

Nano CoFe₂O₄ supported molybdenum as an efficient and magnetically recoverable catalyst for one-pot, four-component synthesis of functionalized pyrroles

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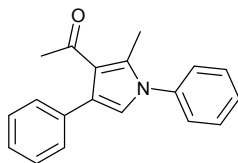
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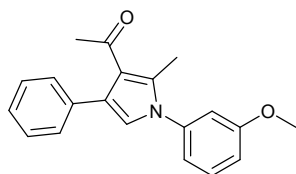
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1-(2-Methyl-1,4-diphenyl-1*H*-pyrrol-3-yl)ethanone (5a).



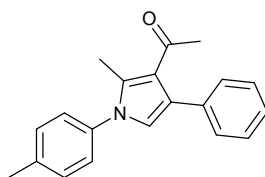
White solid (247 mg, 90%); IR (KBr): 3118, 3057, 2922, 1645, 1498, 1406 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.08 (s, 3H), 2.41 (s, 3H), 6.67 (s, 1H), 7.29-7.34 (m, 3H), 7.36-7.39 (m, 4H), 7.42 (t, $J = 7.5$ Hz, 1H), 7.49 (t, $J = 7.0$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 13.2, 31.4, 120.9, 122.8, 126.5, 126.6, 127.1, 128.4, 128.6, 129.6, 129.6, 135.6, 136.3, 139.0, 197.9 ppm; Anal. Calcd for $\text{C}_{19}\text{H}_{17}\text{NO}$: C, 82.88; H, 6.22; N, 5.09. Found: C, 82.71; H, 6.04; N, 4.93; ESI-MS: $m/z = 276$ ($\text{M}+1$) $^+$.

1-(1-(3-Methoxyphenyl)-2-methyl-4-phenyl-1*H*-pyrrol-3-yl)ethanone (5b).



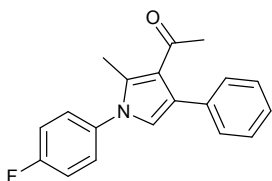
Yellow sticky liquid (262 mg, 86%); IR (KBr): 3125, 2924, 1603, 1494, 1401, 1045, 775, 751 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.07 (s, 3H), 2.42 (s, 3H), 3.84 (s, 3H), 6.67 (s, 1H), 6.68 (t, $J = 2.0$ Hz, 1H), 6.92 (d, $J = 7.5$ Hz, 1H), 6.96 (dd, $J = 2.0$ Hz, 8.5 Hz, 1H), 7.29-7.33 (m, 1H), 7.36-7.40 (m, 5H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.9, 31.1, 55.5, 112.1, 113.7, 118.4, 120.6, 122.6, 126.2, 126.8, 128.3, 129.3, 130.0, 135.2, 136.0, 139.8, 160.25, 197.6 ppm; Anal. Calcd for $\text{C}_{20}\text{H}_{19}\text{NO}_2$: C, 78.66; H, 6.27; N, 4.59. Found: C, 78.47; H, 6.08; N, 4.47; ESI-MS: $m/z = 306$ ($\text{M}+1$) $^+$.

1-(2-Methyl-4-phenyl-1-(*p*-tolyl)-1*H*-pyrrol-3-yl)ethanone (5c).



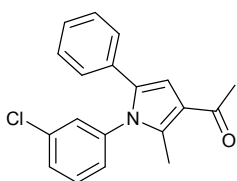
White solid, (265 mg, 92%); IR (KBr): 3113, 3032, 2918, 1647, 1516, 1502, 1230, 820 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.07 (s, 3H), 2.39 (s, 3H), 2.42 (s, 3H), 6.64 (s, 1H), 7.20 (d, $J = 8.5$ Hz, 2H), 7.28 (d, $J = 8.5$ Hz, 2H), 7.31 (q, $J = 5.0$ Hz, 1H), 7.37-7.38 (m, 4H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.5, 20.7, 30.7, 120.3, 122.0, 125.6, 125.8, 126.4, 127.9, 129.0, 129.5, 135.0, 135.7, 135.8, 137.7, 197.2 ppm; Anal. Calcd for $\text{C}_{20}\text{H}_{19}\text{NO}$: C, 83.01; H, 6.62; N, 4.84. Found: C, 82.89; H, 6.46; N, 4.73; ESI-MS: $m/z = 290$ ($\text{M}+1$) $^+$.

1-(1-(4-Fluorophenyl)-2-methyl-4-phenyl-1*H*-pyrrol-3-yl)ethanone (5d).



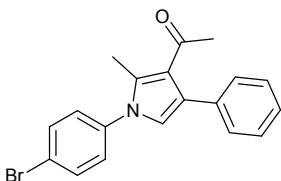
White solid, (263 mg, 90%); IR (KBr): 3080, 2920, 1647, 1515, 1415, 842 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.07 (s, 3H), 2.38 (s, 3H), 6.63 (s, 1H), 7.16 (t, $J = 8.0$ Hz, 2H), 7.26-7.31 (m, 3H), 7.36-7.37 (m, 4H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.7, 31.1, 116.3 (d, $^2J_{\text{CF}} = 22.7$ Hz), 120.6, 122.6, 126.4, 126.9, 128.0 (d, $^3J_{\text{CF}} = 8.3$ Hz), 128.3, 129.3, 134.8 (d, $^4J_{\text{CF}} = 2.8$ Hz), 135.3, 135.8, 162.0 (d, $^1J_{\text{CF}} = 247.1$ Hz), 197.5 ppm; Anal. Calcd for $\text{C}_{19}\text{H}_{16}\text{FNO}$: C, 77.80; H, 5.50; N, 4.77. Found: C, 77.66; H, 5.48; N, 4.72; ESI-MS: $m/z = 294$ (M+1) $^+$.

1-(1-(5-Chlorophenyl)-2-methyl-5-phenyl-1H-pyrrol-3-yl)ethanone (5e).



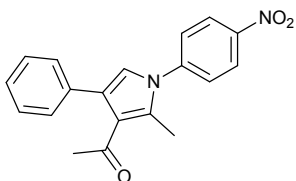
Yellow solid, (247 mg, 80%); IR (KBr): 3112, 3081, 2922, 1647, 1492, 1410, 1228 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.05 (s, 3H), 2.38 (s, 3H), 6.62 (s, 1H), 7.29 (d, $J = 8.5$ Hz, 2H), 7.32-7.38 (m, 5H), 7.45 (d, $J = 8.5$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.8, 31.1, 120.4, 122.8, 126.6, 126.9, 127.4, 128.3, 129.3, 129.6, 134.0, 135.1, 135.7, 137.2, 197.6 ppm; Anal. Calcd for $\text{C}_{19}\text{H}_{16}\text{ClNO}$: C, 73.66; H, 5.21; N, 4.52. Found: C, 73.48; H, 5.12; N, 4.36; ESI-MS: $m/z = 310$ (M+1) $^+$.

1-(1-(4-Bromophenyl)-2-methyl-4-phenyl-1H-pyrrol-3-yl)ethanone (5f).



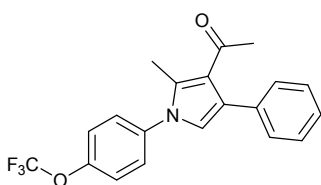
White solid, (289 mg, 82%); IR (KBr): 3070, 2921, 1647, 1502, 1491, 1408, 1228 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 1.95 (s, 3H), 2.29 (s, 3H), 6.52 (s, 1H), 7.10 (d, $J = 8.0$ Hz, 2H), 7.20-7.28 (m, 5H), 7.50 (d, $J = 8.0$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.8, 31.1, 120.3, 122.0, 122.9, 126.6, 126.9, 127.8, 128.3, 129.3, 132.6, 135.0, 135.7, 137.7, 197.5 ppm; Anal. Calcd for $\text{C}_{19}\text{H}_{16}\text{BrNO}$: C, 64.42; H, 4.55; N, 3.95; Found: C, 64.25; H, 4.39; N, 3.80; ESI-MS: $m/z = 354$ (M+1) $^+$.

1-(2-Methyl-1-(4-nitrophenyl)-4-phenyl-1H-pyrrol-3-yl)ethanone (5g).



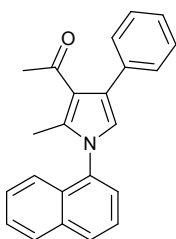
Yellow solid, (160 mg, 50%); IR (KBr): 3129, 3081, 2925, 1641, 1595, 1508, 1402, 1342 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.06 (s, 3H), 2.46 (s, 3H), 6.72 (s, 1H), 7.33-7.42 (m, 5H), 7.54 (d, J = 8.0 Hz, 2H), 8.38 (d, J = 8.0 Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 13.0, 31.1, 119.9, 124.0, 125.0, 126.5, 127.2, 127.5, 128.4, 129.2, 134.6, 135.2, 144.0, 146.8, 197.6 ppm; Anal. Calcd for $\text{C}_{19}\text{H}_{16}\text{N}_2\text{O}_3$: C, 71.24; H, 5.03; N, 8.74; Found: C, 71.06; H, 4.88; N, 8.67; ESI-MS: m/z = 321 ($\text{M}+1$) $^+$.

1-(2-Methyl-4-phenyl-1-(4-(trifluoromethoxy)phenyl)-1H-pyrrol-3-yl)ethanone (5h).



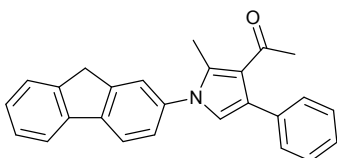
White solid, (287 mg, 80%); IR (KBr): 3246, 3012, 1641, 1508, 1384, 1205, 1099, 854 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.06 (s, 3H), 2.40 (s, 3H), 6.65 (s, 1H), 7.26-7.40 (m, 9H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.8, 31.1, 120.4, 120.4 (q, J_{CF} = 256.6 Hz), 121.8, 121.9, 126.6, 127.0, 127.7, 128.3, 129.3, 135.1, 135.7, 137.2, 148.6, 197.6 ppm; Anal. Calcd for $\text{C}_{20}\text{H}_{16}\text{F}_3\text{NO}_2$: C, 66.85; H, 4.49; N, 3.90; Found: C, 66.68; H, 4.32; N, 3.86; ESI-MS: m/z = 360 ($\text{M}+1$) $^+$.

1-(2-Methyl-1-(naphthalen-1-yl)-4-phenyl-1H-pyrrol-3-yl)ethanone (5i).



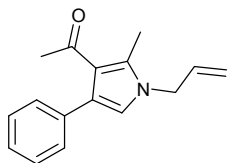
White solid, (156 mg, 48%); IR: 3101, 2920, 1647, 1505, 1440, 1257, 1234, 806, 777 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.15 (s, 3H), 2.22 (s, 3H), 6.71 (s, 1H), 7.32 (t, J = 7.5 Hz, 1H), 7.38-7.48 (m, 6H), 7.50-7.58 (m, 3H), 7.96 (t, J = 9.0 Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.4, 31.2, 121.7, 121.8, 122.9, 125.2, 125.3, 126.1, 126.8, 126.9, 127.6, 128.2, 128.3, 129.3, 129.4, 130.6, 134.1, 135.3, 136.1, 137.0, 197.7 ppm; Anal. Calcd for $\text{C}_{23}\text{H}_{19}\text{NO}$: C, 84.89; H, 5.89; N, 4.30; Found: C, 84.80; H, 5.78; N, 4.17; ESI-MS: m/z = 326 ($\text{M}+1$) $^+$.

1-(1-(9H-fluoren-2-yl)-2-methyl-4-phenyl-1H-pyrrol-3-yl)ethanone (5j).



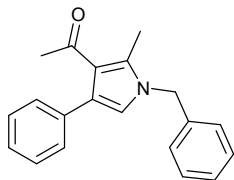
White solid, (301 mg, 83%); IR (KBr): 3030, 2917, 1651, 1512, 1404, 771 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.09 (s, 3H), 2.45 (s, 3H), 3.98 (s, 2H), 6.72 (s, 1H), 7.32-7.43 (m, 8H), 7.50 (s, 1H), 7.58 (d, $J = 7.5$ Hz, 1H), 7.82 (d, $J = 7.5$ Hz, 1H), 7.86 (d, $J = 7.5$ Hz, 1H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 13.1, 31.2, 36.9, 120.2, 120.3, 120.8, 122.5, 123.0, 125.0, 125.2, 126.3, 126.8, 127.1, 127.3, 128.3, 129.4, 135.5, 136.1, 137.2, 140.5, 141.7, 143.4, 145.3, 197.6 ppm; Anal. Calcd for $\text{C}_{26}\text{H}_{21}\text{NO}$: C, 85.92; H, 5.82; N, 3.85; Found: C, 85.78; H, 5.69; N, 3.69; ESI-MS: $m/z = 364$ ($\text{M}+1$) $^+$.

1-(1-Allyl-2-methyl-4-phenyl-1H-pyrrol-3-yl)ethanone (5k).



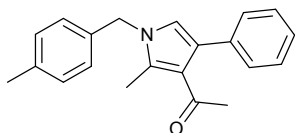
Yellow sticky liquid (210 mg, 88%); IR (KBr): 3050, 2921, 1724, 1645, 1506, 1280, 1242 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.01 (s, 3H), 2.46 (s, 3H), 4.45 (d, $J = 5.0$ Hz, 2H), 5.04 (d, $J = 17.0$ Hz, 1H), 5.23 (d, $J = 10.0$ Hz, 1H), 5.89-5.97 (m, 1H), 6.49 (s, 1H), 7.27-7.37 (m, 5H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 11.3, 31.0, 48.9, 117.5, 119.6, 121.8, 125.7, 126.6, 128.2, 129.3, 132.9, 134.9, 136.4, 197.4 ppm; Anal. Calcd for $\text{C}_{16}\text{H}_{17}\text{NO}$: C, 80.30; H, 7.16; N, 5.85; Found: C, 80.20; H, 7.05; N, 5.77; ESI-MS: $m/z = 240$ ($\text{M}+1$) $^+$.

1-(1-Benzyl-2-methyl-4-phenyl-1H-pyrrol-3-yl)ethanone (5l).



White solid, (260 mg, 90%); IR (KBr): 3081, 2931, 1647, 1506, 1412, 1276 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.03 (s, 3H), 2.43 (s, 3H), 5.06 (s, 2H), 6.54 (s, 1H), 7.09 (d, $J = 7.5$ Hz, 2H), 7.27-7.37 (m, 8H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 11.6, 31.1, 50.3, 120.1, 122.1, 125.9, 126.7, 127.8, 128.2, 128.9, 129.4, 135.1, 136.3, 136.6, 197.4 ppm; Anal. Calcd for $\text{C}_{20}\text{H}_{19}\text{NO}$: C, 83.01; H, 6.62; N, 4.84; Found: C, 82.82; H, 6.48; N, 4.75; ESI-MS: $m/z = 290$ ($\text{M}+1$) $^+$.

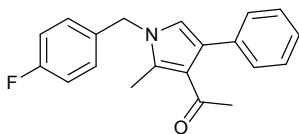
1-(2-Methyl-1-(4-methylbenzyl)-4-phenyl-1H-pyrrol-3-yl)ethanone (5m).



White solid, (275 mg, 91%); IR (KBr): 3051, 2938, 1647, 1506, 830 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.03 (s, 3H), 2.33 (s, 3H), 2.44 (s, 3H), 5.01 (s, 2H), 6.51 (s, 1H), 6.99 (d, $J = 8.0$ Hz, 2H), 7.15 (d, $J = 7.5$ Hz, 2H), 7.26-7.36 (m, 5H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 11.5, 29.7, 31.0, 50.3, 120.1, 122.0, 125.9, 126.7, 127.8, 128.2, 128.9, 129.3, 135.1, 136.3, 136.5, 197.6 ppm;

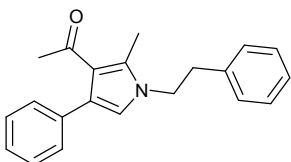
Anal. Calcd for C₂₁H₂₁NO: C, 83.13; H, 6.98; N, 4.62; Found: C, 83.05; H, 6.79; N, 4.45; ESI-MS: m/z = 304 (M+1)⁺.

1-(1-(4-Fluorobenzyl)-2-methyl-4-phenyl-1*H*-pyrrol-3-yl)ethanone (5n).



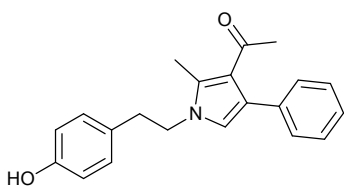
White solid, (267 mg, 87%); IR (KBr): 3130, 2924, 1654, 1502, 1396, 1220, 947 cm⁻¹; ¹H NMR (CDCl₃, 500 MHz) δ 2.03 (s, 3H), 2.42 (s, 3H), 5.02 (s, 2H), 6.52 (s, 1H), 7.01-7.08 (m, 4H), 7.26-7.37 (m, 5H) ppm; ¹³C NMR (CDCl₃, 125MHz) δ 11.5, 31.0, 49.6, 116.4 (d, ²J_{CF} = 21.6 Hz), 119.9, 122.2, 126.0, 126.7, 128.2, 128.4 (d, ³J_{CF} = 8.1 Hz), 129.3, 132.3 (d, ⁴J_{CF} = 3.0 Hz), 134.9, 136.1, 162.3 (d, ¹J_{CF} = 245.1 Hz), 197.6 ppm; Anal. Calcd for C₂₀H₁₈FNO: C, 78.15; H, 5.90; N, 4.56; Found: C, 78.04; H, 5.82; N, 4.48; ESI-MS: m/z = 308 (M+1)⁺.

1-(2-Methyl-1-phenethyl-4-phenyl-1*H*-pyrrol-3-yl)ethanone (5o).



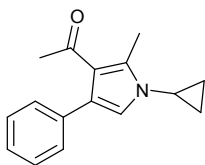
White solid, (275 mg, 91%); IR (KBr): 3113, 2866, 1637, 1508, 1458, 1282, 1072, 947 cm⁻¹; ¹H NMR (CDCl₃, 500 MHz) δ 2.00 (s, 3H), 2.38 (s, 3H), 3.01 (t, *J* = 7.0 Hz, 2H), 4.05 (t, *J* = 7.5 Hz, 2H), 6.40 (s, 1H), 7.10 (d, *J* = 7.0 Hz, 2H), 7.22-7.36 (m, 8H) ppm; ¹³C NMR (CDCl₃, 125MHz) δ 11.3, 31.0, 37.5, 48.1, 119.3, 121.6, 125.7, 126.6, 126.9, 128.1, 128.7, 129.3, 134.7, 136.4, 137.6, 197.4 ppm; Anal. Calcd for C₂₁H₂₁NO: C, 83.13; H, 6.98; N, 4.62; Found: C, 83.09; H, 6.82; N, 4.47; ESI-MS: m/z = 304 (M+1)⁺.

1-(1-(4-Hydroxyphenethyl)-2-methyl-4-phenyl-1*H*-pyrrol-3-yl)ethanone (5p).



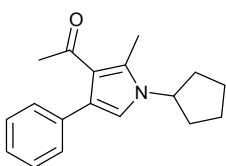
Yellow sticky liquid (287 mg, 90%); IR (KBr): 3082, 2926, 1627, 1516, 1413, 1232, 950, 829 cm⁻¹; ¹H NMR (CDCl₃, 500 MHz) δ 2.01 (s, 3H), 2.36 (s, 3H), 2.93 (t, *J* = 7.5 Hz, 2H), 4.01 (t, *J* = 7.5 Hz, 2H), 5.88 (s, 1H), 6.40 (s, 1H), 6.78 (d, *J* = 8.0 Hz, 2H), 6.93 (d, *J* = 8.5 Hz, 2H), 7.29 (t, *J* = 7.5 Hz, 3H), 7.34 (t, *J* = 8.0 Hz, 2H) ppm; ¹³C NMR (CDCl₃, 125MHz) δ 11.5, 29.7, 31.0, 50.3, 120.1, 122.0, 125.9, 126.7, 127.8, 128.2, 128.9, 129.3, 135.1, 136.3, 136.5, 197.6 ppm; Anal. Calcd for C₂₁H₂₁NO₂: C, 78.97; H, 6.63; N, 4.39; Found: C, 78.86; H, 6.49; N, 4.21; ESI-MS: m/z = 320 (M+1)⁺.

1-(1-Cyclopropyl-2-methyl-4-phenyl-1*H*-pyrrol-3-yl)ethanone (5q).



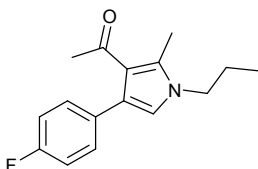
White solid, (215 mg, 90%); IR (KBr): 3111, 2924, 1637, 1506, 1226, 1028, 952, 883 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 0.96 (q, $J = 5.0$ Hz, 2H), 1.04 (q, $J = 7.0$ Hz, 2H), 2.00 (s, 3H), 2.58 (s, 3H), 3.13-3.17 (m, 1H), 6.50 (s, 1H), 7.29 (d, $J = 8.0$ Hz, 3H), 7.34 (t, $J = 7.5$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 6.8, 12.1, 28.1, 31.1, 119.5, 121.9, 125.0, 126.6, 128.2, 129.3, 136.4, 137.3, 197.4 ppm. Anal. Calcd for $\text{C}_{16}\text{H}_{17}\text{NO}$: C, 80.30; H, 7.16; N, 5.85; Found: C, 80.21; H, 7.05; N, 5.68; ESI-MS: $m/z = 240$ ($\text{M}+1$) $^+$.

1-(1-Cyclopentyl-2-methyl-4-phenyl-1H-pyrrol-3-yl)ethanone (5r).



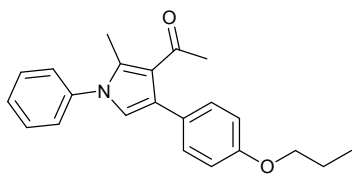
White solid, (230 mg, 86%); IR (KBr): 3099, 2926, 1653, 1508, 1406, 1209, 964 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 1.70-1.89 (m, 6H), 2.01 (s, 3H), 2.11-2.15 (m, 2H), 2.52 (s, 3H), 4.45-4.51 (m, 1H), 6.57 (s, 1H), 7.28-7.36 (m, 5H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 11.6, 24.1, 31.0, 32.2, 56.6, 115.7, 121.5, 125.7, 126.5, 128.2, 129.3, 134.9, 136.7, 197.7 ppm; Anal. Calcd for $\text{C}_{18}\text{H}_{21}\text{NO}$: C, 80.86; H, 7.92; N, 5.24; Found: C, 80.78; H, 7.82; N, 5.10; ESI-MS: $m/z = 268$ ($\text{M}+1$) $^+$.

1-(4-(4-Fluorophenyl)-2-methyl-1-propyl-1H-pyrrol-3-yl)ethanone (5s).



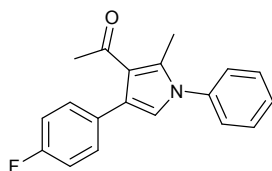
Yellow sticky liquid (233 mg, 90%); IR (KBr): 2966, 1653, 1508, 1419, 1220, 1091, 949, 840 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 0.96 (t, $J = 7.0$ Hz, 3H), 1.73-1.80 (m, 2H), 1.99 (s, 3H), 2.47 (s, 3H), 3.79 (t, $J = 7.5$ Hz, 2H), 6.46 (s, 1H), 7.04 (t, $J = 8.5$ Hz, 2H), 7.24-7.27 (m, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 11.2, 11.5, 24.0, 31.0, 48.2, 115.0 (d, $^2J_{\text{CF}} = 21.3$ Hz), 119.6, 121.6, 124.4, 130.8 (d, $^3J_{\text{CF}} = 7.8$ Hz), 132.5 (d, $^4J_{\text{CF}} = 3.0$ Hz), 134.8, 161.9 (d, $^1J_{\text{CF}} = 243.7$ Hz), 197.1 ppm; Anal. Calcd for $\text{C}_{16}\text{H}_{18}\text{FNO}$: C, 74.11; H, 7.00; N, 5.40; Found: C, 74.01; H, 6.82; N, 5.26; ESI-MS: $m/z = 260$ ($\text{M}+1$) $^+$.

1-(2-Methyl-1-phenyl-4-(4-propoxyphenyl)-1H-pyrrol-3-yl)ethanone (5t).



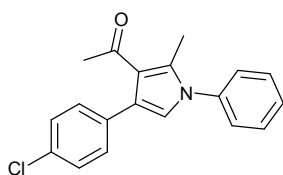
Yellow sticky liquid (269 mg, 81%); IR (KBr): 2964, 1647, 1506, 1386, 1244, 1174, 835 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 1.05 (t, $J = 7.5$ Hz, 3H), 1.79-1.86 (m, 2H), 2.07 (s, 3H), 2.40 (s, 3H), 3.95 (t, $J = 6.5$ Hz, 2H), 6.63 (s, 1H), 6.92 (d, $J = 8.0$ Hz, 2H), 7.28 (d, $J = 8.0$ Hz, 2H), 7.33 (d, $J = 8.0$ Hz, 2H), 7.41 (t, $J = 7.5$ Hz, 1H), 7.48 (t, $J = 7.5$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 10.5, 12.9, 22.6, 31.1, 69.5, 114.3, 120.4, 122.6, 126.0, 126.2, 128.0, 128.1, 129.3, 130.3, 135.1, 138.8, 158.3, 197.7 ppm; Anal. Calcd for $\text{C}_{22}\text{H}_{23}\text{NO}_2$: C, 79.25; H, 6.95; N, 4.20; Found: C, 79.13; H, 6.75; N, 4.06; ESI-MS: $m/z = 334$ ($\text{M}+1$) $^+$.

1-(4-(4-Fluorophenyl)-2-methyl-1-phenyl-1H-pyrrol-3-yl)ethanone (5u).



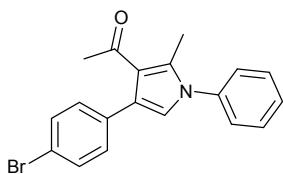
White solid, (254 mg, 87%); IR (KBr): 3028, 2944, 1646, 1506, 1408, 1220 cm^{-1} . ^1H NMR (CDCl_3 , 500 MHz) δ 2.07 (s, 3H), 2.40 (s, 3H), 6.64 (s, 1H), 7.07 (t, $J = 8.5$ Hz, 2H), 7.32-7.35 (m, 4H), 7.43 (t, $J = 7.0$ Hz, 1H), 7.49 (t, $J = 7.5$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.9, 31.1, 115.2 (d, $^2J_{\text{CF}} = 21.1$ Hz), 120.7, 122.5, 125.2, 126.2, 128.2, 129.4, 130.8 (d, $^3J_{\text{CF}} = 7.8$ Hz), 132.0 (d, $^4J_{\text{CF}} = 3.2$ Hz), 135.4, 138.6, 162.0 (d, $^1J_{\text{CF}} = 244.0$ Hz), 197.2 ppm; Anal. Calcd for $\text{C}_{19}\text{H}_{16}\text{FNO}$: C, 77.80; H, 5.50; N, 4.77; Found: C, 77.67; H, 5.38; N, 4.61; ESI-MS: $m/z = 294$ ($\text{M}+1$) $^+$.

1-(4-(4-Chlorophenyl)-2-methyl-1-phenyl-1H-pyrrol-3-yl)ethanone (5v).



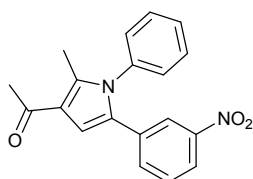
White solid, (265 mg, 86%); IR (KBr): 3118, 3040, 2922, 1647, 1508, 1410, 1087 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.09 (s, 3H), 2.39 (s, 3H), 6.66 (s, 1H), 7.30-7.36 (m, 6H), 7.43 (t, $J = 7.5$ Hz, 1H), 7.49 (t, $J = 7.5$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.9, 31.1, 120.7, 122.5, 125.0, 126.2, 128.2, 128.4, 129.5, 130.5, 132.7, 134.5, 135.5, 137.9, 138.6, 197.1 ppm; Anal. Calcd for $\text{C}_{19}\text{H}_{16}\text{ClNO}$: C, 73.66; H, 5.21; N, 4.52; Found: C, 73.48; H, 5.16; N, 4.38; ESI-MS: $m/z = 310$ ($\text{M}+1$) $^+$.

1-(4-(4-Bromophenyl)-2-methyl-1-phenyl-1H-pyrrol-3-yl)ethanone (5w).



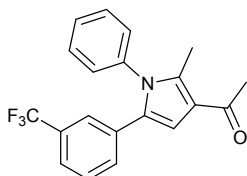
White solid, (300 mg, 85%); IR (KBr): 3041, 2922, 1647, 1500, 1408, 1228 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.10 (s, 3H), 2.39 (s, 3H), 6.66 (s, 1H), 7.24 (d, $J = 7.5$ Hz, 2H), 7.25 (d, $J = 7.5$ Hz, 2H), 7.43 (t, $J = 7.5$ Hz, 1H), 7.47-7.51 (m, 4H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.9, 31.2, 120.7, 120.8, 122.5, 125.0, 126.2, 128.2, 129.5, 130.8, 131.5, 135.0, 135.5, 138.6, 197.1 ppm; Anal. Calcd for $\text{C}_{19}\text{H}_{16}\text{BrNO}$: C, 64.42; H, 4.55; N, 3.95; Found: C, 64.27; H, 4.50; N, 3.80; ESI-MS: $m/z = 354$ ($\text{M}+1$) $^+$.

1-(2-Methyl-5-(5-nitrophenyl)-1-phenyl-1H-pyrrol-3-yl)ethanone (5x).



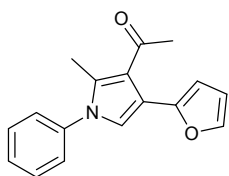
Brown sticky liquid (265 mg, 83%); IR (KBr): 3132, 2920, 1653, 1540, 1516, 1410, 1340, 1224 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.17 (s, 3H), 2.39 (s, 3H), 6.77 (s, 1H), 7.32 (d, $J = 8.0$ Hz, 2H), 7.46 (t, $J = 7.5$ Hz, 1H), 7.50-7.53 (m, 4H), 8.24 (d, $J = 8.0$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.9, 31.2, 121.7, 122.5, 123.6, 125.1, 126.2, 128.6, 129.5, 129.5, 136.1, 138.3, 153.0, 156.5, 196.7 ppm; Anal. Calcd for $\text{C}_{19}\text{H}_{16}\text{N}_2\text{O}_3$: C, 71.24; H, 5.03; N, 8.74; Found: C, 71.13; H, 4.94; N, 8.71; ESI-MS: $m/z = 321$ ($\text{M}+1$) $^+$.

1-(2-Methyl-1-phenyl-5-(5-(trifluoromethyl)phenyl)-1H-pyrrol-3-yl)ethanone(5y).



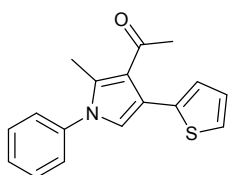
Yellow sticky liquid (291 mg, 85%); IR (KBr): 3040, 2929, 1650, 1502, 1417, 1320, 1224, 1124, 848 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.12 (s, 3H), 2.40 (s, 3H), 6.71 (s, 1H), 7.33 (d, $J = 8.0$ Hz, 2H), 7.45 (t, $J = 7.5$ Hz, 1H), 7.48-7.51 (m, 4H), 7.63 (d, $J = 8.0$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.9, 31.2, 121.1, 122.5, 124.2 (q, $^1J_{\text{FC}} = 270.2$ Hz), 124.8, 125.2 (q, $^3J_{\text{FC}} = 3.6$ Hz), 128.3, 128.8 (q, $^2J_{\text{FC}} = 32.0$ Hz), 129.3, 129.4, 135.7, 138.5, 139.8 197.0 ppm; Anal. Calcd for $\text{C}_{20}\text{H}_{16}\text{F}_3\text{NO}$: C, 69.96; H, 4.70; N, 4.08; Found: C, 69.87; H, 4.56; N, 3.99; ESI-MS: $m/z = 344$ ($\text{M}+1$) $^+$.

1-(4-(Furan-2-yl)-2-methyl-1-phenyl-1H-pyrrol-3-yl)ethanone (5z).



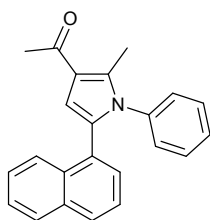
White solid, (159 mg, 60%); IR (KBr): 3125, 2982, 2928, 1647, 1498, 1410, 1240, 952 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.21 (s, 3H), 2.40 (s, 3H), 6.42-6.45 (m, 2H), 6.85 (s, 1H), 7.29 (d, $J = 7.5$ Hz, 2H), 7.43 (t, $J = 7.5$ Hz, 1H), 7.47-7.50 (m, 3H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 13.0, 29.9, 107.9, 111.1, 115.3, 121.7, 121.8, 126.3, 128.3, 129.4, 135.8, 138.5, 141.7, 148.8, 196.6 ppm; Anal. Calcd for $\text{C}_{17}\text{H}_{15}\text{NO}_2$: C, 76.96; H, 5.70; N, 5.28; Found: C, 76.86; H, 5.56; N, 5.10; ESI-MS: $m/z = 266$ ($\text{M}+1$) $^+$.

1-(2-Methyl-1-phenyl-4-(thiophen-2-yl)-1H-pyrrol-3-yl)ethanone (5aa).



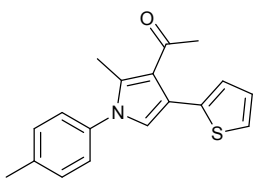
Yellow solid, (199 mg, 71%); IR (KBr): 3110, 3051, 2920, 1653, 1500, 1406, 1234 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.18 (s, 3H), 2.40 (s, 3H), 6.76 (s, 1H), 7.02 (s, 1H), 7.05-7.06 (m, 1H), 7.28 (d, $J = 5.0$ Hz, 1H), 7.31 (d, $J = 8.0$ Hz, 2H), 7.43 (t, $J = 7.0$ Hz, 1H), 7.49 (t, $J = 7.5$ Hz, 2H), ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 13.0, 30.6, 117.7, 122.0, 122.9, 125.0, 126.2, 127.0, 127.2, 128.3, 129.4, 135.6, 136.8, 138.4, 159.5, 197.0 ppm; Anal. Calcd for $\text{C}_{17}\text{H}_{15}\text{NOS}$: C, 72.57; H, 5.37; N, 4.98; Found: C, 72.39; H, 5.27; N, 4.85; ESI-MS: $m/z = 282$ ($\text{M}+1$) $^+$.

1-(2-Methyl-5-(naphthalen-1-yl)-1-phenyl-1H-pyrrol-3-yl)ethanone (5ab).



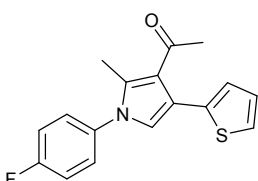
White solid, (260 mg, 80%); IR (KBr): 3110, 3034, 2910, 1653, 1504, 1398, 1238, 801 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 1.71 (s, 3H), 2.54 (s, 3H), 6.74 (s, 1H), 7.39-7.52 (m, 9H), 7.86 (t, $J = 5.0$ Hz, 1H), 7.88 (d, $J = 8.0$ Hz, 1H), 7.95 (d, $J = 8.0$ Hz, 1H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.9, 31.1, 118.8, 119.6, 120.7, 122.5, 124.1, 126.2, 126.8, 127.7, 128.3, 129.3, 130.0, 133.5, 135.5, 136.0, 156.3, 157.4, 197.6 ppm; Anal. Calcd for $\text{C}_{23}\text{H}_{19}\text{NO}$: C, 84.89; H, 5.89; N, 4.30; Found: C, 84.79; H, 5.70; N, 4.25; ESI-MS: $m/z = 326$ ($\text{M}+1$) $^+$.

1-(2-Methyl-4-(thiophen-2-yl)-1-(p-tolyl)-1H-pyrrol-3-yl)ethanone (5ac).



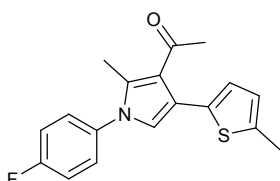
White solid, (236 mg, 80%); IR (KBr): 3028, 2922, 1637, 1506, 1410, 1190, 947, 800 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.18 (s, 3H), 2.38 (s, 3H), 2.42 (s, 3H), 6.73 (s, 1H), 7.00 (d, $J = 4.2$ Hz, 1H), 7.04-7.06 (m, 1H), 7.19 (d, $J = 8.5$ Hz, 2H), 7.27-7.28 (m, 3H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 13.0, 21.1, 30.5, 117.5, 122.1, 122.7, 125.0, 126.0, 127.0, 127.2, 129.9, 135.8, 135.9, 136.9, 138.3, 197.0 ppm; Anal. Calcd for $\text{C}_{18}\text{H}_{17}\text{NOS}$: C, 73.19; H, 5.80; N, 4.74; Found: C, 73.05; H, 5.69; N, 4.57; ESI-MS: $m/z = 297$ ($\text{M}+1$) $^+$.

1-(1-(4-Fluorophenyl)-2-methyl-4-(thiophen-2-yl)-1H-pyrrol-3-yl)ethanone (5ad).



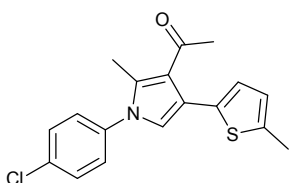
White solid, (224 mg, 75%); IR (KBr): 3110, 2924, 1653, 1508, 1406, 1220, 842 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.17 (s, 3H), 2.37 (s, 3H), 6.72 (s, 1H), 7.00 (d, $J = 3.5$ Hz, 1H), 7.06 (dd, $J = 3.5$ Hz, 5 Hz, 1H), 7.19 (d, $J = 8.5$ Hz, 2H), 7.28-7.30 (m, 3H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.8, 30.6, 116.4 (d, $^2J_{\text{CF}} = 23.1$ Hz), 117.8, 122.0, 122.9, 125.1, 127.1, 127.2, 128.1 (d, $^3J_{\text{CF}} = 6.5$ Hz), 134.5, 135.7 (d, $^4J_{\text{CF}} = 2.1$ Hz), 136.6, 162.0 (d, $^1J_{\text{CF}} = 248.3$ Hz), 197.0 ppm; Anal. Calcd for $\text{C}_{17}\text{H}_{14}\text{FNOS}$: C, 68.21; H, 4.71; N, 4.68; Found: C, 68.11; H, 4.59; N, 4.49; ESI-MS: $m/z = 300$ ($\text{M}+1$) $^+$.

1-(1-(4-Fluorophenyl)-2-methyl-4-(5-methylthiophen-2-yl)-1H-pyrrol-3-yl)ethanone (5ae).



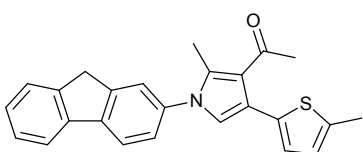
White solid, (244 mg, 78%); IR (KBr): 3072, 2924, 1647, 1508, 1456, 1220, 842 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.22 (s, 3H), 2.36 (s, 3H), 2.49 (s, 3H), 6.68 (s, 1H), 6.70 (d, $J = 3.0$ Hz, 1H), 6.77 (d, $J = 3.0$ Hz, 1H), 7.17 (t, $J = 8.0$ Hz, 2H), 7.27-7.29 (m, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.8, 15.3, 30.6, 116.3 (d, $^2J_{\text{CF}} = 22.8$ Hz), 118.3, 121.8, 122.8, 125.3, 126.9, 128.1 (d, $^3J_{\text{CF}} = 8.6$ Hz), 134.1, 134.5 (d, $^4J_{\text{CF}} = 3.1$ Hz), 135.5, 139.6, 162.1 (d, $^1J_{\text{CF}} = 247.2$ Hz), 197.1 ppm; Anal. Calcd for $\text{C}_{18}\text{H}_{16}\text{FNOS}$: C, 68.99; H, 5.15; N, 4.47; Found: C, 68.82; H, 5.07; N, 4.39; ESI-MS: $m/z = 314$ ($\text{M}+1$) $^+$.

1-(1-(4-Chlorophenyl)-2-methyl-4-(5-methylthiophen-2-yl)-1H-pyrrol-3-yl)ethanone (5af).



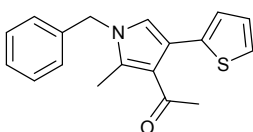
White solid, (230 mg, 70%); IR (KBr): 3047, 2924, 1647, 1489, 1384, 1228, 1070, 833, 804 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.21 (s, 3H), 2.37 (s, 3H), 2.49 (s, 3H), 6.68 (s, 1H), 6.70 (d, $J = 2.5$ Hz, 1H), 6.77 (d, $J = 3.0$ Hz, 1H), 7.19 (d, $J = 8.5$ Hz, 2H), 7.61 (d, $J = 8.5$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.9, 15.3, 30.6, 118.5, 121.5, 121.1, 123.1, 125.4, 127.0, 127.8, 132.6, 134.0, 135.2, 137.5, 139.6, 197.1 ppm; Anal. Calcd for $\text{C}_{18}\text{H}_{16}\text{ClNOS}$: C, 65.54; H, 4.89; N, 4.25; Found: C, 65.37; H, 4.79; N, 4.16; ESI-MS: $m/z = 330$ ($\text{M}+1$) $^+$.

1-(1-(9H-fluoren-2-yl)-2-methyl-4-(5-methylthiophen-2-yl)-1H-pyrrol-3-yl)ethanone (5ag).



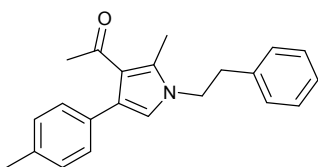
Yellow sticky liquid (307 mg, 80%); IR (KBr): 2922, 1647, 1508, 1458, 1386, 1051, 769 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.24 (s, 3H), 2.42 (s, 3H), 2.50 (s, 3H), 3.97 (s, 2H), 6.71 (d, $J = 3.0$ Hz, 1H), 6.77 (s, 1H), 6.79 (d, $J = 3.5$ Hz, 1H), 7.31 (dd, $J = 1.5, 8.0$ Hz, 1H), 7.35 (t, $J = 7.5$ Hz, 1H), 7.42 (t, $J = 7.5$ Hz, 1H), 7.47 (s, 1H), 7.58 (d, $J = 7.5$ Hz, 1H), 7.82 (d, $J = 7.5$ Hz, 1H), 7.86 (d, $J = 8.0$ Hz, 1H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 13.1, 15.3, 30.6, 36.9, 118.1, 120.2, 120.3, 122.0, 122.7, 123.0, 125.1, 125.1, 125.3, 126.9, 127.1, 127.3, 134.5, 135.7, 137.0, 139.4, 140.5, 141.8, 143.4, 144.3, 197.1 ppm; Anal. Calcd for $\text{C}_{25}\text{H}_{21}\text{NOS}$: C, 78.30; H, 5.52; N, 3.65; Found: C, 78.21; H, 5.39; N, 3.47; ESI-MS: $m/z = 384$ ($\text{M}+1$) $^+$.

1-(1-Benzyl-2-methyl-4-(thiophen-2-yl)-1H-pyrrol-3-yl)ethanone (5ah).



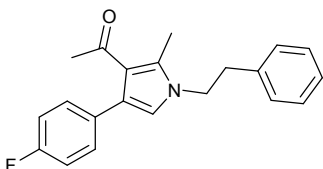
White solid, (236 mg, 80%); IR (KBr): 2922, 1635, 1508, 1458, 1174, 846 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.14 (s, 3H), 3.04 (s, 3H), 5.04 (s, 2H), 6.63 (s, 1H), 6.95 (s, 1H), 7.03 (s, 1H), 7.08 (d, $J = 7.5$ Hz, 2H), 7.28-7.36 (m, 3H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 11.7, 30.5, 50.3, 117.2, 121.5, 122.5, 124.9, 126.7, 126.9, 127.1, 127.9, 129.0, 135.5, 136.3, 137.1, 197.0 ppm; Anal. Calcd for $\text{C}_{18}\text{H}_{17}\text{NOS}$: C, 73.19; H, 5.80; N, 4.74; Found: C, 73.06; H, 5.65; N, 4.59; ESI-MS: $m/z = 296$ ($\text{M}+1$) $^+$.

