

RSC ADVANCES

Supplementary Information associated with the paper

Dual activity of indolin-2-ones containing an arylidene motif: DNA and BSA interaction

Syed Nasir Abbas Bukhari^{1*}, Tariq G. Alsahli², Hasan Ejaz³, Naveed Ahmed⁴, Waqas Ahmad⁵, Mervat A. Elsherif⁶, Nasser H. Alotaibi⁷, Kashaf Junaid⁸, and Nenad Janković^{9*}

¹Department of Pharmaceutical Chemistry, College of Pharmacy, Jouf University, Sakaka, Al Jouf, 72388, Saudi Arabia; sbukhari@ju.edu.sa (SNAB)

² Department of Pharmacology, College of Pharmacy, Jouf University, Sakaka, Al Jouf, 72388, Saudi Arabia; TGAAlsahli@ju.edu.sa (TGA)

³ Department of Clinical Laboratory Sciences, College of Applied Medical Sciences, Sakaka, Jouf University, Al Jouf, 72388, Saudi Arabia; hetariq@ju.edu.sa (HE)

⁴ Department of Pharmaceutics, College of Pharmacy, Jouf University, Sakaka, Al Jouf, 72388, Saudi Arabia; nakahmad@ju.edu.sa (NA)

⁵ Discipline of Pharmaceutical Chemistry, School of Pharmaceutical Sciences, Universiti Sains Malaysia, Gelugor, 11800, Penang, Malaysia; waqas@usm.my (WA)

⁶ Chemistry Department, College of Science, Jouf University, Al Jouf, 72388, Sakaka, Saudi Arabia; maelsherif@ju.edu.sa (MAE)

⁷ Department of Clinical Pharmacy, College of Pharmacy, Jouf University, Sakaka 72388, Saudi Arabia; nhalotaibi@ju.edu.sa (NHA)

⁸ School of Biological and Behavioural Sciences, Queen Mary University of London, London, E1 4NS, UK Email: kashaf.junaid@qmul.ac.uk (KJ)

⁹ University of Kragujevac, Institute for Information of Technologies Kragujevac, Department of Science, Jovana Cvijića bb, 34000 Kragujevac; nenad.jankovic@kg.ac.rs (NJ)

*Correspondence: sbukhari@ju.edu.sa (SNAB); nenad.jankovic@kg.ac.rs (NJ)

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1. Experimental data

1-allylindoline-2,3-dione 1

Red solid; Yield: 96%; Mp = 95 °C; ¹H NMR (200 MHz, DMSO-d₆) δ 7.68-7.53 (m, 2H, CH_{Ar}), 7.16-7.03 (m, 2H, CH_{Ar}), 5.96 – 5.77 (m, 1H, =CH), 5.39-5.16 (m, 2H, =CH₂), 4.31 (dt, *J* = 4.9, 1.7 Hz, 2H, N-CH₂) ppm; ¹³C NMR (50 MHz, DMSO-d₆) δ 183.2, 157.9, 150.5, 138.1, 131.4, 124.5, 123.3, 117.5, 111.2, 41.9 ppm.

1-allyl-3-(2-oxo-2-phenylethylidene)indolin-2-one 4a

Orange solid; Yield: 54 % (1,06 g); Mp = 85 °C; IR ν 3434, 1706, 1658, 1619, 1600, 1464, 1346, 1225 cm⁻¹; ¹H NMR (200 MHz, DMSO-d₆) δ 8.11-8.03 (m, 3H, CH_{Ar}), 7.81 (s, 1H, =CH), 7.77-7.68 (m, 1H, CH_{Ar}), 7.63-7.55 (m, 2H, CH_{Ar}), 7.44-7.35 (m, 1H, CH_{Ar}), 7.04-6.97 (m, 2H, CH_{Ar}), 5.97-5.78 (m, 1H, =CH_{allyl}), 5.24-5.14 (m, 2H, =CH₂), 4.39-4.37 (m, 2H, N-CH₂) ppm; ¹³C NMR (50 MHz, DMSO-d₆) δ 191.3, 166.5, 144.9, 136.9, 135.0, 134.2, 132.7, 131.8, 129.2, 128.7 (2C), 127.1 (2C), 126.4, 122.4, 119.4, 117.1, 109.8, 41.9 ppm; ESI-MS (*m/z*): [M+H]⁺ = 290; Calcd. for C₁₉H₁₅NO₂: C 78.87; H 5.23; N 4.84; Found: C 78.64; H 5.12; N 4.69.

1-allyl-3-(2-oxo-2-*p*-tolylethylidene)indolin-2-one 4b

Orange solid; Yield: 49 % (1,13 g); Mp = 90-92 °C; IR ν 3434, 1714, 1657, 1615, 1605, 1465, 1360, 1348 cm⁻¹; ¹H NMR (200 MHz, DMSO-d₆) δ 8.01-7.95 (m, 3H, CH_{Ar}), 7.79 (s, 1H, =CH), 7.41-7.32 (m, 3H, CH_{Ar}), 7.03-6.96 (m, 2H, CH_{Ar}), 6.01-5.78 (s, 1H, =CH_{allyl}), 5.23-5.14 (m, 2H, CH₂), 4.37 (d, *J* = 5.0 Hz, 2H, N-CH₂), 2.39 (s, 3H, CH₃) ppm; ¹³C NMR (50 MHz, DMSO-d₆) δ 190.8, 166.6, 144.9, 144.8, 134.7, 134.5, 132.6, 131.8, 129.8 (2C), 128.8 (2C), 127.4, 126.3, 122.3, 119.4, 117.1, 109.7, 41.9, 21.5 ppm; ESI-MS (*m/z*): [M+H]⁺ = 304; Calcd. for C₂₀H₁₇NO₂: C 79.19; H 5.65; N 4.62; Found: C 79.02; H 5.48; N 4.50.

1-allyl-3-(2-(4-bromophenyl)-2-oxoethylidene)indolin-2-one 4c

Red solid; Yield: 80 % (2,21 g); Mp = 98 °C; IR ν 3432, 1716, 1665, 1616, 1596, 1466 cm⁻¹; ¹H NMR (200 MHz, DMSO-d₆) δ 8.07-7.97 (m, 3H, CH_{Ar}), 7.97-7.70 (m, 3H, =CH + CH_{Ar}), 7.45-7.35 (m, 1H, CH_{Ar}), 7.06-6.98 (m, 2H, CH_{Ar}), 6.02-5.78 (s, 1H, =CH_{allyl}), 5.23-5.14 (m, 2H, CH₂), 4.37 (d, *J* = 5.0 Hz, 2H, N-CH₂) ppm; ¹³C NMR (50 MHz, DMSO-d₆) δ 190.3, 166.5, 145.1, 136.0, 135.5, 132.9 (2C), 132.2 (2C), 131.8, 130.6, 128.4, 126.6, 126.4, 122.4, 119.4, 117.2, 109.8, 41.9 ppm; ESI-MS (*m/z*): [M]⁺ = 368; Calcd. for C₁₉H₁₄BrNO₂: C 61.97; H 3.83; N 3.80; Found: C 61.70; H 3.64; N 3.72.

1-allyl-3-(2-(3-aminophenyl)-2-oxoethylidene)indolin-2-one 4d

Dark red crystals; Yield: 43 % (1,15 g); Mp = 168 °C; IR ν 3435, 2803, 2752, 2572, 1710, 1657, 1614, 1599, 1466, 1256 cm⁻¹; ¹H NMR (200 MHz, DMSO-d₆) δ 8.07 (d, *J* = 7.4 Hz, 1H, CH_{Ar}), 8.02-7.96 (m, 2H, CH_{Ar}), 7.77 (s, 1H, =CH), 7.66-7.60 (m, 2H, CH_{Ar}), 7.45-7.37 (m, 1H, CH_{Ar}), 7.06-6.98 (m, 2H, CH_{Ar}), 5.96-5.78 (m, 1H, =CH_{allyl}), 5.22-5.13 (m, 2H, =CH₂), 4.38 (d, *J* = 5.0 Hz, 2H, N-CH₂) ppm; ¹³C NMR (50 MHz, DMSO-d₆) δ 190.4, 166.6, 145.1, 138.1, 136.0, 135.6, 133.0, 131.8, 130.6, 127.2, 126.6, 126.5, 126.2, 122.5, 121.4, 119.4, 117.2, 109.9, 41.9 ppm; ESI-MS (*m/z*): [M+H]⁺ = 305; Calcd. for C₁₉H₁₆N₂O₂: C 74.98; H 5.30; N 9.20; Found: C 74.82; H 5.15; N 9.28.

1-allyl-3-(2-(3-nitrophenyl)-2-oxoethylidene)indolin-2-one 4e

Brown solid; Yield: 81 % (2,10 g); Mp = 130 °C; IR ν 3428, 1711, 1657, 1609, 1530, 1467, 1346 cm⁻¹; ¹H NMR (200 MHz, DMSO-d₆) δ 8.73-8.71 (m, 1H, CH_{Ar}), 8.51-8.48 (m, 2H, CH_{Ar}), 8.16 (d, *J* = 7.4 Hz, 1H, CH_{Ar}), 7.92-7.82 (m, 2H, =CH + CH_{Ar}), 7.48-7.39 (m, 1H, CH_{Ar}), 7.08-6.99 (m, 2H, CH_{Ar}), 6.04-5.79 (m, 1H, =CH_{allyl}), 5.24-5.15 (m, 2H, =CH₂), 4.40-4.38 (m, 2H, N-CH₂) ppm; ¹³C NMR (50 MHz, DMSO-d₆) δ 189.2, 166.5, 148.2, 145.4, 138.2, 136.5, 134.8, 133.4, 131.7, 131.0, 128.1,

127.0, 125.4, 122.9, 122.5, 119.3, 117.2, 109.8, 41.9 ppm; ESI-MS (m/z): $[M+H]^+ = 335$; Calcd. for $C_{19}H_{14}N_2O_4$: C 68.26; H 4.22; N 8.38; Found: C 68.10; H 4.20; N 8.25.

1-allyl-3-(2-(3-methoxyphenyl)-2-oxoethylidene)indolin-2-one 4f

Orange amorphous solid; Yield: 64 % (1,31 g); Mp = 80 °C; IR ν 3434, 1715, 1657, 1620, 1591, 1462, 1354, 1262 cm^{-1} ; 1H NMR (200 MHz, DMSO- d_6) δ 8.03 (d, $J = 7.3$ Hz, 1H, CH_{Ar}), 7.78 (s, 1H, =CH), 7.69-7.63 (m, 1H, CH_{Ar}), 7.54-7.26 (m, 4H, CH_{Ar}), 7.05-6.97 (m, 2H, CH_{Ar}), 6.02-5.76 (m, 1H, = CH_{allyl}), 5.23-5.14 (m, 2H, = CH_2), 4.37 (d, $J = 5.0$ Hz, 2H, N- CH_2), 3.84 (s, 3H, OCH_3) ppm; ^{13}C NMR (50 MHz, DMSO- d_6) δ 191.0, 166.6, 159.7, 145.0, 138.3, 135.1, 132.8, 131.8, 130.4, 127.1, 126.4, 122.4, 121.5, 120.4, 119.4, 117.2, 112.6, 109.8, 55.6, 41.9 ppm; ESI-MS (m/z): $[M+H]^+ = 320$; Calcd. for $C_{20}H_{17}NO_3$: C 75.22; H 5.37; N 4.39; Found: C 75.12; H 5.26; N 4.45.

1-allyl-3-(2-oxo-2-(pyridin-2-yl)ethylidene)indolin-2-one 4g

Dark red crystals; Yield: 27 % (0,60 g); Mp = 118-120 °C; IR ν 3434, 1704, 1668, 1619, 1597, 1466, 1363, 1226 cm^{-1} ; 1H NMR (200 MHz, DMSO- d_6) δ 8.82-8.87 (m, 1H, CH_{Ar}), 8.55-8.51 (m, 1H, CH_{Ar}), 8.45 (s, 1H, =CH), 8.14-8.07 (m, 2H, CH_{Ar}), 7.74-7.72 (m, 1H, CH_{Ar}), 7.43-7.39 (m, 1H, CH_{Ar}), 7.06-6.96 (m, 2H, CH_{Ar}), 5.96-5.77 (m, 1H, = CH_{allyl}), 5.22-5.13 (m, 2H, = CH_2), 4.38-4.35 (m, 2H, N- CH_2) ppm; ^{13}C NMR (50 MHz, DMSO- d_6) δ 190.0, 166.9, 153.4, 149.3, 145.5, 138.0, 136.5, 133.4, 131.8, 128.2, 127.6, 124.9, 122.6, 122.5, 119.7, 117.1, 109.7, 41.9 ppm; ESI-MS (m/z): $[M+H]^+ = 291$; Calcd. for $C_{18}H_{14}N_2O_2$: C 74.47; H 4.86; N 9.65; Found: C 74.28; H 4.71; N 9.70.

1-allyl-3-(2-oxo-2-(thiophen-2-yl)ethylidene)indolin-2-one 4h

Red solid; Yield: 27 % (0,64 g); Mp = 119-121 °C; IR ν 3428, 1709, 1643, 1613, 1464, 1413, 1352 cm^{-1} ; 1H NMR (200 MHz, DMSO- d_6) δ 8.33 (d, $J = 7.8$ Hz, 1H, CH_{Ar}), 8.18-8.13 (m, 2H, CH_{Ar}), 7.74 (s, 1H, =CH), 7.43 (td, $J = 7.8, 1.3$ Hz, 1H, CH_{Ar}), 7.32 (dd, $J = 4.9, 3.9$ Hz, 1H, CH_{Ar}), 7.09-6.98 (m, 2H, CH_{Ar}), 5.97-5.78 (m, 1H, = CH_{allyl}), 5.23-5.13 (m, 2H, = CH_2), 4.40-4.36 (m, 2H, N- CH_2) ppm; ^{13}C NMR (50 MHz, DMSO- d_6) δ 182.6, 166.6, 145.2, 144.9, 137.0, 135.8, 134.7, 133.1, 131.8, 129.4, 127.4, 125.5, 122.4, 119.5, 117.1, 109.7, 41.9 ppm; ESI-MS (m/z): $[M+H]^+ = 296$; Calcd. for $C_{17}H_{14}NO_2S$: C 68.90; H 4.65; N 4.73; Found: C 68.82; H 4.57; N 4.63.

