Supporting Information

Synthesis of 3-substitued 1,5-aldehyde esters via an organocatalytic highly enantioselective conjugate addition of new carbonylmethyl 2-pyridinylsulfone to enals

Jing Deng,[a] *Fei Wang,*[b] *Wenzhong Yan,*[a] *Jin Zhu,*[a] *Hualiang Jiang,*[a] *Wei Wang,**[a,c] *and Jian Li**[a]

[a] School of Pharmacy, East China University of Science and Technology, 130 Meilong Road , Shanghai 200237, China
[b] Chinese Pharmacopoeia commission, Building 11, Fahua Nanli, Beijing, 100061, China
[c] Department of Chemistry and Chemical Biology, University of New Mexico, MSC03 2060, Albuquerque, NM 87131-0001, USA.

General. The ^{1}H-NMR and ^{13}C-NMR were recorded on a Bruke DRX 400 (400 MHz) instrument. Chromatography was carried out with silica gel (200-300 mesh) using mixtures of petroleum ether and ethyl acetate as eluents. The enantiomeric excess of products were detected on HPLC (Agilent 1200 series). Optical rotation were recorded with a AUTOPOL III Automatic Polarimeter.

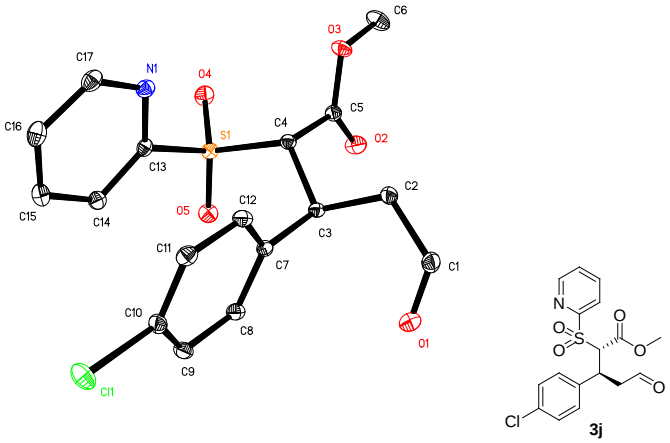
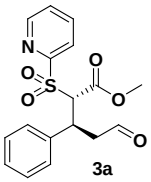


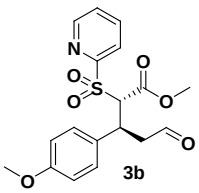
Fig S1. The X-ray crystallographic structure of compound **3j.**

Typical procedure for 4d catalzyed Michael addition of 1a to enals (using 3a as an example):

To a mixture of **4d** (10 mol%, 7.1 mg), cinnamaldehyde (**2a**) (0.24 mmol, 32 mg), in toluene (1.0 mL) at rt is added (**1a**) (0.2 mmol, 43 mg). After stirring for 48 h at the room temperature, the pure product is obtained and purified by column chromatography on silica gel (petroleum ether/ethylacetate 50/50 v/v) to give 0.063 g (90% yield) of **3a** as colorless oil.

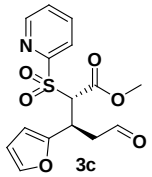


5-Oxo-3-phenyl-2-(pyridine-2-sulfonyl)-pentanoic acid methyl ester (3a) (Table 2, entry 1). 90% yield, colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.80 (d, J = 1.6 Hz, 1H), 8.10 (d, J = 7.6 Hz, 2H), 7.75-7.84 (m, 3H), 7.37-7.44 (m, 5H), 4.73 (d, J = 11.2 Hz, 1H), 4.27-4.34 (m, 1H), 3.75 (dd, J_1 = 3.2 Hz, J_2 = 18.0 Hz, 1H), 3.35-3.40 (m, 1H), 3.31 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 199.1, 165.3, 138.7, 137.5, 134.6, 129.3, 129.2, 128.8, 128.3, 127.9, 74.6, 52.5, 47.3, 38.9; $[\alpha]_D^{15}$ = 0.04 (c = 0.64 in THF); HRMS (EI) m/z calcd for $C_{18}H_{18}O_5S$ (M+1) 347.0875, found 347.0949.

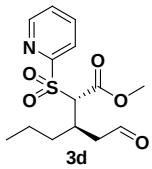


3-(4-Methoxy-phenyl)-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3b) (Table 2, entry 2). 83% yield, white solid, mp: 162-167 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.38 (d, J =

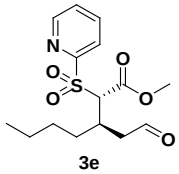
2.0 Hz, 1H), 8.65 (d, *J* = 4.0 Hz, 1H), 7.73-7.77 (m, 1H), 7.54-7.58 (m, 1H), 7.18-7.20 (m, 1H), 6.96 (d, *J* = 8.4 Hz, 2H), 6.43 (d, *J* = 8.8 Hz, 2H), 5.27 (d, *J* = 6.8 Hz, 1H), 3.97-4.03 (m, 1H), 3.80 (s, 3H), 3.62 (s, 3H), 2.92-2.99 (m, 1H), 2.65 (dd, J_1 = 3.6 Hz, J_2 = 16.8 Hz, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 201.3, 165.5, 158.6, 156.2, 150.4, 138.9, 129.3, 128.0, 122.2, 113.7, 70.4, 55.4, 53.7, 47.1, 38.7; $[\alpha]_D^{13}$ = 0.21 (*c* = 0.3 in THF); HRMS (EI) m/z calcd for $C_{18}H_{19}NO_6S$ (M+1) 378.0933, found 378.1012.



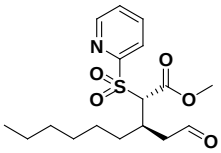
3-Furan-2-yl-5-oxo-2-(pyridine-sulfonyl)-pentanoic acid methyl ester (3c) (Table 2, entry 3). 55% yield, colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.64 (d, *J* = 1.2 Hz, 1H), 8.71 (d, *J* = 4.4 Hz, 1H), 7.82-7.90 (m, 2H), 7.49-7.51 (m, 1H), 7.00 (d, *J* = 1.2 Hz, 1H), 6.13 (d, *J* = 2.8 Hz, 1H), 6.09-6.10 (m, 1H), 5.27 (d, *J* = 7.6 Hz, 1H), 4.42 (q, J_1 = 7.6 Hz, J_2 = 14 Hz, 1H), 3.76 (s, 3H), 3.09-3.11 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 98.6, 164.7, 156.3, 150.5, 150.2, 142.4, 138.1, 127.4, 122.6, 110.4, 108.9, 66.9, 53.3, 44.0, 31.7; $[\alpha]_D^{13}$ = -0.13 (*c* = 1.2 in THF); HRMS (EI) m/z calcd for $C_{15}H_{15}NO_6S$ (M+1) 338.0620, found 338.0704.



3-(2-Oxo-ethyl)-2-(pyridine-2sulfonyl)-hexanoic acid methyl ester (3d) (Table 2, entry 4). 54% yield, yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.70 (d, *J* = 1.6 Hz, 1H), 7.99-8.05 (m, 2H), 7.50-7.53 (m, 2H), 4.80 (d, *J* = 2.8 Hz, 1H), 3.61 (s, 3H), 3.33 (dd, J_1 = 3.2 Hz, J_2 = 18.4 Hz, 1H), 2.84-2.91 (m, 2H), 1.39-1.45 (m, 2H), 0.76-0.85 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 200.5, 165.2, 156.7, 150.3, 138.3, 127.7, 122.8, 65.8, 52.8, 45.4, 35.3, 30.3, 20.0, 13.6; $[\alpha]_D^{15}$ = -0.04 (*c* = 0.6 in THF); HRMS (EI) m/z calcd for $C_{14}H_{19}NO_5S$ (M+1) 314.0984, found 314.1064.

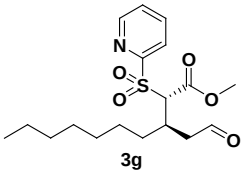


3-(2-Oxo-ethyl)-2-(pyridine-2sulfonyl)-heptanoic acid methyl ester (3e) (Table 2, entry 5). 65% yield, yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.70 (d, *J* = 1.6 Hz, 1H), 8.68-8.70 (m, 1H), 7.99-8.02 (m, 1H), 7.90-7.95 (m, 1H), 7.50-7.54 (m, 1H), 4.81 (d, *J* = 3.2 Hz, 1H), 3.61 (s, 3H), 3.33 (dd, J_1 = 3.6 Hz, J_2 = 18.8 Hz, 1H), 2.84-2.88 (m, 1H), 2.50-2.57 (m, 1H), 1.43-1.44 (m, 3H), 1.13-1.17 (m, 1H), 0.76-0.82 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 200.4, 165.2, 156.7, 150.2, 138.2, 127.6, 122.8, 65.8, 52.8, 45.4, 32.8, 30.4, 28.9, 22.2, 13.8; $[\alpha]_D^{23}$ = -0.04 (*c* = 0.4 in CH_2Cl_2); HRMS (ESI) m/z calcd for $C_{15}H_{21}NO_5S$ $(M+H)^+$ 328.1219, found 328.1218.



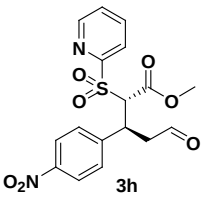
3f

3-(2-Oxo-ethyl)-2-(pyridine-2sulfonyl)-nonanoic acid methyl ester (3f) (Table 2, entry 6). 55% yield, yellow oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.76 (d, *J* = 1.6 Hz, 1H), 8.72-8.75 (m, 1H), 8.04-8.07 (m, 1H), 7.94-8.01 (m, 1H), 7.54-7.60 (m, 1H), 4.86 (d, *J* = 3.3 Hz, 1H), 3.67 (d, *J* = 0.6 Hz, 3H), 3.39 (dd, J_1 = 3.3 Hz, J_2 = 18.6 Hz, 1H), 2.847-2.95 (m, 1H), 2.53-2.63 (m, 1H), 1.20-1.24 (m, 6H), 0.79-0.87 (m, 7H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 200.4, 165.2, 156.7, 150.2, 138.2, 127.6, 122.8, 65.8, 52.8, 45.4, 33.1, 31.5, 30.5, 28.7, 26.7, 22.5, 14.0; $[\alpha]_D^{23}$ = -0.06 (*c* = 0.4 in CH_2Cl_2); HRMS (ESI) m/z calcd for $C_{17}H_{25}NO_5S$ $(M+H)^+$ 356.1532, found 356.1533.



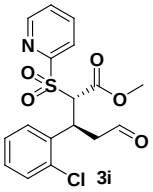
3g

3-(2-Oxo-ethyl)-2-(pyridine-2sulfonyl)-decanoic acid methyl ester (3g) (Table 2, entry 7). 51% yield, yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.70 (d, *J* = 1.6 Hz, 1H), 8.68-8.70 (m, 1H), 8.00-8.02 (m, 1H), 7.91-7.95 (m, 1H), 7.50-7.54 (m, 1H), 4.81 (d, *J* = 3.2 Hz, 1H), 3.61 (s, 3H), 3.33 (dd, J_1 = 3.2 Hz, J_2 = 18.4 Hz, 1H), 2.84-2.88 (m, 1H), 2.49-2.57 (m, 1H), 1.41-1.42 (m, 3H), 1.13-1.17 (m, 7H), 0.76-0.82 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 200.4, 165.2, 156.7, 150.2, 138.2, 127.6, 122.8, 65.8, 52.8, 45.4, 33.1, 31.6, 30.5, 29.6, 29.0, 26.7, 22.5, 14.0; $[\alpha]_D^{23}$ = -0.09 (*c* = 0.4 in CH_2Cl_2); HRMS (ESI) m/z calcd for $C_{18}H_{27}NO_5S$ $(M+H)^+$ 370.1688, found 370.1695.



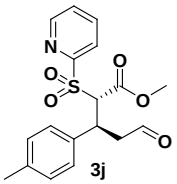
3h

3-(4-Nitro-phenyl)-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3h) (Table 2, entry 8). 80% yield, white solid, mp: 199-201 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.40 (s, 1H), 8.68 (d, *J* = 4.0 Hz, 1H), 7.68-7.76 (m, 3H), 7.56-7.59 (m, 1H), 7.44 (d, *J* = 7.6 Hz, 2H), 7.24 (d, *J* = 7.6 Hz, 1H), 5.46 (d, *J* = 10.8 Hz, 1H), 4.19 (t, *J* = 10.8 Hz, 1H), 3.81 (s, 3H), 3.10-3.15 (m, 1H), 2.79 (d, *J* = 17.6 Hz, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 200.6, 165.1, 156.0, 150.7, 146.7, 146.0, 139.0, 131.2, 128.3, 123.1, 122.5, 69.6, 53.9, 46.9; $[\alpha]_D^{13}$ = 0.10 (*c* = 0.2 in THF); HRMS (EI) m/z calcd for $C_{17}H_{16}N_2O_7S$ (M+1) 393.0678, found 393.0758.

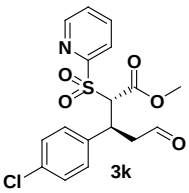


3i

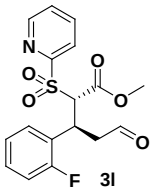
3-(2-Chloro-phenyl)-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3i) (Table 2, entry 9). 88% yield, white solid, mp: 166-170 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.47 (s, 1H), 8.75 (d, J = 6.4 Hz, 1H), 7.88-7.93 (m, 1H), 7.64-7.68 (m, 1H), 7.53 (d, J = 10.4 Hz, 1H), 7.21-7.25 (m, 2H), 7.04-7.10 (m, 1H), 6.93 (t, J = 10.4 Hz, 1H), 5.27 (d, J = 11.6 Hz, 1H), 4.48-4.56 (m, 1H), 3.73 (s, 3H), 3.18-3.24 (m, 1H), 3.02 (dd, J_1 = 5.2 Hz, J_2 = 23.6 Hz, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 200.4, 165.0, 155.8, 150.9, 140.0, 135.4, 133.6, 130.0, 129.5, 128.7, 127.9, 127.4, 122.5, 68.3, 53.8, 52.9, 45.6; $[\alpha]_D^{15}$ = 0.17 (c = 0.2 in THF); HRMS (EI) m/z calcd for $C_{17}H_{16}ClNO_5S$ (M+1) 382.0438, found 382.0515.



3-(4-Methyl-phenyl)-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3j) (Table 2, entry 10). 92% yield, white solid, mp: 174-178 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.38 (s, 1H), 8.64 (d, J = 4.4 Hz, 1H), 7.72 (t, J = 7.6 Hz, 1H), 7.55-7.58 (m, 1H), 7.13 (d, J = 7.6 Hz, 1H), 6.92 (d, J = 7.6 Hz, 2H), 6.66 (d, J = 7.6 Hz, 2H), 5.26 (d, J = 11.6 Hz, 1H), 3.97-4.02 (m, 1H), 3.80 (s, 3H), 2.93-3.00 (m, 1H), 2.66 (d, J = 8.8 Hz, 1H), 2.09 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 201.2, 165.4, 156.1, 150.4, 138.8, 136.8, 134.6, 129.4, 128.8, 127.8, 122.3, 70.4, 53.8, 46.9, 39.0, 20.9; $[\alpha]_D^{13}$ = 0.11 (c = 0.2 in THF); HRMS (EI) m/z calcd for $C_{18}H_{19}NO_5S$ (M+1) 362.0984, found 362.1063.

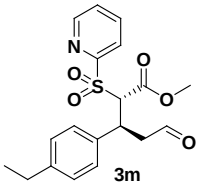


3-(4-Chloro-phenyl)-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3k) (Table 2, entry 11). 82% yield, white solid, mp: 164-170 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.39 (s, 1H), 8.66 (d, J = 8.0 Hz, 1H), 7.77 (t, J = 8.0 Hz, 1H), 7.60-7.63 (m, 1H), 7.30-7.36 (m, 1H), 7.12 (d, J = 7.6 Hz, 2H), 6.93 (d, J = 7.6 Hz, 2H), 5.35 (d, J = 10.8 Hz, 1H), 4.02-4.07 (m, 1H), 3.80 (s, 3H), 2.99-3.06 (m, 1H), 2.69 (d, = 16.8 Hz, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 200.9, 165.3, 156.1, 150.5, 138.9, 136.9, 132.3, 131.5, 128.1, 128.0, 122.3, 70.0, 53.8, 47.0, 38.8; $[\alpha]_D^{13}$ = -0.08 (c = 0.3 in THF); HRMS (EI) m/z calcd for $C_{17}H_{16}ClNO_5S$ (M+1) 382.0438, found 362.0518.

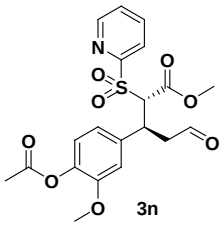


3-(2-Fluoro-phenyl)-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3l) (Table 2, entry 12). 87% yield, white solid, mp: 139-144 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.40 (s, 1H), 8.70 (d, J = 2.0 Hz, 1H), 7.82-7.87 (m, 1H), 7.58-7.62 (m, 1H), 7.26-7.28 (m, 2H), 6.94-7.06 (m, 3H), 5.39 (d, J = 14.8 Hz, 1H), 4.05-4.13 (m, 1H), 3.81 (s, 3H), 2.99-3.08 (m, 1H), 2.69 (dd, J_1 = 8.0

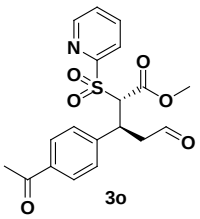
Hz, J_2 = 23.6 Hz, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 200.9, 165.3, 156.2, 150.5, 139.0, 130.1, 129.3, 128.2, 126.2, 123.9, 122.2, 115.9, 114.7, 69.7, 53.8, 47.0, 39.1; $[\alpha]_D^{13}$ = 0.02 (*c* = 0.2 in THF); HRMS (EI) m/z calcd for $C_{17}H_{16}FNO_5S$ (M+1) 366.0733, found 366.0812.



3-(4-Ethyl-phenyl)-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3m) (Table 2, entry 13). 95% yield, white solid, mp: 165-170 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.39 (s, 1H), 8.66 (d, *J* = 5.6 Hz, 1H), 7.70-7.75 (m, 1H), 7.54-7.58 (m, 1H), 7.19 (d, *J* = 10.4 Hz, 1H), 6.96 (d, *J* = 10.8 Hz, 2H), 6.73 (d, *J* = 10.8 Hz, 2H), 5.30 (d, *J* = 14.0 Hz, 1H), 3.99-4.06 (m, 1H), 3.82 (s, 3H), 2.93-3.03 (m, 1H), 2.68 (dd, J_1 = 4.8 Hz, J_2 = 22.4 Hz, 1H), 2.40 (q, J_1 = 9.6 Hz, J_2 = 20.4 Hz, 2H), 1.08 (t, *J* = 10.0 Hz, 3H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 201.2, 165.5, 156.2, 150.4, 142.9, 139.0, 134.8, 129.4, 128.0, 127.7, 122.3, 70.2, 53.8, 47.1, 39.1, 28.1, 15.7; $[\alpha]_D^{15}$ = 0.18 (*c* = 0.2 in THF); HRMS (EI) m/z calcd for $C_{19}H_{21}NO_5S$ (M+1) 376.1140, found 376.1220.

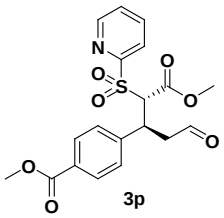


3-(4-Acetoxy-3-methoxy-phenyl)-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3n) (Table 2, entry 14). 76% yield, yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.52 (s, 1H), 8.60 (t, *J* = 1.2 Hz, 1H), 7.71-7.76 (m, 1H), 7.38-7.45 (m, 2H), 6.54-6.66 (m, 3H), 5.23 (t, *J* = 13.2 Hz, 1H), 4.21-4.28 (m, 1H), 3.85 (s, 3H), 3.70 (s, 3H), 2.85-3.01 (m, 2H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.6, 168.5, 165.1, 156.3, 150.8, 149.8, 138.6, 136.3, 127.3, 122.5, 122.4, 120.8, 112.9, 69.7, 55.8, 53.5, 47.0, 38.7, 20.6, 14.2; $[\alpha]_D^{13}$ = 0.19 (*c* = 0.5 in THF); HRMS (EI) m/z calcd for $C_{20}H_{21}NO_8S$ (M) 435.0988, found 435.0986.



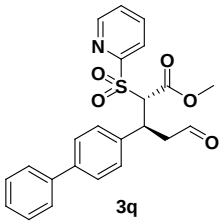
3-(4-Acetyl-phenyl)-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3o) (Table 2, entry 15). 85% yield, white solid, mp: 158-161 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.40 (s, 1H), 8.66 (d, *J* = 4.4 Hz, 1H), 7.63-7.68 (m, 1H), 7.53-7.56 (m, 1H), 7.47 (d, *J* = 8.0 Hz, 2H), 7.25 (d, *J* = 8.0 Hz, 2H), 7.18 (d, *J* = 7.6 Hz, 1H), 5.38 (d, *J* = 10.8 Hz, 1H), 4.10-4.16 (m, 1H), 3.81 (s, 3H), 3.05-3.12 (m, 1H), 2.75 (dd, J_1 = 3.2 Hz, J_2 = 17.6 Hz, 1H), 2.46 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 200.8, 197.7, 165.3, 156.0, 150.6, 143.3, 138.9, 136.0, 129.9, 128.1, 128.0, 122.4,

69.8, 53.8, 46.9, 39.3, 27.1; $[\alpha]_D^{22}$ = 0.15 (*c* = 0.2 in THF); HRMS (ESI) m/z calcd for $C_{19}H_{19}NO_6S$ (M+1) 390.0933, found 390.1003.



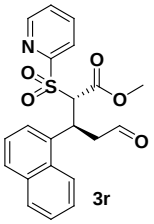
3p

4-{1-[Methoxycarbonyl-(pyridine-2sulfonyl)-methyl]-3-oxo-propyl}-benzoic acid methyl ester (3p) (Table 2, entry 16). 88% yield, colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.55 (s, 1H), 8.64 (d, *J* = 4.4 Hz, 1H), 7.98-8.02 (m, 1H), 7.70 (d, *J* = 8.0 Hz, 2H), 7.50 (d, *J* = 8.0 Hz, 1H), 7.40-7.43 (m, 1H), 7.17 (d, *J* = 8.4 Hz, 2H), 5.20 (d, *J* = 8.8 Hz, 1H), 4.31-4.37 (m, 1H), 3.88 (s, 3H), 3.80 (s, 3H), 3.66-3.71 (m, 1H), 3.08-3.11 (m, 1H); ^{13}C NMR (100 MHz,$CDCl_3$): δ 198.2, 166.3, 164.8, 156.5, 150.0, 143.0, 137.9, 129.6, 128.9, 128.1, 127.3, 122.4, 69.2, 53.5, 52.2, 46.3, 38.3; $[\alpha]_D^{22}$ = -0.03 (*c* = 0.8 in THF); HRMS (ESI) m/z calcd for $C_{19}H_{19}NO_7S$ (M+1) 406.0882, found 406.0958.



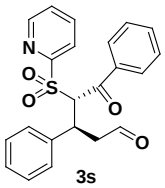
3q

3-Biphenyl-4-yl-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3q) (Table 2, entry 17). 83% yield, white solid, mp: 139-141 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.43 (d, *J* = 1.6 Hz, 1H), 8.65-8.67 (m, 1H), 7.35-7.57 (m, 8H), 7.21 (d, *J* = 6.8 Hz, 1H), 7.14-7.15 (m, 3H), 5.38 (d, *J* = 10.8 Hz, 1H), 4.07-4.13 (m, 1H), 3.83 (s, 3H), 3.02-3.10 (m, 1H), 2.73 (dd, J_1 = 3.6 Hz, J_2 = 17.2 Hz, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 201.1, 165.4, 156.2, 150.5, 140.2, 139.5, 138.8, 136.9, 130.1, 129.4, 127.9, 127.8, 127.1, 126.6, 122.3, 70.2, 53.8, 47.0, 39.1; $[\alpha]_D^{15}$ = 0.34 (*c* = 0.3 in THF); HRMS (EI) m/z calcd for $C_{23}H_{21}NO_5S$ (M+1) 424.1140, found 424.1207.



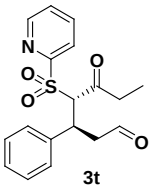
3r

3-Naphthalen-1-yl-5-oxo-2-(pyridine-2sulfonyl)-pentanoic acid methyl ester (3r) (Table 2, entry 18). 85% yield, white solid, mp: 145-148 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.46 (s, 1H), 8.62-8.73 (m, 1H), 8.06-8.14 (m, 1H), 7.50-7.86 (m, 6H), 7.32 (d, *J* = 6.0 Hz, 1H), 7.08-7.10 (m, 2H), 5.21-5.23 (m, 1H), 4.98-5.10 (m, 1H), 3.72 (s, 3H), 3.35-3.42 (m, 1H), 3.13-3.17 (m, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 201.0, 165.2, 156.1, 150.8, 139.7, 139.1, 133.7, 129.2, 126.8, 126.2, 126.1, 125.4, 123.8, 123.5, 122.1, 53.7, 52.6, 46.4, 31.8; $[\alpha]_D^{15}$ = 0.84 (*c* = 0.2 in THF); HRMS (EI) m/z calcd for $C_{21}H_{19}NO_5S$ (M) 397.0984, found 397.0981.



3s

5-Oxo-3,5-diphenyl-4-(pyridine-2sulfonyl)-pentanal (3s) (Table 2, entry 19). 76% yield, white solid, mp: 118-120 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.31 (s, 1H), 8.71 (d, J = 4.0 Hz, 1H), 8.24 (d, J = 7.6 Hz, 2H), 7.77 (t, J = 7.2 Hz, 1H), 7.64-7.70 (m, 3H), 7.53-7.56 (m, 1H), 7.18 (d, J = 6.4 Hz, 2H), 7.07 (d, J = 8.0 Hz, 1H), 6.89-6.91 (m, 3H), 6.58 (d, J = 10.8 Hz, 1H), 4.25-4.31 (m, 1H), 2.90-2.98 (m, 1H), 2.52-2.53 (m, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 199.3, 191.9, 157.2, 149.8, 138.3, 138.0, 134.3, 129.2, 129.1, 128.9, 128.4, 127.5, 126.9, 123.9, 122.2, 67.7, 46.6, 39.7; $[\alpha]_D^{13}$ = -0.75 (c = 0.2 in THF); HRMS (ESI) m/z calcd for $C_{22}H_{19}NO_4S$ (M+1) 394.1035, found 394.1114.

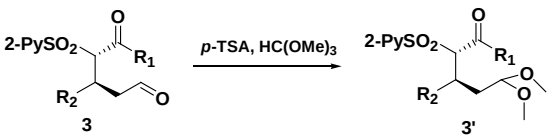


3t

5-Oxo-3-phenyl-4-(pyridine-2sulfonyl)-heptanal (3t) (Table 2, entry 20). 94% yield, white solid, mp: 142-145 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.50 (s, 1H), 8.64 (d, J = 4.0 Hz, 1H), 7.57-7.60 (m, 1H), 7.34-7.40 (m, 2H), 6.97-6.98 (m, 5H), 5.46 (d, J = 9.6 Hz, 1H), 4.16-4.22 (m, 1H), 3.01-3.08 (m, 1H), 2.86-2.91 (m, 2H), 2.55-2.61 (m, 1H), 1.13 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 199.3, 191.9, 157.2, 149.8, 138.3, 138.0, 134.3, 129.2, 129.1, 128.9, 128.4, 127.5, 126.9, 123.9, 122.2, 67.7, 46.6, 39.7; $[\alpha]_D^{15}$ = -0.55 (c = 0.5 in THF); HRMS (ESI) m/z calcd for $C_{18}H_{19}NO_4S$ (M+1) 346.1035, found 346.1111.

Derivation of Michael adducts for chiral HPLC analysis

The following derivation method was used to determine the enantiomeric excess of Michael addition products **3** by converting to corresponsing methyl acetals **3'** (Scheme S1).



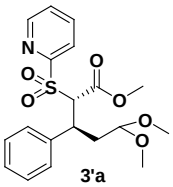
Scheme S1.

General Procedure for the Preparation of dimethoxymethane 3'.

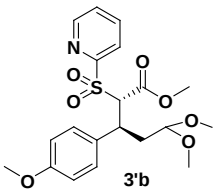
A solution of Michael addition product **3** (0.1 mmol) in CH_2Cl_2 (1.0 mL) was added *p*-toluenesulfonic acid (6 mg, 0.03 mmol) and Trimethyl orthoformate (16 mg, 0.15 mmol). The

reaction mixture was stirred at room temperature until the addition product **3** consumed (determined by TLC) and then purified by column chromatography to yield the desired product.

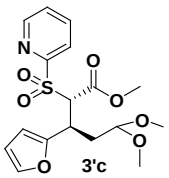
Characterization data of compound 3'



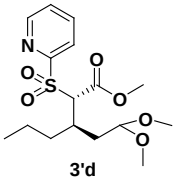
3'a: white solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.53 (d, *J* = 4.4 Hz, 1H), 7.44 (t, *J* = 8.0 Hz, 1H), 7.12-7.18 (m, 2H), 6.88-6.91 (m, 5H), 5.13 (d, *J* = 11.2 Hz, 1H), 3.86 (s, 3H), 3.67-3.73 (m, 2H), 3.16 (s, 3H), 3.05 (s, 3H), 1.88-1.95 (m, 1H), 1.74-1.81 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.3, 156.7, 149.7, 138.5, 137.8, 129.0, 128.1, 127.2, 126.8, 122.2, 101.1, 70.8, 53.4, 53.3, 51.5, 41.0, 36.5; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 210 nm): t(major) = 21.80 min, t(minor) = 40.95 min, ee = 100%; MS (ESI) m/z 416.0 $[M+Na]^+$.



3'b: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.59 (d, *J* = 3.6 Hz, 1H), 7.52 (t, *J* = 8.0 Hz, 1H), 7.31-7.33 (m, 1H), 7.22 (d, *J* = 7.6 Hz, 1H), 6.86 (d, *J* = 8.4, 2H), 6.44 (d, *J* = 8.4 Hz, 2H), 5.14 (d, *J* = 11.6 Hz, 1H), 3.92 (s, 3H), 3.78-3.80 (m, 1H), 3.70-3.73 (m, 1H), 3.68 (s, 3H), 3.22 (s, 3H), 3.12 (s, 3H), 1.91-1.97 (m, 1H), 1.74-1.81 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.4, 158.5, 156.9, 149.7, 137.5, 130.1, 129.5, 126.5, 122.3, 113.5, 101.2, 71.3, 55.2, 53.4, 51.3, 40.3, 36.4, 29.7; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 210 nm): t(major) = 33.04 min, t(minor) = 47.45 min, ee = 100%; MS (ESI) m/z 446.0 $[M+Na]^+$.

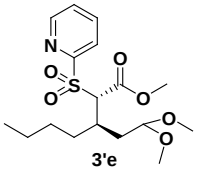


3'c: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.67 (d, *J* = 4.4 Hz, 1H), 7.77 (t, *J* = 8.0 Hz, 1H), 7.62 (d, *J* = 8.0 Hz, 1H), 7.40-7.43 (m, 1H), 6.78 (s, 1H), 6.12 (d, *J* = 2.8 Hz, 1H), 5.99-6.00 (m, 1H), 5.24 (d, *J* = 10.4 Hz, 1H), 3.89-3.93 (m, 2H), 3.86 (s, 3H), 3.24 (s, 3H), 3.18 (s, 3H), 1.91-1.97 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.0, 156.4, 150.2, 149.9, 142.1, 137.8, 126.8, 122.4, 110.1, 108.6, 101.5, 68.5, 53.5, 52.8, 51.8, 34.5, 29.7; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.7 mL/min, λ = 210 nm): t(major) = 18.13 min, t(minor) = 27.72 min, ee = 88%; MS (ESI) m/z 406 $[M+Na]^+$.



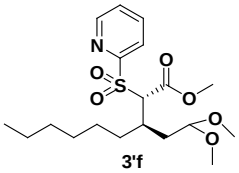
3'd

3'd: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.76 (d, *J* = 4.4 Hz, 1H), 8.12 (d, *J* = 7.6 Hz, 1H), 7.99 (d, *J* = 7.6 Hz, 1H), 7.56-7.59 (m, 1H), 4.86 (d, *J* = 3.6 Hz, 1H), 4.55 (d, *J* = 6.0 Hz, 1H), 3.68-3.70 (m, 1H), 3.65 (s, 3H), 3.37 (s, 3H), 3.35 (s, 3H), 2.52-2.55 (m, 1H), 2.32-2.38 (m, 1H), 1.58-1.65 (m, 2H), 0.87 (t, *J* = 7.2 Hz, 5H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 200.5, 165.3, 156.8, 150.2, 138.2, 127.7, 122.8, 65.8, 52.8, 50.9, 45.4, 35.3, 30.3, 29.7, 20.0, 13.6; HPLC (Chiralpak AS-H, *i*-PrOH/hexane = 10/90, flow rate = 0.5 mL/min, λ = 220 nm): t(major) = 34.35 min, t(minor) = 41.07 min, ee = 100%; MS (ESI) m/z 382.0 $[M+Na]^+$.



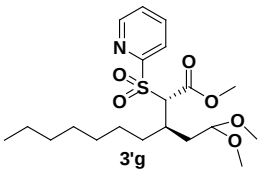
3'e

3'e: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.68 (d, *J* = 4.8 Hz, 1H), 8.04 (d, *J* = 7.6 Hz, 1H), 7.91 (t, *J* = 7.6 Hz, 1H), 7.47-7.51 (m, 1H), 4.95 (d, *J* = 3.6 Hz, 1H), 4.46 (d, *J* = 5.2 Hz, 1H), 3.56 (s, 6H), 3.28 (s, 3H), 2.39-2.45 (m, 1H), 1.74-1.87 (m, 1H), 1.48-1.63 (m, 2H), 0.77-0.85 (m, 7H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.6, 157.3, 150.0, 138.0, 127.4, 122.6, 103.4, 66.5, 53.4, 52.5, 51.7, 34.1, 33.0, 31.6, 29.6, 22.3, 13.9; HPLC (Chiralpak AS-H, *i*-PrOH/hexane = 3/97, flow rate = 0.5 mL/min, λ = 210 nm): t(major) = 84.58 min, t(minor) = 90.04 min, ee = 94%; MS (ESI) m/z 396.1 $[M+Na]^+$.



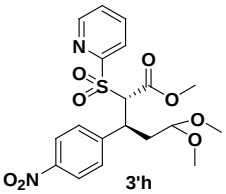
3'f

3'f: colorless oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.73 (d, *J* = 4.5 Hz, 1H), 8.08 (d, *J* = 7.8 Hz, 1H), 7.96 (t, *J* = 7.5 Hz, 1H), 7.52-7.56 (m, 1H), 4.83 (d, *J* = 3.9 Hz, 1H), 4.52 (d, *J* = 6.0 Hz, 1H), 3.62 (s, 6H), 3.34 (s, 3H), 2.26-2.51 (m, 1H), 1.78-1.91 (m, 1H), 1.34-1.41 (m, 3H), 0.87-0.93 (m, 10H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.6, 157.3, 150.0, 138.0, 127.3, 122.6, 102.8, 66.5, 53.7, 52.5, 51.7, 38.7, 33.0, 31.9, 30.3, 29.6, 26.3, 22.5, 14.0; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 5/95, flow rate = 0.5 mL/min, λ = 210 nm): t(major) = 56.48 min, t(minor) = 63.05 min, ee = 94%; MS (ESI) m/z 424.1 $[M+Na]^+$.



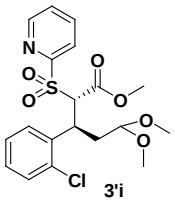
3'g

3'g: colorless oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.72 (d, *J* = 4.8 Hz, 1H), 8.08 (d, *J* = 7.6 Hz, 1H), 7.93-7.98 (m, 1H), 7.51-7.56 (m, 1H), 4.99 (d, *J* = 3.6 Hz, 1H), 4.50 (d, *J* = 5.1 Hz, 1H), 3.61 (s, 6H), 3.32 (s, 3H), 2.42-2.50 (m, 1H), 1.77-1.90 (m, 1H), 1.20-1.26 (m, 11H), 0.83-0.87 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.6, 157.3, 150.0, 138.0, 127.3, 122.6, 102.8, 66.5, 53.7, 52.9, 51.7, 34.1, 33.0, 31.7, 29.6, 29.0, 27.1, 26.3, 22.5, 14.0; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 5/95, flow rate = 0.5 mL/min, λ = 210 nm): t(major) = 46.87 min, t(minor) = 62.04 min, ee = 90%; MS (ESI) m/z 438.1 $[M+Na]^+$.



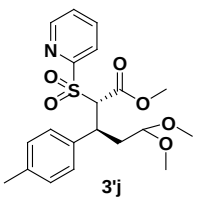
3'h

3'h: white solid; ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.67 (d, *J* = 4.0 Hz, 1H), 7.76 (d, *J* = 8.4 Hz, 2H), 7.67 (t, *J* = 7.6 Hz, 1H), 7.55-7.58 (m, 1H), 7.37 (d, *J* = 8.4 Hz, 2H), 7.17 (d, *J* = 8.0 Hz, 1H), 5.41 (d, *J* = 11.6 Hz, 1H), 3.84 (s, 3H), 3.61-3.64 (m, 2H), 3.11 (s, 3H), 3.00 (s, 3H), 2.03-2.10 (m, 1H), 1.68-1.75 (m, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 165.3, 156.1, 150.7, 146.8, 145.8, 138.9, 131.0, 128.2, 123.1, 122.4, 101.4, 70.3, 53.8, 53.6, 52.1, 41.4, 36.2; HPLC (Chiralpak AS-H, *i*-PrOH/hexane = 40/60, flow rate = 1.0 mL/min, λ = 210 nm): t(major) = 30.99 min, t(minor) = 23.95 min, ee = 100%; MS (ESI) m/z 461.0 $[M+Na]^+$.



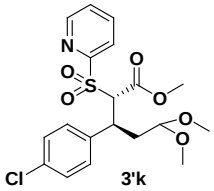
3'i

3'i: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.69 (d, *J* = 4.0 Hz, 1H), 7.80-7.82 (m, 1H), 7.57-7.60 (m, 1H), 7.22-7.38 (m, 2H), 7.15 (d, *J* = 7.6 Hz, 1H), 7.01 (t, *J* = 7.6 Hz, 1H), 6.76-6.79 (m, 1H), 5.18-5.20 (m, 1H), 3.80 (s, 3H), 3.67-3.69 (m, 1H), 3.14-3.16 (m, 1H), 3.12 (s, 3H), 3.00 (s, 3H), 1.83-2.10 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.1, 150.2, 150.1, 138.3, 137.7, 130.1, 128.6, 127.8, 127.0, 126.6, 122.9, 122.1, 101.7, 60.4, 53.3, 52.5, 52.1, 30.0, 14.2; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 210 nm): t(major) = 27.78 min, t(minor) = 60.24 min, ee = 100%; MS (ESI) m/z 450.0 $[M+Na]^+$.



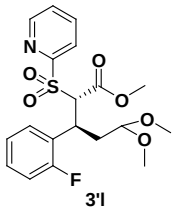
3'j

3'j: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.57 (d, *J* = 4.4 Hz, 1H), 7.47 (t, *J* = 7.6 Hz, 1H), 7.31-7.33 (m, 1H), 7.18 (d, *J* = 7.6 Hz, 1H), 6.83 (d, *J* = 7.6 Hz, 2H), 7.70 (d, *J* = 7.6 Hz, 2H), 5.14 (d, *J* = 11.2 Hz, 1H), 3.92 (s, 3H), 3.78-3.81 (m, 1H), 3.68-3.71 (m, 1H), 3.22 (s, 3H), 3.12 (s, 3H), 2.15 (s, 3H), 1.92-1.97 (m, 1H), 1.76-1.83 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.4, 156.8, 149.7, 137.3, 134.1, 129.0, 128.8, 128.2, 126.3, 122.4, 101.2, 71.3, 53.4, 51.4, 40.6, 36.4, 29.7, 20.8; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 210 nm): t(major) = 21.36 min, t(minor) = 33.89 min, ee = 100%; MS (ESI) m/z 430.0 $[M+Na]^+$.



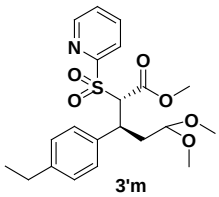
3'k

3'k: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.58 (d, *J* = 4.4 Hz, 1H), 7.58 (t, *J* = 7.6 Hz, 1H), 7.36-7.40 (m, 1H), 7.22 (d, *J* = 7.6 Hz, 1H), 6.86-6.91 (m, 4H), 5.13 (d, *J* = 11.2 Hz, 1H), 3.90 (s, 3H), 3.70-3.79 (m, 2H), 3.20 (s, 3H), 3.11 (s, 3H), 1.92-1.98 (m, 1H), 1.74-1.82 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.1, 156.7, 149.8, 137.7, 135.9, 133.1, 130.5, 128.2, 126.8, 122.2, 100.9, 70.8, 53.5, 51.3, 40.5, 36.2, 29.7; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 1.0 mL/min, λ = 254 nm): t(major) = 13.28 min, t(minor) = 25.42 min, ee = 100%; MS (ESI) m/z 450.0 $[M+Na]^+$.



3'l

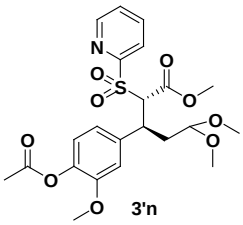
3'l: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.62 (d, *J* = 4.4 Hz, 1H), 7.56 (t, *J* = 7.6 Hz, 1H), 7.33-7.37 (m, 2H), 6.92-6.96 (m, 1H), 6.83 (d, *J* = 7.6 Hz, 1H), 6.62-6.68 (m, 2H), 5.16 (d, *J* = 11.2 Hz, 1H), 3.92 (s, 3H), 3.76-3.80 (m, 2H), 3.22 (s, 3H), 3.13 (s, 3H), 1.95-2.01 (m, 1H), 1.77-1.83 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.0, 156.7, 149.8, 137.6, 129.8, 127.8, 126.9, 125.1, 122.1, 115.5, 114.4, 114.2, 100.8, 70.3, 53.4, 51.3, 40.7, 36.3, 29.6; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 254 nm): t(major) = 23.76 min, t(minor) = 47.62 min, ee = 100%; MS (ESI) m/z 434.0 $[M+Na]^+$.



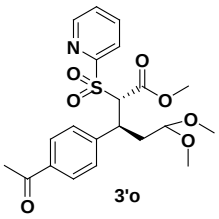
3'm

3'm: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.57 (d, *J* = 4.8 Hz, 1H), 7.45 (t, *J* = 8.0 Hz, 1H), 7.27-7.30 (m, 1H), 7.19 (d, *J* = 8.0 Hz, 1H), 6.85 (d, *J* = 8.0 Hz, 2H), 6.73 (d, *J* = 8.0 Hz, 2H), 5.18 (d, *J* = 11.6 Hz, 1H), 3.93 (s, 3H), 3.69-3.79 (m, 2H), 3.22 (s, 3H), 3.11 (s, 3H), 2.44 (q, J_1 = 7.6 Hz, J_2 = 15.2 Hz, 2H), 1.91-1.98 (m, 1H), 1.76-1.83 (m, 1H), 1.13 (t, *J* = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.4, 156.9, 149.7, 143.0, 137.4, 134.3, 129.0, 127.6, 126.4, 122.3, 101.1, 71.0,

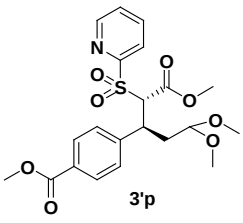
53.4, 52.9, 51.3, 40.7, 36.5, 28.2, 15.4; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 254 nm): t(major) = 23.03 min, t(minor) = 32.89 min, ee = 100%; MS (ESI) m/z 444.1 $[M+Na]^+$.



3'n: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.59 (d, *J* = 4.4 Hz, 1H), 7.65-7.70 (m, 1H), 7.34-7.37 (m, 1H), 7.26 (s, 1H), 6.50-6.57 (m, 3H), 5.17 (d, *J* = 11.6 Hz, 1H), 3.95 (s, 3H), 3.72-3.82 (m, 2H), 3.68 (s, 3H), 3.23 (s, 3H), 3.14 (s, 3H), 2.27 (s, 3H), 1.93-1.99 (m, 1H), 1.73-1.80 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 168.4, 165.2, 156.7, 150.6, 149.5, 138.8, 138.6, 136.2, 126.9, 122.4, 122.2, 121.1, 113.0, 100.9, 70.9, 55.7, 53.5, 53.4, 51.2, 41.0, 36.6, 20.6; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 254 nm): t(major) = 30.40 min, t(minor) = 32.76 min, ee = 97%; MS (ESI) m/z 504.0 $[M+Na]^+$.

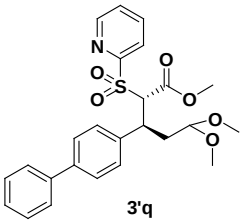


3'o: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.62 (d, *J* = 4.4 Hz, 1H), 7.55 (d, *J* = 8.4 Hz, 2H), 7.46 (t, *J* = 7.7 Hz, 1H), 7.28-7.37 (m, 2H), 7.13 (d, *J* = 8.0 Hz, 2H), 5.21 (d, *J* = 11.2 Hz, 1H), 3.93 (s, 3H), 3.78-3.89 (m, 2H), 3.24 (s, 3H), 3.13 (s, 3H), 2.52 (s, 3H), 2.01-2.08 (m, 1H), 1.84-1.91 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 197.3, 165.0, 156.8, 149.9, 143.2, 137.5, 136.0, 129.4, 128.0, 126.8, 122.2, 100.9, 70.4, 53.5, 51.3, 40.9, 36.1, 29.7, 26.6; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 30/70, flow rate = 1.0 mL/min, λ = 210 nm): t(major) = 14.52 min, t(minor) = 20.53 min, ee = 100%; MS (ESI) m/z 458.1 $[M+Na]^+$.



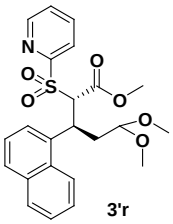
3'p: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.59 (d, *J* = 4.4 Hz, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.60 (d, *J* = 8.0 Hz, 2H), 7.45 (t, *J* = 8.0 Hz, 1H), 7.30-7.35 (m, 1H), 7.07 (d, *J* = 8.0 Hz, 2H), 5.19 (d, *J* = 10.8 Hz, 1H), 3.91 (s, 3H), 3.89 (s, 3H), 3.80-3.87 (m, 1H), 3.73-3.76 (m, 1H), 3.21 (s, 3H), 3.10 (s, 3H), 1.97-2.00 (m, 1H), 1.81-1.88 (m, 1H); HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 30/70, flow rate = 1.0 mL/min, λ = 210 nm): t(major) = 18.29 min, t(minor) = 26.49 min, ee = 95%;

^{13}C NMR (100 MHz, $CDCl_3$): δ 166.4, 165.0, 156.7, 149.8, 142.9, 137.6, 129.9, 129.2, 128.6, 126.9, 122.3, 101.0, 70.4, 60.4, 53.5, 52.2, 41.0, 36.2, 29.7; MS (ESI) m/z 449.9 $[M-1]^+$.



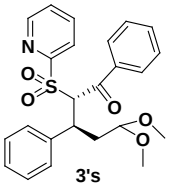
3'q

3'q: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.62 (d, *J* = 4.0 Hz, 1H), 7.35-7.46 (m, 7H), 7.22 (d, *J* = 7.6 Hz, 1H), 7.14 (d, *J* = 8.0 Hz, 2H), 7.04 (d, *J* = 8.0 Hz, 2H), 5.24 (d, *J* = 11.6 Hz, 1H), 3.97 (s, 3H), 3.79-3.89 (m, 2H), 3.27 (s, 3H), 3.15 (s, 3H), 1.98-2.04 (m, 1H), 1.83-1.90 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.3, 156.9, 149.7, 139.9, 137.6, 136.4, 129.6, 128.9, 127.5, 126.9, 126.7, 126.6, 126.4, 122.3, 101.0, 71.2, 60.4, 53.5, 40.8, 36.4, 29.7; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 254 nm): t(major) = 35.12 min, t(minor) = 53.93 min, ee = 100%; MS (ESI) m/z 492.1 $[M+Na]^+$.



3'r

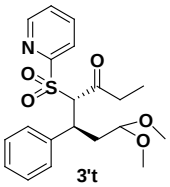
3'r: colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.54 (d, *J* = 3.2 Hz, 1H), 8.40 (d, *J* = 8.8 Hz, 1H), 7.75 (d, *J* = 8.0 Hz, 1H), 7.45-7.63 (m, 3H), 7.22-7.23 (m, 2H), 7.02 (d, *J* = 6.8 Hz, 1H), 6.91 (t, *J* = 7.6 Hz, 1H), 6.67 (d, *J* = 7.2 Hz, 1H), 5.26 (d, *J* = 10.4 Hz, 1H), 4.74-4.80 (m, 1H), 3.95 (s, 3H), 3.68-3.71 (m, 1H), 3.11 (s, 3H), 3.08 (s, 3H), 2.22-2.28 (m, 1H), 1.97-2.09 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.4, 156.7, 150.2, 149.7, 137.2, 134.6, 133.5, 128.2, 127.8, 126.7, 126.4, 126.1, 125.4, 124.7, 124.2, 121.9, 101.4, 71.5, 53.4, 53.0, 52.1, 33.9, 29.7; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 210 nm): t(major) = 31.31 min, t(minor) = 49.58 min, ee = 100%; MS (ESI) m/z 466.0 $[M+Na]^+$.



