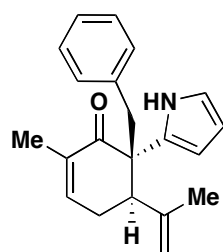


Direct Coupling of Pyrroles with Carbonyl Compounds: Short, Enantioselective Synthesis of (*S*)-Ketorolac

Phil S. Baran*, Jeremy M. Richter and David W. Lin

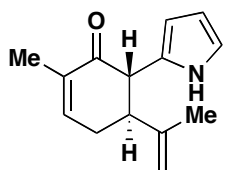
SUPPORTING INFORMATION

General Procedures. All reactions were carried out under a nitrogen atmosphere with dry solvents under anhydrous conditions, unless otherwise noted. Dry tetrahydrofuran (THF), triethylamine, benzene, and dimethoxyethane were obtained by passing commercially available pre-dried, oxygen-free formulations through activated alumina columns. Yields refer to chromatographically and spectroscopically (^1H NMR) homogeneous materials, unless otherwise stated. Reagents were purchased at the highest commercial quality and used without further purification, unless otherwise stated. Reactions were monitored by thin-layer chromatography (TLC) carried out on 0.25 mm E. Merck silica gel plates (60F-254) using UV light as visualizing agent and either an ethanolic solution of phosphomolybdic acid or *p*-anisaldehyde in ethanol/aqueous $\text{H}_2\text{SO}_4/\text{CH}_3\text{CO}_2\text{H}$ and heat as developing agents. NMR spectra were recorded on either Bruker DRX 500 or AMX 400 or Varian Inova-400 instruments, and calibrated using residual undeuterated solvent as an internal reference. The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, quin = quintuplet, sext = sextet, sep = septet, b = broad. IR spectra were recorded on a Perkin-Elmer Spectrum BX spectrometer. High resolution mass spectra (HRMS) were recorded on an Agilent Mass spectrometer using ESI-TOF (electrospray ionization-time of flight). Melting points (m.p.) are uncorrected and were recorded on a Fisher-Johns 12-144 melting point apparatus. Optical rotations were obtained on a Perkin-Elmer 431 Polarimeter.



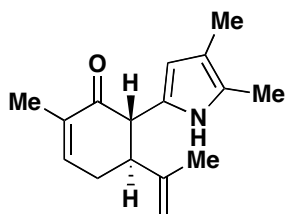
Pyrrole 2: Yield = 54% bsm; yellow oil; $R_f = 0.55$ (silica gel, 3:1 hexane:EtOAc); $[\alpha]_D = -88$ (CH_2Cl_2 , $c = 10.6$); IR (film) ν_{max} 3378, 3029, 2919, 1654, 1602, 1553, 1494, 1452, 1378, 1354, 1286, 1187, 1097, 1034, 896, 806, 790, 702 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 8.02 (bs, 1 H, D_2O exchangeable), 7.05 – 7.10 (m, 3 H), 6.72 (s,

1 H), 6.50 (s, 1 H), 6.48 (s, 1 H), 6.40 (d, $J = 5.6$ Hz, 1 H), 6.06 – 6.08 (m, 1 H), 5.84 (m, 1 H), 5.03 (s, 1 H), 4.67 (s, 1 H), 3.43 (d, $J = 13.6$ Hz, 1 H), 3.12 (d, $J = 13.6$ Hz, 1 H), 2.93-2.97 (m, 1 H), 2.77 (d, $J = 3.0$ Hz), 2.22 (dd, $J = 19.2, 5.6$ Hz, 1 H), 1.82 (s, 3 H), 1.73 (s, 3 H); ^{13}C NMR (100MHz, CDCl_3) δ 200.8, 145.0, 142.4, 137.7, 134.9, 130.9, 128.1, 127.4, 126.2, 117.9, 115.1, 108.3, 108.1, 53.3, 45.6, 40.4, 29.6, 24.0, 16.8. HRMS (ESI-TOF) calcd. for $\text{C}_{21}\text{H}_{23}\text{NO}$ [$\text{M} + \text{H}^+$] 306.1852, found 306.1855.



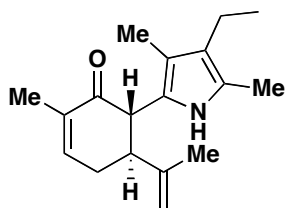
Pyrrole 3: Yield = 53%; colorless cubes; m.p. = 121-122 °C; $R_f = 0.34$ (silica gel, 3:1 hexane:EtOAc); $[\alpha]_D = -49$ (CH_2Cl_2 , $c = 1.79$); IR (film) ν_{max} 3366, 3337, 2915, 1667, 1567, 1436, 1373, 1240, 1202, 1101, 1073, 1029, 903, 886, 777, 718 cm^{-1} ; ^1H NMR

(500 MHz, CDCl_3) δ 8.58 (bs, 1 H, D_2O exchangeable), 6.74 (s, 1 H), 6.72 (s, 1 H), 6.14 (s, 1 H), 6.05 (s, 1 H), 4.82 (s, 1 H), 4.79 (s, 1 H), 3.73 (d, $J = 7.5$ Hz, 1 H), 3.14 (dd, $J = 7.0, 11.5$ Hz, 1 H), 2.60 – 2.63 (m, 1 H), 2.50 – 2.54 (m, 1 H), 1.81 (s, 3 H), 1.71 (s, 3 H); ^{13}C NMR (125 MHz, CDCl_3) δ 198.6, 145.8, 143.8, 124.7, 127.0, 117.4, 112.6, 107.6, 106.1, 49.4, 46.2, 30.1, 19.9, 15.9; HRMS (ESI-TOF) calcd. for $\text{C}_{14}\text{H}_{17}\text{NO}$ [$\text{M} + \text{H}^+$] 216.1383, found 216.1384.

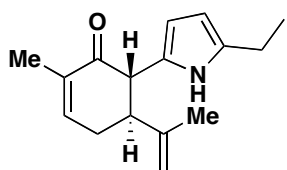


Pyrrole 4: Yield = 67% bsm; brown oil; $R_f = 0.53$ (silica gel, 3:1 hexane:EtOAc); $[\alpha]_D = -85$ (CH_2Cl_2 , $c = 0.2$); IR (film) ν_{max} 3369, 2920, 1662, 1449, 1364, 1228, 1157, 1070, 892, 778, 730 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.90 (bs, 1 H, D_2O

exchangeable), 6.67 – 6.70 (m, 1 H), 5.81 (d, $J = 2.8$ Hz, 1 H), 4.83 (s, 1 H), 4.76 (s, 1 H), 3.64 (d, $J = 7.2$ Hz, 1 H), 3.08 (q, $J = 6.4, 12.8$ Hz, 1 H), 2.67 – 2.73 (m, 1 H), 2.45 – 2.51 (m, 1 H), 2.12 (s, 3 H), 1.97 (s, 3 H), 1.79 (s, 3 H), 1.73 (s, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 199.0, 146.5, 144.2, 135.0, 124.5, 123.9, 114.1, 112.8, 108.1, 49.5, 45.6, 29.9, 21.0, 16.5, 11.3 (2 C); HRMS (ESI-TOF) calcd. for $\text{C}_{16}\text{H}_{21}\text{NO}$ [$\text{M} + \text{H}^+$] 244.1696, found 244.1689.

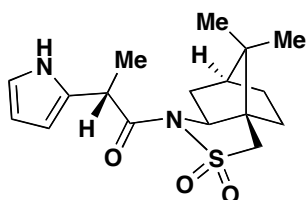


Pyrrole 5: Yield = 54%; green oil; $R_f = 0.50$ (silica gel, 1:1 hexane:EtOAc); $[\alpha]_D = -170$ (CH_2Cl_2 , $c = 0.1$); IR (film) ν_{max} 2927, 1707, 1670, 1438, 1185, 1120, 900, 837, 770, 721 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.13 (bs, 1 H, D_2O exchangeable), 6.75-6.77 (m, 1 H), 4.71-4.73 (m, 2 H), 3.65 (d, $J = 14.5$ Hz, 1 H), 2.88 – 2.94 (m, 1 H), 2.53 – 2.56 (m, 1 H), 2.40 – 2.46 (m, 1 H), 2.34 (dd, $J = 9.5, 19.0$ Hz, 2 H), 2.10 (s, 3 H), 1.88 (s, 3 H), 1.55 (s, 3 H), 1.03 (t, $J = 9.5$ Hz, 3 H); ^{13}C NMR (125 MHz, CDCl_3) δ 199.3, 146.2, 143.7, 135.8, 121.7, 120.7, 120.3, 115.7, 112.3, 49.9, 48.8, 31.6, 20.0, 18.0, 16.4, 15.8, 11.3, 9.7; HRMS (ESI-TOF) calcd. for $\text{C}_{18}\text{H}_{25}\text{NO}$ $[\text{M} + \text{H}^+]$ 272.2009, found 272.2011.



Pyrrole 6: Yield = 42% bsm; brown solid; m.p. = 114-115 $^\circ\text{C}$; $R_f = 0.52$ (silica gel, 3:1 hexane:EtOAc); $[\alpha]_D = -81$ (CH_2Cl_2 , $c = 1.5$); IR (film) ν_{max} 3358, 2968, 2922, 1660, 1588, 1450, 1374, 1230, 1074, 1036, 891, 762 cm^{-1} ; ^1H NMR (400

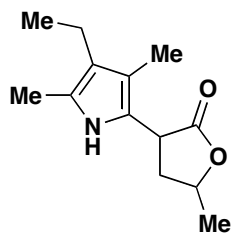
MHz, CDCl_3) δ 8.12 (bs, 1 H, D_2O exchangeable), 6.70 (s, 1 H), 5.94 – 5.95 (m, 1 H), 5.79 – 5.80 (m, 1 H), 4.82 (s, 1 H), 4.76 (s, 1 H), 3.68 (d, $J = 6.4$ Hz, 1 H), 3.11 (dd, $J = 5.6, 10.4$ Hz, 1 H), 2.64 – 2.70 (m, 1 H), 2.58 (dd, $J = 6.0, 12.0$ Hz, 2 H), 2.46 – 2.52 (m, 1 H), 1.79 (s, 3 H), 1.72 (s, 3 H), 1.22 (t, $J = 6.0$ Hz, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 198.9, 146.3, 144.1, 134.9, 134.4, 125.6, 112.7, 106.1, 104.0, 49.4, 45.6, 29.9, 21.0, 20.6, 16.3, 13.6; HRMS (ESI-TOF) calcd. for $\text{C}_{16}\text{H}_{21}\text{NO}$ $[\text{M} + \text{H}^+]$ 244.1696, found 244.1699.



Pyrrole 7: Yield = 42%; colorless cubes; m.p = 131-133 $^\circ\text{C}$; $R_f = 0.27$ (silica gel, 3:1 hexane:EtOAc); $[\alpha]_D = -160$ (CH_2Cl_2 , $c = 0.3$); IR (film) ν_{max} 3412, 2960, 1696, 1561, 1458, 1412, 1376, 1328, 1268, 1236, 1212, 1165, 1133, 1056,

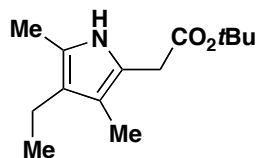
1028, 972, 774, 721 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 8.88 (bs, 1 H, D_2O exchangeable), 6.65 – 6.67 (m, 1 H), 6.10 – 6.11 (m, 2 H), 4.37 (dd, $J = 6.8, 13.6$ Hz, 1 H), 3.88 – 3.91 (m, 1 H), 3.56 (d, $J = 14.0$ Hz, 1 H), 3.52 (d, $J = 14.0$ Hz, 1 H), 1.77 – 1.97 (m, 6 H), 1.58 (s, 1 H), 1.54 (d, $J = 7.2$ Hz, 3 H), 1.32 – 1.41

(m, 3 H), 1.16 – 1.17 (m, 1 H), 0.95 (s, 3 H), 0.94 (s, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 172.7, 129.5, 117.7, 108.7, 106.1, 65.6, 53.6, 48.8, 48.0, 44.7, 39.5, 38.3, 33.0, 26.8, 20.8, 20.2, 16.3; HRMS (ESI-TOF) calcd. for $\text{C}_{17}\text{H}_{24}\text{N}_2\text{O}_3\text{S}$ $[\text{M} + \text{H}^+]$ 337.158, found 337.158.



