

Supplementary Information

1. $C_6H_5-[NHCSNH]-CH_2-C_6H_5$: [3a]

White solid, Mp 146-148 °C. 1H NMR (400 MHz, $CDCl_3$): δ 8.29 (s, 1 H), 7.69 (s, 1 H), 7.42-7.20 (m, 10 H), 4.87 (d, J = 5.2 Hz, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 181.0, 137.2, 135.9, 130.2, 129.2, 128.8, 127.7, 127.6, 127.4, 49.2. HRMS: m/z Calculated for $C_{14}H_{14}N_2NaS$ $[M + Na]^+$ 265.0775; found: 265.0777.

2. [3b]

Gummy. 1H NMR (400 MHz, $CDCl_3$): δ 8.37 (br s, 1 H), 8.12 (br s, 1 H), 7.19-7.13 (m, 8 H), 6.54 (s, 1 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.4, 153.9, 136.0, 134.7, 134.2, 133.9, 127.2, 125.6, 118.7.

3. [3c]

Gummy. 1H NMR (400 MHz, $CDCl_3$): δ 8.38 (br s, 1 H), 8.13 (br s, 1 H), 7.48-7.00 (m, 8 H), 4.63 (s, 2 H), 2.29 (s, 3 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.6, 136.6, 135.1, 130.7, 129.2, 129.0, 128.3, 127.1, 121.8, 52.9, 21.5.

4. [3d]

White solid, Mp 132-134 °C. 1H NMR (400 MHz, $CDCl_3$): δ 8.07 (br s, 1 H), 7.71-7.38 (m, 5 H), 3.82 (t, J = 5.2 Hz, 4 H), 3.73 (t, J = 6.0 Hz, 4 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 183.9, 139.8, 129.2, 125.4, 123.0, 66.1, 49.7. HRMS: m/z Calculated for $C_{11}H_{14}N_2NaOS$ $[M + Na]^+$ 245.0725; found: 245.0724

5. [3e]

White solid, Mp 77-79 °C. 1H NMR (400 MHz, $CDCl_3$): δ 8.18 (br s, 1 H), 7.96 (br s, 1 H), 7.47-7.20 (m, 5 H), 3.62 (q, J = 5.6 Hz, 2 H), 1.61-1.50 (m, 2 H), 1.38-1.28 (m, 2 H), 0.91 (t, J = 5.2 Hz, 3 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.5, 136.3, 130.1, 127.1, 125.2, 45.3, 31.9, 20.0, 13.7. HRMS: m/z Calculated for $C_{11}H_{16}N_2NaS$ $[M + Na]^+$ 231.0932; found: 231.0931.

6. Cbz-Ala- ψ [CH_2NHCSN]-Pro-COOBn: [6a]

White solid, Mp 85-87 °C. IR: 1454, 1165, 732 cm^{-1} (C=S stretching frequencies). 1H NMR (400 MHz, $CDCl_3$): δ 8.09 (br s, 1 H), 7.27-7.19 (m, 10 H), 5.58-5.45 (m, 1 H), 5.22 (s, 2 H), 5.18 (s, 2 H), 3.78-3.69 (m, 3 H), 3.63-3.53 (m, 3 H), 2.20-1.86 (m, 4 H), 1.19 (d, J = 7 Hz, 3 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 184.0, 170.2, 155.2, 135.5, 128.6, 128.3, 128.2, 73.0, 67.0, 66.6, 55.4, 51.0, 50.8, 29.1, 24.6, 17.8. HRMS: m/z Calculated for $C_{24}H_{29}N_3NaO_4S$ $[M + Na]^+$ 478.1776; found: 478.1779.

7. Cbz-Gly- ψ [$CH_2NHCSNH$]-Phe-COOMe: [6b]

Gummy. 1H NMR (400 MHz, $CDCl_3$): δ 8.08 (br s, 1 H), 7.55 (br s, 1 H), 7.29-7.07 (m, 10 H), 5.48-5.44 (m, 1 H), 5.02 (s, 2 H), 3.75 (s, 3 H), 3.73 (s, 1 H), 3.46-3.41 (m, 4 H), 3.23-3.19 (m, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 182.9, 172.4, 155.6, 136.9, 136.2, 129.4, 129.1, 128.4, 127.7, 127.2, 125.0, 67.2, 65.7, 53.1, 47.1, 41.4, 37.4. HRMS: m/z Calculated for $C_{21}H_{25}N_3NaO_4S$ $[M + Na]^+$ 438.1463; found: 438.1461.

8. Cbz-Ile- ψ [CH₂NHCSNH]-Phe-COOEt:[6c]

Gummy. ¹H NMR (400 MHz, CDCl₃): δ 8.38 (br s, 1 H), 8.17 (br s, 1 H), 7.39-7.0 (m, 10 H), 5.49-5.37 (br s, 1 H), 5.04 (s, 2 H), 4.12-4.05 (m, 1 H), 3.95-3.72 (m, 5 H), 3.12-2.98 (m, 2 H), 2.22-2.10 (m, 1 H), 1.56-1.51 (m, 2 H), 1.38 (t, J = 6.8 Hz, 3 H), 1.12-1.08 (m, 6 H). ¹³C NMR (100 MHz, CDCl₃): δ 182.4, 172.6, 156.1, 136.7, 135.9, 129.1, 128.7, 127.7, 127.4, 126.3, 125.1, 67.2, 64.3, 61.9, 59.6, 49.6, 39.9, 37.0, 24.8, 17.6, 14.3, 11.5.

9. Fmoc-Leu- ψ [CH₂NHCSNH]-Leu-COOBn:[6d]

White solid, Mp 178-182 °C. IR: 1520, 1082, 734 cm⁻¹ (C=S stretching frequencies). ¹H NMR (400 MHz, CDCl₃): δ 8.53 (s, 1 H), 8.21 (d, J = 7.4 Hz, 1 H), 7.80-7.26 (m, 13 H), 5.31 (s, 2 H), 4.58 (t, J = 7.2 Hz, 1 H), 4.26-4.18 (m, 6 H), 3.89-3.83 (m, 1 H), 1.87-1.28 (m, 6 H), 0.98-0.81 (m, 12 H). ¹³C NMR (100 MHz, CDCl₃): δ 182.4, 171.6, 156.1, 143.2, 142.3, 136.6, 129.2, 128.5, 127.3, 126.2, 125.9, 125.2, 120.1, 67.6, 66.2, 60.8, 52.9, 52.5, 47.4, 42.8, 40.6, 25.8, 24.4, 22.7, 22.2.

10. Fmoc-Leu- ψ [CH₂NHCSNH]-Phe-COOMe:[6e]

Gummy. ¹H NMR (400 MHz, CDCl₃): δ 8.38-8.08 (m, 1 H), 8.07-7.93 (m, 1 H), 7.42-7.17 (m, 13 H), 4.93-4.78 (m, 1 H), 4.47 (d, J = 4.8 Hz, 2 H), 4.25 (t, J = 5.4 Hz, 1 H), 4.19-3.99 (m, 1 H), 3.83-3.73 (m, 3 H), 3.64 (s, 3 H), 3.07-2.91 (m, 2 H), 1.64 (t, J = 5.4 Hz, 2 H), 1.25-1.11 (m, 1 H), 0.88 (d, J = 6.2 Hz, 6 H). ¹³C NMR (100 MHz, CDCl₃): δ 182.3, 173.5, 156.5, 143.8, 142.4, 136.4, 129.3, 128.2, 127.9, 127.2, 126.5, 125.8, 120.8, 67.2, 63.6, 53.1, 52.7, 51.7, 47.5, 42.8, 37.9, 24.8, 23.0. HRMS: m/z Calculated for C₃₂H₃₇N₃NaO₄S [M + Na]⁺ 582.2402; found: 582.2400.

11. Fmoc-Pro- ψ [CH₂NHCSNH]-Phe-COOMe:[6f]

Gummy. ¹H NMR (400 MHz, CDCl₃): δ 8.67-8.35 (m, 2 H), 7.78-7.25 (m, 13 H), 4.38 (d, J = 5.4 Hz, 2 H), 4.36 (t, J = 5.4 Hz, 1 H), 3.82-3.79 (m, 1 H), 3.68 (s, 3 H), 3.60-3.44 (m, 5 H), 1.87-1.72 (m, 4 H). ¹³C NMR (100 MHz, CDCl₃): δ 179.9, 171.7, 157.6, 143.7, 141.4, 137.2, 127.9, 127.9, 127.2, 127.2, 125.1, 125.0, 120.2, 67.9, 64.0, 63.7, 53.7, 49.9, 47.3, 47.1, 37.2, 29.8, 24.2. HRMS: m/z Calculated for C₃₁H₃₃N₃NaO₄S [M + Na]⁺ 566.2089; found: 566.2092.

12. Boc-Gly- ψ [CH₂NHCSNH]-Phe-COOMe: [6g]

Gummy. ¹H NMR (400 MHz, CDCl₃): δ 8.62 (s, 1 H), 8.21 (s, 1 H), 7.65-7.22 (m, 5 H), 4.69 (s, 1 H), 4.30 (t, J = 4.8 Hz, 2 H), 4.20 (m, 1 H), 3.75-3.60 (m, 5 H), 3.22-3.10 (m, 2 H), 1.46 (s, 9 H). ¹³C NMR (100 MHz, CDCl₃): δ 182.7, 172.5, 155.0, 136.0, 130.3, 127.9, 125.7, 80.8, 64.9, 53.7, 47.1, 41.4, 37.2, 28.4. HRMS: m/z Calculated for C₁₈H₂₈N₃O₄S [M + H]⁺ 382.1801; found: 382.1807.

13. Boc-Phe- ψ [CH₂NHCSNH]-Ala-COOMe: [6h]

Gummy. ¹H NMR (400 MHz, CDCl₃): δ 7.88 (s, 1 H), 7.52 (br s, 1 H), 7.45-7.27 (m, 5 H), 4.92 (s, 1 H), 4.31 (t, J = 5.8 Hz, 2 H), 4.18-4.12 (m, 1 H), 3.93-3.82 (m, 1 H), 3.68 (s, 3 H), 3.31 (d, J = 6.8 Hz, 2 H), 1.32 (s, 9 H), 1.16 (d, J = 6.8 Hz, 3 H).

= 4.4 Hz, 3 H). ^{13}C NMR (100 MHz, CDCl_3): δ 182.7, 172.8, 155.3, 138.6, 129.1, 128.1, 126.4, 80.5, 59.6, 56.7, 51.9, 51.5, 39.6, 28.4, 17.9.

14. Boc-Phe- ψ [CH_2NHCSN]-Pro-COOBn: [6i]

White solid, Mp 124-126 °C. IR: 1524, 1110, 767 cm^{-1} (C=S stretching frequencies). ^1H NMR (400 MHz, CDCl_3): δ 7.64-7.62 (m, 1 H), 7.45-7.43 (m, 5 H), 7.27-7.22 (m, 5 H), 5.23 (s, 2 H), 4.66 (d, J = 7.6 Hz, 1 H), 4.30-4.25 (m, 1 H), 4.06-4.00 (m, 3 H), 3.73 (t, J = 7.8 Hz, 2 H), 3.12-2.95 (m, 2 H), 2.21-1.98 (m, 4 H), 1.33 (s, 9 H). ^{13}C NMR (100 MHz, CDCl_3): δ 184.0, 170.2, 155.5, 135.5, 131.0, 128.8, 128.6, 128.5, 128.5, 128.3, 128.2, 128.2, 128.1, 80.9, 73.0, 67.4, 57.4, 51.0, 50.9, 39.9, 29.1, 28.8, 24.6.

15. Fmoc-Ala- ψ [CH_2NHCSNH]-Val-Leu-COOMe:[7a]

Gummy. ^1H NMR (400 MHz, CDCl_3): δ 8.48-8.43 (m, 1 H), 8.23 (d, J = 7.6 Hz, 1 H), 7.69-7.12 (m, 8 H), 6.41 (s, 1 H), 5.59 (s, 1 H), 5.27-5.24 (m, 1 H), 4.36-4.31 (m, 3 H), 3.99 (d, J = 3.6 Hz, 1 H), 3.68 (s, 3 H), 3.47-3.42 (m, 3 H), 2.28-2.20 (m, 1 H), 1.97-1.90 (m, 2 H), 1.46-1.15 (m, 10 H), 0.97-0.90 (m, 6 H). ^{13}C NMR (100 MHz, CDCl_3): δ 182.7, 172.6, 171.2, 155.7, 143.3, 142.5, 126.7, 125.9, 124.8, 120.3, 69.5, 67.6, 57.5, 52.8, 51.8, 50.7, 47.3, 40.5, 31.5, 24.7, 23.2, 19.4, 17.5.

16. Cbz-Ala- ψ [CH_2NHCSNH]-Phe-Ala-COOMe: [7b]

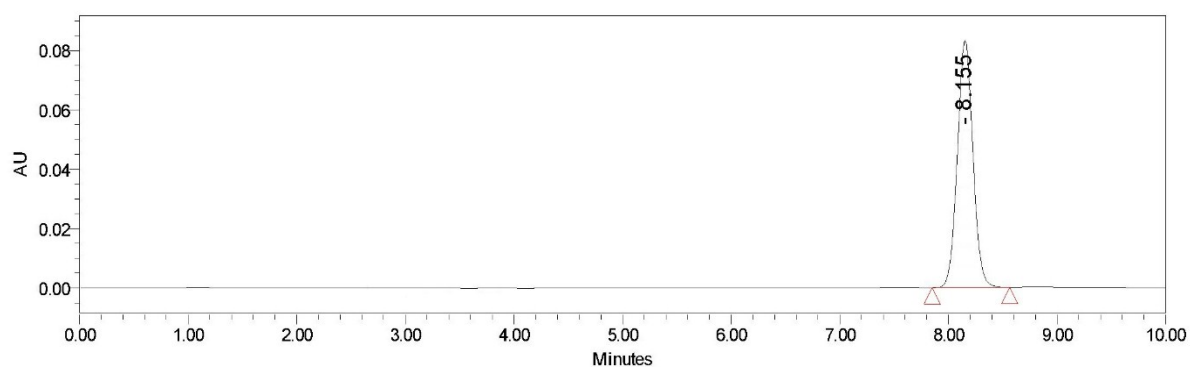
Gummy. ^1H NMR (400 MHz, CDCl_3): δ 7.80 (br s, 1 H), 7.63 (br s, 1 H), 7.38-7.17 (m, 10 H), 6.38 (br s, 1 H), 5.54-5.39 (m, 1 H), 5.18 (s, 2 H), 4.42-4.27 (m, 1 H), 4.10-3.95 (m, 2 H), 3.70 (s, 3 H), 3.54-3.41 (m, 2 H), 3.39-3.05 (m, 2 H), 1.57 (d, J = 7.8 Hz, 3 H), 1.36 (d, J = 7.2 Hz, 3 H). ^{13}C NMR (100 MHz, CDCl_3): δ 182.7, 172.6, 169.7, 155.7, 134.9, 134.3, 131.0, 129.6, 128.9, 127.8, 126.5, 126.1, 67.1, 64.6, 55.5, 53.1, 51.7, 50.9, 37.2, 18.2, 17.8. HRMS: m/z Calculated for $\text{C}_{25}\text{H}_{32}\text{N}_4\text{NaO}_5\text{S}$ [$\text{M} + \text{Na}$] $^+$ 523.1991; found: 523.1998.

