

Electronic Supplementary Material (ESI) for New Journal of Chemistry

**Design, Synthesis, and Antiproliferative Evaluation of Novel
Longifolene-derived Tetraline Pyrimidine Derivatives with
Fluorescence Property**

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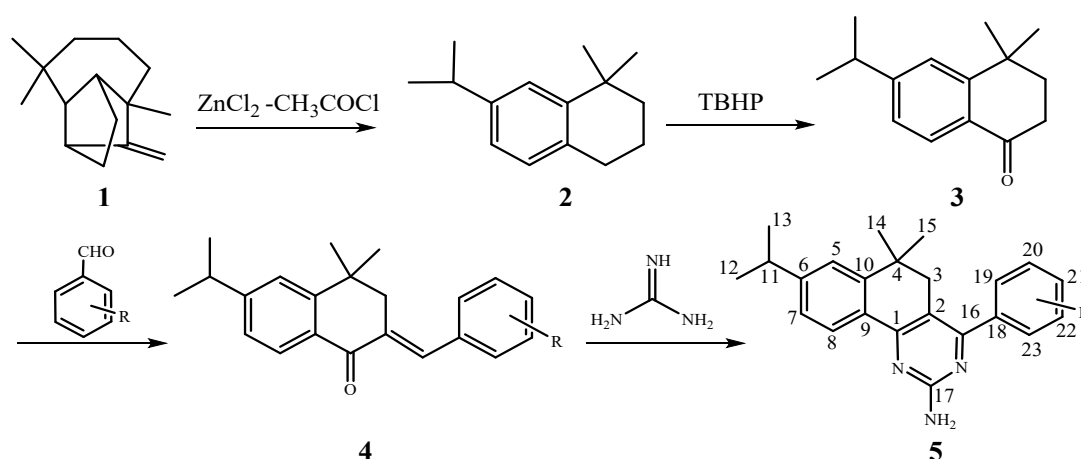
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1. General experimental information

FT-IR, ^1H NMR, ^{13}C NMR, ESI-MS, and elemental analysis were employed to characterize the structure of the target compounds, and the characterization data were included in Supporting Information. FT-IR spectra were recorded by a Nicolet iS50 FT-IR spectrometer using KBr pellets. ^1H and ^{13}C NMR spectra were recorded in a CDCl_3 using a Bruker AVANCE AV-600 spectrometer and TMS as an internal standard. The mass spectra were obtained from the TSQ Quantum Access MAX HPLC-MS instrument. The elemental analyses were tested on PerkinElmer 2400II Elemental Analyzer. Fluorescence spectra were obtained by Hitachi F4700 fluorescence spectrophotometer. The UV-vis absorption spectra were estimated on the UV-1800 ultraviolet-visible spectrophotometer. The melting points of the target compounds were measured on a Hanon MP420 automatic melting point apparatus. XO-SM50 program-controlled ultrasonic-microwave reaction system. Longifolene (GC purity 85%) (**1**) was provided by Wuzhou Pine Chemicals Co., Ltd., Wuzhou, China. All the other reagents were purchased from commercial suppliers and used without further purification.

2. Synthetic Route of Target Compounds 5a-5r



5a: R= *o*-F; 5b: R= *m*-F; 5c: R= *p*-F; 5d: R= *o*-Cl; 5e: R= *m*-Cl; 5f: R= *p*-Cl; 5g: R= *o*-Br; 5h: R= *m*-Br; 5i: R= *p*-Br; 5j: R= *m*-CN; 5k: R= *p*-CN; 5l: R= *o*-CH₃; 5m: R= *p*-CH₃; 5n: R= *m*-OCH₃; 5o: R= *p*-OCH₃; 5p: R= *m*-CF₃; 5q: R= *p*-OCF₃; 5r: R= H;

Scheme 1. Synthetic Route of Target Compounds **5a-5r**

3. IR, NMR and MS data for compound 4 and 5

Compound **4a**: Yellow liquid; yield 85.6%; IR (KBr) ν_{\max} 3065 (Ar-H), 2961, 2929, 2871 (C-H), 1671 (C=O), 1602 (C=C); ^1H NMR (600 MHz, CDCl_3): δ = 8.09 (d, J = 8.1 Hz, 1H), 7.92 (s, 1H), 7.37 – 7.32 (m, 1H), 7.28 (ddd, J = 13.5, 5.6, 2.6 Hz, 1H), 7.25 (d, J = 1.5 Hz, 1H), 7.20 (dd, J = 8.1, 1.6 Hz, 1H), 7.14 (td, J = 7.5, 0.8 Hz, 1H), 7.06 (t, J = 9.1 Hz, 1H), 2.94 (hept, J = 6.9 Hz, 1H), 2.84 (s, 1H), 1.29 (s, 3H), 1.26 (d, J = 7.0 Hz, 3H); ^{13}C NMR (151 MHz, CDCl_3): δ = 186.67, 161.25, 159.59, 154.98, 151.58, 136.17, 130.34, 130.32, 129.99, 129.94, 129.66, 129.64, 129.62, 128.60, 124.63, 123.63, 123.60, 122.47, 115.55, 115.41, 41.87, 34.75, 34.39, 29.64, 23.42; ESI-MS m/z 323.12 $[\text{M}+\text{H}]^+$. Anal. Calcd. For $\text{C}_{22}\text{H}_{23}\text{FO}$: C, 81.95; H, 7.19. Found: C, 81.93; H, 7.21.

Compound **4b**: Yellow liquid; yield 80.3%; IR (KBr) ν_{\max} 3063 (Ar-H), 2961, 2928 (C-H), 1670 (C=O), 1604 (C=C); ^1H NMR (600 MHz, CDCl_3): δ = 8.08 (d, J = 8.0 Hz, 1H), 7.87 (s, 1H), 7.33 (td, J = 7.9, 6.2 Hz, 1H), 7.26 (d, J = 1.2 Hz, 1H), 7.23 – 7.16 (m, 1H), 7.11 (d, J = 9.7 Hz, 1H), 6.99 (td, J = 8.4, 2.2 Hz, 1H), 2.99 – 2.91 (m, 2H), 1.31 (s, 3H), 1.26 (d, J = 7.0 Hz, 3H); ^{13}C NMR (151 MHz, CDCl_3): δ = 186.88, 163.17, 161.54, 154.99, 151.35, 137.90, 137.85, 135.29, 135.11, 129.76, 129.71, 129.69, 128.62, 125.31, 125.30, 124.67, 122.40, 116.05, 115.90, 115.01, 114.87, 41.48, 34.71, 34.40, 29.71, 23.43; ESI-MS m/z 323.12 $[\text{M}+\text{H}]^+$. Anal. Calcd. For $\text{C}_{22}\text{H}_{23}\text{FO}$: C, 81.95; H, 7.19. Found: C, 81.96; H, 7.20.

Compound **4c**: White solid; yield 90.5%; m.p 102.5-114.2 °C; IR (KBr) ν_{\max} 3063, 3039 (Ar-H), 2959, 2928, 2868 (C-H), 1659 (C=O), 1610 (C=C); ^1H NMR (600 MHz, CDCl_3): δ = 8.09 (d, J = 8.0 Hz, 1H), 7.89 (s, 1H), 7.46 – 7.39 (m, 1H), 7.28 – 7.21

(m, 1H), 7.15 – 7.07 (m, 1H), 3.01 – 2.93 (m, 2H), 1.34 (s, 3H), 1.29 (d, $J = 6.9$ Hz, 3H); ^{13}C NMR (151 MHz, CDCl_3): $\delta = 187.48, 163.32, 161.67, 155.18, 151.51, 135.96, 134.09, 131.98, 131.96, 131.64, 131.58, 130.00, 128.79, 124.87, 122.57, 115.55, 115.41, 41.73, 34.92, 34.64, 29.95, 23.67$; ESI-MS m/z 323.12 $[\text{M}+\text{H}]^+$. Anal. Calcd. For $\text{C}_{22}\text{H}_{23}\text{FO}$: C, 81.95; H, 7.19. Found: C, 81.94; H, 7.22.

Compound **4d**: Yellow liquid, yield 80.0%; IR (KBr) ν_{max} 3059 (Ar-H), 2960, 2926 (C-H), 1671 (C=O), 1603 (C=C); ^1H NMR (600 MHz, CDCl_3): $\delta = 8.13$ (d, $J = 8.0$ Hz, 1H), 7.96 (s, 1H), 7.46 – 7.41 (m, 1H), 7.34 – 7.22 (m, 2H), 3.03 – 2.91 (m, 1H), 2.81 (s, 1H), 1.31 (s, 3H), 1.29 (d, $J = 7.0$ Hz, 3H); ^{13}C NMR (151 MHz, CDCl_3): $\delta = 187.26, 155.25, 151.77, 135.91, 134.59, 134.50, 134.09, 130.20, 129.73, 129.53, 129.32, 128.71, 126.26, 124.81, 122.71, 41.75, 35.06, 34.55, 29.74, 23.58$; ESI-MS m/z 323.12 $[\text{M}+\text{H}]^+$. Anal. Calcd. For $\text{C}_{22}\text{H}_{23}\text{ClO}$: C, 77.98; H, 6.84. Found: C, 77.99; H, 6.82.

Compound **4e**: Yellow liquid; yield 88.3%; IR (KBr) ν_{max} 3061 (Ar-H), 2960, 2930 (C-H), 1664 (C=O), 1607 (C=C); ^1H NMR (600 MHz, CDCl_3): $\delta = 8.09$ (d, $J = 8.0$ Hz, 1H), 7.85 (s, 1H), 7.41 (s, 1H), 7.37 – 7.29 (m, 2H), 7.27 – 7.22 (m, 1H), 3.02 – 2.93 (m, 2H), 1.34 (s, 3H), 1.30 (d, $J = 6.9$ Hz, 3H); ^{13}C NMR (151 MHz, CDCl_3) $\delta = 187.29, 155.32, 151.61, 137.74, 135.45, 135.39, 134.28, 129.82, 129.65, 129.40, 128.82, 128.28, 127.78, 124.92, 122.63, 41.68, 35.00, 34.63, 29.95, 23.65$; ESI-MS m/z 323.12 $[\text{M}+\text{H}]^+$. Anal. Calcd. For $\text{C}_{22}\text{H}_{23}\text{ClO}$: C, 77.98; H, 6.84. Found: C, 77.95; H, 6.85.

Compound **4f**: Yellow solid; yield 84.5%; m.p 98.7-101.6 °C; IR (KBr) ν_{\max} 3033 (Ar-H), 2959, 2928, 2870 (C-H), 1659 (C=O), 1605 (C=C); ^1H NMR (600 MHz, CDCl_3): δ = 8.08 (d, J = 7.9 Hz, 1H), 7.87 (s, 1H), 7.41 – 7.35 (m, 2H), 7.27 – 7.22 (m, 1H), 2.99 (dt, J = 13.8, 6.9 Hz, 1H), 2.94 (d, J = 1.8 Hz, 1H), 1.33 (s, 3H), 1.29 (d, J = 6.9 Hz, 3H); ^{13}C NMR (151 MHz, CDCl_3): δ = 187.41, 155.28, 151.56, 135.74, 134.82, 134.36, 134.23, 131.02, 129.93, 128.83, 128.66, 124.92, 122.62, 41.80, 34.98, 34.66, 29.97, 23.68; ESI-MS m/z 323.12 $[\text{M}+\text{H}]^+$. Anal. Calcd. For $\text{C}_{22}\text{H}_{23}\text{ClO}$: C, 77.98; H, 6.84. Found: C, 77.98; H, 6.86.

Compound **4i**: Yellow solid; yield 89.6%; m.p 125.6-126.5 °C; IR (KBr) ν_{\max} 3061, 3026 (Ar-H), 2958, 2935, 2863 (C-H), 1662 (C=O), 1607 (C=C); ^1H NMR (600 MHz, CDCl_3): δ = 8.08 (d, J = 7.9 Hz, 1H), 7.84 (s, 1H), 7.57 – 7.52 (m, 1H), 7.30 (d, J = 8.4 Hz, 1H), 7.27 – 7.22 (m, 1H), 3.01 – 2.95 (m, 1H), 2.94 (t, J = 5.2 Hz, 1H), 1.33 (s, 3H), 1.29 (d, J = 6.9 Hz, 3H); ^{13}C NMR (151 MHz, CDCl_3): δ = 187.40, 155.30, 151.56, 135.75, 134.92, 134.81, 131.62, 131.26, 129.91, 128.83, 124.93, 122.62, 122.51, 41.80, 34.98, 34.66, 29.97, 23.68.

Compound **4k**: White solid; yield 82.3%; m.p 135.6-136.4 °C; IR (KBr) ν_{\max} 2959, 2939, 2871 (C-H), 2222 (C \equiv N), 1664 (C=O), 1610 (C=C); ^1H NMR (600 MHz, CDCl_3) δ 8.08 (d, J = 8.5 Hz, 1H), 7.87 (s, 1H), 7.71 (d, J = 8.3 Hz, 1H), 7.51 (d, J = 8.1 Hz, 1H), 7.27 – 7.23 (m, 1H), 3.01 – 2.95 (m, 1H), 2.92 (d, J = 1.8 Hz, 1H), 1.33 (s, 3H), 1.29 (d, J = 6.9 Hz, 3H); ^{13}C NMR (151 MHz, CDCl_3) δ 187.03, 155.66, 151.57, 140.65, 136.93, 134.60, 132.16, 130.10, 129.63, 128.93, 125.09, 122.72, 118.62, 111.65, 41.83, 35.09, 34.68, 30.00, 23.65.

Compound **4m**: White solid; yield 82.9%; m.p 150.6-151.7 °C; IR (KBr) ν_{\max} 3023 (Ar-H), 2959, 2924, 2868 (C-H), 1658 (C=O), 1608 (C=C); ^1H NMR (600 MHz, CDCl_3): δ = 8.08 (d, J = 8.0 Hz, 1H), 7.93 (s, 1H), 7.37 (d, J = 8.0 Hz, 1H), 7.28 – 7.20 (m, 2H), 3.02 – 2.93 (m, 2H), 2.40 (s, 2H), 1.33 (s, 3H), 1.30 (d, J = 6.9 Hz, 3H); ^{13}C NMR (151 MHz, CDCl_3): δ = 187.74, 155.01, 151.60, 138.55, 137.33, 133.48, 133.08, 130.19, 129.90, 129.13, 128.77, 124.81, 122.53, 41.85, 34.91, 34.65, 29.96, 23.70, 21.38.

Compound **4n**: Yellow solid; yield 86.7%; m.p 95.3-96.7 °C; IR (KBr) ν_{\max} 3063 (Ar-H), 2960, 2933, 2869 (C-H), 1667 (C=O), 1602 (C=C); ^1H NMR (600 MHz, CDCl_3): δ = 8.08 (d, J = 8.0 Hz, 1H), 7.90 (s, 1H), 7.33 (t, J = 7.9 Hz, 1H), 7.27 – 7.21 (m, 2H), 7.04 (d, J = 7.6 Hz, 1H), 6.97 (s, 1H), 6.90 (dd, J = 8.2, 2.2 Hz, 1H), 3.84 (s, 3H), 3.04 – 2.89 (m, 3H), 1.33 (s, 6H), 1.29 (d, J = 6.9 Hz, 6H); ^{13}C NMR (151 MHz, CDCl_3): δ = 187.63, 159.43, 155.12, 151.68, 137.27, 137.01, 134.48, 130.04, 129.36, 128.78, 124.82, 122.58, 122.13, 115.27, 113.80, 55.21, 41.77, 34.93, 34.63, 29.94, 23.67. ESI-MS m/z 335.12 $[\text{M}+\text{H}]^+$. Anal. Calcd. For $\text{C}_{23}\text{H}_{26}\text{O}_2$: C, 82.60; H, 7.84. Found: C, 82.61; H, 7.83.

Compound **4o**: White solid; yield 92.5%; m.p 118.6-119.5 °C; IR (KBr) ν_{\max} 3063, 3001 (Ar-H), 2958, 2929 (C-H), 1656 (C=O), 1604 (C=C); ^1H NMR (600 MHz, CDCl_3): δ = 8.08 (d, J = 8.0 Hz, 1H), 7.92 (s, 1H), 7.44 (d, J = 8.7 Hz, 2H), 7.27 – 7.21 (m, 2H), 6.96 (d, J = 8.7 Hz, 2H), 3.85 (s, 3H), 3.12 – 2.92 (m, 3H), 1.34 (s, 6H), 1.29 (d, J = 6.9 Hz, 6H); ^{13}C NMR (151 MHz, CDCl_3): δ = 187.63, 159.78, 154.87, 151.42, 137.09, 132.33, 131.62, 130.25, 128.70, 128.44, 124.74, 122.45, 113.87,

55.24, 41.87, 34.81, 34.61, 29.96, 23.68; ESI-MS m/z 335.12 $[M+H]^+$. Anal. Calcd.

For $C_{23}H_{26}O_2$: C, 82.60; H, 7.84. Found: C, 82.62; H, 7.80.

Table 1 The part result of molecular docking-based virtual screening for the designed compounds in descending order by D_score and PMF_score based on the crystal structure of the survivin / Smac / DIABLO complex.

	Name	Structure	1: Total_Score	2: Crash	3: Polar	4: D_score	5: PMF_score	6: G_score	7: ChemScore	8: CSCORE
1	M9_000		2.6669	-0.5276	0	-73.422	-22.133	-133.9694	-11.4982	0
2	M78_000		2.3537	-0.9733	0.001	-81.3984	-23.3449	-145.9704	-13.8312	1
3	M10_000		2.775	-1.0637	0.0007	-77.4465	-25.5063	-144.3601	-12.5208	3
4	M28_000		4.4502	-0.5834	0.0007	-88.4459	-26.0985	-152.3659	-11.5425	3
5	NSC80467_000		3.2742	-0.9636	2.4322	-90.1598	-26.2117	-130.0601	-17.7099	3
6	M6_000		2.4948	-0.5151	0	-73.7993	-29.12	-123.2901	-10.5428	2
7	M14_000		1.1493	-0.8791	0	-80.1796	-29.3566	-134.7637	-17.991	2

Rows: (0/89) Data Columns: (2/8) | Visible Rows: 89 | Filtered Rows: 0 | Marked Rows: 0