Pyrrole 8: Yield = 57%; brown solid; m.p. = 85-87 °C; R_f = 0.29 (silica gel, 1:1 hexane:EtOAc); Mixture of two diastereomers, major presented; IR (film) ν_{max} 3376, 2960, 2926, 2866, 1763, 1589, 1452, 1387, 1343, 1263, 1185, 1107, 1047, 948, 809, 772, 726 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 8.36 (bs, 1 H, D_2O exchangeable), 4.59

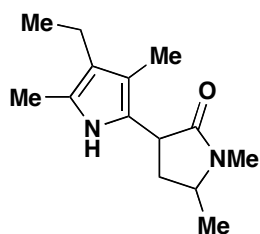
– 4.64 (m, 1 H), 3.97 – 4.02 (m, 1 H), 2.85 – 2.90 (m, 1 H), 2.35 (dd, J = 2.0, 8.0 Hz, 2 H), 2.16 (s, 3 H), 1.92-1.99 (m, 4 H), 1.46 (t, J = 4.8 Hz, 3 H), 1.06 (t, J = 6 Hz, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 177.5, 122.3, 121.2, 118.6, 115.2, 75.8, 39.8, 38.8, 21.2, 18.0, 15.9, 11.2, 9.7; HRMS (ESI-TOF) calcd. for $\text{C}_{13}\text{H}_{19}\text{NO}_2$ $[\text{M} + \text{H}^+]$ 222.1488, found 222.1487.



Pyrrole 9: A modified procedure as follows was required for the ester couplings: *tert*-butylacetate (79.8 μL , 0.625 mmol) and 2,4-dimethyl-3-ethylpyrrole (16.9 μL , 0.125 mmol) were dissolved in THF (7.5 mL). The solution was cooled to -78 °C

and a solution of LDA (0.50 M, 1.58 mL) was added. The reaction was allowed to stir for 30 minutes, after which time it was warmed to 0 °C. The septum was removed and copper(II)-2-ethylhexanoate (91.9 mg, 0.262 mmol) was rapidly added as a solid and then the septum was replaced. The reaction was stirred until the blue color dissipated (approximately 2 min.), then it was quenched by pouring into 5% aqueous NH_4OH (15 mL). The aqueous layer was partitioned with EtOAc (20 mL). The organic layer was separated and washed successively with water (15 mL) then brine (15 mL), dried (MgSO_4), filtered, and the solvent removed *in vacuo*. Flash chromatography (silica gel) of the crude reaction afforded pure coupled product. Yield = 41% bsm (estimated by NMR); *unstable* light brown oil; R_f = 0.67 (silica gel, dichloromethane); IR (film) ν_{max} 3378, 2960, 2927, 1719, 1603, 1456, 1392, 1368, 1316, 1220, 1148, 1122,

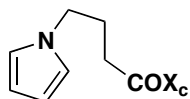
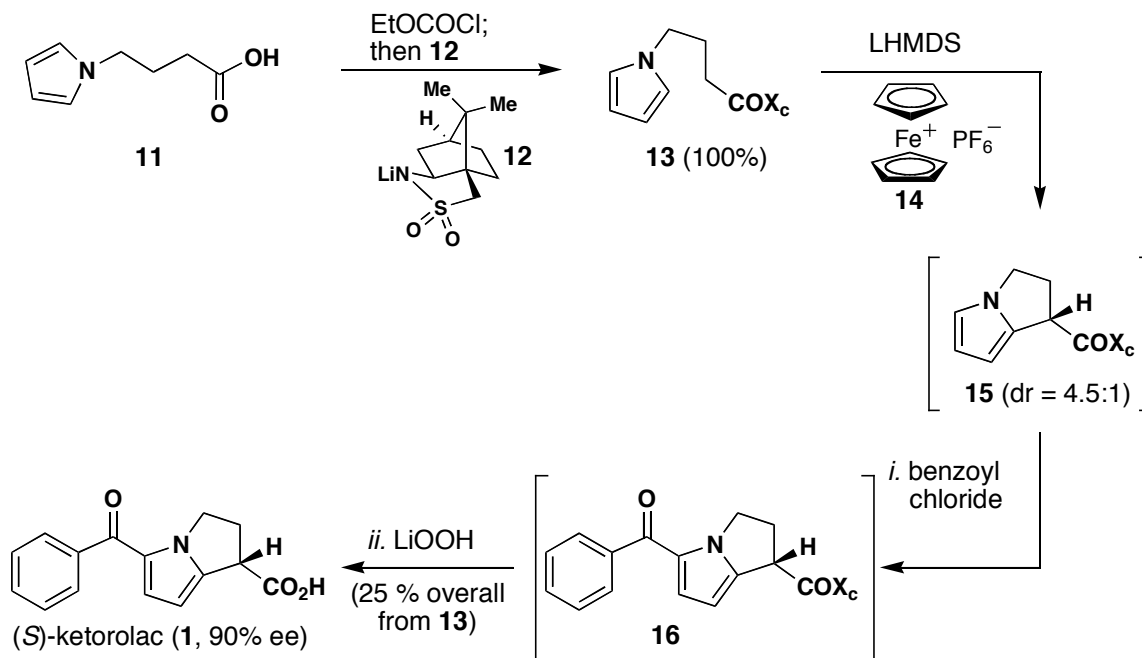
951, 836, 755 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 8.12 (bs, 1 H, D_2O exchangeable), 3.47 (s, 2 H), 2.37 (dd, $J = 7.5, 15$ Hz, 2 H), 2.16 (s, 3 H), 1.94 (s, 3 H), 1.47 (s, 9 H), 1.06 (t, $J = 7.5$ Hz, 3 H); ^{13}C NMR (125 MHz, CDCl_3) δ 171.2, 122.0, 120.5, 117.3, 114.5, 81.2, 32.4, 28.3, 17.8, 15.9, 11.1, 9.1. HRMS (ESI-TOF) calcd. for $\text{C}_{10}\text{H}_{17}\text{NO}_2$ [$\text{M} + \text{H}^+ - t\text{Bu}$] 182.1181, found 182.1179.



Pyrrole 10: Yield = 42%; *unstable* red oil; $R_f = 0.21$ (silica gel, 1:1 hexane:EtOAc); Mixture of two diastereomers, major presented; IR (film) ν_{max} 3301, 2960, 2922, 1671, 1606, 1547, 1530, 1433, 1400, 1378, 1251, 1087, 956, 728 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 8.58 (bs, 1 H, D_2O exchangeable), 3.85 (t, $J = 9.6$ Hz,

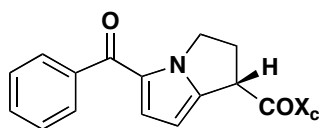
1 H), 3.63 (m, 1 H), 2.86 (s, 1 H), 2.36 (dd, $J = 7.6, 15.2$ Hz, 2 H), 2.26 – 2.32 (m, 2 H), 2.14 (s, 3 H), 1.96 (s, 3 H), 1.26 (d, $J = 6.4$ Hz, 3 H), 1.05 (t, $J = 7.6$ Hz, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 174.5, 122.0, 121.5, 121.1, 114.1, 54.3, 37.9, 34.8, 28.0, 19.0, 17.8, 16.0, 11.2, 9.8. HRMS (ESI-TOF) calcd. for $\text{C}_{14}\text{H}_{23}\text{N}_2\text{O}$ [$\text{M} + \text{H}^+$] 235.1805, found 235.1808.

Scheme S1: Synthetic pathway to ketorolac.



Pyrrole Sultam 13: Compound **11** (460 mg, 3.00 mmol) was dissolved in benzene (3

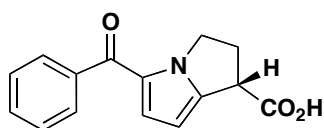
mL) and the solvent removed *in vacuo*. The compound was then dissolved in anhydrous THF (15 mL, 0.2 M) and cooled to 0 °C. Triethylamine (433 μ L, 3.25 mmol) was then added, followed by methyl chloroformate (232 mL, 3.00 mmol), and stirring was continued for 60 minutes. In a separate flask, (*S*)-2,10-camphorsultam (538 mg, 2.50 mmol) was dried *in vacuo* for 30 minutes, was dissolved in THF (12.5 mL, 0.2 M) and cooled to -78 °C. A 2.50 M solution of butyl lithium (1.05 mL, 2.63 mmol) was then added and the solution stirred for 20 minutes. The anhydride solution was then filtered through a medium porosity glass frit under a blanket of nitrogen to remove the triethylamine hydrochloride salt. The filtrate was then cannulated into a solution of the lithiate (**12**) at -78 °C. The reaction was allowed to immediately warm to room temperature, and was quenched in 20% potassium carbonate solution (20 mL), and partitioned with EtOAc (30 mL). The organic layer was washed with water (20 mL) then brine (20 mL) and dried over MgSO₄. Removal of the solvent *in vacuo* gave pure pyrrole sultam **13**, 876 mg (100%) as a light brown oil; $R_f = 0.316$ (silica gel, 3:1 hexane:EtOAc); $[\alpha]_D = -49$ (CH₂Cl₂, $c = 10.6$); IR (film) ν_{\max} 2958, 1813, 1734, 1693, 1500, 1456, 1412, 1390, 1327, 1279, 1237, 1215, 1167, 1118, 1089, 1052, 1035, 987, 948, 866, 813, 772, 727 cm⁻¹; ¹H NMR (400 MHz, CDCl₃) δ 6.65 (t, $J = 2$ Hz, 2 H), 6.13 (t, $J = 2.4$ Hz, 2 H), 3.90 – 3.99 (m, 2 H), 3.84 – 3.87 (m, 1 H), ; ¹³C NMR (100 MHz, CDCl₃) δ 170.8, 120.5, 108.1, 65.1, 52.8, 48.4, 47.7, 44.6, 38.4, 32.8, 32.3, 26.4, 26.3, 20.8, 19.8; LRMS (ESI) $[M + H]^+$ 351, $[M + Na]^+$ 373.



