Supporting Information

Catalytic enantioselective [3+2] and [4+2]-annulation of cyclic *N*-sulfonyl ketimines with γ- or δ-hydroxy-α,β-unsaturated ketones

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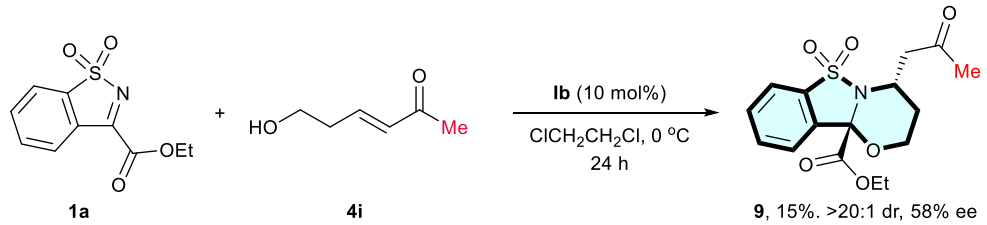
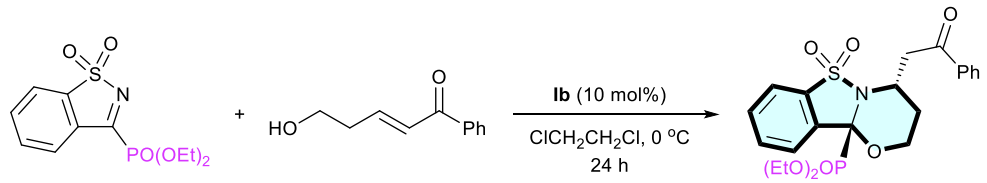
1. General information. Organic solvents were distilled prior to use. Organic solutions were concentrated under reduced pressure using a rotary evaporator. Chromatographic purification of products was accomplished using forced-flow chromatography on ICN 60 32-64 mesh silica gel 63. Thin-layer chromatography (TLC) was performed on EM Reagents 0.25 mm silica gel 60-F plates. Developed chromatograms were visualized by fluorescence quenching and with anisaldehyde stain. ^{1}H, ^{13}C and ^{19}F NMR spectra were recorded (400 MHz for ^{1}H, 101 MHz for ^{13}C and 400 MHz for ^{19}F), and were internally referenced to residual protic solvent signals. Data for ^{1}H NMR are reported as follows: chemical shift (δ ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublets, dt = doublet of triplets, ddd = doublet of doublet of doublets, m = multiplet), coupling constant (Hz) and integration. Data for ^{13}C NMR are reported in terms of chemical shift. IR spectra were recorded on an FT IR spectrometer and are reported in wave numbers. Optical rotations were taken on a digital polarimeter. High-resolution mass spectra (HRMS) were measured on a double focusing mass spectrometer with EI-magnetic sector. The crystal structure was determined by single-crystal diffractometer (a Bruker D8 Venture PHOTON III M14 diffractometer) at the Western Seoul Center of Korea Basic Science Institute. Enantiomeric excesses were determined using an HPLC instrument with Chiralpak columns as noted. *γ*- or *δ*-Hydroxy-*α*,*β*-unsaturated ketones,[1] cyclic *N*-sulfonyl ketamine,[2] and organocatalysts[3] were prepared according to literature.

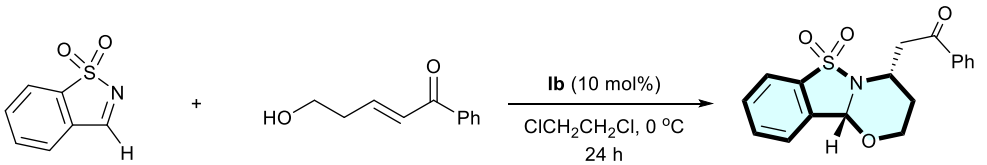
2. Control experiment



1a **4i** **9**, 15%. >20:1 dr, 58% ee

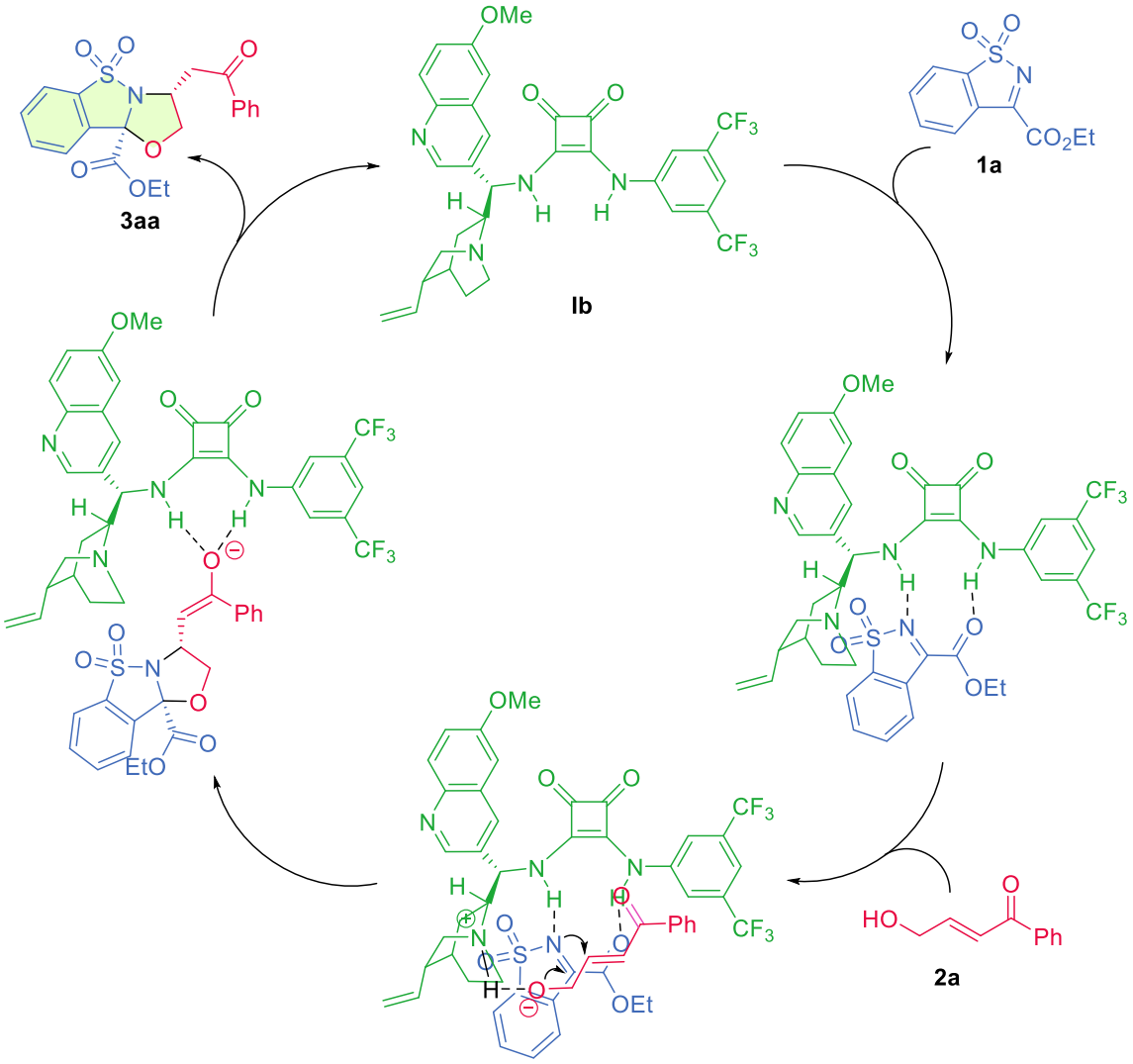


10 **4a** **11**, 53%, 2:1 dr, 89% ee

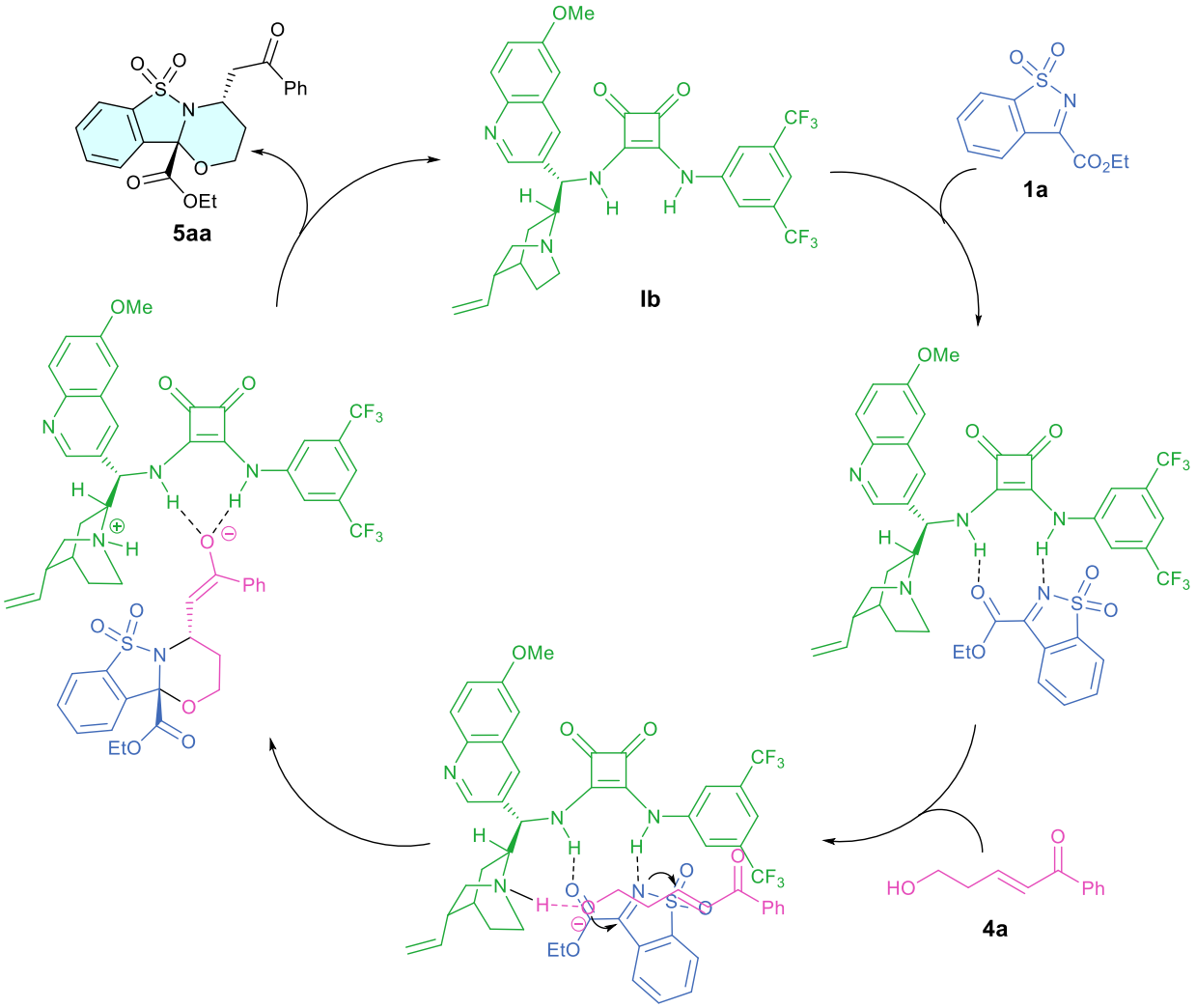


12 **4a** **13**, 66%, 2:1 dr, 94% ee

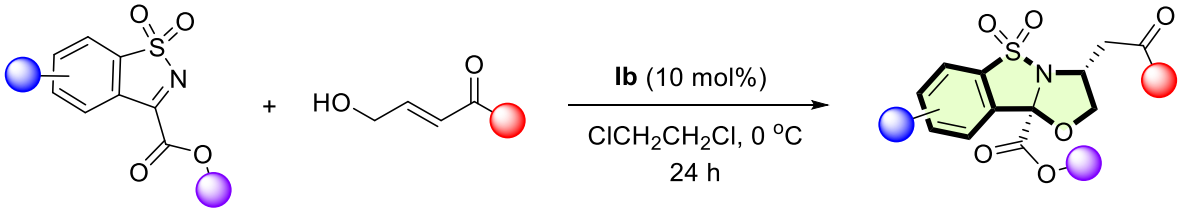
3. Proposed mechanism for asymmetric [3+2]-annulation



4. Proposed mechanism for asymmetric [4+2]-annulation



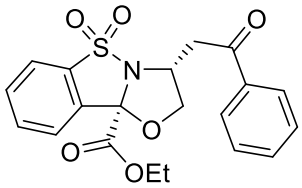
5. General procedure I for asymmetric [3+2]-annulation of γ-hydroxy-α,β-unsaturated ketones with cyclic *N*-sulfonyl ketimines.



1 2 3

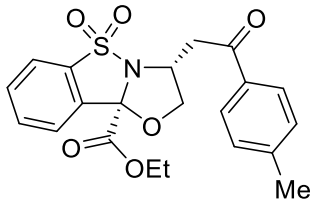
A solution of cyclic *N*-sulfonyl ketimine **1** (0.15 mmol, 1.5 equiv) and catalyst **Ib** (0.01 mmol, 0.1 equiv) in $ClCH_2CH_2Cl$ (1.0 mL, 0.1 M) was stirred for 10 min at 0 °C and then added γ-hydroxy-α,β-unsaturated ketone **2** (0.10 mmol, 1.0 equiv). The reaction mixture was stirred at room temperature for 24 h. Then, the resulting mixture was concentrated in vacuo and was purified by flash column chromatography with EtOAc/CH_2Cl_2/hexanes as eluent to afford desired product **3**. The enantiomeric excess was determined using HPLC analysis.

Ethyl (3*R*,9b*R*)-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3aa**)



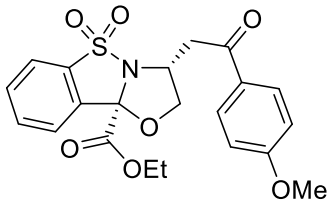
Synthesized by the general procedure I; 40 mg, yield 98%, 14:1 dr, $[\alpha]_D^{26}$ = -71.5 (*c* = 0.98, $CHCl_3$); 96% ee; White solid; m.p. 133-135 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02–7.95 (m, 2H), 7.83–7.77 (m, 1H), 7.75–7.65 (m, 3H), 7.63–7.57 (m, 1H), 7.49 (tt, *J* = 6.5, 1.3 Hz, 2H), 4.84 (td, *J* = 10.3, 6.1 Hz, 1H), 4.55 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 4.17 (dd, *J* = 9.0, 5.9 Hz, 1H), 3.80 (dd, *J* = 18.1, 4.4 Hz, 1H), 3.43 (dd, *J* = 18.1, 9.7 Hz, 1H), 1.25 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 197.1, 167.5, 136.0, 135.9, 134.2, 133.8, 133.6, 132.0, 128.7, 128.0, 125.2, 121.4, 97.3, 74.4, 63.0, 56.6, 43.2, 13.9; IR (neat) 2950, 2916, 2864, 1737, 1676, 1597, 1450, 1361, 1257, 1170 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{20}H_{19}NO_6S$: 401.0933 Found: 401.0946; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 52.8 min and *minor*-isomer t_r = 65.9 min.

Ethyl (3*R*,9b*R*)-3-(2-oxo-2-(*p*-tolyl)ethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ab**)



Synthesized by the general procedure I; 35 mg, yield 84%, 16:1 dr, $[\alpha]_D^{25}$ = -79.4 (*c* = 0.92, $CHCl_3$); 97% ee; Yellow solid; m.p. 142-143 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.3 Hz, 2H), 7.82–7.77 (m, 1H), 7.74–7.63 (m, 3H), 7.30–7.25 (m, 2H), 4.82 (dtd, *J* = 10.3, 6.1, 4.3 Hz, 1H), 4.56 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 4.16 (dd, *J* = 8.9, 6.0 Hz, 1H), 3.77 (dd, *J* = 18.0, 4.3 Hz, 1H), 3.40 (dd, *J* = 18.0, 9.8 Hz, 1H), 2.42 (s, 3H), 1.26 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 196.7, 167.5, 144.6, 135.9, 134.3, 133.82, 133.6, 131.9, 129.4, 128.2, 125.2, 121.4, 97.3, 74.5, 62.9, 56.7, 43.1, 21.7, 13.9; IR (neat) 2940, 2909, 2845, 1751, 1671, 1473, 1419, 1325, 1254, 1175 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{21}NO_6S$: 415.1090 Found: 415.1089; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 44.8 min and *minor*-isomer t_r = 54.3 min.

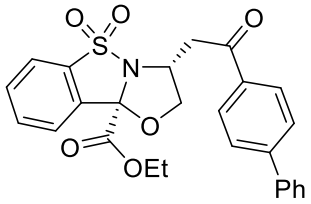
Ethyl (3*R*,9b*R*)-3-(2-(4-methoxyphenyl)-2-oxoethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ac**)



Synthesized by the general procedure I; 38 mg, yield 92%, 10:1 dr, $[\alpha]_D^{26}$ = -82.9 (*c* = 0.98 , $CHCl_3$); 97% ee; Yellow solid; m.p. 170-172 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 8.9 Hz, 2H), 7.82–7.77 (m, 1H), 7.74–7.65 (m, 3H), 6.98–6.92 (m, 2H), 4.81 (dtd, *J* = 10.3, 6.2, 4.3 Hz, 1H), 4.56 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 4.17 (dd, *J* = 9.0, 6.0 Hz, 1H), 3.88 (s, 3H), 3.75 (dd, *J* = 17.8, 4.3 Hz, 1H), 3.37 (dd, *J* = 17.8, 9.9 Hz, 1H), 1.26 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.5, 167.5, 163.9, 135.9, 134.3, 133.8, 131.9, 130.4, 129.2, 125.2, 121.4, 113.8, 97.3, 74.6, 62.9, 56.8, 55.5, 42.9, 13.9; IR (neat) 2940, 2926, 2845, 1758, 1678, 1602, 1576,

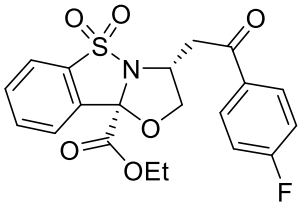
1423, 1326, 1259 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{21}NO_7S$: 431.1039 Found: 431.1039; Chiralpak IC column and IC guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 37.5 min and *major*-isomer t_r = 80.4 min.

Ethyl (3*R*,9b*R*)-3-(2-([1,1'-biphenyl]-4-yl)-2-oxoethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ad**)



Synthesized by the general procedure I; 41 mg, yield 85%, 11:1 dr, $[\alpha]_D^{25}$ = -70.8 (*c* = 1.02, $CHCl_3$); 97% ee; Yellow solid; m.p. 133-135 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^1H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 8.5 Hz, 2H), 7.75–7.70 (m, 1H), 7.67–7.58 (m, 5H), 7.56 (d, *J* = 6.9 Hz, 2H), 7.40 (t, *J* = 7.3 Hz, 2H), 7.33 (t, *J* = 7.3 Hz, 1H), 4.78 (dt, *J* = 10.5, 5.2 Hz, 1H), 4.49 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.21 (q, *J* = 7.1 Hz, 2H), 4.11 (dd, *J* = 8.9, 5.9 Hz, 1H), 3.76 (dd, *J* = 18.0, 4.3 Hz, 1H), 3.38 (dd, *J* = 18.0, 9.7 Hz, 1H), 1.18 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 196.7, 167.5146.3 139.6, 135.9, 134.7 134.2, 133.8, 132.0, 128.9, 128.6, 128.3, 127.3, 127.2, 125.2, 121.4, 97.3, 74.5, 63.0, 56.7, 43.2, 13.9; IR (neat) 3070, 2984, 2907, 1746, 1684, 1572, 1422, 1324, 1239, 1176 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{26}H_{23}NO_6S$: 477.1246 Found: 477.1246; Chiralpak IC column and IC guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 30.5 min and *major*-isomer t_r = 76.8 min.

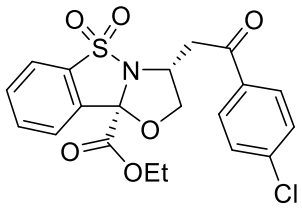
Ethyl (3*R*,9b*R*)-3-(2-(4-fluorophenyl)-2-oxoethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ae**)



Synthesized by the general procedure I; 36 mg, yield 86%, 12:1 dr, $[\alpha]_D^{26}$ = -65.4 (*c* = 1.01, $CHCl_3$); 97% ee; Yellow solid; m.p. 132-134 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^1H NMR (400 MHz, $CDCl_3$) δ 8.04–7.98 (m, 2H), 7.82–7.77 (m, 1H), 7.75–7.65 (m, 3H), 7.20–7.11 (m, 2H), 4.87–4.78 (m,

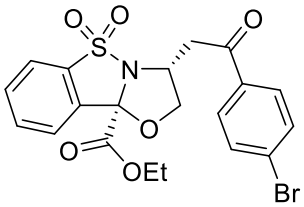
1H), 4.53 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 4.17 (dd, *J* = 9.0, 5.8 Hz, 1H), 3.77 (dd, *J* = 18.1, 4.5 Hz, 1H), 3.40 (dd, *J* = 18.0, 9.5 Hz, 1H), 1.25 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.5, 167.4, 166.0 (d, J^1 = 256.1 Hz), 135.9, 134.2, 133.8, 132.5 (d, J^4 = 2.8 Hz), 132.0, 130.7 (d, J^3 = 9.4 Hz), 125.2, 121.4, 115.9 (d, J^2 = 21.9 Hz), 97.3, 74.3, 63.0, 56.6, 43.1, 13.9; ^{19}F NMR (376 MHz, CDCl3) δ -104.03; IR (neat) 2925, 2874, 2851, 1739, 1686, 1594, 1504, 1447, 1324, 1211 cm-1; HRMS (EI) m/z calcd for [M]+ $C_{20}H_{18}FNO_6S$: 419.0839 Found: 419.0859; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 52.1 min and *minor*-isomer t_r = 64.1 min.

Ethyl (3*R*,9b*R*)-3-(2-(4-chlorophenyl)-2-oxoethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3af**)



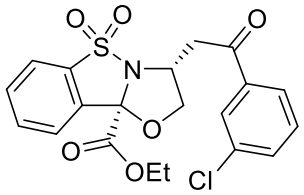
Synthesized by the general procedure I; 35 mg, yield 80%, 12:1 dr, $[\alpha]_D^{25}$ = -65.0 (*c* = 0.96, $CHCl_3$); 97% ee; White solid; m.p. 140-141 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.4 Hz, 2H), 7.83–7.76 (m, 1H), 7.76–7.63 (m, 3H), 7.46 (d, *J* = 8.5 Hz, 2H), 4.82 (dq, *J* = 10.4, 5.9 Hz, 1H), 4.52 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 4.16 (dd, *J* = 8.9, 5.8 Hz, 1H), 3.76 (dd, *J* = 18.1, 4.6 Hz, 1H), 3.39 (dd, *J* = 18.1, 9.5 Hz, 1H), 1.25 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.9, 167.4, 140.2, 135.9, 134.4, 134.2, 133.9, 132.0, 129.5, 129.1, 125.2, 121.4, 97.4, 74.3, 63.0, 56.5, 43.1, 13.9; IR (neat) 3014, 2983, 2907, 1747, 1684, 1572, 1473, 1423, 1324, 1245 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{20}H_{18}ClNO_6S$: 435.0543 Found: 435.0570; Chiralpak IA column and IA guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 38.8 min and *major*-isomer t_r = 47.1 min.

Ethyl (3*R*,9b*R*)-3-(2-(4-bromophenyl)-2-oxoethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ag**)



Synthesized by the general procedure I; 39 mg, yield 81%, 12:1 dr, $[\alpha]_D^{24}$ = -67.7 (*c* = 0.61, $CHCl_3$); 97% ee; Yellow solid; m.p. 153-154 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86–7.81 (m, 2H), 7.81–7.77 (m, 1H), 7.73–7.65 (m, 3H), 7.65–7.60 (m, 2H), 4.82 (dtd, *J* = 9.5, 6.0, 4.5 Hz, 1H), 4.52 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.27 (q, *J* = 7.2 Hz, 2H), 4.16 (dd, *J* = 8.9, 5.8 Hz, 1H), 3.75 (dd, *J* = 18.1, 4.6 Hz, 1H), 3.39 (dd, *J* = 18.1, 9.4 Hz, 1H), 1.25 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 196.1, 167.4, 135.9 134.7, 134.1, 133.8, 132.03, 131.97, 129.5, 128.9, 125.2, 121.3, 97.3, 74. 3, 63.0, 56.5 43.1 13.9; IR (neat) 2951, 2892, 2851, 1746, 1682, 1583, 1448, 1399, 1317, 1260 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{20}H_{18}BrNO_6S$: 479.0038 Found: 479.0015; Chiralpak IA column and IA guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 42.3 min and *major*-isomer t_r = 53.3 min.

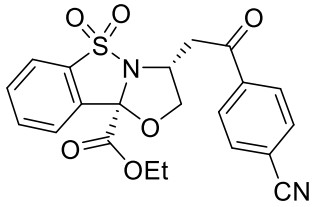
Ethyl (3*R*,9b*R*)-3-(2-(3-chlorophenyl)-2-oxoethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ah**)



Synthesized by the general procedure I; 37 mg, yield 85%, 12:1 dr, $[\alpha]_D^{26}$ = -59.3 (*c* = 0.89, $CHCl_3$); 97% ee; Yellow gum; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (t, *J* = 1.9 Hz, 1H), 7.85 (ddd, *J* = 7.8, 1.7, 1.1 Hz, 1H), 7.82–7.77 (m, 1H), 7.75–7.66 (m, 3H), 7.57 (ddd, *J* = 8.0, 2.1, 1.0 Hz, 1H), 7.44 (t, *J* = 7.9 Hz, 1H), 4.88–4.79 (m, 1H), 4.52 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 4.16 (dd, *J* = 8.9, 5.8 Hz, 1H), 3.77 (dd, *J* = 18.2, 4.6 Hz, 1H), 3.40 (dd, *J* = 18.2, 9.4 Hz, 1H), 1.26 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.8, 167.4, 137.5, 135.9, 135.1, 134.2, 133.9, 133.6, 131.0, 130.1, 128.2, 126.2, 125.2, 121.4, 97.4, 74.2, 63.0, 56.4, 43.2, 13.9; IR (neat) 2985, 2928, 2892, 1746, 1684, 1571, 1423, 1325, 1237, 1115 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{20}H_{18}ClNO_6S$: 435.0543

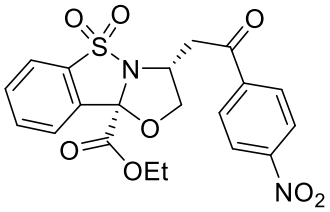
Found: 435.0531; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 53.1 min and *minor*-isomer t_r = 64.6 min.

Ethyl (3*R*,9b*R*)-3-(2-(4-cyanophenyl)-2-oxoethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (3ai)



Synthesized by the general procedure I; 35 mg, yield 83%, >20:1 dr, $[\alpha]_D^{25}$ = -57.1 (*c* = 0.87, $CHCl_3$); 94% ee; White solid; m.p. 178-180 °C; R_f 0.4 (EtOAc:CH_2Cl_2:Hexane=3:10:7); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (d, *J* = 8.5 Hz, 2H), 7.81 (dd, *J* = 9.0, 2.4 Hz, 3H), 7.76–7.64 (m, 3H), 4.85 (dq, *J* = 10.5, 5.4 Hz, 1H), 4.49 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.27 (q, *J* = 7.1 Hz, 2H), 4.17 (dd, *J* = 9.0, 5.6 Hz, 1H), 3.81 (dd, *J* = 18.3, 4.9 Hz, 1H), 3.43 (dd, *J* = 18.2, 9.0 Hz, 1H), 1.24 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.9 167.3, 138.8, 135.8, 134.0, 133.9, 132.6 132.0, 128.5 125.2, 121.3, 117.7, 116.8, 97.4, 74.0, 63.0, 56.3 43.3 13.9; IR (neat) 3071, 2984, 2909, 2361, 1747, 1684, 1571, 1472, 1422, 1324, 1235 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{18}N_2O_6S$: 426.0886 Found: 426.0856; Chiralpak IA column and IA guard column (40% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 33.4 min and *major*-isomer t_r = 51.5 min.

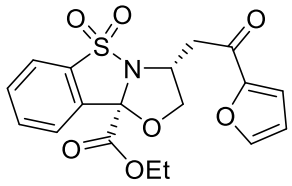
Ethyl (3*R*,9b*R*)-3-(2-(4-nitrophenyl)-2-oxoethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (3aj)



Synthesized by the general procedure I; 34 mg, yield 77%, >20:1 dr, $[\alpha]_D^{25}$ = -55.4 (*c* = 1.00, $CHCl_3$); 92% ee; White solid; m.p. 146-148 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=3:10:7); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (d, *J* = 8.9 Hz, 2H), 8.07 (d, *J* = 8.8 Hz, 2H), 7.72 (dd, *J* = 6.1, 1.5 Hz, 1H), 7.69–7.56 (m, 3H), 4.84–4.73 (m, 1H), 4.42 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.20 (q, *J* = 7.1 Hz, 2H), 4.10 (dd, *J* = 9.0,

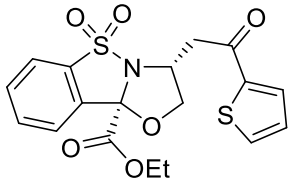
5.6 Hz, 1H), 3.77 (dd, *J* = 18.3, 5.0 Hz, 1H), 3.39 (dd, *J* = 18.3, 8.9 Hz, 1H), 1.17 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.7, 167.3, 150.6, 140.3, 135.8, 134.0, 133.9, 132.0, 129.2, 125.6, 123.9, 121.4, 97.4, 74.0, 63.1, 56.3, 43.5, 13.9; IR (neat) 3071, 2983, 2906, 1745, 1686, 1572, 1531, 1422, 1322, 1240 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{20}H_{18}N_2O_8S$: 446.0784 Found: 446.0764; Chiralpak IA column and IA guard column (50% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 32.2 min and *major*-isomer t_r = 38.4 min.

Ethyl (3*R*,9b*R*)-3-(2-(furan-2-yl)-2-oxoethyl)-5-methylene-2,3-dihydro-5λ^4-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b(5*H*)-carboxylate 5-oxide (**3ak**)



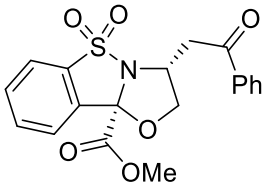
Synthesized by the general procedure I; 32 mg, yield 94%, >20:1 dr, $[\alpha]_D^{25}$ = -66.7 (*c* = 1.29, $CHCl_3$); 92% ee; Yellow solid; m.p. 153-155 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:4); ^1H NMR (400 MHz, $CDCl_3$) δ 7.81–7.76 (m, 1H), 7.75–7.65 (m, 3H), 7.62 (dd, *J* = 1.8, 0.8 Hz, 1H), 7.29–7.25 (m, 1H), 6.57 (dd, *J* = 3.6, 1.7 Hz, 1H), 4.78 (dtd, *J* = 9.5, 6.0, 4.6 Hz, 1H), 4.47 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.28 (qd, *J* = 7.1, 1.4 Hz, 2H), 4.19 (dd, *J* = 9.0, 5.8 Hz, 1H), 3.63 (dd, *J* = 17.7, 4.6 Hz, 1H), 3.29 (dd, *J* = 17.7, 9.6 Hz, 1H), 1.26 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ ^{13}C NMR (100 MHz, $CDCl_3$) δ 185.8, 167.4, 152.0, 146.8, 135.8, 134.1, 133.8, 132.0, 125.2, 121.3, 117.8, 112.4, 97.3, 74.2, 63.0, 56.2, 42.6, 13.8; IR (neat) 2985, 2939, 2892, 1745, 1684, 1571, 1471, 1422, 1322, 1240 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{18}H_{17}NO_7S$: 498.0919 Found: 391.0701; Chiralpak IA column and IA guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 36.8 min and *minor*-isomer t_r = 46.3 min.

Ethyl (3*R*,9b*R*)-5-methylene-3-(2-oxo-2-(thiophen-2-yl)ethyl)-2,3-dihydro-5λ^4-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b(5*H*)-carboxylate 5-oxide (**3al**)



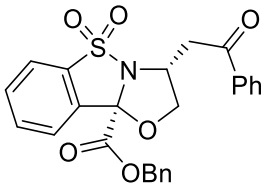
Synthesized by the general procedure I; 35 mg, yield 86%, >20:1 dr, $[\alpha]_D^{26}$ = -57.1 (*c* = 1.07, $CHCl_3$); 95% ee; Yellow solid; m.p. 129-131 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75–7.68 (m, 2H), 7.69–7.56 (m, 4H), 7.09 (dd, *J* = 4.9, 3.8 Hz, 1H), 4.72 (dtd, *J* = 10.4, 6.1, 4.4 Hz, 1H), 4.43 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.21 (q, *J* = 7.1 Hz, 2H), 4.13 (dd, *J* = 9.0, 5.9 Hz, 1H), 3.65 (dd, *J* = 17.5, 4.4 Hz, 1H), 3.30 (dd, *J* = 17.5, 9.8 Hz, 1H), 1.19 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ ^{13}C NMR (100 MHz, $CDCl_3$) δ 189.8, 167.4, 143.2, 135.8, 134.4, 134.2, 133.9, 132.7, 132.0, 128.3, 125.2 121.3, 97.3, 74.3 63.0, 56.5 43.5 13.9; IR (neat) 2984, 2939. 2908, 1744, 1685, 1572, 1472, 1219, 1323, 1239 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{18}H_{17}NO_6S_2$: 407.0497 Found: 407.0490; Chiralpak IC column and IC guard column (15% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 46.2 min and *major*-isomer t_r = 60.2 min.

Methyl (3*R*,9b*R*)-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ba**)



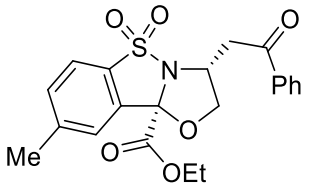
Synthesized by the general procedure I; 36 mg, yield 94%, >20:1 dr, $[\alpha]_D^{26}$ = -85.7 (*c* = 0.98, $CHCl_3$); 95% ee; White solid; m.p. 137-139 °C; R_f 0.4 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (dd, *J* = 8.3, 1.3 Hz, 2H), 7.82–7.78 (m, 1H), 7.75–7.64 (m, 3H), 7.60 (t, *J* = 7.4 Hz, 1H), 7.49 (t, *J* = 7.7 Hz, 2H), 4.83 (dtd, *J* = 10.4, 6.1, 4.4 Hz, 1H), 4.57 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.17 (dd, *J* = 9.0, 6.0 Hz, 1H), 3.87–3.74 (m, 4H), 3.43 (dd, *J* = 18.1, 9.7 Hz, 1H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.0, 168.0, 135.9, 135.8, 134.1, 133.9, 133.7, 132.0, 128.7, 128.0, 125.2, 121.4, 97.2, 74.4, 56.7, 53.7, 43.1; IR (neat) 3070, 2983, 2902, 1748, 1682, 1595, 1450, 1326, 1266, 1215 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{19}H_{17}NO_6S$: 387.0777 Found: 387.0794; Chiralpak IC column and IC guard column (7% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 67.1 min and *major*-isomer t_r = 128.8 min.

Benzyl (3*R*,9b*R*)-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ca**)



Synthesized by the general procedure I; 45 mg, yield 97%, 14:1 dr, $[\alpha]_D^{26}$ = -34.1 (*c* = 0.99, $CHCl_3$); 94% ee; White solid; m.p. 112-114 °C; R_f 0.4 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86–7.77 (m, 3H), 7.68 (dd, *J* = 5.7, 3.2 Hz, 2H), 7.64–7.54 (m, 2H), 7.45 (t, *J* = 7.7 Hz, 2H), 7.31 (s, 5H), 5.24 (d, *J* = 2.4 Hz, 2H), 4.85 (td, *J* = 9.9, 6.0 Hz, 1H), 4.52 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.11 (dd, *J* = 9.0, 5.7 Hz, 1H), 3.63 (dd, *J* = 18.3, 4.3 Hz, 1H), 3.27 (dd, *J* = 18.3, 9.8 Hz, 1H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 197.0, 167.3, 135.8, 134.6, 133.9, 133.8, 133.6, 132.0, 128.63(two peaks overlapping), 128.58, 128.5, 128.1, 128.0, 125.2, 121.4, 97.3, 74.6, 68.3, 56.3, 43.2; IR (neat) 3070, 2984, 2902, 1749, 1682, 1594, 1474, 1325, 1215, 1176 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{25}H_{21}NO_6S$: 463.1090 Found: 463.1081; Chiralpak IC column and IC guard column (7% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 56.4 min and *major*-isomer t_r = 104.8 min.

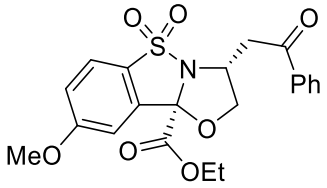
Ethyl (3*R*,9b*R*)-8-methyl-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3da**)



Synthesized by the general procedure I; 37 mg, yield 90%, 11:1 dr, $[\alpha]_D^{26}$ = -65.3 (*c* = 1.01, $CHCl_3$); 97% ee; White solid; m.p. 144-146 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 7.8 Hz, 2H), 7.67 (d, *J* = 8.0 Hz, 1H), 7.60 (t, *J* = 7.6 Hz, 1H), 7.49 (t, *J* = 7.7 Hz, 3H), 7.44 (s, 1H), 4.82 (td, *J* = 10.2, 6.1 Hz, 1H), 4.55 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.29 (qq, *J* = 7.5, 3.6 Hz, 2H), 4.15 (dd, *J* = 8.9, 5.9 Hz, 1H), 3.79 (dd, *J* = 18.1, 4.3 Hz, 1H), 3.41 (dd, *J* = 18.1, 9.8 Hz, 1H), 2.49 (s, 3H), 1.27 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 197.1, 167.6, 145.2, 136.0, 134.5, 133.6, 133.2, 132.9, 128.7, 128.0, 125.2, 121.1, 97.2, 74.4, 62.9, 56.6, 43.2, 21.8, 13.9; IR (neat) 2985, 2927, 2901, 1747, 1653, 1574, 1473, 1419, 1326, 1247 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{21}NO_6S$: 415.1090 Found: 415.1119; Chiralpak OJ-H column and OJ-H guard column (20%

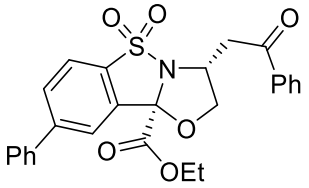
EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 49.4 min and *minor*-isomer t_r = 53.1 min.

Ethyl (3*R*,9b*R*)-8-methoxy-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ea**)



Synthesized by the general procedure I; 41 mg, yield 95%, 11:1 dr, $[\alpha]_D^{25}$ = -43.5 (*c* = 1.01, $CHCl_3$); 96% ee; Yellow solid; m.p. 132-134 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02–7.93 (m, 2H), 7.69 (d, *J* = 8.7 Hz, 1H), 7.64–7.57 (m, 1H), 7.49 (dd, *J* = 8.2, 7.1 Hz, 2H), 7.17 (dd, *J* = 8.7, 2.3 Hz, 1H), 7.06 (d, *J* = 2.3 Hz, 1H), 4.83 (dtd, *J* = 10.1, 6.1, 4.2 Hz, 1H), 4.56 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.29 (qq, *J* = 7.0, 3.6 Hz, 2H), 4.15 (dd, *J* = 8.9, 5.9 Hz, 1H), 3.89 (s, 3H), 3.79 (dd, *J* = 18.1, 4.2 Hz, 1H), 3.41 (dd, *J* = 18.1, 9.9 Hz, 1H), 1.27 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 197.1, 167.5, 164.0, 136.8, 136.0, 133.6, 128.7, 128.0, 127.8, 122.8, 119.3, 108.3, 96.8, 74.3, 62.9, 56.6, 56.0, 43.1, 13.9; IR (neat) 3071, 2984, 2908, 1746, 1685, 1572, 1422, 1324, 1241, 1115 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{21}NO_7S$: 431.1039 Found: 431.1013; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 58.6 min and *minor*-isomer t_r = 72.7 min.

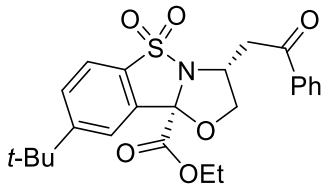
Ethyl (3*R*,9b*R*)-3-(2-oxo-2-phenylethyl)-8-phenyl-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3fa**)



Synthesized by the general procedure I; 41 mg, yield 90%, 10:1 dr, $[\alpha]_D^{26}$ = -41.6 (*c* = 1.00, $CHCl_3$); 96% ee; White solid; m.p. 180-182 °C; R_f 0.4 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02–7.94 (m, 2H), 7.92–7.80 (m, 3H), 7.60 (d, *J* = 7.2 Hz, 3H), 7.55–7.41 (m, 5H), 4.87 (td, *J* = 10.3, 6.1 Hz, 1H), 4.59 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.30 (qq, *J* = 7.1, 3.7 Hz, 2H), 4.19 (dd, *J* = 9.0,

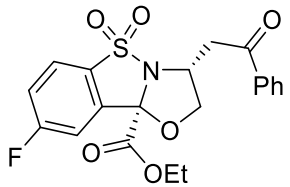
5.9 Hz, 1H), 3.82 (dd, *J* = 18.1, 4.3 Hz, 1H), 3.44 (dd, *J* = 18.1, 9.7 Hz, 1H), 1.27 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 197.1, 167.5, 147.4, 138.6, 136.0, 135.1, 134.4, 133.7, 131.0, 129.2, 128.9, 128.7, 128.0, 127.4, 123.5, 121.7, 97.3, 74.5, 63.0, 56.7, 43.2, 14.0; IR (neat) 2986, 2928, 2901, 1746, 1684, 1576, 1507, 1395, 1321, 1251, 1178 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{26}H_{23}NO_6S$: 477.1246 Found: 477.1235; Chiralpak IA column and IA guard column (30% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 26.2 min and *minor*-isomer t_r = 61.9 min.

Ethyl (3*R*,9b*R*)-8-(*tert*-butyl)-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ga**)



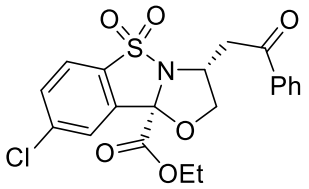
Synthesized by the general procedure I; 41 mg, yield 90%, 13:1 dr, $[\alpha]_D^{26}$ = -49.2 (*c* = 0.97, $CHCl_3$); 96% ee; White solid; m.p. 146-148 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^1H NMR (400 MHz, $CDCl_3$) δ 7.98 (d, *J* = 7.0 Hz, 2H), 7.72 (s, 2H), 7.65 (s, 1H), 7.63–7.57 (m, 1H), 7.49 (t, *J* = 7.8 Hz, 2H), 4.83 (td, *J* = 10.4, 6.3 Hz, 1H), 4.61 (dd, *J* = 8.9, 6.4 Hz, 1H), 4.30 (qd, *J* = 7.1, 3.0 Hz, 2H), 4.16 (dd, *J* = 8.9, 6.1 Hz, 1H), 3.81 (dd, *J* = 18.1, 4.2 Hz, 1H), 3.43 (dd, *J* = 18.1, 9.8 Hz, 1H), 1.36 (s, 9H), 1.26 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 197.1, 167.6, 158.4, 136.0, 134.2, 133.6, 133.0, 129.6, 128.7, 128.0, 121.7, 121.0, 97.4, 74.6, 62.8, 56.4, 43.3, 35.6, 31.0, 13.9; IR (neat) 2972, 2926, 2901, 1746, 1683, 1574, 1472, 1418, 1324, 1258 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{24}H_{27}NO_6S$: 457.1559 Found: 457.1546; Chiralpak IC column and IC guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 18.2 min and *major*-isomer t_r = 50.0 min.

Ethyl (3*R*,9b*R*)-8-fluoro-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ha**)



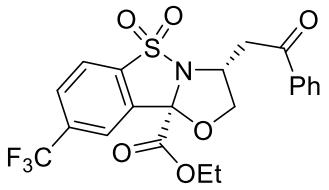
Synthesized by the general procedure I; 37 mg , yield 88%, 10:1 dr, $[\alpha]_D^{25}$ = -64.3 (*c* = 0.99, $CHCl_3$); 94% ee; Pale yellow gum; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01–7.95 (m, 2H), 7.79 (dd, *J* = 8.6, 4.5 Hz, 1H), 7.64–7.58 (m, 1H), 7.49 (t, *J* = 7.6 Hz, 2H), 7.43–7.32 (m, 2H), 4.90–4.80 (m, 1H), 4.54 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.30 (q, *J* = 7.2 Hz, 2H), 4.18 (dd, *J* = 9.0, 5.8 Hz, 1H), 3.79 (dd, *J* = 18.1, 4.5 Hz, 1H), 3.43 (dd, *J* = 18.2, 9.6 Hz, 1H), 1.28 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 197.0, 166.9 (d, J^1 = 256.4 Hz), 164.3, 137.4 (d, J^3= 9.2 Hz), 135.9, 133.7, 132.0 (d, J^4 = 2.7 Hz), 128.7, 128.0, 123.7 (d, J^3 = 10.0 Hz), 120.0 (d, J^2 = 24.6 Hz), 112.6 (d, J^2 = 24.6 Hz), 96.5 (d, J^4 = 2.1 Hz), 74.4, 63.2, 56.9, 43.1, 13.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -102.4; IR (neat) 3070, 2984, 2907, 1746, 1683, 1595, 1449, 1326, 1267, 1175 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{20}H_{18}FNO_6S$: 419.0839 Found: 419.0838; Chiralpak OJ-H column and OJ-H guard column (10% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 39.6 min and *major*-isomer t_r = 54.5 min.

Ethyl (3*R*,9b*R*)-8-chloro-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ia**)



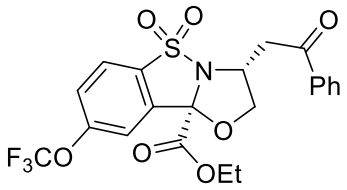
Synthesized by the general procedure I; 39 mg, yield 90%, 17:1 dr, $[\alpha]_D^{25}$ = -47.6 (*c* = 1.11, $CHCl_3$); 92% ee; White solid; m.p. 127-129 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01–7.94 (m, 2H), 7.72 (d, *J* = 8.9 Hz, 1H), 7.69–7.57 (m, 3H), 7.49 (t, *J* = 7.6 Hz, 2H), 4.88–4.79 (m, 1H), 4.52 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.29 (qt, *J* = 7.0, 3.5 Hz, 2H), 4.18 (dd, *J* = 8.9, 5.7 Hz, 1H), 3.79 (dd, *J* = 18.2, 4.5 Hz, 1H), 3.43 (dd, *J* = 18.1, 9.5 Hz, 1H), 1.28 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 197.0, 167.0, 140.3, 136.3, 135.9, 134.4, 133.7, 132.4, 128.7, 128.0, 125.6, 122.6, 96.6, 74.4, 63.2, 56.9, 43.0, 13.9; IR (neat) 2985, 2016, 2852, 1749, 1683, 1572, 1473, 1418, 1327, 1212 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{20}H_{18}ClNO_6S$: 435.0543 Found: 435.0528; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 41.1 min and *minor*-isomer t_r = 51.1 min.

Ethyl (3*R*,9b*R*)-3-(2-oxo-2-phenylethyl)-8-(trifluoromethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ja**)



Synthesized by the general procedure I; 42 mg, yield 89%, 14:1 dr, $[\alpha]_D^{25}$ = -47.2 (*c* = 1.04, $CHCl_3$); 91% ee; White solid; m.p. 139-141 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02–7.91 (m, 5H), 7.65–7.58 (m, 1H), 7.50 (t, *J* = 7.7 Hz, 2H), 4.91–4.81 (m, 1H), 4.54 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.31 (qd, *J* = 7.1, 1.8 Hz, 2H), 4.21 (dd, *J* = 9.0, 5.7 Hz, 1H), 3.82 (dd, *J* = 18.1, 4.6 Hz, 1H), 3.46 (dd, *J* = 18.1, 9.5 Hz, 1H), 1.27 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 196.9, 166.8, 139.2, 135.92, 135.90 (q, J^2 = 33.4 Hz), 135.4, 133.8, 129.2 (q, J^3 = 3.4 Hz), 128.8, 128.0, 123.0 (q, J^3 = 3.8 Hz), 122.8 (q, J^1 = 273.5 Hz), 122.3, 96.9, 74.6, 63.3, 57.0, 43.1, 13.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.9; IR (neat) 2993, 2941, 2902, 1759, 1684, 1571, 1473, 1330, 1215, 1170 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{18}F_3NO_6S$: 469.0807 Found: 469.0793; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 21.3 min and *minor*-isomer t_r = 28.4 min.

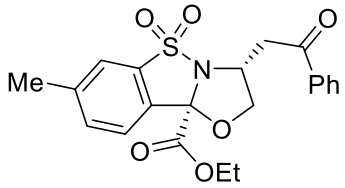
Ethyl (3*R*,9b*R*)-3-(2-oxo-2-phenylethyl)-8-(trifluoromethoxy)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ka**)



Synthesized by the general procedure I; 45 mg, yield 93%, 14:1 dr, $[\alpha]_D^{25}$ = -47.9 (*c* = 1.09, $CHCl_3$); 92% ee; Yellow solid; m.p. 128-130 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02–7.94 (m, 2H), 7.84 (d, *J* = 9.1 Hz, 1H), 7.63–7.58 (m, 1H), 7.57–7.44 (m, 4H), 4.91–4.81 (m, 1H), 4.56 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.30 (q, *J* = 7.2 Hz, 2H), 4.19 (dd, *J* = 9.0, 5.8 Hz, 1H), 3.81 (dd, *J* = 18.1, 4.6 Hz, 1H), 3.45 (dd, *J* = 18.1, 9.5 Hz, 1H), 1.27 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 197.0, 166.8, 152.9 (q, J^2 = 1.8 Hz), 137.0, 135.9, 134.1, 133.7, 128.7, 128.0, 124.5, 123.4, 121.1 (q, J^1 = 260.3 Hz), 117.4, 96.6, 74.6, 63.2, 56.9, 43.1, 13.8; ^{19}F NMR (376 MHz,

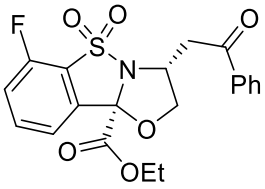
$CDCl_3$) δ -57.8; IR (neat) 2992, 2928, 2891, 1750, 1684, 1571, 1473, 1334, 1260, 1173 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{18}F_3NO_7S$: 485.0756 Found: 485.0736; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 16.7 min and *minor*-isomer t_r = 24.0 min.

Ethyl (3*R*,9b*R*)-7-methyl-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3la**)



Synthesized by the general procedure I; 37 mg, yield 90%, 12:1 dr, $[\alpha]_D^{28}$ = -68.0 (*c* = 1.02, $CHCl_3$); 99% ee; Yellow solid; m.p. 139-142 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^1H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 8.3 Hz, 2H), 7.59 (d, *J* = 8.8 Hz, 2H), 7.56 – 7.46 (m, 4H), 4.83 (td, *J* = 10.2, 6.1 Hz, 1H), 4.54 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.27 (q, *J* = 7.1 Hz, 2H), 4.15 (dd, *J* = 9.0, 5.8 Hz, 1H), 3.79 (dd, *J* = 18.1, 4.4 Hz, 1H), 3.42 (dd, *J* = 18.1, 9.7 Hz, 1H), 2.49 (s, 3H), 1.25 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 197.1, 167.6, 143.0, 136.0, 136.0, 134.9, 133.6, 131.4, 128.7, 128.0, 124.8, 121.2, 97.2, 74.4, 62.9, 56.5, 432., 21.4, 13.9; IR (neat) 2981, 2925, 2881, 1746, 1696, 1571, 1449, 1320, 1270, 1214, 1160 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{21}NO_6S$: 415.1090 Found: 415.1064; Chiralpak OJ-H column and OJ-H guard column (10% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 72.0 min and *minor*-isomer t_r = 82.0 min.

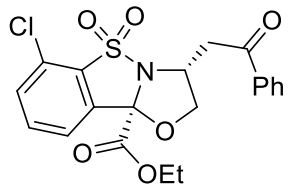
Ethyl (3*R*,9b*R*)-6-fluoro-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3ma**)



Synthesized by the general procedure I; 35 mg, yield 84%, >20:1 dr, $[\alpha]_D^{25}$ = -63.1 (*c* = 0.97, $CHCl_3$); 90% ee; White solid; m.p. 132-134 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^1H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 7.0 Hz, 2H), 7.71 (td, *J* = 8.0, 4.7 Hz, 1H), 7.61 (t, *J* = 7.4 Hz, 1H), 7.54–7.41

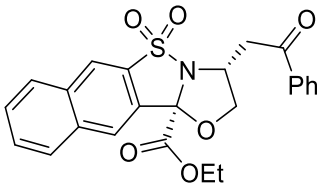
(m, 3H), 7.34 (t, *J* = 8.2 Hz, 1H), 4.86 (td, *J* = 10.2, 6.1 Hz, 1H), 4.56 (dd, *J* = 9.0, 6.3 Hz, 1H), 4.29 (q, *J* = 7.1 Hz, 2H), 4.19 (dd, *J* = 9.0, 5.8 Hz, 1H), 3.79 (dd, *J* = 18.1, 4.3 Hz, 1H), 3.42 (dd, *J* = 18.1, 9.8 Hz, 1H), 1.26 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.0, 167.0, 155.6 (d, J^1 = 260.5 Hz), 137.3, 136.4 (d, J^3 = 6.8 Hz), 135.9, 133.7, 128.7, 128.0, 124.1 (d, J^2 = 23.3 Hz), 120.8 (d, J^3 = 4.2 Hz), 118.7 (d, J^2 = 18.4 Hz), 96.9, 74.5, 63.2, 57.0, 43.1, 13.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -113.8; IR (neat) 2945, 2915, 2876, 1733, 1675, 1597, 1473, 1333, 1274, 1177 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{20}H_{18}FNO_6S$: 419.0839 Found: 419.0862; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 39.8 min and *minor*-isomer t_r = 49.5 min.

Ethyl (3*R*,9b*R*)-6-chloro-3-(2-oxo-2-phenylethyl)-2,3-dihydro-9b*H*-benzo[4,5]isothiazolo[3,2-*b*]oxazole-9b-carboxylate 5,5-dioxide (**3na**)



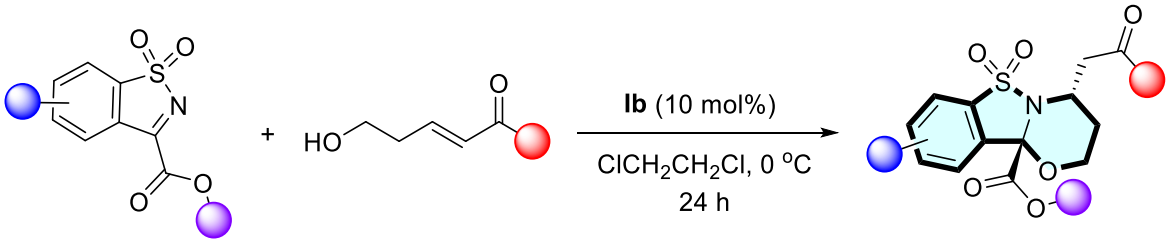
Synthesized by the general procedure I; 38 mg, yield 87%, >20:1 dr, $[\alpha]_D^{25}$ = -71.5 (*c* = 0.96, $CHCl_3$); 91% ee; White solid; m.p. 132-134 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 7.1 Hz, 2H), 7.67–7.59 (m, 3H), 7.55 (dd, *J* = 7.1, 1.6 Hz, 1H), 7.49 (t, *J* = 7.6 Hz, 2H), 4.86 (td, *J* = 10.1, 6.1 Hz, 1H), 4.54 (dd, *J* = 9.0, 6.3 Hz, 1H), 4.28 (q, *J* = 7.1 Hz, 2H), 4.18 (dd, *J* = 9.0, 5.8 Hz, 1H), 3.80 (dd, *J* = 18.1, 4.3 Hz, 1H), 3.43 (dd, *J* = 18.1, 9.8 Hz, 1H), 1.26 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.0, 167.1, 137.0, 135.9, 135.0, 134.0, 133.7, 132.6, 128.8 (two peaks overlapping), 128.0, 123.4, 96.1, 74.4, 63.2, 57.1, 43.1, 13.9; IR (neat) 2985, 2940, 2901, 1749, 1683, 1574, 1473, 1419, 1327, 1213, 1125 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{20}H_{18}ClNO_6S$: 435.0543 Found: 435.0558; Chiralpak IA column and IA guard column (10% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 34.5 min and *minor*-isomer t_r = 44.0 min.

Ethyl (3*R*,11b*R*)-3-(2-oxo-2-phenylethyl)-2,3-dihydro-11b*H*-naphtho[2',3':4,5]isothiazolo[3,2-*b*]oxazole-11b-carboxylate 5,5-dioxide (**3oa**)



Synthesized by the general procedure I; 42 mg, yield 94%, 20:1 dr, $[\alpha]_D^{25}$ = -49.7 (*c* = 1.01, $CHCl_3$); 97% ee; Yellow solid; m.p. 180-182 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:1:4); ^1H NMR (400 MHz, $CDCl_3$) δ 8.33 (s, 1H), 8.16 (s, 1H), 8.05–7.95 (m, 4H), 7.72–7.64 (m, 2H), 7.63–7.58 (m, 1H), 7.49 (t, *J* = 7.7 Hz, 2H), 4.90 (td, *J* = 10.5, 6.1 Hz, 1H), 4.60 (dd, *J* = 9.0, 6.4 Hz, 1H), 4.36–4.25 (m, 2H), 4.18 (dd, *J* = 9.0, 6.0 Hz, 1H), 3.84 (dd, *J* = 18.1, 4.4 Hz, 1H), 3.45 (dd, *J* = 18.1, 9.7 Hz, 1H), 1.26 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 197.1, 167.8, 136.0, 135.3, 134.0, 133.6, 133.2, 129.8, 129.3, 129.2, 128.9, 128.7, 128.6, 128.0, 125.2, 122.2, 97.3, 74.4, 63.0, 56.7, 43.3, 13.9; IR (neat) 2994, 2950, 2903, 1749, 1682, 1540, 1454, 1333, 1172, 1127 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{24}H_{21}NO_6S$: 451.1090 Found: 451.1118; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 64.2 min and *minor*-isomer t_r = 108.1 min.

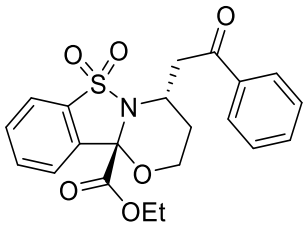
6. General procedure II for asymmetric [4+2]-annulation of δ-hydroxy-α,β-unsaturated ketones with cyclic *N*-sulfonyl ketimines.



1 **4** **5**

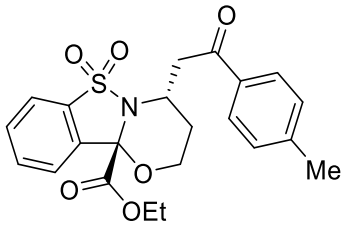
A solution of cyclic *N*-sulfonyl ketimine **1** (0.15 mmol, 1.5 equiv) and catalyst **Ib** (0.01 mmol, 0.1 equiv) in $ClCH_2CH_2Cl$ (1.0 mL, 0.1 M) was stirred for 10 min at 0 °C and then added δ-hydroxy-α,β-unsaturated ketone **4** (0.10 mmol, 1.0 equiv). The reaction mixture was stirred at room temperature for 24 h. Then, the resulting mixture was concentrated in vacuo and was purified by flash column chromatography with EtOAc/CH_2Cl_2/hexanes as eluent to afford desired product **5**. The enantiomeric excess was determined using HPLC analysis.

Ethyl (4*S*,10b*S*)-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5aa**)



Synthesized by the general procedure II; 34 mg, yield 83%, >20:1 dr, $[\alpha]_D^{26}$ = 39.8 (*c* = 0.92, $CHCl_3$); 99% ee; White solid; m.p. 149-151 ˚C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12–8.02 (m, 2H), 7.85–7.78 (m, 1H), 7.71–7.57 (m, 4H), 7.51 (dd, *J* = 8.3, 6.9 Hz, 2H), 4.47–4.31 (m, 3H), 4.30–4.13 (m, 3H), 3.86 (dd, *J* = 17.8, 9.8 Hz, 1H), 2.23–2.08 (m, 1H), 1.77 (dq, *J* = 13.4, 2.4 Hz, 1H), 1.33 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.8, 166.6, 136.3, 135.4, 133.6, 133.6, 133.6, 131.6, 128.7, 128.2, 124.1, 121.2, 89.4, 65.5, 63.2, 50.9, 39.2, 28.3, 14.1; IR (neat) 2957, 2898, 1747, 1684, 1597, 1449, 1373, 1242, 1162, 1053 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{21}NO_6S$: 415.1090 Found: 415.1111; Chiralpak IA column and IA guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 25.6 min and *minor*-isomer t_r = 66.4 min.

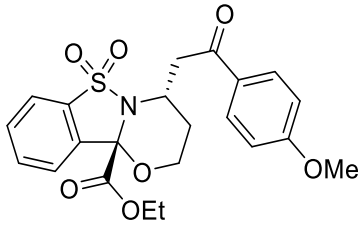
Ethyl (4*S*,10b*S*)-4-(2-oxo-2-(p-tolyl)ethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ab**)



Synthesized by the general procedure II; 37 mg, yield 87%, >20:1 dr, $[\alpha]_D^{26}$ = 23.6 (*c* = 1.01, $CHCl_3$); >99% ee; White solid; m.p. 132-134 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 8.3 Hz, 2H), 7.84–7.77 (m, 1H), 7.72–7.60 (m, 3H), 7.29 (d, *J* = 8.0 Hz, 2H), 4.47–4.30 (m, 3H), 4.26–4.11 (m, 3H), 3.84 (dd, *J* = 17.7, 9.9 Hz, 1H), 2.43 (s, 3H), 2.22–2.07 (m, 1H), 1.77 (dq, *J* = 13.5, 2.4 Hz, 1H), 1.33 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.4, 166.6, 144.5, 135.4, 133.9, 133.6, 133.6, 131.6, 129.4, 128.3, 124.1, 121.2, 89.4, 65.5, 63.2, 51.0, 39.1, 28.3, 21.7, 14.1; IR (neat) 2973, 2926, 1742, 1686, 1607, 1520, 1455, 1384, 1302, 1234, 1172, 1099 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{22}H_{23}NO_6S$: 429.1246 Found: 429.1235; Chiralpak IA column

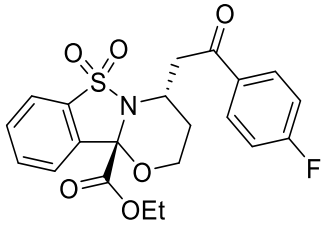
and IA guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 26.1 min and *minor*-isomer t_r = 63.7 min.

Ethyl (4*S*,10b*S*)-4-(2-(4-methoxyphenyl)-2-oxoethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ac**)



Synthesized by the general procedure II; 44 mg, yield 99%, >20:1 dr, $[\alpha]_D^{26}$ = 18.6 (*c* = 1.00, $CHCl_3$); >99% ee; White solid; m.p. 146-148 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.9 Hz, 2H), 7.85–7.77 (m, 1H), 7.74–7.55 (m, 3H), 6.97 (d, *J* = 8.9 Hz, 2H), 4.47–4.30 (m, 3H), 4.18 (dt, *J* = 15.5, 3.6 Hz, 3H), 3.89 (s, 3H), 3.82 (dd, *J* = 17.5, 10.0 Hz, 1H), 2.22–2.07 (m, 1H), 1.77 (dq, *J* = 13.3, 2.3 Hz, 1H), 1.33 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.2, 166.6, 163.8, 135.4, 133.64, 133.55, 131.6, 130.5, 129.5, 124.0, 121.2, 113.8, 89.4, 65.5, 63.2, 55.5, 51.1, 38.8, 28.3, 14.1; IR (neat) 2974, 2881, 1747, 1687, 1599, 1573, 1472, 1429, 1300, 1202, 1173 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{22}H_{23}NO_7S$: 445.1195 Found: 445.1203; Chiralpak IA column and IA guard column (30% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 26.8 min and *minor*-isomer t_r = 44.7 min.

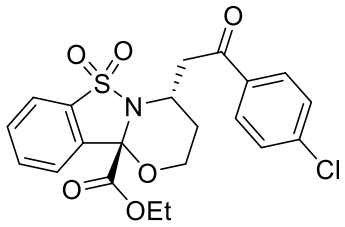
Ethyl (4*S*,10b*S*)-4-(2-(4-fluorophenyl)-2-oxoethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ad**)



Synthesized by the general procedure II; 39 mg, yield 91%, >20:1 dr, $[\alpha]_D^{26}$ = 24.9 (*c* = 0.90, $CHCl_3$); >99% ee; White solid; m.p. 150-152 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14–8.04 (m, 2H), 7.86–7.77 (m, 1H), 7.72–7.61 (m, 3H), 7.23–7.11 (m, 2H), 4.47–4.31 (m, 3H), 4.28–4.13 (m, 3H), 3.78 (dd, *J* = 17.8, 9.6 Hz, 1H), 2.25–2.09 (m, 1H), 1.76 (dq, *J* = 13.2, 2.3 Hz,

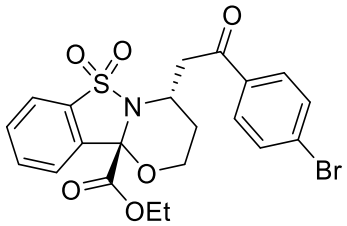
1H), 1.34 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.1, 166.9 (d, J^1 = 255.3 Hz), 164.7, 135.3, 133.63, 133.60, 132.8 (d, J^4 = 3.1 Hz), 131.7, 130.9 (d, J^3 = 9.5 Hz), 124.1, 121.2, 115.8 (d, J^2 = 22.0 Hz), 89.4, 65.5, 63.2, 50.8, 39.2, 28.3, 14.1; ^{19}F NMR (376 MHz, $CDCl_3$) δ -104.2; IR (neat) 2987, 2918, 1747, 1691, 1593, 1498, 1457, 1303, 1224, 1162, 1049 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{20}FNO_6S$: 433.0995 Found: 433.0992; Chiralpak IA column and IA guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 25.7 min and *minor*-isomer t_r = 56.7 min.

Ethyl (4*S*,10b*S*)-4-(2-(4-chlorophenyl)-2-oxoethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ae**)



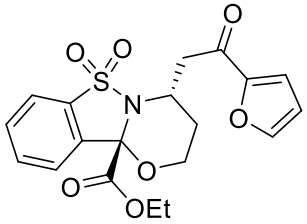
Synthesized by the general procedure II; 35 mg, yield 78%, >20:1 dr, $[\alpha]_D^{26}$ = 19.4 (*c* = 0.94, $CHCl_3$); >99% ee; White solid; m.p. 144-146 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05–7.95 (m, 2H), 7.84–7.77 (m, 1H), 7.72–7.61 (m, 3H), 7.54–7.42 (m, 2H), 4.47–4.31 (m, 3H), 4.29–4.12 (m, 3H), 3.75 (dd, *J* = 17.9, 9.4 Hz, 1H), 2.25–2.10 (m, 1H), 1.75 (dq, *J* = 13.4, 2.4 Hz, 1H), 1.34 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 194.5, 166.5, 140.1, 135.3, 134.7, 133.64, 133.58, 131.7, 129.6, 129.0, 124.1, 121.2, 89.4, 65.5, 63.2, 50.7, 39.2, 28.2, 14.1; IR (neat) 2909, 2891, 1744, 1685, 1589, 1507, 1400, 1361, 1317, 1225, 1134 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{20}ClNO_6S$: 449.0700 Found: 449.0705; Chiralpak IA column and IA guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 29.1 min and *minor*-isomer t_r = 58.9 min.

Ethyl (4*S*,10b*S*)-4-(2-(4-bromophenyl)-2-oxoethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxid (**5af**)



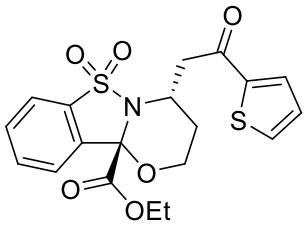
Synthesized by the general procedure II; 46 mg, yield 93%, >20:1 dr, $[\alpha]_D^{26}$ = 13.6 (*c* = 1.01, $CHCl_3$); 99% ee; White solid; m.p. 76-79 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97–7.87 (m, 2H), 7.84–7.77 (m, 1H), 7.73–7.57 (m, 5H), 4.47–4.30 (m, 3H), 4.28–4.11 (m, 3H), 3.74 (dd, *J* = 17.9, 9.4 Hz, 1H), 2.25–2.07 (m, 1H), 1.74 (dq, *J* = 13.4, 2.4 Hz, 1H), 1.34 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 194.7, 166.5, 135.3, 135.1, 133.63, 133.58, 132.0, 131.7, 129.7, 128.8, 124.1, 121.2, 89.4, 65.5, 63.2, 50.6, 39.2, 28.2, 14.1; IR (neat) 2991, 2896, 1743, 1686, 1589, 1543, 1488, 1432, 1391, 1235, 1138 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{20}BrNO_6S$: 493.0195 Found: 493.0181; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 56.7 min and *major*-isomer t_r = 69.1 min.

Ethyl (4*S*,10b*S*)-4-(2-(furan-2-yl)-2-oxoethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ag**)



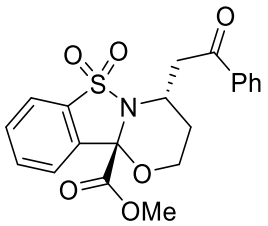
Synthesized by the general procedure II; 34 mg, yield 84%, >20:1 dr, $[\alpha]_D^{26}$ = 30.8 (*c* = 1.22, $CHCl_3$); 99% ee; White solid; m.p. 166-168 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:4:3); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (ddd, *J* = 5.4, 2.4, 0.8 Hz, 1H), 7.73–7.58 (m, 4H), 7.34 (dd, *J* = 3.6, 0.8 Hz, 1H), 6.58 (dd, *J* = 3.6, 1.7 Hz, 1H), 4.44–4.29 (m, 3H), 4.24–4.05 (m, 3H), 3.70 (dd, *J* = 17.5, 9.7 Hz, 1H), 2.27–2.09 (m, 1H), 1.70 (dq, *J* = 13.3, 2.4 Hz, 1H), 1.33 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 184.5, 166.5, 152.1, 147.0, 135.4, 133.58, 133.56, 131.6, 124.1, 121.2, 118.1, 112.4, 89.4, 65.4, 63.2, 50.3, 39.0, 28.2, 14.1; IR (neat) 2956, 2897, 1745, 1681, 1368, 1470, 1342, 1297, 1175, 1047 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{19}H_{19}NO_7S$: 405.0882 Found: 405.0865; Chiralpak IA column and IA guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 28.0 min and *minor*-isomer t_r = 52.9 min.

Ethyl (4*S*,10b*S*)-4-(2-oxo-2-(thiophen-2-yl)ethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ah**)



Synthesized by the general procedure II; 42 mg, yield 99%, >20:1 dr, $[\alpha]_D^{26}$ = 30.6 (*c* = 1.00, $CHCl_3$); >99% ee; White solid; m.p. 163-165 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:10:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (dd, *J* = 3.8, 1.1 Hz, 1H), 7.85–7.77 (m, 1H), 7.74–7.59 (m, 4H), 7.18 (dd, *J* = 5.0, 3.8 Hz, 1H), 4.46–4.30 (m, 3H), 4.25–4.10 (m, 3H), 3.79 (dd, *J* = 17.2, 9.8 Hz, 1H), 2.27–2.10 (m, 1H), 1.74 (dq, *J* = 13.3, 2.4 Hz, 1H), 1.33 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 188.6, 166.5, 143.6, 135.3, 134.4, 133.60, 133.57, 132.8, 131.6, 128.3, 124.1, 121.2, 89.4, 65.4, 63.2, 50.7, 39.8, 28.2, 14.1; IR (neat) 2965, 2898, 1746, 1664, 1518, 1416, 1297, 1230, 1132, 1051 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{19}H_{19}NO_6S_2$: 421.0654 Found: 421.0648; Chiralpak OJ-H column and OJ-H guard column (30% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 33.2 min and *minor*-isomer t_r = 52.0 min.

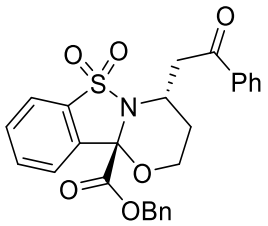
Methyl (4*S*,10b*S*)-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ba**)



Synthesized by the general procedure II; 31 mg, yield 78%, >20:1 dr, $[\alpha]_D^{26}$ = 36.1 (*c* = 1.00, $CHCl_3$); 99% ee; White solid; m.p. 142-144 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=3:20:17); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13–7.97 (m, 2H), 7.86–7.77 (m, 1H), 7.73–7.57 (m, 4H), 7.51 (t, *J* = 7.7 Hz, 2H), 4.41 (ddt, *J* = 12.5, 9.8, 3.2 Hz, 1H), 4.30–4.12 (m, 3H), 3.89 (s, 4H), 2.24–2.08 (m, 1H), 1.78 (dq, *J* = 13.3, 2.4 Hz, 1H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.8, 167.3, 136.3, 135.3, 133.7, 133.6, 133.5, 131.7, 128.7, 128.2, 124.1, 121.2, 89.4, 65.6, 53.9, 51.0, 39.2, 28.3; IR (neat) 2955, 2853, 1746, 1684, 1597, 1449, 1373, 1241, 1176, 1029 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{20}H_{19}NO_6S$: 401.0933 Found:

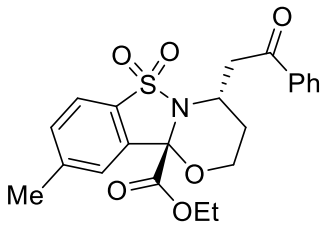
401.0916; Chiralpak IB column and IB guard column (5% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 26.2 min and *minor*-isomer t_r = 31.7 min.

Benzyl (4*S*,10b*S*)-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ca**)



Synthesized by the general procedure II; 40 mg, yield 84%, >20:1 dr, $[\alpha]_D^{26}$ = 29.6 (*c* = 1.00, $CHCl_3$); >99% ee; White solid; m.p. 188-190 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12–7.98 (m, 2H), 7.80 (dd, *J* = 7.5, 1.2 Hz, 1H), 7.66–7.55 (m, 3H), 7.54–7.45 (m, 3H), 7.32 (s, 5H), 5.40–5.24 (m, 2H), 4.40 (tt, *J* = 9.9, 3.1 Hz, 1H), 4.28–4.07 (m, 3H), 3.86 (dd, *J* = 17.7, 10.0 Hz, 1H), 2.13 (dtd, *J* = 13.2, 11.7, 5.7 Hz, 1H), 1.75 (dq, *J* = 13.3, 2.4 Hz, 1H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.7, 166.5, 136.3, 135.3, 134.6, 133.6, 133.5, 133.4, 131.6, 128.7, 128.63, 128.60, 128.4, 128.2, 124.1, 121.2, 89.4, 68.5, 65.5, 51.0, 39.2, 28.3; IR (neat) 2956, 2854, 1746, 1684, 1597, 1449, 1303, 1242, 1134, 1053, cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{26}H_{23}NO_6S$: 477.1246 Found: 477.1224; Chiralpak IB column and IB guard column (10% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 18.7 min and *minor*-isomer t_r = 22.5 min.

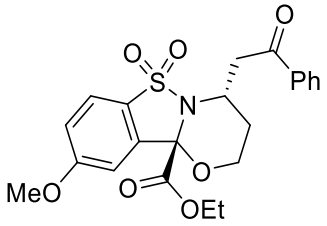
Ethyl (4*S*,10b*S*)-9-methyl-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5da**)



Synthesized by the general procedure II; 36 mg, yield 85%, >20:1 dr, $[\alpha]_D^{26}$ = 24.3 (*c* = 1.00, $CHCl_3$); >99% ee; White solid; m.p. 161-163 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (dd, *J* = 8.4, 1.4 Hz, 2H), 7.69 (d, *J* = 8.0 Hz, 1H), 7.64–7.57 (m, 1H), 7.54–7.41 (m, 4H), 4.47–4.30 (m, 3H), 4.28–4.11 (m, 3H), 3.85 (dd, *J* = 17.8, 9.9 Hz, 1H), 2.46 (s, 3H), 2.23–2.08

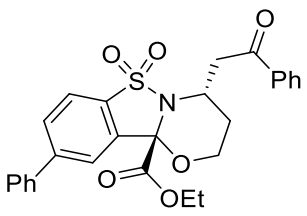
(m, 1H), 1.75 (dq, *J* = 13.2, 2.3 Hz, 1H), 1.34 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 195.8, 166.7, 144.9, 136.3, 133.8, 133.6, 132.6, 132.4, 128.7, 128.2, 124.2, 121.0, 89.3, 65.5, 63.2, 50.8, 39.2, 28.3, 21.8, 14.1; IR (neat) 2972, 2866, 1746, 1682, 1580, 1471, 1449, 1386, 1291, 1177, 1106 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{22}H_{23}NO_6S$: 429.1246 Found: 429.1265; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 33.5 min and *minor*-isomer t_r = 53.1 min.

Ethyl (4*S*,10b*S*)-9-methoxy-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ea**)



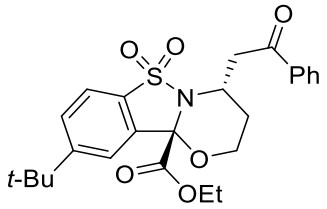
Synthesized by the general procedure II; 35 mg, yield 79%, >20:1 dr, $[\alpha]_D^{26}$ = 17.2 (*c* = 0.98, $CHCl_3$); >99% ee; White solid; m.p. 63-65 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:10:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (dd, *J* = 8.4, 1.4 Hz, 2H), 7.71 (d, *J* = 8.6 Hz, 1H), 7.64–7.57 (m, 1H), 7.50 (t, *J* = 7.6 Hz, 2H), 7.14 (dd, *J* = 8.6, 2.3 Hz, 1H), 7.06 (d, *J* = 2.2 Hz, 1H), 4.46–4.29 (m, 3H), 4.28–4.11 (m, 3H), 3.89–3.80 (m, 4H), 2.24–2.10 (m, 1H), 1.76 (dq, *J* = 13.3, 2.4 Hz, 1H), 1.34 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 195.9, 166.7, 163.8, 136.3, 135.9, 133.6, 128.7, 128.2, 127.2, 122.7, 118.6, 107.9, 89.0, 65.5, 63.2, 56.0, 50.9, 39.2, 28.3, 14.1; IR (neat) 2970, 2899, 1746, 1684, 1597, 1449, 1301, 1241, 1176, 1134, 1053 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{22}H_{23}NO_7S$: 445.1195 Found: 445.1208; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 41.5 min and *minor*-isomer t_r = 75.3 min.

