

SUPPLEMENTARY INFORMATION

Expanding the Chemical Space of Ester of Quinoxaline-7-Carboxylate 1,4-di-N-oxide Derivatives as Potential Antitubercular Agents: An *in vitro* and *in silico* Evaluation Against *Mycobacterium tuberculosis*

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Structural elucidation: Summary of percentage yield IR, NMR, and UPLC-MS information

T-137: 3-acetyl-6-(butoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 2.37 % yield, yellow solid (80-82 °C). FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); 1727, 1700 (C=O); 1323 (*N*-oxide); 1160-1300 ((C=O)-C-O). ^1H NMR (400 MHz, DMSO) δ 8.97 – 8.92 (m, 1H), 8.55 (dd, J = 9.0, 0.6 Hz, 1H), 8.37 (dd, J = 8.9, 1.8 Hz, 1H), 4.41 (t, J = 6.5 Hz, 2H), 2.67 (s, 3H), 2.40 (s, 3H), 1.84 – 1.72 (m, 2H), 1.55 – 1.41 (m, 2H), 0.98 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO) δ 195.61, 164.58, 141.15, 139.73, 138.88, 137.86, 133.48, 130.93, 121.58, 121.22, 66.06, 30.60, 29.96, 19.18, 14.30, 14.02. UPLC-MS: rt. 1.15 min, 319.05 m/z.

T-138: 6-(butoxycarbonyl)-3-(methoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 1.69 % yield, dark red think oil. FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); 1745, 1719 (C=O); 1331 (*N*-oxide); 1160-1300 ((C=O)-C-O). ^1H NMR (400 MHz, DMSO) δ 8.95 – 8.85 (m, 1H), 8.61 – 8.50 (m, 1H), 8.38 (ddd, J = 14.0, 8.9, 1.8 Hz, 1H), 4.41 (t, J = 6.6 Hz, 2H), 4.04 (s, 3H), 2.46 (s, 3H), 1.79 – 1.74 (m, 2H), 1.50 – 1.44 (m, 2H), 0.98 (t, 3H). ^{13}C -NMR (101 MHz, DMSO) δ 164.53, 160.49, 139.90, 138.95, 138.13, 133.64, 132.11, 131.03, 121.63, 121.45, 66.04, 54.47, 30.60, 19.18, 14.61, 14.01. UPLC-MS: rt. 1.15 min, 335.00 m/z

T-139: 6-(butoxycarbonyl)-3-(ethoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 2.03 % yield dark red think oil. FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); 1331 (*N*-oxide); 1745, 1719 (C=O); 1160-1300 ((C=O)-C-O). ^1H NMR (400 MHz, DMSO) δ 8.94 – 8.88 (m, 1H), 8.56 (dd, J = 17.9, 8.9 Hz, 1H), 8.37 (dd, J = 8.9, 1.8 Hz, 1H), 4.53 (q, J = 7.1 Hz, 2H), 4.40 (t, J = 6.5 Hz, 2H), 2.46 (s, 3H), 1.79 – 1.74 (m, 2H), 1.49 – 1.44 (m, 2H), 1.38 (t, J = 7.1 Hz, 3H), 0.97 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (126 MHz, CDCl_3) δ 164.33, 159.57, 134.42, 133.45, 132.45, 131.36, 122.54, 122.32, 121.00, 120.79, 66.22, 63.88, 30.64, 19.23, 14.44, 14.01, 13.73. UPLC-MS: rt. 1.17 min, 348.06 m/z

T-140: 6-(butoxycarbonyl)-3-(tert-butoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 1.25 % yield, dark red think oil. FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); 1724 (C=O); 1335 (*N*-oxide); 1160-1300 ((C=O)-C-O). ^1H NMR (400 MHz, DMSO) δ 8.93 (d, J = 1.7 Hz, 1H), 8.55 – 8.52 (m, 1H), 8.36 (dd, J = 8.9, 1.8 Hz, 1H), 4.40 (t, J = 6.5 Hz, 2H), 2.48 (s, 3H), 1.80 – 1.74 (m, 2H), 1.62 (s, 9H), 1.51 – 1.44 (m, 2H), 0.97 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO) δ 164.56, 158.83, 139.39, 139.02, 138.02, 136.90, 133.49, 130.99, 121.67, 121.41, 86.28, 66.05, 30.60, 28.06 (3C), 19.17, 14.30, 14.01. UPLC-MS: rt. 1.68 min, 377.11 m/z.

T-141: 3-((benzyloxy)carbonyl)-6-(butoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 1.38 % yield, dark red think oil. FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); (*N*-oxide); 1749, 1719 (C=O); 1331; 1300-1160 ((C=O)-C-O). ^1H NMR (400 MHz, DMSO) δ 8.93 (d, J = 1.8 Hz, 1H), 8.55 (d, J = 8.9 Hz, 1H), 8.37 (dd, J = 9.0, 1.8 Hz, 1H), 7.55 – 7.51 (m, 2H), 7.46 – 7.36 (m, 3H), 5.56 (s, 2H), 4.40 (t, J = 6.5 Hz, 2H), 2.42 (s, 3H), 1.78 (d, J = 4.5 Hz, 2H), 1.61 – 1.37 (m, 2H), 0.97 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO) δ 13.74, 14.26, 19.24, 30.64, 66.22, 69.34, 121.03, 122.31, 128.81, 128.87, 128.91, 129.16, 130.89, 131.34, 132.46, 133.98, 134.43, 137.79, 138.72, 139.77, 159.47, 164.32. UPLC-MS: rt. 1.76 min, 411.11 m/z.

T-142: 3-benzoyl-6-(butoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 2.48 % yield, light-yellow solid (124-126 °C). FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); 1721, 1674 (C=O); 1325 (*N*-oxide); 1160-1300 ((C=O)-C-O). ^1H NMR (400 MHz, DMSO) δ 9.04 – 8.99 (m, 1H), 8.52 (dd, J = 8.9, 0.6 Hz, 1H), 8.38 (dd, J = 9.0, 1.8 Hz, 1H), 8.12 – 8.05 (m, 2H), 7.79 (ddt, J = 8.7, 7.1, 1.3 Hz, 1H), 7.65 – 7.51 (m, 2H), 4.43 (t, J = 6.5 Hz, 2H), 2.34 (s, 3H), 1.85 – 1.70 (m, 2H), 1.55 – 1.41 (m, 2H), 0.98 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO) δ 187.43, 164.65, 140.20, 140.01, 139.29, 138.45, 135.93, 134.55, 133.44, 130.85, 129.95, 129.91, 121.68, 121.29, 66.08, 30.61, 19.19, 14.30, 14.03. UPLC-MS: rt. 1.45 min, 381.06 m/z.

T-143: 6-(butoxycarbonyl)-3-((4-chlorophenyl)carbamoyl)-2-methylquinoxaline 1,4-dioxide. 4.39 % yield, light-yellow solid (123-125 °C). FT IR (ν cm^{-1}): 3223.86 (N-H), 2900-3000 (ArC-H), 2900-2800 (C-H), 1720, 1676 (C=O); 1342 (*N*-oxide), 1160-1300 ((C=O)-C-O); 600-830 (ArC-Cl). ^1H NMR (400 MHz, DMSO) δ 11.12 (s, 1H), 9.01 (d, J = 1.8 Hz, 1H), 8.62 (d, J = 9.0 Hz, 1H), 8.42 (dd, J = 8.9, 1.8 Hz, 1H), 7.71 (d, J = 8.9 Hz, 2H), 7.51 (d, J = 10.8 Hz, 2H), 4.42 (t, J = 6.6 Hz, 3H), 2.53 (s, 3H), 1.81–1.74 (m, 2H), 1.49–1.42 (m, 2H), 0.98 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO) δ 163.64, 156.02, 143.21, 138.47, 138.04, 135.56, 135.05,

134.20, 132.21, 130.53, 129.03, 121.28, 120.84, 120.78, 66.48, 30.68, 19.23, 15.09, 13.78. UPLC-MS: rt. 1.38 min, 430.04 m/z.

T-144: 6-(butoxycarbonyl)-3-((2,4-dimethylphenyl)carbamoyl)-2-methylquinoxaline 1,4-dioxide. 2.68 % yield, yellow solid (124-126 °C). FT IR (ν cm^{-1}): 3362.94 (N-H); 2900-3000 (ArC-H); 2900-2800 (C-H); 1720, 1695 (C=O); 1318 (N-oxide); 1160-1300 ((C=O)-C-O). ^1H NMR (400 MHz, DMSO) δ 10.24 (s, 1H), 9.01 (d, J = 1.8 Hz, 1H), 8.64 (d, J = 9.0 Hz, 1H), 8.41 (dd, J = 8.9, 1.8 Hz, 1H), 7.51 (d, J = 8.0 Hz, 1H), 7.12 (s, 1H), 7.08 (dt, J = 8.3, 2.5 Hz, 1H), 4.41 (q, J = 6.8 Hz, 2H), 2.58 (s, 3H), 2.31 (s, 3H), 2.28 (s, 3H), 1.82 – 1.75 (m, 2H), 1.55 – 1.44 (m, 2H), 0.98 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO- d_6) δ 164.58, 157.84, 139.70, 139.03, 137.55, 135.93, 133.52, 132.49, 132.11, 131.62, 131.07, 130.40, 127.25, 125.09, 121.68, 121.62, 66.08, 30.66, 20.98, 19.19, 18.17, 14.73, 14.02. UPLC-MS: rt. 1.30 min, 423.14 m/z.

T-145: 3-acetyl-6-(butoxycarbonyl)-2-(trifluoromethyl)quinoxaline 1,4-dioxide. 6.72 % yield, dark yellow solid (138-139 °C). FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); 1726, 1714 (C=O); 1339 (N-oxide); 1160-1300 ((C=O)-C-O) 1176-1234 (C-F). ^1H NMR (400 MHz, DMSO) δ 8.93 (d, J = 1.7 Hz, 1H), 8.59 (dd, J = 8.9, 0.6 Hz, 1H), 8.52 (dd, J = 8.9, 1.8 Hz, 1H), 4.42 (t, J = 6.5 Hz, 2H), 2.63 (s, 3H), 1.84 – 1.73 (m, 2H), 1.55 – 1.41 (m, 2H), 0.98 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO) δ 191.77, 164.21, 140.81, 140.14, 138.97, 134.14, 133.46, 129.48, 121.65, 121.42, 120.86-118.14, 66.28, 30.56, 29.64, 19.18, 14.01. UPLC-MS: rt. 1.99 min, 373.11 m/z.

T-146: 6-(butoxycarbonyl)-3-(ethoxycarbonyl)-2-(trifluoromethyl)quinoxaline 1,4-dioxide. 6.21 % yield, light-yellow solid (117-118 °C). FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); 1744, 1729 (C=O); 1347 (N-oxide); 1160-1300 ((C=O)-C-O), 1156-1225 (C-F). ^1H NMR (400 MHz, DMSO) δ 8.90 (d, J = 1.7 Hz, 1H), 8.58 (dd, J = 9.0, 0.6 Hz, 1H), 8.50 (dd, J = 9.0, 1.8 Hz, 1H), 4.51 (q, J = 7.1 Hz, 2H), 4.42 (t, J = 6.5 Hz, 2H), 1.84 – 1.72 (m, 2H), 1.55 – 1.41 (m, 2H), 1.36 (t, J = 7.1 Hz, 3H), 0.98 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO) δ 164.20, 158.13, 140.87, 139.39, 135.03, 134.25, 133.50, 121.74, 121.65, 120.7-117.97, 66.27, 64.27, 30.56, 19.17, 14.07, 14.00. UPLC-MS: rt. 1.84 min, 403.09 m/z.

T-148: 3-benzoyl-6-(butoxycarbonyl)-2-(trifluoromethyl)quinoxaline 1,4-dioxide. 19.02 % yield, light-yellow solid (162-164 °C). FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); 1724, 1689 (C=O); 1339 (N-oxide); 1300-1160 ((C=O)-C-O); 1228-1135 (C-F). ^1H NMR (400 MHz, DMSO) δ 8.98 (dd, J = 1.6, 0.8 Hz, 1H), 8.58 – 8.48 (m, 2H), 8.19 – 8.11 (m, 2H), 7.84 – 7.75 (m, 1H), 7.66 – 7.58 (m, 2H), 4.44 (t, J = 6.5 Hz, 2H), 1.79 (dq, J = 7.9, 6.6 Hz, 2H), 1.56 – 1.42 (m, 2H), 0.98 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO) δ 184.53, 164.28, 141.21, 139.69, 138.97, 135.90, 134.40, 134.15, 133.38, 130.52-130.18, 129.90, 129.71, 121.76, 121.50, 120.93-118.22, 66.29, 30.58, 19.18, 14.02. UPLC-MS: rt. 2.13 min, 435.05 m/z.

T-149: 6-(butoxycarbonyl)-3-(thiophene-2-carbonyl)-2-(trifluoromethyl)quinoxaline 1,4-dioxide. 20.58 % yield, light-yellow solid (164-166 °C). FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); 1721, 1661 (C=O); 1330 (N-oxide); 1300-1160 ((C=O)-C-O); 1227-1134 (C-F); 700-600 (ArC-S). ^1H NMR (400 MHz, DMSO) δ 8.98 (d, J = 1.6 Hz, 1H), 8.60 – 8.49 (m, 2H), 8.29 (dd, J = 4.9, 1.2 Hz, 1H), 8.23 (dd, J = 3.9, 1.2 Hz, 1H), 7.32 (dd, J = 4.9, 3.9 Hz, 1H), 4.44 (t, J = 6.5 Hz, 2H), 1.85 – 1.74 (m, 2H), 1.56 – 1.42 (m, 2H), 0.98 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO) δ 176.30, 164.26, 141.29, 141.24, 139.61, 139.02, 138.43, 138.37, 134.20, 133.30, 129.90, 121.73, 121.64, 120.86-118.15, 66.29, 30.57, 19.18, 14.02. UPLC-MS: rt. 1.83 min, 441.02 m/z.

T-150: 3-(2-naphthoyl)-6-(butoxycarbonyl)-2-(trifluoromethyl)quinoxaline 1,4-dioxide. 1.17 % yield, light-yellow solid (165-167 °C). FT IR (ν cm^{-1}): 2900-3000 (ArC-H); 2900-2800 (C-H); 1726, 1675 (C=O); 1338 (N-oxide); 1300-1160 ((C=O)-C-O); 1259-1156 (C-F). ^1H NMR (400 MHz, DMSO) δ 9.03 (dd, J = 1.7, 0.7 Hz, 1H), 8.85 (d, J = 1.1 Hz, 1H), 8.61 – 8.50 (m, 2H), 8.14 (d, J = 1.3 Hz, 2H), 8.09 – 8.01 (m, 2H), 7.75 (ddd, J = 8.3, 6.9, 1.3 Hz, 1H), 7.66 (ddd, J = 8.1, 6.9, 1.3 Hz, 1H), 4.45 (t, J = 6.5 Hz, 2H), 1.84 – 1.76 (m, 2H), 1.52 – 1.46 (m, 2H), 0.99 (t, J = 7.4 Hz, 3H). ^{13}C -NMR (101 MHz, DMSO- d_6) δ 184.40, 164.28, 141.27, 139.65, 139.09, 136.51, 134.21, 133.14, 132.82, 131.89, 131.32, 130.11, 129.71, 128.45, 127.95, 123.45, 121.80, 121.63, 120.93-118.22, 66.32, 30.58, 19.19, 14.02. UPLC-MS: rt. 2.60 min, 484.33 m/z.

T-151: 6-(butoxycarbonyl)-2-phenyl-3-(phenylcarbamoyl)quinoxaline 1,4-dioxide. 21.88 % yield, yellow solid (118-120 °C). FT IR (ν cm^{-1}): 3297.34 (N-H); 2900-3000 (ArC-H); 2900-2800 (C-H); 1719, 1666 (C=O); 1338 (N-oxide); 1160-1300 ((C=O)-C-O). ^1H NMR (400 MHz, DMSO) δ 10.77 (s, 1H), 9.04 (dd, J = 3.0, 1.7 Hz, 1H), 8.69 (dd, J = 9.0, 2.1 Hz, 1H), 8.49 (dt, J = 8.9, 1.7 Hz, 1H), 7.67 – 7.61 (m, 2H), 7.52 – 7.46 (m, 4H), 7.38 (dt, J = 8.3, 1.5 Hz, 2H), 7.34 – 7.28 (m, 2H), 4.43 (td, J = 6.5, 3.6 Hz, 2H), 1.85 – 1.73 (m, 2H), 1.49 (hd, J = 7.4, 2.2 Hz, 2H), 0.98 (td, J = 7.4, 2.3 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 164.54, 156.70, 140.94, 140.30, 139.81, 139.51, 138.26, 137.97, 133.74, 133.42, 132.21, 131.85, 130.80, 130.25, 129.47, 128.71, 128.42, 125.06, 122.28, 121.72, 119.96, 66.12, 30.61, 19.20, 14.03. UPLC-MS: rt. 1.30 min, 458.16 m/z.

T-155: 3-acetyl-6-(isobutoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 13.4 % yield, yellow solid (95-97 °C). FT IR (ν cm^{-1}): 2962 (ArC-H), 1716 (C=O); 1328 (N-oxide). ^1H NMR (400 MHz, DMSO) δ 8.96 (dd, J = 1.8, 0.5 Hz, 1H), 8.56 (dd, J = 8.9, 0.6 Hz, 1H), 8.38 (dd, J = 9.0, 1.8 Hz, 1H), 4.20 (d, J = 6.6 Hz, 2H), 2.67 (s, 3H), 2.40 (s, 3H), 2.12 (hept, J = 6.7 Hz, 1H), 1.03 (d, J = 6.8 Hz, 6H). ^{13}C -NMR (101 MHz, DMSO) δ 195.61, 164.52, 141.16, 139.75, 138.91, 137.87, 133.45, 130.92, 121.58, 121.26, 71.96, 29.96, 27.83, 19.34, 14.00. UPLC-MS: rt. 1.73 min, 319.56 m/z.

T-156: 6-(isobutoxycarbonyl)-3-(methoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 4.3 % yield, yellow solid (115-117 °C). FT IR (ν cm^{-1}): 2959-3099 (ArC-H), 1744, 1718 (C=O), 1327 (N-oxide). ^1H NMR (400 MHz, DMSO) δ 8.96 – 8.87 (m, 1H), 8.56 (dd, J = 17.9, 9.0 Hz, 1H), 8.40 (ddd, J = 13.9, 8.9, 1.8 Hz, 1H), 4.20 (dd, J = 6.5, 2.0 Hz, 2H), 4.04 (s, 3H), 2.46 (d, J = 2.6 Hz, 3H), 2.11 (dpd, J = 13.3, 6.7, 2.6 Hz, 1H), 1.02 (dd, J = 6.7, 1.4 Hz, 6H). ^{13}C -NMR (101 MHz, DMSO) δ 164.48, 160.46, 139.90, 138.15, 136.50, 132.65, 132.10, 131.02, 121.63, 121.44, 71.97, 54.47, 27.83, 19.32, 14.61. UPLC-MS: rt. 1.71 min, 335.54 m/z.

T-157: 3-benzoyl-6-(isobutoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 20 % yield, light-yellow solid (130-132 °C). FT IR (ν cm^{-1}): 2970-3101 (ArC-H), 1726, 1675 (C=O), 1322 (N-oxide). ^1H NMR (400 MHz, DMSO) δ 9.03 (d, J = 1.8 Hz, 1H), 8.52 (d, J = 8.9 Hz, 1H), 8.40 (dd, J = 8.9, 1.8 Hz, 1H), 8.12 – 8.05 (m, 2H), 7.83 – 7.74 (m, 1H), 7.65 – 7.55 (m, 2H), 4.23 (d, J = 6.5 Hz, 2H), 2.34 (s, 3H), 2.13 (hept, J = 6.7 Hz, 1H), 1.04 (d, J = 6.7 Hz, 6H). ^{13}C -NMR (101 MHz, DMSO) δ 187.42, 164.60, 140.21, 140.01, 139.31, 138.47, 135.92, 134.55, 133.40, 130.84, 129.95, 129.90, 121.68, 121.34, 71.96, 27.85, 19.34, 14.30. UPLC-MS: rt. 1.77 min, 381.13 m/z.

T-158: 6-(isobutoxycarbonyl)-2-methyl-3-(phenylcarbamoyl)quinoxaline 1,4-dioxide. 22.5 % yield, yellow solid (135-137 °C). FT IR (ν cm^{-1}): 3260 (N-H), 2960-2874 (ArC-H), 1720, 1677 (C=O), 1375 (N-oxide). ^1H NMR (400 MHz, DMSO) δ 10.96 (s, 1H), 9.02 (d, J = 1.8 Hz, 1H), 8.63 (d, J = 9.0 Hz, 1H), 8.43 (dd, J = 9.0, 1.8 Hz, 1H), 7.72 – 7.64 (m, 2H), 7.43 (t, J = 7.9 Hz, 2H), 7.23 – 7.18 (m, 1H), 4.22 (d, J = 6.5 Hz, 2H), 2.54 (s, 3H), 2.13 (hept, J = 6.6 Hz, 1H), 1.04 (d, J = 6.7 Hz, 6H). ^{13}C -NMR (101 MHz, DMSO) δ 164.52, 157.30, 140.49, 139.32, 138.99, 138.27, 137.63, 133.59, 131.16, 129.63, 125.24, 121.72, 121.65, 120.10, 72, 27.84, 19.36, 14.72. UPLC-MS: rt. 1.80 min, 396.58 m/z.

T-159: 3-((2,4-dimethylphenyl)carbamoyl)-6-(isobutoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 3.7 % yield, yellow solid (128-131 °C). FT IR (ν cm^{-1}): 3349 (N-H), 2957-2873 (ArC-H), 1717, 1695 (C=O), 1374 (N-oxide). ^1H NMR (500 MHz, CDCl_3) δ 10.75 (s, 1H), 9.26 (d, J = 1.7 Hz, 1H), 8.71 (d, J = 9.0 Hz, 1H), 8.47 (dd, J = 9.0, 1.8 Hz, 1H), 7.88 (d, J = 7.9 Hz, 1H), 7.09 (d, J = 7.9 Hz, 2H), 4.25 (d, J = 6.7 Hz, 2H), 2.97 (s, 3H), 2.44 (s, 3H), 2.35 (s, 3H), 2.23 – 2.13 (m, 1H), 1.09 (d, J = 6.7 Hz, 6H). ^{13}C -NMR (126 MHz, CDCl_3) δ 164.23, 159.91, 144.50, 138.11, 137.37, 137.15, 135.92, 134.39, 132.20, 131.65, 131.41, 129.71, 127.34, 123.11, 122.35, 121.23, 72.34, 27.87, 20.99, 19.19, 18.12, 15.84.

T-161: 3-((4-chlorophenyl)carbamoyl)-6-(isobutoxycarbonyl)-2-methylquinoxaline 1,4-dioxide. 14 % yield, yellow solid (130-132 °C). FT IR (ν cm^{-1}): 3245-3188 (N-H), 2965-2873 (ArC-H), 1722, 1685 (C=O), 1342 (N-oxide), 829 (Ar-Cl). ^1H NMR (400 MHz, DMSO) δ 11.12 (s, 1H), 9.02 (d, J = 1.7 Hz, 1H), 8.63 (d, J = 9.0 Hz, 1H), 8.43 (dd, J = 8.9, 1.8 Hz, 1H), 7.75 – 7.67 (m, 2H), 7.50 – 7.46 (m, 2H), 4.21 (d, J = 6.6 Hz, 2H), 2.53 (s, 3H), 2.12 (hept, J = 6.7 Hz, 1H), 1.04 (d, J = 6.7 Hz, 6H). ^{13}C -NMR (101 MHz, DMSO) δ 164.50, 157.41, 140.47, 139.11, 138.96, 137.68, 137.18, 133.64, 131.20, 129.58, 128.95, 121.73, 121.71, 121.66, 72, 27.84, 19.36, 14.71. UPLC-MS: rt. 1.70 min, 430.12 m/z.

T-163. 3-benzoyl-6-(isobutoxycarbonyl)-2-(trifluoromethyl)quinoxaline 1,4-dioxide. 2.7 % yield, light-yellow solid (148-150 °C). FT IR (ν cm^{-1}): 2876-3095 (ArC-H), 1721, 1689 (C=O), 1338 (*N*-oxide), 1285-1132 (Ar-CF₃). ¹H NMR (400 MHz, DMSO) δ 8.99 (s, 1H), 8.54 (s, 1H), 8.15 (d, J = 7.2 Hz, 1H), 7.88 (d, J = 7.8 Hz, 2H), 7.78 (d, J = 7.5 Hz, 1H), 7.62 (t, J = 7.7 Hz, 2H), 4.24 (d, J = 6.5 Hz, 2H), 2.13 (dp, J = 13.3, 6.6 Hz, 1H), 1.04 (d, J = 6.7 Hz, 6H). ¹³C-NMR (101 MHz, DMSO) δ 184.52, 164.23, 141.25, 139.70, 135.90, 134.40, 134.11, 133.38, 129.90, 129.71, 128.96, 127.60, 121.74, 121.55, 72.15, 27.83, 19.32. UPLC-MS: rt. 3.072 min, 435.09 m/z.

T-164. 6-(isobutoxycarbonyl)-3-(thiophene-2-carbonyl)-2-(trifluoromethyl)quinoxaline 1,4-dioxide. 4.1 % yield, light yellow solid (167-168 °C). FT IR (ν cm^{-1}): 2959 (ArC-H), 1720, 1657 (C=O), 1358 (*N*-oxide), 1155 (Ar-CF₃). ¹H NMR (400 MHz, DMSO) δ 8.99 (d, J = 1.7 Hz, 1H), 8.61 – 8.50 (m, 2H), 8.29 (dd, J = 4.9, 1.2 Hz, 1H), 8.22 (dd, J = 3.9, 1.2 Hz, 1H), 7.32 (t, J = 4.4 Hz, 1H), 4.24 (d, J = 6.5 Hz, 2H), 2.13 (hept, J = 6.6 Hz, 1H), 1.04 (d, J = 6.7 Hz, 6H). ¹³C-NMR (101 MHz, DMSO) δ 176.29, 164.22, 141.32, 141.24, 139.63, 139.02, 138.43, 134.16, 133.38, 129.92, 121.73, 121.69, 120.88-118.15, 72.15, 27.83, 19.32. UPLC-MS: rt. 2.66 min, 444.17 m/z.

T-165. 3-(furan-2-carbonyl)-6-(isobutoxycarbonyl)-2-(trifluoromethyl)quinoxaline 1,4-dioxide. 9.0 % yield, light-yellow solid (164-166 °C). FT IR (ν cm^{-1}): 2962-2876 (ArC-H), 1722, 1665 (C=O), 1339 (*N*-oxide). ¹H NMR (400 MHz, DMSO) δ 8.98 (d, J = 1.7 Hz, 1H), 8.56 (qd, J = 8.9, 1.2 Hz, 2H), 8.24 (dd, J = 1.7, 0.7 Hz, 1H), 7.89 (dd, J = 3.7, 0.8 Hz, 1H), 6.84 (dd, J = 3.7, 1.7 Hz, 1H), 4.23 (d, J = 6.5 Hz, 2H), 2.13 (hept, J = 6.7 Hz, 1H), 1.04 (d, J = 6.7 Hz, 6H). ¹³C-NMR (101 MHz, DMSO) δ 170.15, 164.19, 151.42, 150.47, 141.25, 139.61, 137.74, 134.25, 133.44, 130.27, 124.62, 121.75, 121.71, 120.88-118.15, 114.08, 72.16, 27.82, 19.31. UPLC-MS: rt. 2.41 min, 425.47 m/z.

T-166. 3-(2-naphthoyl)-6-(isobutoxycarbonyl)-2-(trifluoromethyl)quinoxaline 1,4-dioxide. 5.0 % yield, yellow solid (180-182 °C). FT IR (ν cm^{-1}): 2875-3095 (ArC-H), 1722, 1687 (C=O), 1339 (*N*-oxide), 1170-1125 (Ar-CF₃). ¹H NMR (400 MHz, DMSO) δ 9.04 (s, 0H), 8.85 (d, J = 1.2 Hz, 1H), 8.62 – 8.52 (m, 2H), 8.14 (d, J = 1.3 Hz, 2H), 8.10 – 7.99 (m, 2H), 7.75 (ddd, J = 8.3, 6.9, 1.3 Hz, 1H), 7.66 (ddd, J = 8.2, 6.9, 1.3 Hz, 1H), 4.25 (d, J = 6.0 Hz, 1H), 2.13 (dh, J = 12.8, 6.4 Hz, 1H), 1.05 (d, J = 6.7 Hz, 6H). ¹³C-NMR (101 MHz, DMSO) δ 184.39, 164.24, 141.30, 139.66, 136.51, 134.18, 133.46, 133.15, 132.82, 131.89, 130.32, 130.11, 129.78, 128.47, 127.95, 123.45, 121.79, 121.68, 120.99-118.26, 72.16, 27.84, 19.32.

T-167. 3-acetyl-6-(isobutoxycarbonyl)-2-(trifluoromethyl)quinoxaline 1,4-dioxide. 4.8 % yield, yellow solid (102 °C). FT IR (ν cm^{-1}): 2962-3093 (ArC-H), 1721 (C=O), 1334 (*N*-oxide), 1282-1152 (Ar-CF₃). ¹H NMR (400 MHz, DMSO) δ 8.96 – 8.91 (m, 1H), 8.60 (dd, J = 8.9, 0.6 Hz, 1H), 8.53 (dd, J = 9.0, 1.8 Hz, 1H), 4.22 (d, J = 6.5 Hz, 2H), 2.63 (s, 3H), 2.12 (hept, J = 6.7 Hz, 1H), 1.03 (d, J = 6.7 Hz, 6H). ¹³C-NMR (101 MHz, DMSO) δ 191.77, 164.16, 140.98, 140.14, 138.98, 134.10, 133.46, 129.15, 121.64, 121.46, 120.896-118.14, 72.15, 29.65, 27.81, 19.32. UPLC-MS: rt. 2.09 min, 373.08 m/z.

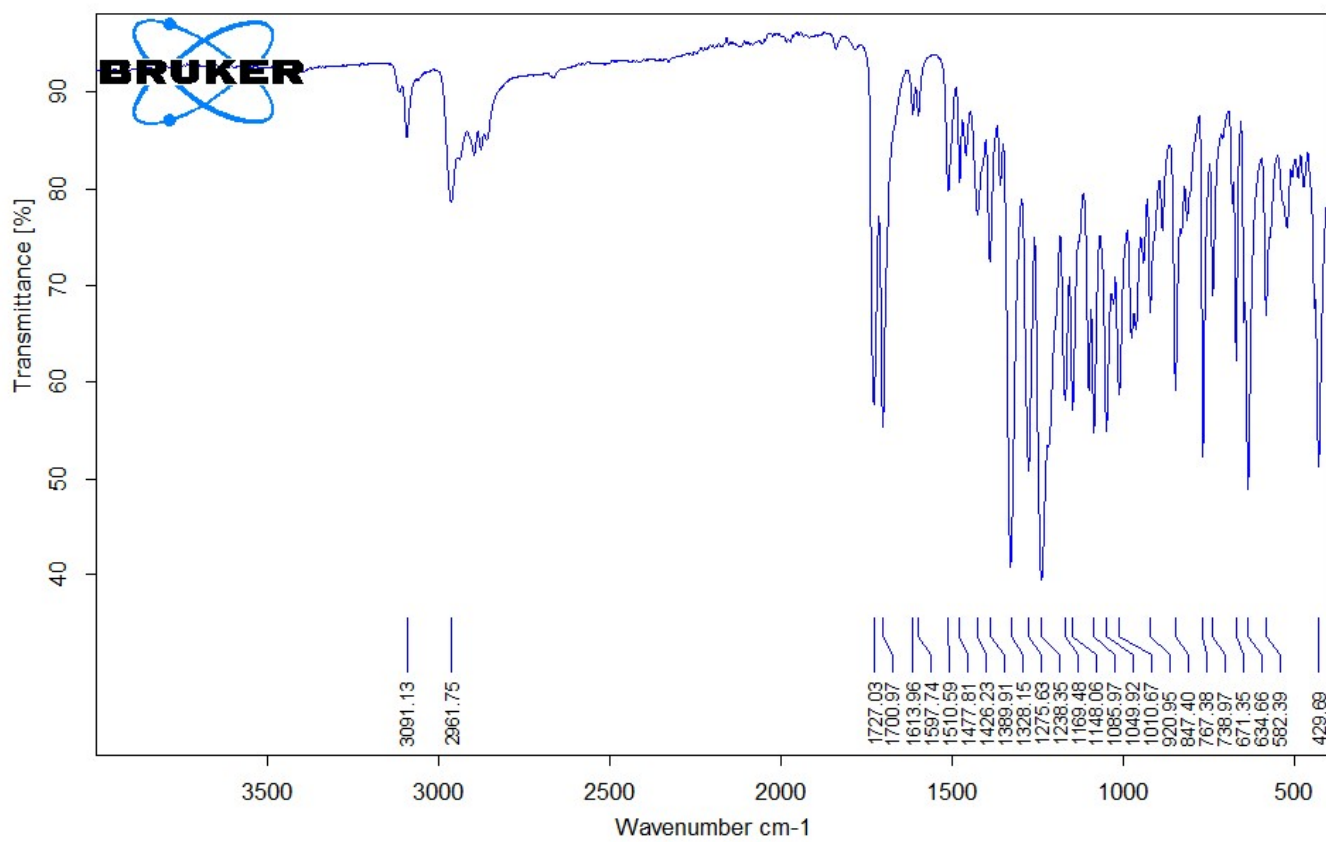
T-168. 2-benzoyl-6-(isobutoxycarbonyl)-3-methylquinoxaline 1,4-dioxide. 10.5 % yield, light-yellow solid (131-133 °C). FT IR (ν cm^{-1}): 2874-3110 (ArC-H), 1718, 1685 (C=O), 1322 (*N*-oxide). ¹H NMR (400 MHz, DMSO) δ 8.88 (d, J = 1.7 Hz, 1H), 8.66 (d, J = 9.0 Hz, 1H), 8.47 (dd, J = 4.0, 1.8 Hz, 1H), 8.13 – 8.05 (m, 2H), 7.83 – 7.74 (m, 1H), 7.64 – 7.56 (m, 2H), 4.21 (d, J = 6.5 Hz, 2H), 2.46 (s, 3H), 2.11 (dh, J = 13.3, 6.6 Hz, 1H), 1.01 (d, J = 5.4 Hz, 6H). ¹³C-NMR (101 MHz, DMSO) δ 187.40, 164.51, 141.75, 140.45, 138.53, 135.91, 133.52, 131.58, 130.39, 129.89, 128.97, 121.54, 121.35, 72.00, 30.26, 27.83, 19.32. UPLC-MS: rt. 1.65 min, 381.13 m/z.

T-169. 6-(isobutoxycarbonyl)-2-phenyl-3-(phenylcarbamoyl)quinoxaline 1,4-dioxide. 3.5 % yield, yellow solid (150-153 °C). FT IR (ν cm^{-1}): 3198 (N-H), 2961 (ArC-H), 1723, 1685 (C=O), 1333 (*N*-oxide). ¹H NMR (400 MHz, DMSO) δ 10.77 (d, J = 17.6 Hz, 1H), 9.06 (d, J = 1.9 Hz, 1H), 8.70 (d, J = 9.0 Hz, 1H), 8.50 (d, J = 8.9 Hz, 1H), 7.64 (dd, J = 6.5, 3.0 Hz, 2H), 7.51 – 7.47 (m, 3H), 7.39 (d, J = 8.0 Hz, 2H), 7.31 (t, J = 7.8 Hz, 2H), 7.11 (t, J = 7.2 Hz, 1H), 4.22 (d, J = 6.4 Hz, 2H), 2.12 (hept, J = 6.9 Hz, 1H), 1.04 (d, J = 6.8 Hz, 6H). ¹³C-NMR (101 MHz, DMSO) δ 164.49, 156.70, 140.96, 139.82, 139.53, 138.27, 137.97, 133.70, 131.84, 130.80, 130.26, 129.47, 128.71, 128.42, 125.06, 122.28, 121.76, 119.97, 72.02, 27.84, 19.35..

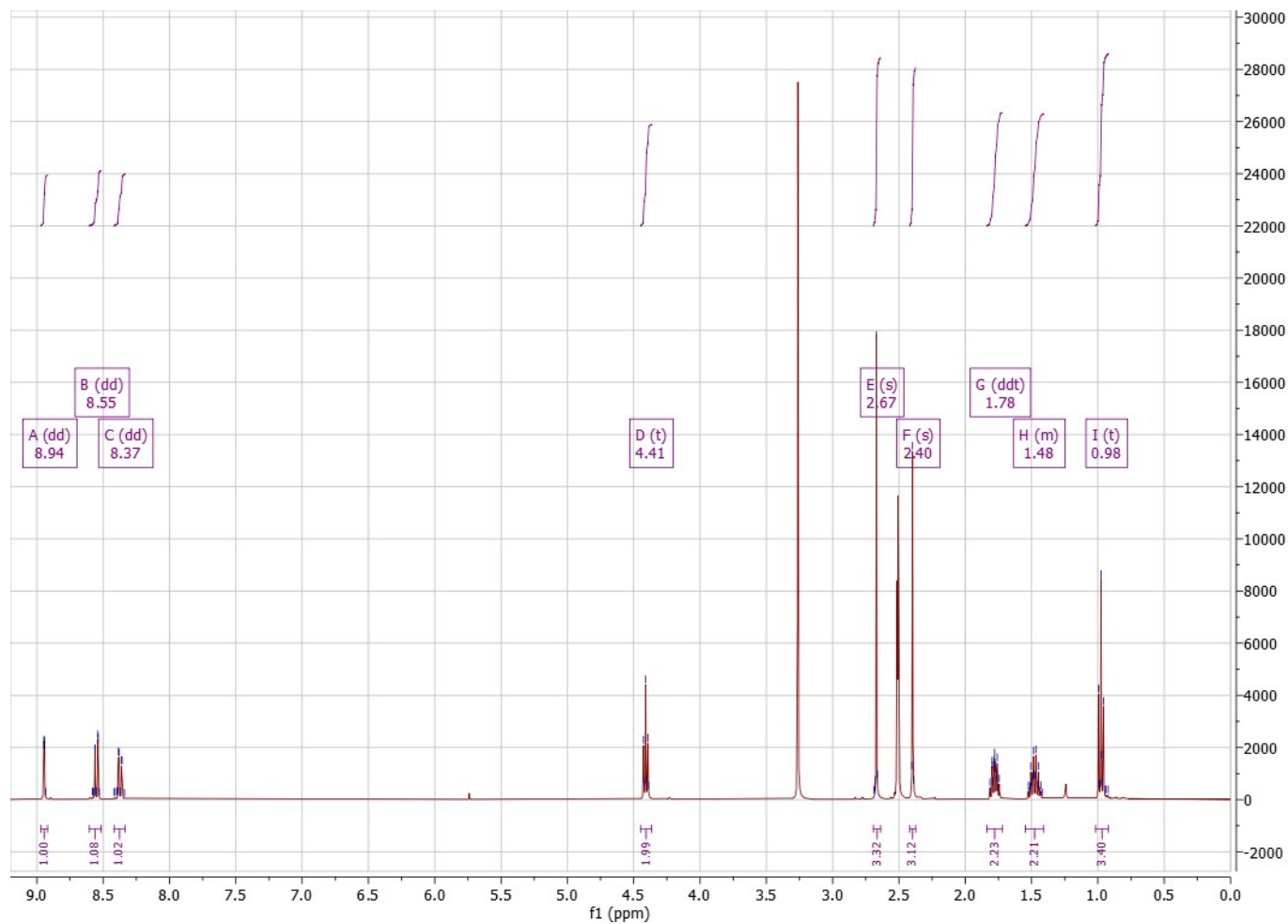
T-170. 2-((2,4-dimethylphenyl)carbamoyl)-6-(isobutoxycarbonyl)-3-methylquinoxaline 1,4-dioxide. 2.3 % yield, yellow solid (129-132 °C). FT IR (ν cm^{-1}): 3103 (N-H), 2960-2872 (ArC-H), 1725, 1664 (C=O), 1335 (N-oxide). ^1H NMR (500 MHz, CDCl_3) δ 9.93 (s, 1H), 8.83 (d, $J = 1.8$ Hz, 1H), 8.49 – 8.38 (m, 1H), 8.18 (d-, $J = 8.7$ Hz, 1H), 8.04 (dd, $J = 8.0, 5.3$ Hz, 1H), 7.16 – 7.09 (m, 2H), 4.24 (d, $J = 6.7$ Hz, 2H), 3.26 (s, 3H), 2.44 (s, 3H), 2.36 (s, 3H), 2.19 (ddt, $J = 13.4, 9.6, 6.7$ Hz, 1H), 1.11 (dd, $J = 6.7, 2.5$ Hz, 6H). ^{13}C -NMR (101 MHz, DMSO) δ 165.58, 161.67, 144.67, 142.41, 140.89, 134.96, 133.24, 132.95, 131.79, 131.29, 131.20, 130.89, 129.45, 128.79, 127.45, 121.95, 71.86, 27.93, 25.13, 20.96, 19.23, 17.78. UPLC-MS: rt. 1.67 min, 424.18 m/z.

ii. IR, NMR, and UPLC-MS spectra

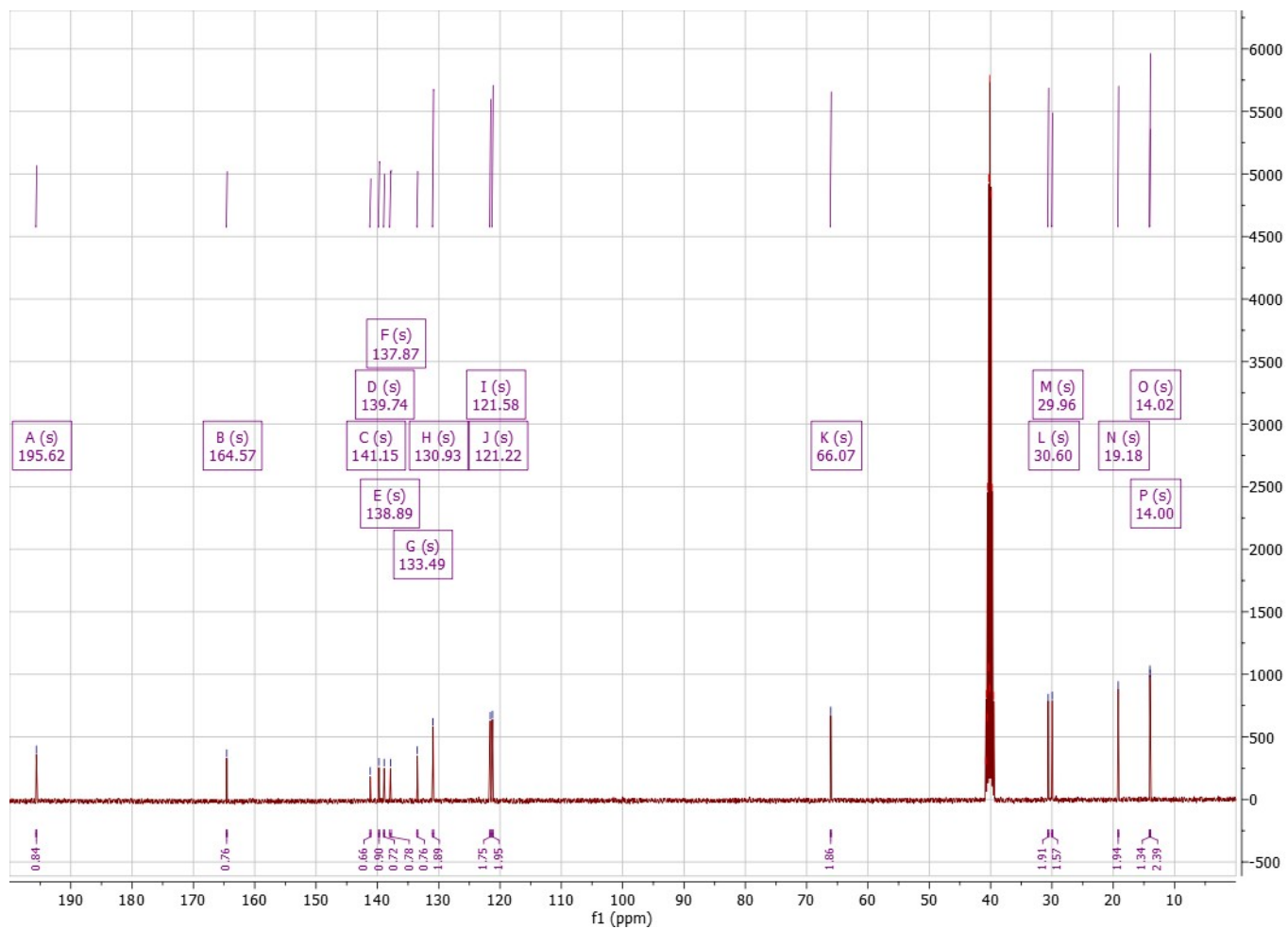
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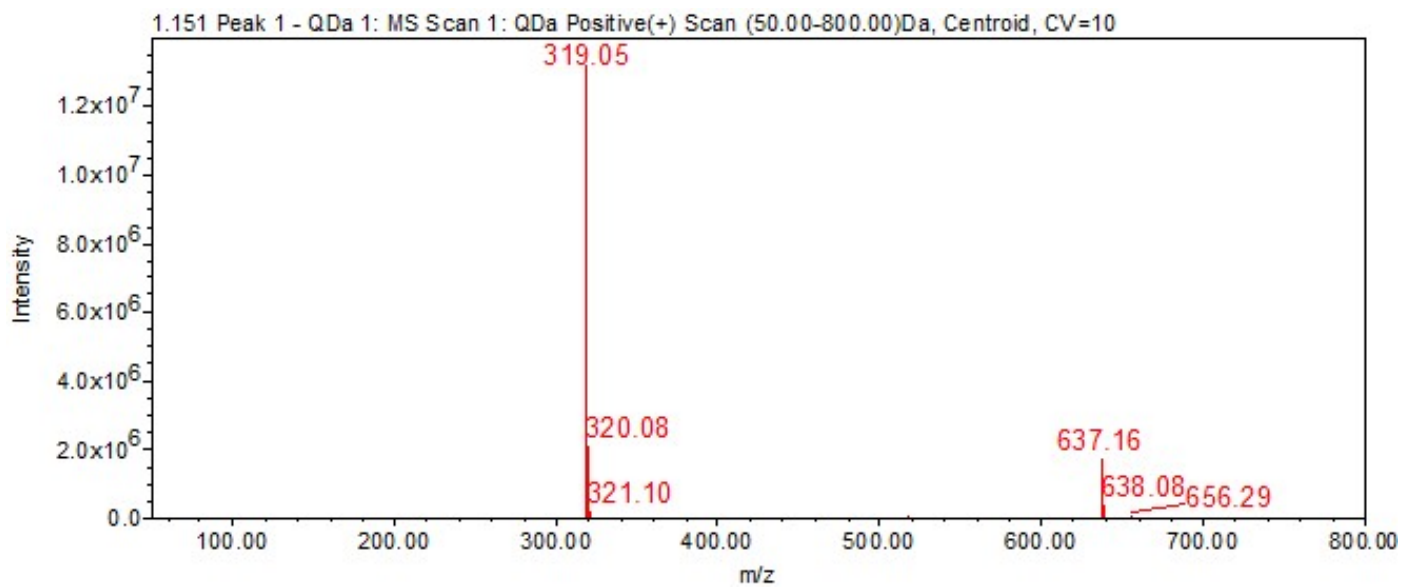
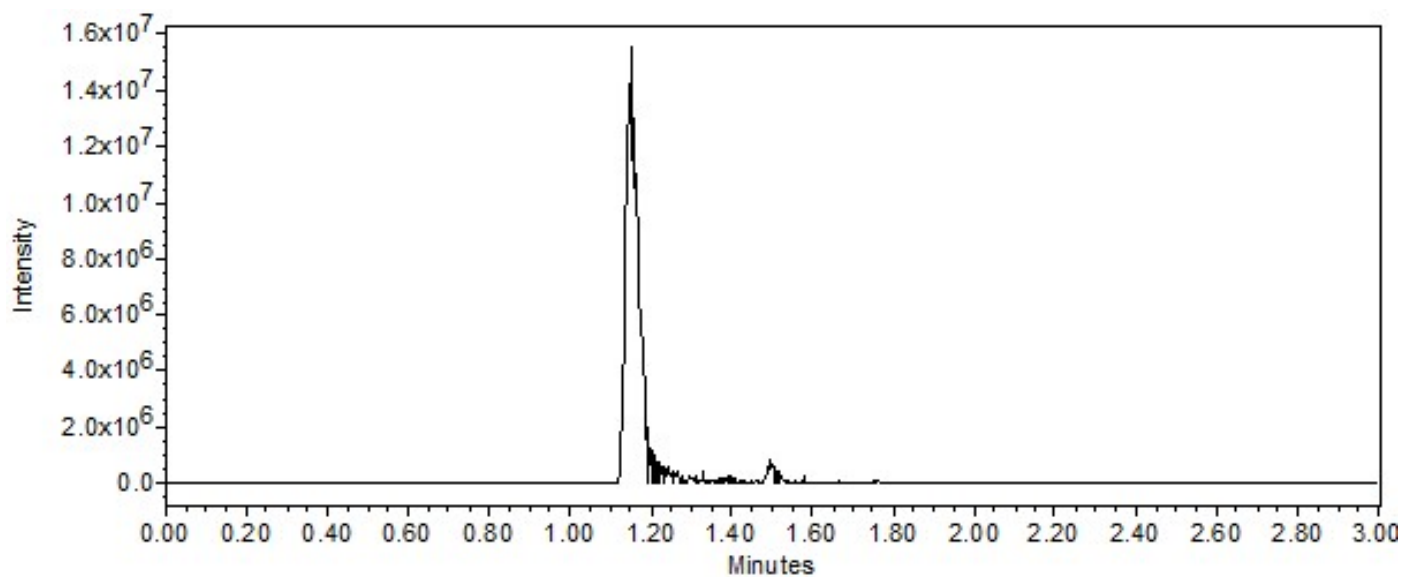
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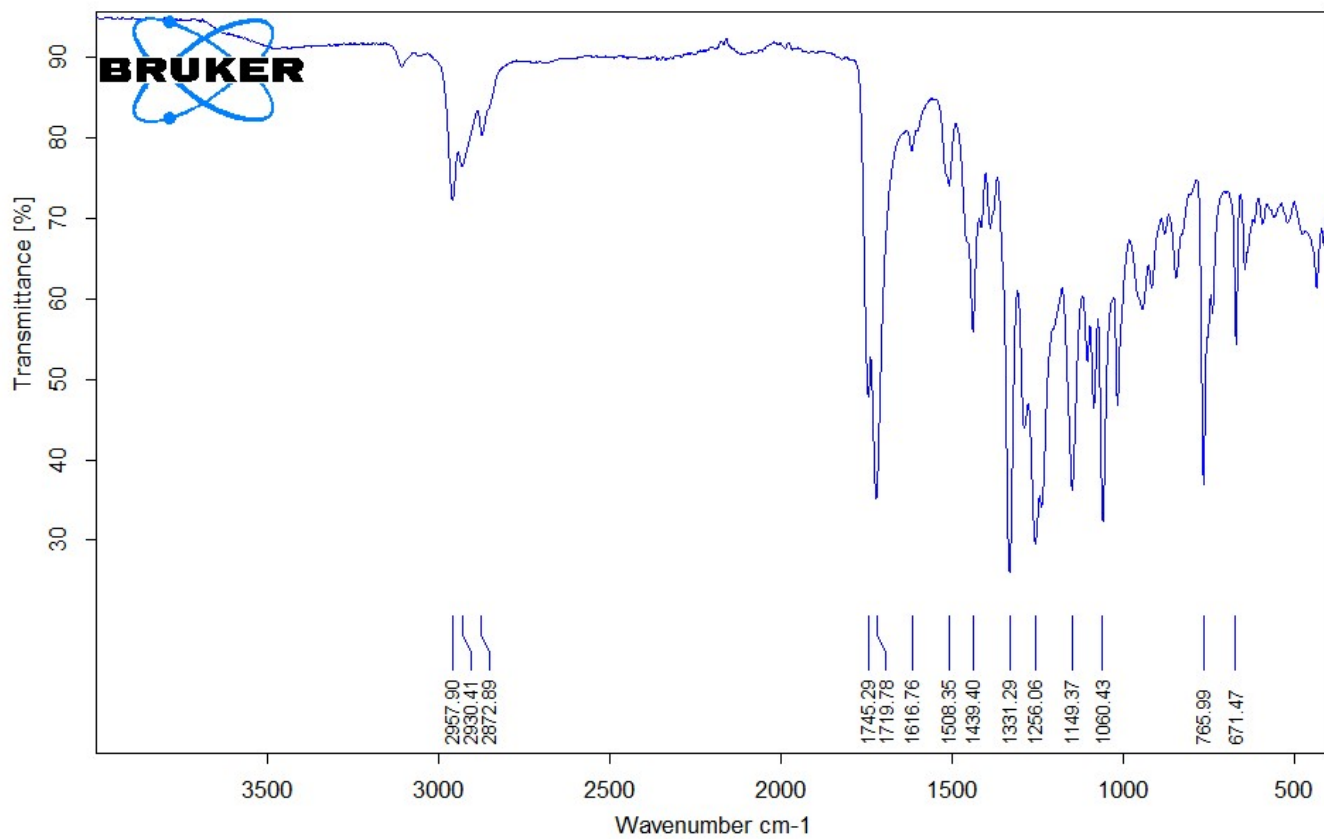
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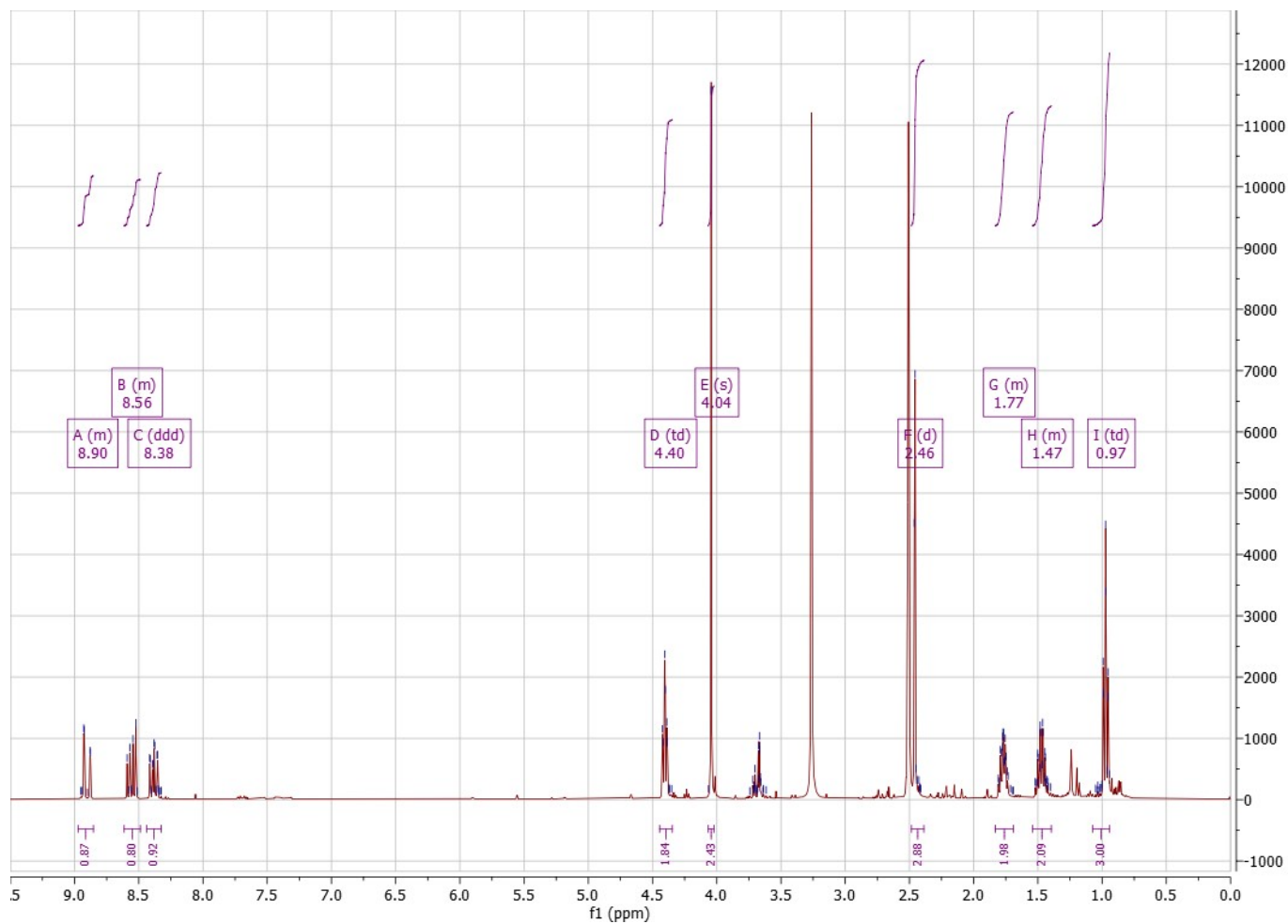
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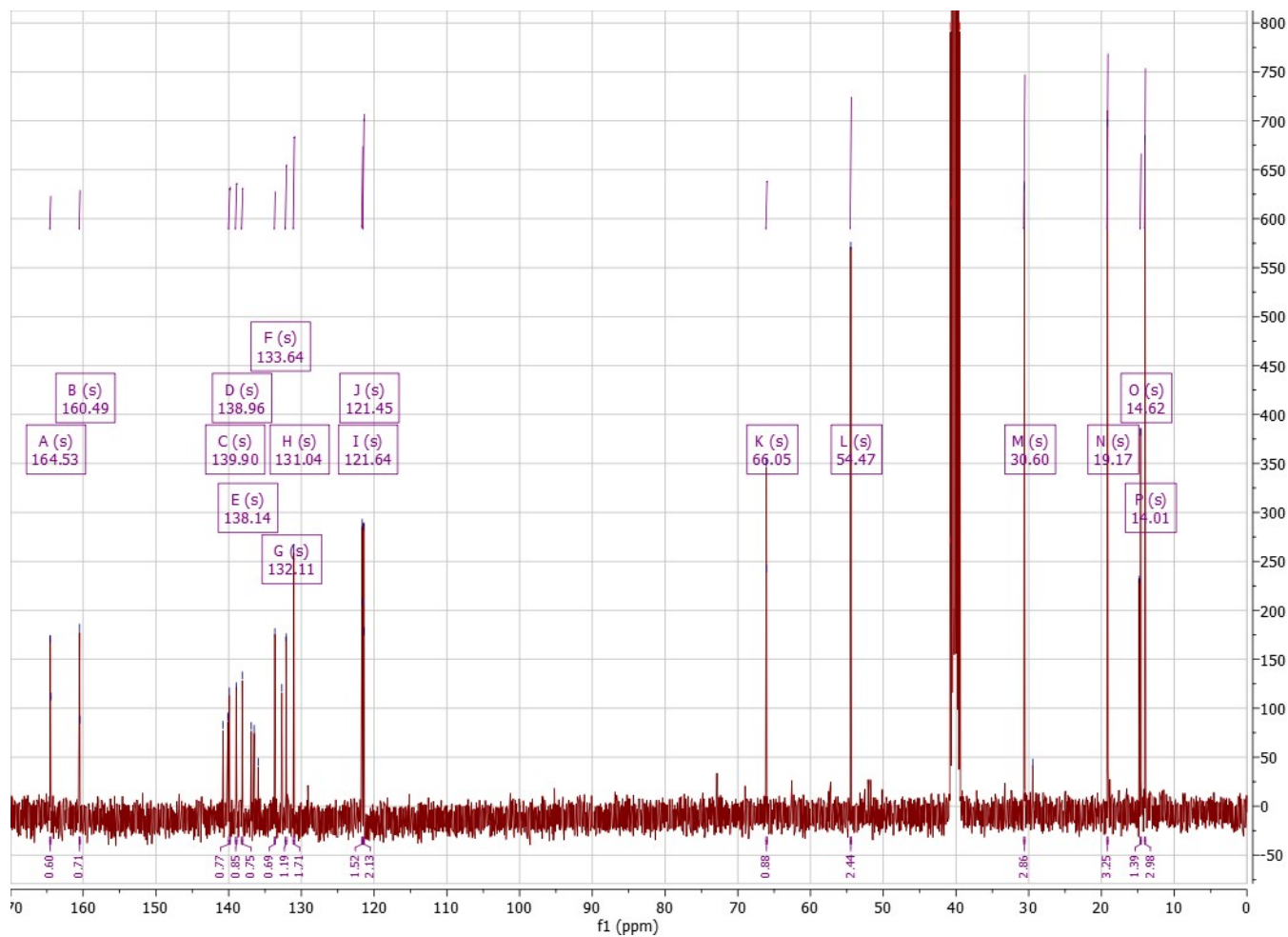
T-138 IR