Annulation Product 16: Compound **13** (39.5 mg, 0.113 mmol) was dried *in vacuo* for 30 minutes, dissolved in anhydrous THF (8.0 mL), and cooled to -78

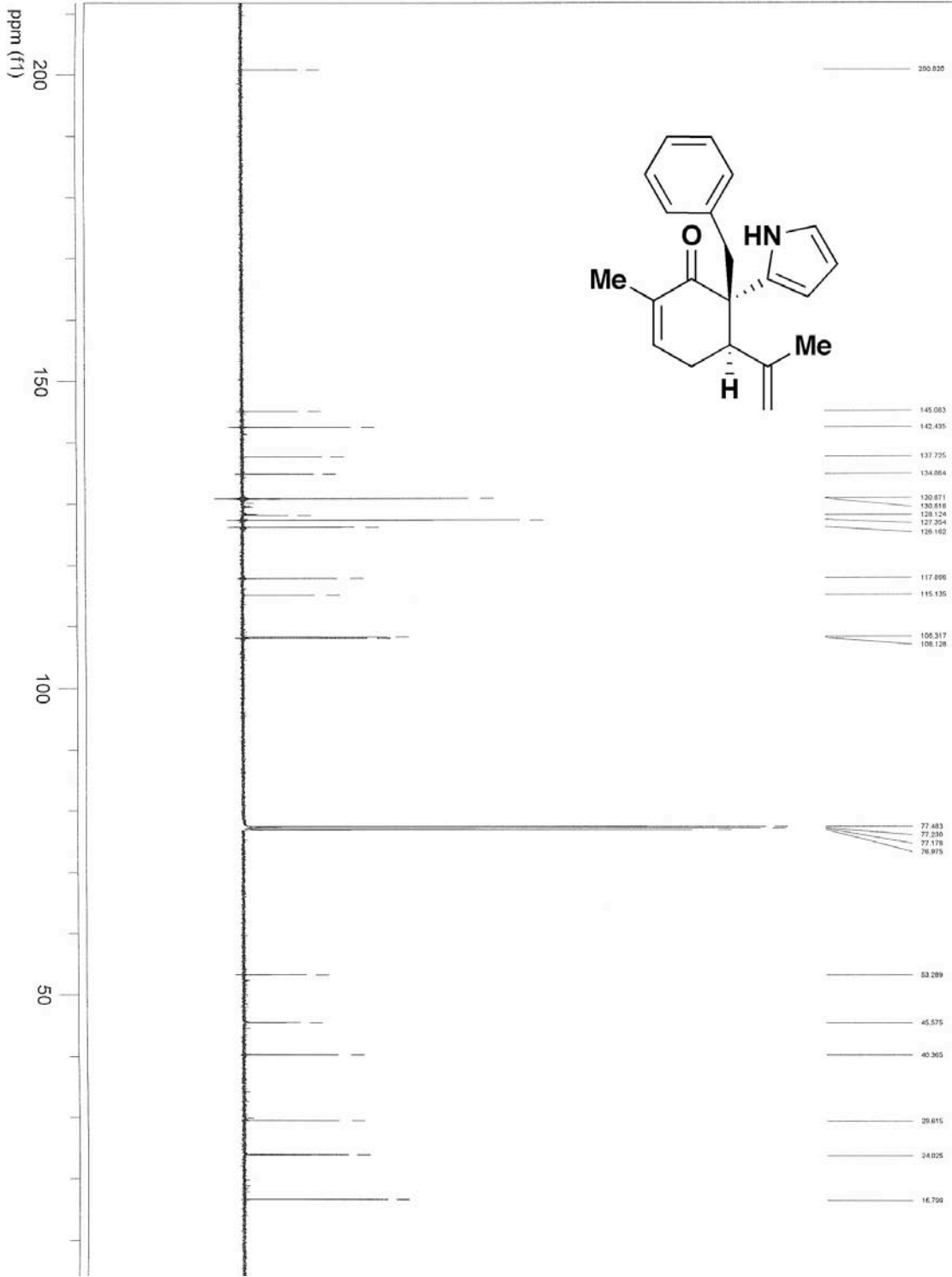
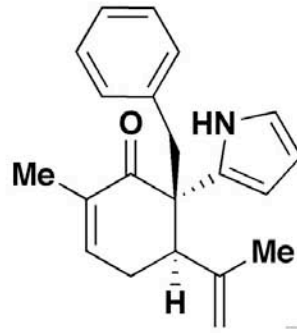
°C. Triethylamine (30 μ L, 0.225 mmol) was added to the reaction mixture, followed by LHMDS solution (1.0 M, 135 μ L). Stirring was continued for 20 minutes, after which time the reaction was warmed to 12 °C. After 15 minutes the septum was removed and solid ferrocenium hexafluorophosphate (28.0 mg, 0.0845 mmol) was added rapidly, after which the septum was replaced. The reaction was vigorously stirred for approximately 5 minutes, until the reaction was yellow and all the ferrocenium salt was

consumed. After this time, the reaction was diluted with 3:1 hexane:EtOAc (15 mL) and filtered through a short plug of silica gel. The solvent was removed *in vacuo* to give 54.8 mg of the crude reaction mixture with 65% bsm yield of product based on NMR (4.5:1 dr). (See attached ¹H NMR spectra of purified **15**). This compounds was quite unstable and was reacted immediately after preparation. Thus, the crude mixture was dissolved in benzoyl chloride (200 μL) and stirred at 70 °C for 4 hours. The reaction was then cooled to ambient temperature, diluted with dichloromethane (10 mL) and washed three times with 2 N NaOH (10 mL), water, then brine (10 mL). The organic layer was dried (MgSO₄) and the solvent removed *in vacuo*. The crude reaction mixture was then subjected to preparative TLC purification (silica gel, dichloromethane), which gave pure annulation product **16** (5.6 mg, 56% yield, 65% yield bsm) and recovered starting material (1.0 mg). At this point, the two diastereomers were also successfully separated (3.9 mg major, 1.7 mg minor). Pyrrole **16** was a stable compound unlike its precursor.

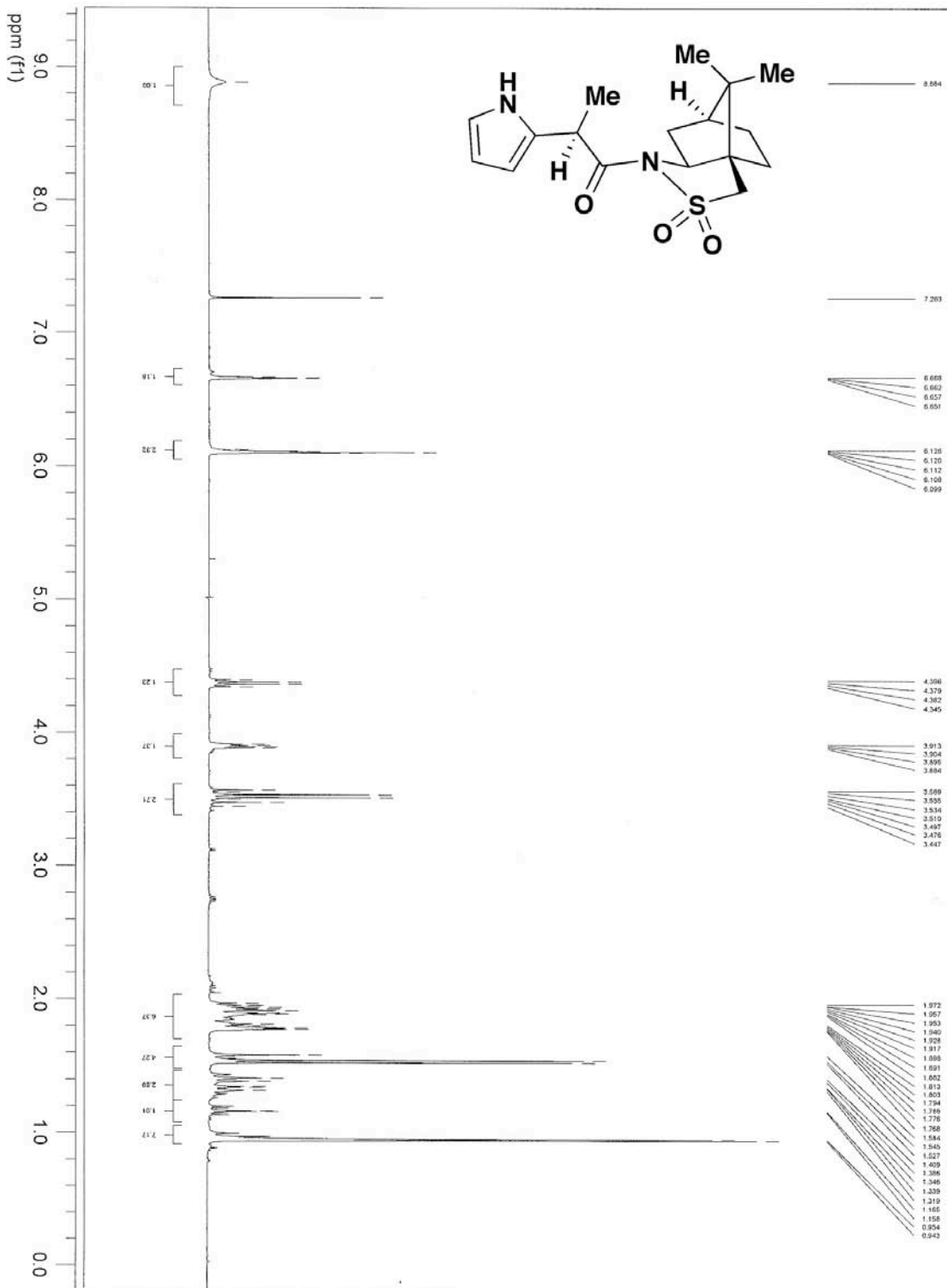
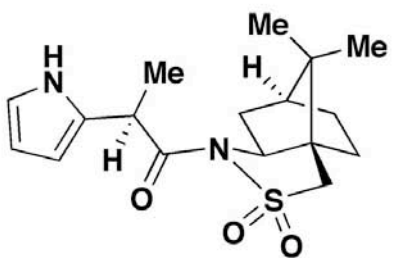


Ketorolac (1): The major diastereomer of **15** (3.9 mg, 0.00860 mmol) was dissolved in dimethoxyethane (35 μL) and cooled to -10 °C. Isobutylene (2.7 μL, 0.0258 mmol) was then added to the reaction mixture, followed by 30% hydrogen peroxide solution (1.9 μL, 0.0172 mmol) then 40% tetrabutylammoniumhydroxide solution (11.2 μL, 0.0172 mmol). Stirring was continued at -10 °C for 3 hours then quenched with four drops of 1.5 M Na₂SO₃, followed by stirring for 1 hour. The reaction was then acidified with 1 M HCl (5 mL) and extracted three times with EtOAc (5 mL). The organic layers were combined, dried with MgSO₄, and the solvent removed *in vacuo*. Ketorolac was isolated by preparative TLC (silica gel, EtOAc) to give material (1.2 mg, 58%) that was spectroscopically identical with an authentic sample. The *ee* (90%) was determined by HPLC analysis (chiralpak AD, hexane:isopropanol:trifluoroacetic acid = 90:10:0.1 v/v%, 310 nm, 0.8 mL/min); retention times of enantiomers: 12.6 min (*R* isomer) and 13.9 min (*S* isomer). ¹H NMR (400 MHz, CDCl₃) δ 7.79 (d, *J* = 7.2 Hz, 2 H), 7.51 (t, *J* = 7.2 Hz, 1 H), 7.43 (t, *J* = 7.6 Hz, 2 H), 6.81 (d, *J* = 4 Hz, 1 H), 6.13 (d, *J* = 4 Hz, 1 H), 4.53-4.58 (m, 1 H), 4.43-4.48 (m, 1 H), 4.08-4.12 (m, 1 H), 2.79-2.92 (m, 2 H).