3's

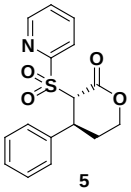
3's: white solid; ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.64 (d, *J* = 4.4 Hz, 1H), 8.12 (t, *J* = 8.0 Hz, 1H), 7.97 (d, *J* = 8.0 Hz, 1H), 7.66-7.70 (m, 2H), 7.47-7.51 (m, 1H), 7.33 (t, *J* = 7.6 Hz, 2H), 7.24 (d, *J* = 7.6 Hz, 2H), 7.06-7.12 (m, 3H), 7.00 (t, *J* = 7.2 Hz, 1H), 6.46 (d, *J* = 10.8 Hz, 1H), 3.67-3.78 (m, 2H), 3.18 (s, 3H), 3.01 (s, 3H), 2.55-2.62 (m, 1H), 1.90-1.97 (m, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 192.7, 157.0, 150.7, 139.6, 139.3, 138.0, 137.1, 134.1, 129.2, 128.9, 128.8, 128.7, 128.5, 127.5, 126.0, 123.3, 101.8, 70.1, 53.1, 51.6, 42.3, 35.7; HPLC (Chiralpak AD-H,

i-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 254 nm): t(major) = 26.33 min, t(minor) = 39.25 min, ee = 100%; MS (ESI) m/z 462.1 $[M+Na]^+$.



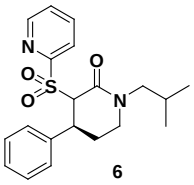
3't

3't: white solid; ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.65 (d, *J* = 3.6 Hz, 1H), 7.61-7.65 (m, 1H), 7.49-7.51 (m, 1H), 6.87-6.99 (m, 6H), 5.62 (d, *J* = 11.2 Hz, 1H), 3.46-3.53 (m, 2H), 3.08 (s, 3H), 2.96 (s, 3H), 2.88-2.94 (m, 2H), 1.88 (t, *J* = 12.8 Hz, 1H), 1.50-1.56 (m, 1H), 1.05 (t, *J* = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 203.5, 156.8, 150.2, 138.9, 137.9, 129.5, 128.1, 127.7, 127.3, 121.8, 101.7, 72.8, 53.3, 52.1, 41.5, 36.1, 23.0, 7.7; HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 20/80, flow rate = 0.5 mL/min, λ = 210 nm): t(major) = 15.93 min, t(minor) = 23.64 min, ee = 100%; MS (ESI) m/z 414.1 $[M+Na]^+$.



5

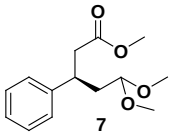
4-Phenyl-3-(pyridine-2-sulfonyl)-tetrahydropyran-2-one (5). To a solution of **3a** (35 mg, 0.1 mmol) in dry MeOH (3 mL), sodium borohydride (5.7 mg, 0.15 mmol) was added at 0 ºC. The mixture was stirred for 4 h at the same tempreture. The solvent was then evaporated under reduced pressure, and the residue was partitioned between AcOEt and sat. NH_4Cl. The organic layer was washed, dried, filtered, and condensed. The residue was purified by chromatography on silica gel to afford **5** in 95% yield as colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.75 (d, *J* = 4.0 Hz, 1H), 8.09 (d, *J* = 8.0 Hz, 1H), 7.96-8.00 (m, 1H), 7.57-7.60 (m, 1H), 7.38-7.42 (m, 2H), 7.30-7.34 (m, 3H), 5.04 (d, *J* = 4.8 Hz, 1H), 4.69-4.75 (m, 1H), 4.43-4.48 (m, 1H), 4.28-4.33 (m, 1H), 2.51-2.58 (m, 1H), 2.07-2.17 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 163.2, 155.4, 150.5, 141.5, 138.0, 129.3, 127.8, 127.7, 127.2, 123.8, 67.9, 66.9, 37.3, 30.4; $[\alpha]_D^{22}$ = -0.33 (*c* = 0.3 in CH_2Cl_2); HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 40/60, flow rate = 1.0 mL/min, λ = 210 nm): t(major) = 16.31 min, t(minor) = 13.21 min, ee = 100%; HRMS (ESI) m/z calcd for $C_{16}H_{15}NO_4S$ $(M+1)^+$ 318.0722, found 318.0797.



6

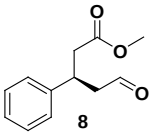
1-Isobutyl-4-phenyl-3-(pyridine-2-sulfonyl)-piperidin-2-one (6). To a solution of sodium triacetoxyborohydride (32 mg, 0.15 mmol) and isobutylamine (15 mg, 0.2mmol) in dry CH_2Cl_2 (3 mL), **3a** (35 mg, 0.1 mmol) was added. The mixture was stirred for 1 h at 25℃ and 2h at 75 ºC. The solution was then poured into water, extracted with CH_2Cl_2 for three times. The combined organic

phases were washed with sat. NH_4Cl, brine and water, dried,filtered, and concentrated. The residue was purified by chromatography on silica gel to afford **6** in 85% yield as colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.75 (d, *J* = 4.4 Hz, 1H), 8.04 (d, *J* = 4.0 Hz, 1H), 7.93-7.97 (m, 1H), 7.51-7.55 (m, 1H), 7.34-7.38 (m, 2H), 7.29-7.31 (m, 1H), 7.24-7.26 (m, 2H), 4.99 (d, *J* = 2.4 Hz, 1H), 4.32-4.36 (m, 1H), 3.33-3.46 (m, 2H), 3.14-3.20 (m, 1H), 3.05-3.10 (m, 1H), 2.61-2.69 (m, 1H), 1.96-2.03 (m, 2H), 0.91 (dd, J_1 = 3.2 Hz, J_2 = 6.8 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 162.0, 157.1, 150.2, 141.3, 137.8, 128.9, 127.3, 127.2, 127.1, 123.3, 65.9, 55.2, 45.2, 36.8, 29.3, 26.6, 20.2, 19.9; $[\alpha]_D^{22}$ = -0.86 (*c* = 0.3 in CH_2Cl_2); HPLC (Chiralpak AD-H, *i*-PrOH/hexane = 30/70, flow rate = 1.0 mL/min, λ = 254 nm): t(major) = 8.56 min, t(minor) =10.22 min, ee = 100%; HRMS (EI) m/z calcd for $C_{20}H_{24}N_2O_3S$ $(M)^+$ 372.1508, found 372.1511.



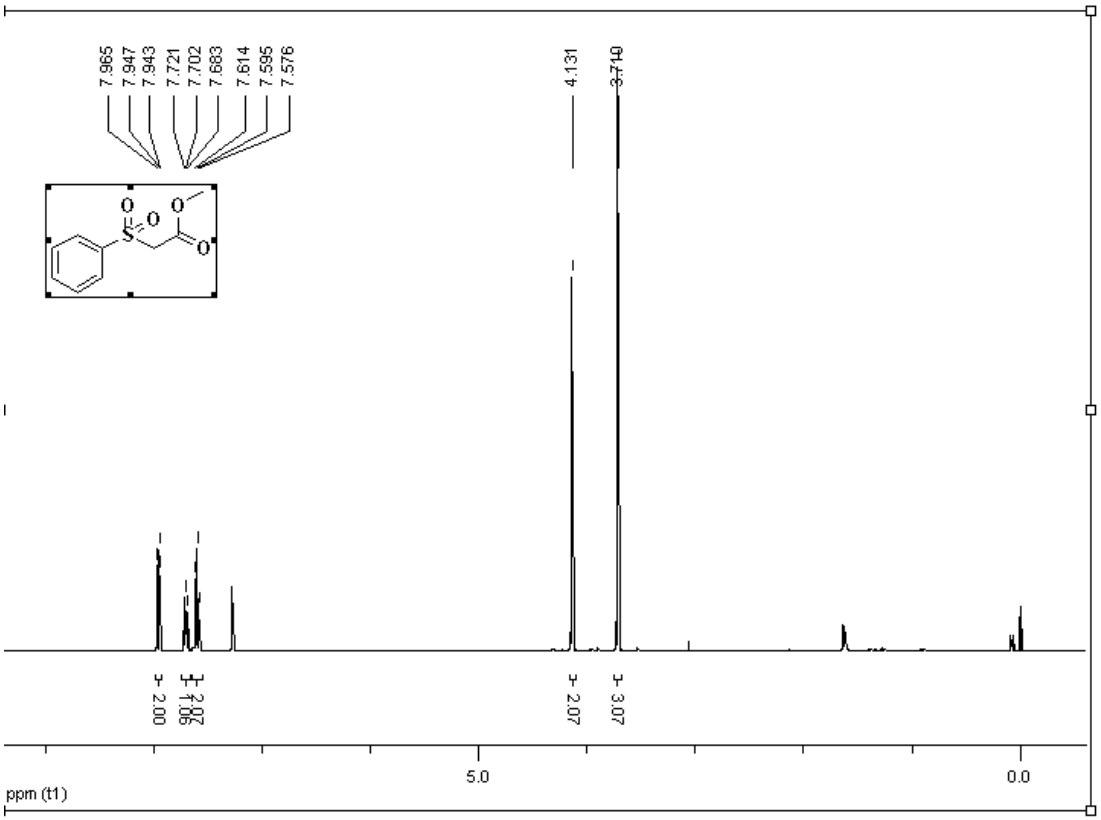
7

5,5-Dimethoxy-3-phenyl-pentanoic acid methyl ester (7). Into 5 mL of absolute methanol was placed 100 mg of activated Mg turnings. The mixture was heated to 45-50 ºC with stirring until gas evolution started (5 min) and 79 mg of **3'a** (0.2 mmol) and Tetrabutyl ammonium bromide (TBAB) (6mg, 0.02mmol) added in one portion. The mixture was stirred without additional heat for 8 h when TLC indicated that all starting material had been consumed. The reaction mixture was poured into sat. NH_4Cl solution and extracted with EtOAc for 3 times. The combined organic layer was washed, dried, filtered, and condensed. The residue was purified by chromatography on silica gel to afford **7** as colorless oil in 74% yield. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30-7.34 (m, 2H), 7.22-7.24 (m, 3H), 4.11 (dd, J_1 = 3.2 Hz, J_2 = 8.0 Hz, 1H), 3.60 (s, 3H), 3.30 (s, 3H), 3.23 (s, 3H), 2.59-2.72 (m, 2H), 2.01-2.08 (m, 1H), 1.82-1.89 (m, 1H); HPLC (Chiralpak OJ-H, *i*-PrOH/hexane = 40/60, flow rate = 0.7 mL/min, λ = 210 nm): t(major) = 22.99 min, t(minor) = 19.96 min, ee = 100%.



8

5-Oxo-3-phenyl-pentanoic acid methyl ester (8). To a solution of above intermediate 6 (25mg, 0.1mmol) in CH_2Cl_2 , 1mL of trifluoroacetic acid/H_2O (1:1, v/v) was added dropwise. The suspension was stirred for another 1h. The reaction mixture was poured into water and extracted with CH_2Cl_2 for 3 times. The combined organic layer was washed, dried, filtered, and condensed. The residue was purified by chromatography on silica gel to afford **7** in 98% yield as colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.69 (s, 1H), 7.31-7.35 (m, 2H), 7.23-7.25 (m, 3H), 3.73-3.80 (m, 1H), 3.62 (s, 3H), 2.82-2.86 (m, 2H), 2.68-2.71 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 200.7, 172.0, 142.4, 128.8, 127.2, 127.1, 51.7, 49.4, 40.7, 36.2; $[\alpha]_D^{13}$ = -0.07 (*c* = 1.2 in THF); HRMS (ESI) m/z calcd for $C_{12}H_{14}O_3$ $(M+1)^+$ 207.0943, found 207.0997.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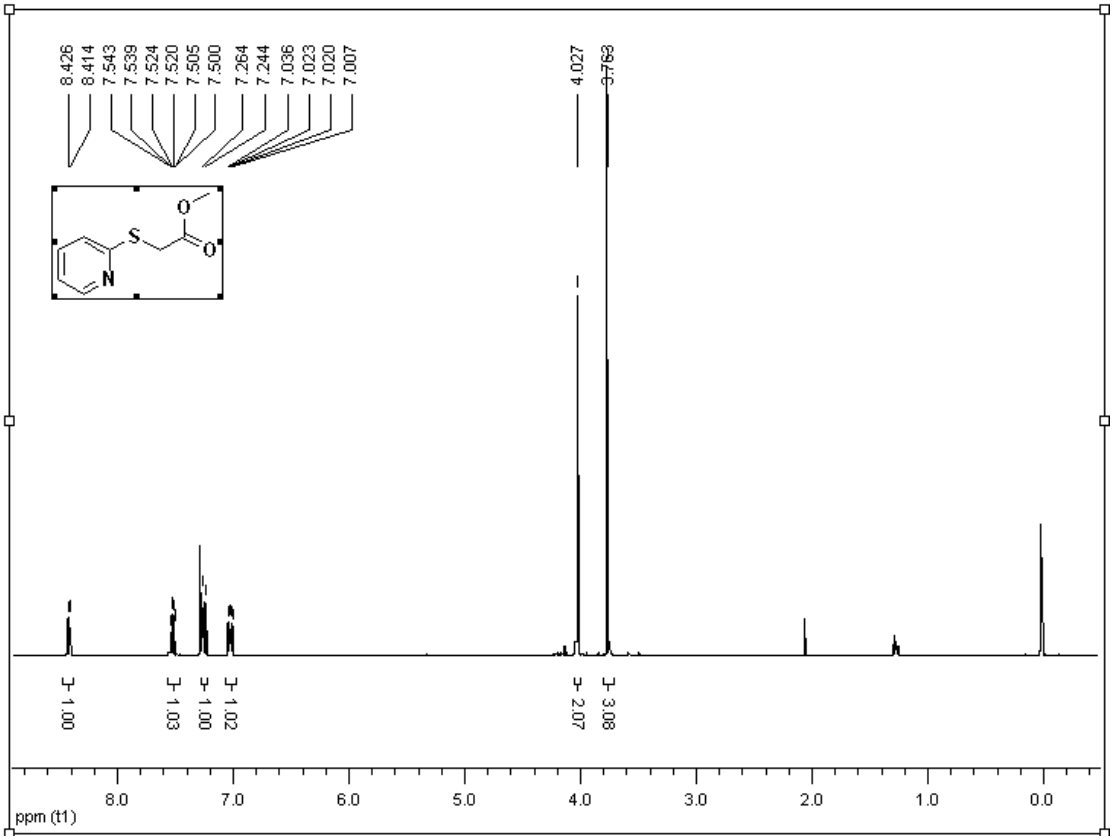
7.943
7.721
7.702
7.683
7.614
7.595
7.576
4.131
3.749
O
O
O
S
O
2.00
2.07
2.07
3.07
5.0
0.0
ppm (t1)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7.543
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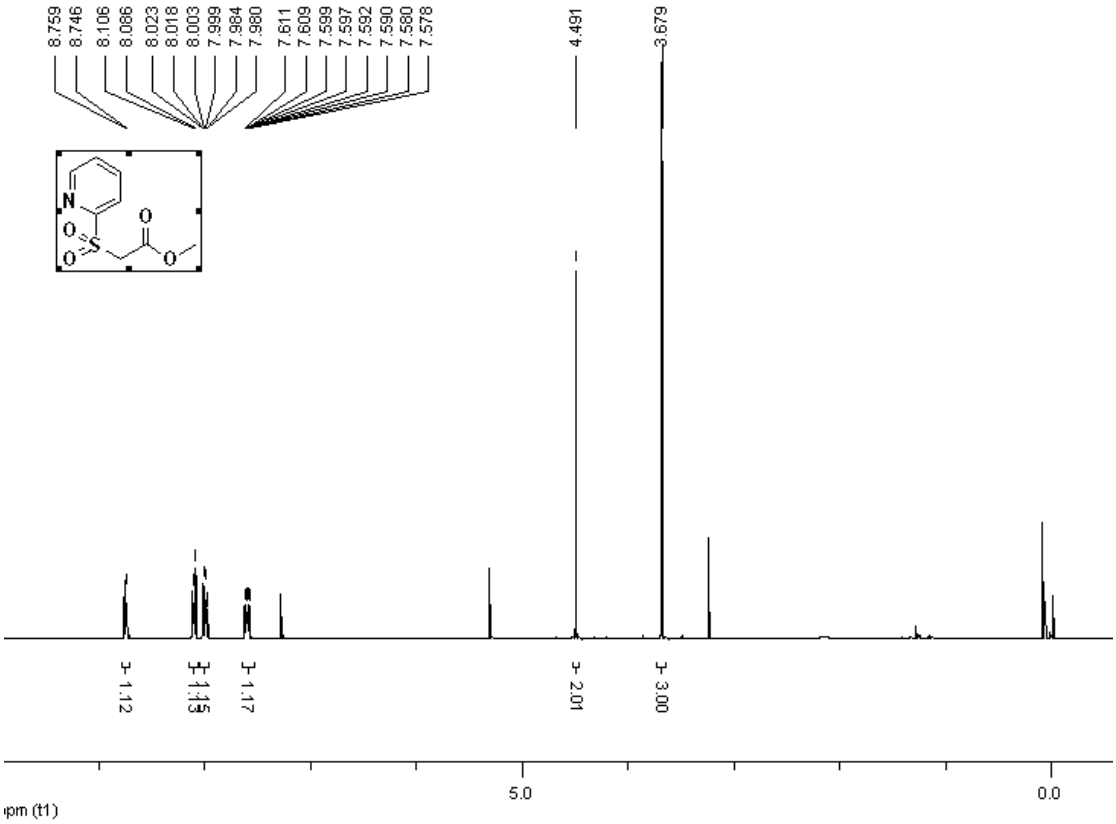
7.524
7.520
7.505
7.500
7.264
7.244
7.036
7.023
7.020
7.007
4.027
3.763
O
S
O
N
1.00
1.03
1.00
1.02
2.07
3.08
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ppm (t1)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8.746
8.106
8.086
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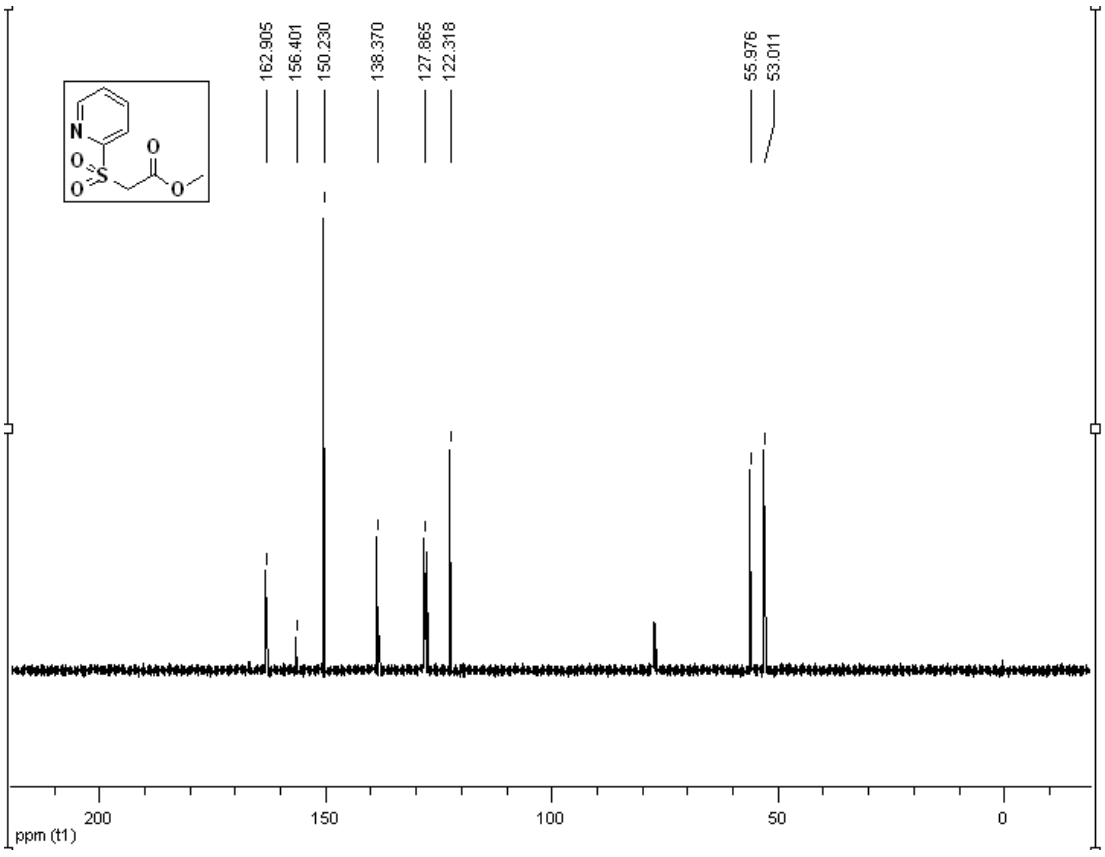
8.018
8.003
7.999
7.984
7.980
7.611
7.609
7.599
7.597
7.592
7.590
7.580
7.576
4.491
3.679
1.12
1.13
1.17
2.01
3.00
5.0
0.0
ppm (t1)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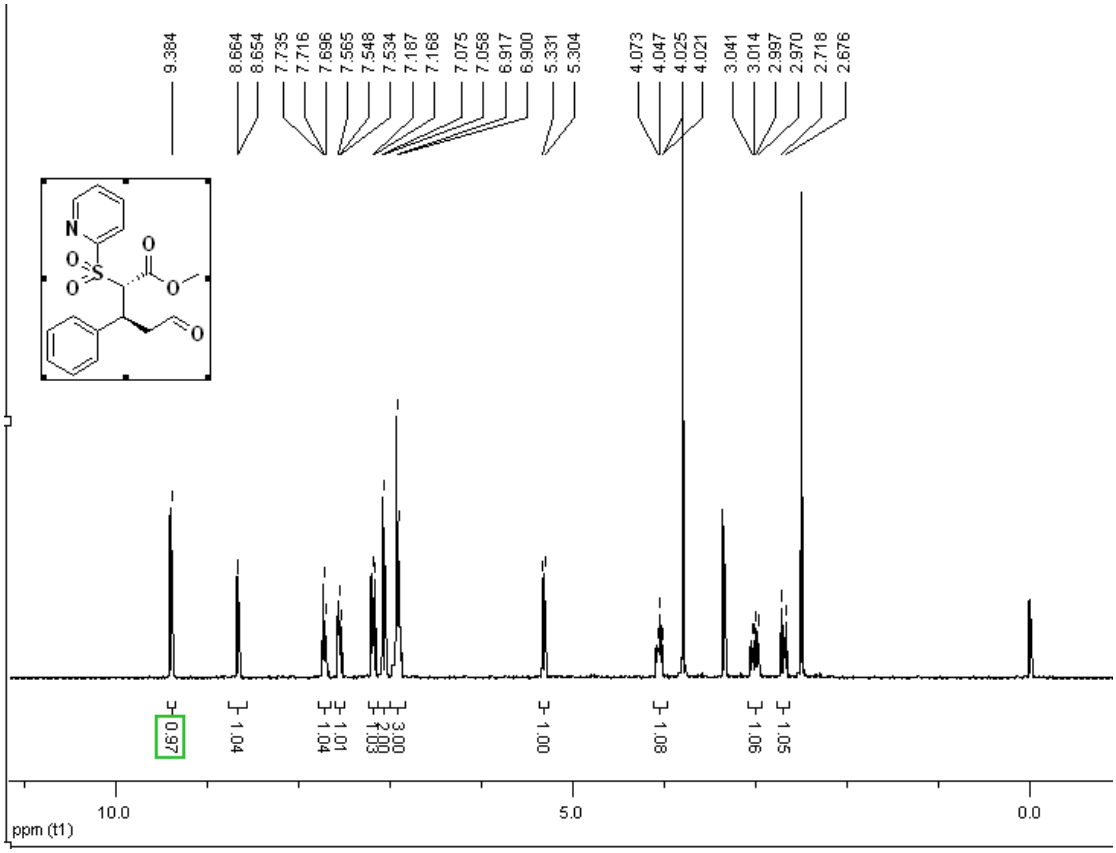
150
100
50
0
ppm (t1)

3a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8.664
8.654
7.735
7.716
7.696
7.565
7.548
7.534
7.187
7.168
7.075
7.058
6.917
6.900
5.331
5.304
4.073
4.047
4.025
4.021
3.041
3.014
2.997
2.970
2.718
2.676
0.97
1.04
1.04
1.01
3.00
2.08
1.00
1.08
1.06
1.05
10.0
5.0
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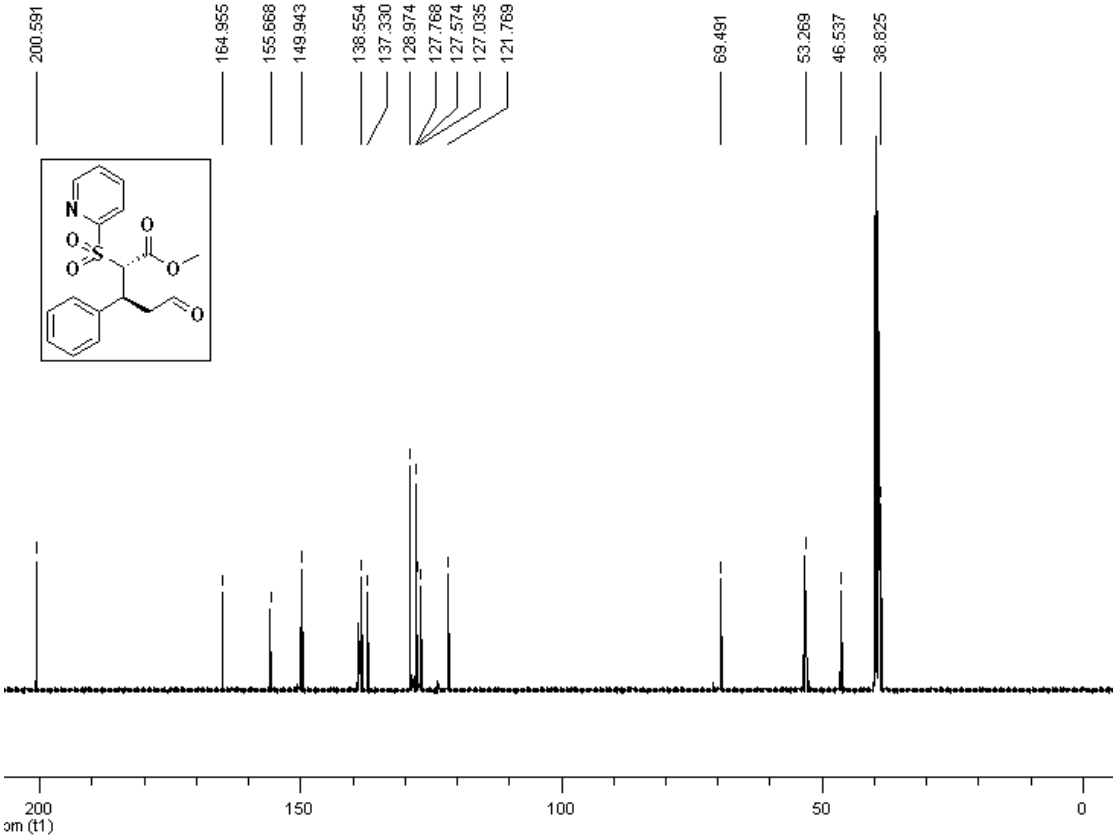
ppm (t1)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164.955
155.668
149.943
138.554
137.330
128.974
127.768
127.574
127.035
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69.491
53.269
46.537
38.825
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150
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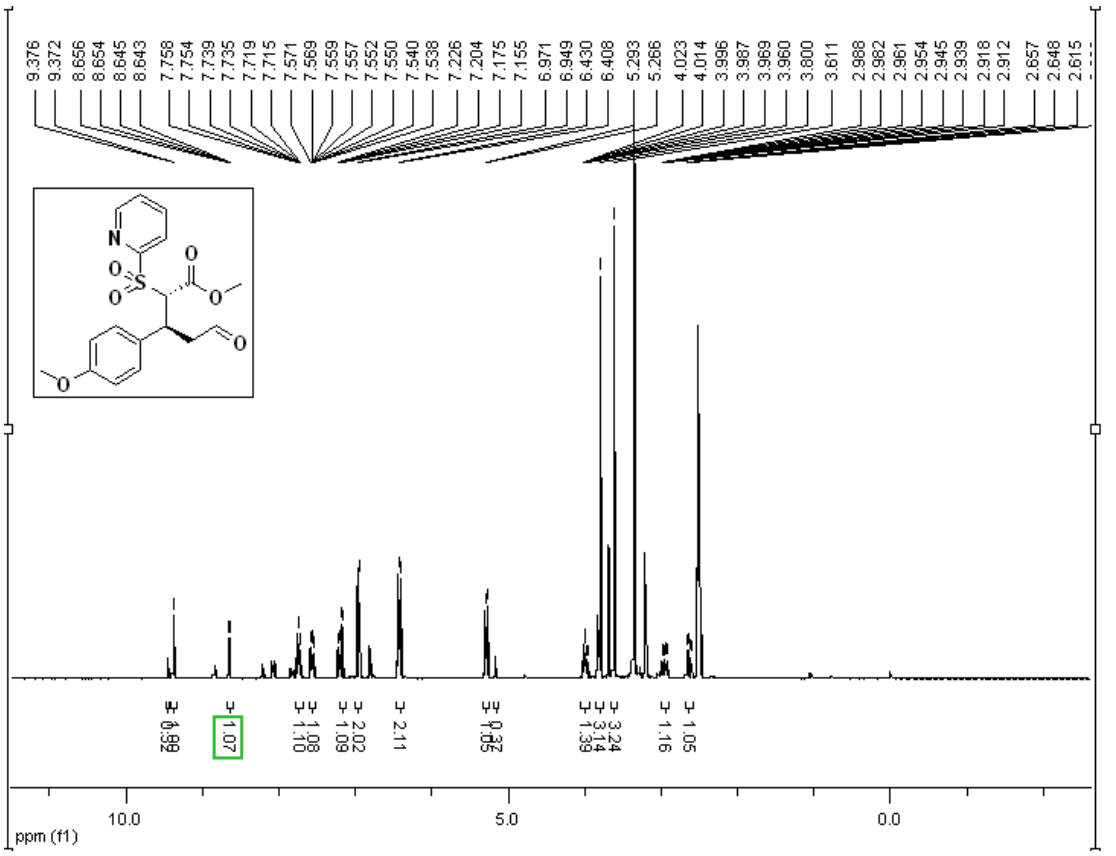
50
0
ppm (t1)

3b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9.372
8.656
8.654
8.645
8.643
7.758
7.754
7.739
7.735
7.719
7.715
7.571
7.569
7.559
7.557
7.552
7.550
7.540
7.538
7.226
7.204
7.175
7.155
6.971
6.949
6.430
6.408
5.293
5.266
4.023
4.014
3.996
3.987
3.969
3.960
3.800
3.611
2.988
2.982
2.961
2.954
2.945
2.939
2.918
2.912
2.657
2.648
2.615
0.89
1.07
1.10
1.08
1.09
2.02
2.11
0.87
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3.14
3.24
1.16
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10.0
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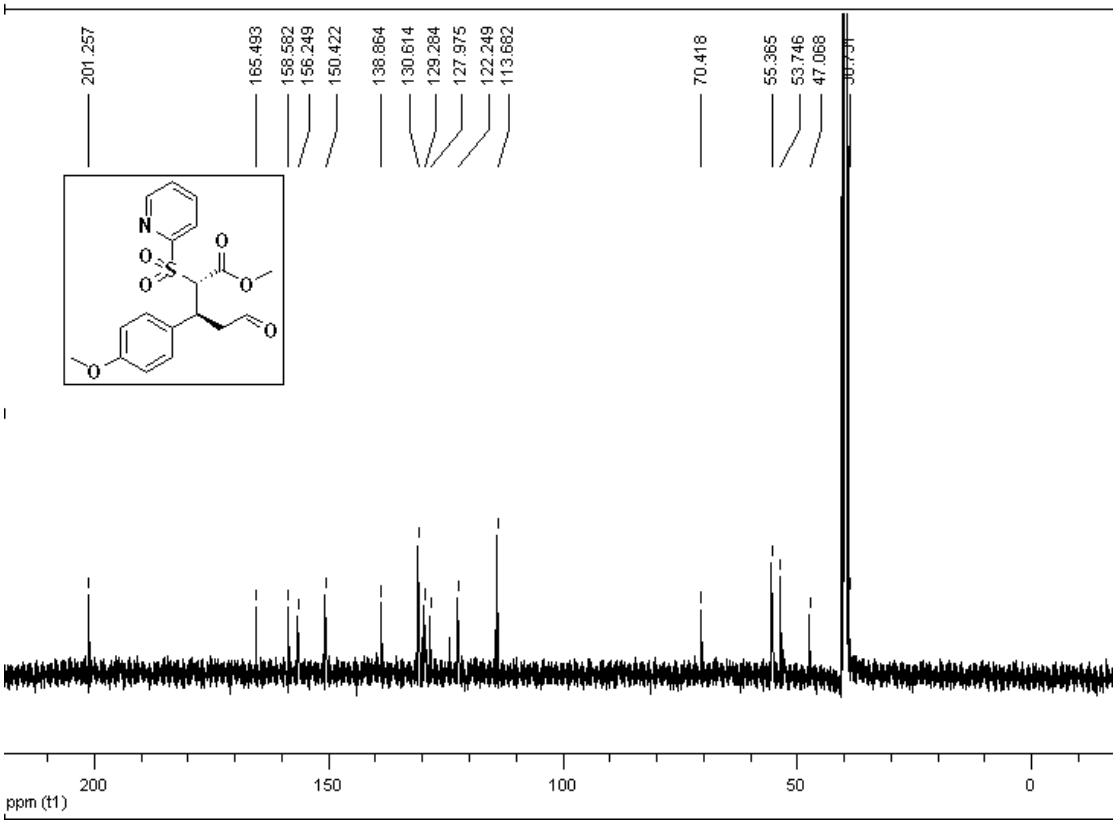
0.0
ppm (f1)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158.582
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138.864
130.614
129.284
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122.249
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70.418
55.365
53.746
47.068
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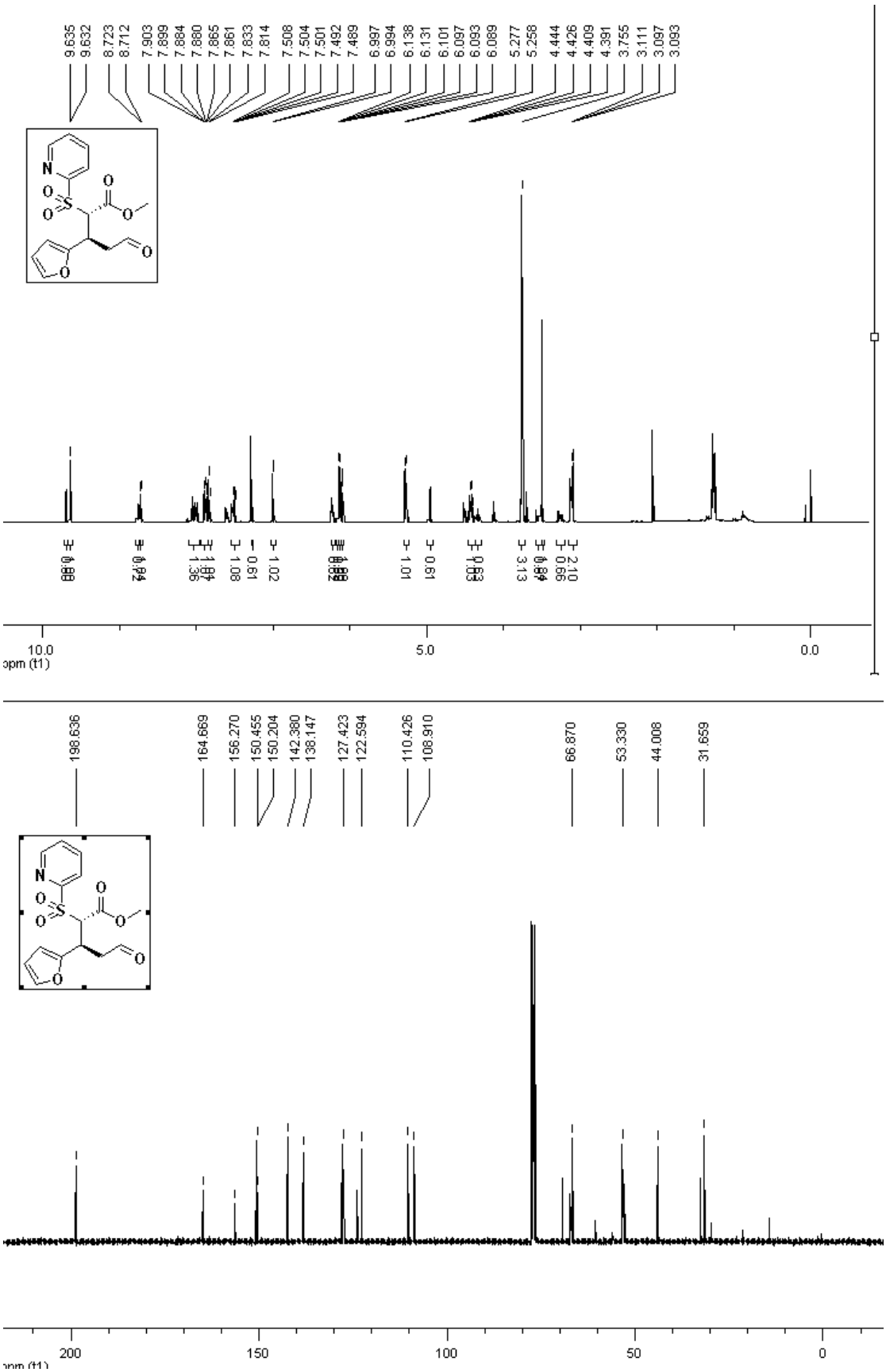
150
100
50
0
ppm (t1)

3c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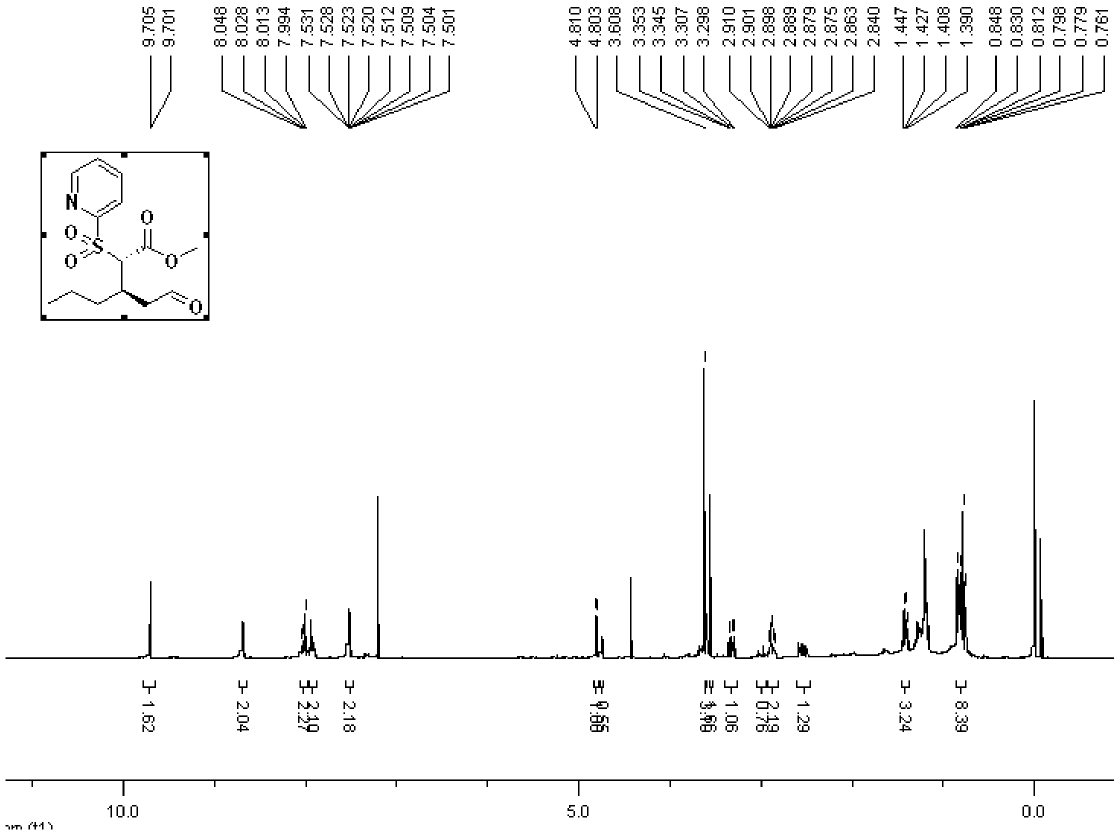
7.899
7.884
7.880
7.865
7.861
7.833
7.814
7.508
7.504
7.501
7.492
7.489
6.997
6.994
6.138
6.131
6.101
6.097
6.093
6.089
5.277
5.258
4.444
4.426
4.409
4.391
3.755
3.111
3.097
3.093
10.0
5.0
0.0
ppm (t1)
198.636
164.669
156.270
150.455
150.204
142.380
138.147
127.423
122.594
110.426
108.910
66.870
53.330
44.008
31.659
200
150
100
50
0

3d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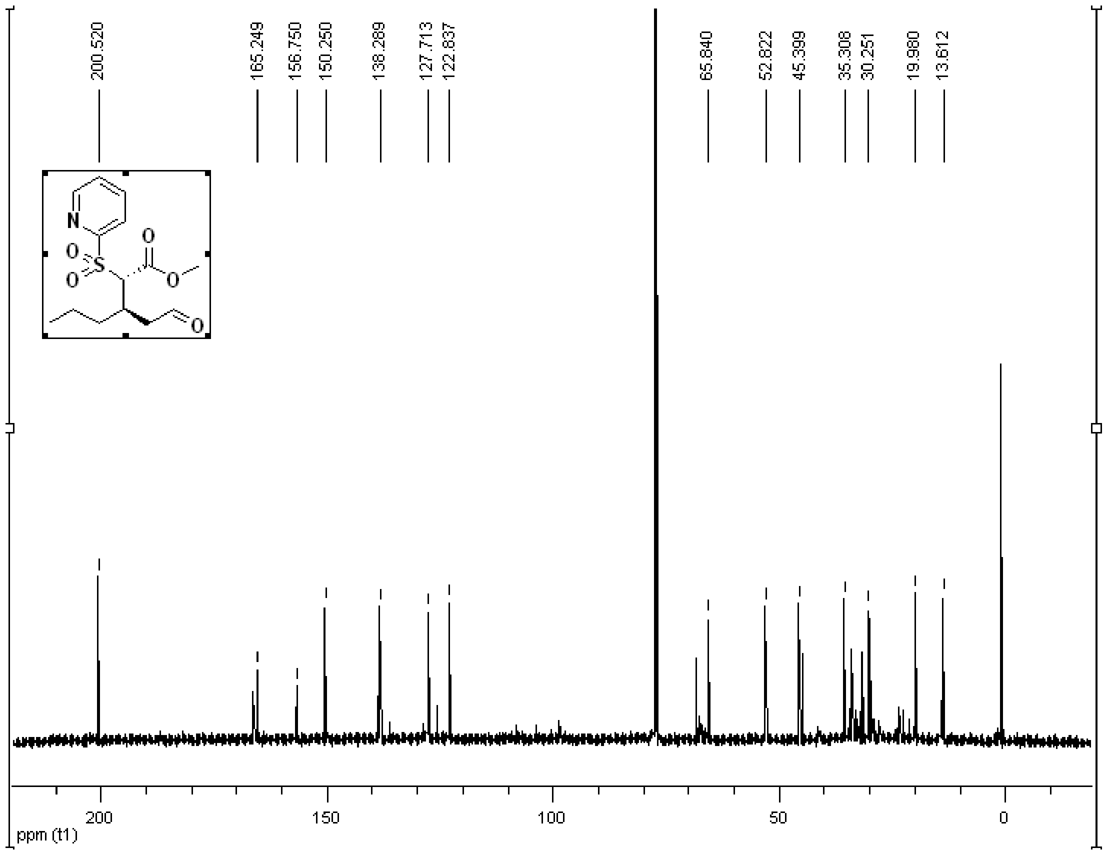
7.512
7.509
7.504
7.501
4.810
4.803
3.608
3.353
3.345
3.307
3.298
2.910
2.901
2.898
2.889
2.879
2.875
2.863
2.840
1.447
1.427
1.408
1.390
0.848
0.830
0.812
0.798
0.779
0.761
N
O
S
O
O
O
O
1.62
2.04
2.18
1.06
1.29
3.24
8.39
10.0
5.0
0.0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150.250
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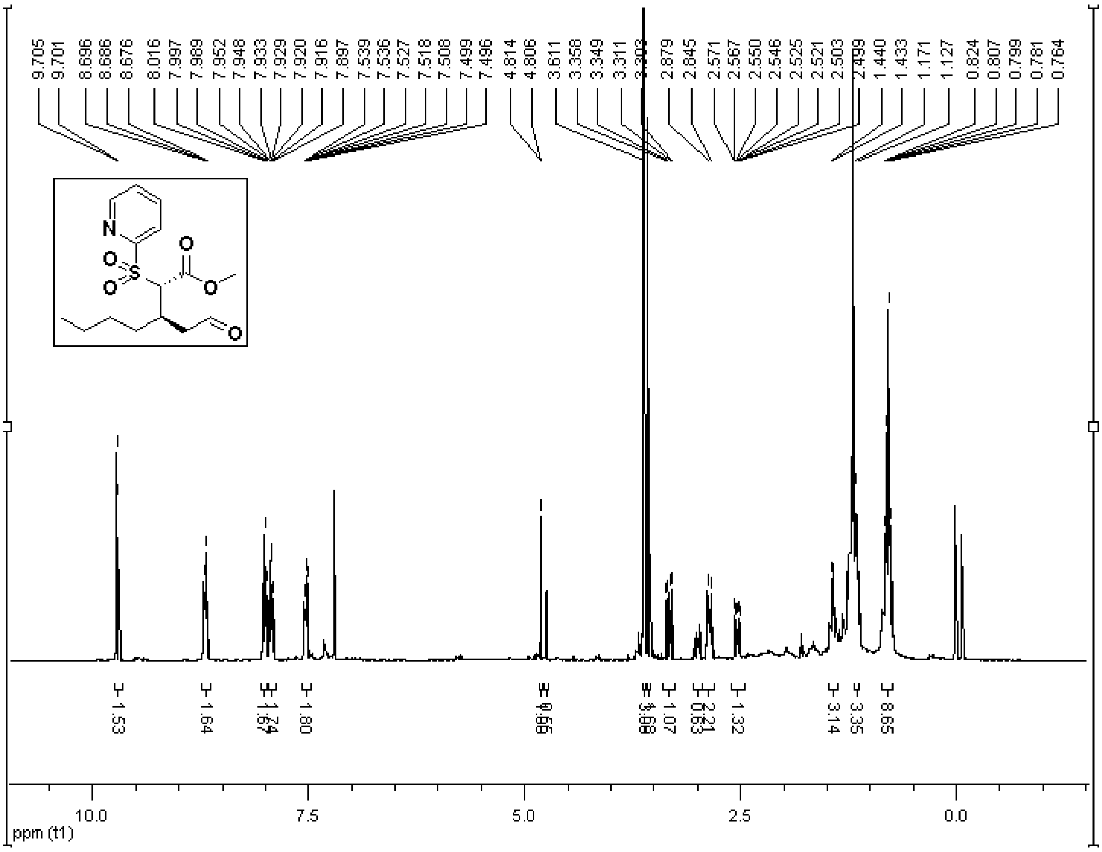
127.713
122.837
65.840
52.822
45.399
35.308
30.251
19.980
13.612
N
O
S
O
O
O
O
200
150
100
50
0
ppm (t1)

