

Enantioselective Synthesis of Polysubstituted Cyclopentanones by Organocatalytic Double Michael Addition Reactions

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Supporting Information

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Experimental part

General information:

For thin-layer chromatography (TLC), Silica gel plates GF254 were used and compounds were visualized by irradiation with UV light, I_2 , or by treatment with a solution of phosphomolybdic acid in ethanol followed by heating. Optical rotations were measured by using a Perkin–Elmer 241MC polarimeter in the solvent indicated. ^1H and ^{13}C NMR spectra were recorded on MERCURY300, Bruker DRX-400, and Bruker AV-500 spectrometers with TMS as the internal standard. HRMS were recorded by using either FTMS-7 or IonSpec 4.7 spectrometers. HPLC was carried out using a Water 515 pump, a Waters 2487 UV detector, a Millennium workstation, and a Daicel Chiralpak HPLC column. Yields refer to pure compounds, unless otherwise indicated.

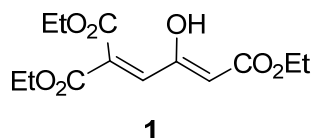
General procedure for the Michael Addition/Michael Addition process:

To a suspension of catalyst **3** (2 mol %) and **1** (0.12 mmol) in toluene (0.2 mL) was added α,β -unsaturated aldehyde (0.13 mmol) at 0 °C. The reaction mixture was stirred for 1 h at the same temperature and then allowed to warm to rt. The stirring was continued until **1** was consumed (monitored by TLC). Ethyl acetate and saturated NaCl were added. The organic phase was separated and the aqueous phase was extracted with ethyl acetate. The combined organic layers were dried over Na_2SO_4 and concentrated to give the crude product. Purification of the residue by flash column chromatography (silica gel) eluting with 10:1 petroleum ether/ethyl acetate afforded the adduct. The enantiomeric excess (ee) was determined by analysis of the alcohol derivative using HPLC on a chiral phase.

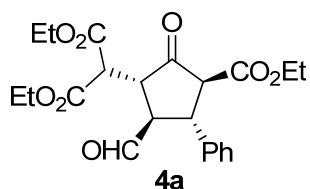
General procedure for reduction of the aldehydes:

The adduct (0.088 mmol) was dissolved in a mixture of EtOH and DCM (1 mL, 3:7). NaBH_4 (0.352 mmol, 4 equiv) was added to the solution at -40 °C. After 10 min, the reaction was quenched with water (1 mL). After 10 min, the solution was allowed to warm up to r.t. and ethyl acetate (2 mL) was added. The organic phase was separated and the aqueous phase was extracted with ethyl acetate. The combined organic layers were dried over Na_2SO_4 and

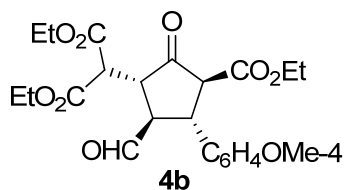
concentrated in vacuo. Purification of the residue by flash column chromatography eluting with 5:1 petroleum ether/ethyl acetate afforded the corresponding alcohol.



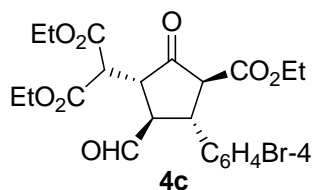
(Z)-Triethyl 3-hydroxybuta-1,3-diene-1,1,4-tricarboxylate 1: A solution of ylide (generated from ethyl 4-chloro-3-oxobutanoate and triphenylphosphine,^[1] 2.8 g, 7.2 mmol) in DCM (8 mL) was added in one portion to a solution of diethyl 2-oxomalonate (1 mL, 6.5 mmol) in DCM (2 mL) at -78 °C. After 10 min, without concentration, the solution was purified by a short flash column chromatography (silica gel, 10:1 petroleum/AcOEt as eluent; product is decomposing during column chromatography) to afford **1** in 61% yield; ¹H NMR (300 MHz, CDCl₃) δ 11.73 (d, *J* = 1.5 Hz, 1H), 6.80 (d, *J* = 1.5 Hz, 1H), 5.30 (s, 1H), 4.13-4.31 (m, 6H), 1.21-1.29 (m, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 171.86, 165.14, 164.65, 163.11, 133.45, 132.03, 98.43, 62.22, 61.86, 61.04, 14.14, 14.04, 13.93; HRMS calcd for C₁₃H₁₈O₇ (M + Na)⁺ 309.0945, found 309.0944.



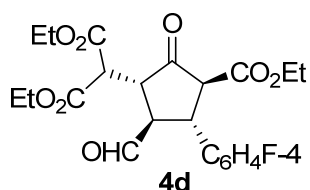
Diethyl 2-((1R,3S,4R,5R)-3-(ethoxycarbonyl)-5-formyl-2-oxo-4-phenylcyclopentyl)malonate 4a: 82% yield; ¹H NMR (400 MHz, CDCl₃) δ 9.59 (d, *J* = 1.2 Hz, 1H), 7.30-7.41 (m, 5H), 4.08-4.26 (m, 7H), 3.73-3.88 (m, 3H), 3.30 (dd, *J* = 4.0, 10.0 Hz, 1H), 1.24-1.29 (m, 6H), 1.20 (t, *J* = 7.2 Hz, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 206.10, 199.92, 167.84, 167.74, 167.27, 138.27, 129.15, 128.03, 127.51, 62.26, 62.22, 62.13, 61.72, 55.25, 51.06, 48.58, 46.52, 14.01, 13.90, 13.80; HRMS calcd for C₂₂H₂₆O₈ (M + Na)⁺ 441.1520, found 441.1532; [α]_D²⁵ = +29.2 (*c* 0.8, CHCl₃); HPLC (Chiralpak AD-H, hexane/*i*-PrOH = 90:10, flow rate 0.7 mL/min, λ = 214 nm), *t_R* = 42.46 (major), 51.74 (minor) min; dr = 20:1; ee > 99%.



Diethyl 2-((1*R*,3*S*,4*R*,5*R*)-3-(ethoxycarbonyl)-5-formyl-4-(4-methoxyphenyl)-2-oxocyclopentyl) malonate **4b:** 79% yield; ^1H NMR (400 MHz, CDCl_3) δ 9.58 (d, $J = 1.2$ Hz, 1H), 7.31 (d, $J = 8.8$ Hz, 2H), 6.89 (d, $J = 8.8$ Hz, 2H), 4.06-4.26 (m, 7H), 3.79 (s, 3H), 3.68-3.82 (m, 3H), 3.27-3.30 (dd, $J = 4.0, 10.0$ Hz, 1H), 1.24-1.29 (m, 6H), 1.20 (t, $J = 7.6$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 206.22, 200.10, 167.85, 167.74, 167.36, 159.25, 130.08, 128.55, 114.49, 62.39, 62.19, 61.12, 61.67, 55.39, 55.21, 51.03, 48.60, 45.87, 14.02, 13.89, 13.80; HRMS calcd for $\text{C}_{23}\text{H}_{28}\text{O}_9$ ($\text{M} + \text{Na}$) $^+$ 471.1626, found 471.1633; $[\alpha]_{\text{D}}^{25} = +38.4$ (c 1.0, CHCl_3); HPLC (Chiralpak AD-H, hexane/*i*-PrOH = 90:10, flow rate 1.0 mL/min, $\lambda = 214$ nm), $t_R = 25.45$ (minor), 36.09 (major) min; dr = 23:1; ee > 99%.

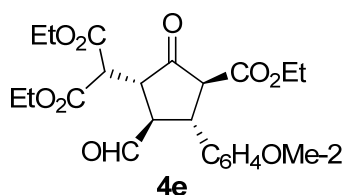


Diethyl 2-((1*R*,2*R*,3*R*,4*S*)-3-(4-bromophenyl)-4-(ethoxycarbonyl)-2-formyl-5-oxocyclopentyl) malonate **4c:** 75% yield; ^1H NMR (400 MHz, CDCl_3) δ 9.58 (d, $J = 1.2$ Hz, 1H), 7.30-7.32 (d, $J = 8.8$ Hz, 2H), 6.89 (d, $J = 8.8$ Hz, 2H), 4.06-4.26 (m, 7H), 3.79 (s, 3H), 3.68-3.82 (m, 3H), 3.29 (dd, $J = 4.0, 10.0$ Hz, 1H), 1.24-1.29 (m, 6H), 1.20 (t, $J = 7.6$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 205.67, 199.58, 167.87, 167.83, 167.12, 137.45, 132.37, 129.32, 122.04, 62.37, 62.28, 62.14, 61.39, 55.12, 51.12, 48.67, 45.88, 14.07, 13.94, 13.85; HRMS calcd for $\text{C}_{22}\text{H}_{25}\text{BrO}_8$ ($\text{M} + \text{Na}$) $^+$ 519.0625, found 519.0630; $[\alpha]_{\text{D}}^{25} = +47.2$ (c 1.0, CHCl_3); HPLC (Chiralpak AD-H, hexane/EtOH = 90:10, flow rate 0.7 mL/min, $\lambda = 214$ nm), $t_R = 33.45$ (major), 53.55 (minor) min; dr = 10:1; ee > 99%.

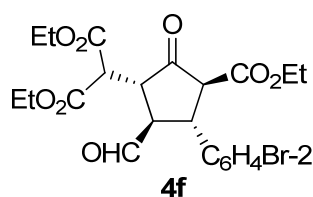


Diethyl 2-((1*R*,3*S*,4*R*,5*R*)-3-(ethoxycarbonyl)-4-(4-fluorophenyl)-5-formyl-2-oxocyclopentyl)malonate **4d:** 83% yield; ^1H NMR (300 MHz, CDCl_3) δ 9.58 (s, 1H), 7.39

(dd, $J = 5.7, 8.4$ Hz, 2H), 7.06 (t, $J = 11.6$ Hz, 2H), 4.06-4.25 (m, 7H), 3.74-3.84 (m, 3H), 3.28 (dd, $J = 4.5, 9.0$ Hz, 1H), 1.22-1.29 (m, 6H), 1.20 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 205.84, 199.74, 167.88, 167.83, 167.21, 163.62, 161.16, 134.111, 134.08, 129.26, 129.18, 116.27, 116.06, 62.37, 62.33, 62.25, 61.86, 55.35, 51.10, 48.69, 45.76, 14.06, 13.93, 13.84; HRMS calcd for $\text{C}_{22}\text{H}_{25}\text{FO}_8$ ($\text{M} + \text{Na}$) $^+$ 459.1426, found 459.1432; $[\alpha]_{\text{D}}^{25} = +29.1$ (c 1.0, CHCl_3); HPLC (Chiralpak AD-H, hexane/*i*-PrOH = 70:30, flow rate 0.7 mL/min, $\lambda = 214$ nm), $t_{\text{R}} = 11.25$ (major), 15.42 (minor) min; dr = 16:1; ee = 99%.

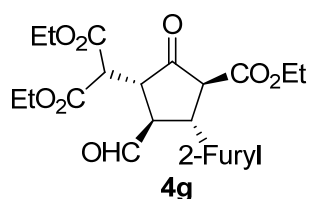


Diethyl 2-((1*R*,3*S*,4*R*,5*R*)-3-(ethoxycarbonyl)-5-formyl-4-(2-methoxyphenyl)-2-oxocyclopentyl)malonate 4e: 95% yield; ^1H NMR (300 MHz, CDCl_3) δ 9.56 (d, $J = 1.8$ Hz, 1H), 7.27-7.34 (m, 2H), 6.97 (t, $J = 1.5$ Hz, 1H), 6.91 (d, $J = 8.4$ Hz, 1H), 4.02-4.25 (m, 9H), 3.84 (s, 3H), 3.78 (dt, $J = 1.8, 10.8$ Hz, 1H), 3.37 (dd, $J = 4.2, 10.5$ Hz, 1H), 1.25-1.30 (m, 6H), 1.21 (t, $J = 6.9$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 206.54, 200.03, 167.86, 167.83, 167.50, 157.34, 129.17, 128.85, 125.60, 121.09, 111.06, 62.04, 62.02, 61.58, 59.19, 55.16, 54.17, 51.04, 48.75, 41.90, 14.05, 13.93, 13.86; HRMS calcd for $\text{C}_{23}\text{H}_{28}\text{O}_9$ ($\text{M} + \text{Na}$) $^+$ 471.1626, found 471.1630; $[\alpha]_{\text{D}}^{25} = +18.0$ (c 1.0, CHCl_3); HPLC (Chiralpak AD-H, hexane/*i*-PrOH = 90:10, flow rate 0.7 mL/min, $\lambda = 214$ nm), $t_{\text{R}} = 43.85$ (major), 54.89 (minor) min; dr = 16:1; ee > 99%.

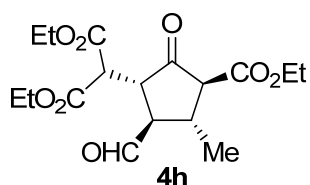


Diethyl 2-((1*R*,2*R*,3*R*,4*S*)-3-(2-bromophenyl)-4-(ethoxycarbonyl)-2-formyl-5-oxocyclopentyl)malonate 4f: 78% yield; Major diastereoisomer: ^1H NMR (400 MHz, CDCl_3) δ 10.66 (s, 1H), 9.60 (d, $J = 1.6$ Hz, 1H), 7.53-7.61 (m, 2H), 7.29-7.43 (m, 1H), 7.08-7.19 (m, 1H), 4.46 (t, $J = 12.0$ Hz, 1H), 4.08-4.25 (m, 7H), 3.92 (d, $J = 12.0$ Hz, 1H), 3.66-3.74 (m, 1H), 3.38 (dd, $J = 4.0, 10.0$ Hz, 1H), 1.25-1.29 (m, 6H), 1.19-1.23 (t, $J = 7.2$ Hz, 3H); Minor diastereoisomer: ^1H NMR (400 MHz, CDCl_3) δ 10.66 (s, 1H), 9.67 (s, 1H), 7.53-

7.61 (m, 2H), 7.29-7.43 (m, 1H), 7.08-7.19 (m, 1H), 4.66 (d, $J = 3.2$ Hz, 1H), 4.08-4.25 (m, 7H), 3.87-3.89 (m, 1H), 3.66-3.74 (m, 1H), 3.16 (t, $J = 5.2$ Hz, 1H), 1.25-1.29 (m, 6H), 1.19-1.23 (t, $J = 7.2$ Hz, 3H); Major diastereoisomer: ^{13}C NMR (100 MHz, CDCl_3) δ 205.86, 198.79, 167.89, 167.82, 167.04, 138.14, 133.40, 129.45, 128.66, 128.42, 124.78, 62.32, 62.23, 61.92, 61.80, 56.79, 51.17, 48.22, 44.58, 14.05, 13.95, 13.85; HRMS calcd for $\text{C}_{22}\text{H}_{25}\text{BrO}_8$ ($\text{M} + \text{Na}$) $^+$ 519.0625, found 519.0630; $[\alpha]_{\text{D}}^{25} = -5.2$ (c 1.0, CHCl_3); HPLC (Chiralpak AD-H, hexane/*i*-PrOH = 90:10, flow rate 0.7 mL/min, $\lambda = 214$ nm), $t_{\text{R}} = 29.75$ (major 1), 35.69 (minor 1), 37.89 (major 2), 49.22 (minor 2) min; dr = 4:1; ee = 99%, 97%.

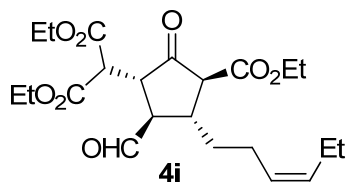


Diethyl 2-((1R,3S,4R,5R)-3-(ethoxycarbonyl)-5-formyl-4-(furan-2-yl)-2-oxocyclopentyl) malonate 4g: 89% yield; ^1H NMR (400 MHz, CDCl_3) δ 9.79 (d, $J = 2.0$ Hz, 1H), 7.40 (d, $J = 1.2$ Hz, 1H), 6.32 (dd, $J = 2.0, 3.2$ Hz, 1H), 6.22 (t, $J = 3.2$ Hz, 1H), 4.13-4.26 (m, 6H), 4.05 (d, $J = 4.0$ Hz, 1H), 3.85-3.91 (m, 2H), 3.71-3.77 (m, 1H), 3.28-3.32 (dd, $J = 4.4, 10.8$ Hz, 1H), 1.22-1.29 (m, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 205.30, 199.76, 167.80, 167.42, 167.24, 151.23, 142.66, 110.51, 107.16, 62.28, 62.21, 61.96, 59.17, 52.80, 50.92, 48.79, 39.72, 14.09, 13.90, 13.85; HRMS calcd for $\text{C}_{20}\text{H}_{24}\text{O}_9$ ($\text{M} + \text{Na}$) $^+$ 431.1313, found 431.1317; $[\alpha]_{\text{D}}^{25} = +45.8$ (c 1.0, CHCl_3); HPLC (Chiralpak AD-H, hexane/*i*-PrOH = 90:10, flow rate 0.7 mL/min, $\lambda = 214$ nm), $t_{\text{R}} = 30.17$ (major), 34.82 (minor) min; dr = 15:1; ee = 98%.

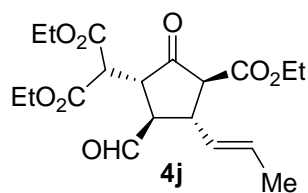


Diethyl 2-((1R,3S,4R,5R)-3-(ethoxycarbonyl)-5-formyl-4-methyl-2-oxocyclopentyl)malonate 4h: 86% yield; ^1H NMR (400 MHz, CDCl_3) δ 9.71 (d, $J = 2.8$ Hz, 1H), 4.12-4.26 (m, 6H), 3.99 (d, $J = 4.4$ Hz, 1H), 3.26 (d, $J = 11.6$ Hz, 1H), 3.19 (dd, $J = 4.0, 10.4$ Hz, 1H), 3.35 (dt, $J = 2.8, 10.8$ Hz, 1H), 2.60-2.71 (m, 1H), 1.23-1.32 (m, 12H); ^{13}C NMR (100 MHz, CDCl_3) δ 206.44, 199.91, 167.89, 167.79, 167.41, 62.11, 62.08, 61.68, 61.50,

55.80, 50.83, 49.36, 35.67, 17.71, 14.11, 13.85, 13.80; HRMS calcd for $C_{17}H_{24}O_8$ ($M + Na$)⁺ 379.1363, found 379.1368; $[\alpha]_D^{25} = +25.4$ (c 1.0, $CHCl_3$); HPLC (Chiralpak AD-H, hexane/i-PrOH = 95:5, flow rate 0.7 mL/min, λ = 214 nm), t_R = 44.73 (major), 55.13 (minor) min; dr = 19:1; ee = 95%.

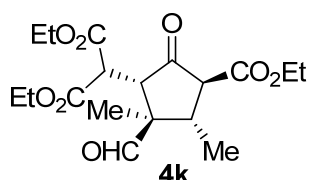


Diethyl 2-((1R,3S,4R,5R)-3-(ethoxycarbonyl)-5-formyl-4-((Z)-hex-3-enyl)-2-oxocyclopentyl)malonate 4i: 70% yield; 1H NMR (300 MHz, $CDCl_3$) δ 9.71 (d, J = 1.8 Hz, 1H), 5.32-5.41 (m, 1H), 5.20-5.28 (m, 1H), 4.10-4.24 (m, 6H), 3.97 (d, J = 4.2 Hz, 1H), 3.31 (d, J = 11.1 Hz, 1H), 3.21 (dd, J = 3.9, 10.5 Hz, 1H), 3.09 (dt, J = 2.7, 10.5 Hz, 1H), 2.66-2.77 (m, 1H), 1.92-2.06 (m, 4H), 1.72-1.84 (m, 1H), 1.57-1.70 (m, 1H), 1.21-1.29 (m, 9H), 0.92 (t, J = 10.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 206.93, 200.04, 168.62, 167.82, 167.43, 132.91, 127.13, 62.15, 62.12, 61.77, 60.24, 54.73, 50.85, 49.38, 40.43, 34.09, 24.95, 20.50, 14.15, 14.09, 13.89, 13.84; HRMS calcd for $C_{22}H_{32}O_8$ ($M + Na$)⁺ 447.1989, found 447.2000; $[\alpha]_D^{25} = +31.2$ (c 1.0, $CHCl_3$); HPLC (Chiralpak AD-H, hexane/i-PrOH = 90:10, flow rate 0.7 mL/min, λ = 214 nm), t_R = 13.92 (major), 16.02 (minor) min; dr = 27:1; ee = 98%.

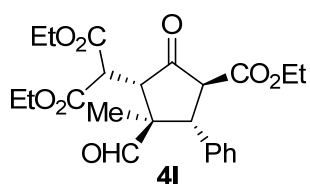


Diethyl 2-((1R,3S,4R,5R)-3-(ethoxycarbonyl)-5-formyl-2-oxo-4-((E)-prop-1-enyl)cyclopentyl)malonate 4j: 76% yield; Major diastereoisomer: 1H NMR (400 MHz, $CDCl_3$) δ 9.69 (d, J = 2.0 Hz, 1H), 5.63-5.74 (m, 1H), 5.44-5.54 (m, 1H), 4.11-4.25 (m, 6H), 3.99 (d, J = 4.0 Hz, 1H), 3.45 (d, J = 11.6 Hz, 1H), 3.23-3.31 (m, 1H), 3.13-3.21 (m, 2H), 1.69 (dd, J = 1.2, 6.8 Hz, 3H), 1.22-1.28 (m, 9H); Minor diastereoisomer: 1H NMR (400 MHz, $CDCl_3$) δ 9.67 (d, J = 2.0 Hz, 1H), 5.63-5.74 (m, 1H), 5.44-5.54 (m, 1H), 4.11-4.25 (m, 6H), 3.99 (d, J = 4.0 Hz, 1H), 3.58 (q, J = 11.2 Hz, 1H), 3.23-3.31 (m, 1H), 3.13-3.21 (m, 2H), 1.69 (dd, J = 1.2, 7.2 Hz, 3H), 1.22-1.28 (m, 9H); Major diastereoisomer: ^{13}C NMR (100

MHz, CDCl₃) δ 206.30, 200.16, 167.77, 167.60, 167.47, 129.95, 128.27, 62.10, 62.06, 61.62, 60.32, 53.93, 50.84, 48.36, 44.33, 17.79, 14.11, 13.85, 13.80; HRMS calcd for C₁₉H₂₆O₈ (M + Na)⁺ 405.1520, found 405.1532; $[\alpha]_D^{25} = +30.2$ (*c* 1.0, CHCl₃); HPLC (Chiralpak AD-H, hexane/*i*-PrOH = 80:20, flow rate 0.7 mL/min, λ = 214 nm) (determined by chiral-phase HPLC analysis of the corresponding *p*-bromobenzoate derivative of the alcohol), *t_R* = 23.22 (minor), 27.81 (major) min; dr = 4:1; ee = 99%.

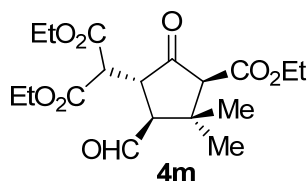


Diethyl 2-((1*S*,2*R*,3*S*,4*S*)-4-(ethoxycarbonyl)-2-formyl-2,3-dimethyl-5-oxocyclopentyl)malonate **4k:** 70% yield; ¹H NMR (400 MHz, CDCl₃) δ 9.47 (s, 1H), 4.20-4.30 (m, 4H), 4.08-4.13 (m, 2H), 3.72 (d, *J* = 10.8 Hz, 1H), 3.41 (d, *J* = 11.2 Hz, 1H), 2.82-2.94 (m, 2H), 1.29 (t, *J* = 7.2 Hz, 6H), 1.23 (t, *J* = 7.2 Hz, 3H), 0.99 (d, *J* = 6.0 Hz, 3H), 0.90 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 205.07, 199.49, 167.47, 167.08, 166.92, 62.36, 62.11, 62.01, 57.73, 56.55, 53.68, 49.28, 37.11, 14.08, 13.86, 13.75, 12.72, 8.93; HRMS calcd for C₁₈H₂₆O₈ (M + Na)⁺ 393.1520, found 393.1523; $[\alpha]_D^{25} = +37.3$ (*c* 1.0, CHCl₃); HPLC (Chiralpak AD-H, hexane/*i*-PrOH = 90:10, flow rate 0.7 mL/min, λ = 214 nm), *t_R* = 22.52 (major), 29.29 (minor) min; dr = 25:1; ee = 90%.

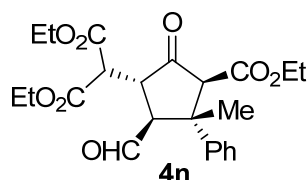


Diethyl 2-((1*S*,2*R*,3*R*,4*S*)-4-(ethoxycarbonyl)-2-formyl-2-methyl-5-oxo-3-phenylcyclopentyl)malonate **4l:** 67% yield; ¹H NMR (300 MHz, CDCl₃) δ 9.65 (s, 1H), 7.27-7.35 (m, 3H), 7.06 (d, *J* = 7.2 Hz, 2H), 4.07-4.30 (m, 7H), 3.90 (d, *J* = 10.2 Hz, 1H), 3.79 (d, *J* = 12.6 Hz, 1H), 3.47 (d, *J* = 10.5 Hz, 1H), 1.18-1.33 (m, 9H), 0.81 (s, 1H); ¹³C NMR (100 MHz, CDCl₃) δ 204.58, 199.82, 167.07, 167.00, 166.91, 133.55, 128.80, 128.18, 62.43, 62.19, 62.16, 56.36, 56.27, 56.21, 49.51, 48.77, 14.01, 13.92, 13.76, 10.80; HRMS calcd for C₂₃H₂₈O₈ (M + Na)⁺ 455.1676, found 455.1680; $[\alpha]_D^{25} = +16.7$ (*c* 1.0, CHCl₃); HPLC (Chiralpak AD-H,

hexane/i-PrOH = 70:30, flow rate 0.7 mL/min, λ = 214 nm), t_R = 7.28 (minor 1), 7.98 (major 1), 13.08 (major 2), 18.08 (minor 2) min; dr = 10:1; ee = 95%, 91%.

