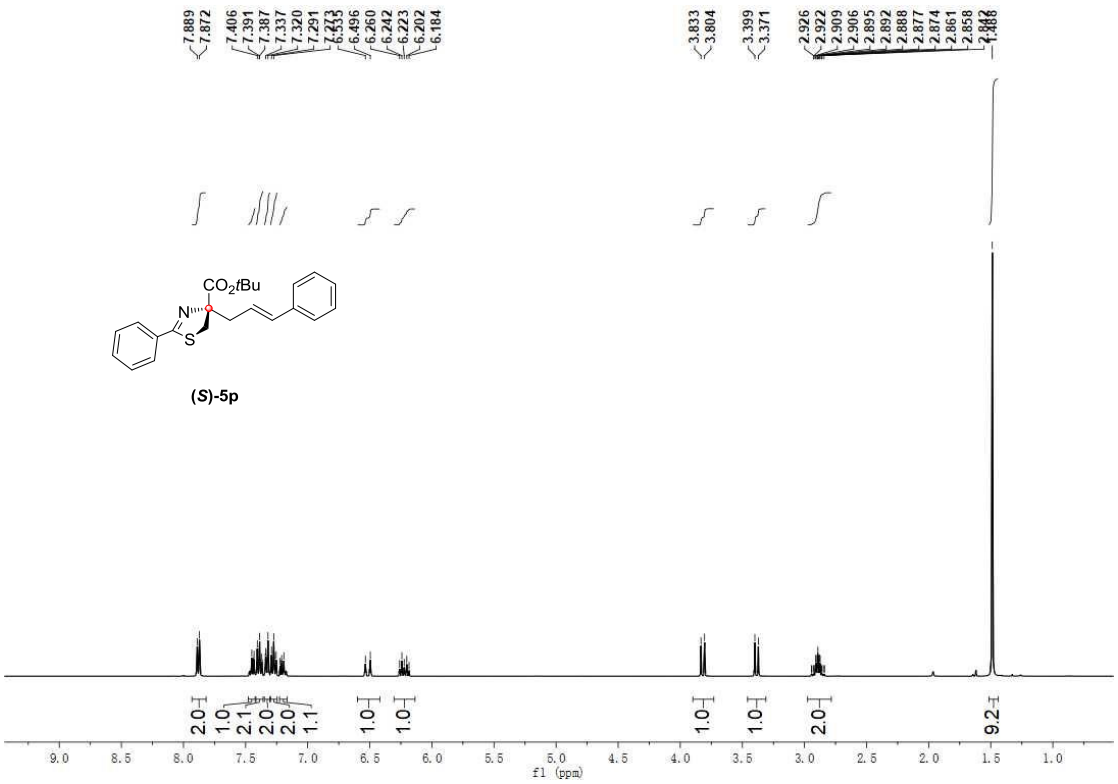


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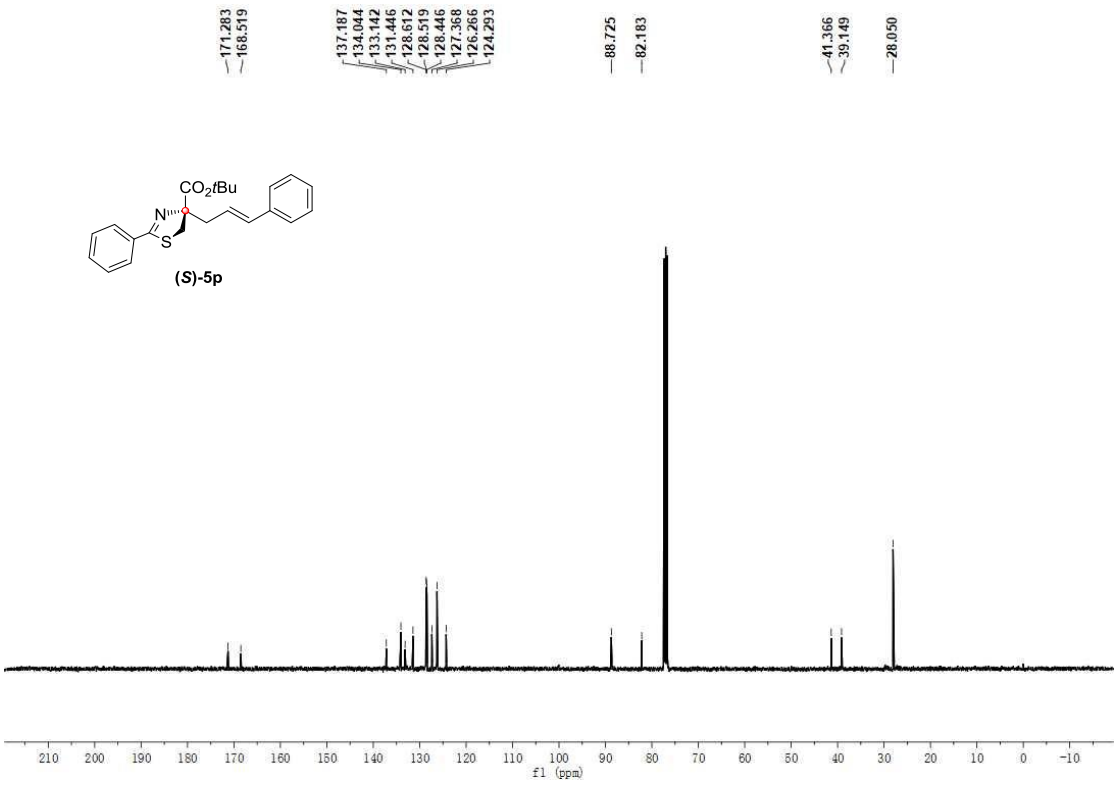
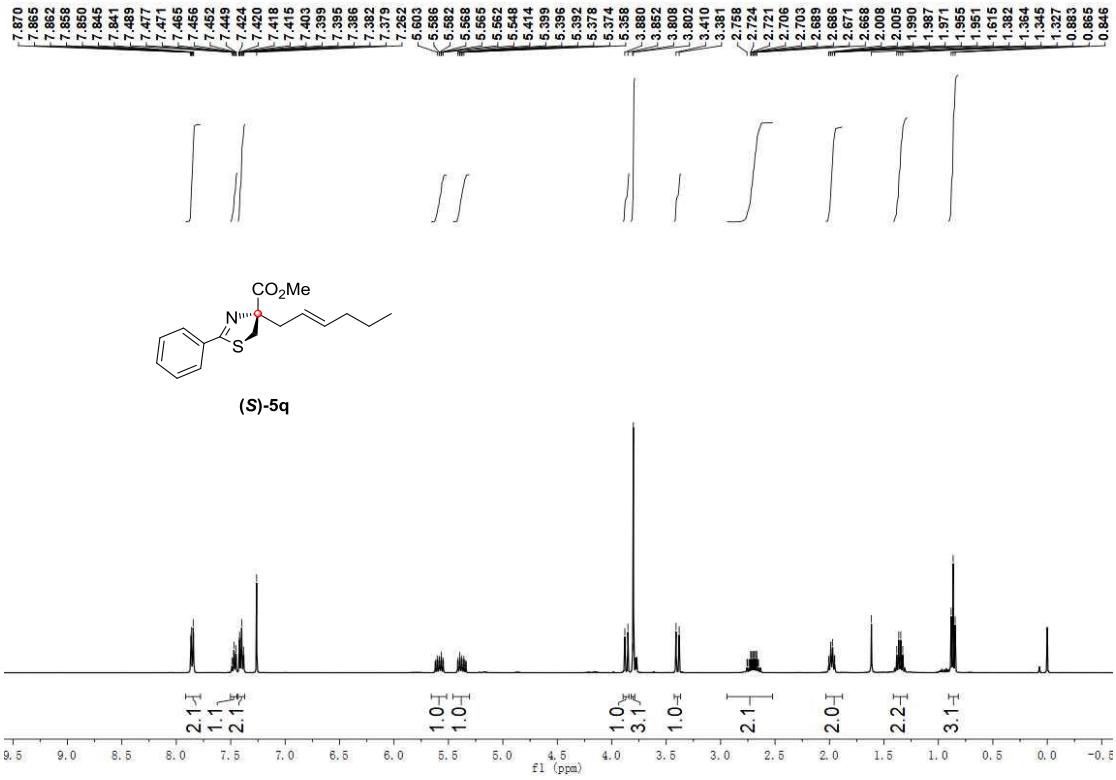
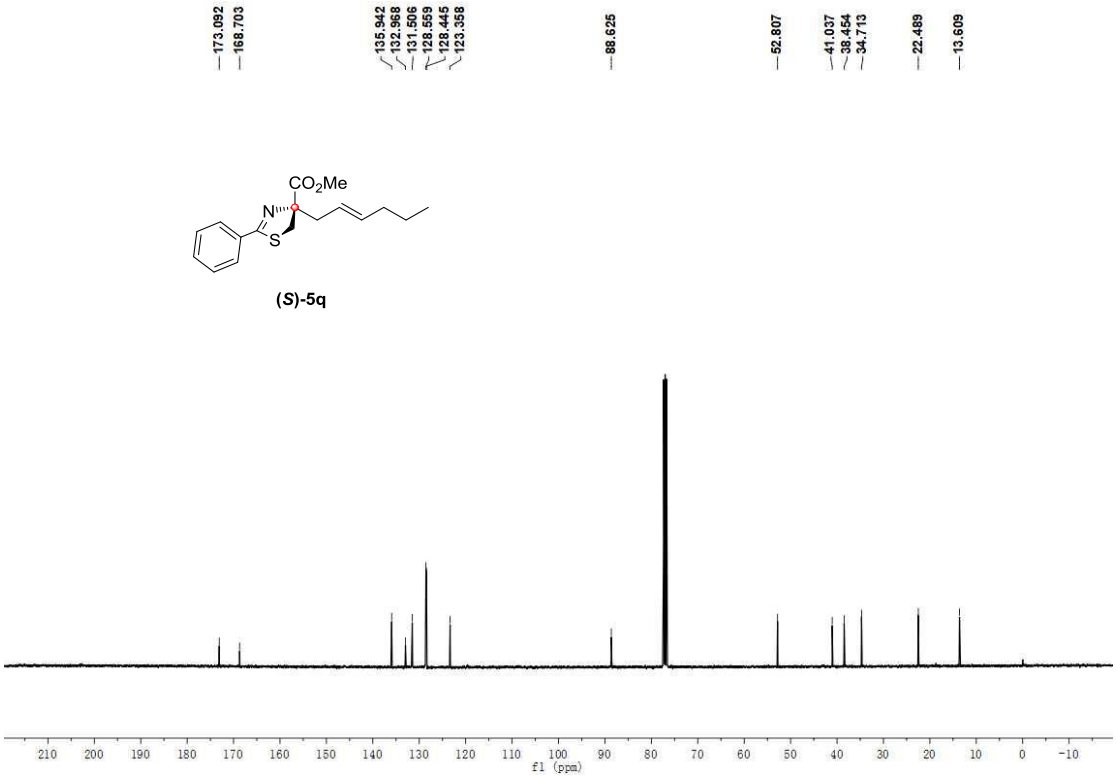


