Supporting Information

Total Synthesis of (±)-Rhazinal Using Novel Palladium-Catalyzed Cyclizations

Alfred L. Bowie Jr., and Dirk Trauner*

Department of Chemistry, University of California; Berkeley, CA 94720.

trauner@berkeley.edu

Table of Contents

General Information. Tetrahydrofuran (THF) was distilled from Na/benzophenone. Triethylamine (Et_3N) was distilled from calcium hydride. Dichloromethane (CH_2Cl_2) and ether (Et_2O) were dried by passing through a column of activated alumina prior to use. n-Butyllithium (n-BuLi) and t-butyllithium (t-BuLi) were titrated periodically with diphenylacetic acid. All other starting materials and solvents are commercially available and were used without further purification. Chromatography was carried out with silica gel. All mixed solvent systems were reported as v/v solutions. Extracts were dried over $MgSO_4$, and solvents were removed with a rotary evaporator under reduced pressure. ^1H and ^{13}C NMR spectra were recorded in $CDCl_3$ (7.27 ppm, 77.23 ppm) on a 400 MHz spectrometer.

General Procedure for Oxidative Heck Reaction of 9 (Table 1, entry 7)

To pyrrole **9** (60 mg, 0.338 mmol) was added first Dioxane:AcOH:DMSO (9:3:1, 0.1M), then $Pd(OAc)_2$ (7.6 mg, 0.034 mmol), then t-BuOOH (1.0 eq, 0.338 mmol). The solution was heated to 45 °C for 3 h, cooled to room temperature, filtered over a plug of silica gel (30% EtOAc in hexanes) and concentrated under vacuum. The product was purified by flash chromatography (10% EtOAc in hexanes) to afford 39.6 mg (62%) of 8-Ethyl-8-vinyl-5,6,7,8-tetrahydro-indolizine **10** as a pale yellow oil.

(*E*)-ethyl 4-ethylhex-4-enoate 7. To the neat known allylic alcohol **6** (1.00 g, 9.88 mmol) was added ethyl orthoacetate (12.7 mL, 69.2 mmol) and propionic acid (44 mg, 0.6 mmol). The solution was heated at 120 °C for 1 h under conditions for distillative removal of ethanol. The product was purified via flash chromatography (10% EtOAc in hexanes) to afford 1.45 g (94%) of the desired ester **7** as a colorless oil: IR (film): 2961, 1726, 1453, 1265 cm^{-1}; ^1H NMR: δ 5.14 (q, *J* = 7.0 Hz, 1H), 4.08 (m, 2H), 2.34 (m, 2H), 2.26 (m, 2H), 1.98 (m, 2H), 1.54 (d, *J* = 7.0 Hz, 3H), 1.20 (m, 3H), 0.96 (m, 3H); ^{13}C NMR: δ 173.4, 139.9, 118.5, 60.2, 32.9, 31.5, 22.7, 14.1, 12.8, 12.6; HRMS (EI+): *m/z* (M+) calcd for $C_{10}H_{18}O_2$ 170.1308; found 170.1307.

(*E*)-ethyl 4-ethylhex-4-en-1-ol . A solution of ester **7** (700 mg, 4.5 mmol) in Et_2O was added over 5 min. to a mixture of lithium aluminum hydride (170 mg, 4.5 mmol) in Et_2O (15mL) at 0 °C. After addition of the ester, the solution was allowed to warm to room temperature and stirred for 2 h. The resulting mixture was then cooled back down to 0°C and sodium sulfate decahydrate was added in excess until there was no visible sign of bubbling. The reaction was then filtered through a plug of Celite and concentrated under vacuum to yield a yellow oil. The product was purified by column chromatography (35% EtOAc in hexanes) to afford 460 mg (80%) of (*E*)-ethyl 4-ethylhex-4-en-1-ol as a colorless oil: IR (film): 3415, 2966, 1457, 1265 cm^{-1}; ^1H NMR: δ 5.20 (q, *J* = 7.0 Hz, 1H), 3.62 (m, 2H), 2.09 (m, 4H), 1.67 (m, 2H), 1.58 (d, *J* = 7.0 Hz, 3H), 1.57 (br s, 1H), 0.97 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR: δ 141.3, 118.2, 62.9, 32.8, 30.9, 22.6, 12.9, 12.7; HRMS (EI+): *m/z* (M+) calcd for $C_8H_{16}O$ 128.1201; found 128.1203.

(*E*)-4-ethylhex-4-enyl 4-methylbenzenesulfonate 8. To a solution of (*E*)-ethyl 4-ethylhex-4-en-1-ol (400 mg, 3.1 mmol) in CH_2Cl_2 (5 mL) at 0 °C was added *p*-toluene sulfonyl chloride (0.91 g, 4.7 mmol) was added, followed by pyridine (0.54 mL, 6.7 mmol). The reaction was allowed to warm to room temperature and stirred overnight. The reaction was dilute with ether (20 mL) and washed with H_2O (20 mL), 1M HCl (20 mL), sat'd soln. $NaHCO_3$ (20 mL), and brine. The organic extracts were combined and dried, filtered and concentrated under vacuum to afford a yellow oil. The product was purified by column chromatography (15% EtOAc in hexanes) to afford 808 mg (92%) of the desired tosylate **8** as a colorless oil: IR (film): 1290, 715 cm^{-1}; ^1H NMR: δ 7.80 (d, *J* = 8.0 Hz, 2H), 7.35 (d, *J* = 8.0 Hz, 2H), 5.04 (q, *J* = 7.0 Hz, 1H), 4.01 (m, 2H), 2.46 (s, 3H), 1.98 (m, 4H), 1.74 (m, 2H), 1.53 (d, *J* = 7.0 Hz, 3H), 0.97 (m, 3H); ^{13}C NMR: δ 144.6, 139.6, 133.1, 129.8, 127.9, 119.0, 70.4, 32.0, 27.3, 22.4, 21.6, 12.9, 12.7; HRMS (EI+): *m/z* (M+H+) calcd for $C_{15}H_{22}O_3S$ 283.1368; found 283.1373.

1-((*E*)-4-ethylhex-4-enyl)-1*H*-pyrrole 9. Pyrrole (568 mg, 8.4 mmol) was added to a stirred suspension of KH (1.10 g, 8.4 mmol) in dry *N*,*N*-dimethylformamide (DMF, 42 mL) and the resulting solution was stirred at room temperature for 5 min. Then a solution of tosylate **8** (1.20 g, 4.2mmol) in DMF (10mL) was added and the flask containing the tosylate was rinsed with an additional 2 mL DMF. The resulting mixture was stirred at room temperature for 2 h, then quenched with H_2O (20mL) and partitioned between ethyl acetate (100mL) and 1 M HCl (20mL). The separated aqueous phase was extracted with ethyl acetate (2x 40mL) and then combined organic phases washed with H_2O (3x40mL) and brine (50 mL), dried, filtered, and concentrated under vacuum to yield a brown oil. The product was purified by column chromatography (10% EtOAc in hexanes) to afford 476 mg (64%) of **9** as a colorless oil: IR (film): 1226, 715 cm^{-1}; ^1H NMR: δ 6.65 (m, 2H), 6.13 (m, 2H), 5.20 (q, *J* = 10.0 Hz, 1H), 3.84 (m, 2H), 2.05 (m, 2H), 1.98 (m, 2H), 1.87 (m, 2H), 1.59 (d, *J* = 10.0 Hz, 3H), 0.97 (m, 3H); ^{13}C NMR: δ 141.2, 120.4, 118.7, 107.7, 49.1, 33.5, 29.7, 22.6, 13.0, 12.7; HRMS (EI+): *m/z* (M+) calcd for $C_{12}H_{19}N$ 177.1517; found 177.1517.

8-Ethyl-8-vinyl-5,6,7,8-tetrahydro-indolizine 10. IR (film): 1276, 715 cm^{-1}; ^{1}H NMR: δ 6.52 (d, *J* = 2.0 Hz, 1H), 6.14 (t, *J* = 3.0 Hz, 1H), 5.93 (d, *J* = 2.0 Hz, 1H), 5.82 (q, *J* = 7.0 Hz, 1H), 5.05 (d, *J* = 12.0 Hz, 1H), 4.81, (d, *J* = 18.5 Hz, 1H), 4.14 (q, *J* = 7.5 Hz, 2H), 3.86 (t, *J* = 7.0 Hz, 2H), 3.93 (m, 1H), 3.84 (m, 1H), 2.36 (m, 2H), 2.05 (m, 2H), 1.88 (m, 2H), 1.79 (m, 1H), 1.70 (m, 1H), 1.23 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR: δ 173.9, 145.2, 132.5, 118.9, 113.8, 107.4, 105.1, 60.3, 45.3, 41.8, 35.6, 31.0, 30.0, 19.8,14.2; HRMS (EI+): *m/z* (M+) calcd for $C_{15}H_{23}NO_2$ 249.1728; found 249.1720.

5-(*tert*-Butyl-diphenyl-silanyloxy)-2-methylene-pentanal 12. To a mixture of an aqueous formaldehyde solution (37% formaldehyde in water, 15.5 mmol, 1.0 eq) and aldehyde **11** (15.5 mmol) in *i*-PrOH (1.55 mL) was added propionic acid (1.55 mmol, 10 mol %) followed by pyrrolidine (1.55 mmol, 10 mol%). The reaction was stirred at 45 °C for 25 h. A sat'd solution of $NaHCO_3$ (45 mL) was added and the mixture was extracted with CH_2Cl_2 (3 x 50 mL). The combined organic extracts were washed with brine, dried, and concentrated under vacuum. The product was purified by column chromatography (10% EtOAc in hexanes) to afford 5.35 g (98%) of **12** as a colorless oil: IR (film): 3070, 1960, 1471 cm^{-1}; ^{1}H NMR: δ 9.51 (s, 1H), 7.69 (m, 4H), 7.45 (m, 6H), 6.22 (s, 1H), 5.98 (s, 1H), 3.68 (m, 2H), 2.39 (m, 2H), 1.73 (m, 2H), 1.09 (s, 9H); ^{13}C NMR: δ 194.6, 149.8, 135.5, 134.2, 133.8, 129.6, 127.7, 63.6, 30.4, 26.8, 24.3, 19.2; HRMS (EI+): *m/z* (M+Li+) calcd for $C_{22}H_{28}O_2Si$ 359.2019; found 359.2021.

6-(*tert*-Butyl-diphenyl-silanyloxy)-3-methylene-hexan-2-ol 13. To a cooled (0 °C) solution of acrolein **12** (4.81 g, 13.36 mmol) in Et_2O (50 mL), was added MeLi (0.8 M in Et_2O, 19 mL, 15.2 mmol) over 2 h via cannula. The flask containing the MeLi was rinsed with an additional 5 mL Et_2O. After addition of MeLi, the solution was allowed to warm to room temperature over 6 h. The resulting solution was then cooled back down to 0 °C and a saturated solution of NH_4Cl was slowly added. The solution was allowed to warm to room temperature and extracted with Et_2O (3 x 100 mL). The combined organic extracts were washed with brine (50 mL), dried, filtered, and concentrated under vacuum to yield a yellow

oil. The product was purified by column chromatography (20% EtOAc in hexanes) to afford 2.52 g (50%) of **13** as a colorless oil: IR (film): 3376, 2933 cm^{-1}; ^{1}H NMR: δ 7.59 (m, 4H), 7.34 (m, 6H), 4.95 (s, 1H), 4.70 (s, 1H), 4.15 (m, 1H), 3.62 (m, 2H), 2.13 (m, 1H), 2.06 (m, 1H), 1.67 (m, 2H), 1.49 (br s, 1H), 1.2 (d, *J* = 2.0 Hz, 3H), 0.97 (m, 1H); ^{13}C NMR: δ 152.9, 135.5, 133.9, 129.5, 127.6, 108.3, 71.0, 63.5, 31.0, 27.9, 26.8, 22.2, 19.2; HRMS (EI+): *m/z* (M+H+) calcd for $C_{23}H_{32}O_2Si$ 369.2250; found 369.2251.

7-(*tert*-Butyl-diphenyl-silanyloxy)-4-eth-(E)-ylidene-heptanoic acid ethyl ester 14. To a solution of allylic alcohol **13** (5.09 g, 13.8 mmol) neat was added ethyl orthoacetate (17.8 mL, 69.2 mmol) and propionic acid (61 mg, 0.8 mmol). The solution was heated at 120 °C for 1 h under conditions for distillative removal of ethanol and excess ethyl orthoacetate. The product was subsequently purified by column chromatography (15% EtOAc in hexanes) to afford 5.70 g (94%) of **14** as a colorless oil: IR (film): 3048, 1654 cm^{-1}; ^{1}H NMR: δ 7.71 (m, 4H), 7.43 (m, 6H), 5.25 (q, *J* = 7.5 Hz, 1H), 4.25 (m, 2H), 3.68 (m, 2H), 2.41 (m, 2H), 2.30 (m, 2H), 2.13 (m, 2H), 1.67 (m, 2H), 1.63 (d, *J* = 7.5 Hz, 3H), 1.28 (m, 3H), 1.08(s, 9H); ^{13}C NMR: δ 173.5, 138.0, 135.5, 134.0, 129.5, 127.6, 119.5, 63.6, 60.2, 33.2, 31.9, 31.1, 26.8, 26.0, 22.2, 19.2, 14.2, 13.2; HRMS (EI+): *m/z* (M+Li+) calcd for $C_{27}H_{38}O_3Si$ 445.2742; found 445.2740.

7-(*tert*-Butyl-diphenyl-silanyloxy)-4-eth-(Z)-ylidene-heptan-1-ol. To a cooled (0 °C) solution a solution of TBDMS-ether **14** (20.0 g, 45.6 mmol) in Et_2O (230 mL) was added TBAF (1.0 M in THF, 59.2 mmol). The reaction was allowed to warm to room temperature and after 1 h the reaction was quenched with a sat'd solution of brine and extracted with Et_2O (3 x 200 mL). The combined organic extracts were washed with brine (50 mL), dried, filtered, and concentrated under vacuum to yield a yellow oil. The product was subsequently purified by column chromatography (20% EtOAc in hexanes) to afford 7.30 g (80%) of 7-(*tert*-Butyl-diphenyl-silanyloxy)-4-eth-(Z)-ylidene-heptan-1-ol as a colorless oil: IR (film): 3508, 2940, 1728 cm^{-1}; ^{1}H NMR: δ 5.20 (q, *J* = 6.8 Hz, 1H), 4.07 (q, *J* q, *J* = 6.8 Hz, 2H), 3.56 (t, *J* = 6.8 Hz, 2H), 2.90 (br s, 1H), 2.35 (m, 2H), 2.25 (m, 2H), 2.05 (m, 2H), 1.67 (m, 2H), 1.63 (d, *J* = 7.5 Hz, 3H), 1.27 (t, *J* = 6.8 Hz, 3H); ^{13}C NMR: δ 173.6, 137.8,

119.7, 62.3, 60.1, 33.2, 31.7, 30.9, 26.5, 14.1, 13.1; HRMS (EI+): *m/z* (M+) calcd for $C_{11}H_{21}O_3$ 201.1491; found 201.1492.

Toluene-4-sulfonic acid 7-(*tert*-butyl-diphenyl-silanyloxy)-4-eth-(E)-ylidene-heptyl ester 15. Following the same procedure as described for compound **8**, reaction of 7-(*tert*-Butyl-diphenyl-silanyloxy)-4-eth-(Z)-ylidene-heptan-1-ol (1.06 g, 5.27 mmol) in CH_2Cl_2 (17.6 mL) with p-toluene sulfonyl chloride (1.3 g, 6.9 mmol) and pyridine (0.9 mL, 11.3 mmol) afforded 1.40g (75%) of **15** as a colorless oil: IR (film): 3043, 1742, 1375 cm^{-1}; ^1H NMR: δ 7.74 (d, *J* = 8.0 Hz, 2H), 7.28 (d, *J* = 8.0 Hz, 2H), 5.20 (q, *J* = 7.0 Hz, 1H), 4.06 (q, *J* = 6.5 Hz, 2H), 3.96 (t, *J* = 6.5 Hz, 2H), 2.38 (s, 1H), 2.28 (m, 2H), 2.18 (m, 2H), 2.01 (m, 2H), 1.66 (m, 2H), 1.48 (d, *J* = 7.0 Hz, 3H), 1.22 (t, *J* = 6.5 Hz, 3H); ^{13}C NMR: δ 173.1, 144.7, 136.2, 133.0, 129.8, 127.8, 120.7, 70.1, 60.3, 33.0, 31.4, 27.1, 25.4, 21.5, 14.1 13.1; HRMS (EI+): *m/z* (M+) calcd for $C_{18}H_{27}O_5$ Si 355.1579; found 355.1583.

4-Eth-(Z)-ylidene-7-pyrrol-1-yl-heptanoic acid ethyl ester 5. Following the same procedure as described for compound **9**, treatment of the potassium salt of pyrrole (568 mg, 8.4 mmol in dry *N*,*N*-dimethylformamide (DMF, 42 mL) with a solution of tosylate **15** (1.20 g, 4.2mmol) in DMF (10mL) afforded 476 mg (67%) of **5** as a colorless oil: IR (film): 3047, 1747 cm^{-1}; ^1H NMR: δ 6.66 (m, 2H), 6.14 (m, 2H), 5.29 (q, *J* = 6.5 Hz, 1H), 4.14 (q, *J* = 7.5 Hz, 2H), 3.86 (t, *J* = 7.5 Hz, 2H), 2.39 (m, 2H), 2.31 (m, 2H), 2.10 (m, 2H), 1.88 (m, 2H), 1.57 (d, *J* = 7.5 Hz, 3H), 1.23 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR: δ 173.4, 137.0, 120.5, 120.31, 109.0, 60.3, 49.3, 33.1, 31.7, 29.8, 26.9,14.2 13.2; HRMS (EI+): *m/z* (M+) calcd for $C_{15}H_{23}NO_2$ 249.1728; found 249.1720.

3-(8-Vinyl-5,6,7,8-tetrahydro-indolizin-8-yl)-propionic acid ethyl ester 16. Following the same procedure as described for compound **10**. IR (film): 2948, 1767, 1712 cm^{-1}; ^1H NMR: δ 6.52 (d, *J* = 2.0 Hz, 1H), 6.14 (t, *J* = 3.0 Hz, 1H), 5.93 (d, *J* = 2.0 Hz, 1H), 5.82 (q, *J* = 7.0 Hz, 1H), 5.05 (d, *J* = 12.0 Hz, 1H), 4.81, (d, *J* = 18.5 Hz, 1H), 4.14 (q, *J* = 7.5 Hz, 2H), 3.86 (t, *J* = 7.0 Hz, 2H), 3.93 (m, 1H), 3.84 (m, 1H), 2.36 (m, 2H), 2.05 (m, 2H), 1.88 (m, 2H), 1.79 (m, 1H), 1.70 (m, 1H), 1.23 (t, *J* = 7.0 Hz, 3H);

^{13}C NMR: δ 173.9, 145.2, 132.5, 118.9, 113.8, 107.4, 105.1, 60.3, 45.3, 41.8, 35.6, 31.0, 30.0, 19.8,14.2; HRMS (EI+): *m/z* (M+) calcd for $C_{15}H_{23}NO_2$ 249.1728; found 249.1720.

