Supporting Information

Enantioselective Organocatalytic Double Michael Addition Reactions

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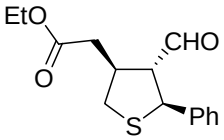
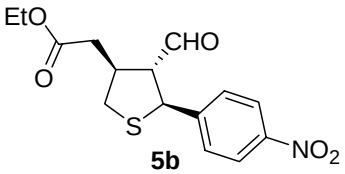
General Information: Commercial reagents were used as received, unless otherwise stated. Merck 60 silica gel was used for chromatography, and Whatman silica gel plates with fluorescence F_{254} were used for thin-layer chromatography (TLC) analysis. ^{1}H and ^{13}C NMR spectra were recorded on Bruker Avance 500, and tetramethylsilane (TMS) was used as a reference. Data for ^{1}H are reported as follows: chemical shift (ppm), and multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet). Data for ^{13}C NMR are reported as ppm.

General Procedure for double Michael addition of *trans* 4-Mercapto-but-2-enoic acid ethyl ester to unsaturated aldehydes (Table 2, entry 1, as an example): To a solution of *trans*-cinnamaldehyde (25 μL, 0.2 mmol) in the presence of catalyst **(**10 mol %) and PhCOOH (0.02 mmol) in toluene (0.5 mL) was 4-Mercapto-but-2-enoic acid ethyl ester (28 μL, 0.2 mmol) and the resulting solution was stirred for 3 d at rt. The reaction mixture was directly purified by silica gel chromatography (EtOAc/Hexane = 10:1) and fractions were collected and concentrated *in vacuo* to give a colorless oil (42 mg, 76% yield), >99% ee (HPLC Daicel CHIRALCEL OD-H column, Hexane/^{i}PrOH = 80:20 at 0.5 ml/ min, λ = 220 nm); t_{minor} = 16.36 min, t_{major} = 17.02 min; $[\alpha]_D^{23}$(major) = -41.7 (c = 1.0, $CHCl_3$).



5a

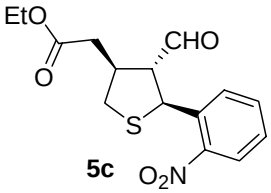
(4-Formyl-5-phenyl-tetrahydro-thiophen-3-yl)-acetic acid ethyl ester (Table 2, entry 1): Yield: 76%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.61 (s, 1H), 7.25-7.45 (m, 5H), 4.76 (d, 1H, J = 9.5 Hz), 4.14 (q, 1H, J = 6.5 Hz), 3.27 (m, 1H), 2.91-3.06 (m, 3H), 2.63 (dd, 1H, J_1 = 4.5 Hz, J_2 = 16.0 Hz), 2.49 (q, 1H, J = 8.0 Hz), 1.26 (t, 3H, J = 6.5 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 200.3, 199.9, 171.3, 139.5, 128.8, 128.6, 127.9, 127.8, 127.7, 67.6, 60.8, 52.3, 49.3, 42.3, 40.8, 37.4, 37.2, 37.0, 33.7, 29.6, 14.1; $[\alpha]_D^{23}$ = -41.7 (c = 1.0, $CHCl_3$); HPLC (Daicel CHIRALCEL OD-H, Hexane/*i*-PrOH = 80:20, flow rate 0.5 mL/min, λ = 220 nm); t_R = 16.36 (minor), 17.02 (major) min.



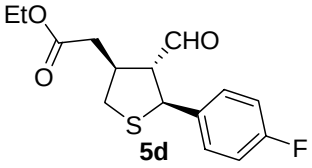
5b

[4-Formyl-5-(4-nitro-phenyl)-tetrahydro-thiophen-3-yl]-acetic acid ethyl ester (Table 2, entry 2): Yield: 84%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.66 (d, 1H, J = 2.0 Hz), 8.17 (d, 2H, J = 8.5 Hz), 7.59 (d, 2H, J = 8.0 Hz), 4.87 (d, 1H, J = 9.5 Hz), 4.15 (q, 2H, J = 7.0 Hz), 3.31 (q, 1H, J = 5.0 Hz), 3.10 (m, 2H), 2.93 (td, 1H, J_1 = 2.0 Hz, J_2 = 9.5 Hz), 2.65 (dd, 1H, J_1 = 5.5 Hz, J_2 = 16.0 Hz), 2.56 (dd, 1H, J_1 = 7.0 Hz, J_2 = 16.0 Hz), 1.26 (t, 3H, J = 6.5 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 199.2, 171.1, 147.6, 147.4, 128.8, 124.0, 67.6, 61.0, 51.1, 42.8, 37.5, 37.1, 14.1; $[\alpha]_D^{23}$ = +11.6 (c = 2.0, $CHCl_3$); HPLC (Daicel CHIRALPAK AS-H, Hexane/*i*-PrOH = 75:25, flow rate 0.5 mL/min, λ = 254 nm); t_R = 49.61 (major), 55.19

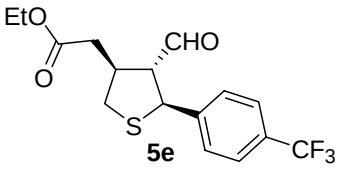
(minor) min.



[4-Formyl-5-(2-nitro-phenyl)-tetrahydro-thiophen-3-yl]-acetic acid ethyl ester (Table 2, entry 3): Yield: 84%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.67 (d, 1H, J = 3.5 Hz), 7.94 (d, 1H, J = 8.0 Hz), 7.79 (d, 1H, J = 8.0 Hz), 7.63 (m, 1H), 7.42 (m, 1H), 5.39 (d, 1H, J = 9.0 Hz), 4.14 (q, 2H, J = 7.0 Hz), 3.33 (dd, 1H, J_1 = 6.0 Hz, J_2 = 10.0 Hz), 3.04-3.17 (m, 2H), 2.94 (td, 1H, J_1 = 3.5 Hz, J_2 = 9.0 Hz), 2.60 (dd, 1H, J_1 = 5.5 Hz, J_2 = 16.0 Hz), 2.50 (dd, 1H, J_1 = 8.0 Hz, J_2 = 16.0 Hz), 1.26 (t, 3H, J = 7.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 199.7, 199.2, 171.9, 171.0, 149.4, 135.2, 133.3, 131.0, 130.6, 128.6, 128.5, 124.9, 124.4, 68.0, 64.0, 60.9, 60.8, 46.0, 45.6, 42.6, 40.0, 37.7, 37.0, 36.1, 33.7, 29.6, 14.1; $[\alpha]_D^{23}$ = +14.5 (c = 2.0, $CHCl_3$); HPLC (Daicel CHIRALCEL OD-H, Hexane/*i*-PrOH = 75:25, flow rate 0.5 mL/min, λ = 254 nm); t_R = 26.26 (major), 36.97 (minor) min.

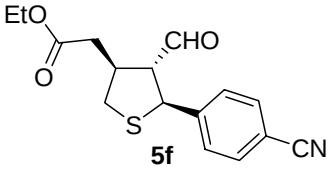


[5-(4-Fluoro-phenyl)-4-formyl-tetrahydro-thiophen-3-yl]-acetic acid ethyl ester (Table 2, entry 4): Yield: 81%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.60 (d, 1H, J = 3.0 Hz), 7.37 (dd, 2H, J_1 = 5.0 Hz, J_2 = 8.5 Hz), 7.00 (t, 2H, J = 8.5 Hz), 4.76 (d, 1H, J = 10.0 Hz), 4.14 (q, 2H, J = 7.0 Hz), 3.27 (dd, 1H, J_1 = 6.5 Hz, J_2 = 10.0 Hz), 2.98-3.10 (m, 2H), 2.87 (td, 1H, J_1 = 3.0 Hz, J_2 = 10.0 Hz), 2.63 (dd, 1H, J_1 = 5.5 Hz, J_2 = 16.0 Hz), 2.50 (dd, 1H, J_1 = 7.5 Hz, J_2 = 16.0 Hz), 1.26 (t, 3H, J = 6.5 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 200.1, 171.2, 163.2, 161.2, 135.1, 129.4, 129.4, 115.8, 115.6, 67.8, 60.9, 51.5, 42.3, 37.3, 37.2, 14.1; $[\alpha]_D^{23}$ = -55.4 (c = 1.0, $CHCl_3$); HPLC (Daicel CHIRALPAK AS-H, Hexane/*i*-PrOH = 80:20, flow rate 0.5 mL/min, λ = 220 nm); t_R = 21.18 (major), 23.58 (minor) min.