5. The copies of IR, NMR and MS spectra for compounds 4 and 5

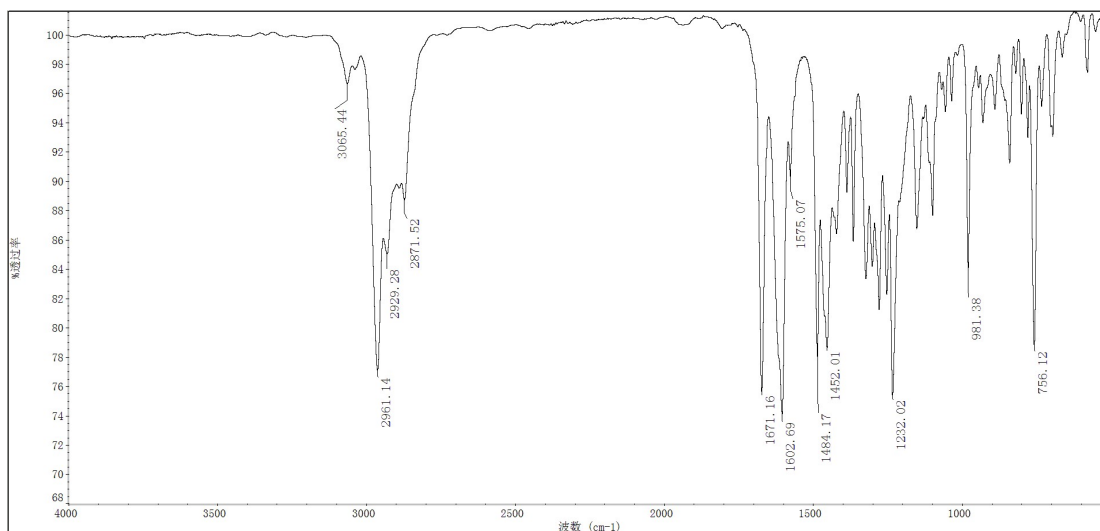


Figure 1. IR spectrum of compound 4a

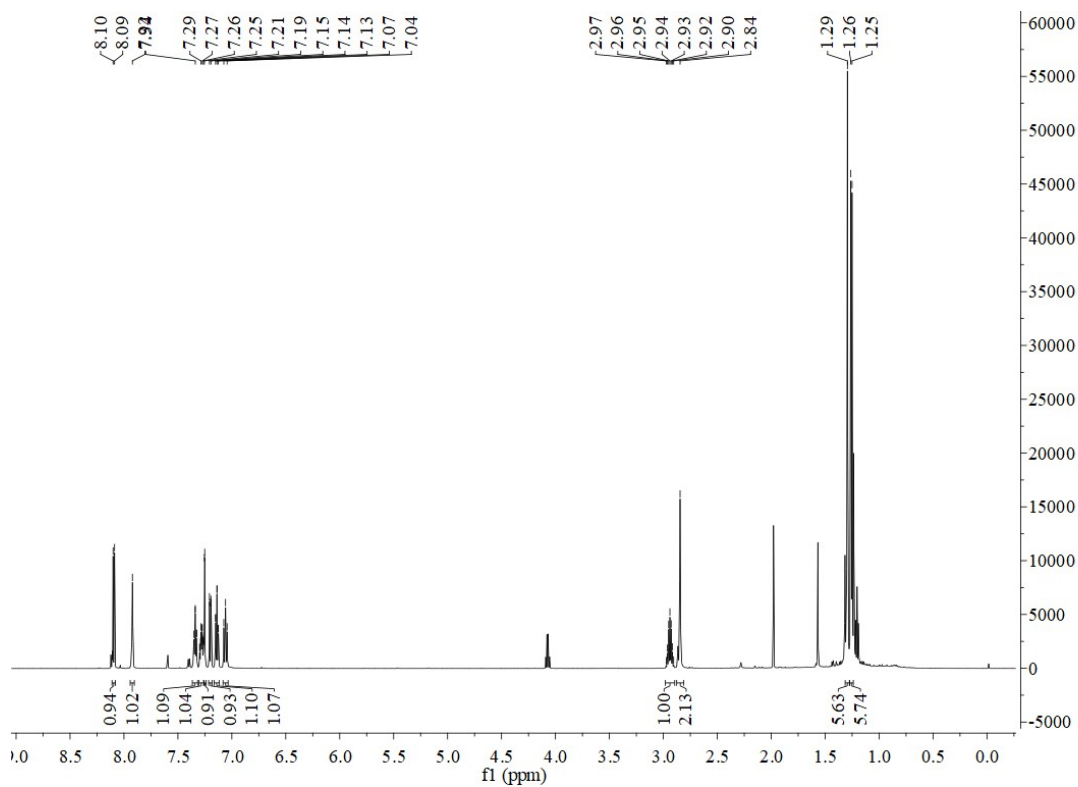


Figure 2. ¹H NMR spectrum of compound 4a

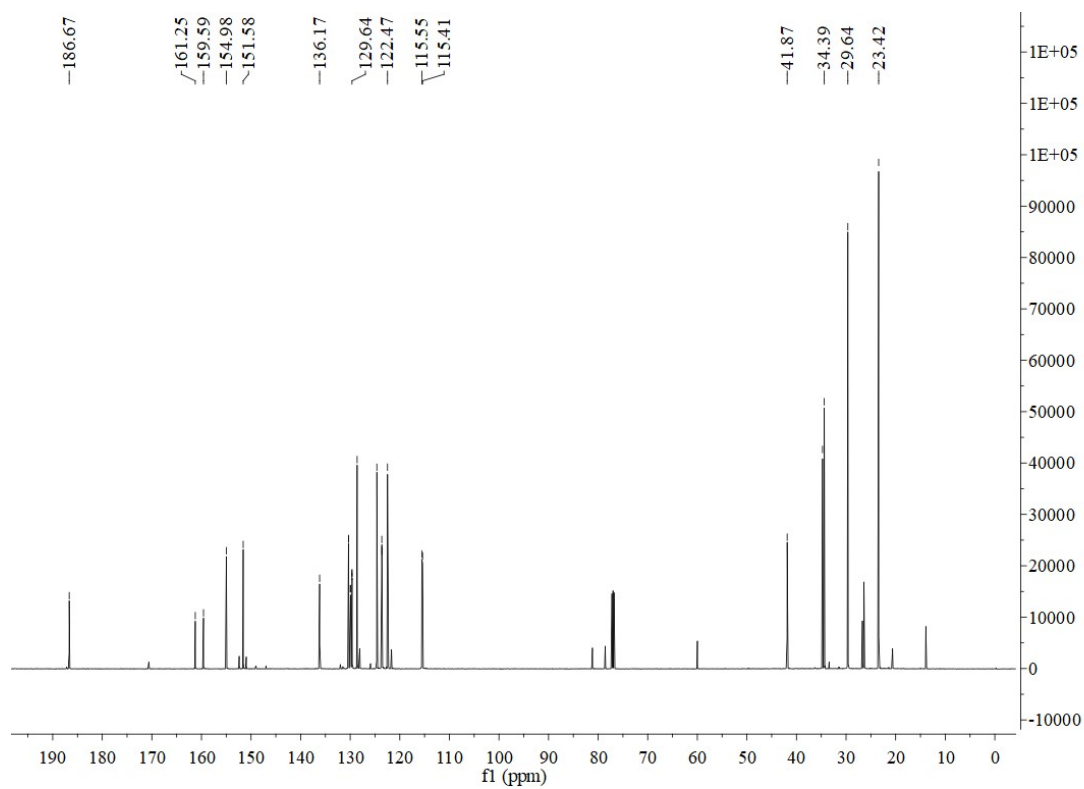


Figure 3. ¹³C NMR spectrum of compound 4a

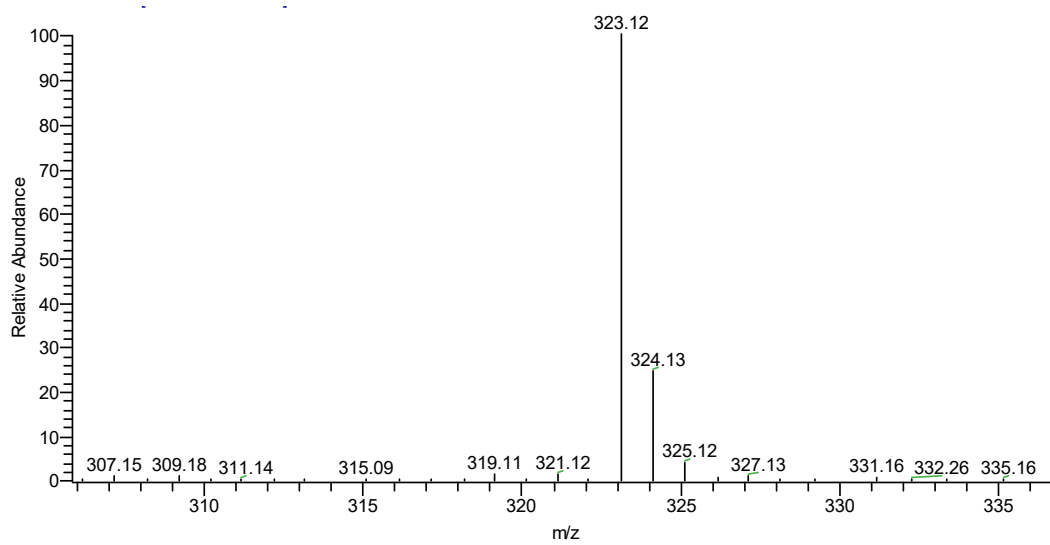


Figure 4. MS spectrum of compound 4a

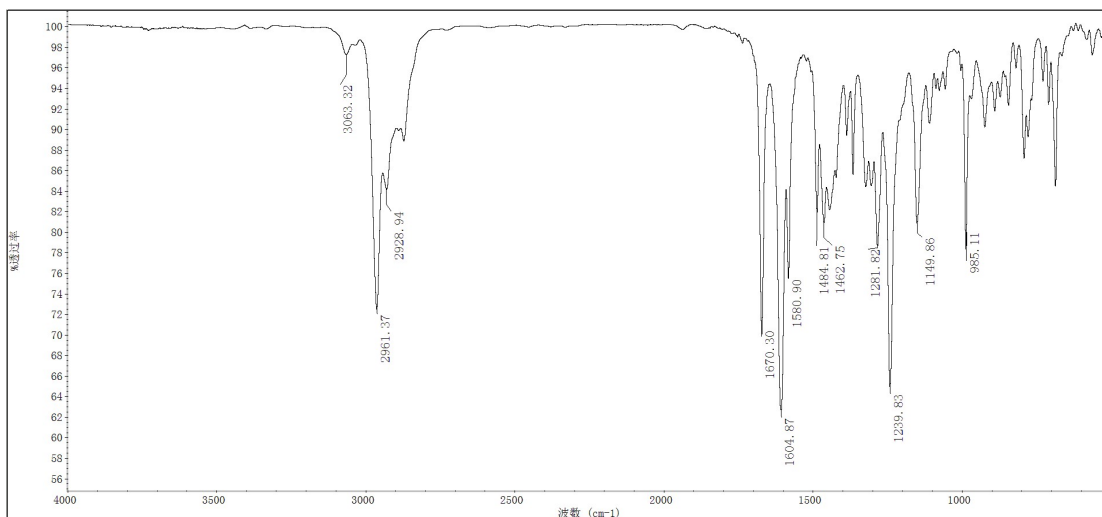


Figure 5. IR spectrum of compound 4b

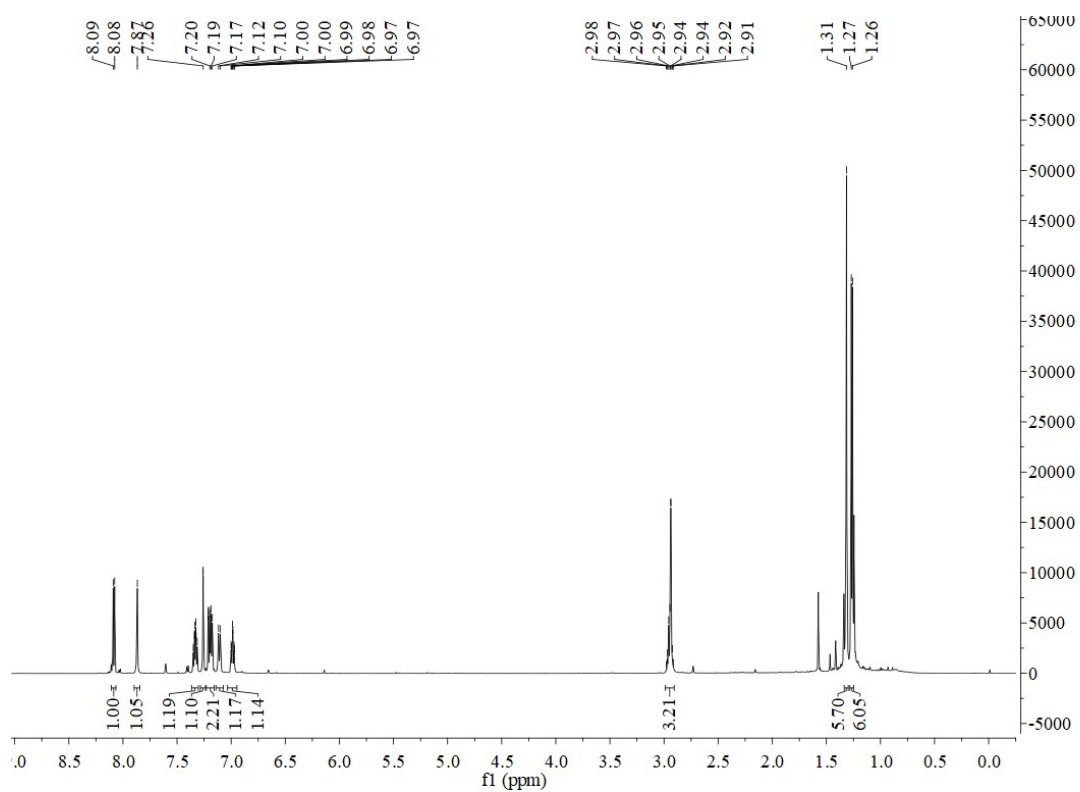


Figure 6. ¹H NMR spectrum of compound 4b

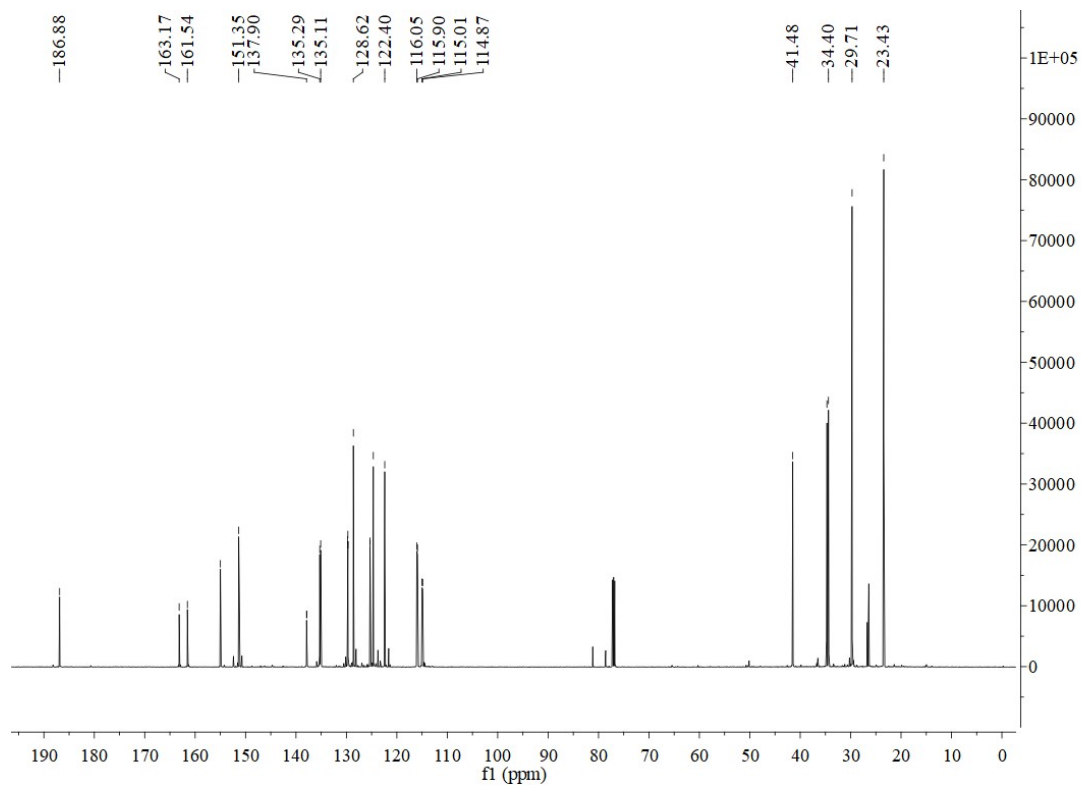


Figure 7. ¹³C NMR spectrum of compound 4b

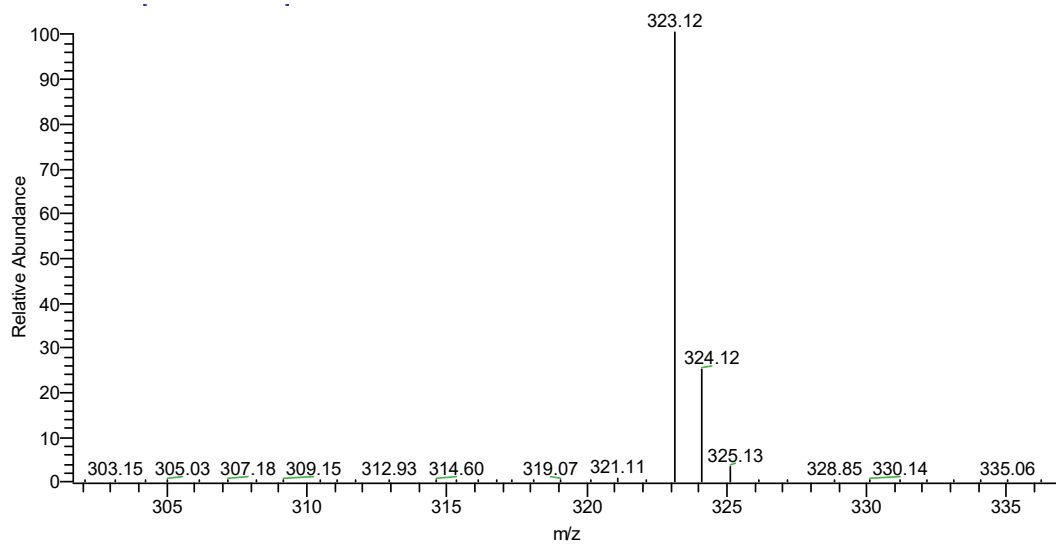


Figure 8. MS spectrum of compound 4b



Figure 9. IR spectrum of compound 4c

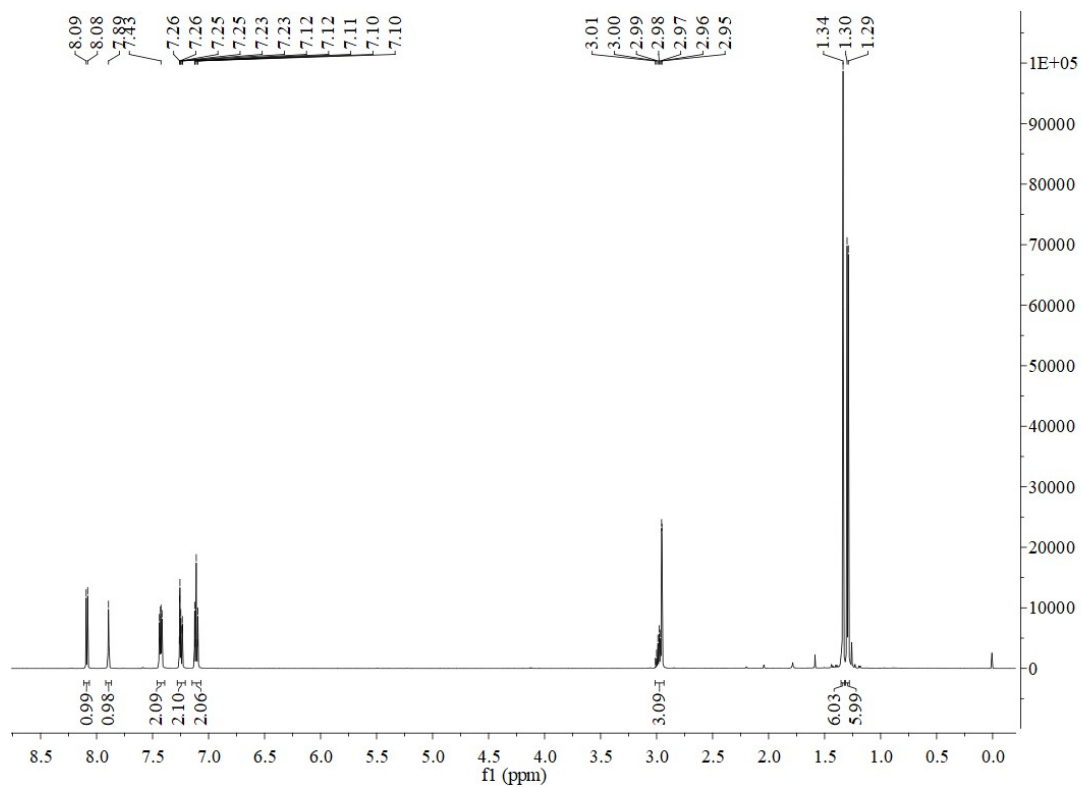


Figure 10. ^1H NMR spectrum of compound 4c

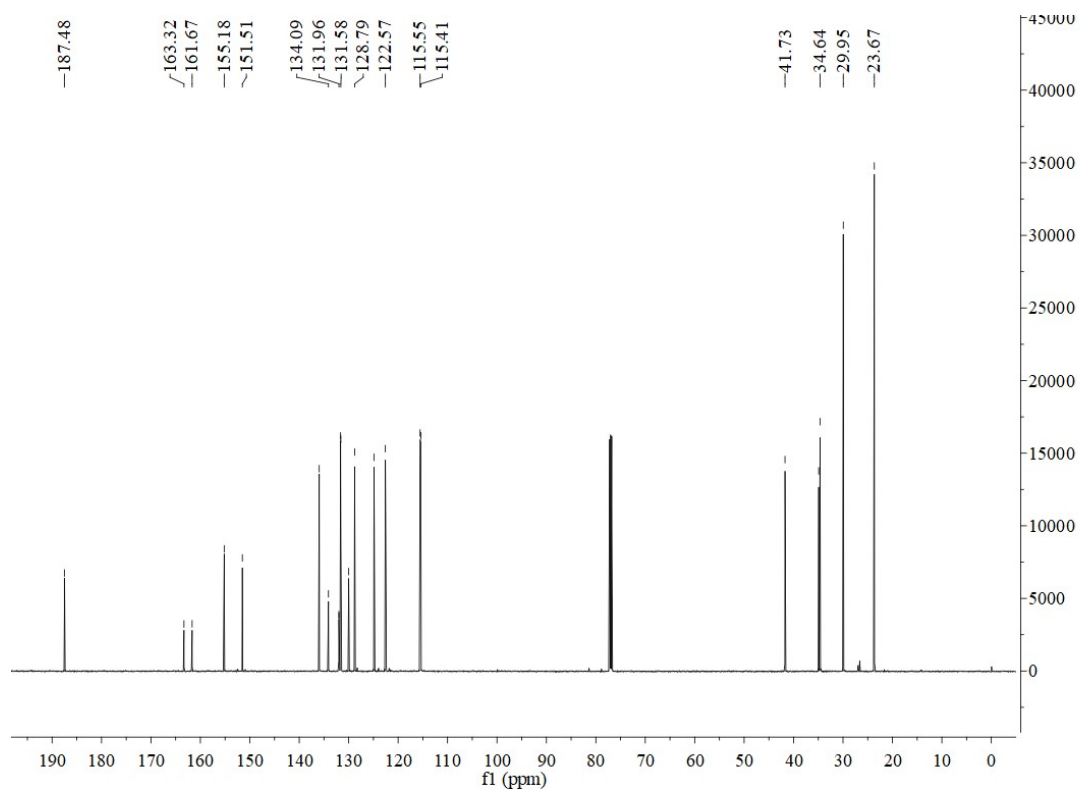


Figure 11. ^{13}C NMR spectrum of compound **4c**

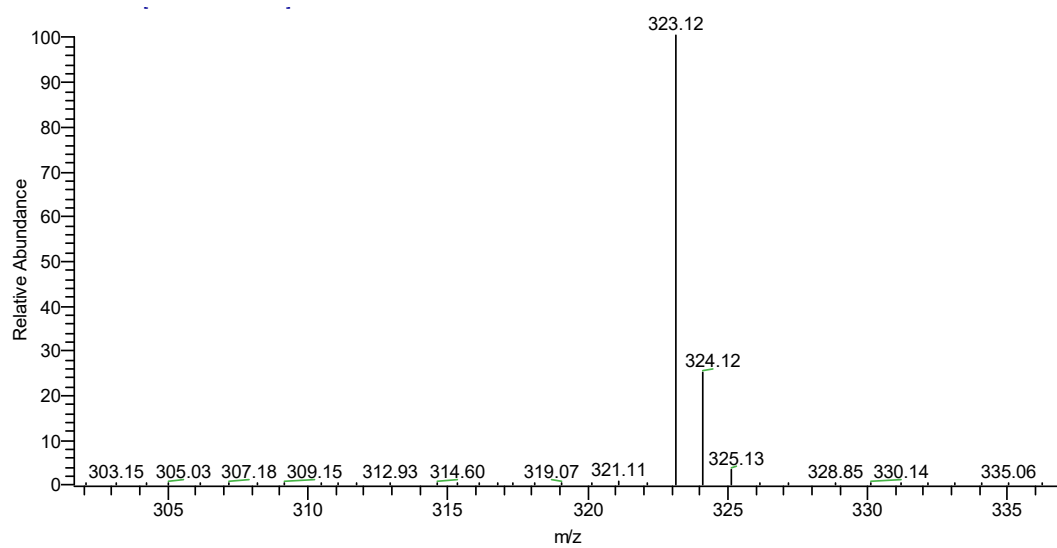


Figure 12. MS spectrum of compound **4c**

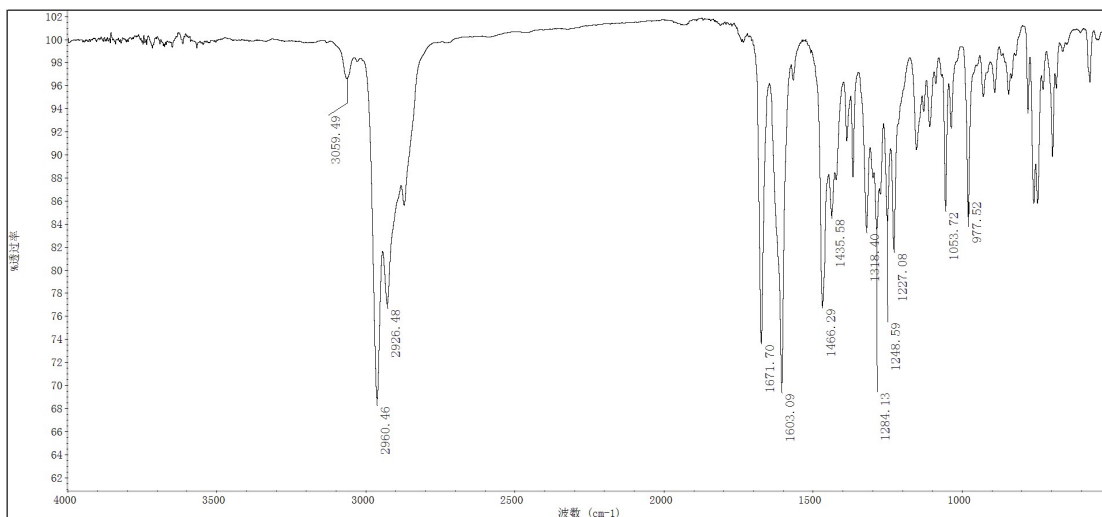


Figure 13. IR spectrum of compound 4d

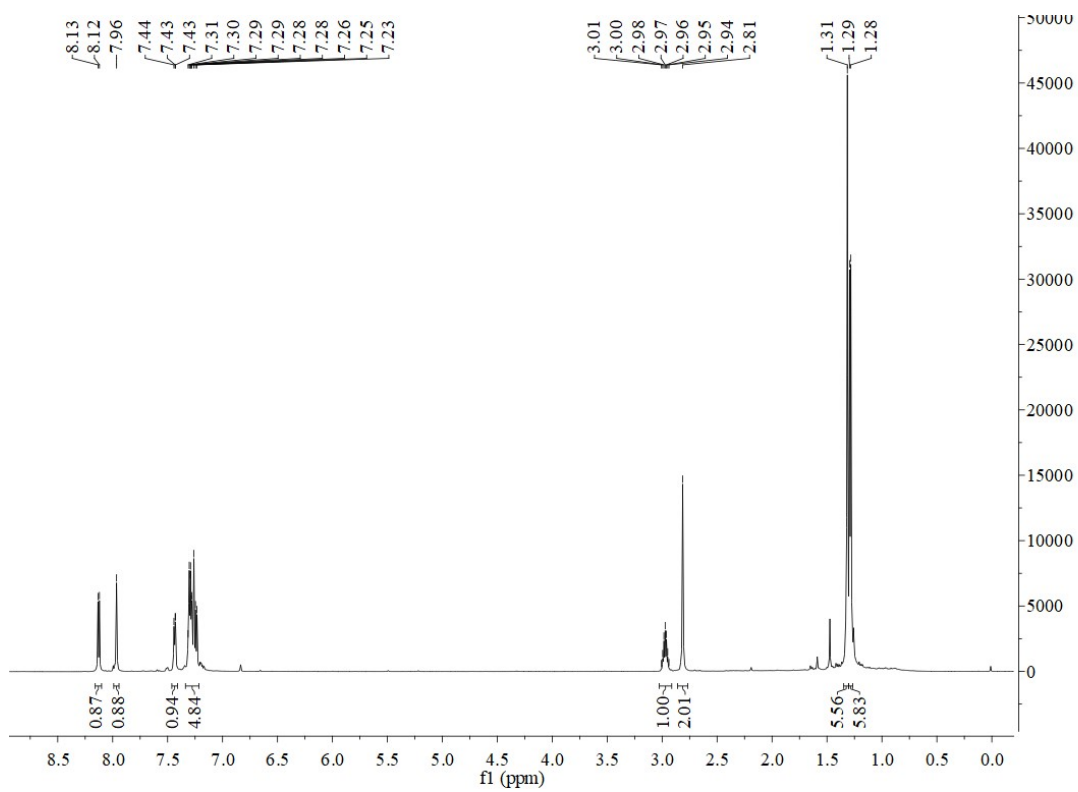


Figure 14. ¹H NMR spectrum of compound 4d

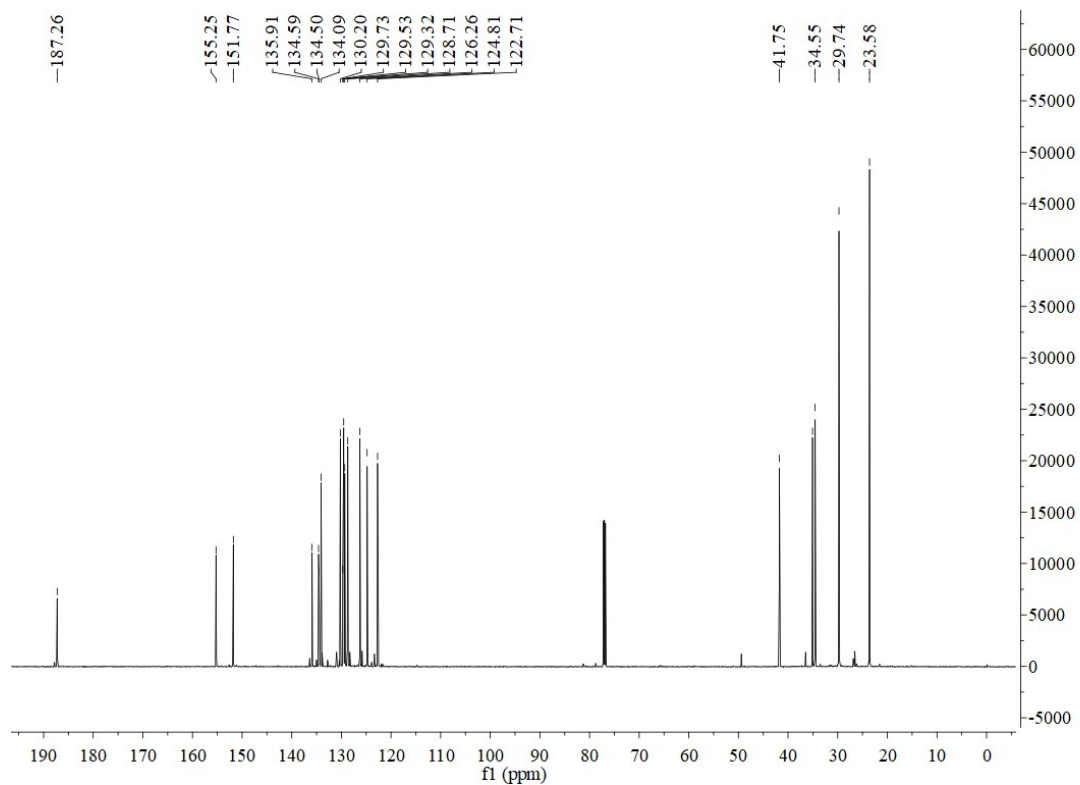


Figure 15. ^{13}C NMR spectrum of compound **4d**

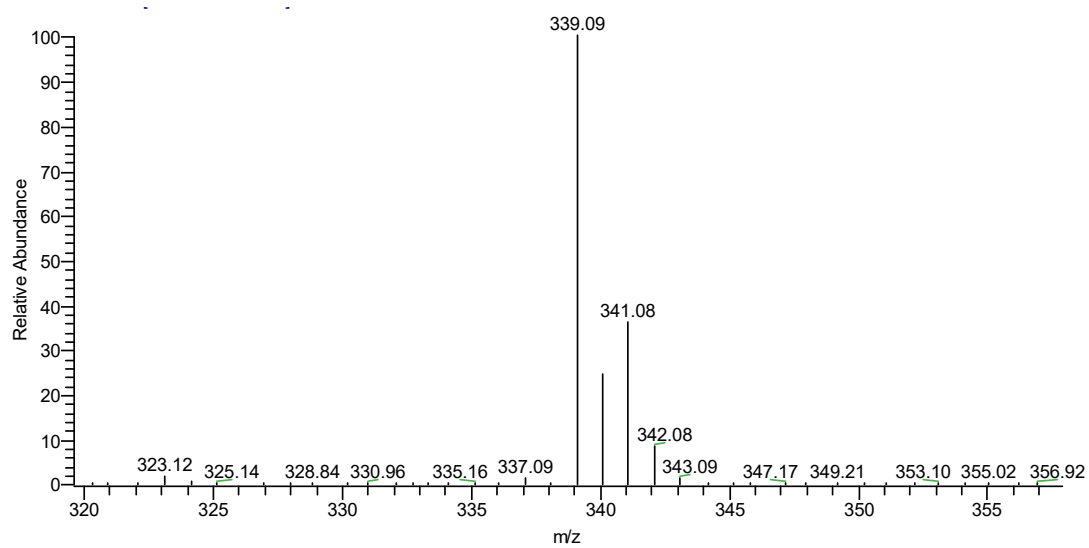


Figure 16. MS spectrum of compound **4d**