3-(8-Ethyl-3-formyl-5,6,7,8-tetrahydro-indolizin-8-yl)-N-(phenyl)-propionamide 3a. Following a procedure analogous to the one described for compound **3b**, **21** and aniline afforded 150 mg (63%) of **3a** as a foamy solid. IR (film): 3300, 1721, 1656 cm^{-1}; ^{1}H NMR: δ 9.42 (s, 1 H), 7.49 (d, *J* = 9.0 Hz, 2 H), 7.35 (d, *J* = 9.0 Hz, 2 H) 7.20 (br s, 1 H), 7.11 (t, *J* = 5 Hz, 1 H), 6.92 (d, *J* = 5.0 Hz, 1 H), 6.01 (t, *J* = 5 Hz, 1 H), 4.41 (m, 1H), 4.33 (m, 1H), 2.34 (m, 1 H), 2.27 (m, 1 H), 2.05 (m, 2 H), 1.97 (m, 2 H), 1.70 (m, 4 H), 0.86 (m, 3H); ^{13}C NMR: δ 178.5, 170.8, 146.2, 137.8, 130.8, 129.0, 124.3, 124.2, 119.6, 107.5, 45.4, 38.2, 35.2, 33.7, 33.0, 28.8, 19.6, 8.6; HRMS (EI+): *m/z* (M+) calcd for $C_{20}H_{25}N_2O_2$ 325.1916; found 325.1909.

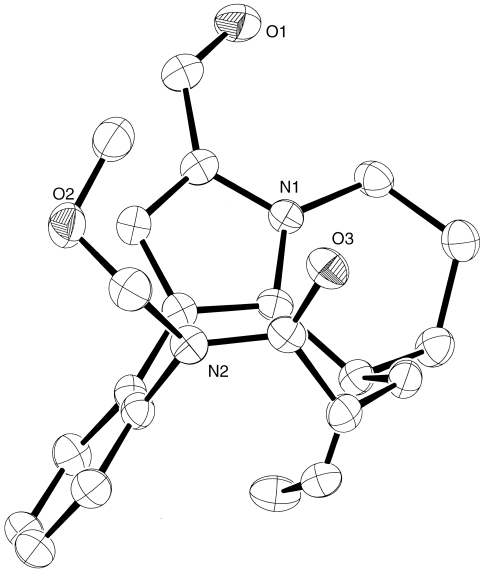
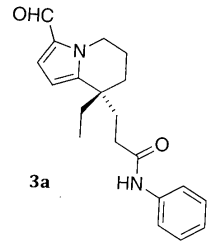


Figure 2. X-ray structure of *N*-MOM-rhazinal **26**. For clarity, the unnatural enantiomeric series is shown and hydrogen atoms are omitted.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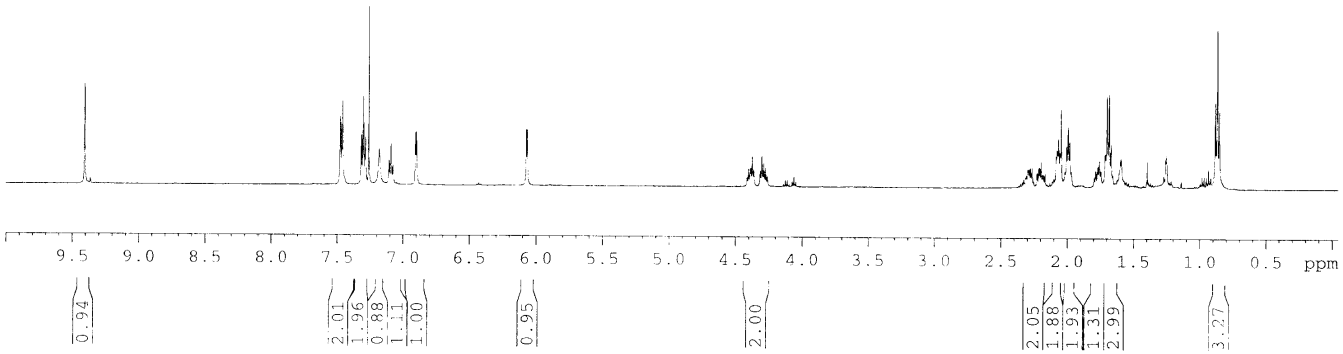
3a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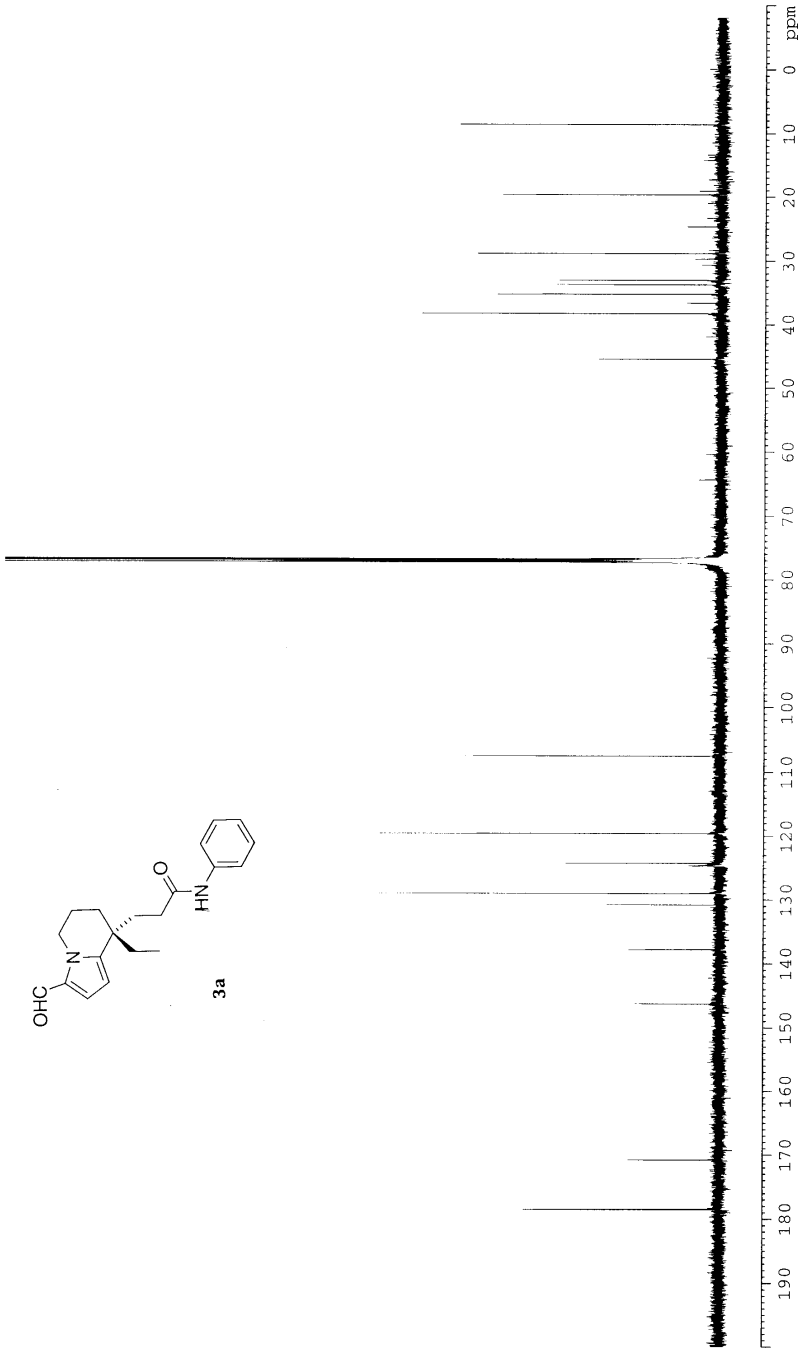
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O
HN
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0.99
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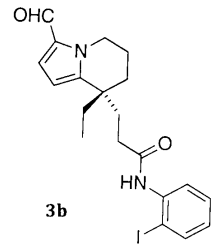
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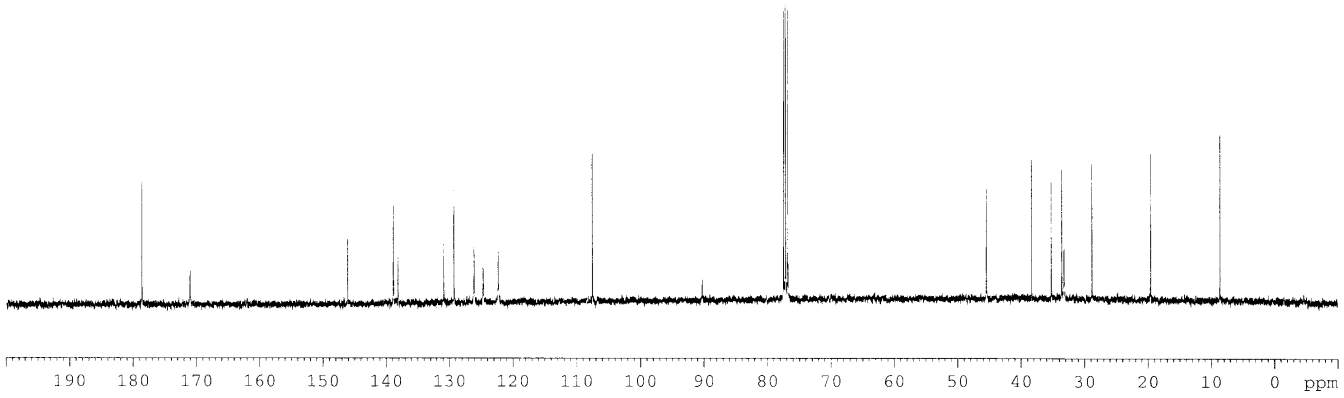
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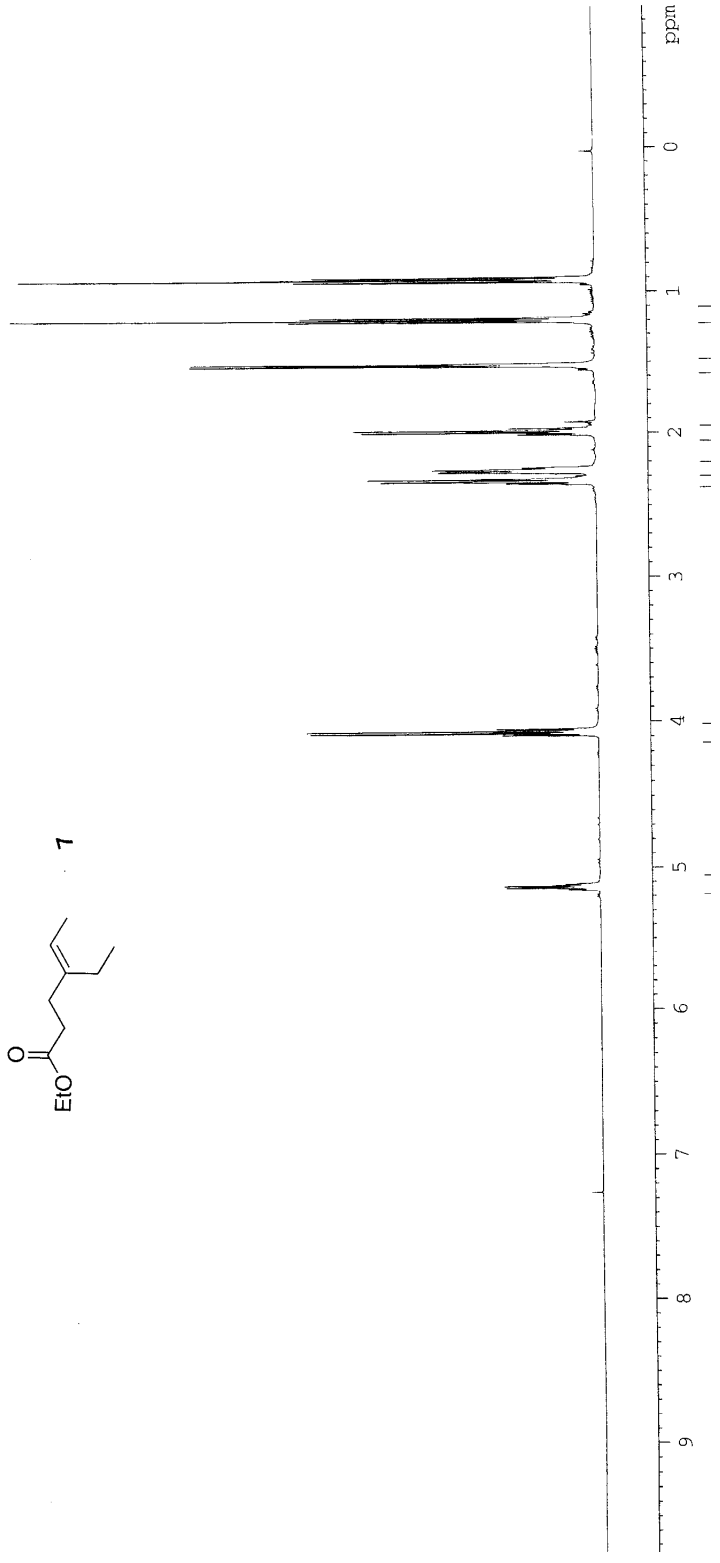
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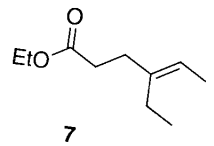
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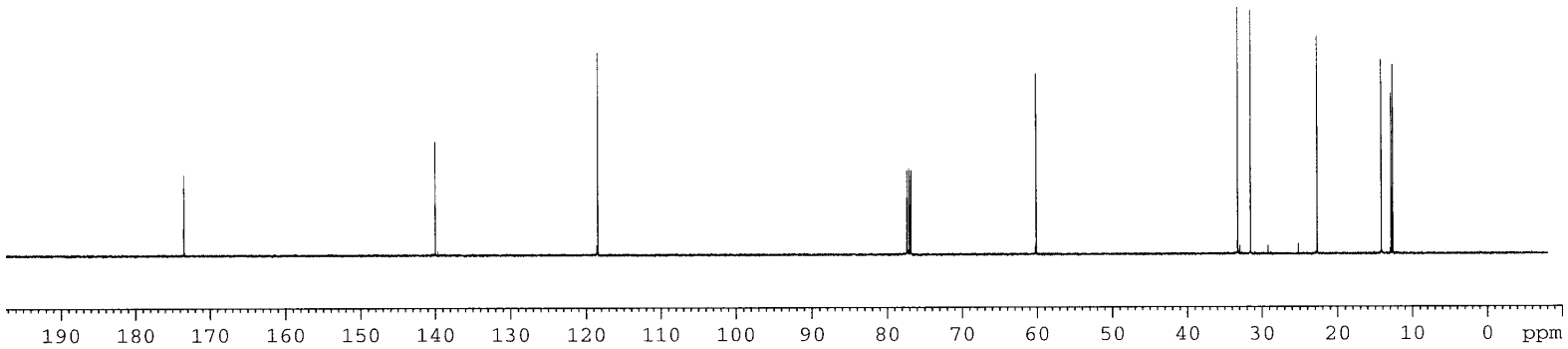
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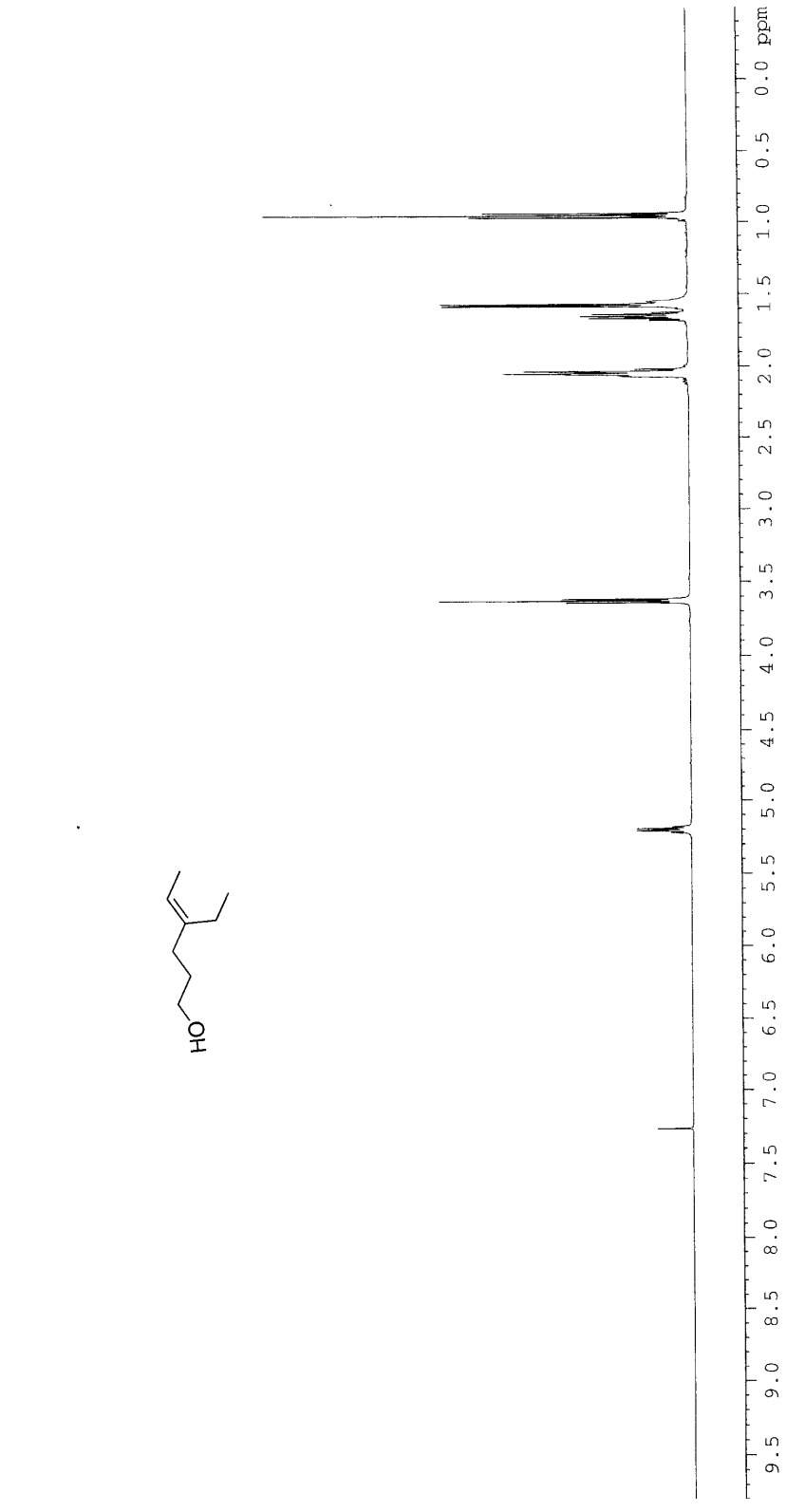
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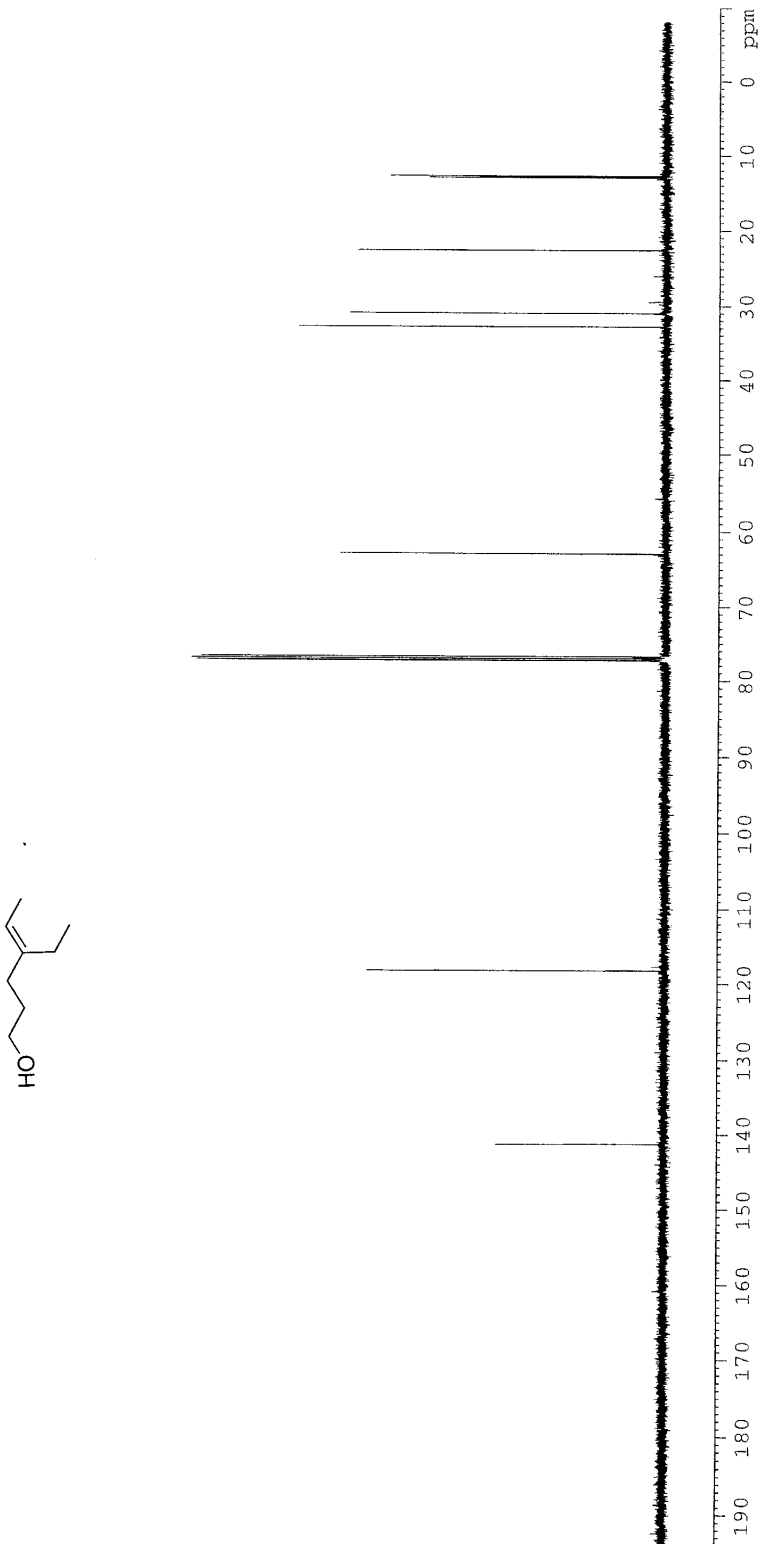
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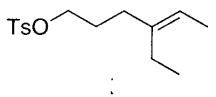