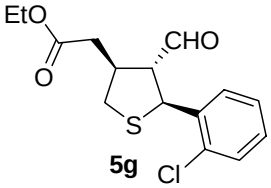
[4-Formyl-5-(4-trifluoromethyl-phenyl)-tetrahydro-thiophen-3-yl]-acetic acid ethyl ester (Table 2, entry 5): Yield: 69%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.63 (d, 1H, J = 3.0 Hz), 7.58 (d, 2H, J = 7.5 Hz), 7.53 (d, 2H, J = 8.0 Hz), 4.82 (d, 1H, J = 9.5 Hz), 4.14 (q, 2H, J = 7.0 Hz), 3.29 (dd, 1H, J_1 = 6.0 Hz, J_2 = 10.0 Hz), 3.02-3.11 (m, 2H), 2.90 (td, 1H, J_1 = 2.5 Hz, J_2 = 10.0 Hz), 2.64 (dd, 1H, J_1 = 5.0 Hz, J_2 = 16.0 Hz), 2.54 (dd, 1H, J_1 = 8.5 Hz, J_2 = 16.0 Hz), 1.26 (t, 3H, J = 6.5 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 199.7, 171.2, 143.9, 130.2, 130.0, 128.2, 125.8, 67.6, 60.9, 51.5, 42.6, 37.4, 37.2, 14.1; $[\alpha]_D^{23}$ = -29.1 (c = 1.0, $CHCl_3$);

HPLC (Daicel CHIRALCEL OD-H, Hexane/*i*-PrOH = 95:5, flow rate 0.5 mL/min, λ = 220 nm); t_R = 27.04 (major), 31.25 (minor) min.



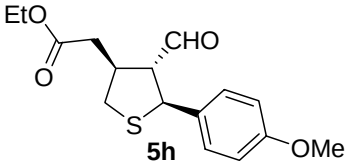
5f

[5-(4-Cyano-phenyl)-4-formyl-tetrahydro-thiophen-3-yl]-acetic acid ethyl ester (Table 2, entry 6): Yield: 65%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.62 (s, 1H), 7.59 (d, 2H, J = 8.0 Hz), 7.51 (d, 2H, J = 8.0 Hz), 4.80 (d, 1H, J = 9.5 Hz), 4.13 (q, 2H, J = 7.0 Hz), 3.27 (dd, 1H, J_1 = 5.5 Hz, J_2 = 9.0 Hz), 3.02 (m, 2H), 2.88 (t, 1H, J = 9.0 Hz), 2.62 (dd, 1H, J_1 = 5.0 Hz, J_2 = 16.0 Hz), 2.52 (dd, 1H, J_1 = 7.0 Hz, J_2 = 16.0 Hz), 1.24 (t, 3H, J = 7.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 199.3, 171.1, 145.5, 132.5, 132.4, 128.7, 118.4, 111.7, 67.5, 60.9, 51.4, 42.7, 37.4, 37.1, 14.1; $[\alpha]_D^{23}$ = +3.9 (c = 1.0, $CHCl_3$); HPLC (Daicel CHIRALCEL OJ-H, Hexane/*i*-PrOH = 80:20, flow rate 0.5 mL/min, λ = 220 nm); t_R = 83.45 (major) min.



5g

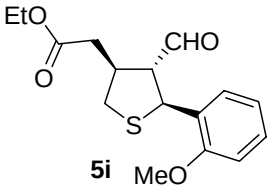
[5-(2-Chloro-phenyl)-4-formyl-tetrahydro-thiophen-3-yl]-acetic acid ethyl ester (Table 2, entry 7): Yield: 85%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.66 (d, 1H, J = 3.0 Hz), 7.72 (d, 1H, J = 8.0 Hz), 7.27-7.38 (m, 2H), 7.20 (t, 1H, J = 8.0 Hz), 5.32 (d, 1H, J = 9.0 Hz), 4.13 (q, 2H, J = 7.0 Hz), 3.29 (dd, 1H, J_1 = 6.5 Hz, J_2 = 10.0 Hz), 3.14 (m, 1H), 3.02 (m, 1H), 2.91 (m, 1H), 2.58 (dd, 1H, J_1 = 5.5 Hz, J_2 = 16.0 Hz), 2.47 (dd, 1H, J_1 = 8.0 Hz, J_2 = 16.0 Hz), 1.25 (t, 3H, J = 7.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 199.6, 171.2, 137.3, 133.5, 129.7, 129.2, 128.9, 127.5, 67.2, 60.8, 47.8, 42.2, 37.3, 37.2, 14.1; $[\alpha]_D^{23}$ = -50.7 (c = 1.0, $CHCl_3$); HPLC (Daicel CHIRALPAK AS-H, Hexane/*i*-PrOH = 85:15, flow rate 0.5 mL/min, λ = 220 nm); t_R = 26.48 (major), 36.13 (minor) min.



5h

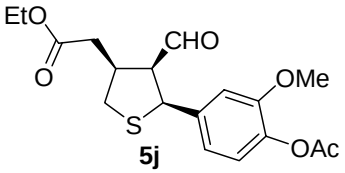
[4-Formyl-5-(4-methoxy-phenyl)-tetrahydro-thiophen-3-yl]-acetic acid ethyl ester (Table 2, entry 8): Yield: 87%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.58 (d, 1H, J = 3.0 Hz), 7.32 (d, 2H, J = 8.5 Hz), 6.84 (d, 2H, J = 8.5 Hz), 4.73 (d, 1H, J = 10.5 Hz), 4.13 (q, 2H, J = 7.0 Hz), 3.78 (s, 3H), 3.26 (dd, 1H, J_1 = 6.5 Hz, J_2 = 10.0 Hz), 2.97-3.09 (m, 2H), 2.89 (td, 1H, J_1 = 2.5 Hz, J_2 = 10.0 Hz), 2.62 (dd, 1H, J_1 = 5.0 Hz, J_2 = 16.0 Hz), 2.48 (dd, 1H, J_1 = 8.0 Hz, J_2 = 16.0 Hz), 1.26 (t, 3H, J = 7.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 193.5, 164.3, 152.2, 124.0, 121.8, 107.1, 106.9, 60.6, 53.7, 48.2, 44.9, 35.0, 30.3, 30.0, 7.1; $[\alpha]_D^{23}$ = -22.9 (c = 2.0, $CHCl_3$); HPLC (Daicel CHIRALCEL OD-H, Hexane/*i*-PrOH = 75:25, flow rate 0.5 mL/min,

λ = 220 nm); t_R = 17.52 (minor), 18.77 (major) min.



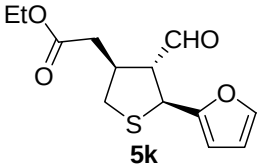
5i

[4-Formyl-5-(2-methoxy-phenyl)-tetrahydro-thiophen-3-yl]-acetic acid ethyl ester (Table 2, entry 9): Yield: 96%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.60 (d, 1H, J = 3.5 Hz), 7.64 (d, 1H, J = 7.5 Hz), 7.24 (t, 1H, J = 8.0 Hz), 6.96 (t, 1H, J = 7.5 Hz), 6.84 (d, 1H, J = 8.5 Hz), 5.21 (d, 1H, J = 9.0 Hz), 4.12 (q, 2H, J = 7.0 Hz), 3.80 (s, 3H), 3.24 (dd, 1H, J_1 = 6.5 Hz, J_2 = 10.5 Hz), 3.04-3.10 (m, 1H), 2.94 (t, 1H, J = 10.0 Hz), 2.73 (td, 1H, J_1 = 3.0 Hz, J_2 = 10.0 Hz), 2.56 (dd, 1H, J_1 = 5.0 Hz, J_2 = 16.0 Hz), 2.41 (dd, 1H, J_1 = 8.0 Hz, J_2 = 16.0 Hz), 1.24 (t, 3H, J = 7.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 200.3, 171.4, 156.5, 128.7, 127.9, 120.8, 110.5, 66.7, 60.7, 55.2, 45.5, 42.4, 37.2, 37.1, 14.1; $[\alpha]_D^{23}$ = -39.3 (c = 2.5, $CHCl_3$); HPLC (Daicel CHIRALPAK AS-H, Hexane/*i*-PrOH = 75:25, flow rate 0.5 mL/min, λ = 210 nm); t_R = 23.34 (major), 33.81 (minor) min.