2. NMR spectra

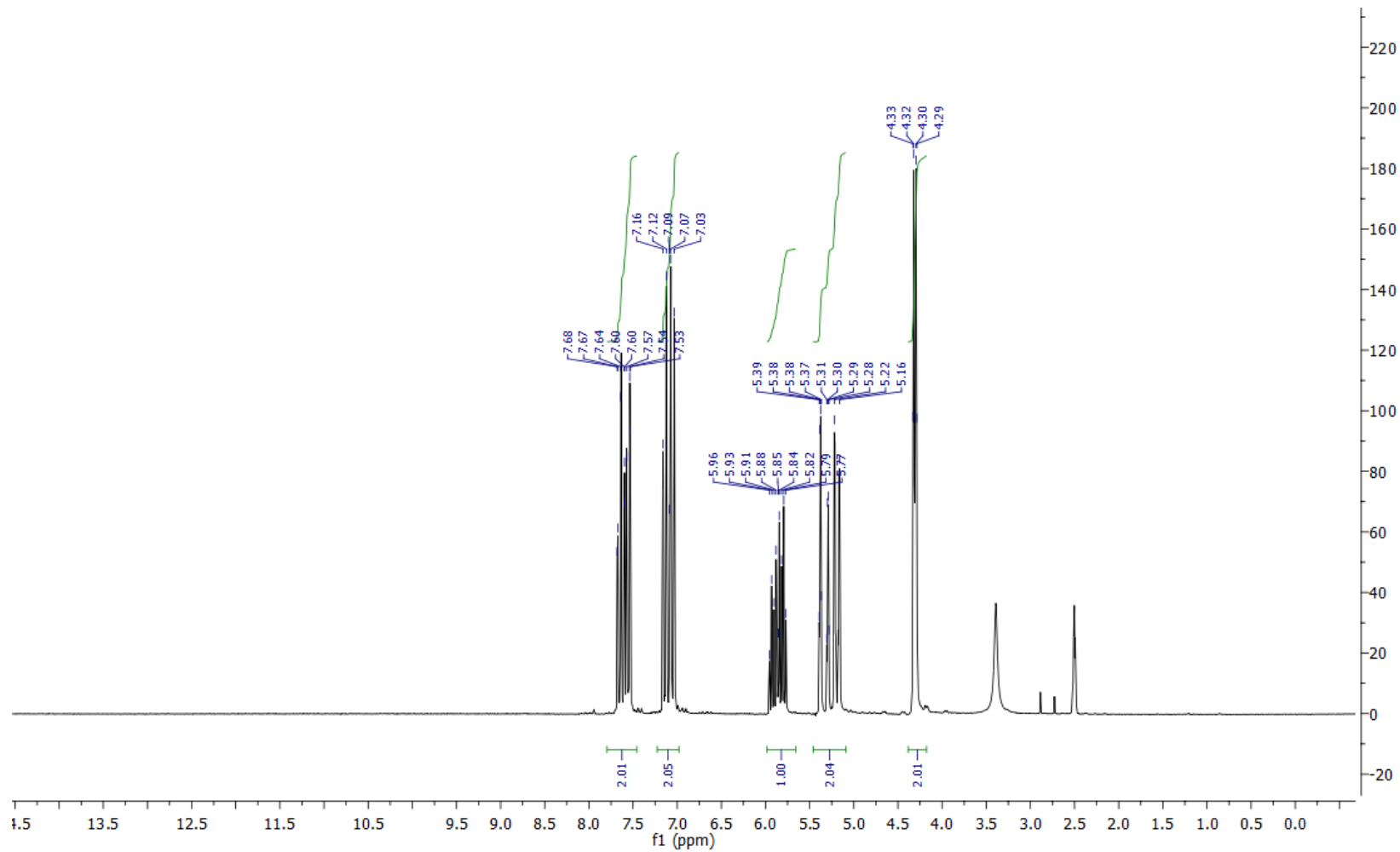


Figure S1. ^1H NMR spectrum of **1**

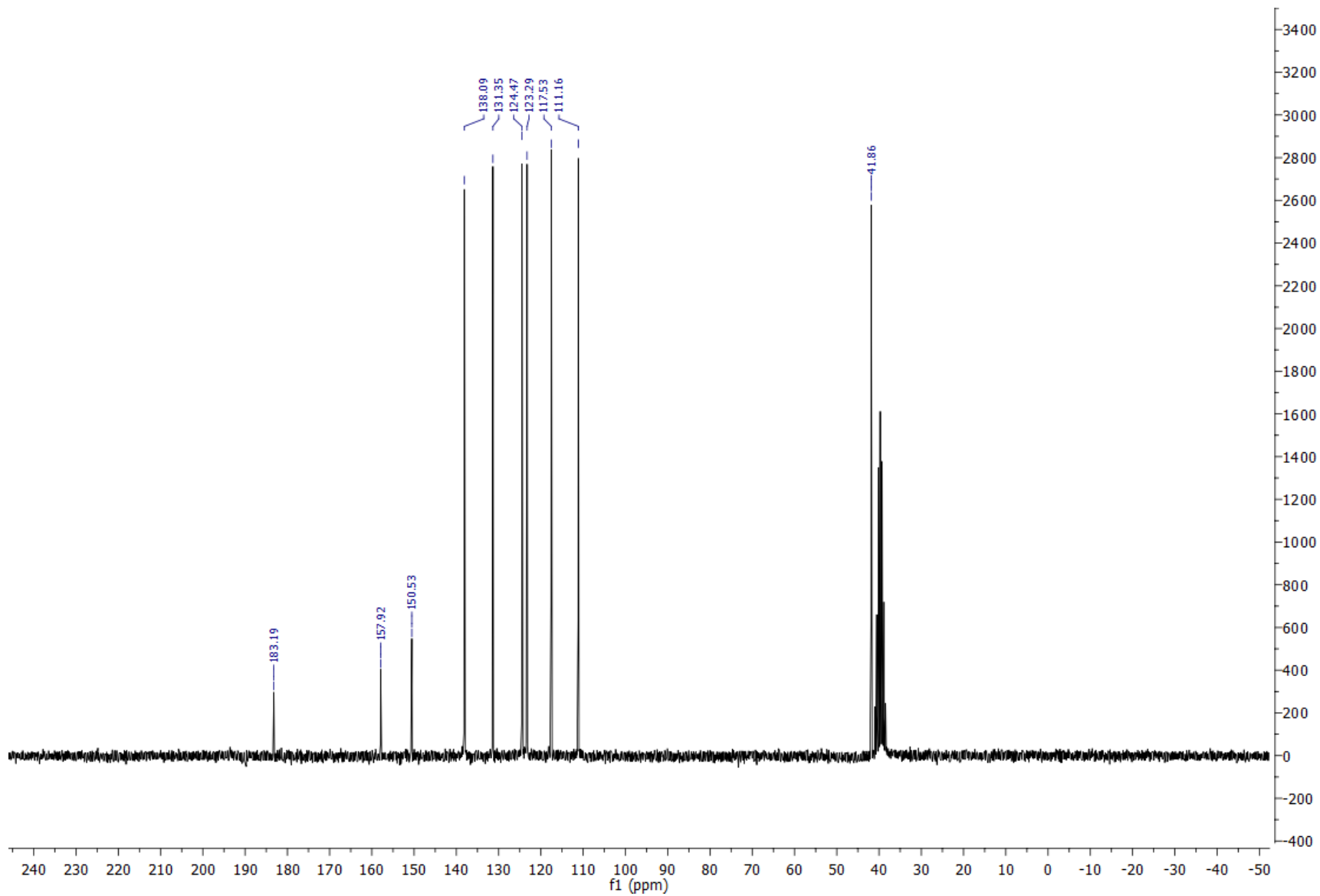


Figure S2. ^{13}C NMR spectrum of 1

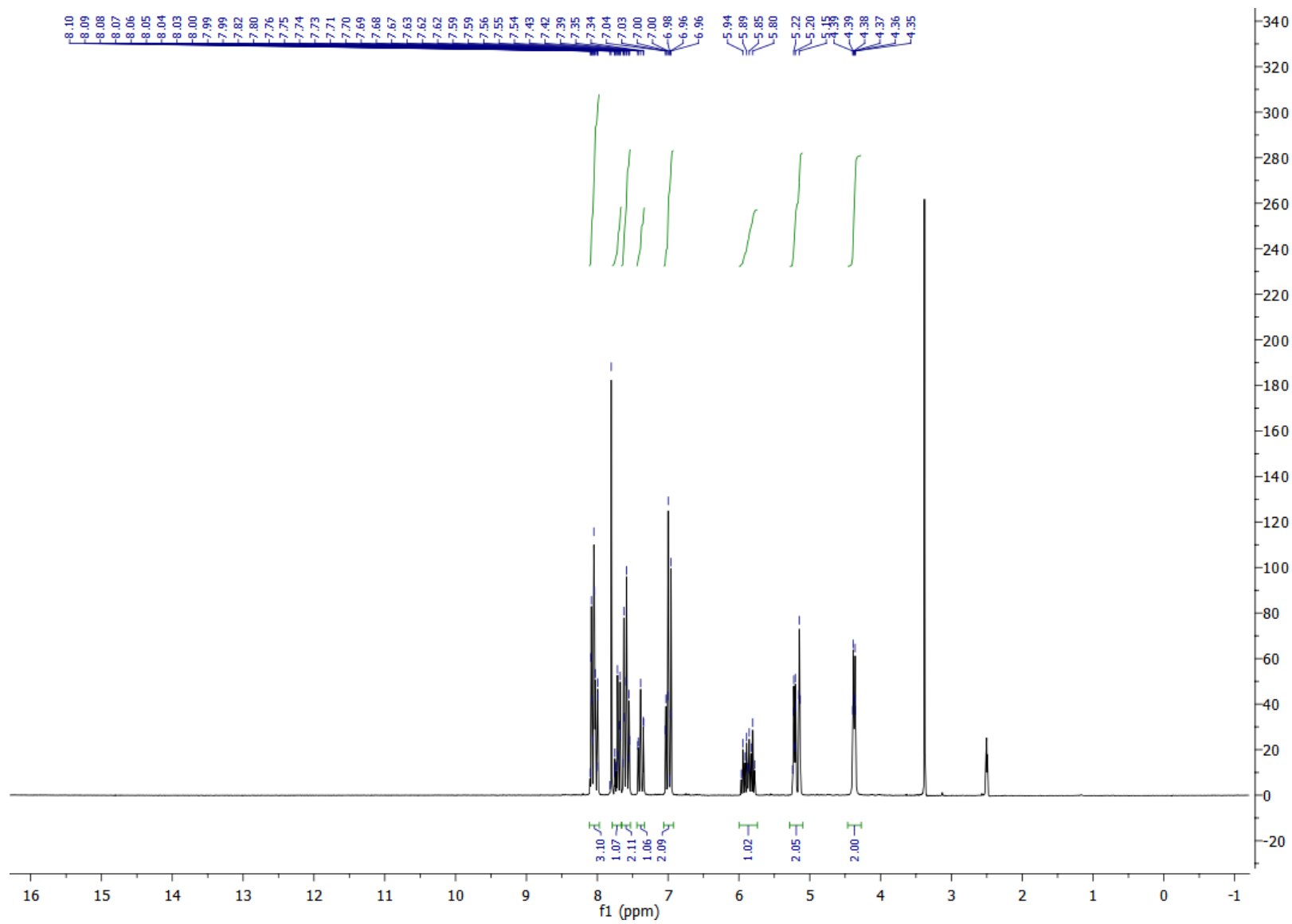


Figure S3. ¹H NMR spectrum of 4a

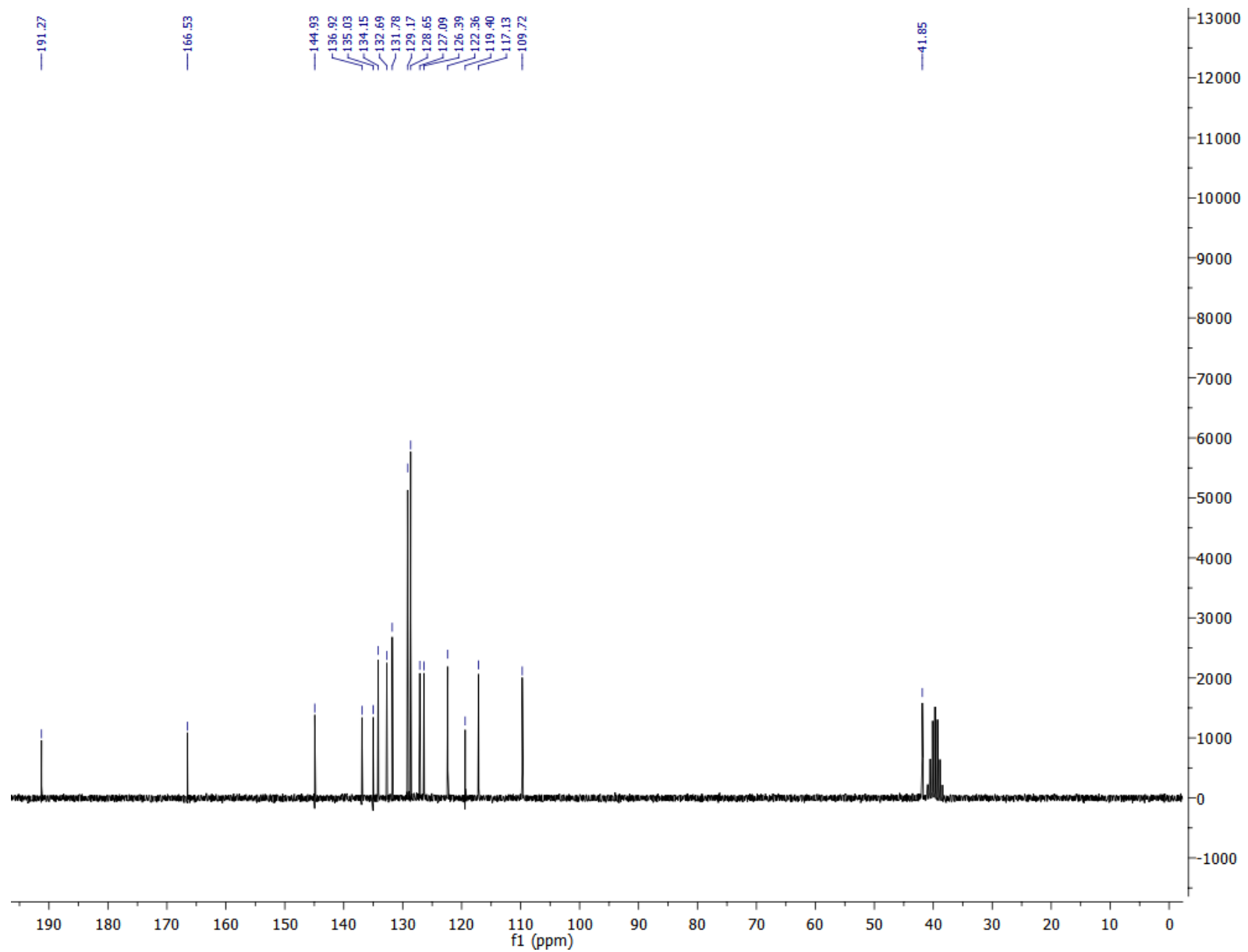