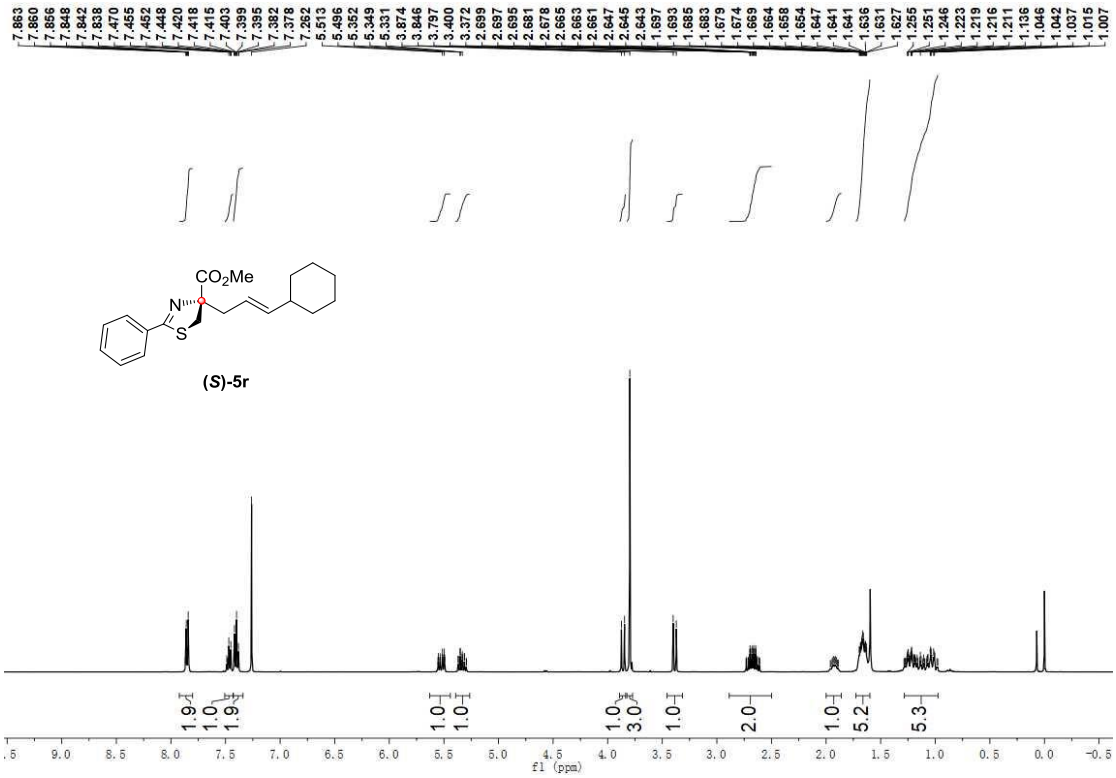

**$^{13}$C NMR** (100 MHz, $CDCl_3$)



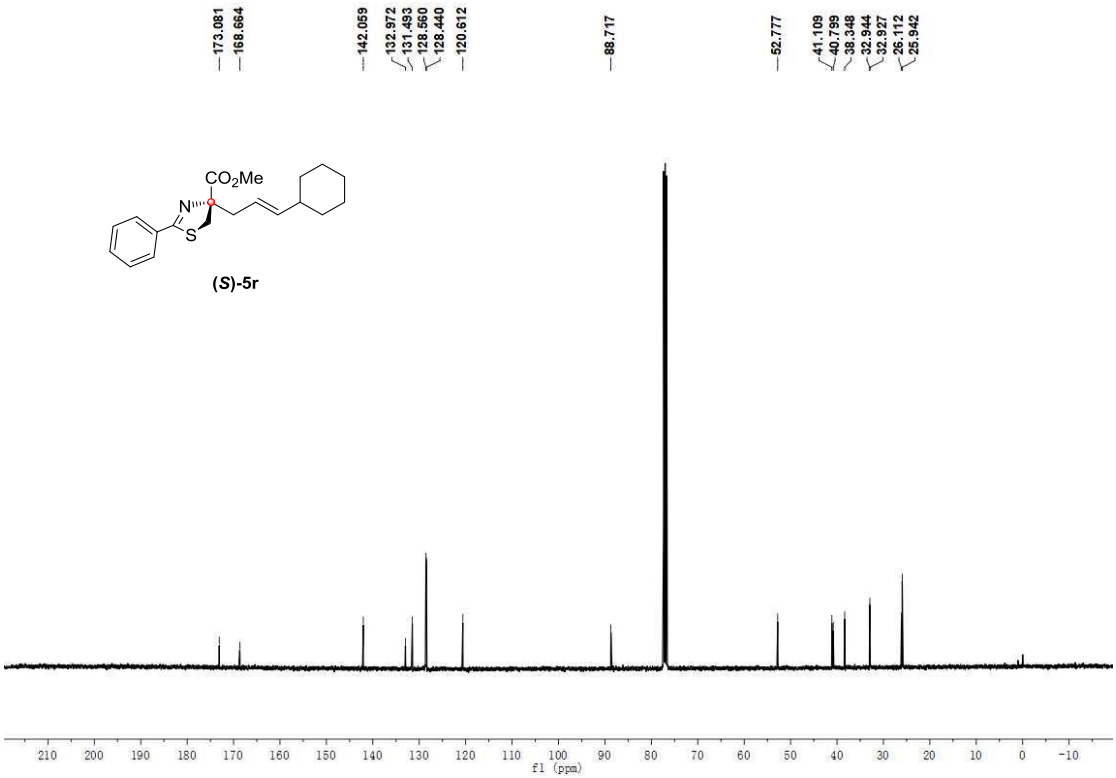

**$^{1}$H NMR** (400 MHz, $CDCl_3$)



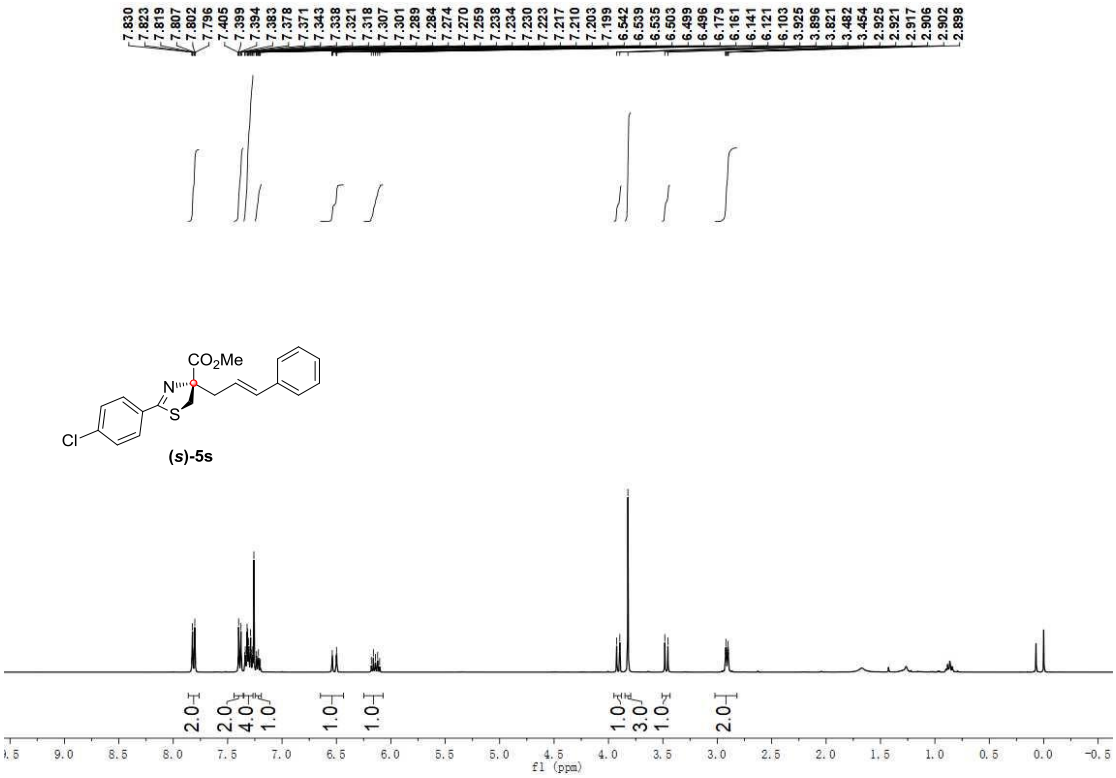

**$^{13}$C NMR** (100 MHz, $CDCl_3$)



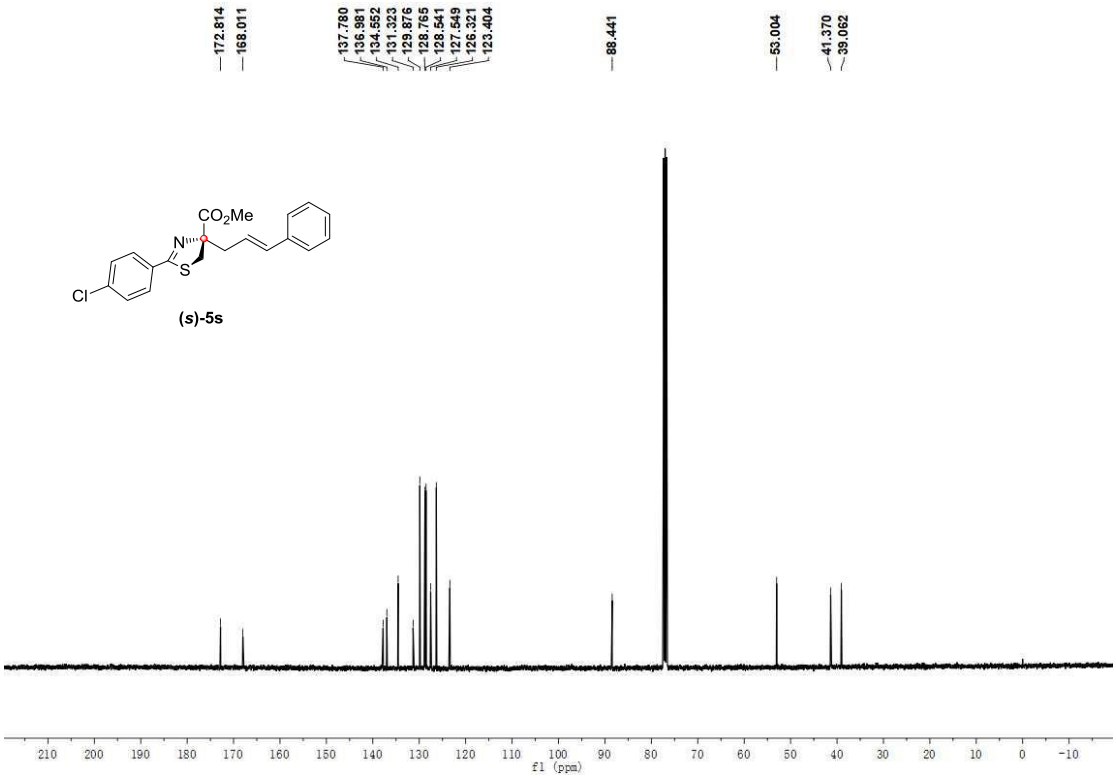

**$^{1}$H NMR** (400 MHz, $CDCl_3$)



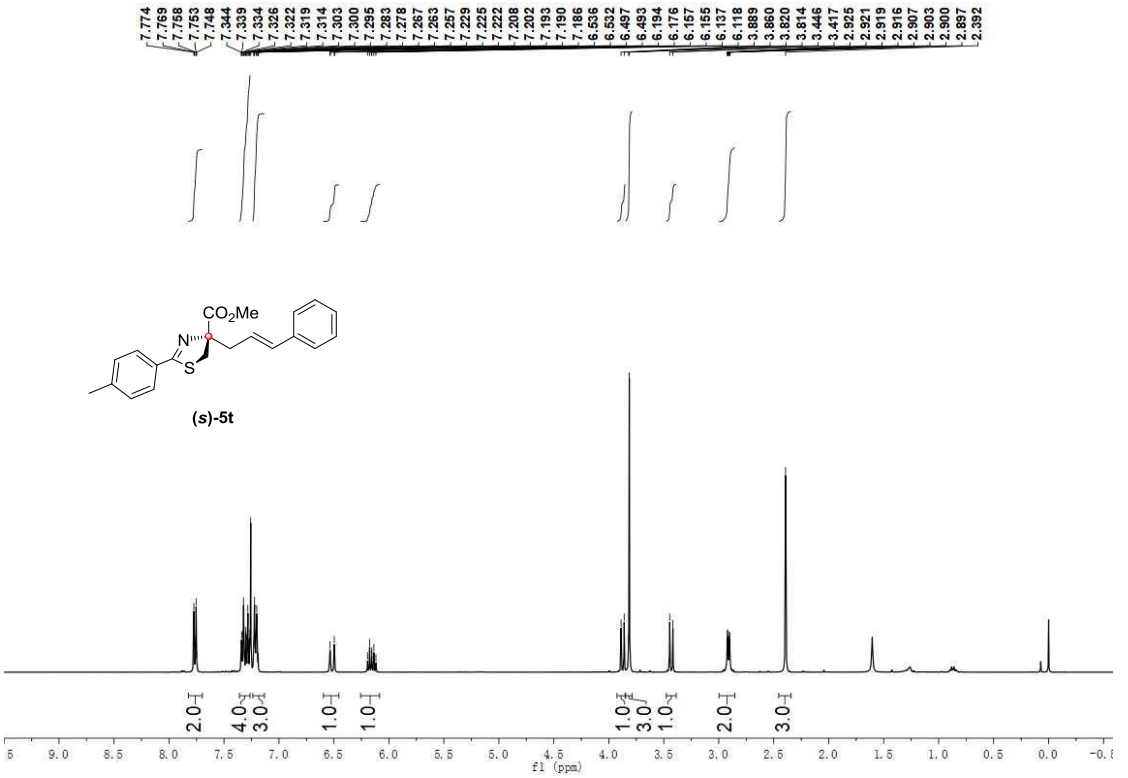

**$^{13}$C NMR** (100 MHz, $CDCl_3$)



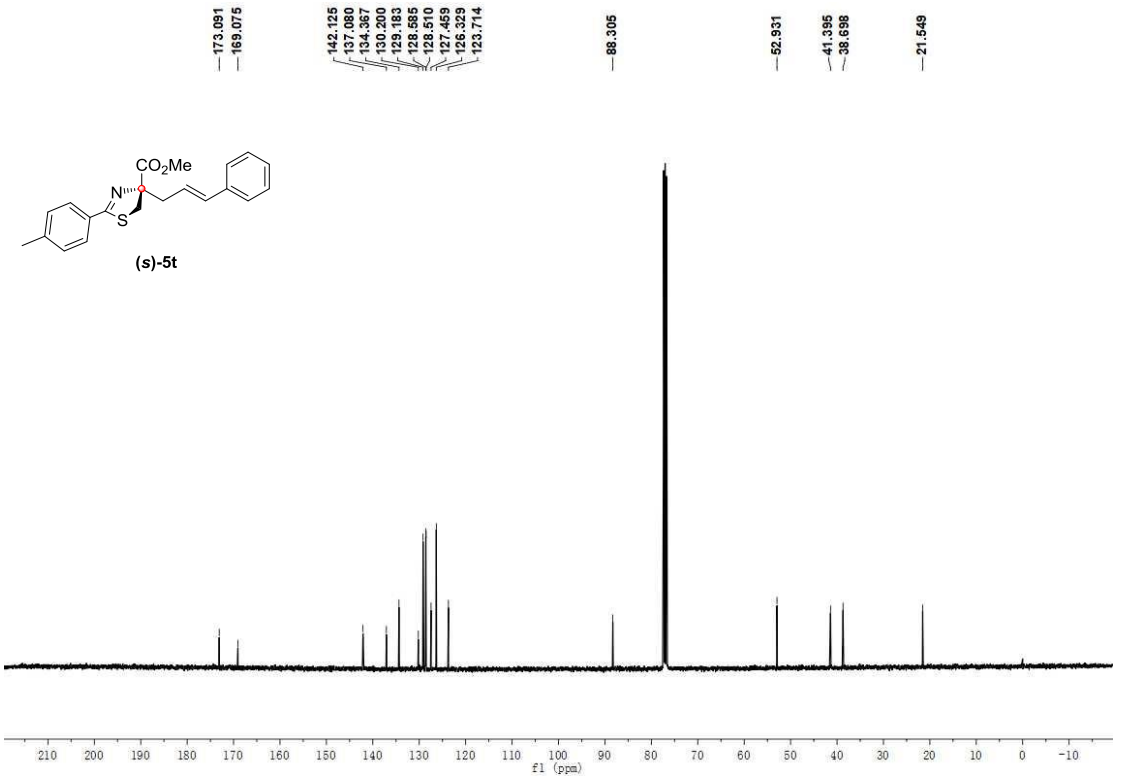

**$^{1}$H NMR** (400 MHz, $CDCl_3$)



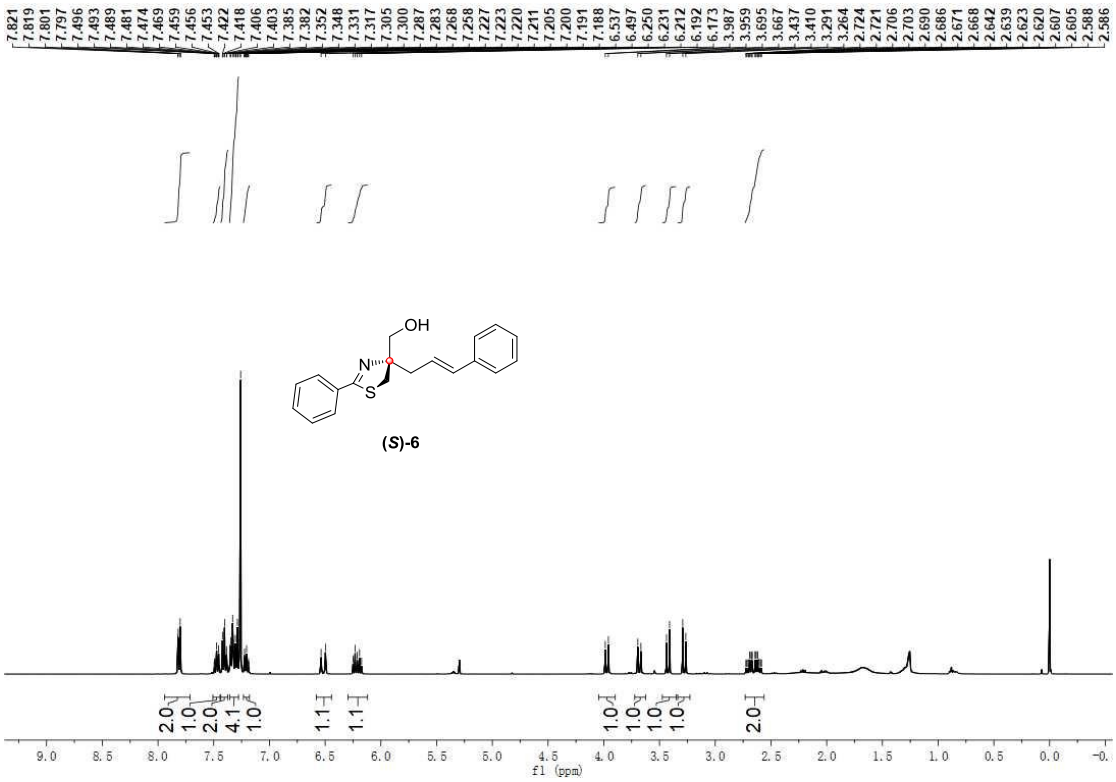

**$^{13}$C NMR** (100 MHz, $CDCl_3$)



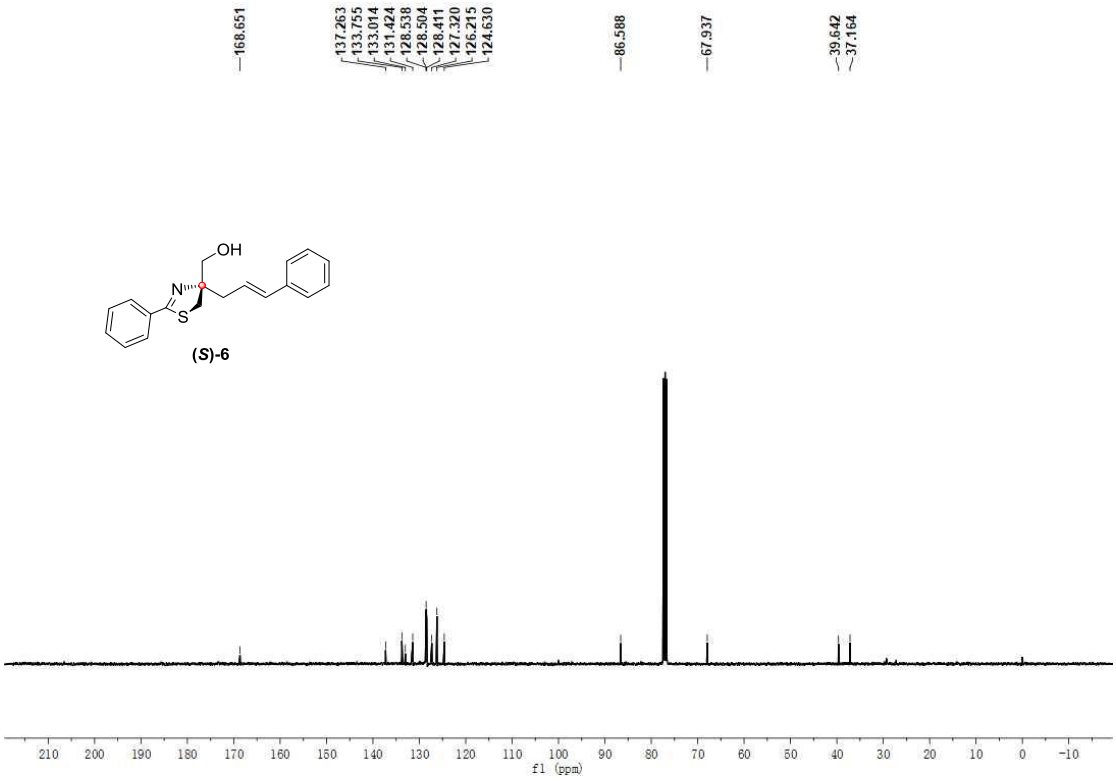

**$^{1}$H NMR** (400 MHz, $CDCl_3$)



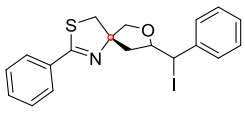

**$^{13}$C NMR** (100 MHz, $CDCl_3$)




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




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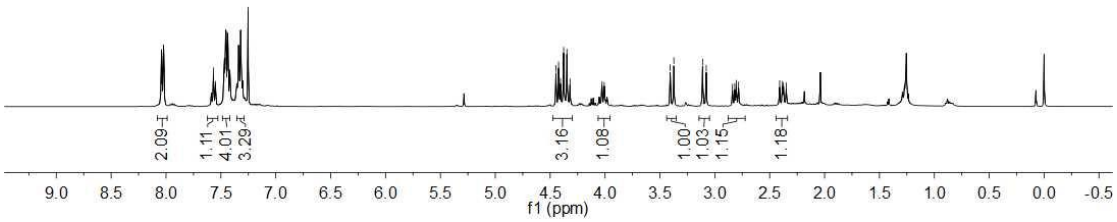
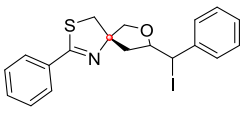



**$^{1}$H NMR** (400 MHz, $CDCl_3$)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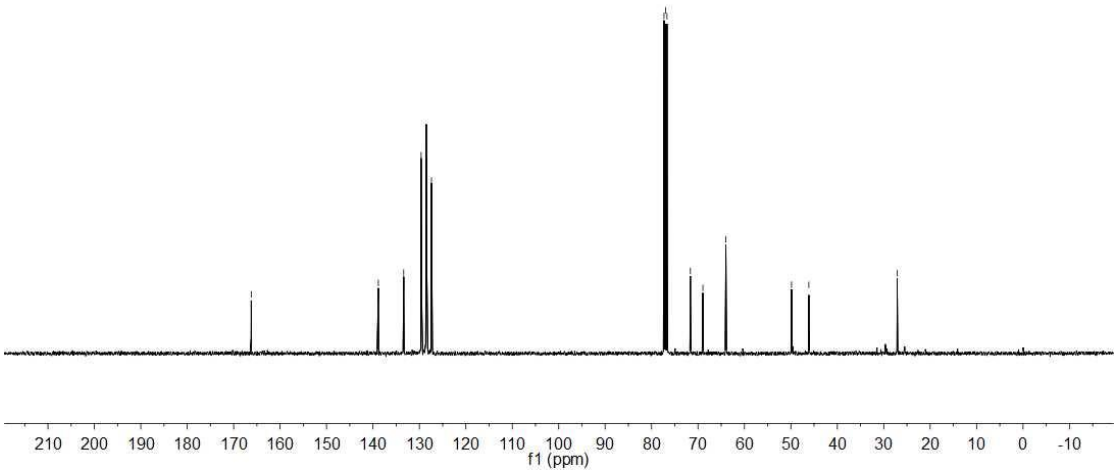
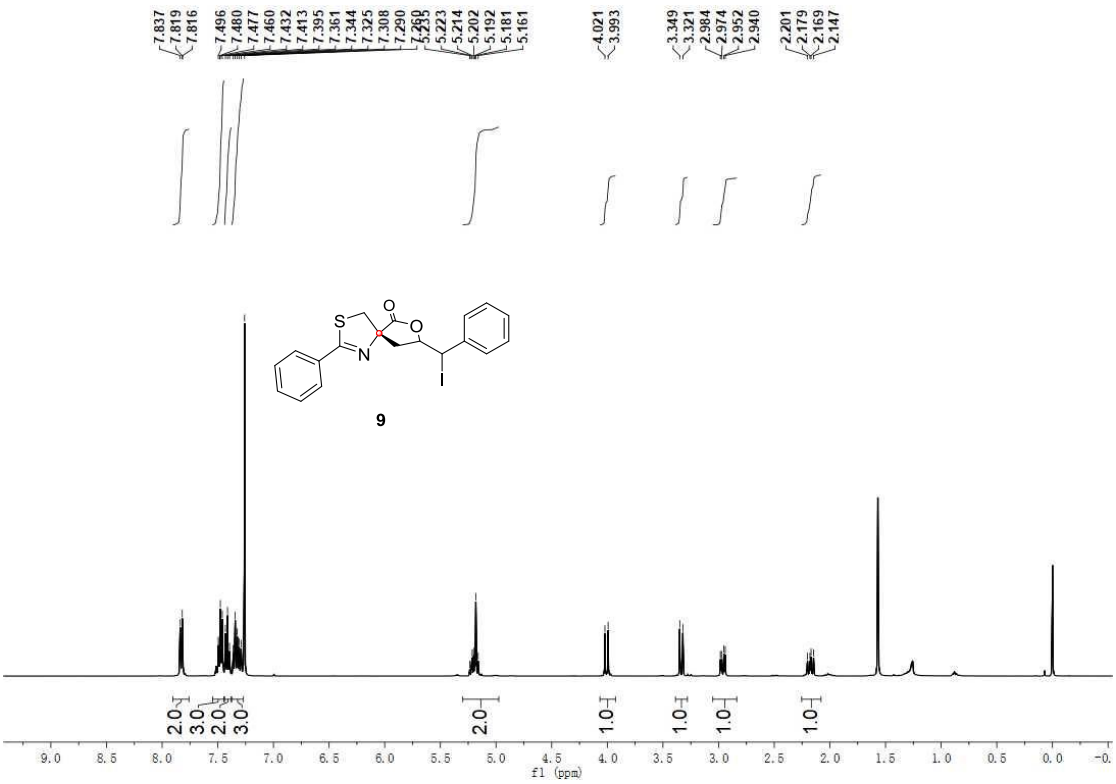
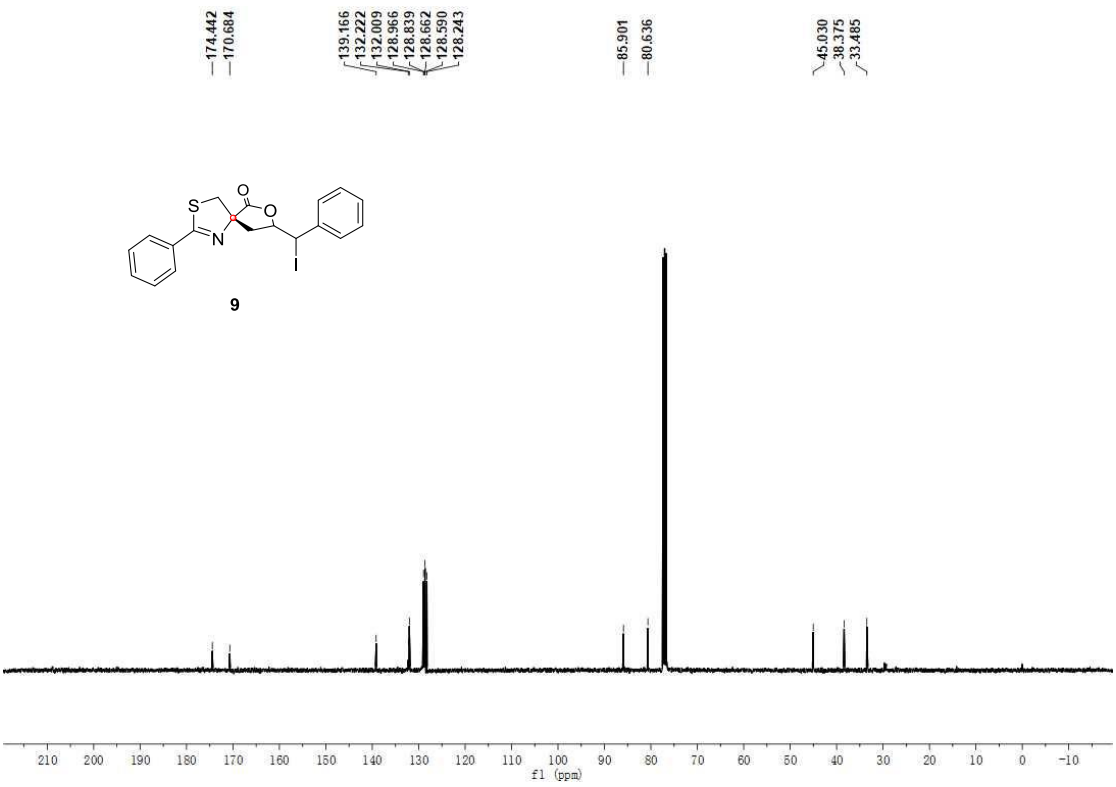


