

Supporting Information

Pd-catalyzed cross-coupling synthesis of 4-aryl-3-formylcoumarins

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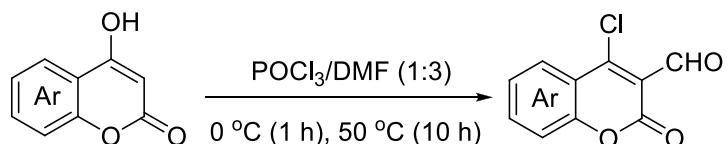
General Information:

The coupling reactions were done in dry Schlenk tubes under N₂ atmosphere conditions. All solvents used in coupling reactions were dried following the standard procedures. These solvents after distillation were stored over oven-dried molecular sieves (4Å) in Schlenk bottles under N₂ atmosphere. Column chromatography was done with 100-200 mesh (Souvenir Chemicals) or 230-400 mesh silica gel (Merck) using EtOAc/hexane as eluent. The instruments of JEOL ECS 400 (400 MHz) and JEOL ECX 500 (500 MHz) were used to measure ¹H and ¹³C NMR spectra. Agilent 6230 LC/TOF analyzer for atmospheric-pressure chemical ionization (APCI) and Agilent 6546 LC/Q-TOF analyzer for Electrospray Ionization (ESI) were used to measure high-resolution mass spectra (HRMS). The Perkin Elmer FT-IR machine was used for recording IR spectra. Chemical shifts in parts per million (ppm) were reported with reference to residual CHCl₃ (δ = 7.26 ppm) for ¹H NMR and δ = 77.16 ppm for CDCl₃ in ¹³C NMR spectrum. Coupling constant (*J*) values were reported in Hertz (Hz). The JSGW melting point apparatus was used to measure the melting points of the products and are reported uncorrected.

Experimental procedures:

The synthesis of 4-hydroxy coumarins was carried out from corresponding 2-hydroxy acetophenone derivatives using the known procedure.¹ These compounds were further transformed into 4-chloro-3-formyl coumarin using POCl₃ and DMF conditions.²

General procedure for preparation of 4-chloro -3-formylcoumarin derivatives (1a-1d):



In an oven-dried round-bottomed flask, DMF (10 mL) was taken and cooled to 0 °C. To this, the POCl₃ (5 mL) was added dropwise with stirring. To this mixture, 4-hydroxycoumarin (3 g, 1 equiv.) in DMF (5 mL) added dropwise. After the complete addition, the mixture was stirred at 50 °C for 10 h. Then, the mixture was cooled to rt and poured into ice-cold water. The resulted solid product was filtered off and dried under reduced pressure. The crude was further purified by silica gel column chromatography using 100-200 silic and ethyl acetate/hexane as an eluent to obtain 4-chloro-3-formylcoumarin.

4-chloro-2-oxo-2H-chromene-3-carbaldehyde (1a): Yellow solid (2.9 g, 75%); m.p. 122-124 °C, ¹H NMR (396 MHz, Chloroform-*d*) δ = 10.36 (s, 1H), 8.12 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.76 – 7.71 (m, 1H), 7.47 – 7.42 (m, 1H), 7.40 – 7.37 (m, 1H). ¹³C NMR (100 MHz, Chloroform-*d*) δ = 186.94, 158.53, 153.70, 153.35, 135.85, 127.75, 125.71, 118.46, 118.26, 117.30. IR (neat, cm⁻¹): 2875, 1702, 1602, 1540, 1300, 966, 751. APCI (m/z) calcd. for C₁₀H₆ClO₃ [M+H]⁺ 209.0005; found 209.0019.

4-chloro-7-methoxy-2-oxo-2H-chromene-3-carbaldehyde (1b): Yellow solid (2.6 g, 70%); m.p. 176-178 °C, ¹H NMR (400 MHz, Chloroform-*d*) δ = 10.33 (s, 1H), 8.00 (d, *J* = 9.0 Hz, 1H), 6.97 (dd, *J* = 9.1, 2.4 Hz, 1H), 6.81 (d, *J* = 2.4 Hz, 1H), 3.94 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 186.94, 166.29, 159.00, 155.78, 154.16, 129.22, 115.12, 114.61, 112.05, 100.63, 56.43. IR (neat, cm⁻¹): 1722, 1691, 1608, 1527, 1292, 1129, 844, 753. APCI (m/z) calcd. for C₁₁H₈ClO₄ [M+H]⁺ 239.0106; found 239.0107.

4-chloro-7-methyl-2-oxo-2H-chromene-3-carbaldehyde (1c): Yellow solid (2.8 g, 74%); m.p. 142-144 °C, ¹H NMR (500 MHz, Chloroform-*d*) δ 10.32 (s, 1H), 7.96 (d, *J* = 8.2 Hz, 1H), 7.23 (d, *J* = 8.8 Hz, 1H), 7.16 (s, 1H), 2.50 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 186.93, 158.75, 153.80, 153.45, 148.25, 127.46, 127.05, 117.30, 117.24, 116.16, 22.13. IR (neat, cm⁻¹): 2868, 1755, 1610, 1534, 1324, 1157, 844, 723. APCI (m/z) calcd. for C₁₁H₈ClO₃ [M+H]⁺ 223.0162; found 223.0166.

4,6-dichloro-7-methyl-2-oxo-2H-chromene-3-carbaldehyde (1d): Yellow solid (2.5 g, 68%); m.p. 130-132 °C, ¹H NMR (500 MHz, Chloroform-*d*) δ = 10.32 (s, 1H), 8.04 (s, 1H), 7.25 (s, 1H), 2.51 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 186.63, 158.29, 152.18, 151.53, 145.77, 132.02, 127.13, 119.16, 118.01, 117.54, 21.09. IR (neat, cm⁻¹): 2924, 1730, 1701, 1534, 1300, 1034, 889, 797. APCI (m/z) calcd. for C₁₁H₇Cl₂O₃ [M+H]⁺ 256.9767; found 256.9767.

General procedure for synthesis of 4-aryl-3-formylcoumarins (2.1 - 2.11, 3.1 - 3.14, Table 2 and Table 3):

The cross-coupling reaction was carried out in an oven-dried Schlenk tube under a nitrogen atmosphere with 4-chloro-3-formylcoumarin derivative (0.825 mmol, 3.3 equiv.), BiAr₃ (0.25 mmol, 1 equiv.), K₃PO₄ (1 mmol, 4 equiv.), Pd₂(dba)₃ (0.0125 mmol, 0.05 equiv.), PPh₃ (0.025 mmol, 0.1 equiv.) in THF (3 mL). The mixture was heated in an oil bath at 60 °C for 4 h. It was then brought to rt and extracted with ethyl acetate (30 mL). The organic extract was washed with water, brine, dried over anhydrous MgSO₄, and concentrated. The crude was purified by silica gel column chromatography using ethyl acetate/hexane as an eluent. The cross-coupled product yield was calculated considering 0.75 mmol as 100% yield.

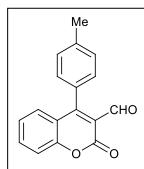
Procedure for one-pot synthesis of Wittig modified 3, 4-disubstituted couamrins (4.1 – 4.6, Table 4):

Step 1: The cross-coupling reaction was carried out in an oven-dried Schlenk tube under a nitrogen atmosphere with 4-chloro-3-formylcoumarin (0.825 mmol, 3.3 equiv.), BiAr₃ (0.25 mmol, 1 equiv.), K₃PO₄ (1 mmol, 4 equiv.), Pd₂(dba)₃ (0.0125 mmol, 0.05 equiv.), PPh₃ (0.025 mmol, 0.1 equiv.) in THF (3 mL). The mixture was heated in an oil bath at 60 °C for 4 h.

Step 2: The product mixture obtained in Schlenk tube from step 1 was cooled to rt. To this, Wittig salt (0.75 mmol, 3 equiv.), NaOMe (0.75 mmol, 3 equiv.) and THF (1 mL) were added under the nitrogen atmosphere. The mixture was heated at 60 °C for 6 h. It was then brought to rt, extracted with ethyl acetate (30 mL). The organic extract was washed with water, brine, dried over anhydrous MgSO₄, and concentrated. The crude was subjected to silica gel column chromatography using ethyl acetate/hexane as an eluent to obtain Wittig modified 3, 4-disubstituted couamrin product. The overall yield was calculated considering 0.75 mmol product as 100% yield.

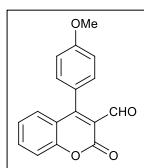
Spectral data of products:

2-oxo-4-*p*-tolyl-2*H*-chromene-3-carbaldehyde (2.1): Yellow solid (166 mg, 84%); m.p. 134–136 °C, ¹H



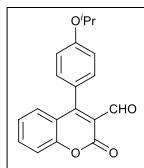
NMR (400 MHz, Chloroform-*d*) δ = 9.92 (s, 1H), 7.68 – 7.62 (m, 1H), 7.40 (d, *J* = 8.3 Hz, 1H), 7.36 (d, *J* = 7.9 Hz, 2H), 7.28 (dd, *J* = 7.9, 1.3 Hz, 1H), 7.24 (d, *J* = 7.1 Hz, 1H), 7.20 (d, *J* = 7.8 Hz, 2H), 2.48 (s, 3H). ¹³C NMR (101 MHz, Chloroform-*d*) δ = 188.53, 161.89, 158.27, 154.65, 140.34, 134.80, 129.57, 129.49, 128.76, 128.50, 124.86, 119.97, 119.14, 117.29, 21.60. IR (neat, cm⁻¹): 2862, 1753, 1722, 1605, 1548, 1365, 1041, 815, 759. APCI (m/z) calcd. for C₁₇H₁₃O₃ [M+H]⁺ 265.0859; found 265.0858.

4-(4-methoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.2): Yellow solid (176 mg, 84%); m.p.



156–158 °C, ¹H NMR (400 MHz, Chloroform-*d*) δ = 9.94 (s, 1H), 7.68 (t, *J* = 7.1 Hz, 1H), 7.43 (d, *J* = 8.2 Hz, 1H), 7.37 (d, *J* = 7.9 Hz, 1H), 7.32 – 7.29 (m, 3H), 7.10 (d, *J* = 8.7 Hz, 2H), 3.94 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.55, 161.41, 161.16, 158.29, 154.70, 134.70, 130.67, 129.45, 124.84, 123.36, 120.06, 119.29, 117.34, 114.38, 55.59. IR (neat, cm⁻¹): 2924, 1753, 1719, 1606, 1543, 1256, 1017, 835, 761. APCI (m/z) calcd. for C₁₇H₁₃O₄ [M+H]⁺ 281.0808; found 281.0825.

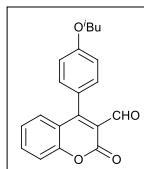
4-(4-isopropoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.3): Yellow solid (179 mg, 77%); m.p.



128–130 °C, ¹H NMR (400 MHz, Chloroform-*d*) δ = 9.87 (s, 1H), 7.64 (td, *J* = 8.0, 7.4, 1.5 Hz, 1H), 7.40 – 7.34 (m, 2H), 7.26 – 7.21 (m, 3H), 7.05 – 6.99 (m, 2H), 4.64 (hept, *J* = 6.0 Hz, 1H), 1.39 (d, *J* = 6.0 Hz, 6H). ¹³C NMR (100 MHz, Chloroform-*d*) δ = 188.58, 161.78, 159.68, 158.07, 154.70, 134.70, 130.84, 129.42, 124.80, 122.74, 119.98, 119.26, 117.33, 115.79, 70.32,

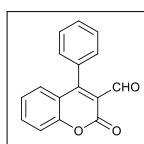
22.11. IR (neat, cm^{-1}): 2978, 1754, 1722, 1605, 1546, 1249, 1106, 953, 758. APCI (m/z) calcd. for $\text{C}_{19}\text{H}_{17}\text{O}_4$ $[\text{M}+\text{H}]^+$ 309.1121; found 309.1129.

4-(4-isobutoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.4): Yellow solid (195 mg, 80%); m.p.



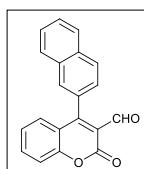
108–110 °C, ^1H NMR (400 MHz, Chloroform-*d*) δ = 9.89 (s, 1H), 7.67 – 7.62 (m, 1H), 7.39 (d, J = 8.2 Hz, 1H), 7.36 (dd, J = 8.0, 1.3 Hz, 1H), 7.26 – 7.22 (m, 3H), 7.06 (d, J = 8.7 Hz, 2H), 3.81 (d, J = 6.4 Hz, 2H), 2.19 – 2.09 (m, 1H), 1.06 (d, J = 6.7 Hz, 6H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.56, 161.63, 160.90, 158.20, 154.70, 134.67, 130.70, 129.45, 124.80, 123.00, 120.05, 119.26, 117.32, 114.85, 74.72, 28.38, 19.36. IR (neat, cm^{-1}): 2960, 1754, 1721, 1605, 1547, 1366, 1027, 758. APCI (m/z) calcd. for $\text{C}_{20}\text{H}_{19}\text{O}_4$ $[\text{M}+\text{H}]^+$ 323.1278; found 323.1275.

2-oxo-4-phenyl-2*H*-chromene-3-carbaldehyde (2.5): Yellow solid (121 mg, 64%); m.p. 140–142 °C, ^1H



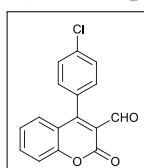
NMR (400 MHz, Chloroform-*d*) δ = 9.95 (s, 1H), 7.68 – 7.64 (m, 1H), 7.57 – 7.53 (m, 3H), 7.41 (d, J = 8.2 Hz, 1H), 7.31 (dd, J = 6.5, 3.1 Hz, 2H), 7.24 – 7.21 (m, 2H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.38, 161.31, 158.41, 154.68, 134.86, 131.74, 129.97, 129.51, 128.88, 128.58, 124.95, 119.95, 119.13, 117.31. IR (neat, cm^{-1}): 2767, 1748, 1676, 1604, 1548, 1372, 893, 762. APCI (m/z) calcd. for $\text{C}_{16}\text{H}_{11}\text{O}_3$ $[\text{M}+\text{H}]^+$ 251.0703; found 251.0713.

4-(naphthalen-2-yl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.6): Yellow solid (204 mg, 90%); m.p.



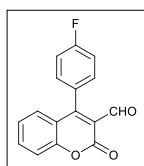
122–124 °C, ^1H NMR (400 MHz, Chloroform-*d*) δ = 9.98 (s, 1H), 8.03 (d, J = 8.3 Hz, 1H), 7.93 (dd, J = 28.7, 7.4 Hz, 2H), 7.80 (s, 1H), 7.68 – 7.61 (m, 3H), 7.42 (dd, J = 15.0, 8.3 Hz, 2H), 7.24 (dd, J = 13.6, 6.2 Hz, 2H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.34, 161.27, 158.46, 154.70, 134.85, 133.63, 132.76, 129.65, 129.16, 128.75, 128.46, 128.44, 128.15, 127.70, 127.43, 125.70, 124.97, 120.06, 119.36, 117.35. IR (neat, cm^{-1}): 2924, 1752, 1721, 1602, 1547, 1324, 821, 754. APCI (m/z) calcd. for $\text{C}_{20}\text{H}_{13}\text{O}_3$ $[\text{M}+\text{H}]^+$ 301.0859; found 301.0850.

4-(4-chlorophenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.7): Yellow solid (157 mg, 74%); m.p. 174–



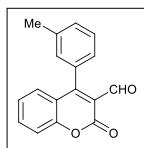
176 °C, ^1H NMR (400 MHz, Chloroform-*d*) δ = 10.06 (s, 1H), 7.69 – 7.65 (m, 1H), 7.54 (d, J = 8.3 Hz, 2H), 7.42 (d, J = 8.4 Hz, 1H), 7.27 – 7.22 (m, 3H), 7.19 (dd, J = 8.0, 1.5 Hz, 1H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.32, 159.12, 159.02, 154.67, 136.13, 134.98, 130.46, 129.79, 129.41, 129.22, 125.13, 119.83, 119.07, 117.44. IR (neat, cm^{-1}): 2924, 1749, 1705, 1596, 1541, 1362, 1089, 762. APCI (m/z) calcd. for $\text{C}_{16}\text{H}_{10}\text{ClO}_3$ $[\text{M}+\text{H}]^+$ 285.0313; found 285.0313.

4-(4-fluorophenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.8): Yellow solid (117 mg, 58%); m.p. 144–



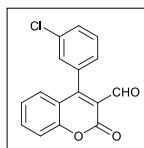
146 °C, ^1H NMR (400 MHz, Chloroform-*d*) δ = 10.03 (s, 1H), 7.69 – 7.65 (m, 1H), 7.42 (d, J = 8.4 Hz, 1H), 7.31 – 7.19 (m, 6H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.36, 163.57 (d, $J_{\text{C}-\text{F}}$ = 249.25 Hz), 159.55, 158.89, 154.66, 134.92, 130.55 (d, $J_{\text{C}-\text{F}}$ = 8.33 Hz), 129.41, 127.81, 125.08, 120.00, 119.28, 117.42, 116.20 (d, $J_{\text{C}-\text{F}}$ = 21.81 Hz). IR (neat, cm^{-1}): 2867, 1752, 1725, 1604, 1548, 1223, 836, 760. APCI (m/z) calcd. for $\text{C}_{16}\text{H}_{10}\text{FO}_3$ $[\text{M}+\text{H}]^+$ 269.0608; found 269.0608.

2-oxo-4-m-tolyl-2H-chromene-3-carbaldehyde (2.9): Yellow solid (160 mg, 81%); m.p. 114–116 °C, ¹H



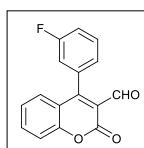
NMR (400 MHz, Chloroform-*d*) δ = 9.91 (s, 1H), 7.68 – 7.64 (m, 1H), 7.41 (dq, *J* = 13.8, 7.7 Hz, 3H), 7.26 – 7.24 (m, 2H), 7.12 (s, 2H), 2.44 (s, 3H). ¹³C NMR (101 MHz, Chloroform-*d*) δ = 188.49, 162.05, 158.14, 154.65, 138.85, 134.88, 131.49, 130.82, 129.52, 129.15, 128.80, 125.80, 124.91, 119.92, 119.07, 117.29, 21.62. IR (neat, cm⁻¹): 2861, 1755, 1721, 1604, 1548, 1364, 998, 758. APCI (m/z) calcd. for C₁₇H₁₃O₃ [M+H]⁺ 265.0859; found 265.0857.

4-(3-chlorophenyl)-2-oxo-2H-chromene-3-carbaldehyde (2.10): Yellow solid (147 mg, 70%); m.p.



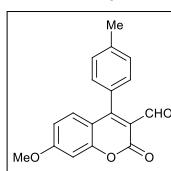
118–120 °C, ¹H NMR (400 MHz, Chloroform-*d*) δ = 10.06 (d, *J* = 0.9 Hz, 1H), 7.70 – 7.66 (m, 1H), 7.55 – 7.48 (m, 2H), 7.42 (d, *J* = 8.4 Hz, 1H), 7.28 – 7.22 (m, 2H), 7.19 – 7.16 (m, 2H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.16, 158.93, 158.57, 154.65, 135.08, 135.04, 133.89, 130.23, 129.94, 129.42, 128.18, 126.52, 125.19, 119.71, 119.02, 117.40. IR (neat, cm⁻¹): 2864, 1755, 1724, 1602, 1550, 1347, 1192, 758. APCI (m/z) calcd. for C₁₆H₁₀ClO₃ [M+H]⁺ 285.0313; found 285.0313.

4-(3-fluorophenyl)-2-oxo-2H-chromene-3-carbaldehyde (2.11): Yellow solid (143 mg, 71%); m.p.



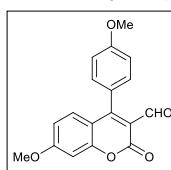
136–138 °C, ¹H NMR (400 MHz, Chloroform-*d*) δ = 10.05 (s, 1H), 7.70 – 7.66 (m, 1H), 7.54 (td, *J* = 8.0, 5.8 Hz, 1H), 7.43 (d, *J* = 8.3 Hz, 1H), 7.29 – 7.24 (m, 2H), 7.19 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.07 (d, *J* = 7.7 Hz, 1H), 7.02 (dt, *J* = 8.5, 1.8 Hz, 1H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.15, 162.77 (d, J_{C-F} = 247.68 Hz), 158.88, 158.76, 154.67, 135.02, 134.13 (d, J_{C-F} = 7.86 Hz), 130.81 (d, J_{C-F} = 8.31 Hz), 129.39, 125.16, 124.14, 124.12, 119.70, 119.04, 117.41, 116.86 (d, J_{C-F} = 20.68 Hz), 115.68 (d, J_{C-F} = 23.11 Hz). IR (neat, cm⁻¹): 2888, 1728, 1703, 1606, 1586, 1347, 1149, 760. APCI (m/z) calcd. for C₁₆H₁₀FO₃ [M+H]⁺ 269.0608; found 269.0608.

7-methoxy-2-oxo-4-p-tolyl-2H-chromene-3-carbaldehyde (3.1): Yellow solid (148 mg, 67%); m.p.



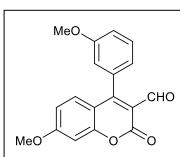
146–148 °C, ¹H NMR (400 MHz, Chloroform-*d*) δ = 9.87 (d, *J* = 1.4 Hz, 1H), 7.34 (d, *J* = 7.8 Hz, 2H), 7.19 – 7.15 (m, 3H), 6.85 (s, 1H), 6.78 (dd, *J* = 9.0, 2.4 Hz, 1H), 3.91 (s, 3H), 2.46 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.47, 165.48, 162.43, 158.65, 157.01, 140.09, 130.84, 129.48, 129.00, 128.64, 116.10, 113.65, 113.51, 100.71, 56.22, 21.56. IR (neat, cm⁻¹): 2924, 1755, 1725, 1614, 1584, 1370, 1287, 771. APCI (m/z) calcd. for C₁₈H₁₅O₄ [M+H]⁺ 295.0965; found 295.0965.

7-methoxy-4-(4-methoxyphenyl)-2-oxo-2H-chromene-3-carbaldehyde (3.2): Yellow solid (196 mg,



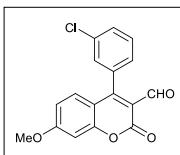
84%); m.p. 144–146 °C, ¹H NMR (400 MHz, Chloroform-*d*) δ = 9.86 (d, *J* = 4.1 Hz, 1H), 7.26 – 7.20 (m, 3H), 7.07 – 7.05 (m, 2H), 6.85 (t, *J* = 2.8 Hz, 1H), 6.81 – 6.78 (m, 1H), 3.91 – 3.90 (m, 6H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.52, 165.42, 162.13, 160.97, 158.59, 156.99, 130.78, 130.52, 123.75, 116.15, 114.25, 113.59, 113.51, 100.74, 56.20, 55.55. IR (neat, cm⁻¹): 2845, 1752, 1719, 1611, 1507, 1287, 1116, 836. APCI (m/z) calcd. for C₁₈H₁₅O₅ [M+H]⁺ 311.0914; found 311.0913.

7-methoxy-4-(3-methoxyphenyl)-2-oxo-2H-chromene-3-carbaldehyde (3.3): Yellow solid (150 mg,



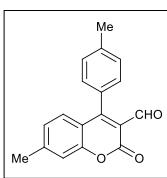
65%); m.p. 154–156 °C, ^1H NMR (500 MHz, Chloroform-*d*) δ = 9.87 (s, 1H), 7.44 (t, J = 7.9 Hz, 1H), 7.14 (d, J = 9.0 Hz, 1H), 7.06 (dd, J = 8.4, 2.4 Hz, 1H), 6.87 – 6.84 (m, 2H), 6.81 – 6.80 (m, 1H), 6.78 (dd, J = 9.1, 2.4 Hz, 1H), 3.90 (s, 3H), 3.84 (s, 3H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.25, 165.59, 161.96, 159.78, 158.46, 157.01, 133.34, 130.79, 130.07, 120.80, 115.96, 115.15, 114.28, 113.73, 113.29, 100.71, 56.22, 55.53. IR (neat, cm^{-1}): 2845, 1755, 1721, 1614, 1535, 1288, 1164, 770. APCI (m/z) calcd. for $\text{C}_{18}\text{H}_{15}\text{O}_5$ $[\text{M}+\text{H}]^+$ 311.0914; found 311.0919.

4-(3-chlorophenyl)-7-methoxy-2-oxo-2H-chromene-3-carbaldehyde (3.4): Yellow solid (145 mg,



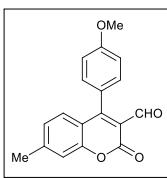
62%); m.p. 108–110 °C, ^1H NMR (500 MHz, Chloroform-*d*) δ = 10.00 (s, 1H), 7.52 – 7.46 (m, 3H), 7.15 (d, J = 7.4 Hz, 1H), 7.05 (d, J = 8.9 Hz, 1H), 6.87 (d, J = 2.6 Hz, 1H), 6.80 (dd, J = 9.0, 2.4 Hz, 1H), 3.91 (s, 3H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.11, 165.69, 159.34, 159.20, 157.06, 134.98, 134.36, 130.74, 130.15, 129.77, 129.14, 128.11, 126.44, 115.79, 113.98, 113.20, 100.90, 56.29. IR (neat, cm^{-1}): 2962, 1756, 1724, 1614, 1536, 1298, 1141, 741. APCI (m/z) calcd. for $\text{C}_{17}\text{H}_{12}\text{ClO}_4$ $[\text{M}+\text{H}]^+$ 315.0424; found 315.0423.

7-methyl-2-oxo-4-p-tolyl-2H-chromene-3-carbaldehyde (3.5): Yellow solid (156 mg, 75%); m.p. 136–



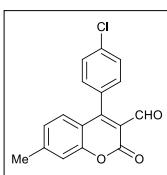
138 °C, ^1H NMR (500 MHz, Chloroform-*d*) δ = 9.89 (s, 1H), 7.34 (d, J = 7.9 Hz, 2H), 7.18 (d, J = 7.9 Hz, 3H), 7.14 (d, J = 8.2 Hz, 1H), 7.03 (d, J = 7.2 Hz, 1H), 2.46 (s, 6H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.53, 162.05, 158.50, 154.77, 146.91, 140.15, 129.47, 129.21, 128.69, 126.19, 118.09, 117.57, 117.33, 22.06, 21.55. IR (neat, cm^{-1}): 2861, 1755, 1722, 1619, 1538, 1369, 1262, 1137, 773. APCI (m/z) calcd. for $\text{C}_{18}\text{H}_{15}\text{O}_3$ $[\text{M}+\text{H}]^+$ 279.1016; found 279.1017.

4-(4-methoxyphenyl)-7-methyl-2-oxo-2H-chromene-3-carbaldehyde (3.6): Yellow solid (171 mg,



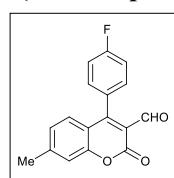
77%); m.p. 140–142 °C, ^1H NMR (500 MHz, Chloroform-*d*) δ = 9.88 (s, 1H), 7.24 (d, J = 8.6 Hz, 2H), 7.20 (d, J = 8.5 Hz, 2H), 7.06 – 7.04 (m, 3H), 3.89 (s, 3H), 2.47 (s, 3H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.62, 161.73, 161.03, 158.50, 154.79, 146.84, 130.61, 129.17, 126.18, 123.52, 118.18, 117.62, 117.39, 114.27, 55.56, 22.05. IR (neat, cm^{-1}): 2841, 1753, 1719, 1608, 1509, 1370, 1252, 1178, 631. APCI (m/z) calcd. for $\text{C}_{18}\text{H}_{15}\text{O}_4$ $[\text{M}+\text{H}]^+$ 295.0965; found 295.0965.

4-(4-chlorophenyl)-7-methyl-2-oxo-2H-chromene-3-carbaldehyde (3.7): Yellow solid (147 mg,



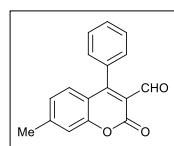
66%); m.p. 158–160 °C, ^1H NMR (500 MHz, Chloroform-*d*) δ = 10.03 (s, 1H), 7.53 – 7.50 (m, 2H), 7.23 – 7.20 (m, 3H), 7.05 (s, 2H), 2.48 (s, 3H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.37, 159.39, 159.25, 154.77, 147.23, 135.94, 130.65, 129.74, 129.11, 126.46, 117.93, 117.49, 117.41, 22.11. IR (neat, cm^{-1}): 2862, 1755, 1724, 1620, 1537, 1369, 1261, 1091, 736. APCI (m/z) calcd. for $\text{C}_{17}\text{H}_{12}\text{ClO}_3$ $[\text{M}+\text{H}]^+$ 299.0469; found 299.0469.

4-(4-fluorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.8): Yellow solid (145 mg, 69%); m.p. 124-126 °C, ¹H NMR (500 MHz, Chloroform-*d*) δ = 10.00 (s, 1H), 7.28 – 7.21 (m, 5H), 7.08 – 7.04 (m, 2H), 2.47 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.42, 163.46 (d, *J*_{C-F} = 248.75 Hz), 159.86, 159.11, 154.76, 147.17, 130.49 (d, *J*_{C-F} = 8.31 Hz), 129.13, 127.98 (d, *J*_{C-F} = 3.03 Hz), 126.42, 118.14, 117.57, 117.46, 116.09 (d, *J*_{C-F} = 21.76 Hz), 22.09. IR (neat, cm⁻¹): 2856, 1753, 1720, 1619, 1537, 1369, 1230, 1015, 673. APCI (m/z) calcd. for C₁₇H₁₂FO₃ [M+H]⁺ 283.0765; found 283.0765.



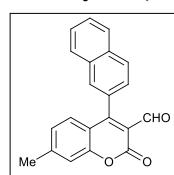
IR (neat, cm⁻¹): 2856, 1753, 1720, 1619, 1537, 1369, 1230, 1015, 673. APCI (m/z) calcd. for C₁₇H₁₂FO₃ [M+H]⁺ 283.0765; found 283.0765.

7-methyl-2-oxo-4-phenyl-2*H*-chromene-3-carbaldehyde (3.9): Yellow solid (136 mg, 69%); m.p. 146-



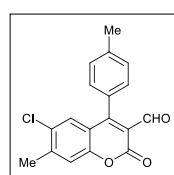
148 °C, ¹H NMR (500 MHz, Chloroform-*d*) δ = 9.93 (s, 1H), 7.56 – 7.53 (m, 3H), 7.29 (dd, *J* = 6.6, 2.8 Hz, 2H), 7.21 (s, 1H), 7.09 (d, *J* = 8.2 Hz, 1H), 7.04 (d, *J* = 8.4 Hz, 1H), 2.48 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.45, 161.52, 158.69, 154.85, 147.03, 132.00, 129.85, 129.25, 128.82, 128.55, 126.30, 118.11, 117.59, 117.42, 22.11. IR (neat, cm⁻¹): 2859, 1754, 1722, 1618, 1537, 1370, 1261, 1076, 755. APCI (m/z) calcd. for C₁₇H₁₃O₃ [M+H]⁺ 265.0859; found 265.0858.

7-methyl-4-(naphthalen-2-yl)-2-oxo-2*H*-chromene-3-carbaldehyde (3.10): Yellow solid (168 mg,



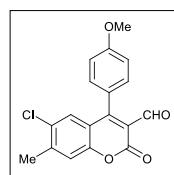
71%); m.p. 148-150 °C, ¹H NMR (500 MHz, Chloroform-*d*) δ = 9.97 (s, 1H), 8.01 (d, *J* = 8.4 Hz, 1H), 7.96 (d, *J* = 7.4 Hz, 1H), 7.89 – 7.87 (m, 1H), 7.78 (s, 1H), 7.63 – 7.58 (m, 2H), 7.38 (dd, *J* = 8.4, 1.6 Hz, 1H), 7.24 (s, 1H), 7.12 (d, *J* = 8.2 Hz, 1H), 7.02 (d, *J* = 8.3 Hz, 1H), 2.48 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.40, 161.47, 158.73, 154.84, 147.03, 133.58, 132.74, 129.39, 128.65, 128.41, 128.36, 128.13, 127.60, 127.35, 126.32, 125.75, 118.31, 117.68, 117.43, 22.10. IR (neat, cm⁻¹): 2861, 1753, 1721, 1620, 1537, 1384, 1263, 1045, 749. APCI (m/z) calcd. for C₂₁H₁₅O₃ [M+H]⁺ 315.1016; found 315.1016.

6-chloro-7-methyl-2-oxo-4-p-tolyl-2*H*-chromene-3-carbaldehyde (3.11): Yellow solid (176 mg,



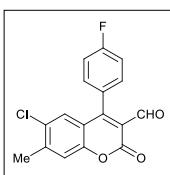
75%); m.p. 180-182 °C, ¹H NMR (500 MHz, Chloroform-*d*) δ = 9.89 (s, 1H), 7.37 (d, *J* = 7.9 Hz, 2H), 7.28 (s, 1H), 7.21 (s, 1H), 7.18 (d, *J* = 8.0 Hz, 2H), 2.48 (s, 6H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.21, 160.61, 158.02, 152.93, 144.35, 140.61, 131.05, 129.75, 128.72, 128.65, 128.11, 119.19, 119.12, 118.97, 21.62, 21.01. IR (neat, cm⁻¹): 2854, 1760, 1726, 1612, 1537, 1366, 1160, 919, 730. APCI (m/z) calcd. for C₁₈H₁₄ClO₃ [M+H]⁺ 313.0626; found 313.0626.

6-chloro-4-(4-methoxyphenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.12): Yellow solid



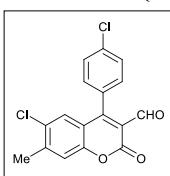
(175 mg, 71%); m.p. 178-180 °C, ¹H NMR (500 MHz, Chloroform-*d*) δ = 9.89 (s, 1H), 7.28 (s, 1H), 7.26 – 7.23 (m, 3H), 7.10 – 7.07 (m, 2H), 3.91 (s, 3H), 2.48 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.29, 161.32, 160.28, 158.02, 152.95, 144.29, 131.03, 130.59, 128.69, 122.89, 119.24, 119.17, 119.04, 114.56, 55.61, 20.99. IR (neat, cm⁻¹): 2841, 1758, 1723, 1607, 1533, 1366, 1253, 1021, 890. APCI (m/z) calcd. for C₁₈H₁₄ClO₄ [M+H]⁺ 329.0575; found 329.0575.

6-chloro-4-(4-fluorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.13): Yellow solid



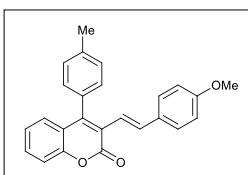
(155 mg, 65%); m.p. 184-186 °C, ¹H NMR (500 MHz, Chloroform-*d*) δ = 10.00 (s, 1H), 7.30 (s, 1H), 7.27 (s, 2H), 7.26 (s, 2H), 7.12 (s, 1H), 2.49 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.08, 163.66 (d, *J*_{C-F} = 249.45 Hz), 158.61, 158.43, 152.89, 144.62, 131.27, 130.48 (d, *J*_{C-F} = 8.34 Hz), 128.62, 127.33 (d, *J*_{C-F} = 3.36 Hz), 119.30, 119.07, 119.04, 116.40 (d, *J*_{C-F} = 22.11 Hz), 21.04. IR (neat, cm⁻¹): 2859, 1758, 1726, 1605, 1536, 1365, 1160, 1021, 889. APCI (m/z) calcd. for C₁₇H₁₁ClFO₃ [M+H]⁺ 317.0375; found 317.0378.

6-chloro-4-(4-chlorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.14): Yellow



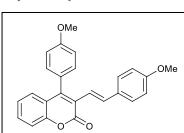
solid (151 mg, 60%); m.p. 138-140 °C, ¹H NMR (500 MHz, Chloroform-*d*) δ = 10.03 (s, 1H), 7.56 – 7.53 (m, 2H), 7.30 (s, 1H), 7.22 – 7.20 (m, 2H), 7.10 (s, 1H), 2.49 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 188.03, 158.71, 158.00, 152.88, 144.69, 136.36, 131.32, 129.96, 129.69, 129.38, 128.58, 119.30, 118.89, 118.83, 21.04. IR (neat, cm⁻¹): 2863, 1759, 1727, 1613, 1534, 1366, 1160, 1015, 889. APCI (m/z) calcd. for C₁₇H₁₁Cl₂O₃ [M+H]⁺ 333.0080; found 333.0084.

(E)-3-(4-methoxystyryl)-4-p-tolyl-2*H*-chromen-2-one (4.1): Yellow solid (154 mg, 56%); m.p. 146-148



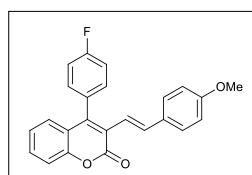
°C, ¹H NMR (500 MHz, Chloroform-*d*) δ = 7.92 (d, *J* = 16.2 Hz, 1H), 7.45 (td, *J* = 7.8, 7.2, 1.5 Hz, 1H), 7.37 (dd, *J* = 8.0, 2.4 Hz, 3H), 7.21 (dd, *J* = 12.0, 8.3 Hz, 4H), 7.15 – 7.11 (m, 1H), 7.08 (dd, *J* = 8.0, 1.5 Hz, 1H), 6.80 (d, *J* = 8.7 Hz, 2H), 6.61 (d, *J* = 16.2 Hz, 1H), 3.78 (s, 3H), 2.50 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 160.20, 159.77, 152.20, 149.77, 138.81, 135.19, 131.83, 130.82, 130.71, 129.67, 129.18, 128.30, 127.53, 124.12, 121.78, 121.27, 119.99, 116.46, 114.14, 55.40, 21.59. IR (neat, cm⁻¹): 2834, 1723, 1605, 1511, 1249, 1074, 755. APCI (m/z) calcd. for C₂₅H₂₁O₃ [M+H]⁺ 369.1485; found 369.1481.

(E)-4-(4-methoxyphenyl)-3-(4-methoxystyryl)-2*H*-chromen-2-one (4.2): Yellow solid (150 mg,



52%); m.p. 122-124 °C, ¹H NMR (400 MHz, Chloroform-*d*) δ = 7.93 (d, *J* = 16.2 Hz, 1H), 7.49 – 7.43 (m, 1H), 7.37 (d, *J* = 8.3 Hz, 1H), 7.24 (dd, *J* = 8.7, 2.4 Hz, 4H), 7.17 – 7.06 (m, 4H), 6.81 (d, *J* = 8.7 Hz, 2H), 6.63 (d, *J* = 16.2 Hz, 1H), 3.93 (s, 3H), 3.79 (s, 3H). ¹³C NMR (101 MHz, Chloroform-*d*) δ = 160.21, 159.99, 159.78, 152.21, 149.47, 135.17, 130.83, 130.73, 128.30, 127.50, 126.89, 124.14, 121.96, 121.38, 120.01, 116.50, 114.40, 114.17, 55.54, 55.41. IR (neat, cm⁻¹): 2926, 1722, 1605, 1511, 1249, 1174, 1074, 755. APCI (m/z) calcd. for C₂₅H₂₁O₄ [M+H]⁺ 385.1434; found 385.1433.

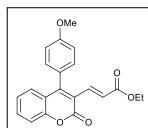
(E)-4-(4-fluorophenyl)-3-(4-methoxystyryl)-2*H*-chromen-2-one (4.3): Yellow solid (106 mg, 38%);



m.p. 118-120 °C, ¹H NMR (500 MHz, Chloroform-*d*) δ = 7.92 (d, *J* = 16.2 Hz, 1H), 7.47 (td, *J* = 8.0, 7.5, 1.5 Hz, 1H), 7.38 – 7.36 (m, 1H), 7.30 (dd, *J* = 6.9, 4.7 Hz, 4H), 7.21 (d, *J* = 8.7 Hz, 2H), 7.17 – 7.14 (m, 1H), 7.02 (dd, *J* = 8.0, 1.1 Hz, 1H), 6.81 (d, *J* = 8.8 Hz, 2H), 6.53 (d, *J* = 16.2 Hz, 1H), 3.79 (s, 3H). ¹³C NMR (126 MHz, Chloroform-*d*) δ = 162.96 (d, *J*_{C-F} = 247.68 Hz), 159.95, 152.15, 148.26, 135.79, 131.21 (d, *J*_{C-F} = 8.10 Hz), 131.02, 130.81, 130.42, 128.32, 127.14, 124.29, 122.24, 121.04, 119.43,

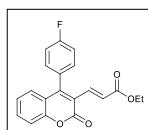
116.59, 116.30 (d, $J_{C-F} = 21.53$ Hz), 114.22, 55.41. IR (neat, cm^{-1}): 2836, 1724, 1604, 1511, 1249, 1075, 755. APCI (m/z) calcd. for $\text{C}_{24}\text{H}_{18}\text{FO}_3$ [$\text{M}+\text{H}]^+$ 373.1234; found 373.1234.

(E)-ethyl 3-(4-(4-methoxyphenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (4.4): White solid (121 mg,



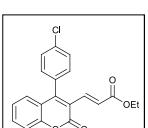
46%); m.p. 146–148 °C, ^1H NMR (400 MHz, Chloroform-*d*) δ = 7.57 (ddd, J = 8.5, 5.8, 2.9 Hz, 1H), 7.42 – 7.36 (m, 1H), 7.34 – 7.28 (m, 2H), 7.25 – 7.17 (m, 4H), 7.12 – 7.07 (m, 2H), 4.19 (q, J = 7.1 Hz, 2H), 3.93 (s, 3H), 1.28 (t, J = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ = 167.65, 160.59, 159.38, 155.97, 153.05, 136.86, 132.69, 130.62, 128.57, 125.42, 124.45, 120.62, 119.49, 116.82, 114.52, 60.57, 55.52, 14.34. IR (neat, cm^{-1}): 2923, 1726, 1634, 1510, 1277, 1170, 750. APCI (m/z) calcd. for $\text{C}_{21}\text{H}_{19}\text{O}_5$ [$\text{M}+\text{H}]^+$ 351.1227; found 351.1229.

(E)-ethyl 3-(4-(4-fluorophenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (4.5): White solid (102 mg, 40%);



m.p. 140–142 °C, ^1H NMR (500 MHz, Chloroform-*d*) δ = 7.60 (ddd, J = 8.5, 7.3, 1.5 Hz, 1H), 7.42 (d, J = 8.9 Hz, 1H), 7.33 – 7.27 (m, 6H), 7.24 – 7.20 (m, 1H), 7.11 (dd, J = 8.1, 1.4 Hz, 1H), 4.19 (q, J = 7.1 Hz, 2H), 1.29 (t, J = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ = 167.44, 163.39 (d, $J_{C-F} = 248.72$ Hz), 159.10, 154.80, 153.02, 136.16, 132.95, 131.04 (d, $J_{C-F} = 8.15$ Hz), 129.40 (d, $J_{C-F} = 3.26$ Hz), 128.23, 125.31, 124.65, 120.34, 119.88, 116.95, 116.48 (d, $J_{C-F} = 21.78$ Hz), 60.70, 14.33. IR (neat, cm^{-1}): 2985, 1729, 1706, 1604, 1508, 1278, 1187, 762. APCI (m/z) calcd. for $\text{C}_{20}\text{H}_{16}\text{FO}_4$ [$\text{M}+\text{H}]^+$ 339.1027; found 339.1022.

(E)-ethyl 3-(4-(4-chlorophenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (4.6): White solid (120 mg, 45%);

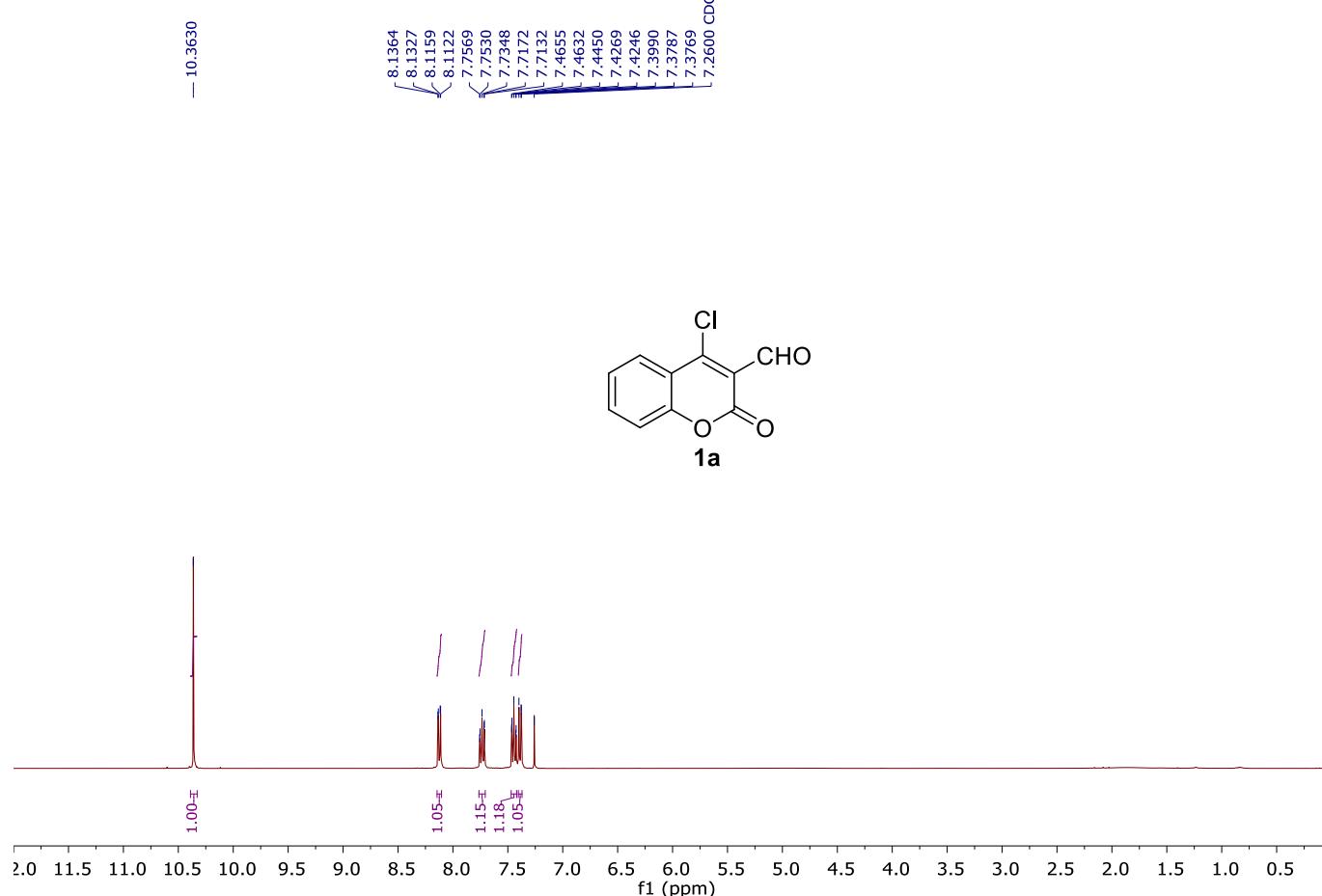


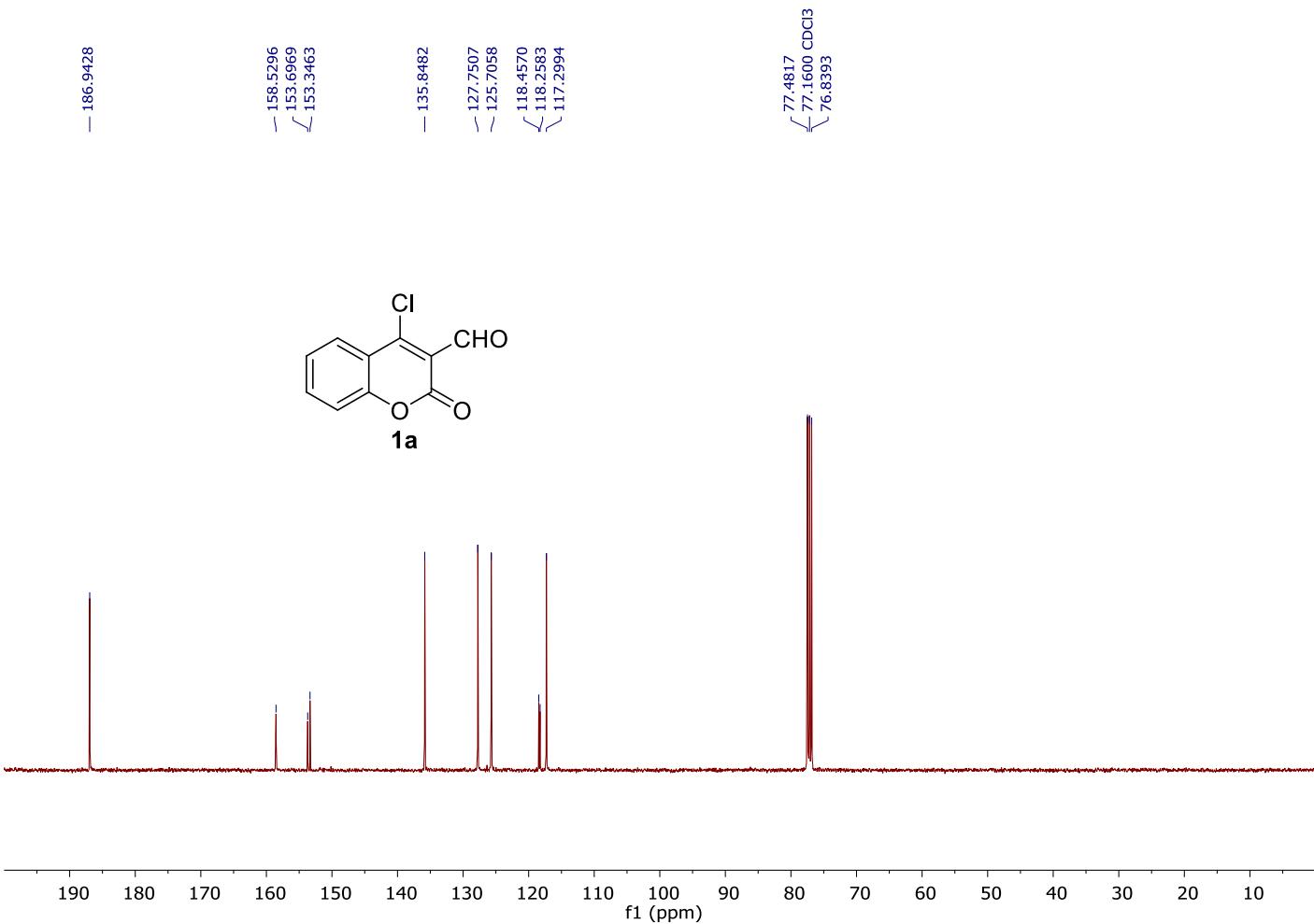
m.p. 138–140 °C, ^1H NMR (500 MHz, Chloroform-*d*) δ = 7.59 – 7.54 (m, 3H), 7.41 – 7.38 (m, 1H), 7.31 – 7.26 (m, 2H), 7.24 – 7.17 (m, 3H), 7.08 (dd, J = 8.1, 1.4 Hz, 1H), 4.17 (q, J = 7.1 Hz, 2H), 1.27 (t, J = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ = 167.44, 159.01, 154.54, 153.03, 136.03, 133.02, 131.87, 130.44, 129.57, 128.17, 125.46, 124.69, 120.13, 119.75, 116.99, 60.74, 14.35. IR (neat, cm^{-1}): 2980, 1724, 1643, 1496, 1276, 1189, 758. APCI (m/z) calcd. for $\text{C}_{20}\text{H}_{16}\text{ClO}_4$ [$\text{M}+\text{H}]^+$ 355.0737; found 355.0743.

References:

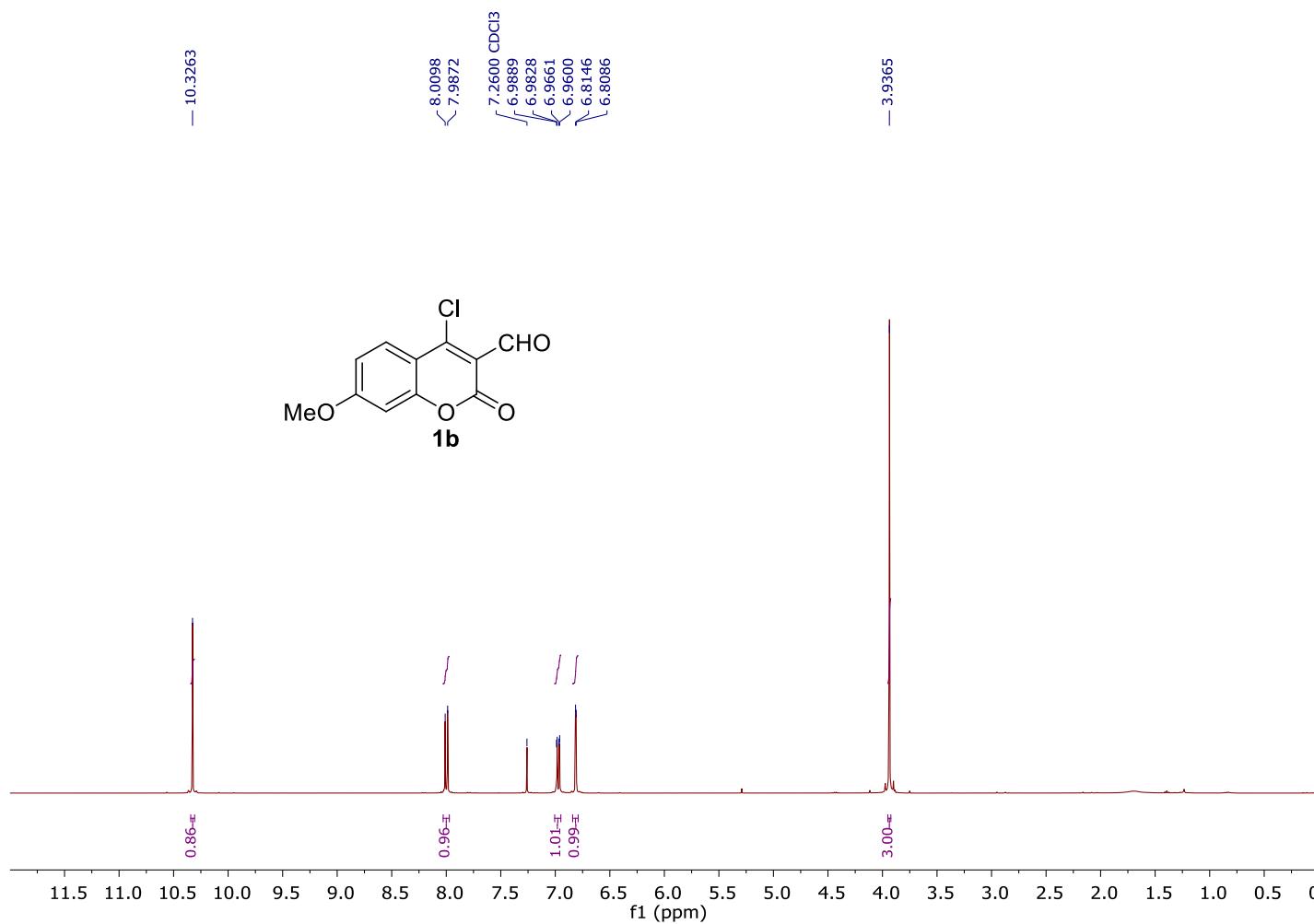
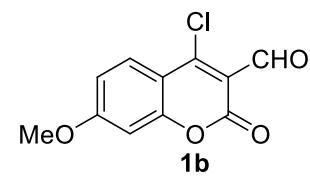
- (1) J. Liu, Y.Q. Sun, Y. Huo, H. Zhang, L. Wang, P. Zhang, D. Song, Y. Shi and W. Guo, *J. Am. Chem. Soc.*, 2014, **136**, 574–577.
- (2) U. R. Saeed, H. C. Zahid, G. Farzana and T. S. Claudius, *J. Enzyme Inhib. Med. Chem.* 2005, **20**, 333.