Ethyl (4*S*,10b*S*)-4-(2-oxo-2-phenylethyl)-9-phenyl--3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5fa**)



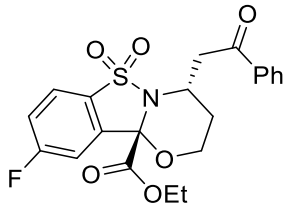
Synthesized by the general procedure II; 41 mg, yield 83%, >20:1 dr, $[\alpha]_D^{26}$ = -14.2 (*c* = 0.99, $CHCl_3$); >99% ee; White solid; m.p. 181-183 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:5:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13–8.01 (m, 2H), 7.91–7.78 (m, 3H), 7.64–7.55 (m, 3H), 7.54–7.40 (m, 5H), 4.49–4.38 (m, 2H), 4.38–4.16 (m, 4H), 3.87 (dd, *J* = 17.8, 9.8 Hz, 1H), 2.26–2.10 (m, 1H), 1.79 (dq, *J* = 13.2, 2.3 Hz, 1H), 1.34 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.8, 166.6, 147.2, 138.7, 136.3, 134.4, 133.9, 133.6, 130.6, 129.1, 128.8, 128.7, 128.2, 127.4, 122.5, 121.6, 89.4, 65.5, 63.2, 50.9, 39.2, 28.3, 14.2; IR (neat) 2970, 2891, 1741, 1681, 1596, 1446, 1411, 1301, 1245, 1198, 1060 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{27}H_{25}NO_6S$: 491.1403 Found: 491.1406; Chiralpak OJ-H column and OJ-H guard column (40% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 34.4 min and *minor*-isomer t_r = 52.8 min.

Ethyl (4*S*,10b*S*)-9-(*tert*-butyl)-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ga**)



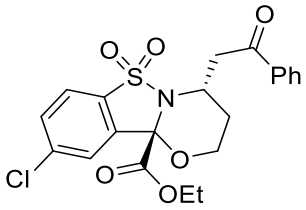
Synthesized by the general procedure II; 40 mg, yield 84%, >20:1 dr, $[\alpha]_D^{26}$ = 14.8 (*c* = 0.99, $CHCl_3$); 99% ee; White solid; m.p. 70-72 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=3:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13–8.00 (m, 2H), 7.77–7.65 (m, 2H), 7.65–7.56 (m, 2H), 7.54–7.46 (m, 2H), 4.48–4.31 (m, 3H), 4.30–4.12 (m, 3H), 3.87 (dd, *J* = 17.8, 10.0 Hz, 1H), 2.24–2.08 (m, 1H), 1.77 (dq, *J* = 13.2, 2.3 Hz, 1H), 1.33 (d, *J* = 3.3 Hz, 12H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.9, 166.7, 158.1, 136.4, 133.61, 133.57, 132.5, 129.1, 128.7, 128.2, 120.8, 120.7, 89.5, 65.6, 63.0, 50.9, 39.2, 35.6, 31.0, 28.3, 14.1; IR (neat) 2958, 2904, 1746, 1684, 1616, 1507, 1449, 1363, 1298, 1226, 1149 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{25}H_{29}NO_6S$: 471.1716 Found: 471.1736; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r =12.7 min and *minor*-isomer t_r = 22.8 min.

Ethyl (4*S*,10b*S*)-9-fluoro-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ha**)



Synthesized by the general procedure II; 33 mg, yield 76%, >20:1 dr, $[\alpha]_D^{26}$ = 25.8 (*c* = 0.82, $CHCl_3$); >99% ee; White solid; m.p. 183-185 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11–8.00 (m, 2H), 7.85–7.77 (m, 1H), 7.65–7.57 (m, 1H), 7.51 (t, *J* = 7.6 Hz, 2H), 7.41–7.29 (m, 2H), 4.49–4.33 (m, 3H), 4.27–4.11 (m, 3H), 3.83 (dd, *J* = 17.8, 9.8 Hz, 1H), 2.23–2.07 (m, 1H), 1.78 (dq, *J* = 13.4, 2.4 Hz, 1H), 1.36 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.6, 166.4 (d, J^1 = 257.0 Hz), 164.2, 136.5 (d, J^3 = 8.9 Hz), 136.3, 133.6, 131.3 (d, J^4 = 4.5 Hz), 128.7, 128.2, 123.6 (d, J^3 = 9.5 Hz), 119.5 (d, J^2 = 24.6 Hz), 111.8 (d, J^2 = 25.4 Hz), 88.7 (d, J^5 = 2.1 Hz), 65.8, 63.5, 51.0, 39.2, 28.2, 14.1; ^{19}F NMR (376 MHz, $CDCl_3$) δ -102.3; IR (neat) 2970, 2853, 1746, 1684, 1597, 1449, 1302, 1242, 1162, 1053, 1029 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{20}FNO_6S$: 433.0995 Found: 433.1023; Chiralpak OJ-H column and OJ-H guard column (30% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 28.5 min and *minor*-isomer t_r = 56.4 min.

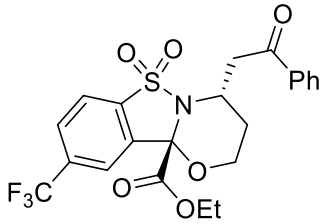
Ethyl (4*S*,10b*S*)-9-chloro-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ia**)



Synthesized by the general procedure II; 35 mg, yield 79%, >20:1 dr, $[\alpha]_D^{26}$ = 15.2 (*c* = 0.80, $CHCl_3$); >99% ee; White solid; m.p. 162-164 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10–7.99 (m, 2H), 7.74 (dd, *J* = 8.1, 0.8 Hz, 1H), 7.68–7.57 (m, 3H), 7.50 (t, *J* = 7.6 Hz, 2H), 4.48–4.32 (m, 3H), 4.26–4.11 (m, 3H), 3.82 (dd, *J* = 17.8, 9.8 Hz, 1H), 2.22–2.07 (m, 1H), 1.77 (dq, *J* = 13.3, 2.3 Hz, 1H), 1.36 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.6, 166.1, 140.2, 136.3, 135.4, 133.8, 133.6, 132.1, 128.7, 128.2, 124.6, 122.5, 88.8, 65.6, 63.5, 51.0, 39.2, 28.2, 14.1; IR (neat) 2982, 2901, 2862, 1749, 1693, 1586, 1449, 1416, 1371, 1237, 1175 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{20}ClNO_6S$: 449.0700 Found: 449.0670; Chiralpak OJ-H column and OJ-H guard

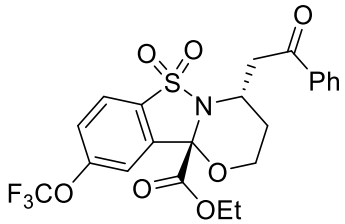
column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 29.4 min and *minor*-isomer t_r = 54.9 min.

Ethyl (4*S*,10b*S*)-4-(2-oxo-2-phenylethyl)-9-(trifluoromethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ja**)



Synthesized by the general procedure II; 42 mg, yield 87%, >20:1 dr, $[\alpha]_D^{26}$ = 15.5 (*c* = 0.95, $CHCl_3$); >99% ee; White solid; m.p. 132-134 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09–8.03 (m, 2H), 7.94 (s, 3H), 7.65–7.59 (m, 1H), 7.56–7.46 (m, 2H), 4.53–4.34 (m, 3H), 4.29–4.14 (m, 3H), 3.83 (dd, *J* = 17.7, 9.8 Hz, 1H), 2.22–2.09 (m, 1H), 1.81 (dq, *J* = 13.4, 2.4 Hz, 1H), 1.36 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.5, 166.0, 138.6, 136.2, 135.7 (q, J^2 = 33.6 Hz), 134.6, 133.7, 128.9 (q, J^3 = 3.5 Hz), 128.7, 128.2, 122.1, 89.0, 122.7 (q, J^1 = 273.4 Hz) 121.8 (q, J^3 = 3.8 Hz), 65.6, 63.6, 51.0, 39.2, 28.3, 14.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.9; IR (neat) 2971, 2875, 1746, 1683, 1596, 1449, 1296, 1242, 1175, 1134, 1029 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{22}H_{20}F_3NO_6S$: 483.0963 Found: 483.0947; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 15.8 min and *minor*-isomer t_r = 25.4 min.

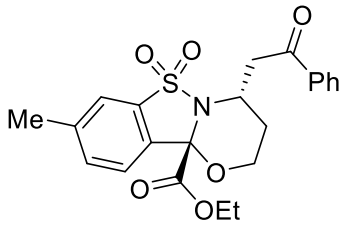
Ethyl (4*S*,10b*S*)-4-(2-oxo-2-phenylethyl)-9-(trifluoromethoxy)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ka**)



Synthesized by the general procedure II; 44 mg, yield 89%, >20:1 dr, $[\alpha]_D^{26}$ = 16.8 (*c* = 1.00, $CHCl_3$); >99% ee; White solid; m.p. 123-126 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10–7.99 (m, 2H), 7.86 (dd, *J* = 7.9, 1.0 Hz, 1H), 7.65–7.59 (m, 1H), 7.56 7.42 (m, 4H),

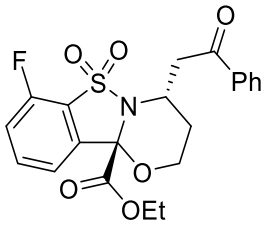
4.51–4.33 (m, 3H), 4.27–4.12 (m, 3H), 3.83 (dd, *J* = 17.8, 9.8 Hz, 1H), 2.22–2.08 (m, 1H), 1.79 (dq, *J* = 13.3, 2.3 Hz, 1H), 1.35 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 195.6, 166.0, 152.7 (q, J^2 = 1.9 Hz), 136.3, 136.1, 133.7, 133.5, 128.7, 128.2, 124.1, 123.3, 116.5, 120.1 (d, *J* = 260.3 Hz), 88.8, 65.6, 63.5, 51.0, 39.1, 28.2, 14.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -57.8; IR (neat) 2972, 2866, 1746, 1682, 1596, 1449, 1292, 1242, 1134 1018 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{22}H_{20}F_3NO_7S$: 499.0913 Found: 499.0898; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 14.9 min and *minor*-isomer t_r = 23.5 min.

Ethyl (4*S*,10b*S*)-8-methyl-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5la**)



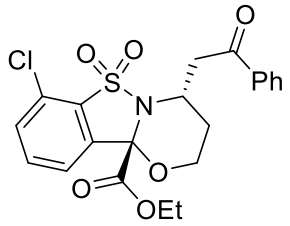
Synthesized by the general procedure II; 36 mg, yield 84%, >20:1 dr, $[\alpha]_D^{26}$ = 37.8 (*c* = 0.96, $CHCl_3$); >99% ee; White solid; m.p. 164-166 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16–7.96 (m, 2H), 7.67–7.57 (m, 2H), 7.57–7.40 (m, 4H), 4.46–4.30 (m, 3H), 4.28–4.10 (m, 3H), 3.86 (dd, *J* = 17.8, 9.9 Hz, 1H), 2.47 (s, 3H), 2.21–2.07 (m, 1H), 1.76 (dq, *J* = 13.3, 2.5 Hz, 1H), 1.33 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 195.8, 166.7, 142.6, 136.3, 135.4, 134.5, 133.6, 130.9, 128.7, 128.2, 123.8, 121.1, 89.3, 65.4, 63.1, 50.9, 39.2, 28.3, 21.5, 14.1; IR (neat) 2890, 2802, 1742, 1693, 1558, 1507, 1456, 1299, 1221, 1163 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{22}H_{23}NO_6S$: 429.1246 Found: 429.1219; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 42.8 min and *minor*-isomer t_r = 51.6 min.

Ethyl (4*S*,10b*S*)-7-fluoro-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5ma**)



Synthesized by the general procedure II; 38 mg, yield 87%, 12:1 dr, $[\alpha]_D^{26}$ = 18.0 (*c* = 1.06, $CHCl_3$); >99% ee; White solid; m.p. 156-158 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12–7.97 (m, 2H), 7.70–7.58 (m, 2H), 7.50 (t, *J* = 7.7 Hz, 2H), 7.43 (d, *J* = 7.1 Hz, 1H), 7.31 (t, *J* = 8.3 Hz, 1H), 4.46–4.31 (m, 3H), 4.28–4.14 (m, 3H), 3.85 (dd, *J* = 17.8, 9.9 Hz, 1H), 2.25–2.06 (m, 1H), 1.79 (dq, *J* = 13.4, 2.4 Hz, 1H), 1.34 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.6, 166.2, 155.7 (d, J^1 = 260.1 Hz), 136.3, 136.0, 135.9, 133.7, 128.7, 128.2, 123.0 (d, J^2 = 17.9 Hz), 119.8 (d, J^3 = 4.7 Hz), 118.8 (d, J^2 = 17.9 Hz), 89.1, 65.6, 63.4, 51.0, 39.2, 28.3, 14.1; ^{19}F NMR (376 MHz, $CDCl_3$) δ -114.5; IR (neat) 2890, 2833, 1743, 1684, 1594, 1541, 1473, 1373, 1279, 1242, 1176 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{20}FNO_6S$: 433.0995 Found: 433.0971; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 35.8 min and *minor*-isomer t_r = 50.9 min.

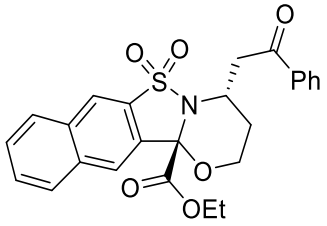
Ethyl (4*S*,10b*S*)-7-chloro-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**5na**)



Synthesized by the general procedure II; 40 mg, yield 89%, 13:1 dr, $[\alpha]_D^{26}$ = 41.9 (*c* = 0.82, $CHCl_3$); 99% ee; White solid; m.p. 174-176 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10–8.00 (m, 2H), 7.64–7.56 (m, 3H), 7.56–7.43 (m, 3H), 4.47–4.32 (m, 3H), 4.30–4.16 (m, 3H), 3.87 (dd, *J* = 17.9, 9.9 Hz, 1H), 2.21–2.08 (m, 1H), 1.80 (dq, *J* = 13.4, 2.4 Hz, 1H), 1.33 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.6, 166.3, 136.25, 136.18, 134.6, 133.7, 132.9, 132., 128.8, 128.7, 128.2, 122.3, 88.4, 65.5, 63.4, 51.0, 39.2, 28.4, 14.1; IR (neat) 2910, 2847, 1738, 1687, 1558, 1507, 1455, 1389, 1306, 1243, 1112 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{21}H_{20}ClNO_6S$:

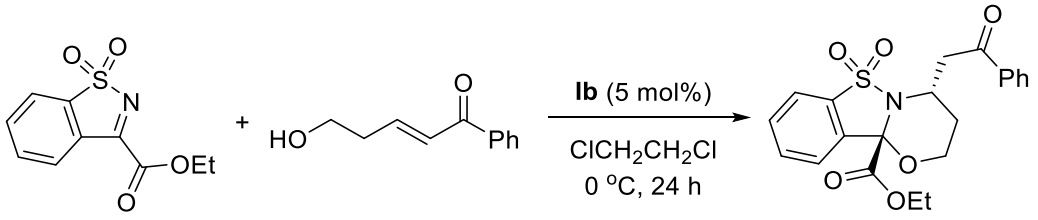
449.0700 Found: 449.0670; Chiralpak IA column and IA guard column (15% IPA:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 21.7 min and *major*-isomer t_r = 28.4 min.

Ethyl (4*S*,12b*S*)-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,12b*H*-naphtho[2',3':4,5]isothiazolo[3,2-*b*][1,3]oxazine-12b-carboxylate 6,6-dioxide (**5oa**)



Synthesized by the general procedure II; 40 mg, yield 86%, >20:1 dr, $[\alpha]_D^{26}$ = -13.0 (*c* = 0.96, $CHCl_3$); >99% ee; White solid; m.p. 208-210 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.34 (s, 1H), 8.15–8.05 (m, 3H), 8.05–7.99 (m, 1H), 7.99–7.92 (m, 1H), 7.71–7.59 (m, 3H), 7.51 (t, *J* = 7.6 Hz, 2H), 4.52–4.41 (m, 2H), 4.38–4.17 (m, 4H), 3.89 (dd, *J* = 17.7, 9.9 Hz, 1H), 2.24 (qd, *J* = 11.9, 5.4 Hz, 1H), 1.78 (dq, *J* = 13.4, 2.4 Hz, 1H), 1.35 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.9, 166.8, 136.4, 135.1, 133.7, 133.6, 132.5, 129.3, 129.2, 129.1, 129.0, 128.7, 128.6, 128.2, 124.3, 122.1, 89.7, 65.6, 63.2, 51.2, 39.4, 28.2, 14.1; IR (neat) 2892, 2834, 1742, 1681, 1558, 1498, 1420, 1362, 1296, 1149, 1069 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{25}H_{23}NO_6S$: 465.1246 Found: 465.1220; Chiralpak OJ-H column and OJ-H guard column (30% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 42.2 min and *minor*-isomer t_r = 58.1 min.

7. Procedure for the gram-scale synthesis of 5aa

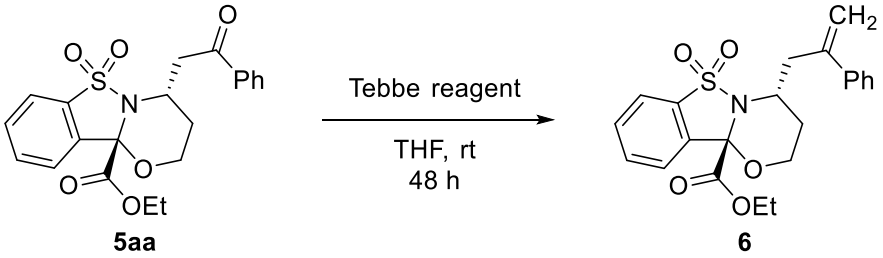


1a **4a** **5aa**

A solution of cyclic *N*-sulfonyl ketimine **1a** (1.08 g, 4.5 mmol, 1.5 equiv) and catalyst **Ib** (95 mg, 0.15 mmol, 0.05 equiv) in $ClCH_2CH_2Cl$ (30 mL, 0.1 M) was stirred for 10 min at 0 °C and then added δ-hydroxy-α,β-unsaturated ketone **4a** (529 mg, 3.0 mmol, 1.0 equiv). The reaction mixture was stirred at room temperature for 24 h. Then, the resulting mixture was concentrated in vacuo and was purified by flash

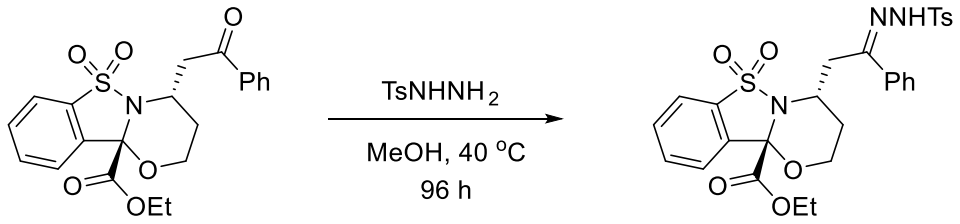
column chromatography with 20% to 30% EtOAc/hexanes as eluent to afford desired product **5aa** (1.08 g, 87% yield, >20:1 dr, >99% ee) as a white solid.

8. Synthetic transformation



5aa **6**

Ethyl (4*R*,10b*S*)-4-(2-phenylallyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**6**)**;** To a solution of 1,3-oxazinane **5aa** (42 mg, 010 mmol) in THF (1.5 mL) was added dropwise Tebbe reagent (0.5 M solution in toluene, 0.60 mL, 0.30 mmol) at 0 ˚C. The reaction mixture was stirred for 48 hour at room temperature. Then, the resulting mixture was quenched with sat. $NaHCO_3$ solution and extracted with Et_2O. The combined organic layers were washed with brine, dried (anhydrous Na_2SO_4), and concentrated in vacuo. The crude residue was purified by flash column chromatography with EtOAc/hexanes as eluent to afford desired product **6**; 30 mg, yield 74%, $[\alpha]_D^{23}$ = 140.5 (*c* = 1.03, $CHCl_3$); >99% ee; Yellow solid; m.p. 148-150 ˚C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85–7.80 (m, 1H), 7.68–7.58 (m, 3H), 7.52–7.45 (m, 2H), 7.38–7.33 (m, 2H), 7.32–7.27 (m, 1H), 5.47 (s, 1H), 5.31 (s, 1H), 4.27 (dq, *J* = 10.7, 7.1 Hz, 1H), 4.18–4.08 (m, 2H), 3.86 (dtd, *J* = 24.5, 13.0, 2.6 Hz, 2H), 3.70–3.63 (m, 1H), 3.26 (dd, *J* = 13.8, 10.8 Hz, 1H), 2.09 (qd, *J* = 12.4, 4.9 Hz, 1H), 1.52 (dq, *J* = 13.8, 2.6 Hz, 1H), 1.16 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 166.7, 143.4, 139.4, 135.8, 133.4, 131.6, 128.6, 127.9, 126.1, 124.1, 121.2, 116.2, 89.3, 65.7, 62.9, 53.8, 36.9, 27.4, 14.0; IR (neat) 2973, 2924, 2874, 1737, 1598, 1493, 1452, 1377, 1303, 1256, 1237, 1164, 1092 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{22}H_{23}NO_5S$: 413.1297 Found: 413.1304; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 32.8 min and *major*-isomer t_r = 58.1 min.



5aa **7**

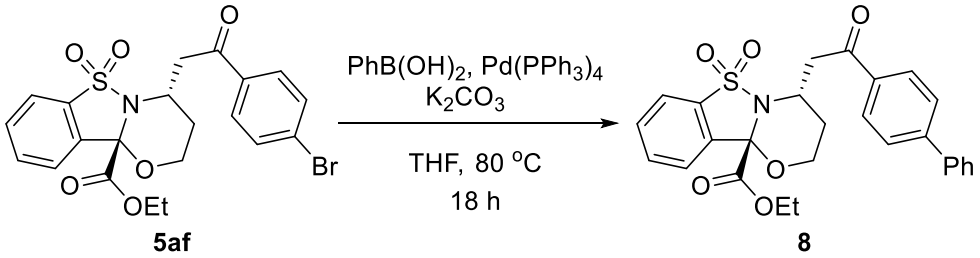
Ethyl (4*S*,10b*S*)-4-((E)-2-phenyl-2-(2-tosylhydrazineylidene)ethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (7);

To a solution of *p*-toluenesulfonyl hydrazide (38 mg, 0.20 mmol) and molecular sieve 4 Å (10 mg) in MeOH (1.0 mL) was added 1,3-oxazinane **5aa** (42 mg, 010 mmol) at room temperature. The reaction mixture was stirred at 40 ˚C in an oil bath until 1,3-oxazinane **5aa** was completely consumed, as determined by TLC. Then, the resulting mixture was filtered through the plug of celite. The filtrate was concentrated in vacuo. The crude residue was purified by flash column chromatography with EtOAc/hexanes as eluent to afford desired product **7**; 53 mg, yield 91%, 2:1 dr.

Major isomer; 33 mg, yield 57%, $[\alpha]_D^{22}$ = 33.5 (*c* = 0.65, $CHCl_3$); >99% ee; White solid; m.p. 100-102 ˚C; R_f 0.3 (Acetone:Hexane=3:7); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.39 (s, 1H), 7.91 (d, *J* = 7.9 Hz, 2H), 7.87–7.82 (m, 1H), 7.75–7.61 (m, 5H), 7.41–7.33 (m, 3H), 7.31–7.26 (m, 2H), 4.29–4.14 (m, 2H), 4.11–4.02 (m, 1H), 3.93 (t, *J* = 11.1 Hz, 1H), 3.85–3.70 (m, 2H), 3.55 (dd, *J* = 14.5, 10.1 Hz, 1H), 2.39 (s, 3H), 2.21 (qd, *J* = 12.5, 4.8 Hz, 1H), 1.34 (d, *J* = 15.9 Hz, 1H), 1.19 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 166.2, 150.8, 144.1, 135.7, 135.2, 135.1, 133.8, 133.2, 131.8, 129.9, 129.5, 128.6, 128.2, 126.4, 124.2, 121.4, 89.4, 65.2, 63.4, 51.9, 28.4, 28.1, 21.6, 14.0; IR (neat) 2923, 2845, 2802, 1744, 1698, 1595, 1444, 1395, 1299, 1235, 1164, 1133, 1053 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{28}H_{29}N_3O_7S_2$: 583.1447 Found: 583.1455; Chiralpak IC column and IC guard column (15% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 47.8 min and *major*-isomer t_r = 72.1 min.

Minor isomer; 16 mg, yield 28%, $[\alpha]_D^{24}$ = 46.2 (*c* = 1.03, $CHCl_3$); >99% ee; White solid; m.p. 92-94 ˚C; R_f 0.2 (Acetone:Hexane=3:7); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81–7.72 (m, 3H), 7.70–7.60 (m, 3H), 7.56 (s, 1H), 7.53–7.43 (m, 3H), 7.26–7.16 (m, 4H), 4.35 (qd, *J* = 7.1, 5.4 Hz, 2H), 4.14 (dddd, *J* = 16.8, 6.9, 4.6, 2.3 Hz, 2H), 4.01 (td, *J* = 12.2, 2.6 Hz, 1H), 3.70 (dd, *J* = 16.8, 4.0 Hz, 1H), 3.25 (dd, *J* = 16.8, 10.1 Hz, 1H), 2.40 (s, 3H), 2.06 (qd, *J* = 12.4, 5.0 Hz, 1H), 1.54 (dq, *J* = 13.3, 2.4 Hz, 1H), 1.24 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 166.5, 152.6, 144.1, 135.5, 135.3, 133.60, 133.57, 132.1, 131.6, 130.3, 129.8, 129.5, 127.9, 126.8, 124.1, 121.1, 89.3, 65.5, 63.1, 51.7, 38.6, 27.6, 21.6, 14.1; IR (neat) 3234, 3202,

3187, 1743, 1597, 1493, 1445, 1385, 1341, 1302, 1235, 1163, 1092 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{28}H_{29}N_3O_7S_2$: 583.1447 Found: 583.1443; Chiralpak IC column and IC guard column (15% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 36.5 min and *minor*-isomer t_r = 61.2 min.

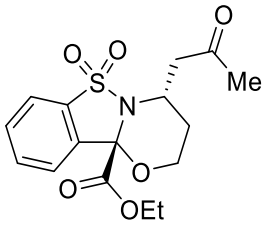


5af **8**

Ethyl (4*S*,10b*S*)-4-(2-([1,1'-biphenyl]-4-yl)-2-oxoethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (8); To a solution of 1,3-oxazinane **5af** (49 mg, 0.10 mmol), phenylboronic acid (37 mg, 0.30 mmol), and $Ph(PPh_3)_4$ (12 mg, 0.010 mmol) in THF (1.0 mL) was added K_2CO_3 (42 mg, 0.20 mmol) at room temperature. The reaction mixture was stirred at 80 ˚C in an oil bath until 1,3-oxazinane **5af** was completely consumed, as determined by TLC. Then, the resulting mixture was filtered through the plug of celite. The filtrate quenched with water and extracted with EtOAc. The combined organic layers were washed with brine, dried (anhydrous Na_2SO_4), and concentrated in vacuo. The crude residue was purified by flash column chromatography with EtOAc/hexane/CH_2Cl_2 as eluent to afford desired product **8**; 28 mg, yield 57%, >20:1 dr, $[\alpha]_D^{25}$ = 12.5 (*c* = 1.10, $CHCl_3$); 99% ee; White solid; m.p. 148-150 ˚C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=1:10:9); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, *J* = 8.5 Hz, 2H), 7.85–7.80 (m, 1H), 7.72 (d, *J* = 8.5 Hz, 2H), 7.70–7.61 (m, 5H), 7.52–7.45 (m, 2H), 7.45–7.38 (m, 1H), 4.51–4.39 (m, 2H), 4.35 (qd, *J* = 7.1, 3.5 Hz, 1H), 4.29 (dd, *J* = 17.7, 3.8 Hz, 1H), 4.26–4.13 (m, 2H), 3.87 (dd, *J* = 17.7, 9.7 Hz, 1H), 2.26–2.11 (m, 1H), 1.79 (dq, *J* = 13.3, 2.3 Hz, 1H), 1.34 (t, *J* = 7.1 Hz, 3H); $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 195.3, 166.6, 146.2, 139.7, 135.6, 135.0, 133.63, 133.61, 131.6, 128.9, 128.8, 128.3, 127.3, 127.3, 124.1, 121.2, 89.4, 65.5, 63.2, 50.9, 39.3, 28.3, 14.1; IR (neat) 3024, 2093, 2924, 1742, 1682, 1603, 1454, 1385, 1302, 1237, 1195, 1161, 1054 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{27}H_{25}NO_6S$: 491.1403 Found: 491.1396; Chiralpak OD-H column and OD-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 17.6 min and *major*-isomer t_r = 26.9 min.

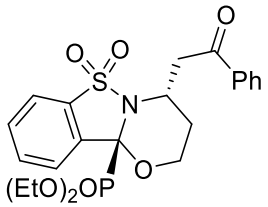
9. Control experiment

Ethyl (4*S*,10b*S*)-4-(2-oxopropyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazine-10b-carboxylate 6,6-dioxide (**9**)



Synthesized by the general procedure II; 5 mg, yield 15%, >20:1 dr, $[\alpha]_D^{26}$ = 16.8 (*c* = 0.21, $CHCl_3$); 58% ee; Colorless gum; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=3:10:7); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85–7.76 (m, 1H), 7.73–7.57 (m, 3H), 4.43–4.28 (m, 2H), 4.26–4.07 (m, 3H), 3.75 (dd, *J* = 18.2, 4.9 Hz, 1H), 3.19 (dd, *J* = 18.2, 8.8 Hz, 1H), 2.29 (s, 3H), 2.10 (dtd, *J* = 13.3, 12.1, 5.2 Hz, 1H), 1.62 (dq, *J* = 13.3, 2.5 Hz, 1H), 1.33 (t, *J* = 7.1 Hz, 3H); ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 204.2, 166.5, 135.3, 133.60, 133.58, 131.6, 124.1, 121.2, 89.3, 65.5, 63.2, 50.2, 43.9, 30.6, 28.0, 14.1; IR (neat) 2959, 2875, 1745, 1697, 1598, 1451, 1389, 1298, 1260, 1177, 1055 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{16}H_{19}NO_6S$: 353.0933 Found: 353.0941; Chiralpak OD-H column and OD-H guard column (7% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *major*-isomer t_r = 19.9 min and *minor*-isomer t_r = 24.0 min.

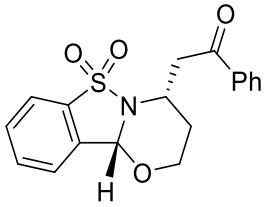
Diethyl ((4*S*,10b*S*)-6,6-dioxido-4-(2-oxo-2-phenylethyl)-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazin-10b-yl)phosphonate (**11**)



Synthesized by the general procedure I; 26 mg, yield 53%, 2:1 dr, $[\alpha]_D^{26}$ = 11.5 (*c* = 0.60, $CHCl_3$); 89% ee; White solid; m.p. 132-134 °C; R_f 0.2 (EtOAc:CH_2Cl_2:Hexane=3:25:10); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10–8.00 (m, 2H), 7.92 (d, *J* = 7.7 Hz, 1H), 7.78 (d, *J* = 7.7 Hz, 1H), 7.74–7.63 (m, 2H), 7.62–7.56 (m, 1H), 7.53–7.45 (m, 2H), 5.37 (dddd, *J* = 12.1, 8.8, 5.2, 3.7 Hz, 1H), 4.63 (dddd, *J* = 11.7, 9.5, 4.3, 2.5 Hz, 1H), 4.36–4.18 (m, 5H), 3.94 (dt, *J* = 11.4, 4.6 Hz, 1H), 3.73 (dd, *J* = 17.8, 8.8 Hz, 1H), 2.18 (dddd, *J* = 13.2, 11.7, 9.6, 5.3 Hz, 1H), 2.00 – 1.90 (m, 1H), 1.39 (t, *J* = 7.1 Hz, 3H), 1.18 (t, *J* = 7.4

Hz, 3H); $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 195.5, 136.7, 134.9 (d, *J* = 3.8 Hz), 133.9 (d, *J* = 2.8 Hz), 133.5, 133.3, 131.4, 128.6, 128.1, 126.3, 120.6, 88.6 (d, *J* = 205.2 Hz), 65.0 (d, *J* = 6.5 Hz), 64.1 (d, *J* = 2.7 Hz), 63.8 (d, *J* = 6.8 Hz), 49.4, 39.8, 28.7, 16.4 (d, *J* = 5.6 Hz), 16.3 (d, *J* = 5.5 Hz); ^{31}P NMR (162 MHz, $CDCl_3$) δ 12.15; IR (neat) 2957, 2904, 1747, 1684, 1597, 1449, 1303, 1241, 1162, 1134, 1029 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{22}H_{26}NO_7PS$: 479.1168 Found: 479.1138; Chiralpak OJ-H column and OJ-H guard column (20% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 16.2 min and *major*-isomer t_r = 32.0 min.

2-((4*S*,10b*R*)-6,6-dioxido-3,4-dihydro-2*H*,10b*H*-benzo[4,5]isothiazolo[3,2-*b*][1,3]oxazin-4-yl)-1-phenylethan-1-one (**13**)



Synthesized by the general procedure II; 22 mg, yield 66%, 2:1 dr, $[\alpha]_D^{22}$ = 5.6 (*c* = 0.61, $CHCl_3$); 94% ee; White solid; m.p. 187-189 °C; R_f 0.3 (EtOAc:CH_2Cl_2:Hexane=1:30:9); ^{1}H NMR (400 MHz, CDCl3) δ 8.10–8.01 (m, 2H), 7.81–7.75 (m, 1H), 7.68–7.55 (m, 4H), 7.53–7.47 (m, 2H), 5.65 (s, 1H), 4.45 (tdd, J = 9.0, 4.6, 2.3 Hz, 1H), 4.31 (ddd, J = 11.6, 4.6, 1.7 Hz, 1H), 4.22 (dd, J = 17.8, 4.7 Hz, 1H), 4.07 (td, J = 12.0, 2.3 Hz, 1H), 3.69 (dd, J = 17.8, 9.0 Hz, 1H), 2.12 (dtd, J = 13.4, 12.1, 4.6 Hz, 1H), 1.79 (dd, J = 13.3, 2.3 Hz, 1H); $^{13}C\{^{1}H\}$ NMR (100 MHz, CDCl3) δ 196.2, 136.7, 136.5, 134.1, 133.7, 133.3, 131.0, 128.8, 128.3, 125.0, 121.1, 86.4, 68.1, 52.9, 39.8, 29.3; IR (neat) 2925, 2854, 2352, 1727, 1676, 1449, 1361, 1260, 1166, 1137, 1092, 1054, 1029 cm^{-1}; HRMS (EI) m/z calcd for $[M]^+$ $C_{18}H_{17}NO_4S$: 343.0878 Found: 343.0892; Chiralpak IA column and IA guard column (50% EtOH:hexanes, 1.0 mL/min flow, λ = 254 nm); *minor*-isomer t_r = 19.8 min and *major*-isomer t_r = 26.8 min.

1. (a) Huang, S.-H.; Shih, Y,-W.; Huang, W.-T.; Li, D.-H.; Yang, T.-F. *RSC Adv.* **2016**, *6*, 91870−91874.

(b) Liu, Y.; Ao, J.; Paladhi, S.; Song, C. E.; Yan, H. *J. Am. Chem. Soc.* **2016**, *138*, 16486−16492.

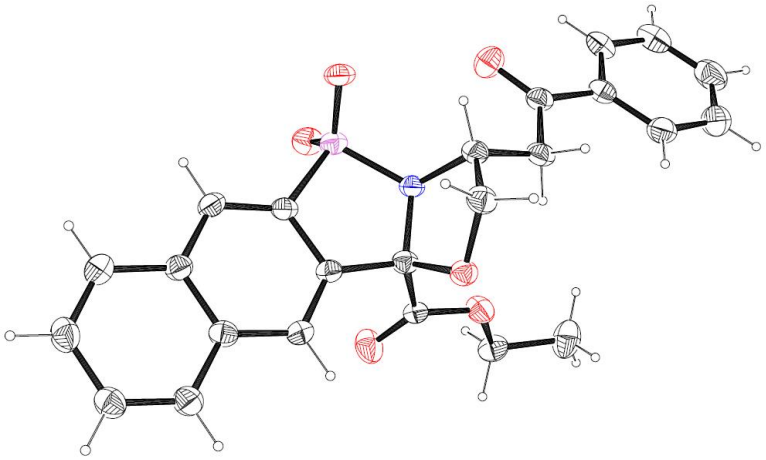
2. Yan, W.; Wang, D.; Feng, J.; Li, P.; Zhao, D.; Wang, R. *Org. Lett.* **2012**, *14*, 2512−2515.

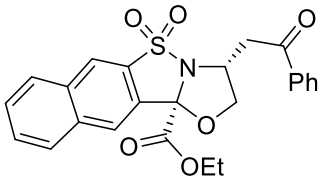
3. (a) Malerich, J. P.; Hagihara, K.; Rawal, V. H. *J. Am. Chem. Soc.* **2008**, *130*, 14416–14417. (b) Yang, W.; Du, D. M. *Org. Lett.* **2010**, *12*, 5450–5453. (c) Zhu, Y.; Malerich, J. P.; Rawal, V. H. *Angew. Chem. Int. Ed.* **2010**, *49*, 153–156.

10. X-ray crystallography data of compound 3oa and 5aa

Sample preparation: The single crystal **3oa** and **5aa** were obtained by slow diffusion of *n*-hexane in to a solution of **3oa** or **5aa** in EtOAc at room temperature.

Crystal measurement: A crystal of **3oa** and **5aa** were picked up with paratone oil and mounted on a Bruker D8 Venture PHOTON III M14 diffractometer equipped with a graphite-monochromated Mo Kα (λ = 0.71073 Å) radiation source and a nitrogen cold stream (223 K). Data collection and integration Data collection and integration were performed with SMART APEX3 (Bruker, 2016) and SAINT (Bruker, 2016). The absorption correction was performed by a multi-scan method implemented in SADABS. The structure was solved by direct methods and refined by full-matrix least-squares on F^2 using SHELXTL. All the non-hydrogen atoms were refined anisotropically, and the hydrogen atoms were added to their geometrically ideal positions. Thermal ellipsoids are drawn at 30% probability level.

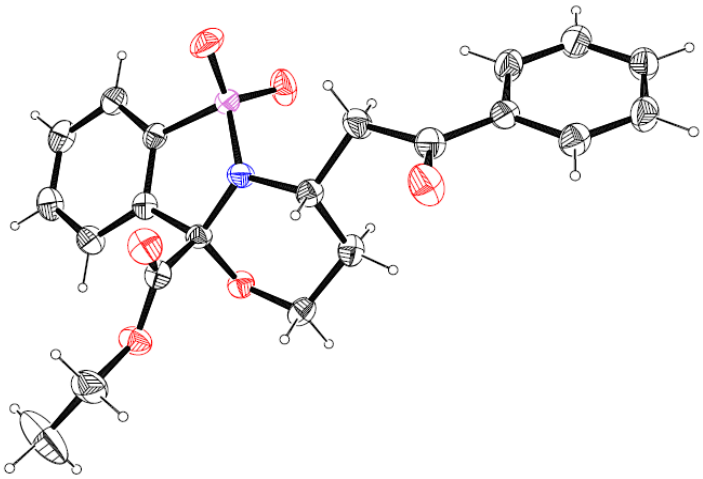


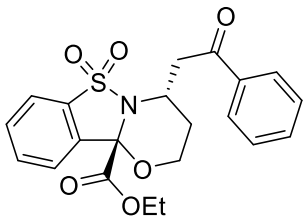


3oa

Identification code	KGU_24_03_a	
Empirical formula	C24 H21 N O6 S	
Formula weight	451.48	
Temperature	223(2) K	
Wavelength	0.71073 Å	
Crystal system	Orthorhombic	
Space group	$P2_12_12_1$	
Unit cell dimensions	a = 9.792(2) Å	α= 90°.
	b = 10.139(3) Å	β= 90°.

	c = 21.399(6) Å γ = 90°.
Volume	2124.5(9) $Å^3$
Z	4
Density (calculated)	1.412 Mg/m^3
Absorption coefficient	0.195 mm^{-1}
F(000)	944
Crystal size	0.253 x 0.152 x 0.122 mm^3
Theta range for data collection	1.903 to 28.282°.
Index ranges	-13<=h<=10, -13<=k<=13, -28<=l<=28
Reflections collected	41951
Independent reflections	5282 [R(int) = 0.0960]
Completeness to theta = 25.242°	100.0 %
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	0.7457 and 0.6646
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	5282 / 0 / 290
Goodness-of-fit on F^2	1.052
Final R indices [I>2sigma(I)]	R1 = 0.0484, wR2 = 0.0844
R indices (all data)	R1 = 0.1003, wR2 = 0.0988
Absolute structure parameter	0.03(5)
Extinction coefficient	n/a
Largest diff. peak and hole	0.179 and -0.308 $e.Å^{-3}$



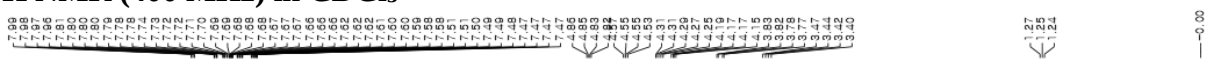


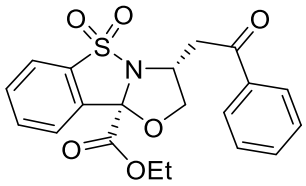
5aa

Identification code	KGU_24_06_a	
Empirical formula	C21 H21 N O6 S	
Formula weight	415.45	
Temperature	223(2) K	
Wavelength	0.71073 Å	
Crystal system	Tetragonal	
Space group	$P4_12_12$	
Unit cell dimensions	a = 8.4145(3) Å	α= 90°.
	b = 8.4145(3) Å	β= 90°.
	c = 56.119(4) Å	γ = 90°.
Volume	3973.5(4) $Å^3$	
Z	8	
Density (calculated)	1.389 Mg/m^3	
Absorption coefficient	0.202 mm^{-1}	
F(000)	1744	
Crystal size	0.220 x 0.135 x 0.054 mm^3	
Theta range for data collection	2.448 to 28.275°.	
Index ranges	-11<=h<=11, -9<=k<=11, -74<=l<=74	
Reflections collected	98435	
Independent reflections	4926 [R(int) = 0.1444]	
Completeness to theta = 25.242°	100.0 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.7457 and 0.6765	
Refinement method	Full-matrix least-squares on F^2	

Data / restraints / parameters	4926 / 0 / 263
Goodness-of-fit on F^2	1.052
Final R indices [I>2sigma(I)]	R1 = 0.0470, wR2 = 0.0918
R indices (all data)	R1 = 0.1172, wR2 = 0.1172
Absolute structure parameter	-0.03(5)
Extinction coefficient	n/a
Largest diff. peak and hole	0.204 and -0.270 e.$Å^{-3}$

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





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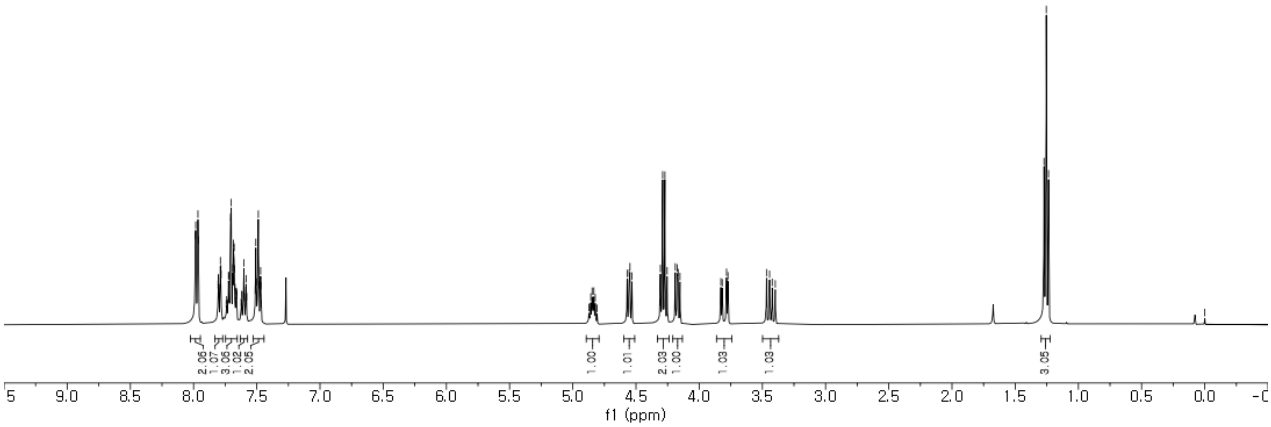
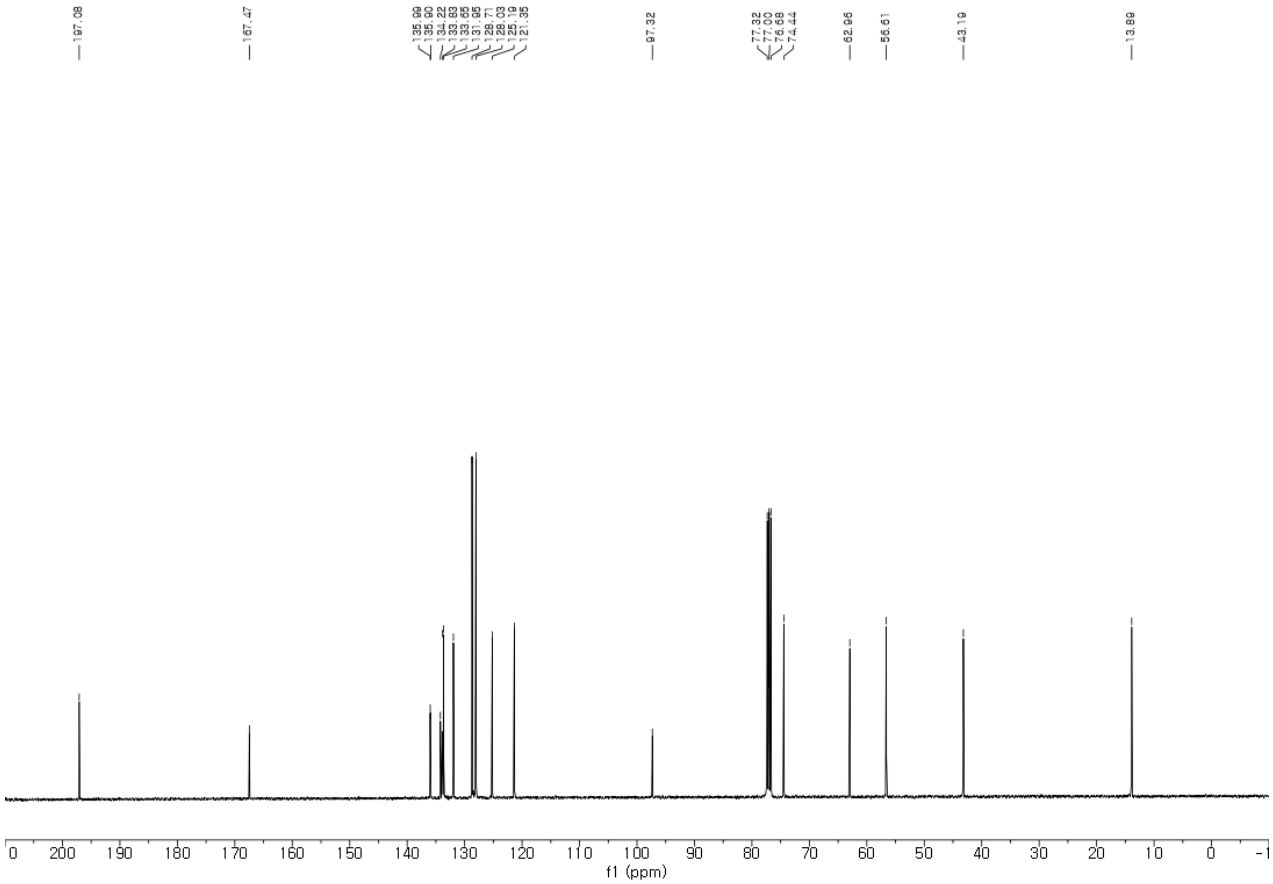
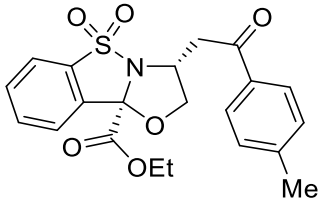


^{13}C NMR (100 MHz) in $CDCl_3$



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



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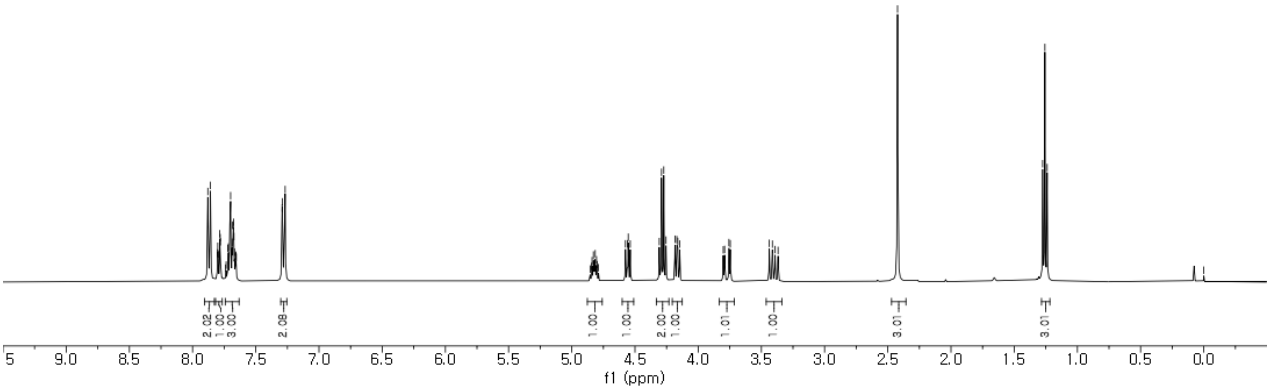
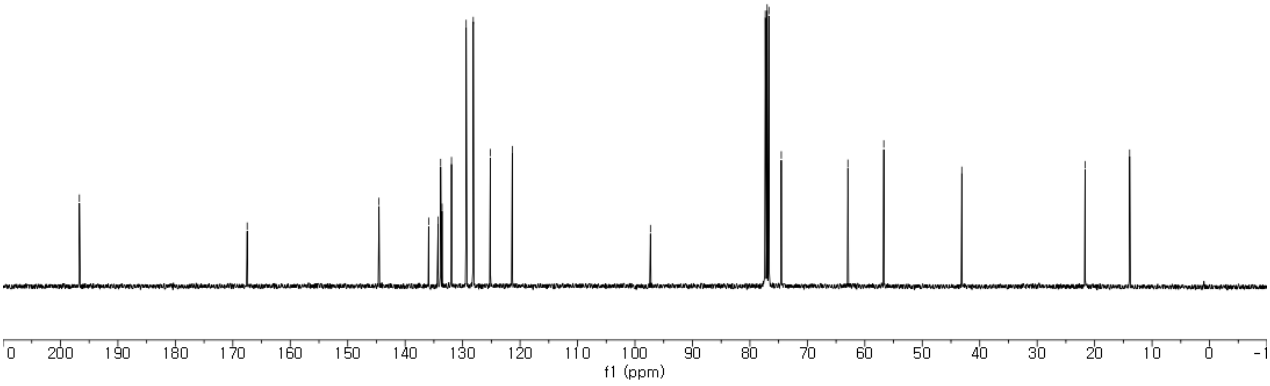
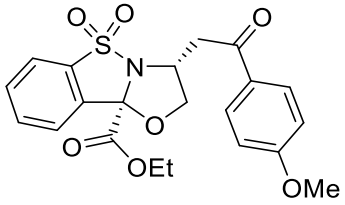


^{13}C NMR (100 MHz) in $CDCl_3$



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



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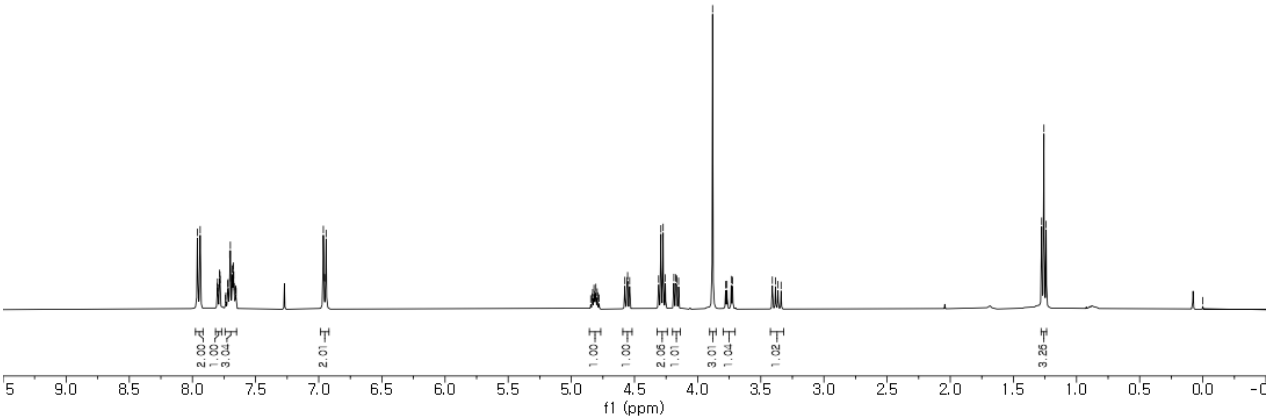
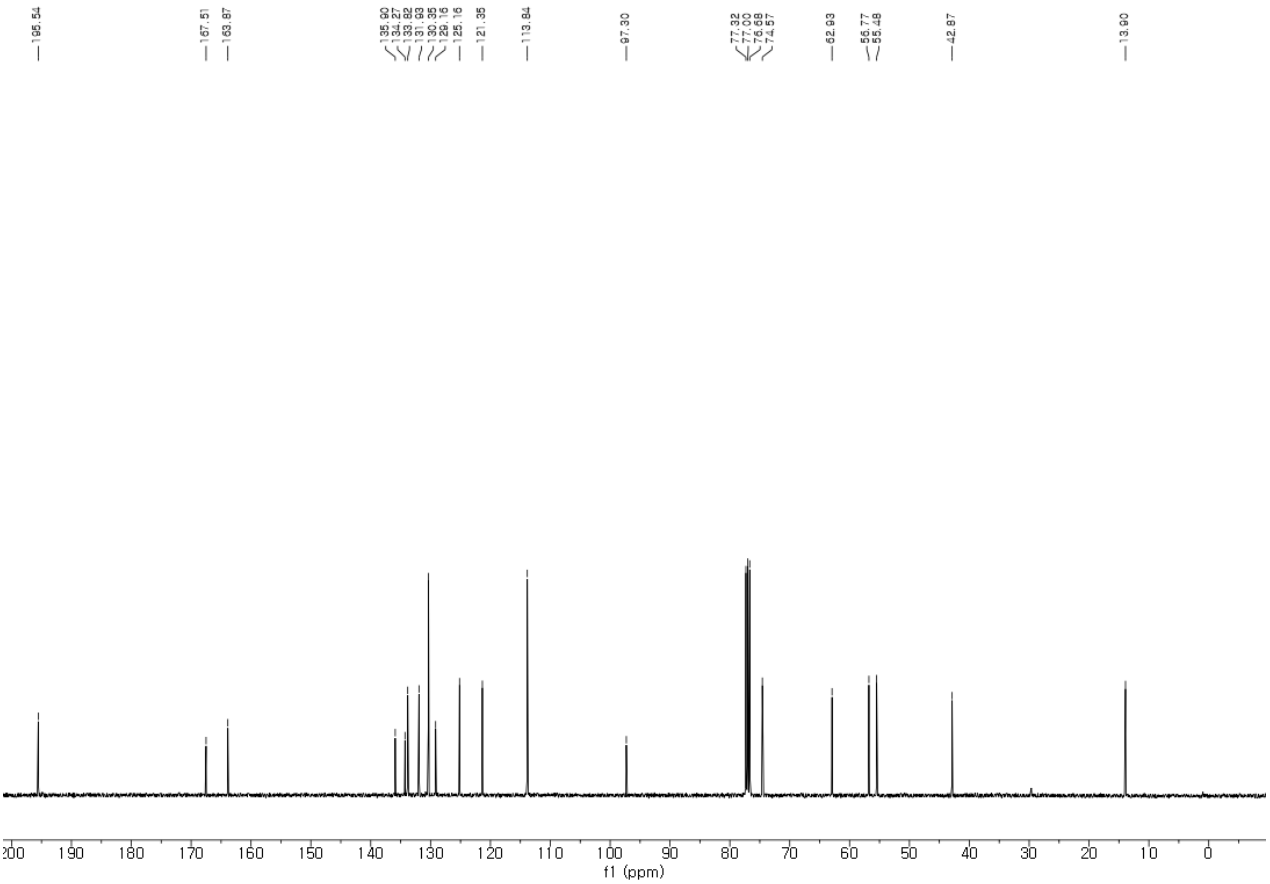
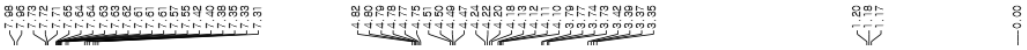
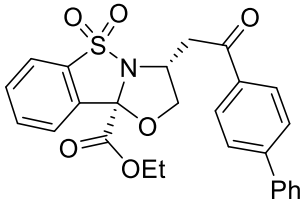


^{13}C NMR (100 MHz) in $CDCl_3$



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





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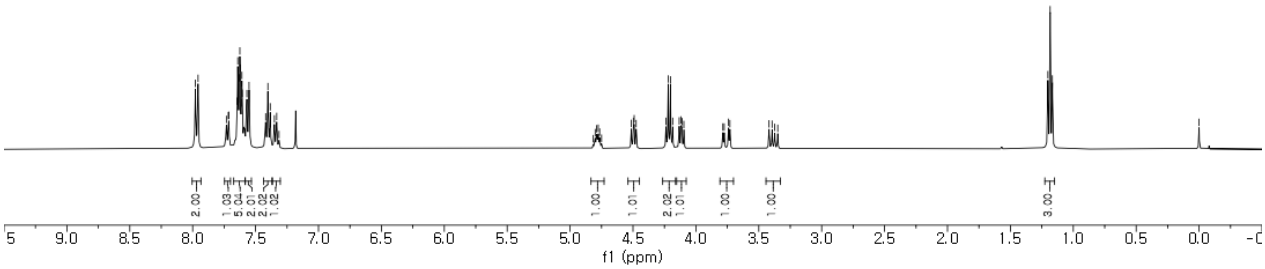
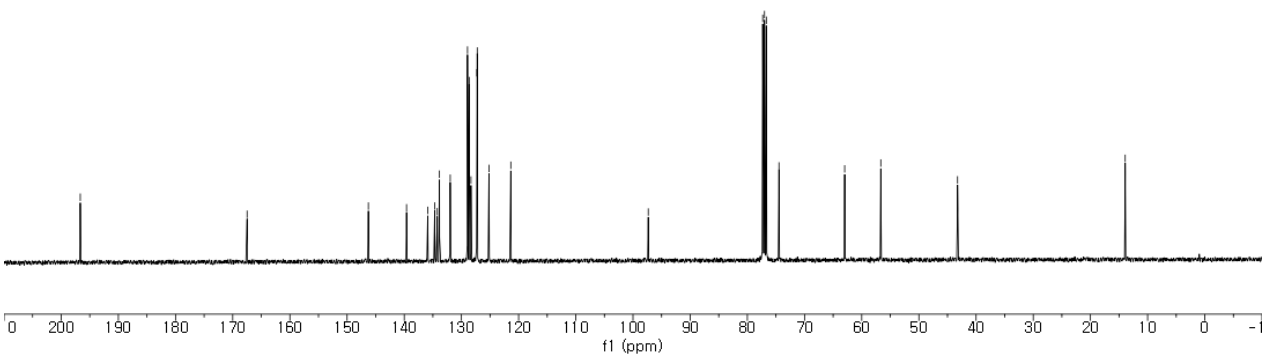
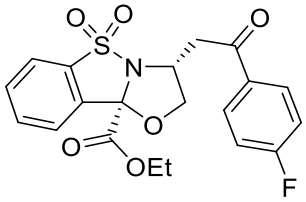


^{13}C NMR (100 MHz) in $CDCl_3$



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



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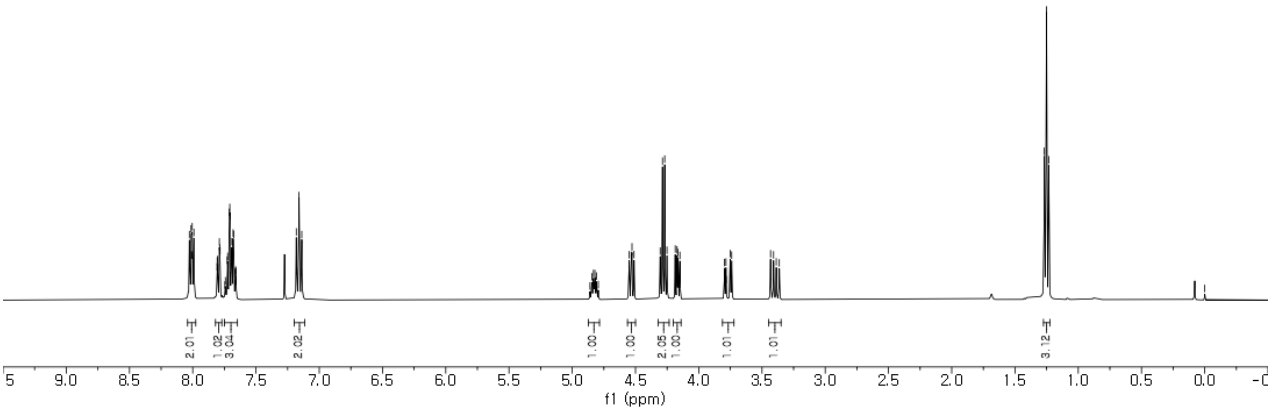
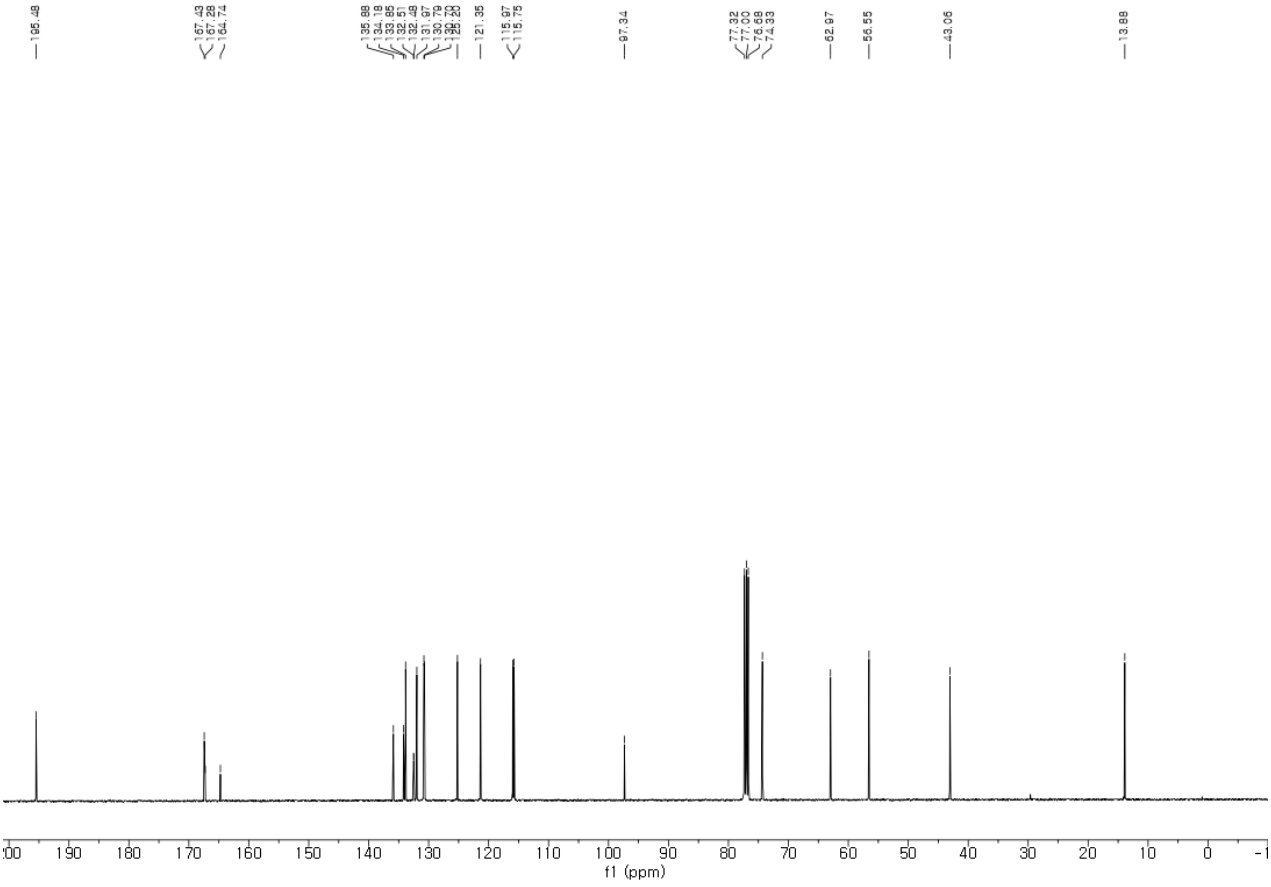
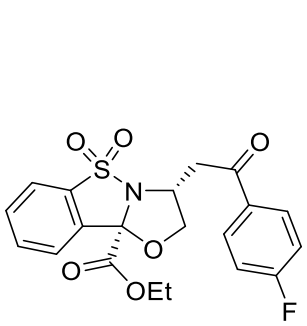


^{13}C NMR (100 MHz) in $CDCl_3$

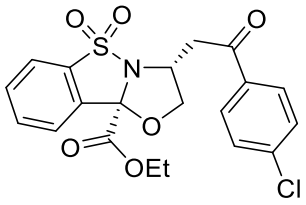


^{19}F NMR (376 MHz) in $CDCl_3$



3ae

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



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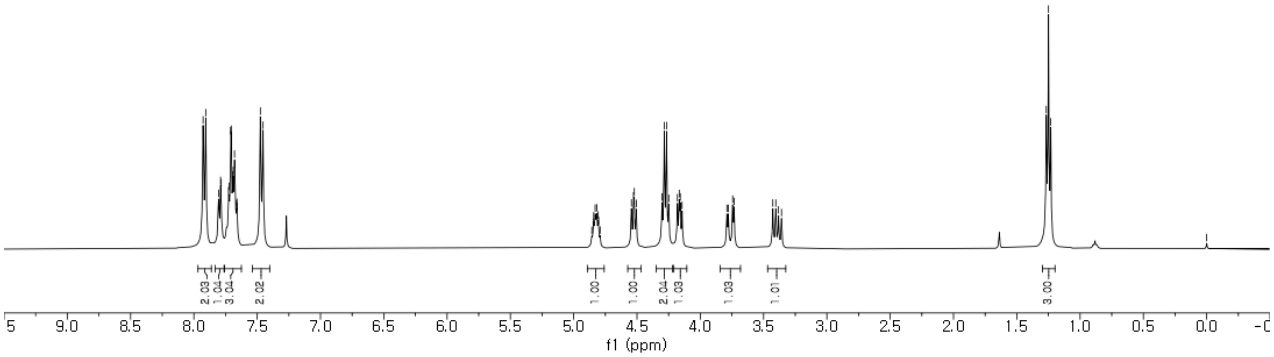
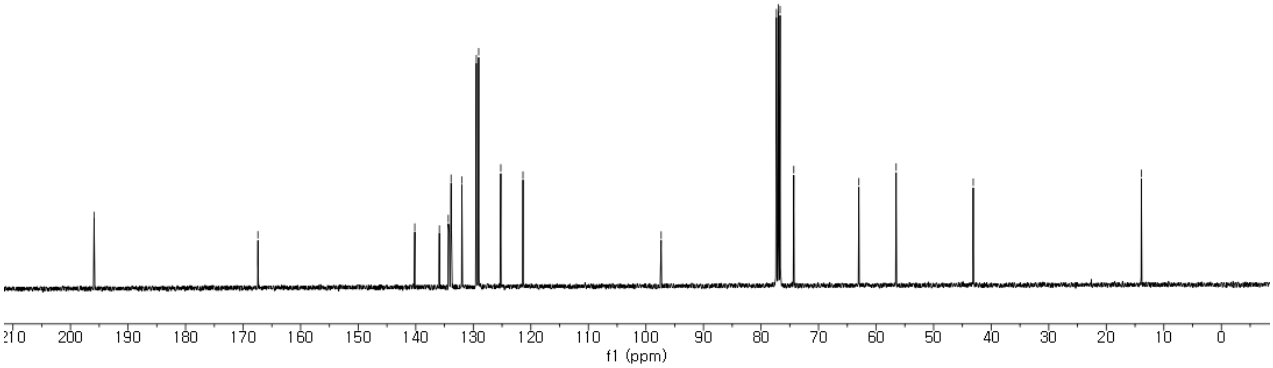
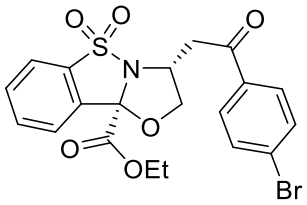


^{13}C NMR (100 MHz) in $CDCl_3$



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



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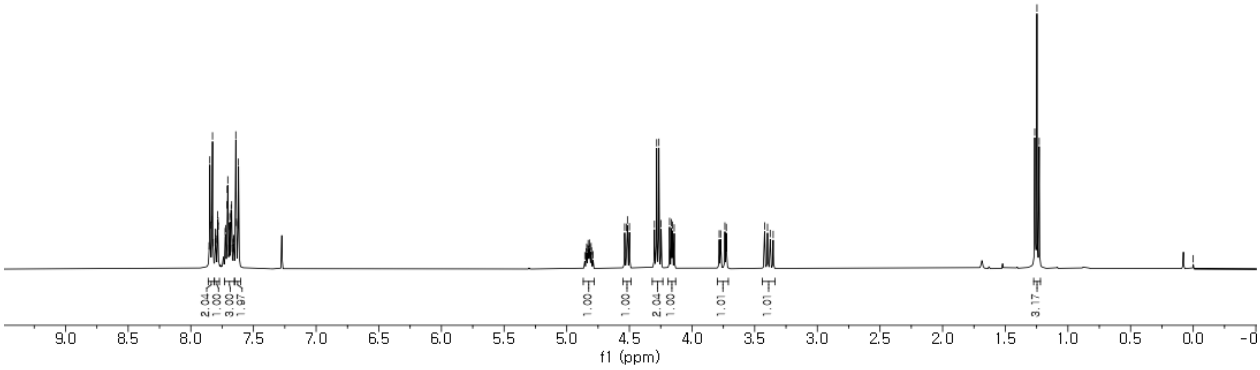
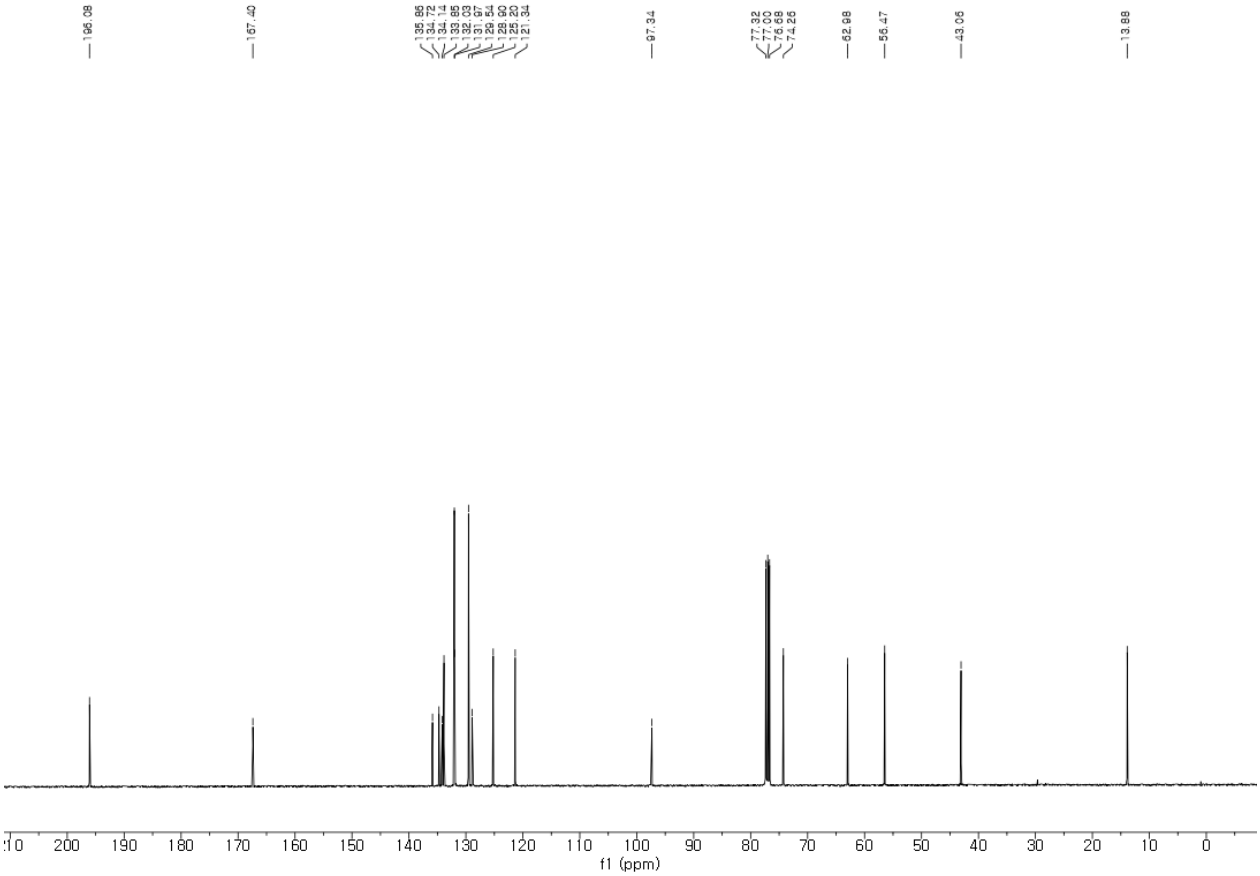
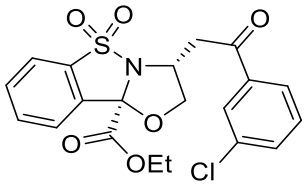


^{13}C NMR (100 MHz) in $CDCl_3$



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



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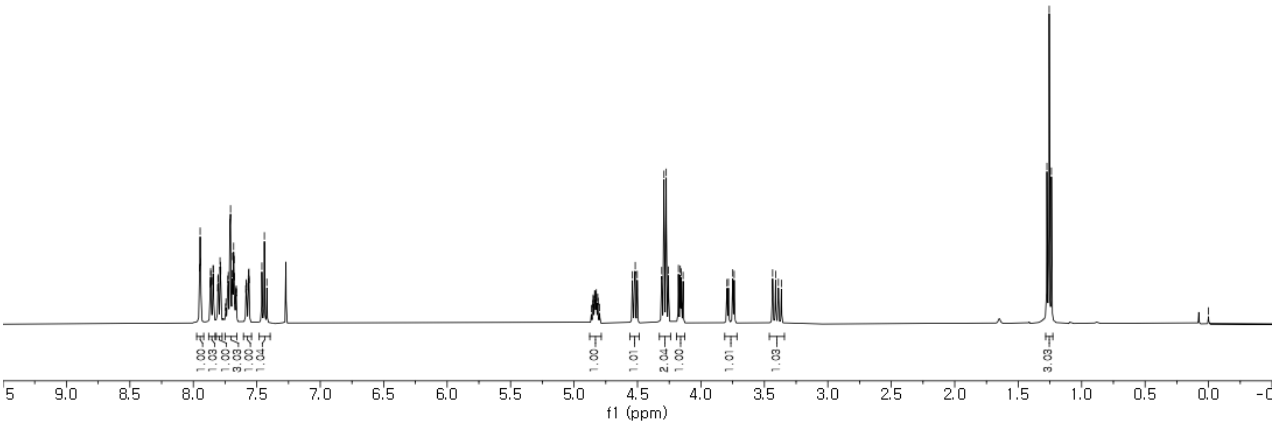
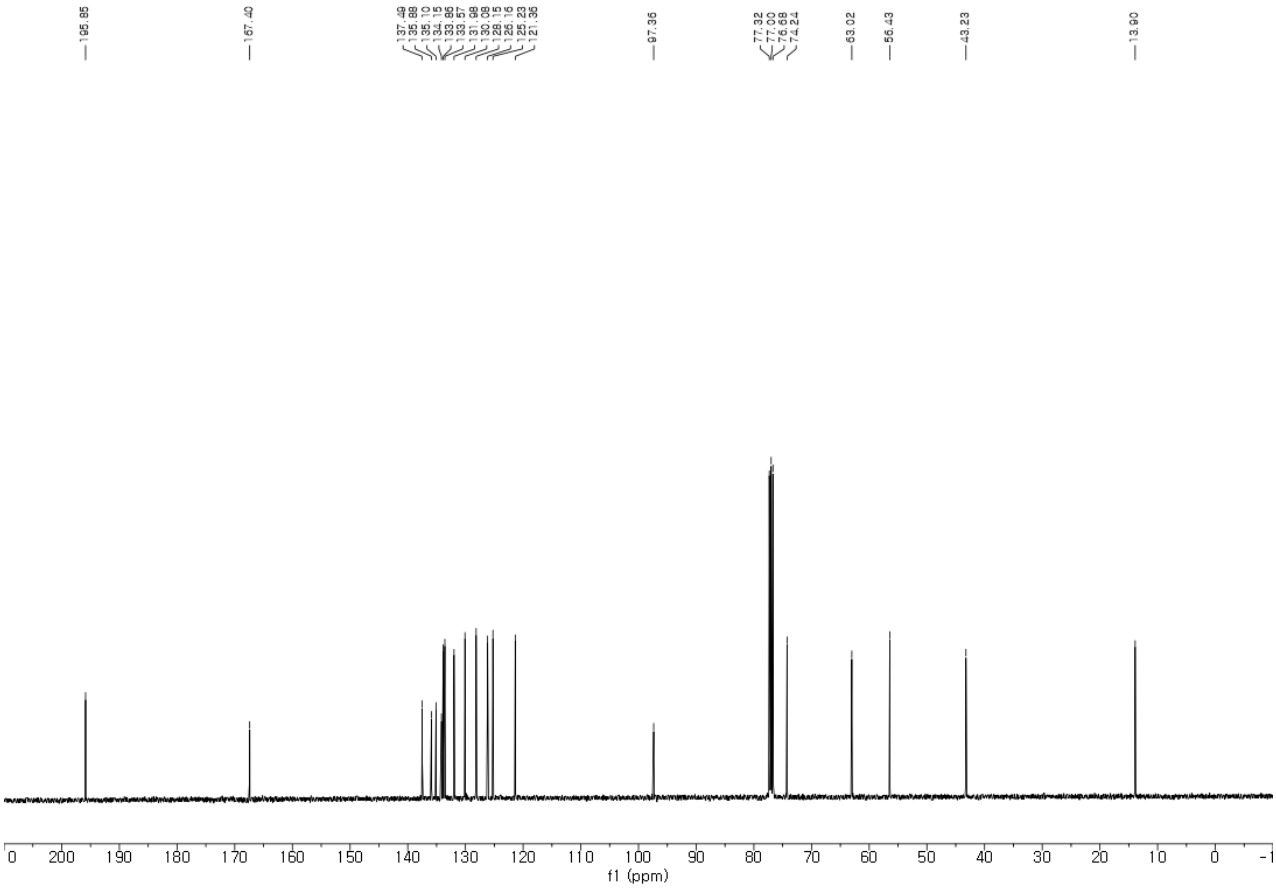
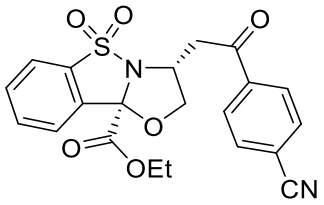