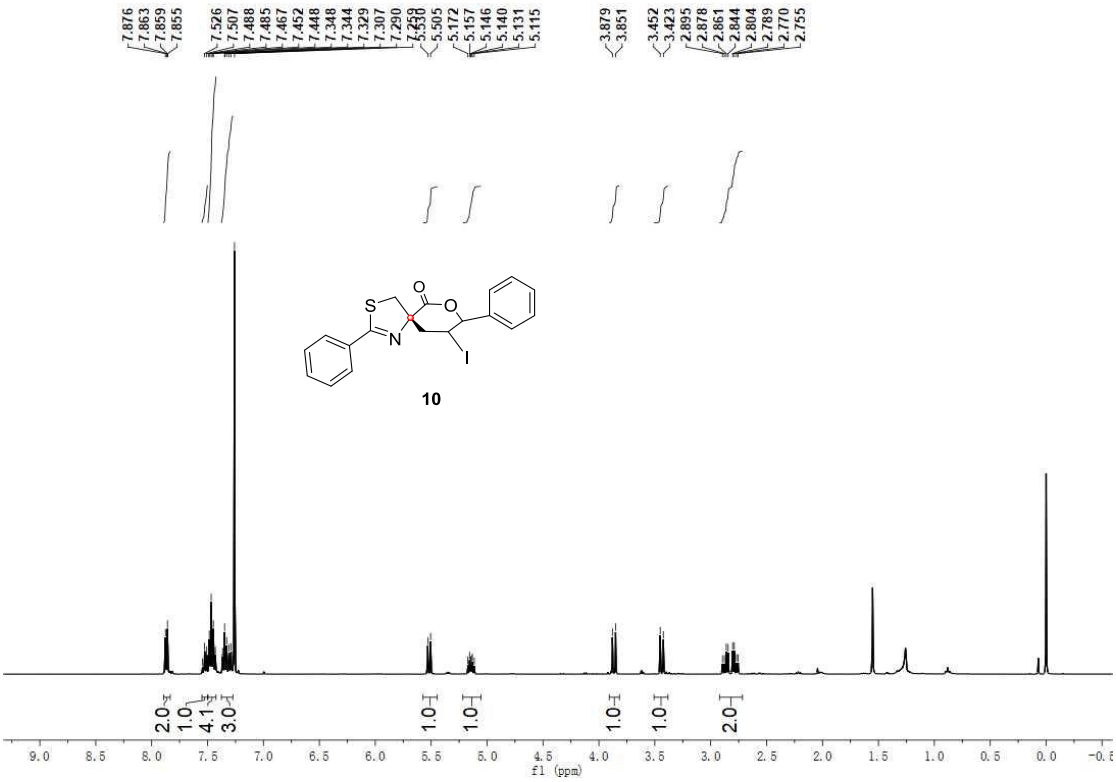

**$^{13}$C NMR** (100 MHz, $CDCl_3$)



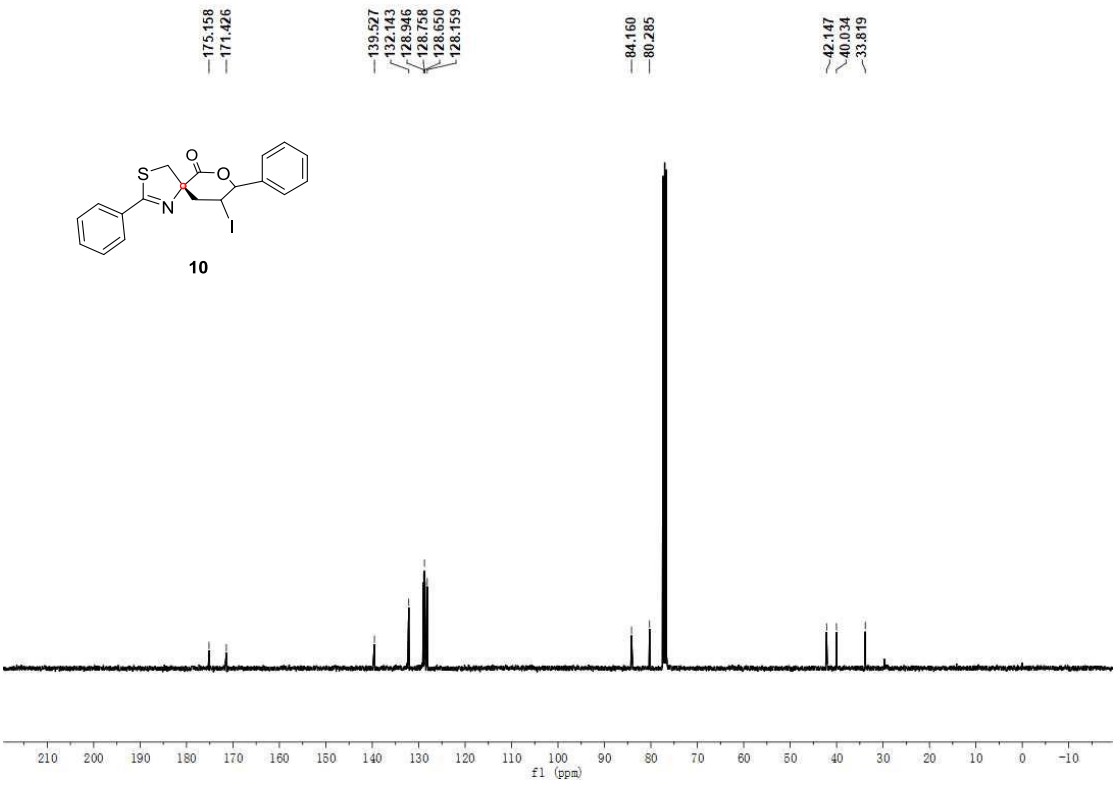

**$^{1}$H NMR** (400 MHz, $CDCl_3$)




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

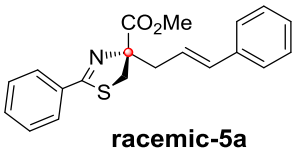



**$^{1}$H NMR** (400 MHz, $CDCl_3$)




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

## VII. HPLC spectra




**racemic-5a**

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Data File E:\DATA\WHM-2\WHM-3-126-PH-RAC 2019-11-27 11-27-40\WHM-3-126-Ph-RAC-2.D
Sample Name: WHM-3-126-Ph-rac-2

    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   1
    Acq. Instrument : 1260                          Location :   3
    Injection Date  : 11/27/2019 11:29:05 AM             Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-3-126-PH-RAC 2019-11-27 11-27-40\IEH-98-2--1ML-20MIN-5UL.
                      M
    Last changed    : 11/27/2019 11:44:31 AM by SYSTEM
                      (modified after loading)
    Analysis Method : E:\DATA\WHM-2\WHM-3-126-PH-RAC 2019-11-27 11-27-40\IEH-98-2--1ML-20MIN-5UL.
                      M (Sequence Method)
    Last changed    : 12/27/2020 8:49:15 PM by SYSTEM
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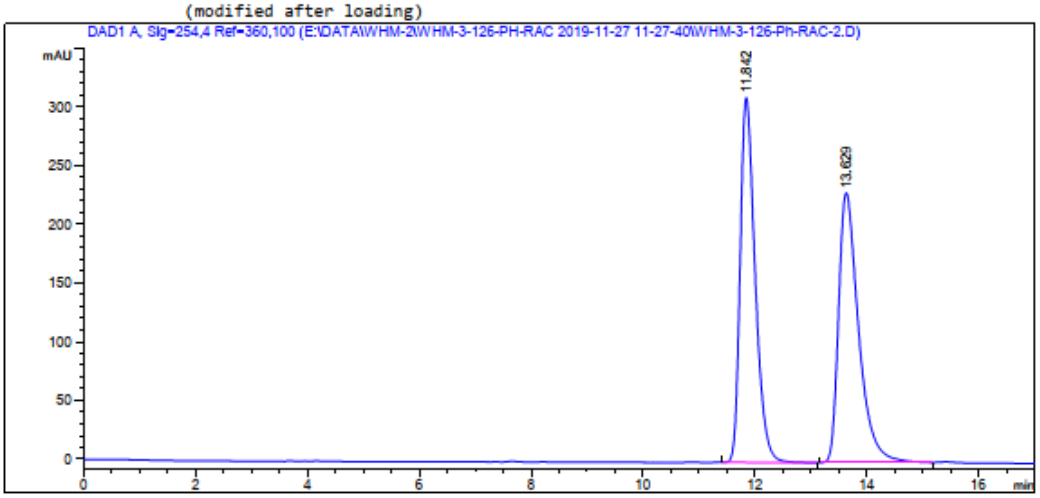


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    ======================================================================
                           Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs


    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|--------|----|--------|----------|----------|--------|
       1  11.842 BB    0.2821 5760.70996  310.93454  50.2634
       2  13.629 BB    0.3733 5700.32324  229.88614  49.7366

    Totals :                  1.14610e4   540.82068

    ======================================================================
                           *** End of Report ***

1260 12/27/2020 8:49:19 PM SYSTEM                              Page   1 of 1
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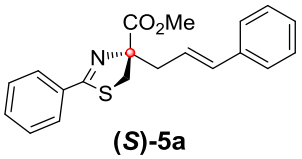


**(*S*)-5a**

Data File E:\DATA\WHM-2\WHM-3-144-THFET2O 2019-12-12 18-05-56\WHM-3-144-THFET2O1.D
Sample Name: WHM-3-144-THF

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==================================================================
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Acq. Instrument : 1260                          Location :   1
Injection Date  : 12/12/2019 6:18:19 PM             Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-3-144-THFET2O 2019-12-12 18-05-56\IEH-98-2--1ML-20MIN-5UL
                  .M
Last changed    : 12/12/2019 6:05:56 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-3-144-THFET2O 2019-12-12 18-05-56\IEH-98-2--1ML-20MIN-5UL
                  .M (Sequence Method)
Last changed    : 1/6/2020 4:47:21 PM by SYSTEM
                  (modified after loading)
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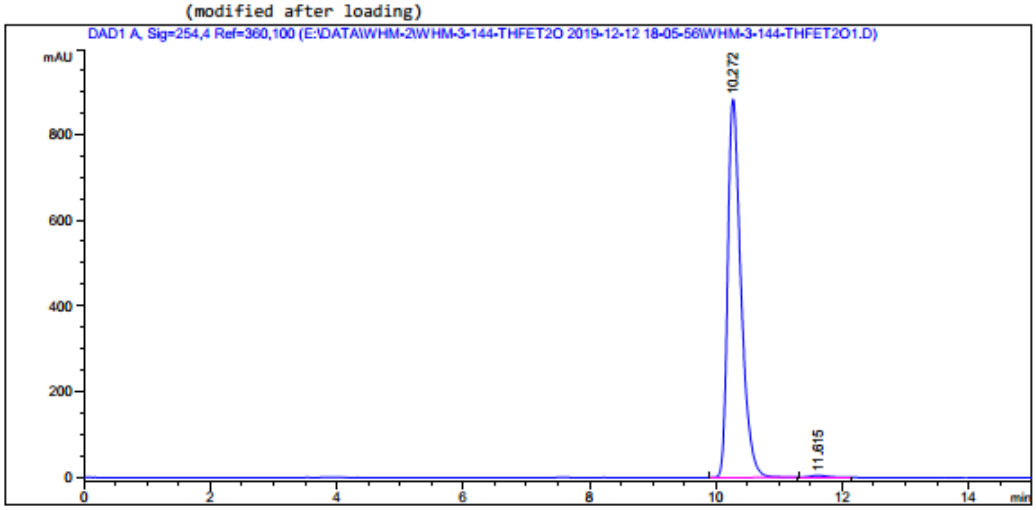


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==================================================================
                      Area Percent Report
==================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.272 BB    0.2199 1.28813e4   884.41986  99.3721
   2  11.615 BB    0.2509   81.38943    4.41863   0.6279

Totals :                  1.29627e4   888.83849


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                      *** End of Report ***

1260 1/6/2020 4:47:26 PM SYSTEM                          Page   1 of 1
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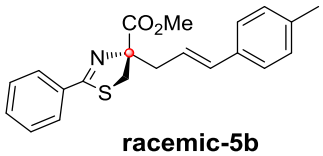


**racemic-5b**

Data File E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\WHM-3-149-P-ME-RAC1.D
Sample Name: WHM-3-149-P-ME-RAC

```
    ======================================================================
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    Acq. Instrument : 1260                           Location :   1
    Injection Date  : 12/16/2019 7:44:33 PM              Inj :   1
                                                   Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                      5UL.M
    Last changed    : 12/16/2019 7:57:07 PM by SYSTEM
                      (modified after loading)
    Analysis Method : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                      5UL.M (Sequence Method)
    Last changed    : 12/27/2020 8:53:41 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
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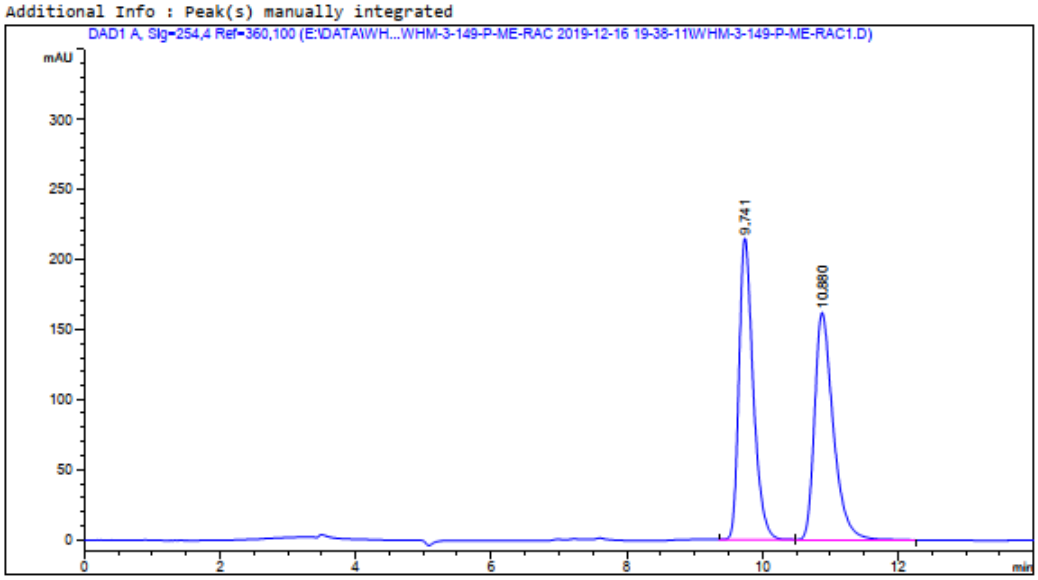


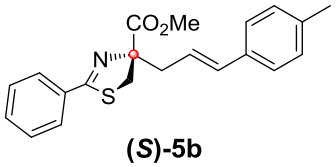

```
    ======================================================================
                          Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs


    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   9.741 BB    0.2212 3137.48145  215.00465  50.1616
       2  10.880 BB    0.2892 3117.26099  162.18855  49.8384

    Totals :                  6254.74243  377.19321
```




**(*S*)-5b**

Data File E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\WHM-3-149-P-ME-RAC5.D
Sample Name: WHM-3-148-P-ME

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    ======================================================================
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    Acq. Instrument : 1260                          Location :   5
    Injection Date  : 12/16/2019 9:04:06 PM             Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                      5UL.M
    Last changed    : 12/16/2019 8:00:08 PM by SYSTEM
    Analysis Method : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                      5UL.M (Sequence Method)
    Last changed    : 1/6/2020 4:57:58 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
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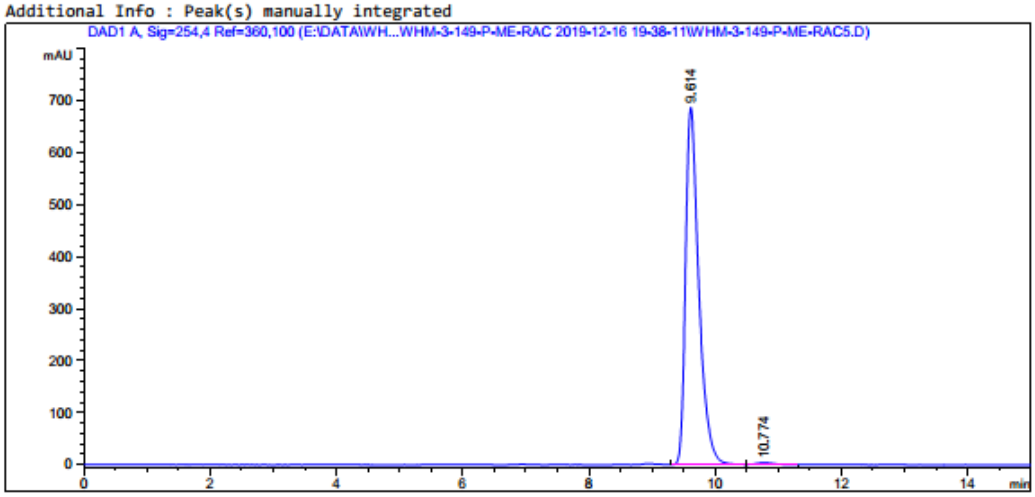


```
    ======================================================================
                              Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs


    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   9.614 BB    0.2189 9989.36816  686.14752  99.3955
       2  10.774 BB    0.2249   60.75687    3.29874   0.6045

    Totals :                  1.00501e4   689.44626

    ======================================================================
                              *** End of Report ***
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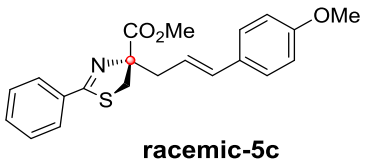
1260 1/6/2020 4:58:02 PM SYSTEM Page 1 of 1




**racemic-5c**

Data File E:\DATA\WHM-2\WHM-3-151-M-OME 2019-12-20 14-52-47\WHM-3-151-M-OME3.D
Sample Name: WHM-3-149-P-OME-RAC

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==========================================================================
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Acq. Instrument : 1260                          Location :   5
Injection Date  : 12/20/2019 3:37:57 PM              Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-3-151-M-OME 2019-12-20 14-52-47\AD-95-5-30min-5UL-0.5ML.M
Last changed    : 12/20/2019 2:55:57 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-3-151-M-OME 2019-12-20 14-52-47\AD-95-5-30min-5UL-0.5ML.M
                  (Sequence Method)
Last changed    : 1/6/2020 5:11:59 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
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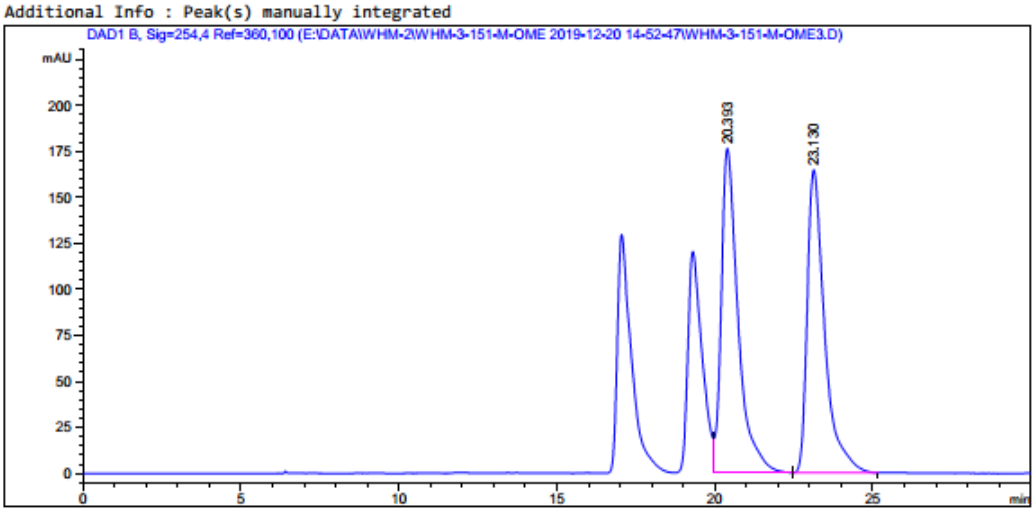


```
==========================================================================
                        Area Percent Report
==========================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 B, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  20.393 VB    0.5243 6505.52002  175.98625  50.8618
   2  23.130 BB    0.5552 6285.05176  164.33684  49.1382

Totals :                  1.27906e4   340.32309


==========================================================================
                        *** End of Report ***
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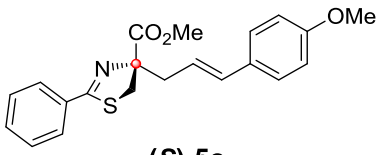


**(*S*)-5c**

Data File E:\DATA\WHM-2\whm-3-148-p-ome-s 2019-12-20 21-43-40\whm-3-148-p-ome-s1.D
Sample Name: whm-3-148-p-ome-s

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=====================================================================
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Acq. Instrument : 1260                          Location :   6
Injection Date  : 12/20/2019 9:56:18 PM              Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\whm-3-148-p-ome-s 2019-12-20 21-43-40\AD-95-5-30min-5UL-0.5ML
                  .M
Last changed    : 12/20/2019 9:43:40 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\whm-3-148-p-ome-s 2019-12-20 21-43-40\AD-95-5-30min-5UL-0.5ML
                  .M (Sequence Method)
Last changed    : 1/6/2020 5:17:10 PM by SYSTEM
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Additional Info : Peak(s) manually integrated
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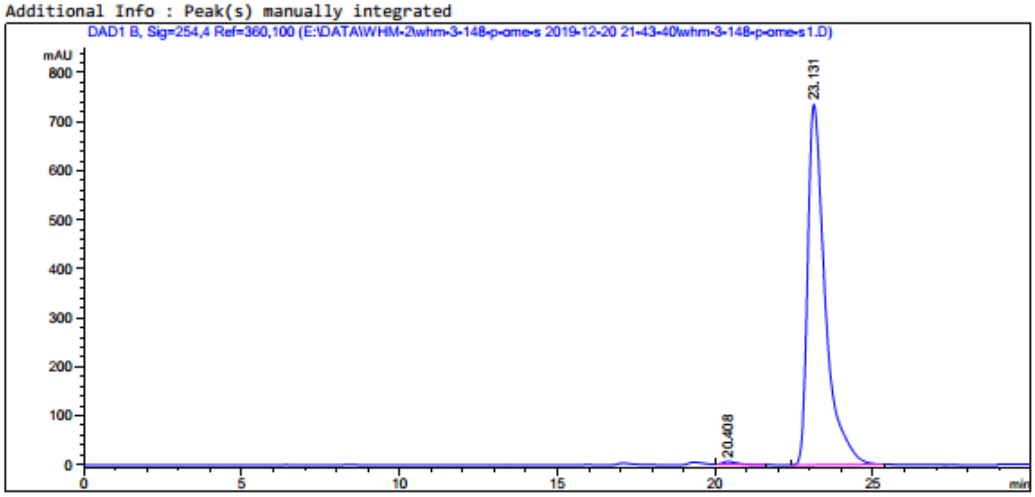