¹H, ¹³C NMR, HRMS spectra:

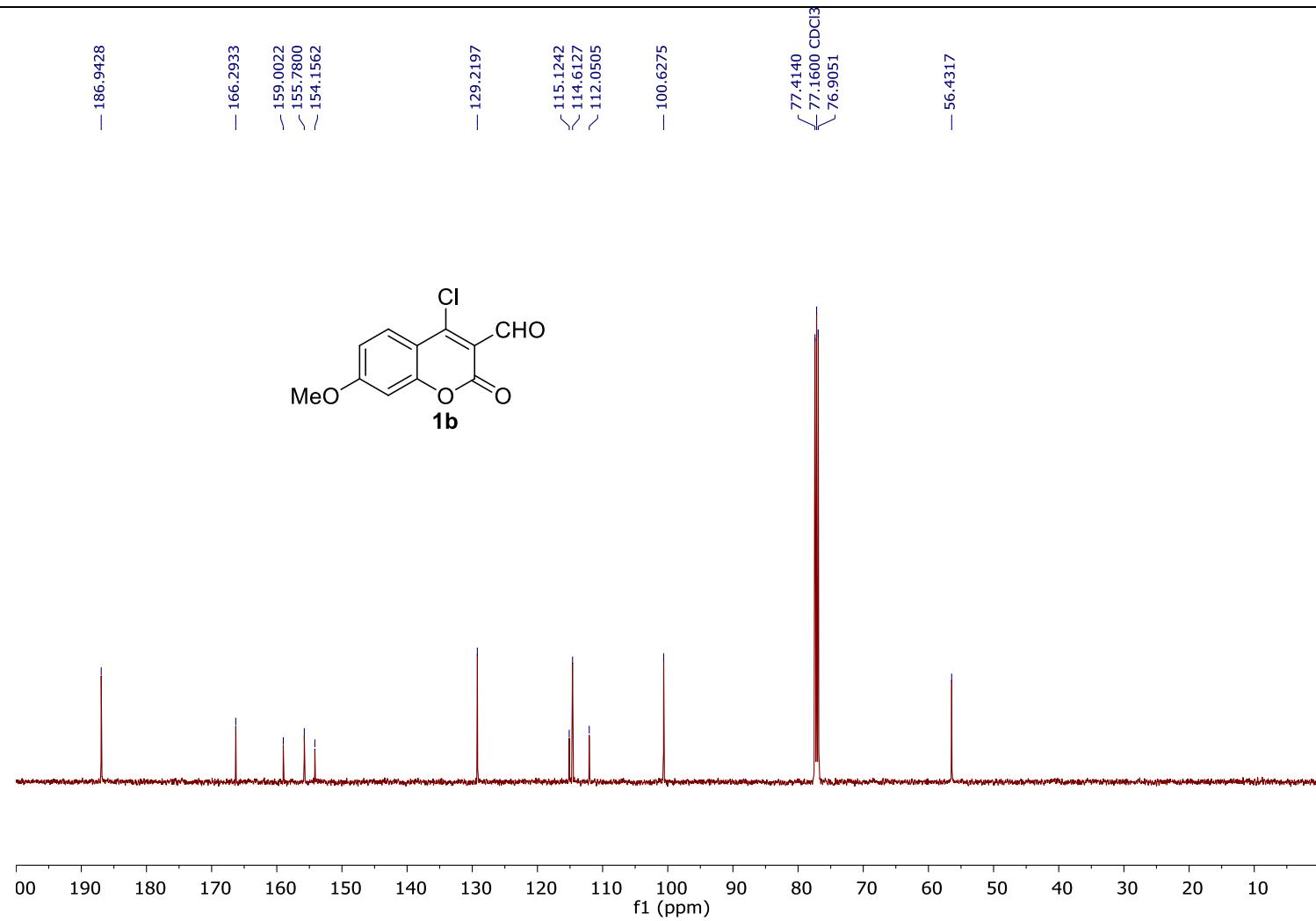




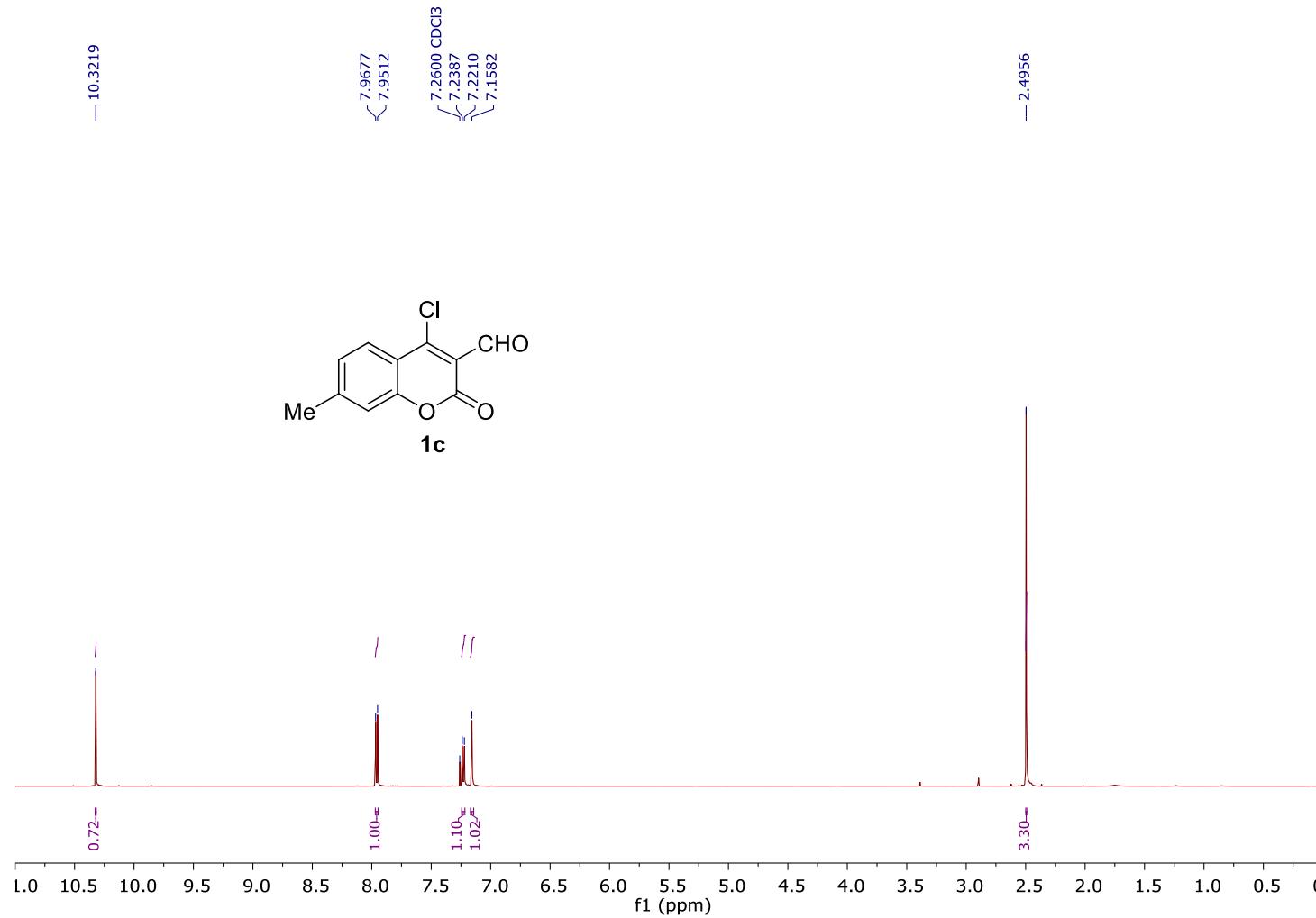
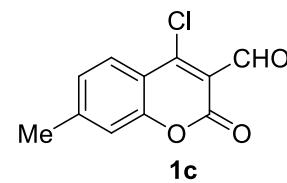
^{13}C Spectrum of 4-chloro-2-oxo-2*H*-chromene-3-carbaldehyde (**1a**)



¹H Spectrum of 4-chloro-7-methoxy-2-oxo-2H-chromene-3-carbaldehyde (1b**)**



^{13}C Spectrum of 4-chloro-7-methoxy-2-oxo-2*H*-chromene-3-carbaldehyde (**1b**)



¹H Spectrum of 4-chloro-7-methyl-2-oxo-2H-chromene-3-carbaldehyde (1c)

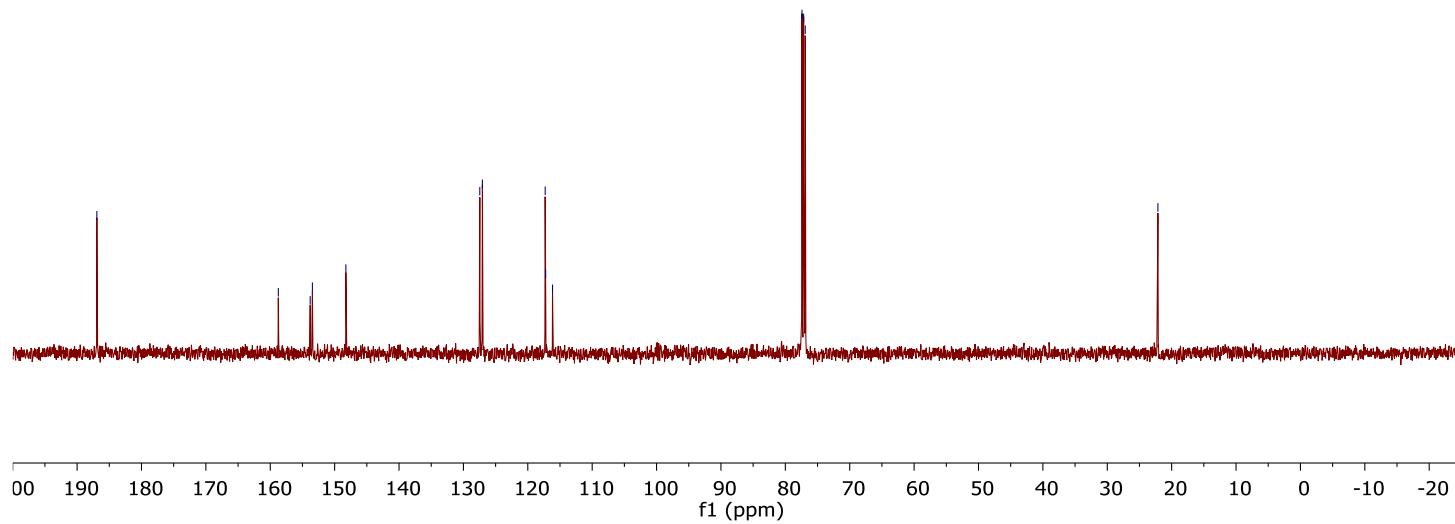
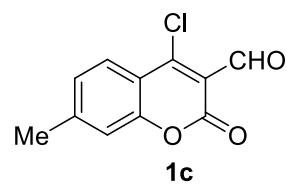
— 186.9325

~ 158.7468
153.7979
153.4950
~ 148.2534

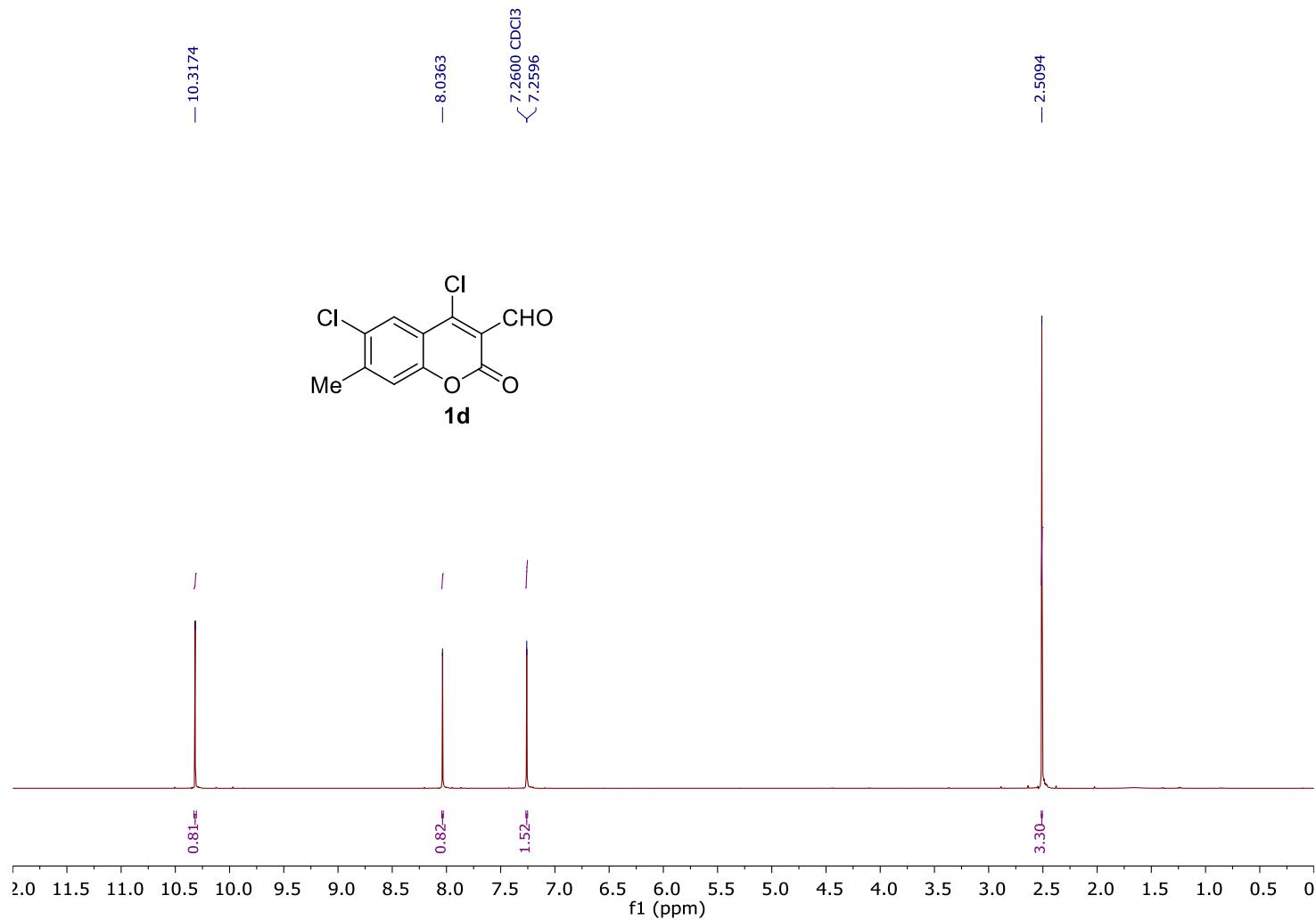
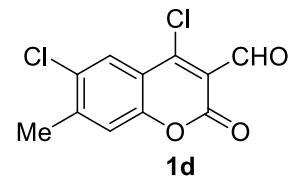
127.4569
127.0502
117.2991
117.2352
116.1558

77.4147
77.1600 CDCl₃
76.9057

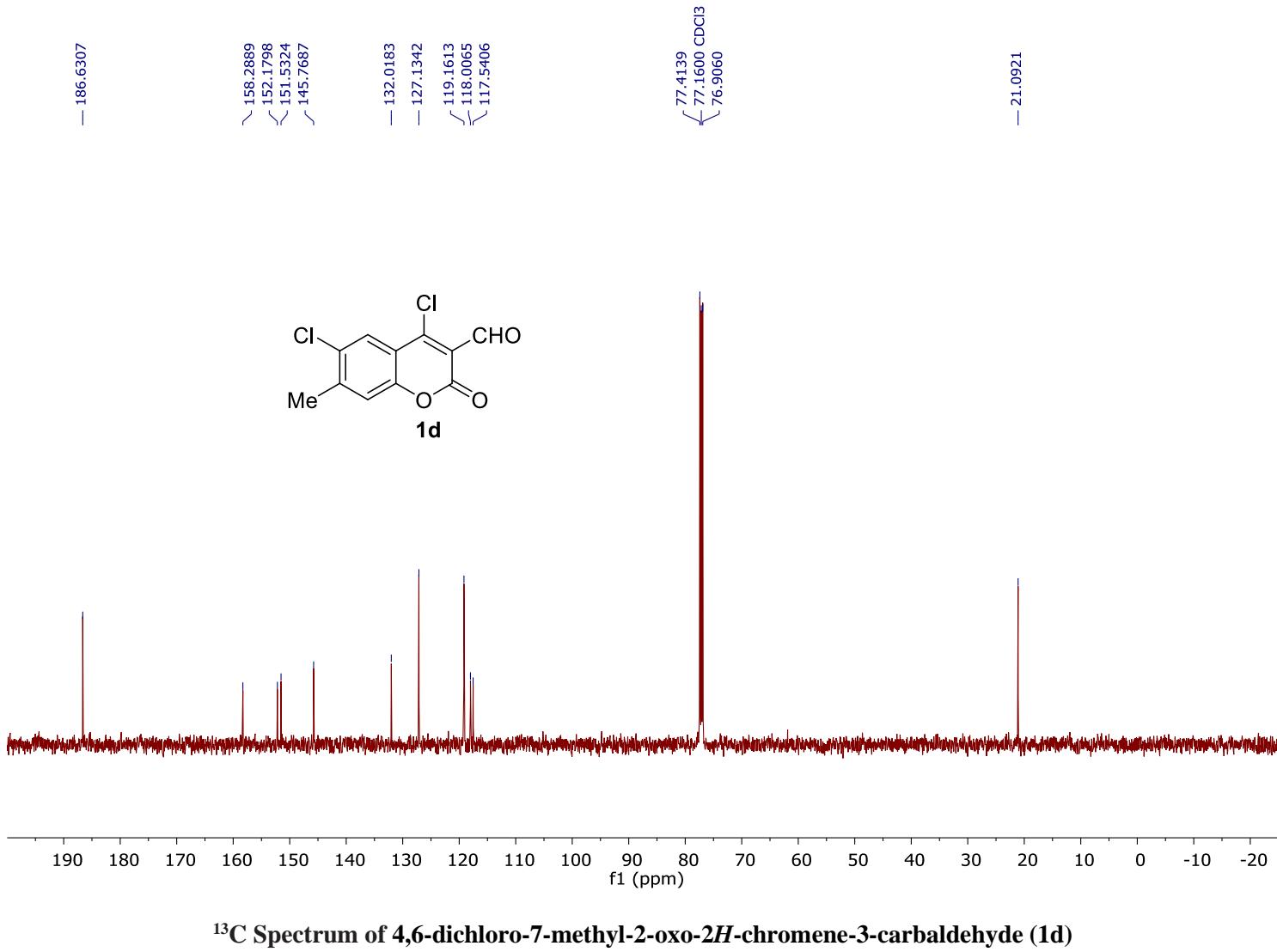
— 22.1339

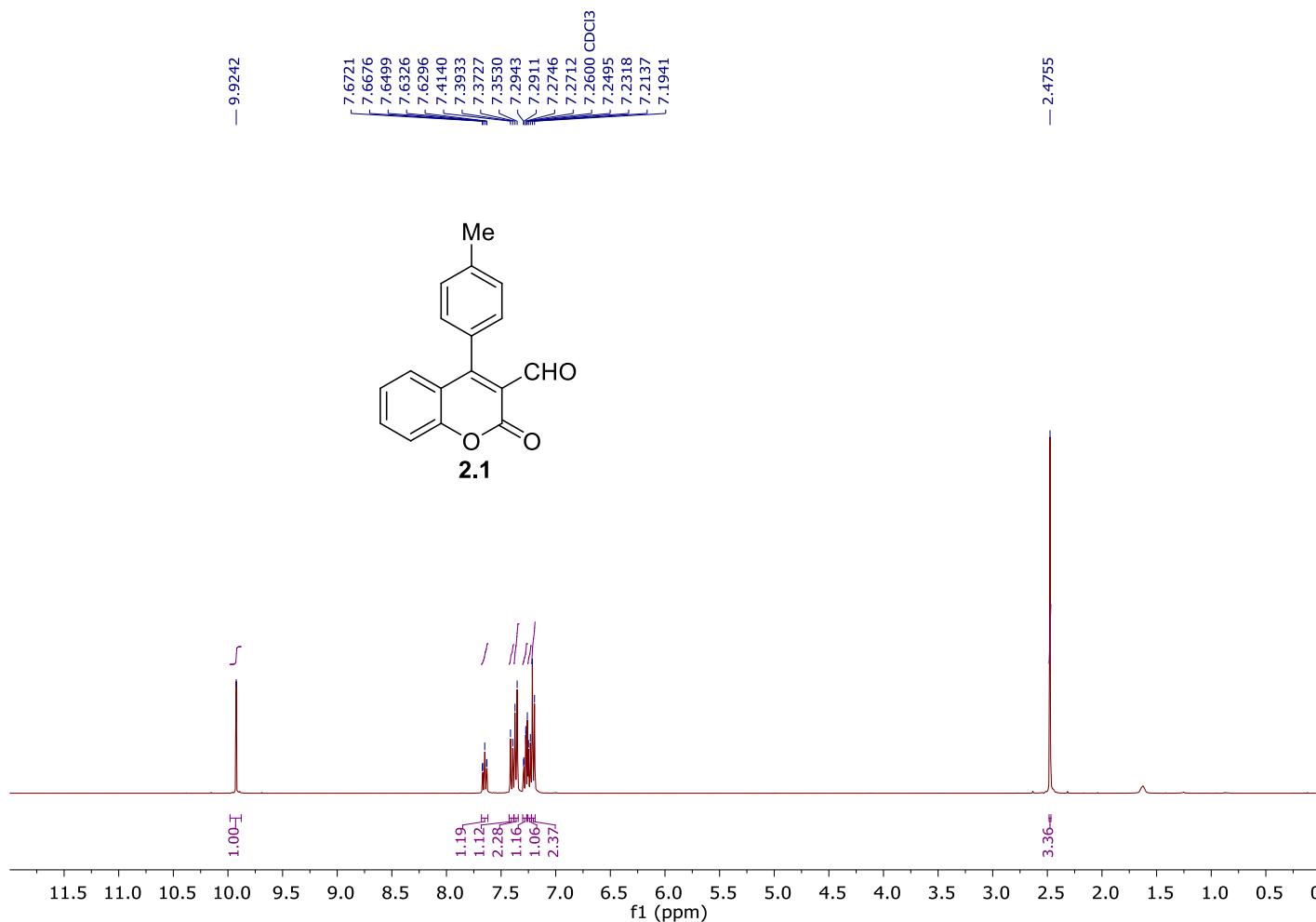


¹³C Spectrum of 4-chloro-7-methyl-2-oxo-2H-chromene-3-carbaldehyde (**1c**)

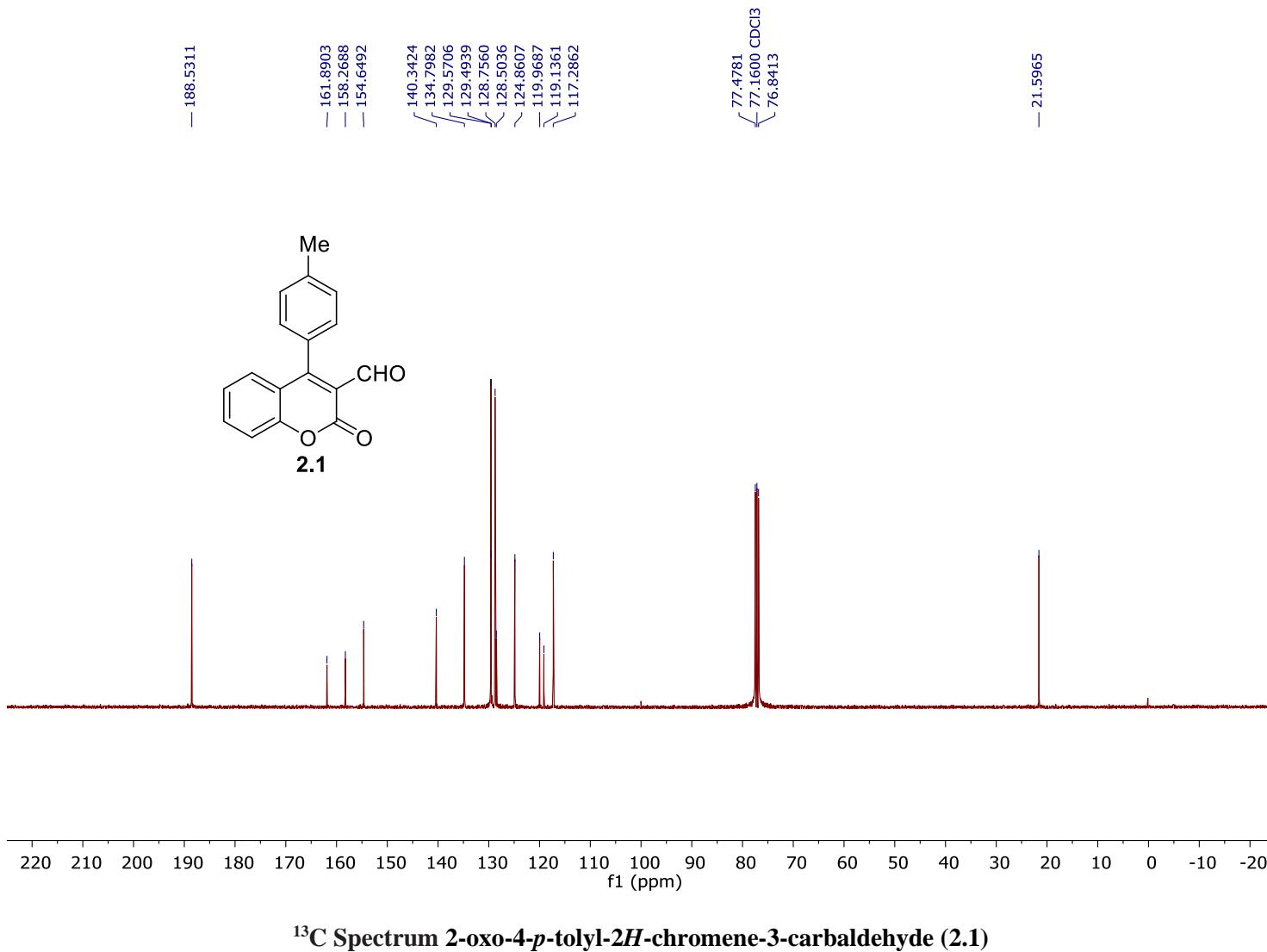


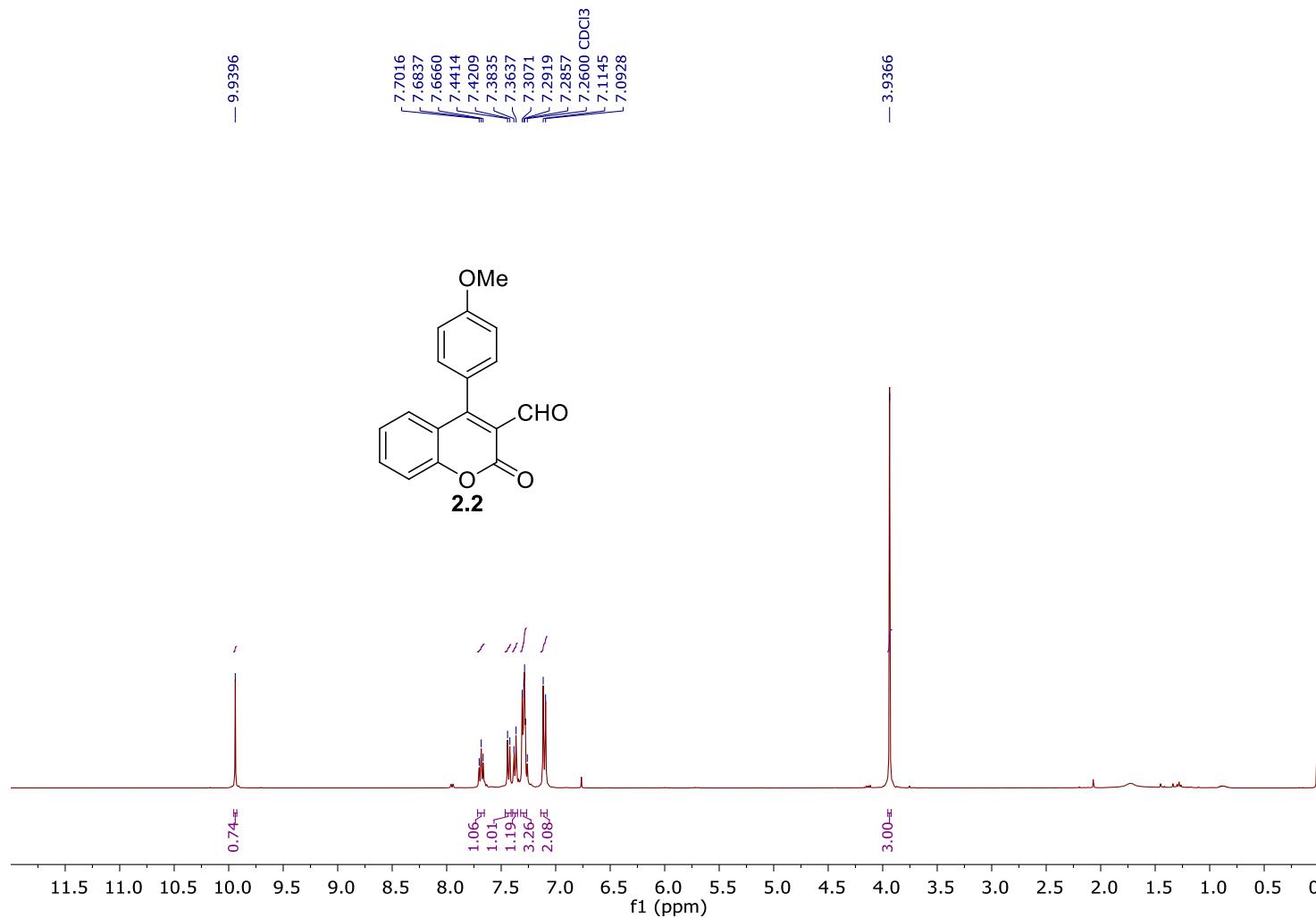
¹H Spectrum of 4,6-dichloro-7-methyl-2-oxo-2H-chromene-3-carbaldehyde (1d)



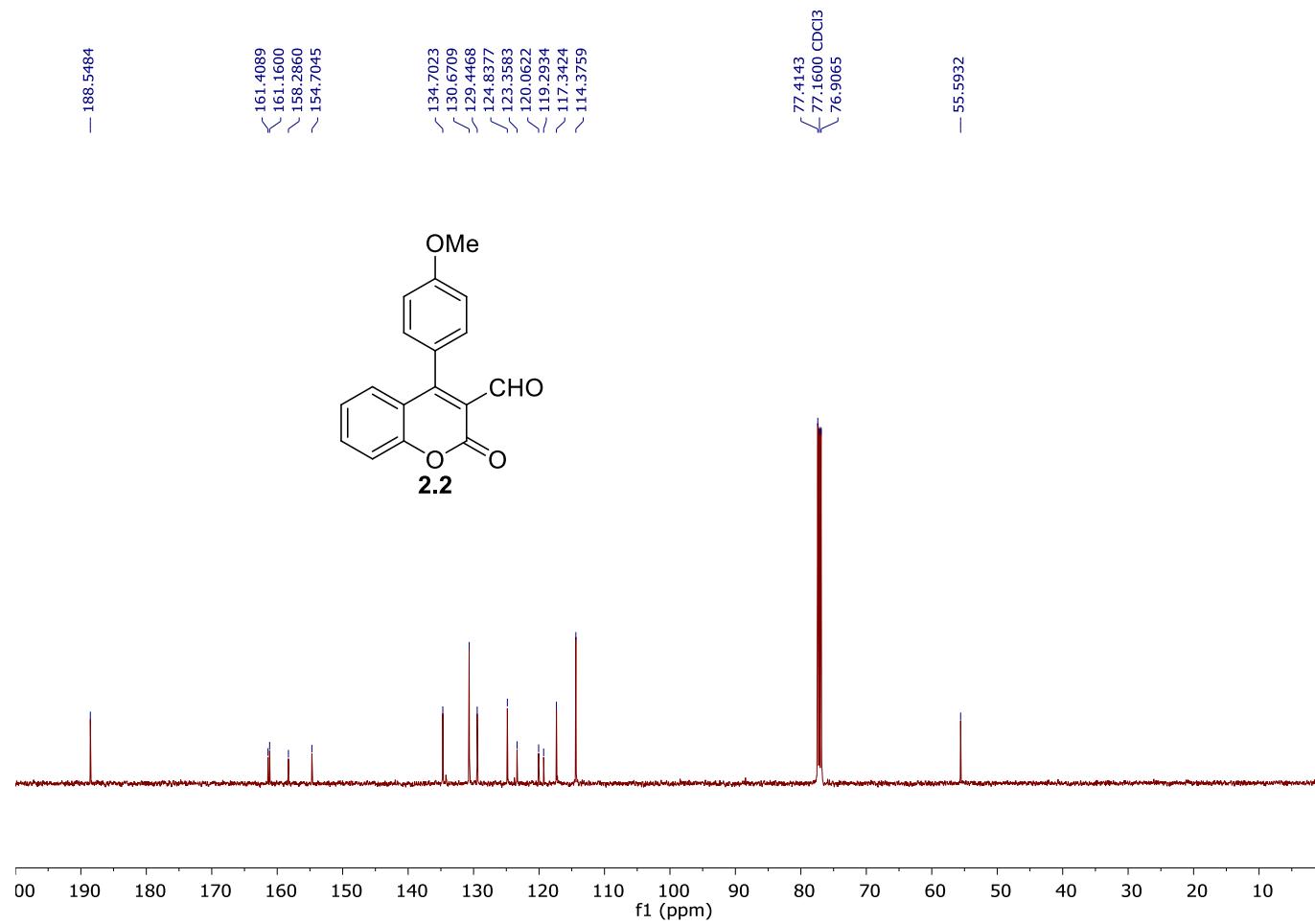


¹H Spectrum of 2-oxo-4-*p*-tolyl-2*H*-chromene-3-carbaldehyde (**2.1**)

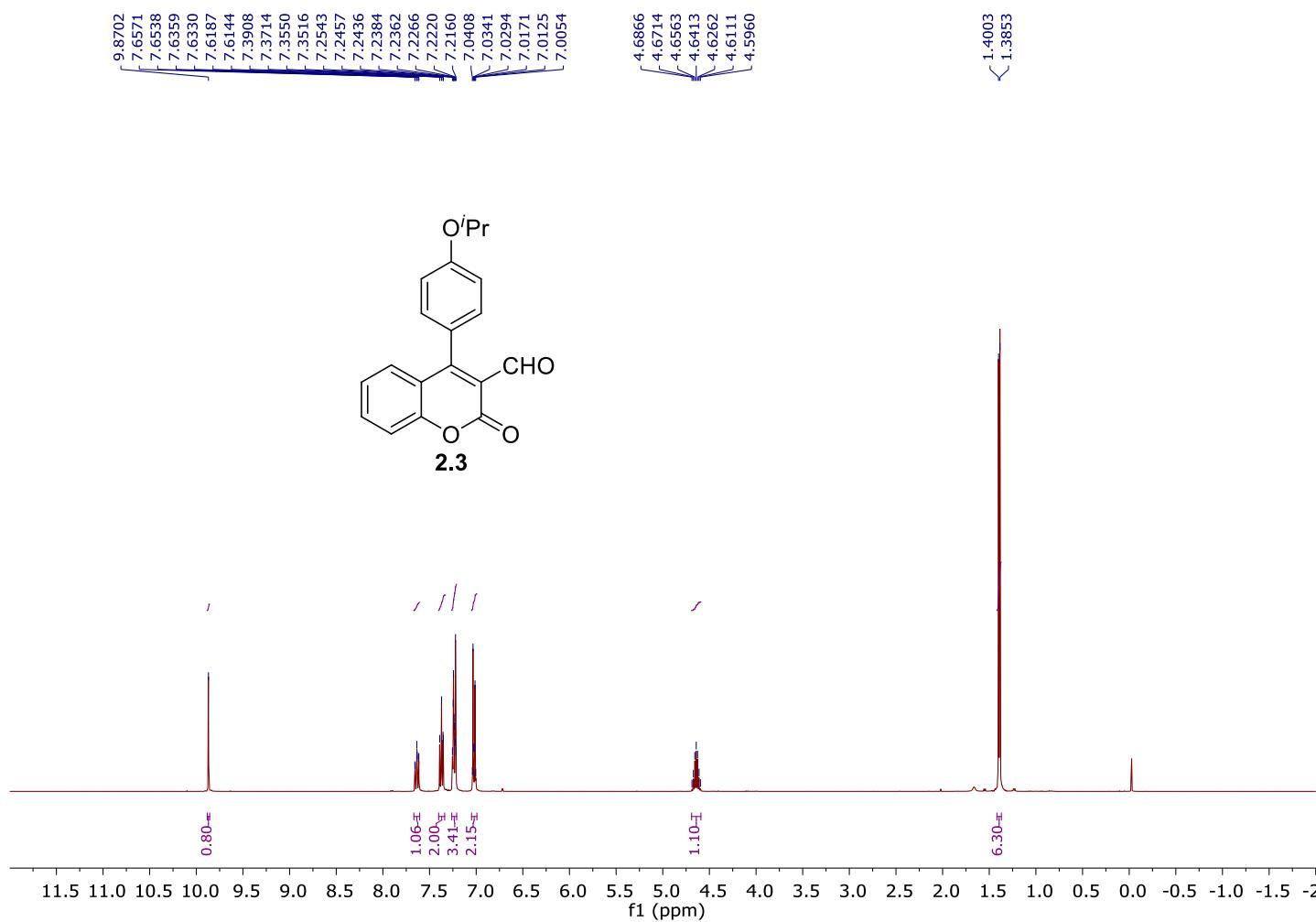
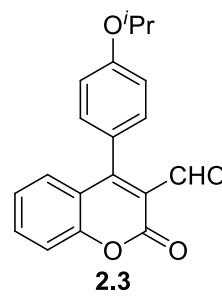




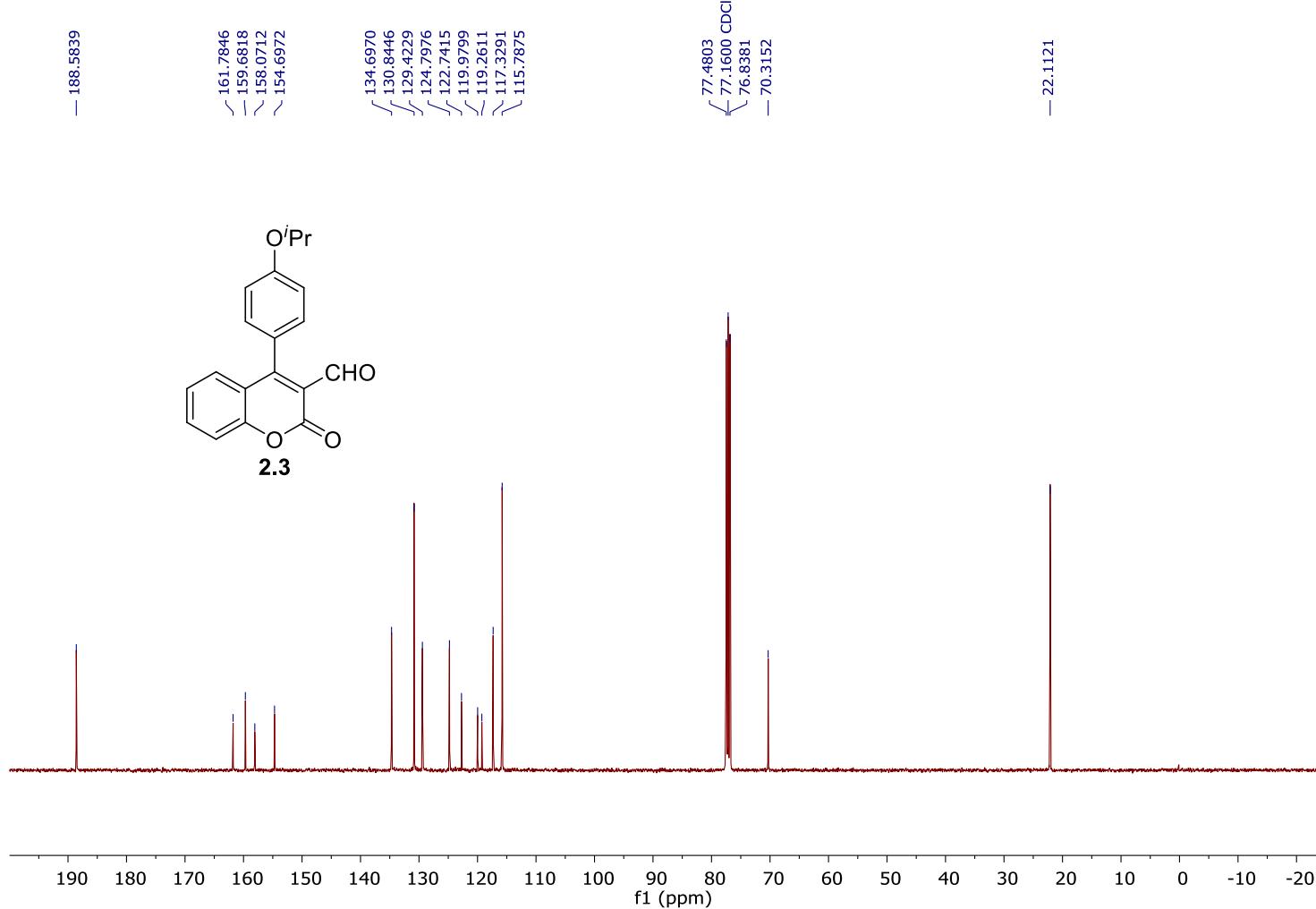
^1H Spectrum of 4-(4-methoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.2)



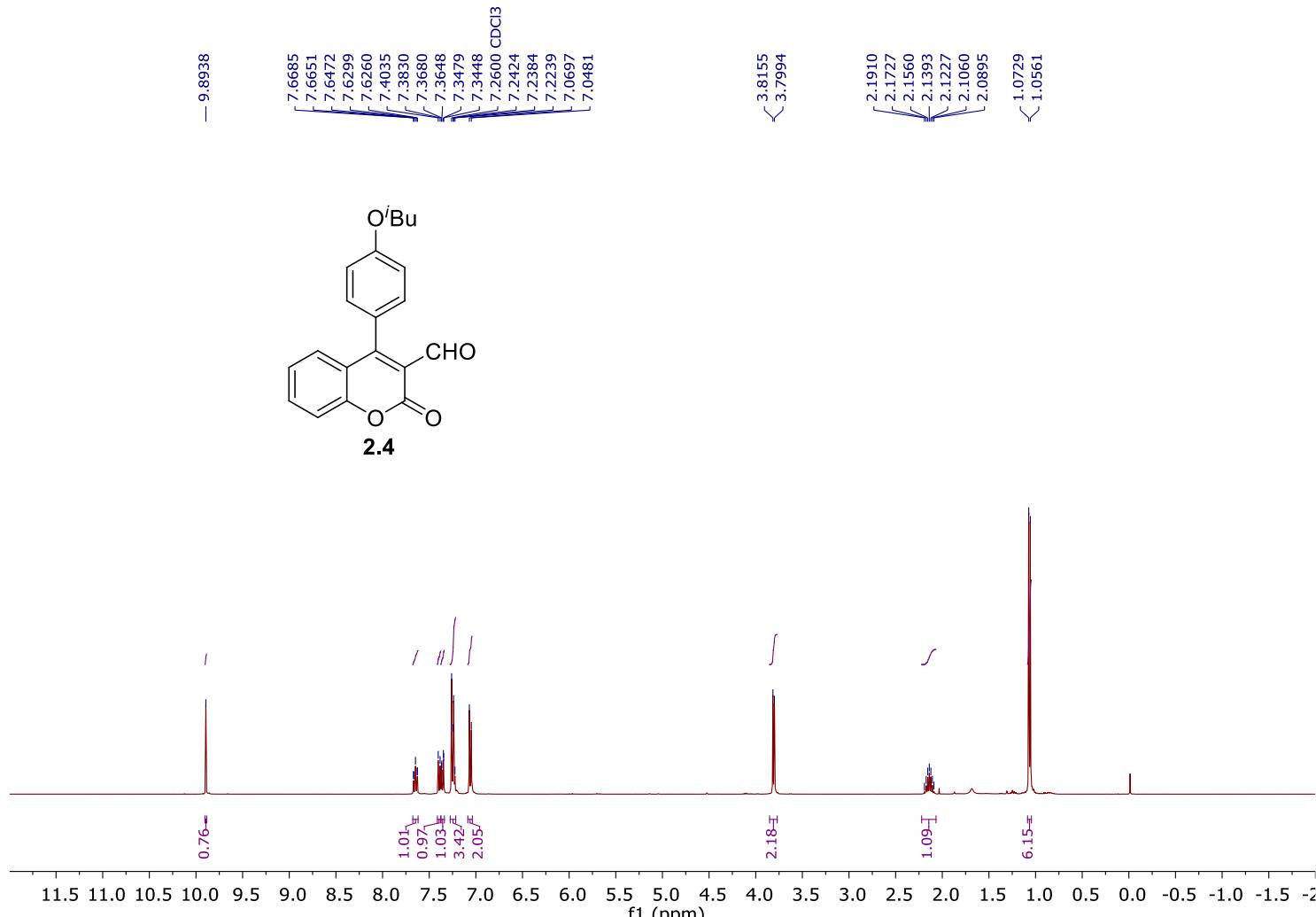
^{13}C Spectrum of 4-(4-methoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.2)



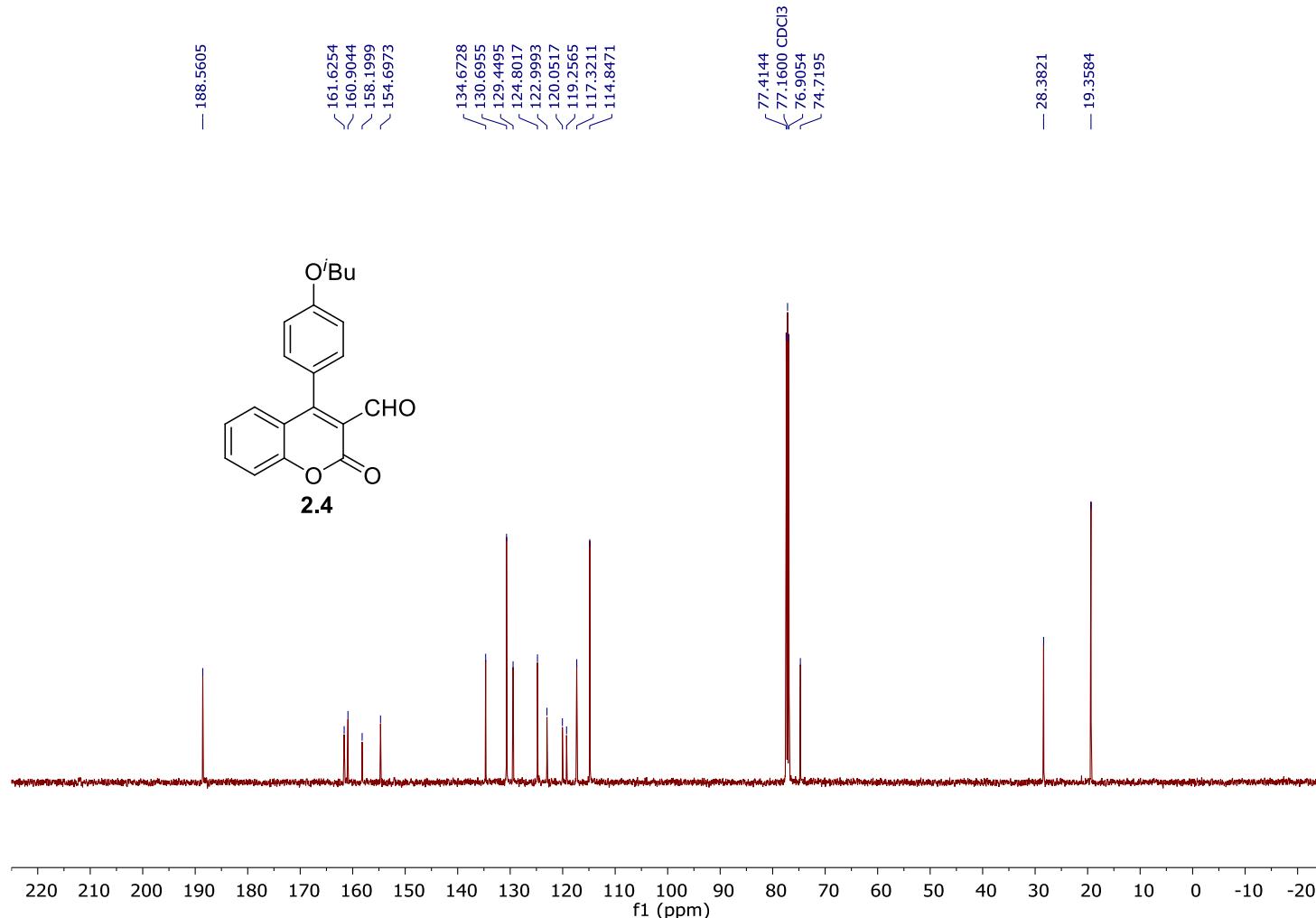
¹H Spectrum of 4-(4-isopropoxypyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.3)



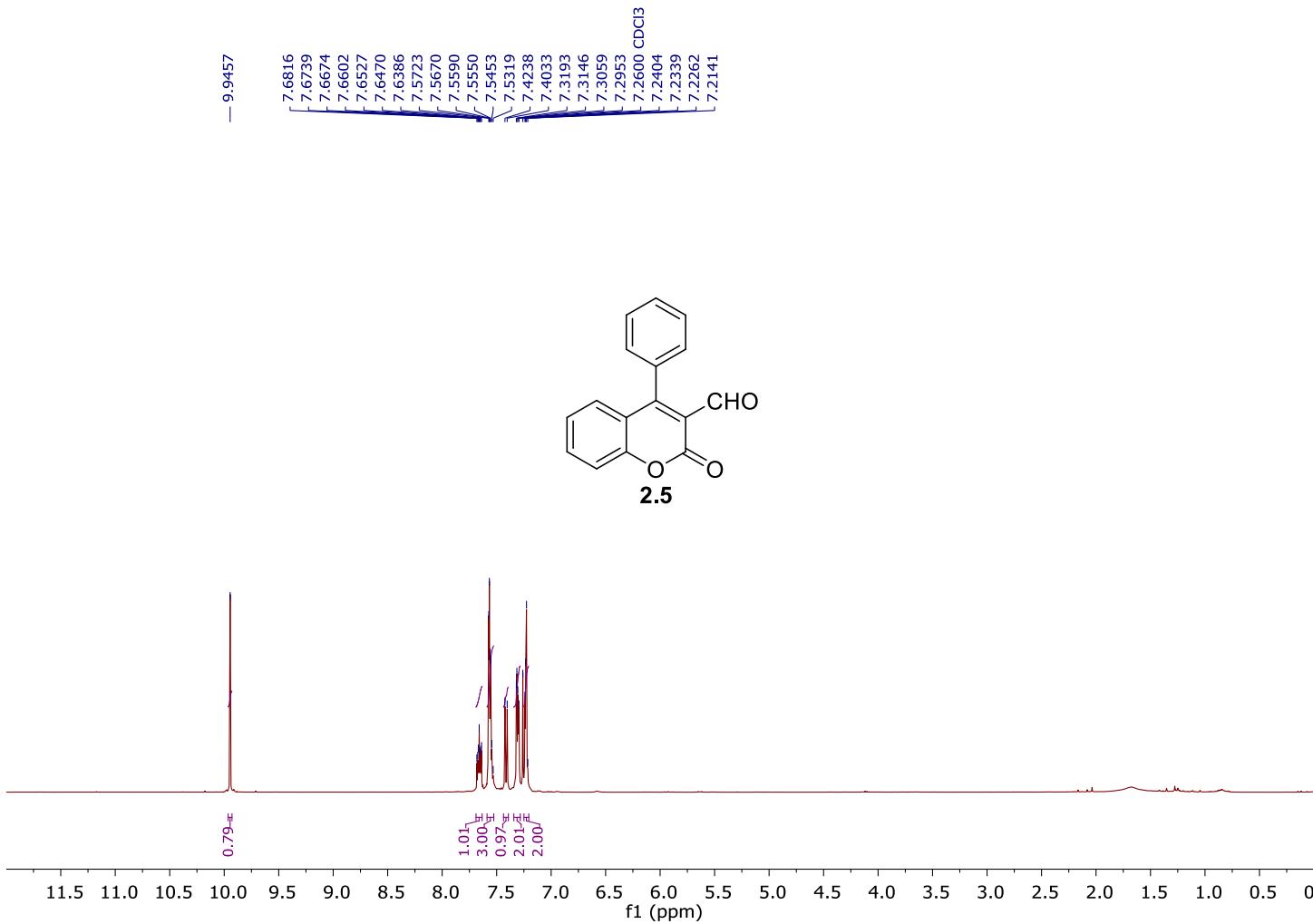
^{13}C Spectrum of 4-(4-isopropoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.3)