17. Cbz-Ala- ψ [$\text{CH}_2\text{NHCSNHCH}_2$]-Gly-Boc: [8a]

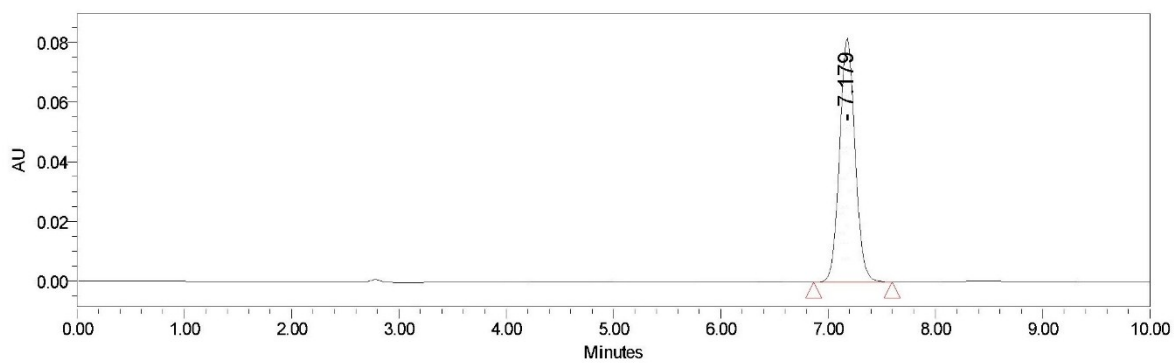
White solid, Mp 118-120 °C. IR: 1519, 1133, 765 cm^{-1} (C=S stretching frequencies). ^1H NMR (400 MHz, CDCl_3): δ 8.54 (br s, 1 H), 8.18 (br s, 1 H), 7.41-7.02 (m, 5 H), 5.51 (br s, 1 H), 5.08 (s, 2 H), 4.62 (s, 1 H), 4.07 (t, J = 7.2 Hz, 2 H), 3.84-3.67 (m, 3 H), 3.57 (t, J = 7.2 Hz, 2 H), 1.51 (s, 9 H), 1.44 (d, J = 7.2 Hz, 3 H). ^{13}C NMR (100 MHz, CDCl_3): δ 181.4, 155.0, 154.6, 137.0, 128.6, 127.2, 126.1, 80.8, 67.4, 54.4, 52.3, 47.7, 41.1, 28.1, 17.5. HRMS: m/z Calculated for $\text{C}_{19}\text{H}_{31}\text{N}_4\text{O}_4\text{S}$ [$\text{M} + \text{H}$] $^+$ 411.2066; found: 411.2072.

18. Fmoc-Phe- ψ [$\text{CH}_2\text{NHCSNHCH}_2$]-Gly-Boc:[8b]

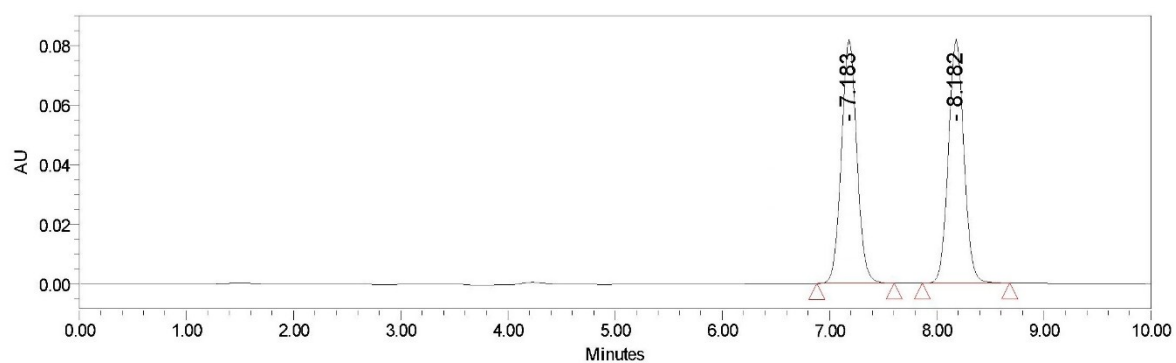
Gummy. ^1H NMR (400 MHz, CDCl_3): δ 8.51 (s, 1 H), 8.11 (s, 1 H), 7.75-7.05 (m, 13 H), 4.86 (s, 1 H), 4.74 (s, 1 H), 4.45-4.16 (m, 5 H), 4.1-3.98 (m, 1 H), 3.71-3.35 (m, 4 H), 3.17-3.05 (m, 2 H), 1.49 (s, 9 H). ^{13}C NMR (100 MHz, CDCl_3): δ 182.4, 155.6, 154.9, 143.6, 142.9, 139.5, 129.7, 128.9, 128.2, 127.8, 125.6, 124.8, 119.2, 80.7, 67.9, 58.2, 51.4, 47.3, 46.2, 41.2, 39.0, 28.4. HRMS: m/z Calculated for $\text{C}_{32}\text{H}_{39}\text{N}_4\text{O}_4\text{S}$ [$\text{M} + \text{H}$] $^+$ 575.2692; found: 575.2697.



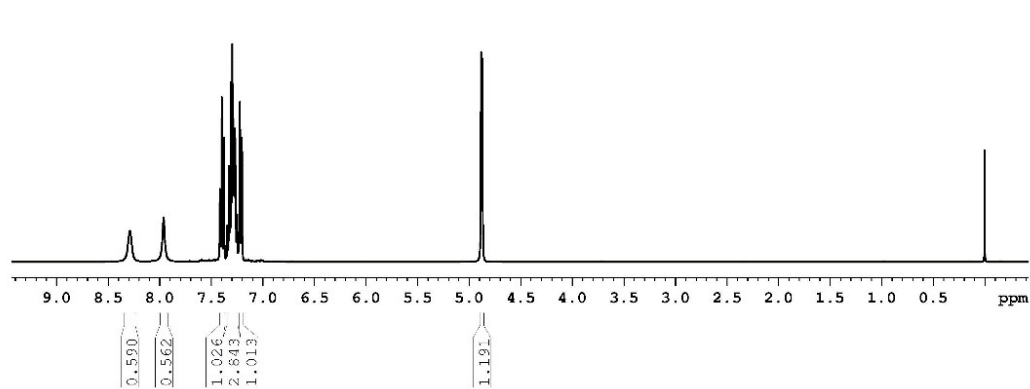
Racemization study of compound 6j [L-isomer]



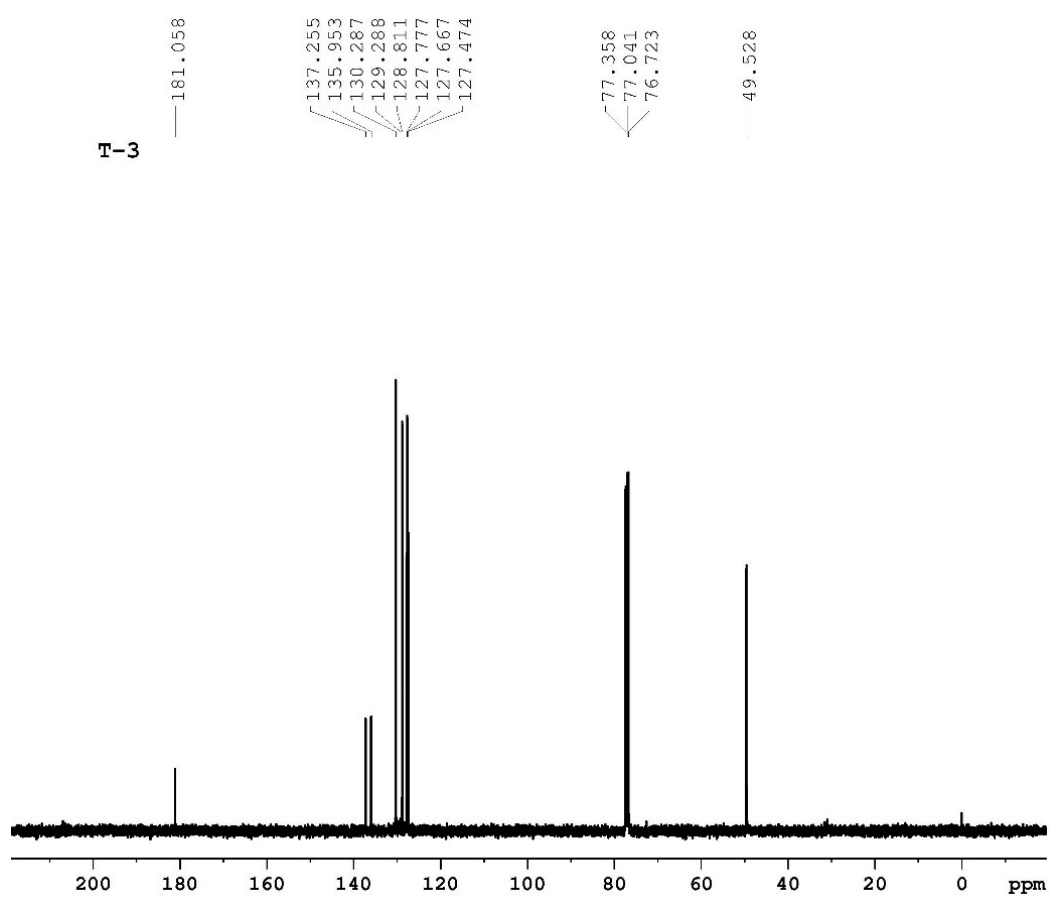
Racemization study of compound 6j* [D-isomer]



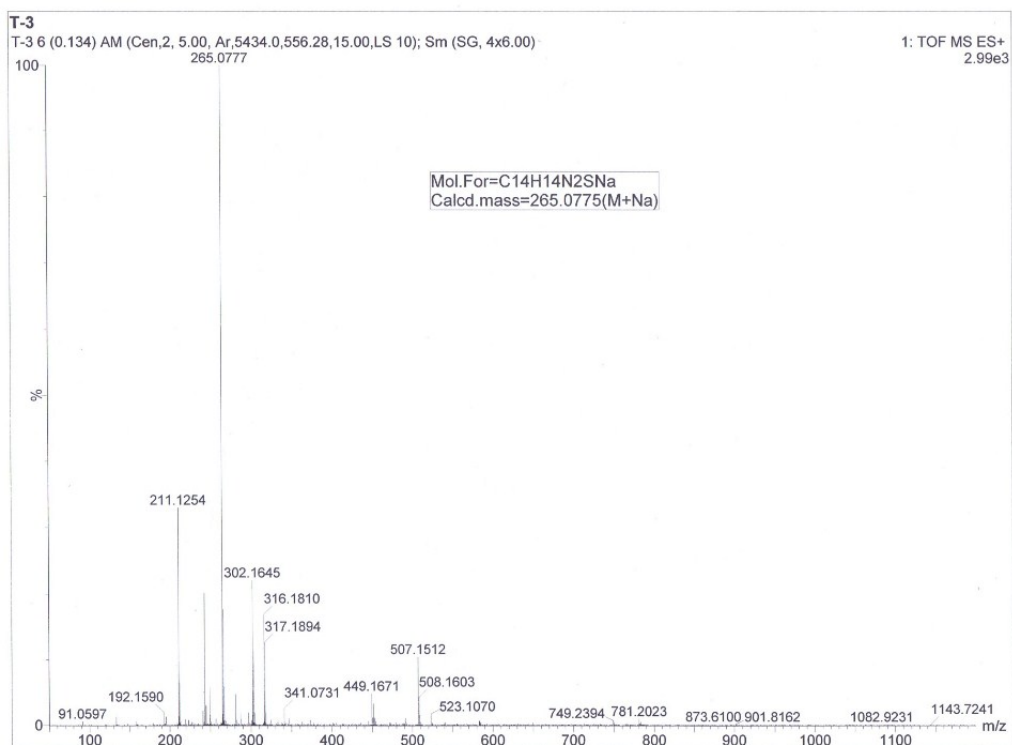
Racemization study of mixture of compound 6j & 6j* [D- & D-isomer]