```
=====================================================================
                        Area Percent Report
=====================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 B, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  20.408 BB    0.3746  175.36024    5.59551   0.6162
   2  23.131 BB    0.5618 2.82832e4   735.26331  99.3838

Totals :                  2.84585e4   740.85882

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                        *** End of Report ***
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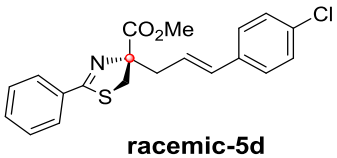
1260 1/6/2020 5:17:13 PM SYSTEM  Page 1 of 1




**racemic-5d**

Data File E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\WHM-3-149-P-ME-RAC3.D
Sample Name: WHM-3-149-P-CL-RAC

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==================================================================
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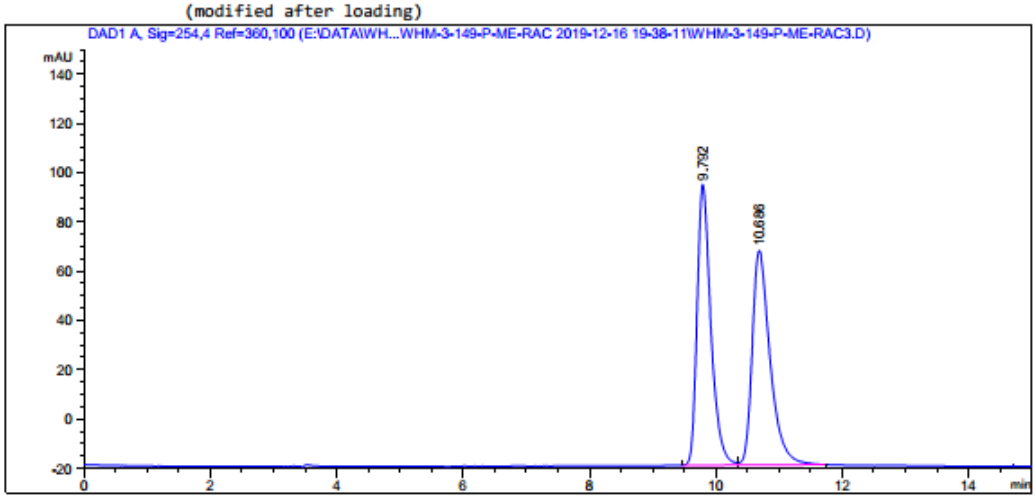
Acq. Instrument : 1260                         Location :   3
Injection Date  : 12/16/2019 8:21:19 PM            Inj :   1
                                             Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                  5UL.M
Last changed    : 12/16/2019 8:00:08 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                  5UL.M (Sequence Method)
Last changed    : 1/6/2020 5:00:49 PM by SYSTEM
                  (modified after loading)
```




```
==================================================================
                      Area Percent Report
==================================================================

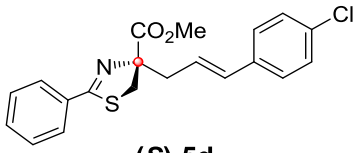
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.792 BV    0.2270 1718.11230  113.86243  50.1000
   2  10.686 VB    0.2946 1711.25476   86.93739  49.9000

Totals :                  3429.36707  200.79982

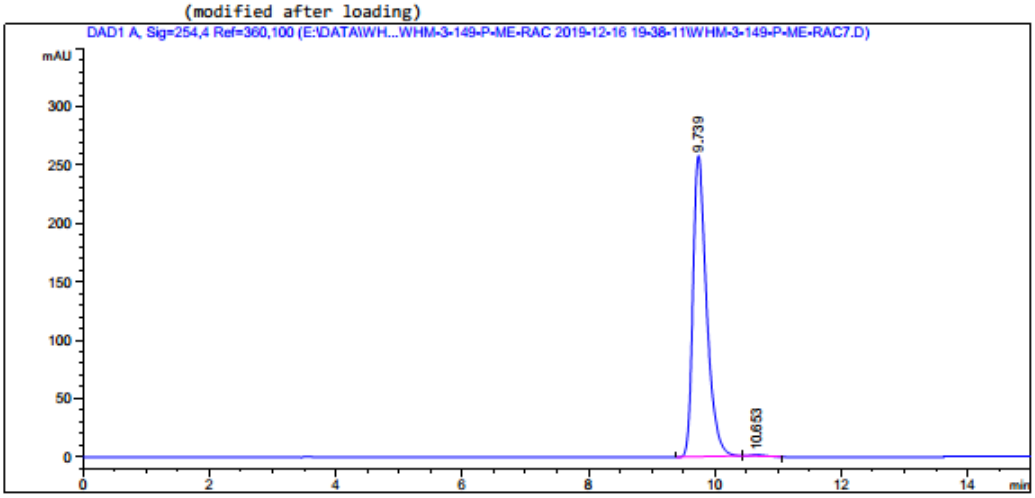
==================================================================
                      *** End of Report ***
```




**(*S*)-5d**

Data File E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\WHM-3-149-P-ME-RAC7.D
Sample Name: WHM-3-148-P-CL

```
    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   8
    Acq. Instrument : 1260                          Location :   7
    Injection Date  : 12/16/2019 9:51:54 PM             Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                      5UL.M
    Last changed    : 12/16/2019 9:53:01 PM by SYSTEM
                      (modified after loading)
    Analysis Method : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                      5UL.M (Sequence Method)
    Last changed    : 1/6/2020 5:02:25 PM by SYSTEM
                      (modified after loading)
```




```
    ======================================================================
                           Area Percent Report
    ======================================================================

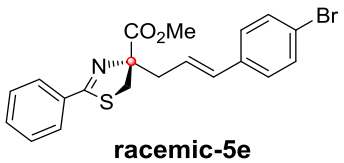
    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs


    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   9.739 BB    0.2246 3862.45410  258.15448  99.4987
       2  10.653 BB    0.1998   19.46106    1.15376   0.5013

    Totals :                  3881.91516  259.30824

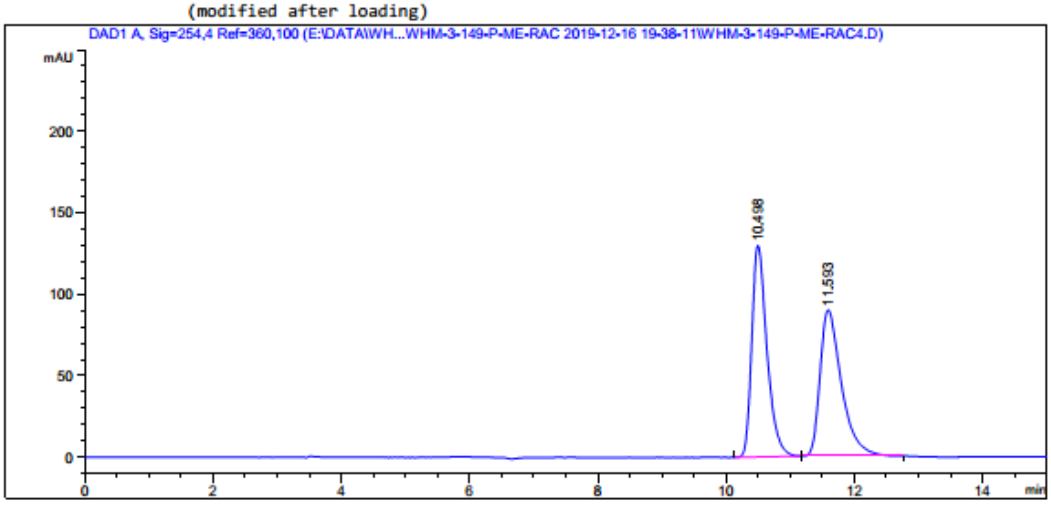
    ======================================================================
                           *** End of Report ***
```




**racemic-5e**

Data File E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\WHM-3-149-P-ME-RAC4.D
Sample Name: WHM-3-149-P-BR-RAC

```
======================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   5
Acq. Instrument : 1260                          Location :   4
Injection Date  : 12/16/2019 8:42:43 PM             Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                  5UL.M
Last changed    : 12/16/2019 8:00:08 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                  5UL.M (Sequence Method)
Last changed    : 1/6/2020 5:04:45 PM by SYSTEM
                  (modified after loading)
```




```
======================================================================
                        Area Percent Report
======================================================================

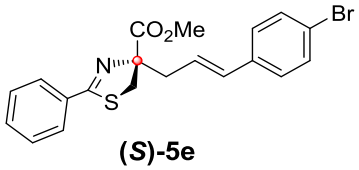
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.498 BB    0.2474 2140.94800  129.81493  50.6023
   2  11.593 BB    0.3459 2089.98291   89.67770  49.3977

Totals :                  4230.93091  219.49262

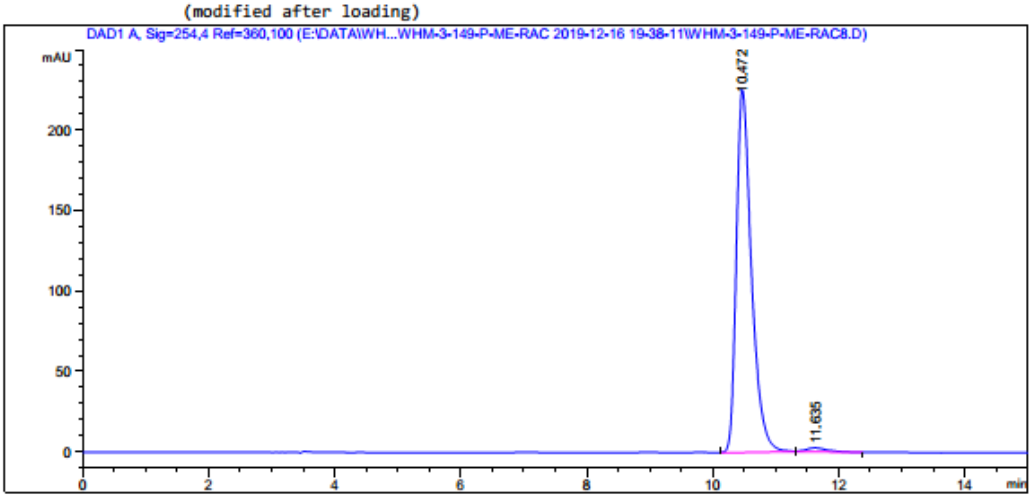

======================================================================
                          *** End of Report ***
```




**(*S*)-5e**

Data File E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\WHM-3-149-P-ME-RAC8.D
Sample Name: WHM-3-148-P-BR

```
    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   9
    Acq. Instrument : 1260                          Location :   8
    Injection Date  : 12/16/2019 10:13:25 PM            Inj :   1
                                                   Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                      5UL.M
    Last changed    : 12/16/2019 9:53:01 PM by SYSTEM
    Analysis Method : E:\DATA\WHM-2\WHM-3-149-P-ME-RAC 2019-12-16 19-38-11\IEH-98-2--1ML-20MIN-
                      5UL.M (Sequence Method)
    Last changed    : 1/6/2020 5:04:45 PM by SYSTEM
                      (modified after loading)
```




```
    ======================================================================
                           Area Percent Report
    ======================================================================

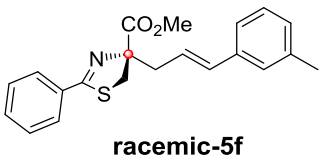
    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs


    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1  10.472 BB    0.2490 3744.96606  225.22913  98.5818
       2  11.635 BB    0.2689   53.87335    2.39118   1.4182

    Totals :                  3798.83941  227.62030

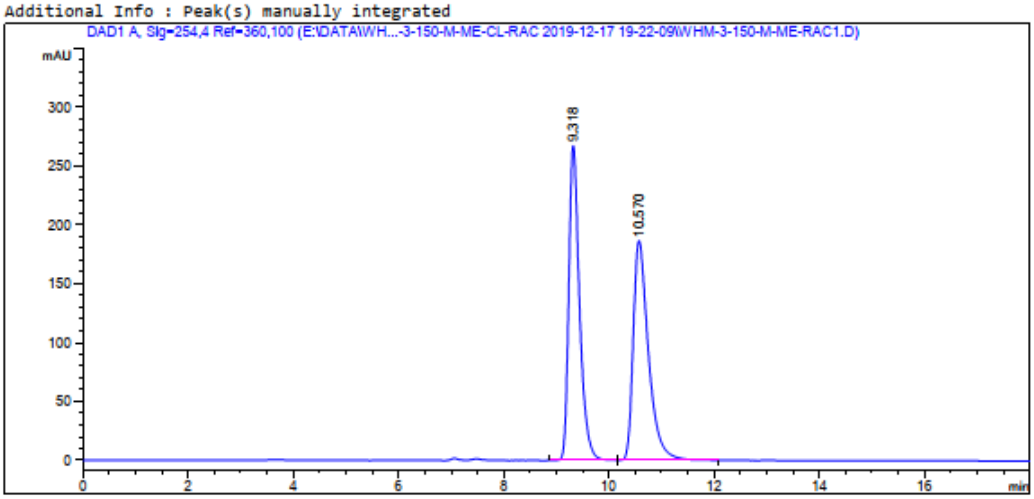

    ======================================================================
                           *** End of Report ***
```




**racemic-5f**

Data File E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\WHM-3-150-M-ME-RAC1.D
Sample Name: WHM-3-150-M-ME-RAC

```
==========================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   2
Acq. Instrument : 1260                          Location :   1
Injection Date  : 12/17/2019 7:34:47 PM              Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\IEH-98-2--1ML-20MIN
                  -5UL.M
Last changed    : 12/17/2019 7:22:09 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\IEH-98-2--1ML-20MIN
                  -5UL.M (Sequence Method)
Last changed    : 12/27/2020 8:57:33 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
==========================================================================
                        Area Percent Report
==========================================================================

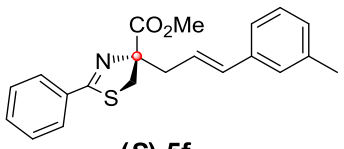
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.318 BB    0.2139 3802.40796  267.43774  50.2975
   2  10.570 BB    0.2999 3757.42700  186.62775  49.7025

Totals :                  7559.83496  454.06549

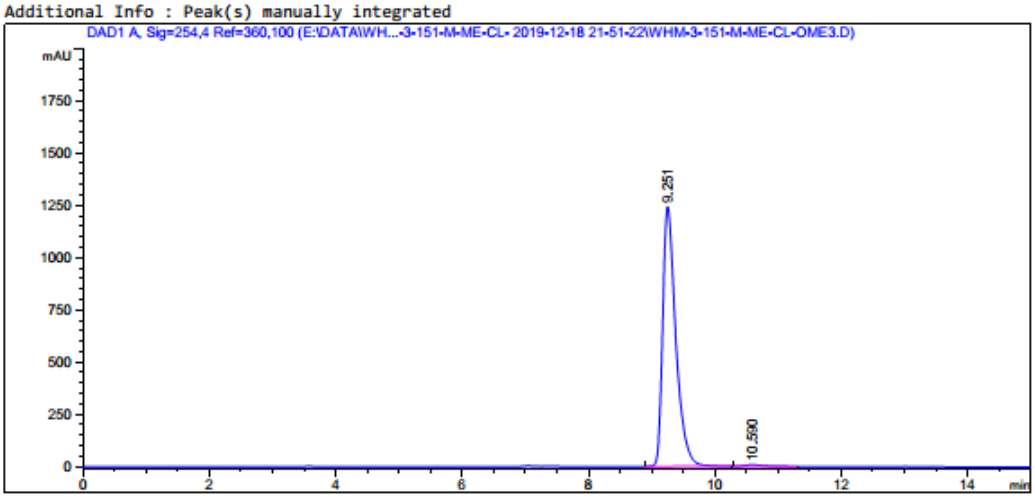
==========================================================================
                        *** End of Report ***
```




**(*S*)-5f**

Data File E:\DATA\WHM-2\WHM-3-151-M-ME-CL- 2019-12-18 21-51-22\WHM-3-151-M-ME-CL-OME3.D
Sample Name: WHM-3-151-M-ME-S

```
==================================================================
Acq. Operator   : SYSTEM                      Seq. Line :   4
Acq. Instrument : 1260                         Location :   3
Injection Date  : 12/18/2019 10:46:50 PM            Inj :   1
                                              Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-3-151-M-ME-CL- 2019-12-18 21-51-22\IEH-98-2--1ML-20MIN-
                  5UL.M
Last changed    : 12/18/2019 9:51:22 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-3-151-M-ME-CL- 2019-12-18 21-51-22\IEH-98-2--1ML-20MIN-
                  5UL.M (Sequence Method)
Last changed    : 1/6/2020 7:57:27 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
==================================================================
                      Area Percent Report
==================================================================

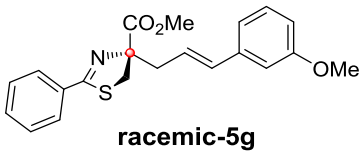
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.251 BB    0.2158 1.78877e4  1243.89124  99.2534
   2  10.590 BB    0.2654  134.55562    6.81284   0.7466

Totals :                  1.80223e4  1250.70408

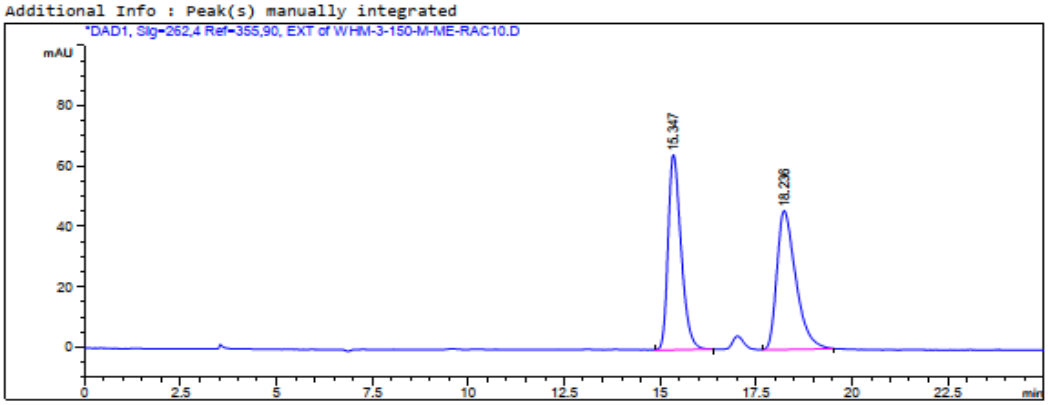
==================================================================
                      *** End of Report ***
```




**racemic-5g**

```
Data File E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\WHM-3-150-M-ME-RAC10.D
Sample Name: WHM-3-150-M-ME-RAC

    ======================================================================
    Acq. Operator    : SYSTEM                        Seq. Line :  11
    Acq. Instrument : 1260                           Location :   6
    Injection Date   : 12/17/2019 10:26:18 PM             Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method      : E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\IEH-98-2--1ML-20MIN
                       -5UL.M
    Last changed     : 12/17/2019 10:54:25 PM by SYSTEM
                       (modified after loading)
    Analysis Method : E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\IEH-98-2--1ML-20MIN
                       -5UL.M (Sequence Method)
    Last changed     : 12/27/2020 9:36:23 PM by SYSTEM
                       (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                            Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

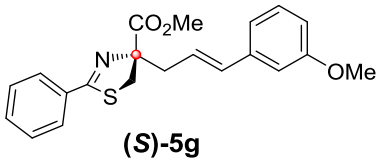

    Signal 1: DAD1, Sig=262,4 Ref=355,90, EXT
     Signal has been modified after loading from rawdata file!

