
SUPPORTING INFORMATION

Combinatorial synthesis of functionalized spirooxindole pyrrolidine/pyrrolizidine/pyrrolothiazole derivatives *via* three-component 1,3-dipolar cycloaddition reactions

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1. Experimental

1.1. General

Melting points were recorded on an Electrothermal digital melting point apparatus and uncorrected. IR Spectra were recorded on a Nicolet FT-IR500 spectrophotometer using KBr optics. ^1H NMR (400 MHz) spectra were recorded on a Varian Mercury MHz spectrometer using $\text{DMSO-}d_6$ or CDCl_3 as solvent and TMS as internal standard. HRMS analyses were conducted on a Bruker micro-TOF-Q-MS analyzer. X-Ray diffraction data were made on a Rigaku Mercury CCD area detector with graphite monochromated Mo-K α radiation.

1.2. Typical experimental procedure

A mixture of isatin (1 mmol), 3-aryl-1-(pyridin-2-yl)prop-2-en-1-one (1 mmol), sarcosine (1 mmol), in methanol (2 mL) was stirred at 60 °C for the 2-3 hours. Upon completion, monitored by TLC, the reaction mixture was allowed to cool to room temperature. The precipitate was filtered off and washed with water (2×20 mL) and cool ethanol (2×0.5 mL) to afford the desired product. The pure compounds **4** were obtained by recrystallization from ethanol, and the single crystals for X-ray diffraction were obtained from ethanol solution by slow evaporation at room temperature. This procedure was followed for the synthesis of all the spirooxindoles **5**, **6**, **8** and **9**.

2. X-Ray crystallographic data

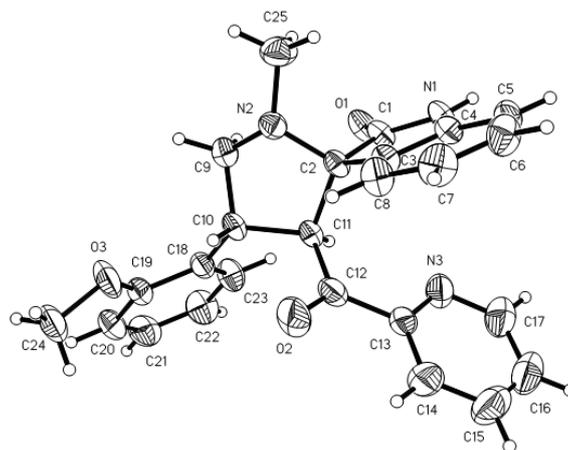


Figure 1. The crystal structure of **4**{9,1,1}

Table 1. Crystallographic data of compound **4**{9,1,1}

Empirical formula	$\text{C}_{25}\text{H}_{23}\text{N}_3\text{O}_3$
Formula weight	413.46
Temperature	293(2) K
Wavelength	0.71073 Å

Crystal system	Monoclinic
space group	P2(1)/n
Unit cell dimensions	$a = 13.1997(9) \text{ \AA}$ $\alpha = 90^\circ$ $b = 12.5568(7) \text{ \AA}$ $\beta = 102.084(2)^\circ$ $c = 13.4736(11) \text{ \AA}$ $\gamma = 90^\circ$
Volume	$2183.7(3) \text{ \AA}^3$
Z	4
Calculated density	1.258 Mg/m^3
Absorption coefficient	0.084 mm^{-1}
F(000)	872
Crystal size	0.40 x 0.35 x 0.34 mm
Theta range for data collection	2.55 to 25.01°
Limiting indices	$-15 \leq h \leq 15$, $-13 \leq k \leq 14$, $-16 \leq l \leq 11$
Reflections collected	8312
Independent reflections	3839 [R(int) = 0.0423]
Data / restraints / parameters	3839 / 0 / 283
Goodness-of-fit on F^2	1.018
Final R indices [$I > 2\sigma(I)$]	$R_1 = 0.0526$, $wR_2 = 0.1102$
R indices (all data)	$R_1 = 0.1033$, $wR_2 = 0.1403$
Largest diff. peak and hole	0.185 and $-0.174 \text{ e. \AA}^{-3}$

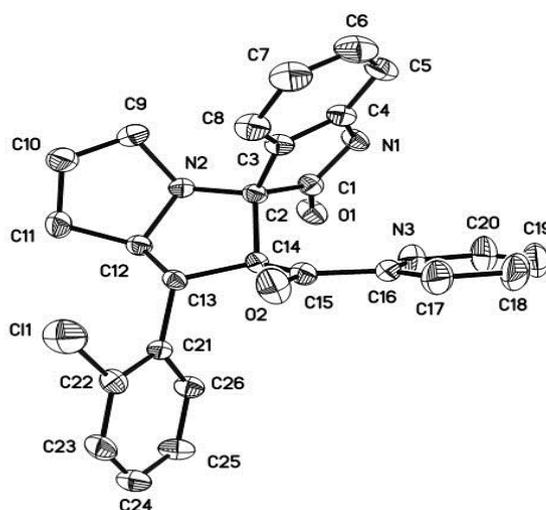


Figure 2. The crystal structure of **5**{2,1,2}

Table 2. Crystallographic data of compound **5**{2,1,2}

Empirical formula	$C_{26}H_{22}ClN_3O_2$
Formula weight	443.93
Temperature	293(2) K
Wavelength	0.71073 Å
Crystal system	Triclinic
space group	P-1
Unit cell dimensions	$a = 10.6576(9)$ Å $\alpha = 110.294(2)^\circ$ $b = 14.4453(19)$ Å $\beta = 94.8810(10)^\circ$ $c = 17.842(2)$ Å $\gamma = 110.901(2)^\circ$
Volume	2337.5(5) Å ³
Z	4
Calculated density	1.313 Mg/m ³
Absorption coefficient	0.196 mm ⁻¹
F(000)	968
Crystal size	0.45 x 0.37 x 0.35 mm
Theta range for data collection	2.70 to 25.02 °
Limiting indices	-12 ≤ h ≤ 12, -17 ≤ k ≤ 16, -21 ≤ l ≤ 21
Reflections collected	8201
Independent reflections	8208 [R(int) = 0.0000]
Data / restraints / parameters	8208 / 0 / 596
Goodness-of-fit on F ²	1.029
Final R indices [I > 2σ(I)]	$R_1 = 0.0791$, $wR_2 = 0.1881$
R indices (all data)	$R_1 = 0.1381$, $wR_2 = 0.2347$
Largest diff. peak and hole	0.325 and -0.293 e. Å ⁻³

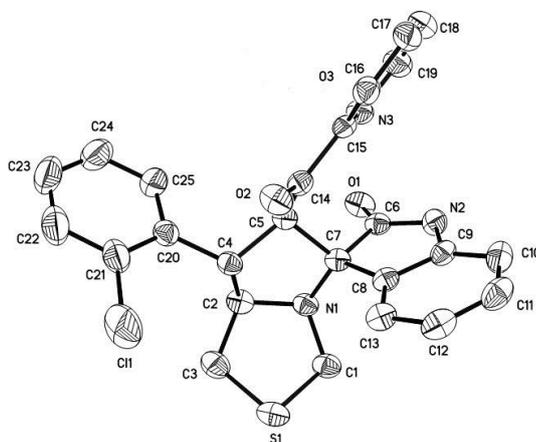


Figure 3. The crystal structure of **6**{2,1,3}**Table 3.** Crystallographic data of compound **6**{2,1,3}

Empirical formula	$C_{25}H_{20}ClN_3O_3S$
Formula weight	461.96
Temperature	293(2) K
Wavelength	0.71073 Å
Crystal system	Monoclinic
space group	P2(1)/n
Unit cell dimensions	$a = 11.5516(8)$ Å $\alpha = 90^\circ$ $b = 16.6544(9)$ Å $\beta = 106.455(2)^\circ$ $c = 13.7742(8)$ Å $\gamma = 90^\circ$
Volume	$2541.4(3)$ Å ³
Z	1
Calculated density	1.404 Mg/m ³
Absorption coefficient	0.271 mm ⁻¹
F(000)	1132
Crystal size	0.40 x 0.32 x 0.30 mm
Theta range for data collection	2.71 to 25.02 °
Limiting indices	-13 ≤ h ≤ 13, -16 ≤ k ≤ 19, -9 ≤ l ≤ 16
Reflections collected	9901
Independent reflections	4476 [R(int) = 0.0407]
Data / restraints / parameters	4476 / 0 / 338
Goodness-of-fit on F ²	1.112
Final R indices [I > 2σ(I)]	$R_1 = 0.0774$, $wR_2 = 0.2395$
R indices (all data)	$R_1 = 0.1272$, $wR_2 = 0.2911$
Largest diff. peak and hole	0.393 and -0.693 e. Å ⁻³

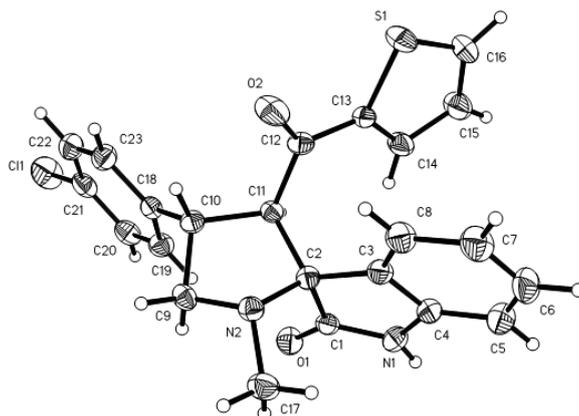


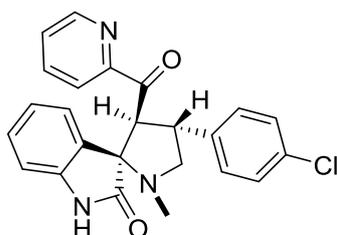
Figure 4. The crystal structure of **9**{13,1,1}

Table 4. Crystallographic data of compound **9**{13,1,1}

Empirical formula	$C_{23}H_{19}ClN_2O_2S$
Formula weight	422.91
Temperature	298(2) K
Wavelength	0.71073 Å
Crystal system	Monoclinic
space group	$C2/c$
Unit cell dimensions	$a = 23.198(2)$ Å $\alpha = 90^\circ$ $b = 6.3569(5)$ Å $\beta = 92.6750(10)^\circ$ $c = 27.482(3)$ Å $\gamma = 90^\circ$
Volume	$4048.3(6)$ Å ³
Z	8
Calculated density	1.388 Mg/m ³
Absorption coefficient	0.314 mm ⁻¹
F(000)	1760
Crystal size	0.40 x 0.35 x 0.27 mm
Theta range for data collection	2.97 to 25.02 °
Limiting indices	$-27 \leq h \leq 24$, $-7 \leq k \leq 7$, $-32 \leq l \leq 31$
Reflections collected	9690
Independent reflections	3577 [R(int) = 0.0448]
Data / restraints / parameters	3577 / 0 / 263
Goodness-of-fit on F^2	1.030
Final R indices [$I > 2\sigma(I)$]	$R_1 = 0.0503$, $wR_2 = 0.1064$

R indices (all data)	$R_1 = 0.0907$, $wR_2 = 0.1250$
Largest diff. peak and hole	0.332 and -0.271 e. Å ⁻³

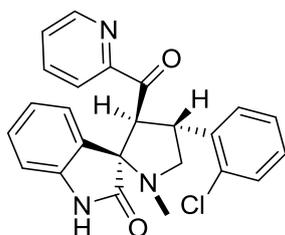
3. Characterization data of compounds



4 {1,1,1}

(3R,3'S,4'R)-4'-(4-chlorophenyl)-1'-methyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 1)

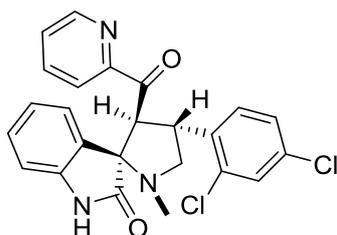
White solid; m.p. 257~259 °C; IR (KBr): ν 3210, 3087, 2968, 1710, 1648, 1559, 1462, 810, 738; ¹H NMR (DMSO-*d*₆, 400 MHz) δ : 2.05 (s, 3H, CH₃), 3.37~3.44 (m, 2H, CH₂), 4.26~4.28 (m, 1H, CH), 4.89~4.91 (m, 1H, CH), 6.38 (d, $J=7.2$ Hz, 1H, ArH), 6.66~6.77 (m, 2H, ArH), 6.84~6.88 (m, 1H, ArH), 7.38~7.47 (m, 1H, ArH), 7.64~7.65 (m, 1H, ArH), 8.37~8.38 (m, 1H, ArH), 10.43 (s, 1H, NH); ¹³C NMR (DMSO-*d*₆, 100 MHz) δ : 34.24, 42.52, 59.59, 60.73, 72.08, 108.71, 121.01, 121.08, 125.01, 127.32, 128.50, 128.74, 129.71, 131.25, 136.99, 140.52, 142.85, 148.21, 151.92, 179.26, 198.36; HRMS calcd for C₂₄H₁₉ClN₃O₂ [M-H]⁺: 416.1166, found: 416.1178.



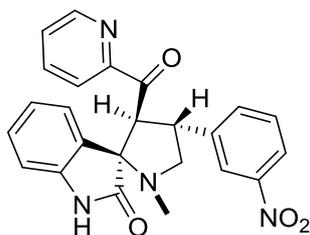
4 {2,1,1}

(3R,3'S,4'R)-4'-(2-chlorophenyl)-1'-methyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 2)

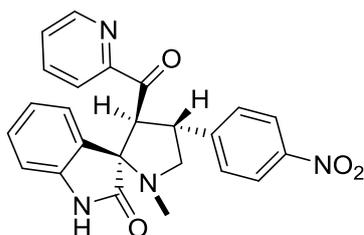
White solid; m.p. 266~268 °C; IR (KBr): ν 3204, 3070, 2945, 2839, 1699, 1618, 1510, 1472, 777, 760; ¹H NMR (DMSO-*d*₆, 400 MHz) δ : 2.04 (s, 3H, CH₃), 3.29 (t, $J=9.6$ Hz, 1H, CH₂), 3.39 (t, $J=8.0$ Hz, 1H, CH₂), 4.83 (dd, $J_1=16.8$ Hz, $J_2=9.6$ Hz, 1H, CH), 5.13 (d, $J=9.2$ Hz, 1H, CH), 6.41 (d, $J=7.6$ Hz, 1H, ArH), 6.70 (t, $J=7.6$ Hz, 1H, ArH), 6.79 (d, $J=7.2$ Hz, 1H, ArH), 6.88 (t, $J=7.6$ Hz, 1H, ArH), 7.25 (t, $J=7.6$ Hz, 1H, ArH), 7.38~7.46 (m, 4H, ArH), 7.67 (t, $J=7.6$ Hz, 1H, ArH), 7.80 (d, $J=8.0$ Hz, 1H, ArH), 8.40 (d, $J=4.4$ Hz, 1H, ArH), 10.46 (s, 1H, NH); ¹³C NMR (DMSO-*d*₆, 100 MHz) δ : 34.21, 39.14, 59.63, 59.75, 71.99, 108.78, 121.06, 121.09, 125.18, 127.12, 127.34, 127.72, 128.27, 128.79, 128.83, 129.33, 133.42, 137.04, 138.85, 142.83, 148.24, 151.92, 179.26, 198.03; HRMS calcd for C₂₄H₁₉ClN₃O₂ [M-H]⁺: 416.1166, found: 416.1178.

**4 {3,1,1}****(3R,3'S,4'R)-4'-(2,4-dichlorophenyl)-1'-methyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 3)**

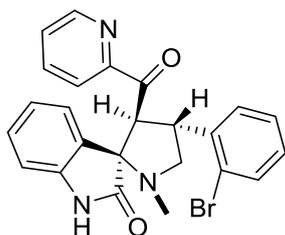
White solid; m.p. 234~236 °C; IR (KBr): ν 3182, 3071, 3036, 2945, 2839, 1734, 1699, 1618, 1510, 1472, 781, 752; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.02 (s, 3H, CH₃), 3.27 (t, $J=9.2$ Hz, 1H, CH₂), 3.38~3.40 (m, 1H, CH₂), 4.78 (dd, $J_1=16.4$ Hz, $J_2=9.2$ Hz, 1H, CH), 5.05 (d, $J=8.8$ Hz, 1H, CH), 6.41 (d, $J=7.6$ Hz, 1H, ArH), 6.68 (t, $J=7.6$ Hz, 1H, ArH), 6.77 (d, $J=7.2$ Hz, 1H, ArH), 6.88 (t, $J=7.6$ Hz, 1H, ArH), 7.37~7.40 (m, 1H, ArH), 7.45 (d, $J=8.0$ Hz, 1H, ArH), 7.49~7.51 (m, 1H, ArH), 7.57~7.58 (m, 1H, ArH), 7.67 (t, $J=8.0$ Hz, 1H, ArH), 7.82 (d, $J=8.4$ Hz, 1H, ArH), 8.38 (d, $J=4.4$ Hz, 1H, ArH), 10.48 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.19, 38.71, 59.59, 59.76, 72.02, 108.84, 121.08, 121.10, 125.16, 126.85, 127.35, 127.94, 128.65, 128.82, 130.29, 131.88, 134.23, 137.03, 138.21, 142.83, 148.22, 151.84, 179.19, 197.83; HRMS calcd for C₂₄H₁₈Cl₂N₃O₂ [M-H]⁺: 450.0776, found: 450.0805.

**4 {4,1,1}****(3R,3'S,4'R)-1'-methyl-4'-(3-nitrophenyl)-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 4)**

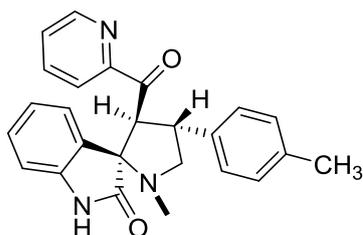
Yellow solid; m.p. 243~245 °C; IR (KBr): ν 3190, 3074, 3031, 2938, 1728, 1698, 1610, 1523, 1478, 771, 722; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.07 (s, 3H, CH₃), 3.37~3.53 (m, 2H, CH₂), 4.44 (dd, $J_1=17.2$ Hz, $J_2=9.6$ Hz, 1H, CH), 4.94 (d, $J=9.6$ Hz, 1H, CH), 6.41 (d, $J=7.6$ Hz, 1H, ArH), 6.69 (t, $J=7.6$ Hz, 1H, ArH), 6.77 (d, $J=7.2$ Hz, 1H, ArH), 6.88 (t, $J=7.6$ Hz, 1H, ArH), 7.38 (t, $J=6.4$ Hz, 1H, ArH), 7.47 (d, $J=7.6$ Hz, 1H, ArH), 7.66 (dd, $J_1=13.2$ Hz, $J_2=7.2$ Hz, 2H, ArH), 7.93 (d, $J=7.6$ Hz, 1H, ArH), 8.10 (d, $J=8.0$ Hz, 1H, ArH), 8.31 (s, 1H, ArH), 8.37 (d, $J=4.0$ Hz, 1H, ArH), 10.49 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.19, 38.71, 59.59, 59.76, 72.02, 108.84, 121.08, 121.10, 125.16, 126.85, 127.35, 127.94, 128.65, 128.82, 130.29, 131.88, 134.23, 137.03, 138.21, 142.83, 148.22, 151.84, 179.19, 197.83; HRMS calcd for C₂₄H₁₉N₄O₄ [M-H]⁺: 427.1407, found: 427.1396.

**4 {5,1,1}****(3R,3'S,4'R)-1'-methyl-4'-(4-nitrophenyl)-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 5)**

Yellow solid; m.p. 245~247 °C; IR (KBr): ν = 3294, 3070, 2937, 2847, 1717, 1690, 1622, 1599, 1518, 1472, 1472, 1342, 752; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.07 (s, 3H, CH₃), 3.43 (t, J =8.0 Hz, 1H, CH₂), 3.51 (t, J =9.2 Hz, 1H, CH₂), 4.43 (dd, J_1 =16.8 Hz, J_2 =9.6 Hz, 1H, CH), 4.96 (d, J =9.6 Hz, 1H, CH), 6.40 (d, J =7.6 Hz, 1H, ArH), 6.70 (t, J =7.6 Hz, 1H, ArH), 6.78 (d, J =7.2 Hz, 1H, ArH), 6.88 (t, J =7.6 Hz, 1H, ArH), 7.38~7.41 (m, 1H, ArH), 7.45 (d, J =7.6 Hz, 1H, ArH), 7.67 (t, J =7.6 Hz, 1H, ArH), 7.43 (d, J =8.4 Hz, 1H, ArH), 8.22 (d, J =8.4 Hz, 1H, ArH), 8.38 (d, J =4.8 Hz, 1H, ArH), 10.47 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.24, 42.99, 59.33, 60.66, 72.13, 108.79, 121.07, 121.13, 123.79, 124.99, 127.11, 127.43, 128.85, 129.21, 137.07, 142.87, 146.38, 148.22, 149.64, 151.79, 179.13, 198.09; HRMS calcd for C₂₄H₁₉N₄O₄ [M-H]⁺: 427.1407, found: 427.1417.

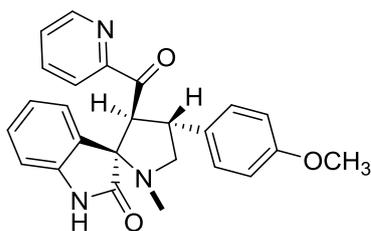
**4 {6,1,1}****(3R,3'S,4'R)-4'-(2-bromophenyl)-1'-methyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 6)**

White solid; m.p. 267~269 °C; IR (KBr): ν 3224, 3061, 2935, 2887, 1715, 1699, 1602, 1590, 1528, 1472, 1342, 752; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.04 (s, 3H, CH₃), 3.26 (t, J =9.6 Hz, 1H, CH₂), 3.40 (t, J =8.0 Hz, 1H, CH₂), 4.81 (dd, J_1 =16.8 Hz, J_2 =9.6 Hz, 1H, CH), 5.14 (d, J =9.2 Hz, 1H, CH), 6.41 (d, J =7.6 Hz, 1H, ArH), 6.70 (t, J =7.6 Hz, 1H, ArH), 6.79 (d, J =7.2 Hz, 1H, ArH), 6.88 (t, J =7.6 Hz, 1H, ArH), 7.17 (t, J =7.6 Hz, 1H, ArH), 7.38~7.46 (m, 3H, ArH), 7.60 (d, J =8.0 Hz, 1H, ArH), 7.67 (t, J =7.6 Hz, 1H, ArH), 7.81 (d, J =8.0 Hz, 1H, ArH), 8.40 (d, J =4.4 Hz, 1H, ArH), 10.47 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.19, 42.02, 59.74, 59.98, 72.06, 108.79, 121.07, 121.10, 124.49, 125.18, 127.01, 127.33, 128.30, 128.64, 128.79, 128.92, 132.62, 137.04, 140.59, 142.83, 148.24, 151.93, 179.28, 197.99; HRMS calcd for C₂₄H₁₉BrN₃O₂ [M-H]⁺: 460.0661, found: 460.0686.

**4 {7,1,1}**

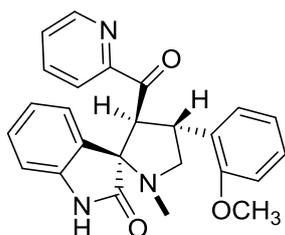
(3R,3'S,4'R)-1'-methyl-3'-picolinoyl-4'-(p-tolyl)spiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 7)

White solid; m.p. 270~272 °C; IR (KBr): ν = 3188, 3092, 3042, 2951, 2853, 1738, 1711, 1618, 1510, 1472, 756; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.05 (s, 3H, NCH₃), 2.24 (s, 3H, CH₃), 3.20 (t, J =8.0 Hz, 1H, CH₂), 3.46 (t, J =9.6 Hz, 1H, CH₂), 4.23 (dd, J_1 =17.2 Hz, J_2 =10.4 Hz, 1H, CH), 4.93 (d, J =9.6 Hz, 1H, CH), 6.38 (d, J =7.6 Hz, 1H, ArH), 6.69 (t, J =7.6 Hz, 1H, ArH), 6.77 (d, J =7.2 Hz, 1H, ArH), 6.86 (t, J =7.6 Hz, 1H, ArH), 7.13 (d, J =7.6 Hz, 2H, ArH), 7.32 (d, J =7.6 Hz, 2H, ArH), 7.36~7.39 (m, 1H, ArH), 7.43 (d, J =7.6 Hz, 1H, ArH), 7.66 (t, J =8.0 Hz, 1H, ArH), 8.38 (d, J =4.4 Hz, 1H, ArH), 10.39 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 20.59, 34.28, 42.82, 59.76, 60.74, 72.06, 108.62, 120.95, 121.03, 125.06, 127.27, 127.50, 127.71, 128.66, 129.05, 135.66, 136.98, 138.37, 142.84, 148.21, 152.03, 179.30, 198.58; HRMS calcd for C₂₅H₂₂N₃O₂ [M-H]⁺: 396.1712, found: 396.1729.

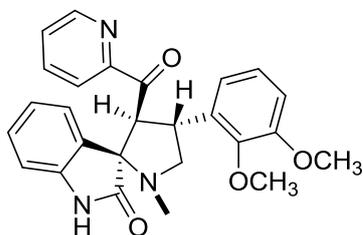
**4 {8,1,1}**

(3R,3'S,4'R)-4'-(4-methoxyphenyl)-1'-methyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 8)

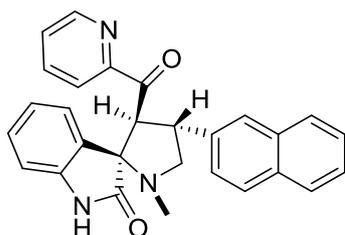
White solid; m.p. 258~260 °C; IR (KBr): ν 3204, 3107, 2928, 2850, 1713, 1695, 1612, 1586, 1511, 1470, 1354, 723; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.05 (s, 3H, NCH₃), 3.31 (t, J =7.6 Hz, 1H, CH₂), 3.45 (t, J =8.8 Hz, 1H, CH₂), 3.70 (s, 3H, OCH₃), 4.22 (dd, J_1 =17.2 Hz, J_2 =10.4 Hz, 1H, CH), 4.90 (d, J =9.6 Hz, 1H, CH), 6.38 (d, J =7.6 Hz, 1H, ArH), 6.69 (t, J =7.6 Hz, 1H, ArH), 6.77 (d, J =7.2 Hz, 1H, ArH), 6.85~6.90 (m, 3H, ArH), 7.34~7.44 (m, 3H, ArH), 7.43 (d, J =7.6 Hz, 1H, ArH), 7.66 (t, J =7.6 Hz, 1H, ArH), 8.38 (d, J =4.4 Hz, 1H, ArH), 10.39 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 33.98, 40.76, 56.64, 59.14, 59.95, 72.23, 109.02, 120.15, 121.28, 125.47, 126.91, 127.45, 127.73, 128.86, 129.17, 135.76, 136.87, 138.24, 141.96, 148.08, 152.13, 179.42, 198.38; HRMS calcd for C₂₅H₂₂N₃O₃ [M-H]⁺: 412.1661, found: 412.1639.

**4 {9,1,1}****(3R,3'S,4'R)-4'-(2-methoxyphenyl)-1'-methyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 9)**

Colorless; m.p. 232~234 °C; IR (KBr): ν = 3209, 3070, 3036, 2945, 2839, 1699, 1618, 1497, 1470, 1242, 760; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.03 (s, 3H, NCH₃), 3.31~3.39 (m, 2H, CH₂), 3.68 (s, 3H, OCH₃), 4.61 (dd, $J_1=16.8$ Hz, $J_2=7.2$ Hz, 1H, CH), 5.13 (d, $J=9.6$ Hz, 1H, CH), 6.39 (d, $J=7.6$ Hz, 1H, ArH), 6.69 (t, $J=7.2$ Hz, 1H, ArH), 6.79 (d, $J=7.2$ Hz, 1H, ArH), 6.87 (t, $J=7.6$ Hz, 1H, ArH), 6.93 (t, $J=7.2$ Hz, 2H, ArH), 7.18 (t, $J=7.6$ Hz, 1H, ArH), 7.38 (t, $J=6.8$ Hz, 1H, ArH), 7.45 (dd, $J_1=15.6$ Hz, $J_2=7.6$ Hz, 2H, ArH), 7.68 (t, $J=7.6$ Hz, 1H, ArH), 8.41 (d, $J=4.4$ Hz, 1H, ArH), 10.36 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.28, 34.30, 55.24, 57.78, 58.77, 71.79, 108.57, 110.91, 111.16, 120.46, 120.92, 125.39, 126.93, 127.18, 127.25, 127.49, 128.55, 129.17, 136.91, 142.79, 148.22, 152.16, 157.19, 179.30, 198.35; HRMS calcd for C₂₅H₂₁N₃O₃ [M-H]⁺: 412.1661, found: 412.1691.