3e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8.676
8.016
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7.920
7.916
7.897
7.539
7.536
7.527
7.518
7.508
7.499
7.496
4.814
4.806
3.611
3.358
3.349
3.311
3.303
2.879
2.845
2.571
2.567
2.550
2.546
2.525
2.521
2.503
2.499
1.440
1.433
1.171
1.127
0.824
0.807
0.799
0.781
0.764
N
O
O
S
O
O
O
1.53
1.64
1.74
1.80
3.08
1.07
2.21
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3.14
3.35
8.65
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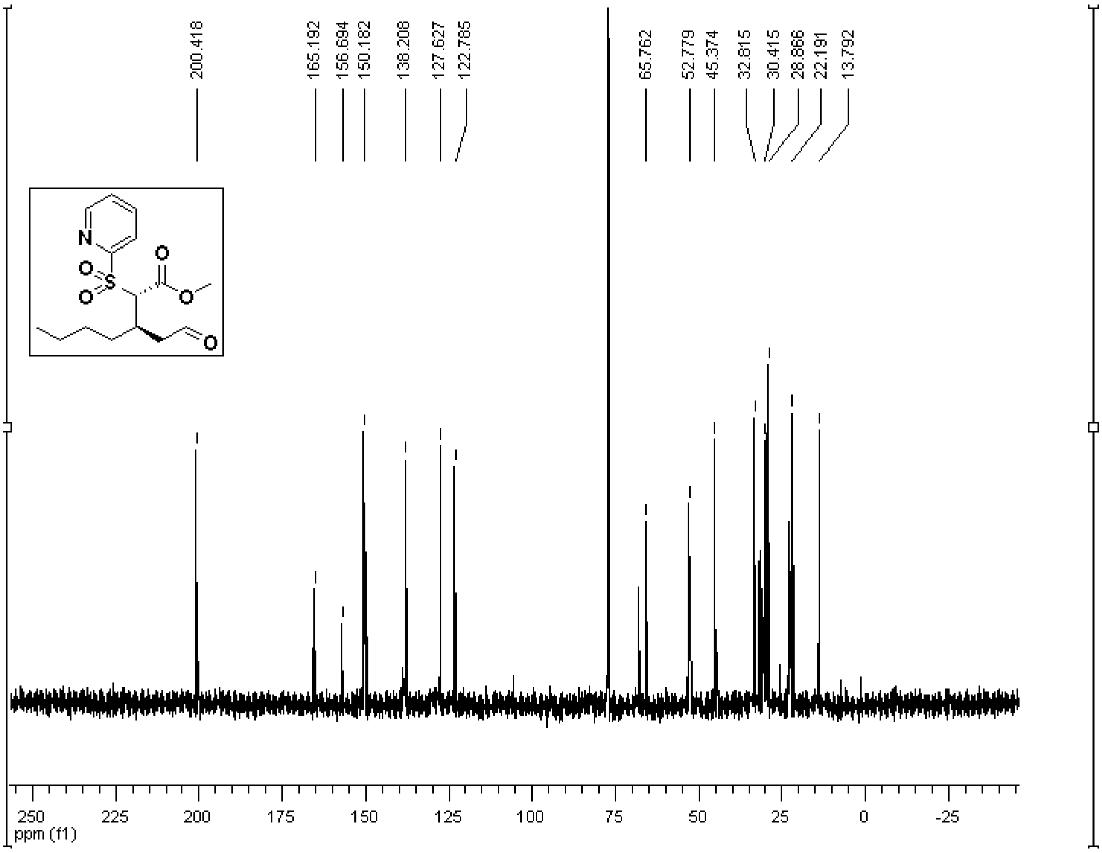
7.5
5.0
2.5
0.0
ppm (t1)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65.762
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45.374
32.815
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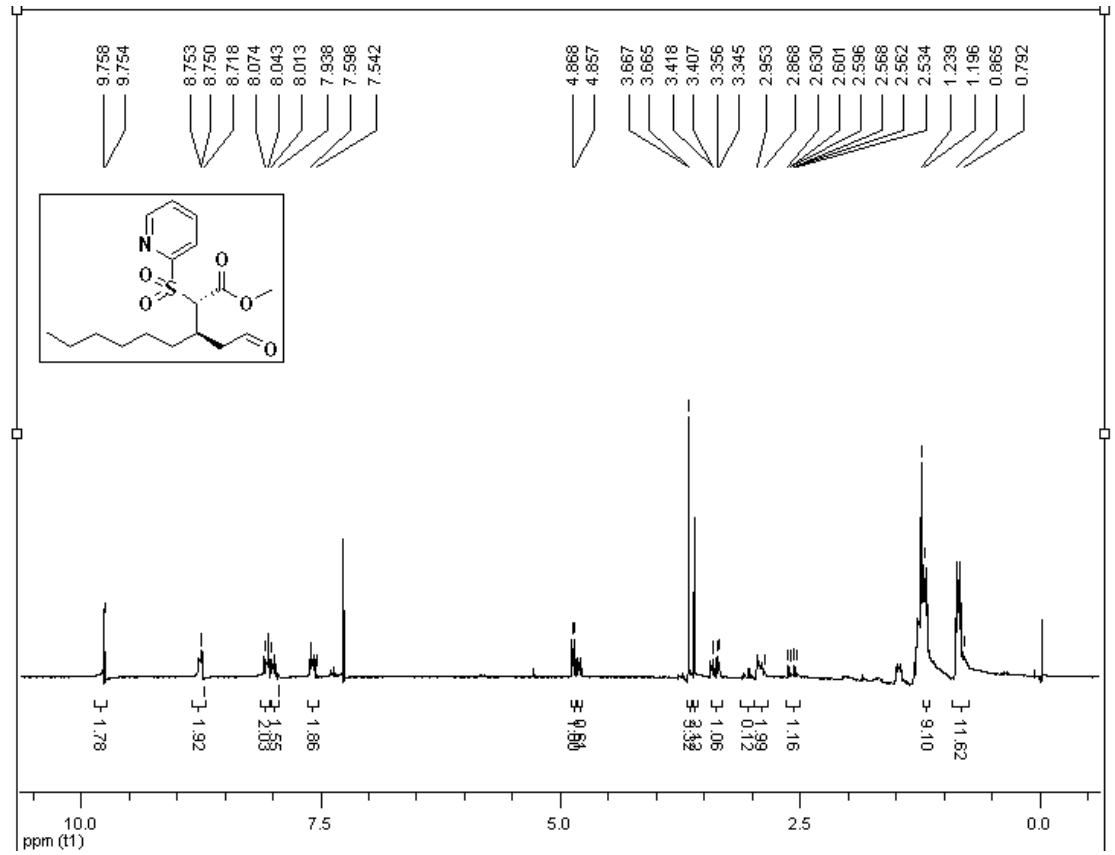
22.191
13.792
N
O
O
S
O
O
O
250
225
200
175
150
125
100
75
50
25
0
-25
ppm (f1)

3f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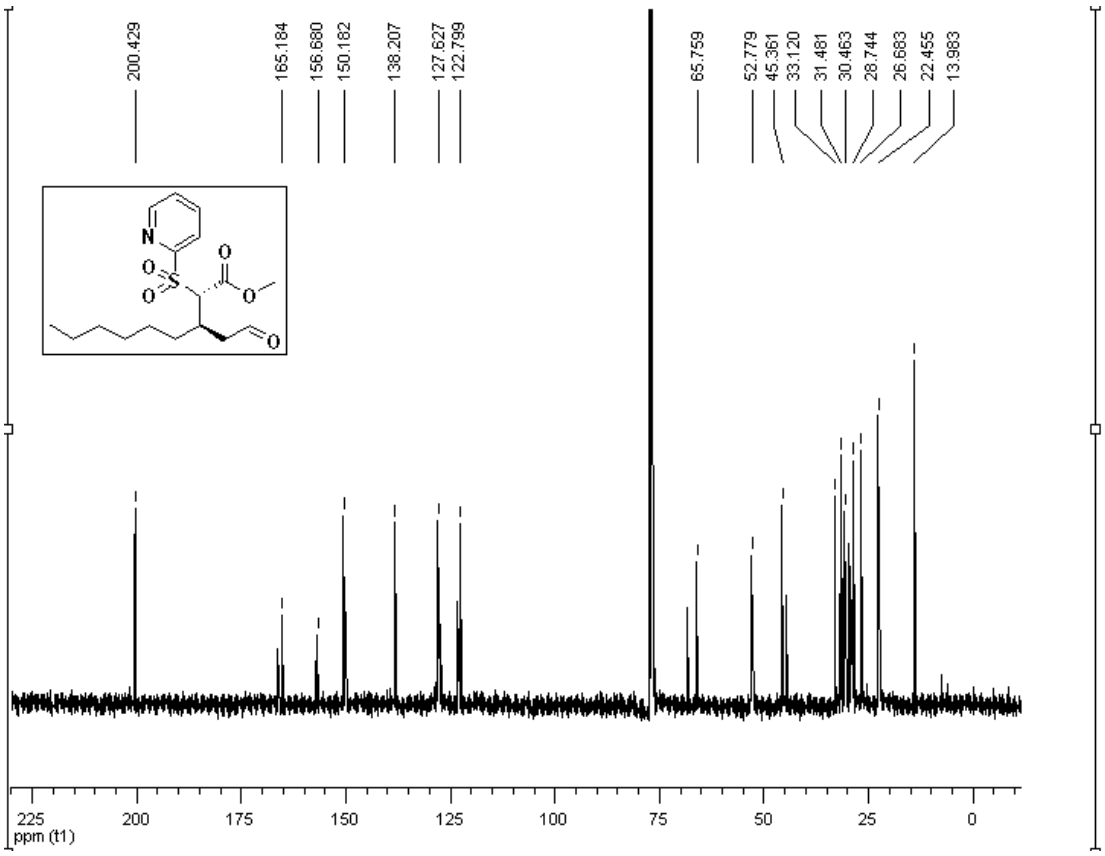
8.043
8.013
7.938
7.598
7.542
4.868
4.857
3.667
3.665
3.418
3.407
3.356
3.345
2.953
2.868
2.630
2.601
2.596
2.568
2.562
2.534
1.239
1.196
0.865
0.792
1.78
1.92
2.03
1.86
9.00
3.32
1.06
1.12
1.99
1.16
9.10
11.62
10.0
7.5
5.0
2.5
0.0
ppm (t1)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150.182
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127.627
122.799
65.759
52.779
45.361
33.120
31.481
30.463
28.744
26.683
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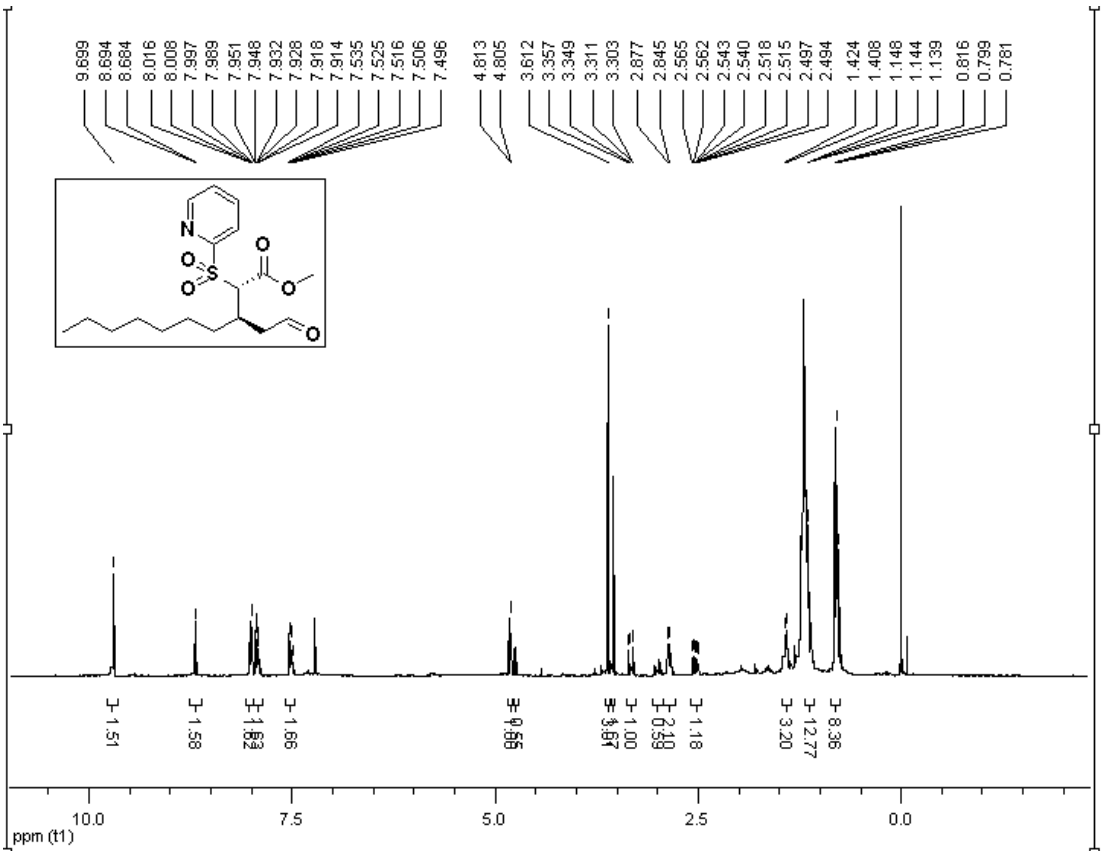
13.983
225
200
175
150
125
100
75
50
25
0
ppm (t1)

3g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7.948
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7.928
7.918
7.914
7.535
7.525
7.516
7.506
7.496
4.813
4.805
3.612
3.357
3.349
3.311
3.303
2.877
2.845
2.565
2.562
2.543
2.540
2.518
2.515
2.497
2.494
1.424
1.408
1.148
1.144
1.139
0.816
0.799
0.781
1.51
1.58
1.82
1.66
0.95
3.97
1.00
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3.20
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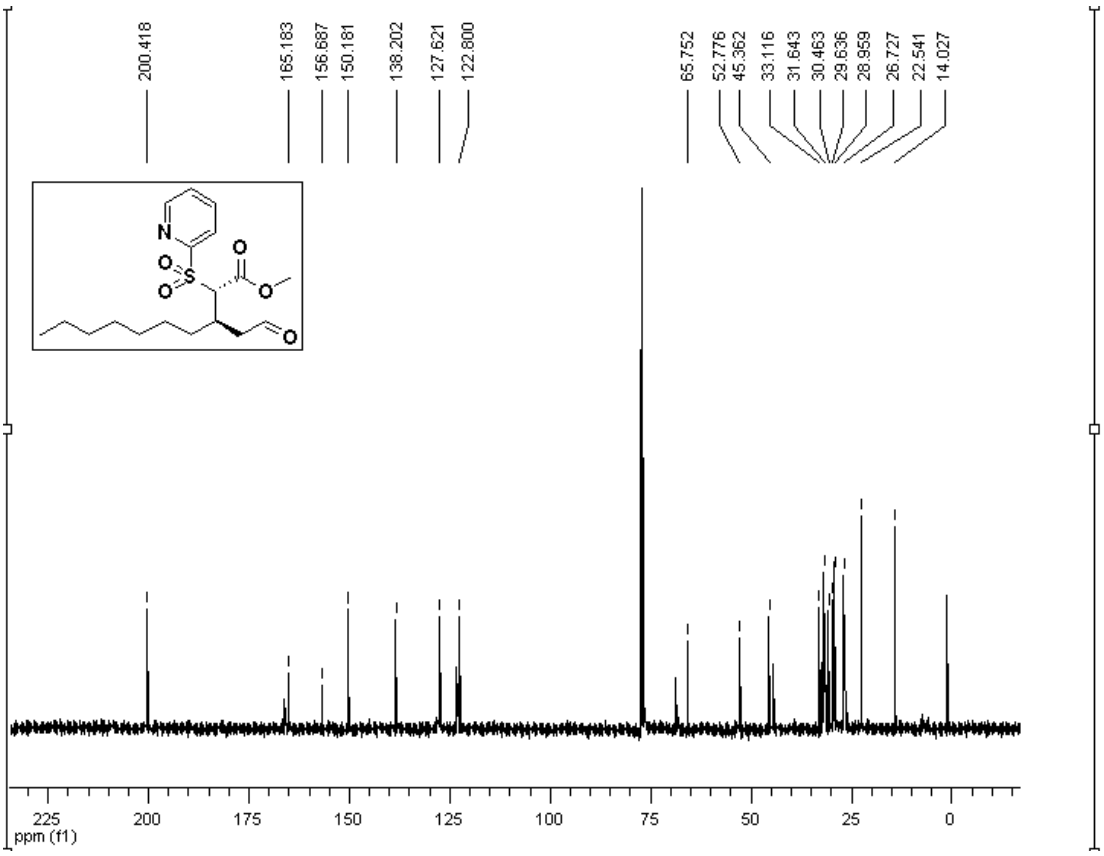
7.5
5.0
2.5
0.0
ppm (t1)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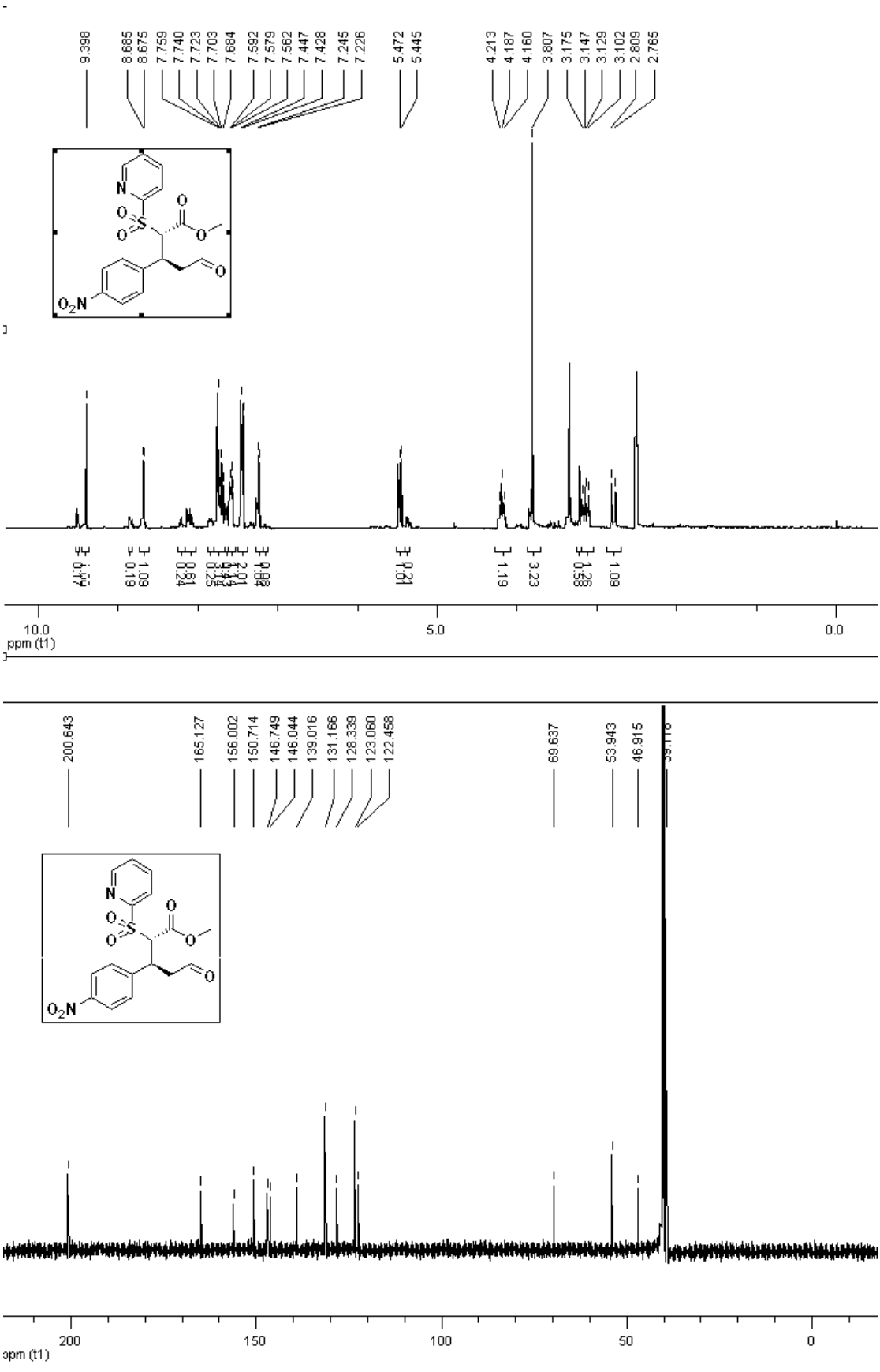
30.463
29.636
28.959
26.727
22.541
14.027
225
200
175
150
125
100
75
50
25
0
ppm (f1)

3h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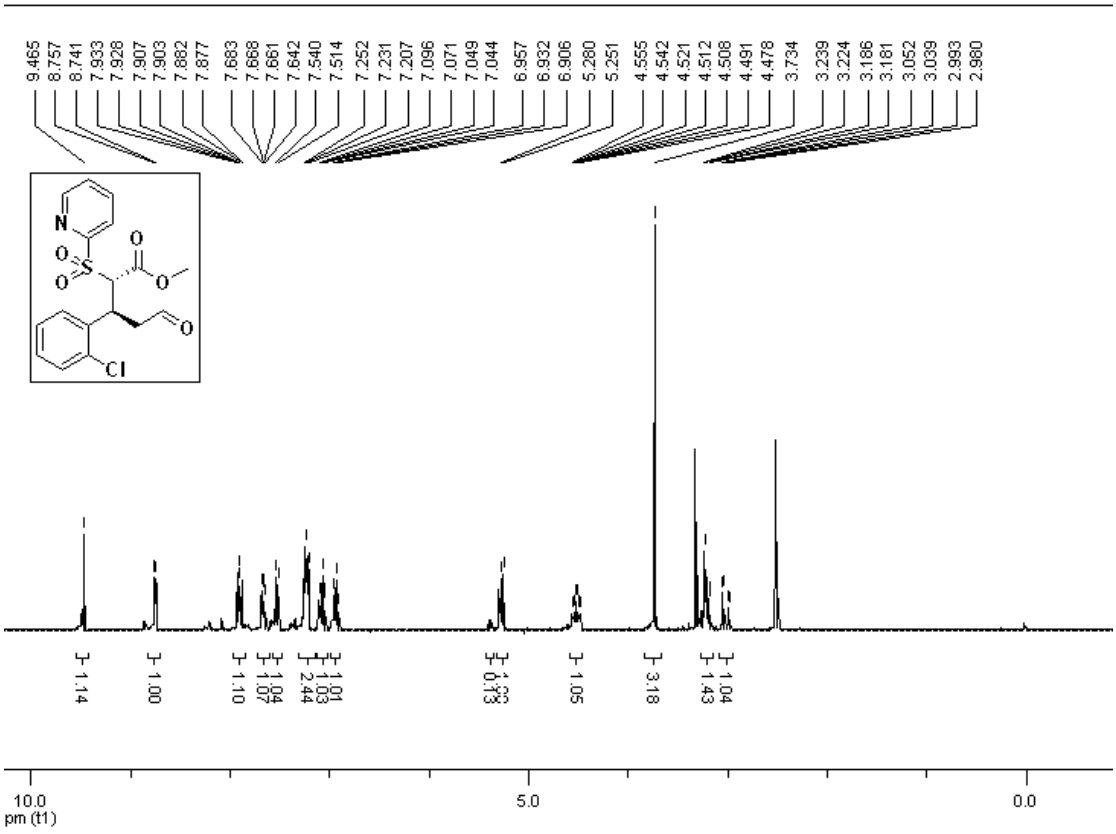
7.740
7.723
7.703
7.684
7.592
7.579
7.562
7.447
7.428
7.245
7.226
5.472
5.445
4.213
4.187
4.160
3.807
3.175
3.147
3.129
3.102
2.809
2.765
10.0
5.0
0.0
ppm (t1)
200.643
165.127
156.002
150.714
146.749
146.044
139.016
131.166
128.339
123.060
122.458
69.637
53.943
46.915
200
150
100
50
0
ppm (t1)

3i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7.903
7.882
7.877
7.683
7.668
7.661
7.642
7.540
7.514
7.252
7.231
7.207
7.096
7.071
7.049
7.044
6.957
6.932
6.906
5.280
5.251
4.555
4.542
4.521
4.512
4.508
4.491
4.478
3.734
3.239
3.224
3.186
3.181
3.052
3.039
2.993
2.980
1.14
1.00
1.10
1.07
1.04
2.44
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0.93
1.05
3.18
1.43
1.04
10.0
5.0
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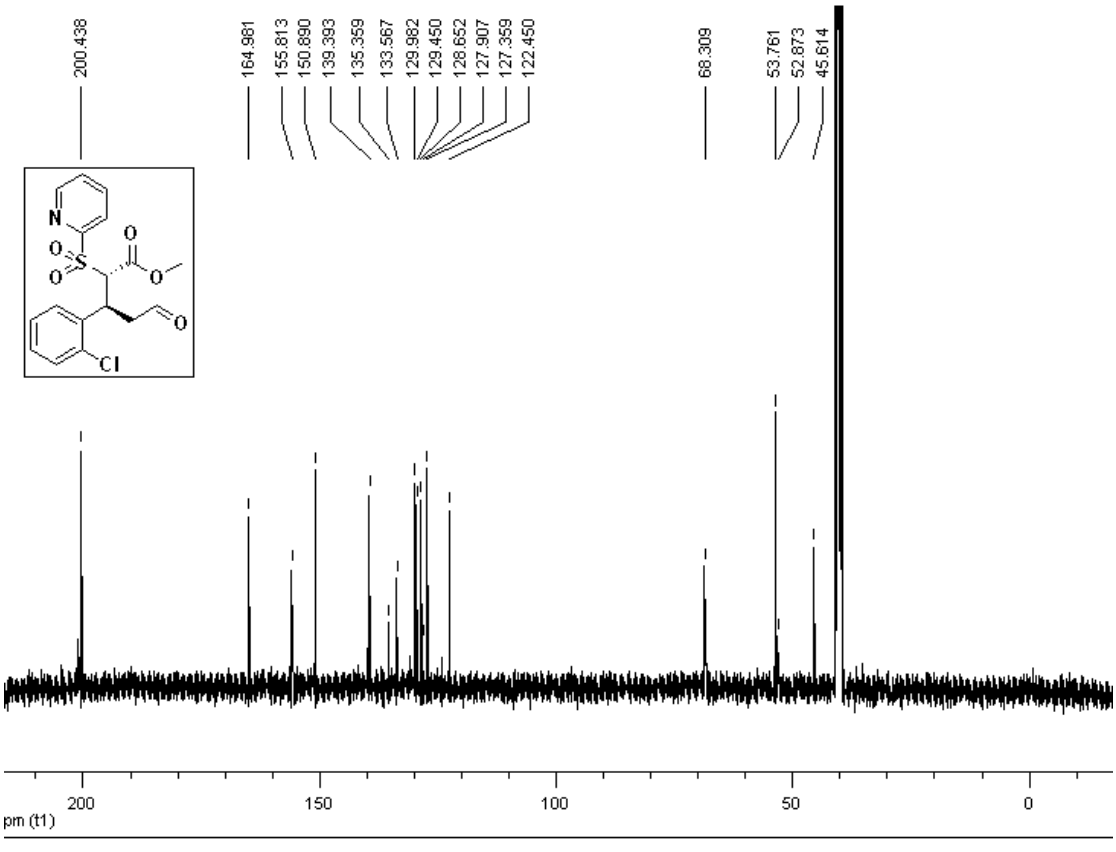
ppm (t1)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135.359
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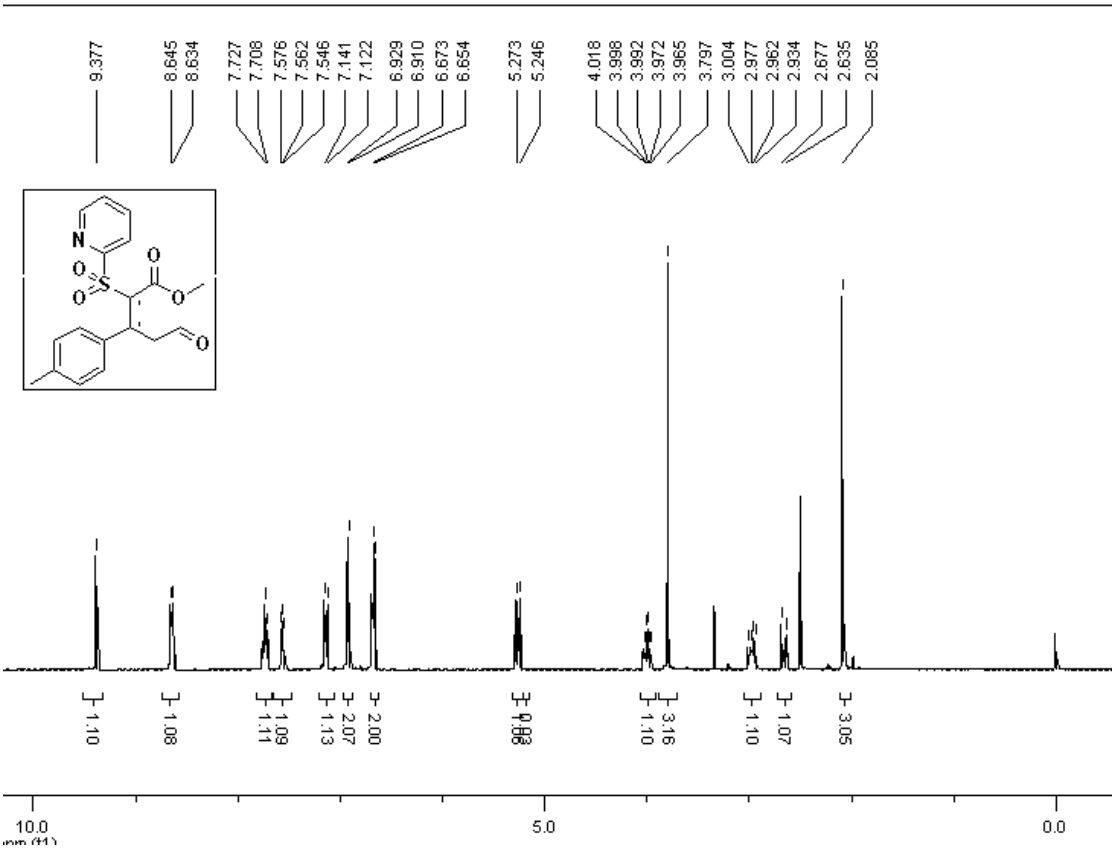
129.982
129.450
128.652
127.907
127.359
122.450
68.309
53.761
52.873
45.614
200
150
100
50
0
ppm (t1)

3j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7.708
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7.562
7.546
7.141
7.122
6.929
6.910
6.673
6.654
5.273
5.246
4.018
3.998
3.992
3.972
3.965
3.797
3.004
2.977
2.962
2.934
2.677
2.635
2.085
1.10
1.08
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1.09
1.13
2.07
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1.07
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10.0
5.0
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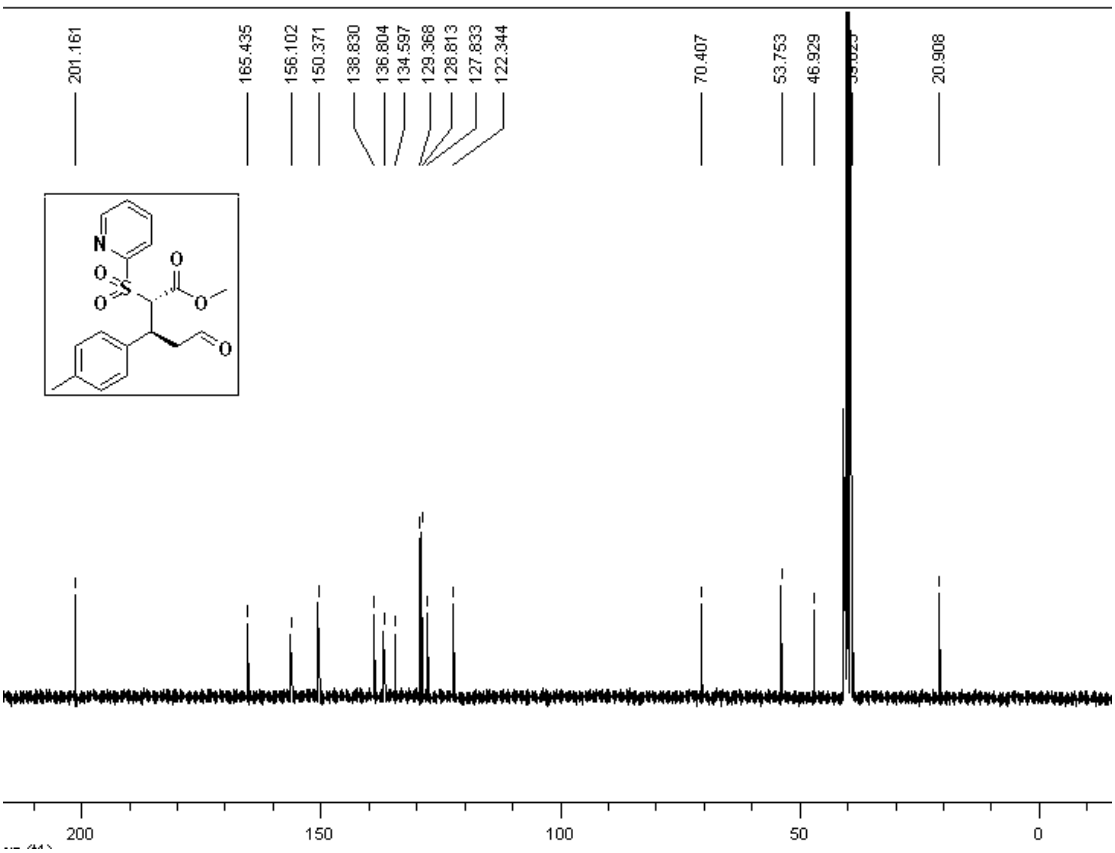
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136.804
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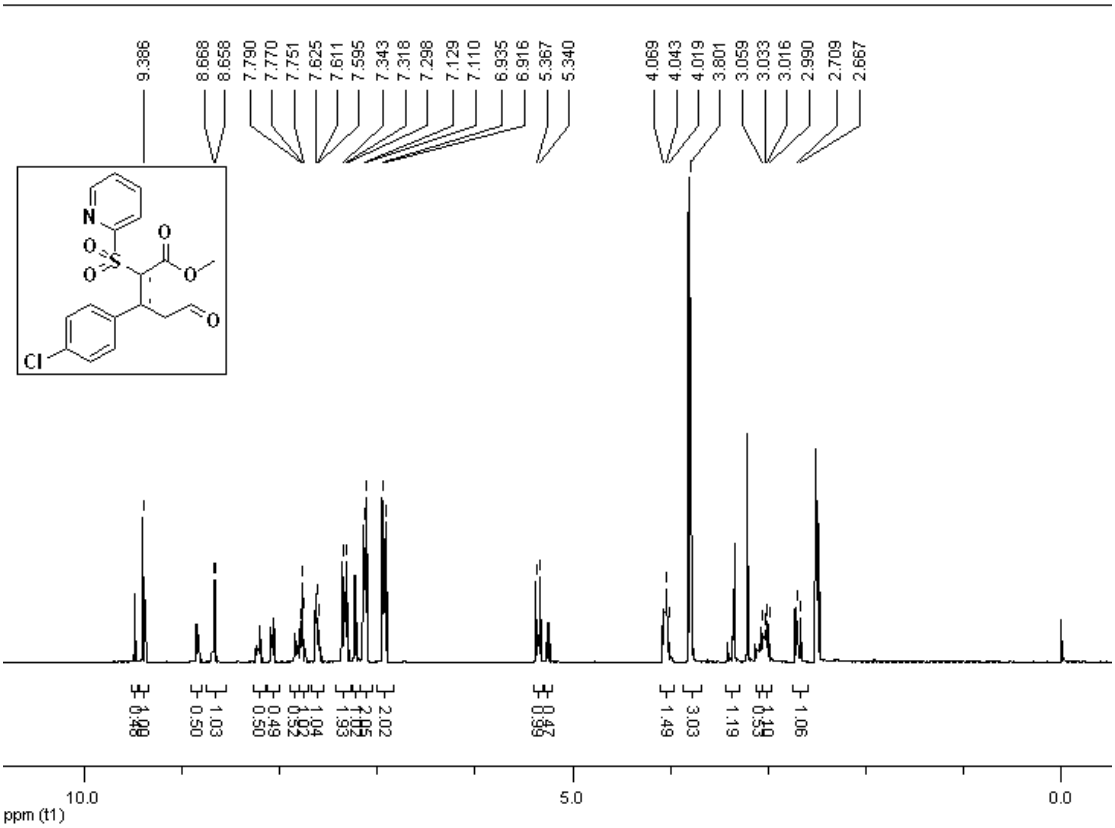
127.833
122.344
70.407
53.753
46.929
20.908
200
150
100
50
0

3k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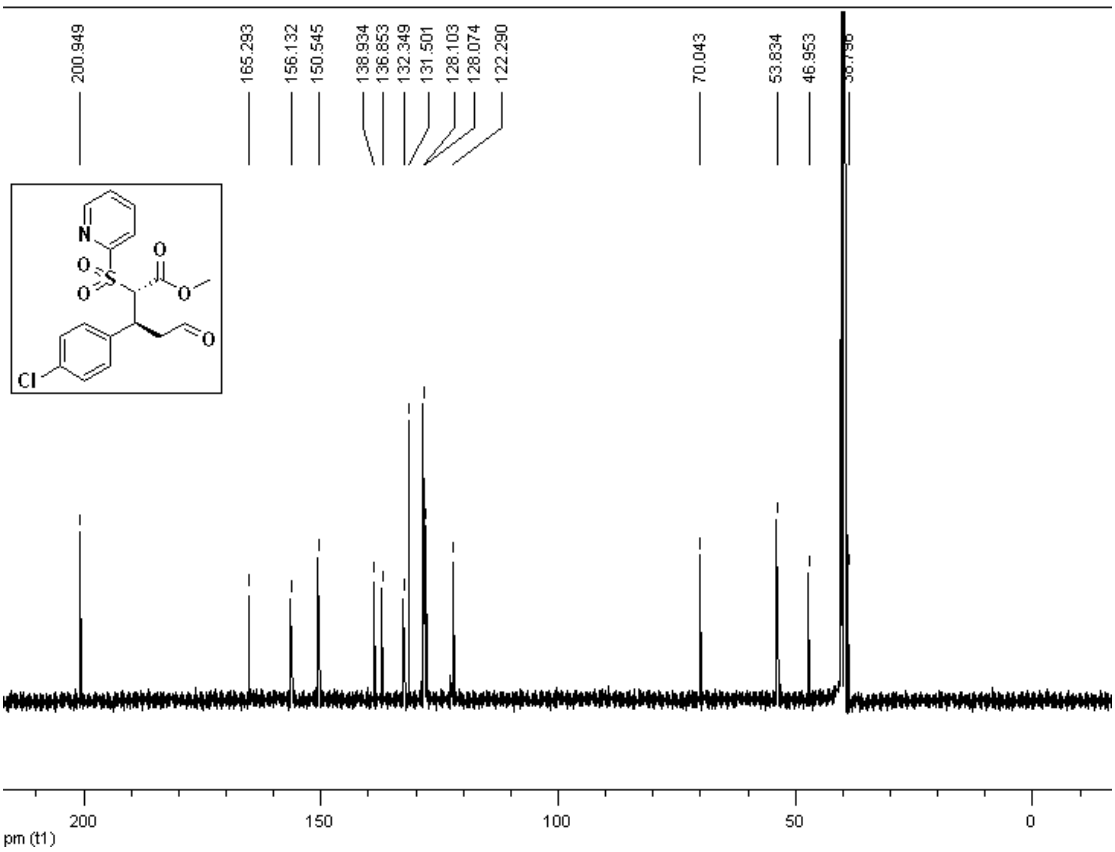
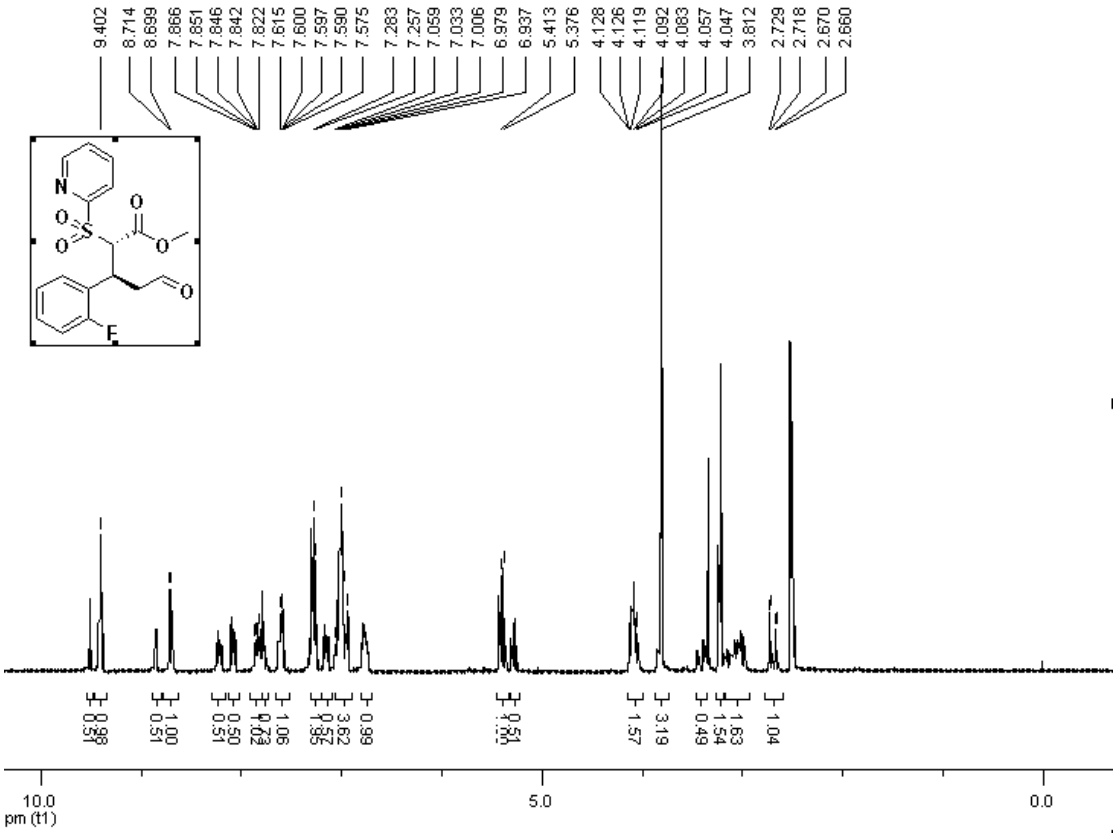
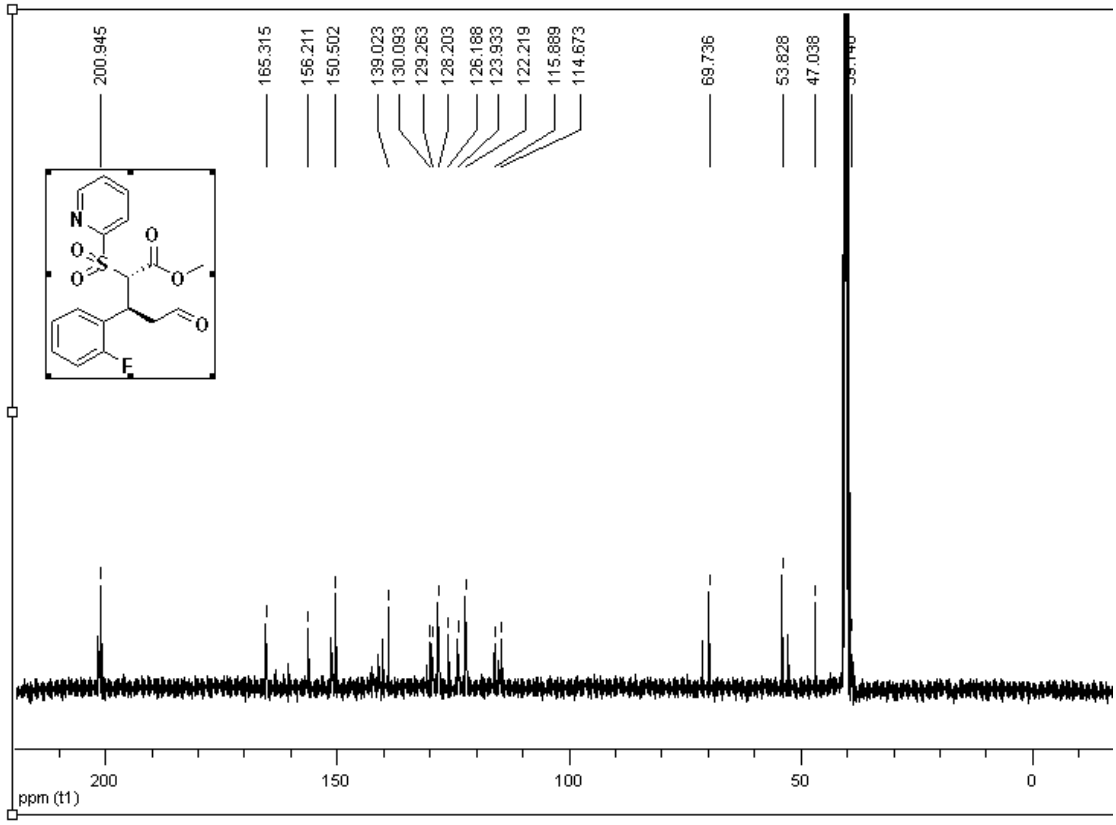
7.110
6.935
6.916
5.367
5.340
4.069
4.043
4.019
3.801
3.059
3.033
3.016
2.990
2.709
2.667
0.98
0.50
1.03
0.50
0.49
0.52
1.04
1.93
2.02
0.99
1.49
3.03
1.19
0.55
1.06
10.0
5.0
0.0
ppm (t1)

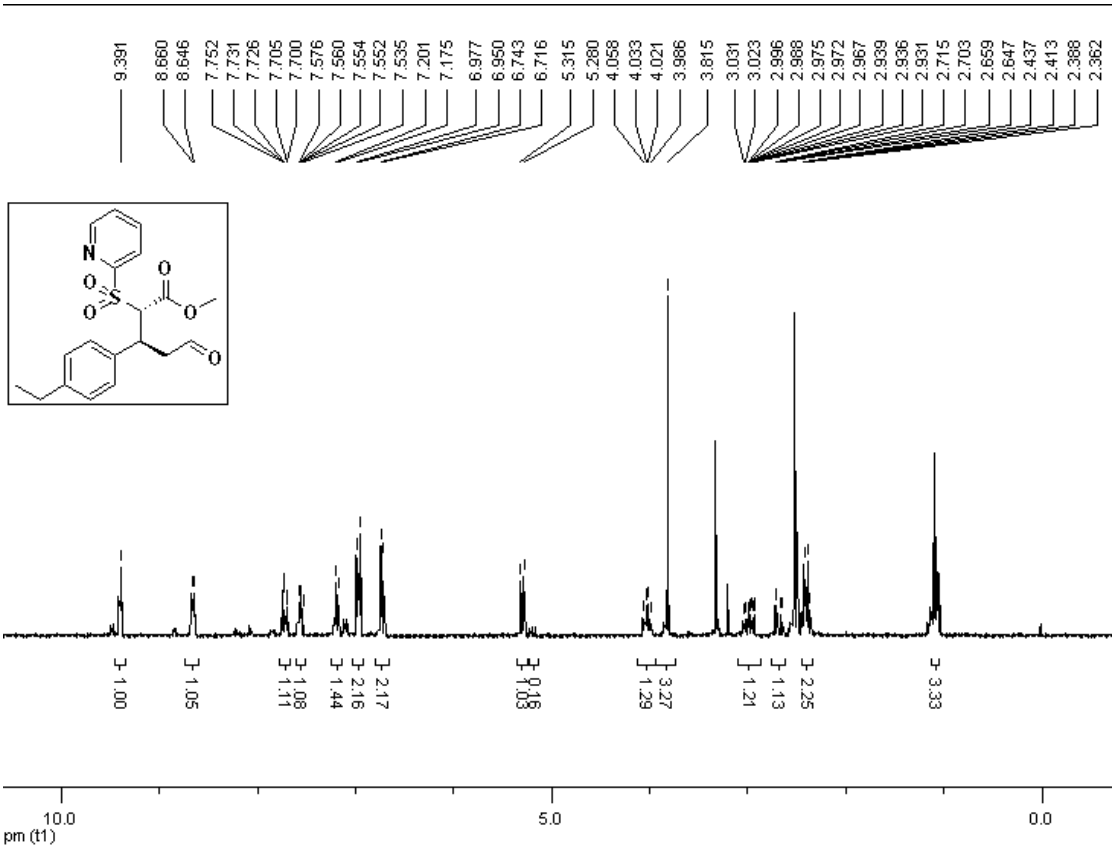

200.949
165.293
156.132
150.545
138.934
136.853
132.349
131.501
128.103
128.074
122.290
70.043
53.834
46.953
200
150
100
50
0
ppm (t1)

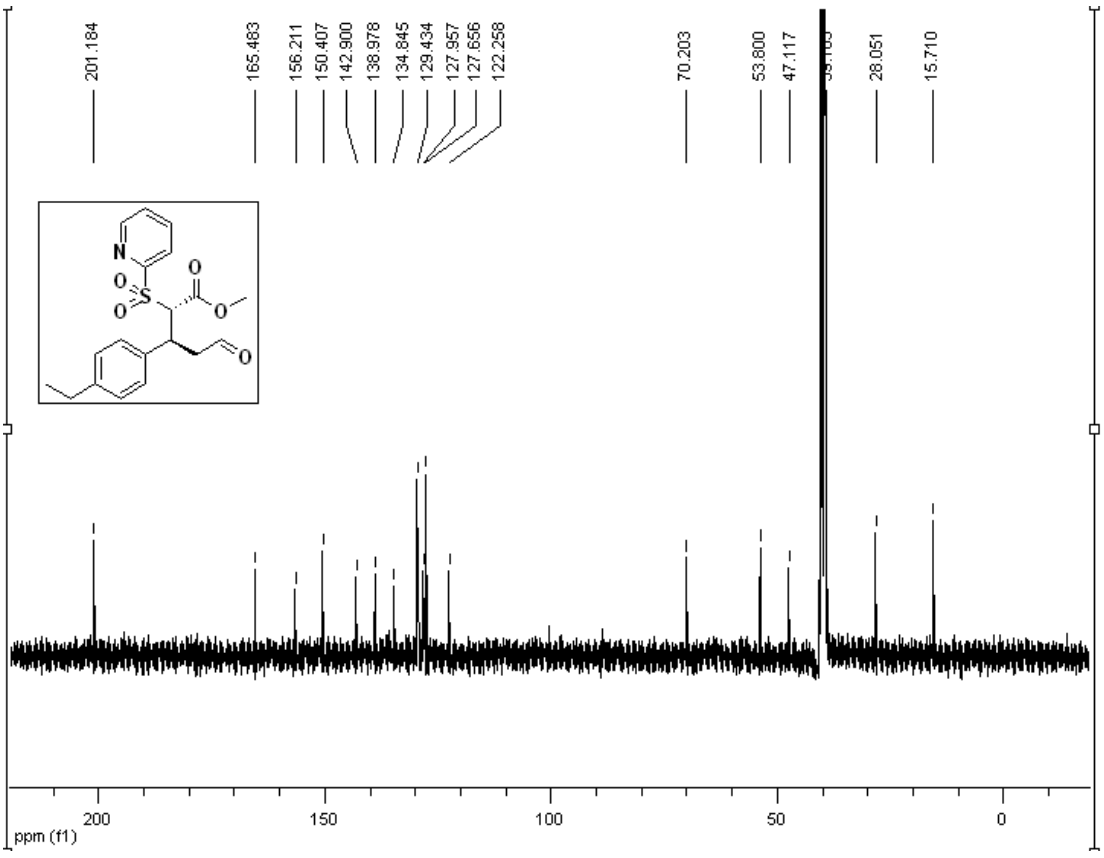
3l


9.402
8.714
8.699
7.866
7.851
7.846
7.842
7.822
7.615
7.600
7.597
7.590
7.575
7.283
7.257
7.059
7.033
7.006
6.979
6.937
5.413
5.376
4.128
4.126
4.119
4.092
4.083
4.057
4.047
3.812
2.729
2.718
2.670
2.660
0.98
1.00
0.51
0.50
0.51
0.42
1.06
3.62
0.99
1.00
1.57
3.19
0.49
1.54
1.63
1.04
10.0
pm (t1)
5.0
0.0