Figure S4. ^{13}C NMR spectrum of 4a

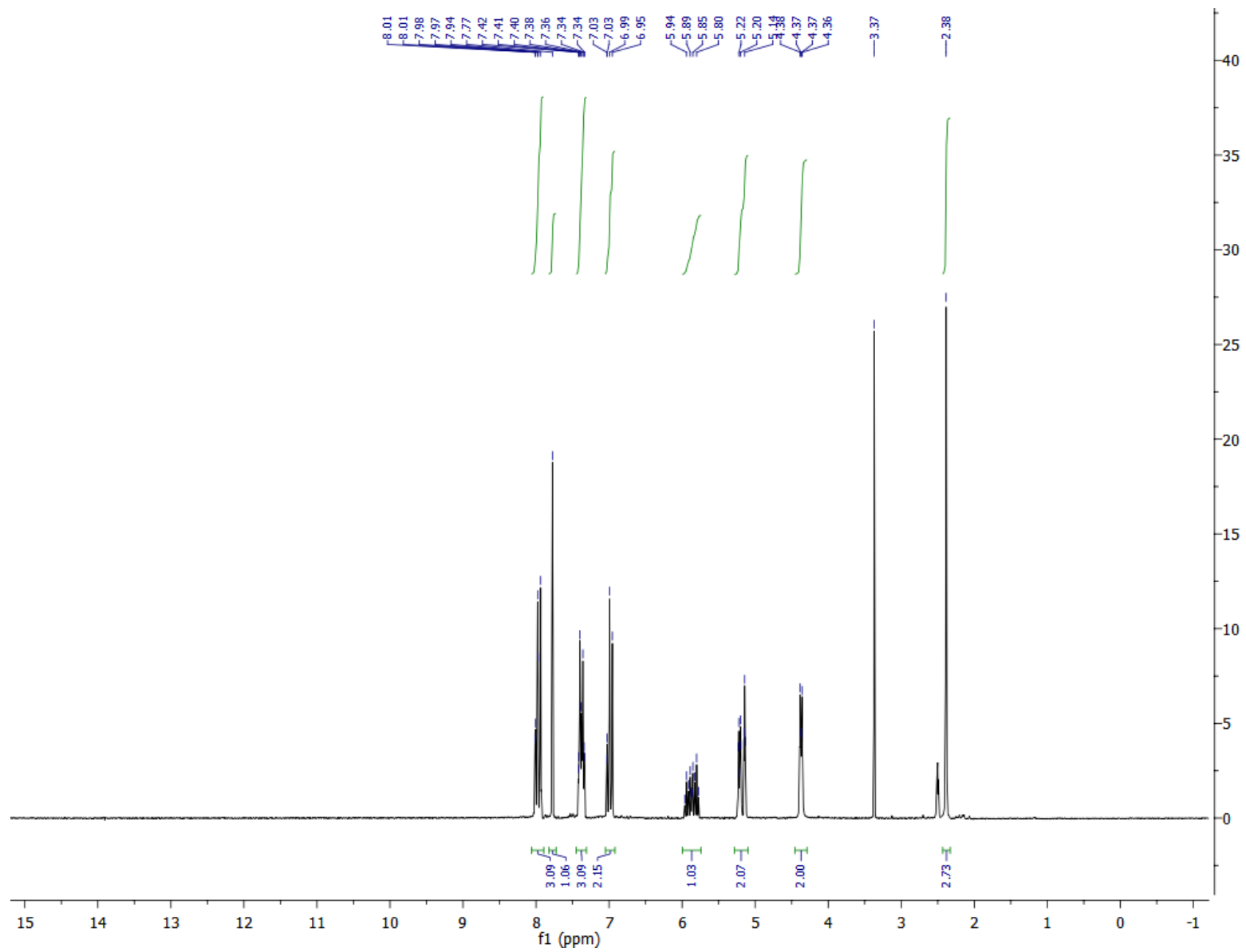


Figure S5. ^1H NMR spectrum of **4b**

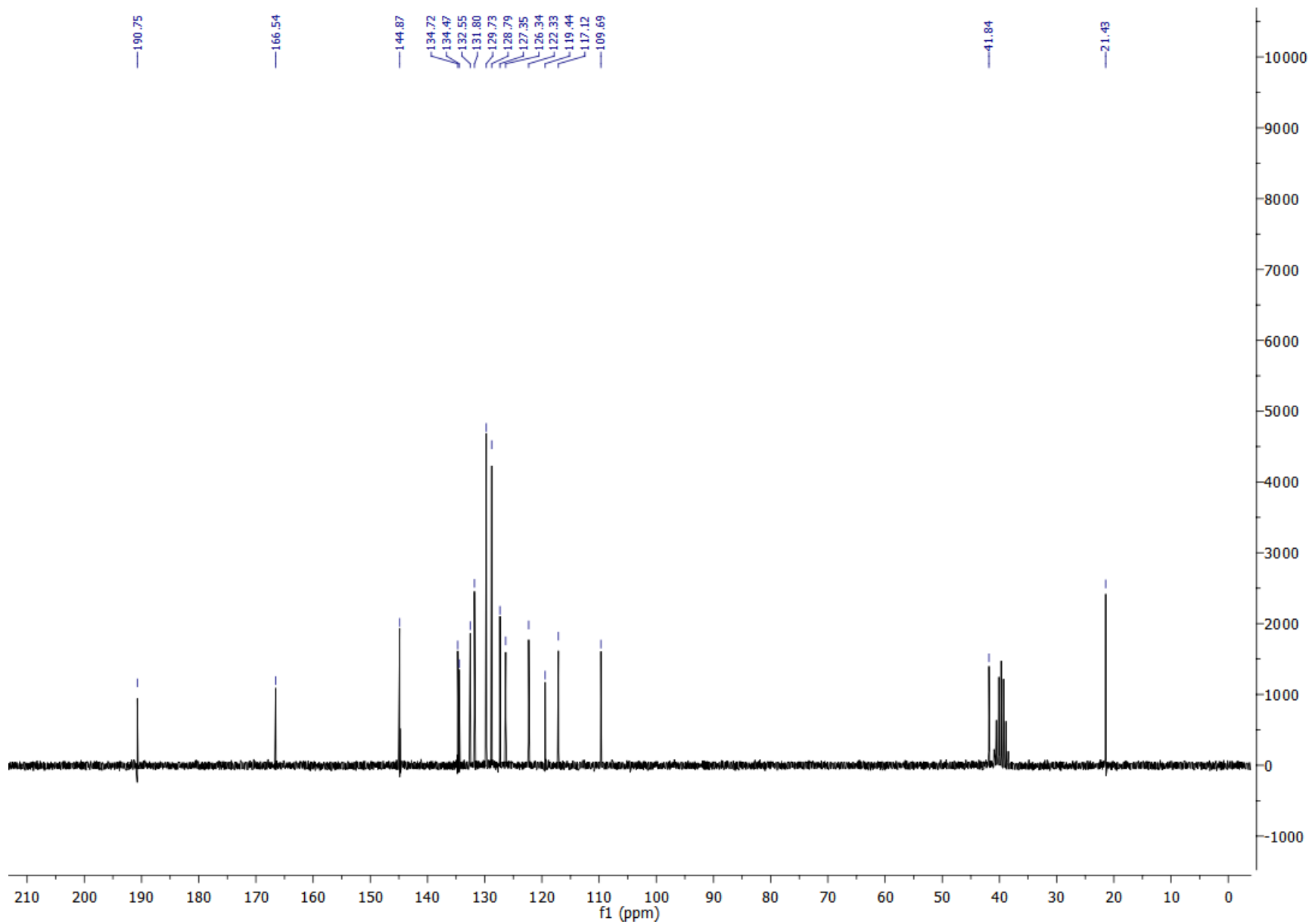


Figure S6. ^{13}C NMR spectrum of **4b**

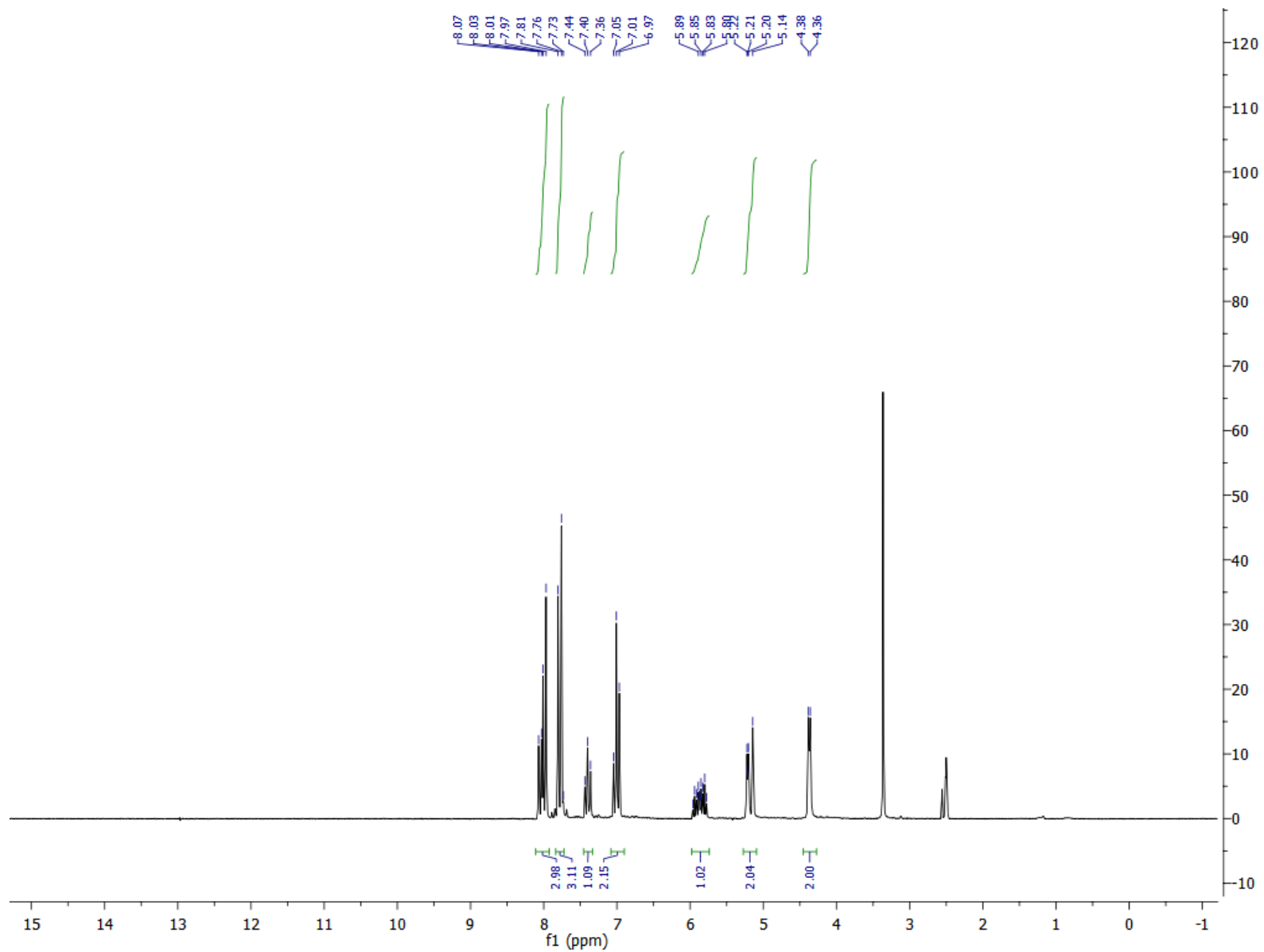


Figure S7. ^1H NMR spectrum of **4c** (10 mg dissolved in 600 μL $\text{DMSO-}d_6$)