**4 {10,1,1}****(3R,3'S,4'R)-4'-(2,3-dimethoxyphenyl)-1'-methyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 10)**

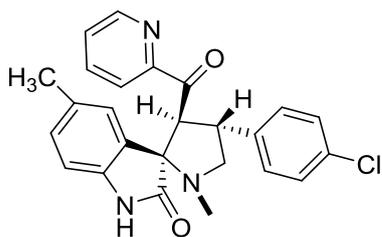
Colorless; m.p. 249~251 °C; IR (KBr): ν = 3188, 3092, 3042, 2945, 2839, 1738, 1703, 1622, 1510, 1479, 1242, 760; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.03 (s, 3H, NCH₃), 3.27~3.35 (m, 2H, CH₂), 3.75 (s, 3H, OCH₃), 3.76 (s, 3H, OCH₃), 4.70 (dd, $J_1=16.8$ Hz, $J_2=7.2$ Hz, 1H, CH), 5.09 (d, $J=9.6$ Hz, 1H, CH), 6.39 (d, $J=8.0$ Hz, 1H, ArH), 6.68 (t, $J=7.6$ Hz, 1H, ArH), 6.78 (d, $J=7.2$ Hz, 1H, ArH), 6.84~6.89 (m, 2H, ArH), 7.06 (t, $J=8.0$ Hz, 1H, ArH), 7.18 (d, $J=7.6$ Hz, 1H, ArH), 7.37 (t, $J=7.2$ Hz, 1H, ArH), 7.44 (d, $J=8.0$ Hz, 1H, ArH), 7.66 (t, $J=7.6$ Hz, 1H, ArH), 8.39 (d, $J=4.4$ Hz, 1H, ArH), 10.39 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 33.77, 35.66, 55.18, 58.79, 59.62, 59.83, 71.67, 108.16, 110.68, 119.13, 120.49, 123.56, 124.88, 125.57, 126.92, 128.09, 134.33, 136.38, 142.43, 146.78, 147.70, 151.89, 151.96, 178.85, 197.95; HRMS calcd for C₂₆H₂₅N₃O₄ [M-H]⁺: 442.1767, found: 442.1758.



4 {12,1,1}

(3R,3'S,4'R)-1'-methyl-4'-(naphthalen-2-yl)-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 11)

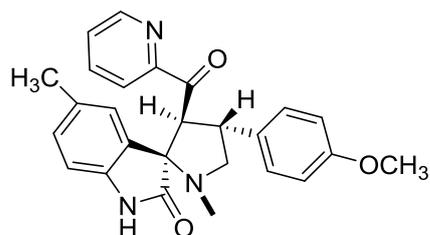
White solid; m.p. 269~271 °C; IR (KBr): ν = 3182, 3076, 2945, 2860, 1720, 1695, 1614, 1514, 1475, 750; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.07 (s, 3H, NCH₃), 3.41 (t, J =9.6 Hz, 1H, CH₂), 3.60 (t, J =11.6 Hz, 1H, CH₂), 4.44 (dd, J_1 =22.8 Hz, J_2 =14.0 Hz, 1H, CH), 5.04 (d, J =13.2 Hz, 1H, CH), 6.38 (d, J =10.0 Hz, 1H, ArH), 6.69 (t, J =10.0 Hz, 1H, ArH), 6.69 (d, J =9.2 Hz, 1H, ArH), 6.83~6.89 (m, 1H, ArH), 7.32~7.37 (m, 1H, ArH), 7.41~7.49 (m, 3H, ArH), 7.60~7.69 (m, 2H, ArH), 7.82~7.91 (m, 4H, ArH), 8.35 (d, J =6.0 Hz, 1H, ArH), 10.42 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 33.58, 36.69, 59.52, 59.88, 71.27, 108.32, 111.08, 118.33, 121.09, 123.96, 124.68, 125.56, 125.45, 126.92, 127.13, 127.55, 127.83, 128.19, 134.43, 136.38, 142.51, 146.18, 147.21, 150.81, 151.86, 178.85, 198.25; HRMS calcd for C₂₈H₂₂N₃O₂ [M-H]⁺: 432.1712, found: 432.1692.



4 {1,3,1}

(3R,3'S,4'R)-4'-(4-chlorophenyl)-1',5-dimethyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 12)

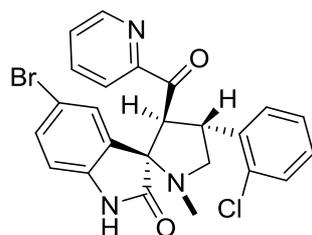
White solid; m.p. 265~267 °C; IR (KBr): ν = 3202, 3056, 2938, 2860, 1718, 1695, 1641, 1544, 1472, 724; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.04 (s, 3H, CH₃), 2.07 (s, 3H, CH₃), 3.43 (t, J =11.6 Hz, 1H, CH), 4.26 (dd, J_1 =22.8 Hz, J_2 =10.0 Hz, 1H, CH), 4.89 (d, J =13.2 Hz, 1H, CH), 6.26 (d, J =10.4 Hz, 1H, ArH), 6.58 (s, 1H, ArH), 6.67 (d, J =10.4 Hz, 1H, ArH), 7.35~7.47 (m, 5H, ArH), 7.68 (t, J =10.4 Hz, 1H, ArH), 8.36 (d, J =6.4 Hz, 1H, ArH), 10.31 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 23.45, 33.84, 41.92, 59.55, 60.23, 71.78, 108.21, 120.83, 121.28, 125.24, 127.82, 128.40, 128.89, 129.31, 131.15, 135.68, 139.97, 142.55, 148.01, 152.12, 179.36, 198.96; HRMS calcd for C₂₅H₂₁ClN₃O₂ [M-H]⁺: 430.1322, found: 410.1357.



4 {8,3,1}

(3R,3'S,4'R)-4'-(4-methoxyphenyl)-1',5-dimethyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 13)

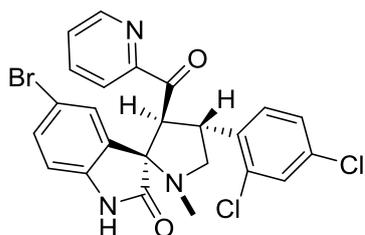
White solid; m.p. 243~246 °C; IR (KBr): ν 3213, 3041, 2908, 2864, 1710, 1690, 1621, 1534, 1469, 767; ^1H NMR (CDCl_3 , 400 MHz) δ : 2.14 (s, 3H, CH_3), 2.27 (s, 3H, NCH_3), 3.11 (s, 1H, CH_2), 3.66 (t, $J=9.6$ Hz, 1H, CH_2), 3.76 (s, 3H, OCH_3), 4.42 (d, $J=6.4$ Hz, 1H, CH), 5.06 (d, $J=9.6$ Hz, 1H, CH), 6.38 (d, $J=7.6$ Hz, 1H, ArH), 6.68 (d, $J=8.0$ Hz, 1H, ArH), 6.81 (s, 1H, ArH), 6.85 (d, $J=8.8$ Hz, 2H, ArH), 7.08~7.11 (m, 1H, ArH), 7.47 (t, $J=7.6$ Hz, 1H, ArH), 7.52 (d, $J=8.8$ Hz, 3H, ArH), 8.38 (d, $J=4.8$ Hz, 1H, ArH), 8.60 (s, 1H, NH); ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) δ : 21.85, 33.73, 40.36, 56.83, 59.42, 59.89, 72.53, 108.89, 120.10, 121.38, 125.21, 126.64, 127.35, 127.90, 128.56, 129.29, 135.06, 136.27, 138.32, 141.54, 148.28, 151.36, 179.65, 198.58; HRMS calcd for $\text{C}_{26}\text{H}_{24}\text{N}_3\text{O}_3$ $[\text{M}-\text{H}]^+$: 426.1818, found: 426.1806.



4 {2,2,1}

(3R,3'S,4'R)-5-bromo-4'-(2-chlorophenyl)-1'-methyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 14)

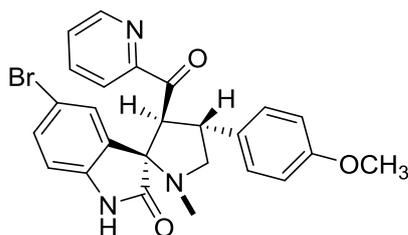
White solid; m.p. 273~275 °C; ν 3203, 3031, 2918, 2844, 1720, 1686, 1609, 1514, 1423, 748; ^1H NMR ($\text{DMSO}-d_6$, 400 MHz) δ : 2.09 (s, 3H, CH_3), 3.28 (t, $J=9.6$ Hz, 1H, CH_2), 3.41 (t, $J=8.0$ Hz, 1H, CH_2), 4.82 (dd, $J_1=16.4$ Hz, $J_2=7.2$ Hz, 1H, CH), 5.12 (d, $J=9.2$ Hz, 1H, CH), 6.41 (d, $J=8.4$ Hz, 1H, ArH), 6.85 (s, 1H, ArH), 7.09 (d, $J=8.0$ Hz, 1H, ArH), 7.25 (t, $J=7.6$ Hz, 1H, ArH), 7.38~7.44 (m, 3H, ArH), 7.53 (d, $J=8.0$ Hz, 1H, ArH), 7.76 (t, $J=8.0$ Hz, 2H, ArH), 8.41 (d, $J=4.4$ Hz, 1H, ArH), 10.64 (s, 1H, NH); ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) δ : 33.99, 59.42, 59.53, 71.71, 110.58, 112.46, 120.82, 127.45, 128.07, 128.46, 129.09, 129.36, 131.24, 133.15, 137.00, 138.19, 141.92, 148.11, 151.52, 178.49, 197.63; HRMS calcd for $\text{C}_{24}\text{H}_{18}\text{BrClN}_3\text{O}_2$ $[\text{M}-\text{H}]^+$: 494.0271, found: 494.0298.



4 {3,2,1}

(3R,3'S,4'R)-5-bromo-4'-(2,4-dichlorophenyl)-1'-methyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 15)

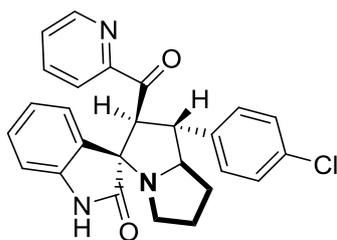
White solid; m.p. 276~278 °C; IR (KBr): ν 3241, 3028, 2935, 2856, 1711, 1694, 1610, 1564, 1433, 834, 748; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.05 (s, 3H, CH₃), 3.26 (t, J =9.2 Hz, 1H, CH₂), 3.39 (t, J =8.0 Hz, 1H, CH₂), 4.77 (dd, J_1 =16.4 Hz, J_2 =7.2 Hz, 1H, CH), 5.04 (d, J =9.2 Hz, 1H, CH), 6.40 (d, J =8.4 Hz, 1H, ArH), 6.84 (s, 1H, ArH), 6.68 (t, J =7.6 Hz, 1H, ArH), 7.08 (d, J =8.0 Hz, 1H, ArH), 7.42 (t, J =7.6 Hz, 1H, ArH), 7.48~7.57 (m, 3H, ArH), 7.76 (dd, J_1 =16.4 Hz, J_2 =7.6 Hz, 1H, ArH), 8.39 (d, J =4.4 Hz, 1H, ArH), 10.65 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 33.99, 59.27, 59.66, 71.74, 110.66, 112.49, 120.56, 127.37, 127.71, 128.45, 129.22, 129.93, 131.29, 131.71, 133.99, 137.02, 137.56, 141.93, 148.10, 151.46, 178.46, 197.46; HRMS calcd for C₂₄H₁₇BrCl₂N₃O₂ [M-H]⁺: 527.9881, found: 527.9907.



4 {8,2,1}

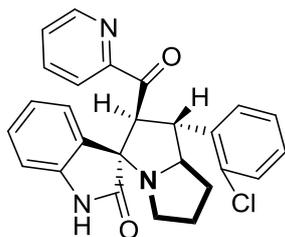
(3R,3'S,4'R)-5-bromo-4'-(4-methoxyphenyl)-1'-methyl-3'-picolinoylspiro[indoline-3,2'-pyrrolidin]-2-one (Table 2, entry 16)

White solid; m.p. 246~248 °C; IR (KBr): ν 3216, 3025, 2921, 2872, 1703, 1690, 1604, 1533, 1412, 718; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.07 (s, 3H, NCH₃), 3.32 (t, J =6.8 Hz, 1H, CH₂), 3.42 (t, J =9.6 Hz, 1H, CH₂), 3.70 (s, 3H, OCH₃), 4.21 (dd, J_1 =17.6 Hz, J_2 =9.6 Hz, 1H, CH), 4.88 (d, J =9.6 Hz, 1H, CH), 6.37 (d, J =8.0 Hz, 1H, ArH), 6.84 (s, 1H, ArH), 6.88 (d, J =8.0 Hz, 2H, ArH), 7.06 (d, J =8.4 Hz, 1H, ArH), 7.33 (d, J =8.0 Hz, 2H, ArH), 7.40~7.43 (m, 1H, ArH), 7.50 (d, J =7.6 Hz, 1H, ArH), 7.70~7.75 (m, 1H, ArH), 8.39 (d, J =4.4 Hz, 1H, ArH), 10.55 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.07, 42.12, 54.71, 59.55, 60.81, 71.79, 110.41, 112.39, 113.70, 120.69, 127.23, 127.38, 128.47, 129.89, 131.11, 132.65, 136.93, 141.91, 148.07, 151.64, 157.76, 178.53, 198.21; HRMS calcd for C₂₅H₂₁BrN₃O₃ [M-H]⁺: 490.0766, found: 490.0789.

**5 {1,1,2}**

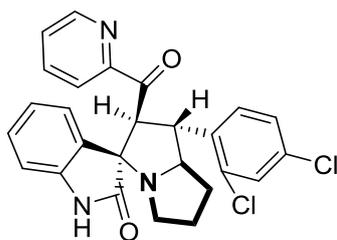
(1'R,2'S,3R,7a'R)-1'-(4-chlorophenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 17)

White solid; m.p. 168~170 °C; IR (KBr): ν 3191, 3078, 2936, 2862, 1731, 1702, 1623, 1514, 1463, 734; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.66~1.76 (m, 2H, CH₂), 1.82~1.94 (m, 2H, CH₂), 2.32~2.36 (m, 1H, CH₂), 2.84 (dd, $J_1=15.2$ Hz, $J_2=8.4$ Hz, 1H, CH₂), 3.82 (t, $J=10.8$ Hz, 1H, CH), 4.04~4.09 (m, 1H, CH), 5.14 (d, $J=10.8$ Hz, 1H, CH), 6.47 (d, $J=7.6$ Hz, 1H, ArH), 6.70 (t, $J=7.6$ Hz, 1H, ArH), 6.95 (t, $J=7.6$ Hz, 2H, ArH), 7.39~7.43 (m, 4H, ArH), 7.48 (d, $J=8.4$ Hz, 2H, ArH), 7.68 (t, $J=7.6$ Hz, 1H, ArH), 8.39 (d, $J=4.4$ Hz, 1H, ArH), 10.30 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 25.41, 27.83, 48.31, 50.75, 63.17, 70.62, 71.37, 109.13, 120.37, 120.94, 125.45, 126.53, 127.33, 128.58, 128.95, 129.71, 131.23, 137.00, 139.72, 142.83, 148.22, 152.05, 179.97, 198.67; HRMS calcd for C₂₆H₂₁ClN₃O₂ [M-H]⁺: 442.1323, found: 442.1321.

**5 {2,1,2}**

(1'R,2'S,3R,7a'R)-1'-(2-chlorophenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 18)

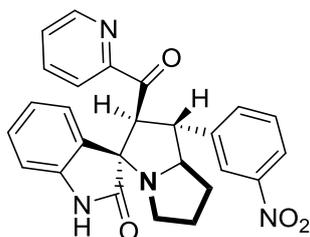
White solid; m.p. 208~210 °C; IR (KBr): ν 3178, 3096, 2957, 2880, 1742, 1718, 1616, 1510, 1477, 744; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.64~1.81 (m, 2H, CH₂), 1.82~1.92 (m, 2H, CH₂), 2.34~2.39 (m, 1H, CH₂), 2.88 (dd, $J_1=15.6$ Hz, $J_2=8.4$ Hz, 1H, CH₂), 4.02~4.09 (m, 1H, CH), 4.52 (t, $J=10.4$ Hz, 1H, CH), 5.26 (d, $J=10.8$ Hz, 1H, CH), 6.48 (d, $J=7.6$ Hz, 1H, ArH), 6.70 (t, $J=7.6$ Hz, 1H, ArH), 6.93 (t, $J=7.6$ Hz, 2H, ArH), 7.20 (t, $J=7.6$ Hz, 1H, ArH), 7.34~7.38 (m, 2H, ArH), 7.42 (d, $J=8.0$ Hz, 2H, ArH), 7.66 (t, $J=7.6$ Hz, 1H, ArH), 7.77 (d, $J=7.6$ Hz, 1H, ArH), 8.37 (d, $J=4.4$ Hz, 1H, ArH), 10.35 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 25.41, 27.83, 48.31, 50.75, 63.17, 70.62, 71.37, 109.13, 120.37, 120.94, 125.45, 126.53, 127.33, 128.58, 128.95, 129.71, 131.23, 137.00, 139.72, 142.83, 148.22, 152.05, 179.97, 198.67; HRMS calcd for C₂₆H₂₁ClN₃O₂ [M-H]⁺: 442.1323, found: 442.1331.



5 {3,1,2}

(1'R,2'S,3R,7a'R)-1'-(2,4-dichlorophenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 19)

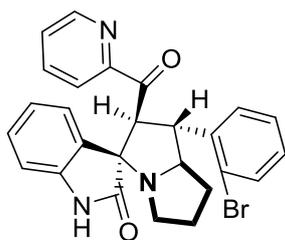
White solid; m.p. 213~215 °C; IR (KBr): ν = 3209, 3070, 2951, 2868, 1730, 1695, 1618, 1510, 1470, 752; ^1H NMR (CDCl_3 , 400 MHz) δ : 1.69 (s, 1H, CH), 1.81~1.92 (m, 2H, CH_2), 1.95~2.01 (m, 2H, CH_2), 2.58~2.65 (m, 1H, CH_2), 2.83~2.90 (m, 1H, CH_2), 4.13~4.18 (m, 1H, CH), 4.56 (t, $J=10.0$ Hz, 1H, CH), 5.32 (d, $J=15.2$ Hz, 1H, CH), 6.58 (d, $J=10.8$ Hz, 1H, ArH), 6.82 (t, $J=10.0$ Hz, 1H, ArH), 6.98 (t, $J=10.0$ Hz, 1H, ArH), 7.10 (d, $J=10.0$ Hz, 1H, ArH), 7.17~7.24 (m, 3H, ArH), 7.42~7.52 (m, 3H, ArH), 7.70 (d, $J=11.2$ Hz, 1H, ArH), 8.46 (d, $J=6.0$ Hz, 1H, ArH), 8.67 (s, 1H, NH); ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) δ : 25.41, 27.83, 48.31, 50.75, 63.17, 70.62, 71.37, 109.13, 120.37, 120.94, 125.45, 126.53, 127.33, 128.58, 128.95, 129.71, 131.23, 137.00, 139.72, 142.83, 148.22, 152.05, 179.97, 198.67; HRMS calcd for $\text{C}_{26}\text{H}_{20}\text{Cl}_2\text{N}_3\text{O}_2$ $[\text{M}-\text{H}]^+$: 477.0933, found: 477.0969.



5 {4,1,2}

(1'R,2'S,3R,7a'R)-1'-(3-nitrophenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 20)

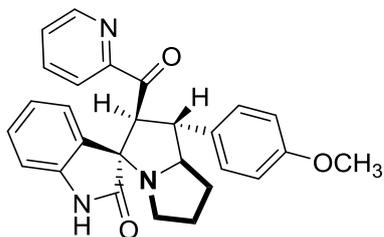
Yellow solid; m.p. 230~232 °C; IR (KBr): ν = 3207, 3074, 2970, 2941, 2872, 1736, 1699, 1620, 1528, 1518, 1474, 1342, 752; ^1H NMR (CDCl_3 , 400 MHz) δ : 1.61 (s, 1H, CH), 1.74~1.91 (m, 2H, CH_2), 1.94~2.08 (m, 2H, CH_2), 2.58~2.66 (m, 1H, CH_2), 2.87 (dd, $J_1=23.2$ Hz, $J_2=12.8$ Hz, 1H, CH_2), 4.31~4.38 (m, 1H, CH), 5.29 (d, $J=15.2$ Hz, 1H, CH), 6.58 (d, $J=10.0$ Hz, 1H, ArH), 6.81 (t, $J=10.0$ Hz, 1H, ArH), 7.01 (dd, $J_1=26.0$ Hz, $J_2=16.0$ Hz, 2H, ArH), 7.18~7.22 (m, 1H, ArH), 7.46~7.53 (m, 3H, ArH), 7.94 (d, $J=10.0$ Hz, 1H, ArH), 8.08 (d, $J=8.8$ Hz, 1H, ArH), 8.34 (s, 1H, NH), 8.45~8.50 (m, 2H, ArH); ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) δ : 25.56, 28.13, 48.08, 50.70, 63.29, 70.52, 71.43, 108.93, 120.35, 121.04, 125.38, 126.63, 127.42, 128.55, 129.02, 129.77, 131.45, 137.12, 139.59, 142.73, 148.36, 152.15, 179.66, 198.23; HRMS calcd for $\text{C}_{26}\text{H}_{21}\text{N}_4\text{O}_4$ $[\text{M}-\text{H}]^+$: 453.1563, found: 453.1569.



5 {6,1,2}

(1'R,2'S,3R,7a'R)-1'-(2-bromophenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 21)

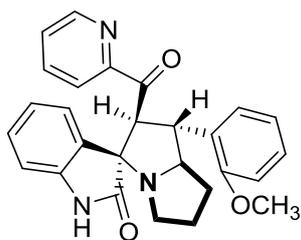
White solid; m.p. 225~227 °C; IR (KBr): ν = 3201, 3073, 2956, 2923, 2862, 1740, 1701, 1667, 1548, 1515, 1452, 1339, 762; ^1H NMR (CDCl_3 , 400 MHz) δ : 1.63 (s, 1H, CH), 1.83~1.95 (m, 2H, CH_2), 1.97~2.04 (m, 2H, CH_2), 2.58~2.66 (m, 1H, CH_2), 2.84~2.92 (m, 1H, CH_2), 4.15~4.22 (m, 1H, CH), 4.62 (t, $J=14.4$ Hz, 1H, CH), 5.35 (d, $J=19.2$ Hz, 1H, CH), 6.55 (d, $J=10.4$ Hz, 1H, ArH), 6.82 (t, $J=9.6$ Hz, 1H, ArH), 6.98 (t, $J=10.0$ Hz, 1H, ArH), 7.05 (t, $J=10.0$ Hz, 1H, ArH), 7.13 (d, $J=10.4$ Hz, 1H, ArH), 7.16~7.21 (m, 1H, ArH), 7.30 (d, $J=10.4$ Hz, 1H, ArH), 7.47~7.52 (m, 2H, ArH), 7.60 (d, $J=10.4$ Hz, 1H, ArH), 7.75 (d, $J=10.8$ Hz, 1H, ArH), 8.31 (s, 1H, NH), 8.46 (d, $J=6.0$ Hz, 1H, ArH); ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) δ : 25.47, 28.26, 48.15, 50.66, 63.41, 70.49, 71.22, 108.76, 120.46, 121.10, 125.44, 126.56, 127.32, 128.69, 129.11, 129.87, 131.32, 137.22, 139.47, 142.87, 148.66, 152.34, 179.57, 198.45; HRMS calcd for $\text{C}_{26}\text{H}_{21}\text{BrN}_3\text{O}_2$ $[\text{M}-\text{H}]^+$: 486.0817, found: 486.0849.



5 {8,1,2}

(1'R,2'S,3R,7a'R)-1'-(4-methoxyphenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 22)

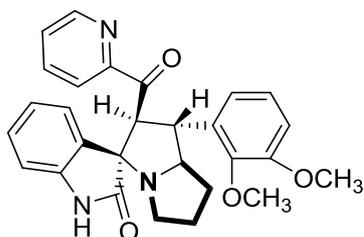
White solid; m.p. 200~202 °C; IR (KBr): ν = 3210, 3066, 2951, 2903, 1749, 1715, 1626, 1514, 1444, 1256, 778; ^1H NMR ($\text{DMSO}-d_6$, 400 MHz) δ : 1.63~1.74 (m, 2H, CH_2), 1.79~1.95 (m, 2H, CH_2), 2.30~2.34 (m, 1H, CH_2), 2.82 (dd, $J_1=20.0$ Hz, $J_2=9.2$ Hz, 1H, CH_2), 3.70 (s, 3H, OCH_3), 3.73 (t, $J=14.4$ Hz, 1H, CH), 4.01~4.06 (m, 1H, CH), 5.12 (d, $J=14.8$ Hz, 1H, CH), 6.44 (d, $J=10.0$ Hz, 1H, ArH), 6.69 (t, $J=9.6$ Hz, 1H, ArH), 6.92 (dd, $J_1=20.0$ Hz, $J_2=9.6$ Hz, 4H, ArH), 7.34~7.43 (m, 4H, ArH), 7.67 (t, $J=10.4$ Hz, 1H, ArH), 8.38 (d, $J=6.8$ Hz, 1H, ArH), 10.25 (s, 1H, NH); ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) δ : 25.26, 28.17, 44.13, 47.94, 55.56, 61.27, 70.42, 71.38, 108.82, 110.98, 119.85, 120.34, 125.21, 126.33, 126.82, 127.01, 127.47, 128.22, 128.66, 129.57, 142.38, 147.67, 148.56, 152.45, 157.65, 179.55, 198.79; HRMS calcd for $\text{C}_{27}\text{H}_{24}\text{N}_3\text{O}_3$ $[\text{M}-\text{H}]^+$: 438.1818, found: 438.1829.



5 {9,1,2}

(1'R,2'S,3R,7a'R)-1'-(2-methoxyphenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 23)

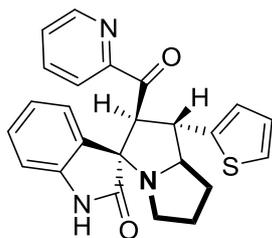
White solid; m.p. 180~183 °C; IR (KBr): ν = 3217, 3076, 2959, 2881, 1742, 1717, 1618, 1510, 1477, 1248, 743; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.60~1.79 (m, 2H, CH₂), 1.81~1.92 (m, 2H, CH₂), 2.32~2.36 (m, 1H, CH₂), 2.86 (dd, $J_1=15.6$ Hz, $J_2=6.8$ Hz, 1H, CH₂), 3.77 (s, 3H, OCH₃), 4.02~4.07 (m, 1H, CH), 4.31 (t, $J=10.8$ Hz, 1H, CH), 5.32 (d, $J=11.2$ Hz, 1H, CH), 6.46 (d, $J=7.6$ Hz, 1H, ArH), 6.71 (t, $J=7.6$ Hz, 1H, ArH), 6.91~6.96 (m, 4H, ArH), 7.16 (t, $J=6.8$ Hz, 1H, ArH), 7.36~7.42 (m, 2H, ArH), 7.40 (d, $J=6.4$ Hz, 1H, ArH), 7.67 (t, $J=8.0$ Hz, 1H, ArH), 8.40 (d, $J=4.4$ Hz, 1H, ArH), 10.24 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 25.28, 28.08, 44.20, 47.62, 55.44, 61.12, 70.12, 71.19, 108.79, 111.32, 120.05, 120.64, 125.49, 126.40, 126.75, 127.11, 127.48, 128.50, 128.52, 129.71, 142.59, 147.93, 148.22, 152.32, 157.47, 179.60, 198.64; HRMS calcd for C₂₇H₂₄N₃O₃ [M-H]⁺: 438.1818, found: 438.1835.



5 {10,1,2}

(1'R,2'S,3R,7a'R)-1'-(2,3-dimethoxyphenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 24)

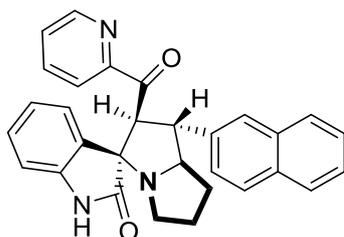
White solid; m.p. 210~212 °C; IR (KBr): ν = 3196, 3070, 2959, 2881, 1742, 1703, 1618, 1514, 1475, 1279, 781, 756; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.61~1.76 (m, 2H, CH₂), 1.79~1.95 (m, 2H, CH₂), 2.33~2.37 (m, 1H, CH₂), 2.89 (dd, $J_1=16.0$ Hz, $J_2=7.2$ Hz, 1H, CH₂), 3.77 (s, 3H, OCH₃), 3.83 (s, 3H, OCH₃), 3.96~4.01 (m, 1H, CH), 4.33 (t, $J=10.4$ Hz, 1H, CH), 5.26 (d, $J=10.8$ Hz, 1H, CH), 6.46 (d, $J=7.6$ Hz, 1H, ArH), 6.70 (t, $J=7.6$ Hz, 1H, ArH), 6.87 (d, $J=8.0$ Hz, 1H, ArH), 6.93 (t, $J=7.2$ Hz, 2H, ArH), 7.06 (t, $J=8.0$ Hz, 1H, ArH), 7.17 (d, $J=7.6$ Hz, 1H, ArH), 7.38 (t, $J=7.2$ Hz, 1H, ArH), 7.42 (d, $J=7.6$ Hz, 1H, ArH), 7.67 (t, $J=7.6$ Hz, 1H, ArH), 8.38 (d, $J=4.4$ Hz, 1H, ArH), 10.28 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 25.06, 27.59, 43.68, 47.79, 55.34, 60.15, 62.07, 70.66, 71.22, 108.81, 110.67, 119.16, 120.06, 120.65, 123.77, 125.44, 126.34, 126.81, 128.54, 133.67, 136.61, 142.64, 147.27, 147.92, 152.22, 152.26, 179.65, 198.73; HRMS calcd for C₂₈H₂₆N₃O₄ [M-H]⁺: 468.1923, found: 468.1918.