5j

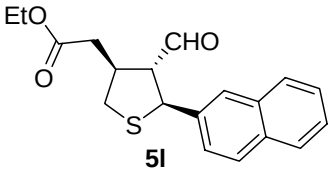
[5-(4-Acetoxy-3-methoxy-phenyl)-4-formyl-tetrahydro-thiophen-3-yl]-acetic acid ethyl ester (Table 2, entry 10): Yield: 89%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.61 (d, 1H, J = 2.5 Hz), 7.02 (s, 1H), 6.94 (s, 2H), 4.74 (d, 1H, J = 10.0 Hz), 4.11 (q, 2H, J = 7.0 Hz), 3.81 (s, 3H), 3.23 (dd, 1H, J_1 = 6.0 Hz, J_2 = 10.0 Hz), 2.88-3.03 (m, 3H), 2.62 (dd, 1H, J_1 = 5.0 Hz, J_2 = 16.0 Hz), 2.47 (dd, 1H, J_1 = 7.5 Hz, J_2 = 16.0 Hz), 2.28 (s, 3H), 1.25 (t, 3H, J = 7.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 200.2, 171.2, 168.8, 151.1, 139.2, 138.3, 122.8, 119.8, 111.7, 67.4, 60.8, 55.8, 52.0, 42.3, 37.3, 37.1, 20.6, 14.1; $[\alpha]_D^{23}$ = -13.2 (c = 1.0, $CHCl_3$); HPLC (Daicel CHIRALCEL OJ-H, Hexane/*i*-PrOH = 70:30, flow rate 0.5 mL/min, λ = 220 nm); t_R = 52.94 (minor), 68.68 (major) min.



5k

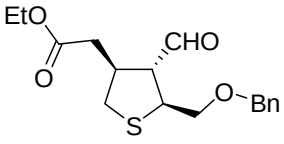
(4-Formyl-5-furan-2-yl-tetrahydro-thiophen-3-yl)-acetic acid ethyl ester (Table 2, entry 11): Yield: 88%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.68 (d, 1H, J = 2.0 Hz), 7.37 (s, 1H), 6.28 (m, 2H), 4.83 (d, 1H, J = 7.5 Hz), 4.15 (m, 2H), 3.20 (dd, 1H, J_1 = 6.0 Hz, J_2 = 11.0 Hz), 3.07-3.13 (m, 2H), 2.92-2.97 (m, 1H), 2.65 (m, 1H), 2.52 (dd, 1H, J_1 = 7.0 Hz, J_2 = 16.0 Hz), 1.27 (t, 3H, J = 7.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 199.5, 171.4, 152.7, 142.6, 110.4, 107.0, 63.9, 60.8, 43.8, 41.9, 37.3, 37.1, 14.1; $[\alpha]_D^{23}$ = +44.2 (c = 2.0, $CHCl_3$); HPLC (Daicel CHIRALCEL OJ-H, Hexane/*i*-PrOH = 85:15, flow rate 0.5 mL/min, λ = 220 nm); t_R = 39.33

(minor), 43.94 (major) min.