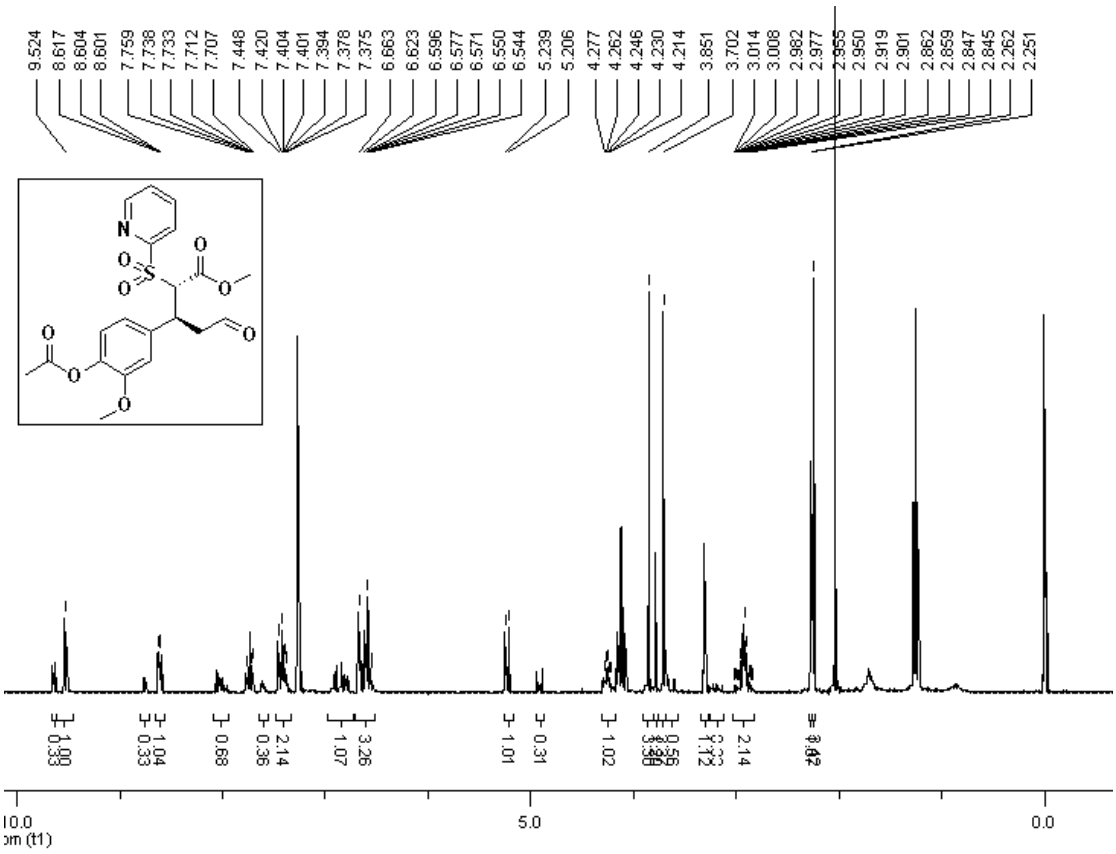

200.945
165.315
156.211
150.502
139.023
130.093
129.263
128.203
126.188
123.933
122.219
115.889
114.673
69.736
53.828
47.038
200
150
100
50
0
ppm (t1)

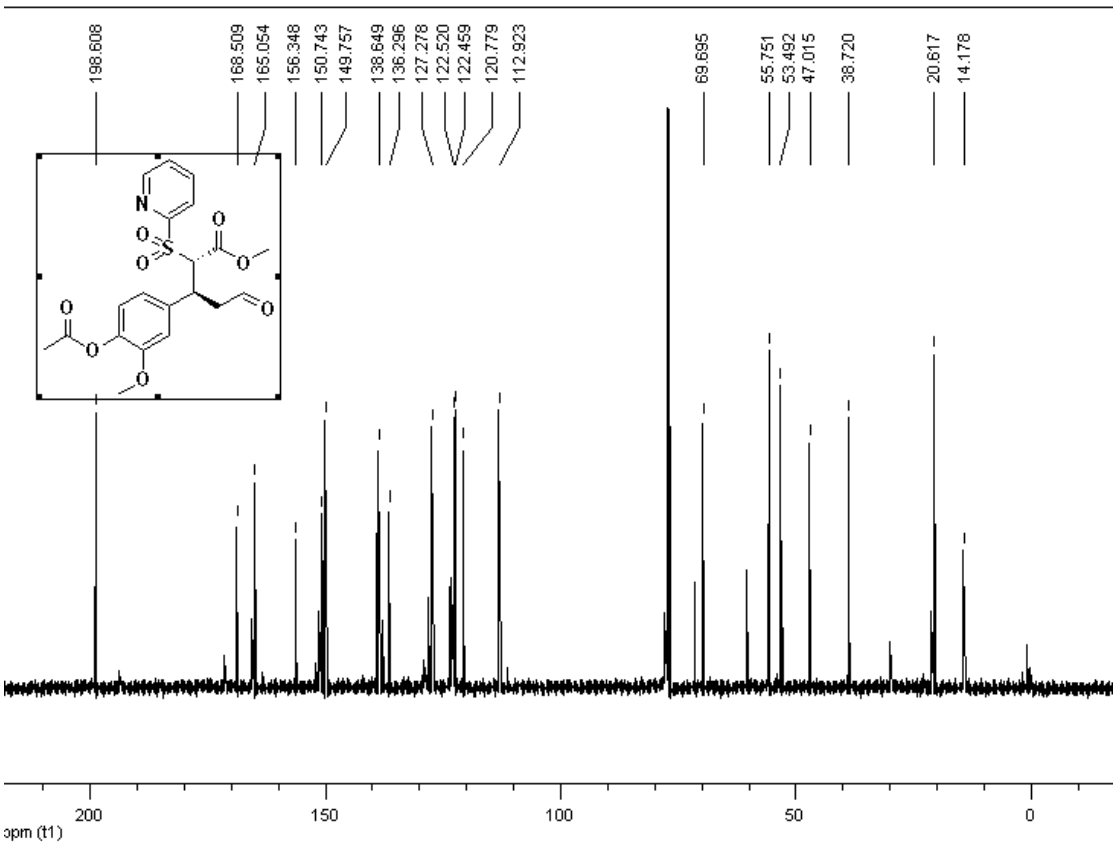
3m


9.391
8.660
8.646
7.752
7.731
7.726
7.705
7.700
7.576
7.560
7.554
7.552
7.535
7.201
7.175
6.977
6.950
6.743
6.716
5.315
5.280
4.058
4.033
4.021
3.986
3.815
3.031
3.023
2.996
2.988
2.975
2.972
2.967
2.939
2.936
2.931
2.715
2.703
2.659
2.647
2.437
2.413
2.388
2.362
1.00
1.05
1.11
1.08
1.44
2.16
2.17
1.03
3.27
1.29
1.21
1.13
2.25
3.33
10.0
5.0
0.0
ppm (t1)

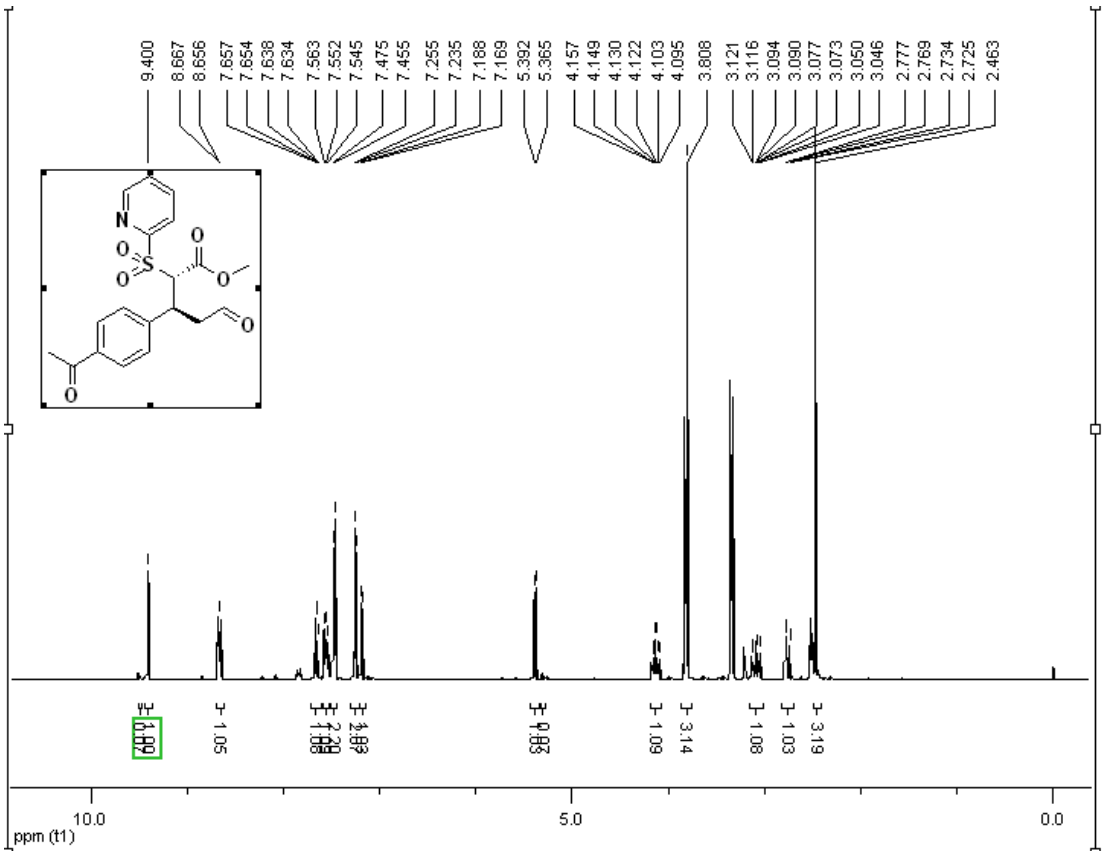

201.184
165.483
156.211
150.407
142.900
138.978
134.845
129.434
127.957
127.656
122.258
70.203
53.800
47.117
28.051
15.710
200
150
100
50
0
ppm (f1)

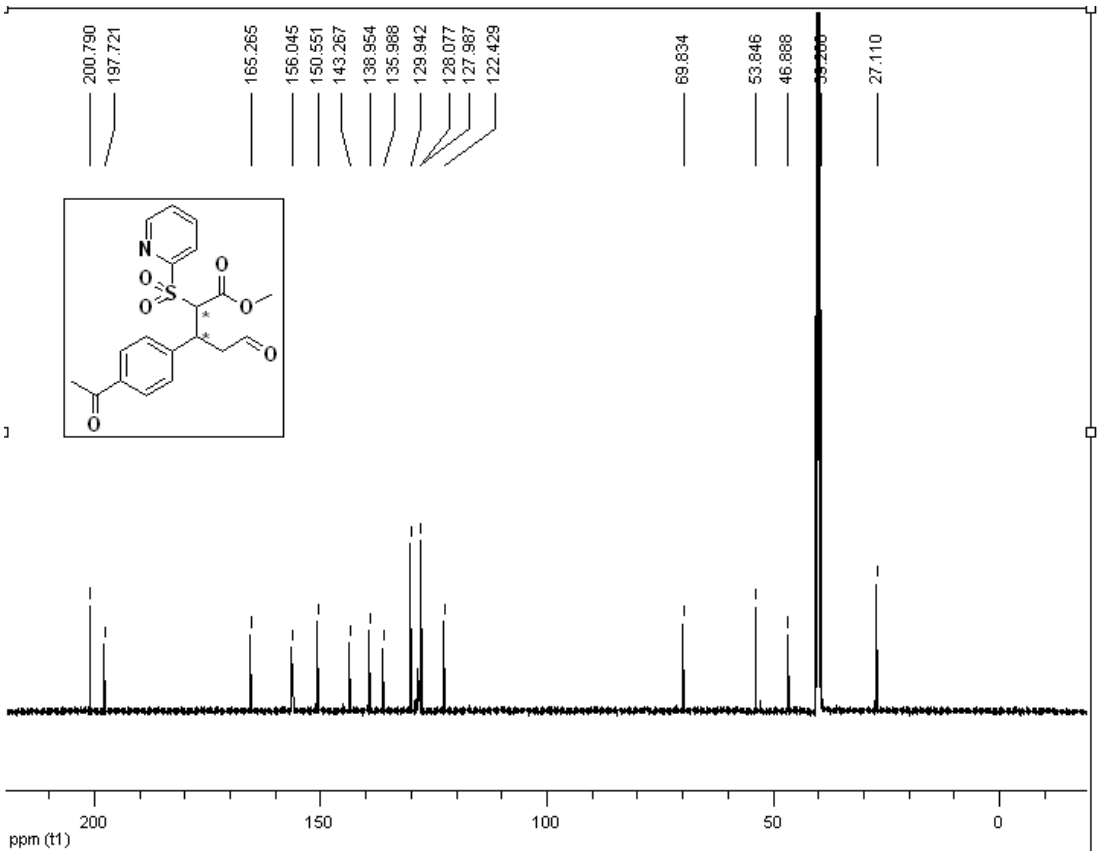
3n


9.524
8.617
8.604
8.601
7.759
7.738
7.733
7.712
7.707
7.448
7.420
7.404
7.401
7.394
7.378
7.375
6.663
6.623
6.596
6.577
6.571
6.550
6.544
5.239
5.206
4.277
4.262
4.246
4.230
4.214
3.851
3.702
3.014
3.008
2.982
2.977
2.955
2.950
2.919
2.901
2.862
2.859
2.847
2.845
2.262
2.251
1.00
1.04
0.33
2.14
0.68
0.36
2.14
1.07
3.36
1.01
0.31
1.02
2.14
10.0
5.0
0.0
ppm (t1)

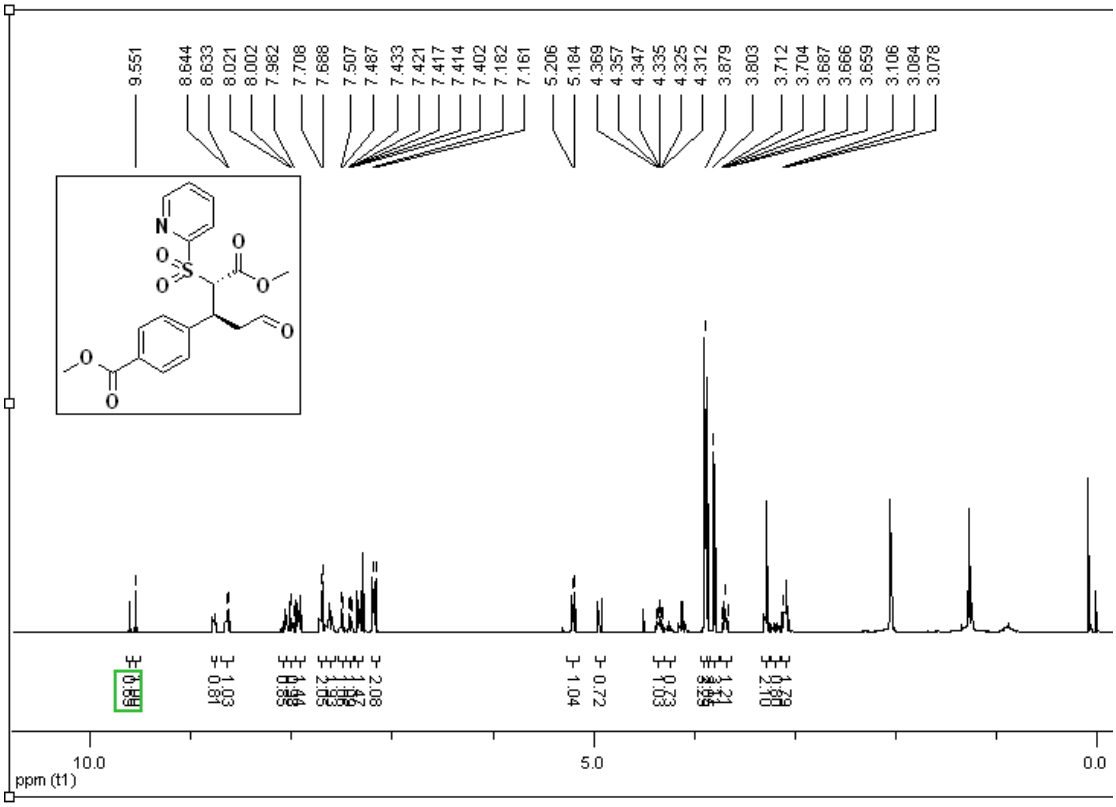

198.608
168.509
165.054
156.348
150.743
149.757
138.649
136.296
127.278
122.520
122.459
120.779
112.923
69.695
55.751
53.492
47.015
38.720
20.617
14.178
200
150
100
50
0
ppm (t1)

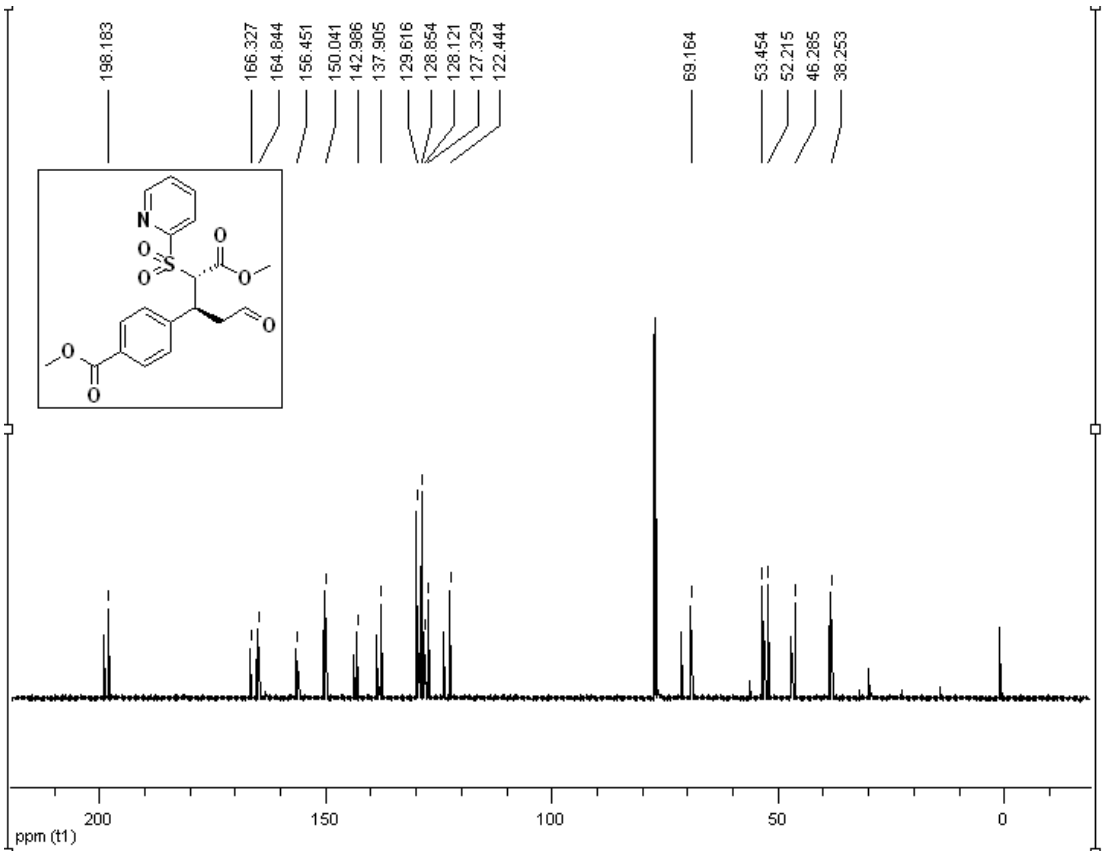
3o


9.400
8.667
8.656
7.657
7.654
7.638
7.634
7.563
7.552
7.545
7.475
7.455
7.255
7.235
7.188
7.169
5.392
5.365
4.157
4.149
4.130
4.122
4.103
4.095
3.808
3.121
3.116
3.094
3.090
3.077
3.073
3.050
3.046
2.777
2.769
2.734
2.725
2.463
1.00
1.05
1.09
1.14
1.08
1.03
3.19
10.0
5.0
0.0
ppm (t1)

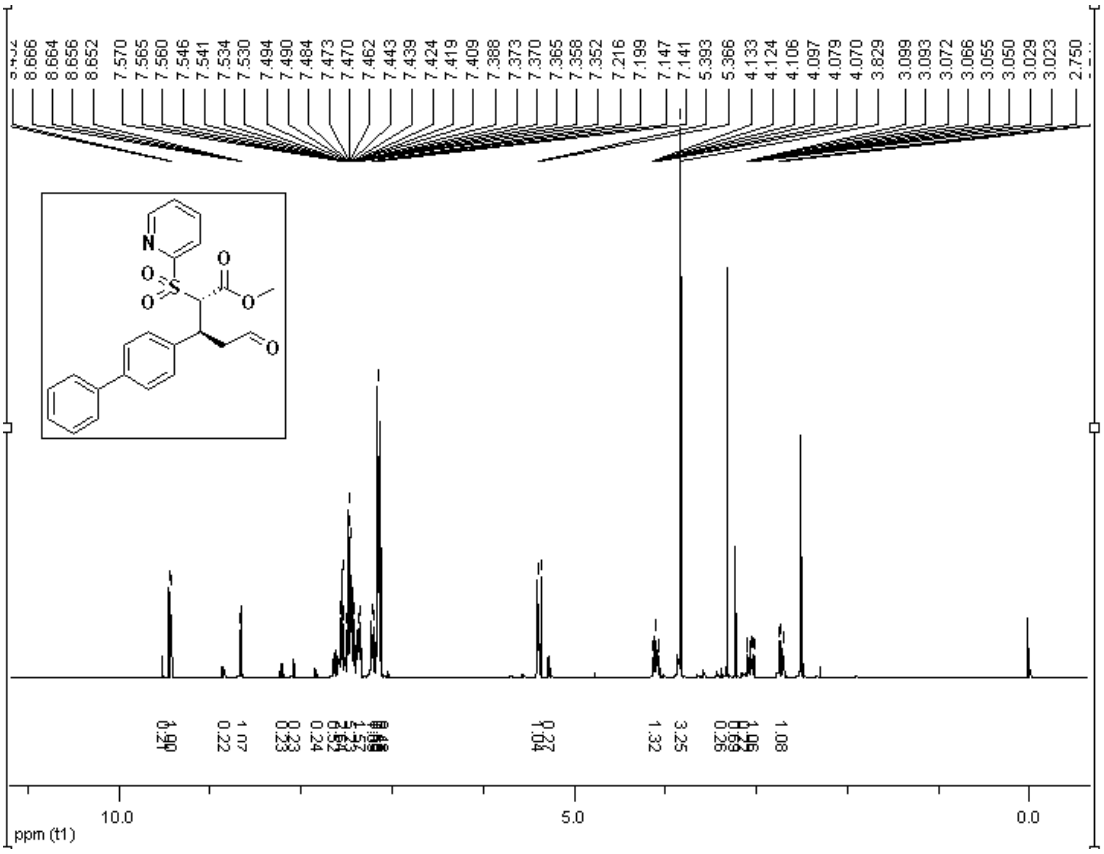

200.790
197.721
165.265
156.045
150.551
143.267
138.954
135.988
129.942
128.077
127.987
122.429
69.834
53.846
46.888
39.200
27.110
200
150
100
50
0
ppm (t1)

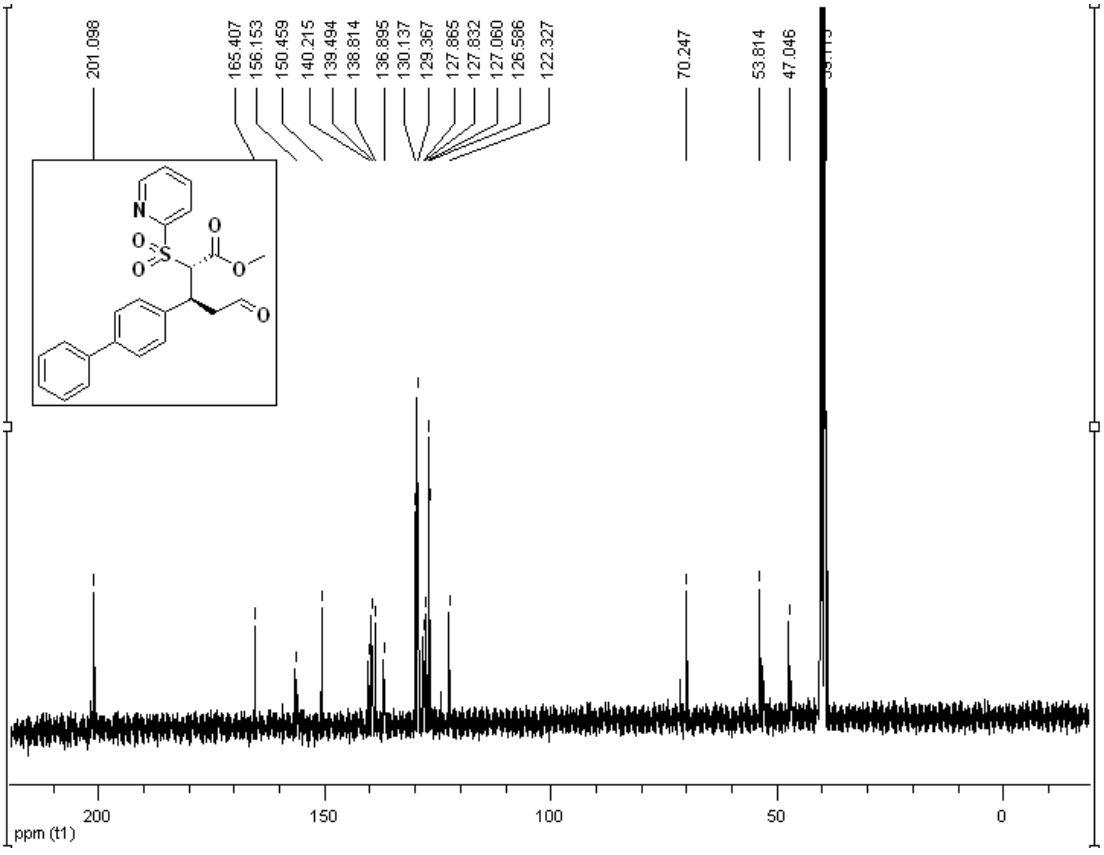
3p


9.551
8.644
8.633
8.021
8.002
7.982
7.708
7.688
7.507
7.487
7.433
7.421
7.417
7.414
7.402
7.182
7.161
5.206
5.184
4.369
4.357
4.347
4.335
4.325
4.312
3.879
3.803
3.712
3.704
3.687
3.666
3.659
3.106
3.084
3.078
10.0
5.0
0.0
ppm (t1)

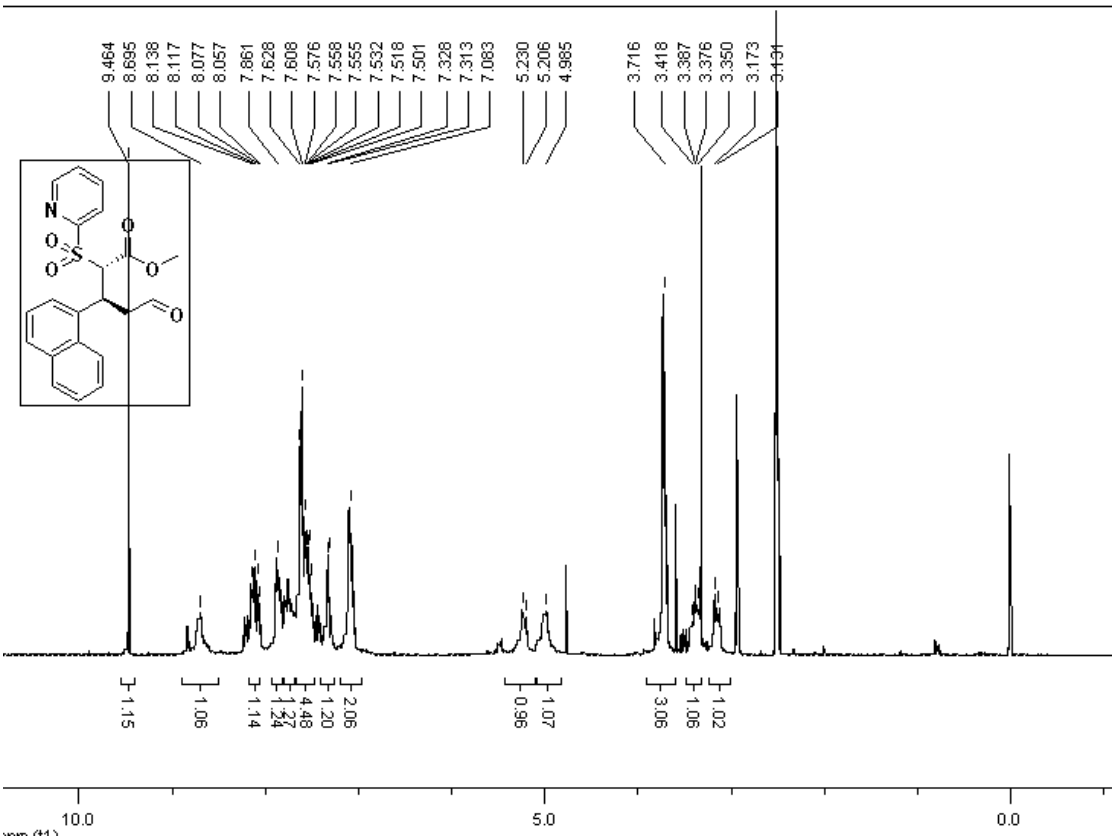

198.183
166.327
164.844
156.451
150.041
142.986
137.905
129.616
128.854
128.121
127.329
122.444
69.164
53.454
52.215
46.285
38.253
200
150
100
50
0
ppm (t1)

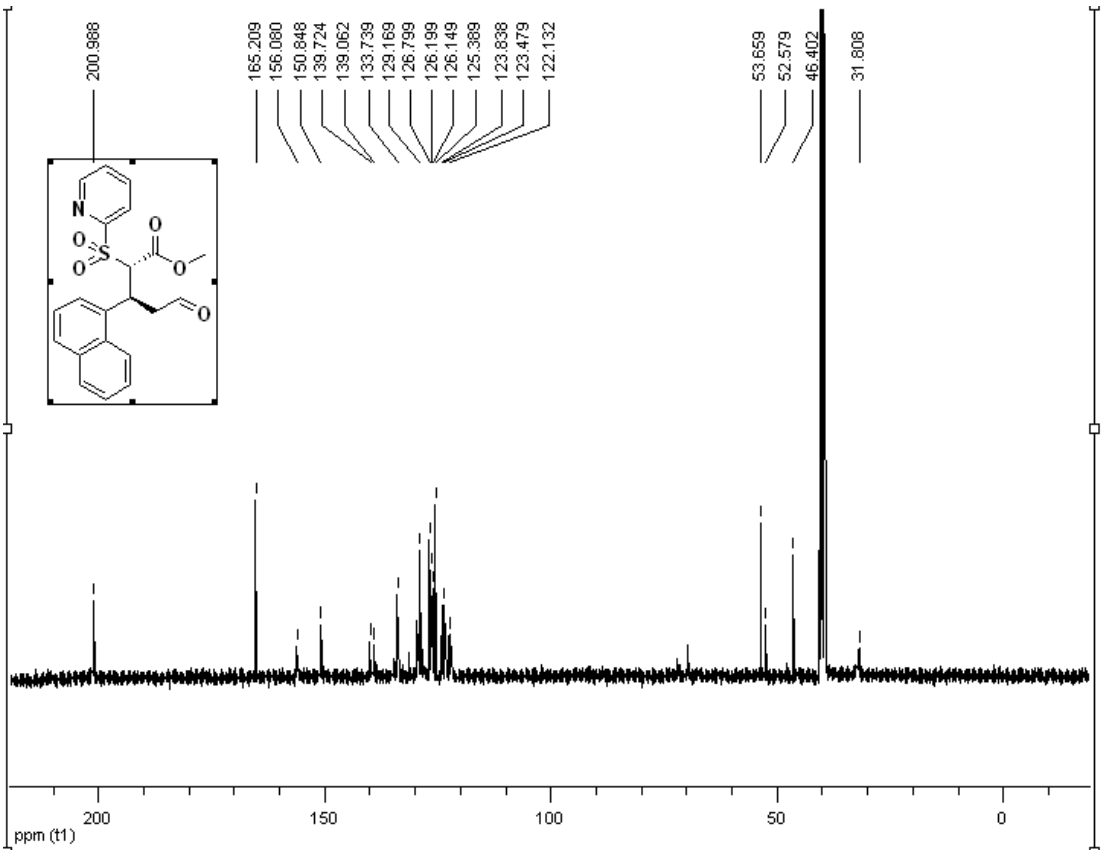
3p


8.666
8.664
8.656
8.652
7.570
7.565
7.560
7.546
7.541
7.534
7.530
7.494
7.490
7.484
7.473
7.470
7.462
7.443
7.439
7.424
7.419
7.409
7.388
7.373
7.370
7.365
7.358
7.352
7.216
7.199
7.147
7.141
5.393
5.366
4.133
4.124
4.106
4.097
4.079
4.070
3.829
3.099
3.093
3.072
3.066
3.055
3.050
3.029
3.023
2.750
0.90
0.22
1.07
0.23
0.24
0.27
1.32
3.25
0.26
1.08
10.0
5.0
0.0
ppm (t1)

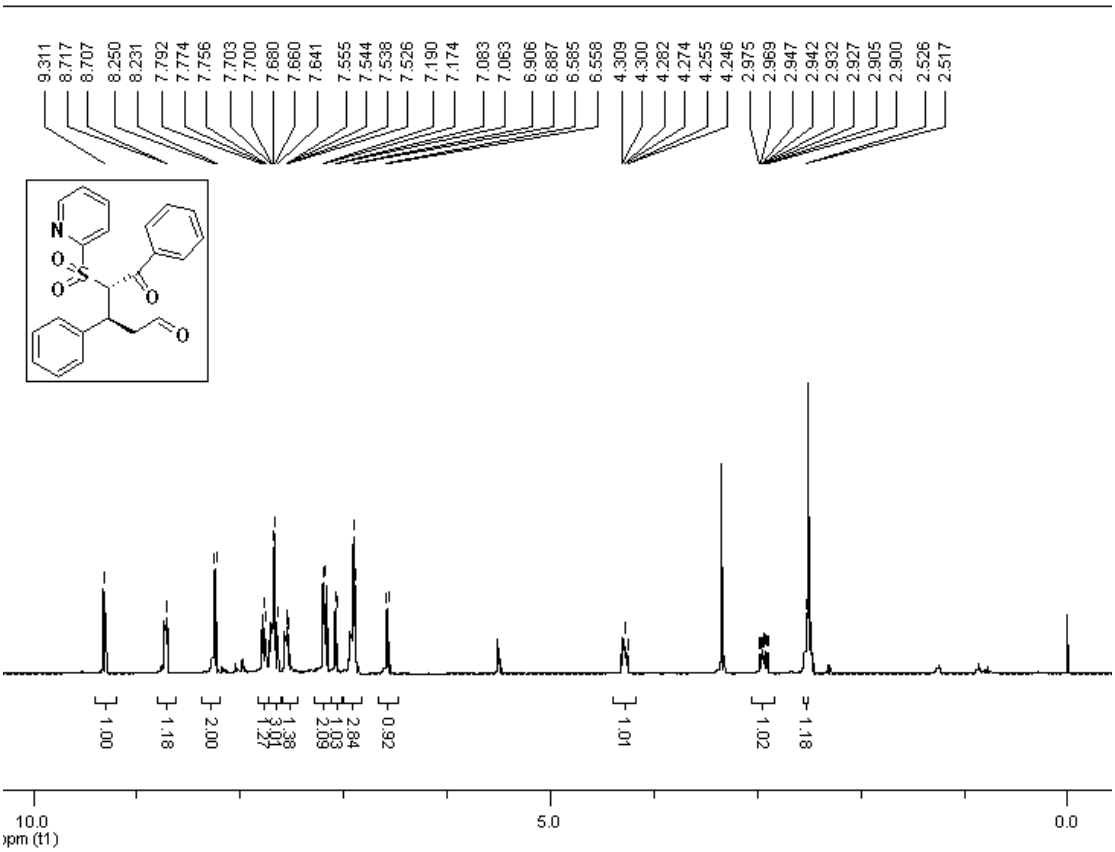

201.098
165.407
156.153
150.459
140.215
139.494
138.814
136.895
130.137
129.367
127.865
127.832
127.060
126.586
122.327
70.247
53.814
47.046
200
150
100
50
0
ppm (t1)

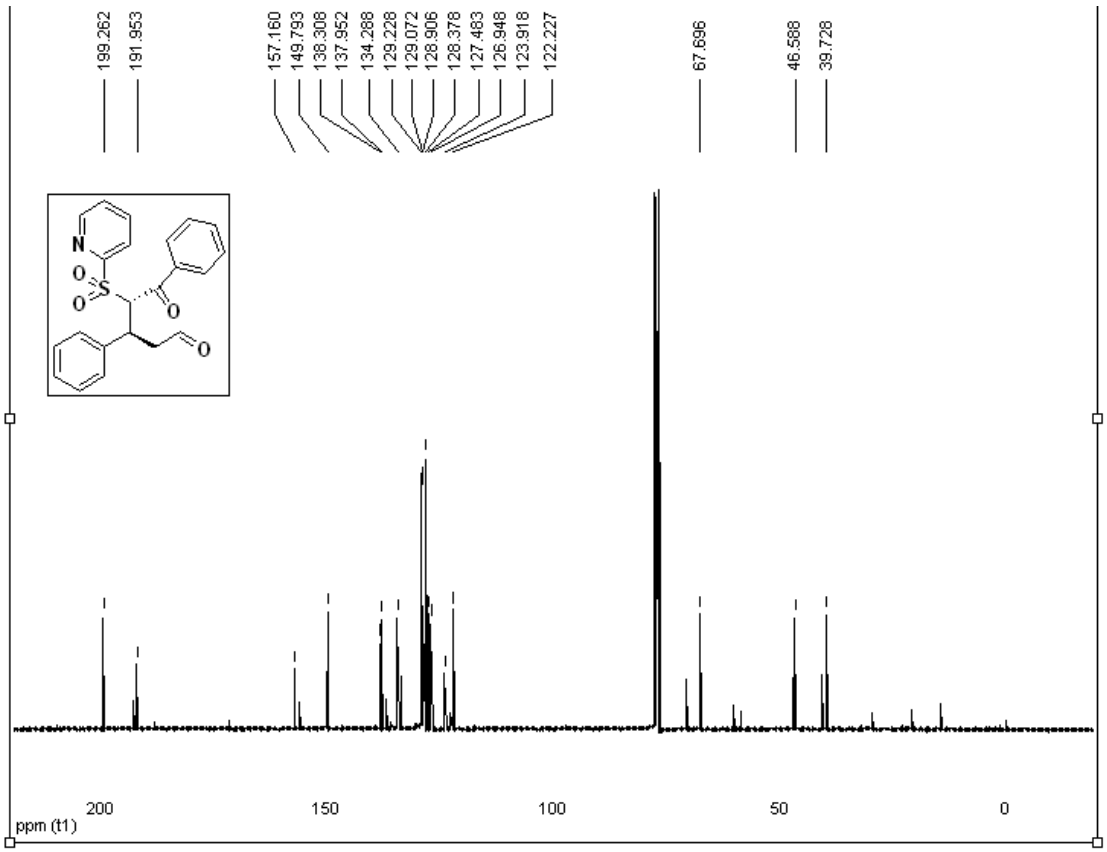
3r


9.464
8.695
8.138
8.117
8.077
8.057
7.861
7.628
7.608
7.576
7.558
7.555
7.532
7.518
7.501
7.328
7.313
7.083
5.230
5.206
4.985
3.716
3.418
3.387
3.376
3.350
3.173
3.131
1.15
1.06
1.14
4.48
1.20
2.06
0.98
1.07
3.06
1.06
1.02
10.0
5.0
0.0

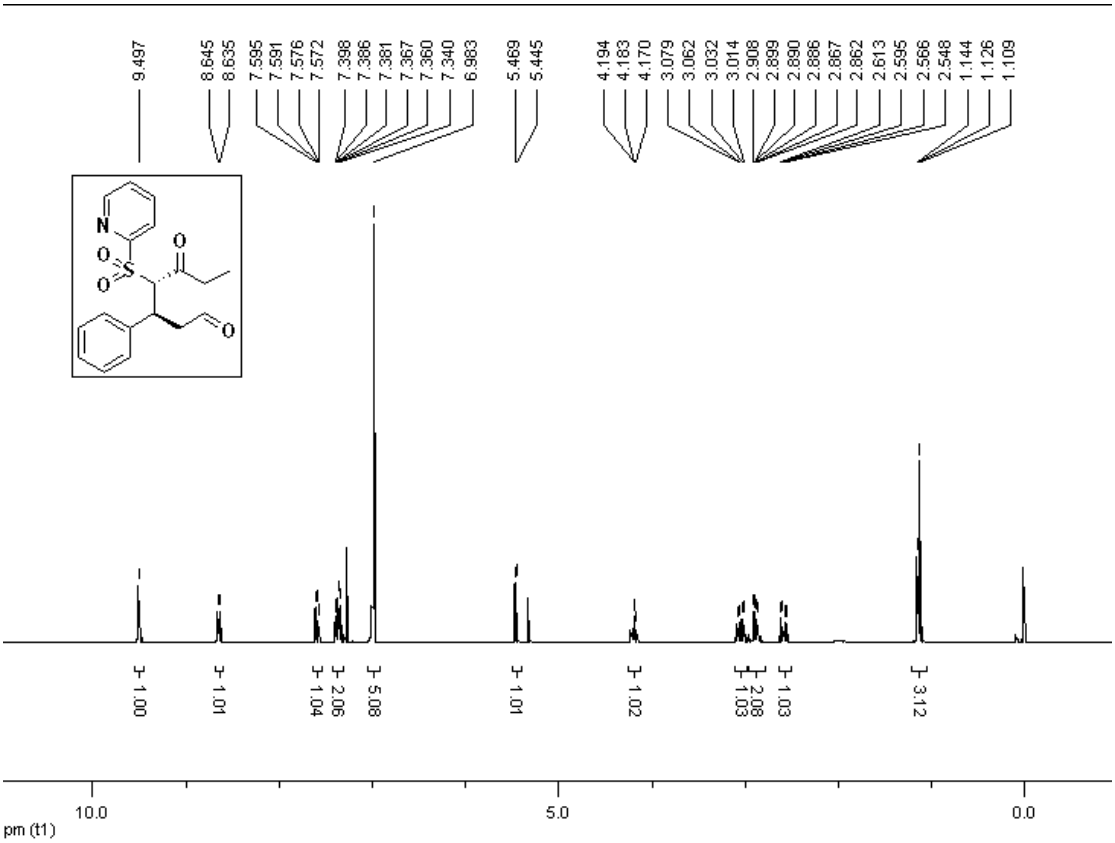

200.988
165.209
156.080
150.848
139.724
139.062
133.739
129.169
126.799
126.199
126.149
125.389
123.838
123.479
122.132
53.659
52.579
46.402
31.808
200
150
100
50
0
ppm (t1)

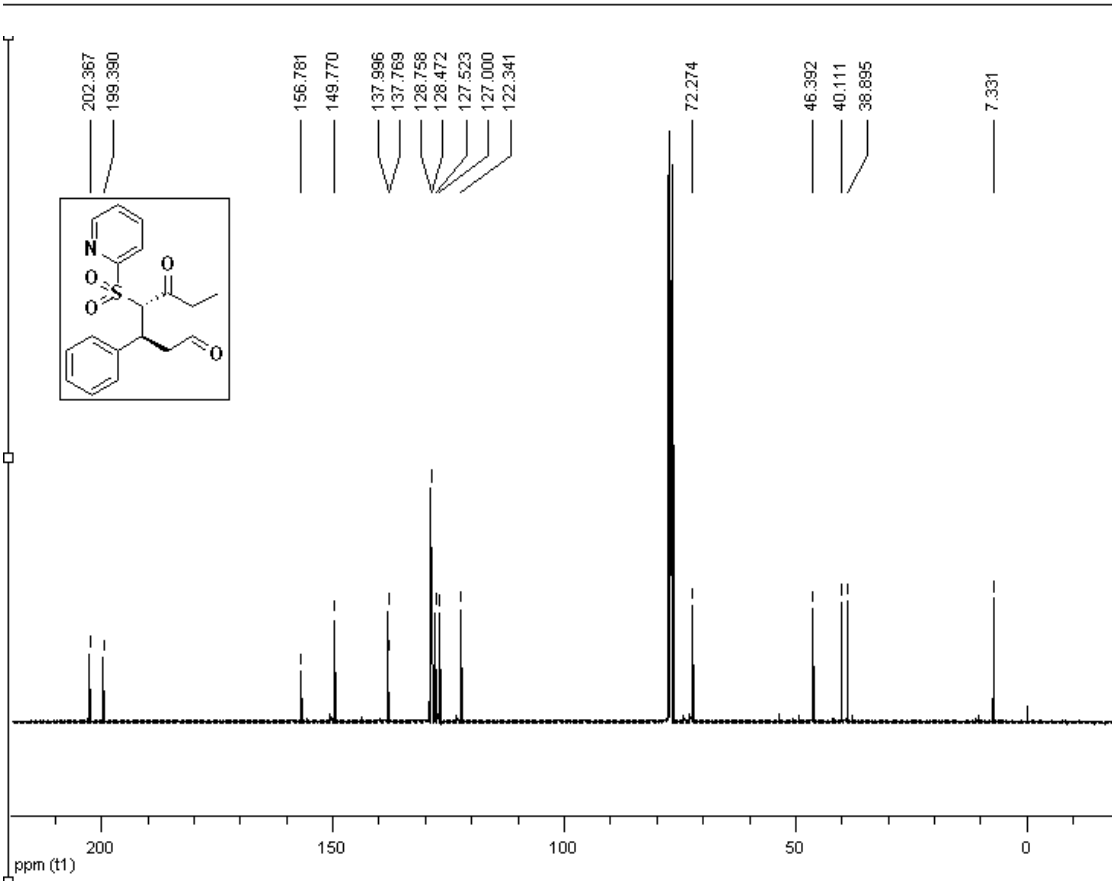
3s


9.311
8.717
8.707
8.250
8.231
7.792
7.774
7.756
7.703
7.700
7.680
7.660
7.641
7.555
7.544
7.538
7.526
7.190
7.174
7.083
7.063
6.906
6.887
6.585
6.558
4.309
4.300
4.282
4.274
4.255
4.246
2.975
2.969
2.947
2.942
2.932
2.927
2.905
2.900
2.526
2.517
1.00
1.18
2.00
3.01
1.27
1.38
2.09
1.03
2.84
0.92
1.01
1.02
11.18
10.0
5.0
0.0
ppm (t1)