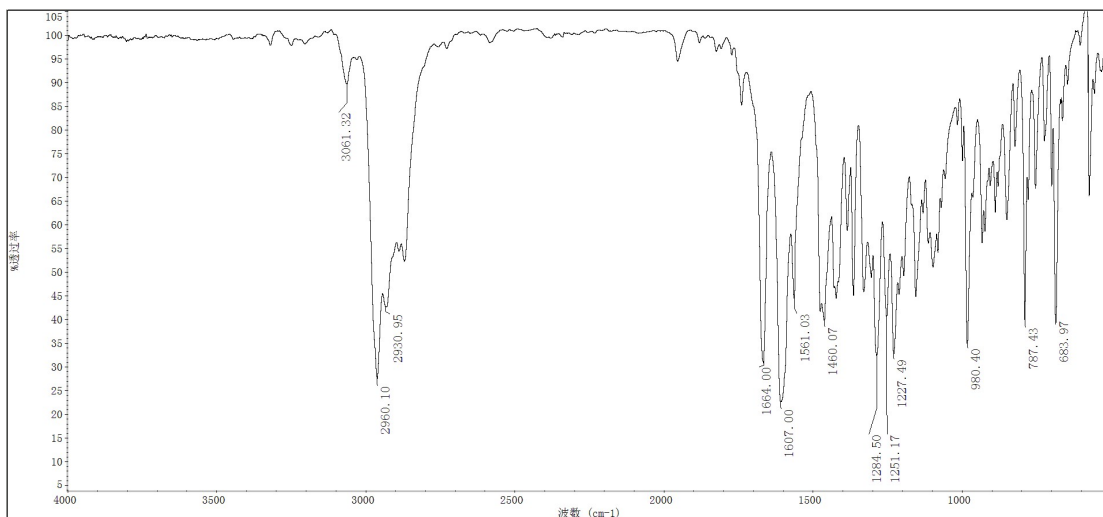


Figure 17. IR spectrum of compound 4e

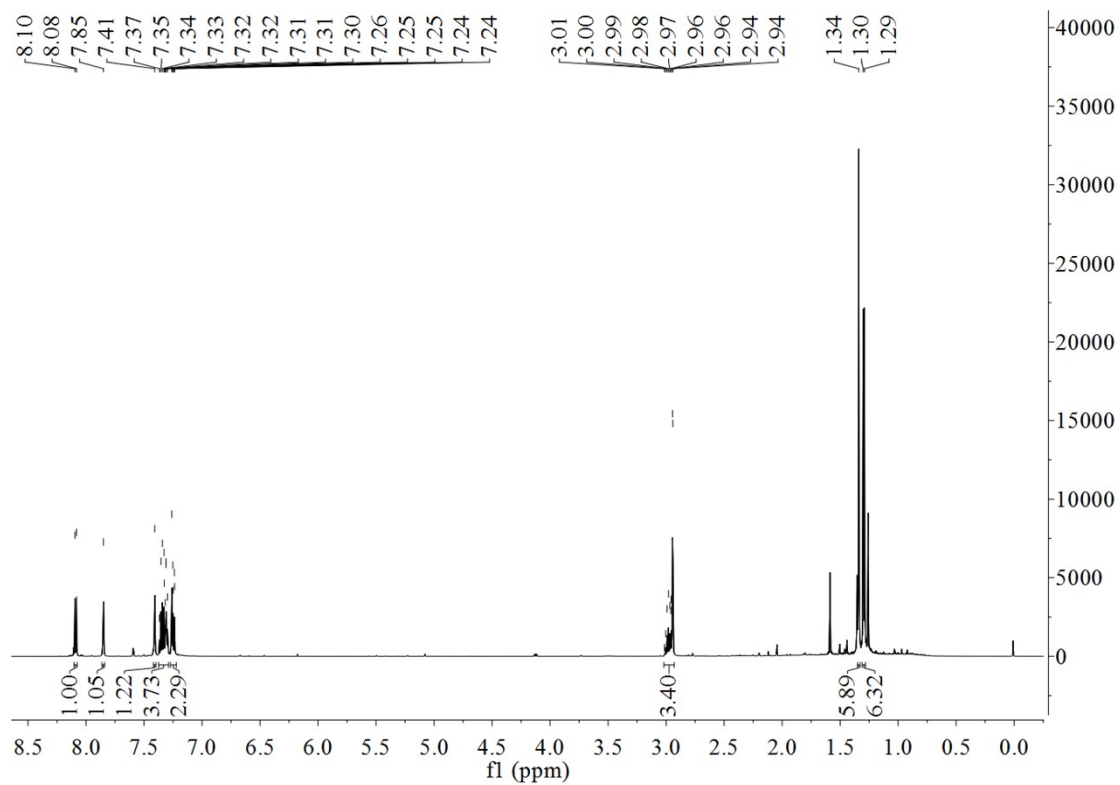


Figure 18. ¹H NMR spectrum of compound 4e

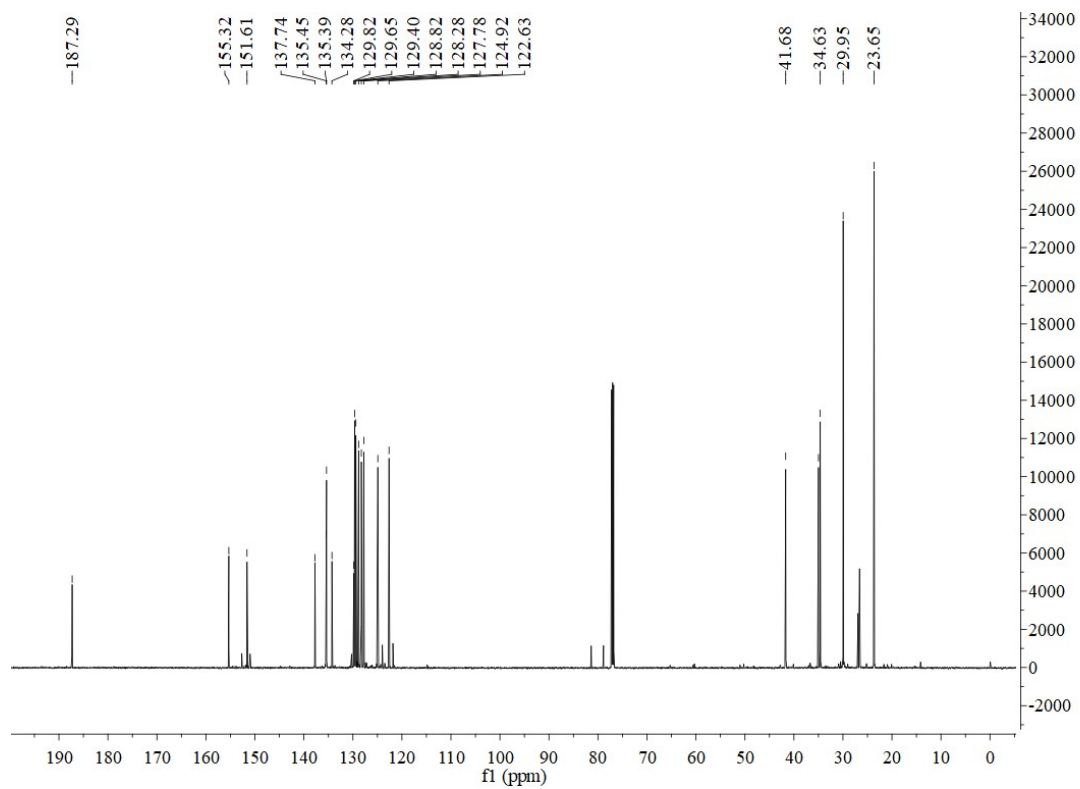


Figure 19. ¹³C NMR spectrum of compound **4e**

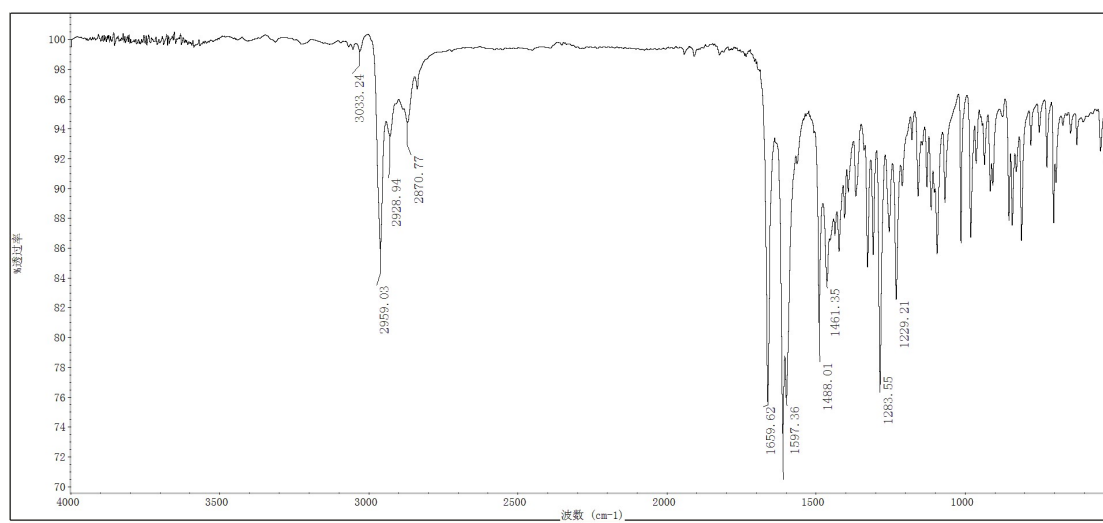


Figure 20. IR spectrum of compound **4f**

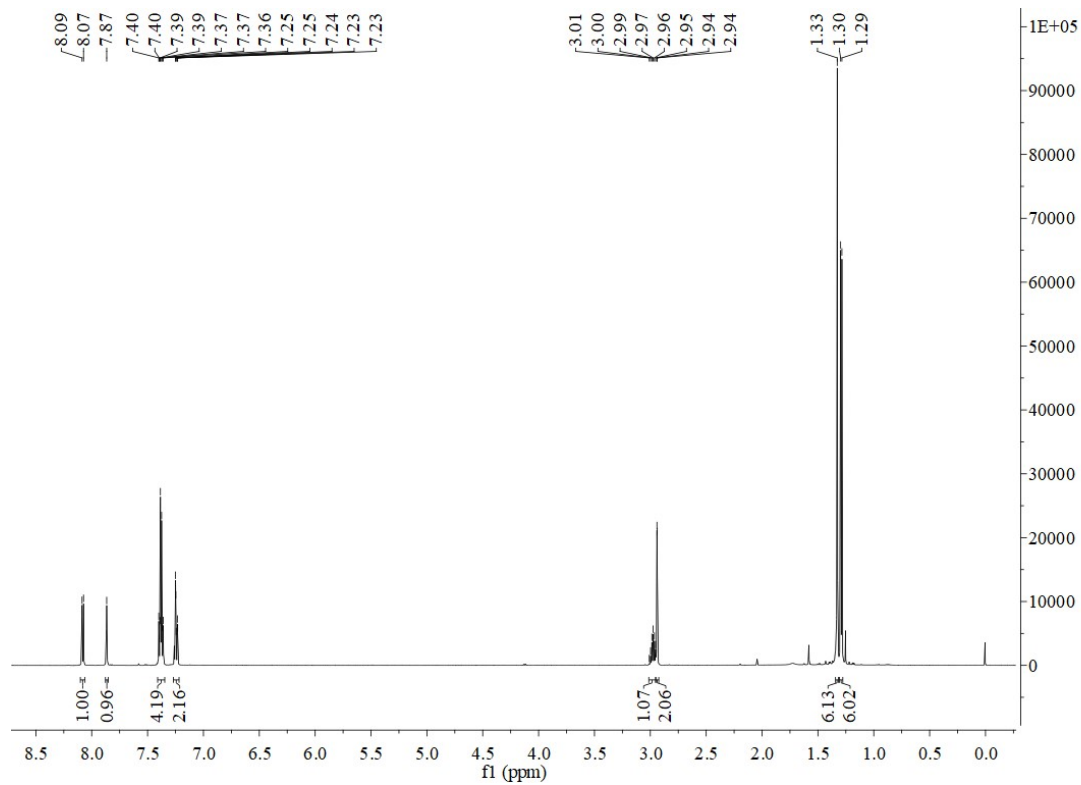


Figure 21. ^1H NMR spectrum of compound **4f**

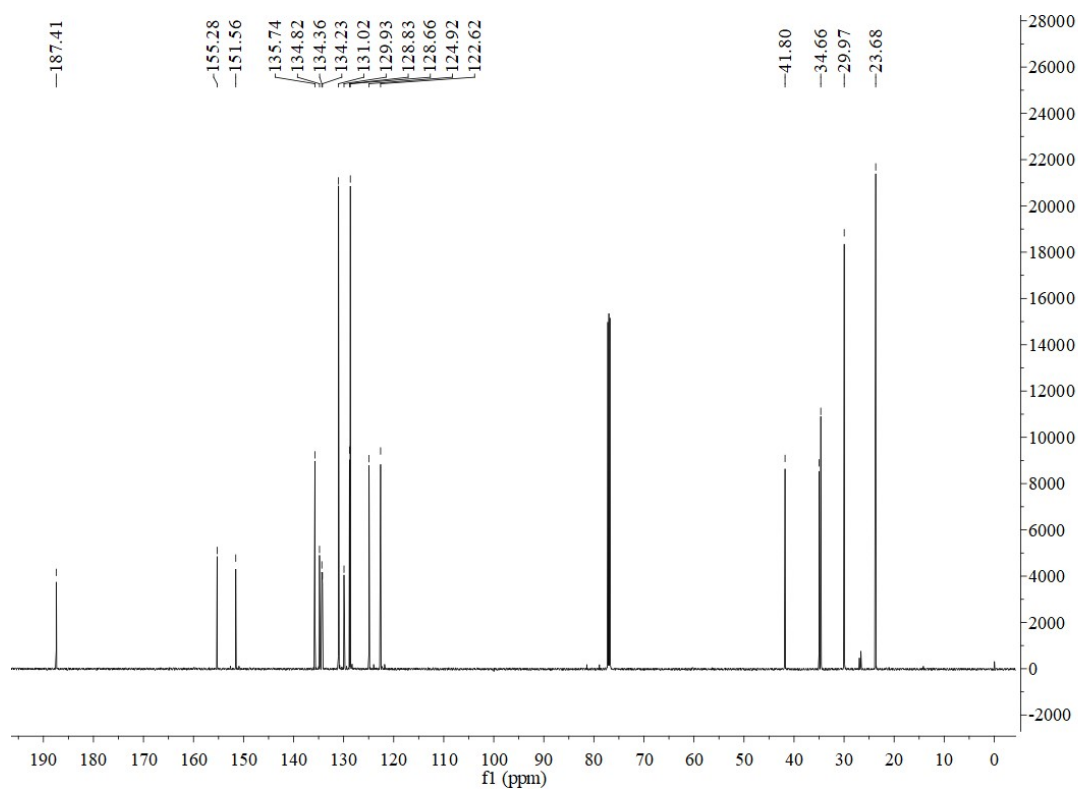


Figure 22. ^{13}C NMR spectrum of compound **4f**

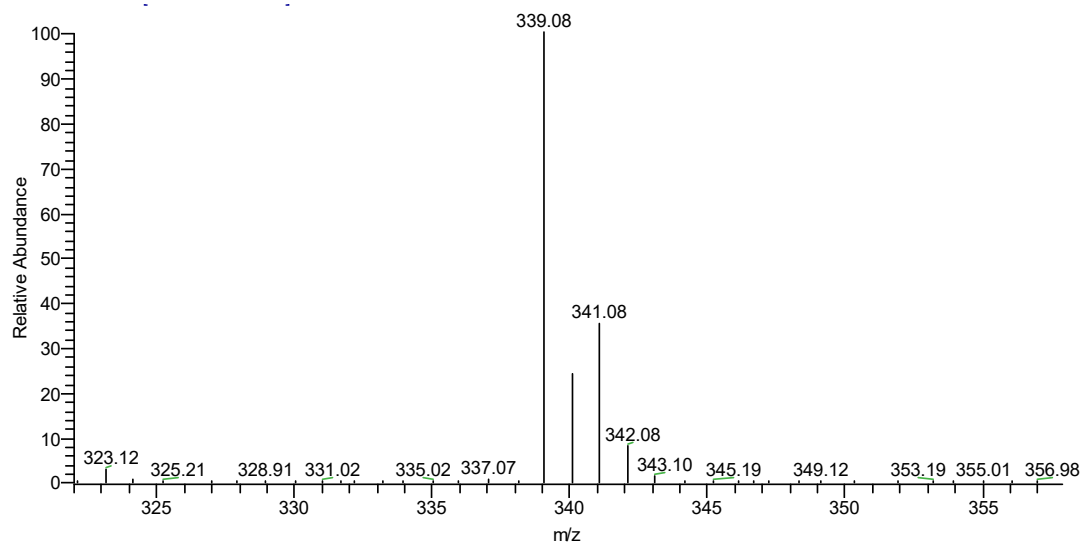


Figure 23. MS spectrum of compound 4f

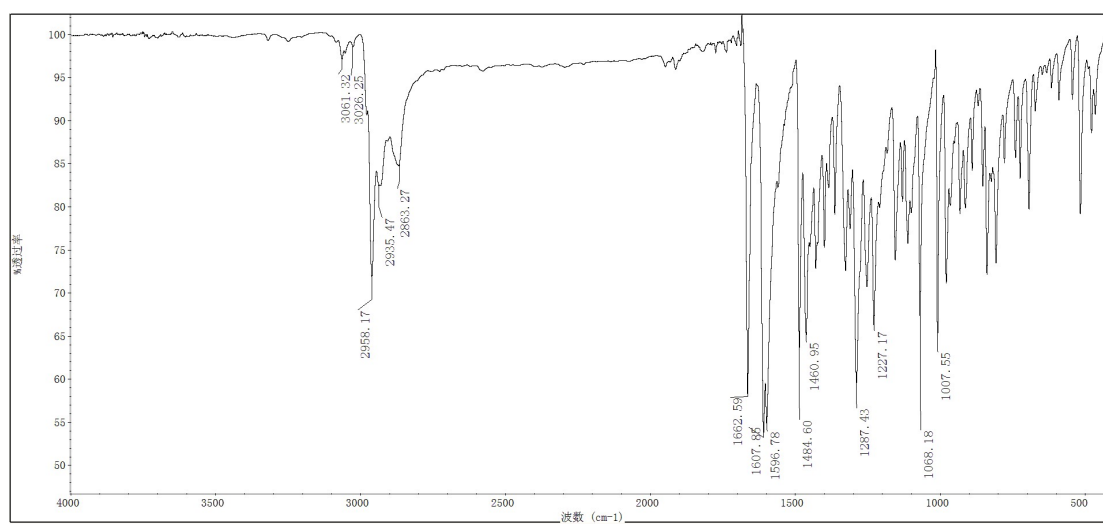


Figure 24. IR spectrum of compound 4i

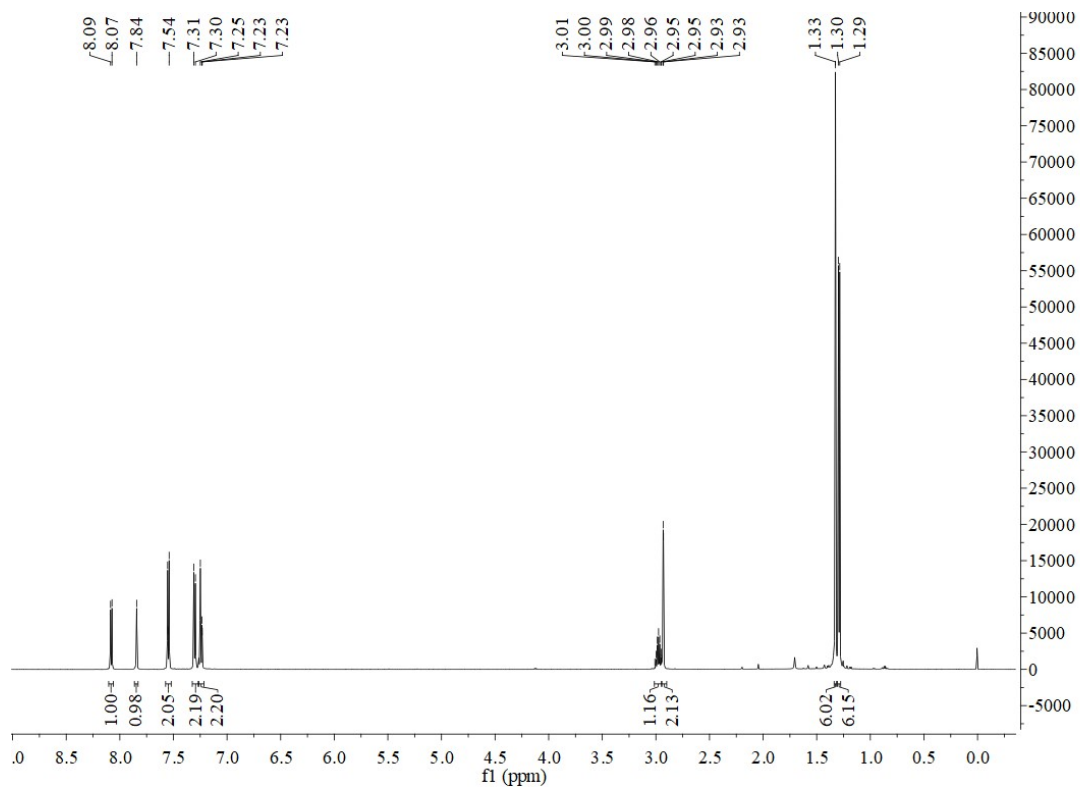


Figure 25. ^1H NMR spectrum of compound **4i**

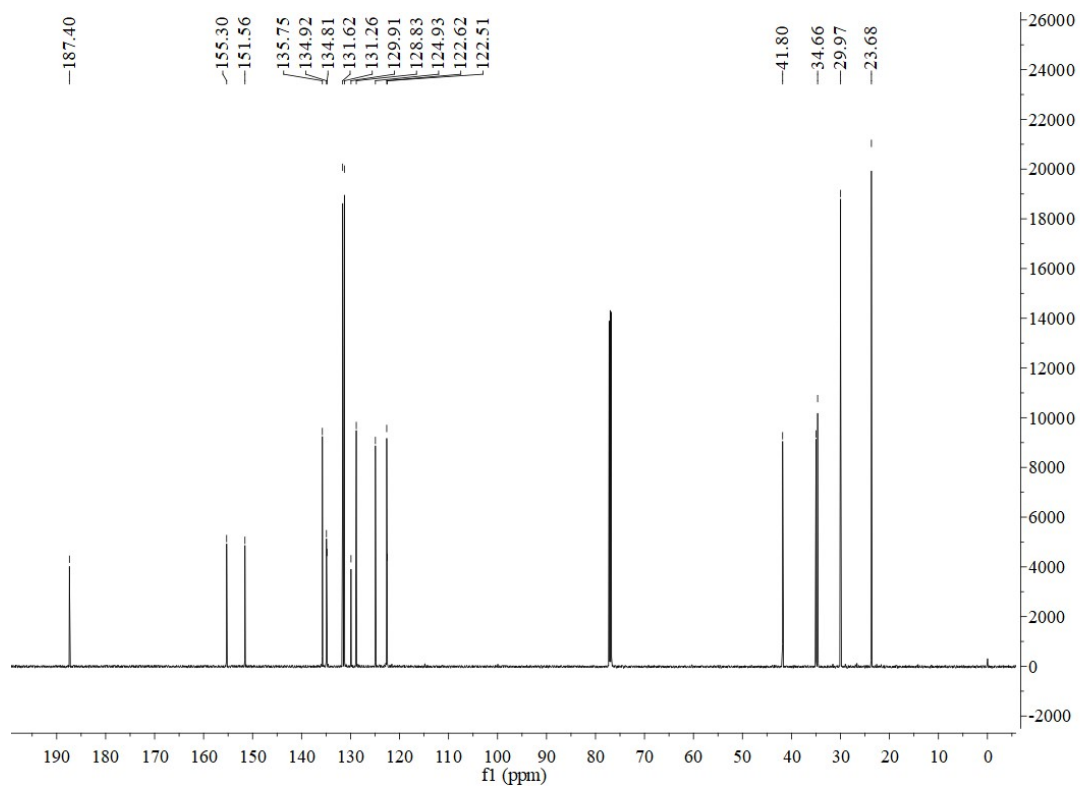


Figure 26. ^{13}C NMR spectrum of compound **4i**

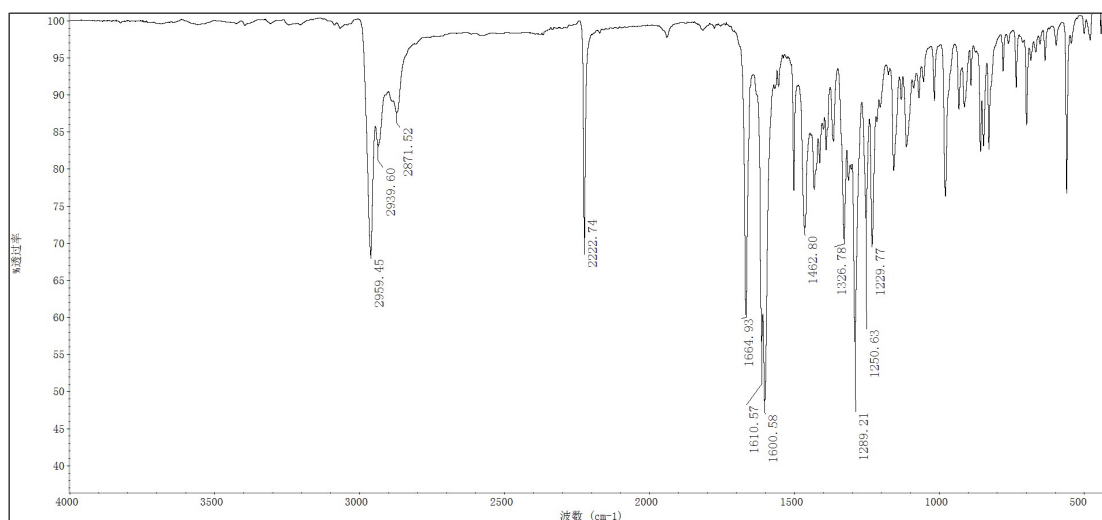


Figure 27. IR spectrum of compound 4k

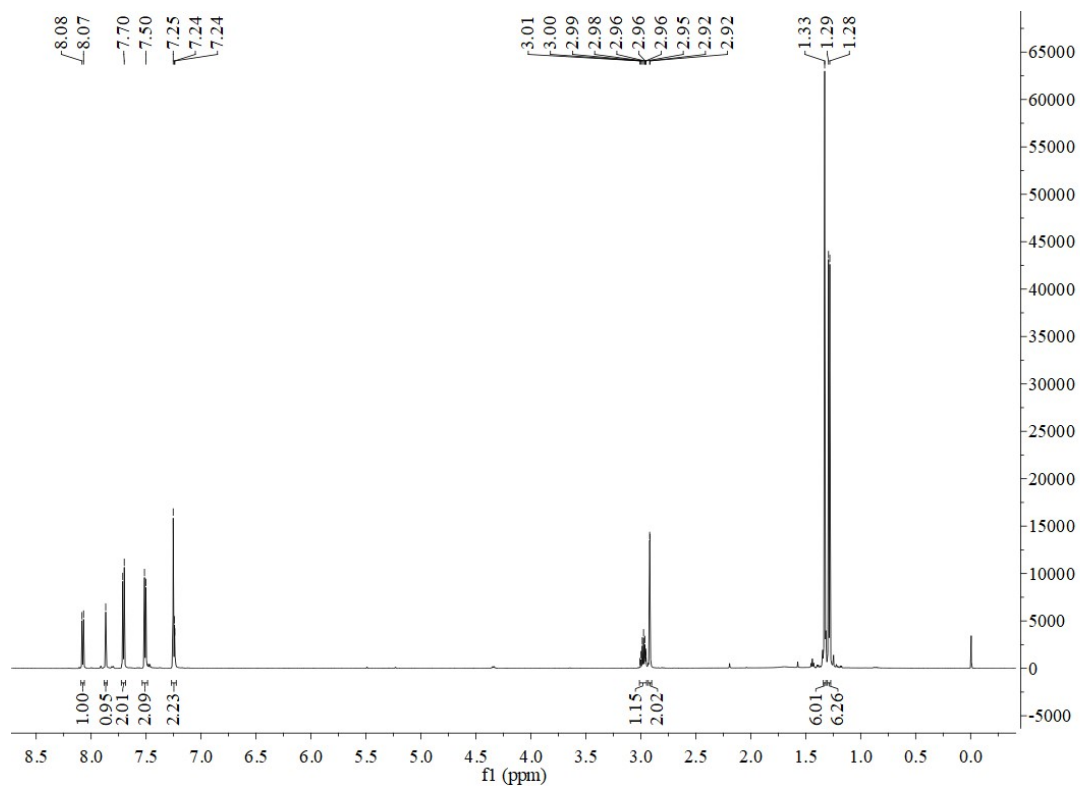


Figure 28. ¹H NMR spectrum of compound 4k

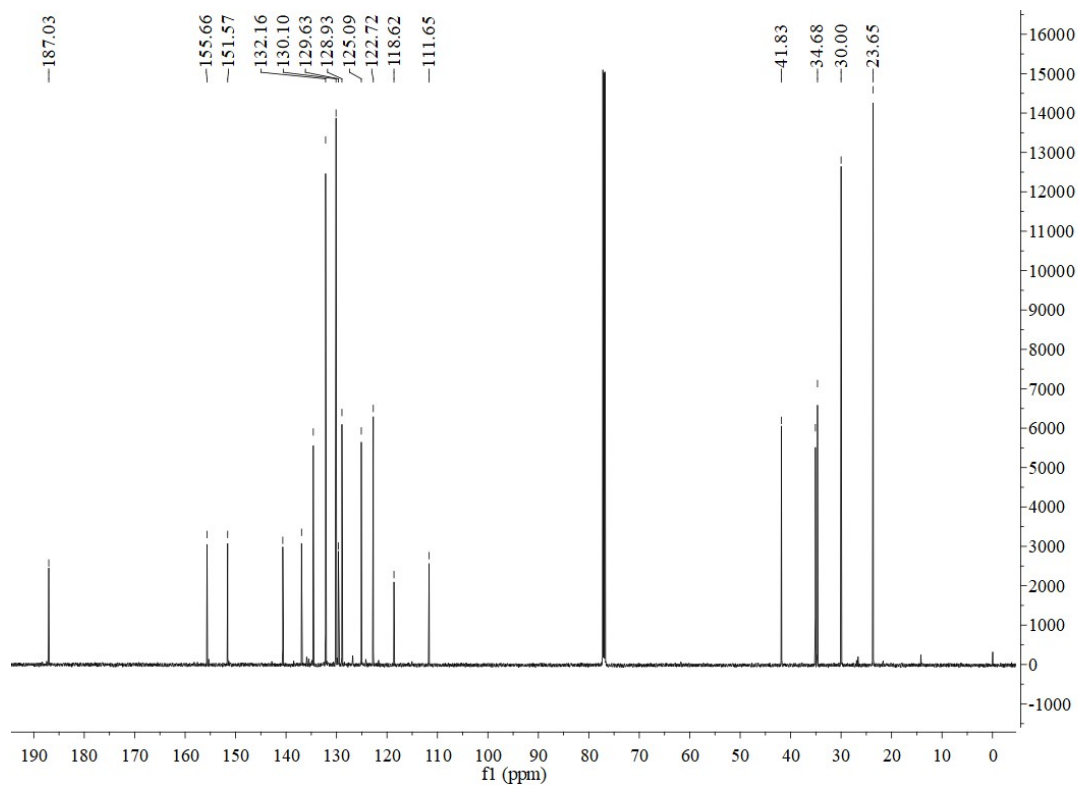


Figure 29. ^{13}C NMR spectrum of compound **4k**

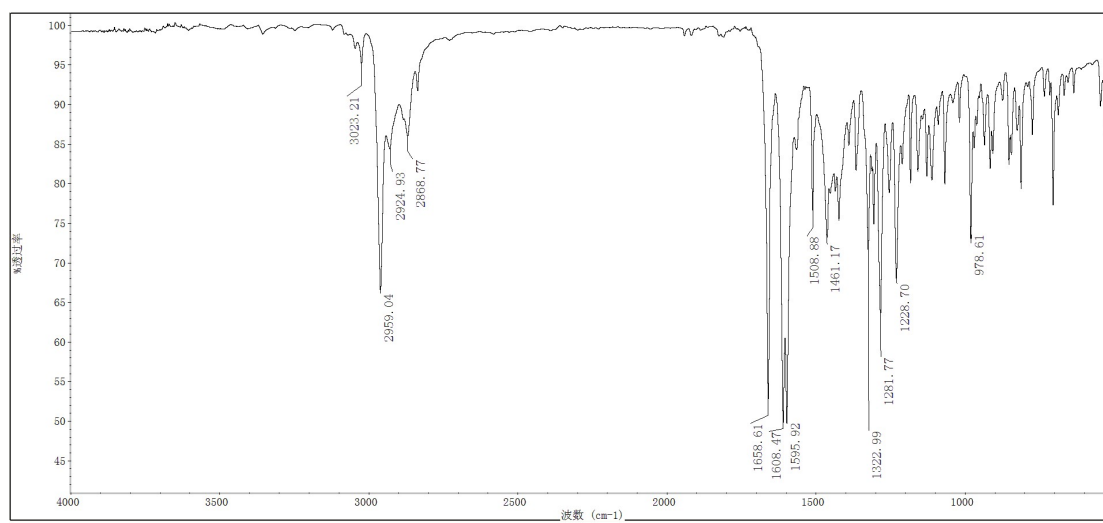


Figure 30. IR spectrum of compound **4m**

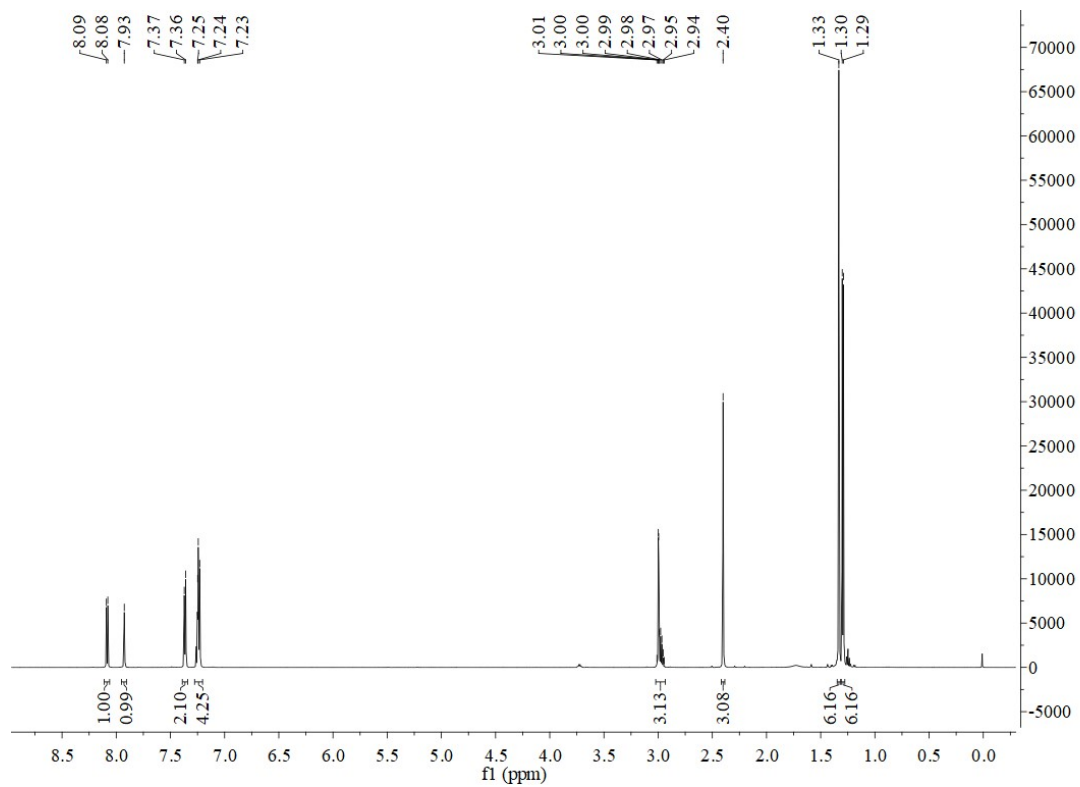


Figure 31. ^1H NMR spectrum of compound 4m

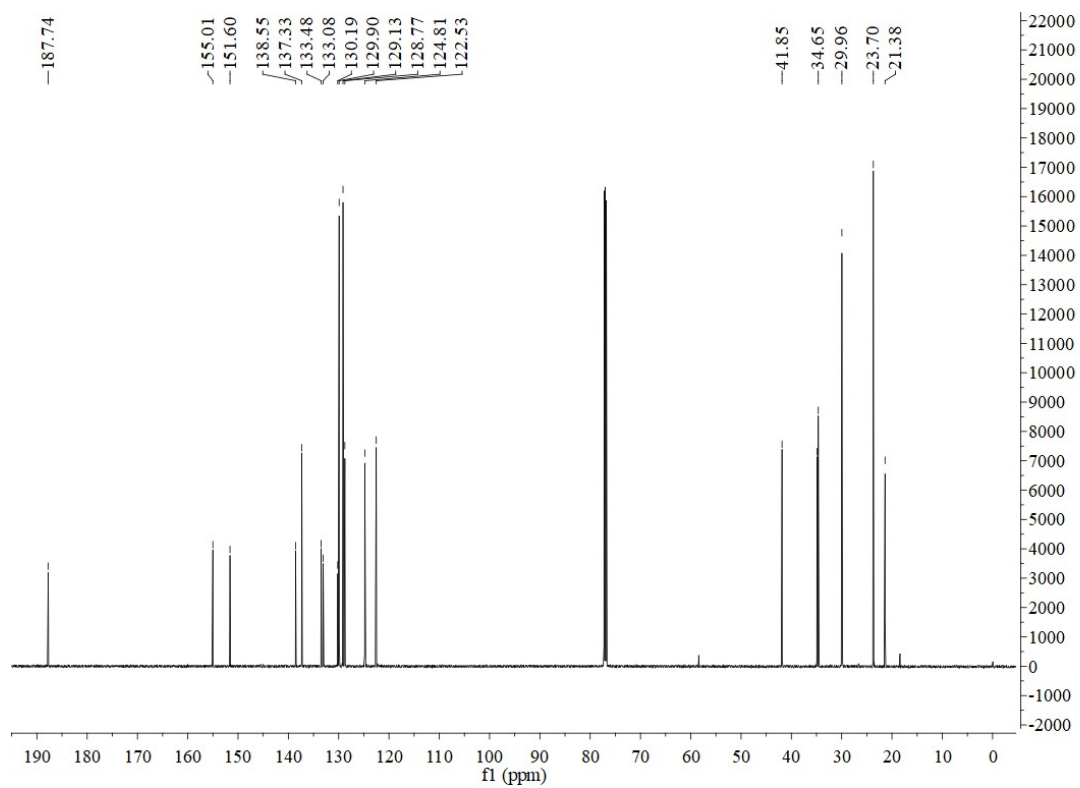


Figure 32. ^{13}C NMR spectrum of compound 4m