¹H Spectrum of 4-(4-isobutoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.4)



^{13}C Spectrum of 4-(4-isobutoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.4)



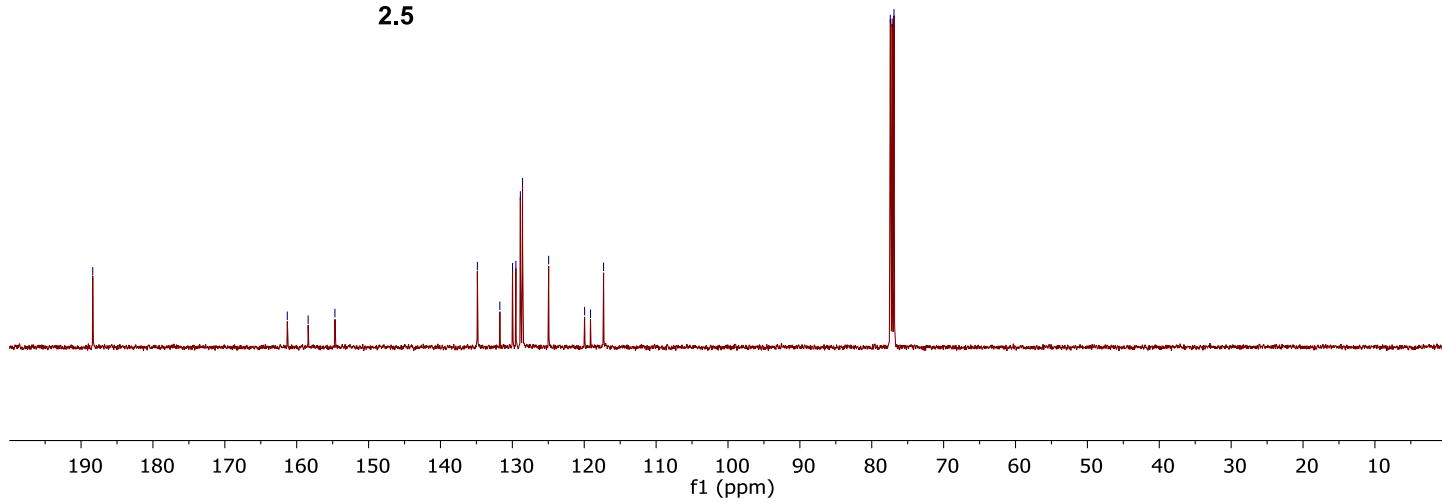
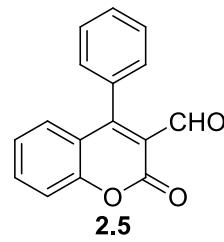
¹H Spectrum of 2-oxo-4-phenyl-2*H*-chromene-3-carbaldehyde (2.5)

— 188.3756

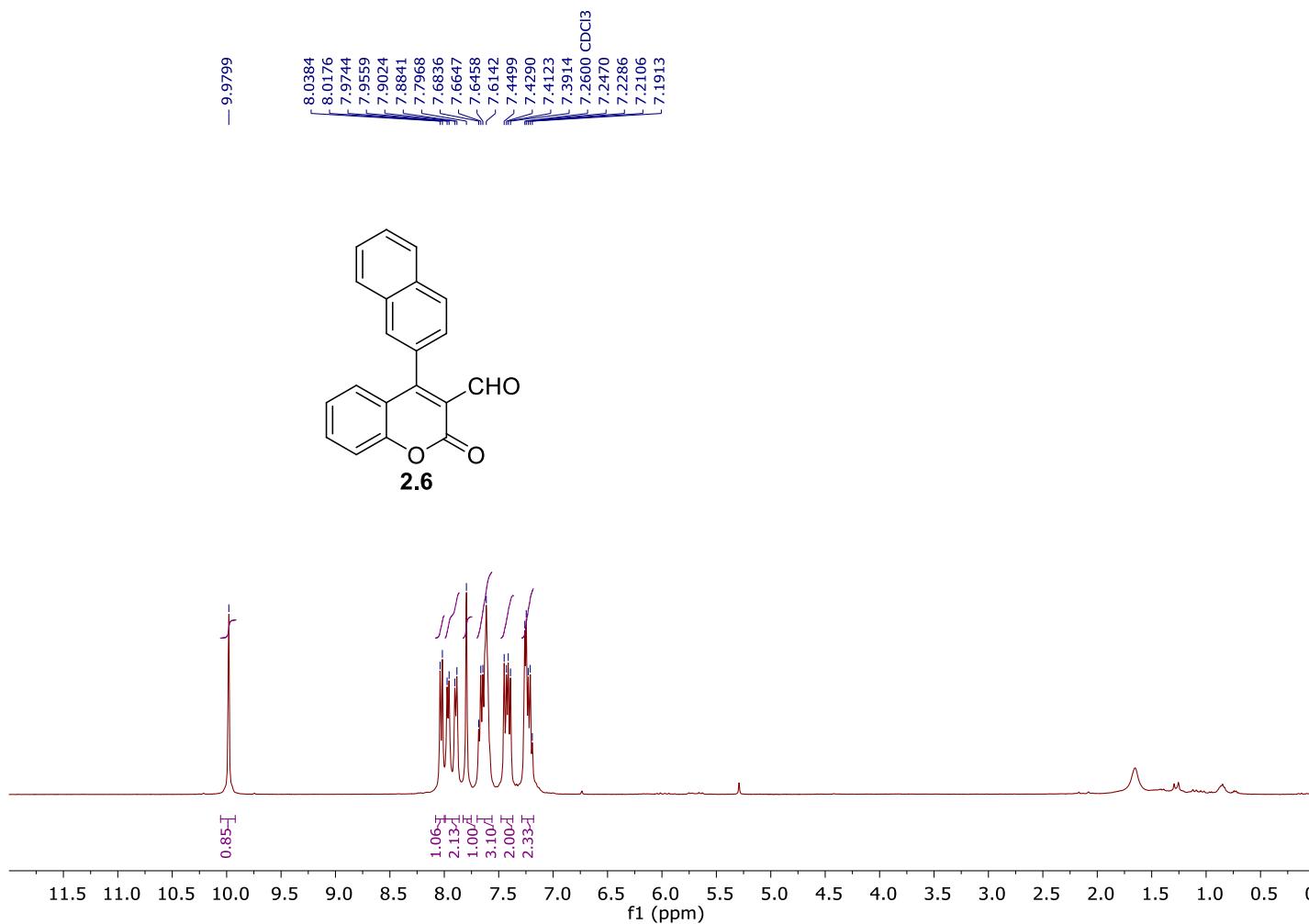
— 161.3110
— 158.4058
— 154.6836

— 134.8645
— 131.7398
— 129.9733
— 129.5106
— 128.8848
— 128.5835
— 124.9490
— 119.5056
— 119.1285
— 117.3136

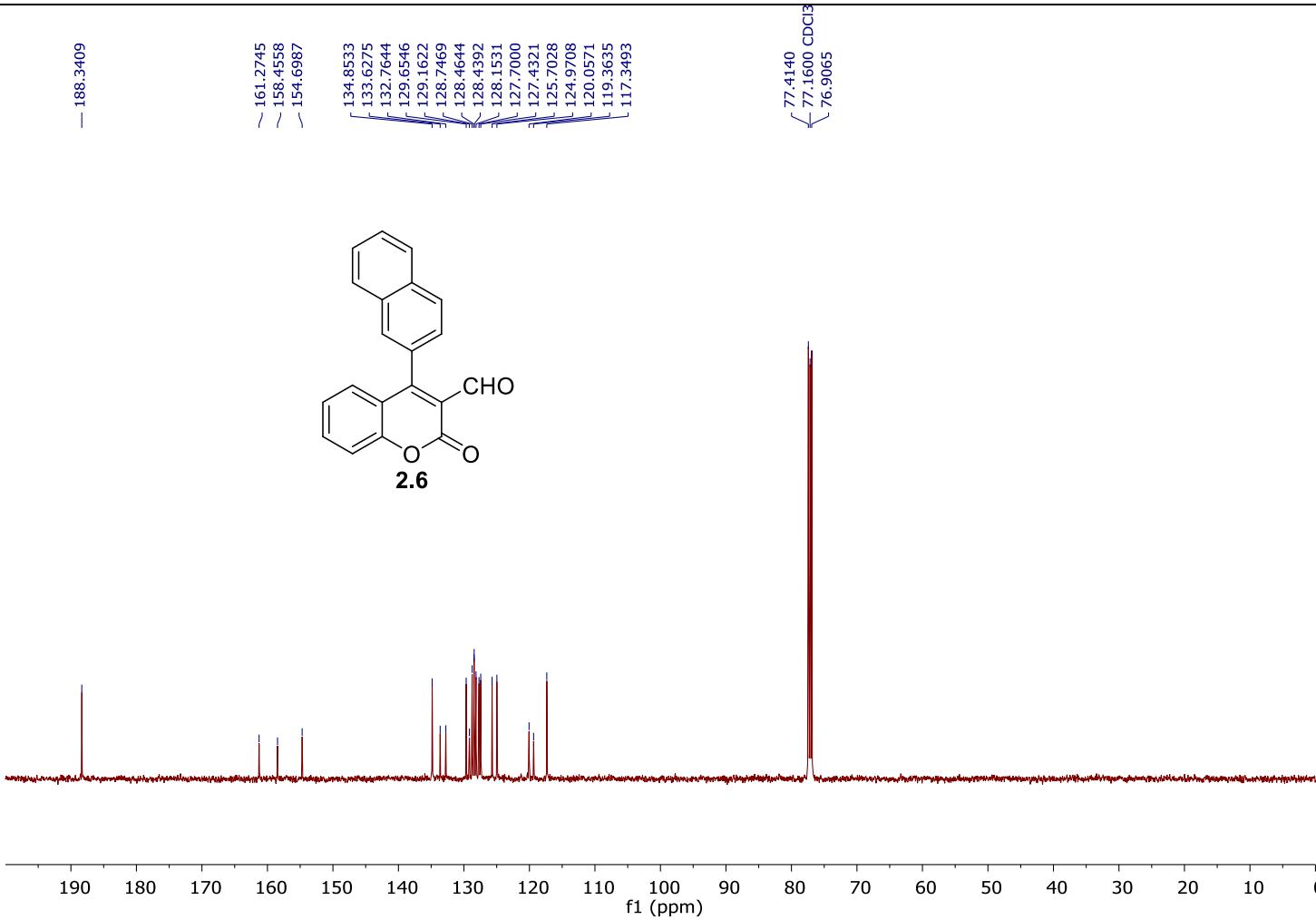
— 77.4135
— 77.1600 CDCl₃
— 76.9057



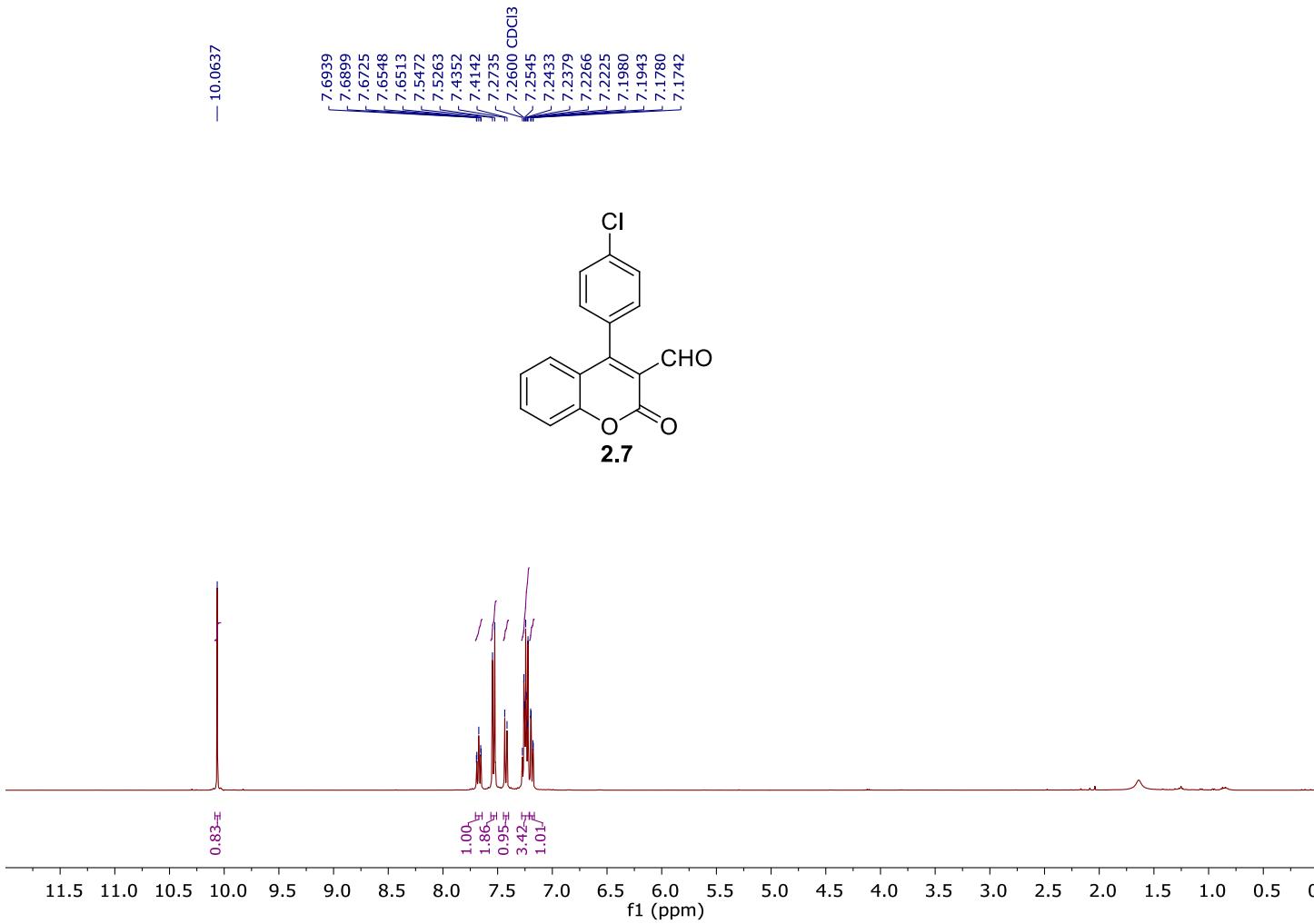
¹³C Spectrum of 2-oxo-4-phenyl-2H-chromene-3-carbaldehyde (**2.5**)



^1H Spectrum of 4-(naphthalen-2-yl)-2-oxo-2*H*-chromene-3-carbaldehyde (**2.6**)

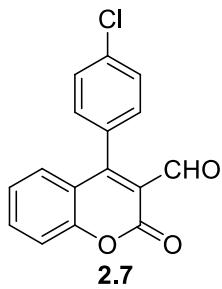


^{13}C Spectrum of 4-(naphthalen-2-yl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.6)



¹H Spectrum of 4-(4-chlorophenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.7)

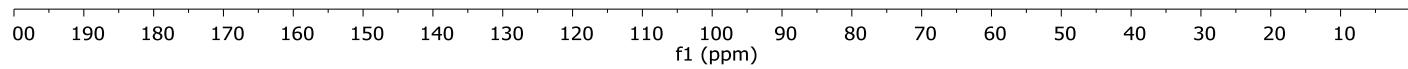
— 188.3248



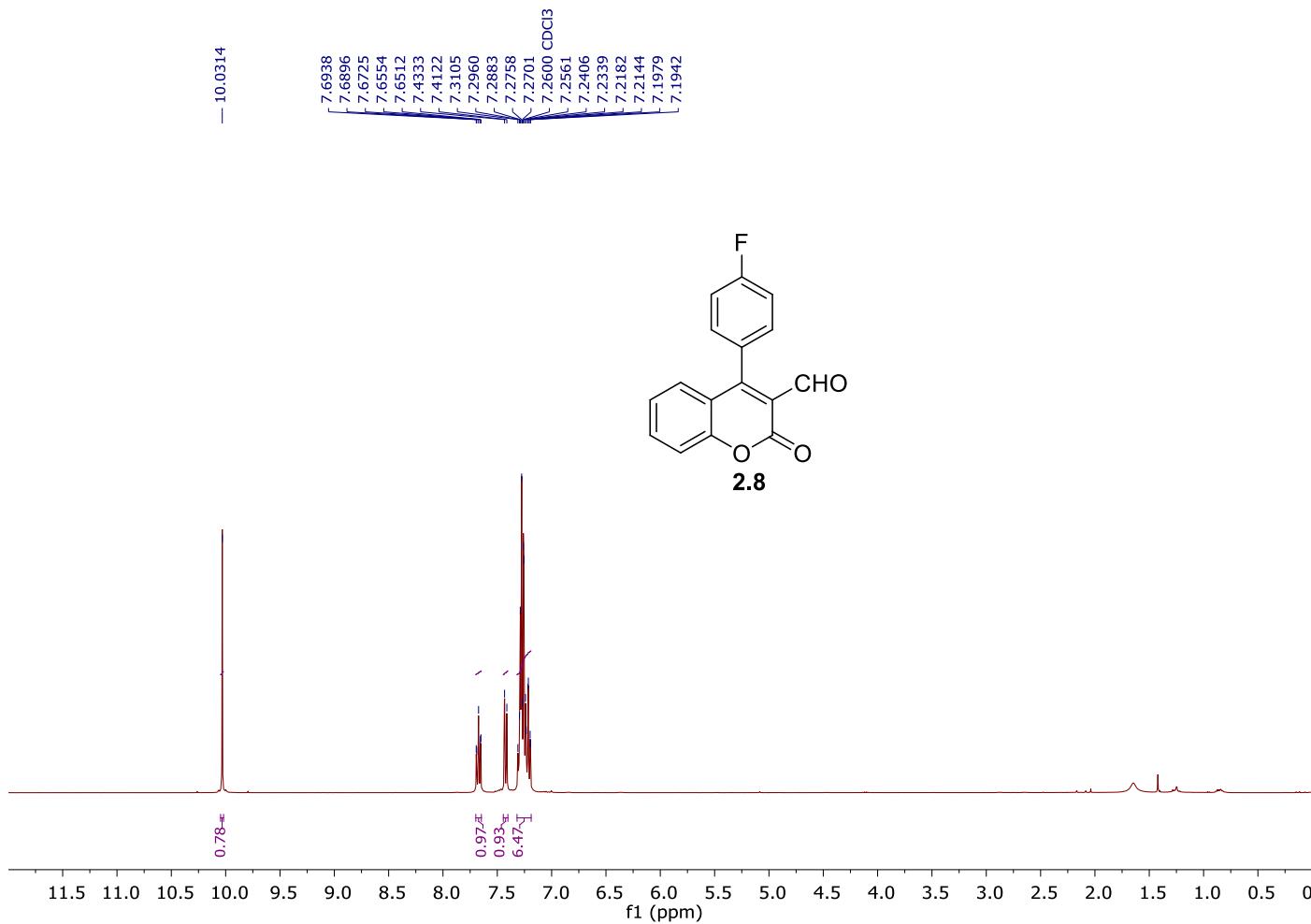
159.1200
159.0217
~ 154.6656

136.1251
134.9765
130.4604
129.7858
129.4133
129.2191
125.1263
119.8337
119.0581
117.4357

77.4134
77.1600 CDCl₃
76.9050



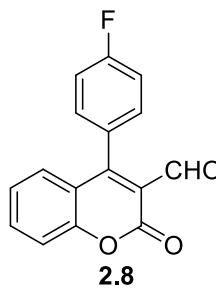
¹³C Spectrum of 4-(4-chlorophenyl)-2-oxo-2H-chromene-3-carbaldehyde (**2.7**)



^1H Spectrum of 4-(4-fluorophenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.8)

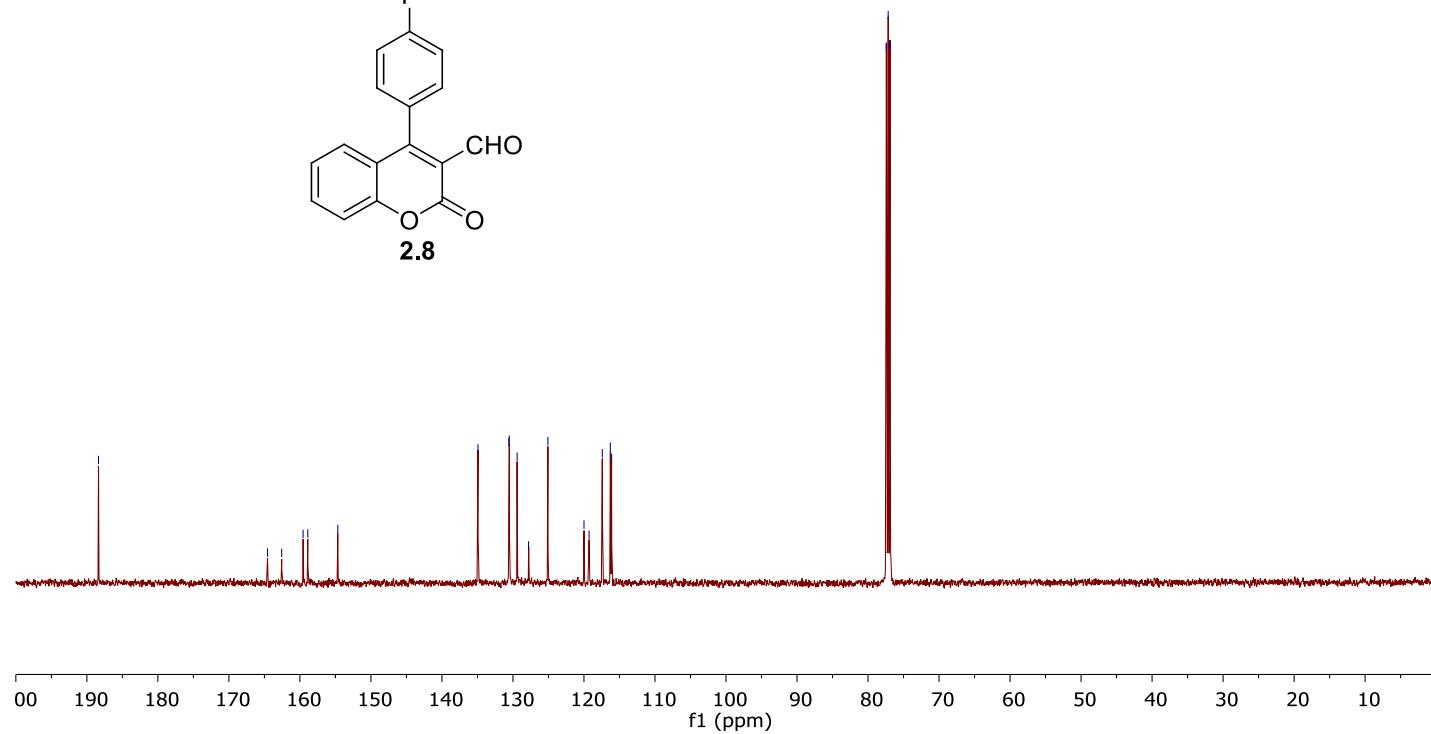
— 188.3634

— 164.5620
— 162.5680
— 159.5506
— 158.8907
— 154.6629

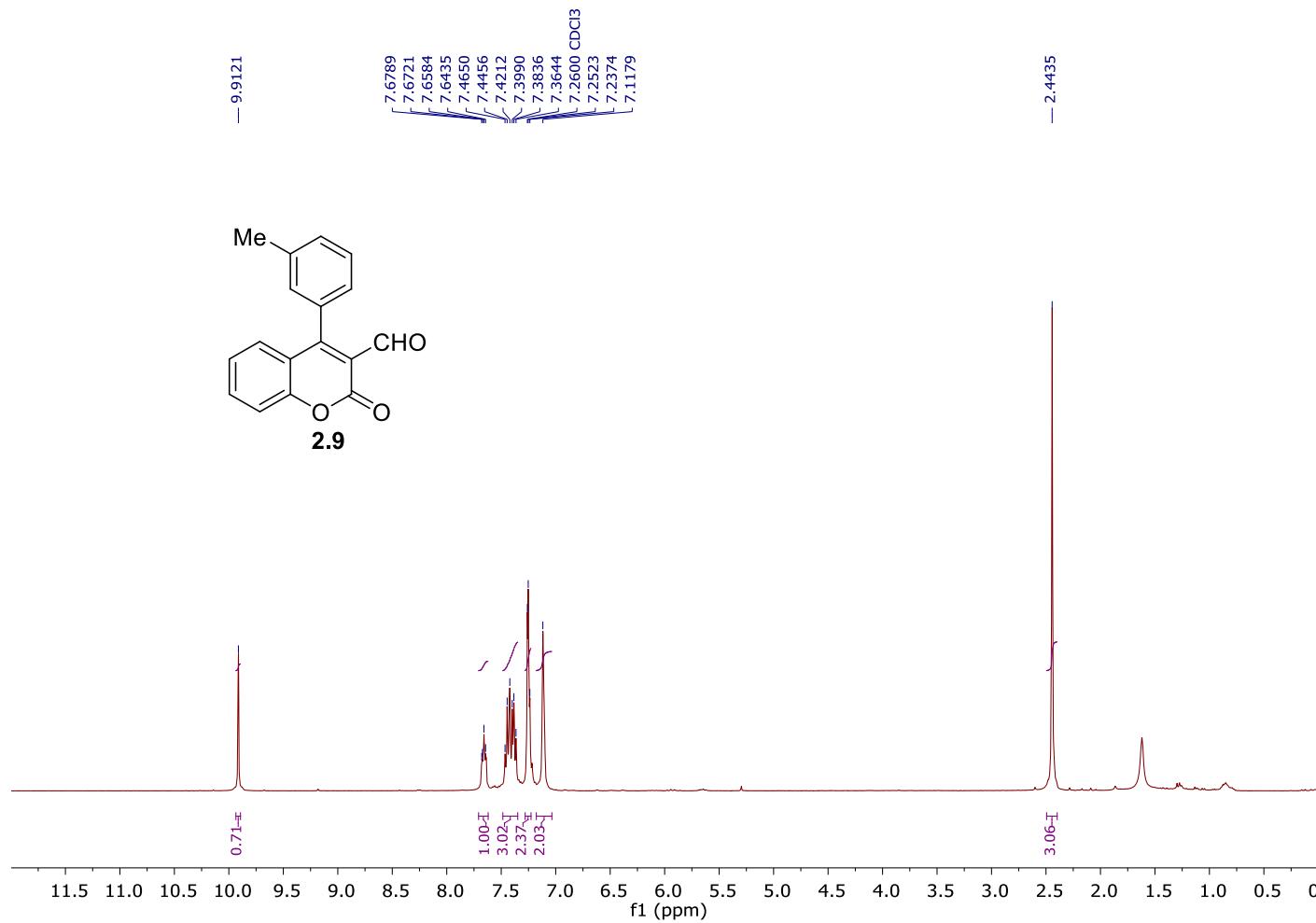
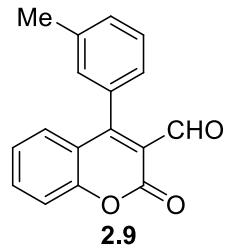


— 134.9244
— 130.5829
— 130.5163
— 129.4147
— 127.8073
— 125.0789
— 119.9956
— 119.2772
— 117.4157
— 116.2846
— 116.1101

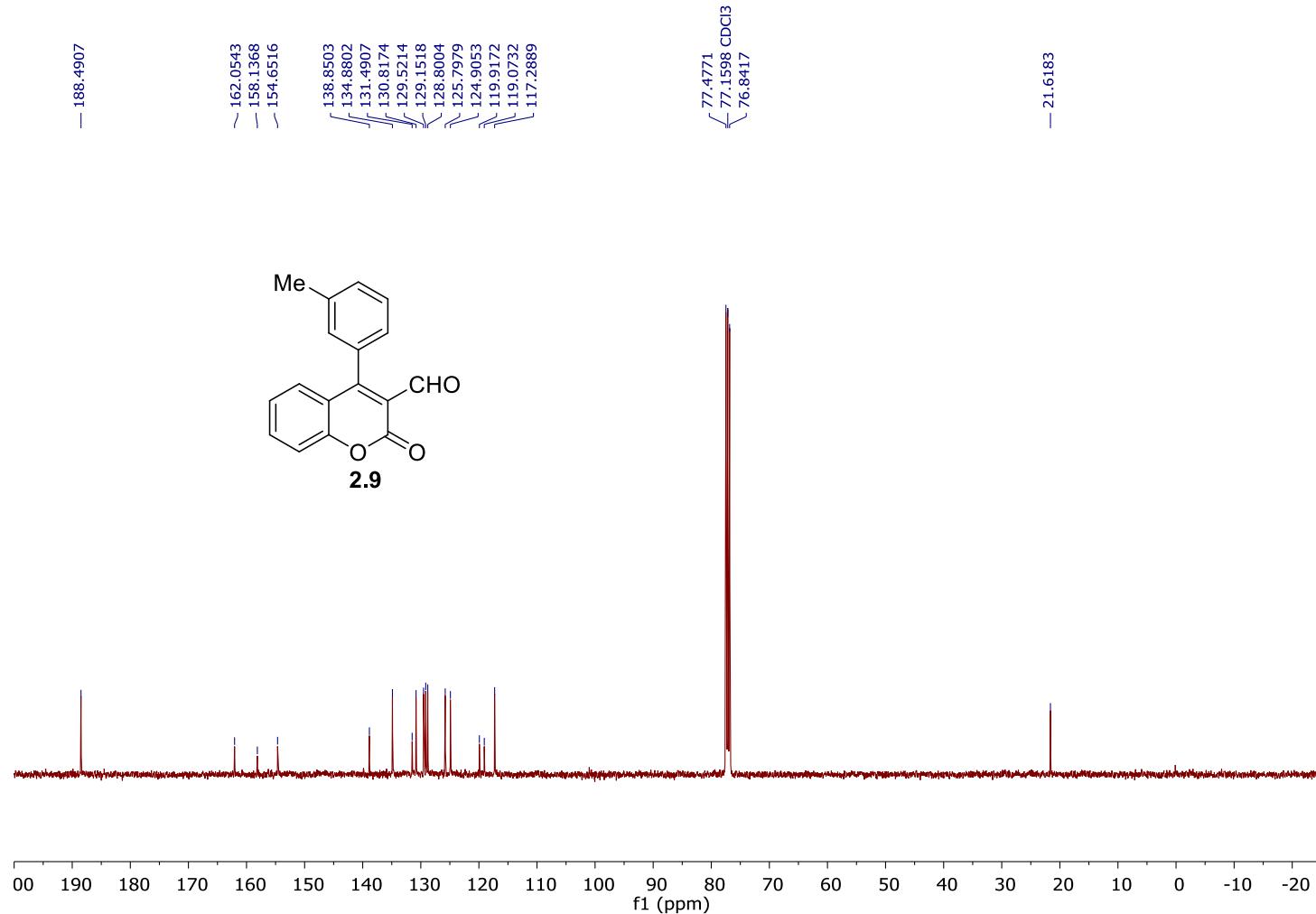
— 77.4144
— 77.1600 CDCl₃
— 76.9056

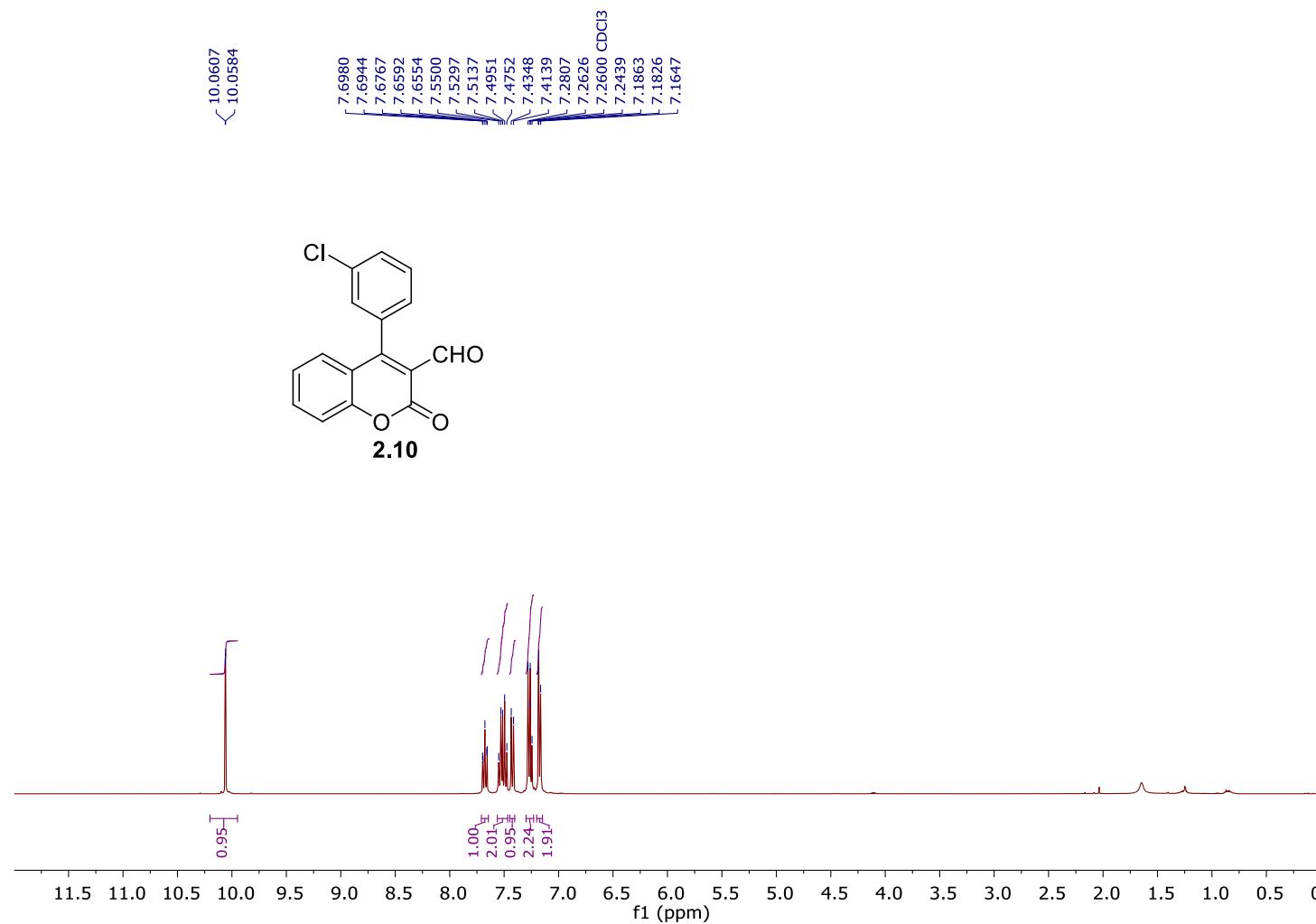


¹³C Spectrum of 4-(4-fluorophenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (**2.8**)



¹H Spectrum of 2-oxo-4-*m*-tolyl-2*H*-chromene-3-carbaldehyde (2.9)





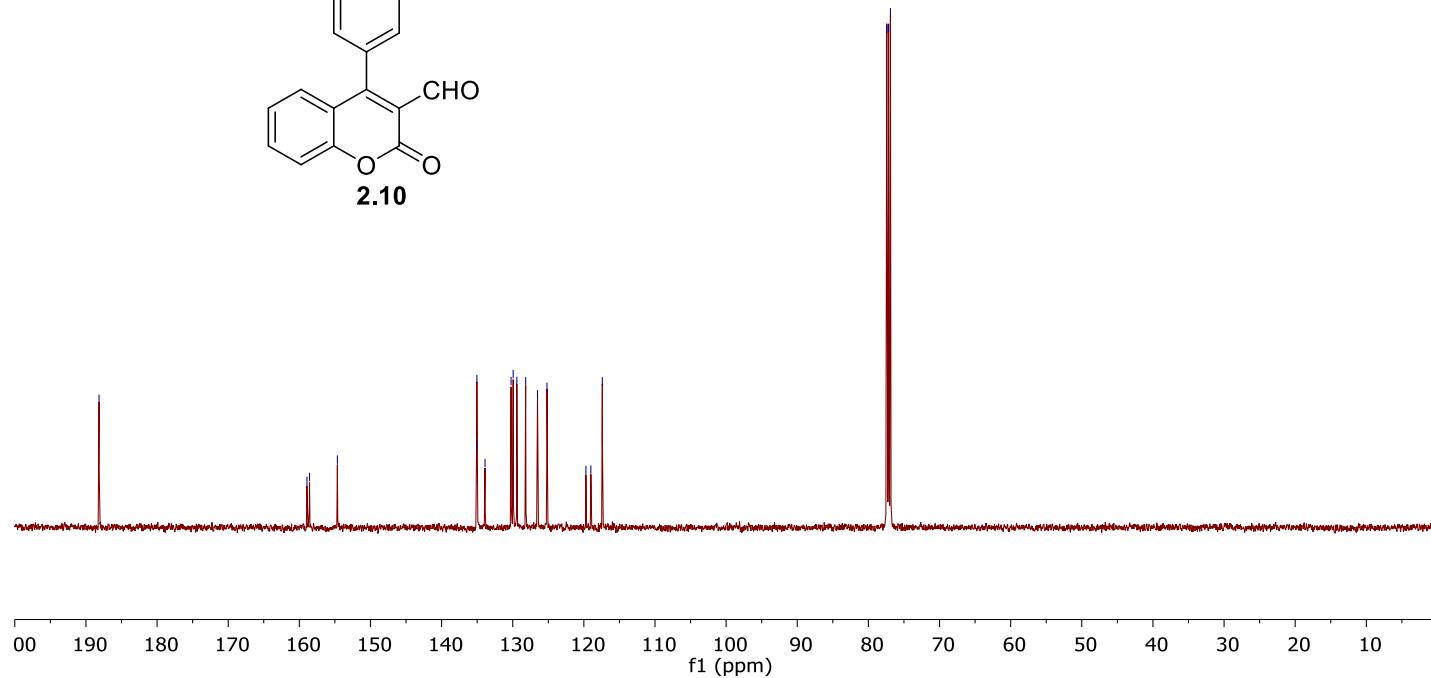
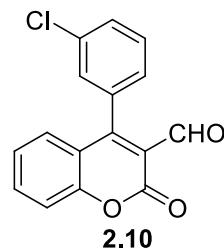
¹H Spectrum of 4-(3-chlorophenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (**2.10**)

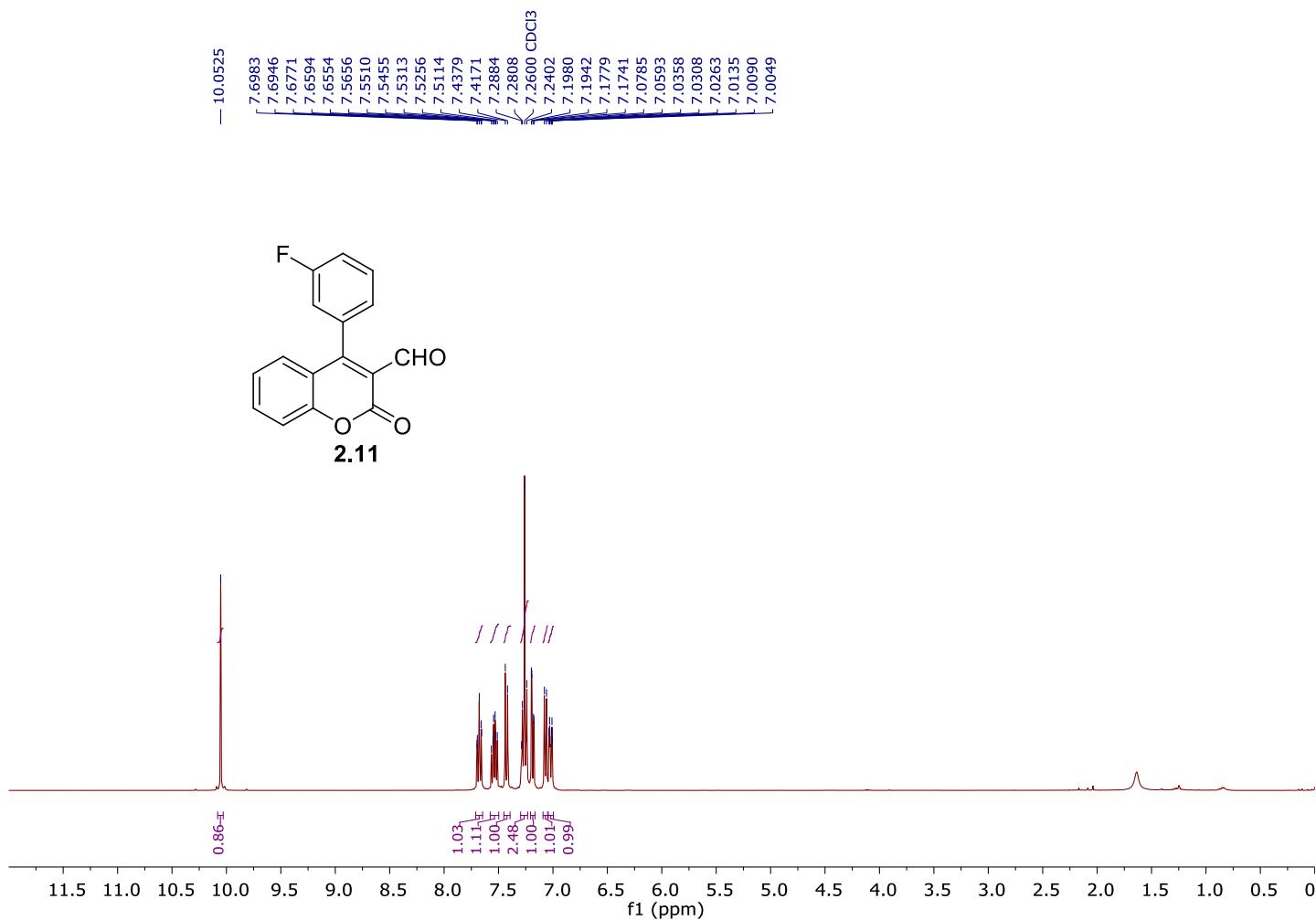
— 188.1552

158.9299
158.5656
~ 154.6487

135.0763
135.0358
133.8909
130.2323
129.9363
129.4207
128.1820
126.5161
125.1853
119.7086
119.0166
117.4046

77.4131
77.1600 CDCl₃
76.9052

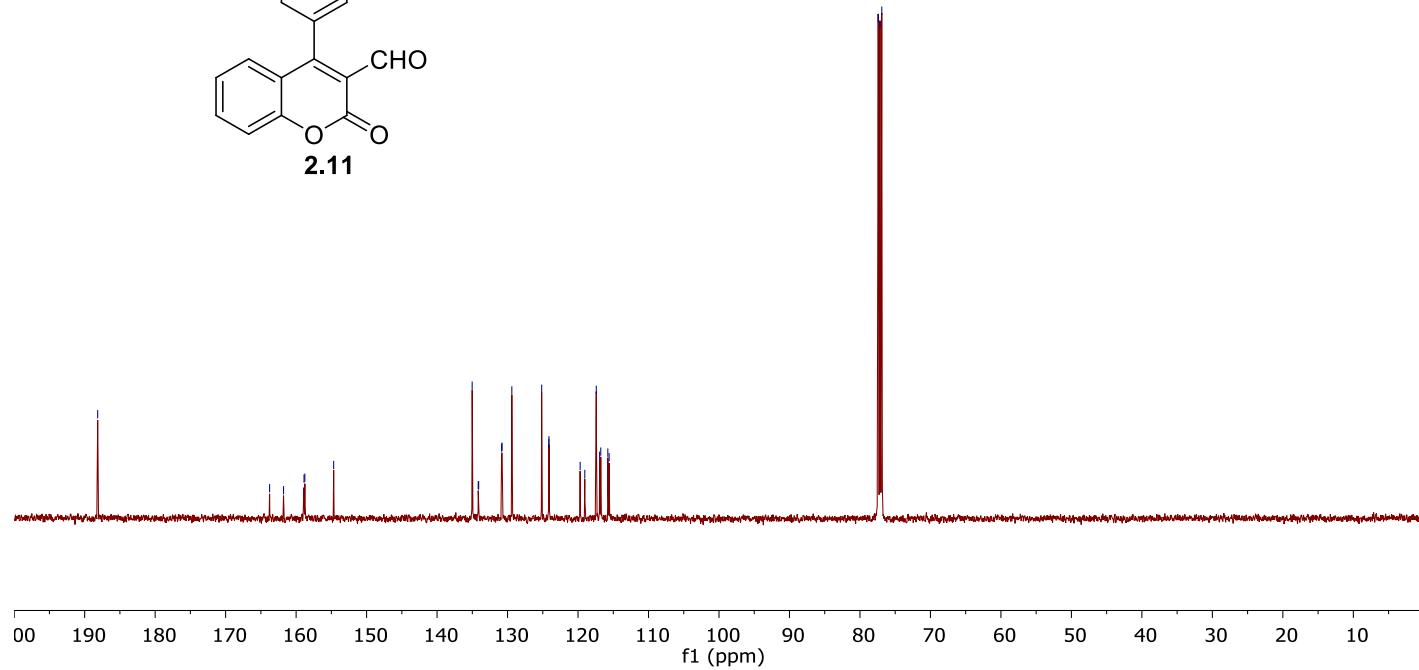
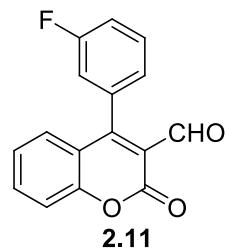




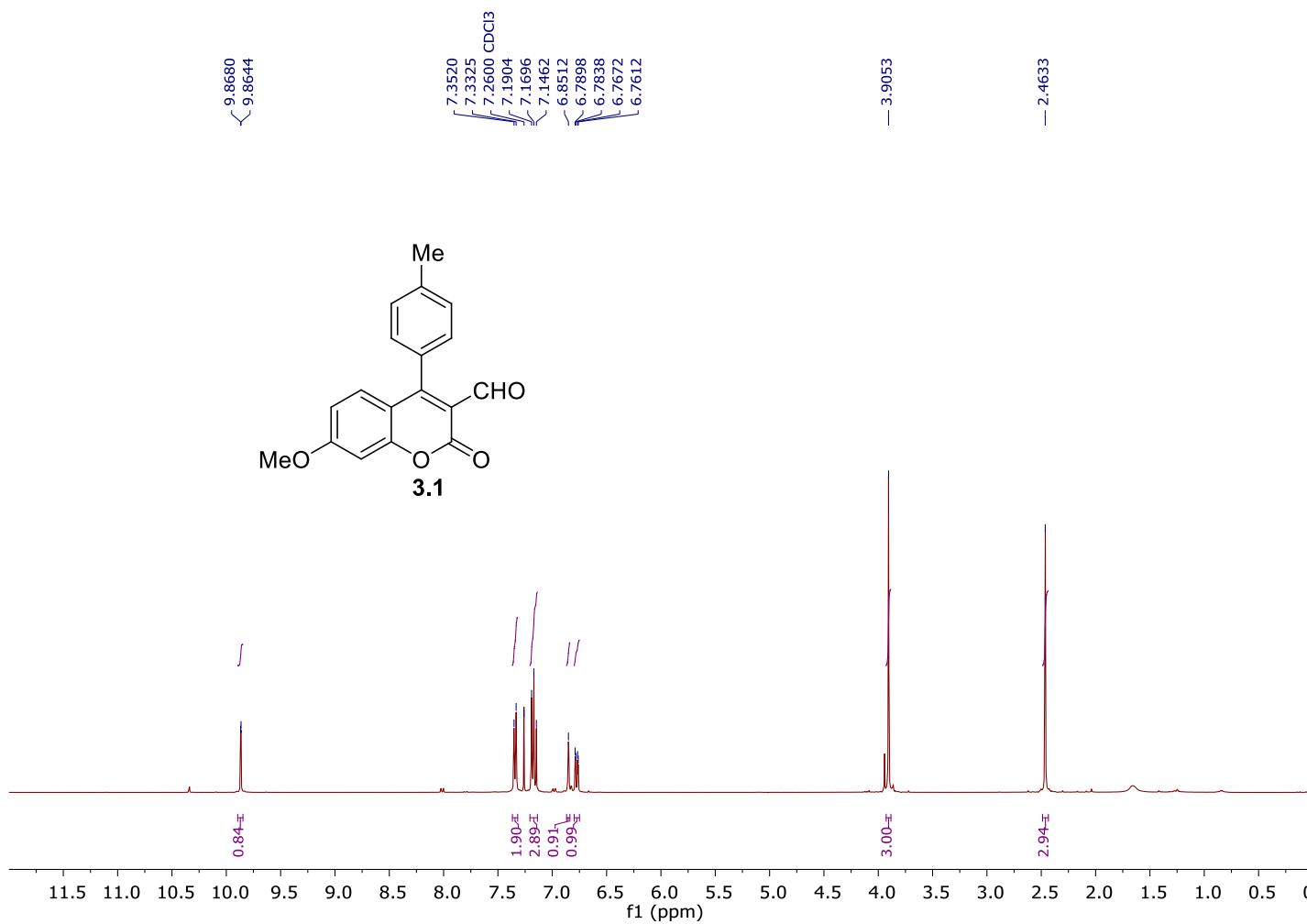
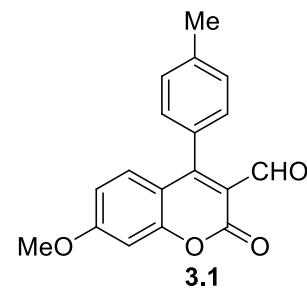
^1H Spectrum of 4-(3-fluorophenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (**2.11**)

- 188.1518

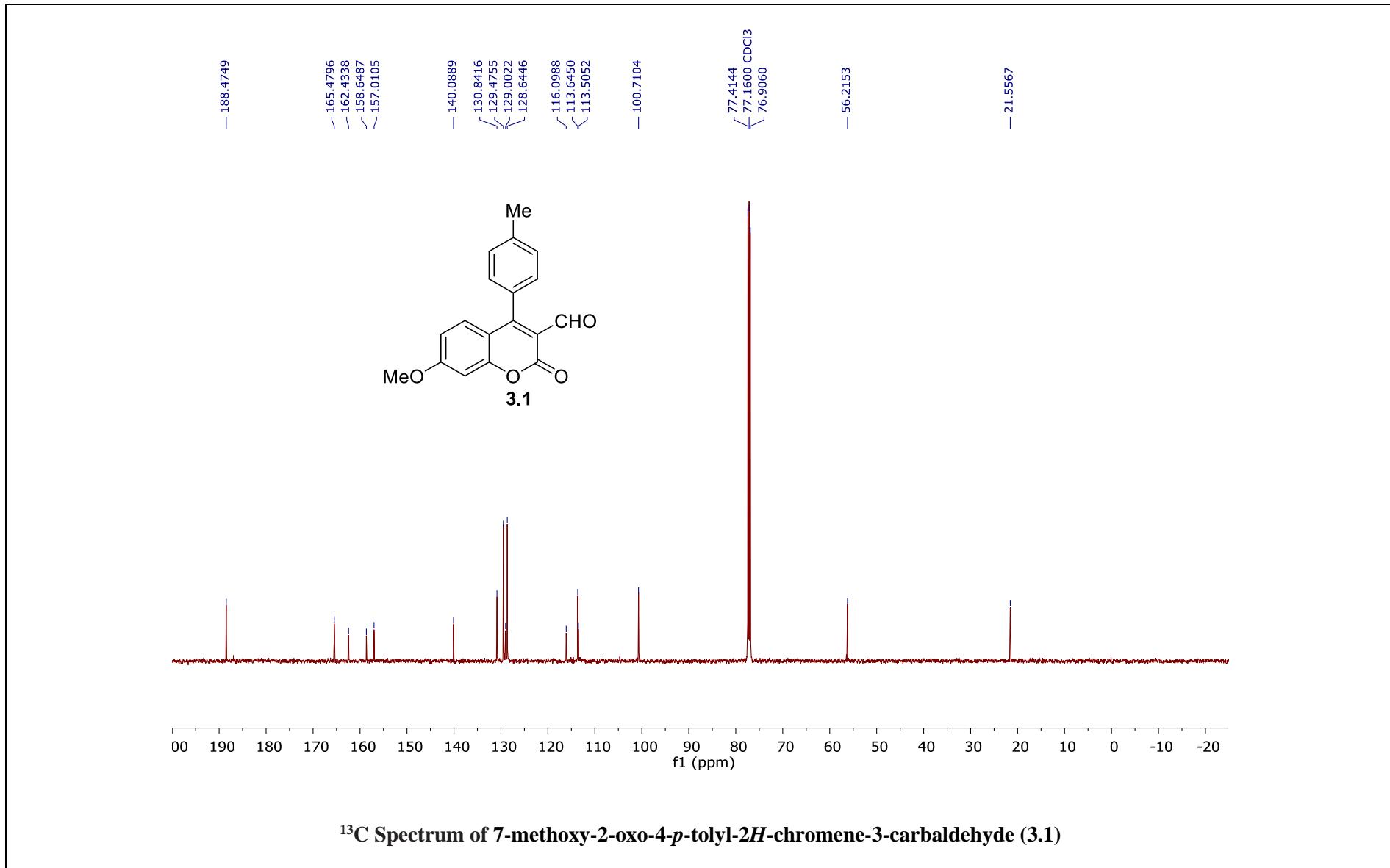
✓ 163.7624
✓ 161.7810
✓ 158.8778
✓ 158.7594
✓ 154.6682
✓ 135.0212
✓ 134.1612
✓ 134.0983
✓ 130.8427
✓ 130.7762
✓ 129.3928
✓ 125.1578
✓ 124.1444
✓ 124.1217
✓ 119.7019
✓ 119.0424
✓ 117.4120
✓ 116.9394
✓ 116.7740
✓ 115.7724
✓ 115.5875