1-(2-Methyl-1-phenethyl-4-(p-tolyl)-1H-pyrrol-3-yl)ethanone (5ai).



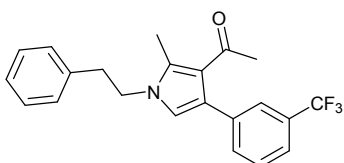
White solid, (278 mg, 88%); IR (KBr): 3105, 2922, 1631, 1508, 1415, 1176, 950, 827 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.00 (s, 3H), 2.37 (s, 3H), 2.38 (s, 3H), 3.00 (t, $J = 7.5$ Hz, 2H), 4.04 (t, $J = 7.5$ Hz, 2H), 6.38 (s, 1H), 7.10 (d, $J = 7.5$ Hz, 2H), 7.14-7.18 (s, 4H), 7.23-7.26 (m, 1H), 7.29 (t, $J = 7.5$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 11.3, 21.2, 31.1, 37.5, 48.0, 119.2, 121.6, 125.7, 126.9, 128.7, 128.9, 129.2, 133.4, 134.6, 136.2, 137.7, 197.5 ppm; Anal. Calcd for $\text{C}_{22}\text{H}_{23}\text{NO}$: C, 83.24; H, 7.30; N, 4.41; Found: C, 83.14; H, 7.11; N, 4.36; ESI-MS: $m/z = 318$ ($\text{M}+1$) $^+$.

1-(4-(4-Fluorophenyl)-2-methyl-1-phenethyl-1H-pyrrol-3-yl)ethanone (5aj).



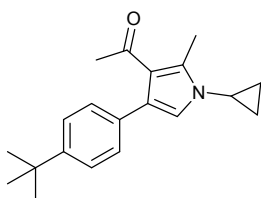
White solid, (285 mg, 89%); IR (KBr): 3082, 2922, 1641, 1508, 1419, 1222, 1089, 837 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 1.98 (s, 3H), 2.38 (s, 3H), 3.00 (t, $J = 7.5$ Hz, 2H), 4.05 (t, $J = 7.0$ Hz, 2H), 6.36 (s, 1H), 7.04 (t, $J = 8.5$ Hz, 2H), 7.09 (d, $J = 7.0$ Hz, 2H), 7.21-7.24 (m, 3H), 7.30 (t, $J = 7.0$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 11.4, 31.0, 37.5, 48.1, 115.1 (d, $^2J_{\text{CF}} = 21.2$ Hz), 119.5, 121.6, 124.6, 127.0, 128.7, 130.8 (d, $^3J_{\text{CF}} = 8.0$ Hz), 132.4 (d, $^4J_{\text{CF}} = 3.3$ Hz), 134.8, 137.6, 161.9 (d, $^1J_{\text{CF}} = 243.8$ Hz), 197.0 ppm; Anal. Calcd for $\text{C}_{21}\text{H}_{20}\text{FNO}$: C, 78.48; H, 6.27; N, 4.36; Found: C, 78.32; H, 6.16; N, 4.30; ESI-MS: $m/z = 322$ ($\text{M}+1$) $^+$.

1-(2-Methyl-1-phenethyl-4-(3-(trifluoromethyl)phenyl)-1H-pyrrol-3-yl)ethanone (5ak).



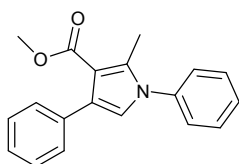
Yellow sticky liquid (315 mg, 85%); IR (KBr): 3030, 2951, 1647, 1506, 1228, 1176, 949 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.00 (s, 3H), 2.38 (s, 3H), 3.01 (t, $J = 7.5$ Hz, 2H), 4.07 (t, $J = 7.0$ Hz, 2H), 6.41 (s, 1H), 7.09 (d, $J = 7.0$ Hz, 2H), 7.26 (t, $J = 7.5$ Hz, 1H), 7.30 (t, $J = 7.5$ Hz, 2H), 7.45-7.48 (m, 2H), 7.53 (s, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 11.3, 31.0, 37.5, 48.2, 119.9, 121.5, 123.2 (q, $^3J_{\text{FC}} = 3.5$ Hz), 124.1, 124.1 (q, $^1J_{\text{FC}} = 270.5$ Hz), 125.8 (q, $^3J_{\text{FC}} = 3.6$ Hz), 127.0, 128.5, 128.7, 130.5 (q, $^2J_{\text{FC}} = 32.2$ Hz), 132.6, 135.2, 137.2, 137.5, 196.7 ppm; Anal. Calcd for $\text{C}_{22}\text{H}_{20}\text{F}_3\text{NO}$: C, 71.15; H, 5.43; N, 3.77; Found: C, 71.02; H, 5.27; N, 3.59; ESI-MS: $m/z = 372$ ($\text{M}+1$) $^+$.

1-(4-(4-(tert-butyl)phenyl)-1-cyclopropyl-2-methyl-1H-pyrrol-3-yl)ethanone (5al).



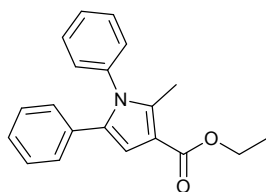
Yellow sticky liquid (259 mg, 88%); IR (KBr): 3012, 2926, 1653, 1508, 1417, 1222, 1030, 952, 840 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 0.95 (q, $J = 5.0$ Hz, 2H), 1.03 (q, $J = 7.5$ Hz, 2H), 1.34 (s, 9H), 2.02 (s, 3H), 2.58 (s, 3H), 3.12-3.17 (m, 1H), 6.49 (s, 1H), 7.22 (d, $J = 8.0$ Hz, 2H), 7.36 (d, $J = 8.0$ Hz, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 6.7, 12.2, 28.1, 31.0, 31.4, 34.4, 119.5, 121.9, 124.9, 125.0, 128.9, 133.3, 137.1, 149.4, 197.3 ppm; Anal. Calcd for $\text{C}_{20}\text{H}_{25}\text{NO}$: C, 81.31; H, 8.53; N, 4.74; Found: C, 81.25; H, 8.36; N, 4.62; ESI-MS: $m/z = 296$ ($\text{M}+1$) $^+$.

Methyl 2-methyl-1,4-diphenyl-1H-pyrrole-3-carboxylate (5am).



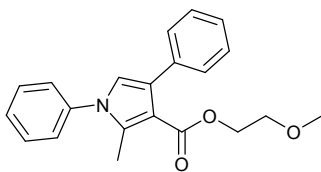
Yellow sticky liquid (233 mg, 80%); IR (KBr): 3050, 2914, 1699, 1500, 1420, 1220 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.46 (s, 3H), 3.70 (s, 3H), 6.72 (s, 1H), 7.26-7.29 (m, 1 H), 7.32-7.37 (m, 4H), 7.42-7.43 (m, 3H), 7.44-7.51 (m, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.8, 50.6, 111.4, 121.0, 126.3, 126.6, 127.7, 128.1, 129.1, 129.4, 135.5 136.8, 138.9, 166.3 ppm; Anal. Calcd for $\text{C}_{19}\text{H}_{17}\text{NO}_2$: C, 78.33; H, 5.88; N, 4.81; Found: C, 78.27; H, 5.71; N, 4.71; ESI-MS: $m/z = 292$ ($\text{M}+1$) $^+$.

Ethyl 2-methyl-1,5-diphenyl-1H-pyrrole-3-carboxylate (5an).



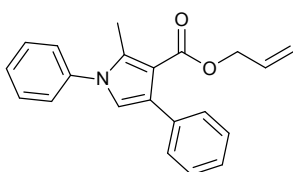
Yellow sticky liquid (250 mg, 82%); IR (KBr): 3050, 2980, 1695, 1590, 1519, 1380, 1224 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 1.14 (t, $J = 7.0$ Hz, 3H), 2.46 (s, 3H), 4.19 (q, $J = 7.0$ Hz, 2H), 6.72 (s, 1H), 7.25-7.28 (m, 1H), 7.32-7.35 (m, 4H), 7.41-7.44 (m, 3H), 7.47-7.50 (m, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.7, 14.1, 59.5, 111.8, 120.9, 126.3, 126.7, 127.6, 128.1, 129.3, 129.4, 135.6, 136.6, 139.0, 165.8 ppm; Anal. Calcd for $\text{C}_{20}\text{H}_{19}\text{NO}_2$: C, 78.66; H, 6.27; N, 4.59; Found: C, 78.48; H, 6.16; N, 4.45; ESI-MS: $m/z = 306$ ($\text{M}+1$) $^+$.

2-Methoxyethyl 2-methyl-1,4-diphenyl-1H-pyrrole-3-carboxylate (5ao).



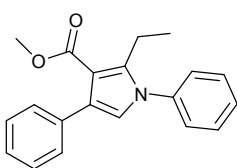
Yellow sticky liquid (268 mg, 80%); IR (KBr): 3055, 2920, 1695, 1510, 1420, 1222 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.46 (s, 3H), 3.24 (s, 3H), 3.47 (t, $J = 5.0$ Hz, 2H), 4.28 (t, $J = 5.0$ Hz, 2H), 6.71 (s, 1H), 7.25-7.28 (m, 1 H), 7.31-7.35 (m, 4H), 7.40-7.44 (m, 3H), 7.47-7.50 (m, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.8, 58.7, 62.6, 70.4, 111.4, 121.0, 126.8, 127.6, 128.1, 129.4, 135.6, 136.9, 138.9, 165.6 ppm; Anal. Calcd for $\text{C}_{21}\text{H}_{21}\text{NO}_3$: C, 75.20; H, 6.31; N, 4.18; Found: C, 75.03; H, 6.29; N, 4.10; ESI-MS: $m/z = 336$ ($\text{M}+1$) $^+$.

Allyl 2-methyl-1,4-diphenyl-1H-pyrrole-3-carboxylate (5ap).



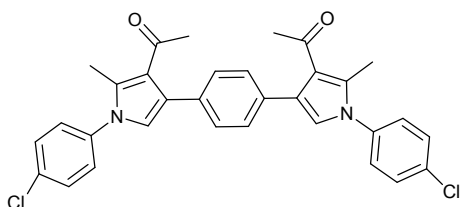
Yellow sticky liquid (248 mg, 78%); IR (KBr): 3050, 2929, 1940, 1697, 1521, 1400, 1276, 1222, 977 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.46 (s, 3H), 4.65 (d, $J = 5.5$ Hz, 2H), 5.07-5.10 (m, 2H), 5.78-5.86 (m, 1H), 6.71 (s, 1H), 7.25-7.27 (m, 1 H), 7.31-7.35 (m, 4H), 7.41-7.45 (m, 3H), 7.47-7.50 (m, 2H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.8, 64.4, 111.5, 117.4, 121.0, 126.3, 126.4, 126.8, 127.7, 128.2, 129.3, 129.4, 132.6, 135.6, 136.9, 138.9, 165.4 ppm; Anal. Calcd for $\text{C}_{21}\text{H}_{19}\text{NO}_2$: C, 79.47; H, 6.03; N, 4.41; Found: C, 79.30; H, 5.88; N, 4.30; ESI-MS: $m/z = 318$ ($\text{M}+1$) $^+$.

Methyl 2-ethyl-1,4-diphenyl-1H-pyrrole-3-carboxylate (5aq).



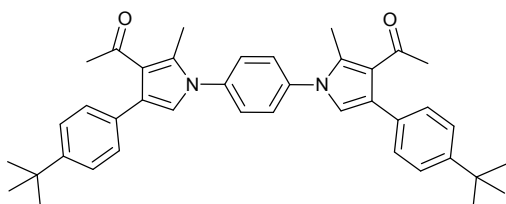
Yellow sticky liquid (244 mg, 80%); IR (KBr): 3030, 2928, 1702, 1541, 1276, 1224 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 1.10 (t, $J = 7.5$ Hz, 3H), 2.85 (q, $J = 7.5$ Hz, 2H), 3.69 (s, 3H), 6.66 (s, 1H), 7.27-7.50 (m, 10H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 14.6, 19.2, 50.6, 110.3, 121.2, 126.2, 126.4, 126.7, 127.6, 128.4, 129.1, 129.3, 135.5, 139.0, 143.0, 166.1 ppm; Anal. Calcd for $\text{C}_{20}\text{H}_{19}\text{NO}_2$: C, 78.66; H, 6.27; N, 4.59; Found: C, 78.51; H, 6.29; N, 4.46; ESI-MS: $m/z = 306$ ($\text{M}+1$) $^+$.

1,1'-(4,4'-(1,4-Phenylene)bis(1-(4-chlorophenyl)-2-methyl-1H-pyrrole-4,3-diyl))diethanone (6).



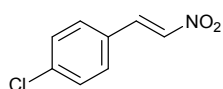
White solid, (405 mg, 75%); IR (KBr): 3120, 2924, 1647, 1508, 1224, 947, 852 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 2.10 (s, 6H), 2.42 (s, 6H), 6.71 (s, 2H), 7.37 (d, $J = 6.0$ Hz, 4H), 7.38 (s, 4H), 7.43 (d, $J = 6.5$ Hz, 4H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 12.9, 31.1, 120.4, 123.0, 124.4, 126.5, 128.4, 129.2, 130.3, 134.4, 135.1, 139.8, 197.5 ppm; Anal. Calcd for $\text{C}_{32}\text{H}_{26}\text{Cl}_2\text{N}_2\text{O}_2$: C, 70.98; H, 4.84; N, 5.17; Found: C, 70.90; H, 4.72; N, 5.03; ESI-MS: $m/z = 541$ ($\text{M}+1$) $^+$.

1,1'-(1,1'-(1,4-Phenylene)bis(4-(4-(tert-butyl)phenyl)-2-methyl-1H-pyrrole-3,1-diyl))diethanone (7).



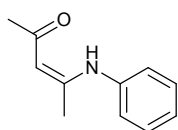
White solid, (455 mg, 78%); IR (KBr): 3130, 1964, 1637, 1508, 1417, 1232, 1016, 835 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 1.35 (s, 18H), 2.10 (s, 6H), 2.46 (s, 6H), 6.70 (s, 2H), 7.31 (d, $J = 8.5$ Hz, 4H), 7.41 (d, $J = 8.5$ Hz, 4H), 7.46 (s, 4H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 13.0, 31.2, 31.4, 34.5, 120.3, 123.1, 125.2, 126.7, 127.0, 128.9, 132.6, 134.9, 138.3, 150.0, 197.8 ppm; Anal. Calcd for $\text{C}_{40}\text{H}_{44}\text{N}_2\text{O}_2$: C, 82.15; H, 7.58; N, 4.79; Found: C, 82.02; H, 7.47; N, 4.69; ESI-MS: $m/z = 585$ ($\text{M}+1$) $^+$.

(E)-1-Chloro-4-(2-nitrovinyl)benzene (intermediate A).



Yellow solid, mp 109-110 $^\circ\text{C}$; IR (KBr): 3039, 1633, 1516, 1338, 1259 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 7.43 (d, $J = 8.5$ Hz, 2H), 7.49 (d, $J = 8.5$ Hz, 2H), 7.56 (d, $J = 13.5$ Hz, 1H), 7.96 (d, $J = 13.5$ Hz, 1H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 128.5, 129.7, 130.3, 137.4, 137.7, 138.3 ppm; Anal. Calcd for $\text{C}_8\text{H}_6\text{ClNO}_2$: C, 52.34; H, 3.29; N, 7.63; Found: C, 52.24; H, 3.11; N, 7.50; ESI-MS: $m/z = 184$ ($\text{M}+1$) $^+$.

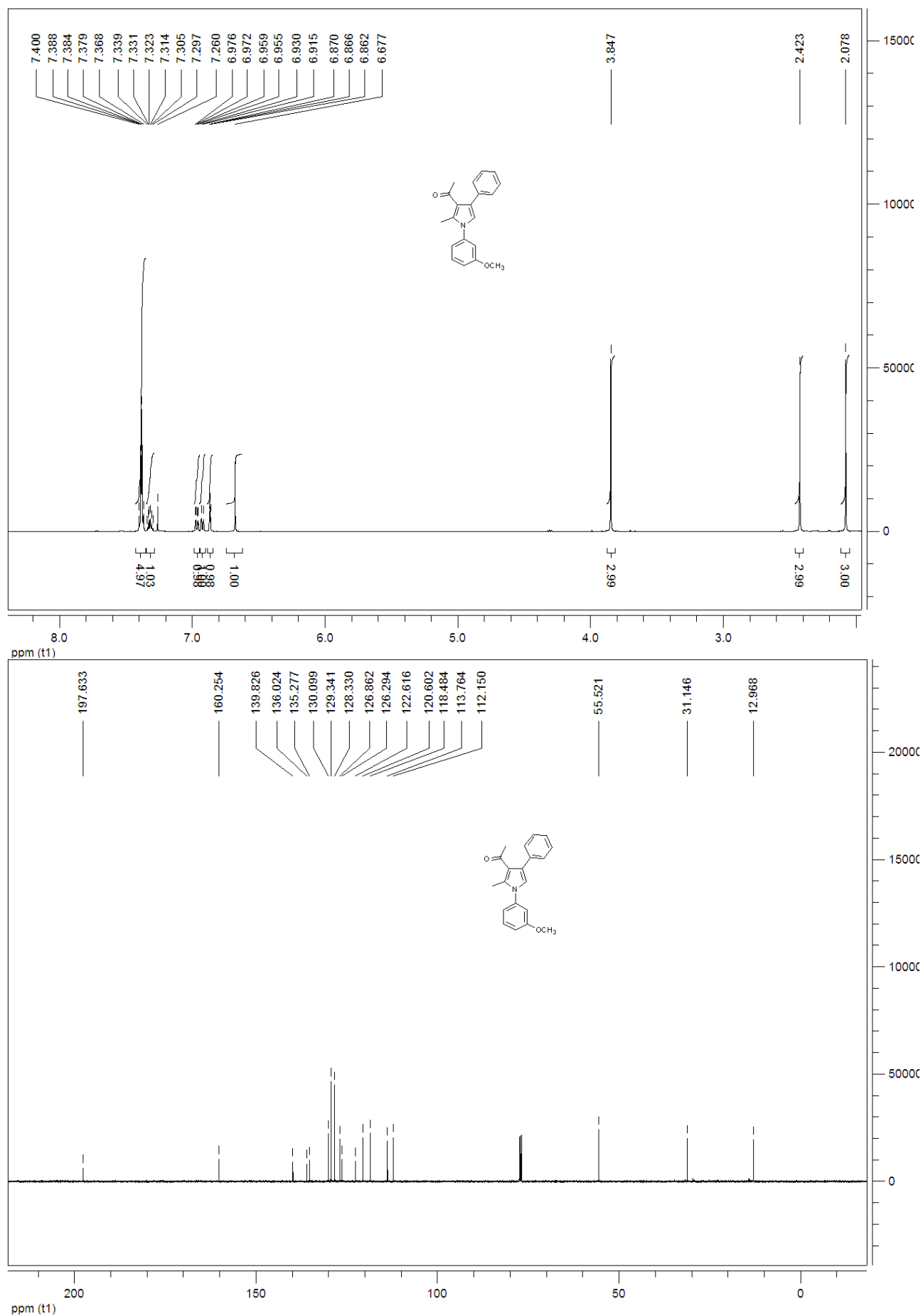
(Z)-4-(Phenylamino)pent-3-en-2-one (intermediate B).



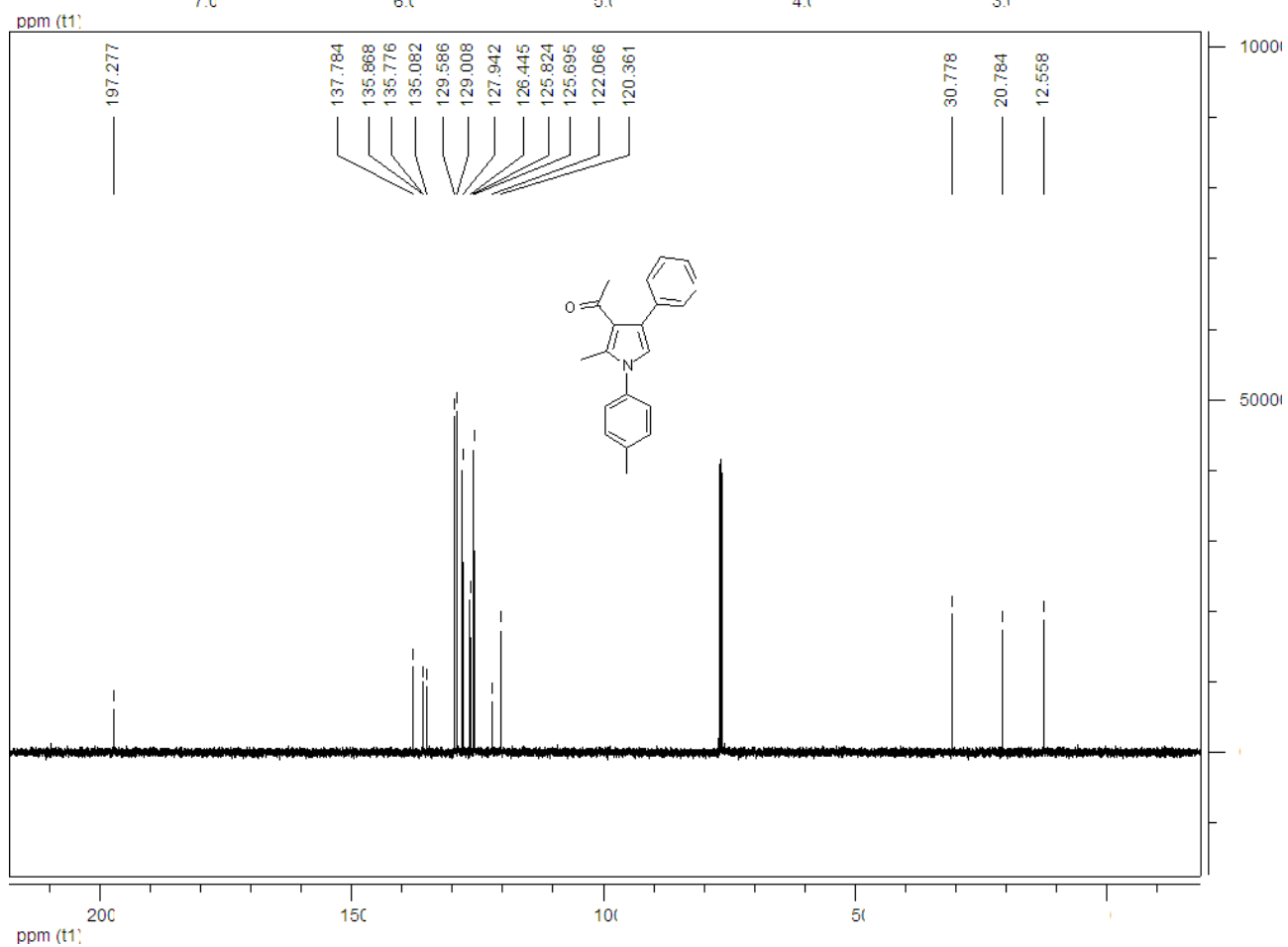
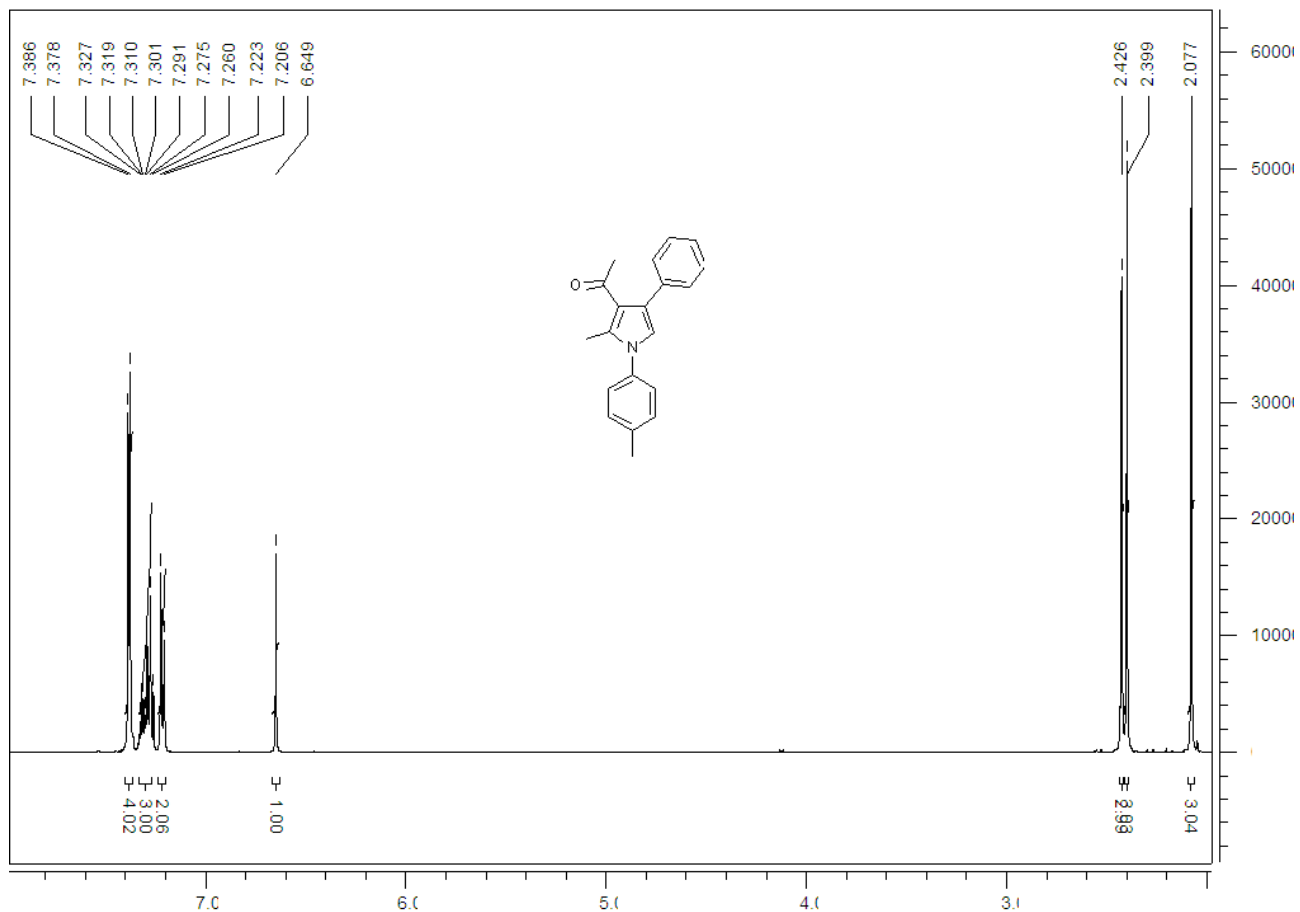
Yellow sticky liquid; IR (KBr): 3030, 2995, 2926, 2854, 1614, 1556, 1504, 1435, 1278, 1188, 1024 cm^{-1} ; ^1H NMR (CDCl_3 , 500 MHz) δ 1.98 (s, 3H), 2.09 (s, 3H), 5.18 (s, 1H), 7.10 (d, $J = 7.5$

Hz , 2H), 7.18 (t, $J = 7.5$ Hz, 1H), 7.35 (t, $J = 8.0$ Hz, 2H), 12.46 (s, 1H) ppm; ^{13}C NMR (CDCl_3 , 125MHz) δ 19.8, 28.1, 124.7, 125.5, 129.0, 138.7, 160.2, 196.1 ppm; Anal. Calcd for $\text{C}_{11}\text{H}_{13}\text{NO}$: C, 75.40; H, 7.48; N, 7.99; Found: C, 75.23; H, 7.40; N, 7.87; ESI-MS: $m/z = 176$ ($\text{M}+1$) $^+$.

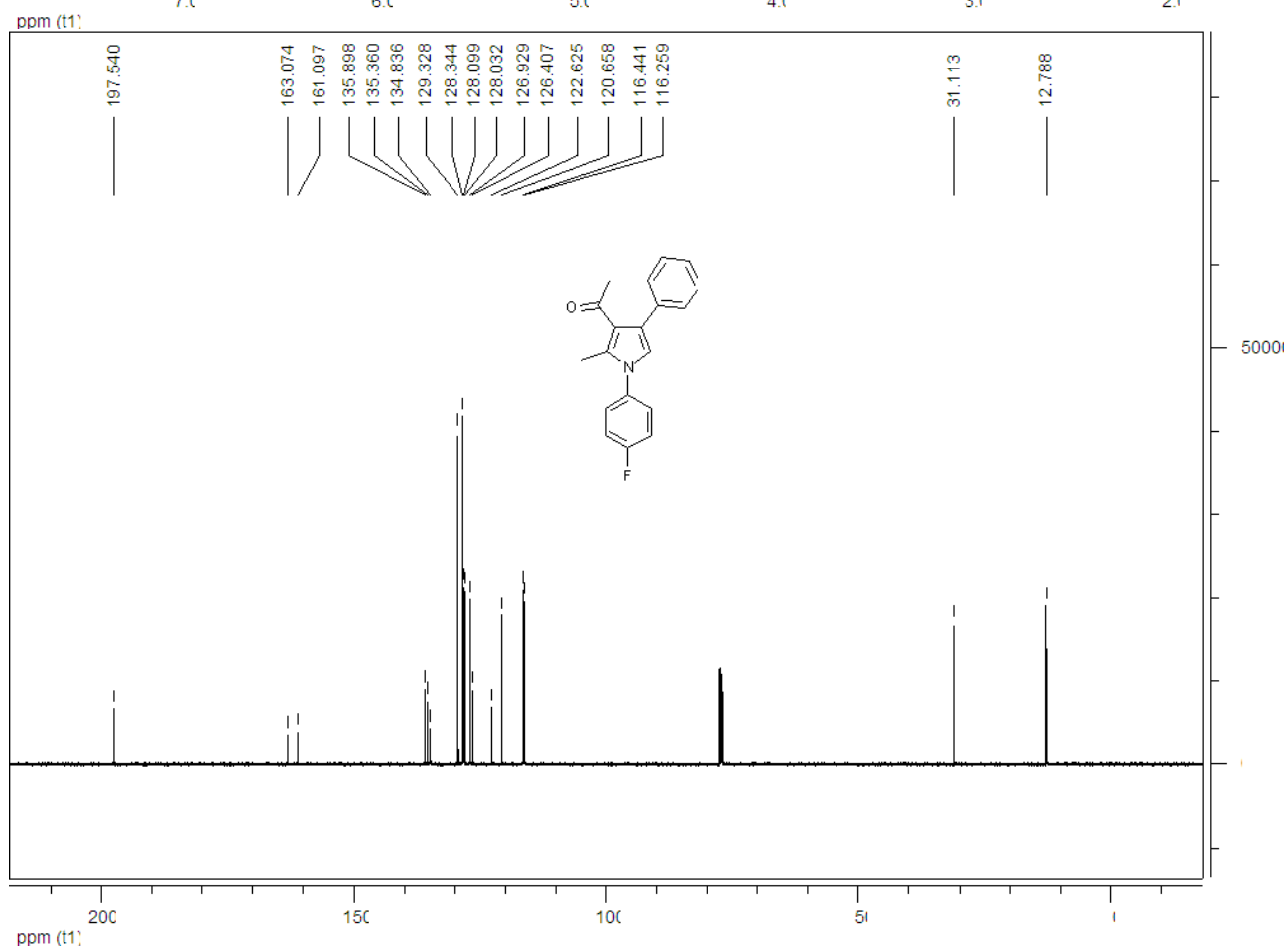
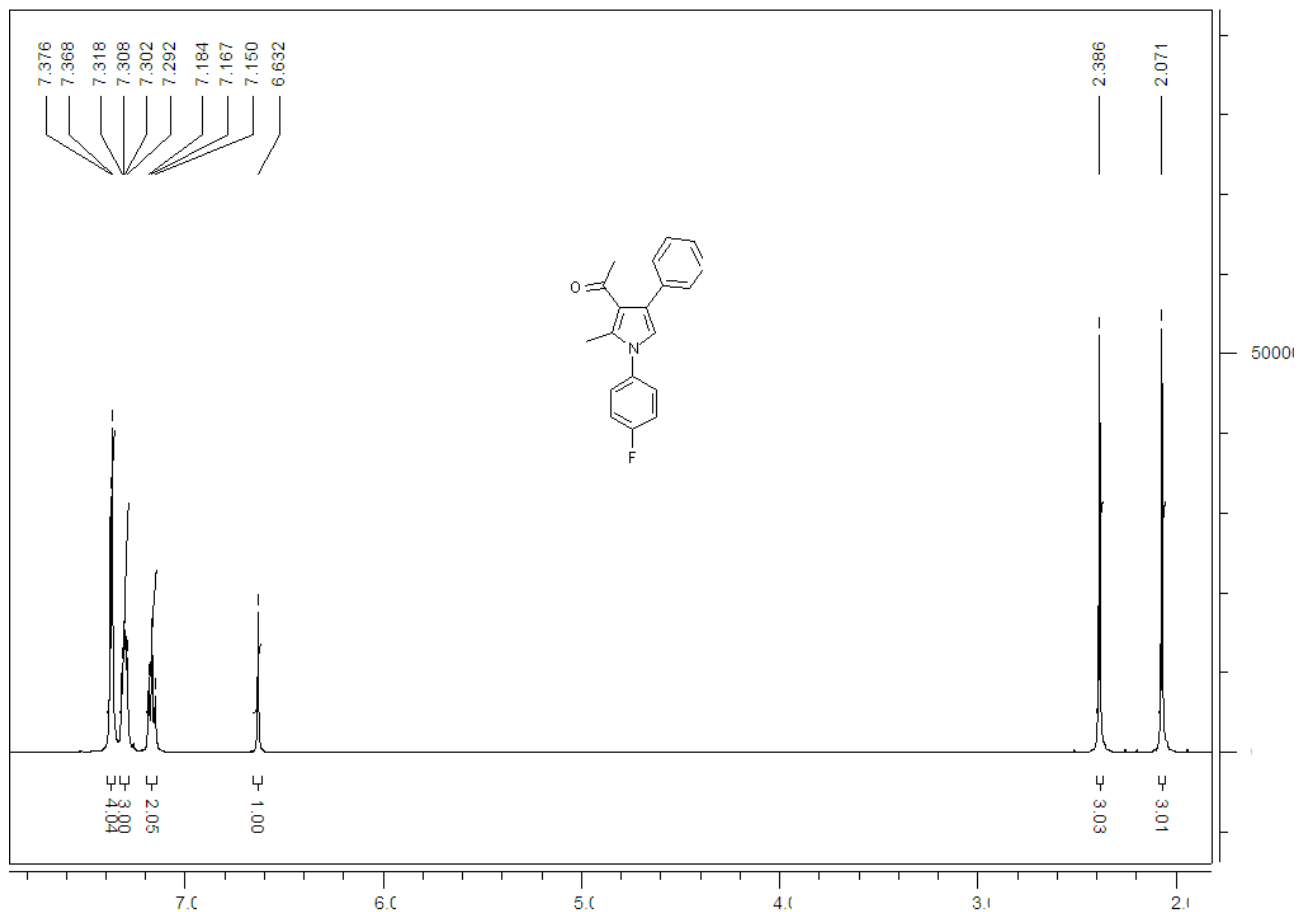
^1H NMR and ^{13}C NMR of compound **5b**



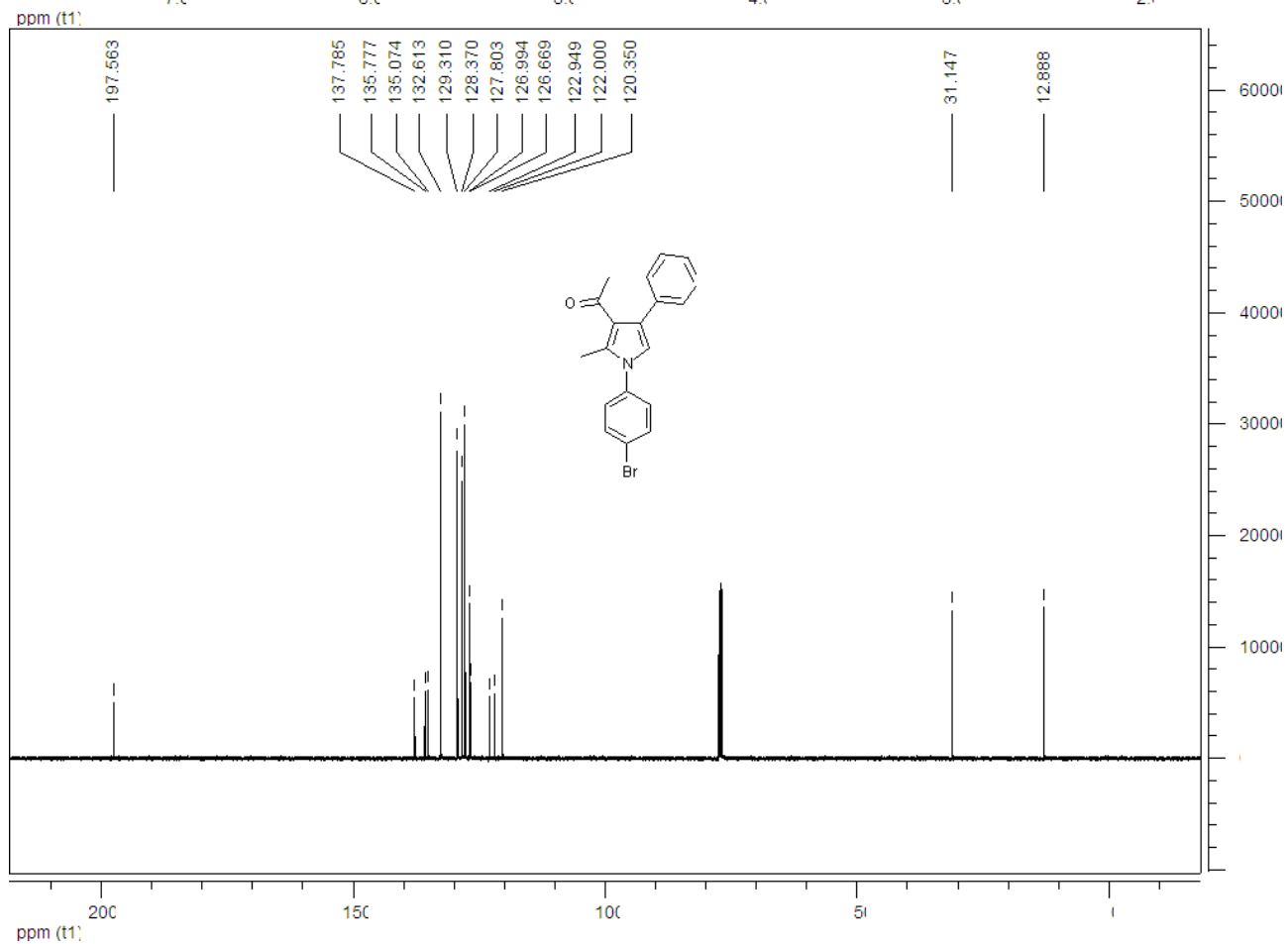
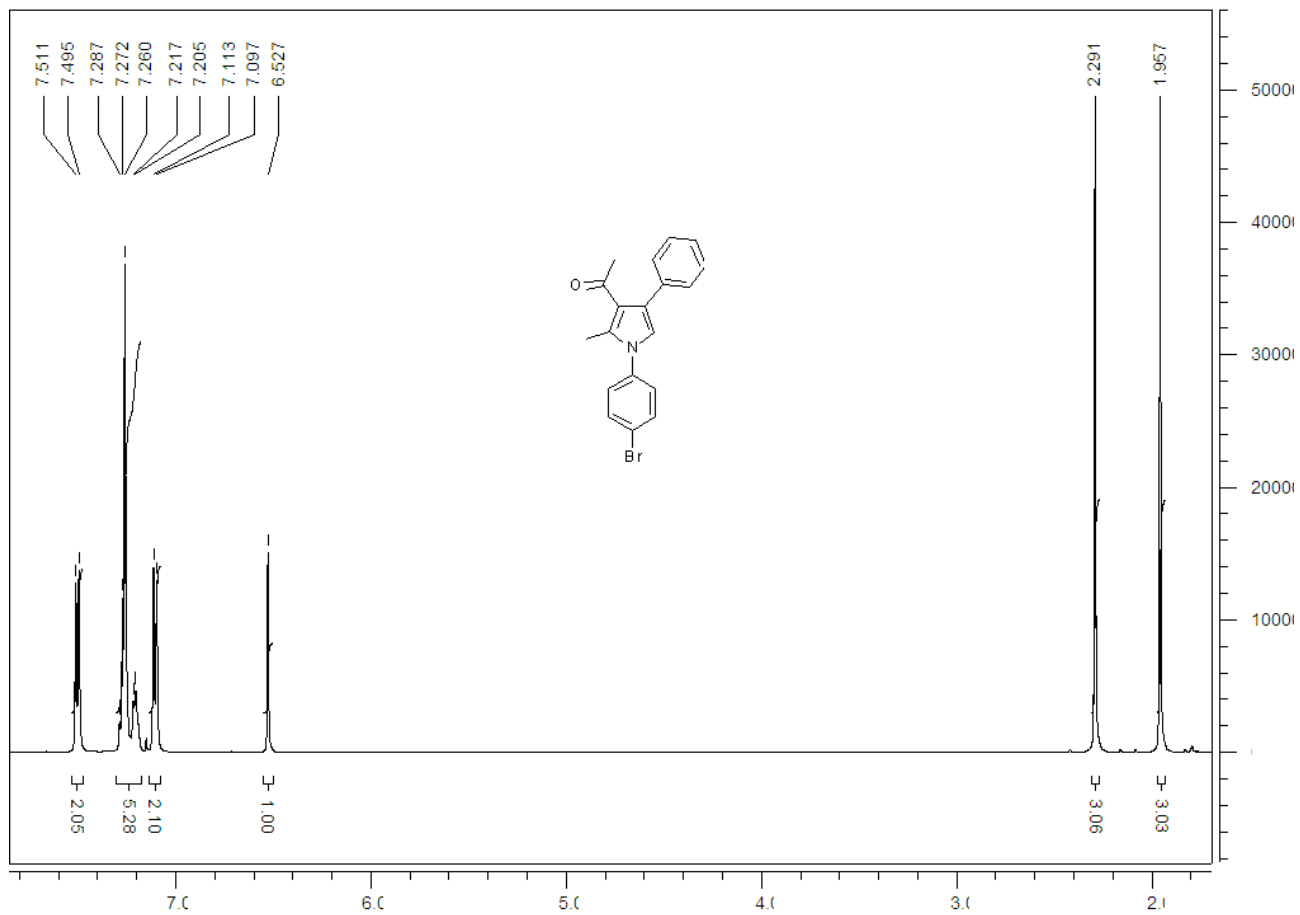
¹H NMR and ¹³C NMR of compound **5c**