5 {11,1,2}

(1'S,2'S,3R,7a'R)-2'-picolinoyl-1'-(thiophen-2-yl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 25)

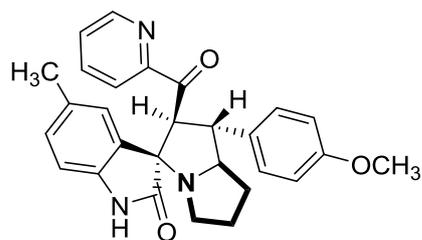
White solid; m.p. 217~219 °C; IR (KBr): ν = 3209, 3097, 3042, 2937, 2847, 1742, 1717, 1618, 1514, 1472, 781, 756; ^1H NMR (CDCl_3 , 400 MHz) δ : 1.62 (s, 1H, CH_2), 1.79~1.85 (m, 1H, CH_2), 1.89~1.95 (m, 2H, CH_2), 2.08~2.16 (m, 1H, CH_2), 2.55~2.61 (m, 1H, CH_2), 2.78~2.86 (m, 1H, CH), 4.31~4.38 (m, 1H, CH), 5.24 (d, $J=15.2$ Hz, 1H, CH), 6.53 (d, $J=10.0$ Hz, 1H, ArH), 6.81 (t, $J=10.0$ Hz, 1H, ArH), 6.92~6.99 (m, 2H, ArH), 7.03~7.09 (m, 2H, ArH), 7.14~7.23 (m, 2H, ArH), 7.49~7.54 (m, 2H, ArH), 8.35 (s, 1H, NH), 8.48 (d, $J=6.0$ Hz, 1H, ArH); ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) δ : 25.06, 28.14, 48.29, 52.64, 62.15, 70.52, 71.48, 108.93, 112.77, 118.35, 120.40, 120.91, 123.68, 125.21, 126.54, 127.86, 135.49, 137.61, 145.34, 147.85, 148.01, 152.45, 152.32, 179.58, 198.27; HRMS calcd for $\text{C}_{24}\text{H}_{20}\text{N}_3\text{O}_2\text{S}$ $[\text{M}-\text{H}]^+$: 414.1276, found: 414.1268.



5 {12,1,2}

(1'R,2'S,3R,7a'R)-1'-(naphthalen-2-yl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 26)

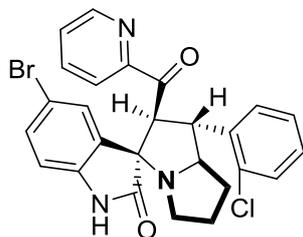
White solid; m.p. 243~245 °C ; IR (KBr): ν = 3204, 3084, 3042, 2964, 2881, 1738, 1703, 1616, 1510, 1470, 781, 744; ^1H NMR ($\text{DMSO}-d_6$, 400 MHz) δ : 1.18~1.23 (m, 1H, CH_2), 1.42~1.48 (m, 1H, CH_2), 1.51~1.55 (m, 1H, CH_2), 1.76~1.80 (m, 1H, CH_2), 2.56 (t, $J=6.8$ Hz, 1H, CH_2), 3.18~3.24 (m, 1H, CH_2), 4.33 (d, $J=12.4$ Hz, 1H, CH), 4.70 (dd, $J_1=16.8$ Hz, $J_2=8.8$ Hz, 1H, CH), 5.92 (t, $J=11.2$ Hz, 1H, CH), 6.54 (d, $J=7.6$ Hz, 1H, ArH), 7.04 (t, $J=7.6$ Hz, 1H, ArH), 7.16 (dd, $J_1=18.4$ Hz, $J_2=9.2$ Hz, 2H, ArH), 7.36~7.38 (m, 2H, ArH), 7.57~7.65 (m, 3H, ArH), 7.69~7.71 (m, 2H, ArH), 7.82 (d, $J=7.6$ Hz, 1H, ArH), 7.90 (d, $J=7.6$ Hz, 1H, ArH), 7.99 (t, $J=8.0$ Hz, 1H, ArH), 8.88 (d, $J=4.4$ Hz, 1H, ArH), 10.07 (s, 1H, NH); ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) δ : 25.37, 28.21, 47.84, 50.19, 63.69, 70.56, 71.27, 108.93, 119.87, 120.65, 124.95, 125.34, 125.83, 126.39, 127.12, 127.76, 128.56, 129.21, 129.86, 131.55, 137.48, 139.62, 143.13, 148.14, 155.22, 179.24, 198.13; HRMS calcd for $\text{C}_{30}\text{H}_{23}\text{N}_3\text{O}_2$ $[\text{M}-\text{H}]^+$: 458.1869, found: 458.1852.



5 {8,3,2}

(1'R,2'S,3R,7a'R)-1'-(4-methoxyphenyl)-5-methyl-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 27)

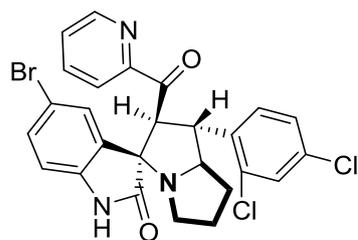
White solid; m.p. 127~130 °C; IR (KBr): ν = 3207, 3096, 3031, 2967, 2890, 1729, 1702, 1613, 1522, 1456, 754, 737; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.78~1.86 (m, 1H, CH₂), 1.92~2.10 (m, 2H, CH₂), 2.04~2.12 (m, 1H, CH₂), 2.18 (s, 3H, CH₃), 2.73~2.79 (m, 1H, CH₂), 2.94 (dd, $J_1=17.6$ Hz, $J_2=9.6$ Hz, 1H, CH₂), 3.72 (dd, $J_1=14.0$ Hz, $J_2=7.2$ Hz, 1H, CH), 3.76 (s, 3H, OCH₃), 4.49~4.45 (m, 1H, CH), 5.26 (d, $J=11.2$ Hz, 1H, CH), 6.54 (d, $J=8.0$ Hz, 1H, ArH), 6.76 (d, $J=8.0$ Hz, 1H, ArH), 6.86 (t, $J=8.4$ Hz, 3H, ArH), 7.16~7.19 (m, 1H, ArH), 7.46 (t, $J=8.8$ Hz, 2H, ArH), 7.51 (d, $J=8.8$ Hz, 2H, ArH), 8.48 (d, $J=4.4$ Hz, 1H, ArH), 9.04 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 21.57, 25.12, 28.29, 44.38, 48.65, 51.48, 62.34, 70.75, 71.50, 108.33, 110.21, 119.35, 120.46, 125.65, 126.13, 126.79, 127.15, 127.83, 128.34, 128.81, 129.69, 142.39, 147.57, 148.60, 152.75, 157.39, 179.61, 198.58; HRMS calcd for C₂₈H₂₉N₃O₃ [M-H]⁺: 452.1974, found: 452.1967.



5 {2,2,2}

(1'R,2'S,3R,7a'R)-5-bromo-1'-(2-chlorophenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 28)

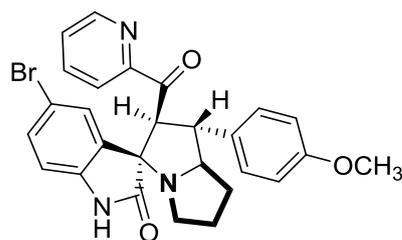
White solid; m.p. 226~228 °C; IR (KBr): ν = 3219, 3095, 3038, 2978, 2856, 1733, 1712, 1645, 1538, 1463, 748; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.69~1.81 (m, 2H, CH₂), 1.83~1.95 (m, 2H, CH₂), 2.38~2.42 (m, 1H, CH₂), 2.85 (dd, $J_1=16.0$ Hz, $J_2=7.6$ Hz, 1H, CH₂), 4.02~4.07 (m, 1H, CH), 4.49 (t, $J=10.4$ Hz, 1H, CH), 5.26 (d, $J=10.8$ Hz, 1H, CH), 6.46 (d, $J=8.0$ Hz, 1H, ArH), 7.00 (s, 1H, ArH), 7.14 (d, $J=8.0$ Hz, 1H, ArH), 7.22 (t, $J=7.6$ Hz, 1H, ArH), 7.37 (t, $J=8.0$ Hz, 1H, ArH), 7.42 (t, $J=8.4$ Hz, 2H, ArH), 7.52 (d, $J=8.0$ Hz, 1H, ArH), 7.74 (t, $J=7.6$ Hz, 2H, ArH), 8.38 (d, $J=4.4$ Hz, 1H, ArH), 10.53 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 24.97, 27.11, 46.07, 47.87, 63.06, 71.03, 71.48, 110.87, 111.79, 120.76, 127.29, 127.49, 127.58, 127.83, 128.51, 129.21, 131.48, 133.33, 136.97, 137.54, 142.01, 148.08, 151.59, 179.16, 198.18; HRMS calcd for C₂₆H₂₀BrClN₃O₂ [M-H]⁺: 520.0427, found: 520.0469.



5 {3,2,2}

(1'R,2'S,3R,7a'R)-5-bromo-1'-(2,4-dichlorophenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydros piro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 29)

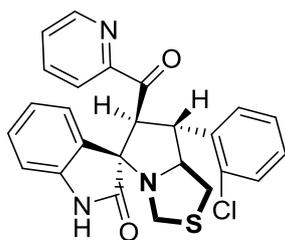
White solid; m.p. 148~150 °C; IR (KBr): ν = 3261, 3085, 3029, 2988, 2846, 1747, 1715, 1663, 1554, 1452, 757; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.73~1.87 (m, 2H, CH₂), 1.90~2.06 (m, 2H, CH₂), 2.61 (s, 1H, CH₂), 2.95 (dd, $J_1=16.0$ Hz, $J_2=7.6$ Hz, 1H, CH₂), 4.10~4.16 (m, 1H, CH), 4.55 (t, $J=10.0$ Hz, 1H, CH), 5.31 (d, $J=10.8$ Hz, 1H, CH), 6.57 (d, $J=8.4$ Hz, 1H, ArH), 7.09 (s, 1H, ArH), 7.24 (d, $J=8.4$ Hz, 1H, ArH), 7.51~7.54 (m, 2H, ArH), 7.63~7.70 (m, 2H, ArH), 7.86 (t, $J=6.0$ Hz, 2H, ArH), 8.48 (d, $J=4.8$ Hz, 1H, ArH), 10.66 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 25.45, 27.58, 46.26, 48.37, 63.58, 71.53, 71.79, 111.47, 112.36, 121.28, 127.83, 127.97, 128.24, 128.99, 130.39, 131.98, 134.67, 137.19, 137.47, 142.48, 148.55, 151.98, 179.67, 198.53; HRMS calcd for C₂₆H₁₉BrCl₂N₃O₂ [M-H]⁺: 554.0038, found: 554.0082.



5 {8,2,2}

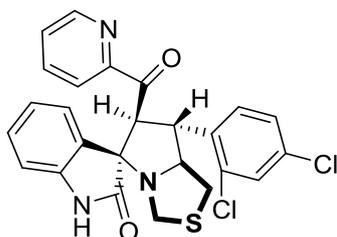
(1'R,2'S,3R,7a'R)-5-bromo-1'-(4-methoxyphenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 2, entry 30)

White solid; m.p. 145~147 °C; IR (KBr): ν = 3223, 3083, 3034, 2946, 1736, 1692, 1575, 1464, 1369, 761; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.66~1.73 (m, 2H, CH₂), 1.80~1.94 (m, 2H, CH₂), 2.31~2.35 (m, 1H, CH₂), 2.76 (dd, $J_1=15.6$ Hz, $J_2=7.2$ Hz, 1H, CH₂), 3.70 (s, 3H, OCH₃), 3.74 (t, $J=10.4$ Hz, 1H, CH), 3.98~4.03 (m, 1H, CH), 5.11 (d, $J=11.2$ Hz, 1H, CH), 6.43 (d, $J=8.0$ Hz, 1H, ArH), 6.89 (d, $J=8.4$ Hz, 2 H, ArH), 7.06 (s, 1H, ArH), 7.13 (d, $J=8.0$ Hz, 1H, ArH), 7.36 (d, $J=8.4$ Hz, 2H, ArH), 7.42 (t, $J=4.8$ Hz, 1H, ArH), 7.46 (d, $J=8.0$ Hz, 1H, ArH), 7.73 (d, $J=7.6$ Hz, 1H, ArH), 8.39 (d, $J=4.8$ Hz, 1H, ArH), 10.41 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 25.47, 27.62, 47.75, 50.13, 54.72, 63.09, 70.41, 70.84, 110.79, 111.84, 113.82, 120.68, 127.29, 127.83, 128.51, 128.76, 131.41, 131.86, 136.95, 141.92, 148.09, 151.81, 157.79, 179.30, 198.45; HRMS calcd for C₂₇H₂₃BrN₃O₃ [M-H]⁺: 516.0923, found: 516.0944.

**6 {2,1,3}**

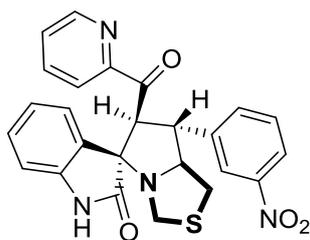
(3R,6'S,7'R,7a'S)-7'-(2-chlorophenyl)-6'-picolinoyl-1',6',7',7a'-tetrahydro-3'H-spiro[indoline-3,5'-pyrrolo[1,2-c]thiazol]-2-one (Table 2, entry 31)

White solid; m.p. 208~210 °C; IR (KBr): ν = 3211, 3087, 3030, 2978, 1745, 1712, 1627, 1533, 1469, 752; $^1\text{H NMR}$ (DMSO- d_6 , 400 MHz) δ : 2.91 (dd, $J_1=11.2$ Hz, $J_2=4.4$ Hz, 1H, CH₂), 3.02 (dd, $J_1=10.8$ Hz, $J_2=6.0$ Hz, 1H, CH₂), 3.33 (d, $J=9.6$ Hz, 1H, CH₂), 3.68 (d, $J=9.6$ Hz, 1H, CH₂), 4.04~4.09 (m, 1H, CH), 4.46 (t, $J=5.6$ Hz, 1H, CH), 5.16 (d, $J=10.4$ Hz, 1H, CH), 6.42 (d, $J=7.6$ Hz, 1H, ArH), 6.78 (t, $J=7.6$ Hz, 1H, ArH), 6.97 (t, $J=7.6$ Hz, 1H, ArH), 7.06 (d, $J=7.2$ Hz, 1H, ArH), 7.23~7.29 (m, 2H, ArH), 7.36~7.43 (m, 3H, ArH), 7.65 (t, $J=7.6$ Hz, 1H, ArH), 7.75 (d, $J=7.6$ Hz, 1H, ArH), 8.43 (d, $J=4.4$ Hz, 1H, ArH), 10.34 (s, 1H, NH); $^{13}\text{C NMR}$ (DMSO- d_6 , 100 MHz) δ : 35.25, 42.76, 51.38, 60.07, 71.42, 73.45, 108.93, 110.87, 120.45, 120.77, 120.91, 123.63, 126.68, 127.25, 127.54, 127.88, 128.10, 129.24, 136.65, 142.56, 147.37, 151.39, 157.28, 178.61, 197.86; HRMS calcd for C₂₅H₁₉ClN₃O₂S [M-H]⁺: 460.0887, found: 460.0892.

**6 {3,1,3}**

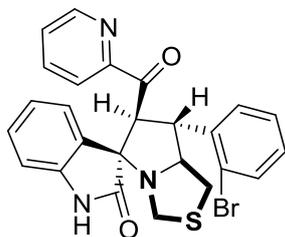
(3R,6'S,7'R,7a'S)-7'-(2,4-dichlorophenyl)-6'-picolinoyl-1',6',7',7a'-tetrahydro-3'H-spiro[indoline-3,5'-pyrrolo[1,2-c]thiazol]-2-one (Table 2, entry 32)

White solid; m.p. 224~227 °C; IR (KBr): ν = 3209, 3084, 3028, 2980, 1749, 1717, 1618, 1518, 1472, 756; $^1\text{H NMR}$ (DMSO- d_6 , 400 MHz) δ : 2.91 (dd, $J_1=11.2$ Hz, $J_2=4.8$ Hz, 1H, CH₂), 3.04 (dd, $J_1=10.8$ Hz, $J_2=6.0$ Hz, 1H, CH₂), 3.35 (d, $J=10.4$ Hz, 1H, CH₂), 3.69 (d, $J=9.2$ Hz, 1H, CH₂), 4.05~4.10 (m, 1H, CH), 4.37 (t, $J=5.2$ Hz, 1H, CH), 5.18 (d, $J=10.0$ Hz, 1H, CH), 6.41 (d, $J=7.6$ Hz, 1H, ArH), 6.96 (t, $J=8.0$ Hz, 1H, ArH), 7.05 (d, $J=7.6$ Hz, 1H, ArH), 7.23~7.31 (m, 2H, ArH), 7.39~7.49 (m, 3H, ArH), 7.65 (t, $J=9.2$ Hz, 1H, ArH), 7.76 (d, $J=7.6$ Hz, 1H, ArH), 8.43 (d, $J=4.4$ Hz, 1H, ArH), 10.35 (s, 1H, NH); $^{13}\text{C NMR}$ (DMSO- d_6 , 100 MHz) δ : 35.32, 42.57, 50.88, 59.96, 70.92, 73.34, 108.78, 110.29, 120.24, 120.85, 121.11, 123.36, 126.79, 127.03, 127.46, 127.91, 128.25, 129.37, 136.35, 142.48, 147.53, 151.59, 157.46, 178.57, 197.73; HRMS calcd for C₂₅H₁₈Cl₂N₃O₂S [M-H]⁺: 494.0498, found: 494.0526.

**6 {4,1,3}**

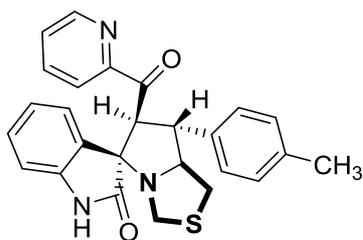
(3R,6'S,7'R,7a'S)-7'-(3-nitrophenyl)-6'-picolinoyl-1',6',7',7a'-tetrahydro-3'H-spiro[indoline-3,5'-pyrrolo[1,2-c]thiazol]-2-one (Table 2, entry 33)

White solid; m.p. 250~253 °C; IR (KBr): ν = 3209, 3084, 3028, 2930, 2826, 1734, 1699, 1618, 1545, 1506, 1472, 1337, 760; ^1H NMR (CDCl_3 , 400 MHz) δ : 2.98 (dd, $J_1=11.6$ Hz, $J_2=8.4$ Hz, 1H, CH_2), 3.08 (dd, $J_1=11.6$ Hz, $J_2=5.6$ Hz, 1H, CH_2), 3.55 (d, $J=9.6$ Hz, 1H, CH_2), 3.90 (d, $J=9.6$ Hz, 1H, CH_2), 4.09 (t, $J=9.6$ Hz, 1H, CH), 4.39~4.44 (m, 1H, CH), 5.18 (d, $J=11.2$ Hz, 1H, CH), 6.51 (d, $J=8.0$ Hz, 1H, ArH), 6.89 (t, $J=7.6$ Hz, 1H, ArH), 7.02 (t, $J=7.6$ Hz, 1H, ArH), 7.23~7.25 (m, 1H, ArH), 7.32 (d, $J=7.6$ Hz, 1H, ArH), 7.39 (t, $J=7.6$ Hz, 1H, ArH), 7.48~7.52 (m, 1H, ArH), 7.54 (d, $J=7.6$ Hz, 1H, ArH), 7.97 (d, $J=8.0$ Hz, 1H, ArH), 8.12 (d, $J=8.4$ Hz, 1H, ArH), 8.12 (s, 1H, NH), 8.48 (s, 1H, ArH), 8.50 (d, $J=4.4$ Hz, 1H, ArH); ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) δ : 35.58, 43.69, 50.21, 60.46, 71.31, 74.25, 108.83, 109.65, 119.96, 120.48, 121.51, 123.47, 126.62, 127.35, 127.58, 128.02, 128.43, 129.55, 136.41, 142.78, 147.69, 151.84, 157.72, 178.71, 198.13; HRMS calcd for $\text{C}_{25}\text{H}_{21}\text{N}_4\text{O}_4\text{S}$ $[\text{M}+\text{H}]^+$: 473.1283, found: 473.1307.

**6 {6,1,3}**

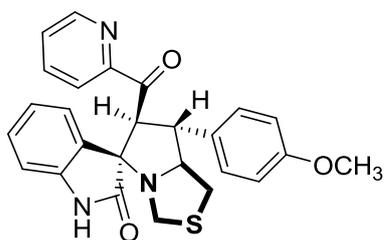
(3R,6'S,7'R,7a'S)-7'-(2-bromophenyl)-6'-picolinoyl-1',6',7',7a'-tetrahydro-3'H-spiro[indoline-3,5'-pyrrolo[1,2-c]thiazol]-2-one (Table 2, entry 34)

White solid; m.p. 226~228 °C; IR (KBr): ν = 3202, 3084, 3020, 2916, 1738, 1713, 1618, 1510, 1475, 779, 752; ^1H NMR (CDCl_3 , 400 MHz) δ : 3.07 (dd, $J_1=11.6$ Hz, $J_2=5.6$ Hz, 1H, CH_2), 3.26 (dd, $J_1=11.2$ Hz, $J_2=9.2$ Hz, 1H, CH_2), 3.54 (d, $J=10.4$ Hz, 1H, CH_2), 3.91 (d, $J=10.0$ Hz, 1H, CH_2), 4.26~4.30 (m, 1H, CH), 4.74 (t, $J=9.2$ Hz, 1H, CH), 5.27 (d, $J=11.2$ Hz, 1H, CH), 6.54 (d, $J=7.6$ Hz, 1H, ArH), 6.90 (t, $J=7.2$ Hz, 1H, ArH), 7.02 (t, $J=7.2$ Hz, 1H, ArH), 7.09 (d, $J=7.9$ Hz, 1H, ArH), 7.22 (t, $J=6.0$ Hz, 1H, ArH), 7.32 (t, $J=7.2$ Hz, 1H, ArH), 7.42 (t, $J=8.4$ Hz, 2H, ArH), 7.48 (t, $J=7.6$ Hz, 1H, ArH), 7.63 (d, $J=8.0$ Hz, 1H, ArH), 7.75 (d, $J=7.6$ Hz, 1H, ArH), 8.51 (d, $J=4.0$ Hz, 1H, ArH), 8.74 (s, 1H, NH); ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) δ : 35.31, 42.82, 50.05, 60.34, 71.26, 74.37, 108.43, 109.75, 120.06, 120.49, 121.65, 123.78, 126.54, 127.45, 127.89, 128.22, 128.63, 129.72, 136.36, 142.58, 147.73, 151.44, 157.38, 178.83, 197.88; HRMS calcd for $\text{C}_{25}\text{H}_{19}\text{N}_3\text{O}_2\text{S}$ $[\text{M}+\text{H}]^+$: 504.0381, found: 504.0363.

**6 {7,1,3}**

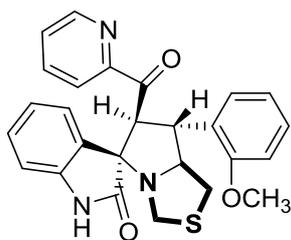
(3R,6'S,7'R,7a'S)-6'-picolinoyl-7'-(p-tolyl)-1',6',7',7a'-tetrahydro-3'H-spiro[indoline-3,5'-pyrrolo[1,2-c]thiazol]-2-one (Table 2, entry 35)

White solid; m.p. 228~230 °C; IR (KBr): ν = 3190, 3097, 3028, 2945, 2868, 1738, 1713, 1618, 1510, 1472, 777, 752; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.24 (s, 3H, CH₃), 2.87 (dd, $J_1=10.8$ Hz, $J_2=4.8$ Hz, 1H, CH₂), 2.96 (dd, $J_1=10.8$ Hz, $J_2=6.0$ Hz, 1H, CH₂), 3.34 (d, $J=7.6$ Hz, 1H, CH₂), 3.63 (d, $J=8.8$ Hz, 1H, CH₂), 4.11~4.16 (m, 1H, CH), 4.55 (t, $J=9.2$ Hz, 1H, CH), 5.11 (d, $J=10.4$ Hz, 1H, CH), 6.40 (d, $J=7.6$ Hz, 1H, ArH), 6.77 (t, $J=7.2$ Hz, 1H, ArH), 6.96 (t, $J=7.6$ Hz, 1H, ArH), 7.06 (d, $J=7.2$ Hz, 1H, ArH), 7.15 (d, $J=8.0$ Hz, 2H, ArH), 7.28 (d, $J=7.6$ Hz, 1H, ArH), 7.35 (d, $J=8.0$ Hz, 2H, ArH), 7.41~7.45 (m, 1H, ArH), 7.66 (t, $J=7.6$ Hz, 1H, ArH), 8.43 (d, $J=4.4$ Hz, 1H, ArH), 10.30 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 21.25, 35.82, 48.32, 51.13, 61.83, 71.05, 73.43, 109.28, 113.96, 120.02, 120.75, 124.17, 126.35, 127.47, 128.56, 129.46, 131.65, 137.36, 142.48, 148.36, 151.54, 158.19, 178.68, 197.75; HRMS calcd for C₂₆H₂₂N₃O₂S [M-H]⁺: 440.1433, found: 440.1454.

**6 {8,1,3}**

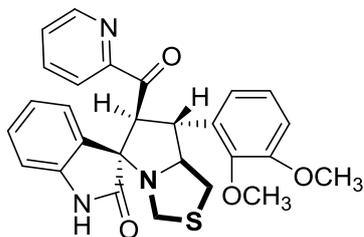
(3R,6'S,7'R,7a'S)-7'-(4-methoxyphenyl)-6'-picolinoyl-1',6',7',7a'-tetrahydro-3'H-spiro[indoline-3,5'-pyrrolo[1,2-c]thiazol]-2-one (Table 2, entry 36)

White solid; m.p. 153~155 °C; IR (KBr): ν = 3204, 3097, 3036, 2937, 2839, 1738, 1709, 1614, 1510, 1472, 1248, 773, 756; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.87 (dd, $J_1=10.8$ Hz, $J_2=4.4$ Hz, 1H, CH₂), 2.97 (dd, $J_1=10.8$ Hz, $J_2=6.0$ Hz, 1H, CH₂), 3.35 (d, $J=8.8$ Hz, 1H, CH₂), 3.64 (d, $J=8.8$ Hz, 1H, CH₂), 3.71 (s, 3H, OCH₃), 3.81 (t, $J=10.0$ Hz, 1H, CH), 4.11~4.12 (m, 1H, CH), 5.08 (d, $J=10.8$ Hz, 1H, CH), 6.41 (d, $J=7.6$ Hz, 1H, ArH), 6.78 (t, $J=7.6$ Hz, 1H, ArH), 6.92 (d, $J=9.2$ Hz, 2H, ArH), 6.97 (t, $J=7.6$ Hz, 1H, ArH), 7.07 (d, $J=7.6$ Hz, 1H, ArH), 7.28 (d, $J=8.0$ Hz, 1H, ArH), 7.39 (d, $J=8.8$ Hz, 2H, ArH), 7.43~7.46 (m, 1H, ArH), 7.67 (t, $J=7.6$ Hz, 1H, ArH), 8.44 (d, $J=4.4$ Hz, 1H, ArH), 10.31 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 18.56, 34.71, 48.45, 51.07, 55.01, 56.01, 62.81, 71.09, 73.94, 109.11, 114.13, 120.72, 120.84, 124.26, 126.43, 127.52, 128.96, 129.39, 131.95, 137.09, 142.61, 148.16, 151.84, 158.23, 178.75, 197.56; HRMS calcd for C₂₆H₂₂N₃O₃S [M-H]⁺: 456.1382, found: 456.1365.

**6 {9,1,3}**

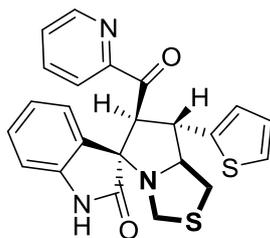
(3R,6'S,7'R,7a'S)-7'-(2-methoxyphenyl)-6'-picolinoyl-1',6',7',7a'-tetrahydro-3'H-spiro[indoline-3,5'-pyrrolo[1,2-c]thiazol]-2-one (Table 2, entry 37)

White solid; m.p. 241~243 °C; IR (KBr): ν = 3203, 3025, 2928, 1742, 1704, 1618, 1525, 1472, 787, 748; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.91 (dd, $J_1=10.8$ Hz, $J_2=6.0$ Hz, 1H, CH₂), 2.99 (dd, $J_1=10.8$ Hz, $J_2=4.8$ Hz, 1H, CH₂), 3.31 (d, $J=9.2$ Hz, 1H, CH₂), 3.64 (d, $J=9.2$ Hz, 1H, CH₂), 3.81 (s, 3H, OCH₃), 4.09~4.14 (m, 1H, CH), 4.31 (t, $J=8.8$ Hz, 1H, CH), 5.32 (d, $J=10.8$ Hz, 1H, CH), 6.40 (d, $J=7.6$ Hz, 1H, ArH), 6.77 (t, $J=7.6$ Hz, 1H, ArH), 6.93~6.99 (m, 3H, ArH), 7.07 (d, $J=7.6$ Hz, 1H, ArH), 7.21 (t, $J=8.0$ Hz, 1H, ArH), 7.27 (d, $J=8.0$ Hz, 1H, ArH), 7.43 (t, $J=6.8$ Hz, 1H, ArH), 7.49 (d, $J=7.6$ Hz, 1H, ArH), 7.65 (t, $J=8.0$ Hz, 1H, ArH), 8.46 (d, $J=4.4$ Hz, 1H, ArH), 10.26 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 35.13, 42.65, 51.49, 55.38, 59.95, 71.36, 73.28, 108.81, 111.17, 120.35, 120.47, 120.61, 123.85, 126.43, 127.17, 127.69, 127.79, 127.98, 129.14, 136.78, 142.45, 147.88, 151.76, 157.19, 178.59, 197.49; HRMS calcd for C₂₆H₂₂N₃O₃S [M-H]⁺: 456.1382, found: 456.1373.