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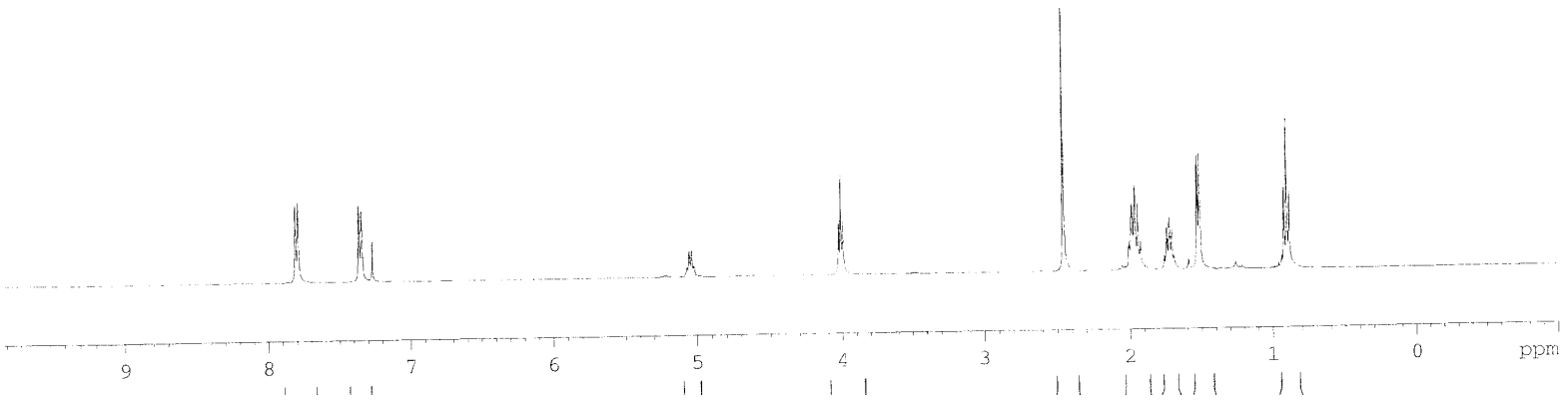
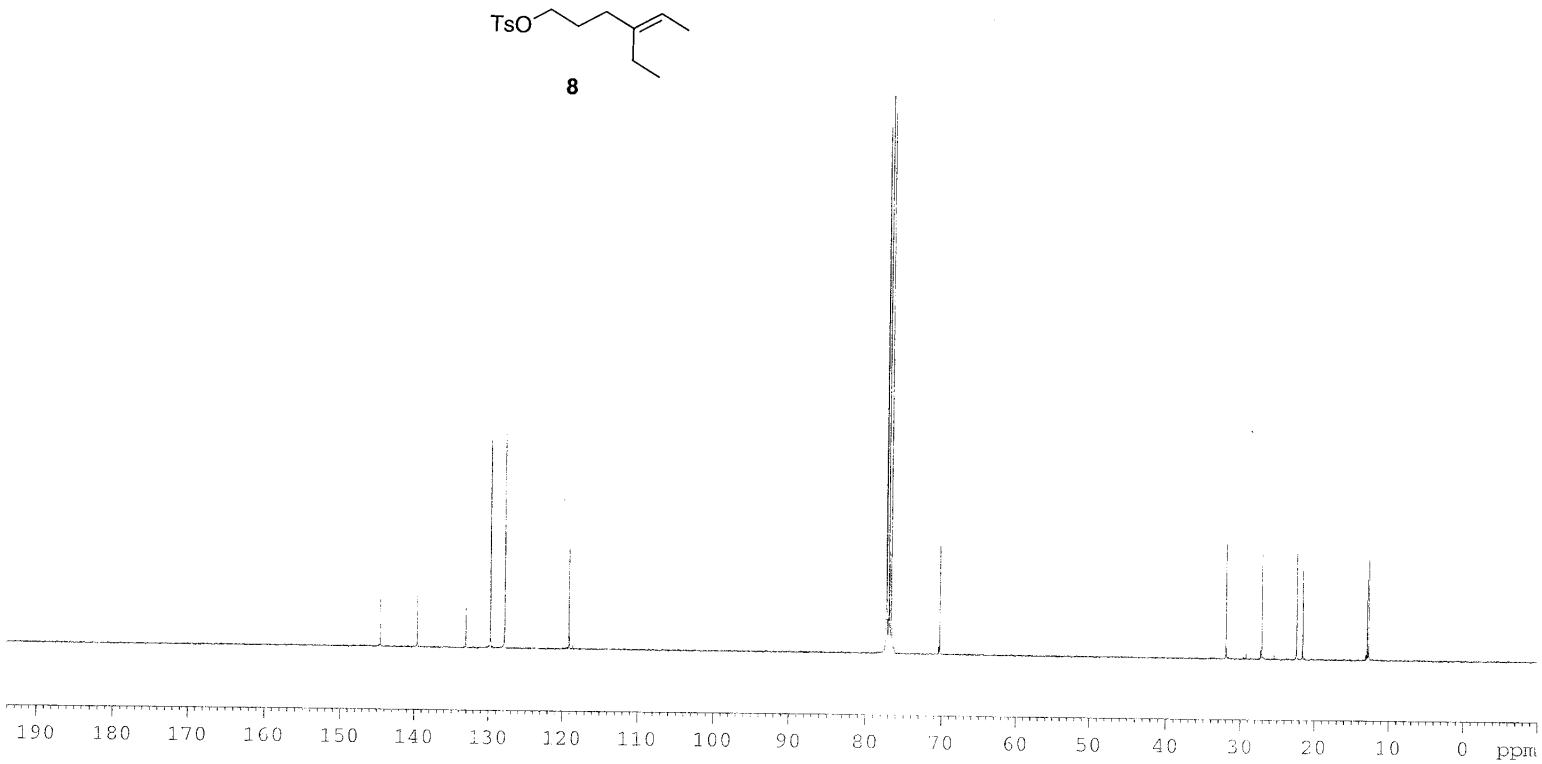
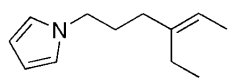



TsO
8
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm



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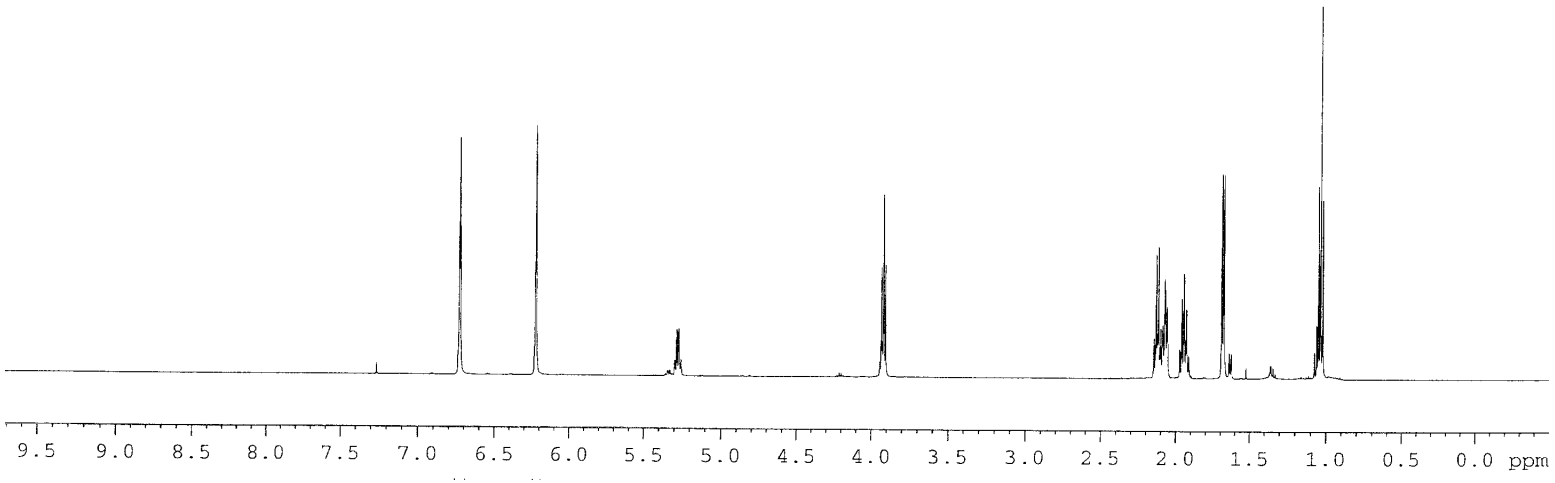

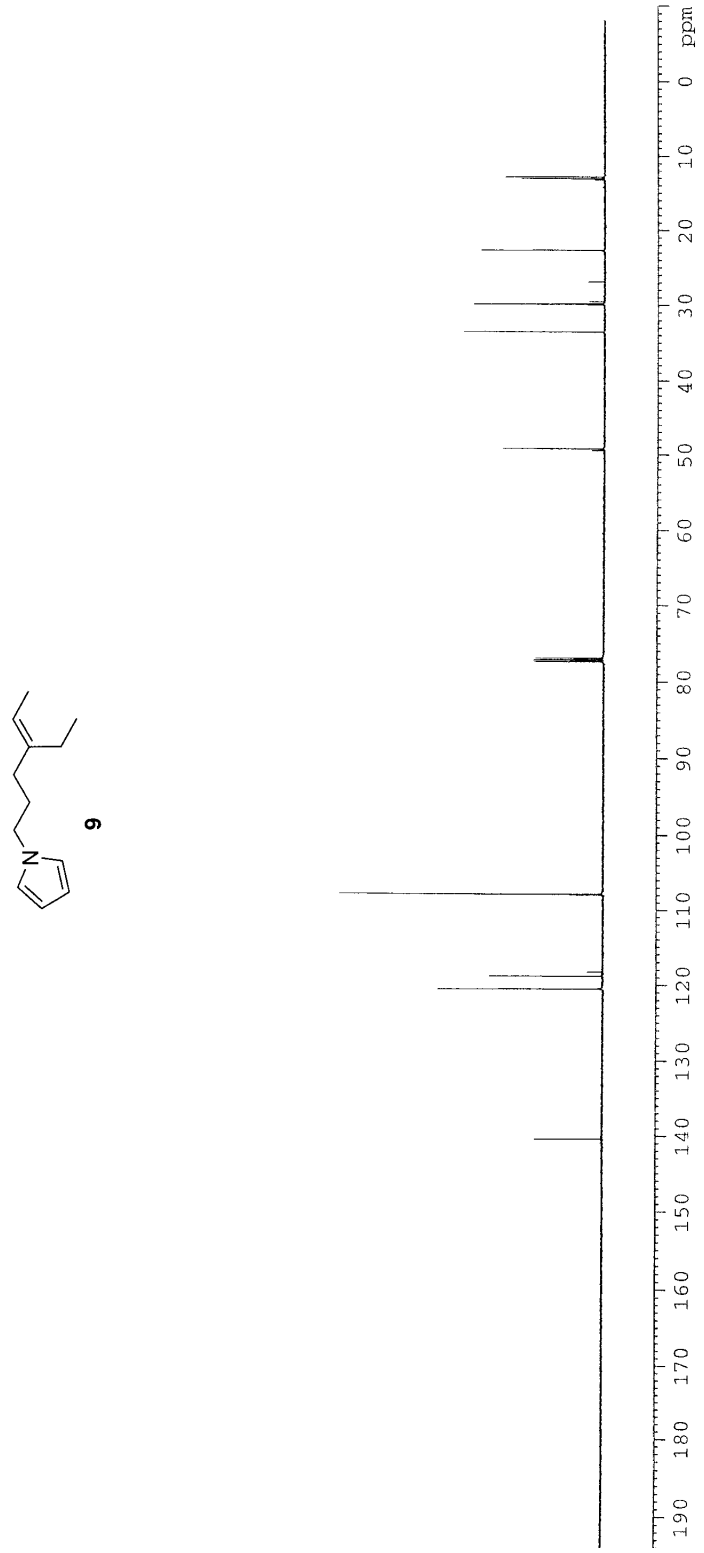
N
6
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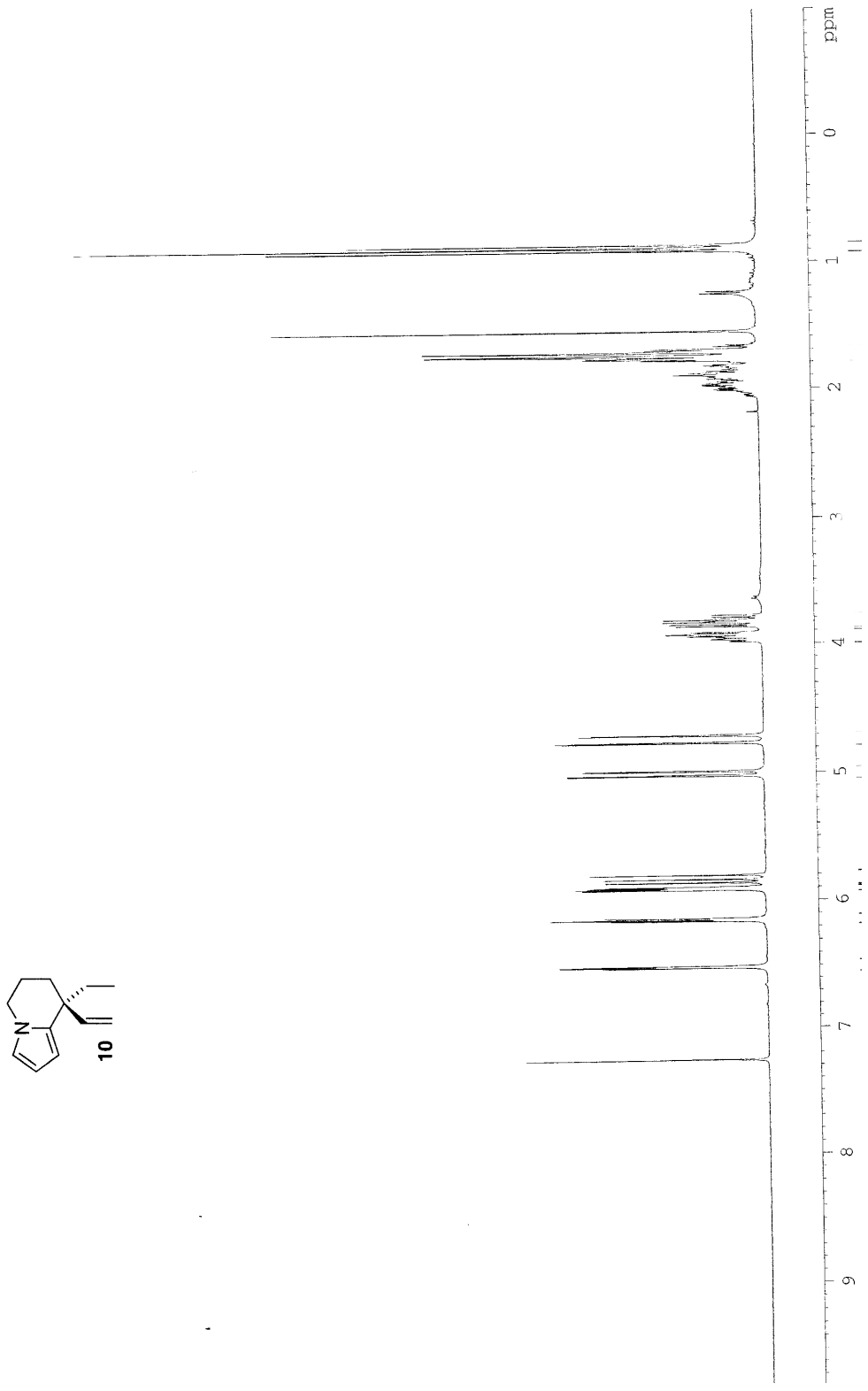