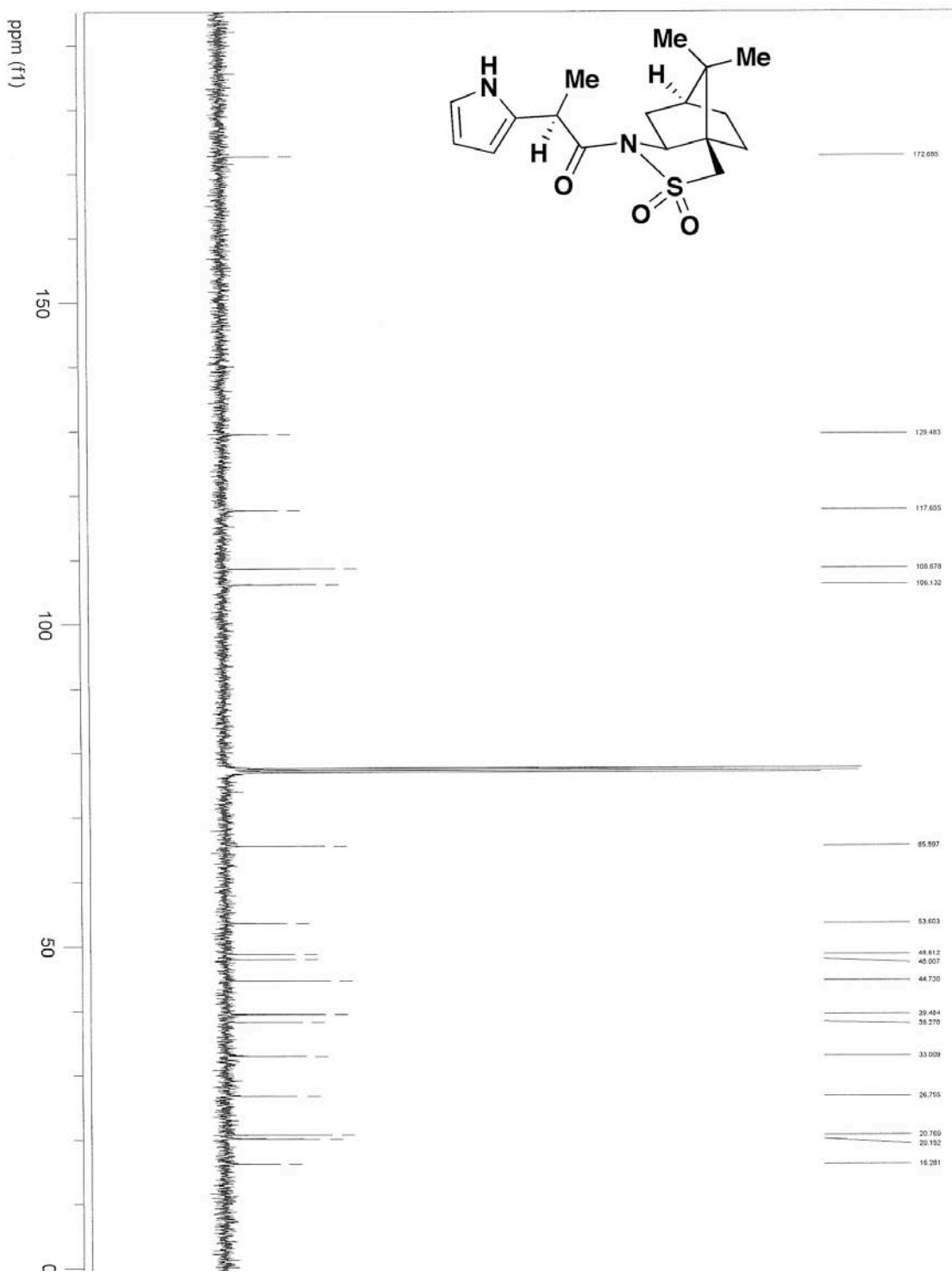
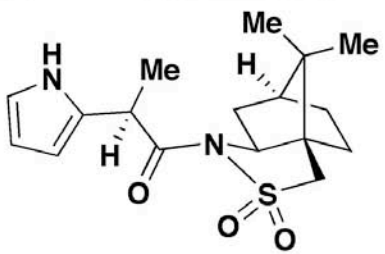
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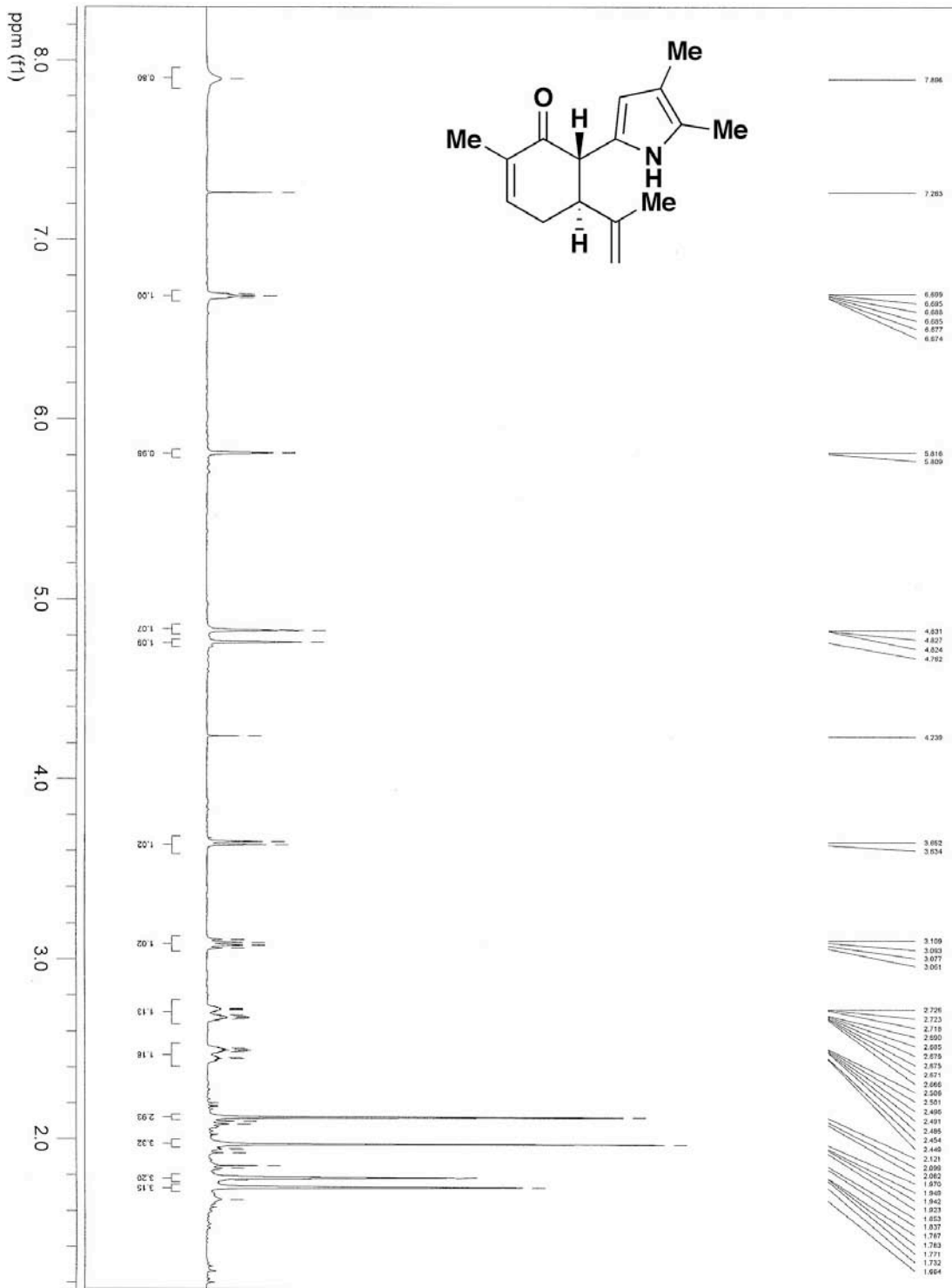
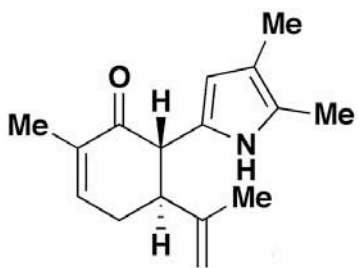
Сдвинутий у вигляді, 400МН 12



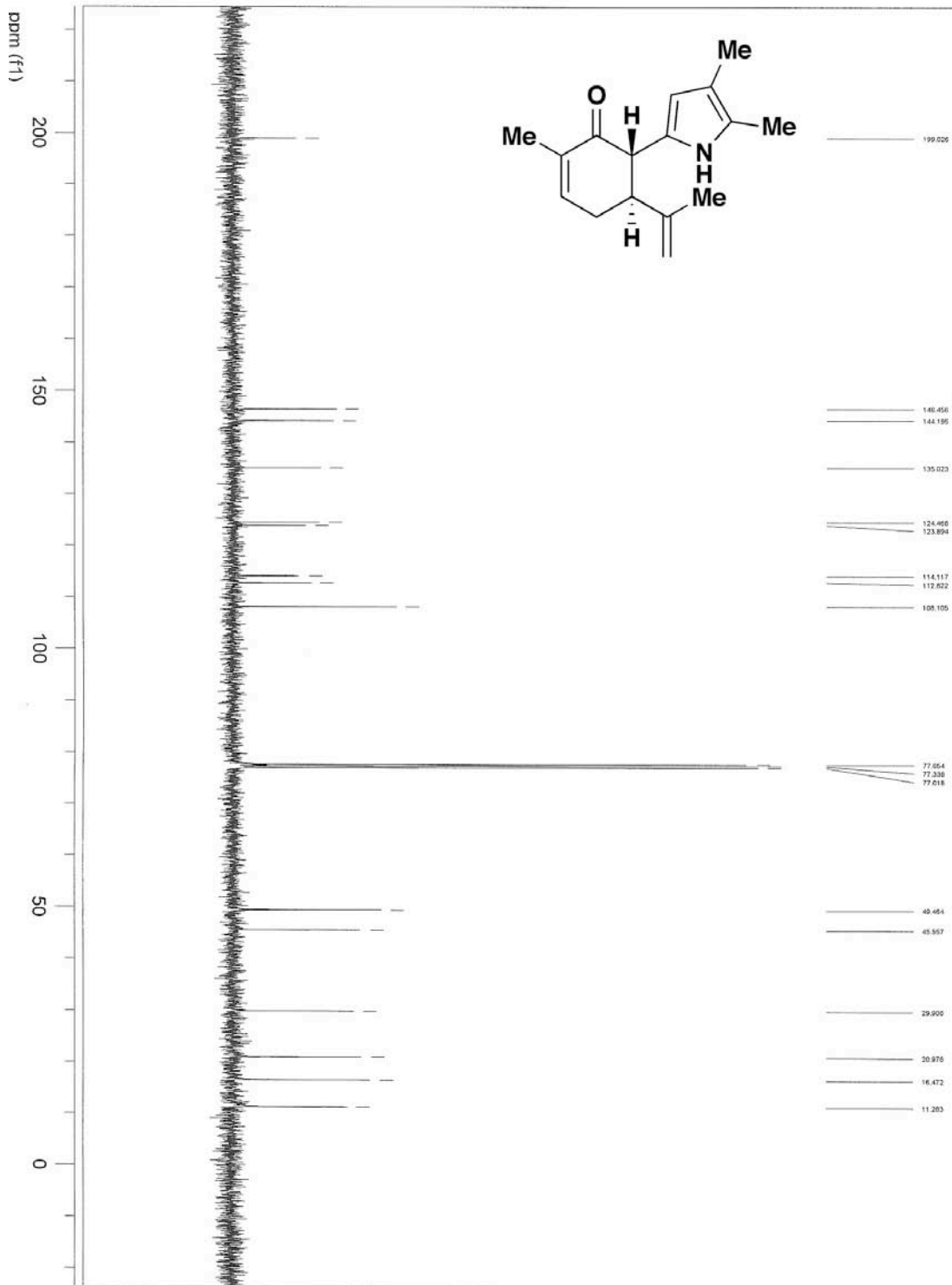
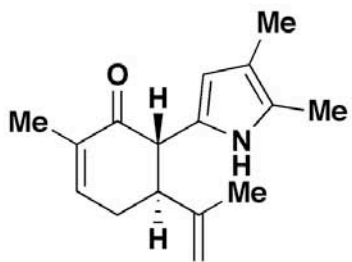
CamphorPyrrole-XRay: 400MHz