**6 {10,1,3}**

(3R,6'S,7'R,7a'S)-7'-(2,3-dimethoxyphenyl)-6'-picolinoyl-1',6',7',7a'-tetrahydro-3'H-spiro[indoline-3,5'-pyrrolo[1,2-c]thiazol]-2-one (Table 2, entry 38)

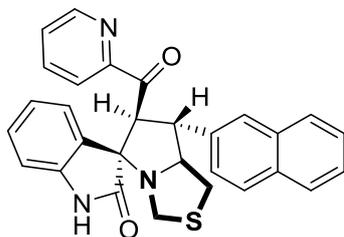
White solid; m.p. 144~146 °C; IR (KBr): ν = 3213, 3031, 2909, 1745, 1709, 1622, 1537, 1471, 758; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.90 (dd, $J_1=10.8$ Hz, $J_2=6.0$ Hz, 1H, CH₂), 2.96 (dd, $J_1=10.8$ Hz, $J_2=4.8$ Hz, 1H, CH₂), 3.40~3.46 (m, 1H, CH₂), 3.64 (d, $J=9.2$ Hz, 1H, CH₂), 3.79 (s, 3H, OCH₃), 3.87 (s, 3H, OCH₃), 3.99~4.04 (m, 1H, CH), 4.37 (t, $J=10.8$ Hz, 1H, CH), 5.25 (d, $J=10.8$ Hz, 1H, CH), 6.41 (d, $J=8.0$ Hz, 1H, ArH), 6.79 (t, $J=7.6$ Hz, 1H, ArH), 6.92 (d, $J=8.0$ Hz, 1H, ArH), 6.97 (t, $J=7.6$ Hz, 1H, ArH), 7.06 (t, $J=7.6$ Hz, 2H, ArH), 7.13 (d, $J=6.8$ Hz, 1H, ArH), 7.27 (d, $J=8.0$ Hz, 1H, ArH), 7.44 (t, $J=6.4$ Hz, 1H, ArH), 7.66 (t, $J=7.6$ Hz, 1H, ArH), 8.45 (d, $J=4.0$ Hz, 1H, ArH), 10.29 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 18.27, 34.59, 41.57, 51.24, 55.29, 60.04, 71.19, 74.19, 108.81, 110.93, 118.95, 120.41, 120.57, 120.61, 123.79, 124.01, 126.24, 127.17, 129.12, 133.24, 136.76, 142.41, 147.87, 151.66, 152.27, 178.52, 197.43; HRMS calcd for C₂₇H₂₄N₃O₄S [M-H]⁺: 486.1488, found: 486.1563.



6 {11,1,3}

(3R,6'S,7'S,7a'S)-6'-picolinoyl-7'-(thiophen-2-yl)-1',6',7',7a'-tetrahydro-3'H-spiro[indoline-3,5'-pyrrolo[1,2-c]thiazol]-2-one (Table 2, entry 39)

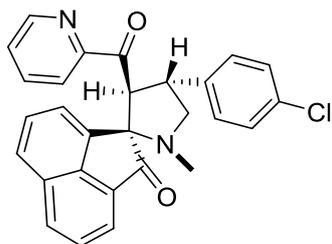
Colorless; m.p. 244~246 °C; IR (KBr): ν = 3188, 3119, 3015, 2930, 2860, 1747, 1705, 1618, 1514, 1475, 781, 756; $^1\text{H NMR}$ (DMSO- d_6 , 400 MHz) δ : 2.99 (dd, $J_1=10.4$ Hz, $J_2=3.2$ Hz, 1H, CH₂), 3.09 (dd, $J_1=10.8$ Hz, $J_2=5.2$ Hz, 1H, CH₂), 3.35 (d, $J=10.0$ Hz, 1H, CH₂), 3.63 (d, $J=8.8$ Hz, 1H, CH₂), 4.12 (d, $J=9.6$ Hz, 1H, CH), 4.16~4.20 (m, 1H, CH), 5.04 (d, $J=10.4$ Hz, 1H, CH), 6.40 (d, $J=8.0$ Hz, 1H, ArH), 6.78 (t, $J=7.6$ Hz, 1H, ArH), 6.98 (t, $J=8.8$ Hz, 2H, ArH), 7.06 (d, $J=8.0$ Hz, 1H, ArH), 7.10 (d, $J=2.4$ Hz, 1H, ArH), 7.32 (d, $J=8.0$ Hz, 1H, ArH), 7.39 (d, $J=5.2$ Hz, 1H, ArH), 7.46 (t, $J=5.6$ Hz, 1H, ArH), 7.69 (t, $J=7.6$ Hz, 1H, ArH), 8.46 (d, $J=4.4$ Hz, 1H, ArH), 10.29 (s, 1H, NH); $^{13}\text{C NMR}$ (DMSO- d_6 , 100 MHz) δ : 35.33, 42.67, 51.28, 60.12, 71.38, 73.65, 108.74, 110.23, 120.55, 120.90, 123.45, 126.57, 127.14, 127.53, 127.92, 128.23, 129.26, 136.54, 142.43, 147.24, 151.49, 157.35, 178.57, 197.79; HRMS calcd for C₂₆H₂₂N₃O₂S [M-H]⁺: 432.0841, found: 432.0871.



6 {12,1,3}

(3R,6'S,7'R,7a'S)-7'-(naphthalen-2-yl)-6'-picolinoyl-1',6',7',7a'-tetrahydro-3'H-spiro[indoline-3,5'-pyrrolo[1,2-c]thiazol]-2-one (Table 2, entry 40)

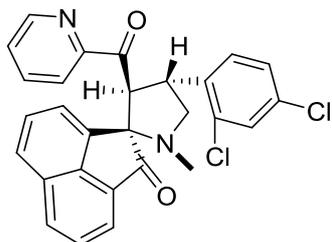
White solid; m.p. 167~170 °C; IR (KBr): ν = 3204, 3084, 3028, 2937, 2895, 1717, 1703, 1618, 1506, 1472, 781, 756; $^1\text{H NMR}$ (CDCl₃, 400 MHz) δ : 3.07 (d, $J=4.0$ Hz, 2H, CH₂), 3.58 (d, $J=10.0$ Hz, 1H, CH₂), 3.93 (d, $J=10.0$ Hz, 1H, CH₂), 4.13 (t, $J=10.0$ Hz, 1H, CH), 4.49~4.54 (m, 1H, CH), 5.32 (d, $J=11.6$ Hz, 1H, CH), 6.51 (d, $J=8.0$ Hz, 1H, ArH), 6.91 (t, $J=8.0$ Hz, 1H, ArH), 7.03 (t, $J=8.0$ Hz, 1H, ArH), 7.22 (t, $J=6.0$ Hz, 1H, ArH), 7.37 (d, $J=8.0$ Hz, 1H, ArH), 7.41~7.46 (m, 4H, ArH), 7.75 (d, $J=8.4$ Hz, 1H, ArH), 7.79 (d, $J=7.6$ Hz, 1H, ArH), 7.84 (d, $J=8.8$ Hz, 2H, ArH), 8.04 (s, 1H, ArH), 8.11 (s, 1H, NH), 8.50 (d, $J=4.4$ Hz, 1H, ArH); $^{13}\text{C NMR}$ (DMSO- d_6 , 100 MHz) δ : 35.63, 42.54, 51.37, 60.05, 71.32, 73.85, 108.53, 110.36, 120.45, 120.83, 121.12, 123.45, 125.39, 125.86, 126.48, 127.16, 127.59, 127.89, 128.26, 129.57, 136.63, 142.65, 147.34, 151.56, 157.64, 178.75, 198.43; HRMS calcd for C₂₉H₂₄N₃O₂S [M+H]⁺: 478.1589, found: 478.1608.



8 {1,4,1}

(1R,3'S,4'R)-4'-(4-chlorophenyl)-1'-methyl-3'-picolinoyl-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 41)

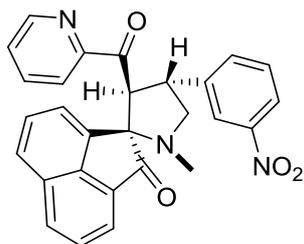
Yellow solid; m.p. 200~203 °C; IR (KBr): $\nu = 3043, 1721, 1689, 1556, 1431, 779, 724$; ¹H NMR (DMSO-*d*₆, 400 MHz) δ : 2.00 (s, 3H, NCH₃), 3.47~3.56 (m, 2H, CH₂), 4.41 (dd, $J_1=17.2$ Hz, $J_2=8.8$ Hz, 1H, CH), 4.90 (d, $J=9.6$ Hz, 1H, CH), 6.97 (t, $J=5.6$ Hz, 1H, ArH), 7.21 (d, $J=6.8$ Hz, 1H, ArH), 7.28 (d, $J=8.0$ Hz, 1H, ArH), 7.41~7.46 (m, 3H, ArH), 7.51 (d, $J=6.8$ Hz, 3H, ArH), 7.64 (d, $J=8.0$ Hz, 1H, ArH), 7.72 (t, $J=7.6$ Hz, 1H, ArH), 7.92 (t, $J=6.8$ Hz, 1H, ArH), 8.00 (d, $J=8.0$ Hz, 1H, ArH), 8.54 (t, $J=8.4$ Hz, 1H, ArH); ¹³C NMR (DMSO-*d*₆, 100 MHz) δ : 34.18, 42.69, 59.86, 61.47, 75.35, 119.91, 120.42, 121.86, 123.67, 124.42, 126.33, 127.56, 127.89, 128.75, 129.12, 131.09, 131.87, 136.48, 136.90, 141.24, 146.34, 146.78, 149.34, 150.52, 197.64, 207.05; HRMS calcd for C₂₈H₂₀ClN₂O₂ [M-H]⁺: 451.1214, found: 451.1204.



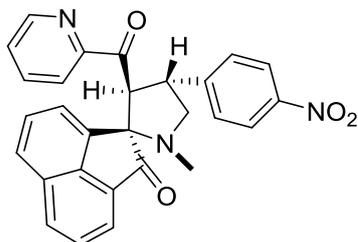
8 {3,4,1}

(1R,3'S,4'R)-4'-(2,4-dichlorophenyl)-1'-methyl-3'-picolinoyl-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 42)

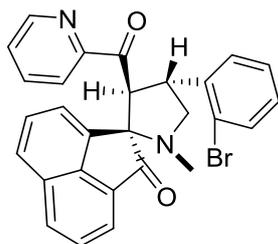
Yellow solid; m.p. 205~206 °C; IR (KBr): $\nu = 3073, 3017, 1732, 1699, 1545, 1429, 810, 714$; ¹H NMR (DMSO-*d*₆, 400 MHz) δ : 1.97 (s, 3H, NCH₃), 3.37 (d, $J=8.8$ Hz, 1H, CH₂), 3.53 (t, $J=8.4$ Hz, 1H, CH₂), 4.89 (dd, $J_1=16.0$ Hz, $J_2=8.4$ Hz, 1H, CH), 5.07 (d, $J=8.8$ Hz, 1H, CH), 6.98 (t, $J=8.0$ Hz, 1H, ArH), 7.23 (d, $J=7.2$ Hz, 1H, ArH), 7.29 (d, $J=7.6$ Hz, 1H, ArH), 7.45 (t, $J=8.0$ Hz, 2H, ArH), 7.52~7.55 (m, 2H, ArH), 7.62~7.69 (m, 2H, ArH), 7.73 (t, $J=8.0$ Hz, 1H, ArH), 7.85 (d, $J=8.4$ Hz, 1H, ArH), 7.94 (d, $J=6.8$ Hz, 1H, ArH), 8.02 (d, $J=8.0$ Hz, 1H, ArH); ¹³C NMR (DMSO-*d*₆, 100 MHz) δ : 34.43, 43.16, 59.93, 61.52, 75.38, 119.85, 120.37, 121.96, 123.60, 124.78, 126.26, 127.48, 127.92, 128.63, 129.21, 131.11, 131.77, 136.36, 136.80, 141.32, 146.15, 146.82, 149.41, 150.73, 197.82, 207.18; HRMS calcd for C₂₈H₁₉Cl₂N₂O₂ [M-H]⁺: 486.0824, found: 486.0869.

**8 {4,4,1}****(1R,3'S,4'R)-1'-methyl-4'-(3-nitrophenyl)-3'-picolinoyl-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 43)**

Yellow solid; m.p. 227~229 °C; IR (KBr): ν = 3038, 1719, 1682, 1567, 1445, 783, 712; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.01 (s, 3H, NCH₃), 3.58 (t, J =8.8 Hz, 2H, CH₂), 4.58 (dd, J_1 =17.2 Hz, J_2 =8.8 Hz, 1H, CH), 4.93 (d, J =7.2 Hz, 1H, CH), 6.97 (t, J =6.4 Hz, 1H, ArH), 7.23 (d, J =6.8 Hz, 1H, ArH), 7.31 (d, J =7.6 Hz, 1H, ArH), 7.43~7.47 (m, 2H, ArH), 7.50 (d, J =4.4 Hz, 1H, ArH), 7.65~7.76 (m, 3H, ArH), 7.95~8.03 (m, 3H, ArH), 8.12 (d, J =8.4 Hz, 1H, ArH), 8.37 (s, 1H, ArH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.23, 43.39, 59.88, 61.46, 75.45, 119.78, 120.61, 121.76, 123.49, 124.65, 126.34, 127.39, 127.94, 128.53, 129.37, 131.15, 131.66, 136.38, 136.87, 141.41, 146.23, 146.76, 149.30, 150.64, 197.73, 207.24; HRMS calcd for C₂₈H₂₀N₃O₄ [M+H]⁺: 464.1610, found: 464.1618.

**8 {5,4,1}****(1R,3'S,4'R)-1'-methyl-4'-(4-nitrophenyl)-3'-picolinoyl-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 44)**

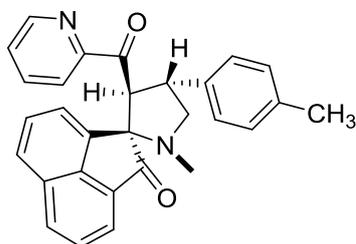
Yellow solid; m.p. 215~217 °C; IR (KBr): ν = 3039, 1743, 1678, 1564, 1432, 788, 736; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.01 (s, 3H, NCH₃), 3.58 (m, 2H, CH₂), 4.57 (dd, J_1 =16.8 Hz, J_2 =7.2 Hz, 1H, CH), 4.95 (d, J =10.0 Hz, 1H, CH), 6.98 (t, J =4.8 Hz, 1H, ArH), 7.23 (d, J =7.2 Hz, 1H, ArH), 7.29 (d, J =8.0 Hz, 1H, ArH), 7.42~7.48 (m, 2H, ArH), 7.51 (d, J =4.4 Hz, 1H, ArH), 7.66 (d, J =8.4 Hz, 1H, ArH), 7.73 (t, J =7.2 Hz, 1H, ArH), 7.79 (d, J =8.8 Hz, 2H, ArH), 7.95 (d, J =7.2 Hz, 1H, ArH), 8.01 (d, J =8.0 Hz, 1H, ArH), 8.24 (d, J =8.8 Hz, 2H, ArH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.22, 42.82, 59.97, 61.38, 75.26, 119.96, 120.53, 121.99, 123.58, 124.55, 126.57, 127.86, 127.92, 128.94, 129.00, 131.15, 131.98, 136.51, 136.84, 141.13, 146.14, 146.87, 149.45, 150.63, 197.57, 207.14; HRMS calcd for C₂₈H₂₀N₃O₄ [M+H]⁺: 464.1610, found: 464.1627.



8 {6,4,1}

(1R,3'S,4'R)-4'-(2-bromophenyl)-1'-methyl-3'-picolinoyl-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 45)

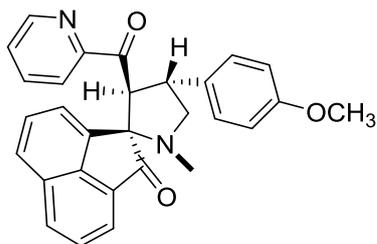
Yellow solid; m.p. 203~204 °C; IR (KBr): $\nu = 3041, 1746, 1672, 1538, 1461, 774, 731$; $^1\text{H NMR}$ (DMSO- d_6 , 400 MHz) δ : 1.98 (s, 3H, NCH₃), 3.34 (t, $J=8.8$ Hz, 1H, CH₂), 3.54 (t, $J=8.8$ Hz, 1H, CH₂), 4.91 (dd, $J_1=16.0$ Hz, $J_2=8.0$ Hz, 1H, CH), 5.14 (d, $J=9.2$ Hz, 1H, CH), 6.98 (t, $J=7.2$ Hz, 1H, ArH), 7.19 (t, $J=7.6$ Hz, 1H, ArH), 7.23 (d, $J=6.8$ Hz, 1H, ArH), 7.28 (d, $J=7.6$ Hz, 1H, ArH), 7.42~7.49 (m, 3H, ArH), 7.56 (d, $J=4.0$ Hz, 1H, ArH), 7.64 (t, $J=8.8$ Hz, 2H, ArH), 7.73 (t, $J=7.2$ Hz, 1H, ArH), 7.83 (d, $J=8.0$ Hz, 1H, ArH), 7.94 (d, $J=6.8$ Hz, 1H, ArH), 8.02 (d, $J=8.0$ Hz, 1H, ArH); $^{13}\text{C NMR}$ (DMSO- d_6 , 100 MHz) δ : 34.20, 41.89, 60.42, 60.52, 75.17, 119.94, 120.51, 122.18, 124.32, 124.49, 126.50, 127.86, 127.89, 128.12, 128.34, 128.44, 129.04, 131.17, 131.99, 132.49, 136.49, 136.74, 140.41, 141.12, 146.92, 150.77, 197.49, 207.31; HRMS calcd for C₂₈H₂₂BrN₂O₂ [M+H]⁺: 497.0865, found: 497.0896.



8 {7,4,1}

(1R,3'S,4'R)-1'-methyl-3'-picolinoyl-4'-(p-tolyl)-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 46)

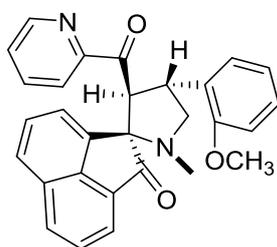
Yellow solid; m.p. 225~228 °C; IR (KBr): $\nu = 3040, 1737, 1691, 1564, 1445, 1169, 787, 735$; $^1\text{H NMR}$ (DMSO- d_6 , 400 MHz) δ : 2.01 (s, 3H, NCH₃), 2.25 (s, 3H, CH₃), 3.46 (t, $J=7.2$ Hz, 1H, CH₂), 3.56 (t, $J=8.8$ Hz, 1H, CH₂), 4.36 (dd, $J_1=17.2$ Hz, $J_2=6.8$ Hz, 1H, CH), 4.93 (d, $J=10.0$ Hz, 1H, CH), 6.97 (t, $J=6.4$ Hz, 1H, ArH), 7.15 (d, $J=7.6$ Hz, 1H, ArH), 7.21 (d, $J=6.8$ Hz, 2H, ArH), 7.27 (d, $J=8.0$ Hz, 1H, ArH), 7.37 (d, $J=8.0$ Hz, 2H, ArH), 7.41~7.47 (m, 2H, ArH), 7.53 (d, $J=4.4$ Hz, 1H, ArH), 7.63 (d, $J=8.0$ Hz, 1H, ArH), 7.72 (t, $J=7.2$ Hz, 1H, ArH), 7.92 (d, $J=6.8$ Hz, 1H, ArH), 7.99 (d, $J=8.0$ Hz, 1H, ArH); $^{13}\text{C NMR}$ (DMSO- d_6 , 100 MHz) δ : 20.79, 34.69, 43.08, 60.86, 61.89, 75.69, 99.70, 120.22, 120.86, 122.42, 124.81, 126.88, 127.86, 127.88, 128.31, 129.32, 131.46, 132.46, 135.94, 136.88, 137.76, 138.55, 141.56, 147.34, 151.29, 198.52, 208.04; HRMS calcd for C₂₉H₂₃N₂O₂ [M+H]⁺: 433.1946, found: 433.1936.



8 {8,4,1}

(1R,3'S,4'R)-4'-(4-methoxyphenyl)-1'-methyl-3'-picolinoyl-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 47)

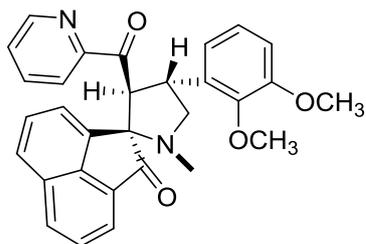
Yellow solid; m.p. 182~185 °C; IR (KBr): ν = 3037, 1738, 1674, 1537, 1442, 1214, 767, 718; ¹H NMR (DMSO-*d*₆, 400 MHz) δ : 2.00 (s, 3H, NCH₃), 3.45 (t, *J*=9.6 Hz, 1H, CH₂), 3.55 (t, *J*=11.6 Hz, 1H, CH₂), 3.71 (s, 3H, OCH₃), 4.35 (dd, *J*₁=22.8 Hz, *J*₂=10.0 Hz, 1H, CH), 4.90 (d, *J*=13.2 Hz, 1H, CH), 6.90~6.99 (m, 3H, ArH), 7.21 (d, *J*=9.2 Hz, 1H, ArH), 7.27 (d, *J*=10.4 Hz, 1H, ArH), 7.39~7.47 (m, 3H, ArH), 7.53 (d, *J*=5.6 Hz, 1H, ArH), 7.64 (t, *J*=11.2 Hz, 1H, ArH), 7.72 (t, *J*=9.6 Hz, 1H, ArH), 7.92 (d, *J*=8.8 Hz, 1H, ArH), 7.99 (d, *J*=10.8 Hz, 1H, ArH); ¹³C NMR (DMSO-*d*₆, 100 MHz) δ : 34.21, 36.28, 55.36, 58.67, 59.54, 75.19, 110.78, 119.56, 120.43, 120.55, 122.31, 124.23, 126.48, 127.10, 127.37, 127.85, 128.04, 128.79, 129.07, 130.91, 132.11, 136.43, 137.35, 141.46, 146.83, 151.14, 157.27, 197.89, 207.29; HRMS calcd for C₂₉H₂₅N₂O₃ [M+H]⁺: 449.1865, found: 449.1876.



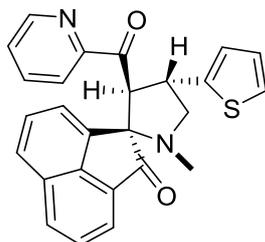
8 {9,4,1}

(1R,3'S,4'R)-4'-(2-methoxyphenyl)-1'-methyl-3'-picolinoyl-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 48)

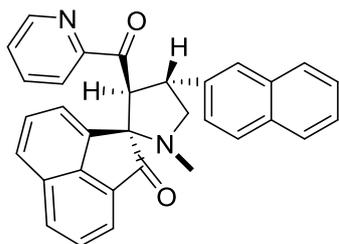
Yellow solid; m.p. 206~208 °C; IR (KBr): ν = 3030, 1720, 1683, 1543, 1451, 1228, 769, 732; ¹H NMR (DMSO-*d*₆, 400 MHz) δ : 1.98 (s, 3H, NCH₃), 3.42 (t, *J*=9.6 Hz, 1H, CH₂), 3.49 (t, *J*=8.4 Hz, 1H, CH₂), 3.77 (s, 3H, OCH₃), 4.73 (dd, *J*₁=16.4 Hz, *J*₂=6.8 Hz, 1H, CH), 5.18 (d, *J*=9.6 Hz, 1H, CH), 6.94~7.01 (m, 3H, ArH), 7.22 (t, *J*=7.2 Hz, 2H, ArH), 7.29 (d, *J*=8.0 Hz, 1H, ArH), 7.45 (t, *J*=7.2 Hz, 3H, ArH), 7.60 (d, *J*=4.0 Hz, 1H, ArH), 7.64 (d, *J*=8.4 Hz, 1H, ArH), 7.71 (t, *J*=6.8 Hz, 1H, ArH), 7.90 (d, *J*=7.2 Hz, 1H, ArH), 7.99 (d, *J*=8.0 Hz, 1H, ArH); ¹³C NMR (DMSO-*d*₆, 100 MHz) δ : 34.29, 36.55, 55.17, 58.54, 59.45, 75.01, 110.83, 119.69, 120.31, 120.41, 122.22, 124.29, 126.34, 127.01, 127.39, 127.80, 127.84, 128.82, 128.97, 130.97, 132.01, 136.41, 137.27, 141.09, 146.99, 151.06, 157.09, 197.98, 207.44; HRMS calcd for C₂₉H₂₅N₂O₃ [M+H]⁺: 449.1865, found: 449.1883.

**8 {10,4,1}****(1R,3'S,4'R)-4'-(2,3-dimethoxyphenyl)-1'-methyl-3'-picolinoyl-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 49)**

Yellow solid; m.p. 232~234 °C; IR (KBr): ν = 3043, 1721, 1689, 1556, 1431, 1243, 1185, 779, 724; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.99 (s, 3H, NCH₃), 3.39~3.45 (m, 2H, CH₂), 3.78 (s, 3H, OCH₃), 3.82 (s, 3H, OCH₃), 4.82 (dd, $J_1=17.2$ Hz, $J_2=8.0$ Hz, 1H, CH), 5.12 (d, $J=9.6$ Hz, 1H, CH), 6.91~7.12 (m, 1H, ArH), 7.19~7.29 (m, 3H, ArH), 7.42~7.47 (m, 2H, ArH), 7.57 (d, $J=4.8$ Hz, 1H, ArH), 7.64 (d, $J=8.4$ Hz, 1H, ArH), 7.72 (t, $J=6.8$ Hz, 2H, ArH), 7.92 (d, $J=7.2$ Hz, 1H, ArH), 8.00 (d, $J=8.0$ Hz, 2H, ArH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.23, 35.89, 55.30, 59.96, 60.09, 60.74, 75.18, 110.75, 119.00, 119.76, 120.41, 122.16, 123.98, 124.35, 126.38, 127.83, 128.97, 131.23, 131.99, 134.43, 136.41, 137.18, 141.12, 146.79, 146.92, 150.99, 152.21, 197.97, 207.62; HRMS calcd for C₃₀H₂₇N₂O₄ [M+H]⁺: 479.1971, found: 479.1991.

**8 {11,4,1}****(1R,3'S,4'S)-1'-methyl-3'-picolinoyl-4'-(thiophen-2-yl)-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 50)**

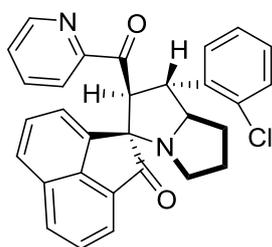
Yellow solid; m.p. 188~190 °C; IR (KBr): ν = 3042, 1728, 1675, 1532, 1441, 1123, 778, 722; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.00 (s, 3H, NCH₃), 3.52~3.64 (m, 2H, CH₂), 4.67 (dd, $J_1=23.2$ Hz, $J_2=13.6$ Hz, 1H, CH), 4.88 (d, $J=13.2$ Hz, 1H, CH), 6.97~7.03 (m, 3H, ArH), 7.21 (d, $J=8.8$ Hz, 1H, ArH), 7.32 (d, $J=10.4$ Hz, 1H, ArH), 7.38 (d, $J=6.0$ Hz, 1H, ArH), 7.46 (t, $J=8.4$ Hz, 2H, ArH), 7.54 (d, $J=5.6$ Hz, 1H, ArH), 7.64 (d, $J=10.8$ Hz, 1H, ArH), 7.71 (t, $J=10.0$ Hz, 1H, ArH), 7.92 (d, $J=9.2$ Hz, 1H, ArH), 7.99 (d, $J=10.8$ Hz, 1H, ArH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.28, 42.05, 60.36, 60.95, 75.27, 119.87, 120.47, 122.13, 124.39, 124.52, 126.38, 127.76, 127.93, 128.25, 128.64, 129.13, 131.20, 131.84, 132.44, 136.58, 136.85, 140.53, 141.32, 146.91, 150.78, 197.74, 207.28; HRMS calcd for C₂₆H₂₁N₂O₂S [M+H]⁺: 425.1323, found: 425.1346.