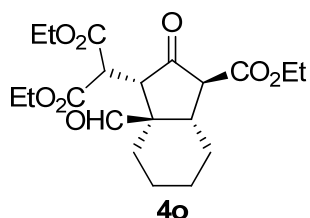


Diethyl 2-((1*R*,2*S*,4*S*)-4-(ethoxycarbonyl)-2-formyl-3,3-dimethyl-5-oxocyclopentyl)malonate 4m: 90% yield; Major diastereoisomer: ^1H NMR (400 MHz, CDCl_3) δ 10.86 (s, 1H), 9.78 (s, 1H), 4.10-4.27 (m, 6H), 3.99 (s, 1H), 3.51 (s, 1H), 3.33 (s, 2H), 1.59 (s, 3H), 1.21-1.30 (m, 9H), 0.96 (s, 3H); Minor diastereoisomer: ^1H NMR (400 MHz, CDCl_3) δ 10.86 (s, 1H), 9.74 (d, J = 2.8 Hz, 1H), 4.10-4.27 (m, 6H), 3.93-3.96 (m, 1H), 2.98-3.24 (m, 3H), 1.49 (s, 3H), 1.21-1.30 (m, 9H), 1.11 (s, 3H); ^{13}C NMR (for two isomers, 100 MHz, CDCl_3) δ 206.92, 201.25, 200.80, 200.19, 171.79, 169.45, 168.05, 167.87, 167.72, 167.45, 167.33, 167.13, 107.53, 66.54, 65.74, 62.14, 62.03, 61.95, 61.85, 61.71, 61.63, 61.11, 60.63, 60.27, 59.18, 58.90, 52.24, 51.19, 50.90, 47.53, 46.01, 44.02, 42.02, 41.93, 41.74, 30.28, 29.65, 28.90, 28.50, 24.86, 24.01, 23.61, 20.08, 14.22, 14.16, 14.10, 13.88, 13.83; HRMS calcd for $\text{C}_{18}\text{H}_{26}\text{O}_8$ ($\text{M} + \text{Na}$) $^+$ 393.1520, found 393.1528; $[\alpha]_{\text{D}}^{25}$ = +55.0 (c 1.0, CHCl_3); HPLC (Chiralpak AD-H, hexane/i-PrOH = 90:10, flow rate 0.7 mL/min, λ = 214 nm), t_R = 18.92 (major 1), 20.40 (minor 1), 30.10 (major 2), 36.37 (minor 2) min; dr = 5:2:1; ee >99%, = 95%. (According to the dr value obtained from the NMR spectra, three pairs of peaks had been expected in the HPLC spectrum, but only two pairs could be identified. Therefore it is impossible to determine the ee value of the third diastereomer)

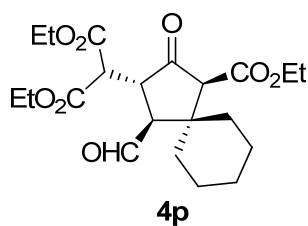


Diethyl 2-((1*R*,2*S*,3*R*,4*S*)-4-(ethoxycarbonyl)-2-formyl-3-methyl-5-oxo-3-phenylcyclopentyl) malonate 4n: 82% yield; Major diastereoisomer: ^1H NMR (400 MHz, CDCl_3) δ 10.89 (s, 1H), 9.63 (d, J = 1.2 Hz, 1H), 7.61 (d, J = 7.6 Hz, 1H), 7.43-7.47 (m, 2H), 7.34 (t, J = 7.6 Hz, 2H), 3.91-4.31 (m, 8H), 3.83 (d, J = 5.6 Hz, 1H), 3.59 (d, J = 9.2 Hz, 1H), 1.50 (s,

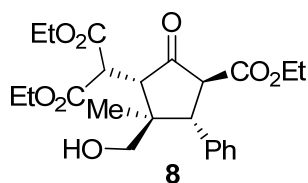
3H), 1.22-1.30 (m, 6H), 0.86 (t, $J = 6.8$ Hz, 3H); Minor diastereoisomer: ^1H NMR (400 MHz, CDCl_3) δ 10.89 (s, 1H), 9.46 (s, 1H), 7.61 (d, $J = 7.6$ Hz, 1H), 7.43-7.47 (m, 2H), 7.23 (t, $J = 7.2$ Hz, 2H), 3.91-4.31 (m, 8H), 3.89 (d, $J = 7.2$ Hz, 2H), 3.44 (dd, $J = 4.0, 10.4$ Hz, 1H), 1.41 (s, 3H), 1.22-1.30 (m, 6H), 1.07 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (for two isomers, 100 MHz, CDCl_3) δ 206.62, 200.05, 199.64, 172.66, 168.84, 168.09, 168.05, 167.80, 166.67, 147.19, 143.01, 128.90, 128.20, 127.53, 126.34, 126.08, 125.77, 108.16, 66.70, 63.11, 62.09, 61.79, 61.66, 60.87, 59.84, 59.76, 51.14, 50.47, 49.55, 47.16, 44.99, 41.08, 20.53, 17.96, 13.94, 13.89, 13.84, 13.79, 13.61; HRMS calcd for $\text{C}_{23}\text{H}_{28}\text{O}_8$ ($\text{M} + \text{Na}$) $^+$ 455.1676, found 455.1684; $[\alpha]_{\text{D}}^{25} = +29.8$ (c 1.0, CHCl_3); HPLC (Chiralpak AD-H, hexane/EtOH = 95:5, flow rate 0.7 mL/min, $\lambda = 214$ nm), $t_{\text{R}} = 25.79$ (major 1), 29.59 (minor 1), 53.85 (major 2), 95.65 (minor 2) min; dr = 1.6:1; ee >99%, >99%.



Diethyl 2-((1S,3S,3aS,7aR)-3-(ethoxycarbonyl)-7a-formyl-2-oxooctahydro-1H-inden-1-yl) malonate 4o: 81% yield; Major diastereoisomer: ^1H NMR (400 MHz, CDCl_3) δ 9.50 (s, 1H), 4.03-4.26 (m, 6H), 3.65 (d, $J = 11.2$ Hz, 1H), 3.35 (d, $J = 10.8$ Hz, 1H), 3.28 (d, $J = 11.2$ Hz, 1H), 3.03 (d, $J = 12.0$ Hz, 1H), 2.00 (d, $J = 14.0$ Hz, 1H), 1.76 (d, $J = 14.4$ Hz, 1H), 1.42-1.66 (m, 5H), 1.21-1.31 (m, 9H), 0.86 (t, $J = 12.8$ Hz, 1H); Minor diastereoisomer: ^1H NMR (400 MHz, CDCl_3) δ 9.54 (s, 1H), 4.03-4.26 (m, 6H), 3.74 (d, $J = 9.6$ Hz, 1H), 3.35 (d, $J = 10.8$ Hz, 1H), 3.28 (d, $J = 11.2$ Hz, 1H), 3.12 (d, $J = 9.6$ Hz, 1H), 2.24 (d, $J = 15.2$ Hz, 1H), 1.76 (d, $J = 14.4$ Hz, 1H), 1.42-1.66 (m, 5H), 1.21-1.31 (m, 9H), 0.86 (t, $J = 12.8$ Hz, 1H); ^{13}C NMR (for two isomers, 100 MHz, CDCl_3) δ 205.99, 205.14, 204.03, 200.17, 167.98, 167.73, 167.30, 166.95, 166.84, 62.25, 62.15, 62.02, 62.00, 61.92, 61.72, 57.43, 55.85, 55.03, 53.19, 52.93, 52.34, 49.64, 48.55, 38.05, 36.98, 30.20, 29.62, 24.94, 23.90, 23.02, 21.85, 21.32, 20.26, 18.66, 14.07, 13.84, 13.78, 13.72; HRMS calcd for $\text{C}_{20}\text{H}_{28}\text{O}_8$ ($\text{M} + \text{Na}$) $^+$ 419.1676, found 419.1679; $[\alpha]_{\text{D}}^{25} = +57.5$ (c 1.0, CHCl_3); HPLC (Chiralpak AD-H, hexane/EtOH = 90:10, flow rate 0.7 mL/min, $\lambda = 214$ nm), $t_{\text{R}} = 24.74$ (major 1), 26.29 (minor 1), 33.95 (minor 2), 39.62 (major 2) min; dr = 3:1; ee >99%, = 97%.

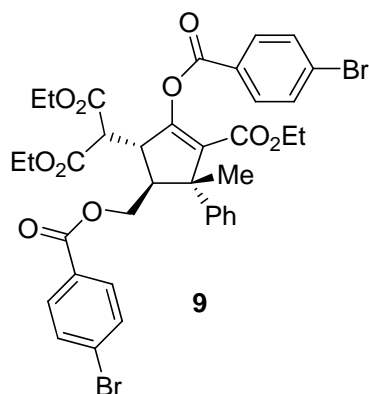


Diethyl 2-((1S,2R,4S)-4-(ethoxycarbonyl)-1-formyl-3-oxospiro[4.5]decan-2-yl)malonate **4p:** 90% yield; Major diastereoisomer: ^1H NMR (300 MHz, CDCl_3) δ 11.13 (s, 1H), 9.81 (d, $J = 3.6$ Hz, 1H), 4.07-4.29 (m, 6H), 3.57-3.94 (m, 2H), 3.51 (s, 1H), 3.14 (dd, $J = 3.3$, 10.8 Hz, 1H), 1.34-1.82 (m, 10H), 1.19-1.32 (m, 9H); Minor diastereoisomer: ^1H NMR (300 MHz, CDCl_3) δ 11.13 (s, 1H), 9.87 (d, $J = 2.4$ Hz, 1H), 4.07-4.29 (m, 6H), 3.57-3.94 (m, 2H), 3.35 (s, 1H), 2.99 (dd, $J = 2.4$, 8.7 Hz, 1H), 1.34-1.82 (m, 10H), 1.19-1.32 (m, 9H); ^{13}C NMR (for two isomers, 100 MHz, CDCl_3) δ 208.64, 207.27, 201.53, 168.48, 167.91, 167.52, 167.49, 64.28, 62.12, 61.99, 61.91, 61.73, 61.61, 59.95, 52.52, 51.82, 51.02, 48.71, 47.00, 46.90, 46.78, 46.39, 45.30, 40.19, 32.91, 31.80, 30.88, 30.05, 25.39, 25.31, 25.04, 22.80, 22.73, 21.83, 14.04, 13.90, 13.83; HRMS calcd for $\text{C}_{21}\text{H}_{30}\text{O}_8$ ($\text{M} + \text{Na}$) $^+$ 433.1833, found 433.1839; $[\alpha]_{\text{D}}^{25} = +54.8$ (c 1.0, CHCl_3); HPLC (Chiralpak AD-H, hexane/EtOH = 90:10, flow rate 0.7 mL/min, $\lambda = 214$ nm), $t_{\text{R}} = 14.59$ (major 1), 18.02 (minor 1), 22.52 (major 2), 34.45 (major 2) min; dr = 11:3:1:1; ee >99%, = 98%. (According to the dr value obtained from the NMR spectra, four pairs of peaks had been expected in the HPLC spectrum, but only three pairs could be identified. Therefore it is impossible to determine the ee value of the other two diastereomers)



Diethyl 2-((1S,2R,3R,4S)-4-(ethoxycarbonyl)-2-(hydroxymethyl)-2-methyl-5-oxo-3-phenylcyclopentyl)malonate **8:** 85% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.33-7.36 (m, 2H), 7.25-7.30 (m, 3H), 4.22-4.31 (m, 4H), 4.05-4.16 (m, 3H), 3.70 (d, $J = 10.4$ Hz, 2H), 3.53 (d, $J = 10.0$ Hz, 1H), 3.28 (t, $J = 10.4$ Hz, 1H), 3.01 (d, $J = 14.0$ Hz, 1H), 2.93 (br, 1H), 1.30 (q, $J = 8.0$ Hz, 6H), 1.17 (d, $J = 7.6$ Hz, 3H), 0.53 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 206.84, 169.35, 167.98, 167.48, 134.98, 129.34, 128.45, 127.63, 63.02, 62.77, 62.20, 61.74,

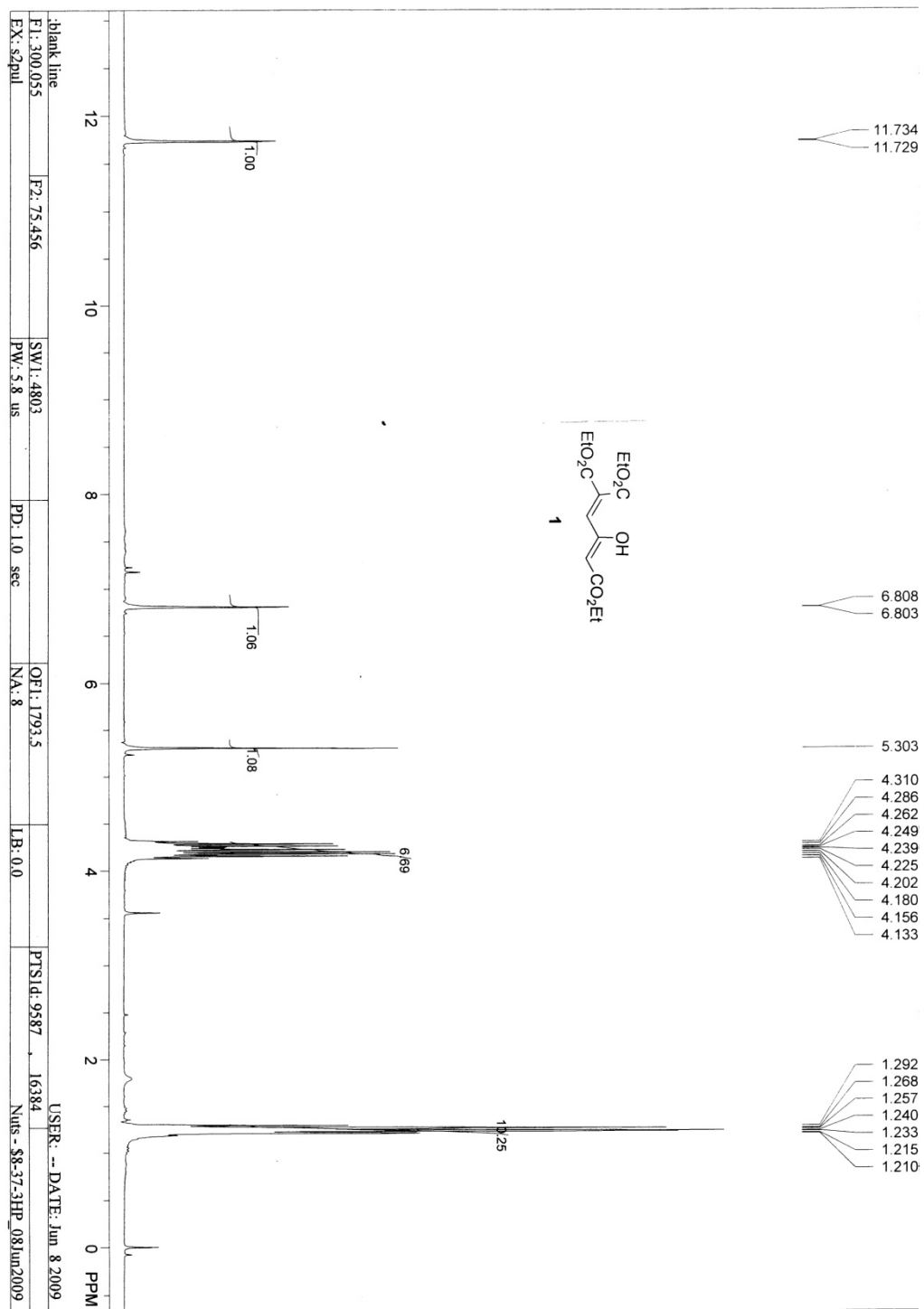
55.73, 54.23, 49.66, 47.84, 46.68, 14.11, 14.02, 13.99, 13.87; HRMS calcd for $C_{23}H_{30}O_8$ ($M + Na$)⁺ 457.1833, found 457.1816; $[\alpha]_D^{25} = +6.5$ (c 1.0, $CHCl_3$).

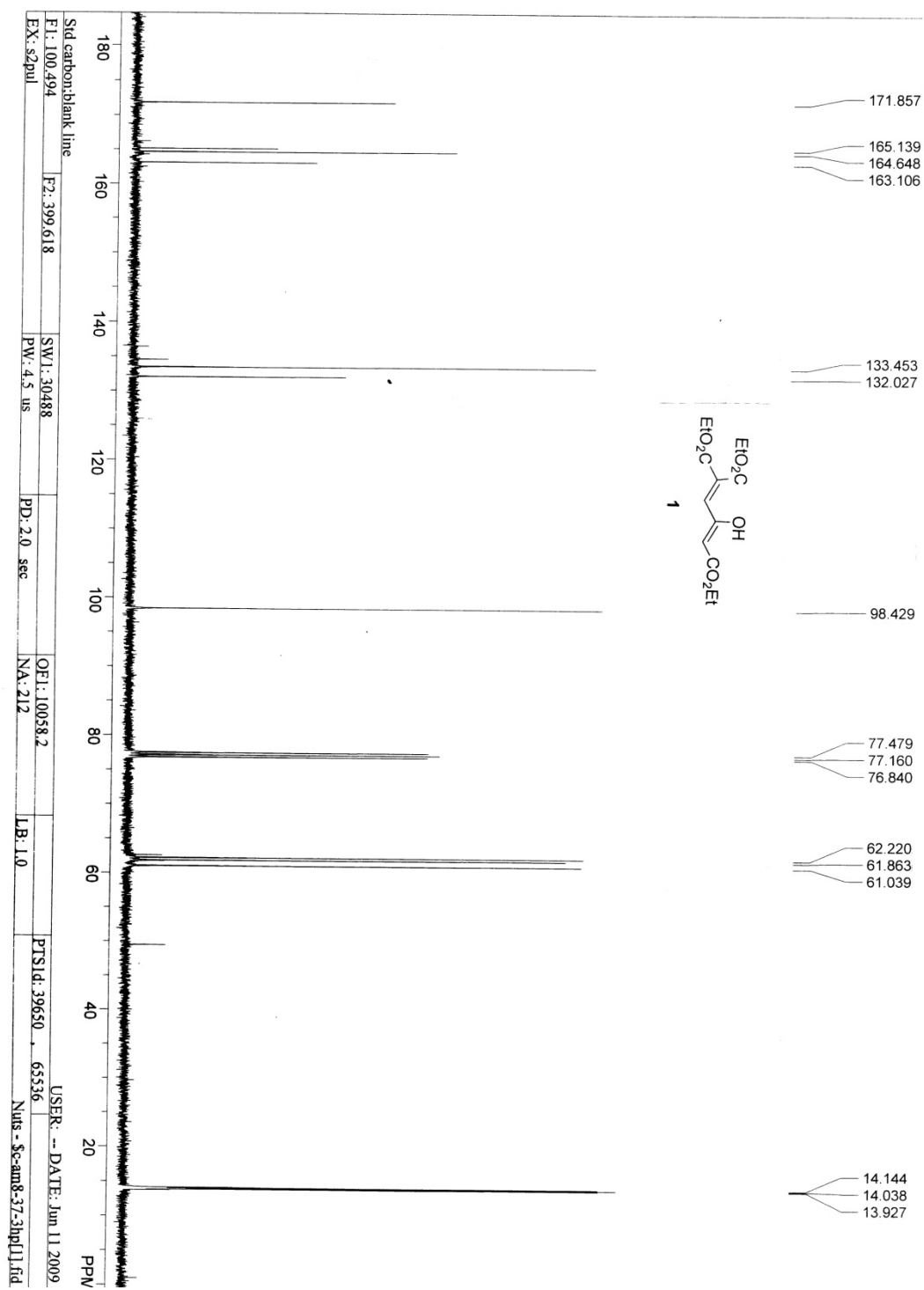


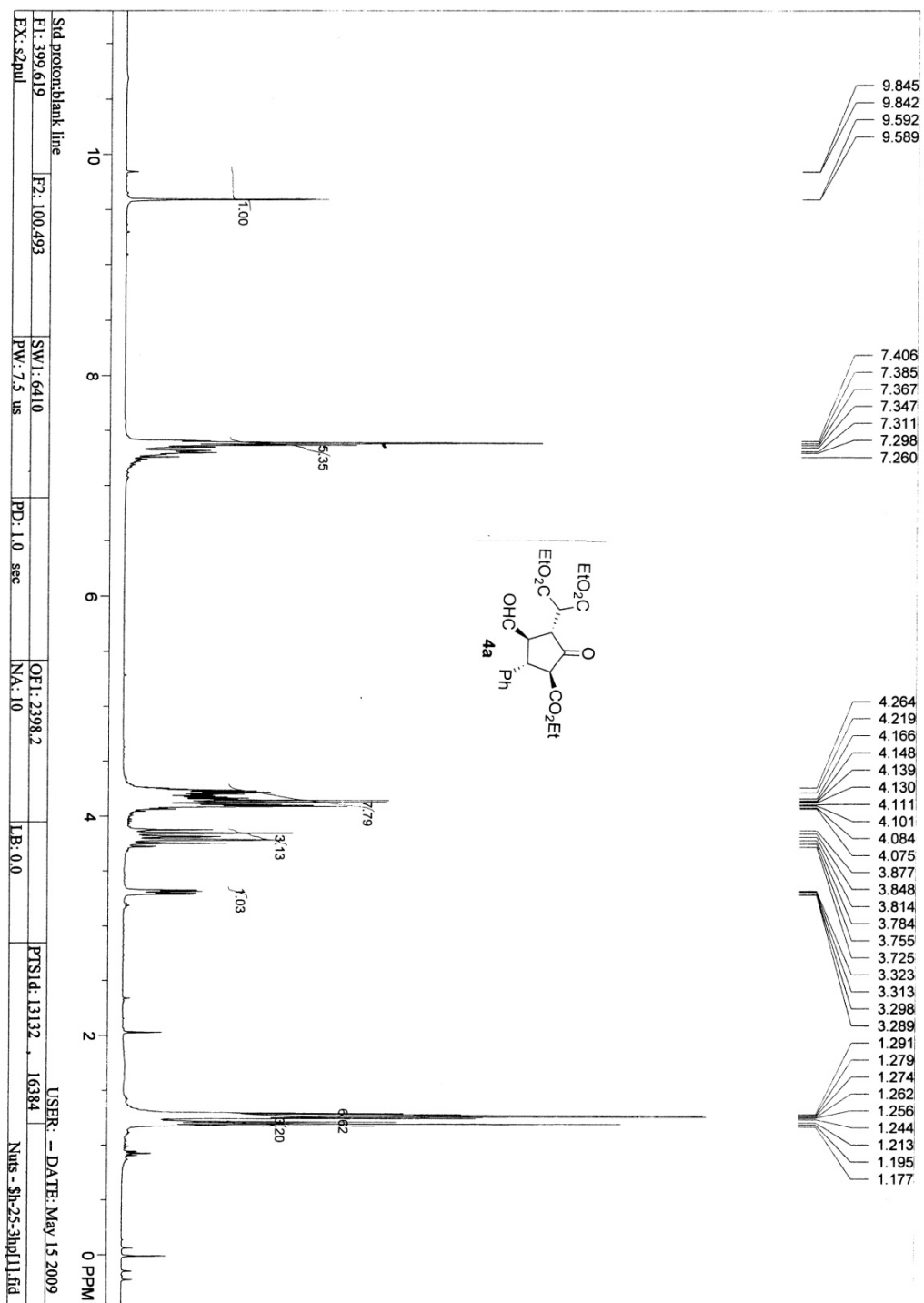
Diethyl 2-((1R,4S,5S)-2-(4-bromobenzoyloxy)-5-((4-bromobenzoyloxy)methyl)-3-(ethoxycarbonyl)-4-methyl-4-phenylcyclopent-2-enyl)malonate **9:** DMAP (0.45 mg, 0.0037 mmol), Et_3N (16 μ L, 0.111 mmol), and 4-bromobenzoyl chloride (20.2 mg, 0.092 mmol) were added to a solution of the corresponding alcohol from aldehyde **4n** (16 mg, 0.037 mmol) in DCM (0.8 mL) at 0 °C. Then the solution was stirred at r.t. overnight. Solvents were removed in vacuo and the residue was purified by flash column chromatography (silica gel, 10:1 petroleum/AcOEt as eluent) to afford **9** in 81% yield; 1H NMR (300 MHz, $CDCl_3$) δ 7.97 (d, J = 8.4 Hz, 2H), 7.66 (d, J = 8.4 Hz, 2H), 7.64 (d, J = 8.4 Hz, 2H), 7.51 (d, J = 8.4 Hz, 2H), 7.40 (d, J = 7.8 Hz, 2H), 7.31 (t, J = 7.2 Hz, 2H), 7.21 (t, J = 7.5 Hz, 1H), 4.37-4.49 (m, 2H), 4.27 (q, J = 6.9 Hz, 2H), 3.85-3.95 (m, 4H), 3.72-3.82 (m, 2H), 2.77 (dt, J = 6.6, 9.9 Hz, 1H), 1.78 (s, 3H), 1.31 (t, J = 6.9 Hz, 3H), 1.10 (t, J = 7.2 Hz, 3H), 0.72 (t, J = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.89, 167.51, 165.50, 162.33, 162.11, 156.33, 147.02, 132.02, 131.71, 131.66, 131.20, 129.21, 128.40, 128.29, 127.71, 127.61, 126.32, 126.23, 63.88, 62.00, 61.88, 59.96, 51.88, 51.56, 51.01, 46.18, 18.16, 14.08, 13.76, 13.55; HRMS calcd for $C_{37}H_{36}O_{10}Br_2$ ($M + Na$)⁺ 821.0568, found 821.0585; $[\alpha]_D^{25} = +25.4$ (c 0.5, $CHCl_3$); HPLC (Chiralpak AD-H, hexane/*i*-PrOH = 50:50, flow rate 0.7 mL/min, λ = 214 nm), t_R = 29.84 (minor), 61.78 (major) min; ee > 99%.

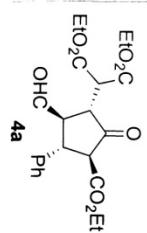
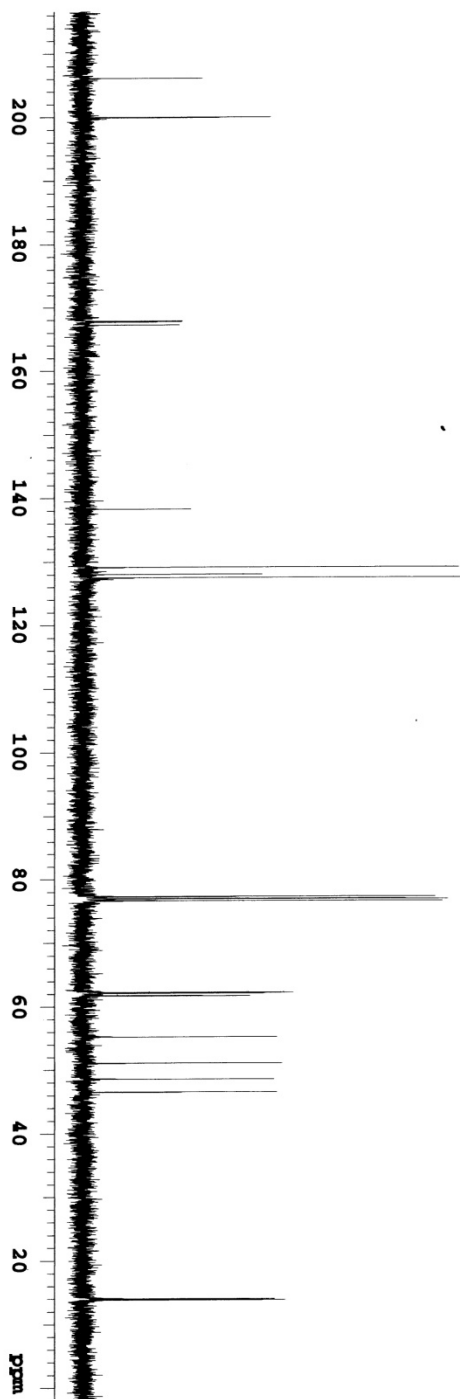
References:

[1] E. Holtz, U. Albrecht, P. Langer, *Tetrahedron* **2007**, 63, 3293.