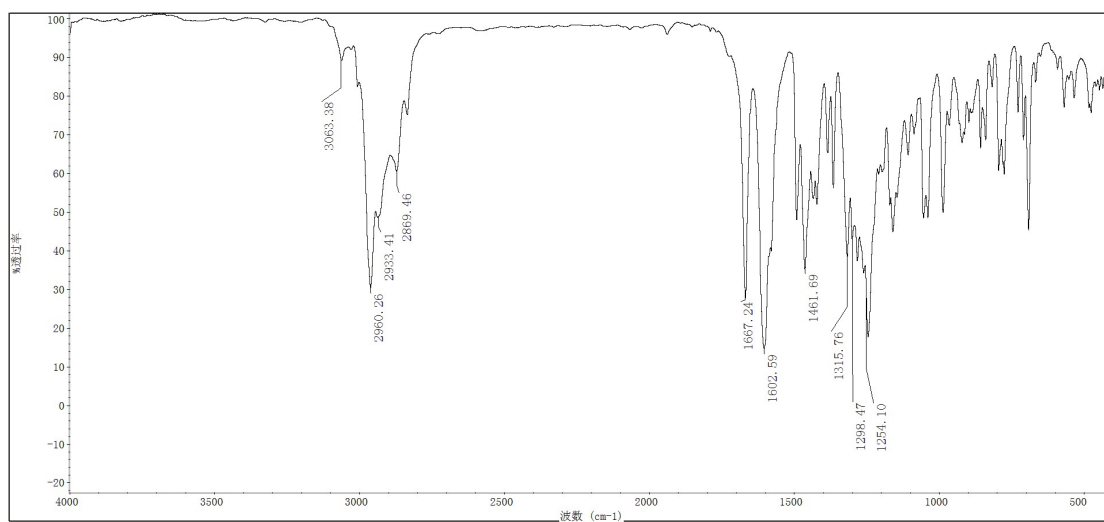


Figure 33. IR spectrum of compound 4n

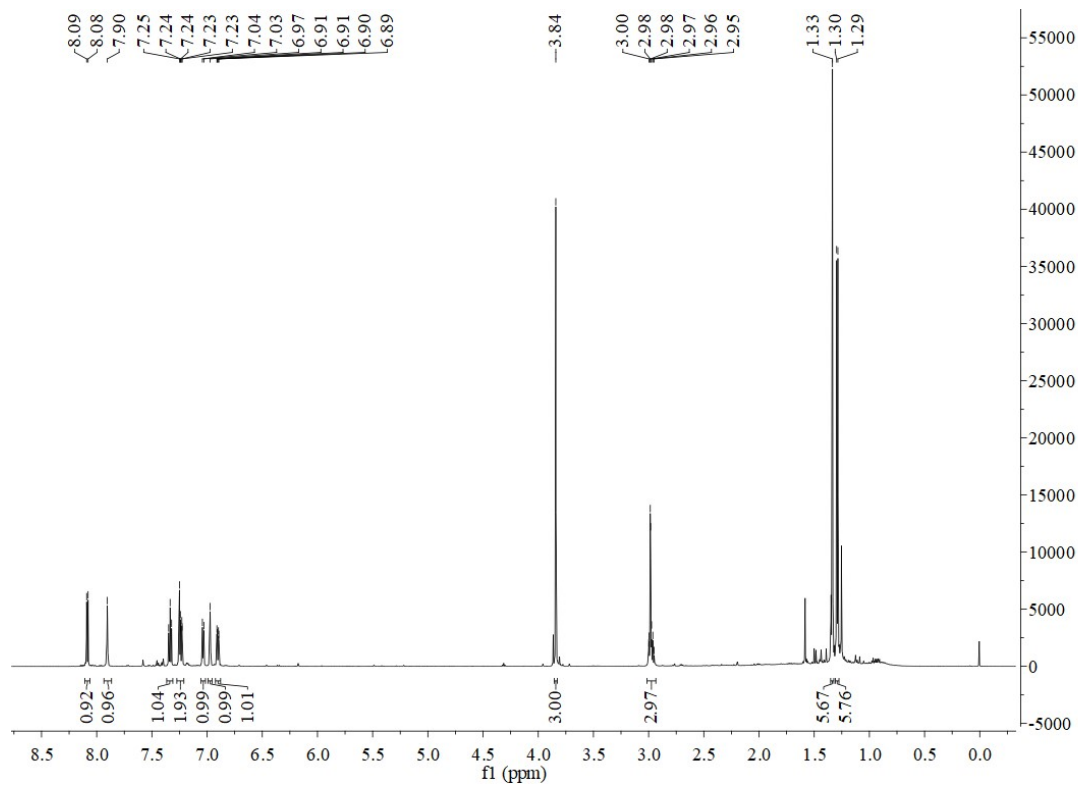


Figure 34. ¹H NMR spectrum of compound 4n

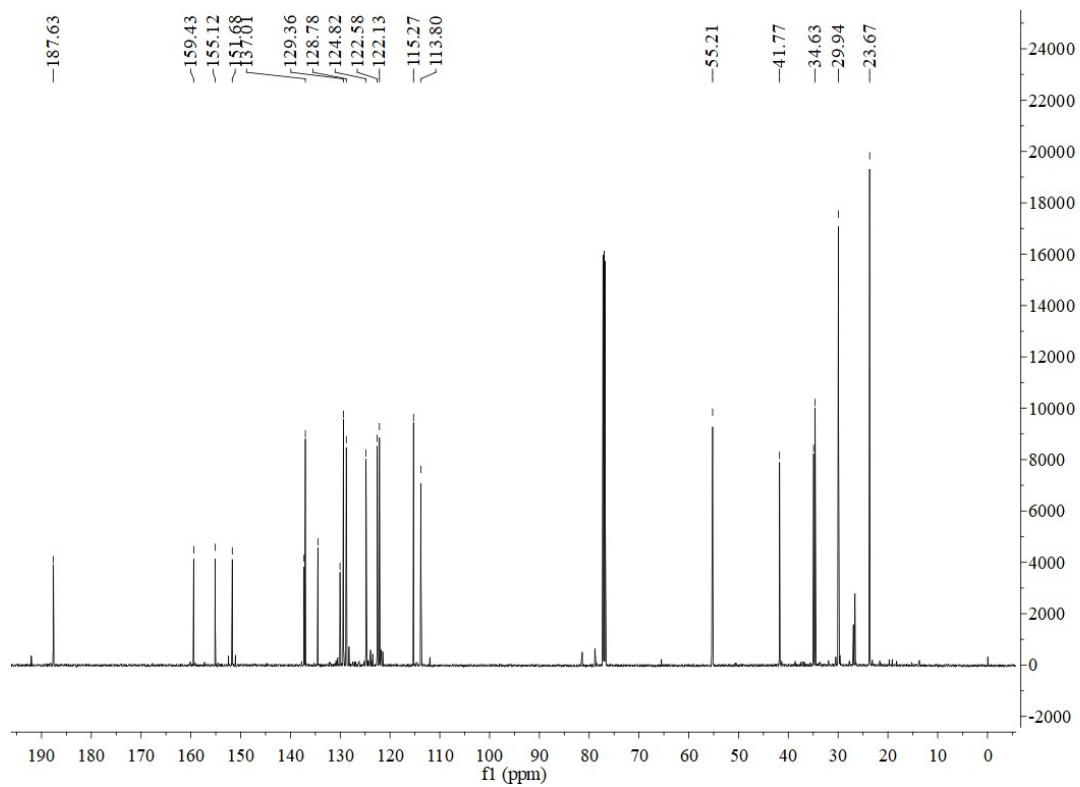


Figure 35. ^{13}C NMR spectrum of compound **4n**

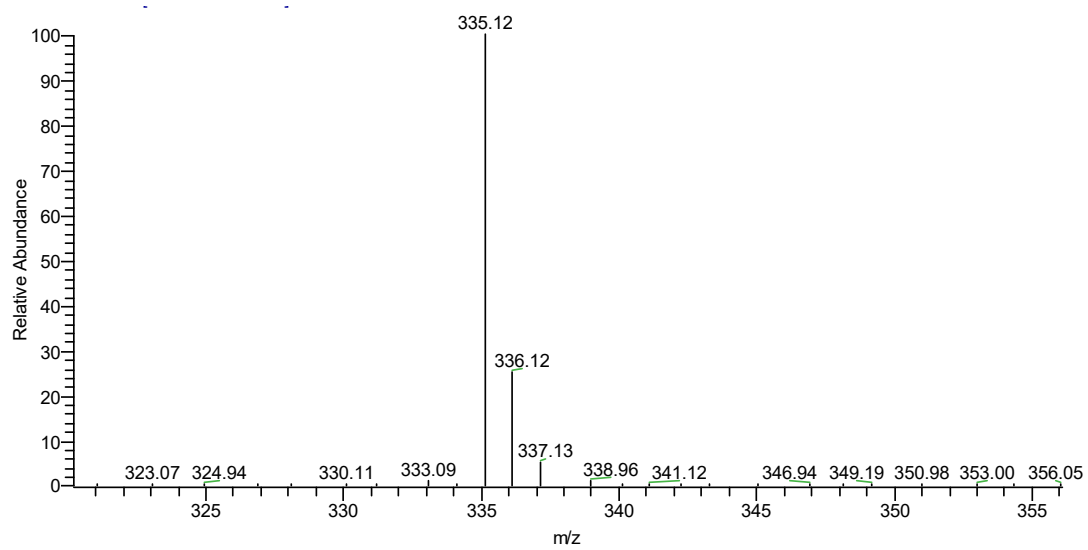


Figure 36. MS spectrum of compound **4n**

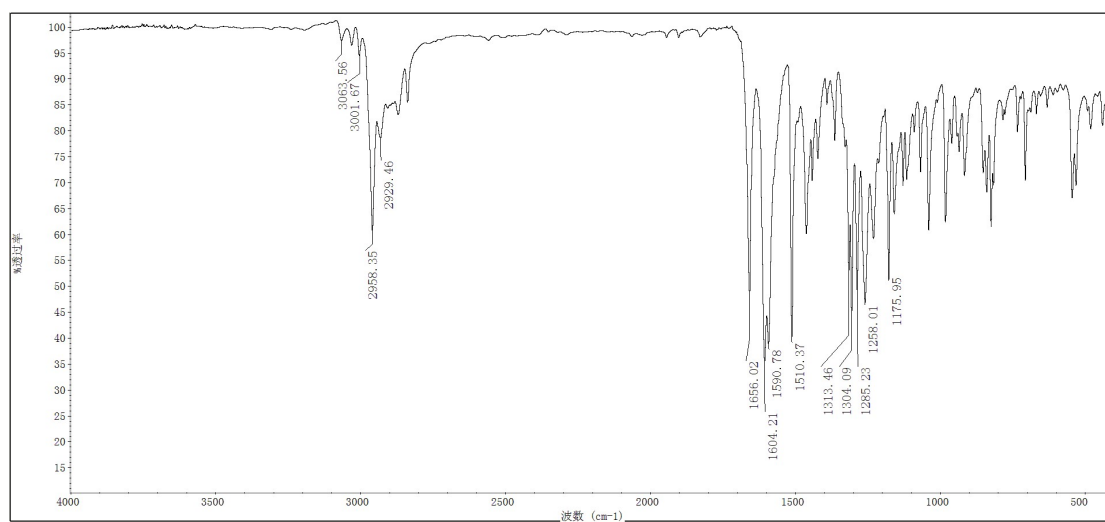


Figure 37. IR spectrum of compound 40

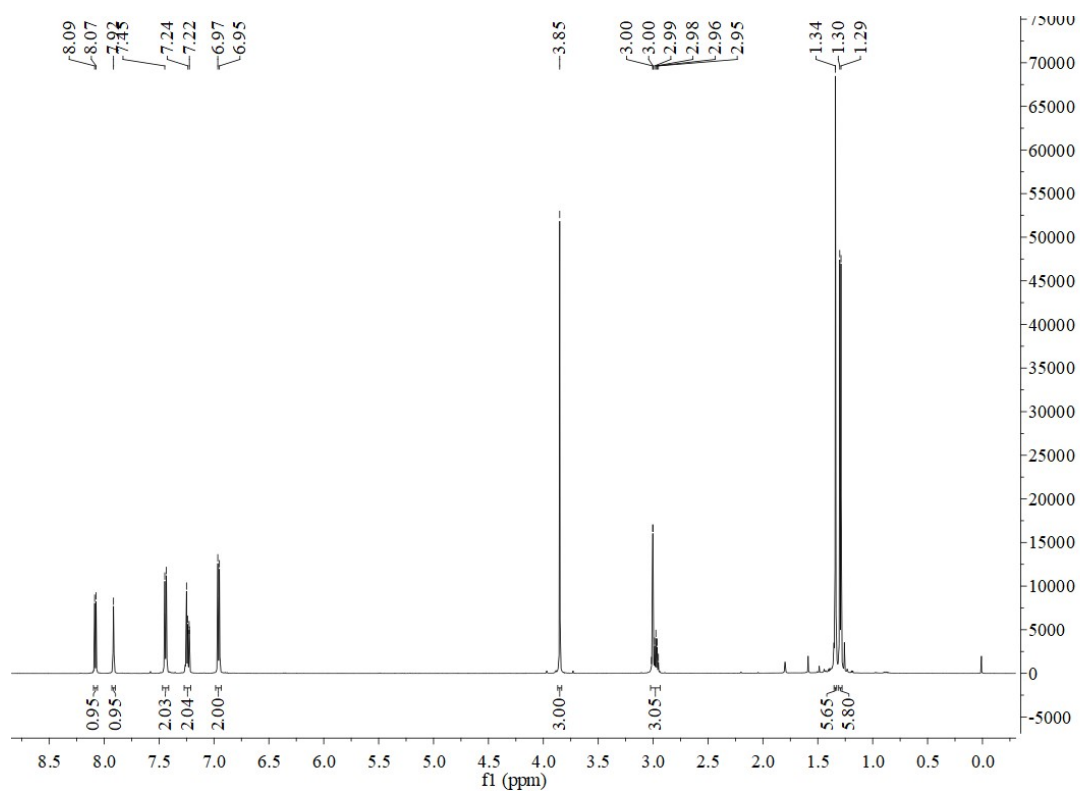


Figure 38. ¹H NMR spectrum of compound 40

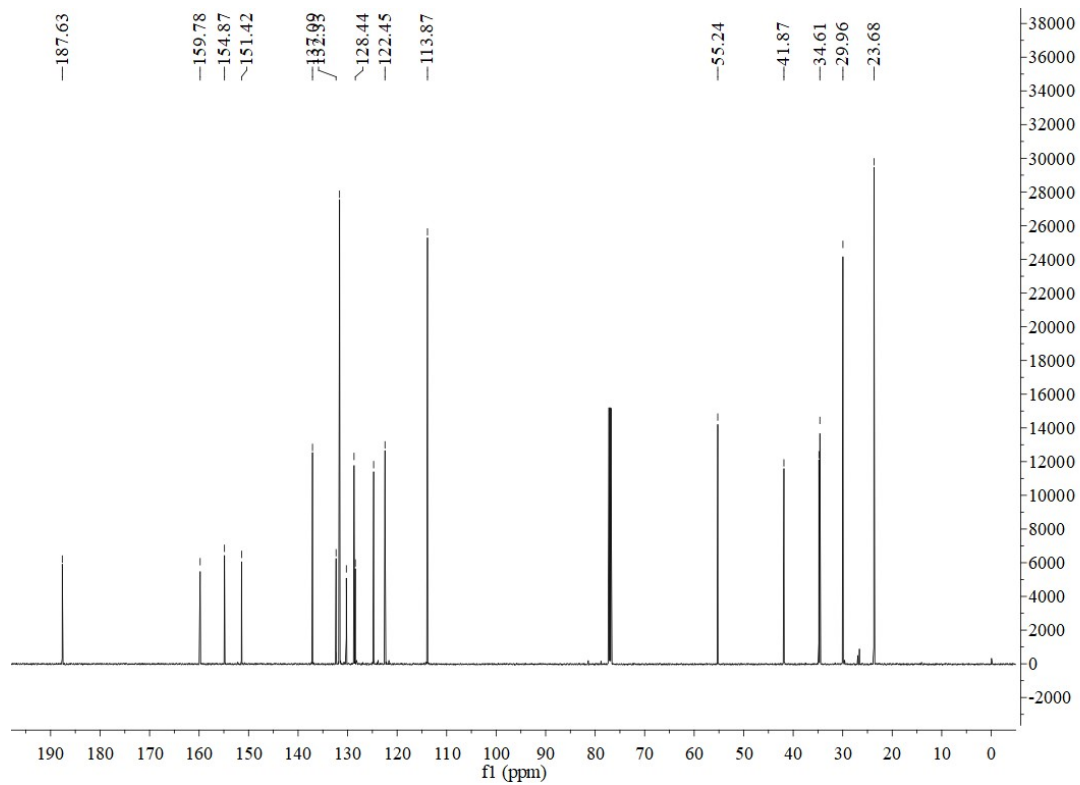


Figure 39. ^{13}C NMR spectrum of compound **4o**

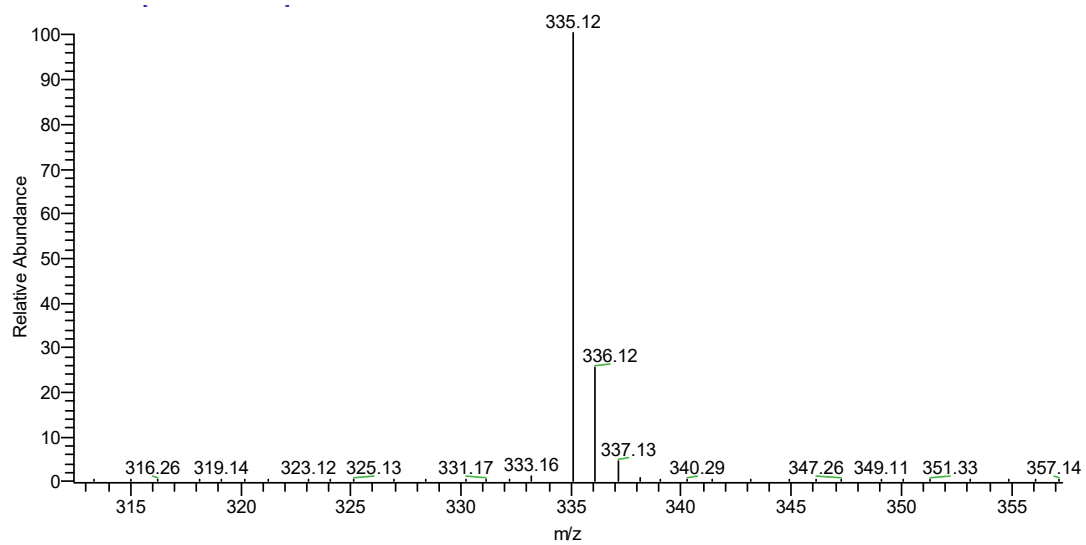


Figure 40. MS spectrum of compound **4o**

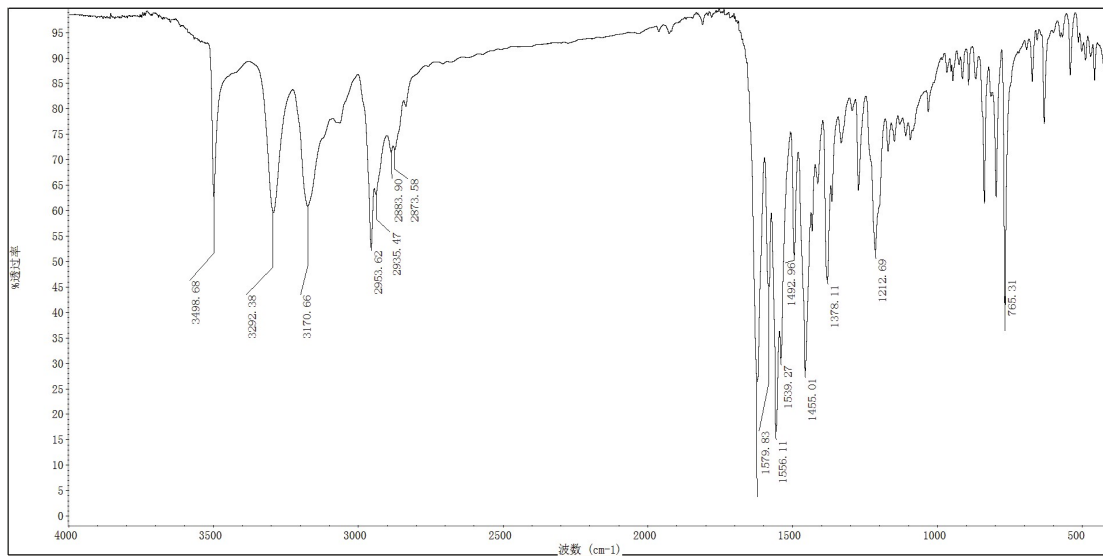


Figure 41. IR spectrum of compound 5a

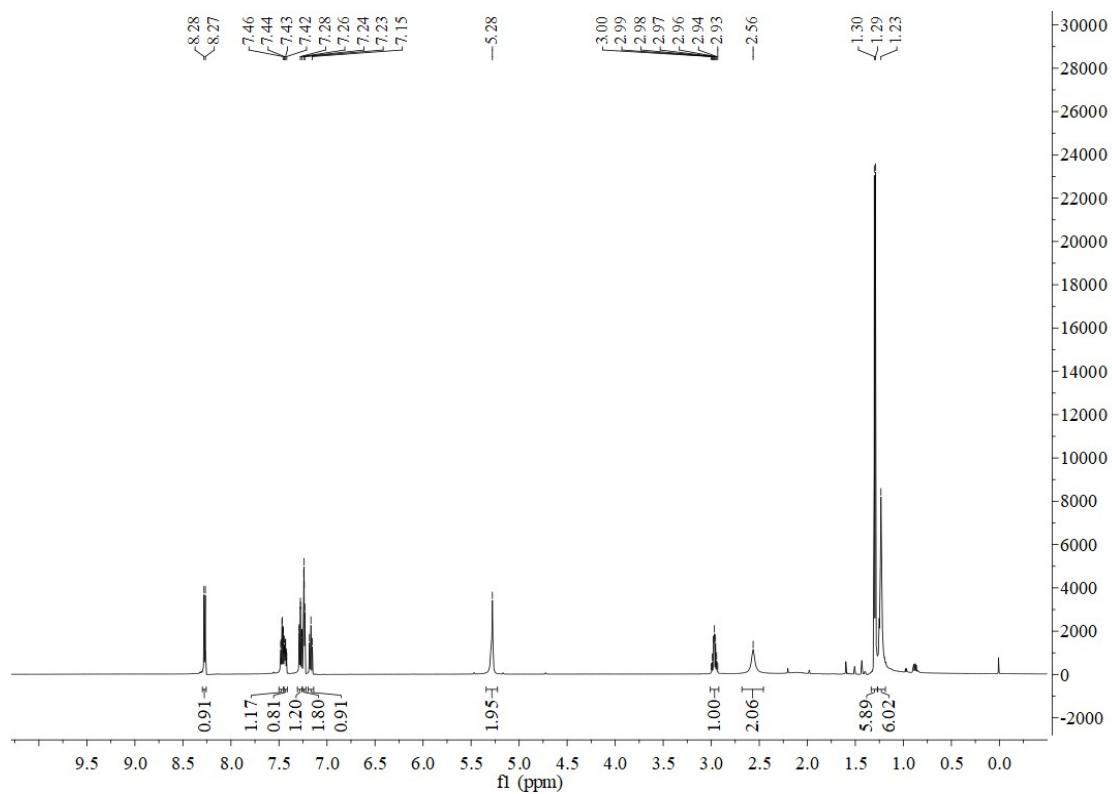


Figure 42. ^1H NMR spectrum of compound 5a

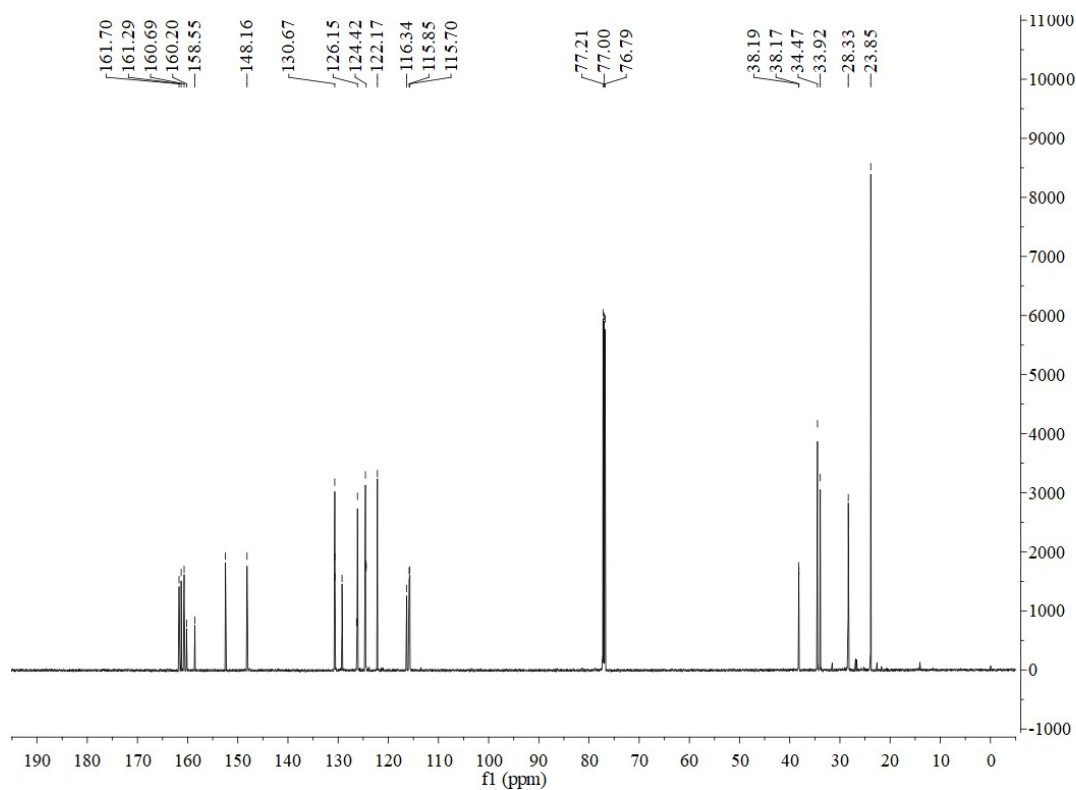


Figure 43. ^{13}C NMR spectrum of compound **5a**

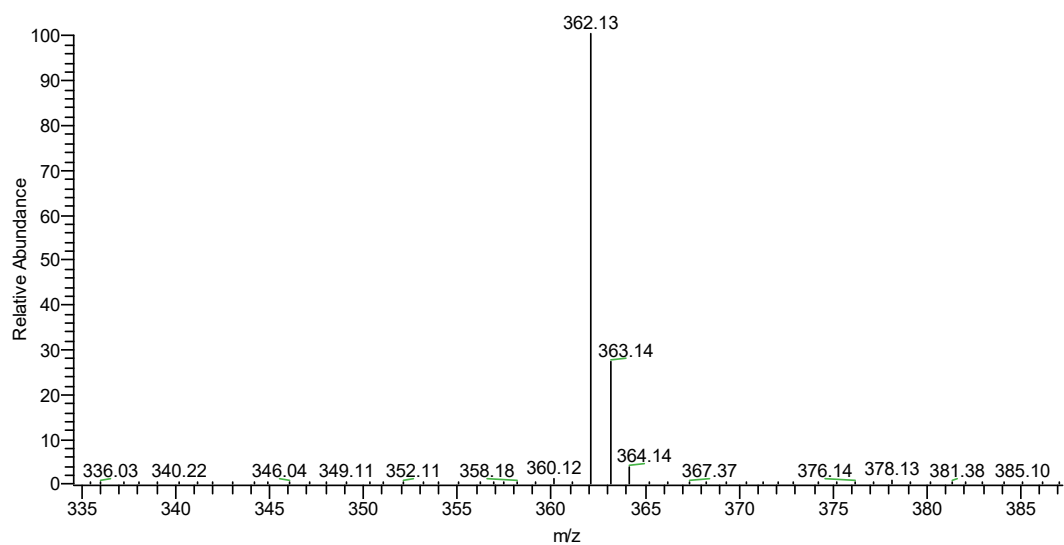


Figure 44. MS spectrum of compound **5a**

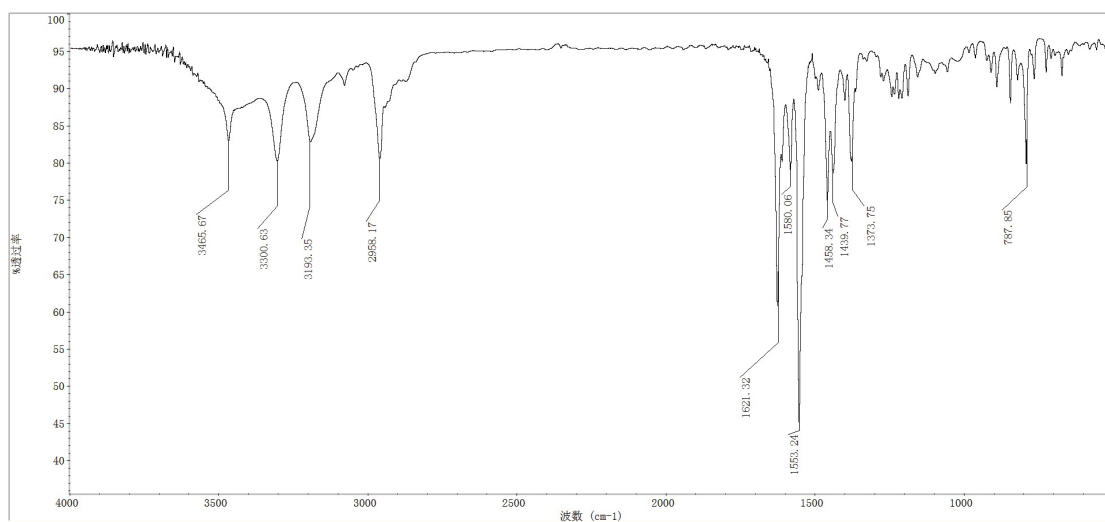


Figure 45. IR spectrum of compound **5b**

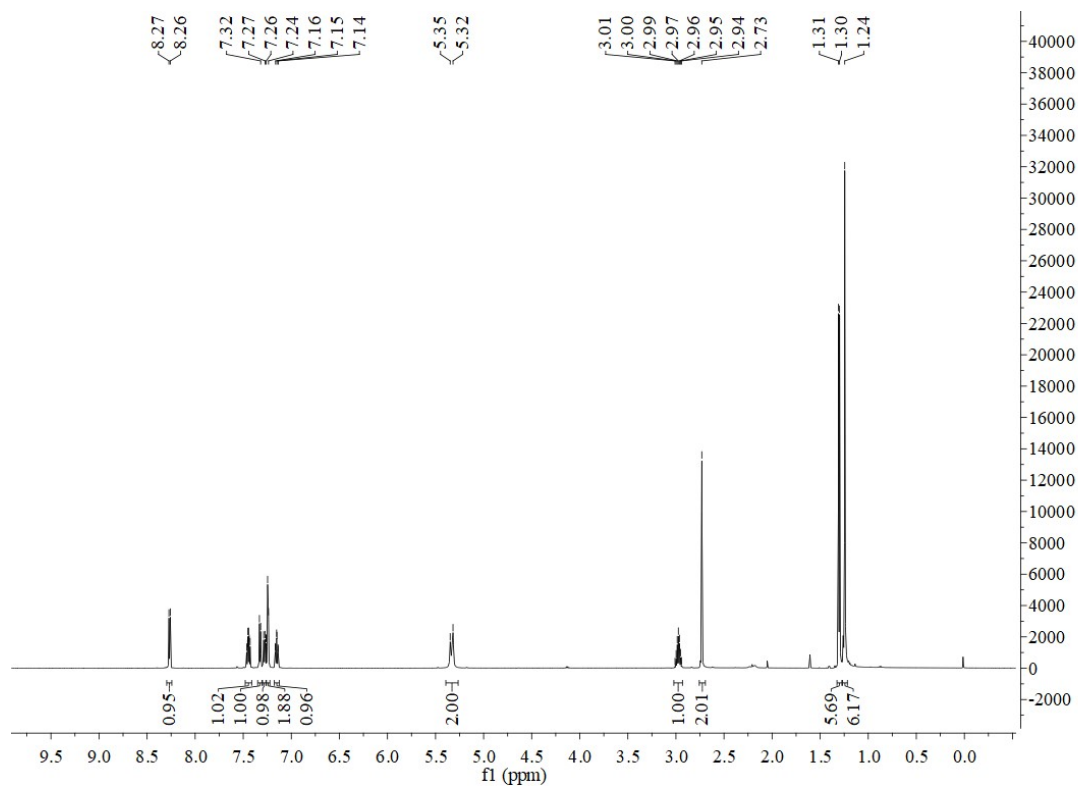


Figure 46. ¹H NMR spectrum of compound **5b**

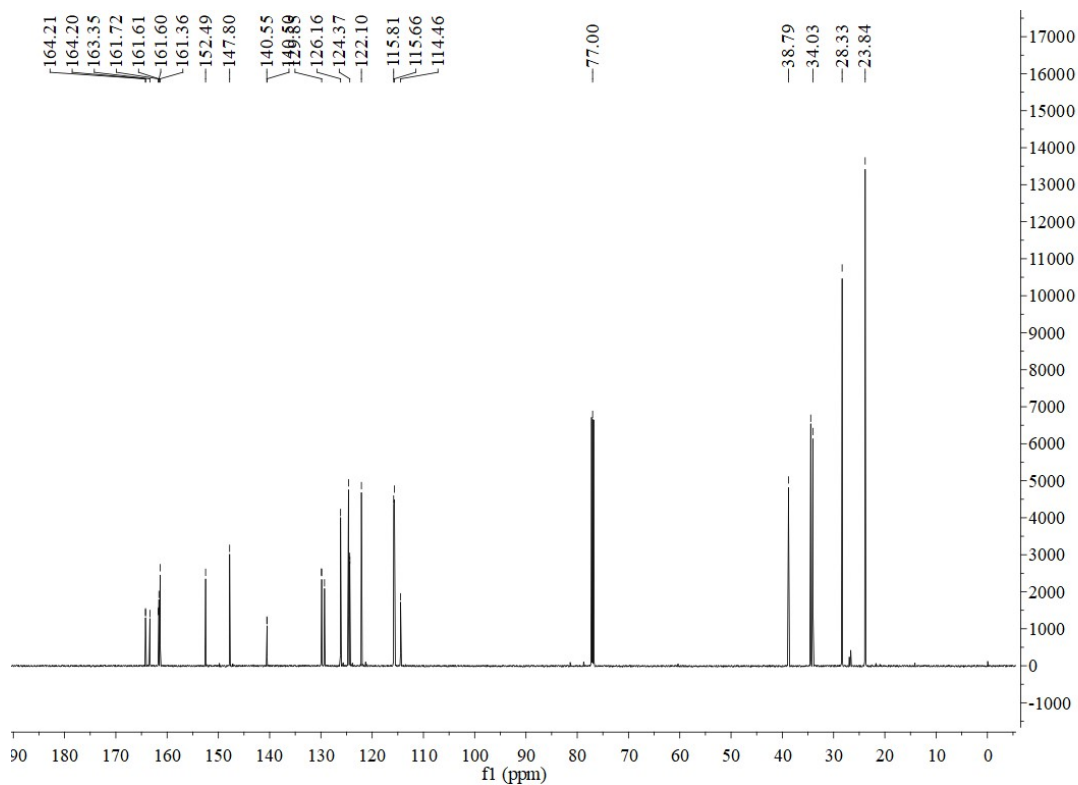


Figure 47. ^{13}C NMR spectrum of compound **5b**

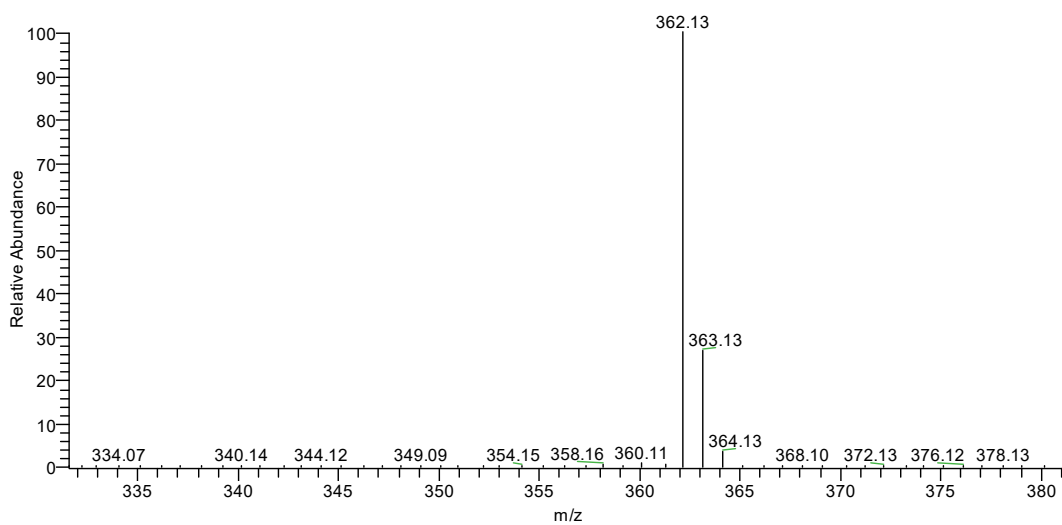


Figure 48. MS spectrum of compound **5b**