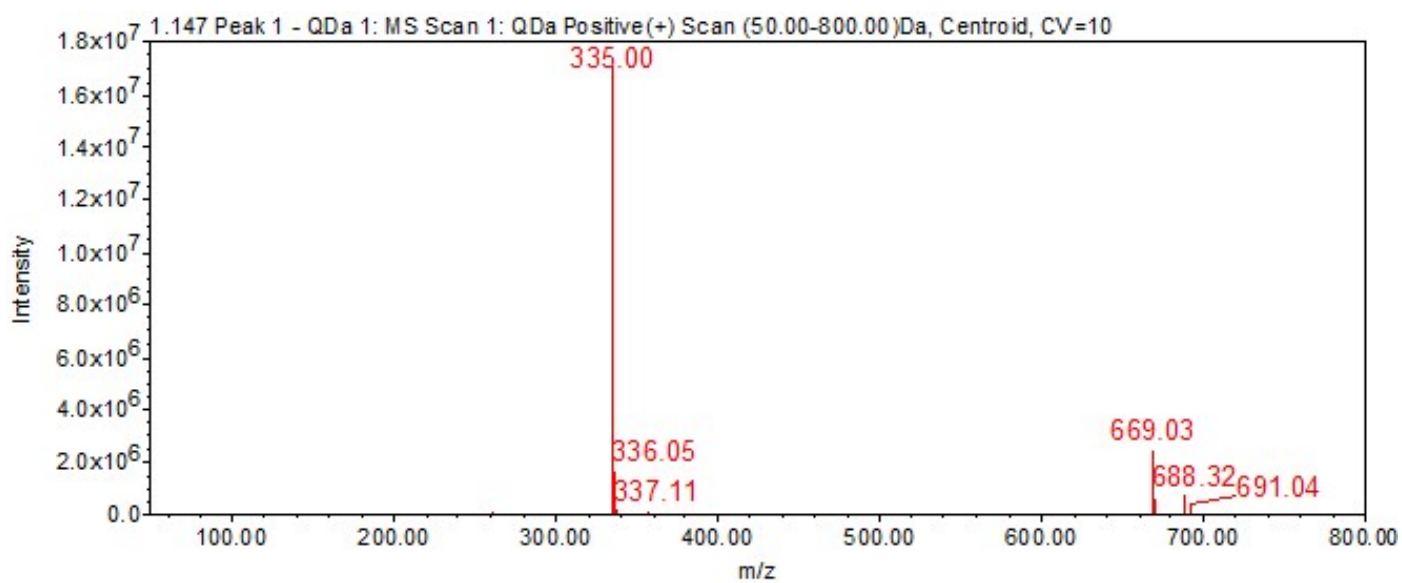
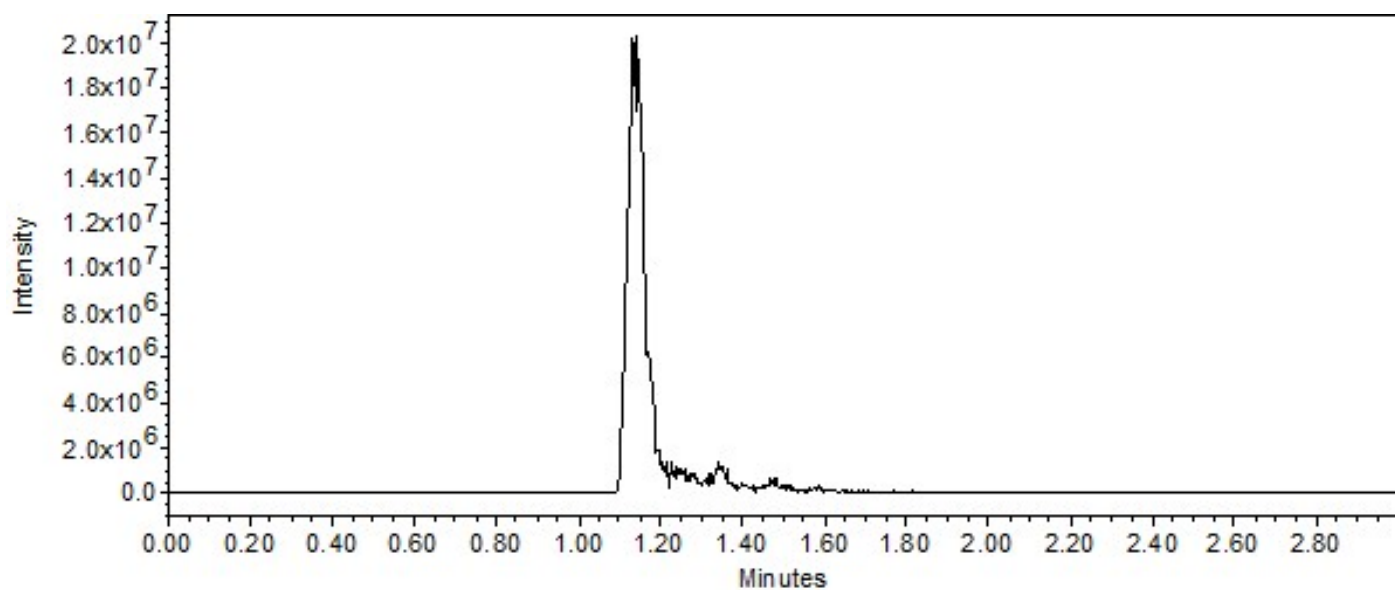
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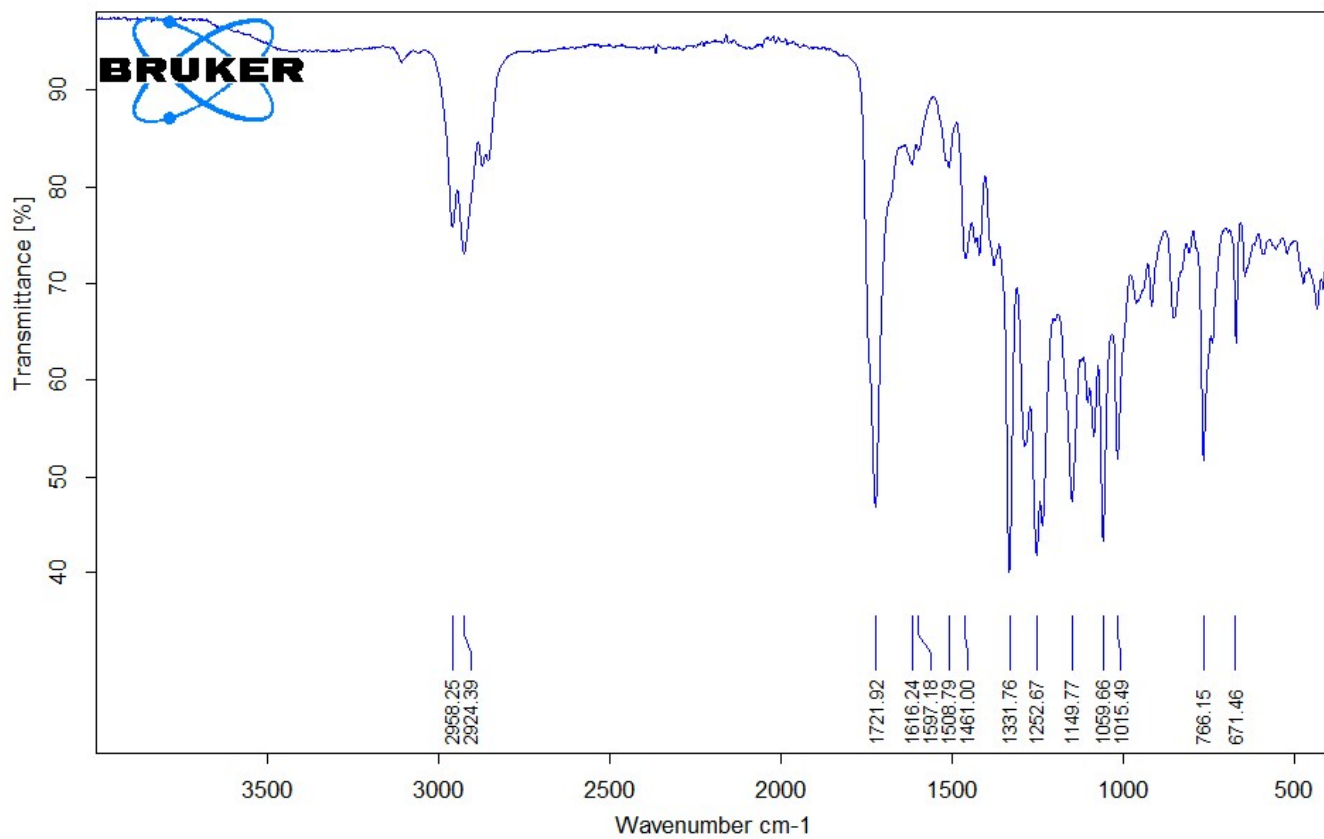
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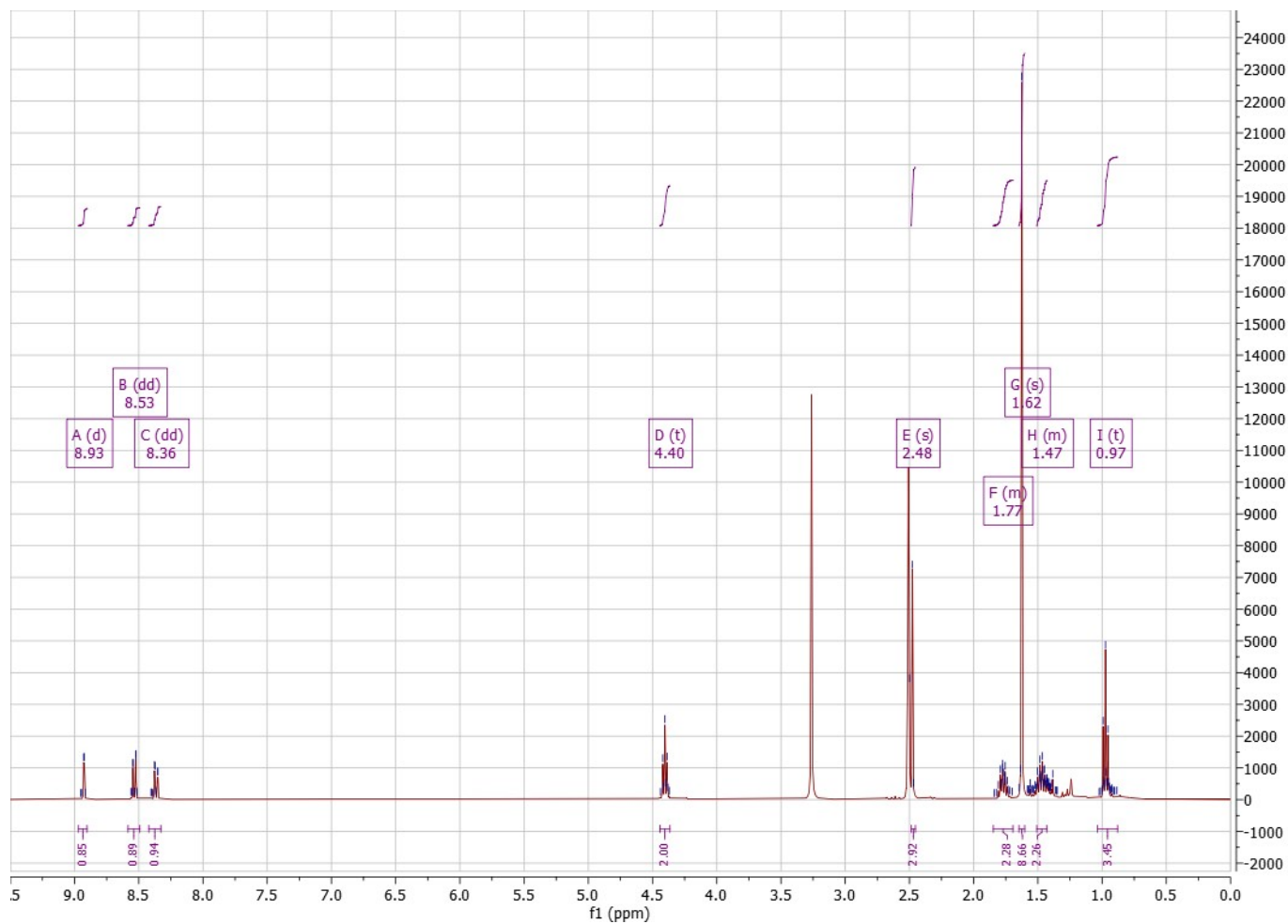
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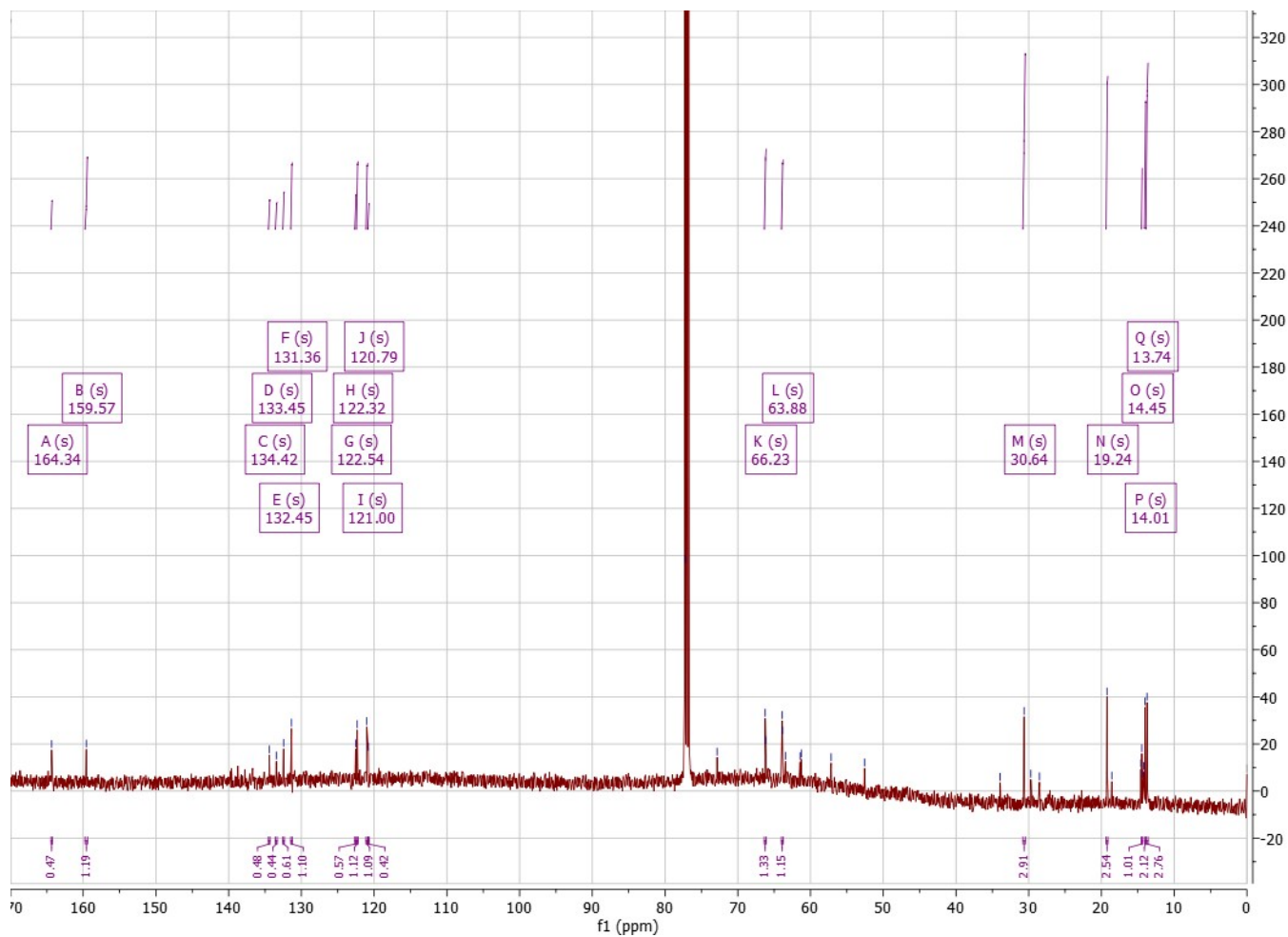
T-139 IR



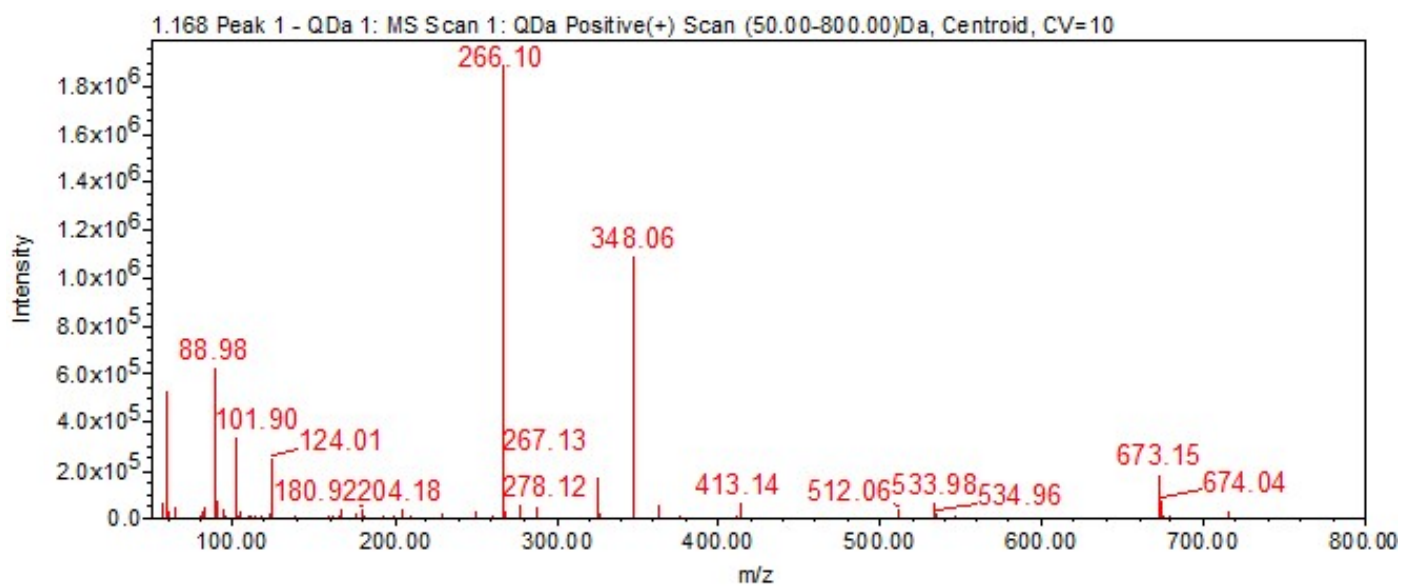
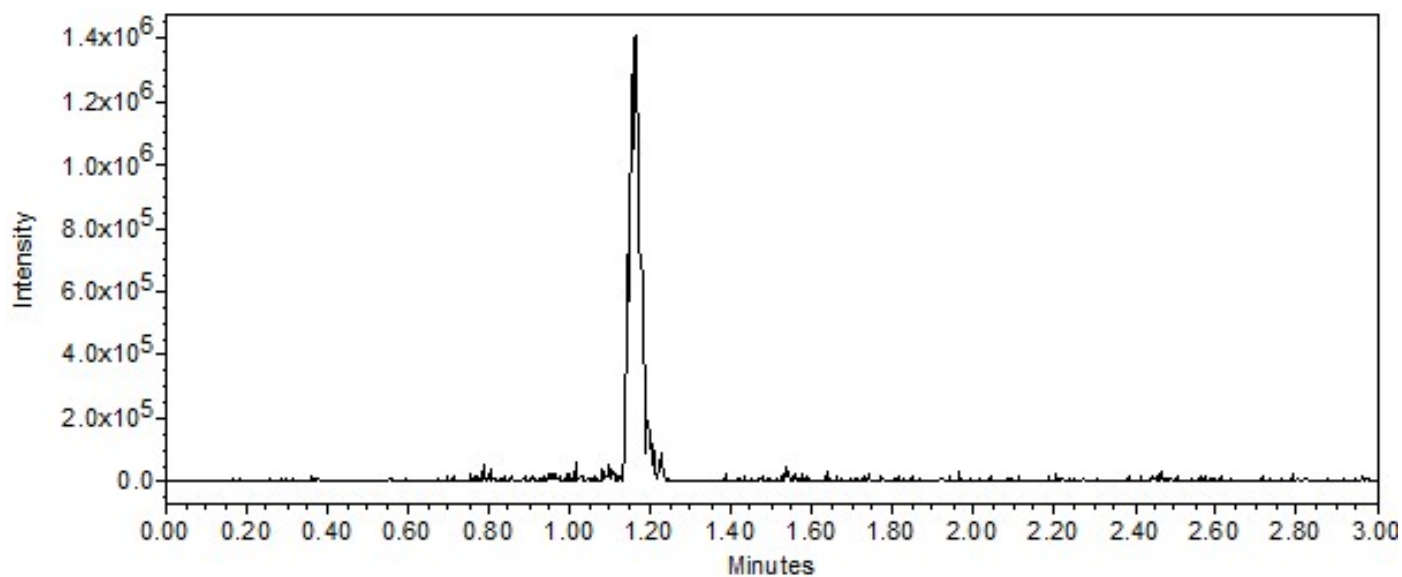
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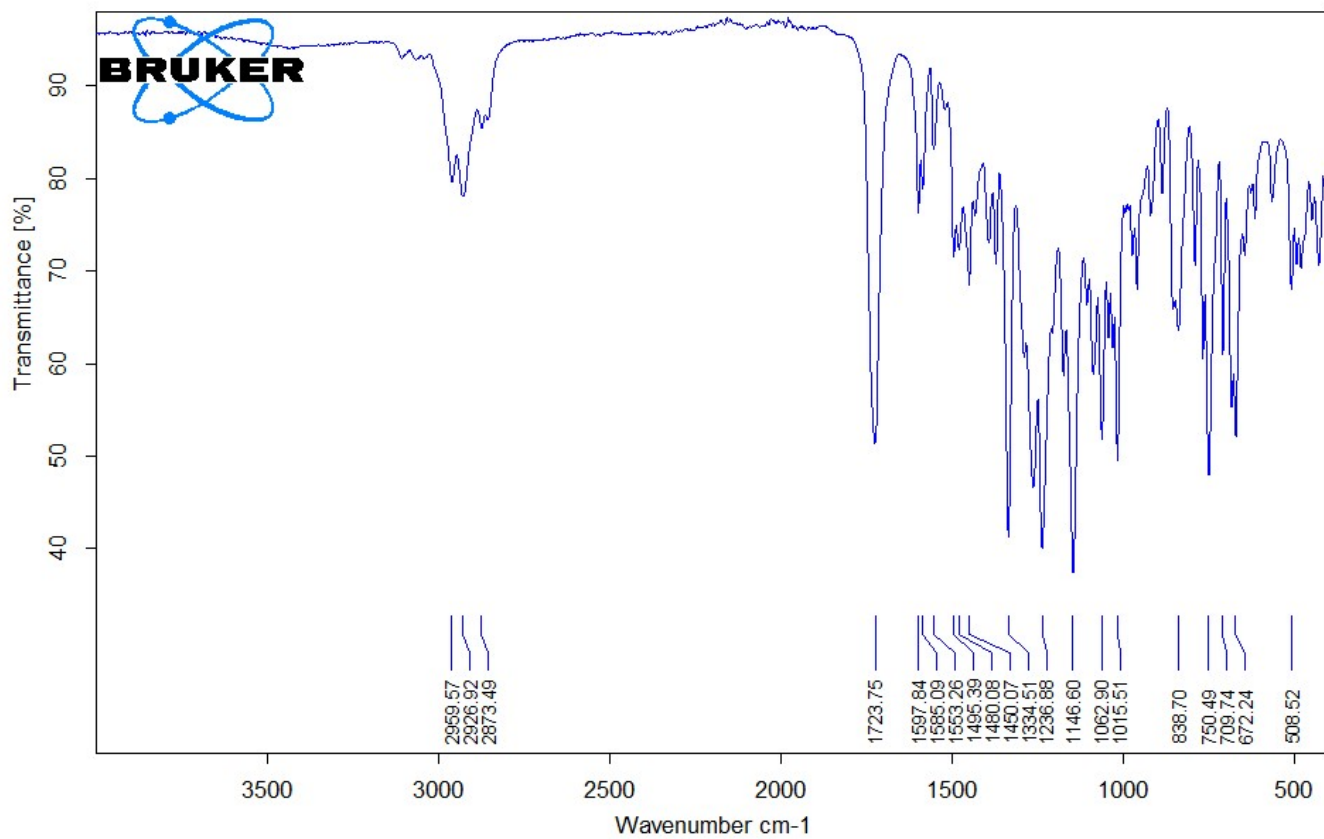
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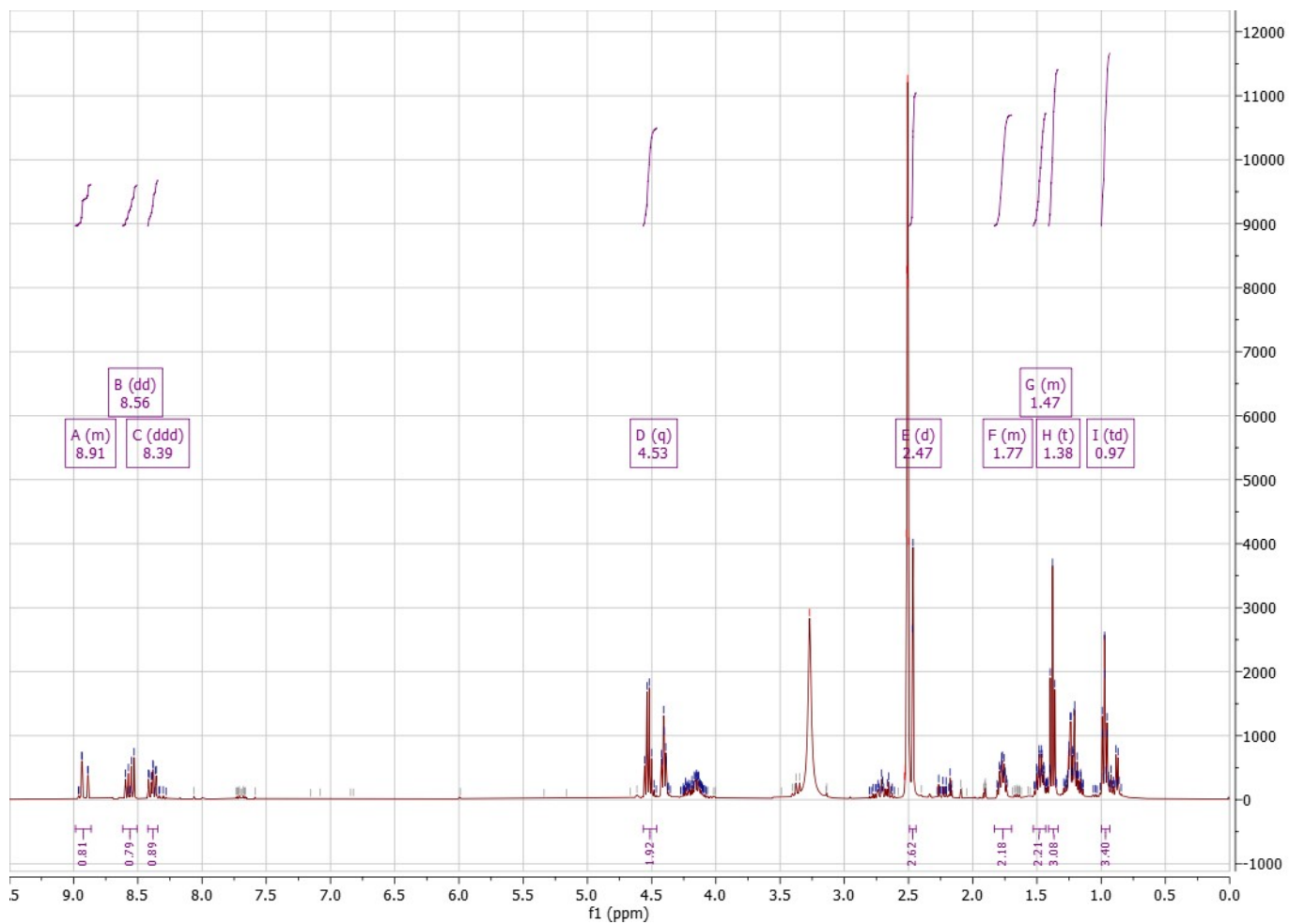
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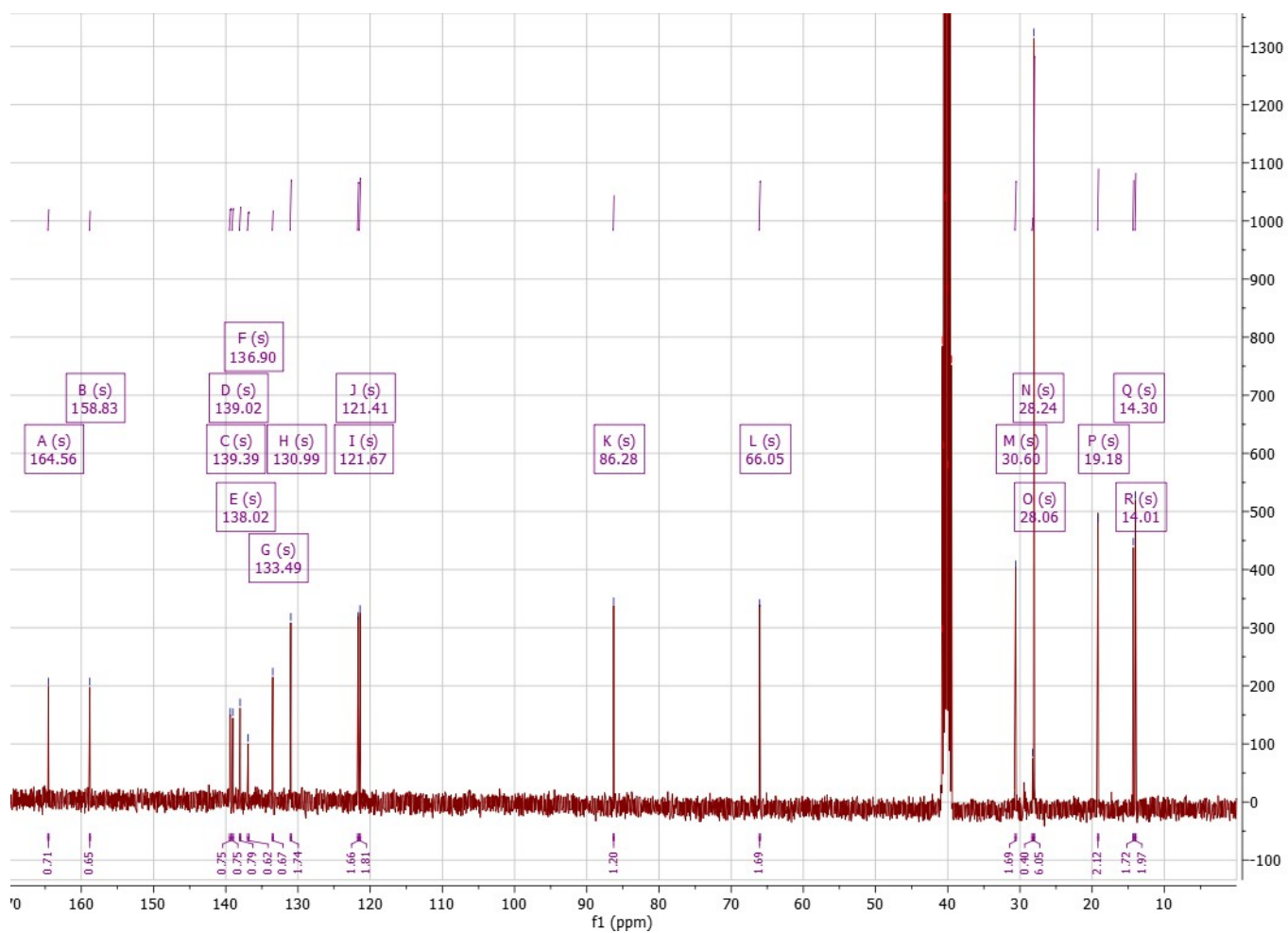
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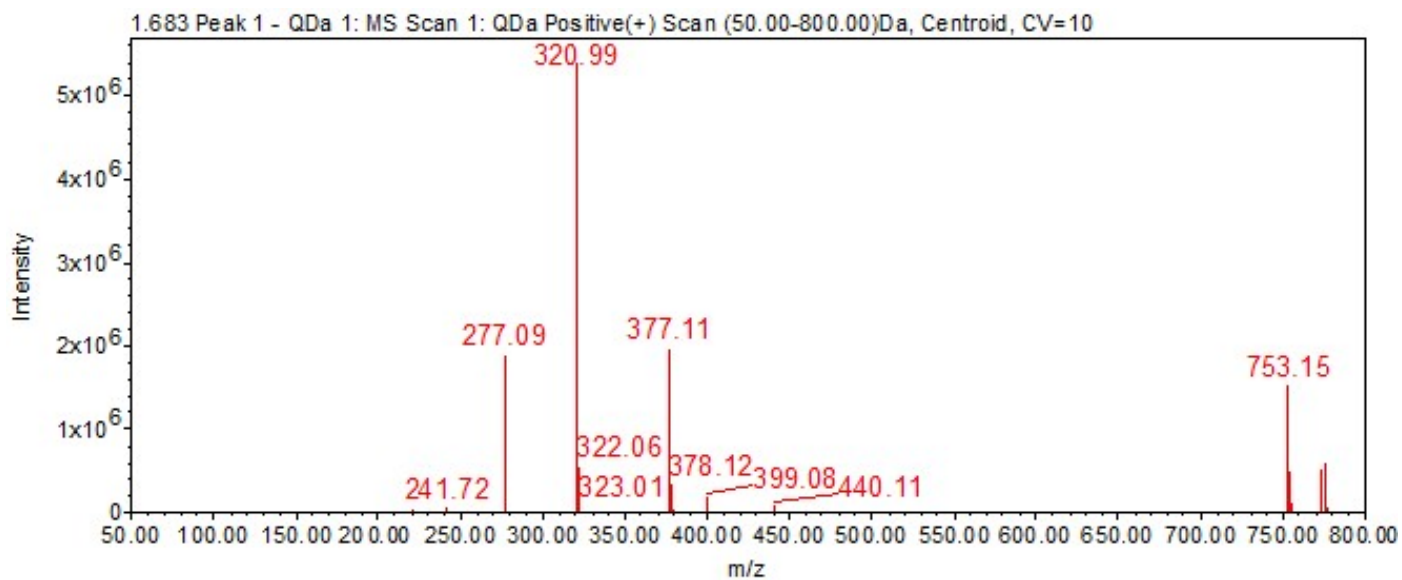
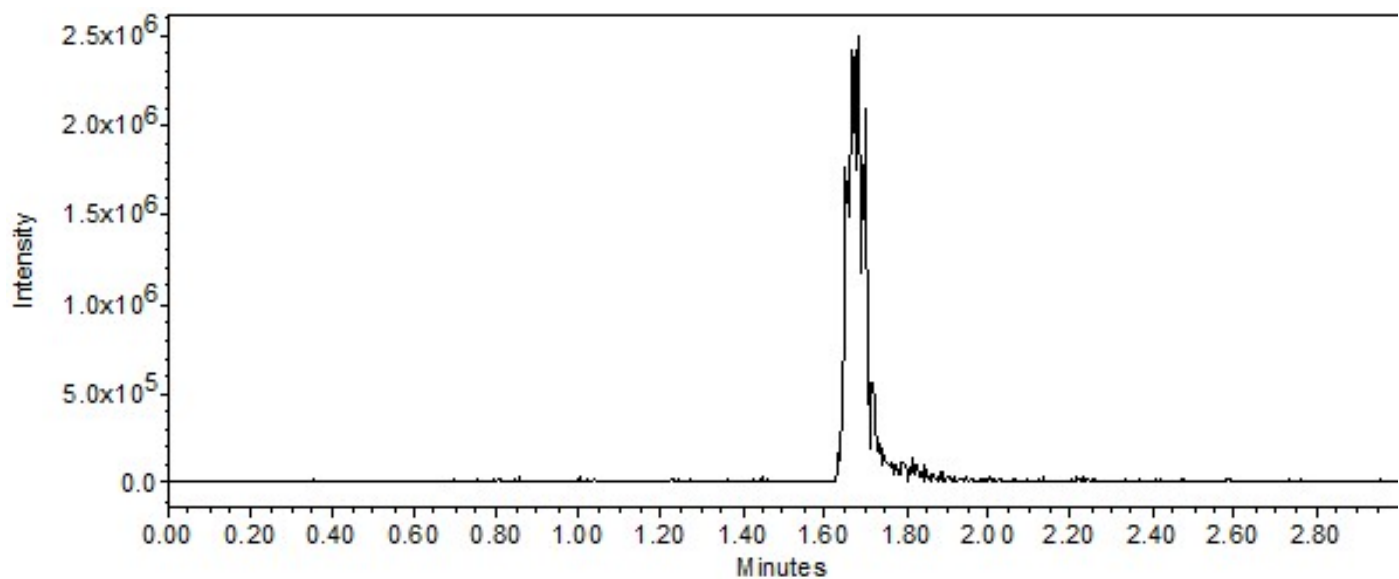
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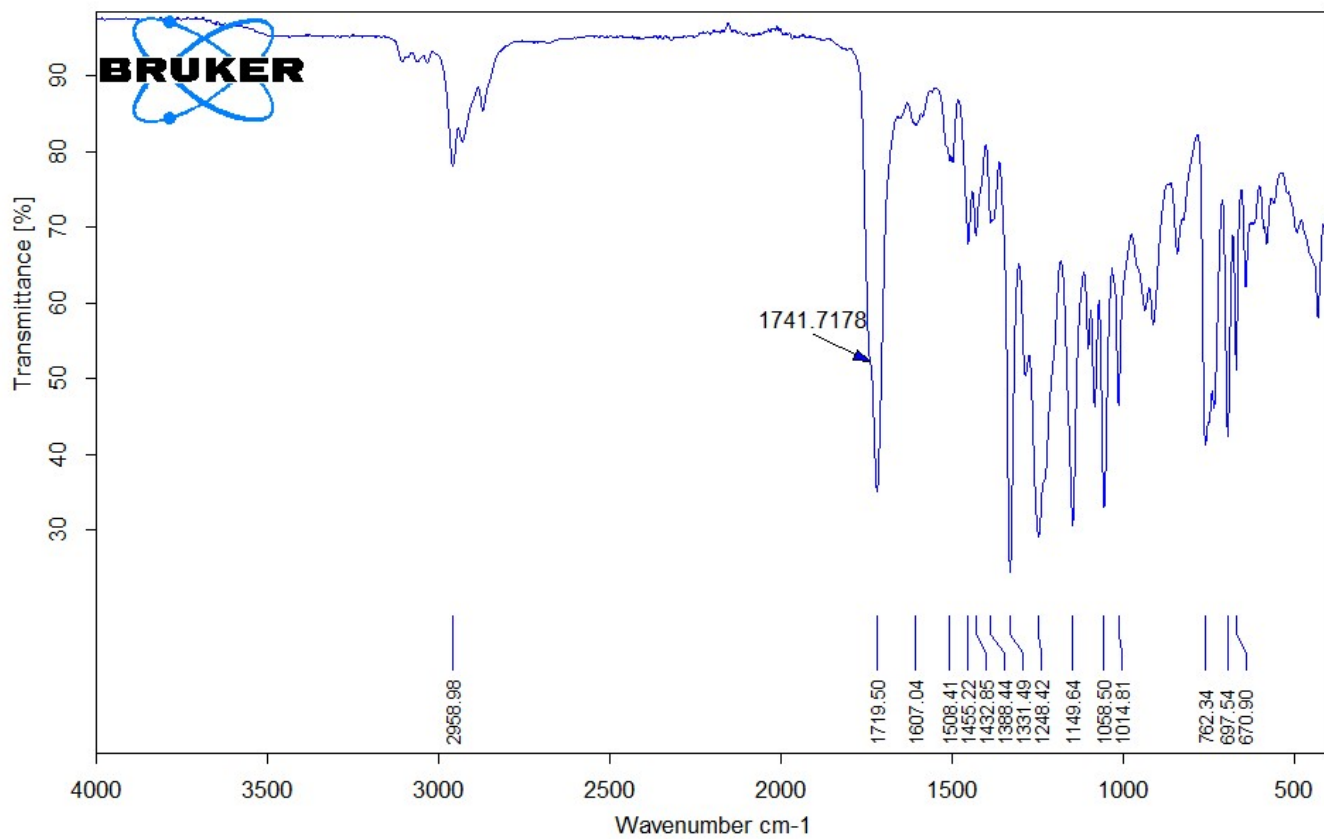
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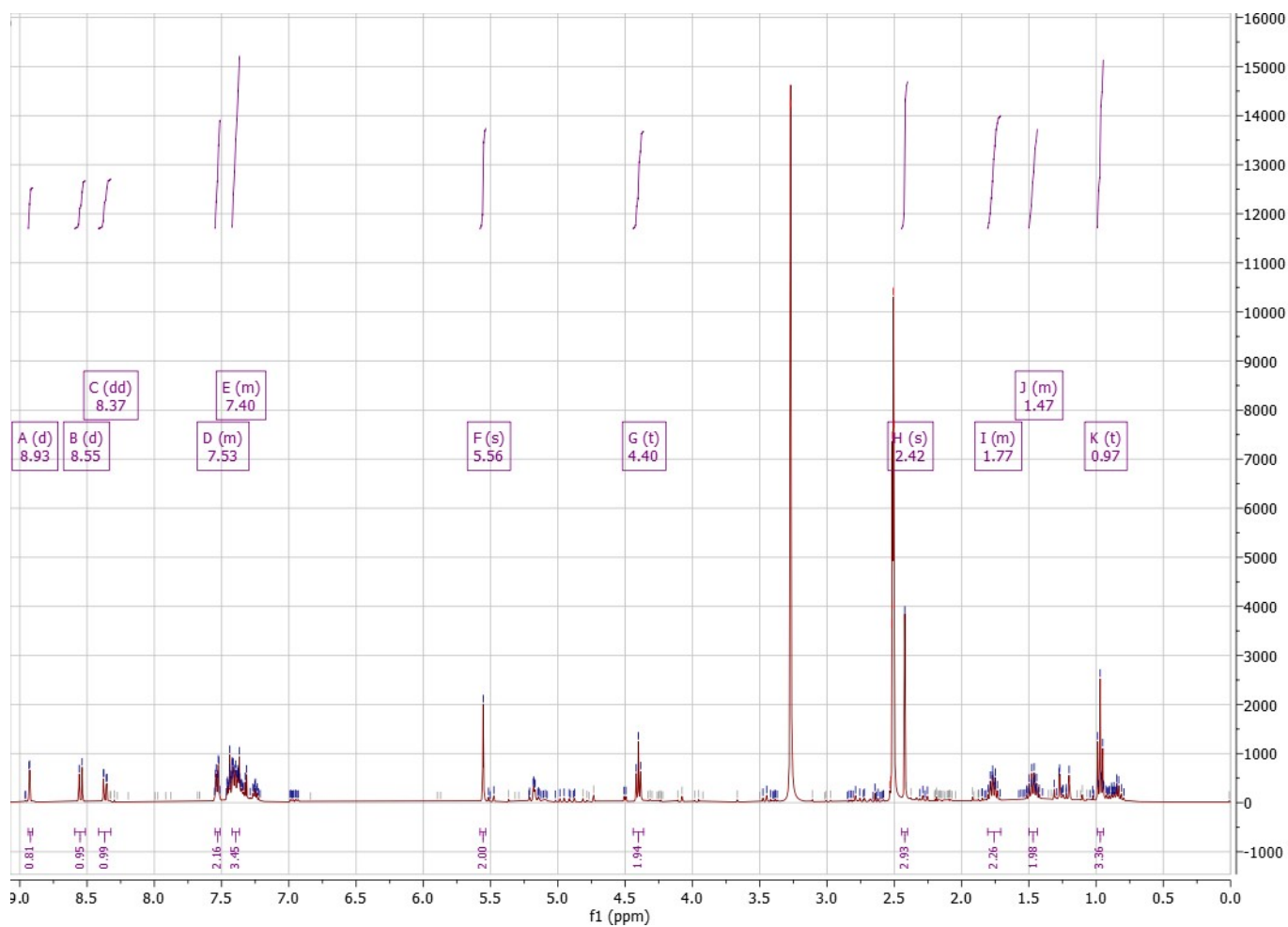
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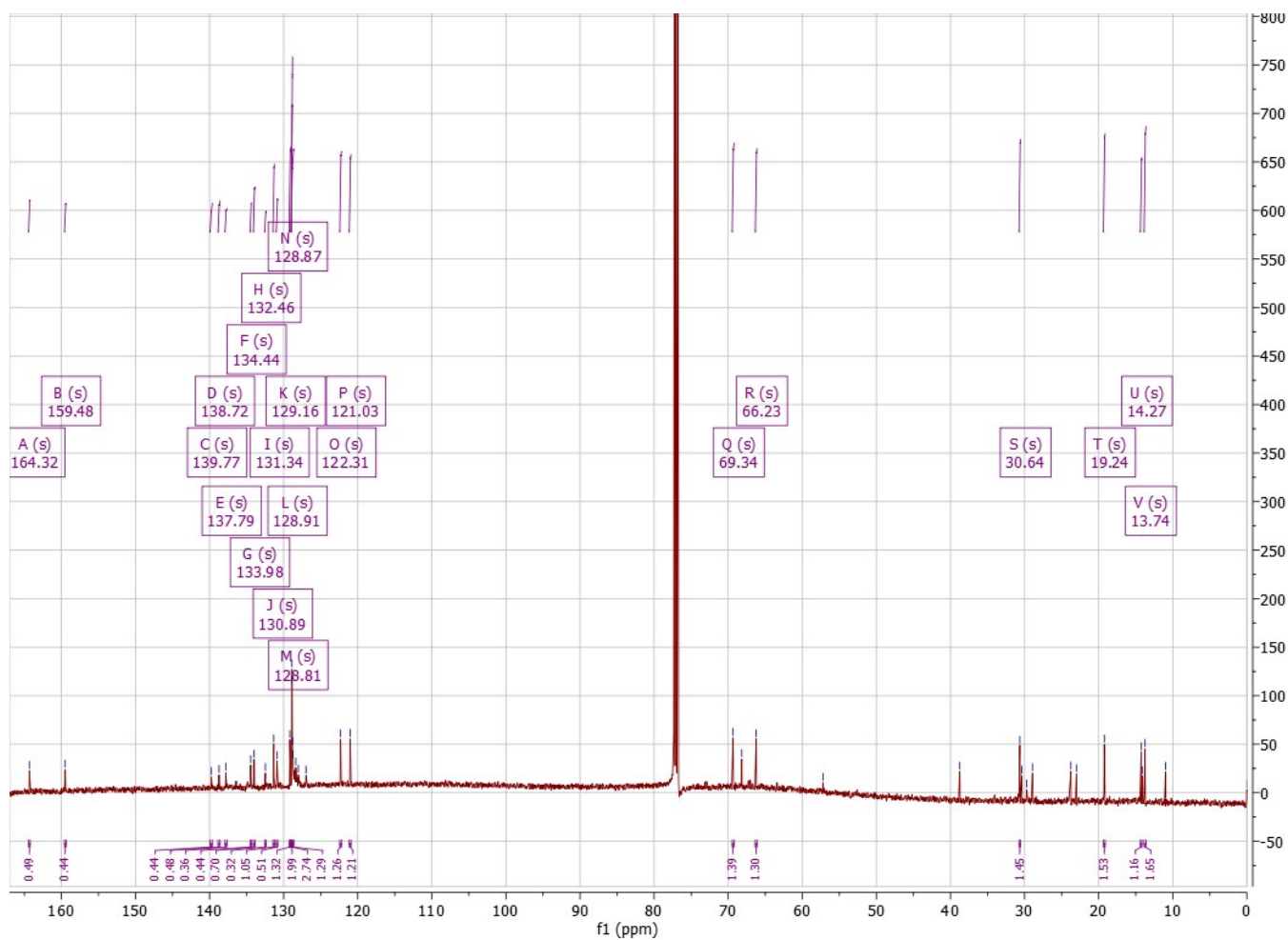
T-141 IR