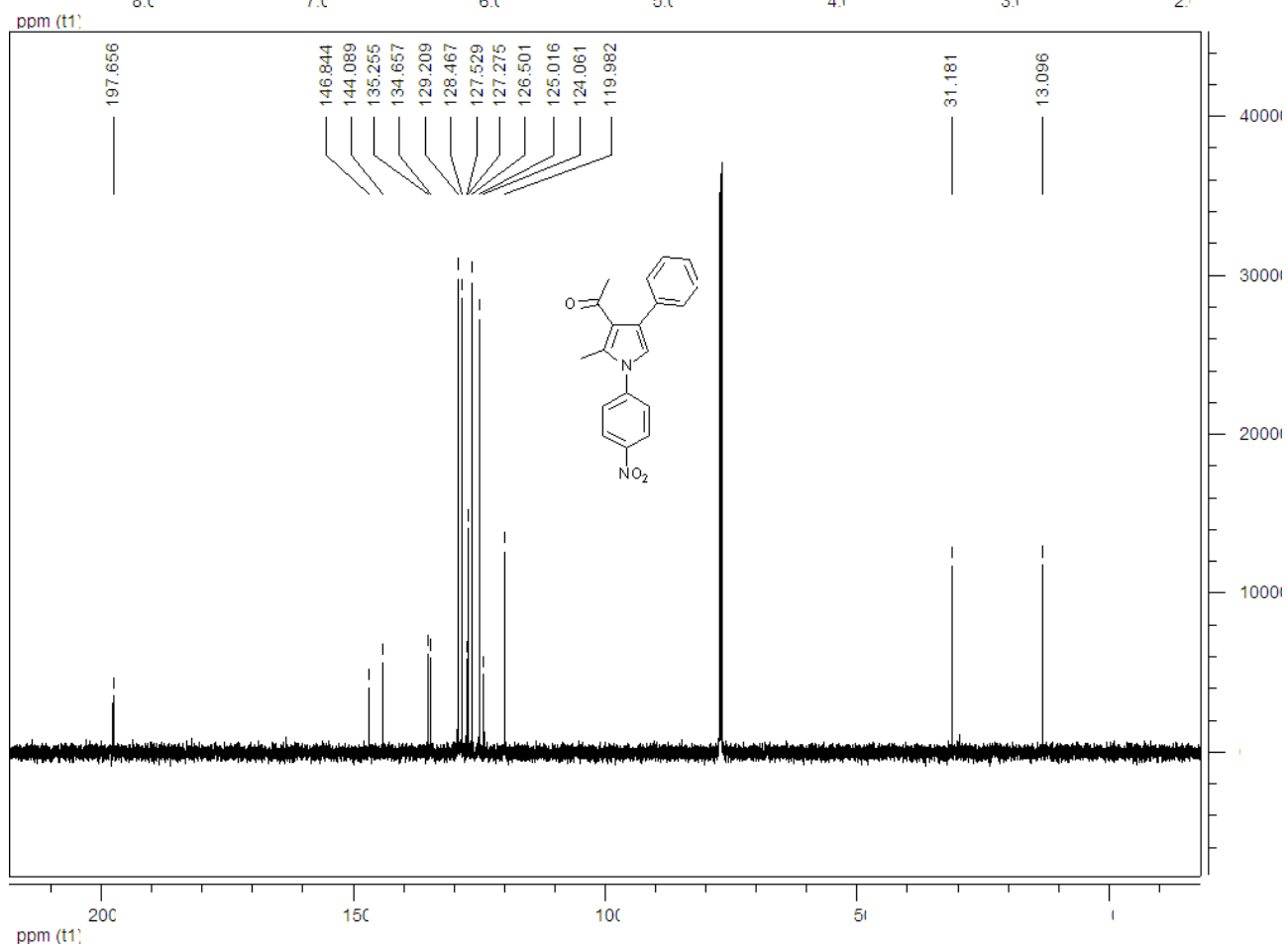
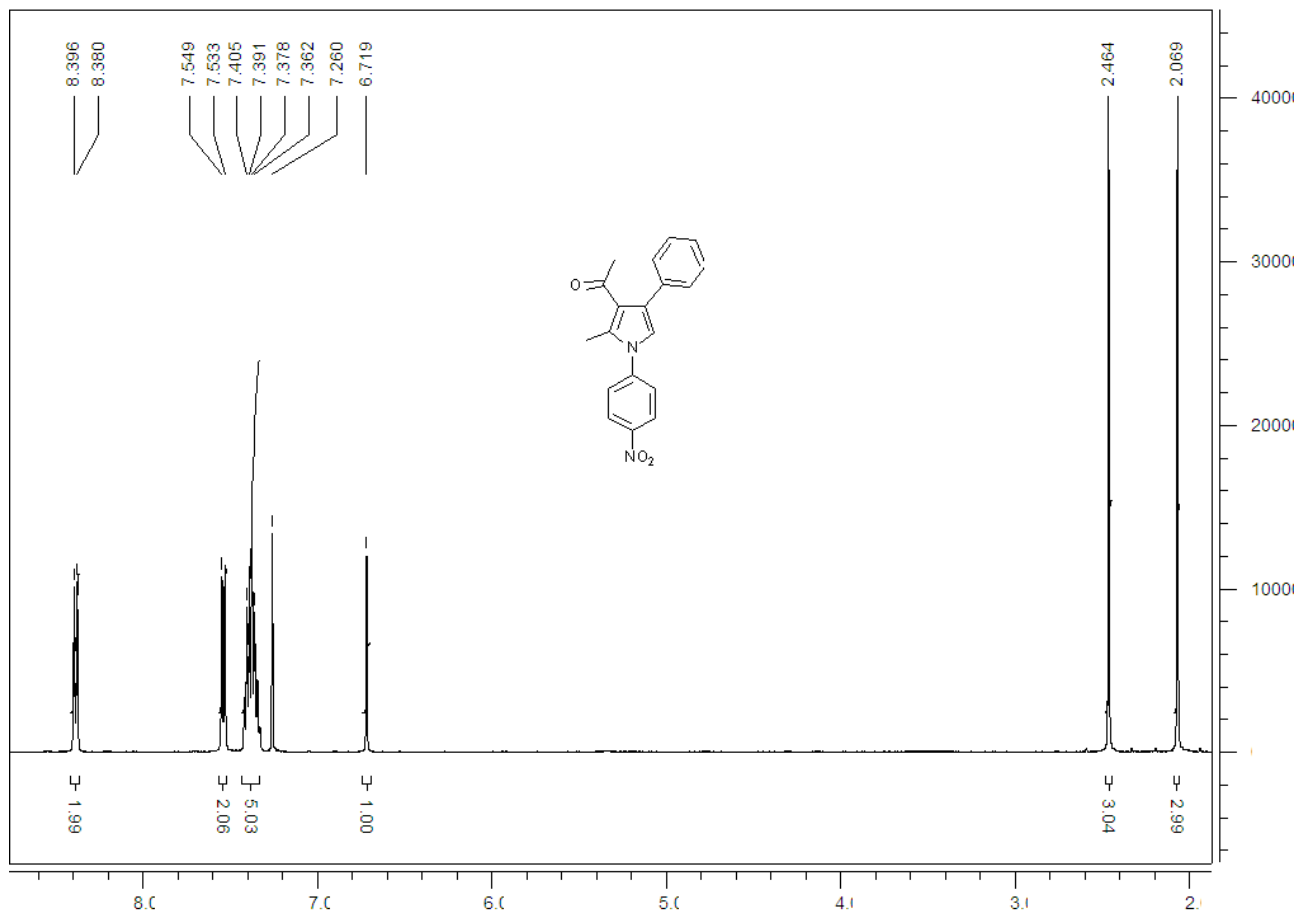
¹H NMR and ¹³C NMR of compound **5d**



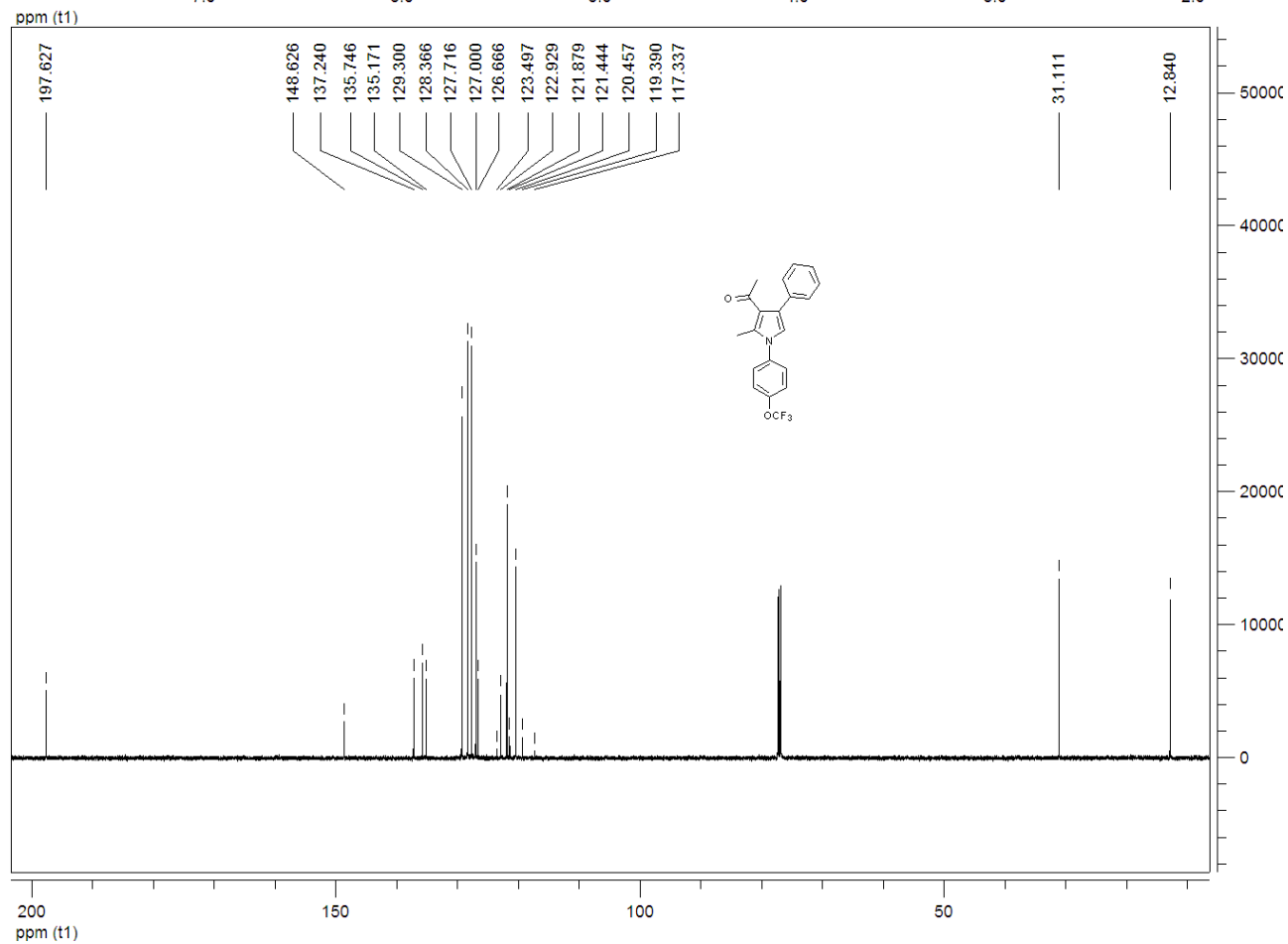
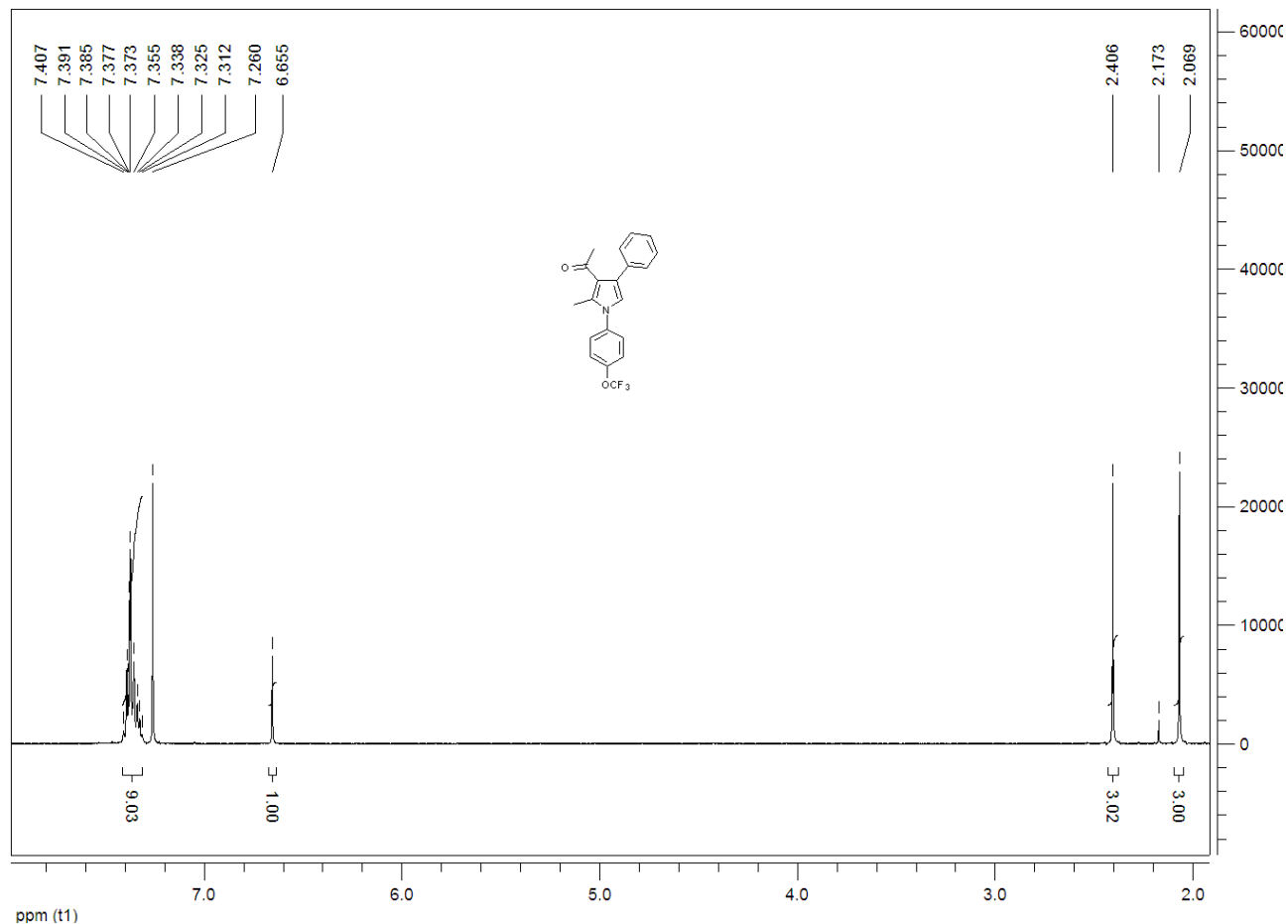
¹H NMR and ¹³C NMR of compound **5f**



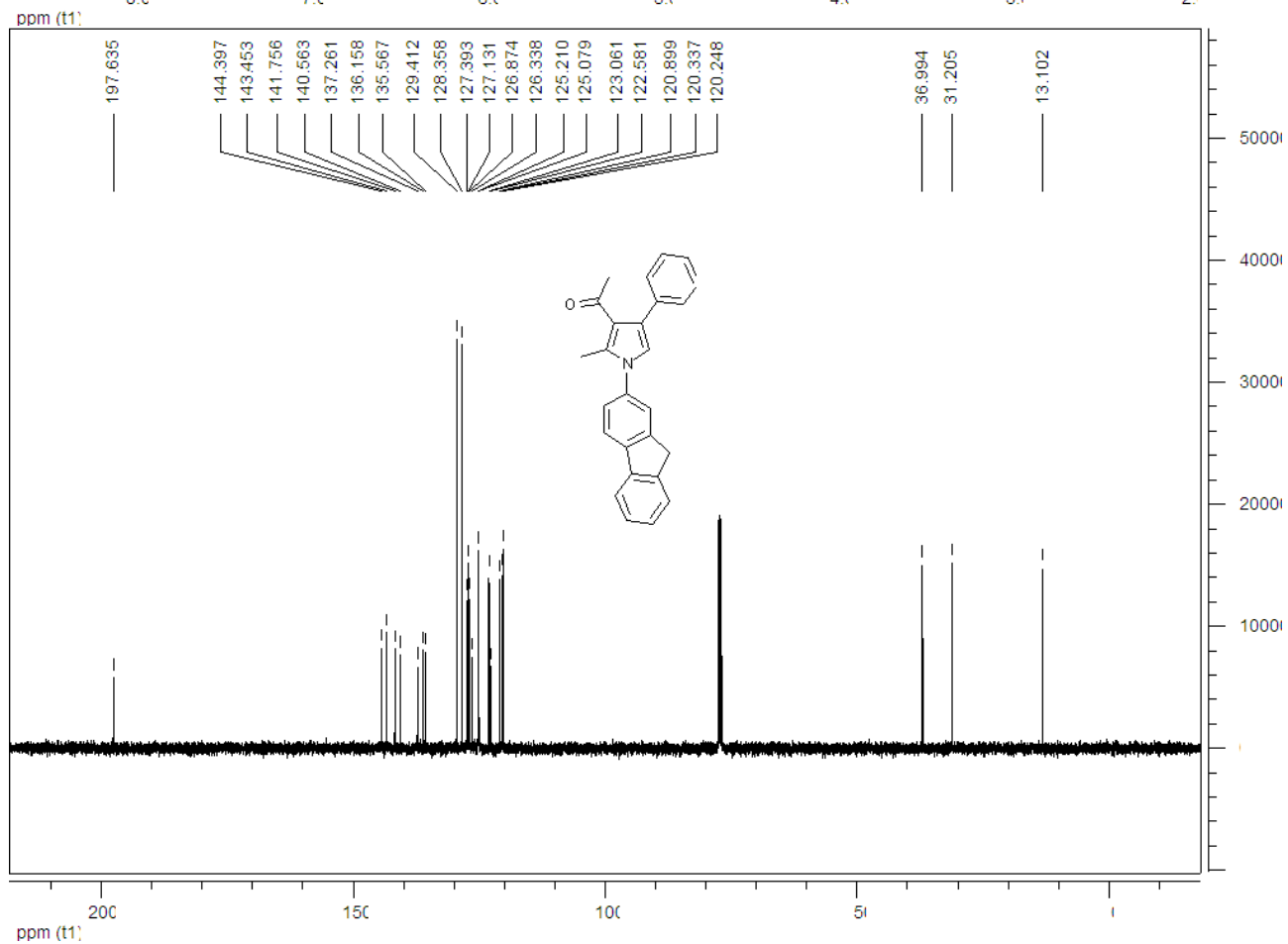
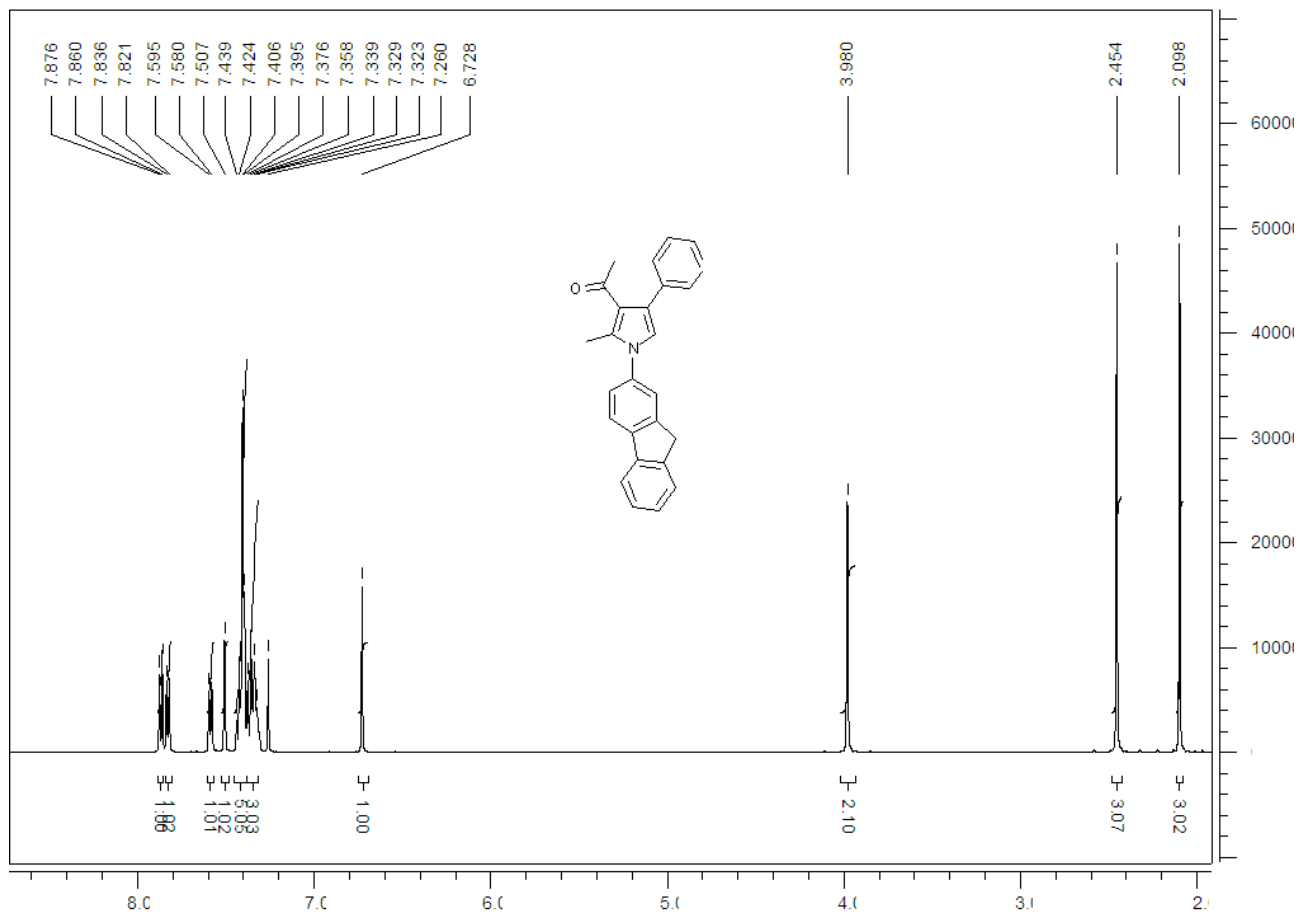
¹H NMR and ¹³C NMR of compound **5g**



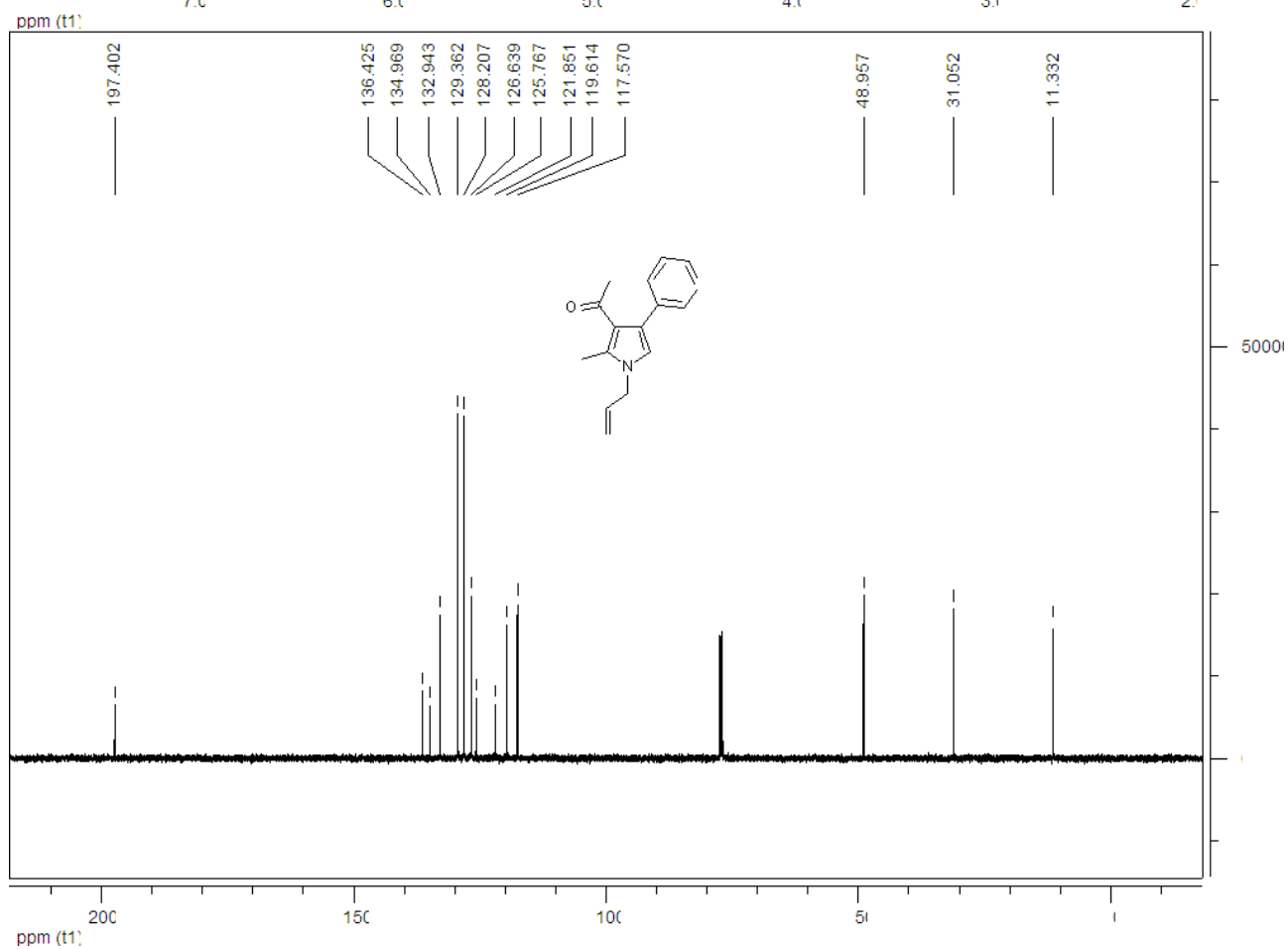
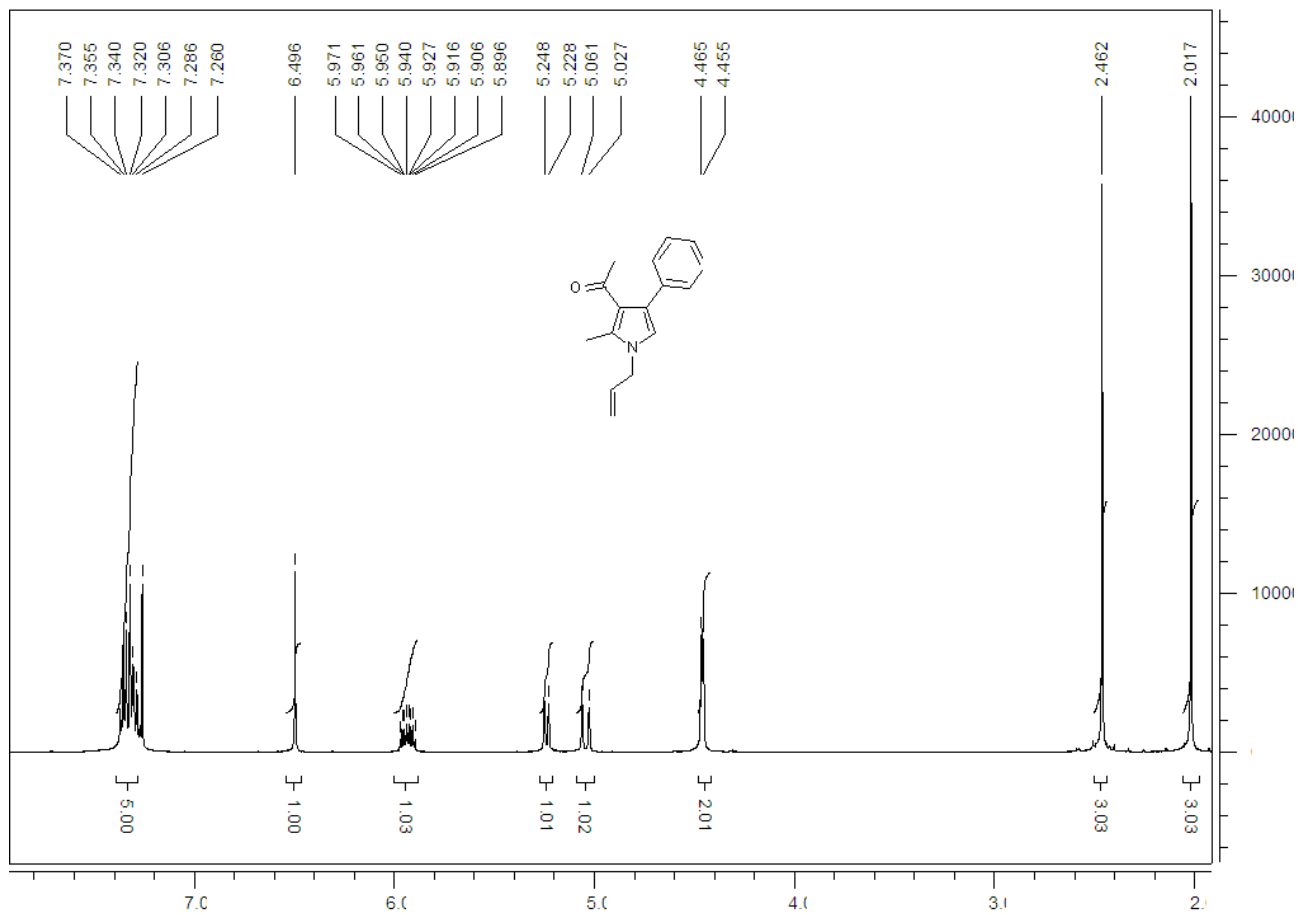
^1H NMR and ^{13}C NMR of compound **5h**



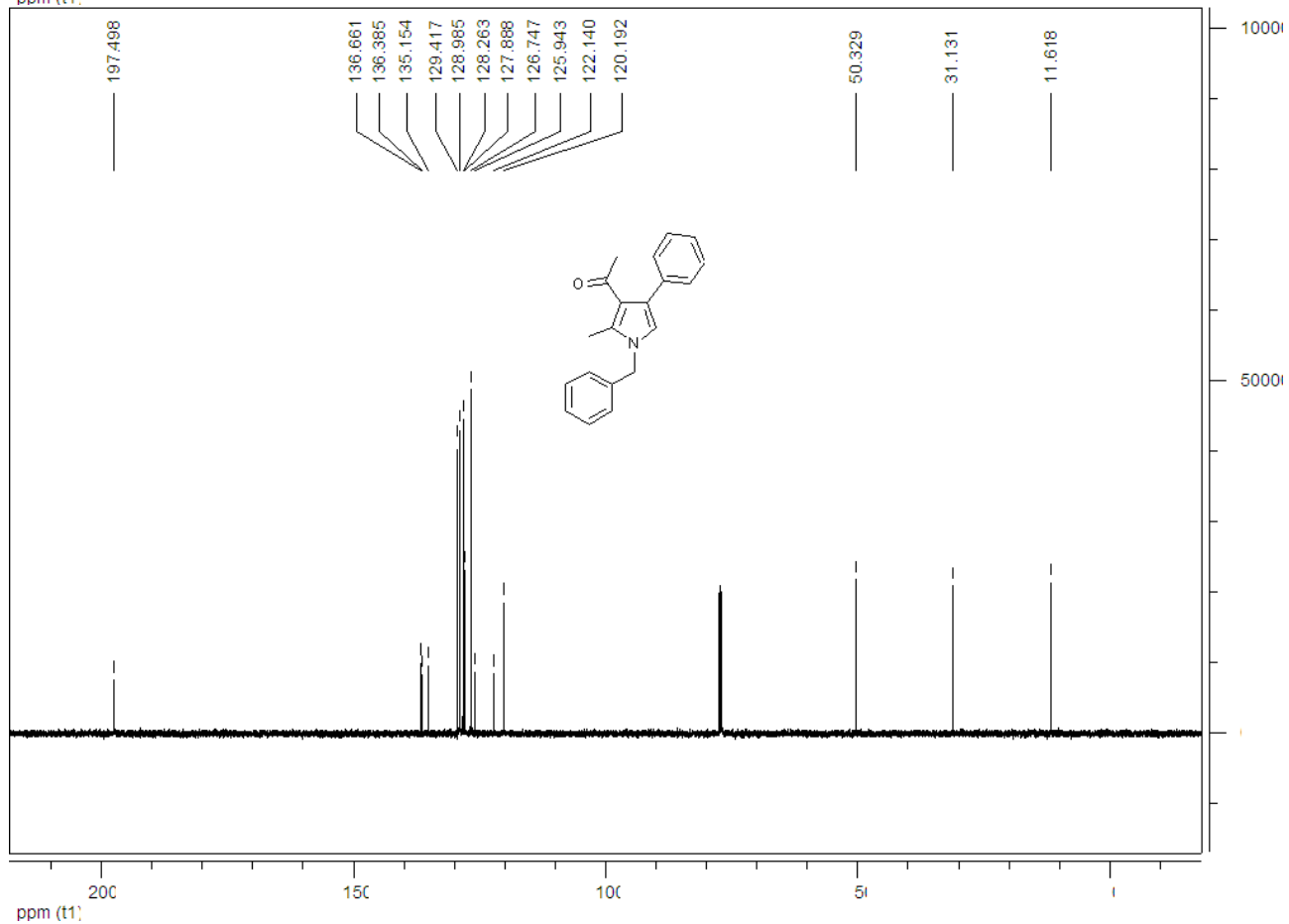
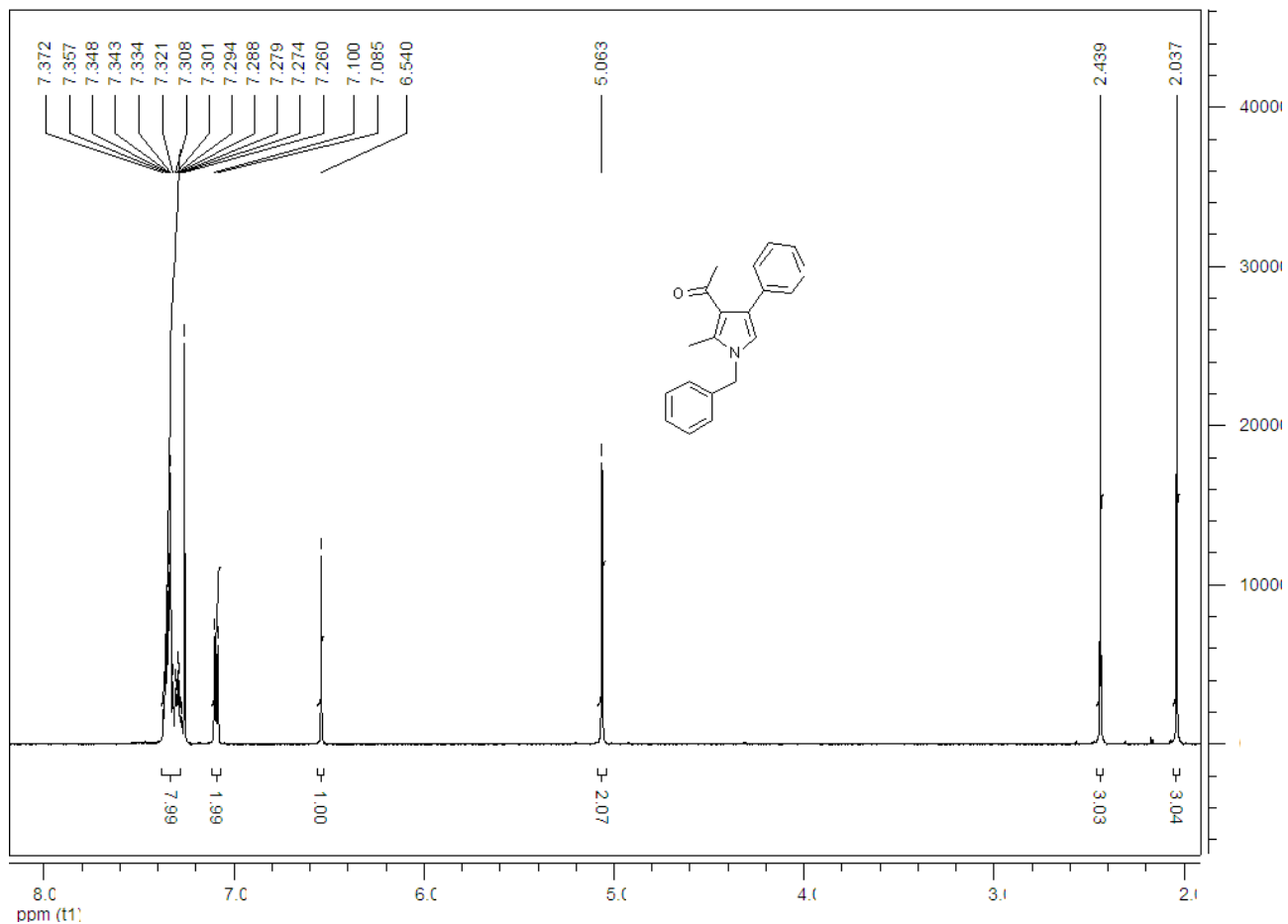
¹H NMR and ¹³C NMR of compound **5j**



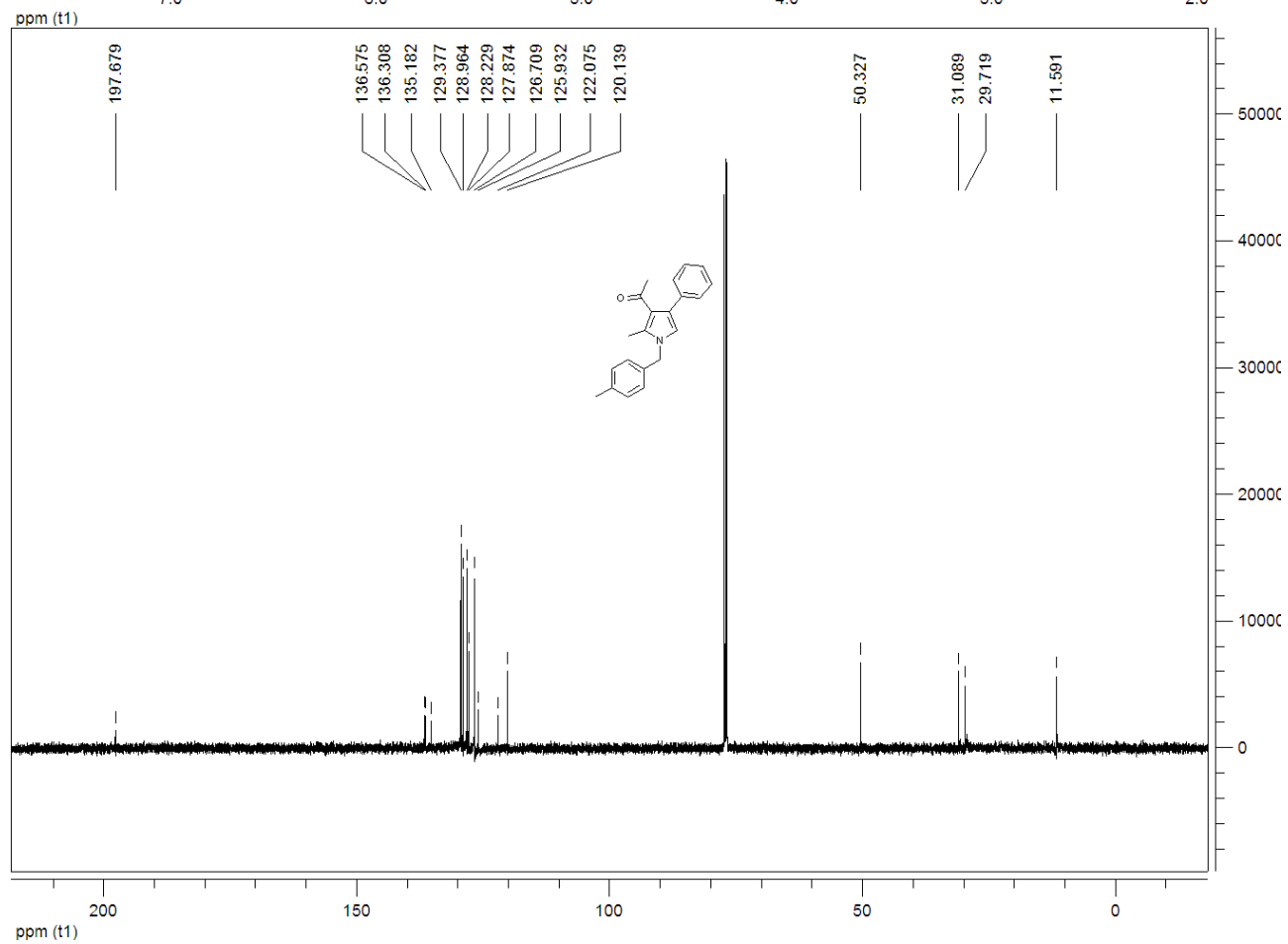
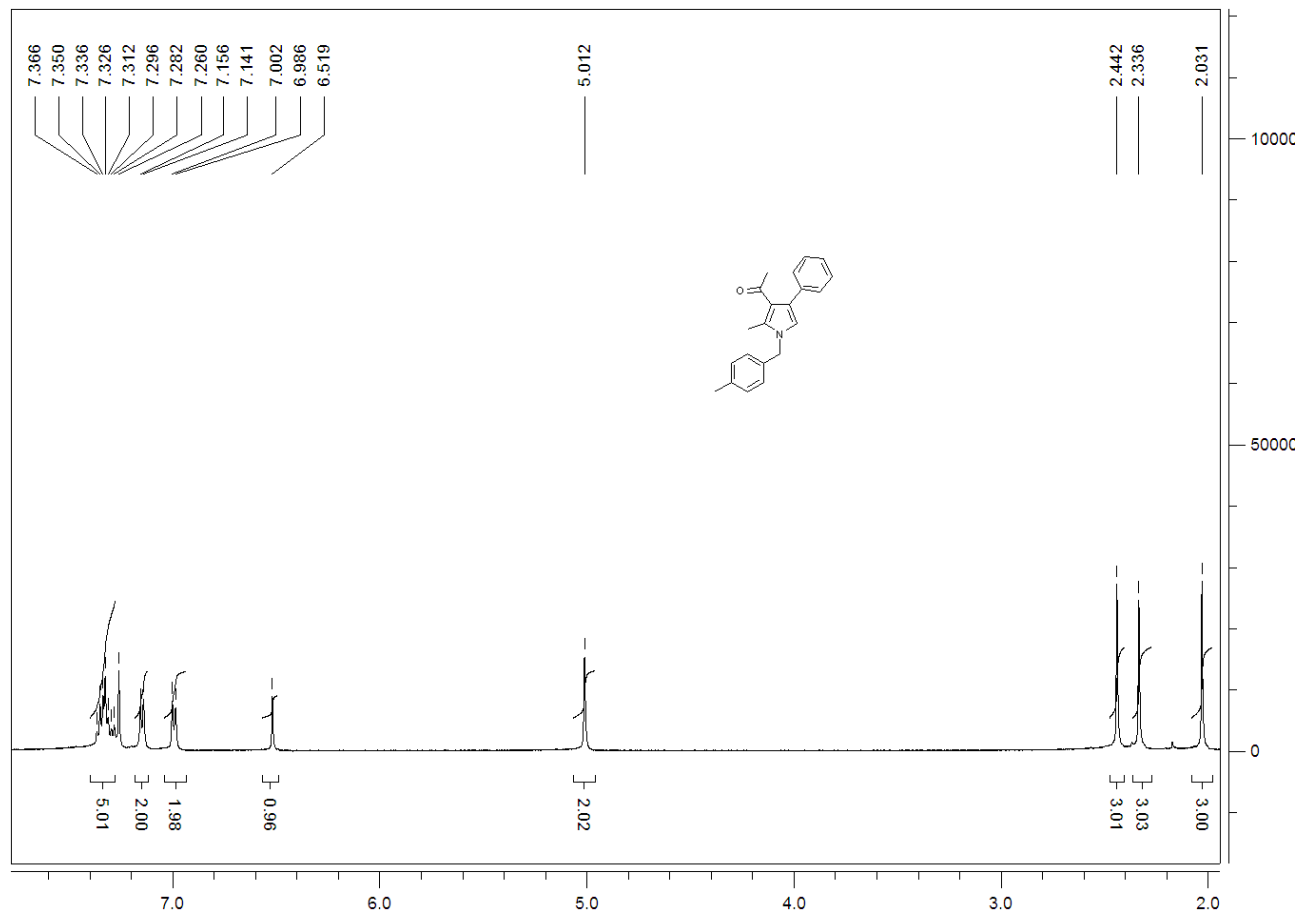
^1H NMR and ^{13}C NMR of compound **5k**