8 {12,4,1}

(1R,3'S,4'R)-1'-methyl-4'-(naphthalen-2-yl)-3'-picolinoyl-2H-spiro[acenaphthylene-1,2'-pyrrolidin]-2-one (Table 3, entry 51)

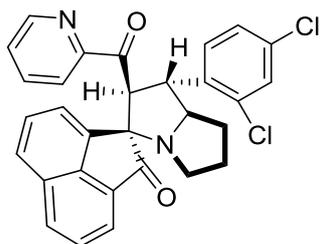
Yellow solid; m.p. 227~230 °C; IR (KBr): ν = 3033, 2981 1727, 1665, 1549, 1427, 766, 724; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.05 (s, 3H, NCH₃), 3.57 (t, J =7.2 Hz, 1H, CH₂), 3.72 (t, J =8.8 Hz, 1H, CH₂), 4.60 (dd, J_1 =16.8 Hz, J_2 =6.8 Hz, 1H, CH), 5.07 (d, J =10.0 Hz, 1H, CH), 6.96 (t, J =6.4 Hz, 1H, ArH), 7.27 (d, J =9.6 Hz, 2H, ArH), 7.42 (d, J =7.6 Hz, 1H, ArH), 7.45~7.49 (m, 3H, ArH), 7.52 (d, J =4.8 Hz, 1H, ArH), 7.65 (d, J =8.4 Hz, 1H, ArH), 7.73 (t, J =7.6 Hz, 2H, ArH), 7.87 (d, J =7.2 Hz, 1H, ArH), 7.91~7.95 (m, 4H, ArH), 8.01 (d, J =8.0 Hz, 1H, ArH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.28, 43.18, 60.35, 61.33, 75.38, 119.84, 120.45, 122.01, 124.42, 125.43, 125.83, 125.97, 126.02, 126.45, 127.19, 127.25, 127.88, 128.03, 128.98, 131.07, 131.73, 132.04, 132.70, 136.43, 137.23, 138.77, 141.15, 146.68, 150.82, 197.98, 207.52; HRMS calcd for C₃₂H₂₅N₂O₂ [M+H]⁺: 469.1916, found: 469.1932.



8 {2,4,2}

(1R,1'R,2'S,7a'R)-1'-(2-chlorophenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydro-2H-spiro[acenaphthylene-1,3'-pyrrolizin]-2-one (Table 3, entry 52)

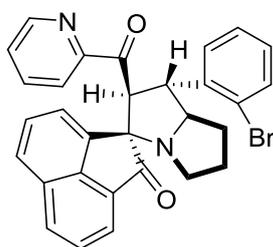
Yellow solid; m.p. 191~193 °C; IR (KBr): ν = 3034, 1728, 1679, 1564, 1456, 775, 731; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.64~1.72 (m, 1H, CH₂), 1.85~1.87 (m, 1H, CH₂), 1.88~1.93 (m, 2H, CH₂), 2.20~2.24 (m, 1H, CH₂), 2.81~2.87 (m, 1H, CH₂), 4.04~4.09 (m, 1H, CH), 4.64 (t, J =10.8 Hz, 1H, CH), 5.34 (d, J =11.6 Hz, 1H, CH), 7.04 (t, J =7.2 Hz, 1H, ArH), 7.24 (d, J =7.6 Hz, 1H, ArH), 7.27 (d, J =5.2 Hz, 1H, ArH), 7.30~7.33 (m, 1H, ArH), 7.39~7.45 (m, 1H, ArH), 7.48~7.51 (m, 3H, ArH), 7.66~7.67 (m, 1H, ArH), 7.72~7.79 (m, 3H, ArH), 7.98 (d, J =6.8 Hz, 1H, ArH), 8.05 (d, J =8.0 Hz, 1H, ArH); HRMS calcd for C₃₀H₂₄ClN₂O₂ [M+H]⁺: 479.1448, found: 479.1547. ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 22.35, 28.47, 33.62, 42.38, 49.51, 60.13, 75.14, 118.84, 120.29, 122.31, 124.56, 124.98, 126.46, 127.65, 127.83, 128.09, 128.48, 128.83, 129.14, 131.21, 131.72, 132.54, 136.69, 137.24, 140.51, 141.27, 146.72, 150.62, 197.57, 207.28; HRMS calcd for C₃₀H₂₄ClN₂O₂ [M+H]⁺: 479.1526, found: 479.1548.



8 {3,4,2}

(1R,1'R,2'S,7a'R)-1'-(2,4-dichlorophenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydro-2H-spiro[acenaphthylene-1,3'-pyrrolizin]-2-one (Table 3, entry 53)

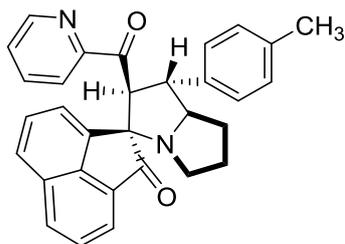
Yellow solid; m.p. 209~221 °C; IR (KBr): $\nu = 3032, 1742, 1682, 1546, 1428, 783, 732$; $^1\text{H NMR}$ (DMSO- d_6 , 400 MHz) δ : 1.63~1.72 (m, 1H, CH₂), 1.79~1.84 (m, 1H, CH₂), 1.85~1.95 (m, 2H, CH₂), 2.19~2.24 (m, 1H, CH₂), 2.79~2.86 (m, 1H, CH₂), 4.02~4.07 (m, 1H, CH), 4.57 (t, $J=10.8$ Hz, 1H, CH), 5.29 (d, $J=11.2$ Hz, 1H, CH), 7.04 (t, $J=6.8$ Hz, 1H, ArH), 7.31 (d, $J=6.8$ Hz, 2H, ArH), 7.45~7.51 (m, 3H, ArH), 7.64~7.65 (m, 2H, ArH), 7.72~7.76 (m, 2H, ArH), 7.79 (d, $J=8.4$ Hz, 1H, ArH), 7.99 (d, $J=6.8$ Hz, 1H, ArH), 8.05 (d, $J=8.0$ Hz, 1H, ArH); $^{13}\text{C NMR}$ (DMSO- d_6 , 100 MHz) δ : 23.72, 28.31, 33.58, 42.46, 49.32, 60.35, 75.20, 118.75, 120.55, 122.69, 124.32, 125.01, 126.36, 127.43, 127.92, 128.11, 128.46, 128.93, 129.54, 131.37, 131.85, 132.62, 136.49, 137.28, 140.31, 141.46, 146.83, 150.75, 197.73, 207.35; HRMS calcd for C₃₀H₂₃Cl₂N₂O₂ [M+H]⁺: 513.1137, found: 513.1167.



8 {6,4,2}

(1R,1'R,2'S,7a'R)-1'-(2-bromophenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydro-2H-spiro[acenaphthylene-1,3'-pyrrolizin]-2-one (Table 3, entry 54)

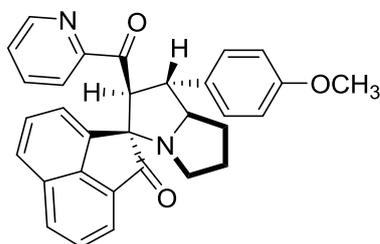
Yellow solid; m.p. 212~214 °C; IR (KBr): $\nu = 3035, 1732, 1675, 1553, 1441, 763, 716$; $^1\text{H NMR}$ (DMSO- d_6 , 400 MHz) δ : 1.63~1.72 (m, 1H, CH₂), 1.86~1.89 (m, 1H, CH₂), 1.91~1.97 (m, 2H, CH₂), 2.2~2.26 (m, 1H, CH₂), 2.81~2.87 (m, 1H, CH₂), 4.03~4.08 (m, 1H, CH), 4.61 (t, $J=10.8$ Hz, 1H, CH), 5.31 (d, $J=11.2$ Hz, 1H, CH), 7.04 (t, $J=6.0$ Hz, 1H, ArH), 7.17 (t, $J=8.0$ Hz, 1H, ArH), 7.30 (d, $J=6.8$ Hz, 2H, ArH), 7.43~7.51 (m, 3H, ArH), 7.65~7.67 (m, 2H, ArH), 7.72~7.77 (m, 3H, ArH), 7.98 (d, $J=6.8$ Hz, 1H, ArH), 8.05 (d, $J=8.0$ Hz, 1H, ArH); $^{13}\text{C NMR}$ (DMSO- d_6 , 100 MHz) δ : 23.64, 28.88, 33.89, 43.21, 49.63, 60.72, 75.35, 118.96, 120.63, 122.77, 124.37, 125.24, 126.47, 127.28, 127.89, 128.26, 128.54, 128.87, 129.35, 131.42, 131.67, 132.41, 136.53, 137.17, 140.27, 141.51, 146.54, 150.55, 197.62, 207.84; HRMS calcd for C₃₀H₂₄BrN₂O₂ [M+H]⁺: 523.1021, found: 523.1049.



8 {7,4,2}

(1R,1'R,2'S,7a'R)-2'-picolinoyl-1'-(p-tolyl)-1',2',5',6',7',7a'-hexahydro-2H-spiro[acenaphthylene-1,3'-pyrrolizin]-2-one (Table 3, entry 55)

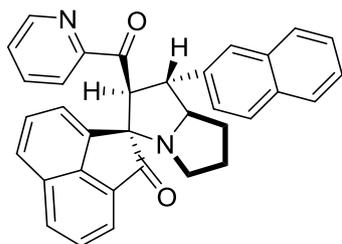
Yellow solid; m.p. 222~224 °C; IR (KBr): $\nu = 3036, 1726, 1673, 1564, 1442, 783, 739$; $^1\text{H NMR}$ (DMSO- d_6 , 400 MHz) δ : 1.63~1.69 (m, 1H, CH₂), 1.75~1.79 (m, 1H, CH₂), 1.88~1.91 (m, 2H, CH₂), 1.96 (s, 1H, CH₂), 2.25 (s, 3H, CH₃), 2.82 (dd, $J_1=14.8$ Hz, $J_2=6.0$ Hz, 1H, CH₂), 3.88 (t, $J=10.8$ Hz, 1H, CH), 4.06 (s, 1H, CH), 5.20 (d, $J=11.6$ Hz, 1H, CH), 7.02~7.04 (m, 1H, ArH), 7.16 (d, $J=7.2$ Hz, 1H, ArH), 7.26 (d, $J=7.6$ Hz, 1H, ArH), 7.33 (d, $J=6.8$ Hz, 1H, ArH), 7.40 (d, $J=7.6$ Hz, 1H, ArH), 7.46 (dd, $J_1=14.4$ Hz, $J_2=7.2$ Hz, 2H, ArH), 7.68~7.74 (m, 3H, ArH), 7.80 (d, $J=7.2$ Hz, 1H, ArH), 7.94 (d, $J=6.8$ Hz, 1H, ArH), 8.03 (d, $J=7.6$ Hz, 1H, ArH), 8.16 (t, $J=6.4$ Hz, 1H, ArH); $^{13}\text{C NMR}$ (DMSO- d_6 , 100 MHz) δ : 21.12, 23.27, 29.25, 33.64, 43.31, 49.91, 60.63, 75.38, 118.76, 120.43, 122.08, 124.45, 125.37, 126.69, 127.15, 127.92, 128.33, 128.64, 129.02, 129.43, 131.16, 131.58, 132.22, 136.41, 137.81, 140.47, 141.42, 146.63, 150.56, 197.57, 207.64; HRMS calcd for C₃₁H₂₇N₂O₂ [M+H]⁺: 459.2072, found: 459.2092.



8 {8,4,2}

(1R,1'R,2'S,7a'R)-1'-(4-methoxyphenyl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydro-2H-spiro[acenaphthylene-1,3'-pyrrolizin]-2-one (Table 3, entry 56)

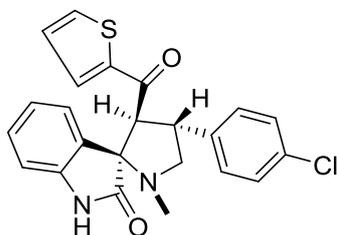
Yellow solid; m.p. 196~198 °C; IR (KBr): $\nu = 3035, 1734, 1674, 1538, 1442, 1221, 782, 736$; $^1\text{H NMR}$ (DMSO- d_6 , 400 MHz) δ : 1.60~1.10 (m, 1H, CH₂), 1.72~1.79 (m, 1H, CH₂), 1.87~1.90 (m, 2H, CH₂), 2.14~2.18 (m, 1H, CH₂), 2.82 (dd, $J_1=14.2$ Hz, $J_2=6.4$ Hz, 1H, CH₂), 3.71 (s, 3H, OCH₃), 3.87 (t, $J=10.8$ Hz, 1H, CH), 4.05~4.10 (m, 1H, CH), 5.17 (d, $J=11.2$ Hz, 1H, CH), 6.92 (d, $J=8.4$ Hz, 2H, ArH), 7.03 (t, $J=6.8$ Hz, 1H, ArH), 7.26 (d, $J=7.6$ Hz, 1H, ArH), 7.33 (d, $J=7.2$ Hz, 1H, ArH), 7.42~7.49 (m, 4H, ArH), 7.68 (t, $J=4.0$ Hz, 1H, ArH), 7.12 (d, $J=4.4$ Hz, 2H, ArH), 7.94 (d, $J=6.8$ Hz, 1H, ArH), 8.03 (d, $J=8.4$ Hz, 1H, ArH); $^{13}\text{C NMR}$ (DMSO- d_6 , 100 MHz) δ : 23.39, 28.34, 33.65, 43.52, 49.78, 56.93, 60.72, 75.30, 118.62, 120.51, 122.68, 124.23, 125.36, 126.61, 127.33, 127.79, 128.12, 128.66, 128.78, 129.42, 131.38, 131.75, 132.53, 136.65, 137.28, 140.37, 141.49, 146.21, 150.38, 197.75, 207.76; HRMS calcd for C₃₁H₂₇N₂O₃ [M+H]⁺: 475.2021, found: 475.2038.



8 {12,4,2}

(1R,1'R,2'S,7a'R)-1'-(naphthalen-2-yl)-2'-picolinoyl-1',2',5',6',7',7a'-hexahydro-2H-spiro[acenaphthylene-1,3'-pyrrolizin]-2-one (Table 3, entry 57)

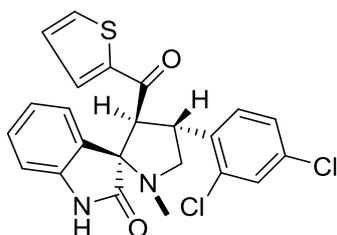
Yellow solid; m.p. 192~195 °C; IR (KBr): $\nu = 3033, 2992, 1732, 1675, 1563, 1447, 776, 715$; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.63~1.72 (m, 1H, CH₂), 1.78~1.86 (m, 1H, CH₂), 1.87~1.96 (m, 2H, CH₂), 2.18~2.23 (m, 1H, CH₂), 2.87 (dd, $J_1=19.6$ Hz, $J_2=8.4$ Hz, 1H, CH₂), 4.11 (t, $J=14.8$ Hz, 1H, CH), 4.22~4.29 (m, 1H, CH), 5.36 (d, $J=14.8$ Hz, 1H, CH), 6.99~7.04 (m, 1H, ArH), 7.26 (d, $J=10.4$ Hz, 1H, ArH), 7.38 (d, $J=9.2$ Hz, 1H, ArH), 7.41~7.47 (m, 3H, ArH), 7.51 (d, $J=9.2$ Hz, 1H, ArH), 7.67 (d, $J=6.0$ Hz, 1H, ArH), 7.02~7.77 (m, 3H, ArH), 7.88 (d, $J=9.6$ Hz, 1H, ArH), 7.92~8.01 (m, 4H, ArH), 8.04 (d, $J=10.8$ Hz, 1H, ArH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 23.81, 28.45, 33.67, 43.52, 49.78, 60.62, 75.48, 118.67, 120.84, 122.69, 124.57, 125.36, 126.54, 127.35, 127.75, 128.30, 128.61, 128.83, 129.45, 131.62, 131.82, 132.56, 136.43, 137.22, 140.24, 141.35, 146.55, 150.63, 197.31, 207.65; HRMS calcd for C₃₄H₂₇N₂O₂ [M+H]⁺: 495.2072, found: 495.2103.



9 {13,1,1}

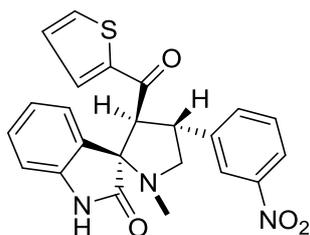
(3R,3'S,4'R)-4'-(4-chlorophenyl)-1'-methyl-3'-(thiophene-2-carbonyl)spiro[indoline-3,2'-pyrrolidin]-2-one (Table 4, entry 58)

Colorless; m.p. 222~224 °C; IR (KBr): $\nu = 3244, 3105, 2945, 2868, 2804, 1728, 1655, 1612, 1518, 1470, 777, 756, 721$; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.05 (s, 3H, CH₃), 3.38~3.41 (m, 2H, CH₂), 4.23 (d, $J=9.6$ Hz, 1H, CH), 4.32 (dd, $J_1=17.2$ Hz, $J_2=8.0$ Hz, 1H, CH), 6.57 (d, $J=7.6$ Hz, 1H, ArH), 6.85 (t, $J=7.2$ Hz, 1H, ArH), 6.97~6.99 (m, 2H, ArH), 7.03 (t, $J=7.6$ Hz, 1H, ArH), 7.36~7.38 (m, 3H, ArH), 7.43 (d, $J=8.8$ Hz, 2H, ArH), 7.78 (dd, $J_1=5.2$ Hz, $J_2=1.2$ Hz, 1H, ArH), 10.61 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.24, 43.09, 59.27, 62.44, 72.89, 108.99, 121.55, 125.90, 126.19, 128.12, 128.37, 128.92, 129.32, 131.21, 131.72, 135.55, 139.94, 141.79, 143.54, 178.68, 188.90; HRMS calcd for C₂₃H₂₀ClN₂O₂S [M+H]⁺: 423.0928, found: 423.0956.

**9 {14,1,1}**

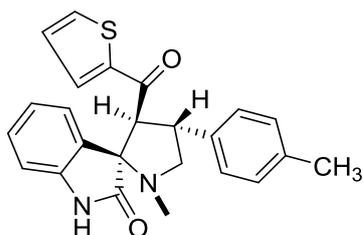
(3R,3'S,4'R)-4'-(2,4-dichlorophenyl)-1'-methyl-3'-(thiophene-2-carbonyl)spiro[indoline-3,2'-pyrrolidin]-2-one (Table 4, entry 59)

White solid; m.p. 243~245 °C; IR (KBr): ν = 3204, 3092, 3036, 2951, 2868, 1747, 1720, 1618, 1520, 1472, 777, 760, 725; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.03 (s, 3H, CH₃), 3.25 (t, J =9.2 Hz, 1H, CH₂), 3.42 (t, J =8.4 Hz, 1H, CH₂), 4.38 (d, J =8.8 Hz, 1H, CH), 4.79 (dd, J_1 =16.0 Hz, J_2 =8.4 Hz, 1H, CH), 6.58 (d, J =7.6 Hz, 1H, ArH), 6.85 (t, J =7.2 Hz, 1H, ArH), 6.97~7.00 (m, 2H, ArH), 7.01~7.06 (m, 1H, ArH), 7.44~7.49 (m, 2H, ArH), 7.55 (d, J =2.4 Hz, 1H, ArH), 7.79 (d, J =5.2 Hz, 1H, ArH), 7.86 (d, J =6.4 Hz, 1H, ArH), 10.64 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.15, 59.18, 61.18, 72.82, 109.08, 121.47, 125.63, 125.94, 127.72, 128.06, 128.41, 128.93, 129.99, 131.79, 131.89, 133.88, 135.54, 137.75, 141.76, 143.35, 178.44, 188.49; HRMS calcd for C₂₃H₁₉Cl₂N₂O₂S [M+H]⁺: 457.0544, found: 457.0573.

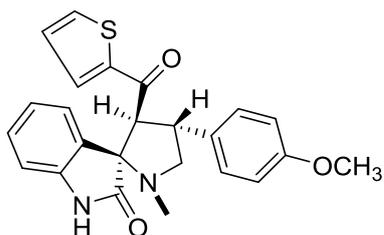
**9 {15,1,1}**

(3R,3'S,4'R)-1'-methyl-4'-(3-nitrophenyl)-3'-(thiophene-2-carbonyl)spiro[indoline-3,2'-pyrrolidin]-2-one (Table 4, entry 60)

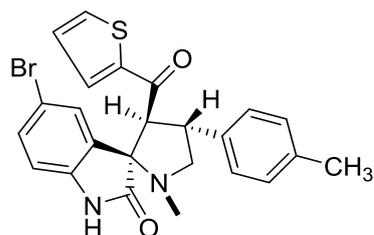
Colorless; m.p. 218~220 °C; IR (KBr): ν = 3294, 3097, 3070, 2959, 2853, 1724, 1705, 1614, 1541, 1520, 1460, 1342, 781, 756; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.07 (s, 3H, CH₃), 3.47 (d, J =8.4 Hz, 2H, CH₂), 4.30 (d, J =8.8 Hz, 1H, CH), 4.49 (dd, J_1 =17.2 Hz, J_2 =8.4 Hz, 1H, CH), 6.58 (d, J =8.0 Hz, 1H, ArH), 6.85 (t, J =7.6 Hz, 1H, ArH), 6.96~6.70 (m, 2H, ArH), 7.03 (t, J =7.6 Hz, 1H, ArH), 7.41 (d, J =4.0 Hz, 1H, ArH), 7.63 (d, J =8.0 Hz, 1H, ArH), 7.78 (dd, J_1 =5.2 Hz, J_2 =1.2 Hz, 1H, ArH), 7.88 (d, J =7.6 Hz, 1H, ArH), 8.07~8.10 (m, 1H, ArH), 8.28 (t, J =2.0 Hz, 1H, ArH), 10.64 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.12, 43.14, 59.21, 62.34, 72.90, 109.03, 121.53, 121.65, 122.18, 125.79, 125.96, 128.05, 128.96, 129.91, 131.94, 134.92, 135.58, 141.79, 143.73, 147.75, 178.52, 188.73; HRMS calcd for C₂₃H₂₀N₃O₄S [M+H]⁺: 434.1174, found: 434.1189.

**9 {16,1,1}****(3R,3'S,4'R)-1'-methyl-3'-(thiophene-2-carbonyl)-4'-(p-tolyl)spiro[indoline-3,2'-pyrrolidin]-2-one (Table 4, entry 61)**

Colorless; m.p. 209~211 °C; IR (KBr): ν = 3238, 3084, 3028, 2937, 2874, 1724, 1616, 1514, 1472, 783, 766, 727; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.08 (s, 3H, NCH₃), 2.23 (s, 3H, CH₃), 3.33~3.37 (m, 1H, CH₂), 3.42~3.44 (m, 1H, CH₂), 4.23~4.29 (m, 2H, CH), 6.57 (d, J =7.6 Hz, 1H, ArH), 6.85 (t, J =7.6 Hz, 1H, ArH), 6.97~7.04 (m, 3H, ArH), 7.12 (d, J =7.6 Hz, 2H, ArH), 7.28 (d, J =8.0 Hz, 2H, ArH), 7.36 (dd, J_1 =4.0 Hz, J_2 =1.2 Hz, 1H, ArH), 7.77 (dd, J_1 =4.8 Hz, J_2 =0.8 Hz, 1H, ArH), 10.58 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 20.23, 34.23, 43.42, 59.47, 62.65, 72.91, 108.95, 121.54, 126.02, 126.46, 127.30, 128.15, 128.99, 131.55, 135.44, 135.73, 137.84, 141.86, 143.79, 178.74, 189.03; HRMS calcd for C₂₄H₂₃N₂O₂S [M+H]⁺: 403.1480, found: 403.1486.

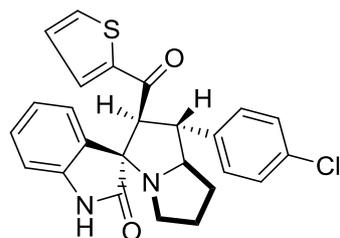
**9 {17,1,1}****(3R,3'S,4'R)-4'-(4-methoxyphenyl)-1'-methyl-3'-(thiophene-2-carbonyl)spiro[indoline-3,2'-pyrrolidin]-2-one (Table 4, entry 62)**

White solid; m.p. 223~225 °C; IR (KBr): ν = 3182, 3092, 3015, 2964, 2881, 1724, 1618, 1514, 1466, 1248, 783, 756; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.05 (s, 3H, NCH₃), 3.33 (t, J =6.0 Hz, 1H, CH₂), 3.39 (t, J =8.4 Hz, 1H, CH₂), 3.69 (s, 3H, OCH₃), 4.20~4.26 (m, 2H, CH), 6.57 (d, J =7.6 Hz, 1H, ArH), 6.83~6.90 (m, 3H, ArH), 6.97~7.04 (m, 3H, ArH), 7.31 (d, J =8.8 Hz, 2H, ArH), 7.36 (dd, J_1 =3.6 Hz, J_2 =0.8 Hz, 1H, ArH), 7.77 (dd, J_1 =5.4 Hz, J_2 =1.2 Hz, 1H, ArH), 10.58 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 34.74, 43.56, 55.23, 59.95, 63.19, 73.34, 109.38, 114.28, 121.98, 126.41, 126.87, 128.59, 128.83, 129.28, 131.98, 133.08, 135.85, 142.20, 144.19, 158.33, 179.30, 189.61; HRMS calcd for C₂₄H₂₃N₂O₃S [M+H]⁺: 419.1429, found: 419.1440.

**9 {16,2,1}**

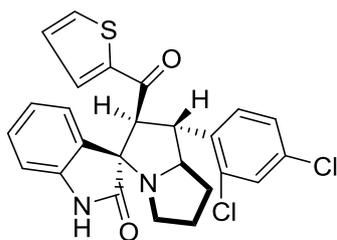
(3R,3'S,4'R)-5-bromo-1'-methyl-3'-(thiophene-2-carbonyl)-4'-(p-tolyl)spiro[indoline-3,2'-pyrrolidin]-2-one (Table 4, entry 63)

Colorless; m.p. 231~233 °C; IR (KBr): ν = 3204, 3097, 2951, 2881, 1730, 1616, 1514, 1472, 783, 766, 727; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 2.08 (s, 3H, NCH₃), 2.24 (s, 3H, CH₃), 3.36~3.41 (m, 2H, CH₂), 4.26 (m, 2H, CH), 6.53 (d, J =8.4 Hz, 1H, ArH), 7.01 (t, J =4.8 Hz, 1H, ArH), 7.07 (s, 1H, ArH), 7.12 (d, J =7.6 Hz, 2H, ArH), 7.22 (d, J =8.0 Hz, 1H, ArH), 7.27 (d, J =8.0 Hz, 2H, ArH), 7.84 (d, J =3.6 Hz, 1H, ArH), 10.73 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 20.52, 34.53, 43.60, 59.64, 62.79, 73.02, 111.12, 113.42, 127.42, 128.41, 128.69, 128.98, 131.75, 131.97, 135.87, 136.09, 137.54, 141.29, 143.72, 178.41, 189.19; HRMS calcd for C₂₄H₂₂BrN₂O₂S [M+H]⁺: 481.0585, found: 481.0594.

**9 {13,1,2}**

(1'R,2'S,3R,7a'R)-1'-(4-chlorophenyl)-2'-(thiophene-2-carbonyl)-1',2',5',6',7',7a'-hexahydro piro[indoline-3,3'-pyrrolizin]-2-one (Table 4, entry 64)

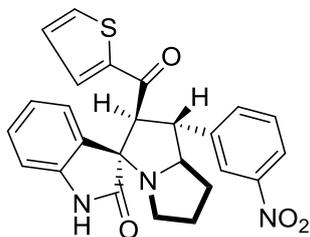
White solid, m.p. 135~137 °C; IR (KBr): ν = 3205, 3037, 2981, 1733, 1618, 1524, 1471, 773, 727; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.69~1.74 (m, 2H, CH₂), 1.81~1.90 (m, 2H, CH₂), 2.33~2.38 (m, 1H, CH₂), 2.58 (dd, J_1 =15.6 Hz, J_2 =7.6 Hz, 1H, CH₂), 3.84~3.93 (m, 2H, CH), 4.65 (d, J =11.2 Hz, 1H, CH), 6.61 (d, J =8.0 Hz, 1H, ArH), 6.93 (t, J =7.6 Hz, 1H, ArH), 7.06~7.13 (m, 2H, ArH), 7.27 (d, J =7.6 Hz, 1H, ArH), 7.37 (d, J =8.4 Hz, 2H, ArH), 7.47 (d, J =8.8 Hz, 2H, ArH), 7.58 (d, J =4.0 Hz, 1H, ArH), 7.82 (dd, J_1 =4.8 Hz, J_2 =0.8 Hz, 1H, ArH), 10.40 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 26.37, 28.99, 47.27, 51.19, 63.54, 70.95, 72.66, 109.39, 120.90, 124.33, 127.18, 128.20, 128.32, 129.04, 129.31, 131.17, 132.58, 135.55, 138.44, 141.53, 143.44, 179.16, 188.15; HRMS calcd for C₂₅H₂₂ClN₂O₂S [M+H]⁺: 449.1090, found: 449.1119.