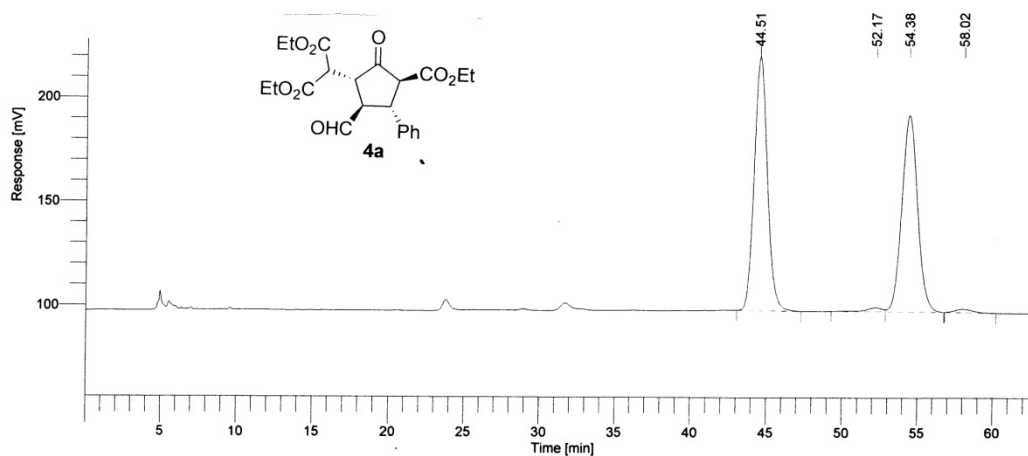
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167.842
167.738
167.273
138.271
129.150
128.031
127.506
77.300
76.985
76.665
62.264
62.219
62.134
61.715
55.246
51.060
48.577
46.524
14.011
13.896
13.801

9.2.24

Software Version : 6.3.1.0504
Sample Name : AM8-34-2+-
Instrument Name : NCI901
Rack/Vial : 0/0
Sample Amount : 1.000000
Cycle : 1

Date : 2009-3-19 9:38:58
Data Acquisition Time : 2009-3-19 8:23:31
Channel : A
Operator : manager
Dilution Factor : 1.000000

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Sequence File : D:\200903019-.seq



HPLC REPORT

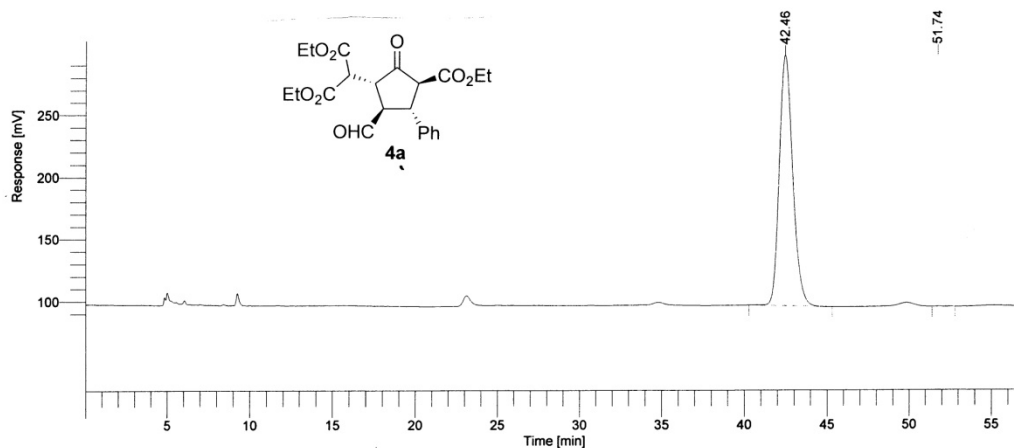
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3		54.384	6893623.31	94481.03	47.474	VB
4		58.024	130007.51	1664.04	0.895	BB

1.45e+07 219939.07

Software Version : 6.3.1.0504
Sample Name : AM8-38-5
Instrument Name : NCI901
Rack/Vial : 0/0
Sample Amount : 1.000000
Cycle : 1

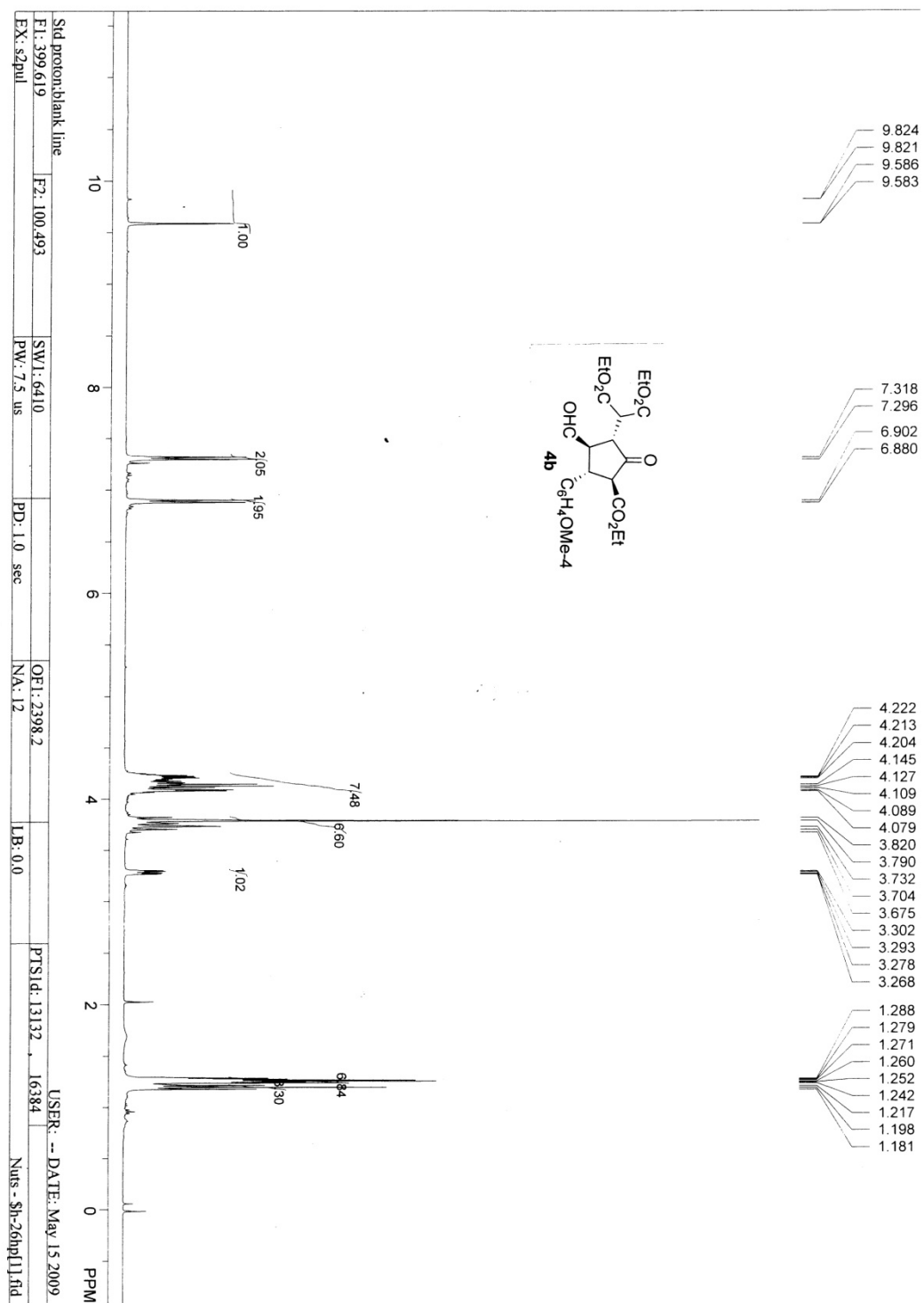
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Dilution Factor : 1.000000

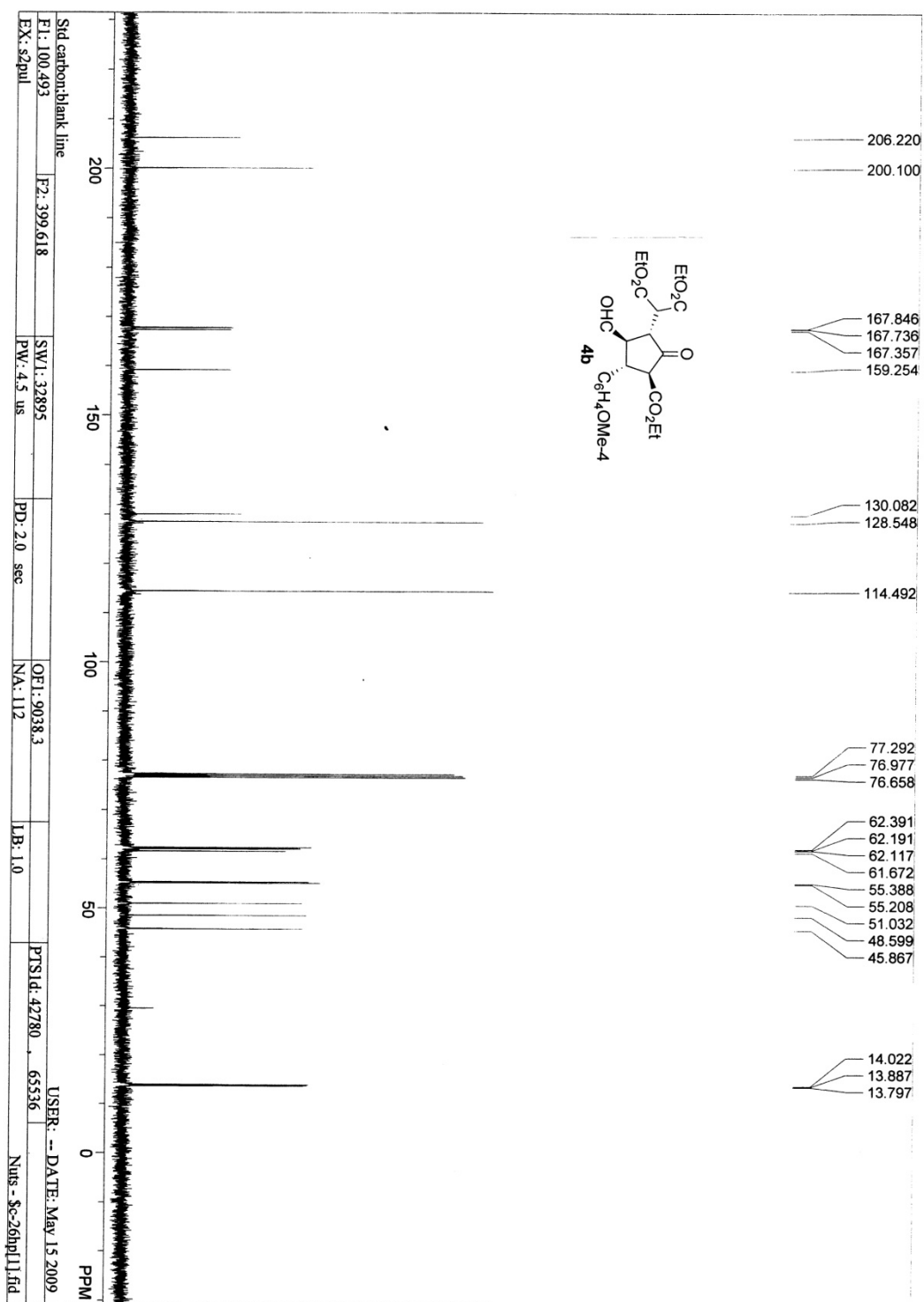
Result File : D:\AM8-38-5.rst
Sequence File : D:\200903019-.seq



HPLC REPORT

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			1.14e+07	201267.60	1e+02	





HPLC REPORT

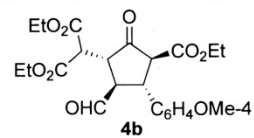
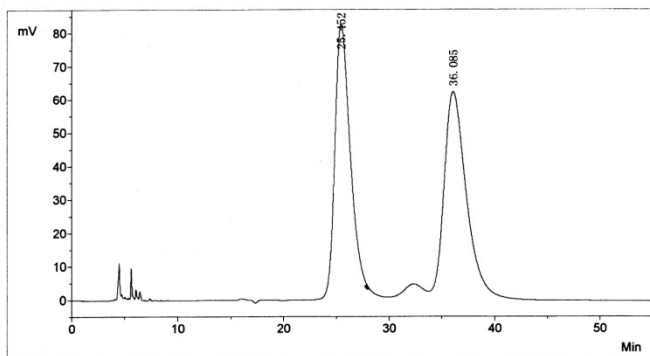
Data File: MAQ-AM-8-30-2. che

Sample Name:

Date: 2009-03-10

Time: 15:14

Operator:



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1	1		25.452	82293.2	8578092.7	50.2410
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HPLC REPORT

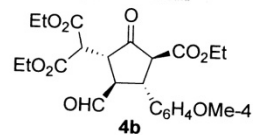
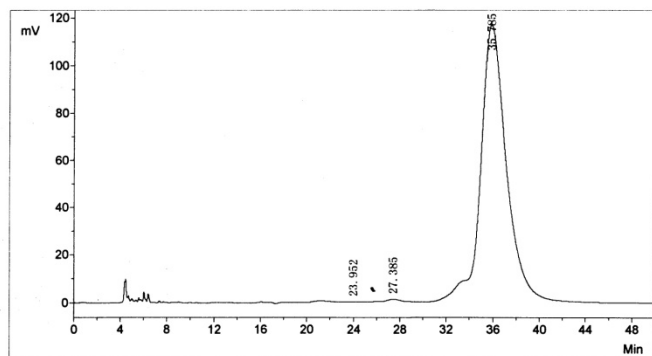
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Sample Name:

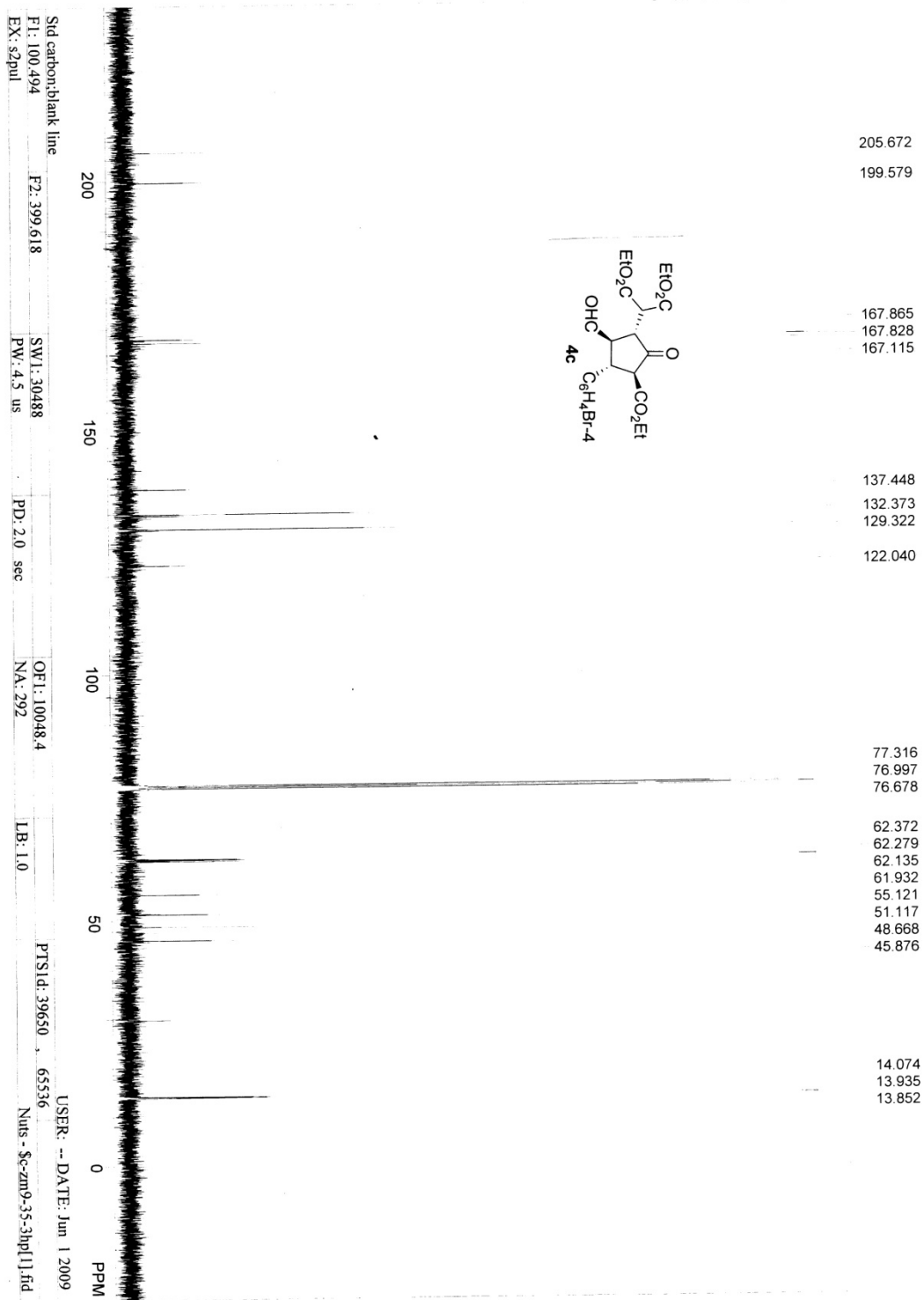
Date: 2009-03-10

Time: 16:10

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
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2	2		27.385	1208.1	104013.2	0.5794
3	3		35.785	116643.2	17843416.0	99.4020
Total				117917.0	17950763.3	100.0000



HPLC REPORT

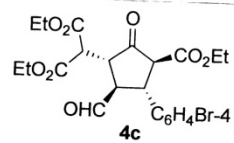
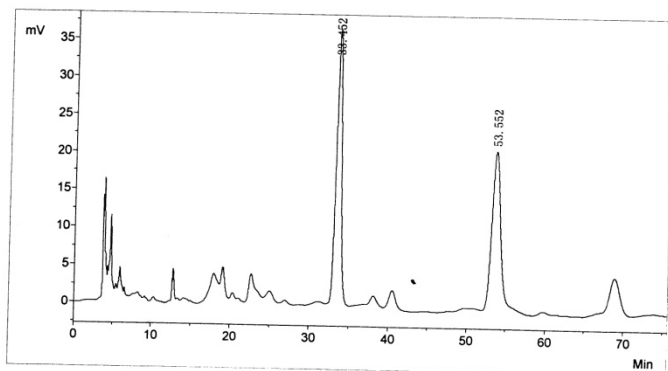
Data File:MAQ-AM-8-33-4+-.che

Sample name:

Date:2009-03-10

Time :16:40

Operator:



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Total				57670.0	3381984.8	100.0000

HPLC REPORT

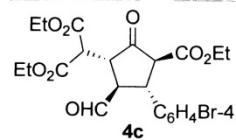
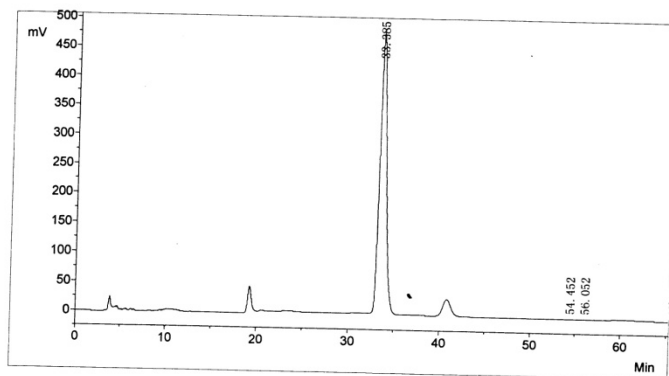
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Sample name:

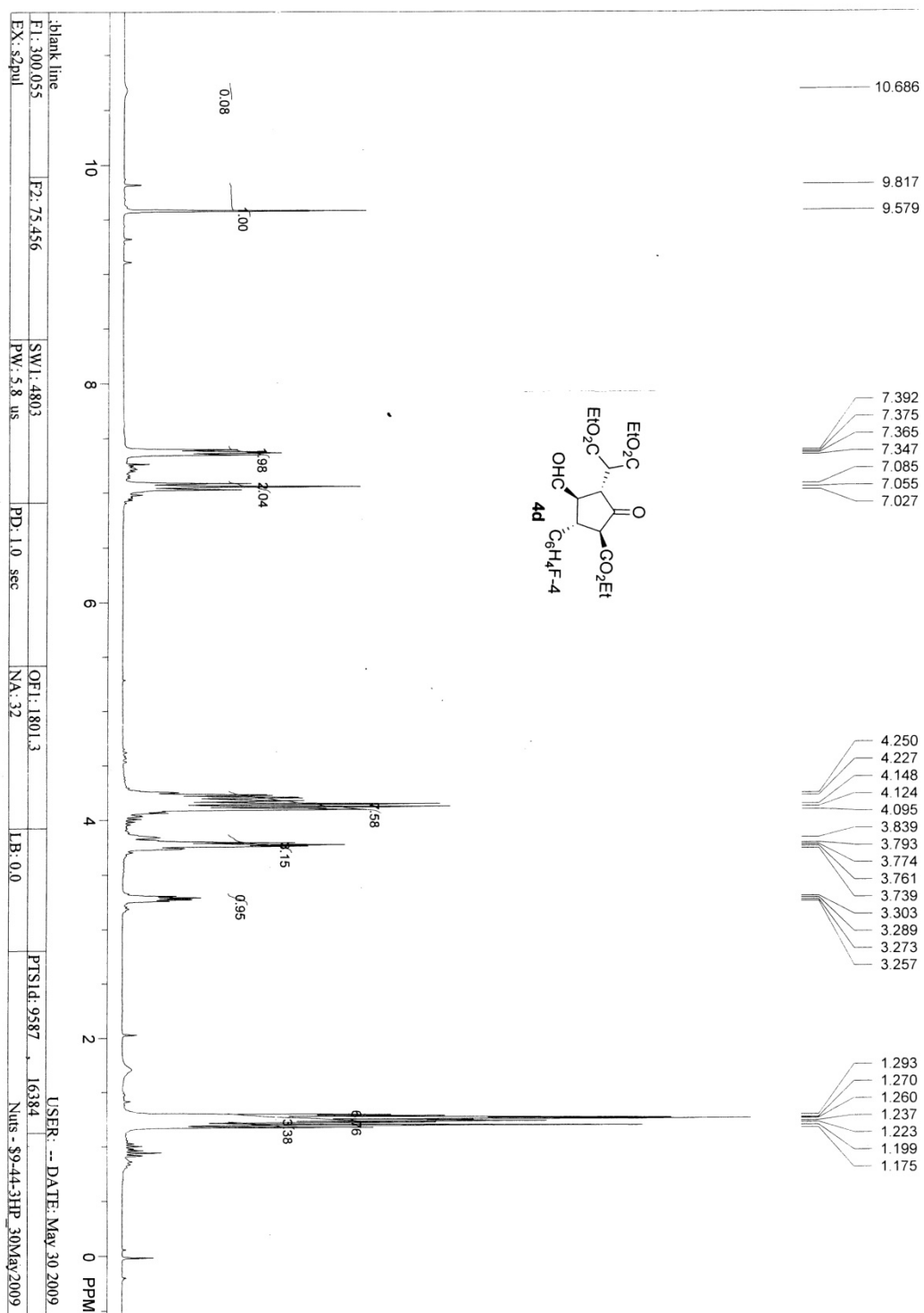
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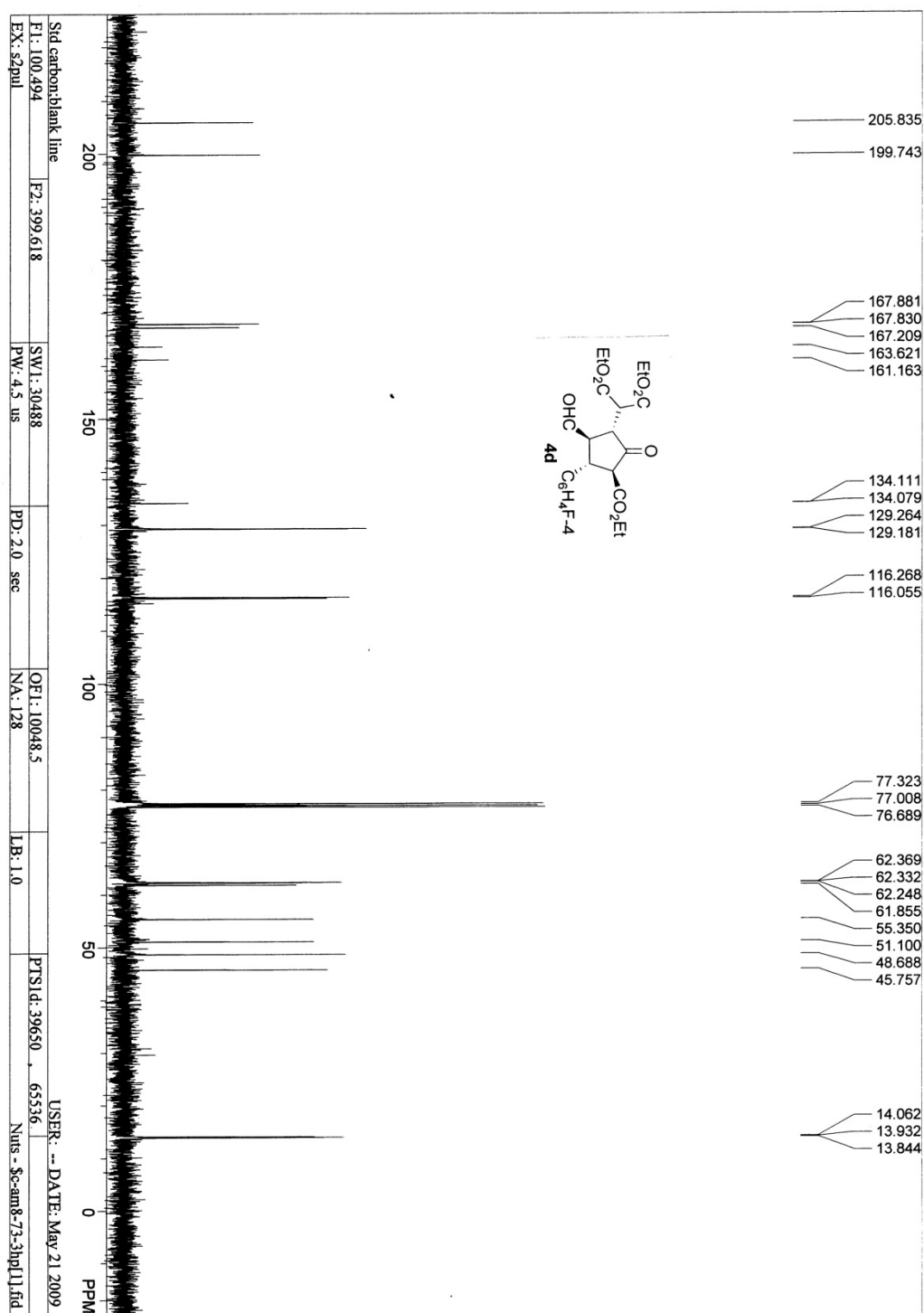
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Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
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Total				478049.4	24565068.0	100.0000

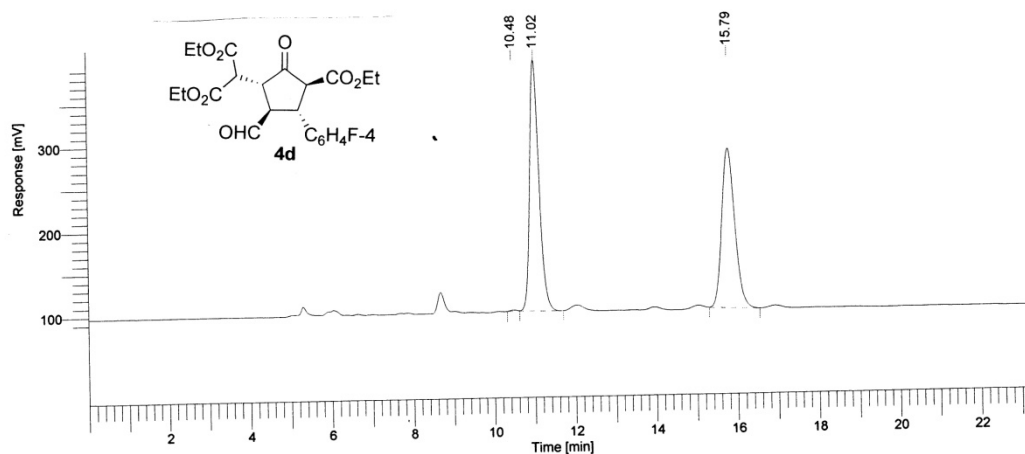




Software Version : 6.3.1.0504
Sample Name : AM8-42-3+-
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Rack/Vial : 0/0
Sample Amount : 1.000000
Cycle : 1

Date : 2009-5-19 10:23:46
Data Acquisition Time : 2009-5-19 9:19:45
Channel : A
Operator : manager
Dilution Factor : 1.000000