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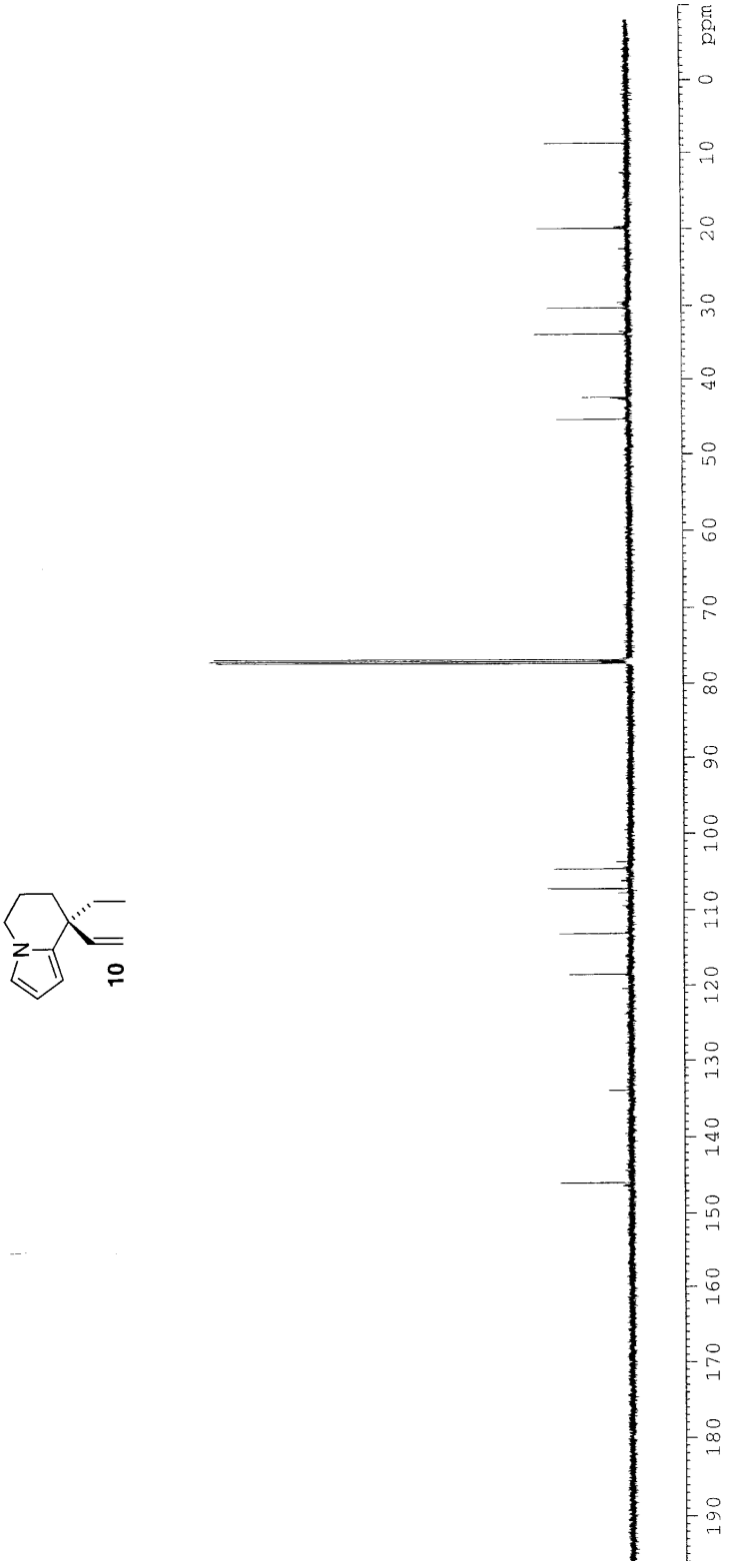
N
10
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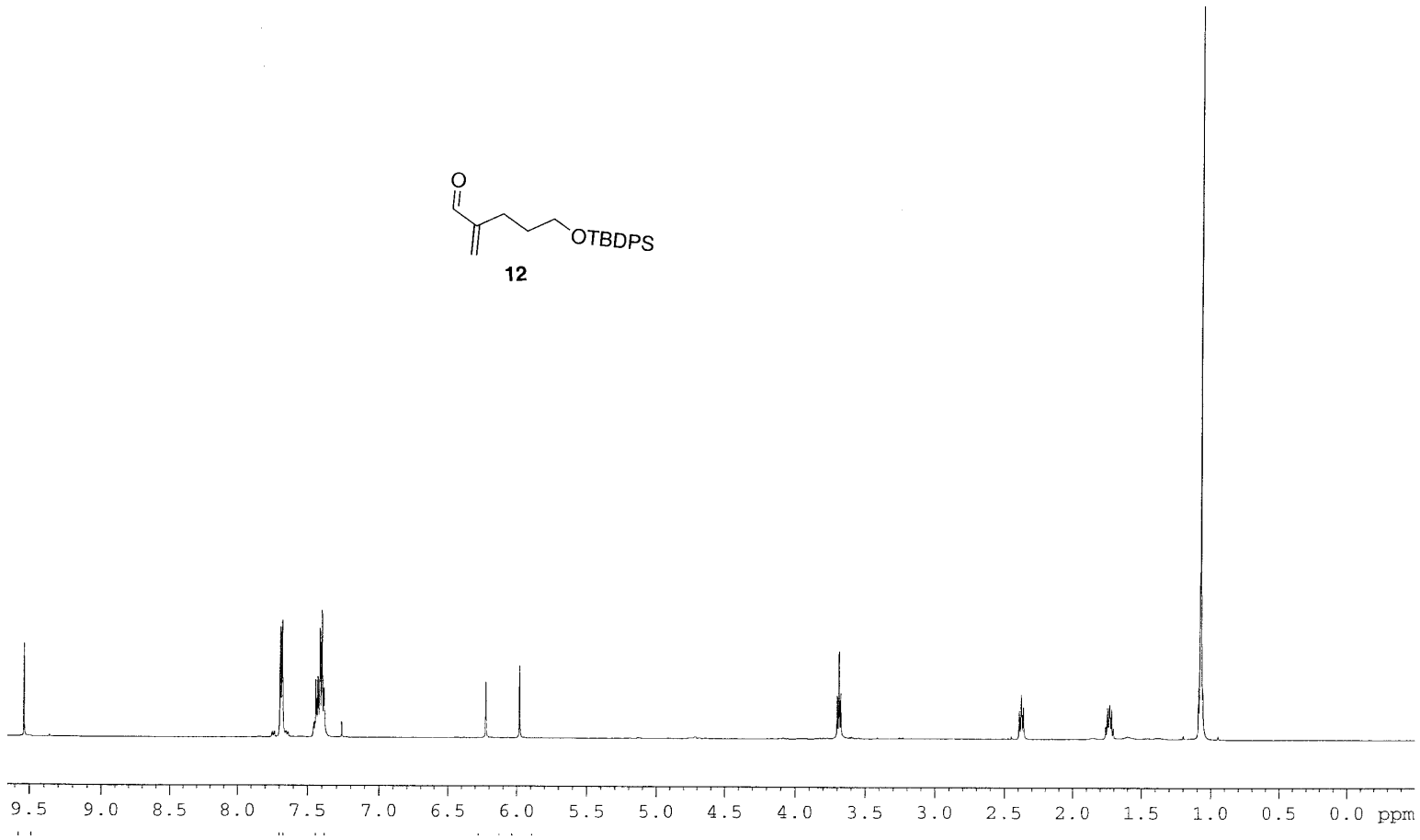
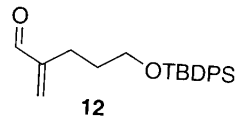
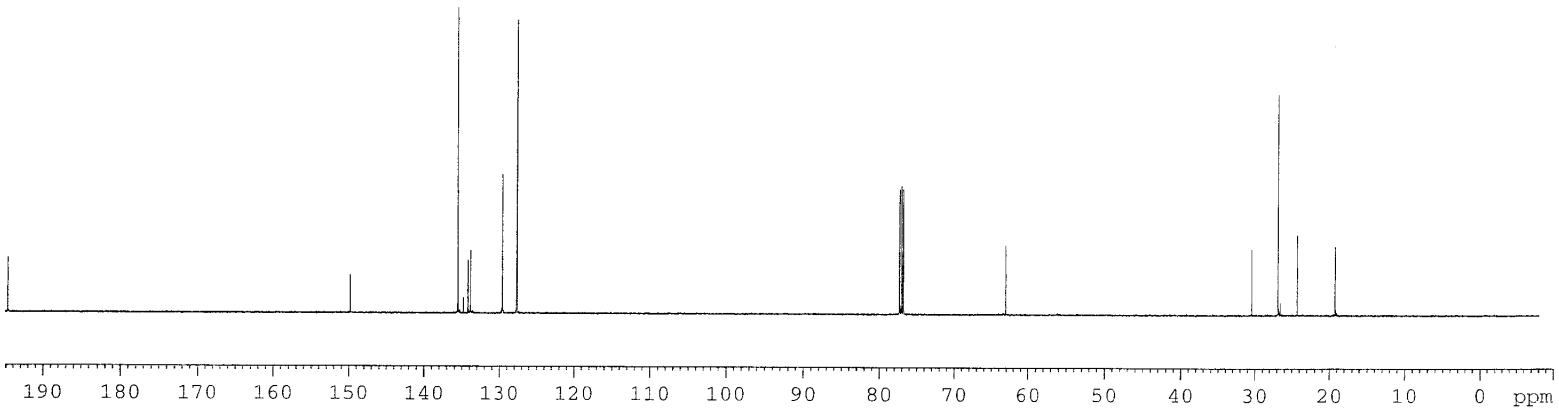

O
OTBDPS
12
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm


O
OTBDPS

12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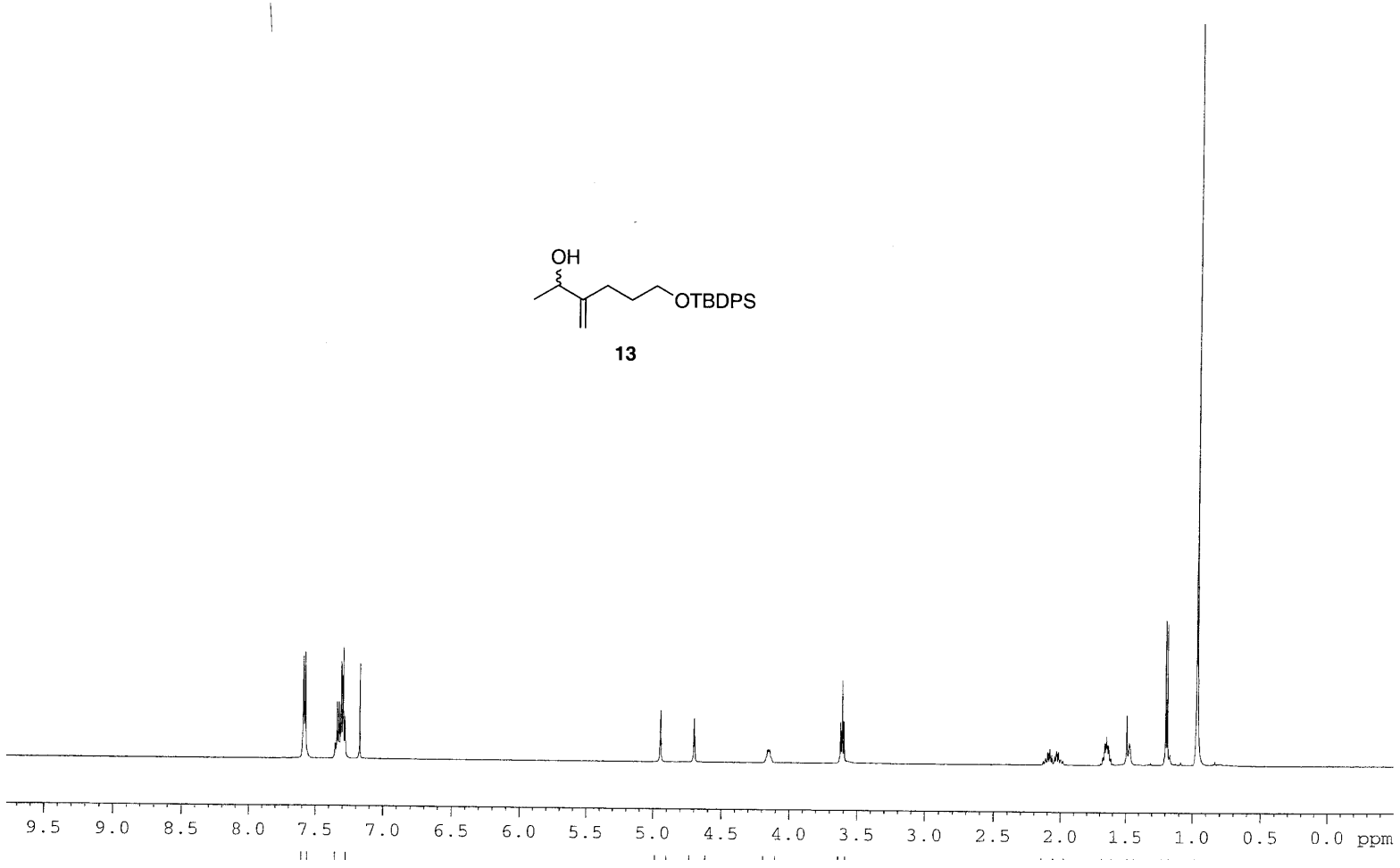
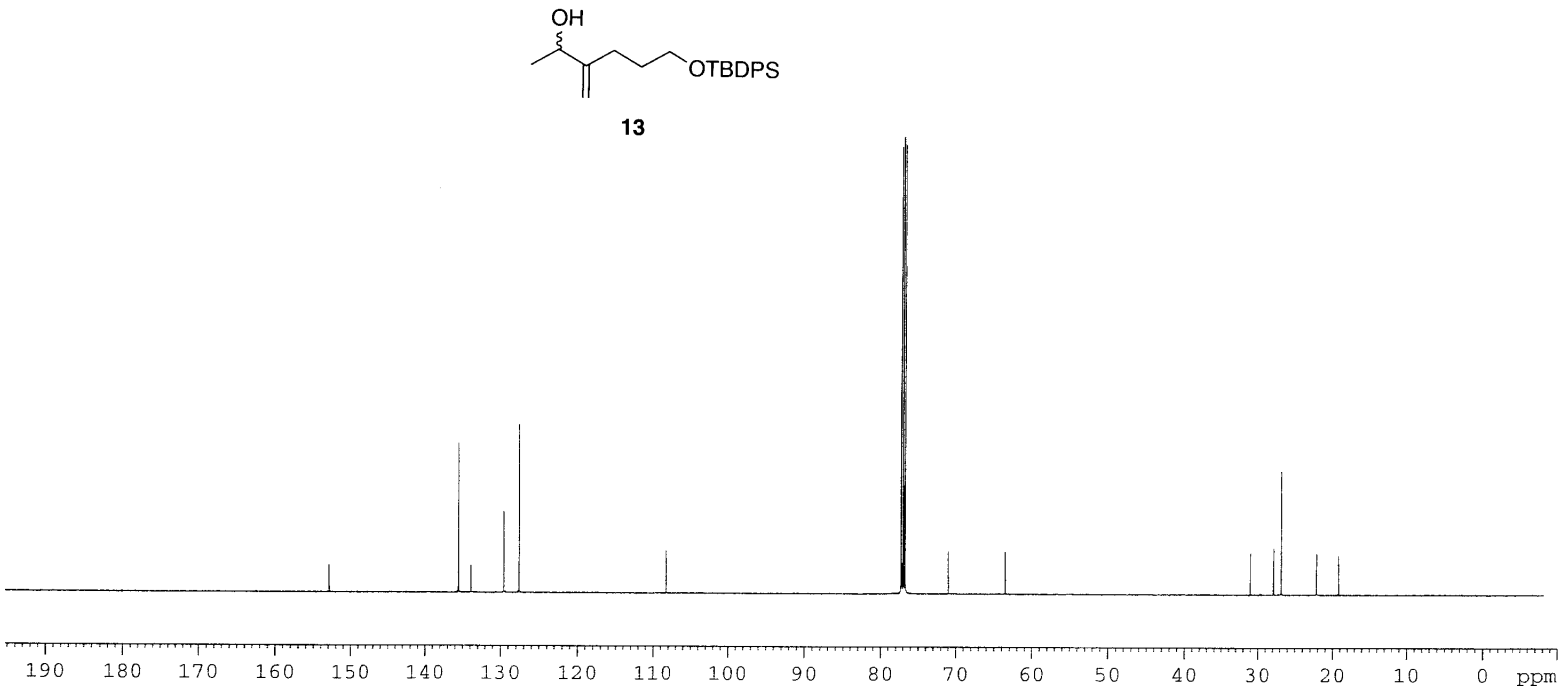
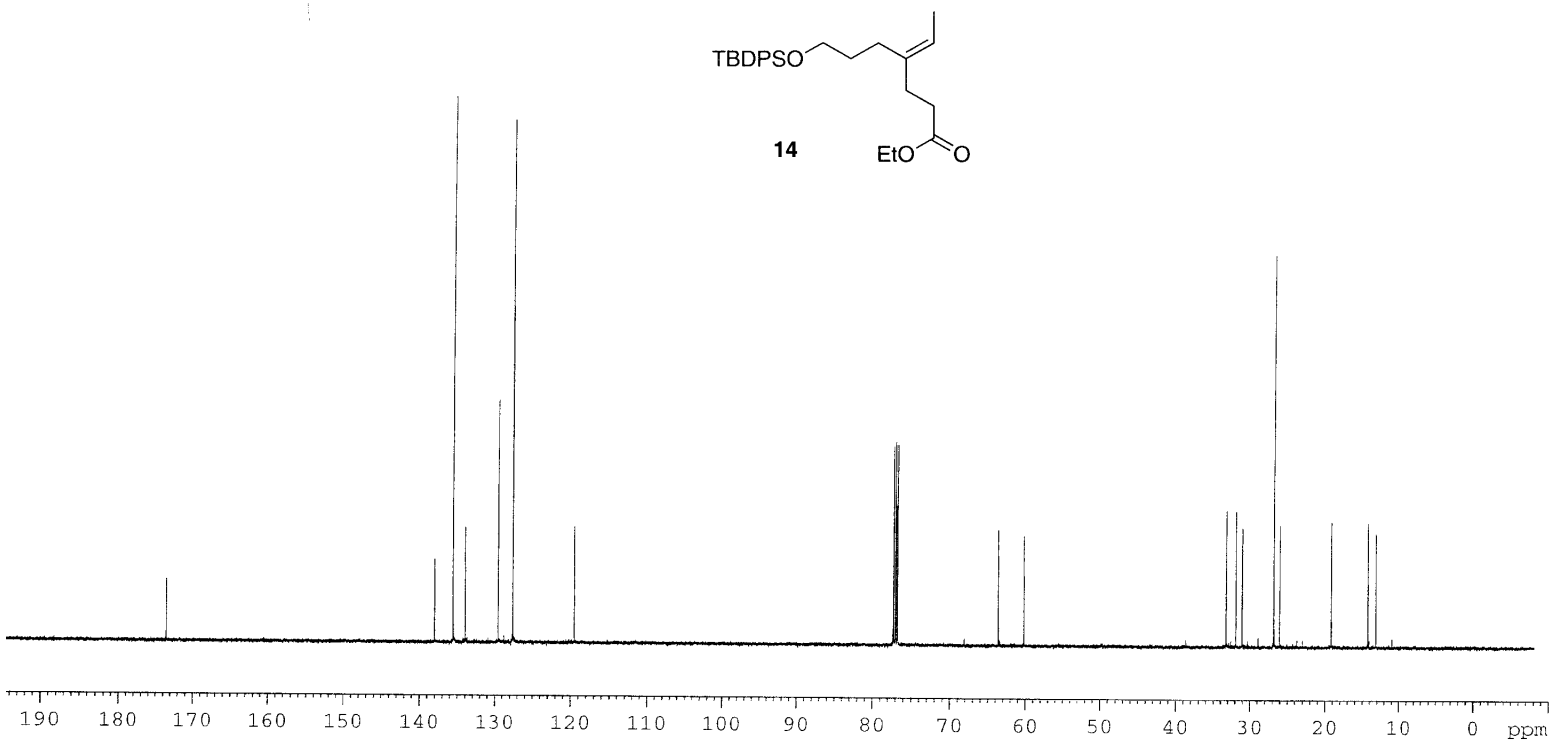
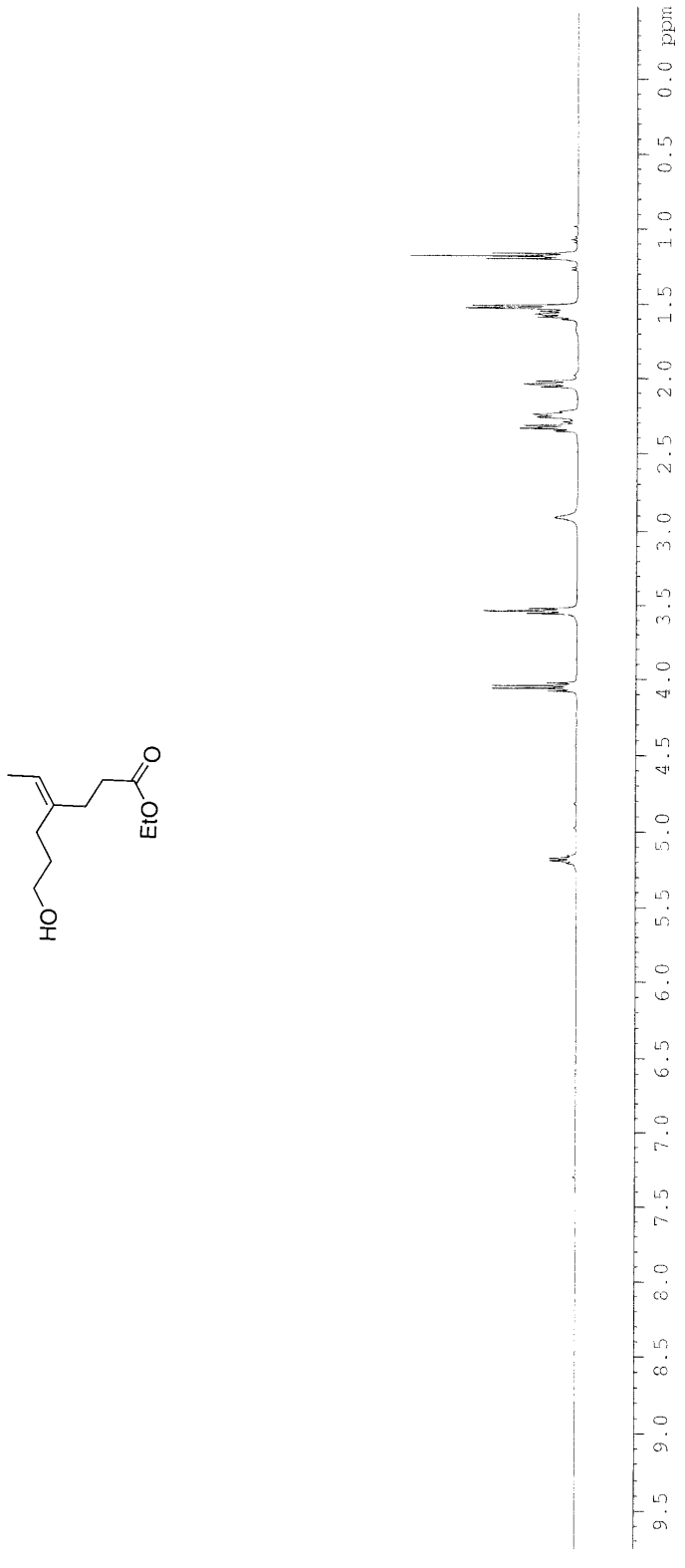
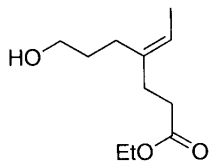