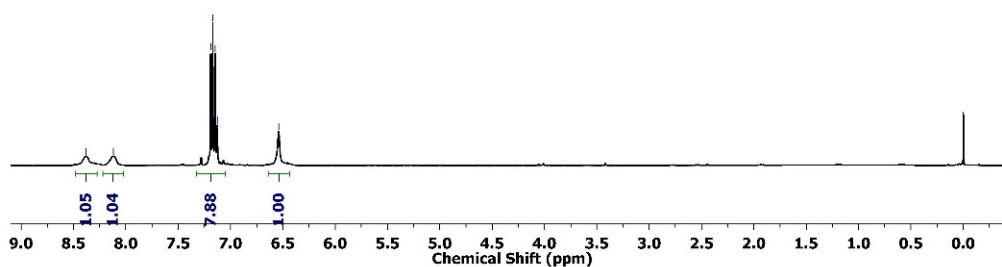
¹H NMR Spectrum of Compound 3a



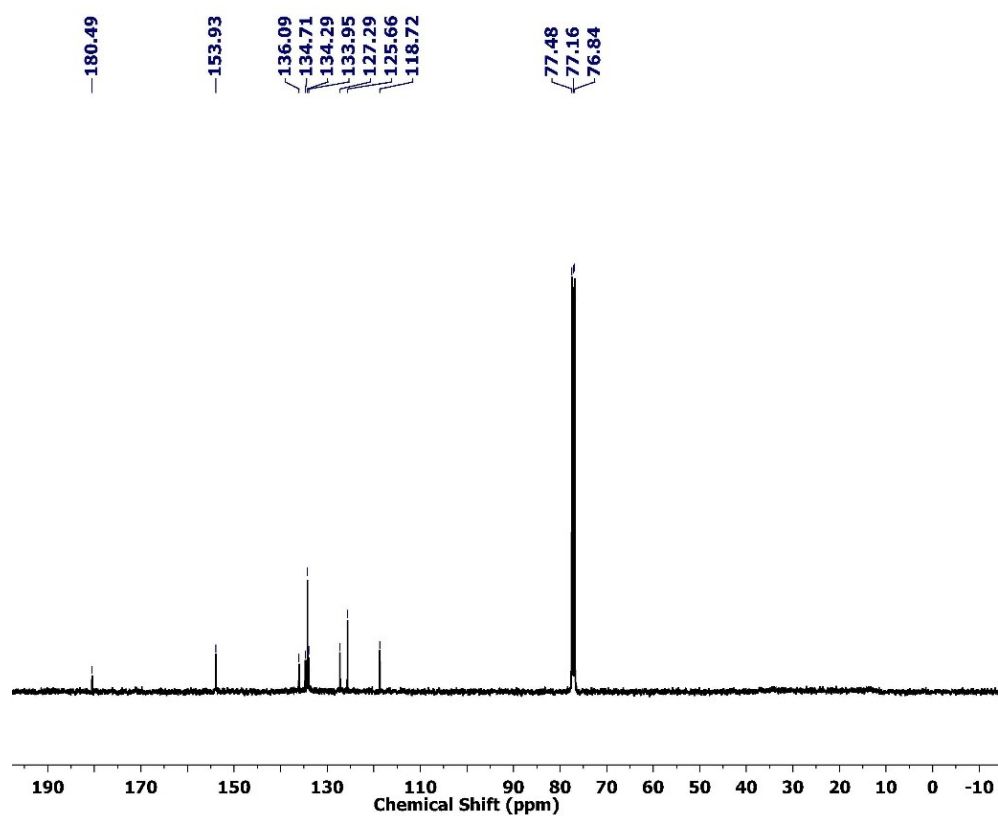
¹³C NMR Spectrum of Compound 3a



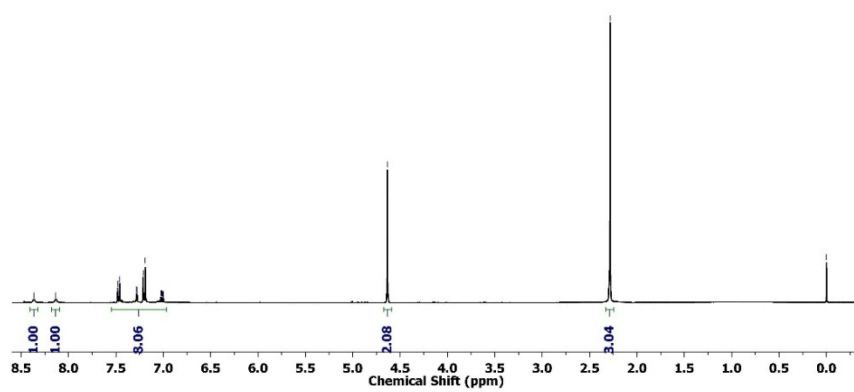
HRMS of Compound 3a



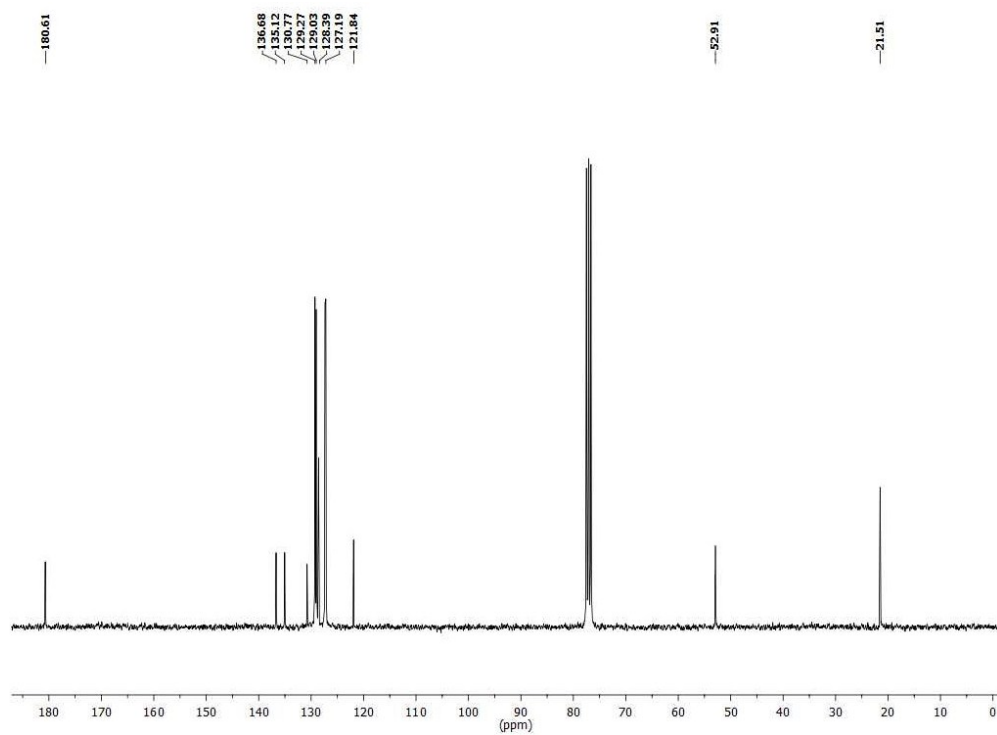
¹H NMR Spectrum of Compound 3b



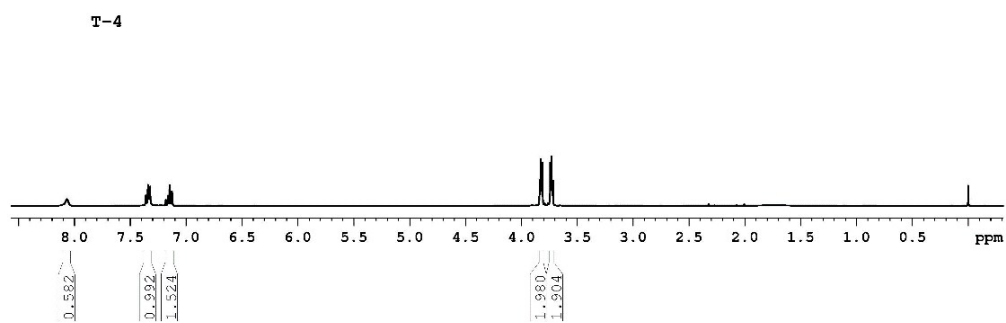
¹³C NMR Spectrum of Compound 3b



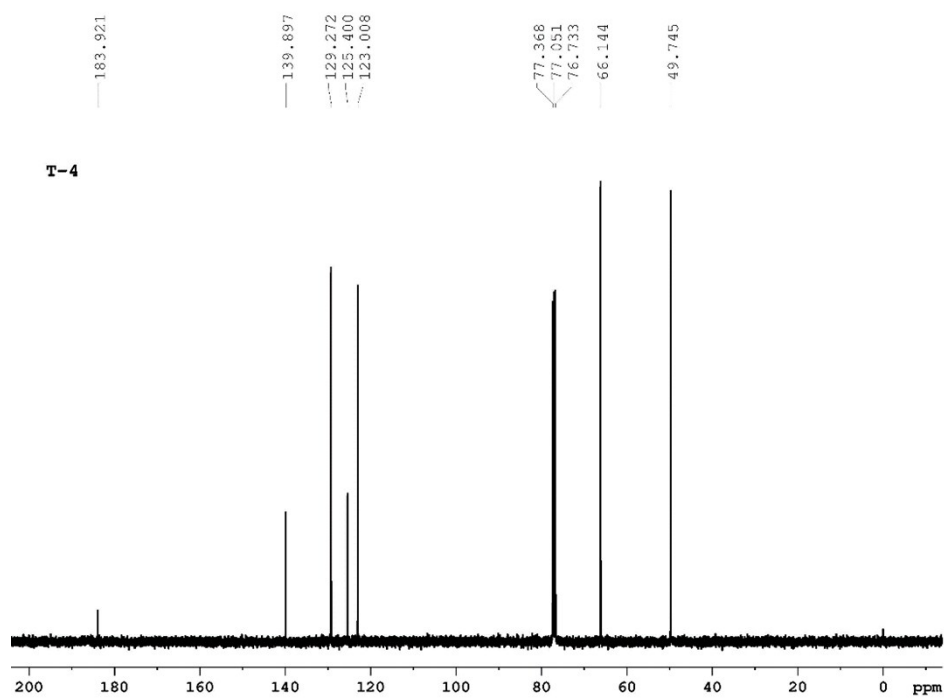
¹H NMR Spectrum of Compound 3c



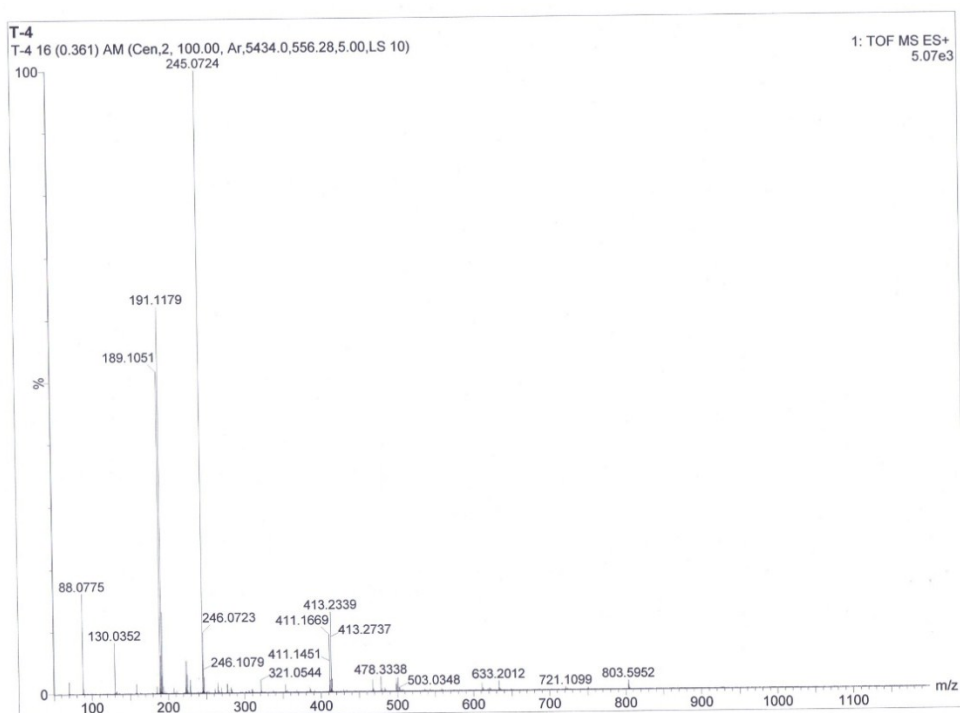
¹³C NMR Spectrum of Compound 3c



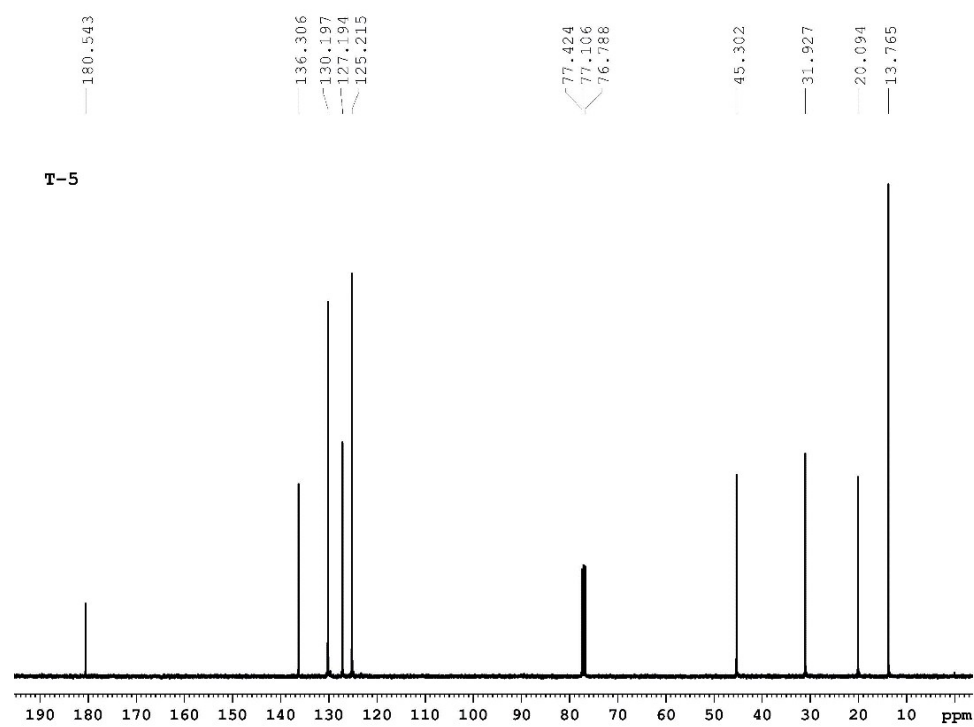
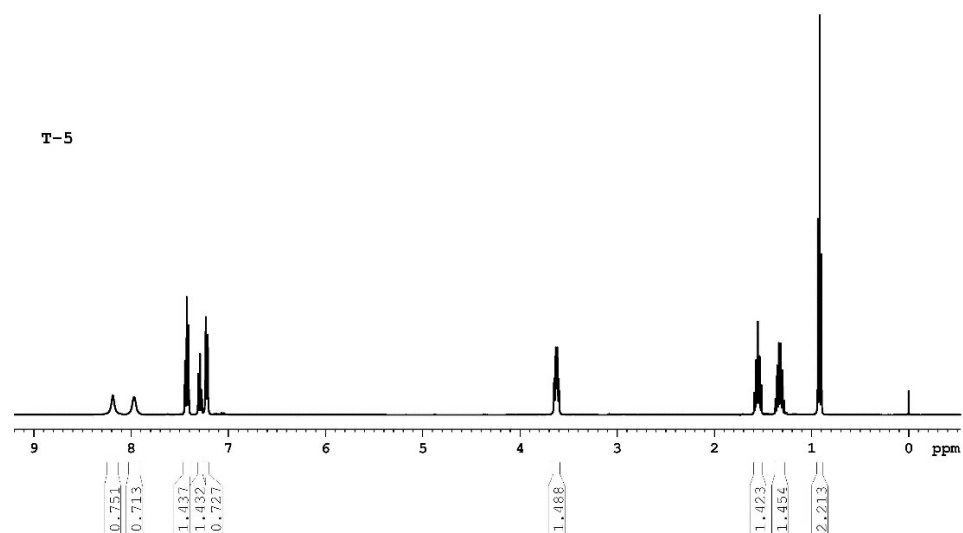
¹H NMR Spectrum of Compound 3d