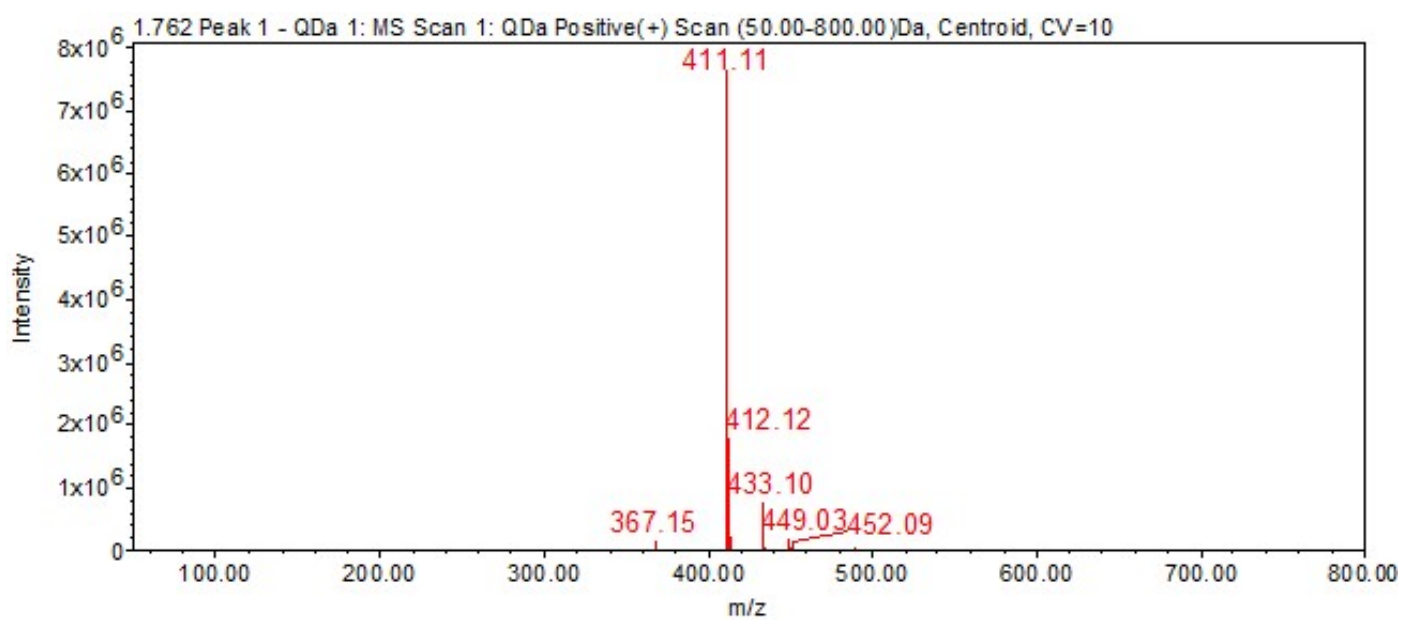
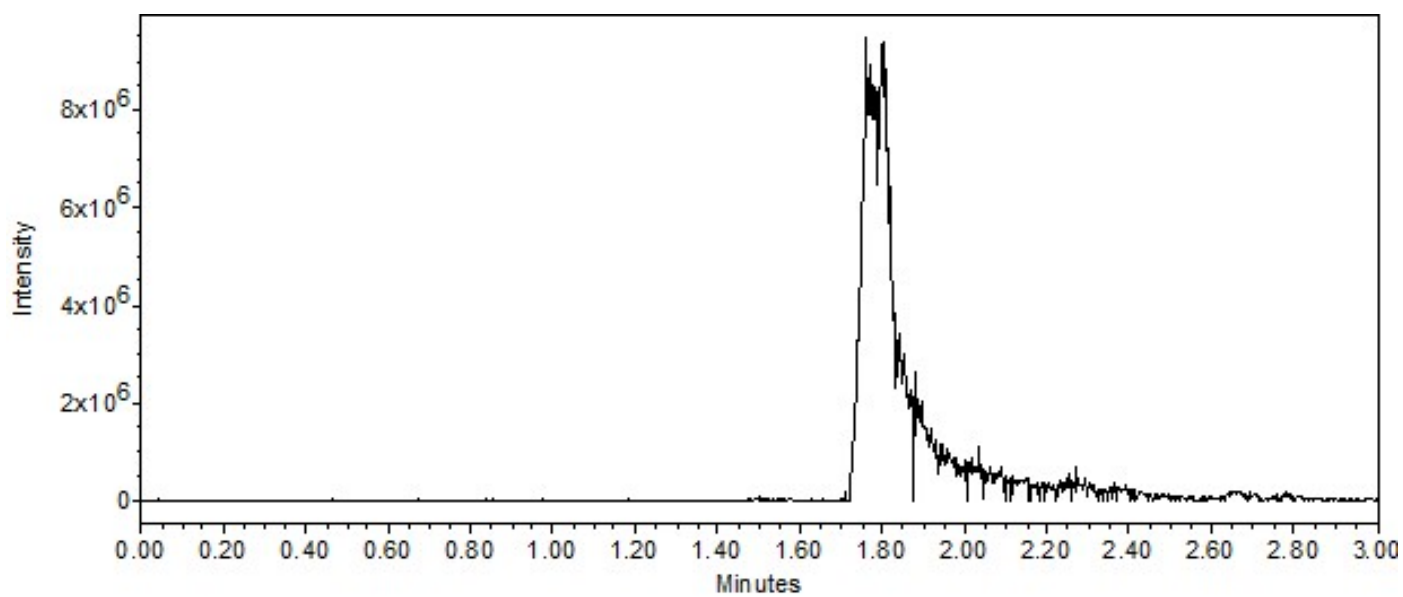
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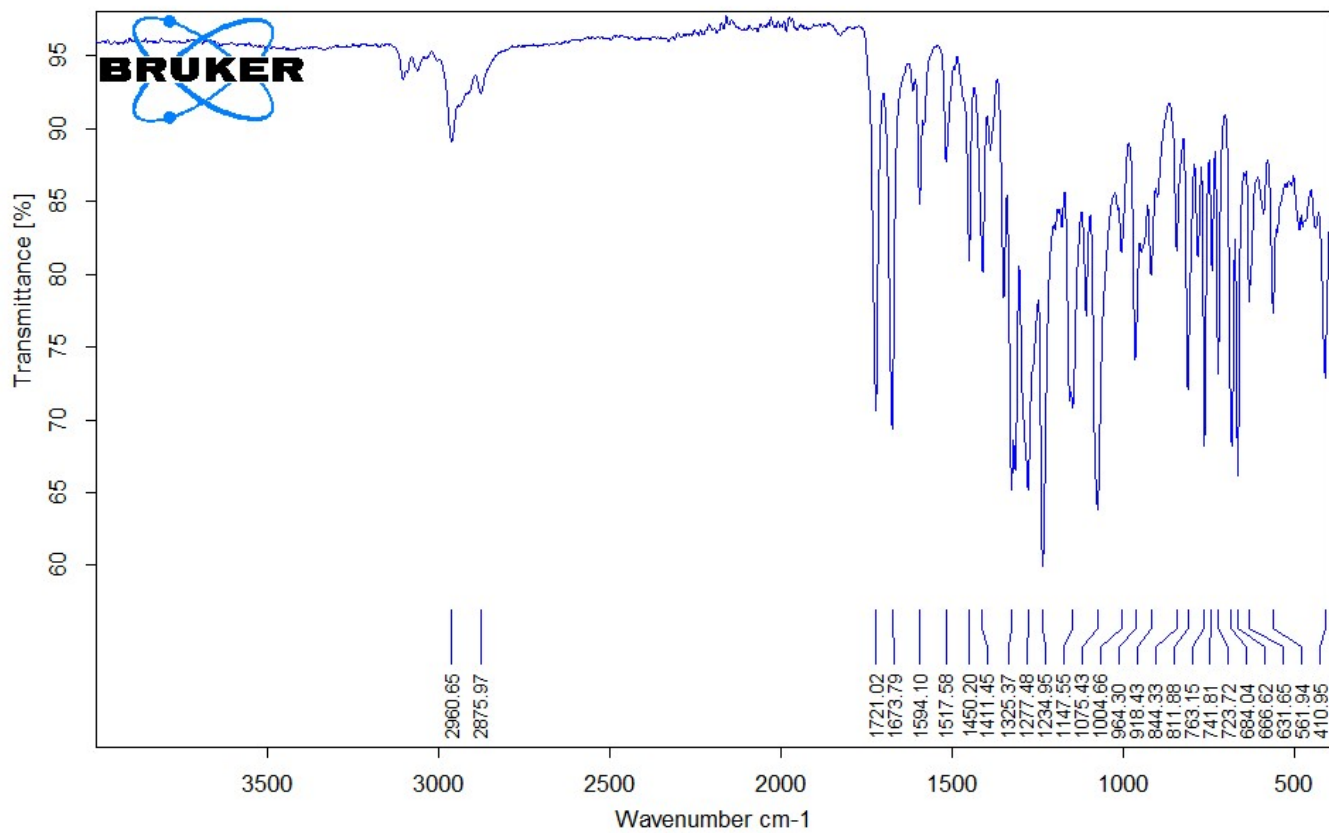
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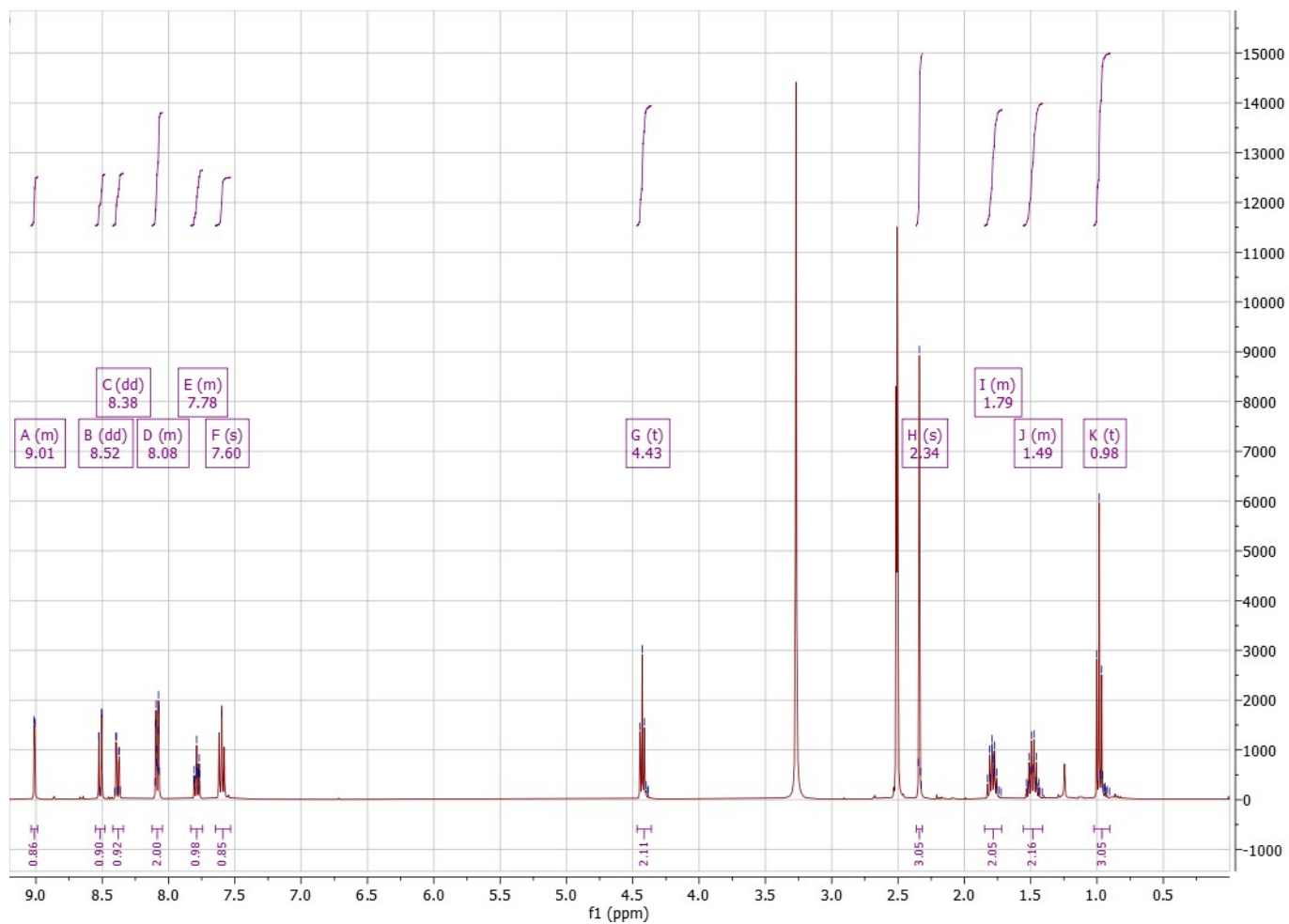
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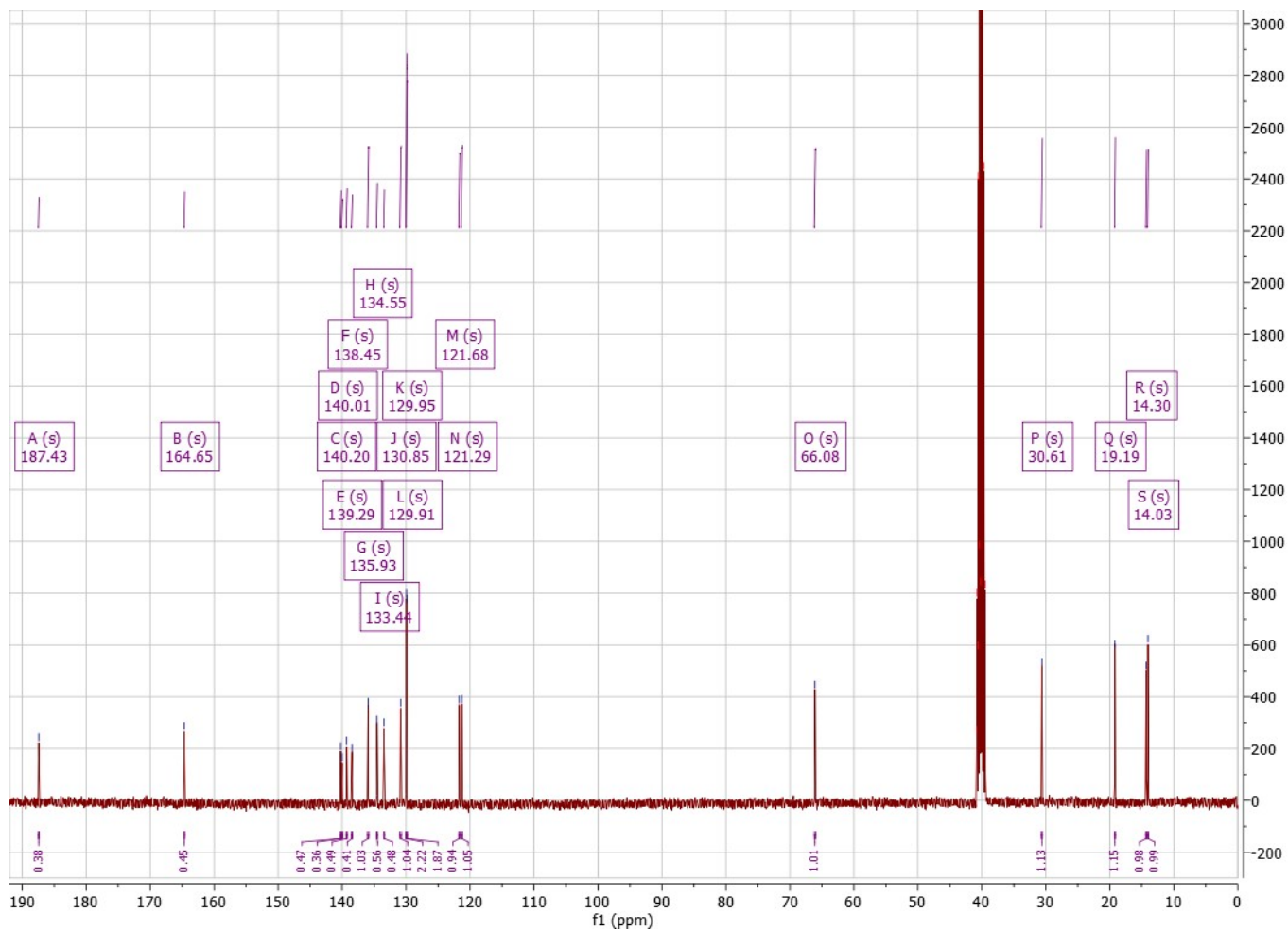
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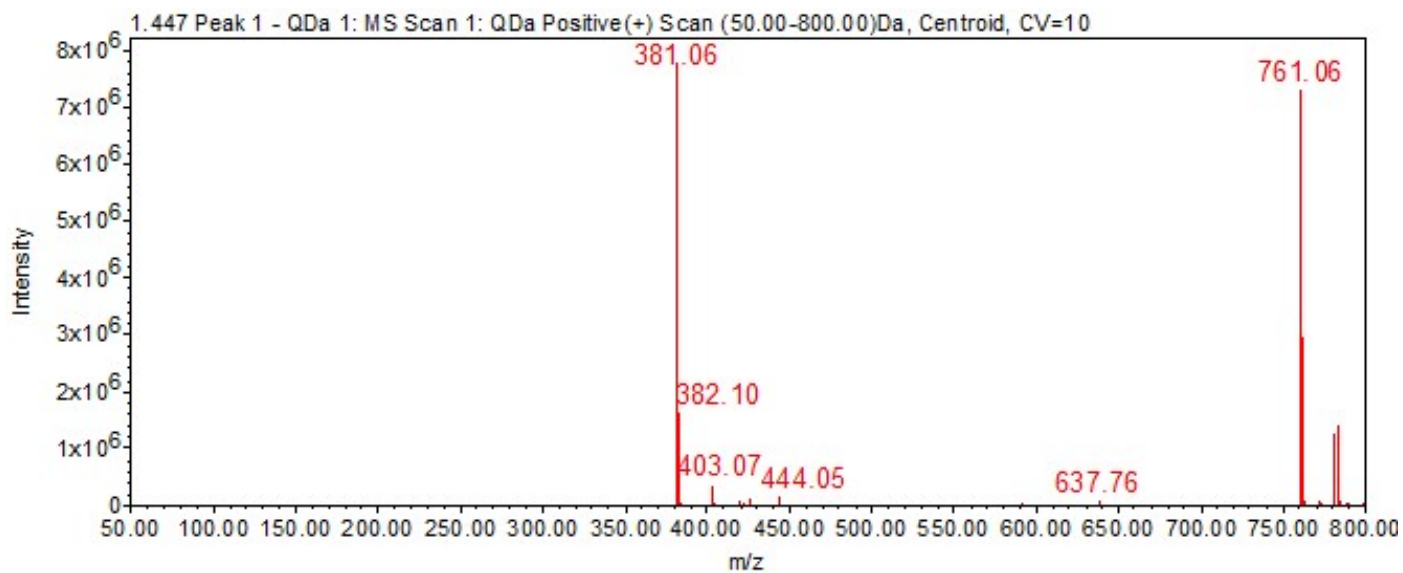
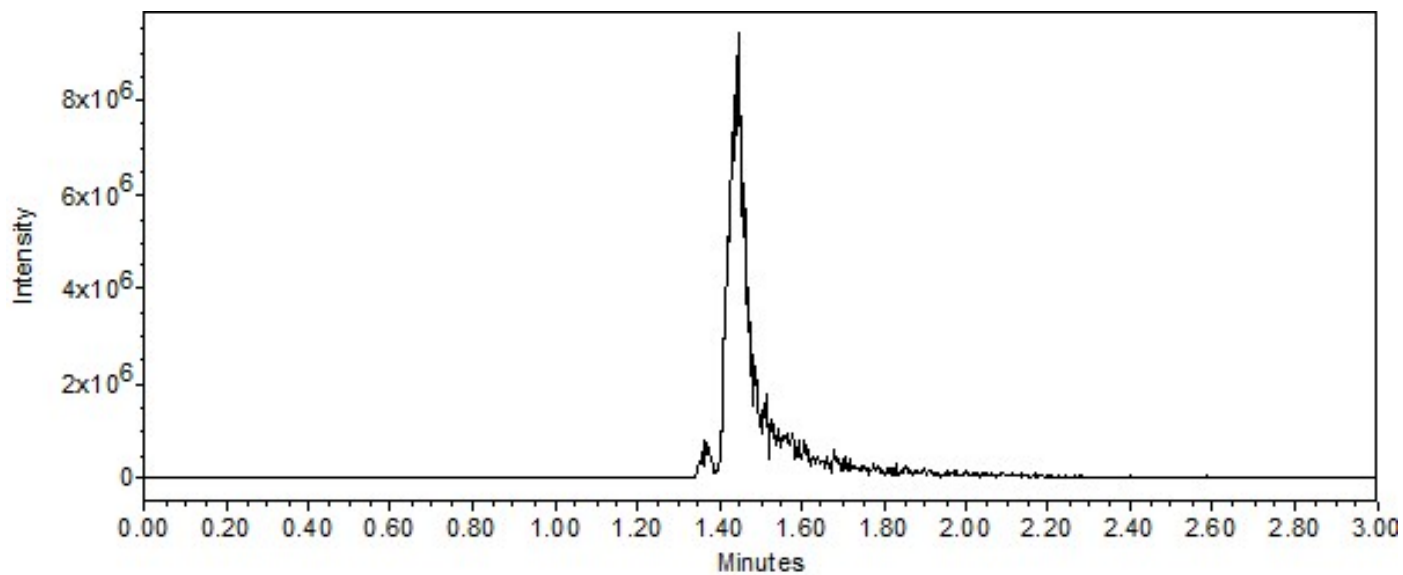
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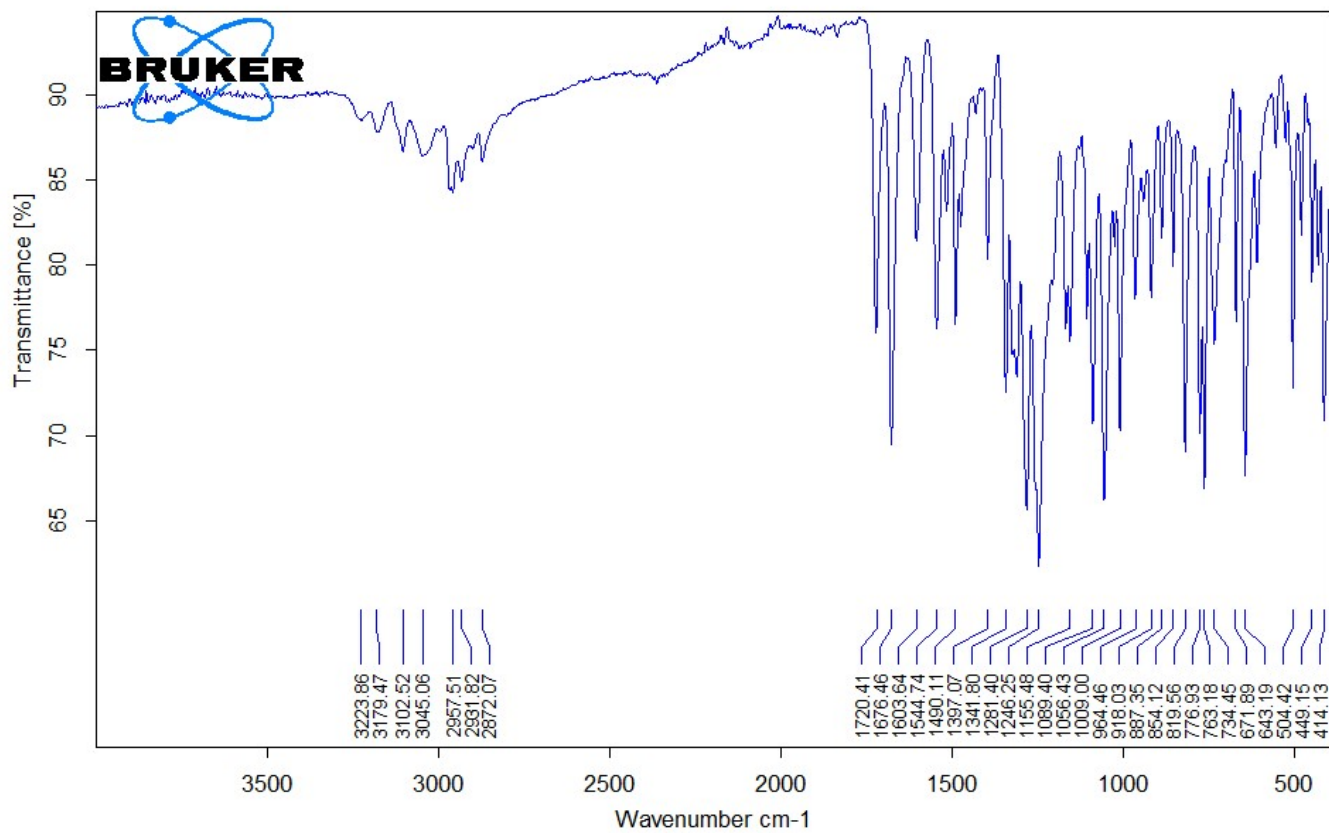
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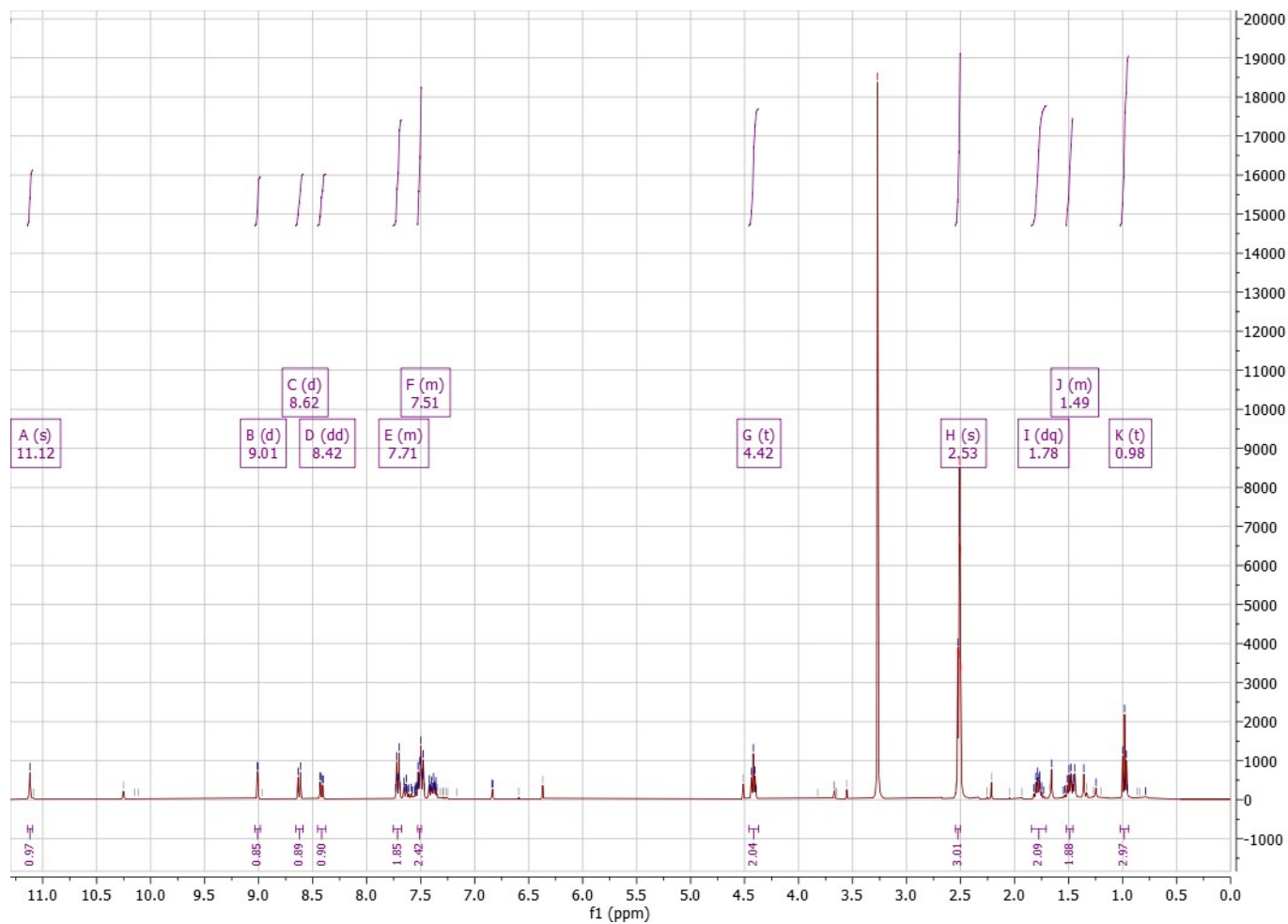
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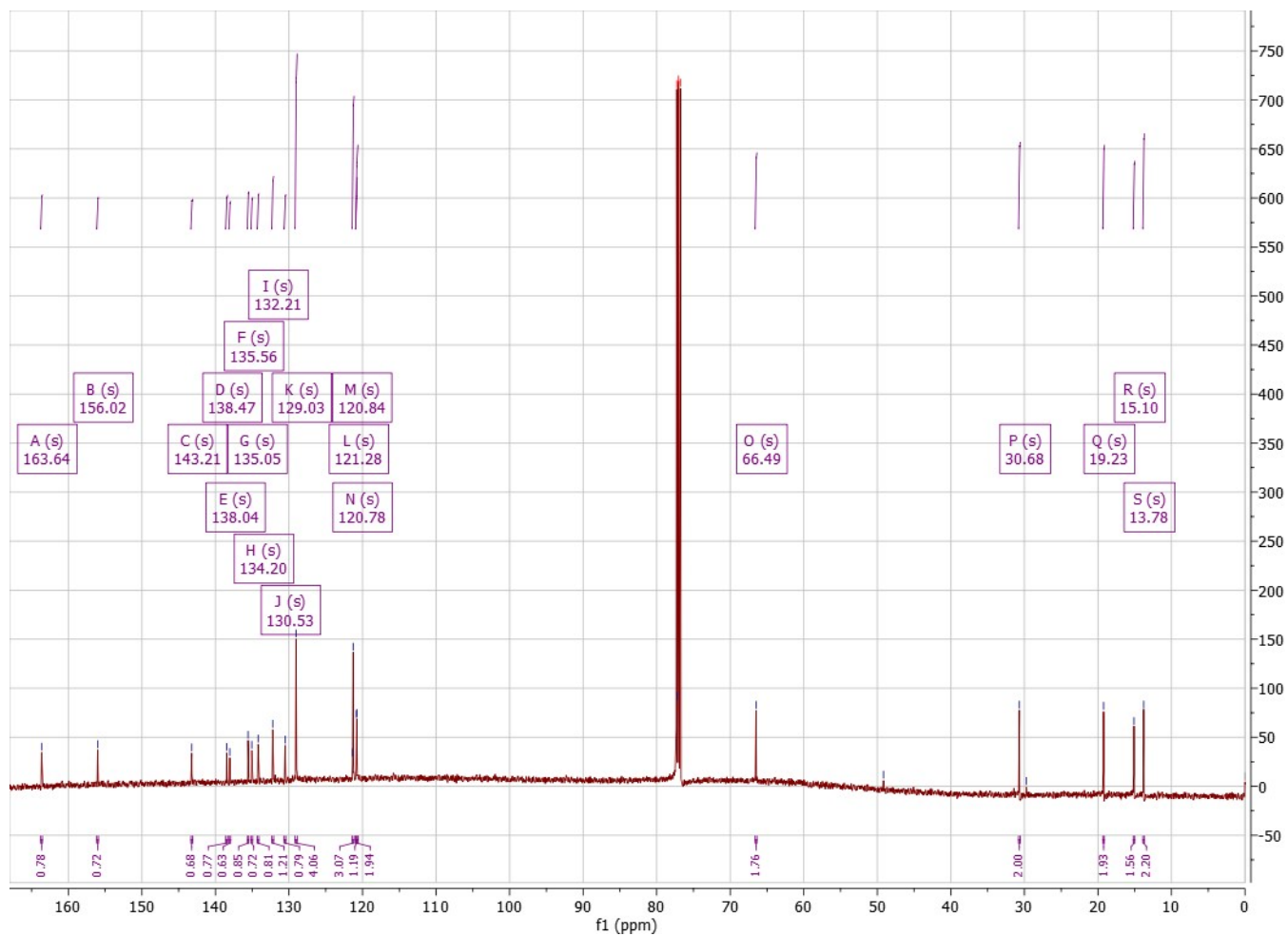
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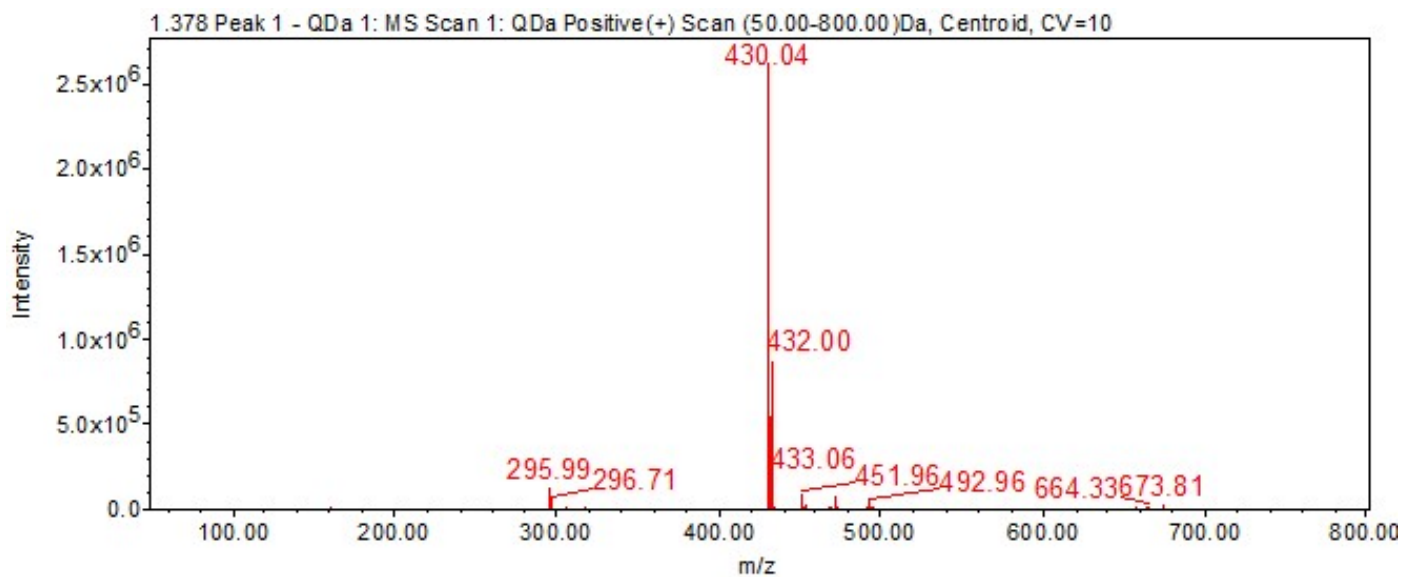
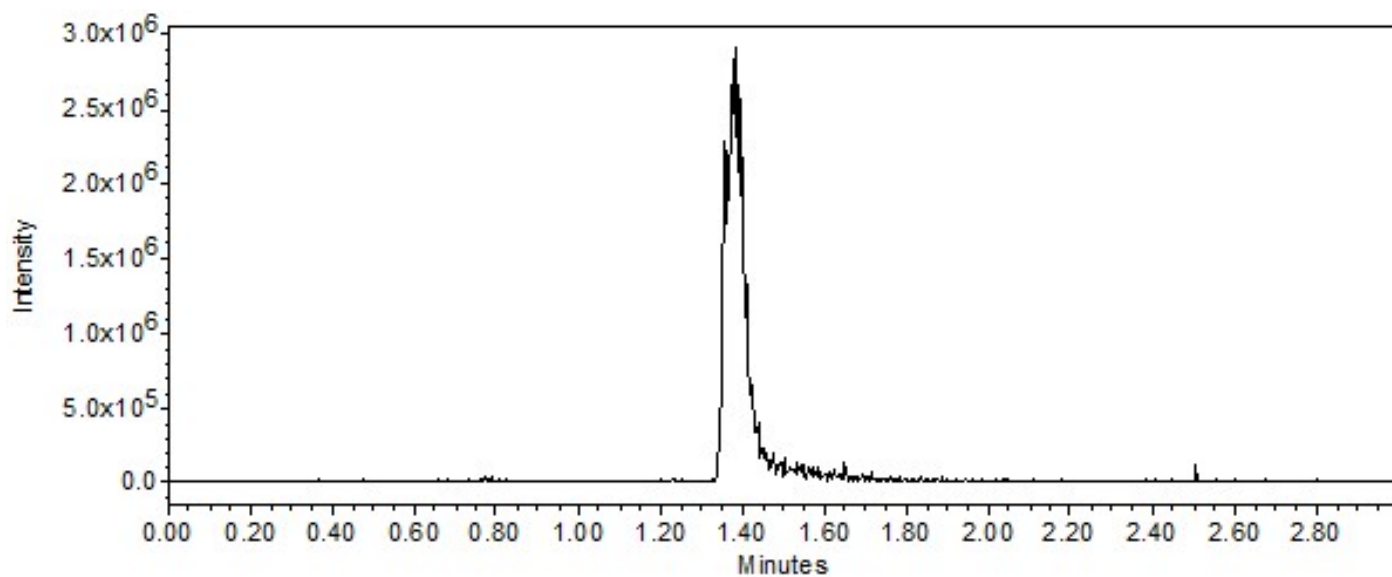
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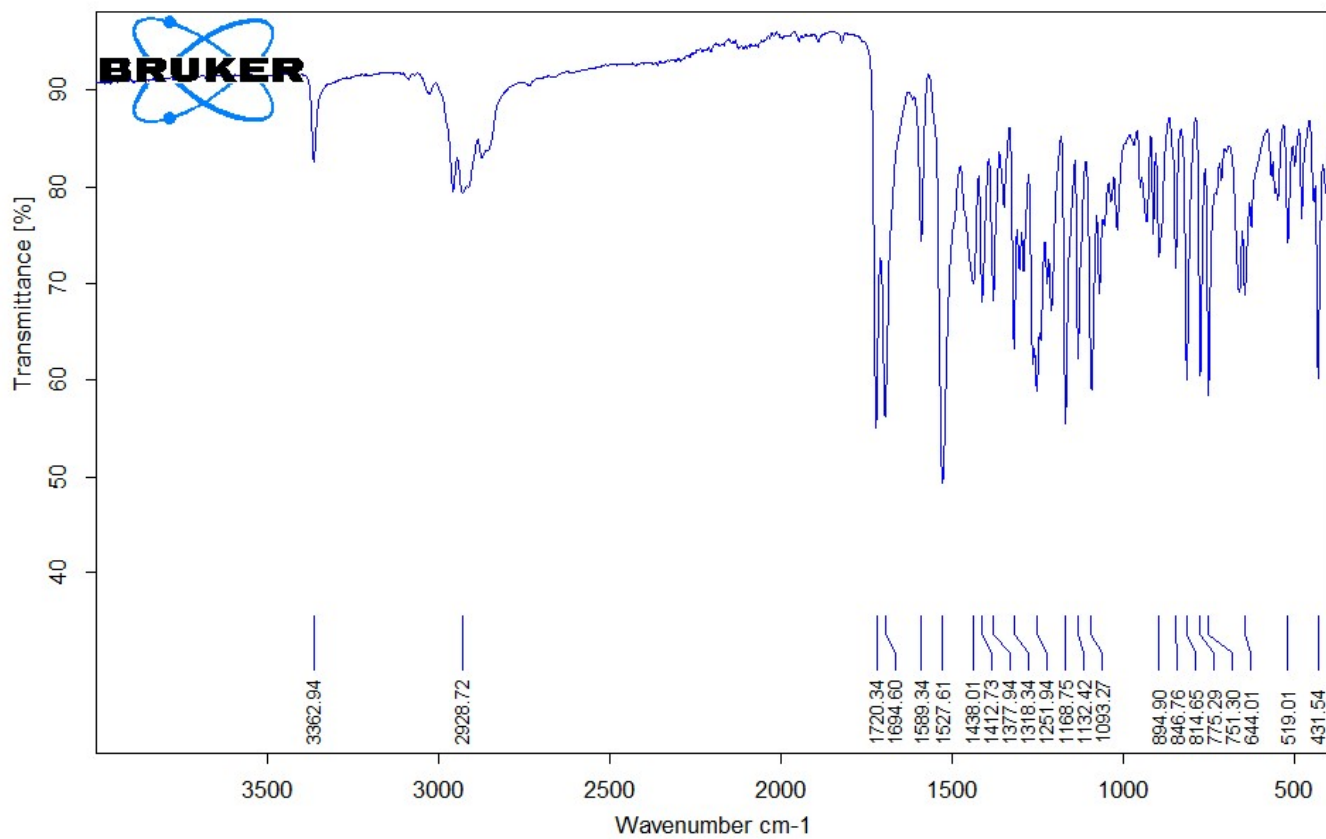
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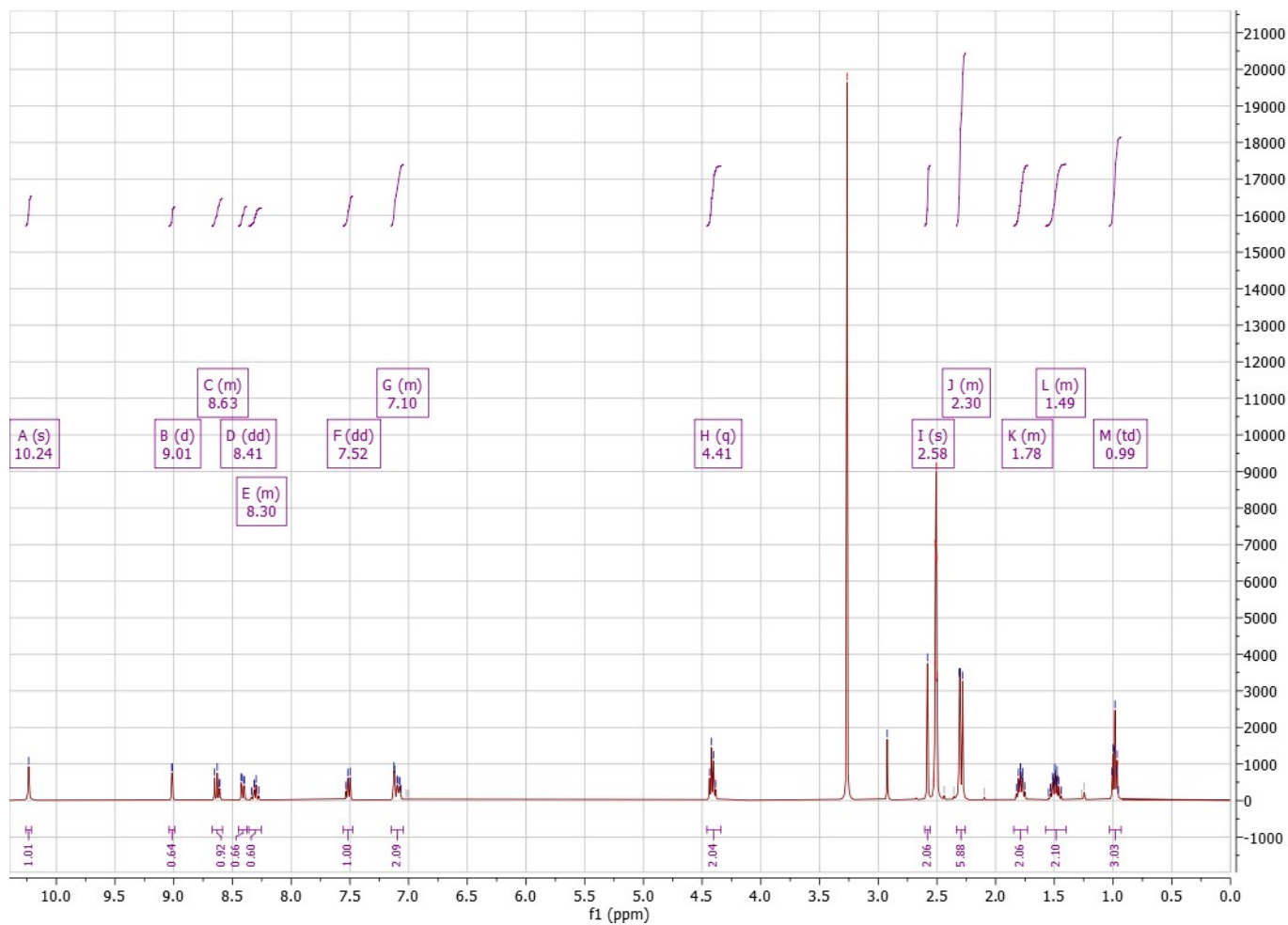
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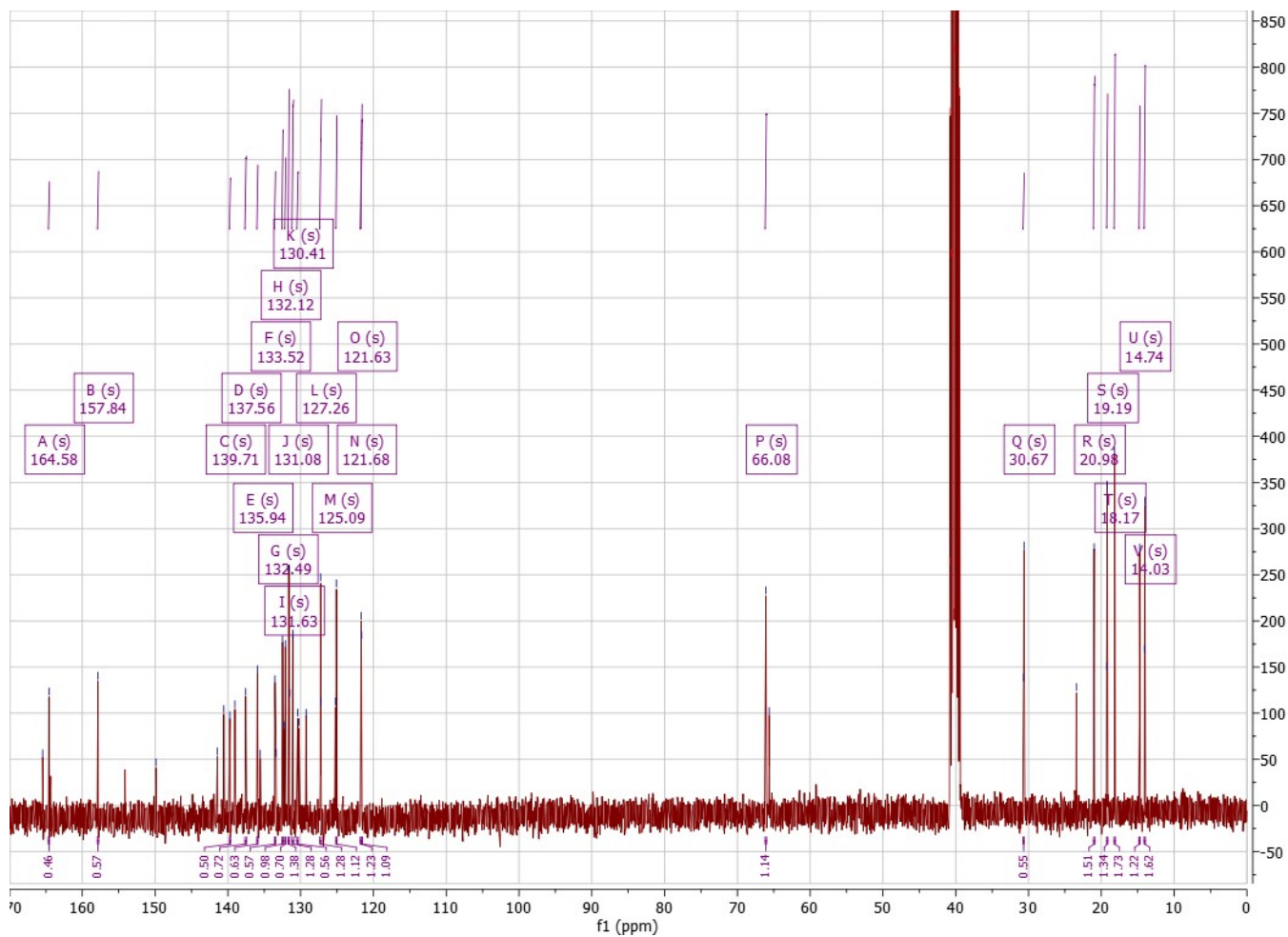
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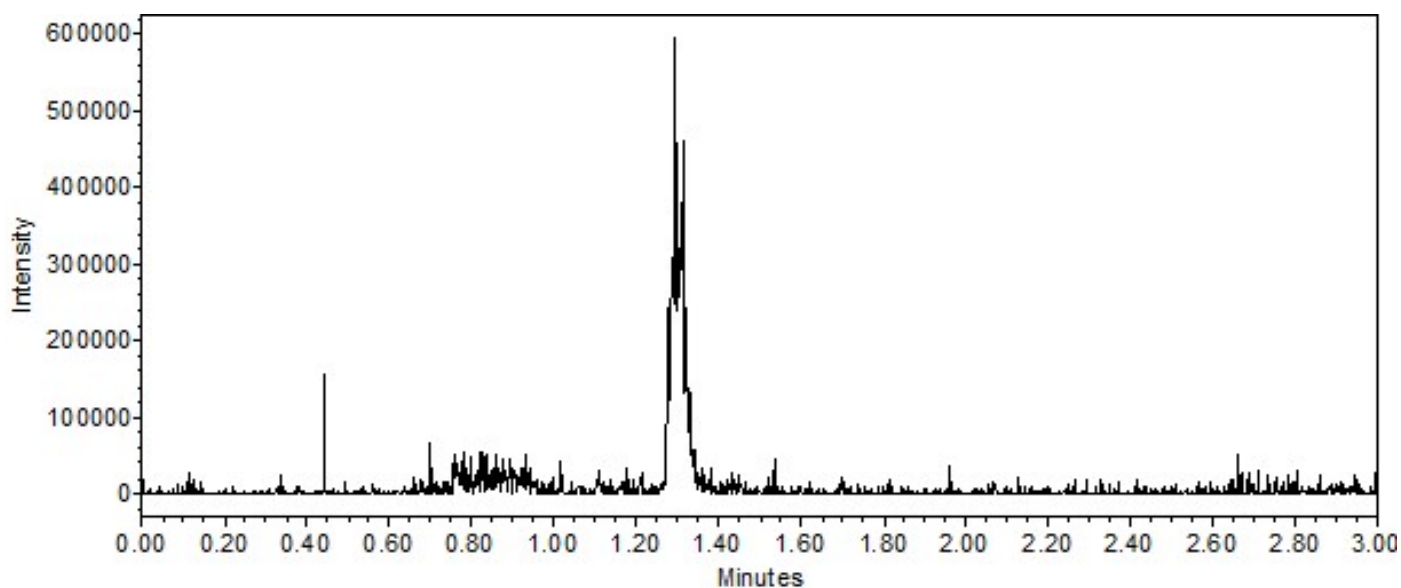
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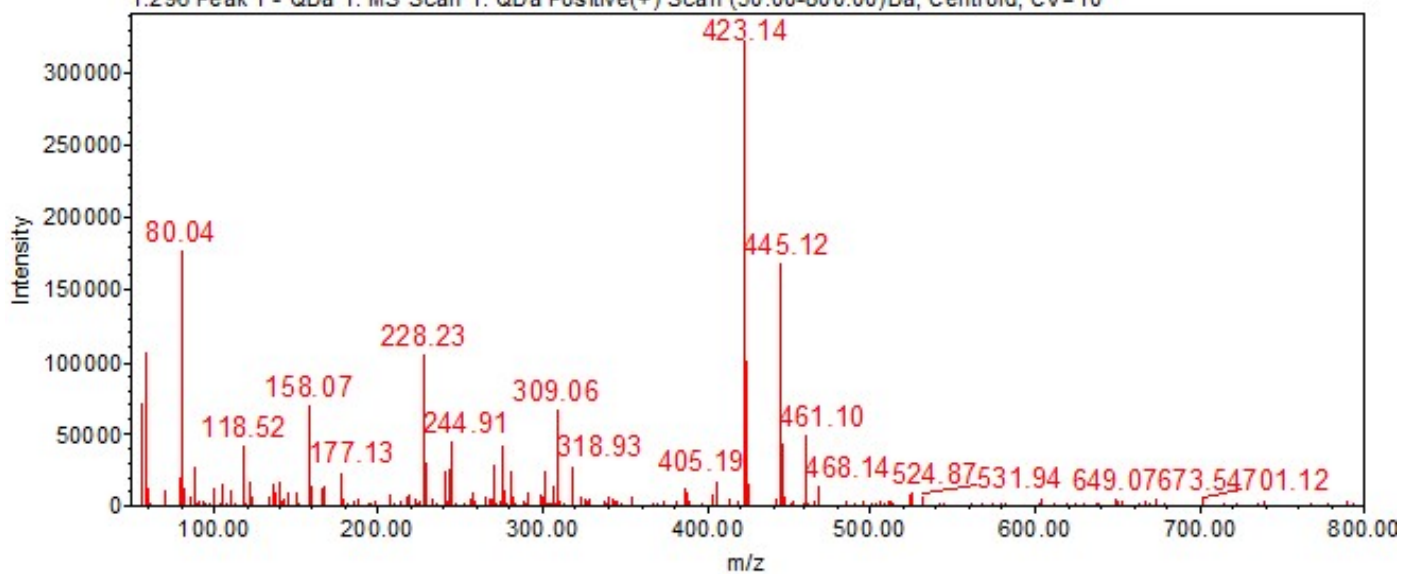
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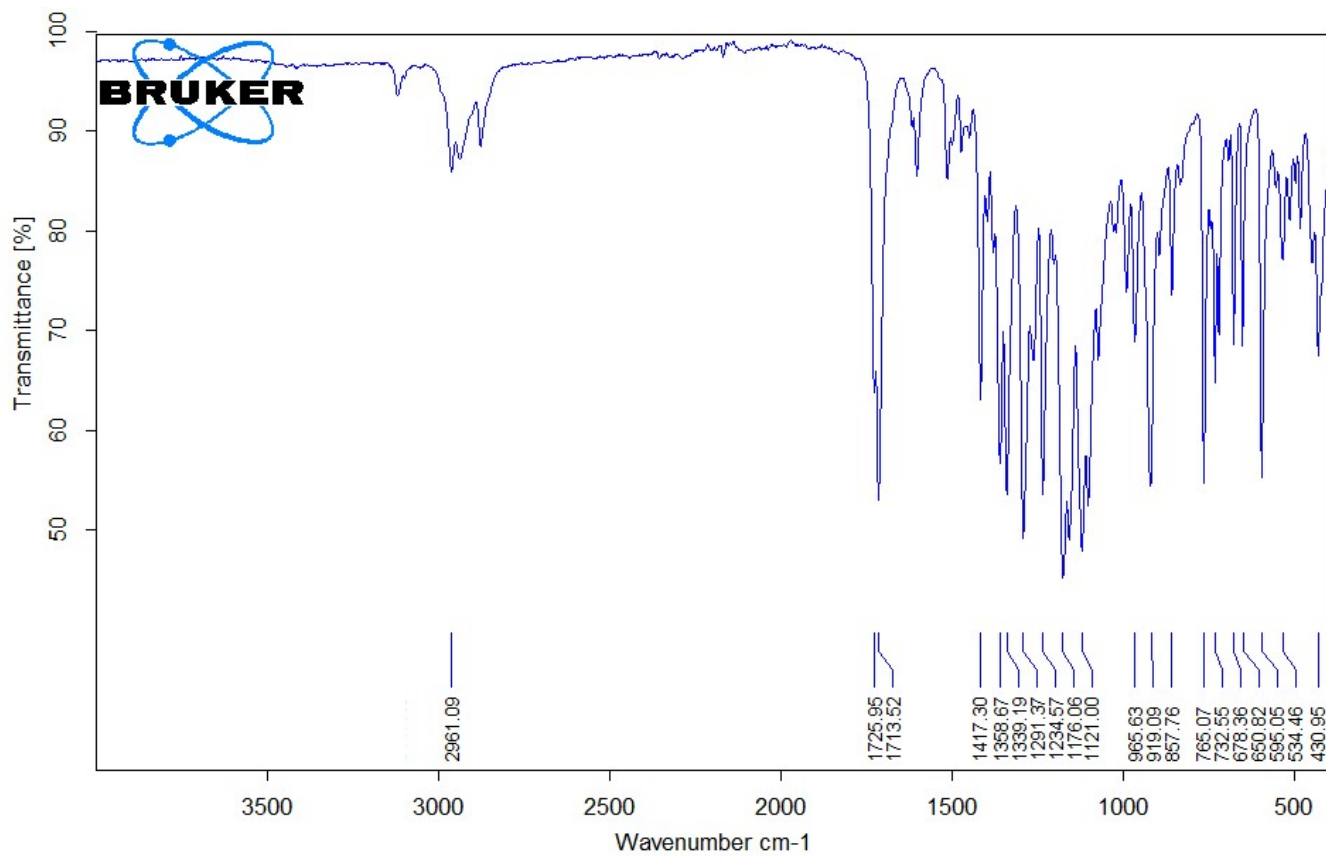
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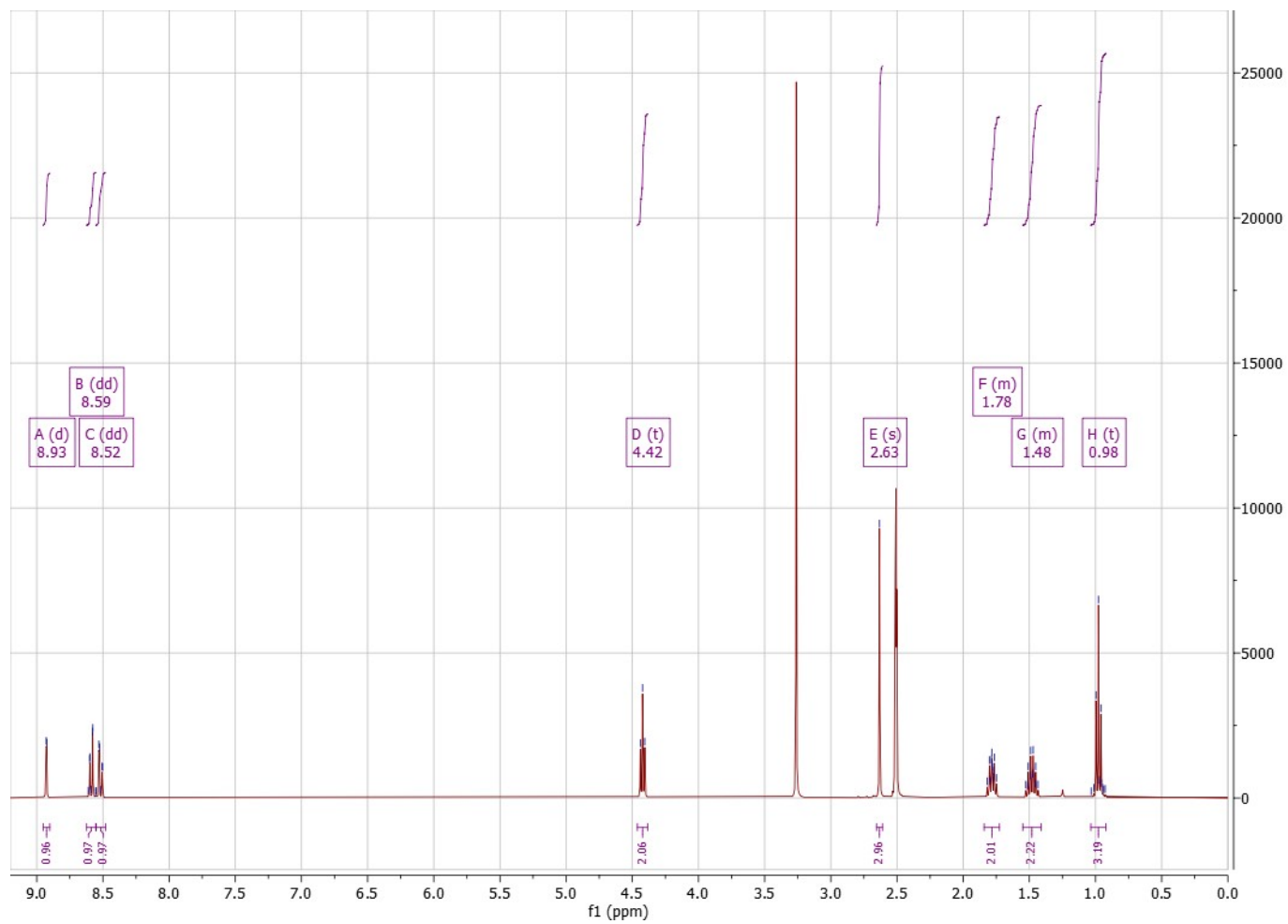
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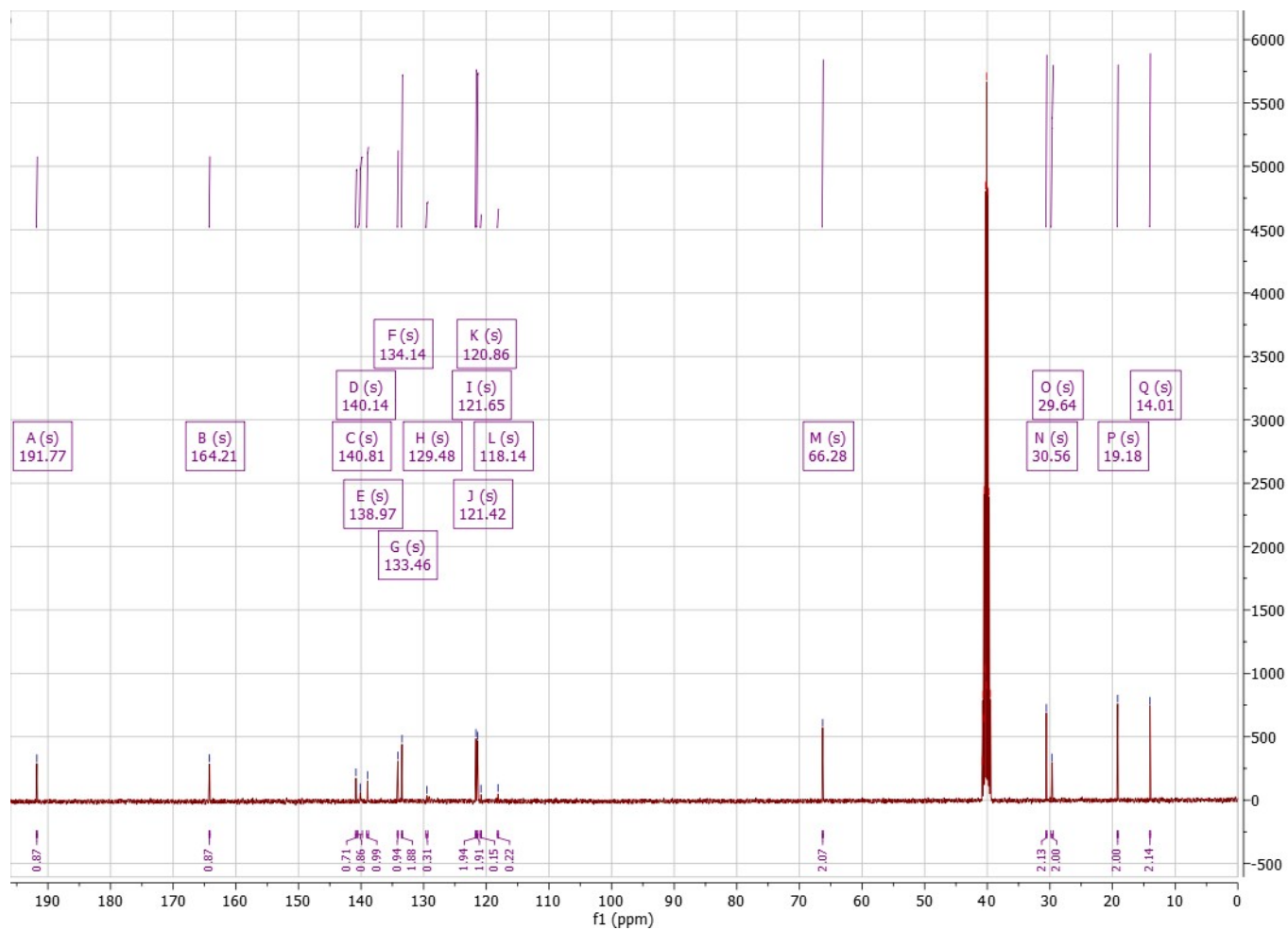
T-145 IR



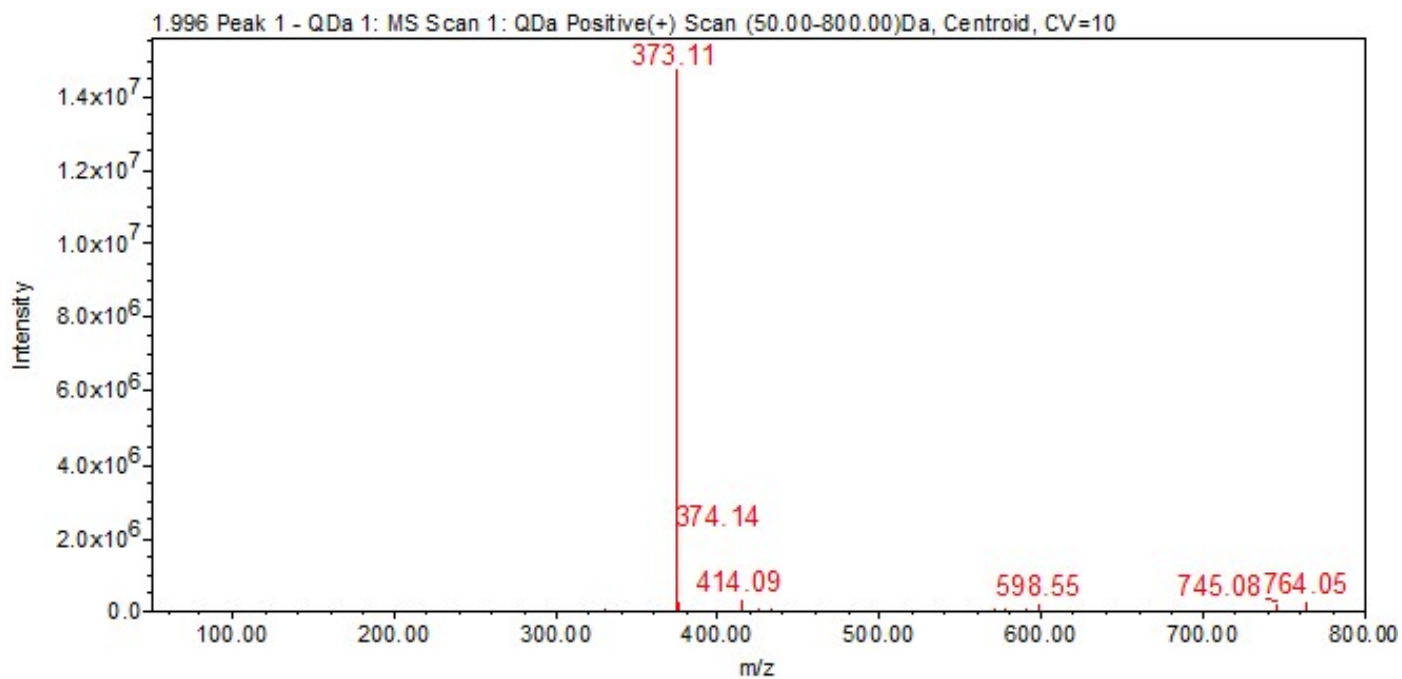
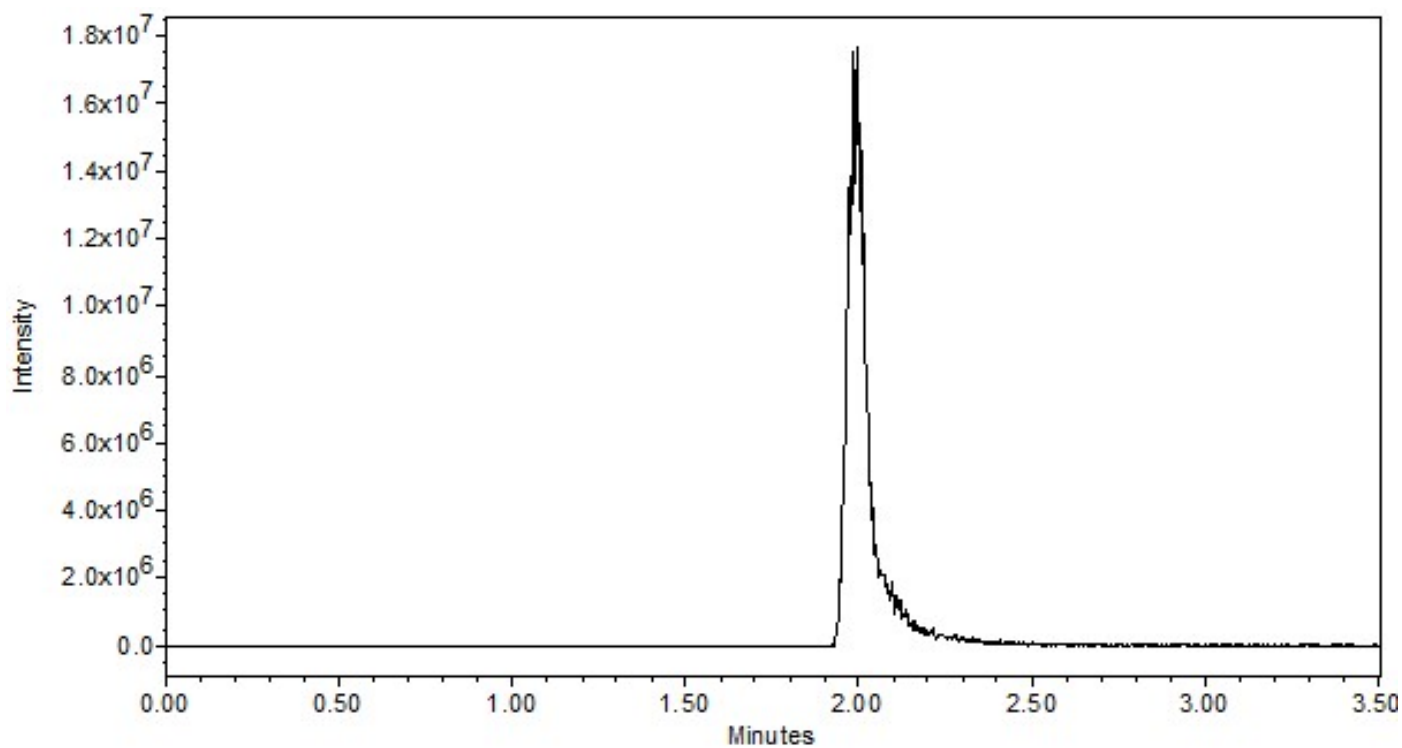
T-145 ¹H-NMR