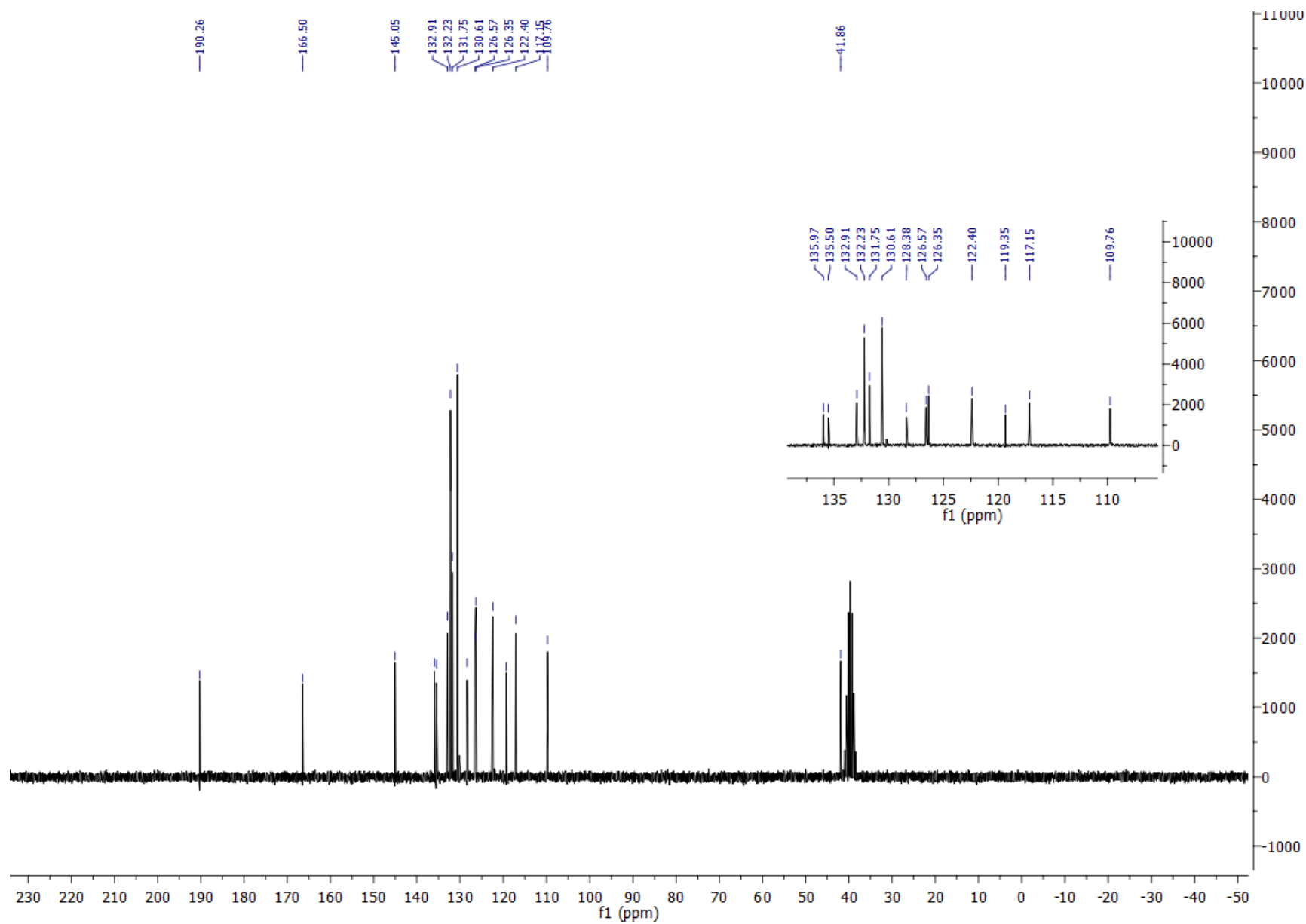


Figure S8. ^{13}C NMR spectrum of 4c

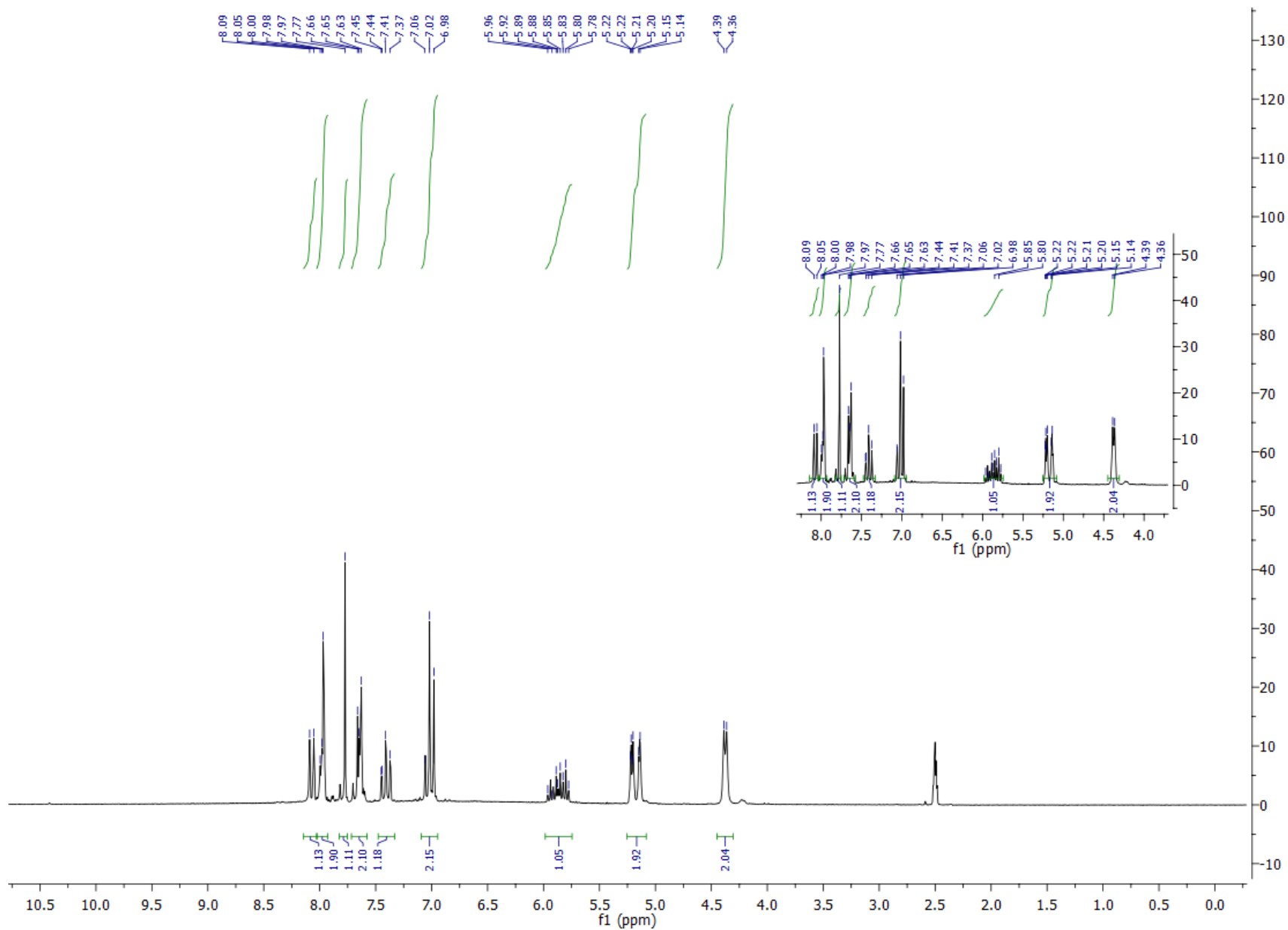


Figure S9. ^1H NMR spectrum of **4d**

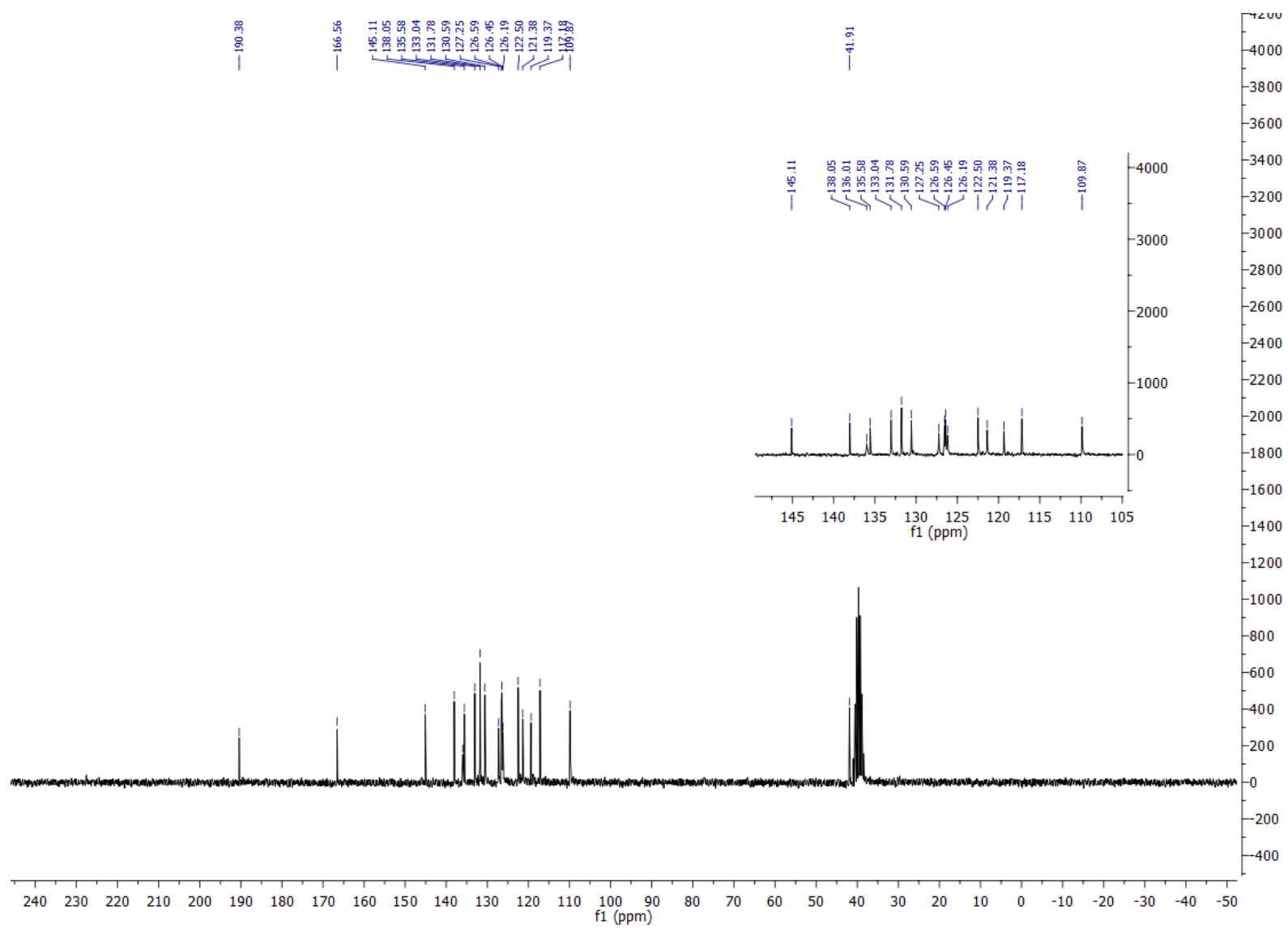


Figure S10. ^{13}C NMR spectrum of 4d

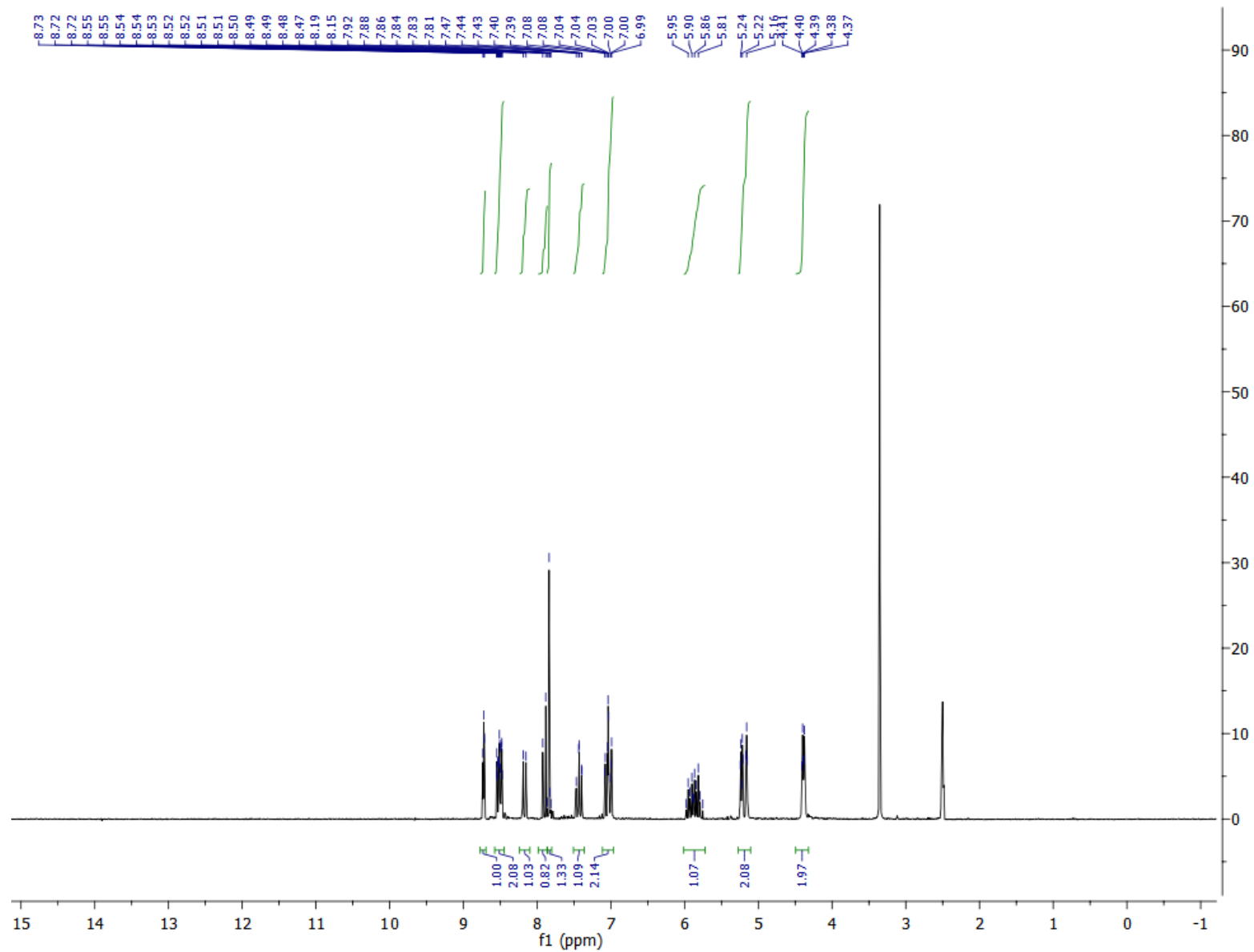


Figure S11. ^1H NMR spectrum of **4e** (10 mg of **4e** dissolved in 600 μL $\text{DMSO-}d_6$)