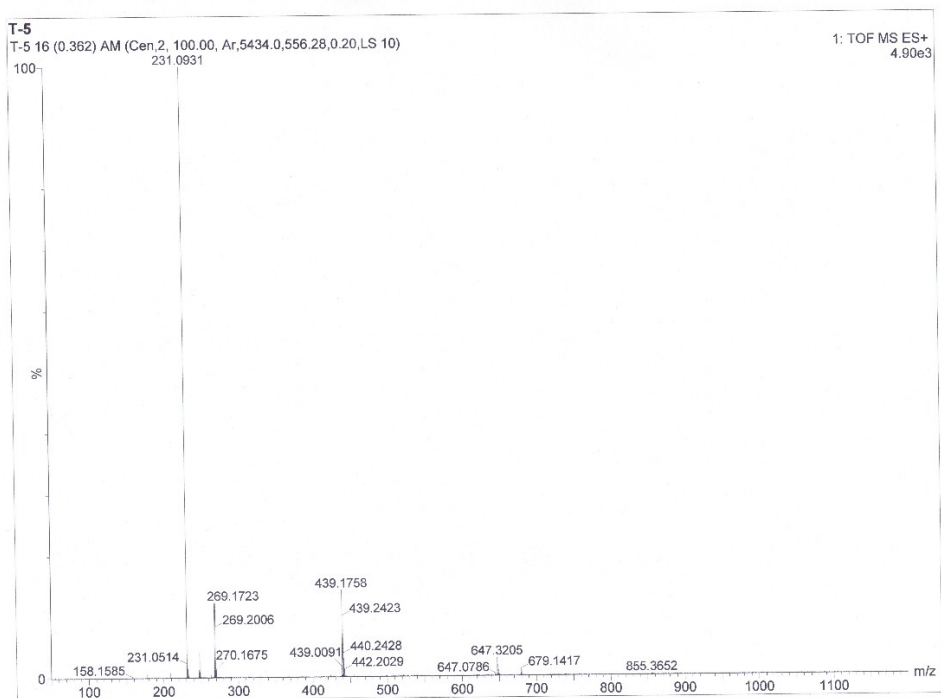


¹³C NMR Spectrum of Compound 3d

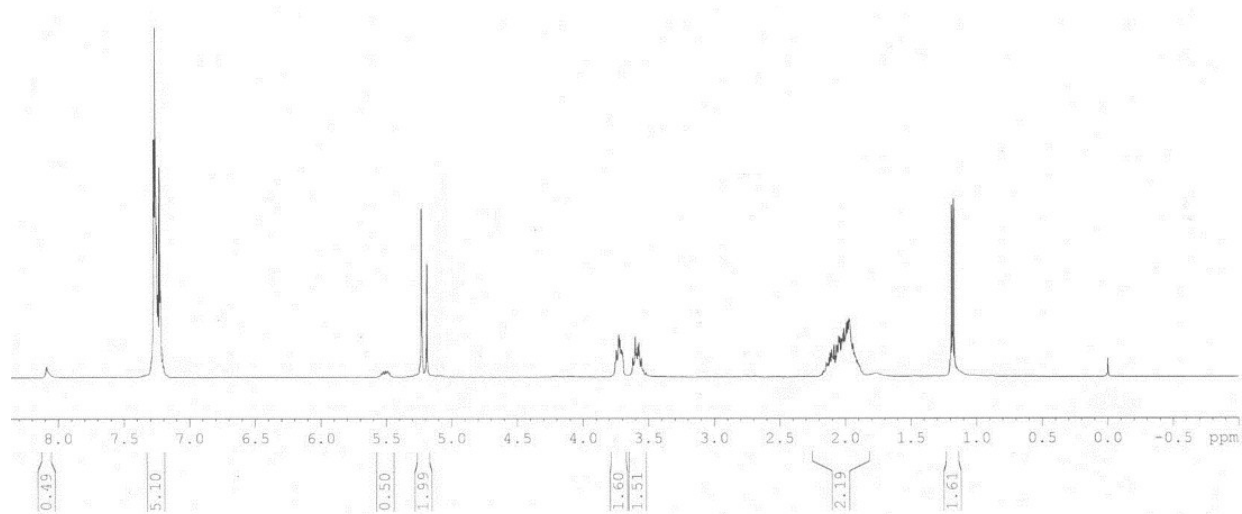


HRMS of Compound 3d

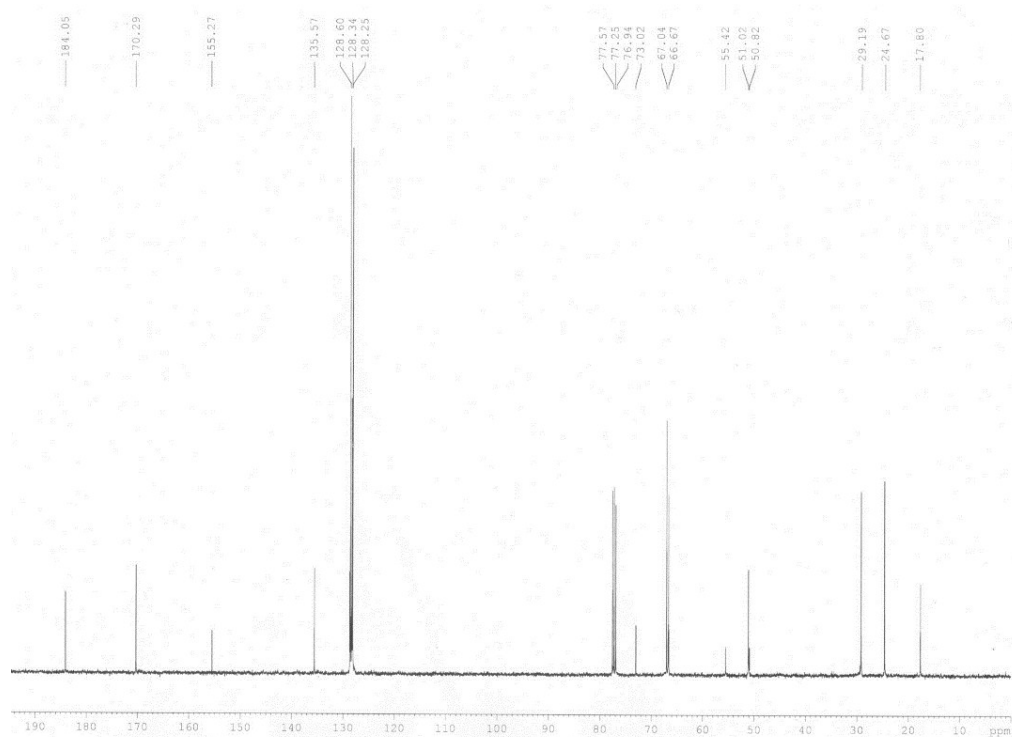




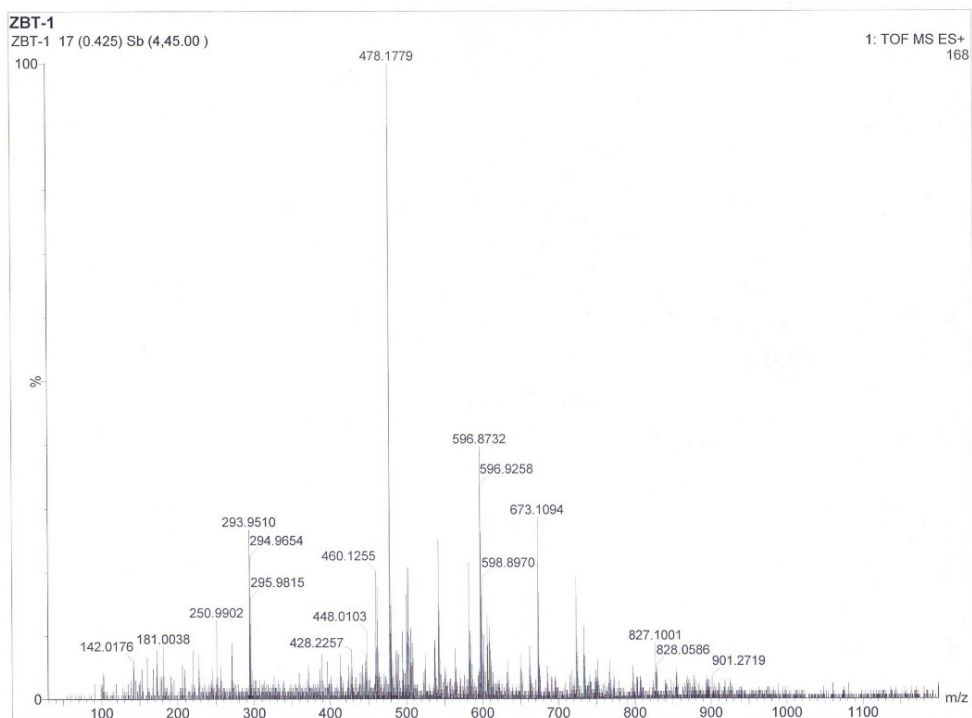
HRMS of Compound 3e



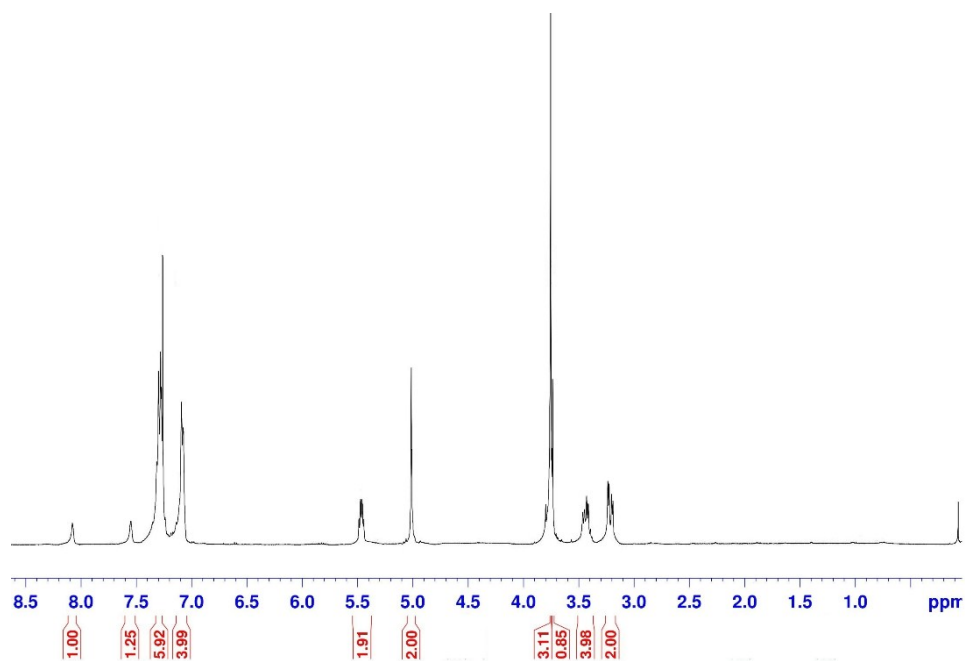
^1H NMR Spectrum of Compound 6a



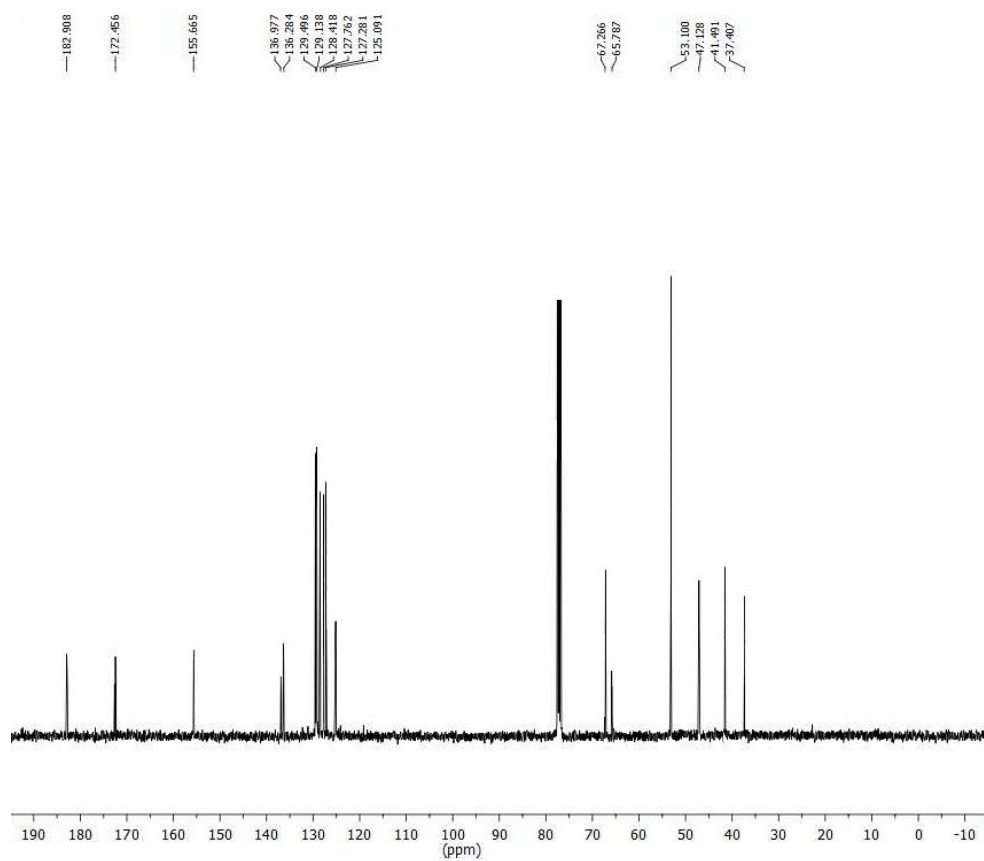
¹³C NMR Spectrum of Compound 6a



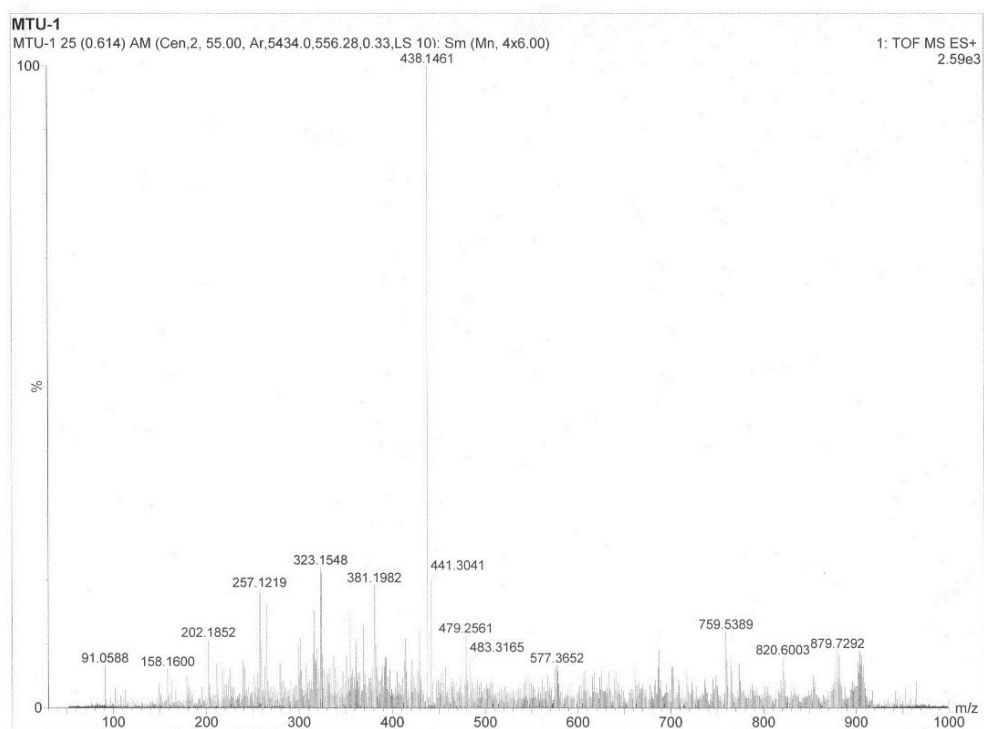
HRMS of Compound 6a



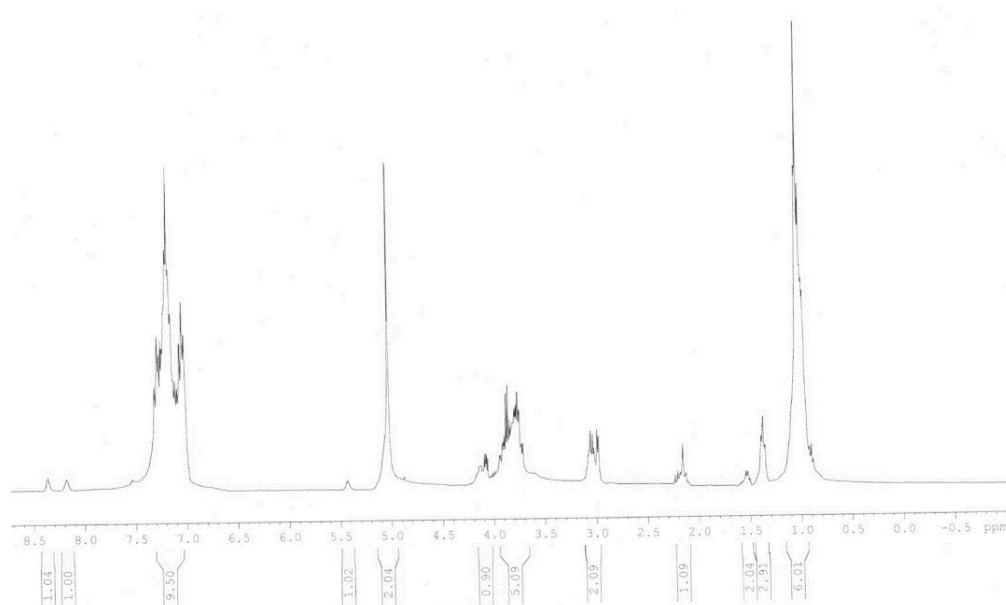