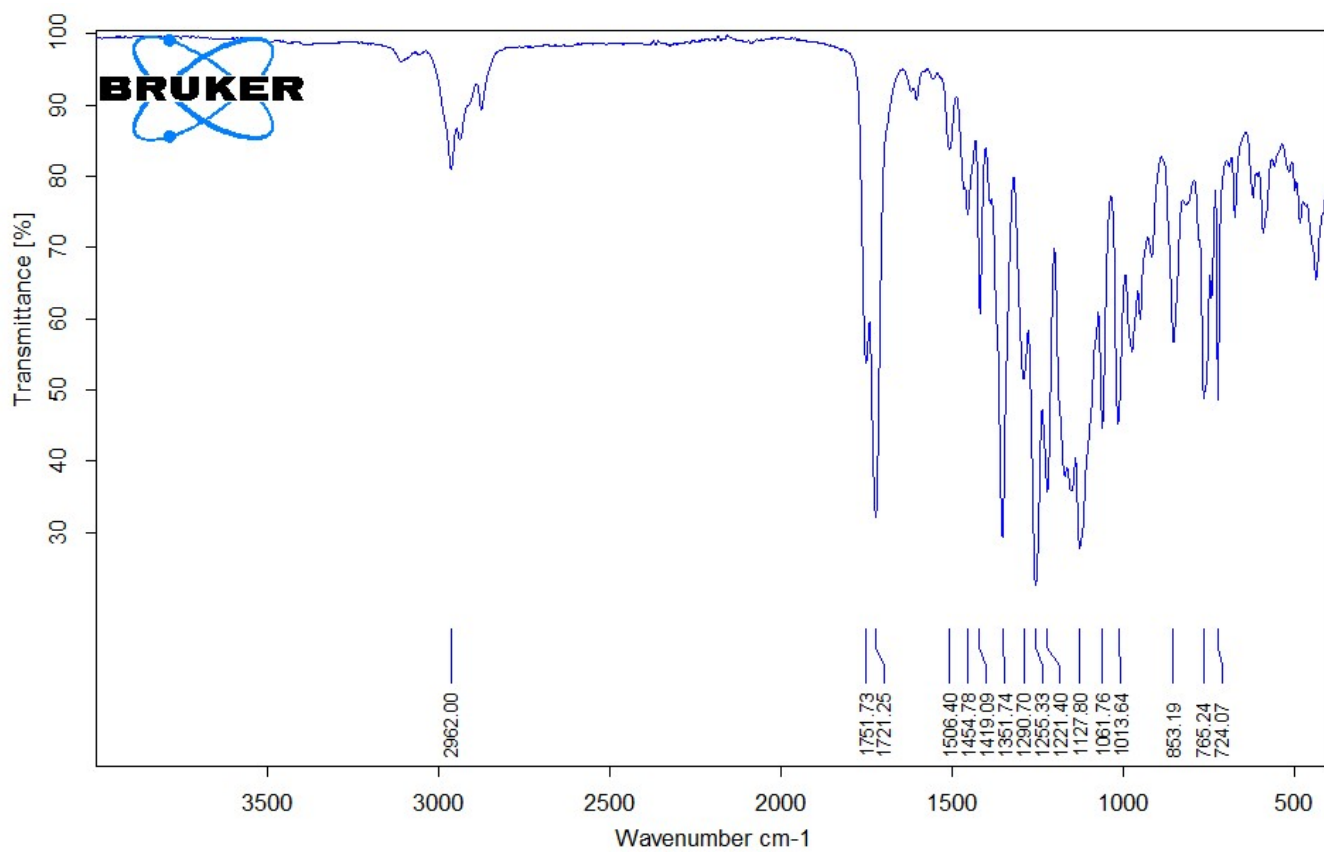
T-145 ¹³C-NMR



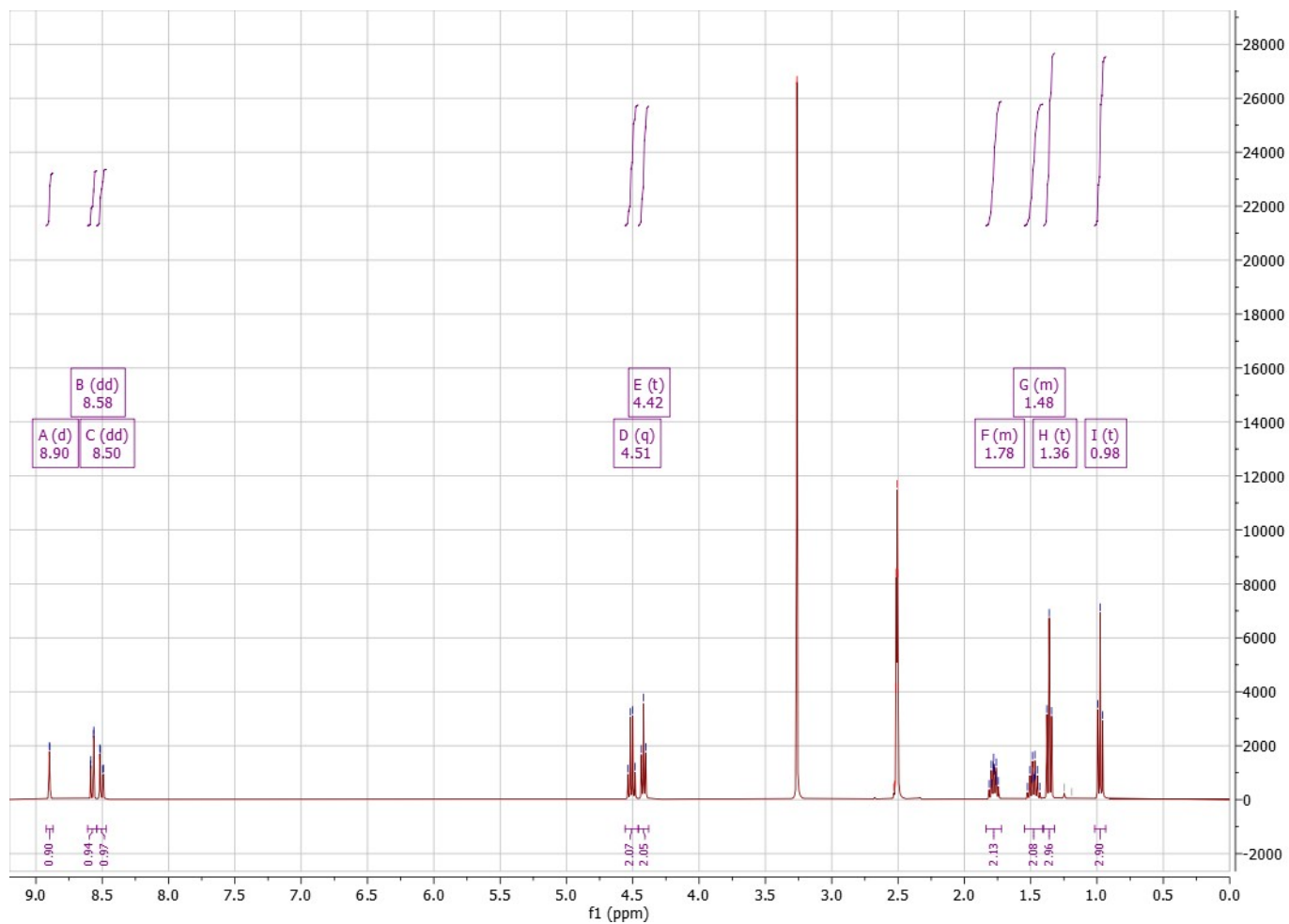
T-145 UPLC-MS



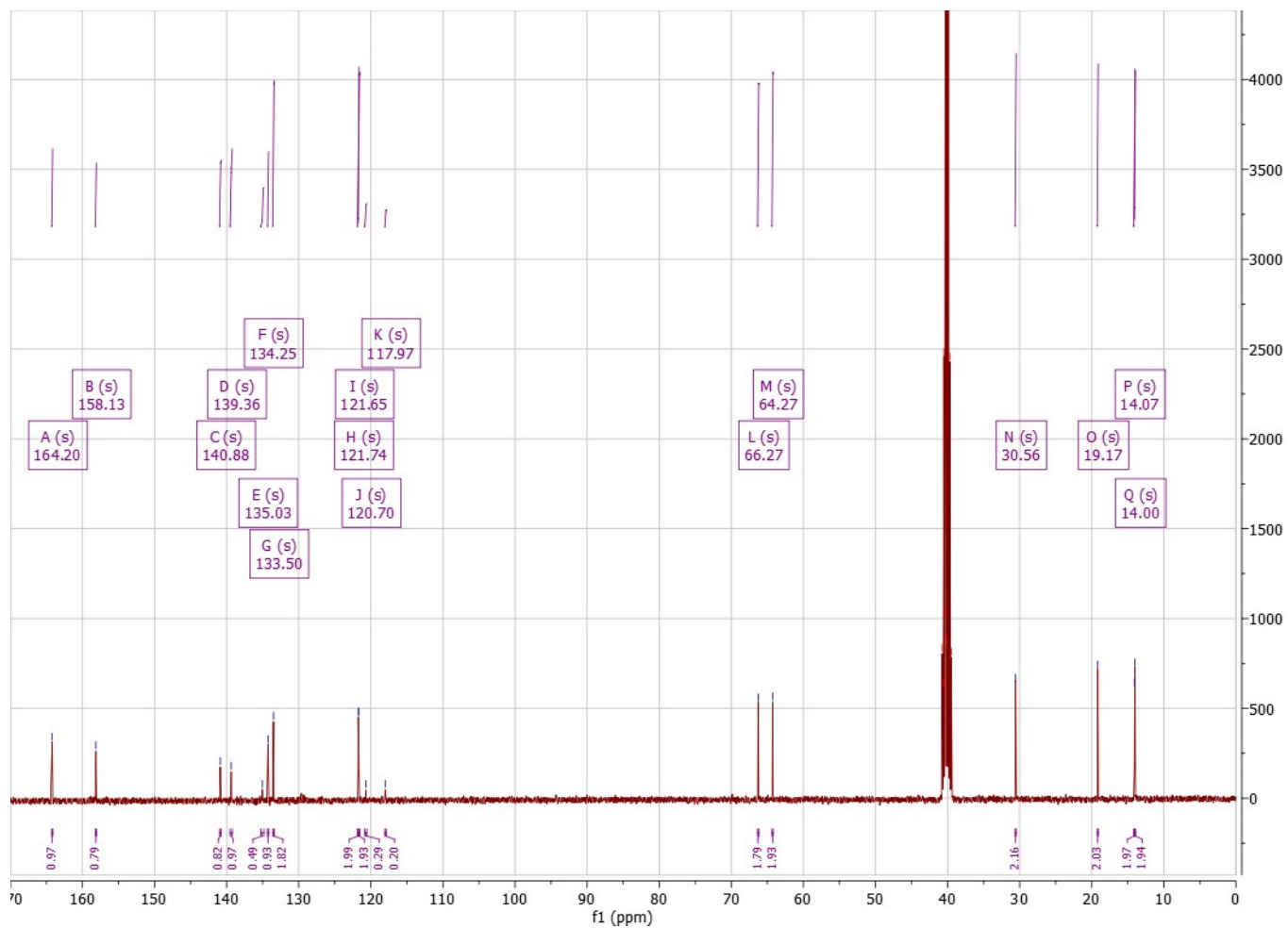
T-146 IR



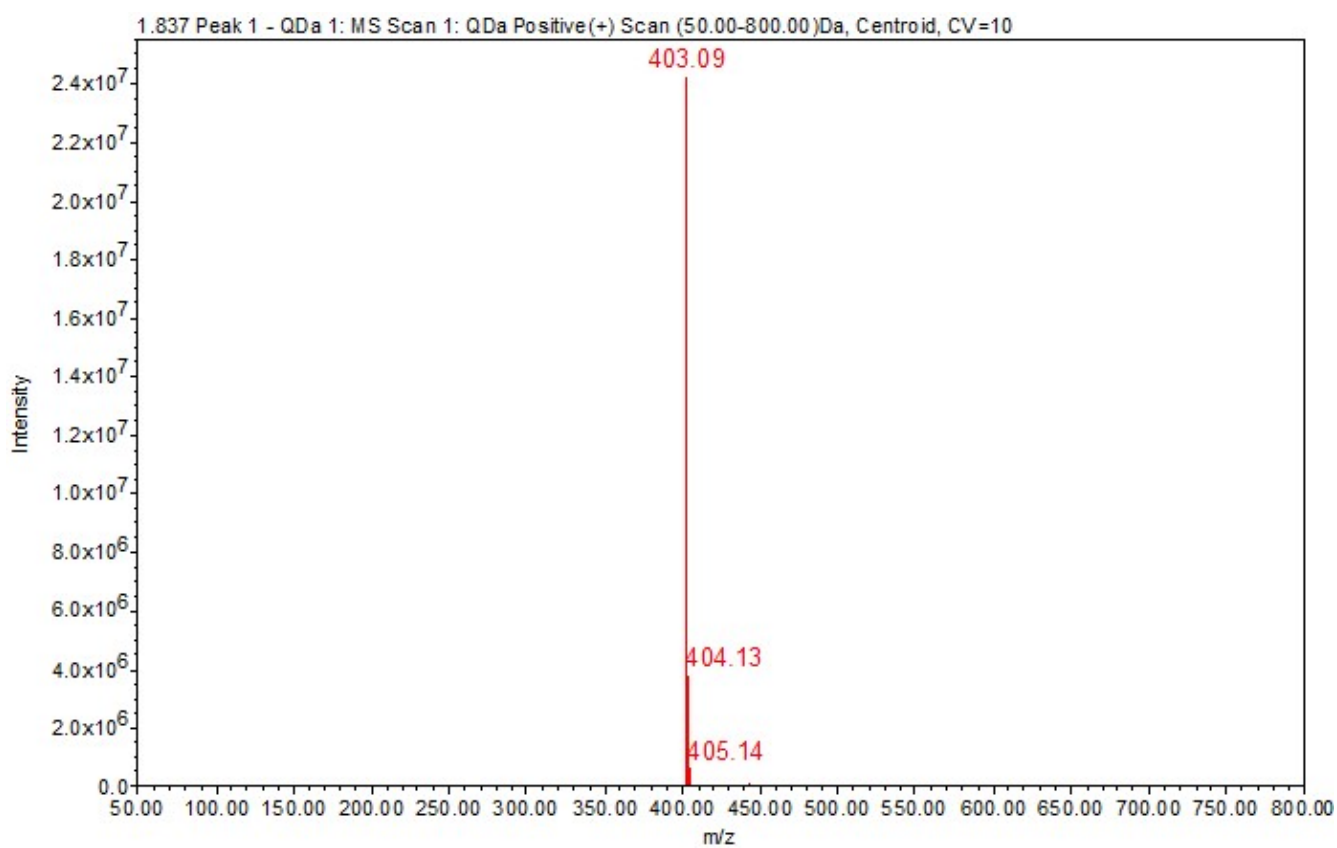
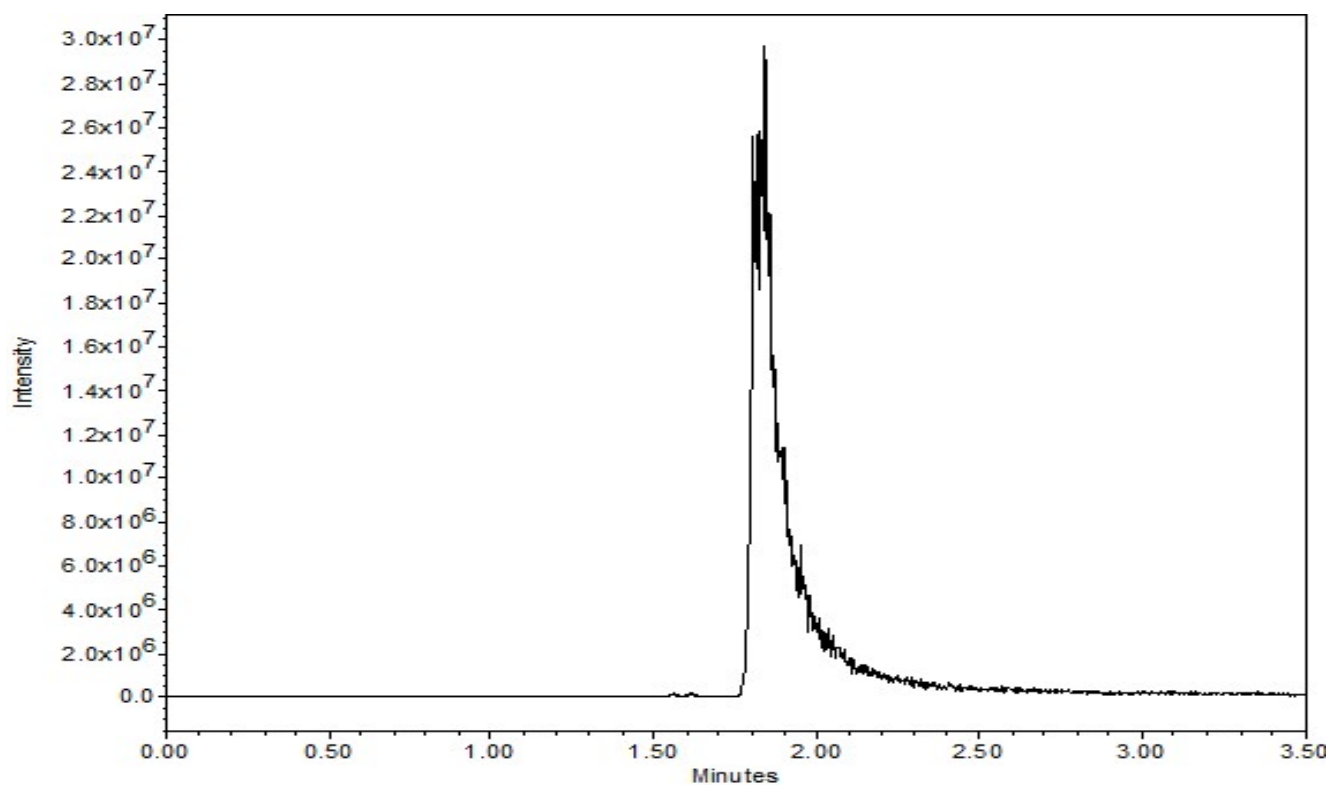
T-146 ¹H-NMR



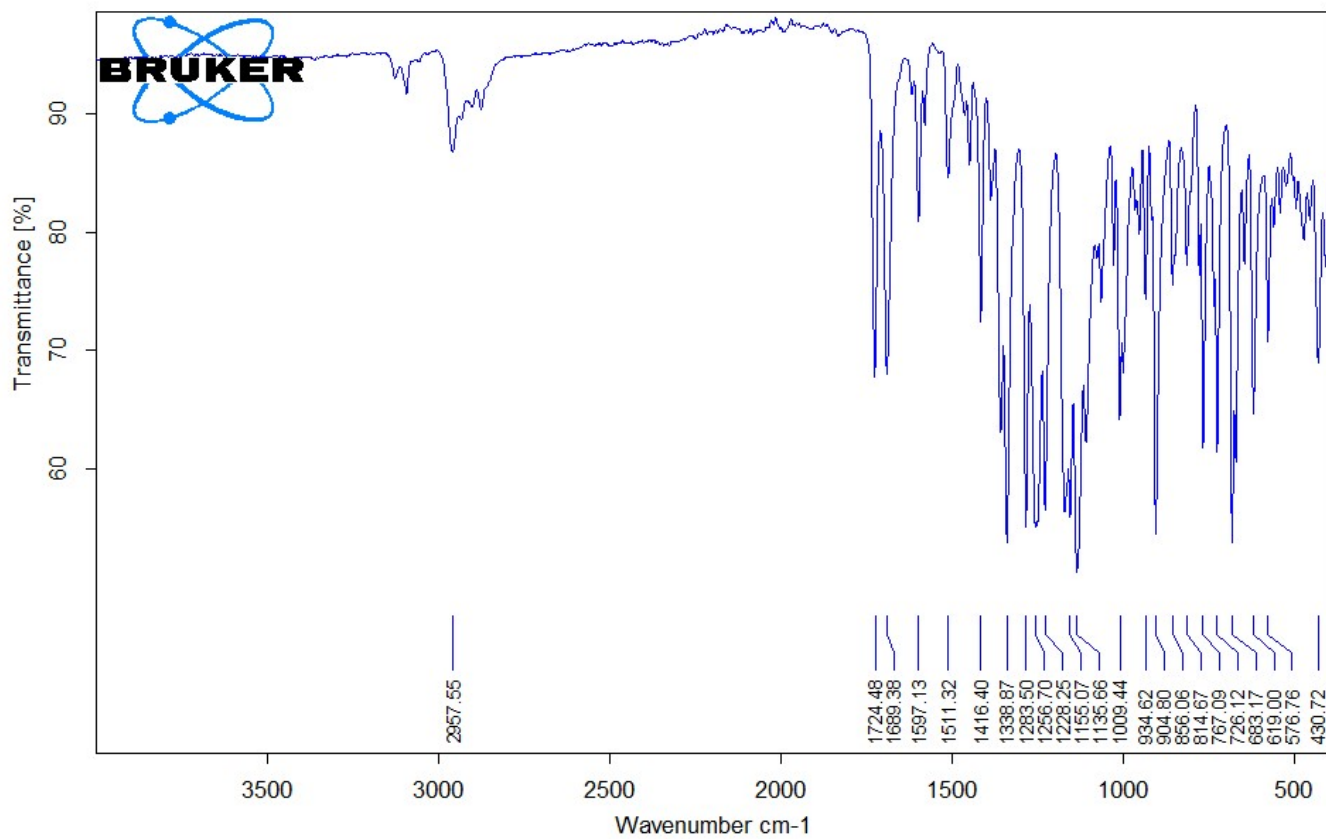
T-146 ¹³C-NMR



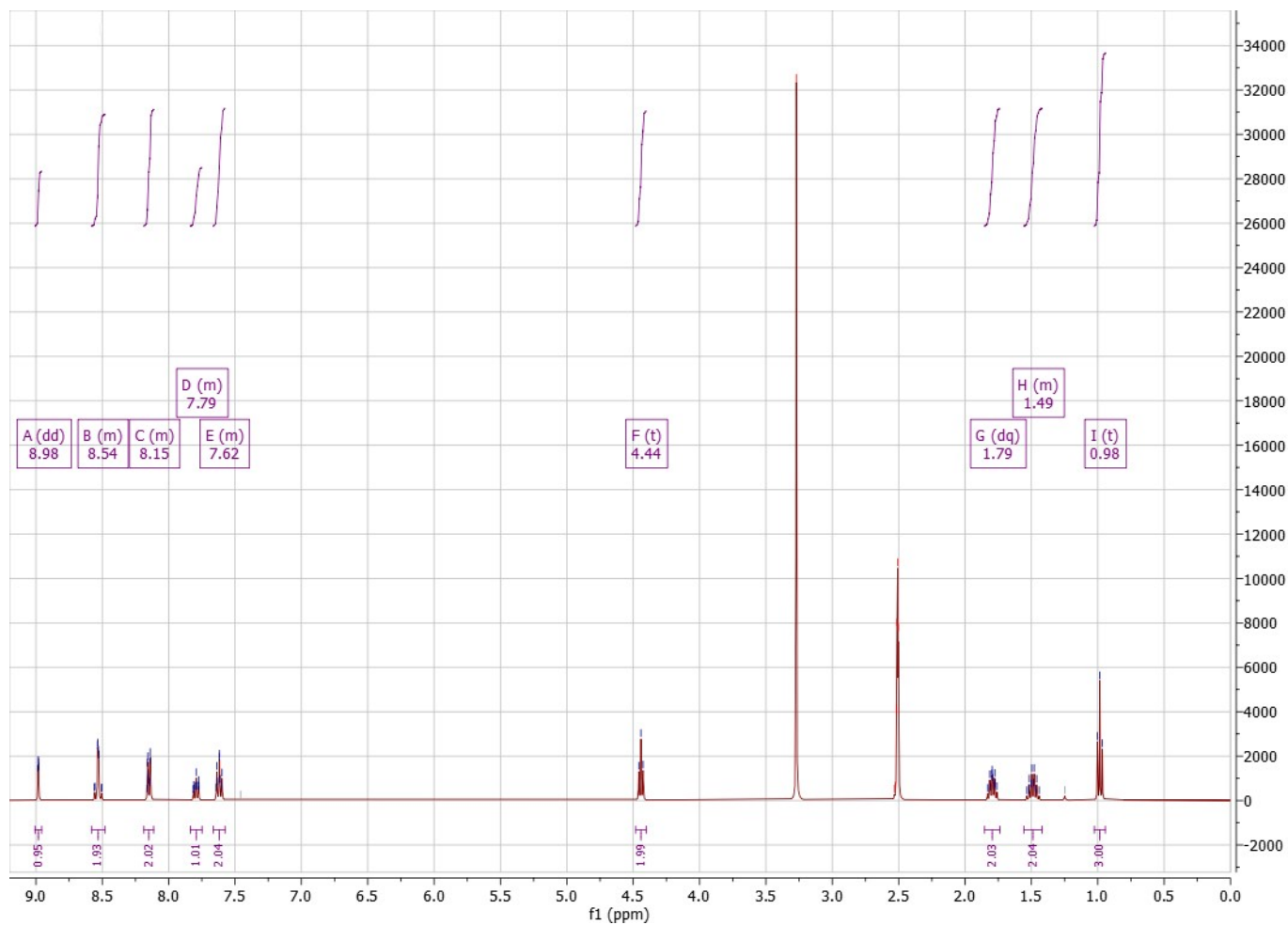
T-146 UPLC-MS



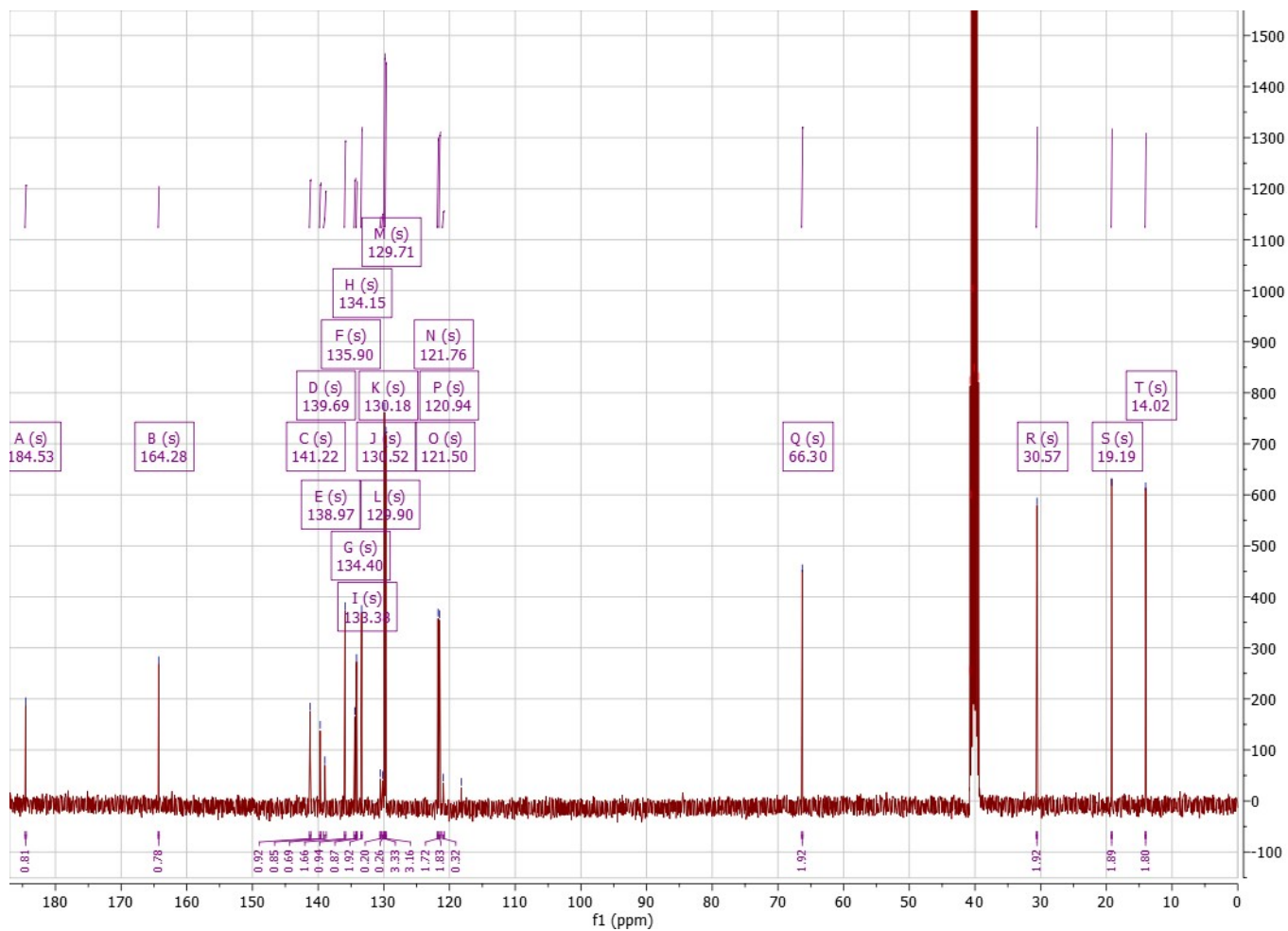
T-148 IR



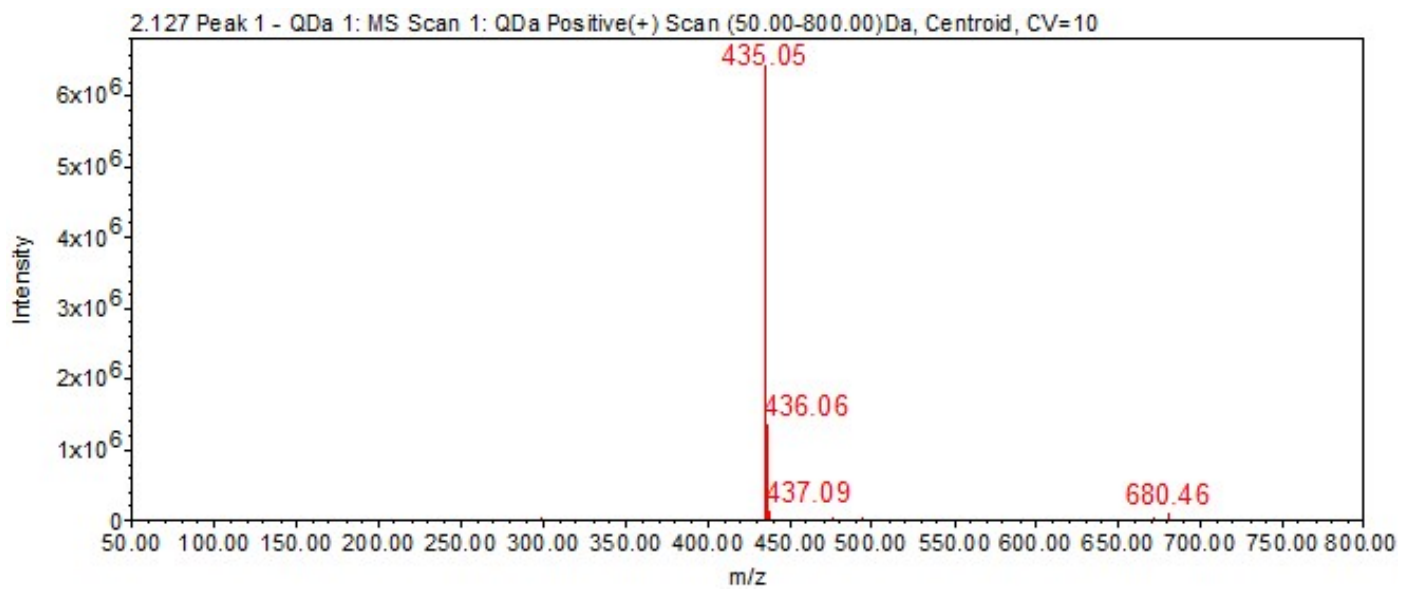
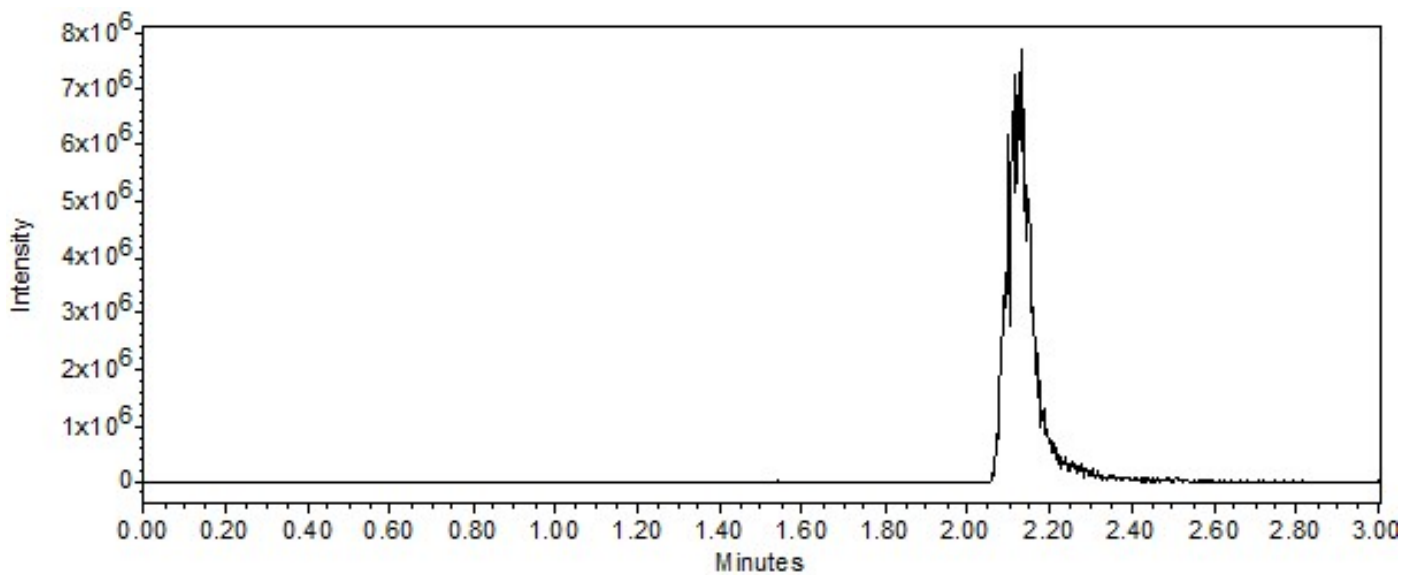
T-148 ¹H-NMR



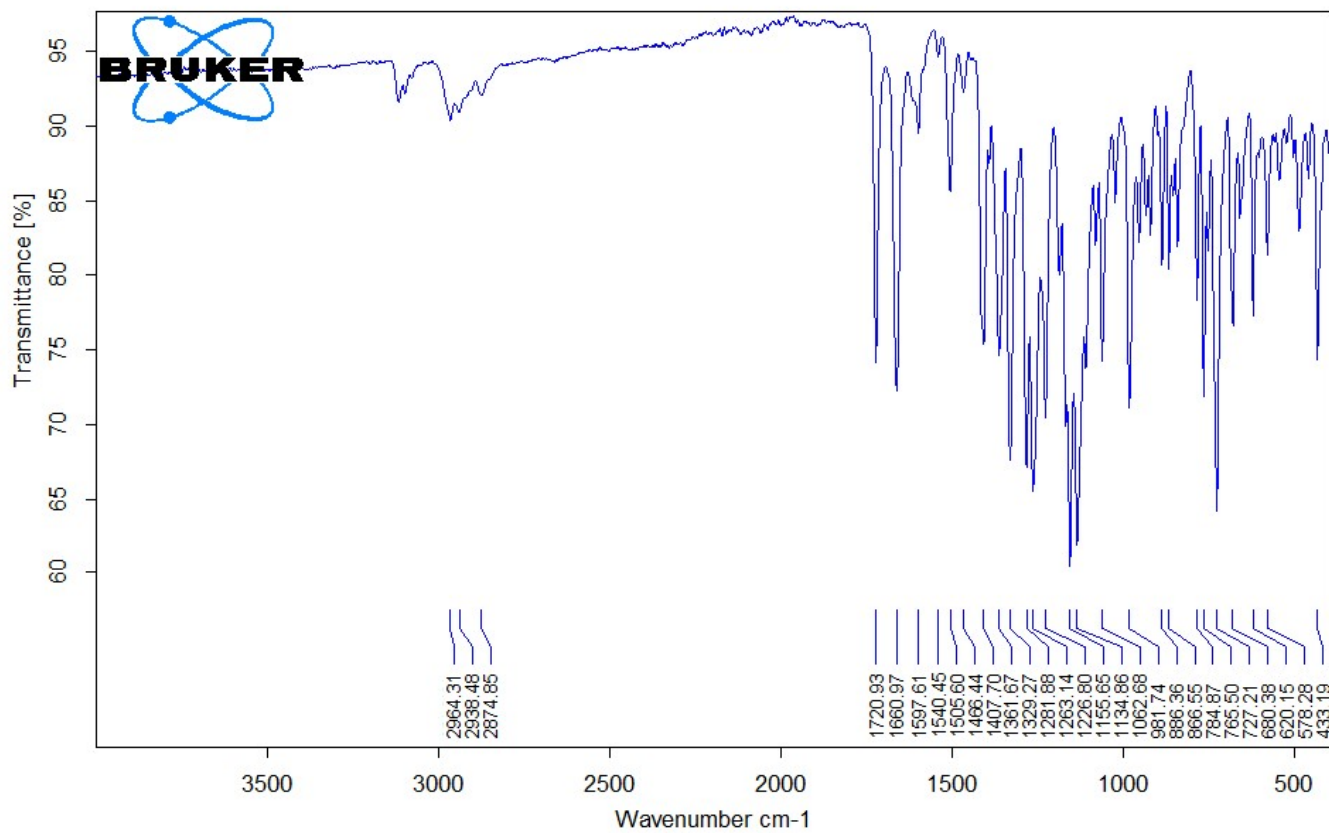
T-148 ¹³C-NMR



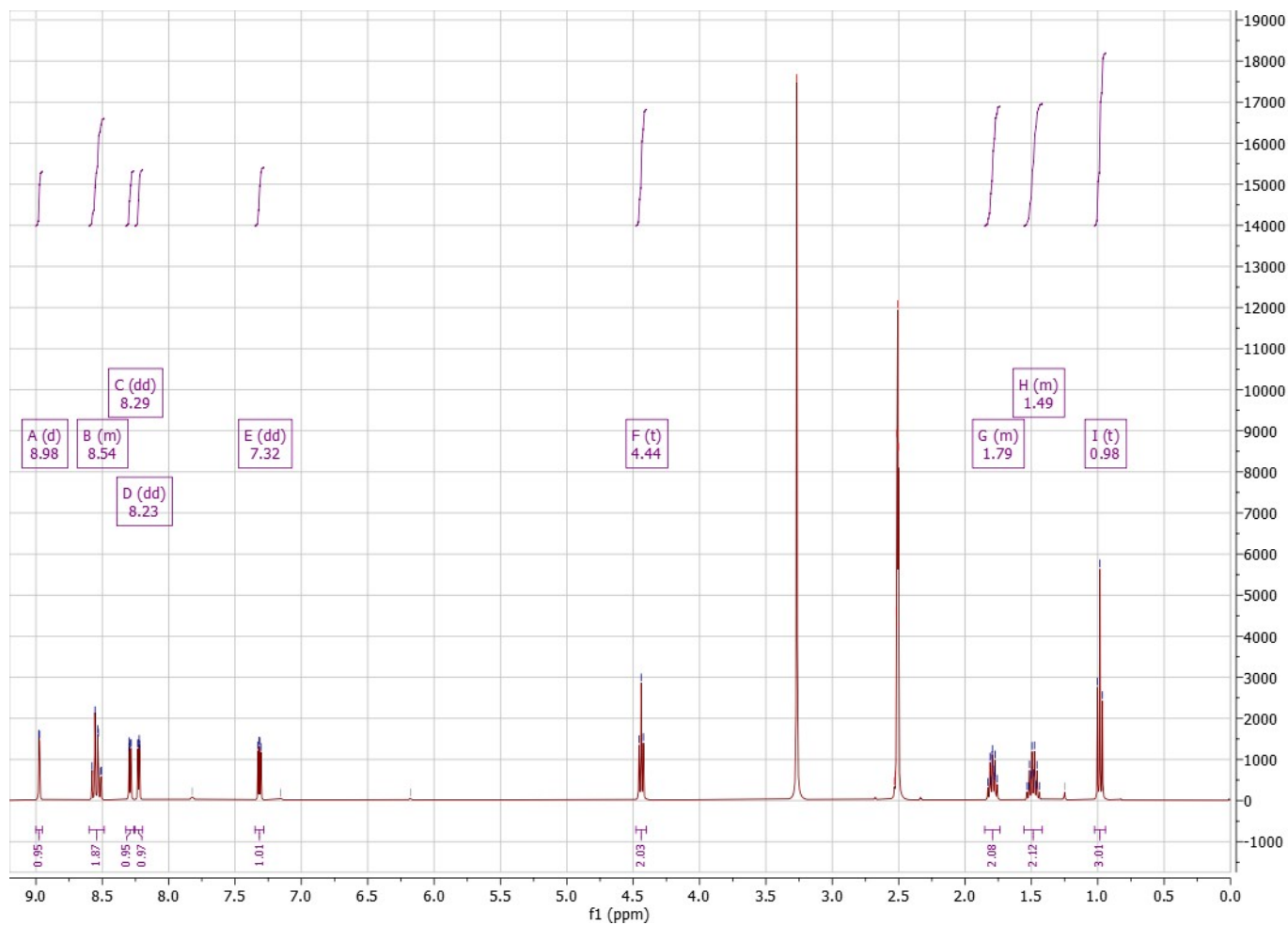
T-148 UPLC-MS



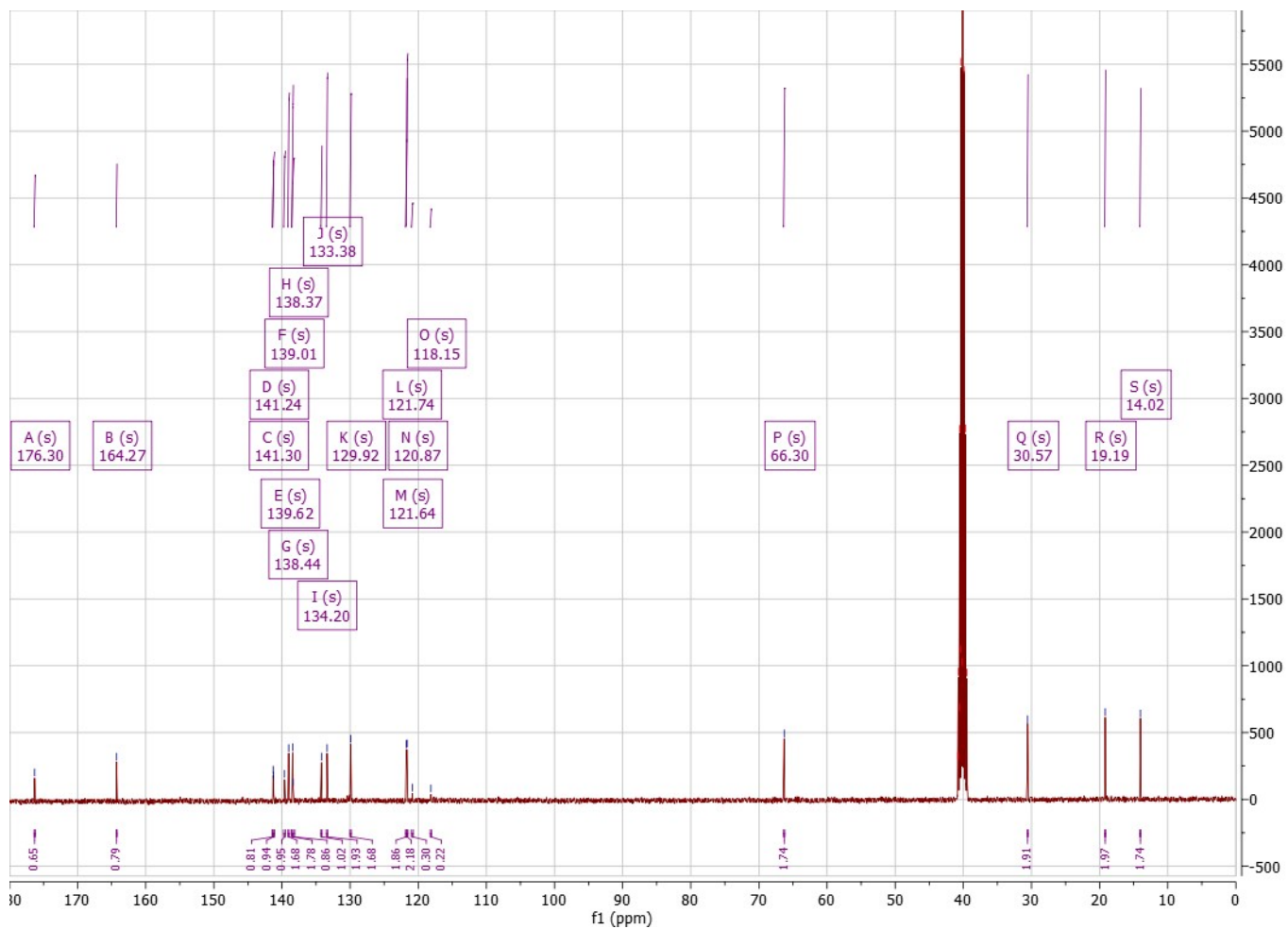
T-149 IR



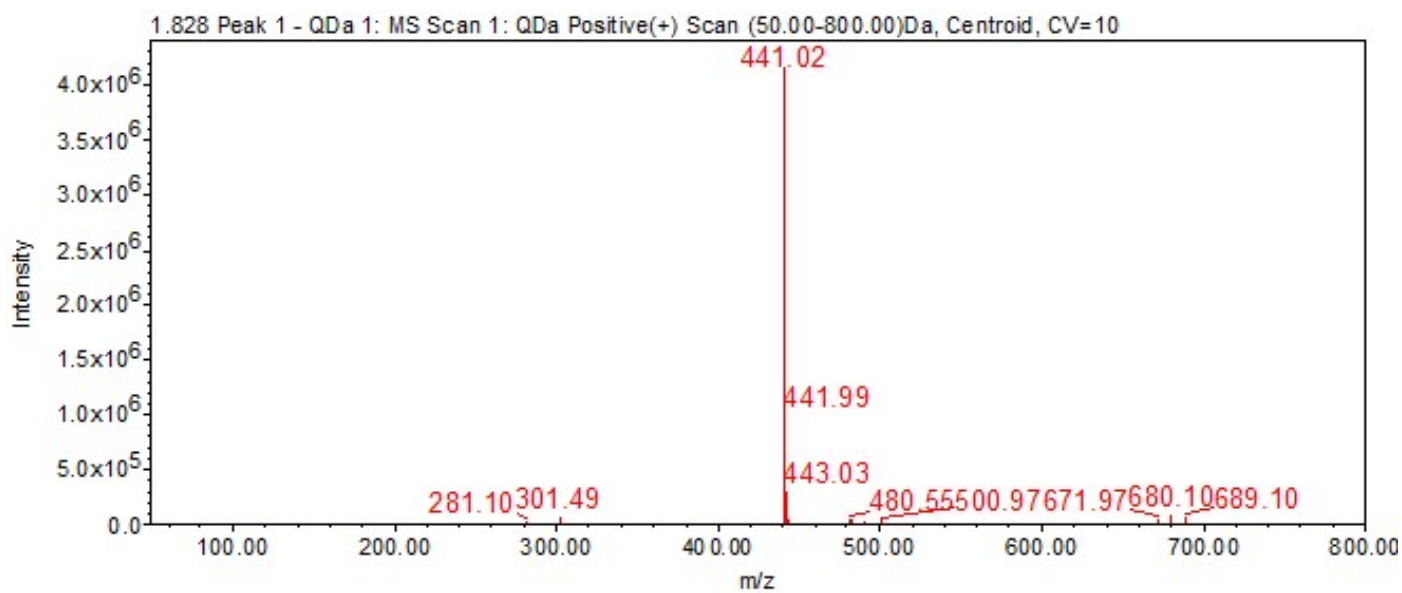
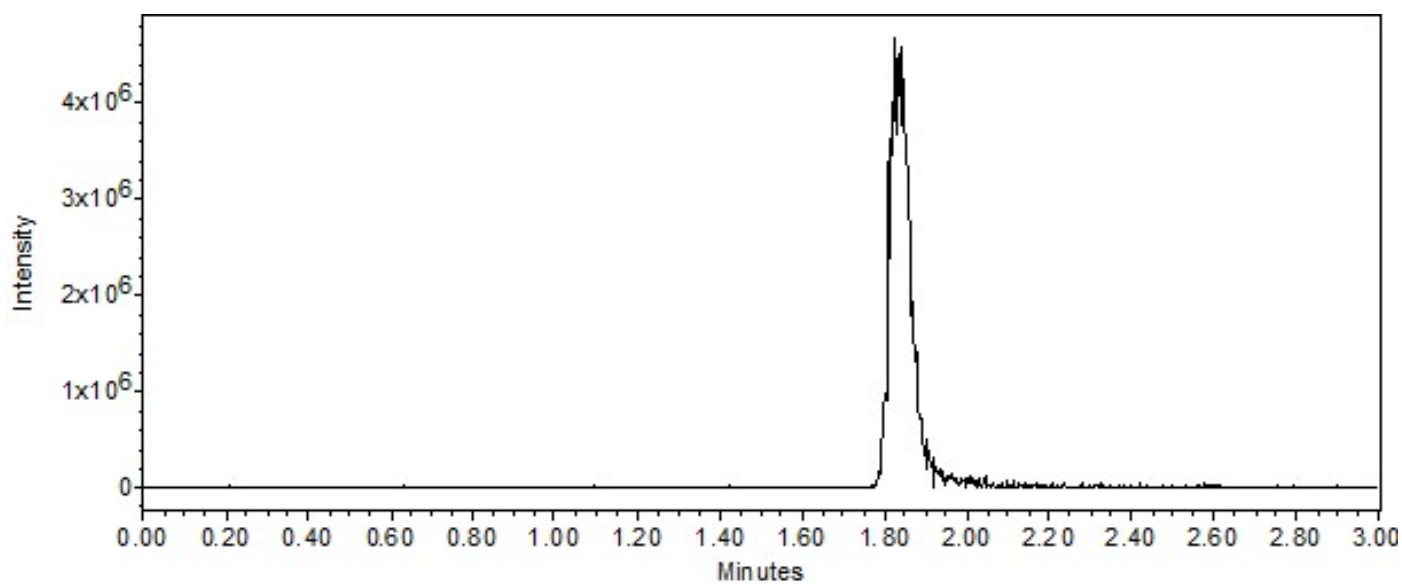
T-149 ¹H-NMR



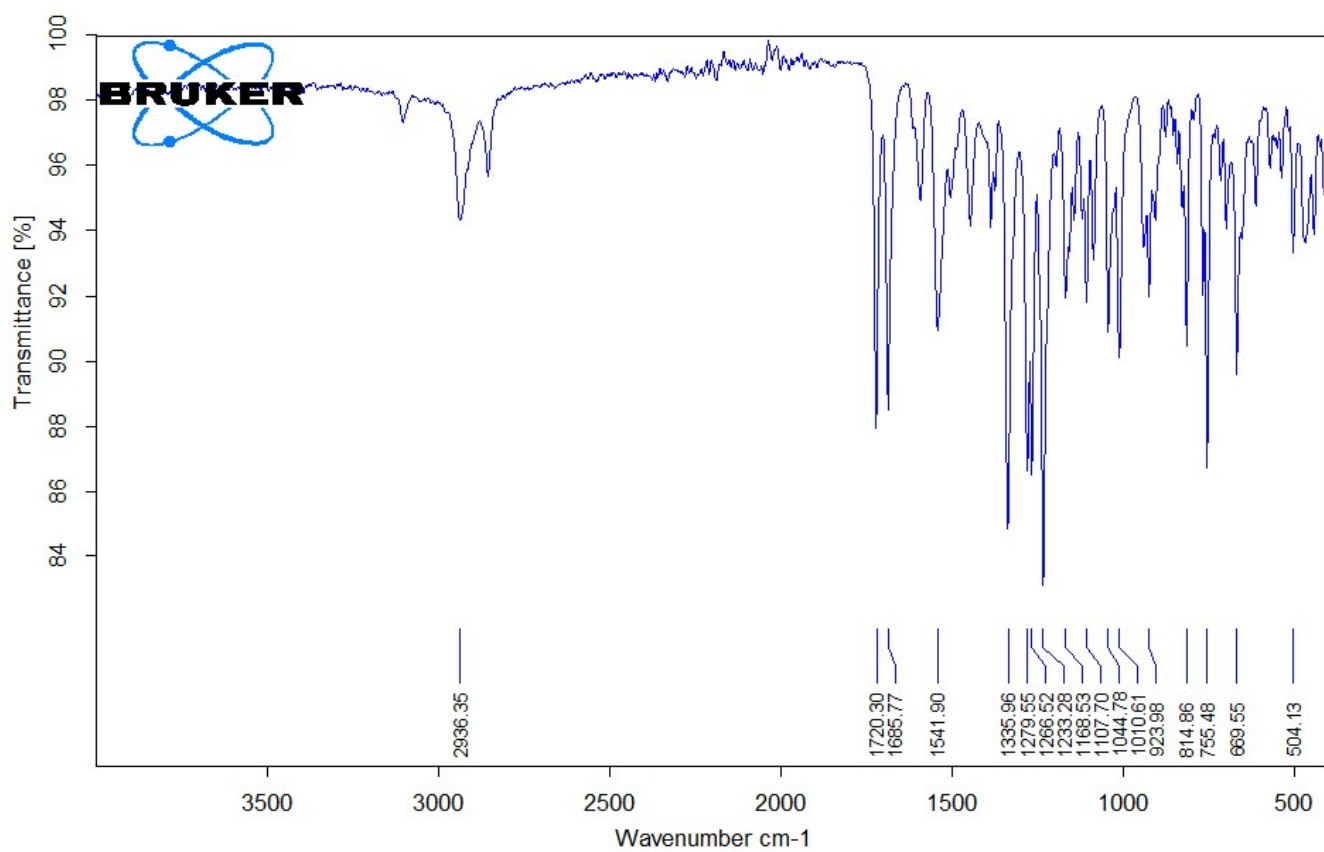
T-149 ¹³C-NMR



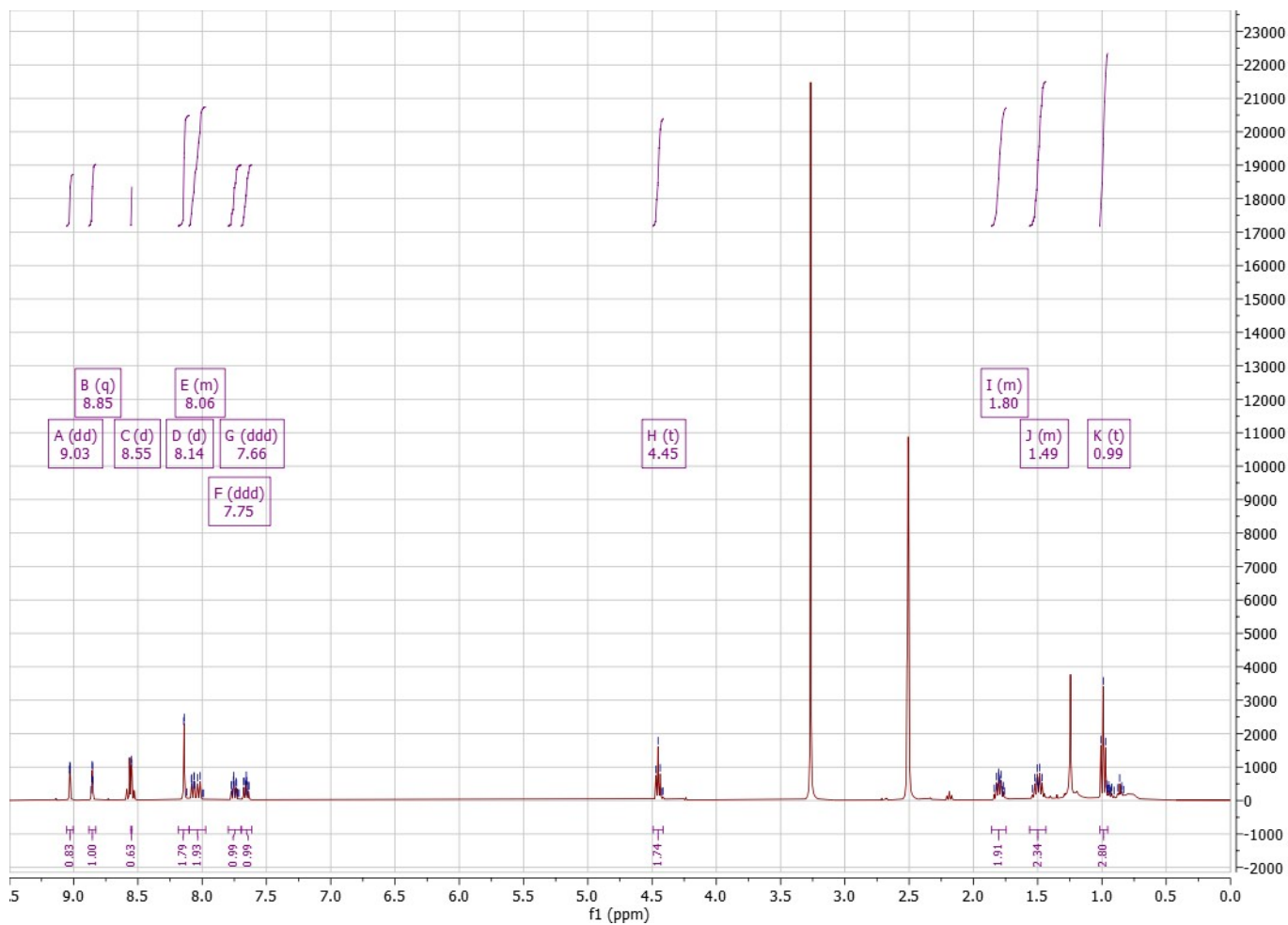
T-149 UPLC-MS



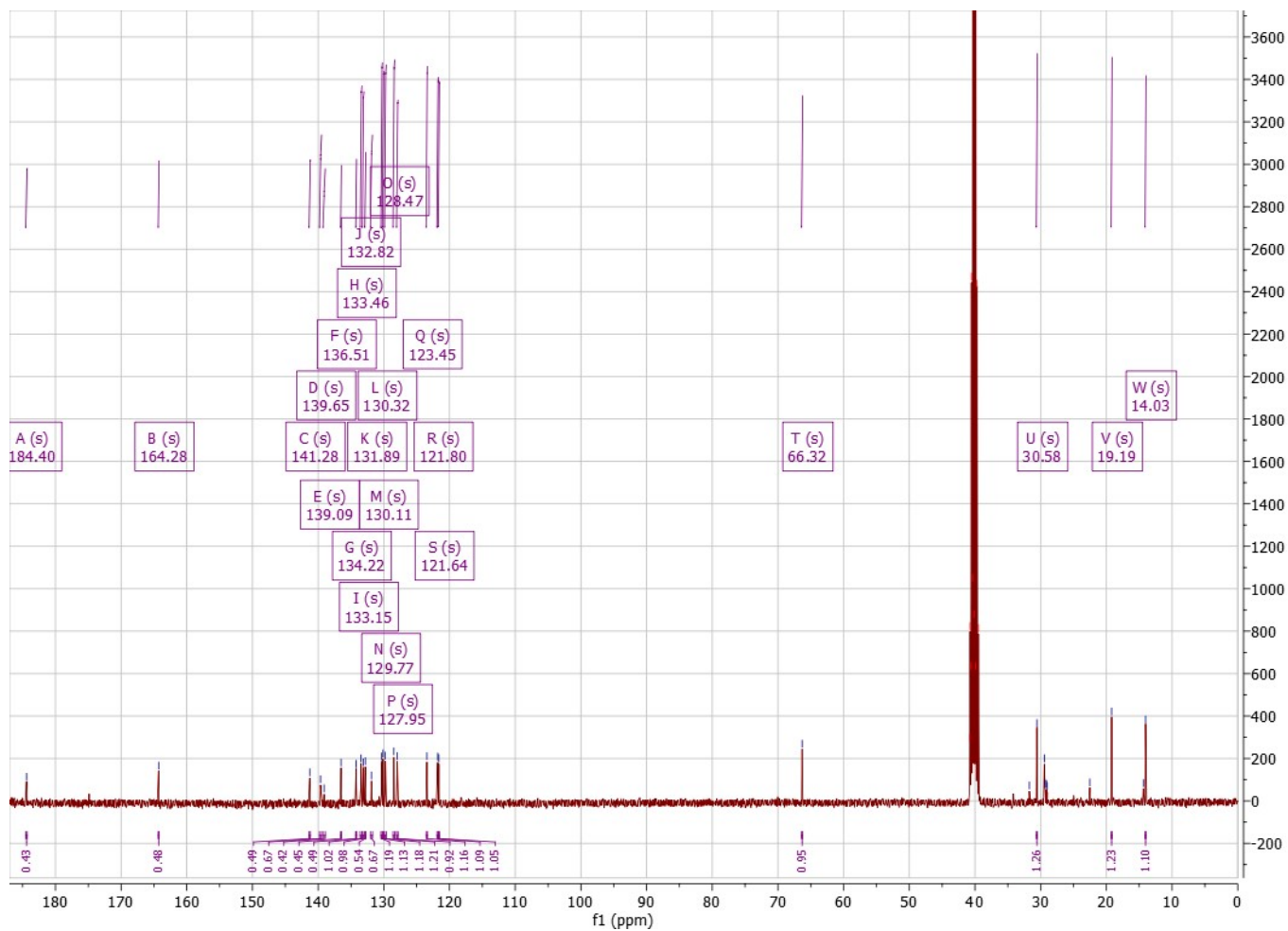
T-150 IR



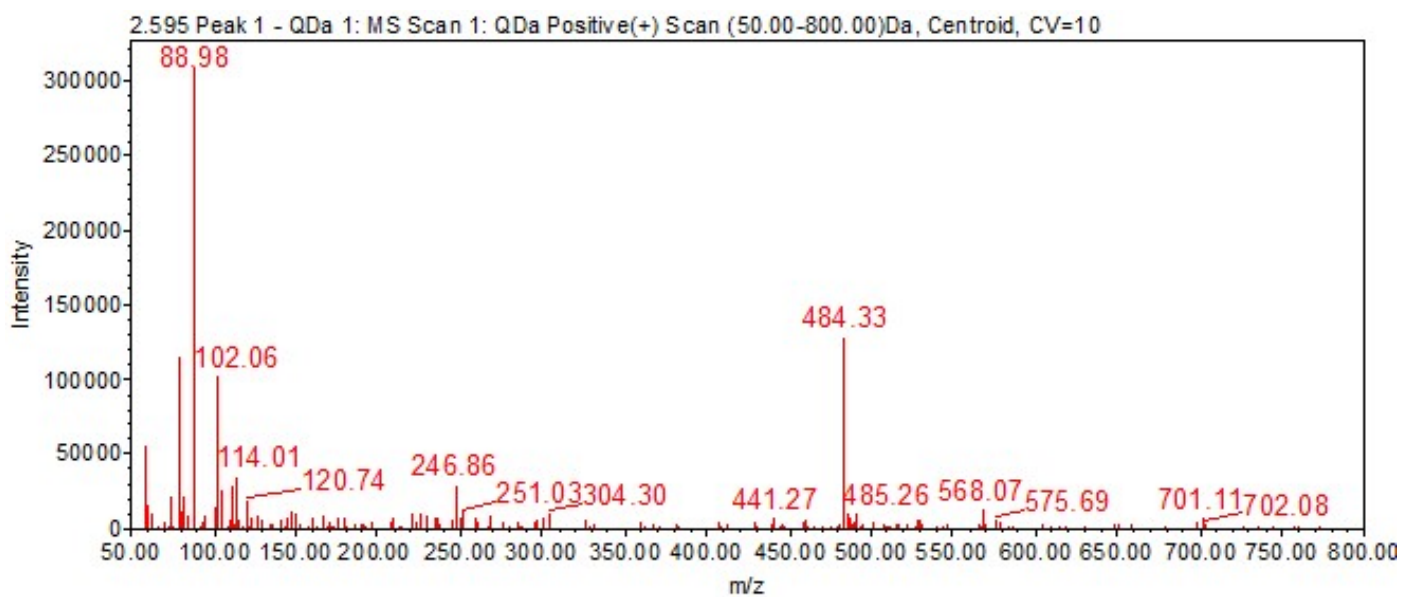
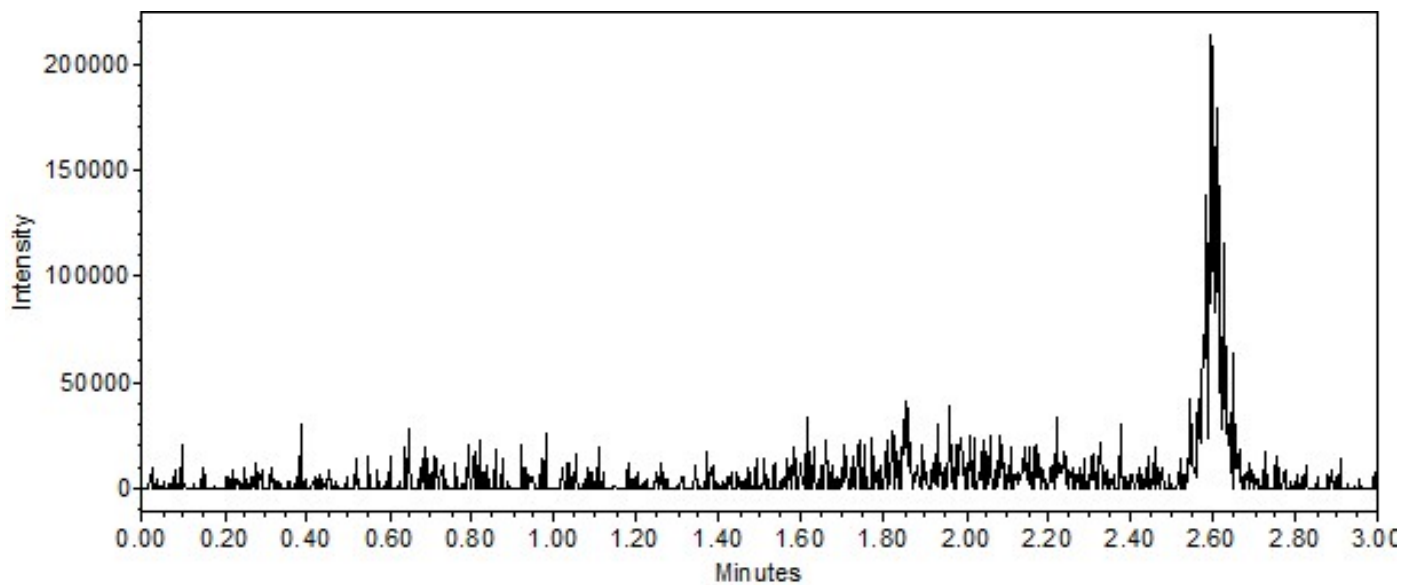
T-150 ¹H-NMR