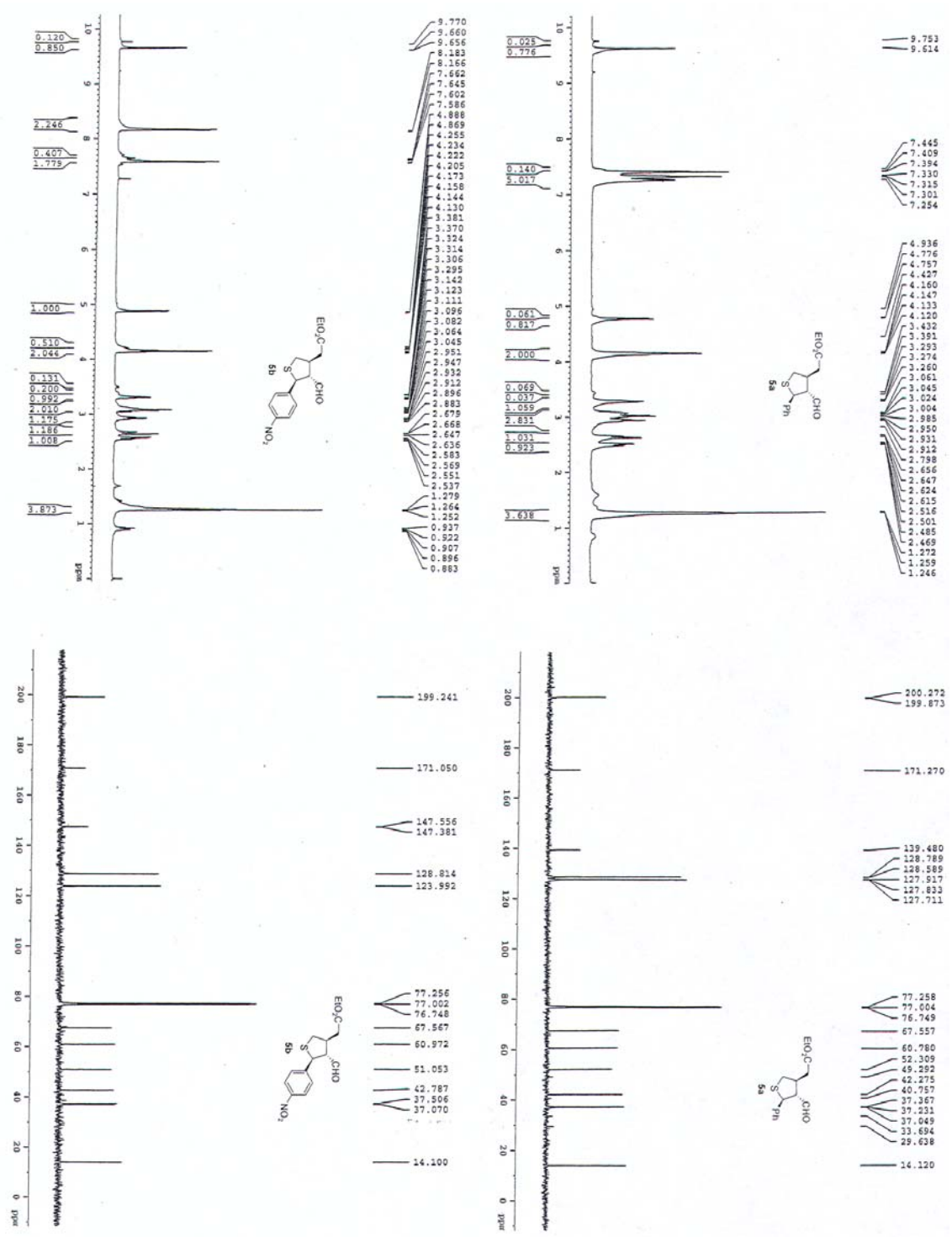
5l

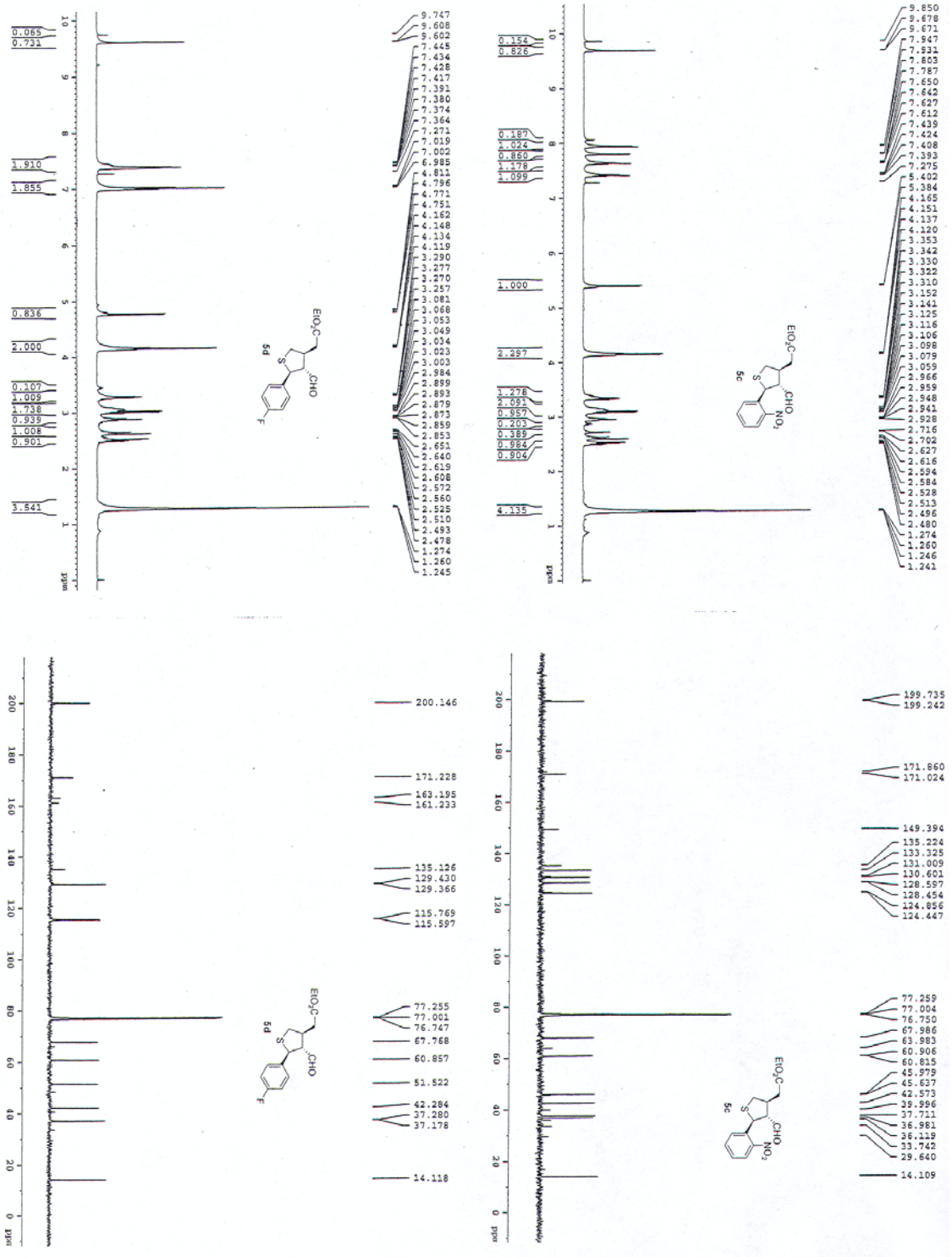
4-Formyl-5-naphthalen-2-yl-tetrahydron-thiophen-3-yl)-acetic acid ethyl ester (Table 2, entry 12). Yield: 55%; ^{1}H NMR (500 MHz, $CDCl_3$): 9.63 (s, 1H), 7.46-7.83 (m, 7H), 4.93 (d, 1H, J = 9.5 Hz), 4.15 (q, 2H, J = 7.0 Hz), 3.29-3.33 (m, 1H), 3.02-3.10 (m, 3H), 2.63-2.68 (m, 1H), 2.49-2.53 (m, 1H), 1.26 (t, 3H, J = 7.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 200.3, 171.3, 136.7, 133.1, 133.0, 128.9, 127.8, 127.6, 126.7, 126.4, 126.2, 125.2, 67.3, 60.8, 52.6, 42.3, 37.4, 37.3, 14.1; HPLC (Chiralpak AS-H, Hexane/*i*-PrOH = 80:20, flow rate = 0.5 mL/min, λ = 254 nm): t_{minor} = 28.75 min, t_{major} = 36.28 min, ee = 96%, dr = 8:1.

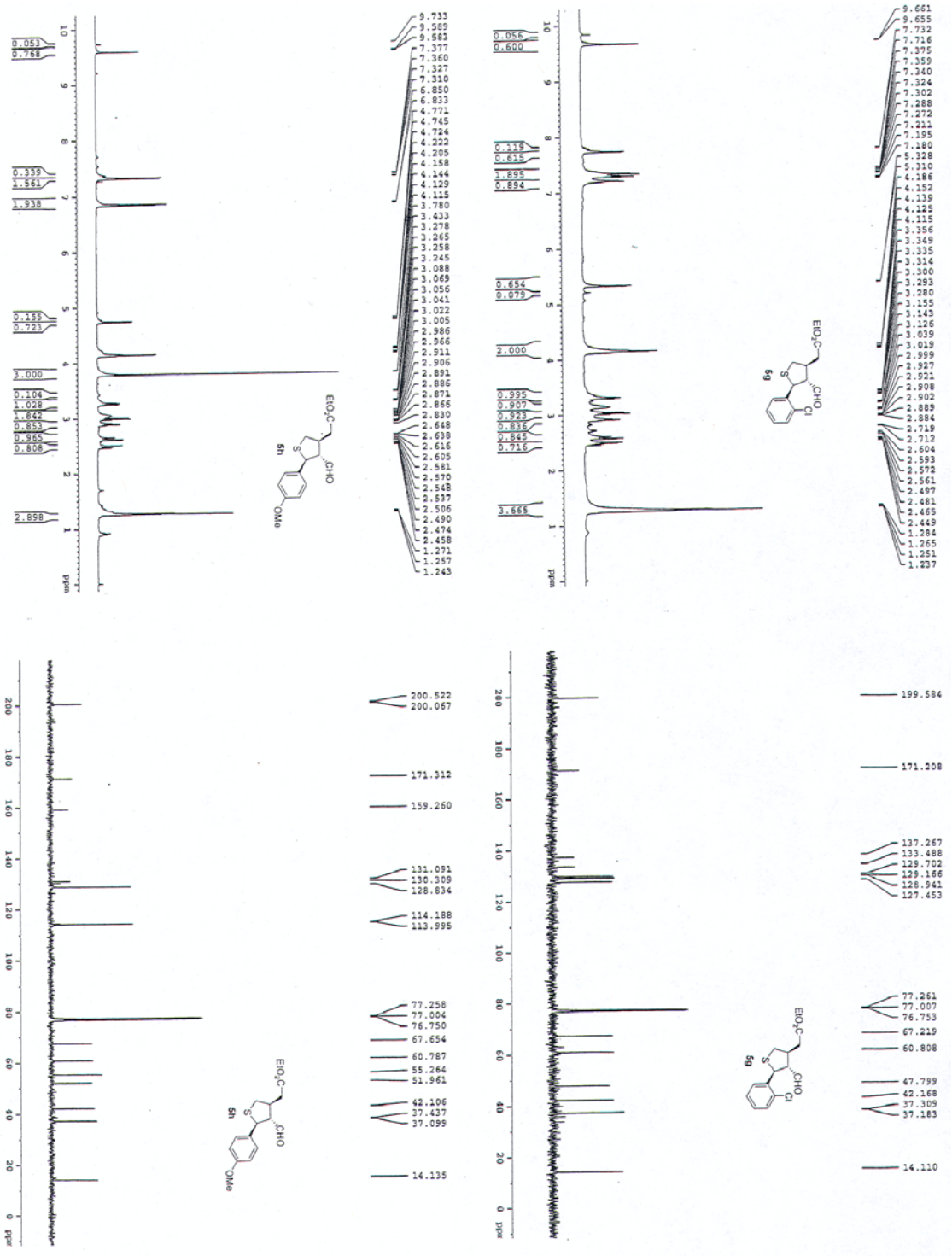


5m

(5-Benzyloxymethyl-4-formyl-tetrahydro-thiophen-3-yl)-acetic acid ethyl ester (Table 2, entry 13): Yield: 62%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.66 (d, 1H, J = 2.5 Hz), 7.26-7.36 (m, 5H), 4.53 (s, 2H), 4.12 (q, 2H, J = 7.0 Hz), 3.87 (dd, 1H, J_1 = 8.0 Hz, J_2 = 14.0 Hz), 3.60 (dd, 1H, J_1 = 5.0 Hz, J_2 = 9.0 Hz), 3.50 (t, 1H, J = 9.0 Hz), 3.10 (dd, 1H, J_1 = 6.5 Hz, J_2 = 10.5 Hz), 2.99 (m, 1H), 2.73 (t, 1H, J = 10.0 Hz), 2.54-2.58 (m, 2H), 2.38 (dd, 1H, J_1 = 8.5 Hz, J_2 = 16.0 Hz), 1.25 (t, 3H, J = 7.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$): δ 200.5, 190.5, 176.1, 171.4, 137.6, 130.8, 128.8, 128.4, 127.9, 127.7, 127.6, 73.2, 73.1, 68.1, 65.8, 63.6, 60.7, 47.1, 42.3, 37.2, 36.6, 34.6, 31.5, 30.3, 29.7, 29.0, 28.9, 25.2, 23.7, 22.9, 22.6, 18.7, 15.2, 14.1; $[\alpha]_D^{23}$ = -7.3 (c = 1.5, $CHCl_3$); HPLC (Daicel CHIRALPAK AS-H, Hexane/*i*-PrOH = 85:15, flow rate 0.5 mL/min, λ = 210 nm); t_R = 25.91 (minor), 32.39 (major) min.