¹H NMR Spectrum of Compound 6b



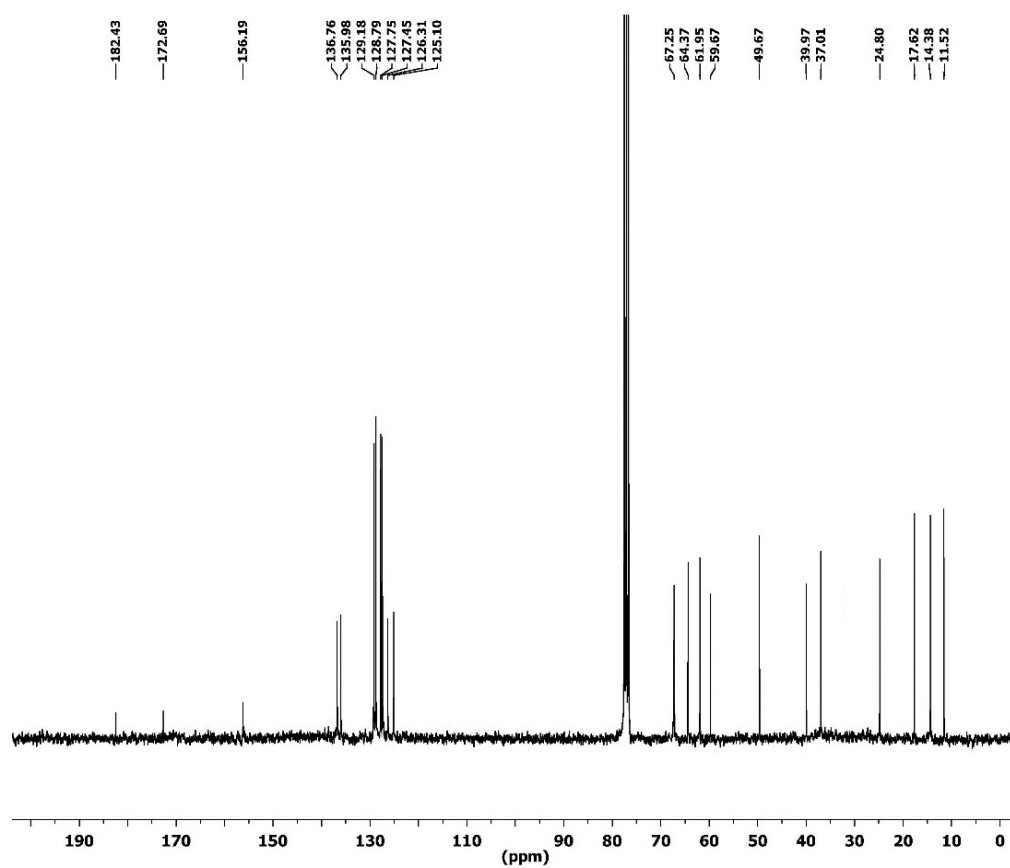
¹³C NMR Spectrum of Compound 6b



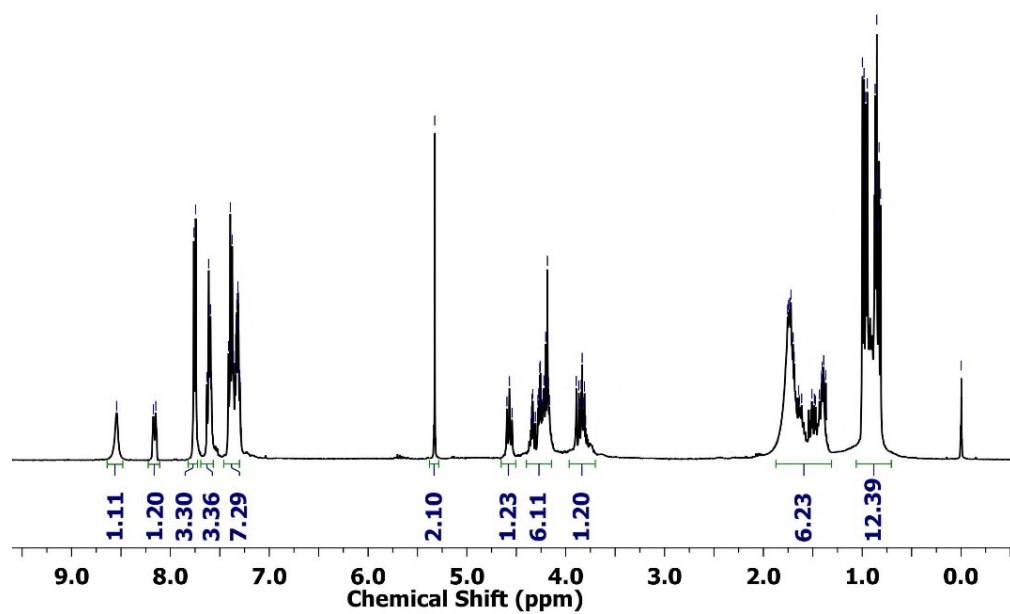
HRMS of Compound 6b



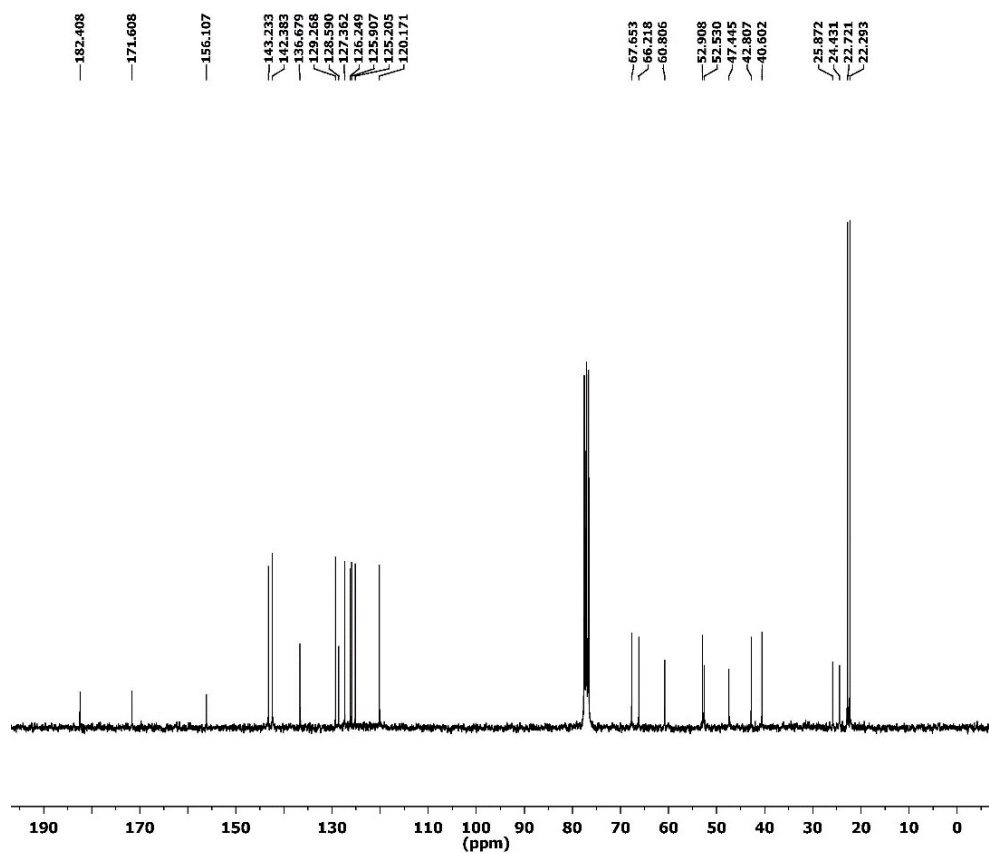
¹H NMR Spectrum of Compound 6c



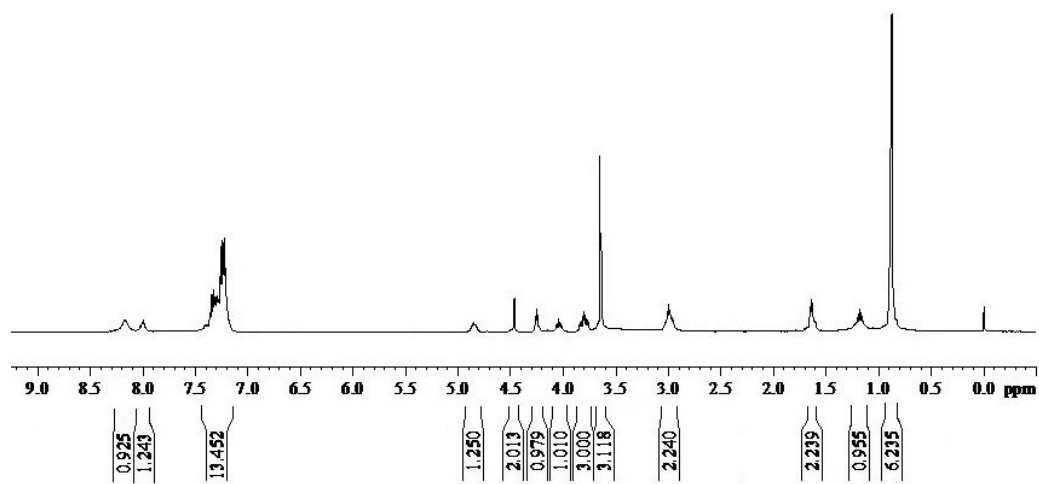
^{13}C NMR Spectrum of Compound 6c



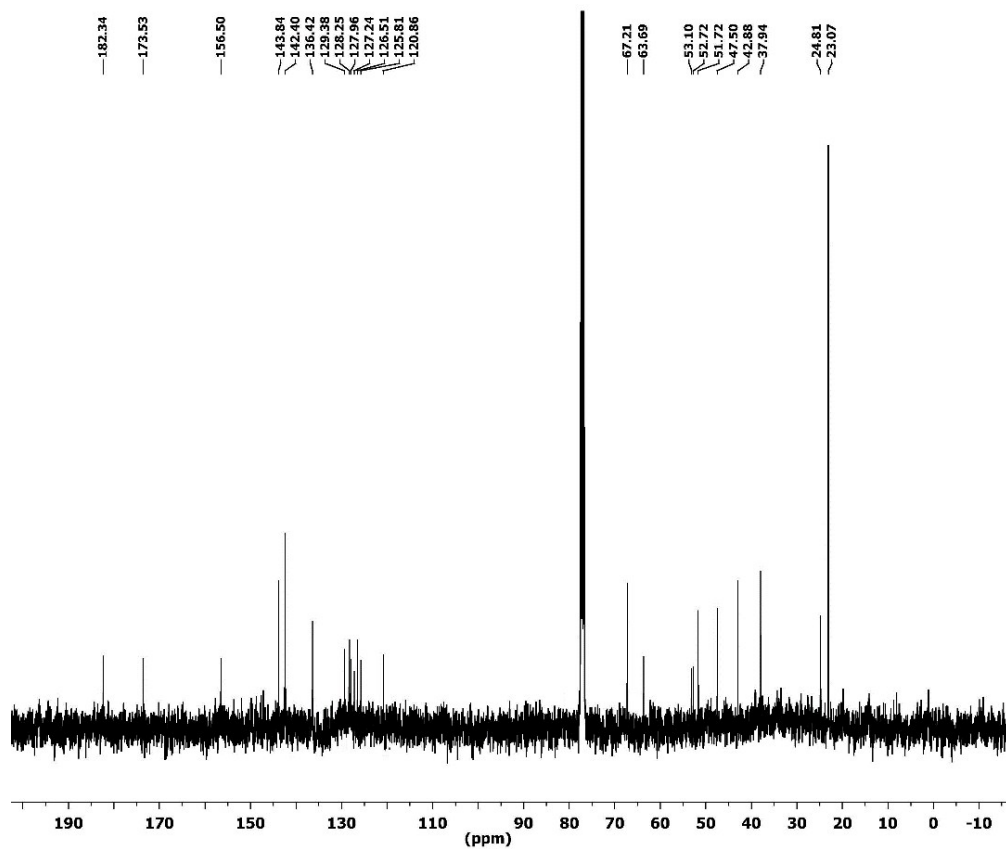
^1H NMR Spectrum of Compound 6d



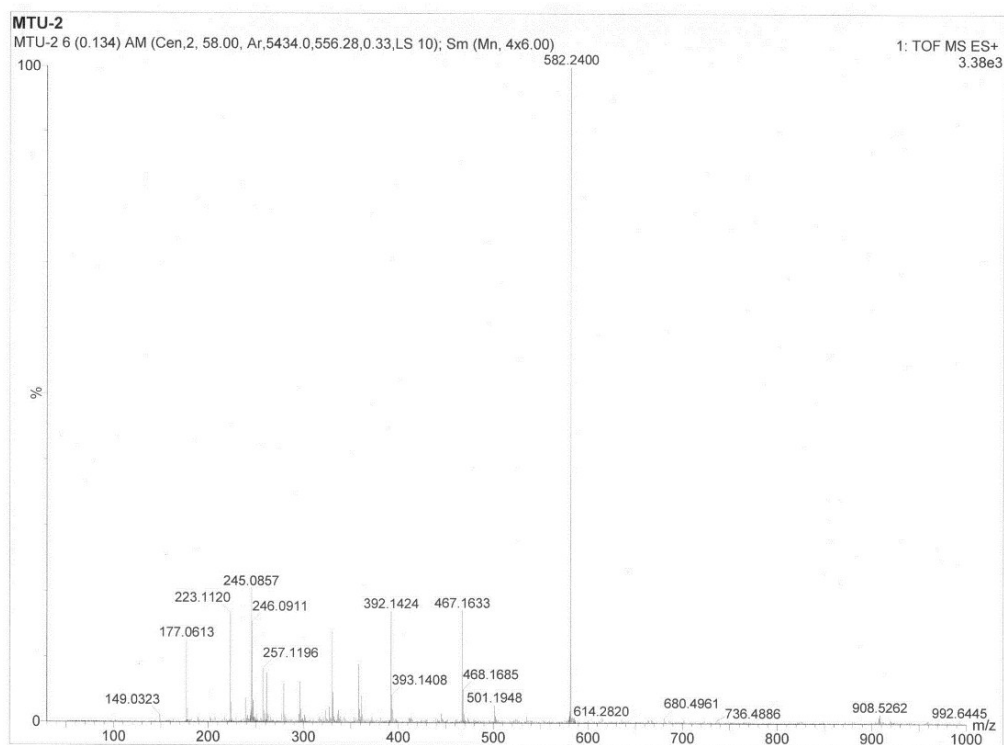
¹³C NMR Spectrum of Compound 6d



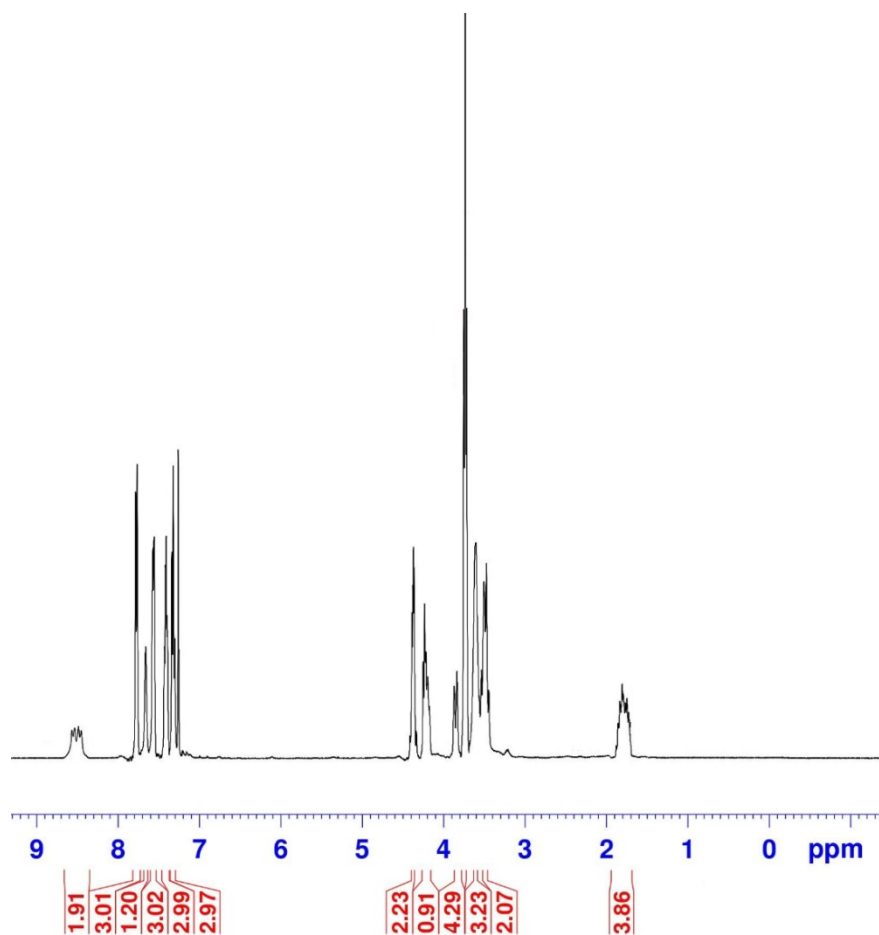