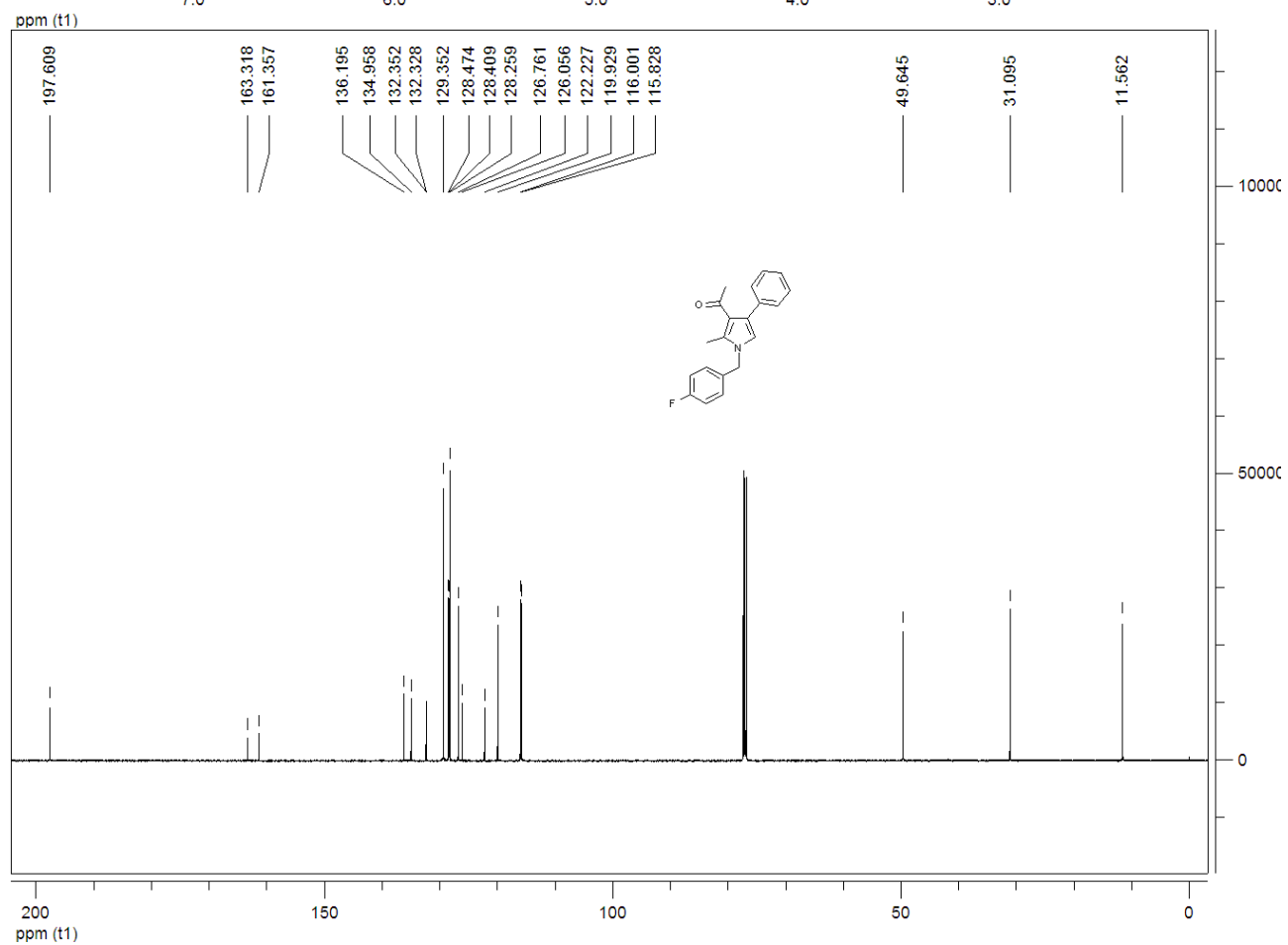
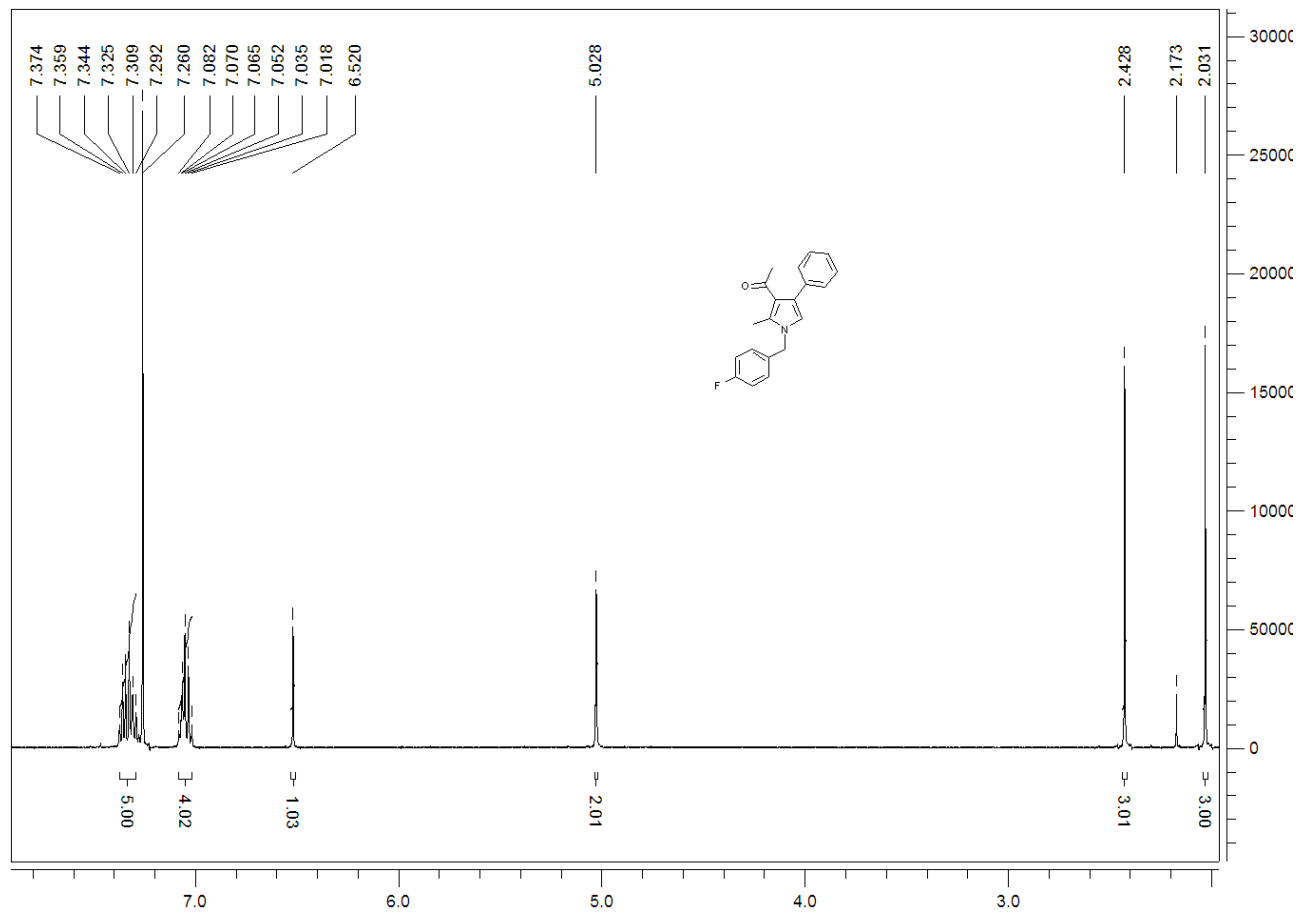
¹H NMR and ¹³C NMR of compound **5l**



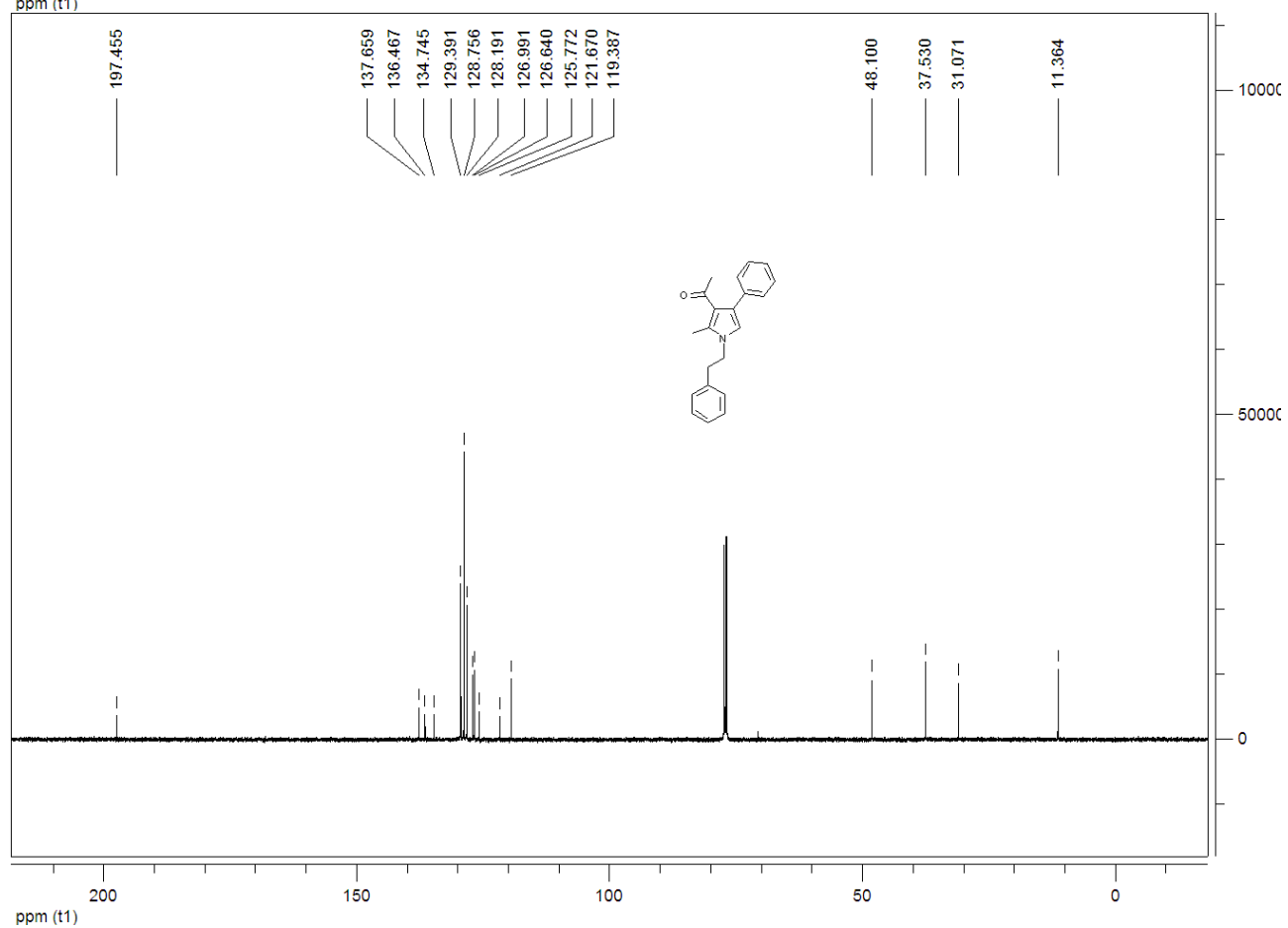
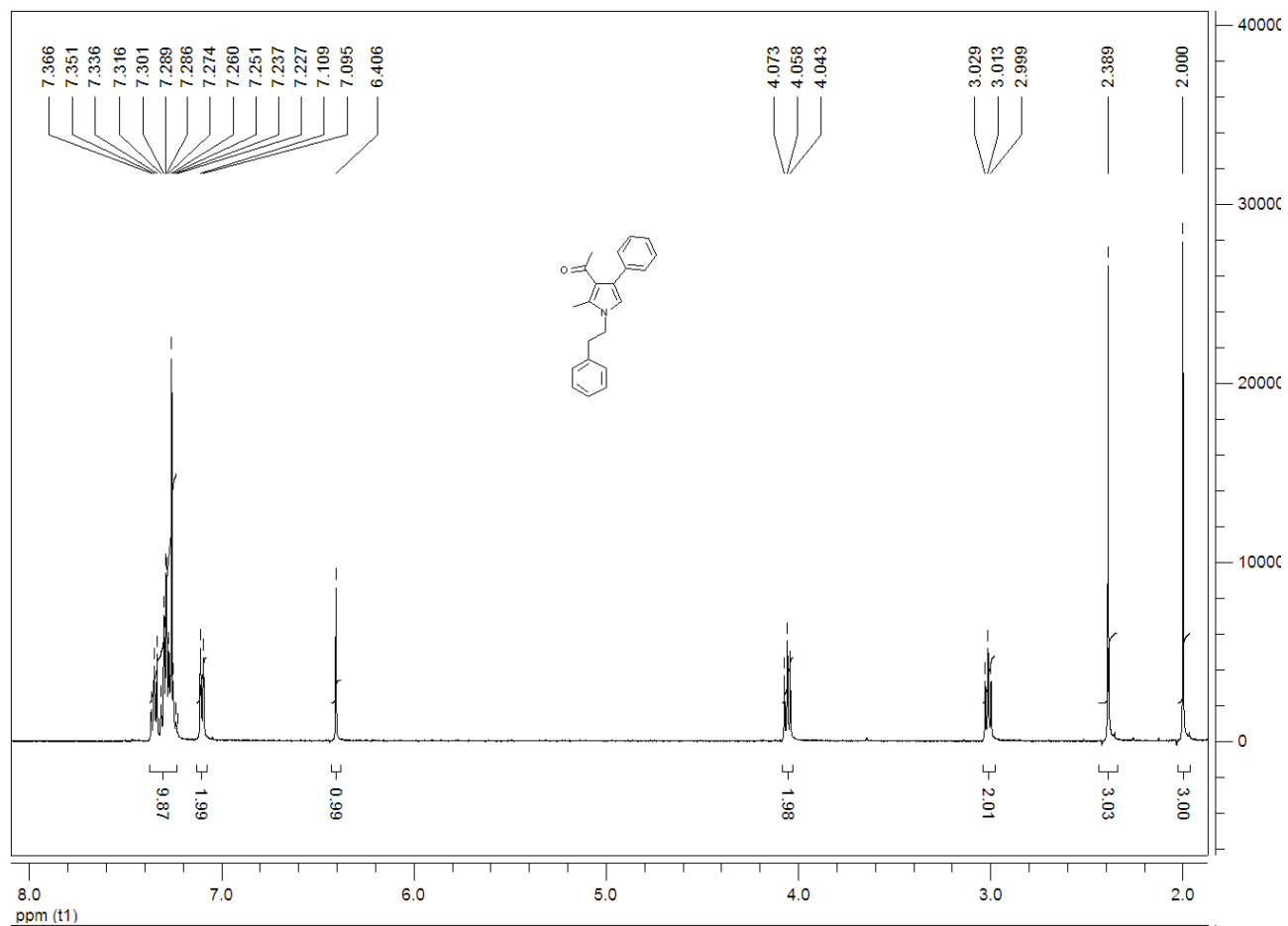
^1H NMR and ^{13}C NMR of compound **5m**



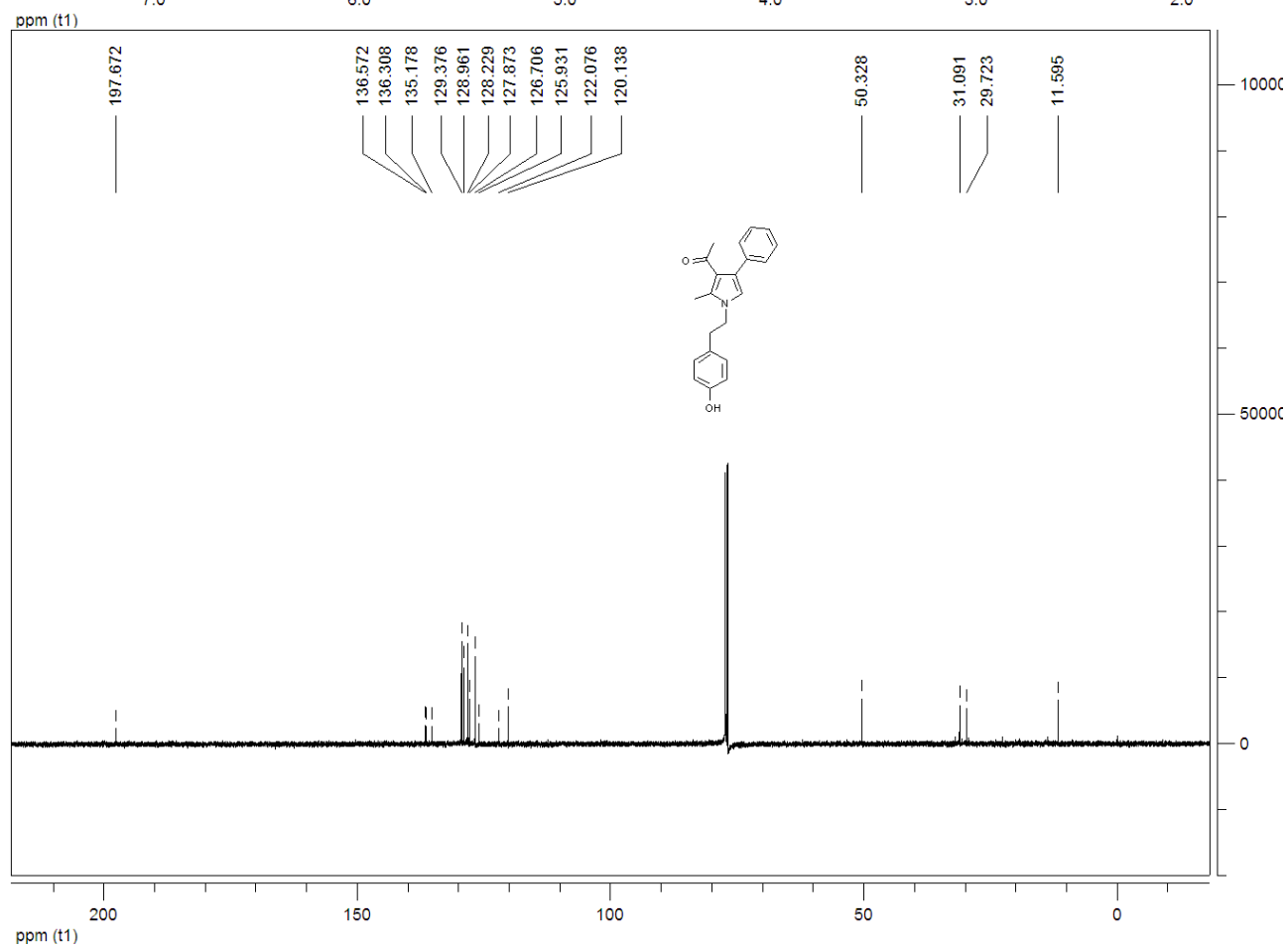
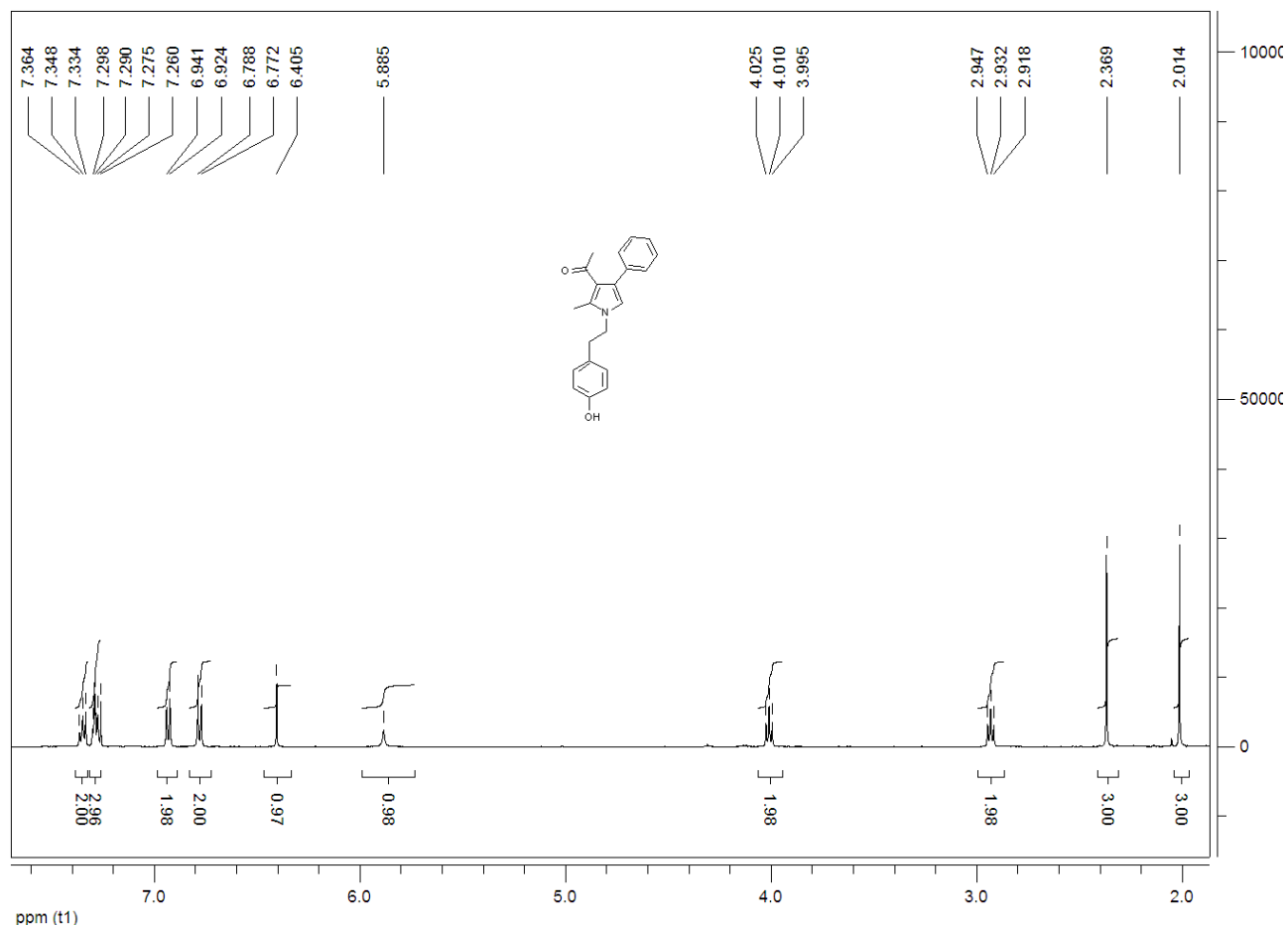
^1H NMR and ^{13}C NMR of compound **5n**



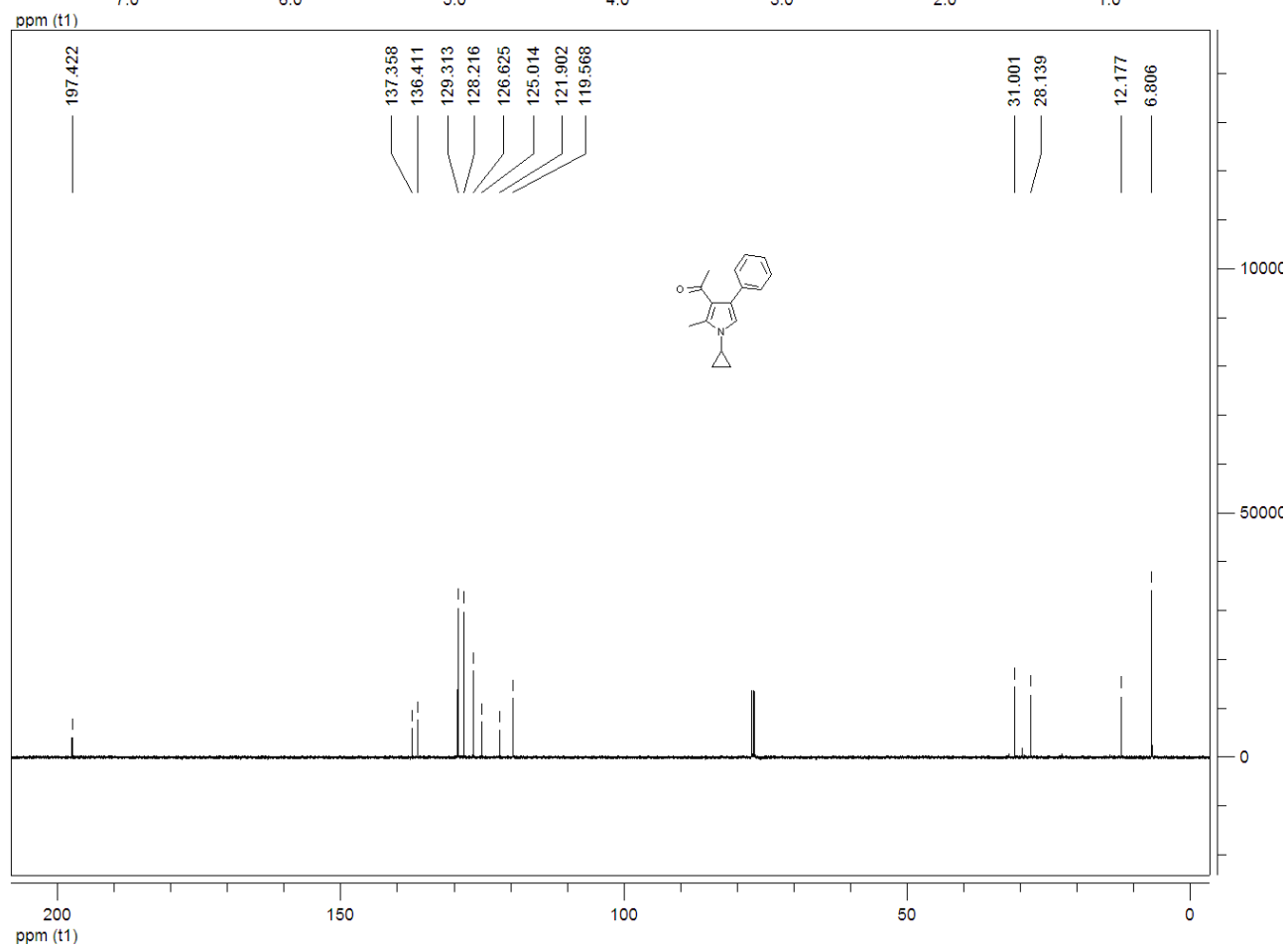
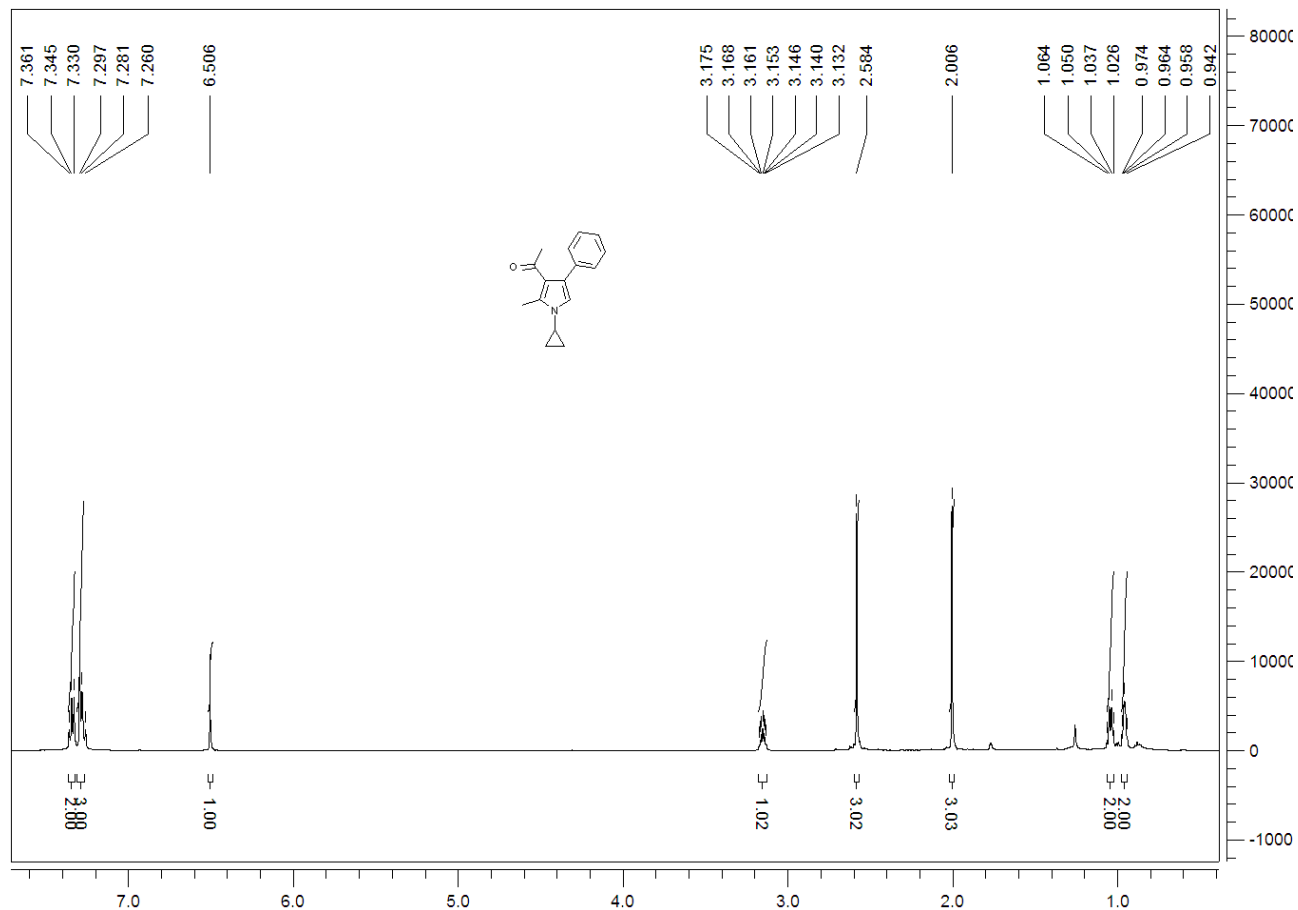
¹H NMR and ¹³C NMR of compound **5o**



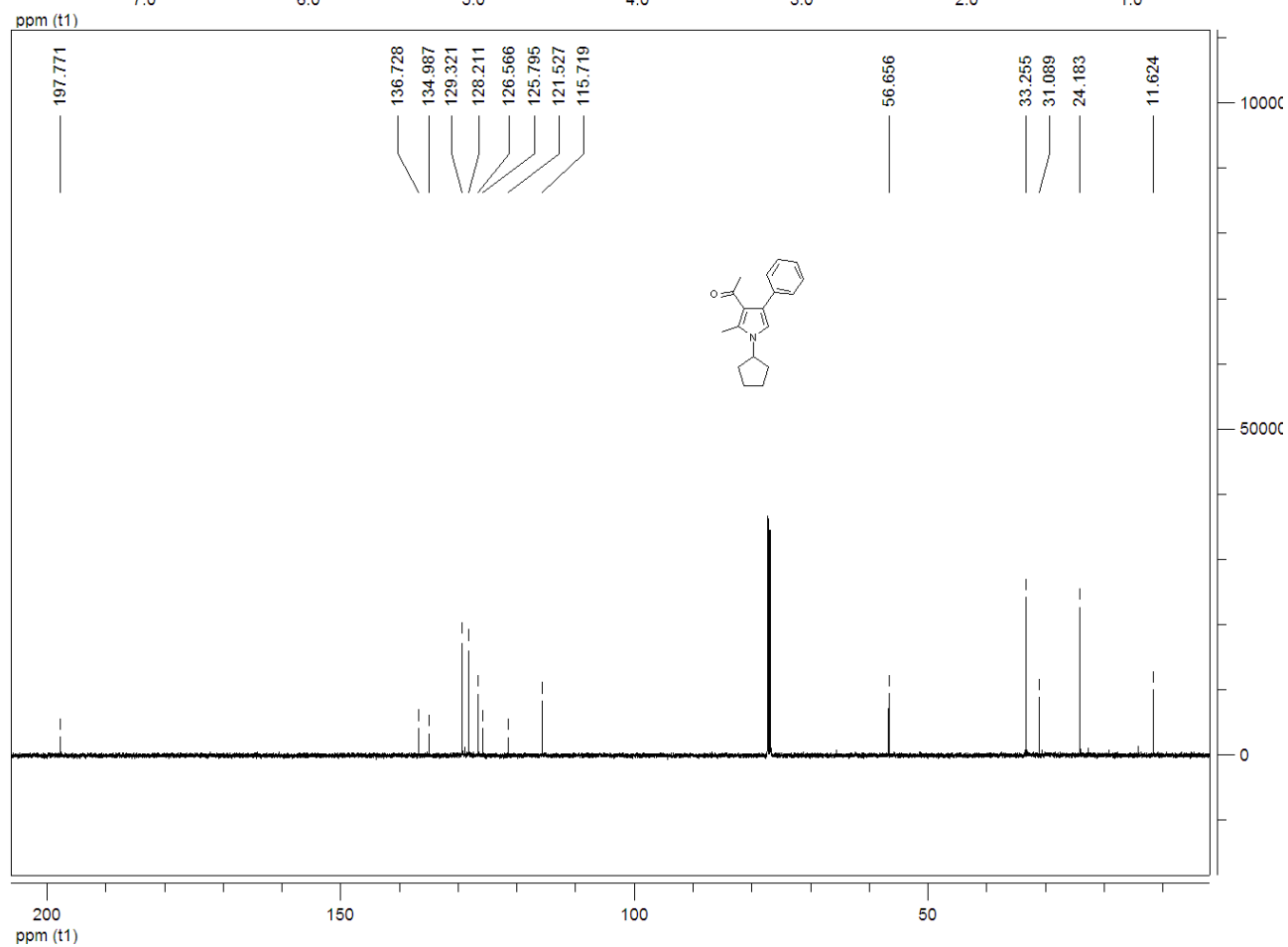
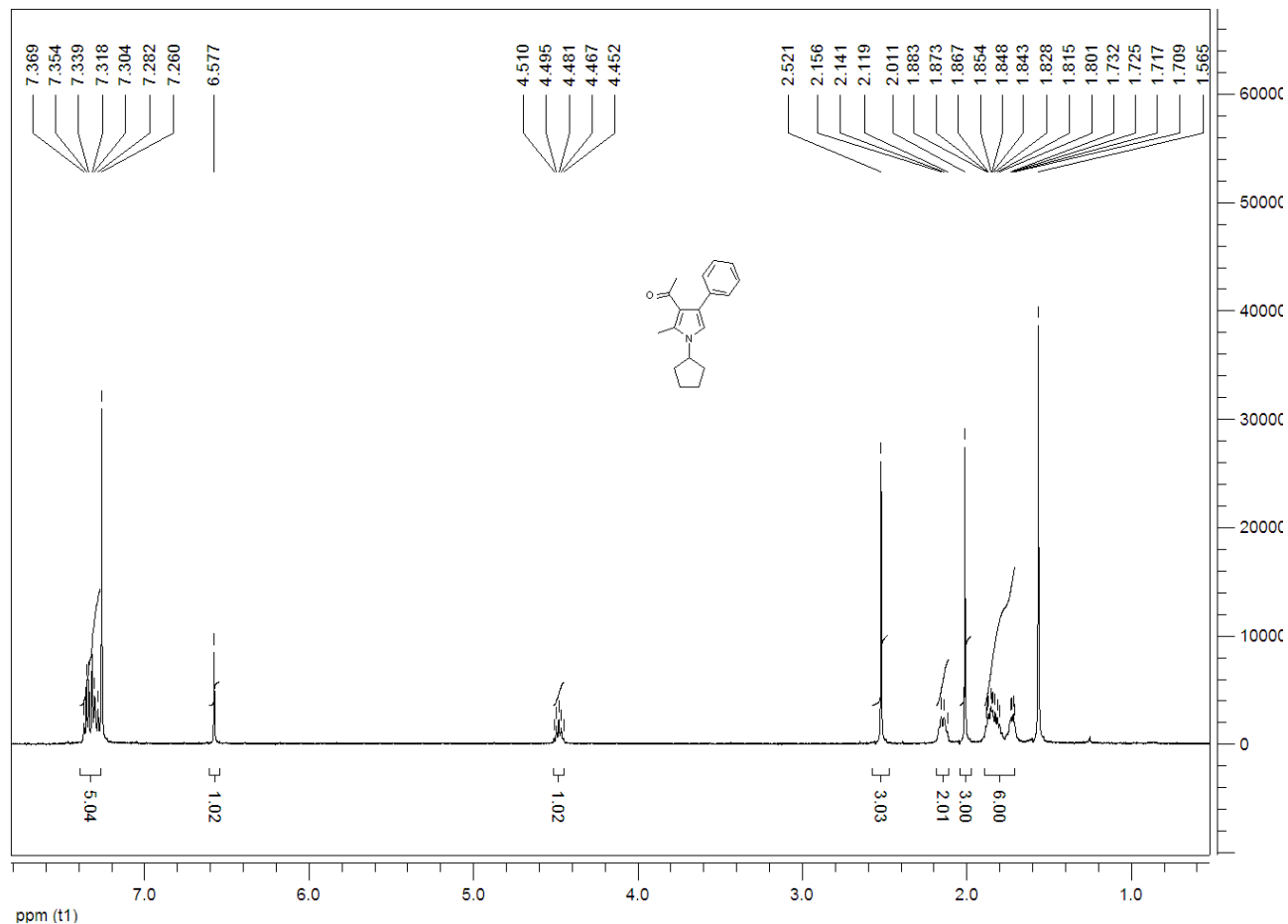
¹H NMR and ¹³C NMR of compound **5p**



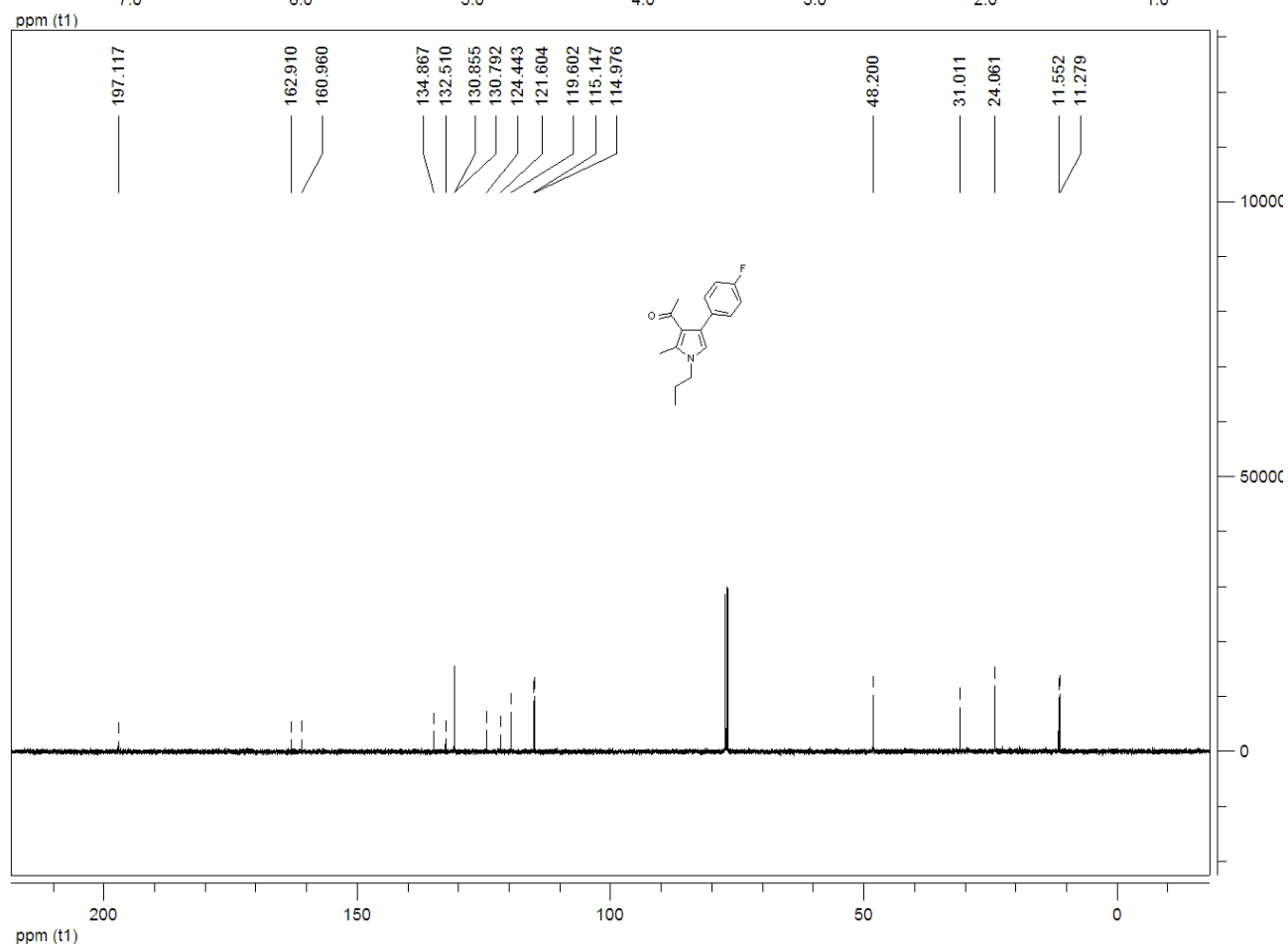
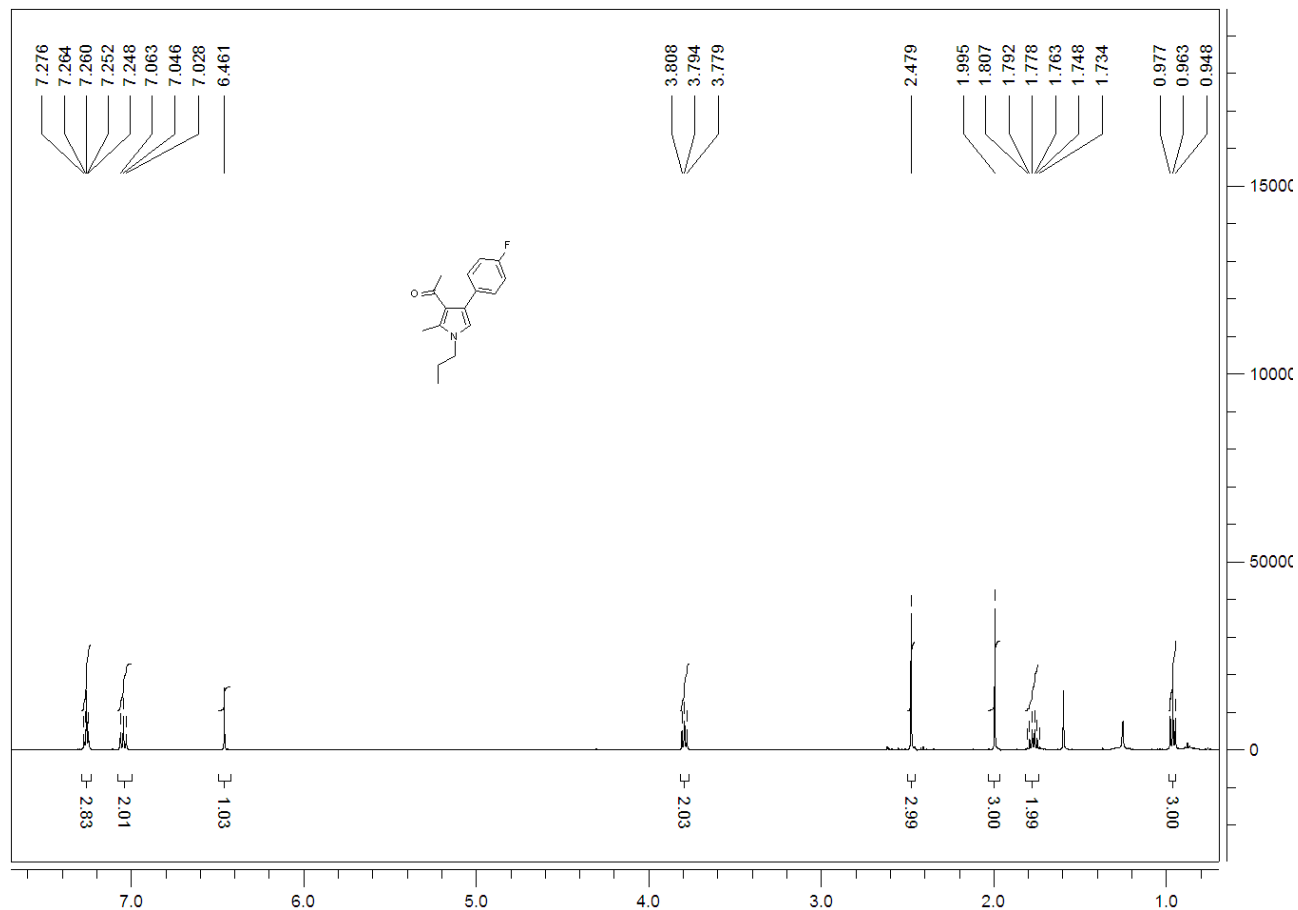
¹H NMR and ¹³C NMR of compound **5q**