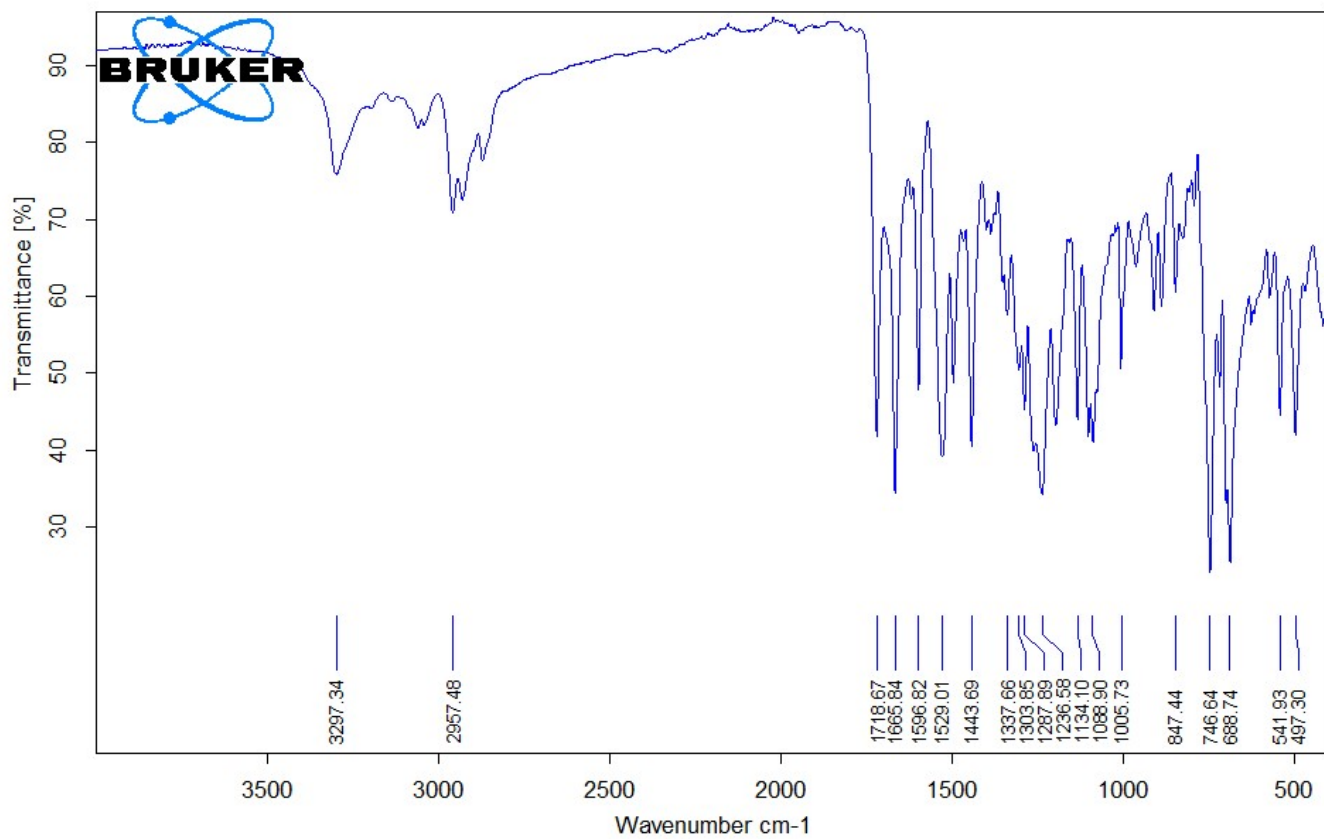
T-150 ¹³C-NMR



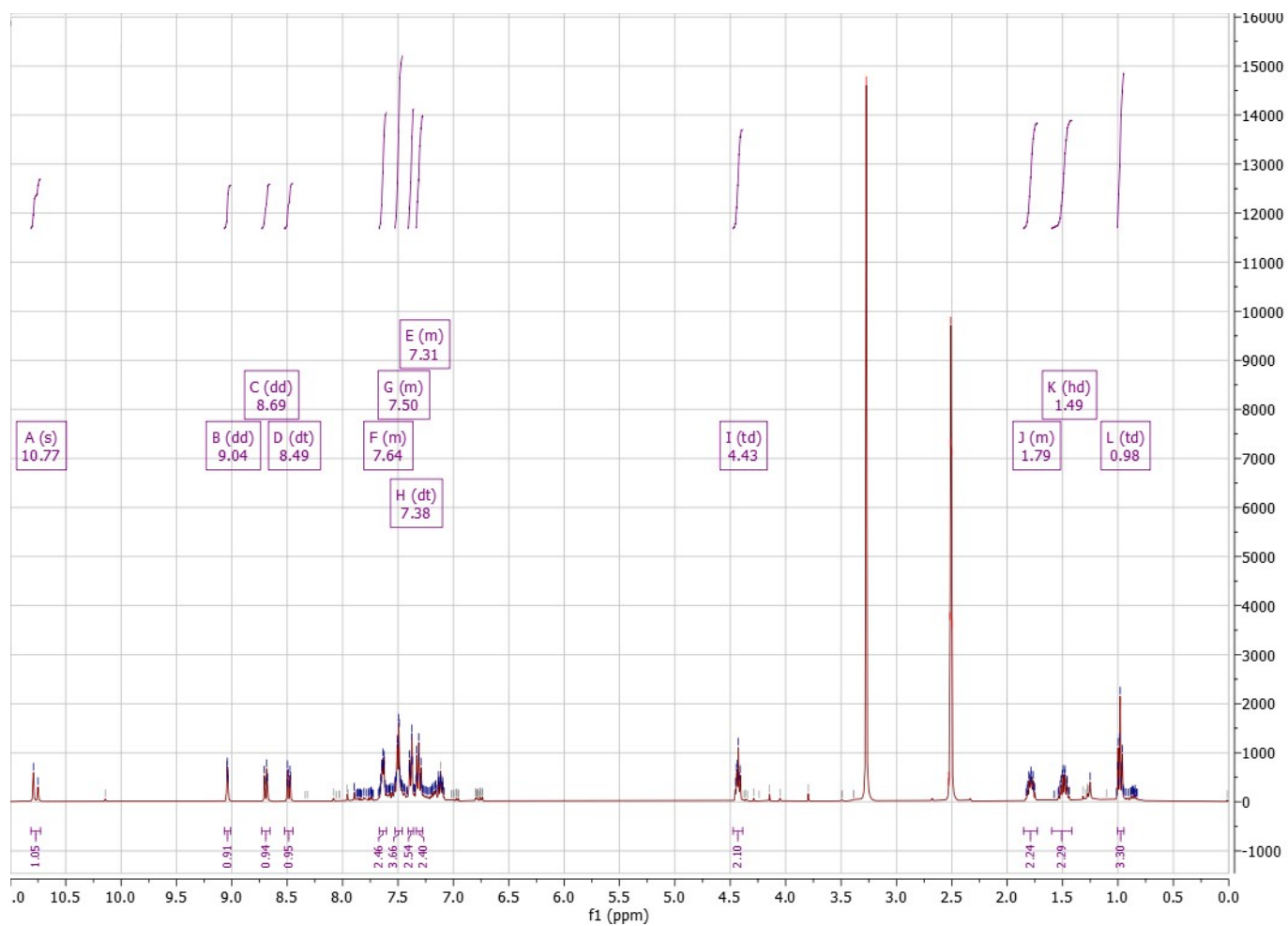
T-150 UPLC-MS



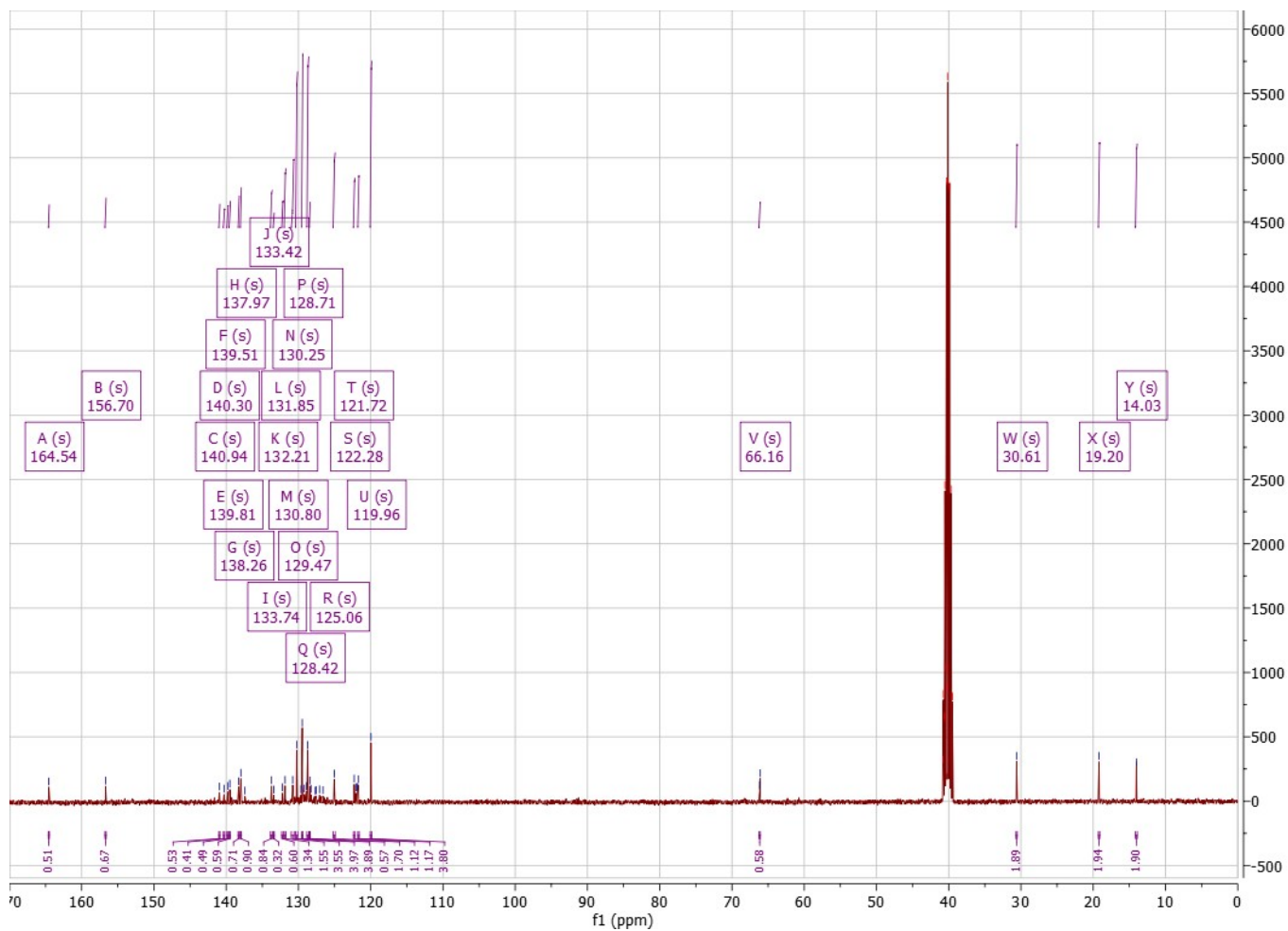
T-151 IR



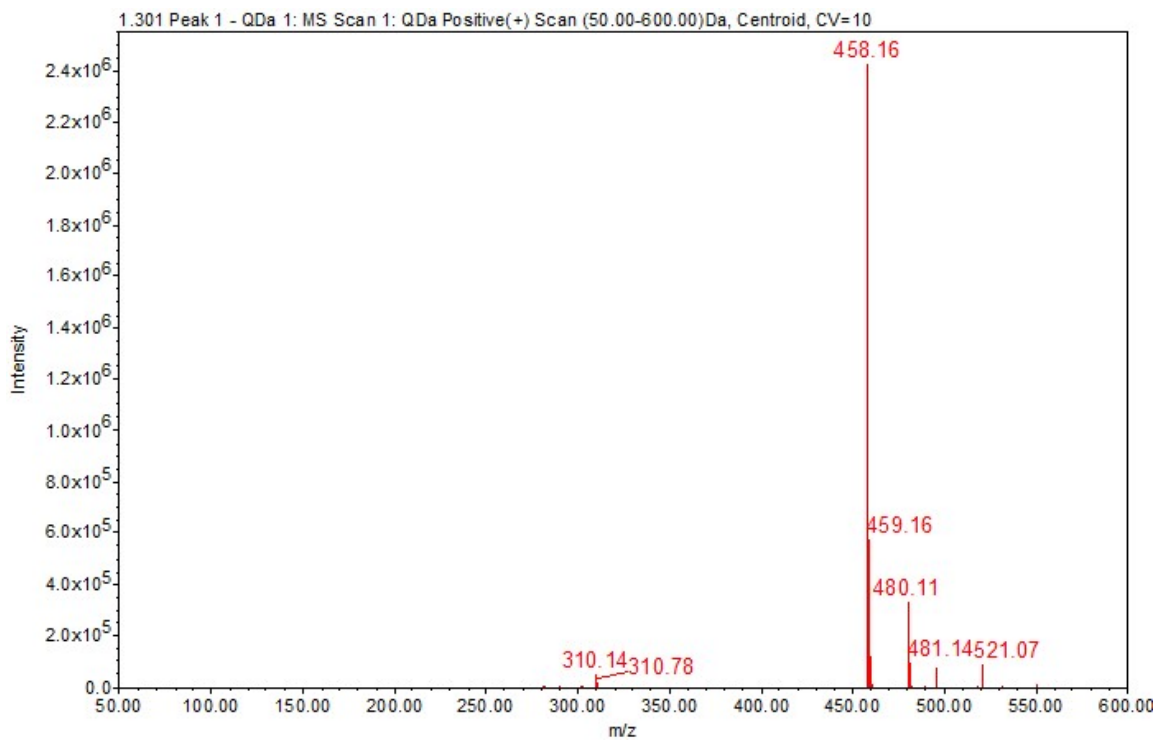
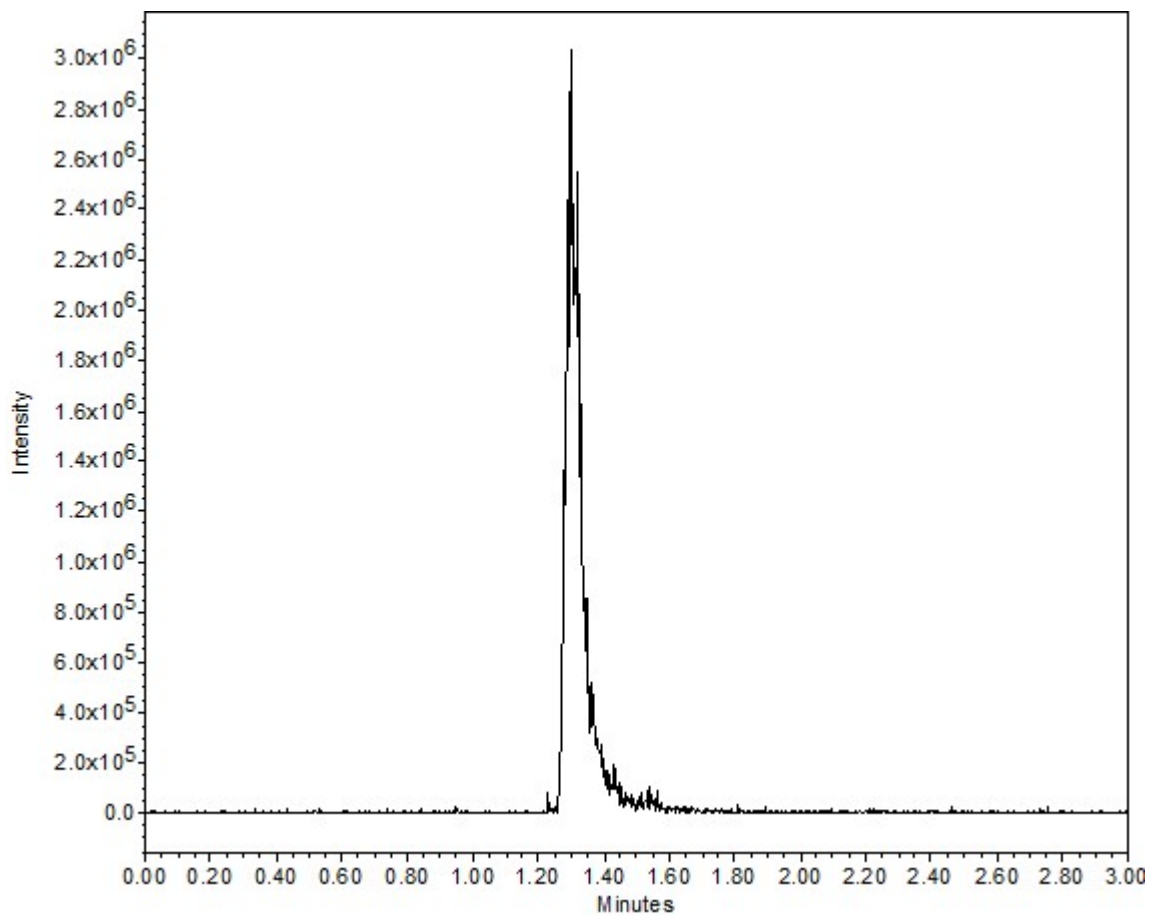
T-151 ¹H-NMR



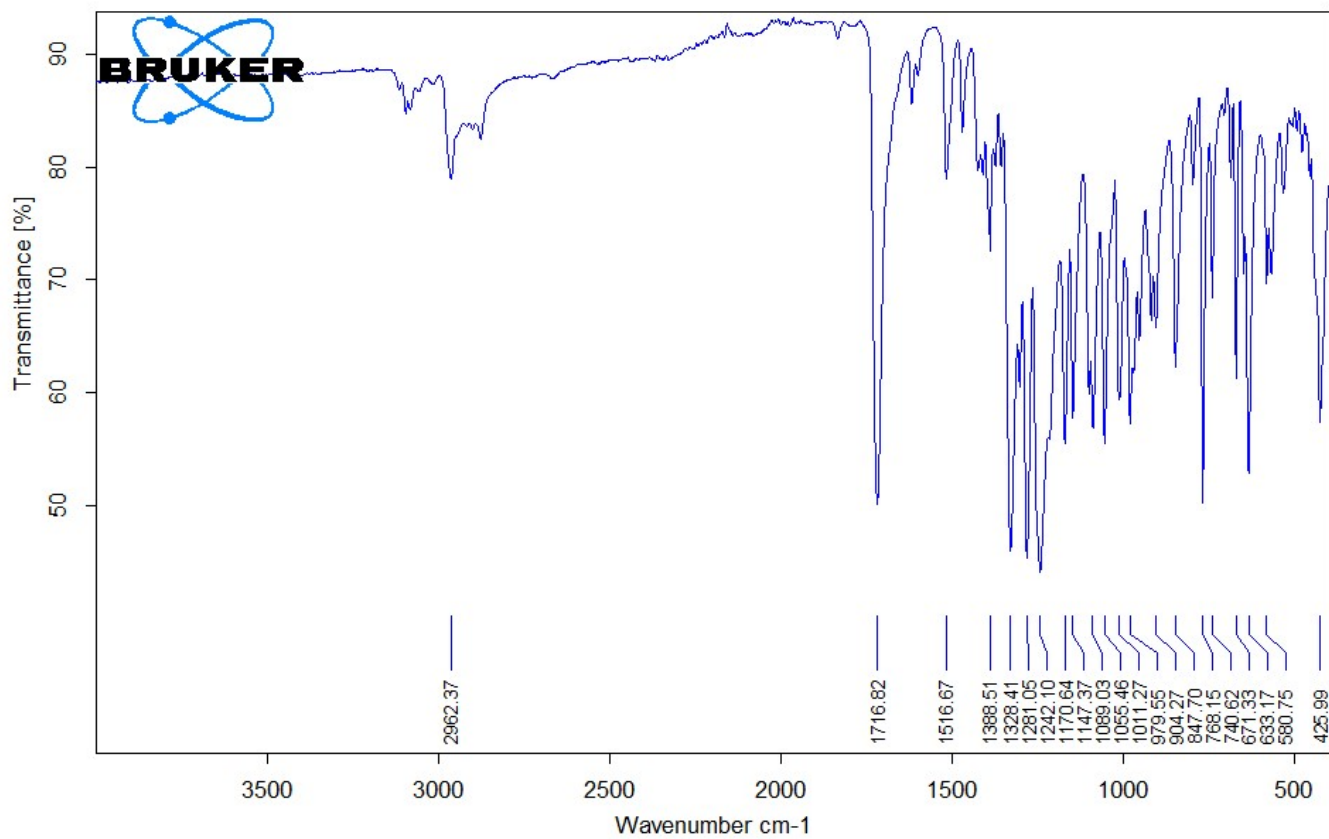
T-151 ¹³C-NMR



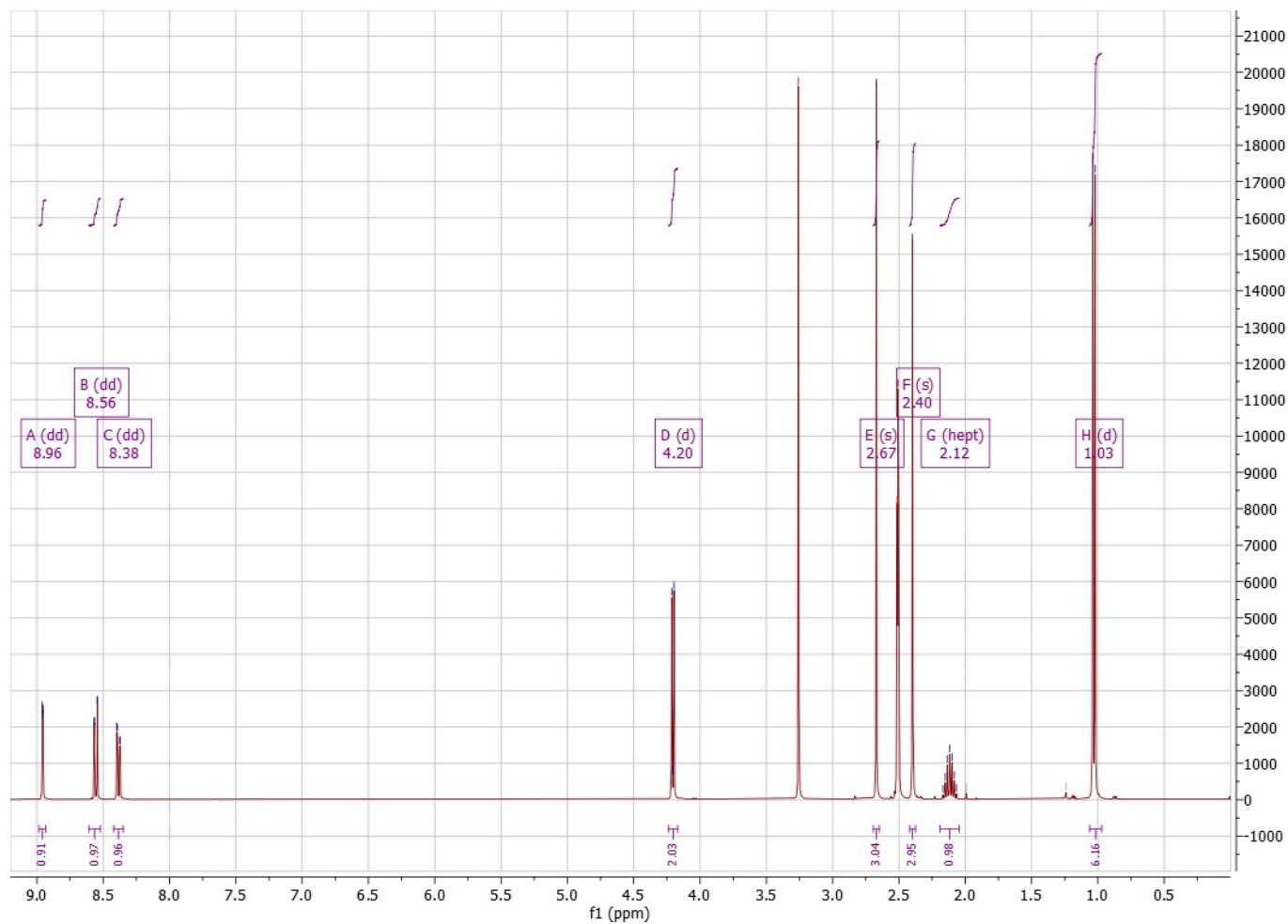
T-151 UPLC-MS



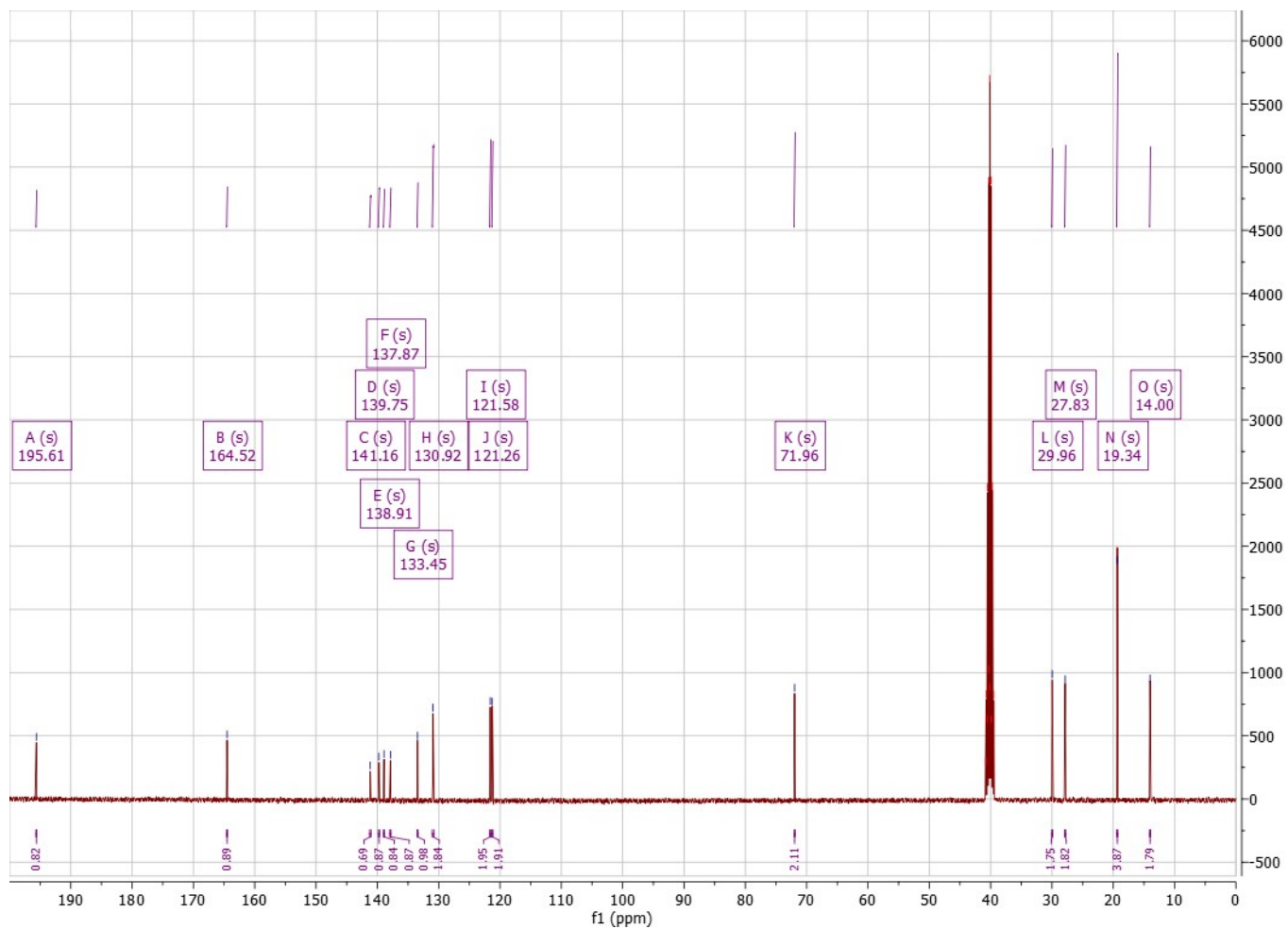
T-155 IR



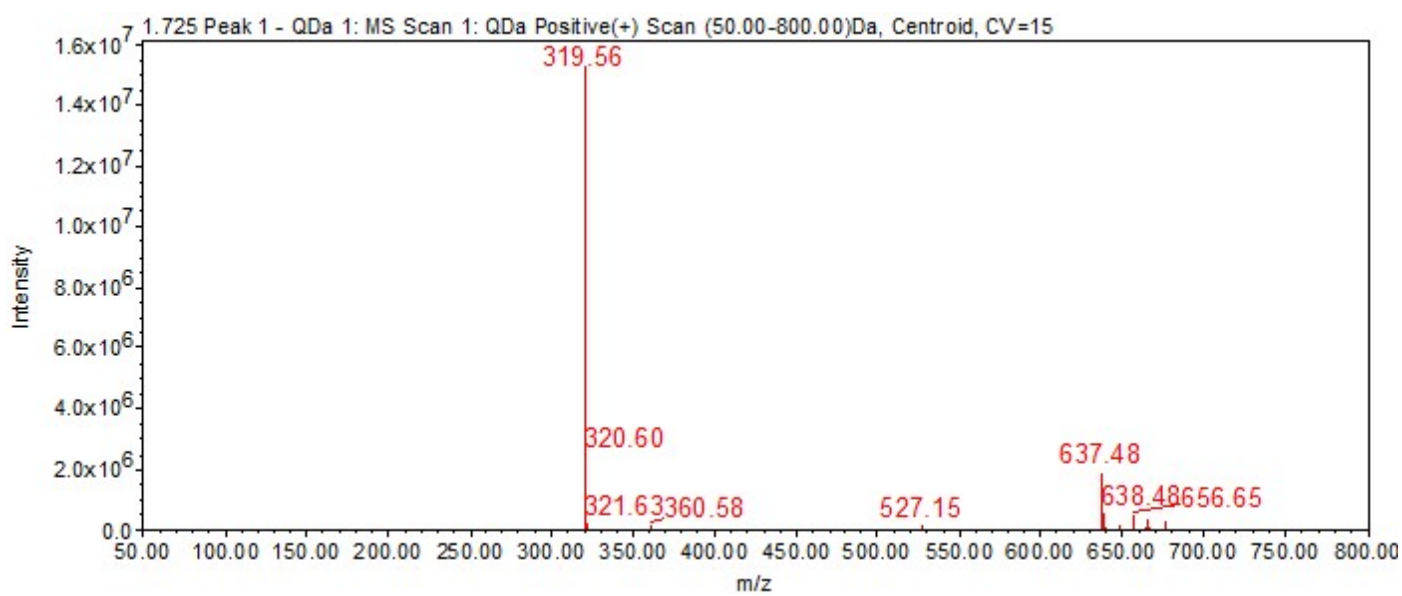
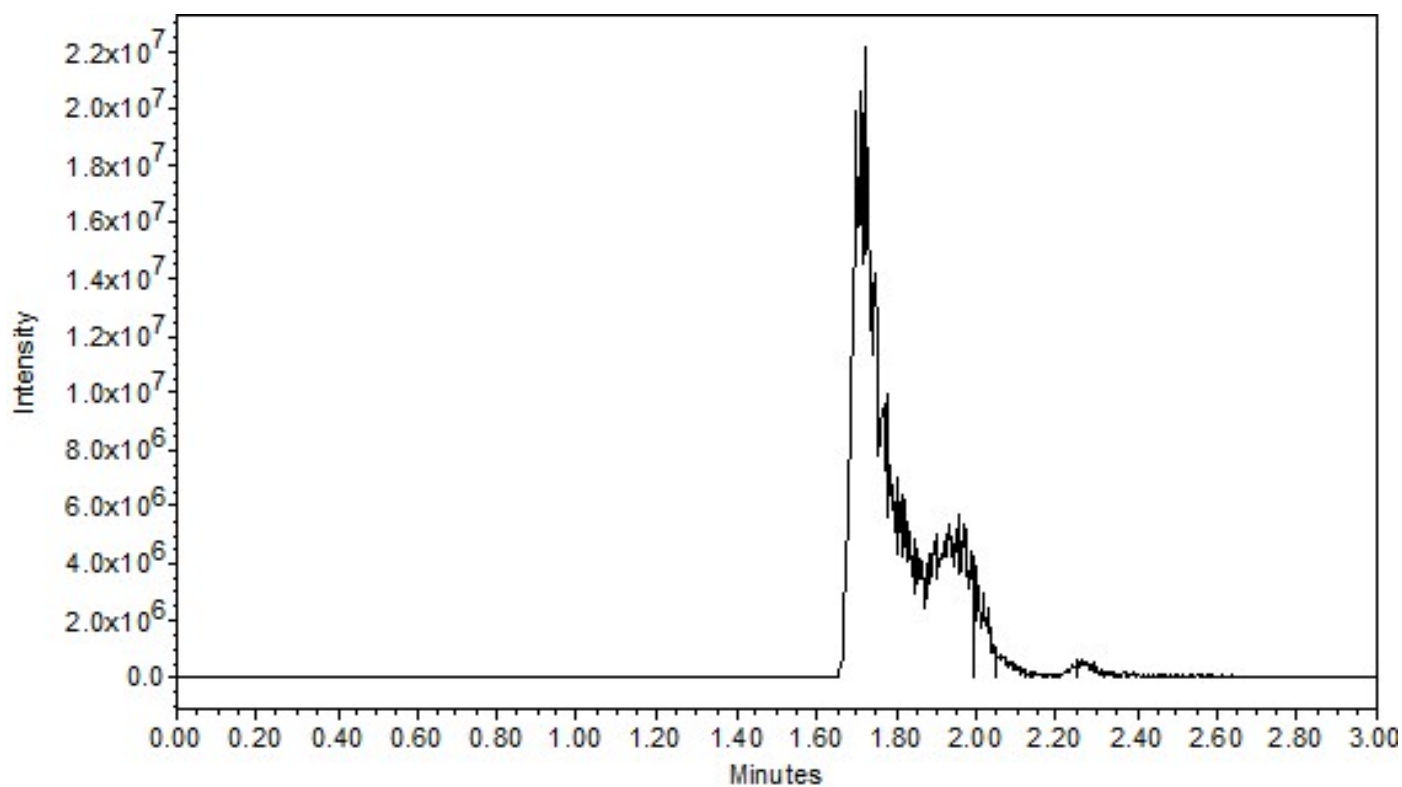
T-155 ¹H-NMR



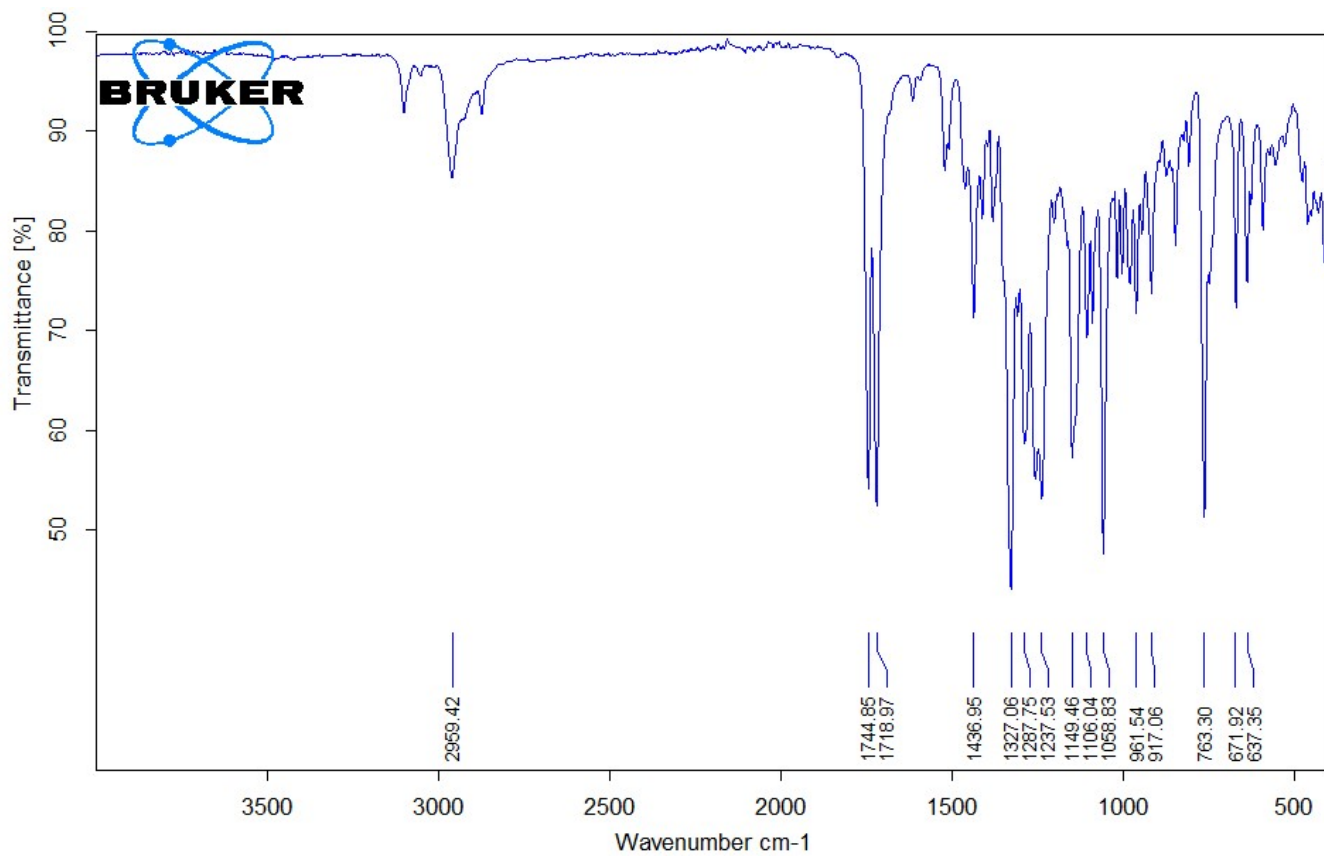
T-155 ¹³C-NMR



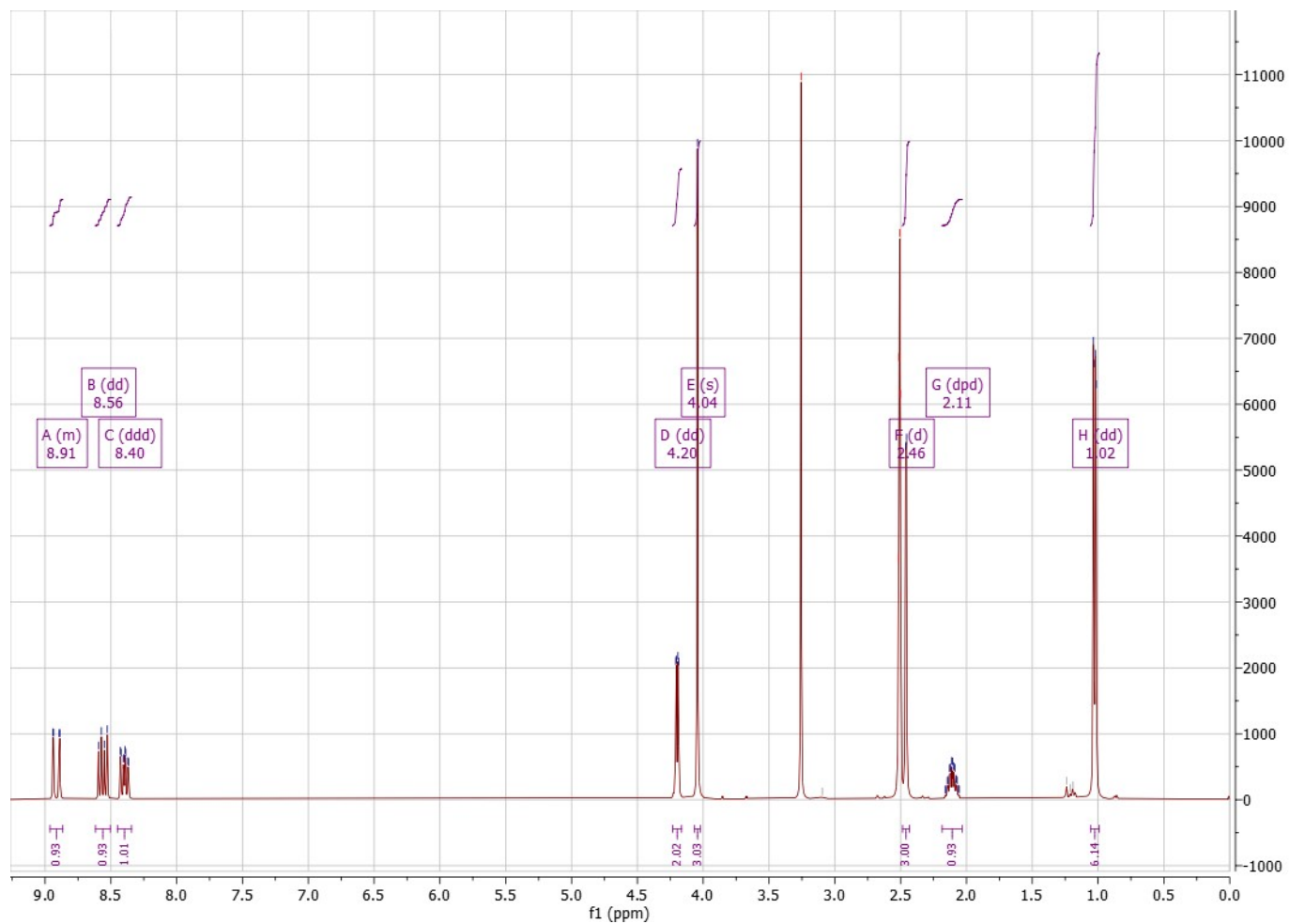
T-155 UPLC-MS



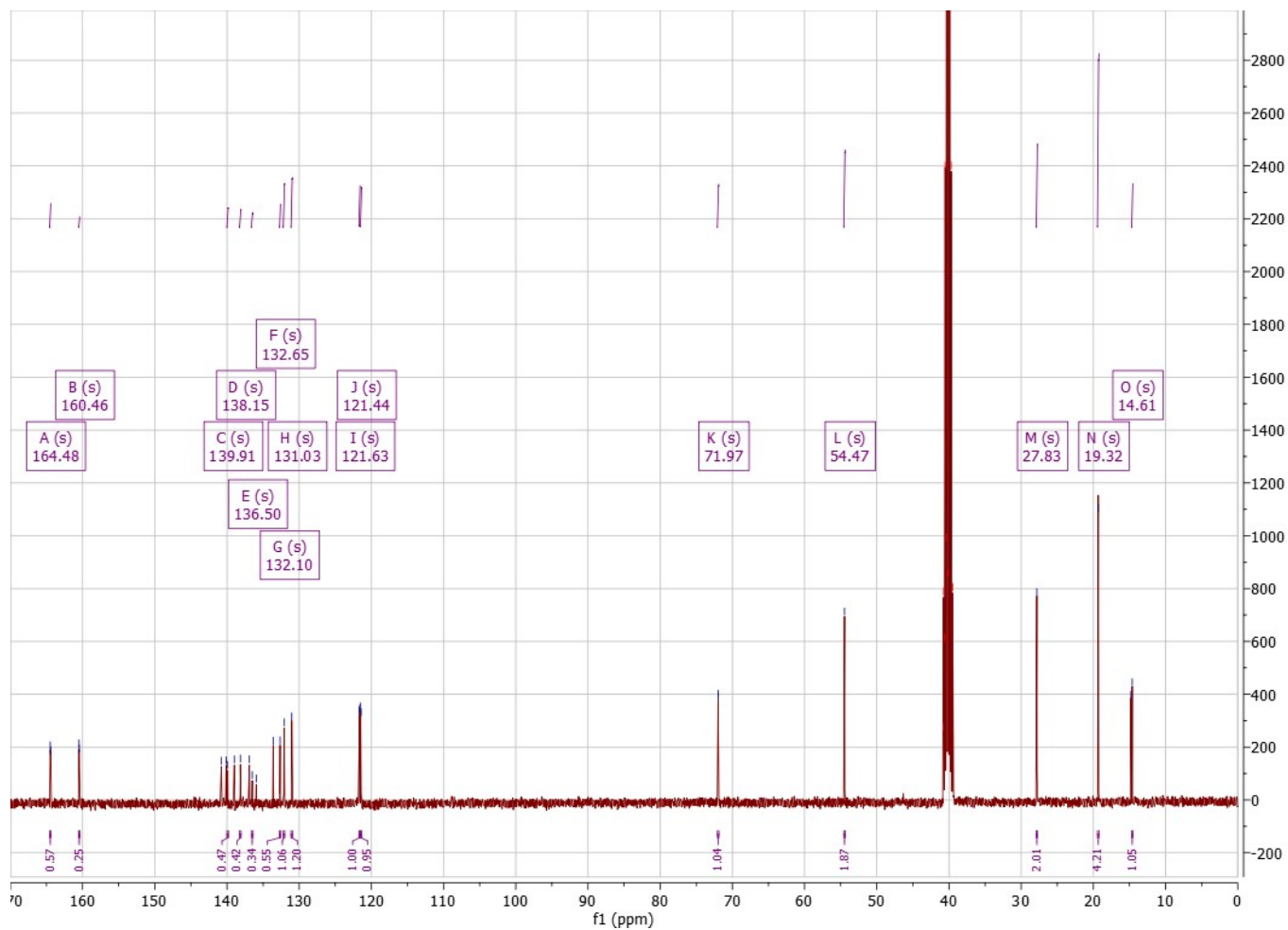
T-156 IR



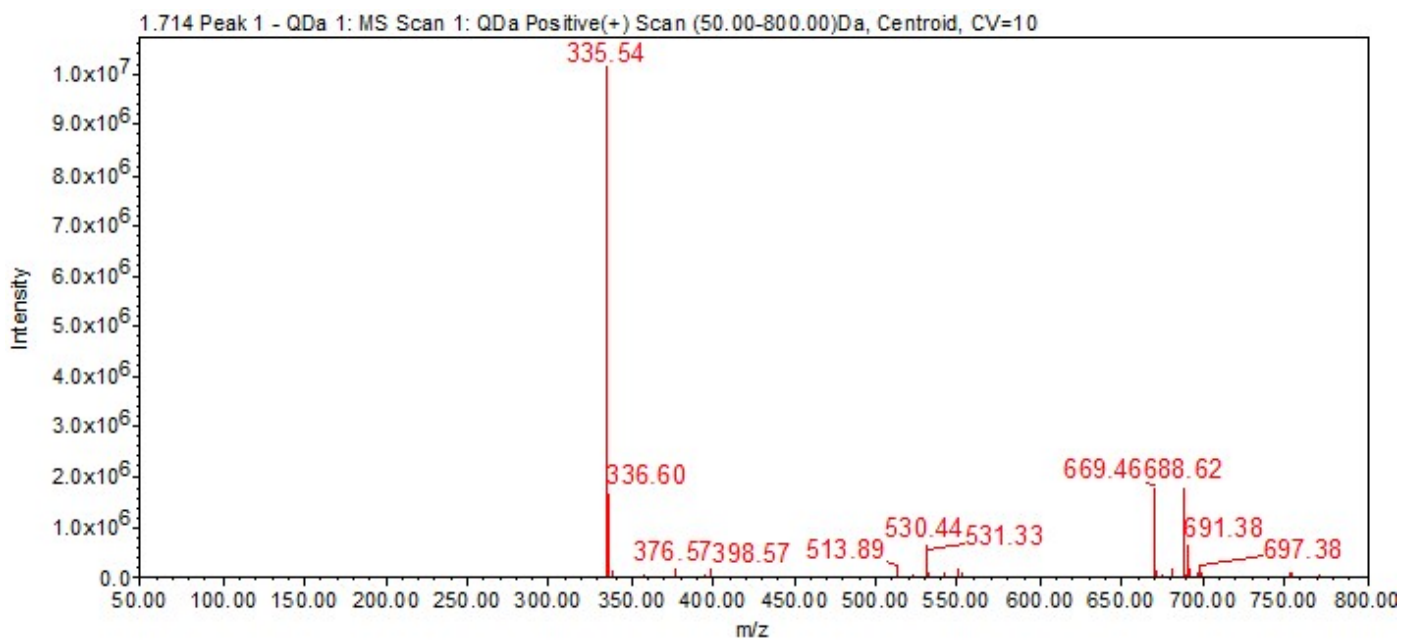
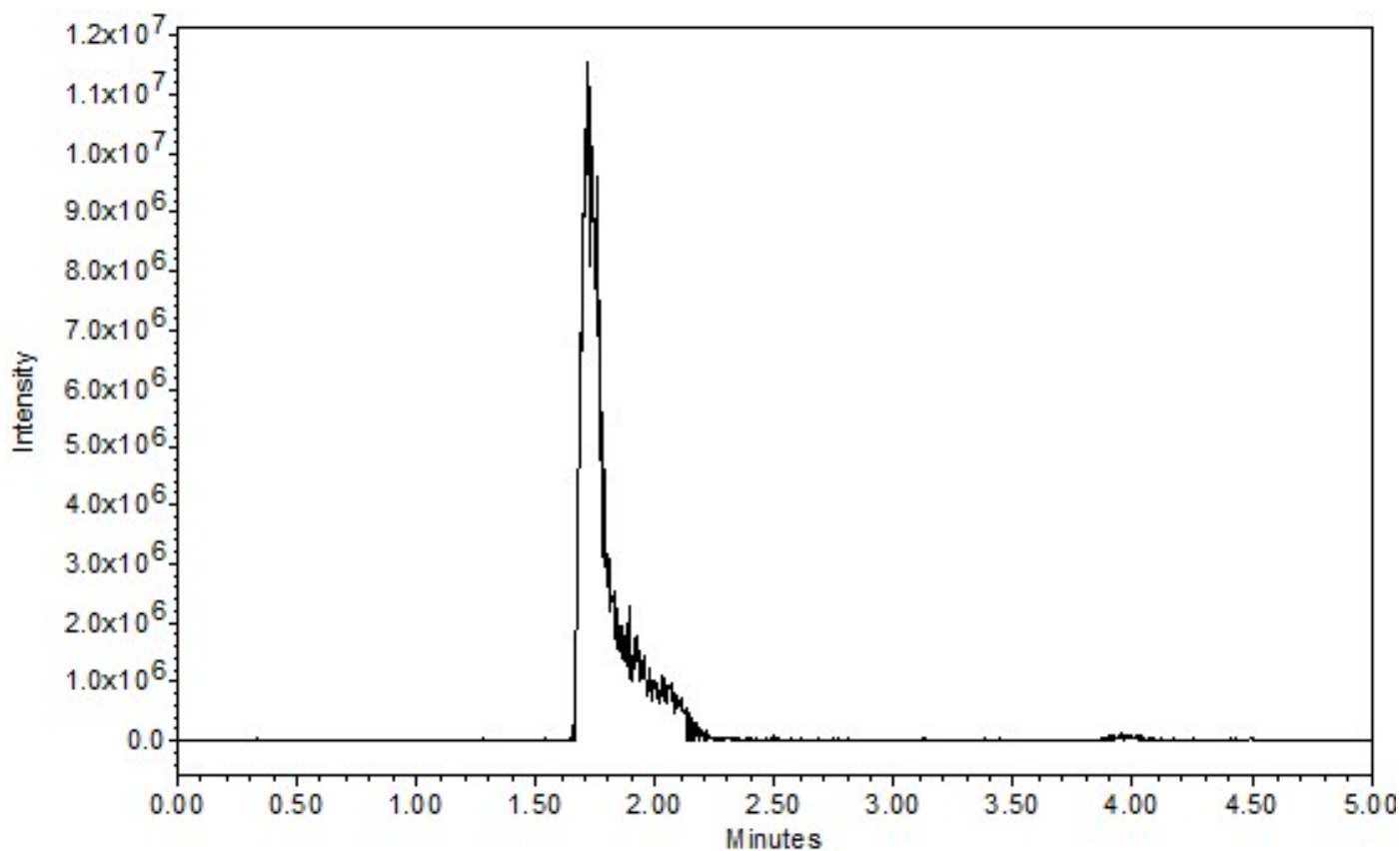
T-156 ¹H-NMR