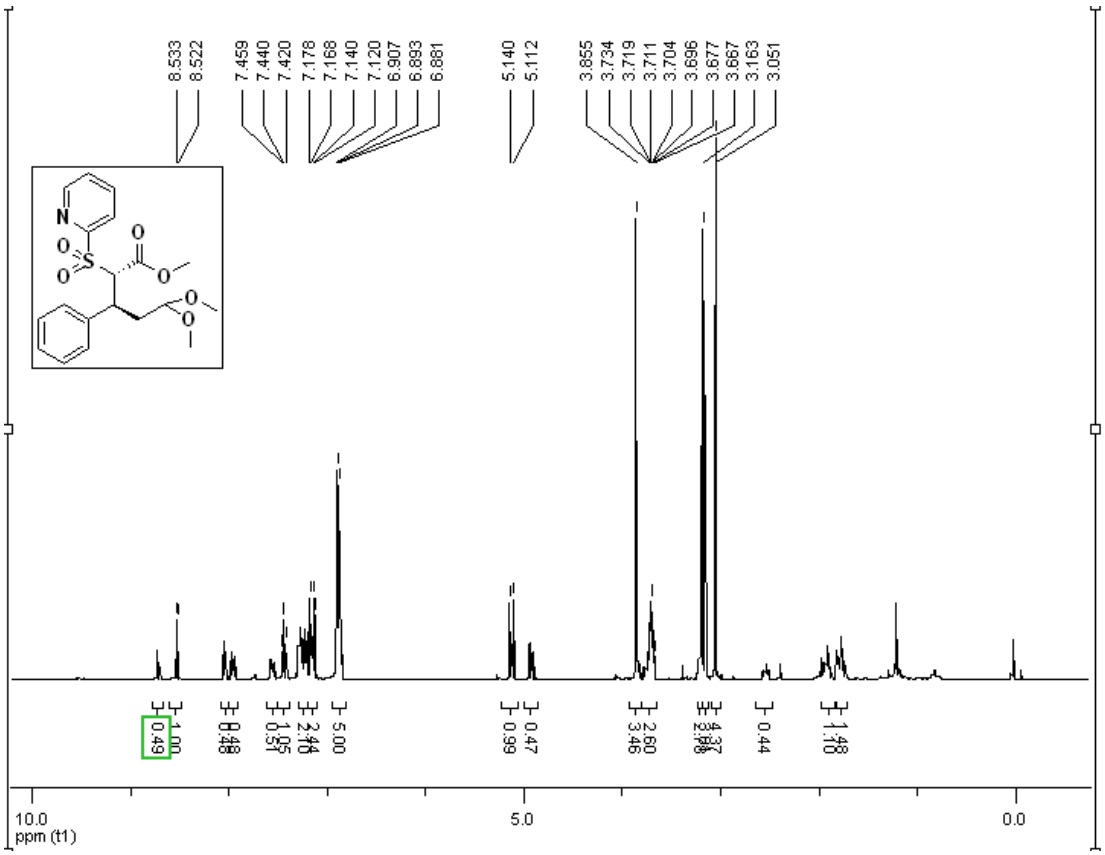

199.262
191.953
157.160
149.793
138.308
137.952
134.288
129.228
129.072
128.906
128.378
127.483
126.948
123.918
122.227
67.696
46.588
39.728
200
150
100
50
0
ppm (t1)

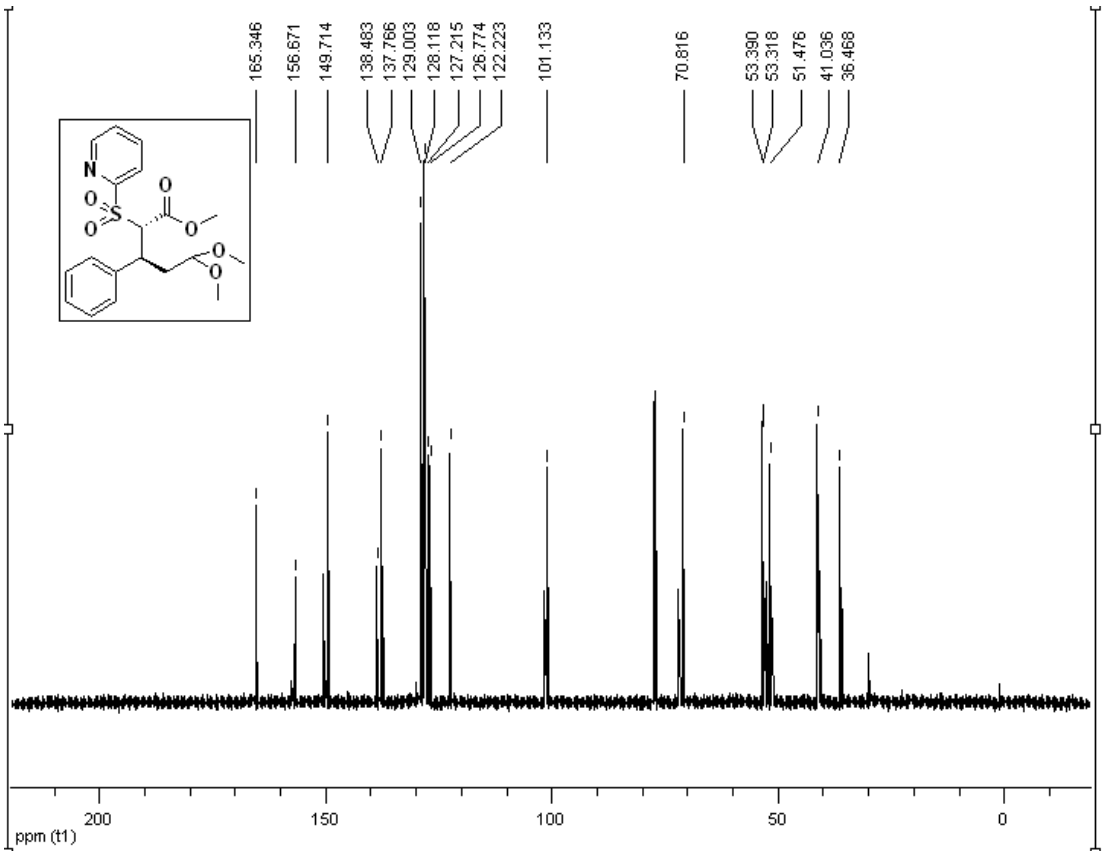
3t


9.497
8.645
8.635
7.595
7.591
7.576
7.572
7.398
7.386
7.381
7.367
7.360
7.340
6.983
5.469
5.445
4.194
4.183
4.170
3.079
3.062
3.032
3.014
2.908
2.899
2.890
2.886
2.867
2.862
2.613
2.595
2.566
2.548
1.144
1.126
1.109
1.00
1.01
1.04
2.06
5.08
1.01
1.02
1.03
2.08
1.03
3.12
10.0
5.0
0.0
pm (t1)

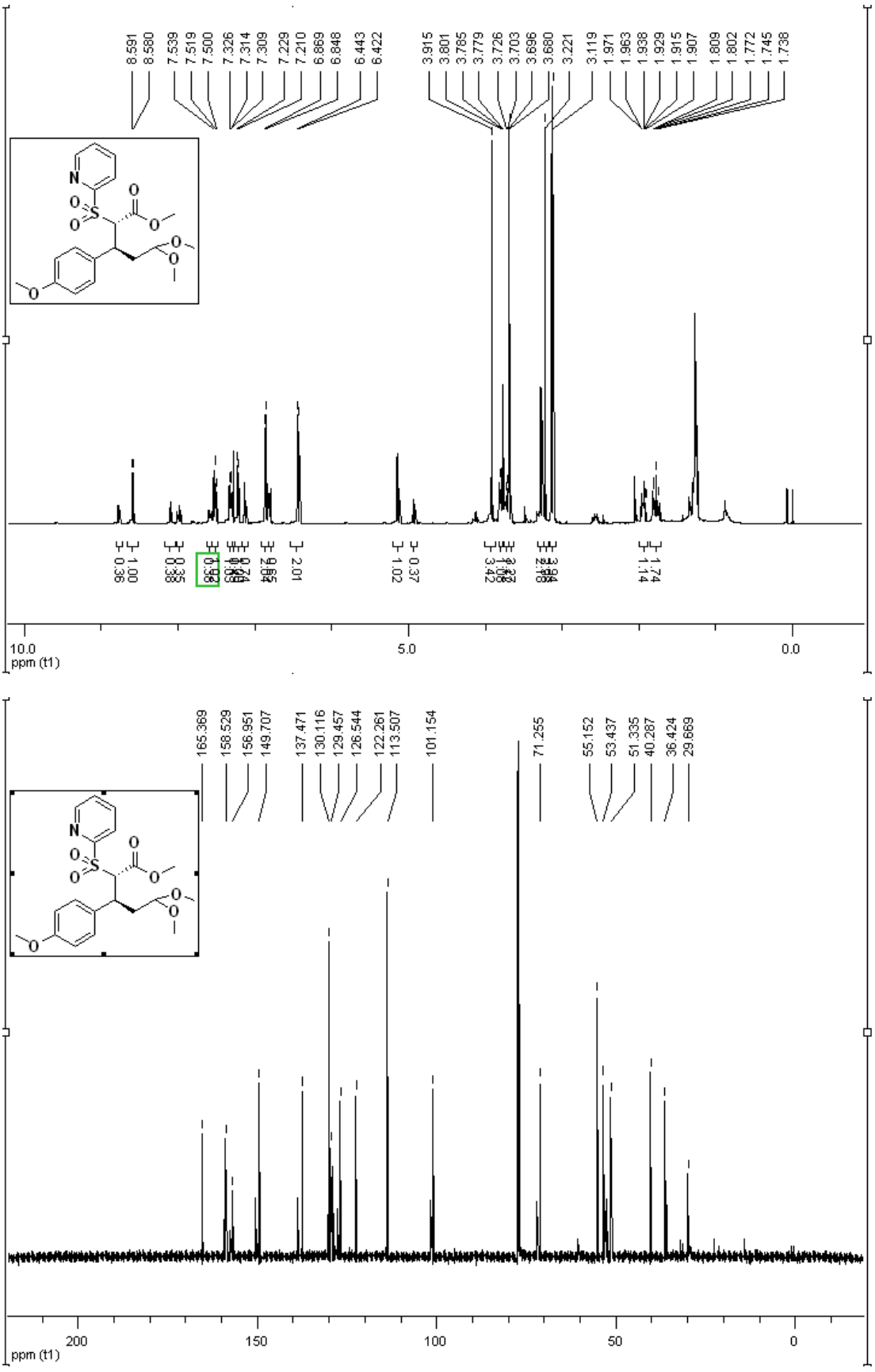

202.367
199.390
156.781
149.770
137.996
137.769
128.758
128.472
127.523
127.000
122.341
72.274
46.392
40.111
38.895
7.331
200
150
100
50
0
ppm (t1)

3'a

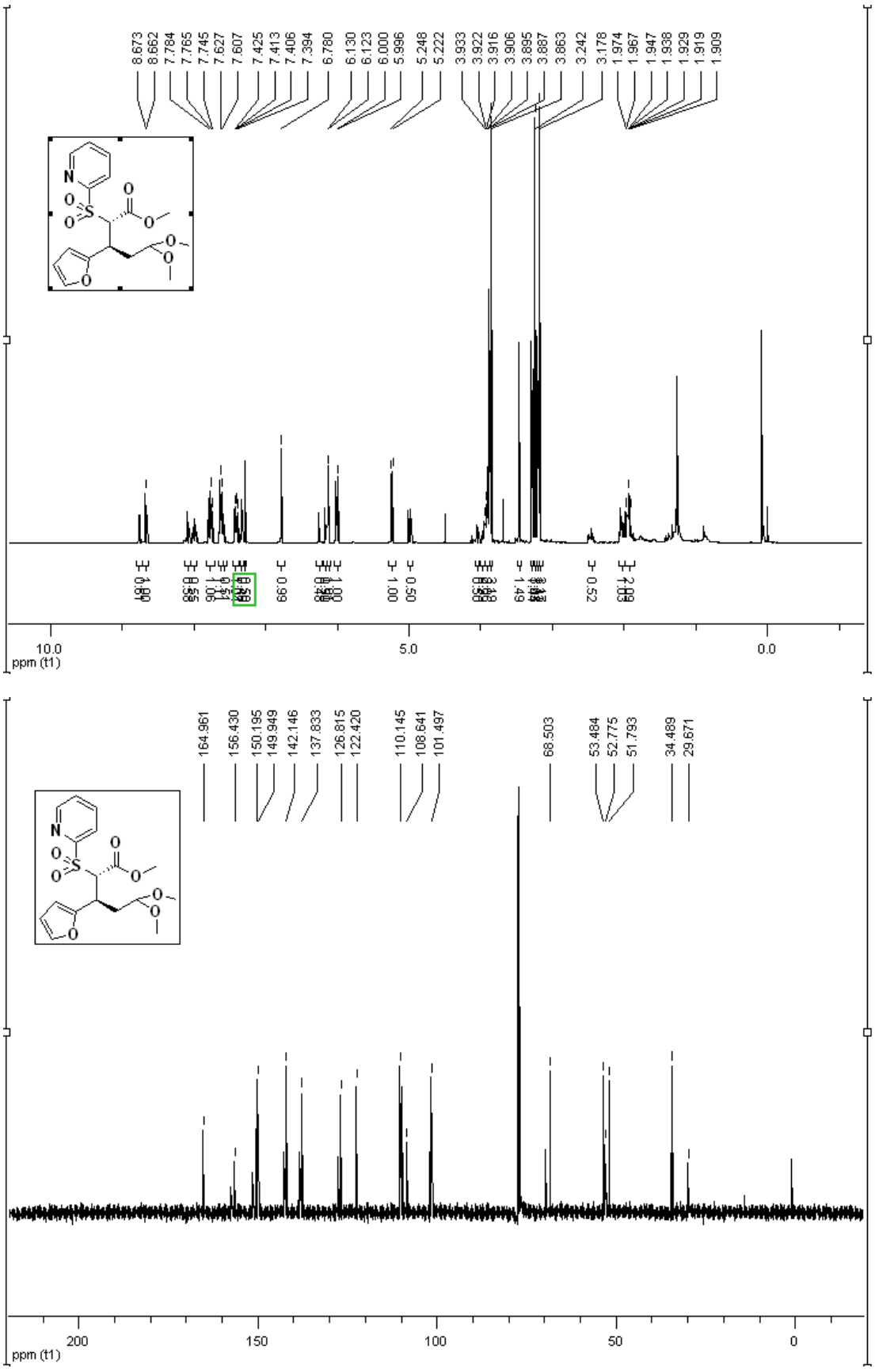

8.533
8.522
7.459
7.440
7.420
7.178
7.168
7.140
7.120
6.907
6.893
6.881
5.140
5.112
3.855
3.734
3.719
3.711
3.704
3.696
3.677
3.667
3.163
3.051
1.00
0.48
0.48
0.51
2.40
5.00
0.99
0.47
3.46
2.60
3.37
2.98
0.44
1.78
1.48
10.0
ppm (t1)
5.0
0.0


165.346
156.671
149.714
138.483
137.766
129.003
128.118
127.215
126.774
122.223
101.133
70.816
53.390
53.318
51.476
41.036
36.468
200
150
100
50
0
ppm (t1)

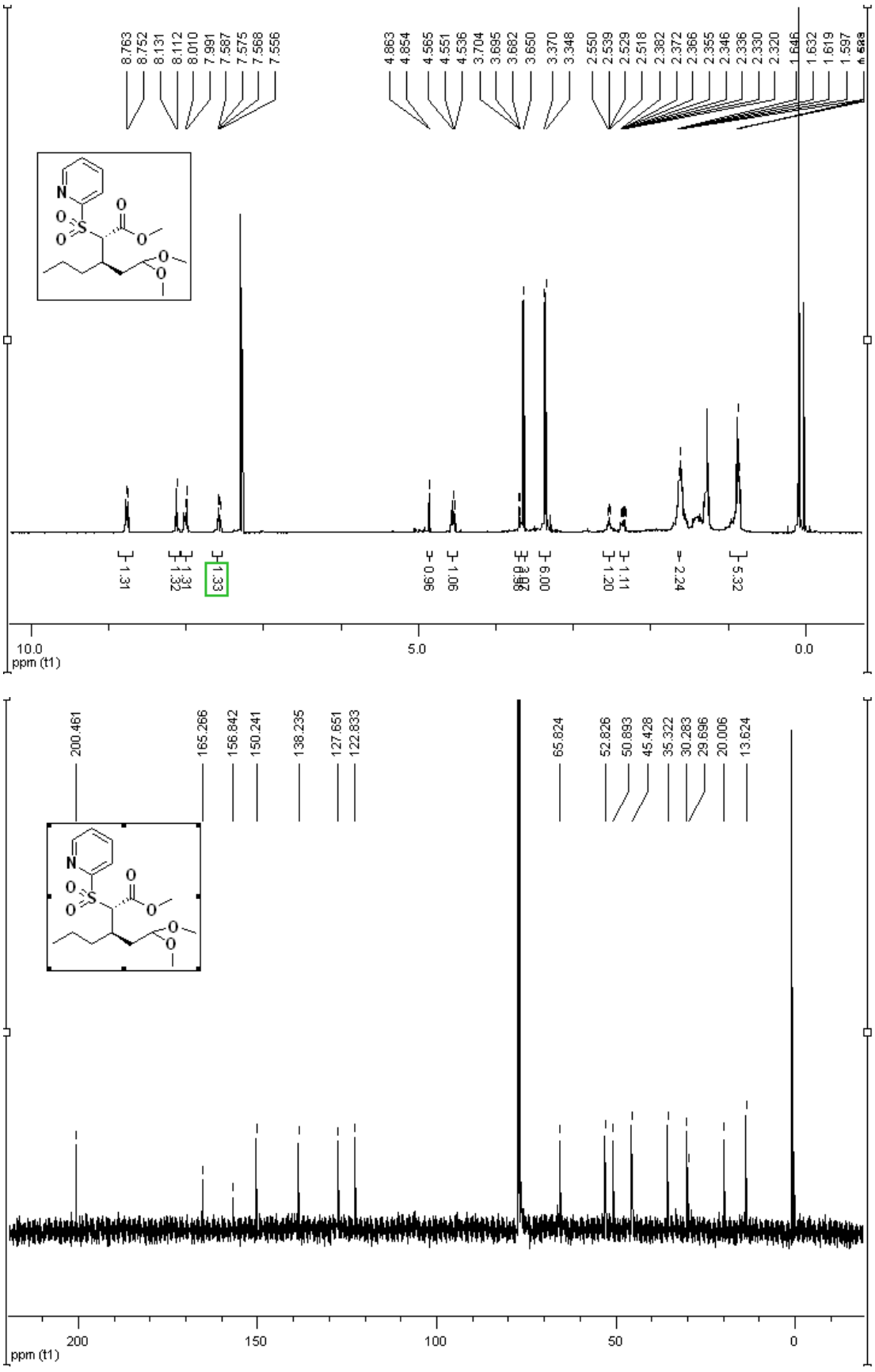
3'b


8.591
8.580
7.539
7.519
7.500
7.326
7.314
7.309
7.229
7.210
6.869
6.848
6.443
6.422
3.915
3.801
3.785
3.779
3.726
3.703
3.696
3.680
3.221
3.119
1.971
1.963
1.938
1.929
1.915
1.907
1.809
1.802
1.772
1.745
1.738
1.00
0.36
0.38
0.98
2.84
2.01
0.37
1.02
3.42
1.14
1.74
10.0
5.0
0.0
ppm (t1)
165.369
158.529
156.951
149.707
137.471
130.116
129.457
126.544
122.261
113.507
101.154
71.255
55.152
53.437
51.335
40.287
36.424
29.669
200
150
100
50
0
ppm (t1)

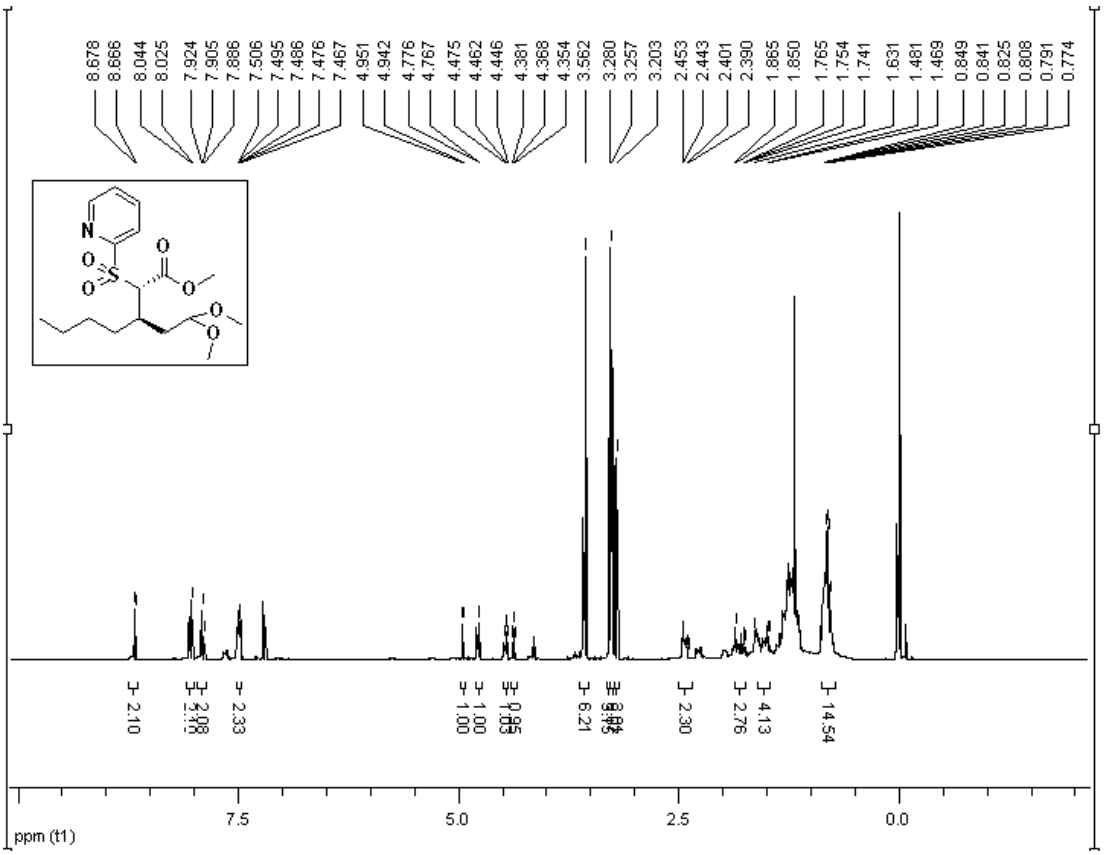
3'c


8.673
8.662
7.784
7.765
7.745
7.627
7.607
7.425
7.413
7.406
7.394
6.780
6.130
6.123
6.000
5.996
5.248
5.222
3.933
3.922
3.916
3.906
3.895
3.887
3.863
3.242
3.178
1.974
1.967
1.947
1.938
1.929
1.919
1.909
0.89
0.58
1.06
0.99
1.00
0.50
1.49
0.52
2.09
10.0
5.0
0.0
ppm (t1)
164.961
156.430
150.195
149.949
142.146
137.833
126.815
122.420
110.145
108.641
101.497
68.503
53.484
52.775
51.793
34.489
29.671
200
150
100
50
0
ppm (t1)

3'd


8.763
8.752
8.131
8.112
8.010
7.991
7.587
7.575
7.568
7.556
4.863
4.854
4.565
4.551
4.536
3.704
3.695
3.682
3.650
3.370
3.348
2.550
2.539
2.529
2.518
2.382
2.372
2.366
2.355
2.346
2.336
2.330
2.320
1.632
1.619
1.597
1.31
1.31
1.32
1.33
0.96
1.06
6.00
1.11
1.20
2.24
5.32
10.0
ppm (t1)
5.0
0.0
200.461
165.266
156.842
150.241
138.235
127.651
122.833
65.824
52.826
50.893
45.428
35.322
30.283
29.696
20.006
13.624
200
150
100
50
0
ppm (t1)

3'e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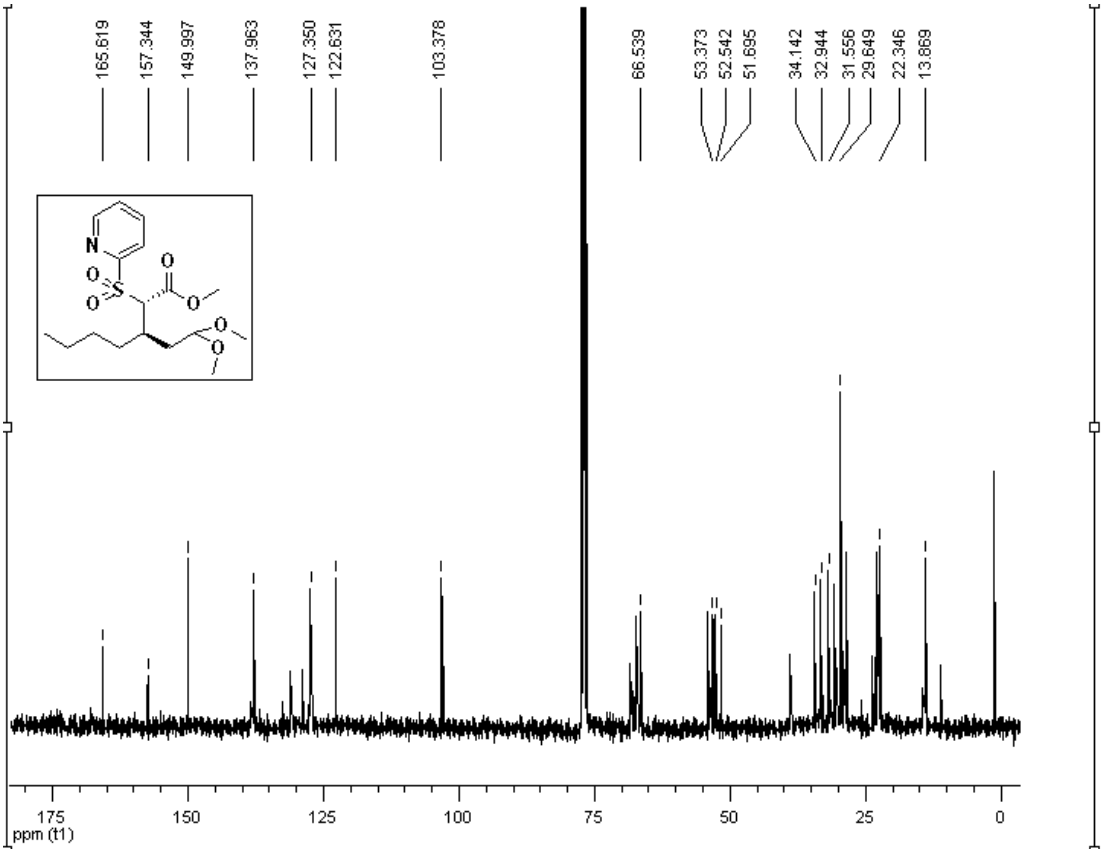
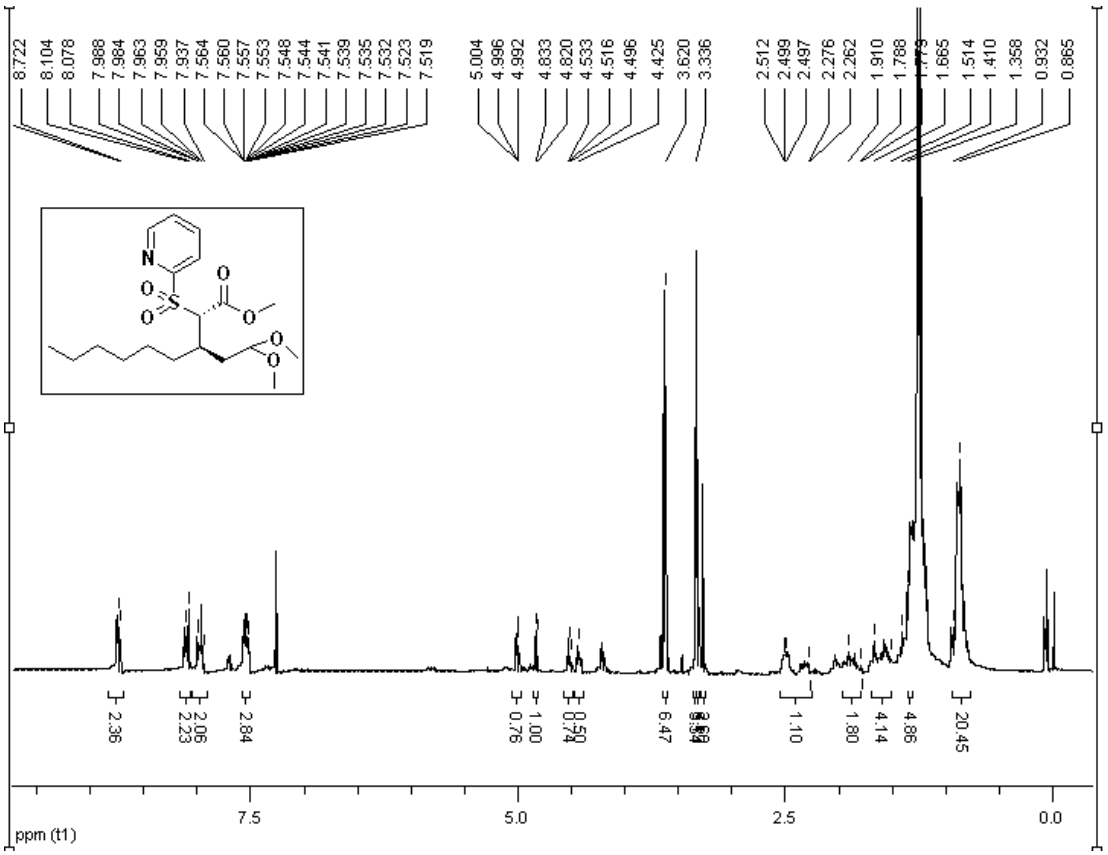
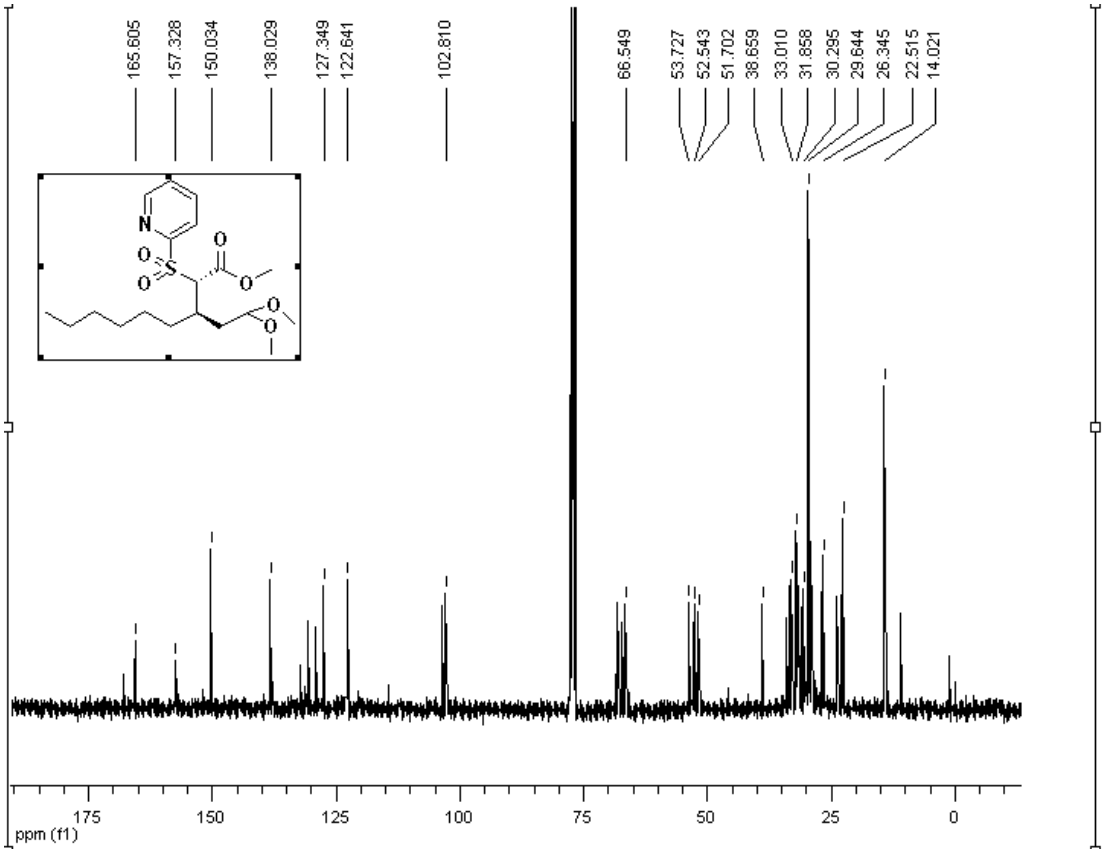
8.666
8.044
8.025
7.924
7.905
7.886
7.506
7.495
7.486
7.476
7.467
4.951
4.942
4.776
4.767
4.475
4.462
4.446
4.381
4.368
4.354
3.562
3.280
3.257
3.203
2.453
2.443
2.401
2.390
1.865
1.850
1.765
1.754
1.741
1.631
1.481
1.469
0.849
0.841
0.825
0.808
0.791
0.774
2.10
2.33
1.00
6.21
2.30
2.76
4.13
14.54
7.5
5.0
2.5
0.0
ppm (t1)

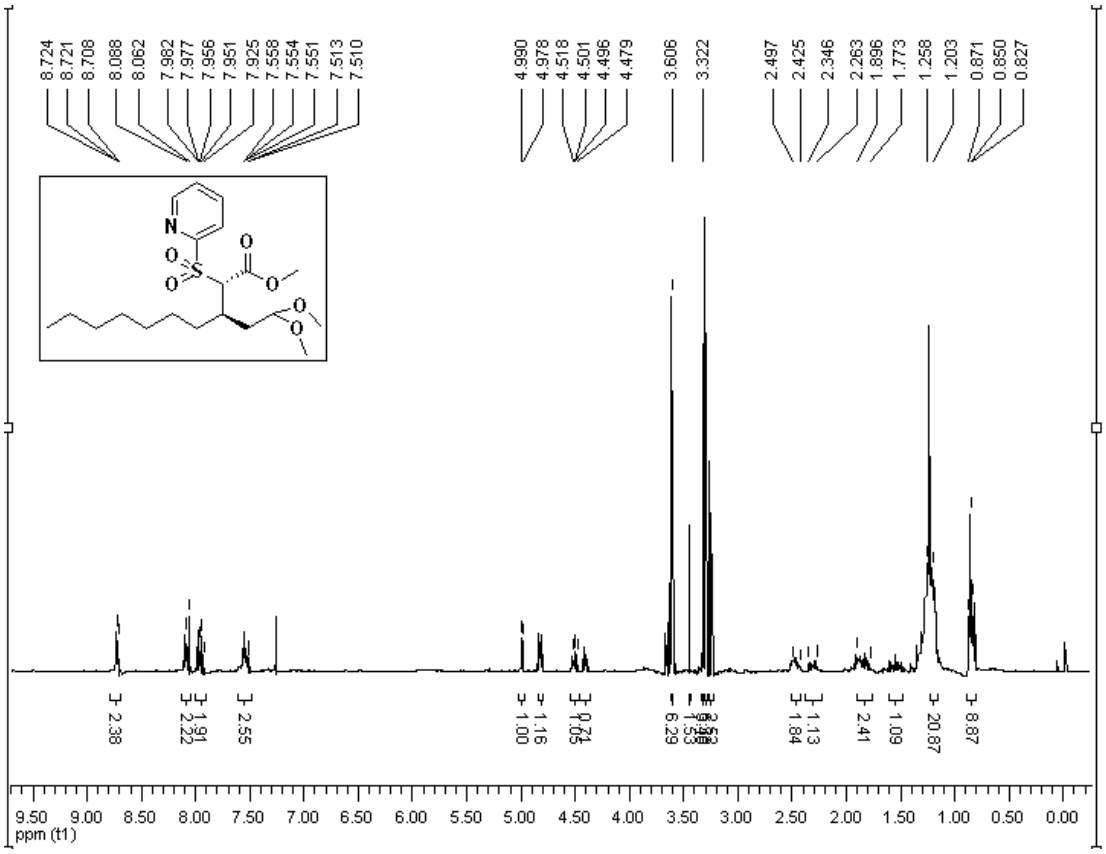

165.619
157.344
149.997
137.963
127.350
122.631
103.378
66.539
53.373
52.542
51.695
34.142
32.944
31.556
29.649
22.346
13.869
175
150
125
100
75
50
25
0
ppm (t1)

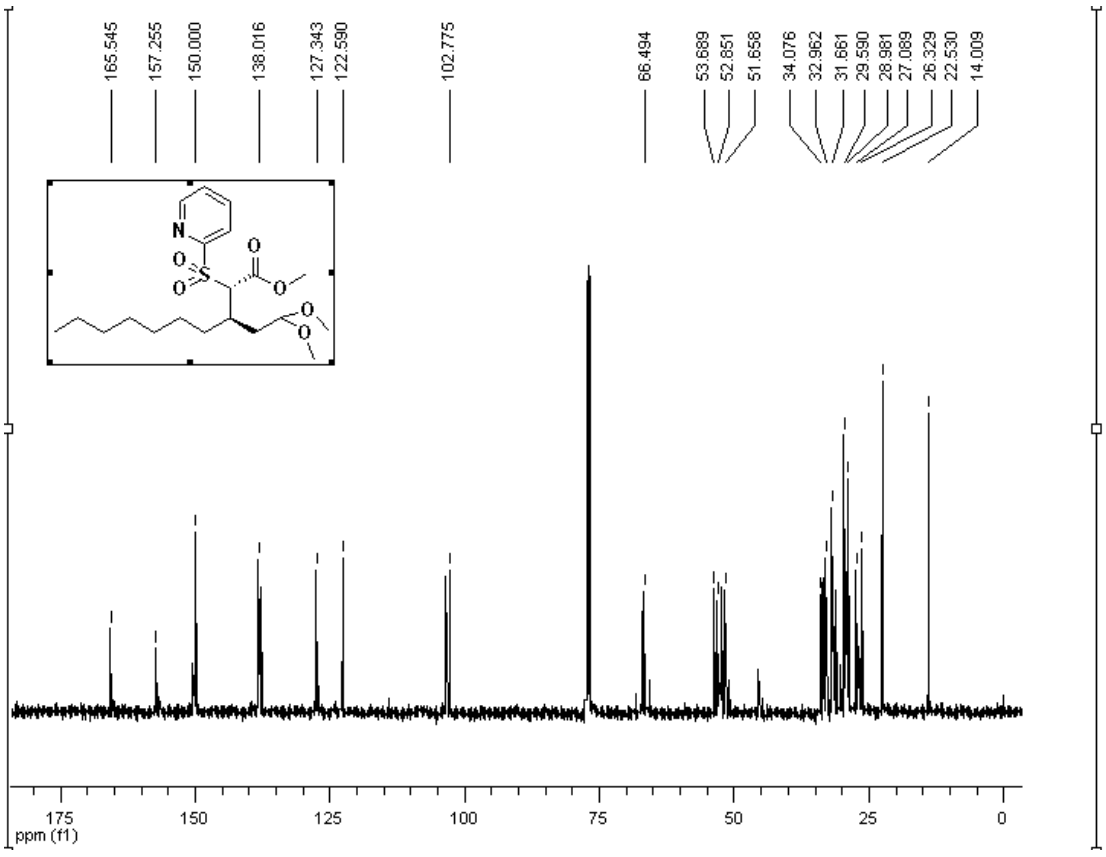
3'f


8.722
8.104
8.078
7.988
7.984
7.963
7.959
7.937
7.564
7.560
7.557
7.553
7.548
7.544
7.541
7.539
7.535
7.532
7.523
7.519
5.004
4.996
4.992
4.833
4.820
4.533
4.516
4.496
4.425
3.620
3.336
2.512
2.499
2.497
2.276
2.262
1.910
1.788
1.665
1.514
1.410
1.358
0.932
0.865
2.36
2.23
2.06
2.84
0.78
1.00
0.74
0.50
9.47
1.10
1.80
4.14
4.86
20.45
7.5
5.0
2.5
0.0
ppm (t1)

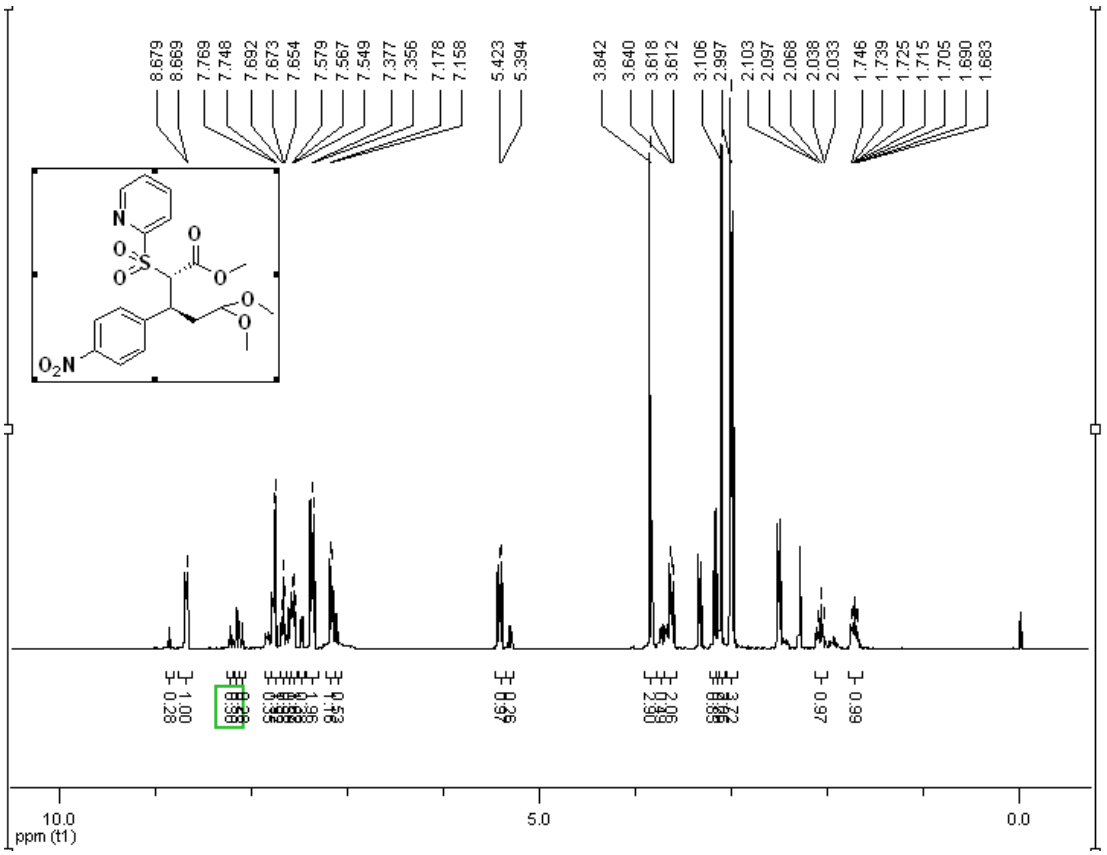

165.605
157.328
150.034
138.029
127.349
122.641
102.810
66.549
53.727
52.543
51.702
38.659
33.010
31.858
30.295
29.644
26.345
22.515
14.021
175
150
125
100
75
50
25
0
ppm (f1)

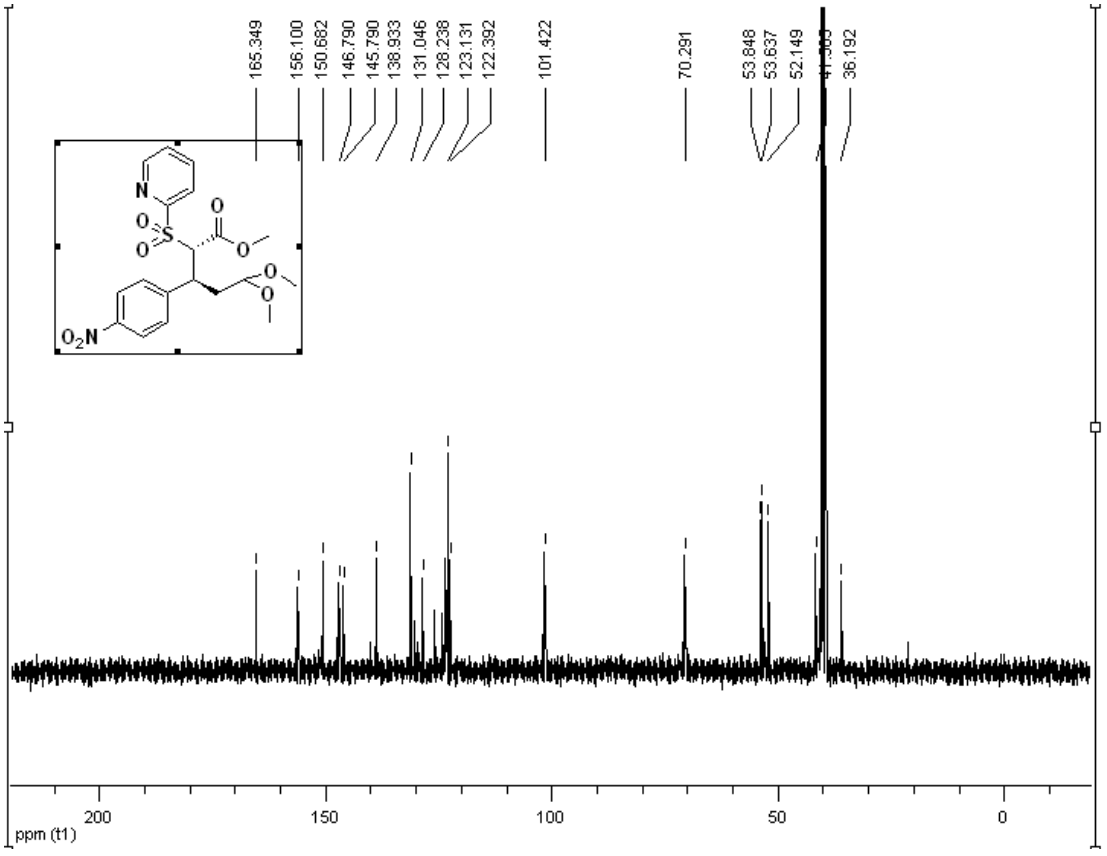
3'g


8.724
8.721
8.708
8.088
8.062
7.982
7.977
7.956
7.951
7.925
7.558
7.554
7.551
7.513
7.510
4.990
4.978
4.518
4.501
4.496
4.479
3.606
3.322
2.497
2.425
2.346
2.263
1.896
1.773
1.258
1.203
0.871
0.850
0.827
2.38
2.22
2.55
1.00
1.19
0.71
6.29
1.84
1.13
2.41
1.09
20.87
8.87
9.50 9.00 8.50 8.00 7.50 7.00 6.50 6.00 5.50 5.00 4.50 4.00 3.50 3.00 2.50 2.00 1.50 1.00 0.50 0.00
ppm (t1)

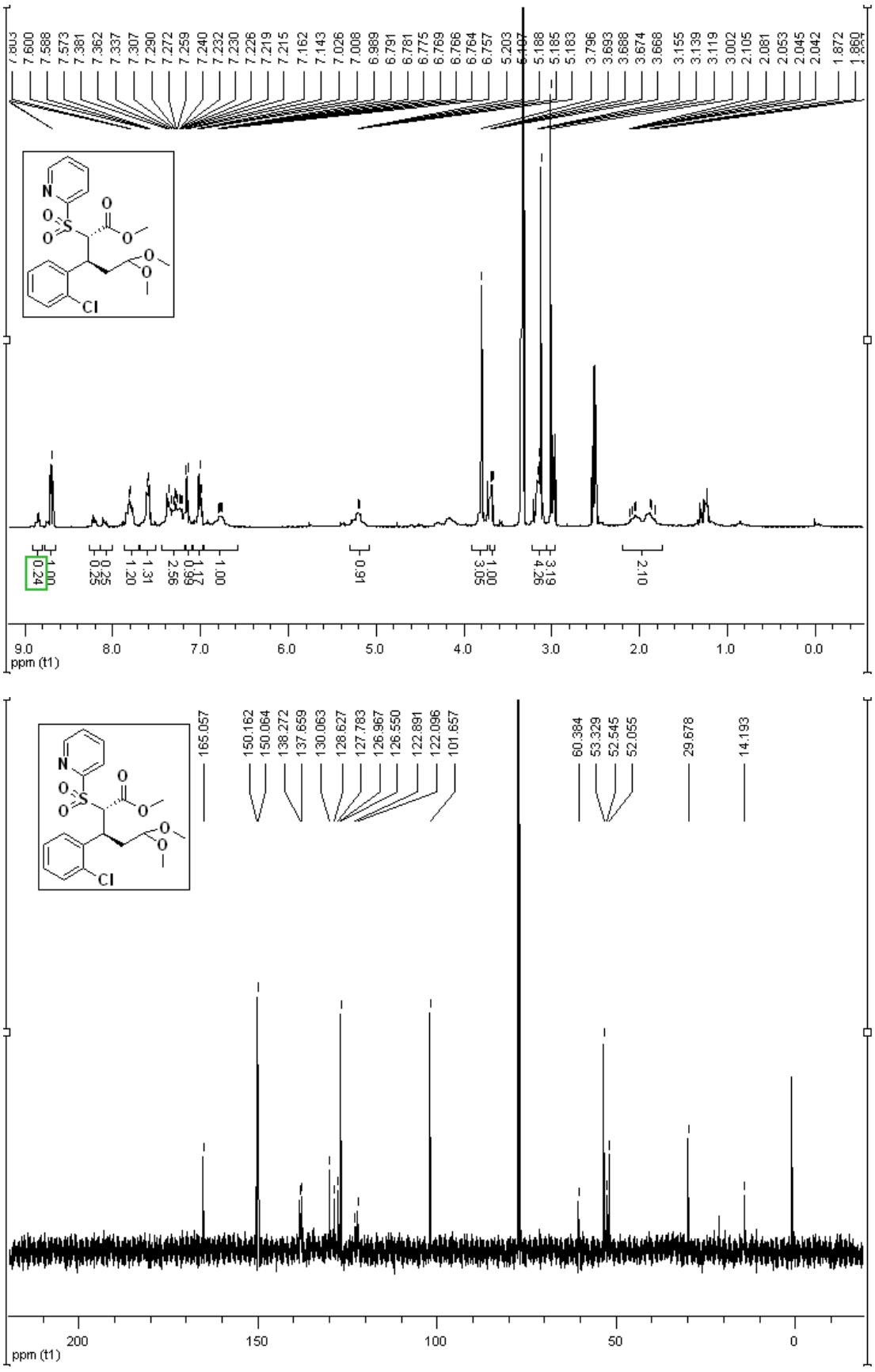

165.545
157.255
150.000
138.016
127.343
122.590
102.775
66.494
53.689
52.851
51.658
34.076
32.962
31.661
29.590
28.981
27.089
26.329
22.530
14.009
175 150 125 100 75 50 25 0
ppm (f1)