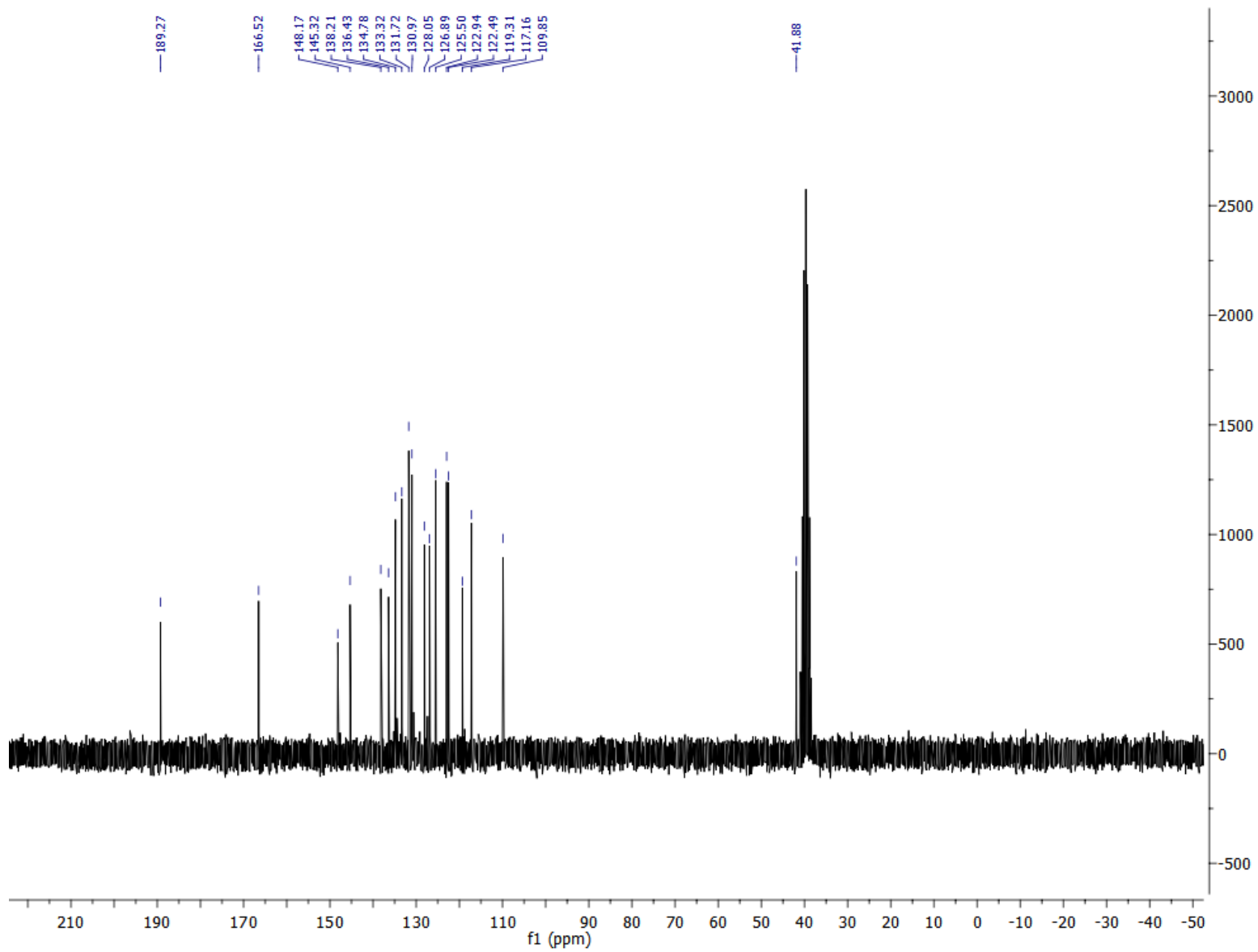


Figure S12. ^{13}C NMR spectrum of 4e

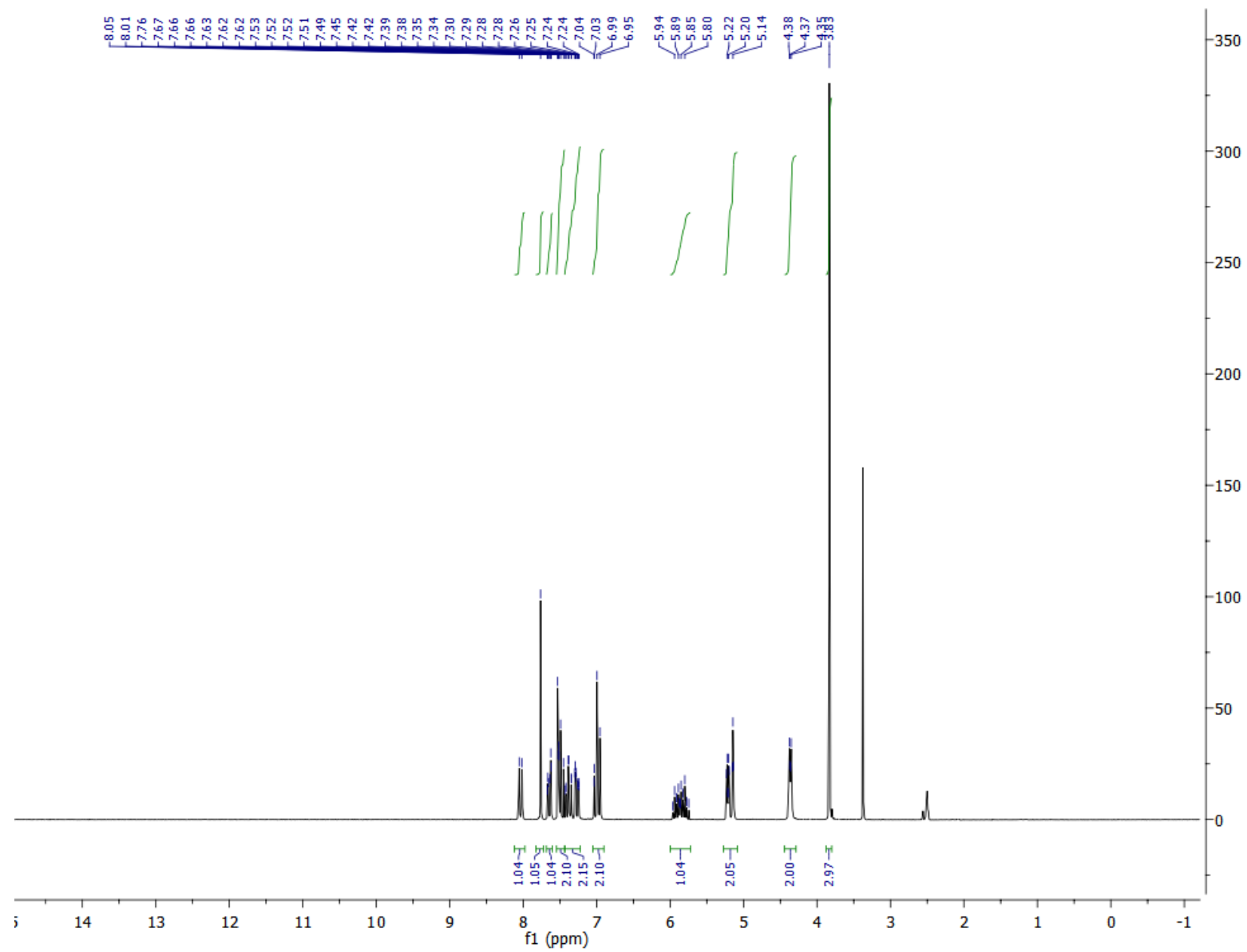


Figure S13. ¹H NMR spectrum of 4f

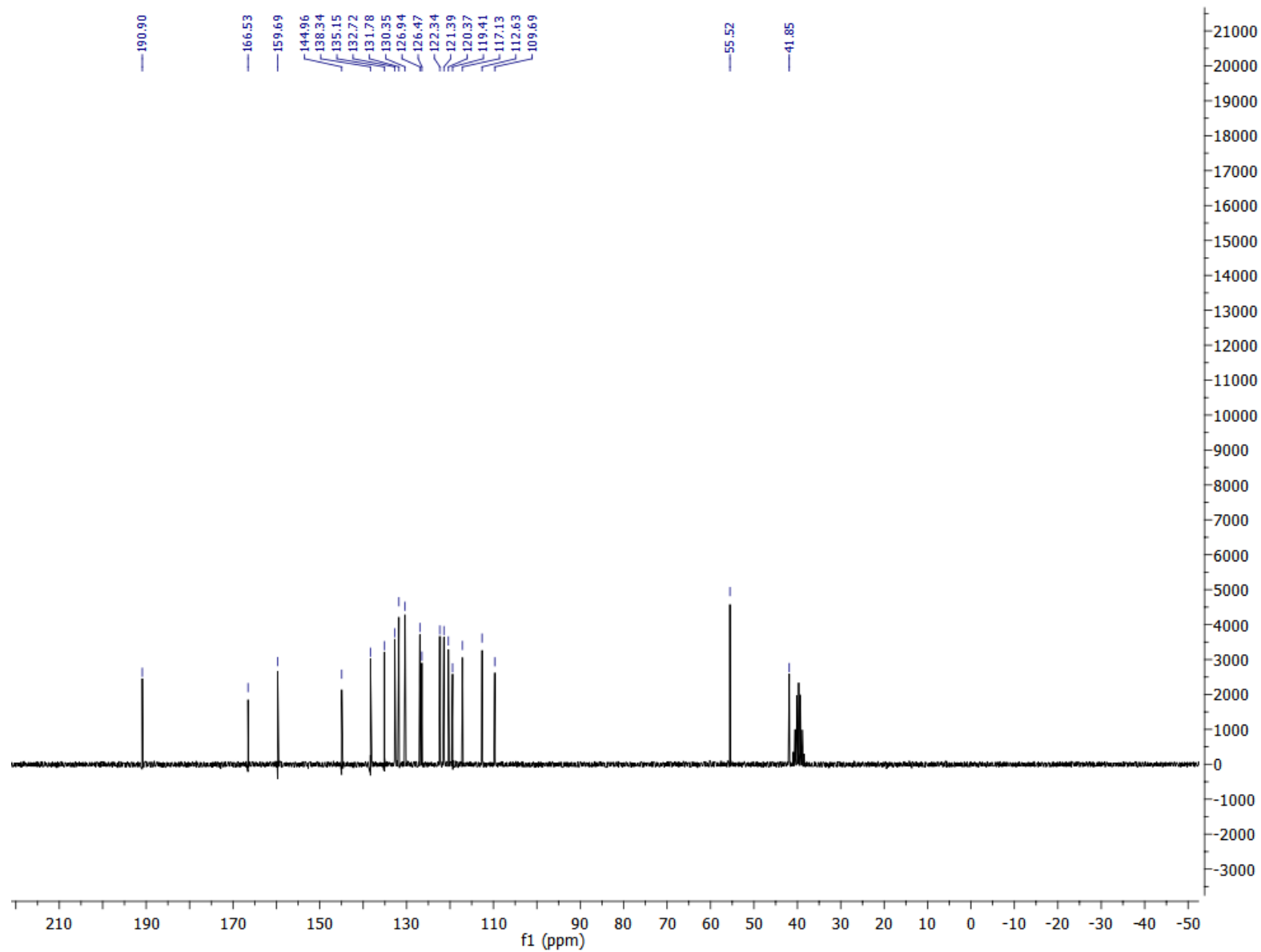


Figure S14. ^{13}C NMR spectrum of 4f

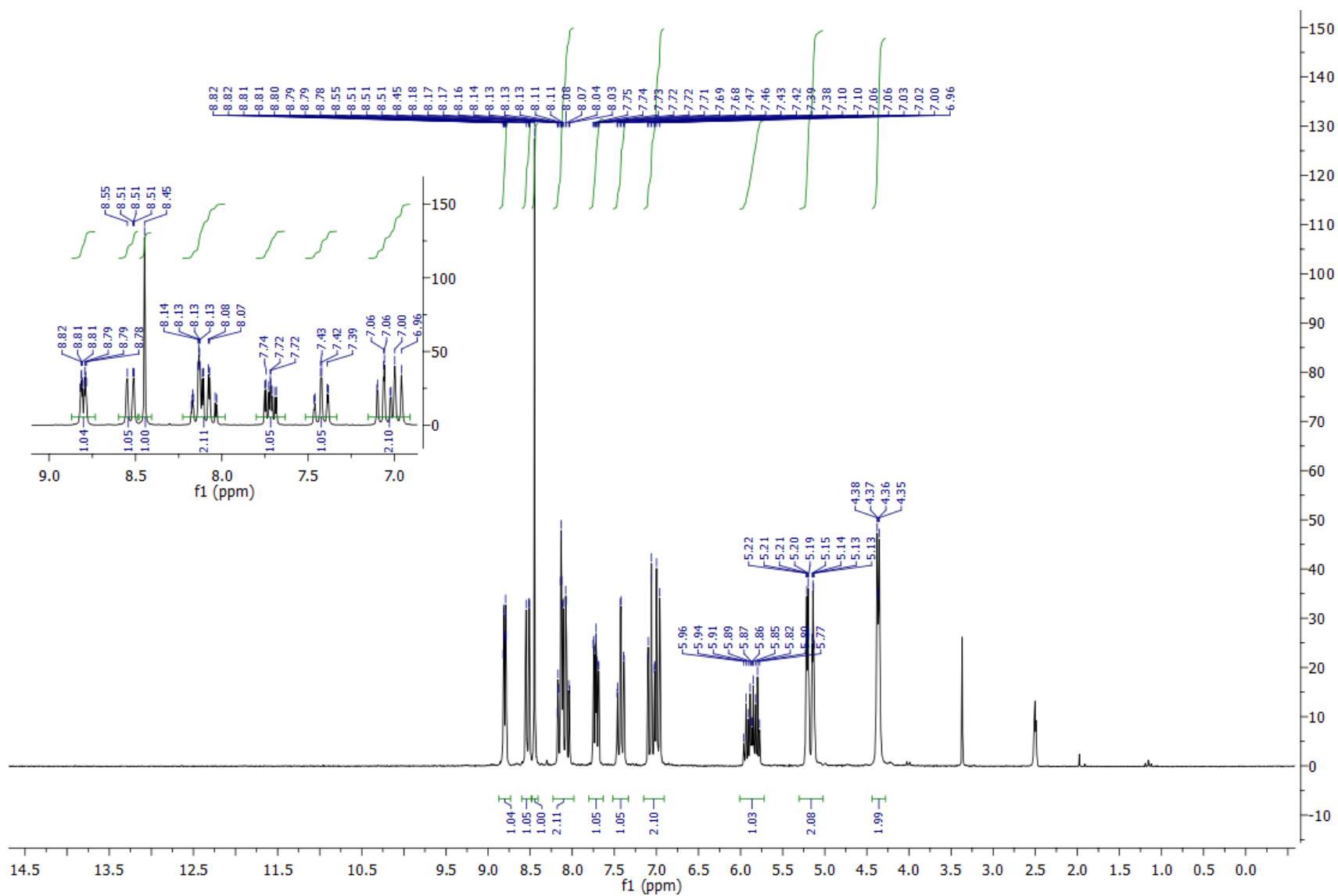


Figure S15. ¹H NMR spectrum of **4g**

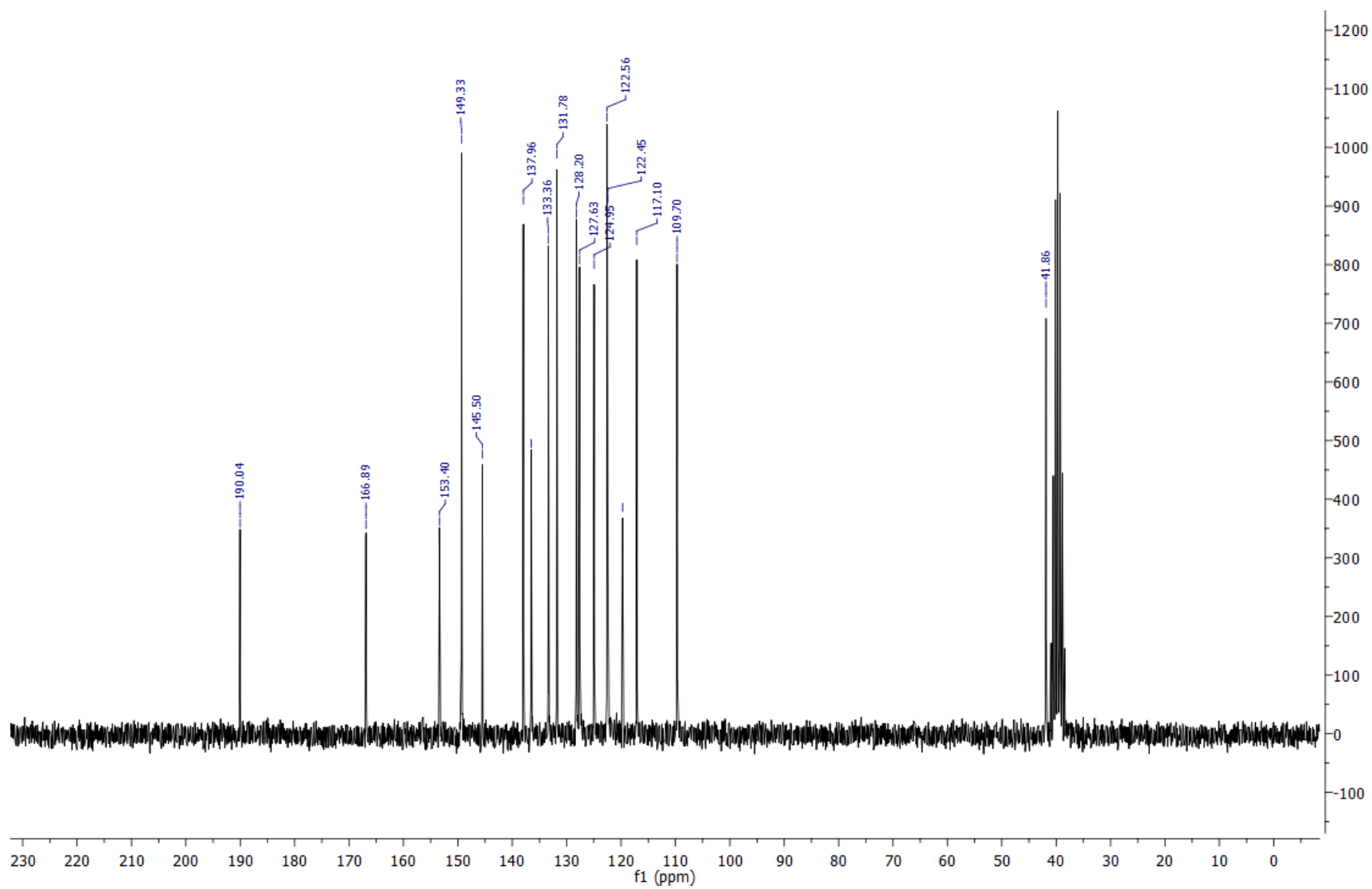


Figure S16. ^{13}C NMR spectrum of 4g

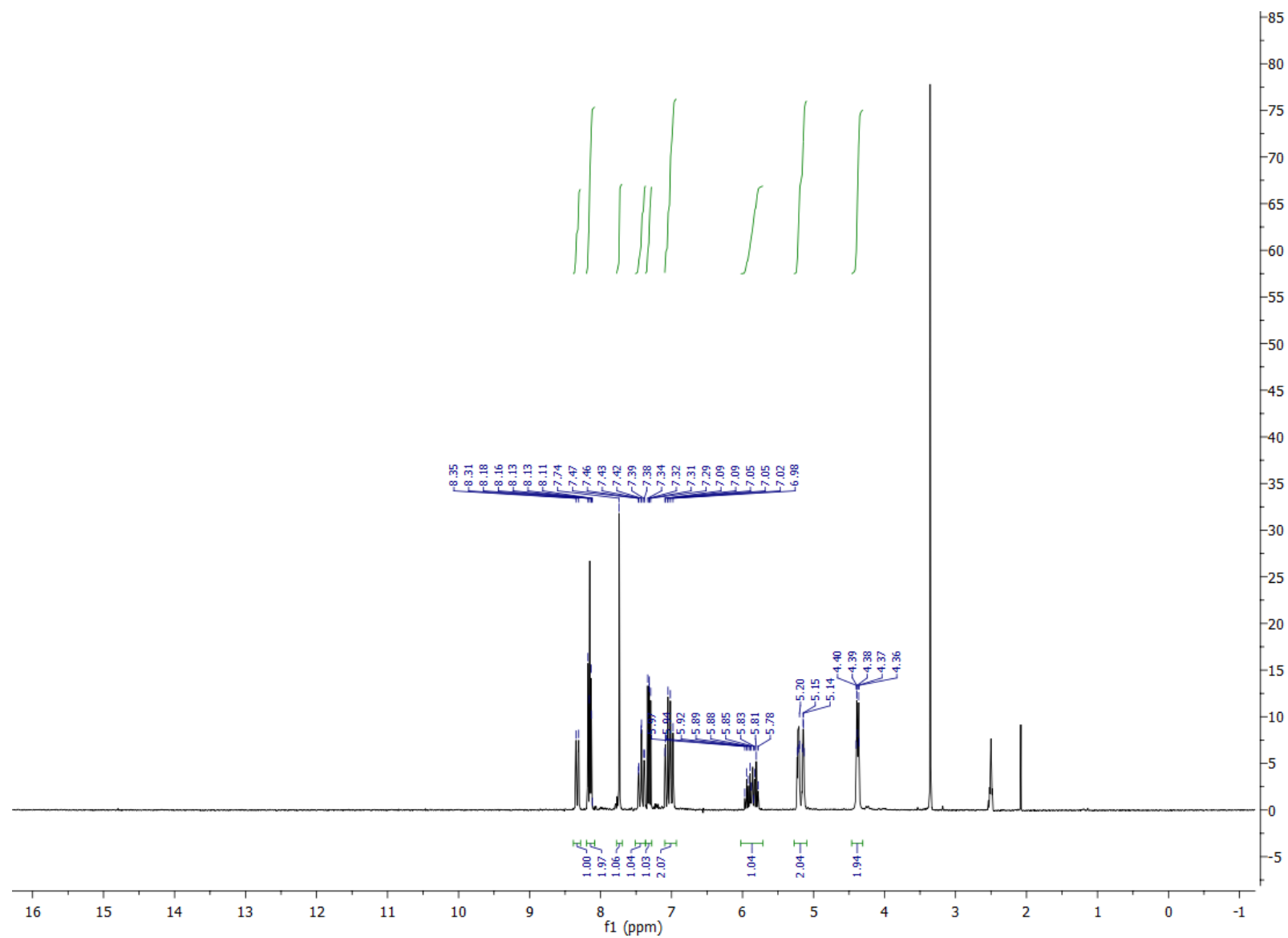


Figure S17. ^1H NMR spectrum of **4h** (residual solvent acetone at 2.10 ppm, reference J. Org. Chem, 1997, 62(21), 7513)