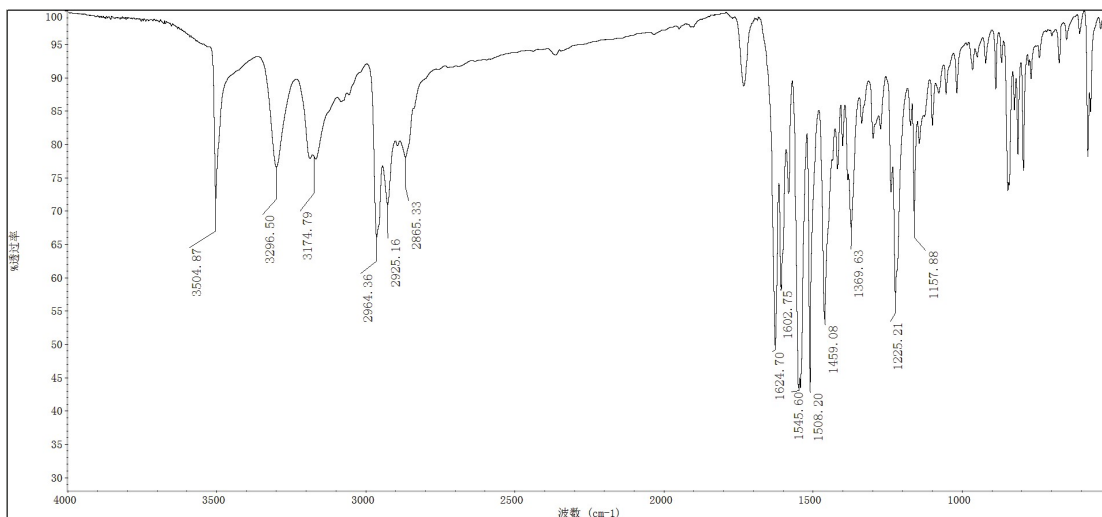


Figure 49. IR spectrum of compound 5c

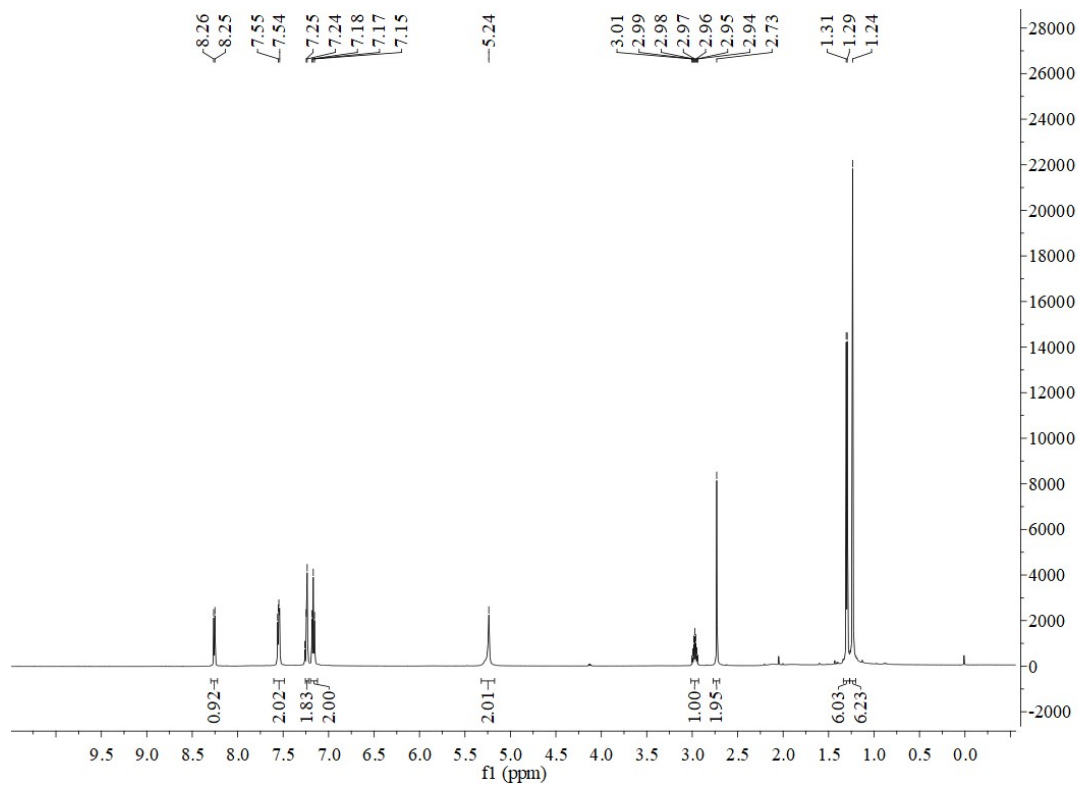


Figure 50. ¹H NMR spectrum of compound 5c

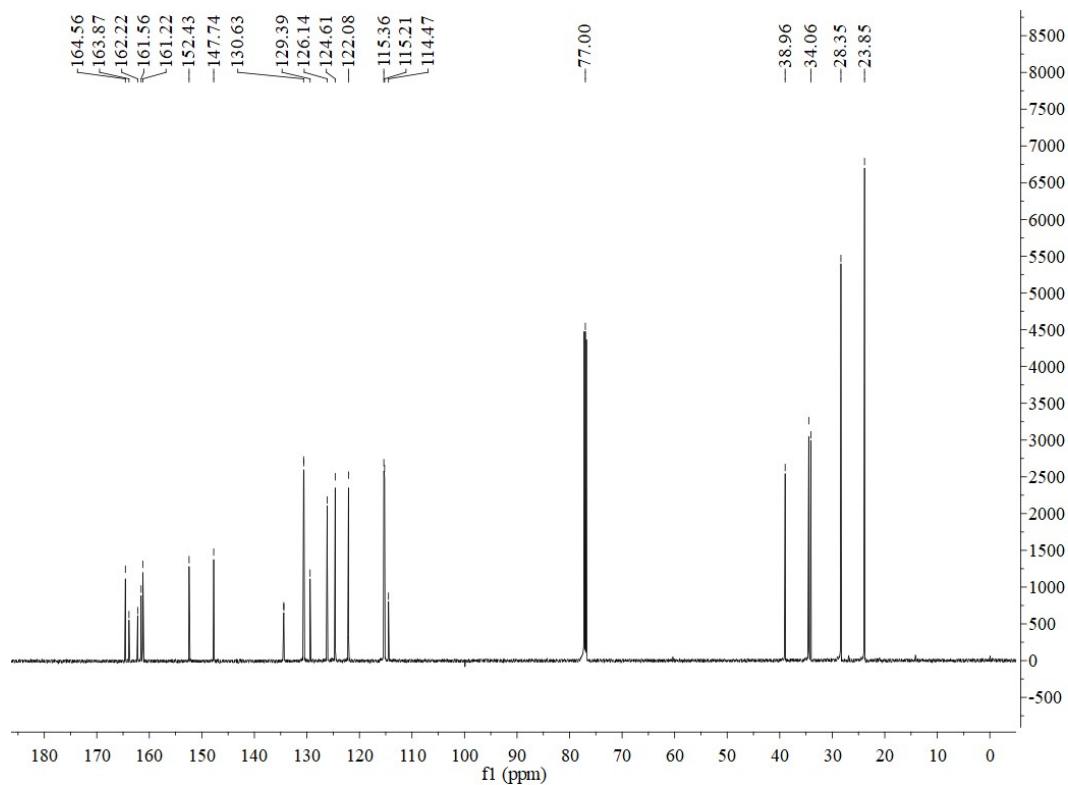


Figure 51. ^{13}C NMR spectrum of compound **5c**

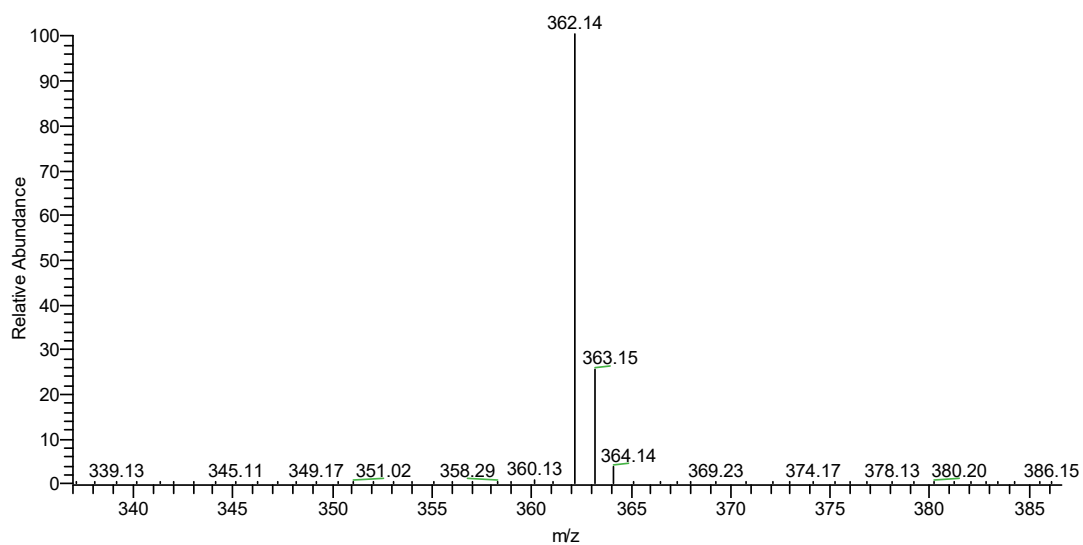


Figure 52. MS spectrum of compound **5c**

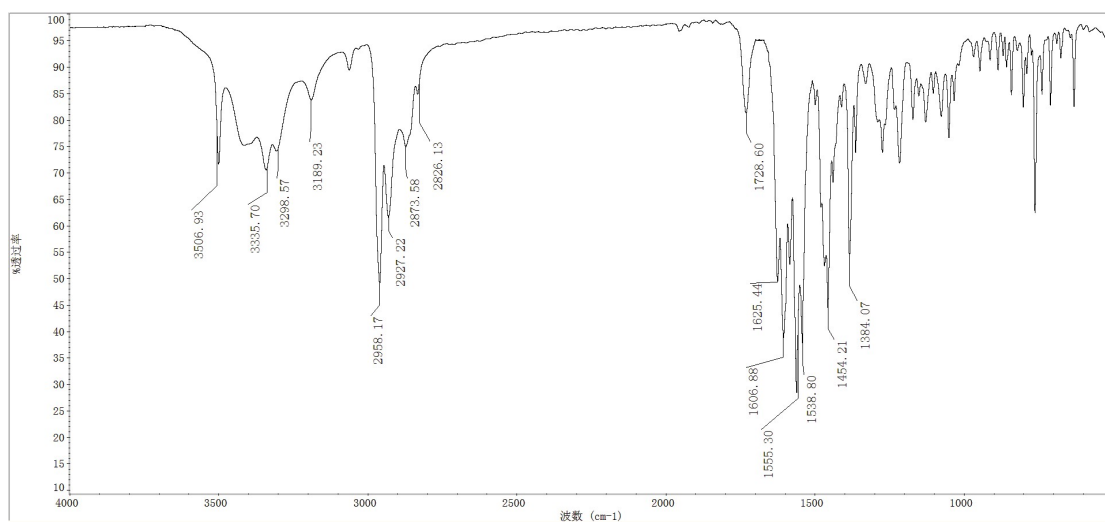


Figure 53. IR spectrum of compound 5d

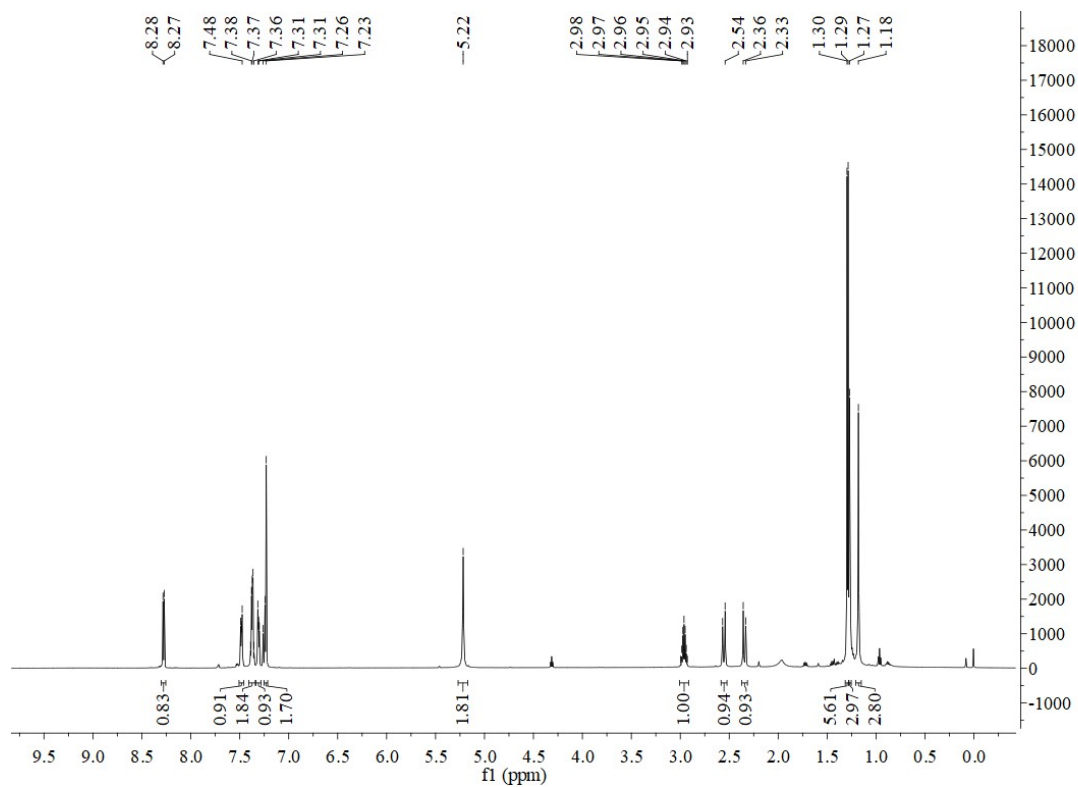


Figure 54. ¹H NMR spectrum of compound 5d

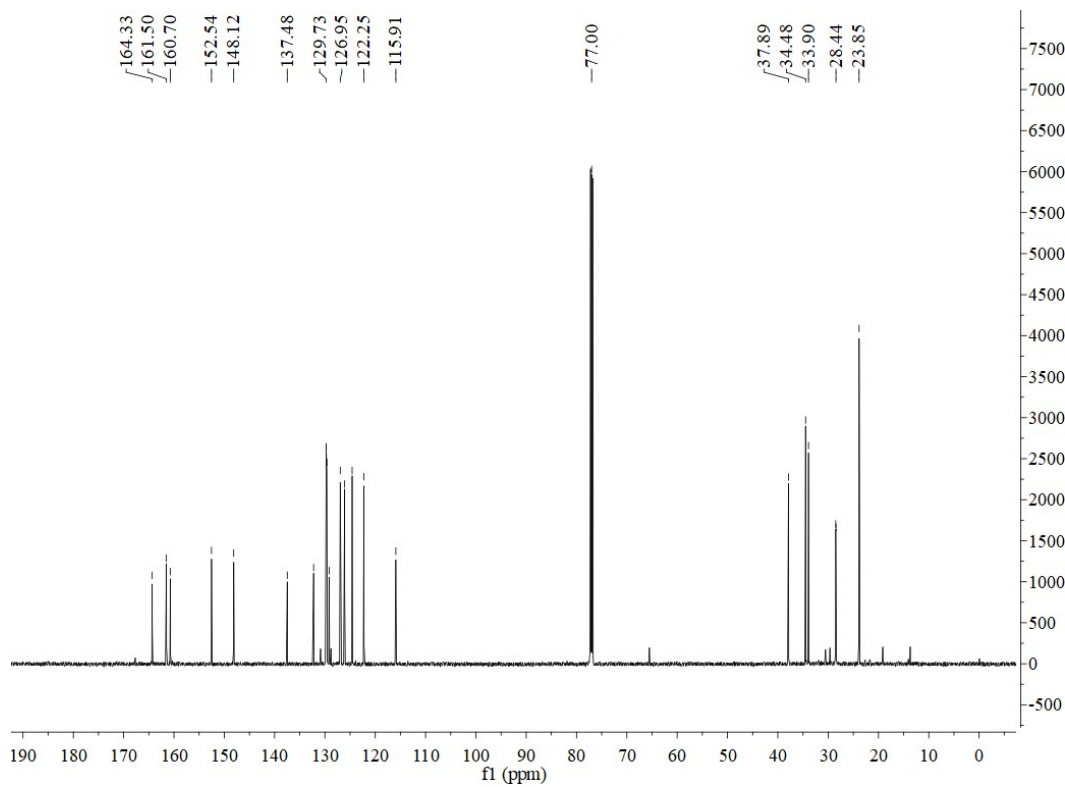


Figure 55. ^{13}C NMR spectrum of compound **5d**

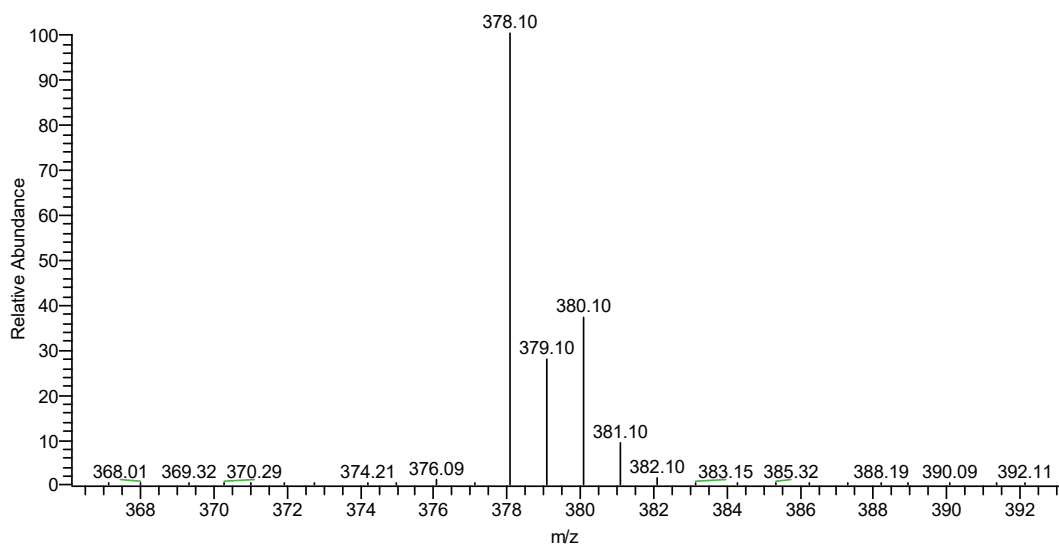


Figure 56. MS spectrum of compound **5d**

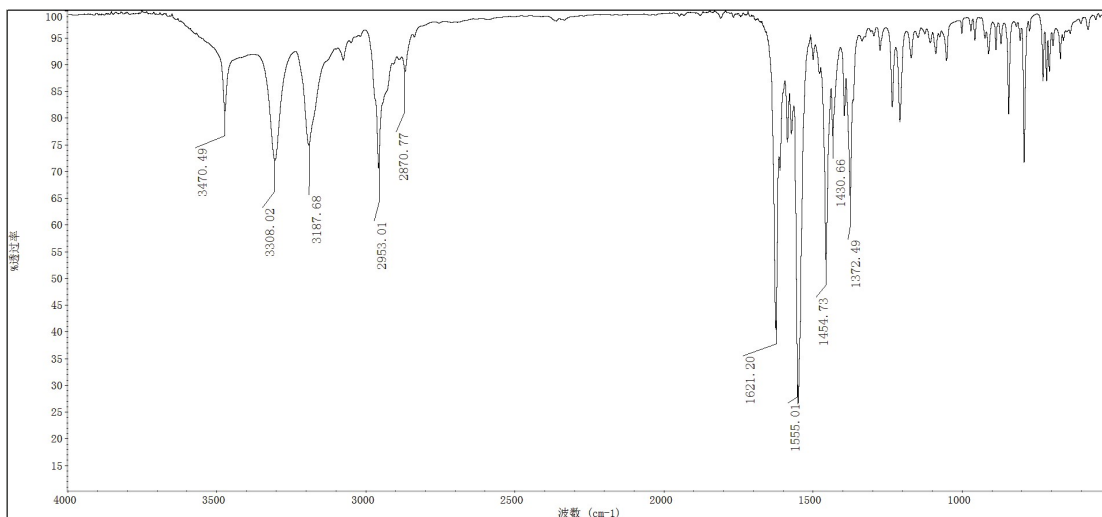


Figure 57. IR spectrum of compound 5e

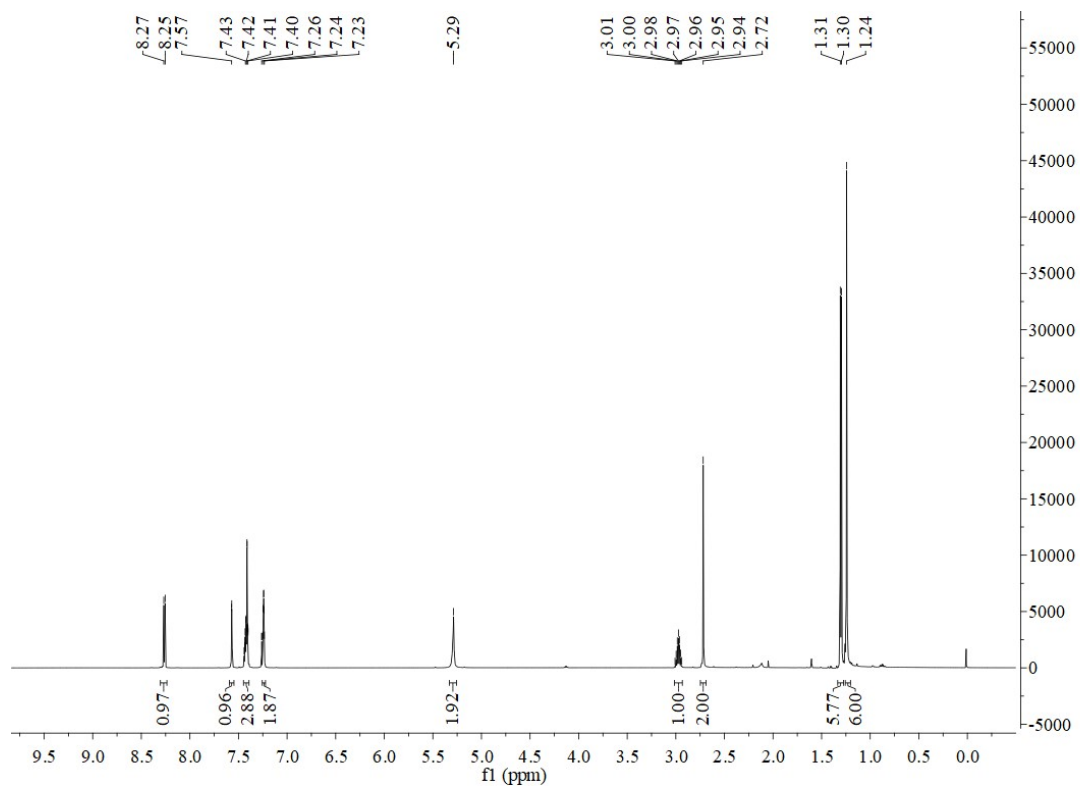


Figure 58. ¹H NMR spectrum of compound 5e

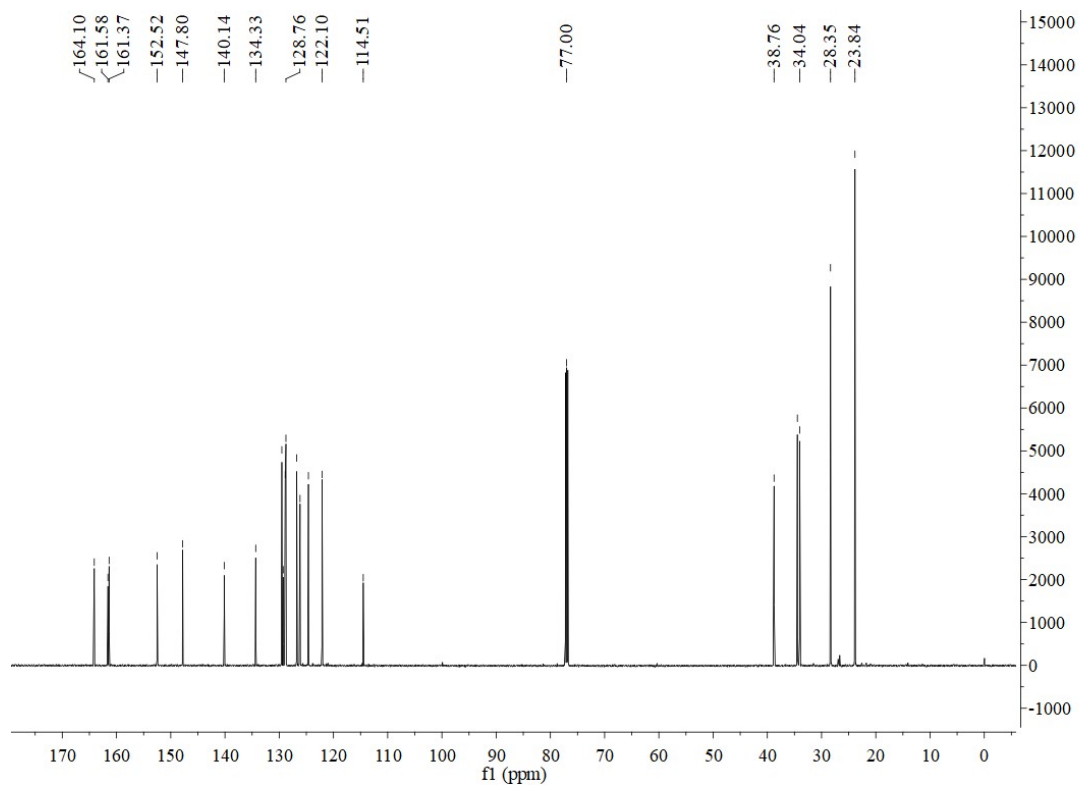


Figure 59. ^{13}C NMR spectrum of compound **5e**

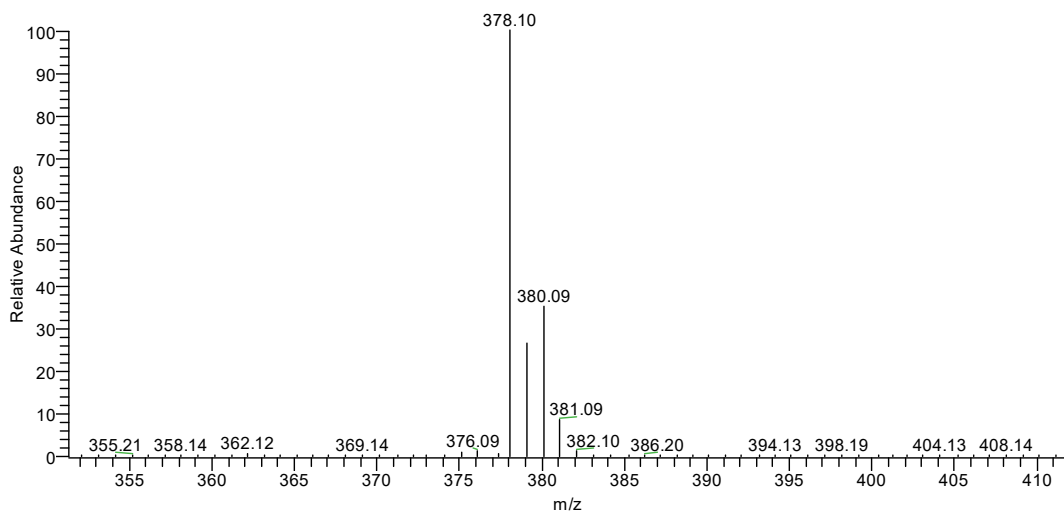


Figure 60. MS spectrum of compound **5e**

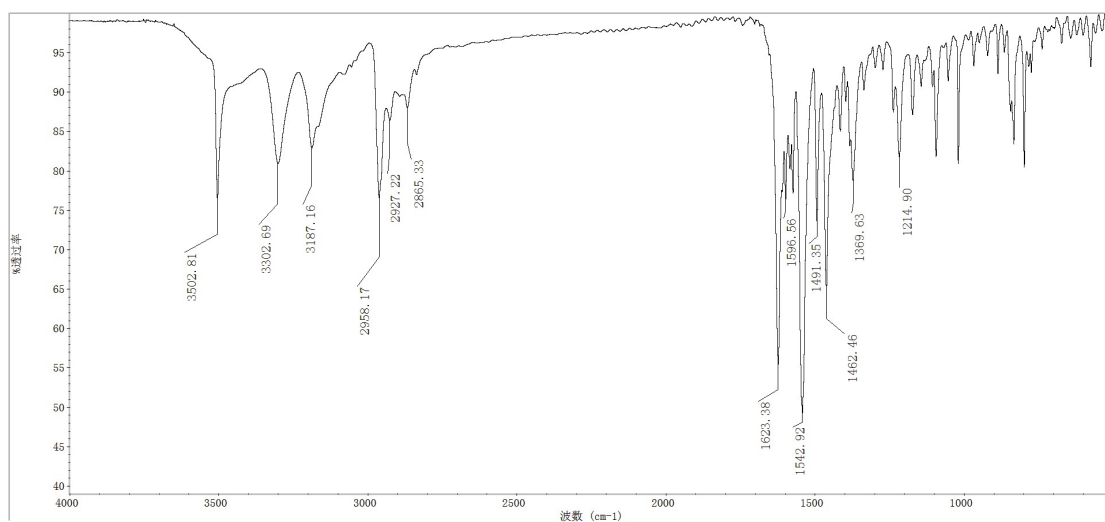


Figure 61. IR spectrum of compound **5f**

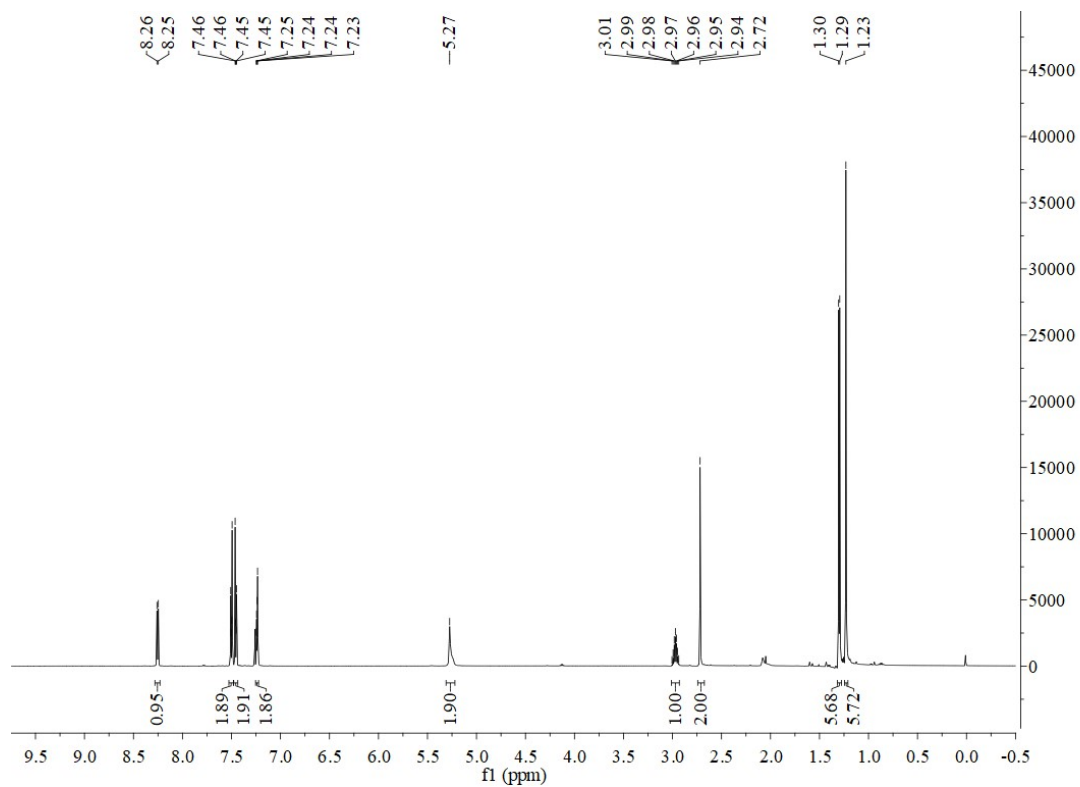


Figure 62. ^1H NMR spectrum of compound **5f**

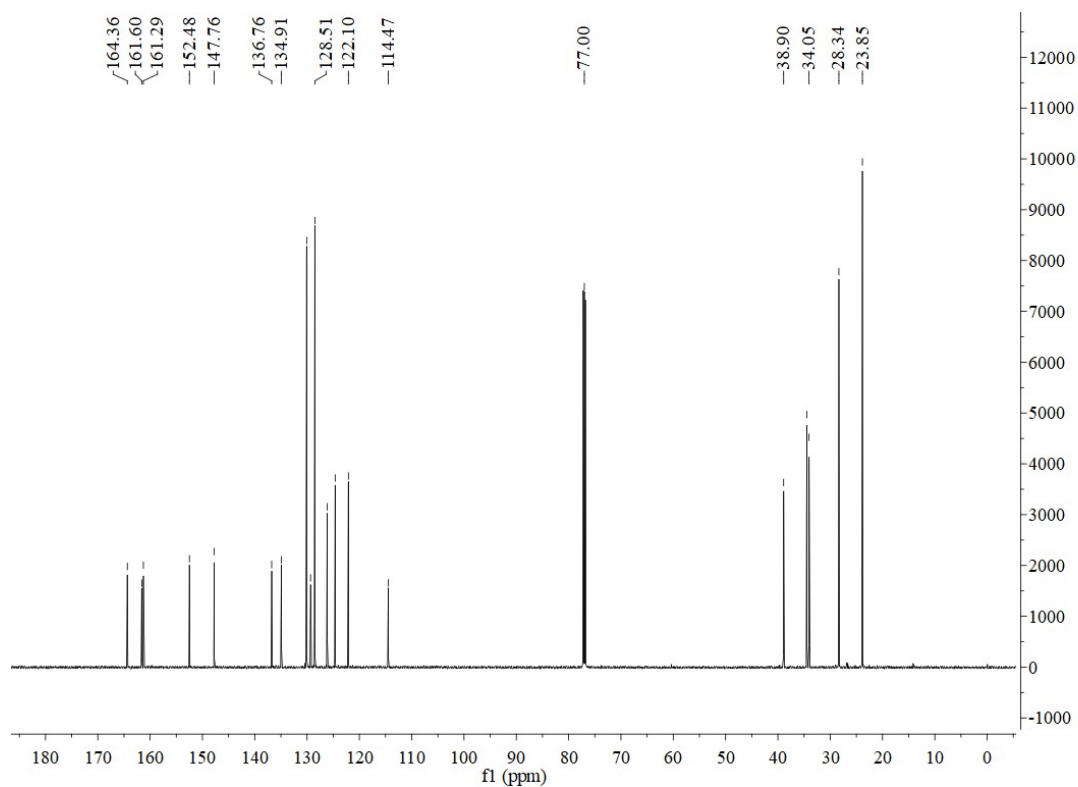


Figure 63. ^{13}C NMR spectrum of compound **5f**

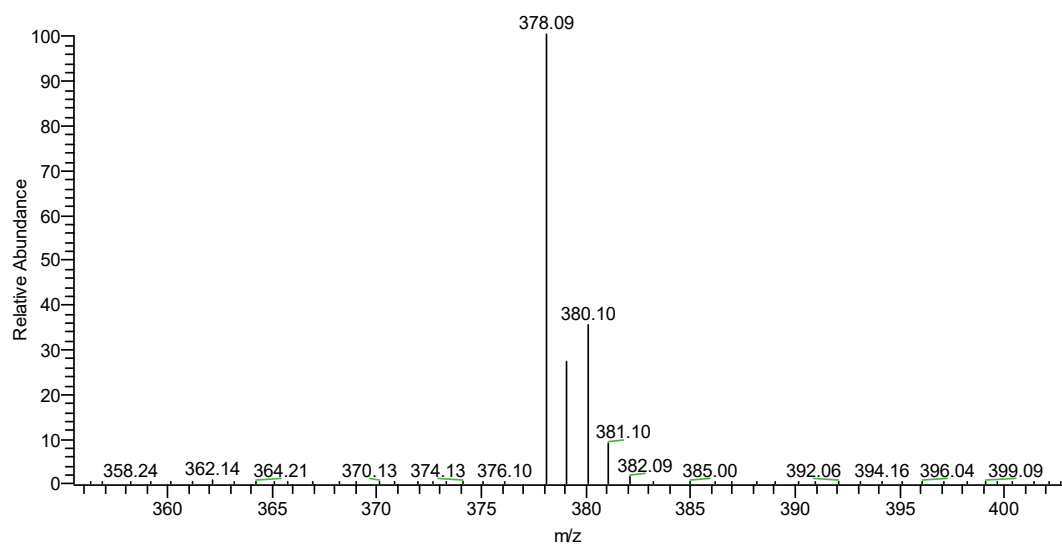


Figure 64. MS spectrum of compound **5f**