5d
5c
5d
5c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S
CHO
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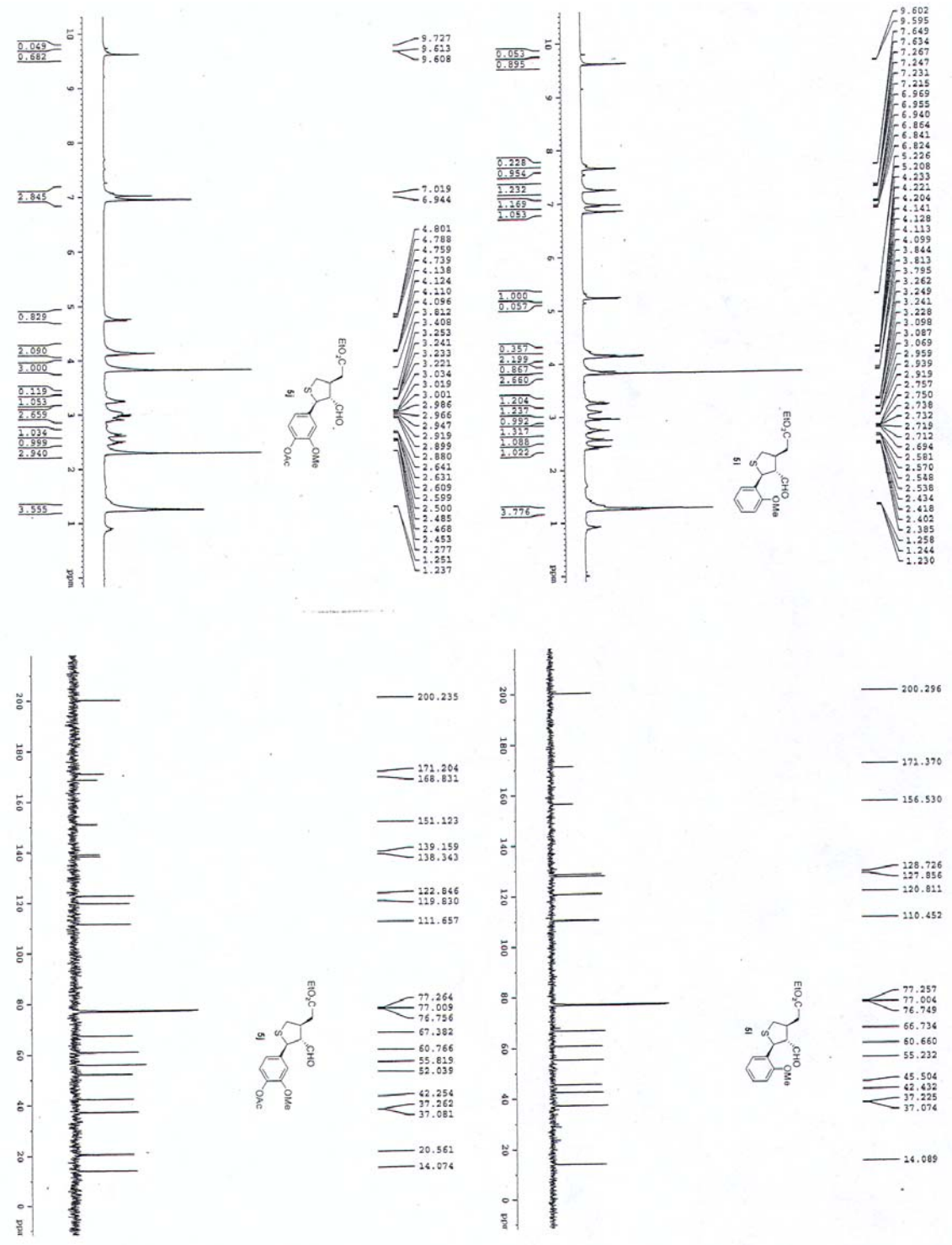