¹H NMR Spectrum of Compound 6e



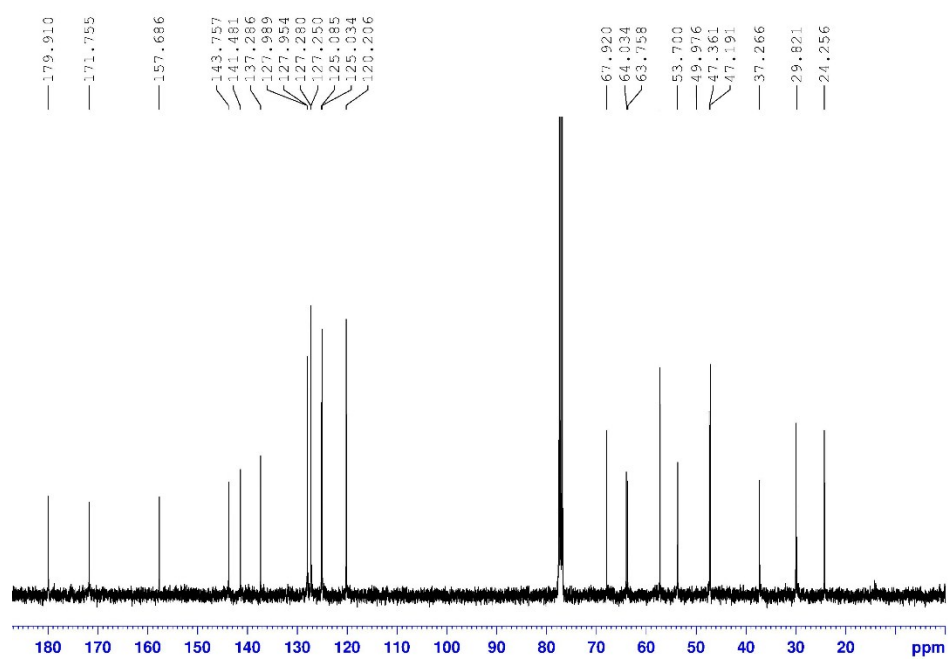
¹³C NMR Spectrum of Compound 6e



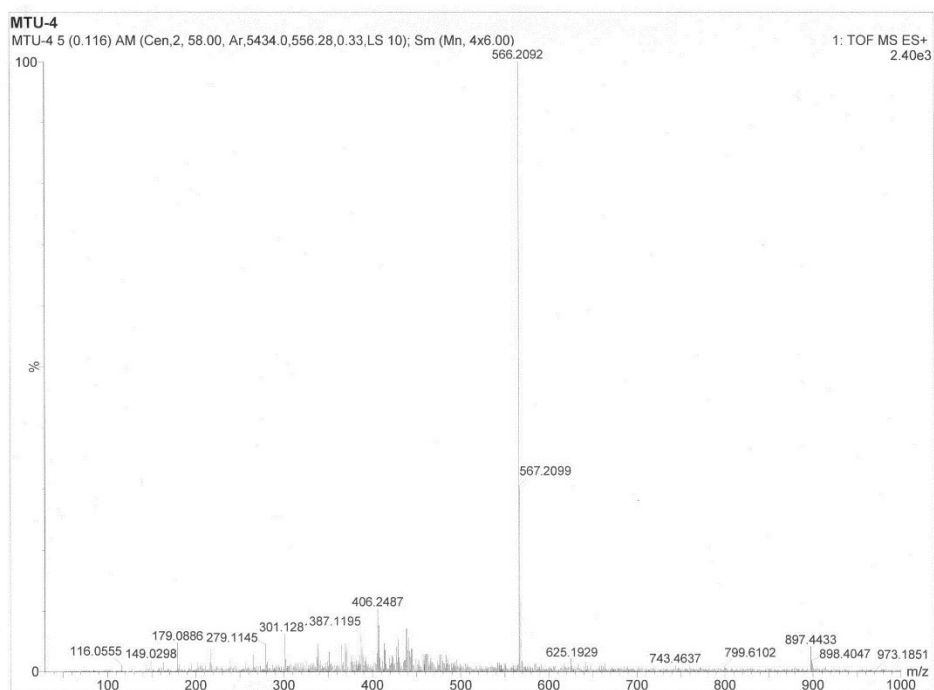
HRMS of Compound 6e



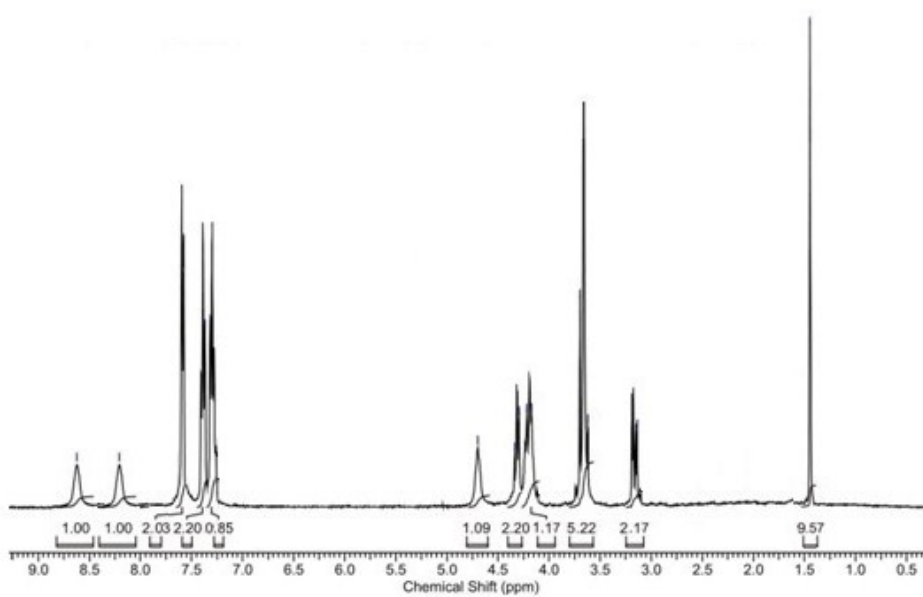
¹H NMR Spectrum of Compound 6f



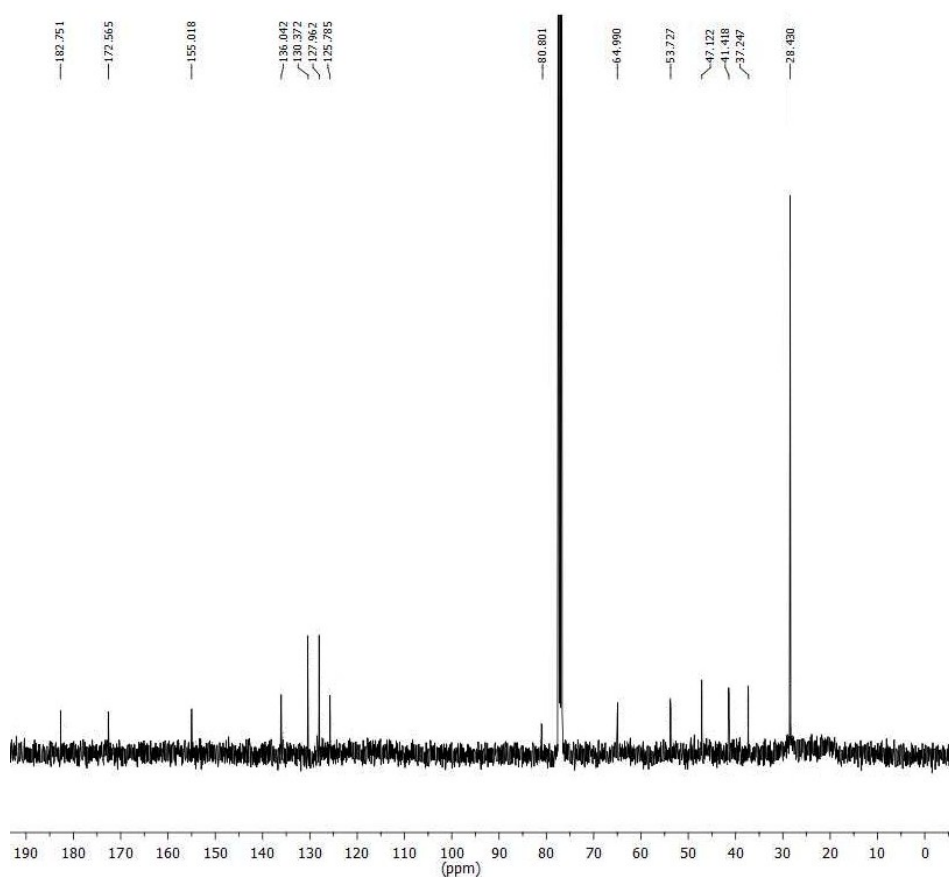
¹³C NMR Spectrum of Compound 6f



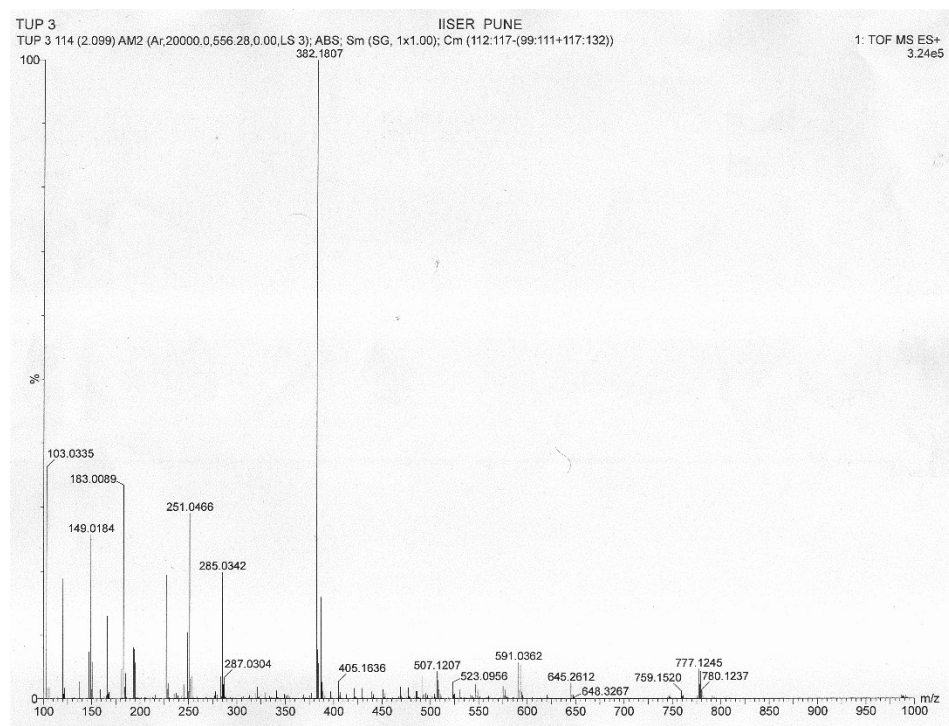
HRMS of Compound 6f



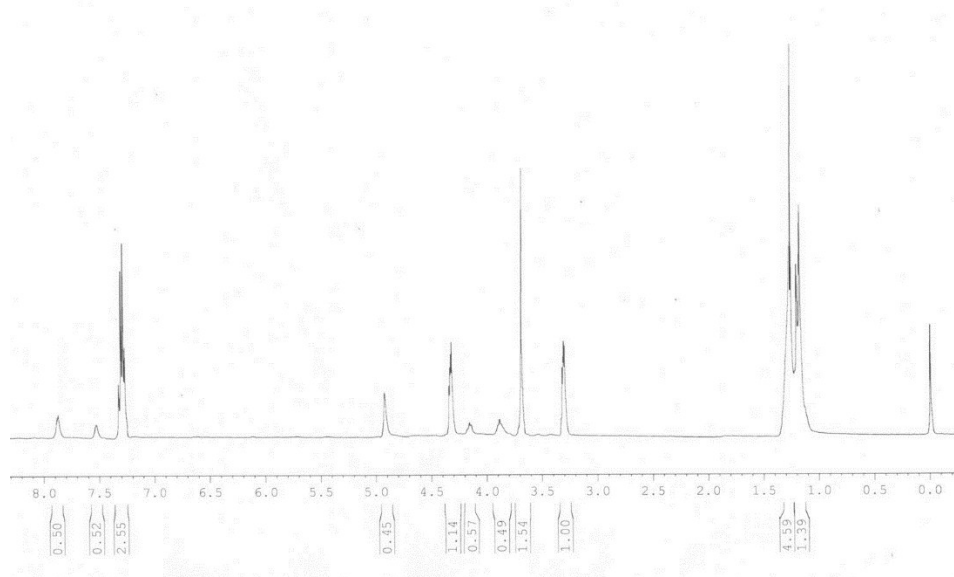
¹H NMR Spectrum of Compound 6g



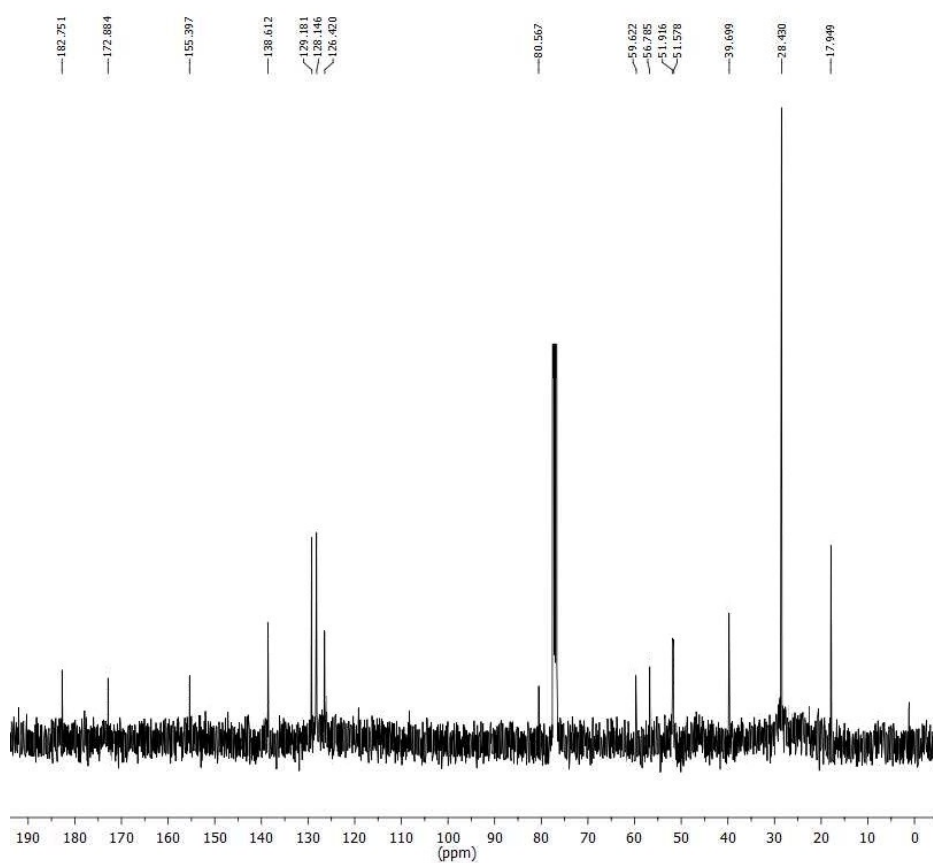
¹³C NMR Spectrum of Compound 6g