^{13}C NMR (100 MHz) in $CDCl_3$



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



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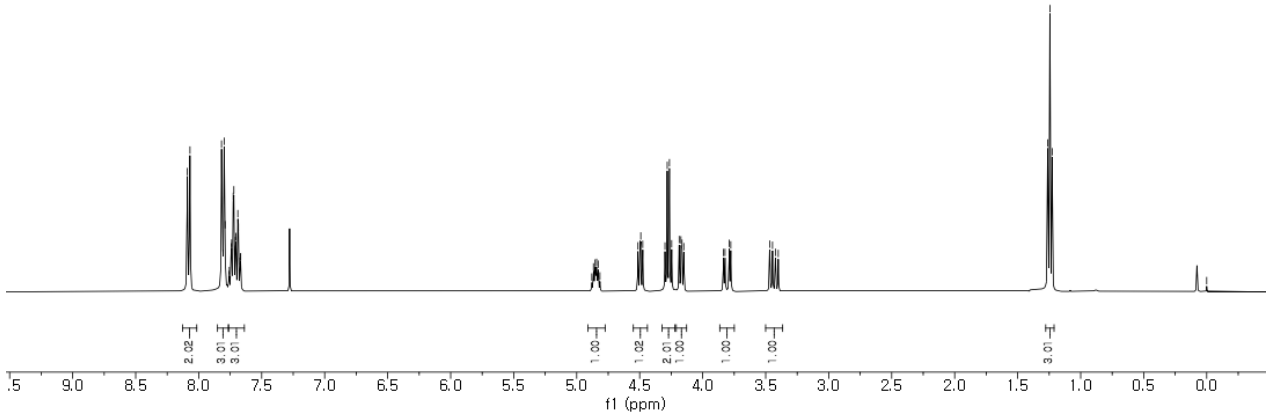
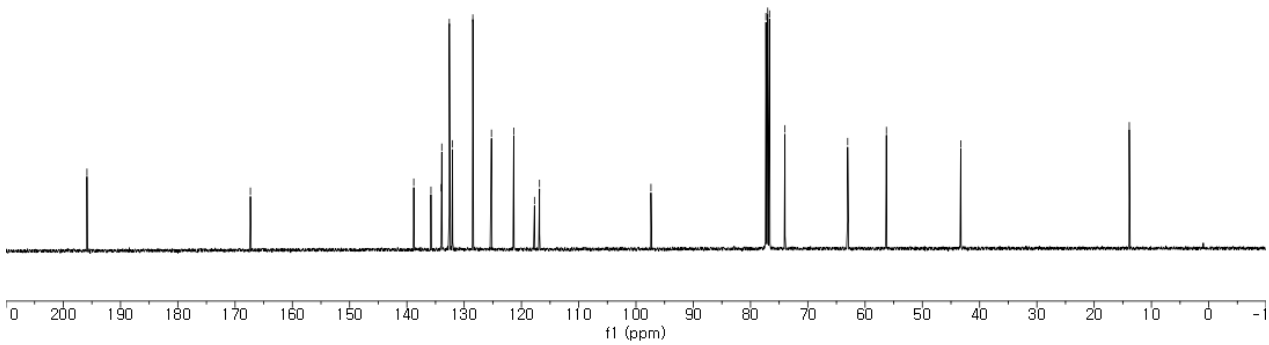
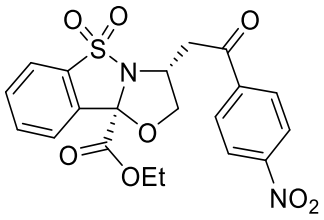


^{13}C NMR (100 MHz) in $CDCl_3$



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



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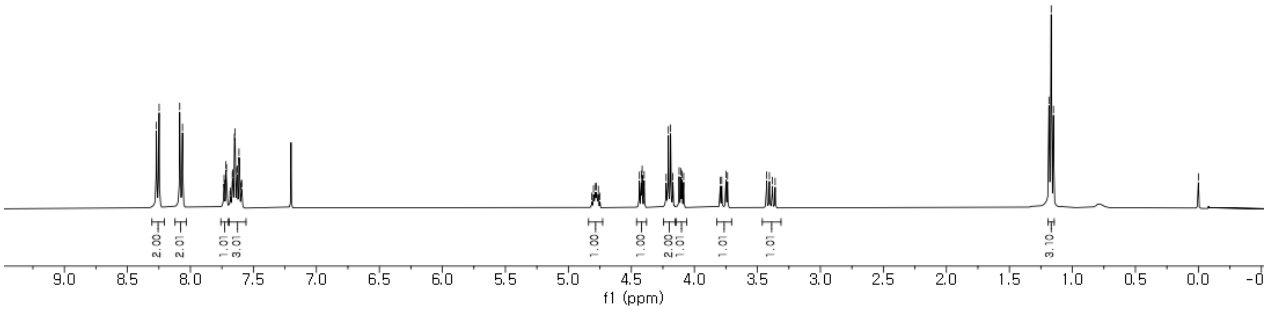
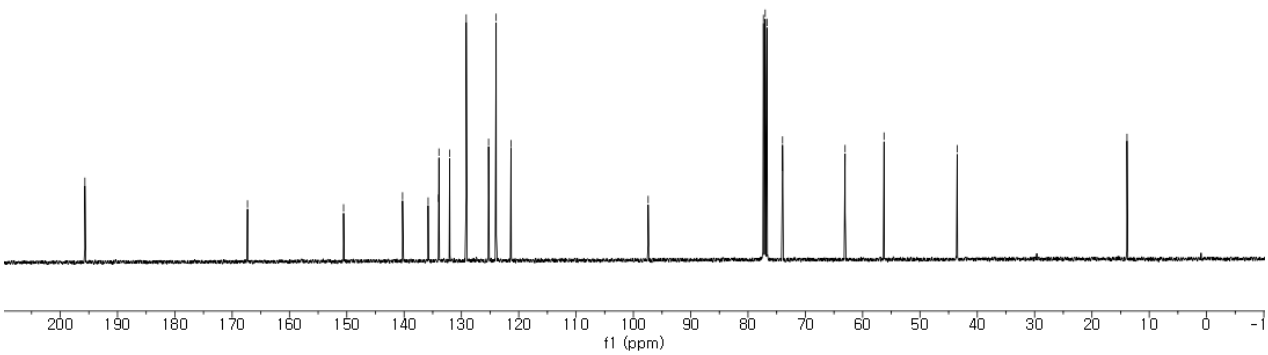
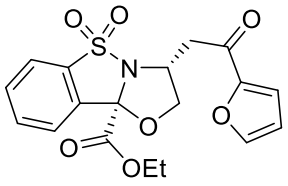


^{13}C NMR (100 MHz) in $CDCl_3$



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



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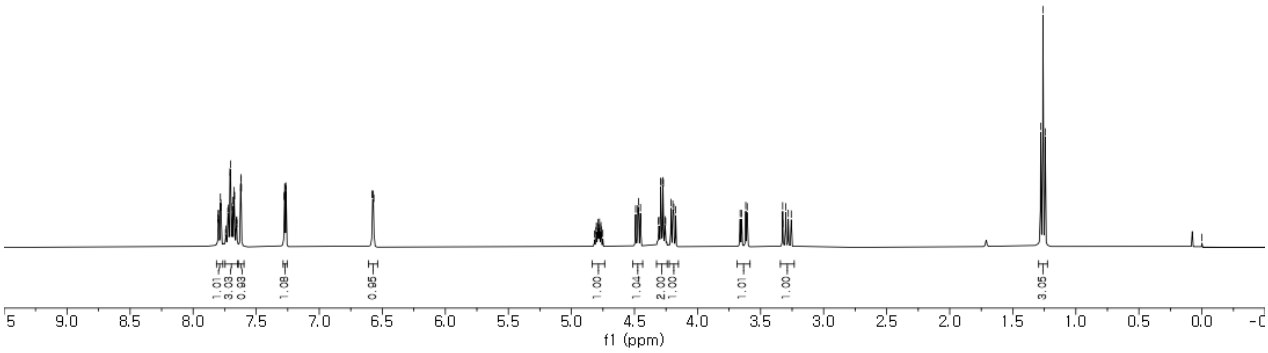
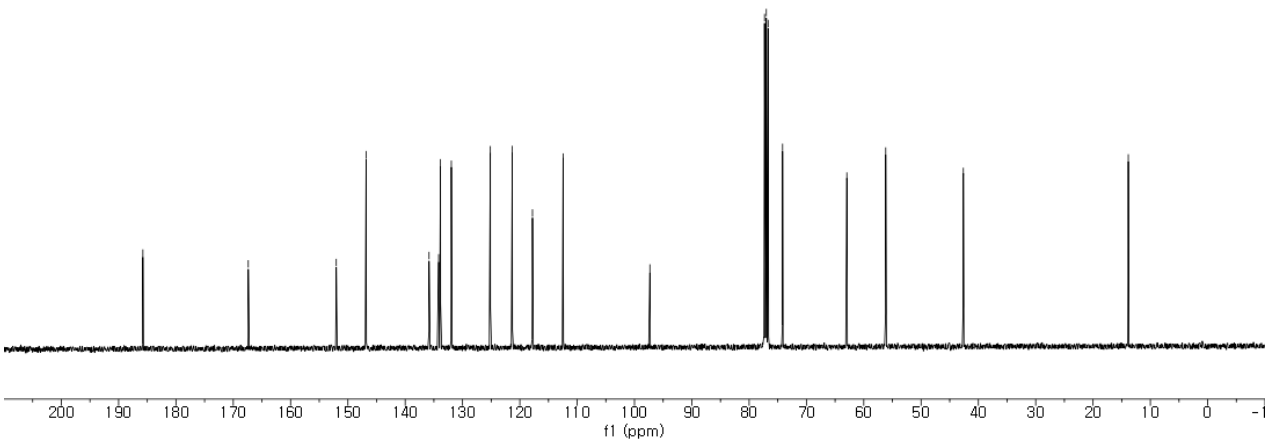
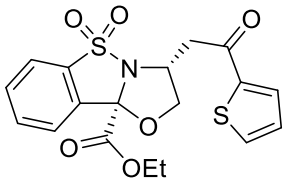


^{13}C NMR (100 MHz) in $CDCl_3$



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



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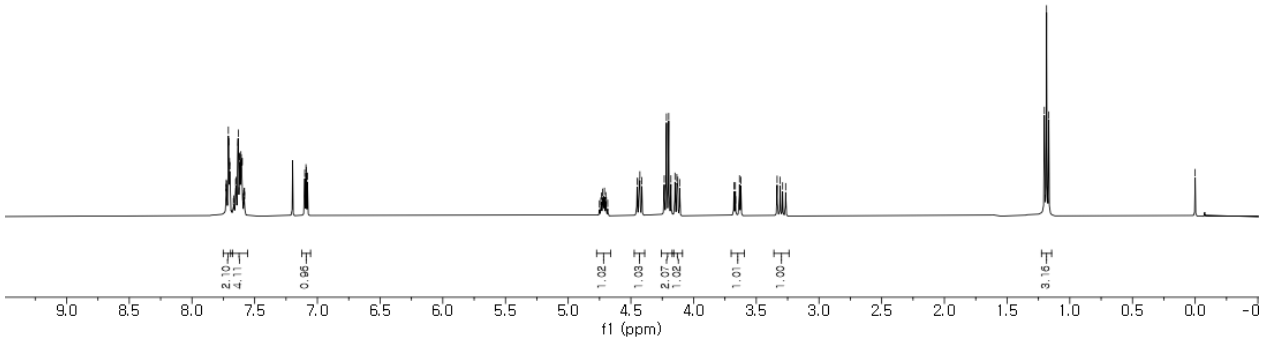
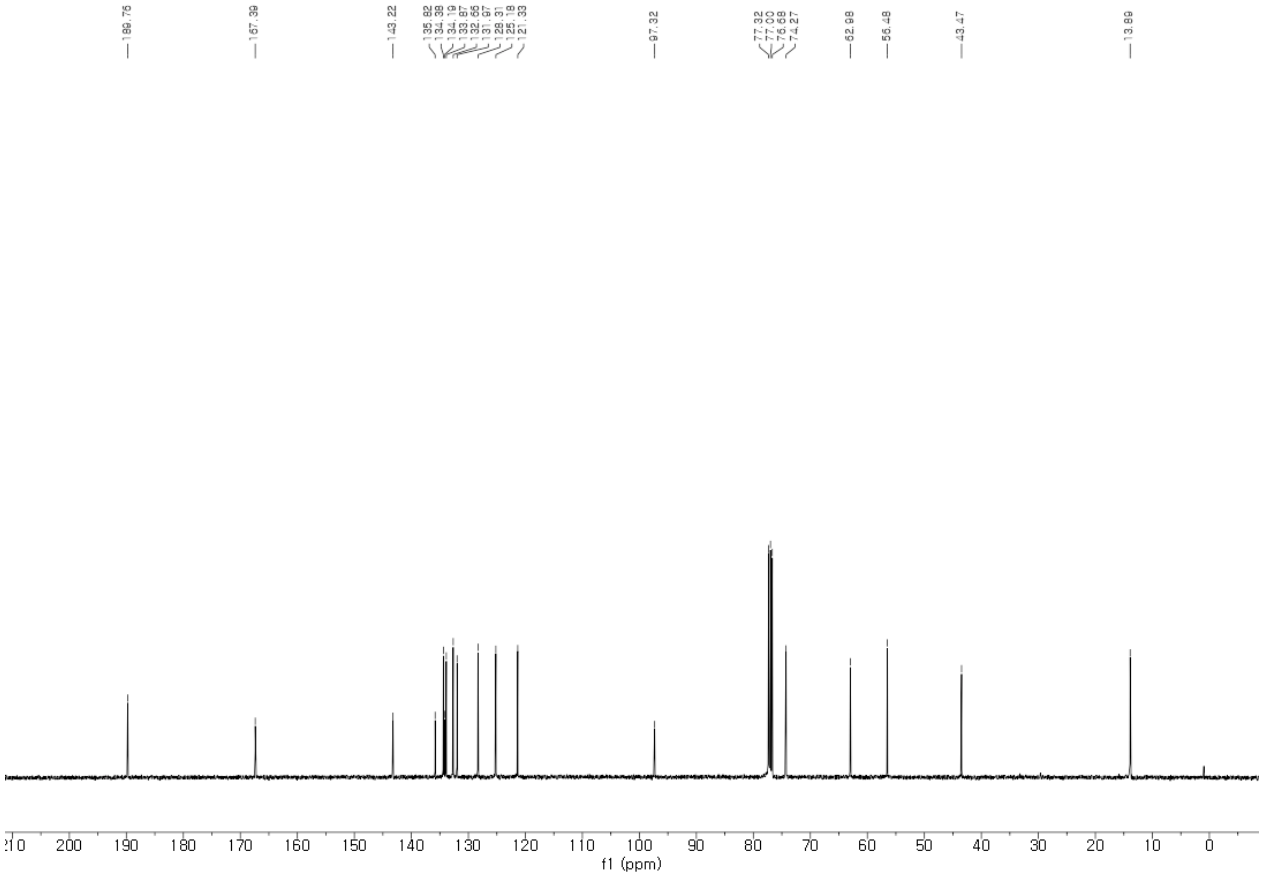
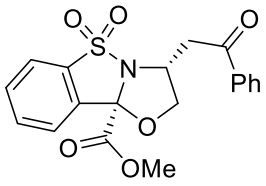


^{13}C NMR (100 MHz) in $CDCl_3$



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



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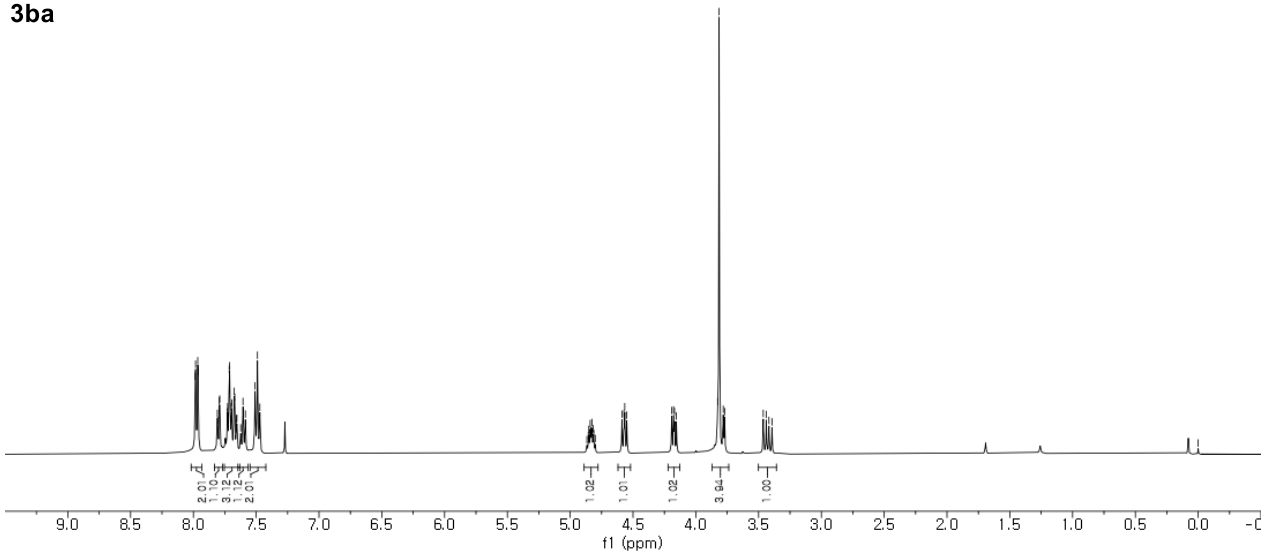
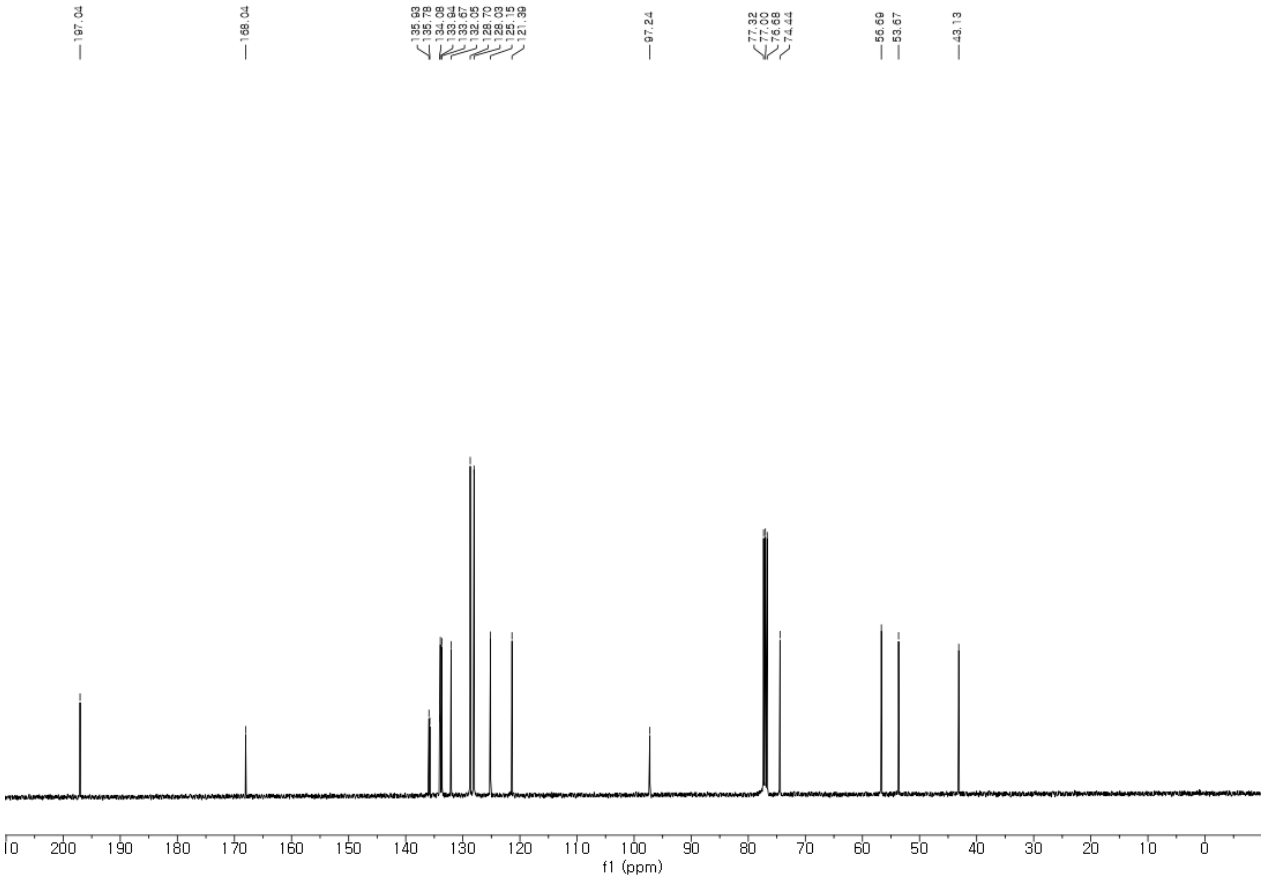
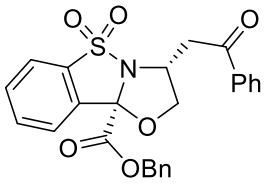


^{13}C NMR (100 MHz) in $CDCl_3$



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



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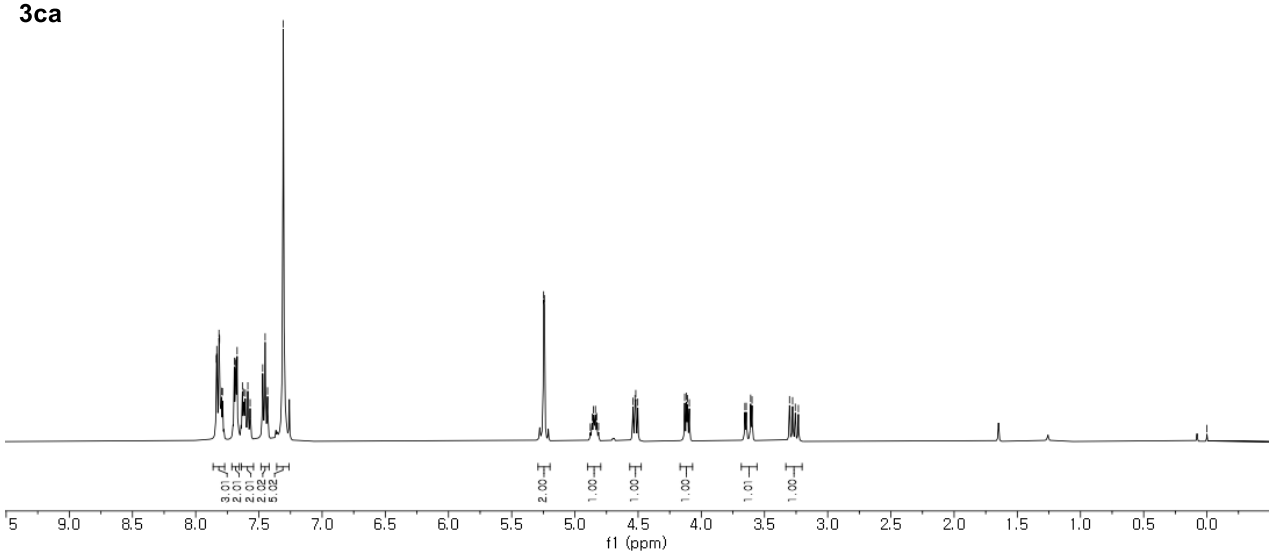
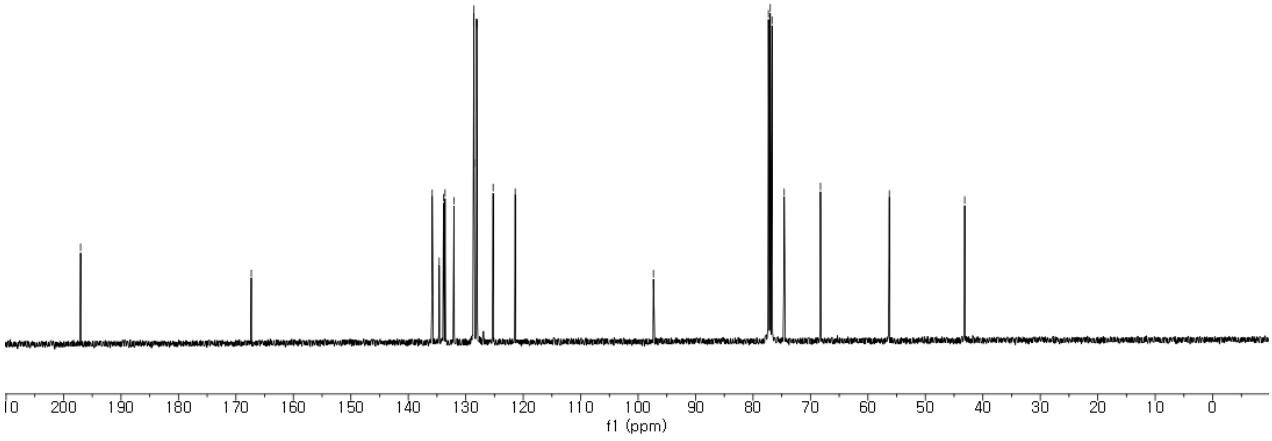
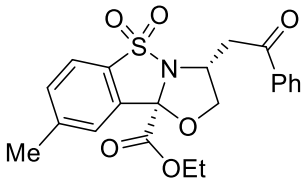


^{13}C NMR (100 MHz) in $CDCl_3$



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



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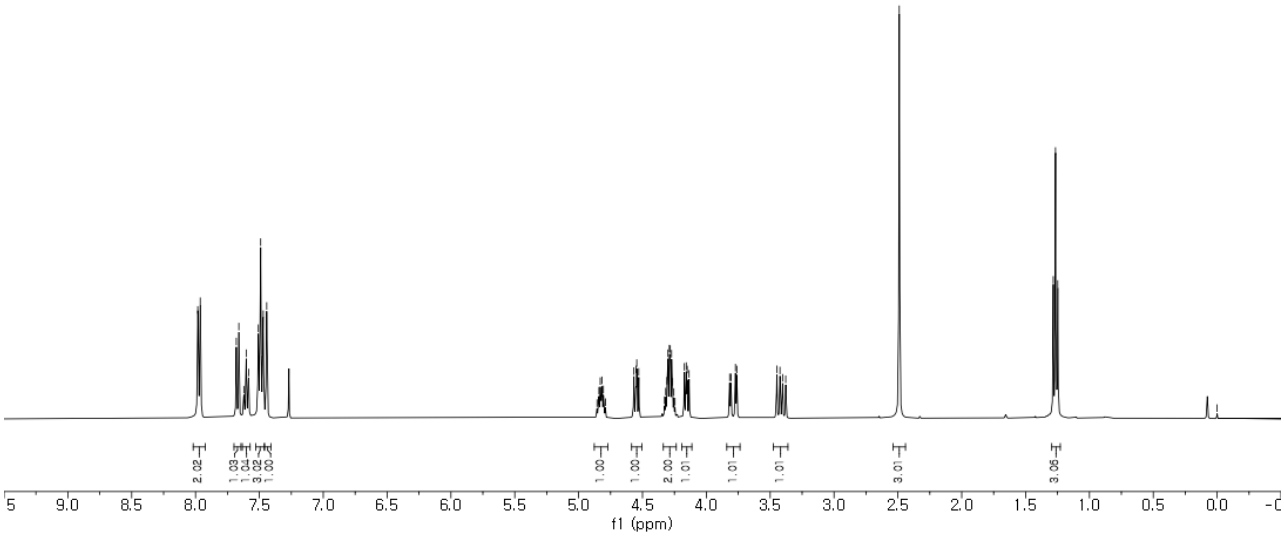
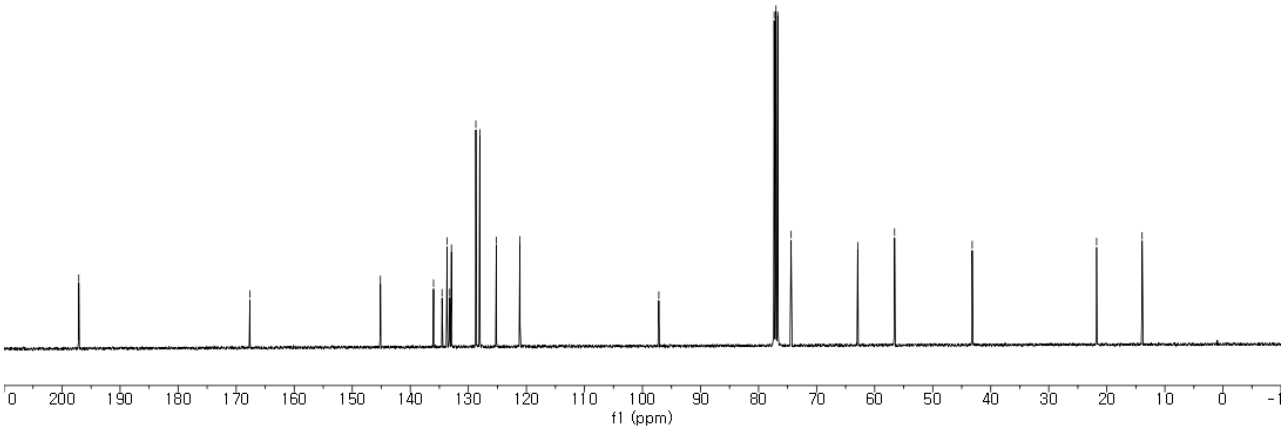
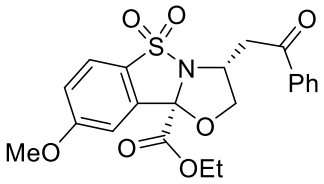


^{13}C NMR (100 MHz) in $CDCl_3$



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



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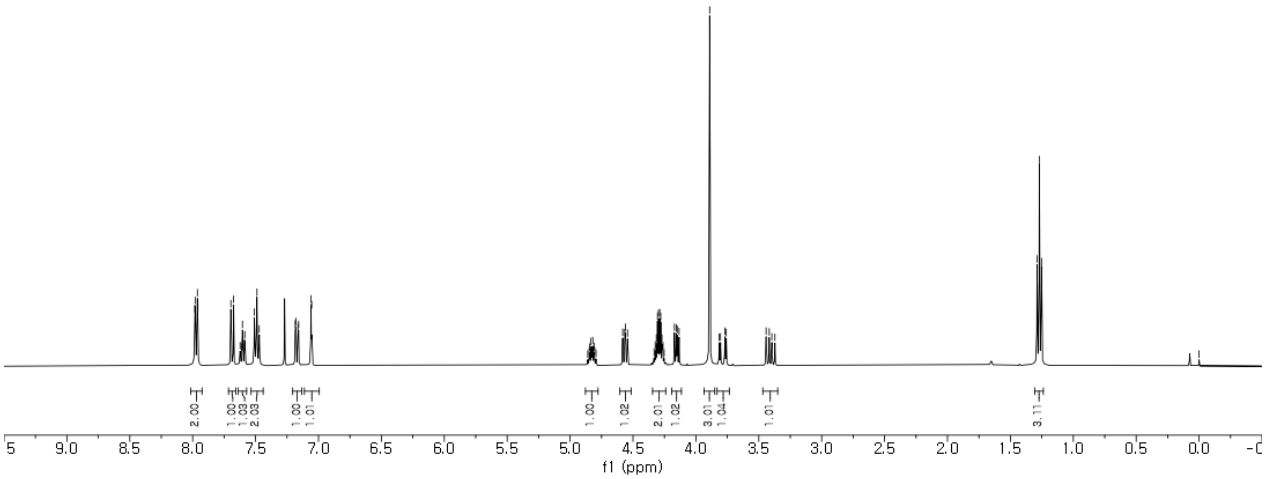
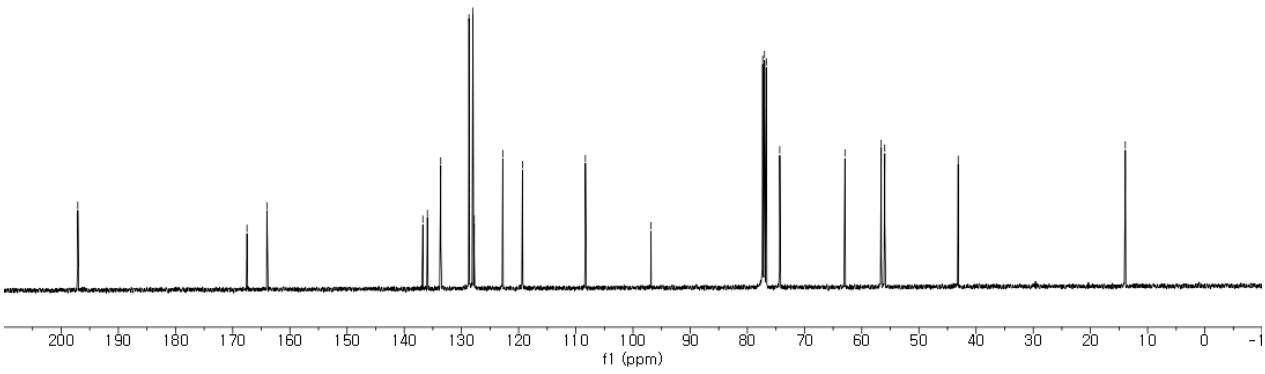
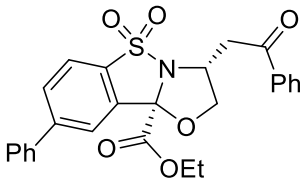


^{13}C NMR (100 MHz) in $CDCl_3$



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



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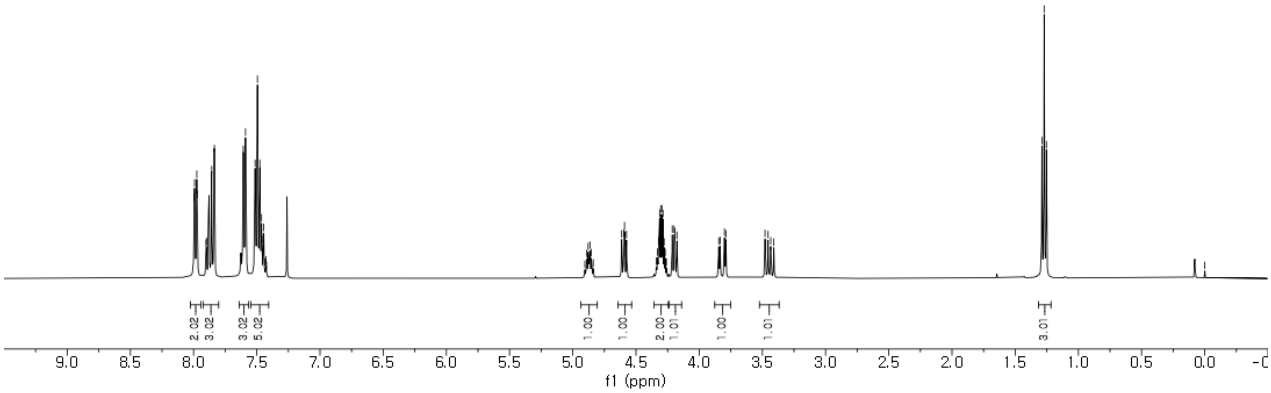
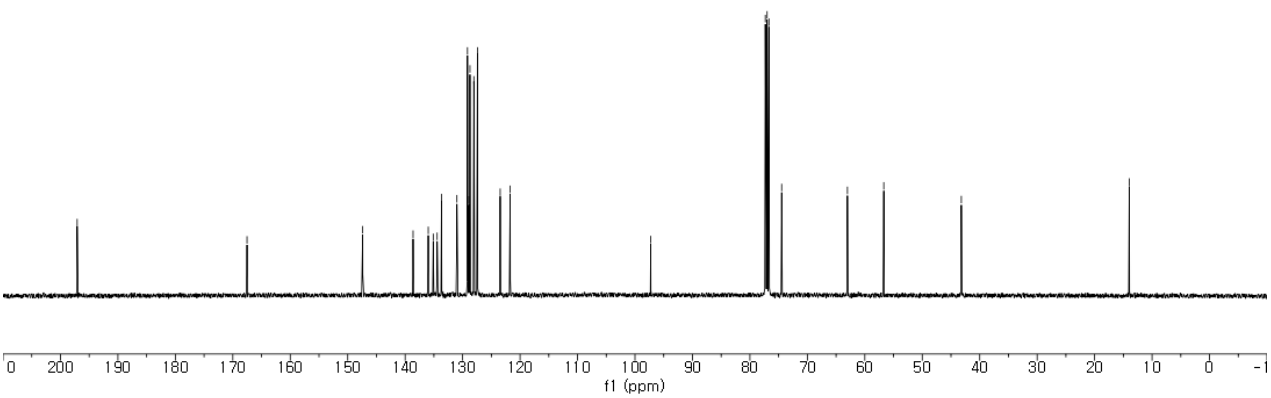
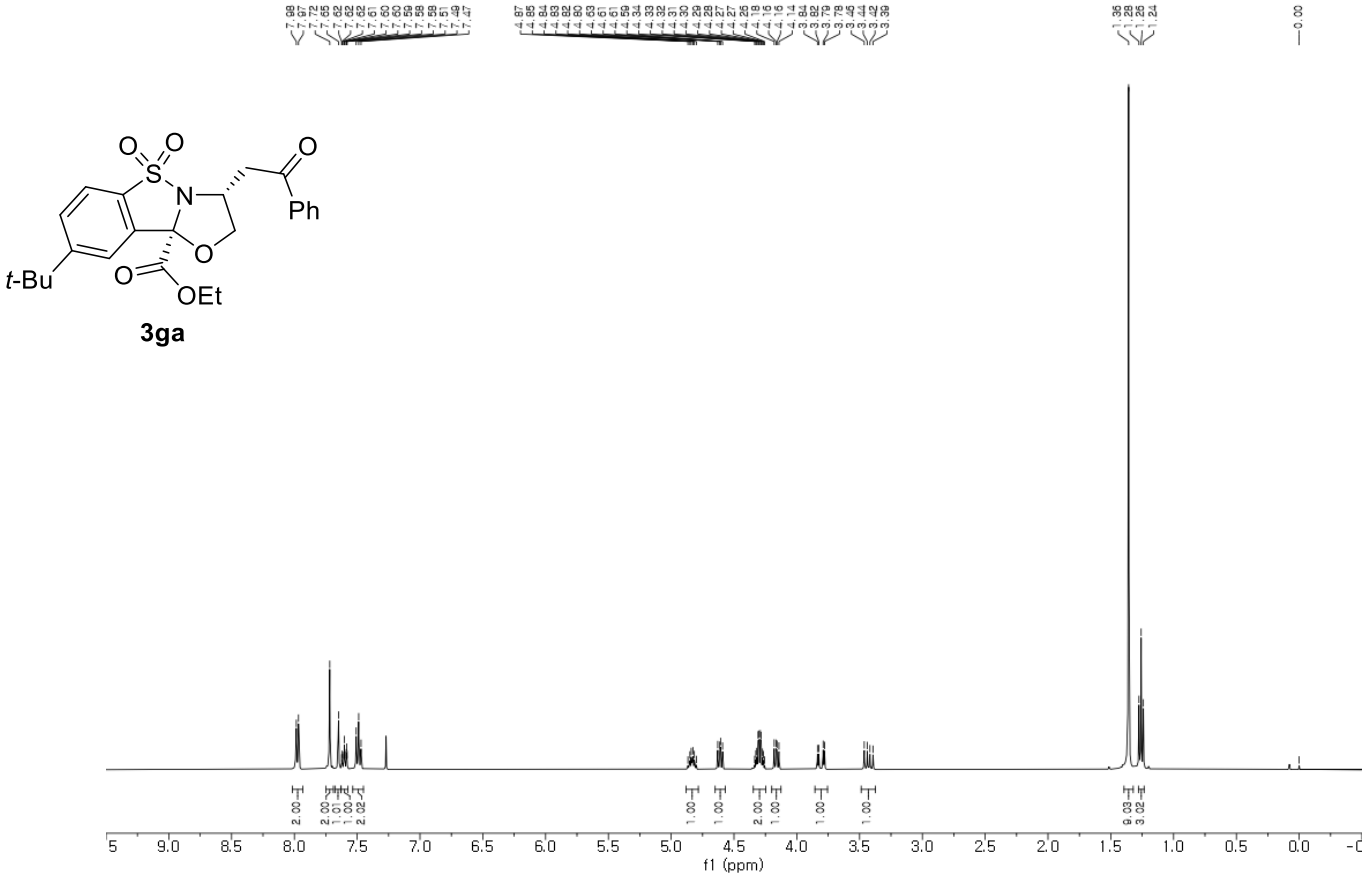


^{13}C NMR (100 MHz) in $CDCl_3$



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



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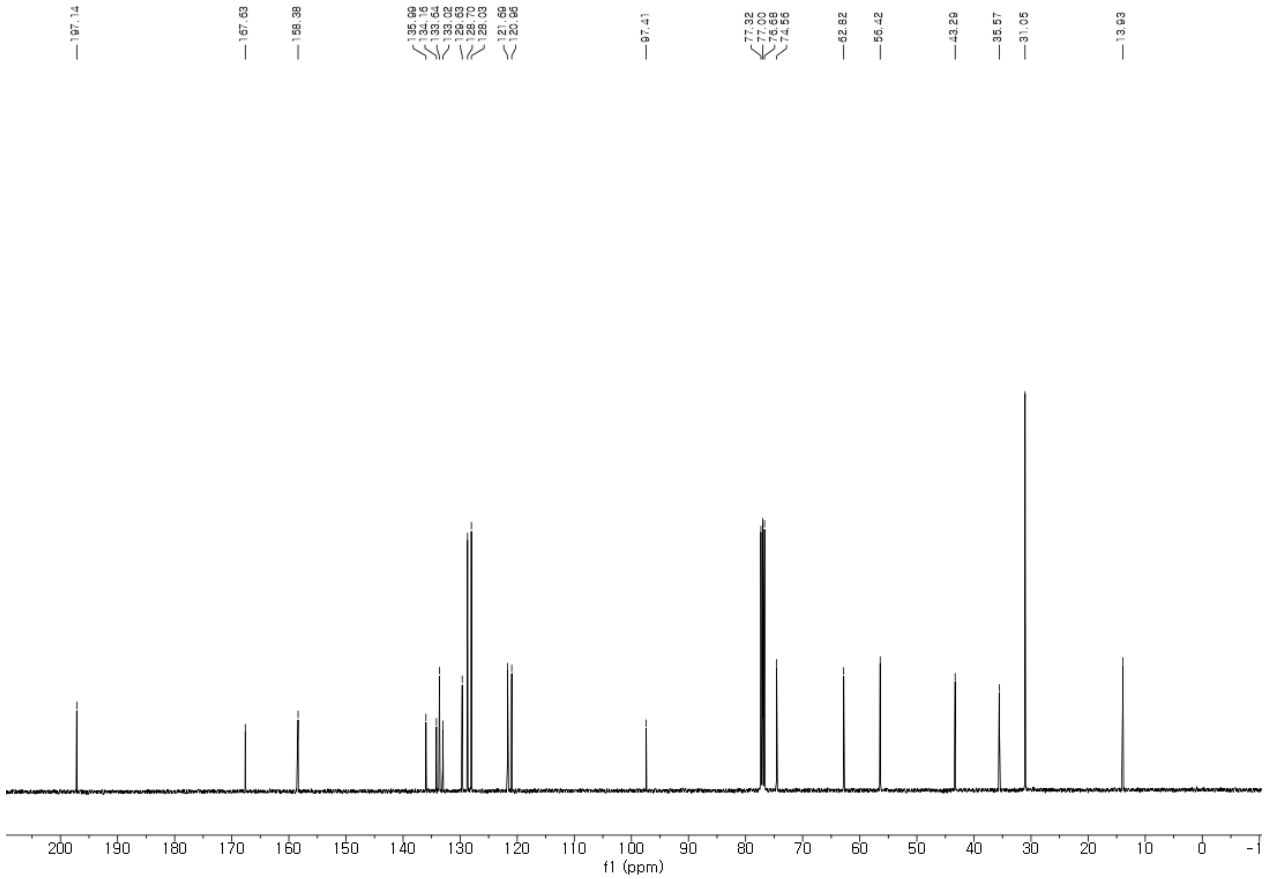
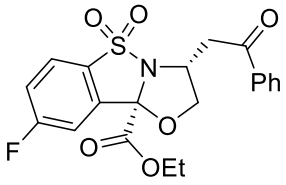


^{1}H NMR (400 MHz) in $CDCl_3$



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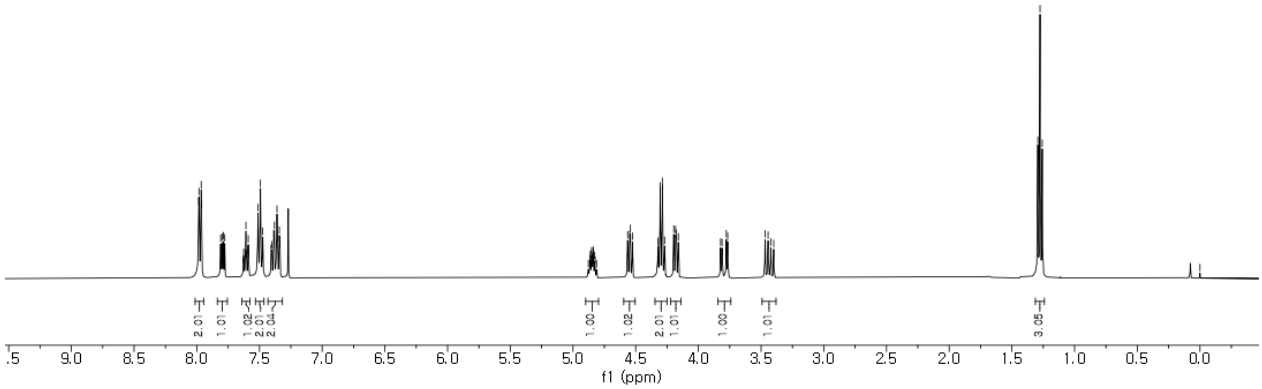
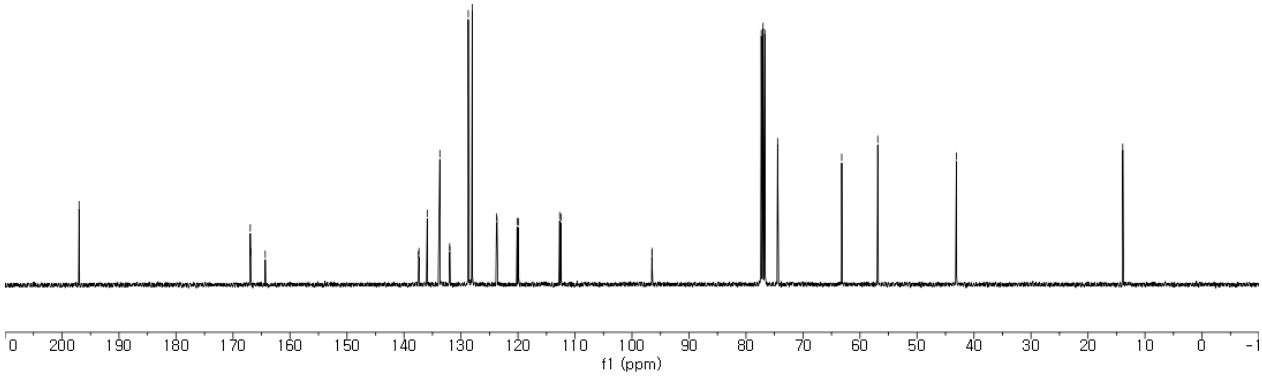
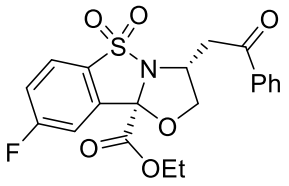


^{13}C NMR (100 MHz) in $CDCl_3$



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



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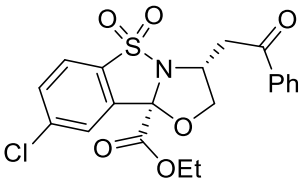

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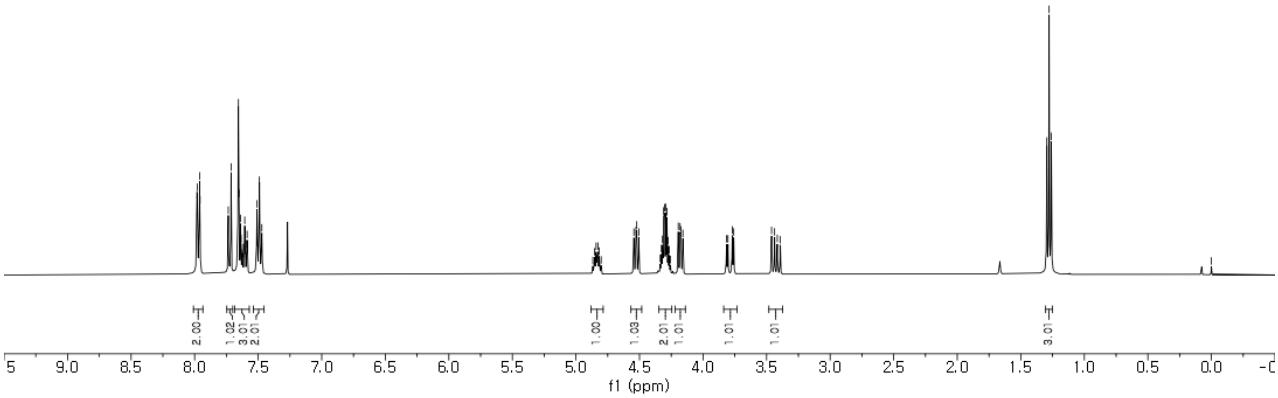
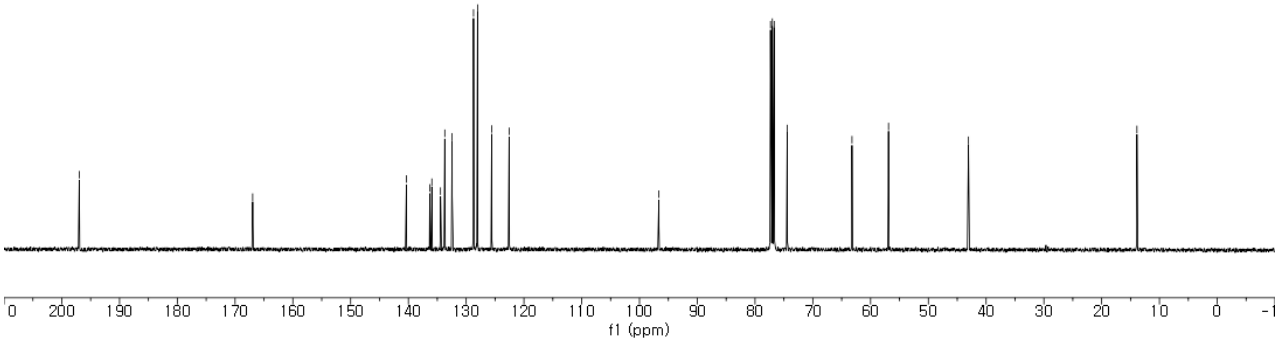


^{13}C NMR (100 MHz) in $CDCl_3$



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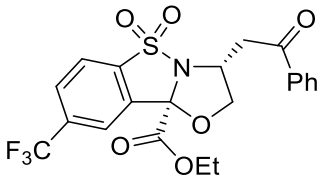

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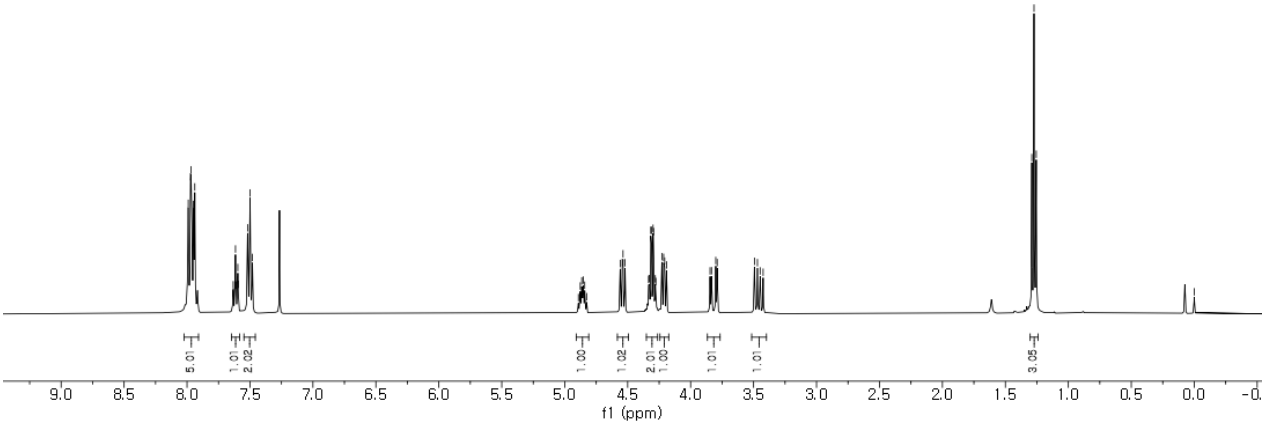

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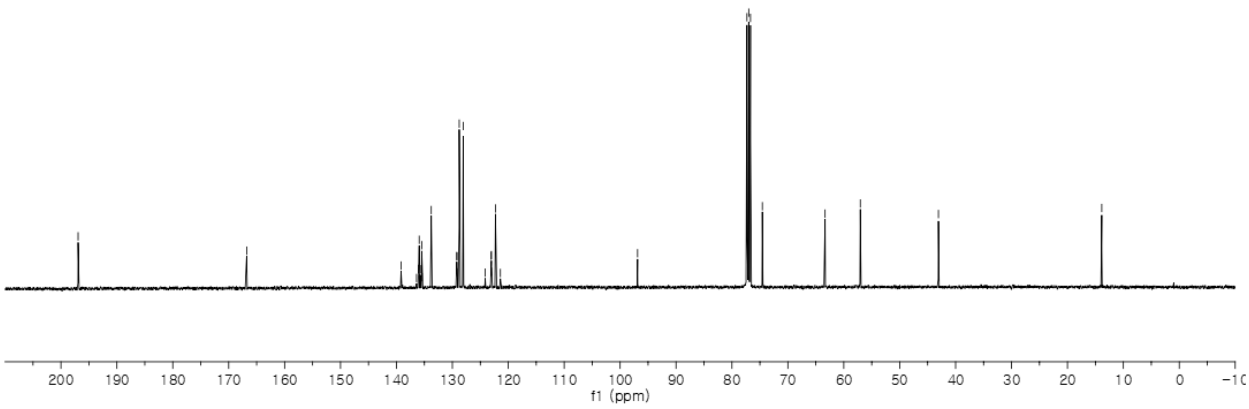
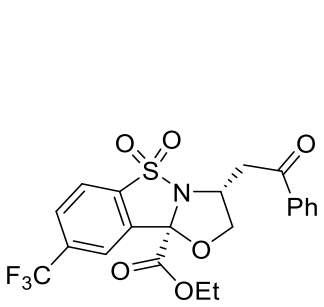


^{19}F NMR (376 MHz) in $CDCl_3$



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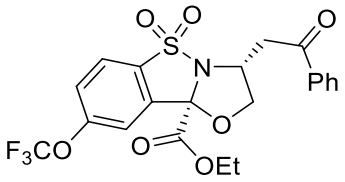

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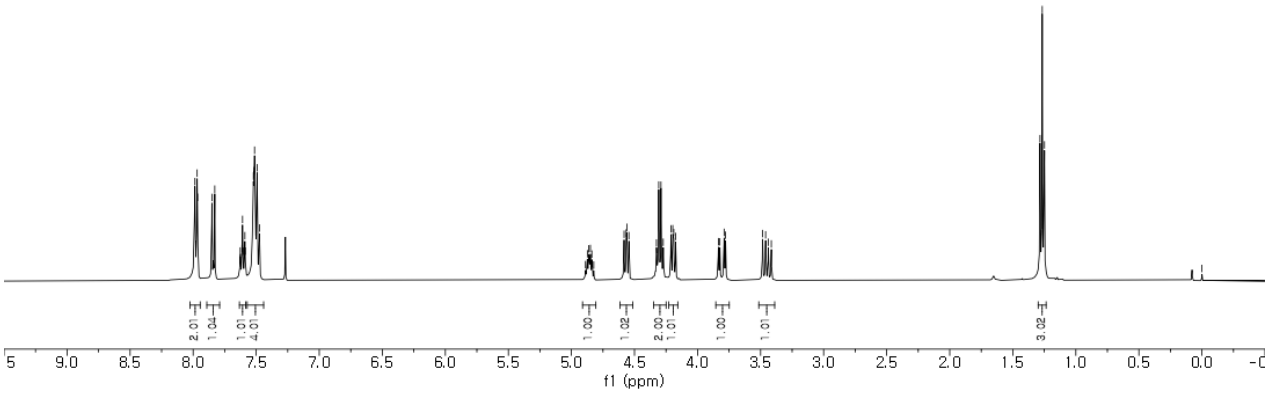
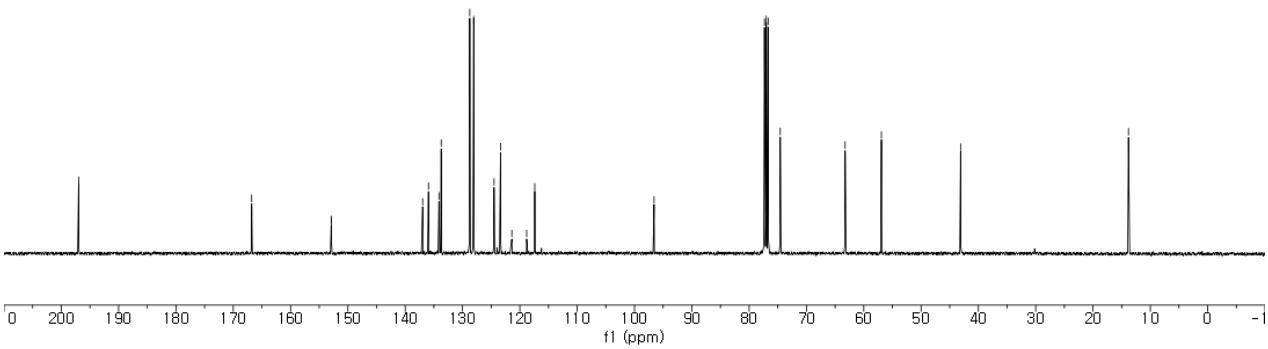
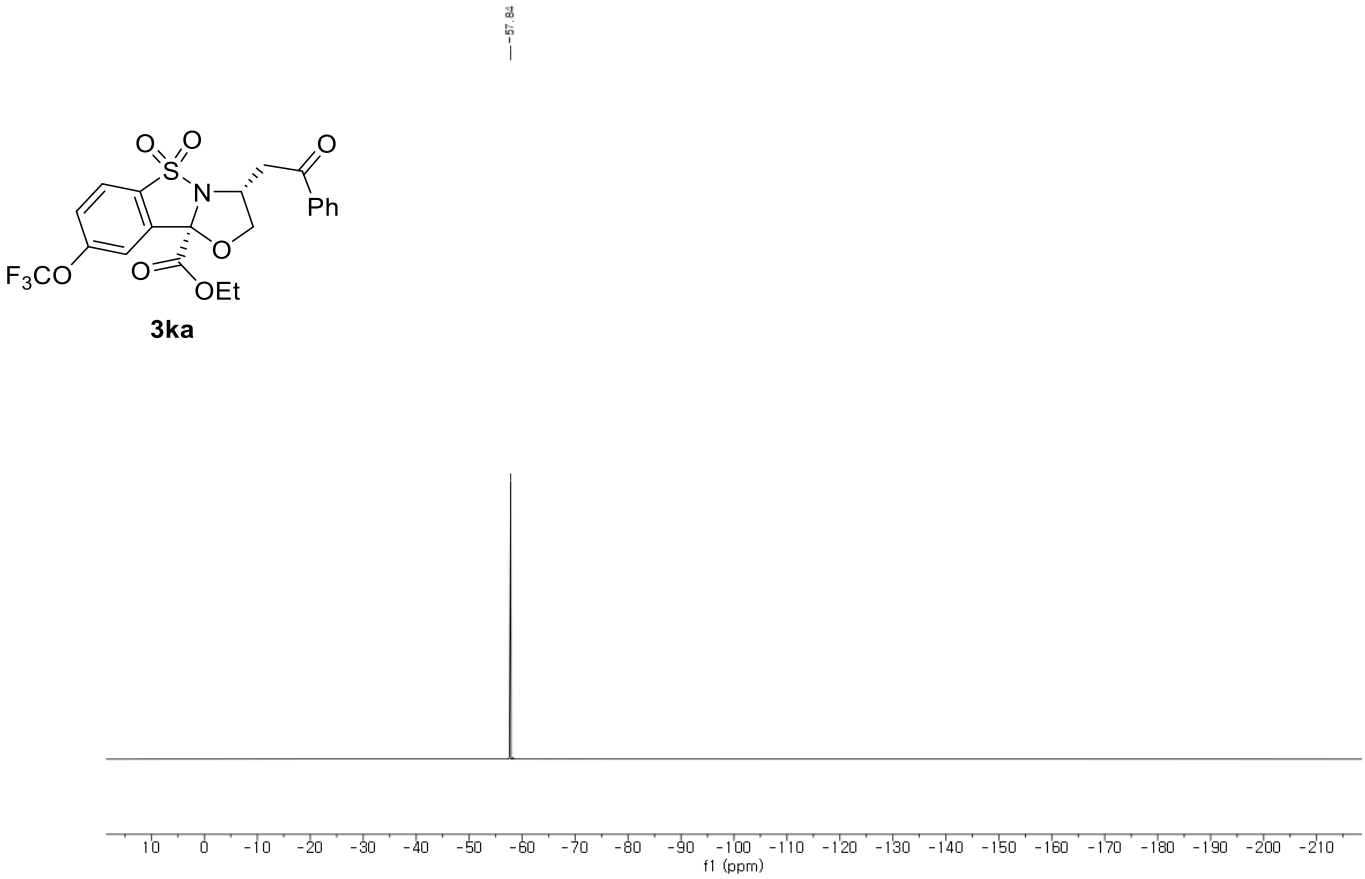


^{13}C NMR (100 MHz) in $CDCl_3$



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



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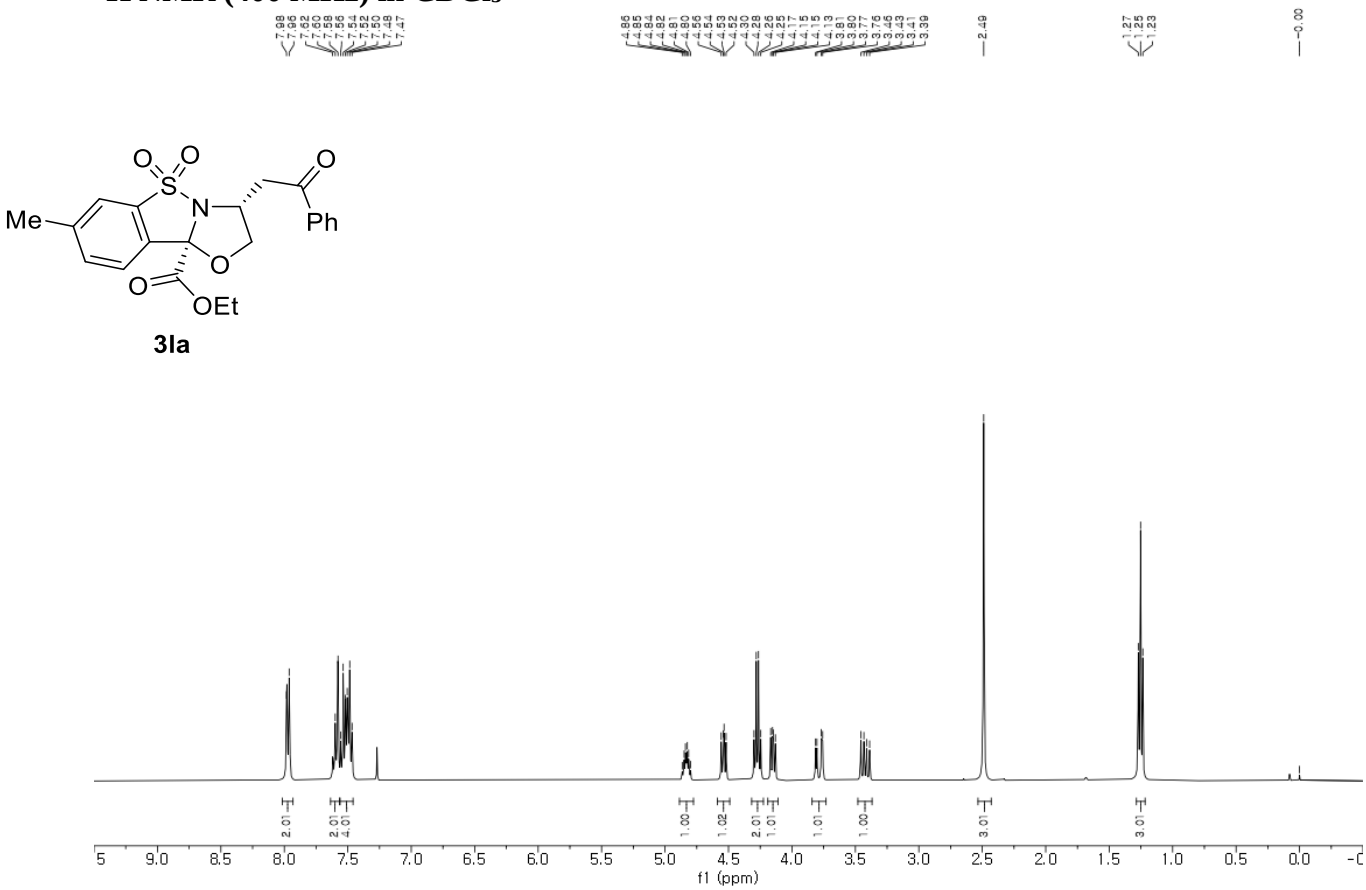

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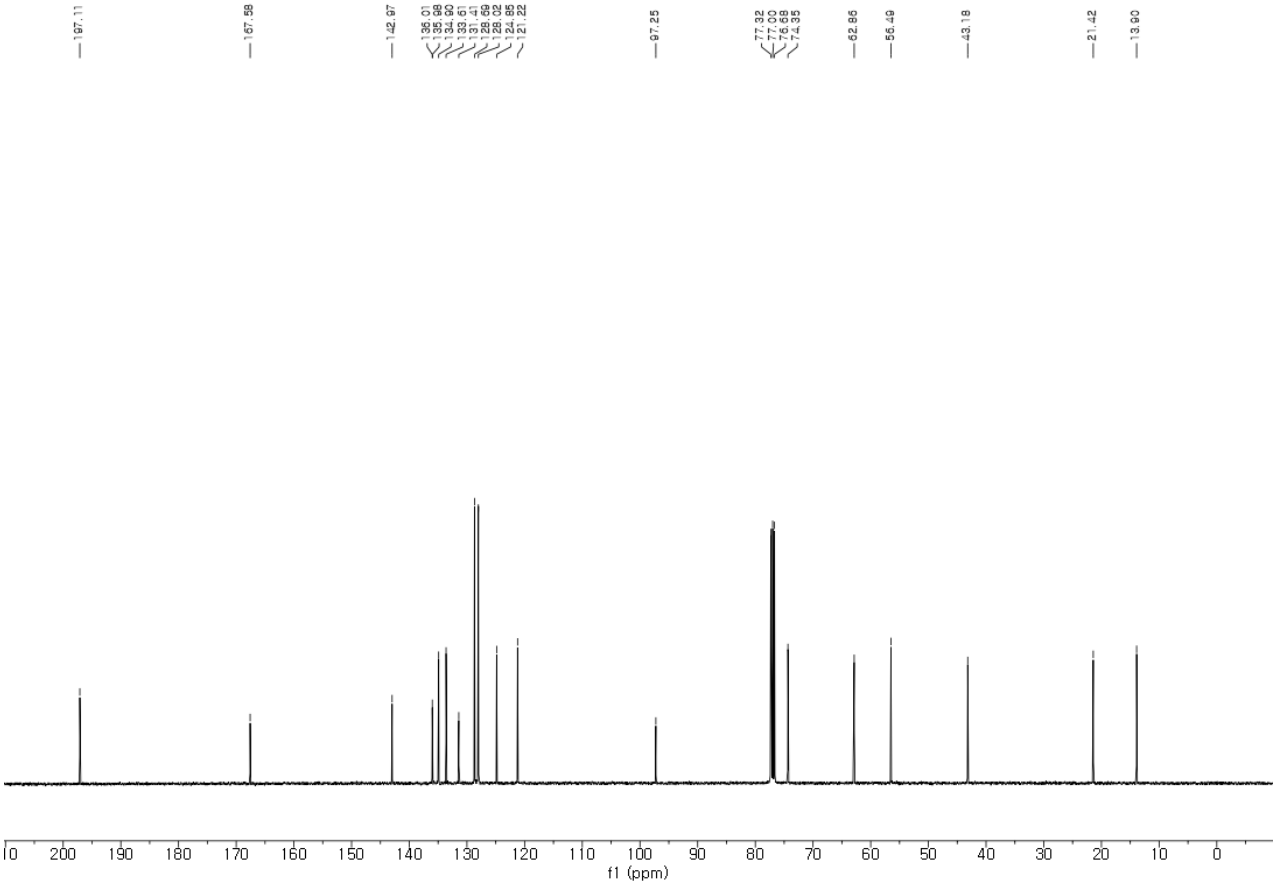
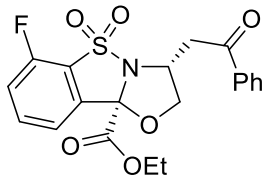


^{1}H NMR (400 MHz) in $CDCl_3$



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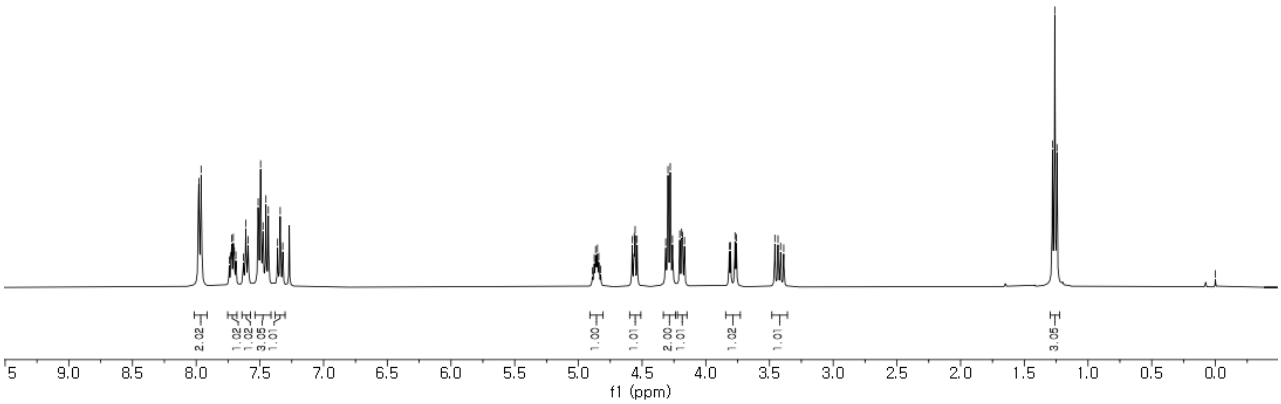
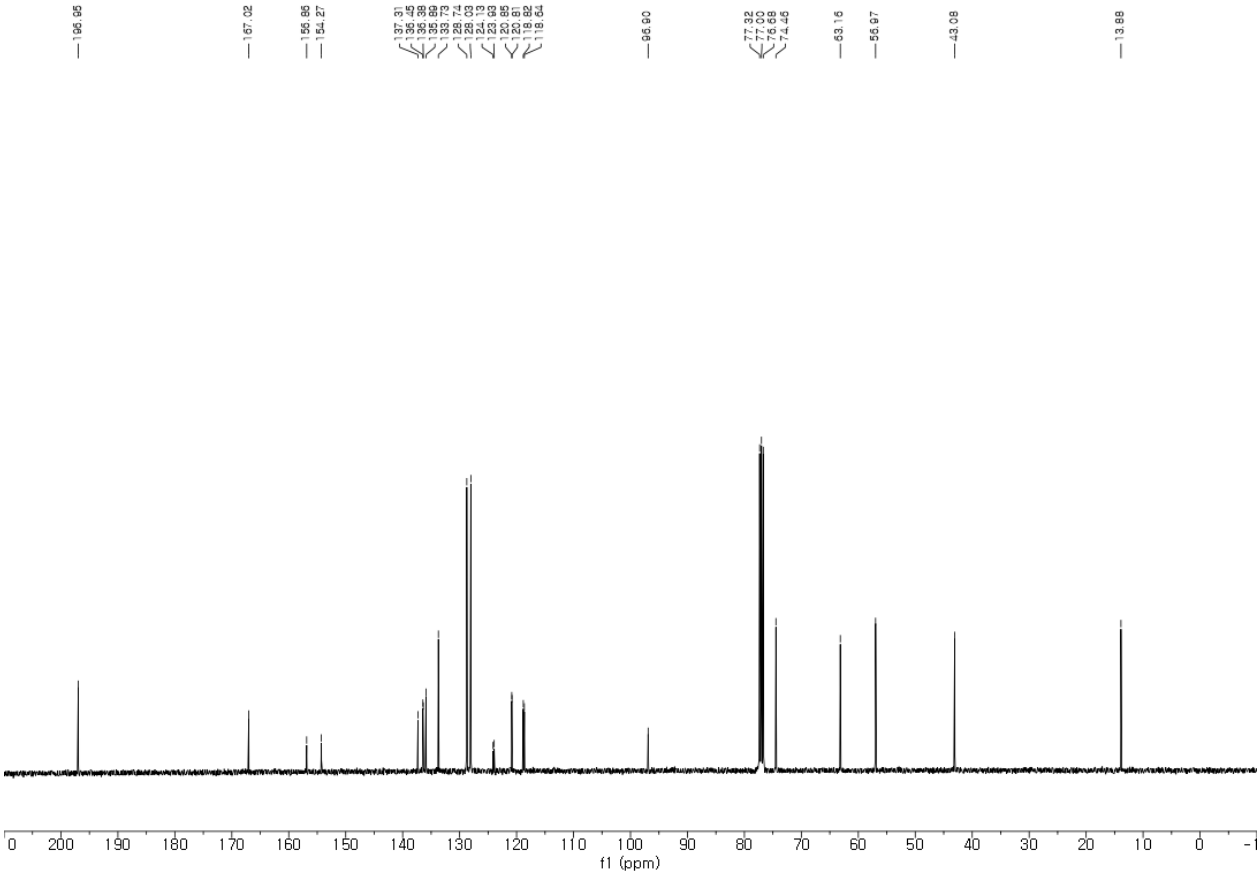
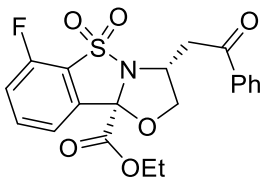


^{13}C NMR (100 MHz) in $CDCl_3$



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



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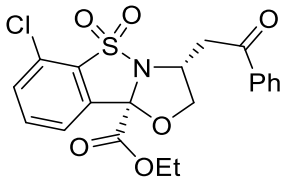

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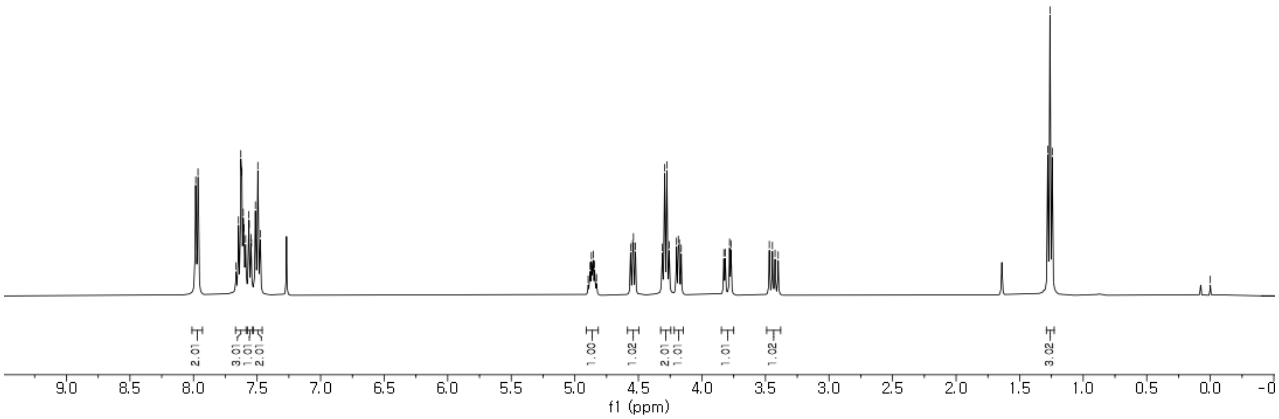