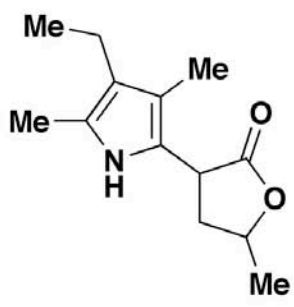
Dimethylpyrrolicarvone: 400MHz



Dimethylpyrrolicarvone: 400MHz



1H NMR spectrum of 2-methyl-5-(2-methyl-1H-imidazol-4-yl)oxazolidin-3-one



8.362
8.085

4.607
4.798
4.784
4.755
4.642
4.622
4.620
4.609
4.599
4.556
4.043
4.023
4.017
4.000
3.991
3.974

2.900
2.880
2.860
2.875
2.885
2.858
2.840
2.826
2.810
2.506
2.430
2.421
2.419
2.410
2.395
2.375
2.370
2.365
2.355
2.345
2.340
2.155
2.145
1.988
1.968
1.941
1.938
1.918
1.924
1.477
1.485
1.488
1.075
1.090
1.040

9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0

0.86
0.28

0.34
1.00

1.33

1.01

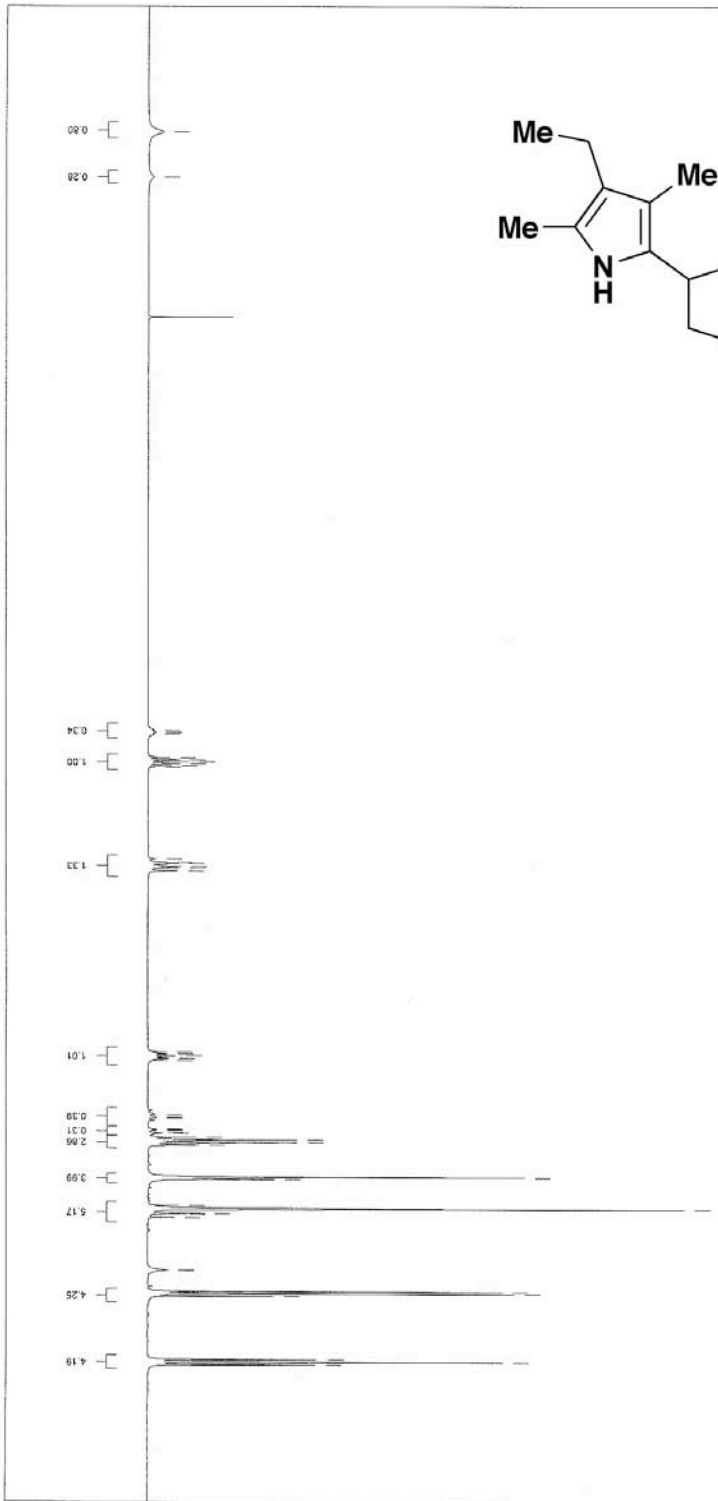
0.39
0.31
2.86

3.09

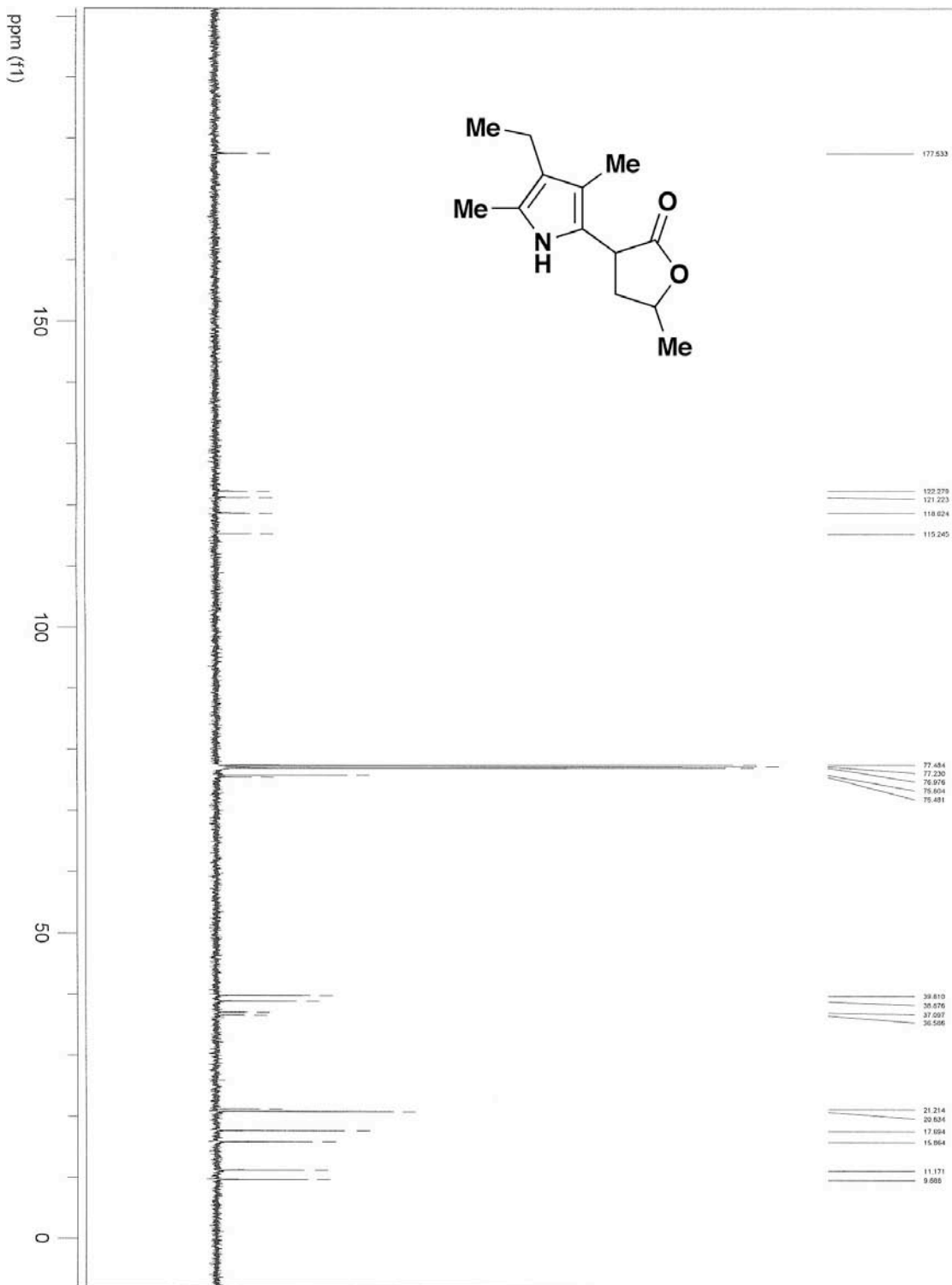
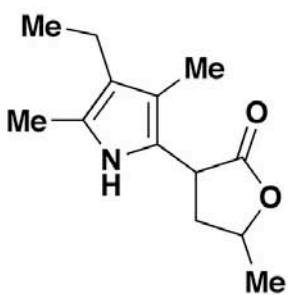
5.17

4.25

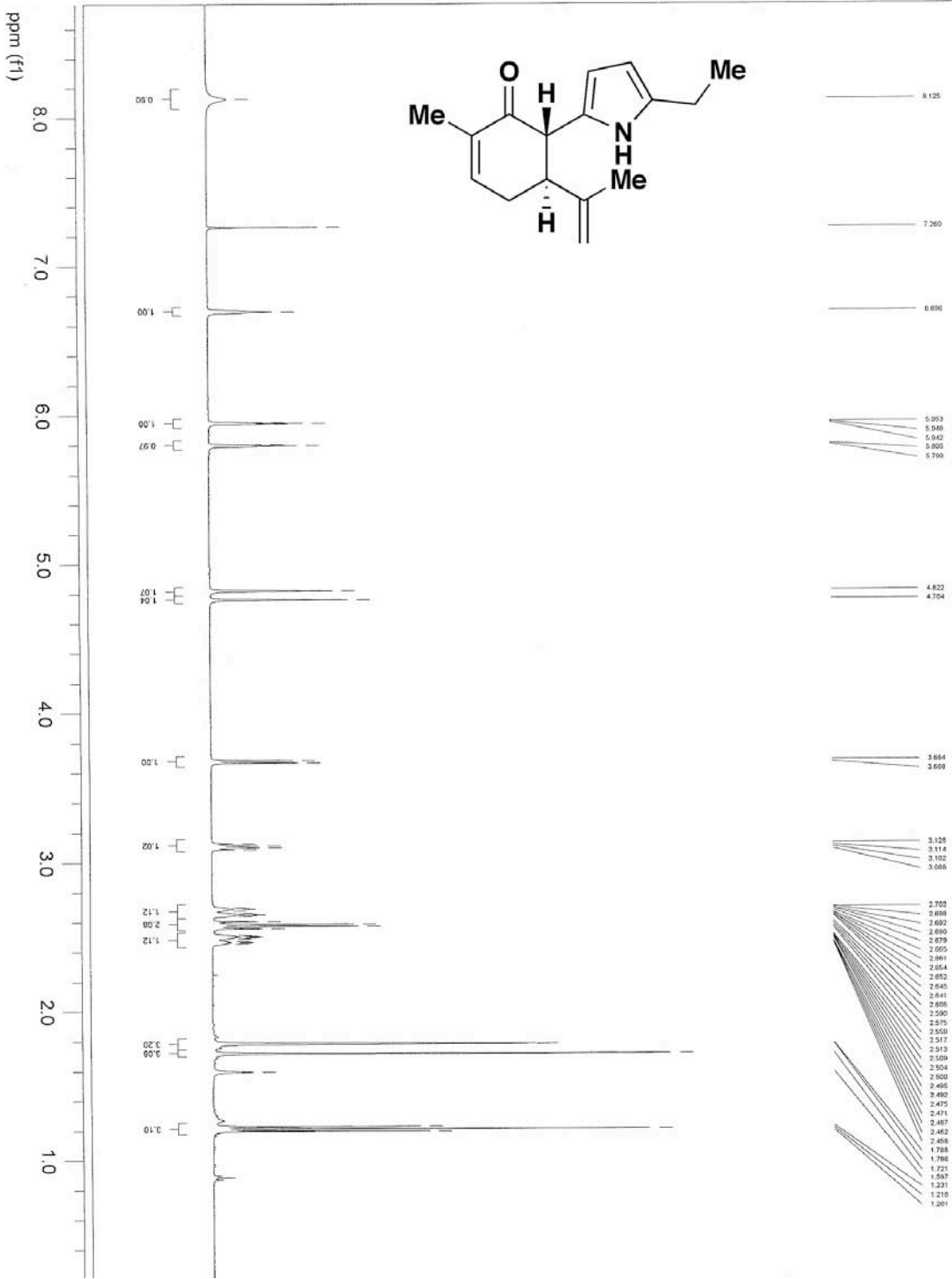
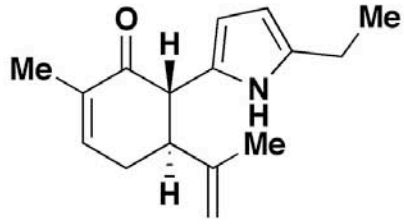
4.19