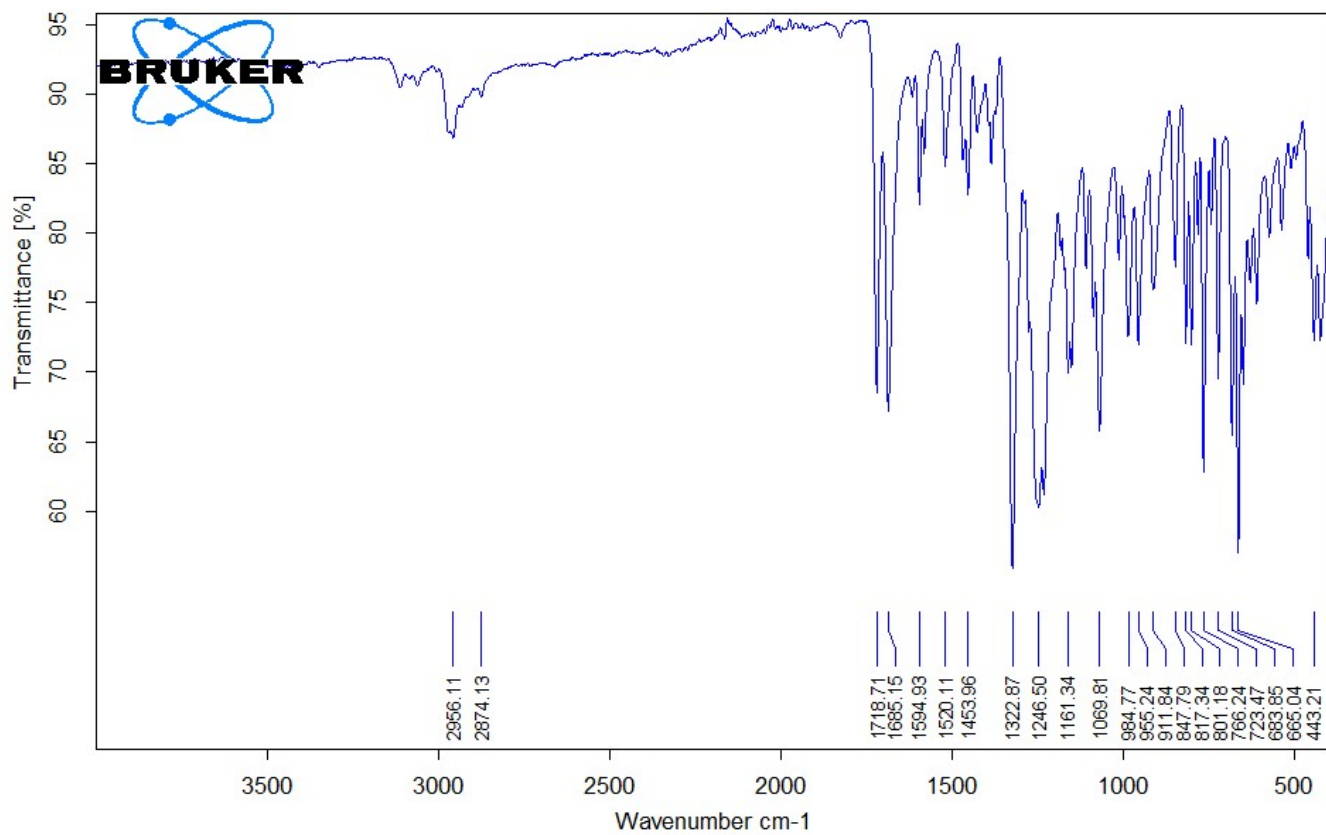
T-156 ¹³C-NMR



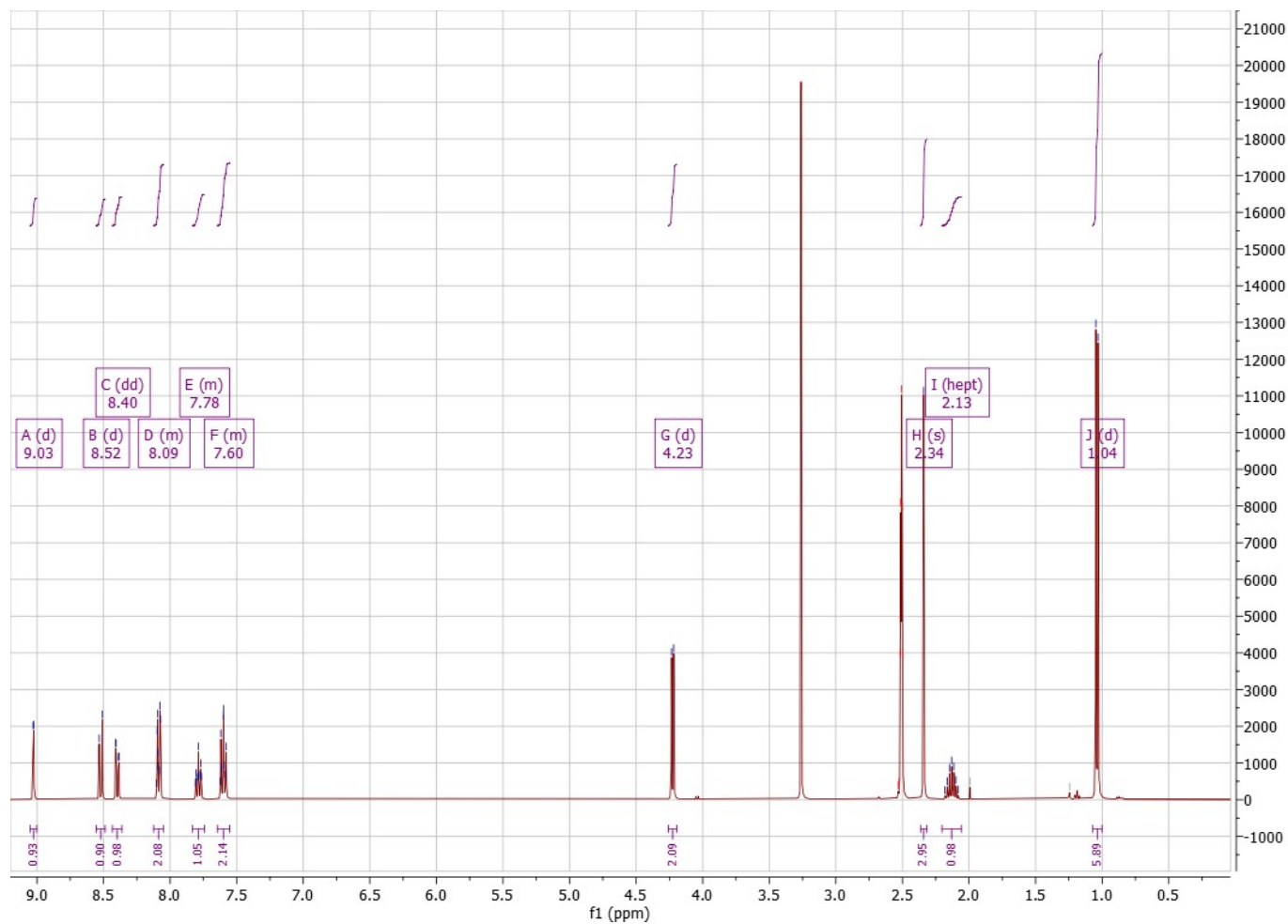
T-156 UPLC-MS



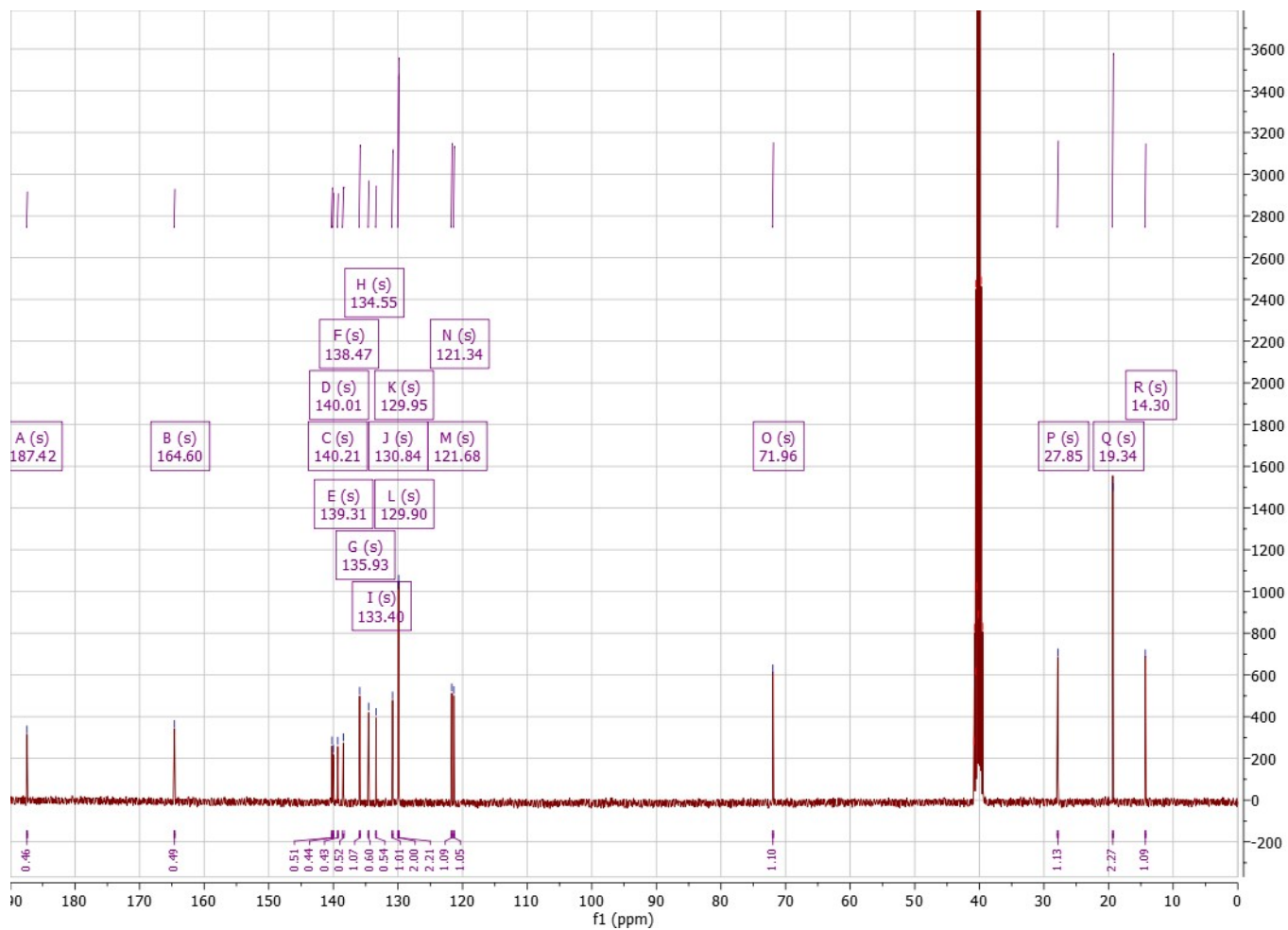
T-157 IR



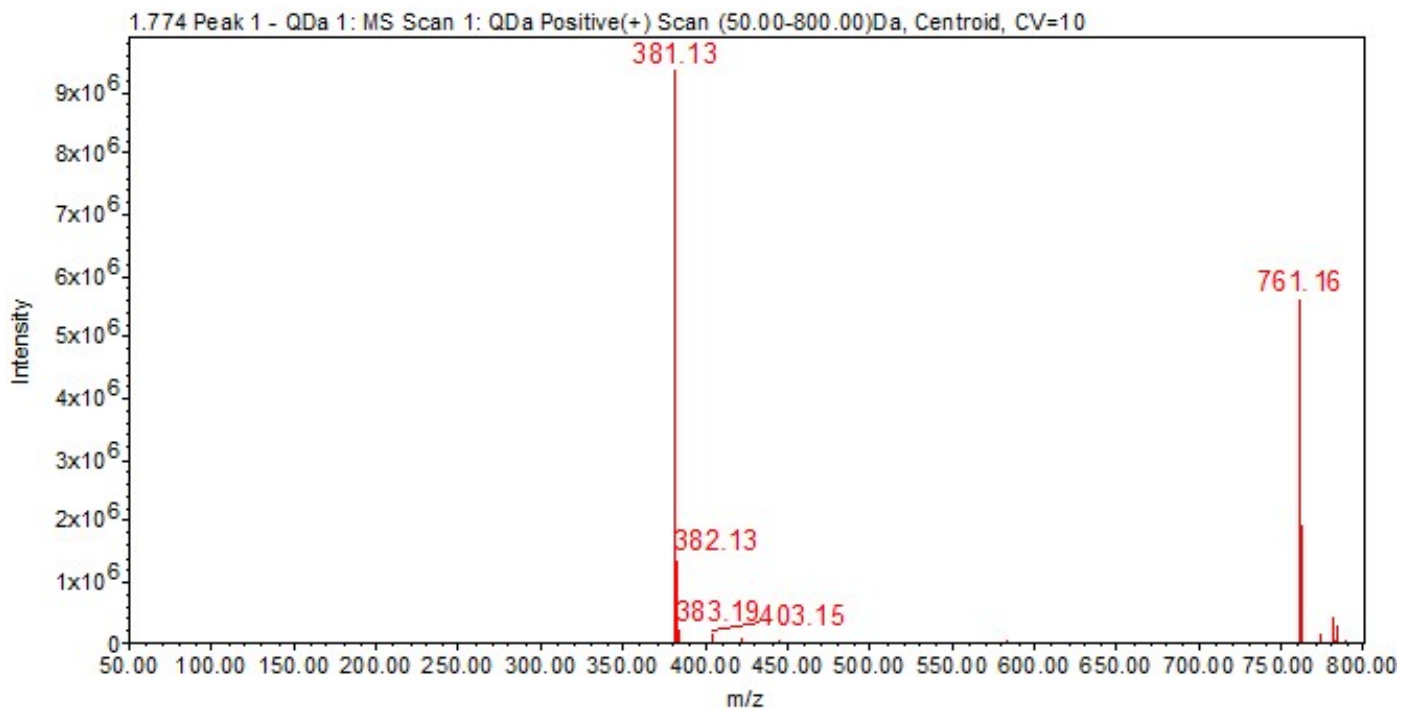
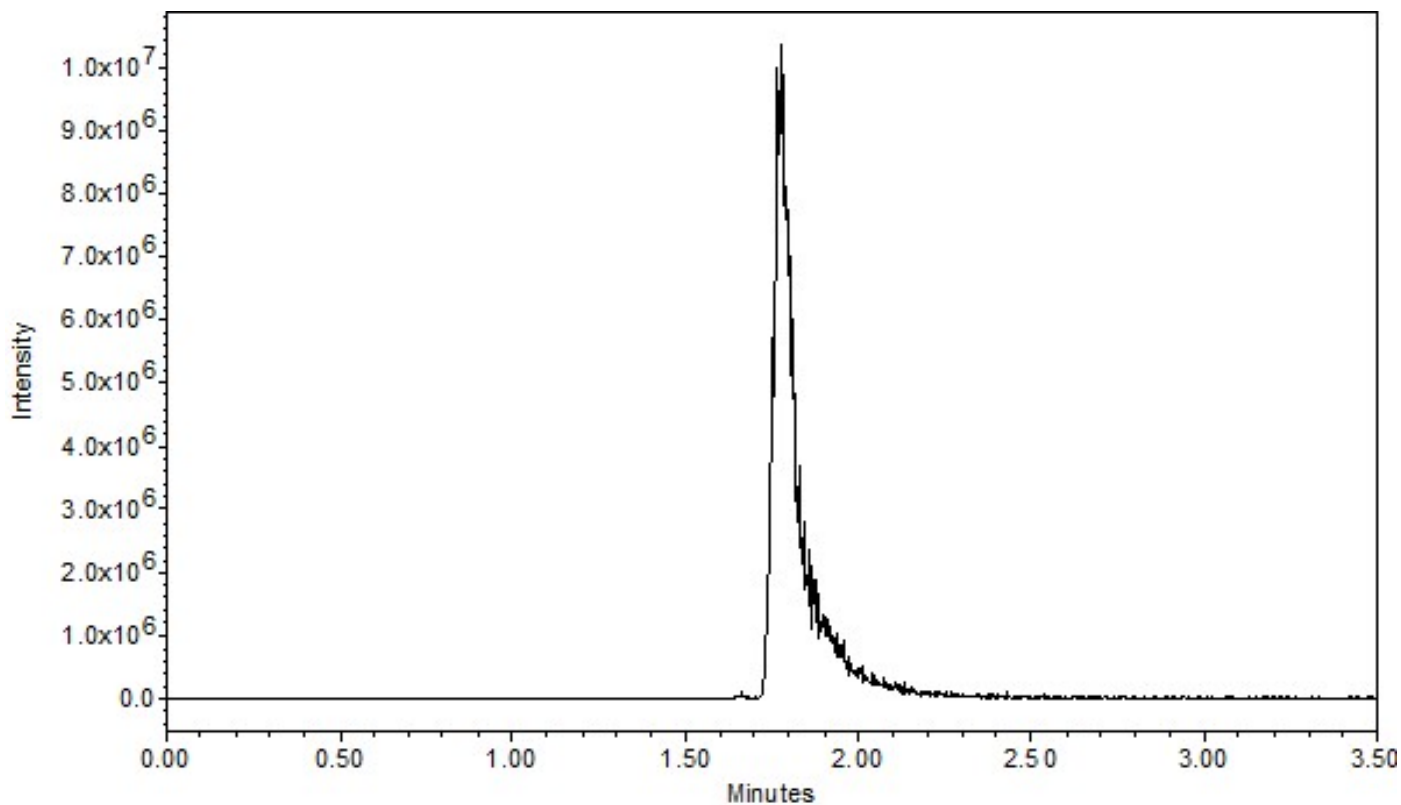
T-157 ¹H-NMR



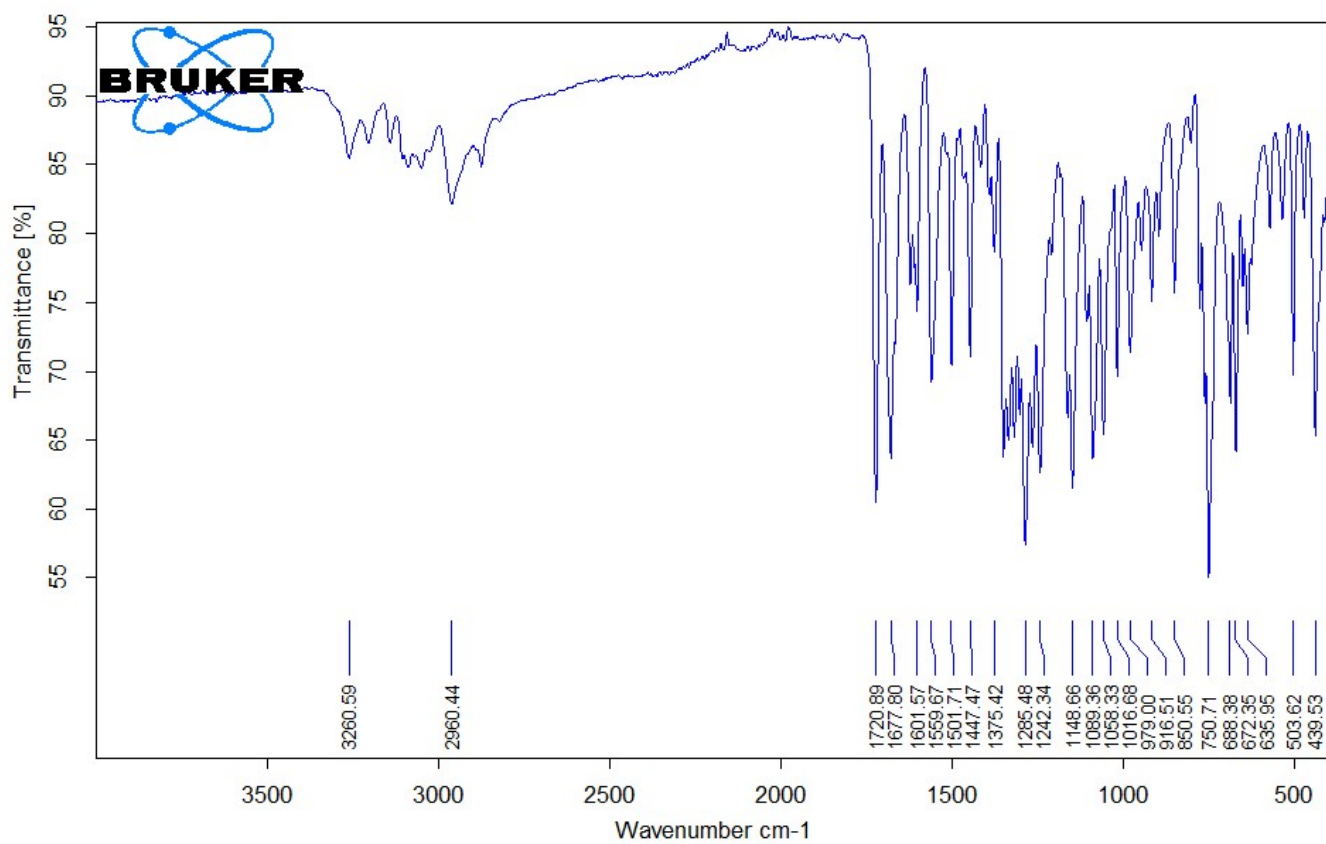
T-157 ¹³C-NMR



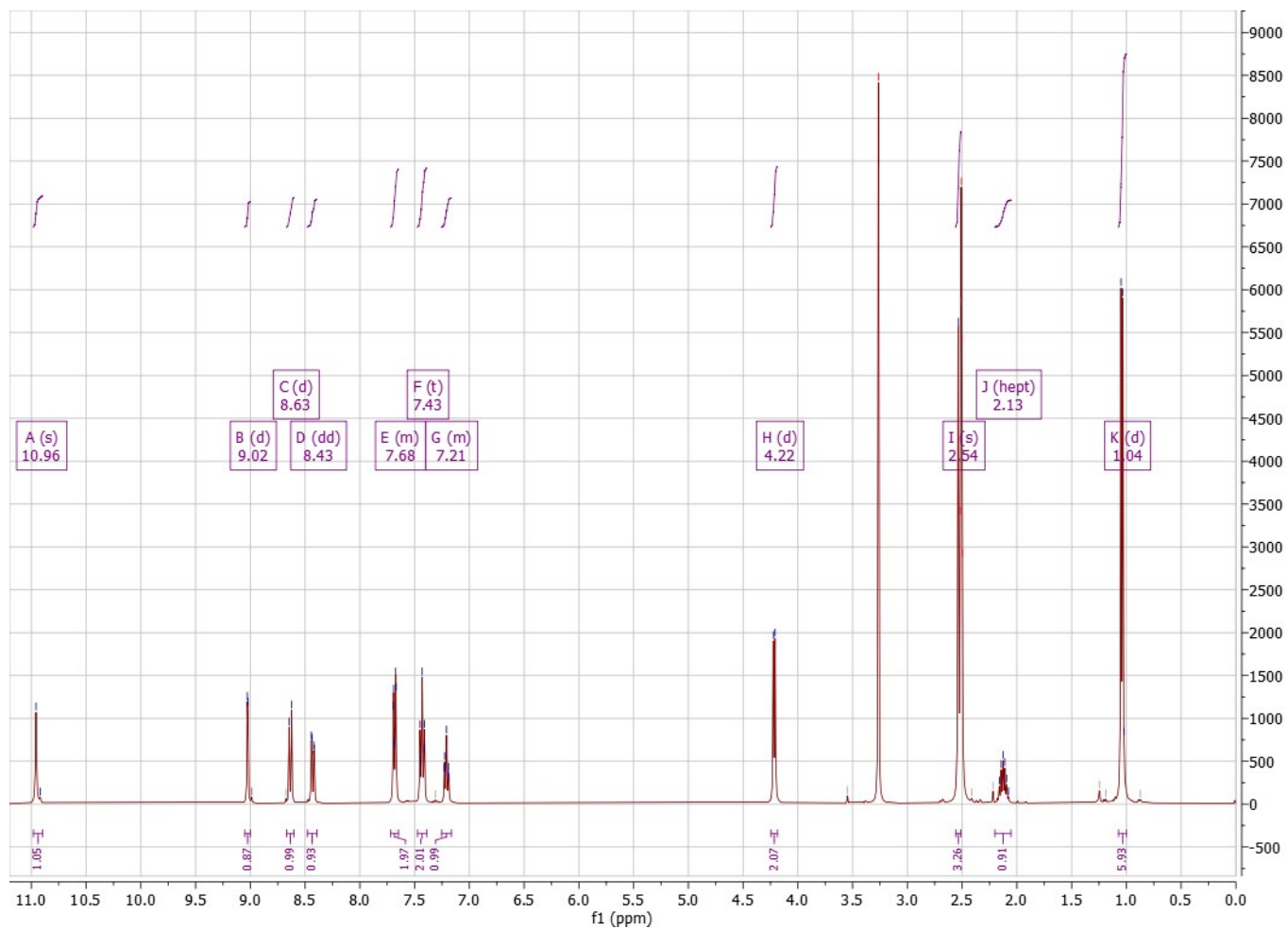
T-157 UPLC-MS



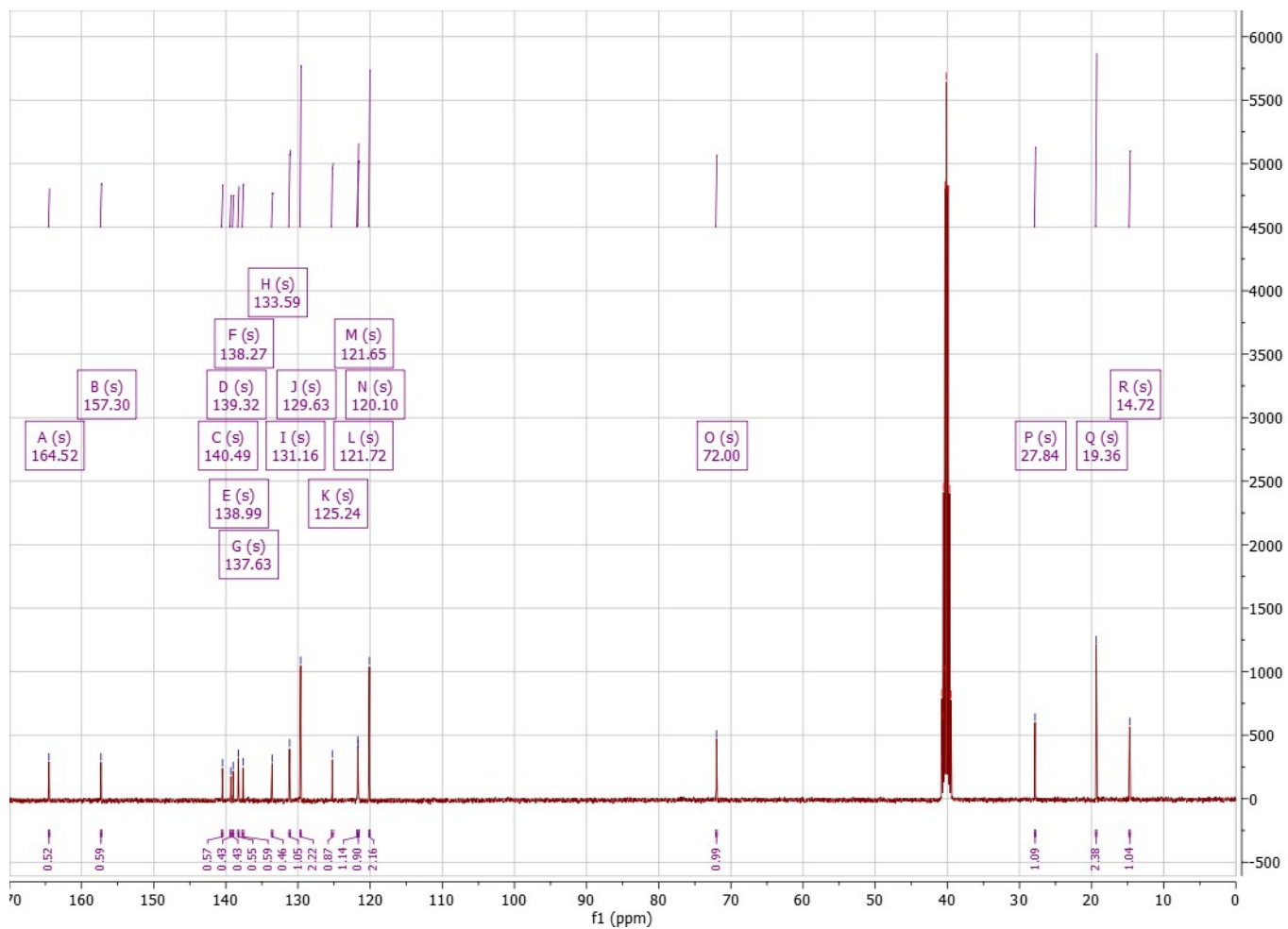
T-158 IR



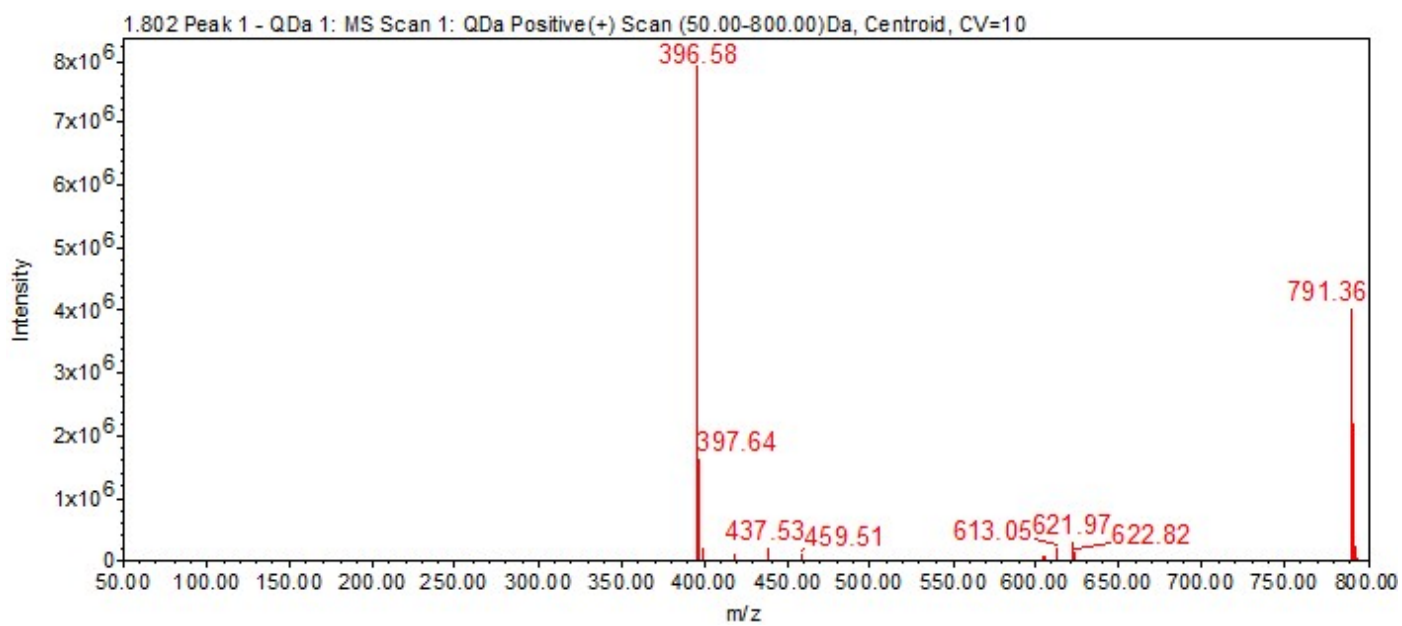
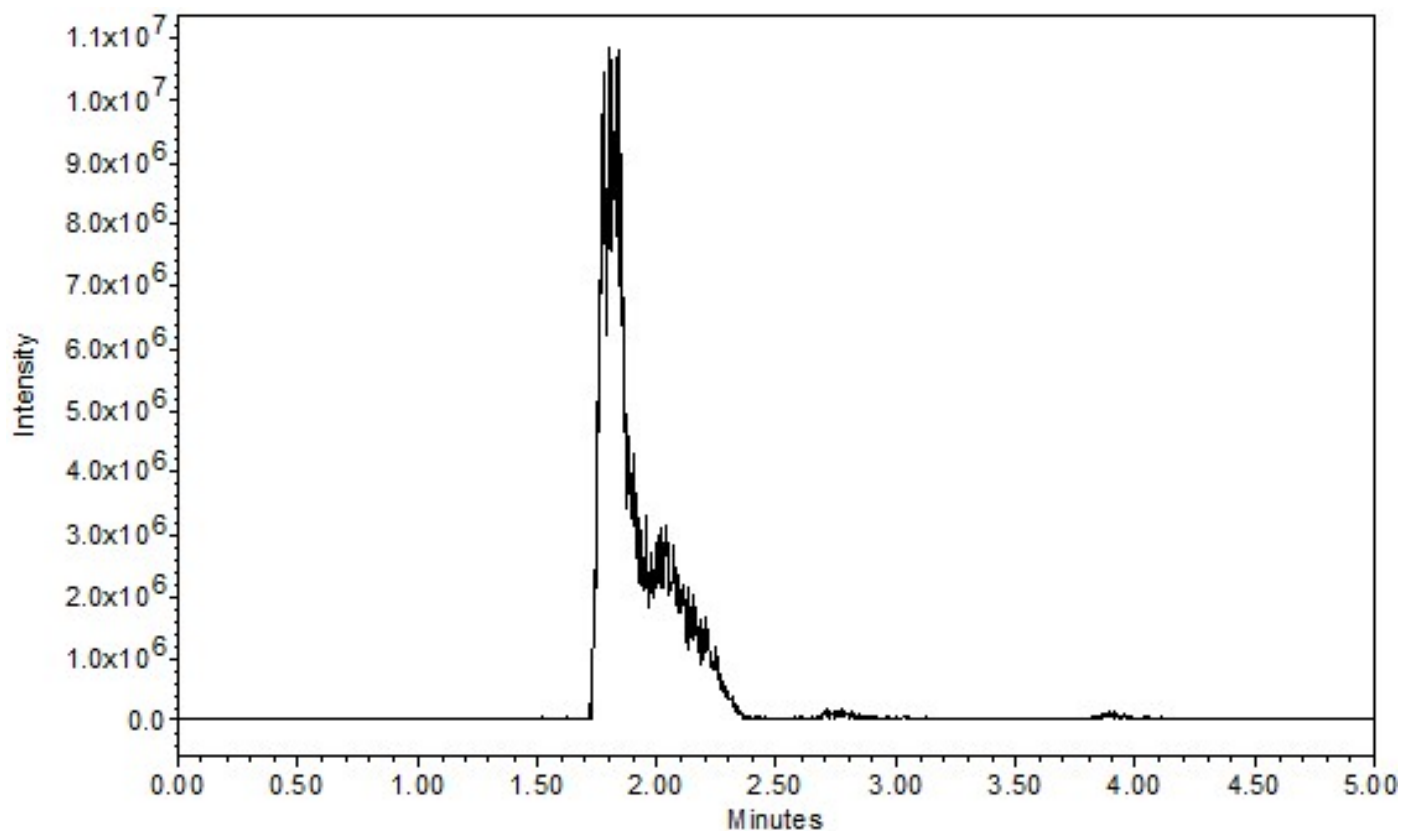
T-158 ¹H-NMR



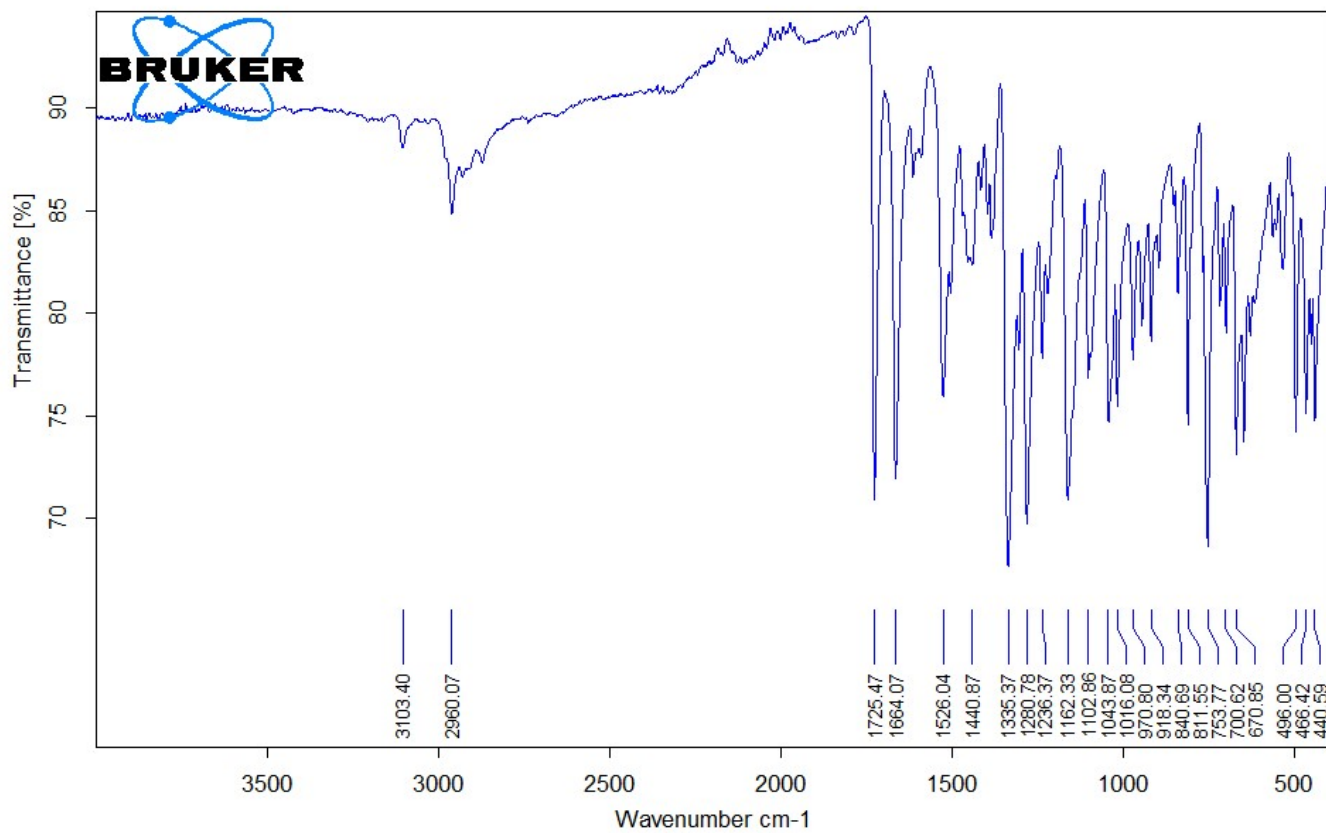
T-158 ¹³C-NMR



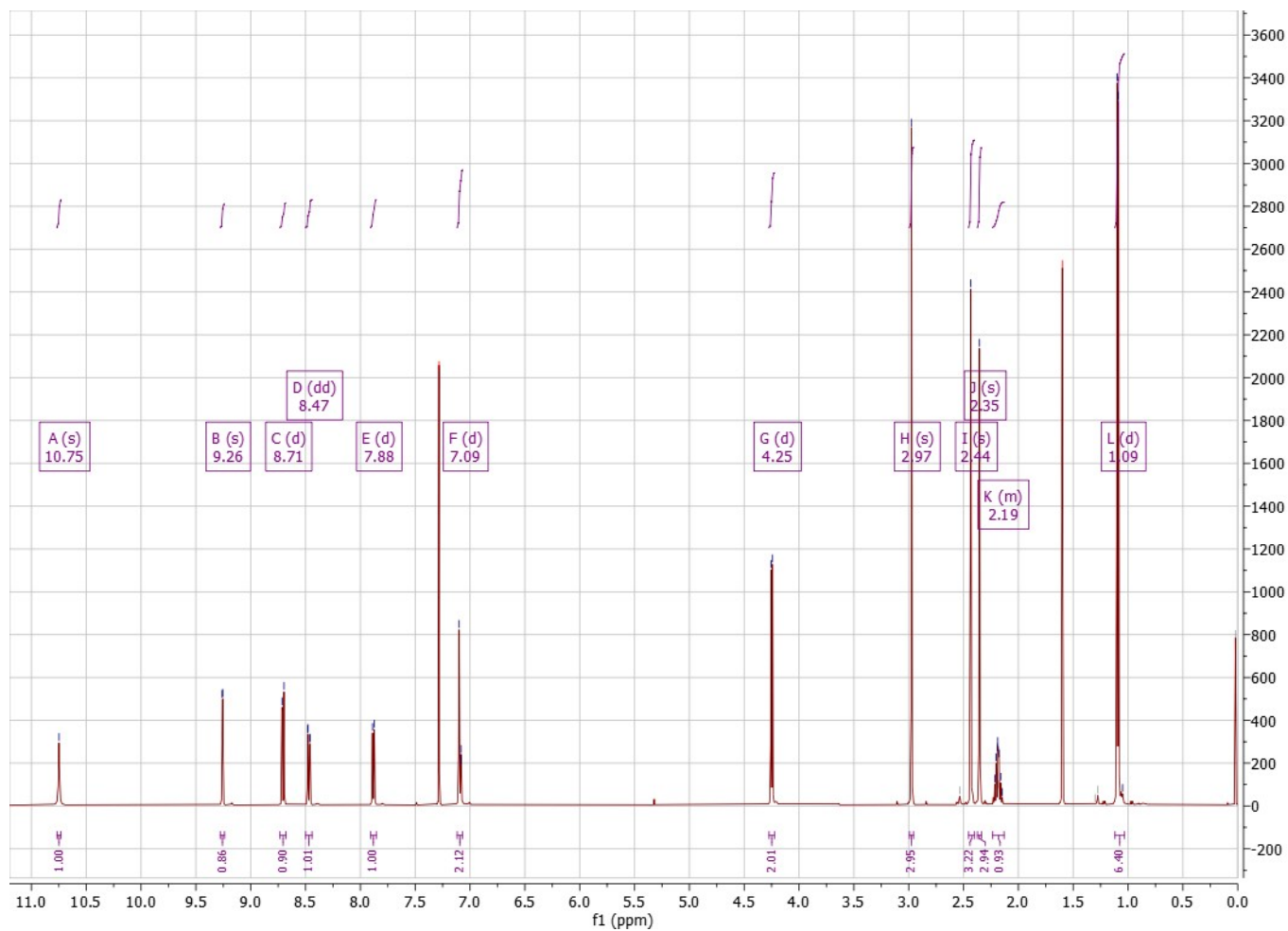
T-158 UPLC-MS



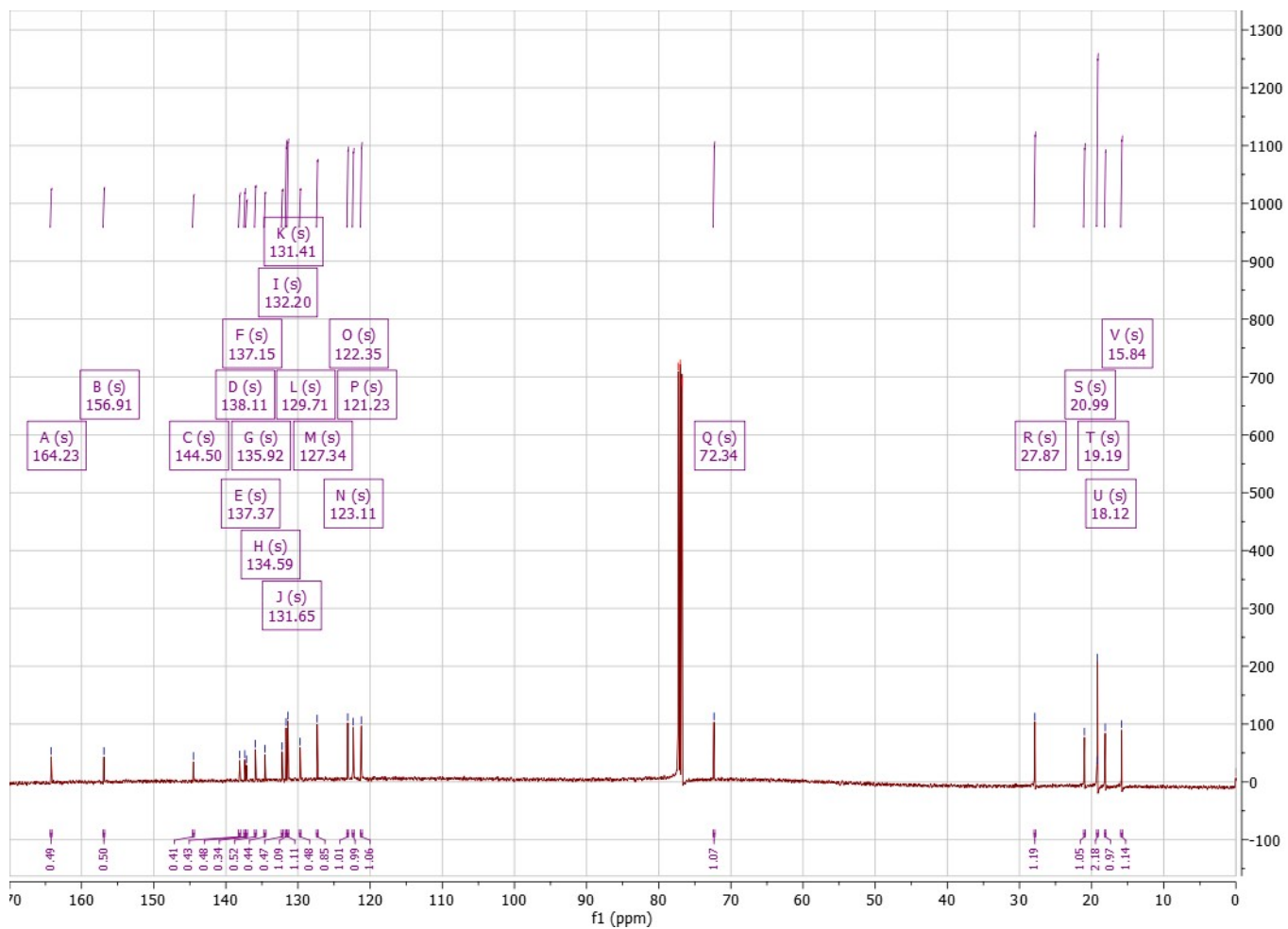
T-159 IR



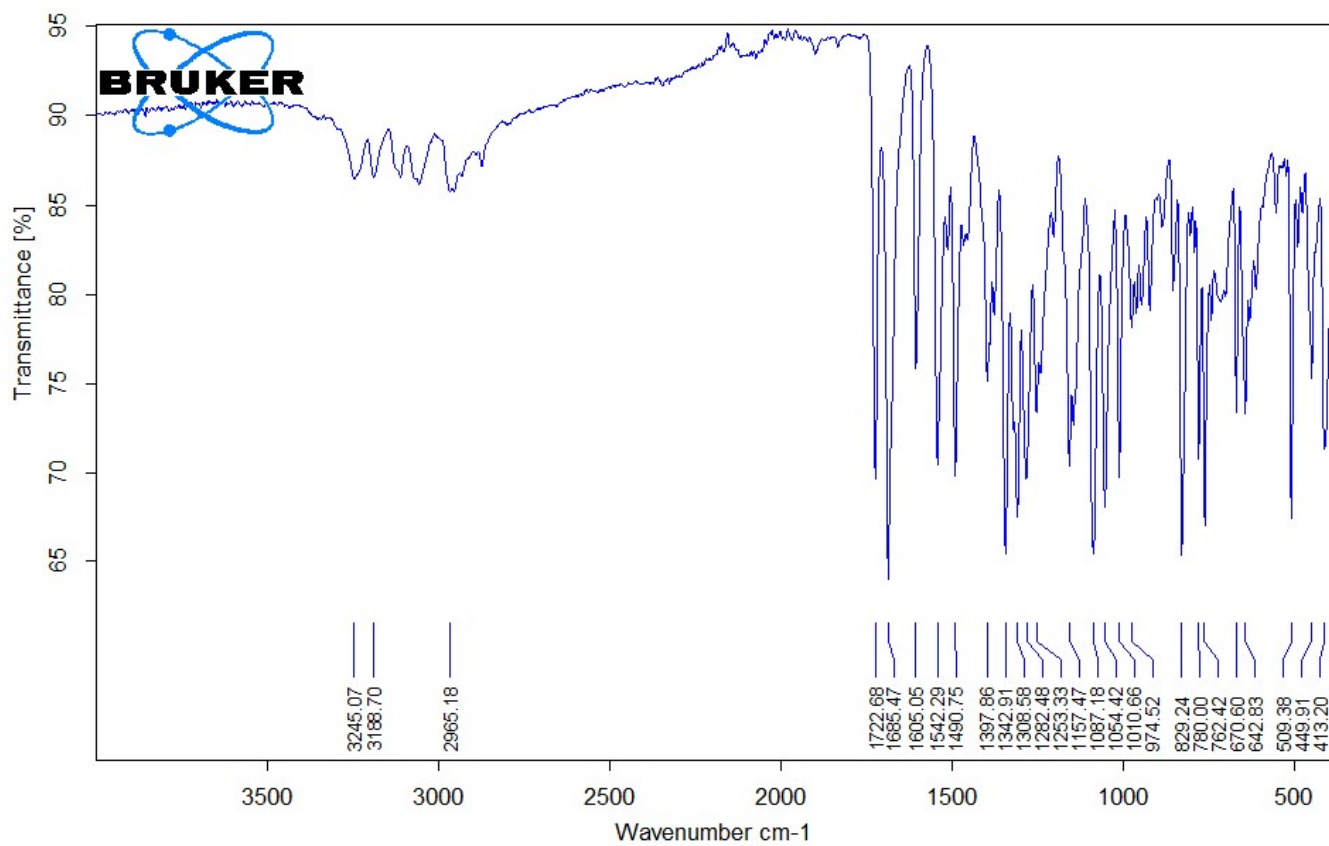
T-159 ¹H-NMR



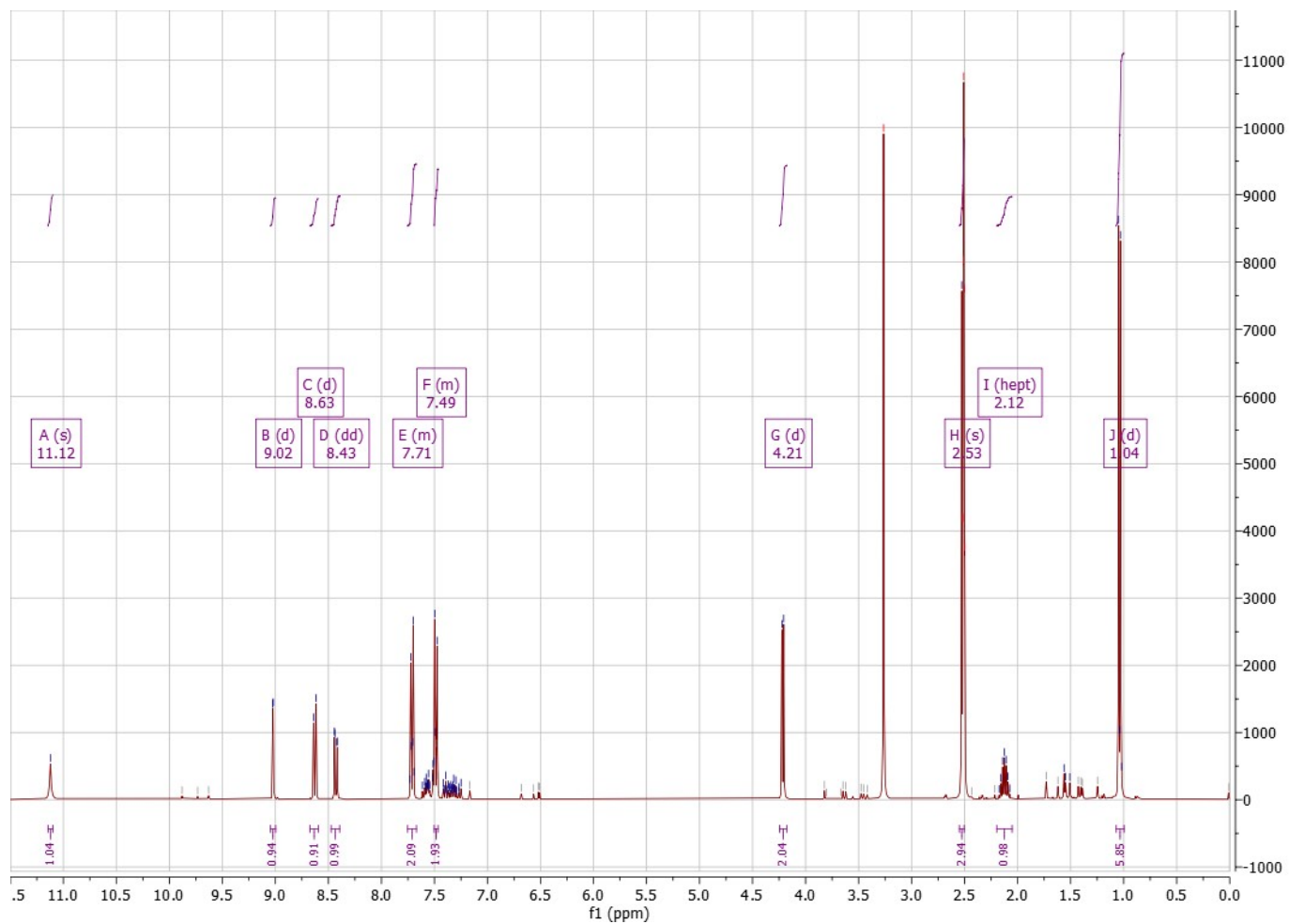
T-159 ¹³C-NMR



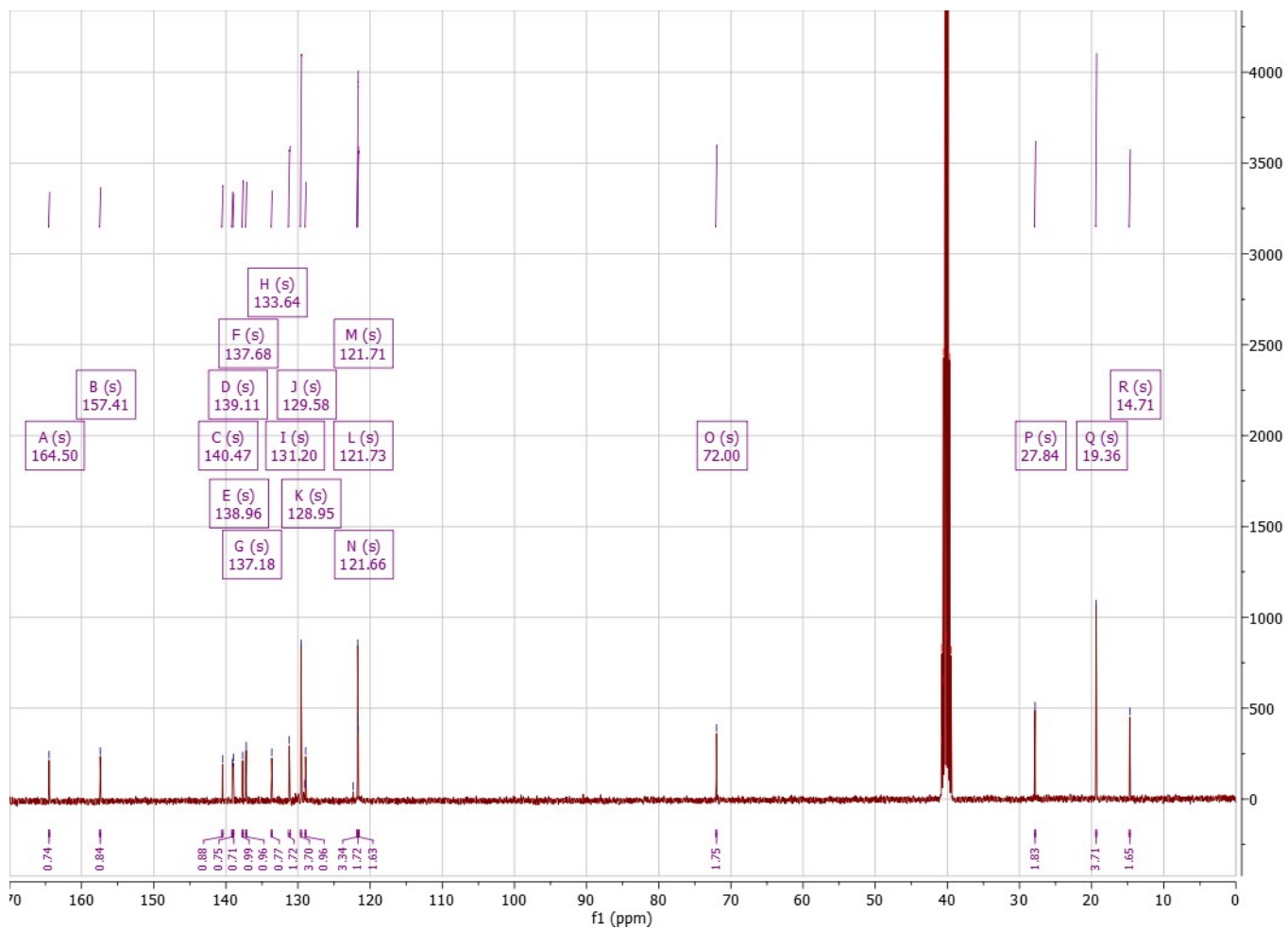
T-161 IR



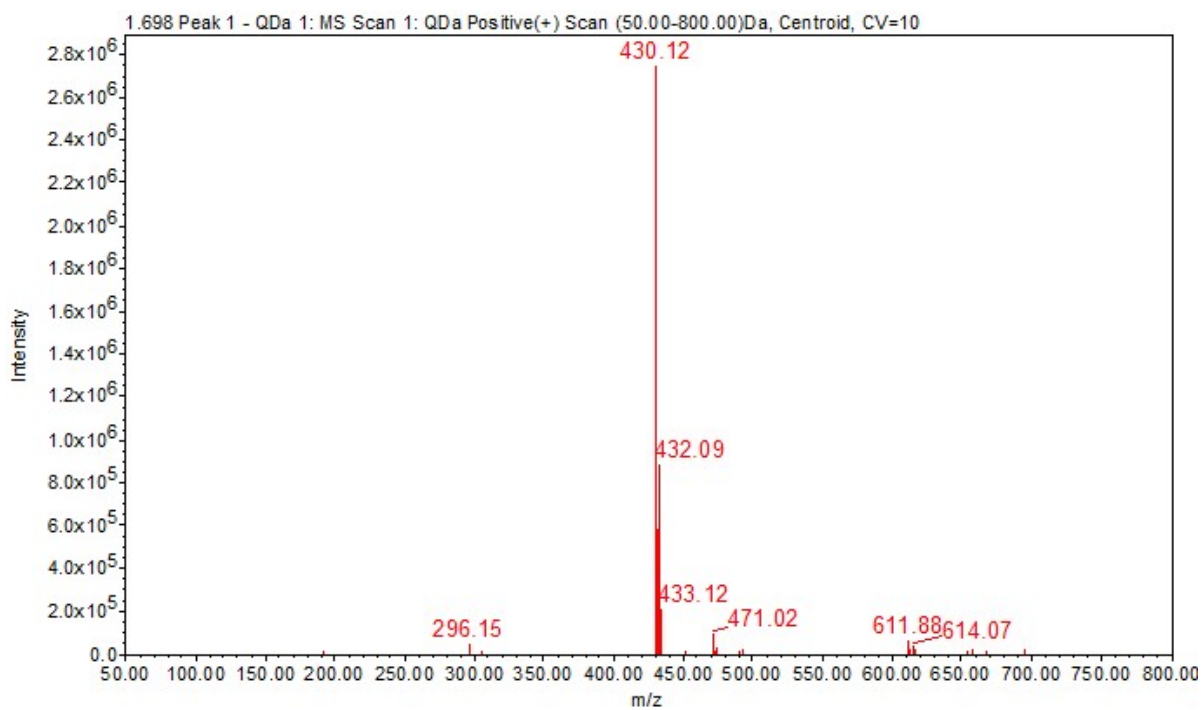
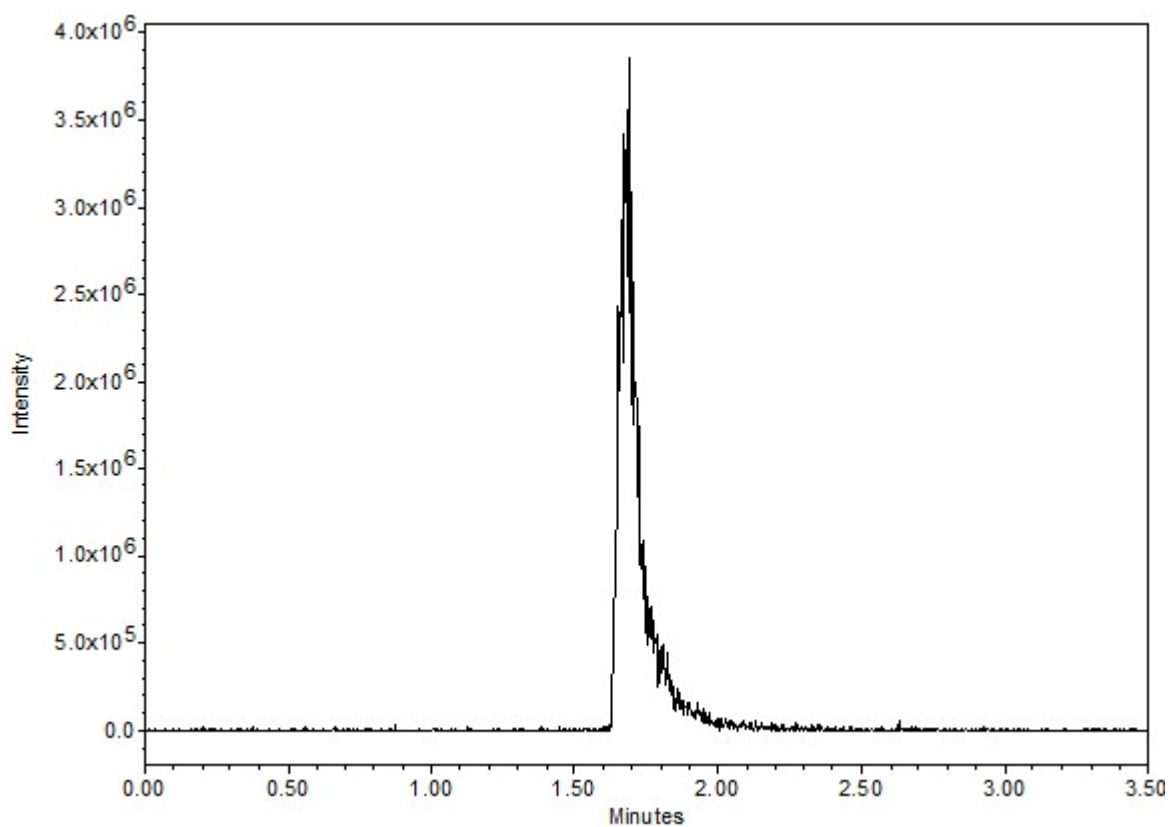
T-161 ¹H-NMR