Result File :
Sequence File : D:\200905019-.seq



HPLC REPORT

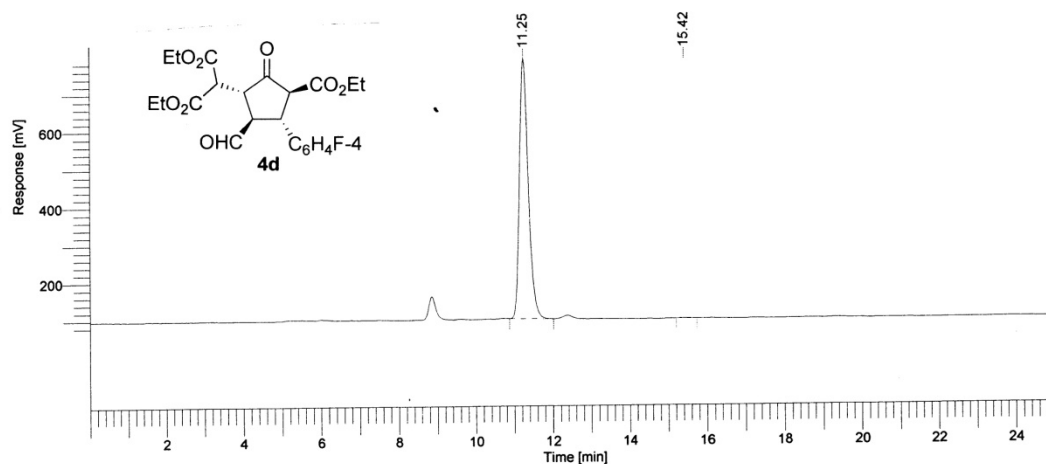
Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL
1		10.482	17620.32	1458.43	0.198	BV
2		11.022	4720265.50	296879.82	52.931	*VB
3		15.790	4179873.29	188473.50	46.871	*BB

8917759.10 486811.75 1e+02

Software Version : 6.3.1.0504
Sample Name : AM9-34-3
Instrument Name : NCI901
Rack/Vial : 0/0
Sample Amount : 1.000000
Cycle : 1

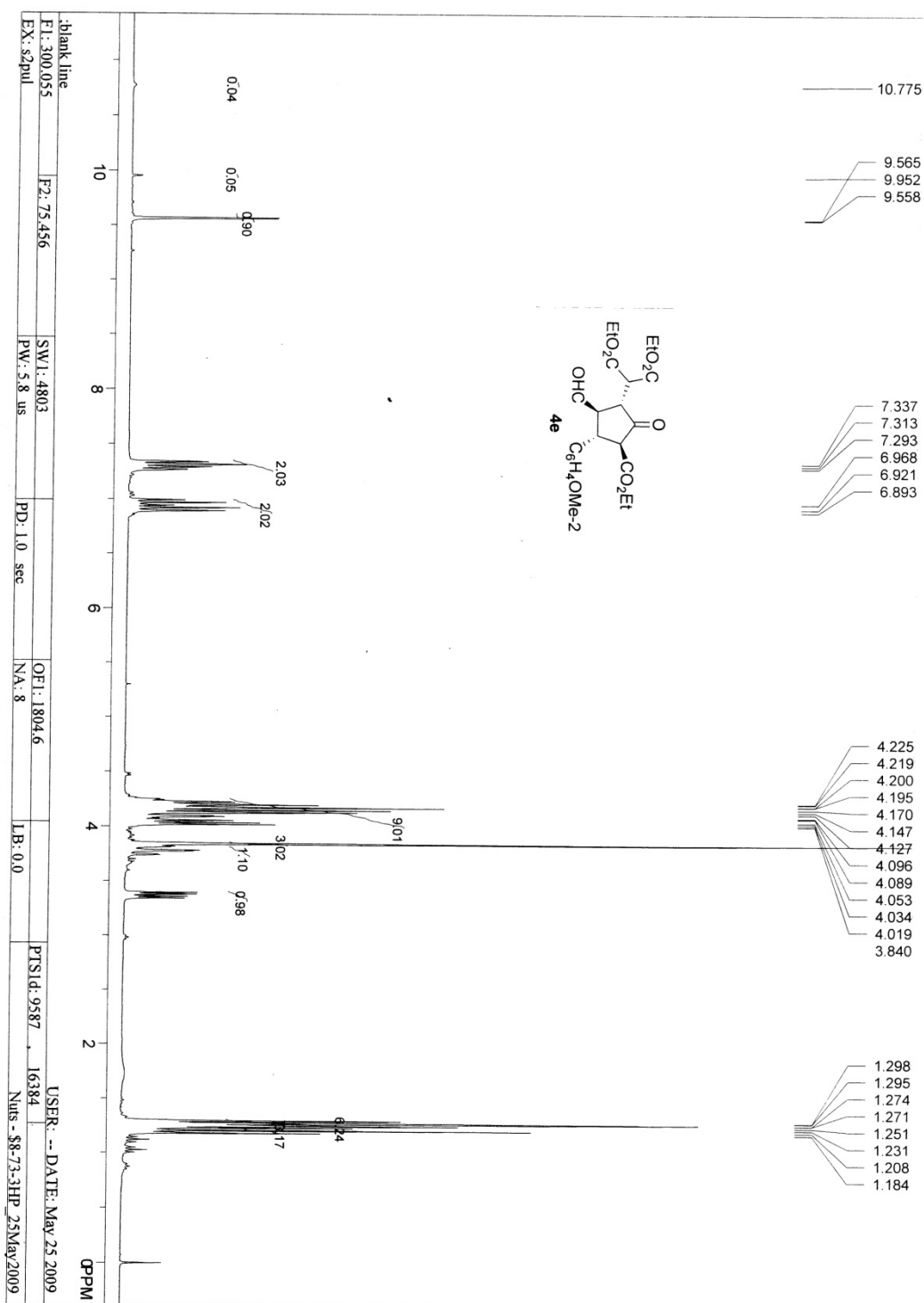
Date : 2009-5-19 10:27:14
Data Acquisition Time : 2009-5-19 9:59:00
Channel : A
Operator : manager
Dilution Factor : 1.000000

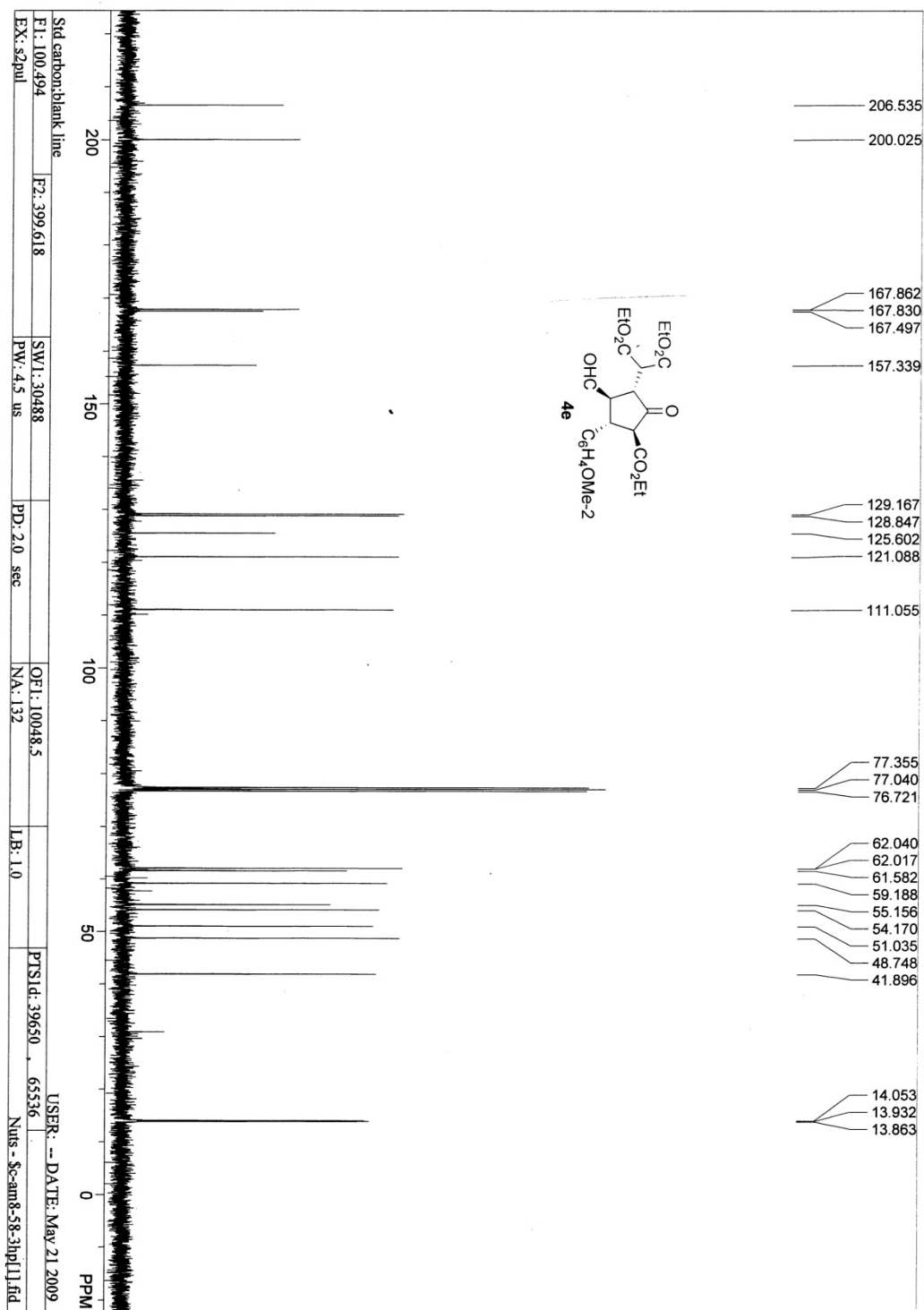
Result File :
Sequence File : D:\200905019-.seq



HPLC REPORT

Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL
1		11.248	1.10e+07	687940.99	99.874	*BB
2		15.422	13861.71	812.85	0.126	*BB
			1.10e+07	688753.84	1e+02	





HPLC REPORT

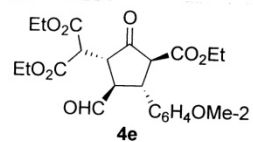
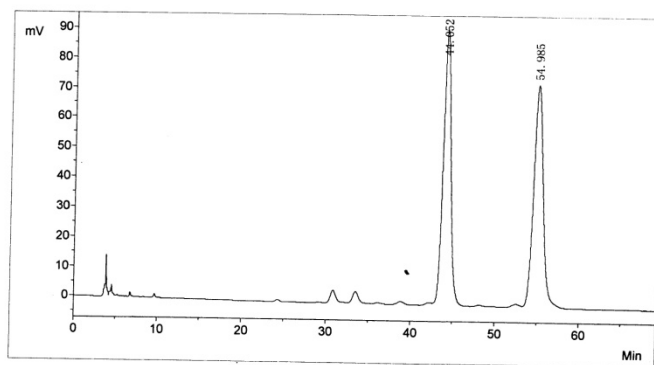
Data File:MAQ-AM-8-71-3+-.che

Sample name:

Date:2009-04-10

Time :14:22

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		44.052	91645.4	5784125.8	49.7941
2	2		54.985	74020.7	5831959.8	50.2059
Total				165666.2	11616085.5	100.0000

HPLC REPORT

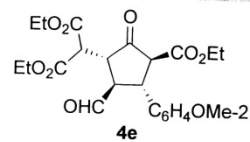
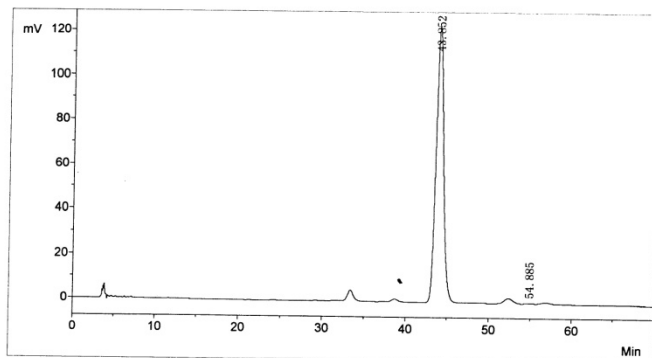
Data File:MAQ-AM-8-73-3.che

Sample name:

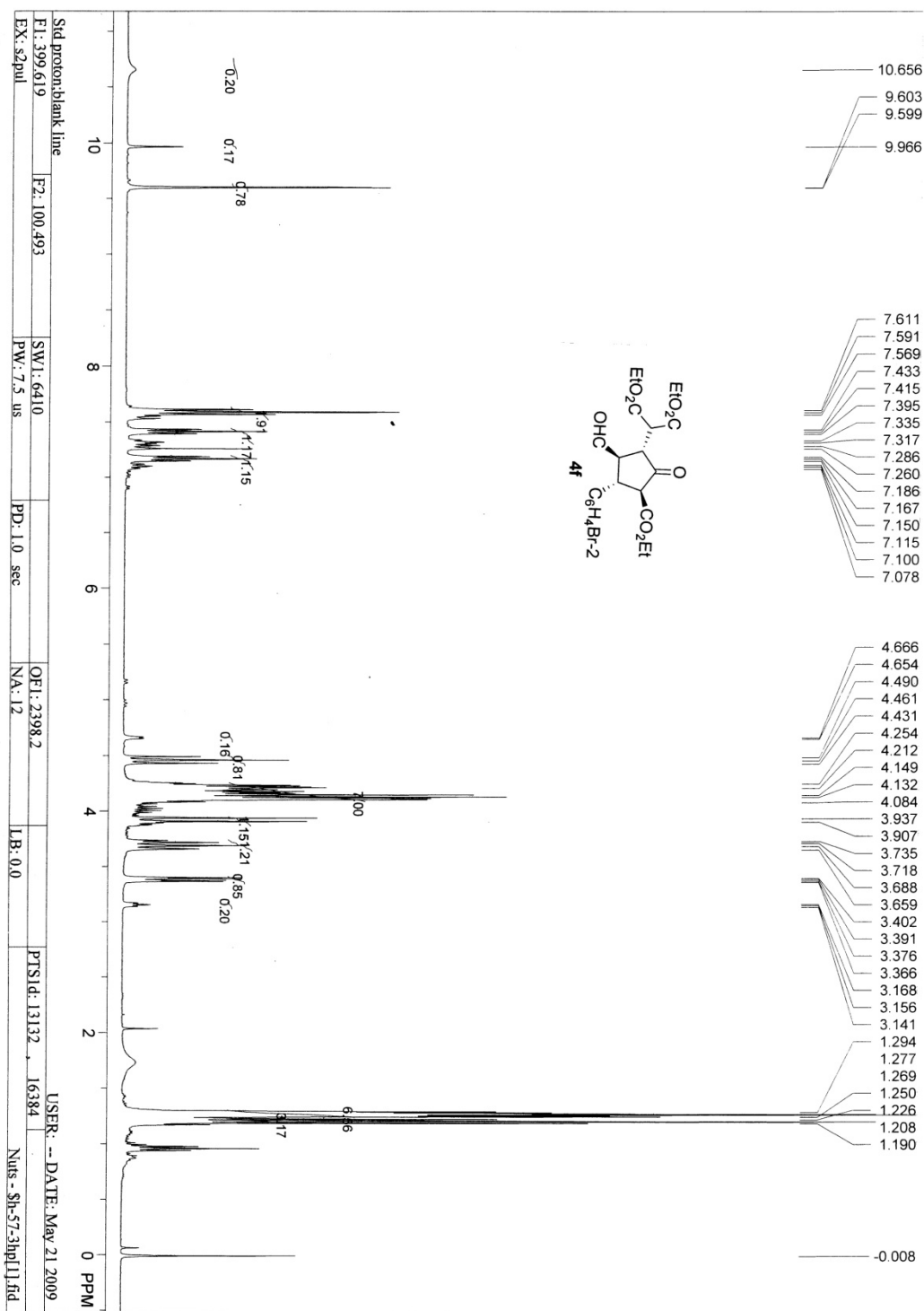
Date:2009-04-10

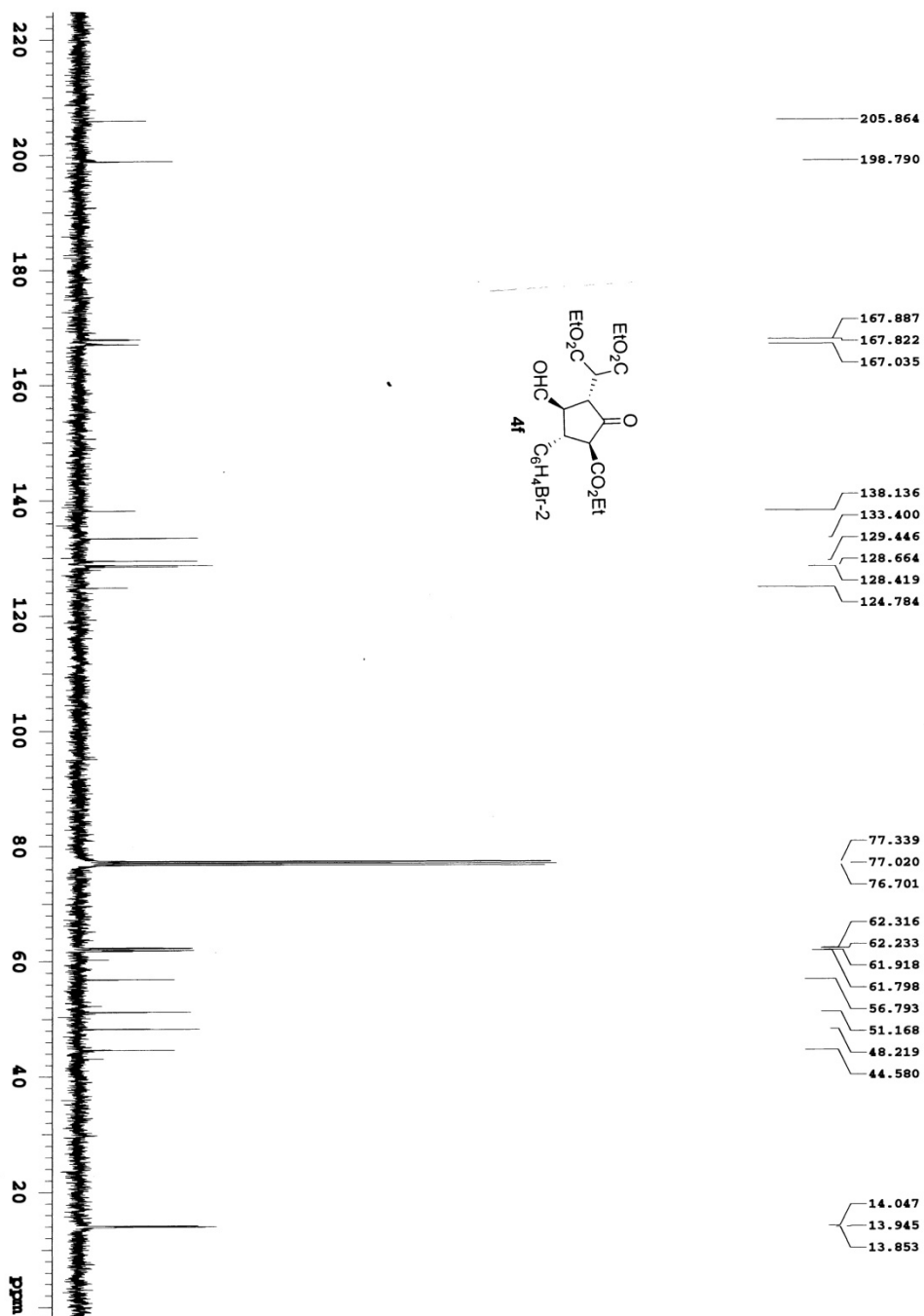
Time :15:33

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		43.852	123509.8	7810521.0	99.8919
2	2		54.885	173.4	8454.1	0.1081
Total				123683.3	7818975.1	100.0000





4f
100%

HPLC REPORT

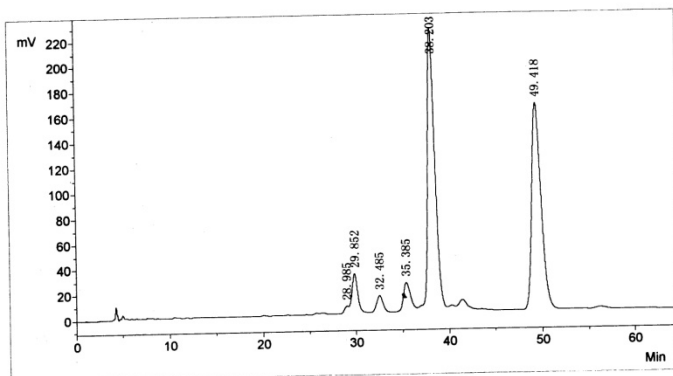
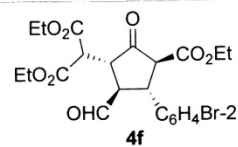
Data File:MAQ-AM8-41-3+-.che

Sample Name:

Date:2009-05-15

Time:14:18

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		28.985	5908.7	175731.4	0.6721
2	2		29.852	31284.6	1357337.4	5.1912
3	3		32.485	13051.6	620575.0	2.3734
4	4		35.385	21516.7	1035576.9	3.9606
5	5		38.203	219388.7	11517194.3	44.0478
6	6		49.418	162855.8	11440629.3	43.7550
Total				454006.1	26147044.3	100.0000

HPLC REPORT

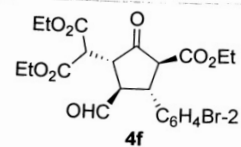
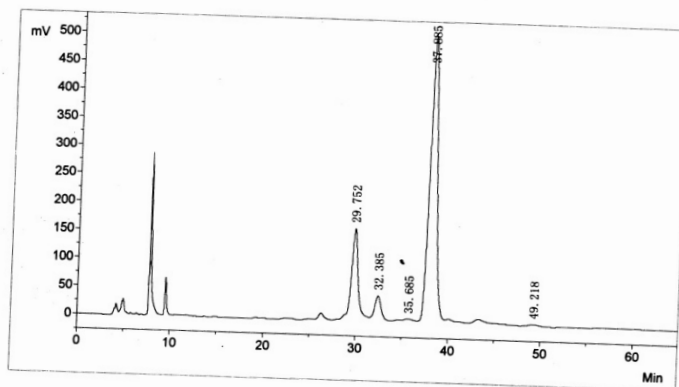
Data File: MAQ-AM8-57-3.che

Sample Name:

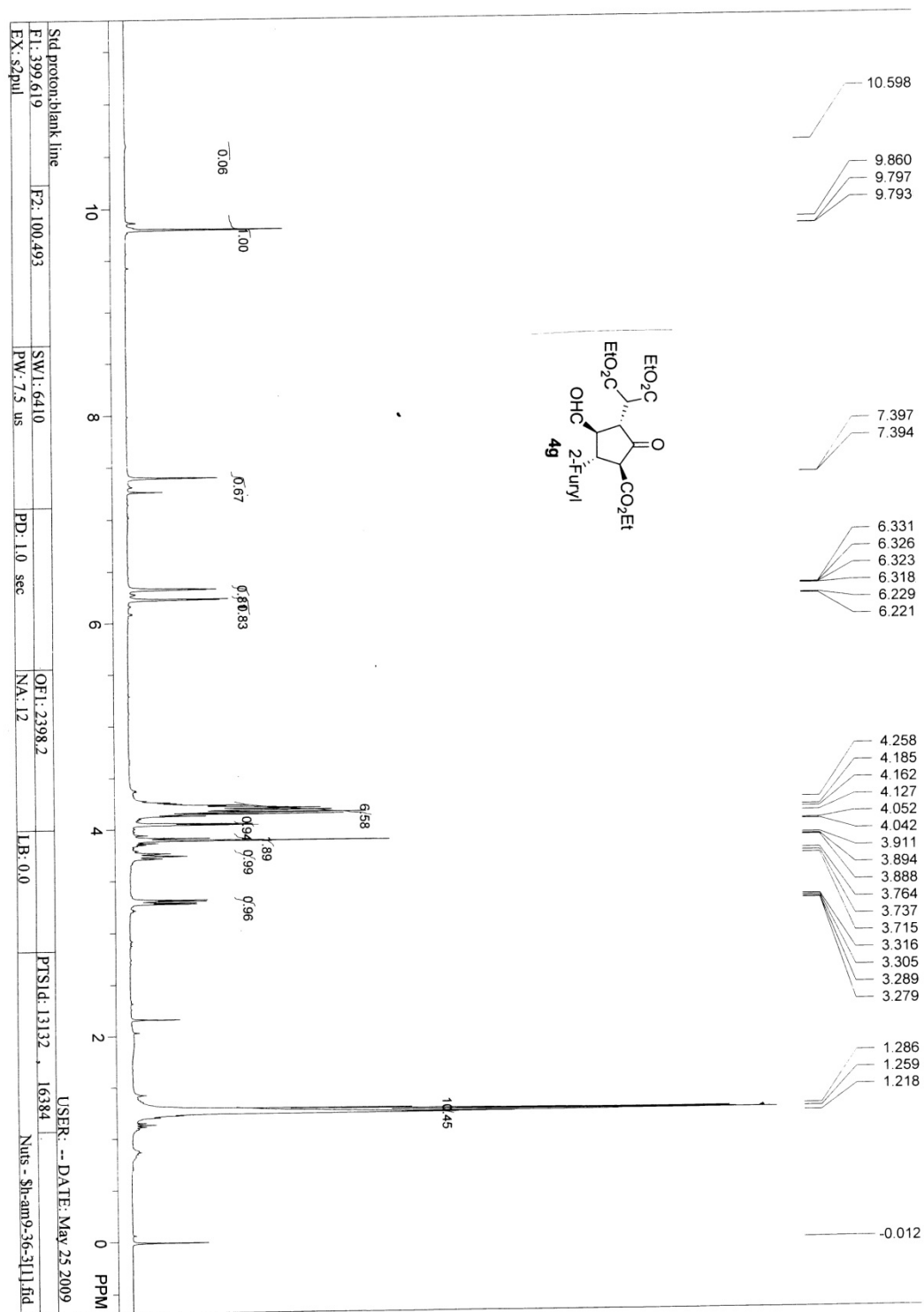
Date: 2009-05-15

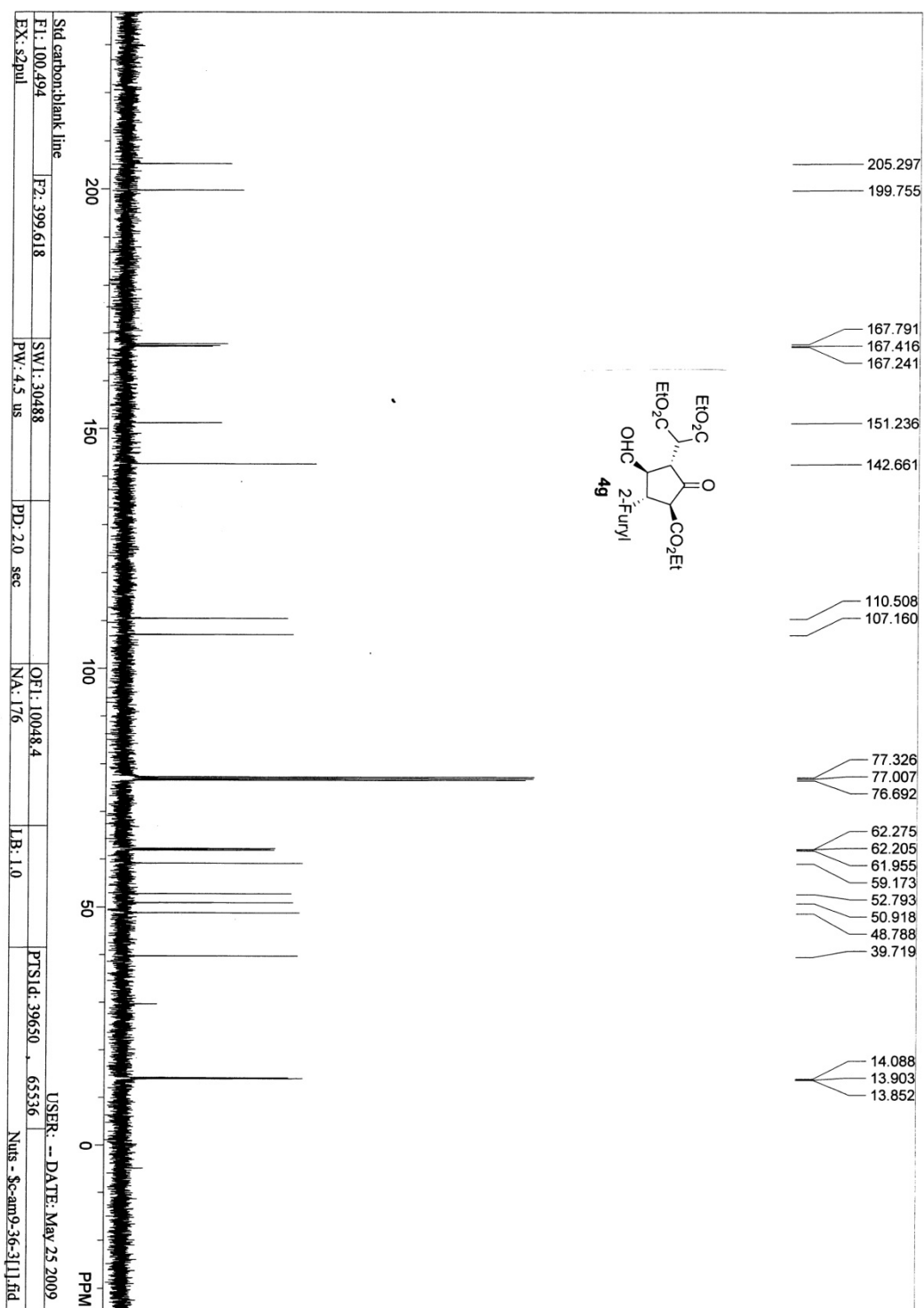
Time: 15:27

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		29.752	158044.3	7557414.5	20.2026
2	2		32.385	42174.4	2059222.3	5.5047
3	3		35.685	2576.7	132020.0	0.3529
4	4		37.885	501466.4	27438831.4	73.3499
5	5		49.218	3082.4	220625.7	0.5898
Total				707344.2	37408113.8	100.0000