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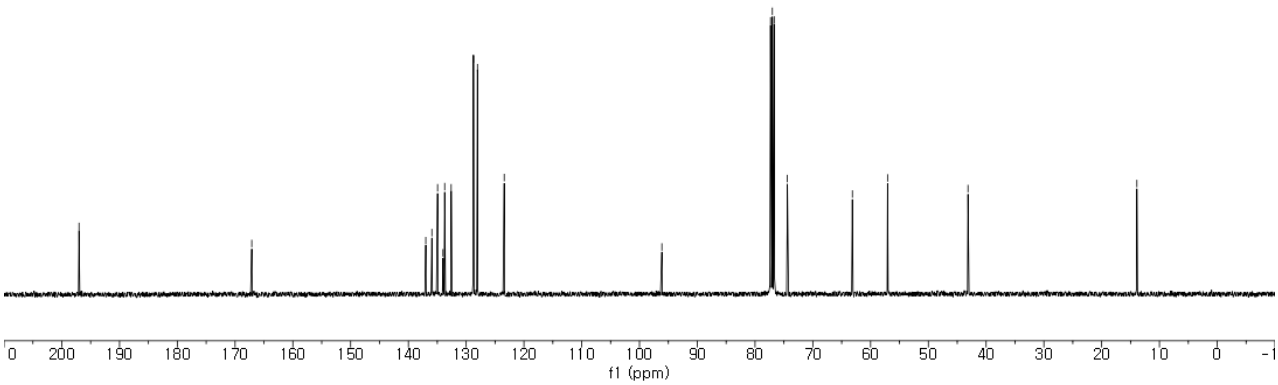

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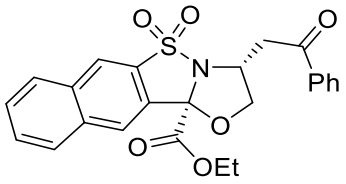

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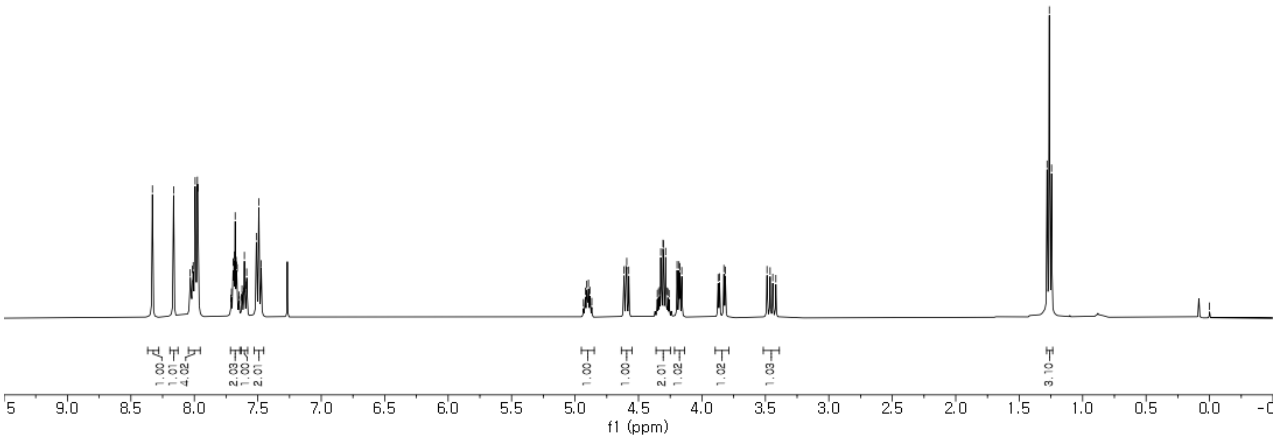

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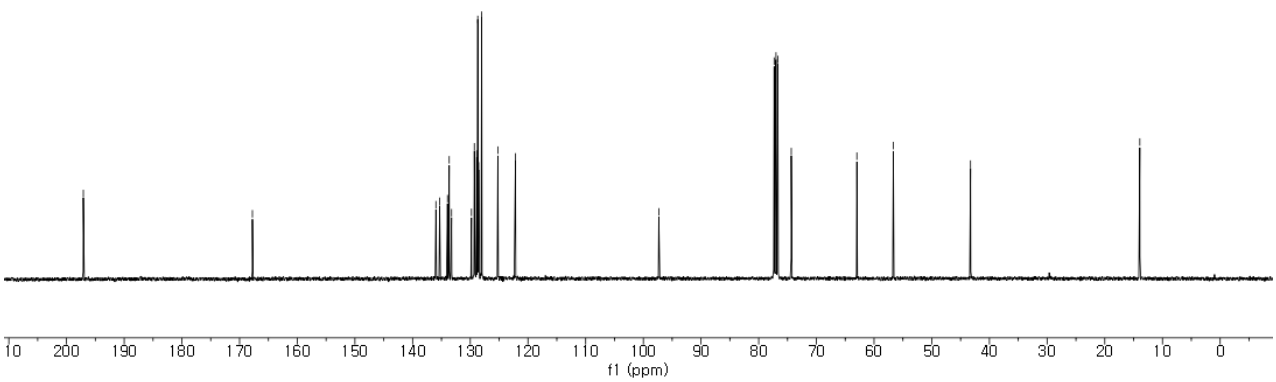

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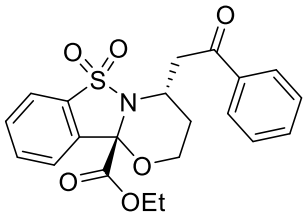

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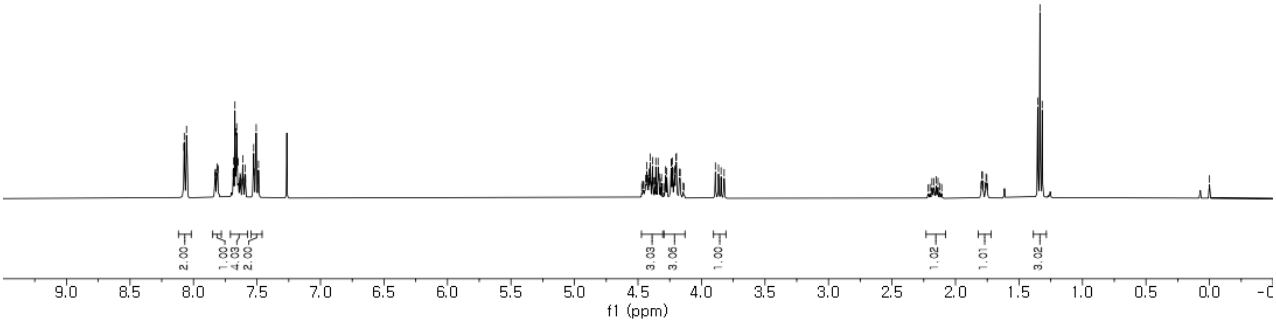

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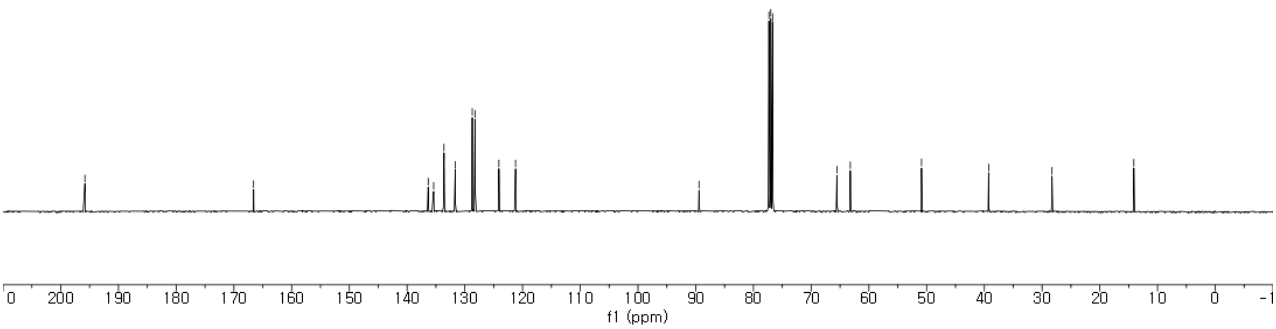

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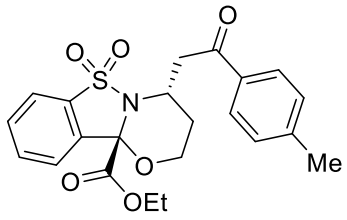

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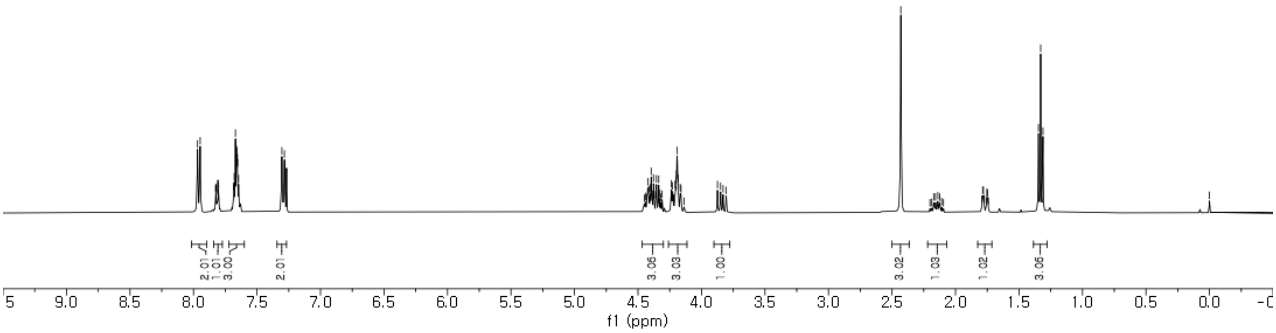
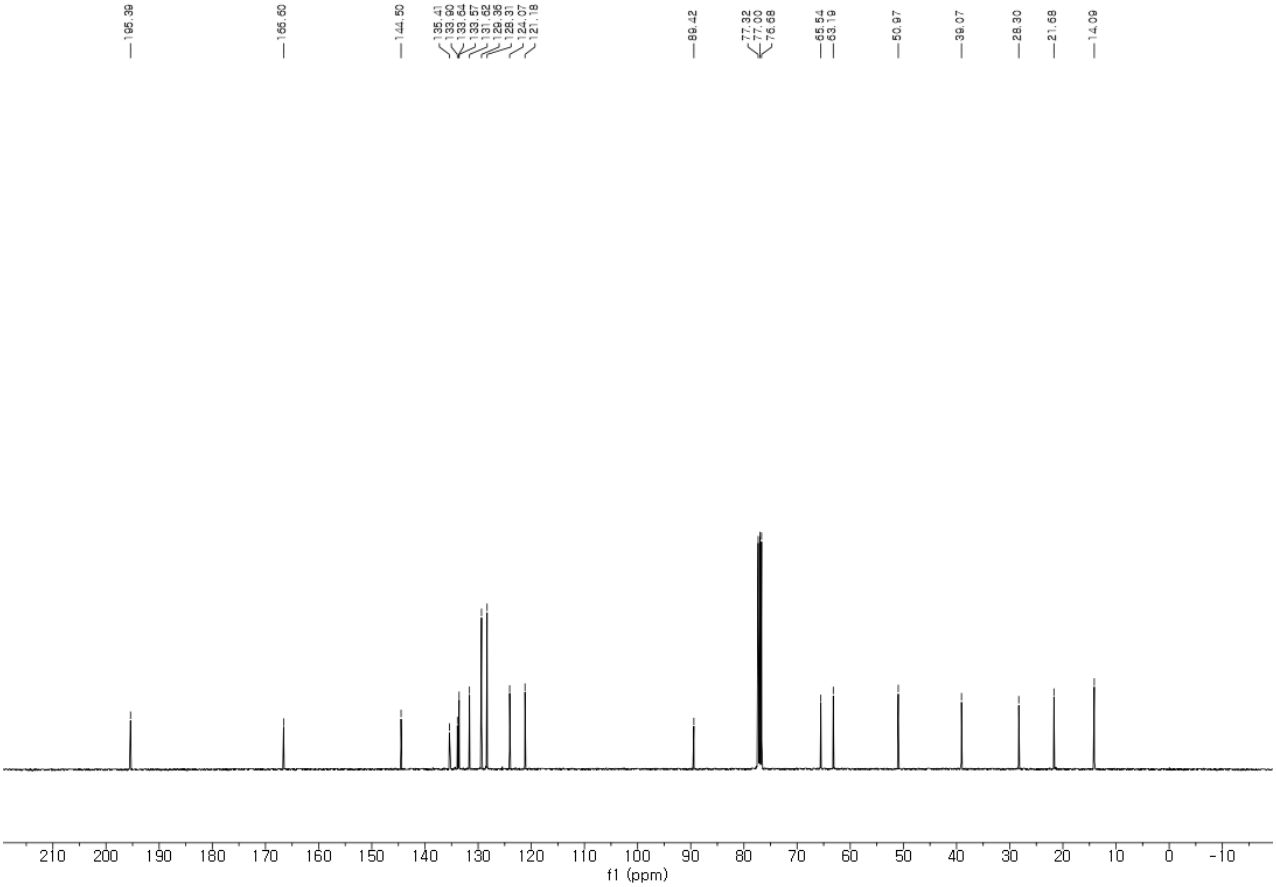
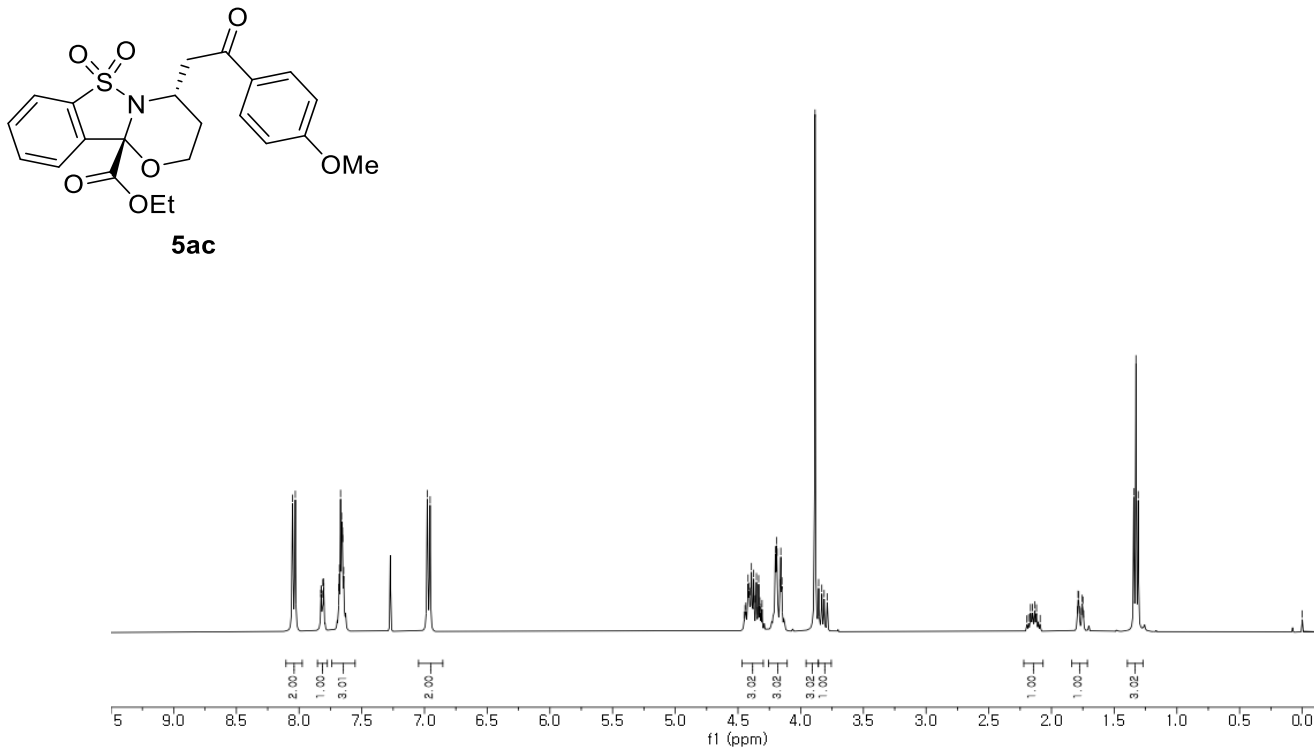


^{13}C NMR (100 MHz) in $CDCl_3$



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



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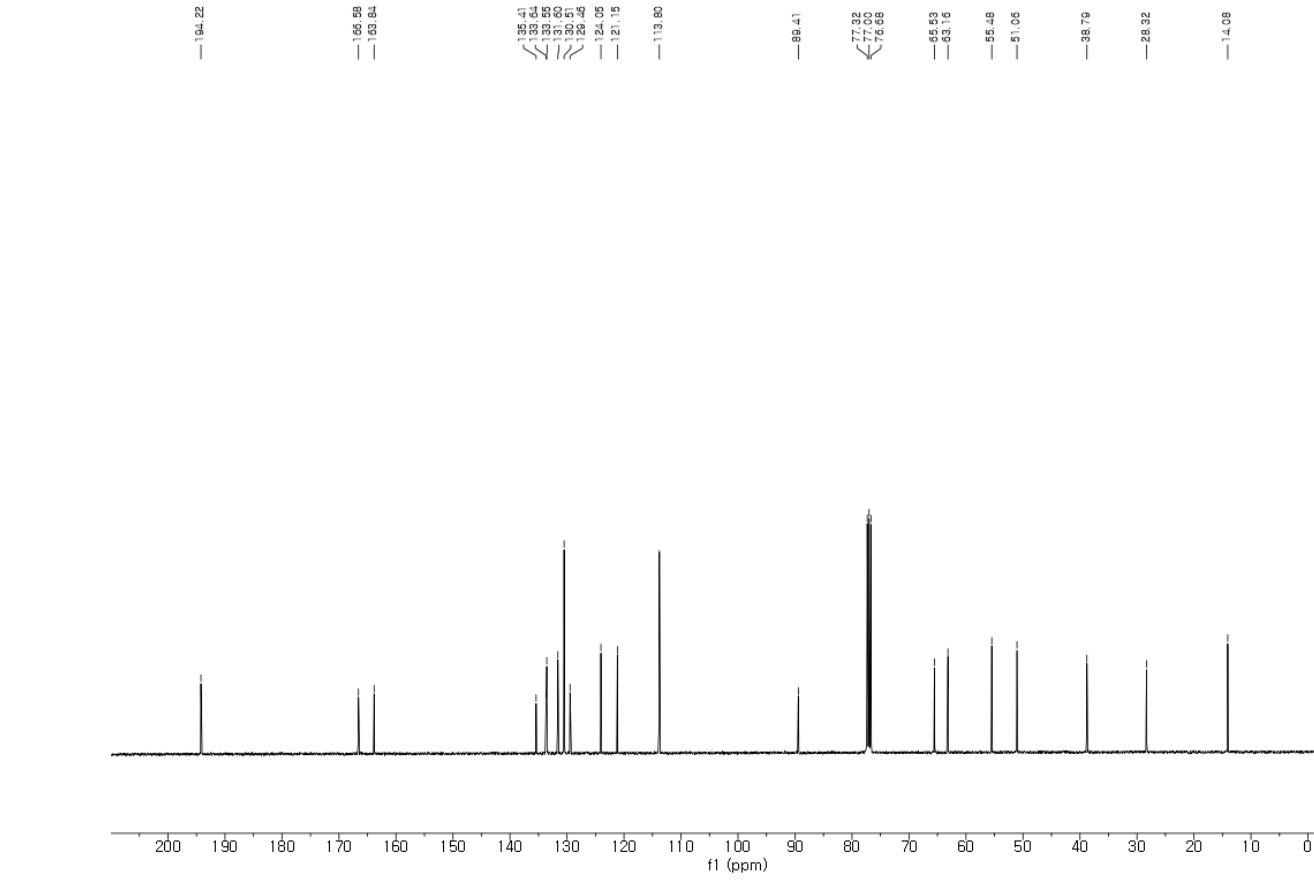
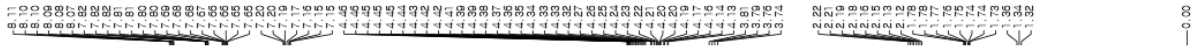
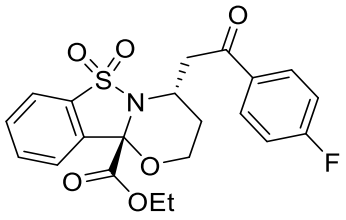


^{1}H NMR (400 MHz) in $CDCl_3$





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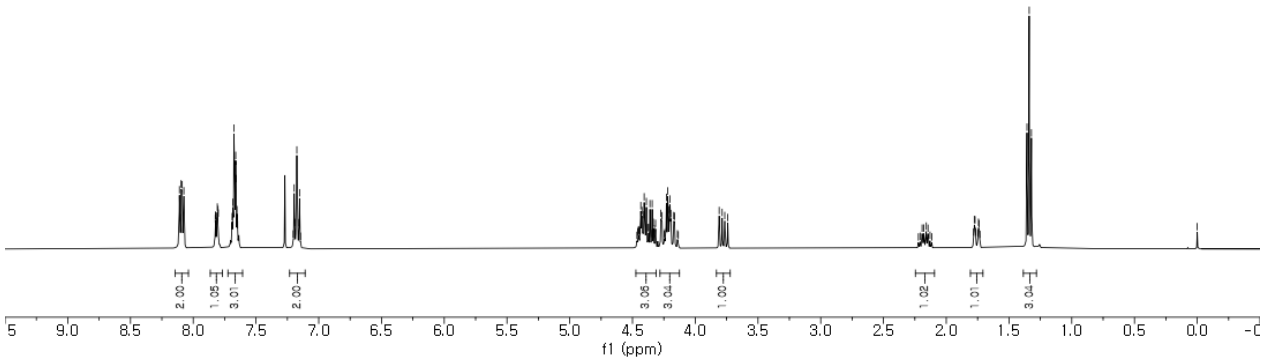
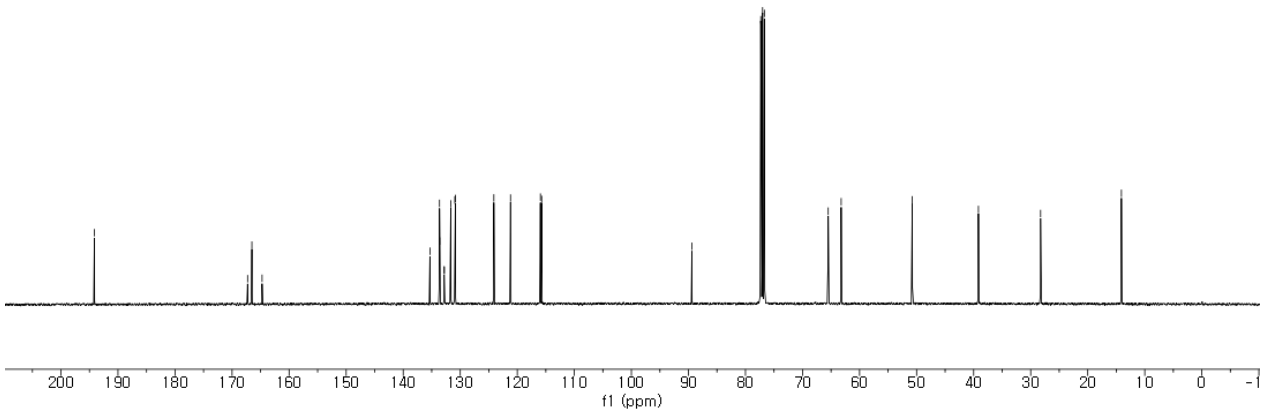
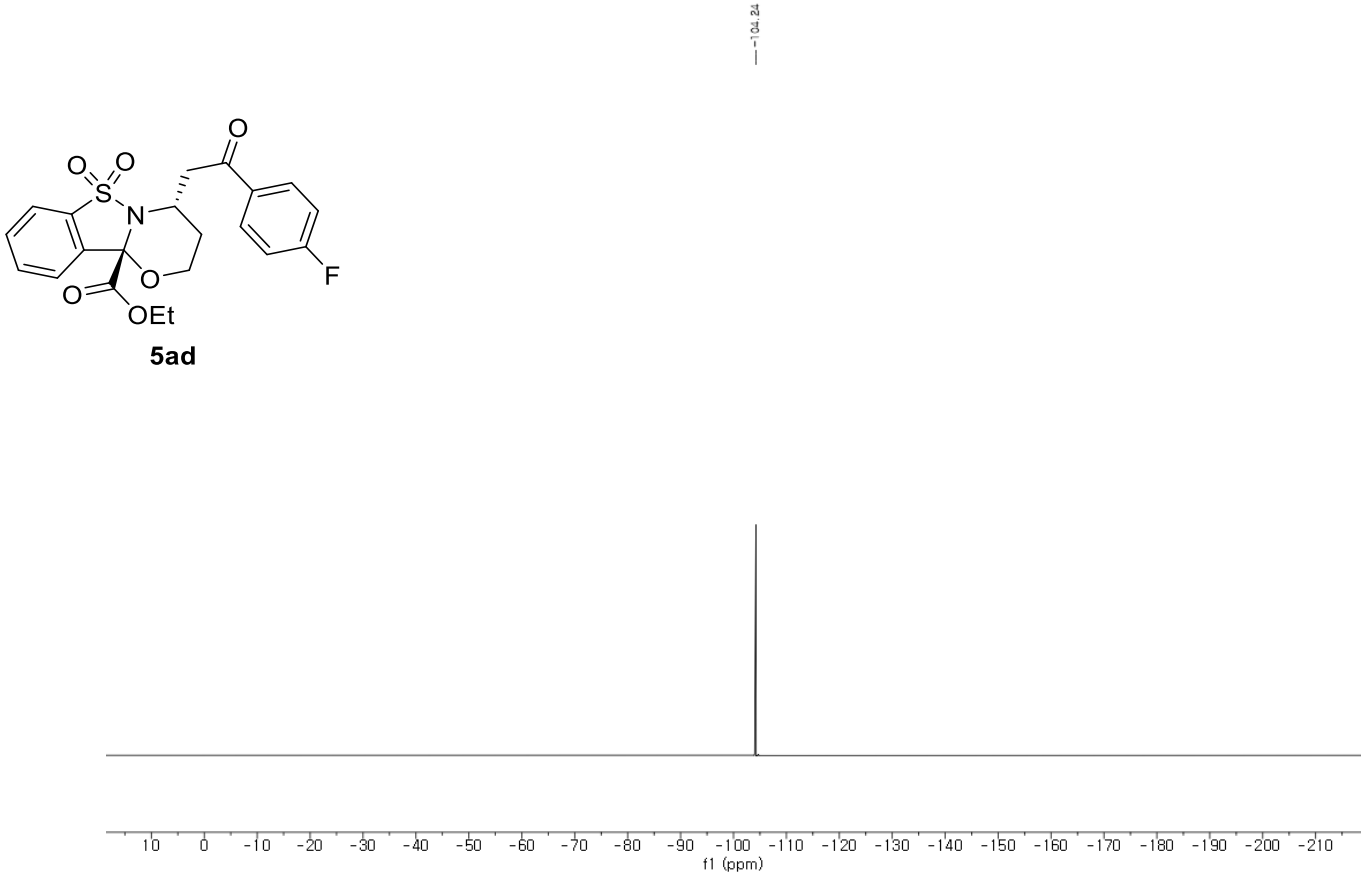


^{13}C NMR (100 MHz) in $CDCl_3$



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



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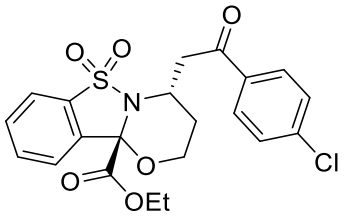

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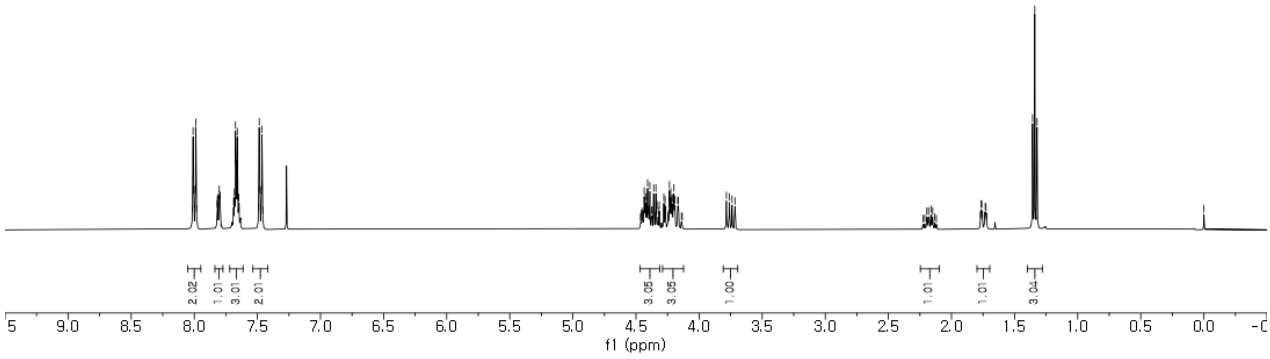

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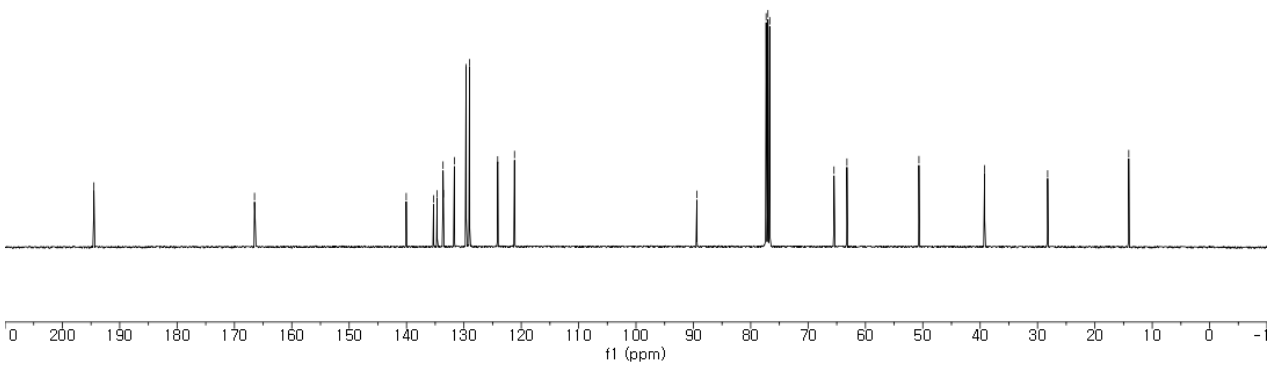

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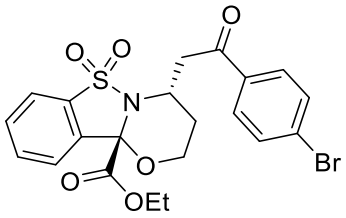

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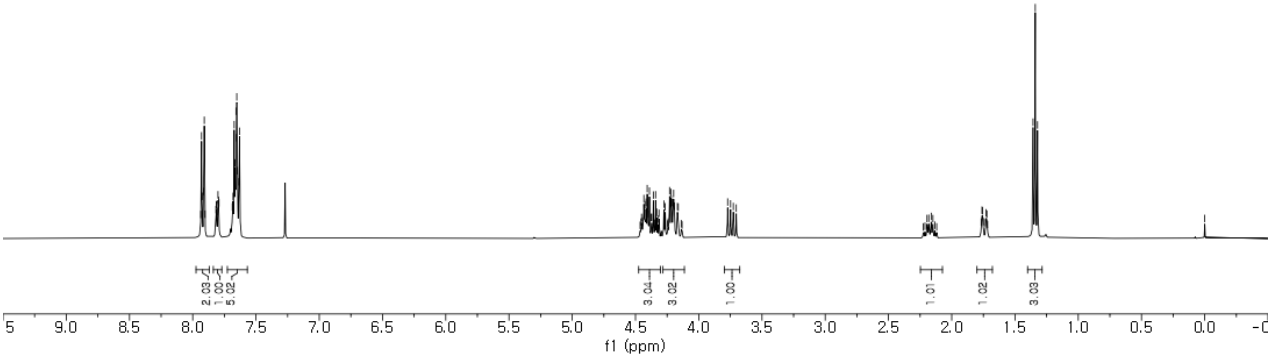

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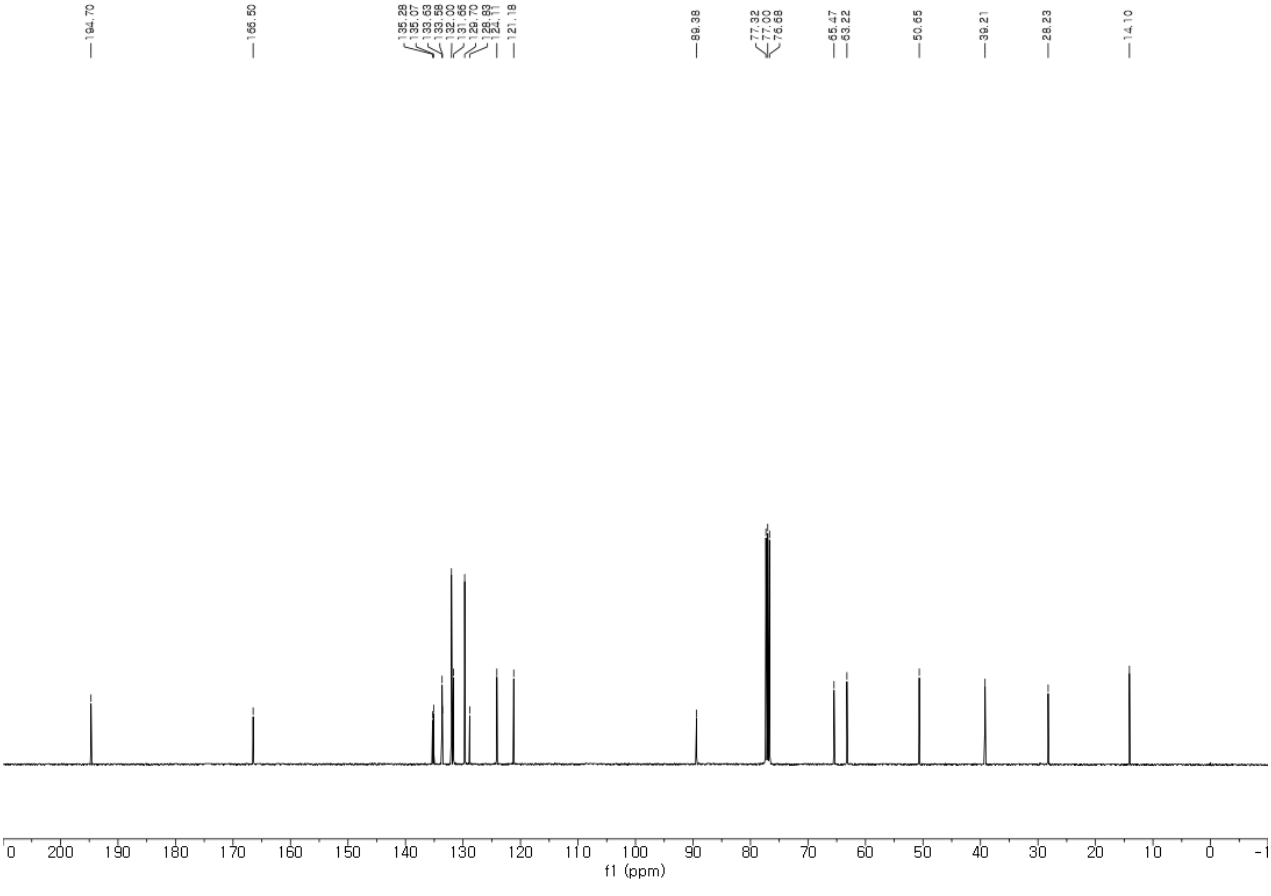

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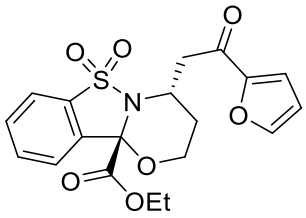

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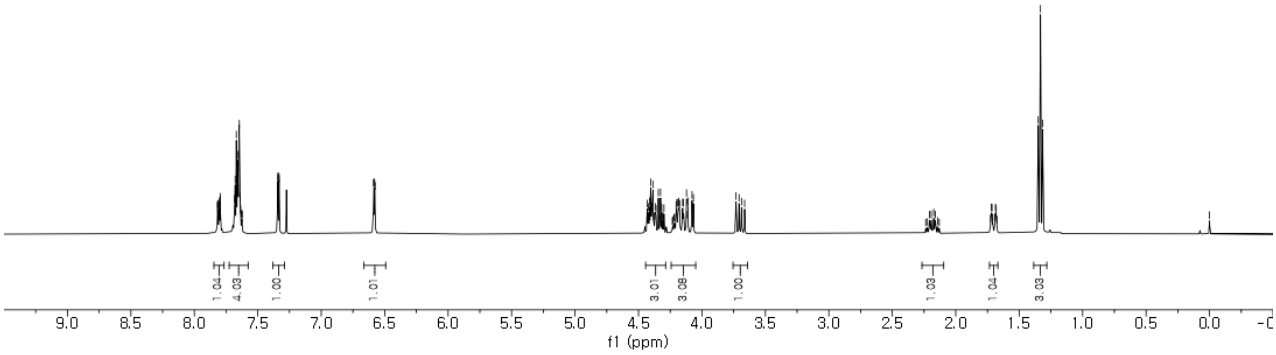

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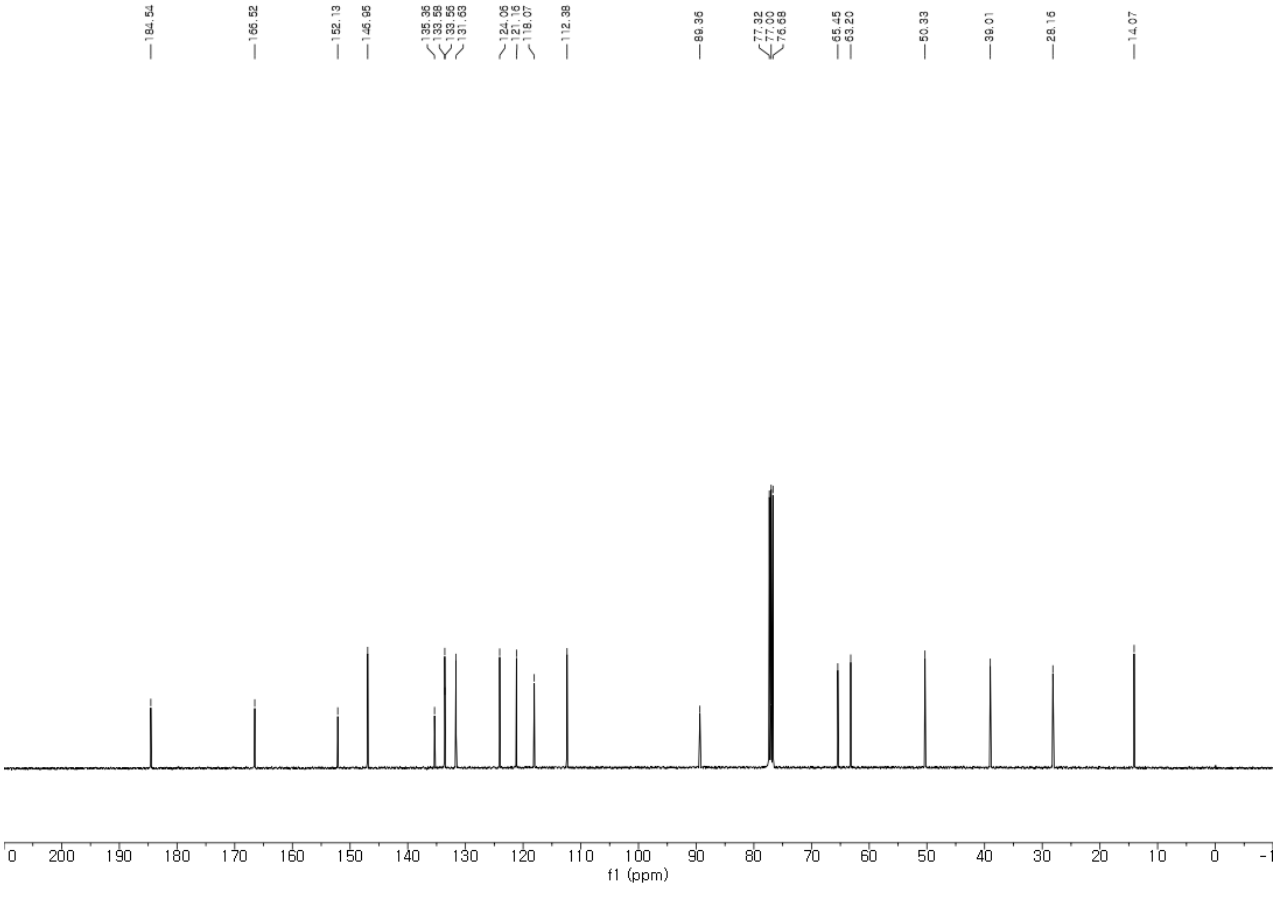
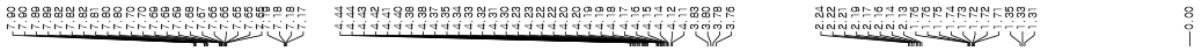
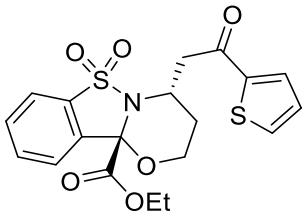


^{1}H NMR (400 MHz) in $CDCl_3$





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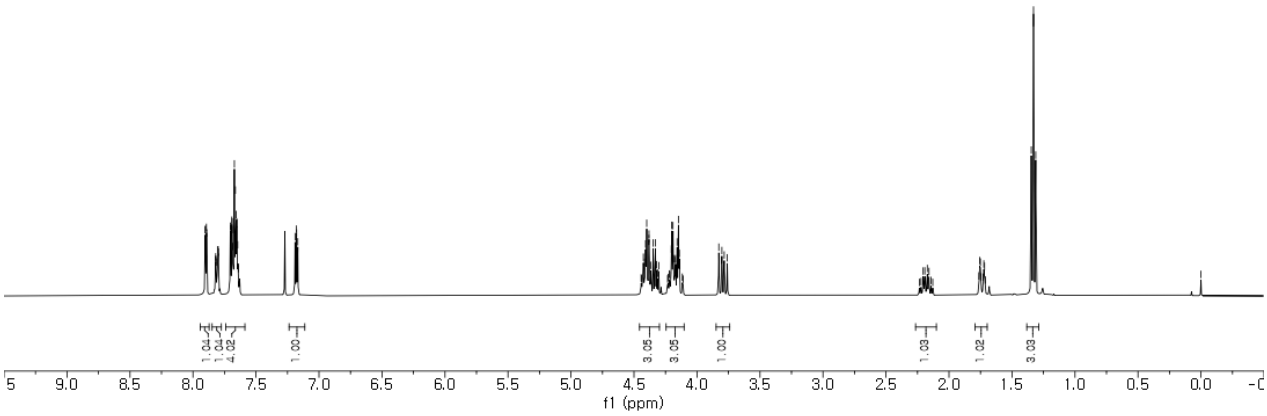
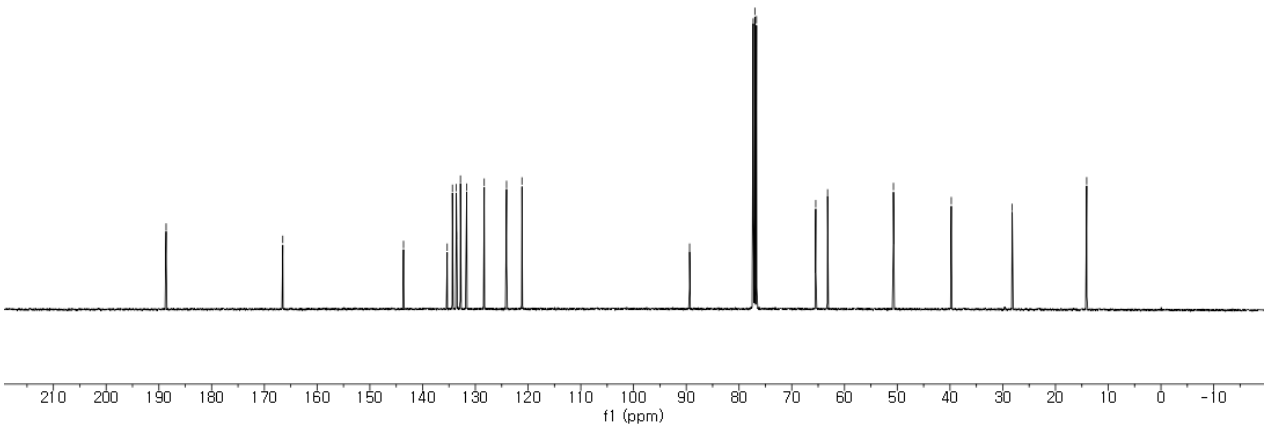
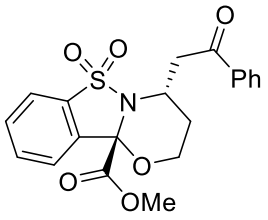


^{13}C NMR (100 MHz) in $CDCl_3$



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



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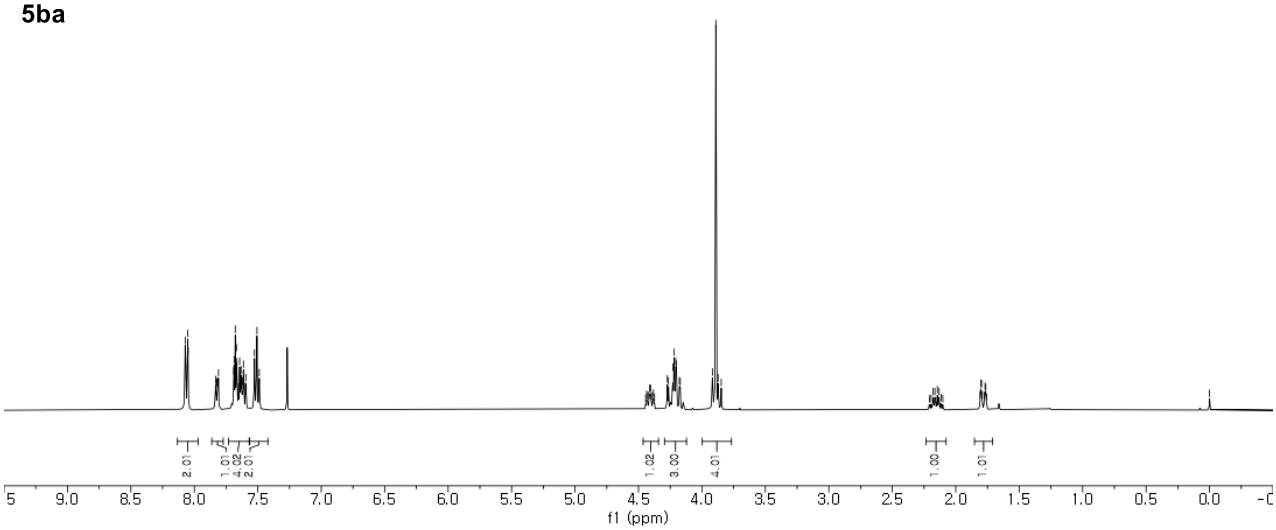
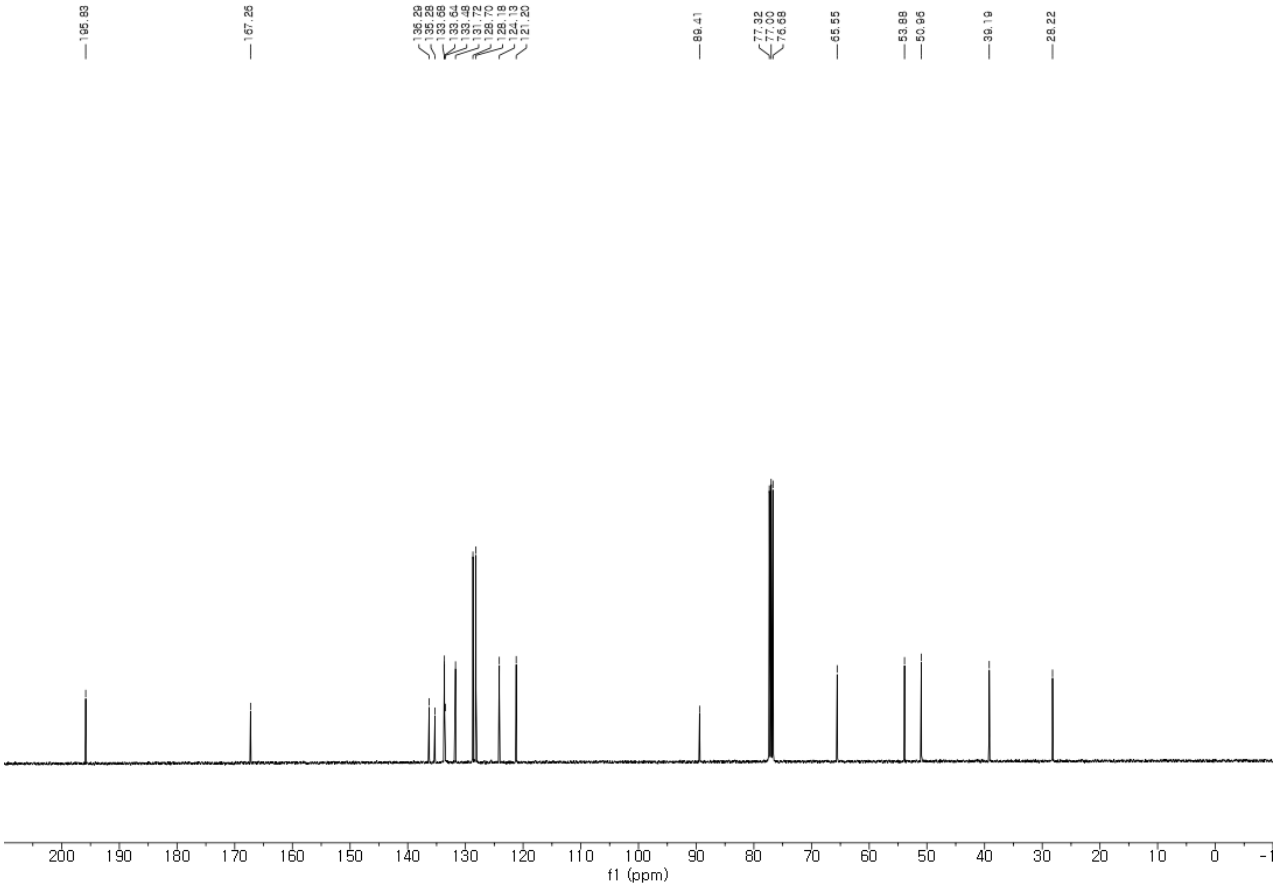
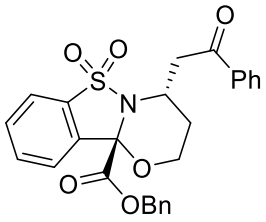


^{13}C NMR (100 MHz) in $CDCl_3$



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



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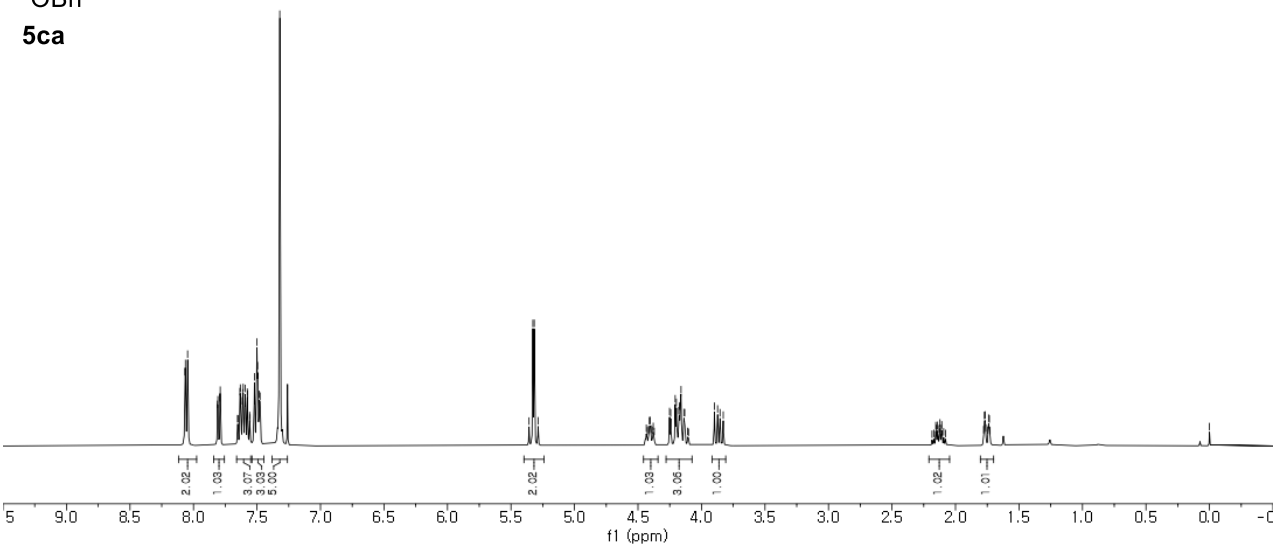
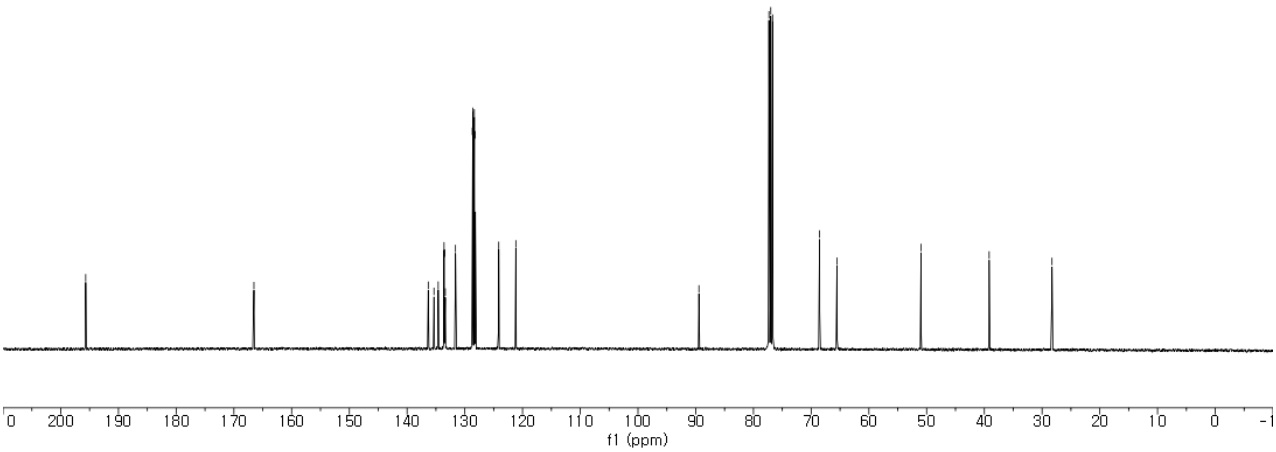


^{13}C NMR (100 MHz) in $CDCl_3$



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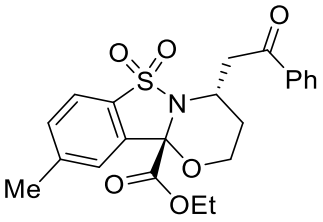

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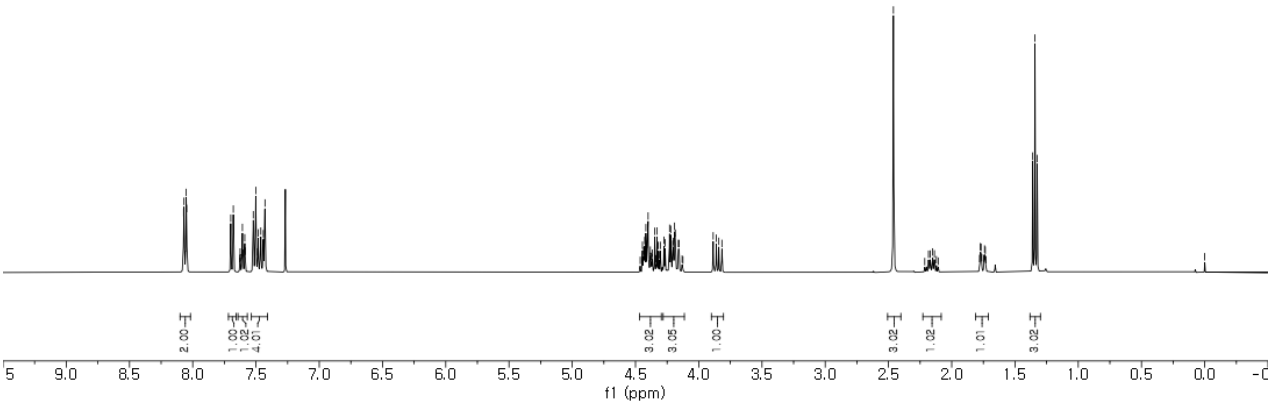
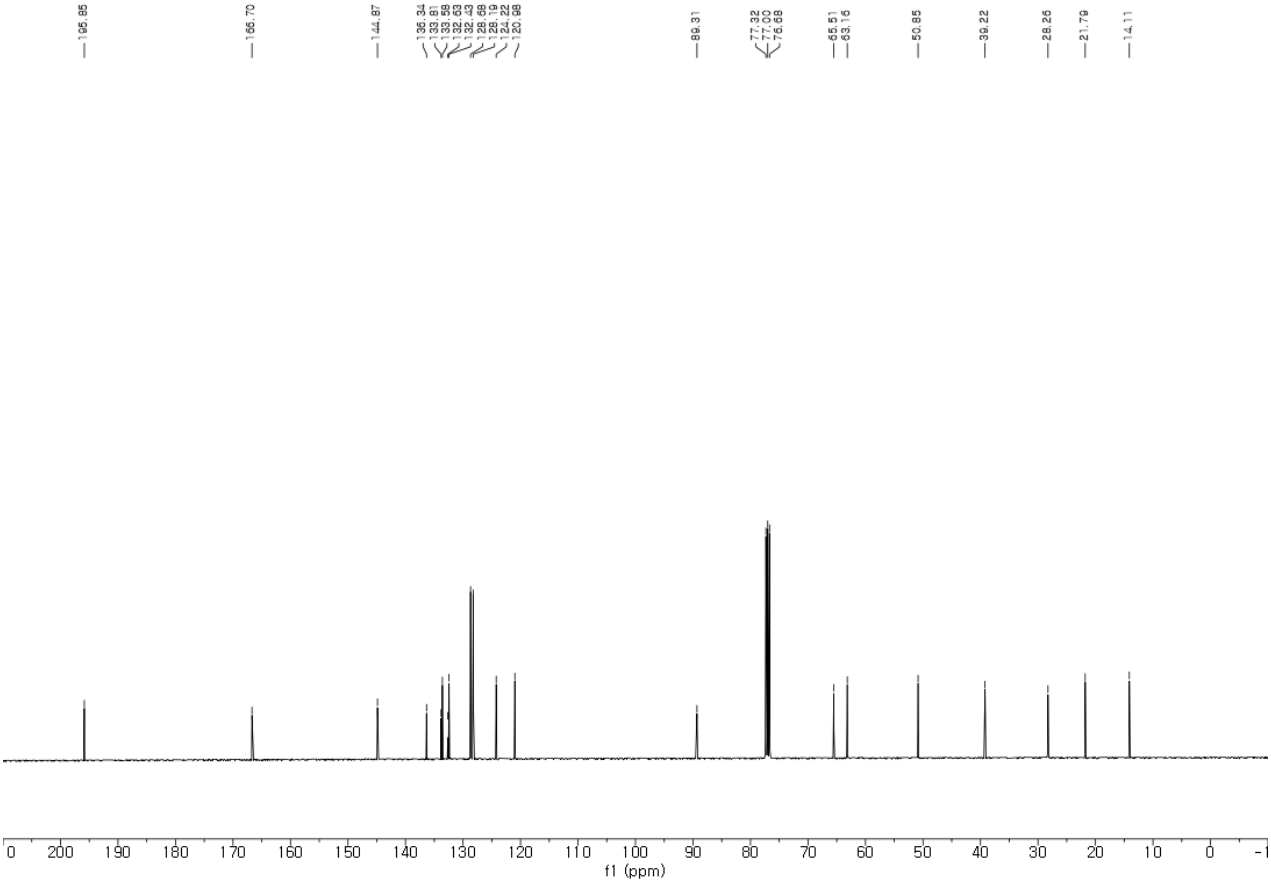


^{13}C NMR (100 MHz) in $CDCl_3$



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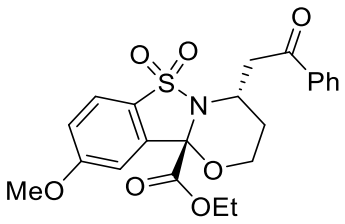

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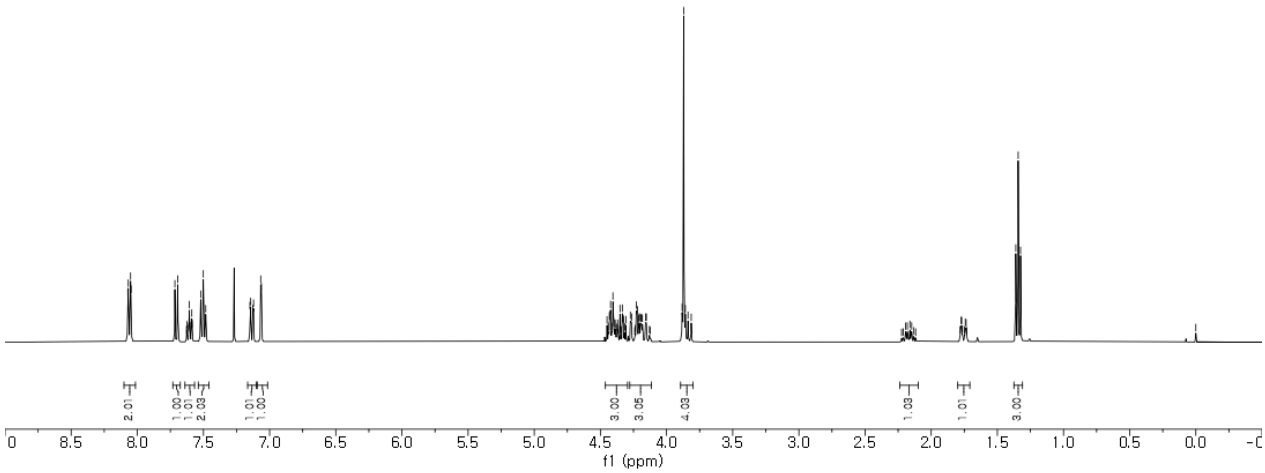
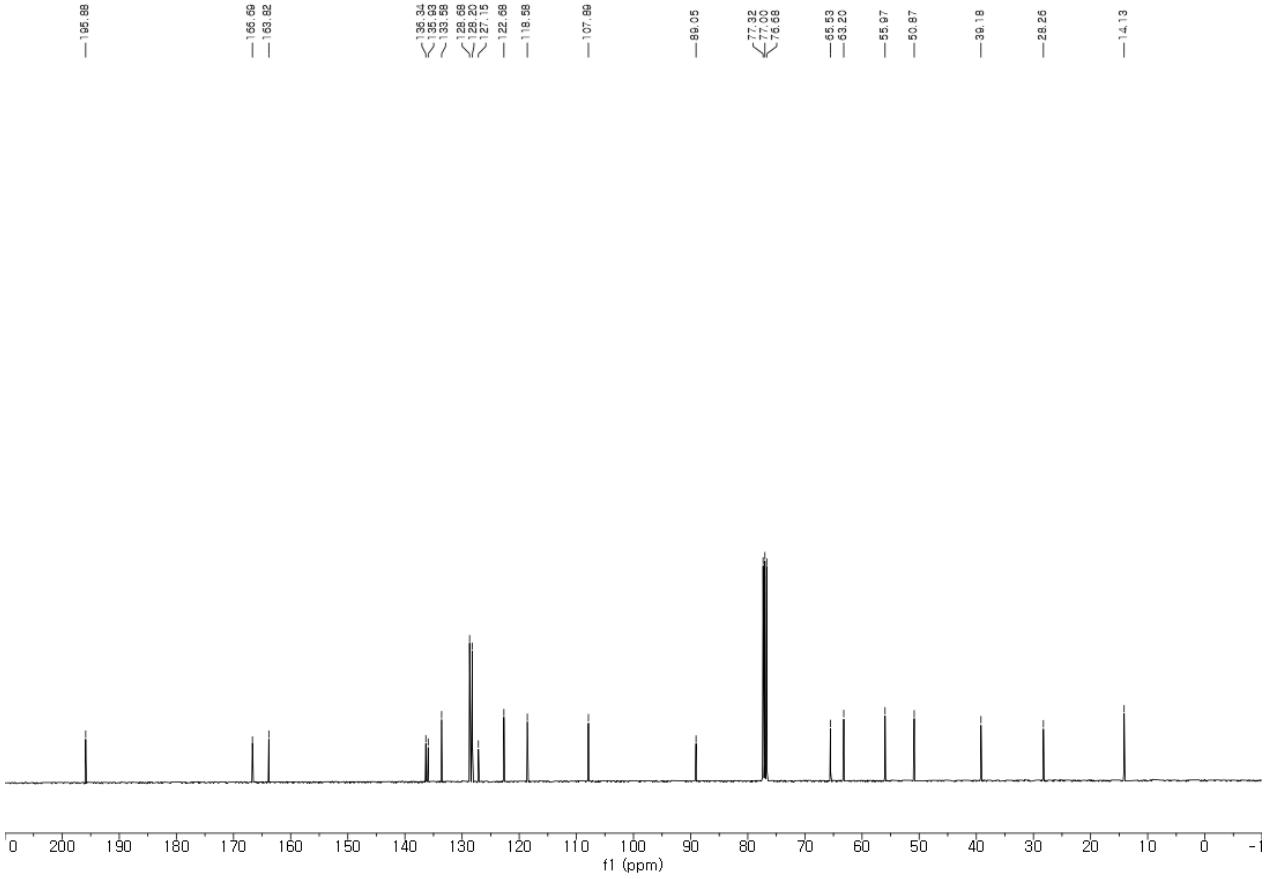


^{13}C NMR (100 MHz) in $CDCl_3$



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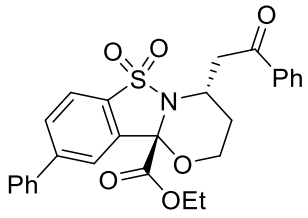

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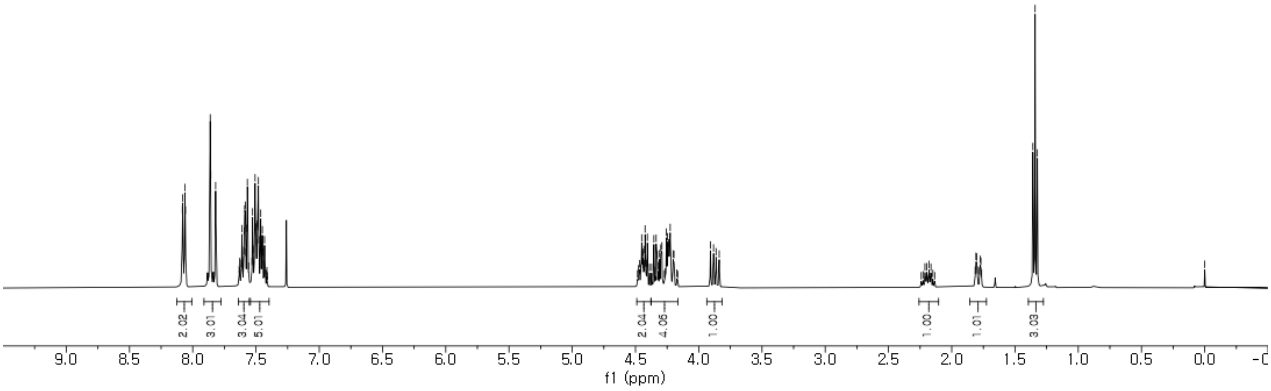
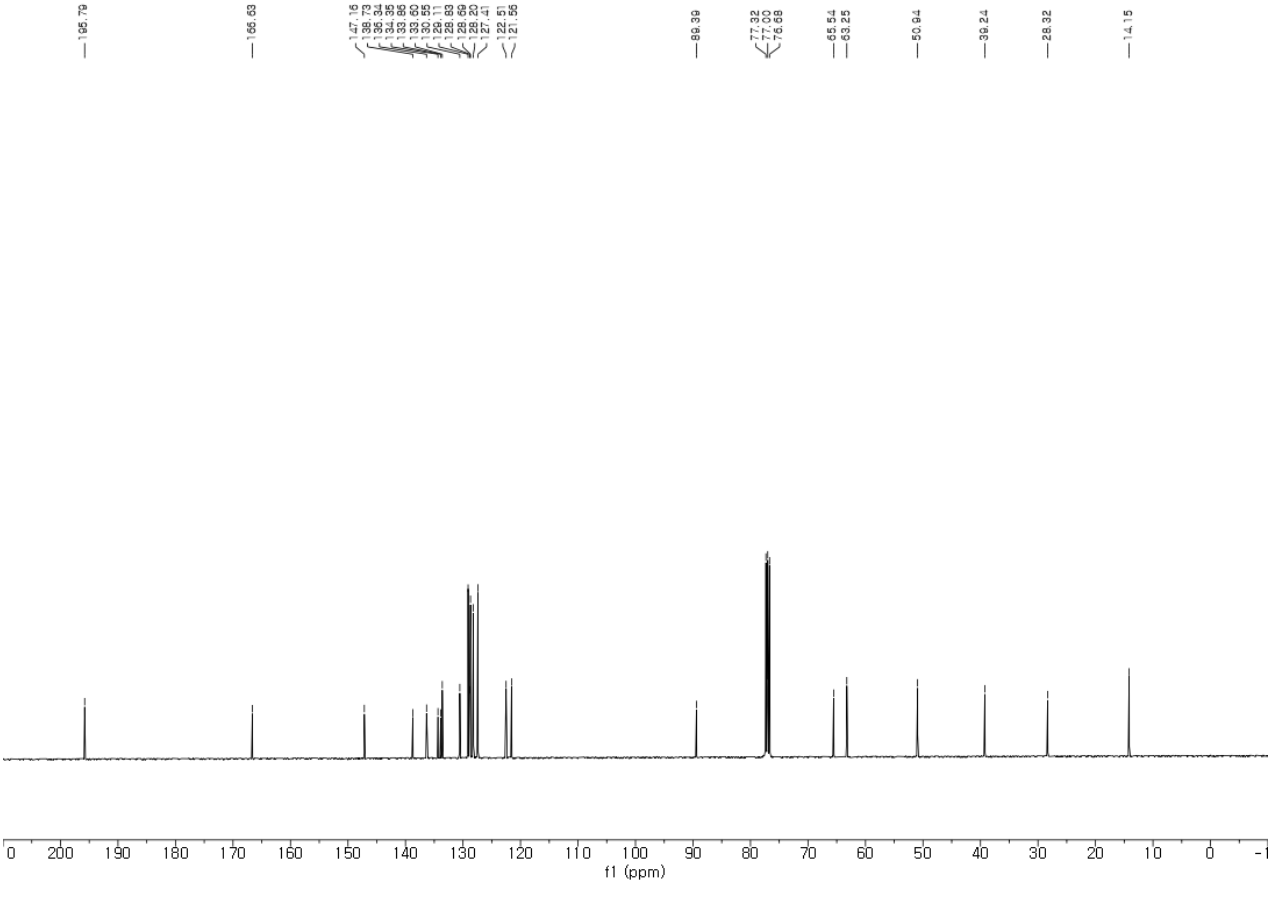
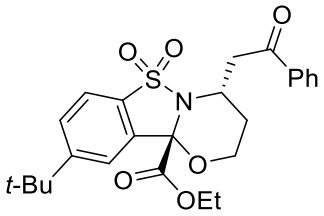


^{13}C NMR (100 MHz) in $CDCl_3$



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



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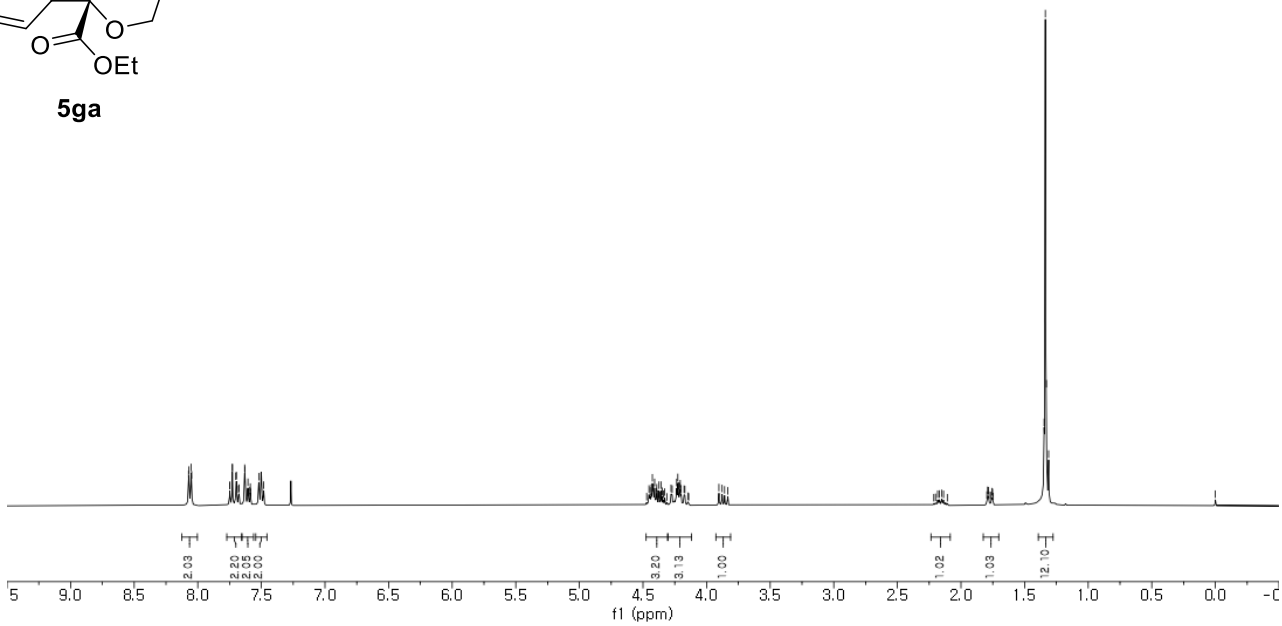
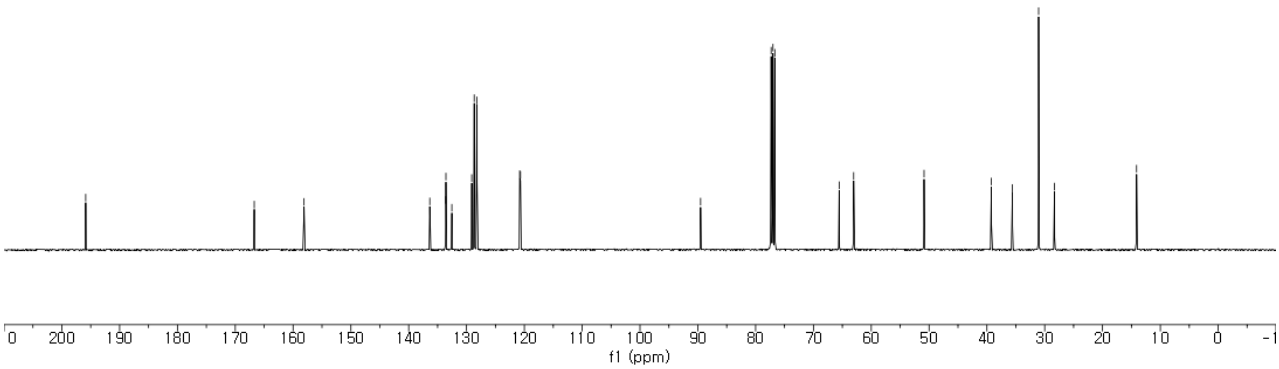


^{13}C NMR (100 MHz) in $CDCl_3$



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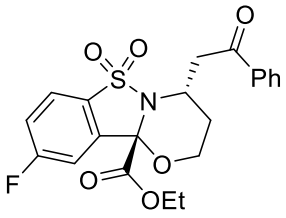

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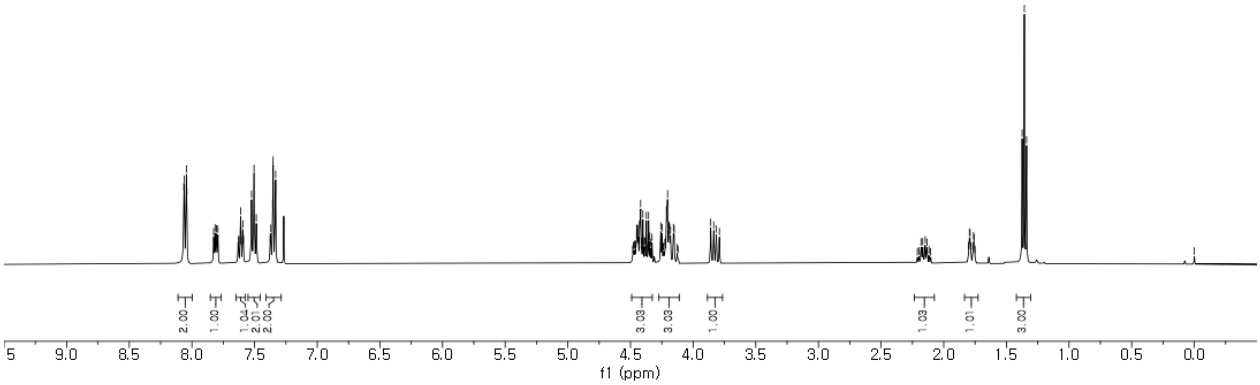