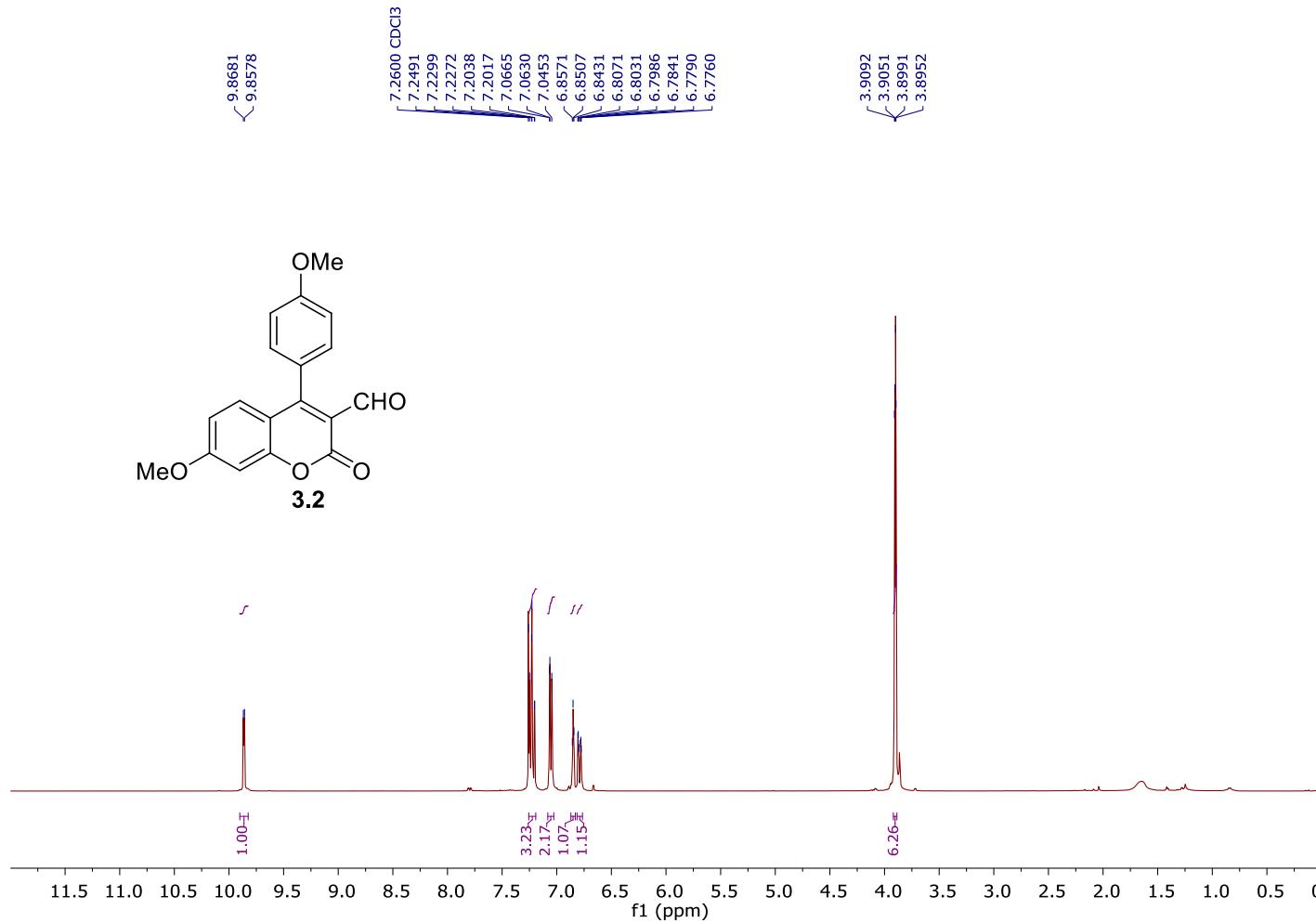
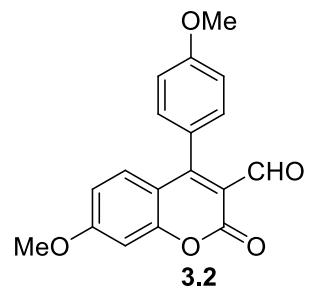


¹³C Spectrum of 4-(3-fluorophenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (**2.11**)

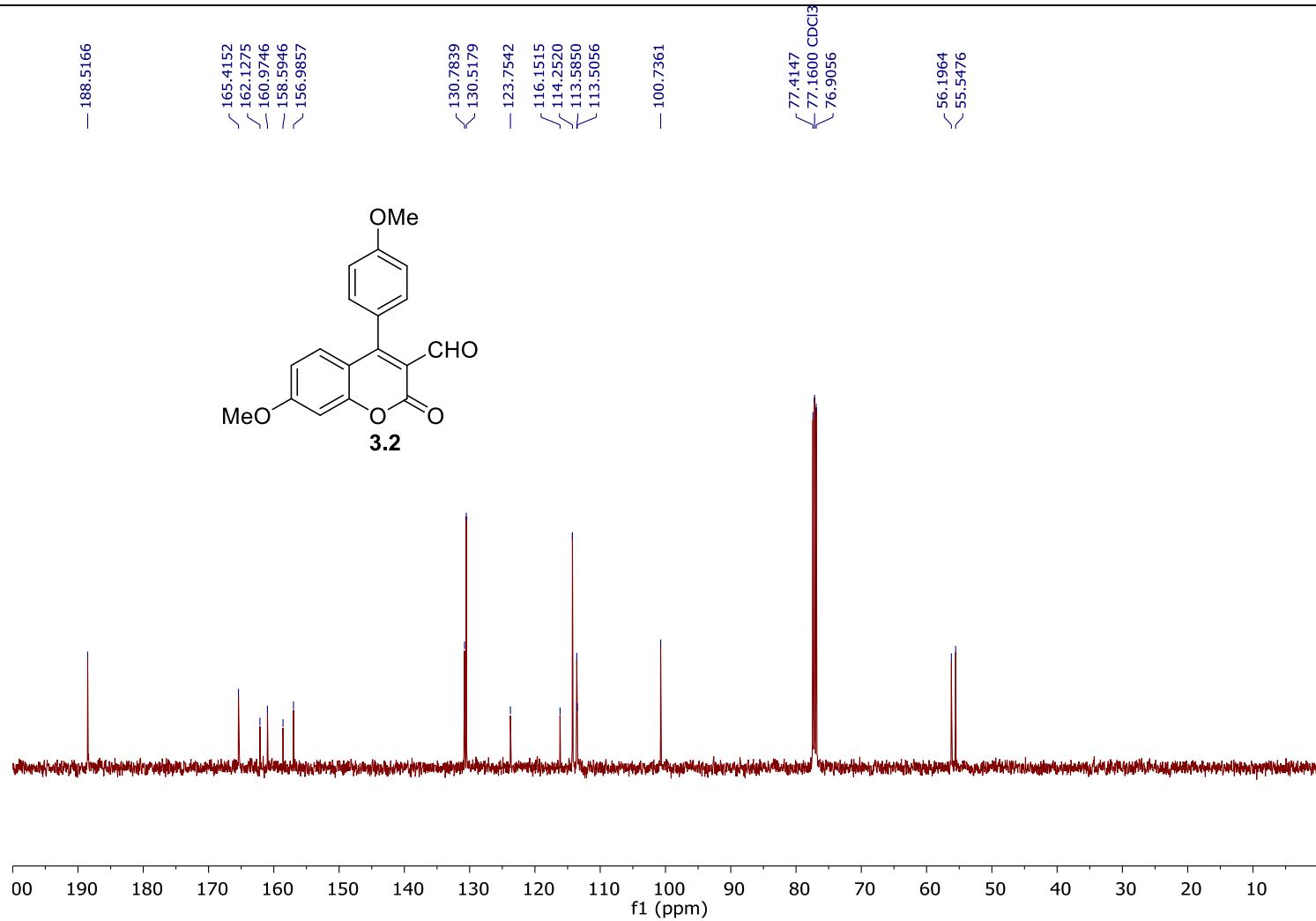
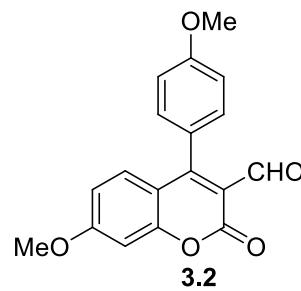


¹H Spectrum of 7-methoxy-2-oxo-4-p-tolyl-2H-chromene-3-carbaldehyde (**3.1**)

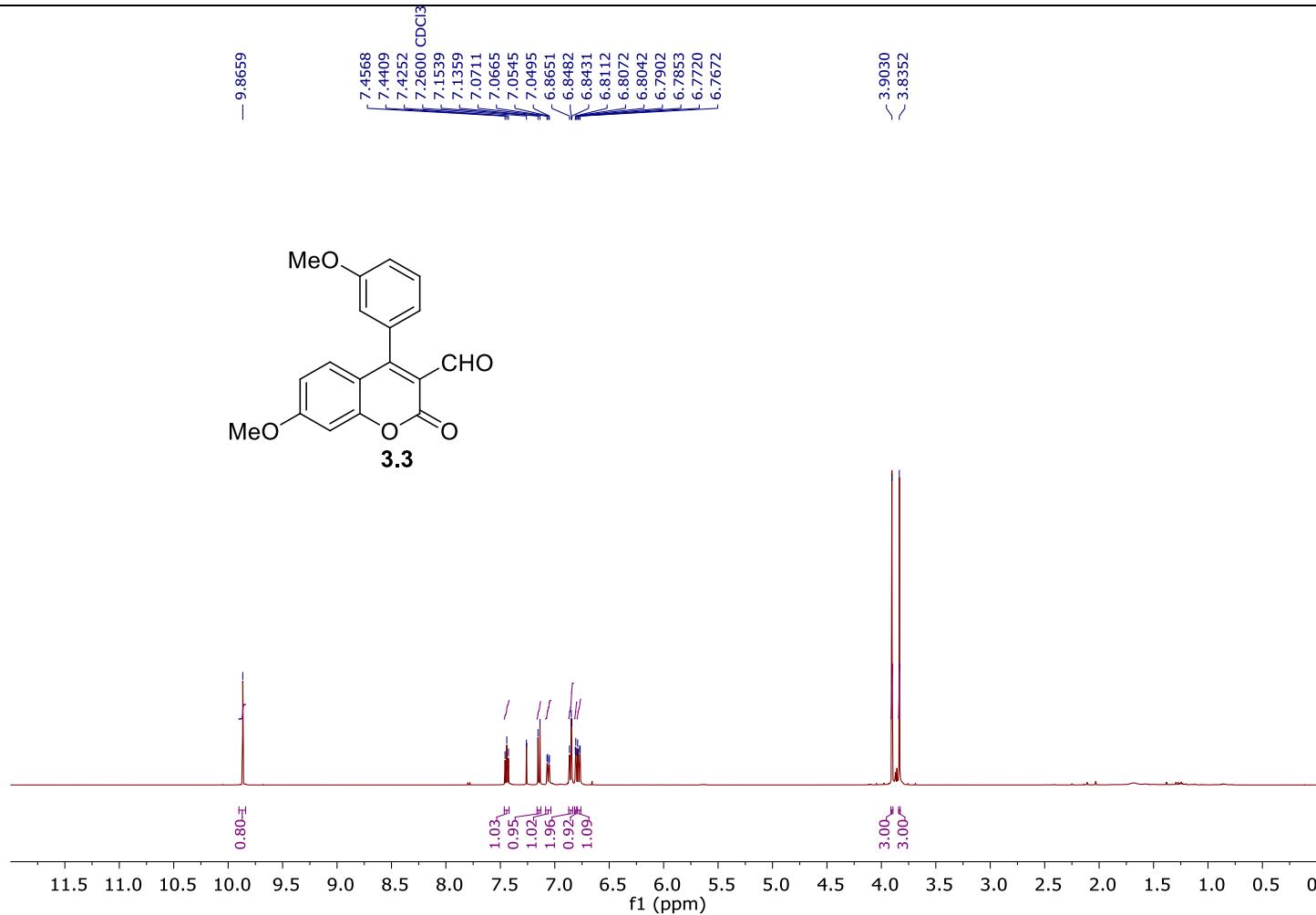




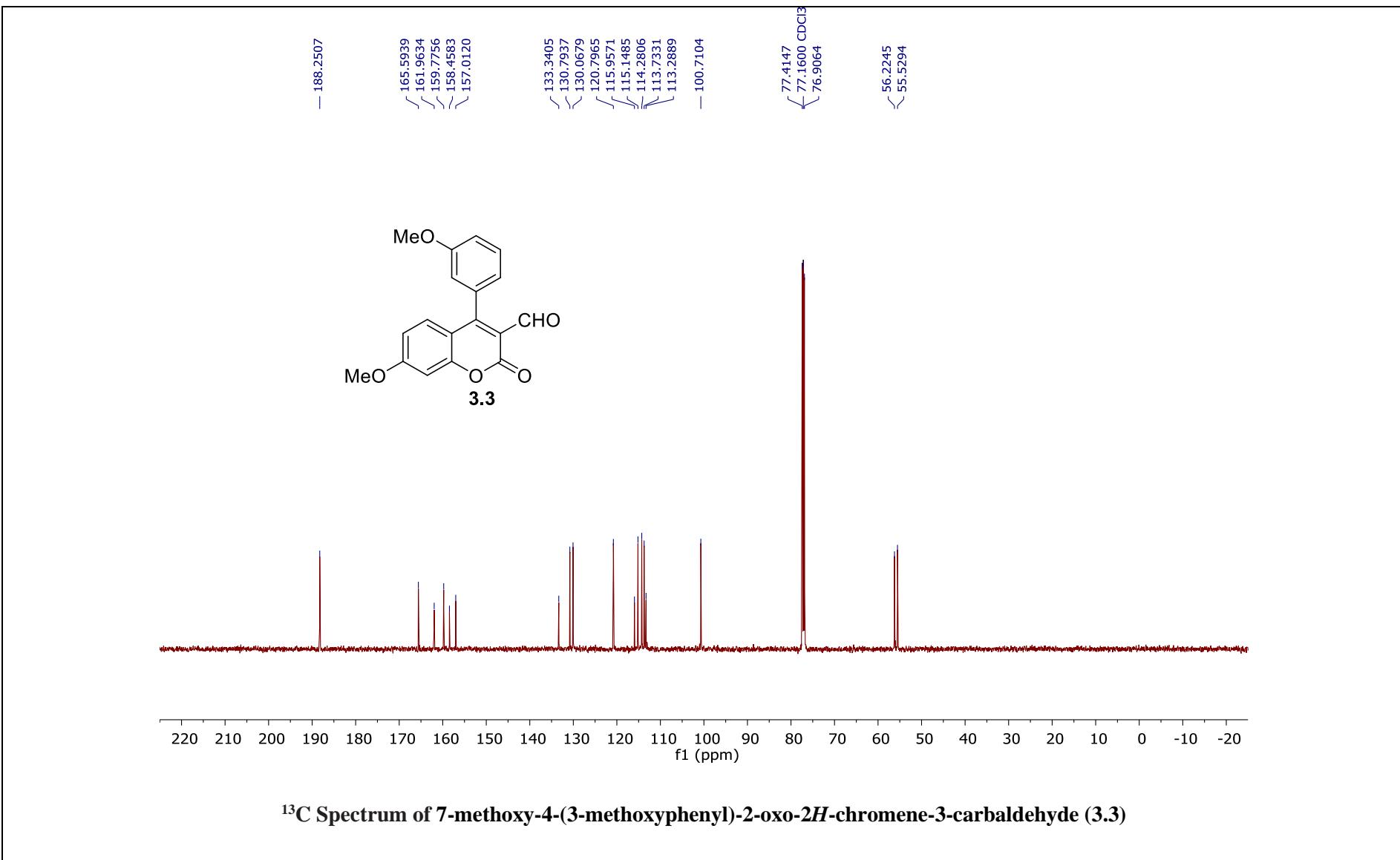
¹H Spectrum of 7-methoxy-4-(4-methoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (3.2)

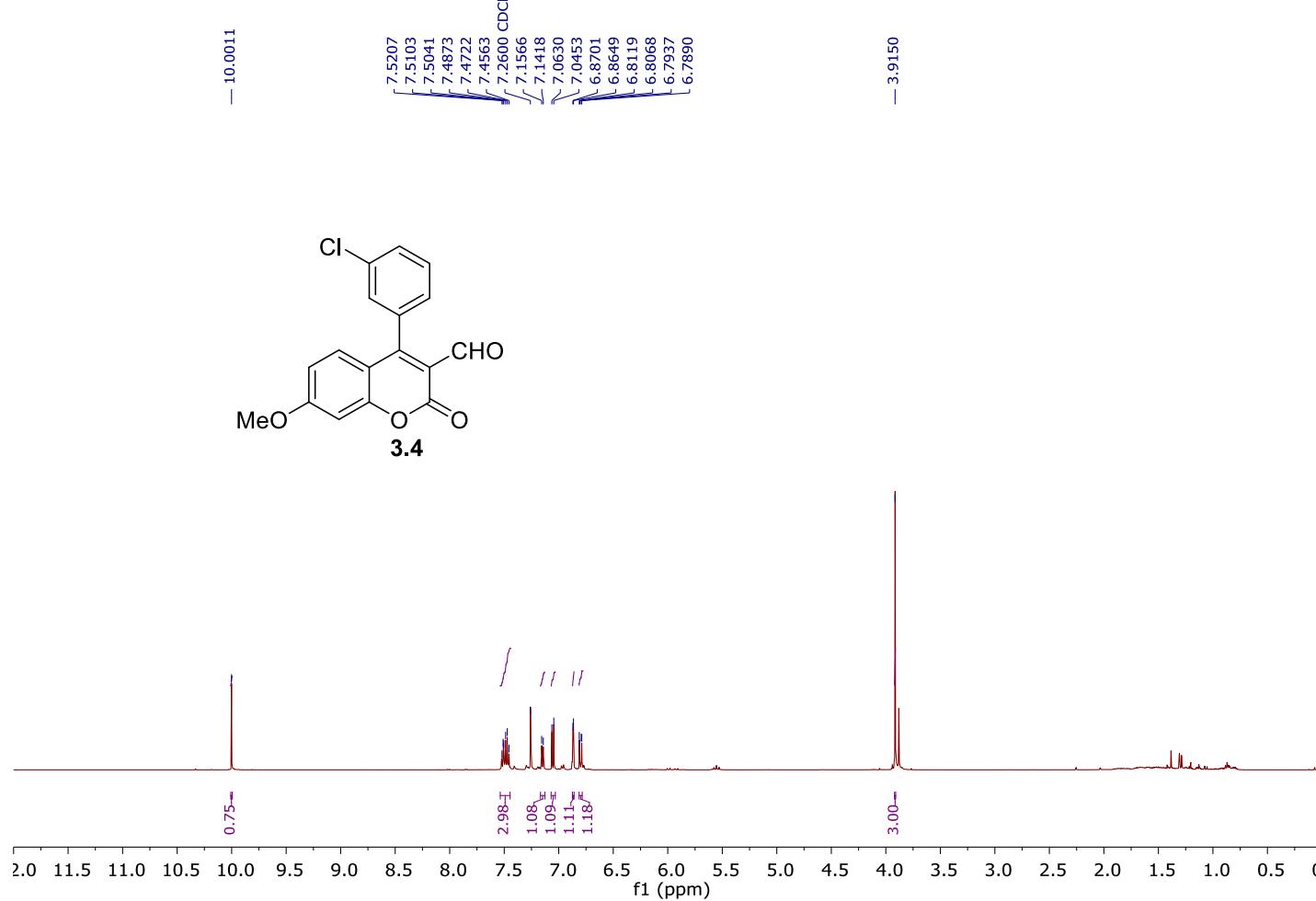
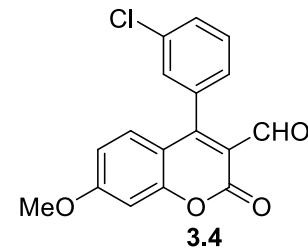


¹³C Spectrum of 7-methoxy-4-(4-methoxyphenyl)-2-oxo-2H-chromene-3-carbaldehyde (3.2)

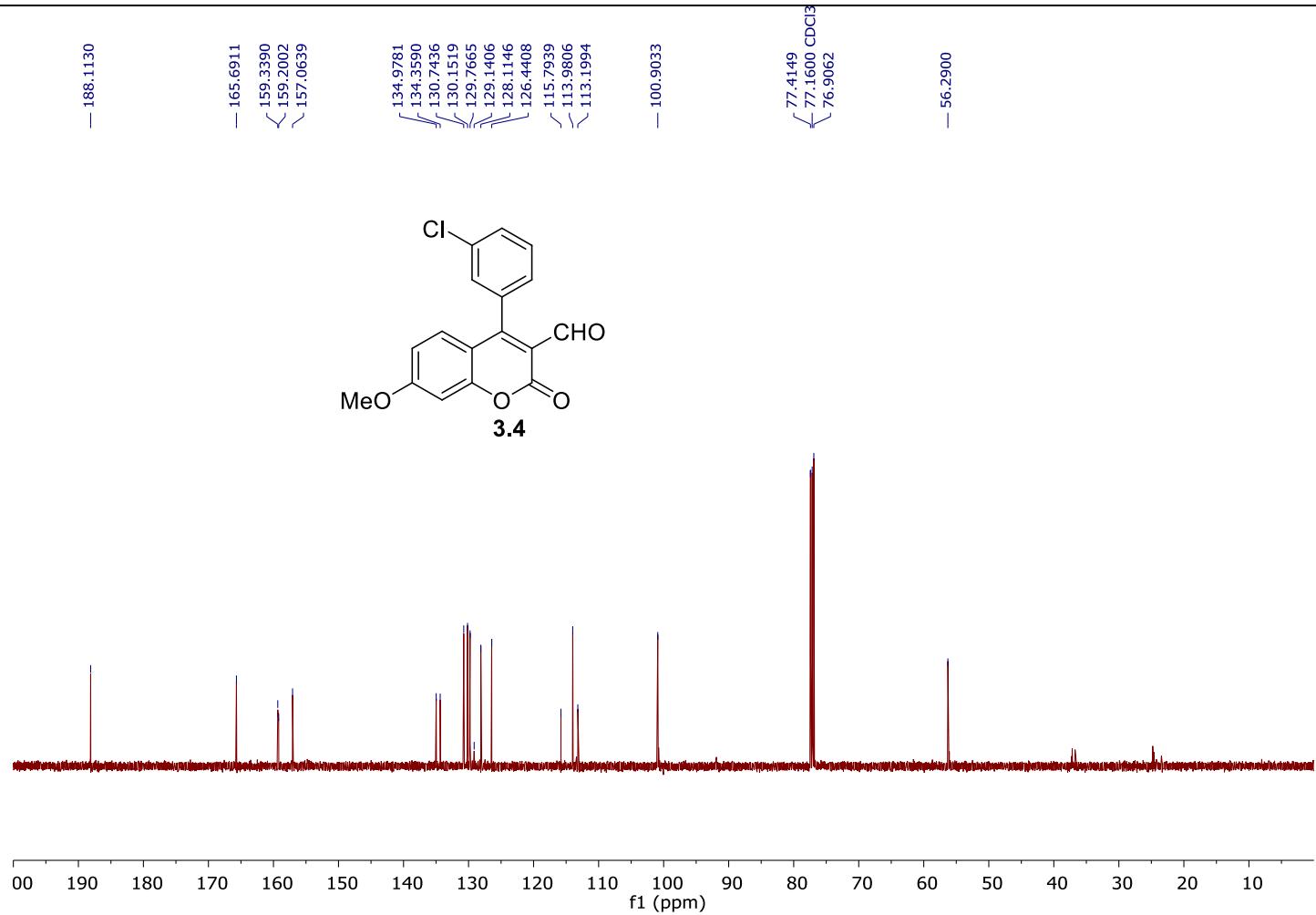


^1H Spectrum of 7-methoxy-4-(3-methoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (3.3)

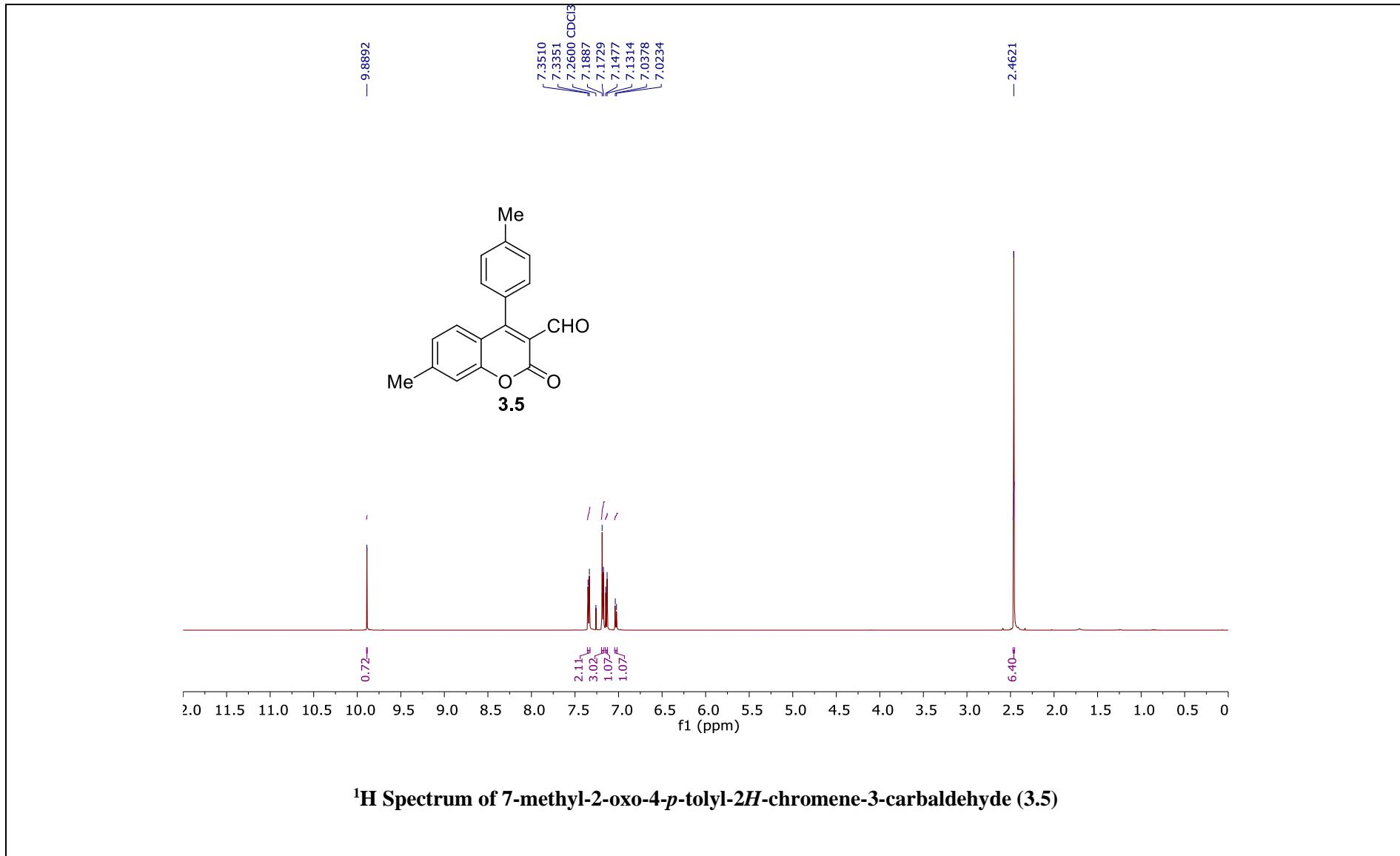


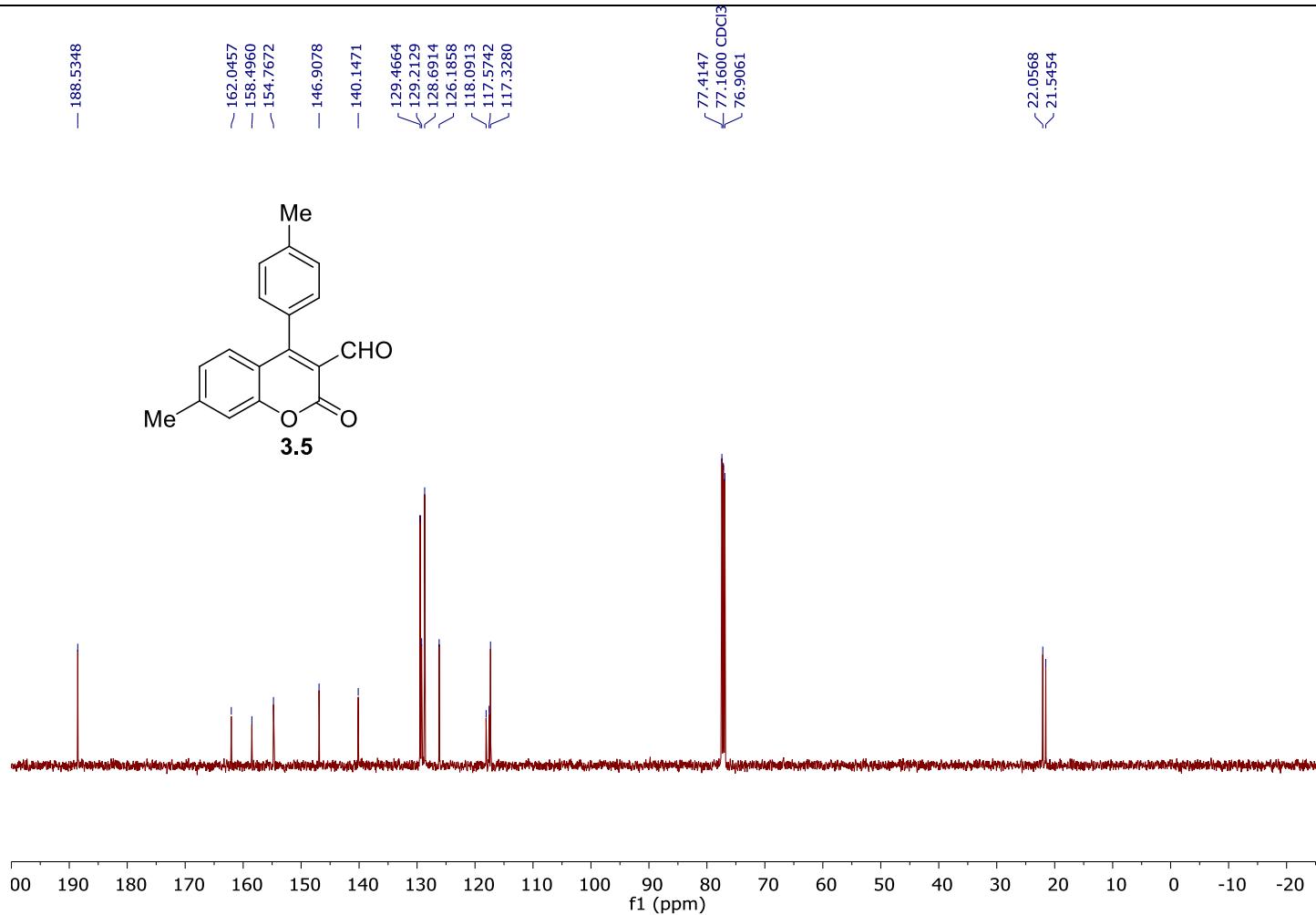


¹H Spectrum of 4-(3-chlorophenyl)-7-methoxy-2-oxo-2*H*-chromene-3-carbaldehyde (3.4)

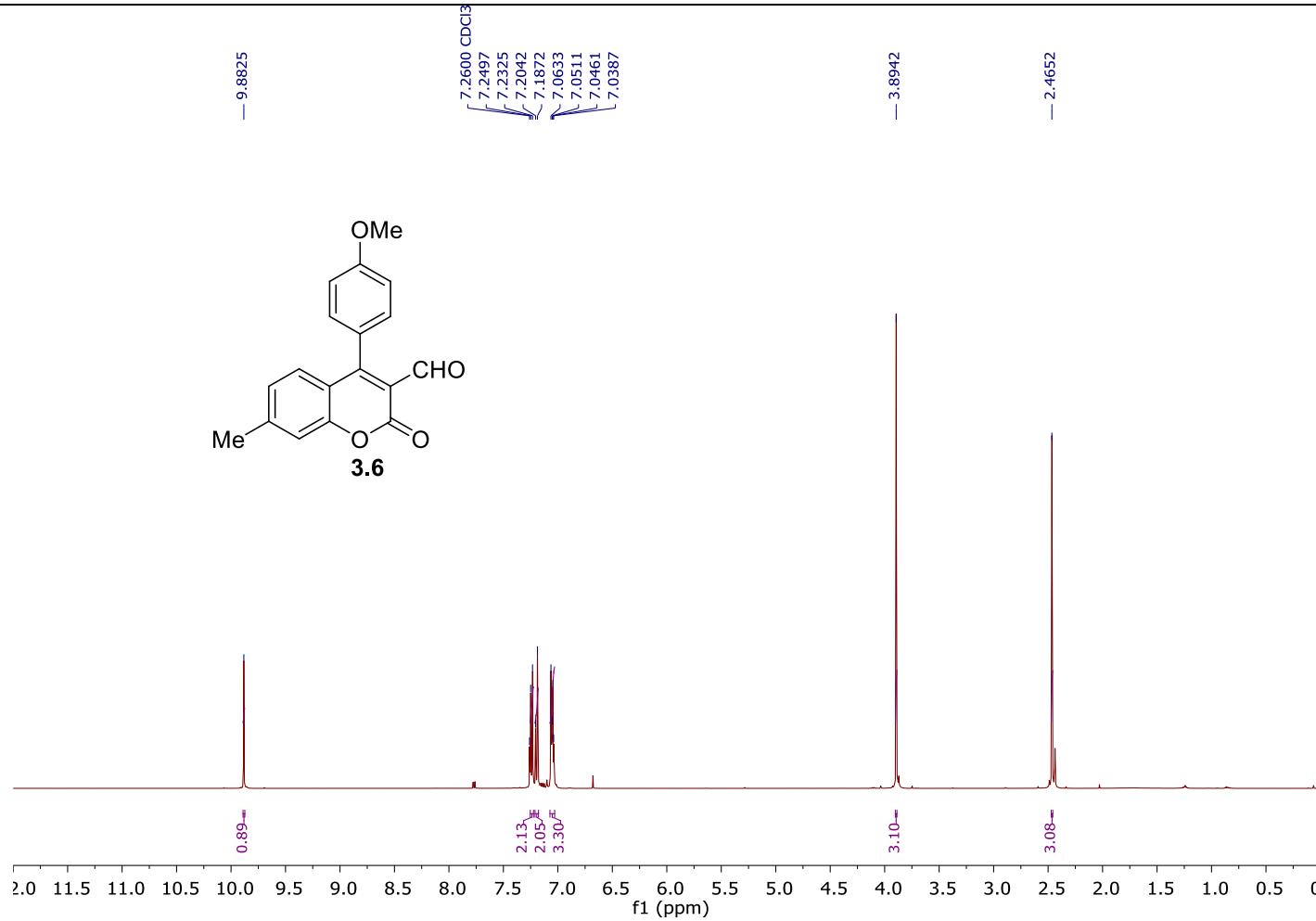
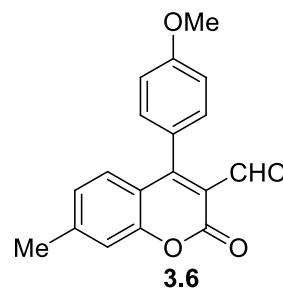


^{13}C Spectrum of 4-(3-chlorophenyl)-7-methoxy-2-oxo-2*H*-chromene-3-carbaldehyde (3.4)

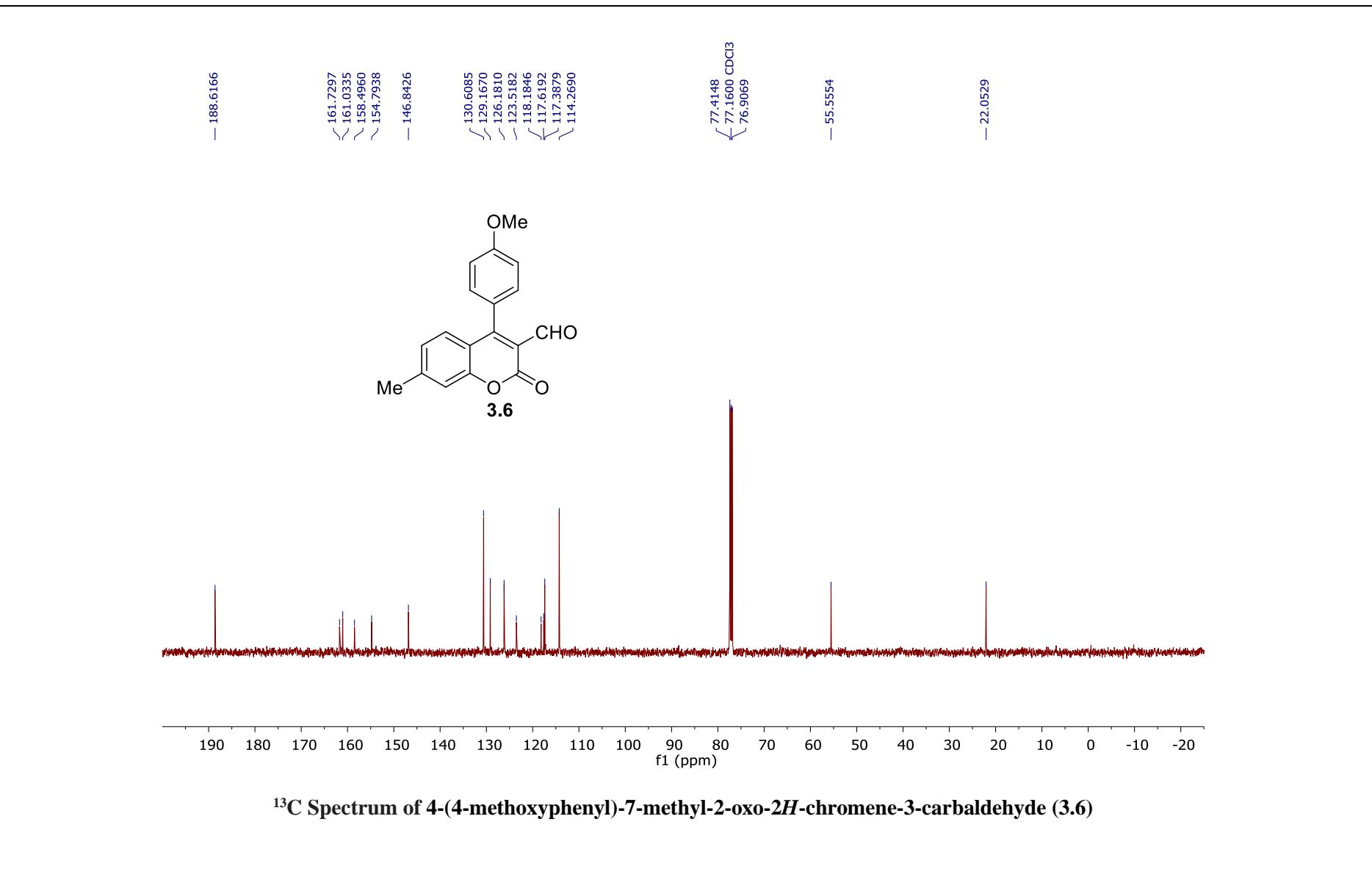


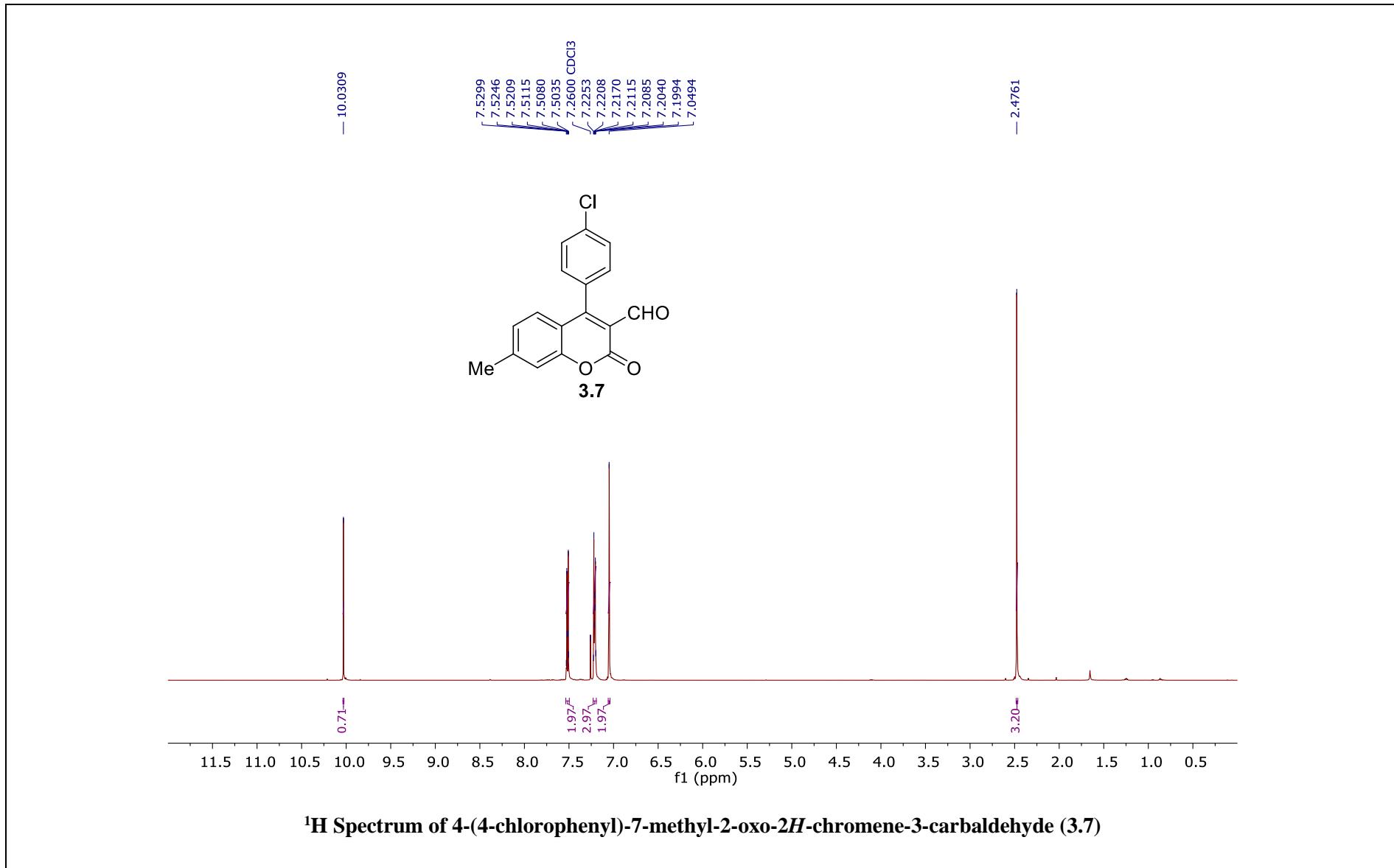


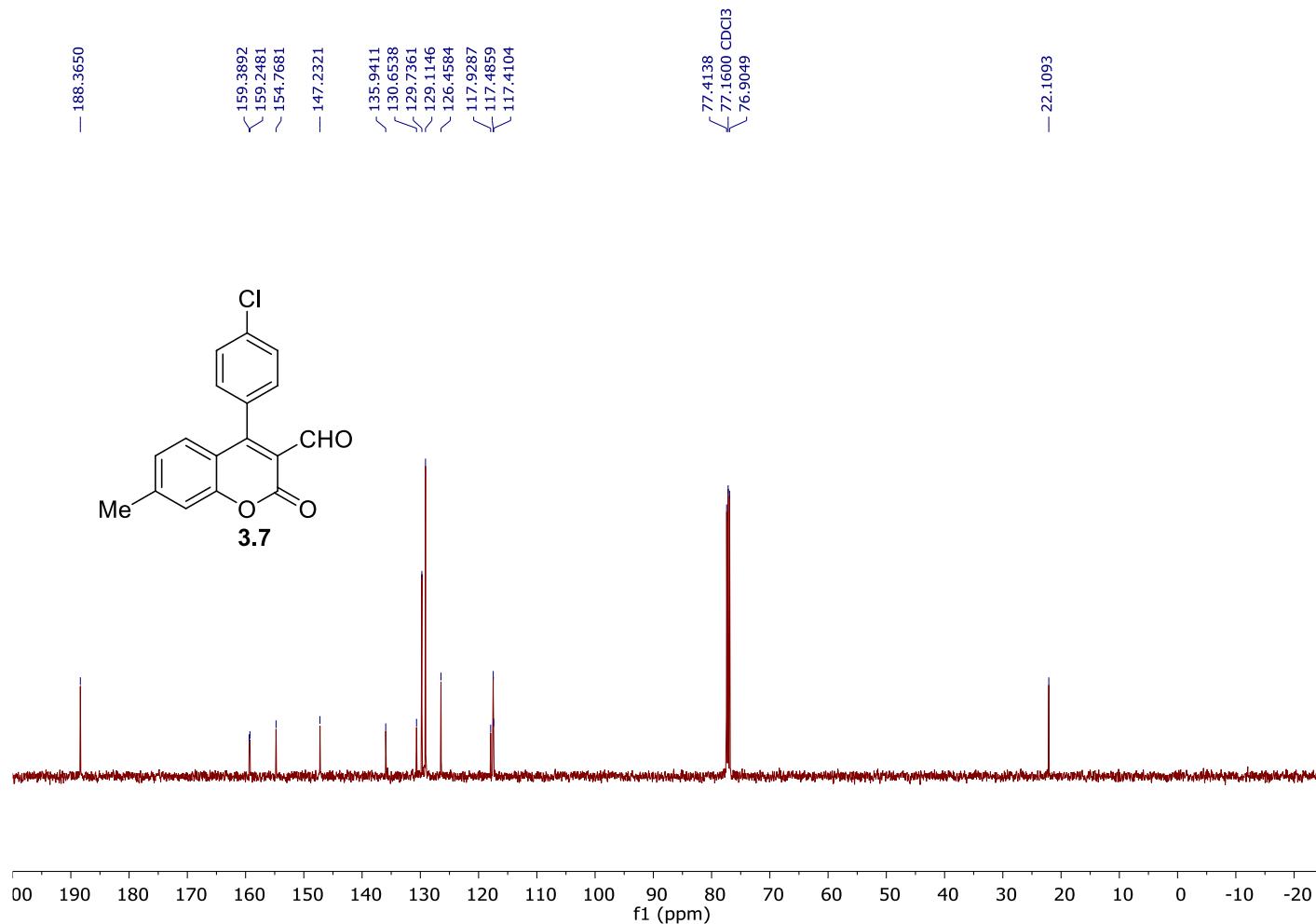
^{13}C Spectrum of 7-methyl-2-oxo-4-*p*-tolyl-2*H*-chromene-3-carbaldehyde (3.5)



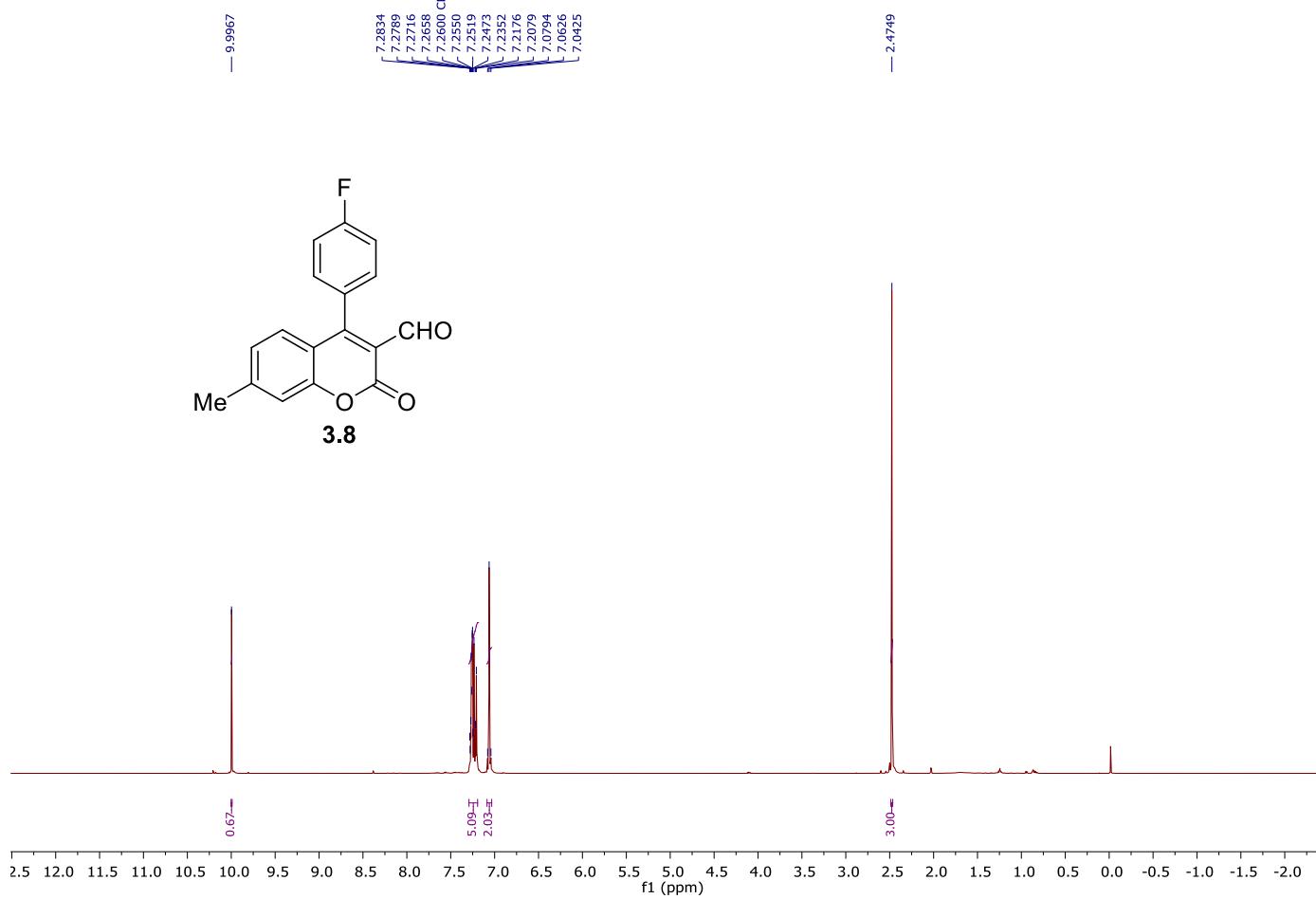
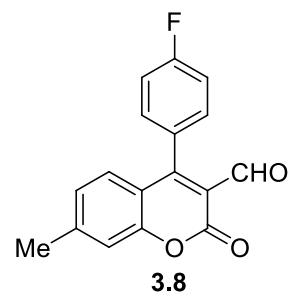
¹H Spectrum of 4-(4-methoxyphenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.6)



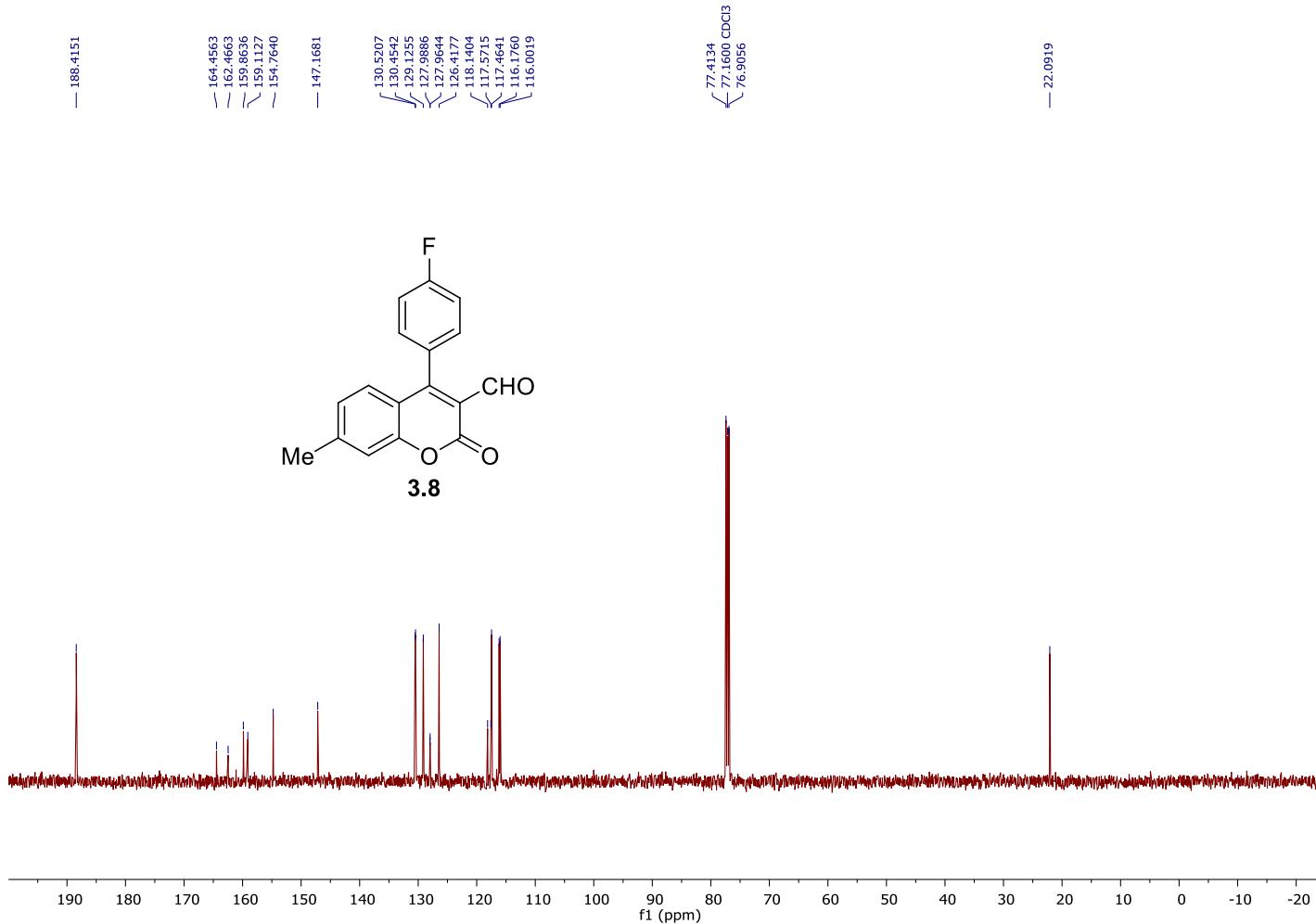




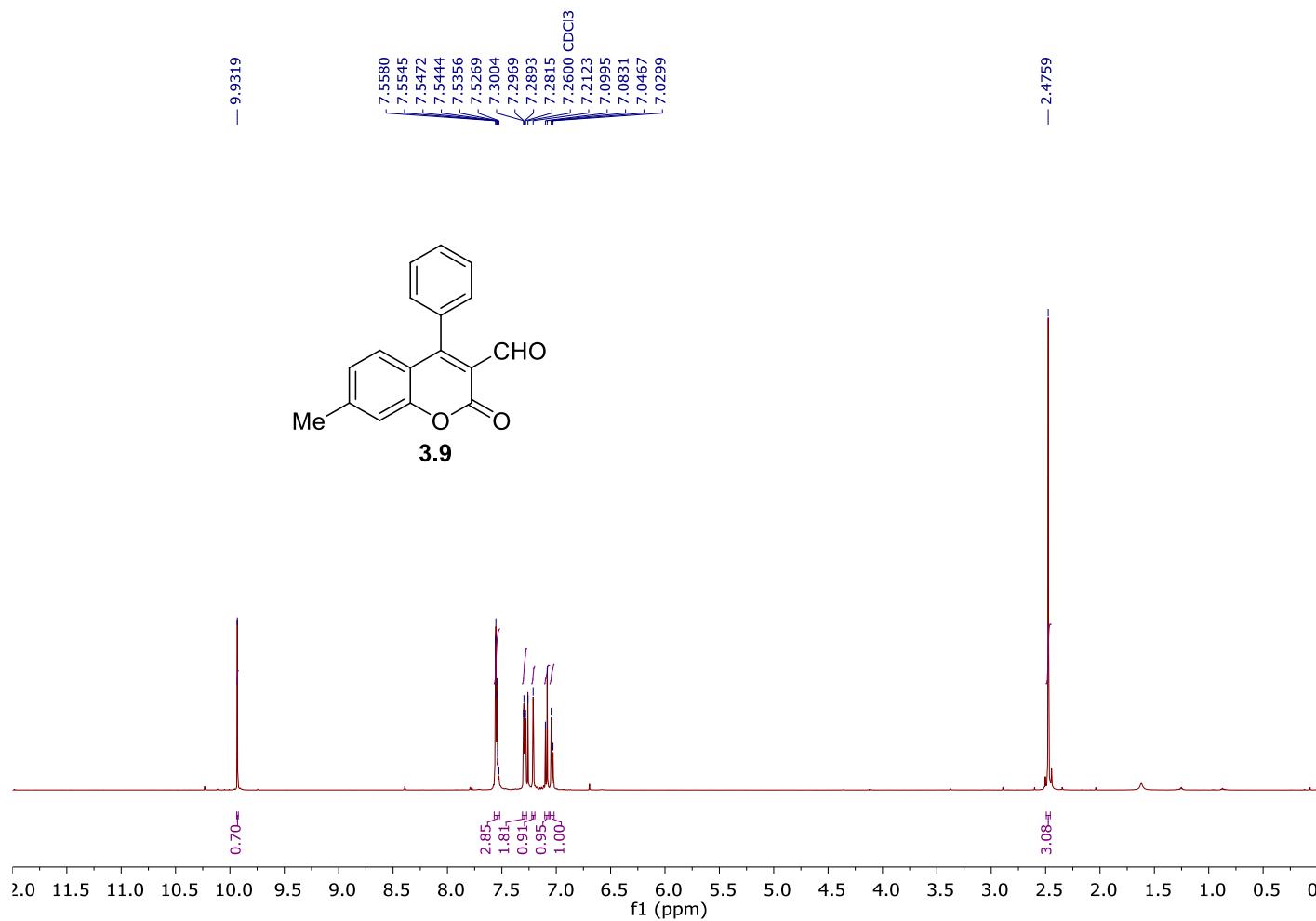
^{13}C Spectrum of 4-(4-chlorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.7)