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]       [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1  15.347 BB    0.3573 1524.78882   64.62830  49.1873
       2  18.236 BB    0.4712 1575.17395   45.91649  50.8127

    Totals :                  3099.96277  110.54479


    ======================================================================
                            *** End of Report ***

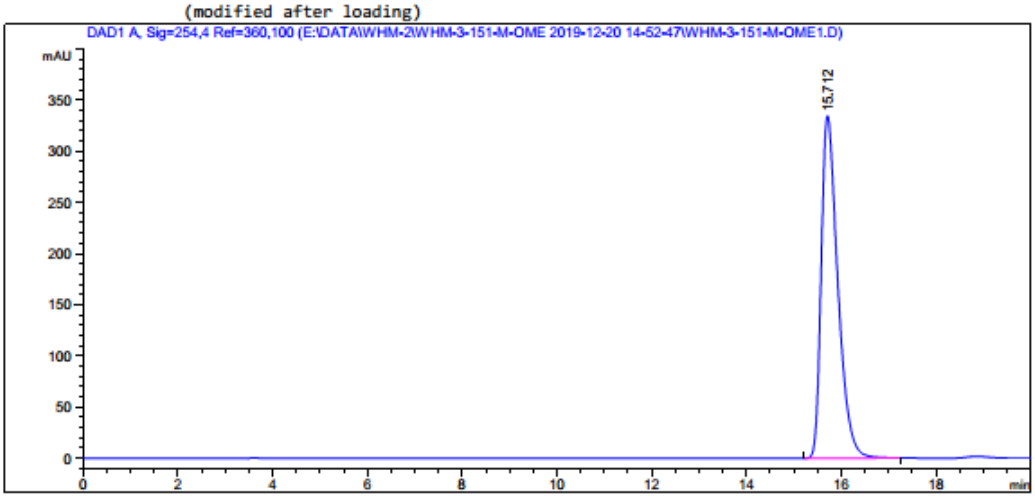
1260 12/27/2020 9:36:26 PM SYSTEM                                Page   1 of 1
```




**(*S*)-5g**

Data File E:\DATA\WHM-2\WHM-3-151-M-OME 2019-12-20 14-52-47\WHM-3-151-M-OME1.D
Sample Name: WHM-3-151-M-OME-S

```
======================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   2
Acq. Instrument : 1260                          Location :   4
Injection Date  : 12/20/2019 3:05:28 PM              Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-3-151-M-OME 2019-12-20 14-52-47\IEH-98-2--1ML-20MIN-5UL.M
Last changed    : 12/20/2019 2:52:47 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-3-151-M-OME 2019-12-20 14-52-47\IEH-98-2--1ML-20MIN-5UL.M
                  (Sequence Method)
Last changed    : 1/6/2020 7:59:39 PM by SYSTEM
                  (modified after loading)
```




```
======================================================================
                        Area Percent Report
======================================================================

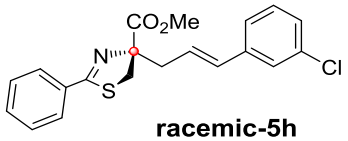
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  15.712 BB    0.3644 8135.17773  334.85144 100.0000

Totals :                  8135.17773  334.85144

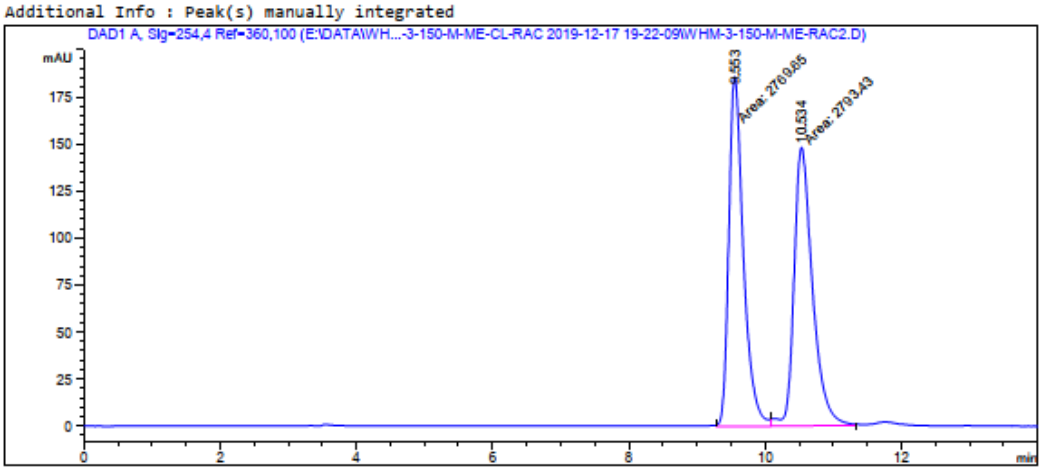

======================================================================
                        *** End of Report ***
```




**racemic-5h**

```
Data File E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\WHM-3-150-M-ME-RAC2.D
Sample Name: WHM-3-150-M-CL-RAC

    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   3
    Acq. Instrument : 1260                         Location :   2
    Injection Date  : 12/17/2019 7:56:13 PM             Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\IEH-98-2--1ML-20MIN
                      -5UL.M
    Last changed    : 12/17/2019 8:08:39 PM by SYSTEM
                      (modified after loading)
    Analysis Method : E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\IEH-98-2--1ML-20MIN
                      -5UL.M (Sequence Method)
    Last changed    : 12/27/2020 9:44:56 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                           Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

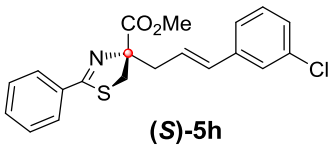

    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   9.553 MF    0.2486 2769.64697  185.71367  49.7862
       2  10.534 FM    0.3148 2793.42969  147.90947  50.2138

    Totals :                  5563.07666  333.62314


    ======================================================================
                              *** End of Report ***

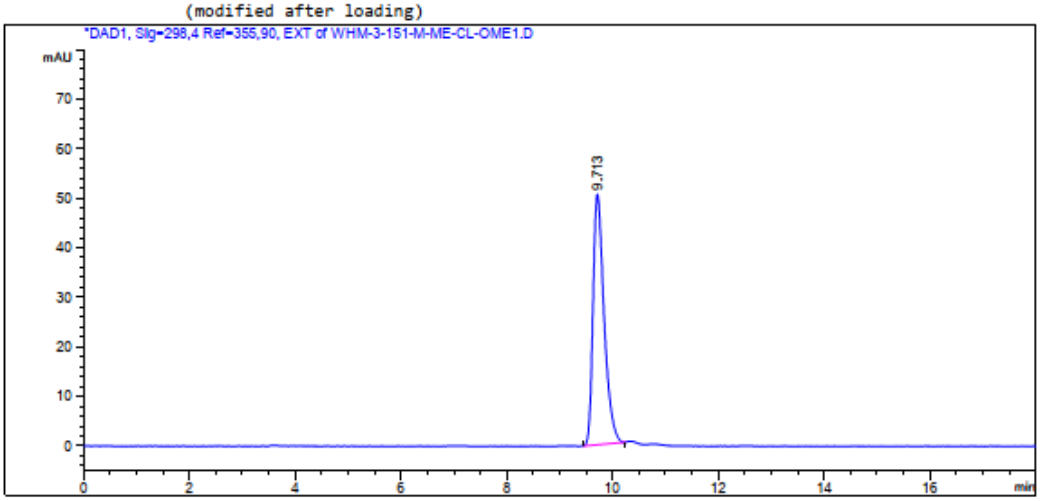
1260 12/27/2020 9:44:59 PM SYSTEM                          Page   1 of 1
```




**(*S*)-5h**

```
Data File E:\DATA\WHM-2\WHM-3-151-M-ME-CL- 2019-12-18 21-51-22\WHM-3-151-M-ME-CL-OME1.D
Sample Name: WHM-3-151M--CL-S

    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   2
    Acq. Instrument : 1260                         Location :   1
    Injection Date  : 12/18/2019 10:04:03 PM            Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-3-151-M-ME-CL- 2019-12-18 21-51-22\IEH-98-2--1ML-20MIN-
                      5UL.M
    Last changed    : 12/18/2019 9:51:22 PM by SYSTEM
    Analysis Method : E:\DATA\WHM-2\WHM-3-151-M-ME-CL- 2019-12-18 21-51-22\IEH-98-2--1ML-20MIN-
                      5UL.M (Sequence Method)
    Last changed    : 12/27/2020 9:49:08 PM by SYSTEM
                      (modified after loading)
```




```
    ======================================================================
                            Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

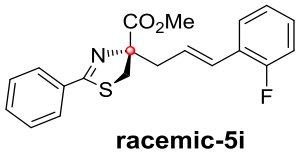

    Signal 1: DAD1, Sig=298,4 Ref=355,90, EXT
     Signal has been modified after loading from rawdata file!

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   9.713 BB    0.2227  735.06769   50.52641 100.0000

    Totals :                   735.06769   50.52641

    ======================================================================
                            *** End of Report ***

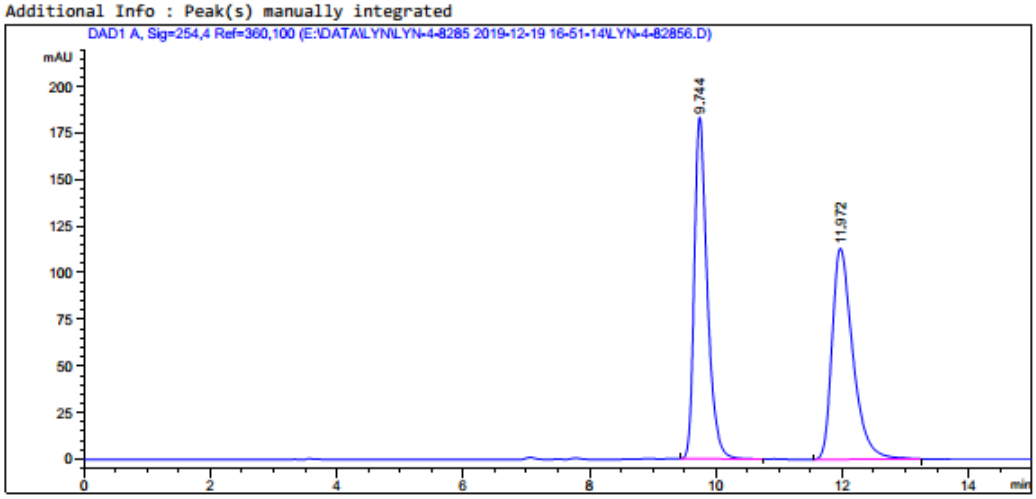
1260 12/27/2020 9:49:10 PM SYSTEM                          Page   1 of 1
```




**racemic-5i**

Data File E:\DATA\LYN\LYN-4-8285 2019-12-19 16-51-14\LYN-4-82856.D
Sample Name: WHM-4-1-O-F-RAC

```
==================================================================
Acq. Operator   : SYSTEM                      Seq. Line :   7
Acq. Instrument : 1260                         Location :   1
Injection Date  : 12/19/2019 8:00:40 PM            Inj :   1
                                             Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\LYN\LYN-4-8285 2019-12-19 16-51-14\IEH-98-2--1ML-20MIN-5UL.M
Last changed    : 12/19/2019 5:26:48 PM by SYSTEM
Analysis Method : E:\DATA\LYN\LYN-4-8285 2019-12-19 16-51-14\IEH-98-2--1ML-20MIN-5UL.M (
                  Sequence Method)
Last changed    : 1/6/2020 8:11:36 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
==================================================================
                      Area Percent Report
==================================================================

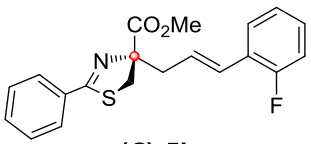
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]       [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.744 BB    0.2152 2609.38867  183.20775  50.2958
   2  11.972 BB    0.3430 2578.69580  113.08957  49.7042

Totals :                  5188.08447  296.29732

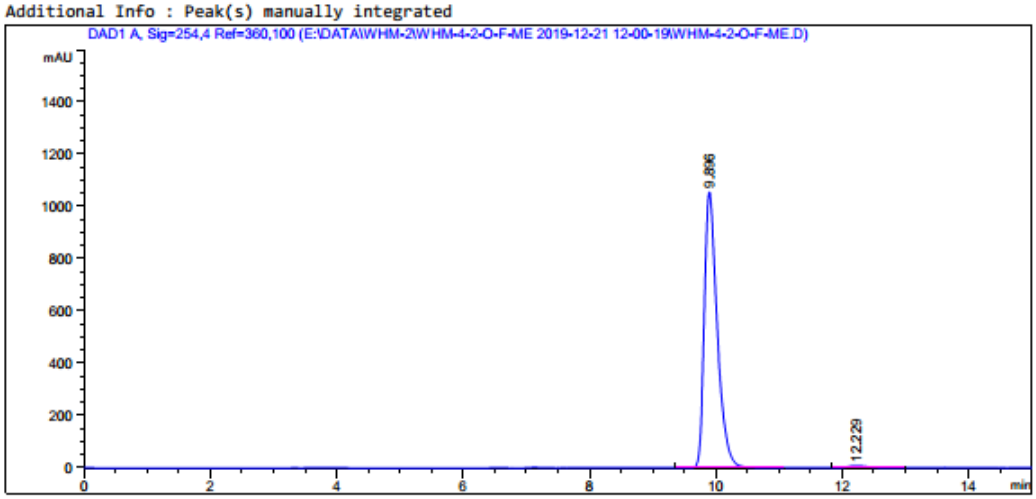
==================================================================
                      *** End of Report ***
```




**(*S*)-5i**

Data File E:\DATA\WHM-2\WHM-4-2-O-F-ME 2019-12-21 12-00-19\WHM-4-2-O-F-ME.D
Sample Name: WHM-4-2-O-F-S

```
=====================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   1
Acq. Instrument : 1260                          Location :   1
Injection Date  : 12/21/2019 12:01:44 PM             Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-4-2-O-F-ME 2019-12-21 12-00-19\IEH-98-2--1ML-20MIN-5UL.M
Last changed    : 12/21/2019 12:00:19 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-4-2-O-F-ME 2019-12-21 12-00-19\IEH-98-2--1ML-20MIN-5UL.M
                  (Sequence Method)
Last changed    : 1/6/2020 8:16:50 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
=====================================================================
                        Area Percent Report
=====================================================================

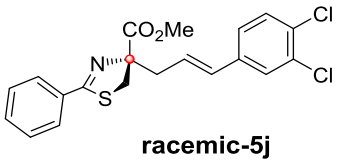
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.896 BB    0.2152 1.50268e4  1055.04871  98.7718
   2  12.229 BB    0.3108  186.85089    8.07989   1.2282

Totals :                  1.52136e4  1063.12860

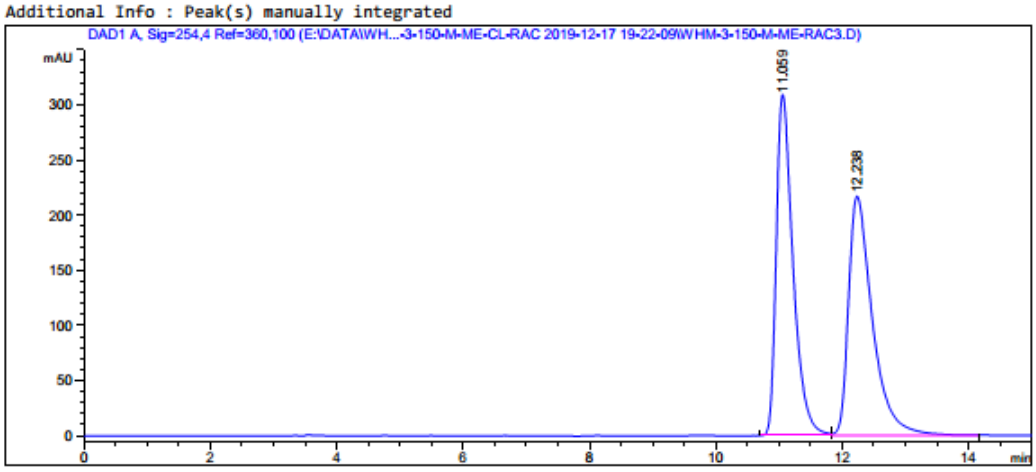

=====================================================================
                        *** End of Report ***
```




**racemic-5j**

Data File E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\WHM-3-150-M-ME-RAC3.D
Sample Name: WHM-3-150-3,4-CL-RAC

```
    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   4
    Acq. Instrument : 1260                          Location :   3
    Injection Date  : 12/17/2019 8:11:42 PM             Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\IEH-98-2--1ML-20MIN
                      -5UL.M
    Last changed    : 12/17/2019 8:13:45 PM by SYSTEM
                      (modified after loading)
    Analysis Method : E:\DATA\WHM-2\WHM-3-150-M-ME-CL-RAC 2019-12-17 19-22-09\IEH-98-2--1ML-20MIN
                      -5UL.M (Sequence Method)
    Last changed    : 1/6/2020 5:45:32 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                              Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

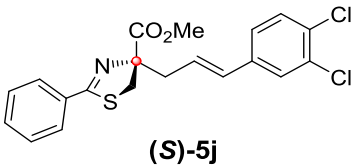

    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1  11.059 BV    0.2783 5708.60791  309.31778  49.9240
       2  12.238 VB    0.3982 5725.99268  216.77391  50.0760

    Totals :                  1.14346e4   526.09169


    ======================================================================
                              *** End of Report ***

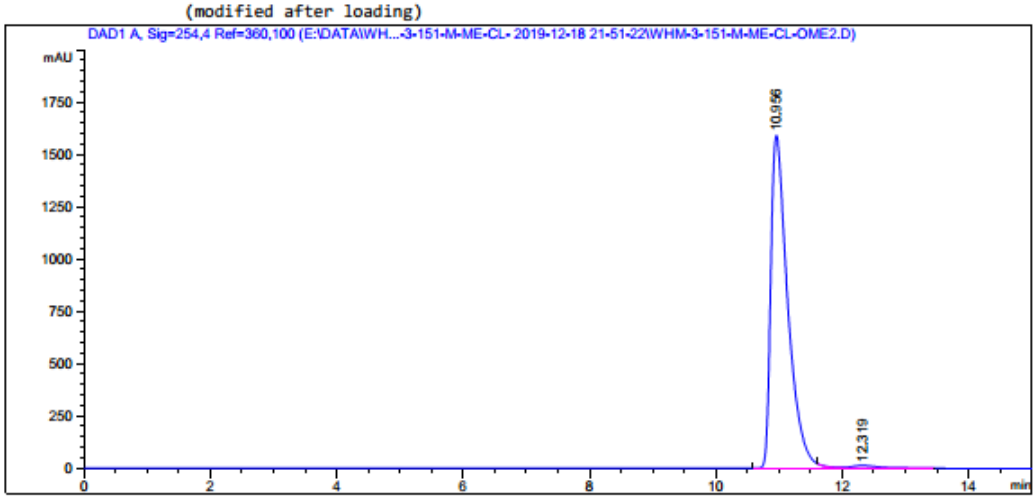
1260 1/6/2020 5:45:34 PM SYSTEM                                Page   1 of 1
```




**(*S*)-5j**

Data File E:\DATA\WHM-2\WHM-3-151-M-ME-CL- 2019-12-18 21-51-22\WHM-3-151-M-ME-CL-OME2.D
Sample Name: WHM-3-151-3,4-CL-S

```
==========================================================================
Acq. Operator   : SYSTEM                        Seq. Line :   3
Acq. Instrument : 1260                          Location :   2
Injection Date  : 12/18/2019 10:25:27 PM             Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-3-151-M-ME-CL- 2019-12-18 21-51-22\IEH-98-2--1ML-20MIN-
                  5UL.M
Last changed    : 12/18/2019 9:51:22 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-3-151-M-ME-CL- 2019-12-18 21-51-22\IEH-98-2--1ML-20MIN-
                  5UL.M (Sequence Method)
Last changed    : 1/6/2020 7:56:20 PM by SYSTEM
                  (modified after loading)
```




```
==========================================================================
                        Area Percent Report
==========================================================================

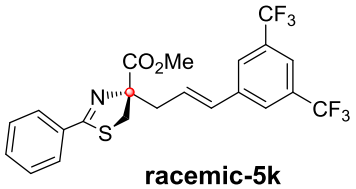
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.956 BV R  0.2786 2.96761e4  1590.88013  98.6672
   2  12.319 VB E  0.4214  400.87311   12.13612   1.3328

Totals :                  3.00769e4  1603.01625

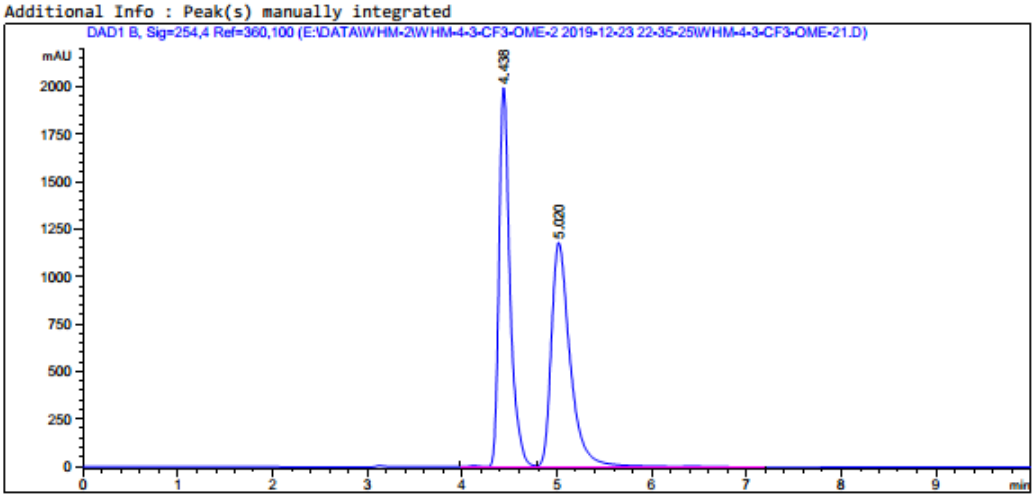

==========================================================================
                        *** End of Report ***
```




**racemic-5k**

Data File E:\DATA\WHM-2\WHM-4-3-CF3-OME-2 2019-12-23 22-35-25\WHM-4-3-CF3-OME-21.D
Sample Name: WHM-4-3-CF3-RAC