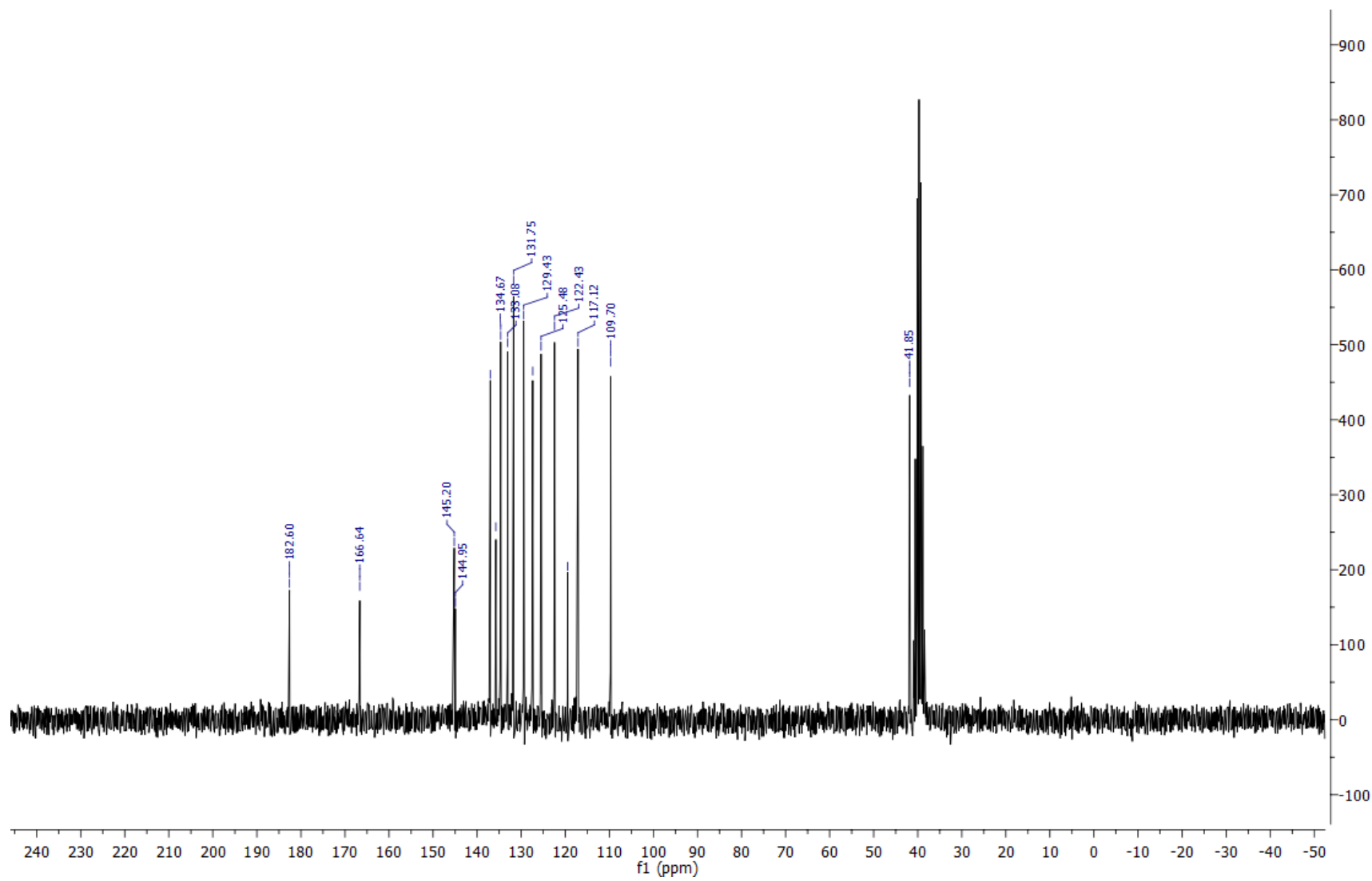


Figure S18. ^{13}C NMR spectrum of 4h

3. MS spectra of 4a-h

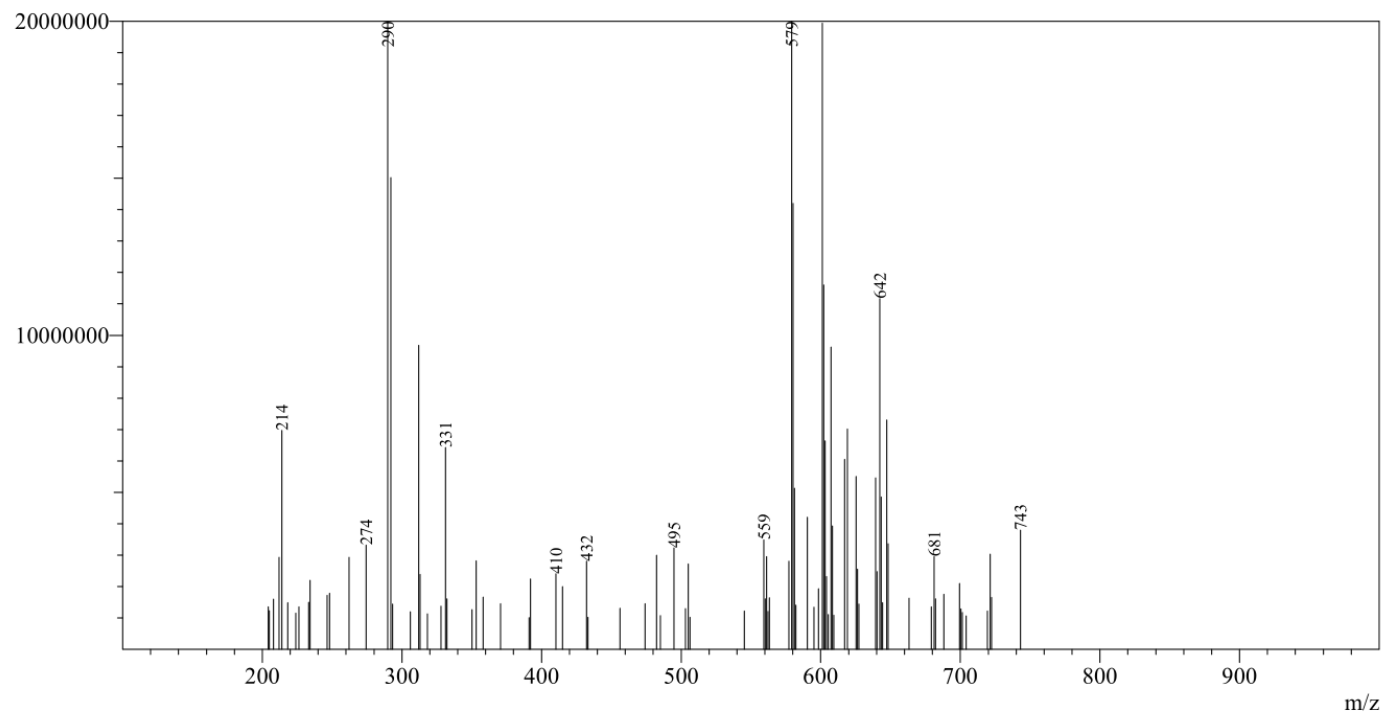


Figure S19. MS spectrum of 4a

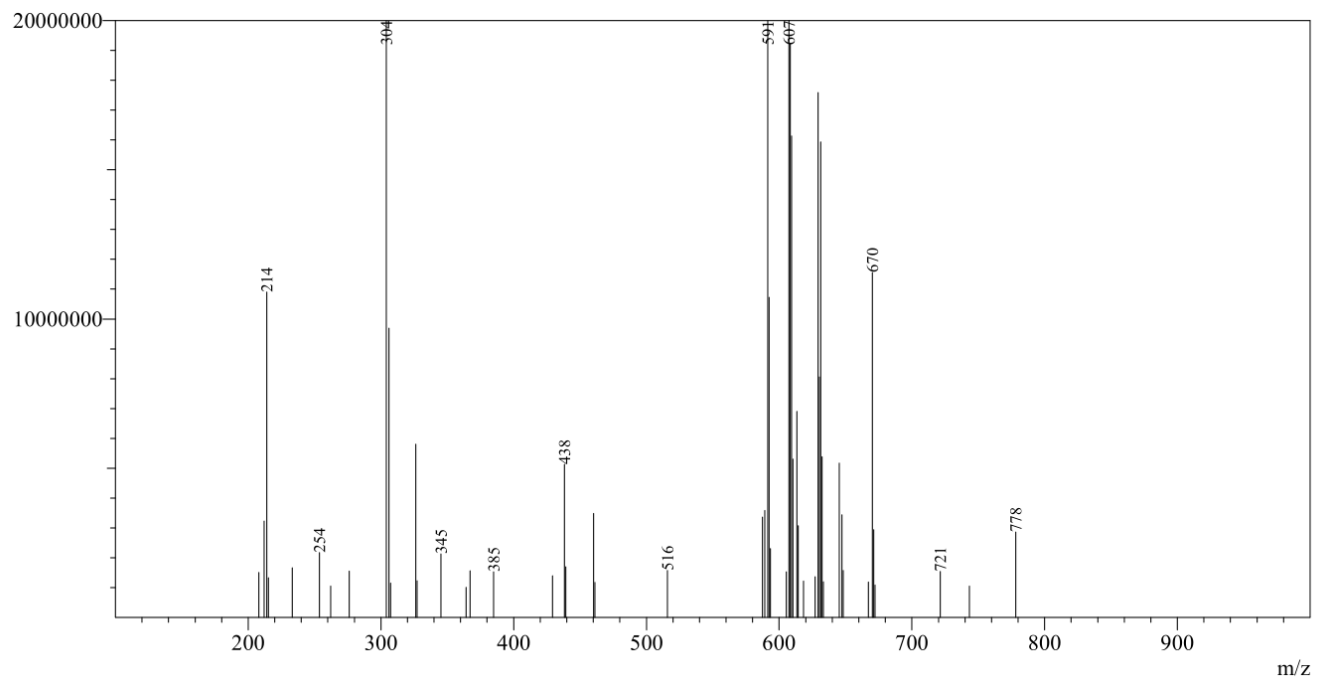


Figure S20. MS spectrum of **4b**

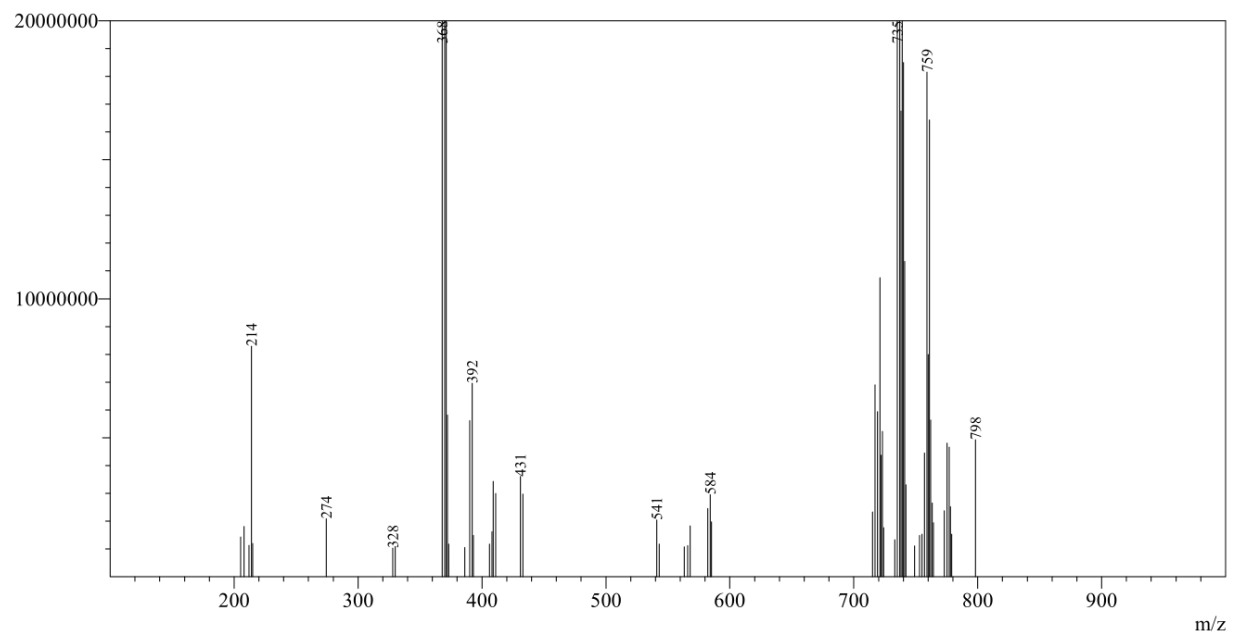


Figure S21. MS spectrum of **4c**

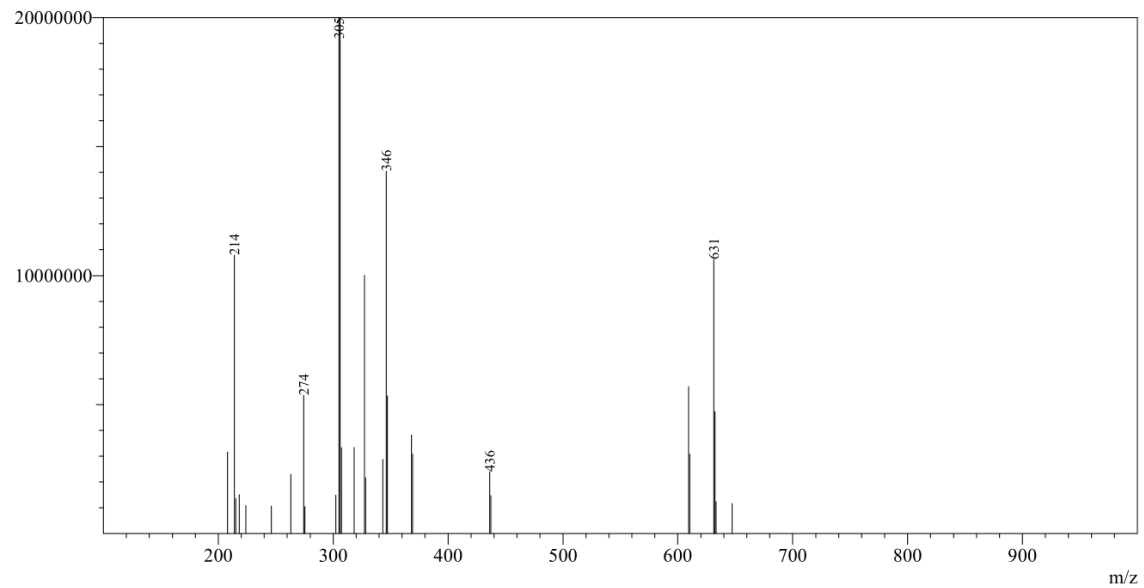


Figure S22. MS spectrum of 4d

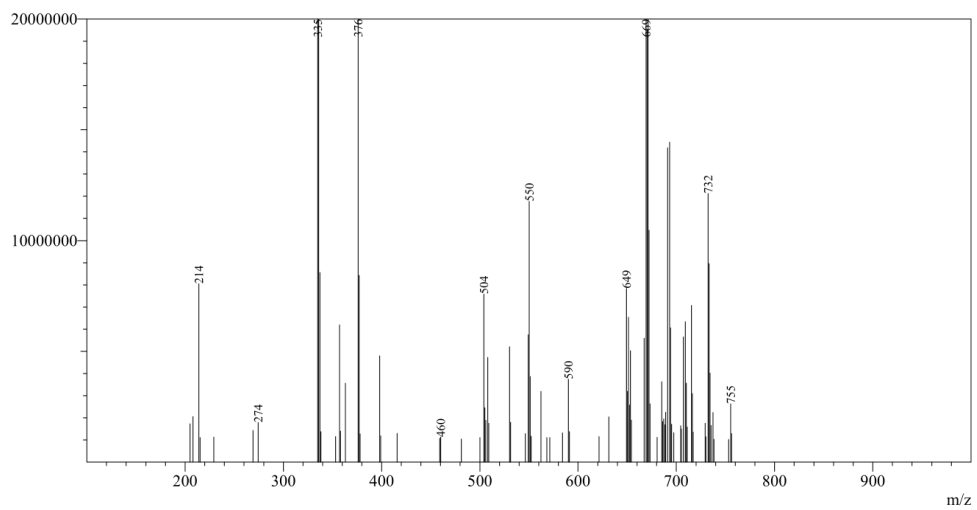