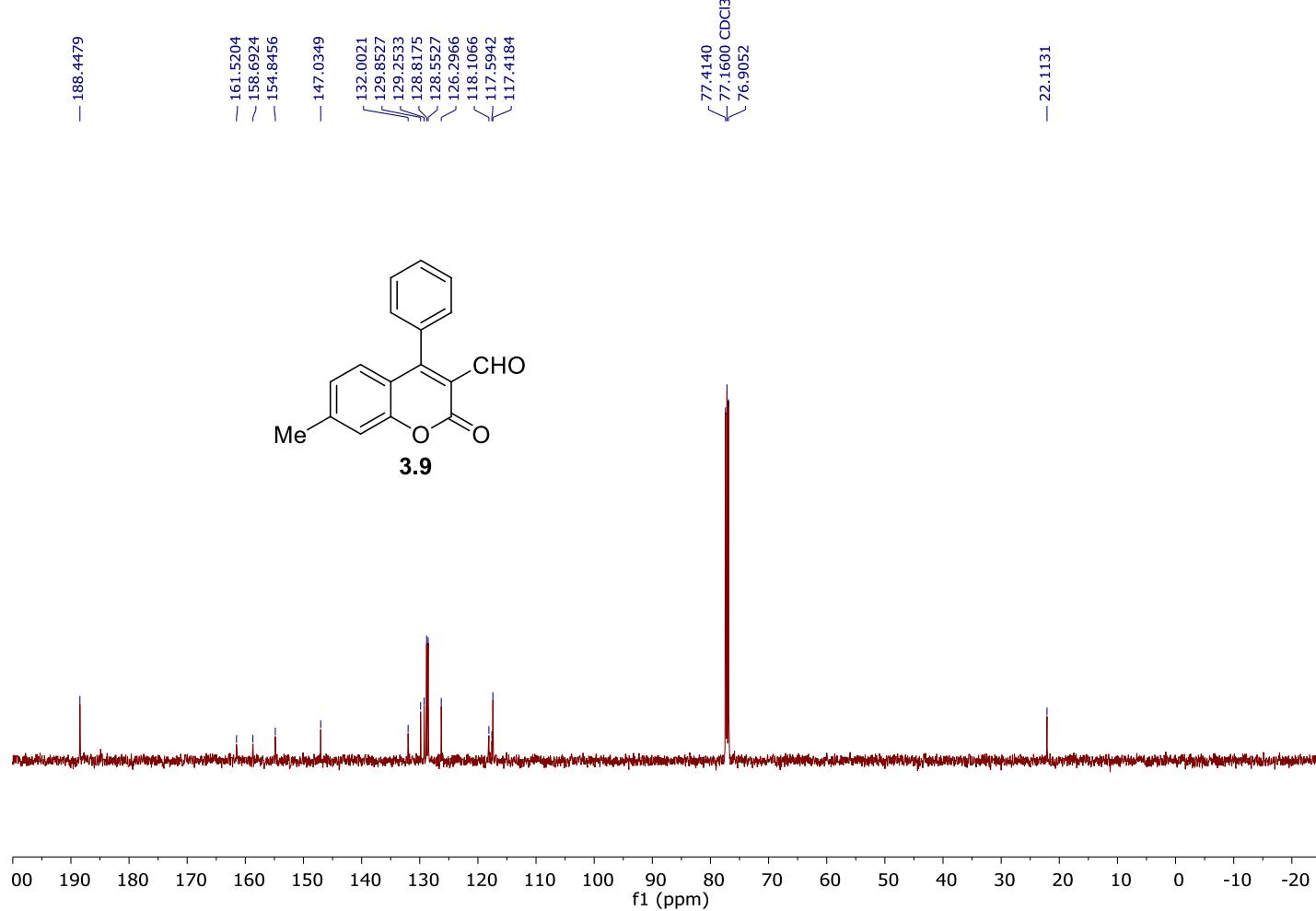
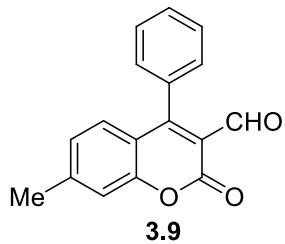
¹H Spectrum of 4-(4-fluorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.8)



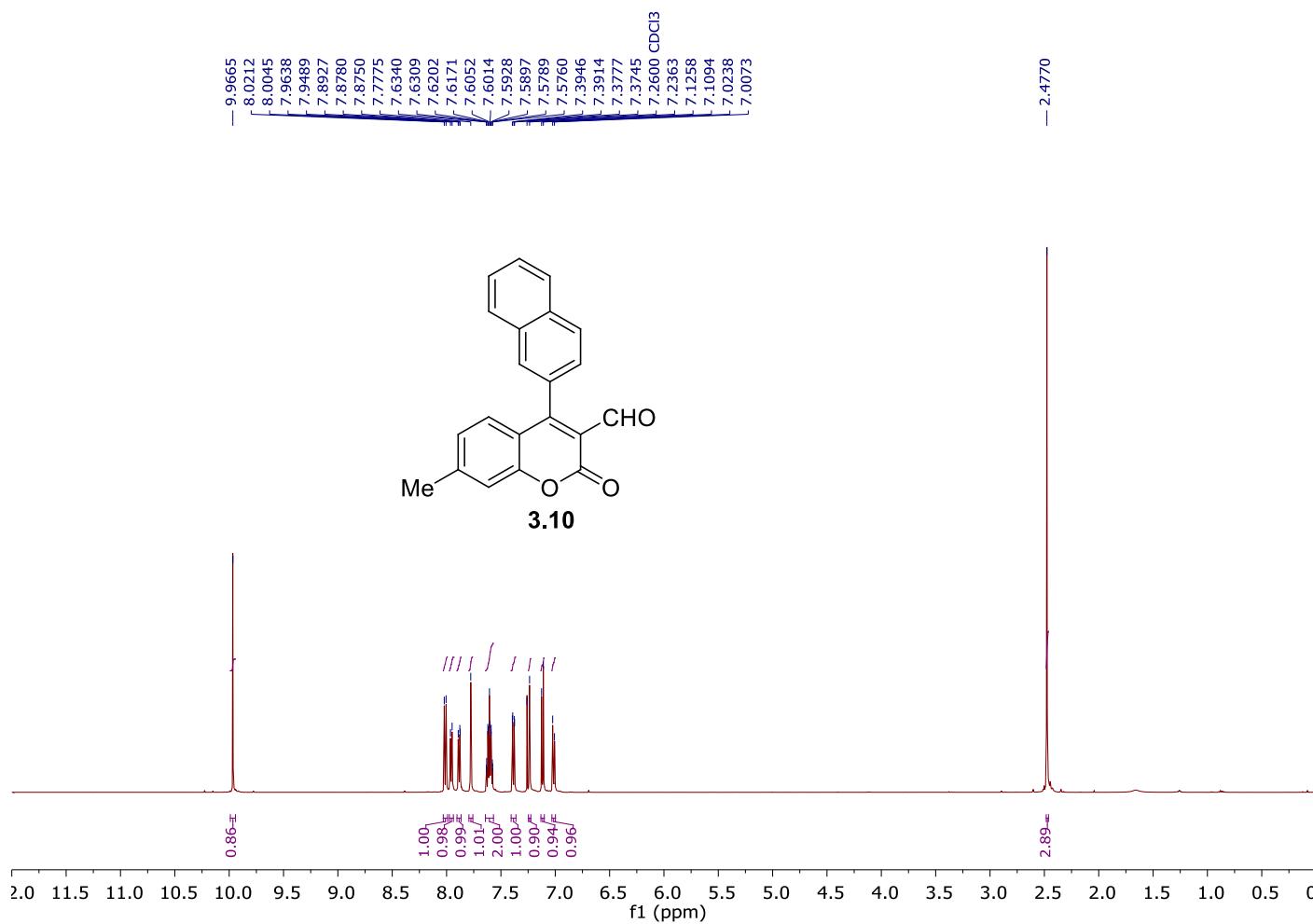
^{13}C Spectrum of 4-(4-fluorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.8)



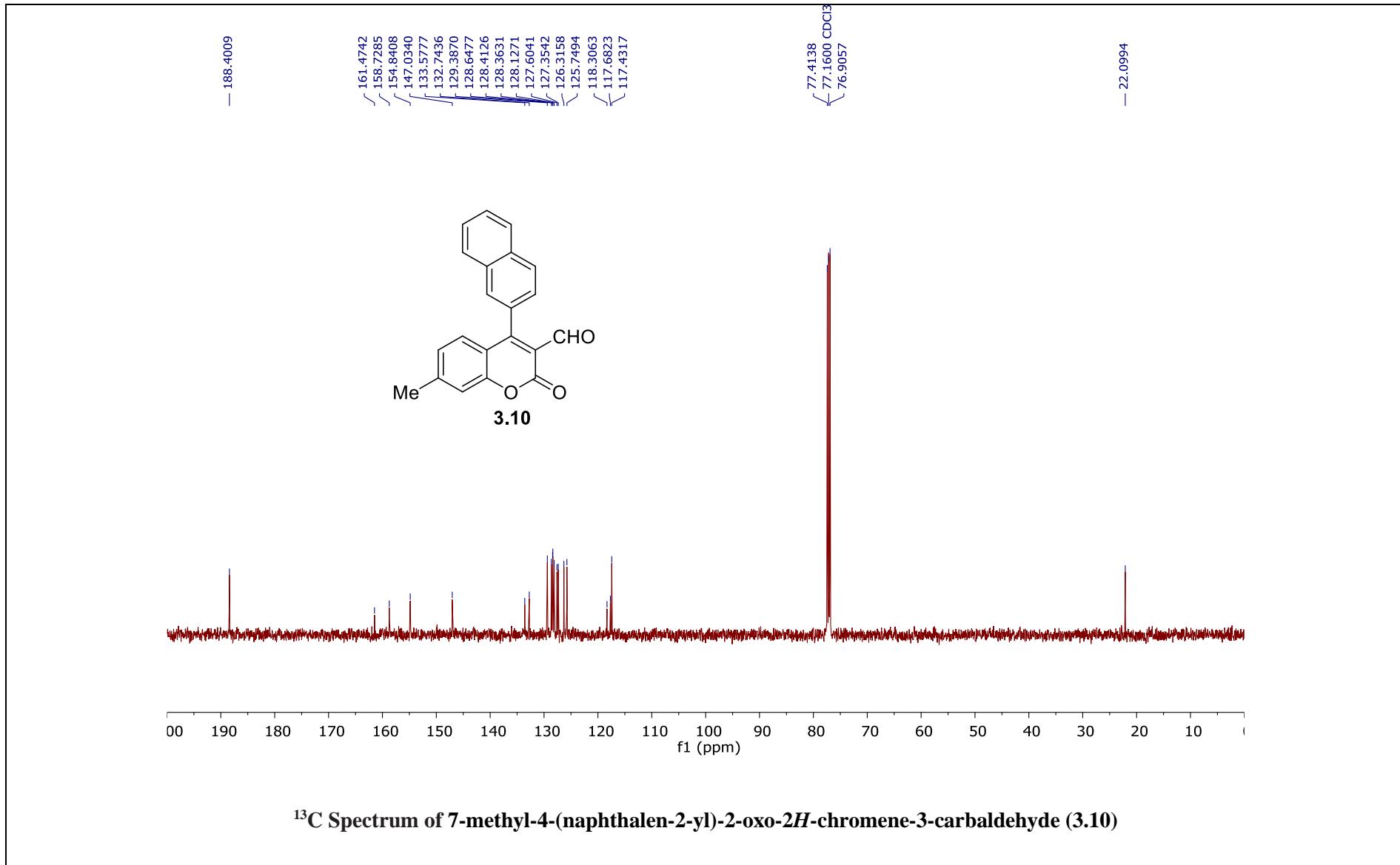
¹H Spectrum of 7-methyl-2-oxo-4-phenyl-2H-chromene-3-carbaldehyde (3.9)



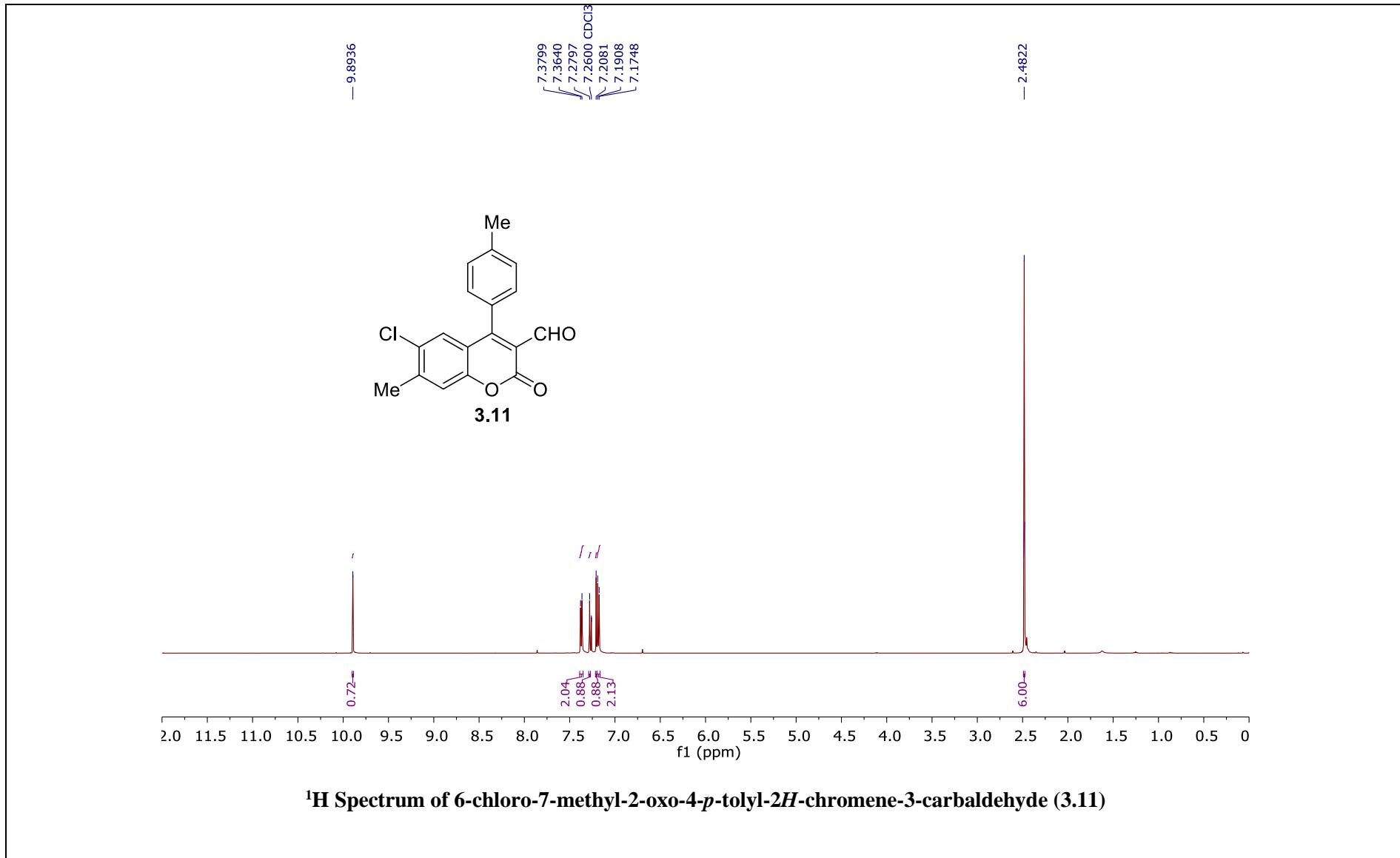
¹³C Spectrum of 7-methyl-2-oxo-4-phenyl-2H-chromene-3-carbaldehyde (3.9)



¹H Spectrum of 7-methyl-4-(naphthalen-2-yl)-2-oxo-2*H*-chromene-3-carbaldehyde (**3.10**)

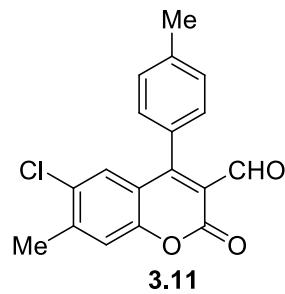


^{13}C Spectrum of 7-methyl-4-(naphthalen-2-yl)-2-oxo-2*H*-chromene-3-carbaldehyde (**3.10**)



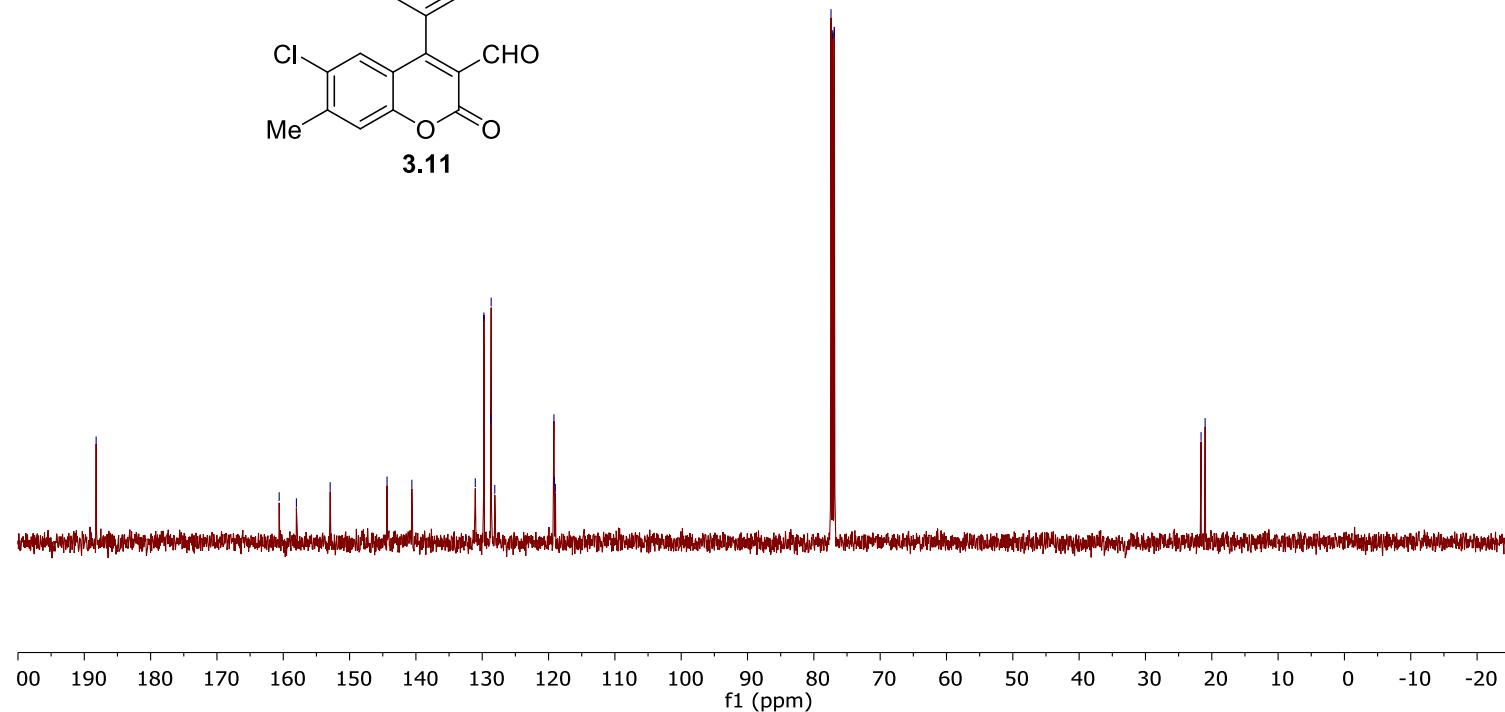
— 188.2137

~ 160.6141
~ 158.0174
~ 152.9291
144.3532
140.6100
131.0455
129.7509
128.7167
128.6517
128.1116
119.1887
119.1167
118.9731

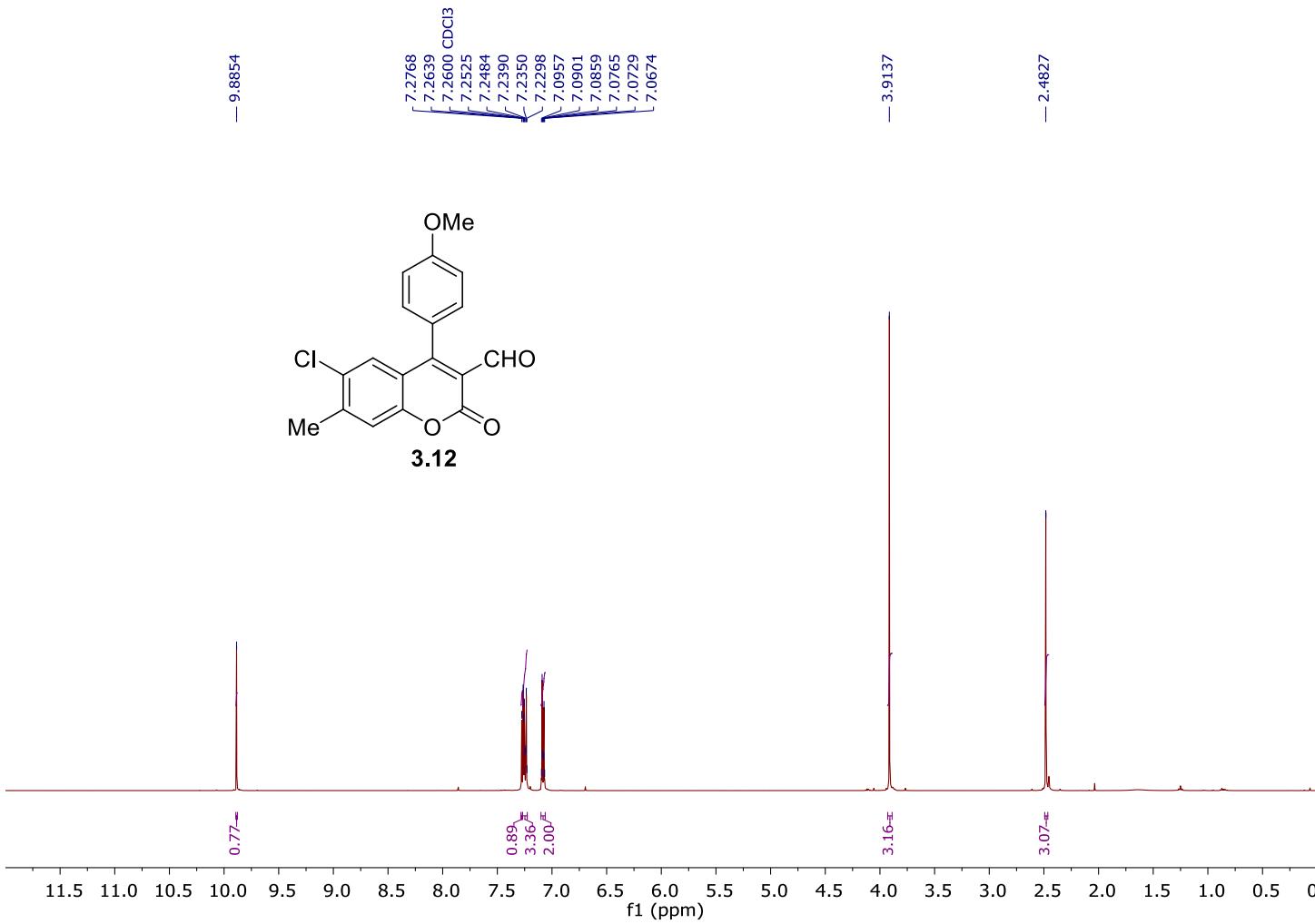


77.4142
77.1600 CDCl₃
76.9064

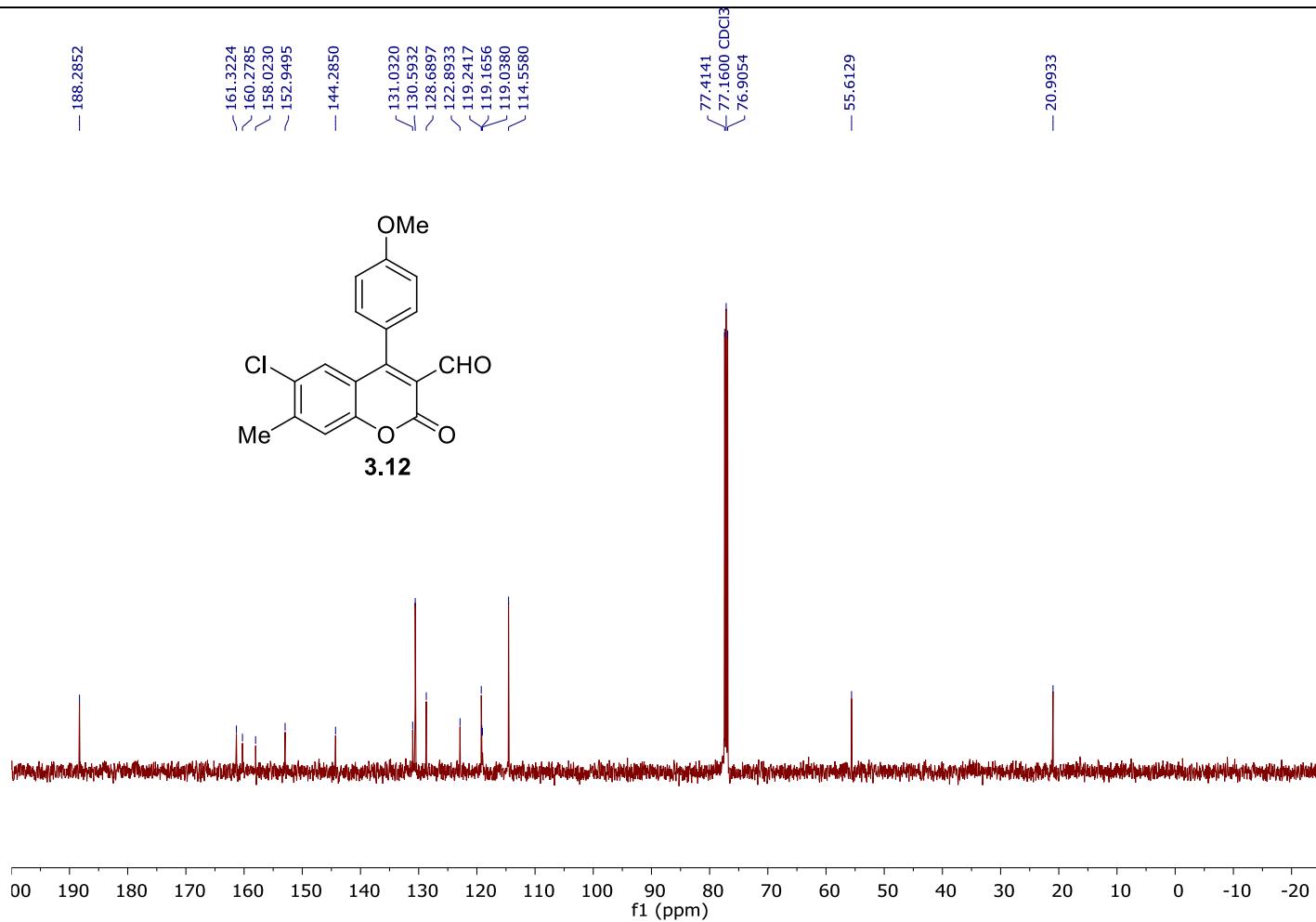
21.6164
21.0057



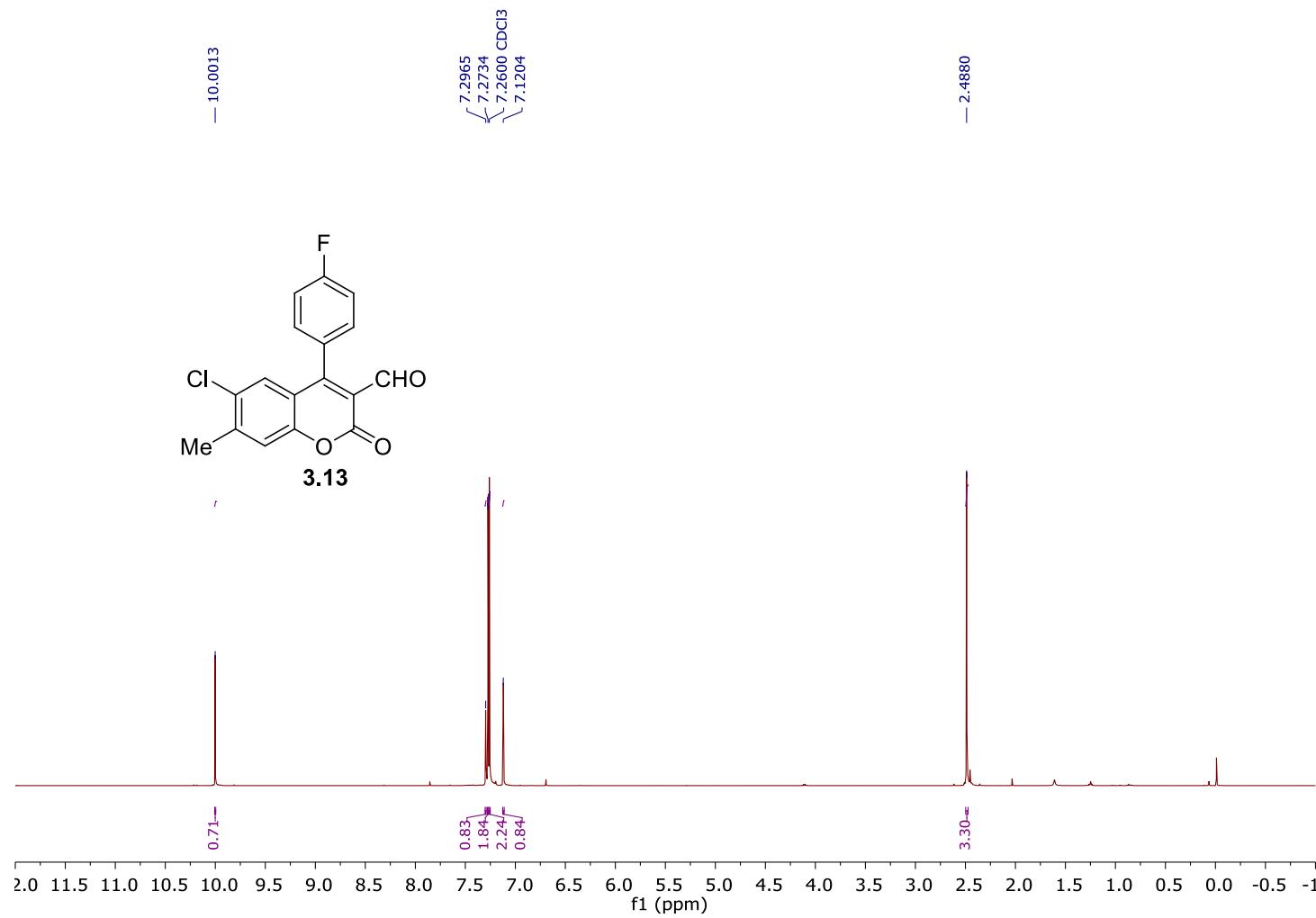
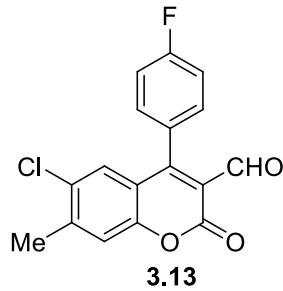
¹³C Spectrum of 6-chloro-7-methyl-2-oxo-4-p-tolyl-2H-chromene-3-carbaldehyde (3.11)

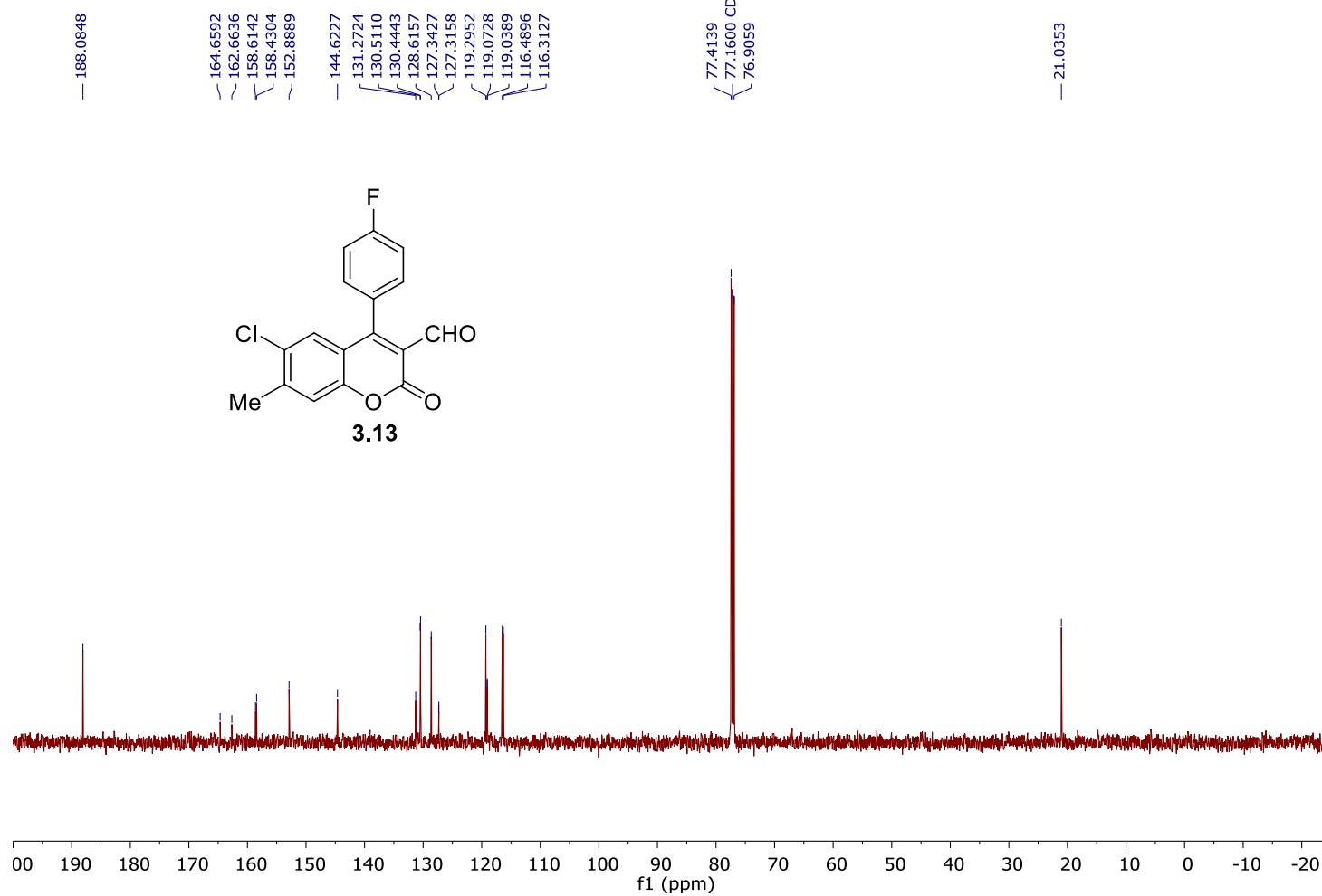


^1H Spectrum of 6-chloro-4-(4-methoxyphenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (**3.12**)

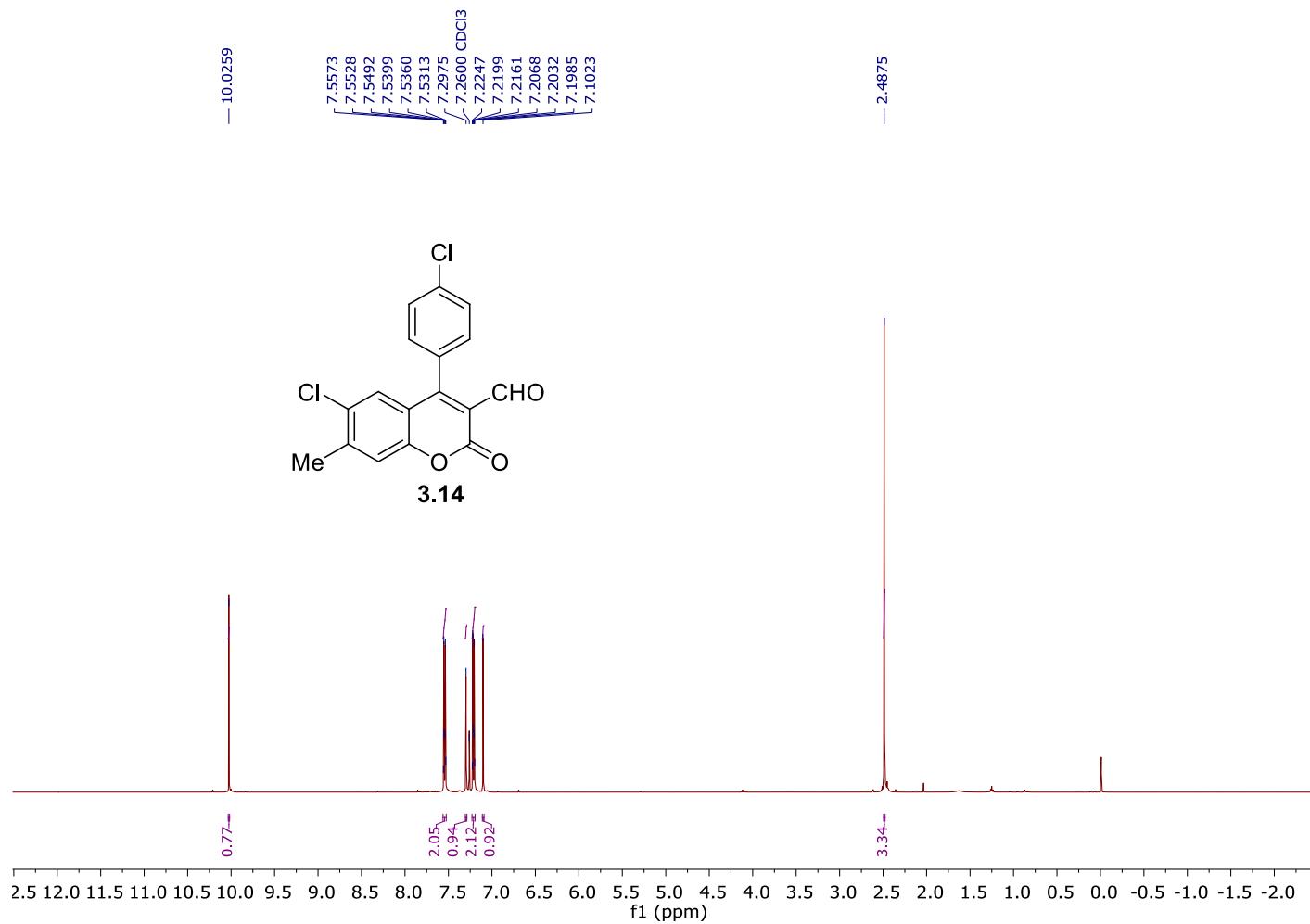
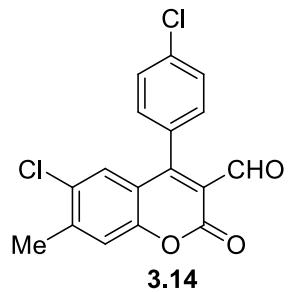


^{13}C Spectrum of 6-chloro-4-(4-methoxyphenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.12)





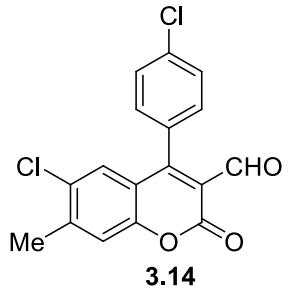
^{13}C Spectrum of 6-chloro-4-(4-fluorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.13)



¹H Spectrum of 6-chloro-4-(4-chlorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (**3.14**)

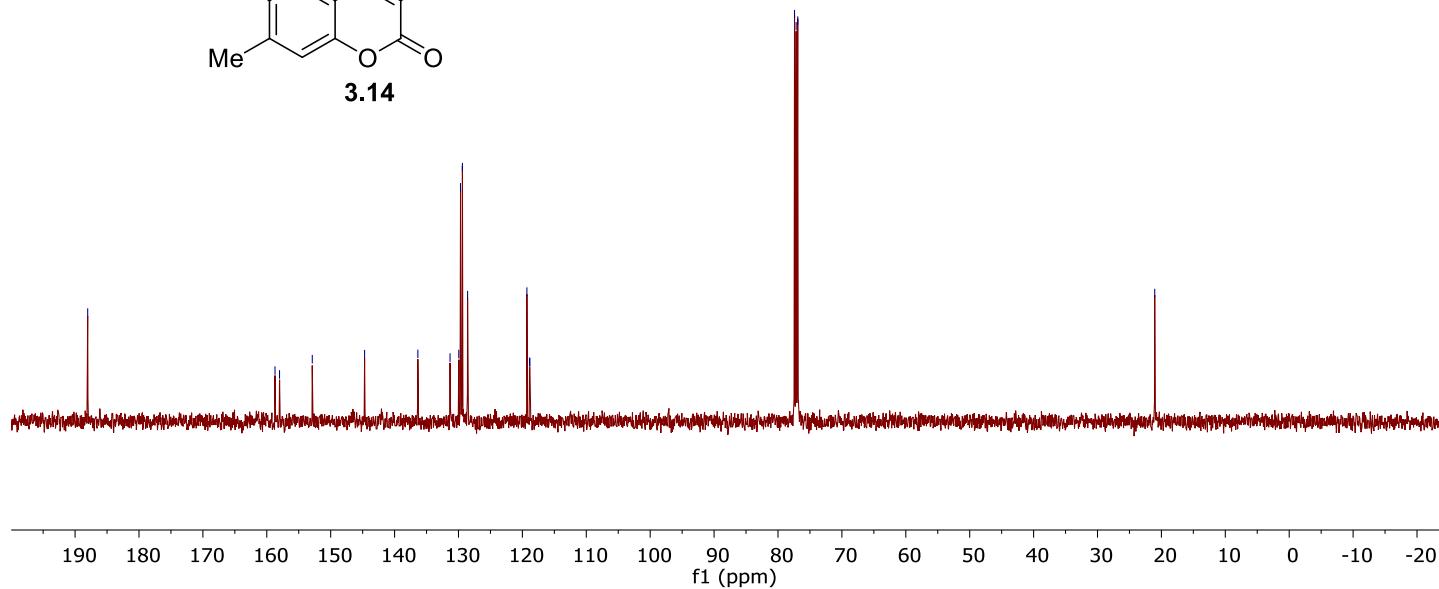
— 188.0269

158.7135
158.0035
152.8827
144.6923
136.3576
131.3215
129.9578
129.6855
129.3847
128.5761
119.2960
118.8856
118.8259

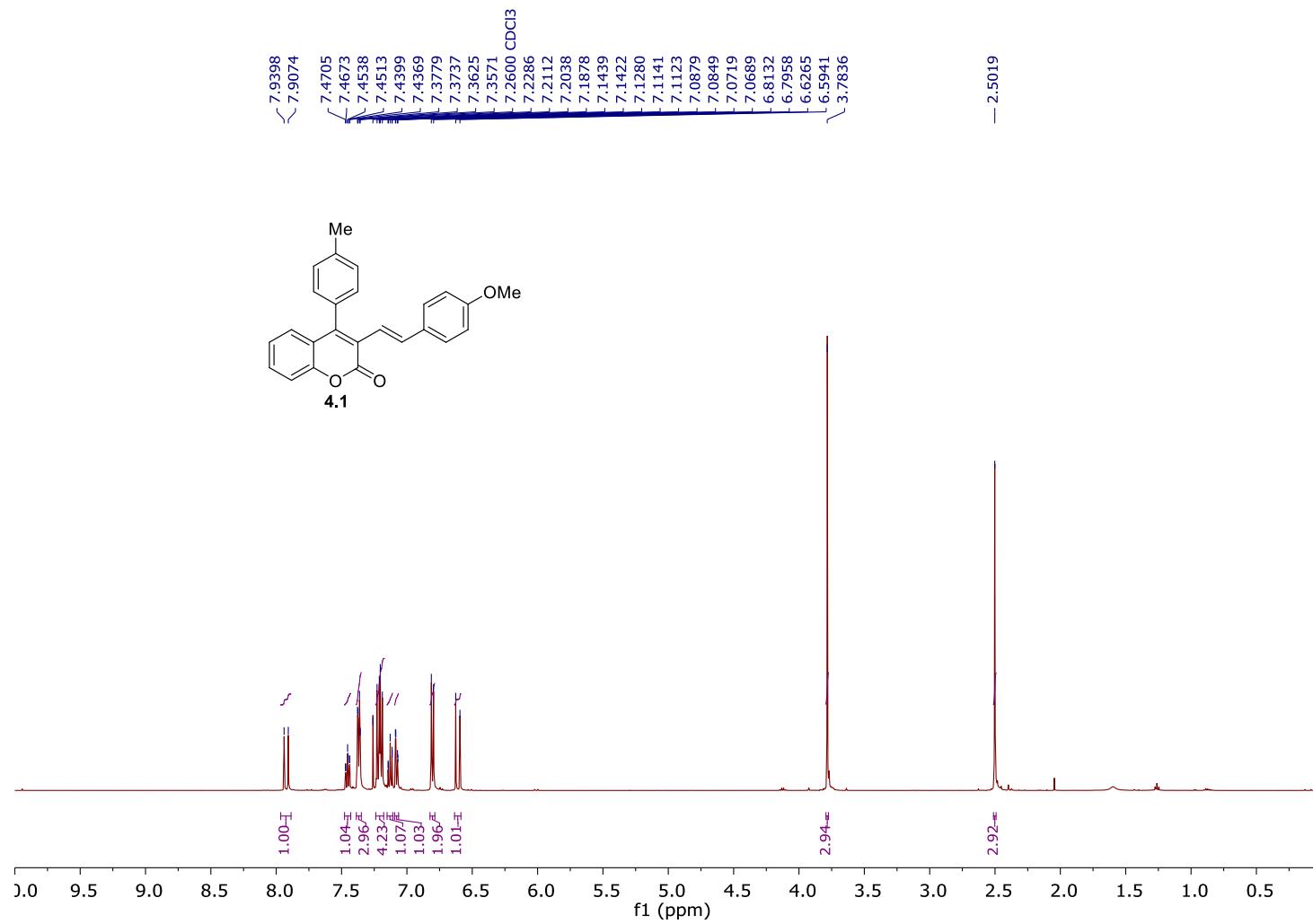


— 21.0422

77.4143
77.1600 CDCl₃
76.9067



¹³C Spectrum of 6-chloro-4-(4-chlorophenyl)-7-methyl-2-oxo-2H-chromene-3-carbaldehyde (**3.14**)



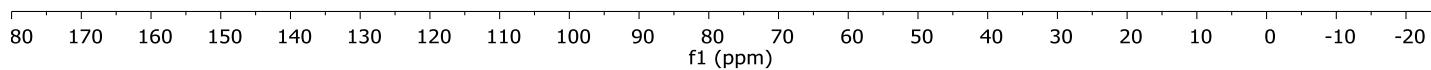
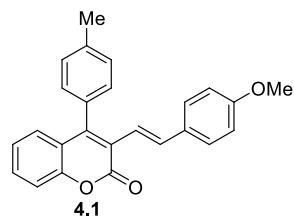
¹H Spectrum of (*E*)-3-(4-methoxystyryl)-4-*p*-tolyl-2*H*-chromen-2-one (4.1)

160.1955
159.7714
— 152.1980
— 149.7668
— 138.8105
— 135.1900
131.8323
130.8219
130.7076
129.6684
129.1776
128.3033
127.5286
124.1249
121.7766
121.2697
119.9880
116.4645
114.1418