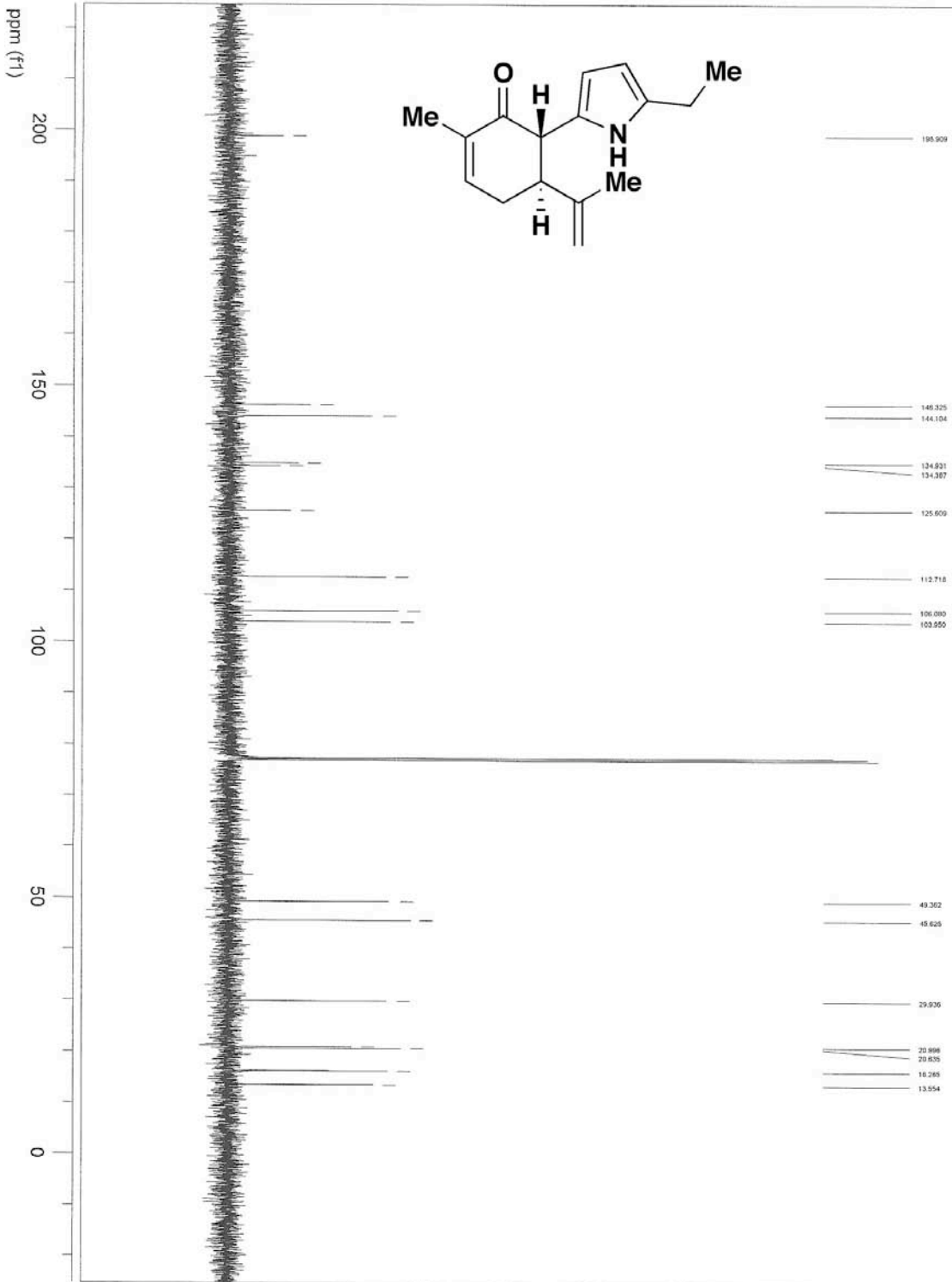
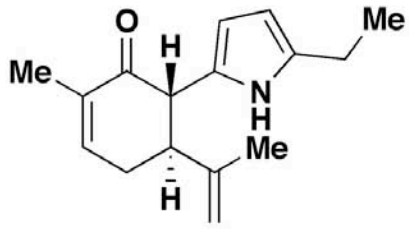
13C NMR spectrum of compound 12



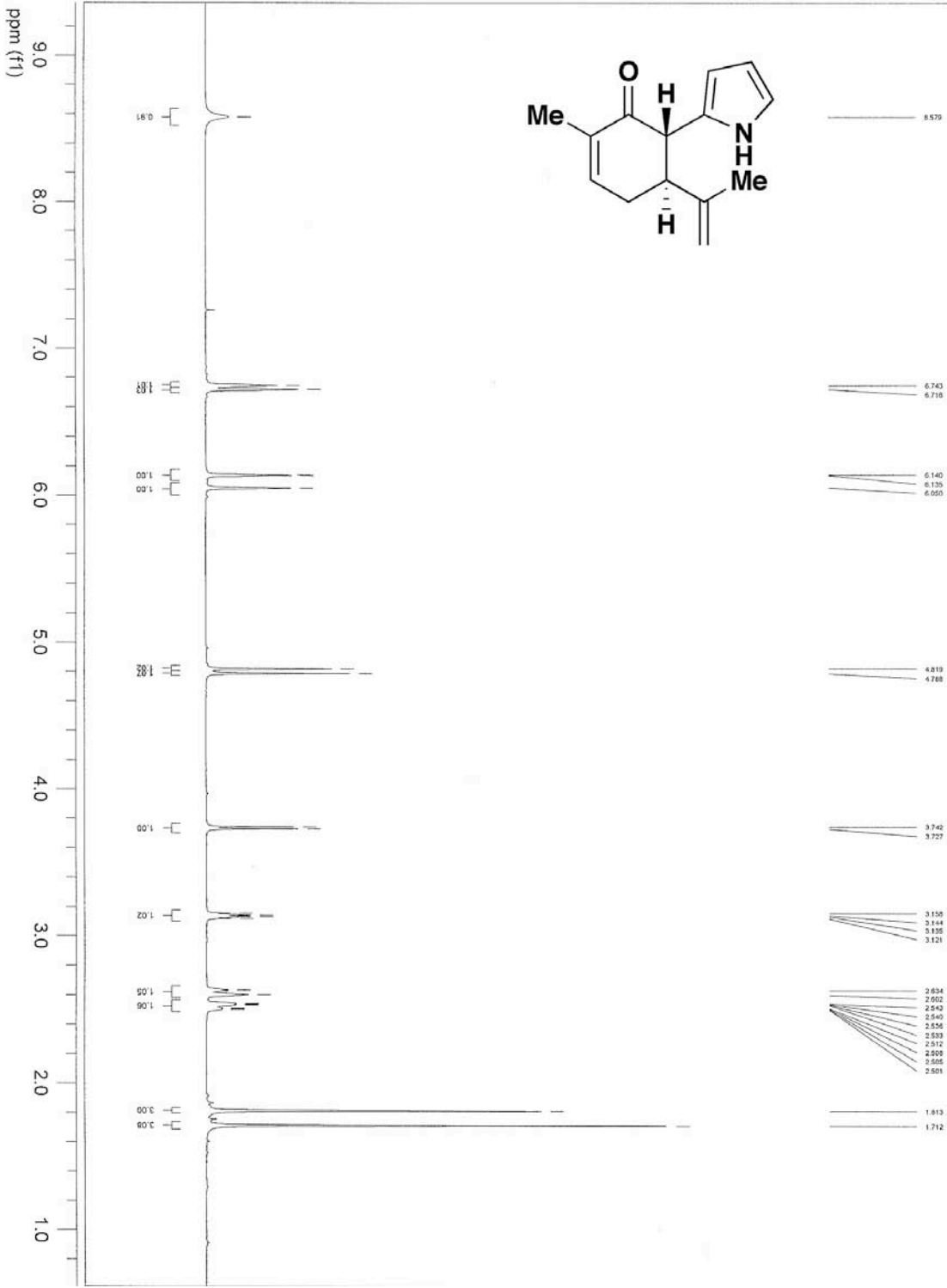
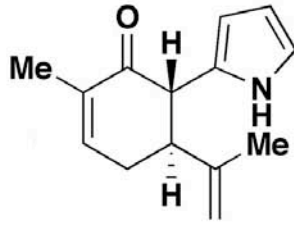
Ethylpyrrolecarvone: 4UUMHZ