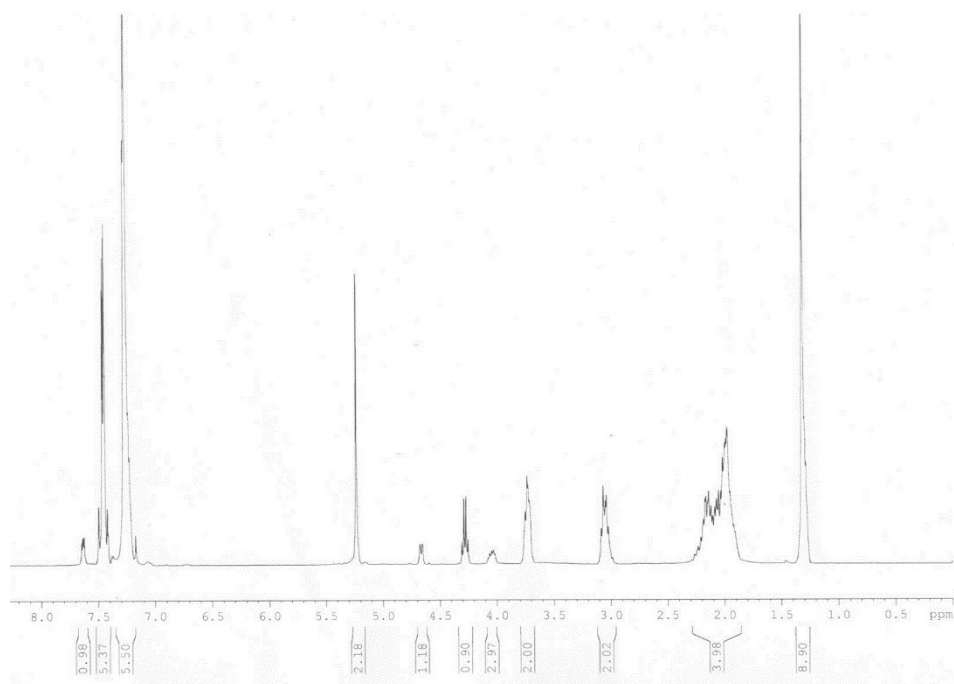
HRMS of Compound 6g



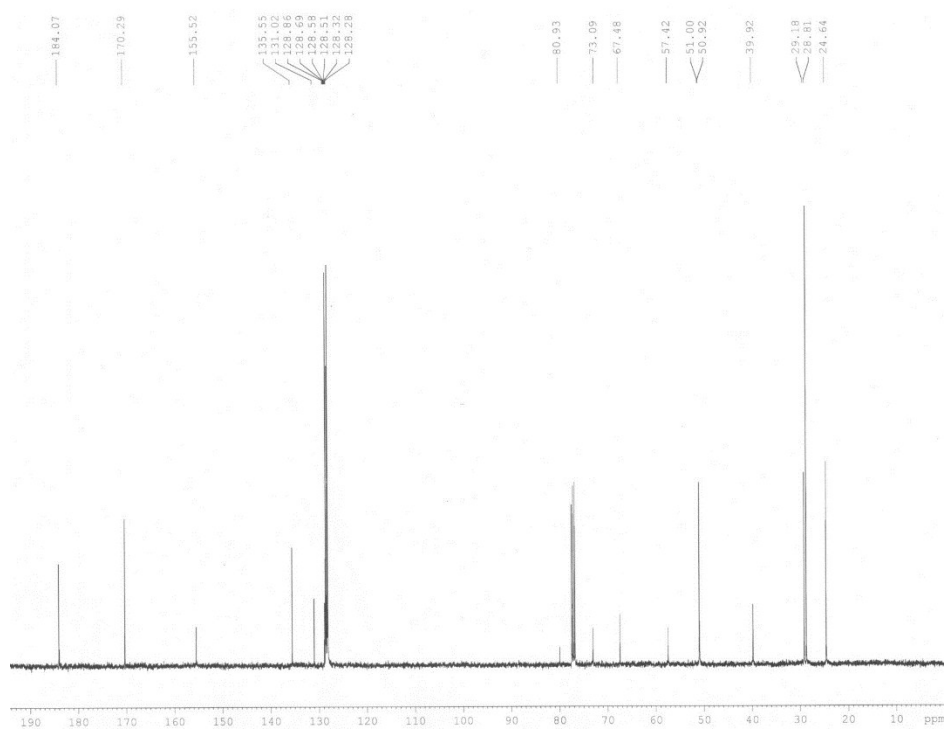
¹H NMR Spectrum of Compound 6h



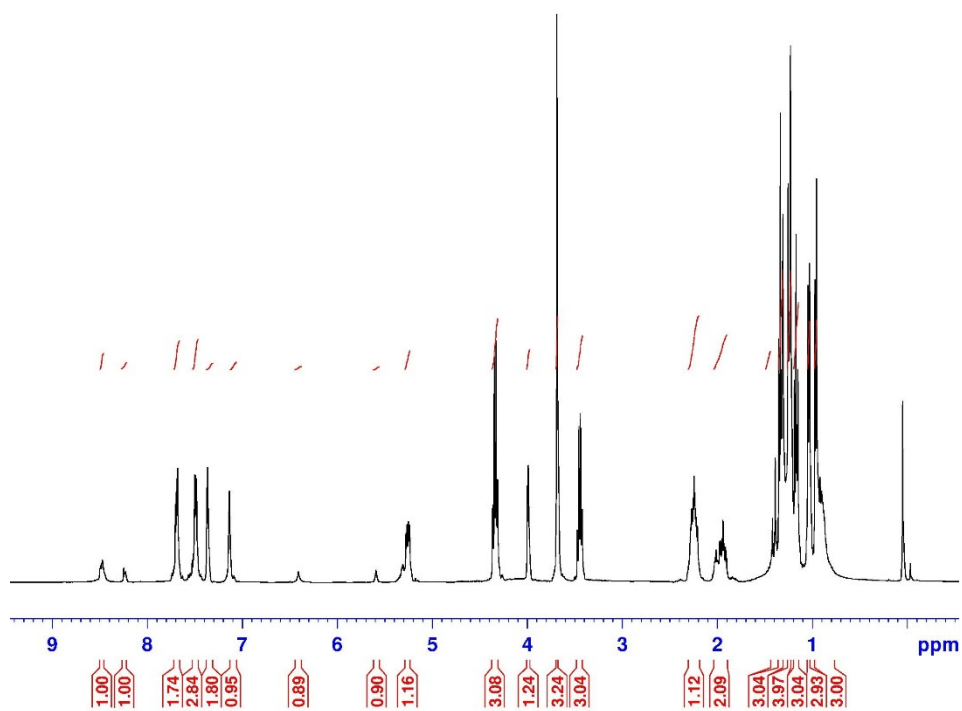
¹³C NMR Spectrum of Compound 6h



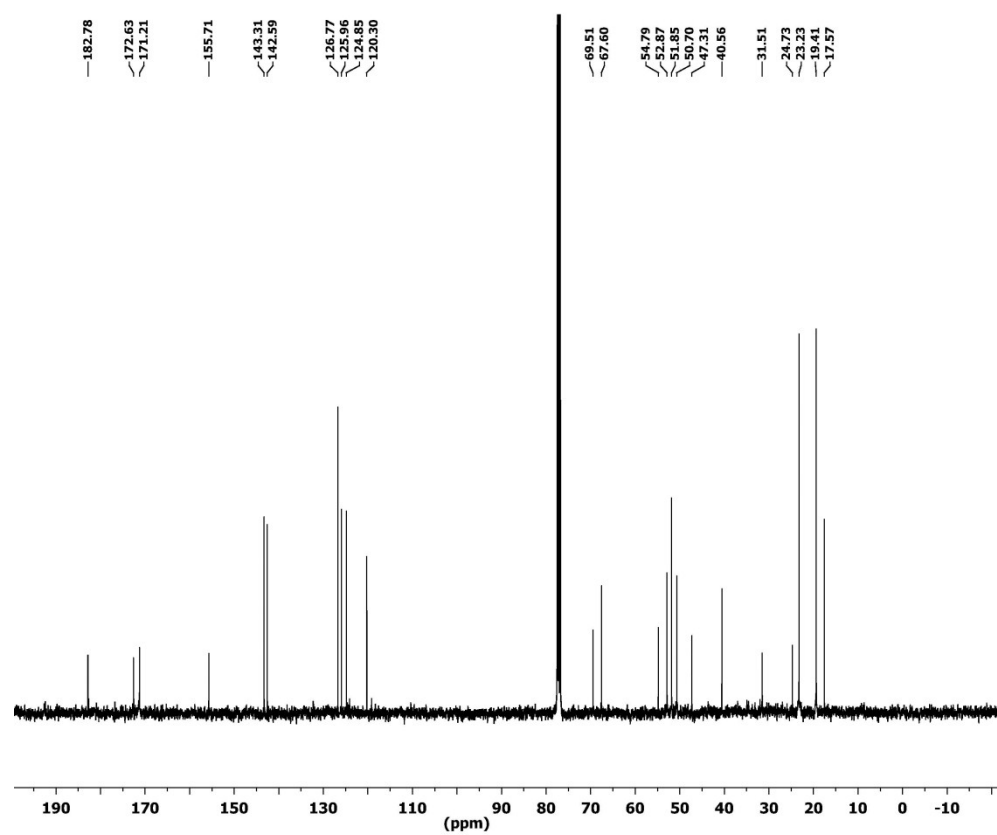
¹H NMR Spectrum of Compound 6i



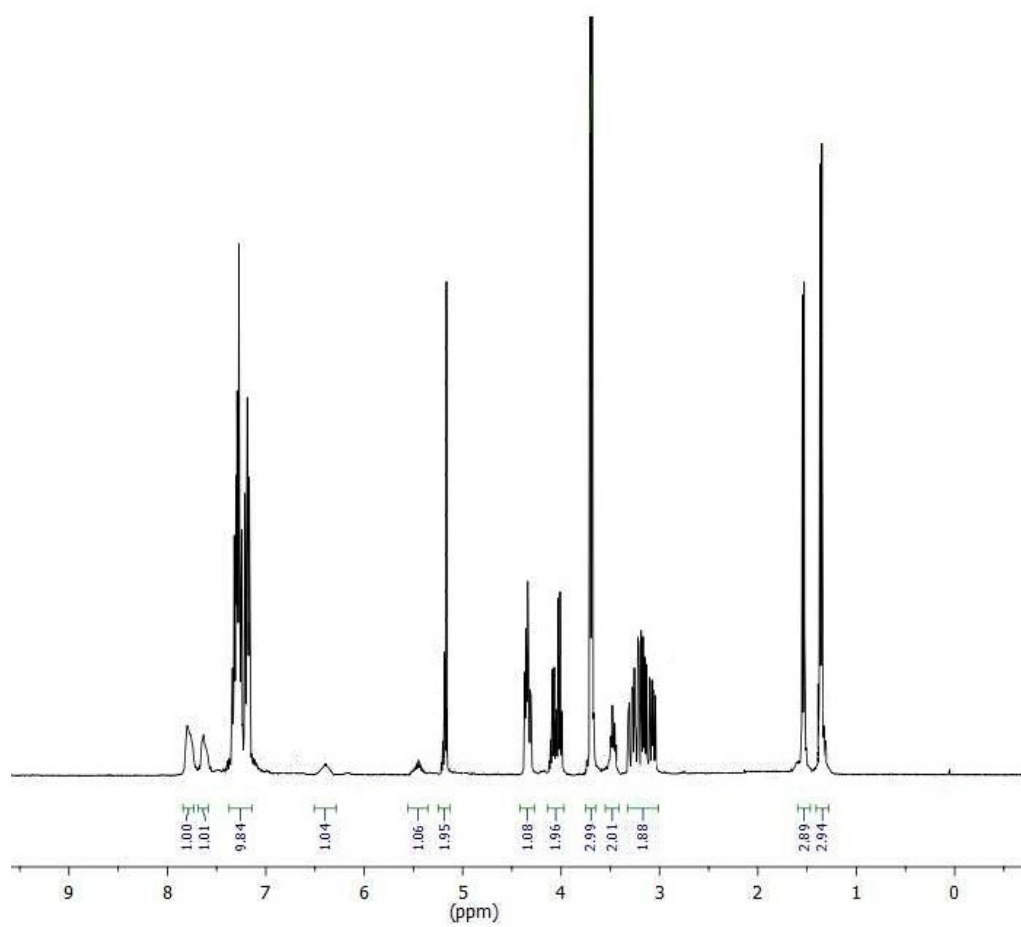
¹³C NMR Spectrum of Compound 6i



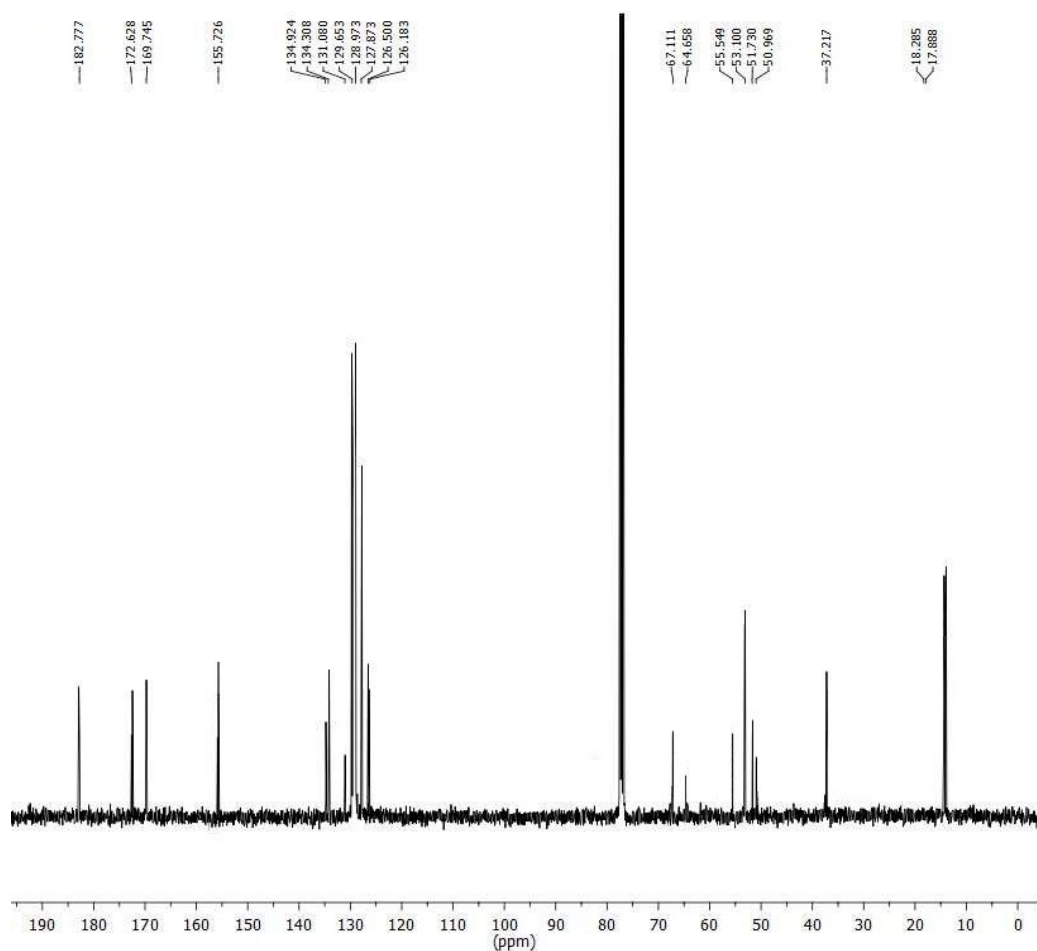
¹H NMR Spectrum of Compound 7a



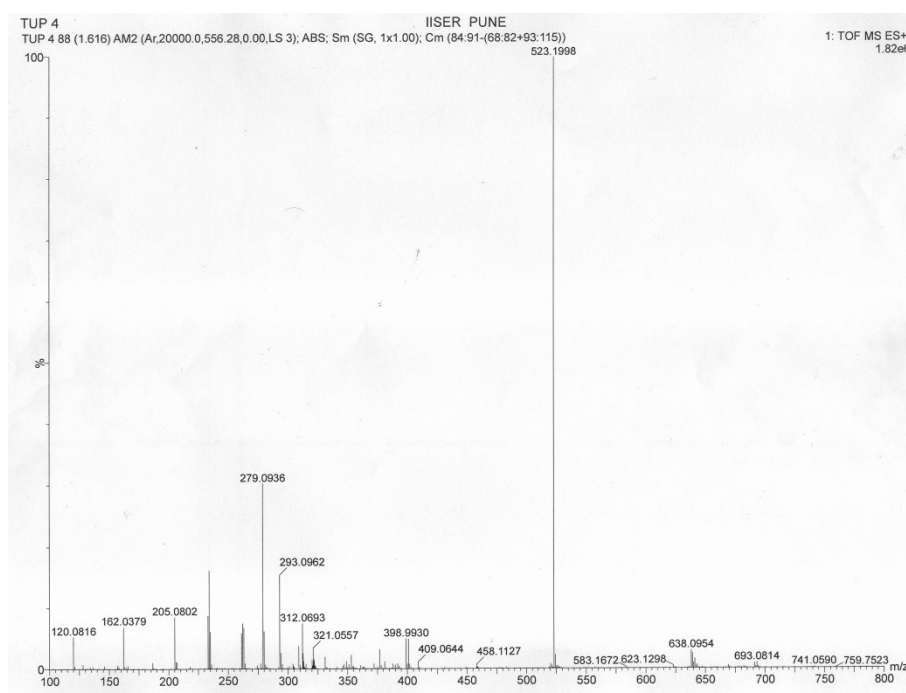
¹³C NMR Spectrum of Compound 7a