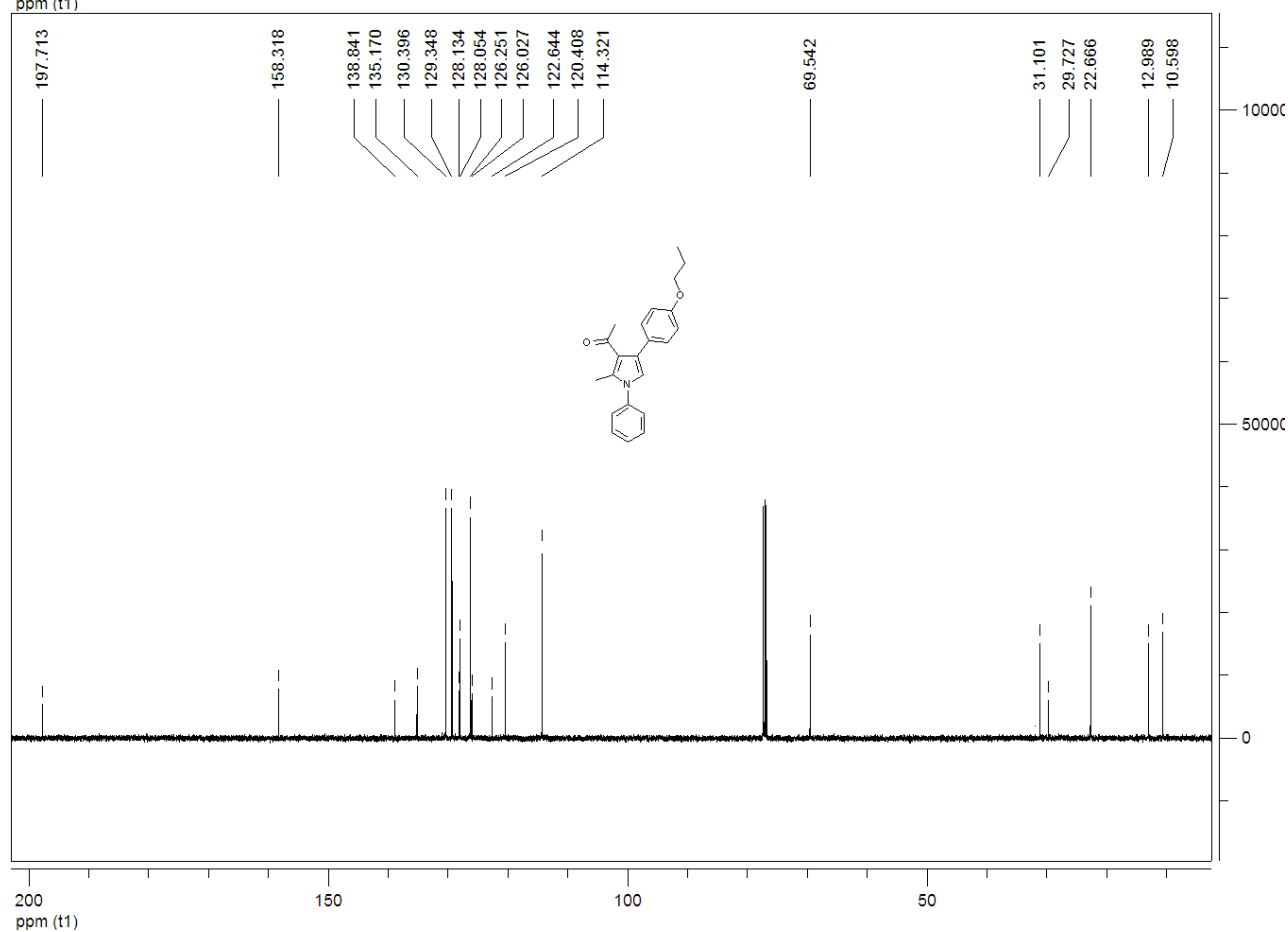
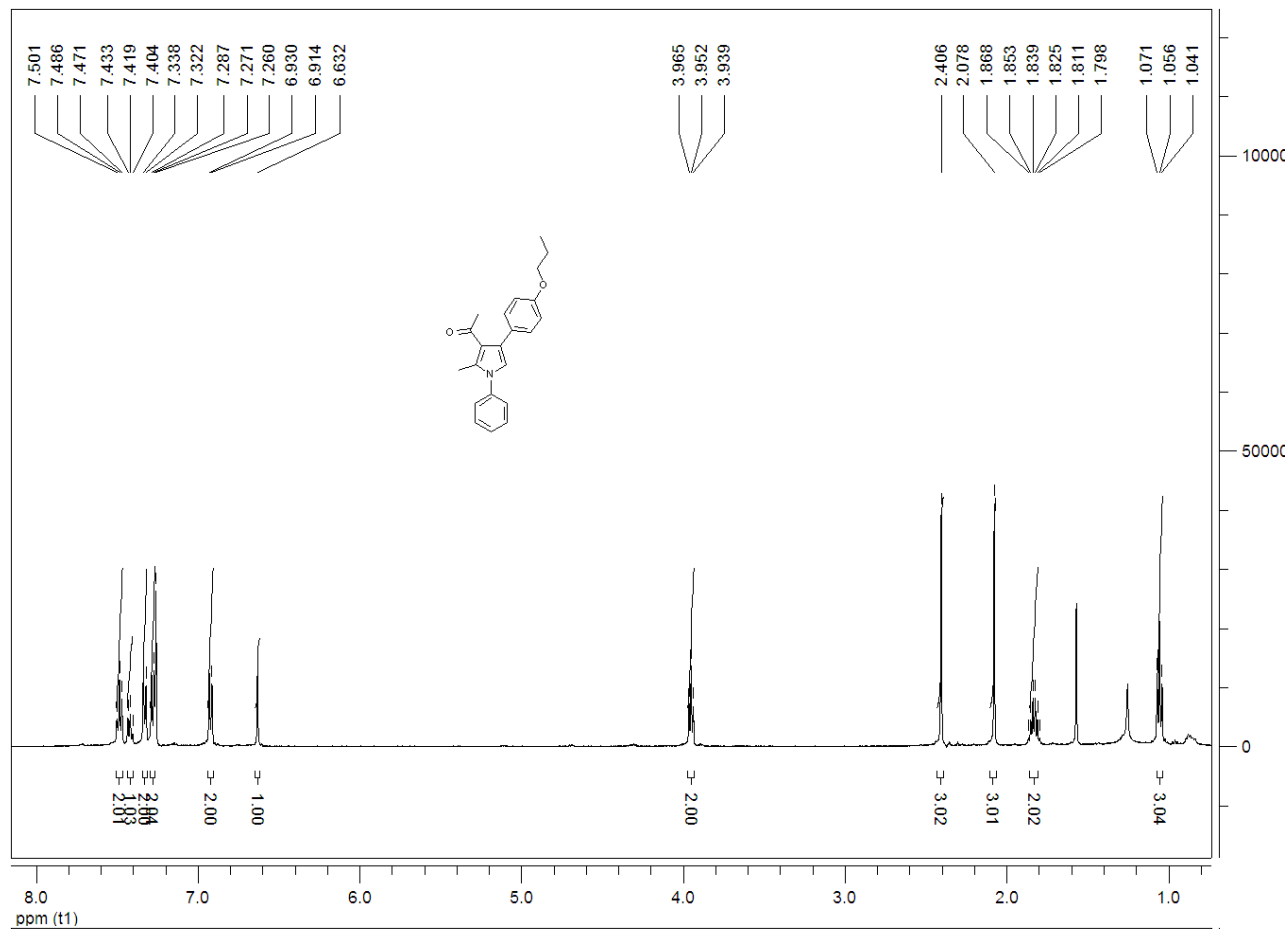
¹H NMR and ¹³C NMR of compound **5r**



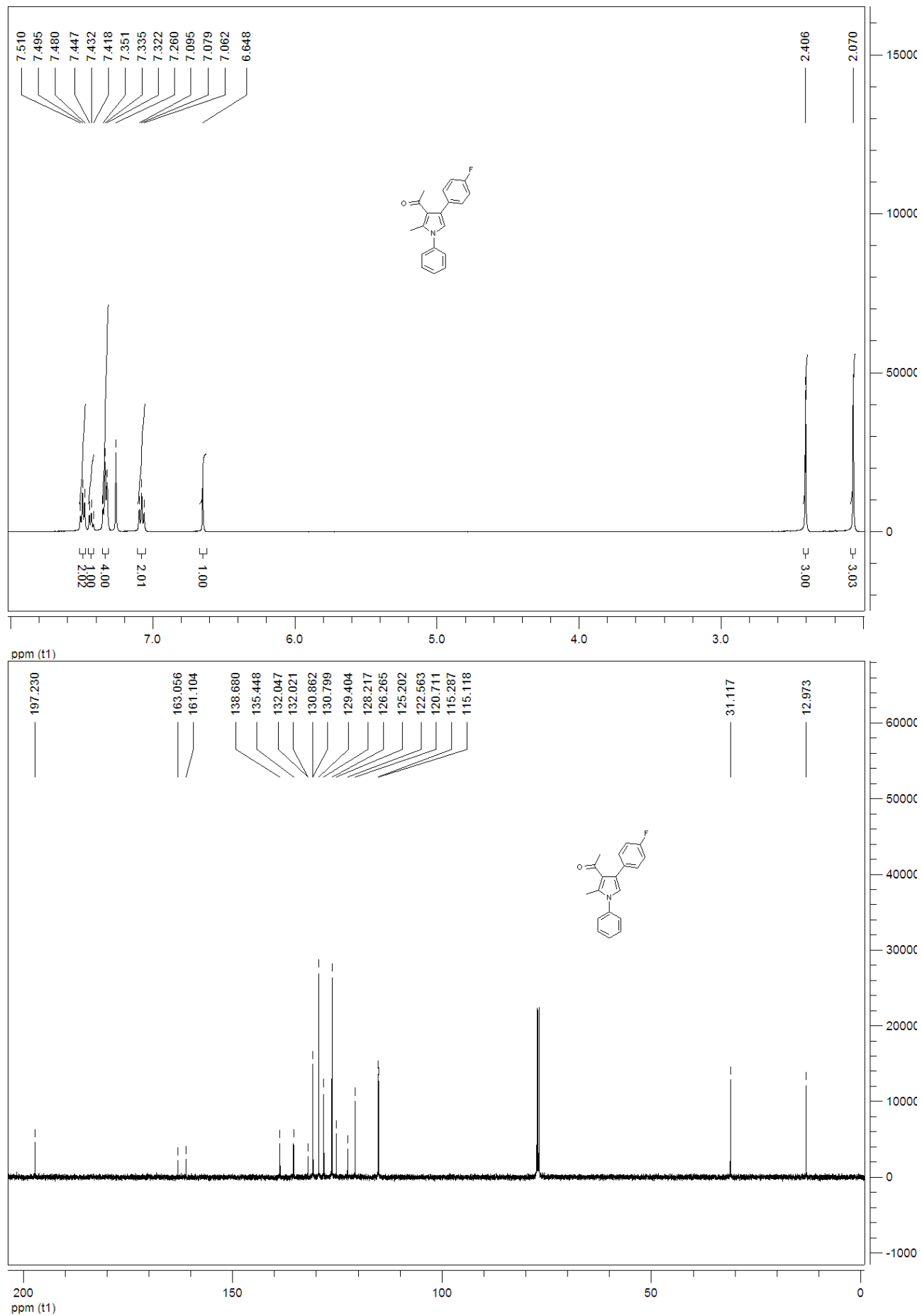
¹H NMR and ¹³C NMR of compound **5s**



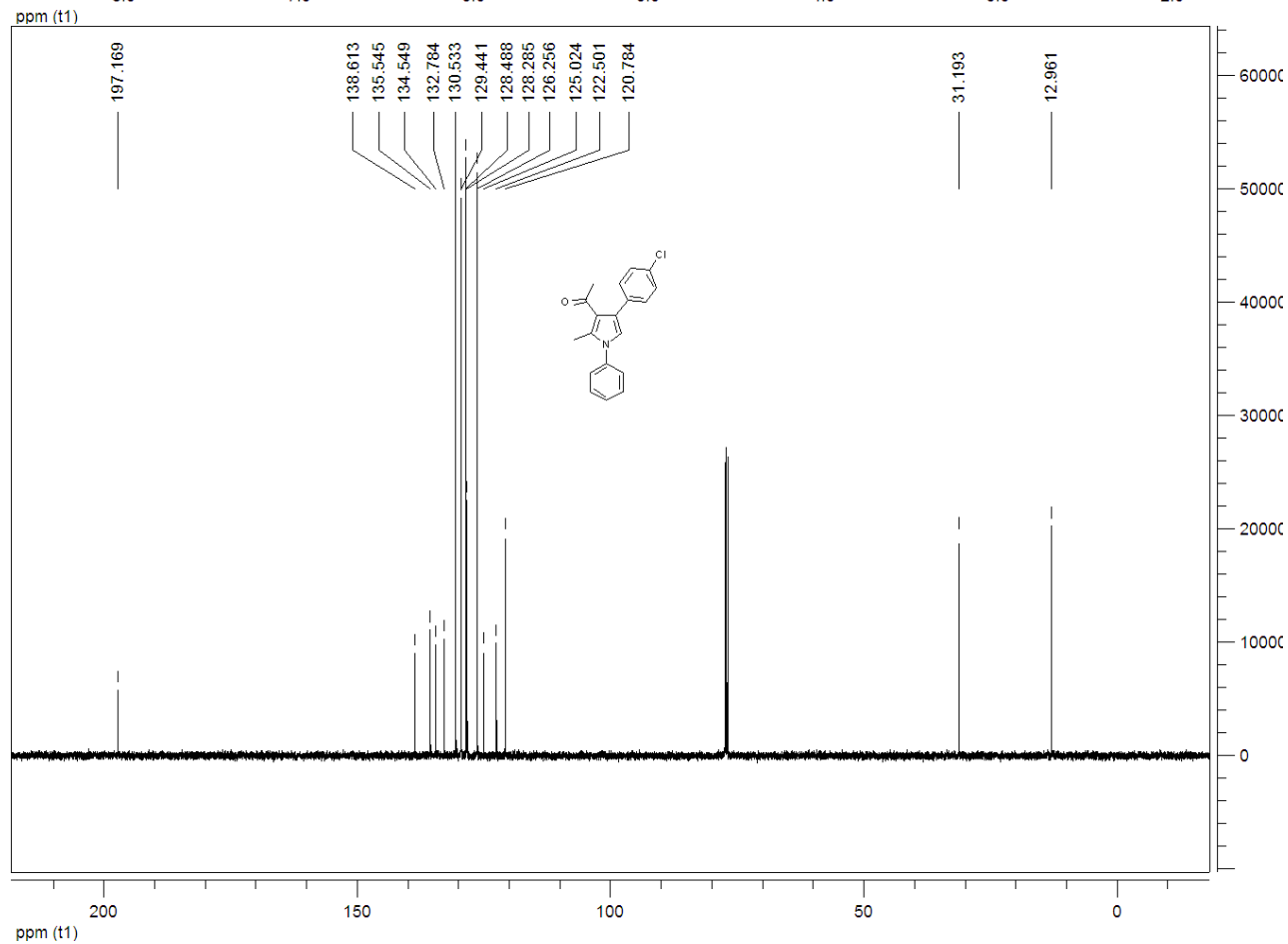
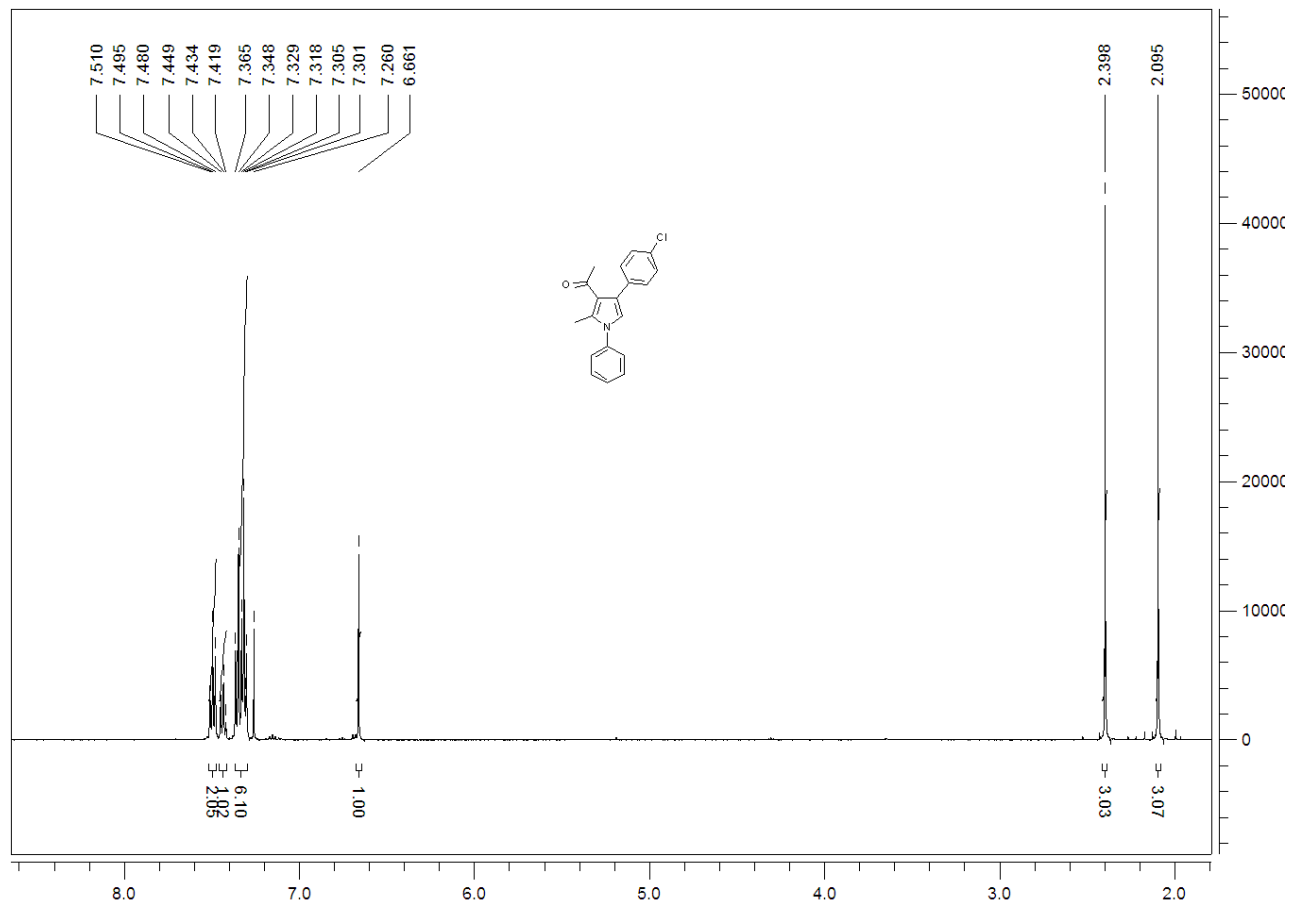
¹H NMR and ¹³C NMR of compound **5t**



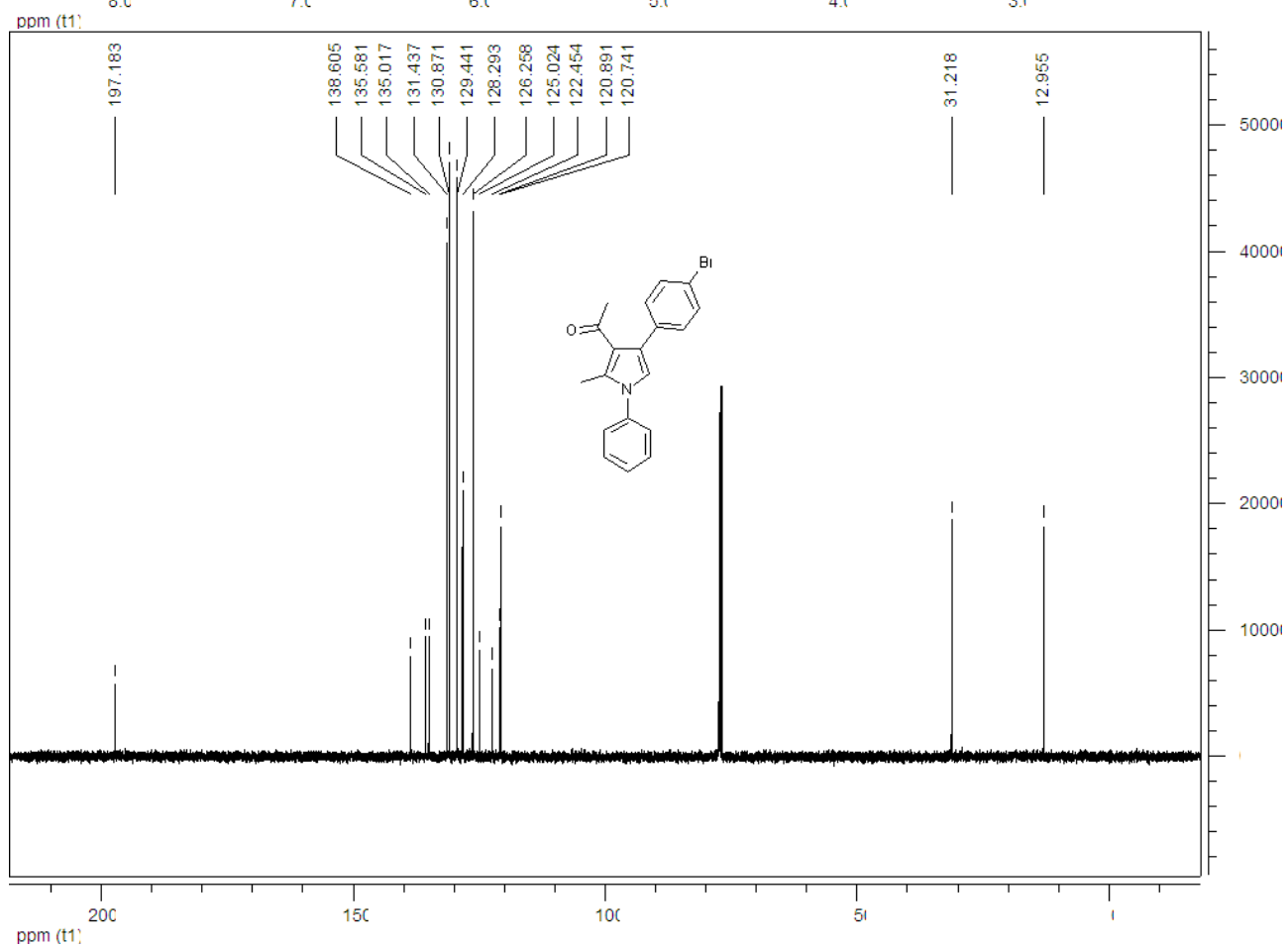
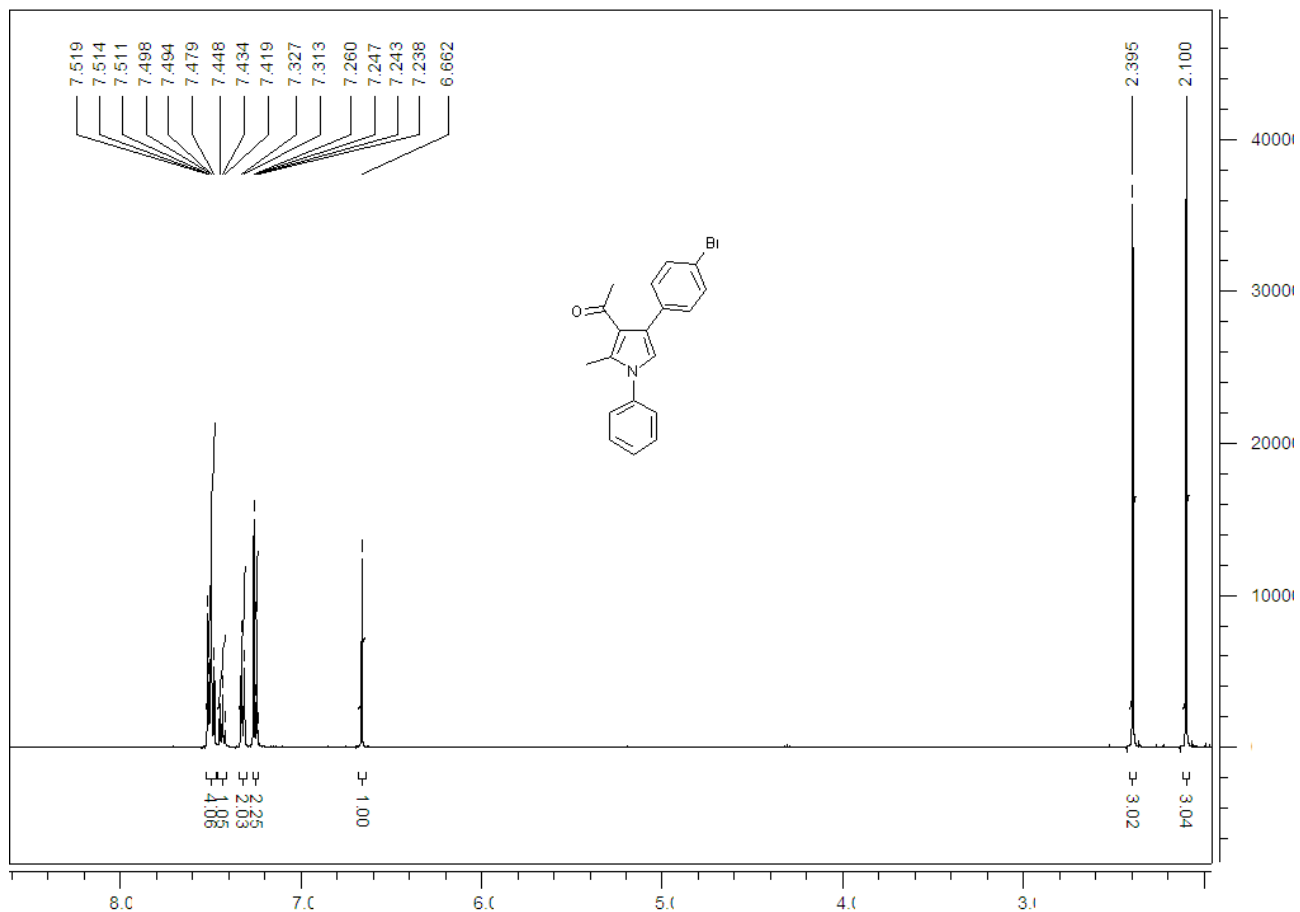
^1H NMR and ^{13}C NMR of compound **5u**



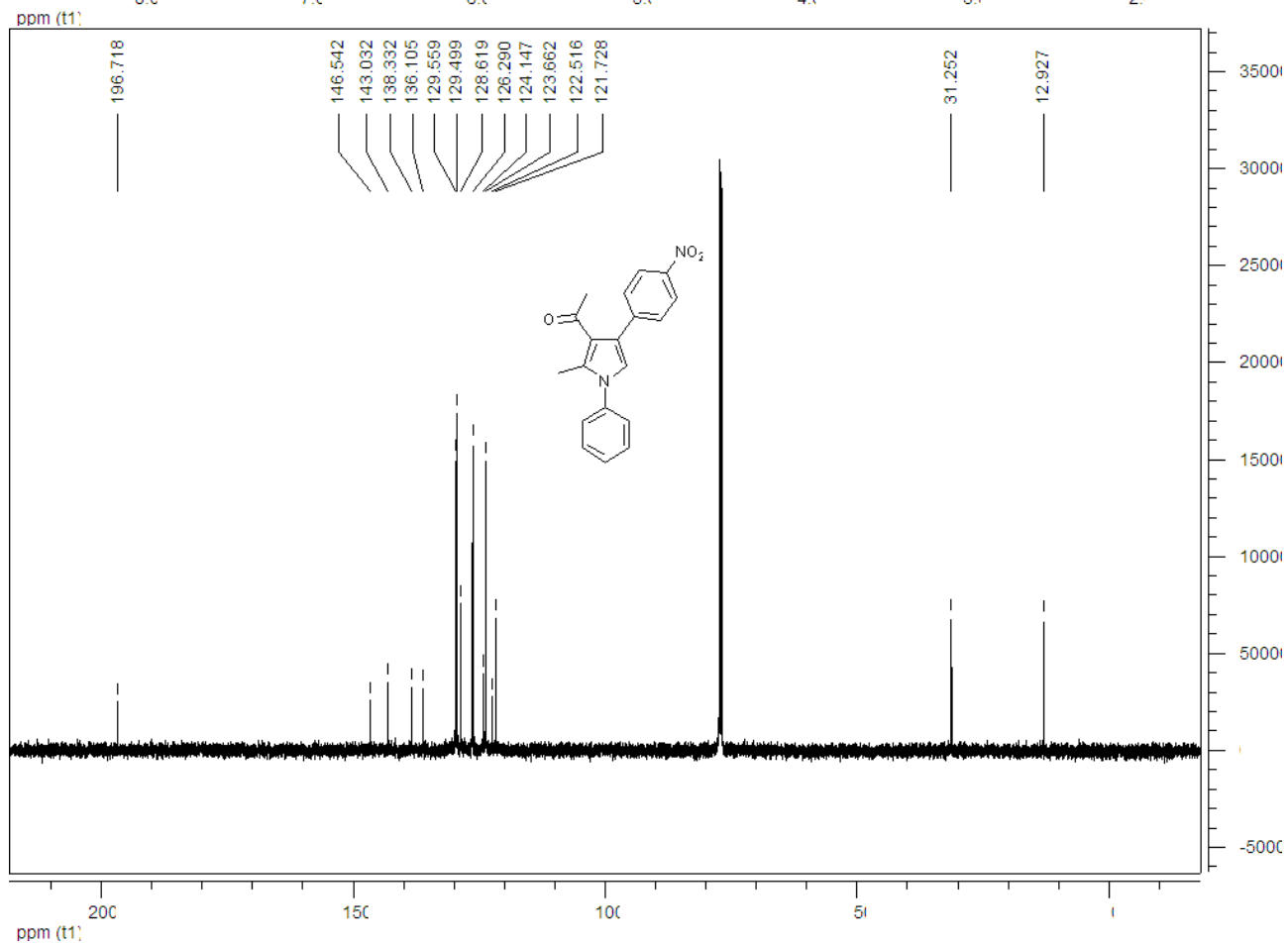
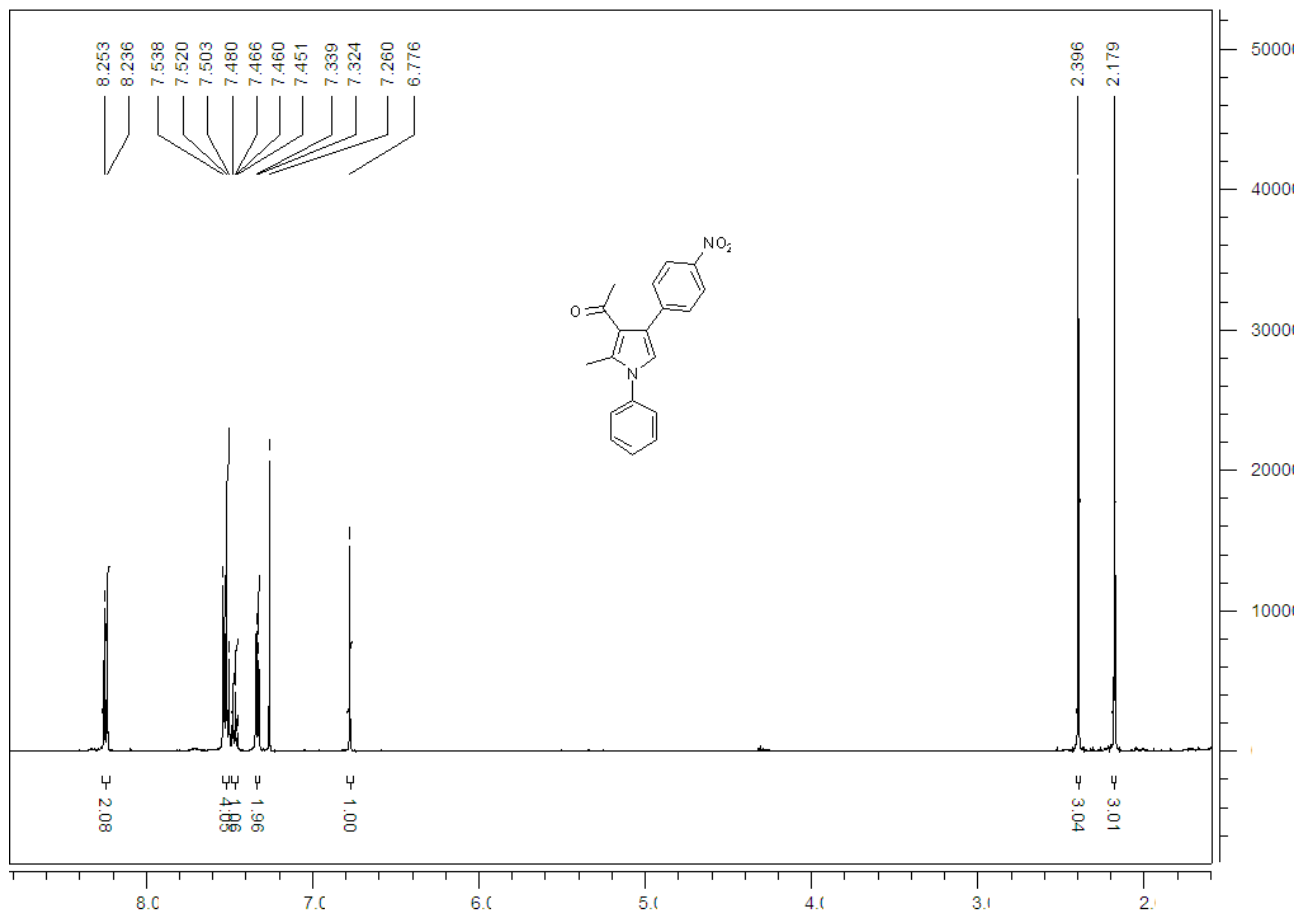
^1H NMR and ^{13}C NMR of compound **5v**



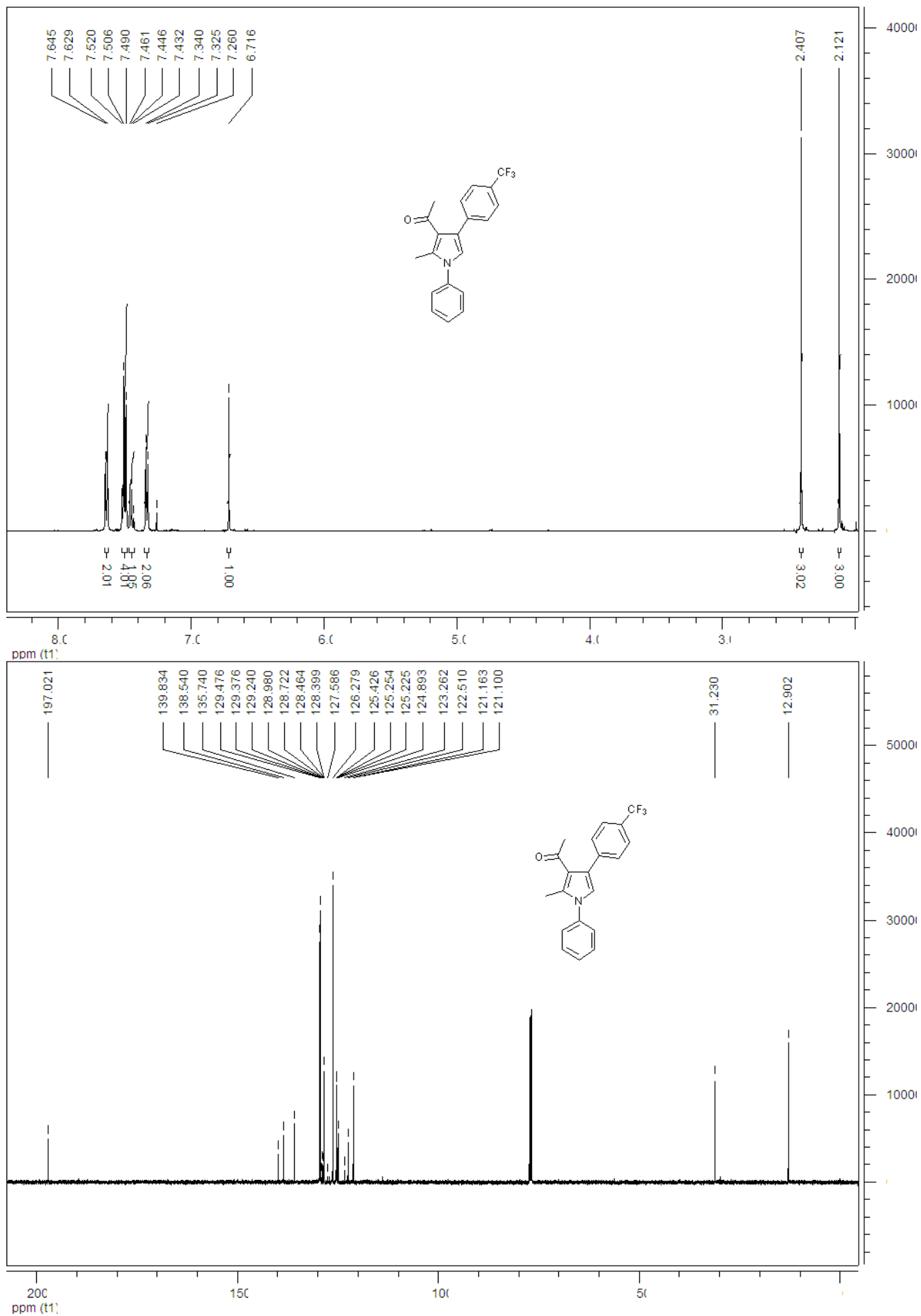
^1H NMR and ^{13}C NMR of compound **5w**



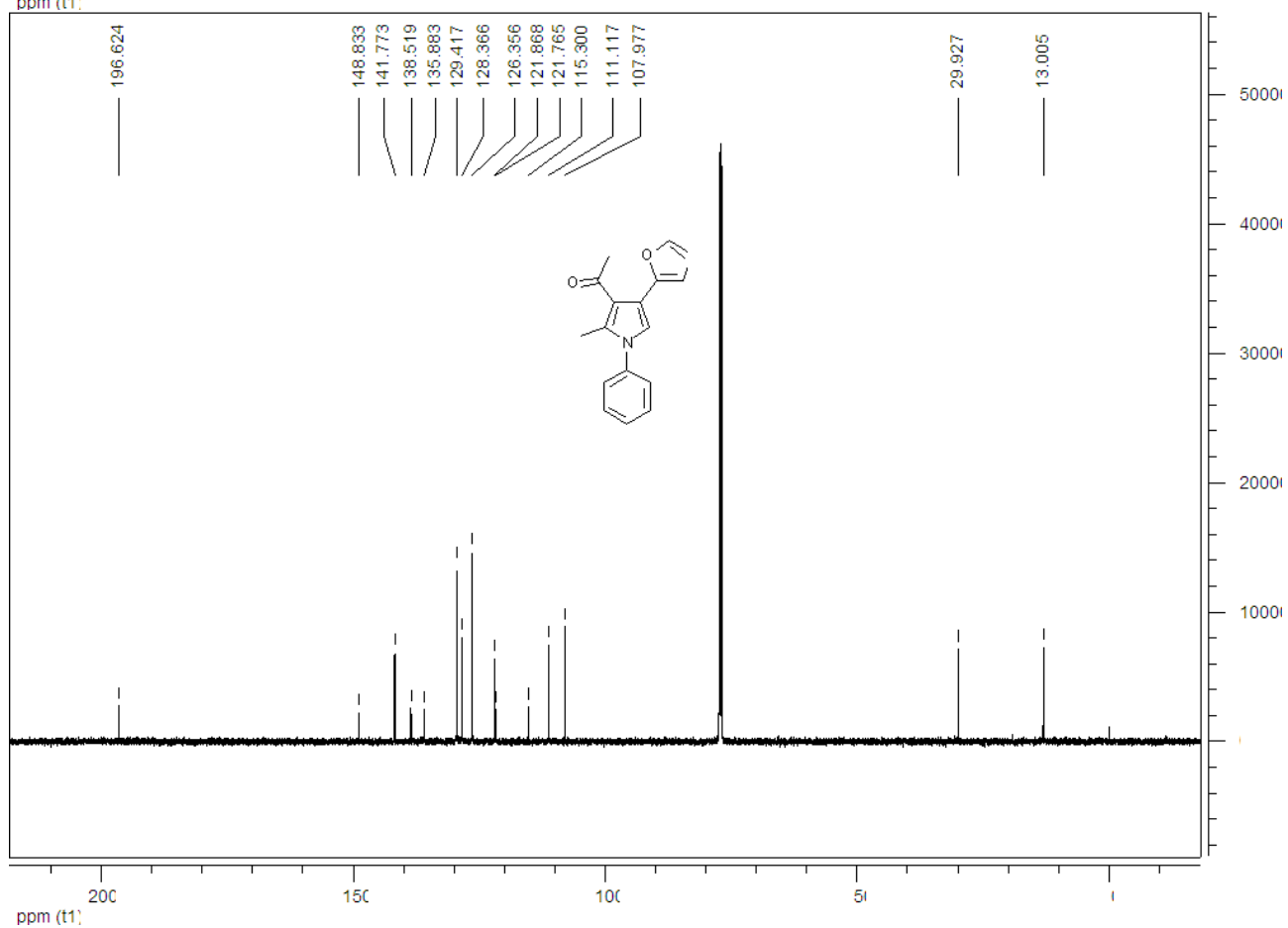
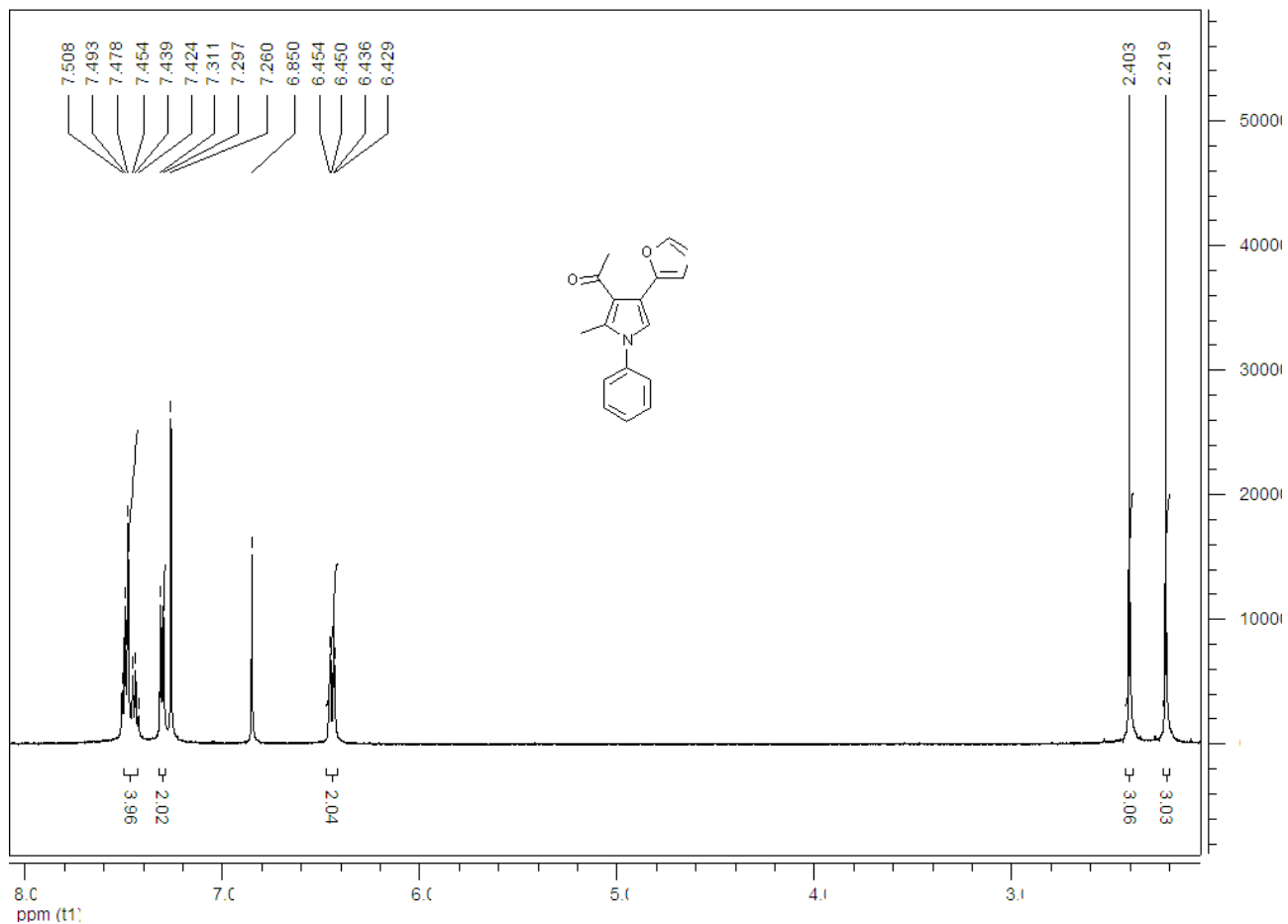
^1H NMR and ^{13}C NMR of compound **5x**