```
==========================================================================
Acq. Operator   : SYSTEM                        Seq. Line :   2
Acq. Instrument : 1260                          Location :   3
Injection Date  : 12/23/2019 10:45:23 PM             Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-4-3-CF3-OME-2 2019-12-23 22-35-25\ASH-98-2-1ML-ALL-20MIN-
                  5UL.M
Last changed    : 12/23/2019 10:41:12 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-4-3-CF3-OME-2 2019-12-23 22-35-25\ASH-98-2-1ML-ALL-20MIN-
                  5UL.M (Sequence Method)
Last changed    : 1/6/2020 8:31:37 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
==========================================================================
                          Area Percent Report
==========================================================================

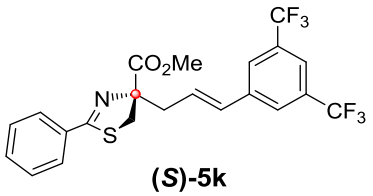
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 B, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   4.438 VV R  0.1225 1.62164e4  1998.11462  49.8381
   2   5.020 VV R  0.2051 1.63218e4  1180.02246  50.1619

Totals :                  3.25382e4  3178.13708

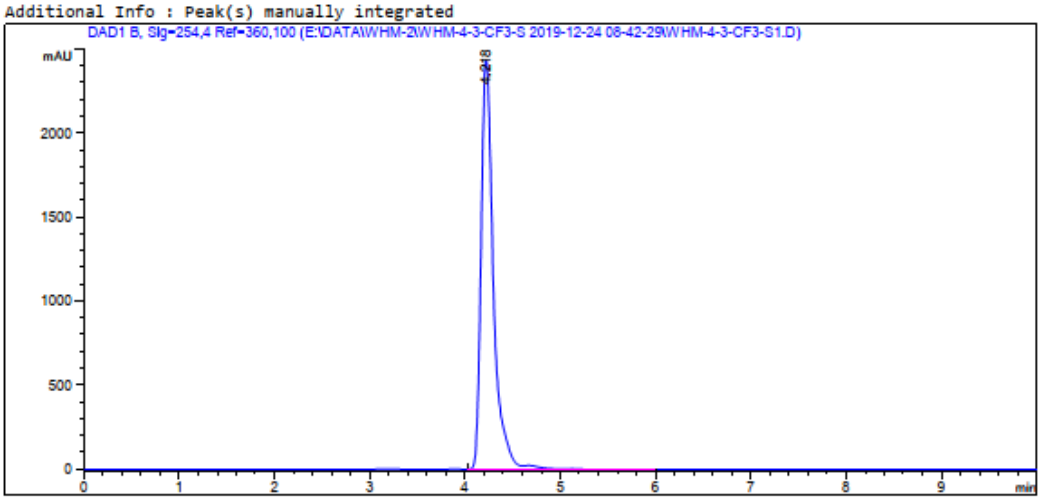
==========================================================================
                          *** End of Report ***
```




**(*S*)-5k**

Data File E:\DATA\WHM-2\WHM-4-3-CF3-S 2019-12-24 08-42-29\WHM-4-3-CF3-S1.D
Sample Name: WHM-4-3-CF3-S

```
=====================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   2
Acq. Instrument : 1260                          Location :   5
Injection Date  : 12/24/2019 8:54:24 AM              Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-4-3-CF3-S 2019-12-24 08-42-29\ASH-98-2-1ML-ALL-10MIN-5UL.
                  M
Last changed    : 12/24/2019 8:42:29 AM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-4-3-CF3-S 2019-12-24 08-42-29\ASH-98-2-1ML-ALL-10MIN-5UL.
                  M (Sequence Method)
Last changed    : 12/27/2020 9:52:13 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
=====================================================================
                        Area Percent Report
=====================================================================

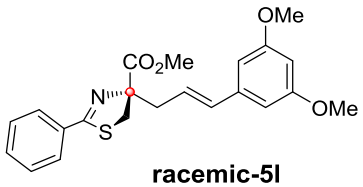
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 B, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   4.218 BV R  0.1341 2.19910e4  2433.72241 100.0000

Totals :                  2.19910e4  2433.72241

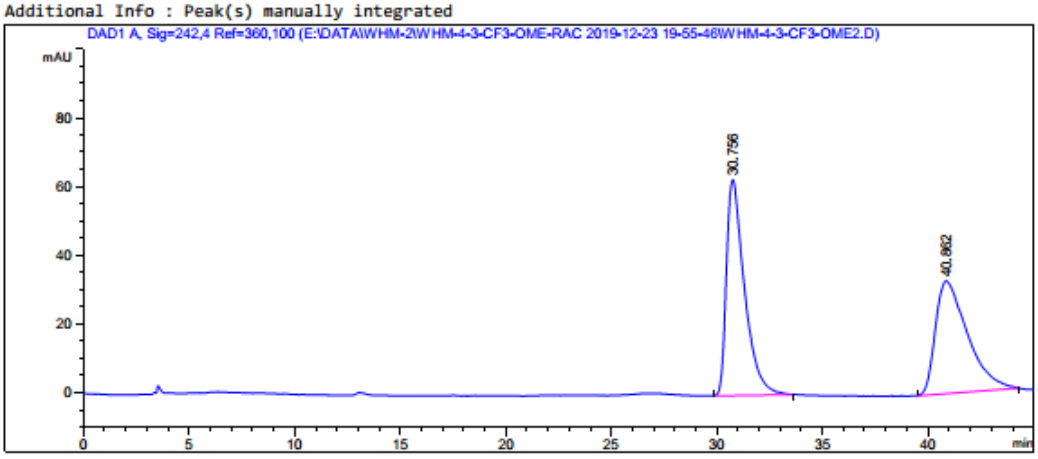

=====================================================================
                          *** End of Report ***
```




**racemic-5l**

Data File E:\DATA\WHM-2\WHM-4-3-CF3-OME-RAC 2019-12-23 19-55-46\WHM-4-3-CF3-OME2.D
Sample Name: WHM-4-3-OME-RAC

```
=====================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   3
Acq. Instrument : 1260                          Location :   4
Injection Date  : 12/23/2019 8:30:03 PM              Inj :   1
                                               Inj Volume : 10.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-4-3-CF3-OME-RAC 2019-12-23 19-55-46\IE-98-2-1.0ML-5UL-
                  40MIN.M
Last changed    : 12/23/2019 9:07:44 PM by SYSTEM
                  (modified after loading)
Analysis Method : E:\DATA\WHM-2\WHM-4-3-CF3-OME-RAC 2019-12-23 19-55-46\IE-98-2-1.0ML-5UL-
                  40MIN.M (Sequence Method)
Last changed    : 1/6/2020 8:29:04 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
=====================================================================
                        Area Percent Report
=====================================================================

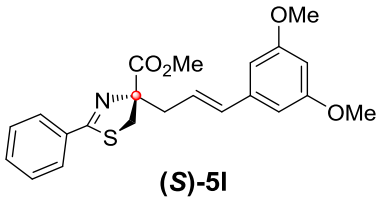
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=242,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  30.756 BB    0.8211 3732.42529   62.73220  51.9002
   2  40.862 BB    1.2382 3459.11475   32.75167  48.0998

Totals :                  7191.54004   95.48386

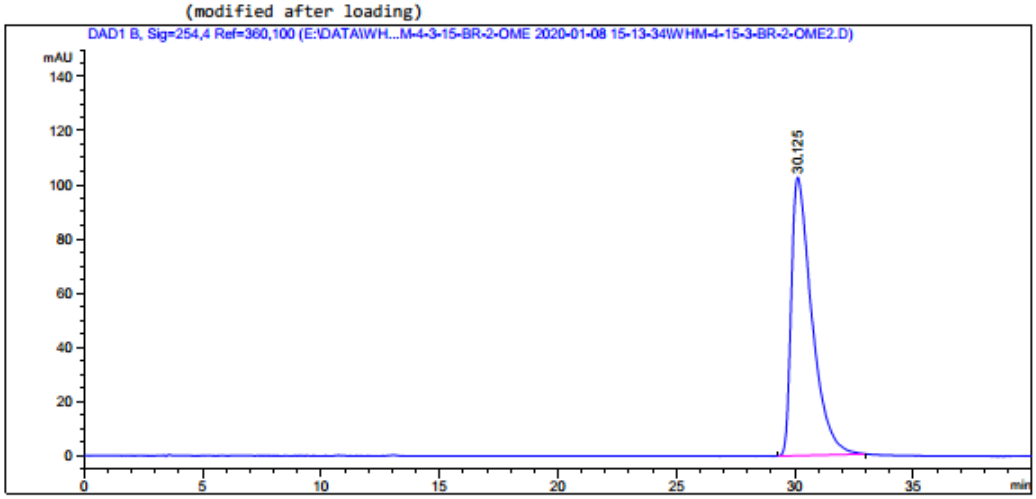

=====================================================================
                        *** End of Report ***
```




**(*S*)-5l**

Data File E:\DATA\WHM-2\WHM-4-3-15-BR-2-OME 2020-01-08 15-13-34\WHM-4-15-3-BR-2-OME2.D
Sample Name: WHM-4-3-2-OME-S

```
==================================================================
Acq. Operator   : SYSTEM                      Seq. Line :   3
Acq. Instrument : 1260                         Location :   2
Injection Date  : 1/8/2020 3:47:19 PM              Inj :   1
                                             Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-4-3-15-BR-2-OME 2020-01-08 15-13-34\IE-98-2-1ML-5UL-45MIN
                  .M
Last changed    : 1/8/2020 3:13:35 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-4-3-15-BR-2-OME 2020-01-08 15-13-34\IE-98-2-1ML-5UL-45MIN
                  .M (Sequence Method)
Last changed    : 1/8/2020 6:11:10 PM by SYSTEM
                  (modified after loading)
```




```
==================================================================
                      Area Percent Report
==================================================================

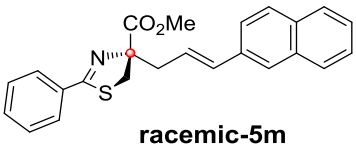
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 B, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  30.125 BB    0.8093 6181.26563  102.83443 100.0000

Totals :                  6181.26563  102.83443

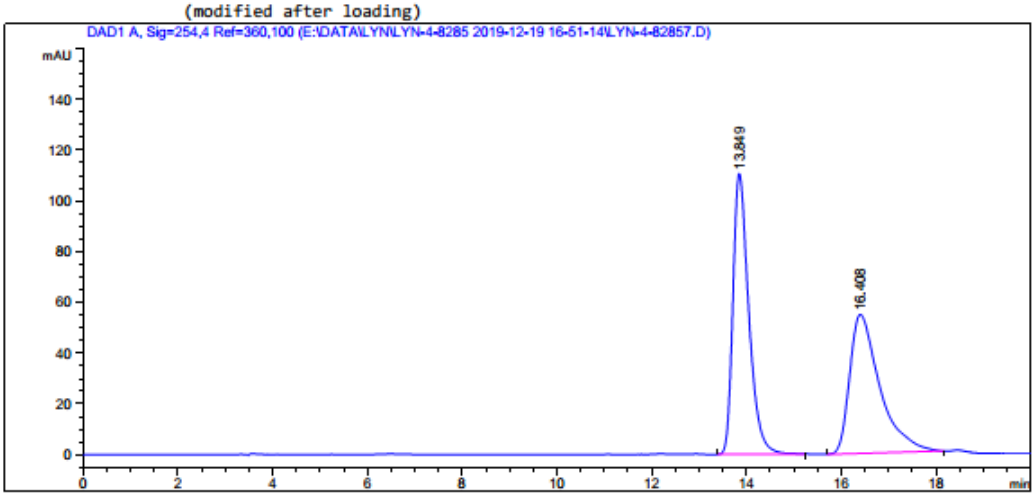

==================================================================
                        *** End of Report ***
```




**racemic-5m**

Data File E:\DATA\LYN\LYN-4-8285 2019-12-19 16-51-14\LYN-4-82857.D
Sample Name: WHM-4-1-2-NA-RAC

```
==================================================================
Acq. Operator   : SYSTEM                      Seq. Line :   8
Acq. Instrument : 1260                         Location :   2
Injection Date  : 12/19/2019 8:21:58 PM             Inj :   1
                                              Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\LYN\LYN-4-8285 2019-12-19 16-51-14\IEH-98-2--1ML-20MIN-5UL.M
Last changed    : 12/19/2019 5:26:48 PM by SYSTEM
Analysis Method : E:\DATA\LYN\LYN-4-8285 2019-12-19 16-51-14\IEH-98-2--1ML-20MIN-5UL.M (
                  Sequence Method)
Last changed    : 1/6/2020 8:12:33 PM by SYSTEM
                  (modified after loading)
```




```
==================================================================
                      Area Percent Report
==================================================================

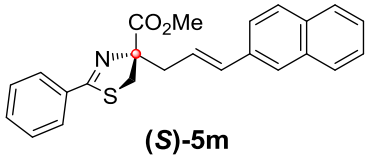
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  13.849 BB    0.3502 2571.99951  110.65259  51.5761
   2  16.408 BB    0.5990 2414.80371   54.70195  48.4239

Totals :                  4986.80322  165.35454

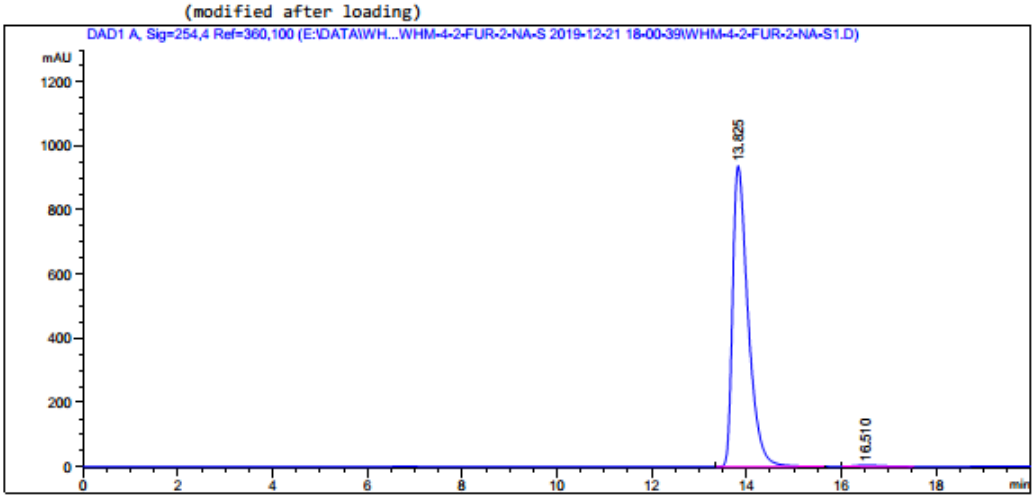
==================================================================
                      *** End of Report ***
```




**(*S*)-5m**

Data File E:\DATA\WHM-2\WHM-4-2-FUR-2-NA-S 2019-12-21 18-00-39\WHM-4-2-FUR-2-NA-S1.D
Sample Name: WHM-4-2-2-NA-S

```
=====================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   2
Acq. Instrument : 1260                          Location :   2
Injection Date  : 12/21/2019 6:23:21 PM             Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-4-2-FUR-2-NA-S 2019-12-21 18-00-39\IEH-98-2--1ML-20MIN-
                  5UL.M
Last changed    : 12/21/2019 6:00:39 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-4-2-FUR-2-NA-S 2019-12-21 18-00-39\IEH-98-2--1ML-20MIN-
                  5UL.M (Sequence Method)
Last changed    : 1/6/2020 8:19:45 PM by SYSTEM
                  (modified after loading)
```




```
=====================================================================
                        Area Percent Report
=====================================================================

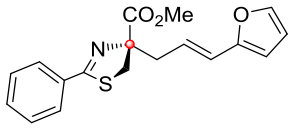
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]       [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  13.825 BB    0.3398 2.12095e4   937.91632  99.3225
   2  16.510 BB    0.4832  144.67897    3.53714   0.6775

Totals :                  2.13542e4   941.45346

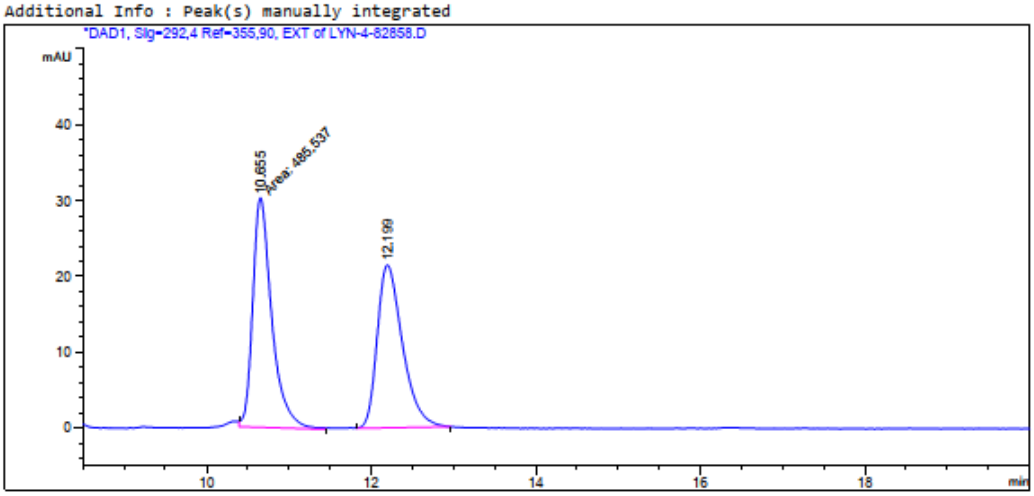
=====================================================================
                        *** End of Report ***
```




**racemic-5n**

Data File E:\DATA\LYN\LYN-4-8285 2019-12-19 16-51-14\LYN-4-82858.D
Sample Name: WHM-4-1-FUR-RAC

```
    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   9
    Acq. Instrument : 1260                          Location :   3
    Injection Date  : 12/19/2019 8:43:22 PM              Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\LYN\LYN-4-8285 2019-12-19 16-51-14\IEH-98-2--1ML-20MIN-5UL.M
    Last changed    : 12/19/2019 5:26:48 PM by SYSTEM
    Analysis Method : E:\DATA\LYN\LYN-4-8285 2019-12-19 16-51-14\IEH-98-2--1ML-20MIN-5UL.M (
                      Sequence Method)
    Last changed    : 12/27/2020 10:01:15 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                           Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

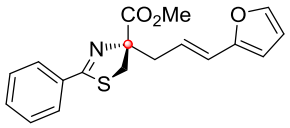

    Signal 1: DAD1, Sig=292,4 Ref=355,90, EXT
     Signal has been modified after loading from rawdata file!