OH
OTBDPS
13
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm

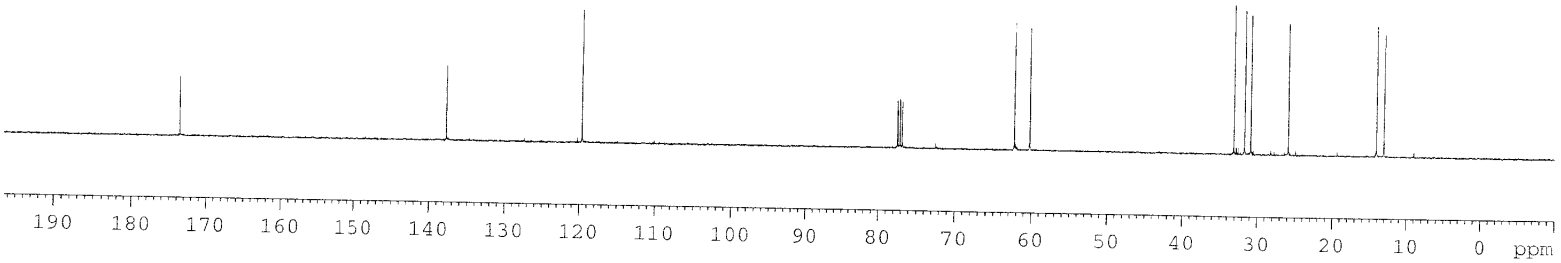

OH
OTBDPS
13
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

TBDPSO
EtO
O
14
ppm
0
1
2
3
4
5
6
7
8
9


TBDPSO
14
EtO
O
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm


HO
EtO
O
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm


HO
EtO
O


190
180
170
160
150
140
130
120
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100
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60
50
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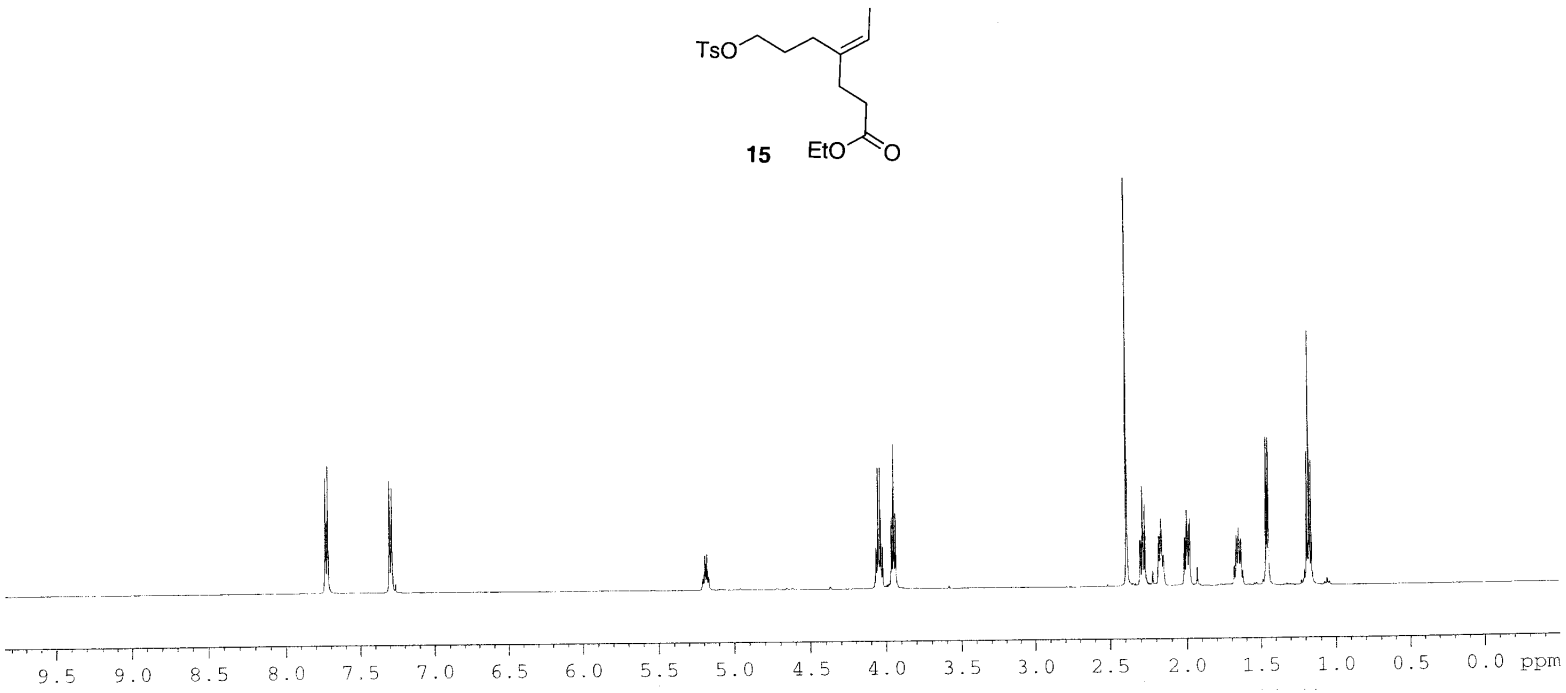
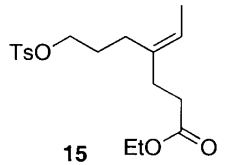
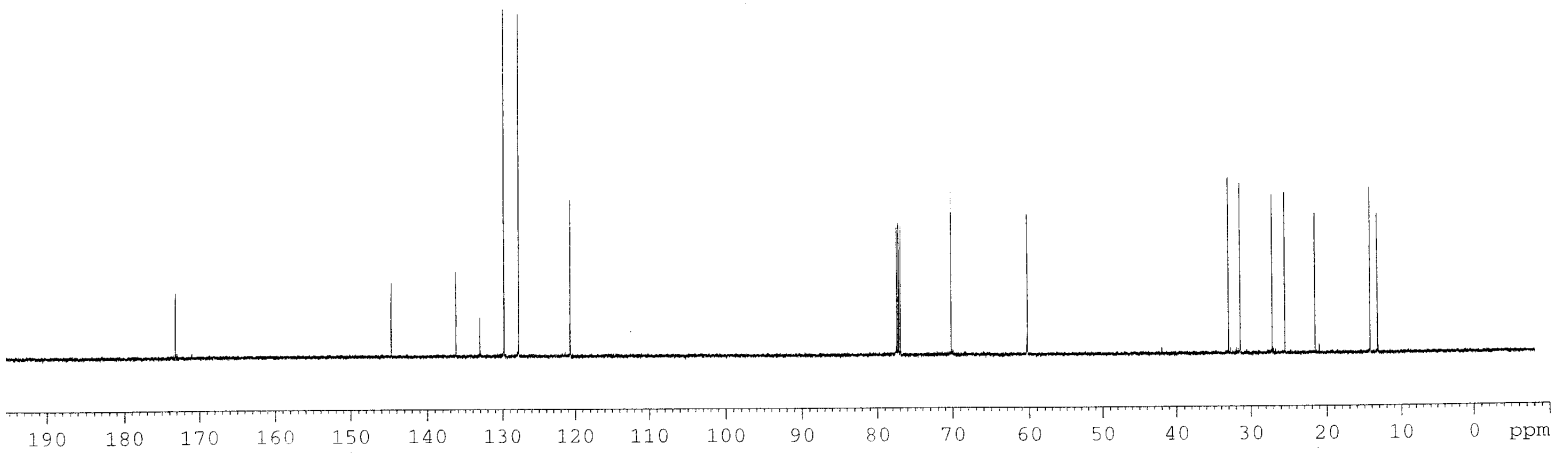
20
10
0
ppm