3'h

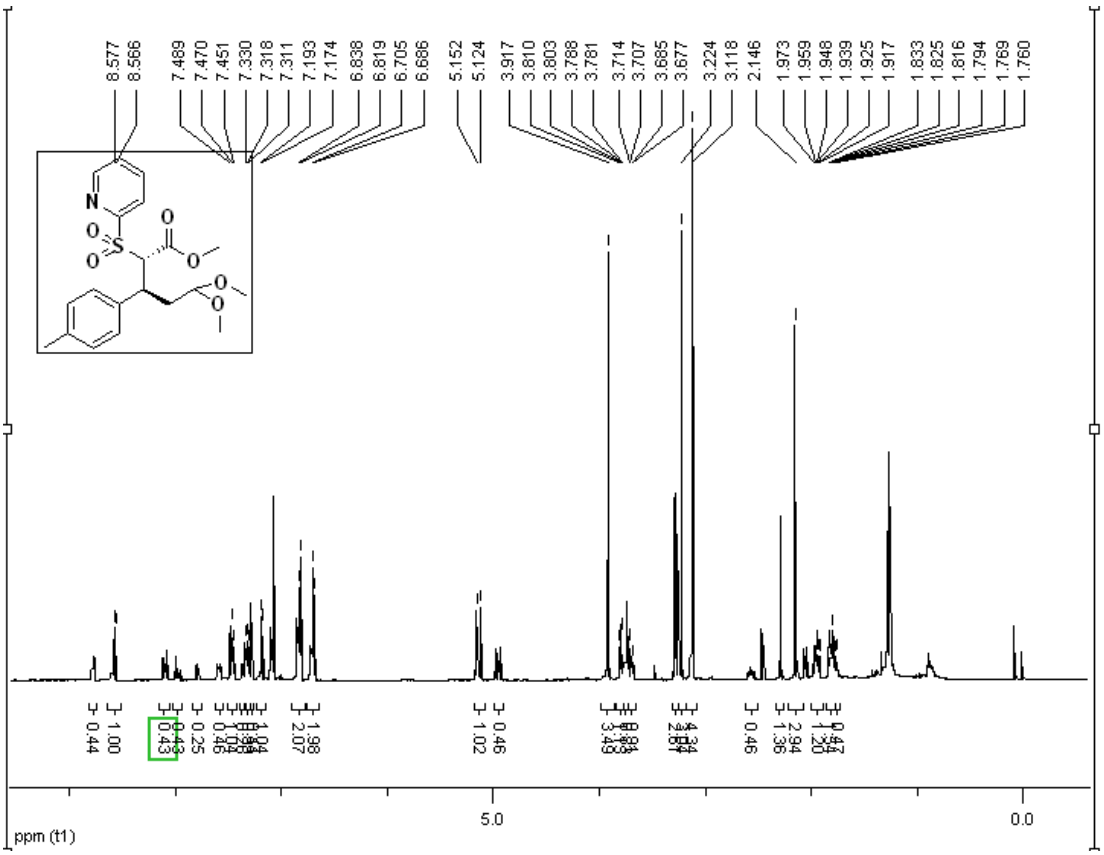

8.679
8.669
7.769
7.748
7.692
7.673
7.654
7.579
7.567
7.549
7.377
7.356
7.178
7.158
5.423
5.394
3.842
3.640
3.618
3.612
3.106
2.997
2.103
2.097
2.068
2.038
2.033
1.746
1.739
1.725
1.715
1.705
1.690
1.683
1.00
0.28
0.97
0.99
10.0
5.0
0.0
ppm (t1)

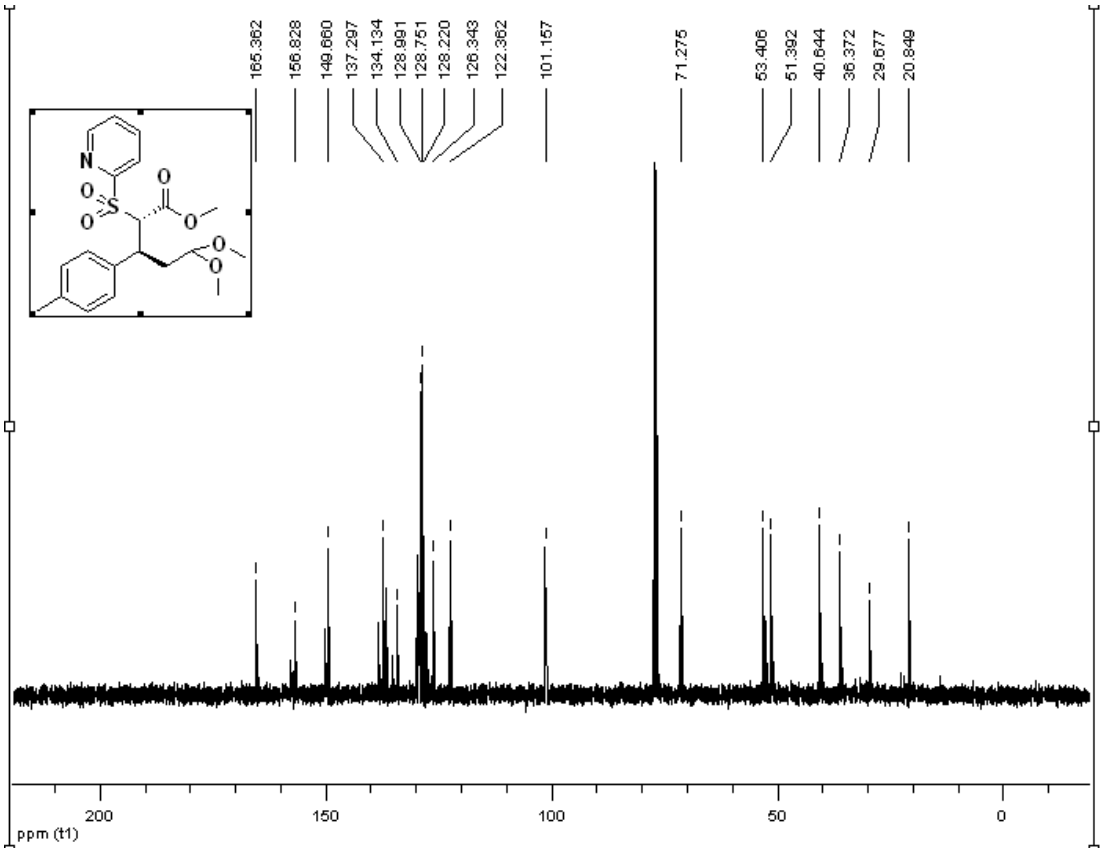

165.349
156.100
150.682
146.790
145.790
138.933
131.046
128.238
123.131
122.392
101.422
70.291
53.848
53.637
52.149
41.303
36.192
200
150
100
50
0
ppm (t1)

3'i

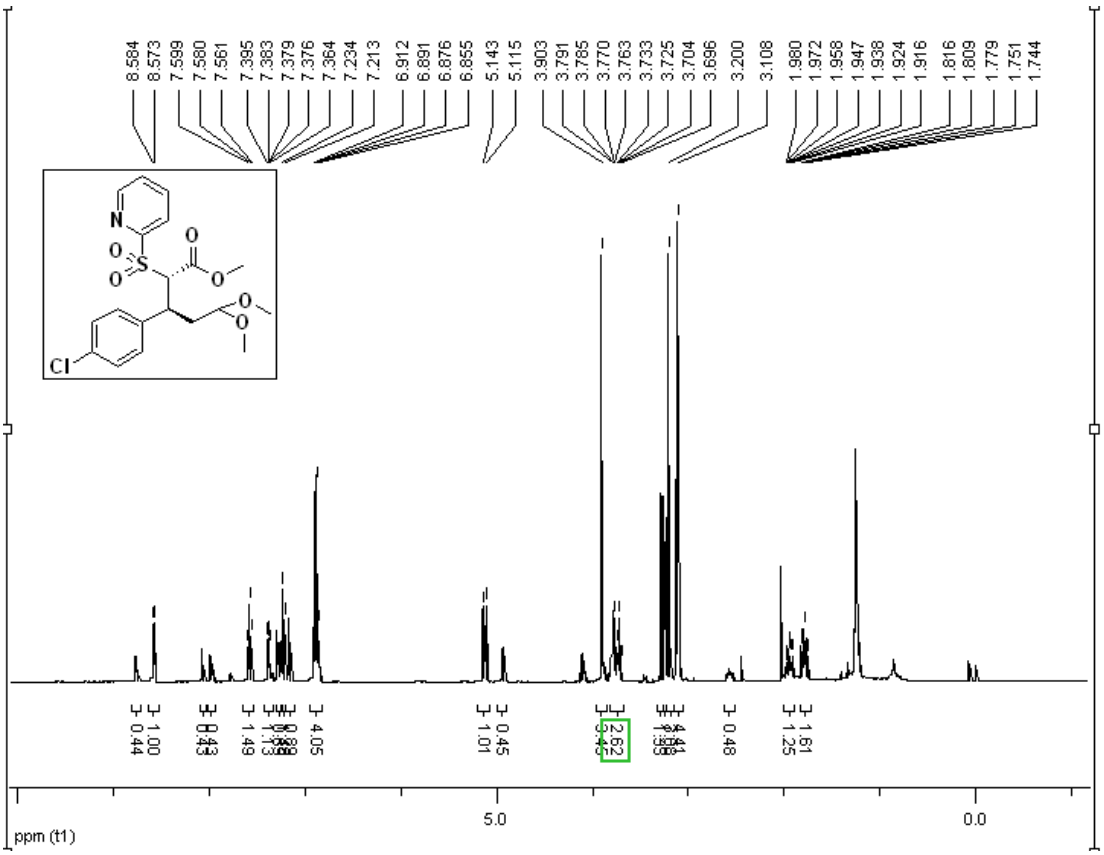

7.600
7.588
7.573
7.381
7.362
7.337
7.307
7.290
7.272
7.259
7.240
7.232
7.230
7.226
7.219
7.215
7.162
7.143
7.026
7.008
6.989
6.791
6.781
6.775
6.769
6.766
6.764
6.757
5.203
5.188
5.185
5.183
3.796
3.693
3.688
3.674
3.668
3.155
3.139
3.119
3.002
2.105
2.081
2.053
2.045
2.042
1.872
1.860
0.24
1.00
0.25
0.25
1.20
1.31
2.56
0.99
1.17
1.00
0.91
3.05
1.00
4.26
3.19
2.10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ppm (t1)
N
O
O
S
O
O
O
O
Cl
165.057
150.162
150.064
138.272
137.659
130.063
128.627
127.783
126.967
126.550
122.891
122.096
101.657
60.384
53.329
52.545
52.055
29.678
14.193
200
150
100
50
0
ppm (t1)

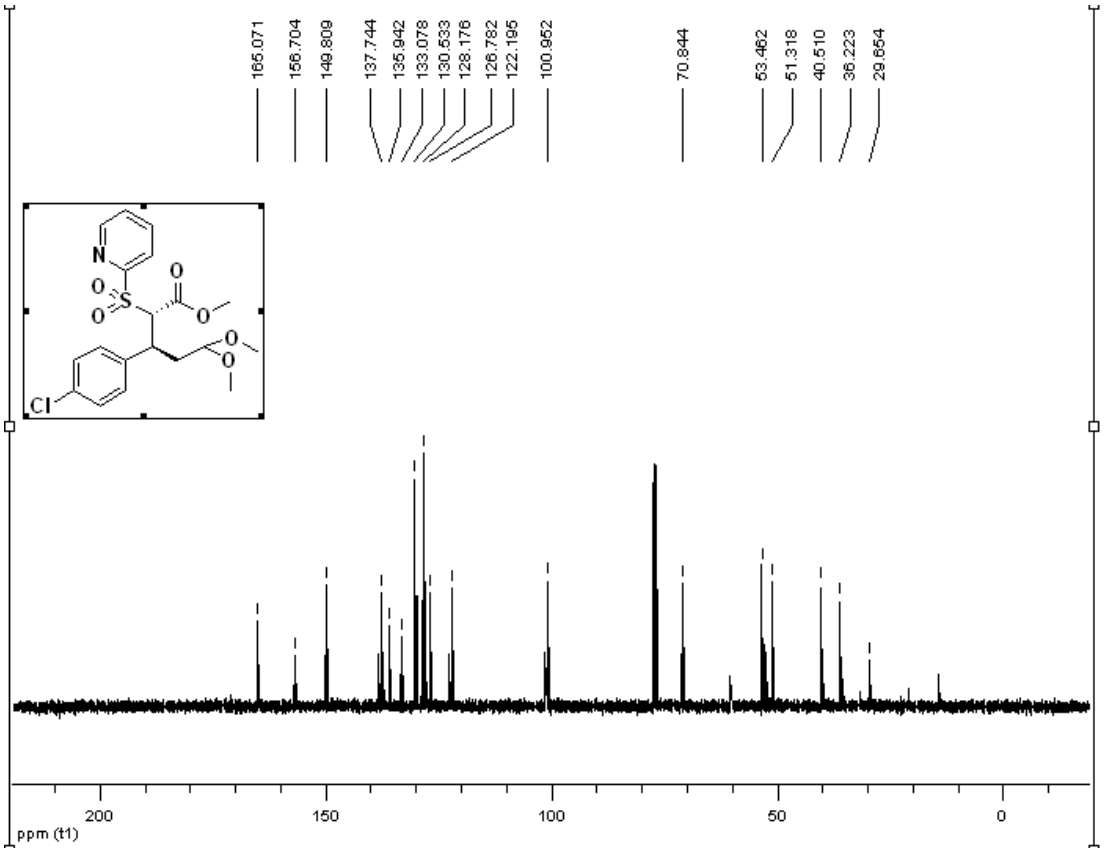
3'j


8.577
8.566
7.489
7.470
7.451
7.330
7.318
7.311
7.193
7.174
6.838
6.819
6.705
6.686
5.152
5.124
3.917
3.810
3.803
3.788
3.781
3.714
3.707
3.685
3.677
3.224
3.118
2.146
1.973
1.959
1.948
1.939
1.925
1.917
1.833
1.825
1.816
1.794
1.769
1.760
ppm (t1)
5.0
0.0

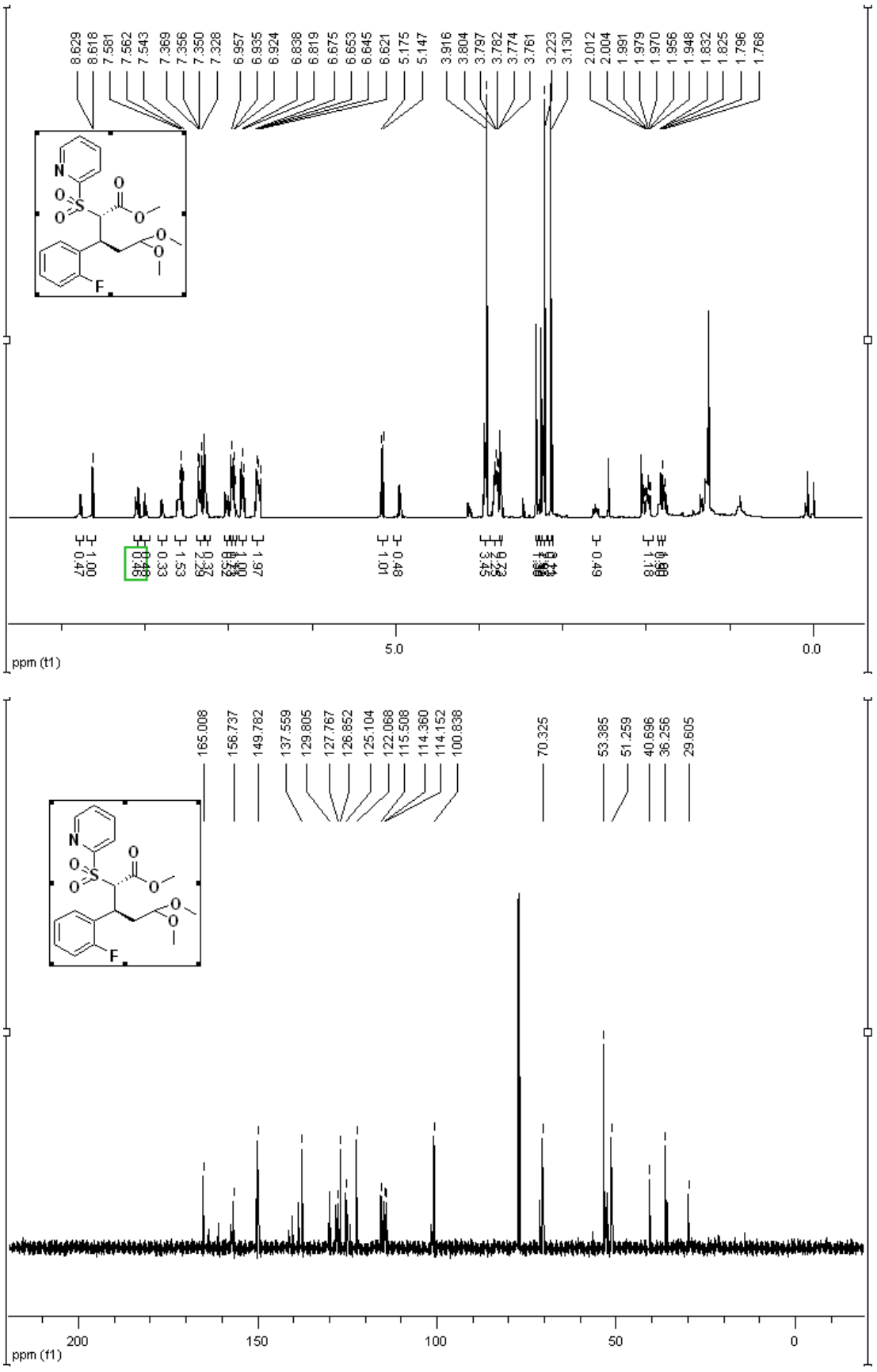

165.362
156.828
149.660
137.297
134.134
128.991
128.751
128.220
126.343
122.362
101.157
71.275
53.406
51.392
40.644
36.372
29.677
20.849
ppm (t1)
200
150
100
50
0

3'k

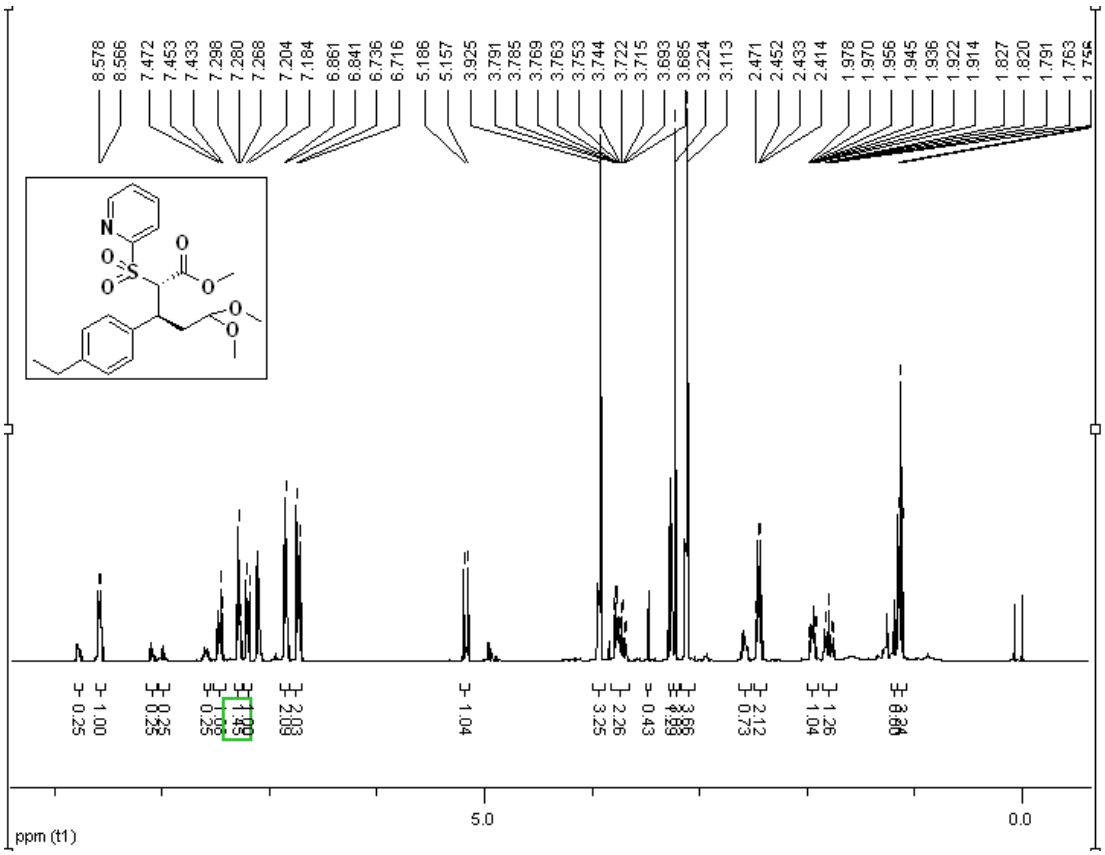

8.584
8.573
7.599
7.580
7.561
7.395
7.383
7.379
7.376
7.364
7.234
7.213
6.912
6.891
6.876
6.855
5.143
5.115
3.903
3.791
3.785
3.770
3.763
3.733
3.725
3.704
3.696
3.200
3.108
1.980
1.972
1.958
1.947
1.938
1.924
1.916
1.816
1.809
1.779
1.751
1.744
N
O
O
S
O
O
O
O
Cl
5.0
0.0
ppm (t1)

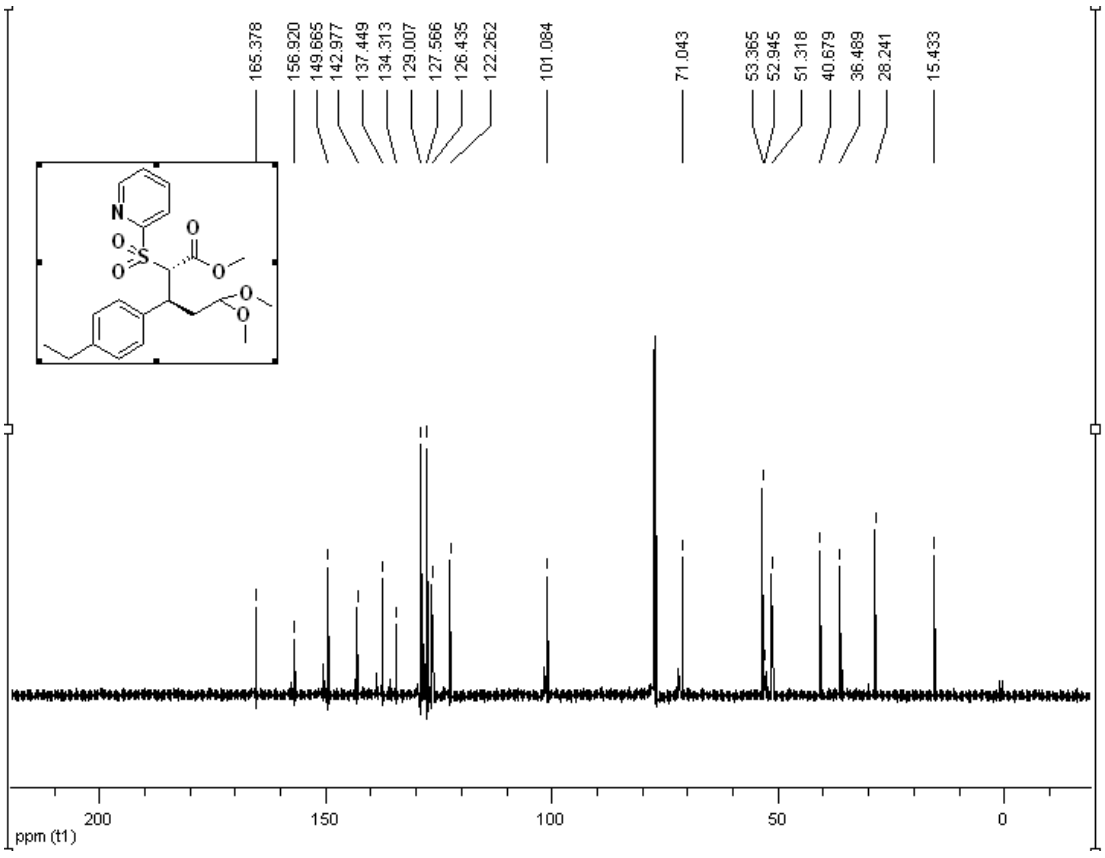

165.071
156.704
149.809
137.744
135.942
133.078
130.533
128.176
126.782
122.195
100.952
70.844
53.462
51.318
40.510
36.223
29.654
N
O
O
S
O
O
O
O
Cl
200
150
100
50
0
ppm (t1)

3'l

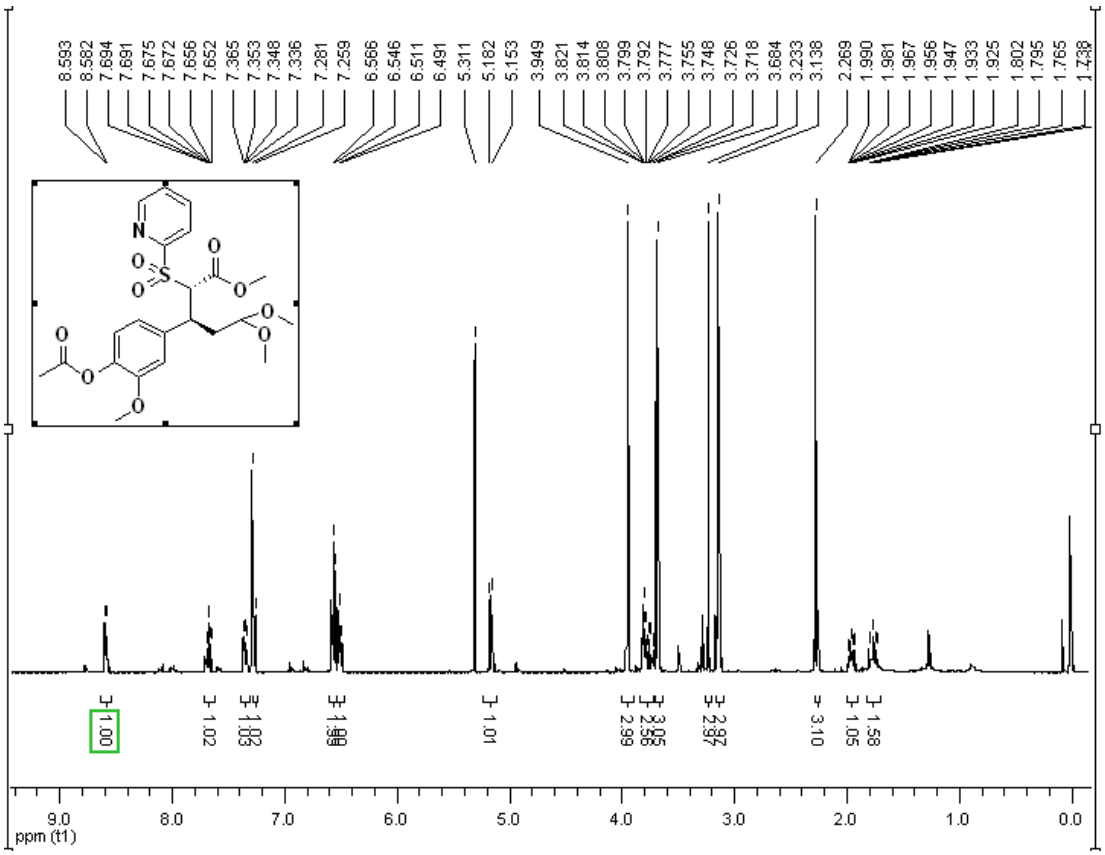

8.629
8.618
7.581
7.562
7.543
7.369
7.356
7.350
7.328
6.957
6.935
6.924
6.838
6.819
6.675
6.653
6.645
6.621
5.175
5.147
3.916
3.804
3.797
3.782
3.774
3.761
3.223
3.130
2.012
2.004
1.991
1.979
1.970
1.956
1.948
1.832
1.825
1.796
1.768
ppm (t1)
5.0
0.0
165.008
156.737
149.782
137.559
129.805
127.767
126.852
125.104
122.068
115.508
114.360
114.152
100.838
70.325
53.385
51.259
40.696
36.256
29.605
ppm (f1)
200
150
100
50
0

3'm


8.578
8.566
7.472
7.453
7.433
7.298
7.280
7.268
7.204
7.184
6.861
6.841
6.736
6.716
5.186
5.157
3.925
3.791
3.785
3.769
3.763
3.753
3.744
3.722
3.715
3.693
3.685
3.224
3.113
2.471
2.452
2.433
2.414
1.978
1.970
1.956
1.945
1.936
1.922
1.914
1.827
1.820
1.791
1.763
0.25
1.00
0.35
0.25
2.08
1.04
3.25
2.26
0.43
3.89
0.73
2.12
1.04
1.26
8.80
5.0
0.0
ppm (t1)


165.378
156.920
149.665
142.977
137.449
134.313
129.007
127.566
126.435
122.262
101.084
71.043
53.365
52.945
51.318
40.679
36.489
28.241
15.433
200
150
100
50
0
ppm (t1)

3'n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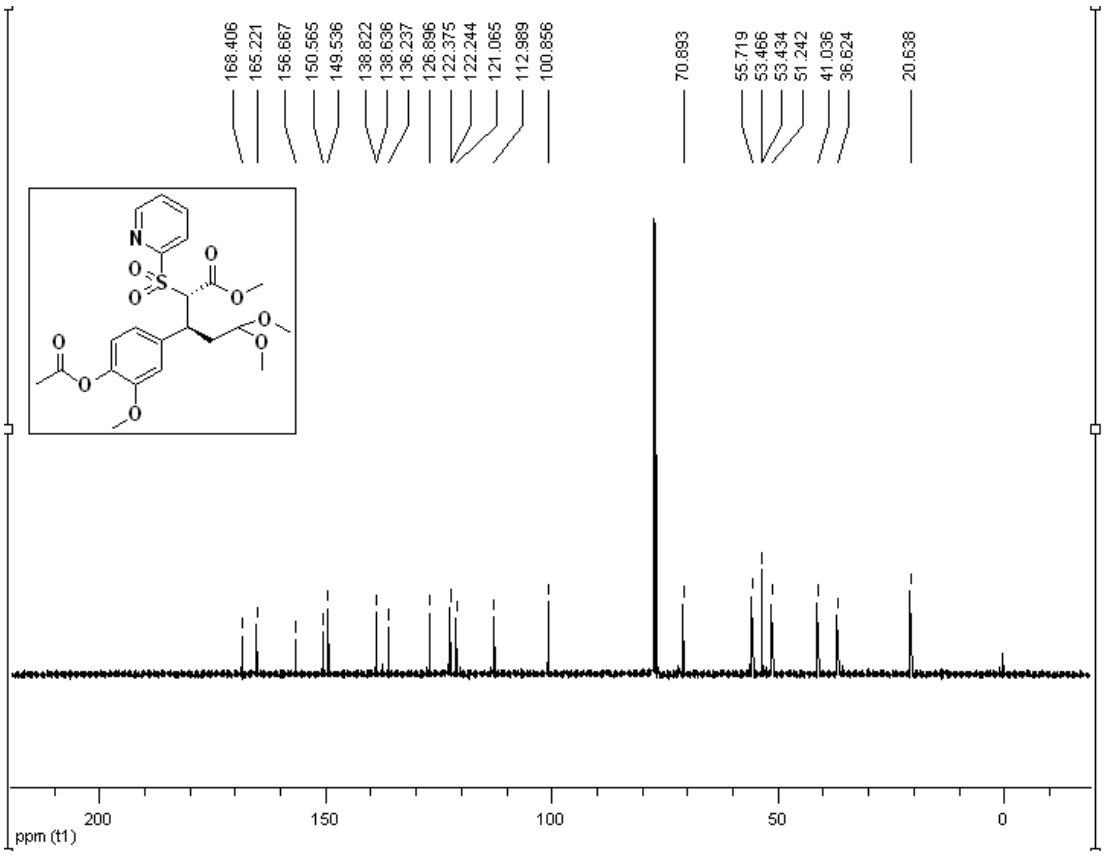
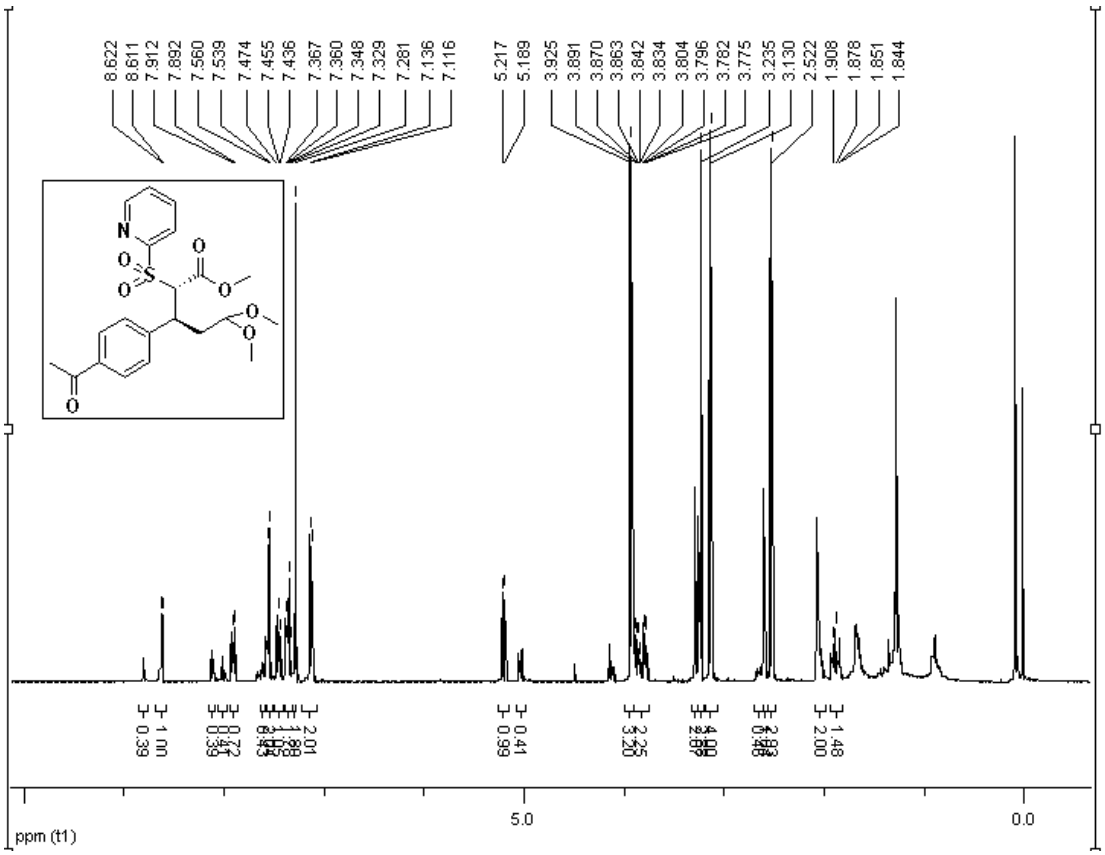
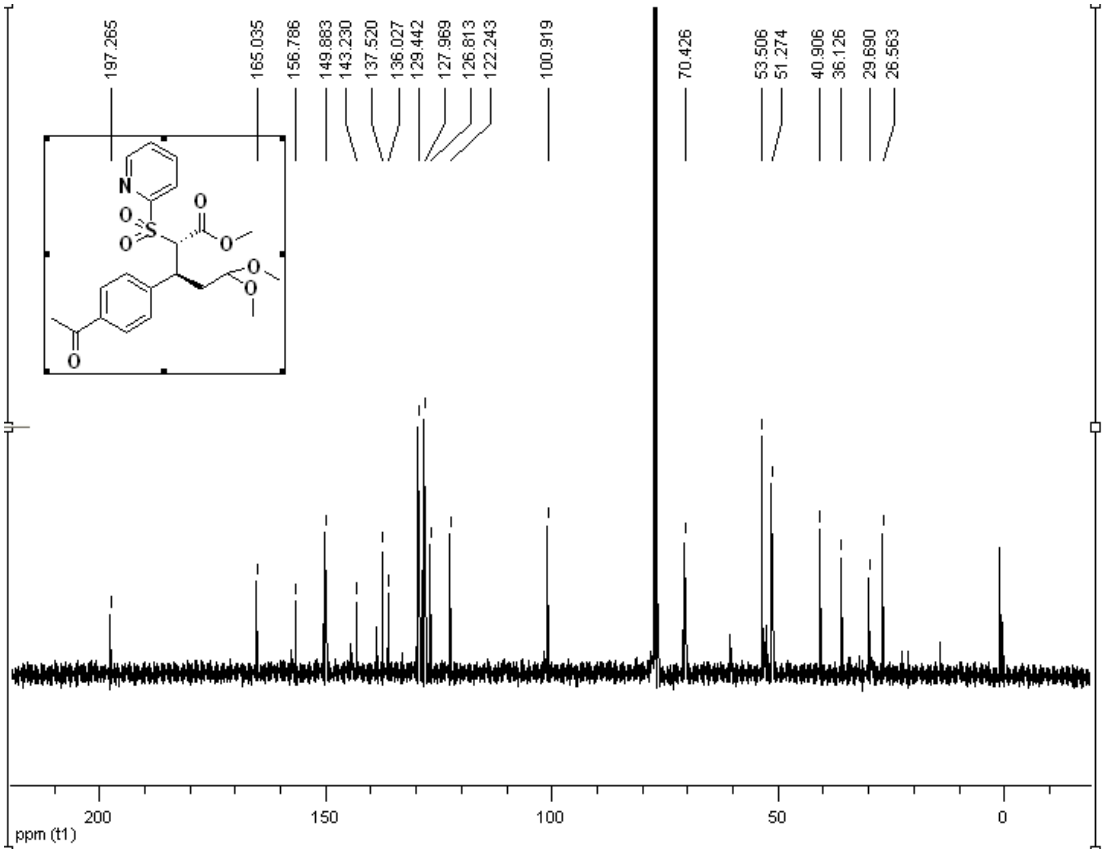
8.582
7.694
7.691
7.675
7.672
7.656
7.652
7.365
7.353
7.348
7.336
7.281
7.259
6.566
6.546
6.511
6.491
5.311
5.182
5.153
3.949
3.821
3.814
3.808
3.799
3.792
3.777
3.755
3.748
3.726
3.718
3.684
3.233
3.138
2.269
1.990
1.981
1.967
1.956
1.947
1.933
1.925
1.802
1.795
1.765
1.438
1.00
1.02
3.03
1.98
1.01
2.99
3.05
2.97
3.10
1.05
1.58
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ppm (t1)

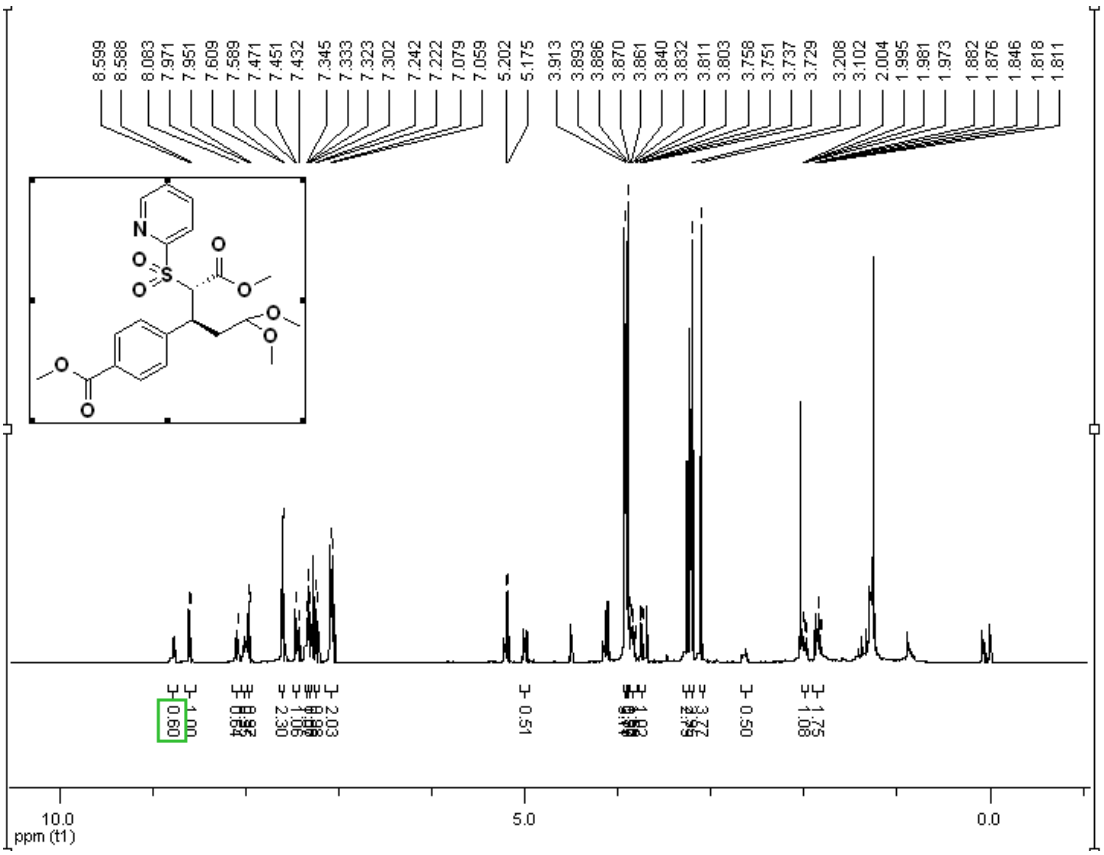

168.406
165.221
156.667
150.565
149.536
138.822
138.636
136.237
126.896
122.375
122.244
121.065
112.989
100.856
70.893
55.719
53.466
53.434
51.242
41.036
36.624
20.638
200
150
100
50
0
ppm (t1)

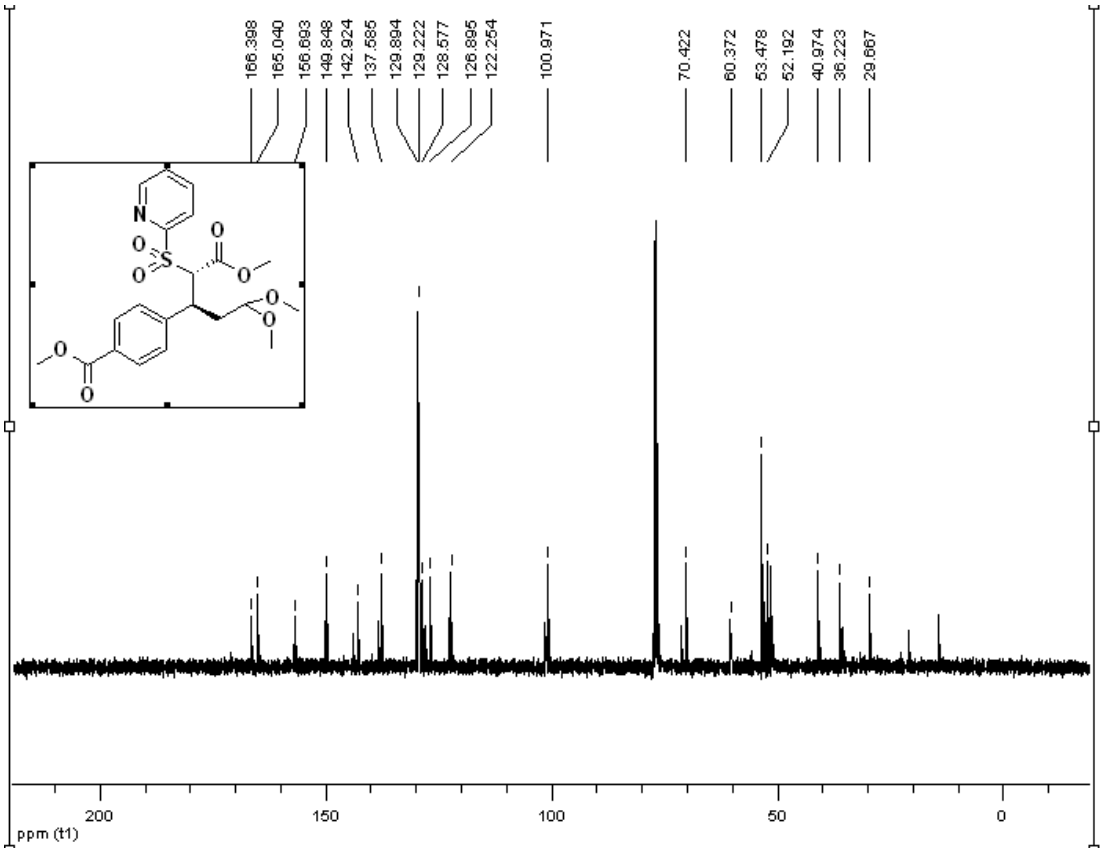
3'o


8.622
8.611
7.912
7.892
7.560
7.539
7.474
7.455
7.436
7.367
7.360
7.348
7.329
7.281
7.136
7.116
5.217
5.189
3.925
3.891
3.870
3.863
3.842
3.834
3.804
3.796
3.782
3.775
3.235
3.130
2.522
1.908
1.878
1.851
1.844
0.39
1.00
0.99
0.41
3.25
1.48
2.00
ppm (t1)
5.0
0.0

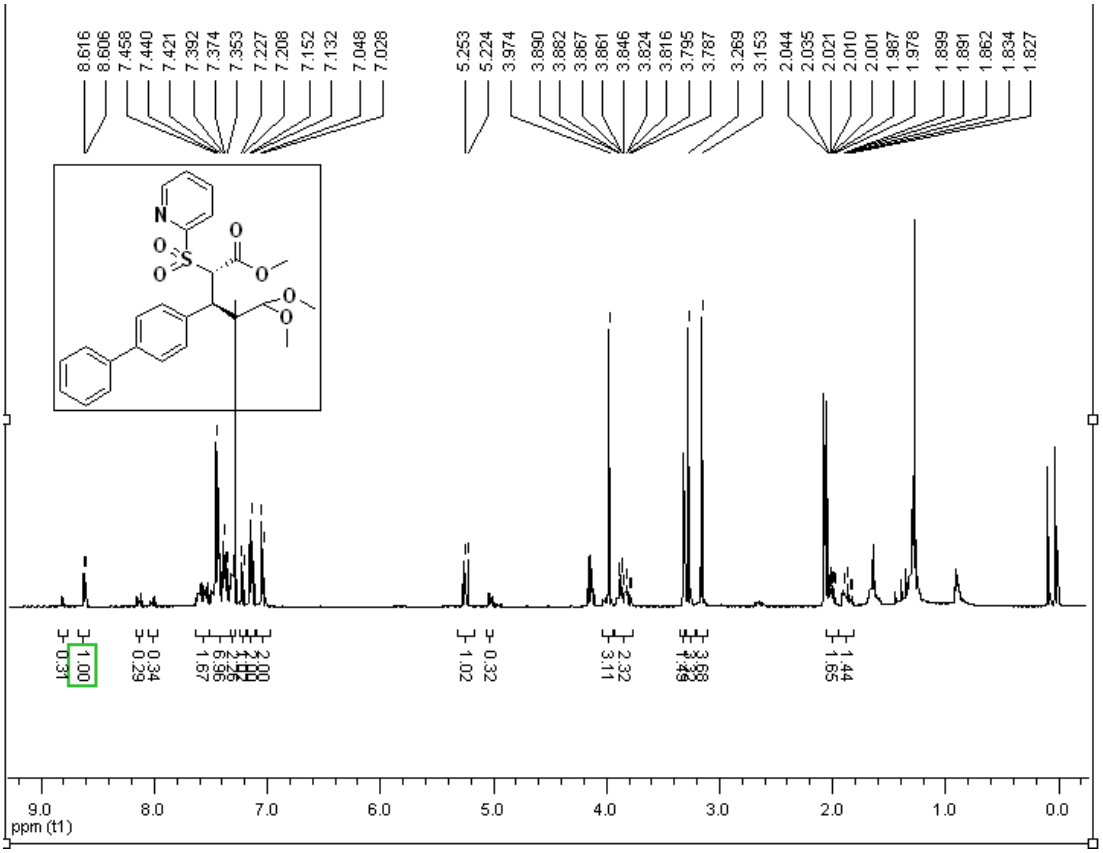

197.265
165.035
156.786
149.883
143.230
137.520
136.027
129.442
127.969
126.813
122.243
100.919
70.426
53.506
51.274
40.906
36.126
29.690
26.563
ppm (t1)
200
150
100
50
0