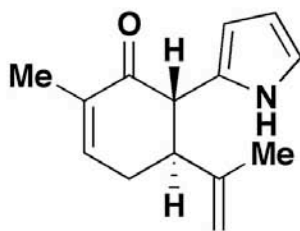
Lutyrinone (1), 400 MHz, CDCl₃



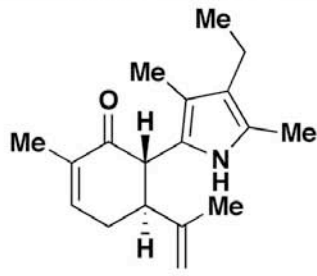
1H NMR Spectrum



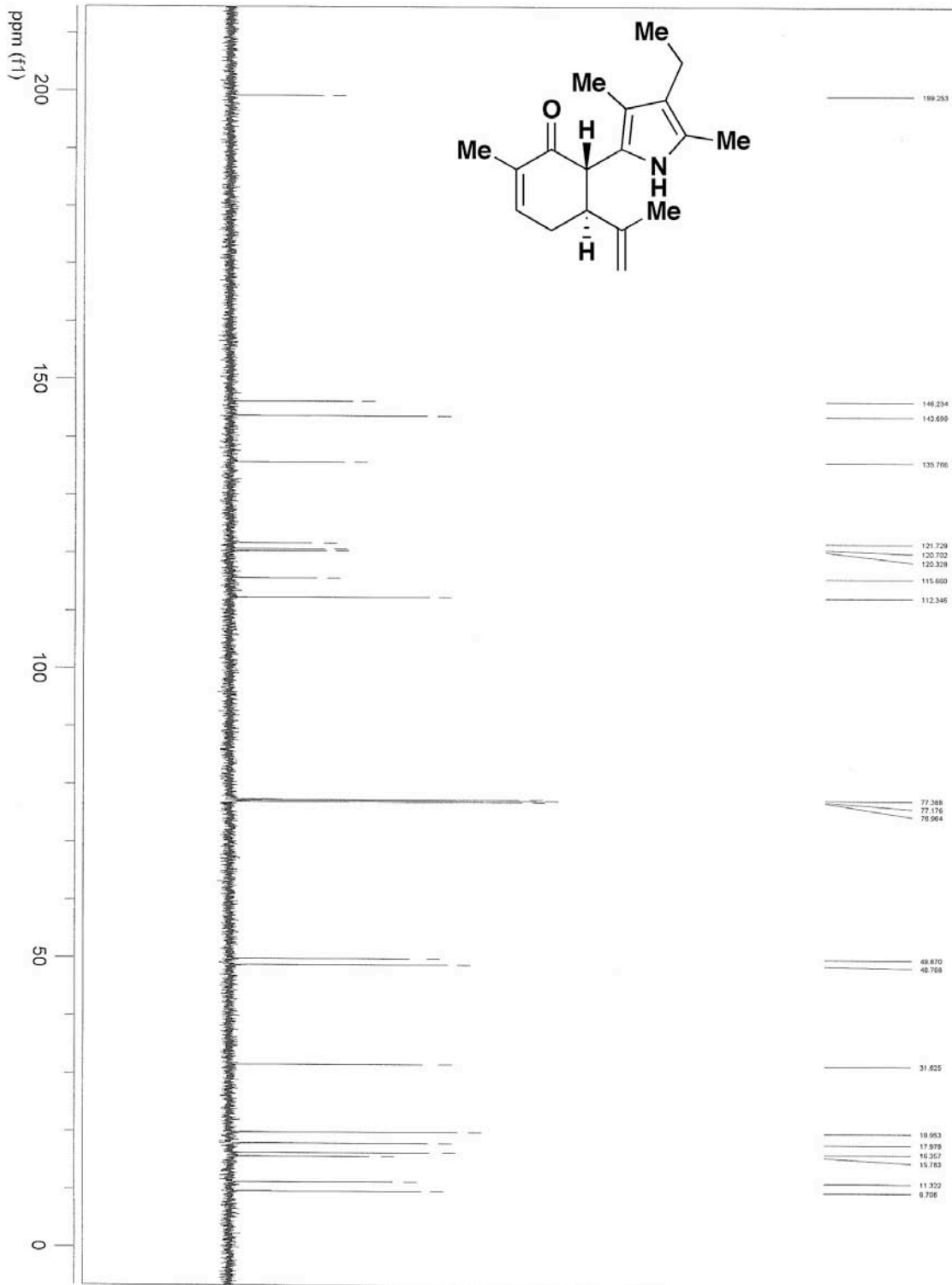
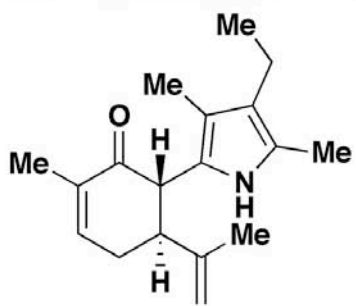
13C NMR (CDCl3)

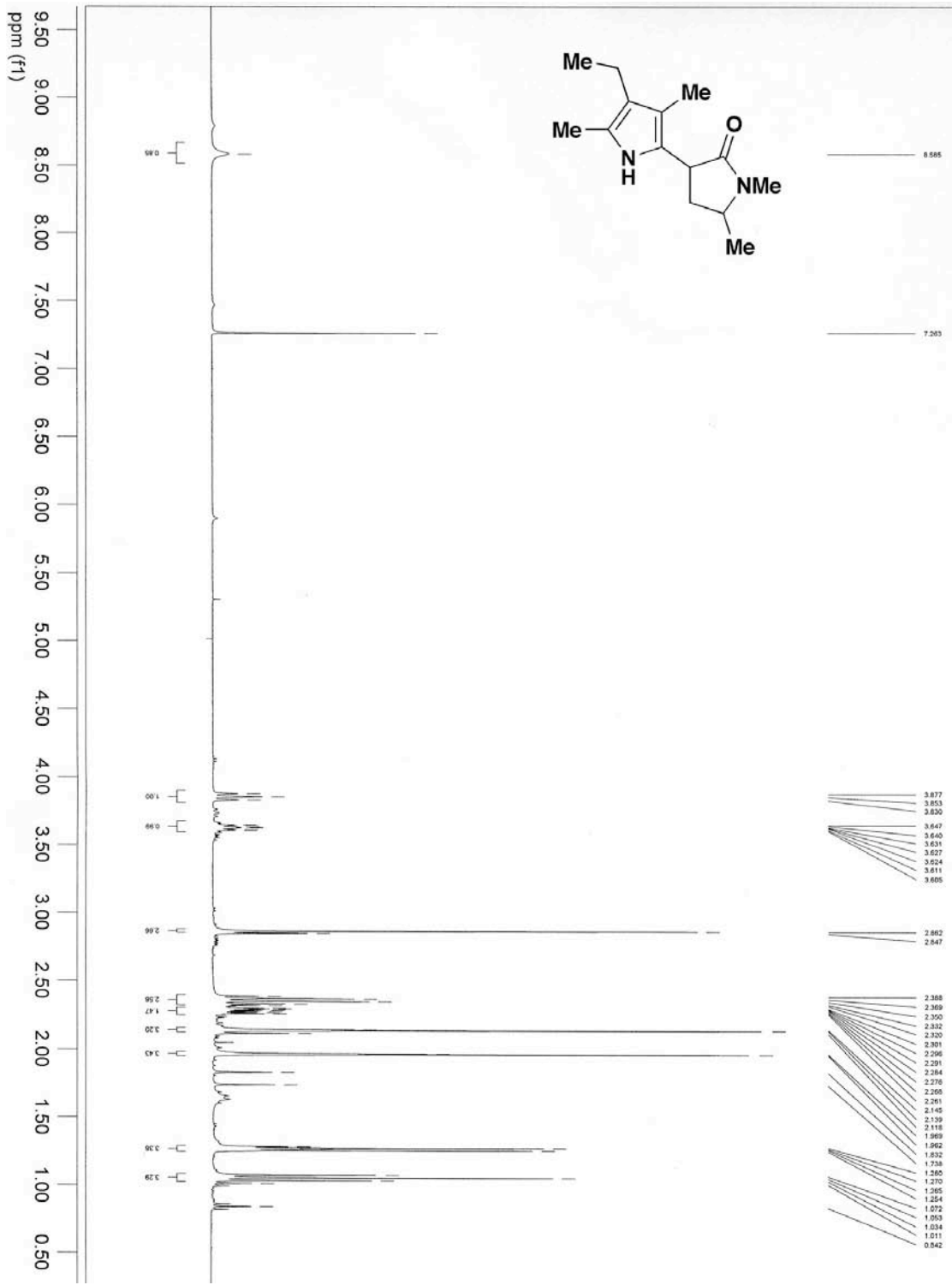
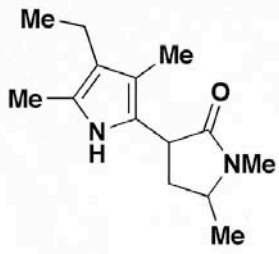


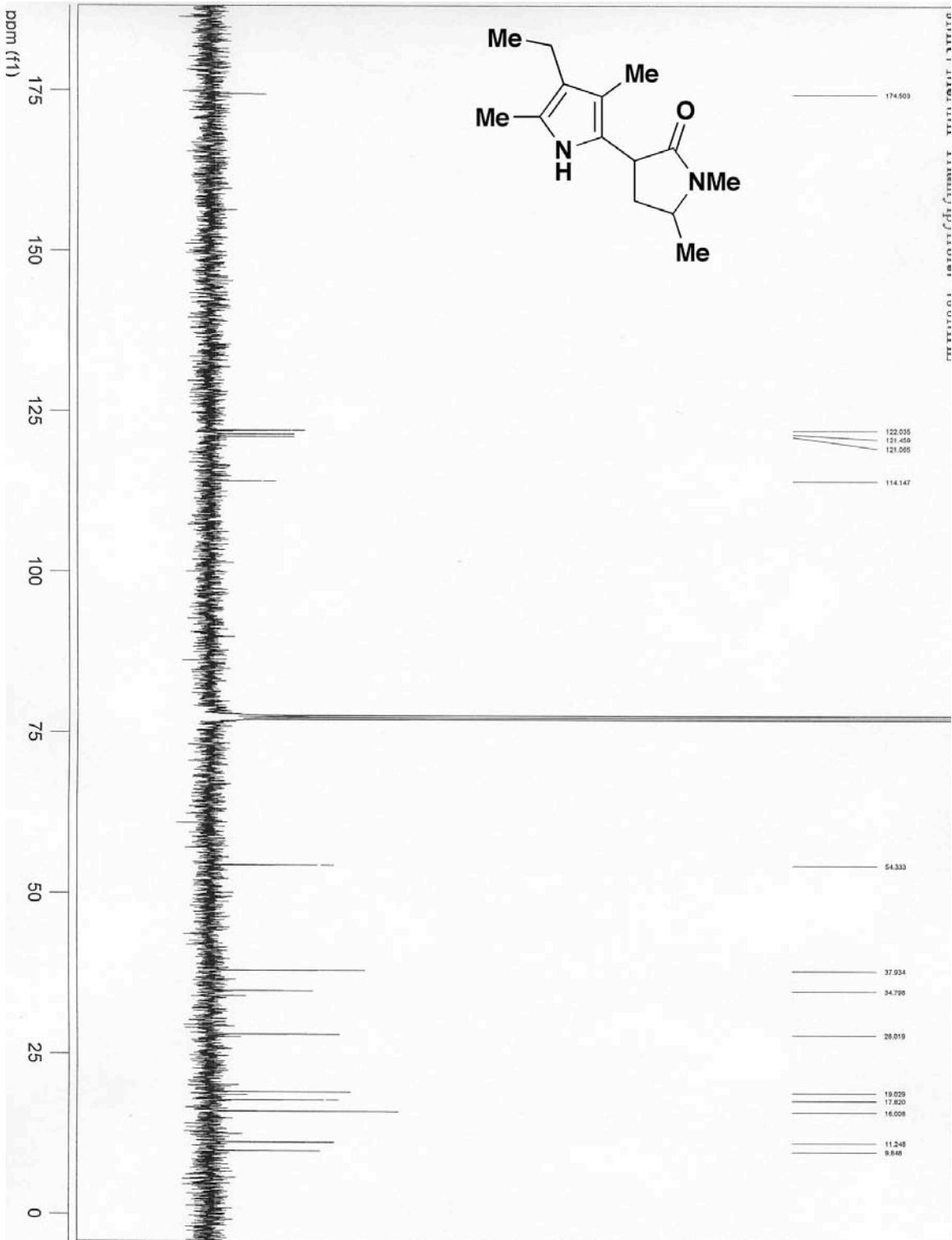
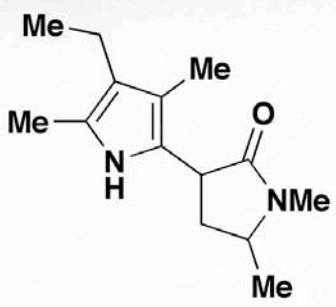
DimethylEthylPyrroleCarvone