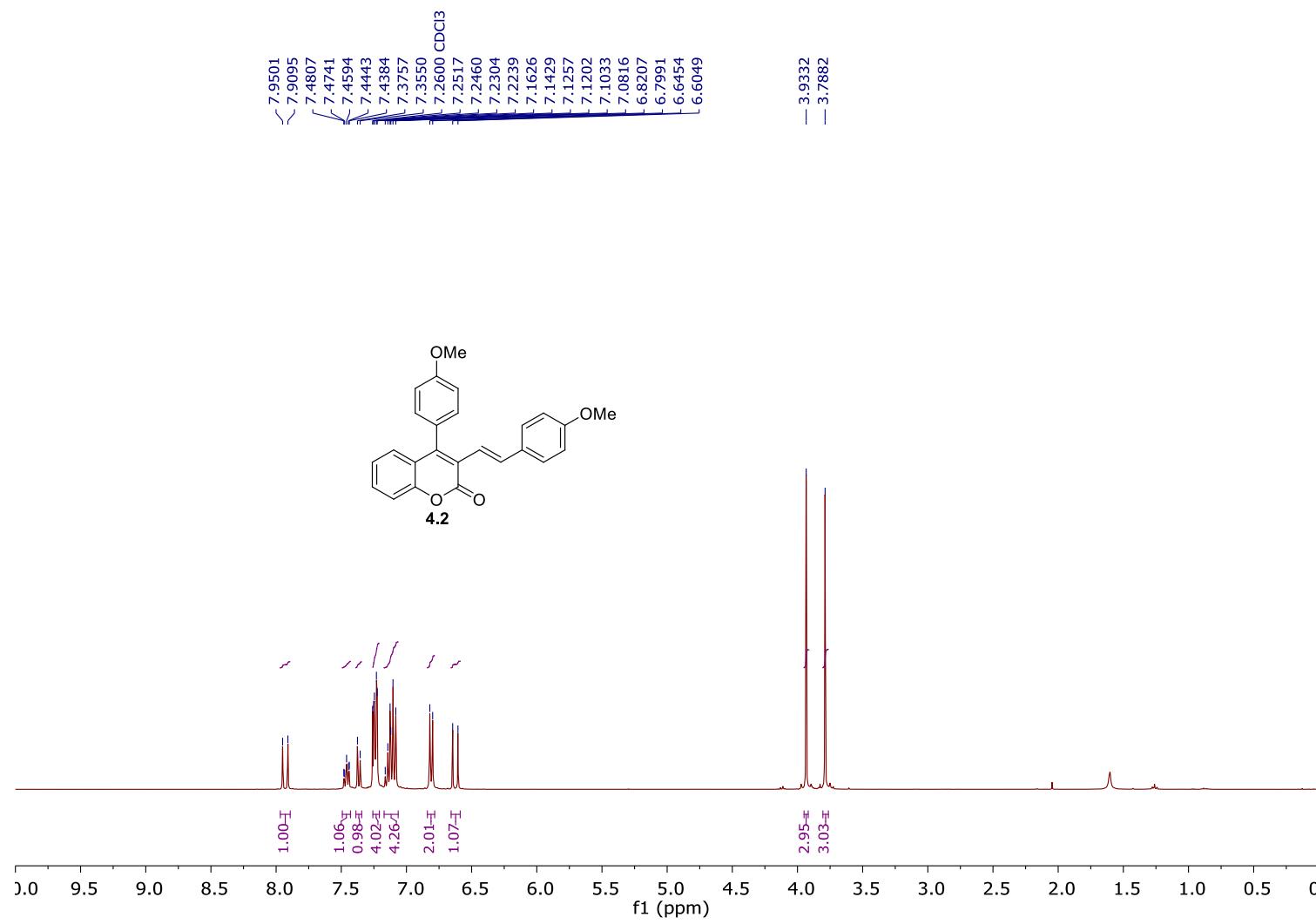
77.4148
77.1600 CDCl₃
76.9057

— 55.4014

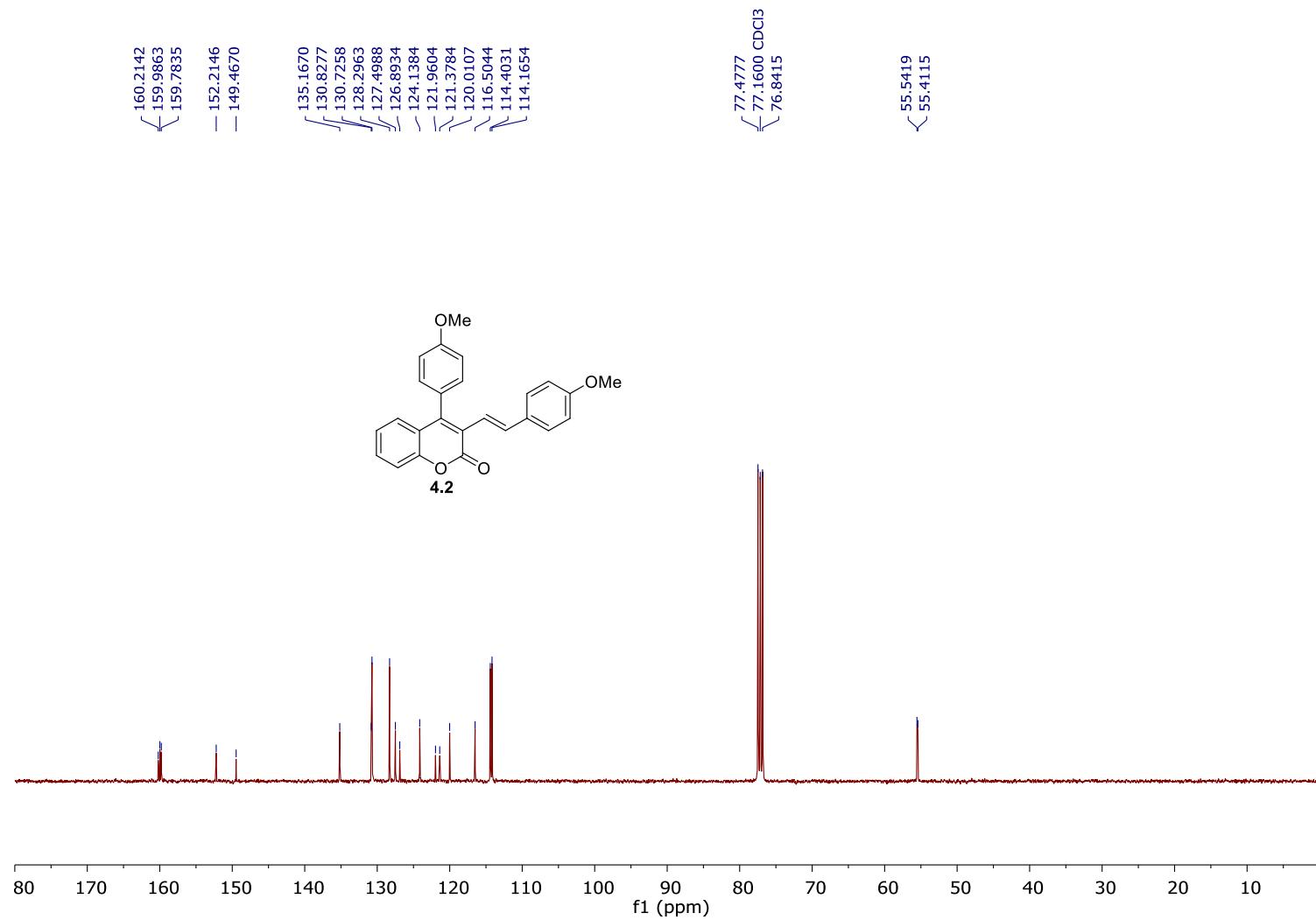
— 21.5923

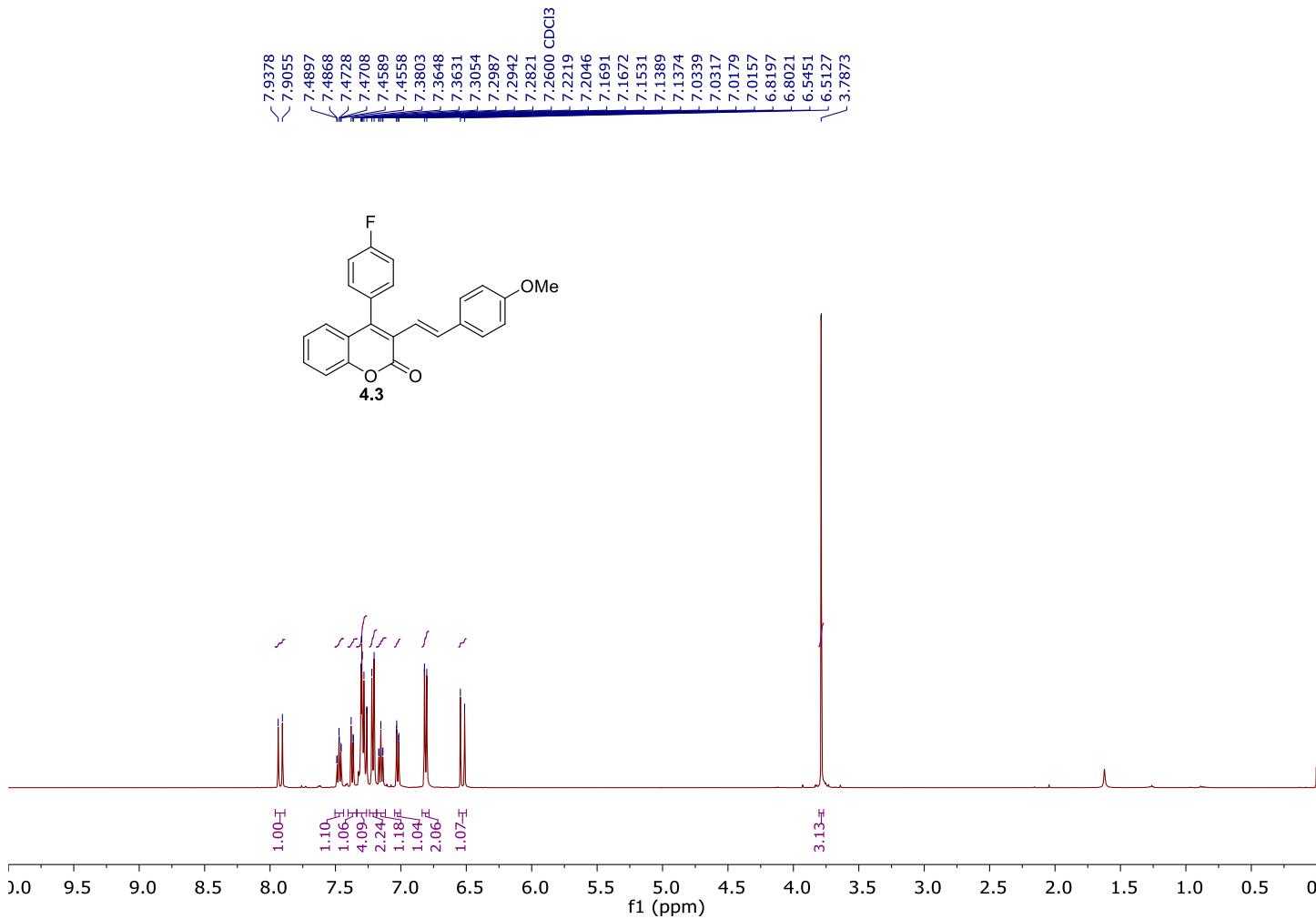


¹³C Spectrum of (*E*)-3-(4-methoxystyryl)-4-*p*-tolyl-2*H*-chromen-2-one (4.1)



¹H Spectrum of (E)-4-(4-methoxyphenyl)-3-(4-methoxystyryl)-2H-chromen-2-one (4.2)





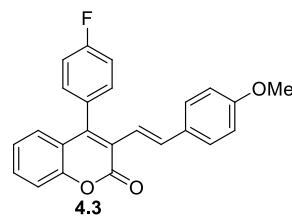
¹H Spectrum of (E)-4-(4-fluorophenyl)-3-(4-methoxystyryl)-2H-chromen-2-one (4.3)

— 163.9471
— 161.9700
~ 159.9467

— 152.1533

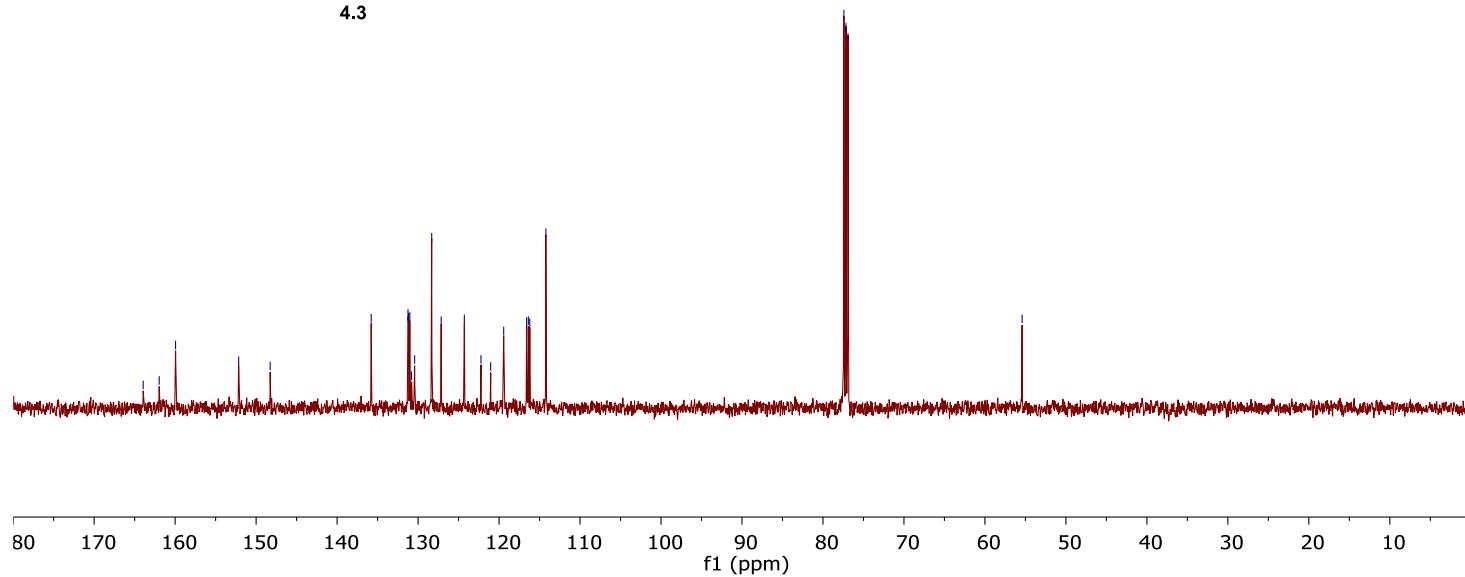
— 148.2631

135.7886
131.2459
131.1811
131.0175
130.8102
130.4228
128.3165
~ 127.1441
~ 124.2876
~ 122.2355
~ 121.0368
119.4267
116.5948
116.3825
116.2103
114.2188

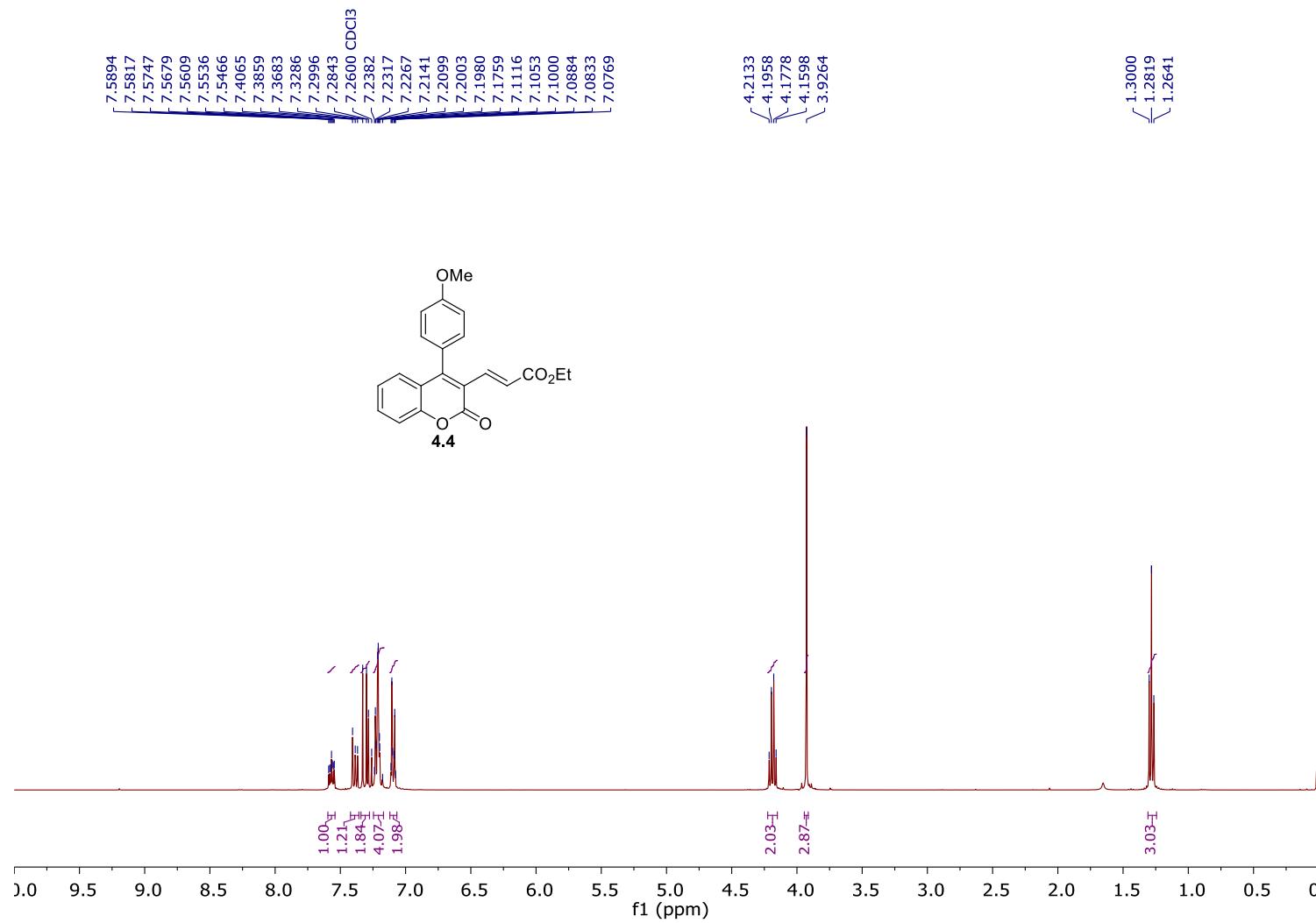


77.4149
77.1600 CDCl₃
76.9072

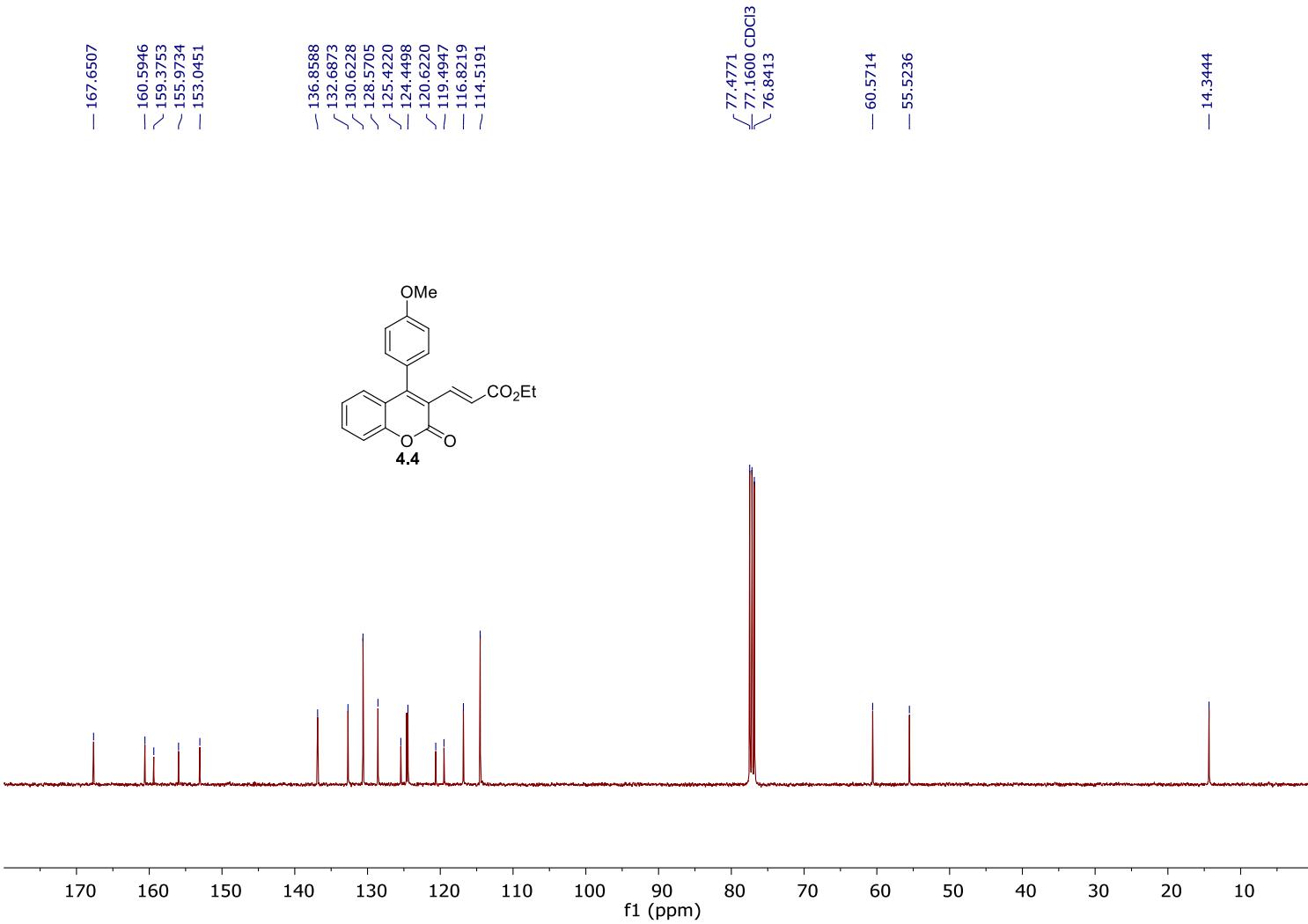
— 55.4068



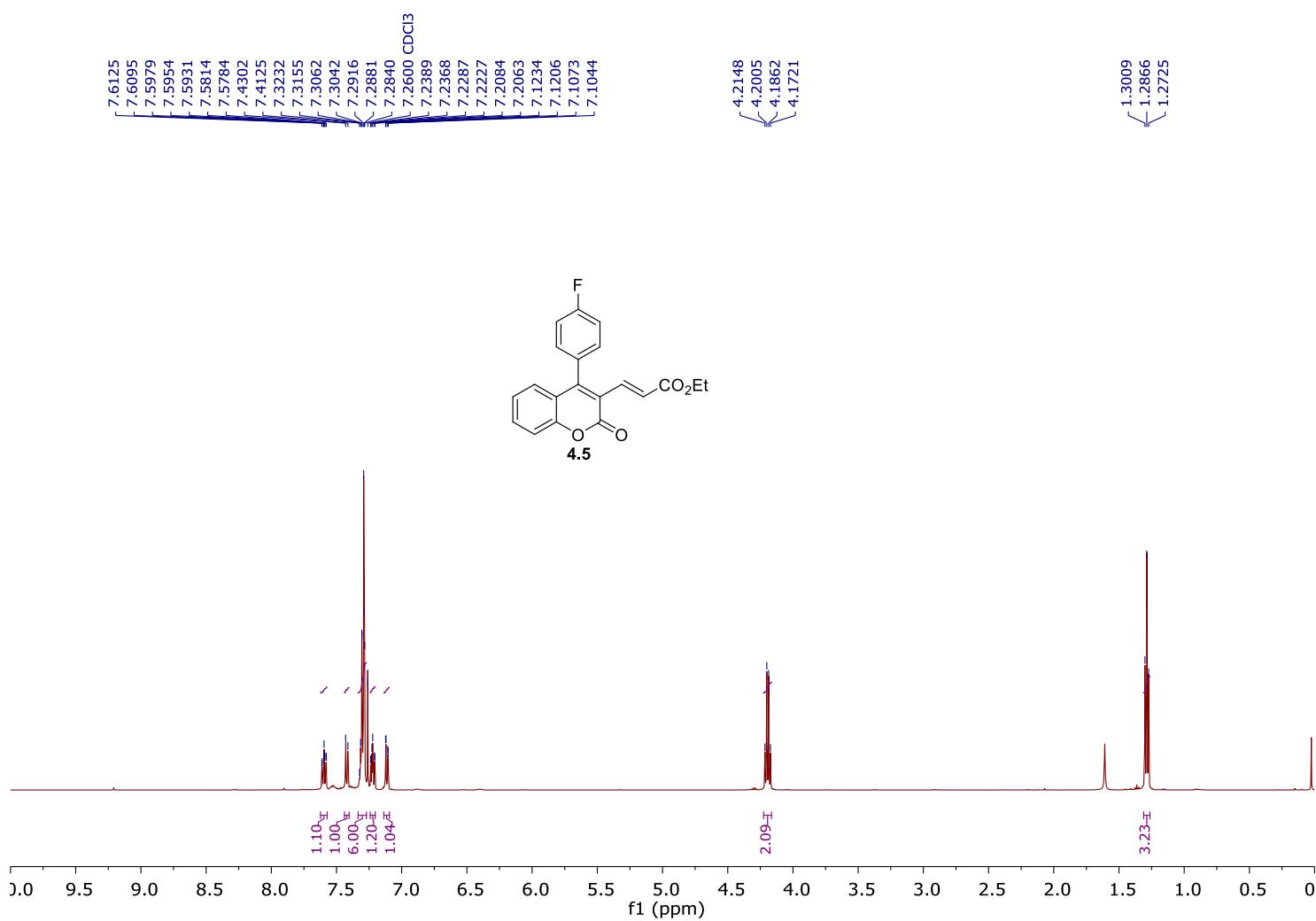
¹³C Spectrum of (E)-4-(4-fluorophenyl)-3-(4-methoxystyryl)-2H-chromen-2-one (4.3)



¹H Spectrum of (*E*)-ethyl 3-(4-(4-methoxyphenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (4.4)



^{13}C Spectrum of (*E*)-ethyl 3-(4-(4-methoxyphenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (4.4)



¹H Spectrum of (*E*)-ethyl 3-(4-(4-fluorophenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (**4.5**)

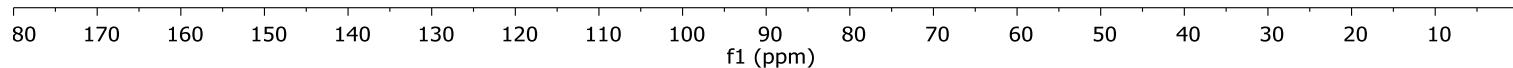
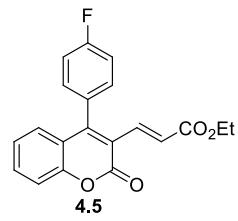
— 167.4375
— 164.6297
— 162.1425
— 159.0956
— 154.7990
— 153.0244

136.1597
132.9530
131.0802
130.9987
129.4092
129.3766
128.2331
125.3113
124.6450
120.3367
119.8753
116.9550
116.5907
116.3729

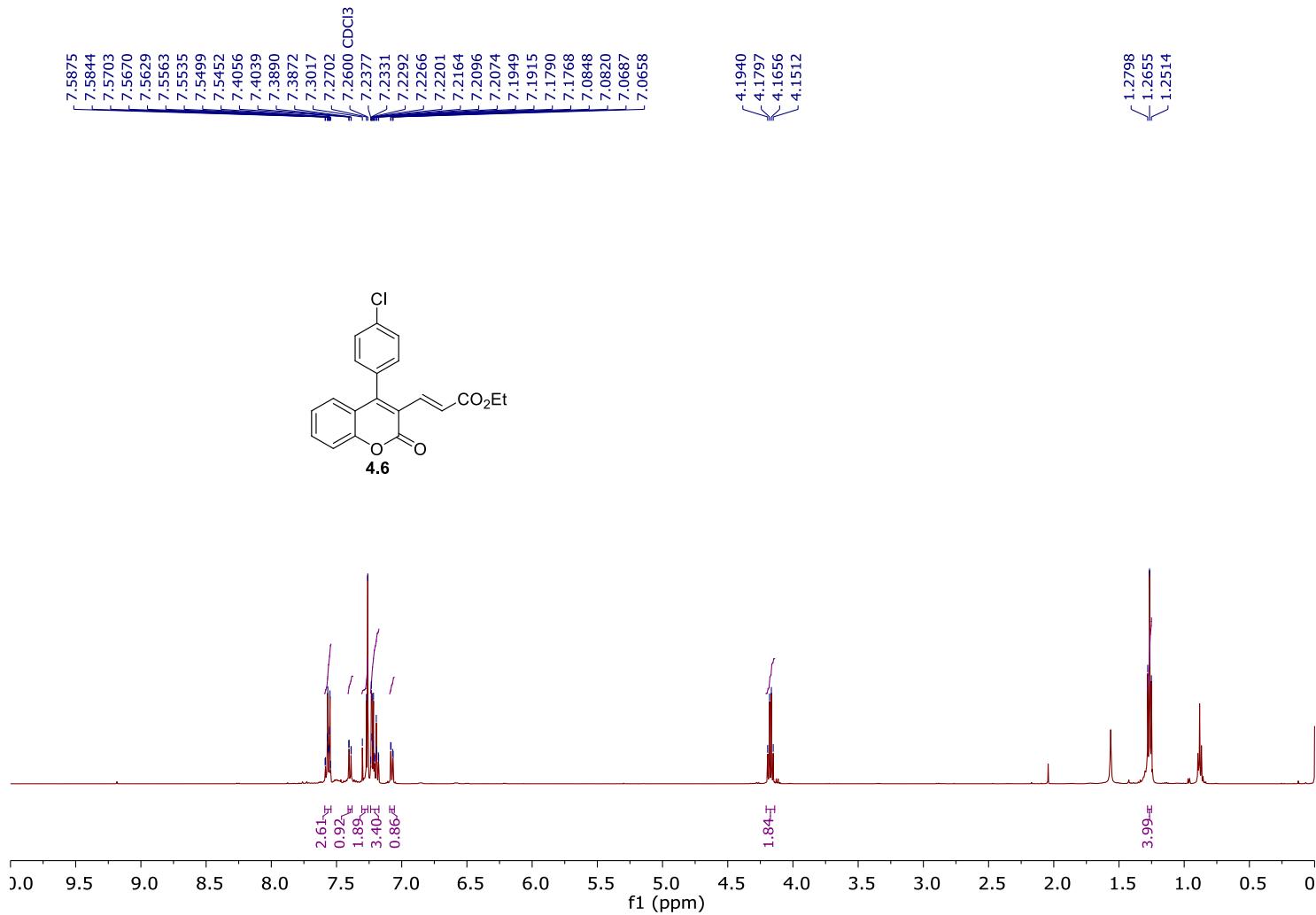
77.4776
77.1600 CDCl₃
76.8428

— 60.7023

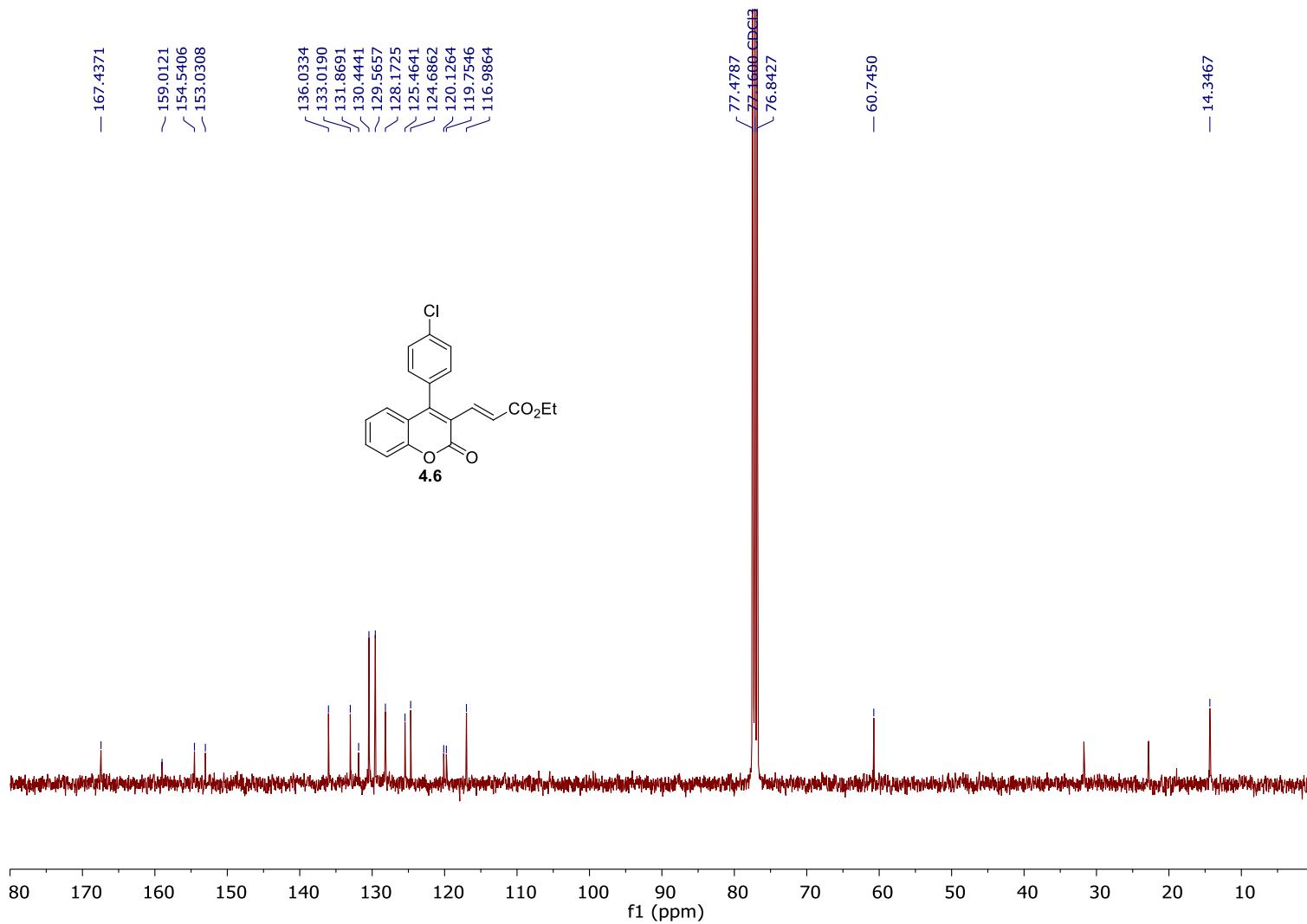
— 14.3350



¹³C Spectrum of (*E*)-ethyl 3-(4-(4-fluorophenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (**4.5**)



¹H Spectrum of (*E*)-ethyl 3-(4-(4-chlorophenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (4.6)

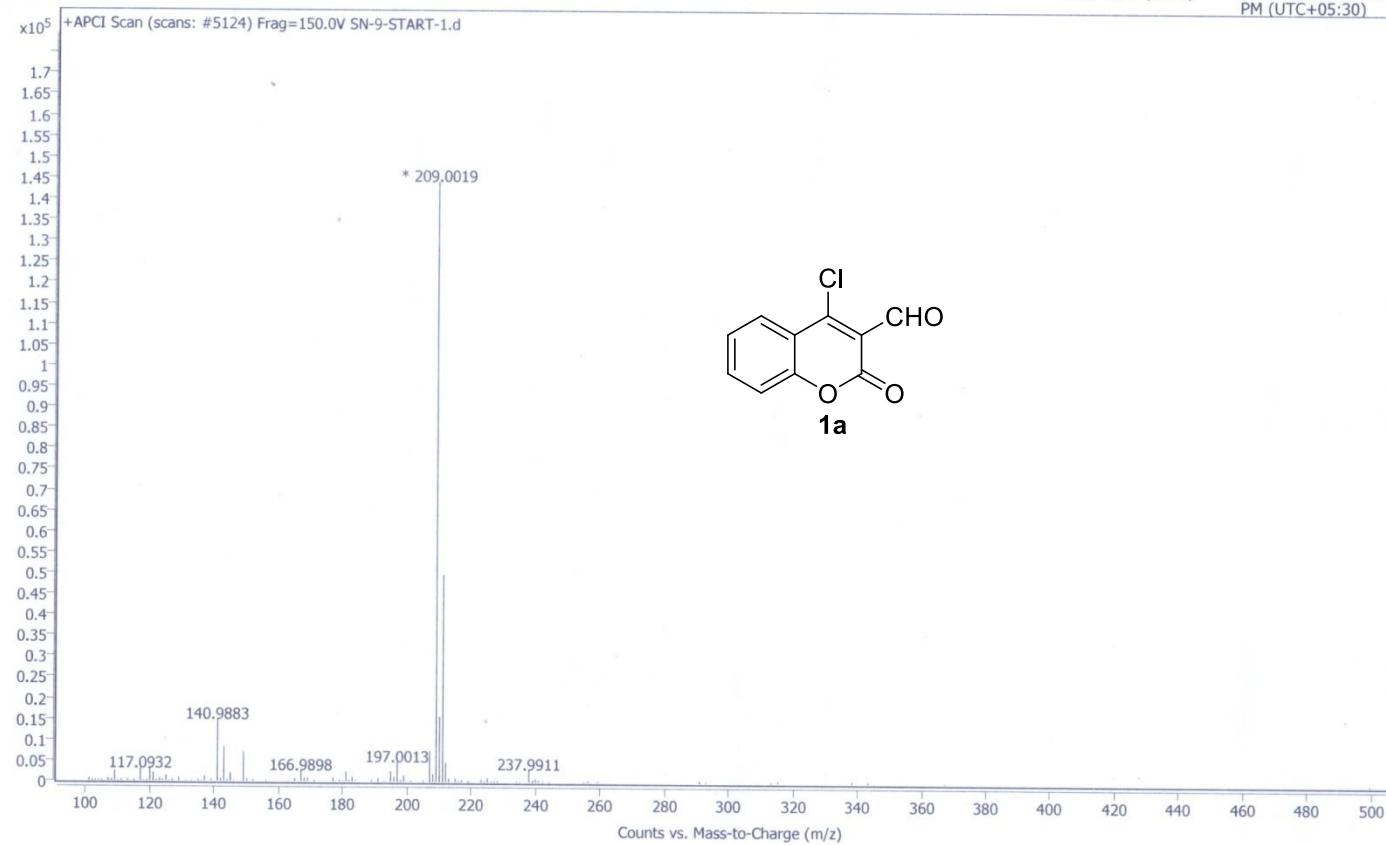


^{13}C Spectrum of (*E*)-ethyl 3-(4-(4-chlorophenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (**4.6**)

User Spectrum Plot Report



Name Inj. Vol. (μl)	Rack Pos.	Instrument	Operator
Data File	Plate Pos.	IRM Status	
	Method (Acq)	Comment	
		Success	
			Acq. Time (Local)
			13-04-2021 12:49:38
			PM (UTC+05:30)

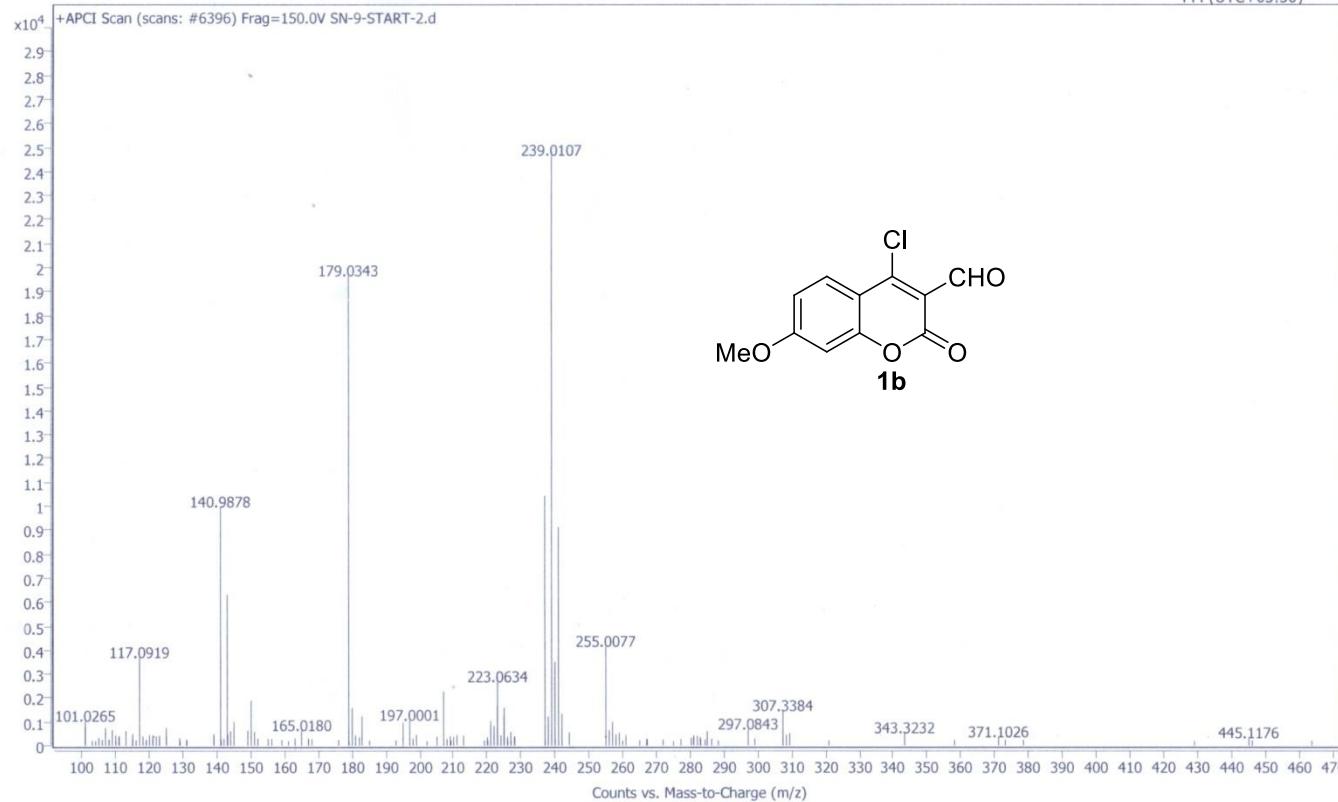


Mass Spectrum of 4-chloro-2-oxo-2H-chromene-3-carbaldehyde (1a)

User Spectrum Plot Report



Name	Rack Pos.	Instrument	Success	Operator
Inj. Vol. (μl)	Plate Pos.	IRM Status		
Data File	Method (Acq)	Comment		
SN-9-START-2.d				Acq. Time (Local) 13-04-2021 12:06:27 PM (UTC+05:30)

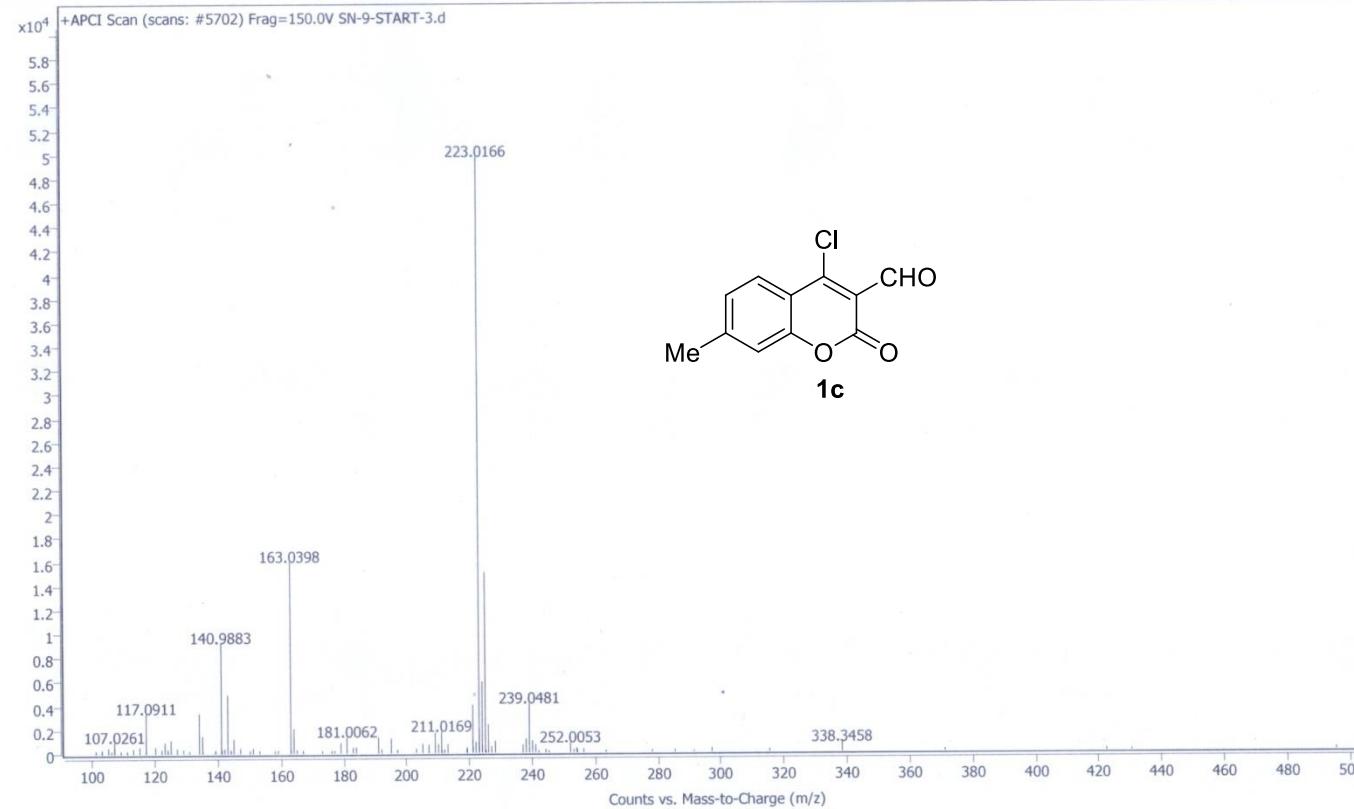


Mass Spectrum of 4-chloro-7-methoxy-2-oxo-2*H*-chromene-3-carbaldehyde (**1b**)

User Spectrum Plot Report



Name Inj. Vol. (uL) Data File	Rack Pos. Plate Pos. Method (Acq)	Instrument IRM Status Comment	Success	Operator Acq. Time (Local)	13-04-2021 12:24:32 PM (UTC+05:30)
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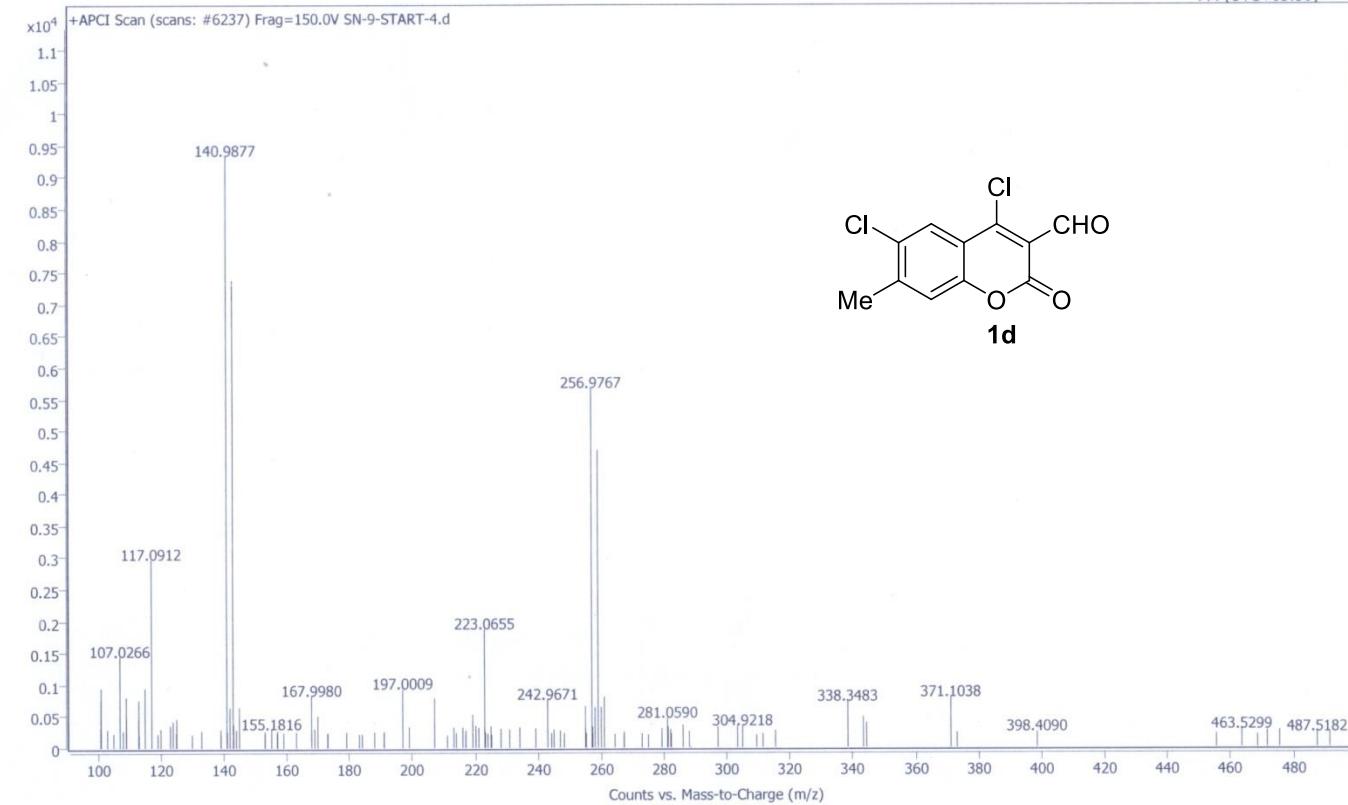


Mass Spectrum of 4-chloro-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (**1c**)

User Spectrum Plot Report

 Agilent | Trusted Answers

Name Inj. Vol. (ul)	SN-9-START-4 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-START-4.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	13-04-2021 01:09:26 PM (UTC+05:30)

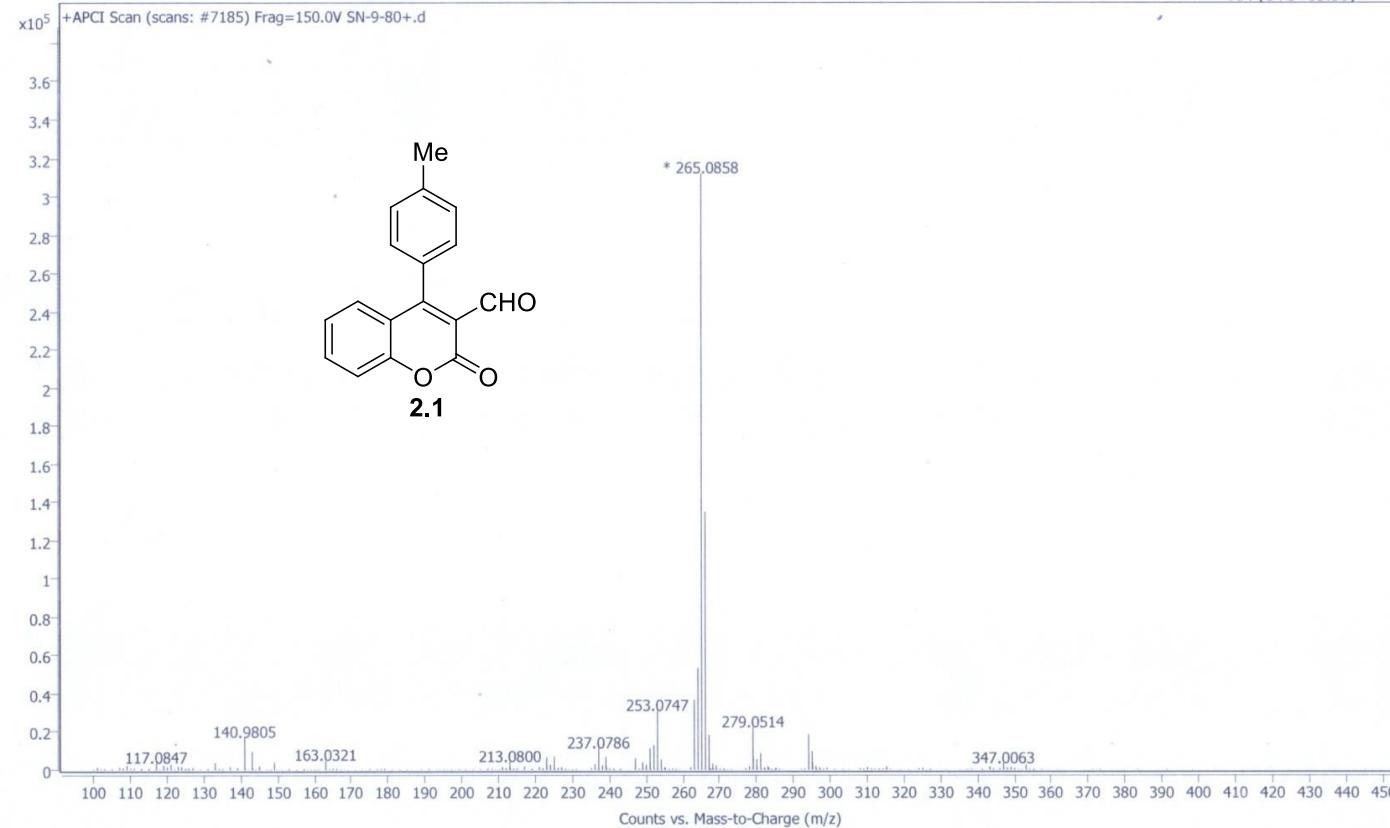


Mass Spectrum of 4,6-dichloro-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (**1d**)

User Spectrum Plot Report



Name Inj. Vol. (ul)	SN-9-80 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File SN-9-80+.d		Method (Acq) GCAPCIITK.m	Comment		Acq. Time (Local)	20-04-2021 11:12:22 AM (UTC+05:30)

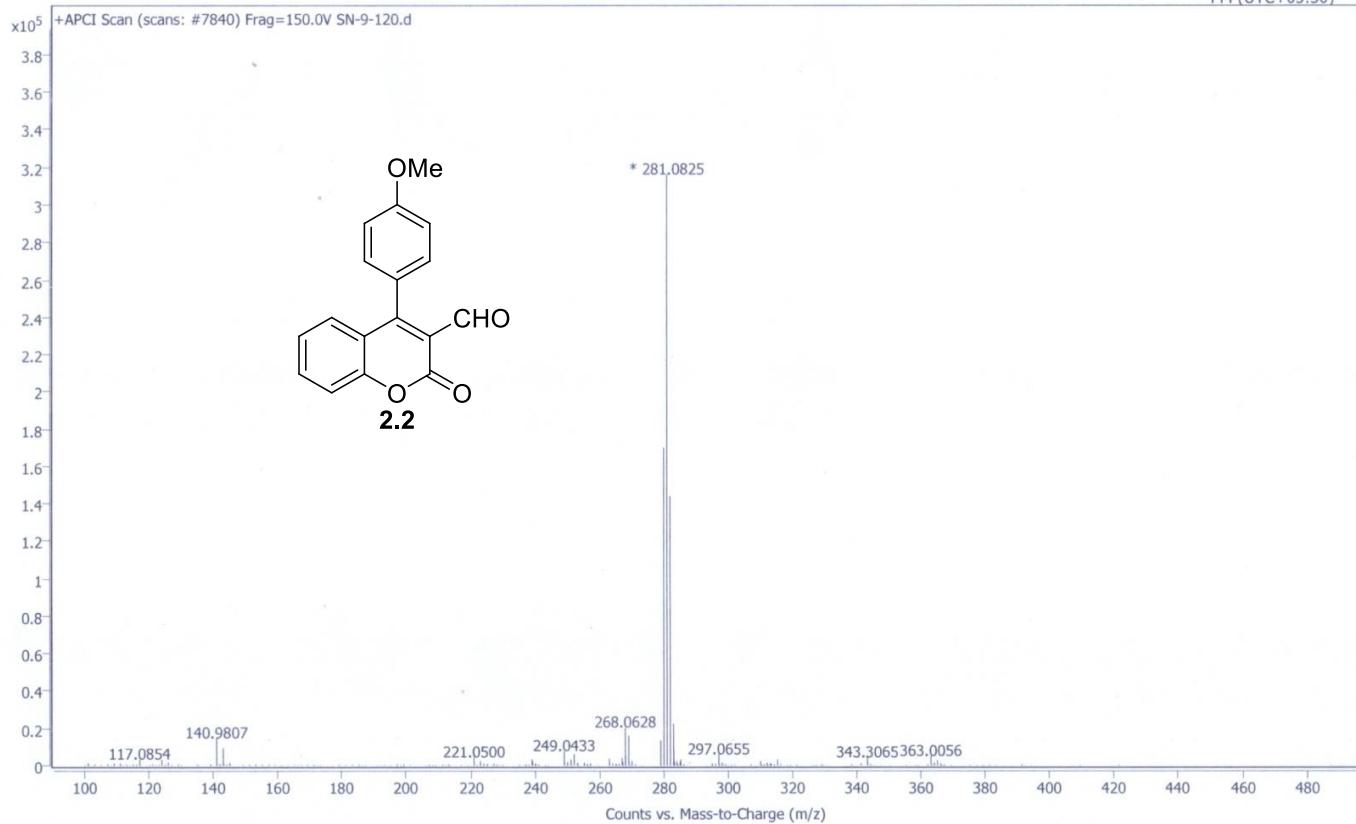


Mass Spectrum of 2-oxo-4-*p*-tolyl-2*H*-chromene-3-carbaldehyde (**2.1**)