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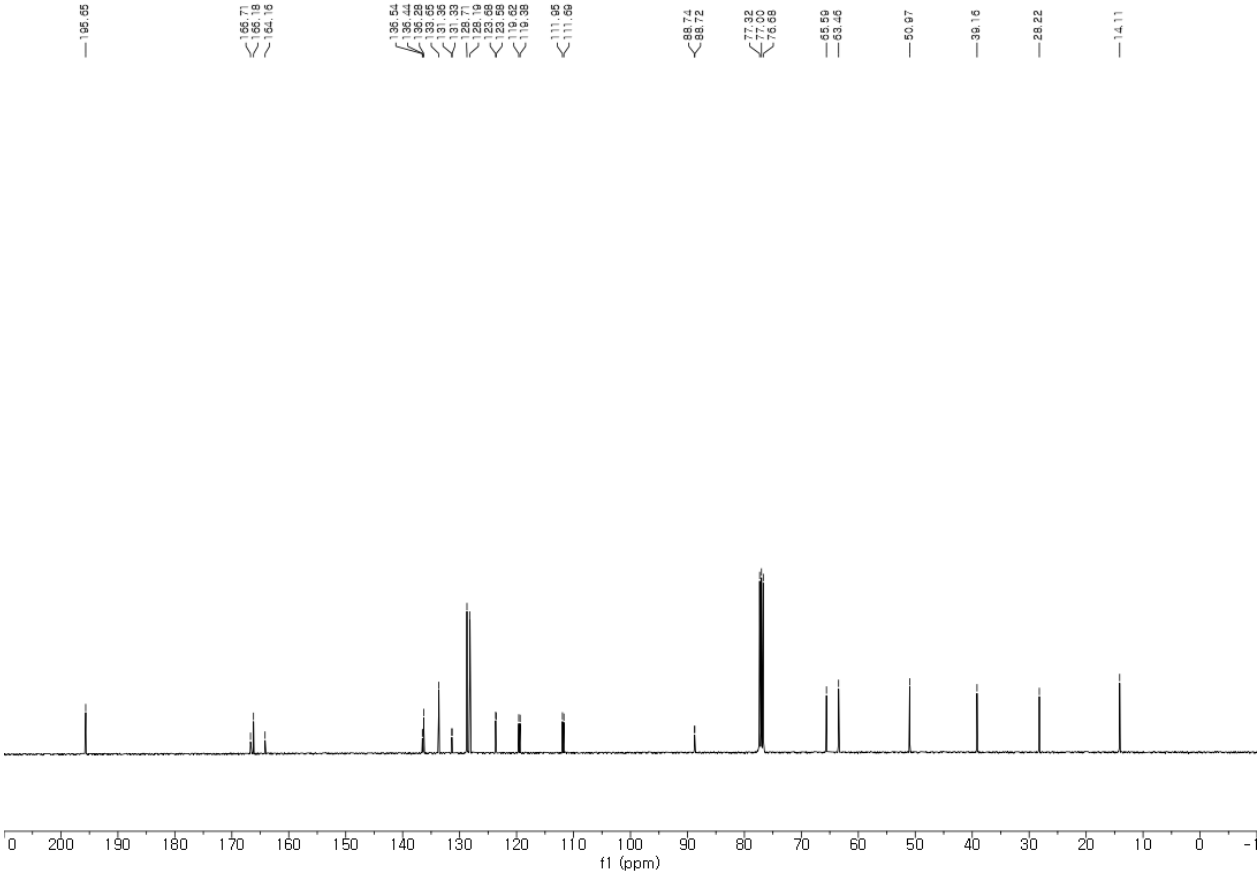
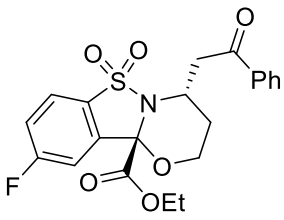


^{19}F NMR (376 MHz) in $CDCl_3$



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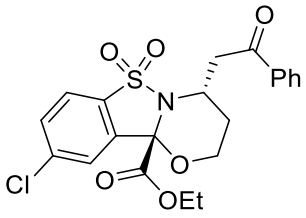

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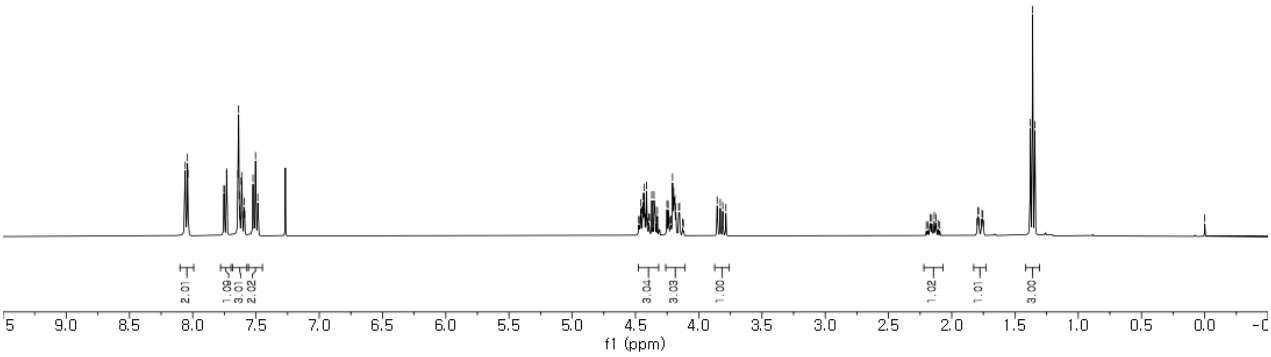
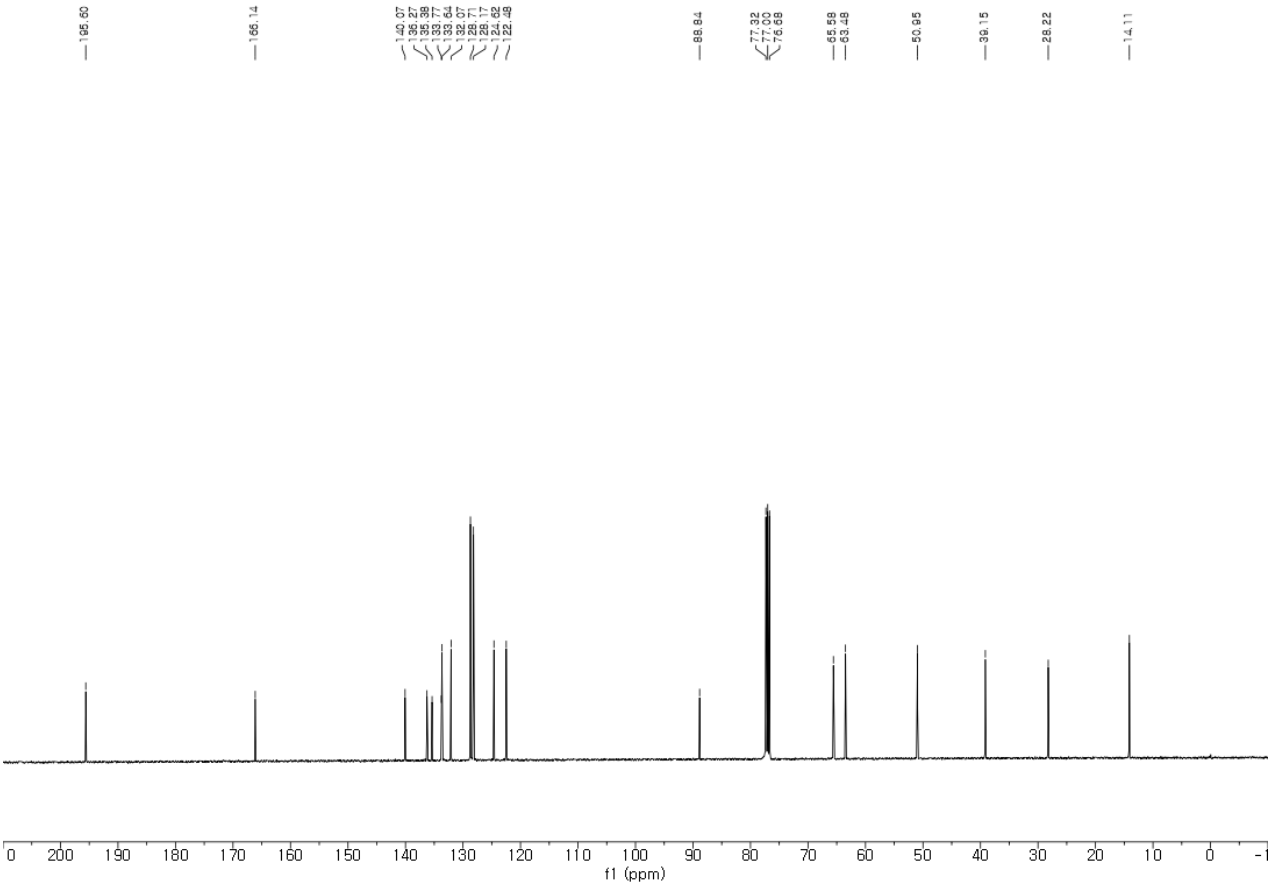
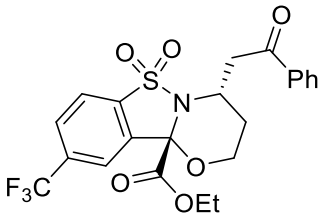


^{13}C NMR (100 MHz) in $CDCl_3$



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



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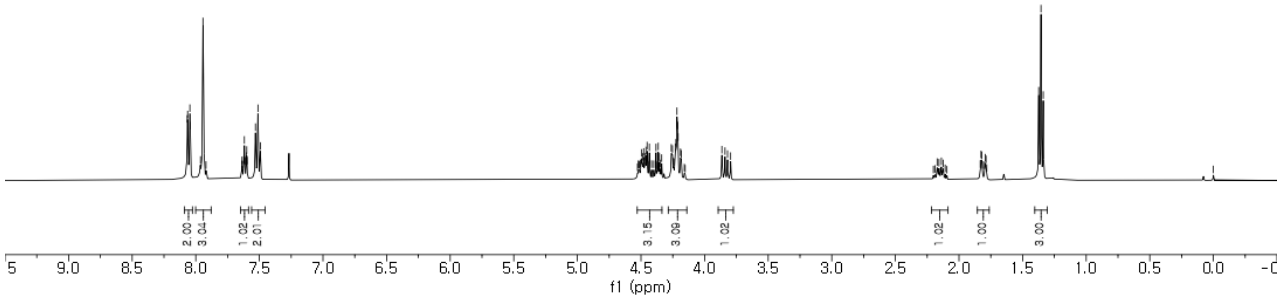
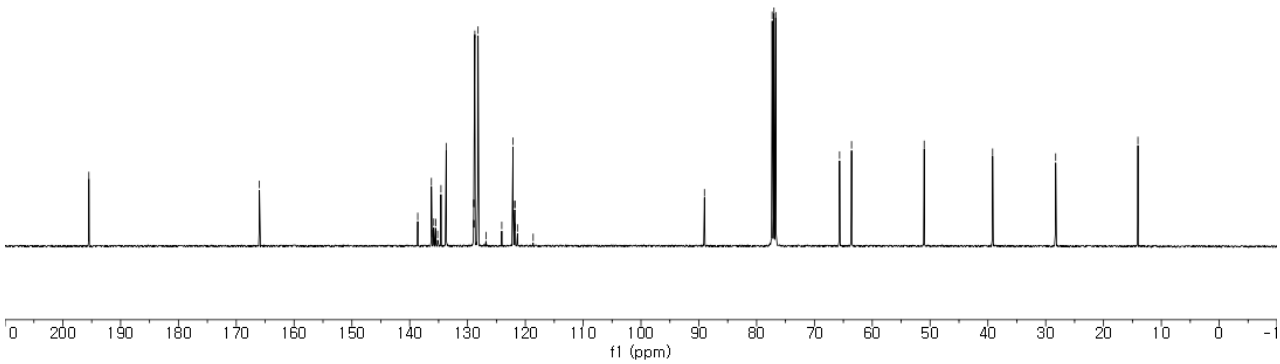
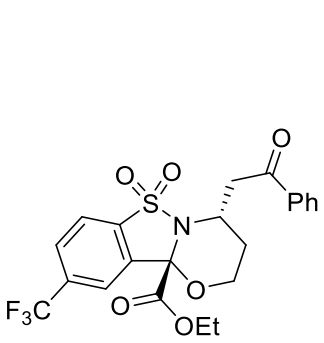


^{13}C NMR (100 MHz) in $CDCl_3$



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



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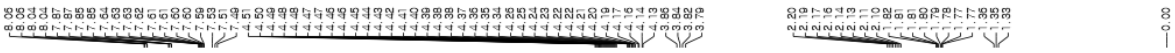
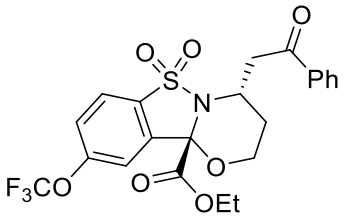
^{1}H NMR (400 MHz) in $CDCl_3$





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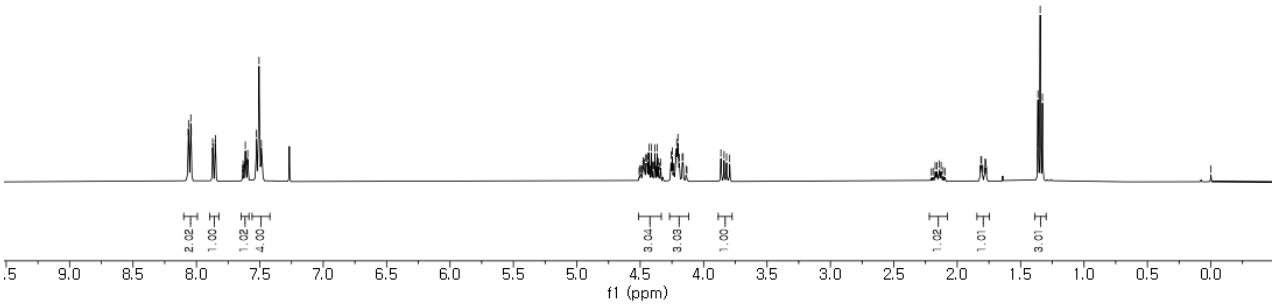
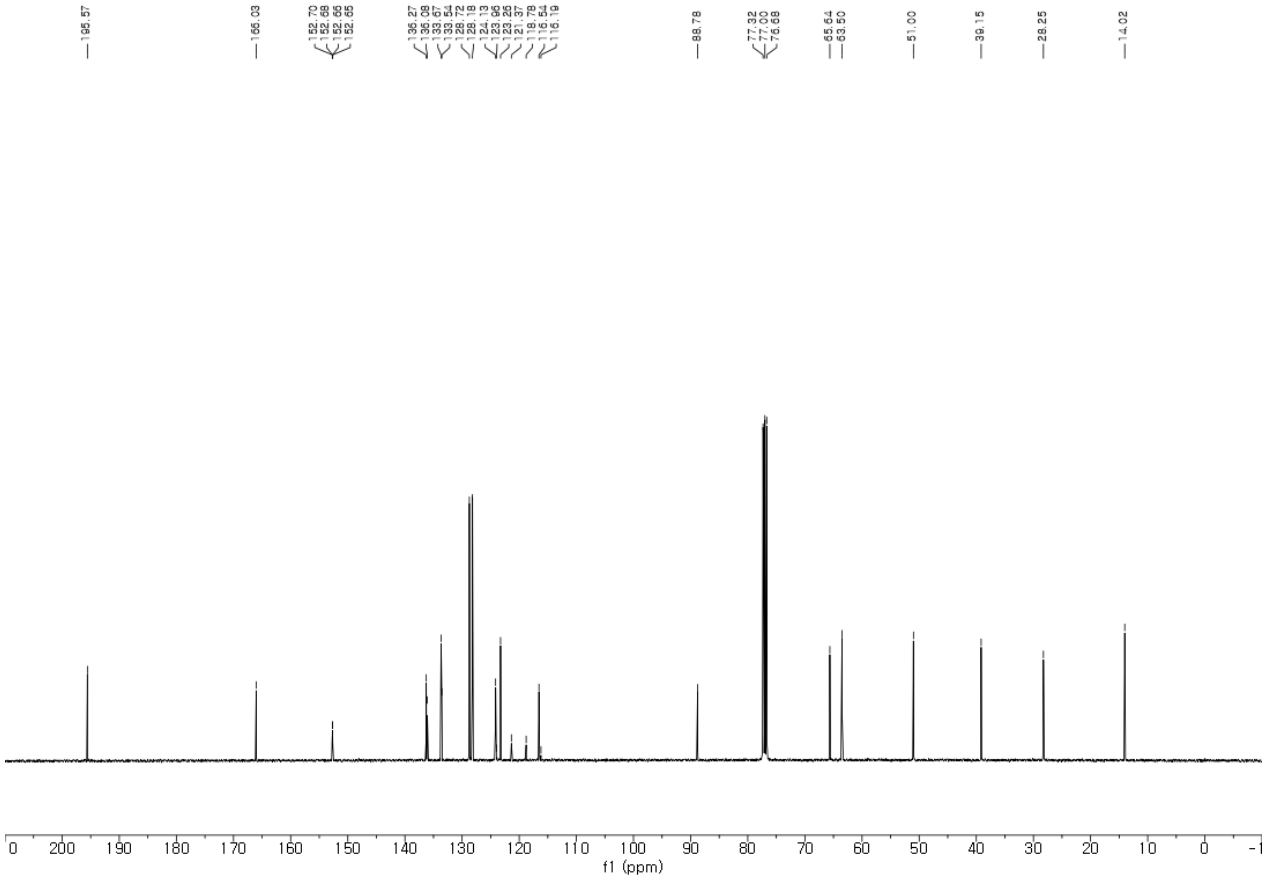


^{13}C NMR (100 MHz) in $CDCl_3$



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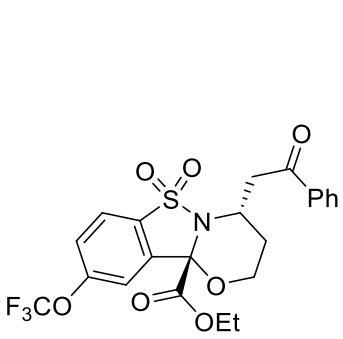

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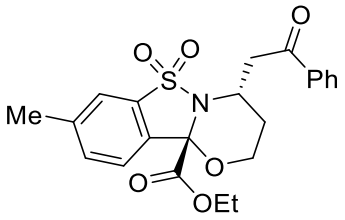

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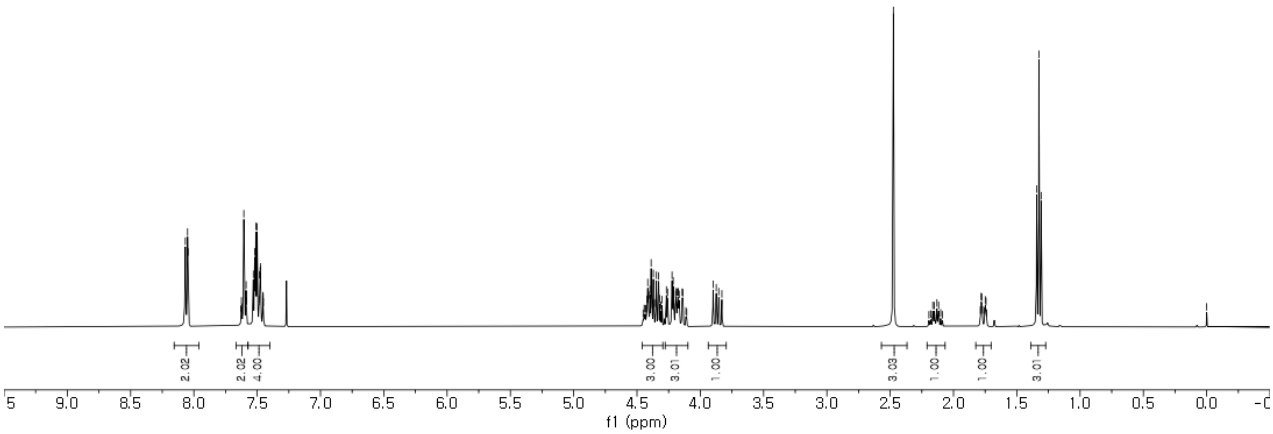
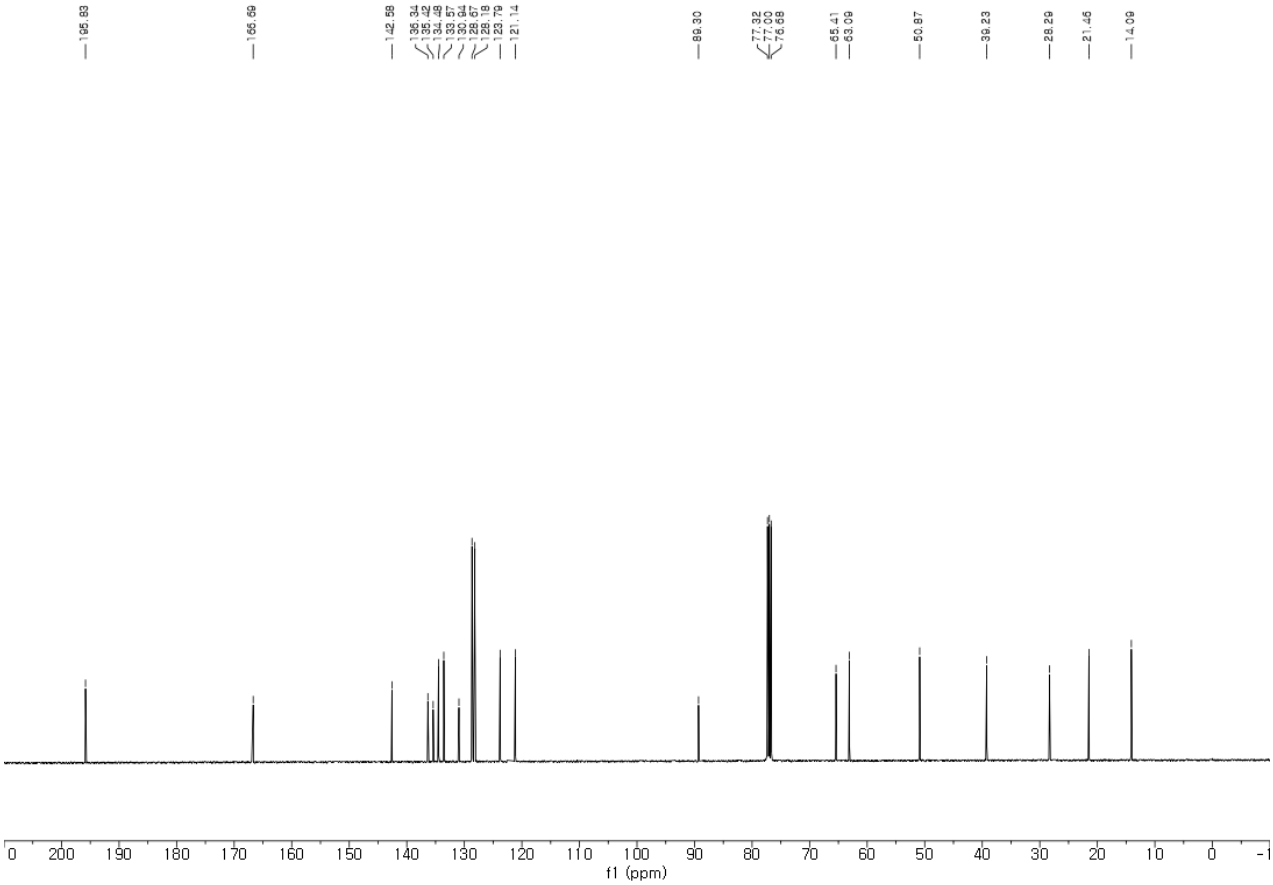


^{13}C NMR (100 MHz) in $CDCl_3$



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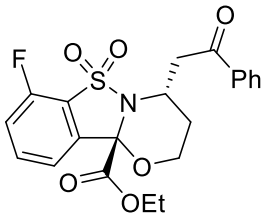

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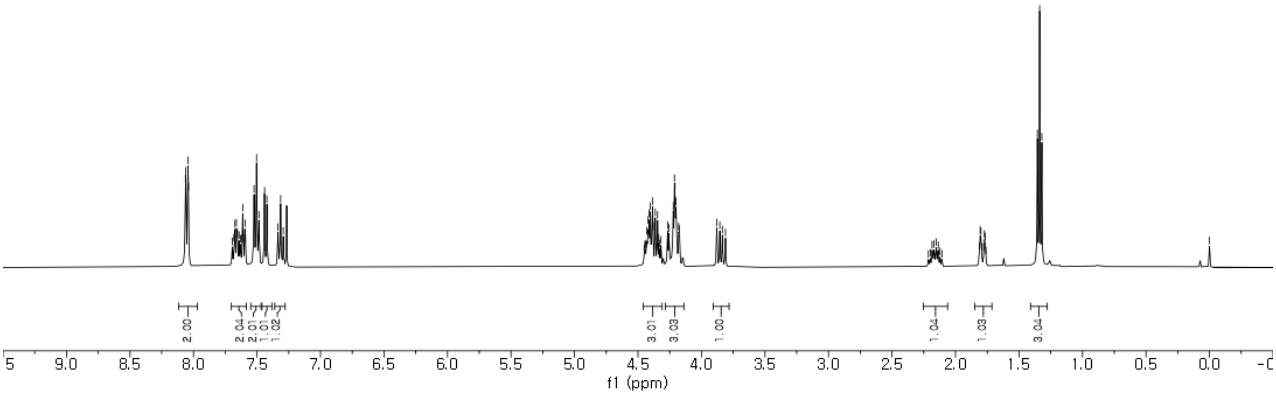

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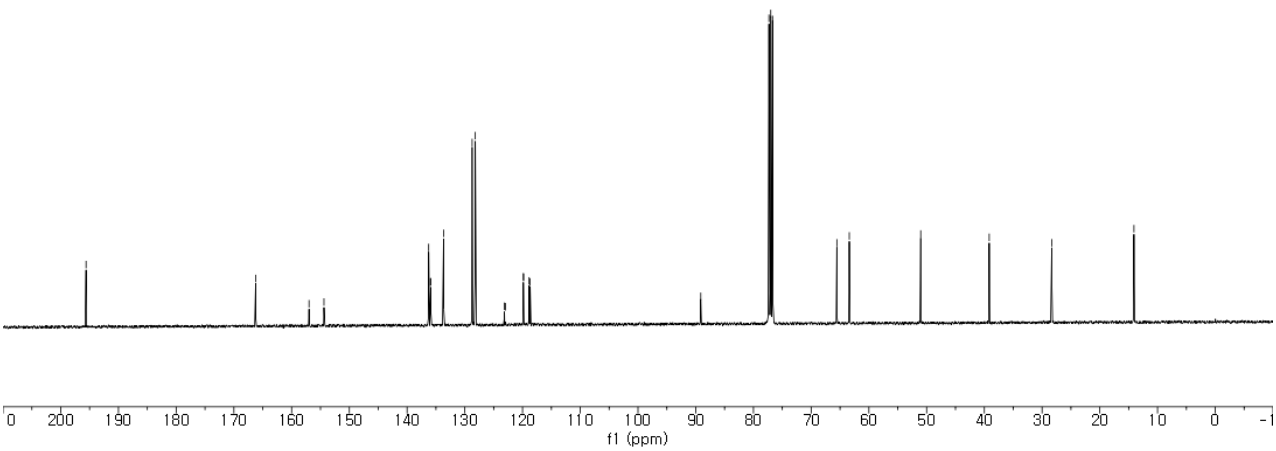

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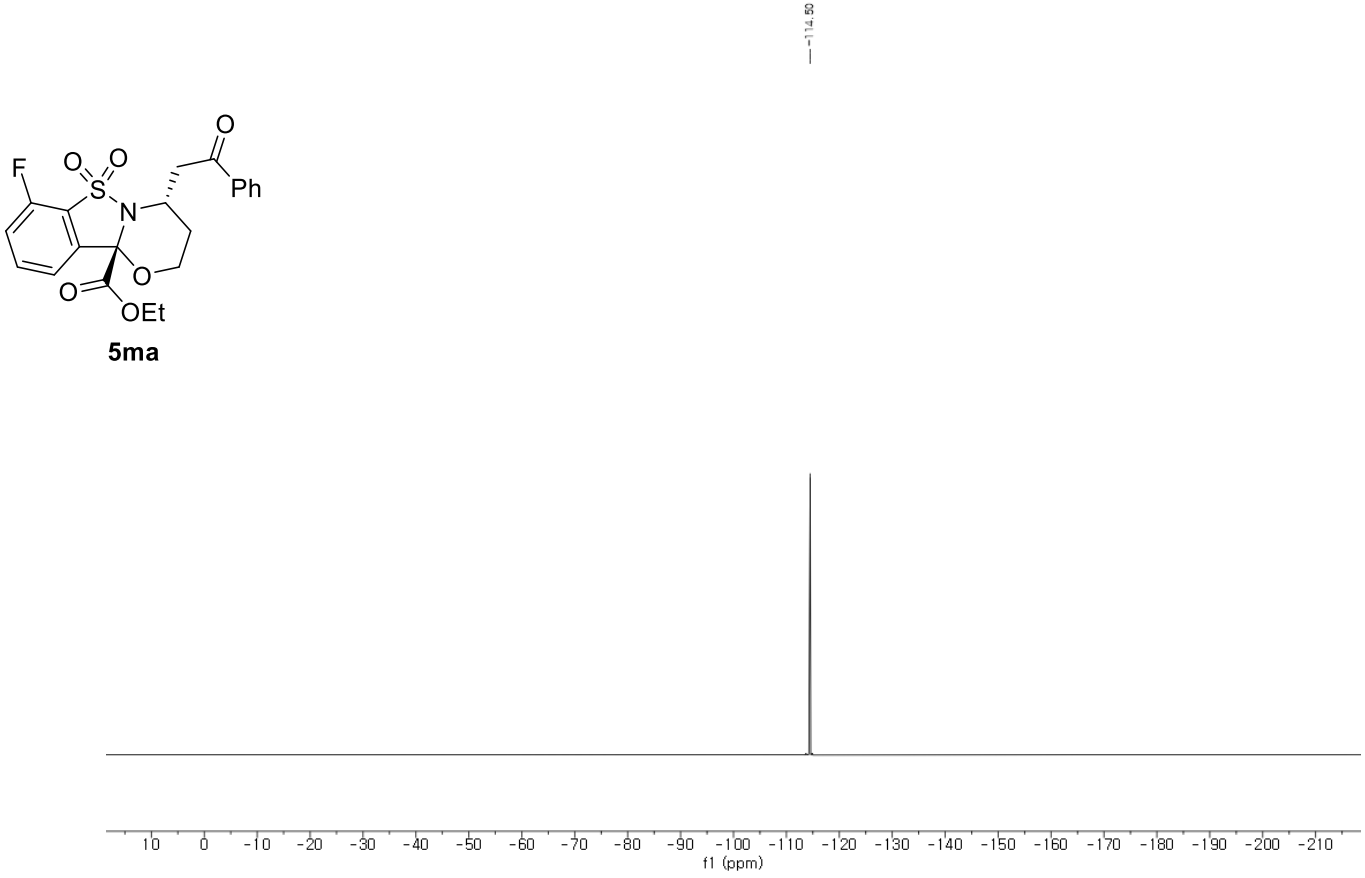

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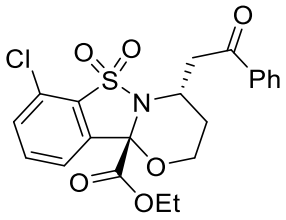

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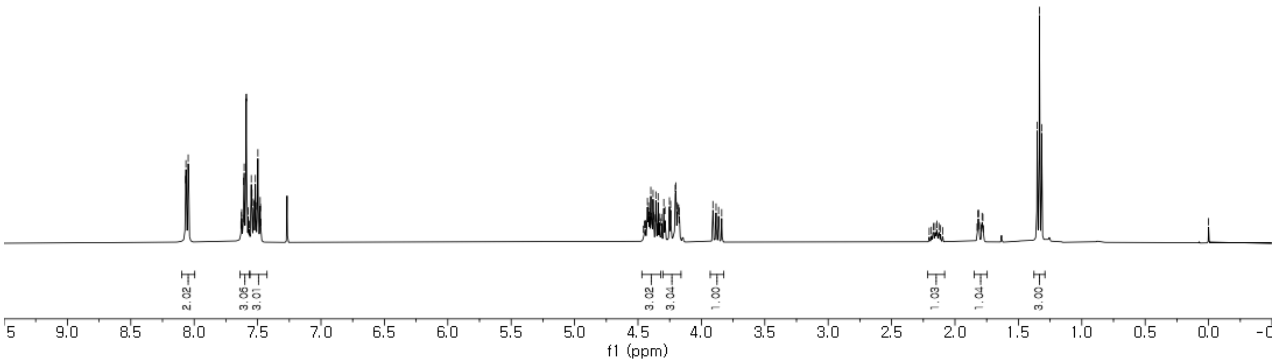

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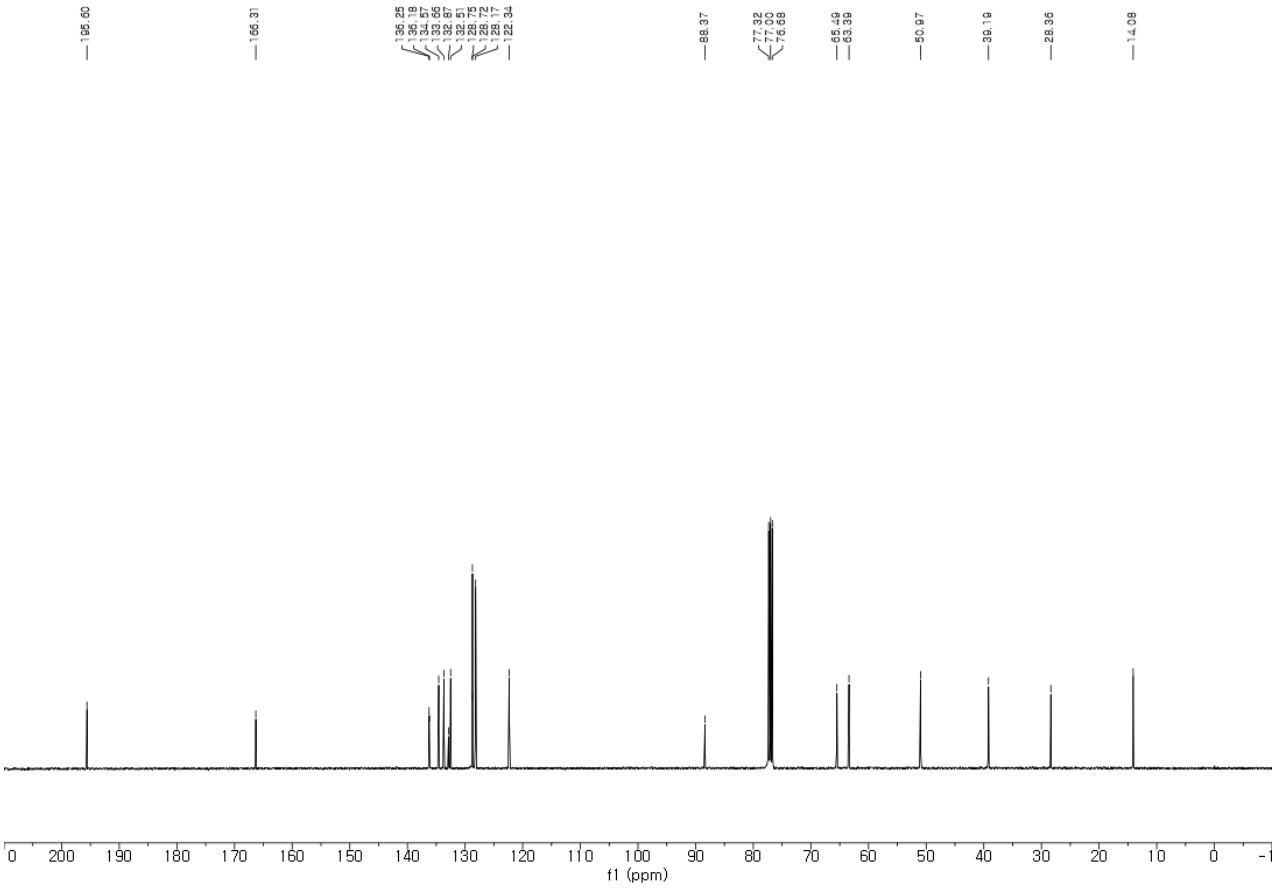

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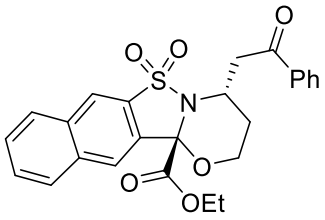

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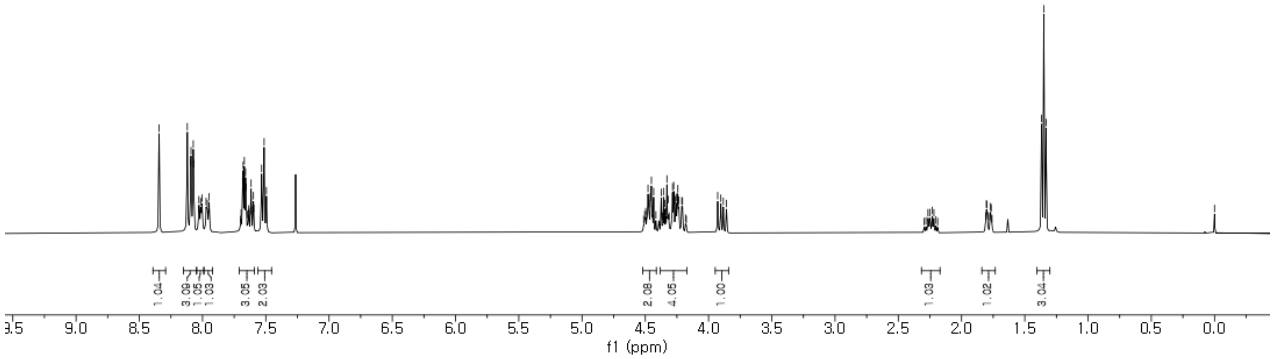

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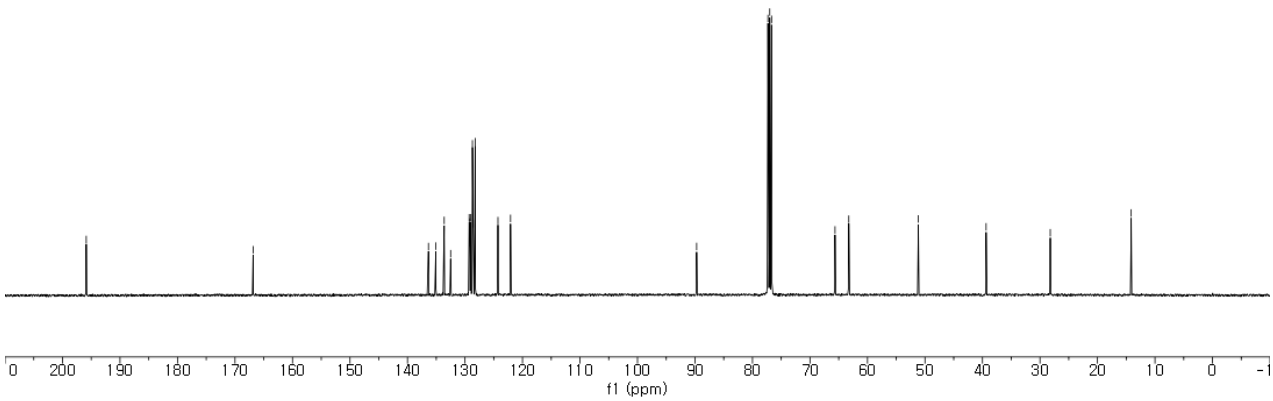

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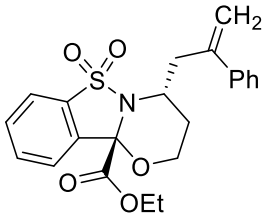

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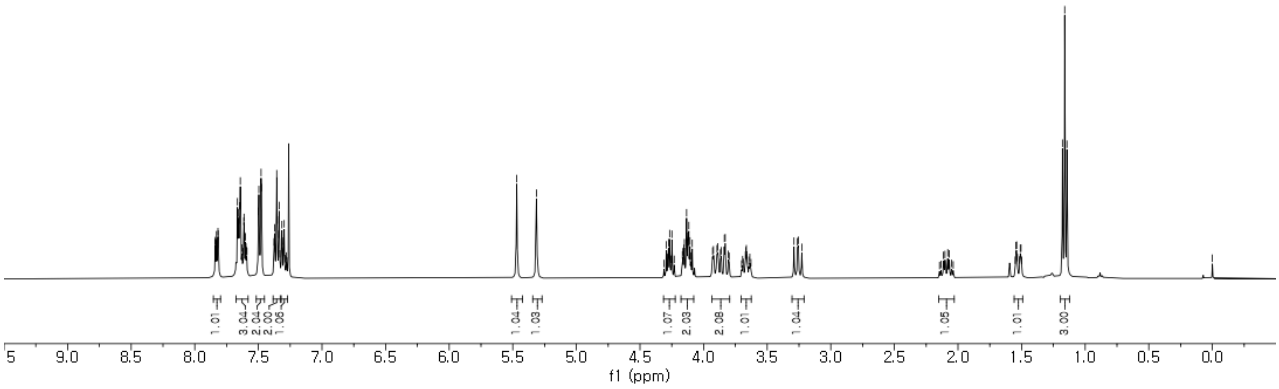

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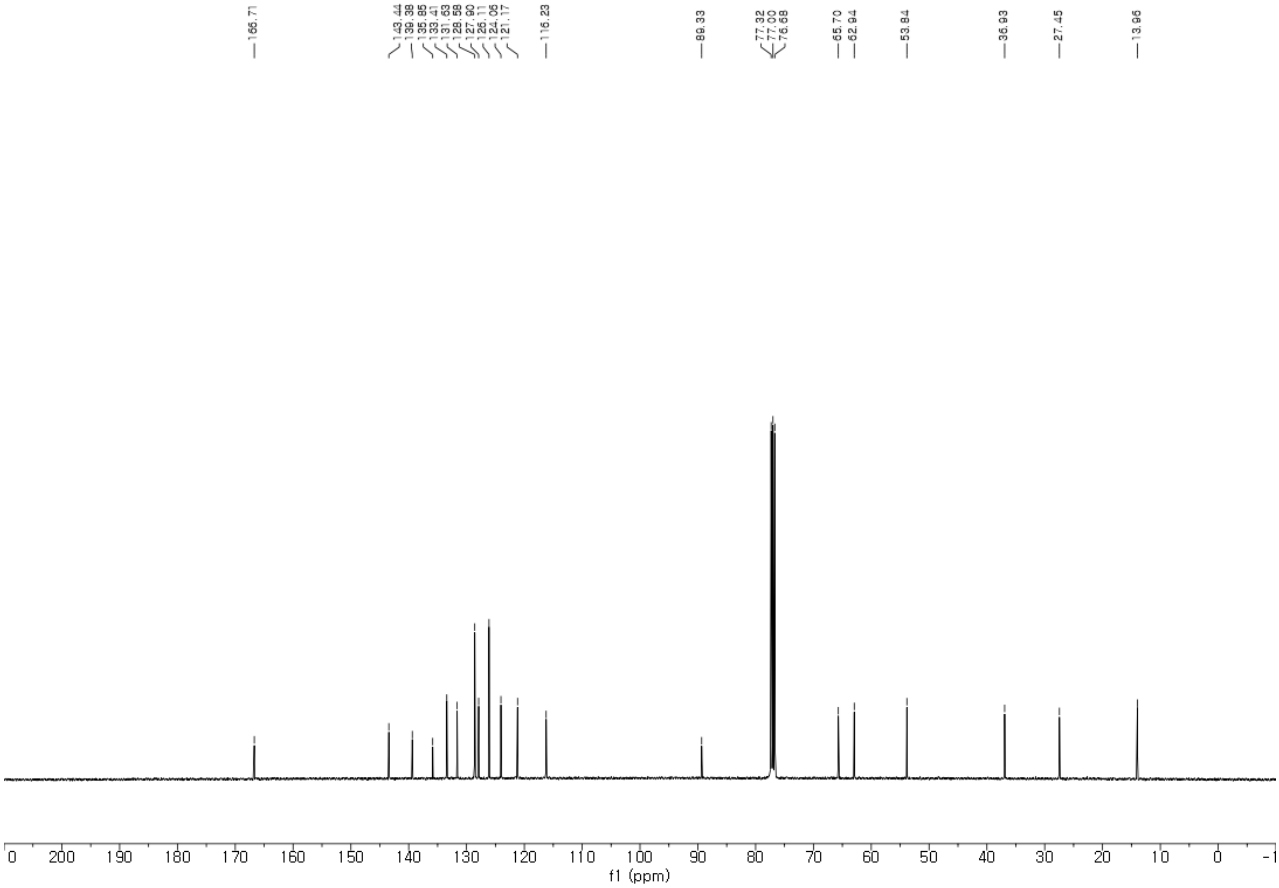

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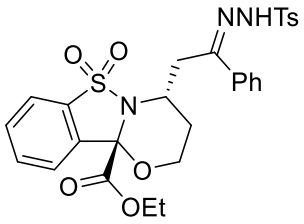

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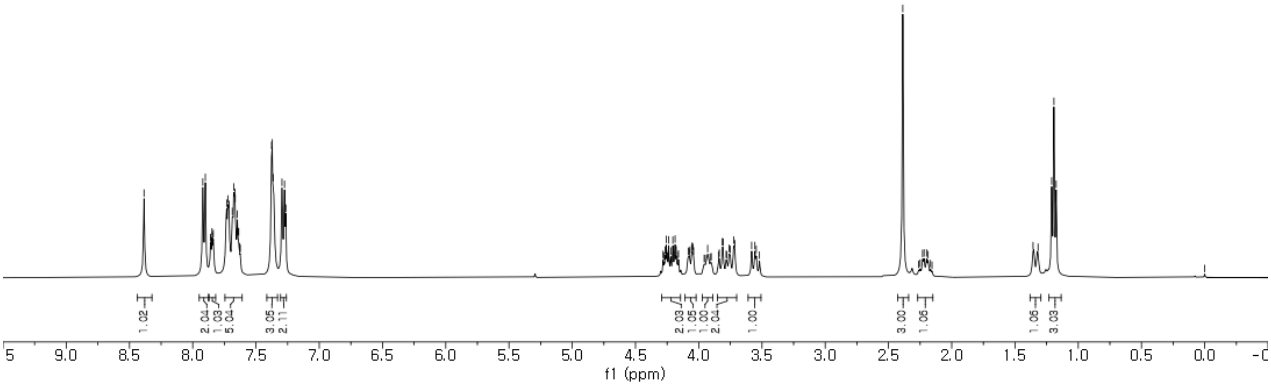
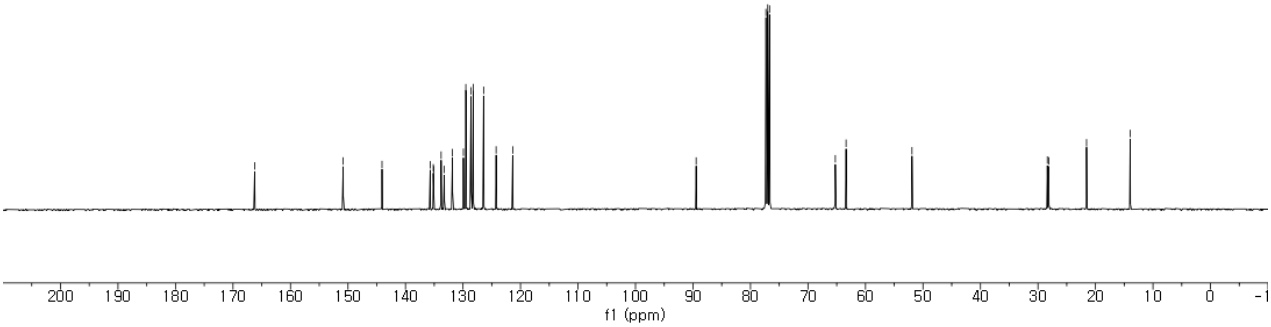
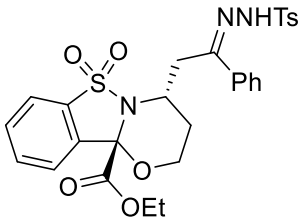


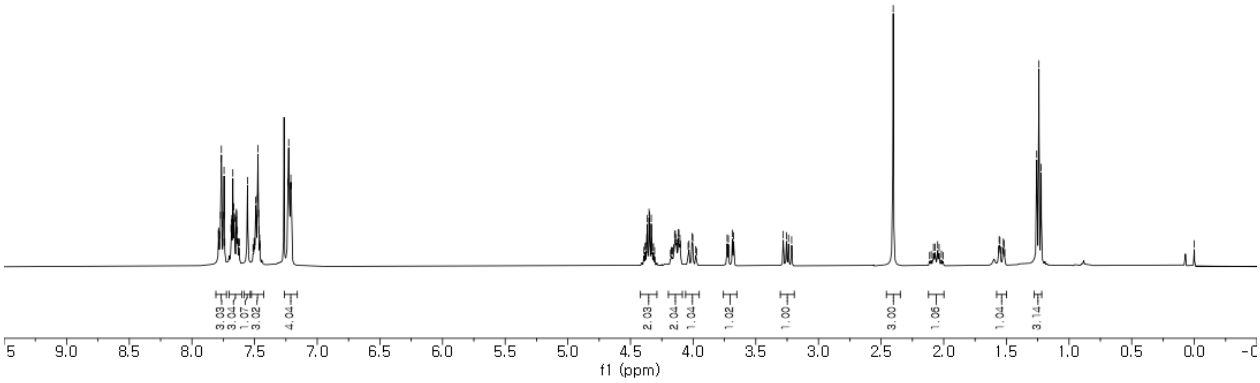
^{13}C NMR (100 MHz) in $CDCl_3$



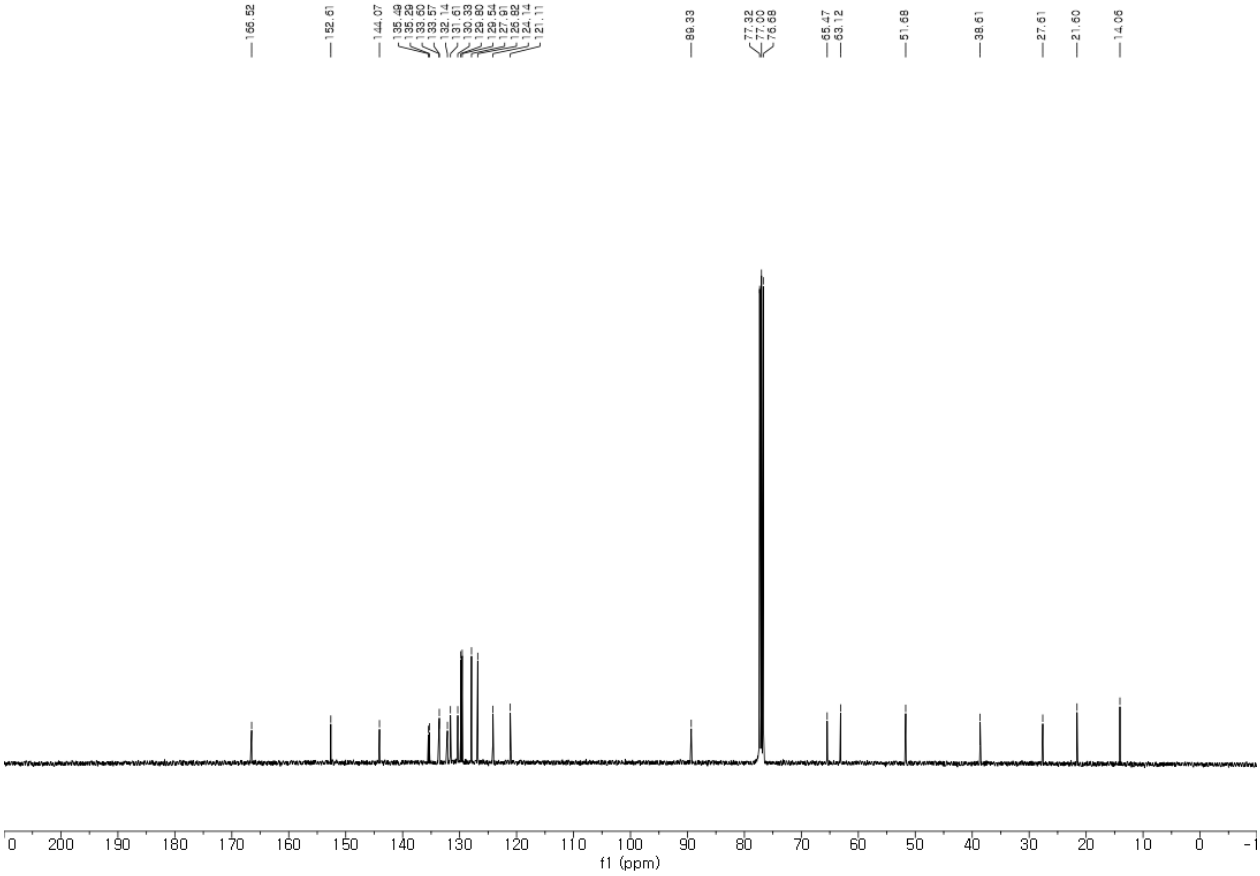
^{1}H NMR (400 MHz) in $CDCl_3$



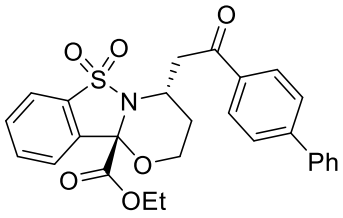
7 (minor)



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



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



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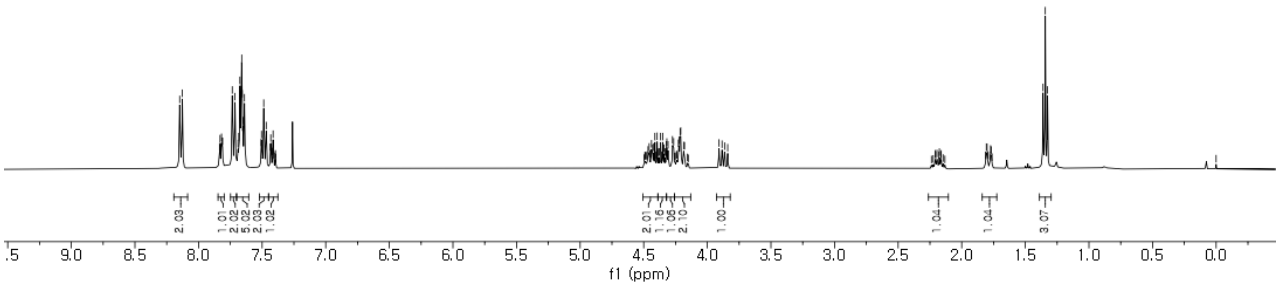
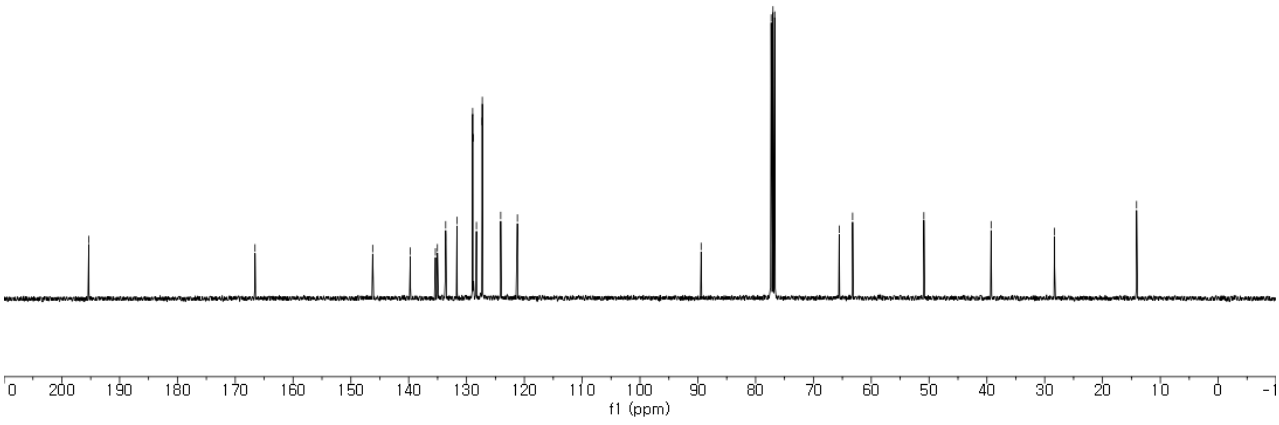
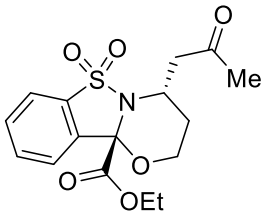


^{13}C NMR (100 MHz) in $CDCl_3$



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



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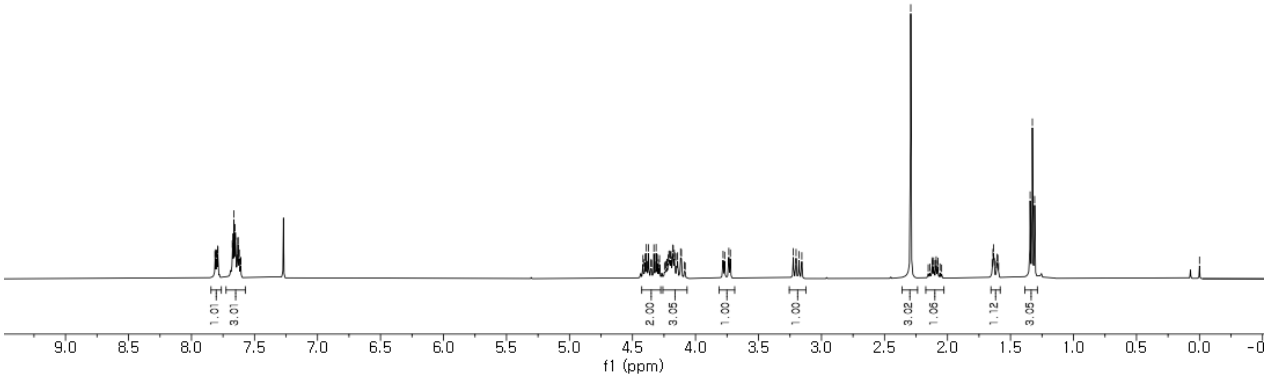
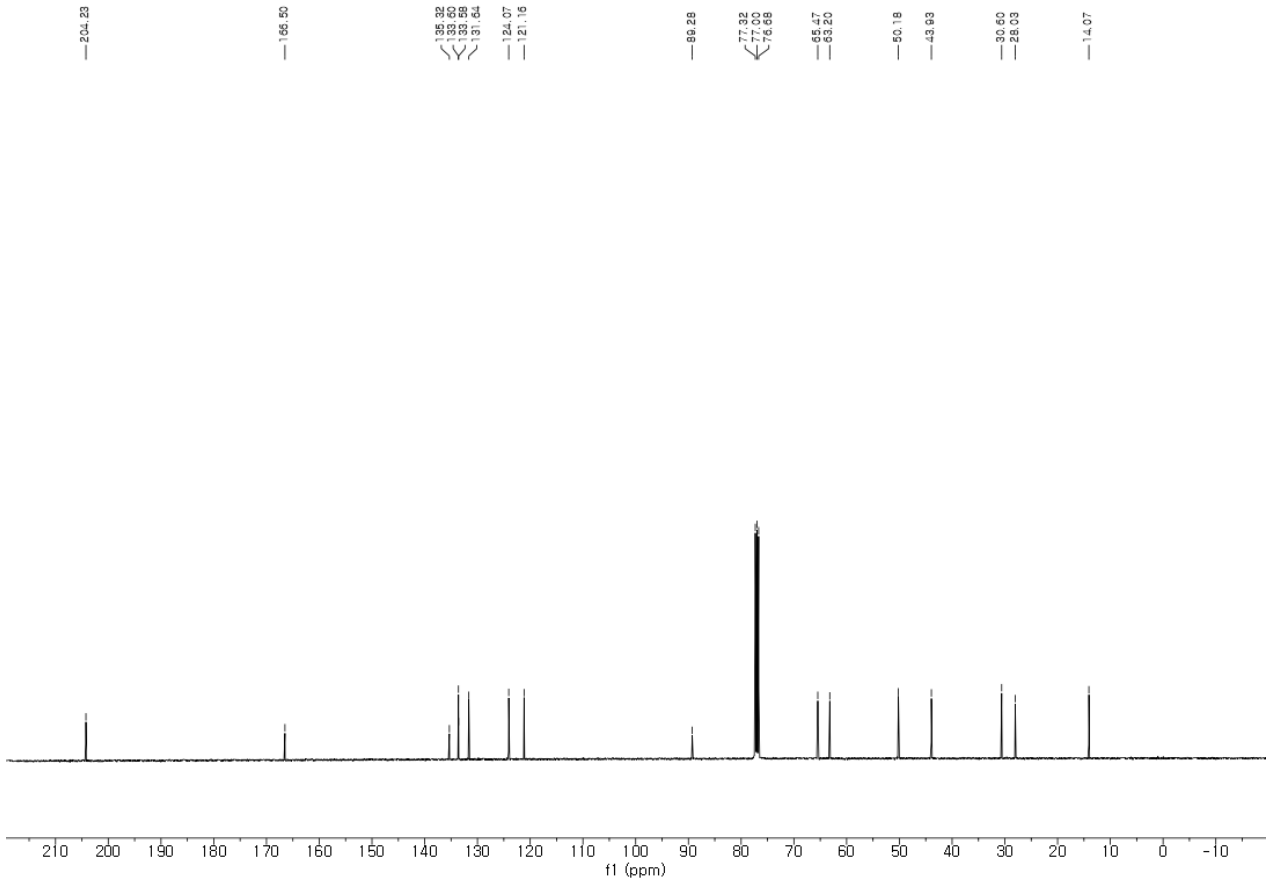
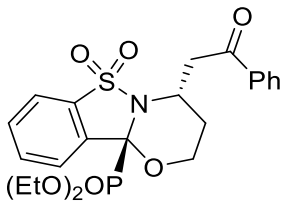


^{13}C NMR (100 MHz) in $CDCl_3$



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



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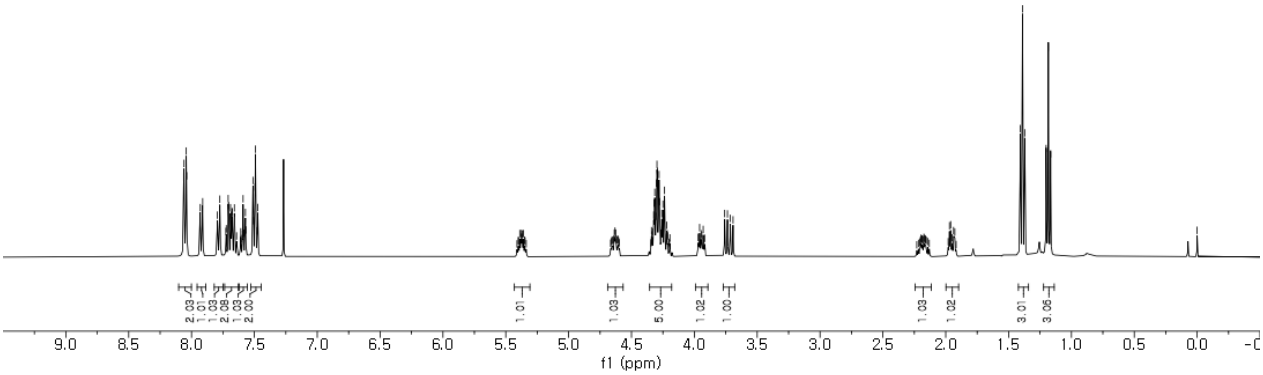
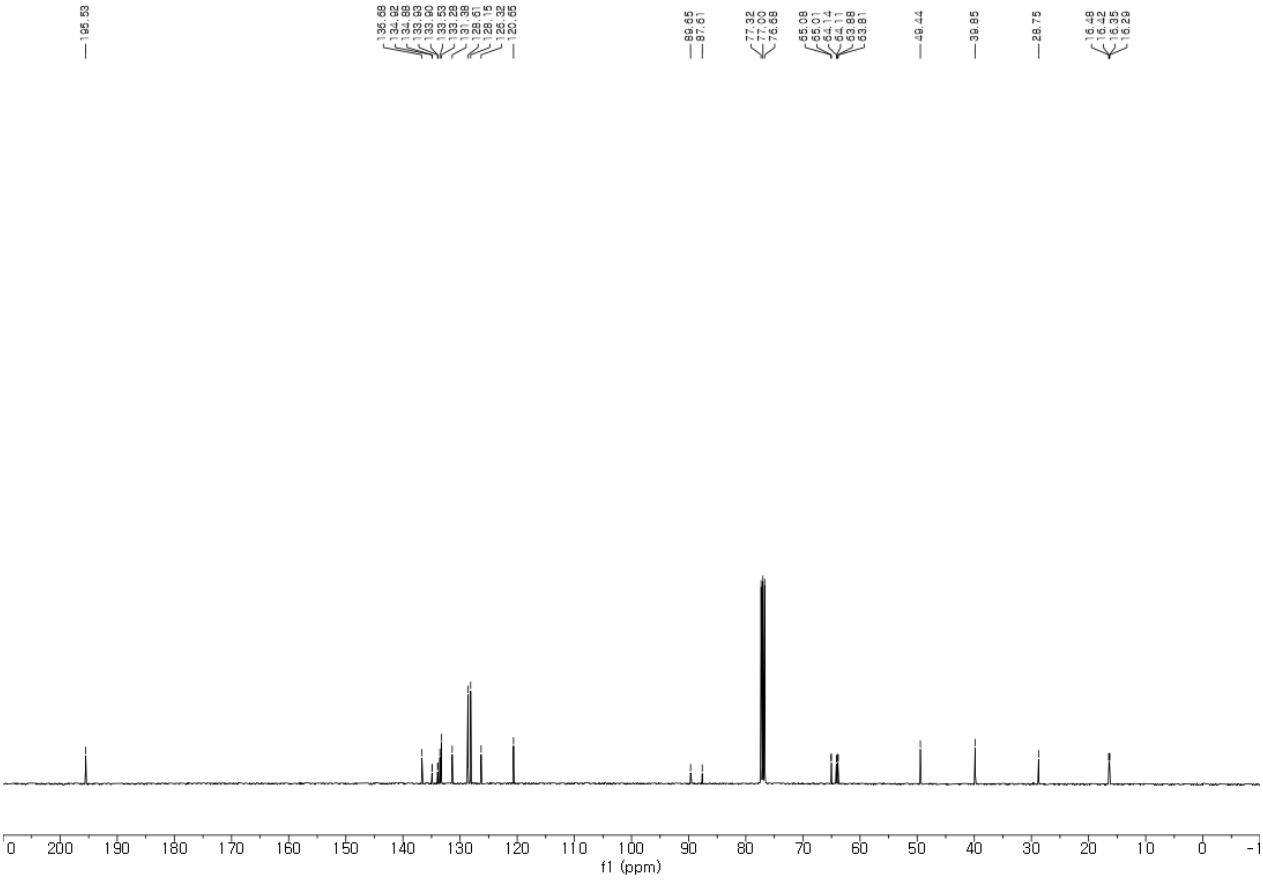
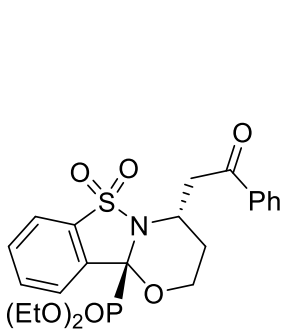


^{13}C NMR (100 MHz) in $CDCl_3$

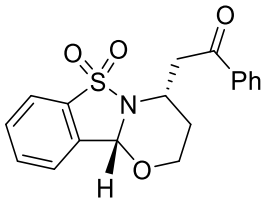


^{31}P NMR (162 MHz) in $CDCl_3$



11

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



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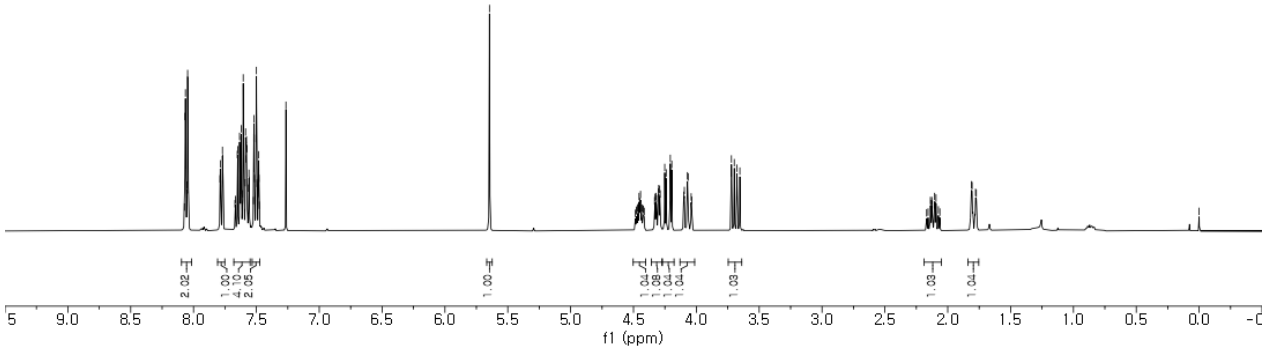
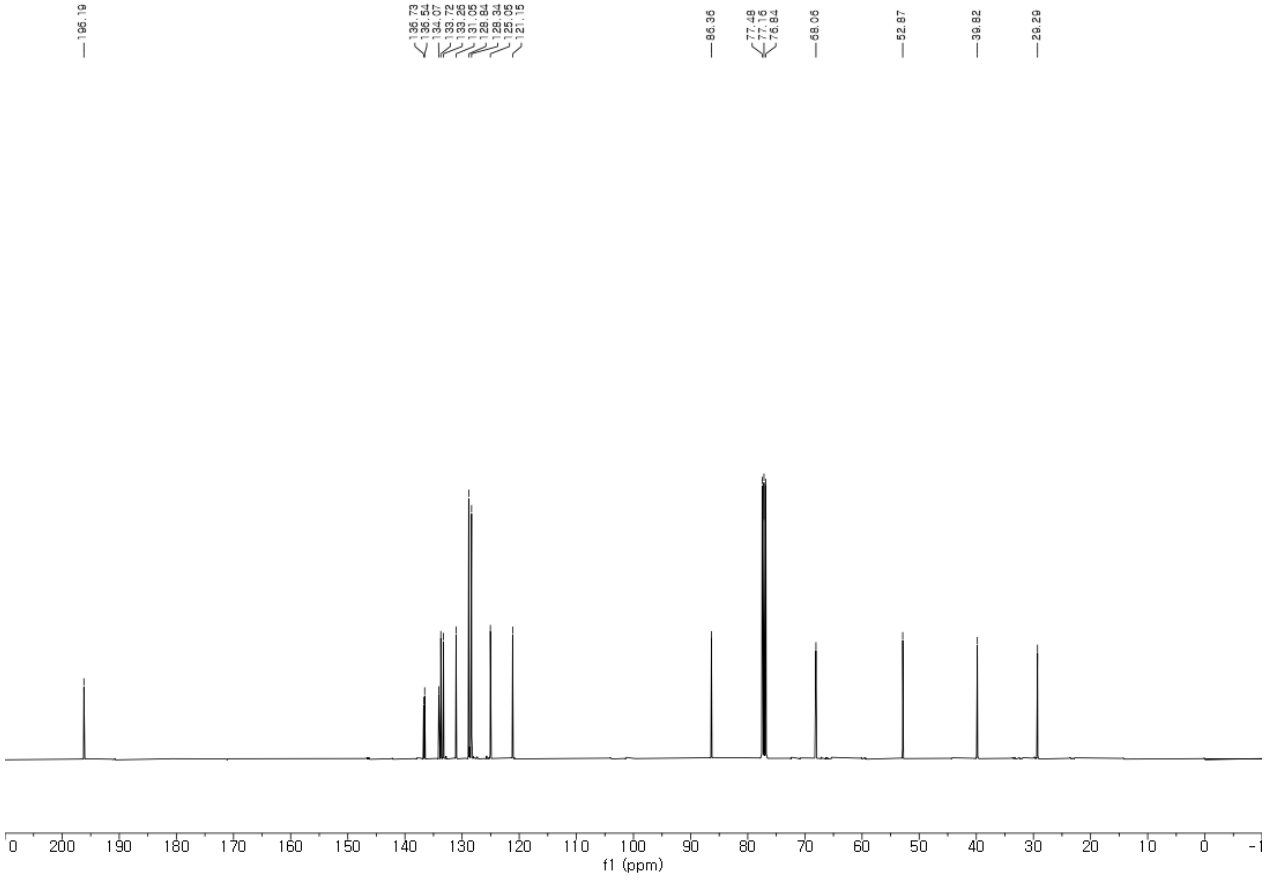
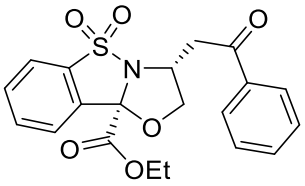


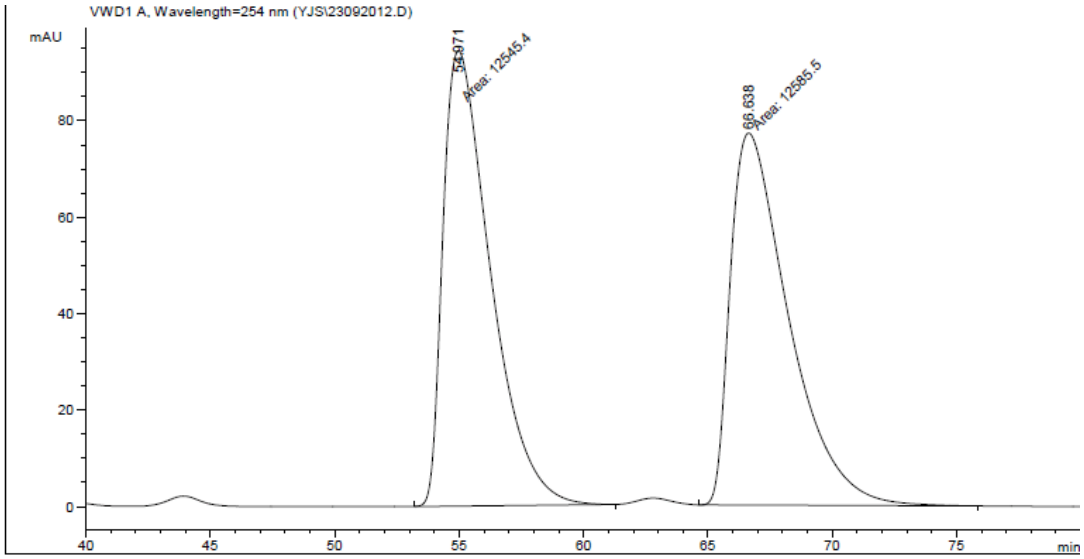
^{13}C NMR (100 MHz) in $CDCl_3$



HPLC chromatogram



3aa

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Peak RetTime Type  Width     Area      Height     Area
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   1  54.971 MM    2.2139 1.25454e4    94.44248  49.9203
   2  66.638 MM    2.7182 1.25855e4    77.16689  50.0797

Totals :                 2.51308e4   171.60937
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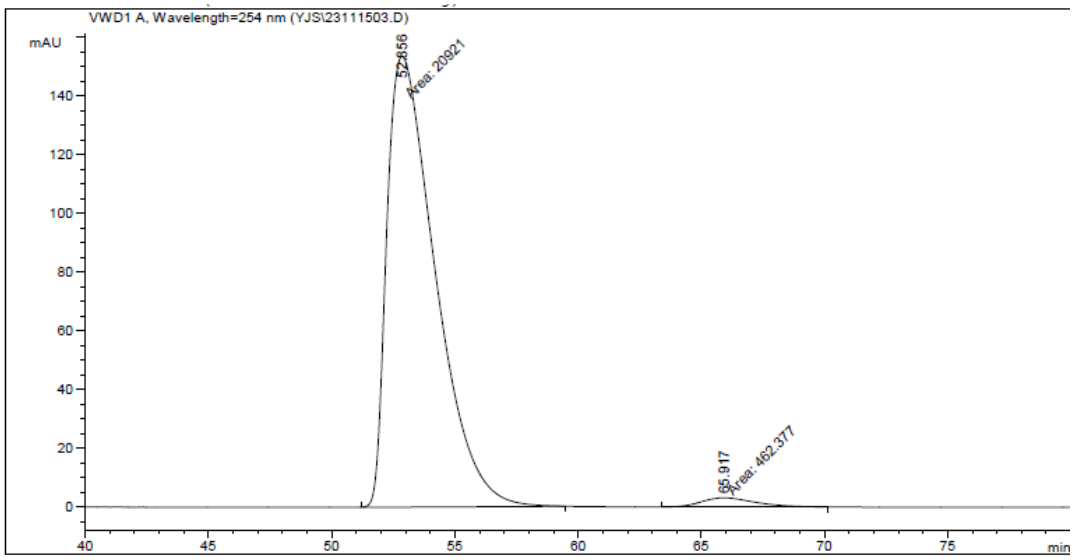


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----|-------|----|-------|----------|----------|--------|
   1  52.856 MM    2.2718 2.09210e4   153.48010  97.8377
   2  65.917 MM    2.4966  462.37704    3.08670   2.1623
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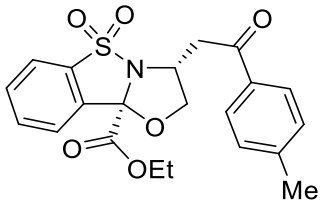