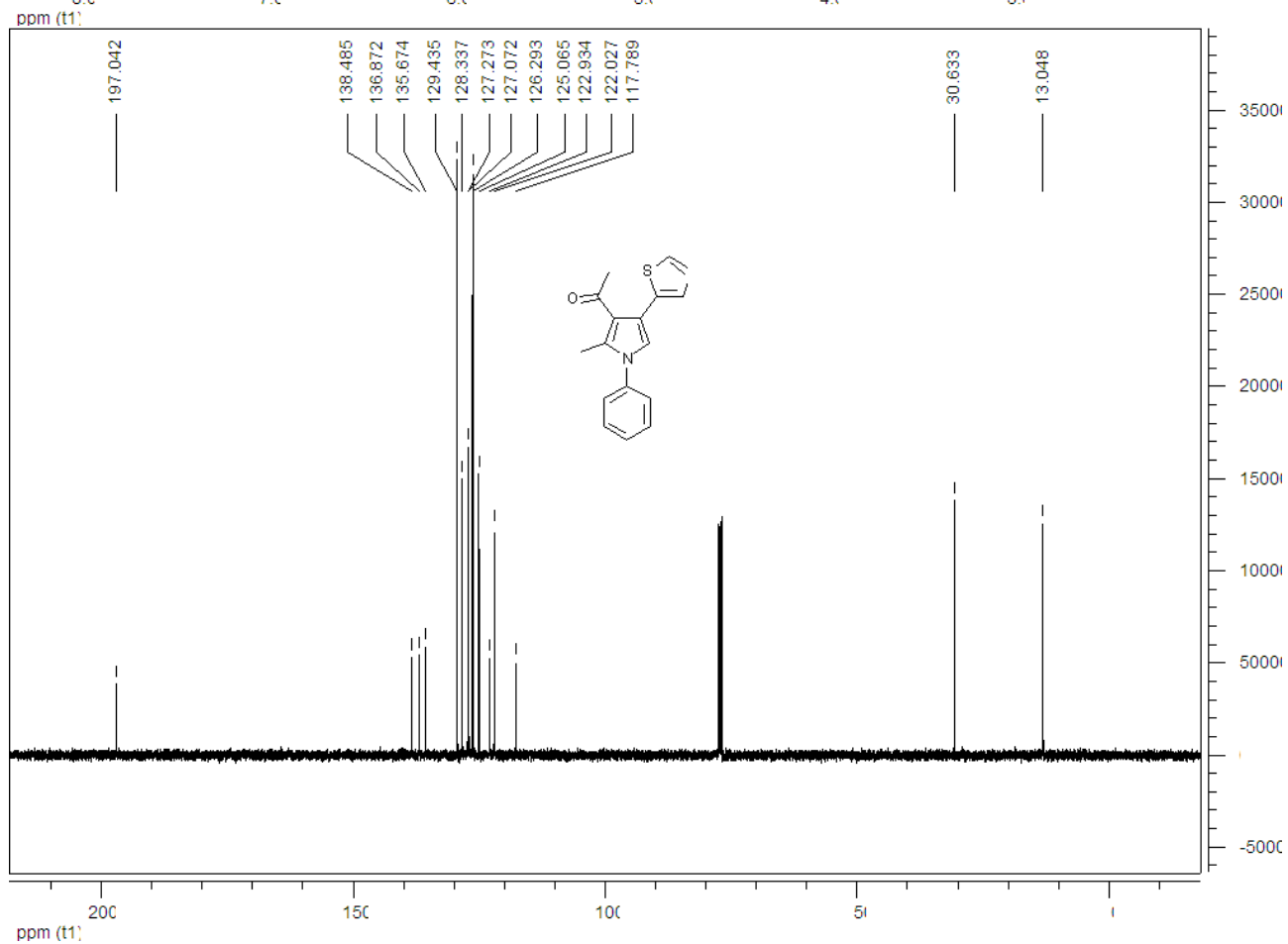
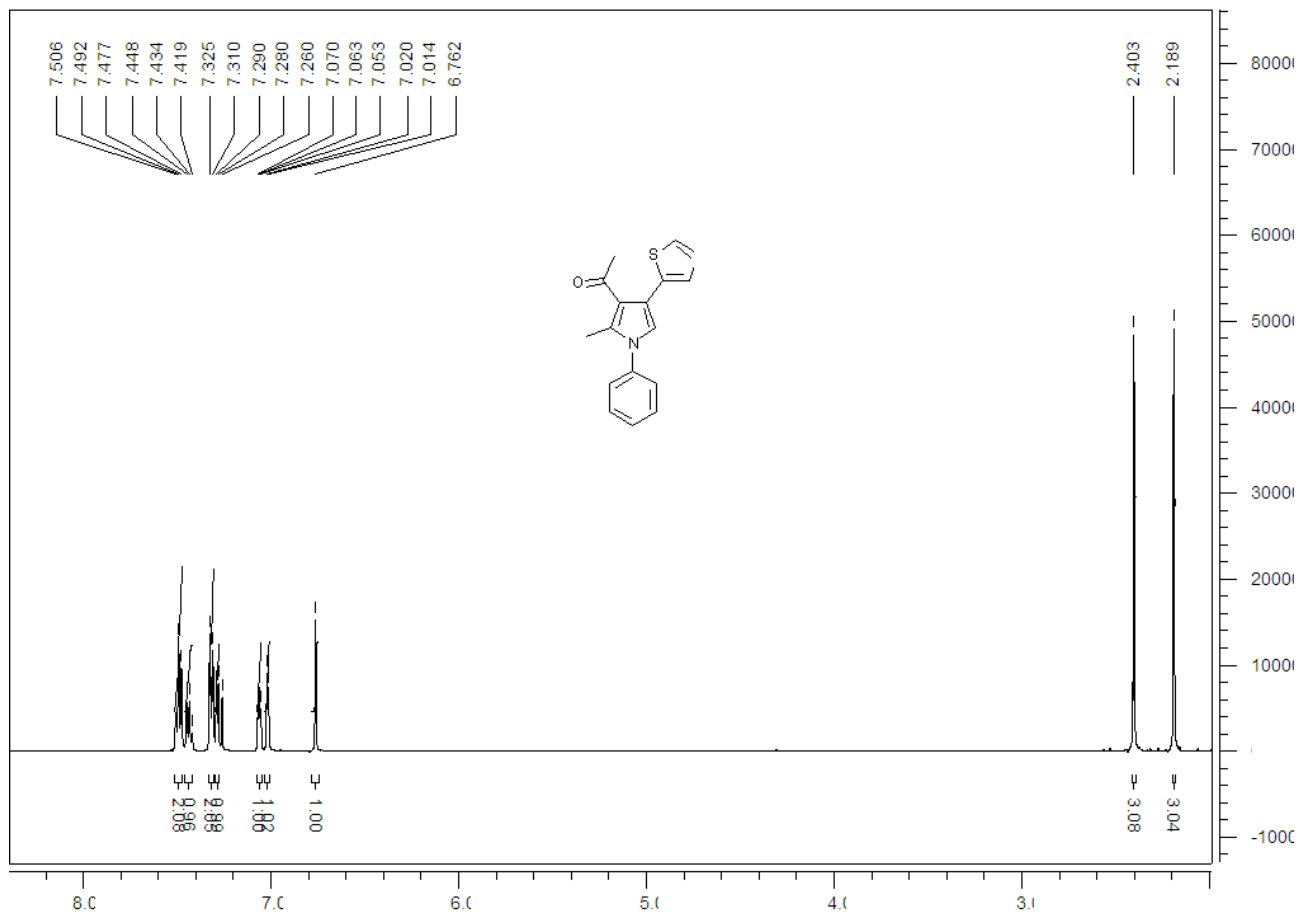
¹H NMR and ¹³C NMR of compound **5y**



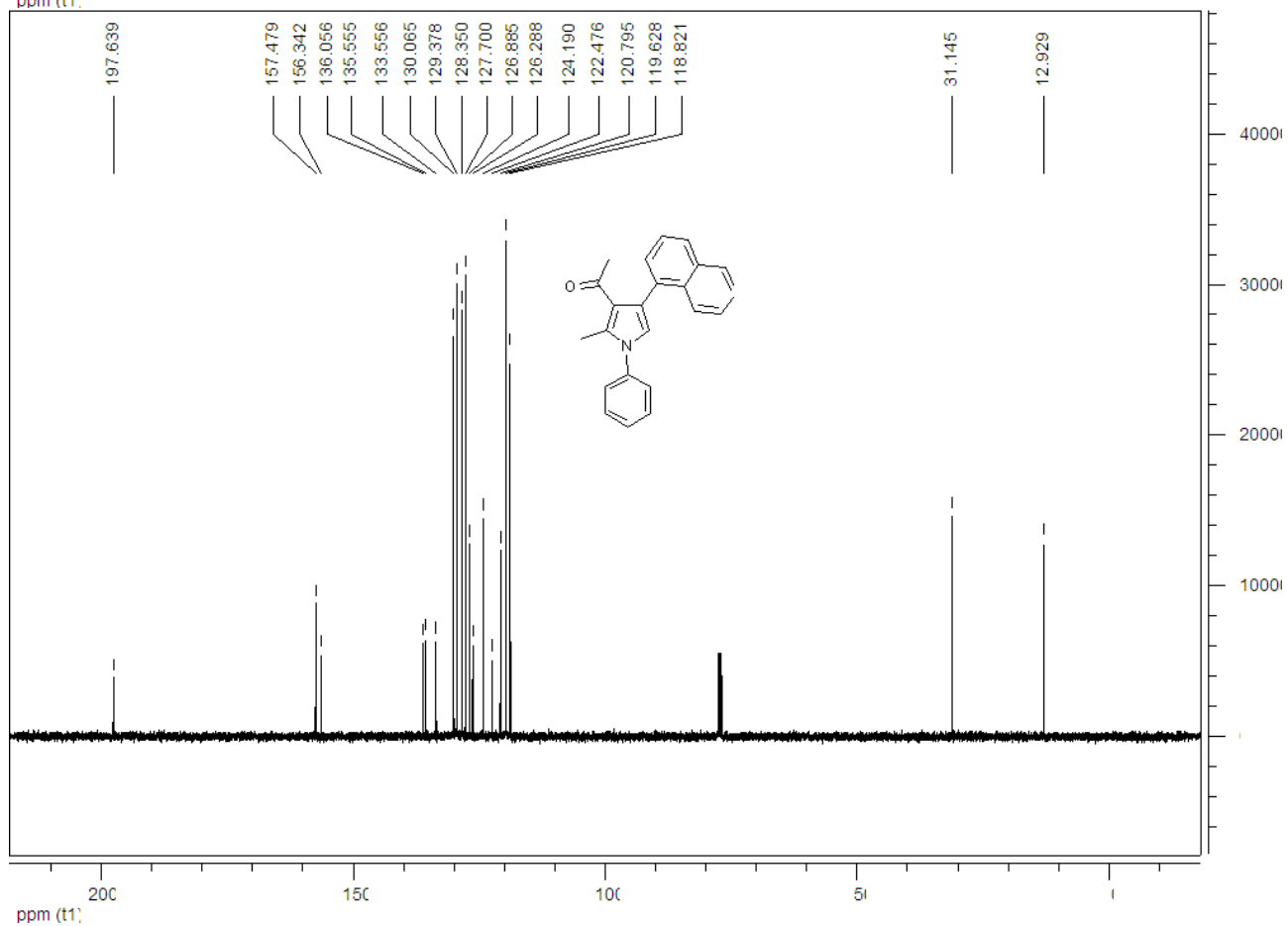
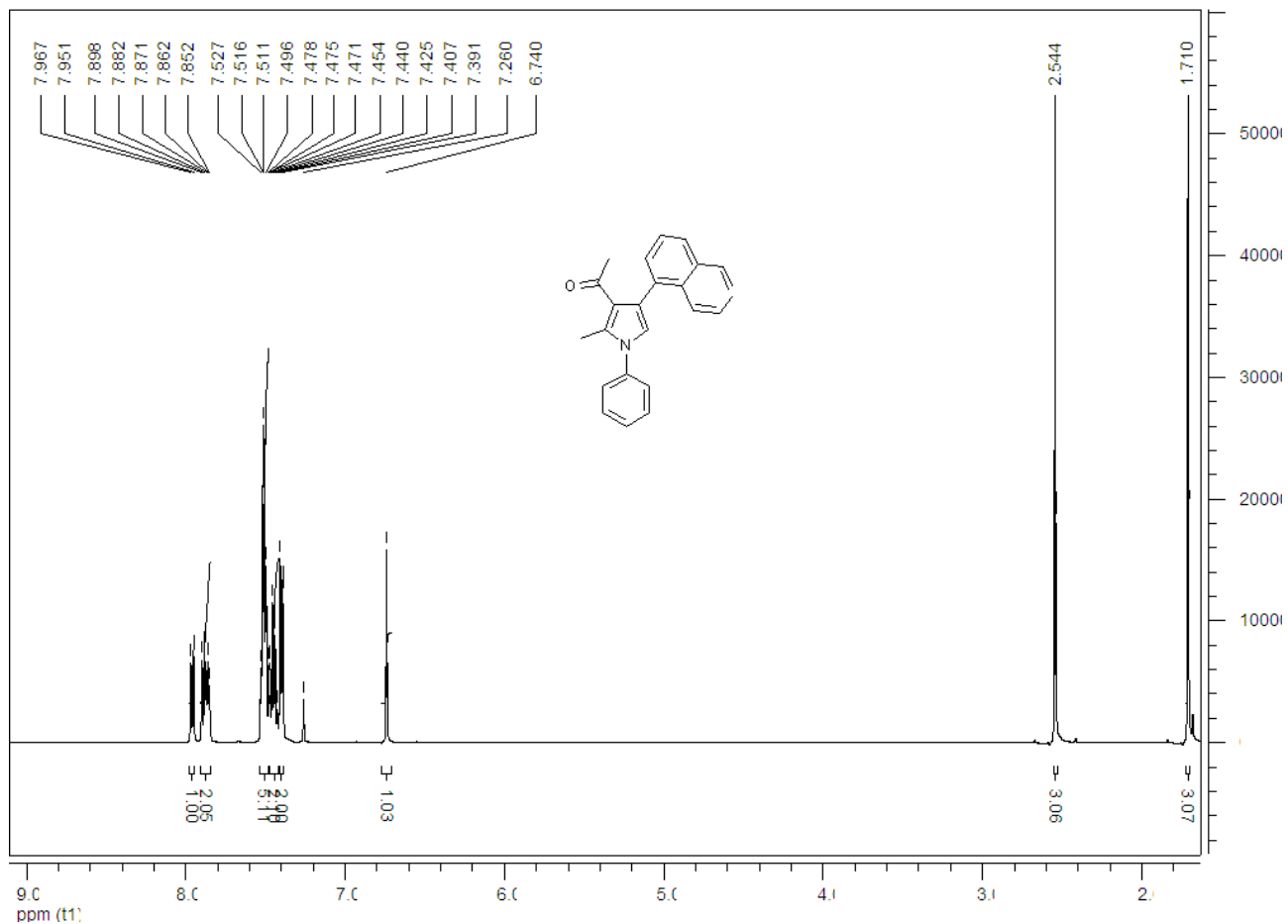
^1H NMR and ^{13}C NMR of compound **5z**



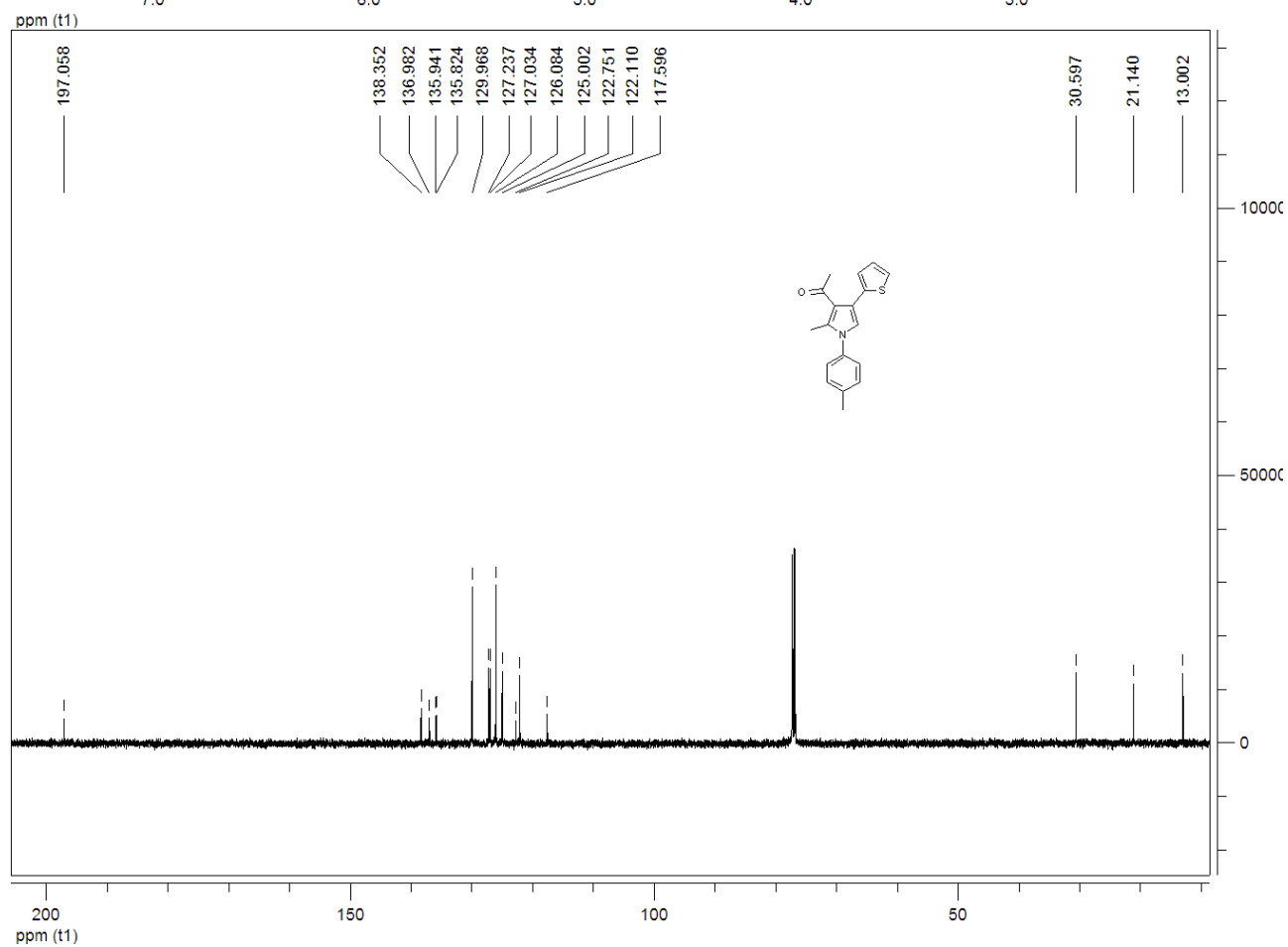
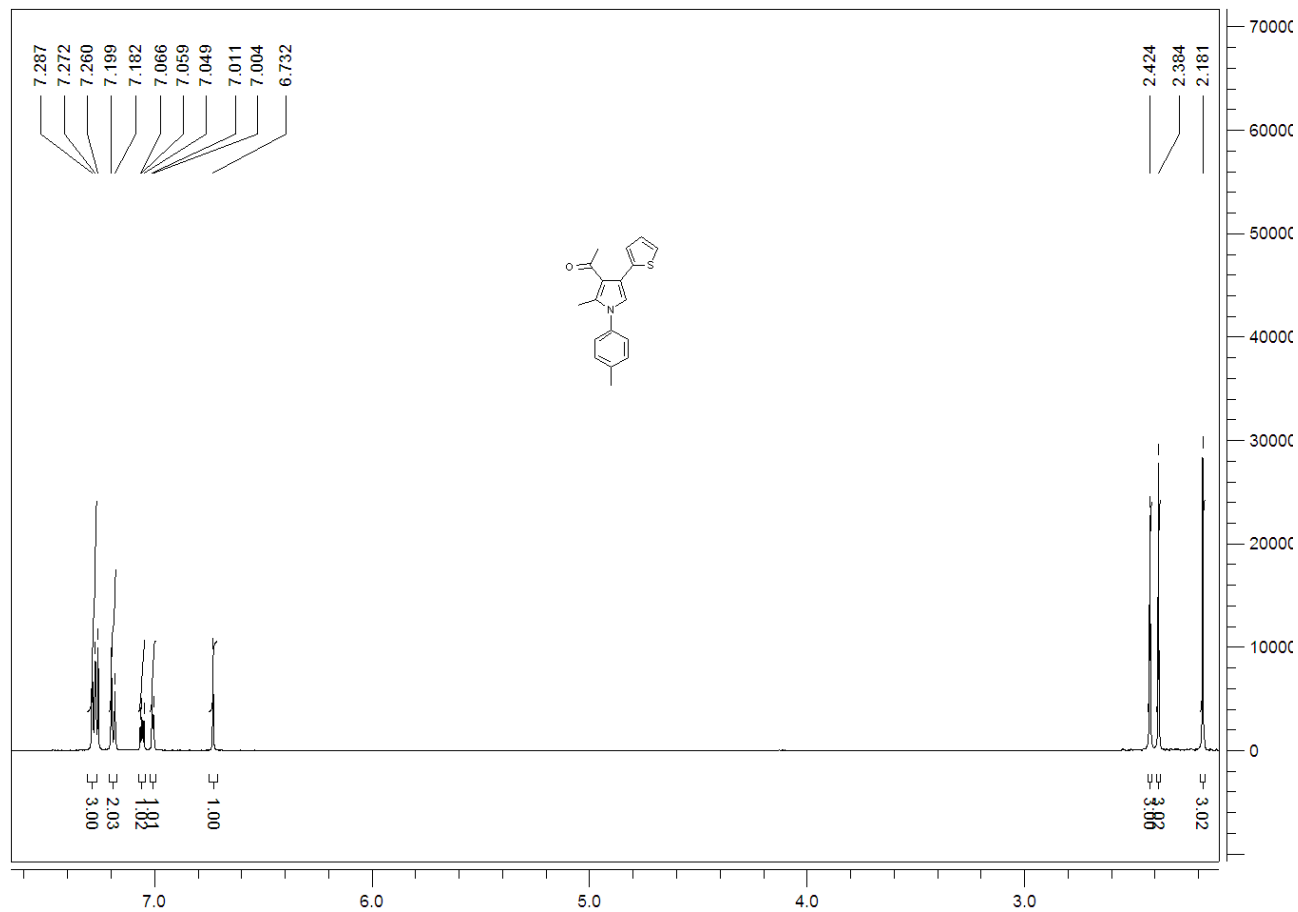
^1H NMR and ^{13}C NMR of compound **5aa**



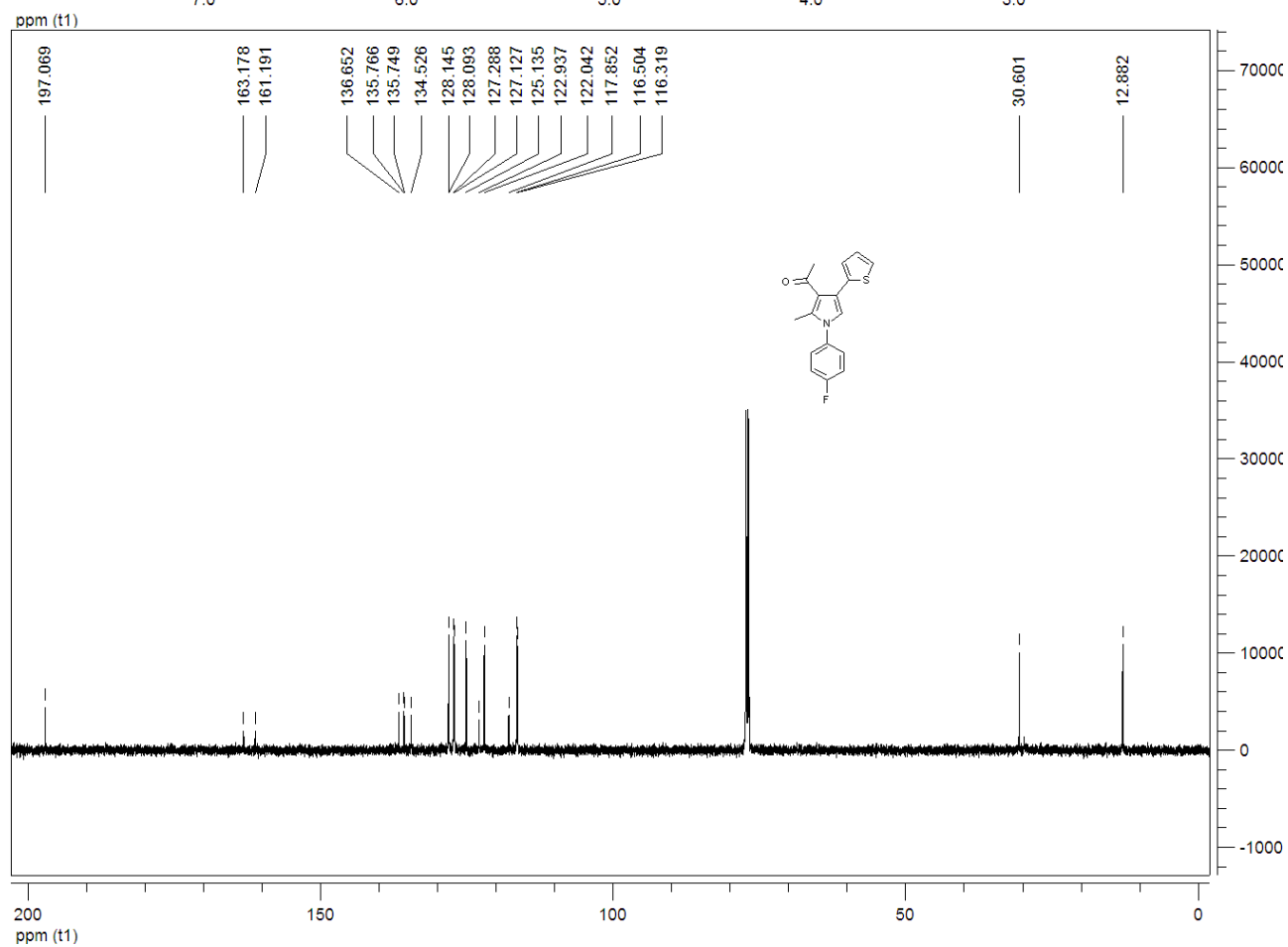
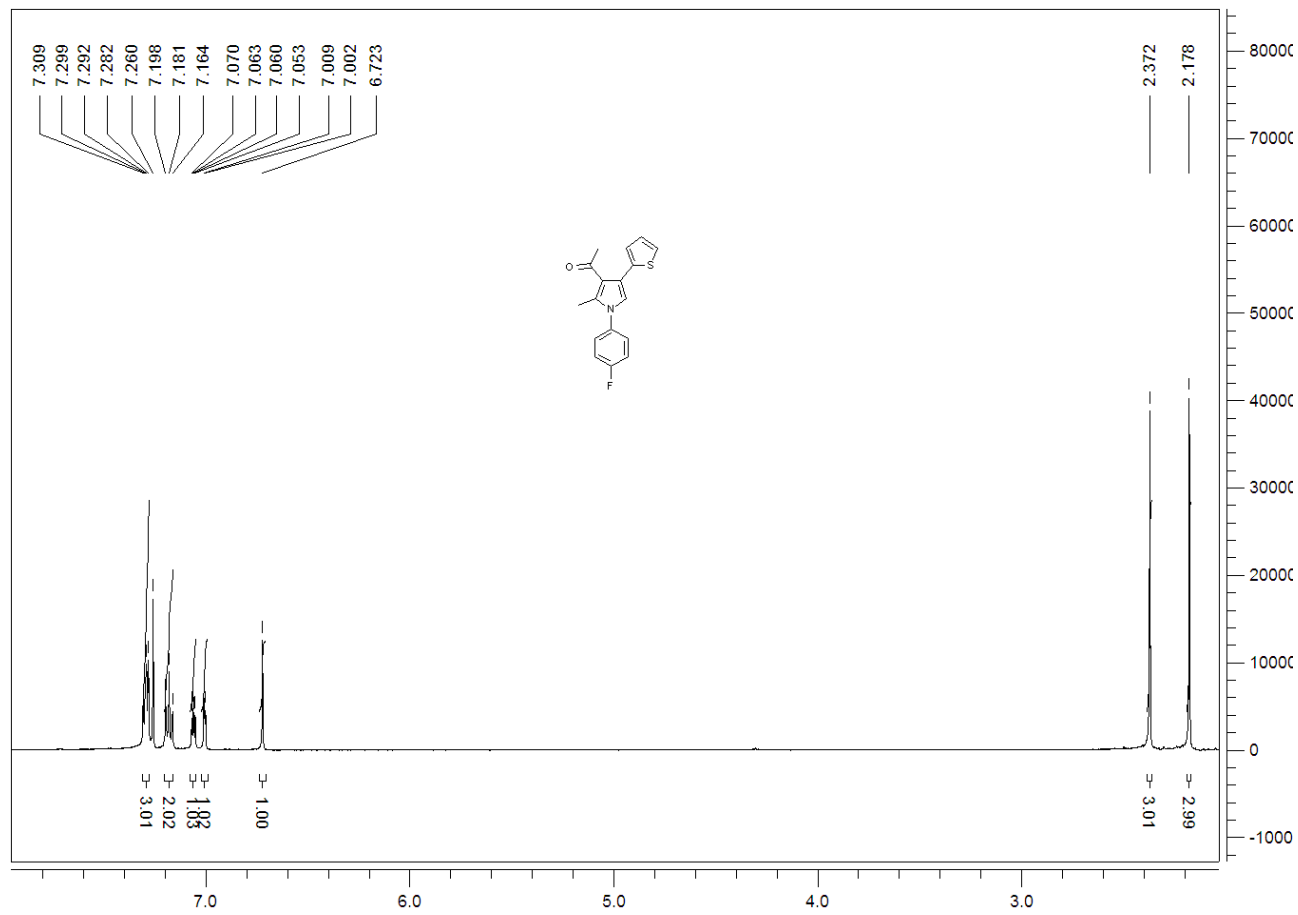
¹H NMR and ¹³C NMR of compound **5ab**



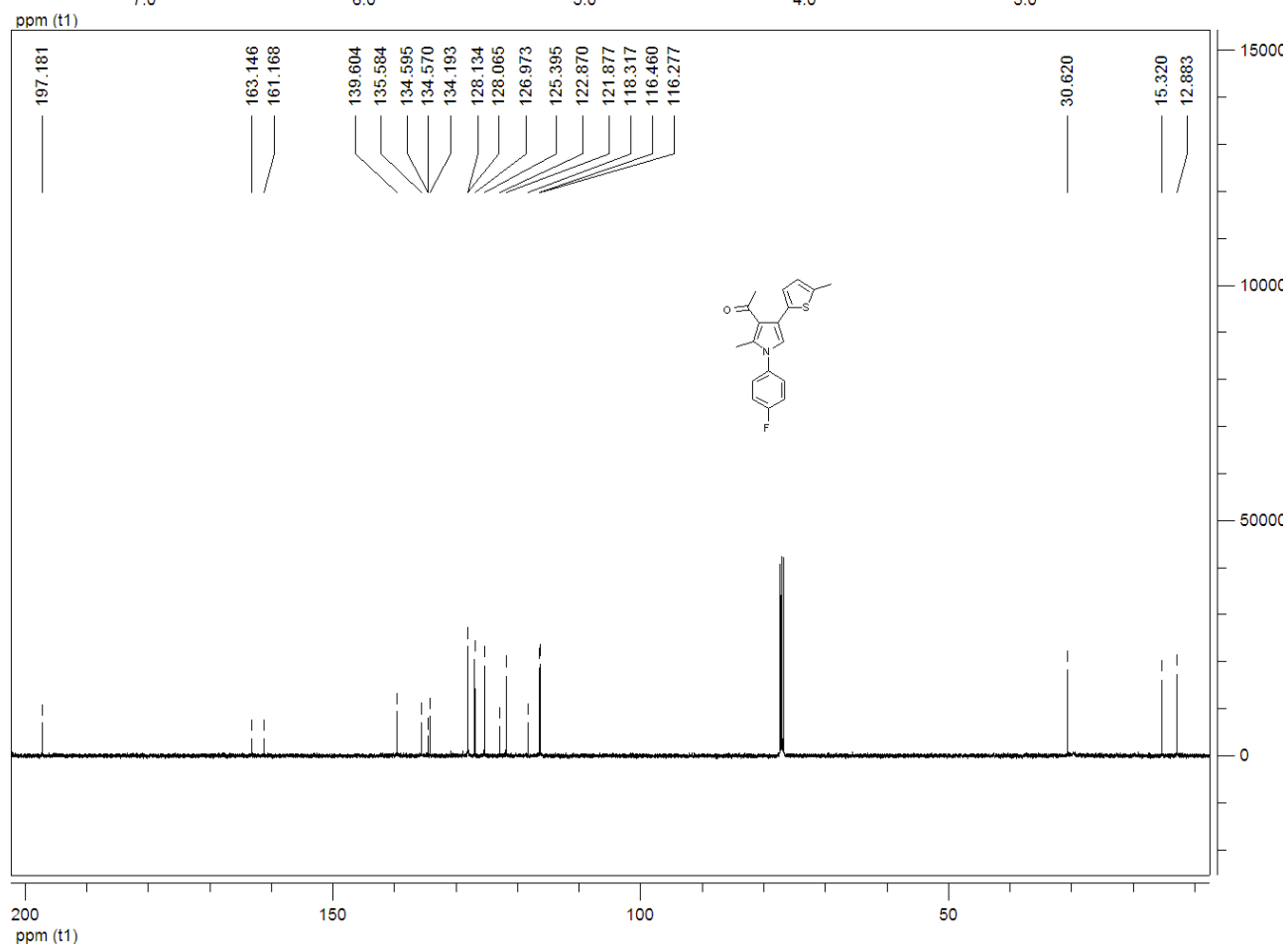
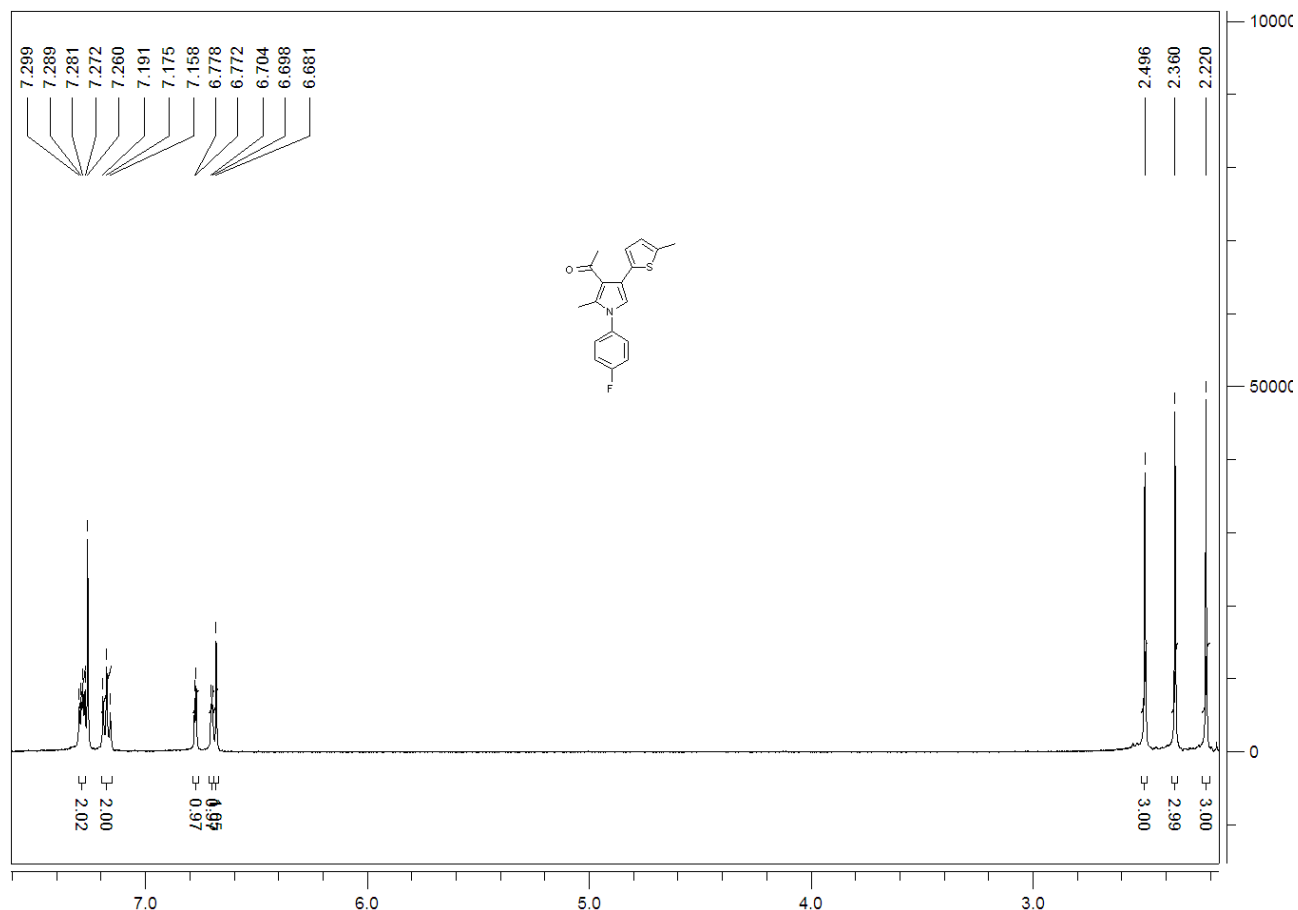
¹H NMR and ¹³C NMR of compound **5ac**