9 {14,1,2}

(1'R,2'S,3R,7a'R)-1'-(2,4-dichlorophenyl)-2'-(thiophene-2-carbonyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 4, entry 65)

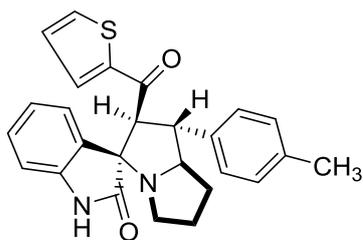
White solid, m.p. 158~160 °C; IR (KBr): ν = 3210, 3045, 2992, 1745, 1639 1576, 1478, 782, 733; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.69~1.78 (m, 2H, CH₂), 1.82~1.89 (m, 2H, CH₂), 2.36~2.41 (m, 1H, CH₂), 2.60 (dd, $J_1=16.8$ Hz, $J_2=7.6$ Hz, 1H, CH₂), 3.85~3.90 (m, 1H, CH), 4.44 (t, $J=10.0$ Hz, 1H, CH), 4.80 (d, $J=11.2$ Hz, 1H, CH), 6.63 (d, $J=7.6$ Hz, 1H, ArH), 6.94 (t, $J=7.6$ Hz, 1H, ArH), 7.06 (t, $J=4.8$ Hz, 1H, ArH), 7.12 (t, $J=7.6$ Hz, 1H, ArH), 7.19 (d, $J=7.6$ Hz, 1H, ArH), 7.40 (dd, $J_1=8.4$ Hz, $J_2=2.0$ Hz, 1H, ArH), 7.58 (d, $J=2.4$ Hz, 1H, ArH), 7.59 (dd, $J_1=2.7$ Hz, $J_2=0.8$ Hz, 1H, ArH), 7.76 (d, $J=8.8$ Hz, 1H, ArH), 7.82 (dd, $J_1=5.2$ Hz, $J_2=1.2$ Hz, 1H, ArH), 10.45 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 26.83, 29.50, 47.68, 47.89, 63.93, 72.08, 73.37, 110.23, 121.76, 124.84, 127.46, 128.37, 128.88, 129.35, 129.89, 130.34, 132.38, 133.43, 134.99, 136.29, 142.28, 143.87, 179.62, 188.88; HRMS calcd for C₂₅H₂₁ Cl₂N₂O₂S [M+H]⁺: 483.0701, found: 483.0726.



9 {15,1,2}

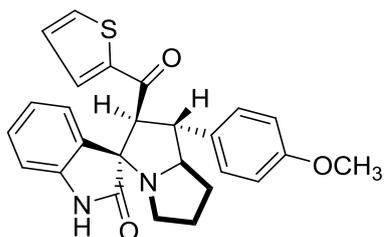
(1'R,2'S,3R,7a'R)-1'-(3-nitrophenyl)-2'-(thiophene-2-carbonyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 4, entry 66)

Colorless; m.p. 208~210 °C; IR (KBr): ν = 3208, 3054, 2990, 1735, 1621, 1538, 1467, 793, 733; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.67~1.80 (m, 2H, CH₂), 1.81~1.92 (m, 2H, CH₂), 2.34~2.39 (m, 1H, CH₂), 2.59 (dd, $J_1=16.8$ Hz, $J_2=7.6$ Hz, 1H, CH₂), 3.96~4.01 (m, 1H, CH), 4.08 (d, $J=10.4$ Hz, 1H, ArH), 4.73 (d, $J=11.2$ Hz, 1H, CH), 6.62 (d, $J=7.6$ Hz, 1H, ArH), 6.93 (t, $J=7.6$ Hz, 1H, ArH), 7.06 (t, $J=4.4$ Hz, 1H, ArH), 7.12 (t, $J=7.6$ Hz, 1H, ArH), 7.33 (d, $J=7.6$ Hz, 1H, ArH), 7.60~7.64 (m, 2H, ArH), 7.81 (d, $J=4.8$ Hz, 1H, ArH), 7.95 (d, $J=7.6$ Hz, 1H, ArH), 8.07 (dd, $J_1=8.0$ Hz, $J_2=2.0$ Hz, 1H, ArH), 8.32 (t, $J=2.0$ Hz, 1H, ArH), 10.43 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 26.73, 29.19, 47.74, 51.60, 64.09, 71.39, 73.17, 109.85, 121.38, 122.07, 122.97, 124.66, 127.59, 128.59, 129.55, 130.34, 133.24, 134.59, 136.00, 141.94, 143.60, 148.13, 179.51, 188.49; HRMS calcd for C₂₅H₂₂N₃O₄S [M+H]⁺: 460.1331, found: 460.1349.

**9 {16,1,2}**

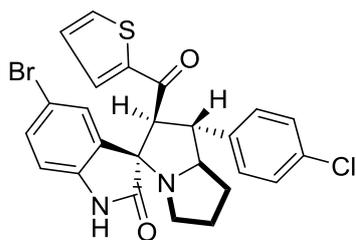
(1'R,2'S,3R,7a'R)-2'-(thiophene-2-carbonyl)-1'-(p-tolyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 4, entry 67)

White solid, m.p. 202~204 °C; IR (KBr): ν = 3209, 3029, 2978, 1726, 1622, 1536, 1463, 771, 734; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.68~1.75 (m, 2H, CH₂), 1.80~1.89 (m, 2H, CH₂), 2.22 (s, 3H, CH₃), 2.32~2.37 (m, 1H, CH₂), 2.58 (dd, $J_1=15.6$ Hz, $J_2=7.2$ Hz, 1H, CH₂), 3.81 (t, $J=11.2$ Hz, 1H, CH), 3.88~3.93 (m, 1H, CH), 4.66 (d, $J=11.6$ Hz, 1H, CH), 6.63 (d, $J=7.6$ Hz, 1H, ArH), 6.93 (t, $J=7.6$ Hz, 1H, ArH), 7.06 (t, $J=4.8$ Hz, 1H, ArH), 7.09~7.13 (m, 3H, ArH), 7.26 (d, $J=7.6$ Hz, 1H, ArH), 7.30 (d, $J=8.0$ Hz, 2H, ArH), 7.57 (dd, $J_1=4.0$ Hz, $J_2=1.2$ Hz, 1H, ArH), 7.80 (dd, $J_1=5.2$ Hz, $J_2=1.2$ Hz, 1H, ArH), 10.39 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 20.31, 26.44, 29.22, 47.29, 51.78, 63.59, 71.08, 72.72, 109.39, 120.90, 124.49, 127.24, 128.22, 128.96, 132.39, 135.42, 135.66, 136.33, 141.53, 143.70, 179.33, 188.27; HRMS calcd for C₂₆H₂₅N₂O₂S [M+H]⁺: 429.1636, found: 429.1649.

**9 {17,1,2}**

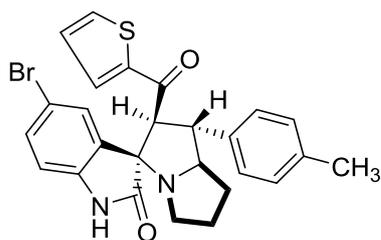
(1'R,2'S,3R,7a'R)-1'-(4-methoxyphenyl)-2'-(thiophene-2-carbonyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 4, entry 68)

Colorless; m.p. 138~140 °C; IR (KBr): ν = 3207, 3032, 2964, 1729, 1623, 1550, 1491, 813, 757; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.68~1.73 (m, 2H, CH₂), 1.83~1.88 (m, 2H, CH₂), 2.34~2.38 (m, 1H, CH₂), 2.58 (dd, $J_1=16.0$ Hz, $J_2=7.6$ Hz, 1H, CH₂), 3.69 (s, 3H, OCH₃), 3.80 (t, $J=11.2$ Hz, 1H, CH), 3.87~3.93 (m, 1H, CH), 4.37 (t, $J=4.8$ Hz, 1H, CH), 6.62 (d, $J=7.6$ Hz, 1H, ArH), 6.87 (d, $J=8.8$ Hz, 2H, ArH), 6.93 (t, $J=7.6$ Hz, 1H, ArH), 7.06~7.13 (m, 2H, ArH), 7.27 (d, $J=7.6$ Hz, 1H, ArH), 7.34 (d, $J=8.8$ Hz, 2H, ArH), 7.57 (dd, $J_1=4.0$ Hz, $J_2=0.8$ Hz, 1H, ArH), 7.81 (dd, $J_1=4.8$ Hz, $J_2=0.8$ Hz, 1H, ArH), 10.38 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 18.25, 26.41, 29.19, 47.25, 51.25, 54.67, 55.76, 63.69, 71.01, 72.67, 109.34, 113.79, 120.85, 124.50, 127.23, 128.34, 128.93, 131.17, 132.37, 135.39, 141.51, 143.71, 157.85, 179.27, 188.27; HRMS calcd for C₂₆H₂₅N₂O₃S [M+H]⁺: 445.1586, found: 445.1597.

**9 {13,2,2}**

(1'R,2'S,3R,7a'R)-5-bromo-1'-(4-chlorophenyl)-2'-(thiophene-2-carbonyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 4, entry 69)

Colorless; m.p. 212~214 °C; IR (KBr): ν : 3209, 3031, 2985, 1746, 1647, 1543, 1476, 782, 746; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.80~1.91 (m, 2H, CH₂), 1.92~2.01 (m, 2H, CH₂), 2.63~2.71 (m, 2H, CH₂), 3.98~4.02 (m, 2H, CH), 4.82 (d, J =8.4 Hz, 1H, CH), 6.73 (d, J =8.0 Hz, 1H, ArH), 7.19~7.22 (m, 1H, ArH), 7.43 (d, J =8.4 Hz, 1H, ArH), 7.48 (d, J =8.4 Hz, 2H, ArH), 7.54 (s, 1H, ArH), 7.61 (d, J =8.4 Hz, 2H, ArH), 7.69~7.74 (m, 1H, ArH), 7.97~7.99 (m, 1H, ArH), 10.70 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 18.28, 26.59, 28.83, 47.27, 50.94, 55.80, 63.49, 71.06, 72.67, 111.37, 112.93, 126.83, 128.32, 129.33, 129.62, 131.27, 131.96, 132.85, 135.94, 138.15, 140.93, 143.33, 178.69, 188.06; HRMS calcd for C₂₅H₂₁BrClN₂O₂S [M+H]⁺: 527.0195, found: 527.0223.

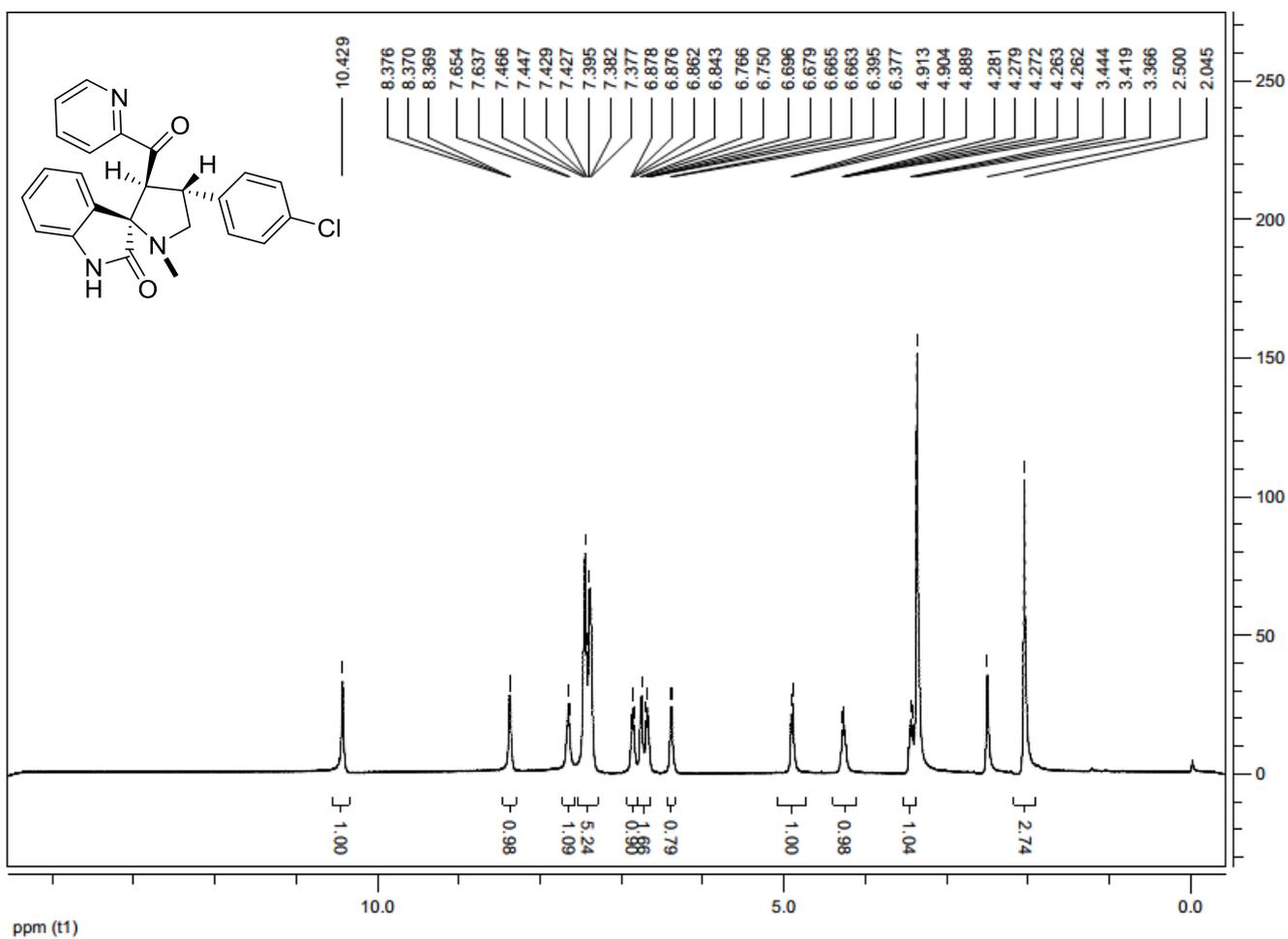
**9 {16,2,2}**

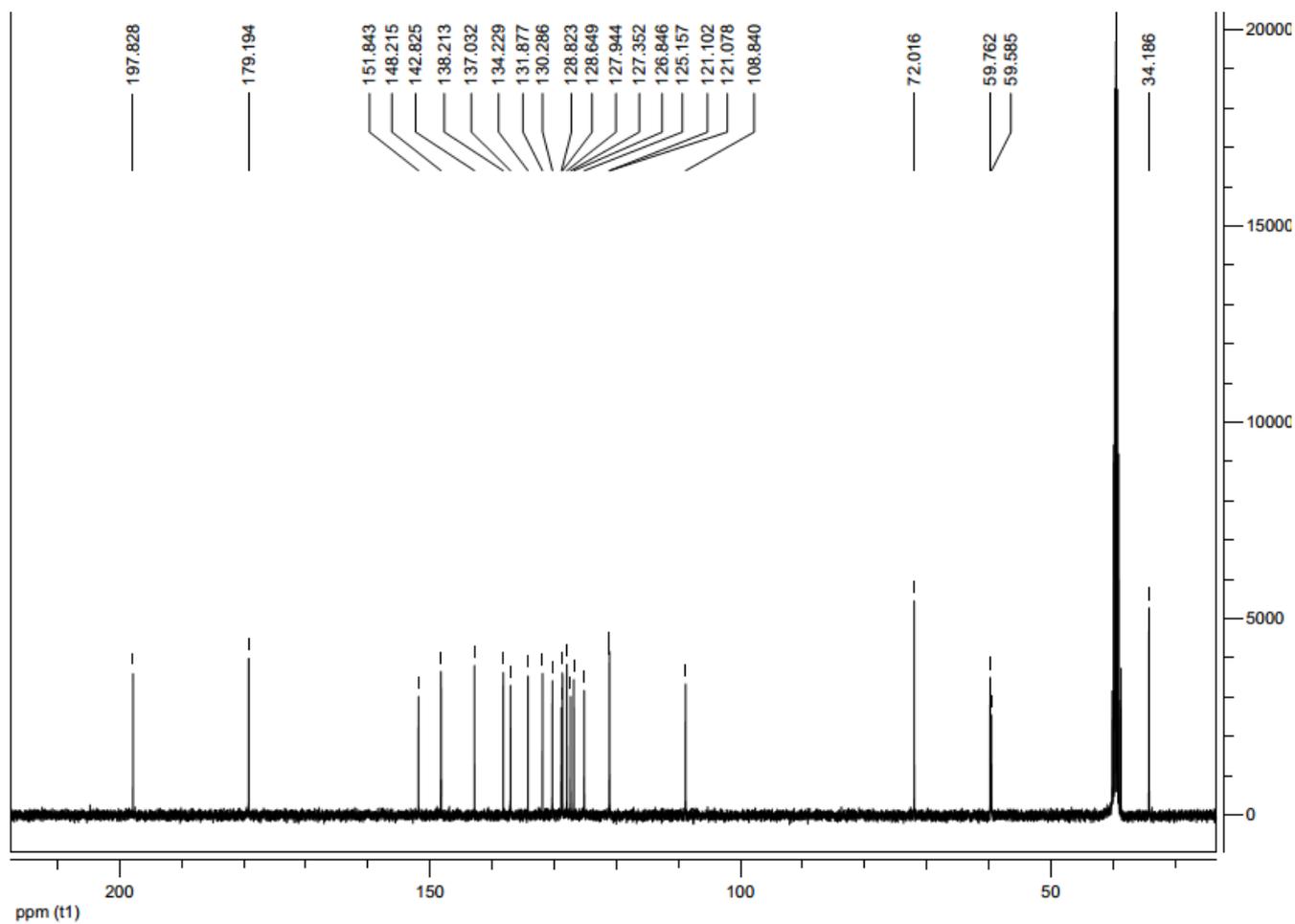
(1'R,2'S,3R,7a'R)-5-bromo-2'-(thiophene-2-carbonyl)-1'-(p-tolyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one (Table 4, entry 70)

Colorless; m.p. 147~149 °C; IR (KBr): ν : 3208, 3032, 2979, 1730, 1625, 1547, 1471, 779, 742; ^1H NMR (DMSO- d_6 , 400 MHz) δ : 1.69~1.78 (m, 2H, CH₂), 1.80~1.90 (m, 2H, CH₂), 2.23 (s, 3H, CH₃), 2.35~2.40 (m, 1H, CH₂), 2.56 (dd, J_1 =16.0 Hz, J_2 =8.4 Hz, 1H, CH₂), 3.80 (t, J =10.8 Hz, 1H, CH), 3.86~3.91 (m, 1H, CH), 4.68 (d, J =9.6 Hz, 1H, CH), 6.59 (d, J =8.4 Hz, 1H, ArH), 6.93 (t, J =7.6 Hz, 1H, ArH), 7.06~7.12 (m, 3H, ArH), 7.31 (d, J =7.2 Hz, 2H, ArH), 7.40 (s, 1H, ArH), 7.59 (d, J =4.4 Hz, 1H, ArH), 7.87 (d, J =4.8 Hz, 1H, ArH), 10.54 (s, 1H, NH); ^{13}C NMR (DMSO- d_6 , 100 MHz) δ : 18.26, 20.28, 26.62, 28.98, 47.16, 51.34, 55.74, 63.49, 71.15, 72.63, 112.27, 112.79, 126.91, 127.18, 128.30, 128.90, 129.60, 131.82, 132.61, 35.65, 135.80, 135.98, 140.86, 143.48, 178.73, 188.14; HRMS calcd for C₂₆H₂₄BrN₂O₂S [M+H]⁺: 507.0742, found: 507.0765.