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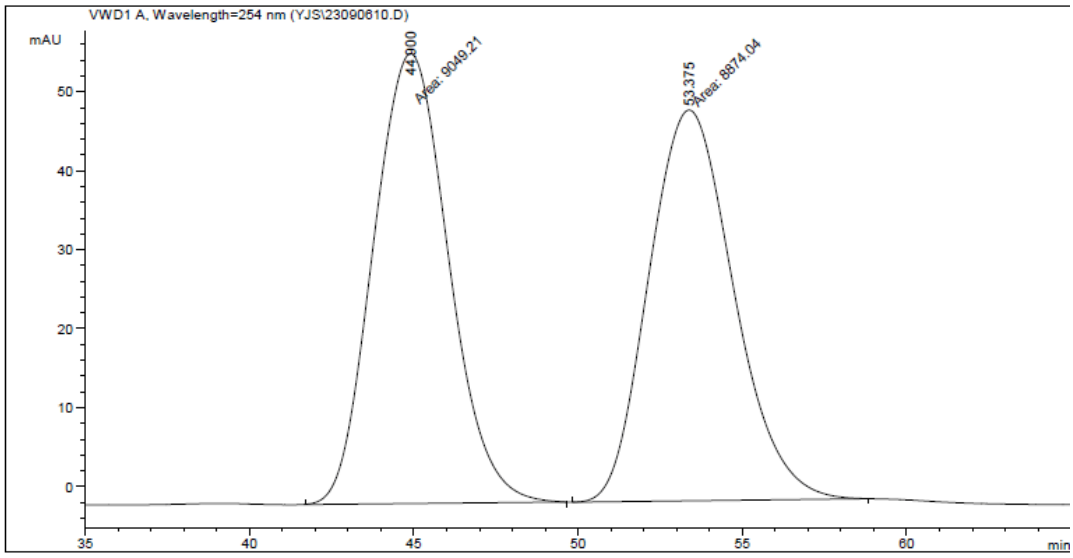


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                      Area Percent Report
=====================================================================
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----|-------|----|-------|----------|----------|--------|
   1  44.900 MM    2.6460 9049.20801   56.99987  50.4887
   2  53.375 MM    2.9872 8874.04004   49.51224  49.5113

Totals :                  1.79232e4   106.51211
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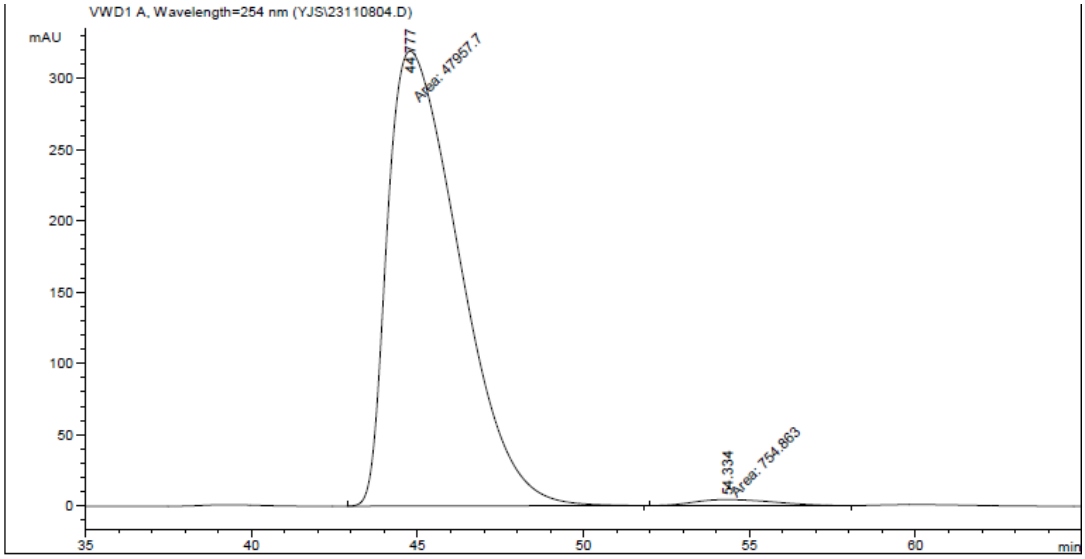


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Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
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   1  44.777 MM    2.5050 4.79577e4   319.08612  98.4504
   2  54.334 MM    2.8831  754.86316    4.36377   1.5496

Totals :                  4.87126e4   323.44989
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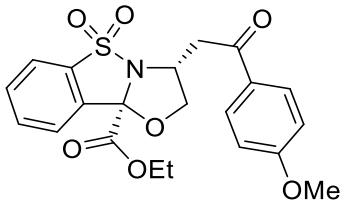

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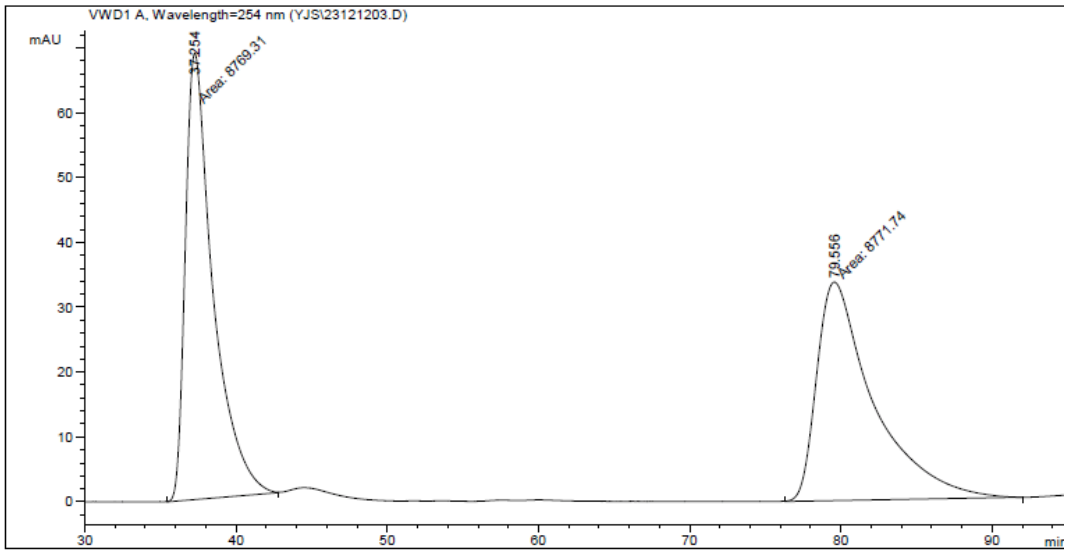


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Peak RetTime Type  Width     Area      Height     Area
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----|-------|----|-------|----------|----------|--------|
   1  37.254 MM    2.1233 8769.30957   68.83312  49.9931
   2  79.556 MM    4.3374 8771.73730   33.70578  50.0069

Totals :                  1.75410e4   102.53890
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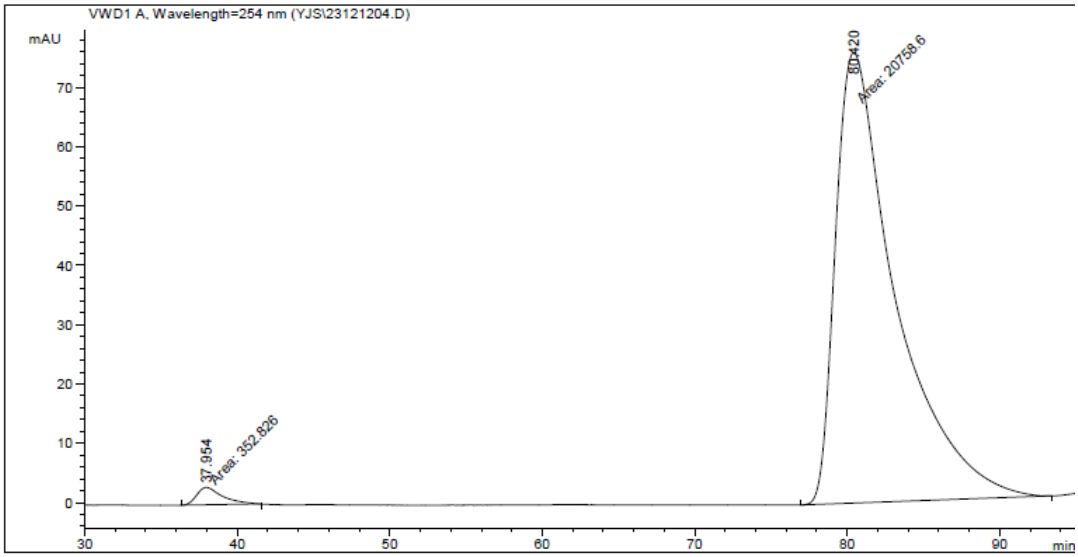


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Peak RetTime Type  Width     Area      Height     Area
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----|-------|----|-------|----------|----------|--------|
   1  37.954 MM    1.9881  352.82587    2.95775   1.6713
   2  80.420 MM    4.5539 2.07586e4    75.97385  98.3287

Totals :                  2.11115e4    78.93160
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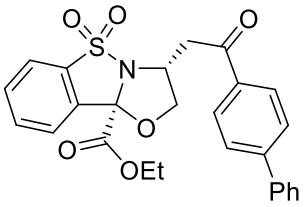

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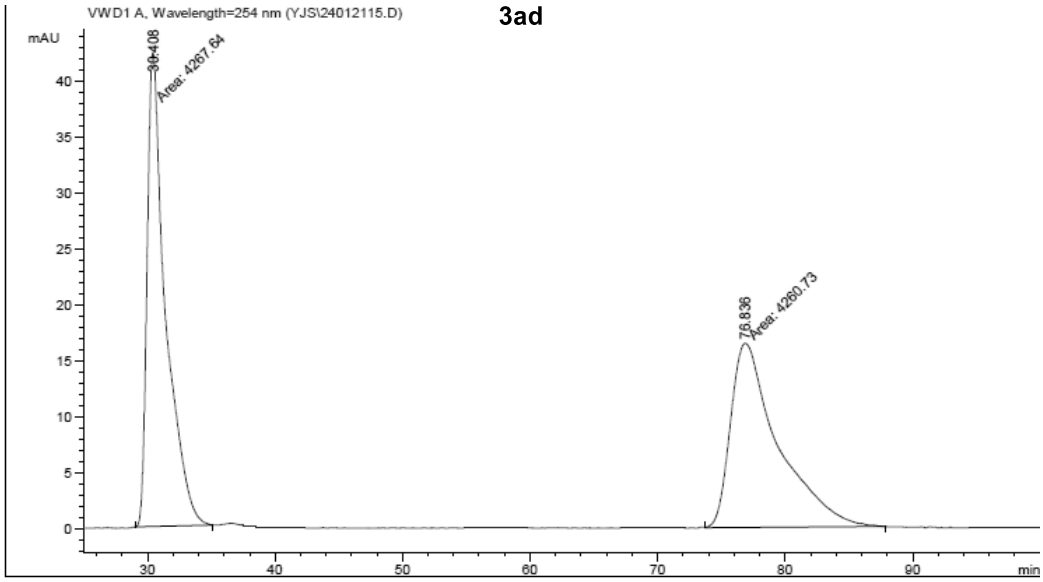


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                        Area Percent Report
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Peak RetTime Type  Width     Area      Height     Area
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----|-------|----|-------|----------|----------|--------|
   1  30.408 MM    1.6781 4267.64063   42.38490  50.0405
   2  76.836 MM    4.3126 4260.72705   16.46601  49.9595

Totals :                  8528.36768   58.85092
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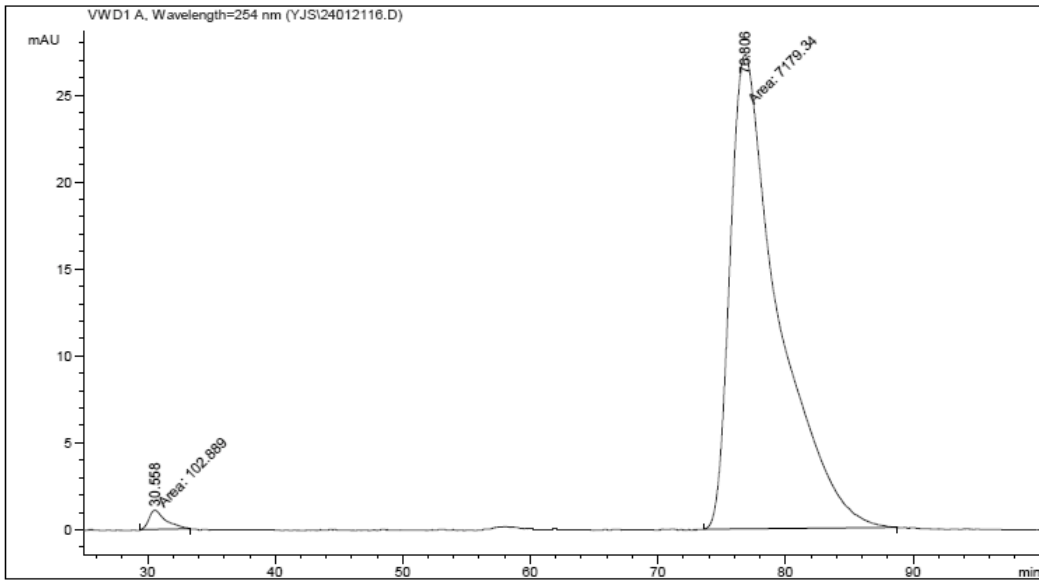


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                        Area Percent Report
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Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  30.558 MM    1.5326  102.88939    1.11887   1.4129
   2  76.806 MM    4.3839 7179.34424   27.29442  98.5871

Totals :                  7282.23363   28.41329
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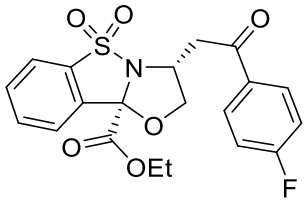

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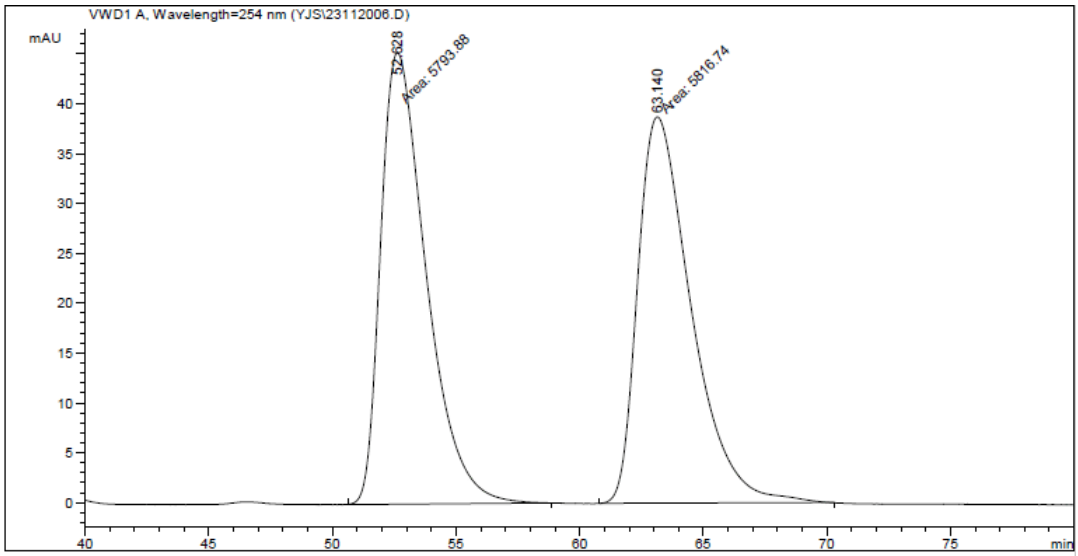


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Peak RetTime Type  Width     Area      Height     Area
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----|-------|----|-------|----------|----------|--------|
   1  52.628 MM    2.1333 5793.88428   45.26604  49.9016
   2  63.140 MM    2.5025 5816.74023   38.73976  50.0984

Totals :                  1.16106e4    84.00581
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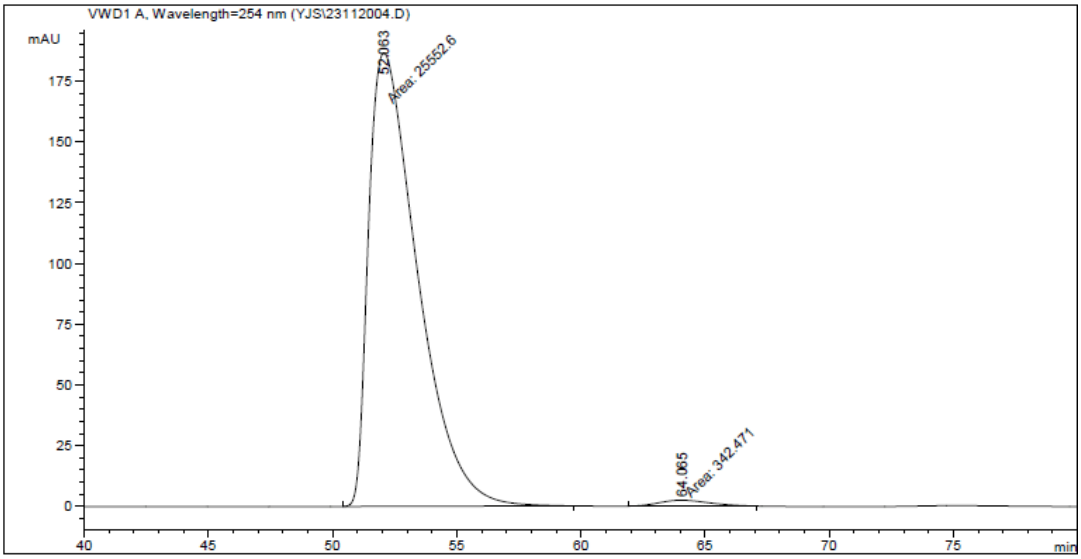


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Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  52.063 MM    2.2809 2.55526e4   186.71410  98.6775
   2  64.065 MM    2.3391  342.47061    2.44016   1.3225

Totals :                  2.58950e4   189.15426
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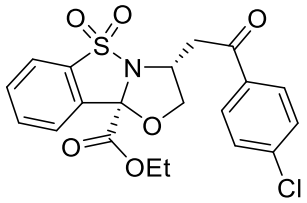

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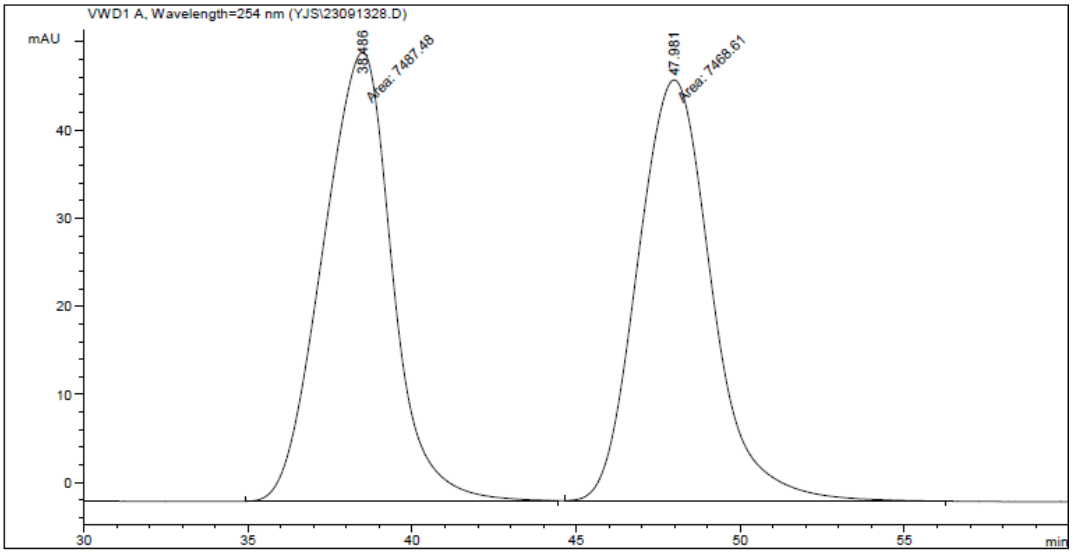
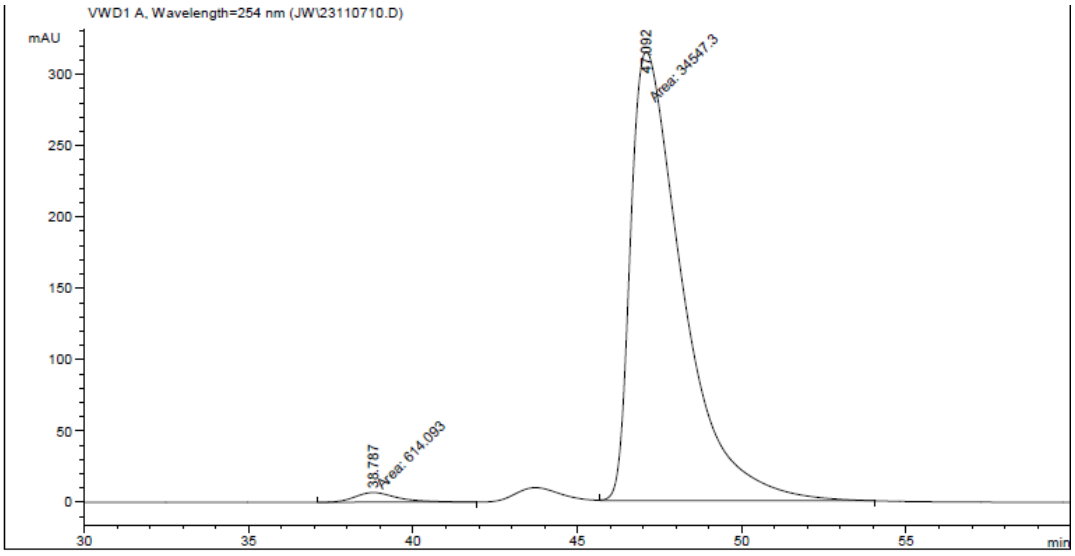


Area Percent Report

Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	38.486	MM	2.4506	7487.48437	50.92266	50.0631
2	47.981	MM	2.6063	7468.61475	47.76084	49.9369

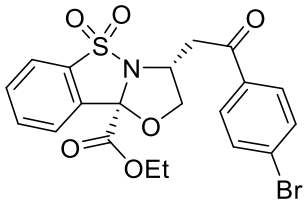
Totals : 1.49561e4 98.68350



Area Percent Report

Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	38.787	MM	1.5053	614.09296	6.79905	1.7465
2	47.092	MM	1.8293	3.45473e4	314.75281	98.2535

Totals : 3.51614e4 321.55186



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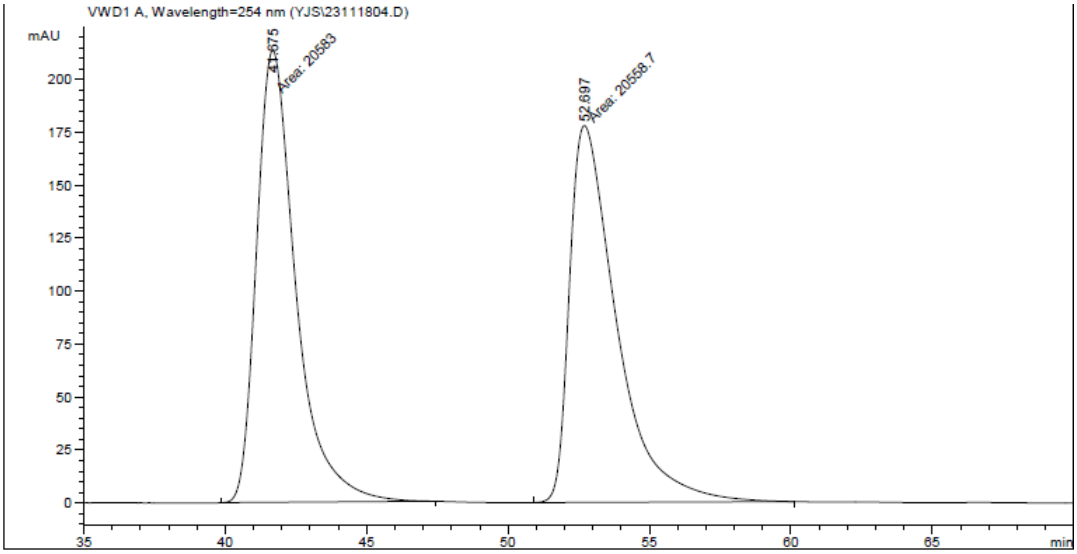


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=====================================================================
                      Area Percent Report
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Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  41.675 MM    1.6079 2.05830e4   213.35580  50.0296
   2  52.697 MM    1.9256 2.05587e4   177.94009  49.9704

Totals :                 4.11417e4   391.29590
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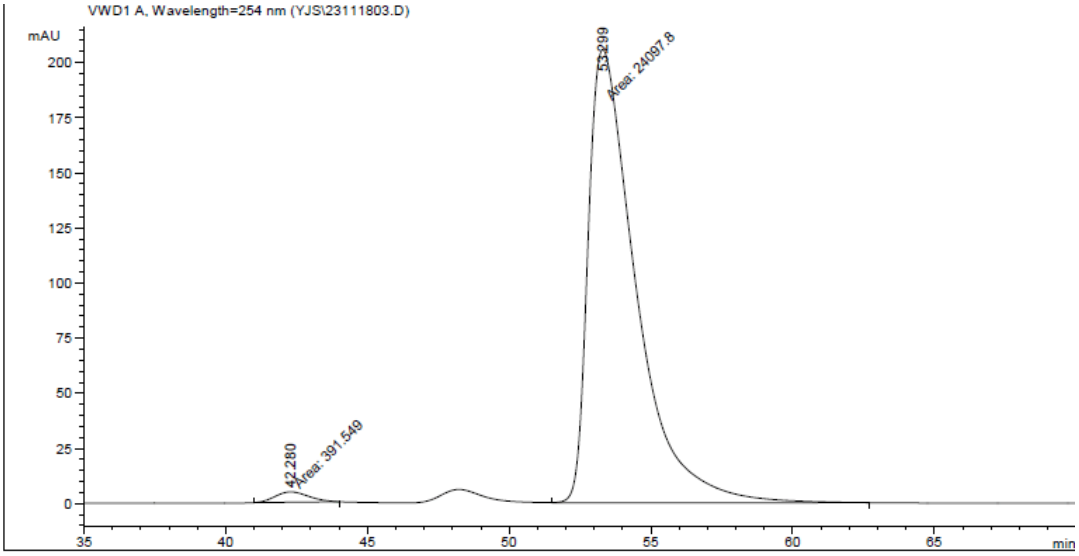


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=====================================================================
                      Area Percent Report
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Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  42.280 MM    1.3769  391.54889    4.73942   1.5989
   2  53.299 MM    1.9537 2.40978e4   205.57700  98.4011

Totals :                 2.44893e4   210.31642
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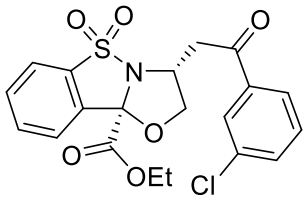

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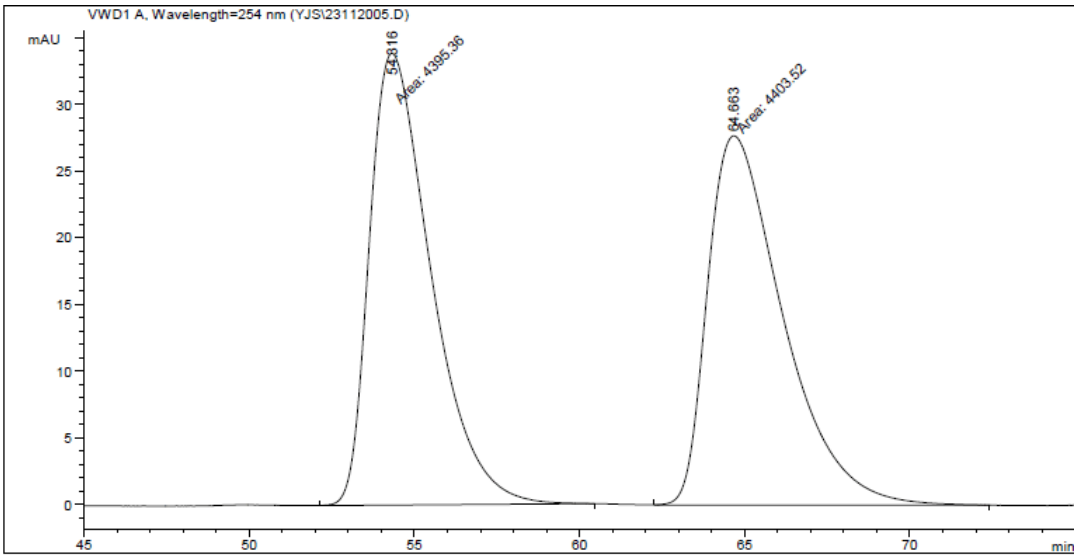


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================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  54.316 MM    2.1619 4395.35840   33.88573  49.9536
   2  64.663 MM    2.6506 4403.52441   27.68893  50.0464

Totals :                  8798.88281   61.57465
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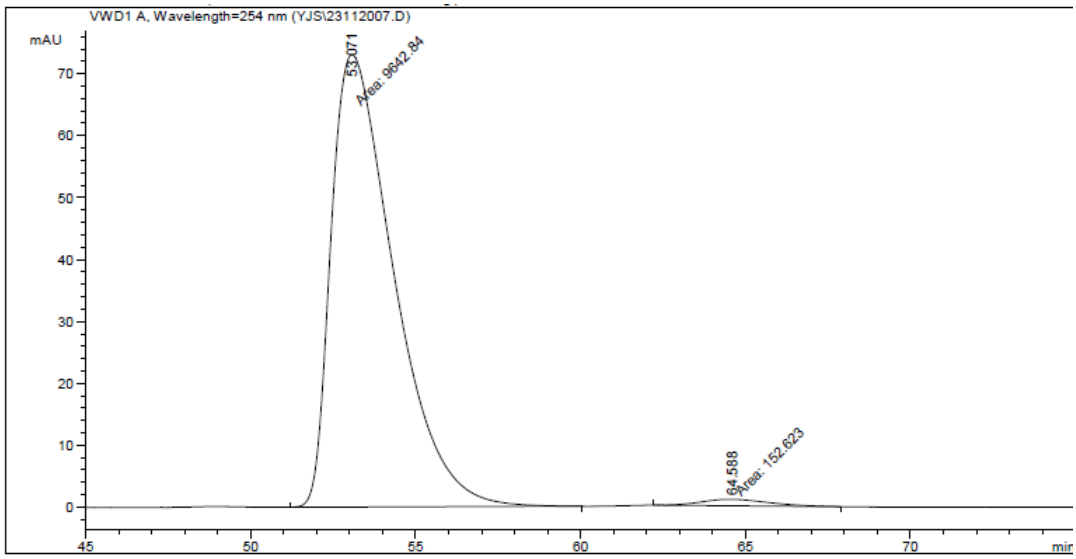


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================================================================================
                          Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
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----|-------|----|-------|----------|----------|--------|
   1  53.071 MM    2.1993 9642.83594   73.07610  98.4419
   2  64.588 MM    2.3937  152.62308    1.06269   1.5581

Totals :                  9795.45901   74.13879
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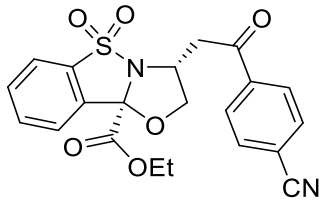
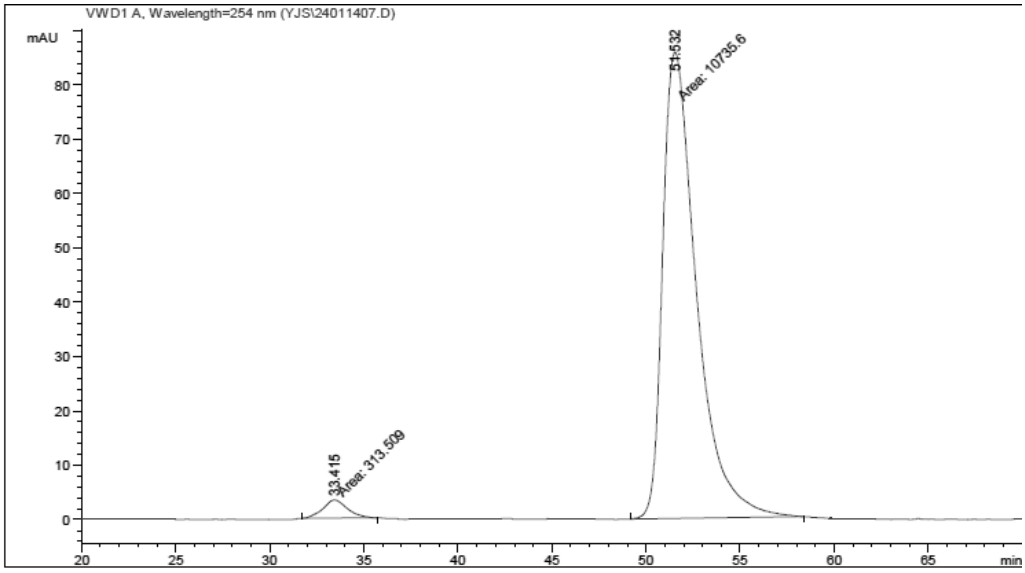


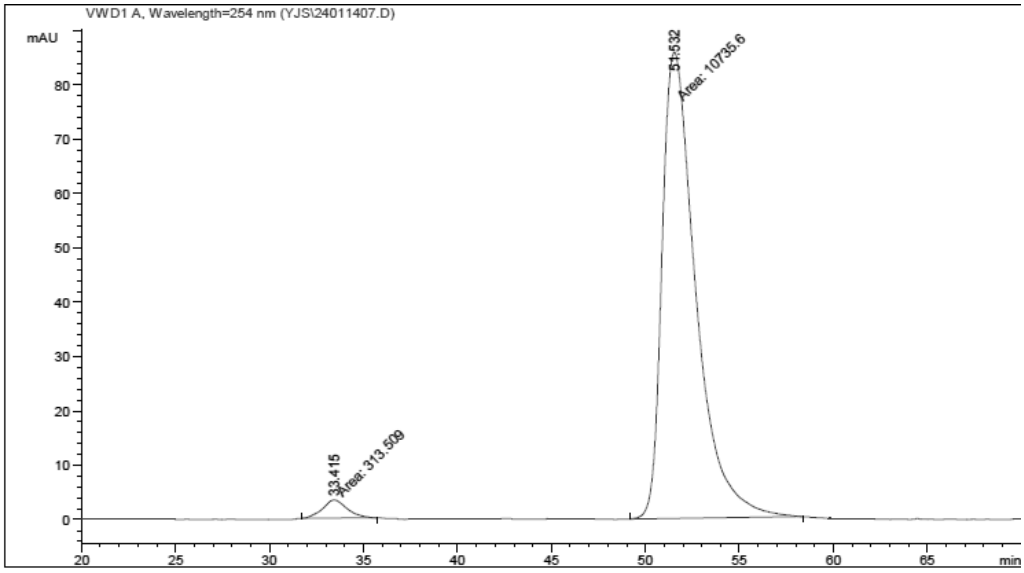
3ai




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]       %
----|-------|----|-------|----------|----------|--------|
   1  33.415 MM    1.5421  313.50909    3.38840   2.8374
   2  51.532 MM    2.0856 1.07356e4    85.79202  97.1626

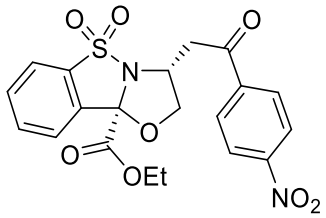
Totals :                  1.10491e4    89.18041
```



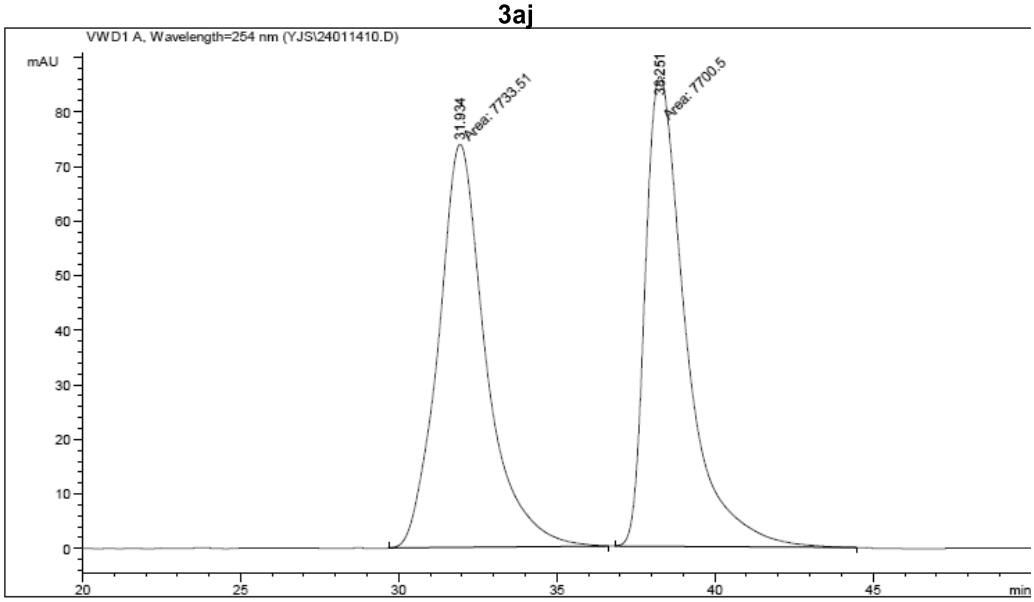

```
================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]       %
----|-------|----|-------|----------|----------|--------|
   1  33.415 MM    1.5421  313.50909    3.38840   2.8374
   2  51.532 MM    2.0856 1.07356e4    85.79202  97.1626

Totals :                  1.10491e4    89.18041
```

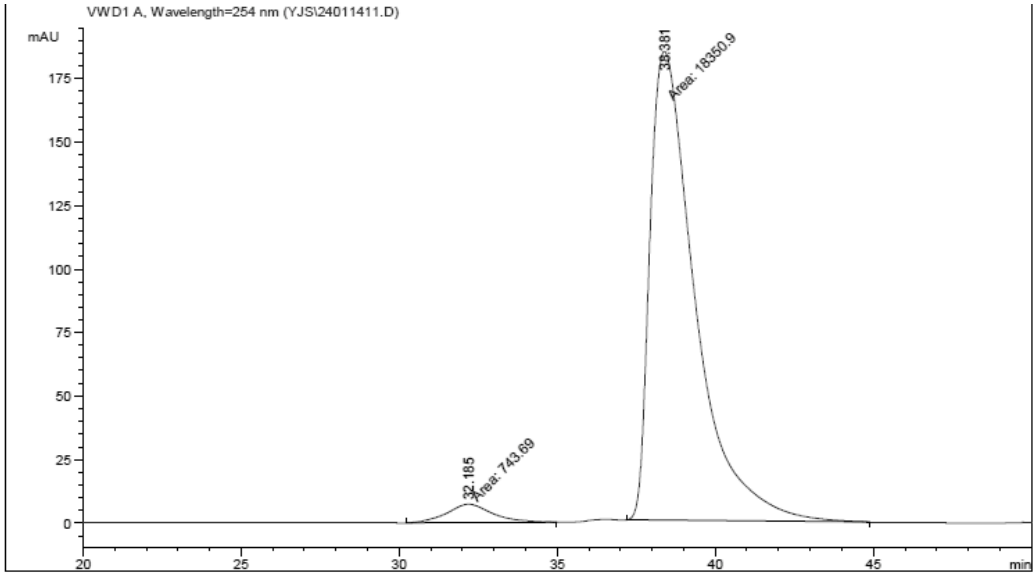


3aj



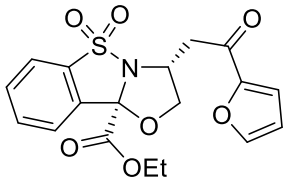

```
================================================================================
                          Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  31.934 MM    1.7451 7733.51367   73.85845  50.1069
   2  38.251 MM    1.4895 7700.50488   86.16288  49.8931

Totals :                  1.54340e4   160.02133
```

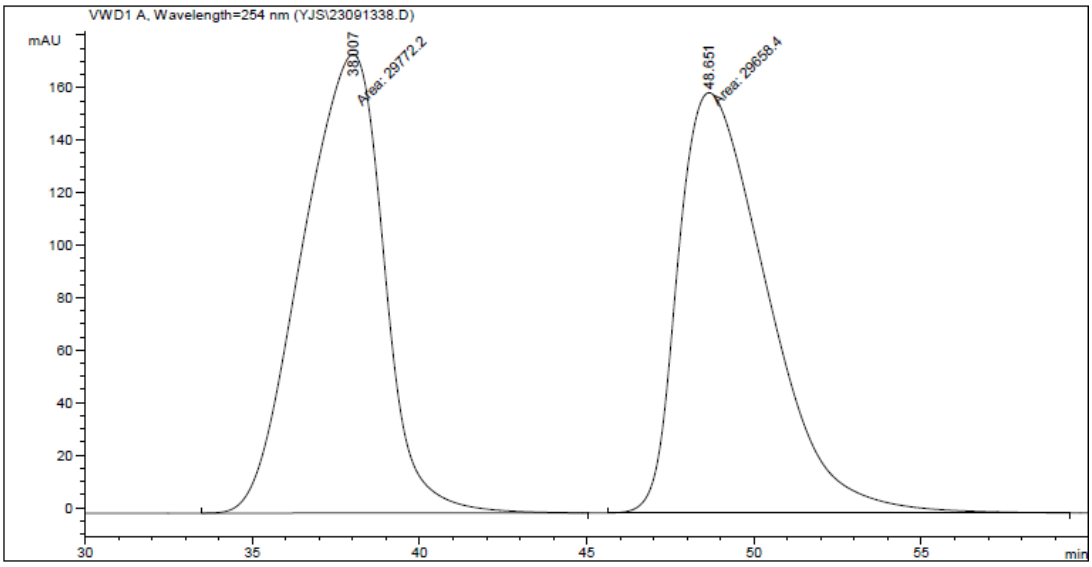



```
================================================================================
                          Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  32.185 MM    1.6989  743.68994    7.29582   3.8948
   2  38.381 MM    1.6569 1.83509e4   184.59230  96.1052

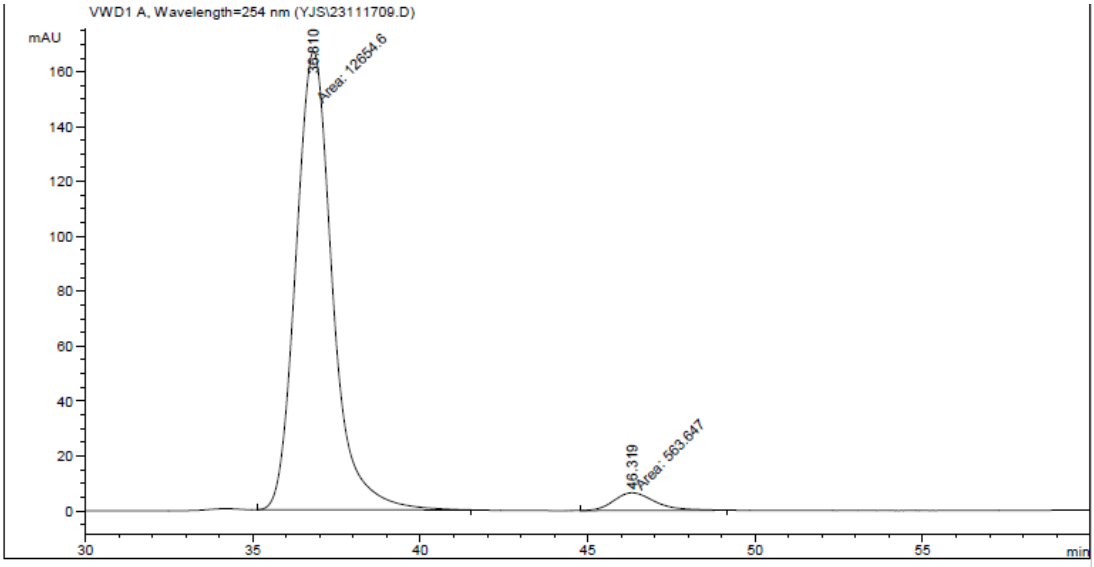
Totals :                  1.90946e4   191.88812
```



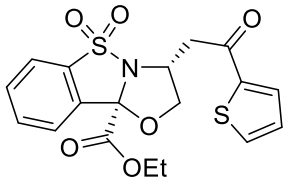
3ak



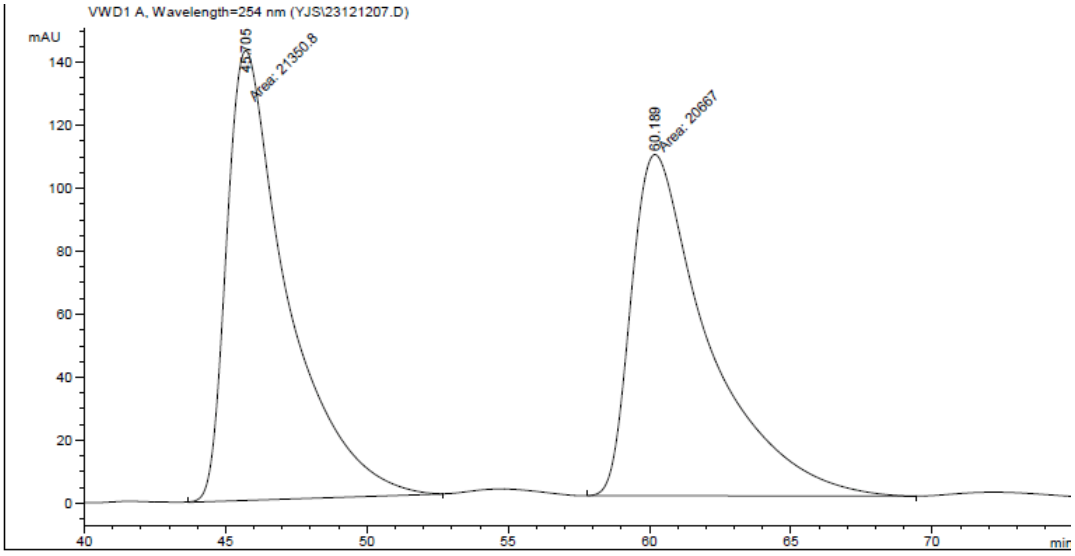
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	38.007	MM	2.8370	2.97722e4	174.90184	50.0958
2	48.651	MM	3.0863	2.96584e4	160.16086	49.9042
Totals :				5.94306e4	335.06270	



Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	36.810	MM	1.2627	1.26546e4	167.02542	95.7358
2	46.319	MM	1.4420	563.64746	6.51460	4.2642
Totals :				1.32182e4	173.54002	



3al




```
================================================================================
                          Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  45.705 MM    2.4909 2.13508e4   142.86078  50.8137
   2  60.189 MM    3.1776 2.06670e4   108.39913  49.1863

Totals :                  4.20178e4   251.25991
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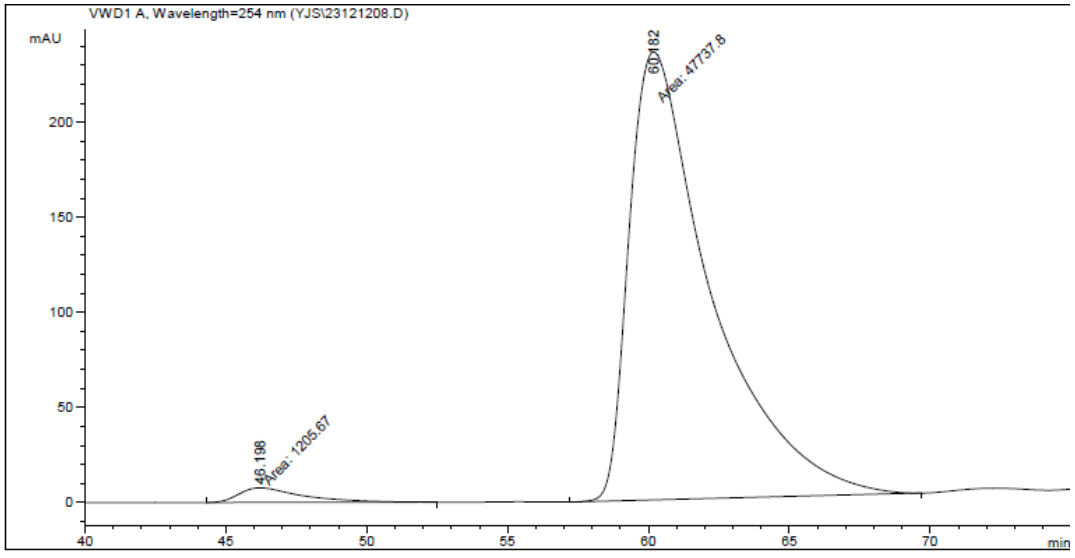
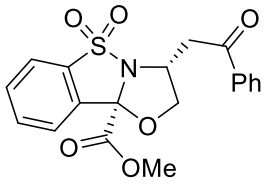
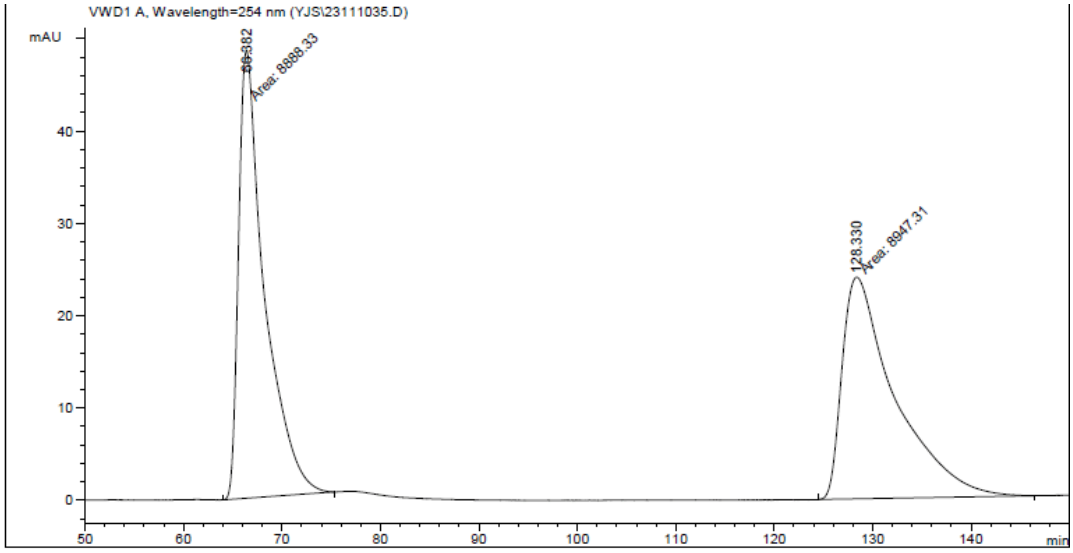



```
================================================================================
                          Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  46.198 MM    2.6084 1205.66663    7.70381   2.4634
   2  60.182 MM    3.3766 4.77378e4   235.63216  97.5366

Totals :                  4.89435e4   243.33597
```



3ba




```
=====================================================================
                        Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|------|----------|----------|--------|
   1  66.382 MM    3.0544 8888.33105   48.49949  49.8347
   2 128.330 MM    6.2082 8947.30957   24.02021  50.1653

Totals :                  1.78356e4    72.51970
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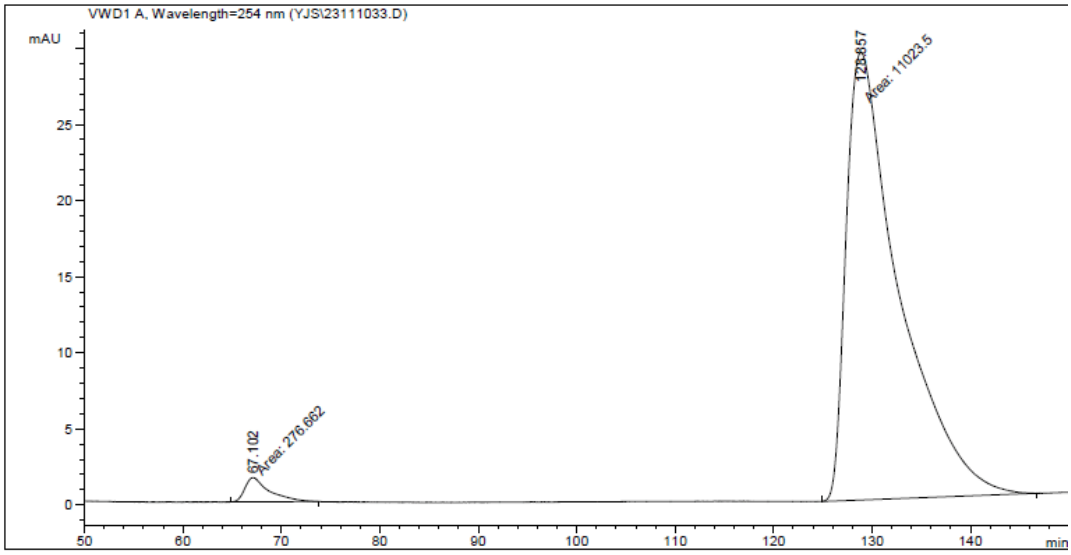


```
=====================================================================
                        Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|------|----------|----------|--------|
   1  67.102 MM    2.8922  276.66168    1.59427   2.4483
   2 128.857 MM    6.2436 1.10235e4    29.42617  97.5517

Totals :                  1.13001e4    31.02045
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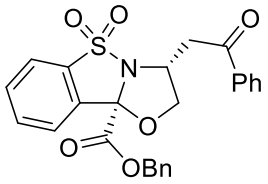
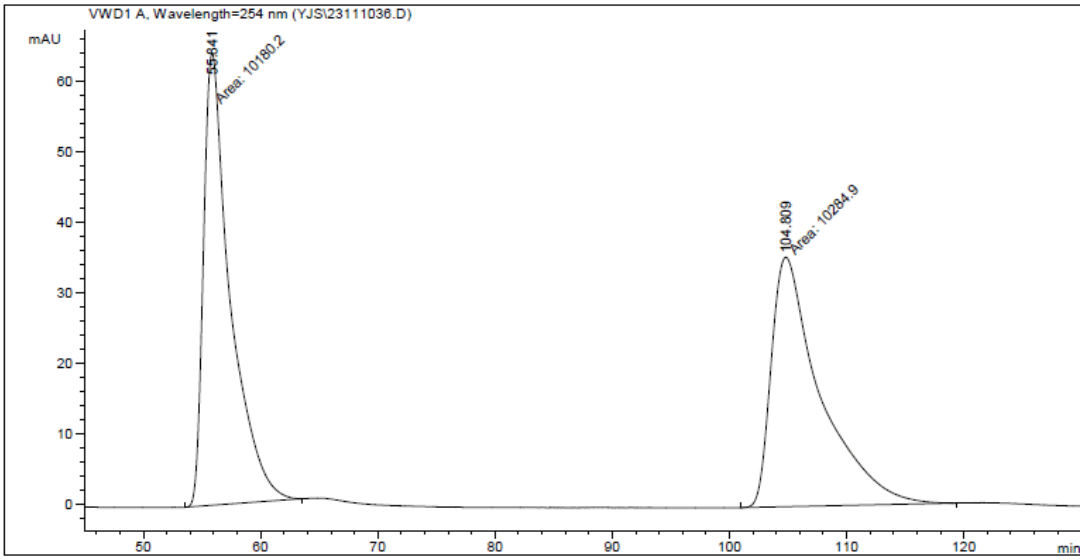


3ca




```
================================================================================
                            Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  55.841 MM    2.6405 1.01802e4    64.25721  49.7444
   2 104.809 MM    4.8352 1.02849e4    35.45117  50.2556

Totals :                  2.04651e4    99.70838
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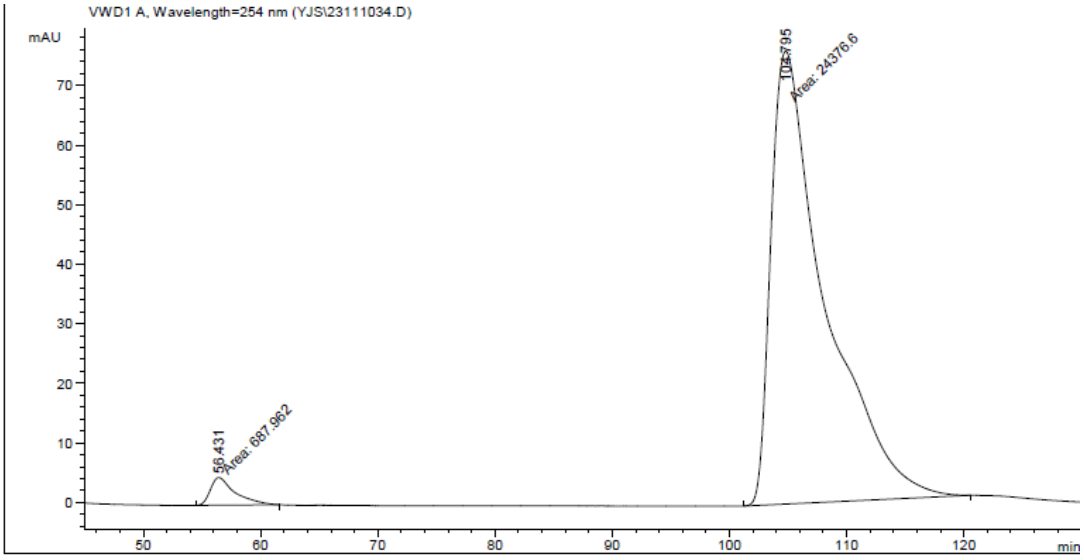


```
================================================================================
                            Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  56.431 MM    2.4583  687.96246    4.66414   2.7448
   2 104.795 MM    5.3405 2.43766e4    76.07428  97.2552

Totals :                  2.50645e4    80.73842
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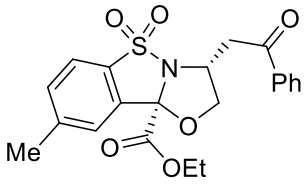
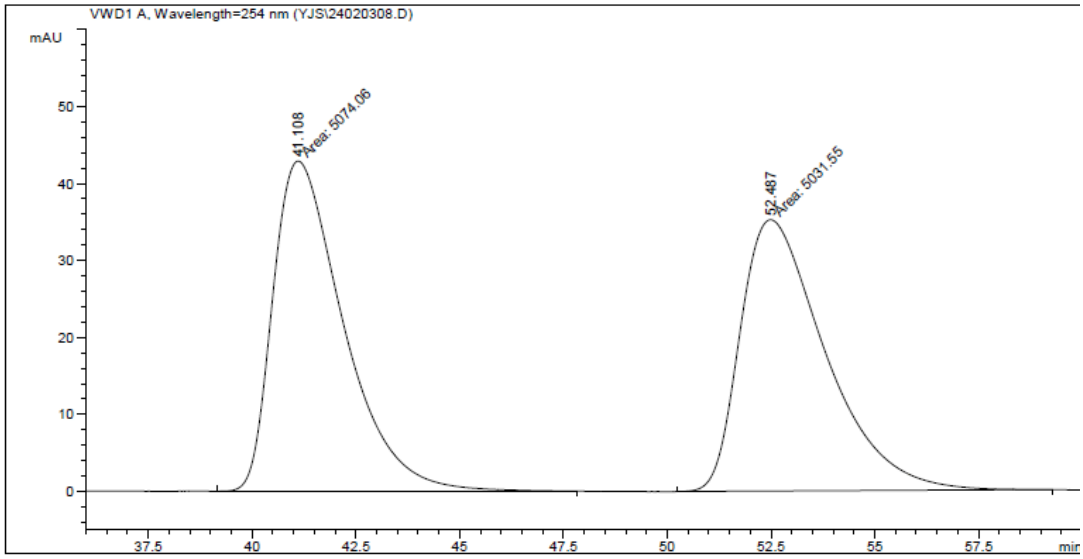


3da




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  41.108 MM    1.9710 5074.05713   42.90505  50.2103
   2  52.487 MM    2.3776 5031.55225   35.27067  49.7897

Totals :                  1.01056e4    78.17572
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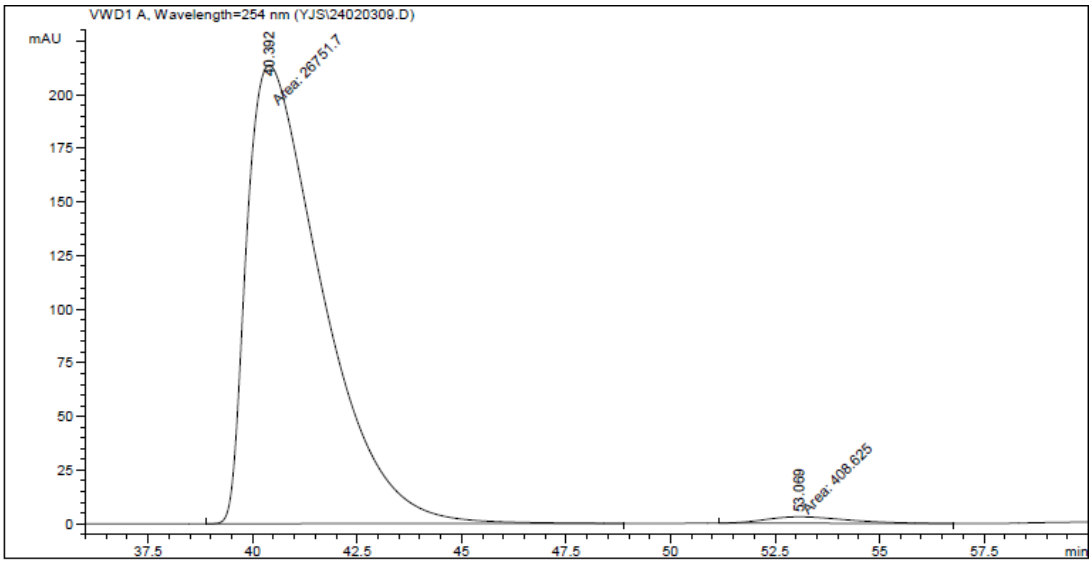


```
================================================================================
                              Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  40.392 MM    2.0852 2.67517e4   213.82088  98.4955
   2  53.069 MM    2.2588  408.62451    3.01503   1.5045

Totals :                  2.71604e4   216.83591
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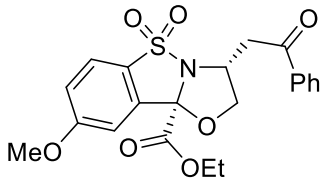
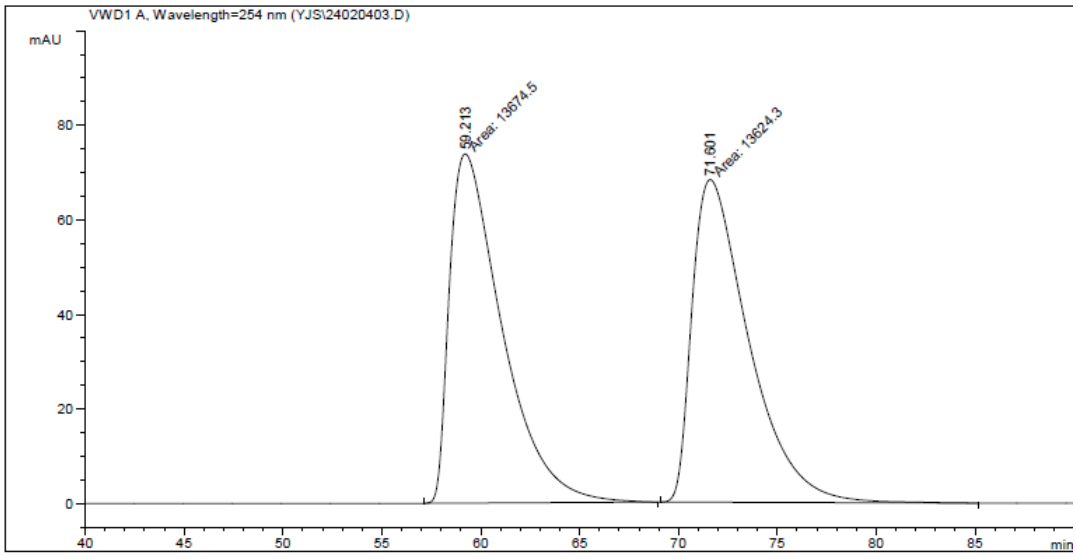


3ea




```
================================================================================
                          Area Percent Report
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Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  59.213 MM    3.0819 1.36745e4    73.95036  50.0920
   2  71.601 MM    3.3248 1.36243e4    68.29609  49.9080

Totals :                  2.72987e4   142.24644
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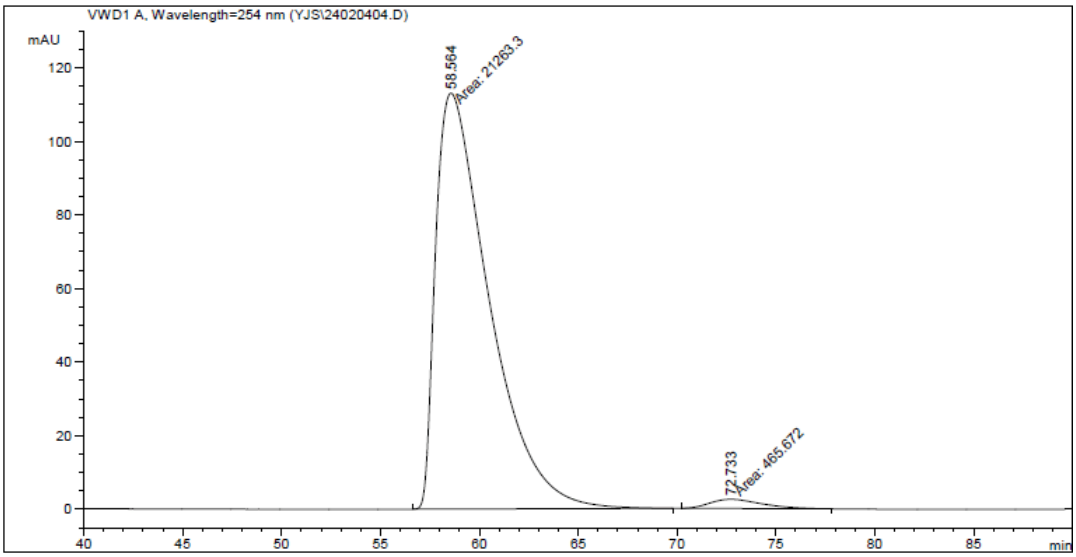


```
================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  58.564 MM    3.1345 2.12633e4   113.06108  97.8569
   2  72.733 MM    3.0685  465.67245    2.52933   2.1431

Totals :                  2.17290e4   115.59041
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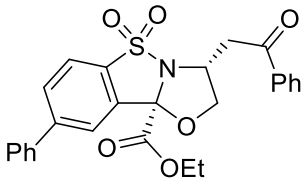
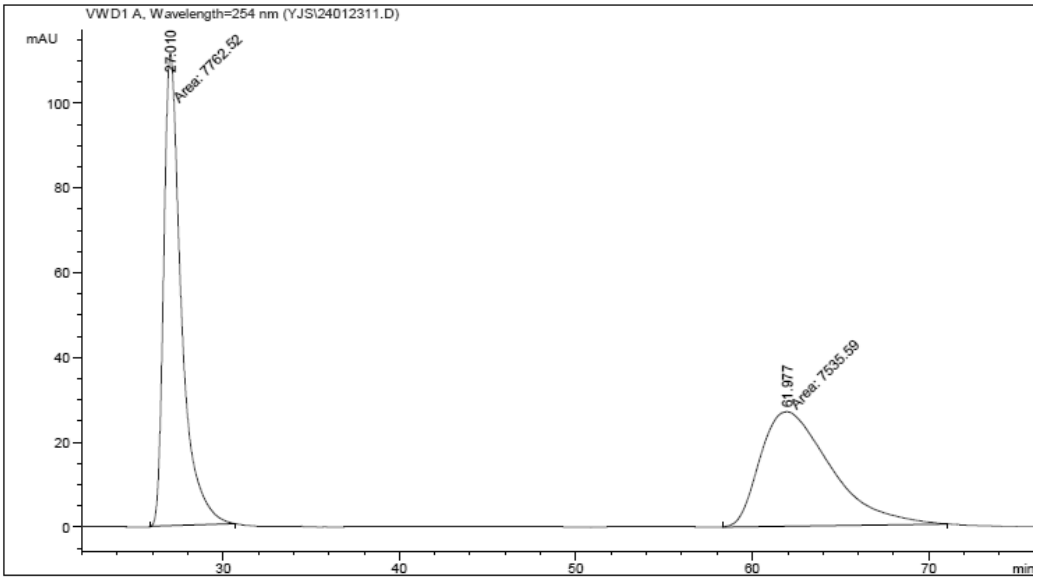


3fa




```
================================================================================
                            Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  27.010 MM    1.1600 7762.52344  111.53474  50.7417
   2  61.977 MM    4.6426 7535.59277   27.05228  49.2583

Totals :                  1.52981e4   138.58702
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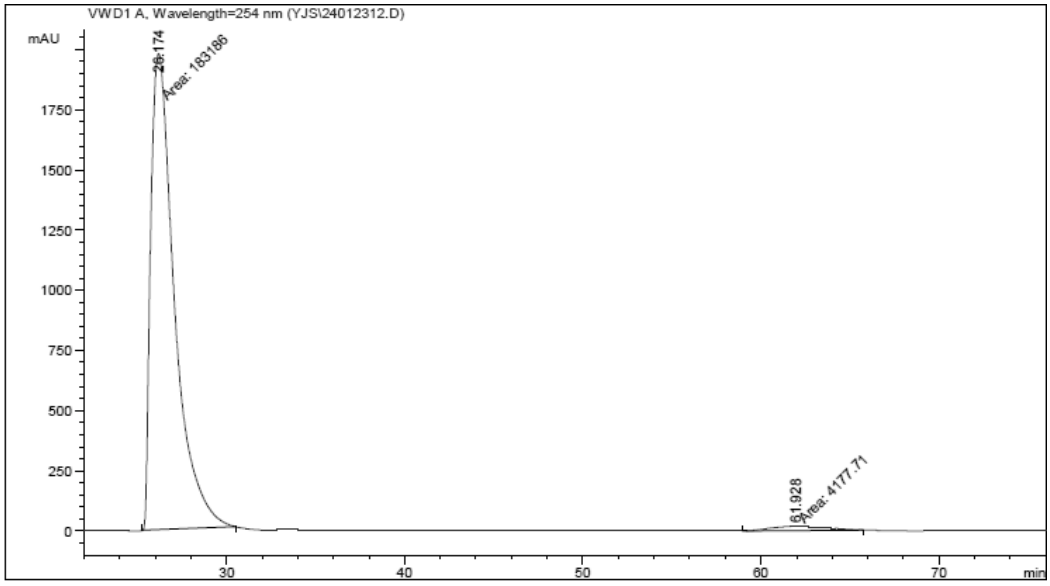


```
================================================================================
                            Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  26.174 MM    1.5427 1.83186e5  1979.08765  97.7703
   2  61.928 MM    2.7149 4177.71387   18.02417   2.2297

Totals :                  1.87364e5  1997.11181
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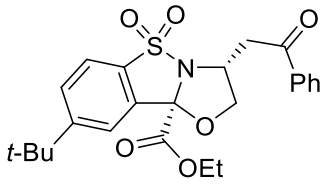
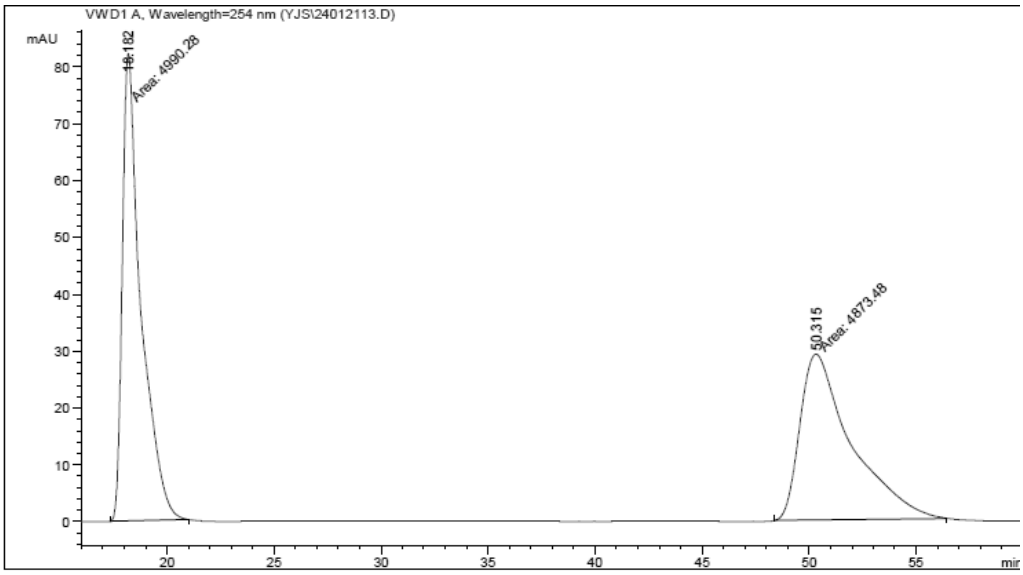


3ga




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  18.182 MM    1.0114 4990.28223   82.23005  50.5921
   2  50.315 MM    2.7816 4873.47998   29.20090  49.4079

Totals :                  9863.76221  111.43095
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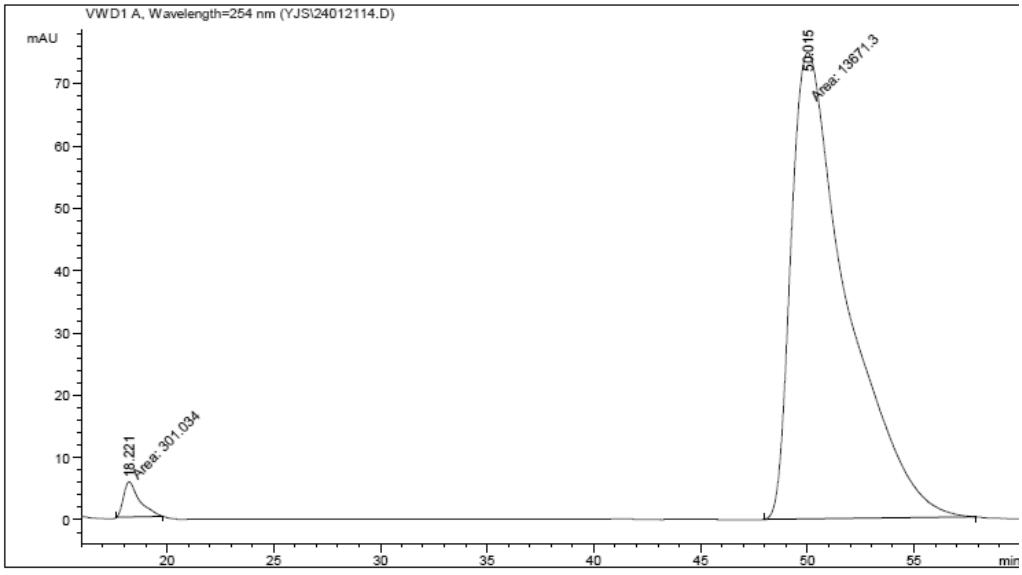


```
=====================================================================
                        Area Percent Report
=====================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  18.221 MM    0.8817  301.03372    5.69030   2.1545
   2  50.015 MM    3.0429 1.36713e4    74.88007  97.8455

Totals :                  1.39723e4    80.57037
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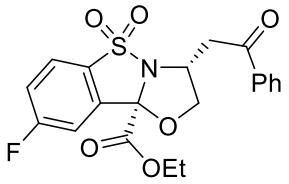
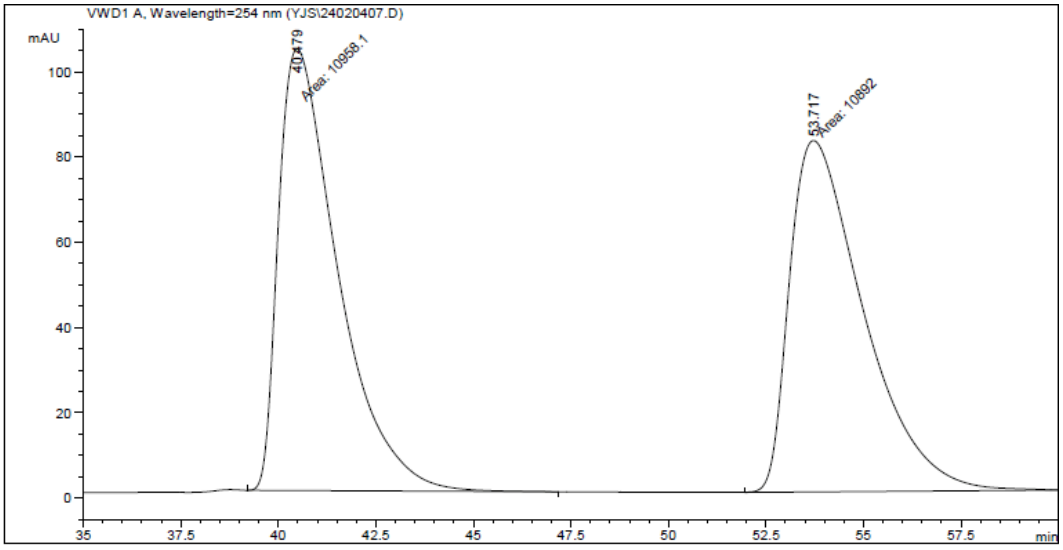
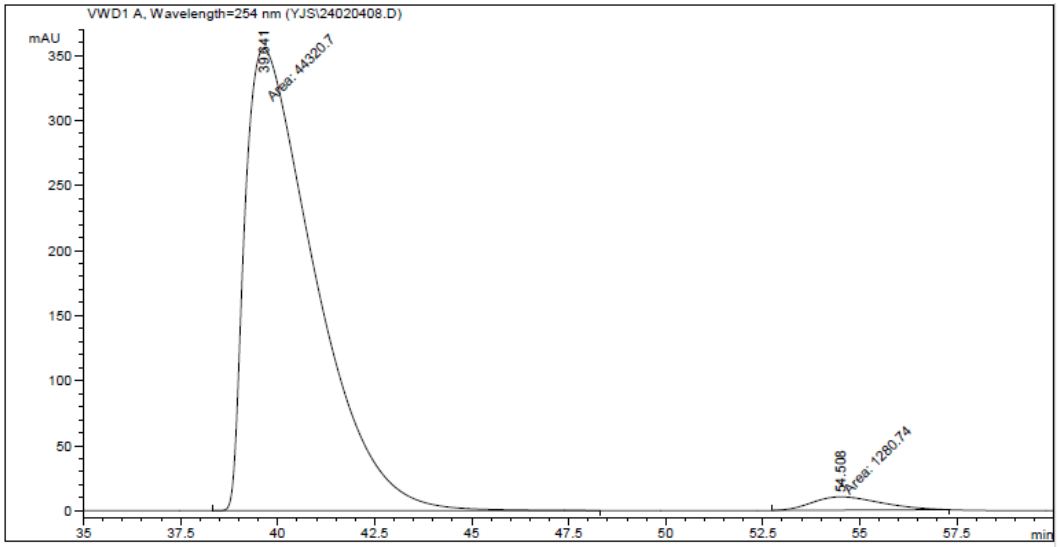