Figure S23. MS spectrum of 4e

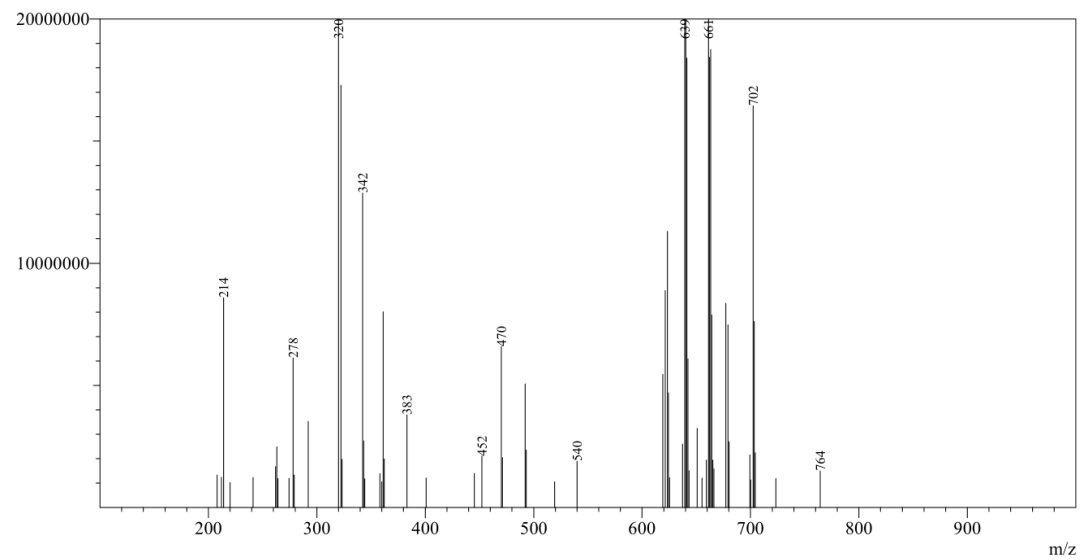


Figure S24. MS spectrum of 4f

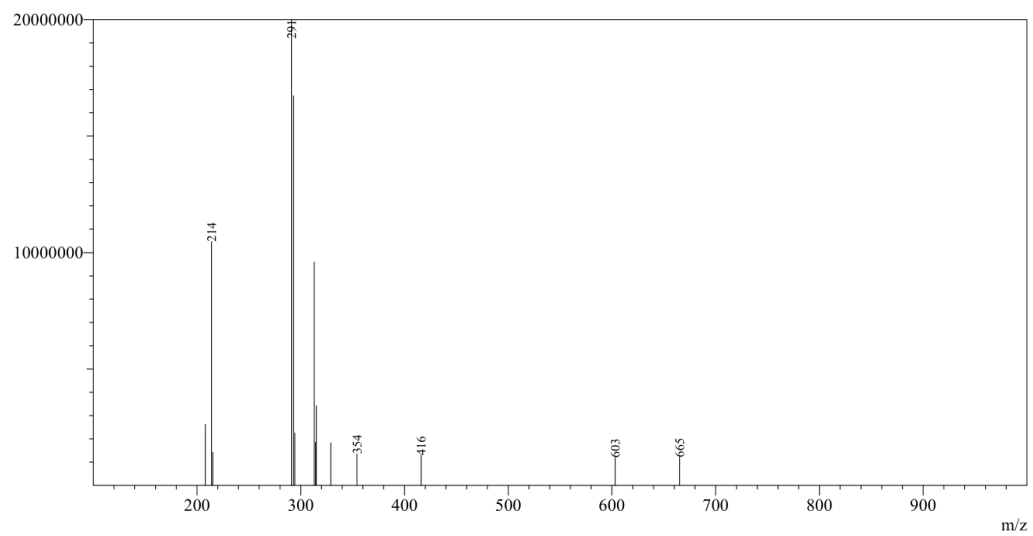


Figure S25. MS spectrum of 4g

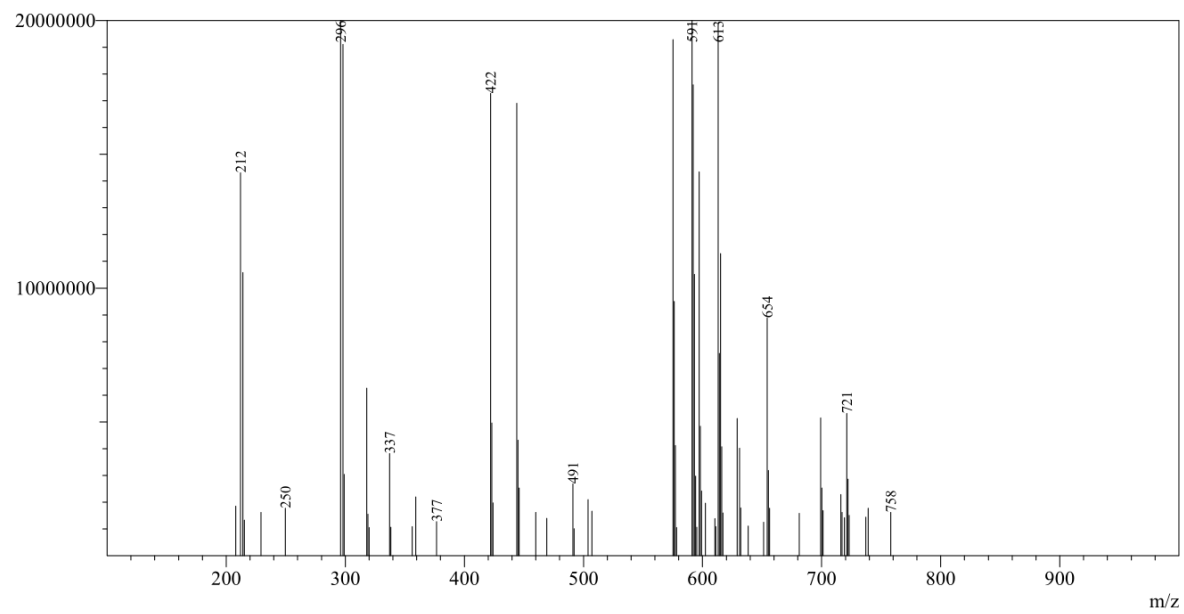


Figure S26. MS spectrum of 4h

4. IR spectra of 4a-h

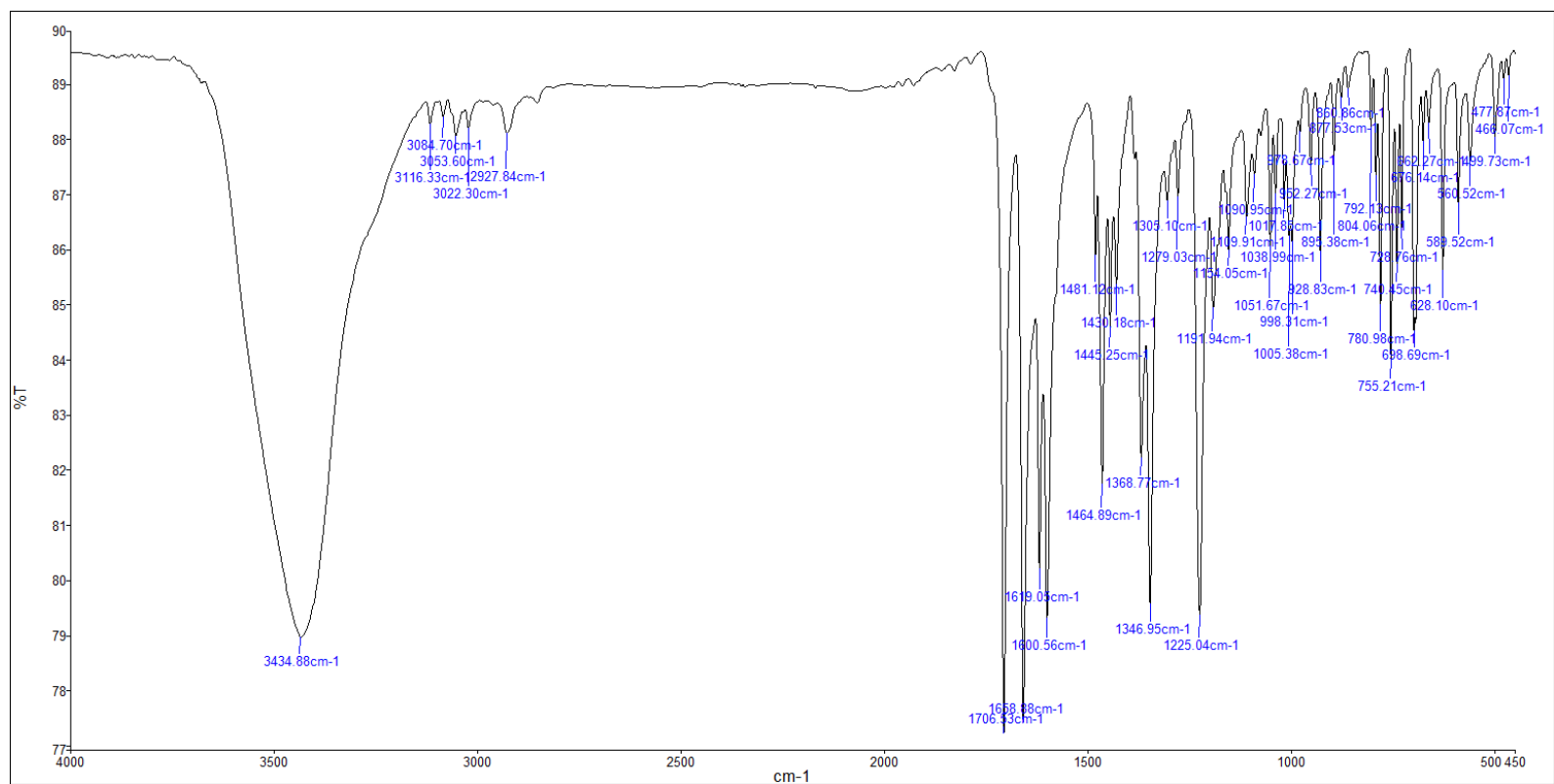


Figure S27. IR spectrum of 4a

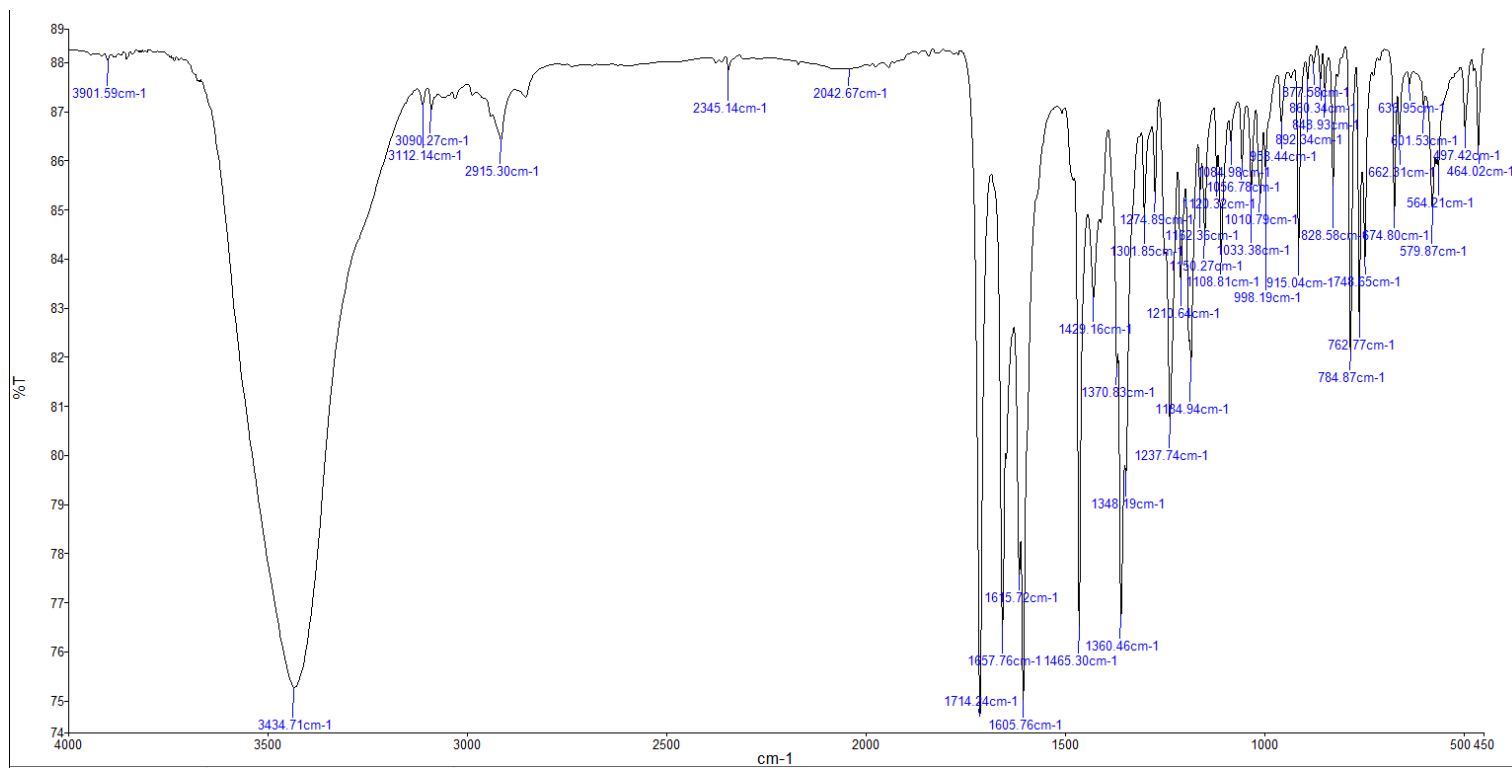


Figure S28. IR spectrum of 4b