HPLC REPORT

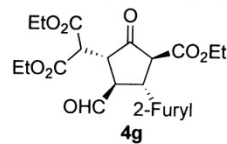
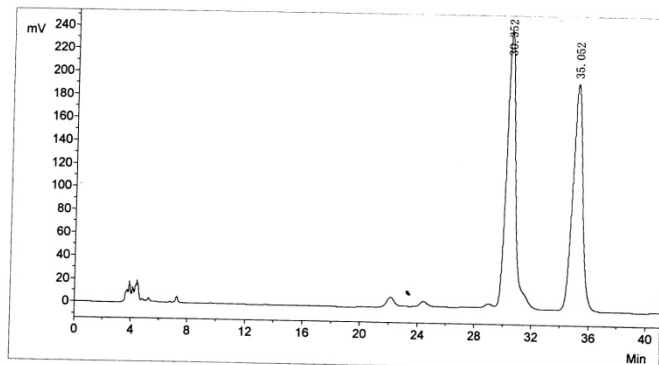
Data File:AM8-44-3RP+-.che

Sample name:

Date:2009-04-07

Time :09:55

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		30.352	239632.7	10465096.6	52.5700
2	2		35.052	196153.9	9441877.4	47.4300
Total				435786.6	19906974.1	100.0000

HPLC REPORT

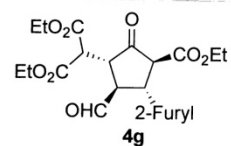
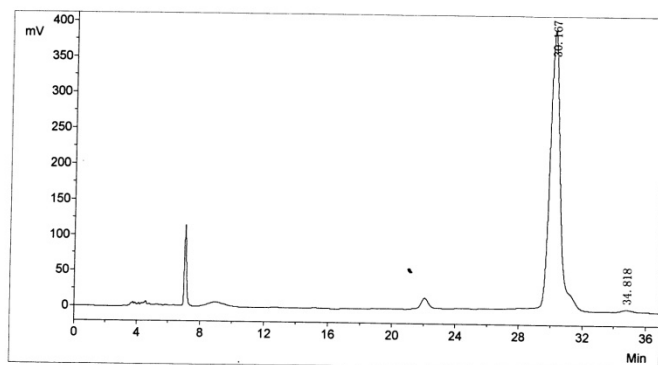
Data File: AM8-67-3RP.che

Sample name:

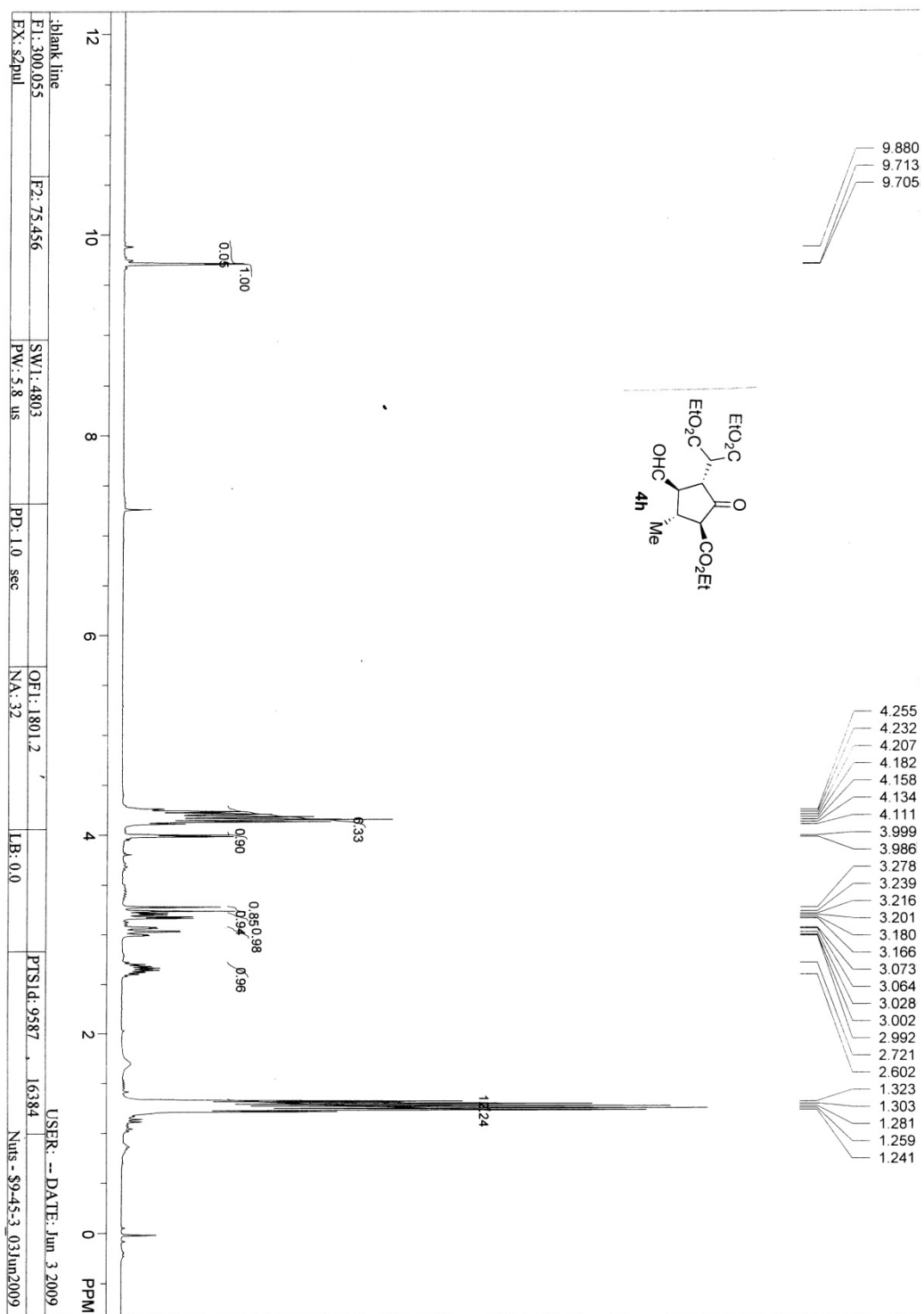
Date: 2009-04-07

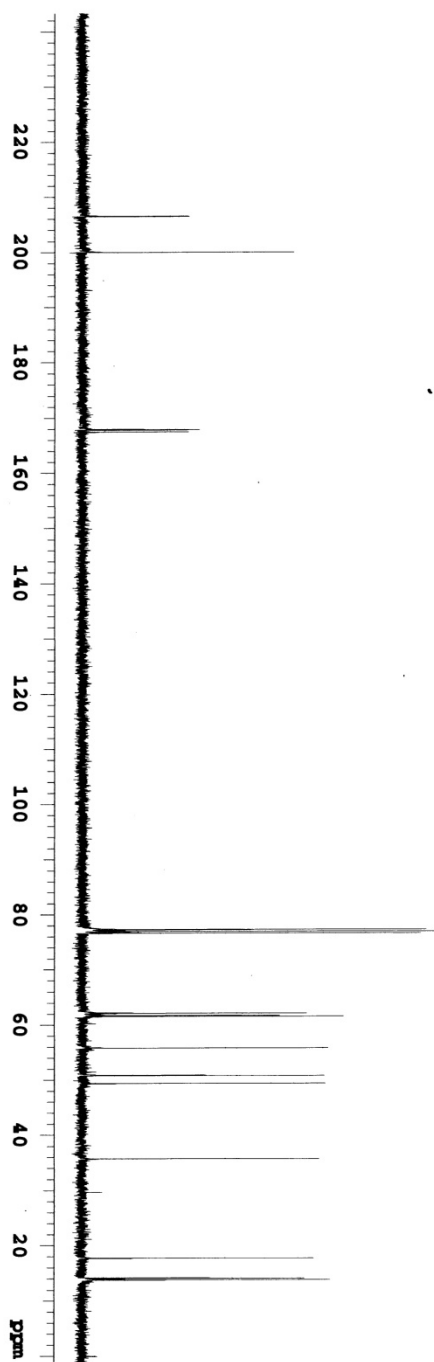
Time : 10:39

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		30.167	367889.1	15220207.7	99.0339
2	2		34.818	3009.1	148474.4	0.9661
Total				370898.2	15368682.1	100.0000





206.440
199.911

167.887
167.787
167.408

77.270
76.950
76.635
62.114
62.084
61.680
61.500
55.801
50.830
49.357
35.665

17.707
14.106
13.846
13.796

4078-22-1415

HPLC REPORT

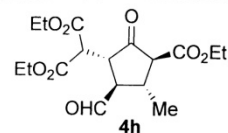
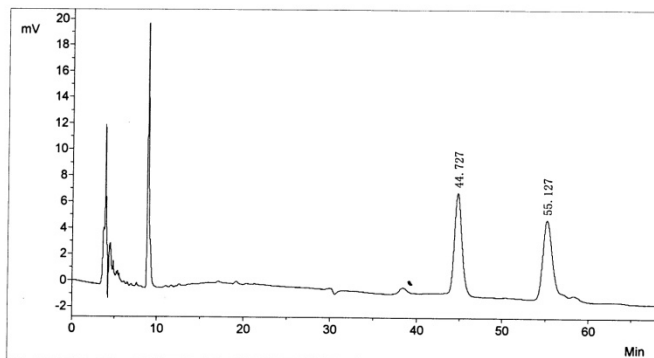
Data File:MAQ-AM-8-40-4+-.che

Sample name:

Date:2009-04-20

Time :14:30

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		44.727	7716.4	464038.1	50.3103
2	2		55.127	5969.6	458314.3	49.6897
Total				13686.0	922352.4	100.0000

HPLC REPORT

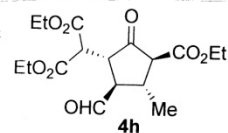
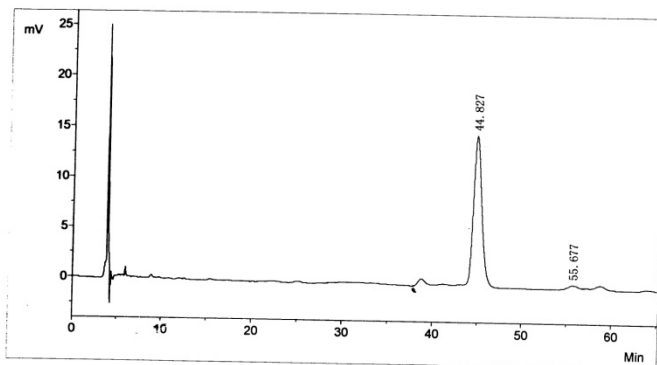
Data File:MAQ-AM-8-92-3. che

Sample name:

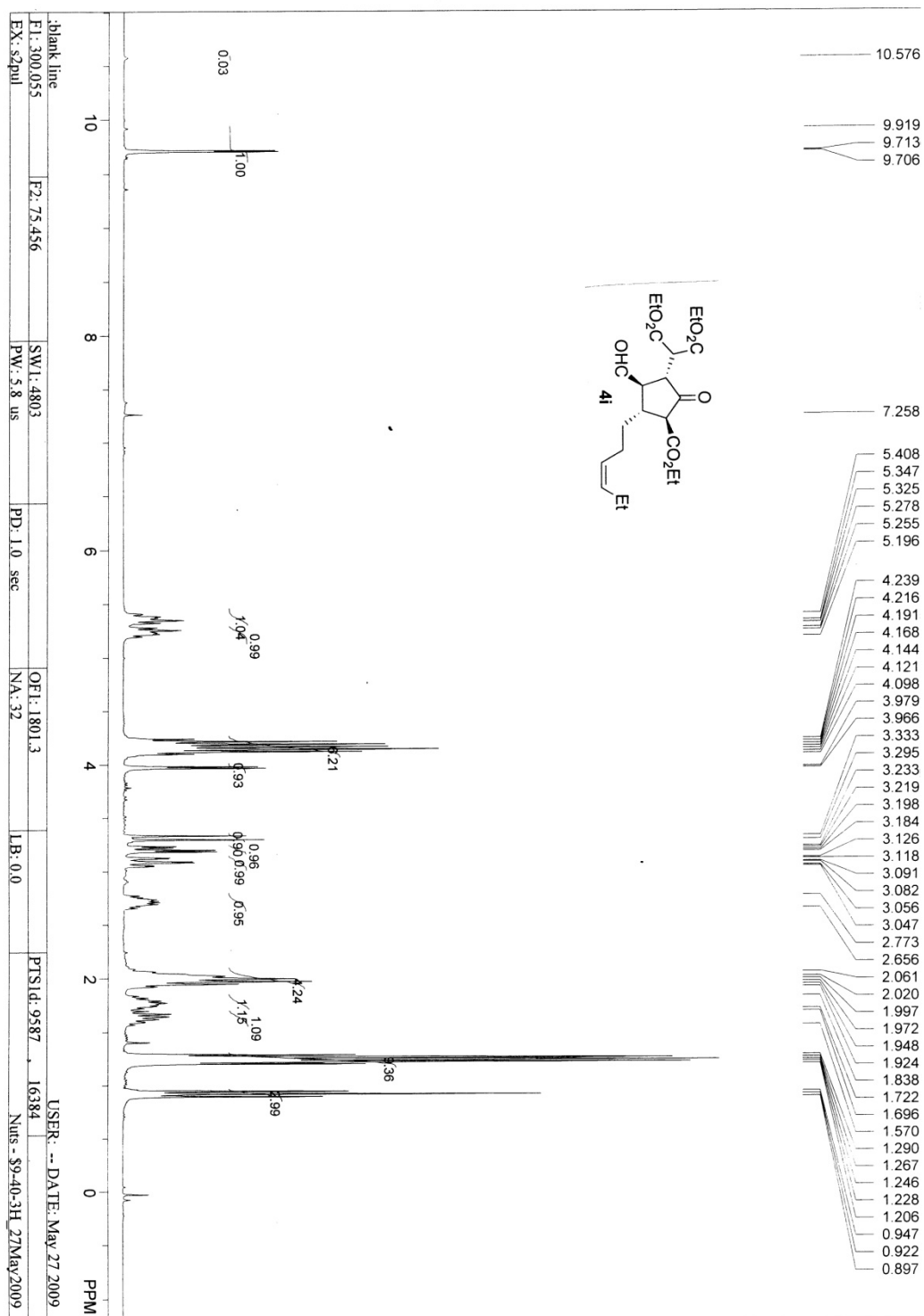
Date:2009-04-20

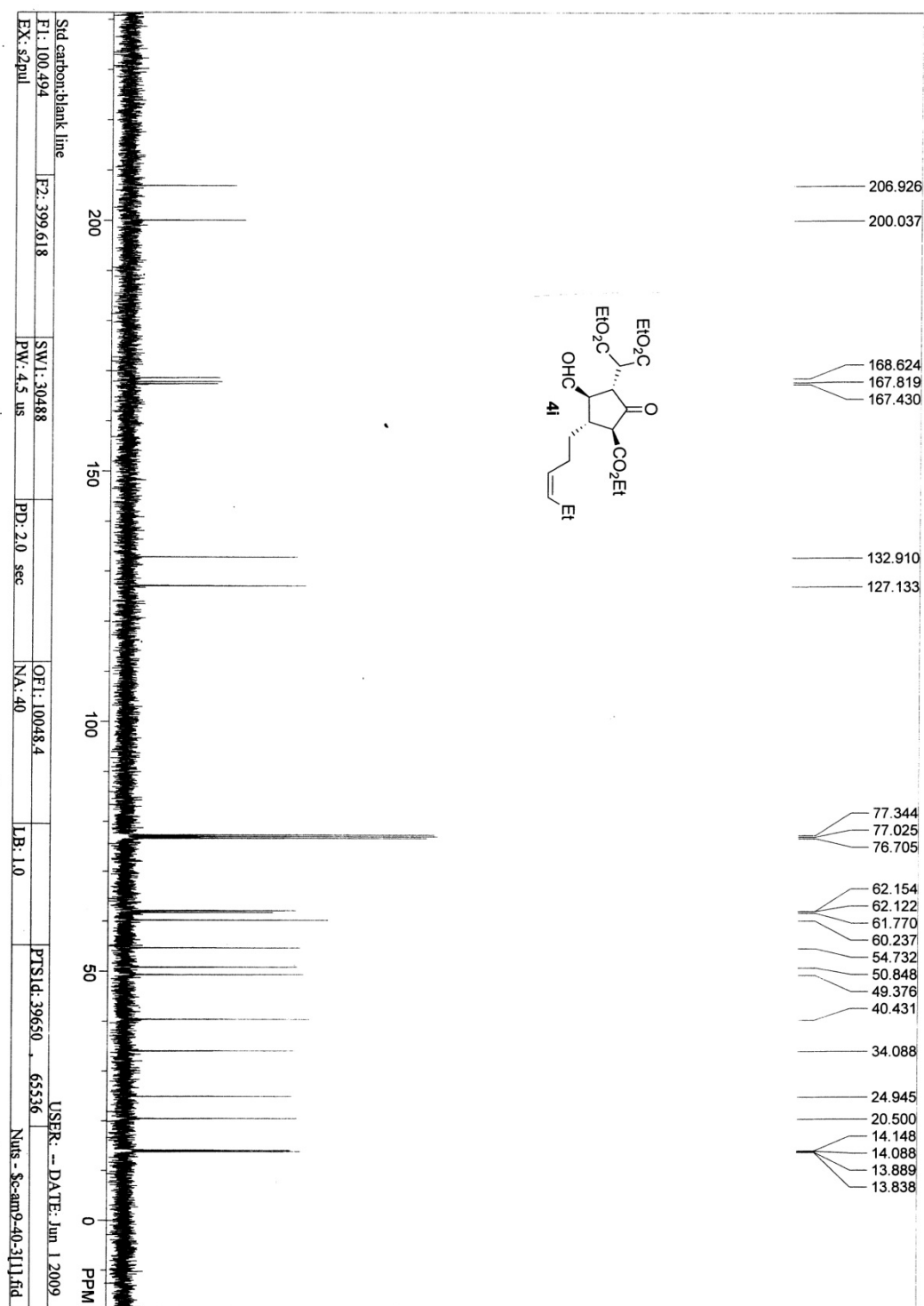
Time :15:39

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		44.827	14830.6	944386.1	97.5704
2	2		55.677	342.1	23515.7	2.4296
Total				15172.7	967901.9	100.0000





HPLC REPORT

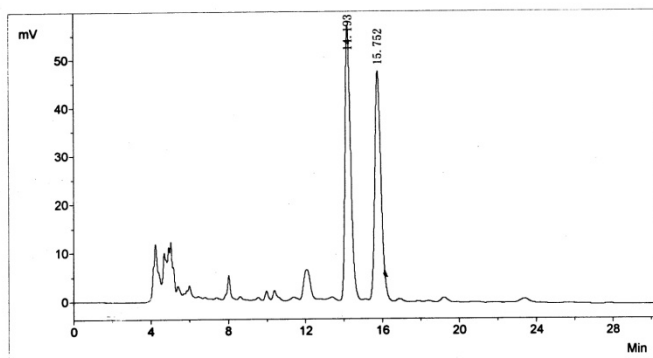
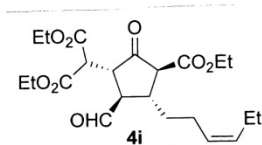
Data File: MAQ-AM8-46-3+-.che

Sample Name:

Date: 2009-04-29

Time: 09:02

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		14.193	56840.5	1115812.8	51.2552
2	2		15.752	47440.9	1061161.6	48.7448
Total				104281.4	2176974.4	100.0000

HPLC REPORT

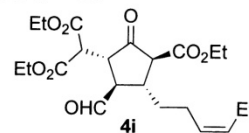
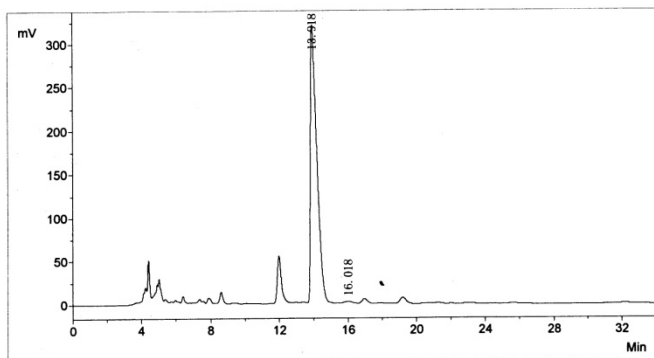
Data File: MAQ-AM9-11-3. che

Sample Name:

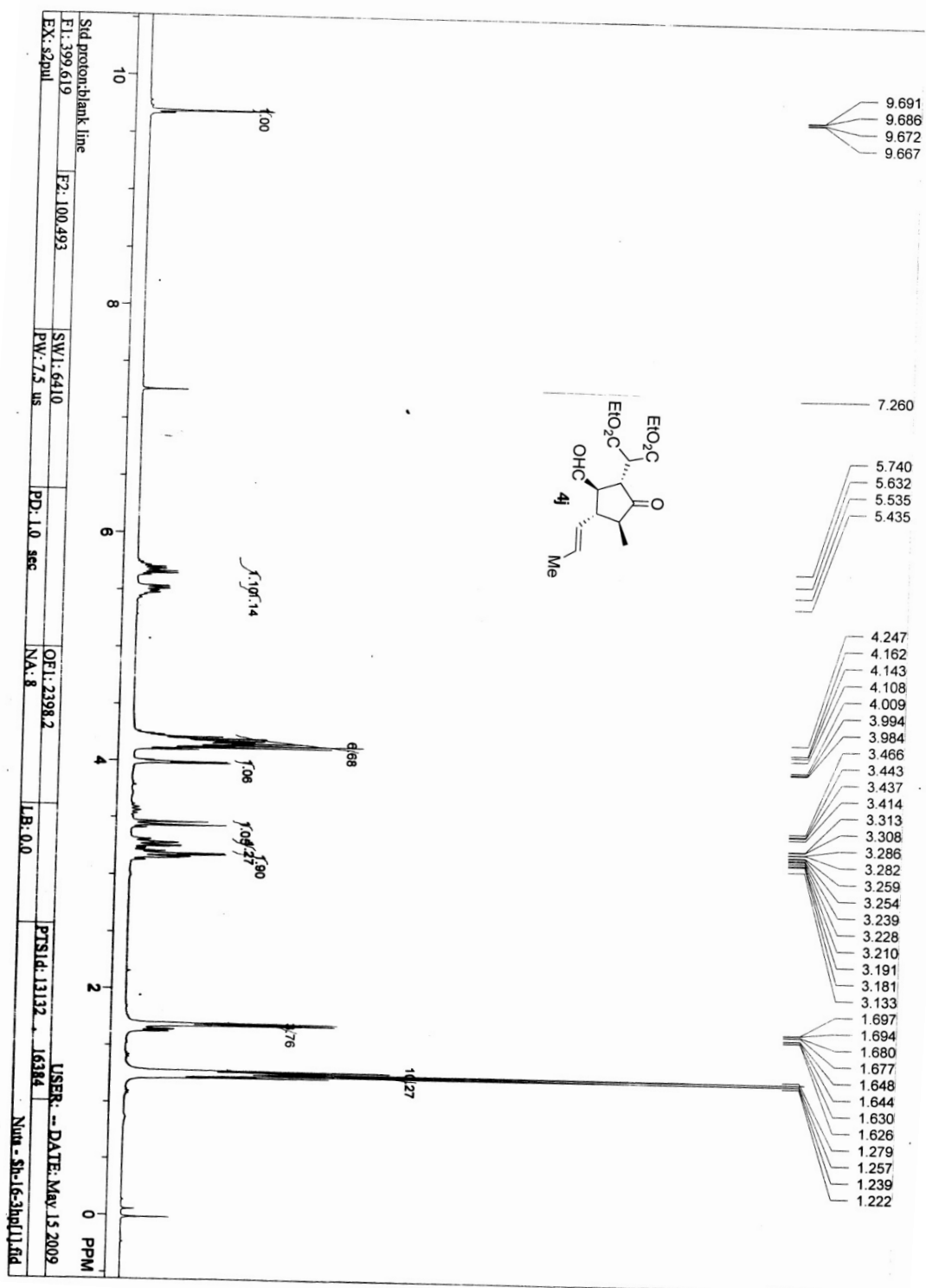
Date: 2009-04-29

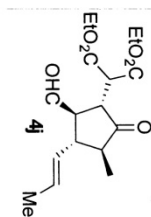
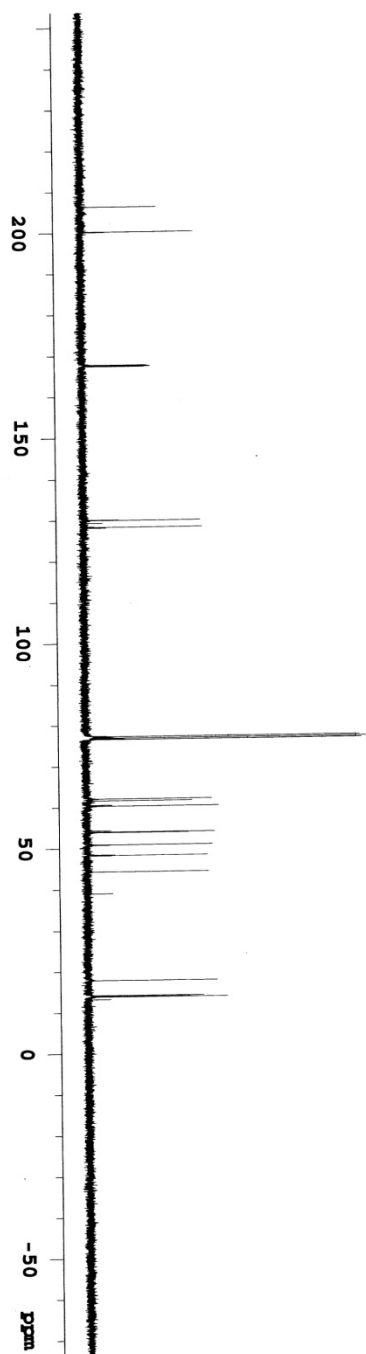
Time: 09:35