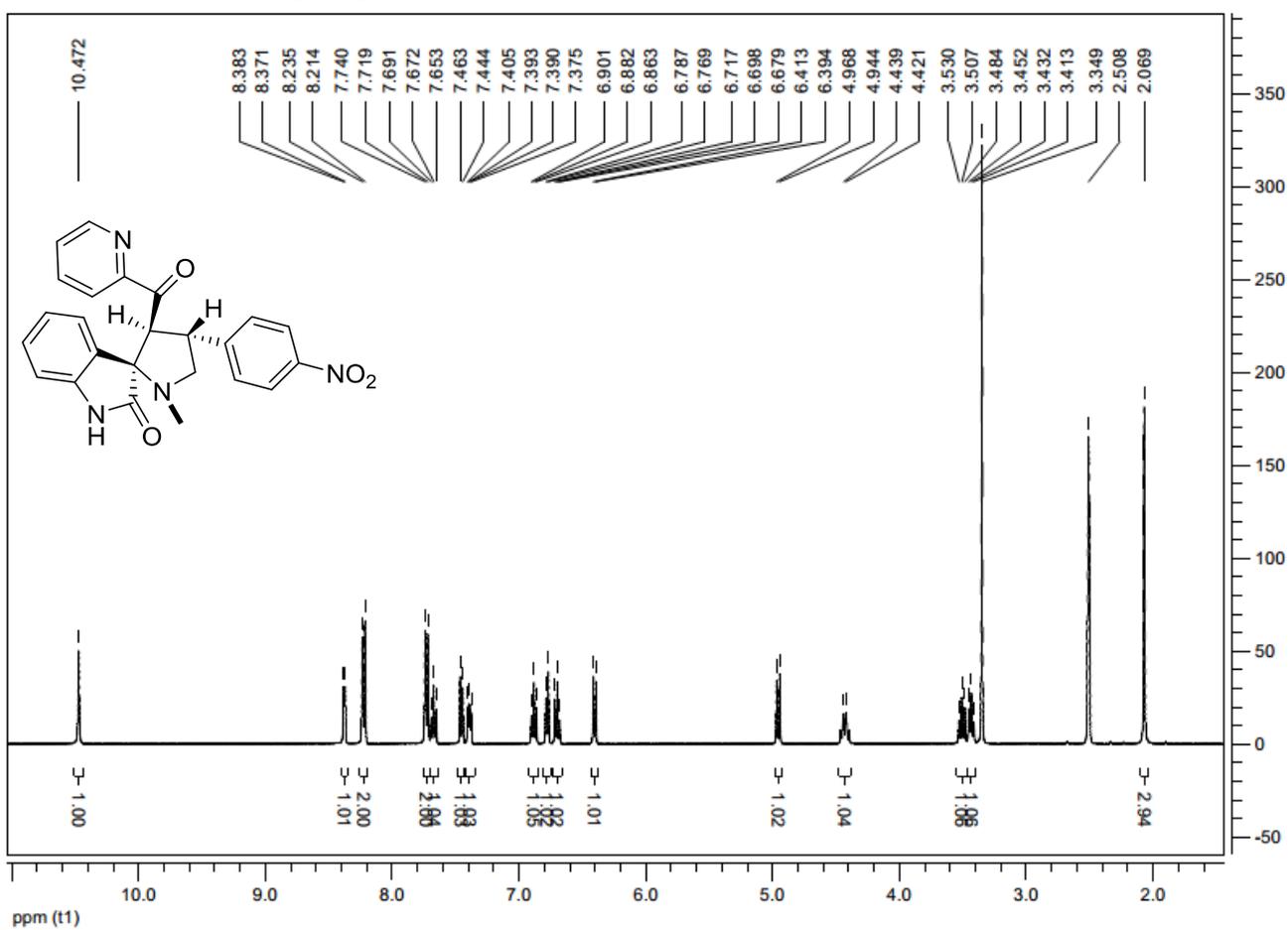
4. ^1H and ^{13}C NMR spectra

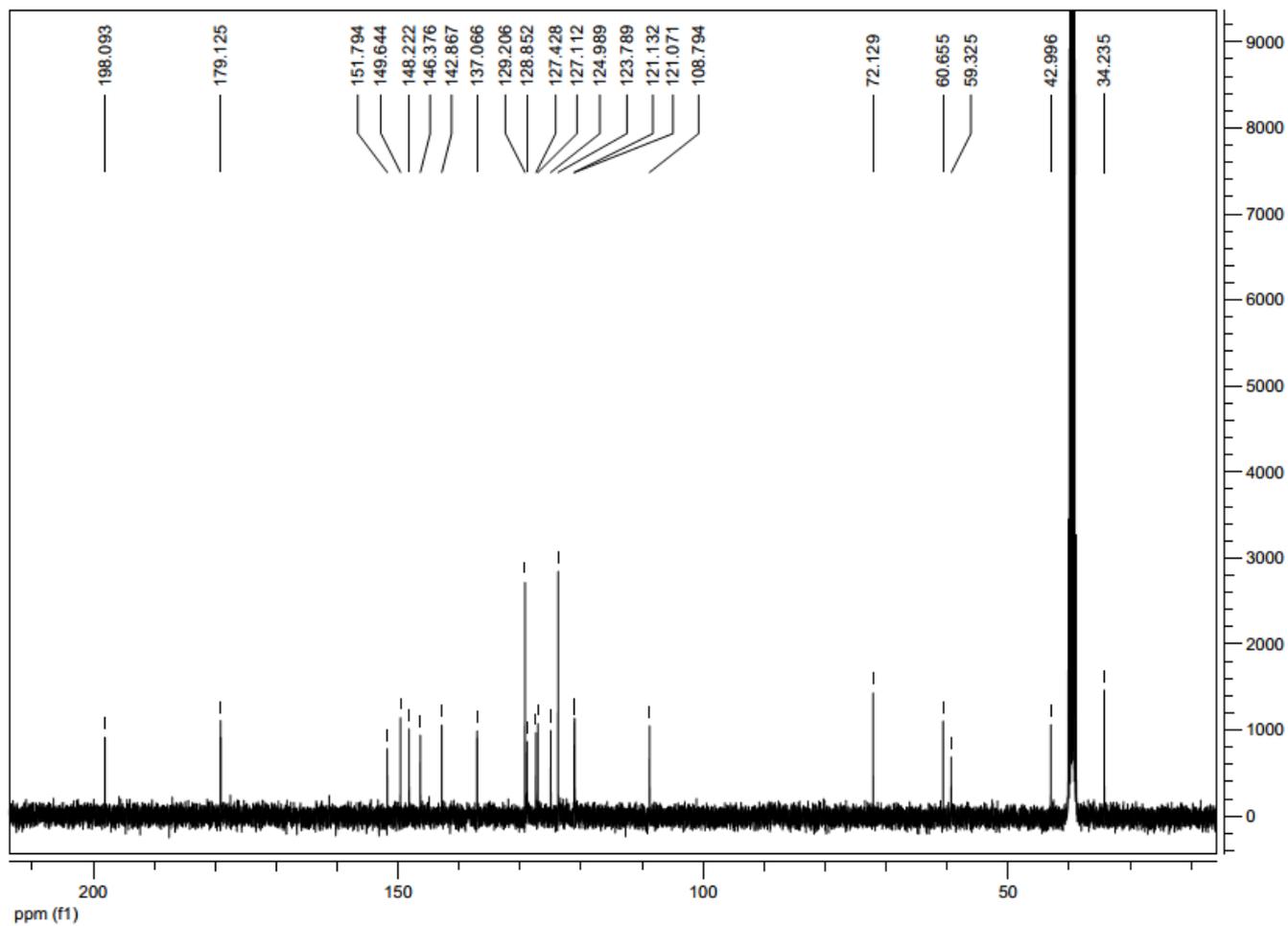
^1H and ^{13}C NMR for 4 {1,1,1}



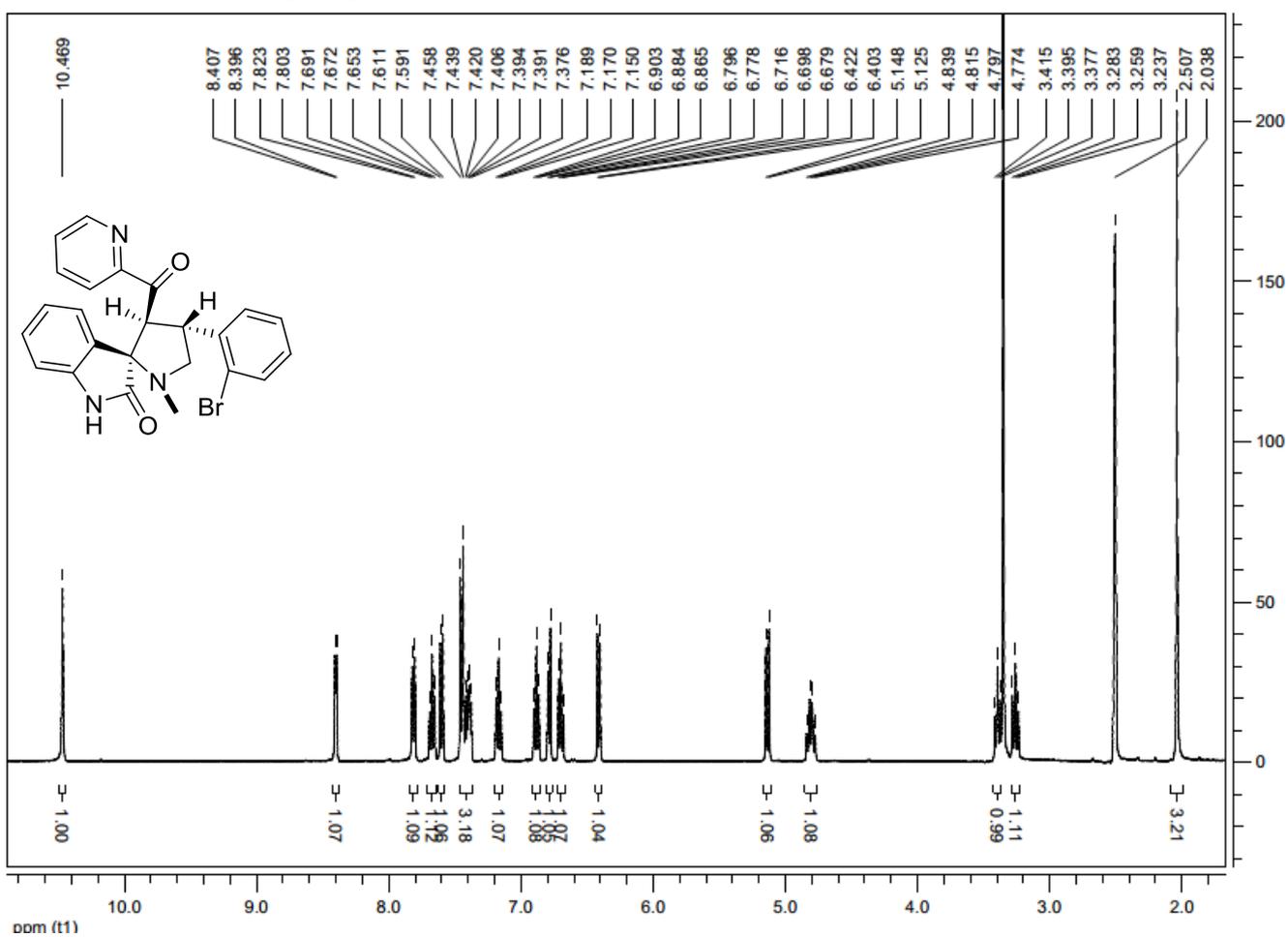


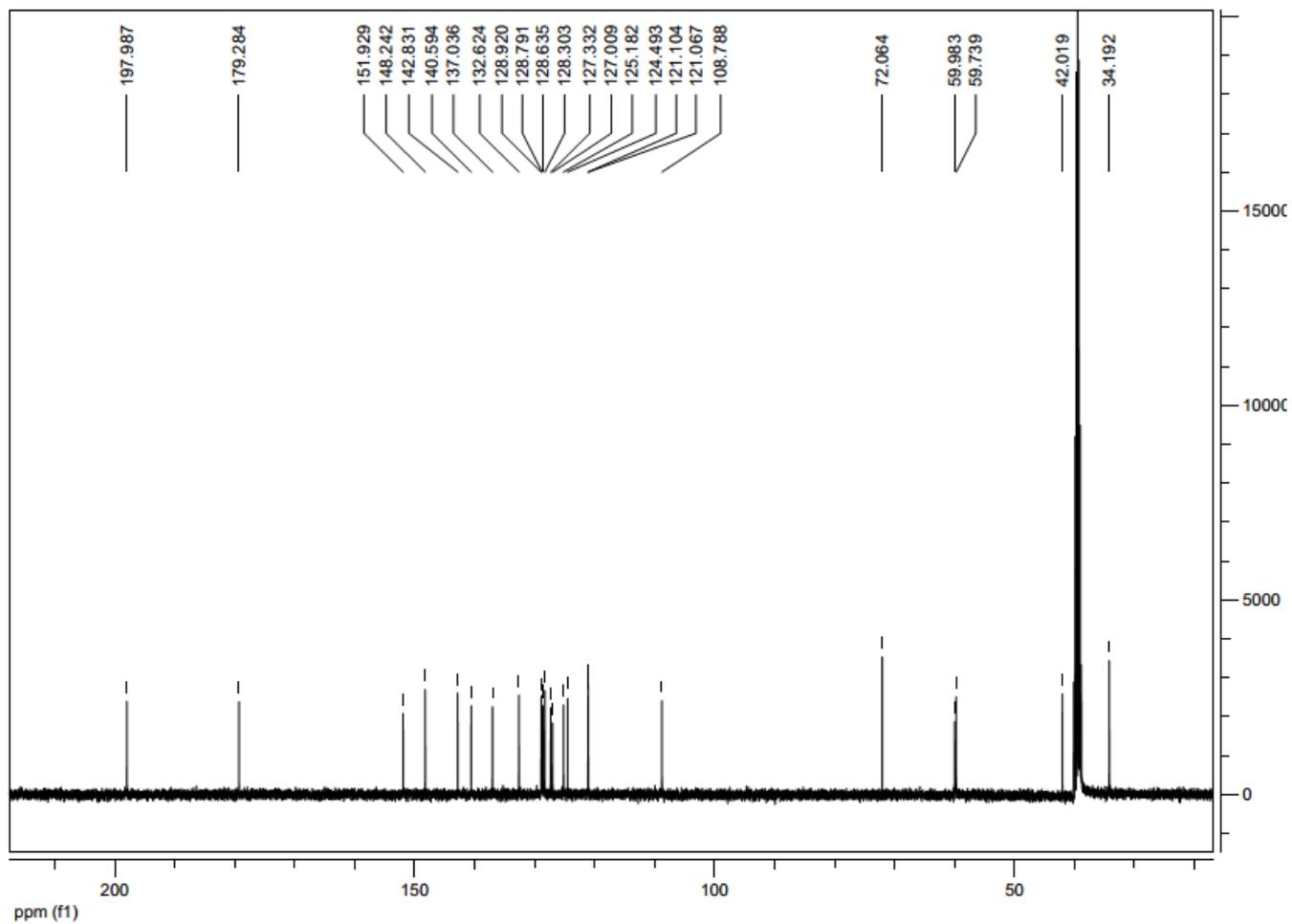
^1H and ^{13}C NMR for 4 {5,1,1}



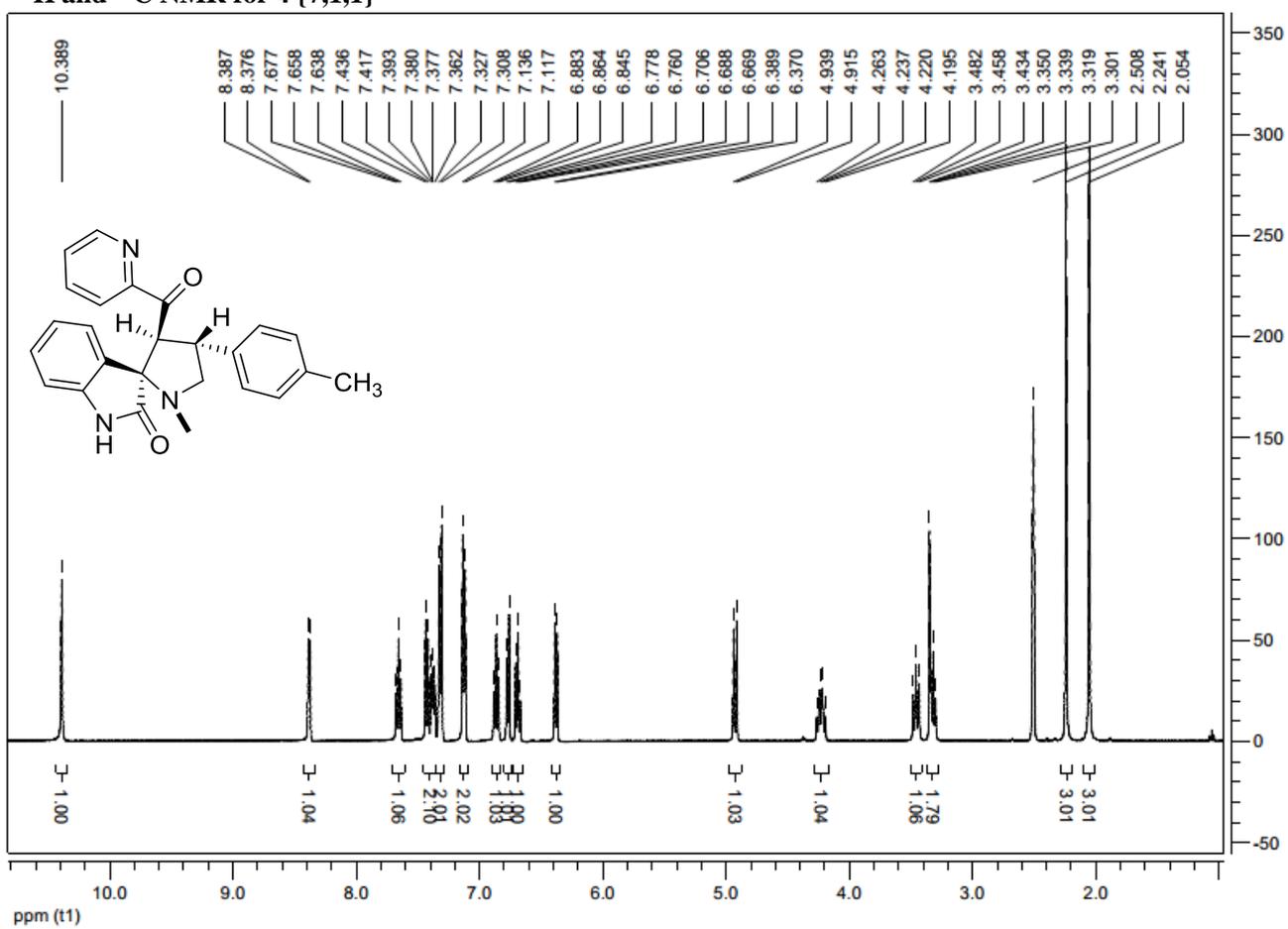


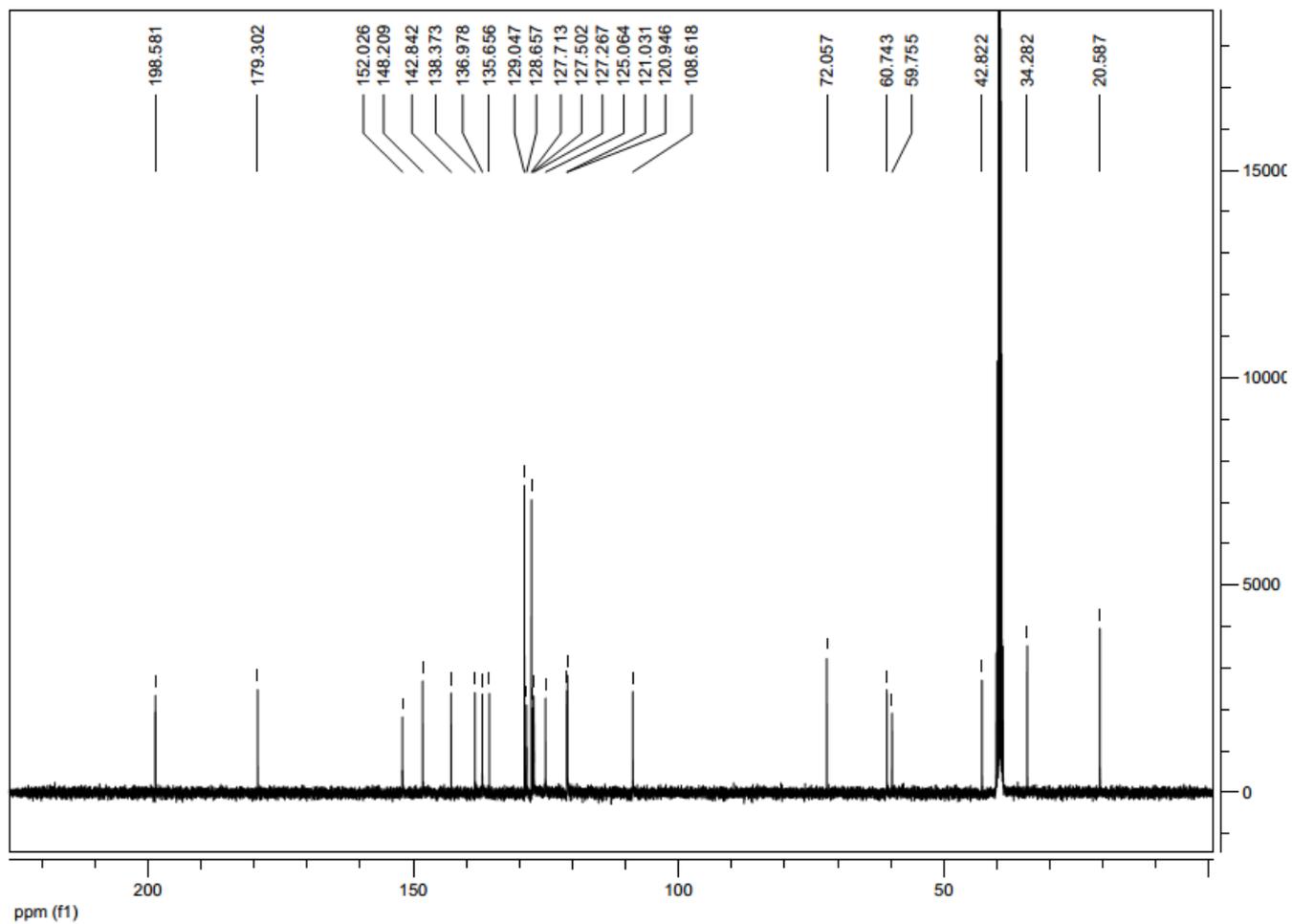
¹H and ¹³C NMR for 4 {6,1,1}



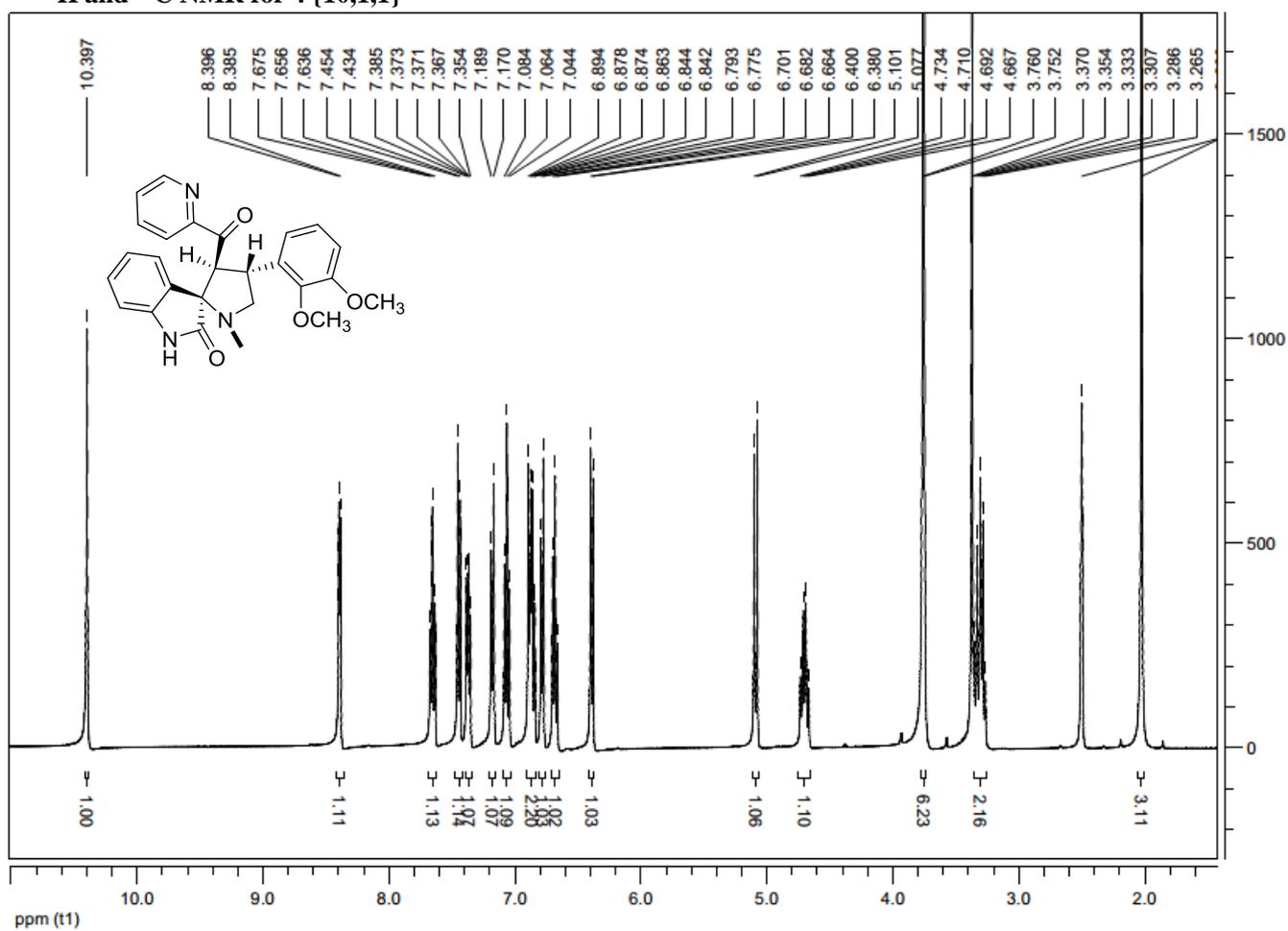


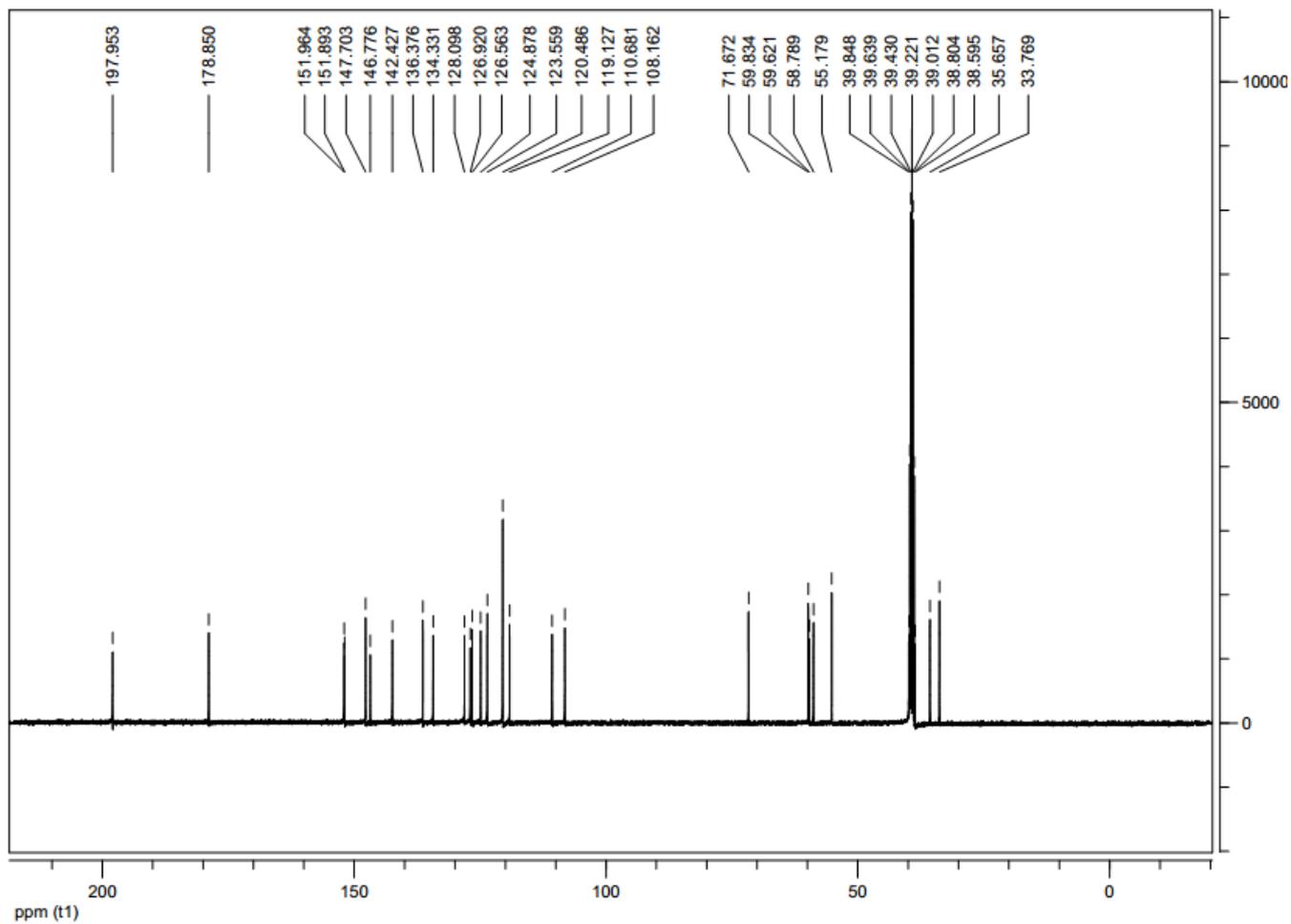
¹H and ¹³C NMR for 4 {7,1,1}



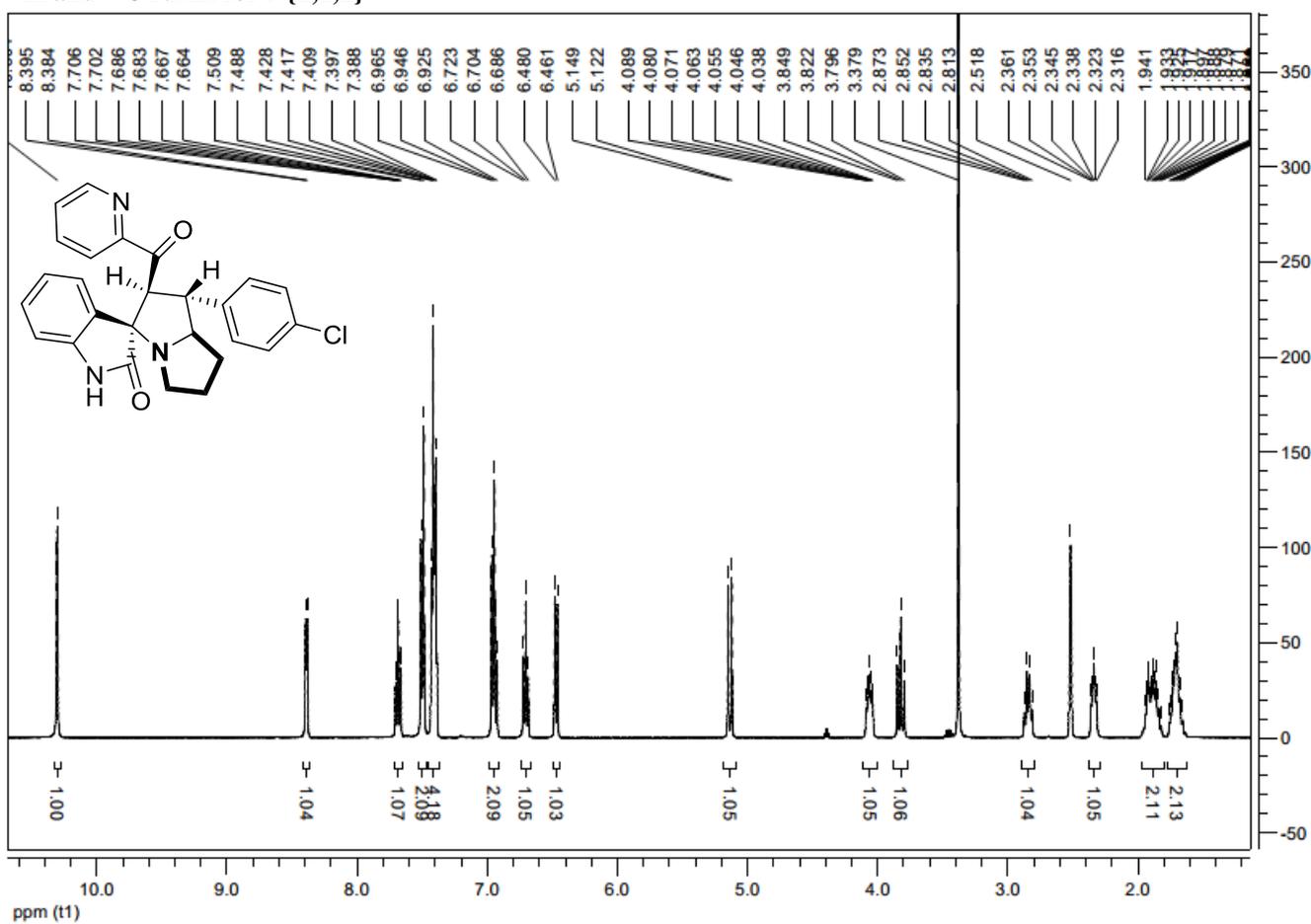