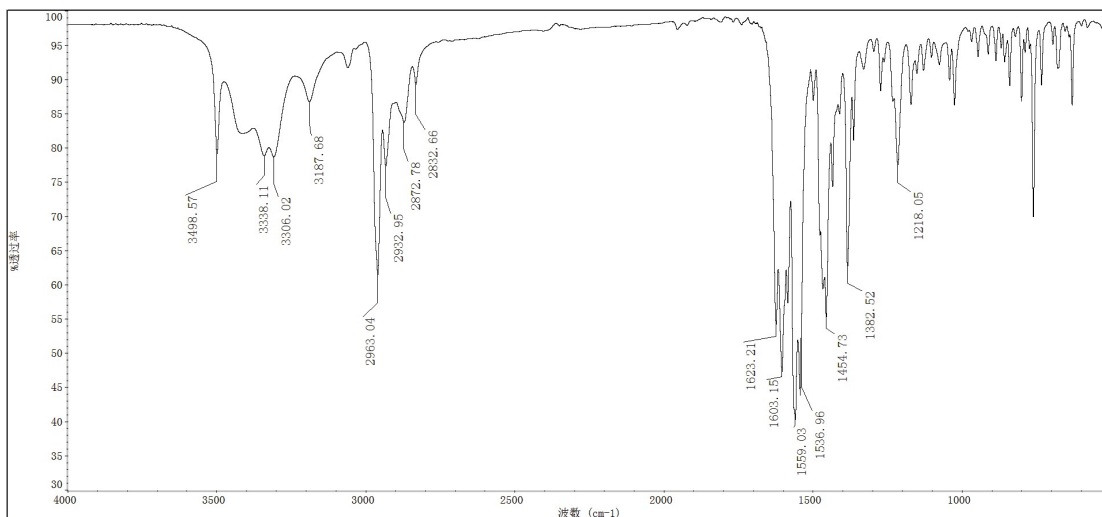


Figure 65. IR spectrum of compound 5g

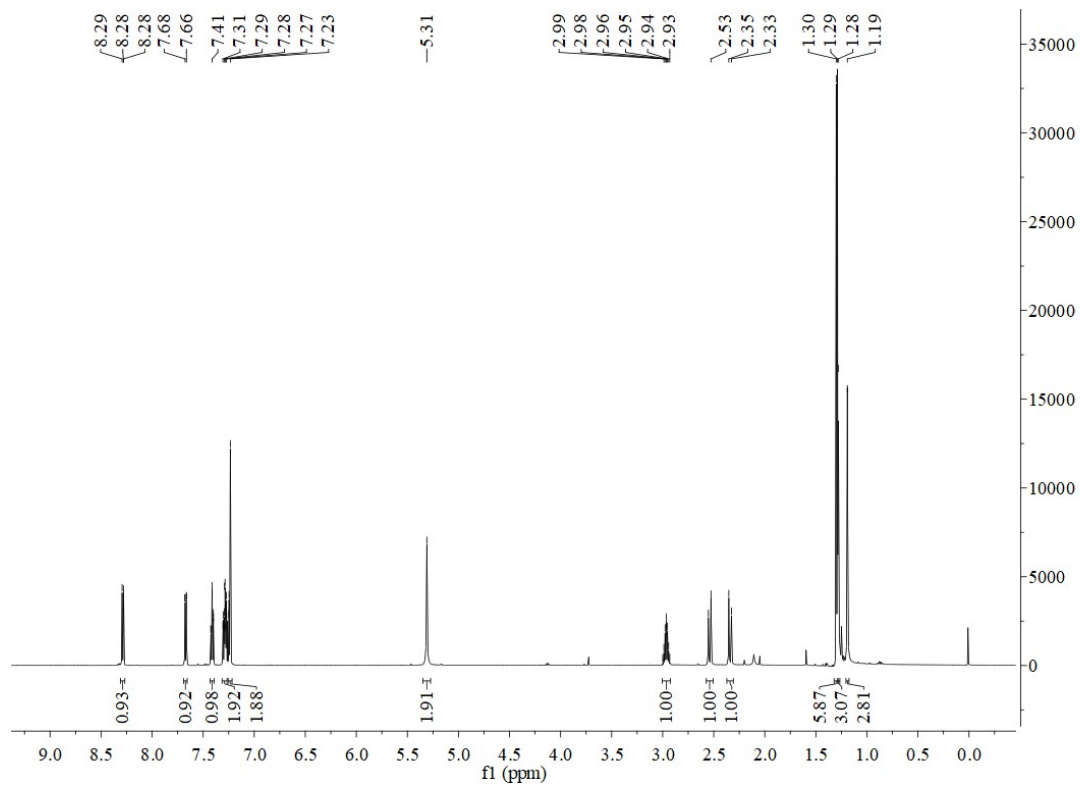


Figure 66. ¹H NMR spectrum of compound 5g

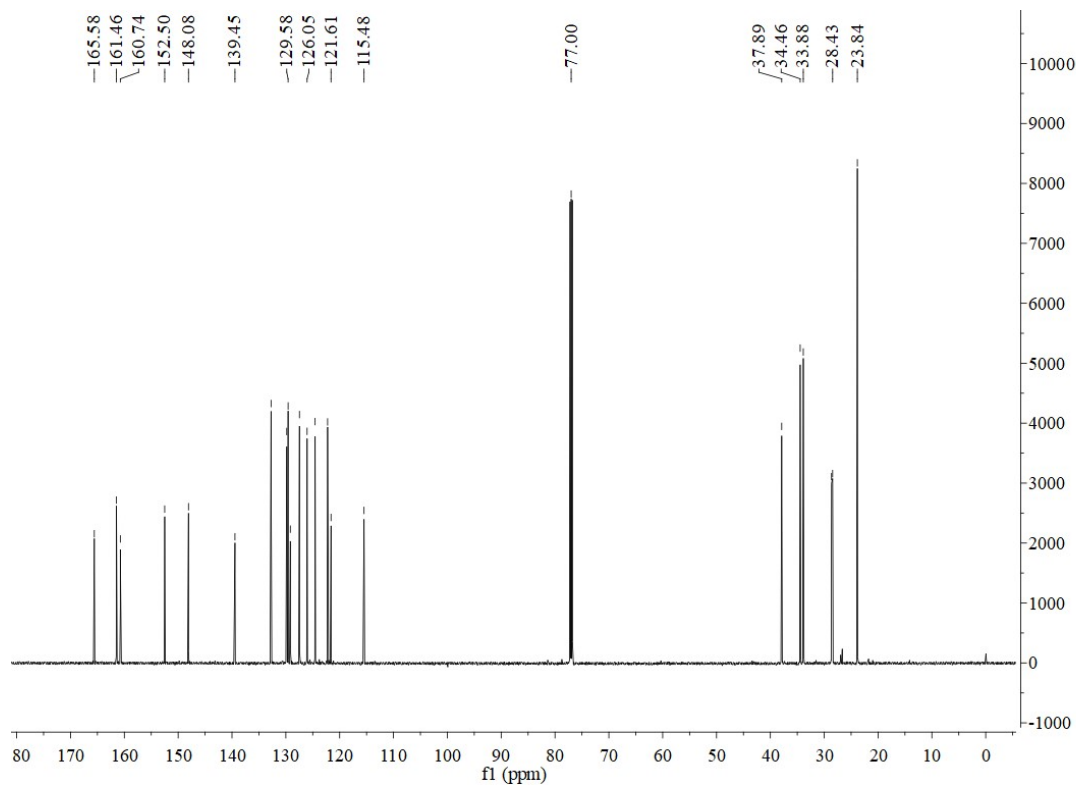


Figure 67. ^{13}C NMR spectrum of compound **5g**

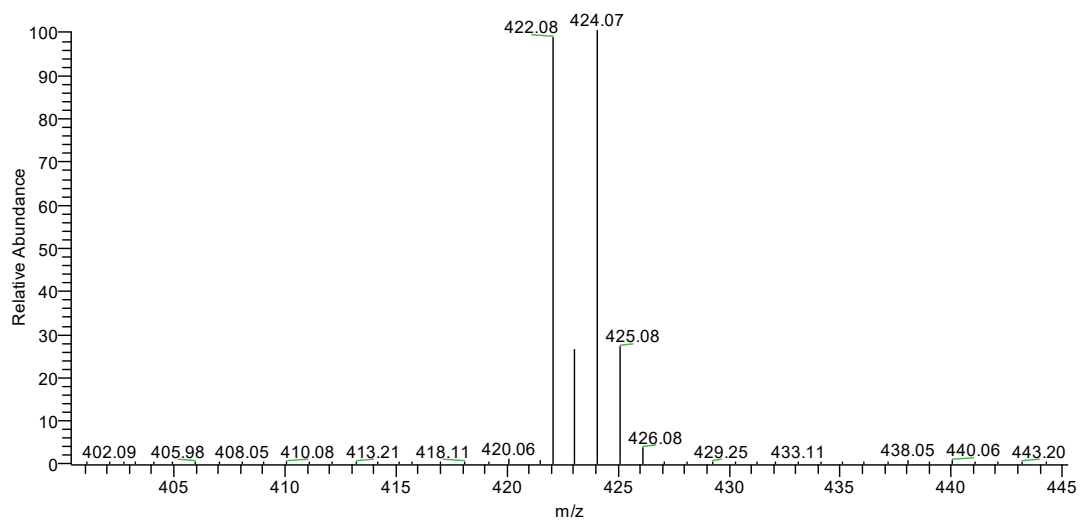


Figure 68. MS spectrum of compound **5g**

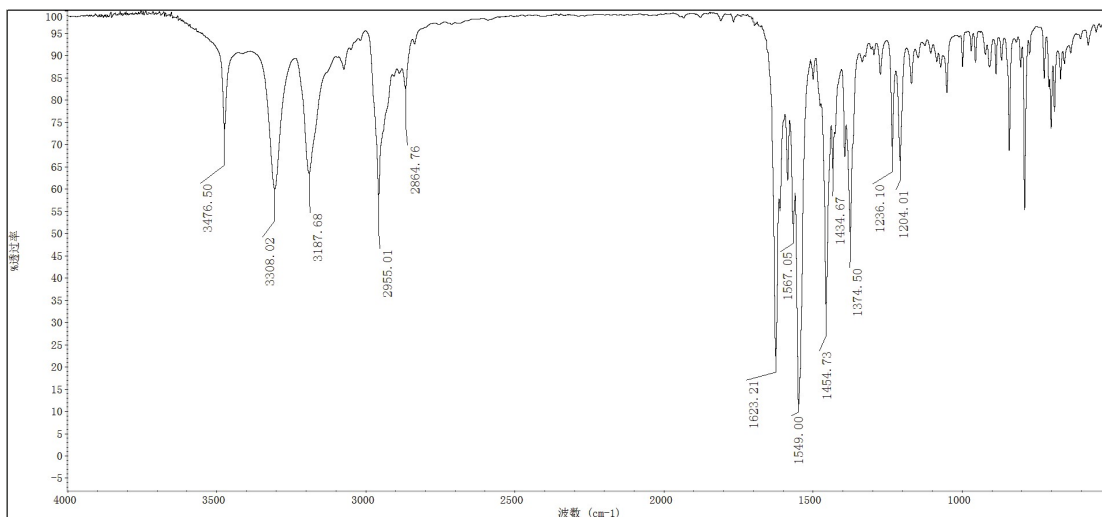


Figure 69. IR spectrum of compound 5h

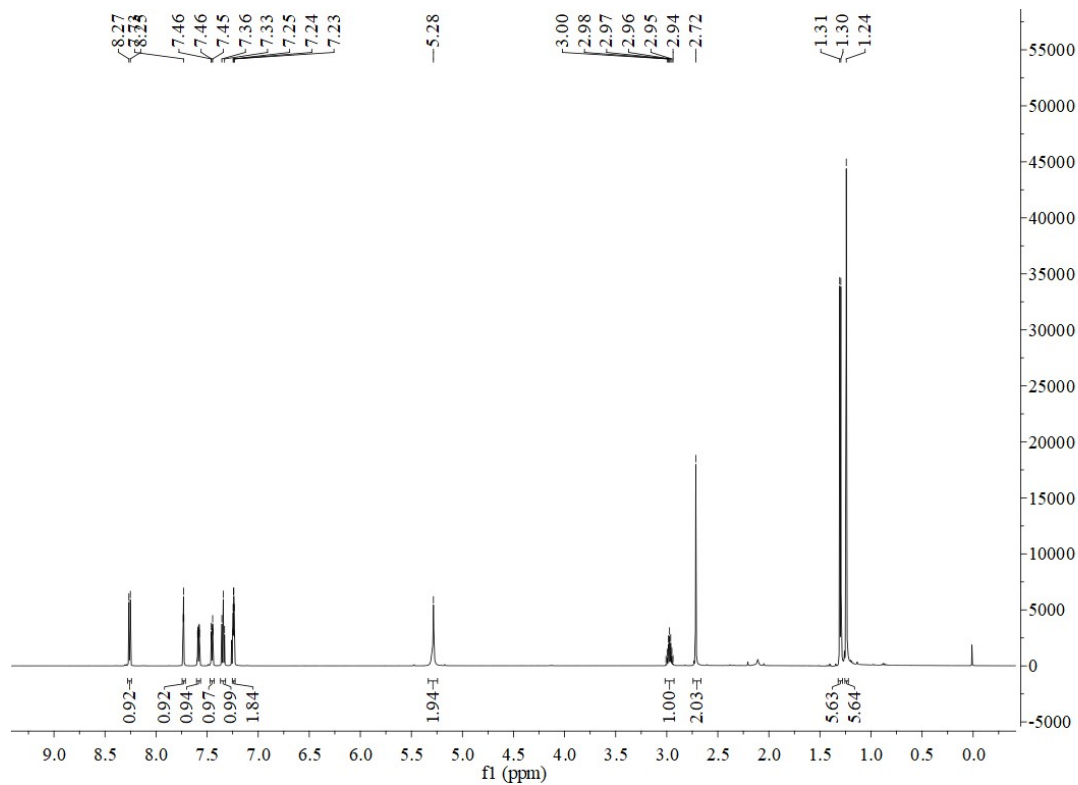


Figure 70. ¹H NMR spectrum of compound 5h

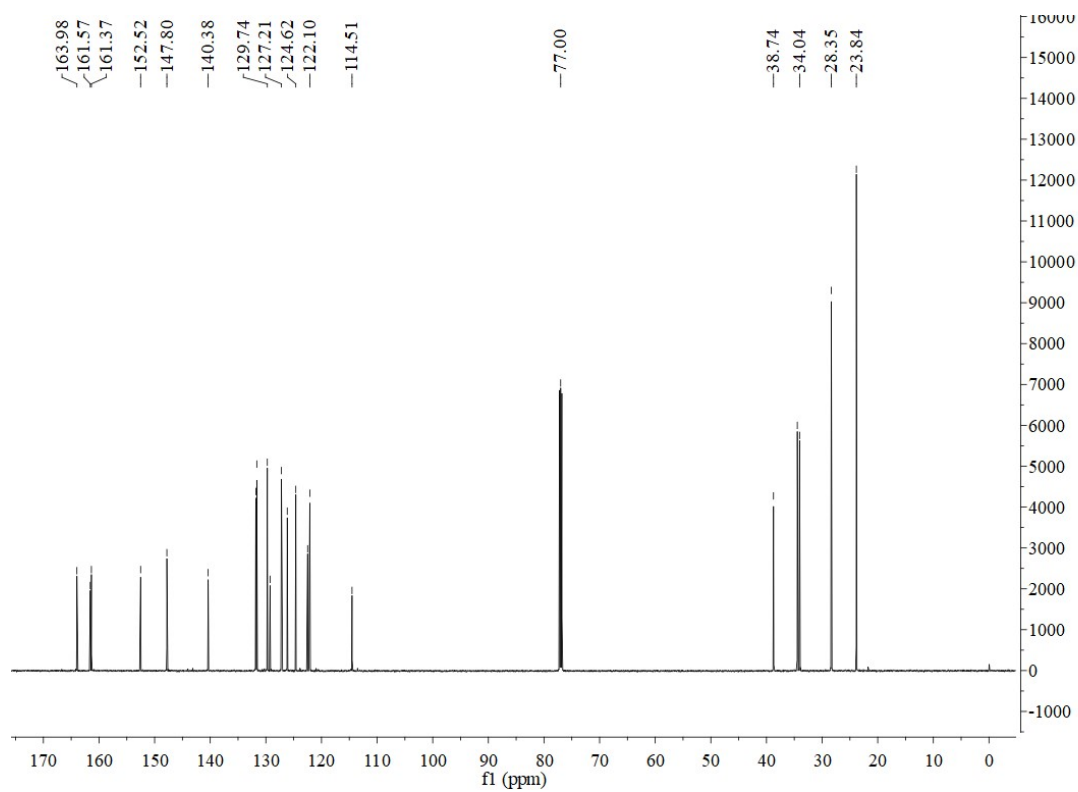


Figure 71. ^{13}C NMR spectrum of compound **5h**

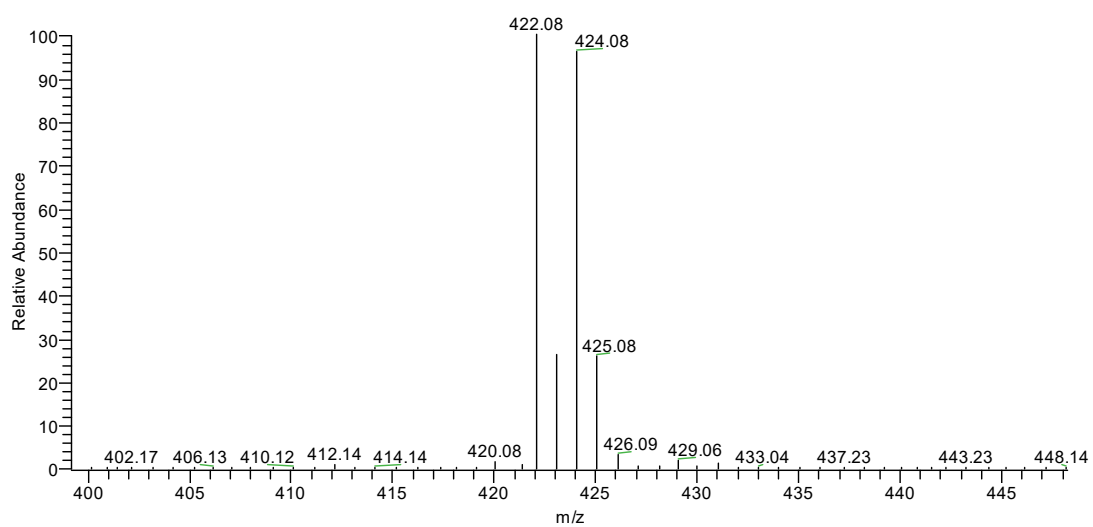


Figure 72. MS spectrum of compound **5h**

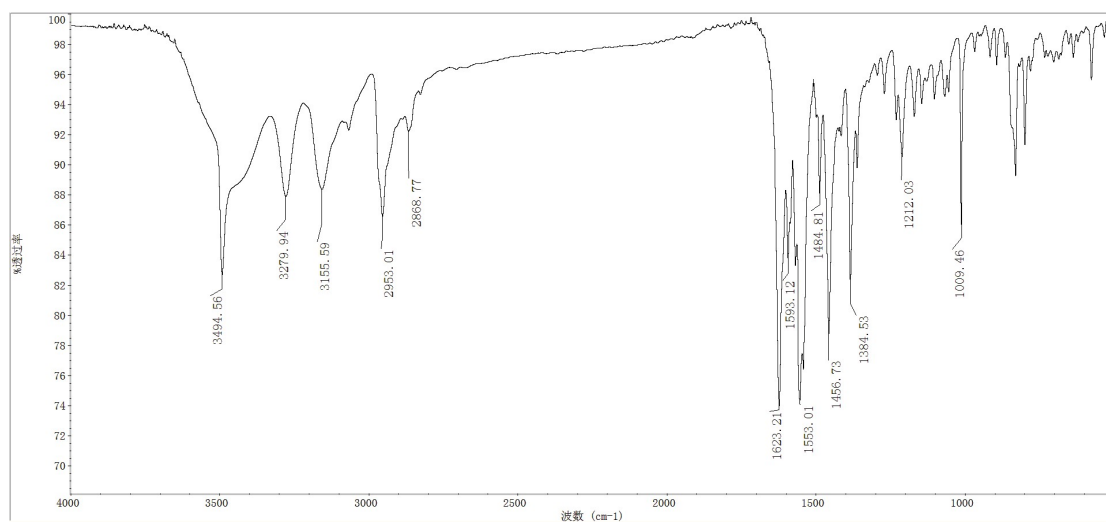


Figure 73. IR spectrum of compound **5i**

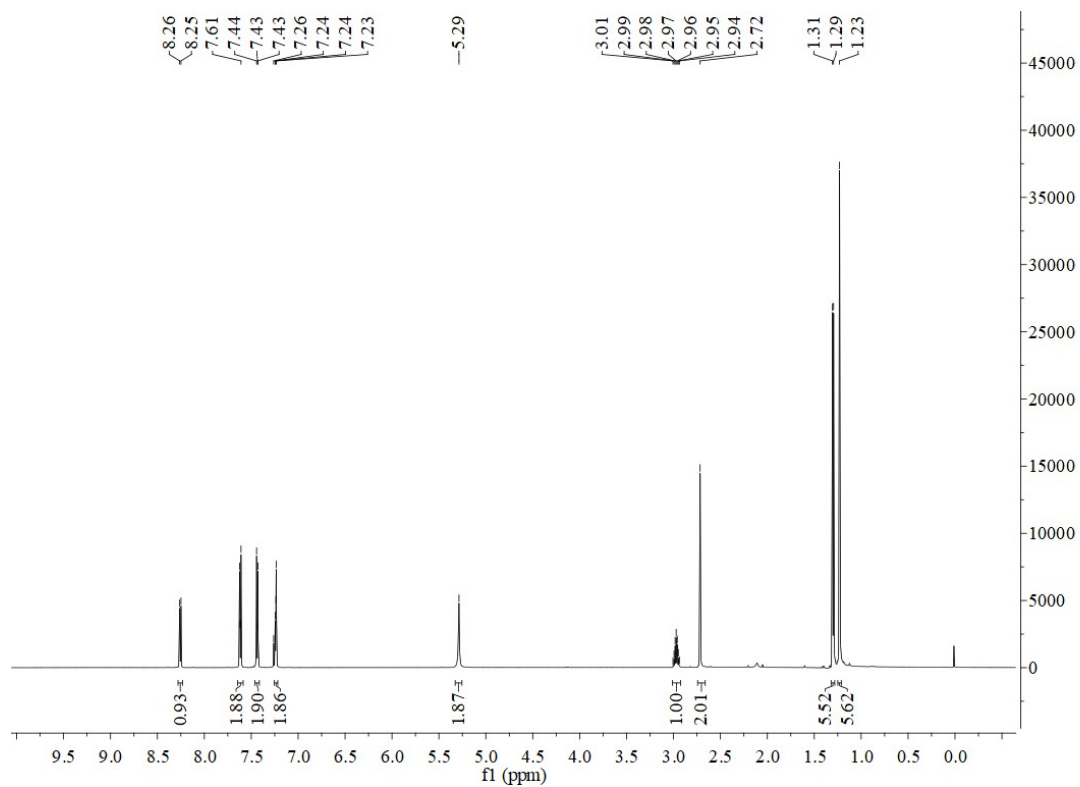


Figure 74. ^1H NMR spectrum of compound **5i**

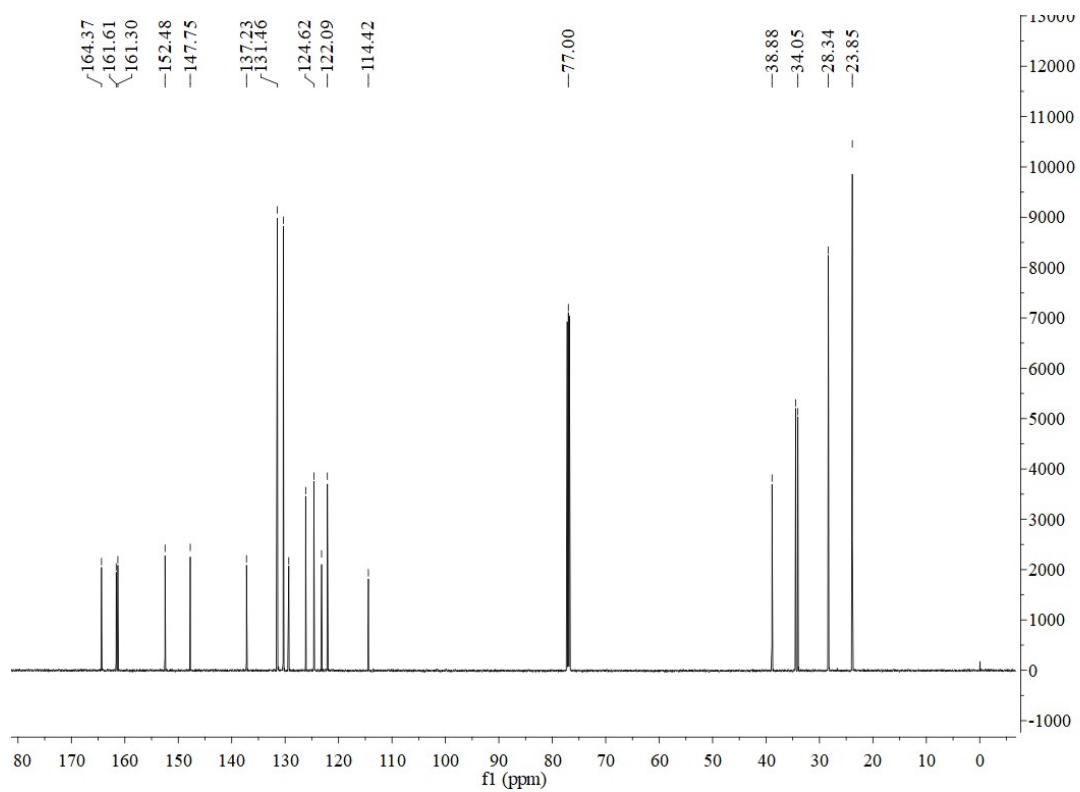


Figure 75. ^{13}C NMR spectrum of compound **5i**

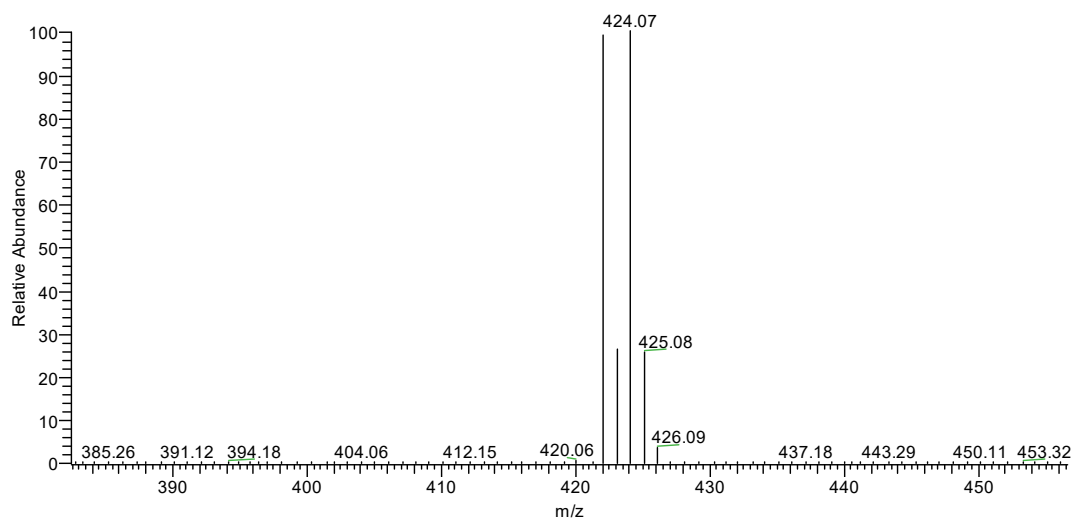


Figure 76. MS spectrum of compound **5i**

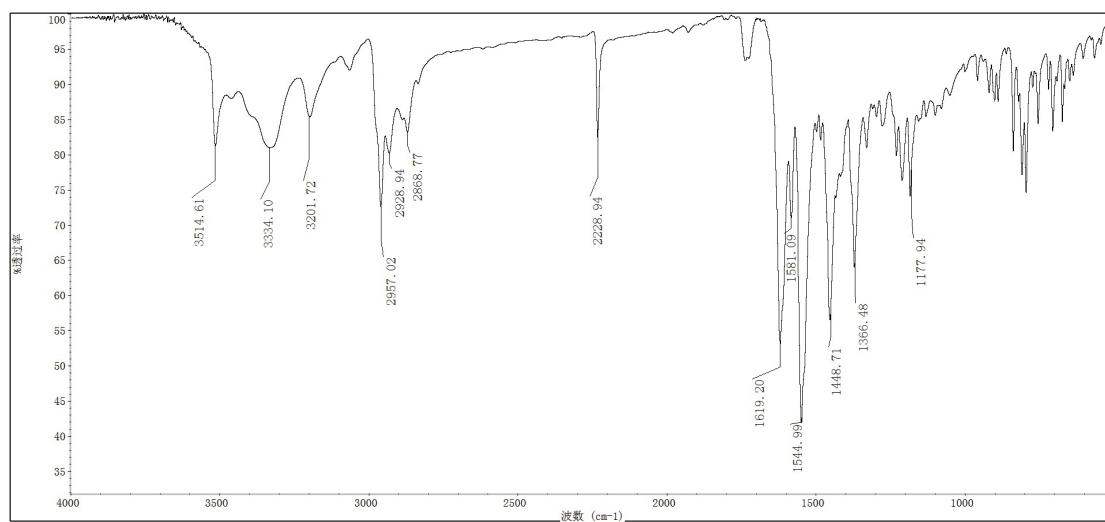


Figure 77. IR spectrum of compound **5j**

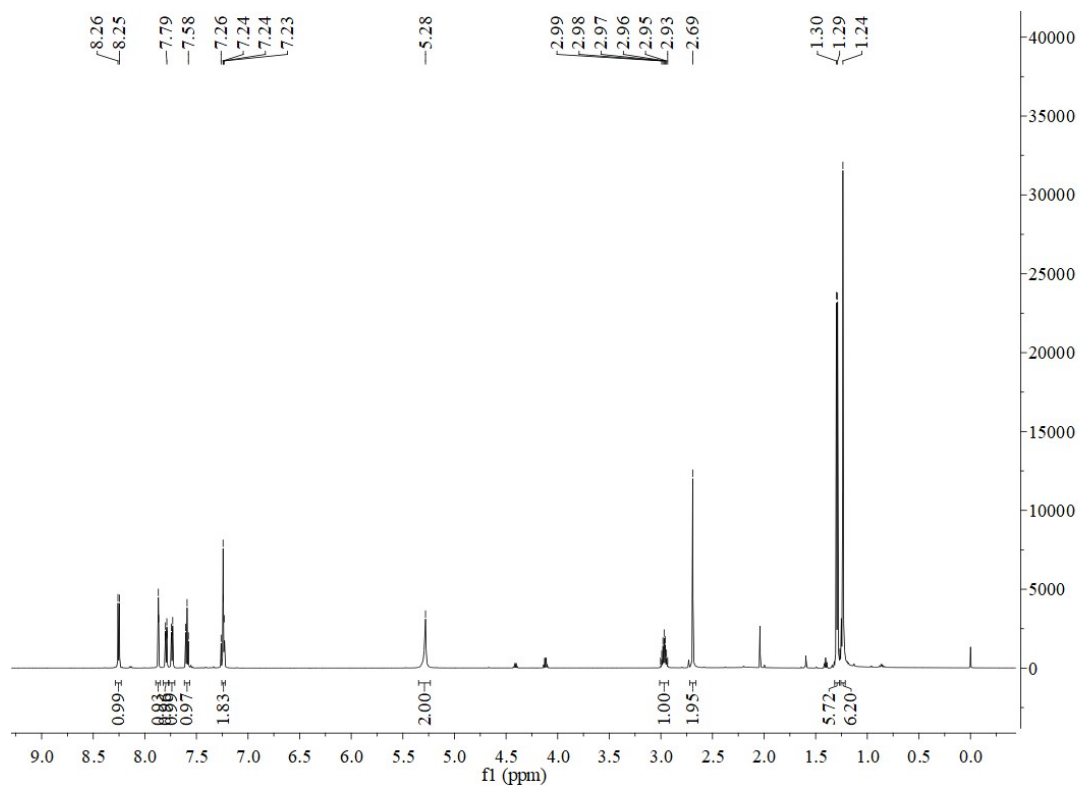


Figure 78. ¹H NMR spectrum of compound **5j**

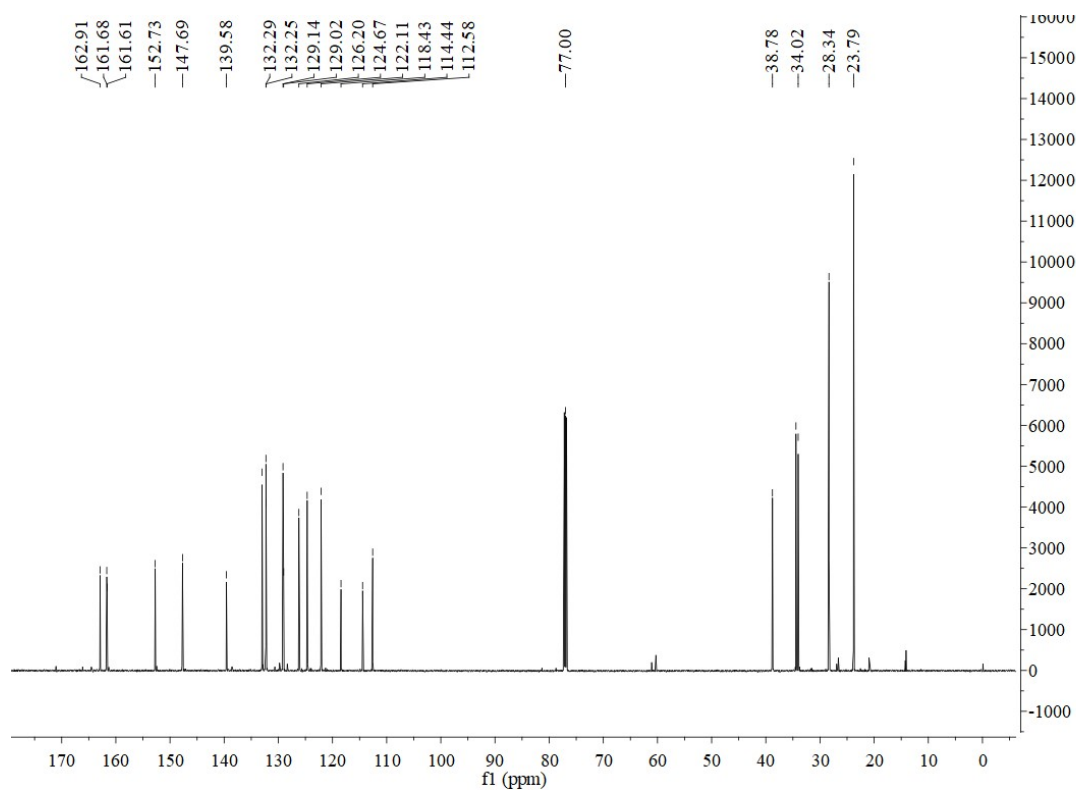


Figure 79. ^{13}C NMR spectrum of compound **5j**

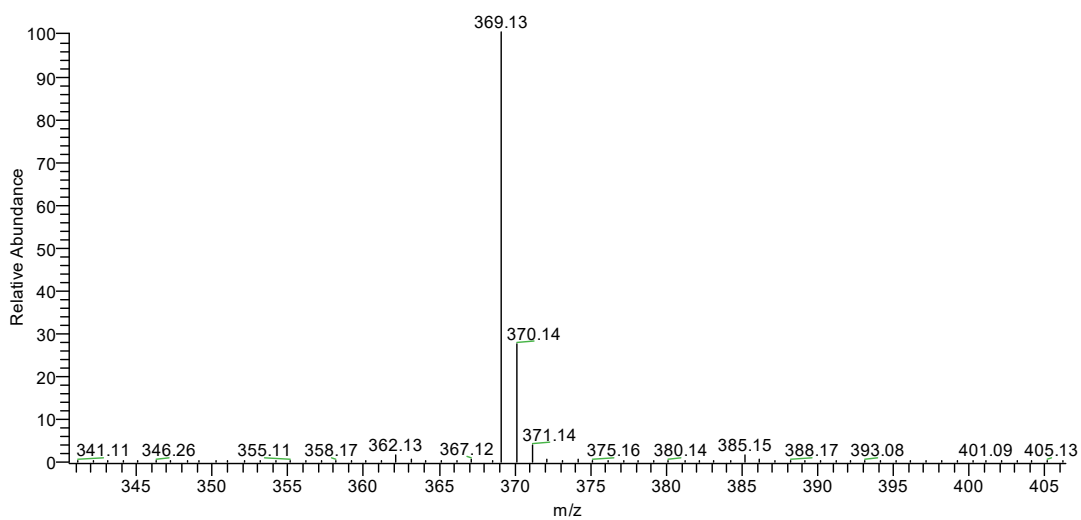


Figure 80. MS spectrum of compound **5j**