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		13.918	319329.5	8239216.2	99.1930
2	2		16.018	2285.4	67032.7	0.8070
Total				321614.9	8306248.8	100.0000





206.300
200.161

167.772
167.598
167.468

129.954
128.266

77.285
76.965
76.645
62.099
62.059
61.615
60.321
53.927
50.835
48.358
44.327

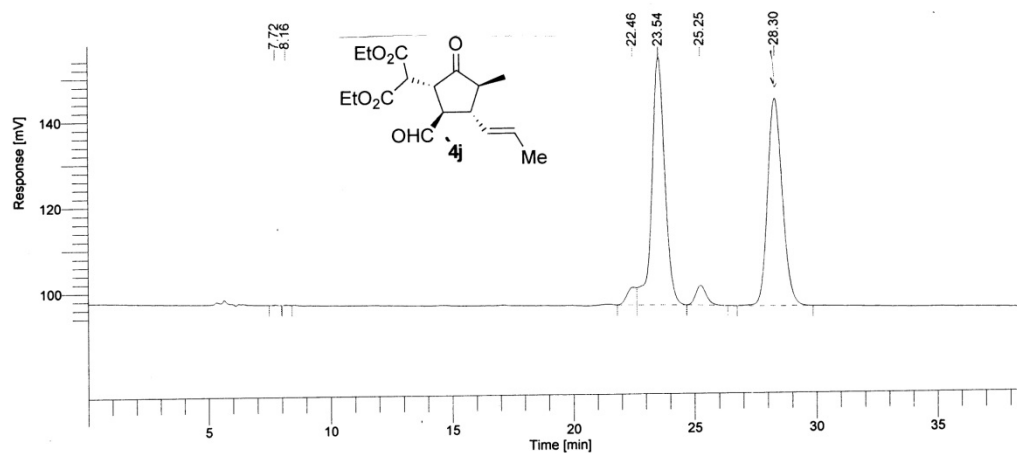
17.792
14.106
13.851
13.796

177.772
167.598
167.468

Software Version : 6.3.1.0504
Sample Name : AM9-19-3+-
Instrument Name : NCI901
Rack/Vial : 0/0
Sample Amount : 1.000000
Cycle : 1

Date : 2009-5-4 10:52:13
Data Acquisition Time : 2009-5-4 10:12:17
Channel : A
Operator : manager
Dilution Factor : 1.000000

Result File :
Sequence File : D:\200090504-.seq



HPLC REPORT

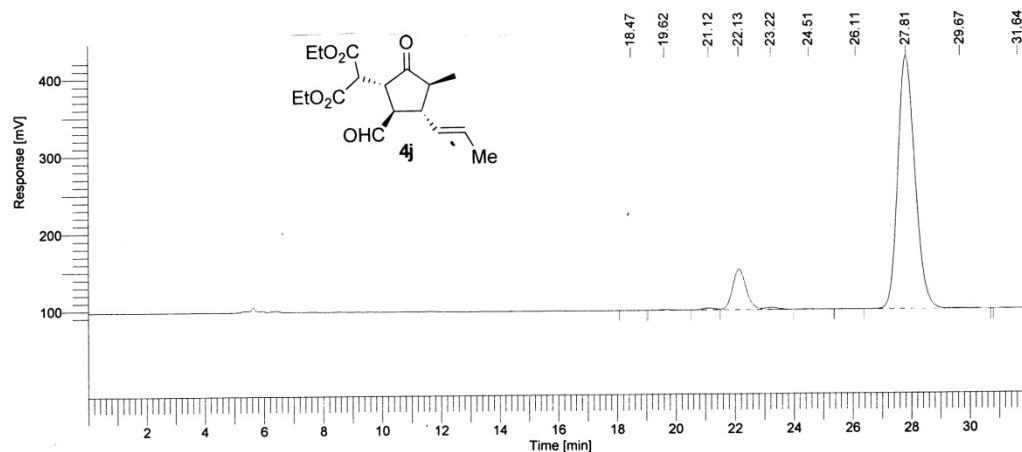
Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL
1		7.723	1140.65	95.11	0.026	BB
2		8.164	1203.95	109.67	0.027	BB
3		22.461	111166.02	4192.05	2.503	BV
4		23.536	2143793.07	57956.47	48.265	VB
5		25.246	140439.37	4656.98	3.162	BB
6		28.300	2043975.36	48552.60	46.018	BB

4441718.43 115562.89

Software Version : 6.3.1.0504
 Sample Name : AM9-19-6
 Instrument Name : NCI901
 Rack/Vial : 0/0
 Sample Amount : 1.000000
 Cycle : 1

Date : 2009-5-4 14:00:29
 Data Acquisition Time : 2009-5-4 13:26:57
 Channel : A
 Operator : manager
 Dilution Factor : 1.000000

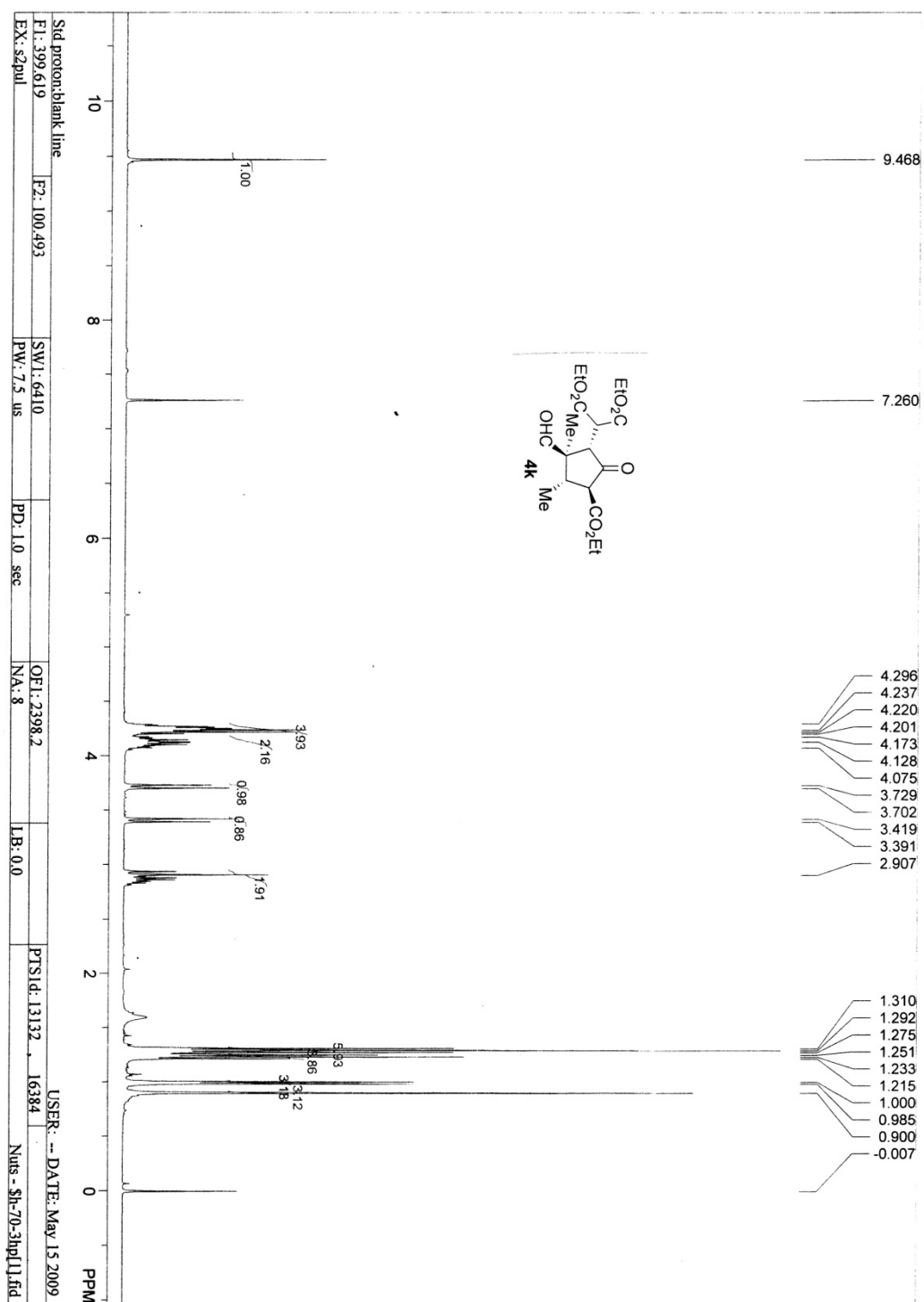
Result File :
 Sequence File : D:\200090504-.seq

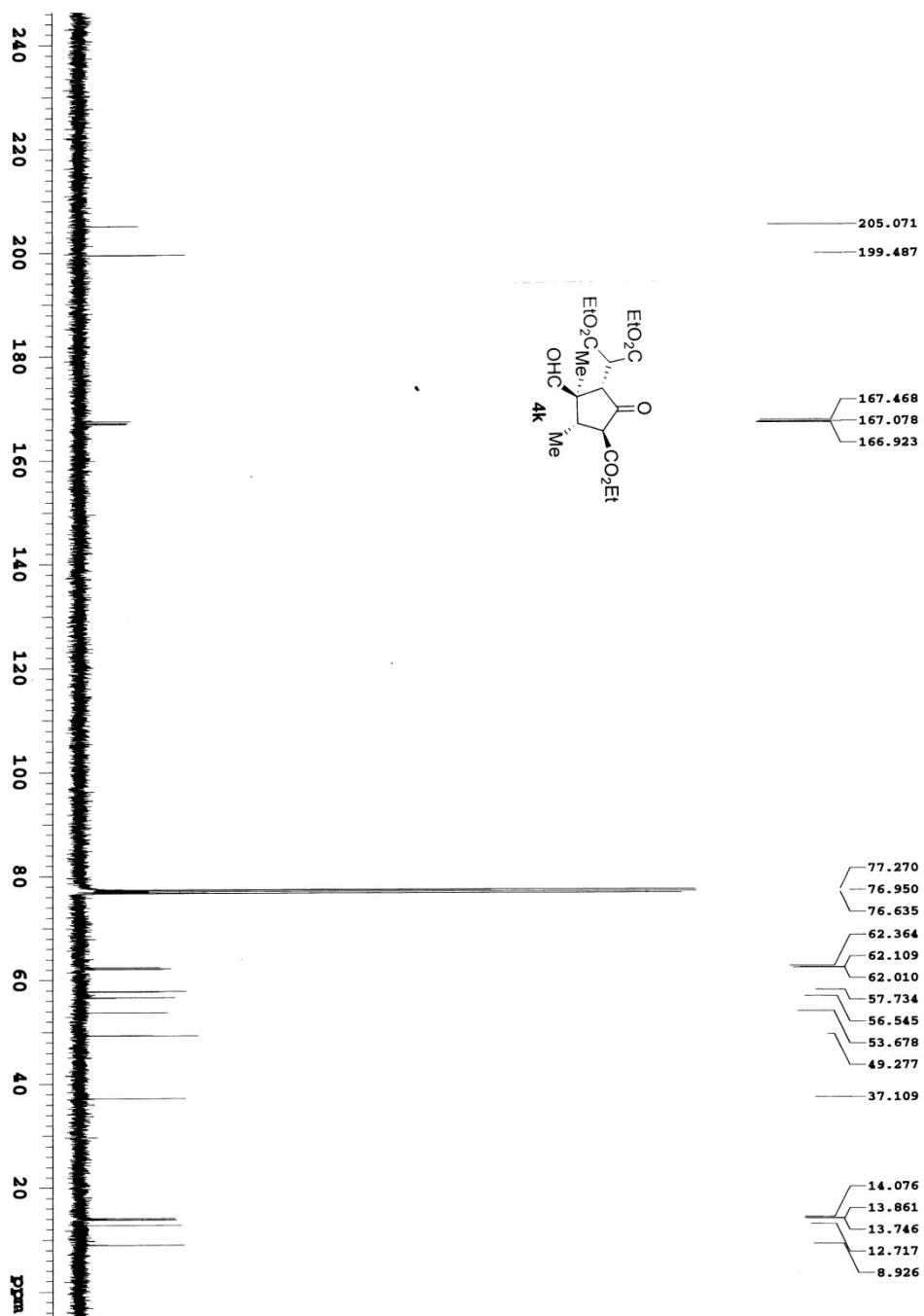


HPLC REPORT

Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL
1		18.474	2444.86	88.67	0.016	BB
2		19.623	22449.97	718.83	0.146	BB
3		21.123	70629.59	2411.21	0.459	BV
4		22.133	1708475.44	53069.36	11.112	VE
5		23.224	84027.71	2664.17	0.547	EV
6		24.510	14059.68	348.44	0.091	VB
7		26.108	6454.15	181.44	0.042	BV
8		27.815	1.34e+07	327337.56	87.430	VE
9		29.668	16425.55	425.85	0.107	EB
10		31.636	7626.71	182.07	0.050	BB

1.54e+07 387427.60 1e+02





AK 10-03
200

HPLC REPORT

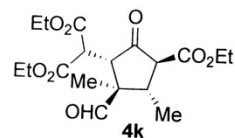
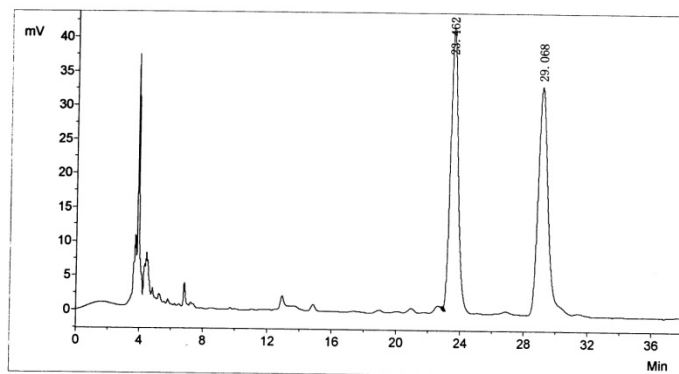
Data File: AM8-61-3RP+-.che

Sample name:

Date: 2009-04-14

Time : 08:23

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		23.462	41134.8	1362675.1	50.5591
2	2		29.068	32889.9	1332538.3	49.4409
Total				74024.7	2695213.4	100.0000

HPLC REPORT

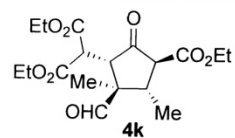
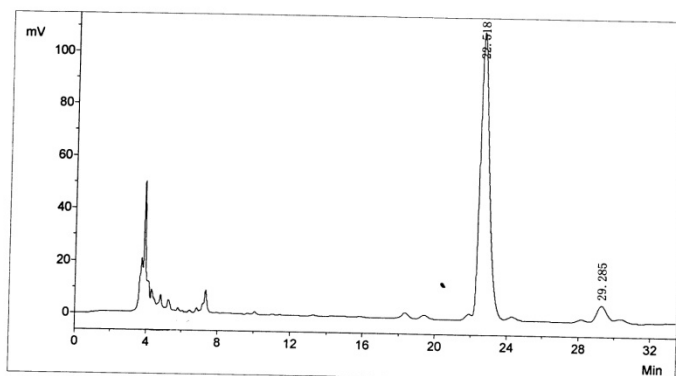
Data File: AM8-70-3RP.che

Sample name:

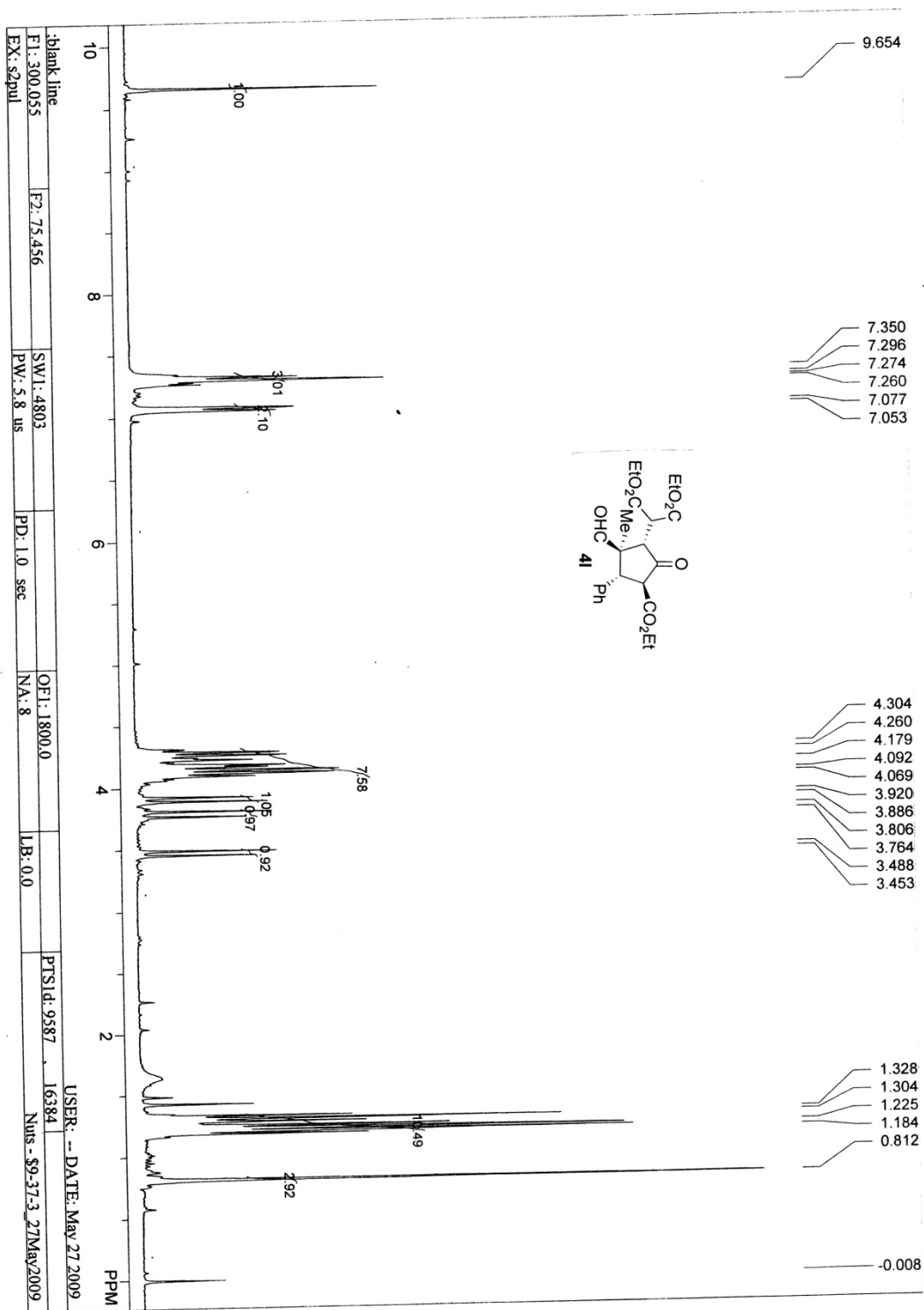
Date: 2009-04-14

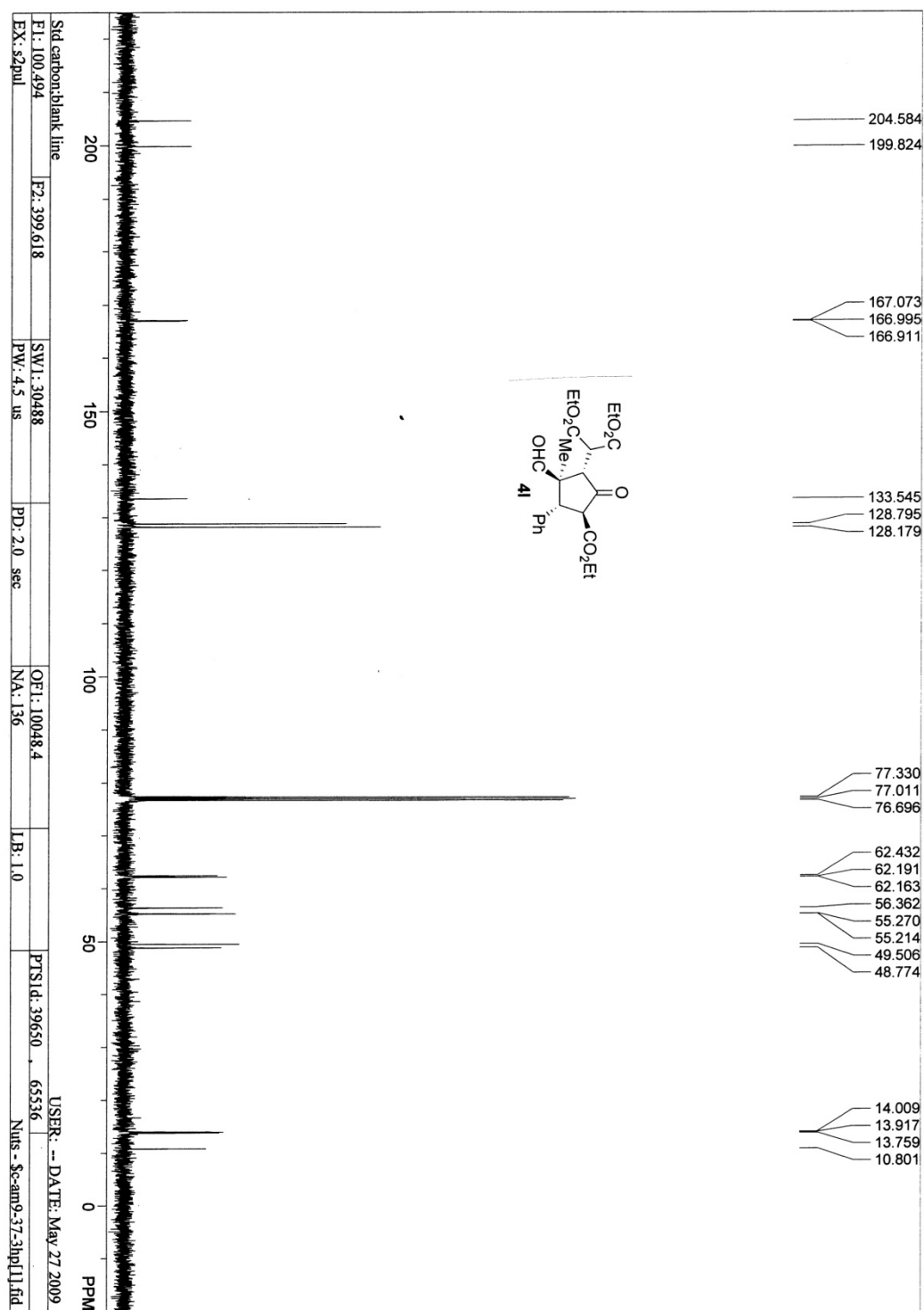
Time : 09:07

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		22.518	108349.9	3776156.7	94.8505
2	2		29.285	5858.5	205009.4	5.1495
Total				114208.4	3981166.1	100.0000





HPLC REPORT

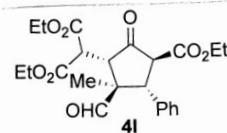
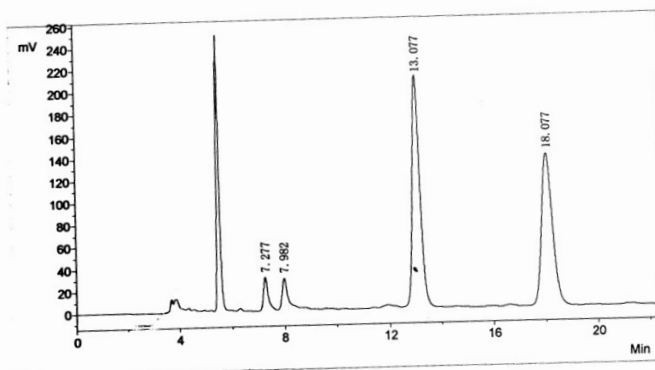
Data File:MAQ-AM-8-60-3+-...che

Sample name:

Date:2009-03-30

Time :16:53

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		7.277	29886.6	371107.8	4.1081
2	2		7.982	27877.7	396379.6	4.3878
3	3		13.077	207544.5	4253955.6	47.0901
4	4		18.077	137109.4	4012217.6	44.4141
Total				402418.2	9033660.5	100.0000

HPLC REPORT

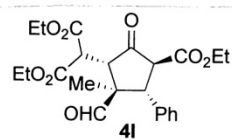
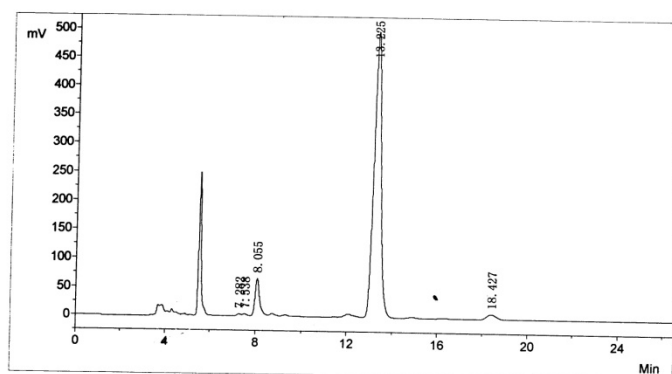
Data File:MAQ-AM-8-65-3. che

Sample name:

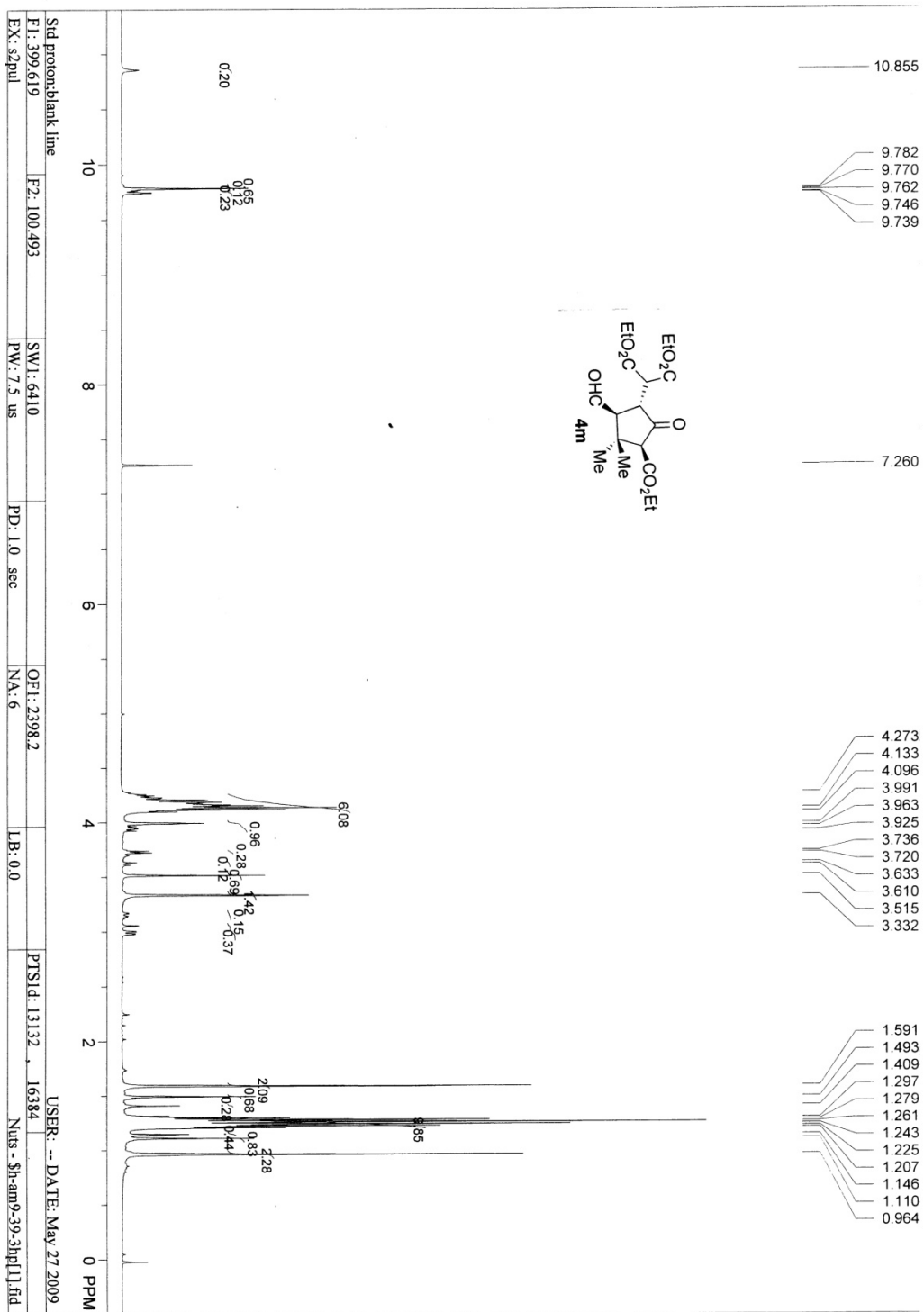
Date:2009-03-30

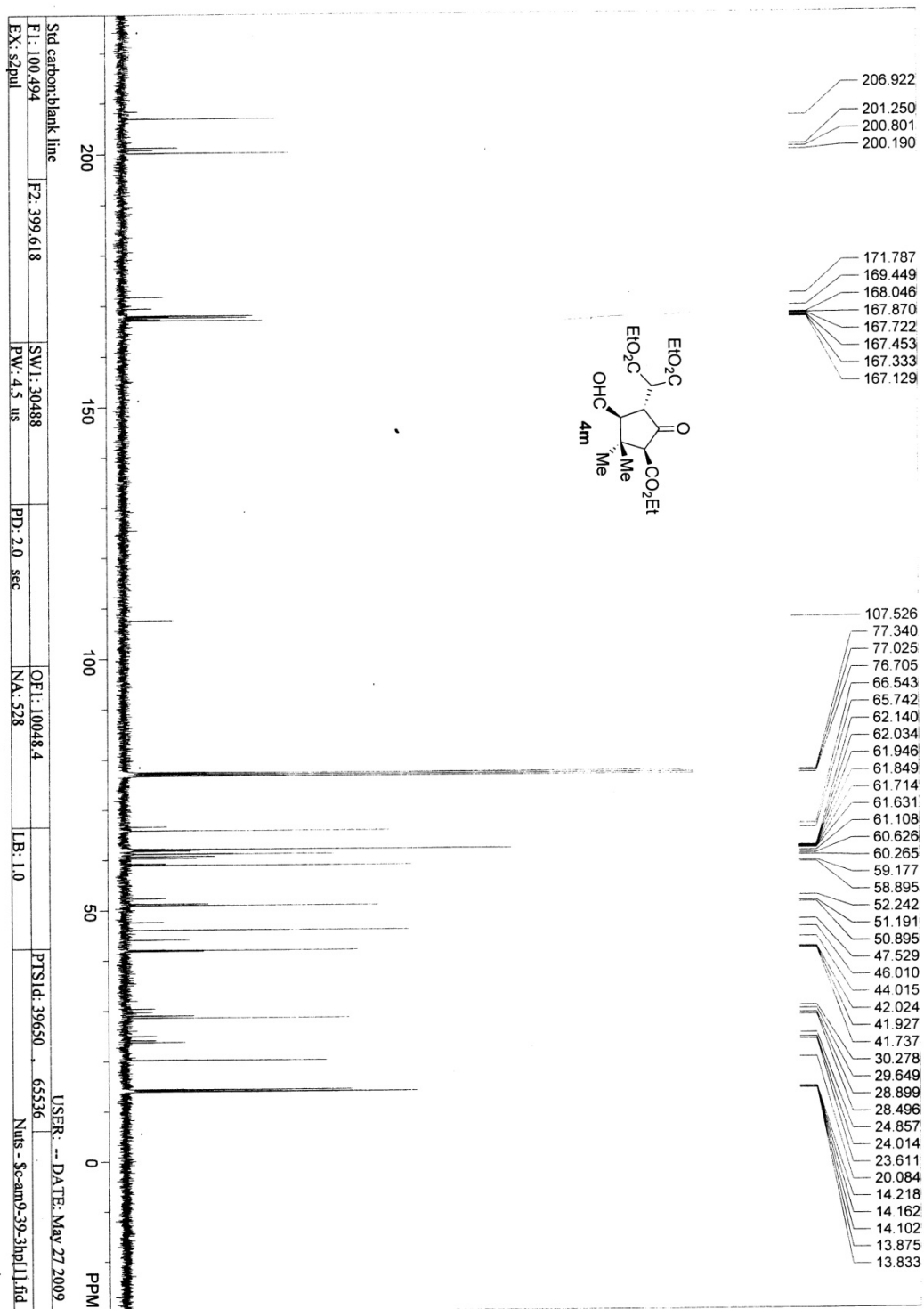
Time :21:45

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		7.282	3388.0	38714.5	0.3191
2	2		7.538	3043.8	35115.0	0.2894
3	3		8.055	64095.1	862552.2	7.1096
4	4		13.225	497087.6	10907629.8	89.9059
5	5		18.427	9409.7	288255.6	2.3759
Total				577024.2	12132267.1	100.0000

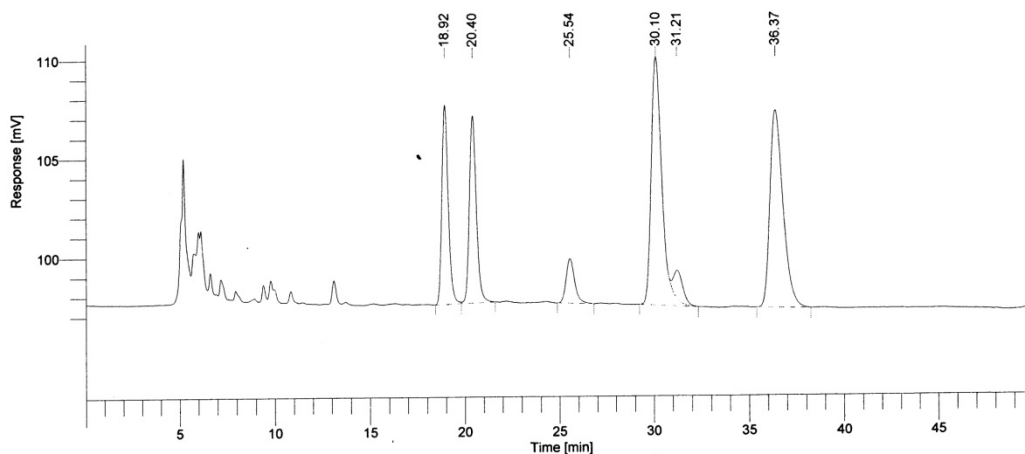




Software Version : 6.3.1.0504
 Sample Name : AM8-68-3RP+-
 Instrument Name : NCI901
 Rack/Vial : 0/0
 Sample Amount : 1.000000
 Cycle : 1

Date : 2009-5-19 13:26:06
 Data Acquisition Time : 2009-5-19 12:34:04
 Channel : A
 Operator : manager
 Dilution Factor : 1.000000

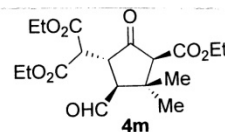
Result File :
 Sequence File : D:\200905019-.seq



HPLC REPORT

Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL
1		18.924	237075.80	10087.25	15.065	BV
2		20.398	242052.74	9463.96	15.381	VB
3		25.539	70404.53	2243.88	4.474	BB
4		30.097	495817.33	12561.31	31.507	BE
5		31.210	49123.17	1428.61	3.122	EB
6		36.367	479199.97	9993.14	30.451	BB

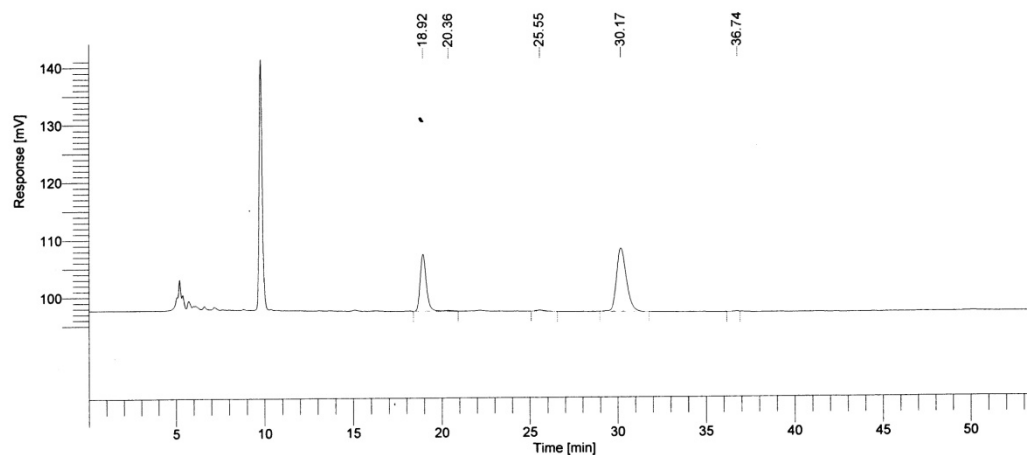
1573673.55 45778.14 1e+02



Software Version : 6.3.1.0504
 Sample Name : AM8-66-3
 Instrument Name : NCI901
 Rack/Vial : 0/0
 Sample Amount : 1.000000
 Cycle : 1

Date : 2009-5-19 19:28:03
 Data Acquisition Time : 2009-5-19 13:30:47
 Channel : A
 Operator : manager
 Dilution Factor : 1.000000

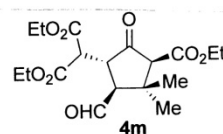
Result File :
 Sequence File : D:\200905019-.seq

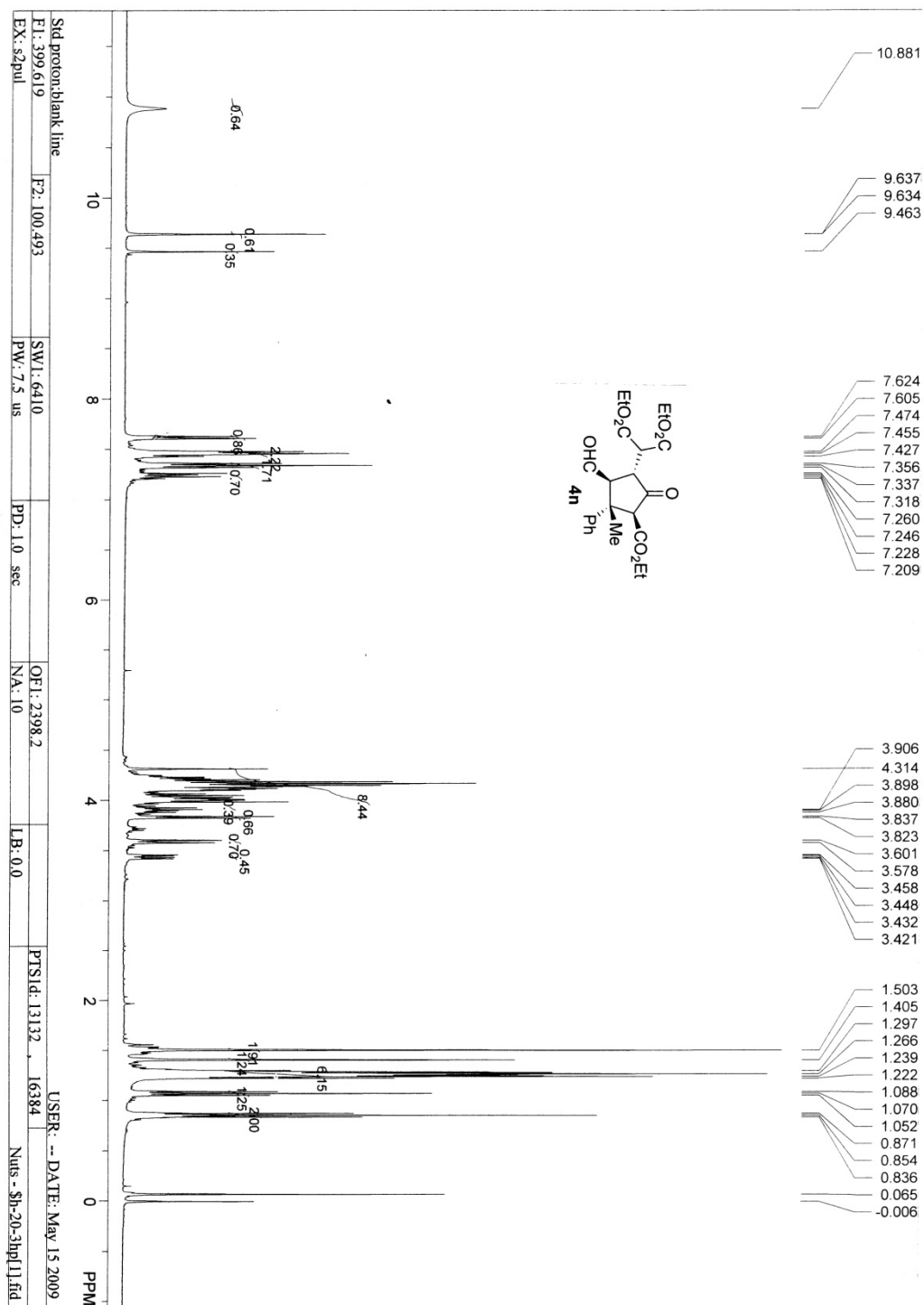


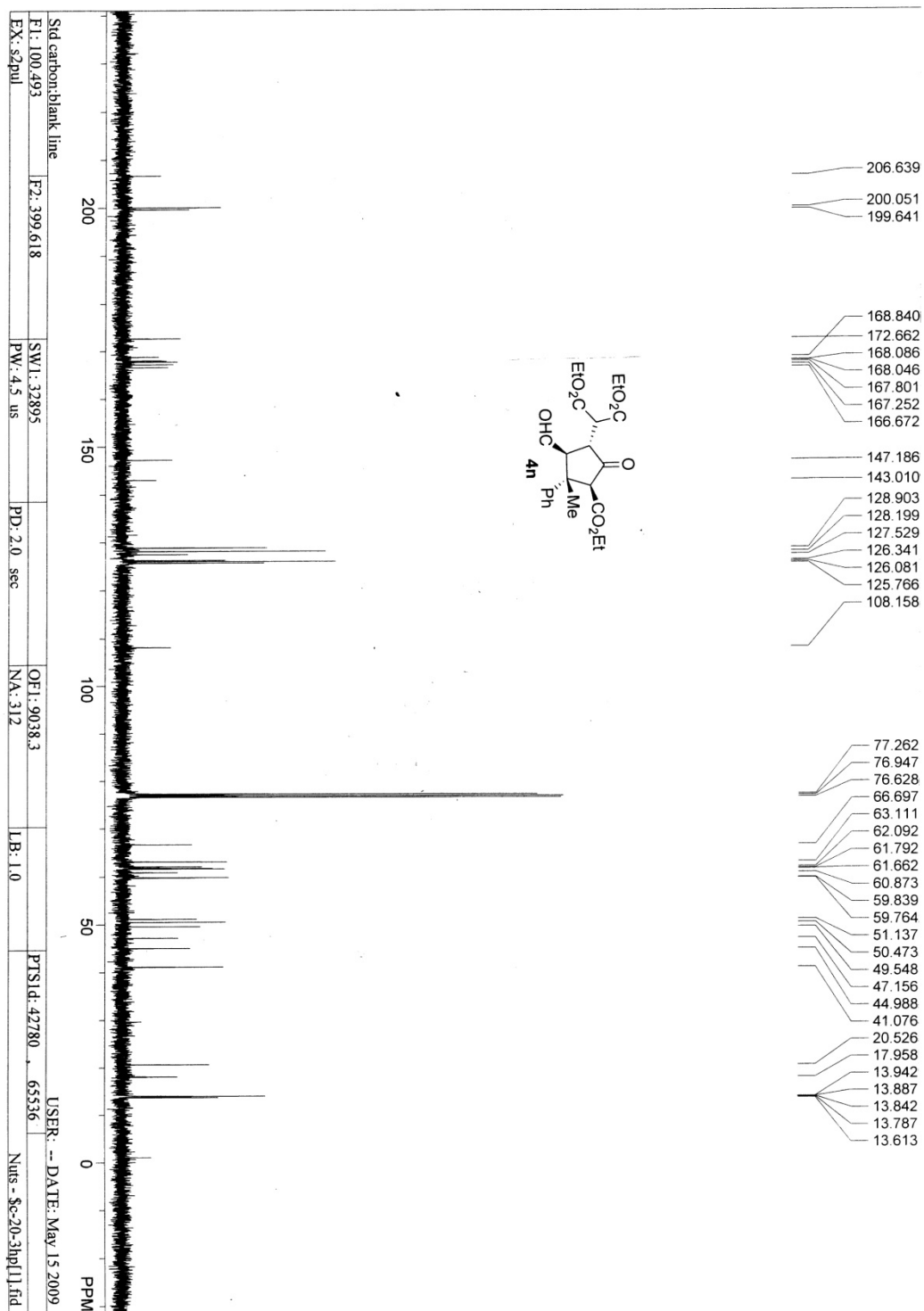
HPLC REPORT

Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL
1		18.920	236793.83	9947.20	34.686	BE
2		20.363	4619.84	124.63	0.677	EB
3		25.546	6761.79	211.74	0.990	BB
4		30.174	433667.75	11104.07	63.524	BB
5		36.743	844.33	32.97	0.124	BB

682687.53 21420.61







HPLC REPORT

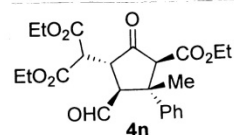
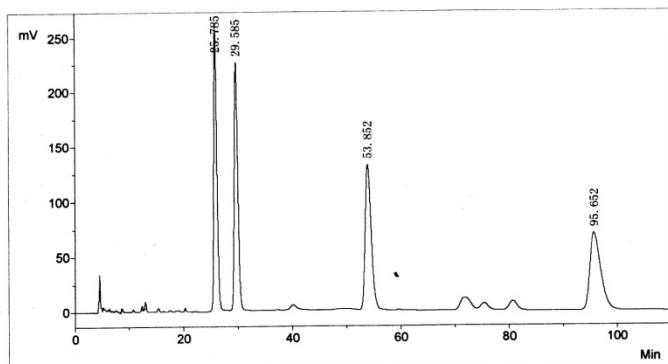
Data File:MAQ-AM9-12-3+-.che

Sample Name:

Date:2009-05-12

Time:13:32

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		25.785	258496.4	10208546.6	25.0568
2	2		29.585	225870.2	10227743.7	25.1040
3	3		53.852	131802.7	10335338.8	25.3680
4	4		95.652	70251.8	9969930.2	24.4712
Total				686421.2	40741559.3	100.0000

HPLC REPORT

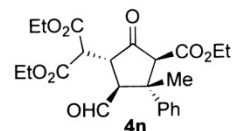
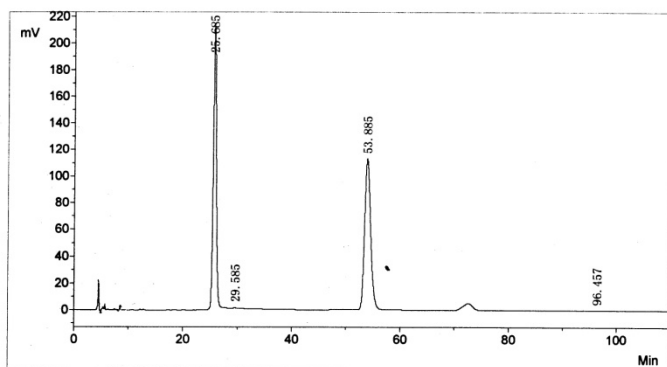
Data File: MAQ-AM9-20-3. che

Sample Name:

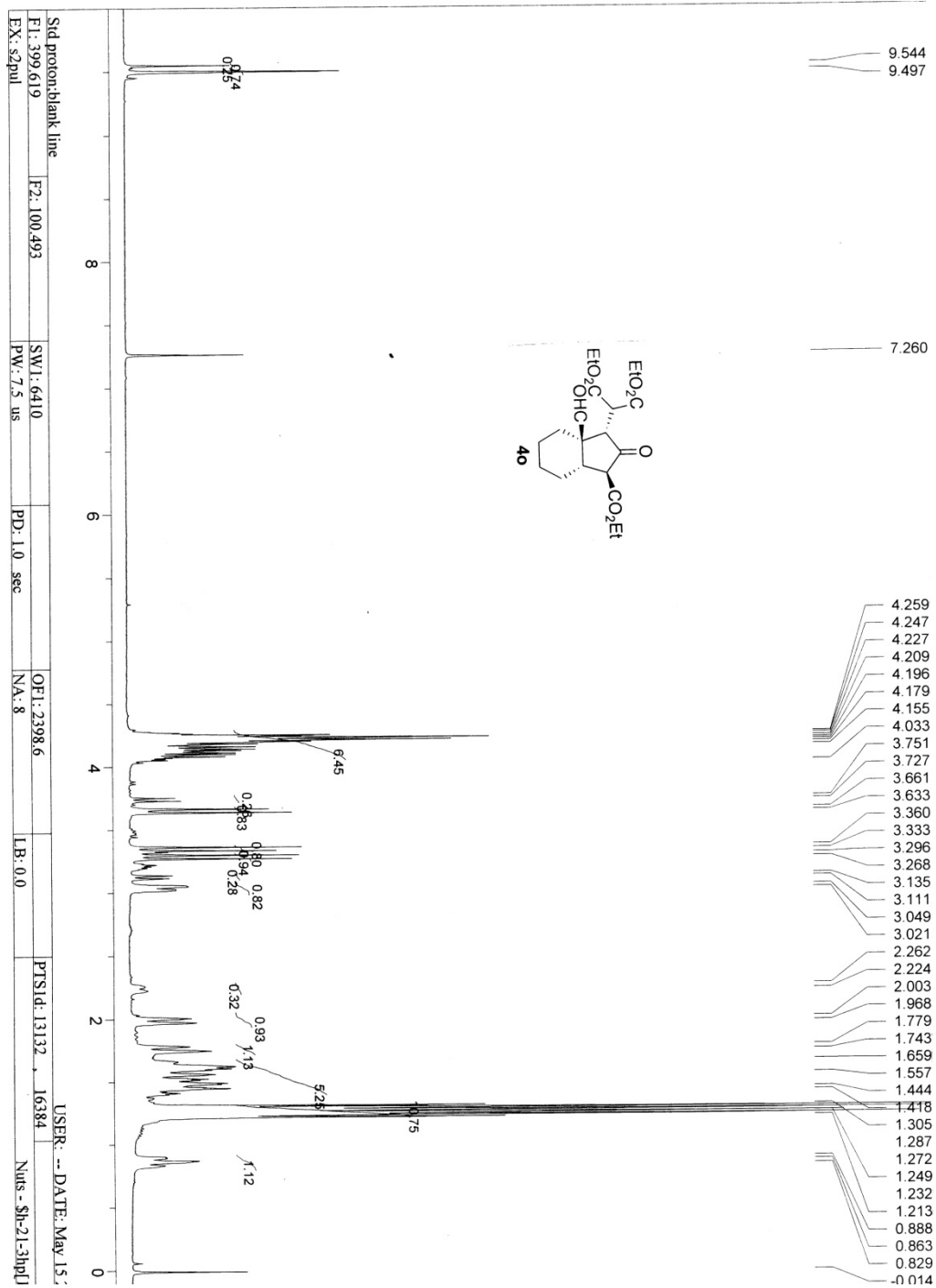
Date: 2009-05-12

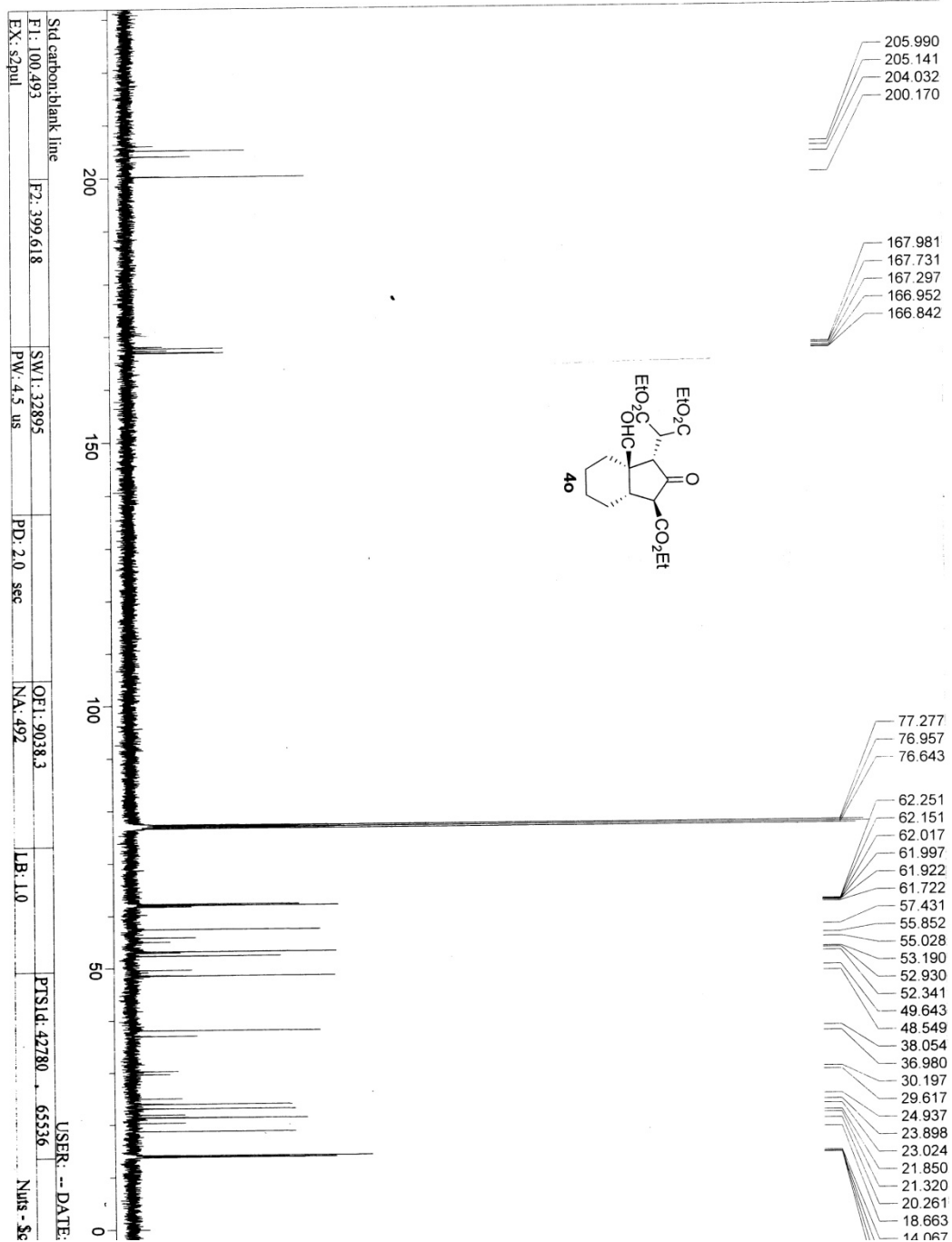
Time: 15:23

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		25.685	211852.2	8415871.1	48.8178
2	2		29.585	257.3	9906.6	0.0575
3	3		53.885	112928.0	8806896.5	51.0860
4	4		96.457	41.1	6671.8	0.0387
Total				325078.6	17239346.0	100.0000