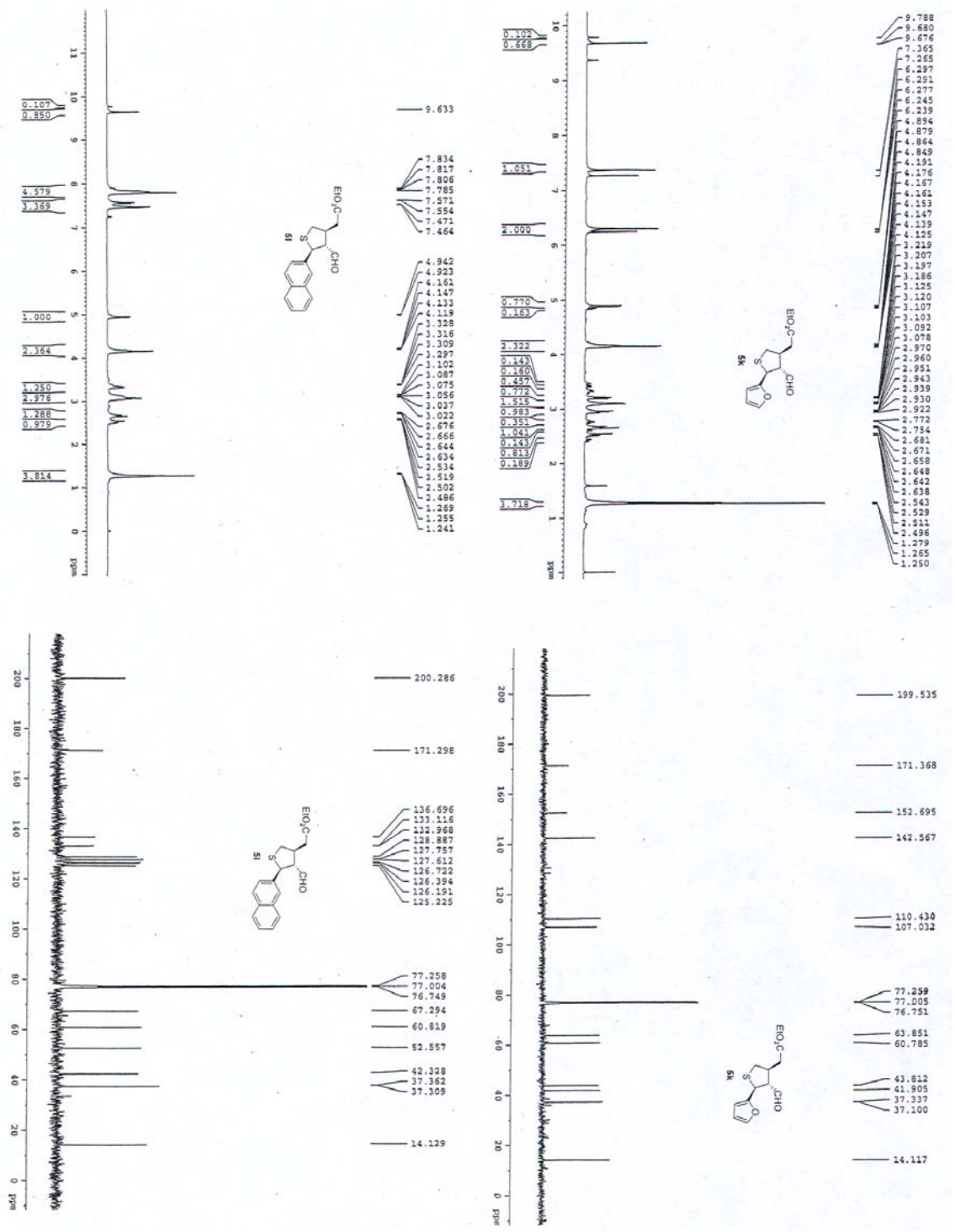

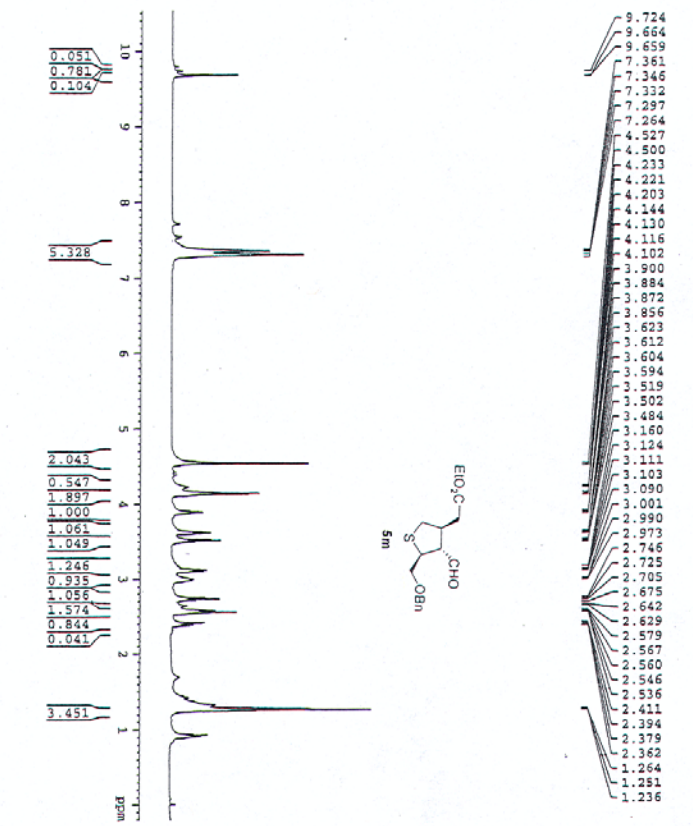
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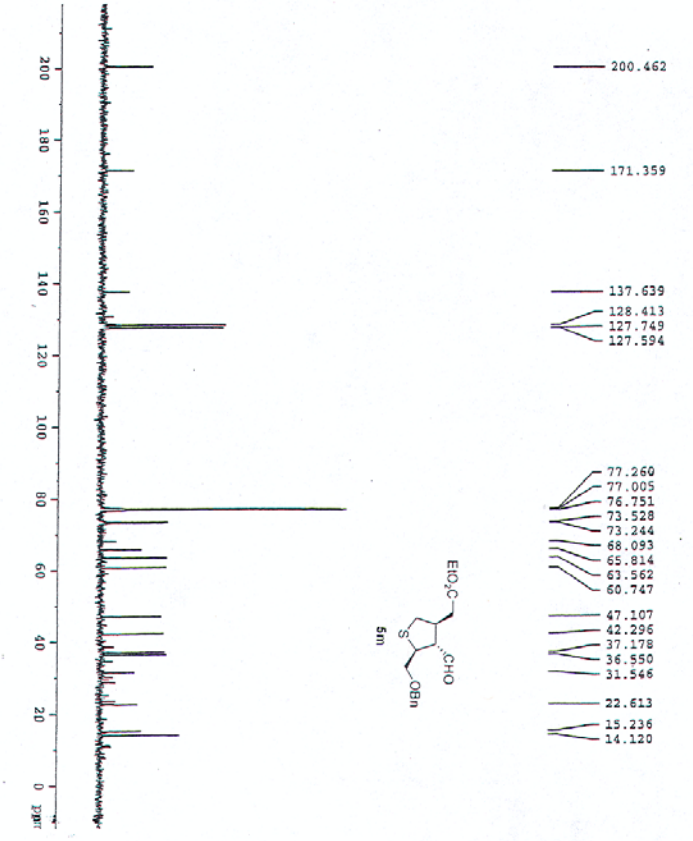
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EtO2C
CHO
S
OBn
5m
ppm

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Method Name: C:\EZStart\Projects\WeiWang\hl00331.met
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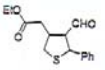
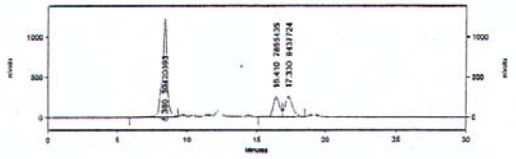
Sample ID: hlq80e





SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
2	16.410	7895435	16.534
3	17.330	9437724	19.763
Totals		17333159	36.297

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Method Name: C:\EZStart\Projects\WeiWang\hl00331.met
Data File: C:\EZStart\Projects\WeiWang\hlq83e1.dat
Date Acquired: 11/11/2006 12:08:36 PM Date Printed: 12/11/2006 10:25:00 AM
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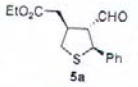

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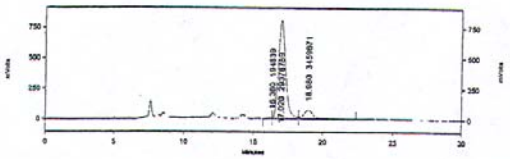

SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	16.360	194839	0.590
2	17.020	29378789	88.937
3	18.980	3459671	10.473
Totals		33033299	100.000

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Method Name: C:\EZStart\Projects\WeiWang\slc0787.met
Data File: C:\EZStart\Projects\WeiWang\hlr23e1.dat
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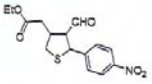

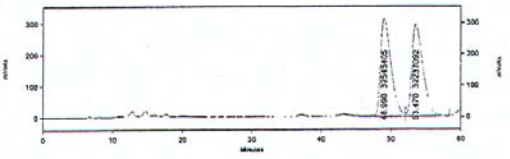

SPD-10Avp
Ch1-254nm Results

Pk #	RT	Area	Area %
1	48.990	32545405	50.238
2	53.470	32237092	49.762
Totals		64782497	100.000

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Method Name: C:\EZStart\Projects\WeiWang\hl00015.met
Data File: C:\EZStart\Projects\WeiWang\hlr16e1.dat
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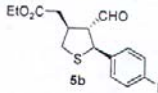

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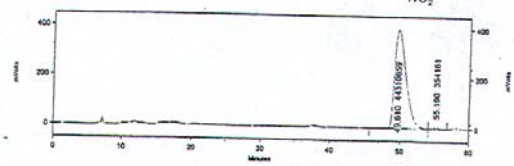

SPD-10Avp
Ch1-254nm Results

Pk #	RT	Area	Area %
1	49.610	44310659	99.207
2	55.190	354161	0.793
Totals		44664820	100.000

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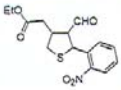
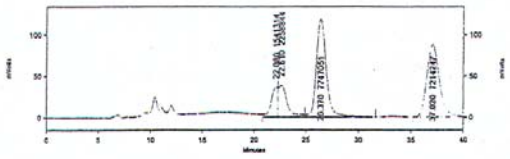
Method Name: C:\EZStart\Projects\WeiWang\hl00016.mat
Data File: C:\EZStart\Projects\WeiWang\hlr24e3.dat
Date Acquired: 12/1/2006 9:26:12 PM Date Printed: 12/11/2006 09:55:03 AM
Sample ID: hlr24e





SPD-10Avp
Ch1-254nm Results

Pk #	RT	Area	Area %
1	22.080	1541314	8.215
2	22.610	2258844	12.040
3	26.370	7747051	41.292
4	37.020	7214247	38.452
Totals		18761456	100.000