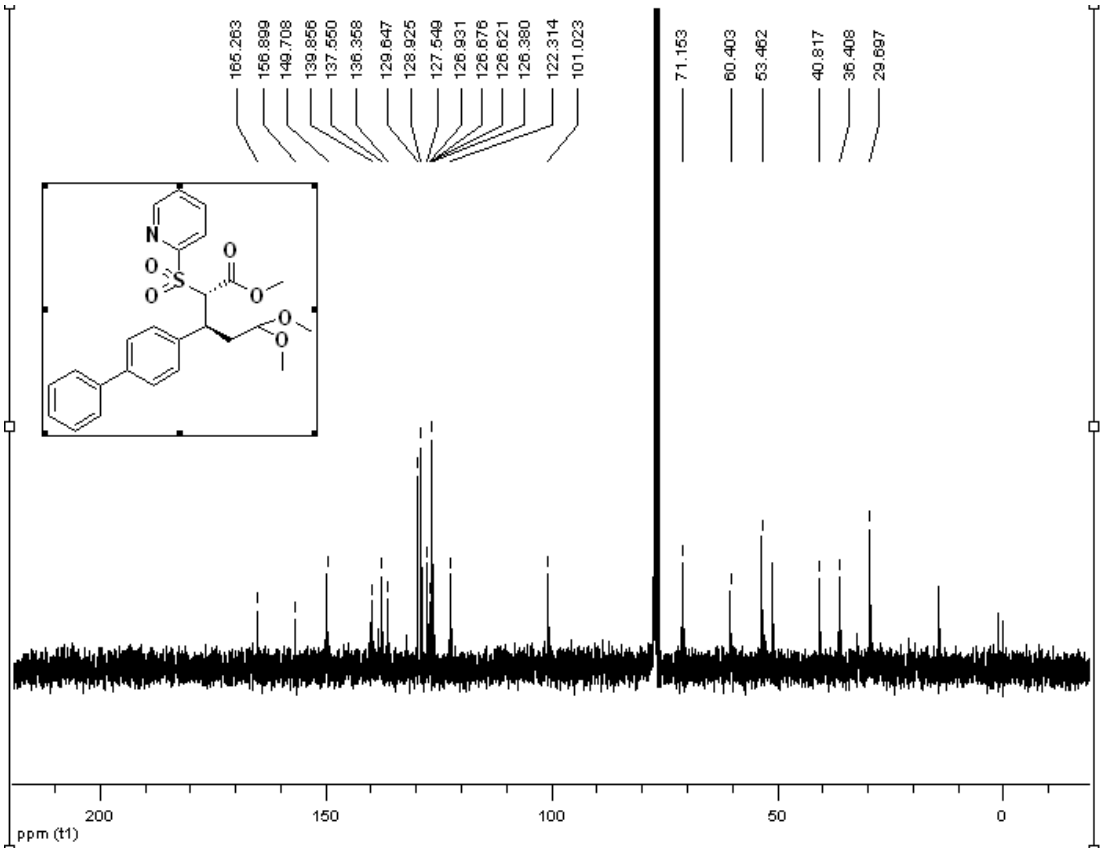
3'p


8.599
8.588
8.083
7.971
7.951
7.609
7.589
7.471
7.451
7.432
7.345
7.333
7.323
7.302
7.242
7.222
7.079
7.059
5.202
5.175
3.913
3.893
3.886
3.870
3.861
3.840
3.832
3.811
3.803
3.758
3.751
3.737
3.729
3.208
3.102
2.004
1.995
1.981
1.973
1.882
1.876
1.846
1.818
1.811
1.00
0.60
2.30
2.03
0.51
2.99
2.27
0.50
1.08
1.25
10.0
5.0
0.0
ppm (t1)

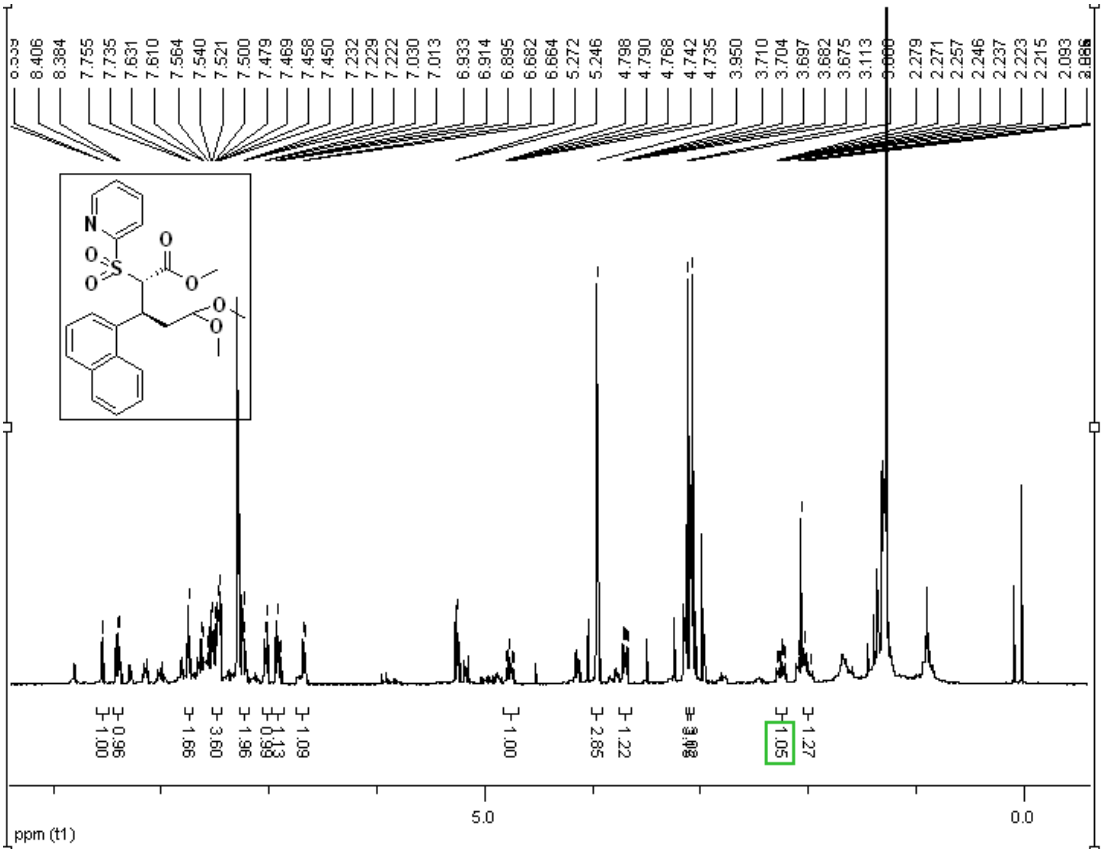

166.398
165.040
156.693
149.848
142.924
137.685
129.894
129.222
128.577
126.895
122.254
100.971
70.422
60.372
53.478
52.192
40.974
36.223
29.667
200
150
100
50
0
ppm (t1)

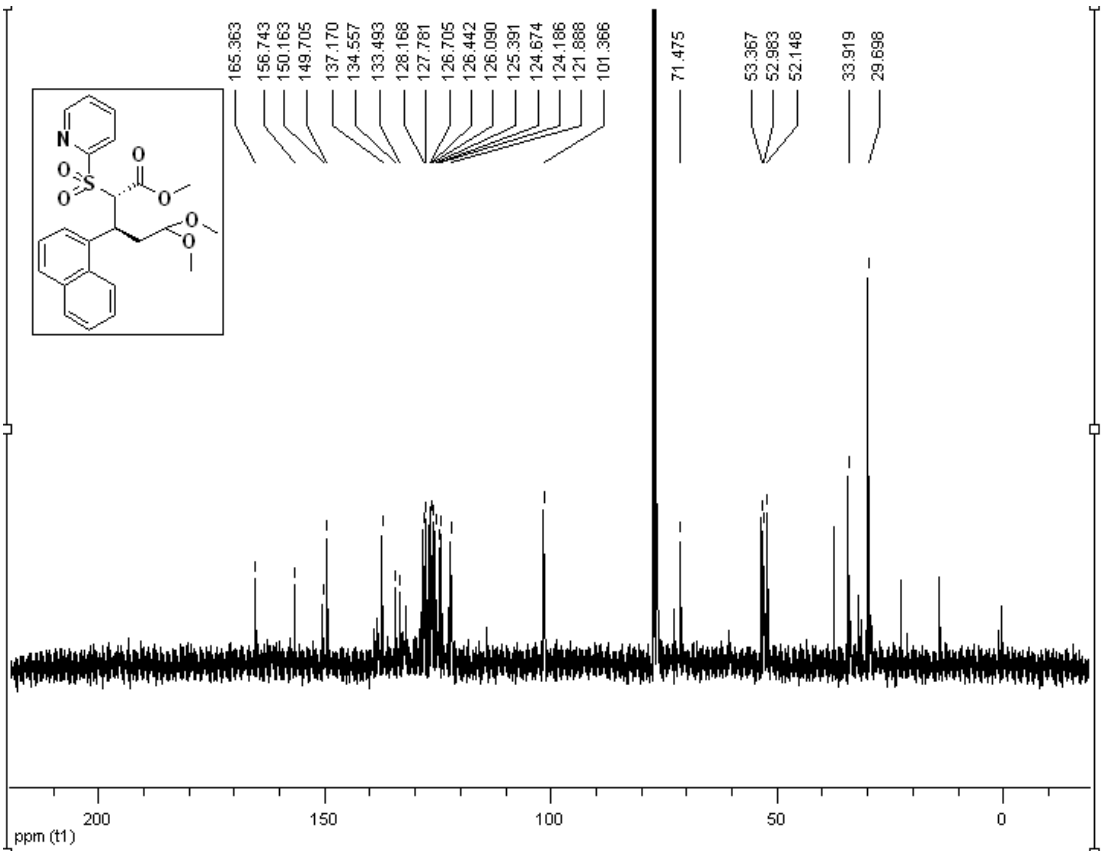
3'q


8.616
8.606
7.458
7.440
7.421
7.392
7.374
7.353
7.227
7.208
7.152
7.132
7.048
7.028
5.253
5.224
3.974
3.890
3.882
3.867
3.861
3.846
3.824
3.816
3.795
3.787
3.269
3.153
2.044
2.035
2.021
2.010
2.001
1.987
1.978
1.899
1.891
1.862
1.834
1.827
0.31
1.00
0.34
0.29
1.67
6.96
2.00
1.02
0.32
3.11
2.32
3.89
4.46
1.65
1.44
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ppm (t1)

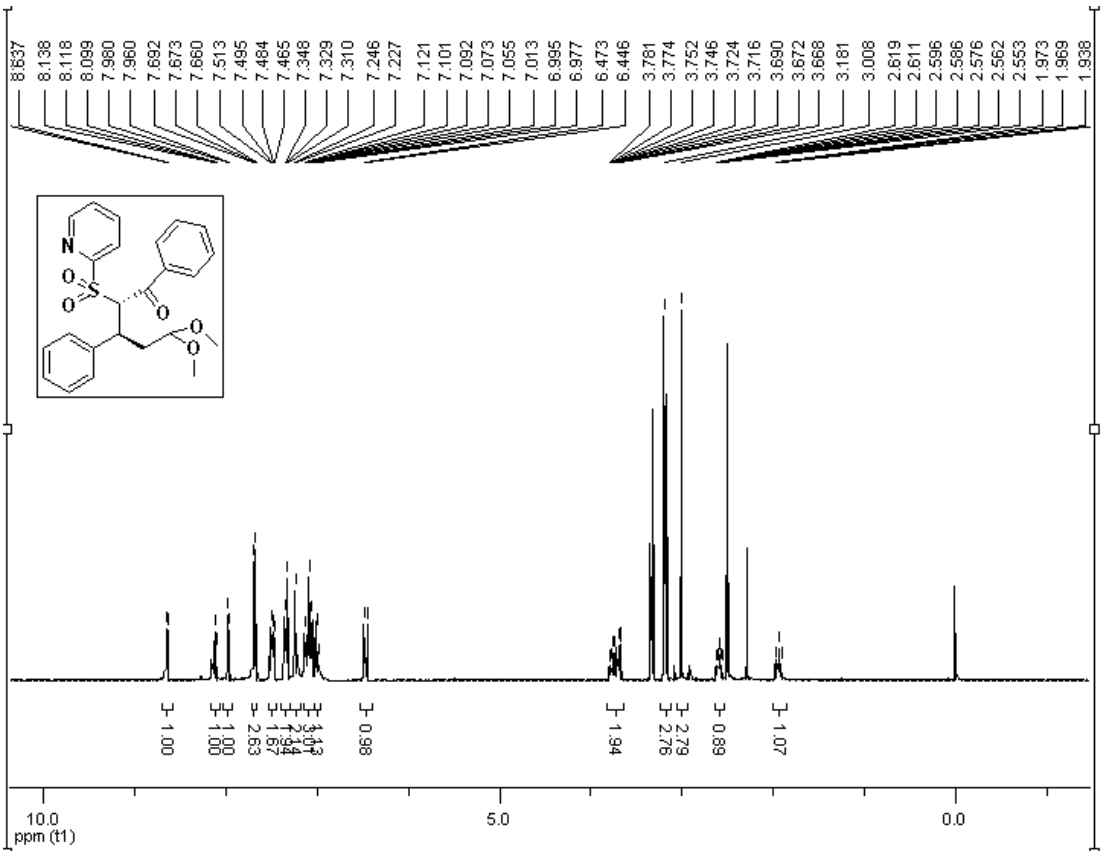

165.263
158.899
149.708
139.856
137.550
136.358
129.647
128.925
127.549
126.931
126.676
126.621
126.380
122.314
101.023
71.153
60.403
53.462
40.817
36.408
29.697
200
150
100
50
0
ppm (t1)

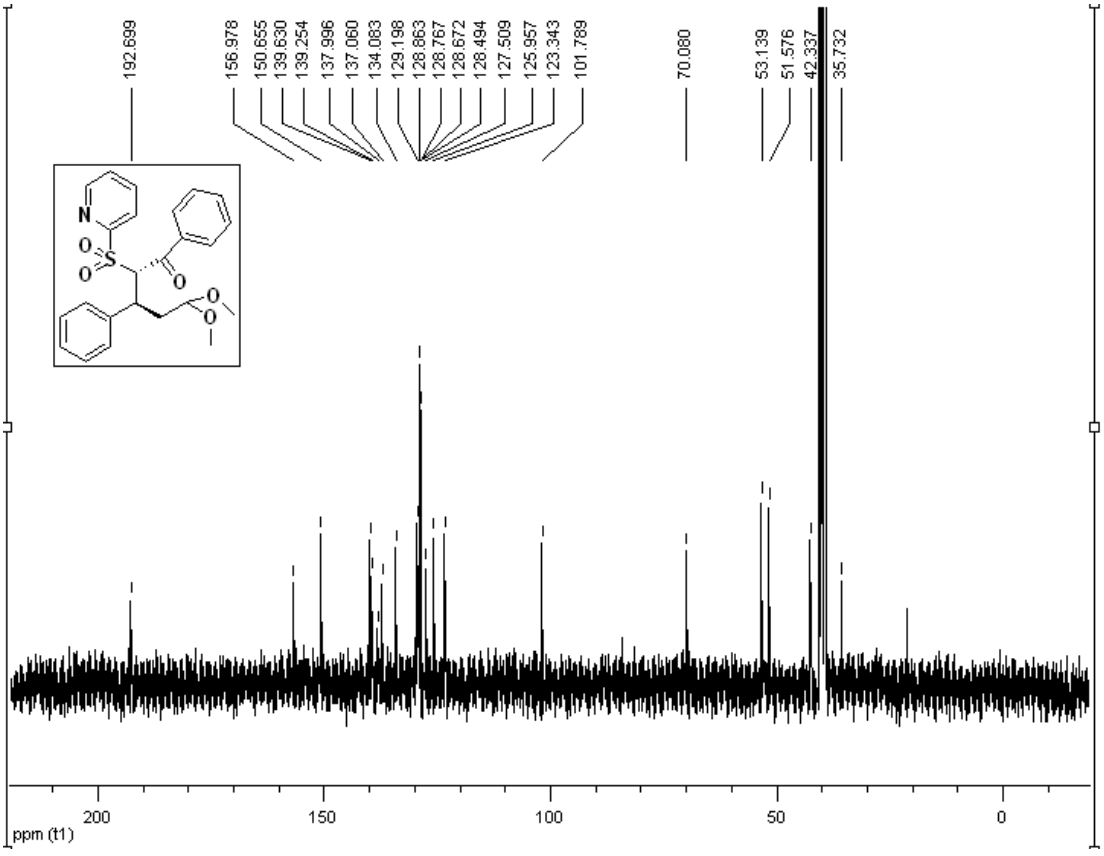
3'r


8.406
8.384
7.755
7.735
7.631
7.610
7.564
7.540
7.521
7.500
7.479
7.469
7.458
7.450
7.232
7.229
7.222
7.030
7.013
6.933
6.914
6.895
6.682
6.664
5.272
5.246
4.798
4.790
4.768
4.742
4.735
3.950
3.710
3.704
3.697
3.682
3.675
3.113
2.279
2.271
2.257
2.246
2.237
2.223
2.215
2.093
0.96
1.66
3.60
1.96
0.99
1.13
1.09
1.00
2.86
1.22
1.05
1.27
5.0
0.0
ppm (t1)

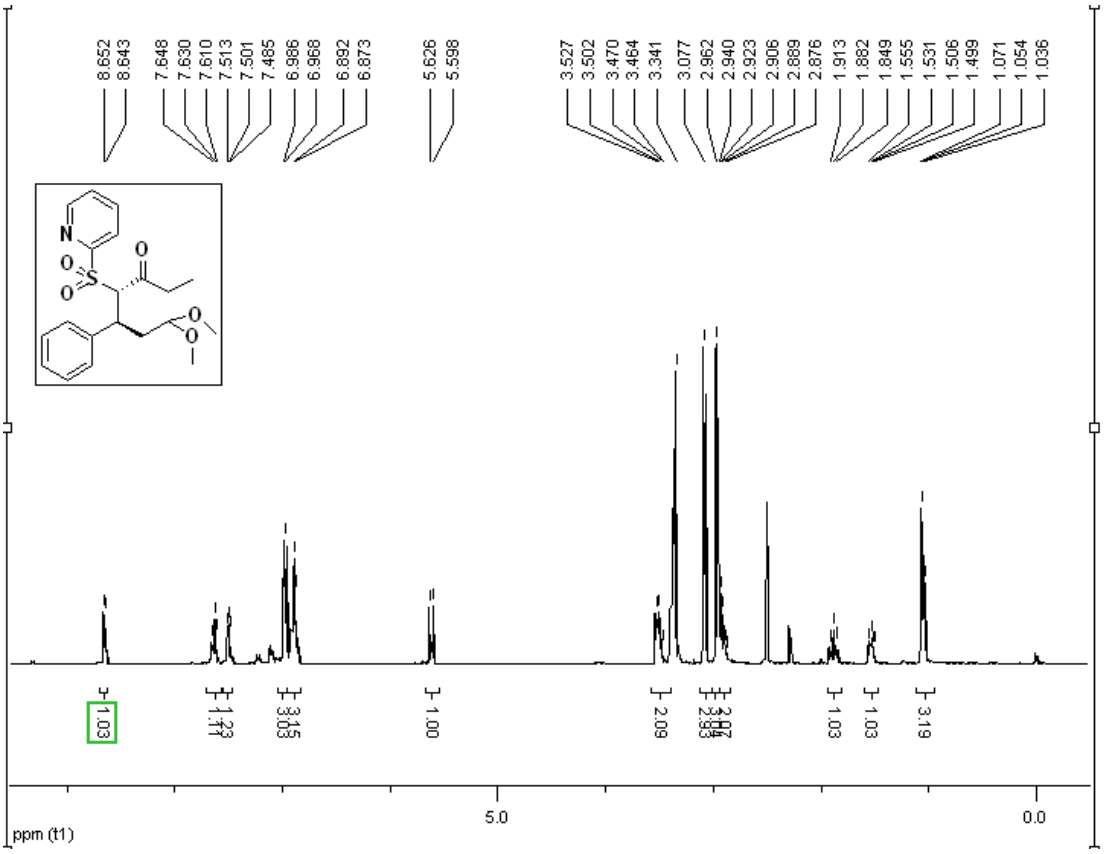

165.363
156.743
150.163
149.705
137.170
134.557
133.493
128.168
127.781
126.705
126.442
126.090
125.391
124.674
124.186
121.888
101.366
71.475
53.367
52.983
52.148
33.919
29.698
200
150
100
50
0
ppm (t1)

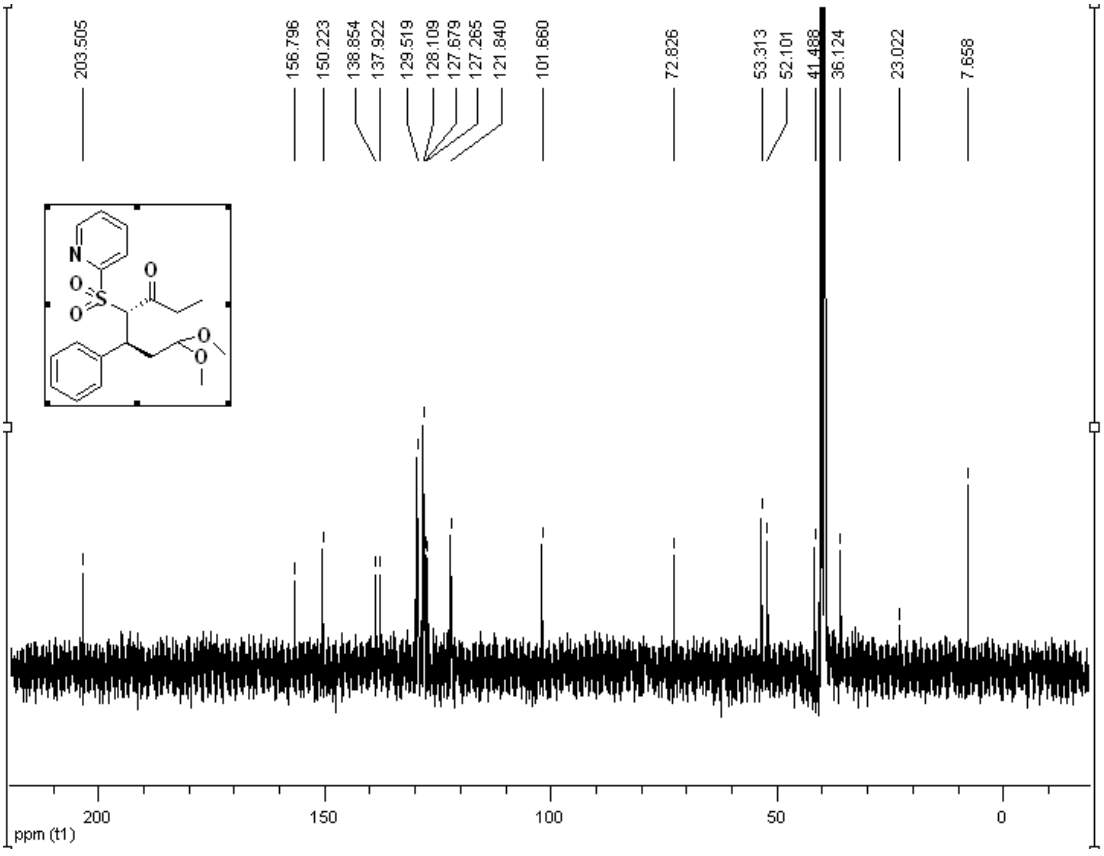
3's


8.637
8.138
8.118
8.099
7.980
7.960
7.692
7.673
7.660
7.513
7.495
7.484
7.465
7.348
7.329
7.310
7.246
7.227
7.121
7.101
7.092
7.073
7.055
7.013
6.995
6.977
6.473
6.446
3.781
3.774
3.752
3.746
3.724
3.716
3.690
3.672
3.668
3.181
3.008
2.619
2.611
2.596
2.586
2.576
2.562
2.553
1.973
1.969
1.938
1.00
1.00
2.63
0.98
1.94
2.76
2.79
0.89
1.07
10.0
5.0
0.0
ppm (t1)

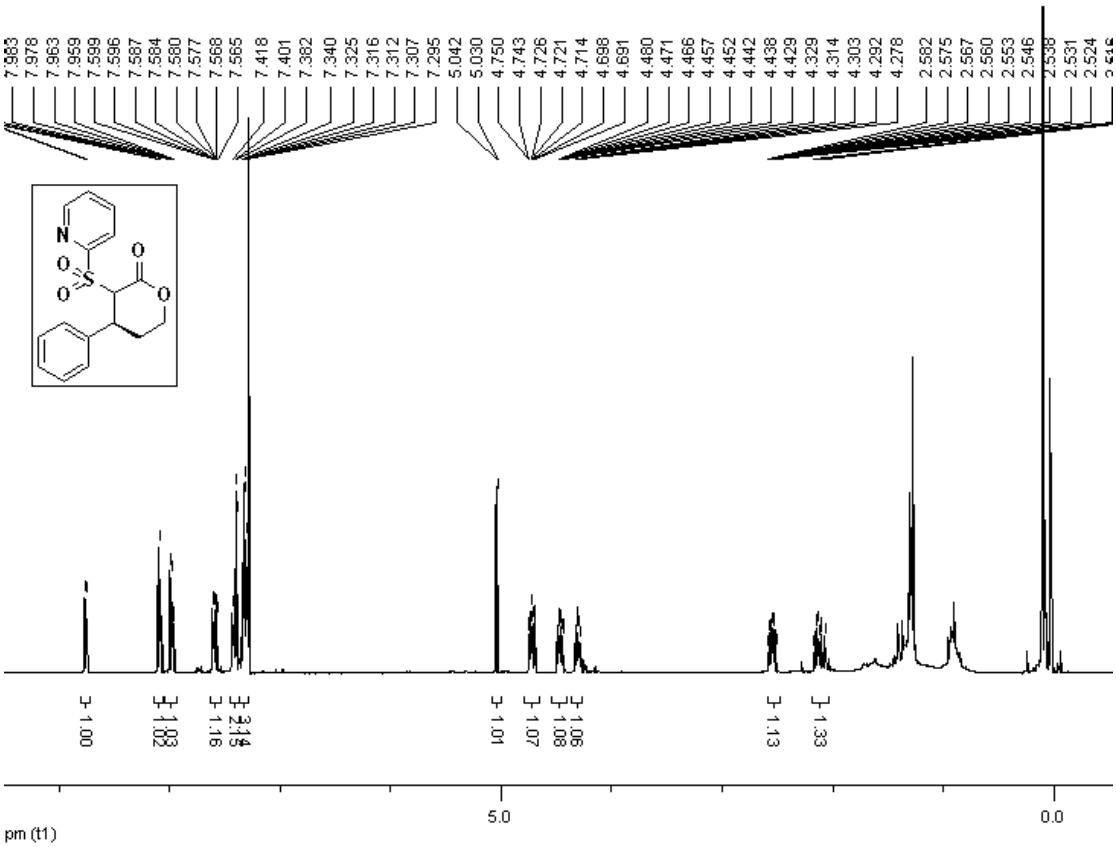

192.699
156.978
150.655
139.630
139.254
137.996
137.060
134.083
129.198
128.863
128.767
128.672
128.494
127.509
125.957
123.343
101.789
70.080
53.139
51.576
42.337
35.732
200
150
100
50
0
ppm (t1)

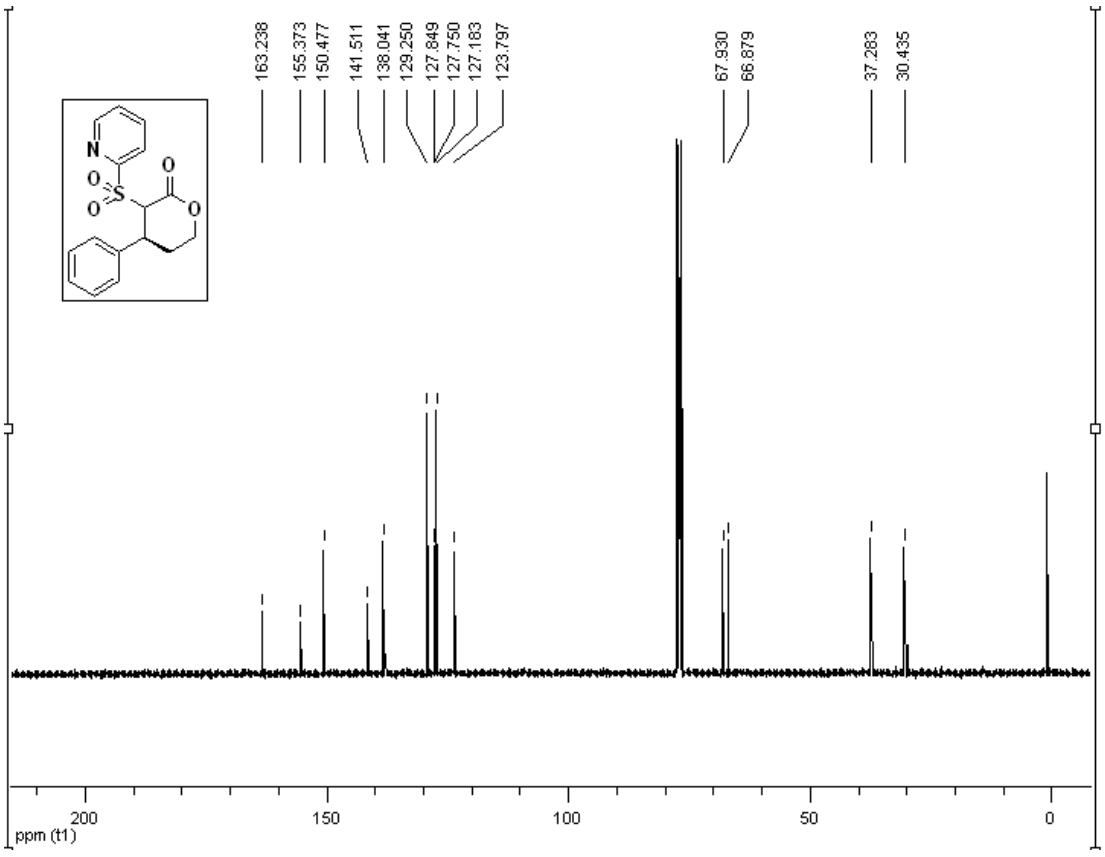
3't


8.652
8.643
7.648
7.630
7.610
7.513
7.501
7.485
6.986
6.968
6.892
6.873
5.626
5.598
3.527
3.502
3.470
3.464
3.341
3.077
2.962
2.940
2.923
2.906
2.889
2.876
1.913
1.882
1.849
1.555
1.531
1.506
1.499
1.071
1.054
1.036
1.03
1.12
3.15
1.00
2.09
3.07
1.03
1.03
3.19
5.0
0.0
ppm (t1)

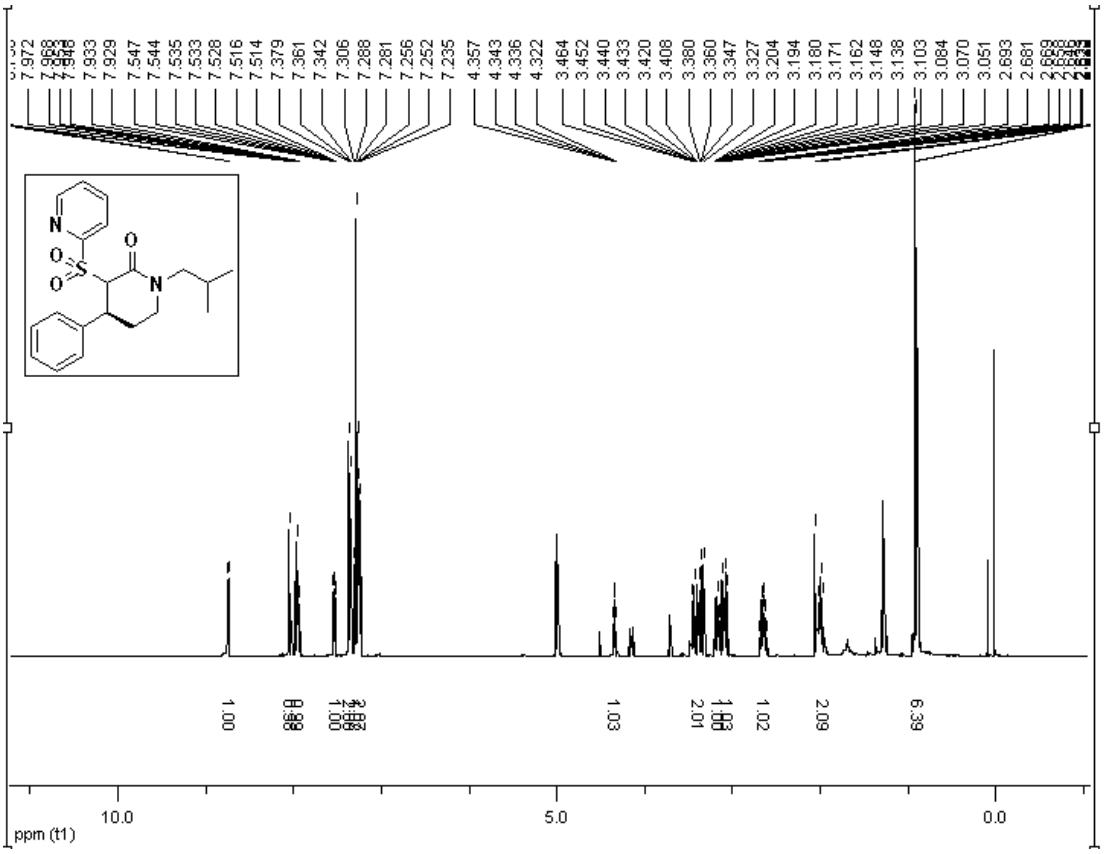

203.505
156.796
150.223
138.854
137.922
129.519
128.109
127.679
127.265
121.840
101.660
72.826
53.313
52.101
41.488
36.124
23.022
7.658
200
150
100
50
0
ppm (t1)

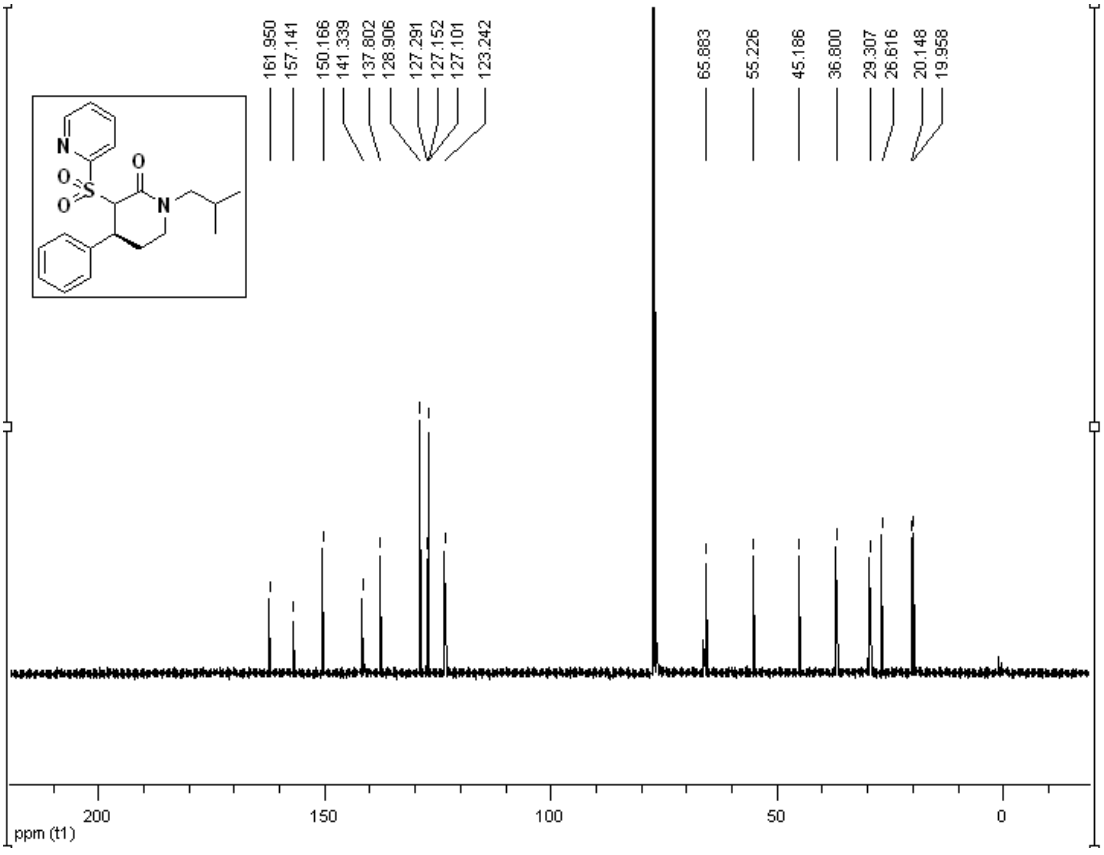
5


7.983
7.978
7.963
7.959
7.599
7.596
7.587
7.584
7.580
7.577
7.568
7.565
7.418
7.401
7.382
7.340
7.325
7.316
7.312
7.307
7.295
5.042
5.030
4.750
4.743
4.726
4.721
4.714
4.698
4.691
4.480
4.471
4.466
4.457
4.452
4.442
4.438
4.429
4.329
4.314
4.303
4.292
4.278
2.582
2.575
2.567
2.560
2.553
2.546
2.538
2.531
2.524
1.00
1.02
1.03
1.16
2.14
2.15
1.01
1.07
1.08
1.06
1.13
1.33
5.0
0.0
ppm (t1)

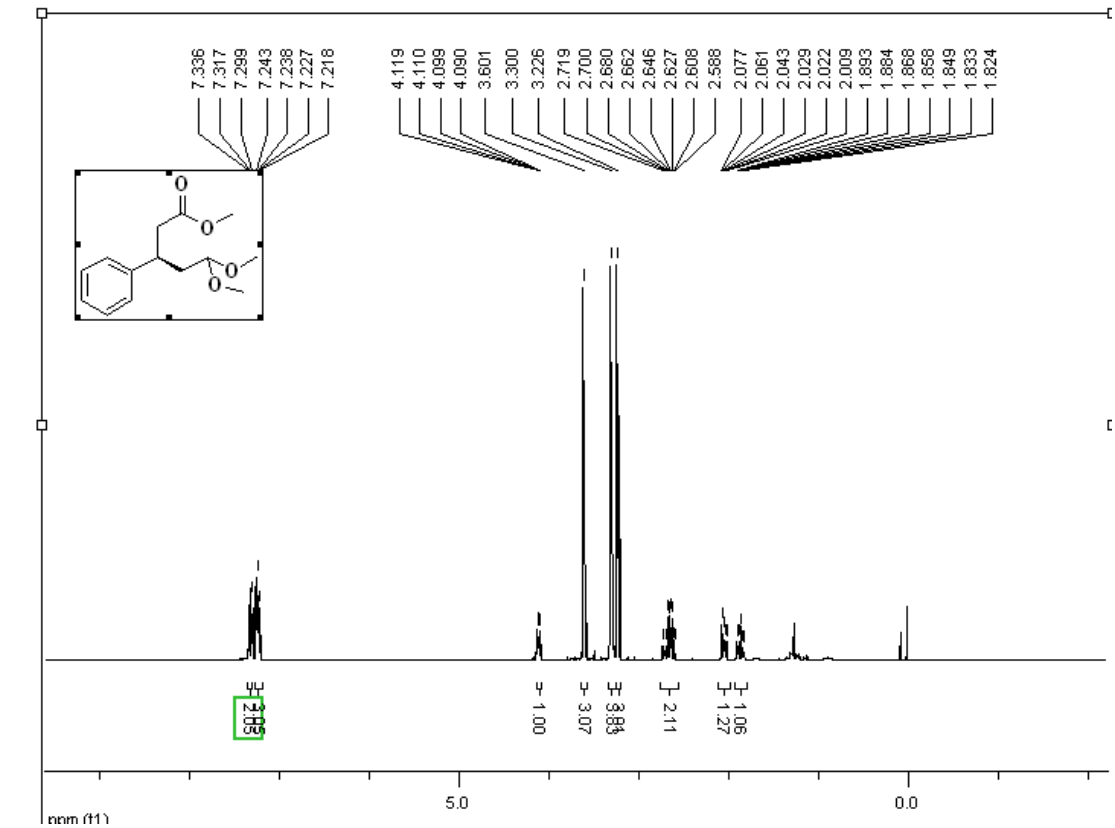

163.238
155.373
150.477
141.511
138.041
129.250
127.849
127.750
127.183
123.797
67.930
66.879
37.283
30.435
200
150
100
50
0
ppm (t1)

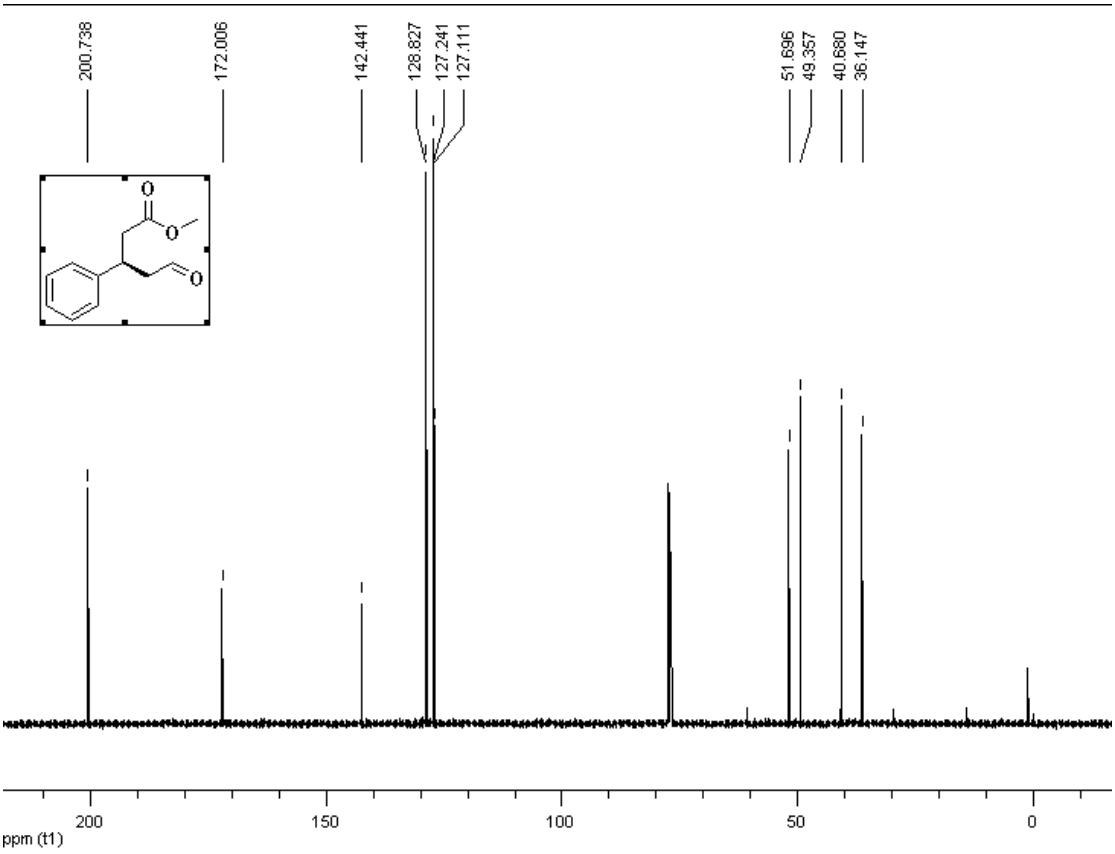
6


7.972
7.547
7.544
7.535
7.533
7.528
7.516
7.514
7.379
7.361
7.342
7.306
7.288
7.281
7.256
7.252
7.235
4.357
4.343
4.336
4.322
3.464
3.452
3.440
3.433
3.420
3.408
3.380
3.360
3.347
3.327
3.204
3.194
3.180
3.171
3.162
3.148
3.138
3.103
3.084
3.070
3.051
2.693
2.681
1.00
1.03
2.01
1.02
2.09
6.39
10.0
5.0
0.0
ppm (t1)

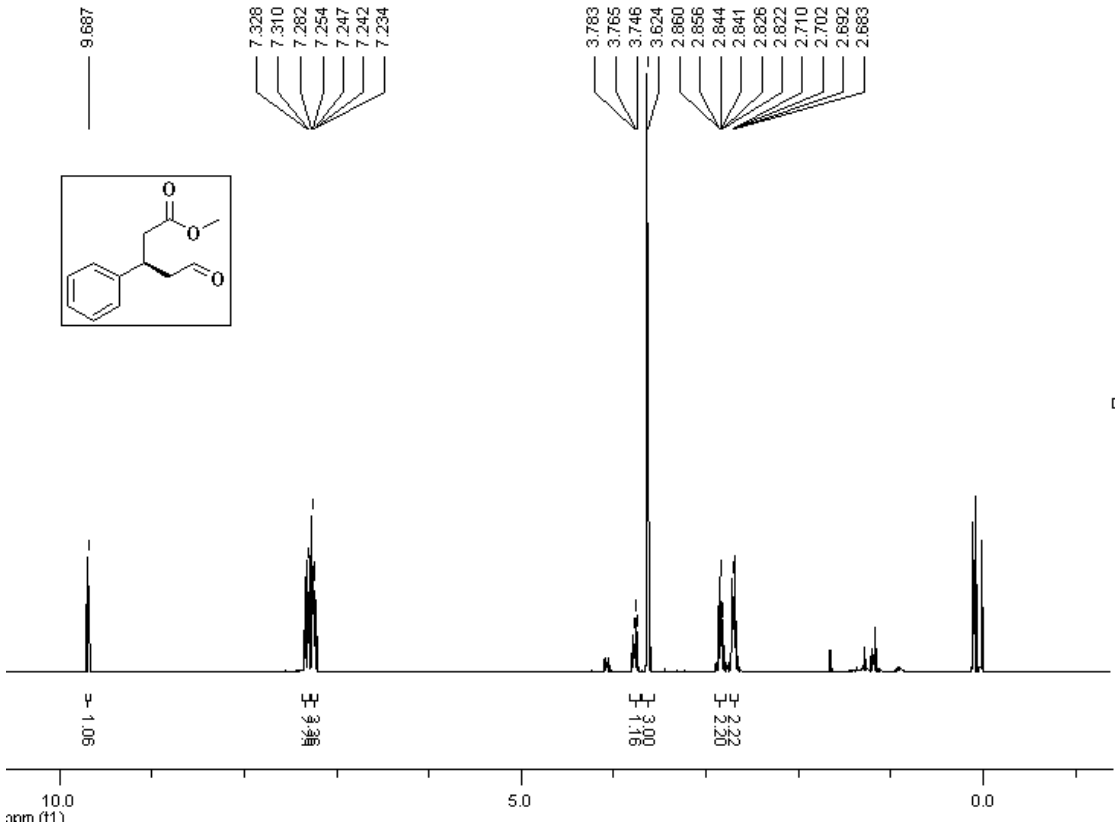

161.950
157.141
150.166
141.339
137.802
128.906
127.291
127.152
127.101
123.242
65.883
55.226
45.186
36.800
29.307
26.616
20.148
19.958
200
150
100
50
0
ppm (t1)

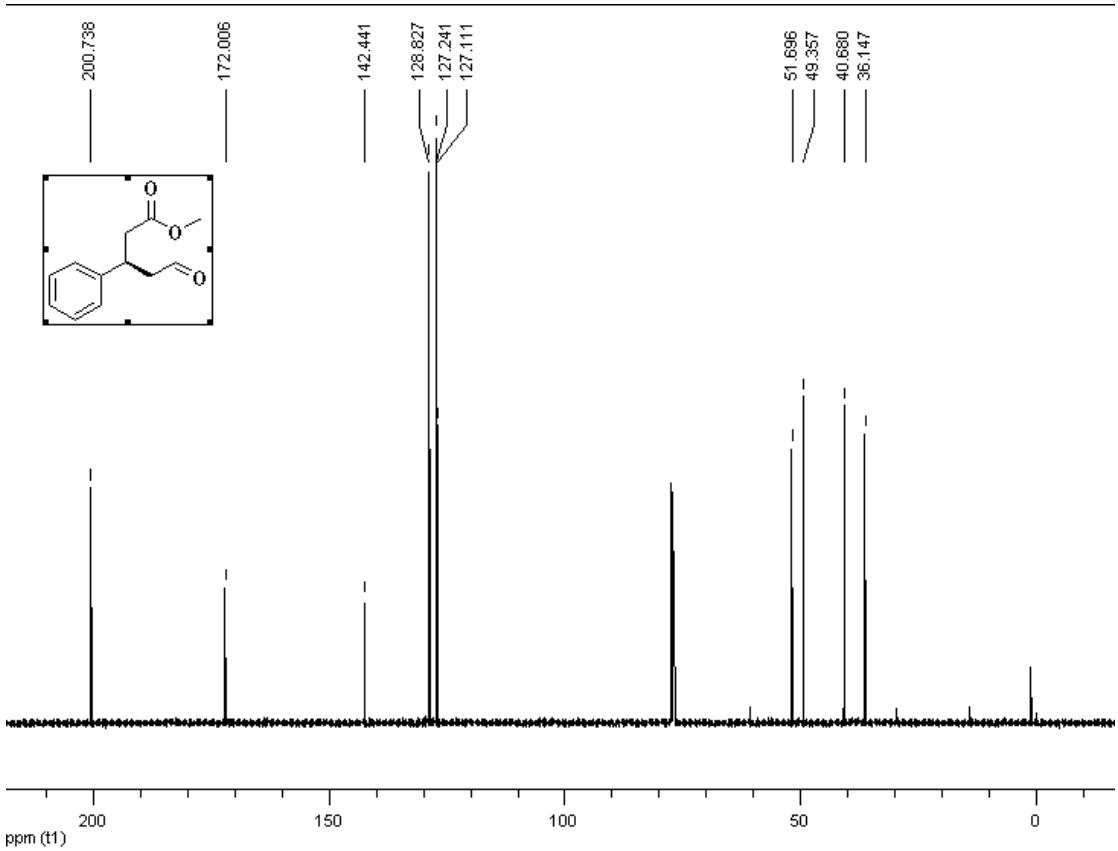
7


7.336
7.317
7.299
7.243
7.238
7.227
7.218
4.119
4.110
4.099
4.090
3.601
3.300
3.226
2.719
2.700
2.680
2.662
2.646
2.627
2.608
2.588
2.077
2.061
2.043
2.029
2.022
2.009
1.893
1.884
1.868
1.858
1.849
1.833
1.824
2.05
1.00
3.07
8.84
2.11
1.06
1.27
5.0
0.0
ppm (t1)