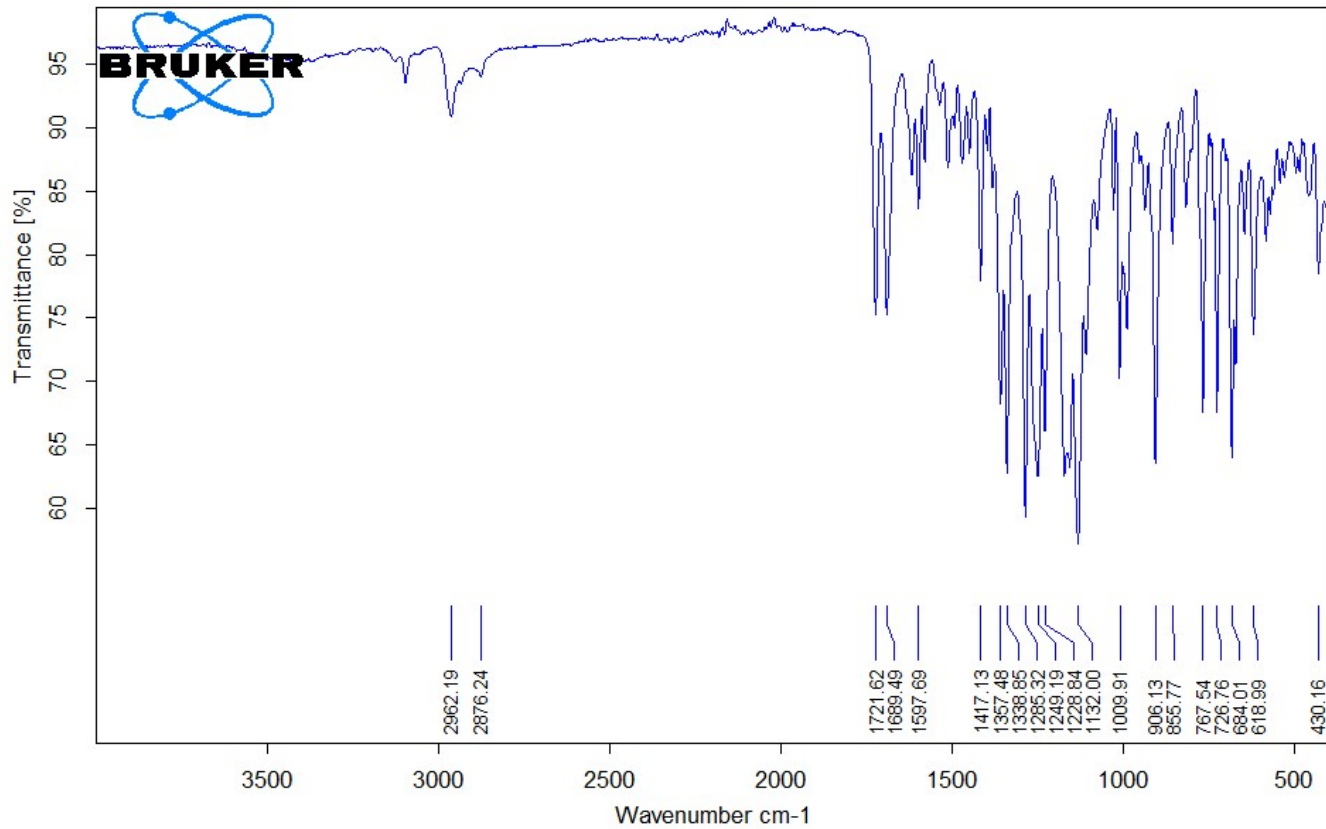
T-161 ¹³C-NMR



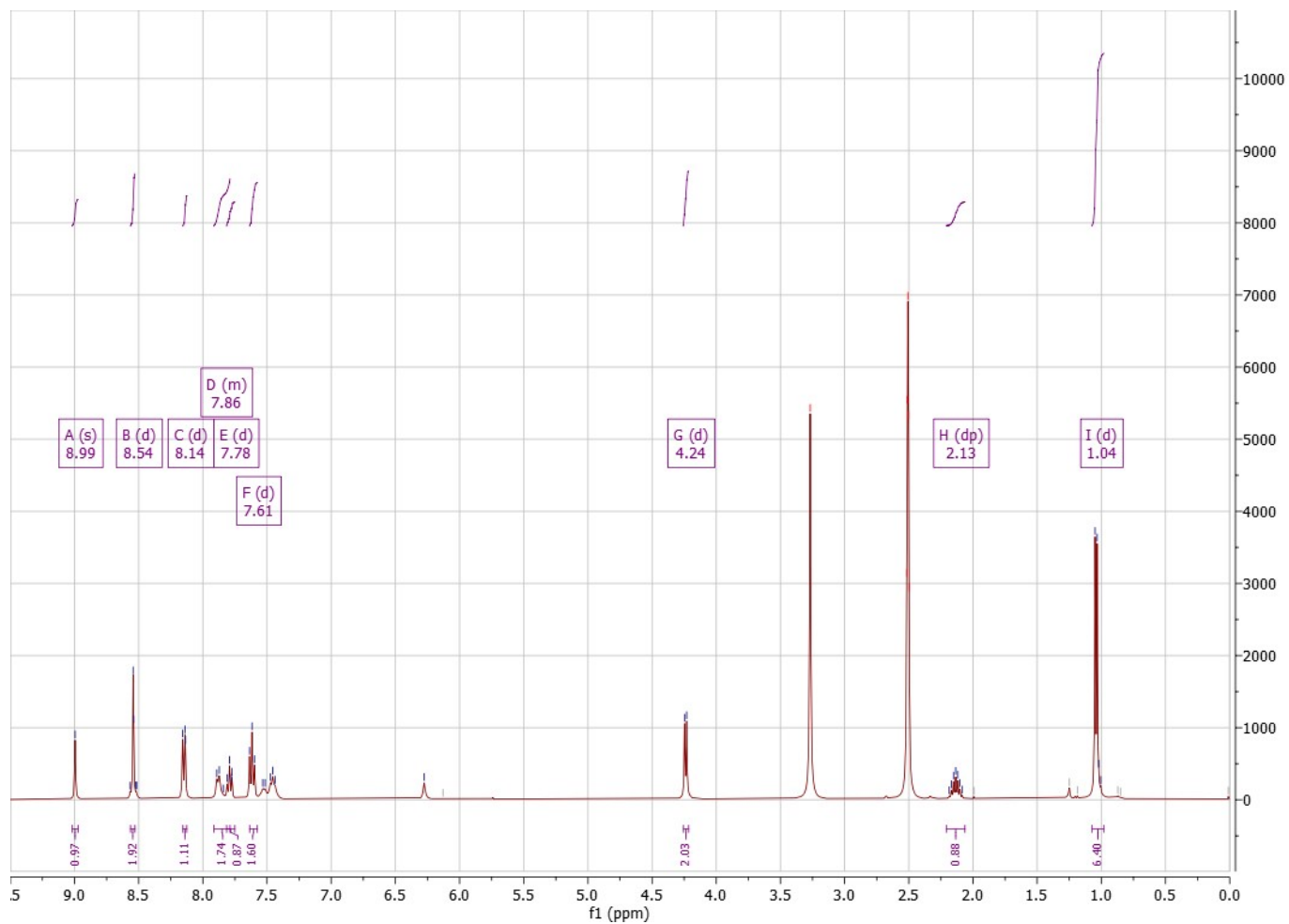
T-161 UPLC-MS



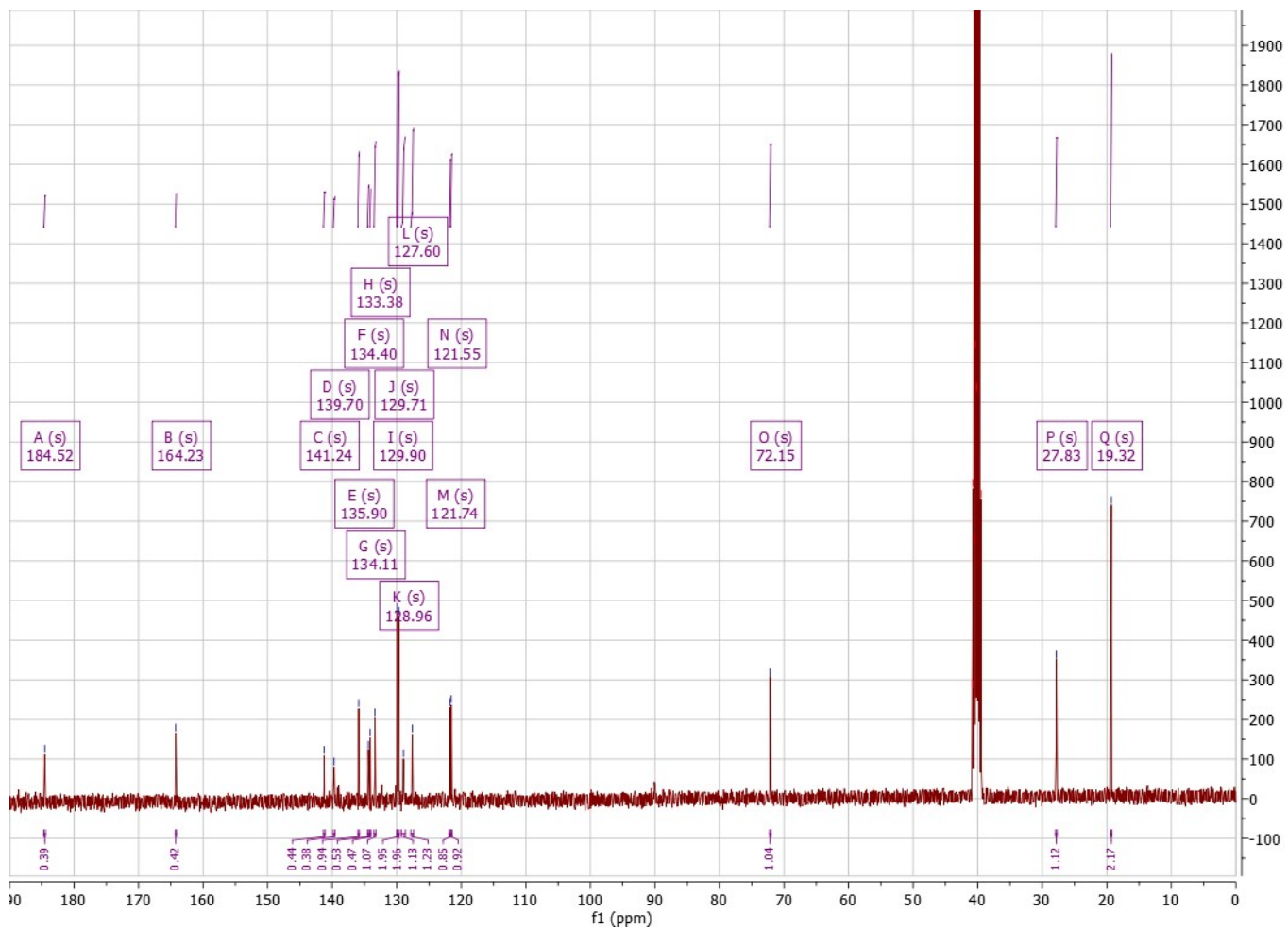
T-163 IR



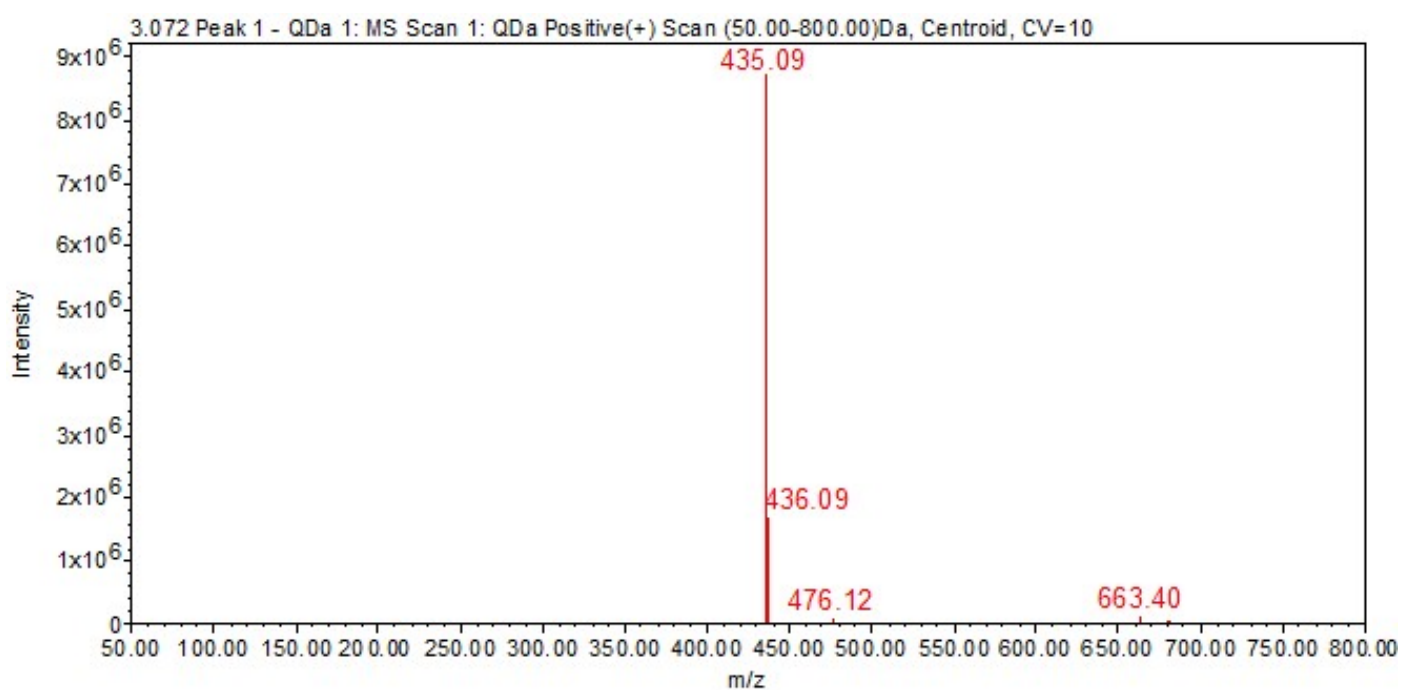
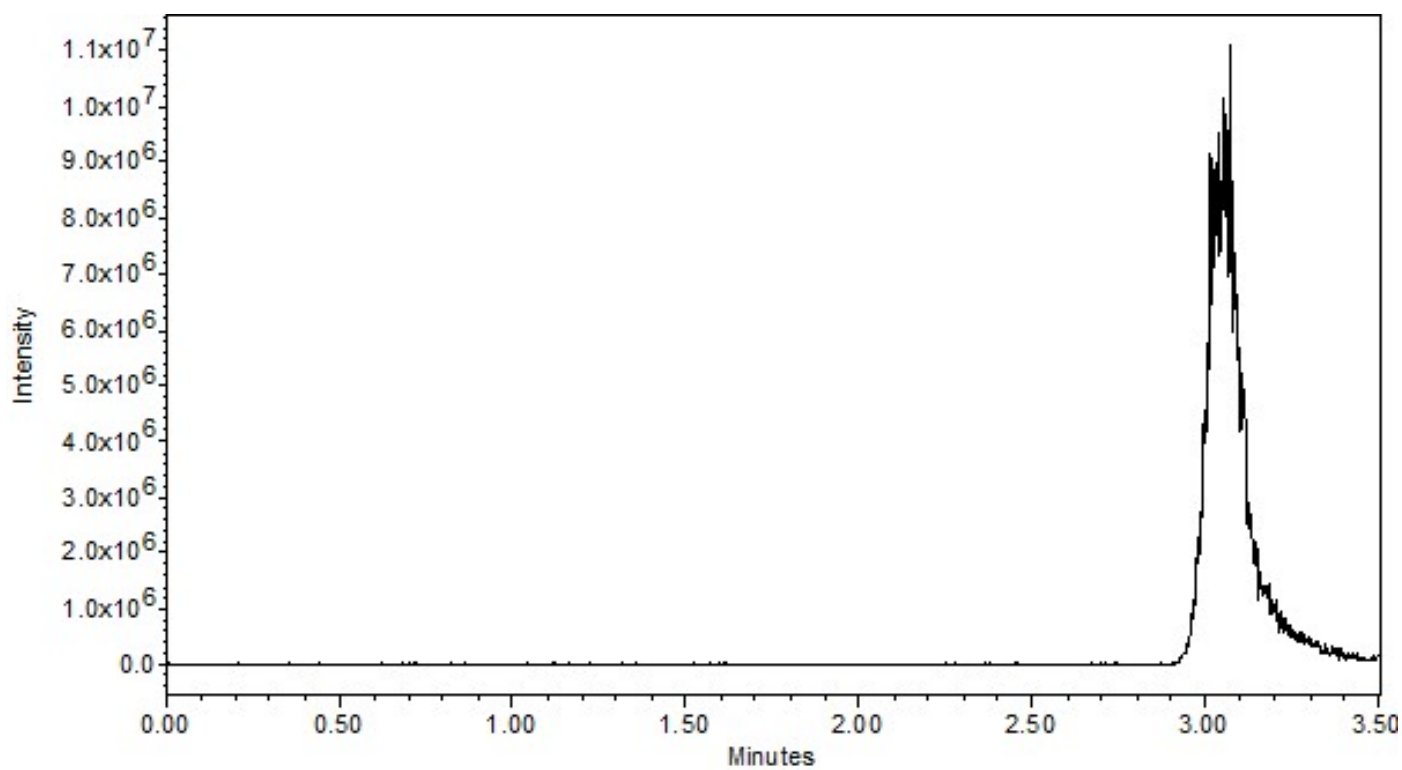
T-163 ¹H-NMR



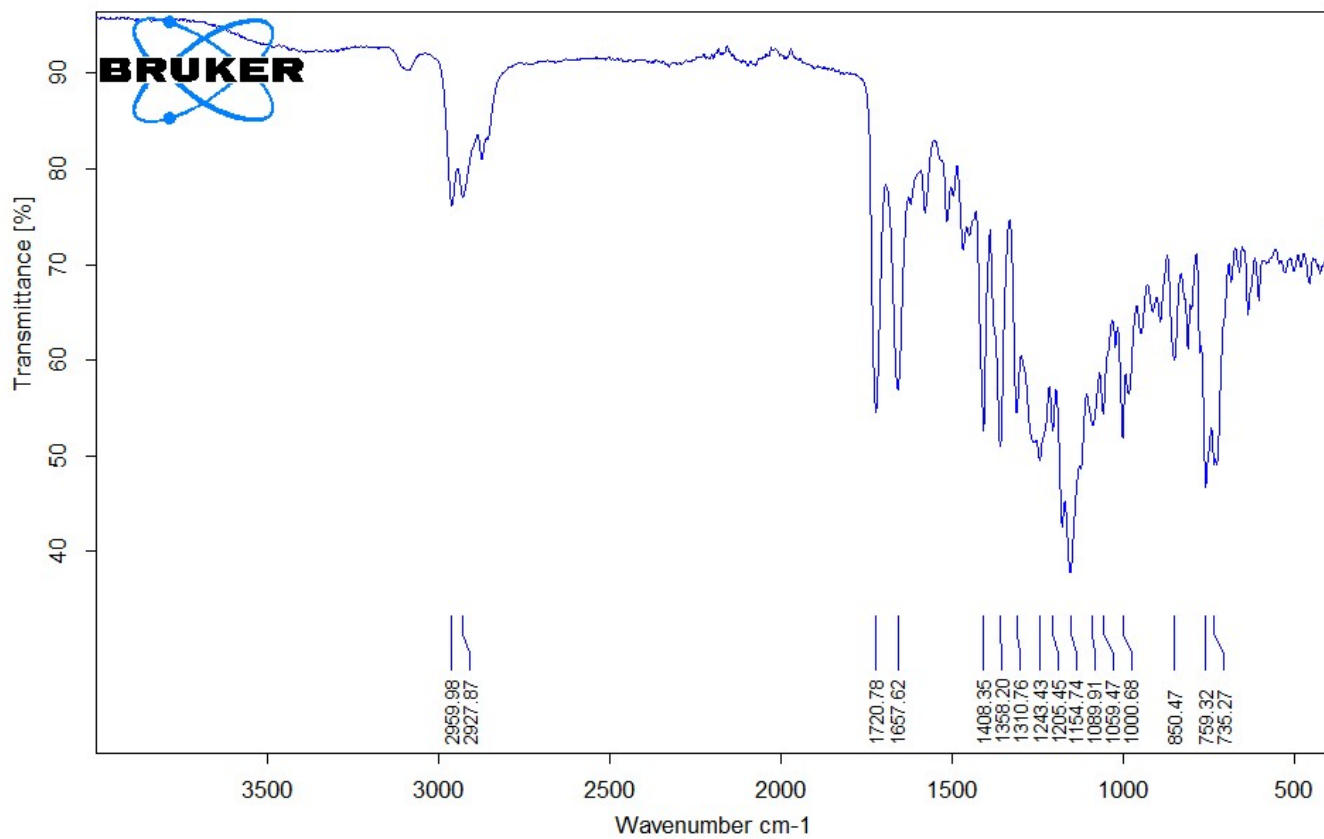
T-163 ¹³C-NMR



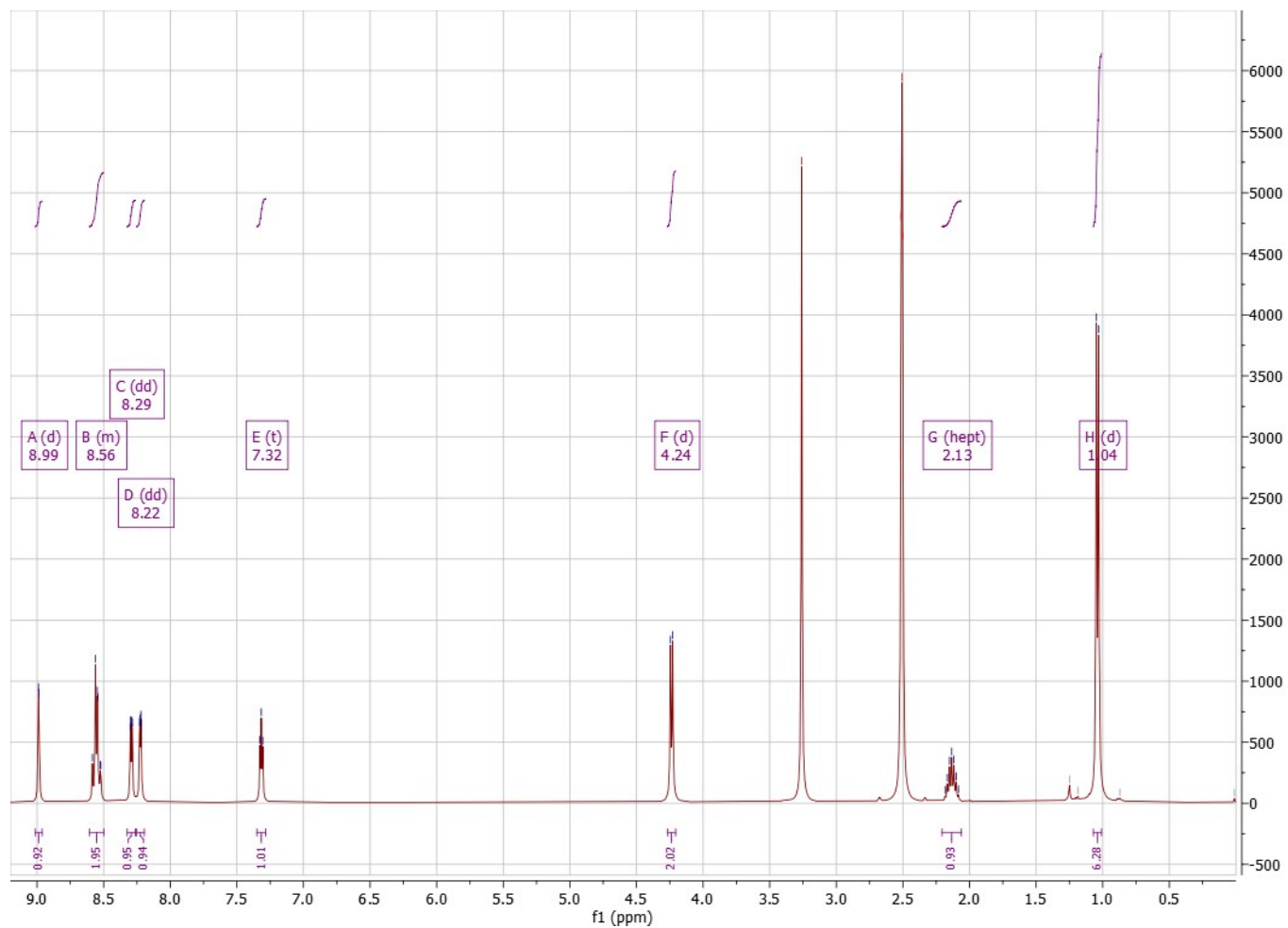
T-163 UPLC-MS



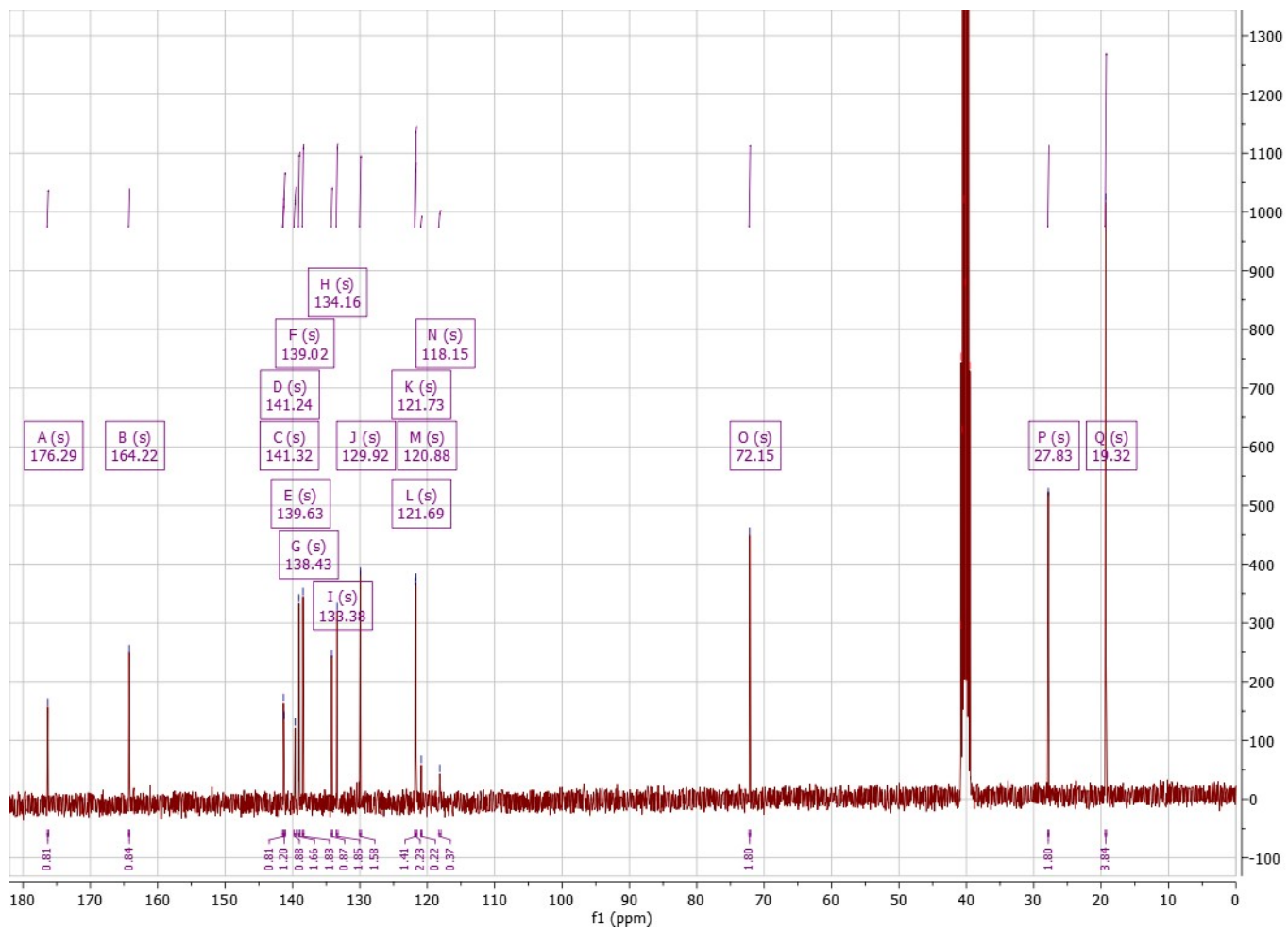
T-164 IR



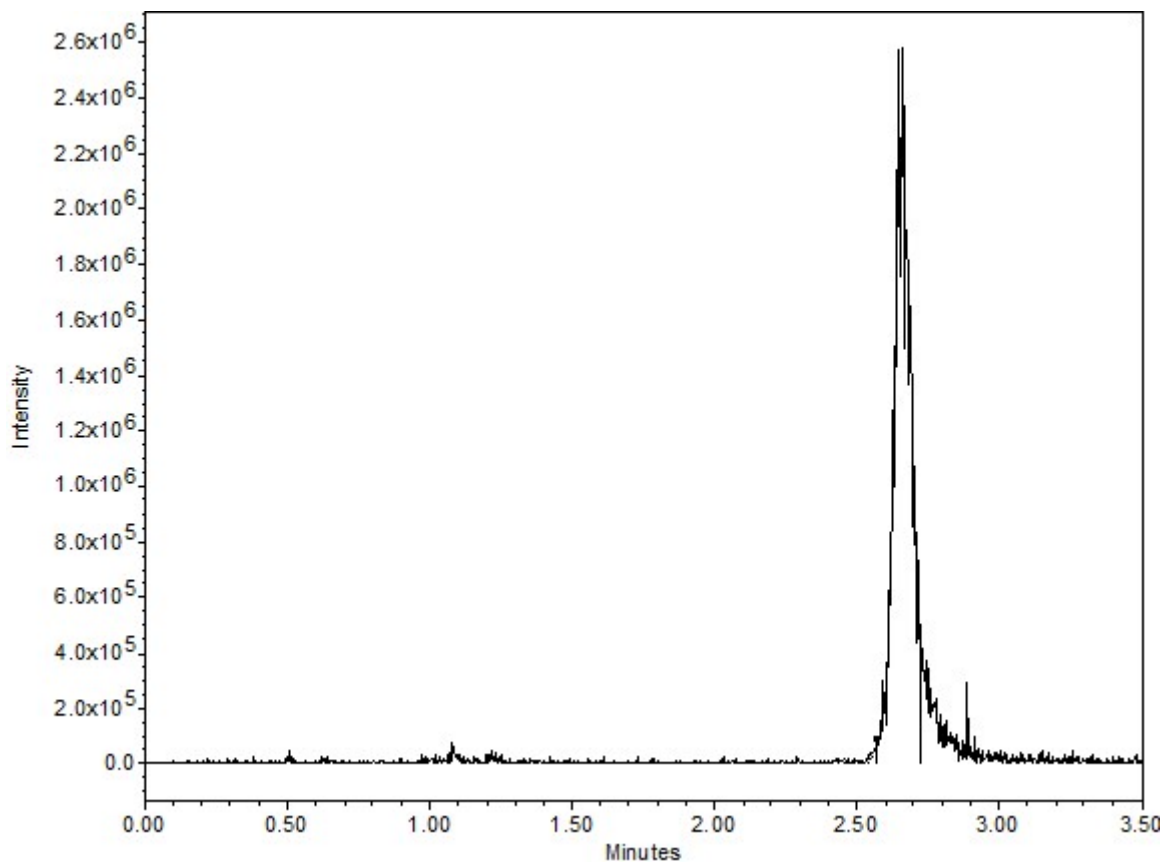
T-164 ¹H-NMR



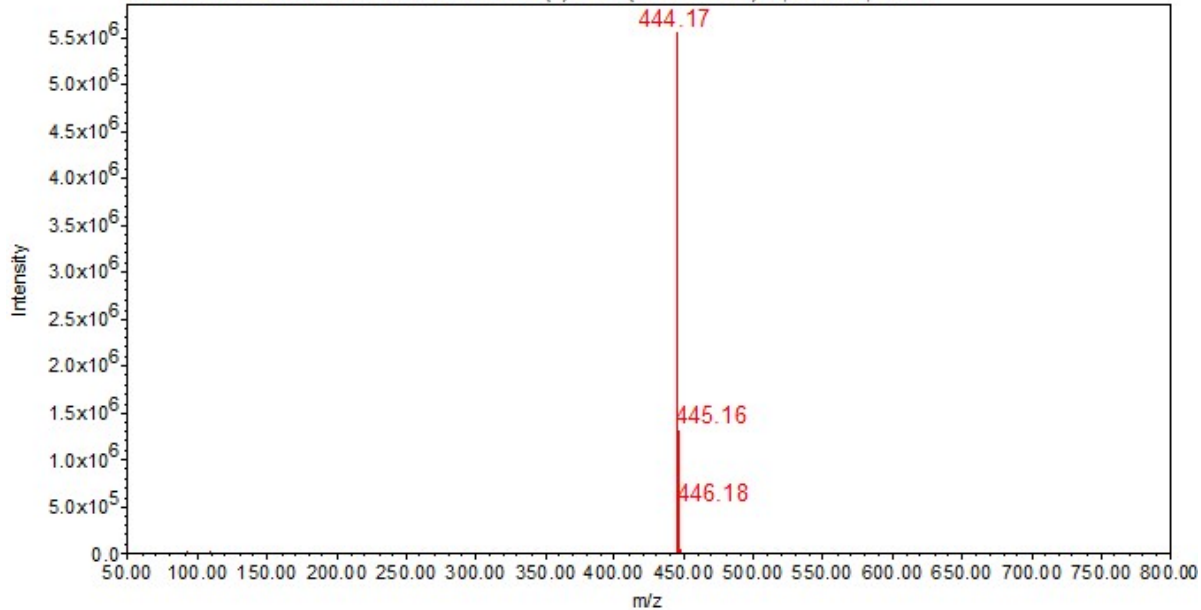
T-164 ¹³C-NMR



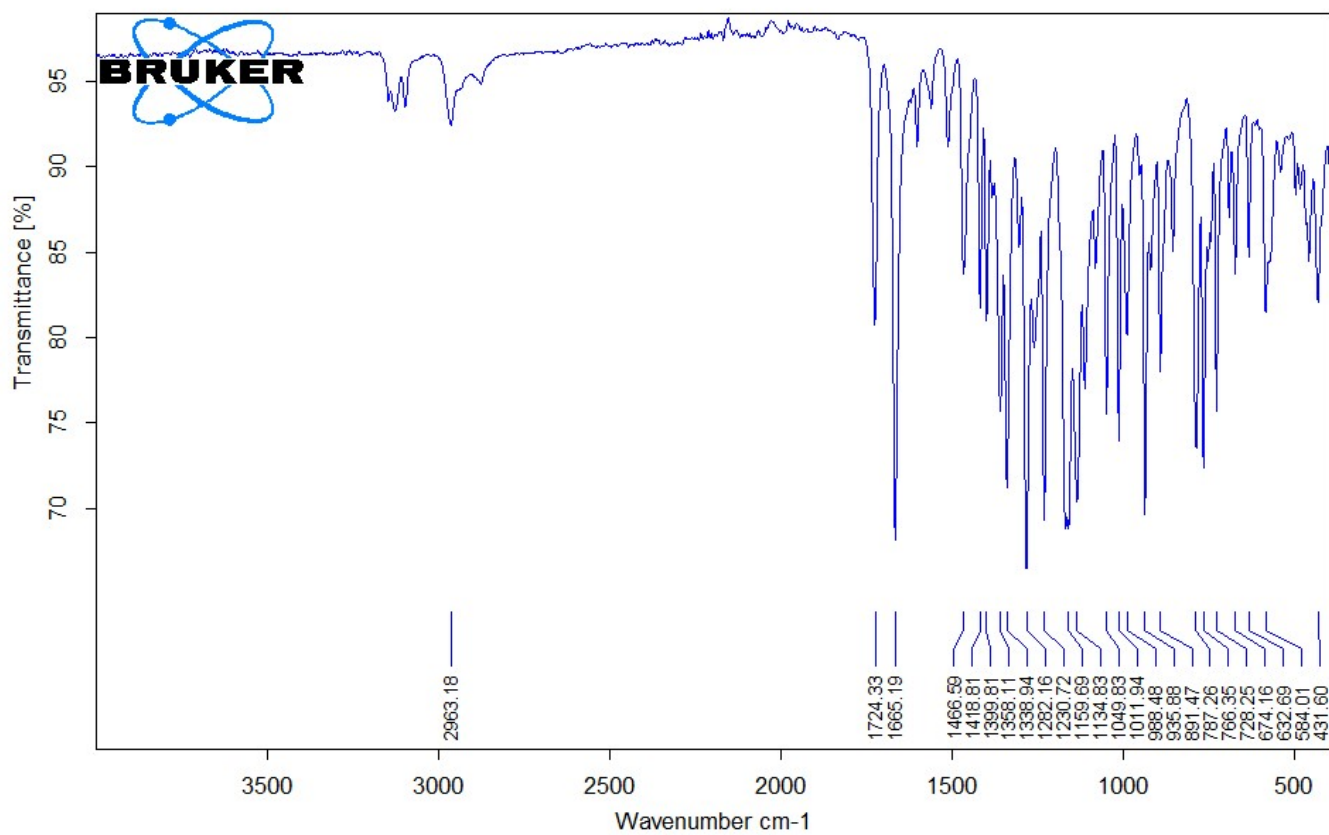
T-164 UPLC-MS



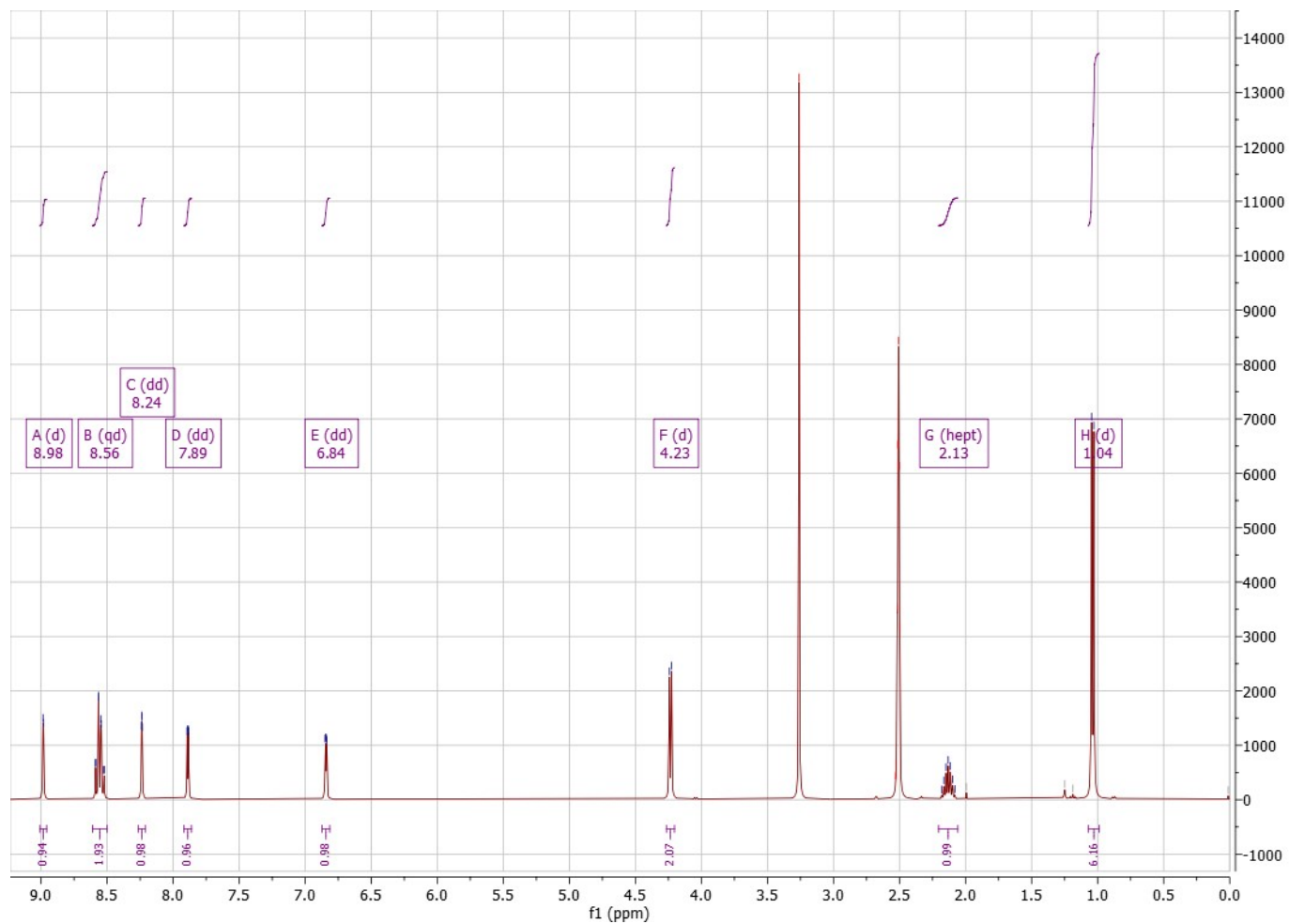
2.657 Peak 1 - QDa 1: MS Scan 1: QDa Positive(+) Scan (50.00-800.00)Da, Centroid, CV=10



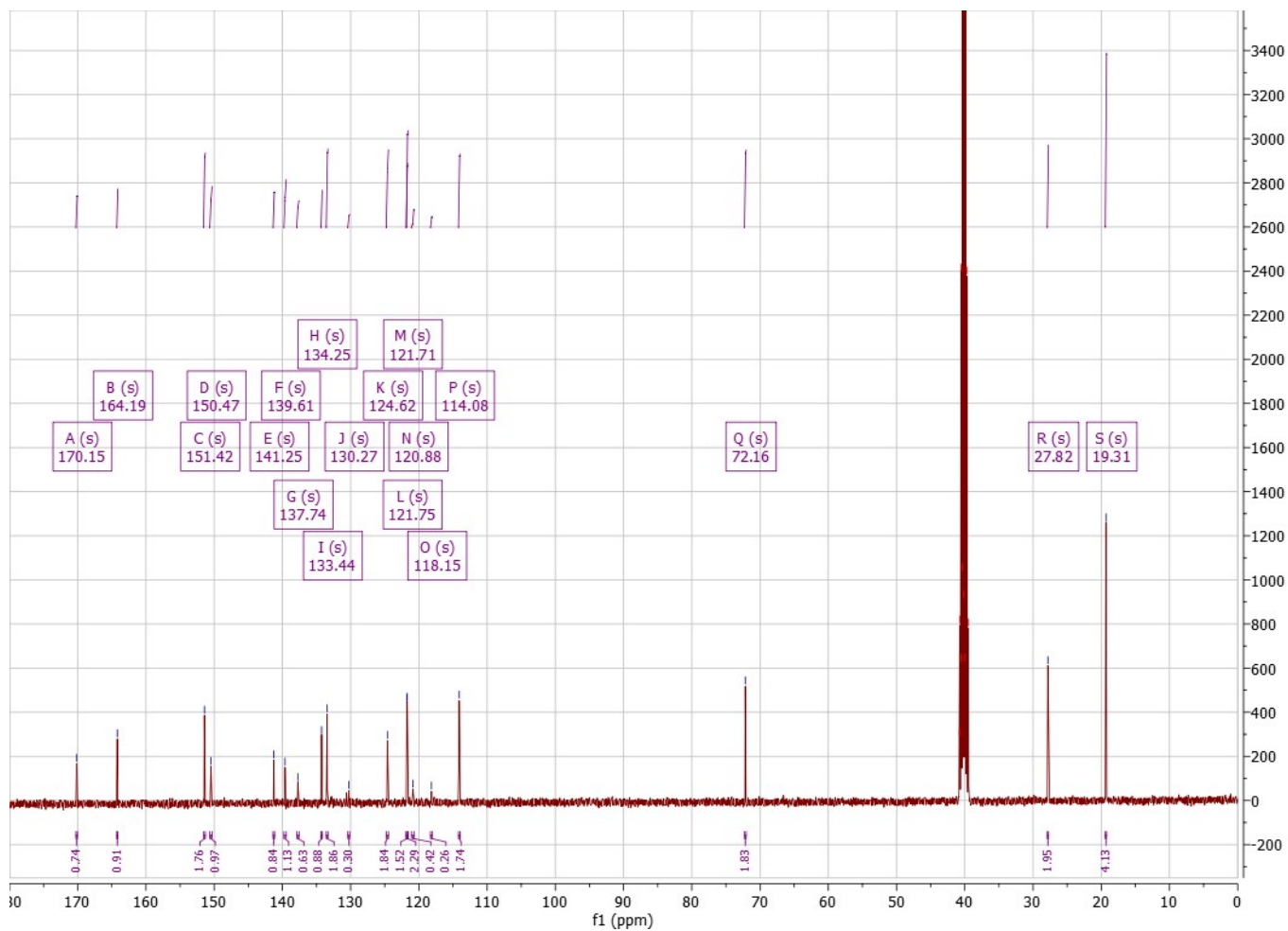
T-165 IR



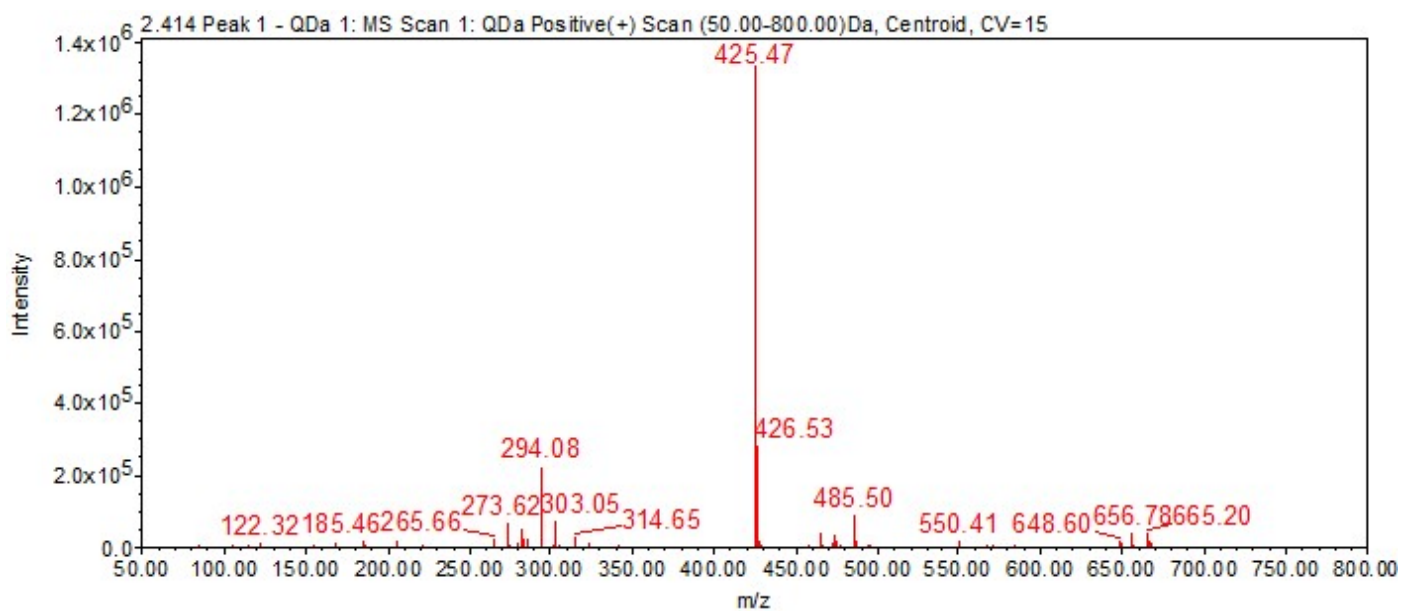
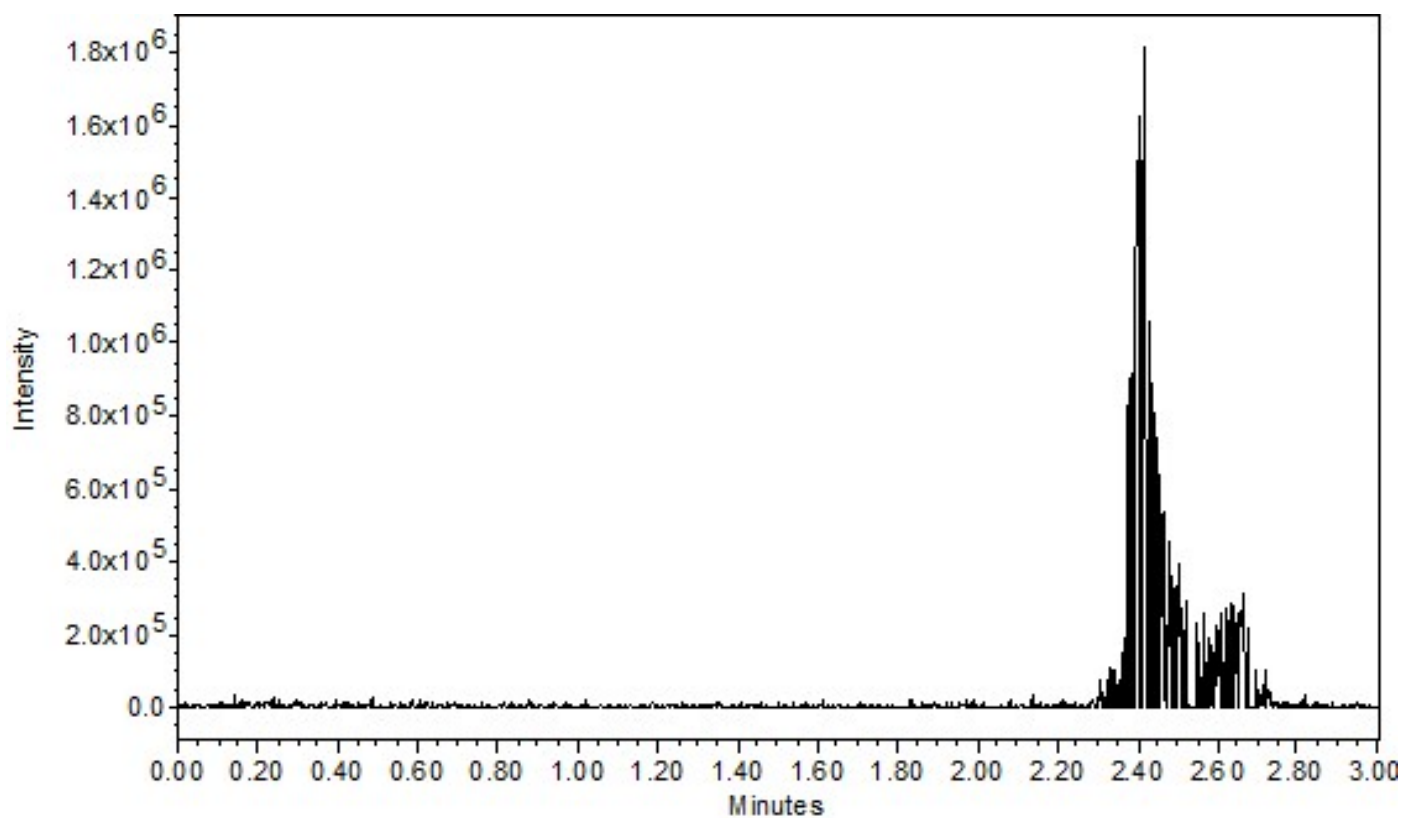
T-165 ¹H-NMR