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1  10.655 FM    0.2674  485.53683   30.25993  51.4546
       2  12.199 BB    0.3020  458.08582   21.46368  48.5454

    Totals :                   943.62265   51.72361

    ======================================================================
                              *** End of Report ***

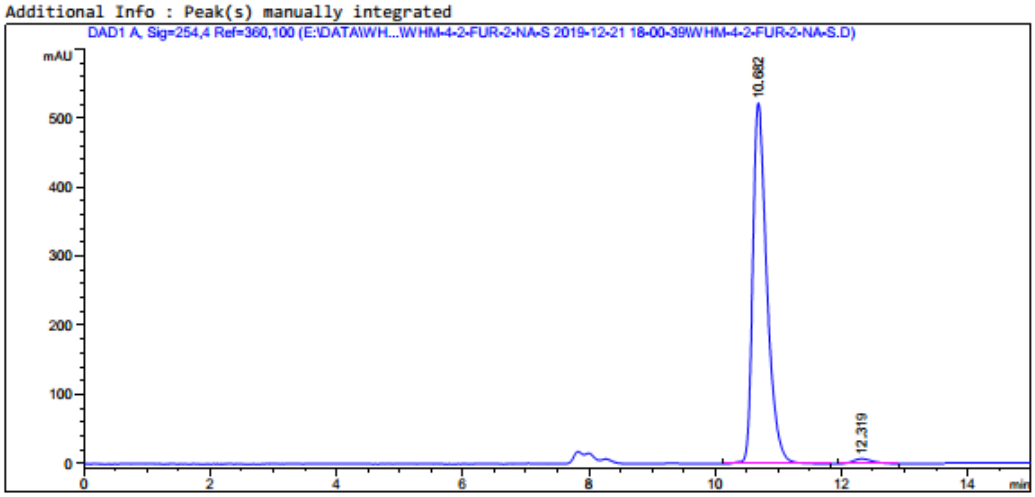
1260 12/27/2020 10:01:18 PM SYSTEM                                Page   1 of 1
```




**(*S*)-5n**

Data File E:\DATA\WHM-2\WHM-4-2-FUR-2-NA-S 2019-12-21 18-00-39\WHM-4-2-FUR-2-NA-S.D
Sample Name: WHM-4-2-FUR-S

```
    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   1
    Acq. Instrument : 1260                          Location :   1
    Injection Date  : 12/21/2019 6:01:59 PM             Inj :   1
                                                   Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-4-2-FUR-2-NA-S 2019-12-21 18-00-39\IEH-98-2--1ML-20MIN-
                      5UL.M
    Last changed    : 12/21/2019 6:00:39 PM by SYSTEM
    Analysis Method : E:\DATA\WHM-2\WHM-4-2-FUR-2-NA-S 2019-12-21 18-00-39\IEH-98-2--1ML-20MIN-
                      5UL.M (Sequence Method)
    Last changed    : 1/6/2020 8:18:38 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                            Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

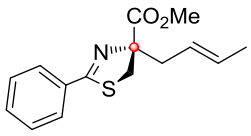

    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1  10.682 BB    0.2351 8106.73047  522.13721  98.2272
       2  12.319 BB    0.2873  146.31215    6.90337   1.7728

    Totals :                  8253.04262  529.04057


    ======================================================================
                            *** End of Report ***

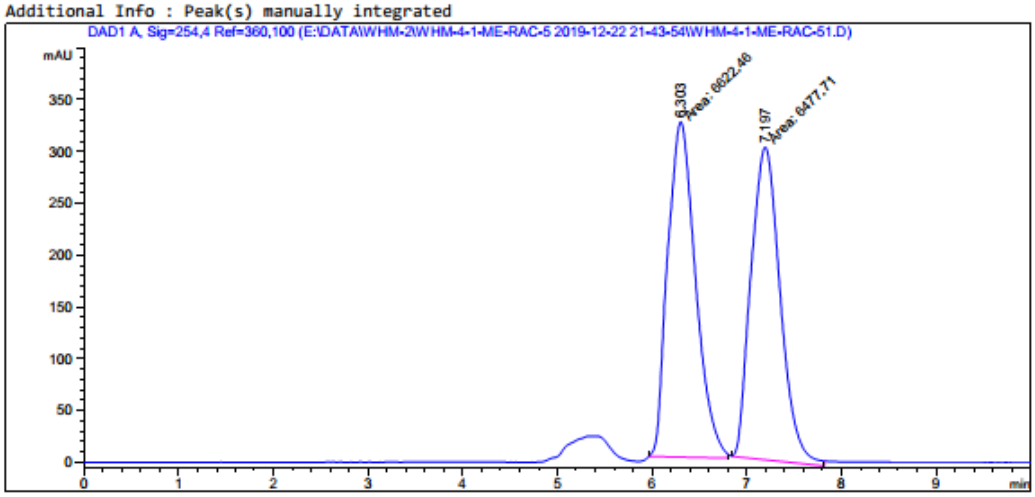
1260 1/6/2020 8:18:47 PM SYSTEM                              Page   1 of 1
```




**racemic-5o**

Data File E:\DATA\WHM-2\WHM-4-1-ME-RAC-5 2019-12-22 21-43-54\WHM-4-1-ME-RAC-51.D
Sample Name: WHM-4-1-ME-RAC-4

```
=====================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   2
Acq. Instrument : 1260                          Location :   1
Injection Date  : 12/22/2019 9:56:12 PM              Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-4-1-ME-RAC-5 2019-12-22 21-43-54\IDH-98-2--1ML-20MIN-5UL.
                  M
Last changed    : 12/22/2019 9:43:55 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-4-1-ME-RAC-5 2019-12-22 21-43-54\IDH-98-2--1ML-20MIN-5UL.
                  M (Sequence Method)
Last changed    : 1/6/2020 8:06:35 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
=====================================================================
                        Area Percent Report
=====================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs

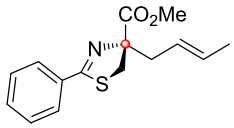

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   6.303 MM    0.3408 6622.45703  323.86935  50.5525
   2   7.197 MM    0.3573 6477.71240  302.13586  49.4475

Totals :                  1.31002e4   626.00522

=====================================================================
                        *** End of Report ***
```

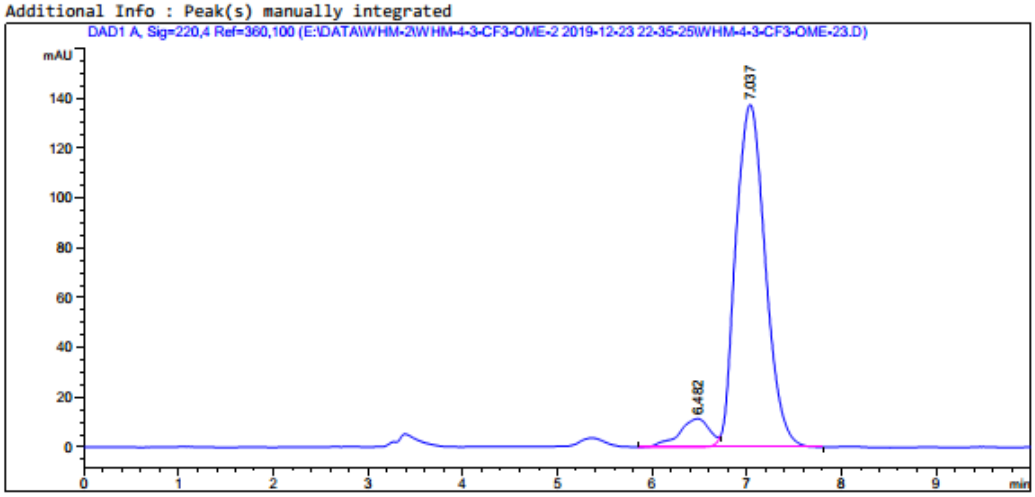
1260 1/6/2020 8:06:39 PM SYSTEM  Page 1 of 1




**(*S*)-5o**

Data File E:\DATA\WHM-2\WHM-4-3-CF3-OME-2 2019-12-23 22-35-25\WHM-4-3-CF3-OME-23.D
Sample Name: WHM-4-2-ME-S

```
    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   4
    Acq. Instrument : 1260                          Location :   2
    Injection Date  : 12/23/2019 11:18:01 PM            Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-4-3-CF3-OME-2 2019-12-23 22-35-25\IDH-98-2-5UL-10MIN-1ML.
                      M
    Last changed    : 12/23/2019 10:42:19 PM by SYSTEM
    Analysis Method : E:\DATA\WHM-2\WHM-4-3-CF3-OME-2 2019-12-23 22-35-25\IDH-98-2-5UL-10MIN-1ML.
                      M (Sequence Method)
    Last changed    : 1/6/2020 8:24:40 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                              Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

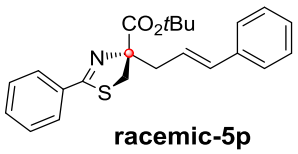

    Signal 1: DAD1 A, Sig=220,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   6.482 BV E  0.2955  254.22264   11.47256   7.8343
       2   7.037 VB R  0.3528 2990.76416  137.47588  92.1657

    Totals :                   3244.98680  148.94844

    ======================================================================
                              *** End of Report ***

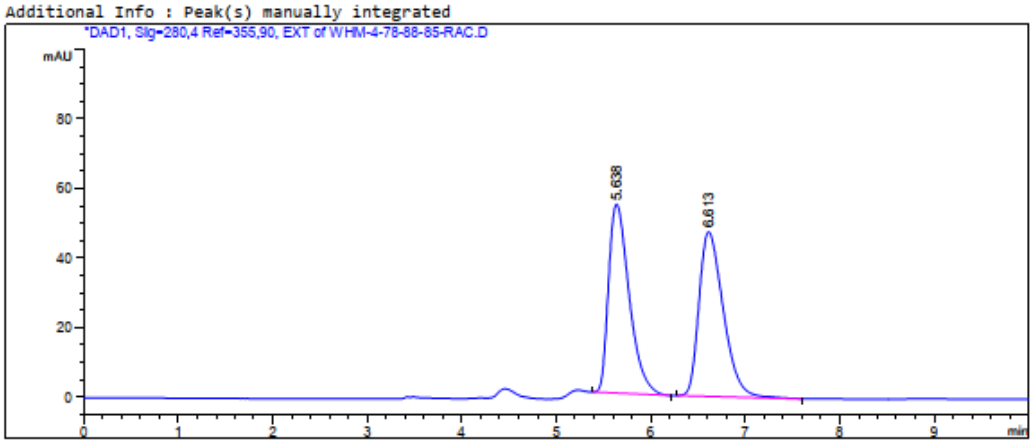
1260 1/6/2020 8:24:45 PM SYSTEM                          Page   1 of 1
```




**racemic-5p**

Data File E:\DATA\WHM-2\WHM-4-78-88-85-RAC-2 2020-08-14 08-35-29\WHM-4-78-88-85-RAC.D
Sample Name: WHM-4-78-T-BU-RAC

```
    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   1
    Acq. Instrument : 1260                          Location :   41
    Injection Date  : 8/14/2020 8:37:00 AM               Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-4-78-88-85-RAC-2 2020-08-14 08-35-29\IDH-99-1--1ML-40MIN-
                      5UL.M
    Last changed    : 8/14/2020 8:35:29 AM by SYSTEM
    Analysis Method : E:\DATA\WHM-2\WHM-4-78-88-85-RAC-2 2020-08-14 08-35-29\IDH-99-1--1ML-40MIN-
                      5UL.M (Sequence Method)
    Last changed    : 12/27/2020 10:09:42 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                           Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

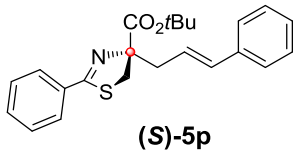

    Signal 1: DAD1, Sig=280,4 Ref=355,90, EXT
     Signal has been modified after loading from rawdata file!

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   5.638 BB    0.2333  824.50134   54.25043  49.4290
       2   6.613 BB    0.2743  843.55042   47.23598  50.5710

    Totals :                  1668.05176  101.48641

    ======================================================================
                           *** End of Report ***

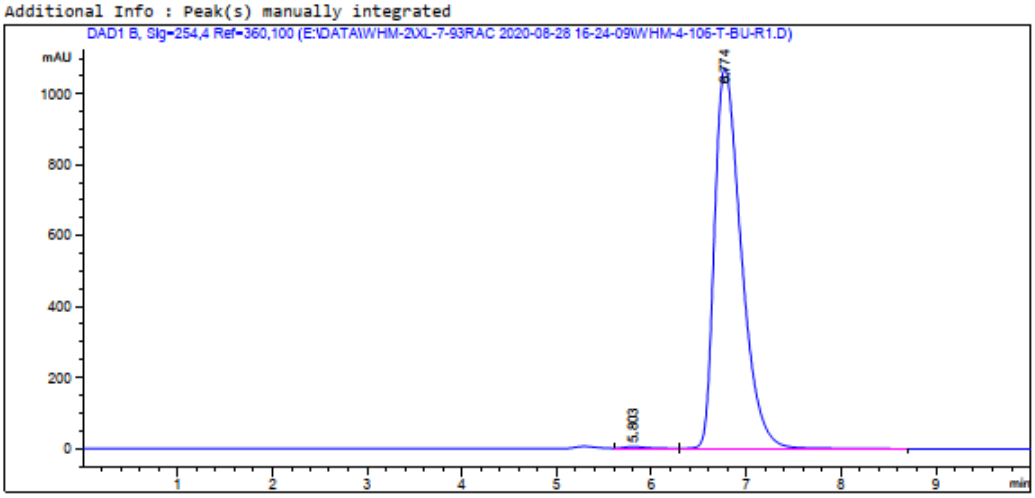
1260 12/27/2020 10:09:45 PM SYSTEM                                Page   1 of 1
```




**(*S*)-5p**

Data File E:\DATA\WHM-2\XL-7-93RAC 2020-08-28 16-24-09\WHM-4-106-T-BU-R1.D
Sample Name: WHM-4-106-T-BU-R

```
==================================================================
Acq. Operator   : SYSTEM                      Seq. Line :   2
Acq. Instrument : 1260                         Location :   41
Injection Date  : 8/28/2020 4:36:33 PM              Inj :   1
                                              Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\XL-7-93RAC 2020-08-28 16-24-09\IDH-99-1-1.0ML-254NM-10MIN.M
Last changed    : 8/28/2020 4:24:09 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\XL-7-93RAC 2020-08-28 16-24-09\IDH-99-1-1.0ML-254NM-10MIN.M (
                  Sequence Method)
Last changed    : 12/27/2020 10:13:18 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
==================================================================
                      Area Percent Report
==================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs

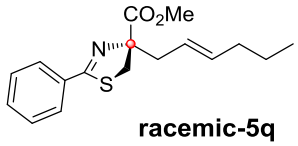

Signal 1: DAD1 B, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   5.803 VB    0.2487   85.69625    5.08174   0.4077
   2   6.774 BB    0.3029 2.09317e4  1071.44800  99.5923

Totals :                  2.10174e4  1076.52974

==================================================================
                      *** End of Report ***

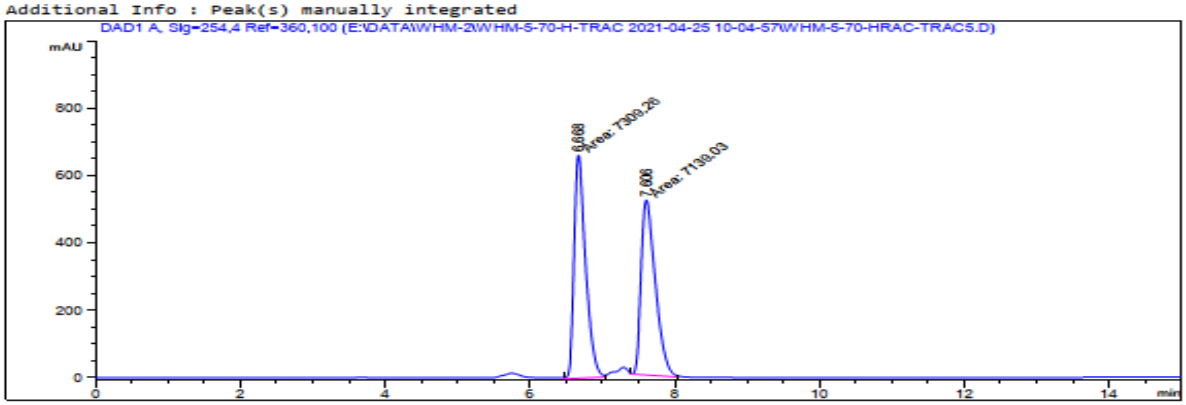
1260 12/27/2020 10:13:21 PM SYSTEM                    Page   1 of 1
```




**racemic-5q**

```
Data File E:\DATA\WHM-2\WHM-5-70-H-TRAC 2021-04-25 10-04-57\WHM-5-70-HRAC-TRAC5.D
Sample Name: WHM-5-70-H-RAC

    ======================================================================
    Acq. Operator    : SYSTEM                          Seq. Line :   6
    Acq. Instrument : 1260                              Location :   12
    Injection Date   : 4/25/2021 11:21:00 AM                 Inj :   1
                                                      Inj Volume : 5.000 µl
    Acq. Method      : E:\DATA\WHM-2\WHM-5-70-H-TRAC 2021-04-25 10-04-57\IEH-98-2--1ML-20MIN-5UL.M
    Last changed     : 4/25/2021 10:34:41 AM by SYSTEM
    Analysis Method : E:\DATA\WHM-2\WHM-5-70-H-TRAC 2021-04-25 10-04-57\IEH-98-2--1ML-20MIN-5UL.M
                      (Sequence Method)
    Last changed     : 4/25/2021 12:20:28 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                              Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

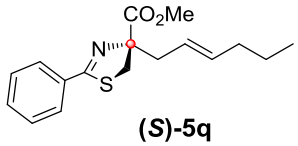

    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   6.668 MM    0.1840 7309.25830  662.24860  50.5891
       2   7.606 MM    0.2293 7139.03320  518.89240  49.4109

    Totals :                  1.44483e4  1181.14099


    ======================================================================
                              *** End of Report ***

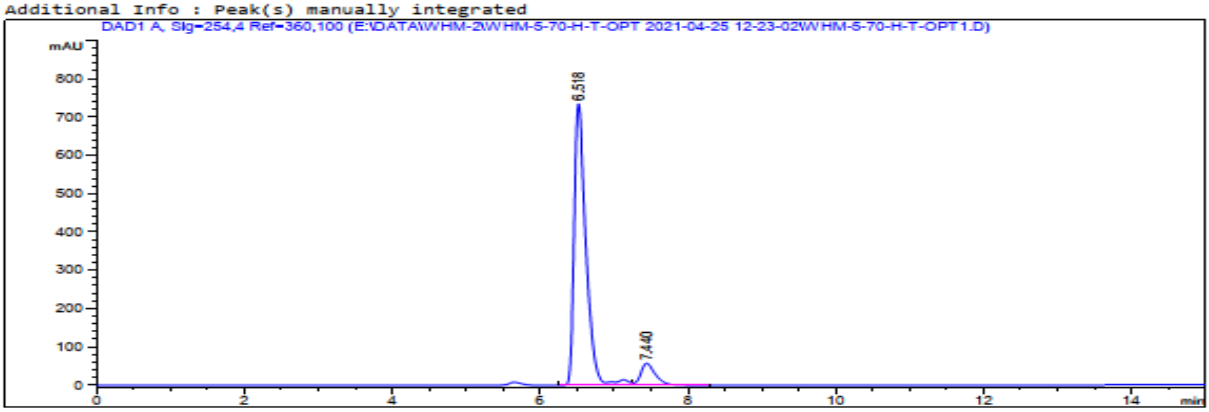
1260 4/25/2021 12:20:31 PM SYSTEM                          Page   1 of 1
```




**(*S*)-5q**

```
Data File E:\DATA\WHM-2\WHM-5-70-H-T-OPT 2021-04-25 12-23-02\WHM-5-70-H-T-OPT1.D
Sample Name: WHM-5-70-T-RAC

    ======================================================================
    Acq. Operator   : SYSTEM                          Seq. Line :   2
    Acq. Instrument : 1260                            Location :   14
    Injection Date  : 4/25/2021 12:45:48 PM              Inj :   1
                                                    Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-5-70-H-T-OPT 2021-04-25 12-23-02\IEH-98-2--1ML-20MIN-5UL.
                      M
    Last changed    : 4/25/2021 12:23:03 PM by SYSTEM
    Analysis Method : E:\DATA\WHM-2\WHM-5-70-H-T-OPT 2021-04-25 12-23-02\IEH-98-2--1ML-20MIN-5UL.
                      M (Sequence Method)
    Last changed    : 4/25/2021 1:27:21 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                              Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

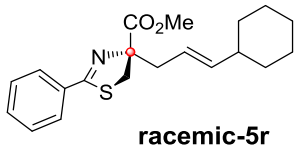

    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   6.518 BV R  0.1615 8166.49414  734.77649  91.2360
       2   7.440 VB E  0.2068  784.46008   56.90783   8.7640

    Totals :                  8950.95422  791.68432


    ======================================================================
                              *** End of Report ***

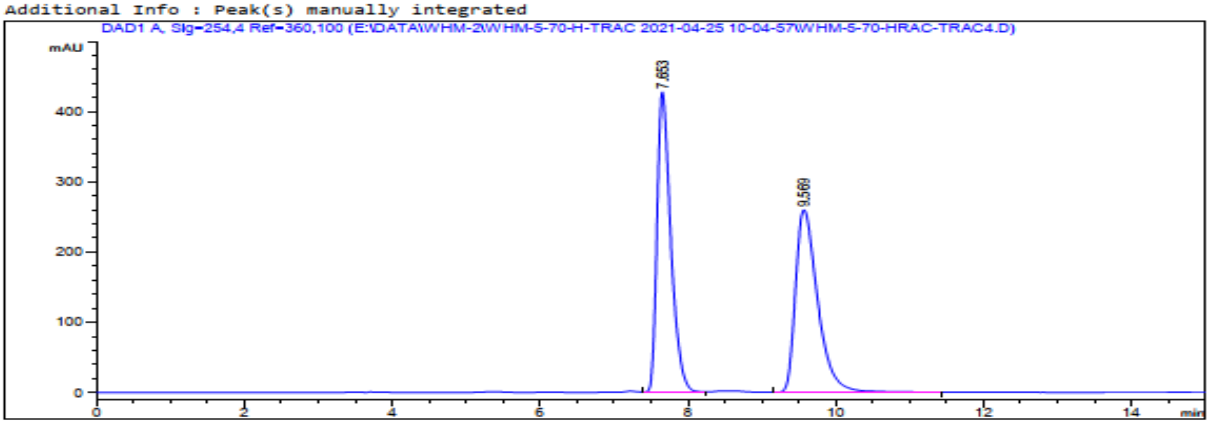
1260 4/25/2021 1:29:38 PM SYSTEM                                  Page    1 of 1
```




**racemic-5r**

```
Data File E:\DATA\WHM-2\WHM-5-70-H-TRAC 2021-04-25 10-04-57\WHM-5-70-HRAC-TRAC4.D
Sample Name: WHM-5-70-H-RAC

    ======================================================================
    Acq. Operator   : SYSTEM                          Seq. Line :   5
    Acq. Instrument : 1260                           Location :   11
    Injection Date  : 4/25/2021 10:59:36 AM             Inj :   1
                                                    Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-5-70-H-TRAC 2021-04-25 10-04-57\IEH-98-2--1ML-20MIN-5UL.M
    Last changed    : 4/25/2021 10:34:41 AM by SYSTEM
    Analysis Method : E:\DATA\WHM-2\WHM-5-70-H-TRAC 2021-04-25 10-04-57\IEH-98-2--1ML-20MIN-5UL.M
                      (Sequence Method)
    Last changed    : 4/25/2021 12:08:23 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                            Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

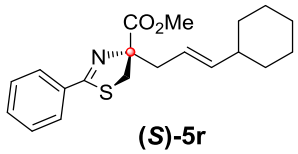

    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   7.653 BB    0.1957 5519.87500  427.41336  50.3823
       2   9.569 BB    0.3192 5436.09668  259.72821  49.6177

    Totals :                  1.09560e4   687.14157


    ======================================================================
                              *** End of Report ***