User Spectrum Plot Report



Name Inj. Vol. (uL)	SN-9-120 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-120.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	19-04-2021 02:38:12 PM (UTC+05:30)

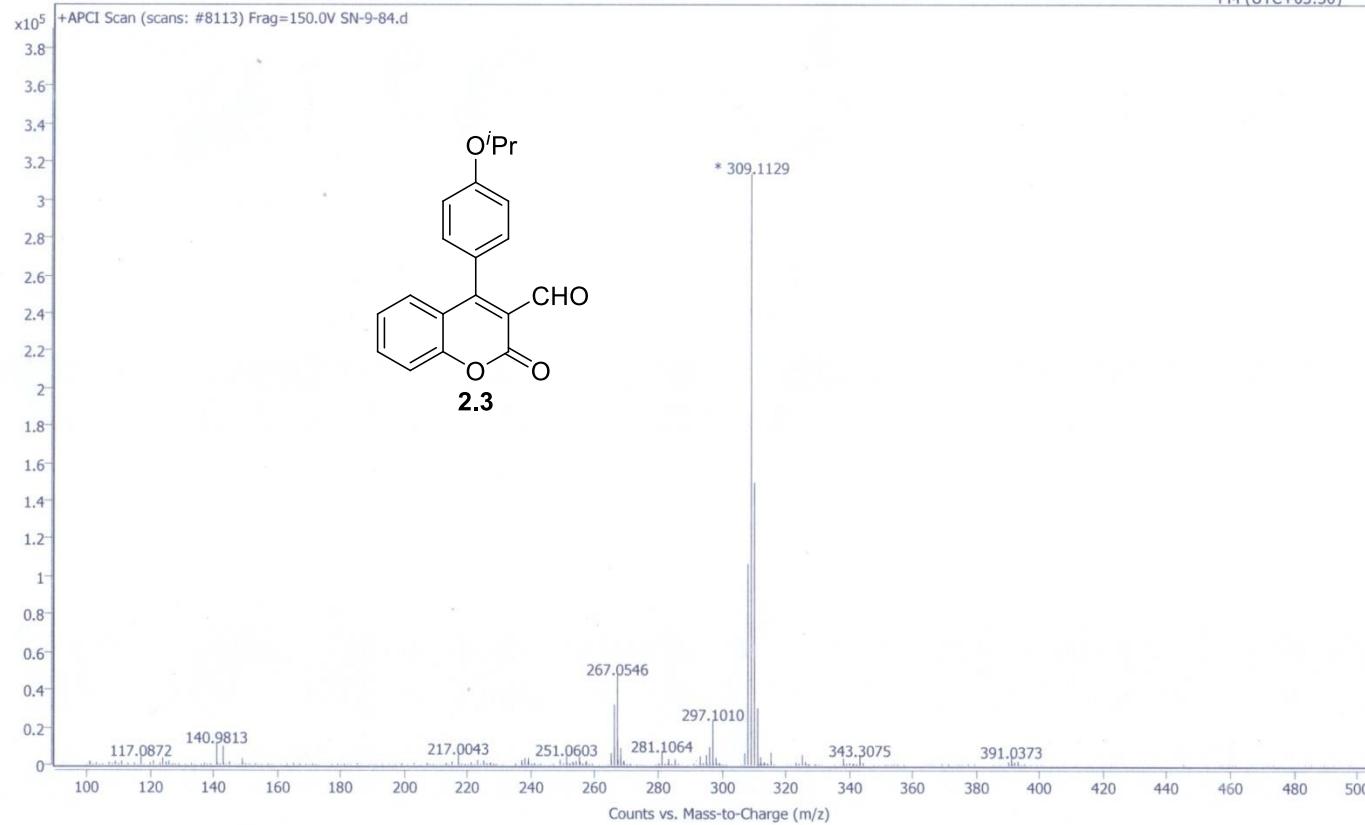


Mass Spectrum of 4-(4-methoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.2)

User Spectrum Plot Report

 Agilent | Trusted Answers

Name Inj. Vol. (uL)	SN-9-84 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-84.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	19-04-2021 01:53:19 PM (UTC+05:30)

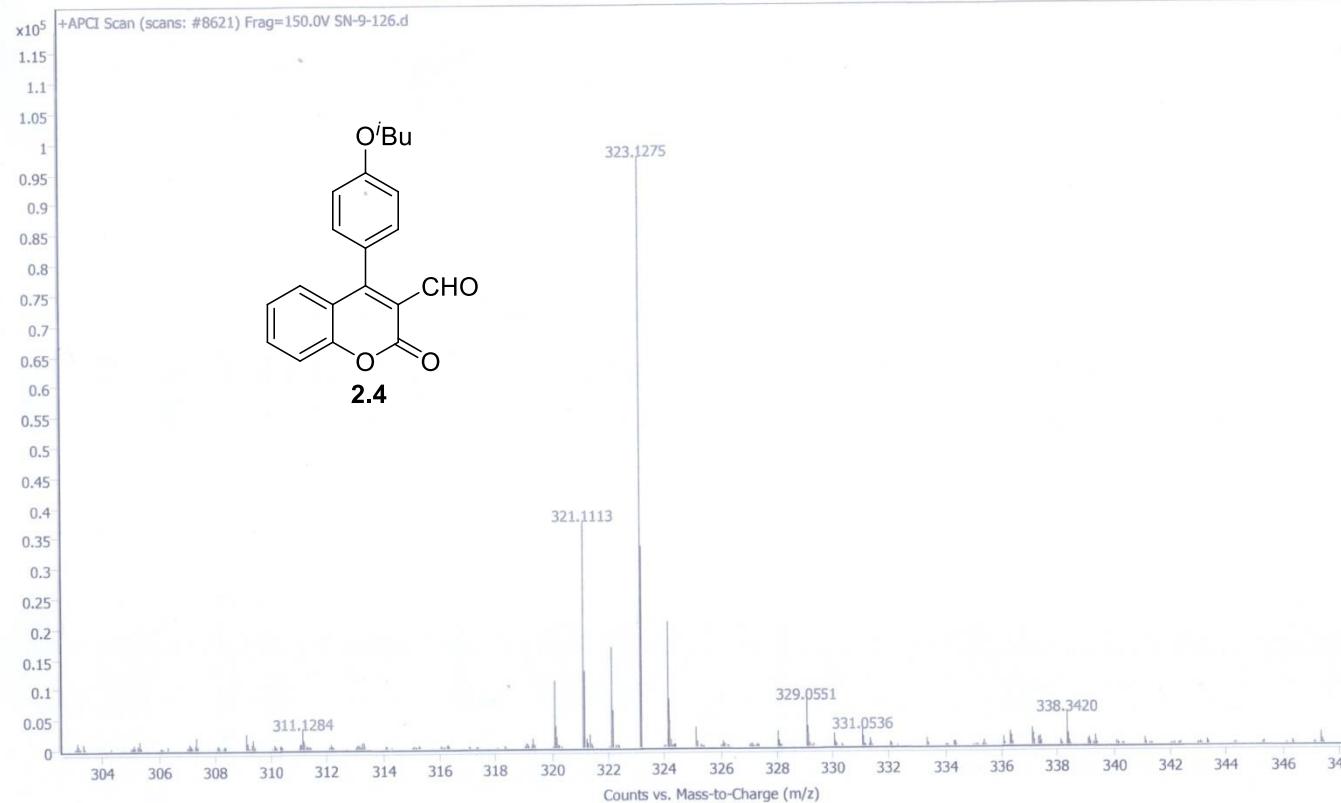


Mass Spectrum of 4-(4-isopropoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.3)

User Spectrum Plot Report

 Agilent | Trusted Answers

Name Inj. Vol. (ul)	SN-9-126 Unknown / Injection Program SN-9-126.d	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	Method (Acq)	GCAPCIIITK.m	Comment		Acq. Time (Local)	22-07-2021 02:29:24 PM (UTC+05:30)



Mass Spectrum of **4-(4-isobutoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (2.4)**

User Spectrum Plot Report

Agilent | Trusted Answers

Name
Inj. Vol. (uL)
Data File

SN-9-124.d

Rack Pos.
Plate Pos.
Method (Acq)

Instrument
IRM Status
Comment

Success

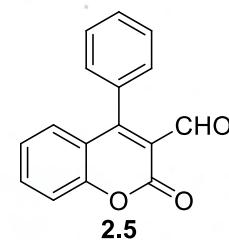
Operator
Acq. Time (Local)

19-04-2021 03:38:22
PM (UTC+05:30)

+APCI Scan (scans: #6765) Frag=150.0V SN-9-124.d

x10⁵

3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0



* 251.0713

121.0247
140.9814
211.0665
239.0608
265.0392
332.9984

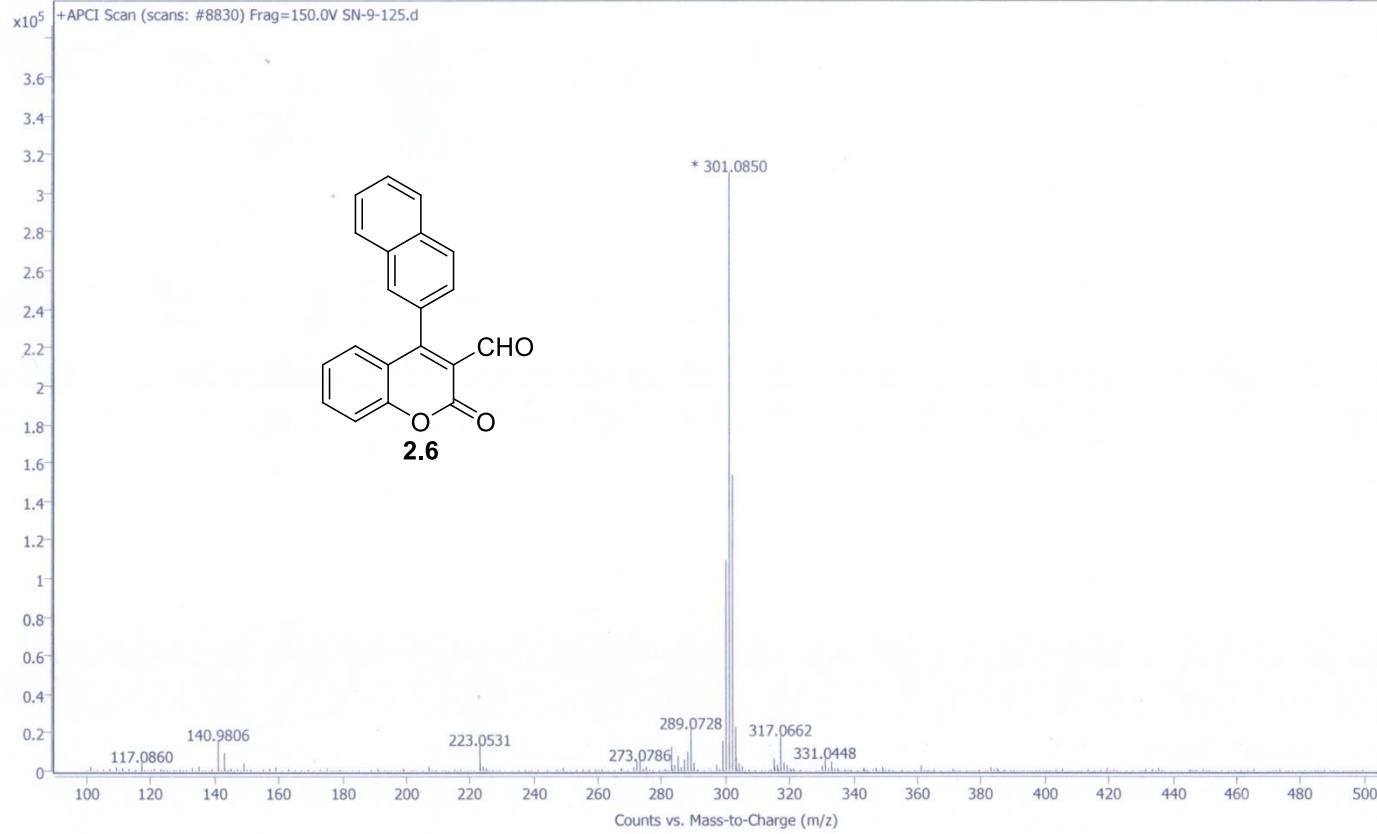
Counts vs. Mass-to-Charge (m/z)

Mass Spectrum of 2-oxo-4-phenyl-2H-chromene-3-carbaldehyde (2.5)

User Spectrum Plot Report



Name Inj. Vol. (uL)	SN-9-125 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-125.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	20-04-2021 11:52:56 AM (UTC+05:30)

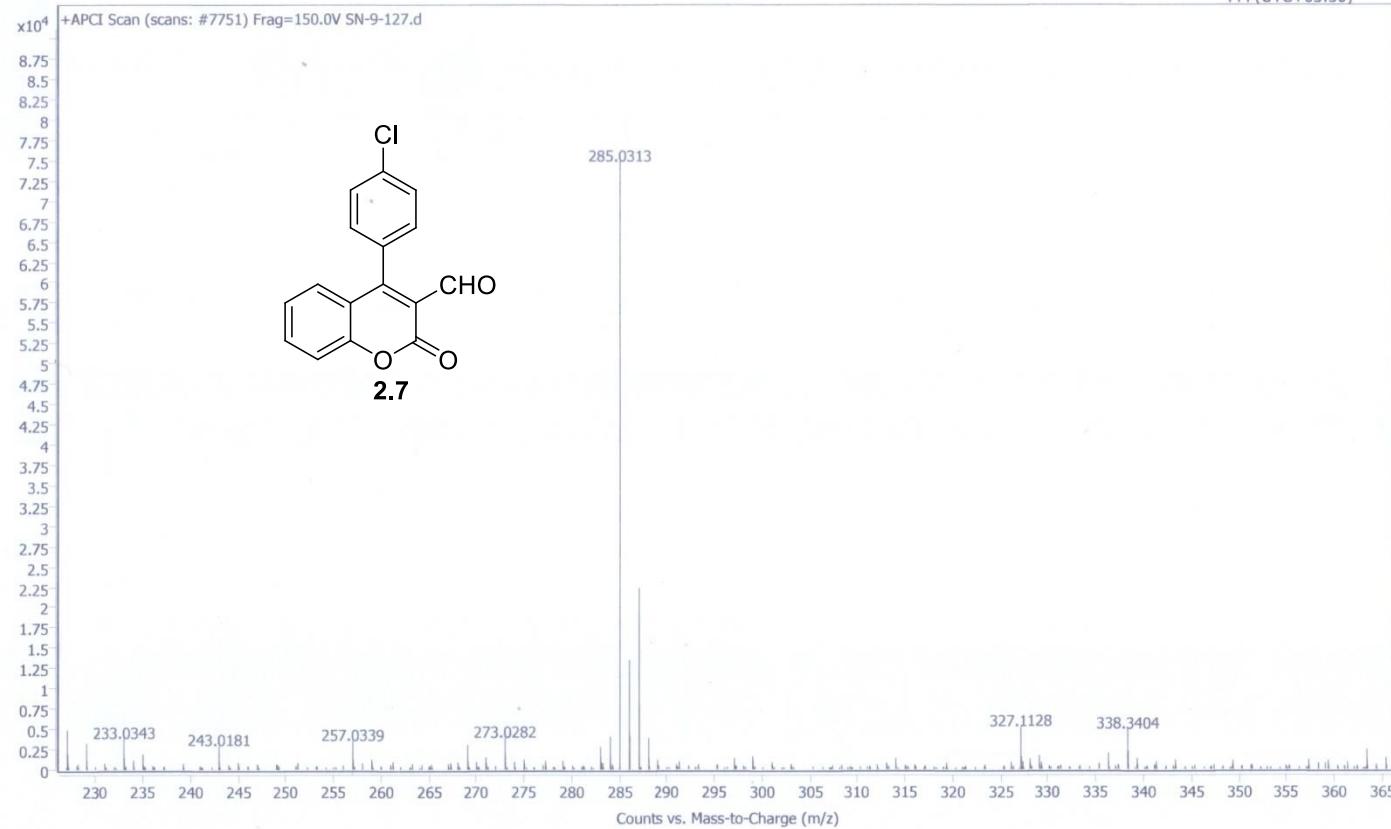


Mass Spectrum of 4-(naphthalen-2-yl)-2-oxo-2*H*-chromene-3-carbaldehyde (**2.6**)

User Spectrum Plot Report



Name Inj. Vol. (uL)	SN-9-127 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-127.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	22-07-2021 12:45:43 PM (UTC+05:30)

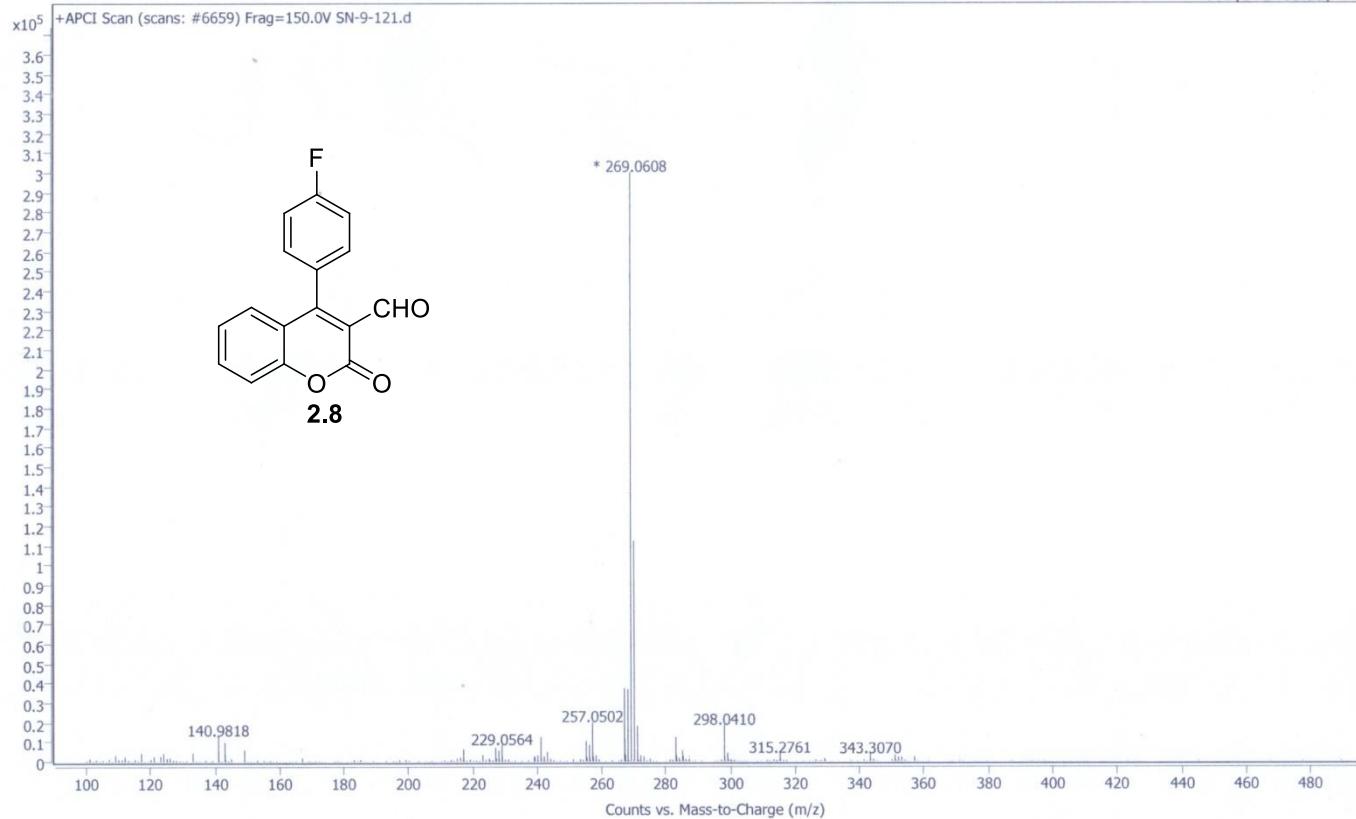


Mass Spectrum of 4-(4-chlorophenyl)-2-oxo-2H-chromene-3-carbaldehyde (2.7)

User Spectrum Plot Report



Name Inj. Vol. (ul)	SN-9-121 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-121.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	19-04-2021 02:15:43 PM (UTC+05:30)

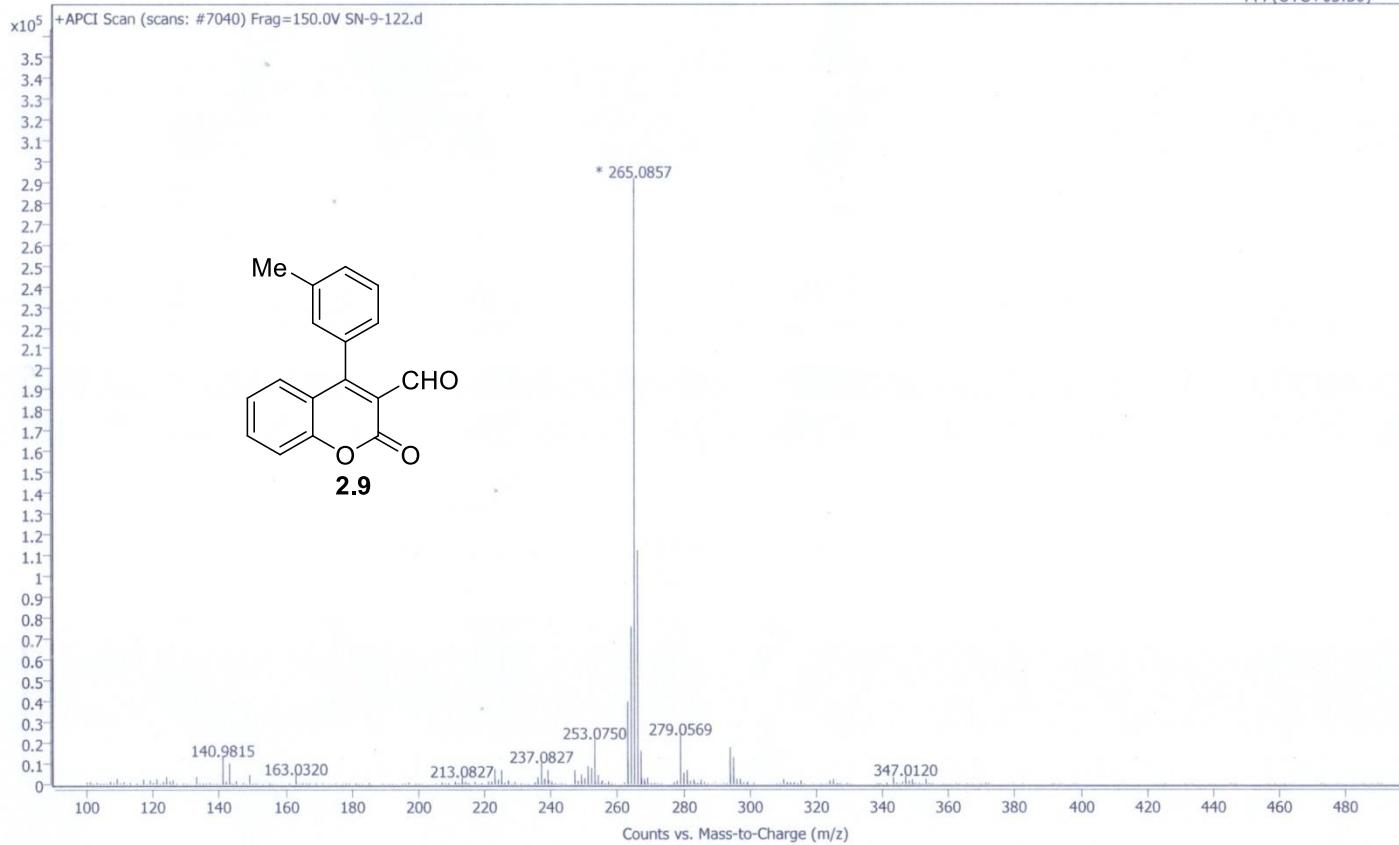


Mass Spectrum of 4-(4-fluorophenyl)-2-oxo-2H-chromene-3-carbaldehyde (2.8)

User Spectrum Plot Report



Name	SN-9-122	Rack Pos.	Instrument	APCI-GCMS	Operator	ABHISHEK16IITK
Inj. Vol. (ul)	Unknown / Injection Program	Plate Pos.	IRM Status	Success		
Data File	SN-9-122.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	19-04-2021 03:20:43 PM (UTC+05:30)

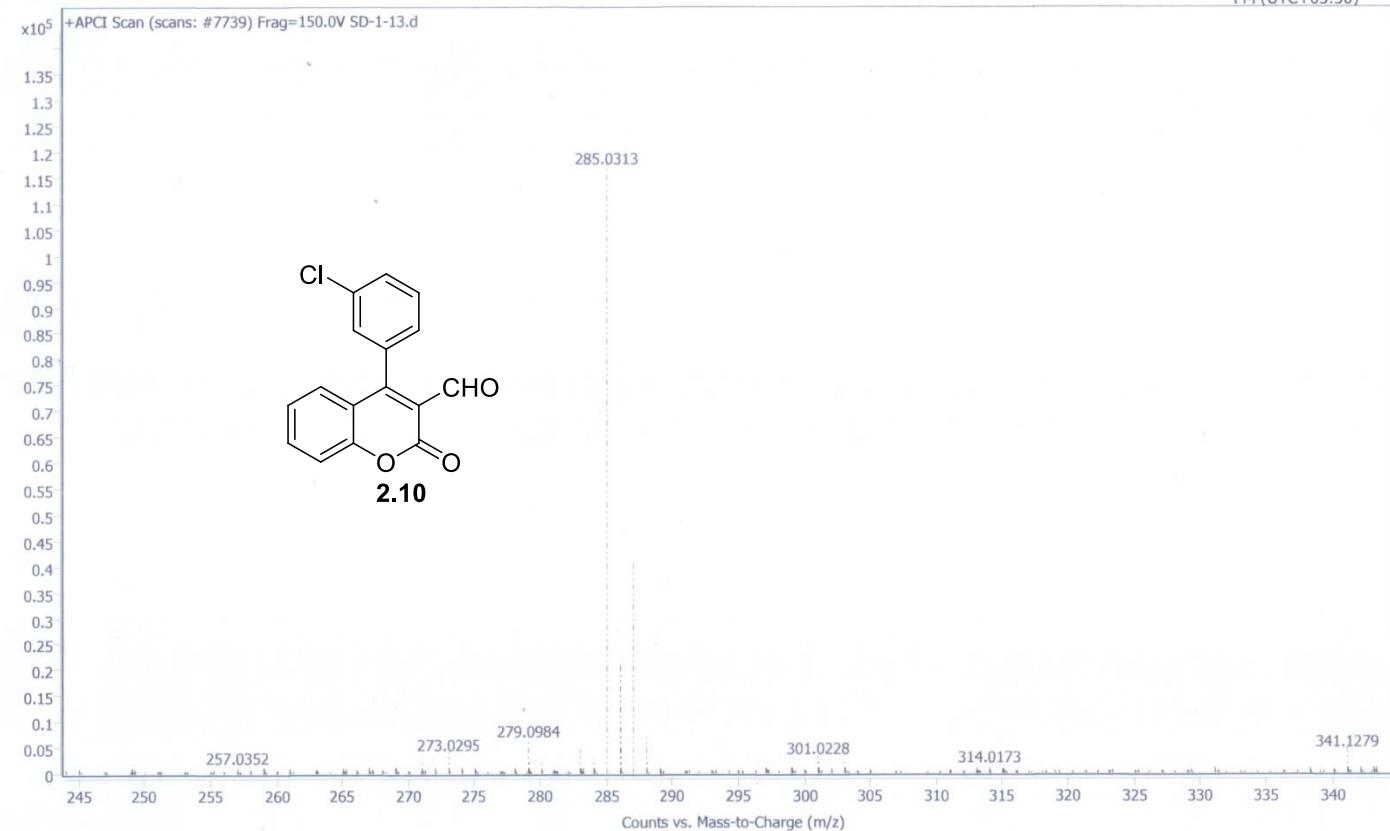


Mass Spectrum of 2-oxo-4-m-tolyl-2H-chromene-3-carbaldehyde (2.9)

User Spectrum Plot Report

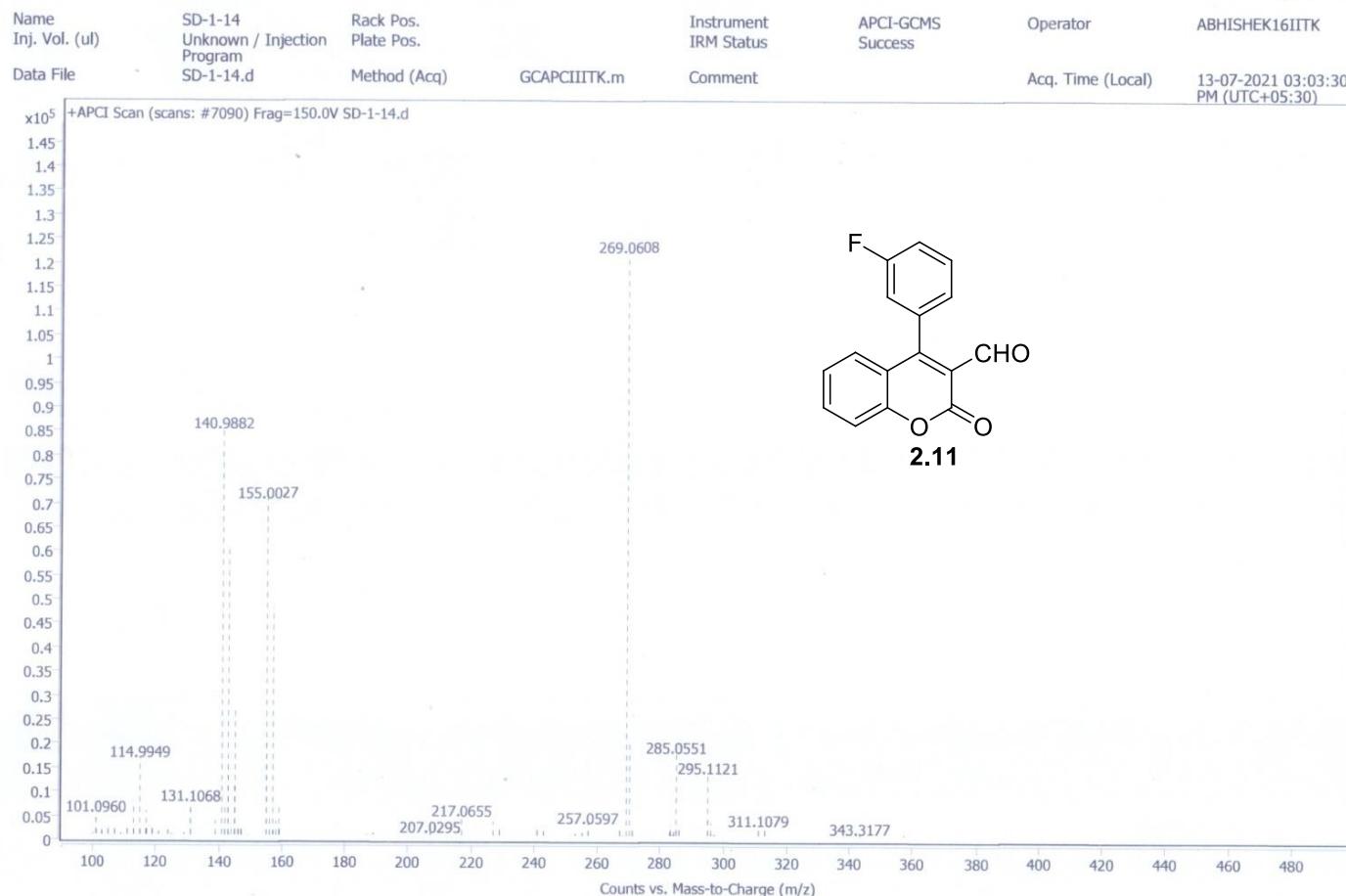


Name Inj. Vol. (uL)	SD-1-13 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SD-1-13.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	22-07-2021 12:23:10 PM (UTC+05:30)



Mass Spectrum of 4-(3-chlorophenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (**2.10**)

User Spectrum Plot Report

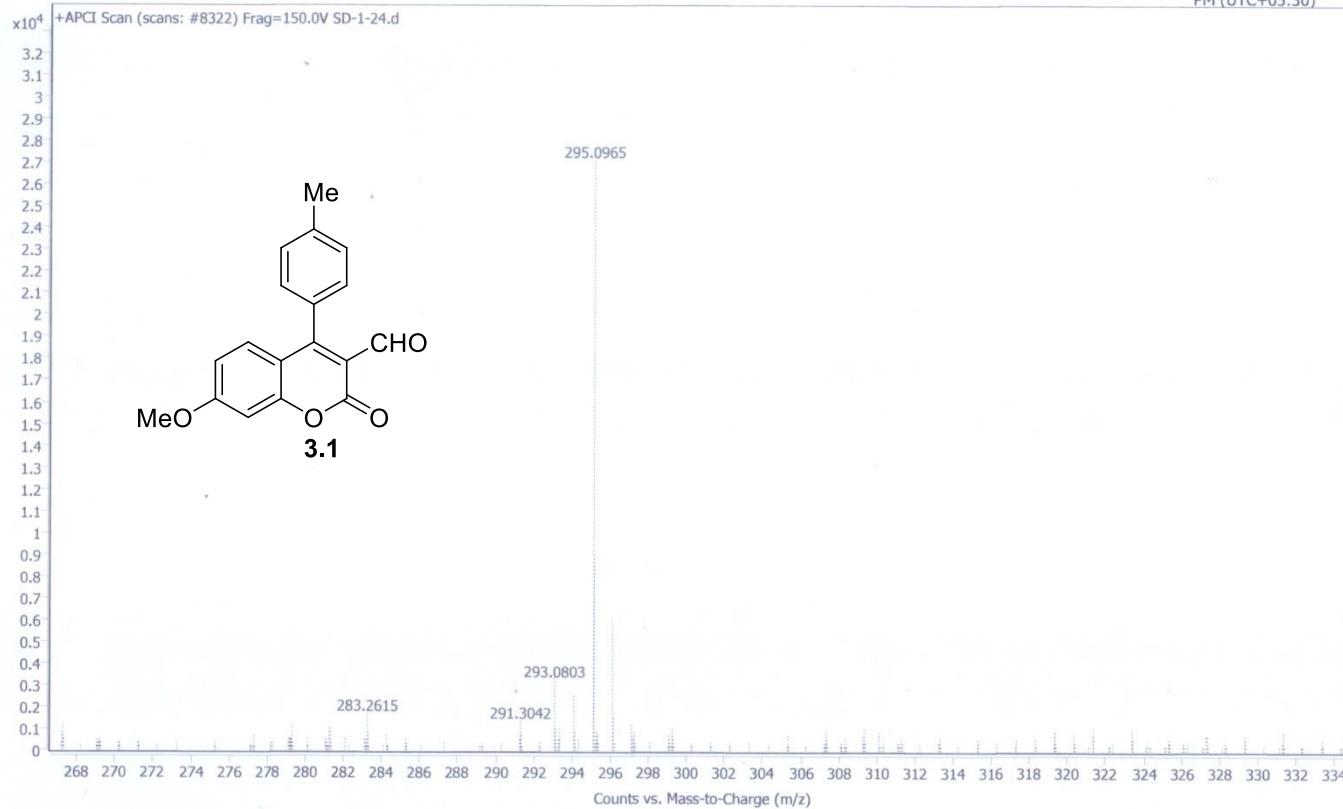


Mass Spectrum of 4-(3-fluorophenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (**2.11**)

User Spectrum Plot Report



Name Inj. Vol. (uL)	SD-1-24 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GC/MS Success	Operator	ABHISHEK16IITK
Data File	SD-1-24.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	13-07-2021 03:26:03 PM (UTC+05:30)

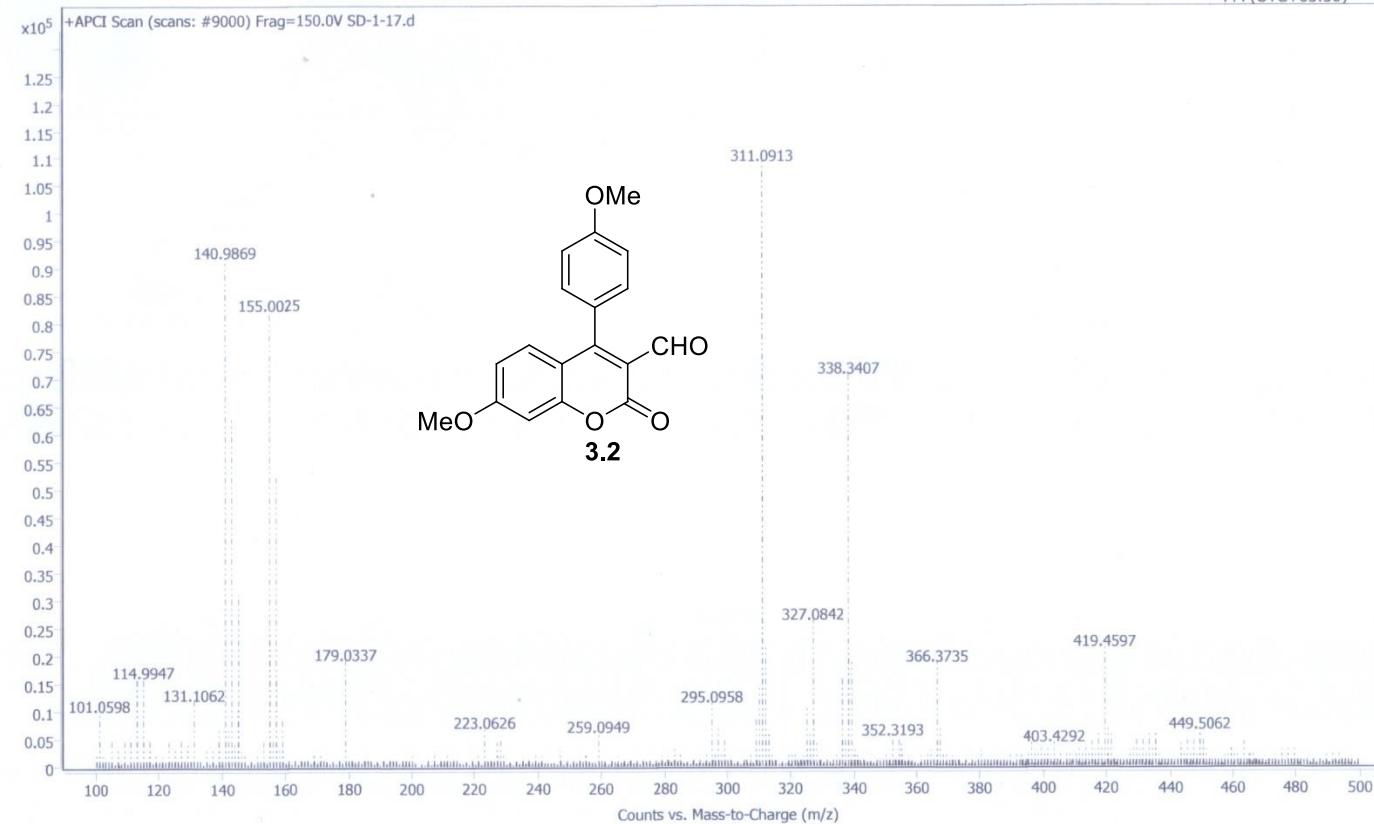


Mass Spectrum of 7-methoxy-2-oxo-4-p-tolyl-2H-chromene-3-carbaldehyde (3.1)

User Spectrum Plot Report



Name Inj. Vol. (ul)	SD-1-17 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SD-1-17.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	13-07-2021 02:20:48 PM (UTC+05:30)



Mass Spectrum of 7-methoxy-4-(4-methoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (3.2)

User Spectrum Plot Report



Name
Inj. Vol. (ul)
Data File

SD-1-20.d

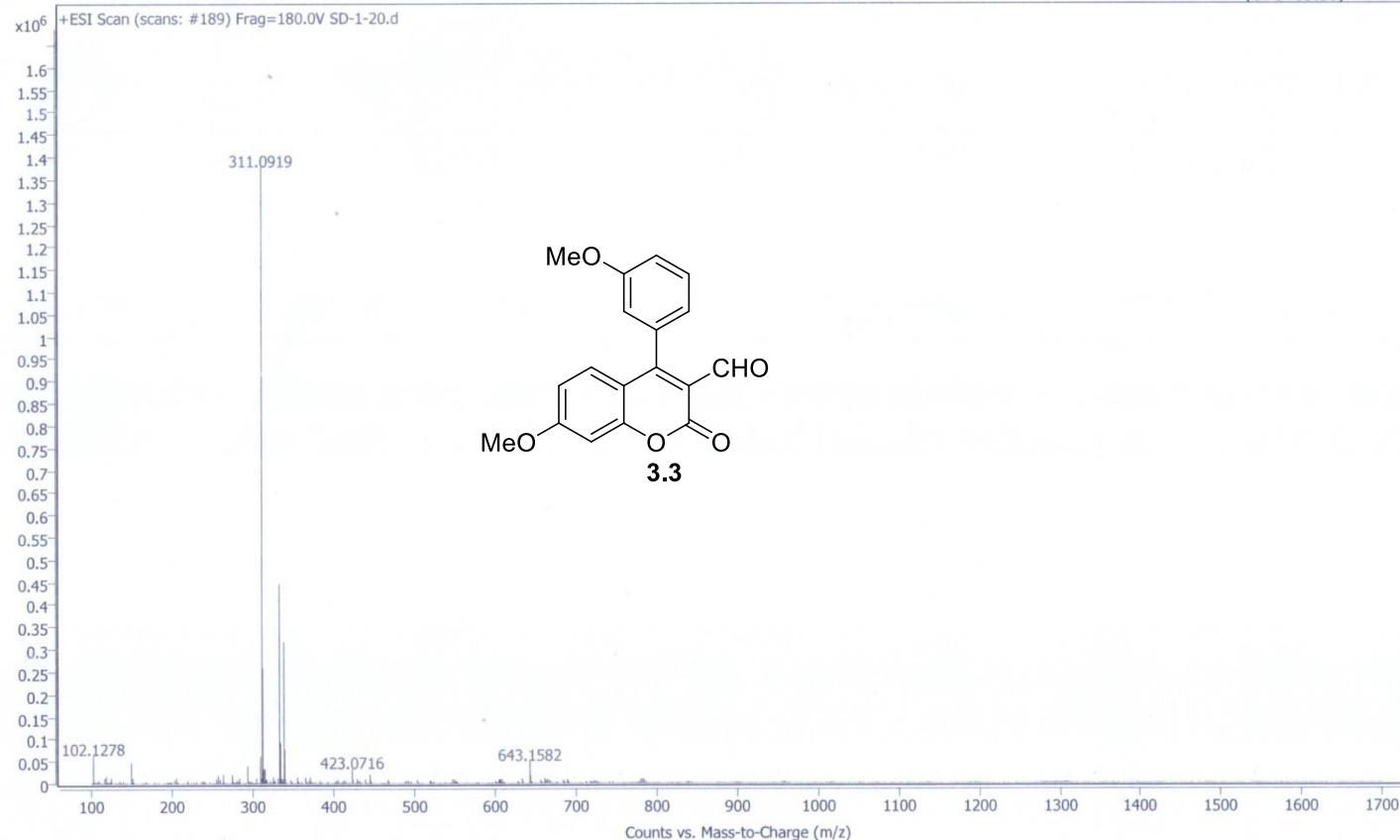
Rack Pos.
Plate Pos.
Method (Acq)

Instrument
IRM Status
Comment

Success

Operator

Acq. Time (Local)
22-06-2021 15:20:36
(UTC+05:30)

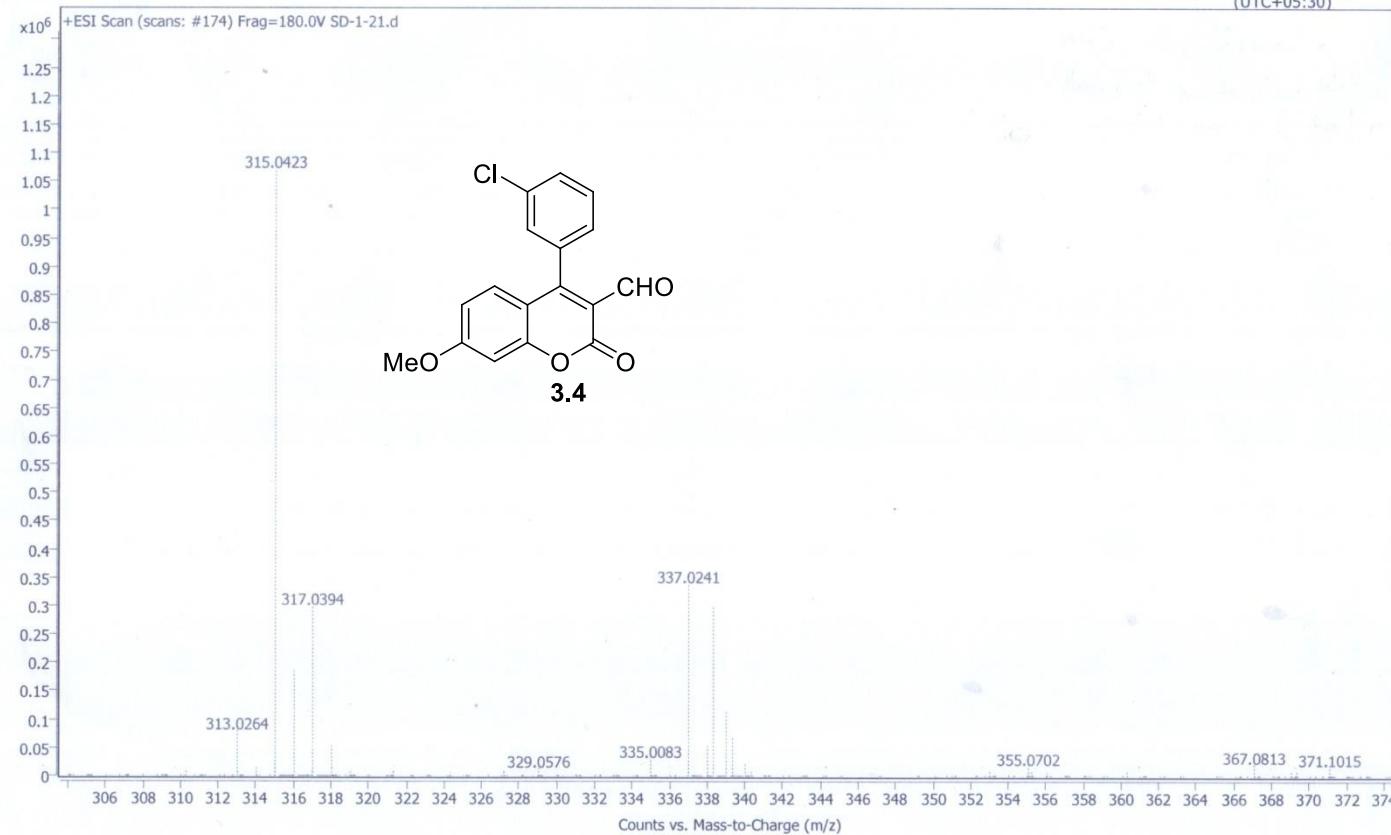


Mass Spectrum of 7-methoxy-4-(3-methoxyphenyl)-2-oxo-2*H*-chromene-3-carbaldehyde (3.3)

User Spectrum Plot Report



Name Inj. Vol. (ul) Data File	SD-1-21 1 SD-1-21.d	Rack Pos. Plate Pos. Method (Acq)	Instrument IRM Status ORGANIC METHODE.m Comment	ESI-MS Success	Operator
					Acq. Time (Local) 22-06-2021 15:07:33 (UTC+05:30)

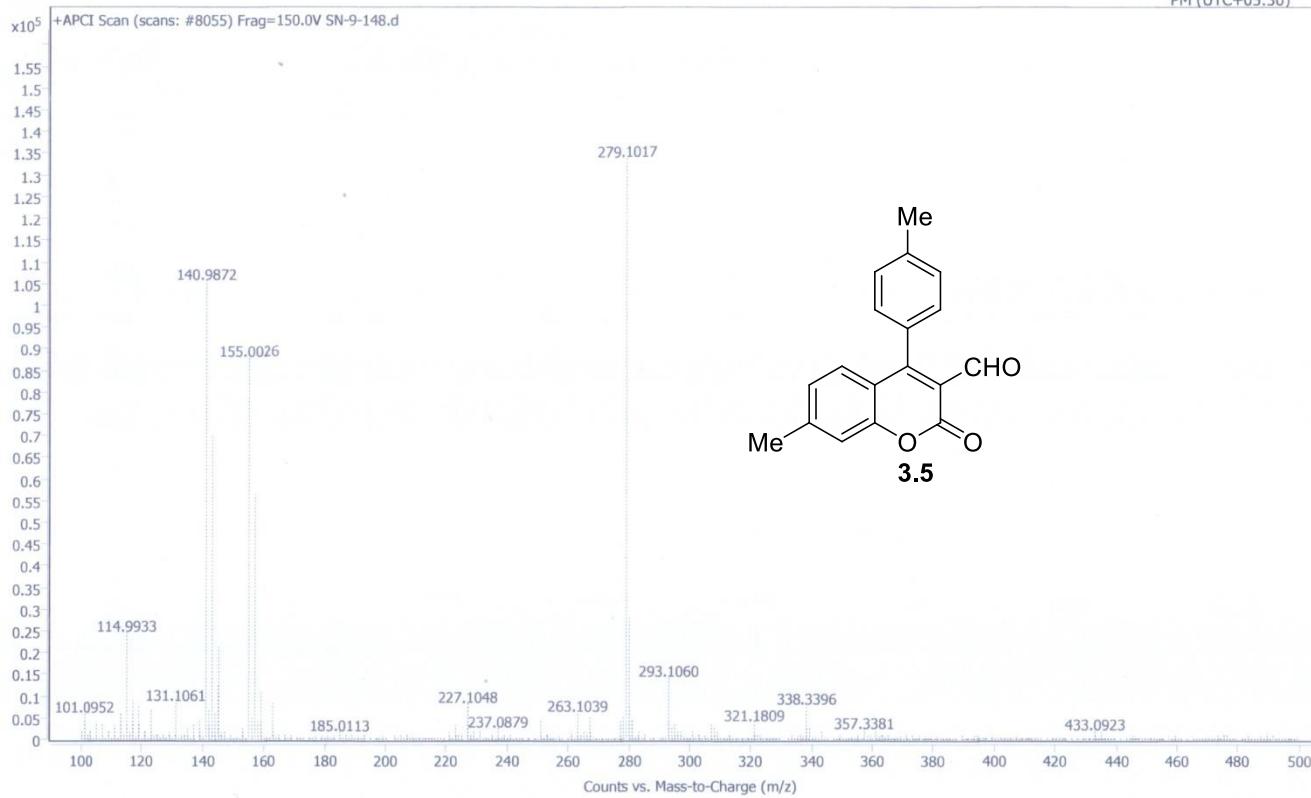


Mass Spectrum of 4-(3-chlorophenyl)-7-methoxy-2-oxo-2*H*-chromene-3-carbaldehyde (**3.4**)

User Spectrum Plot Report

 Agilent | Trusted Answers

Name	SN-9-148	Rack Pos.		Instrument	APCI-GC/MS	Operator	ABHISHEK16IITK
Inj. Vol. (μl)	Unknown / Injection Program	Plate Pos.		IRM Status	Success		
Data File	SN-9-148.d	Method (Acq)	GCAPCIIITK.m	Comment		Acq. Time (Local)	15-07-2021 01:49:34 PM (UTC+05:30)

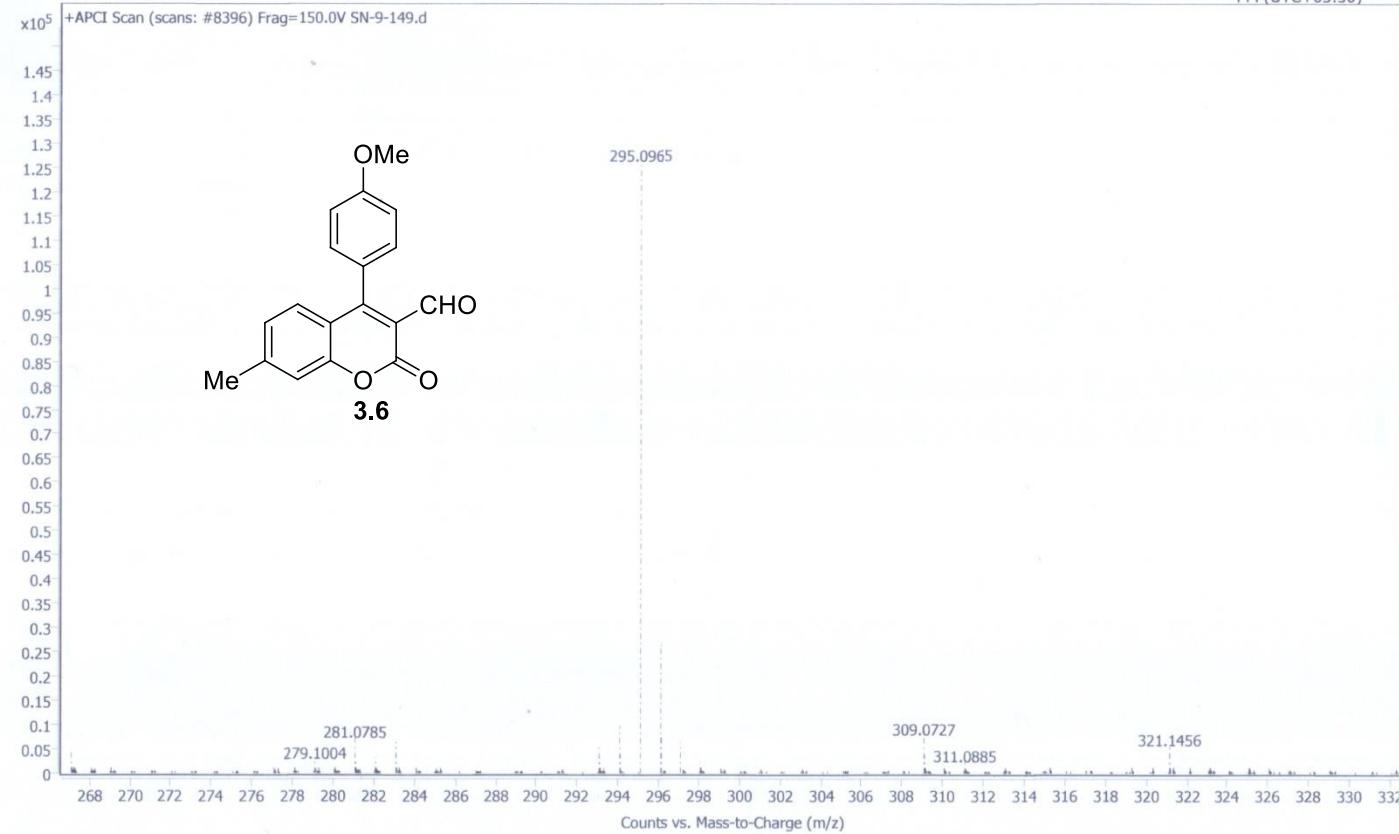


Mass Spectrum of 7-methyl-2-oxo-4-p-tolyl-2*H*-chromene-3-carbaldehyde (3.5)