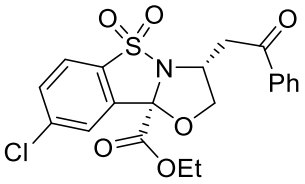
3ha



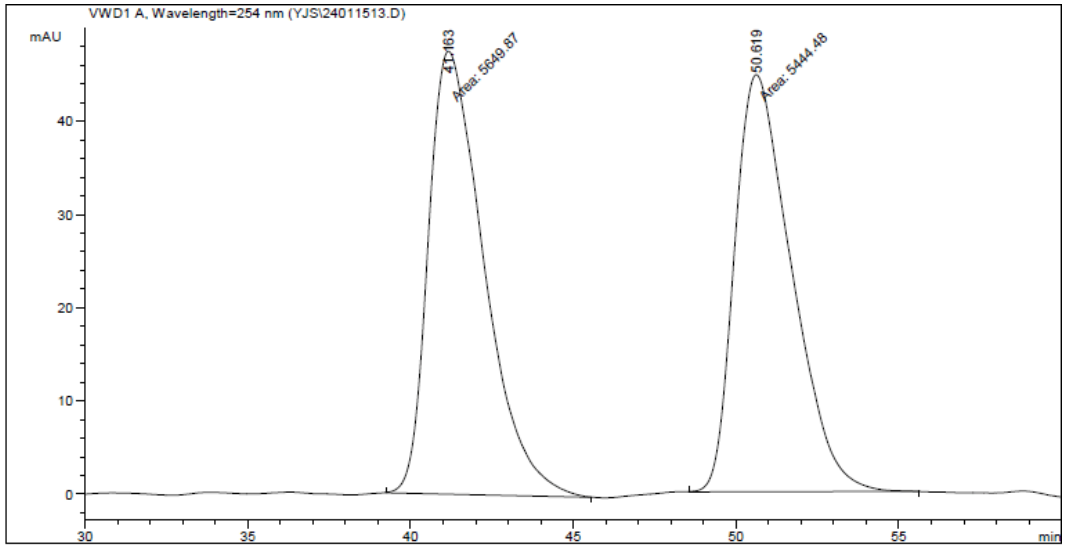
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	40.479	MM	1.7609	1.09581e4	103.71749	50.1513
2	53.717	MM	2.2016	1.08920e4	82.45395	49.8487
Totals :				2.18500e4	186.17144	



Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	39.641	MM	2.0793	4.43207e4	355.24704	97.1914
2	54.508	MM	2.0652	1280.74402	10.33570	2.8086
Totals :				4.56014e4	365.58274	



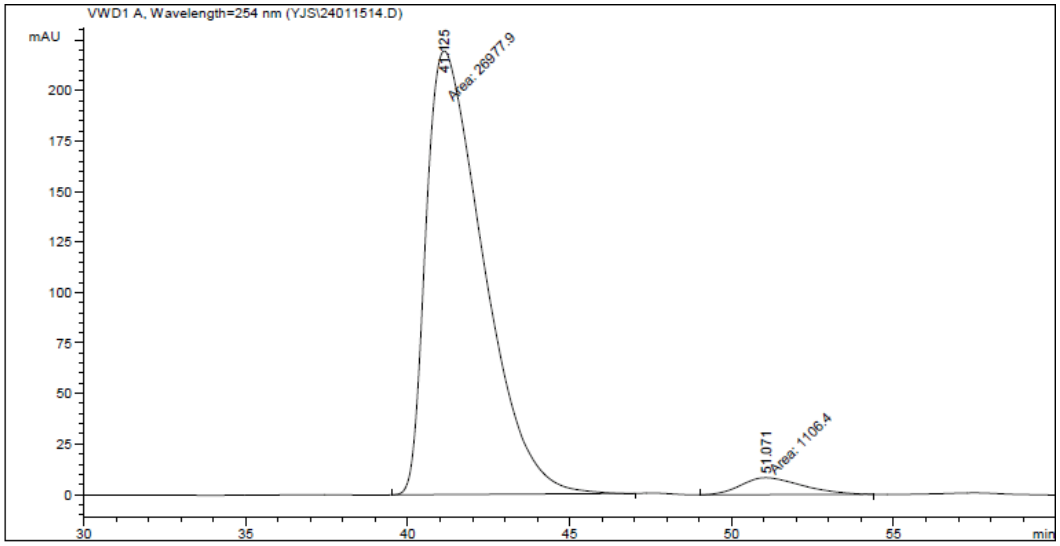
3ia



Area Percent Report

Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	41.163	MM	1.9806	5649.87354	47.54253	50.9257
2	50.619	MM	2.0268	5444.48242	44.77027	49.0743

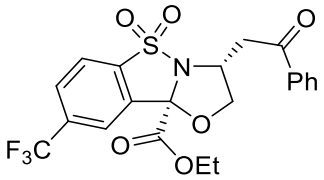
Totals : 1.10944e4 92.31280



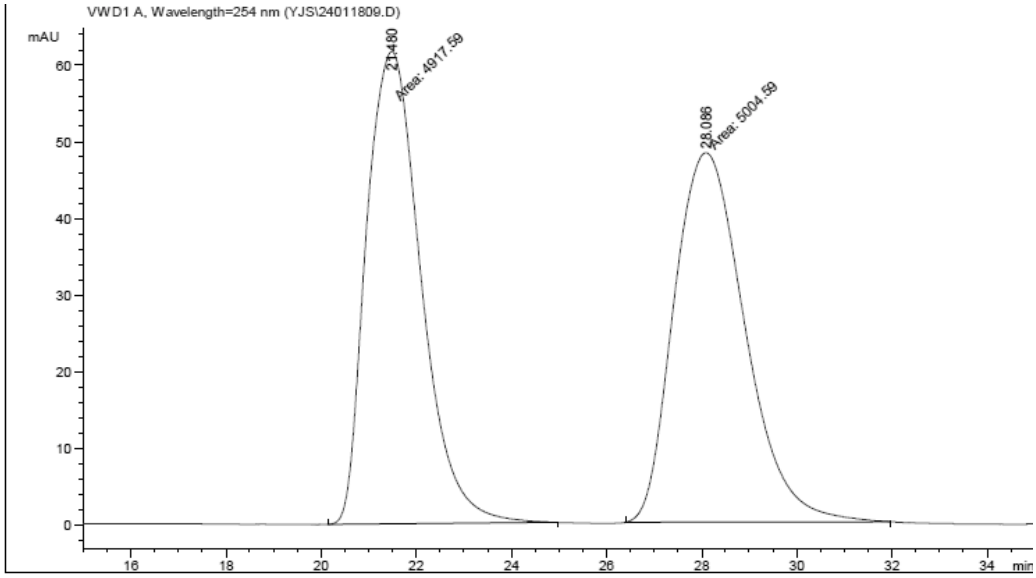
Area Percent Report

Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	41.125	MM	2.0460	2.69779e4	219.76683	96.0604
2	51.071	MM	2.1906	1106.40491	8.41775	3.9396

Totals : 2.80843e4 228.18458

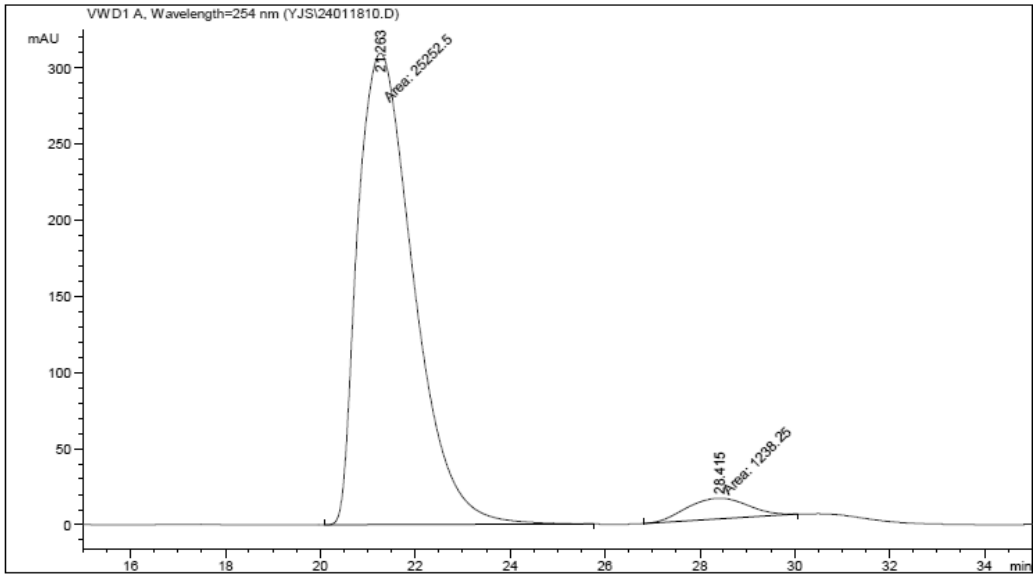


3ja



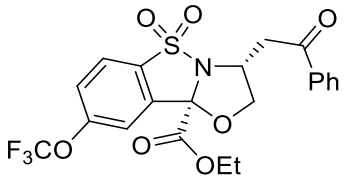

```
==================================================================
                        Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  21.480 MM    1.3297 4917.59131   61.63726  49.5616
   2  28.086 MM    1.7304 5004.59082   48.20208  50.4384

Totals :                  9922.18213  109.83934
```

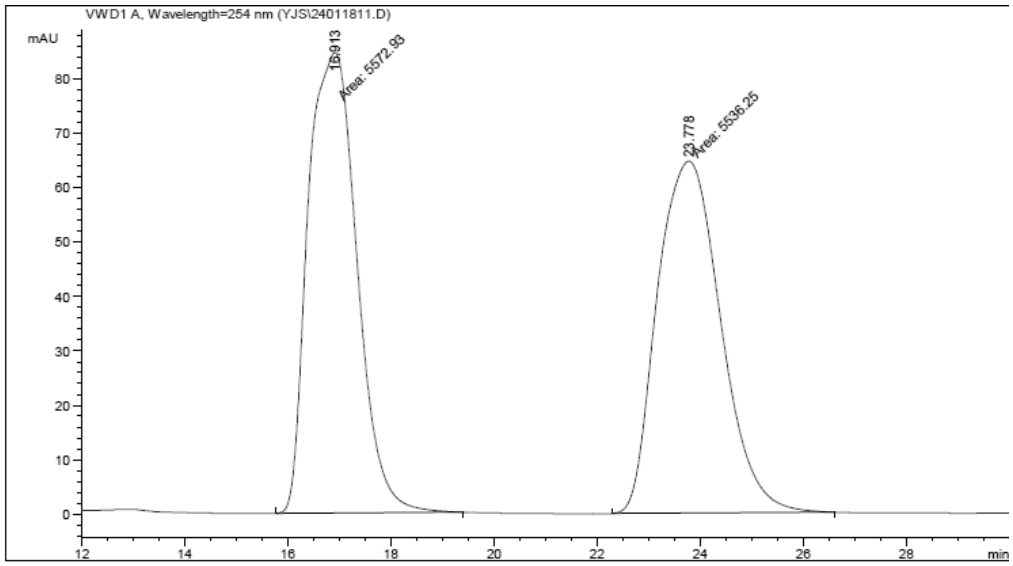



```
==================================================================
                        Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  21.263 MM    1.3589 2.52525e4   309.70761  95.3257
   2  28.415 MM    1.5179 1238.24792   13.59621   4.6743

Totals :                  2.64907e4   323.30382
```



3ka




```
=====================================================================
                        Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  16.913 MM    1.0977 5572.93018   84.61305  50.1651
   2  23.778 MM    1.4269 5536.25293   64.66332  49.8349

Totals :                 1.11092e4   149.27637
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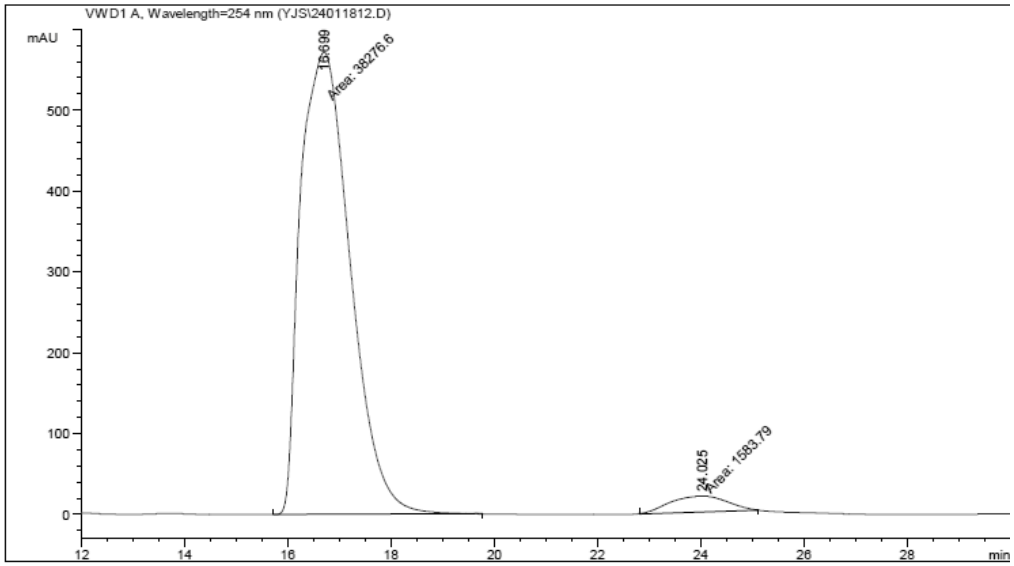
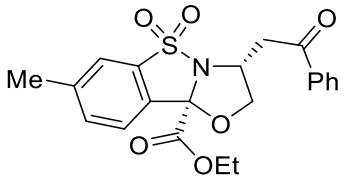
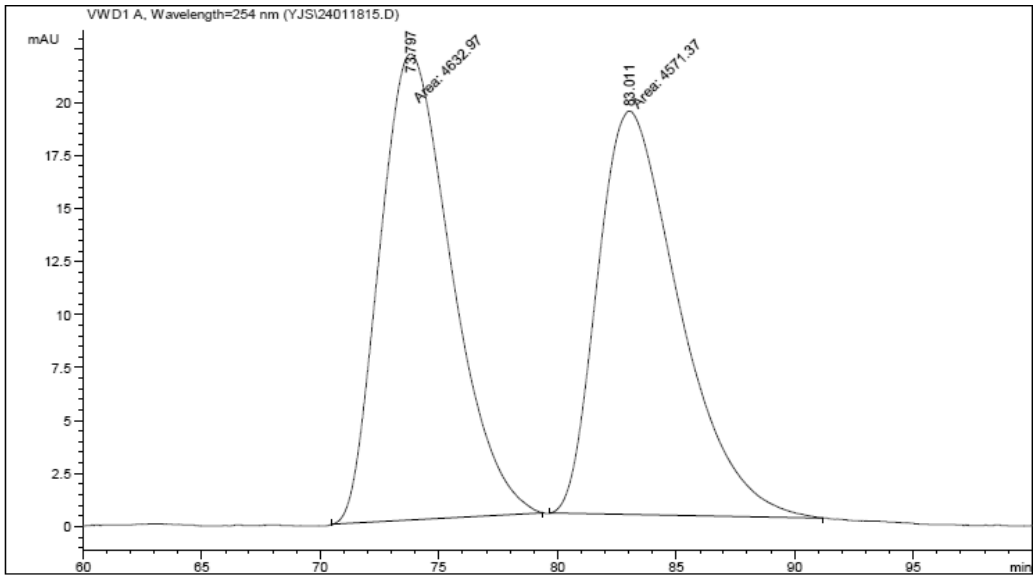



```
=====================================================================
                        Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  16.699 MM    1.1155 3.82766e4   571.88263  96.0266
   2  24.025 MM    1.3126 1583.79407   20.10987   3.9734

Totals :                 3.98604e4   591.99250
```

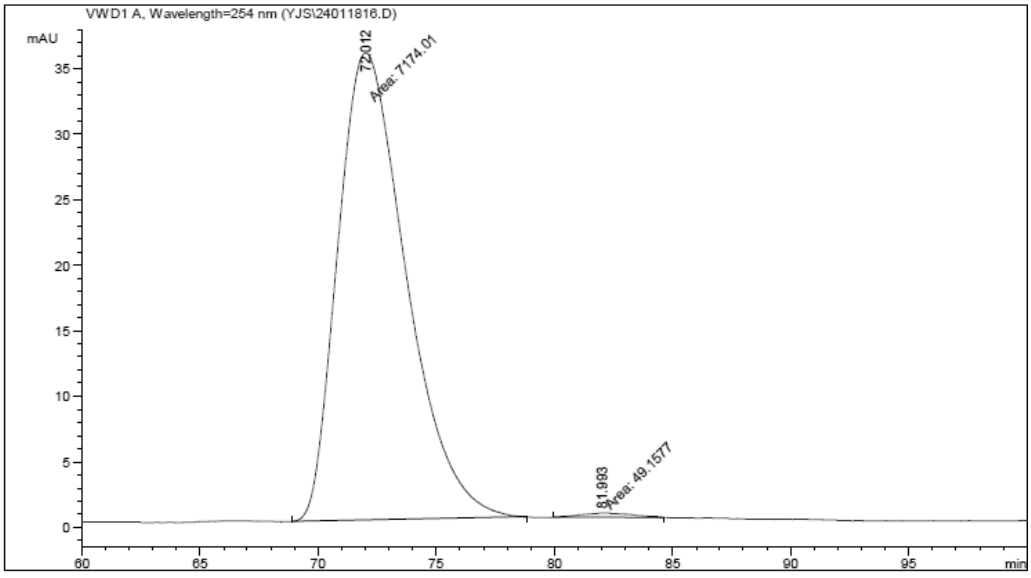


3la



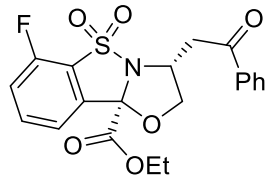

```
================================================================================
                            Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  73.797 MM    3.5115 4632.96729   21.98962  50.3346
   2  83.011 MM    4.0020 4571.36865   19.03792  49.6654

Totals :                  9204.33594   41.02754
```

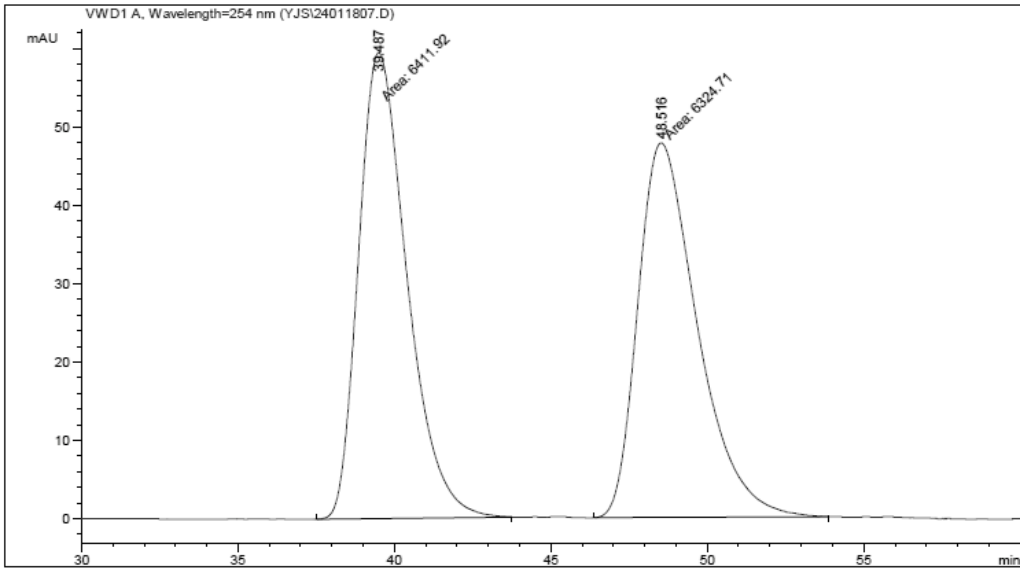



```
================================================================================
                            Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  72.012 MM    3.3524 7174.01172   35.66621  99.3194
   2  81.993 MM    2.5140   49.15774 3.25896e-1   0.6806

Totals :                  7223.16946   35.99211
```



3ma




```
==================================================================
                        Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  39.487 MM    1.7950 6411.91748   59.53635  50.3424
   2  48.516 MM    2.2033 6324.70703   47.84243  49.6576

Totals :                 1.27366e4   107.37878
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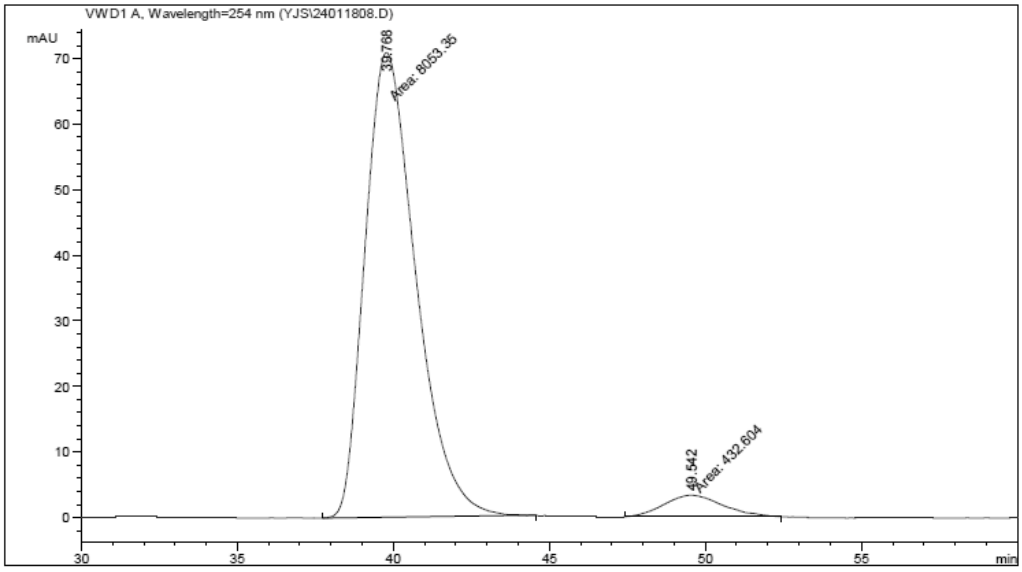


```
==================================================================
                        Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  39.768 MM    1.8911 8053.34961   70.97485  94.9021
   2  49.542 MM    2.1823  432.60382    3.30395   5.0979

Totals :                 8485.95343   74.27880
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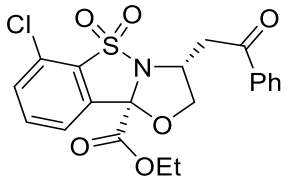
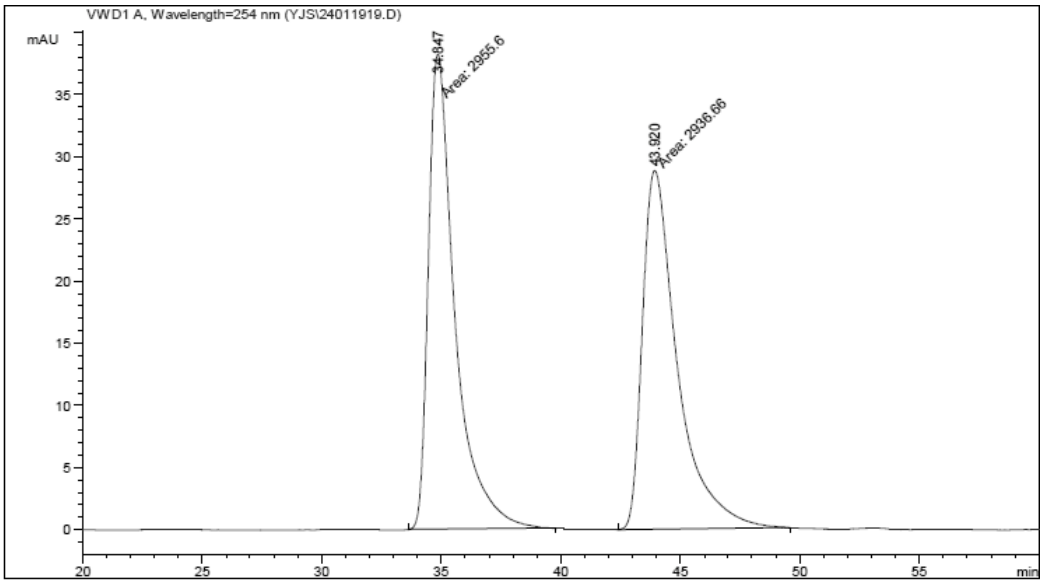


3na




```
=====================================================================
                      Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  34.847 MM    1.2892 2955.60278   38.20910  50.1607
   2  43.920 MM    1.6950 2936.66479   28.87659  49.8393

Totals :                 5892.26758   67.08569
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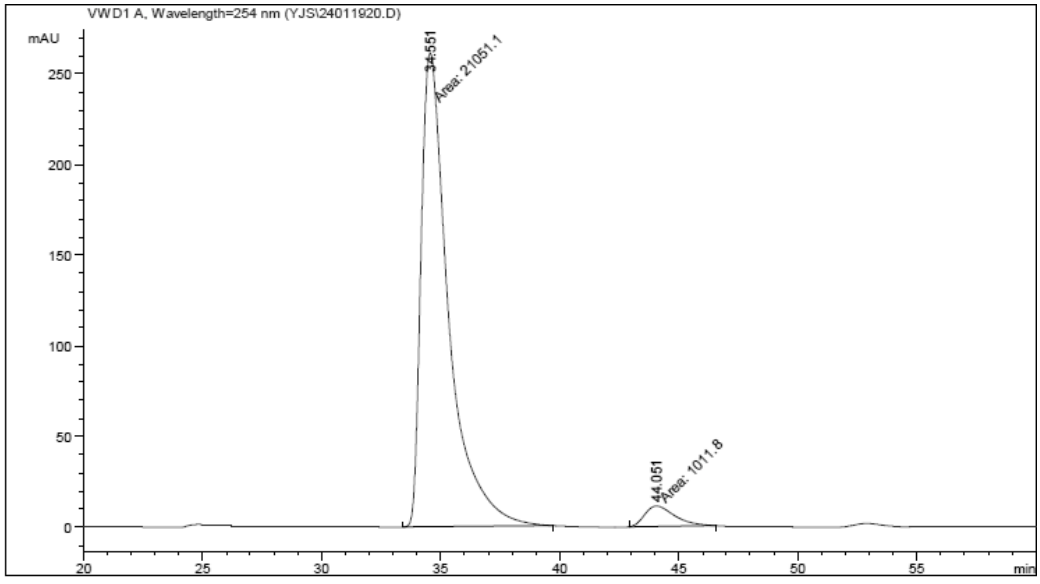


```
=====================================================================
                      Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  34.551 MM    1.3427 2.10511e4   261.30438  95.4140
   2  44.051 MM    1.4823 1011.80121   11.37684   4.5860

Totals :                 2.20629e4   272.68122
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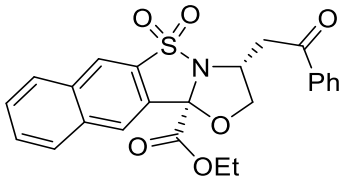
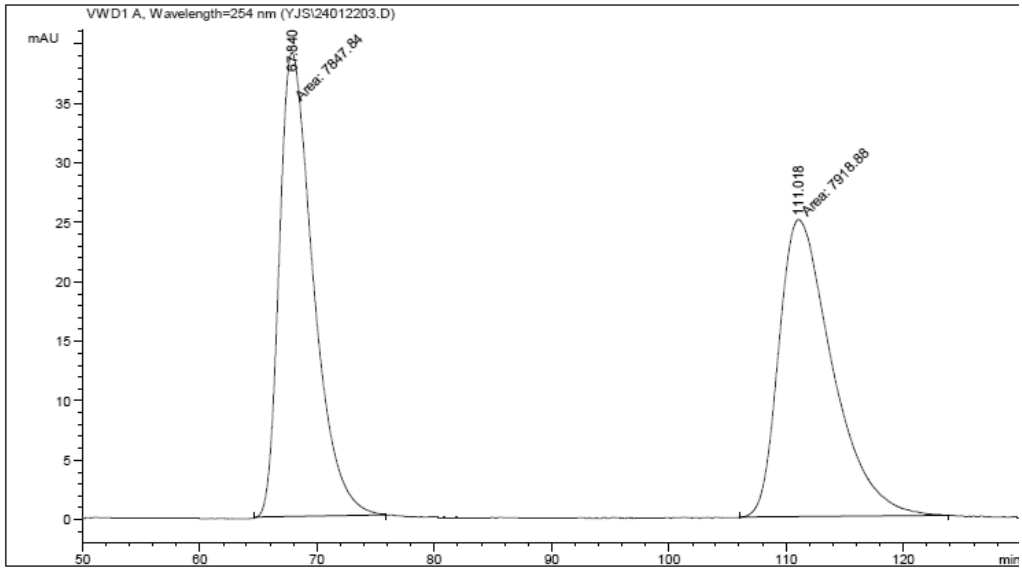


3oa




```
================================================================================
                            Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  67.840 MM    3.3530 7847.84131   39.00858  49.7747
   2 111.018 MM    5.2768 7918.88037   25.01141  50.2253

Totals :                  1.57667e4    64.01999
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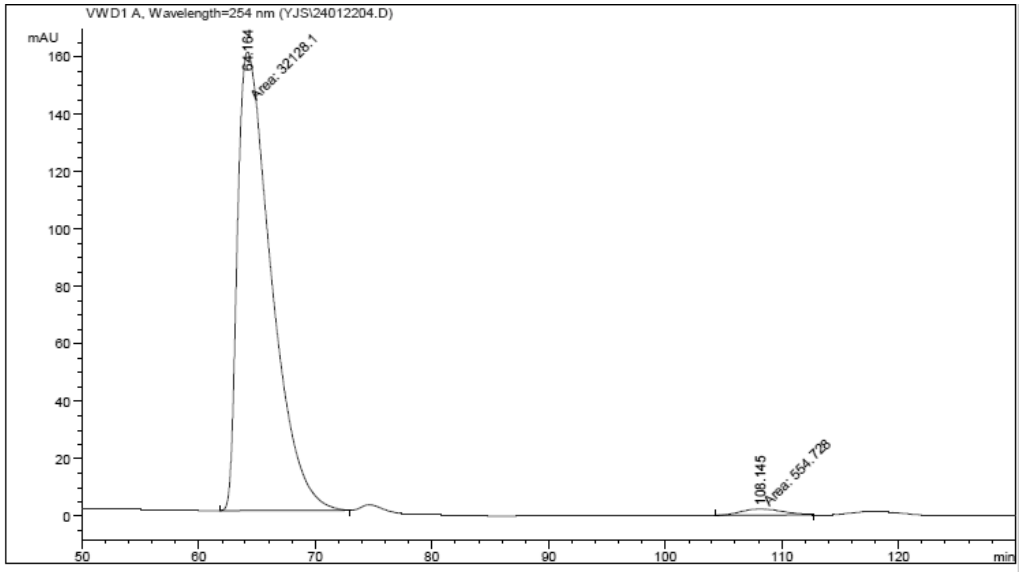


```
================================================================================
                            Area Percent Report
================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  64.164 MM    3.3503 3.21281e4   159.82529  98.3027
   2 108.145 MM    4.2355  554.72772    2.18286   1.6973

Totals :                  3.26829e4   162.00814
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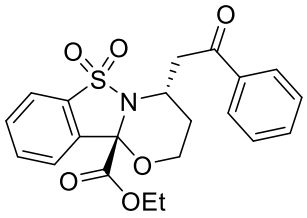
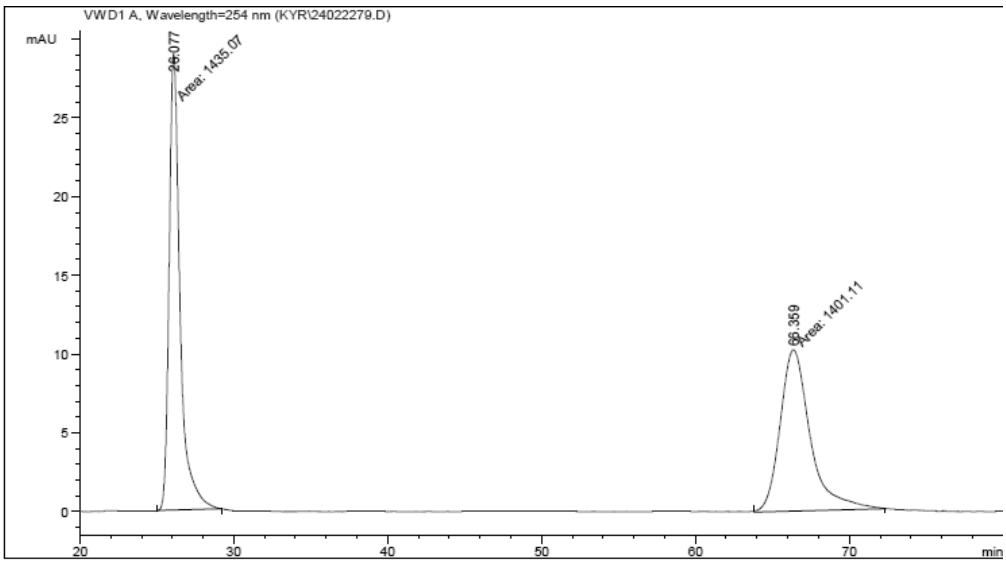


5aa




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  26.077 MM    0.8242 1435.06665   29.01784  50.5987
   2  66.359 MM    2.2803 1401.10547   10.24048  49.4013

Totals :                  2836.17212   39.25832
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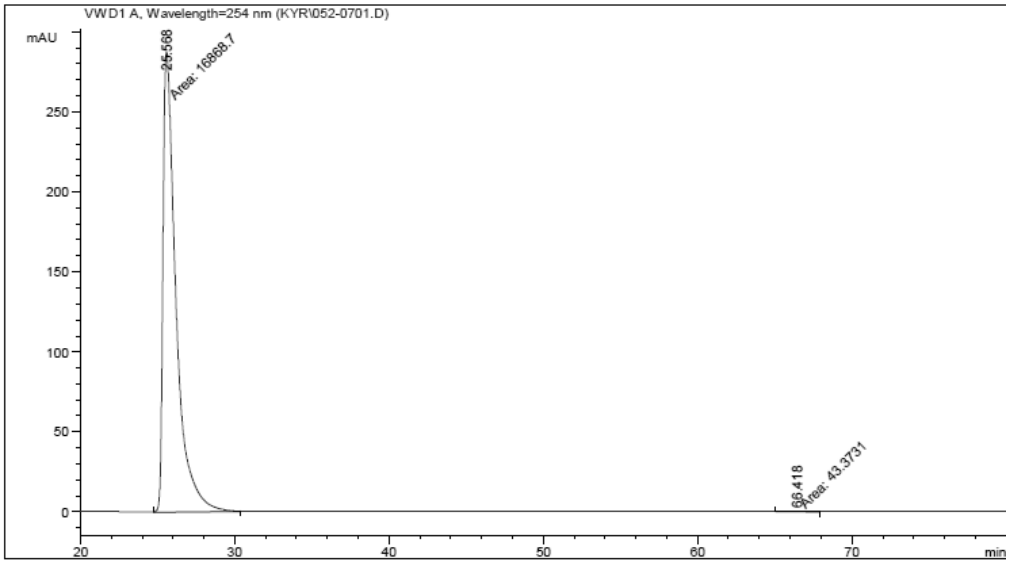
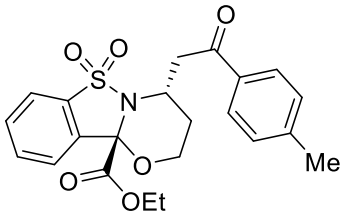


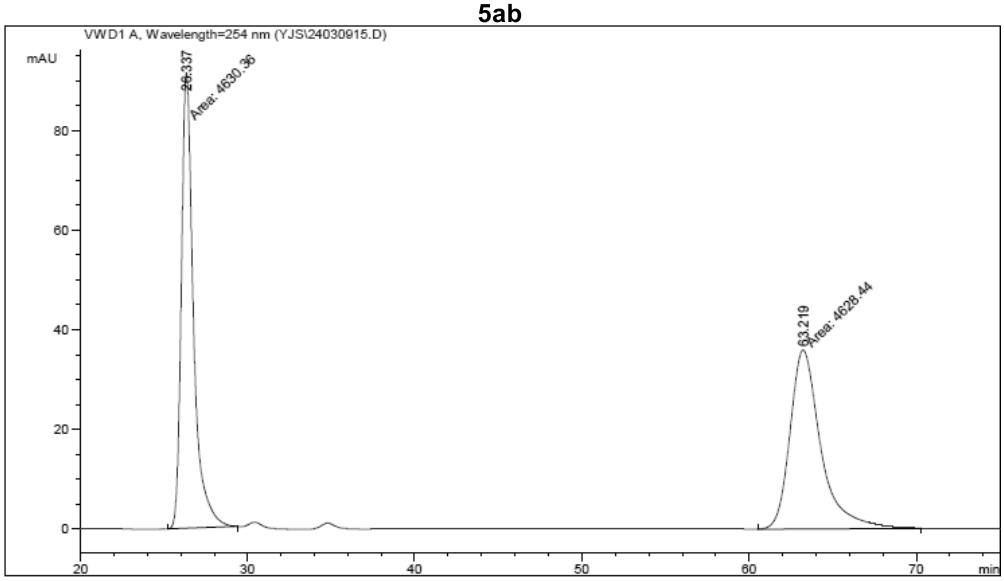

```
================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  25.568 MM    0.9766 1.68687e4   287.86905  99.7435
   2  66.418 MM    1.7038   43.37315 4.24270e-1   0.2565

Totals :                  1.69121e4   288.29332
```



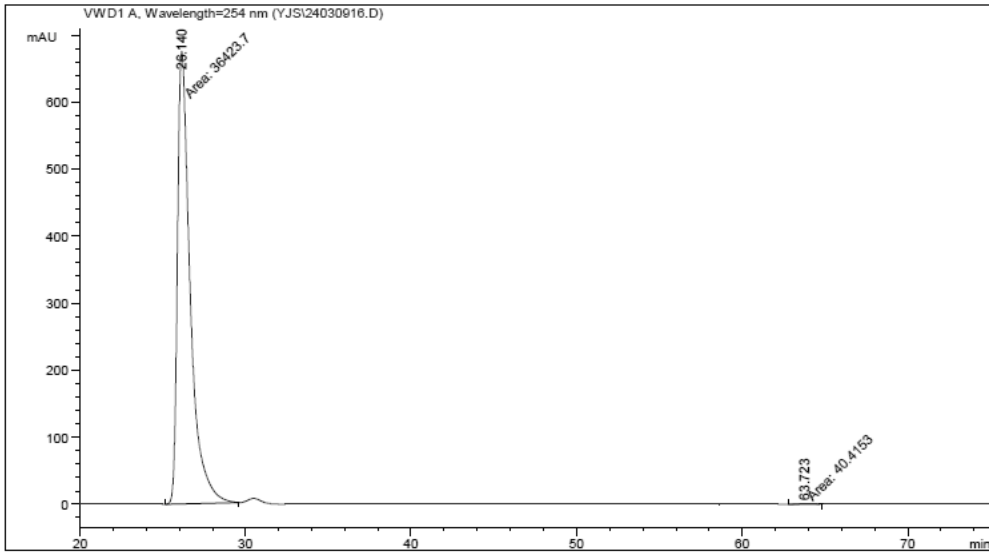
5ab




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  26.337 MM    0.8434 4630.36084   91.50466  50.0104
   2  63.219 MM    2.1471 4628.43604   35.92761  49.9896

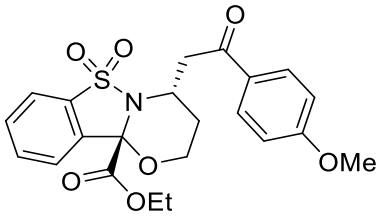
Totals :                  9258.79688  127.43227
```



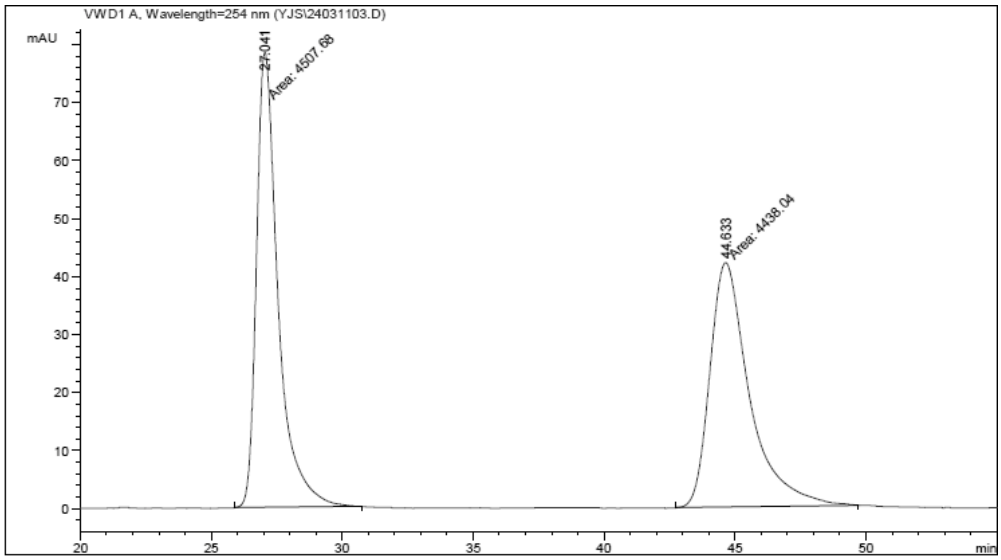

```
================================================================================
                            Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  26.140 MM    0.8984 3.64237e4   675.69019  99.8892
   2  63.723 MM    0.8724   40.41528 5.47247e-1   0.1108

Totals :                  3.64641e4   676.23743
```



5ac




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  27.041 MM    0.9569 4507.68262   78.51146  50.3892
   2  44.633 MM    1.7550 4438.04199   42.14626  49.6108

Totals :                  8945.72461  120.65771
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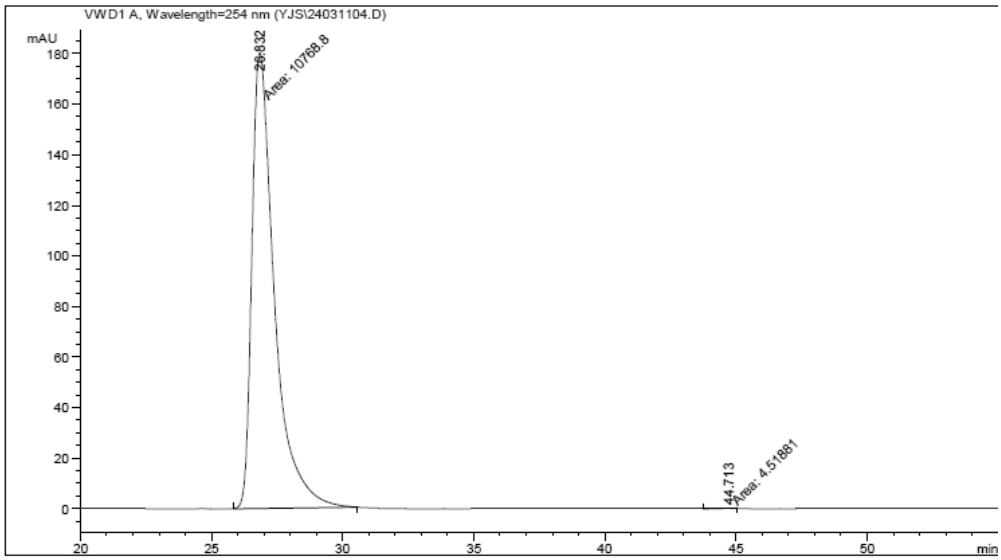
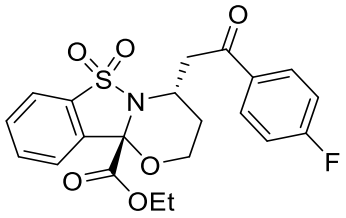


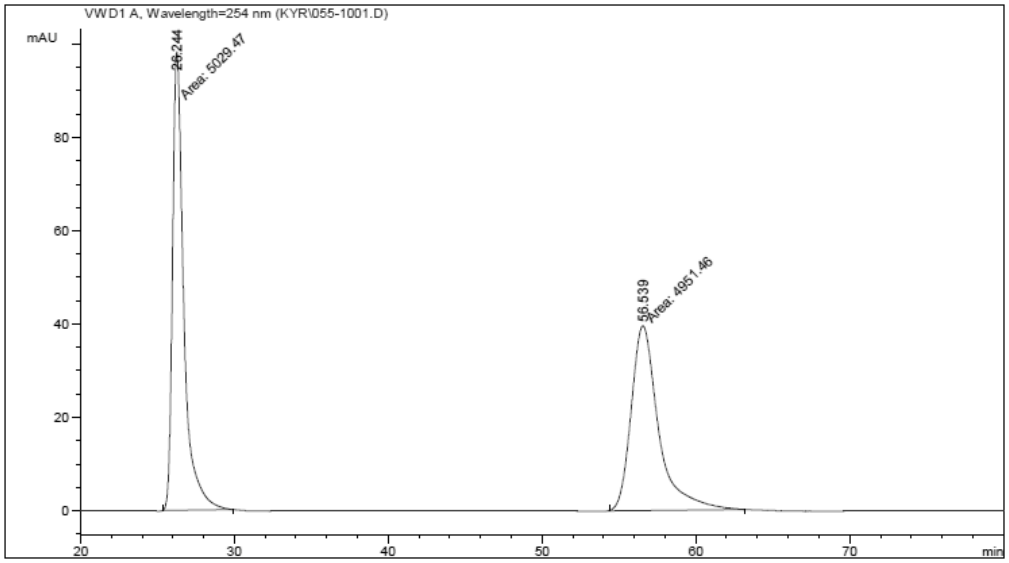

```
================================================================================
                            Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  26.832 MM    0.9953 1.07688e4   180.32288  99.9581
   2  44.713 MM    1.8151    4.51881 4.14933e-2   0.0419

Totals :                  1.07733e4   180.36437
```



5ad




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  26.244 MM    0.8519 5029.47266   98.39513  50.3908
   2  56.539 MM    2.0802 4951.46045   39.67060  49.6092

Totals :                  9980.93311  138.06573
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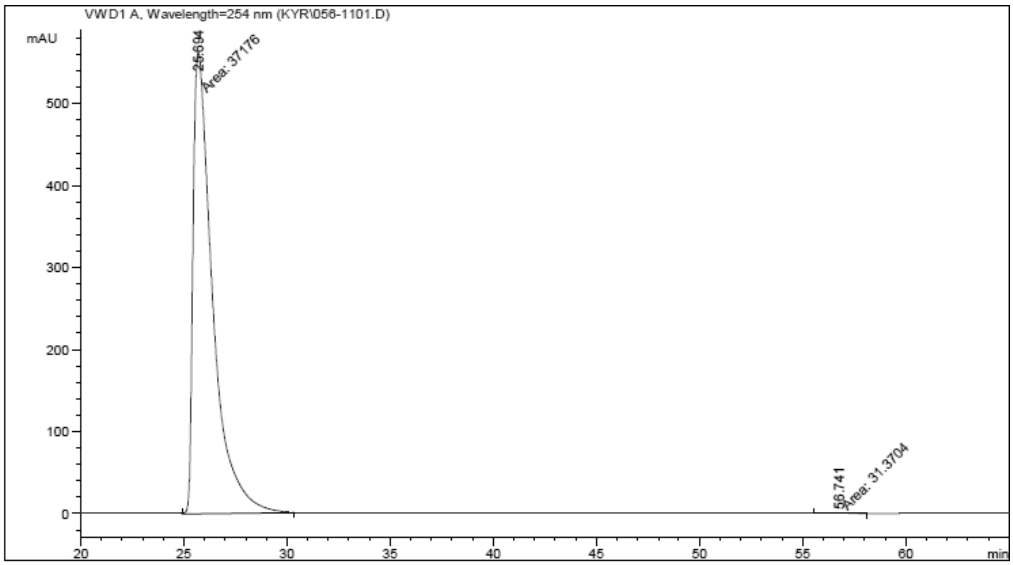
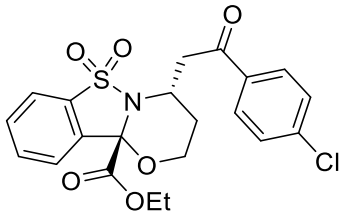


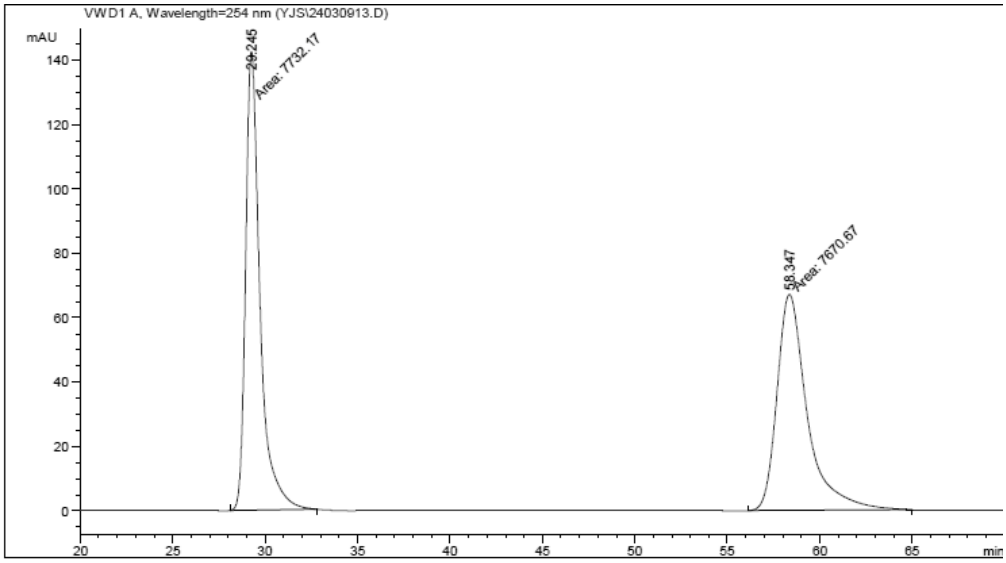

```
================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  25.694 MM    1.1014 3.71760e4   562.57941  99.9157
   2  56.741 MM    1.0252   31.37039 5.09964e-1   0.0843

Totals :                  3.72074e4   563.08937
```



5ae




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  29.245 MM    0.9045 7732.17139  142.47307  50.1996
   2  58.347 MM    1.9047 7670.67236   67.12000  49.8004

Totals :                  1.54028e4   209.59307
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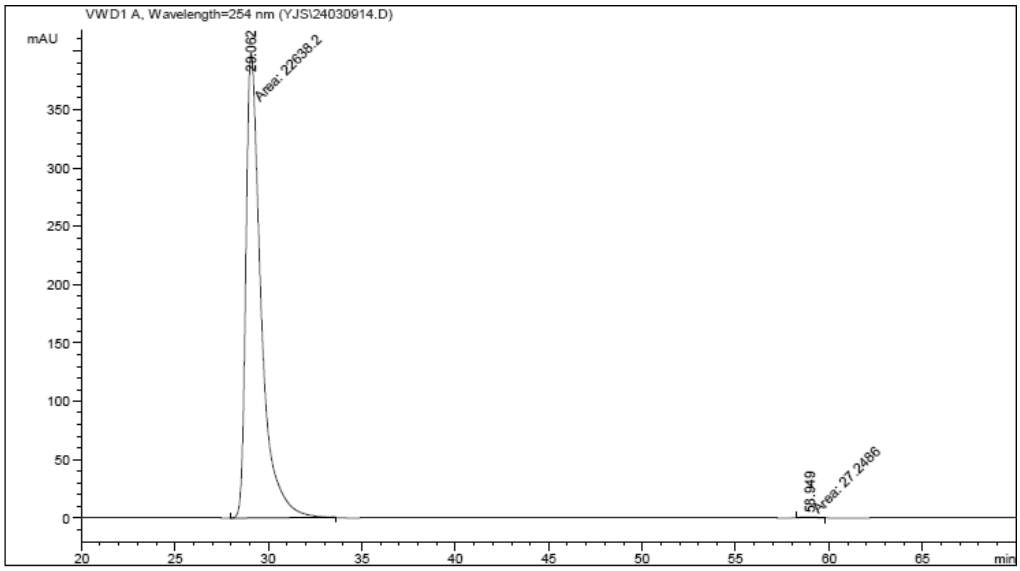
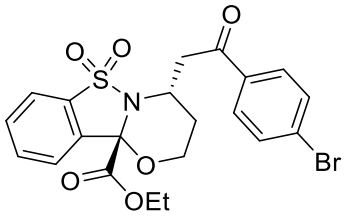


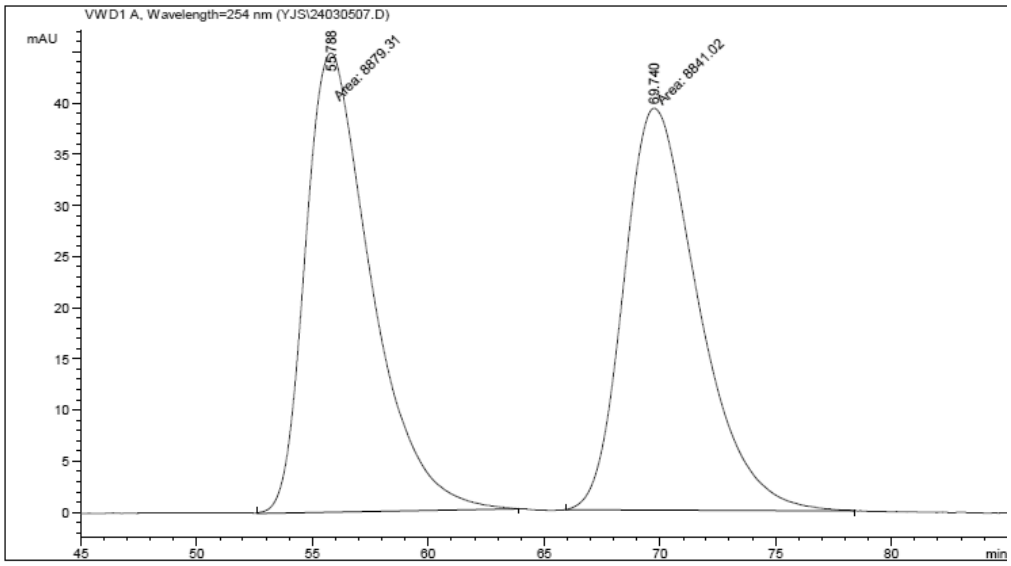

```
================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  29.062 MM    0.9472 2.26382e4   398.34402  99.8798
   2  58.949 MM    1.0020   27.24857 4.53228e-1   0.1202

Totals :                  2.26654e4   398.79725
```



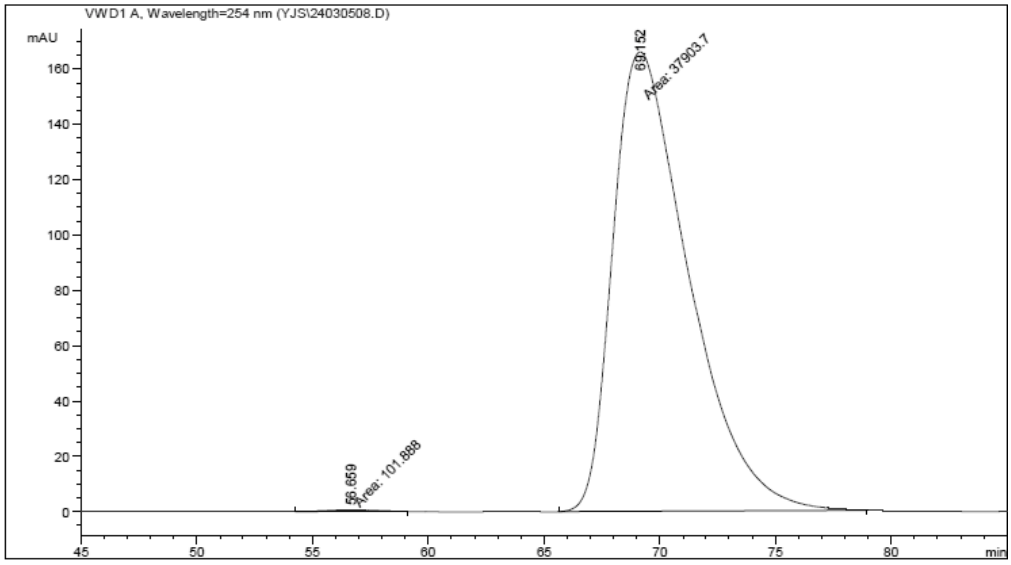
5af




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  55.788 MM    3.2957 8879.31055   44.90297  50.1080
   2  69.740 MM    3.7497 8841.02344   39.29702  49.8920

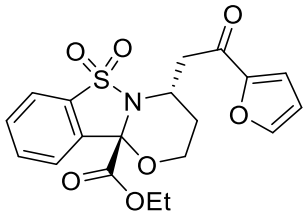
Totals :                  1.77203e4    84.19999
```



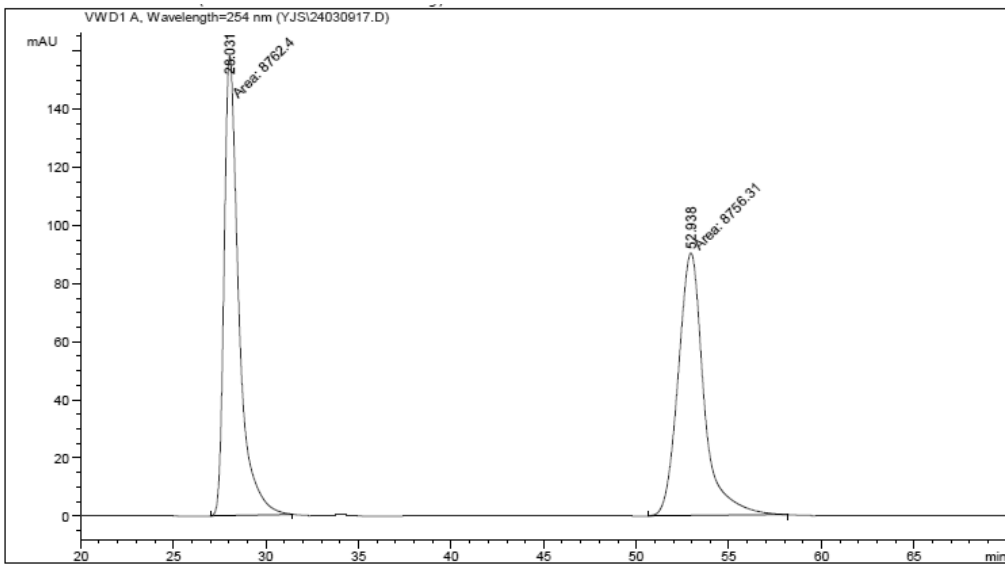

```
================================================================================
                            Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  56.659 MM    2.6159  101.88846 6.49151e-1   0.2681
   2  69.152 MM    3.8044 3.79037e4   166.05357  99.7319

Totals :                  3.80056e4   166.70272
```



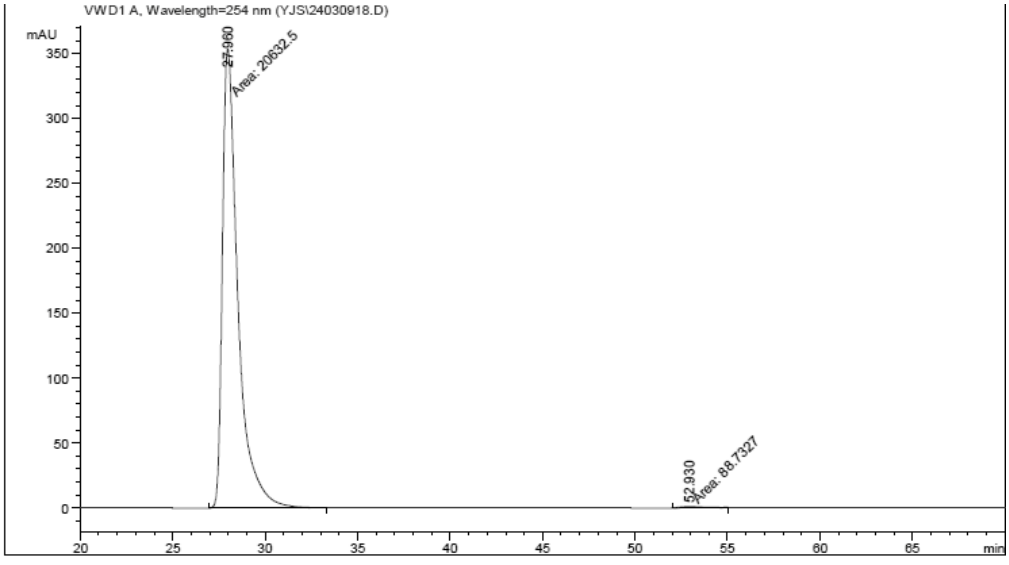
5ag




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  28.031 MM    0.9228 8762.40039  158.26346  50.0174
   2  52.938 MM    1.6147 8756.30664   90.38179  49.9826

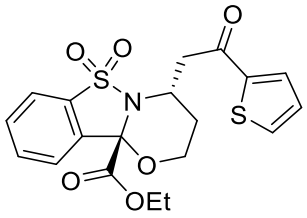
Totals :                  1.75187e4   248.64525
```



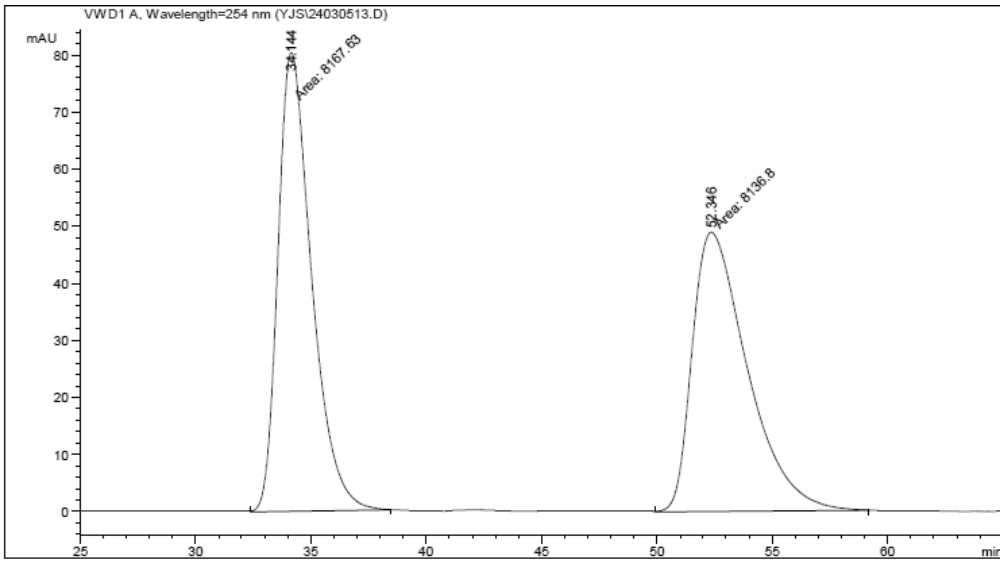

```
================================================================================
                            Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  27.960 MM    0.9722 2.06325e4   353.70554  99.5718
   2  52.930 MM    1.3779   88.73273     1.07331   0.4282

Totals :                  2.07212e4   354.77885
```



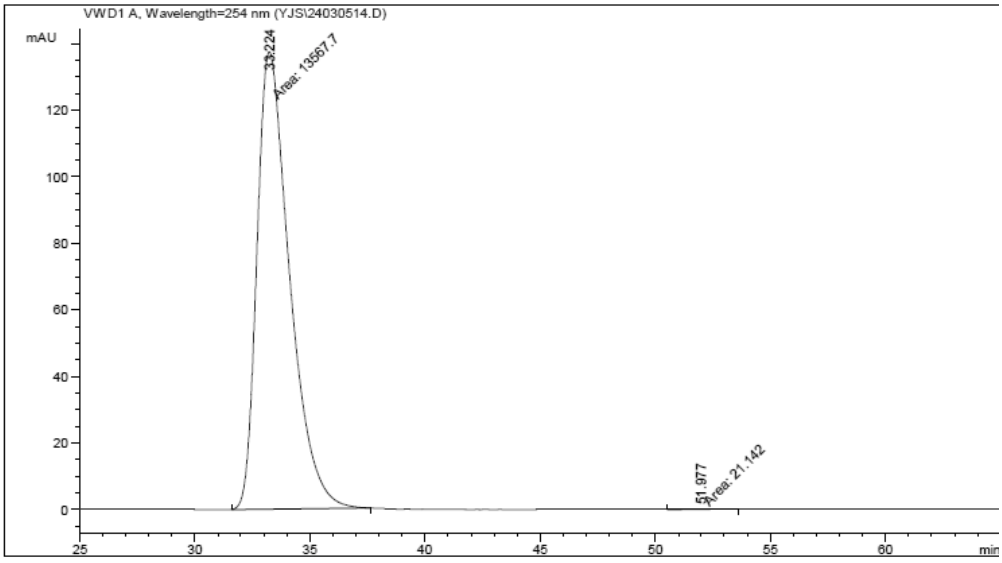
5ah




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]     %
----|-------|----|-------|----------|----------|--------|
   1  34.144 MM    1.6923 8167.62646   80.44122  50.0945
   2  52.346 MM    2.7698 8136.79541   48.96076  49.9055

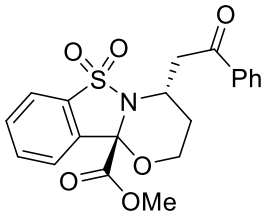
Totals :                  1.63044e4   129.40197
```



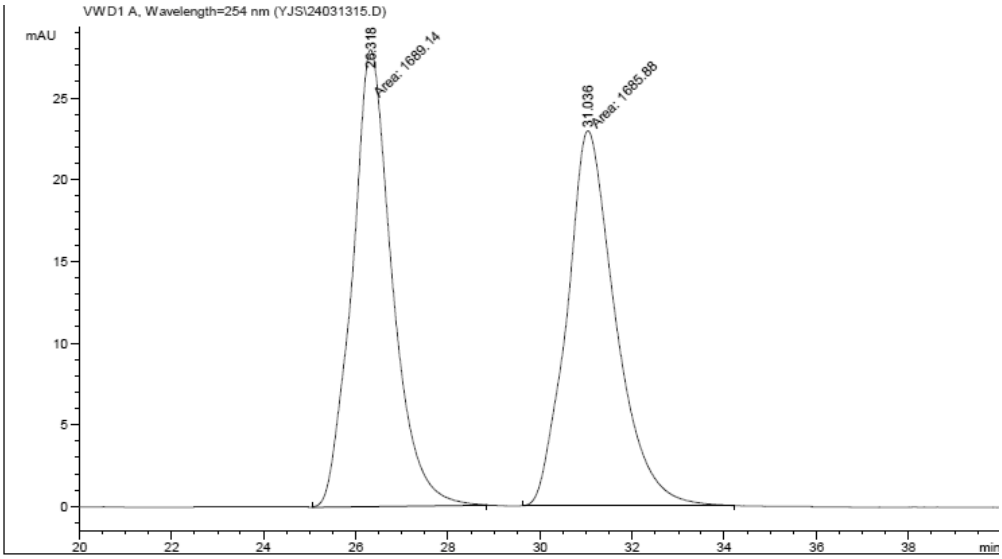

```
================================================================================
                            Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]     %
----|-------|----|-------|----------|----------|--------|
   1  33.224 MM    1.6439 1.35677e4   137.55606  99.8444
   2  51.977 MM    1.7933   21.14202 1.96486e-1   0.1556

Totals :                  1.35889e4   137.75255
```



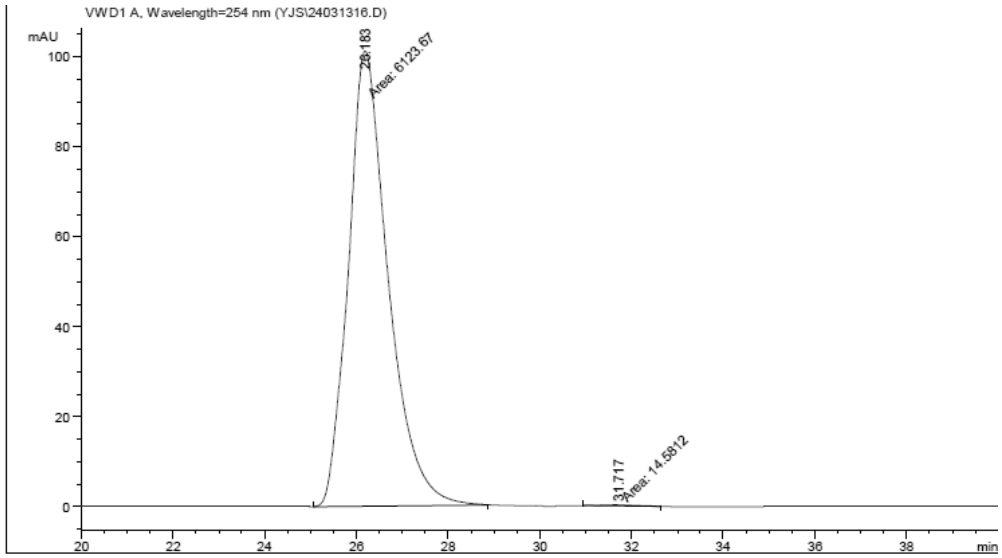
5ba




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  26.318 MM    1.0059 1689.13953   27.98795  50.0483
   2  31.036 MM    1.2245 1685.87927   22.94571  49.9517

Totals :                  3375.01880   50.93365
```

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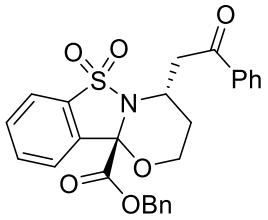
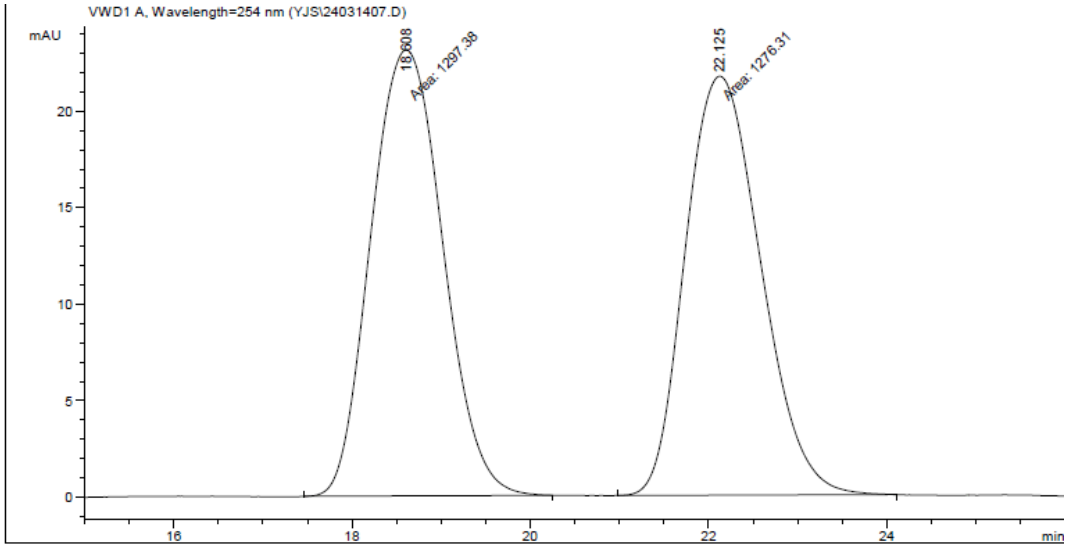
================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  26.183 MM    1.0079 6123.66699  101.26205  99.7625
   2  31.717 MM    0.8958   14.58122 2.71277e-1   0.2375

Totals :                  6138.24821  101.53332
```



5ca




```
=====================================================================
                      Area Percent Report
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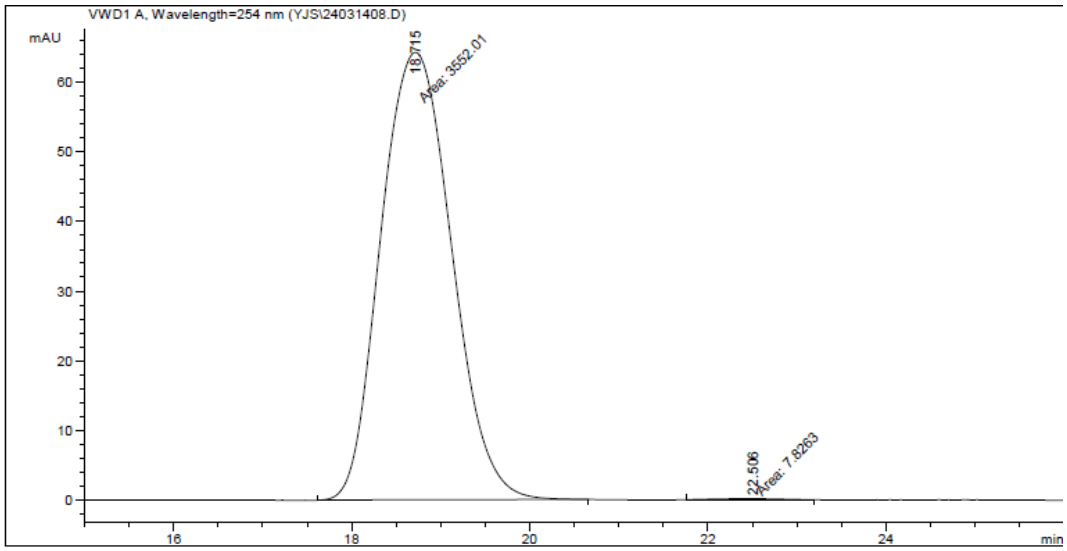
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  18.608 MM    0.9359 1297.37866   23.10303  50.4093
   2  22.125 MM    0.9800 1276.31238   21.70555  49.5907

Totals :                  2573.69104   44.80858
```




```
=====================================================================
                      Area Percent Report
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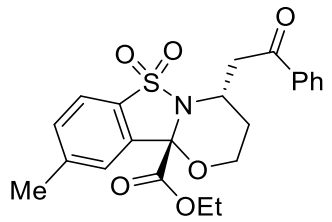
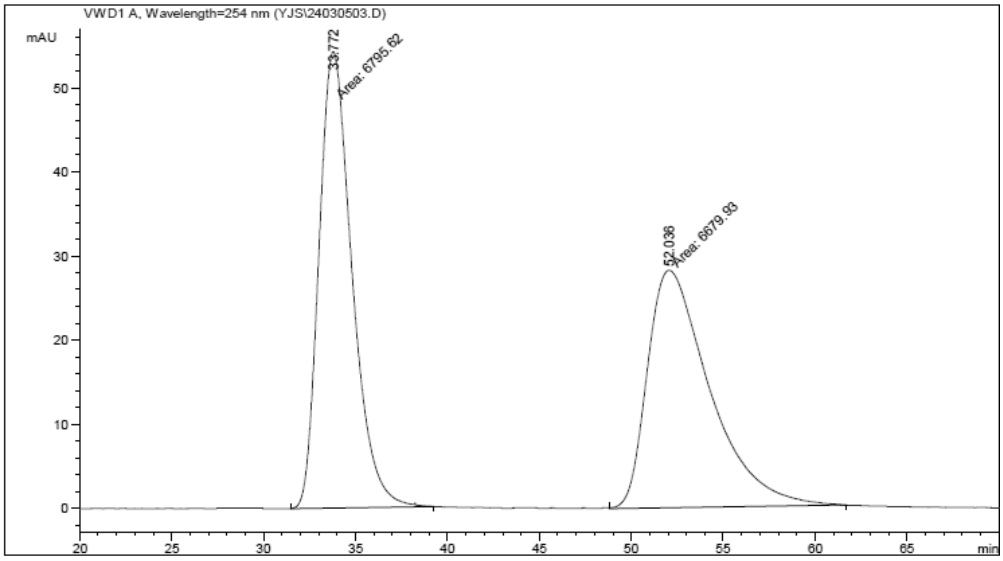
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  18.715 MM    0.9215 3552.00952   64.24580  99.7801
   2  22.506 MM    0.8502    7.82630 1.53417e-1   0.2199

Totals :                  3559.83582   64.39922
```



5da




```
================================================================================
                            Area Percent Report
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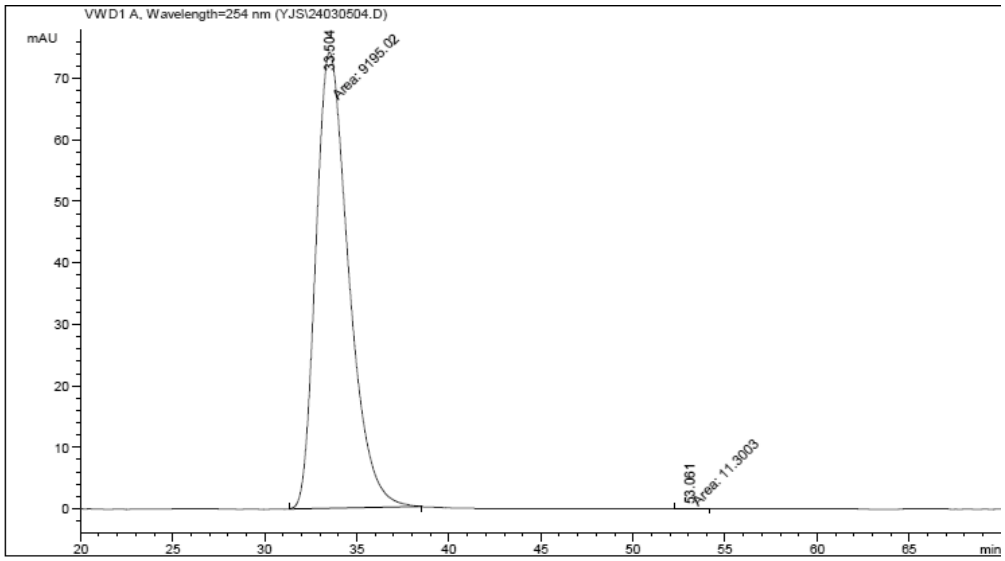
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  33.772 MM    2.0859 6795.62207   54.29781  50.4293
   2  52.036 MM    3.9385 6679.93115   28.26743  49.5707