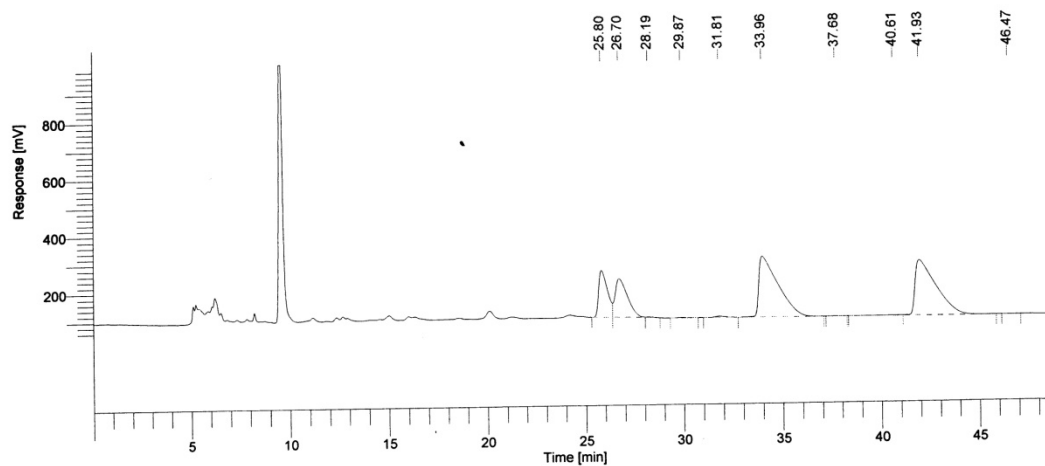




Software Version : 6.3.1.0504
 Sample Name : AM9-23-3+
 Instrument Name : NCI901
 Rack/Vial : 0/0
 Sample Amount : 1.000000
 Cycle : 1

Date : 2009-5-6 14:29:06
 Data Acquisition Time : 2009-5-6 13:22:07
 Channel : A
 Operator : manager
 Dilution Factor : 1.000000

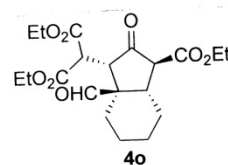
Result File :
 Sequence File : D:\20090506-.seq



HPLC REPORT

Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL
1		25.805	5123269.04	164513.80	12.756	BV
2		26.701	5846320.01	135057.46	14.557	VB
3		28.193	28535.96	907.51	0.071	BB
4		29.875	28659.58	864.23	0.071	BB
5		31.806	152424.51	4254.91	0.380	BV
6		33.964	1.45e+07	213353.51	35.992	VB
7		37.678	3440.44	101.27	0.009	BB
8		40.610	87288.51	1086.35	0.217	BV
9		41.926	1.44e+07	194177.11	35.939	VB
10		46.466	3210.99	99.18	0.008	BB

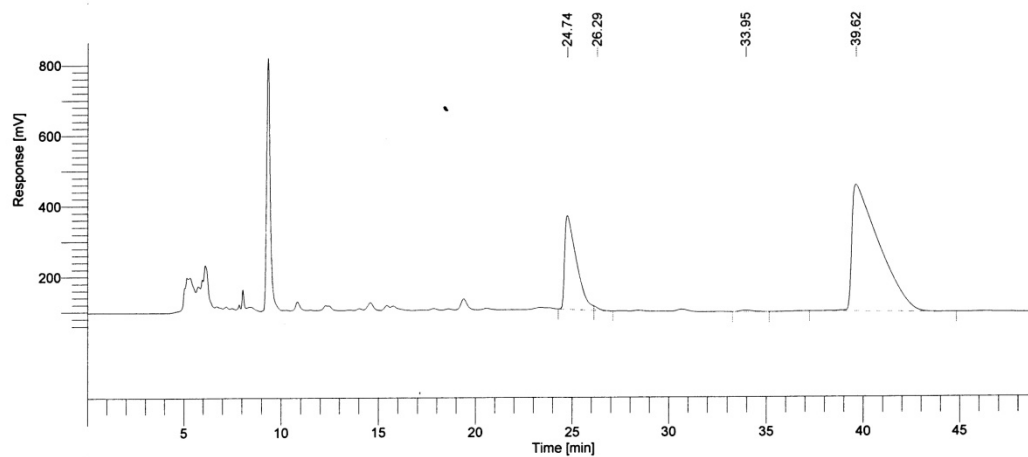
4.02e+07 714415.33 1e+02



Software Version : 6.3.1.0504
 Sample Name : AM9-21-3
 Instrument Name : NCI901
 Rack/Vial : 0/0
 Sample Amount : 1.000000
 Cycle : 1

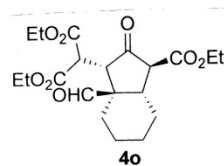
Date : 2009-5-6 15:44:08
 Data Acquisition Time : 2009-5-6 14:49:37
 Channel : A
 Operator : manager
 Dilution Factor : 1.000000

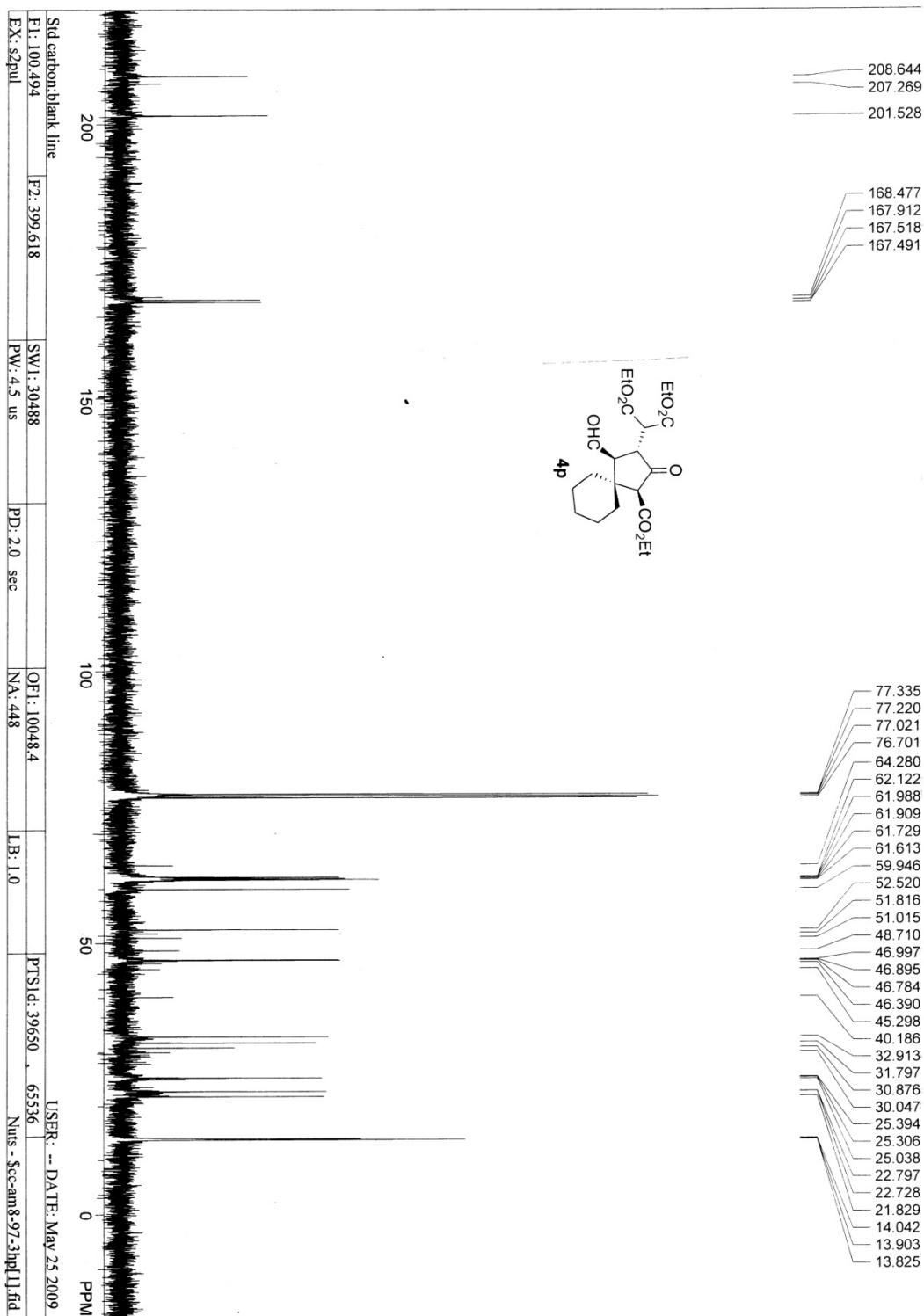
Result File :
 Sequence File : D:\20090506-.seq



HPLC REPORT

Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL
1		24.743	1.13e+07	265960.38	24.228	*BV
2		26.288	179473.47	7810.65	0.384	*VB
3		33.947	158615.36	4014.12	0.340	BB
4		39.616	3.51e+07	359314.89	75.048	*BB
			4.67e+07	637100.04	1e+02	





HPLC REPORT

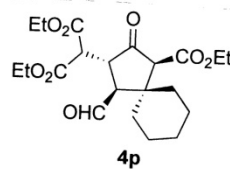
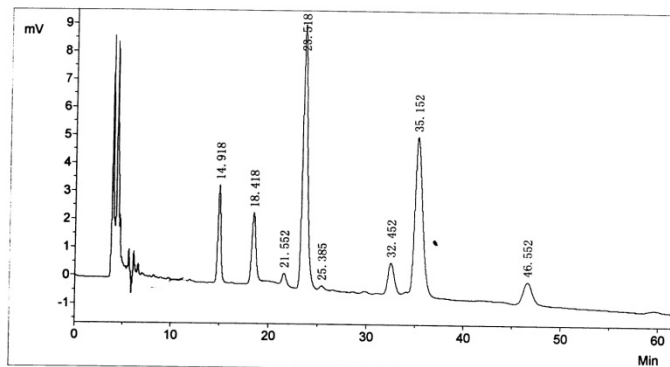
Data File: MAQ-AM-8-94-3+-. che

Sample name:

Date: 2009-04-28

Time : 08:24

Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		14.918	3456.1	72353.3	8.2675
2	2		18.418	2468.0	71002.5	8.1132
3	3		21.552	408.8	11659.1	1.3322
4	4		23.518	9352.8	321252.4	36.7083
5	5		25.385	129.5	3894.8	0.4450
6	6		32.452	1083.4	46768.1	5.3440
7	7		35.152	5558.1	299290.2	34.1987
8	8		46.552	769.0	48929.8	5.5910
Total				23225.7	875150.2	100.0000

HPLC REPORT

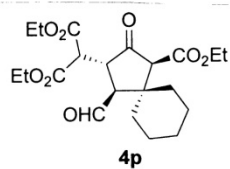
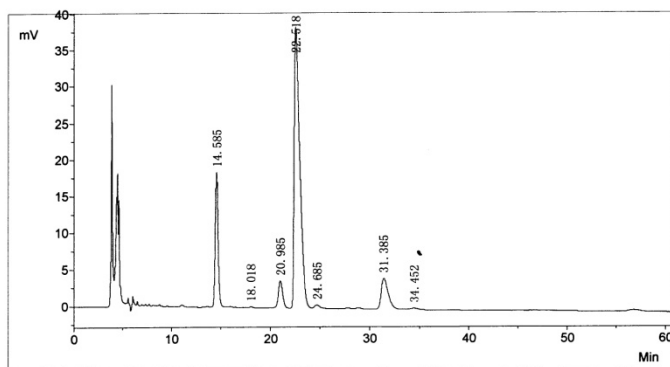
Data File:MAQ-AM-8-97-3. che

Sample name:

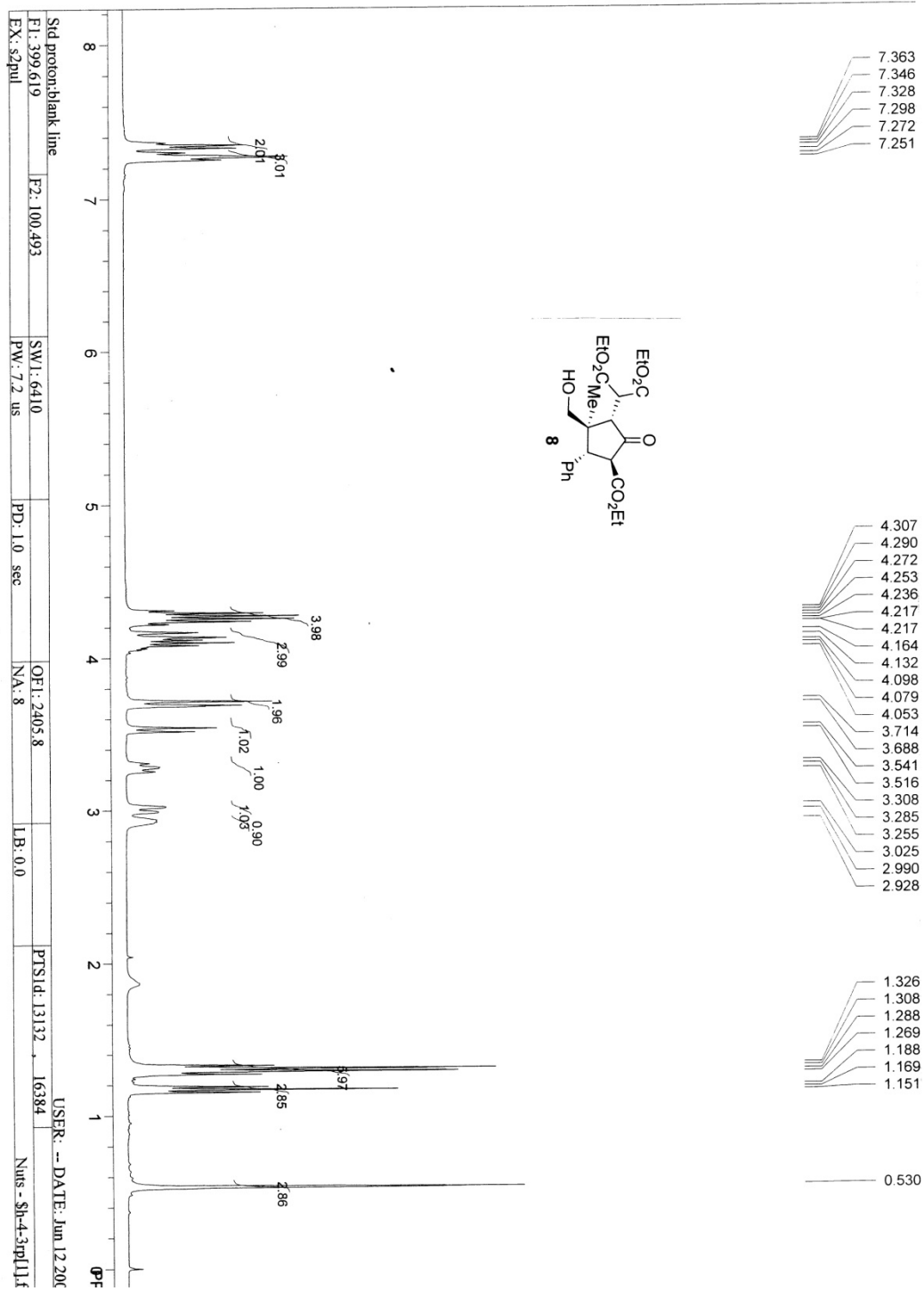
Date:2009-04-28

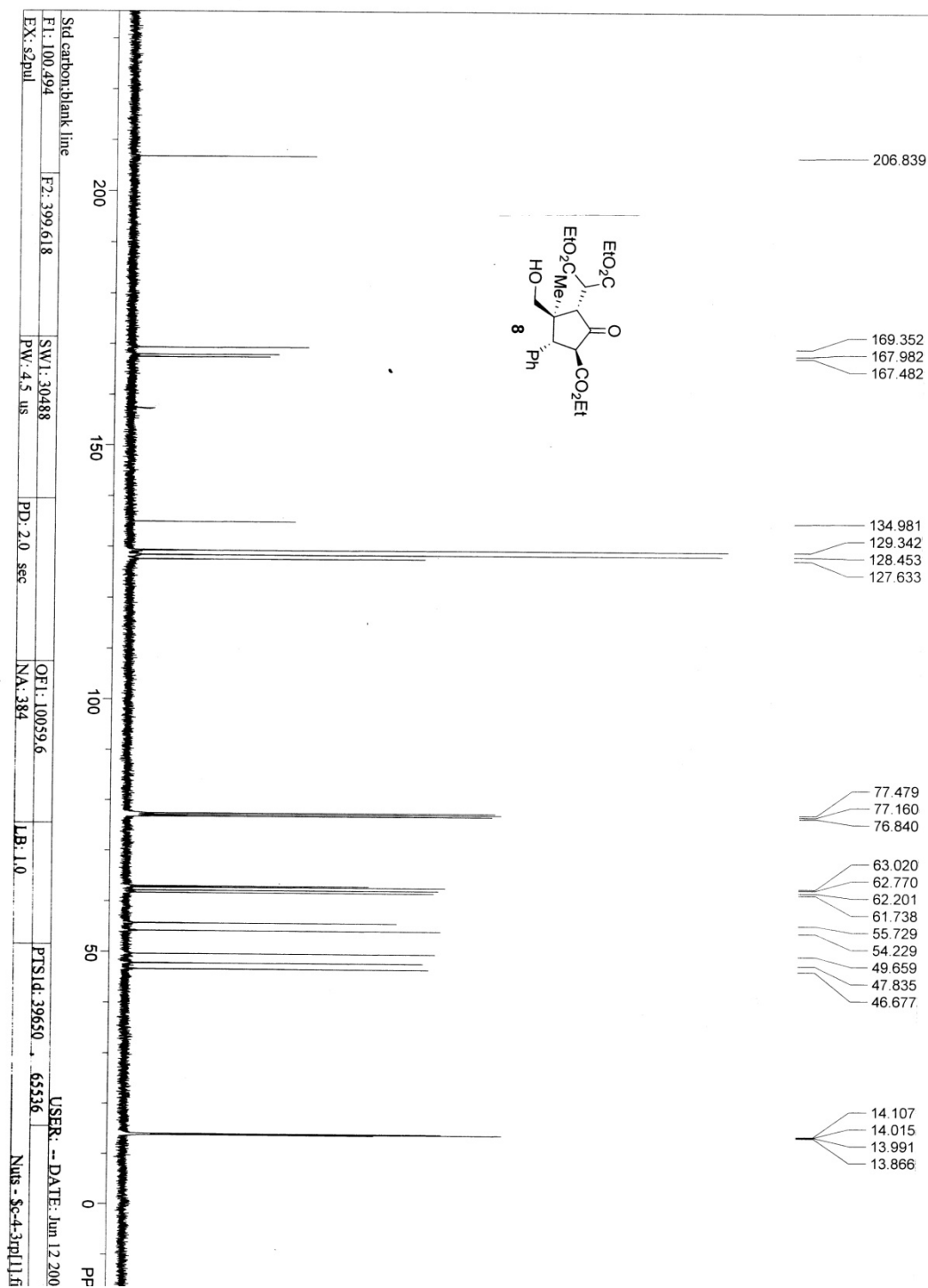
Time :09:32

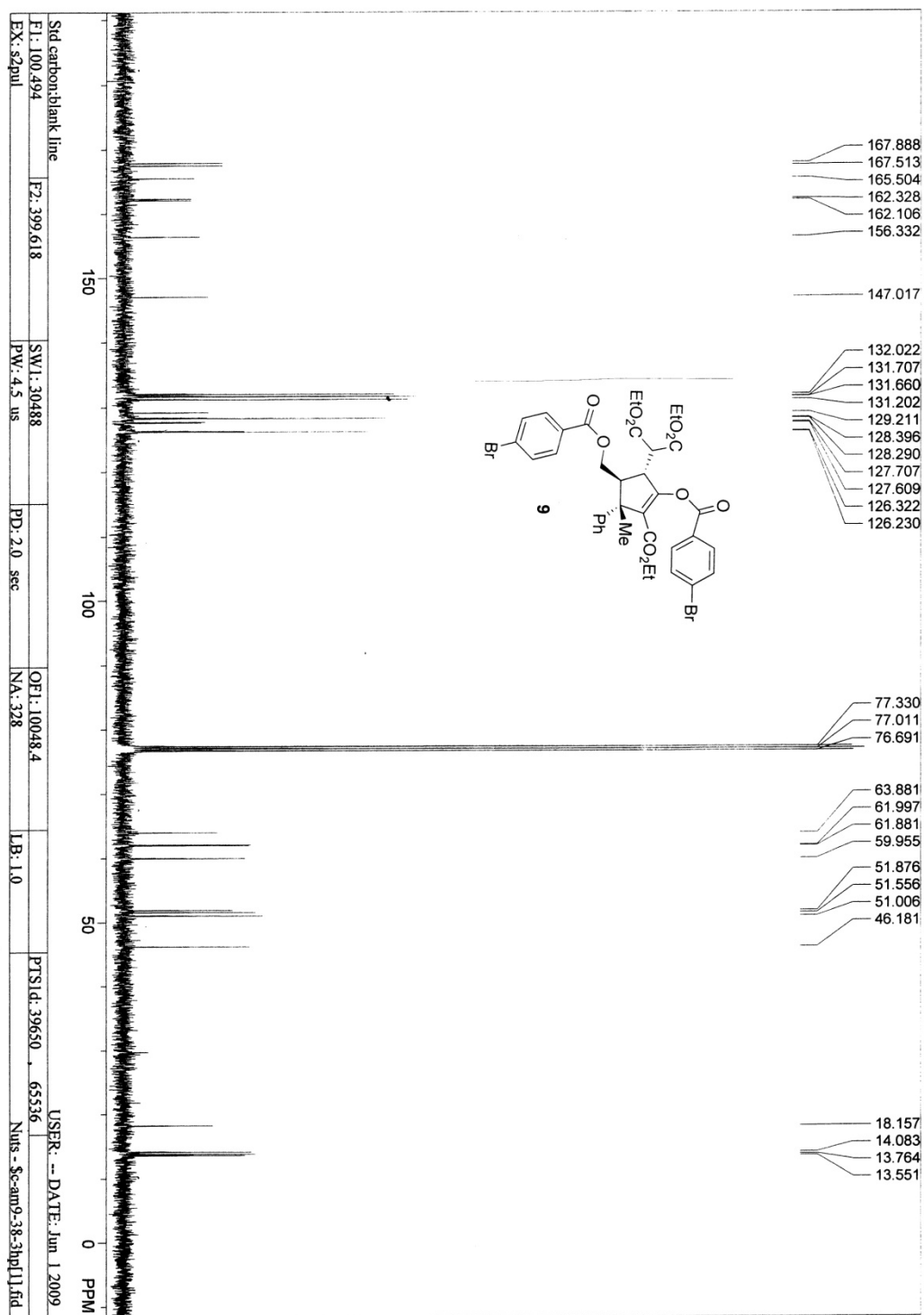
Operator:



No.	PeakNo	ID. Name	R. Time	PeakHeight	PeakArea	PerCent
1	1		14.585	18340.9	368337.3	16.7517
2	2		18.018	108.3	2623.4	0.1193
3	3		20.985	3723.5	109109.6	4.9622
4	4		22.518	38435.3	1502910.7	68.3513
5	5		24.685	412.4	13447.4	0.6116
6	6		31.385	4192.4	197373.9	8.9764
7	7		34.452	126.0	4999.4	0.2274
Total				65338.8	2198801.8	100.0000



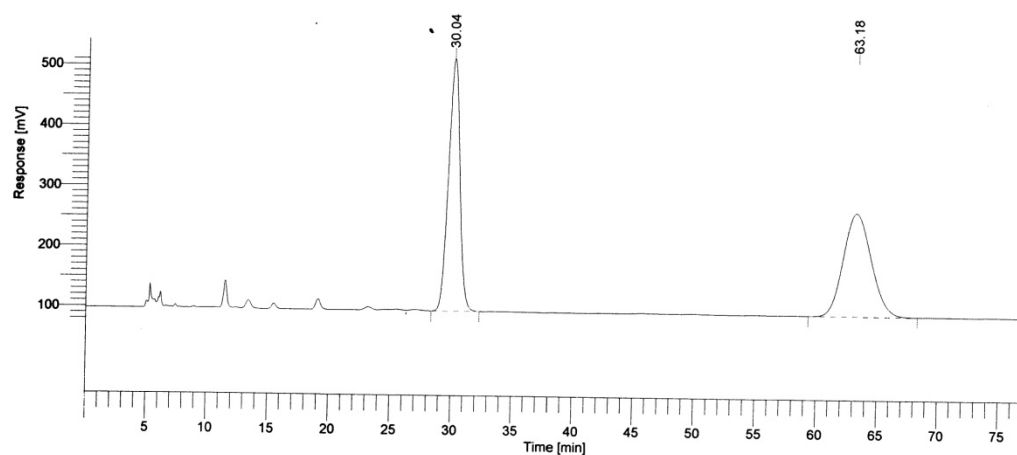




Software Version : 6.3.1.0504
 Sample Name : AM-9-38-3+
 Instrument Name : NCI901
 Rack/Vial : 0/0
 Sample Amount : 1.000000
 Cycle : 1

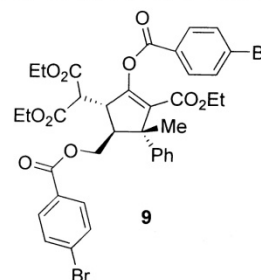
Date : 2009-5-25 21:46:08
 Data Acquisition Time : 2009-5-25 19:06:34
 Channel : A
 Operator : manager
 Dilution Factor : 1.000000

Result File :
 Sequence File : D:\200905025-.seq



HPLC REPORT

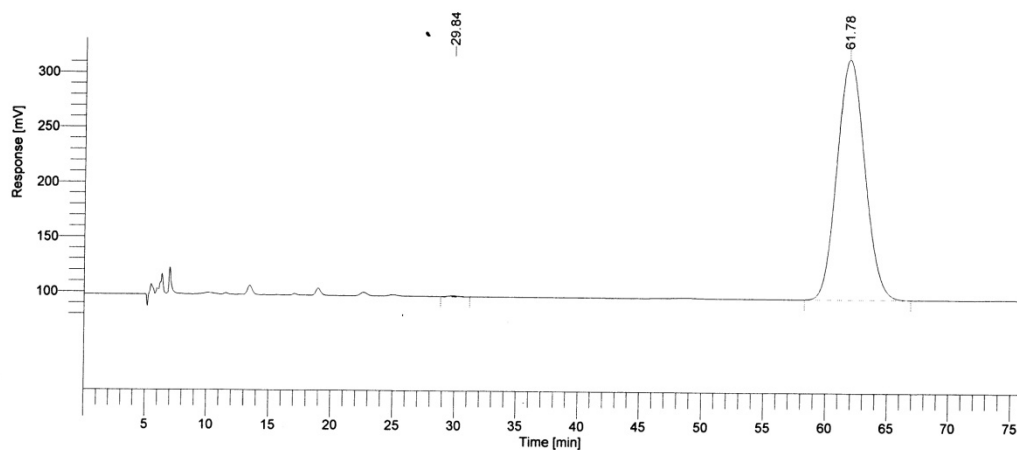
Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL
1		30.045	2.73e+07	419196.96	49.799	*BB
2		63.183	2.75e+07	171968.38	50.201	BB
			5.48e+07	591165.34	1e+02	



Software Version : 6.3.1.0504
Sample Name : AM-9-38-3
Instrument Name : NCI901
Rack/Vial : 0/0
Sample Amount : 1.000000
Cycle : 1

Date : 2009-5-25 21:47:01
Data Acquisition Time : 2009-5-25 20:29:07
Channel : A
Operator : manager
Dilution Factor : 1.000000

Result File :
Sequence File : D:\200905025-.seq



HPLC REPORT

Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL
1		29.845	45801.79	786.23	0.133	BB
2		61.782	3.45e+07	220128.59	99.867	BB
			3.46e+07	220914.82	1e+02	