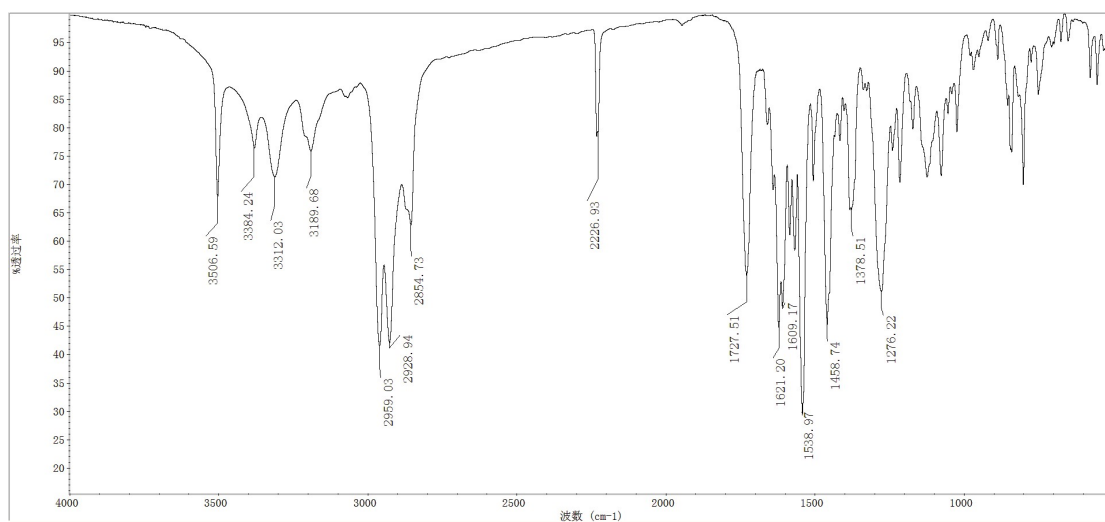


Figure 81. IR spectrum of compound **5k**

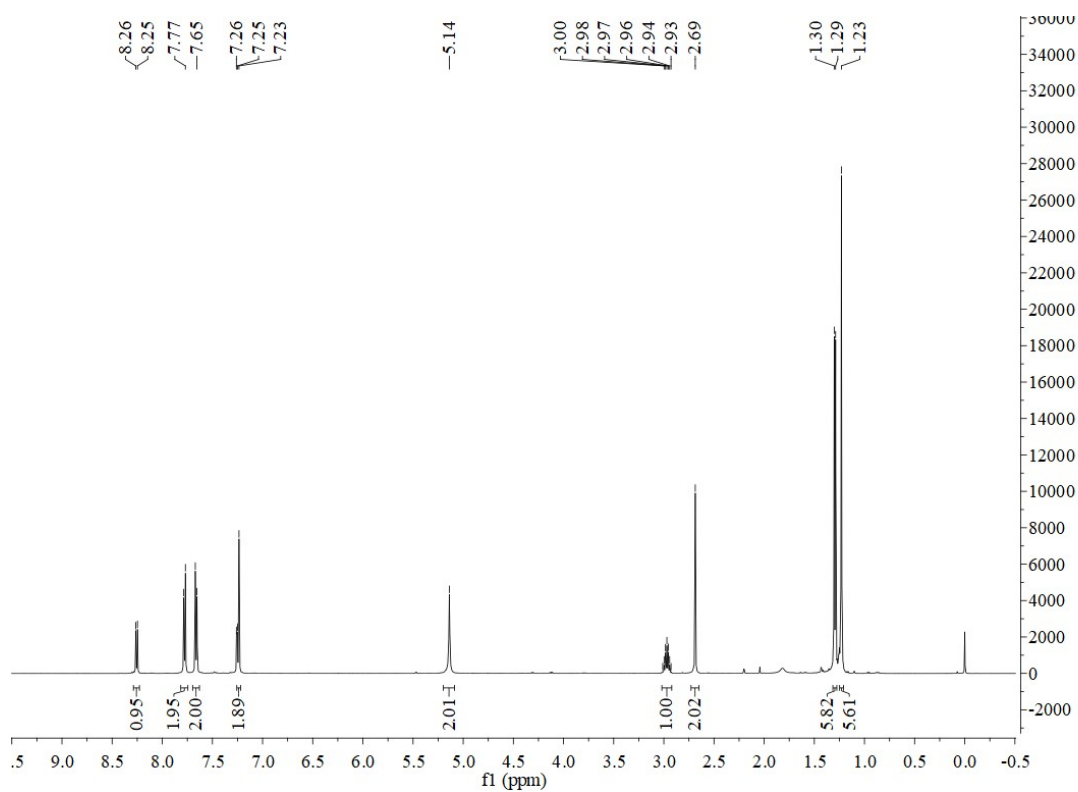


Figure 82. ^1H NMR spectrum of compound **5k**

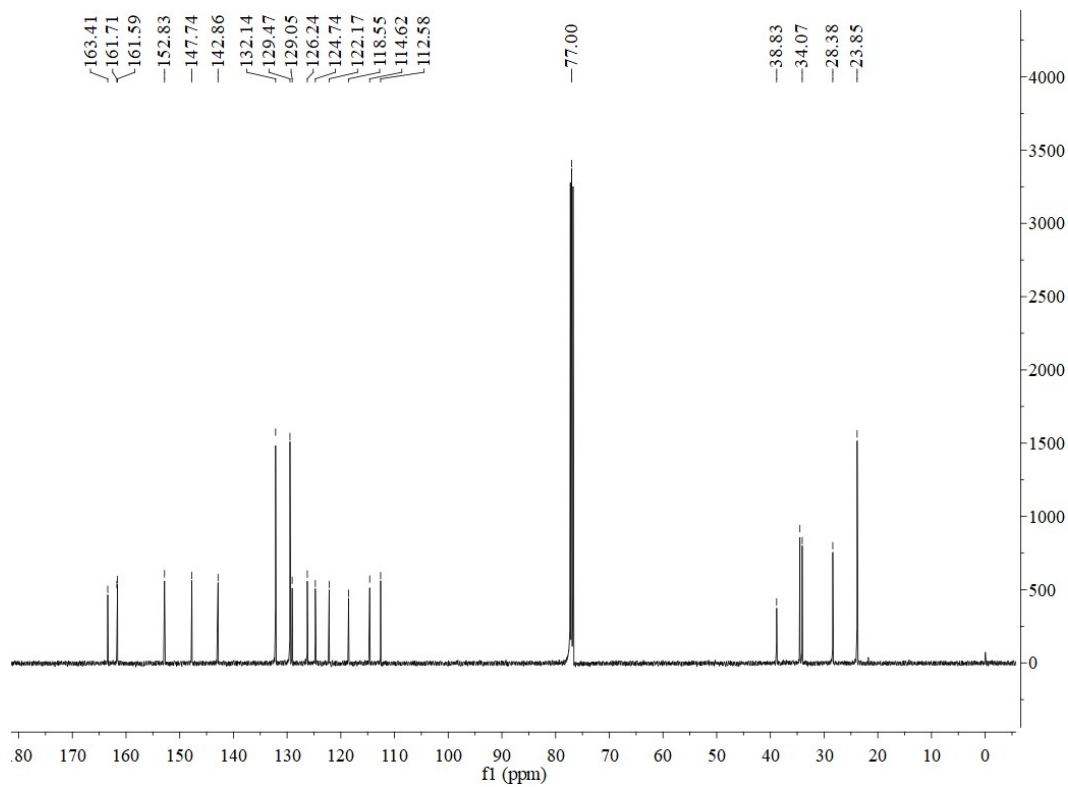


Figure 83. ^{13}C NMR spectrum of compound **5k**

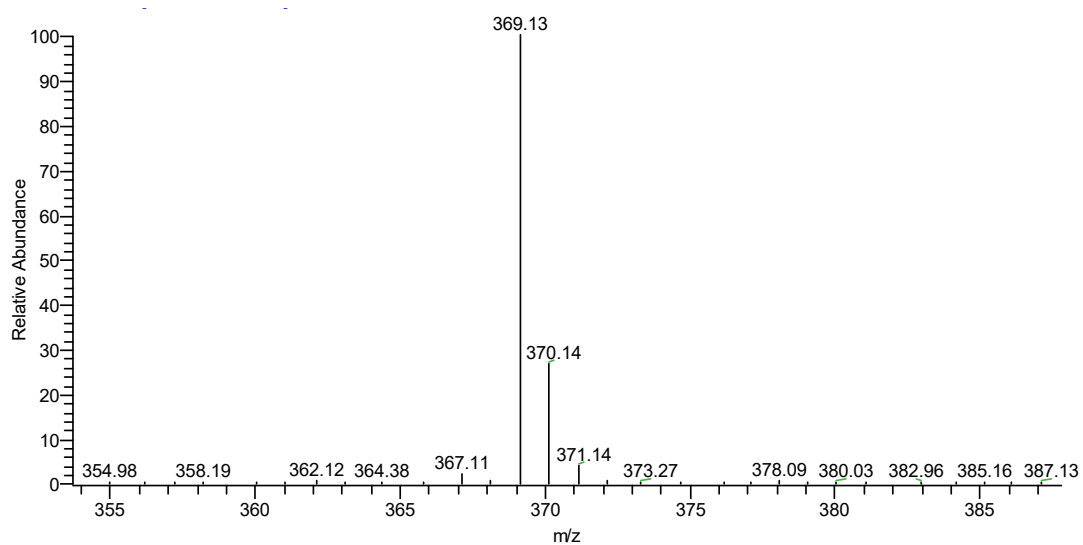


Figure 84. MS spectrum of compound **5k**

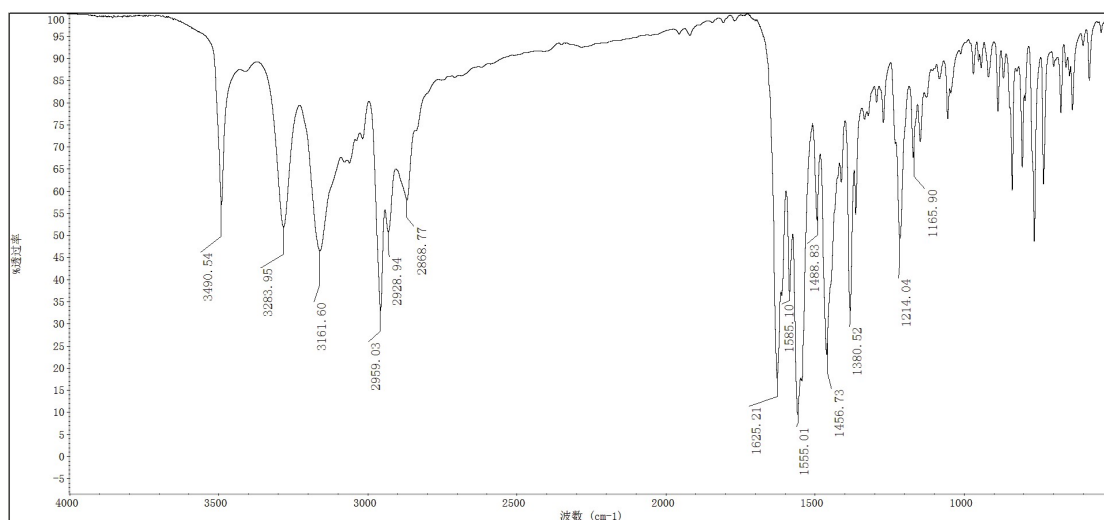


Figure 85. IR spectrum of compound 51

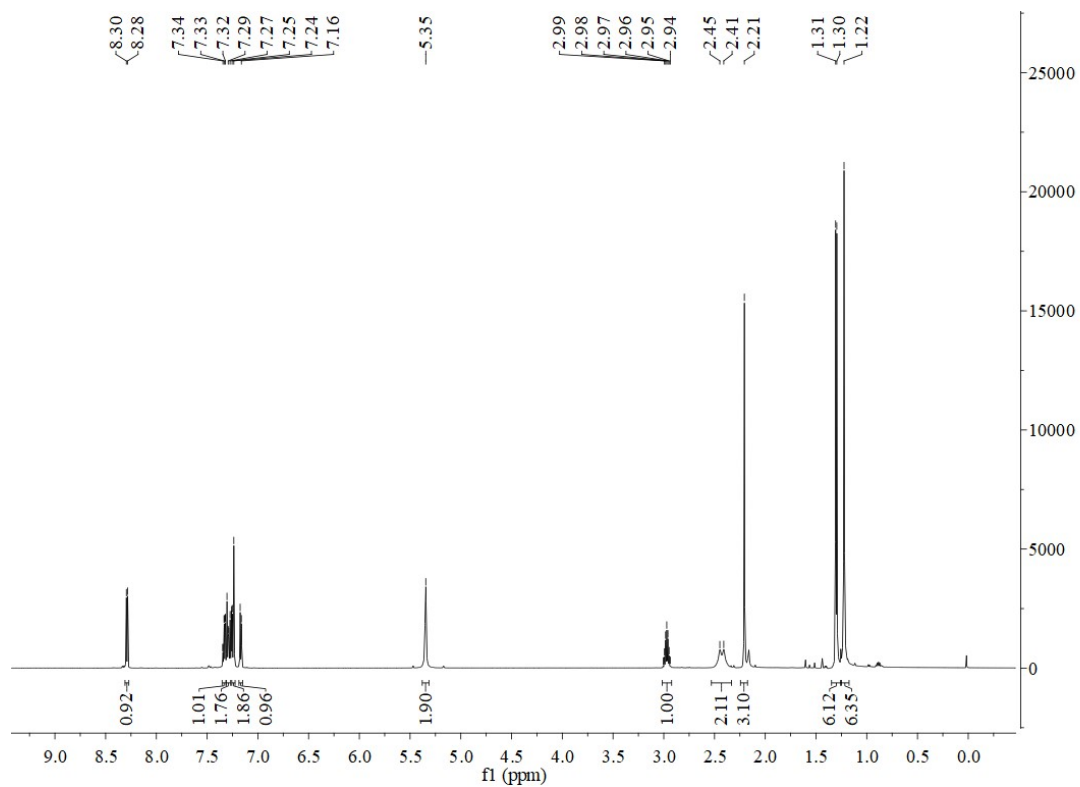


Figure 86. ¹H NMR spectrum of compound 51

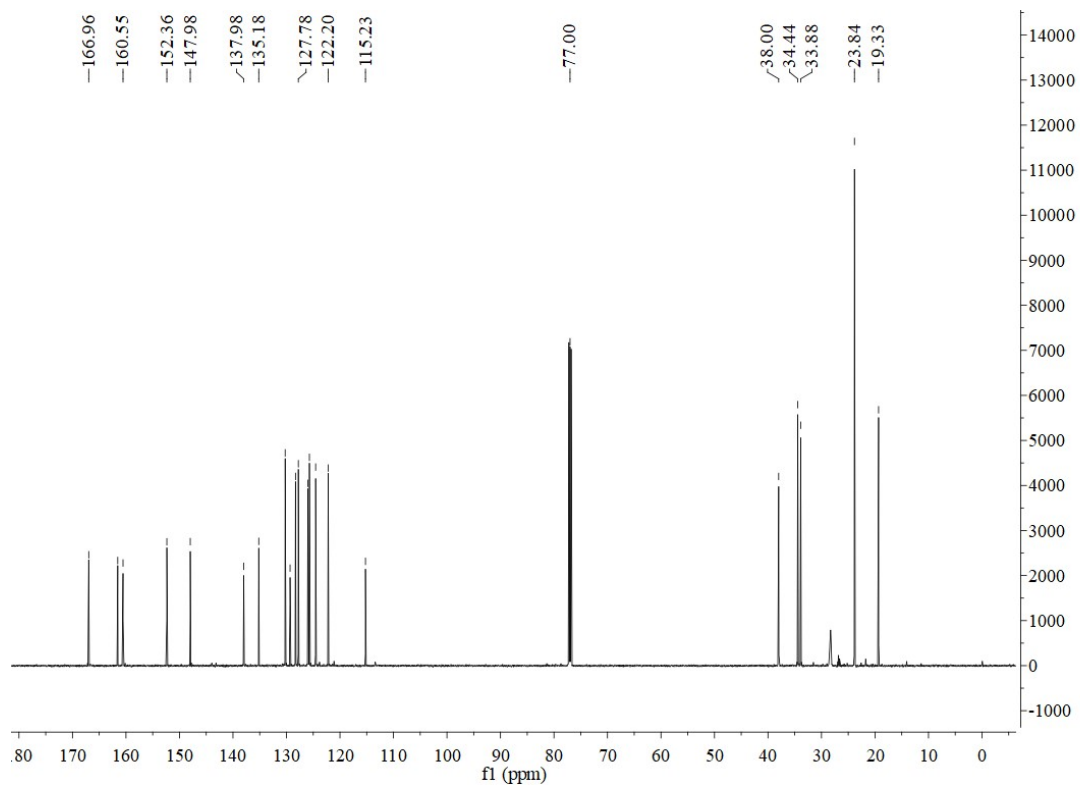


Figure 87. ^{13}C NMR spectrum of compound **5I**

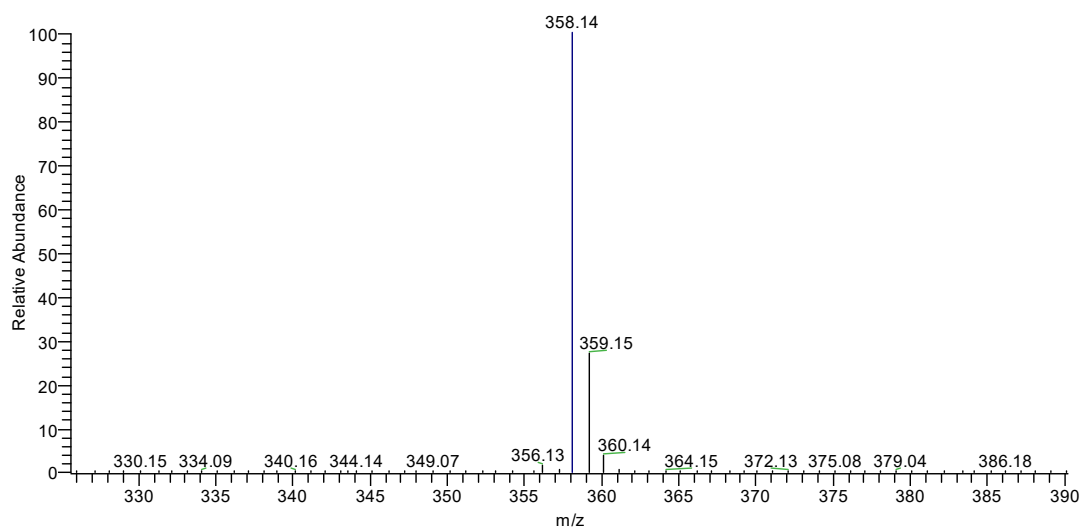


Figure 88. MS spectrum of compound **5I**

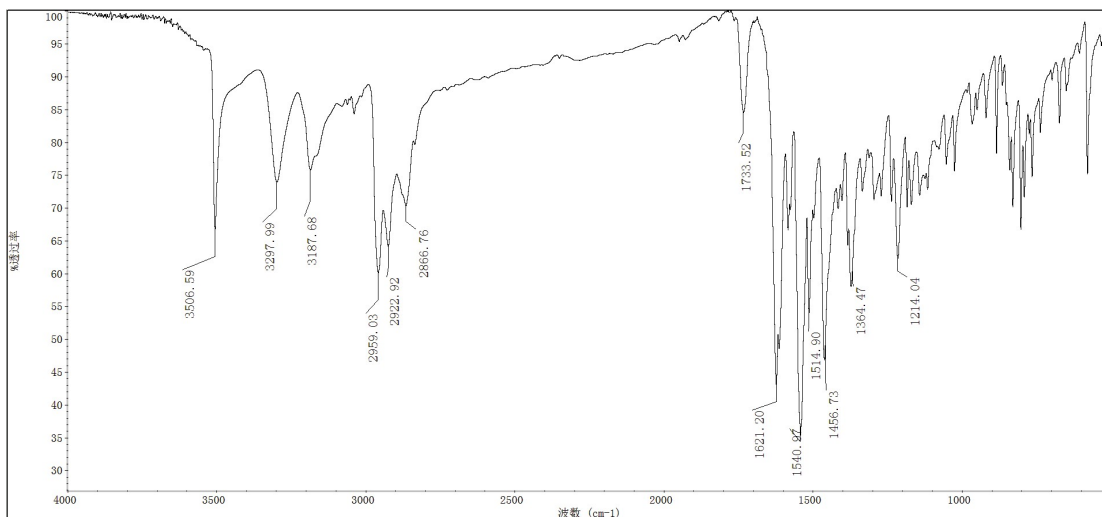


Figure 89. IR spectrum of compound 5m

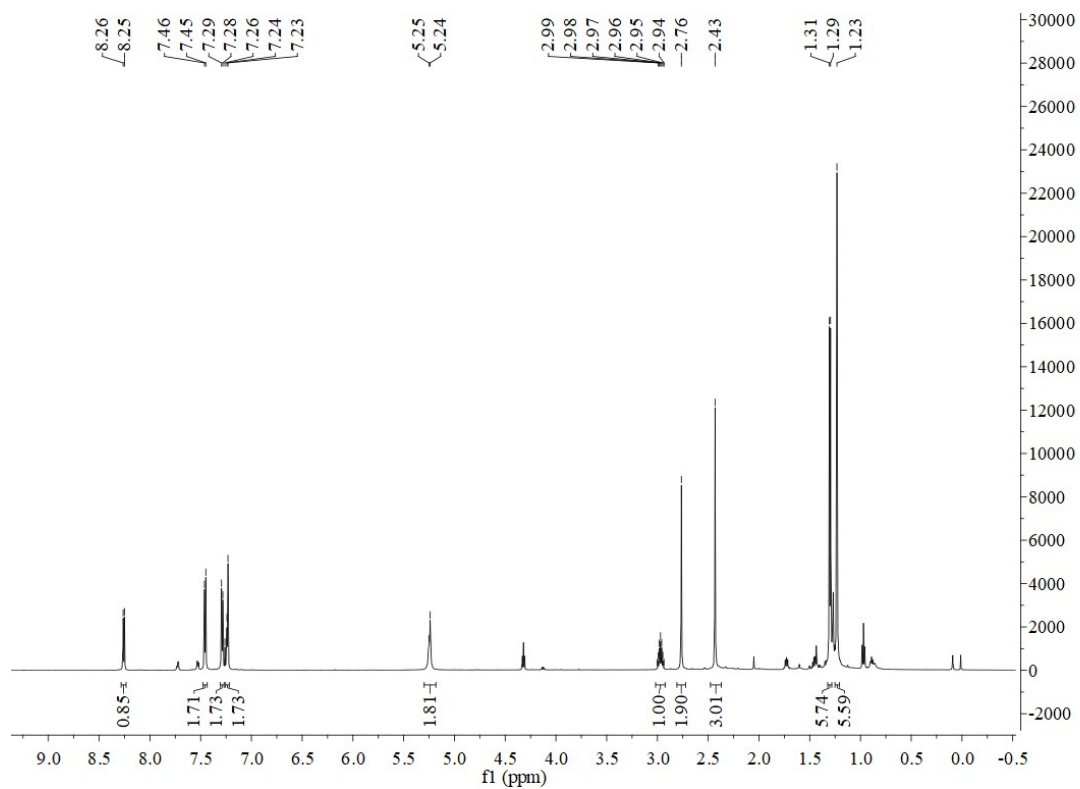


Figure 90. ¹H NMR spectrum of compound 5m

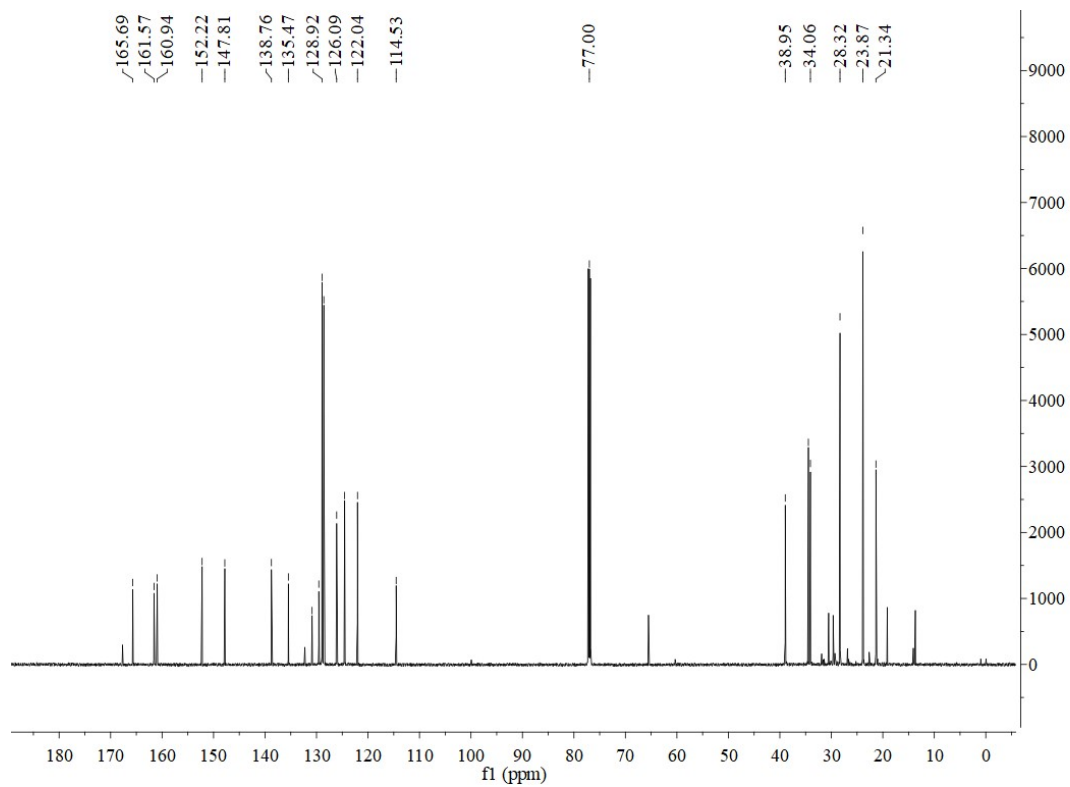


Figure 91. ^{13}C NMR spectrum of compound **5m**

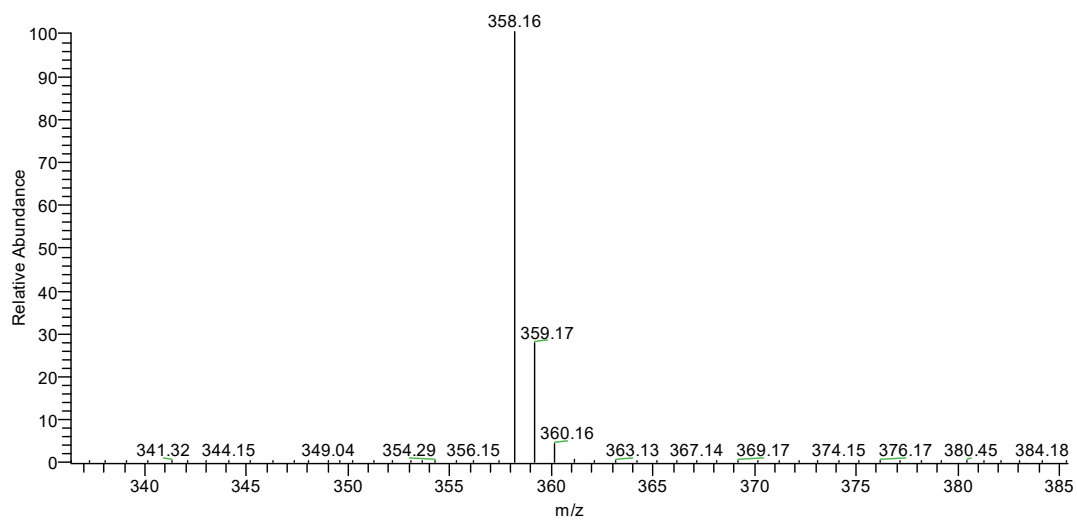


Figure 92. MS spectrum of compound **5m**

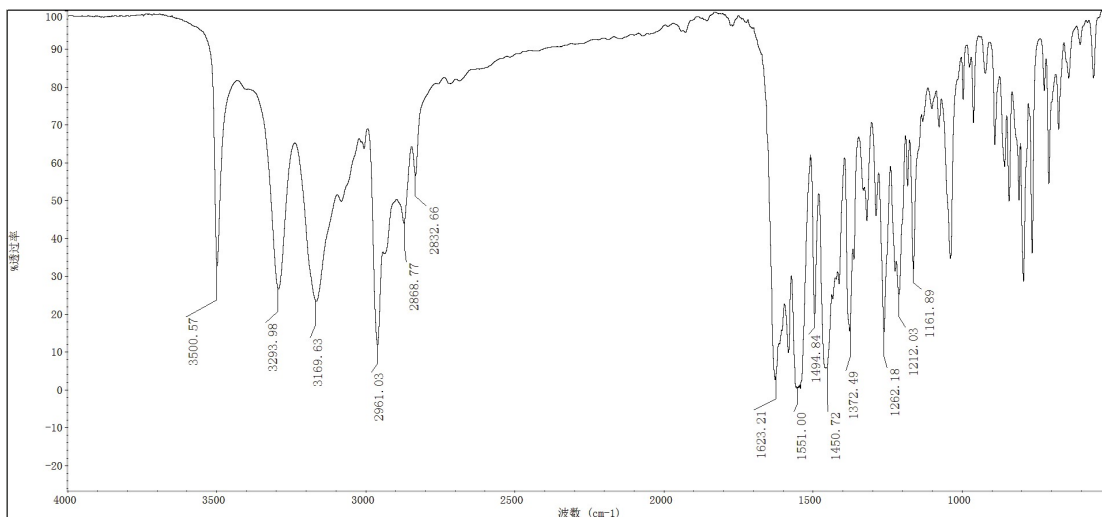


Figure 93. IR spectrum of compound 5n

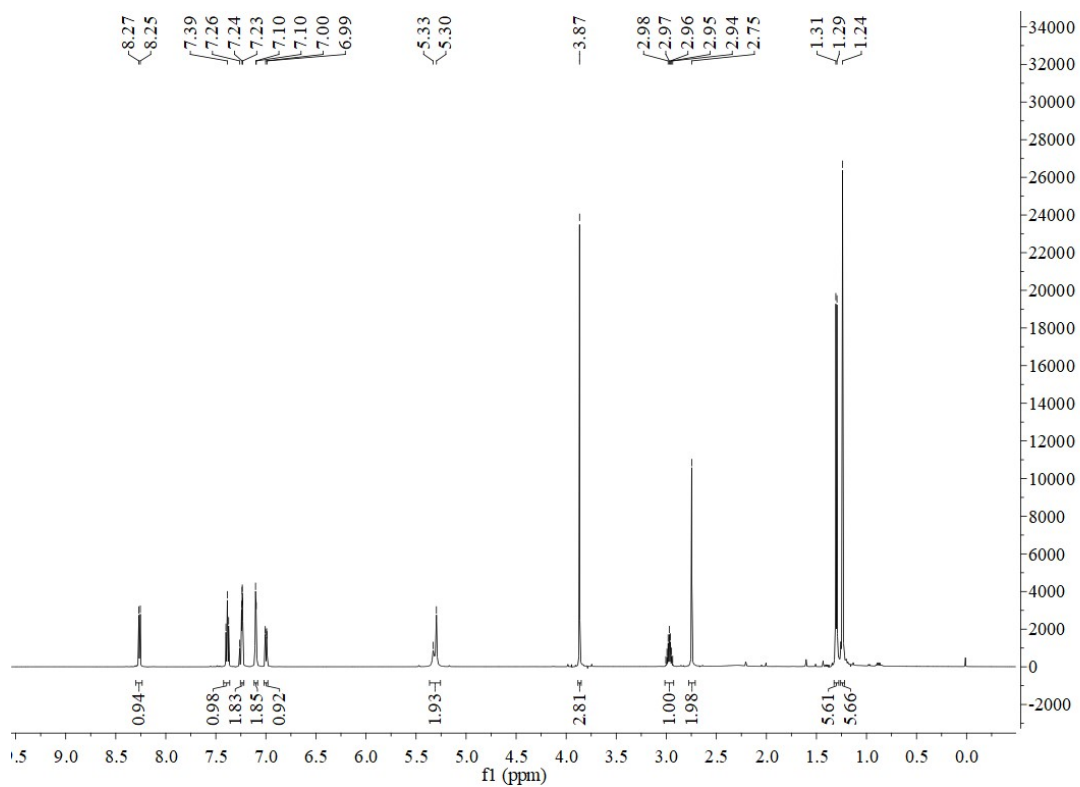


Figure 94. ¹H NMR spectrum of compound 5n

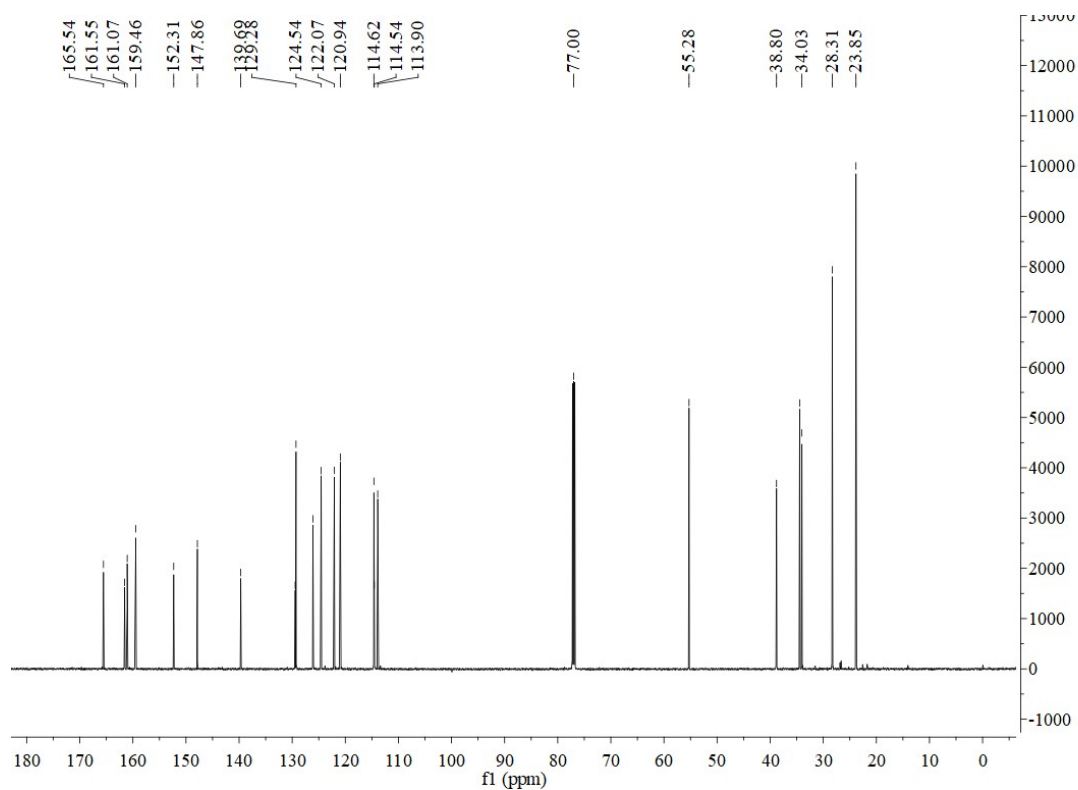


Figure 95. ^{13}C NMR spectrum of compound **5n**

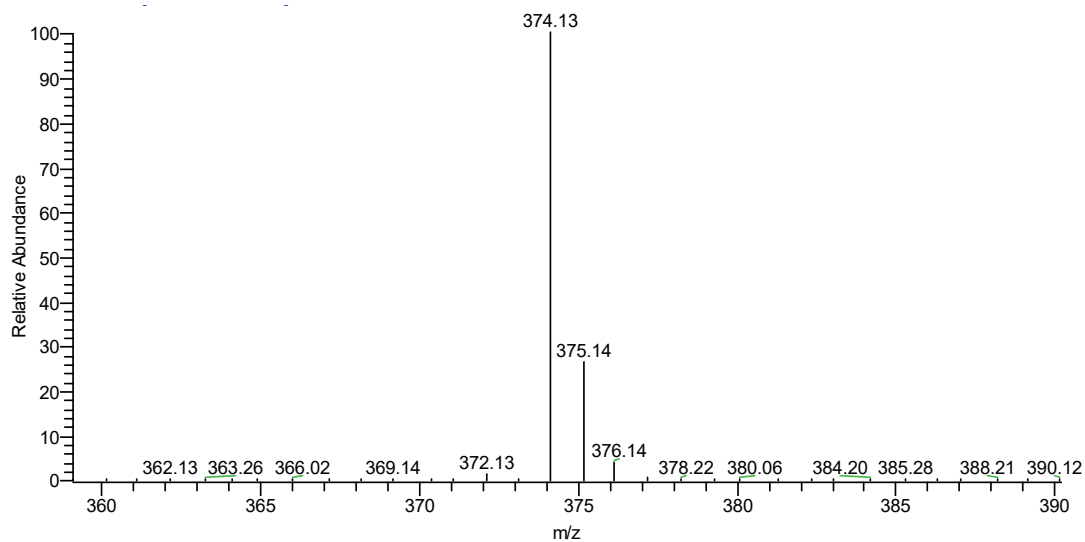


Figure 96. MS spectrum of compound **5n**