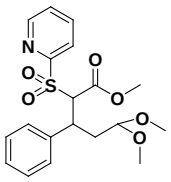

200.738
172.006
142.441
128.827
127.241
127.111
51.696
49.357
40.680
36.147
200
150
100
50
0
ppm (t1)

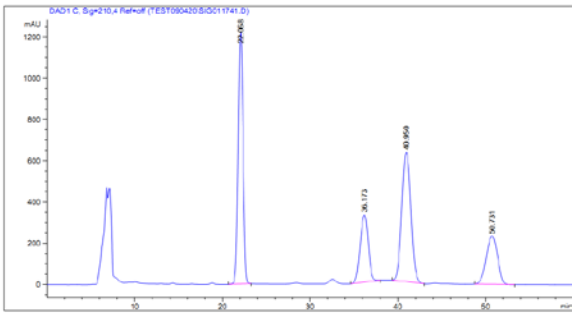
8


9.687
7.328
7.310
7.282
7.254
7.247
7.242
7.234
3.783
3.765
3.746
3.624
2.860
2.856
2.844
2.841
2.826
2.822
2.710
2.702
2.692
2.683
1.06
3.00
2.20
10.0
5.0
0.0
ppm (t1)


200.738
172.006
142.441
128.827
127.241
127.111
51.696
49.357
40.680
36.147
200
150
100
50
0
ppm (t1)

Racemate **3'a**



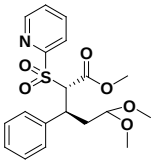


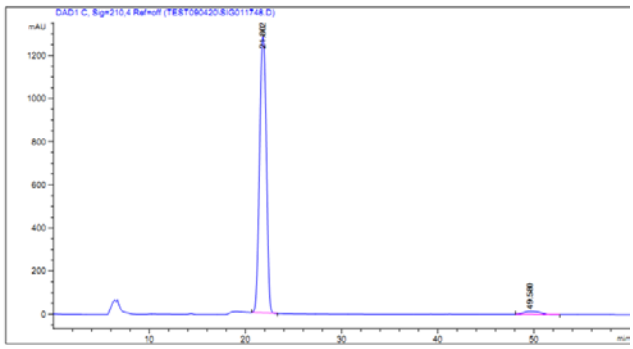
信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	22.068	BB	0.6055	4.69653e4	1218.95557	34.8890
2	36.173	BB	1.0318	2.10429e4	325.70312	15.6321
3	40.950	BB	1.1510	4.56975e4	627.99451	33.9472
4	50.731	BB	1.4334	2.09077e4	232.88129	15.5316

总量 : 1.34613e5 2405.53448

3'a



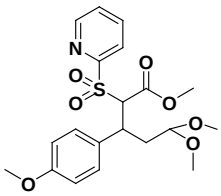


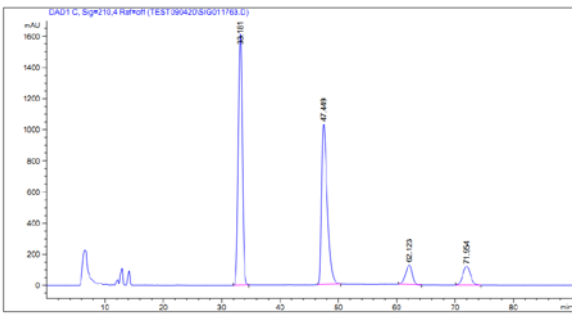
信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	21.802	BB	0.7965	6.27896e4	1284.12219	97.4271
2	49.580	BB	1.4080	1658.20630	13.89786	2.5729

总量 : 6.44478e4 1298.02005

Racemate **3'b**



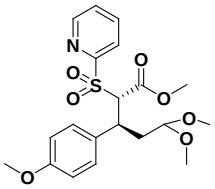


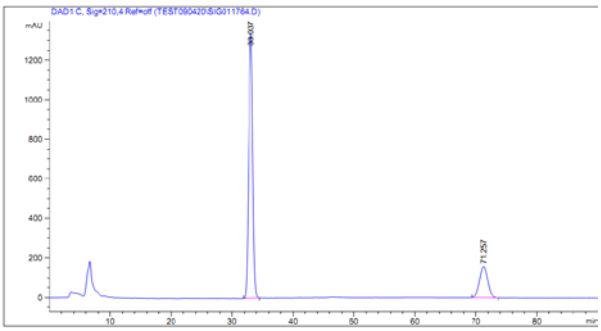
信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	33.181	BB	0.7453	7.66172e4	1615.50757	45.5331
2	47.449	BB	1.0391	7.03091e4	1031.68335	41.7842
3	62.123	BB	1.2411	1.02397e4	127.75002	6.0854
4	71.954	BB	1.3998	1.11011e4	120.83765	6.5973

总量 : 1.68267e5 2895.77859

3'b



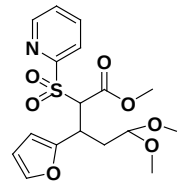


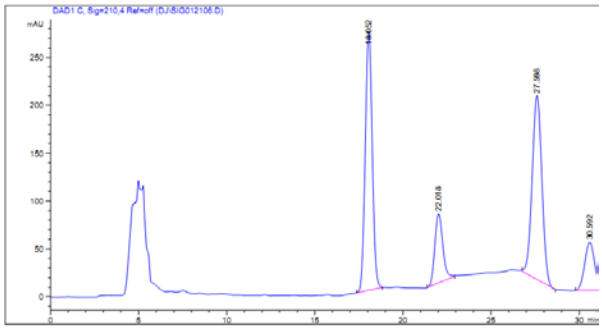
信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	33.037	BB	0.7369	6.25480e4	1334.28406	81.2980
2	71.257	BB	1.4211	1.43887e4	156.72523	18.7020

总量 : 7.69367e4 1491.00929

Racemate **3'c**

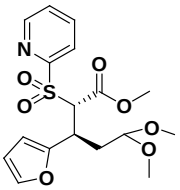


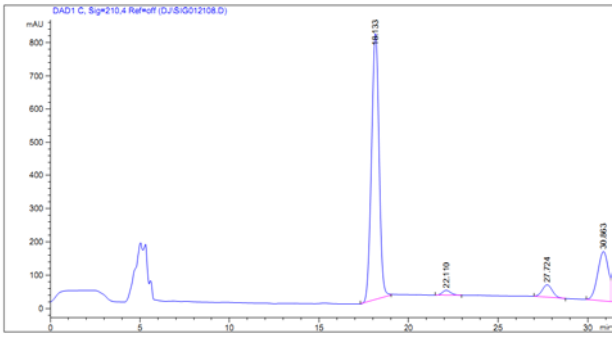


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	18.052	BB	0.4312	7454.32861	269.11685	39.1256
2	22.018	BB	0.4888	2286.53784	72.33623	12.0014
3	27.598	BB	0.5986	7353.49121	192.10066	38.5964
4	30.592	BV	0.6003	1957.92737	50.50402	10.2766
总量 :				1.90523e4	584.05776	

3'c

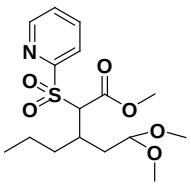


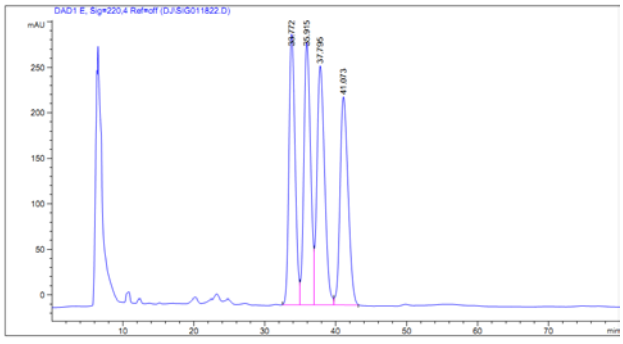


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	18.133	BB	0.4554	2.33952e4	799.48352	74.3658
2	22.110	BB	0.5019	477.73395	14.51721	1.5186
3	27.724	BB	0.6085	1457.21863	37.23995	4.6320
4	30.863	BV	0.6387	6129.46436	148.77377	19.4836
总量 :				3.14596e4	1000.01446	

Racemate **3'd**

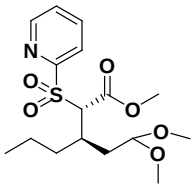


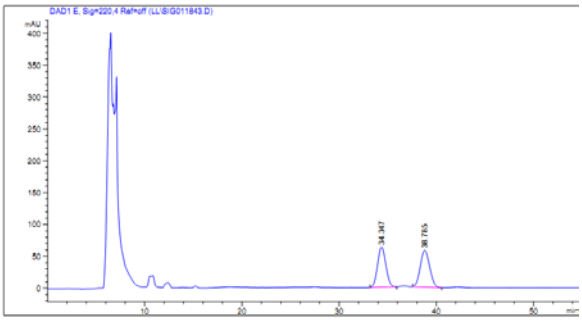


信号 1: DAD1 E, Sig=220,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	33.772	BV	0.9392	1.78522e4	297.04208	24.0074
2	35.915	VV	1.0167	1.89585e4	287.75232	25.4952
3	37.795	VB	1.1584	1.95832e4	262.48431	26.3352
4	41.073	BB	1.2280	1.79673e4	228.33182	24.1622
总量 :				7.43613e4	1075.61053	

3'd

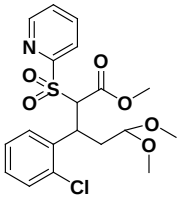


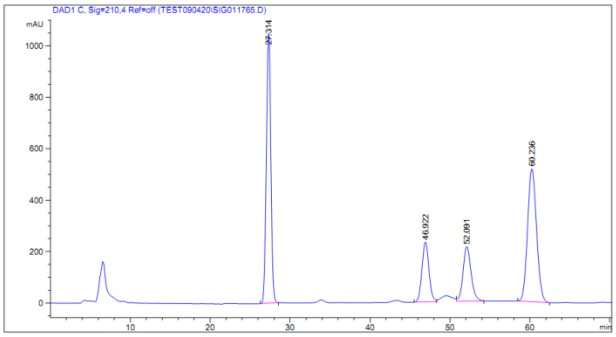


信号 1: DAD1 E, Sig=220,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	34.347	BB	0.9290	3748.79761	62.92931	49.1767
2	38.785	BB	1.0345	3874.32007	57.46770	50.8233
总量 :				7623.11768	120.39701	

Racemate **3'h**

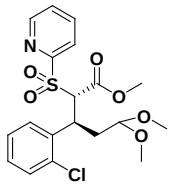


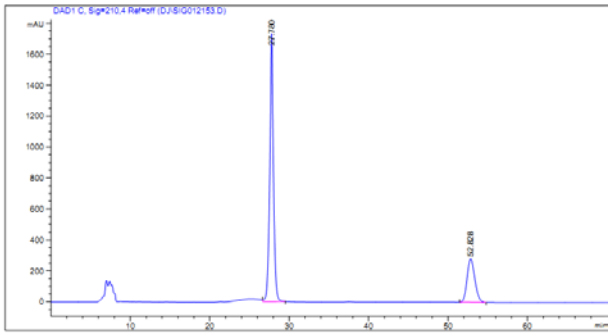


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	27.314	BB	0.6101	4.08610e4	1049.85974	36.9578
2	46.922	BV	0.9470	1.42284e4	232.81276	12.8692
3	52.091	VB	1.0743	1.49463e4	212.56812	13.5186
4	60.236	BB	1.2250	4.05256e4	516.70850	36.6544
总量 :				1.10561e5	2011.94911	

3'h

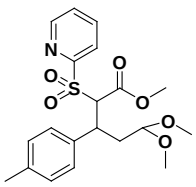


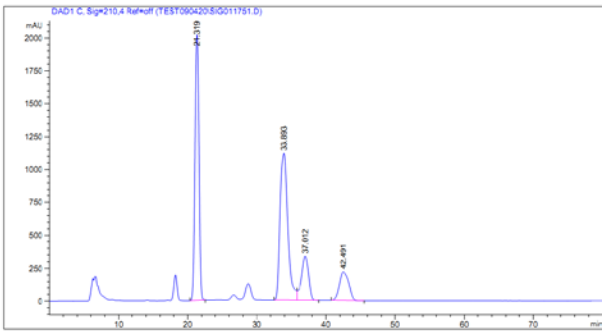


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	27.780	VB	0.4329	5.54262e4	1733.91211	74.4234
2	52.828	BB	1.0480	1.90480e4	280.58072	25.5766
总量 :				7.44742e4	2014.49283	

Racemate **3'i**

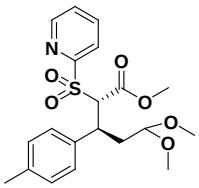


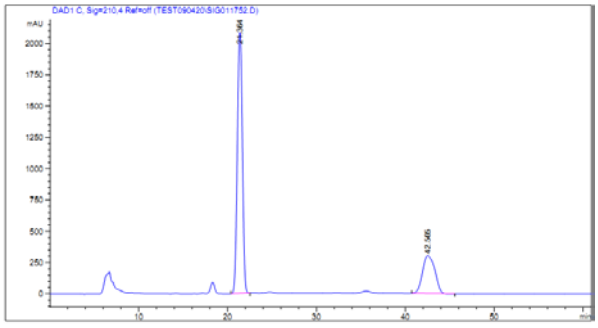


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	21.319	BB	0.6293	7.96509e4	2023.00928	37.6379
2	33.893	BV	1.2096	8.64573e4	1116.28149	40.8542
3	37.012	VB	1.1403	2.42921e4	334.07599	11.4789
4	42.491	BB	1.5788	2.12239e4	220.13037	10.0291
总量 :				2.11624e5	3693.49713	

3'i

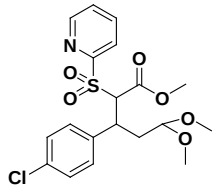


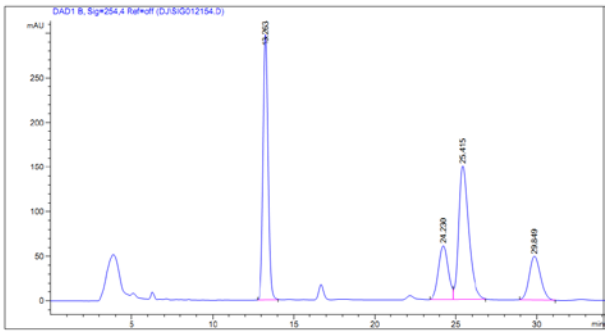


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	21.364	BB	0.6285	8.23509e4	2086.45703	73.8378
2	42.505	BB	1.5915	2.91785e4	301.38864	26.1622
总量 :				1.11529e5	2387.84567	

Racemate **3'j**

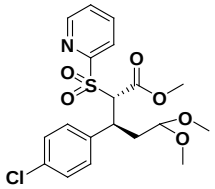


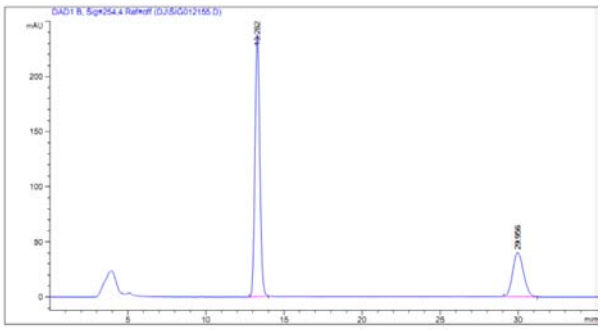


信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	13.263	BB	0.3340	6432.50781	297.77905	36.1894
2	24.230	BV	0.6442	2540.39526	60.70746	14.2923
3	25.415	VB	0.6515	6443.93408	149.90292	36.2537
4	29.849	BB	0.7460	2357.71191	48.94502	13.2645
总量 :				1.77745e4	557.33446	

3'j

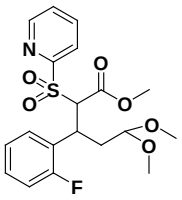


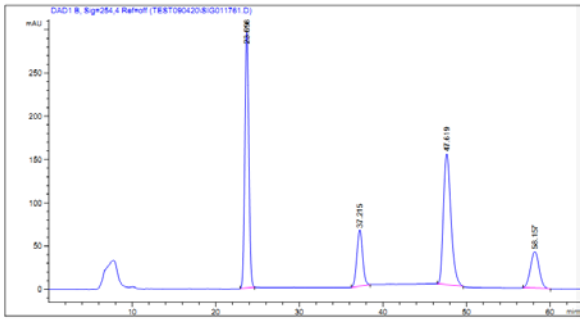


信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	13.282	BB	0.3351	5116.92725	237.75604	72.6306
2	29.956	BB	0.7389	1928.21667	39.96405	27.3694
总量 :				7045.14392	277.72009	

Racemate **3'k**

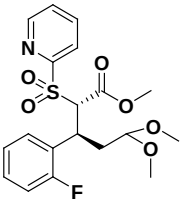


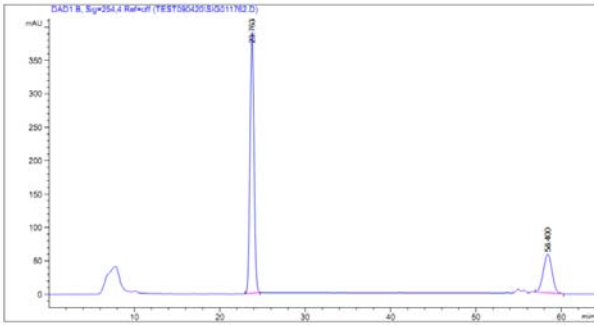


信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	23.698	BB	0.5203	9842.39551	295.71466	38.5657
2	37.215	BB	0.7408	3112.36279	64.74809	12.1952
3	47.619	BB	0.9768	9514.93652	151.48306	37.2826
4	58.157	BB	1.0972	3051.44165	42.42099	11.9565
总量 :				2.55211e4	554.36680	

3'k

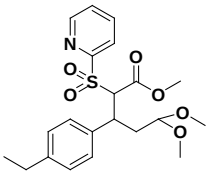


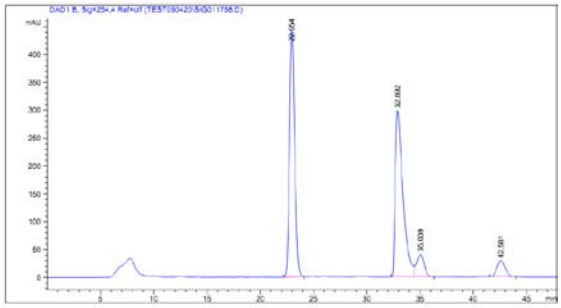


信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	23.763	BB	0.5076	1.28113e4	391.71698	75.5416
2	58.400	BB	1.0960	4147.97607	57.88717	24.4584
总量 :				1.69593e4	449.60415	

Racemate **3'l**

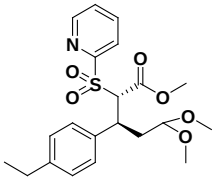


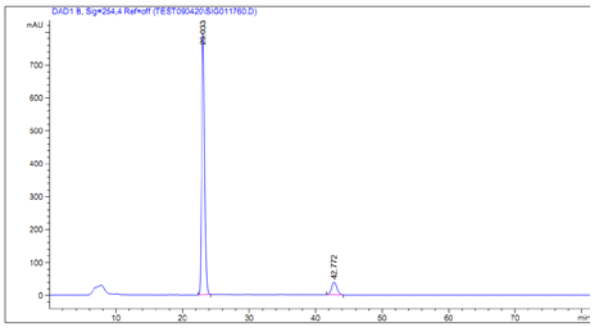


信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	22.954	BB	0.5208	1.48102e4	442.09882	44.1415
2	32.892	BB	0.7524	1.51068e4	298.53824	45.0255
3	35.039	BB	0.7545	2040.74011	40.73016	6.0824
4	42.581	BB	0.8406	1593.91516	29.30354	4.7506
总量 :				3.35517e4	810.67076	

3'l

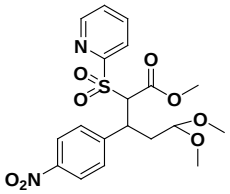


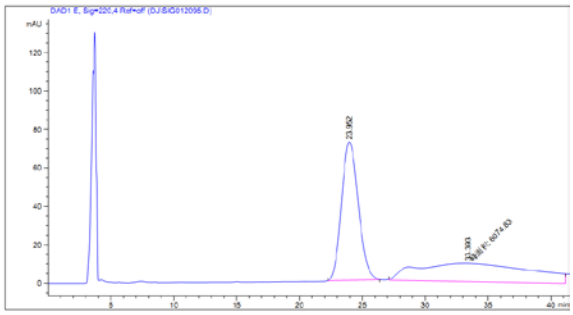


信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	23.033	BB	0.4975	2.56988e4	794.28491	92.2379
2	42.772	BB	0.8519	2162.64624	39.42959	7.7621
总量 :				2.78614e4	833.71450	

Racemate **3'm**

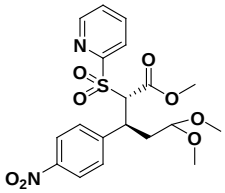


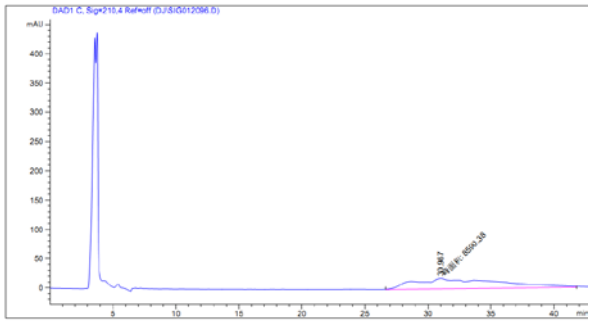


信号 1: DAD1 E, Sig=220,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	23.952	BB	1.3905	6702.79688	71.97561	52.4573
2	33.393	MM	10.6184	6074.83105	9.53503	47.5427
总量 :				1.27776e4	81.51064	

3'm

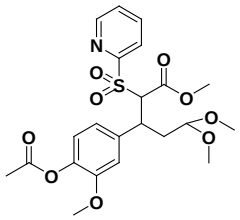


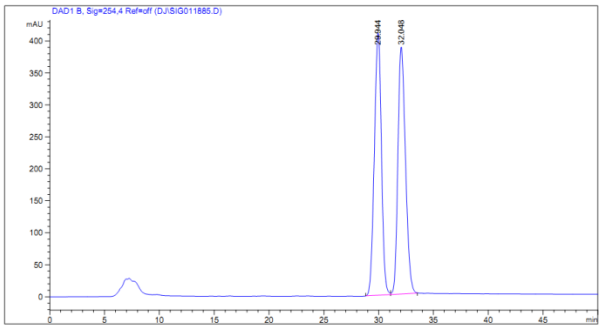


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	30.987	MM	7.8106	8590.37793	18.33062	100.0000
总量 :				8590.37793	18.33062	

Racemate **3'n**



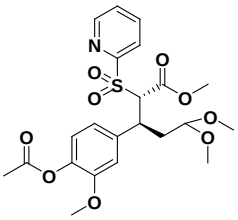


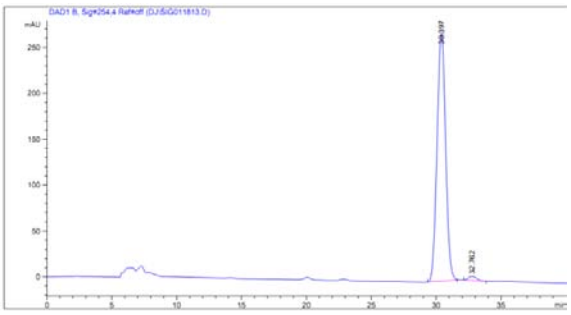
信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	29.944	BV	0.7040	1.84781e4	409.83621	49.8939
2	32.048	VB	0.7444	1.85566e4	386.30484	50.1061

总量 : 3.70347e4 796.14105

3'n



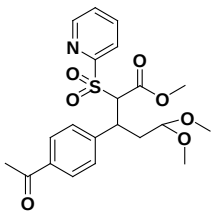


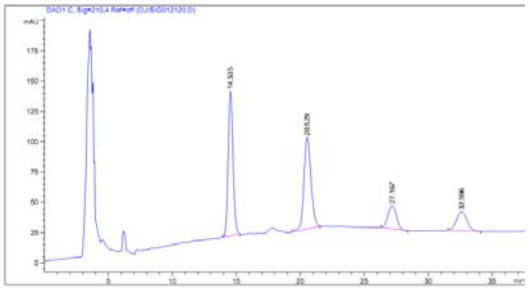
信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	30.397	BB	0.7181	1.24309e4	270.52759	98.4253
2	32.762	BB	0.5551	198.88196	4.53958	1.5747

总量 : 1.26297e4 275.06717

Racemate **3'o**



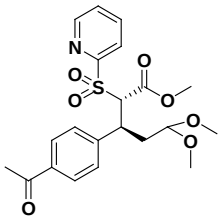


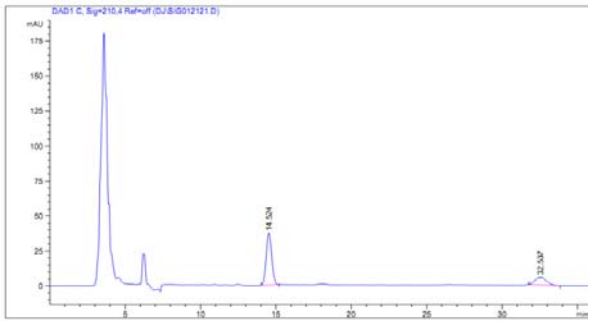
信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	14.535	BB	0.4081	3153.11816	119.39832	40.1149
2	20.529	BB	0.5921	2911.74536	75.47983	37.0441
3	27.167	BB	0.6807	891.26581	19.15950	11.3390
4	32.596	BB	0.8092	904.08173	15.66741	11.5020

总量 : 7860.21106 229.70506

3'o



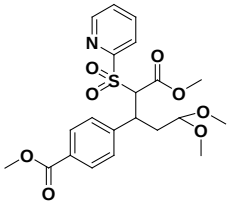


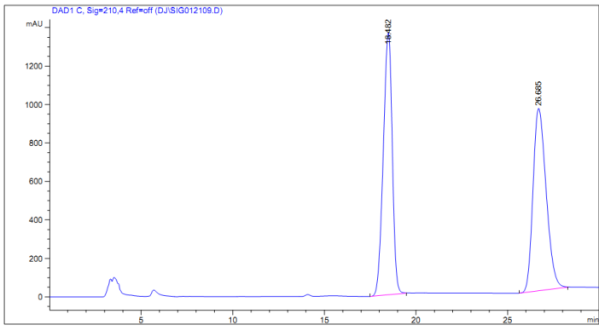
信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	14.524	BB	0.4020	956.33136	37.18581	76.7518
2	32.537	BB	0.6398	289.67297	5.41783	23.2482

总量 : 1246.00433 42.60363

Racemate **3'p**

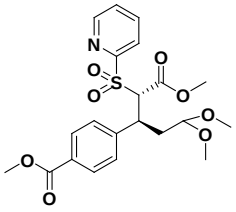


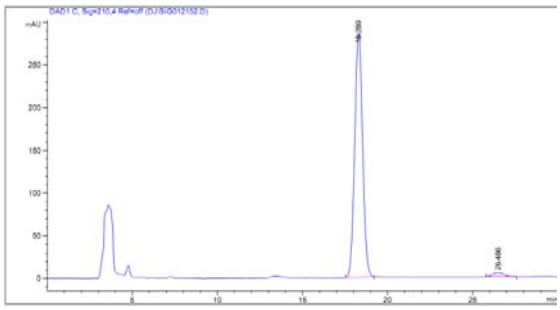


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	18.482	BB	0.5316	4.64473e4	1362.77588	49.5203
2	26.685	BB	0.7803	4.73471e4	948.68878	50.4797
总量 :				9.37944e4	2311.46466	

3'p

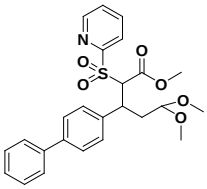


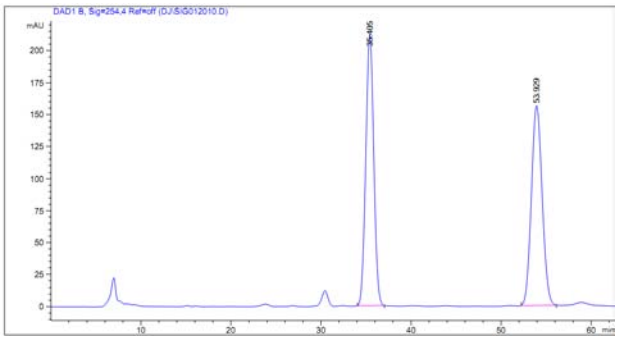


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	18.289	BB	0.4992	9220.82031	286.68713	97.5837
2	26.486	BB	0.5843	228.32300	5.04250	2.4163
总量 :				9449.14331	291.72963	

Racemate **3'q**

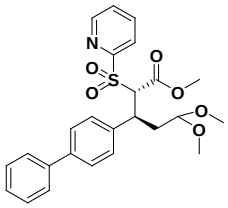


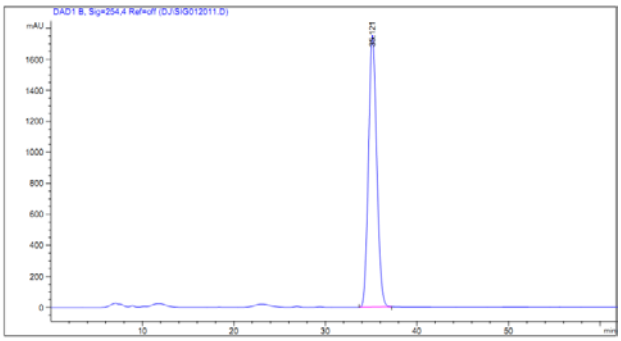


信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	35.405	BB	0.9508	1.30426e4	211.69682	50.1599
2	53.929	BB	1.2894	1.29594e4	155.96481	49.8401
总量 :				2.60020e4	367.66164	

3'q

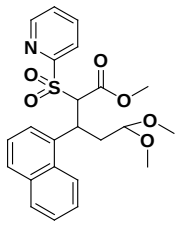


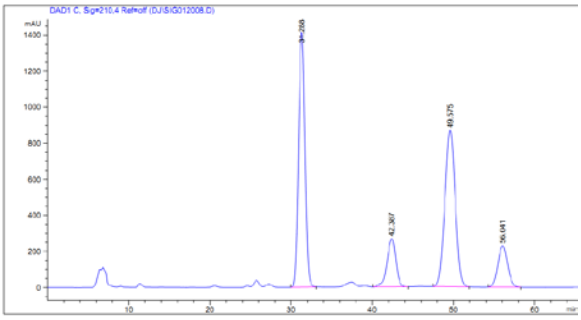


信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	35.121	BB	0.9636	1.10435e5	1756.33582	100.0000
总量 :				1.10435e5	1756.33582	

Racemate **3'r**

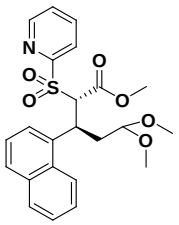


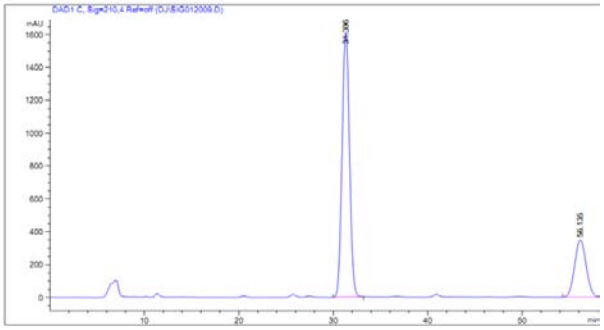


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	31.288	BB	0.8559	7.73723e4	1415.05701	39.8434
2	42.387	VB	1.1728	2.02921e4	266.96844	10.4496
3	49.575	BB	1.3933	7.72442e4	867.08545	39.7774
4	56.041	BB	1.3015	1.92825e4	229.66447	9.9296
总量 :				1.94191e5	2778.77538	

3'r

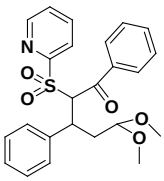


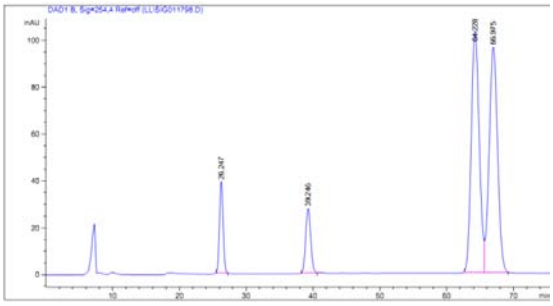


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	31.306	BB	0.8591	8.82418e4	1610.80408	74.7801
2	56.135	BBA	1.3187	2.97599e4	350.45367	25.2199
总量 :				1.18002e5	1961.25775	

Racemate **3's**

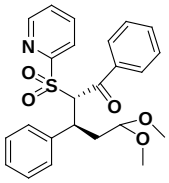


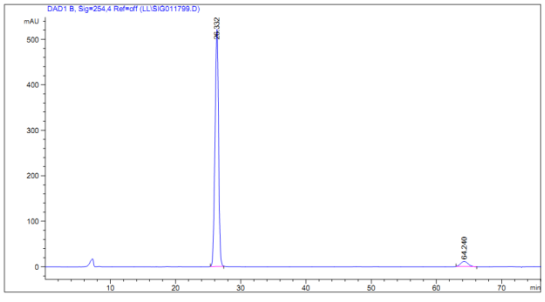


信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	26.247	BB	0.5915	1485.43115	39.07188	7.4425
2	39.246	BB	0.7988	1438.33777	27.56194	7.2066
3	64.228	BV	1.2757	8573.15918	103.14497	42.9544
4	66.975	VB	1.3552	8461.81152	96.29413	42.3965
总量 :				1.99587e4	266.07292	

3's

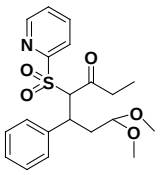


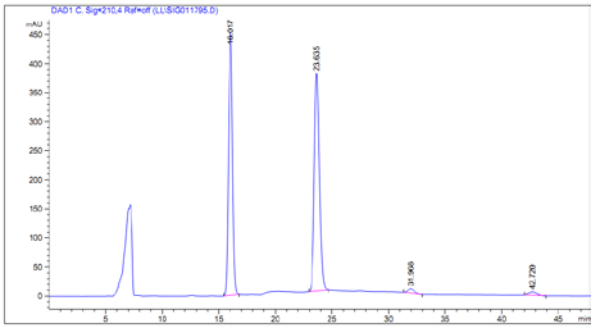


信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	26.332	BB	0.5902	1.96812e4	521.55621	95.6171
2	64.240	BB	0.9537	902.14423	11.37023	4.3829
总量 :				2.05833e4	532.92644	

Racemate **3't**

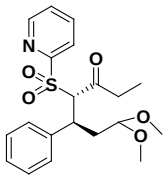


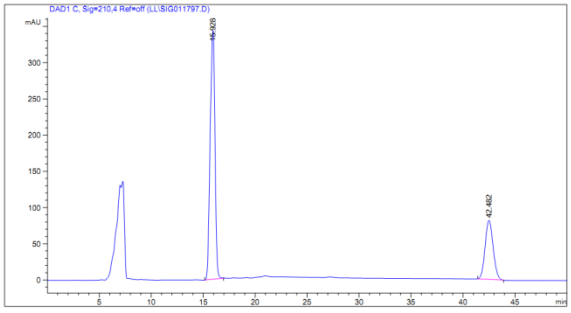


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	16.017	BB	0.3957	1.13655e4	451.51709	47.8204
2	23.635	BB	0.4910	1.18462e4	374.55511	49.8427
3	31.968	BB	0.5475	291.18808	7.76436	1.2252
4	42.720	BB	0.5944	264.22415	5.48106	1.1117
总量 :				2.37671e4	839.31763	

3't

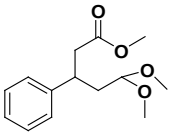


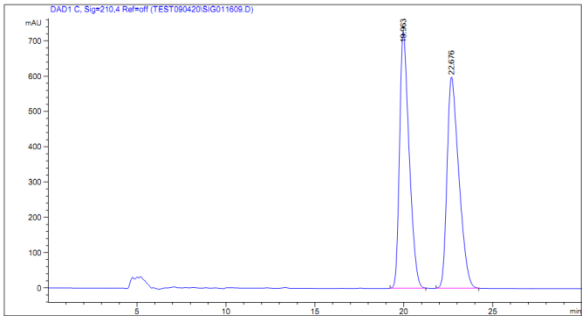


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	15.928	BB	0.5294	1.09955e4	343.51038	71.4864
2	42.482	BB	0.8324	4385.75293	81.68188	28.5136
总量 :				1.53813e4	425.19225	

Racemate **7**

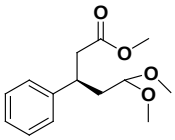


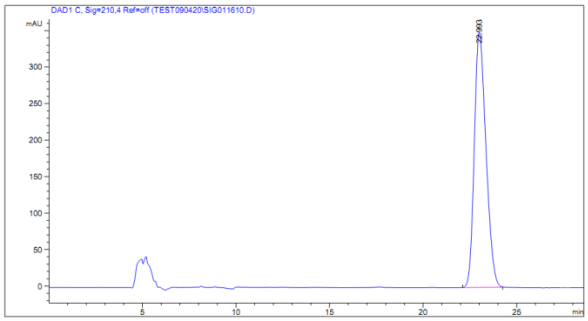


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	19.963	BB	0.5583	2.72171e4	727.84436	49.6822
2	22.676	BB	0.6895	2.75653e4	598.34149	50.3178
总量 :				5.47823e4	1326.18585	

7

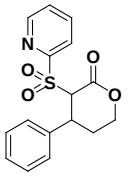


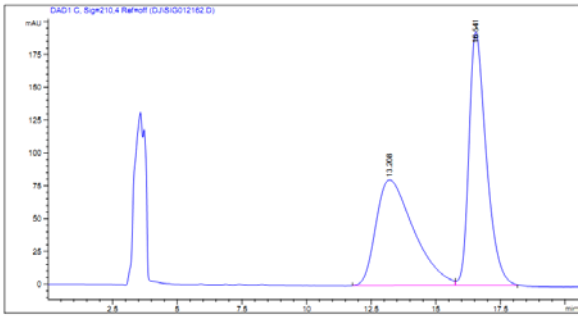


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	22.993	BB	0.6668	1.51284e4	349.61194	100.0000
总量 :				1.51284e4	349.61194	

Racemate **5**



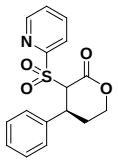


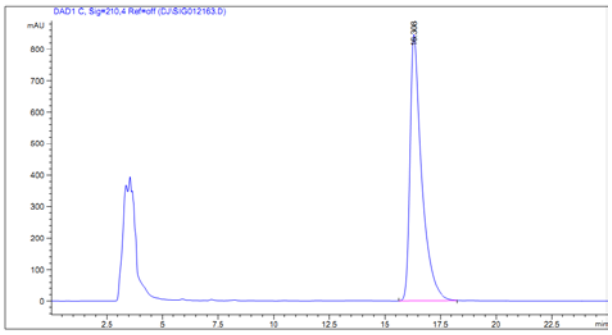
信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	13.208	BV	1.4602	8186.67139	80.65759	47.6048
2	16.541	VB	0.6998	9010.48730	193.30914	52.3952

总量 : 1.71972e4 273.96674

5



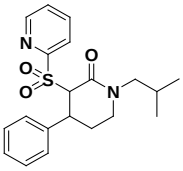


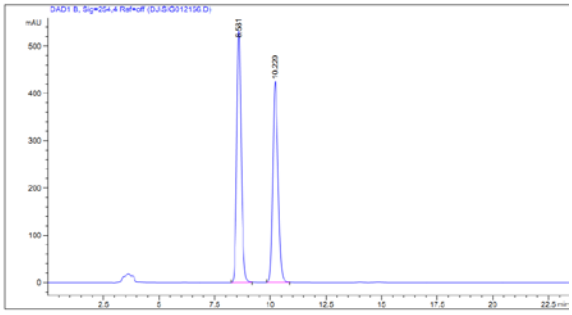
信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	16.308	BB	0.5200	3.06203e4	846.59802	100.0000

总量 : 3.06203e4 846.59802

Racemate **6**



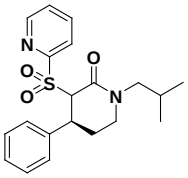


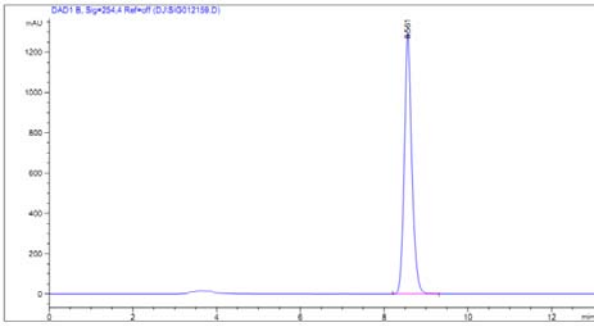
信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	8.581	BB	0.2155	7454.63184	532.00537	51.8056
2	10.220	BB	0.2503	6934.98096	425.05777	48.1944

总量 : 1.43896e4 957.06314

6



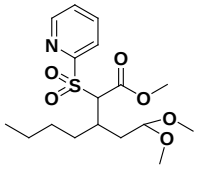


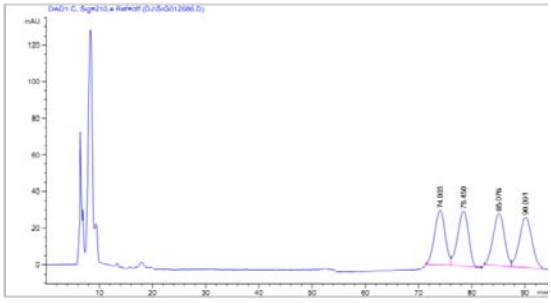
信号 1: DAD1 B, Sig=254,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	8.561	BB	0.1798	1.62413e4	1299.95496	100.0000

总量 : 1.62413e4 1299.95496

Racemate **3'e**

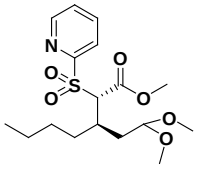


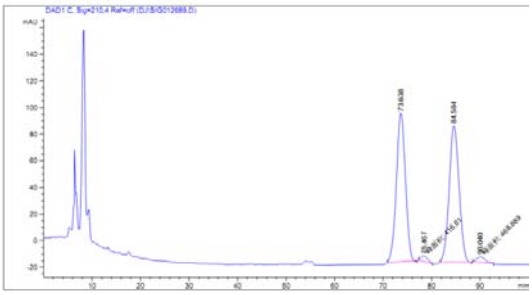


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	74.035	BV	1.6631	4171.50049	29.80035	24.3273
2	78.450	VB	1.6469	4209.07422	29.96249	24.5464
3	85.076	BV	1.7500	4248.51318	28.55226	24.7764
4	90.091	VB	1.9186	4518.33252	27.56133	26.3499
总量：				1.71474e4	115.87643	

3'e

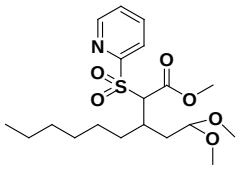


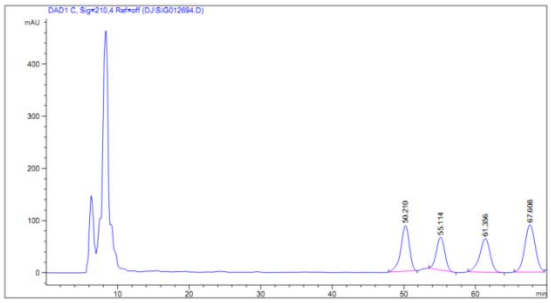


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	73.638	BB	1.8385	1.44664e4	111.58743	48.4605
2	78.467	MM	1.5983	416.60980	4.34430	1.3956
3	84.584	BB	1.8612	1.45000e4	102.57803	48.5732
4	90.040	MM	1.9486	468.88892	4.01052	1.5707
总量：				2.98519e4	222.52029	

Racemate **3'f**

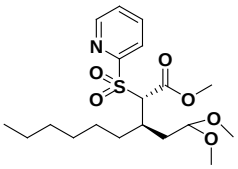


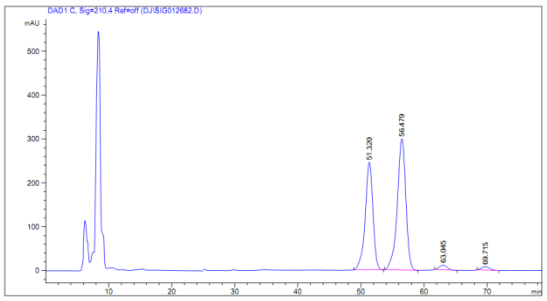


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	50.210	BV	1.2329	7351.67285	87.79832	25.9628
2	55.114	BB	1.2091	5149.95264	62.77442	18.1873
3	61.356	BB	1.4481	6603.46826	64.51751	23.3205
4	67.608	BV	1.4596	9211.06445	90.79160	32.5294
总量：				2.83162e4	305.88185	

3'f

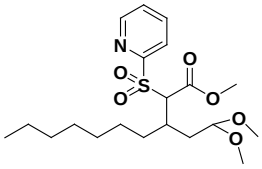


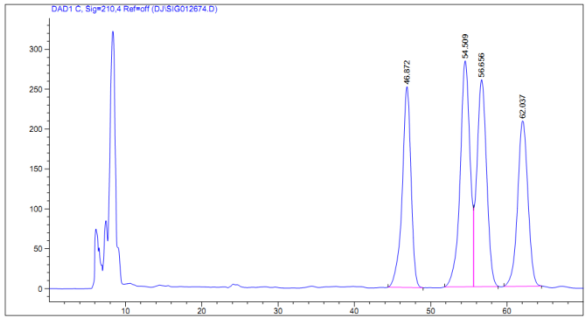


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	51.320	BB	1.3046	2.09979e4	245.32005	41.2761
2	56.479	BB	1.4212	2.82718e4	298.98630	55.5746
3	63.045	BB	1.0296	907.54388	10.40493	1.7840
4	69.715	BB	1.0757	694.57507	7.66134	1.3653
总量：				5.08717e4	562.37262	

Racemate **3'g**

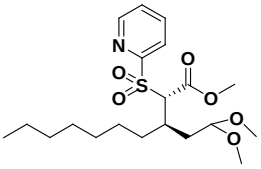


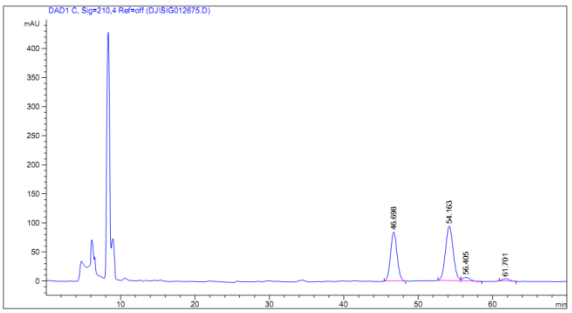


信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	46.872	BB	1.2003	2.03000e4	251.86313	22.9277
2	54.509	BV	1.3434	2.56793e4	283.33817	29.0032
3	56.656	VB	1.3303	2.30624e4	259.62640	26.0476
4	62.037	BB	1.4474	1.94976e4	207.28615	22.0214
总量 :				8.85393e4	1002.11385	

3'g





信号 1: DAD1 C, Sig=210,4 Ref=off

峰 #	保留时间 [min]	类型	峰宽 [min]	峰面积 [mAU*s]	峰高 [mAU]	峰面积 %
1	46.698	BB	0.9285	5195.93652	84.60181	40.8984
2	54.163	BV	1.1043	6809.93945	94.09781	53.6025
3	56.405	VB	0.8279	442.16867	6.33824	3.4804
4	61.701	BB	0.7833	256.46515	3.85907	2.0187
总量 :				1.27045e4	188.89693	