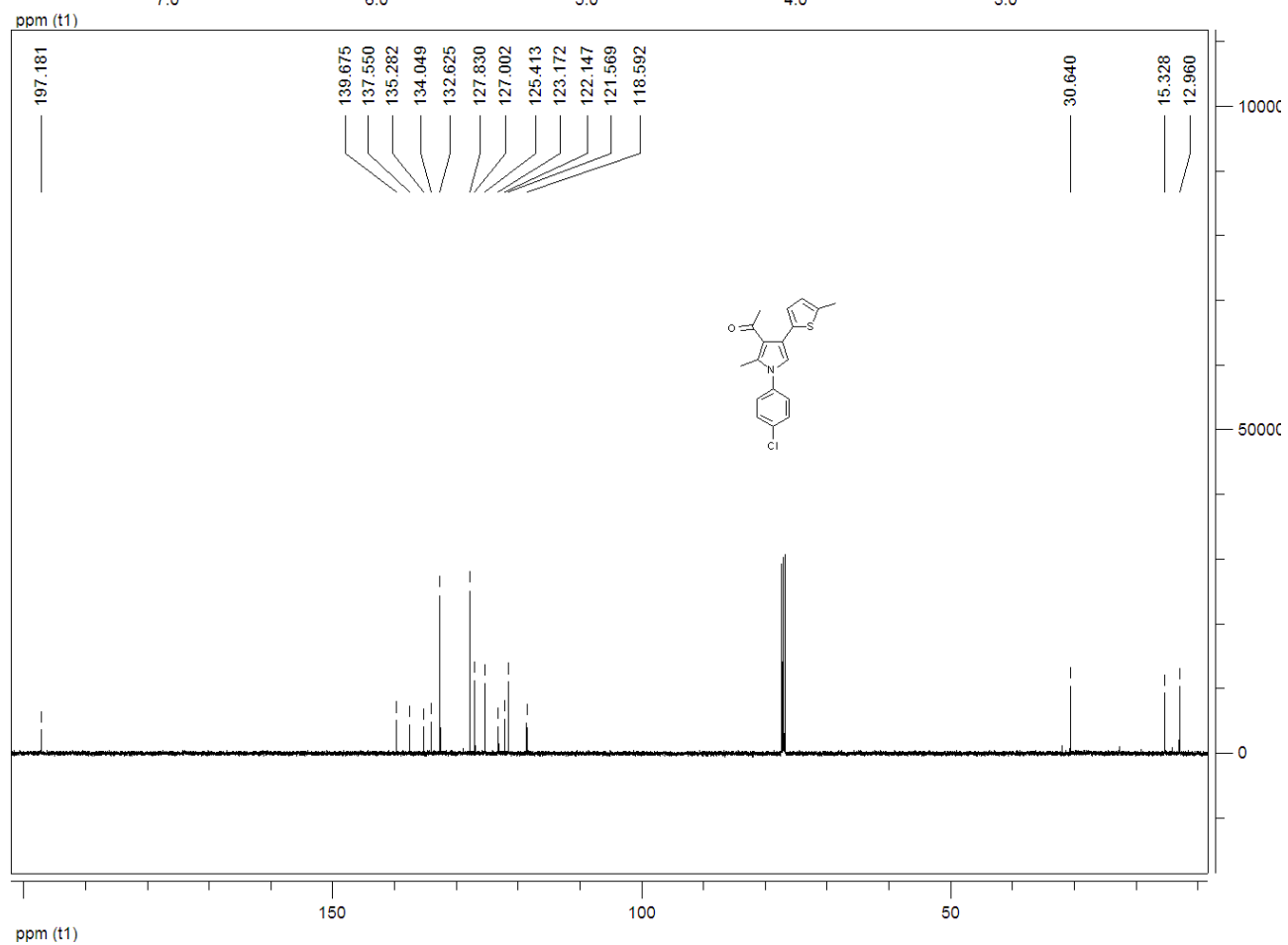
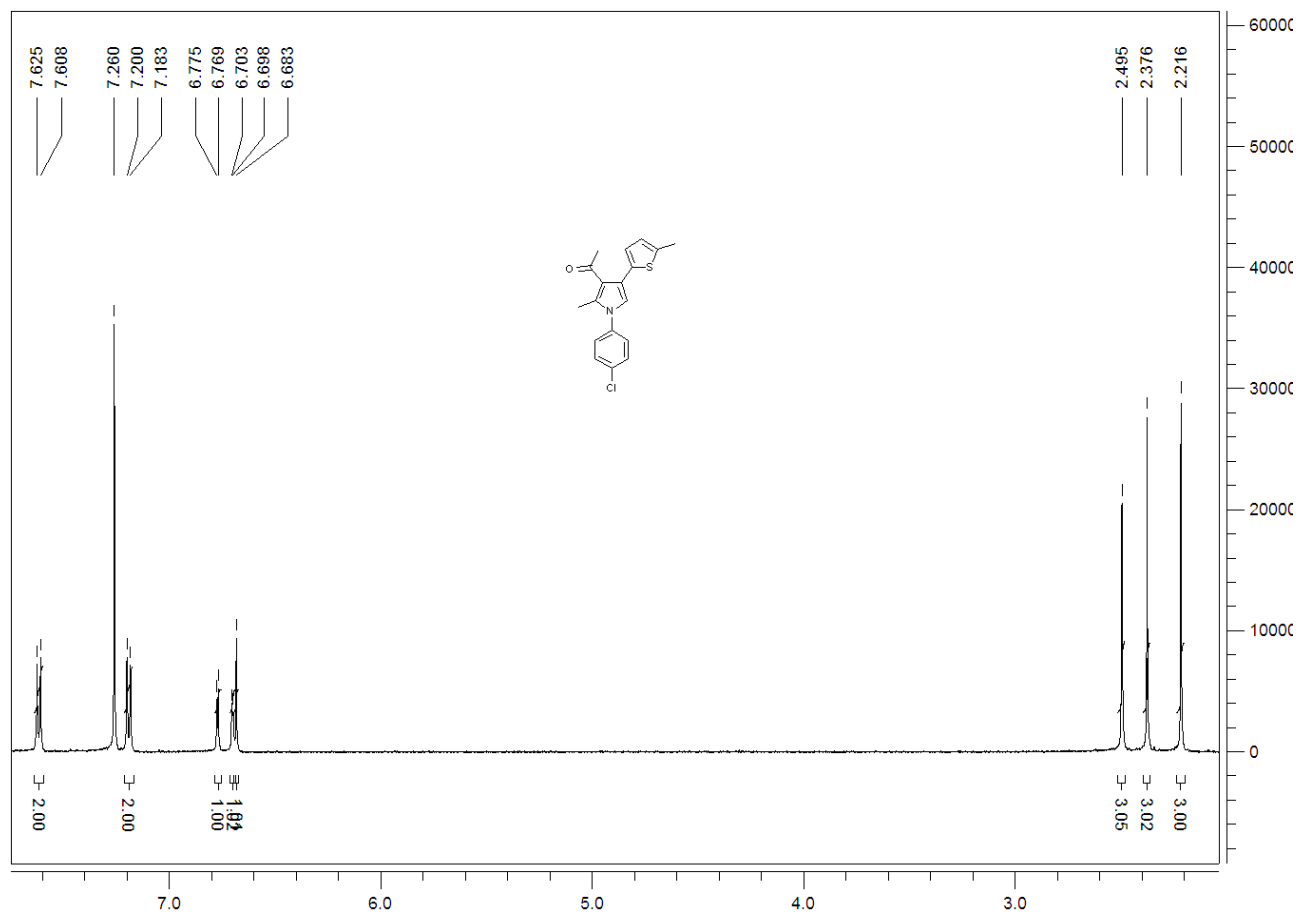
¹H NMR and ¹³C NMR of compound **5ad**



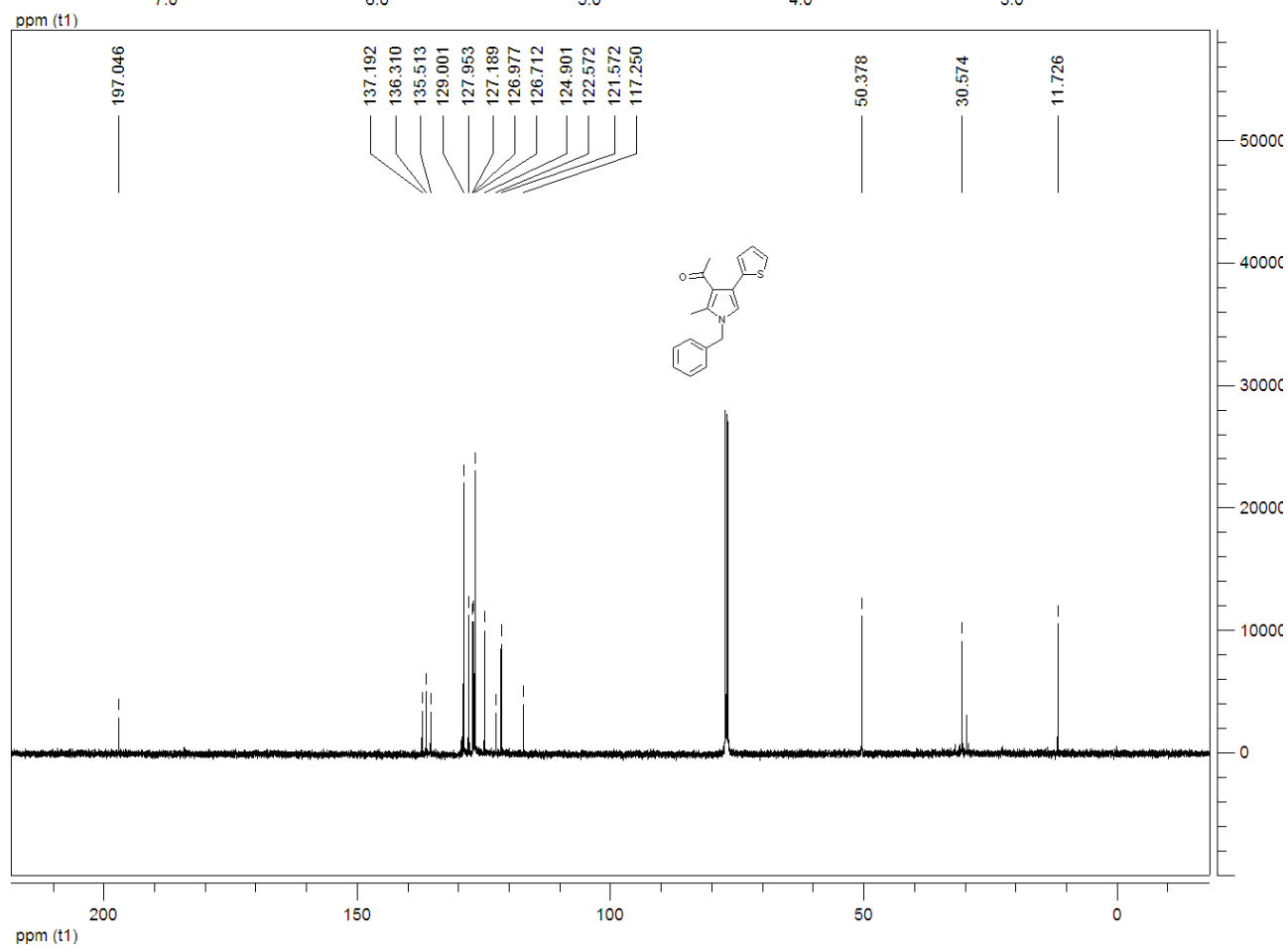
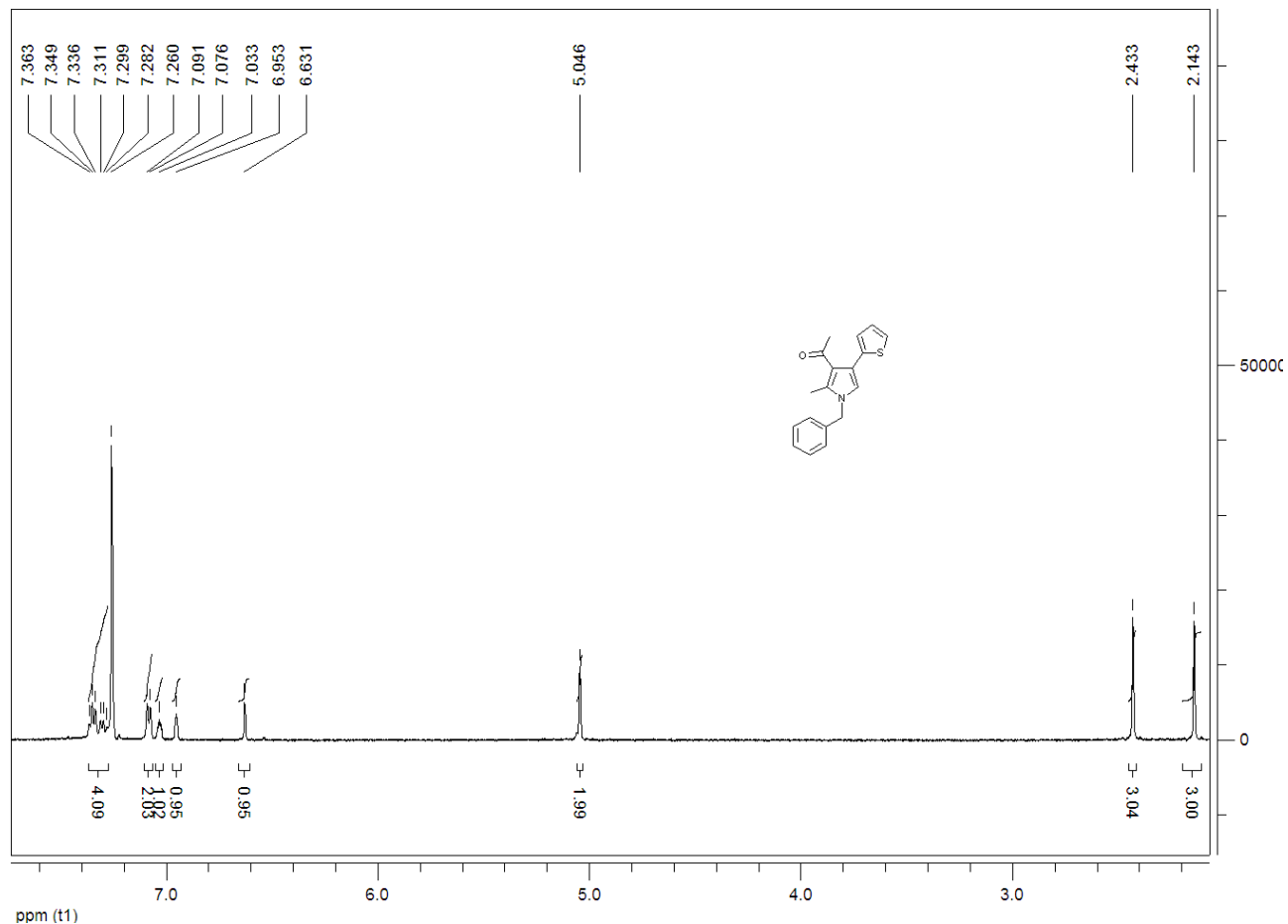
¹H NMR and ¹³C NMR of compound **5ae**



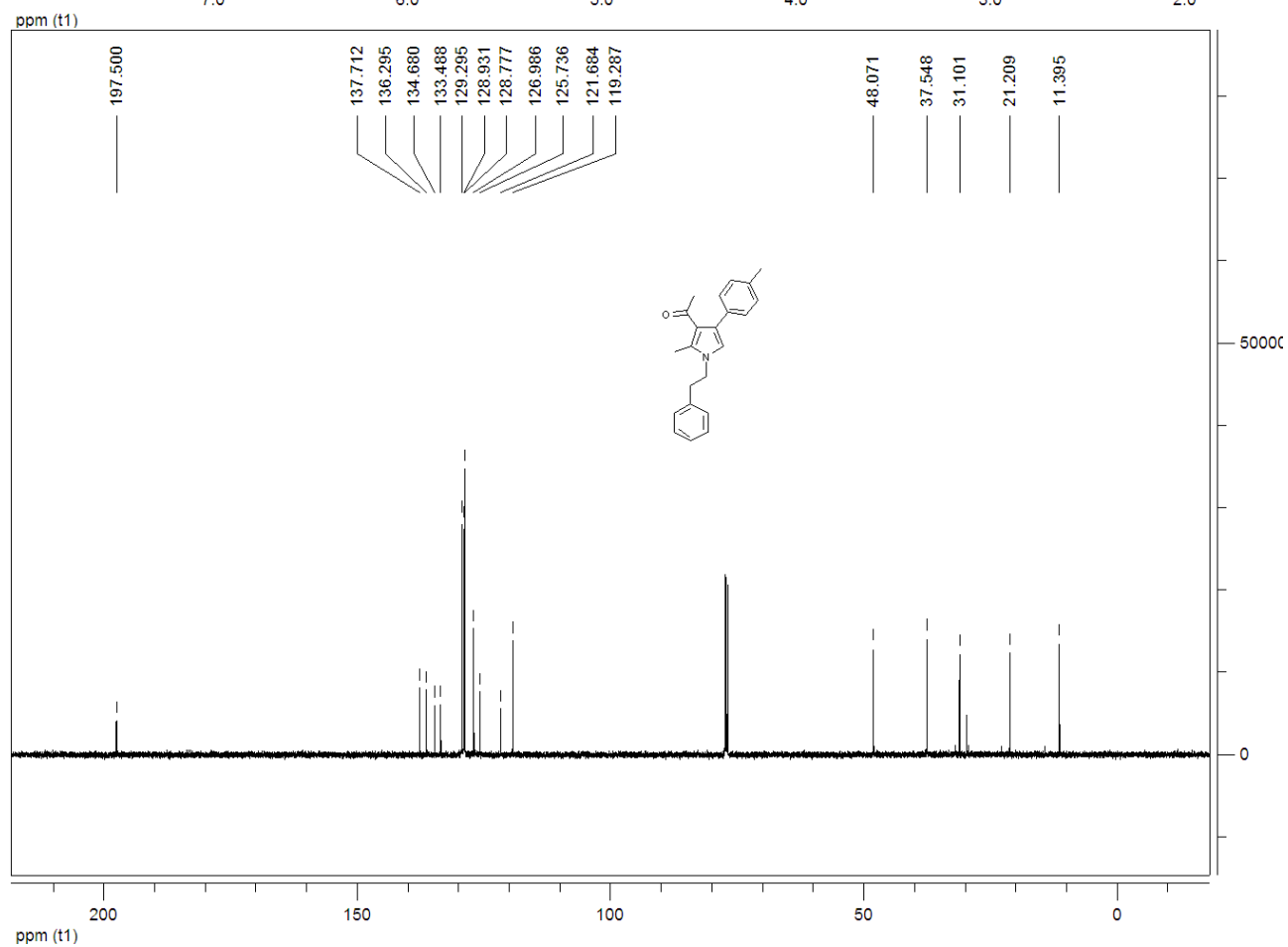
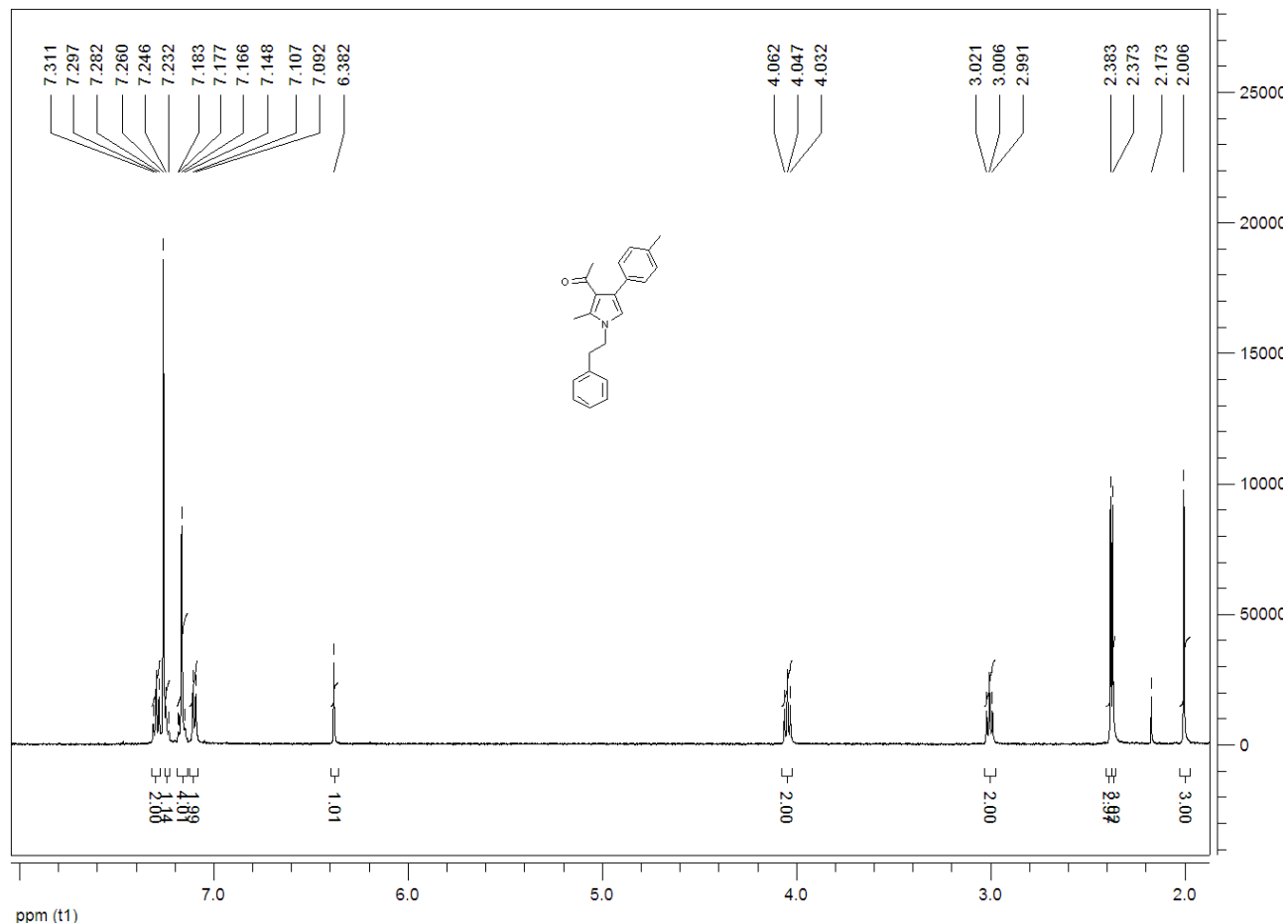
¹H NMR and ¹³C NMR of compound **5af**



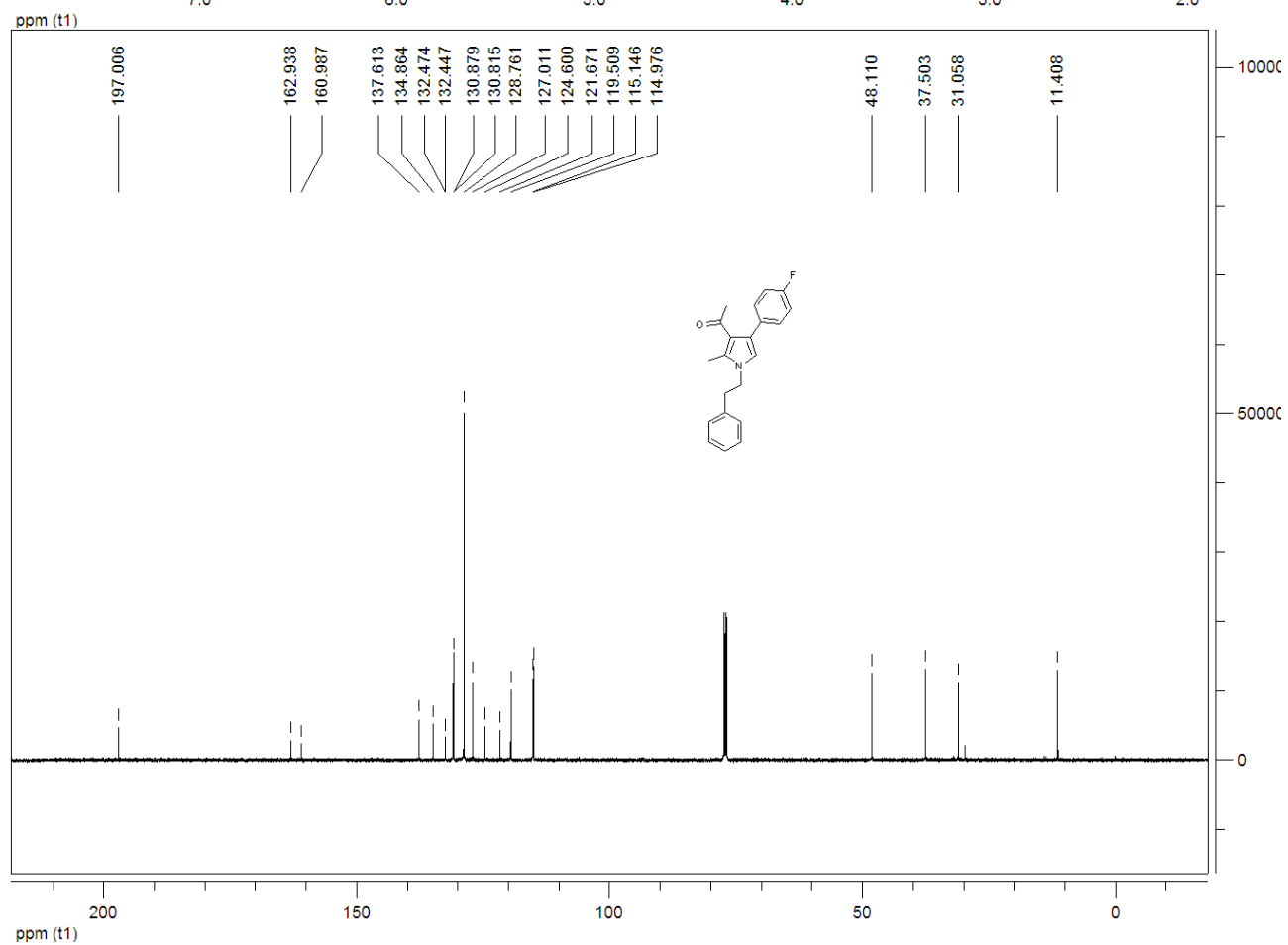
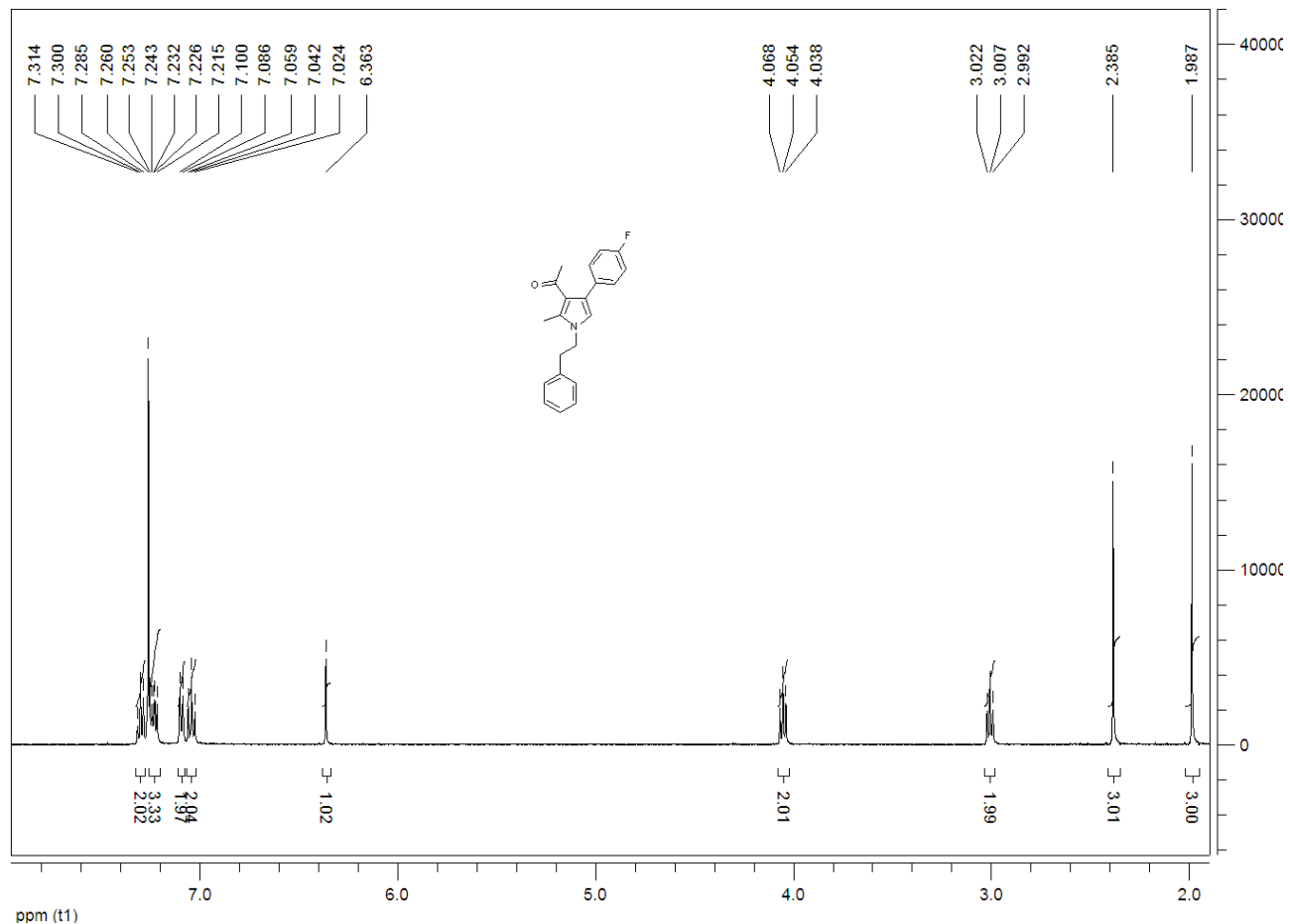
¹H NMR and ¹³C NMR of compound **5ah**



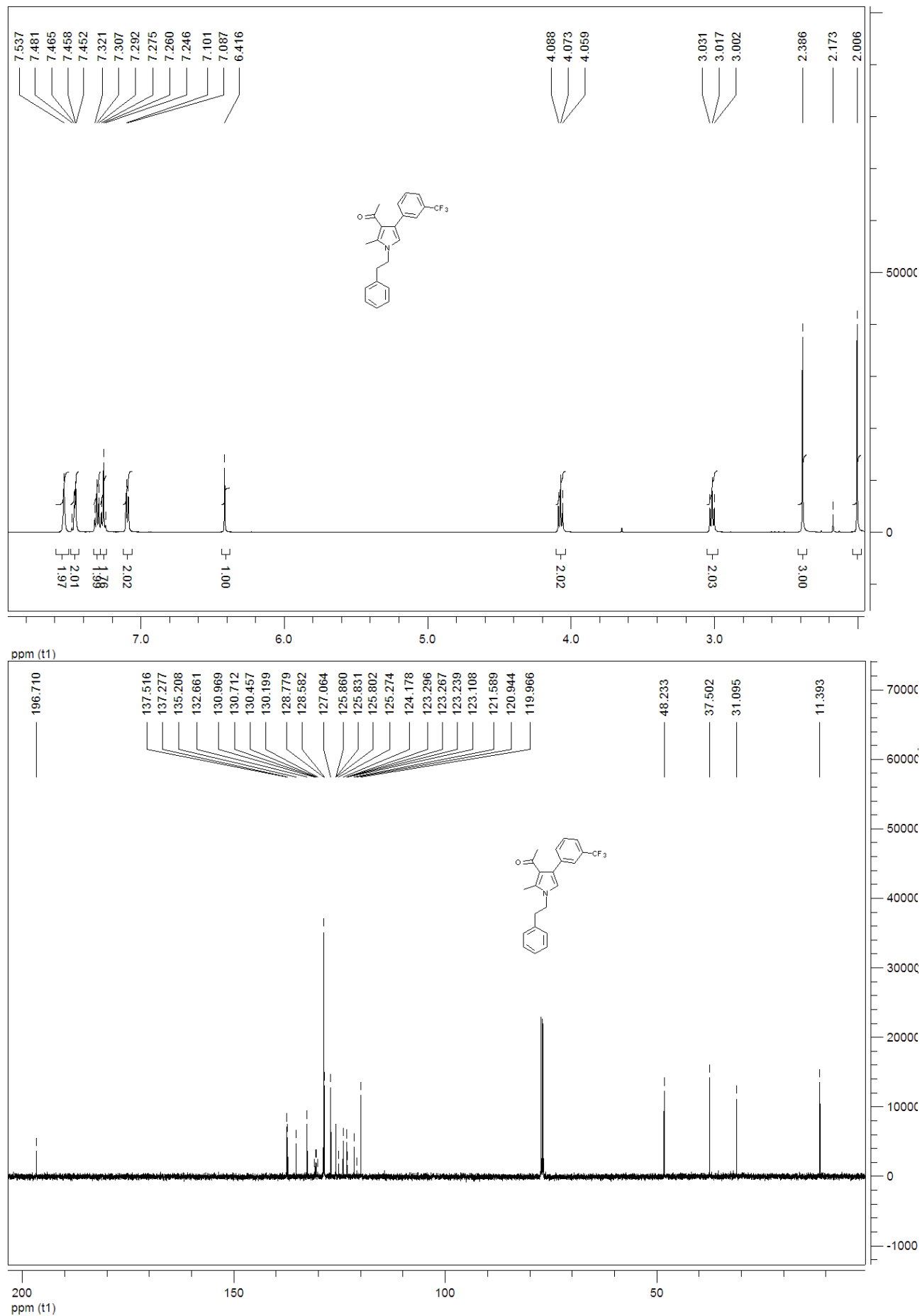
¹H NMR and ¹³C NMR of compound **5ai**



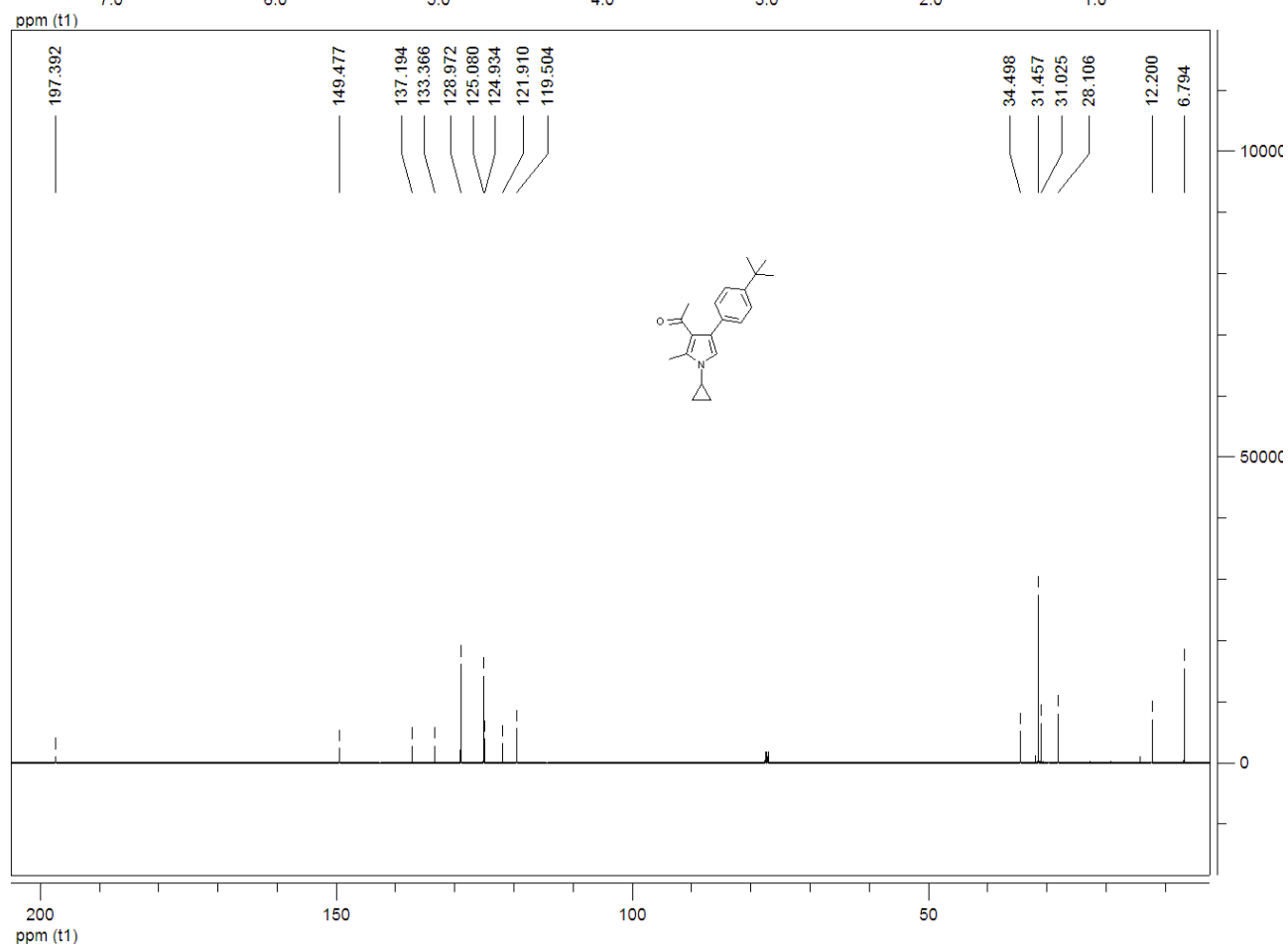
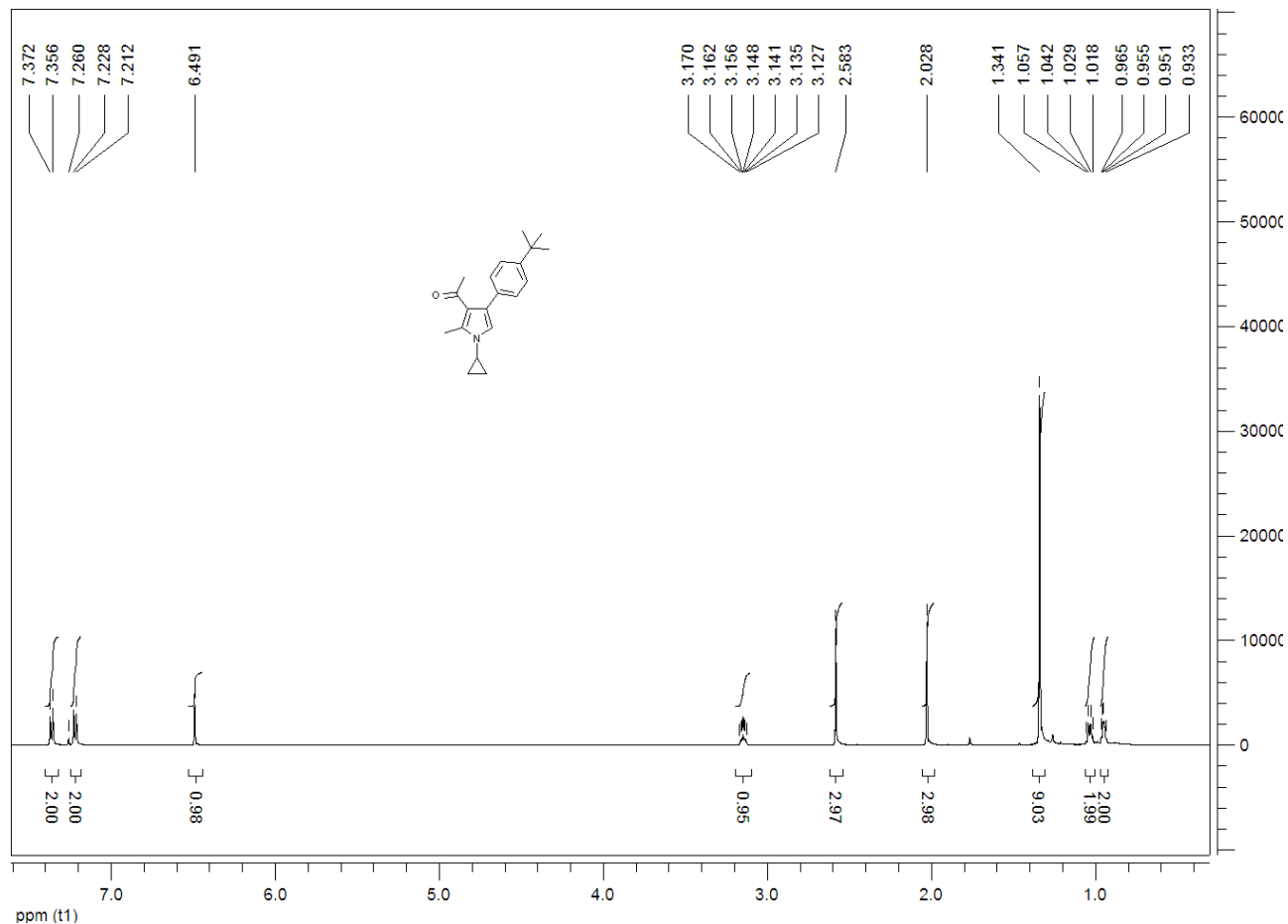
¹H NMR and ¹³C NMR of compound **5aj**



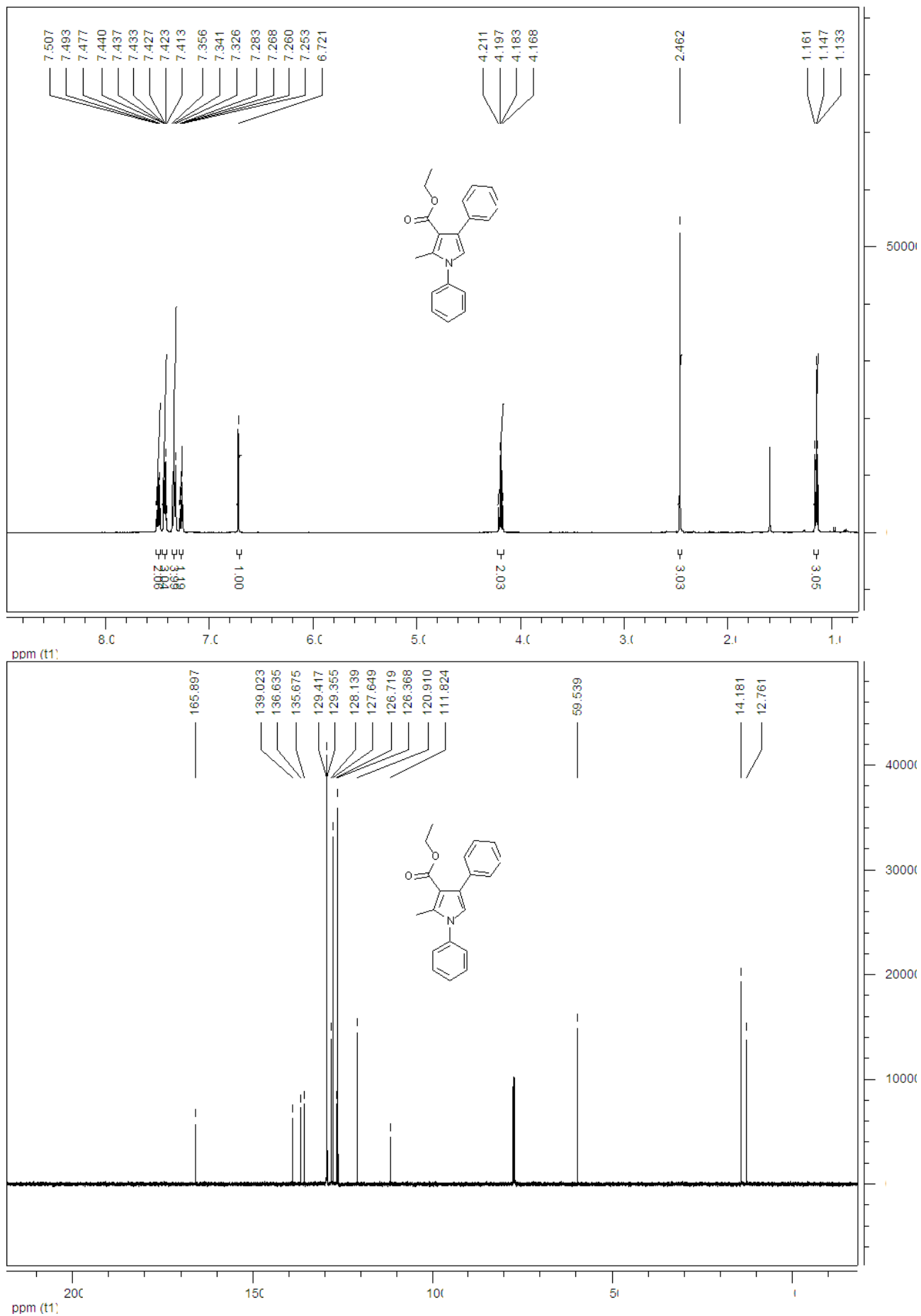
^1H NMR and ^{13}C NMR of compound **5ak**