TsO
EtO
O
15
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm


TsO
EtO
O

15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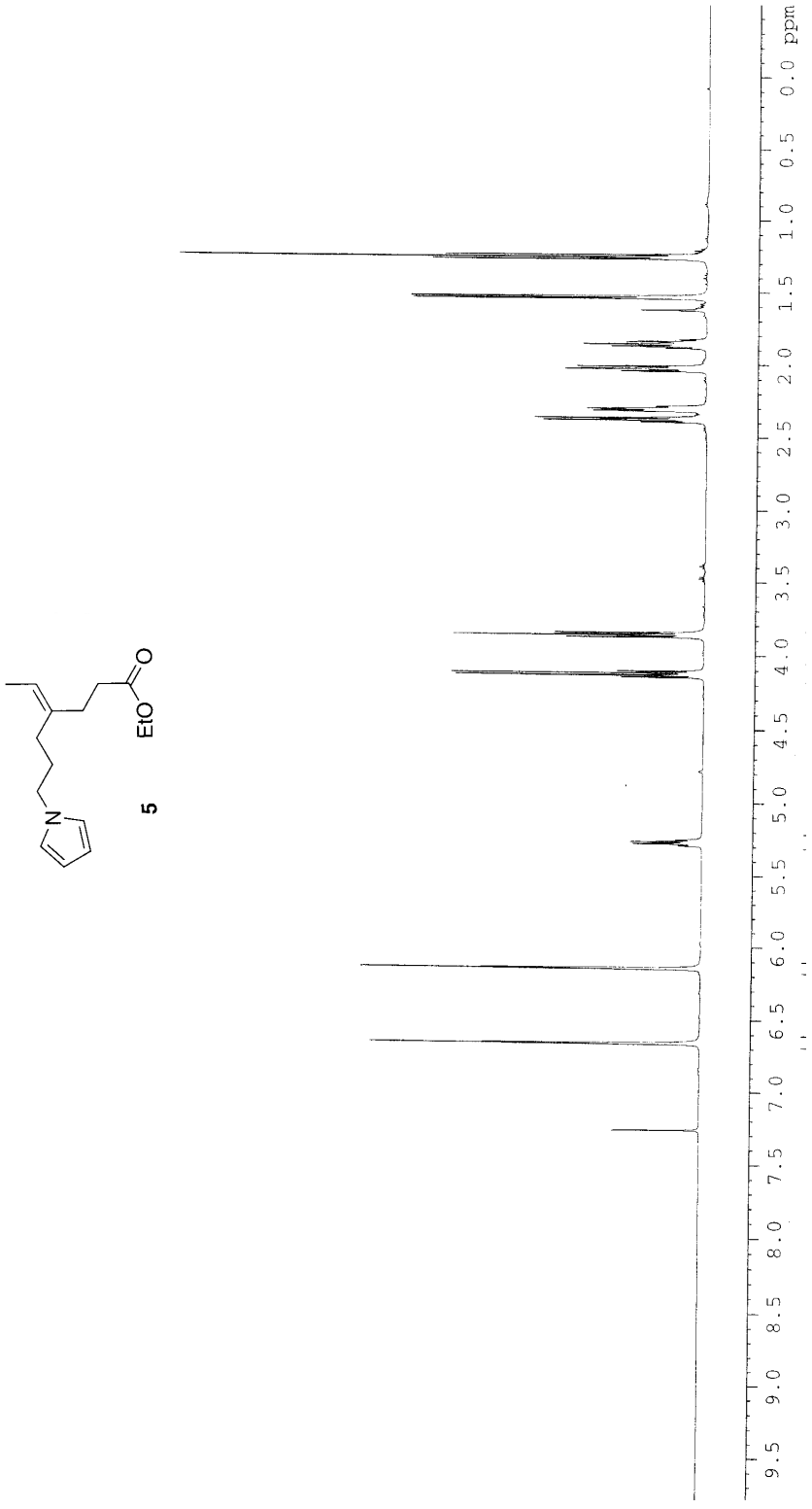
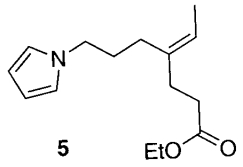
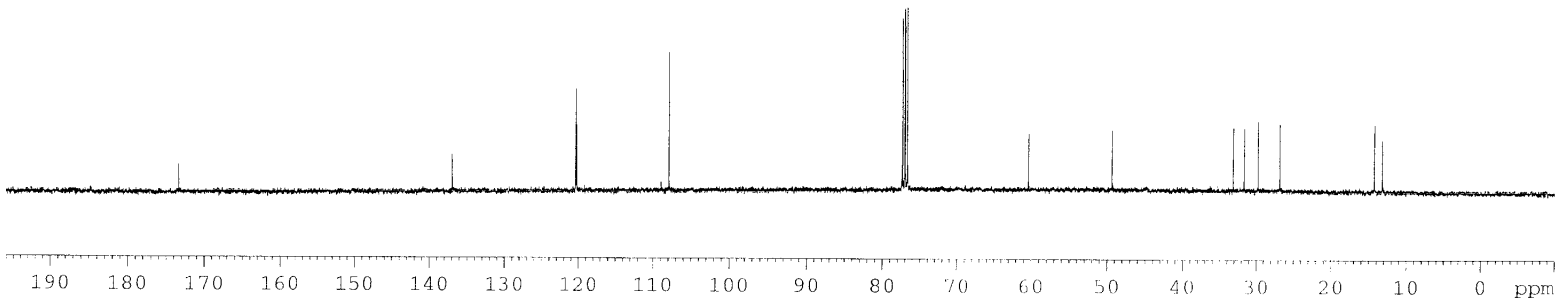
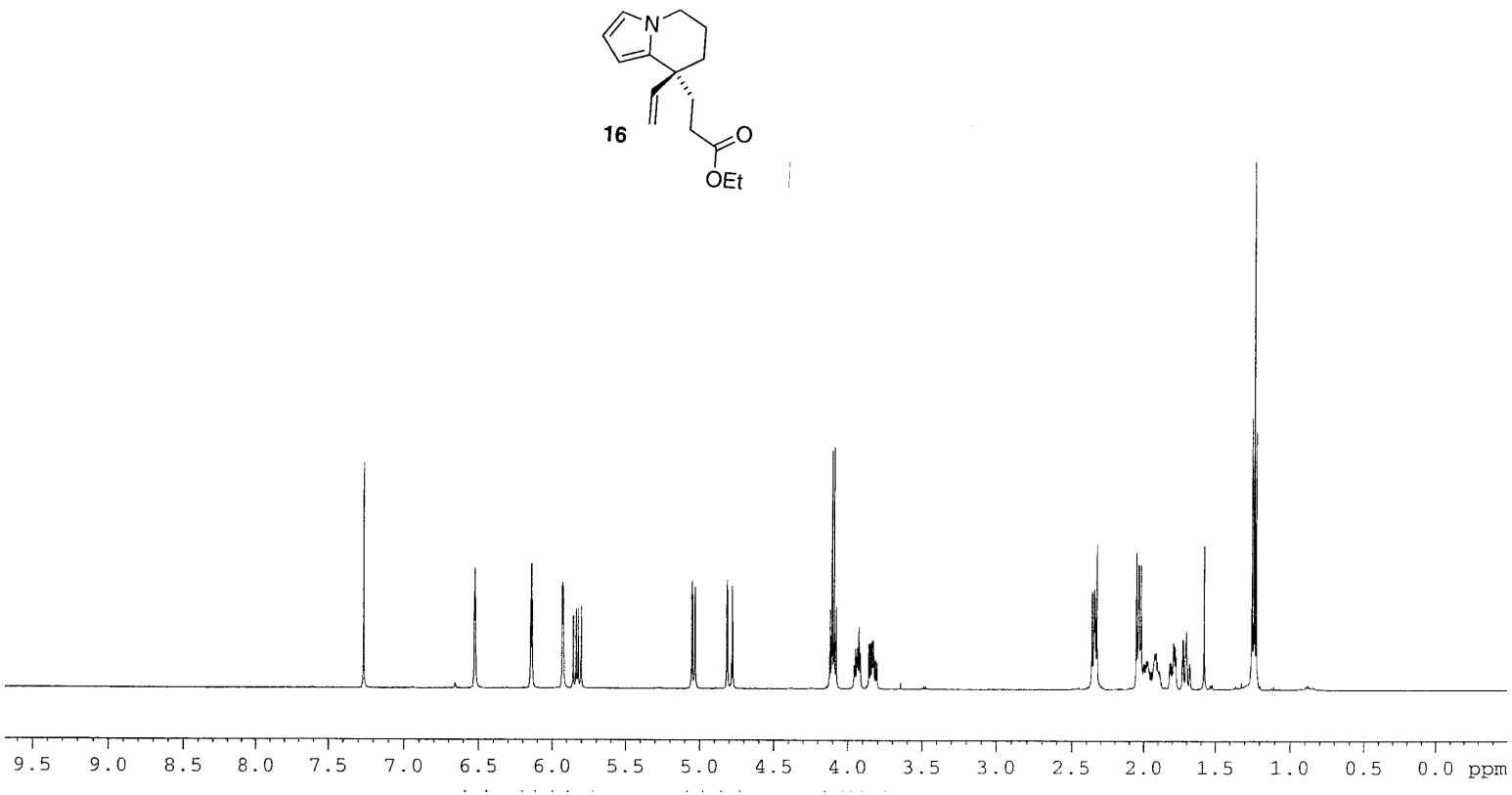
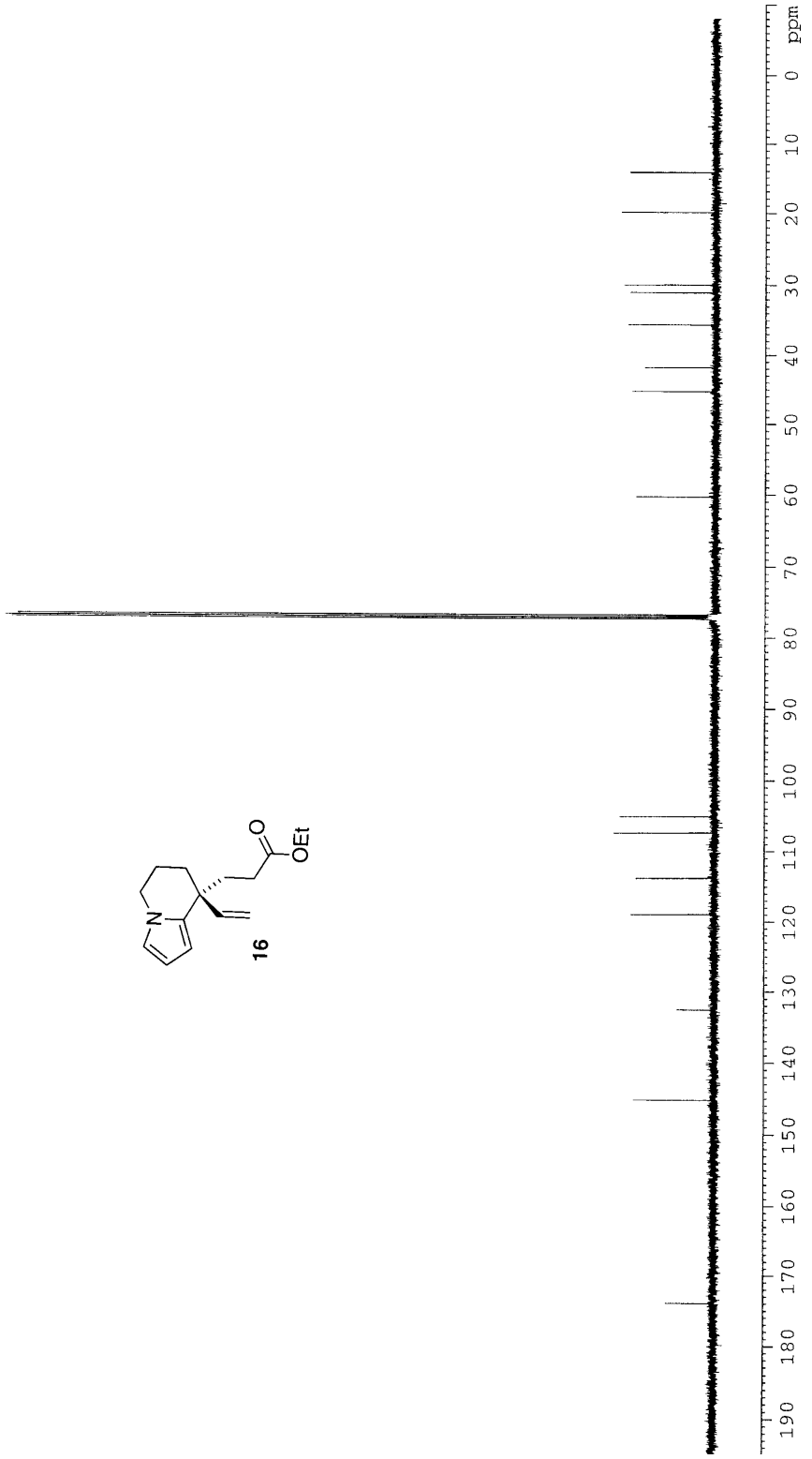

N
EtO
O
5
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm

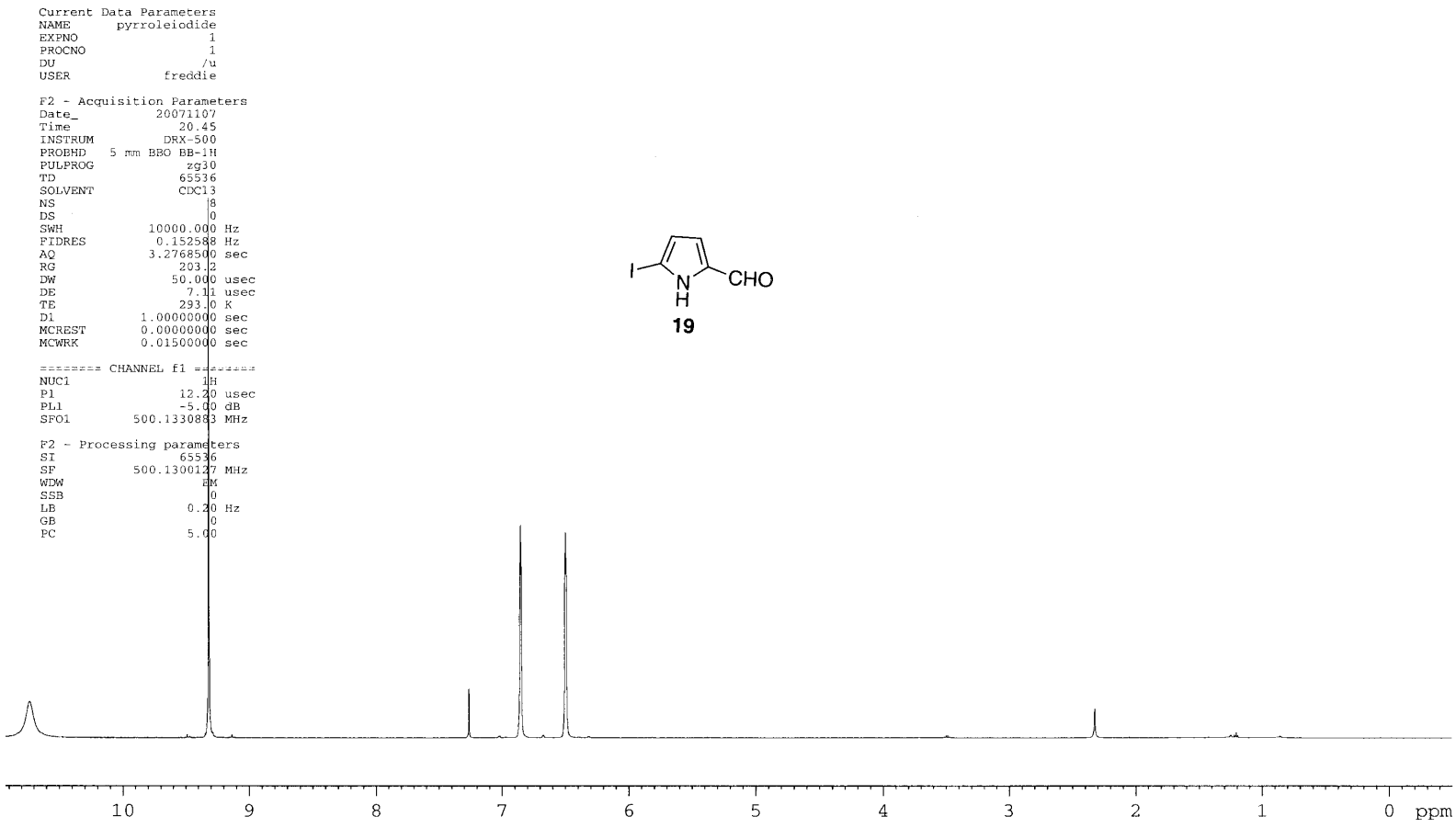

N
EtO
O

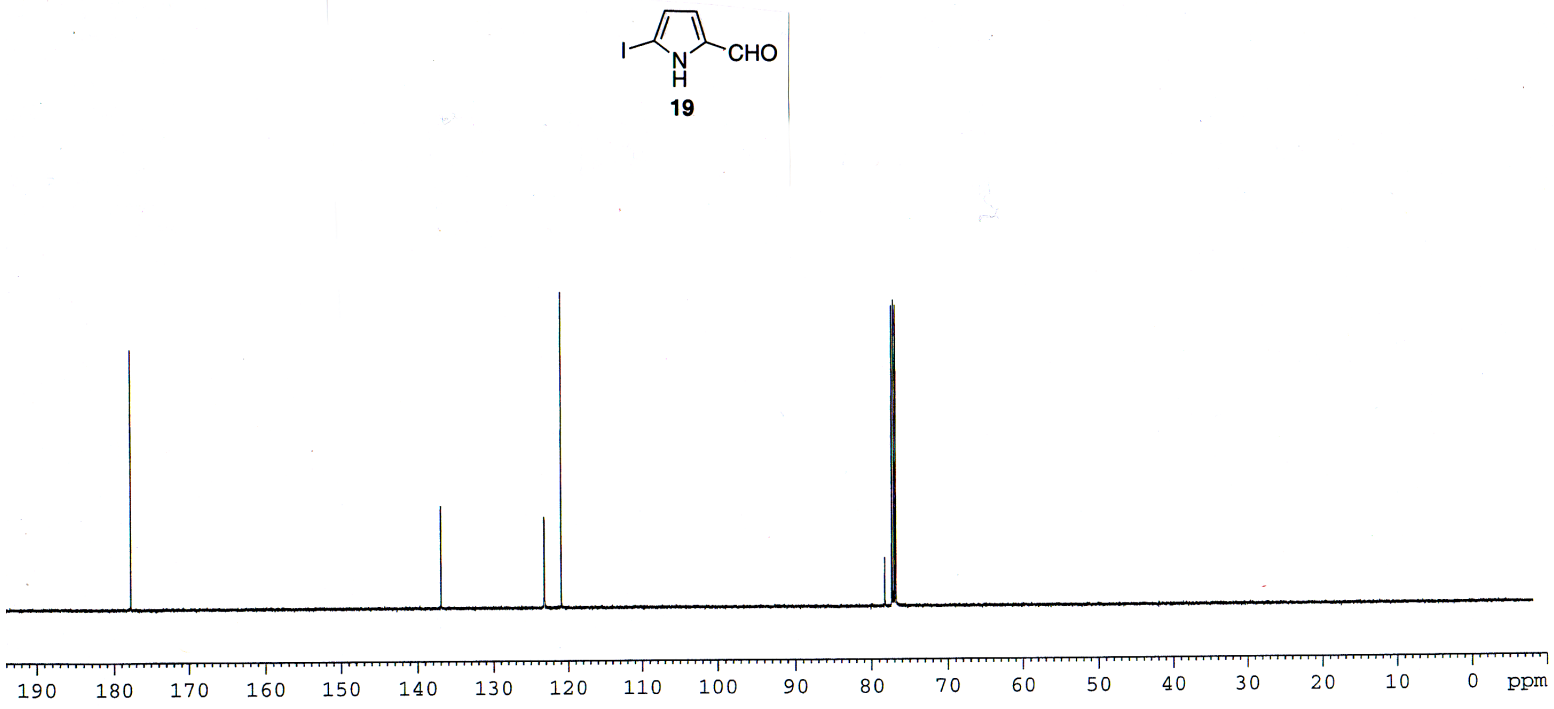
5

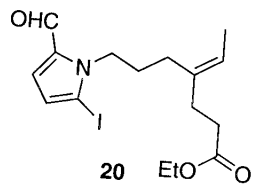

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


N
16
O
OEt
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm

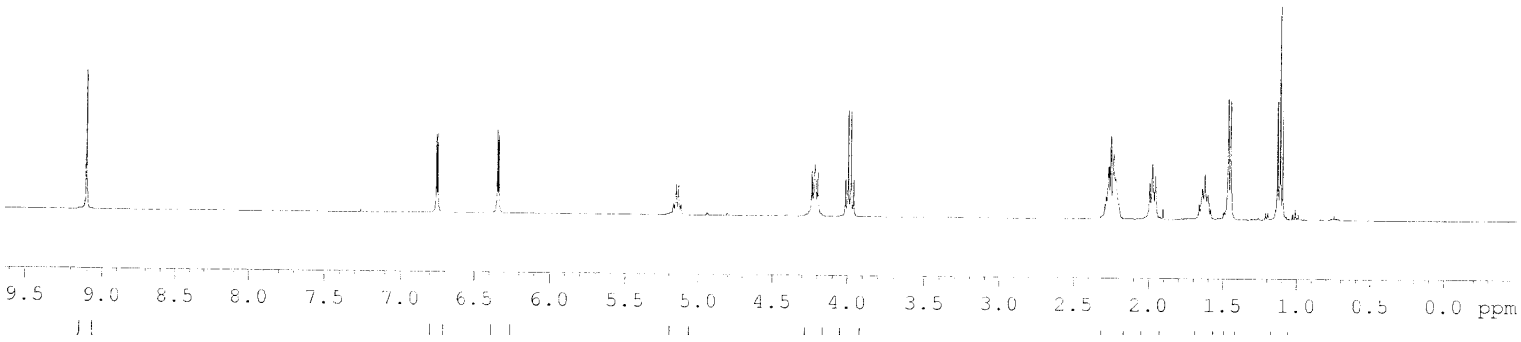

O
OEt
N
16
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

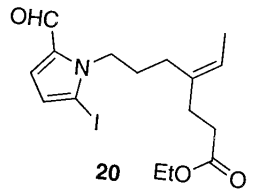

Current Data Parameters
NAME pyrroleiodide
EXPNO 1
PROCNO 1
DU /u
USER freddie
F2 - Acquisition Parameters
Date_ 20071107
Time 20.45
INSTRUM DRX-500
PROBHD 5 mm BBO BB-1H
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 8
DS 0
SWH 10000.000 Hz
FIDRES 0.152588 Hz
AQ 3.2768500 sec
RG 203.2
DW 50.000 usec
DE 7.11 usec
TE 293.0 K
D1 1.00000000 sec
MCREST 0.00000000 sec
MCWRK 0.01500000 sec
======== CHANNEL f1 ========
NUC1 1H
P1 12.20 usec
PL1 -5.00 dB
SFO1 500.1330883 MHz
F2 - Processing parameters
SI 65536
SF 500.1300127 MHz
WDW EM
SSB 0
LB 0.20 Hz
GB 0
PC 5.00
I
N
H
CHO
19
10
9
8
7
6
5
4
3
2
1
0
ppm