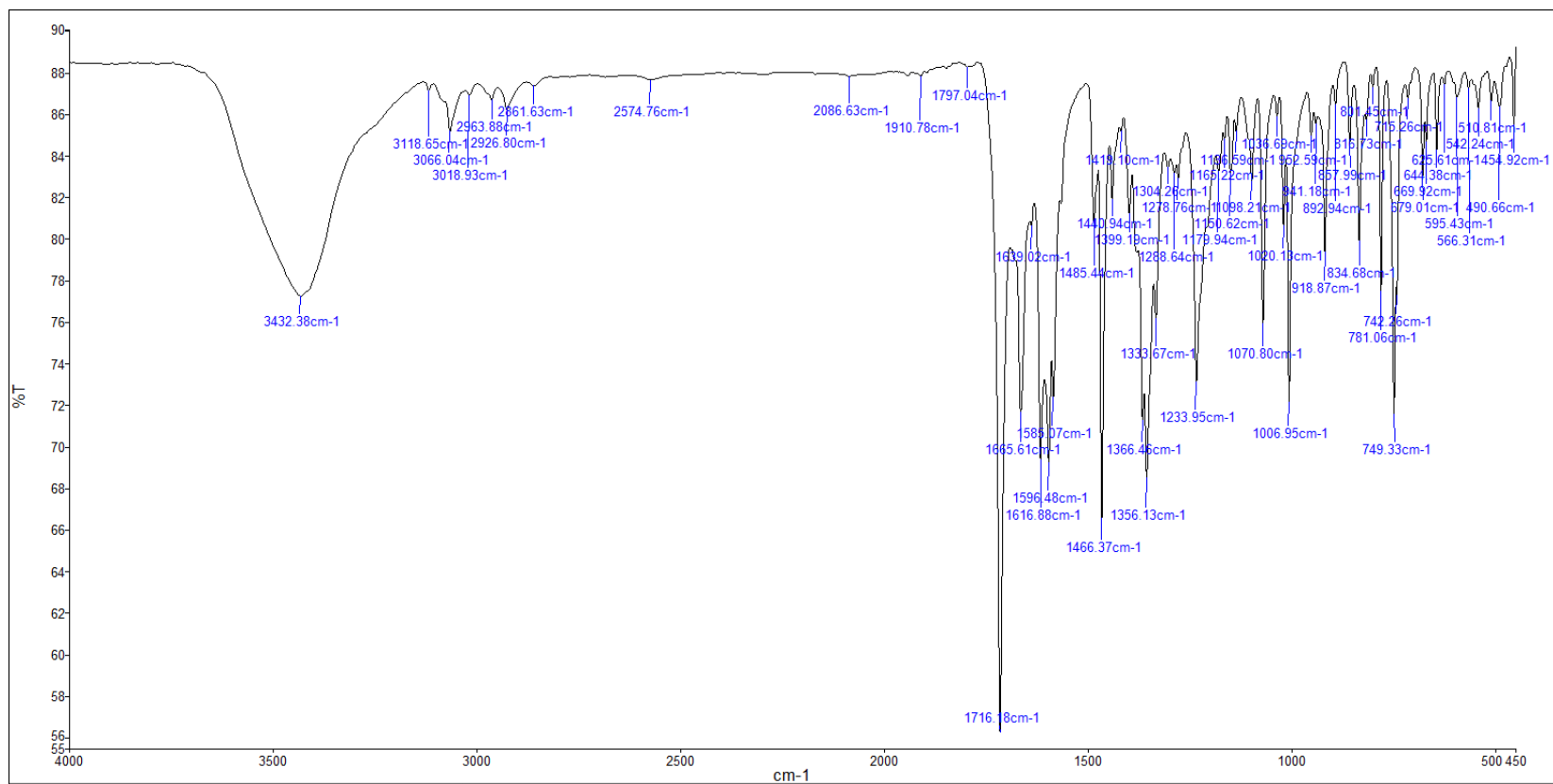


Figure S29. IR spectrum of 4c

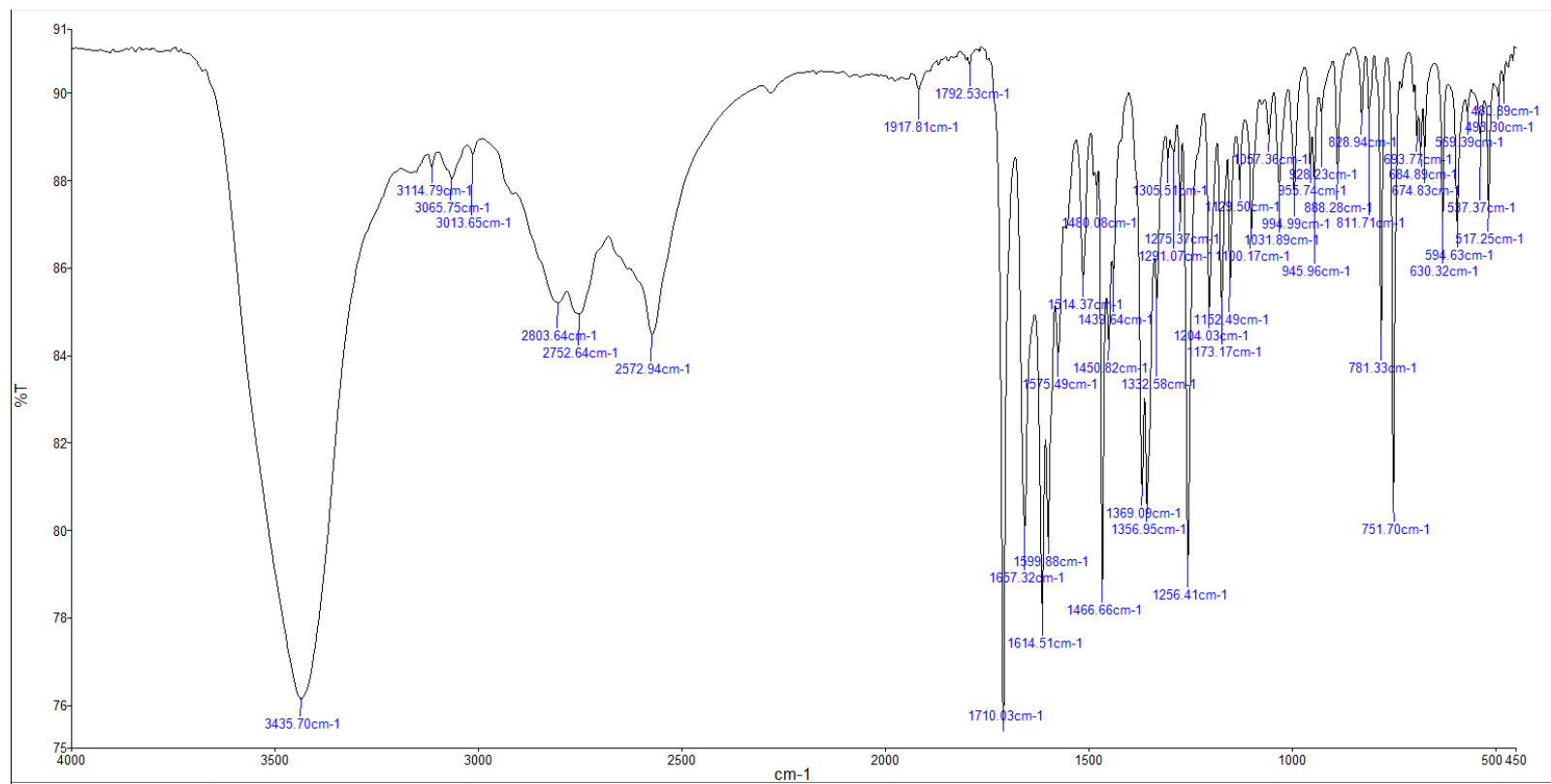


Figure S30. IR spectrum of 4d

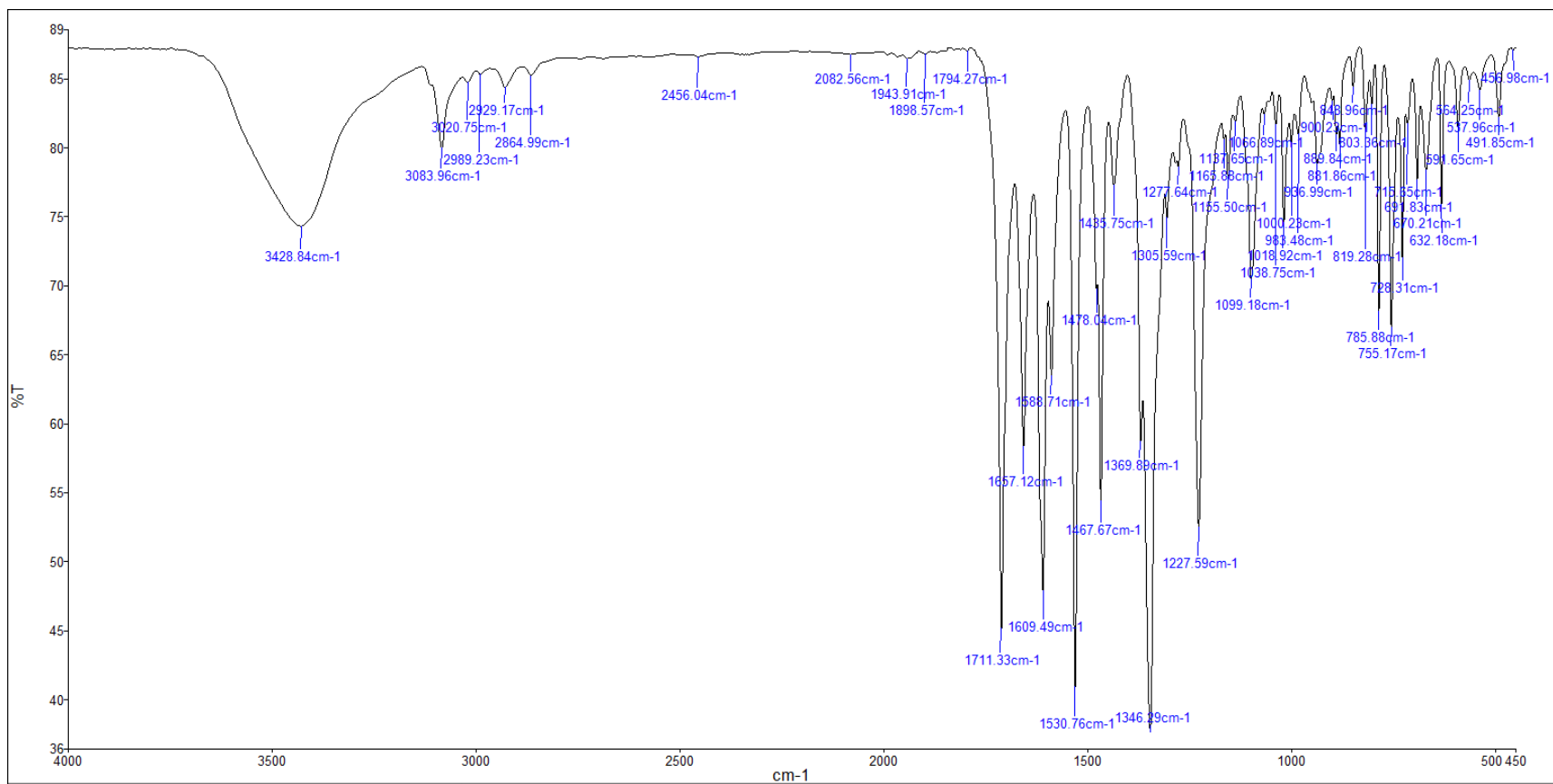


Figure S31. IR spectrum of 4e

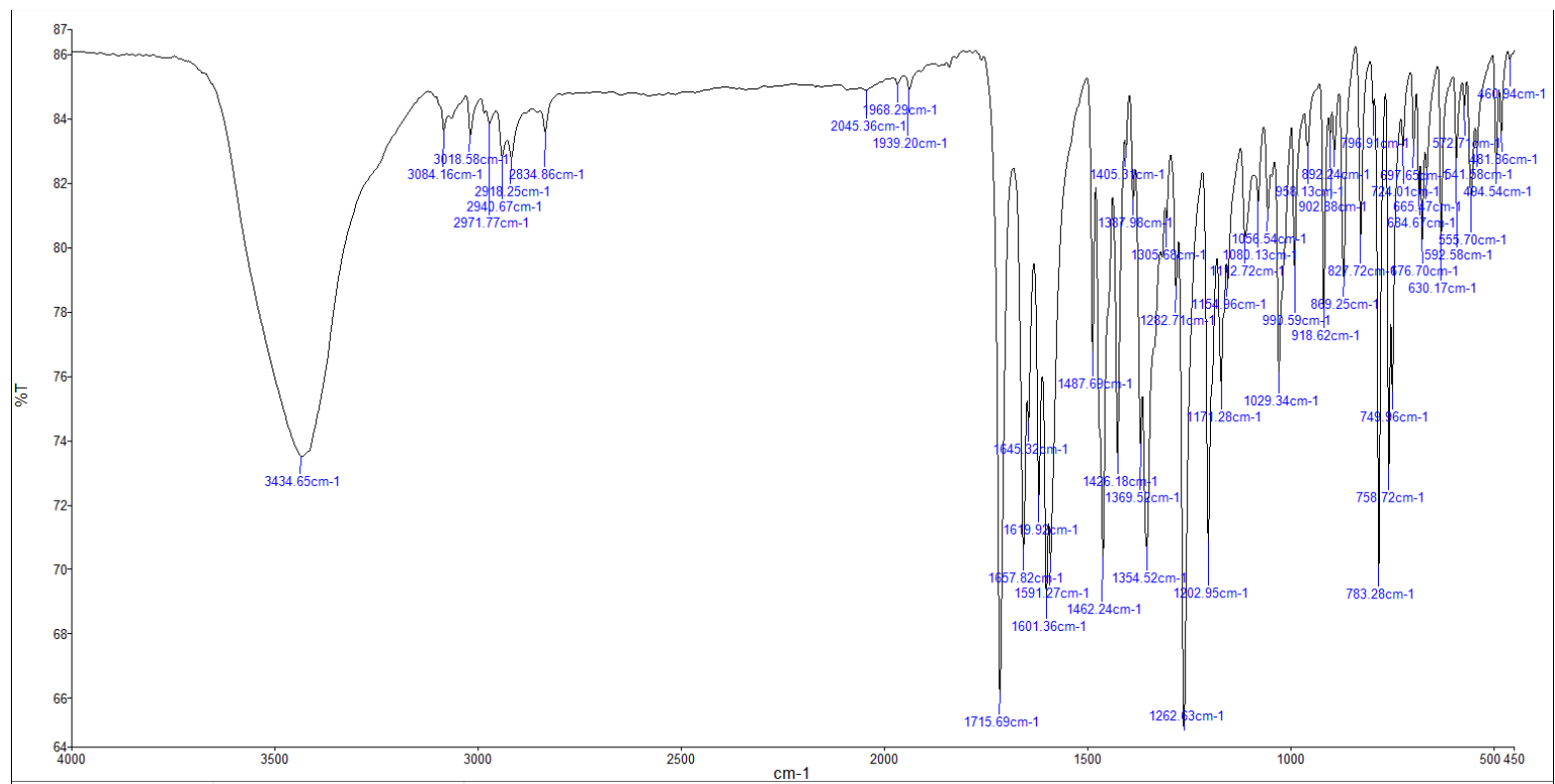


Figure S32. IR spectrum of 4f

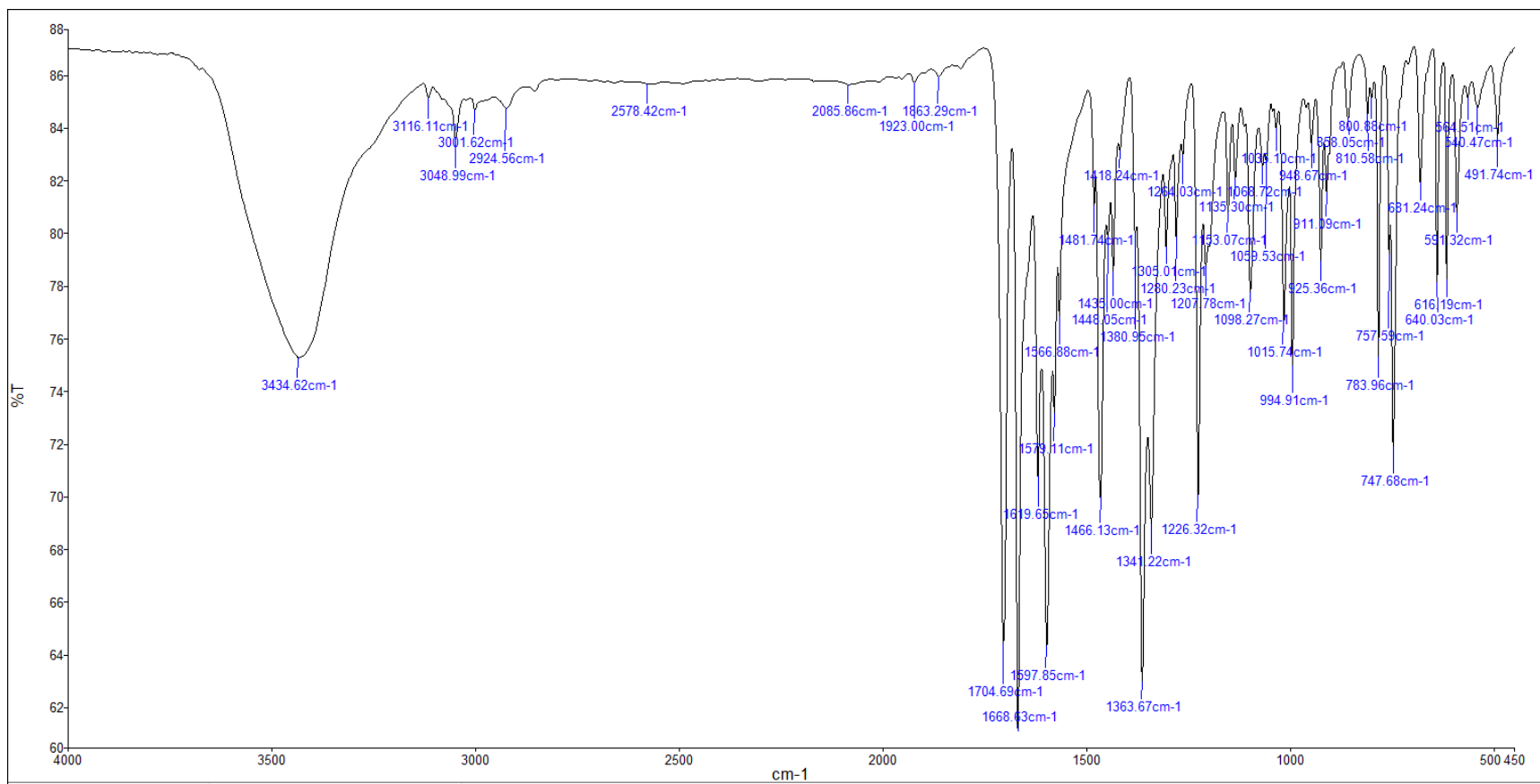


Figure S33. IR spectrum of 4g

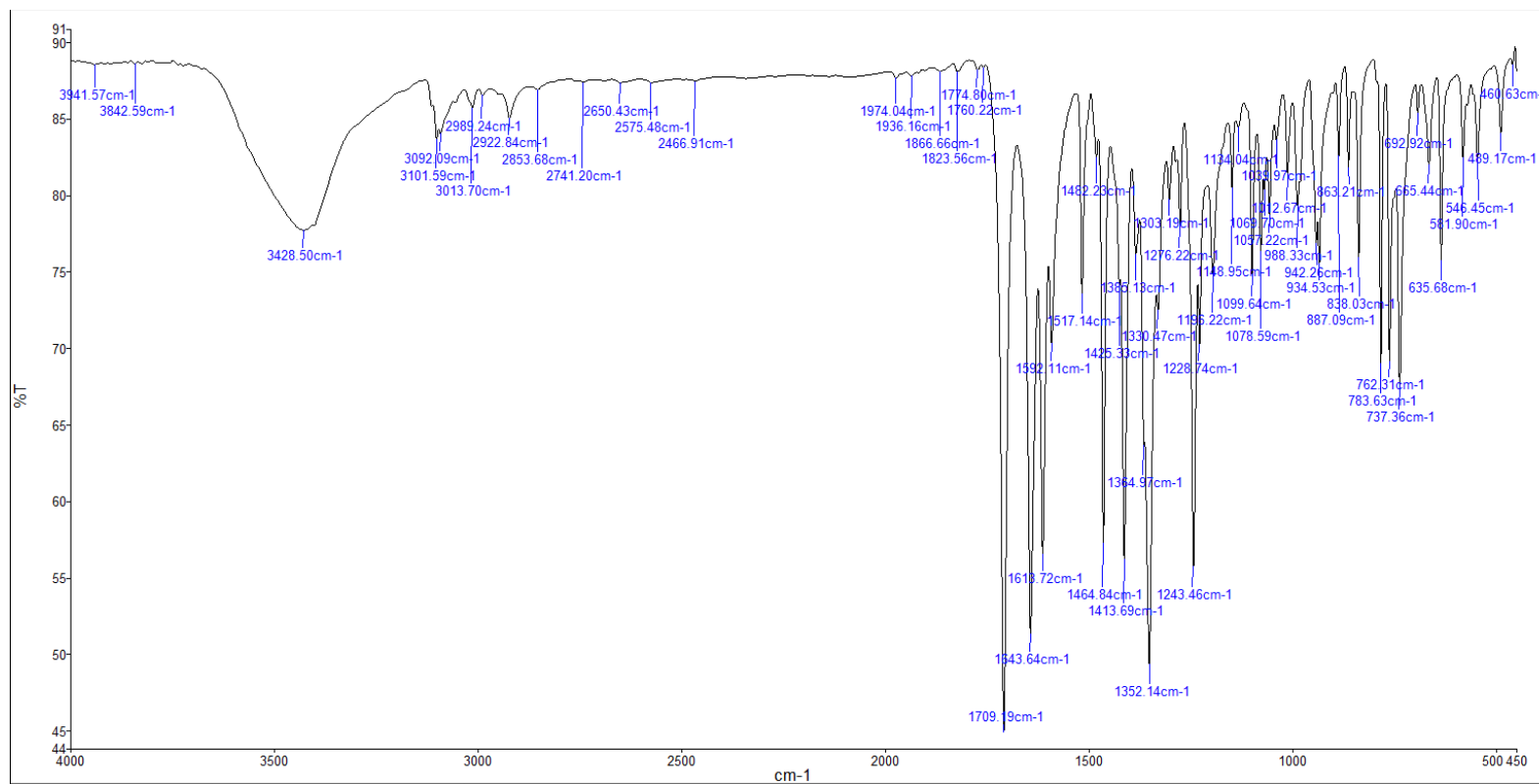


Figure S34. IR spectrum of 4h