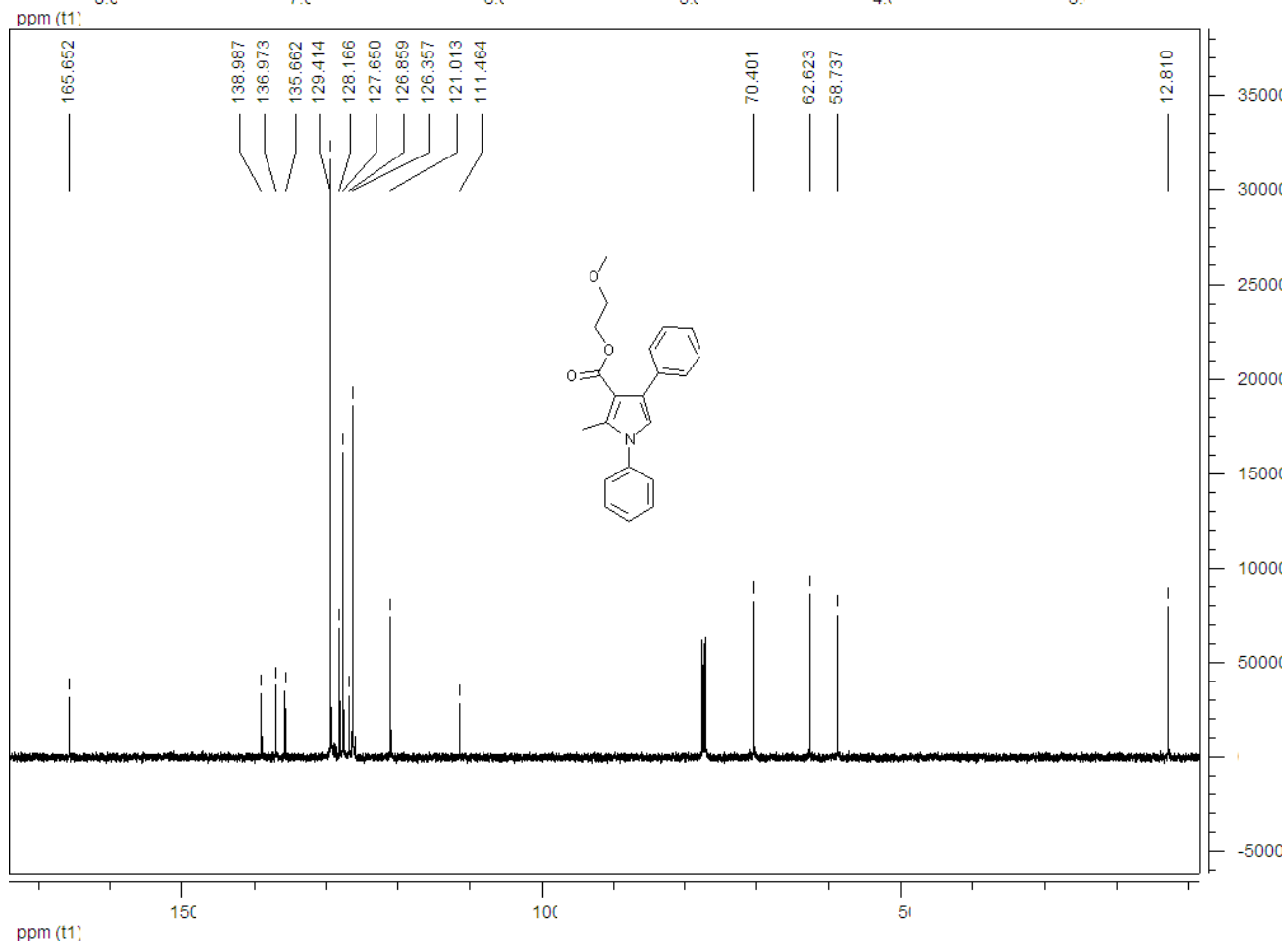
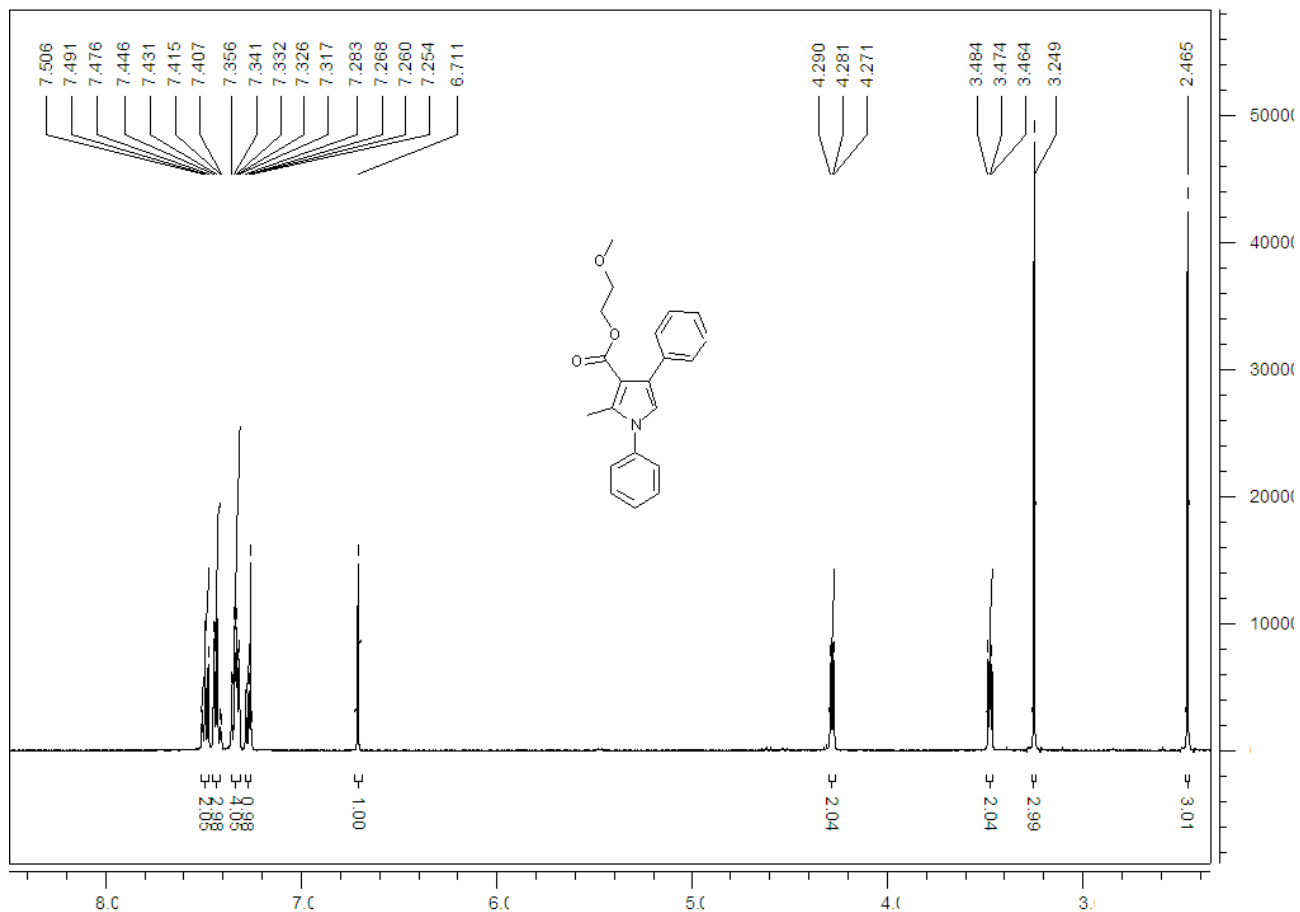
¹H NMR and ¹³C NMR of compound **5al**



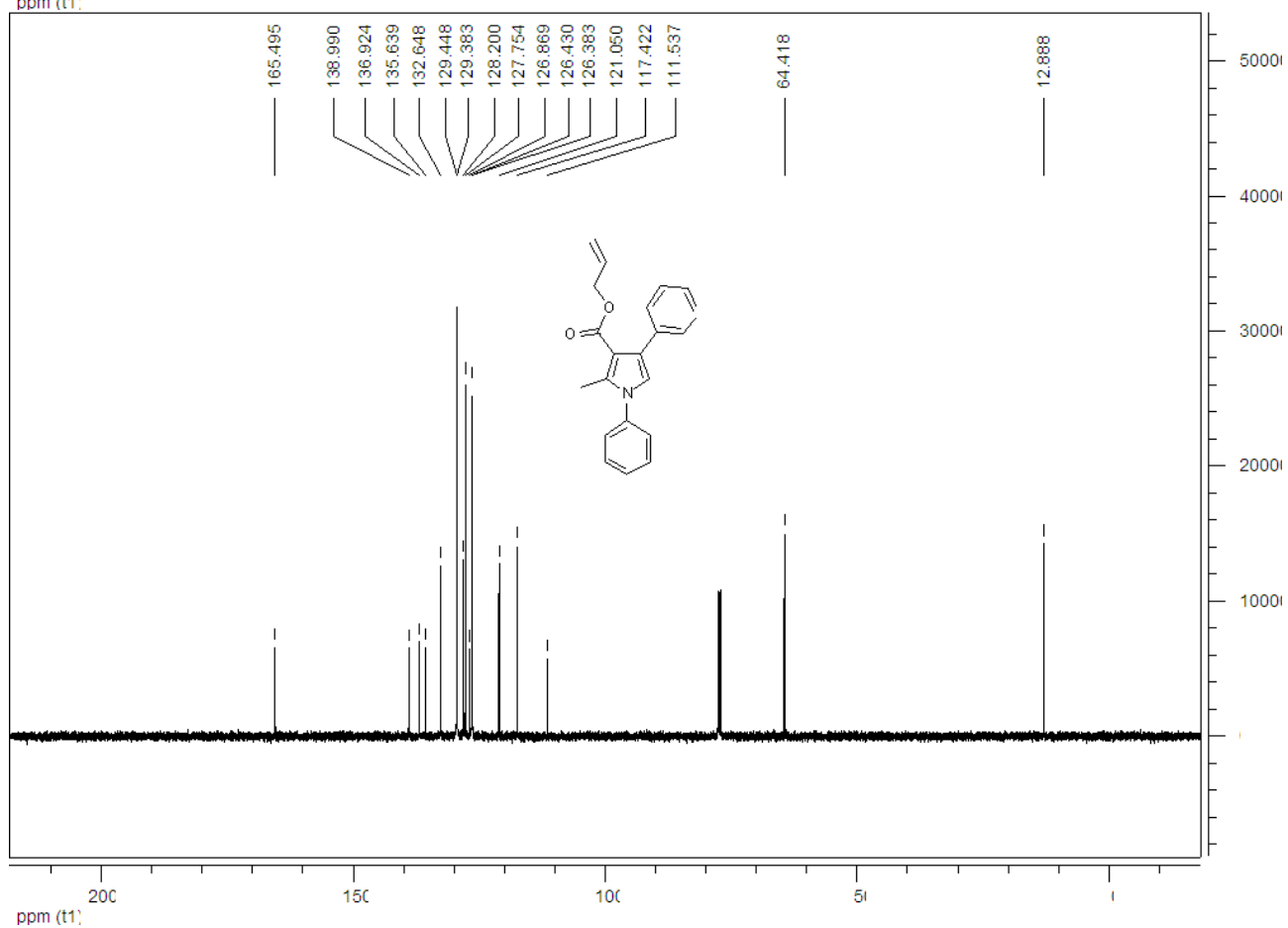
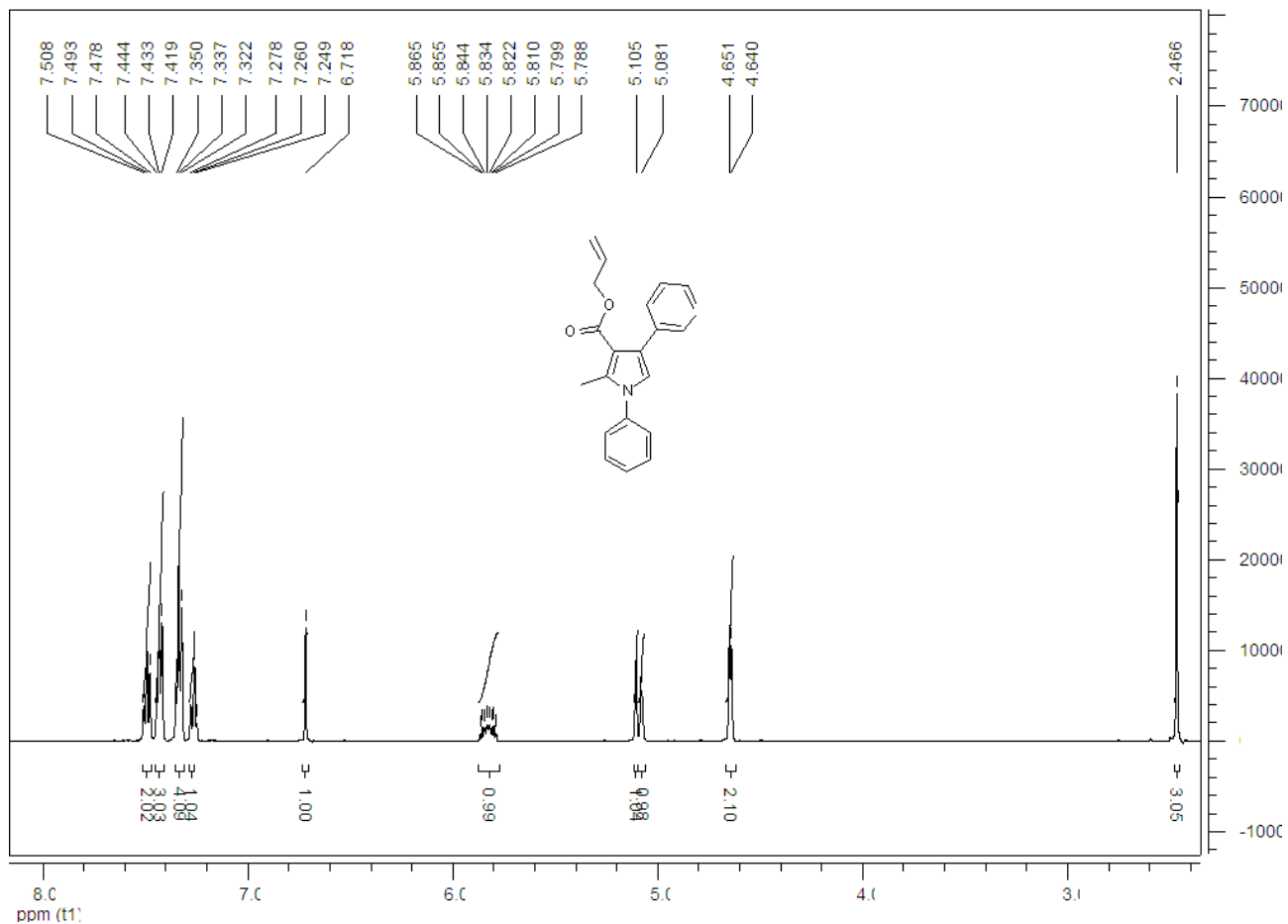
^1H NMR and ^{13}C NMR of compound **5an**



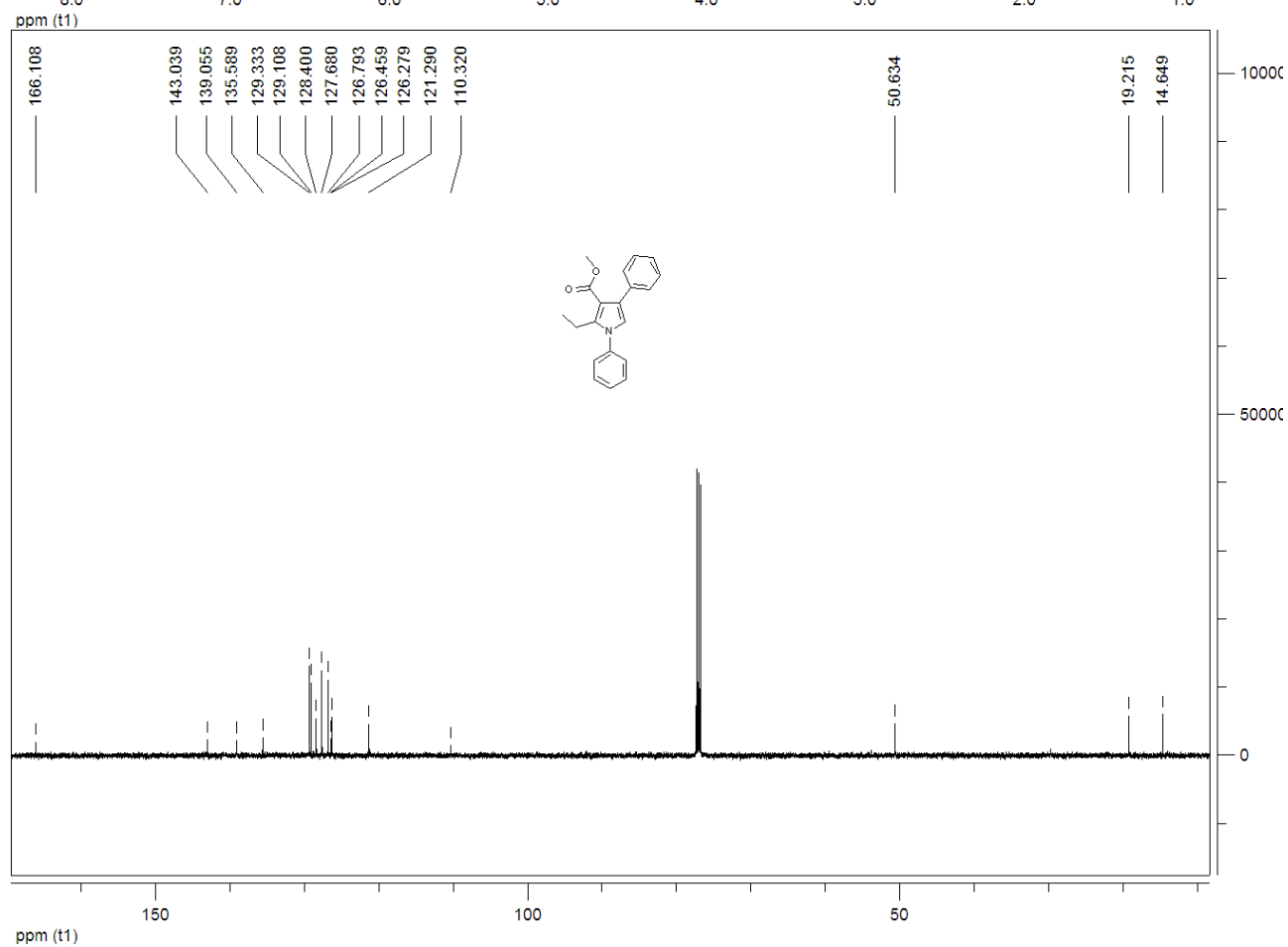
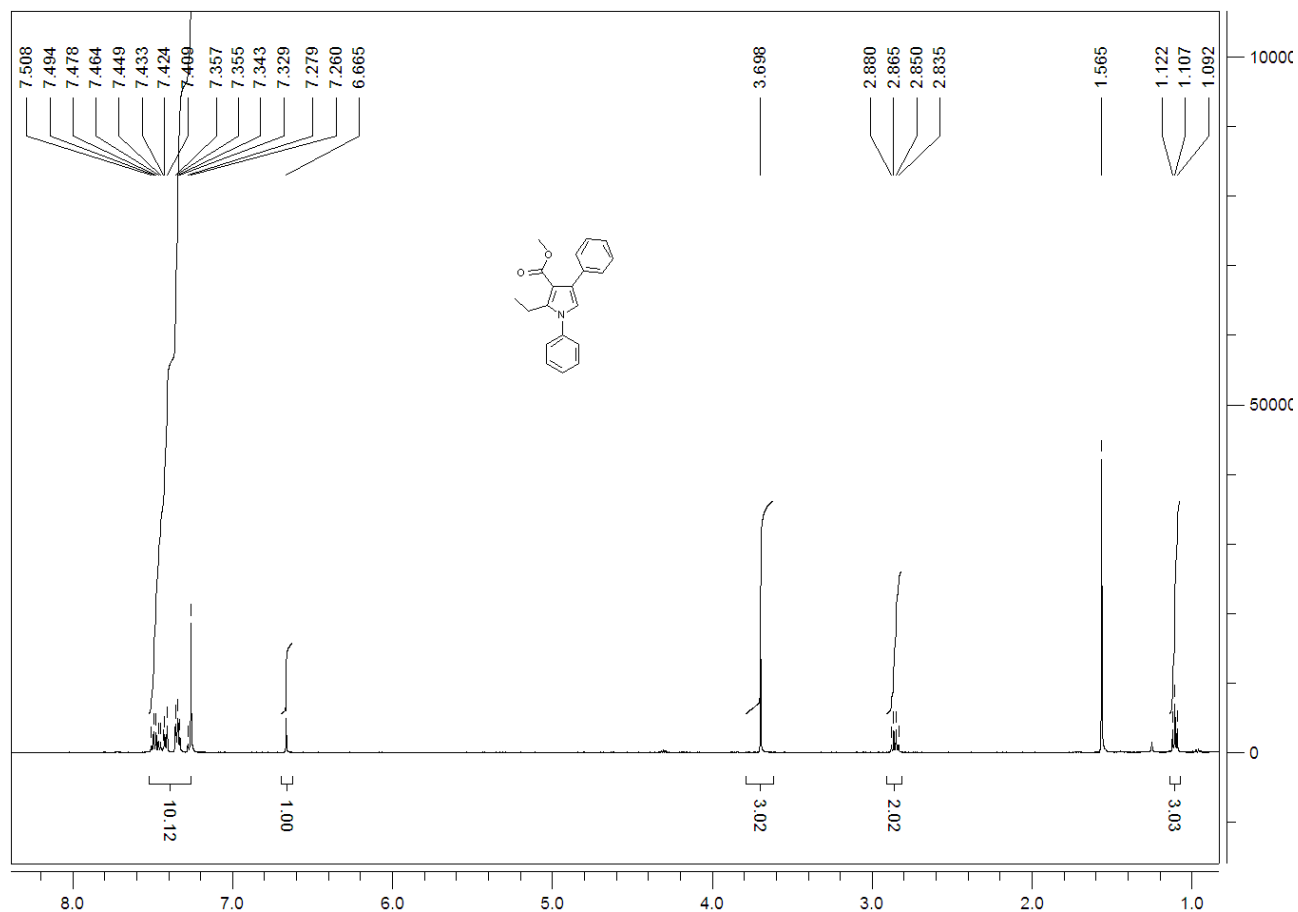
¹H NMR and ¹³C NMR of compound **5ao**



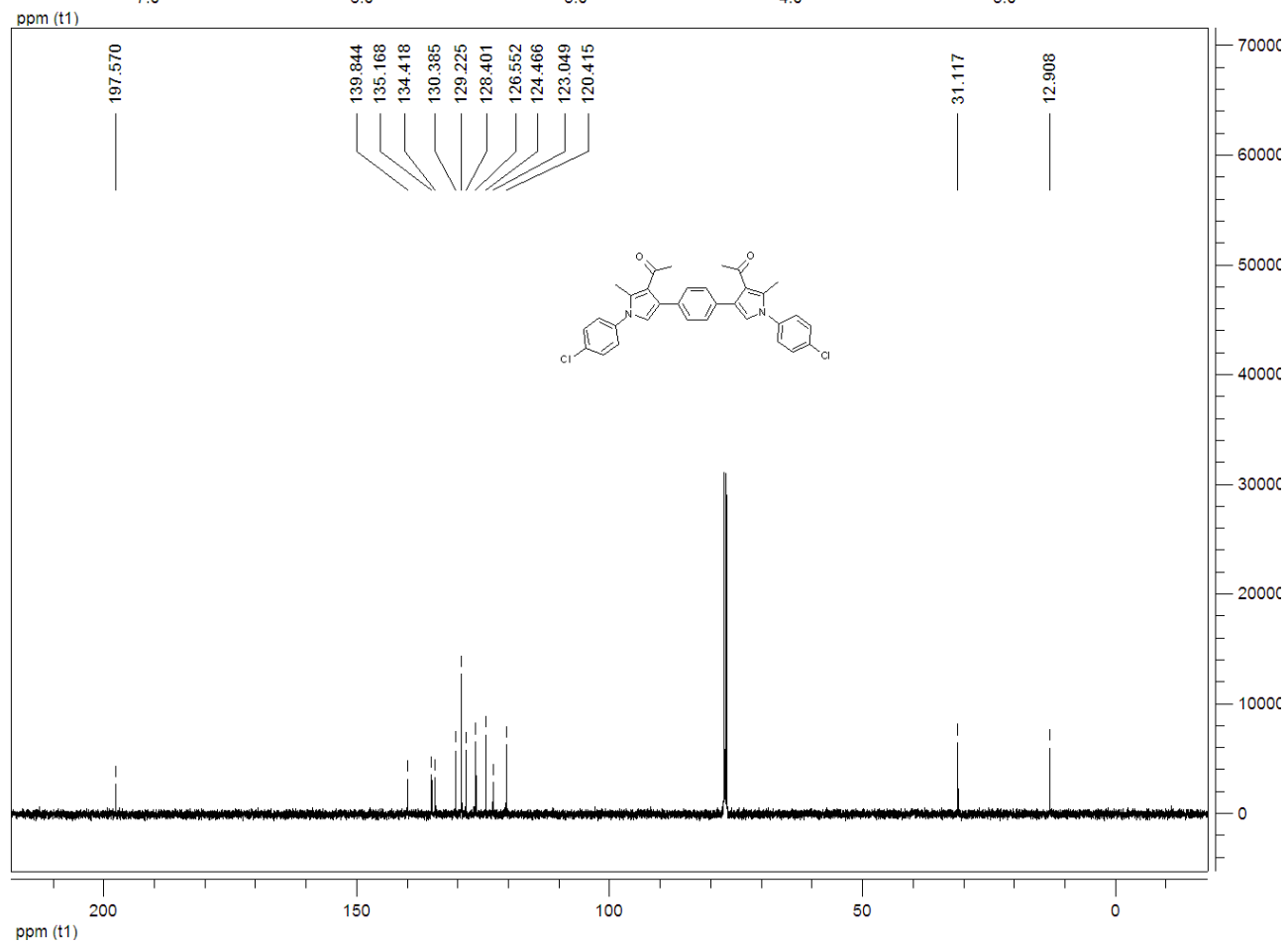
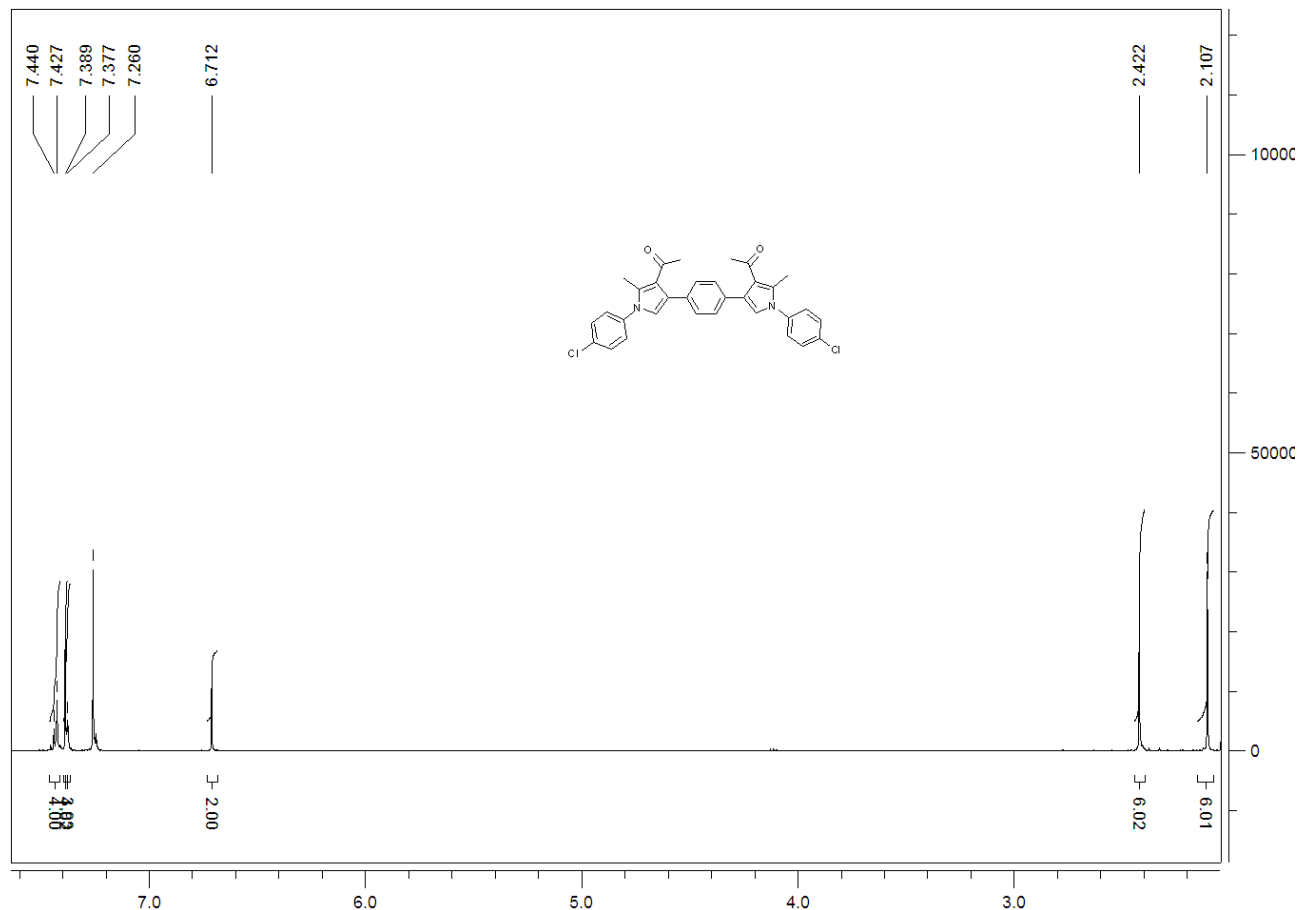
¹H NMR and ¹³C NMR of compound **5ap**



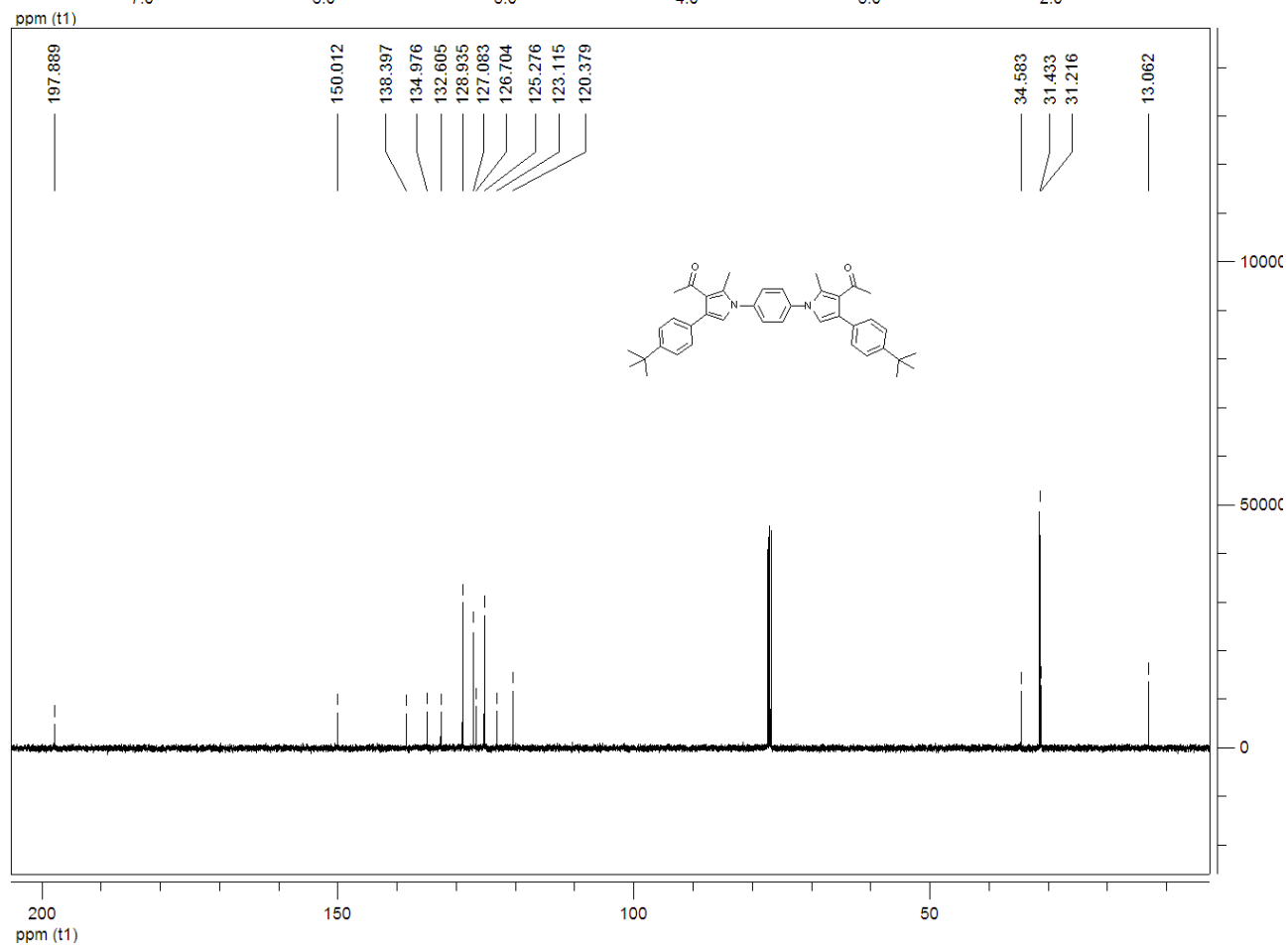
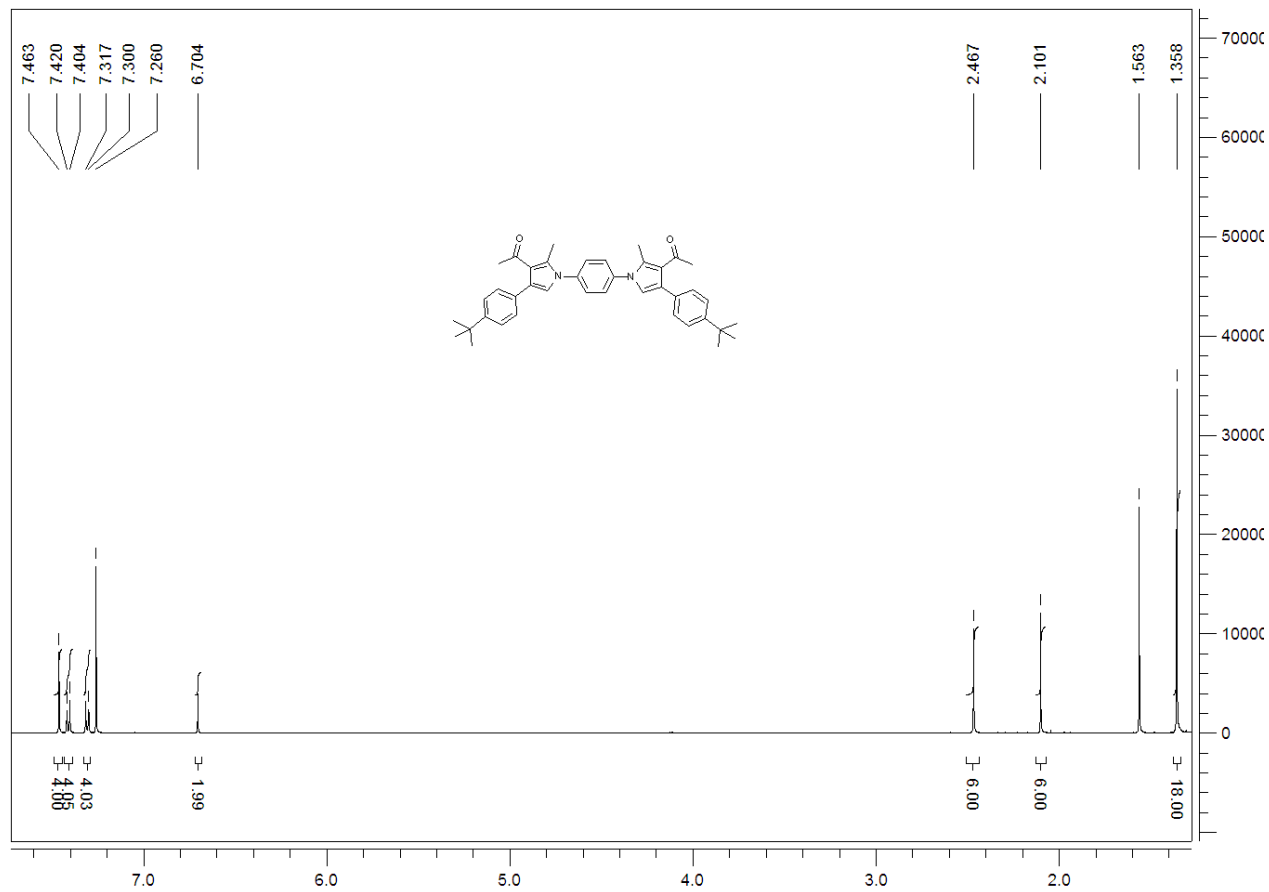
¹H NMR and ¹³C NMR of compound **5aq**



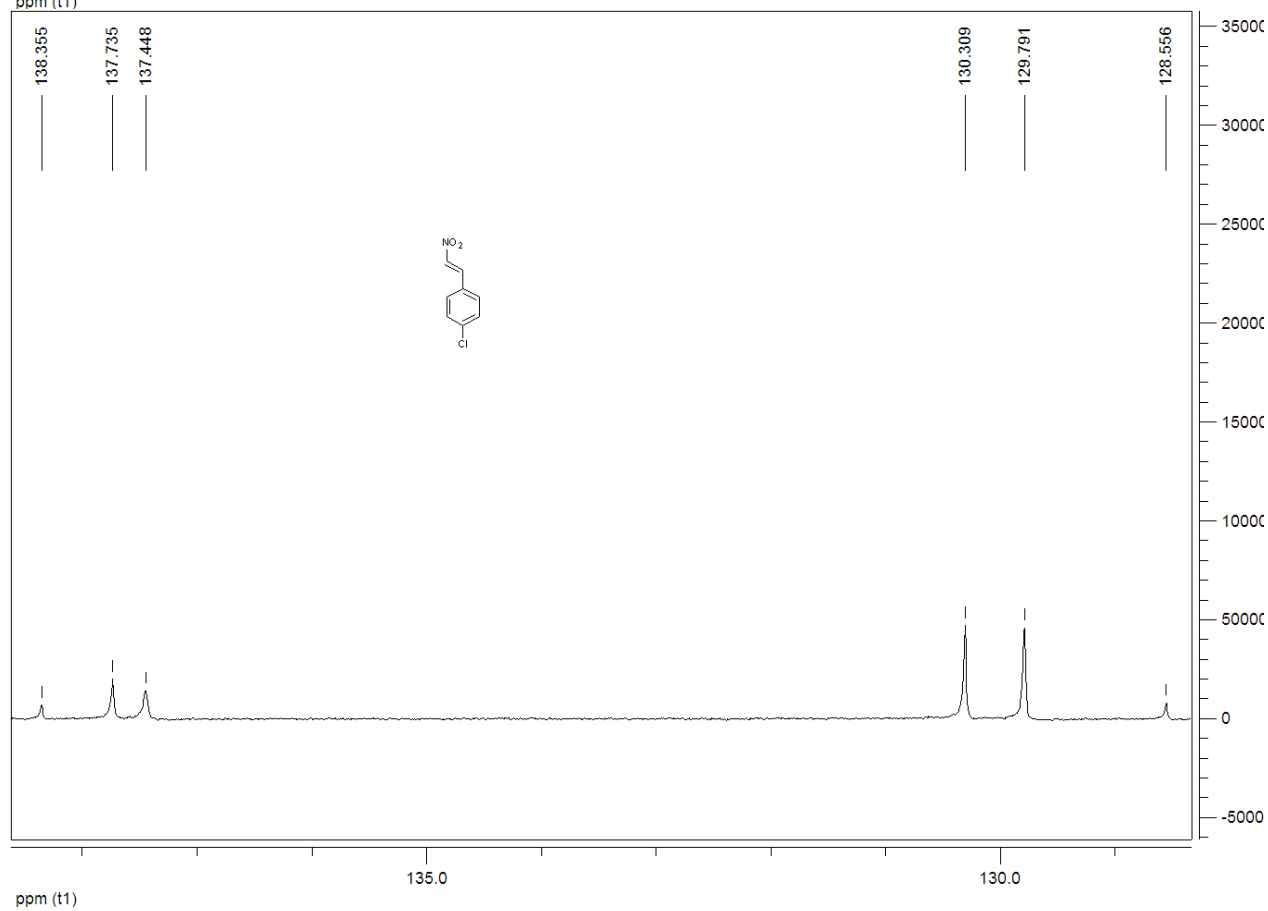
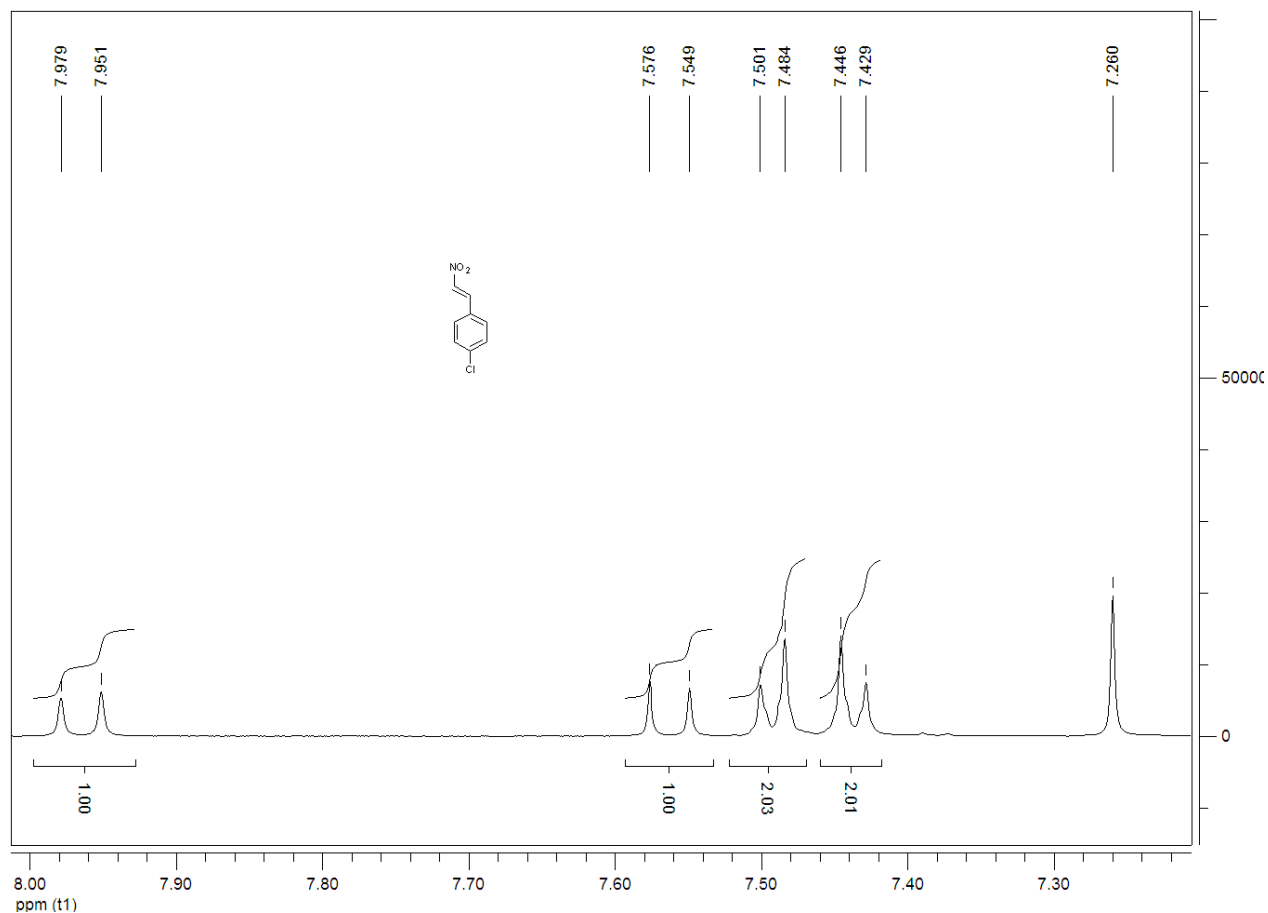
^1H NMR and ^{13}C NMR of compound 6



¹H NMR and ¹³C NMR of compound 7



^1H NMR and ^{13}C NMR of compound **intermediate A**



¹H NMR and ¹³C NMR of compound **intermediate B**