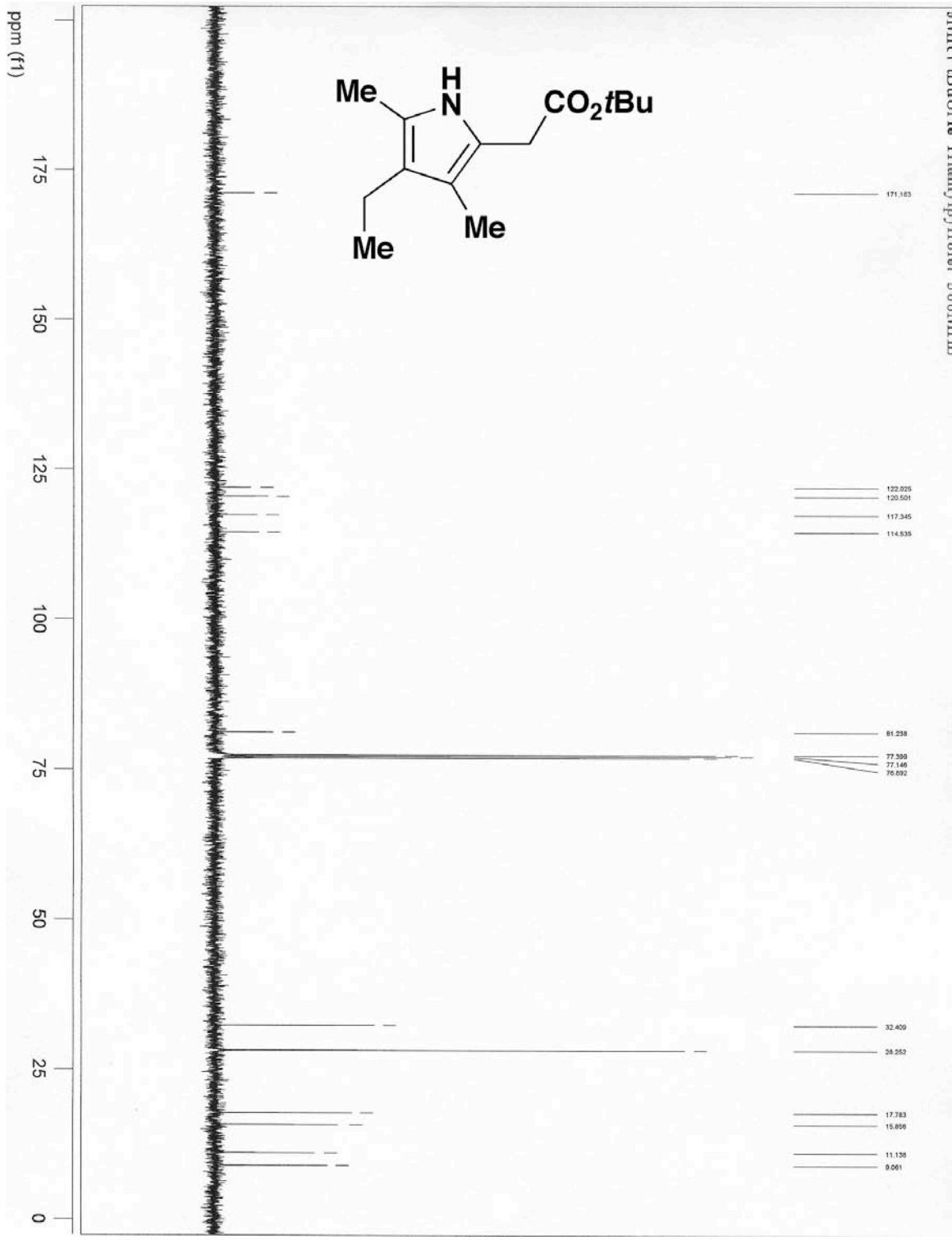


13C NMR spectrum of 2,3,4-trimethyl-5-(prop-1-en-2-yl)pyrrole

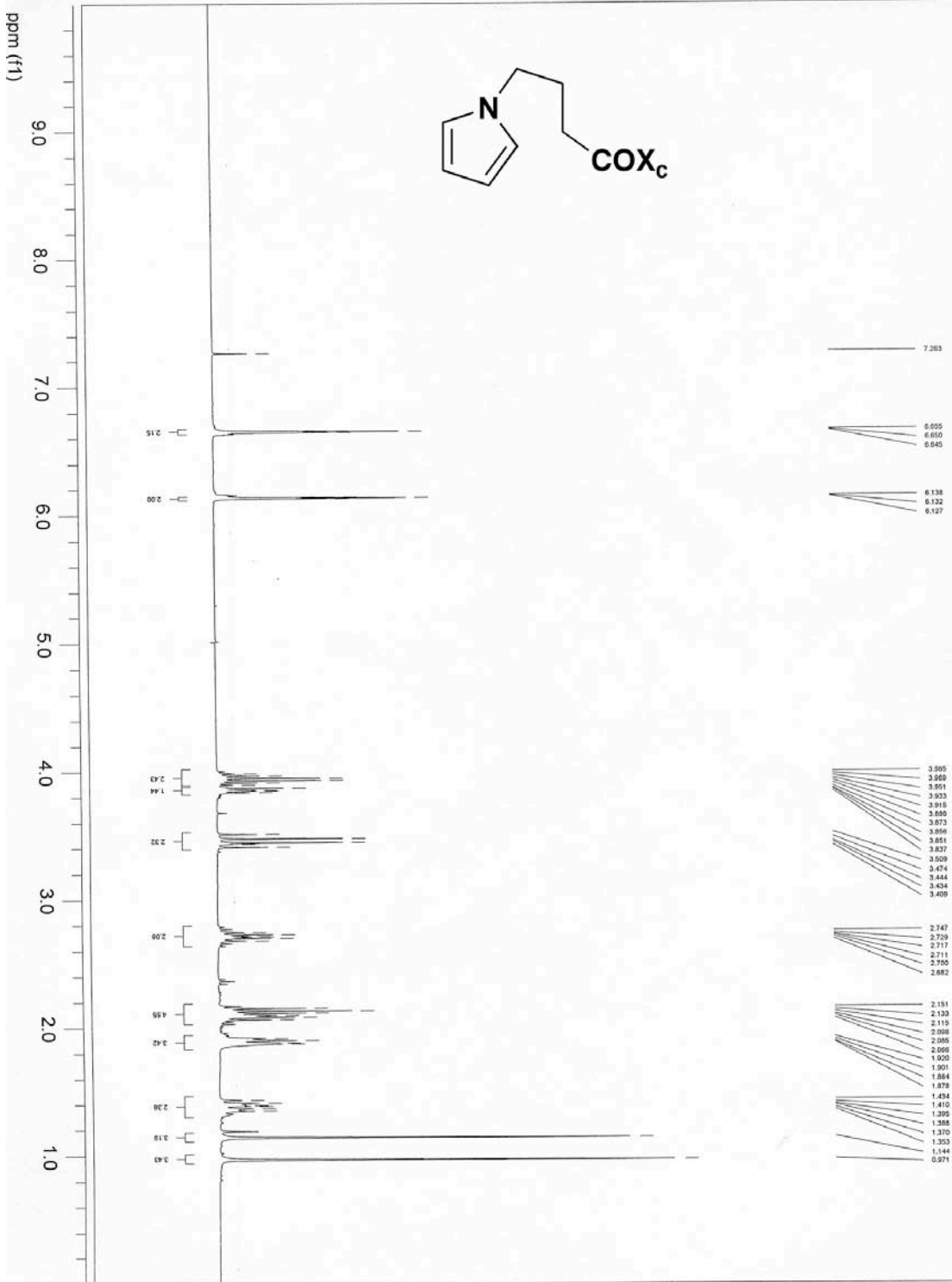
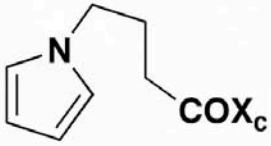


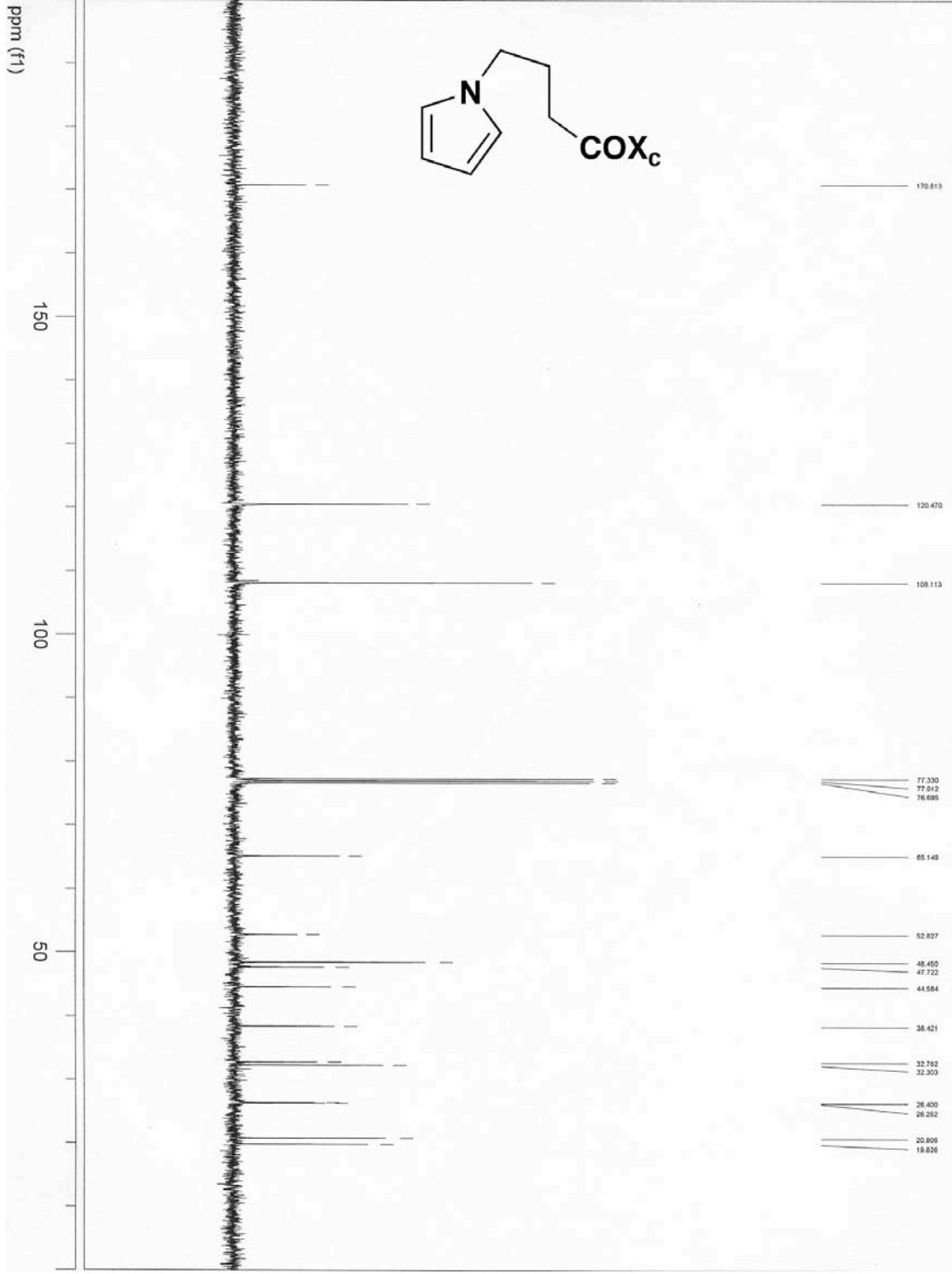
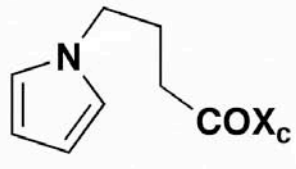






JMK-3-293CT006: 400MHZ





JMK3-ZU1: INOVA400