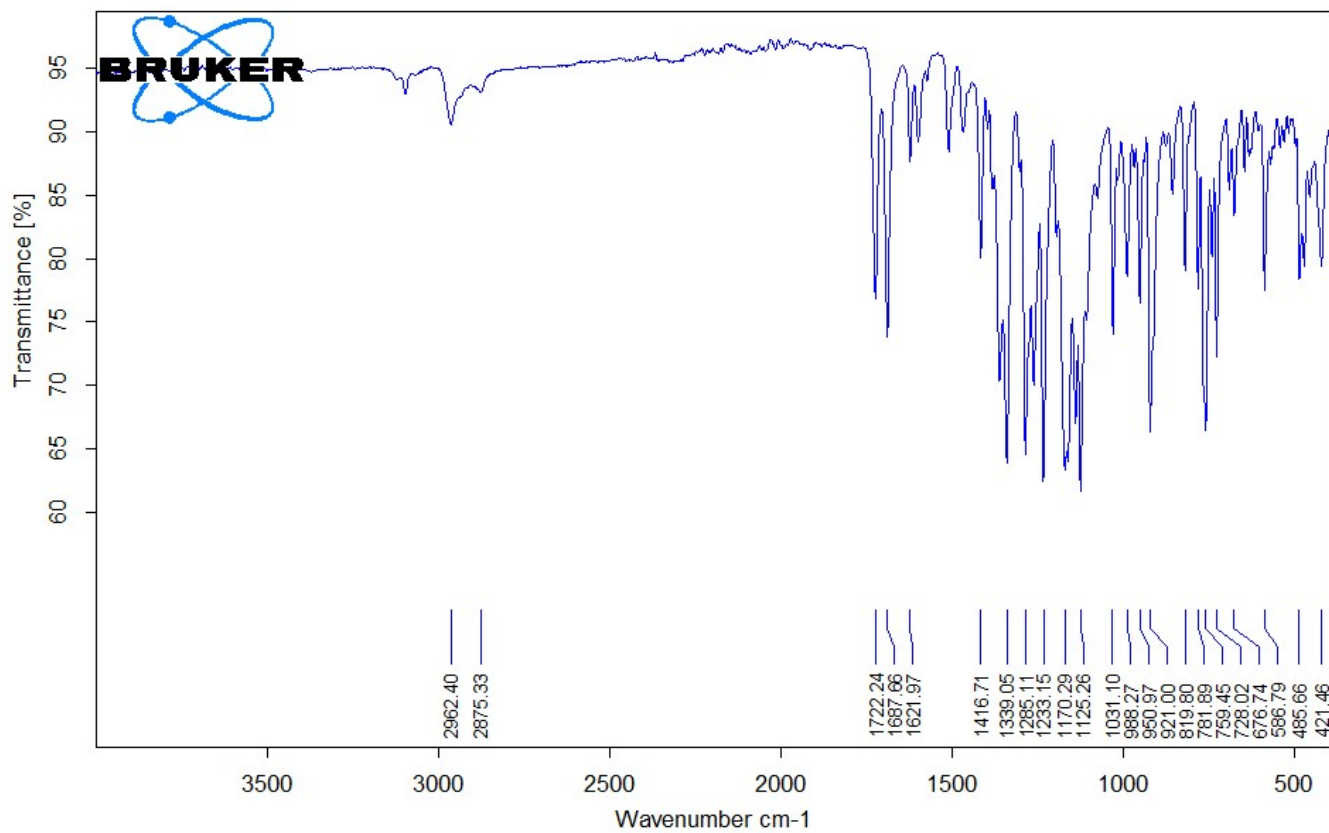
T-165 ¹³C-NMR



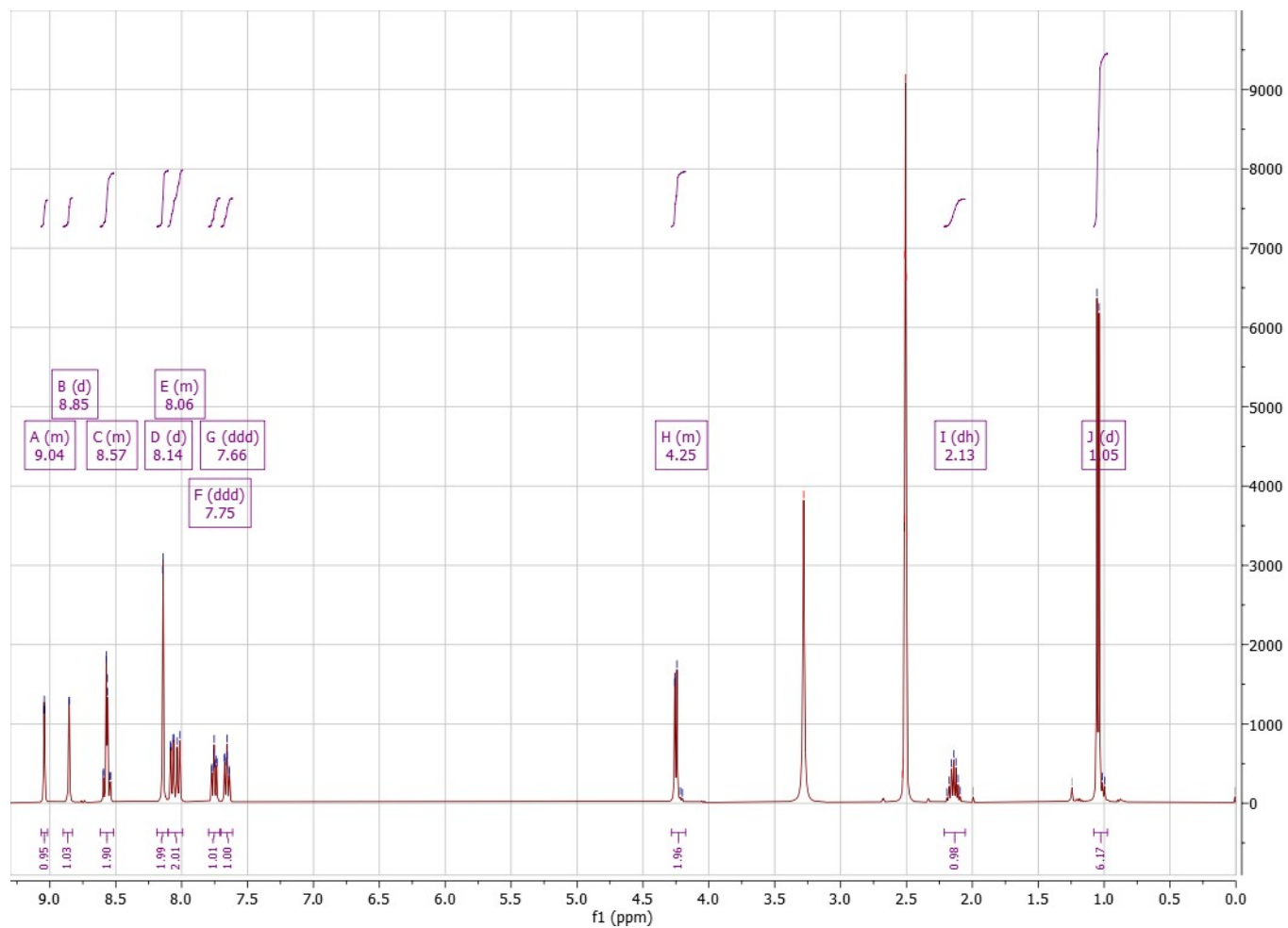
T-165 UPLC-MS



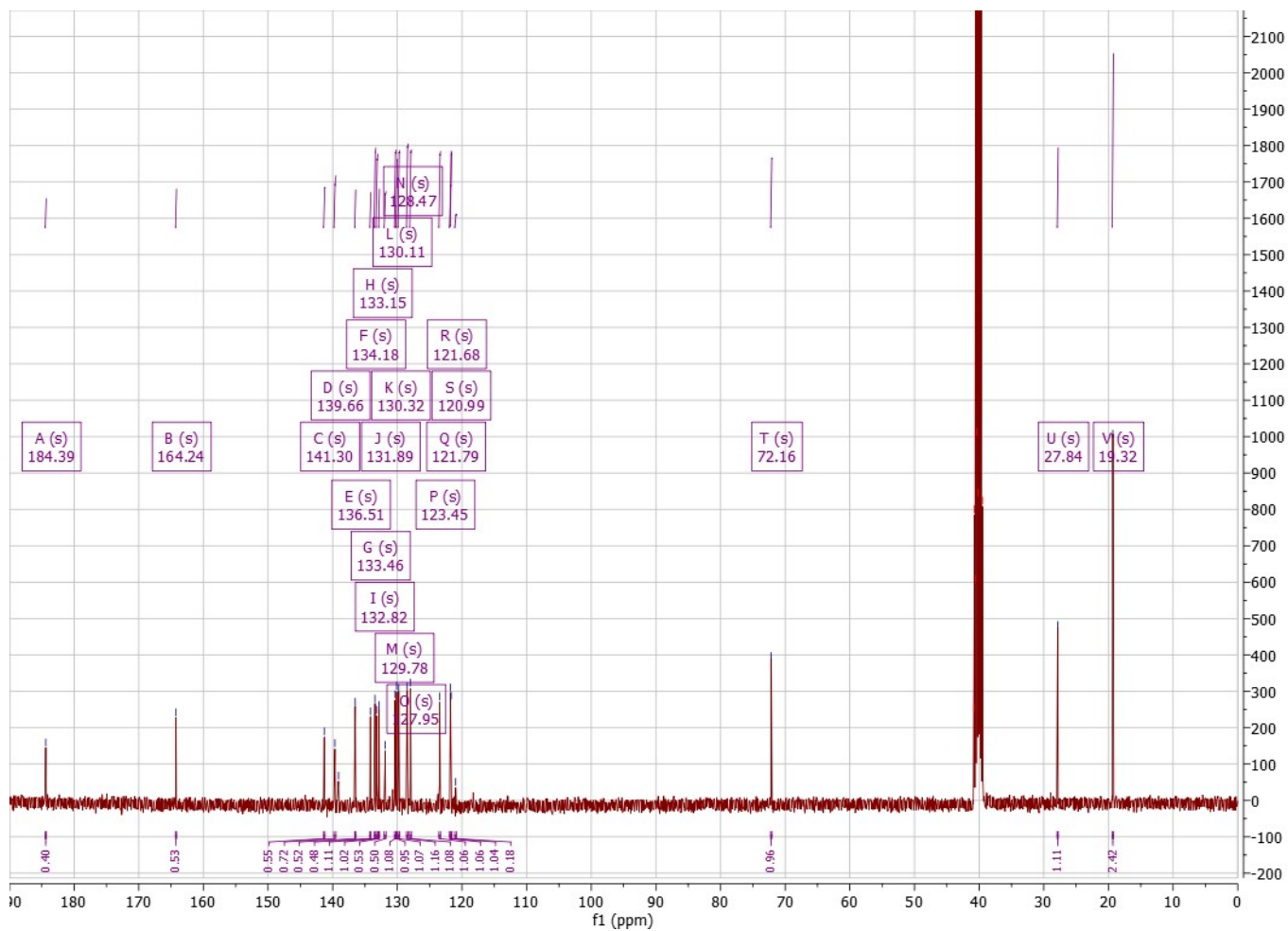
T-166 IR



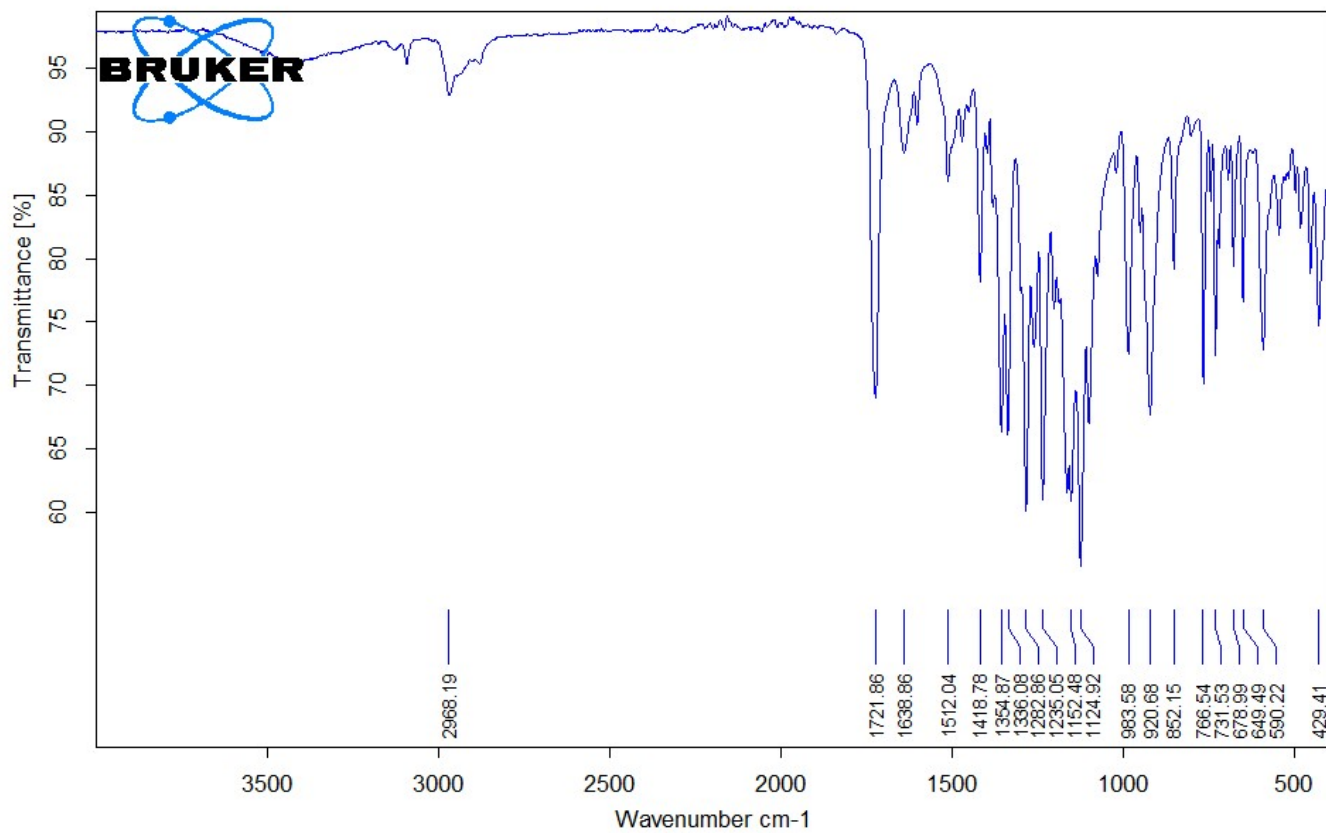
T-166 ¹H-NMR



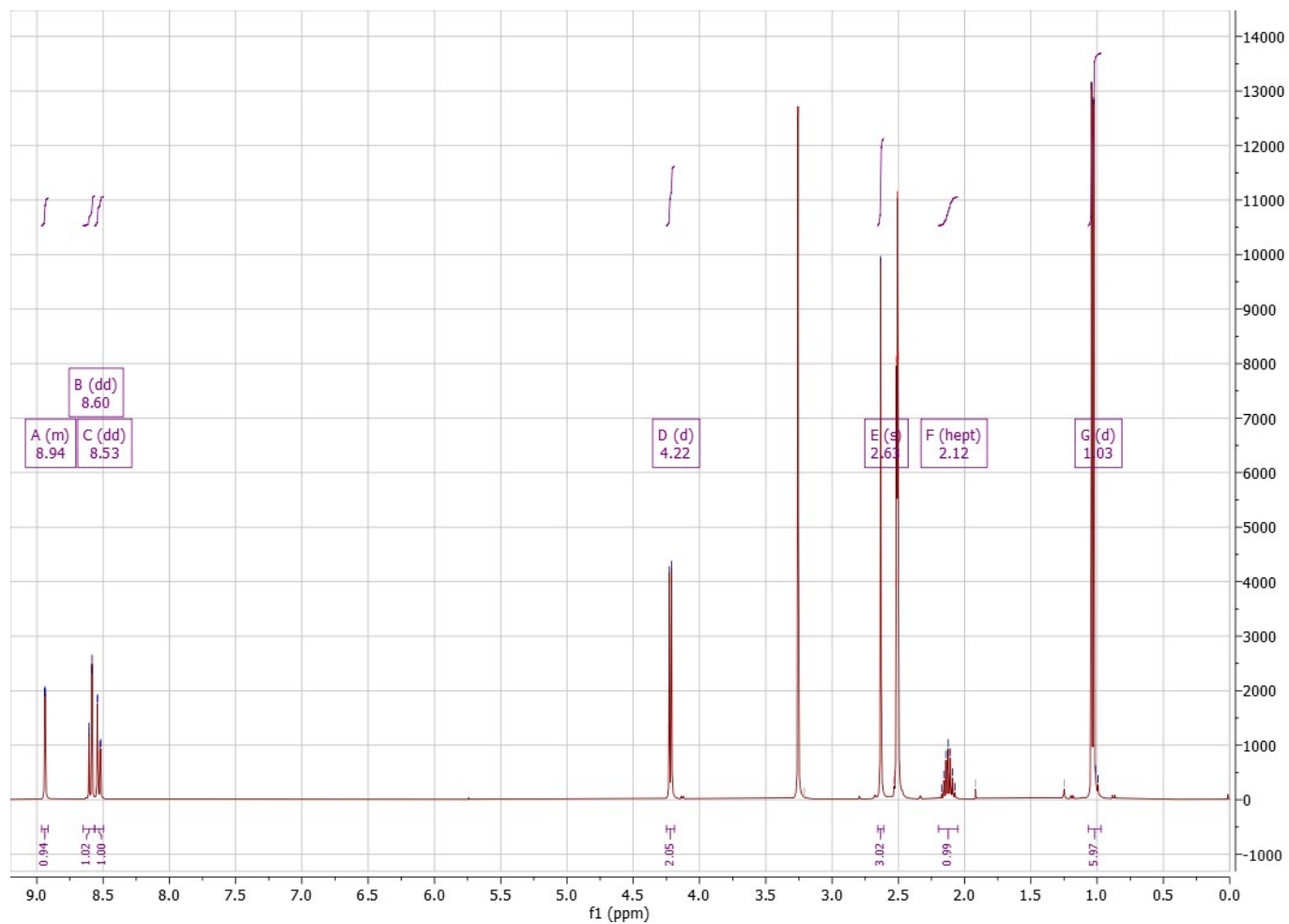
T-166 ¹³C-NMR



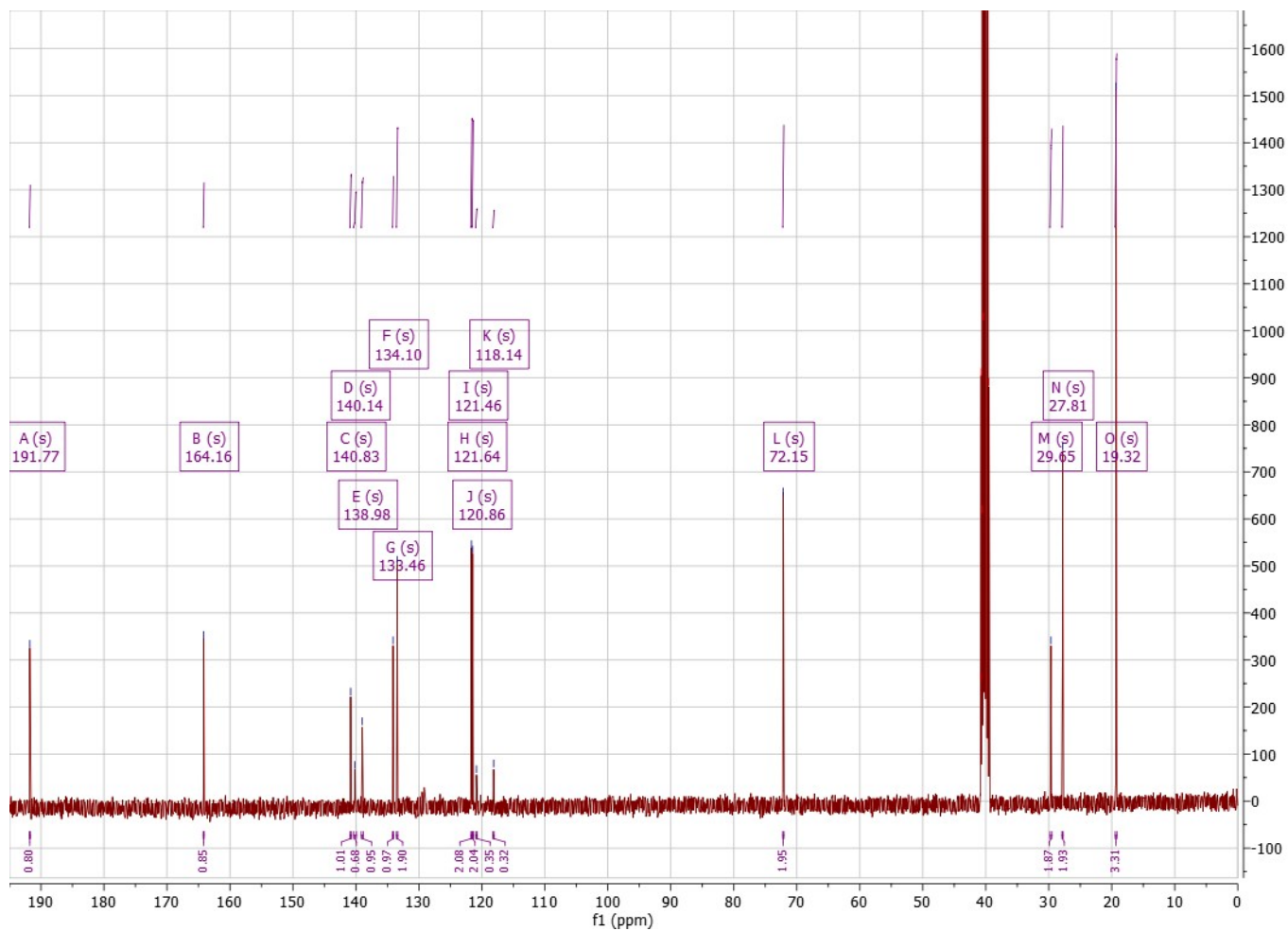
T-167 IR



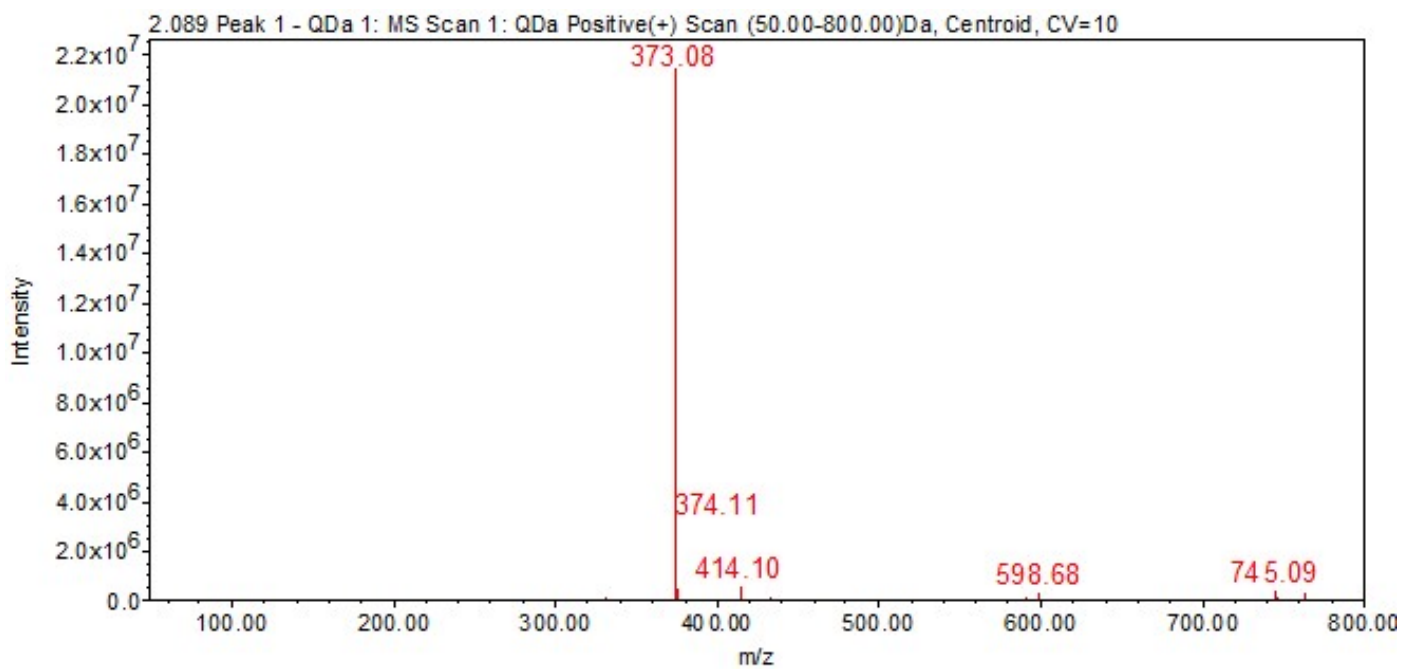
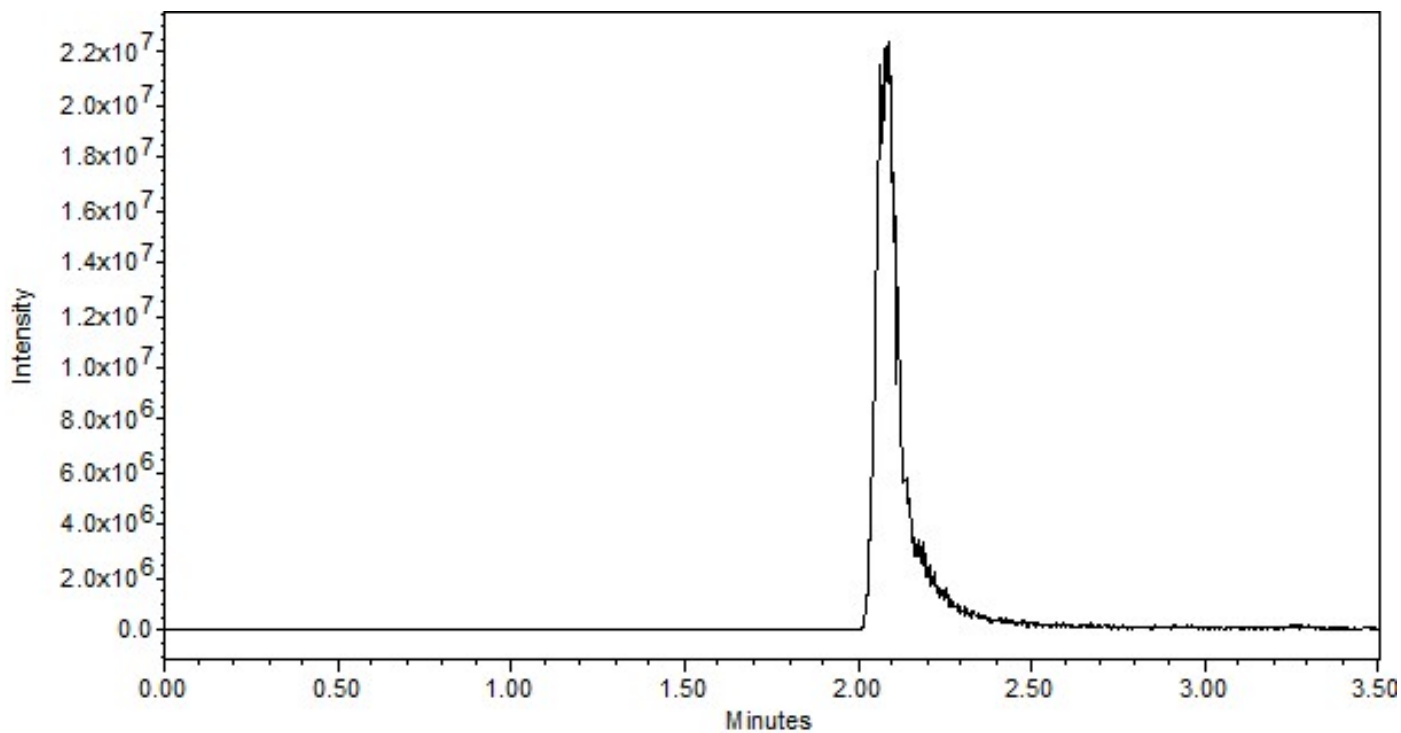
T-167 ¹H-NMR



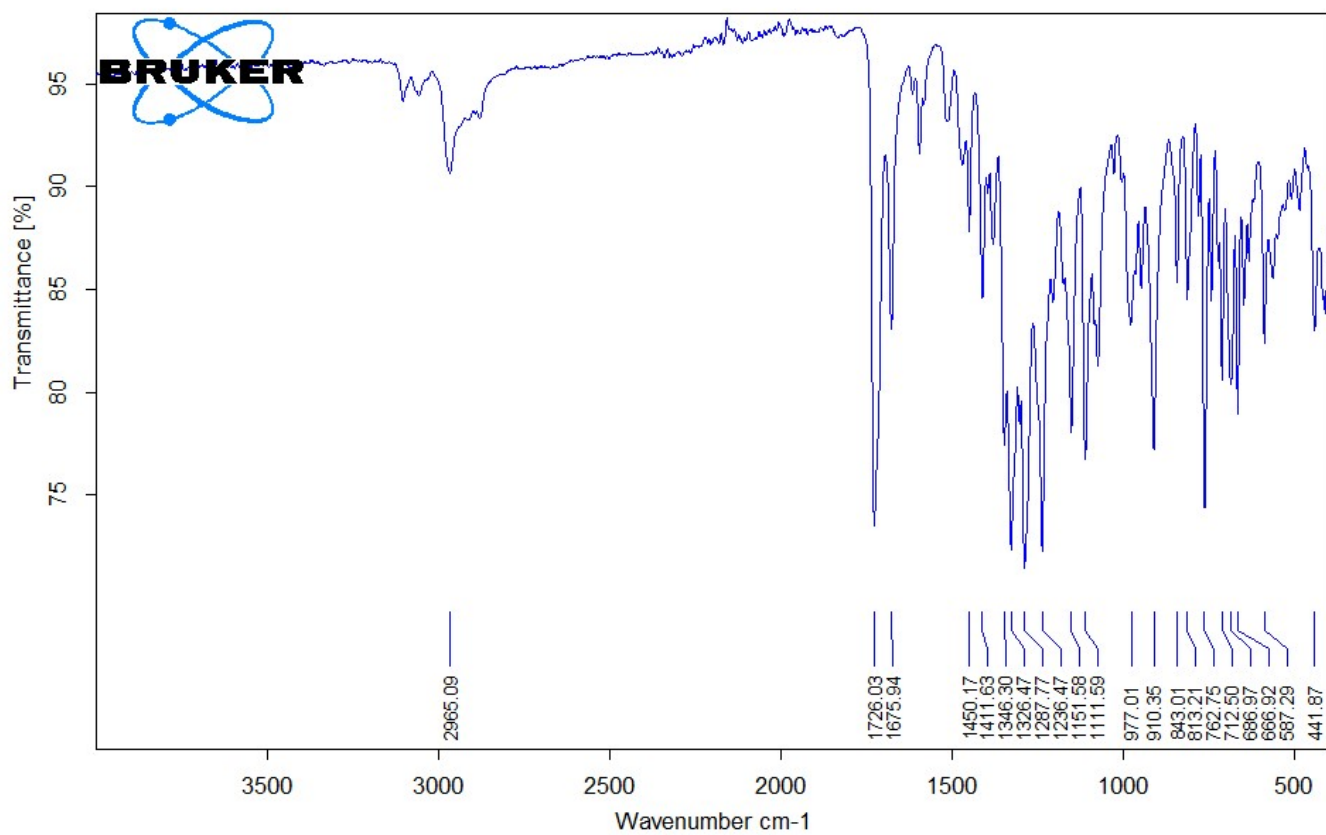
T-167 ¹³C-NMR



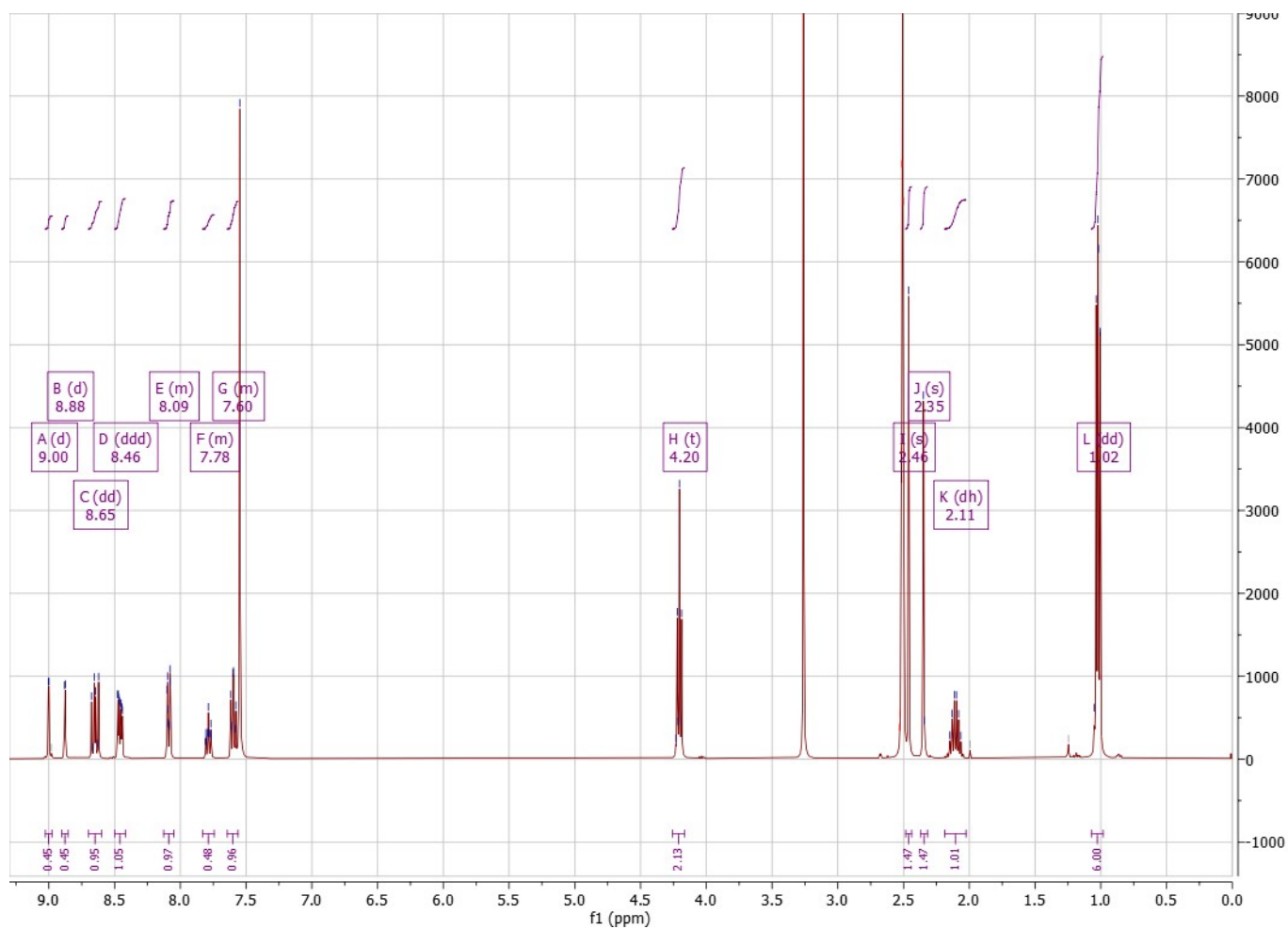
T-167 UPLC-MS



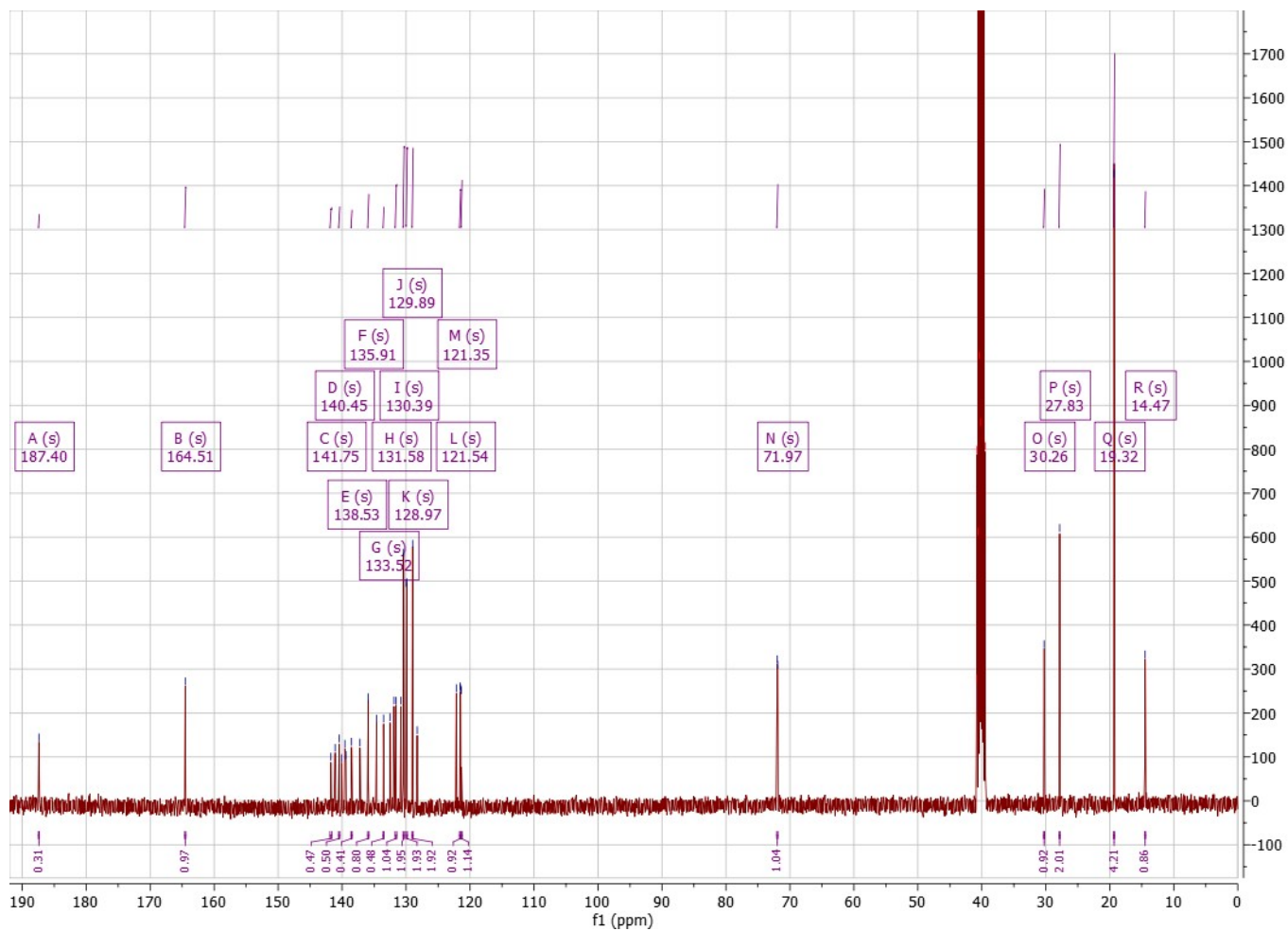
T-168 IR



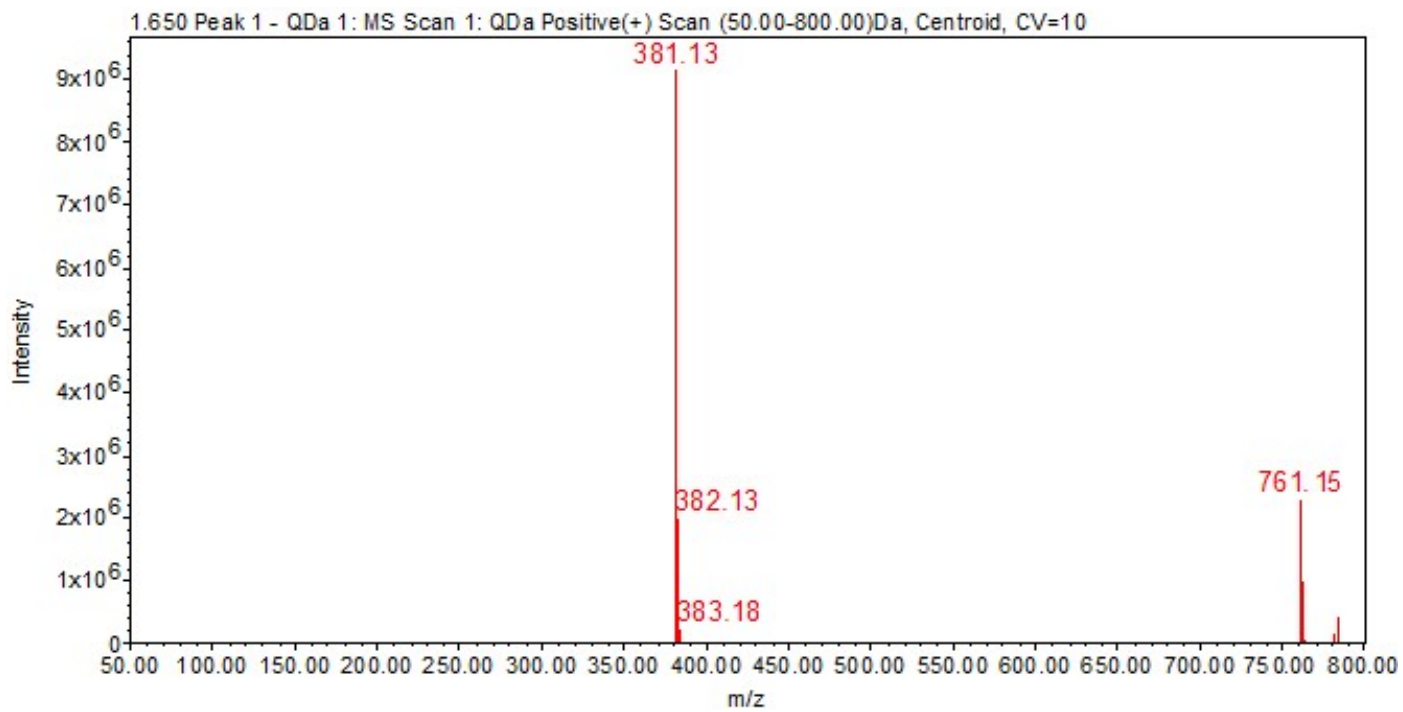
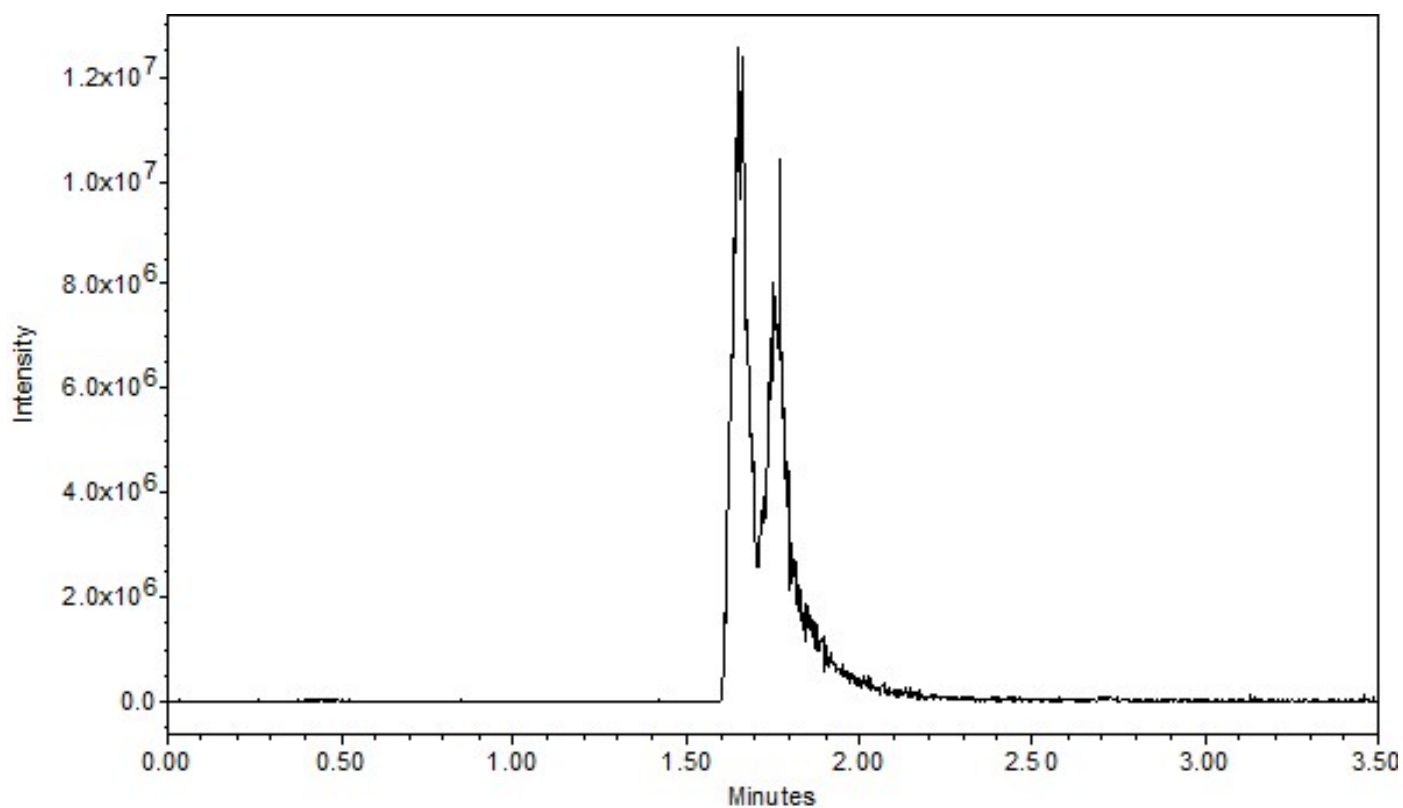
T-168 ¹H-NMR



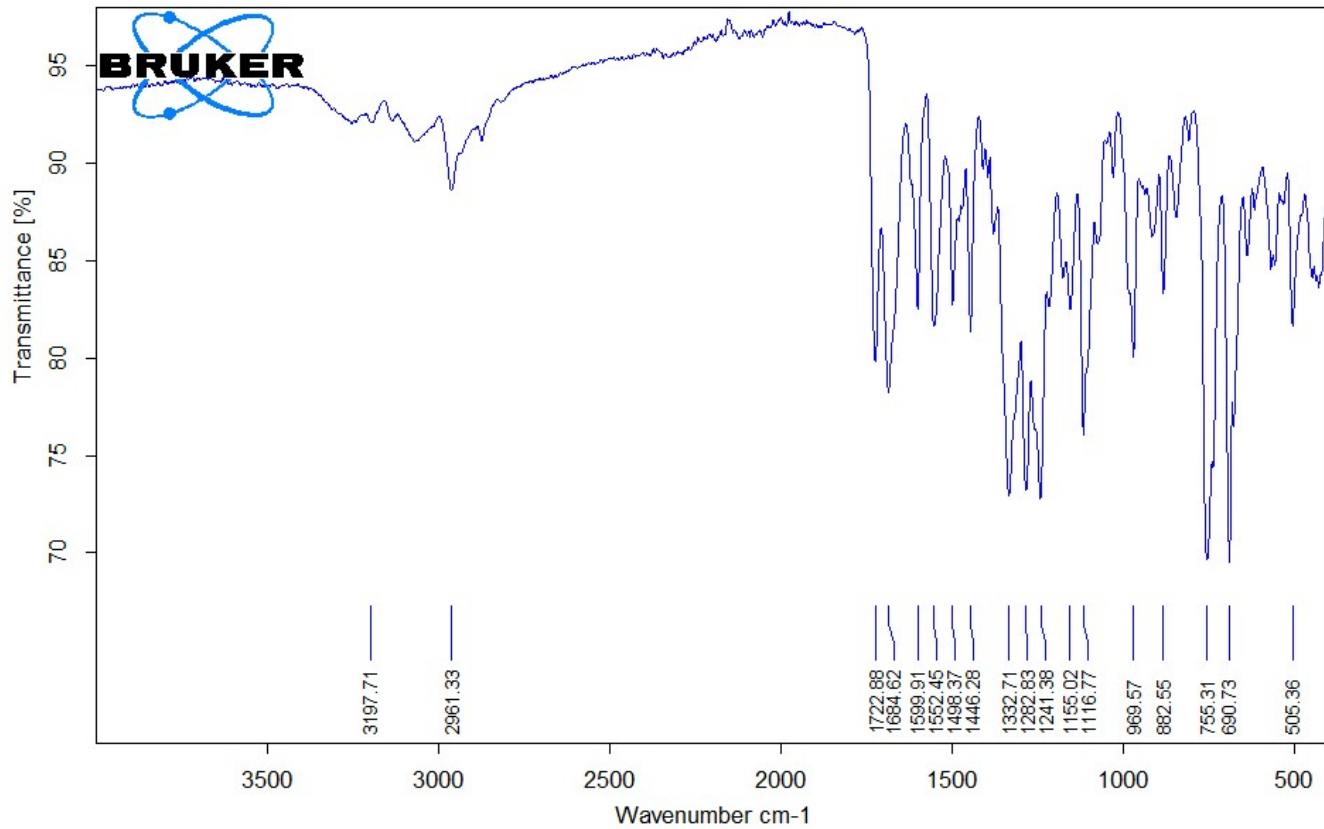
T-168 ¹³C-NMR



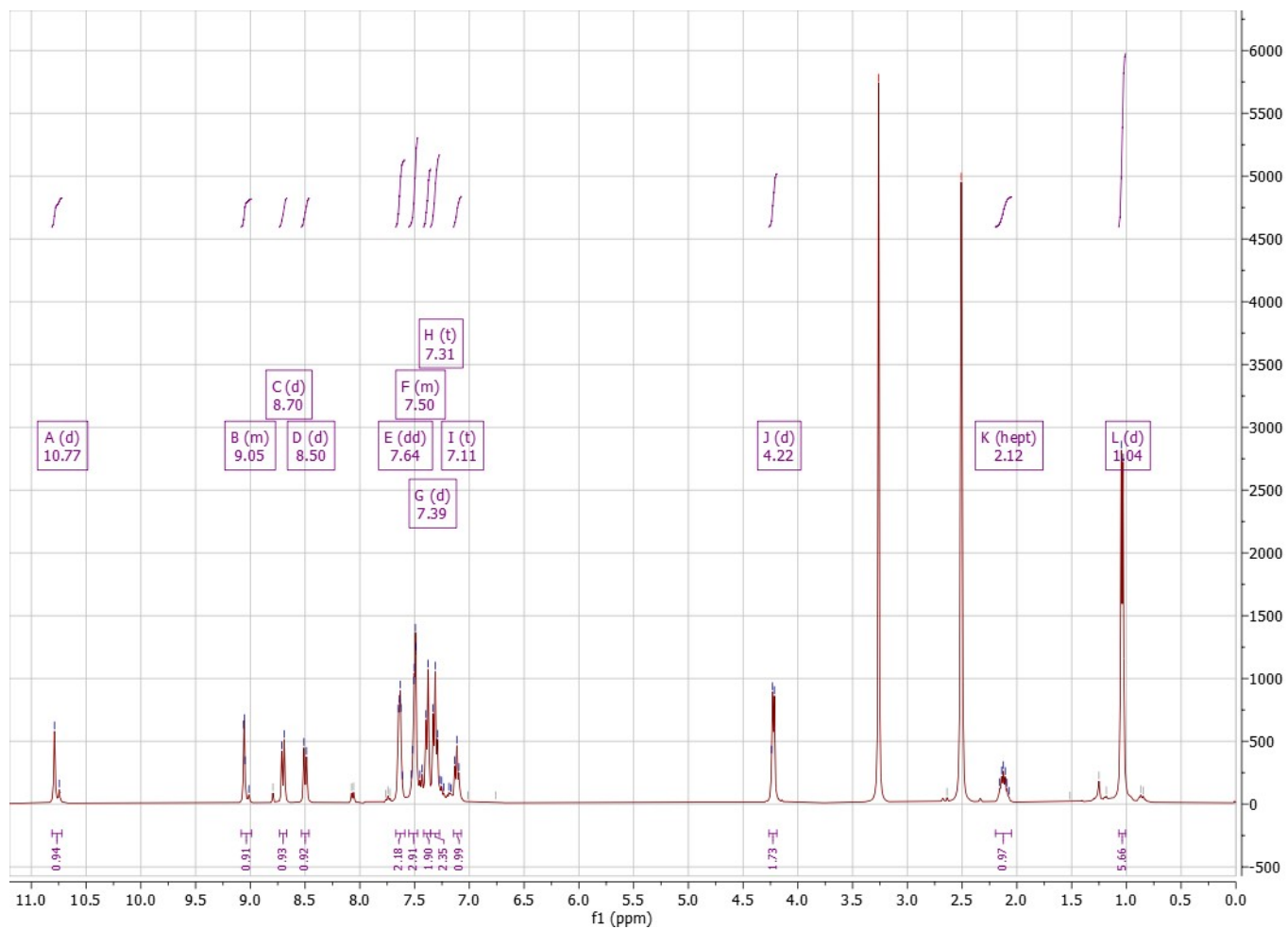
T-168 UPLC-MS



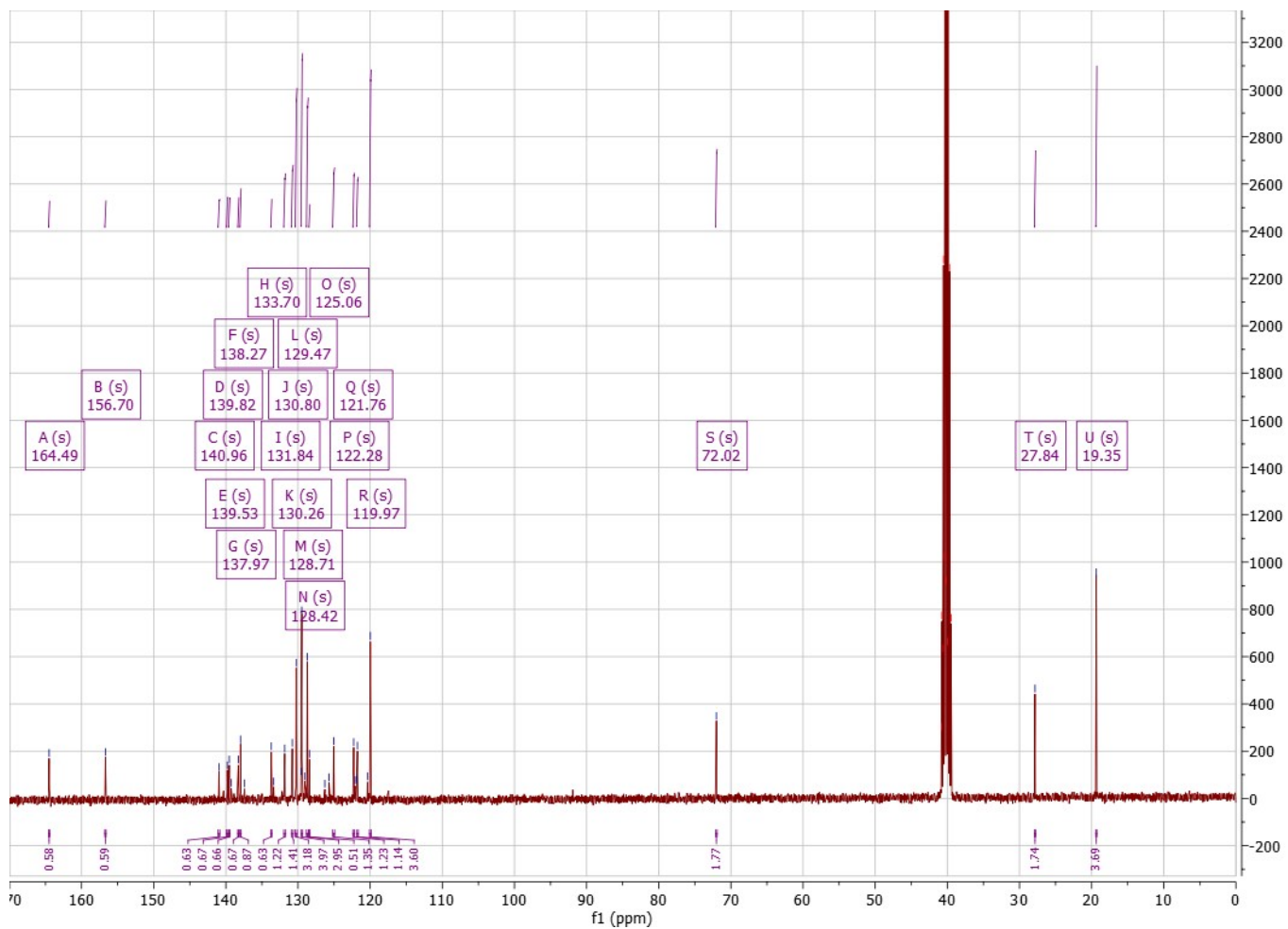
T-169 IR



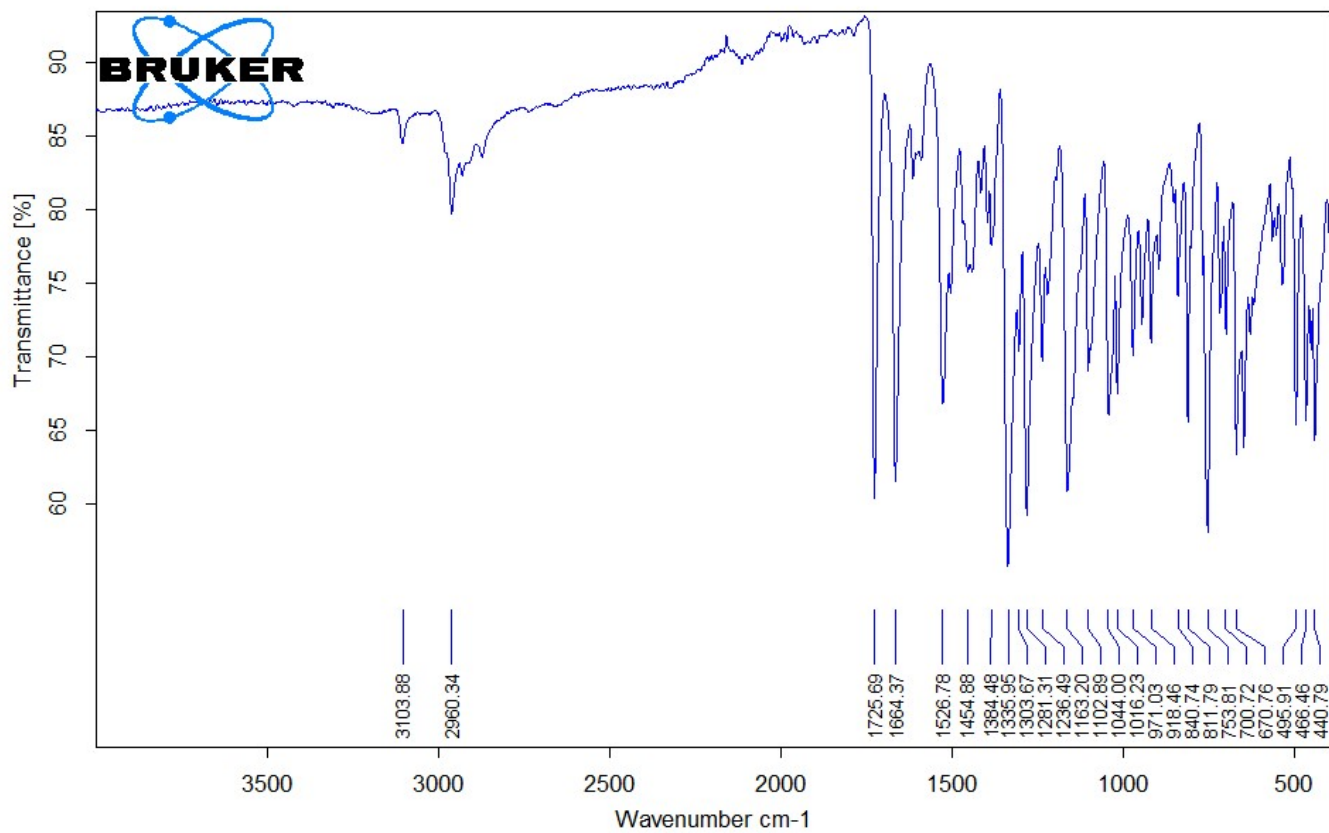
T-169 ¹H-NMR



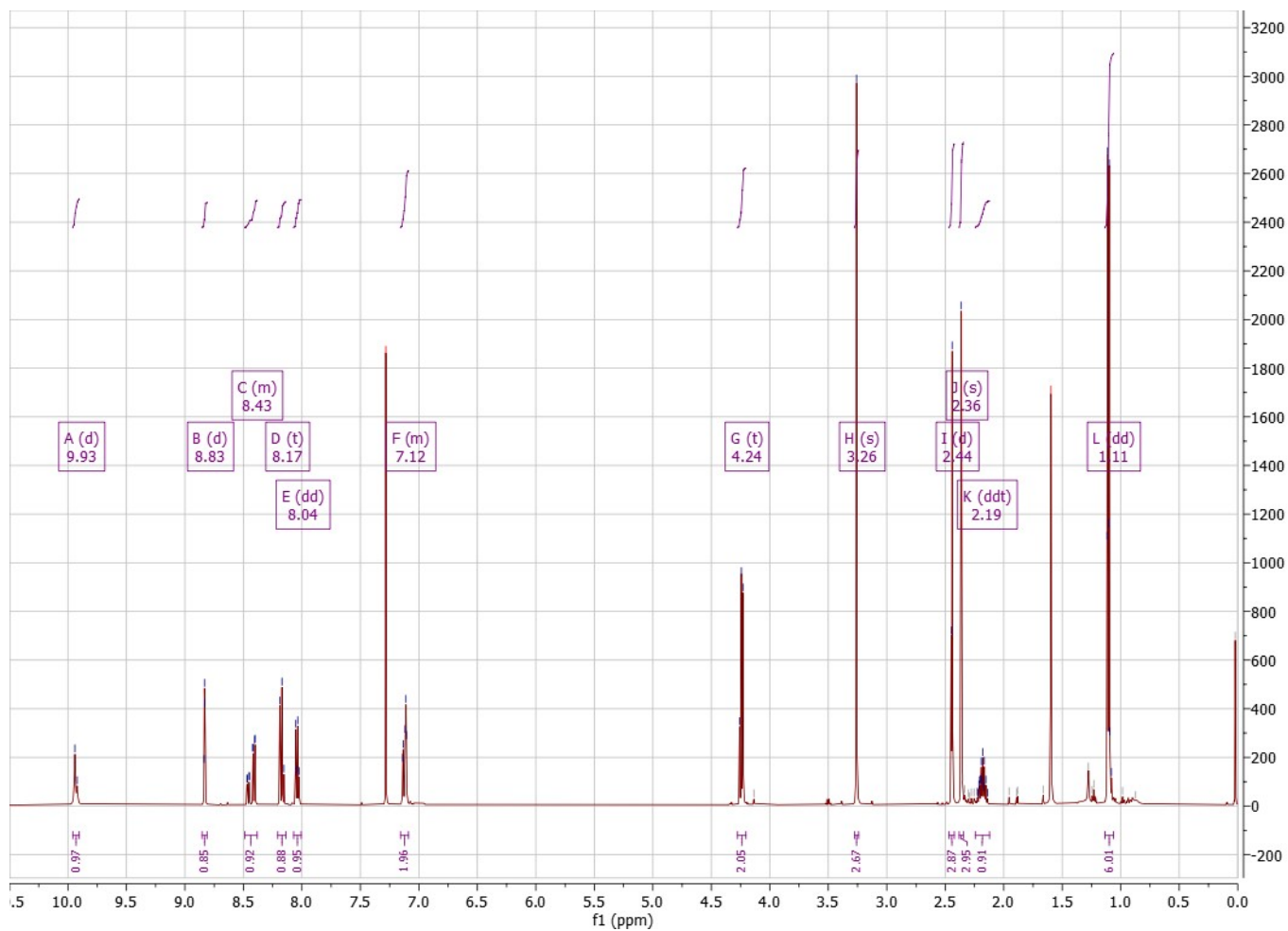
T-169 ¹³C-NMR



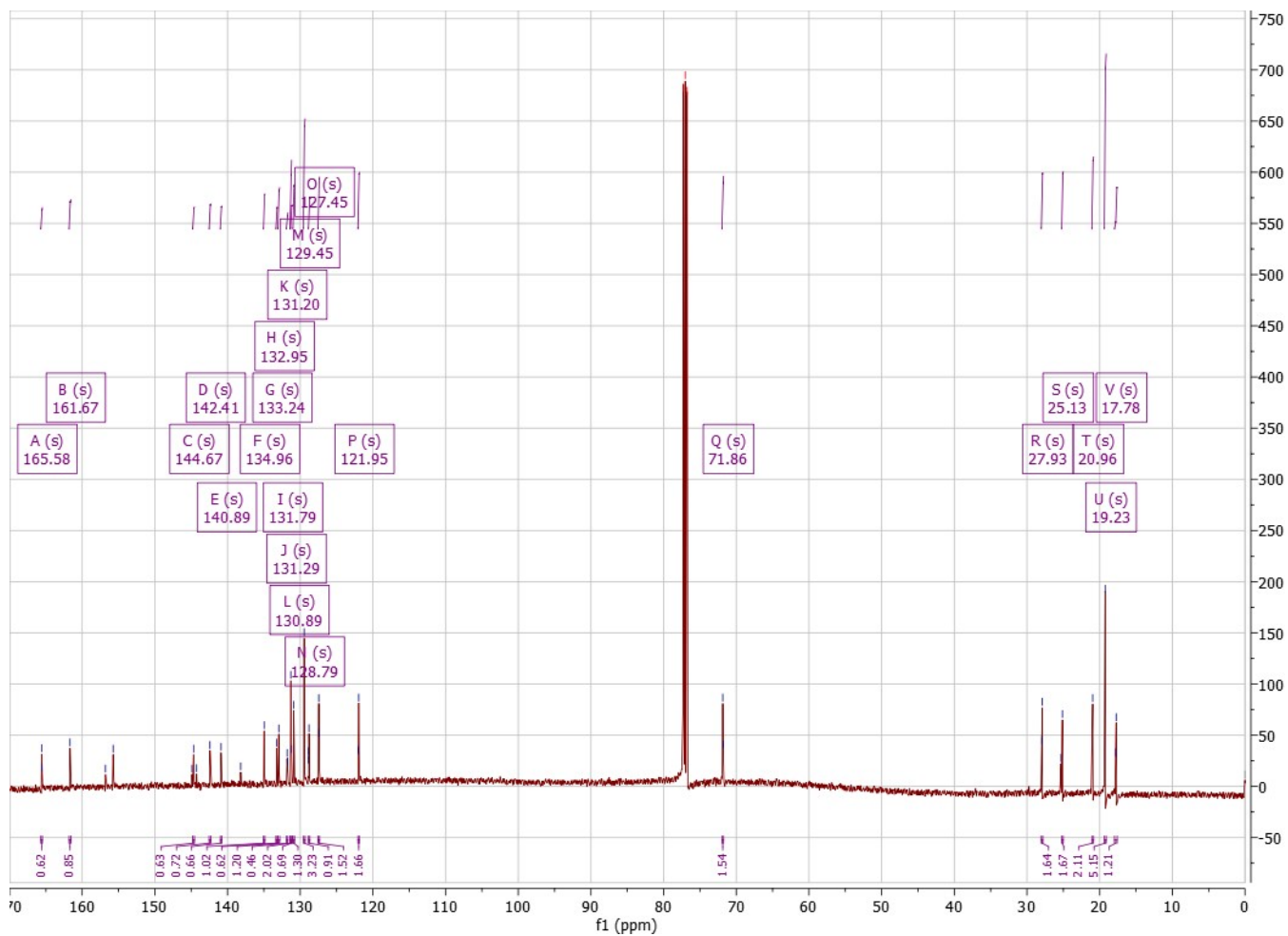
T-170 IR



T-170 ¹H-NMR



T-170 ¹³C-NMR



T-170 UPLC-MS