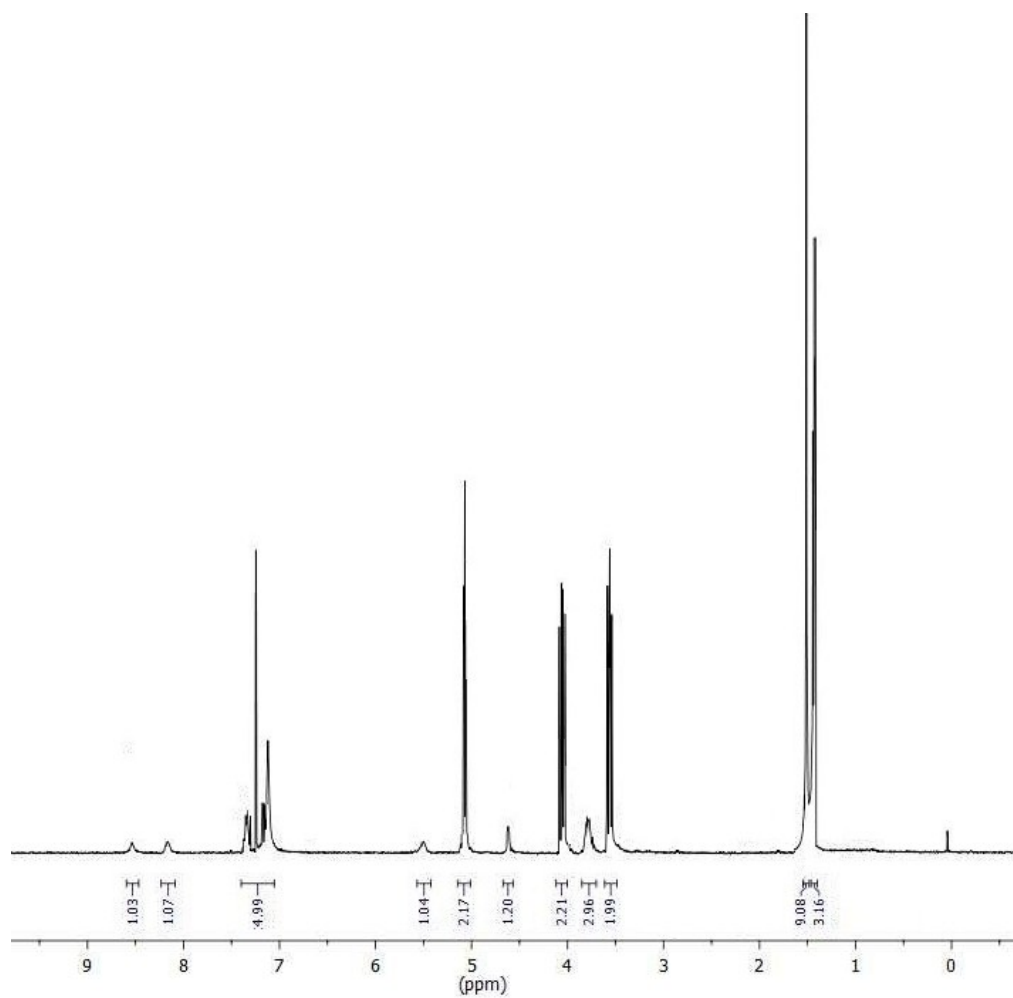
^1H NMR Spectrum of Compound 7b



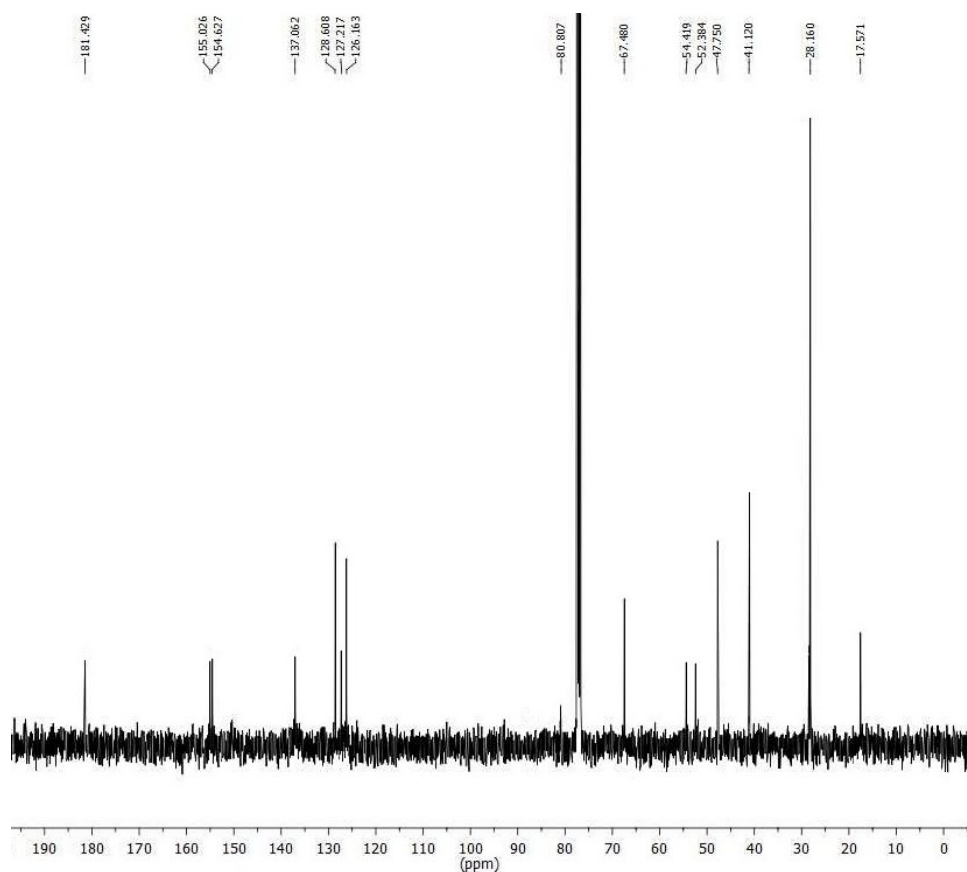
¹³C NMR Spectrum of Compound 7b



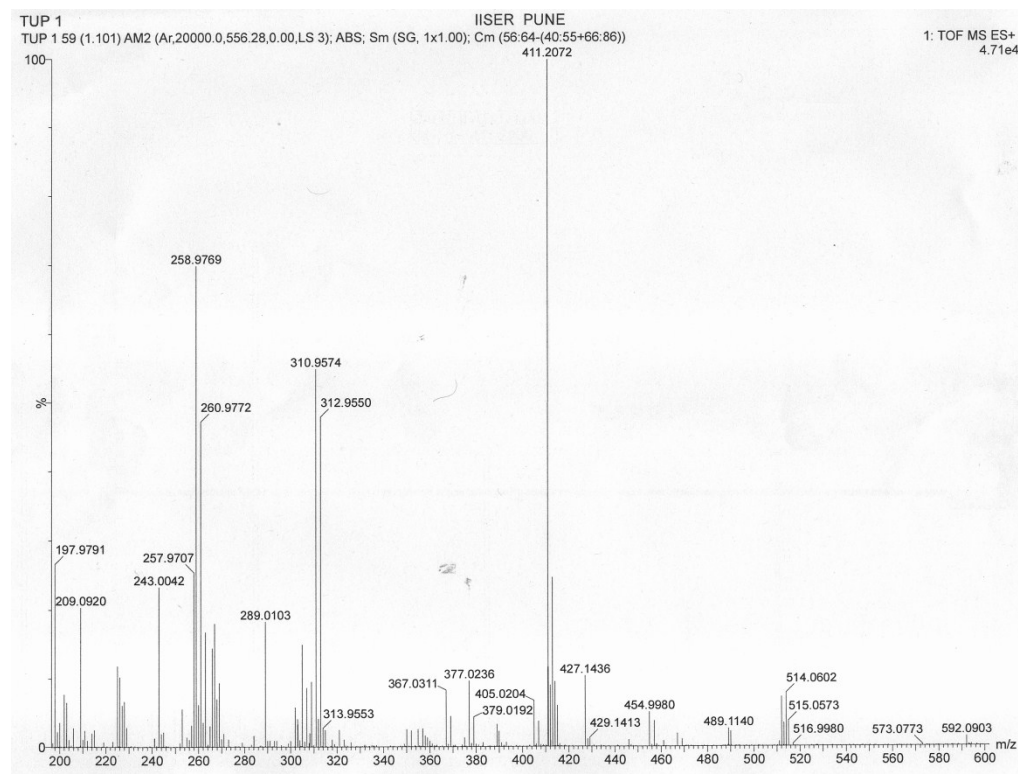
HRMS of Compound 7b



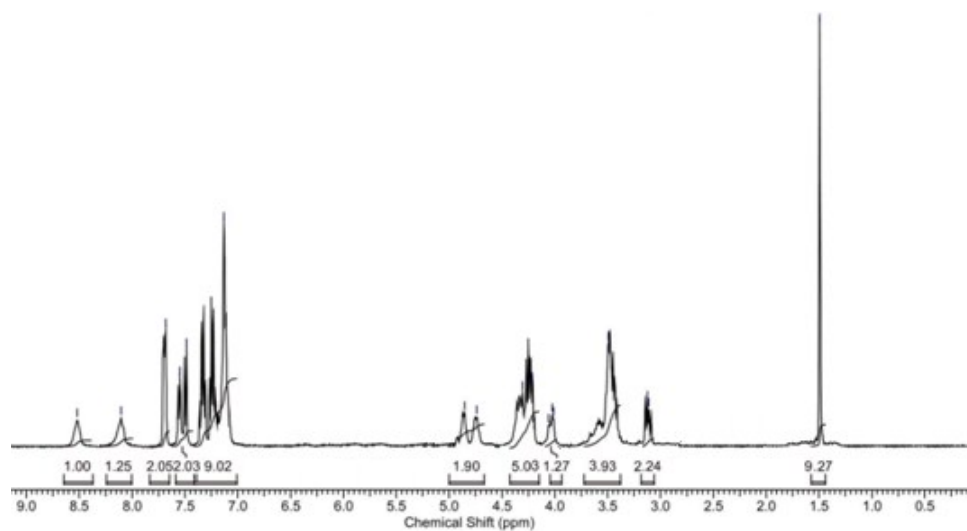
^1H NMR Spectrum of Compound 8a



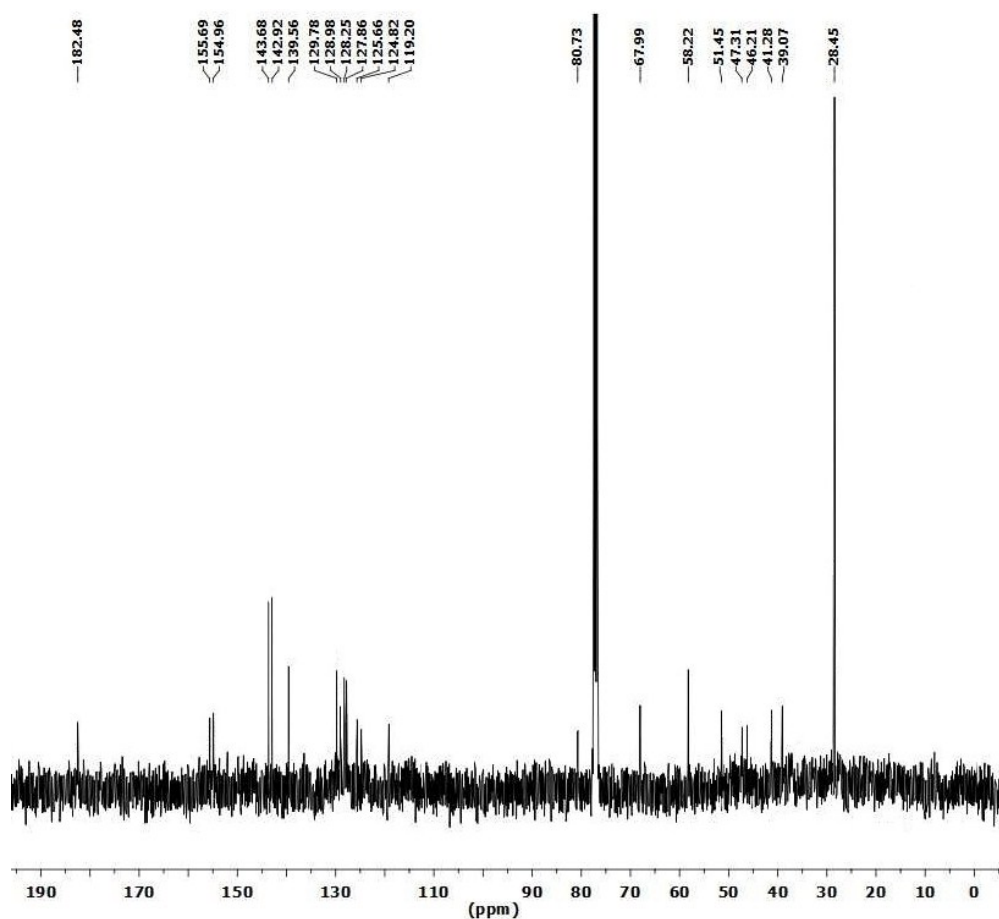
¹³C NMR Spectrum of Compound 8a



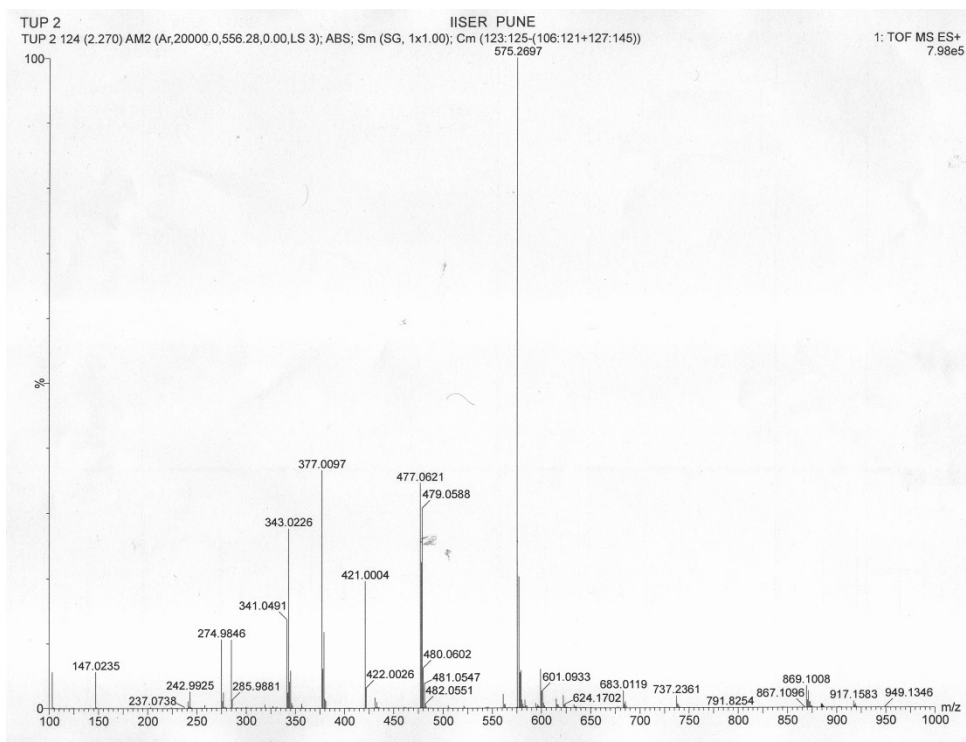
HRMS of Compound 8a



¹H NMR Spectrum of Compound 8b



¹³C NMR Spectrum of Compound 8b



HRMS of Compound 8b