I
N
H
CHO
19
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

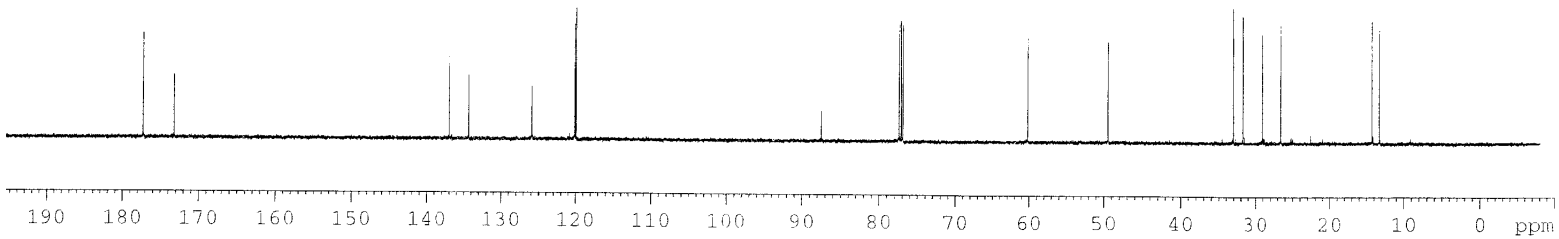

OHC
N
I
EtO
O

20


9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm


OHC
N
I
EtO
O

20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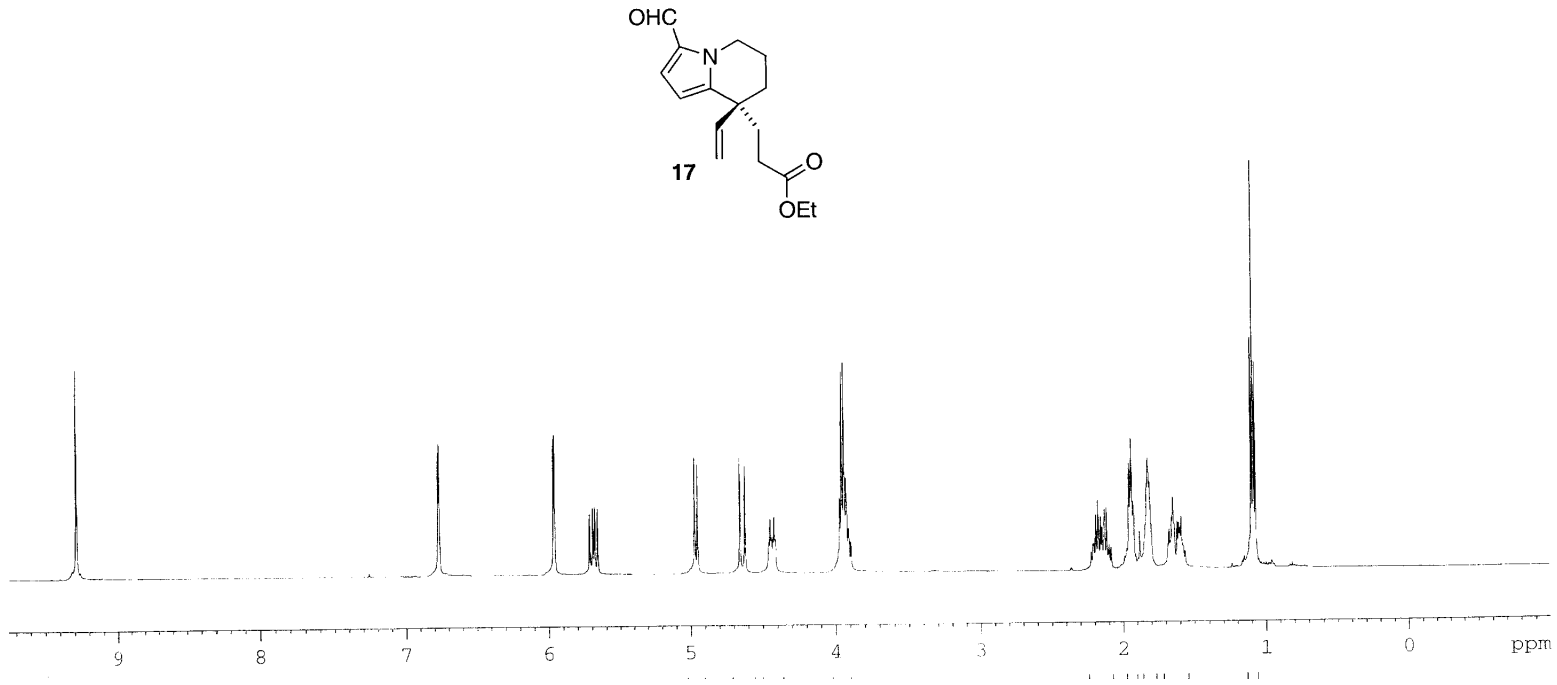
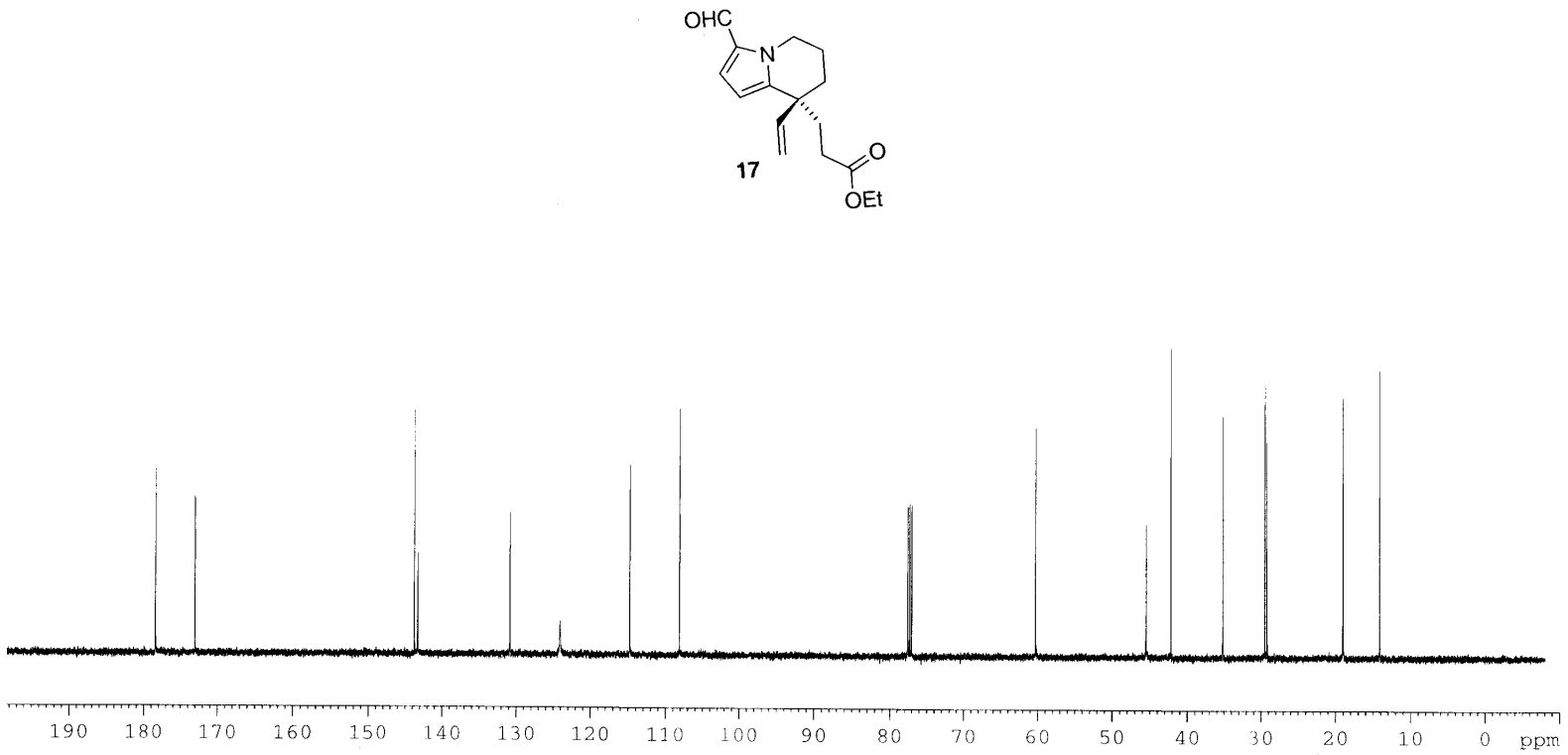
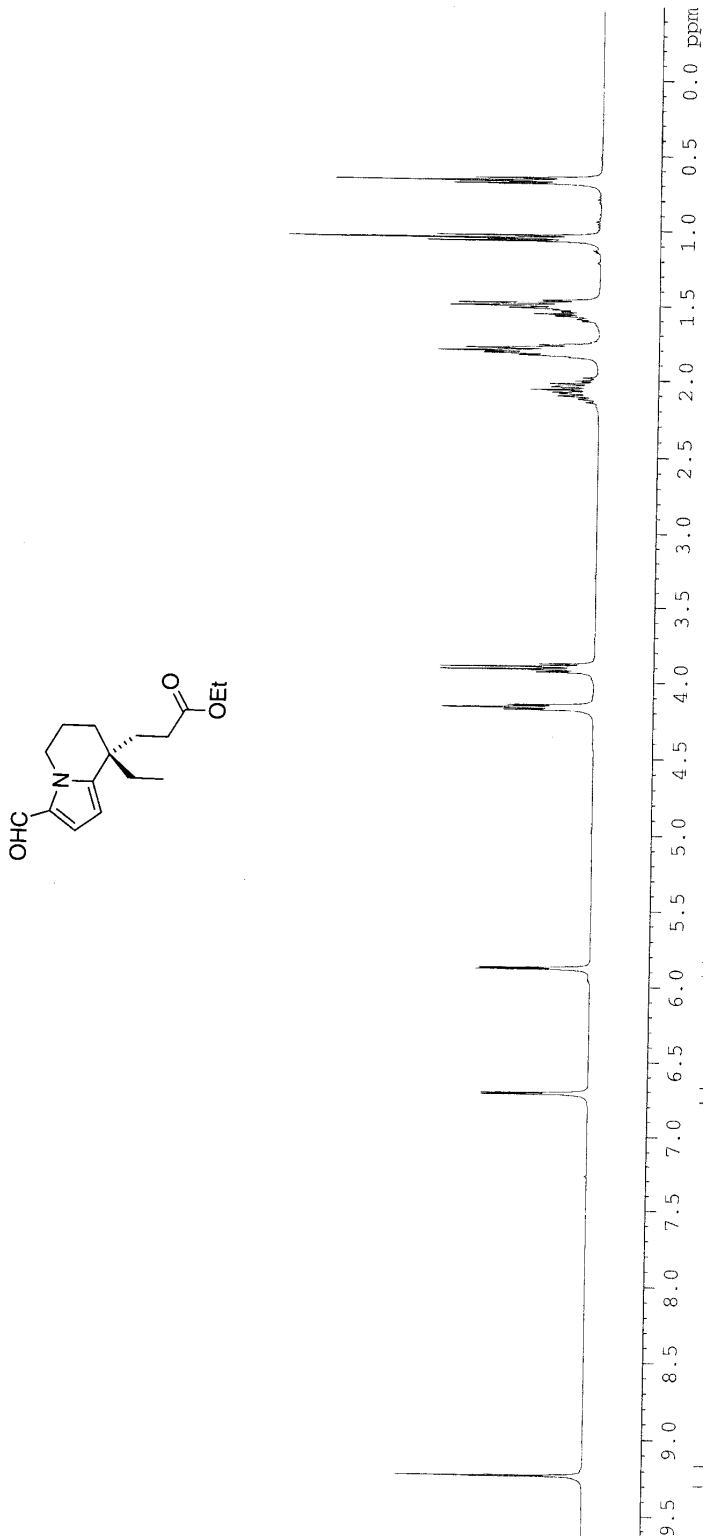
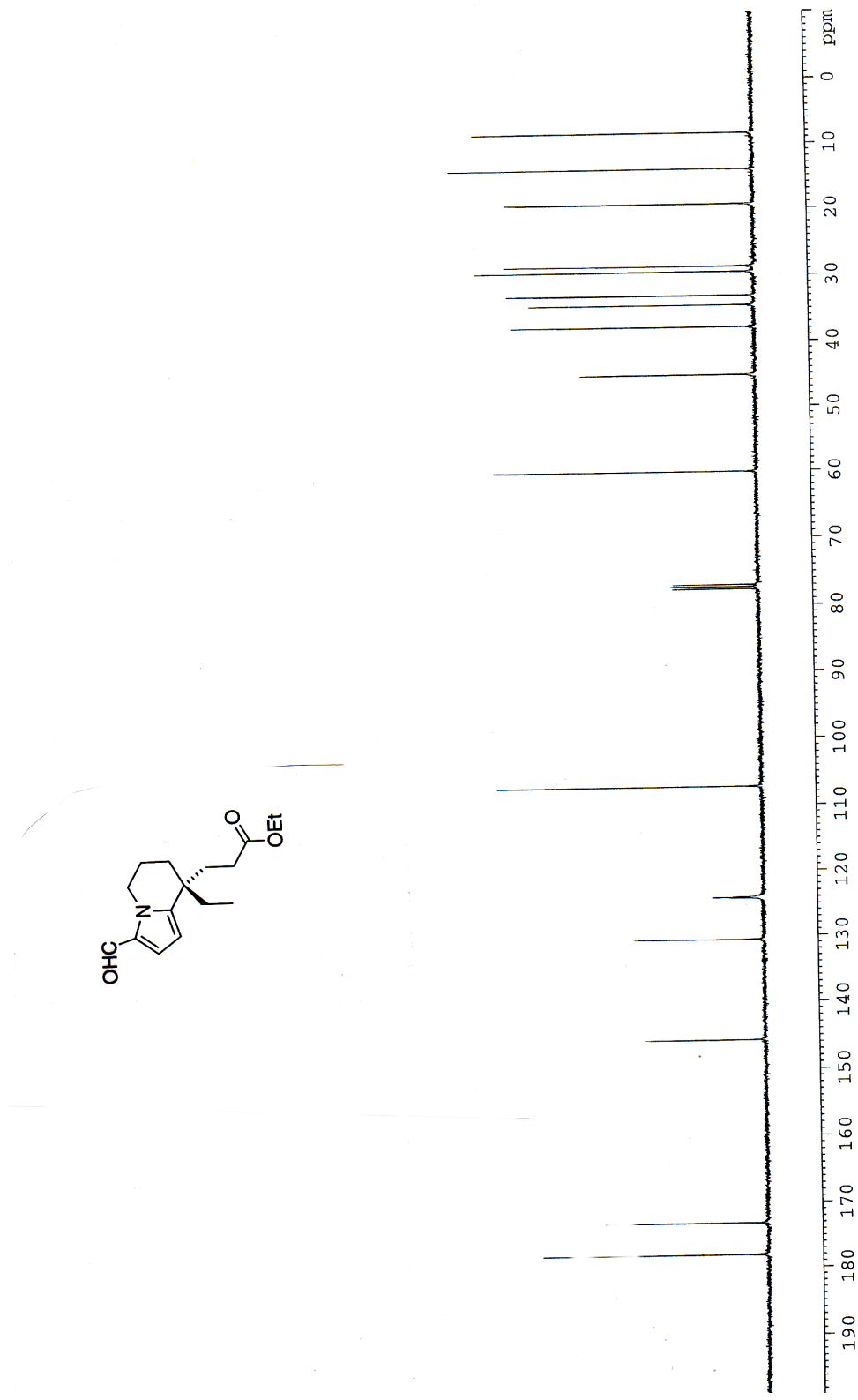
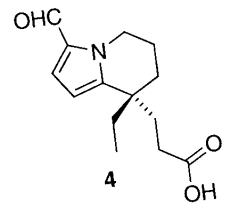