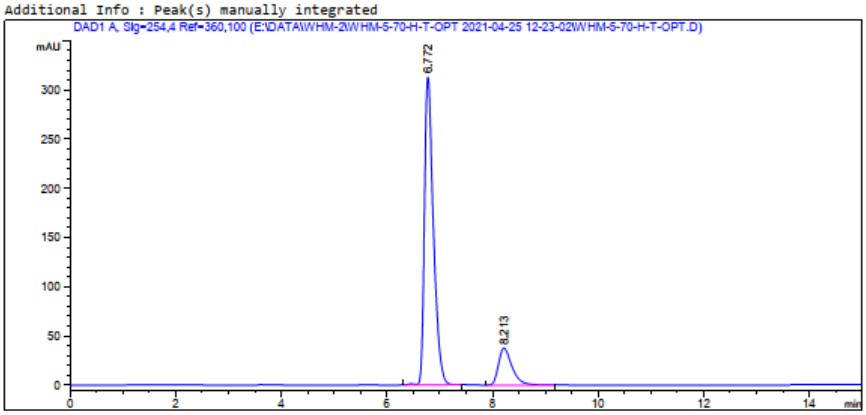
1260 4/25/2021 12:08:28 PM SYSTEM                          Page   1 of 1
```




**(*S*)-5r**

Data File E:\DATA\WHM-2\WHM-5-70-H-T-OPT 2021-04-25 12-23-02\WHM-5-70-H-T-OPT.D
Sample Name: WHM-5-70-H-RAC

```
==========================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   1
Acq. Instrument : 1260                         Location :   13
Injection Date  : 4/25/2021 12:24:27 PM            Inj :   1
                                              Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-5-70-H-T-OPT 2021-04-25 12-23-02\IEH-98-2--1ML-20MIN-5UL.
                  M
Last changed    : 4/25/2021 12:23:03 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-5-70-H-T-OPT 2021-04-25 12-23-02\IEH-98-2--1ML-20MIN-5UL.
                  M (Sequence Method)
Last changed    : 5/3/2021 9:52:23 AM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
==========================================================================
                        Area Percent Report
==========================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs

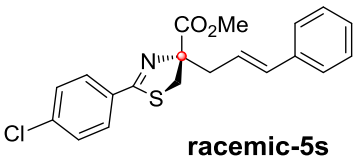

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   6.772 VB R  0.1762 3687.91235  312.83078  84.5577
   2   8.213 BB    0.2691  673.50323   37.57082  15.4423

Totals :                  4361.41559  350.40160

==========================================================================
                          *** End of Report ***

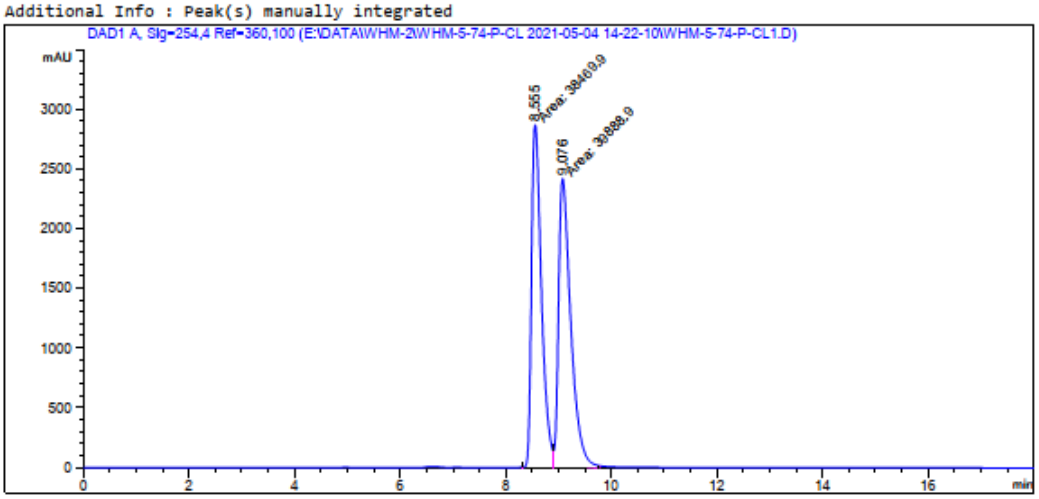
1260 5/3/2021 9:52:26 AM SYSTEM                              Page   1 of 1
```




**racemic-5s**

Data File E:\DATA\WHM-2\WHM-5-74-P-CL 2021-05-04 14-22-10\WHM-5-74-P-CL1.D
Sample Name: WHM-5-74-P-CL-RAC

```
======================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   2
Acq. Instrument : 1260                          Location :   71
Injection Date  : 5/4/2021 2:34:29 PM                Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-5-74-P-CL 2021-05-04 14-22-10\IEH-98-2--1ML-20MIN-5UL.M
Last changed    : 5/4/2021 2:22:10 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-5-74-P-CL 2021-05-04 14-22-10\IEH-98-2--1ML-20MIN-5UL.M (
                  Sequence Method)
Last changed    : 5/7/2021 5:01:32 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
======================================================================
                        Area Percent Report
======================================================================

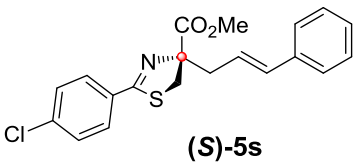
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.555 MF    0.2215 3.84699e4  2894.13574  49.0945
   2   9.076 FM    0.2729 3.98889e4  2435.91846  50.9055

Totals :                  7.83589e4  5330.05420

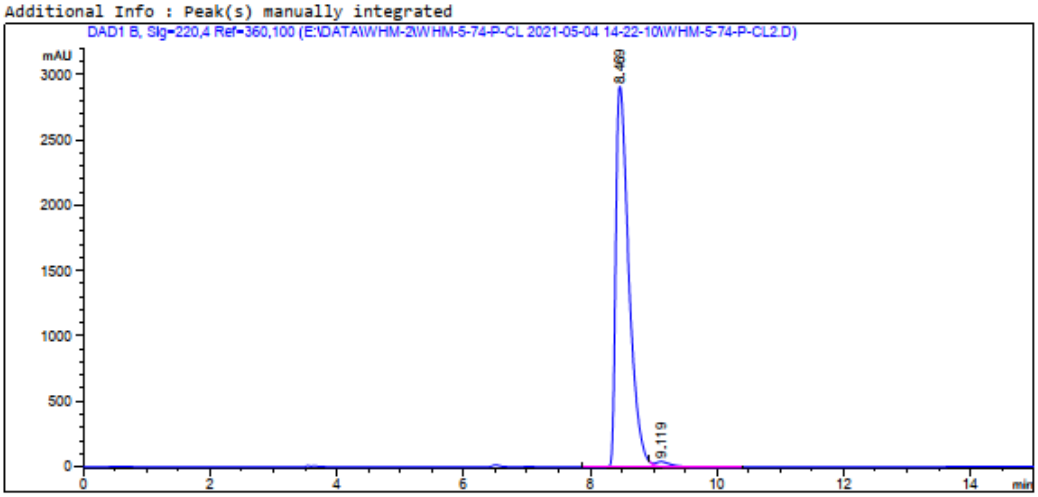
======================================================================
                        *** End of Report ***
```




**(*S*)-5s**

Data File E:\DATA\WHM-2\WHM-5-74-P-CL 2021-05-04 14-22-10\WHM-5-74-P-CL2.D
Sample Name: WHM-5-74-P-CL-OPT

```
    ======================================================================
    Acq. Operator   : SYSTEM                        Seq. Line :   3
    Acq. Instrument : 1260                           Location :   72
    Injection Date  : 5/4/2021 2:55:52 PM                 Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-5-74-P-CL 2021-05-04 14-22-10\IEH-98-2--1ML-20MIN-5UL.M
    Last changed    : 5/4/2021 2:57:58 PM by SYSTEM
                      (modified after loading)
    Analysis Method : E:\DATA\WHM-2\WHM-5-74-P-CL 2021-05-04 14-22-10\IEH-98-2--1ML-20MIN-5UL.M (
                      Sequence Method)
    Last changed    : 5/7/2021 5:03:55 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                            Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

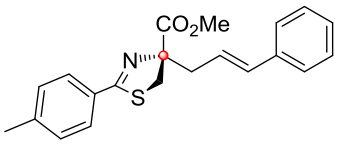

    Signal 1: DAD1 B, Sig=220,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1   8.469 BV R  0.2167 4.18701e4  2912.47876  98.4509
       2   9.119 VB E  0.2578  658.82886   36.81040   1.5491

    Totals :                  4.25290e4  2949.28916


    ======================================================================
                              *** End of Report ***

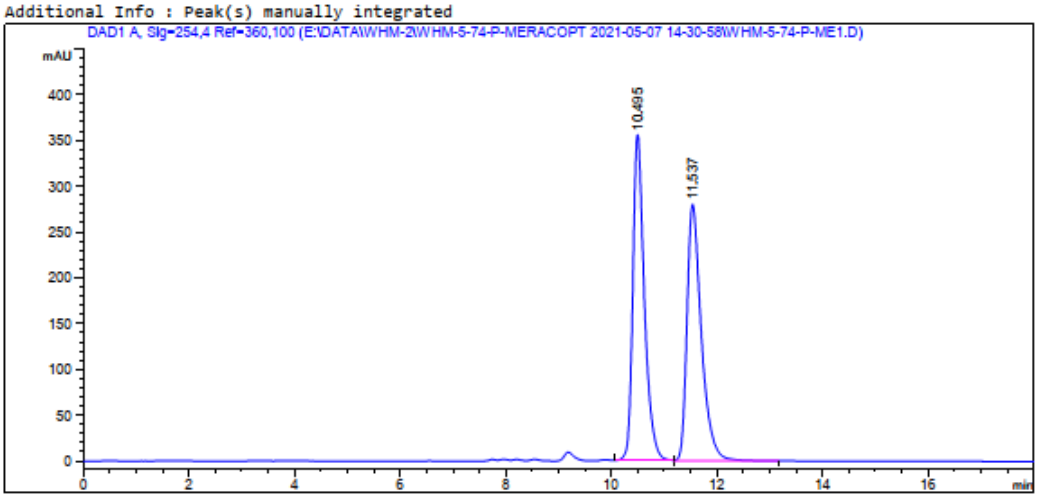
1260 5/7/2021 5:03:58 PM SYSTEM                                Page   1 of 1
```




**racemic-5t**

Data File E:\DATA\WHM-2\WHM-5-74-P-MERACOPT 2021-05-07 14-30-58\WHM-5-74-P-ME1.D
Sample Name: WHM-P-ME-5-74-RAC

```
    ======================================================================
    Acq. Operator   : SYSTEM                       Seq. Line :   2
    Acq. Instrument : 1260                          Location :   11
    Injection Date  : 5/7/2021 2:43:25 PM               Inj :   1
                                                  Inj Volume : 5.000 µl
    Acq. Method     : E:\DATA\WHM-2\WHM-5-74-P-MERACOPT 2021-05-07 14-30-58\IEH-98-2--1ML-20MIN-
                      5UL.M
    Last changed    : 5/7/2021 2:30:59 PM by SYSTEM
    Analysis Method : E:\DATA\WHM-2\WHM-5-74-P-MERACOPT 2021-05-07 14-30-58\IEH-98-2--1ML-20MIN-
                      5UL.M (Sequence Method)
    Last changed    : 5/7/2021 4:54:48 PM by SYSTEM
                      (modified after loading)
    Additional Info : Peak(s) manually integrated
```




```
    ======================================================================
                              Area Percent Report
    ======================================================================

    Sorted By             :      Signal
    Multiplier            :      1.0000
    Dilution              :      1.0000
    Do not use Multiplier & Dilution Factor with ISTDs

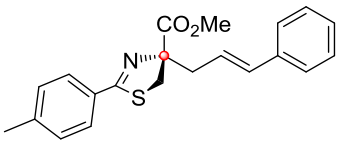

    Signal 1: DAD1 A, Sig=254,4 Ref=360,100

    Peak RetTime Type  Width     Area      Height     Area
      #   [min]        [min]   [mAU*s]     [mAU]       %
    ----|-------|----|-------|----------|----------|--------|
       1  10.495 BB    0.2266 5386.50391  355.75015  50.5993
       2  11.537 BB    0.2825 5258.89941  279.51376  49.4007

    Totals :                  1.06454e4   635.26392


    ======================================================================
                              *** End of Report ***

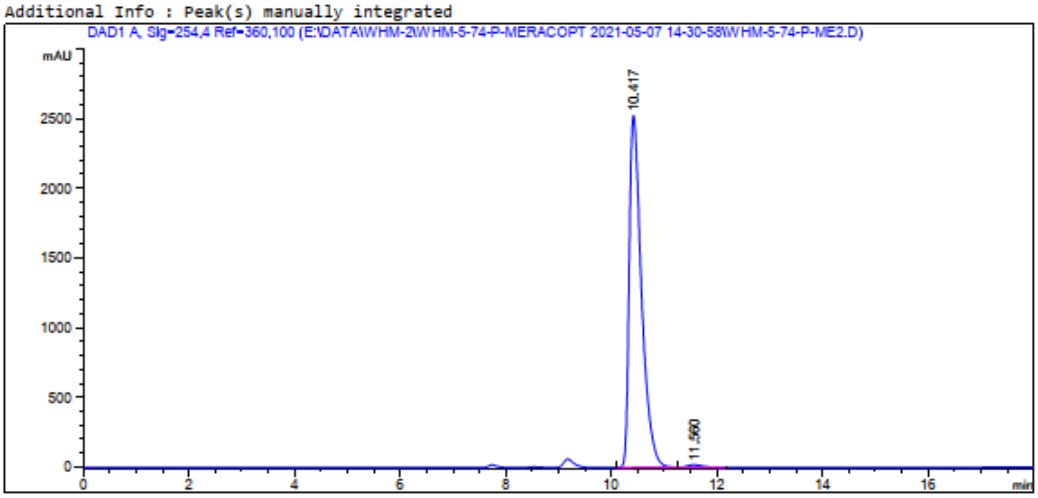
1260 5/7/2021 4:54:52 PM SYSTEM                                Page   1 of 1
```




**(*S*)-5t**

Data File E:\DATA\WHM-2\WHM-5-74-P-MERACOPT 2021-05-07 14-30-58\WHM-5-74-P-ME2.D
Sample Name: WHM-P-ME-5-74-OPT

```
=====================================================================
Acq. Operator   : SYSTEM                       Seq. Line :   3
Acq. Instrument : 1260                          Location :   12
Injection Date  : 5/7/2021 3:04:44 PM                Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-5-74-P-MERACOPT 2021-05-07 14-30-58\IEH-98-2--1ML-20MIN-
                  5UL.M
Last changed    : 5/7/2021 2:30:59 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-5-74-P-MERACOPT 2021-05-07 14-30-58\IEH-98-2--1ML-20MIN-
                  5UL.M (Sequence Method)
Last changed    : 5/7/2021 4:56:50 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
=====================================================================
                        Area Percent Report
=====================================================================

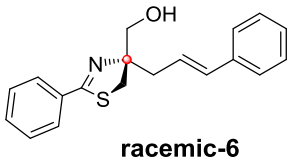
Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.417 BB    0.2438 4.06050e4  2521.85547  99.2319
   2  11.560 BB    0.2785  314.30731   17.09144   0.7681

Totals :                  4.09193e4  2538.94691

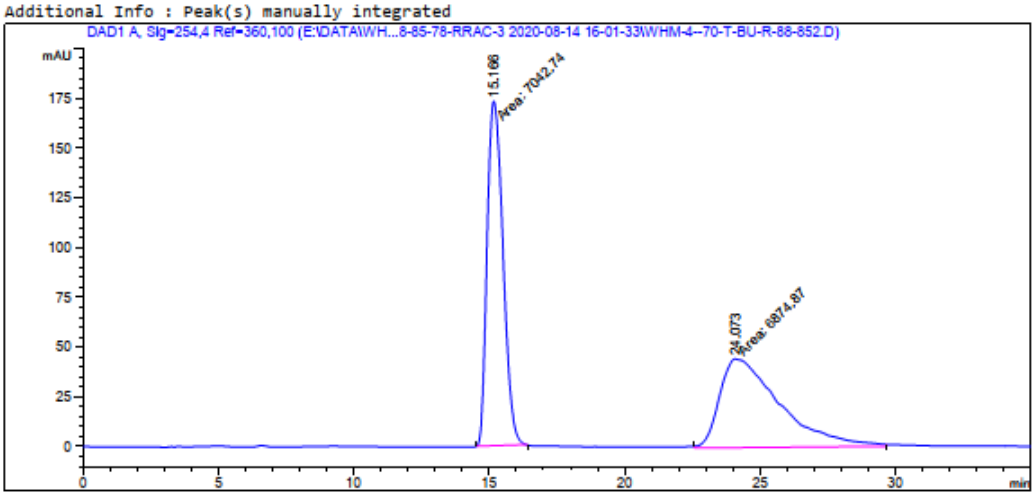
=====================================================================
                          *** End of Report ***
```




**racemic-6**

Data File E:\DATA\WH...WHM-4-88-85-78-RRAC-3 2020-08-14 16-01-33\WHM-4--70-T-BU-R-88-852.D
Sample Name: WHM-4-85-OH-RAC

```
==========================================================================
Acq. Operator   : SYSTEM                        Seq. Line :   3
Acq. Instrument : 1260                          Location :   45
Injection Date  : 8/14/2020 4:25:30 PM               Inj :   1
                                               Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-4-88-85-78-RRAC-3 2020-08-14 16-01-33\IDH-98-2--1ML-40MIN
                  -5UL.M
Last changed    : 8/14/2020 4:01:33 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-4-88-85-78-RRAC-3 2020-08-14 16-01-33\IDH-98-2--1ML-40MIN
                  -5UL.M (Sequence Method)
Last changed    : 12/27/2020 10:16:51 PM by SYSTEM
                  (modified after loading)
Additional Info : Peak(s) manually integrated
```




```
==========================================================================
                        Area Percent Report
==========================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs

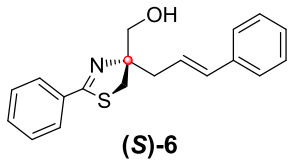

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  15.166 MM    0.6790 7042.73730  172.86771  50.6031
   2  24.073 MM    2.5697 6874.87012   44.58984  49.3969

Totals :                  1.39176e4   217.45755

==========================================================================
                        *** End of Report ***
```

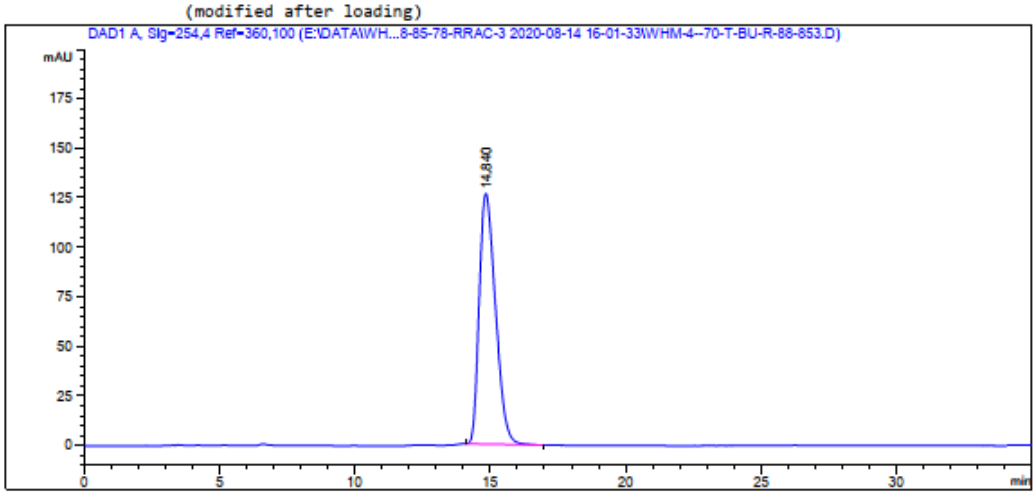
1260 12/27/2020 10:18:08 PM SYSTEM  Page 1 of 1




**(*S*)-6**

Data File E:\DATA\WH...WHM-4-88-85-78-RRAC-3 2020-08-14 16-01-33\WHM-4--70-T-BU-R-88-853.D
Sample Name: WHM-4-84-OH-R

```
======================================================================
Acq. Operator   : SYSTEM                      Seq. Line :   4
Acq. Instrument : 1260                        Location :   46
Injection Date  : 8/14/2020 5:07:00 PM             Inj :   1
                                             Inj Volume : 5.000 µl
Acq. Method     : E:\DATA\WHM-2\WHM-4-88-85-78-RRAC-3 2020-08-14 16-01-33\IDH-98-2--1ML-40MIN
                  -5UL.M
Last changed    : 8/14/2020 4:01:33 PM by SYSTEM
Analysis Method : E:\DATA\WHM-2\WHM-4-88-85-78-RRAC-3 2020-08-14 16-01-33\IDH-98-2--1ML-40MIN
                  -5UL.M (Sequence Method)
Last changed    : 12/27/2020 10:19:12 PM by SYSTEM
                  (modified after loading)
```




```
======================================================================
                        Area Percent Report
======================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Do not use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  14.840 BB    0.6345 5276.73193  126.53205 100.0000

Totals :                  5276.73193  126.53205

======================================================================
                          *** End of Report ***
```