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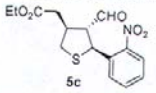
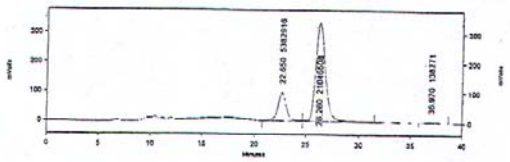
Method Name: C:\EZStart\Projects\WeiWang\hl00016.mat
Data File: C:\EZStart\Projects\WeiWang\hlr26e1.dat
Date Acquired: 12/1/2006 8:44:51 PM Date Printed: 12/11/2006 09:48:37 AM
Sample ID: hlr26e



5c



SPD-10Avp
Ch1-254nm Results

Pk #	RT	Area	Area %
1	22.650	5382916	20.261
2	26.260	21046608	79.218
3	36.970	138271	0.520
Totals		26567795	100.000

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Method Name: C:\EZStart\Projects\WeiWang\zls0816.met
Data File: C:\EZStart\Projects\WeiWang\hlr37e1.dat
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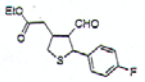

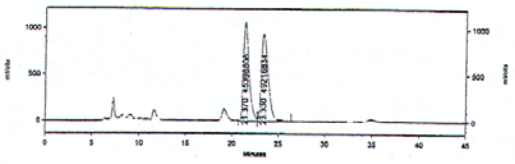

SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	21.370	45398608	47.982
2	23.330	49216834	52.018
Totals		94615642	100.000

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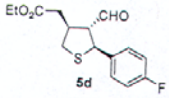
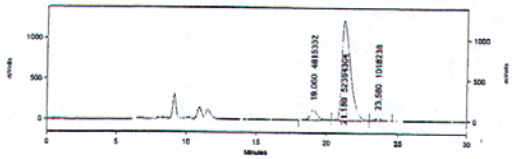
Method Name: C:\EZStart\Projects\WeiWang\hl00019.met
Data File: C:\EZStart\Projects\WeiWang\hlr41e1.dat
Date Acquired: 12/9/2006 1:20:47 PM Date Printed: 12/11/2006 09:29:16 AM
Sample ID: hlr41e





SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	19.060	4815332	8.270
2	21.180	52394304	89.981
3	23.580	1018238	1.749
Totals		58227874	100.000

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Method Name: C:\EZStart\Projects\WeiWang\zls0816.met
Data File: C:\EZStart\Projects\WeiWang\hlr38e2.dat
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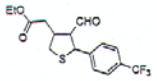

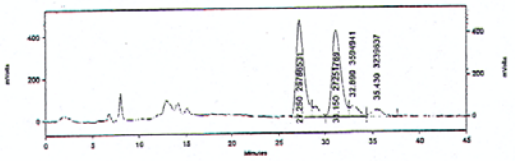

SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	27.250	26786531	44.004
2	31.150	27251789	44.768
3	32.890	3594941	5.906
4	35.430	3239637	5.322
Totals		60872898	100.000

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Method Name: C:\EZStart\Projects\WeiWang\hl00010.met
Data File: C:\EZStart\Projects\WeiWang\hlr42e1.dat
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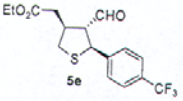

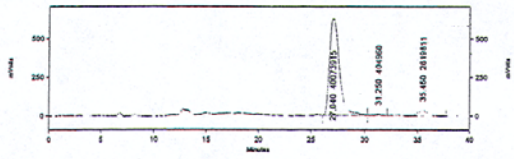

SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	27.040	40073915	92.982
2	31.250	404960	0.940
3	35.460	2619811	6.079
Totals		43098686	100.000

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Method Name: C:\EZStart\Projects\WeiWang\zls0822.met
Data File: C:\EZStart\Projects\WeiWang\hlr39e6.dat
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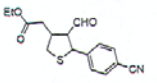
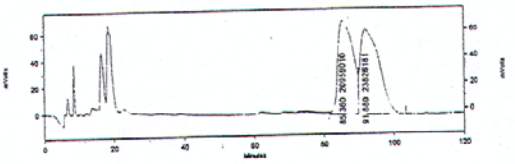
Sample ID: hlr39e





SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	85.360	20959010	46.799
2	91.880	23826181	53.201
Totals		44785191	100.000

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Method Name: C:\EZStart\Projects\WeiWang\zls0822-1.met
Data File: C:\EZStart\Projects\WeiWang\hlr43e1.dat
Date Acquired: 12/10/2006 9:23:26 AM Date Printed: 12/11/2006 09:26:57 AM
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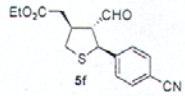

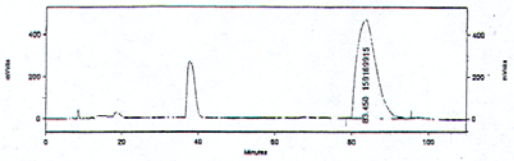

SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	83.450	159169915	100.000
Totals		159169915	100.000

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Method Name: C:\EZStart\Projects\WeiWang\zls0816.met
Data File: C:\EZStart\Projects\WeiWang\hlr40e2.dat
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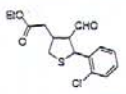
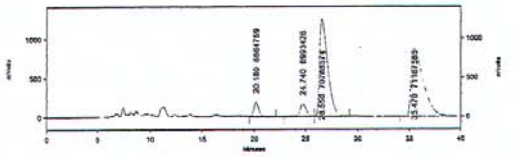
Sample ID: hlr40e





SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	20.180	6664789	4.283
2	24.740	6993426	4.494
3	26.550	70780574	45.490
4	35.470	71167585	45.733
Totals		155614344	100.000

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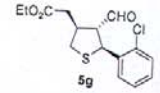
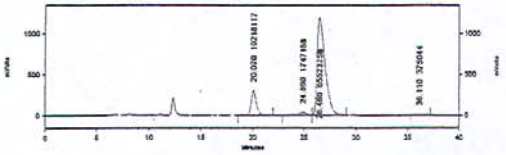
Method Name: C:\EZStart\Projects\WeiWang\hl100019.met
Data File: C:\EZStart\Projects\WeiWang\hlr44e2.dat
Date Acquired: 12/9/2006 12:29:31 PM Date Printed: 12/11/2006 09:23:47 AM
Sample ID: hlr44e



5g



SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	20.070	10218117	13.123
2	24.890	1747188	2.244
3	26.480	65523258	84.151
4	36.110	375044	0.482
Totals		77863607	100.000

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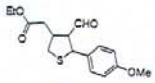
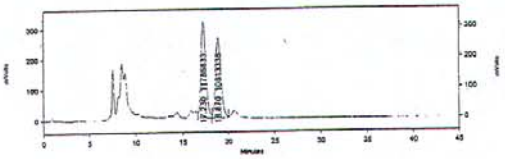
Method Name: C:\EZStart\Projects\WeiWang\zls0777-1.met
Data File: C:\EZStart\Projects\WeiWang\hlr1e1.dat
Date Acquired: 11/16/2006 9:46:30 PM Date Printed: 12/11/2006 10:12:58 AM
Sample ID: hlr1e





SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	17.230	11788833	52.154
2	18.870	10813338	47.846
Totals		22600171	100.000

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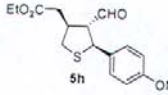
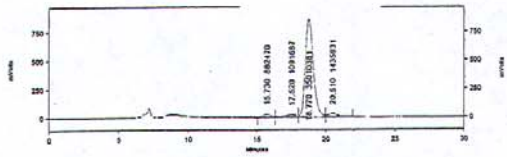
Method Name: C:\EZStart\Projects\WeiWang\hl100014.met
Data File: C:\EZStart\Projects\WeiWang\hlr17e1.dat
Date Acquired: 11/28/2006 6:57:52 PM Date Printed: 12/11/2006 10:02:42 AM
Sample ID: hlr17e



5h



SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	15.730	882470	2.297
2	17.520	1091687	2.841
3	18.770	35010381	91.124
4	20.510	1435931	3.737
Totals		38420469	100.000

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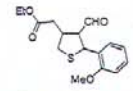
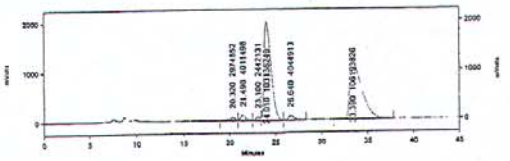
Method Name: C:\EZStart\Projects\WeiWang\zls0777-1.met
Data File: C:\EZStart\Projects\WeiWang\hlr3e2.dat
Date Acquired: 11/17/2006 5:22:41 PM Date Printed: 12/11/2006 10:00:28 AM
Sample ID: hlr3e