Totals :                  1.34756e4    82.56524
```




```
================================================================================
                            Area Percent Report
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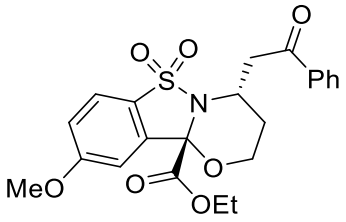
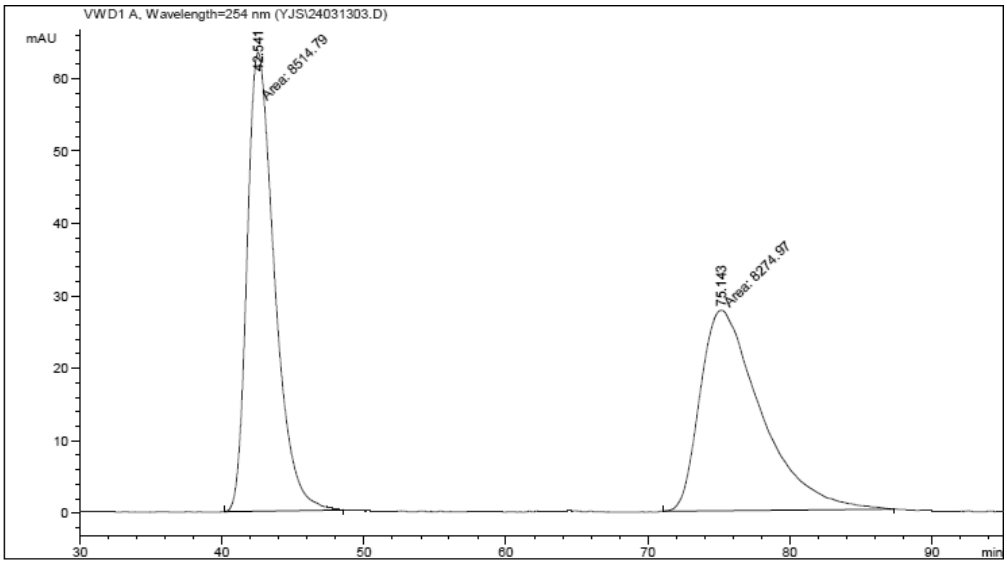
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  33.504 MM    2.0672 9195.02246   74.13548  99.8773
   2  53.061 MM    1.5341   11.30028 1.22765e-1   0.1227

Totals :                  9206.32274   74.25825
```



5ea




```
================================================================================
                            Area Percent Report
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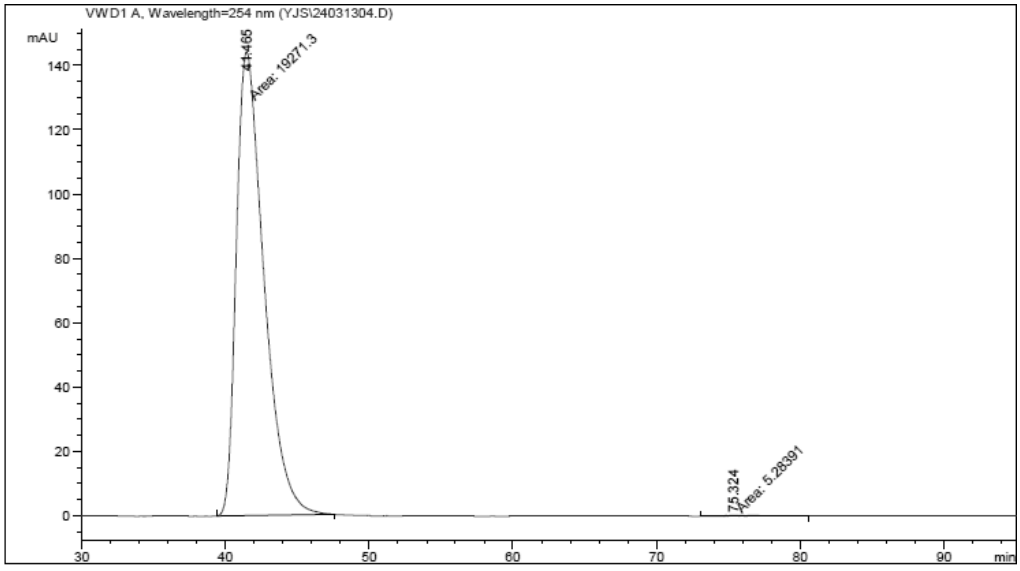
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  42.541 MM    2.2394 8514.78809   63.36987  50.7142
   2  75.143 MM    4.9787 8274.97070   27.70111  49.2858

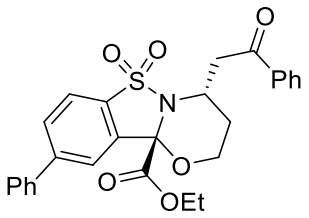
Totals :                  1.67898e4    91.07098
```



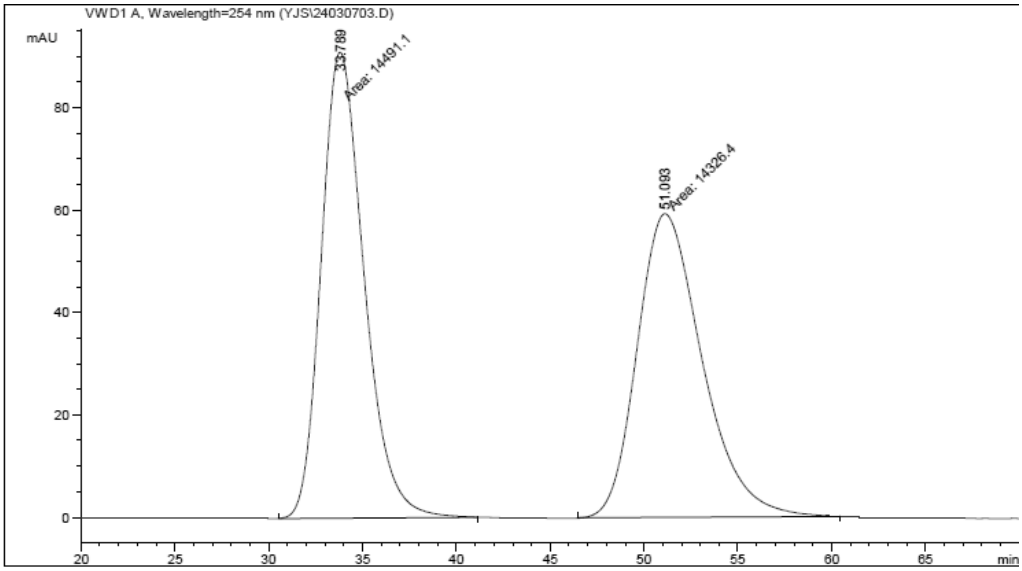

```
================================================================================
                            Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  41.465 MM    2.2286 1.92713e4   144.12285  99.9726
   2  75.324 MM    1.3814    5.28391 6.37526e-2   0.0274

Totals :                  1.92766e4   144.18660
```



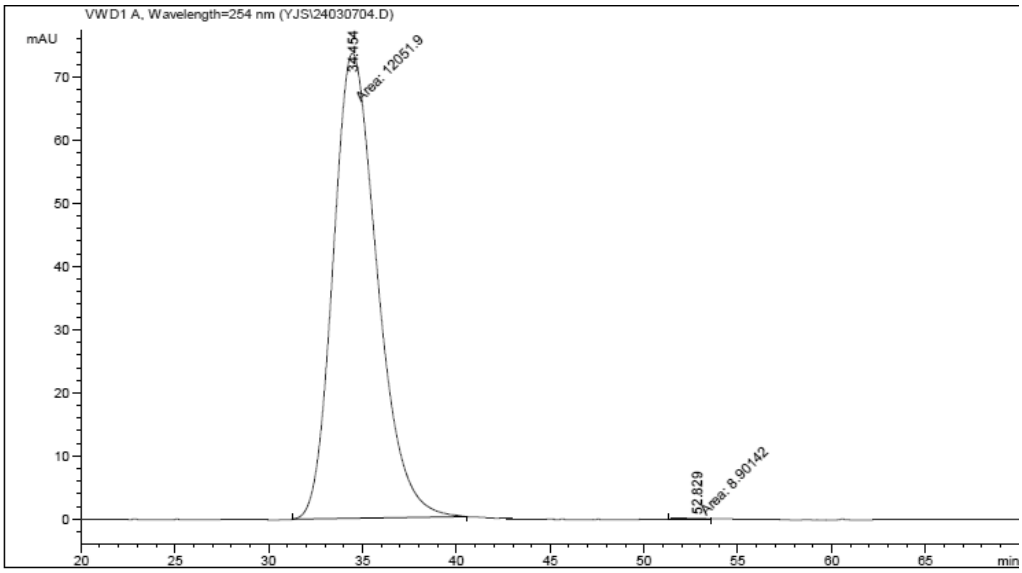
5fa




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  33.789 MM    2.6522 1.44911e4    91.06343  50.2857
   2  51.093 MM    4.0226 1.43264e4    59.35849  49.7143

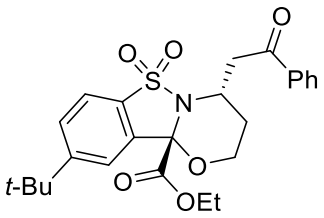
Totals :                  2.88175e4   150.42192
```



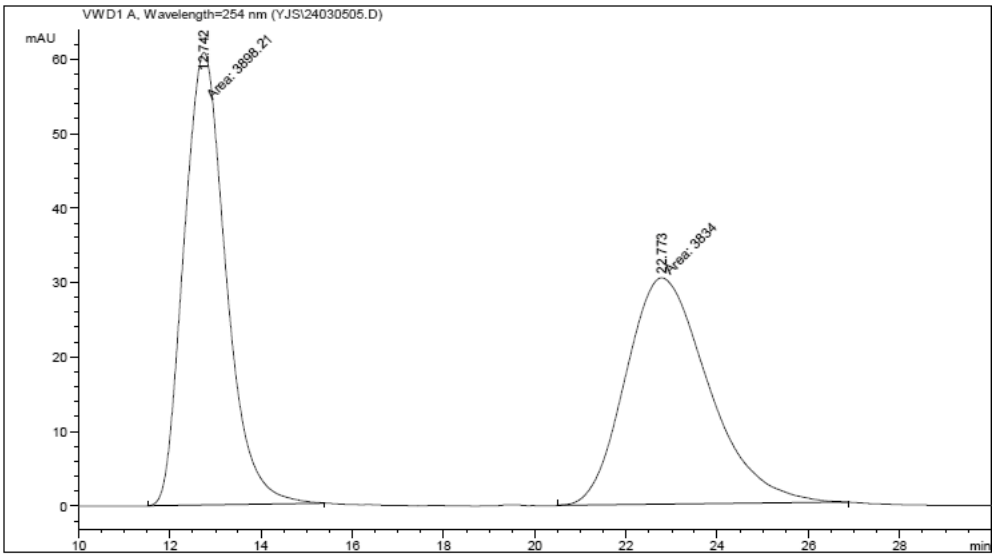

```
================================================================================
                            Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  34.454 MM    2.7278 1.20519e4    73.63513  99.9262
   2  52.829 MM    1.3495    8.90142 1.09937e-1   0.0738

Totals :                  1.20608e4    73.74507
```



5ga




```
=====================================================================
                        Area Percent Report
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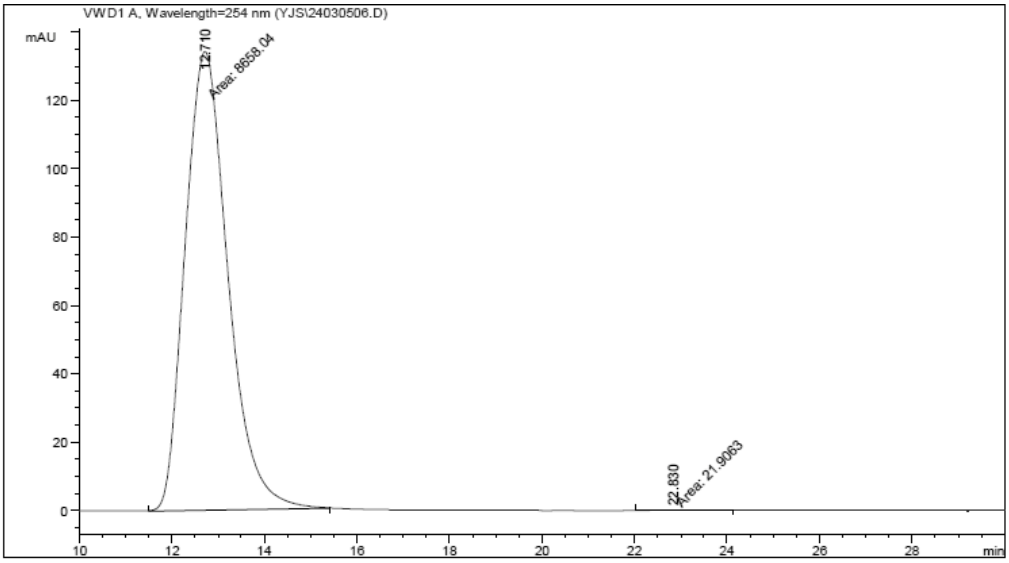
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  12.742 MM    1.0692 3898.21436   60.76381  50.4152
   2  22.773 MM    2.1029 3834.00293   30.38699  49.5848

Totals :                  7732.21729   91.15081
```




```
=====================================================================
                        Area Percent Report
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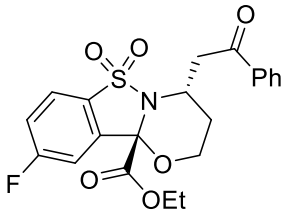
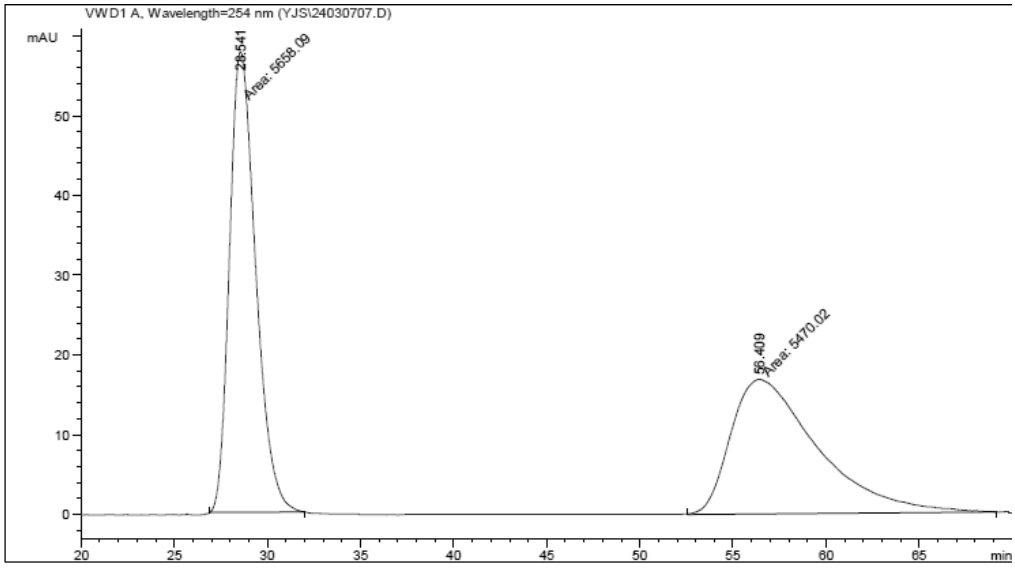
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  12.710 MM    1.0747 8658.03906  134.26691  99.7476
   2  22.830 MM    1.3739   21.90628 2.65750e-1   0.2524

Totals :                  8679.94534  134.53266
```



5ha

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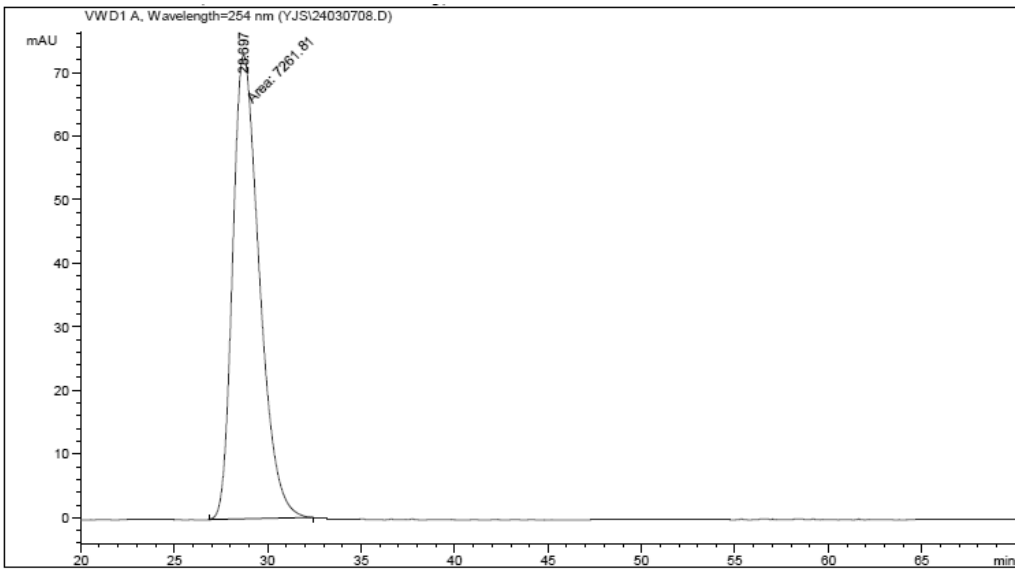
=====================================================================
                        Area Percent Report
=====================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  28.541 MM    1.6333 5658.09229   57.73697  50.8450
   2  56.409 MM    5.4038 5470.02490   16.87080  49.1550

Totals :                  1.11281e4    74.60777
```

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=====================================================================
                        Area Percent Report
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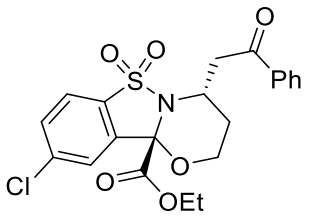
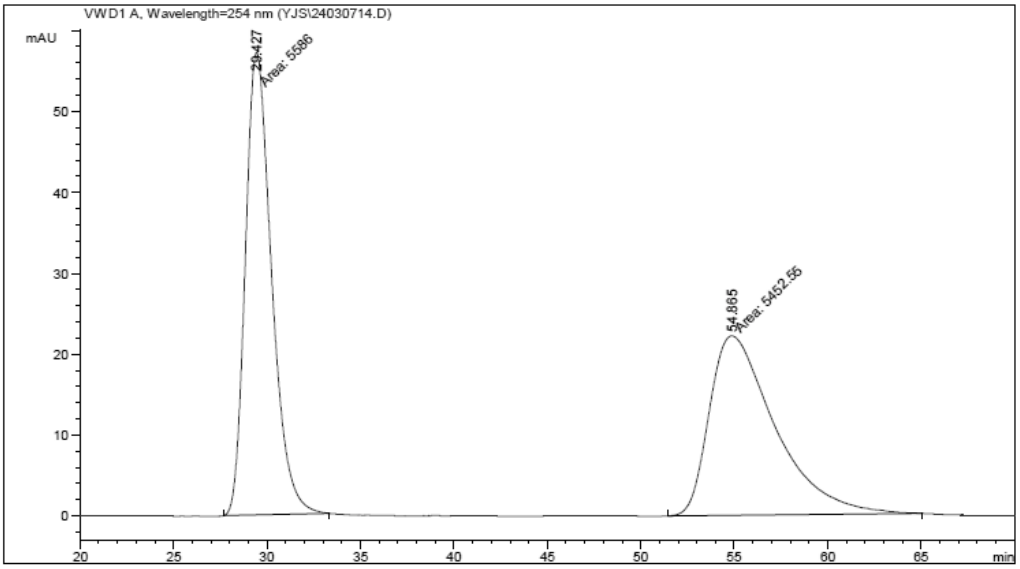
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  28.697 MM    1.6574 7261.81104   73.02557 100.0000

Totals :                  7261.81104   73.02557
```



5ia

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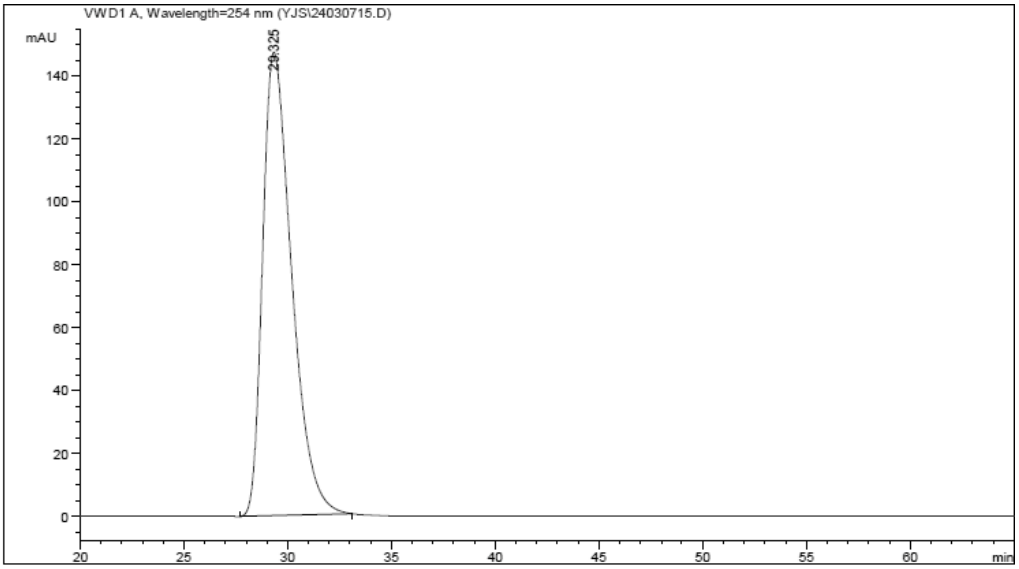
=====================================================================
                        Area Percent Report
=====================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  29.427 MM    1.6278 5586.00098   57.19431  50.6045
   2  54.865 MM    4.0890 5452.55127   22.22460  49.3955

Totals :                 1.10386e4    79.41891
```

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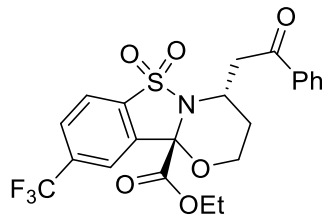
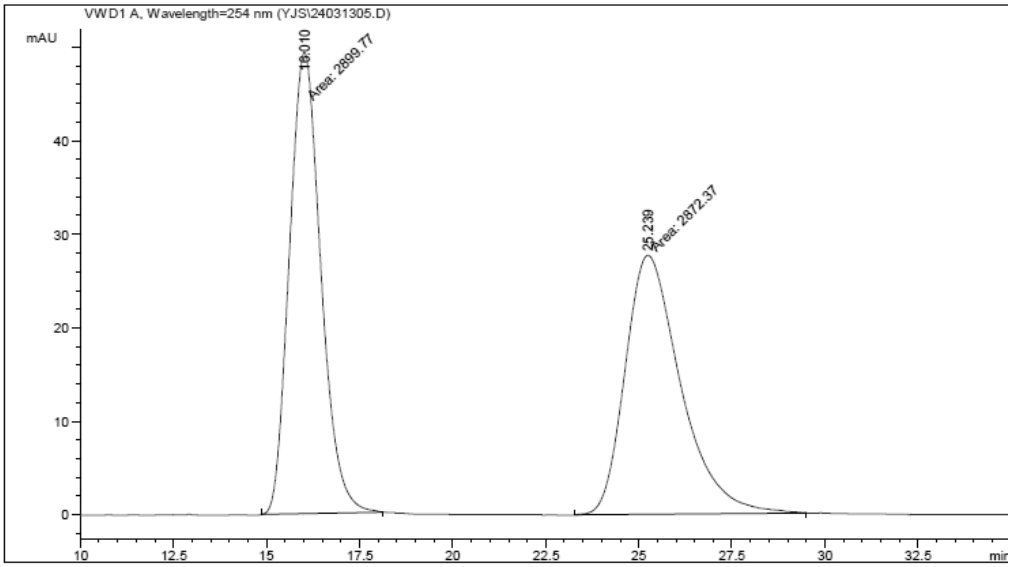
=====================================================================
                        Area Percent Report
=====================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  29.325 BB    1.4698 1.43180e4   147.37784 100.0000

Totals :                 1.43180e4   147.37784
```



5ja




```
================================================================================
                          Area Percent Report
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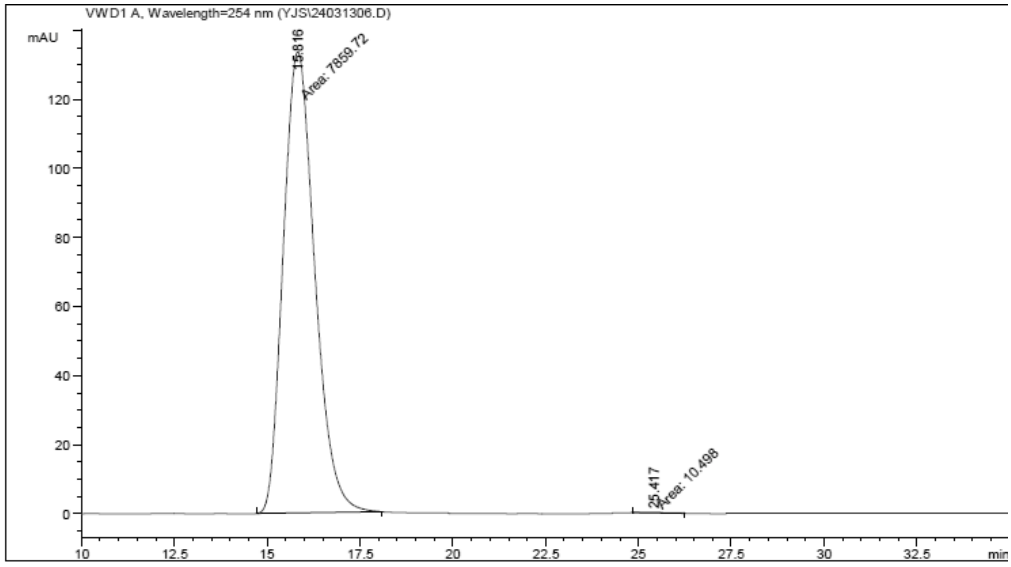
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  16.010 MM    0.9794 2899.77490   49.34570  50.2373
   2  25.239 MM    1.7289 2872.37451   27.68925  49.7627

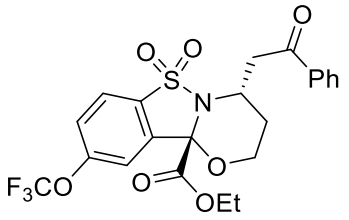
Totals :                 5772.14941   77.03495
```



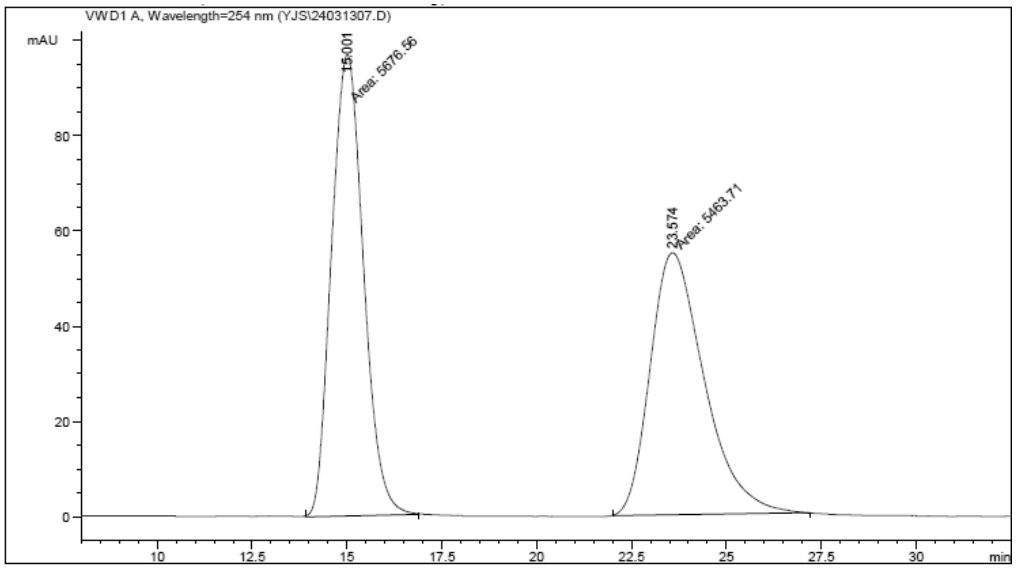

```
================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  15.816 MM    0.9810 7859.72168  133.53566  99.8666
   2  25.417 MM    1.0500   10.49804 1.66632e-1   0.1334

Totals :                 7870.21972  133.70229
```



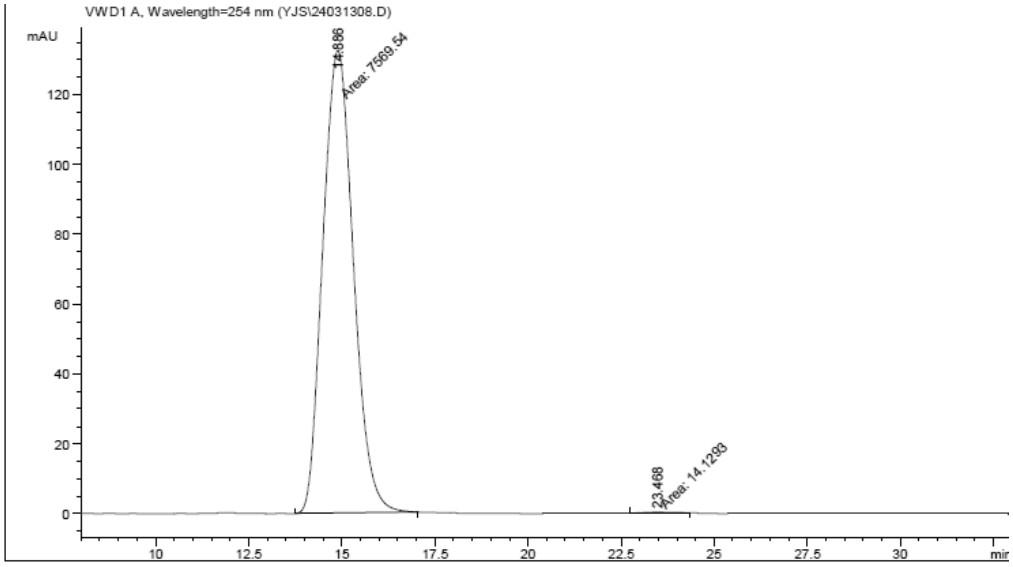
5ka




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  15.001 MM    0.9758 5676.55811   96.95181  50.9553
   2  23.574 MM    1.6543 5463.70605   55.04451  49.0447

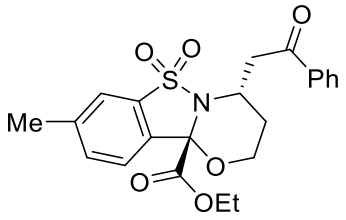
Totals :                  1.11403e4   151.99633
```



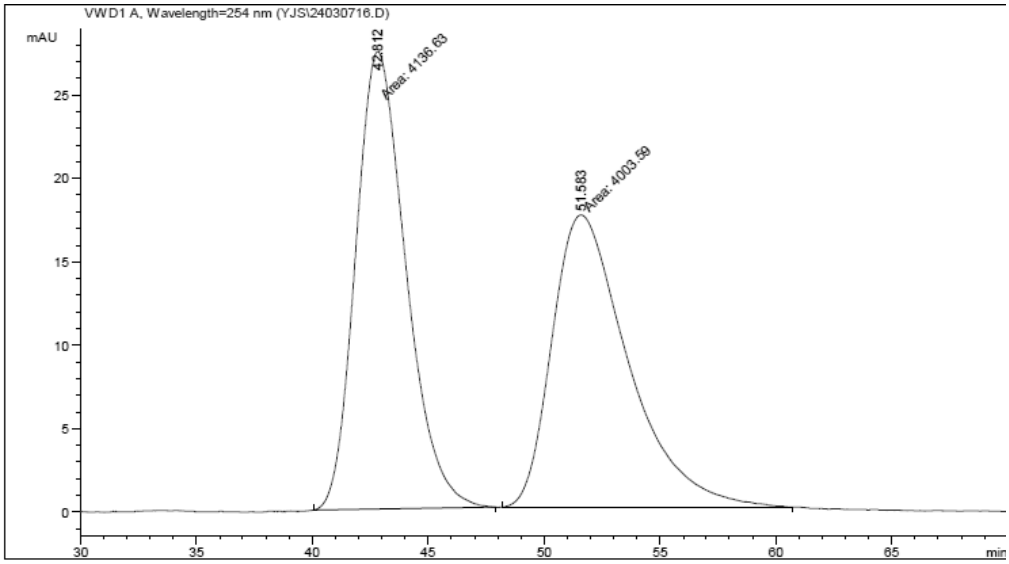

```
================================================================================
                            Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  14.886 MM    0.9521 7569.53516  132.50885  99.8137
   2  23.468 MM    0.9372   14.12932 2.51260e-1   0.1863

Totals :                  7583.66448  132.76011
```



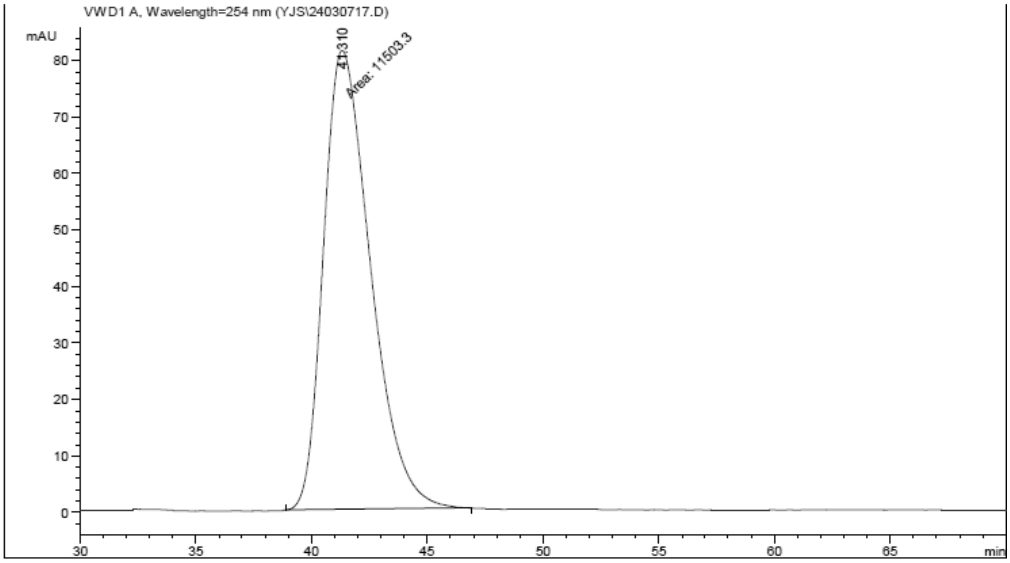
5la




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  42.812 MM    2.5144 4136.62939   27.41990  50.8172
   2  51.583 MM    3.8117 4003.59155   17.50572  49.1828

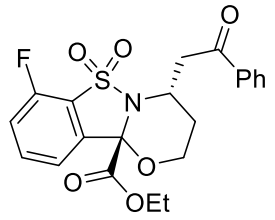
Totals :                  8140.22095   44.92561
```



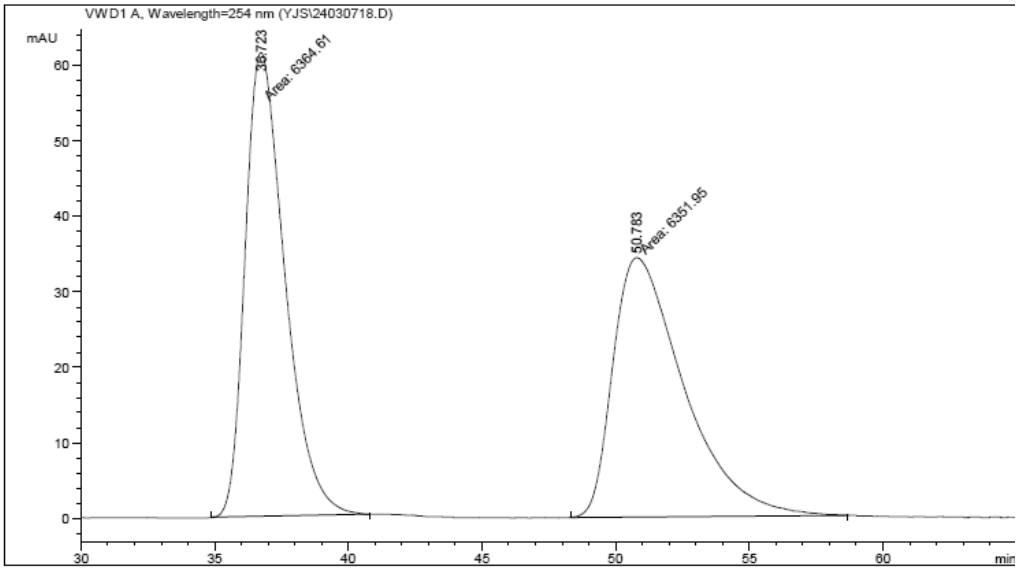

```
================================================================================
                            Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  41.310 MM    2.3578 1.15033e4    81.31471 100.0000

Totals :                  1.15033e4    81.31471
```



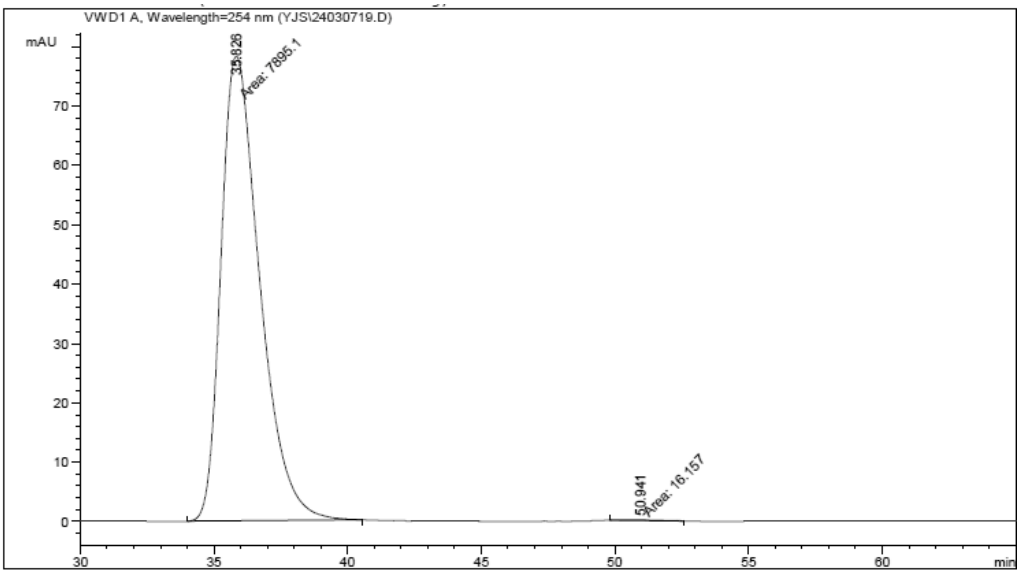
5ma




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  36.723 MM    1.7265 6364.60547   61.44190  50.0497
   2  50.783 MM    3.0817 6351.95410   34.35361  49.9503

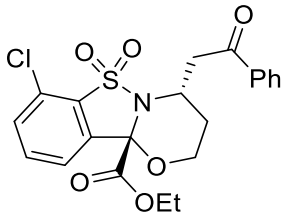
Totals :                  1.27166e4    95.79551
```



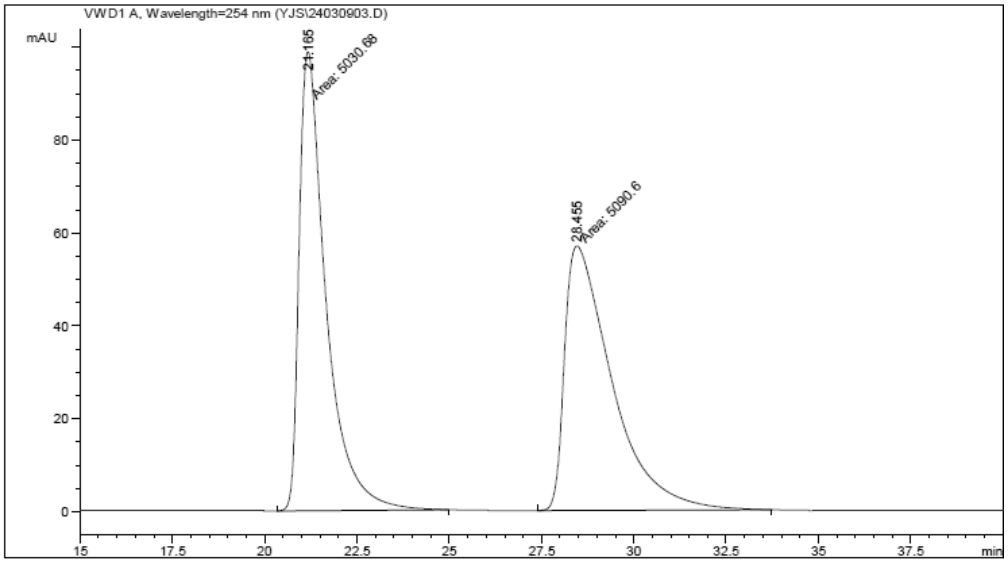

```
================================================================================
                            Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  35.826 MM    1.6805 7895.09766   78.30009  99.7958
   2  50.941 MM    1.8129   16.15705 1.48539e-1   0.2042

Totals :                  7911.25470   78.44863
```



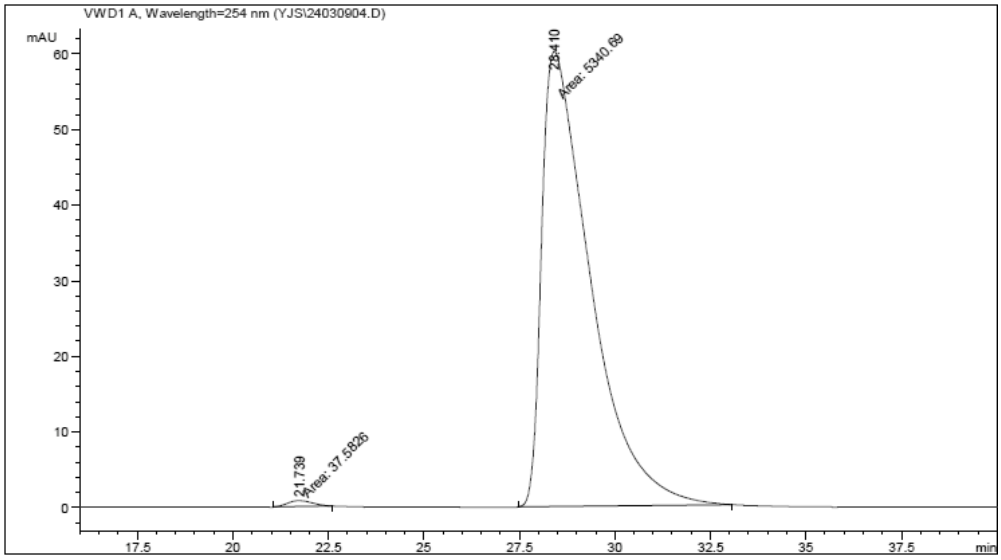
5na




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  21.165 MM    0.8473 5030.68115   98.95753  49.7040
   2  28.455 MM    1.4883 5090.60059   57.00760  50.2960

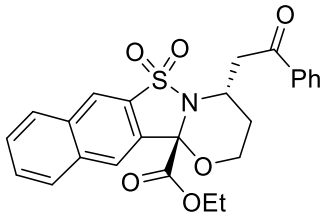
Totals :                  1.01213e4   155.96512
```



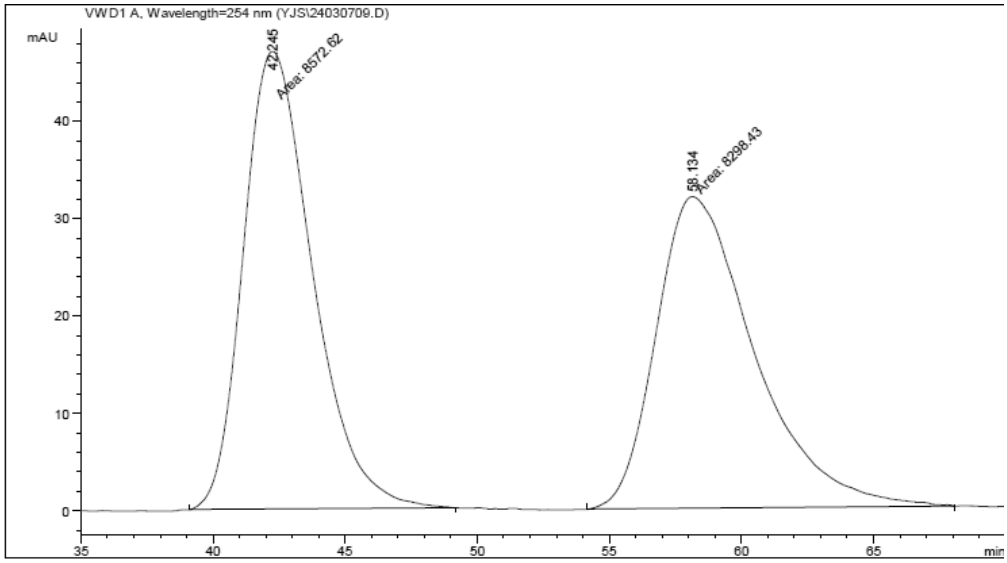

```
=====================================================================
                      Area Percent Report
=====================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  21.739 MM    0.7699   37.58263 8.13627e-1   0.6988
   2  28.410 MM    1.4799 5340.68896   60.14654  99.3012

Totals :                  5378.27159   60.96016
```



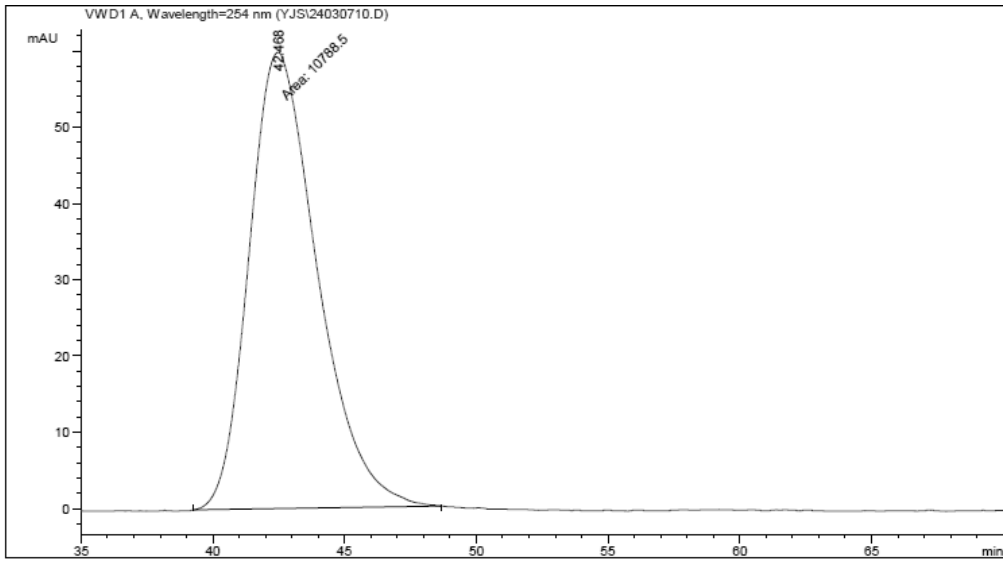
5oa




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  42.245 MM    3.0395 8572.62305   47.00602  50.8126
   2  58.134 MM    4.3182 8298.43359   32.02880  49.1874

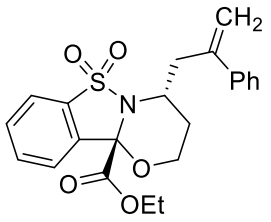
Totals :                  1.68711e4    79.03482
```



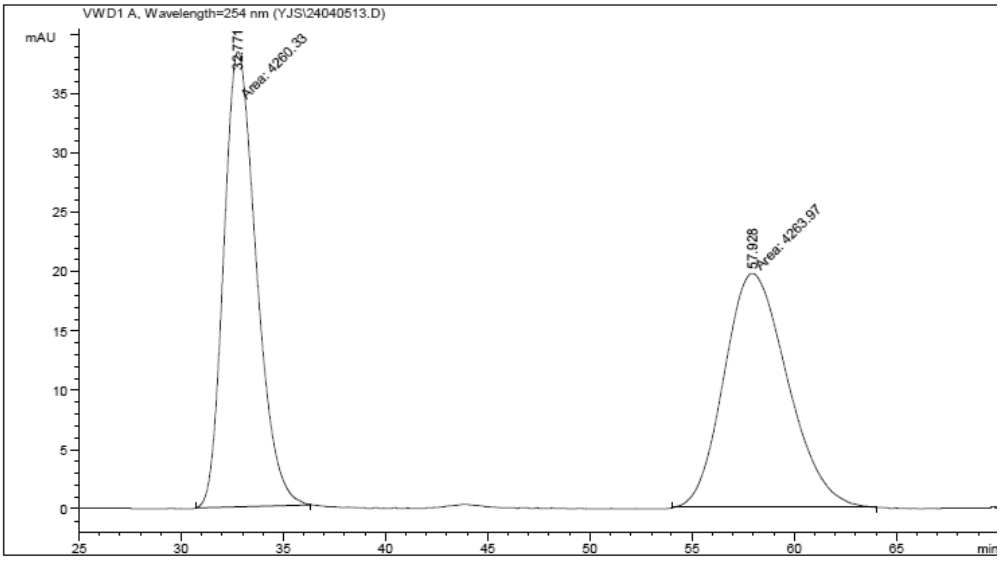

```
================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  42.468 MM    3.0048 1.07885e4    59.83943 100.0000

Totals :                  1.07885e4    59.83943
```



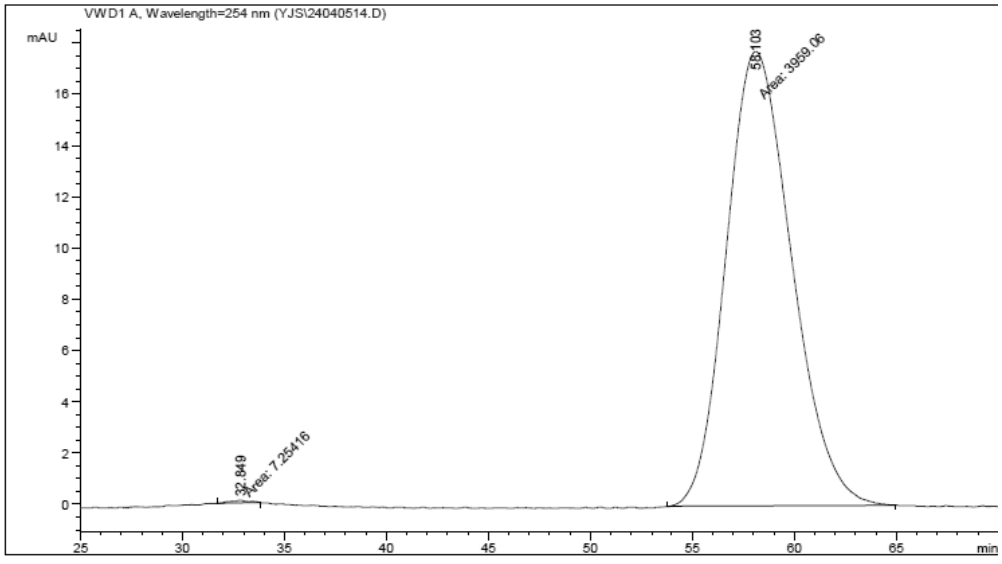
6




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  32.771 MM    1.8495 4260.33252   38.39244  49.9787
   2  57.928 MM    3.6019 4263.96582   19.73010  50.0213

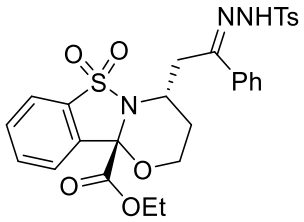
Totals :                  8524.29834   58.12254
```



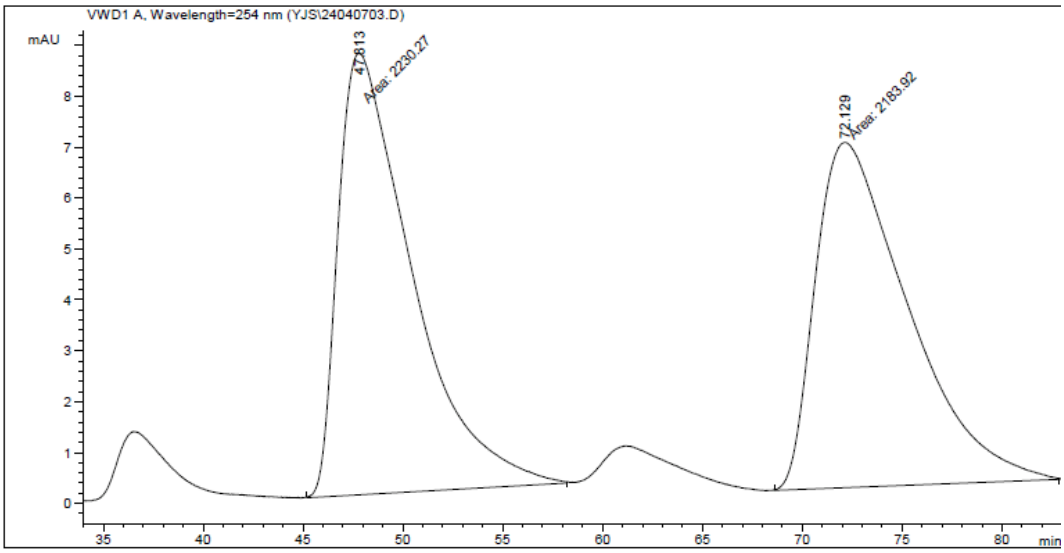

```
================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  32.849 MM    1.1749    7.25416 1.02902e-1   0.1829
   2  58.103 MM    3.7211 3959.05542   17.73268  99.8171

Totals :                  3966.30958   17.83558
```



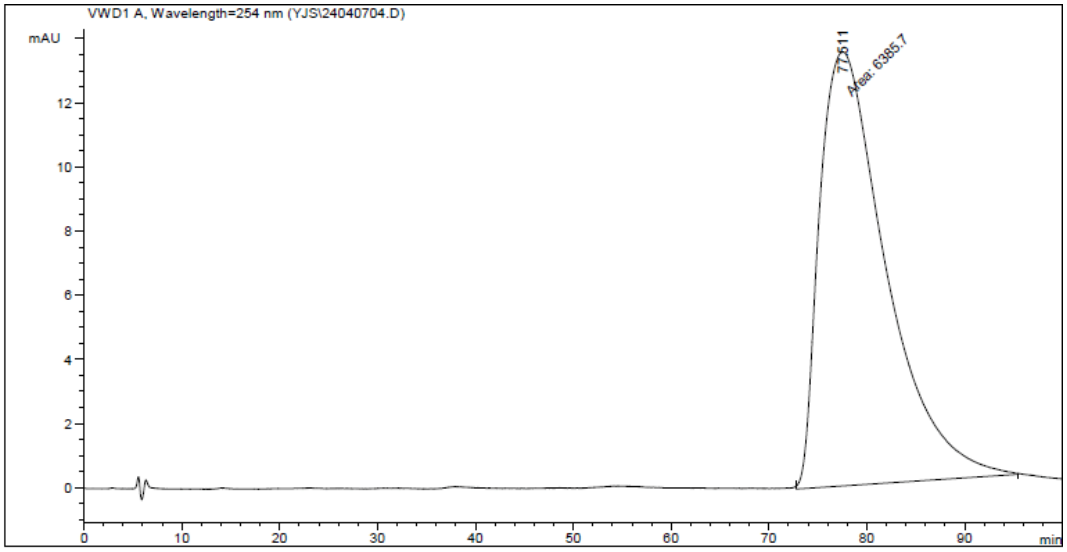
7 (major)




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  47.813 MM    4.2833 2230.27100    8.67817  50.5250
   2  72.129 MM    5.3655 2183.92065    6.78386  49.4750

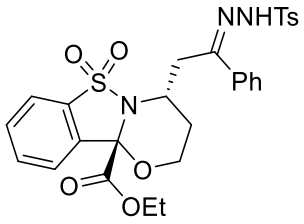
Totals :                  4414.19165   15.46203
```



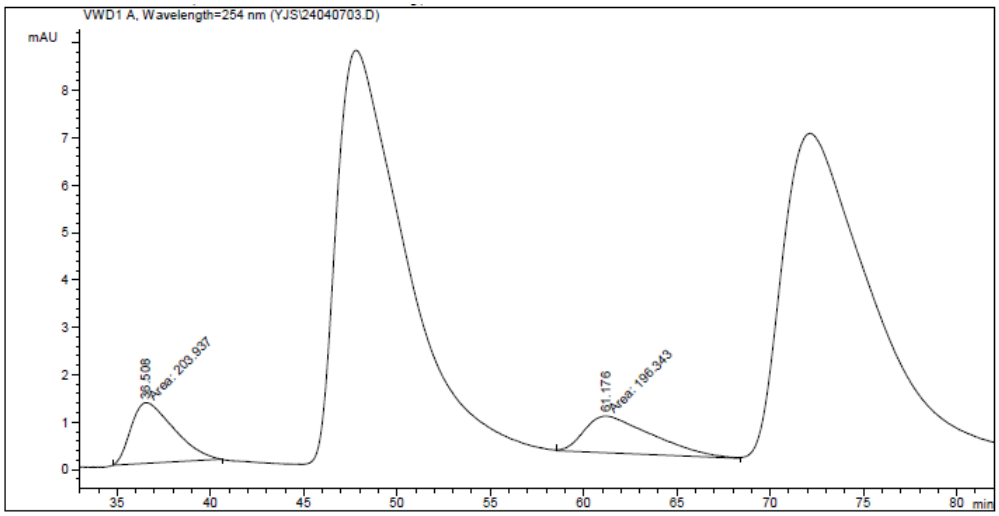

```
================================================================================
                          Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  77.511 MM    7.8622 6385.70361   13.53672 100.0000

Totals :                  6385.70361   13.53672
```



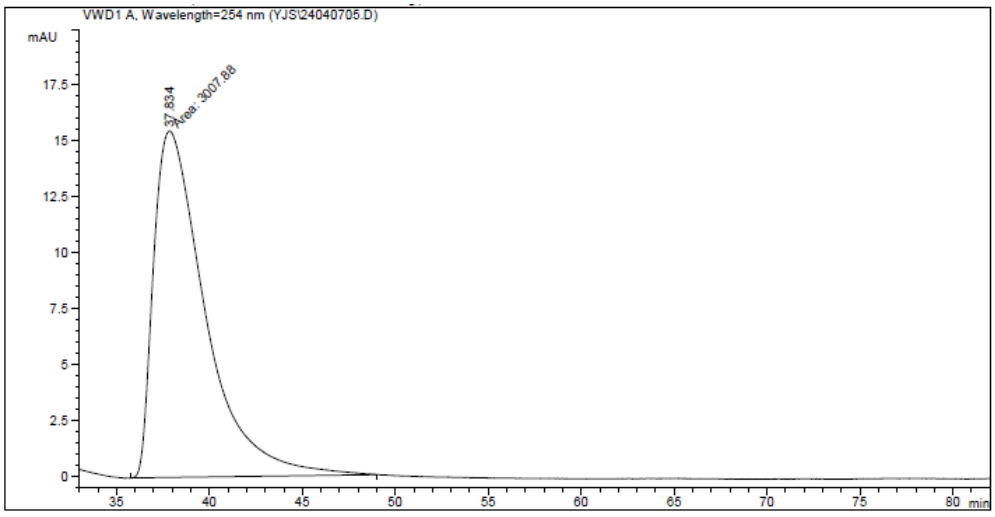
7 (minor)




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  36.508 MM    2.6549  203.93655    1.28025  50.9485
   2  61.176 MM    4.2179  196.34338 7.75830e-1  49.0515

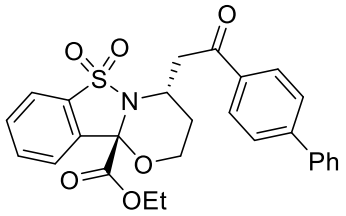
Totals :                   400.27994    2.05608
```



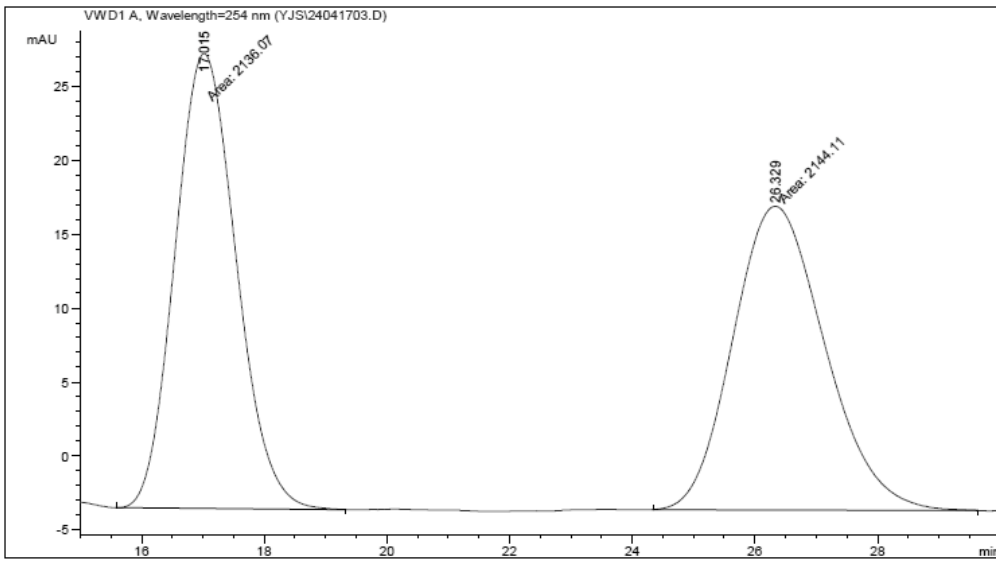

```
================================================================================
                              Area Percent Report
================================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  37.834 MM    3.2347 3007.87720   15.49807 100.0000

Totals :                  3007.87720   15.49807
```



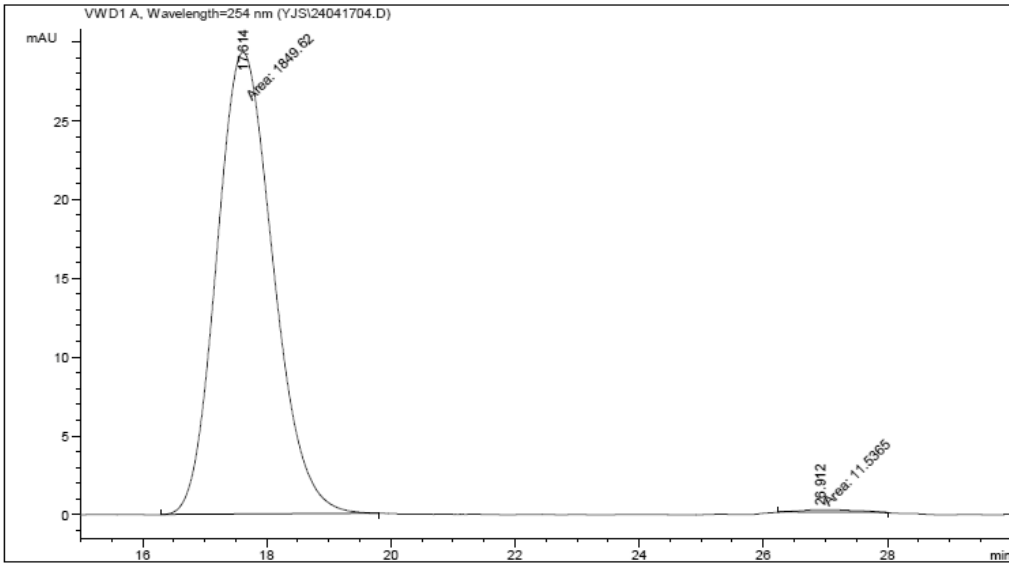
8




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  17.015 MM    1.1564 2136.07495   30.78555  49.9061
   2  26.329 MM    1.7381 2144.11328   20.56036  50.0939

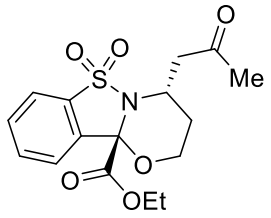
Totals :                  4280.18823   51.34591
```



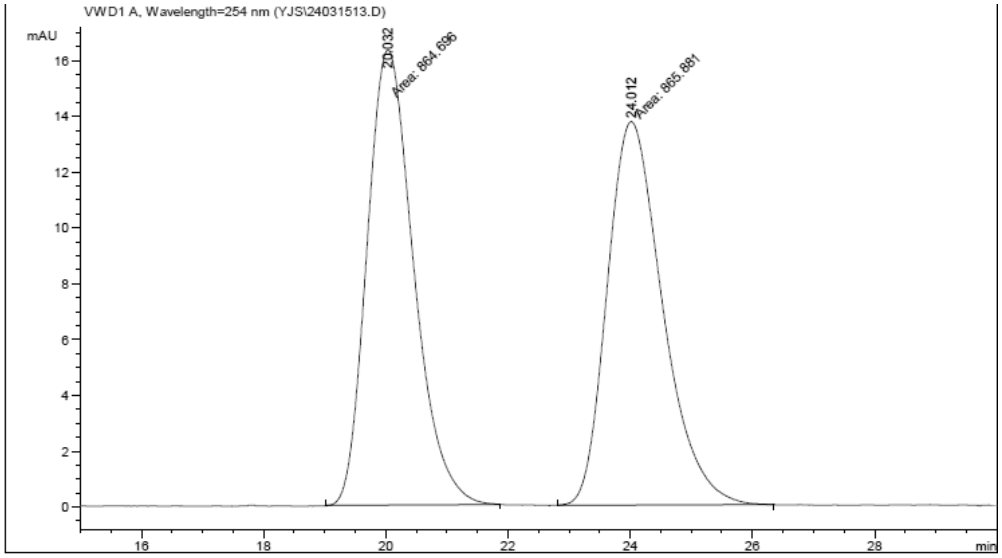

```
=====================================================================
                        Area Percent Report
=====================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s    [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  17.614 MM    1.0514 1849.61865   29.32053  99.3801
   2  26.912 MM    1.0696   11.53654 1.79770e-1   0.6199

Totals :                  1861.15519   29.50030
```



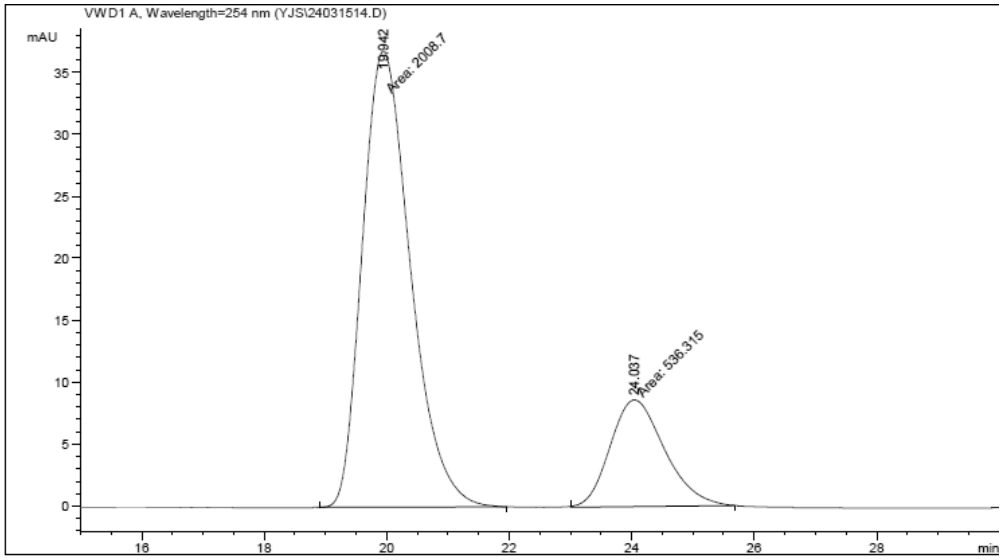
9




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  20.032 MM    0.8833  864.69629   16.31497  49.9658
   2  24.012 MM    1.0501  865.88086   13.74317  50.0342

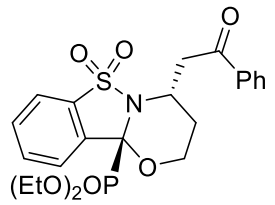
Totals :                  1730.57715   30.05814
```



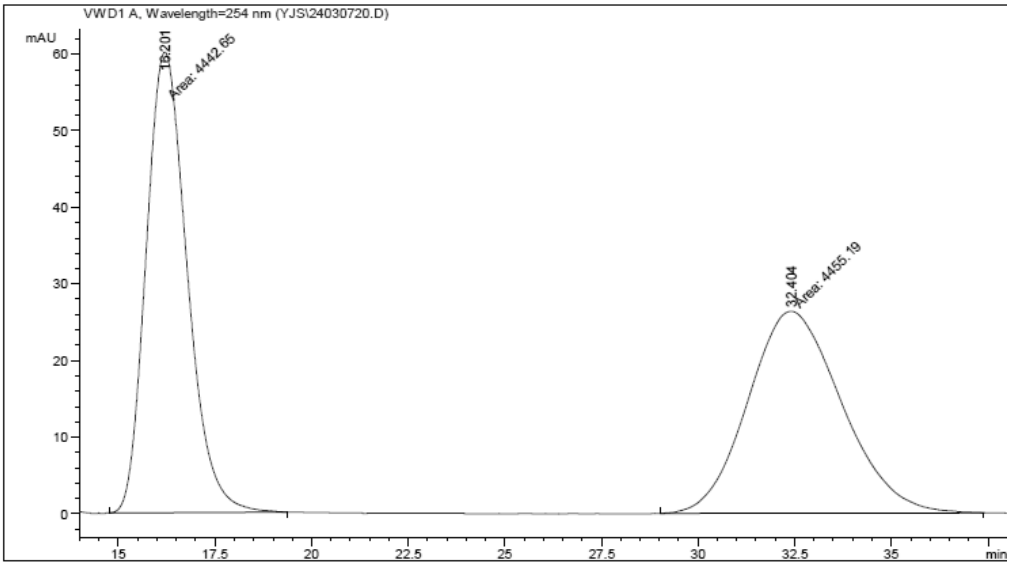

```
=====================================================================
                        Area Percent Report
=====================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  19.942 MM    0.9101 2008.69849   36.78579  78.9268
   2  24.037 MM    1.0357  536.31464    8.63055  21.0732

Totals :                  2545.01312   45.41634
```



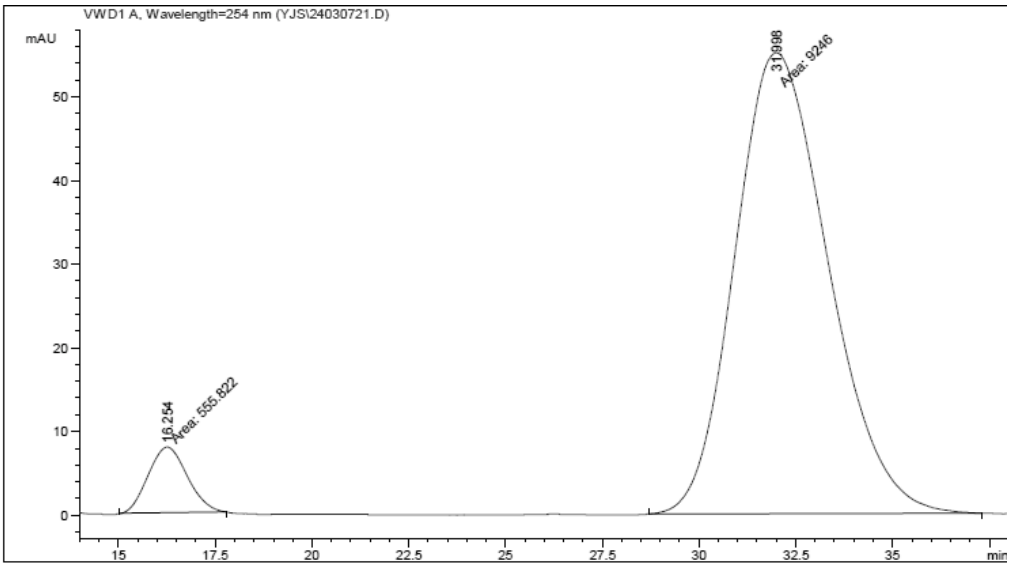
11




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  16.201 MM    1.2313 4442.64648   60.13655  49.9295
   2  32.404 MM    2.8174 4455.19385   26.35565  50.0705

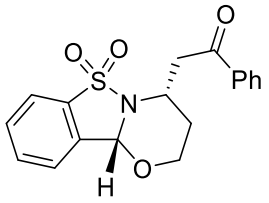
Totals :                  8897.84033   86.49220
```



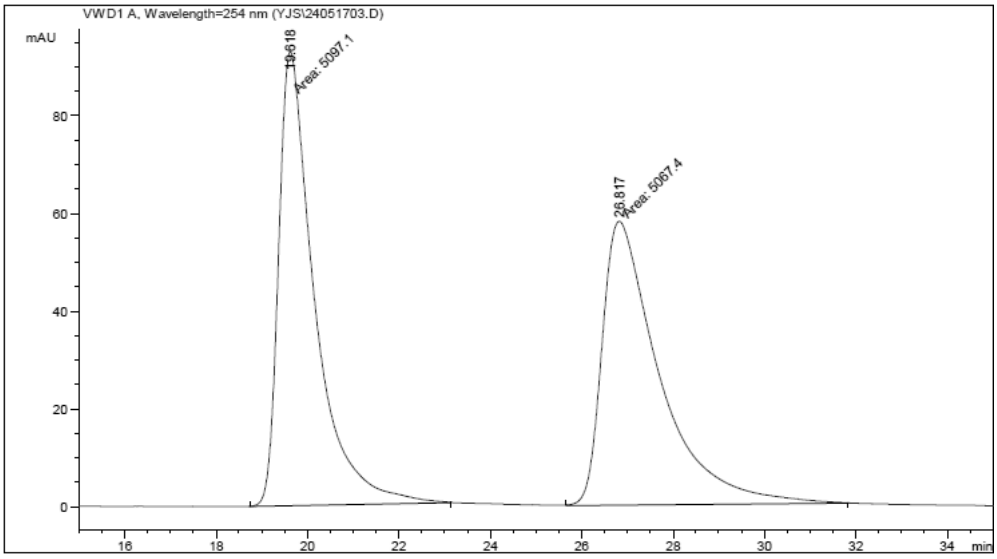

```
=====================================================================
                        Area Percent Report
=====================================================================

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  16.254 MM    1.1763  555.82202    7.87550   5.6706
   2  31.998 MM    2.7966 9245.99512   55.10250  94.3294

Totals :                  9801.81714   62.97799
```



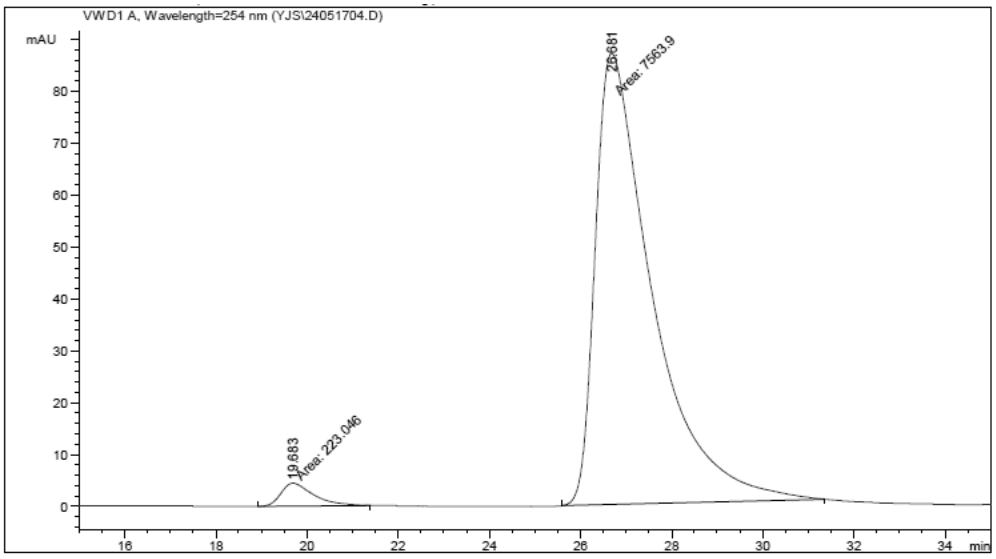
13




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  19.618 MM    0.9138 5097.10010   92.96667  50.1461
   2  26.817 MM    1.4532 5067.40039   58.11724  49.8539

Totals :                 1.01645e4   151.08391
```




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  19.683 MM    0.8359  223.04604    4.44715   2.8644
   2  26.681 MM    1.4488 7563.90381   87.01071  97.1356

Totals :                 7786.94984   91.45786
```