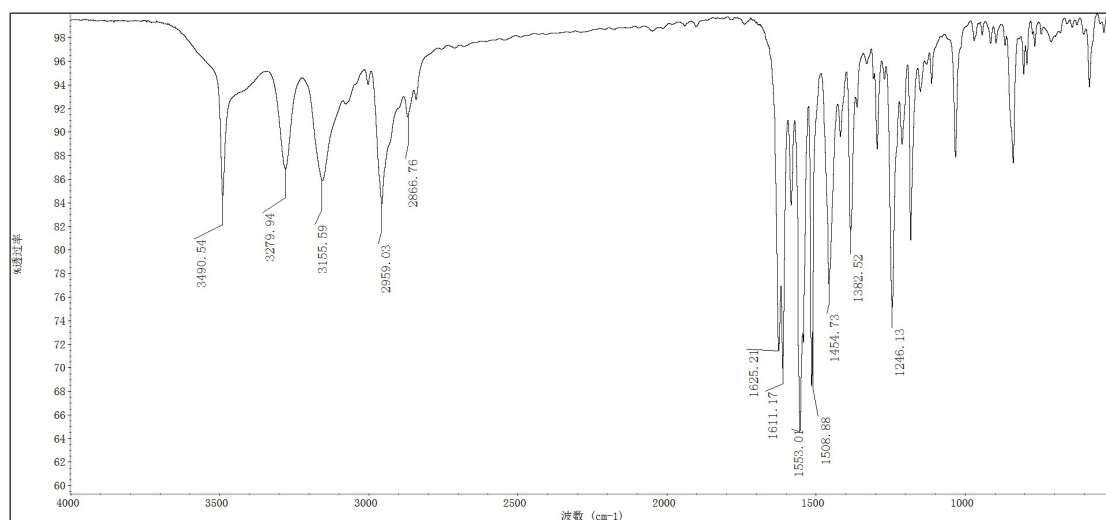


Figure 97. IR spectrum of compound 50

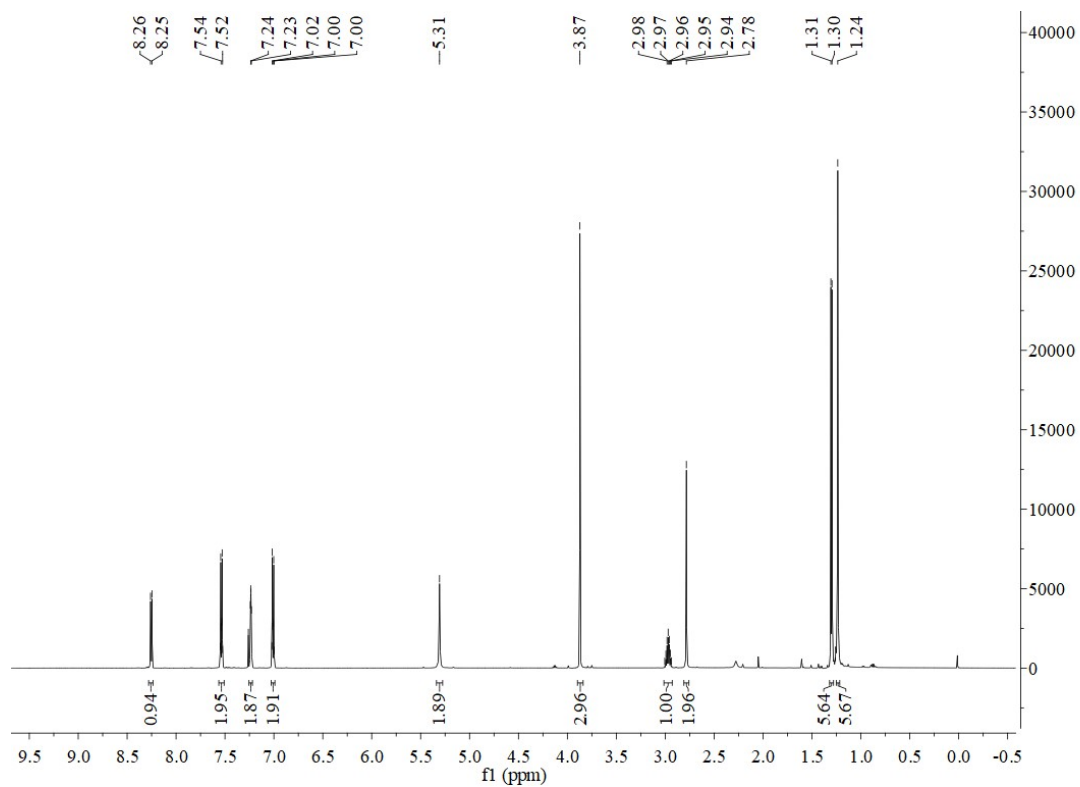


Figure 98. ¹H NMR spectrum of compound 50

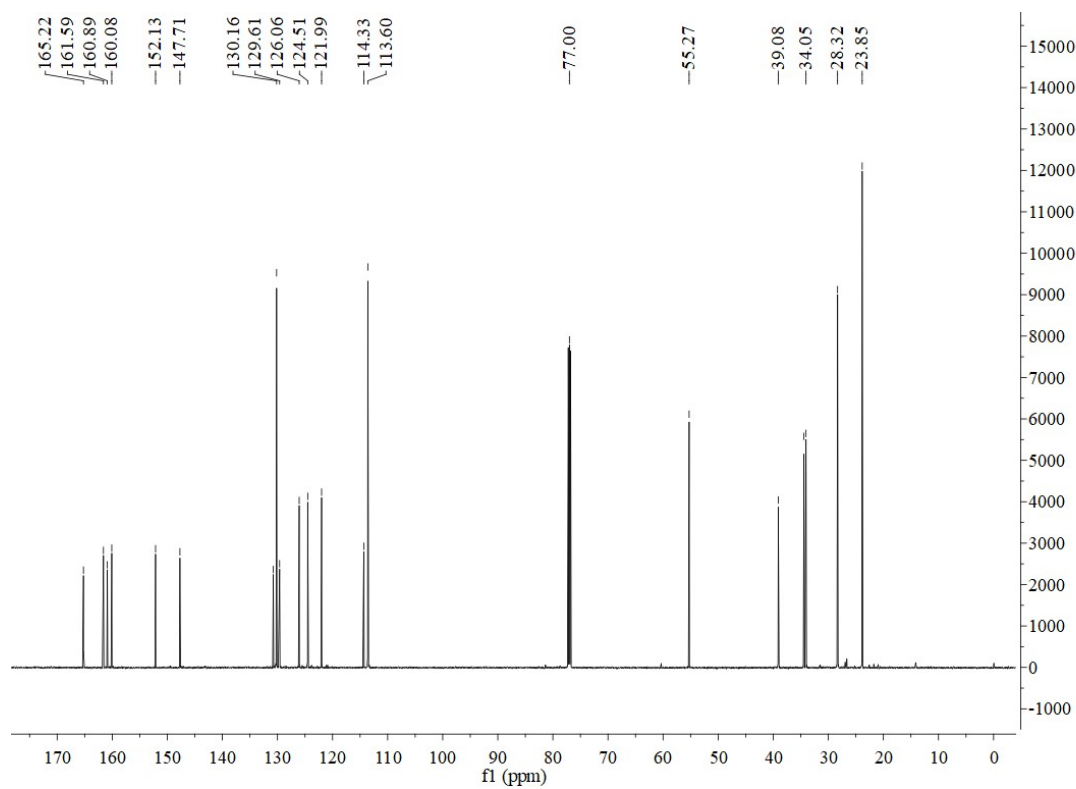


Figure 99. ^{13}C NMR spectrum of compound **50**

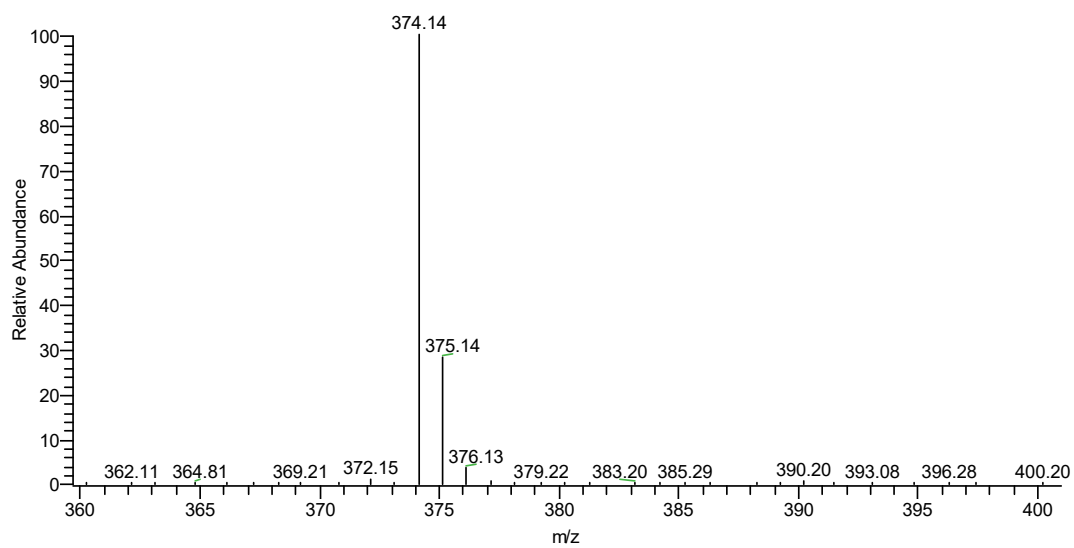


Figure 100. MS spectrum of compound **50**

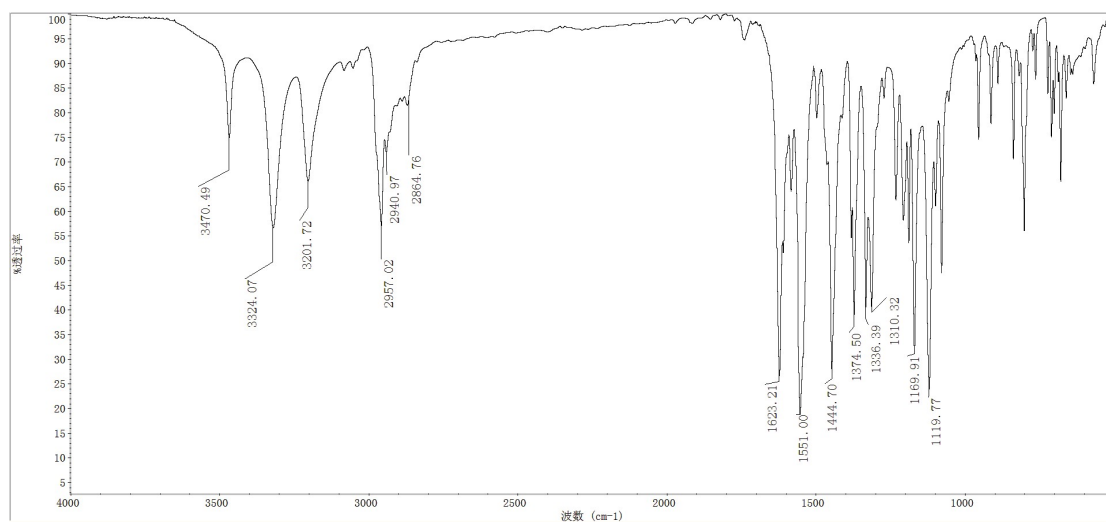


Figure 101. IR spectrum of compound 5p

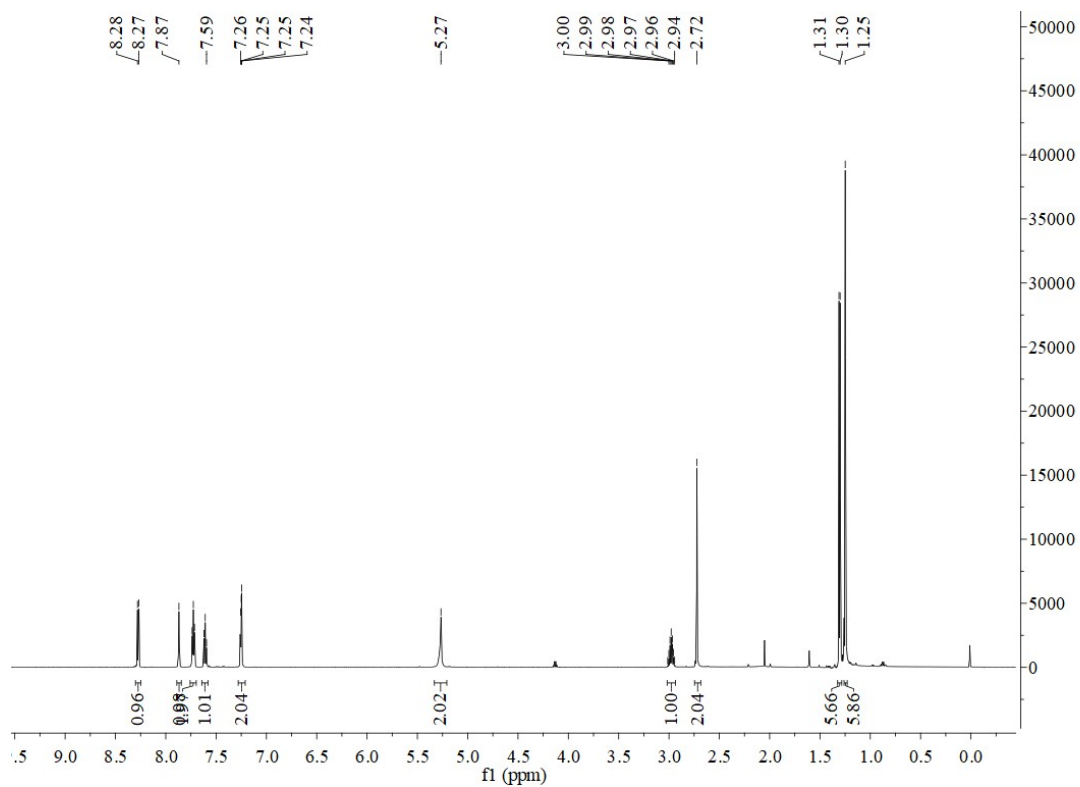


Figure 102. ¹H NMR spectrum of compound 5p

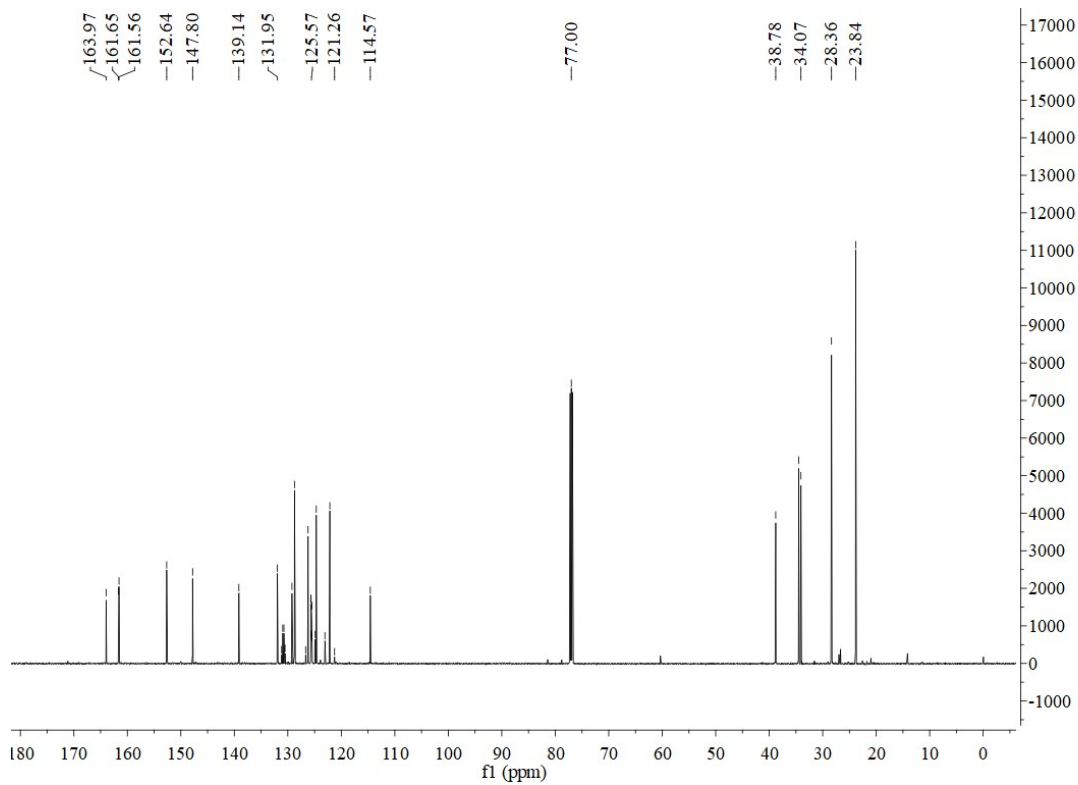


Figure 103. ^{13}C NMR spectrum of compound **5p**

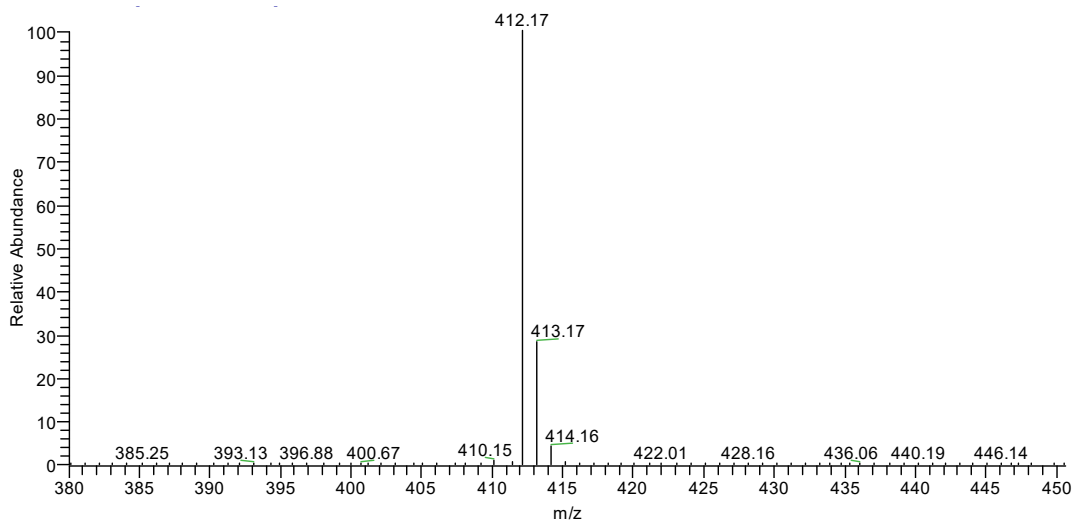


Figure 104. MS spectrum of compound **5p**

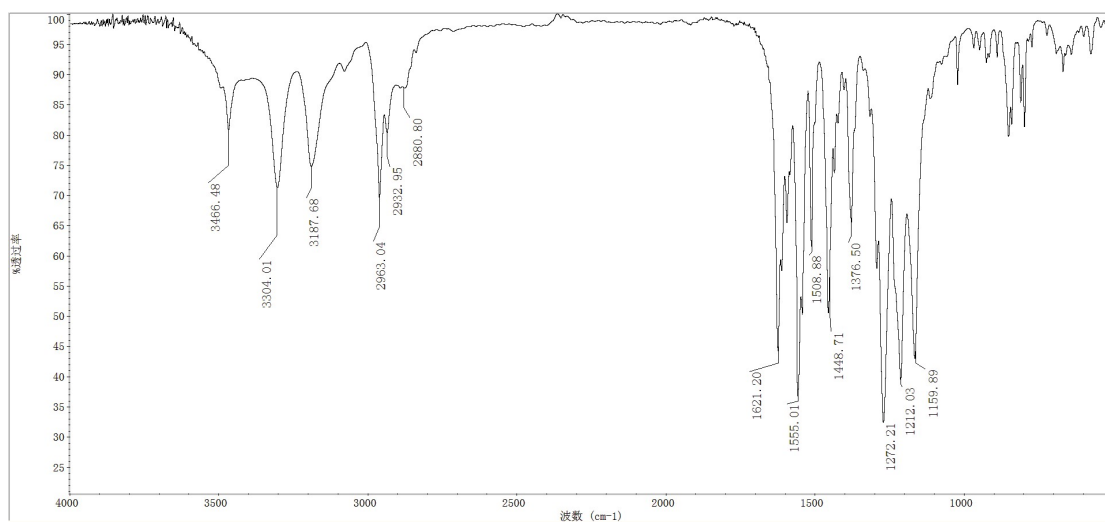


Figure 105. IR spectrum of compound **5q**

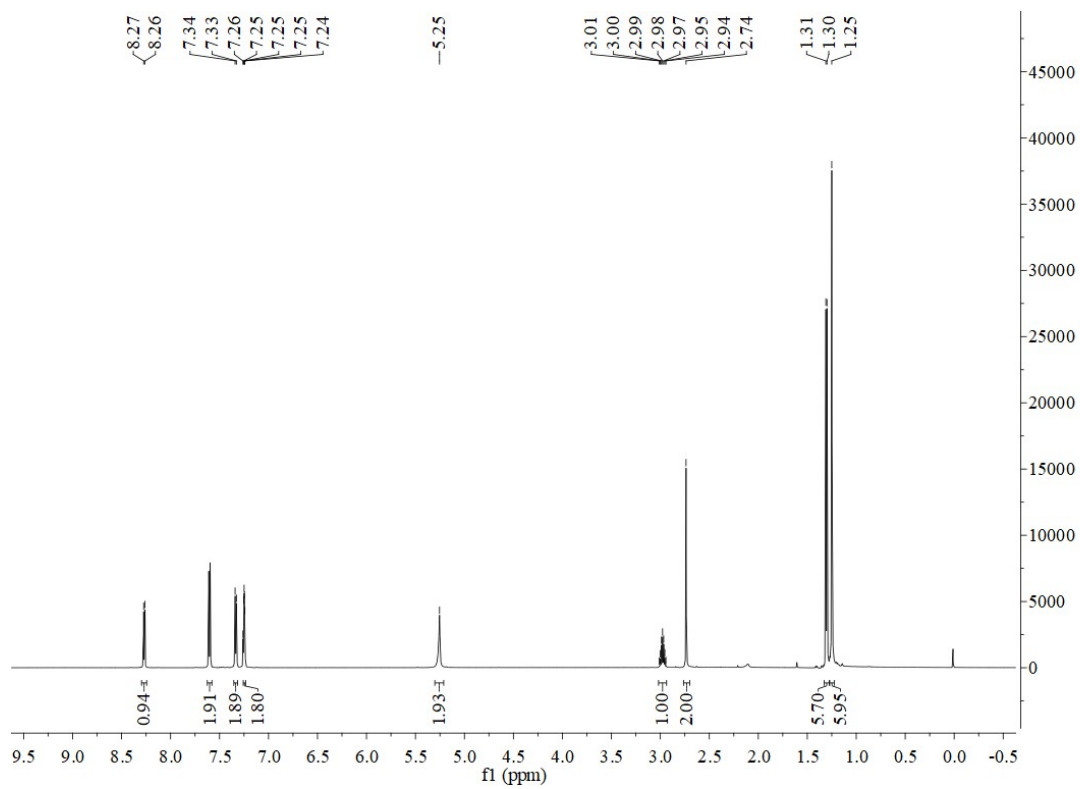


Figure 106. ^1H NMR spectrum of compound **5q**

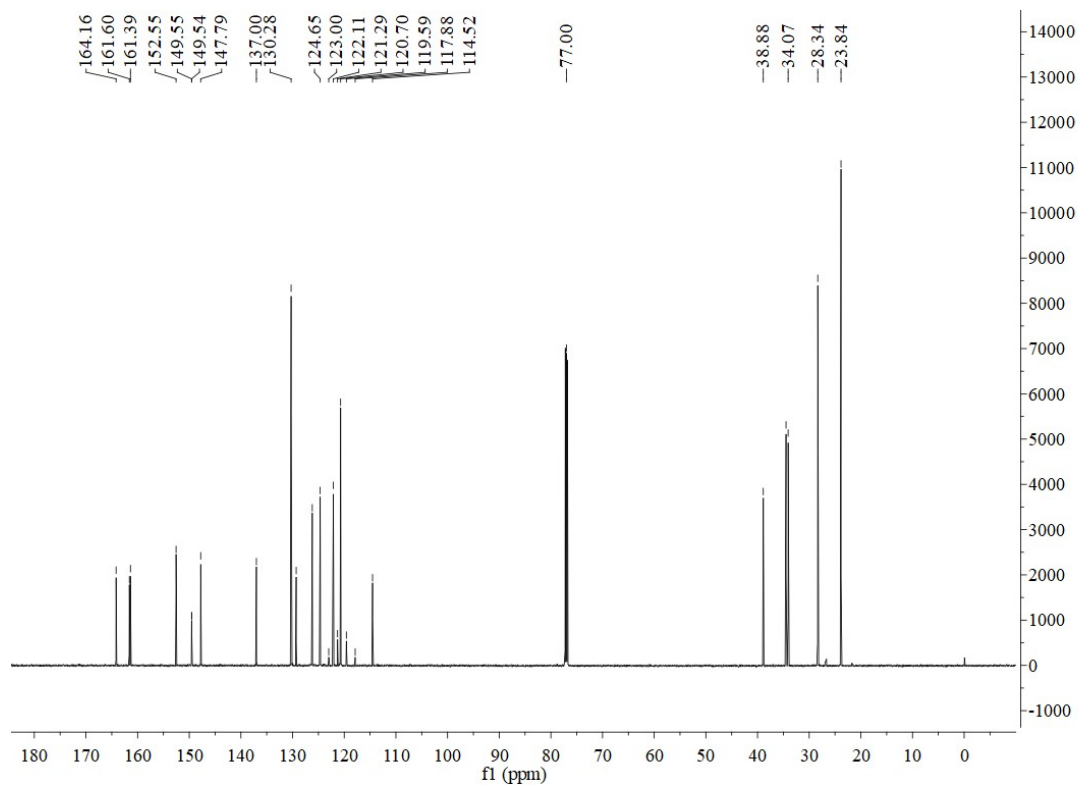


Figure 107. ^{13}C NMR spectrum of compound **5r**

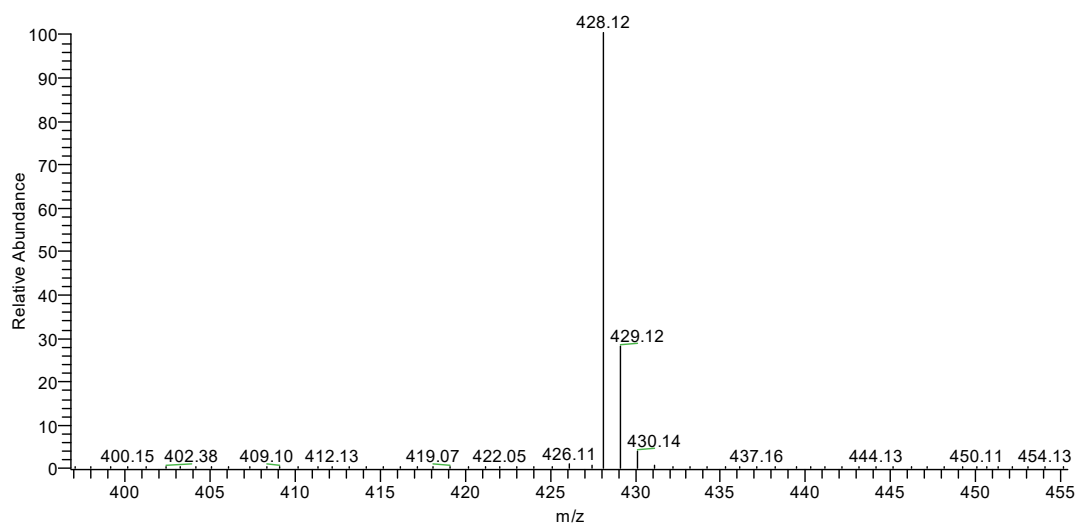


Figure 108. MS spectrum of compound **5q**

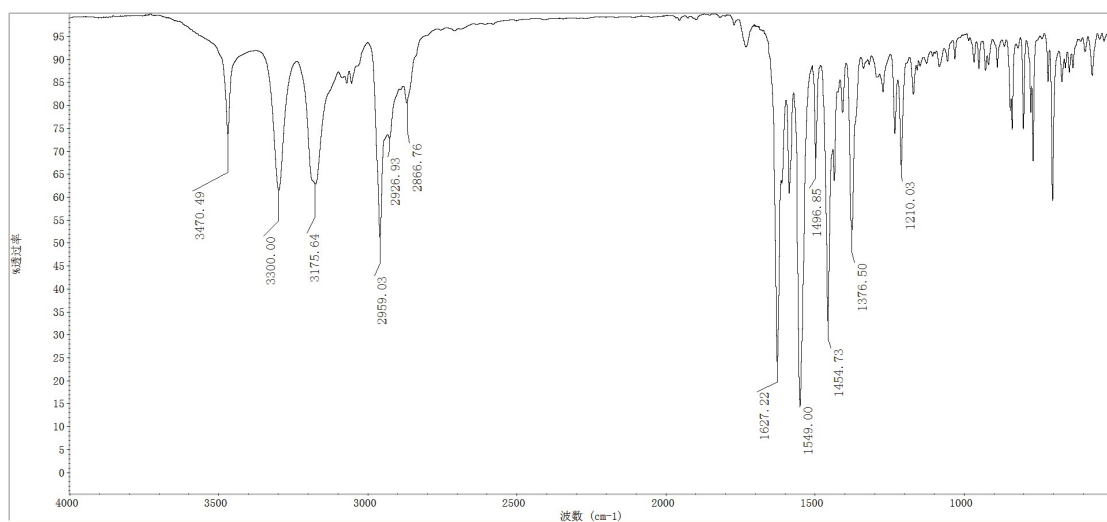


Figure 109. IR spectrum of compound 5r

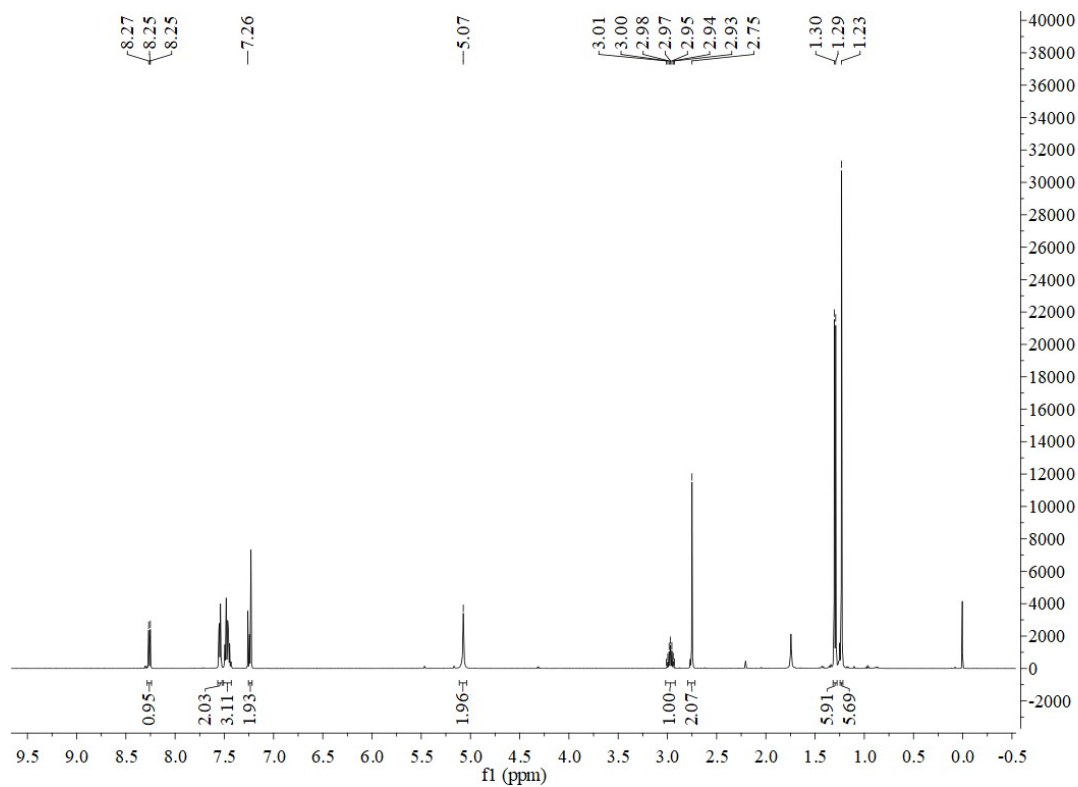


Figure 110. ¹H NMR spectrum of compound 5r

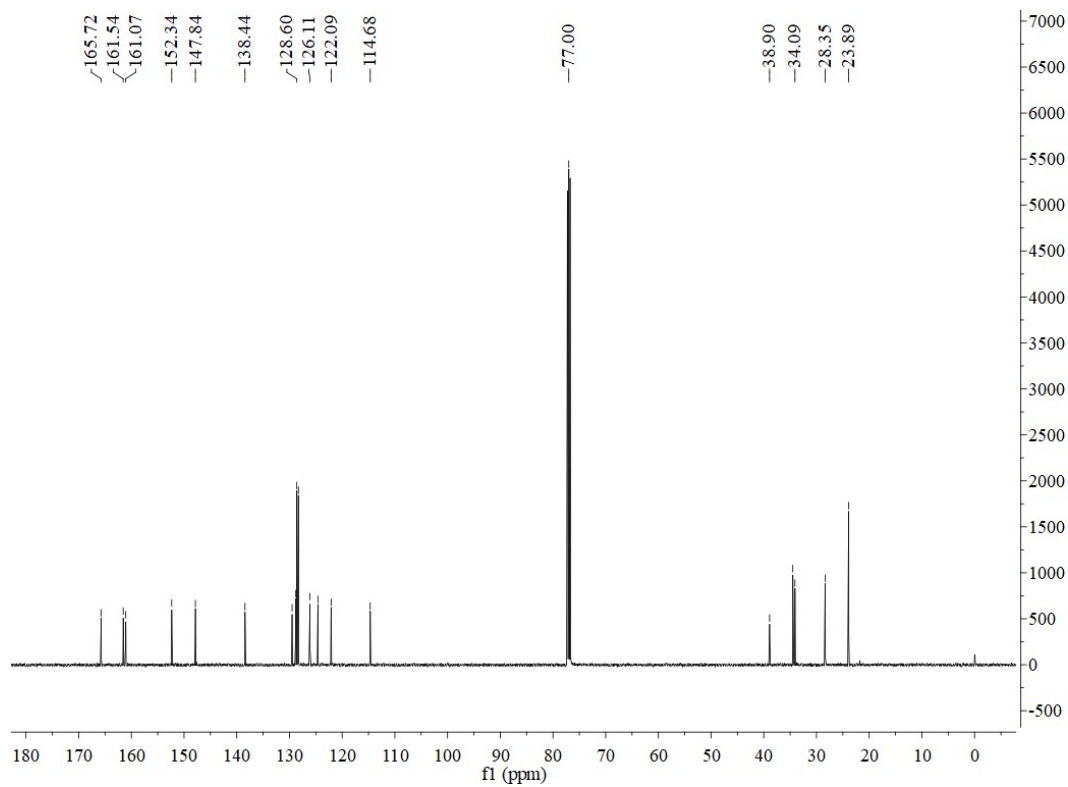


Figure 111. ^{13}C NMR spectrum of compound **5r**

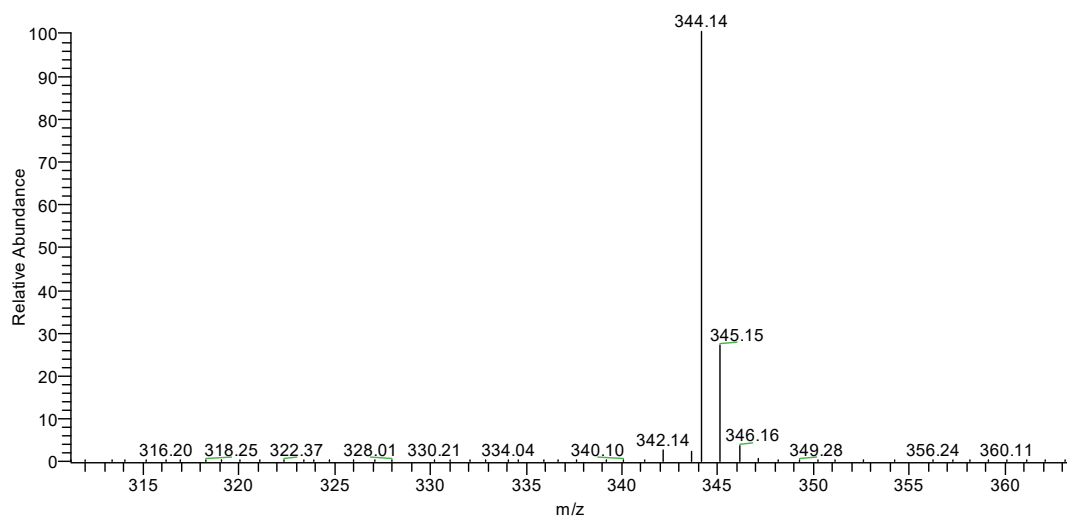


Figure 112. MS spectrum of compound **5r**