SPD-10Avp
Ch1-210nm Results

Pk #	RT	Area	Area %
1	20.320	2974852	1.335
2	21.490	4011498	1.800
3	23.100	2442131	1.096
4	24.010	103136249	46.290
5	26.640	4044913	1.815
6	33.390	106193826	47.663
Totals		222803469	100.000

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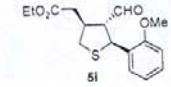
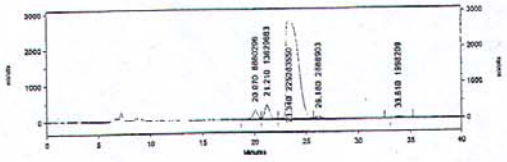
Method Name: C:\EZStart\Projects\WeiWang\hl100014.met
Data File: C:\EZStart\Projects\WeiWang\hlr18e1.dat
Date Acquired: 11/28/2006 6:01:16 PM Date Printed: 12/11/2006 10:00:51 AM
Sample ID: hlr18e



5i



SPD-10Avp
Ch1-210nm Results

Pk #	RT	Area	Area %
1	20.070	8880296	3.514
2	21.210	13629663	5.394
3	23.340	225283550	89.157
4	26.180	2888903	1.143
5	33.810	1998209	0.791
Totals		252680621	100.000

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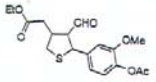
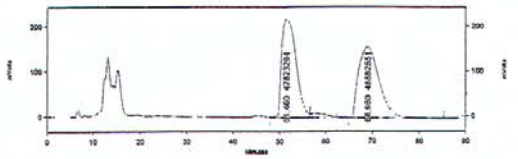
Method Name: C:\ZZStart\Projects\WeiWang\hl10001.met
Data File: C:\ZZStart\Projects\WeiWang\hlr5e4.dat
Date Acquired: 11/30/2006 3:11:55 PM Date Printed: 12/11/2006 10:09:29 AM
Sample ID: hlr5e





SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	51.460	47823294	49.452
2	68.980	48882551	50.548
Totals		96705845	100.000

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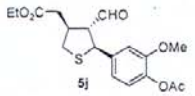
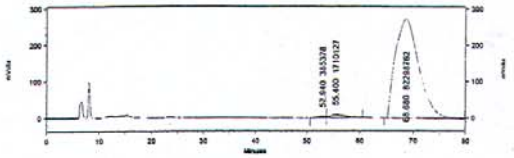
Method Name: C:\ZZStart\Projects\WeiWang\hl10001.met
Data File: C:\ZZStart\Projects\WeiWang\hlr30e1.dat
Date Acquired: 12/3/2006 10:49:38 AM Date Printed: 12/11/2006 09:37:35 AM
Sample ID: hlr30e



5j



SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	52.940	385378	0.457
2	55.400	1710127	2.026
3	68.680	82298762	97.517
Totals		84394267	100.000

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Method Name: C:\ZZStart\Projects\WeiWang\hl10001.met
Data File: C:\ZZStart\Projects\WeiWang\hlr25e4.dat
Date Acquired: 12/2/2006 2:06:30 PM Date Printed: 12/11/2006 09:51:18 AM
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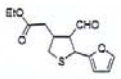

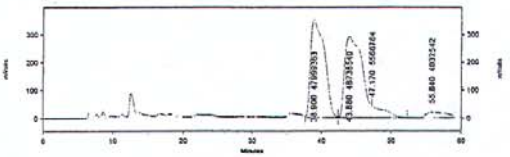

SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	38.900	47999363	45.139
2	43.880	48738540	45.834
3	47.170	5566764	5.235
4	55.840	4032542	3.792
Totals		106337209	100.000

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Method Name: C:\ZZStart\Projects\WeiWang\hl10001.met
Data File: C:\ZZStart\Projects\WeiWang\hlr27e1.dat
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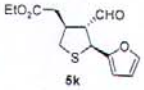

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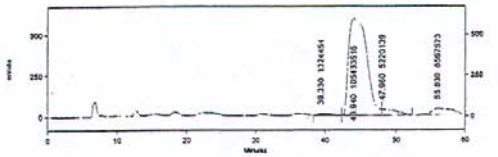

SPD-10Avp
Ch1-220nm Results

Pk #	RT	Area	Area %
1	39.330	1324454	1.099
2	43.940	105433516	87.464
3	47.960	5220139	4.330
4	55.830	8567523	7.107
Totals		120545632	100.000

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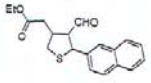
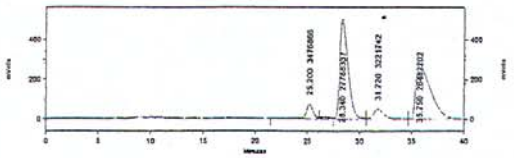
Method Name: C:\ZZStart\Projects\WeiWang\zls0822-1.met
Data File: C:\ZZStart\Projects\WeiWang\hlr48e1.dat
Date Acquired: 12/10/2006 11:31:45 AM Date Printed: 12/11/2006 09:19:51 AM
Sample ID: hlr48e





SPD-10Avp
Ch1-254nm Results

Pk #	RT	Area	Area %
1	25.200	2476866	5.703
2	28.340	27788337	45.578
3	31.720	3221742	5.284
4	35.750	26482202	43.435
Totals		60969147	100.000

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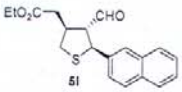
Method Name: C:\ZZStart\Projects\WeiWang\hlr49.met
Data File: C:\ZZStart\Projects\WeiWang\hlr49e1.dat
Date Acquired: 12/12/2006 1:07:31 PM Date Printed: 12/12/2006 03:46:17 PM
Sample ID: hlr49



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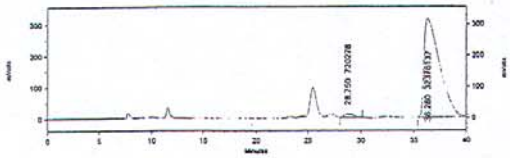

SPD-10Avp
Ch1-254nm Results

Pk #	RT	Area	Area %
1	28.750	710276	2.176
2	36.280	32376137	97.824
Totals		33096413	100.000

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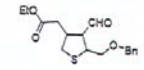
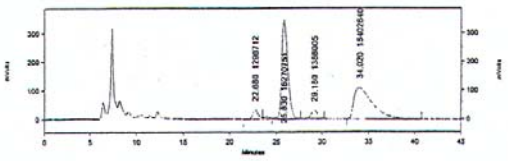
Method Name: C:\EZStart\Projects\WeiWang\h100017.met
Data File: C:\EZStart\Projects\WeiWang\hlr28e1.dat
Date Acquired: 12/3/2006 12:29:35 PM Date Printed: 12/11/2006 09:39:33 AM
Sample ID: hlr28e





SPD-10Avp
Ch1-210nm Results

Pk #	RT	Area	Area %
1	22.680	1296712	3.774
2	25.830	16270751	47.356
3	29.180	1388005	4.040
4	34.020	15402640	44.830
Totals		34358108	100.000

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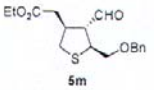
Method Name: C:\EZStart\Projects\WeiWang\h100017.met
Data File: C:\EZStart\Projects\WeiWang\hlr29e1.dat
Data Acquired: 12/3/2006 1:16:38 PM Date Printed: 12/11/2006 09:42:26 AM
Sample ID: hlr29e



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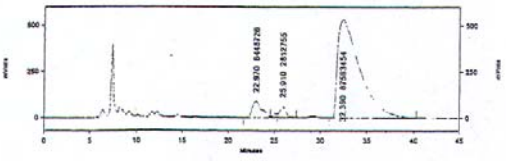

SPD-10Avp
Ch1-210nm Results

Pk #	RT	Area	Area %
1	22.970	6448726	6.658
2	25.910	2812755	2.904
3	32.390	87593454	90.438
Totals		96854935	100.000