User Spectrum Plot Report



Name Inj. Vol. (ul)	SN-9-149 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-149.d	Method (Acq)	GCAPCIITK.m	Comment	Acq. Time (Local)	15-07-2021 02:12:07 PM (UTC+05:30)

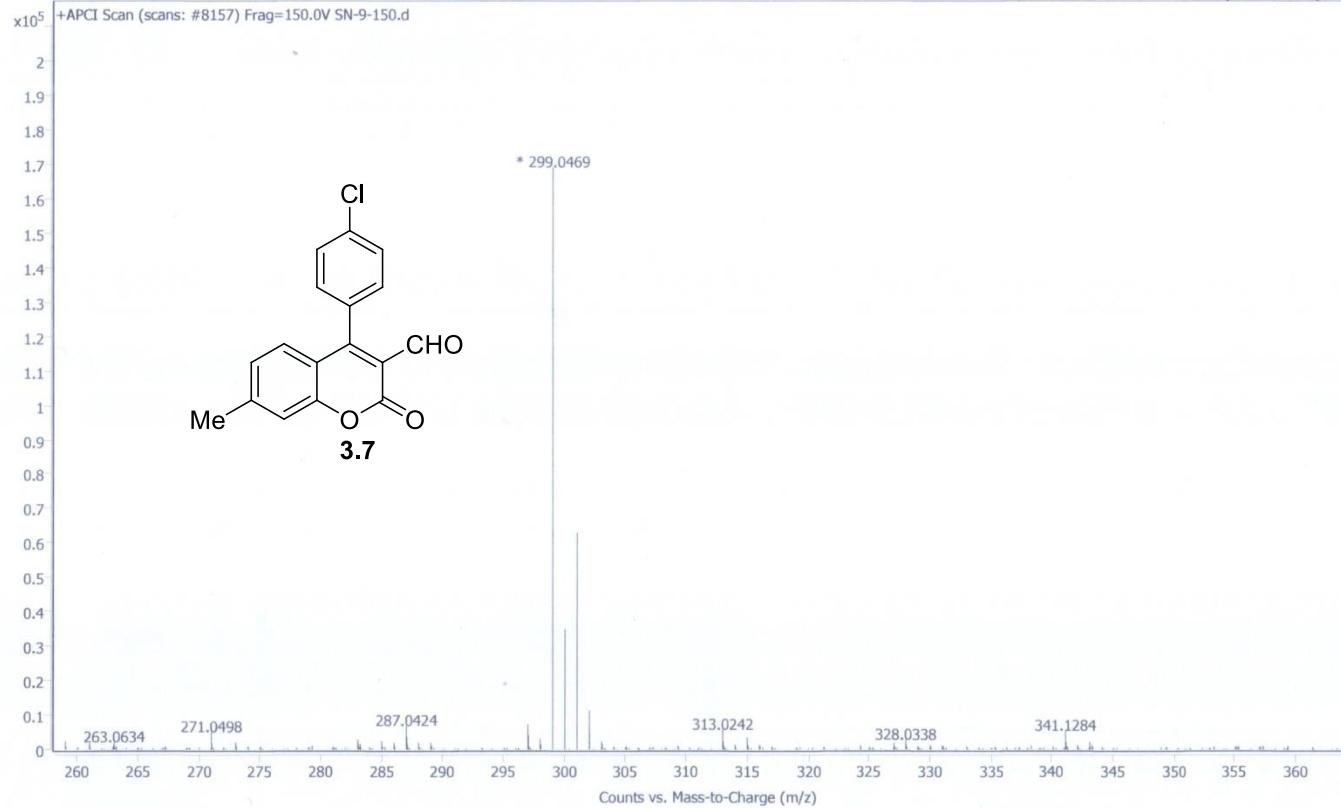


Mass Spectrum of 4-(4-methoxyphenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.6)

User Spectrum Plot Report

 Agilent | Trusted Answers

Name Inj. Vol. (ul)	SN-9-150 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-150.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	22-07-2021 10:53:23 AM (UTC+05:30)

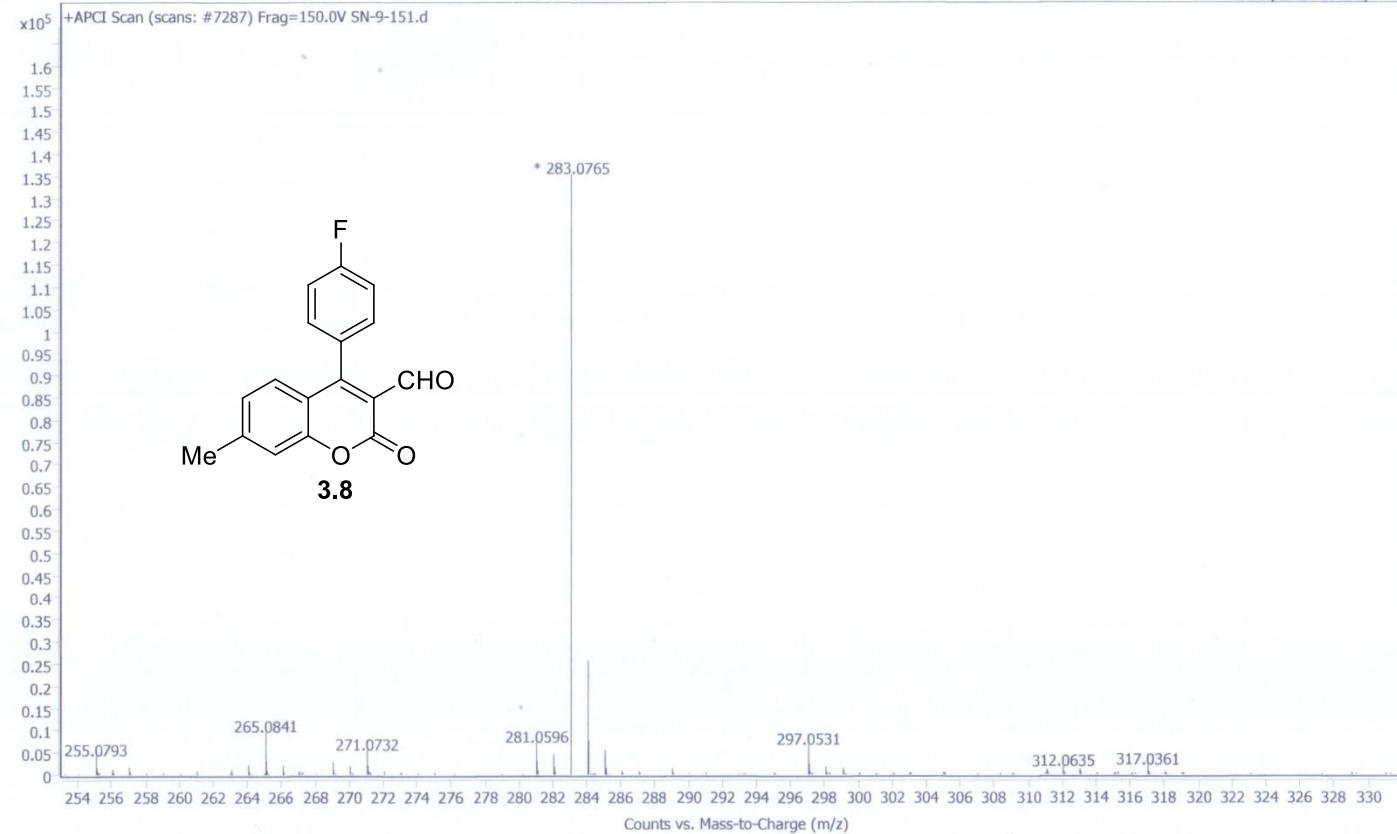


Mass Spectrum of 4-(4-chlorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.7)

User Spectrum Plot Report



Name Inj. Vol. (ul)	SN-9-151 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-151.d	Method (Acq)	GCAPCIITK.m	Comment	Acq. Time (Local)	22-07-2021 10:34:44 AM (UTC+05:30)

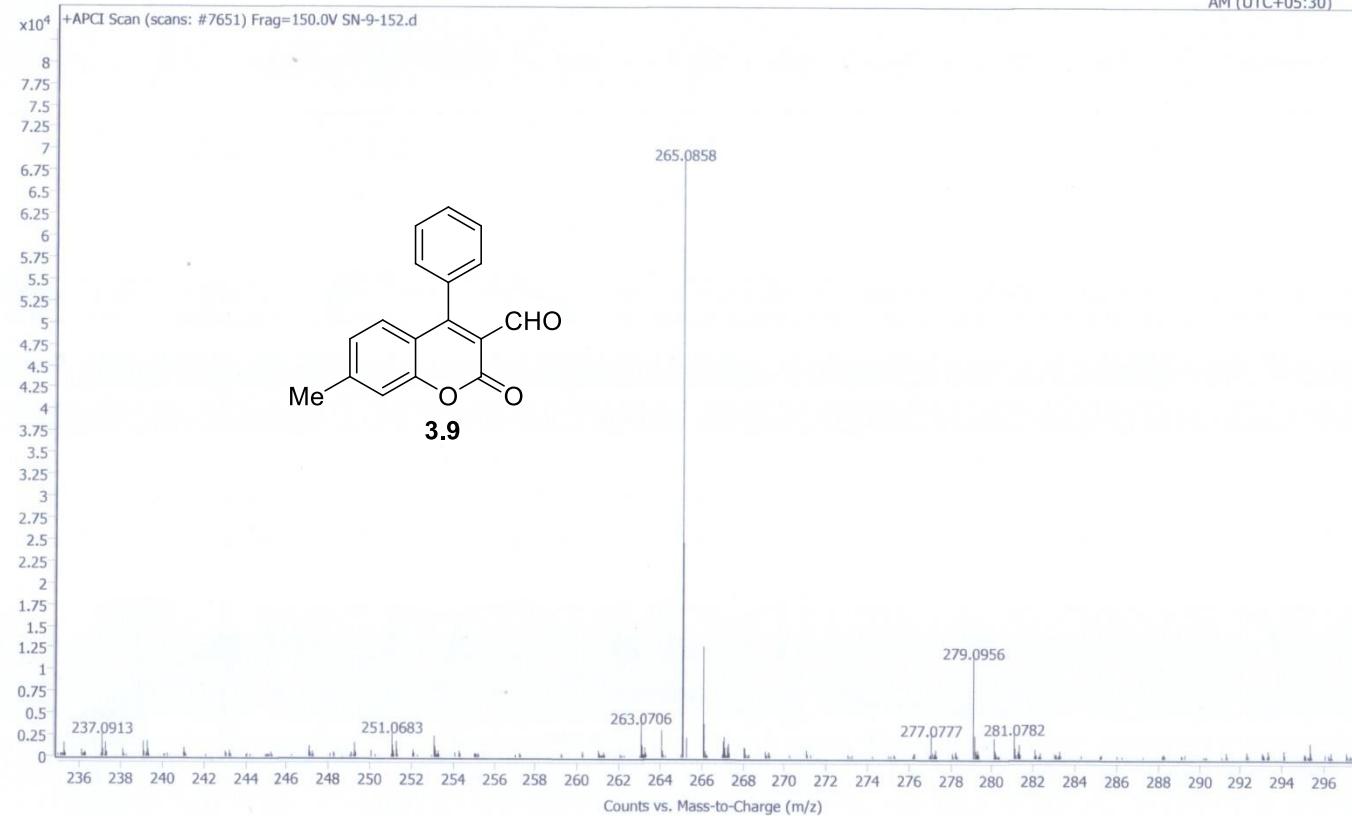


Mass Spectrum of 4-(4-fluorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.8)

User Spectrum Plot Report

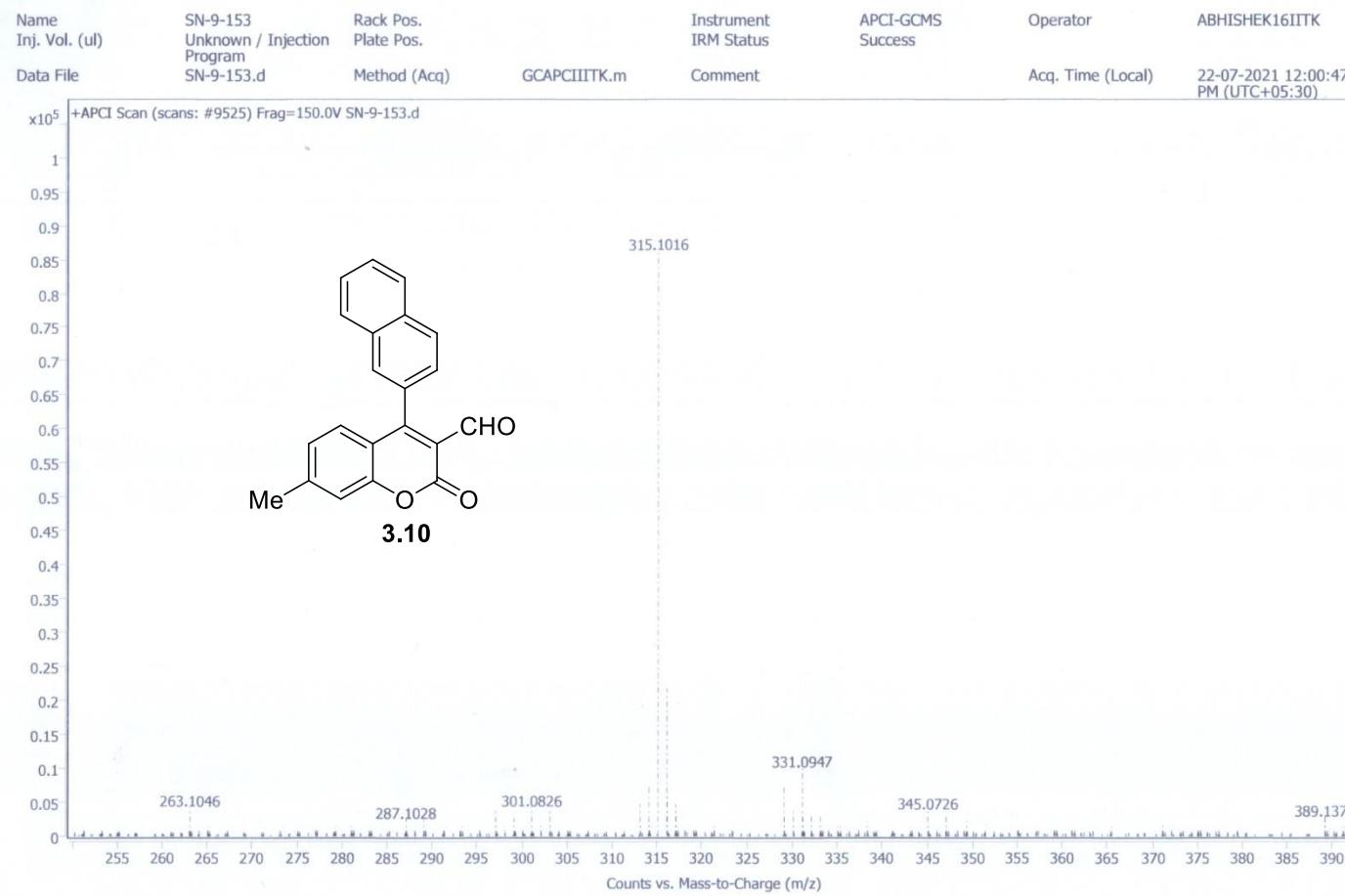
Agilent | Trusted Answers

Name Inj. Vol. (ul)	SN-9-152 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-152.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	23-07-2021 11:00:30 AM (UTC+05:30)



Mass Spectrum of 7-methyl-2-oxo-4-phenyl-2*H*-chromene-3-carbaldehyde (**3.9**)

User Spectrum Plot Report

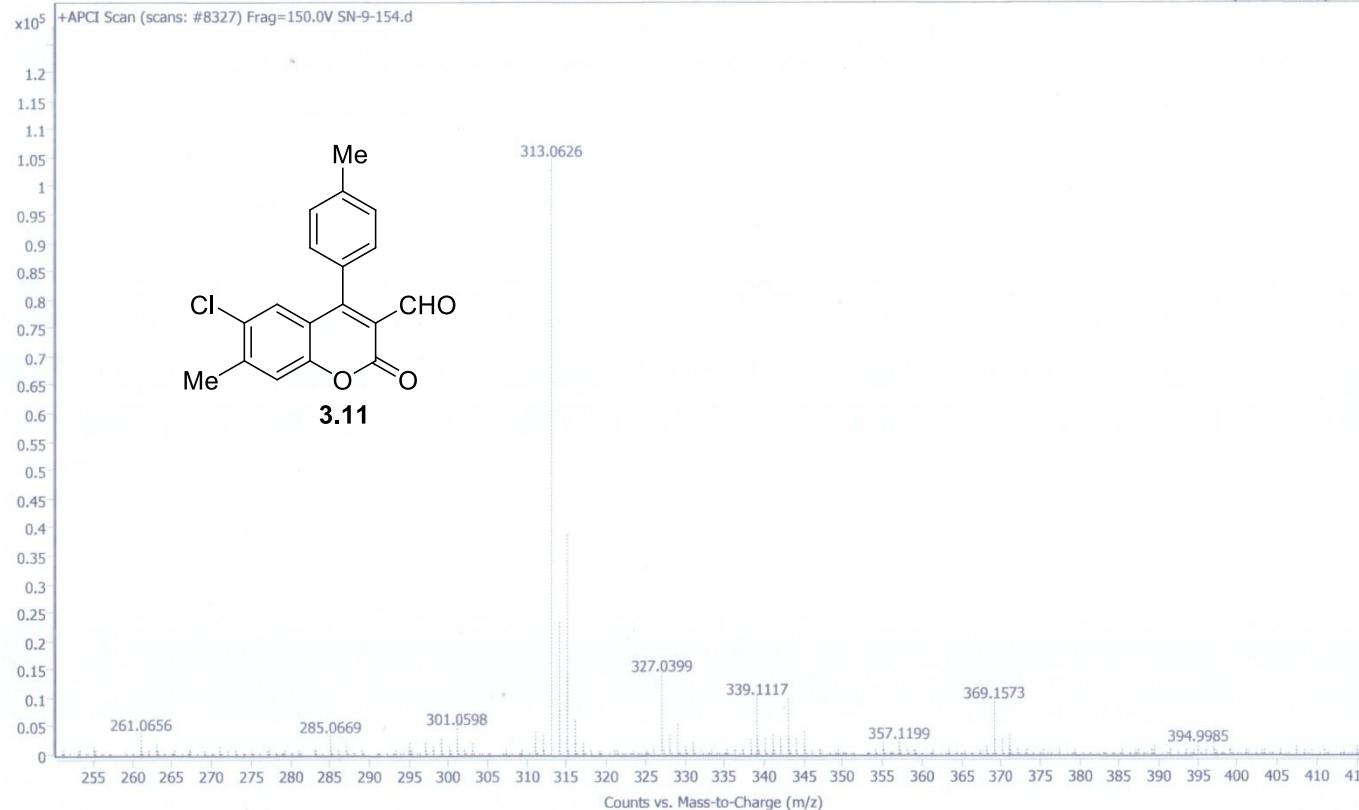


Mass Spectrum of 7-methyl-4-(naphthalen-2-yl)-2-oxo-2*H*-chromene-3-carbaldehyde (**3.10**)

User Spectrum Plot Report

 Agilent | Trusted Answers

Name Inj. Vol. (μl)	SN-9-154 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-154.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	22-07-2021 11:38:14 AM (UTC+05:30)

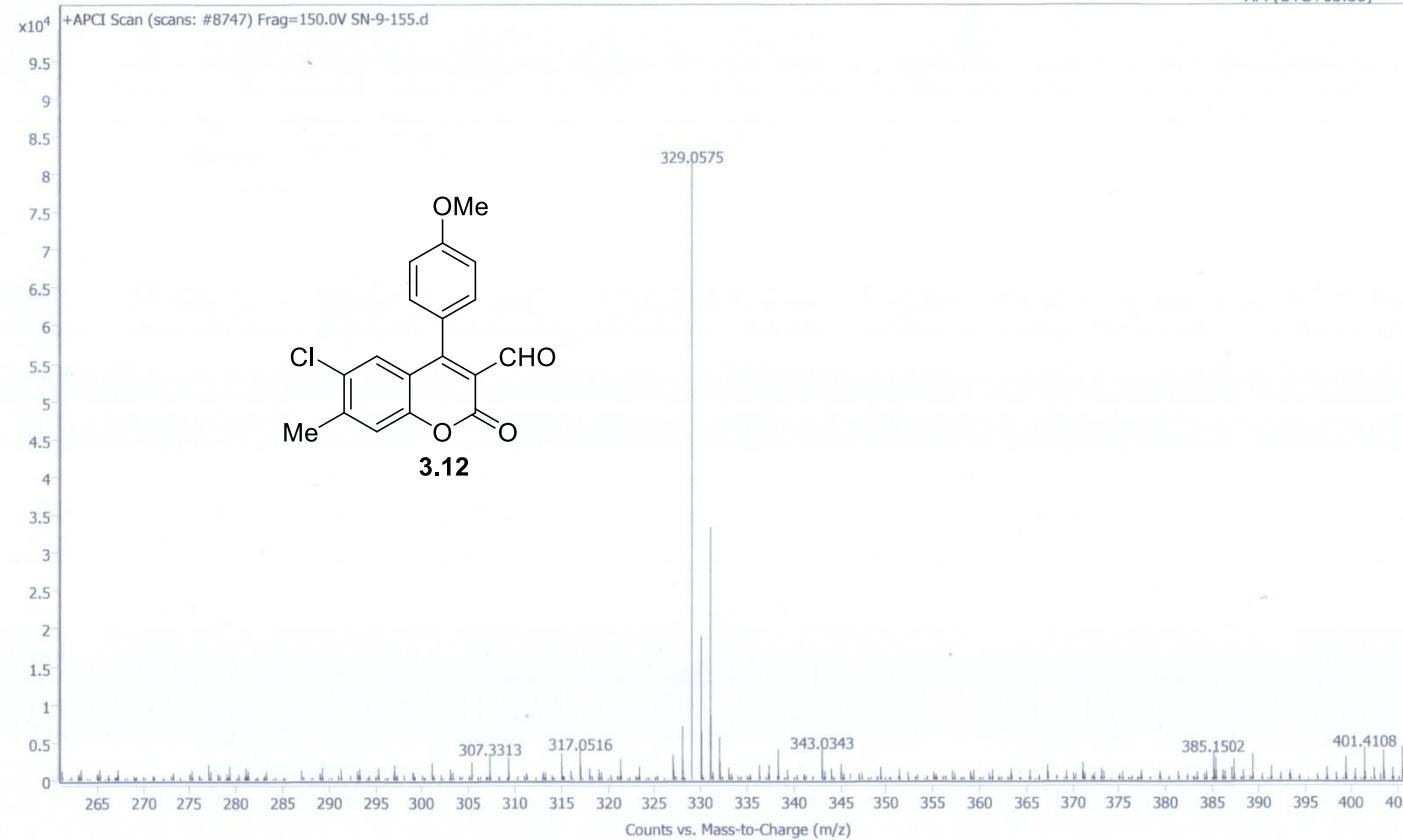


Mass Spectrum of 6-chloro-7-methyl-2-oxo-4-p-tolyl-2*H*-chromene-3-carbaldehyde (3.11)

User Spectrum Plot Report



Name	SN-9-155	Rack Pos.		Instrument	APCI-GCMS	Operator	ABHISHEK16IITK
Inj. Vol. (ul)	Unknown / Injection Program	Plate Pos.	<th>IRM Status</th> <td>Success</td> <th></th> <td></td>	IRM Status	Success		
Data File	SN-9-155.d	Method (Acq)	GCAPCIITK.m	Comment		Acq. Time (Local)	22-07-2021 11:15:47 AM (UTC+05:30)

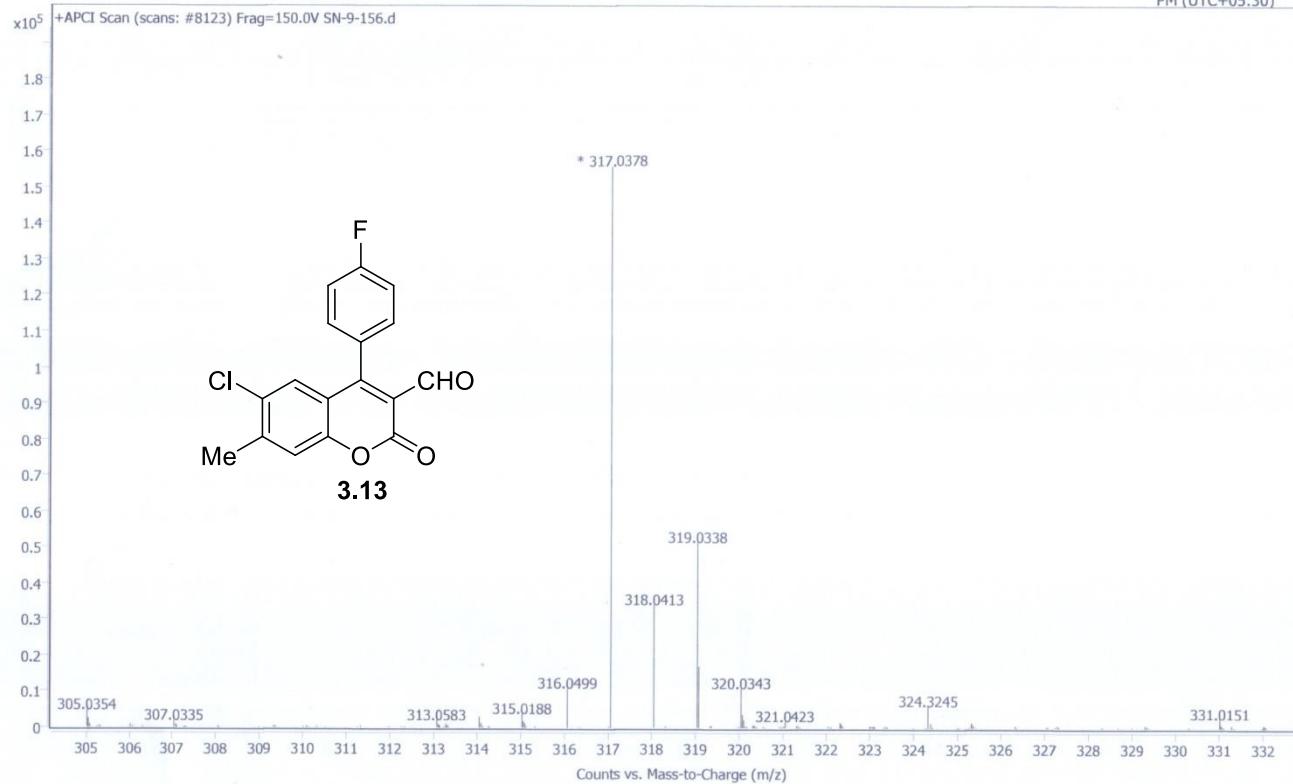


Mass Spectrum of 6-chloro-4-(4-methoxyphenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.12)

User Spectrum Plot Report



Name Inj. Vol. (μl)	SN-9-156 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File SN-9-156.d		Method (Acq) GCAPCIIITK.m	Comment		Acq. Time (Local)	15-07-2021 12:46:29 PM (UTC+05:30)

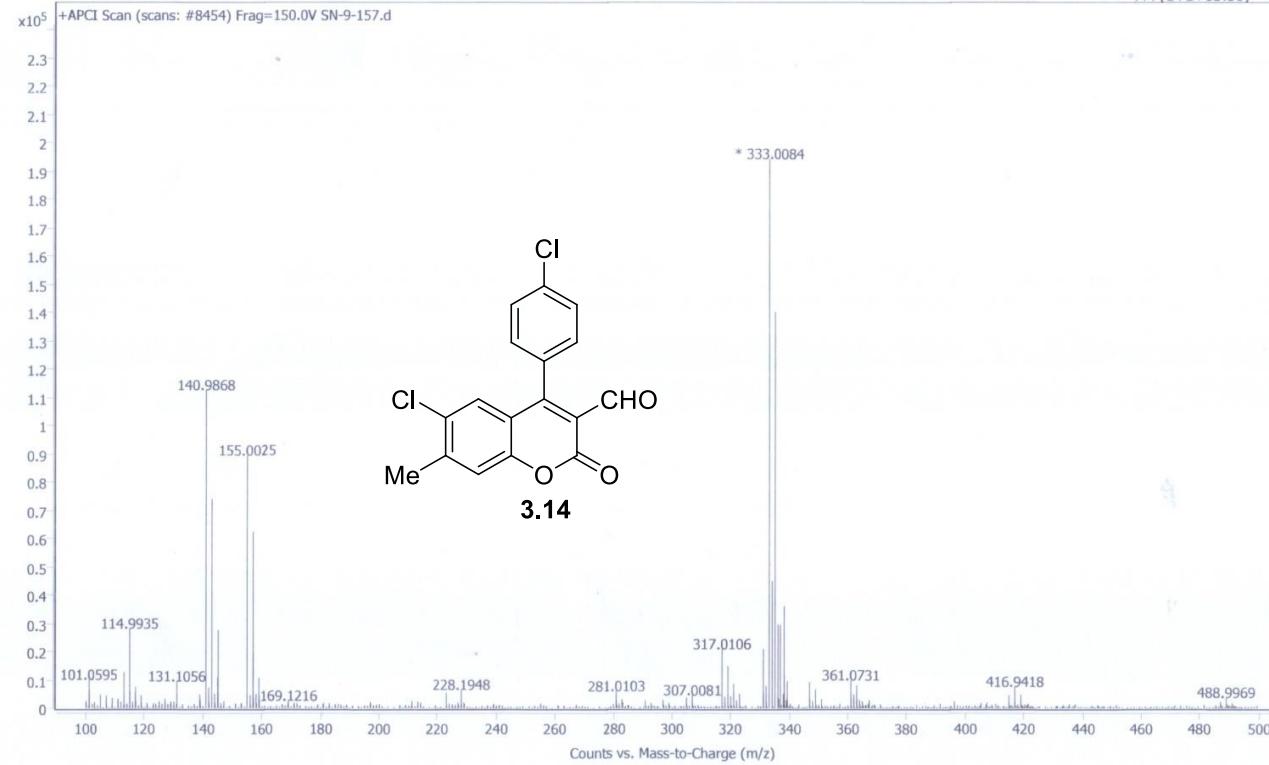


Mass Spectrum of 6-chloro-4-(4-fluorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.13)

User Spectrum Plot Report



Name Inj. Vol. (μl)	SN-9-157 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-157.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	15-07-2021 01:04:53 PM (UTC+05:30)

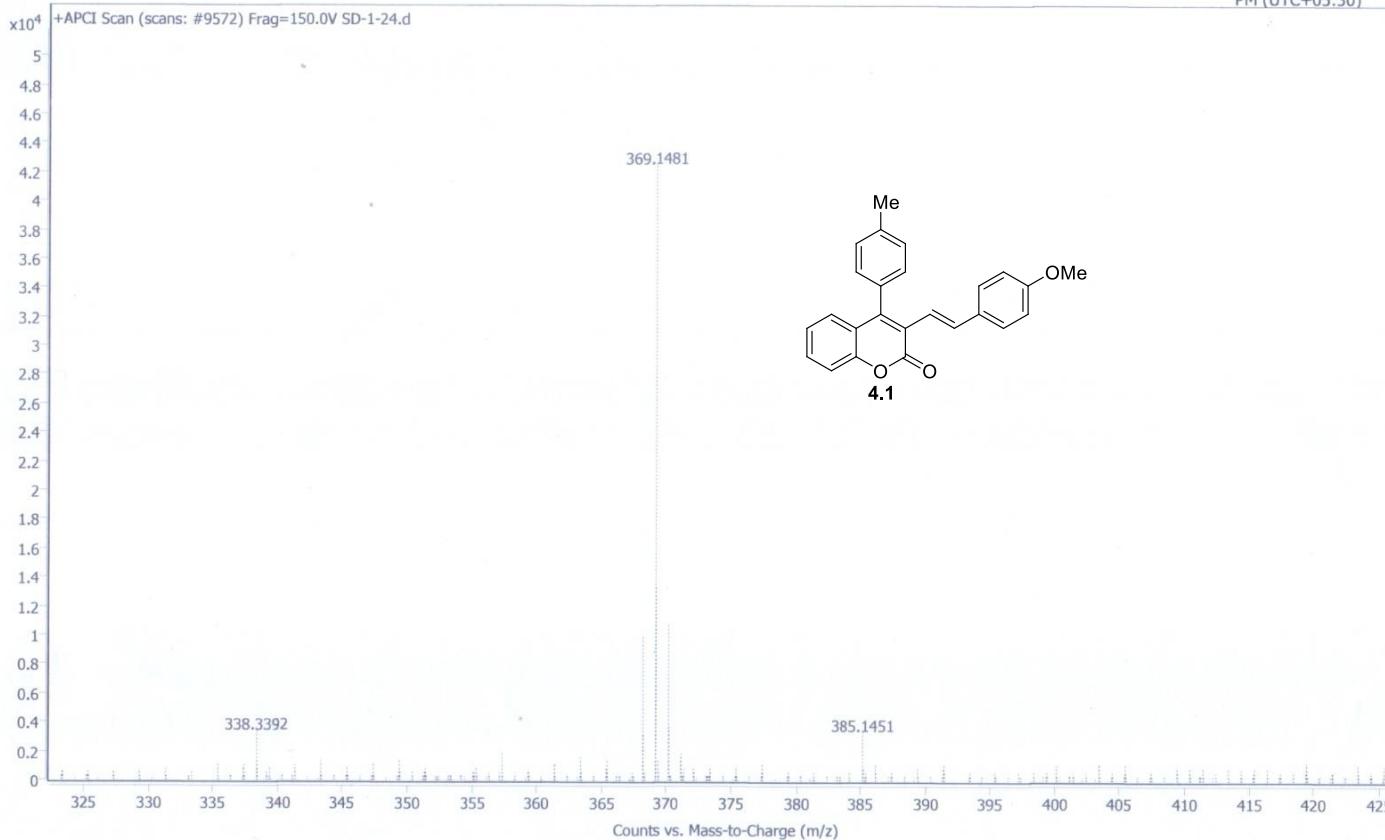


Mass Spectrum of 6-chloro-4-(4-chlorophenyl)-7-methyl-2-oxo-2*H*-chromene-3-carbaldehyde (3.14)

User Spectrum Plot Report



Name Inj. Vol. (uL)	SD-1-24 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SD-1-24.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	13-07-2021 03:26:03 PM (UTC+05:30)

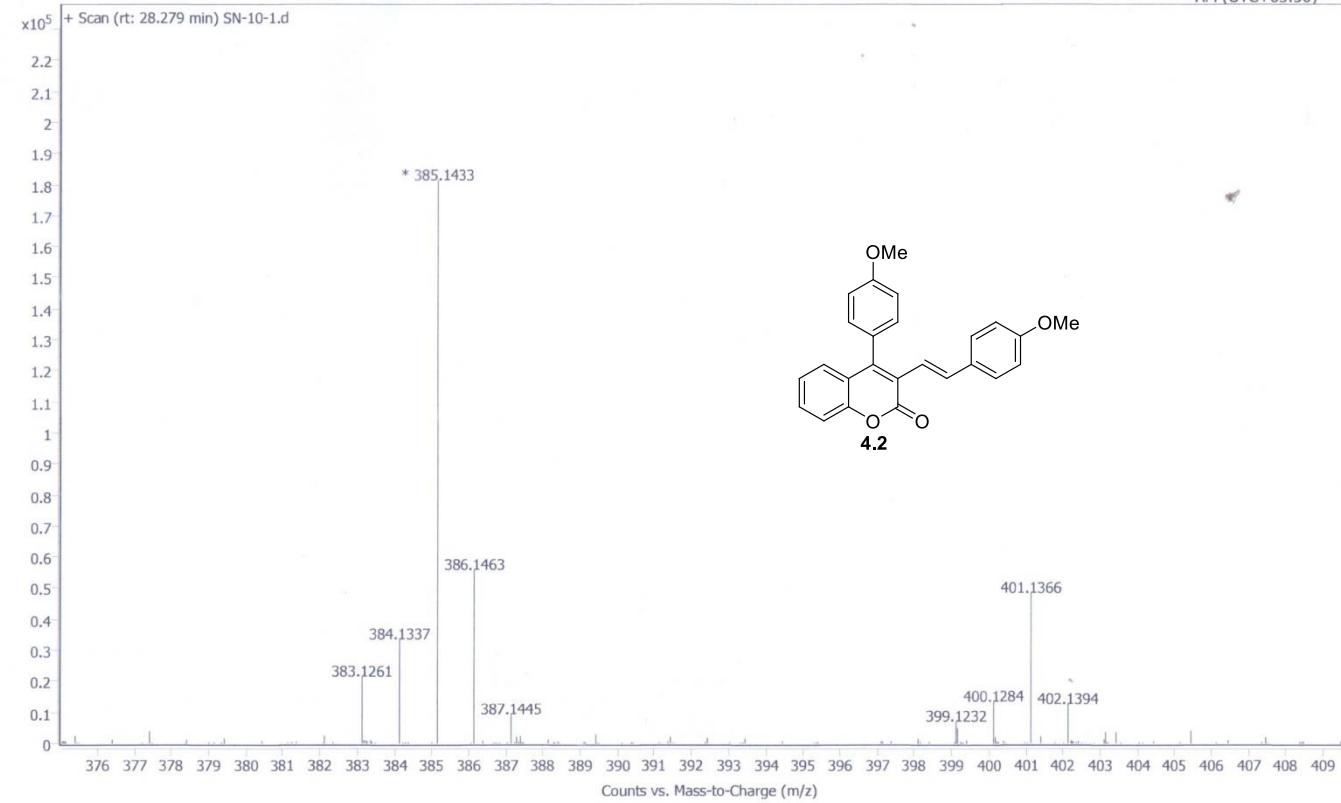


Mass Spectrum of (*E*)-3-(4-methoxystyryl)-4-p-tolyl-2*H*-chromen-2-one (**4.1**)

User Spectrum Plot Report

 Agilent | Trusted Answers

Name Inj. Vol. (ul)	SN-10-1 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-10-1.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	16-12-2021 10:38:14 AM (UTC+05:30)



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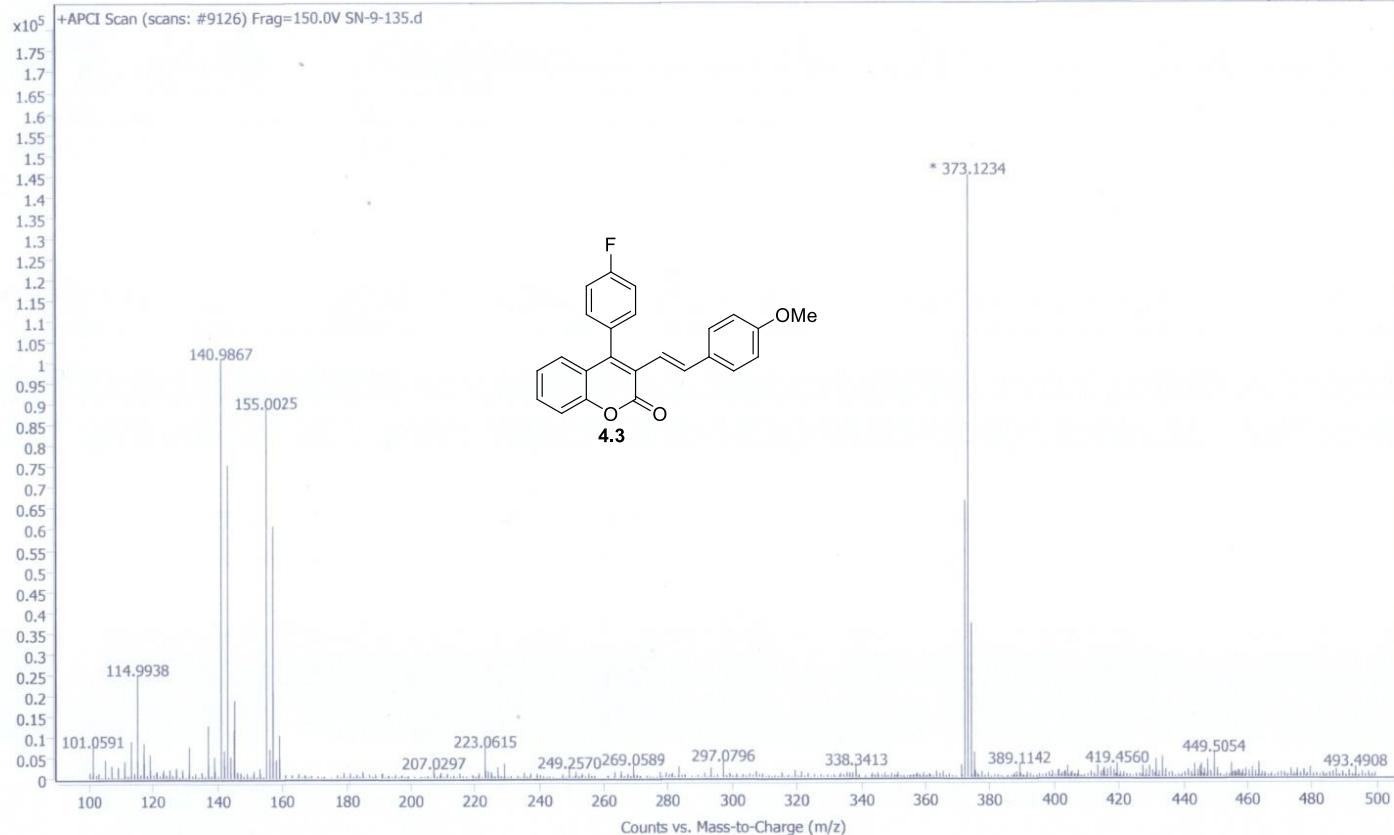
Generated at 11:58 AM on 16-12-2021

Mass Spectrum of (*E*)-4-(4-methoxyphenyl)-3-(4-methoxystyryl)-2*H*-chromen-2-one (**4.2**)

User Spectrum Plot Report



Name Inj. Vol. (ul)	SN-9-135 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-135.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	15-07-2021 01:27:12 PM (UTC+05:30)

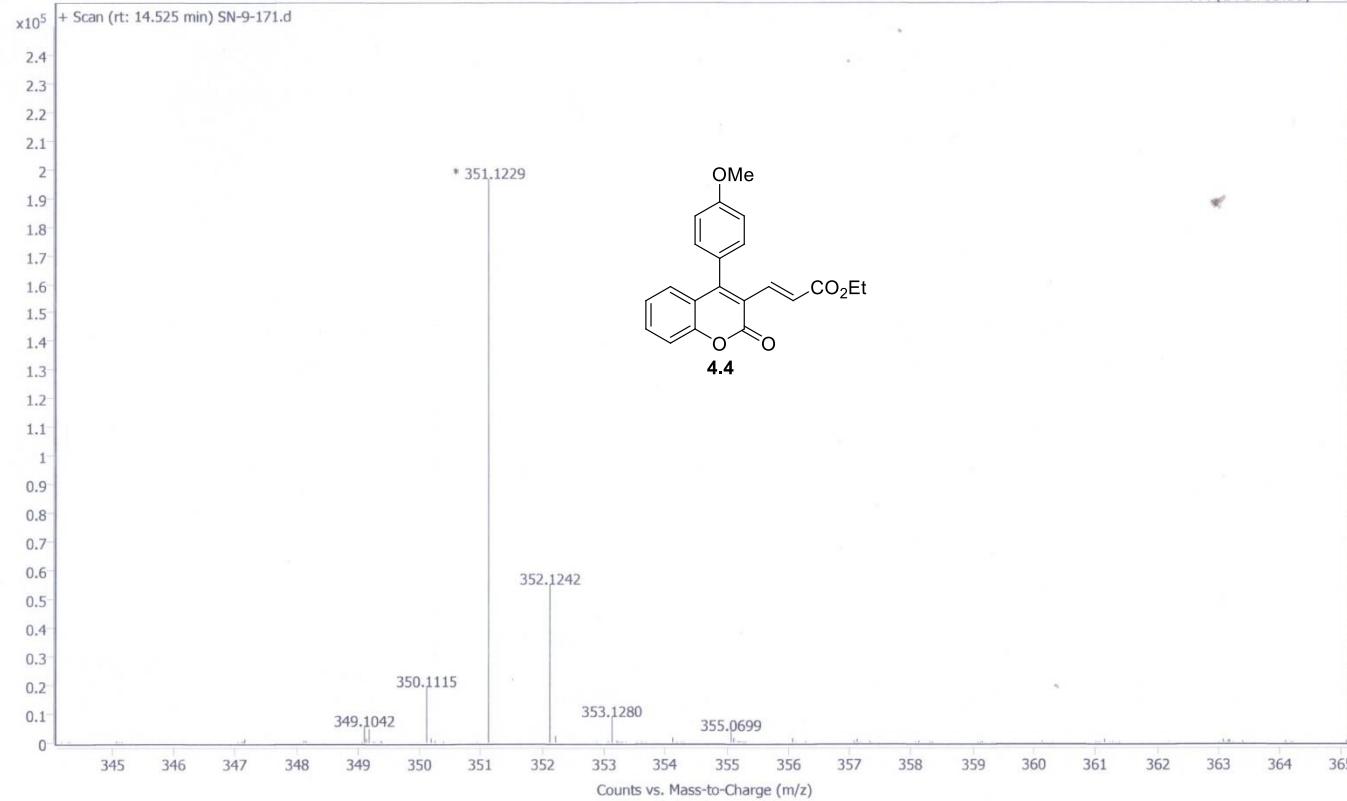


Mass Spectrum of (*E*)-4-(4-fluorophenyl)-3-(4-methoxystyryl)-2*H*-chromen-2-one (**4.3**)

User Spectrum Plot Report



Name Inj. Vol. (ul)	SN-9-171 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-171.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	08-12-2021 02:38:11 PM (UTC+05:30)

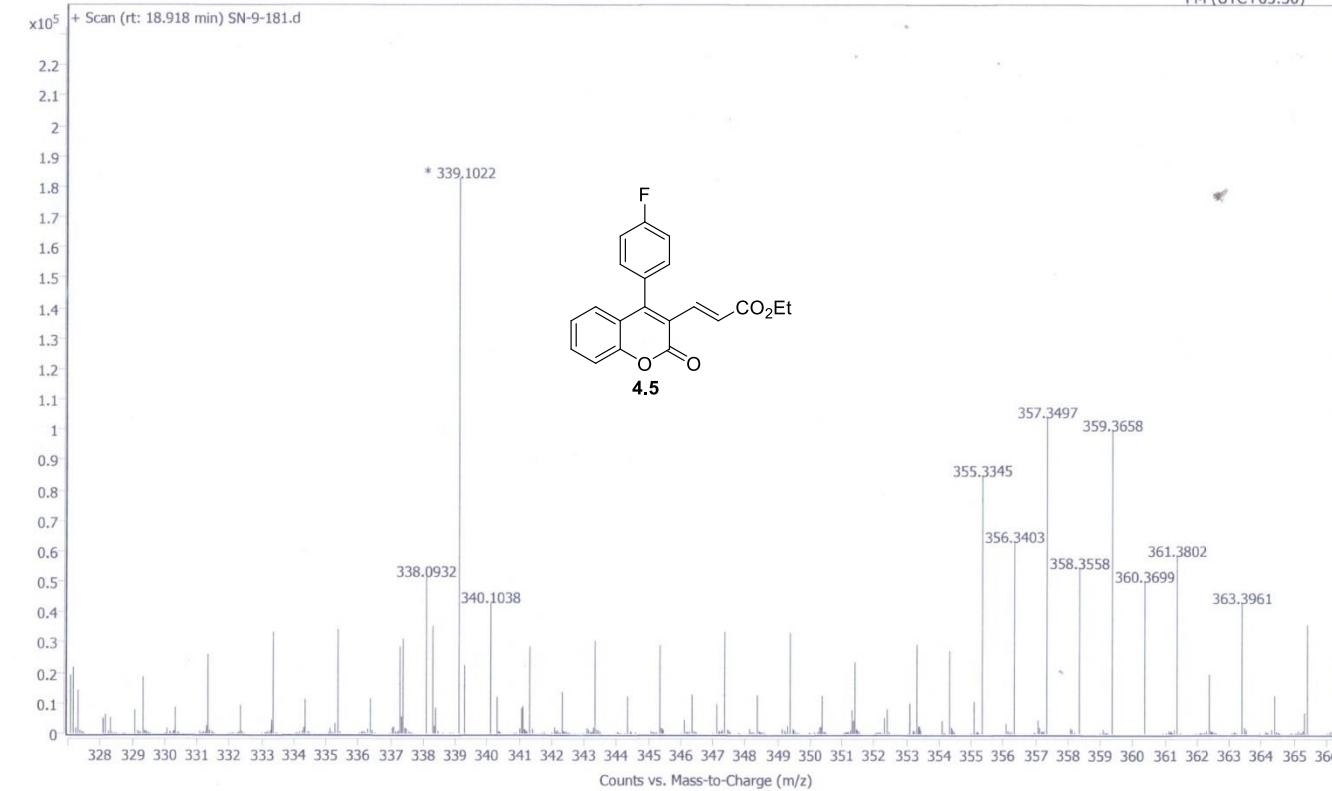


Mass Spectrum of (*E*)-ethyl 3-(4-(4-methoxyphenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (**4.4**)

User Spectrum Plot Report



Name Inj. Vol. (uL)	SN-9-181 Unknown / Injection Program	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	SN-9-181.d	Method (Acq)	GCAPCIIITK.m	Comment	Acq. Time (Local)	15-12-2021 12:20:51 PM (UTC+05:30)



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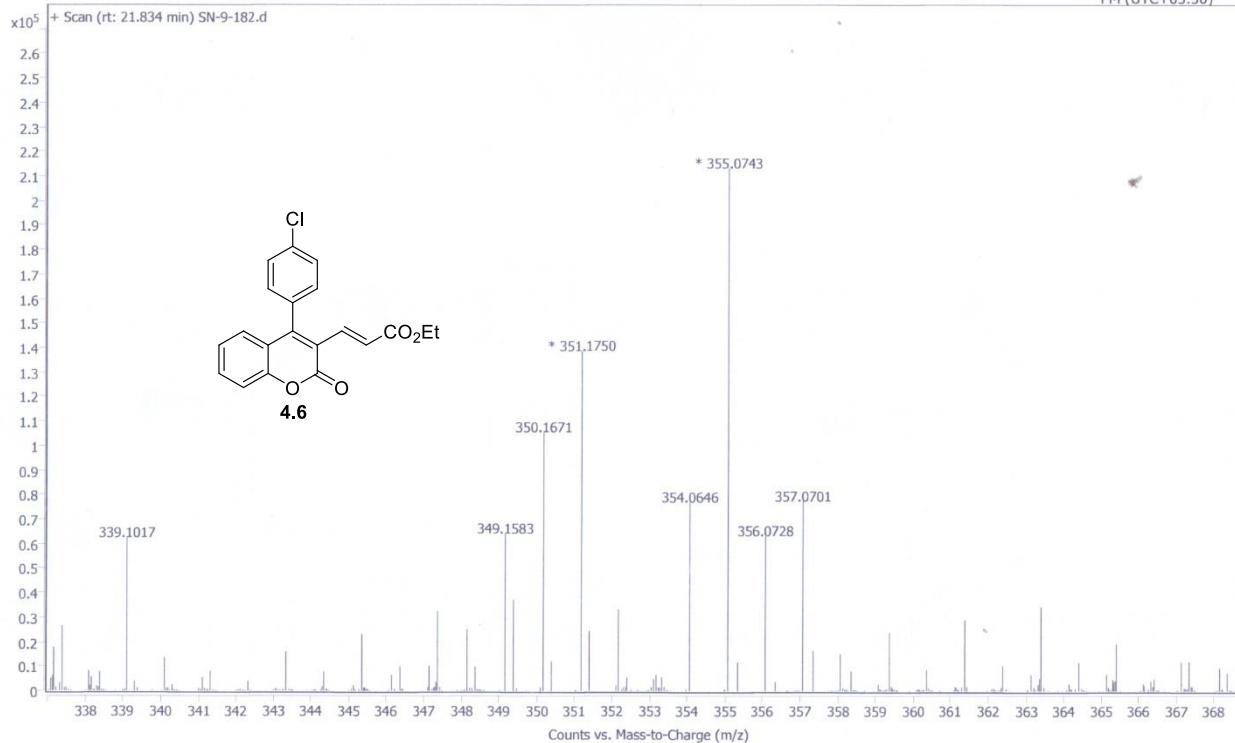
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Mass Spectrum of (*E*)-ethyl 3-(4-(4-fluorophenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (4.5)

User Spectrum Plot Report

Agilent | Trusted Answers

Name Inj. Vol. (uL)	SN-9-182 Unknown / Injection Program SN-9-182.d	Rack Pos. Plate Pos.	Instrument IRM Status	APCI-GCMS Success	Operator	ABHISHEK16IITK
Data File	GCAPCIITK.m	Method (Acq)	Comment		Acq. Time (Local)	15-12-2021 01:33:24 PM (UTC+05:30)



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Generated at 04:40 PM on 15-12-2021

Mass Spectrum of (*E*)-ethyl 3-(4-(4-chlorophenyl)-2-oxo-2*H*-chromen-3-yl)acrylate (4.6)