OHC
N
O
OEt
17
9
8
7
6
5
4
3
2
1
0
ppm

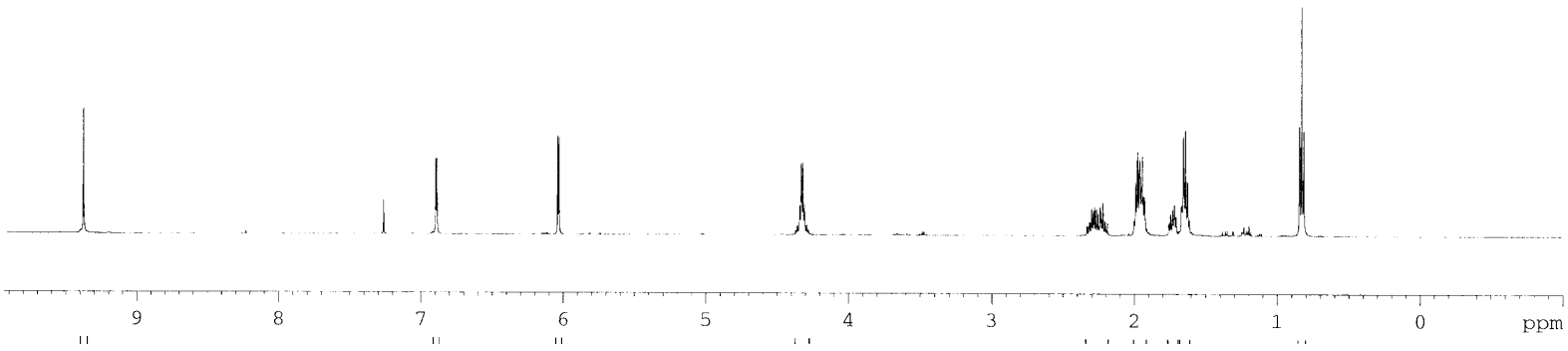

OHC
N
O
OEt
17
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm

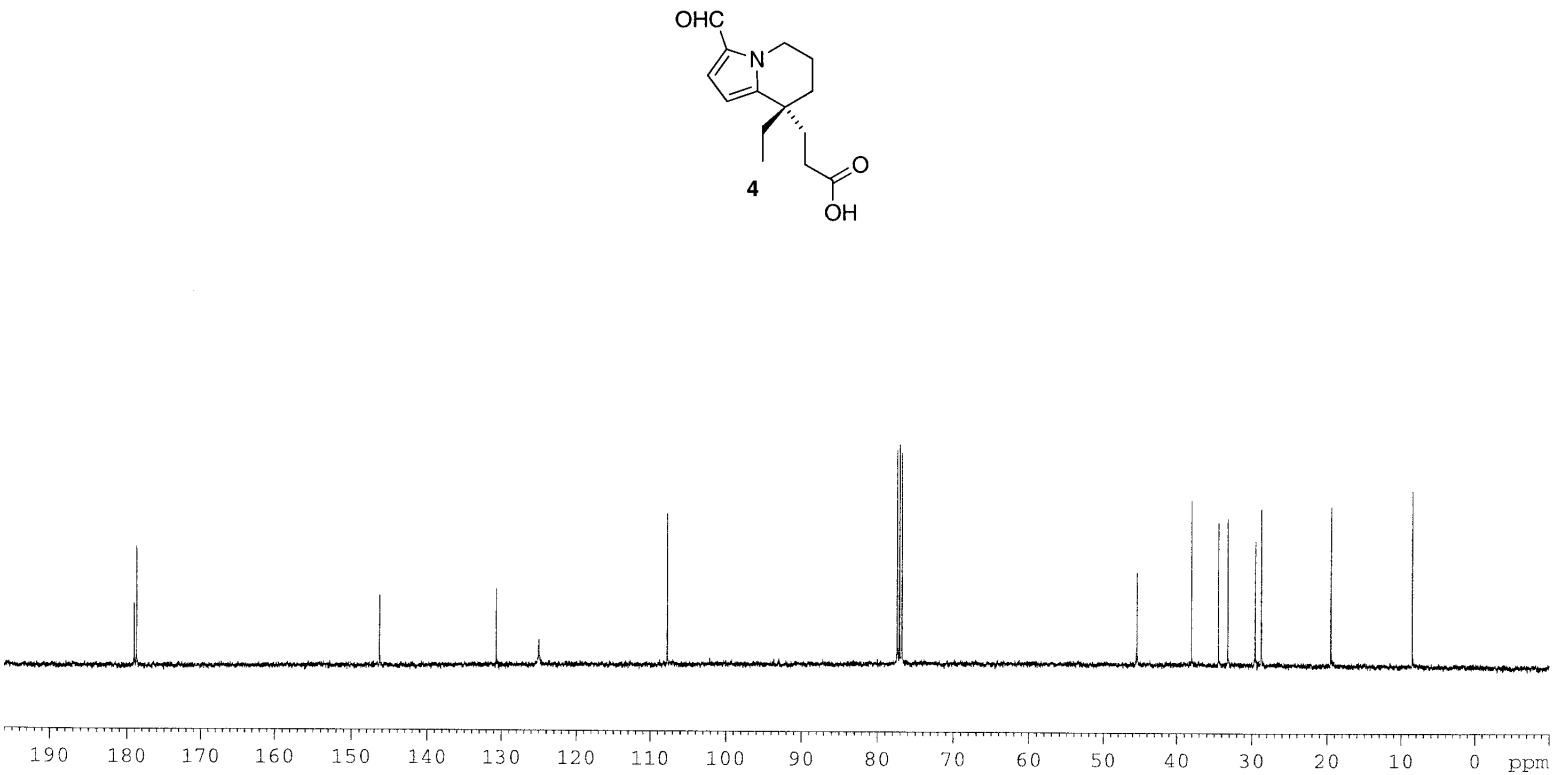

OHC
N
O
OEt
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm

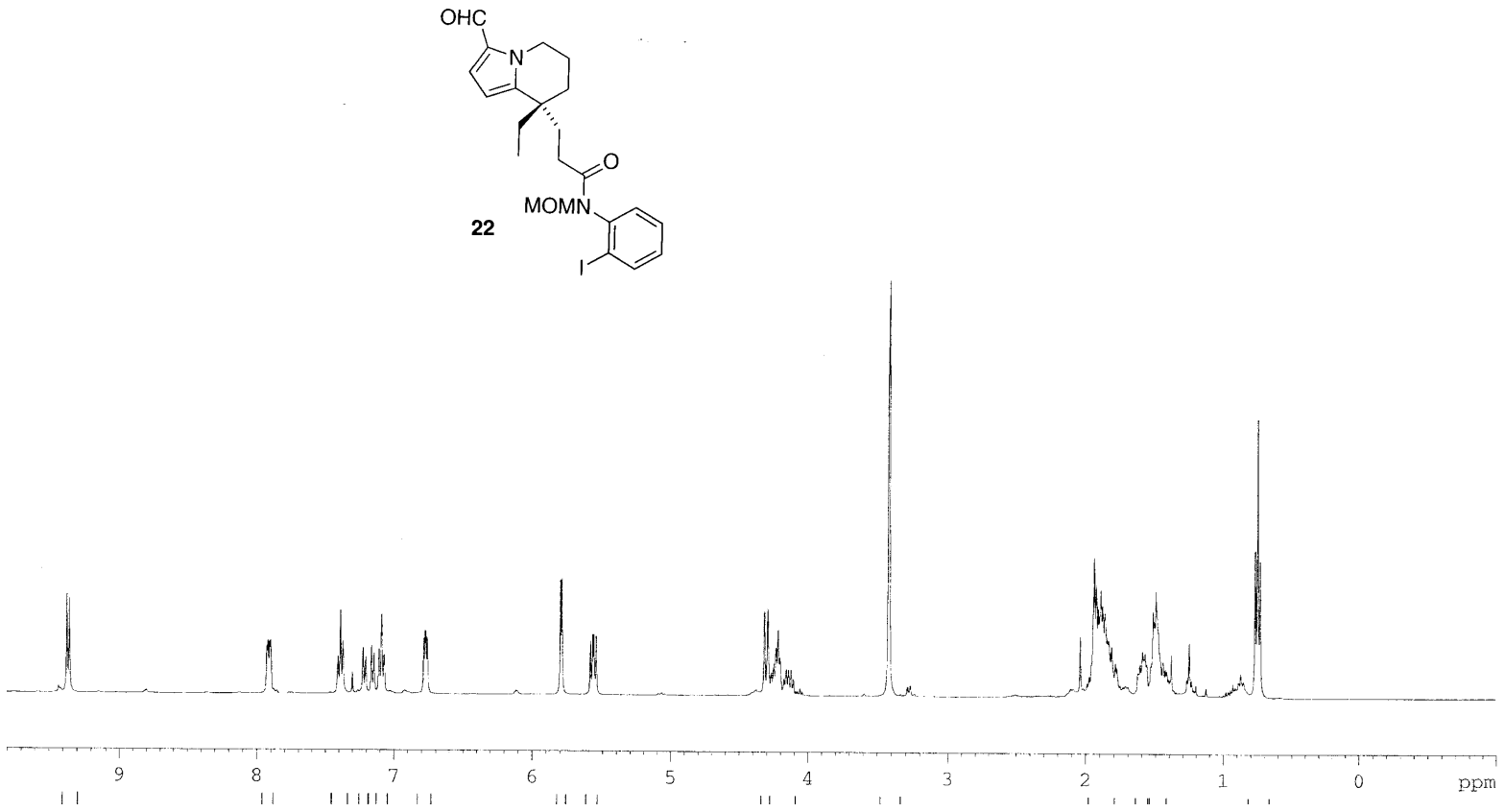

OHC
N
O
OEt
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190

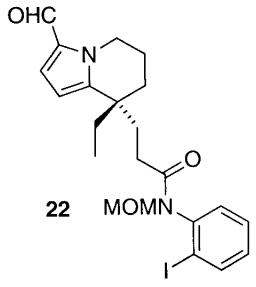


4

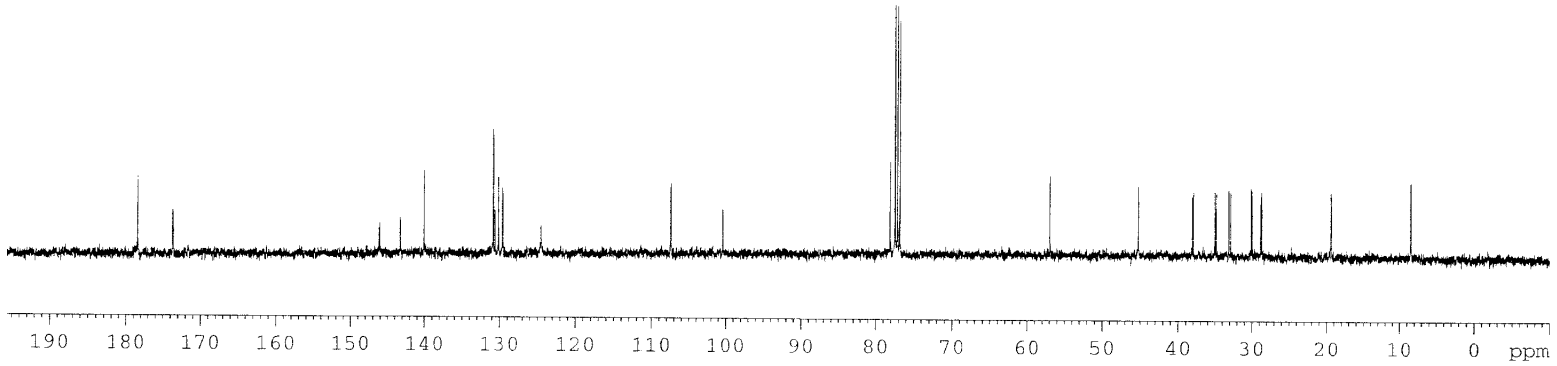


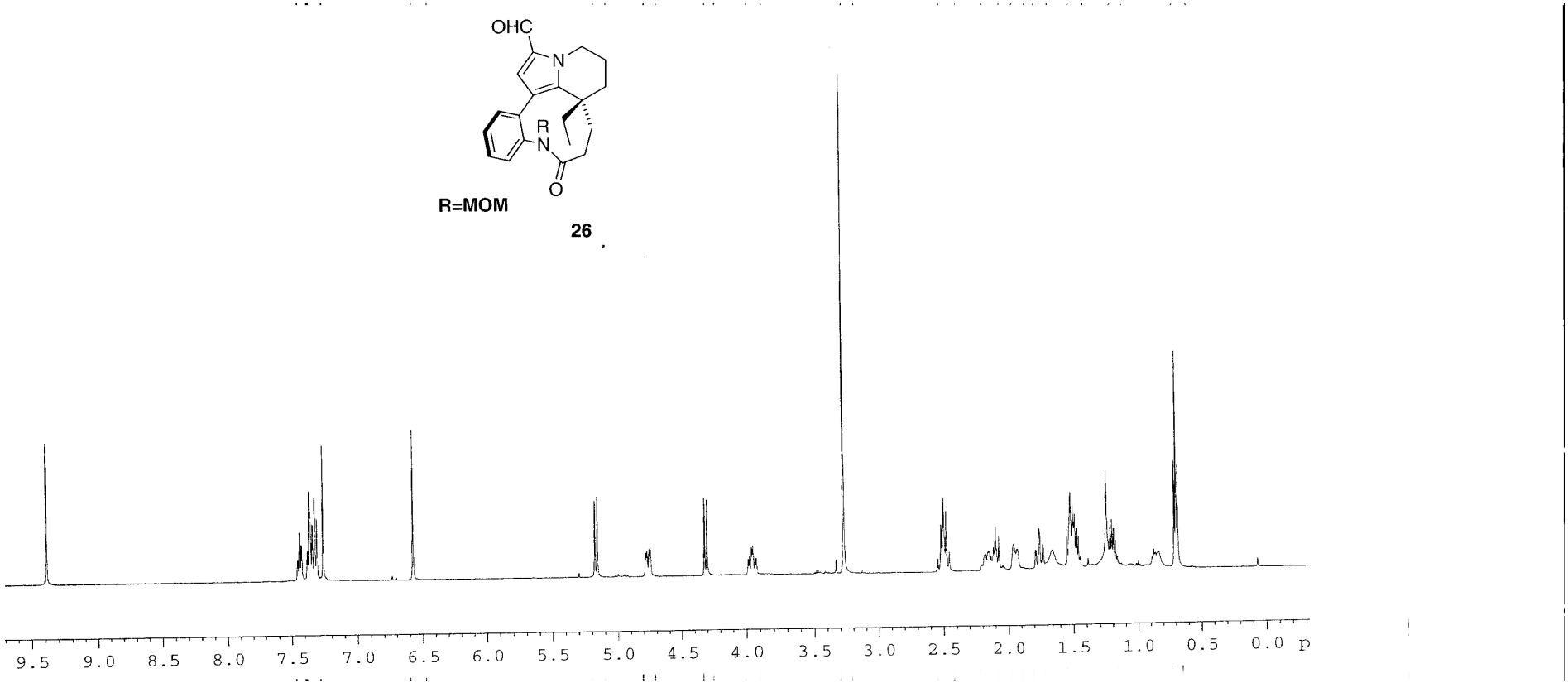

OHC
N
O
OH
4
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm

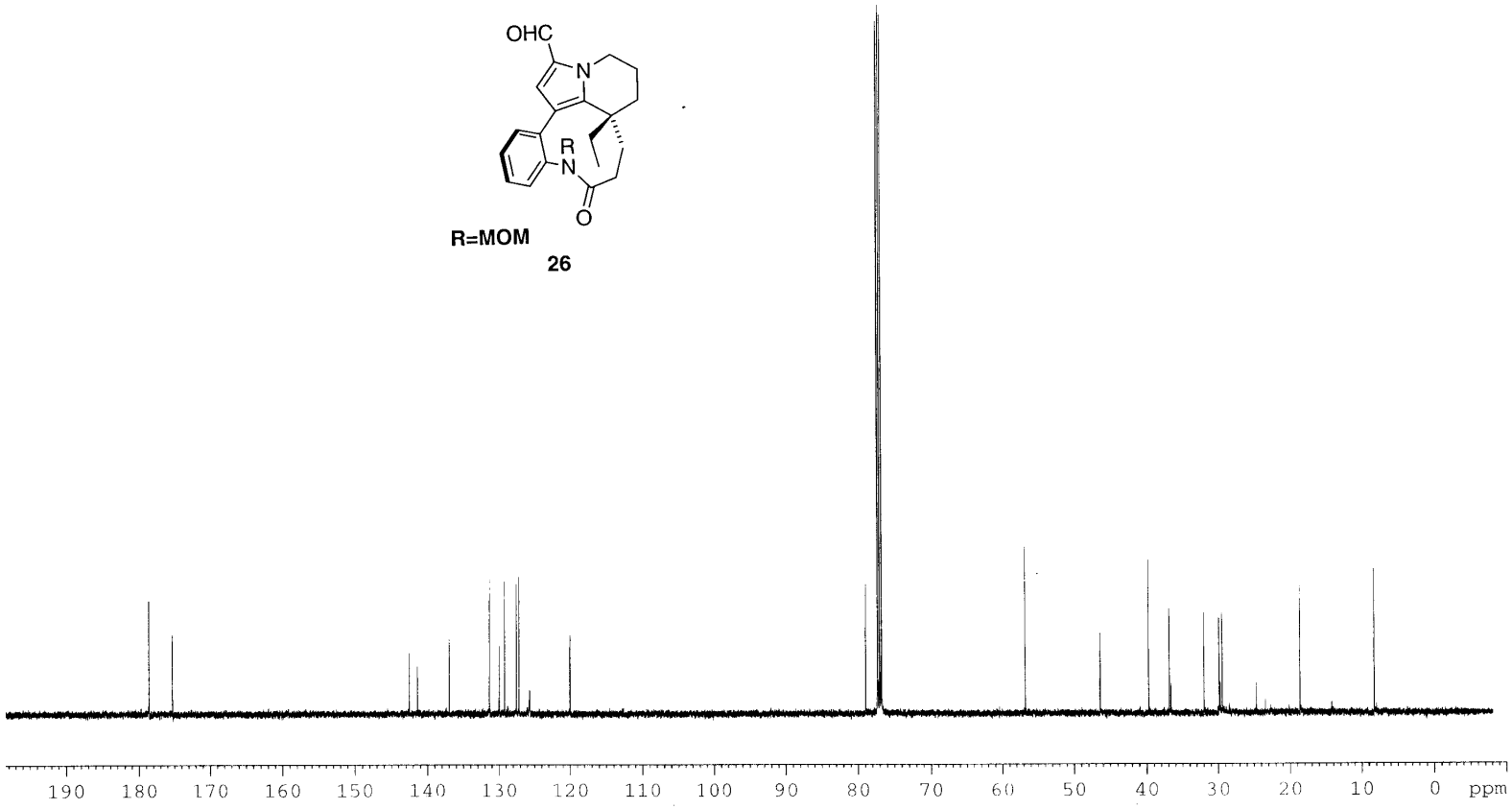

OHC
N
O
MOMN
I
22
9
8
7
6
5
4
3
2
1
0
ppm

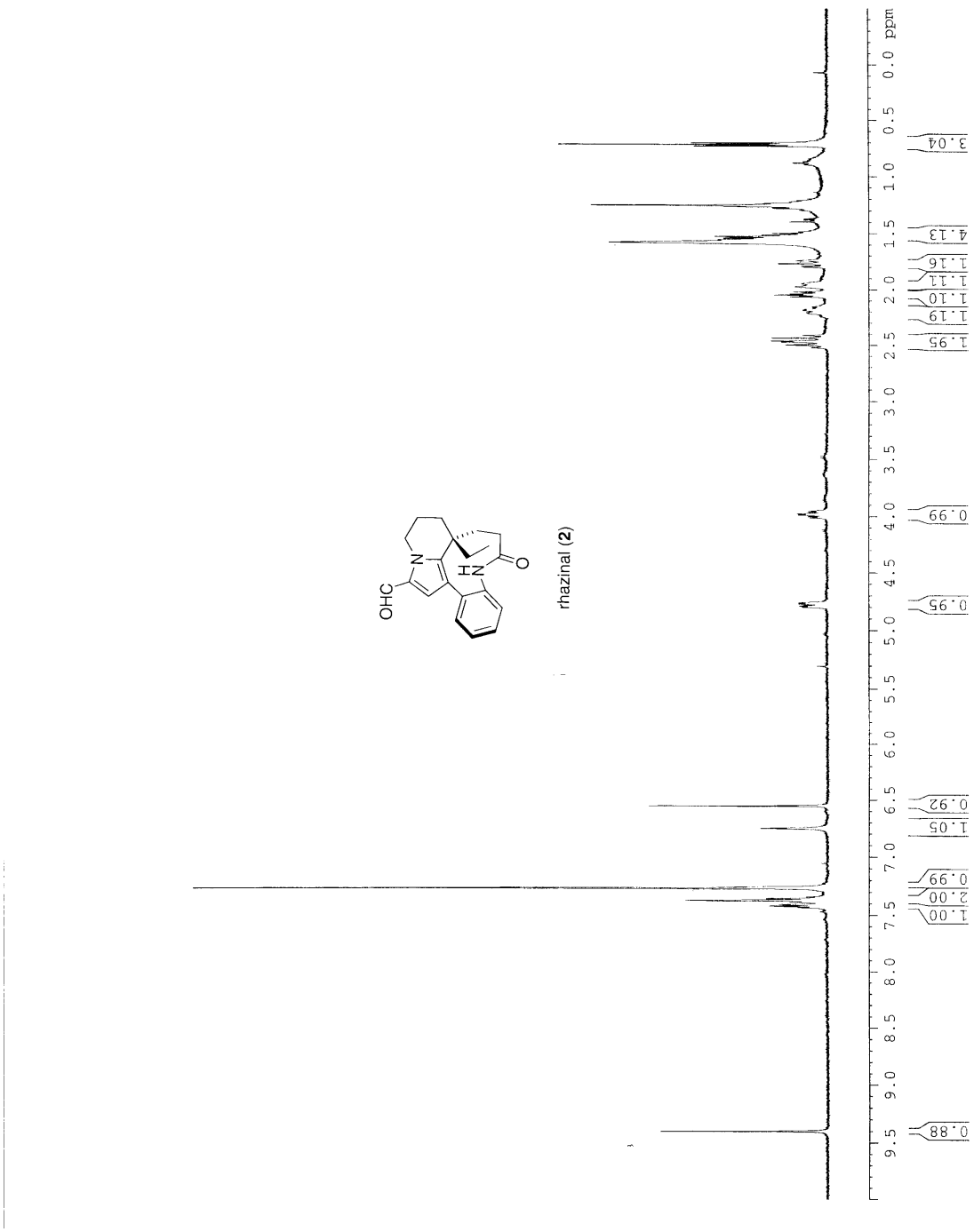

OHC
N
O
MOMN
I

22


190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


OHC
N
R
N
O
R=MOM
26
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 p


OHC
N
R
N
O
R=MOM
26
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


rhazinal (2)
OHC
N
H
N
O
0.88
1.00
2.00
0.99
1.05
0.92
0.95
0.99
1.95
1.19
1.10
1.11
1.16
4.13
3.04
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm

OHC
N
H
N
O
rhazinal (2)
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
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