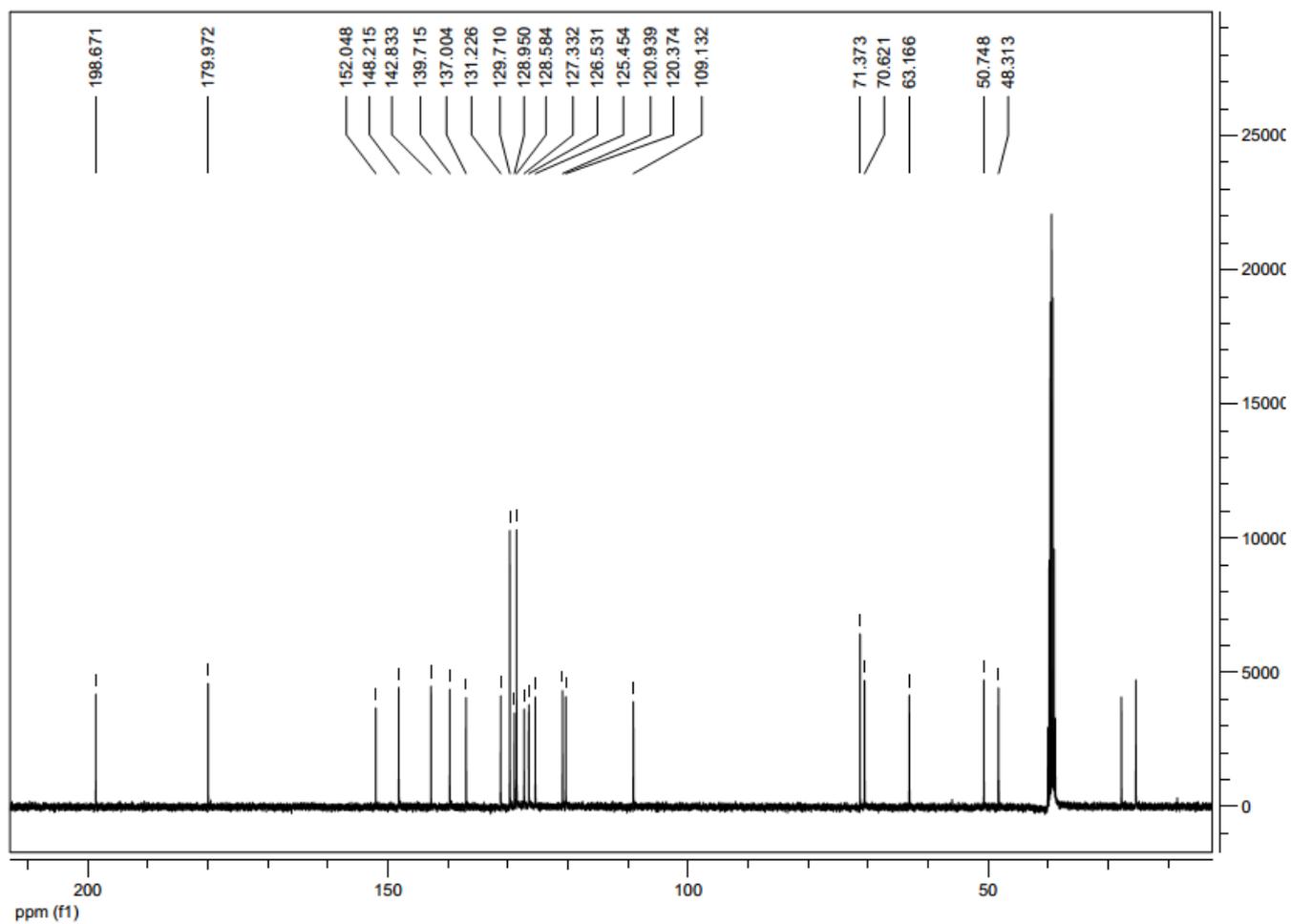
^1H and ^{13}C NMR for 4 {10,1,1}



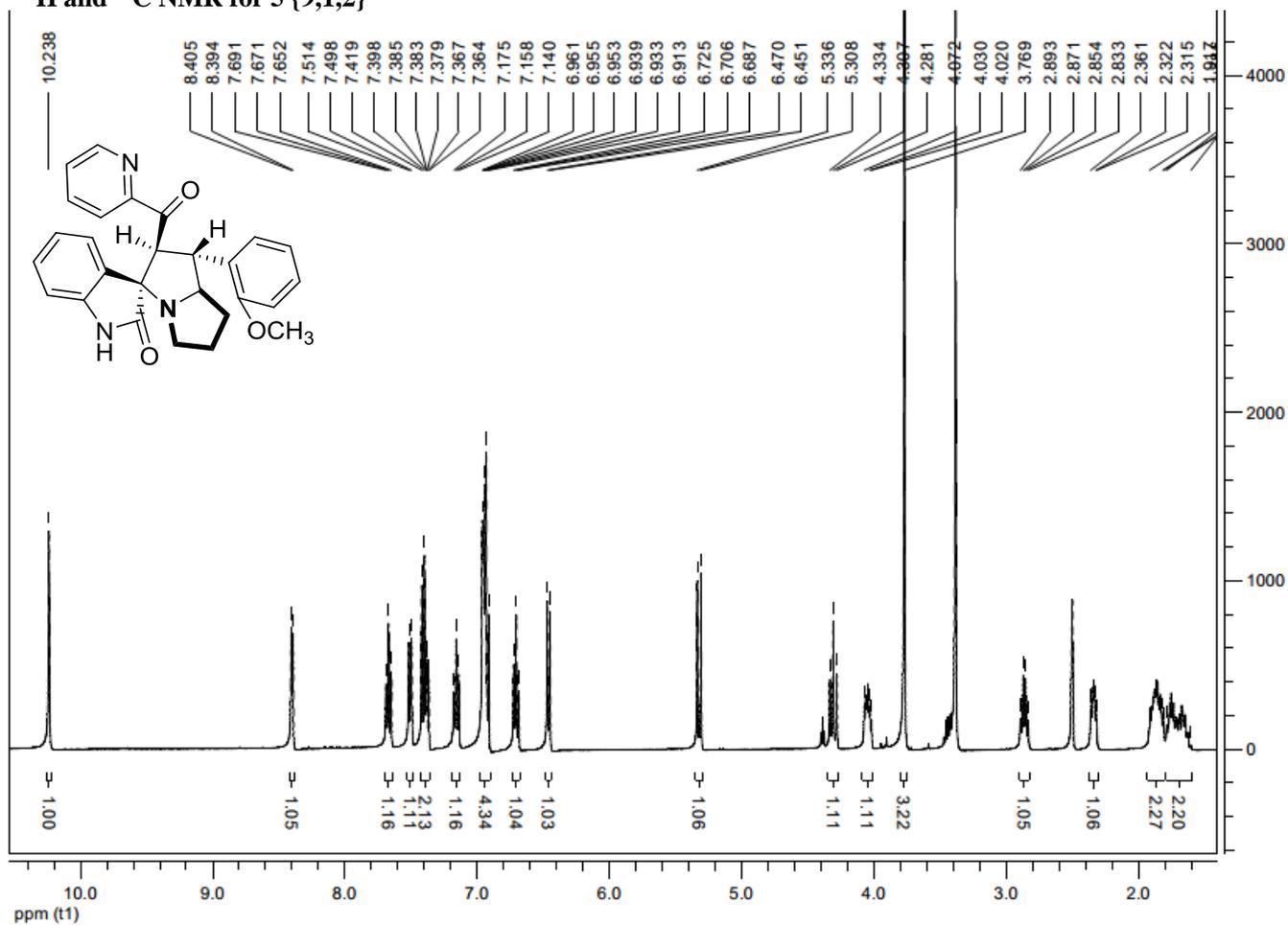


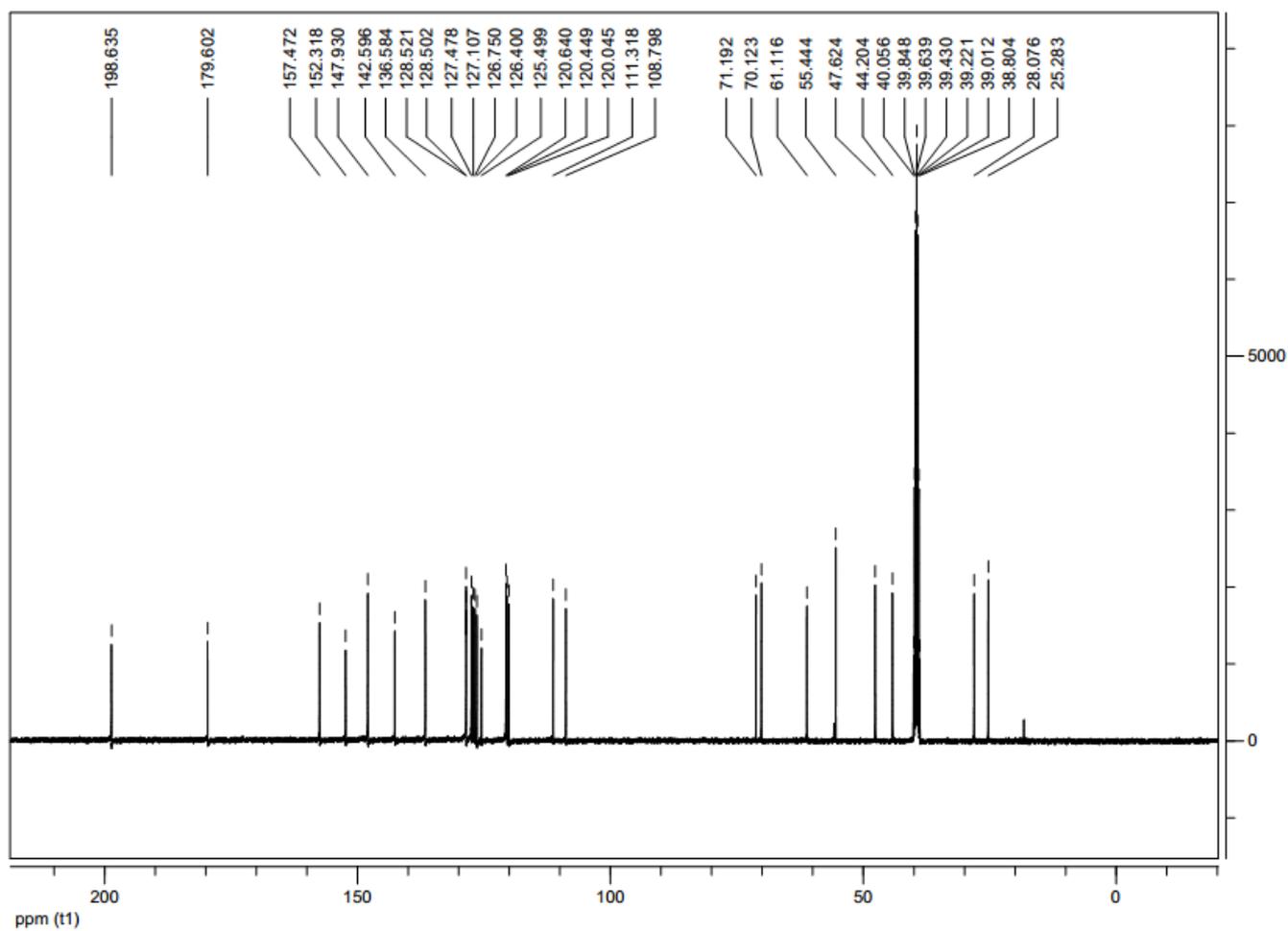
^1H and ^{13}C NMR for 5 {1,1,2}



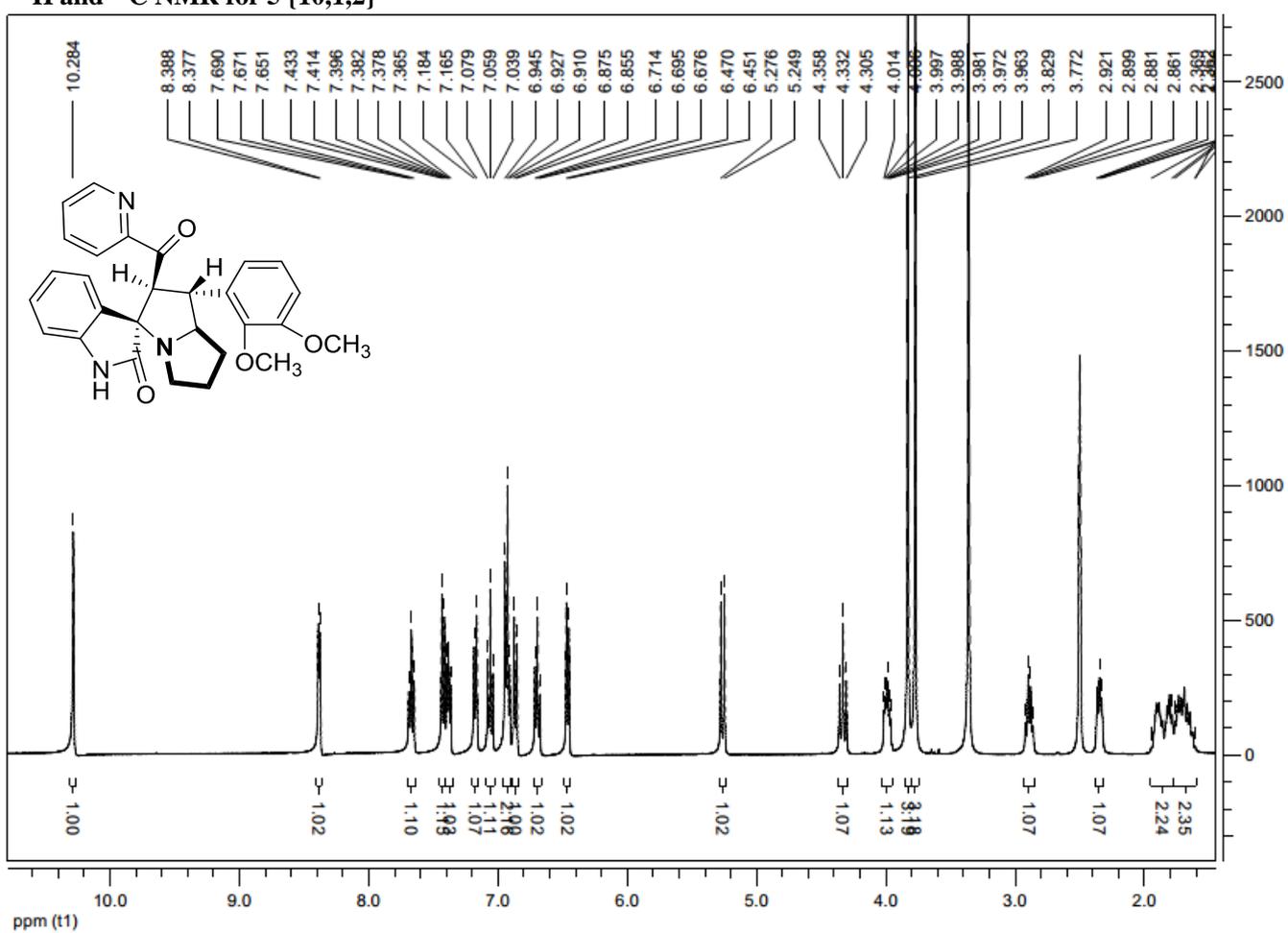


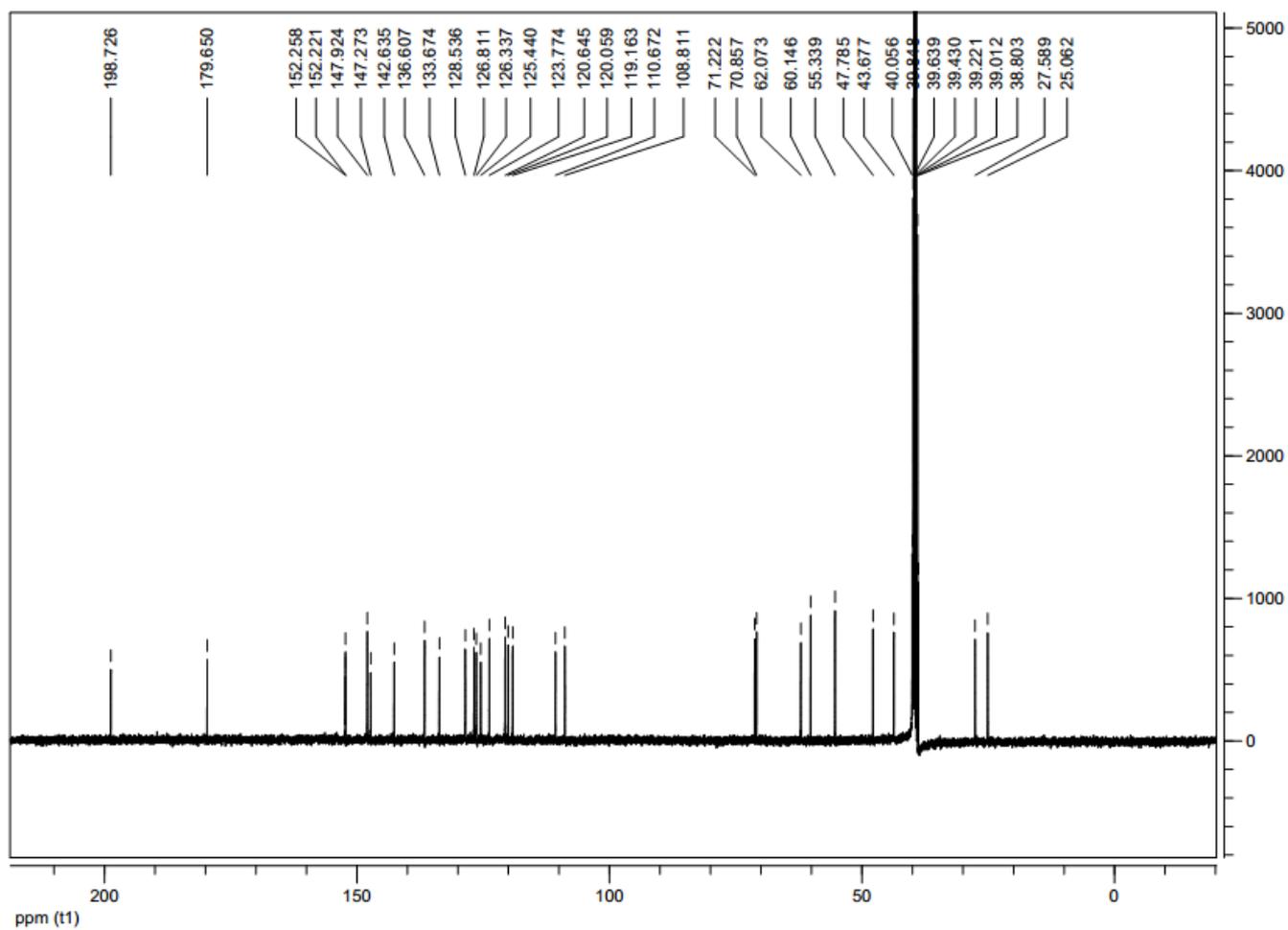
^1H and ^{13}C NMR for 5 {9,1,2}



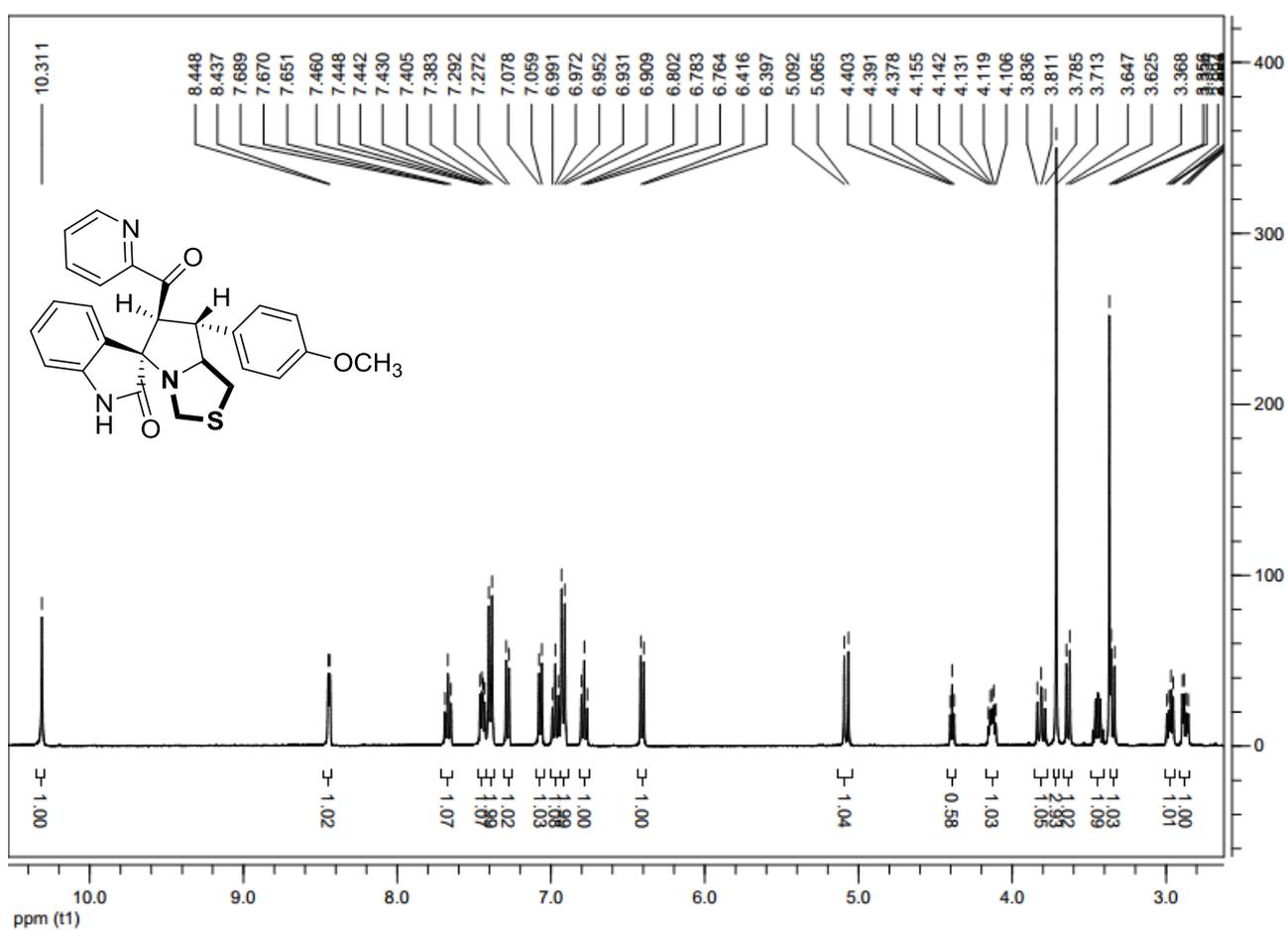


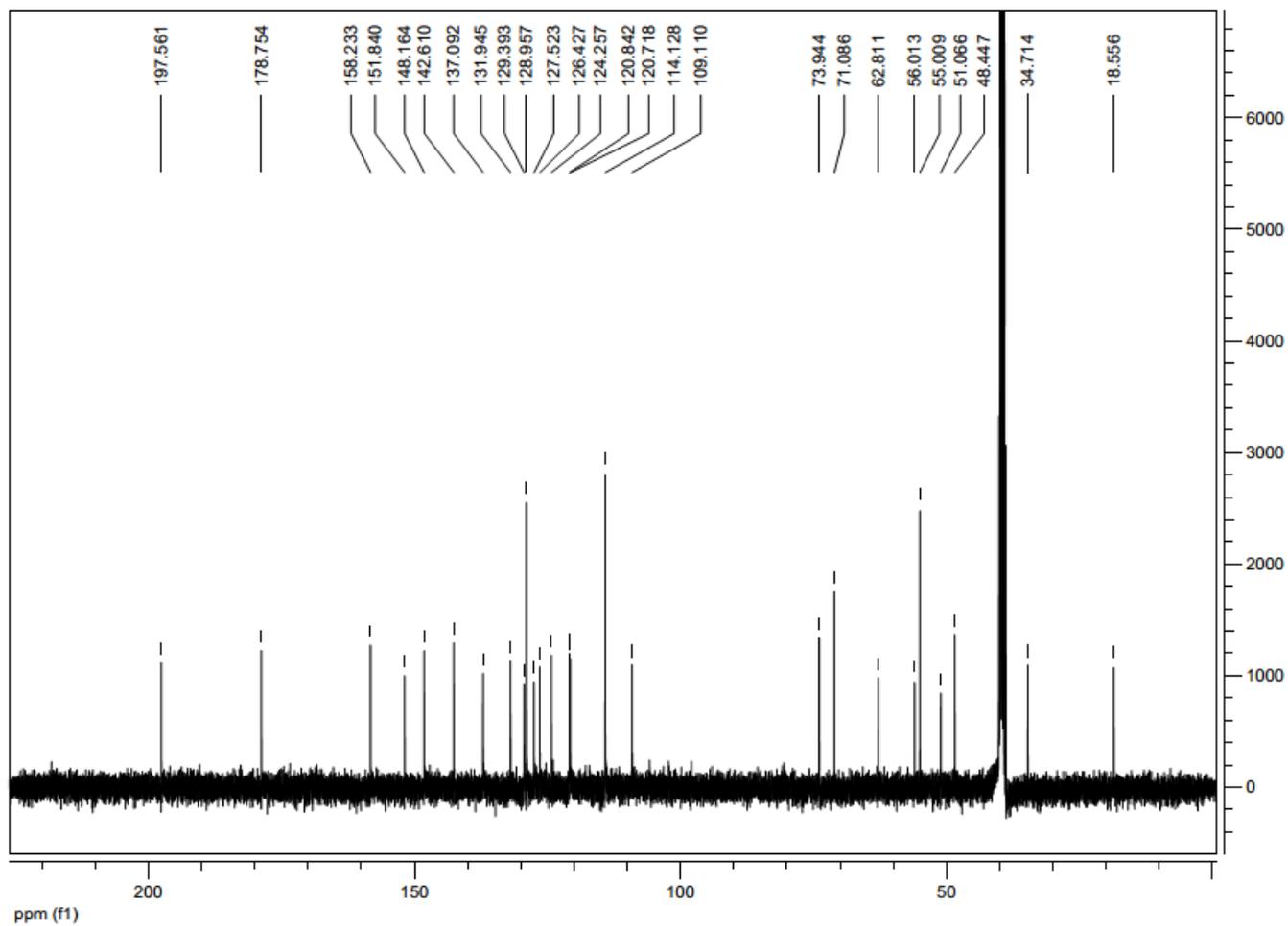
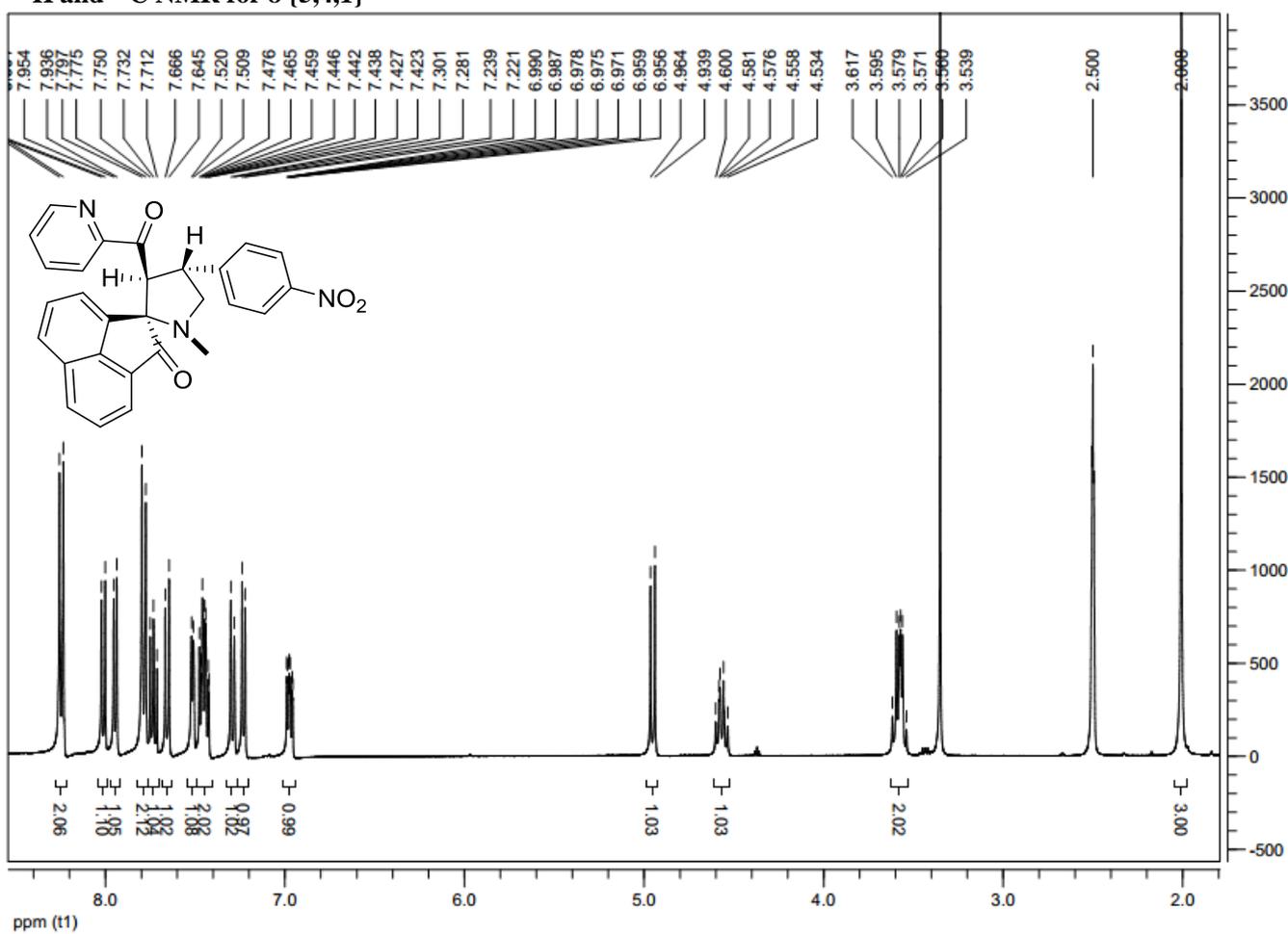
¹H and ¹³C NMR for 5 {10,1,2}

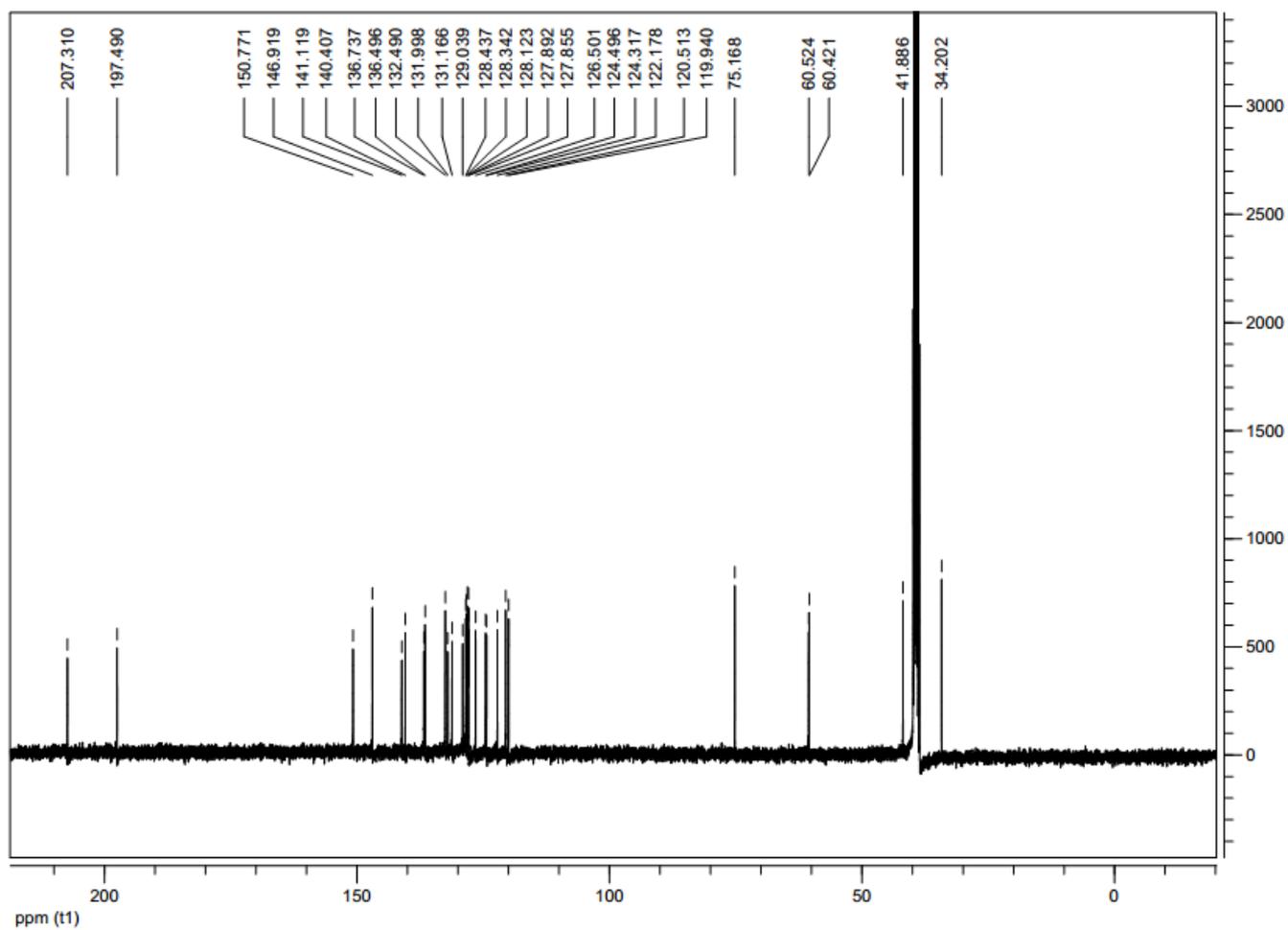




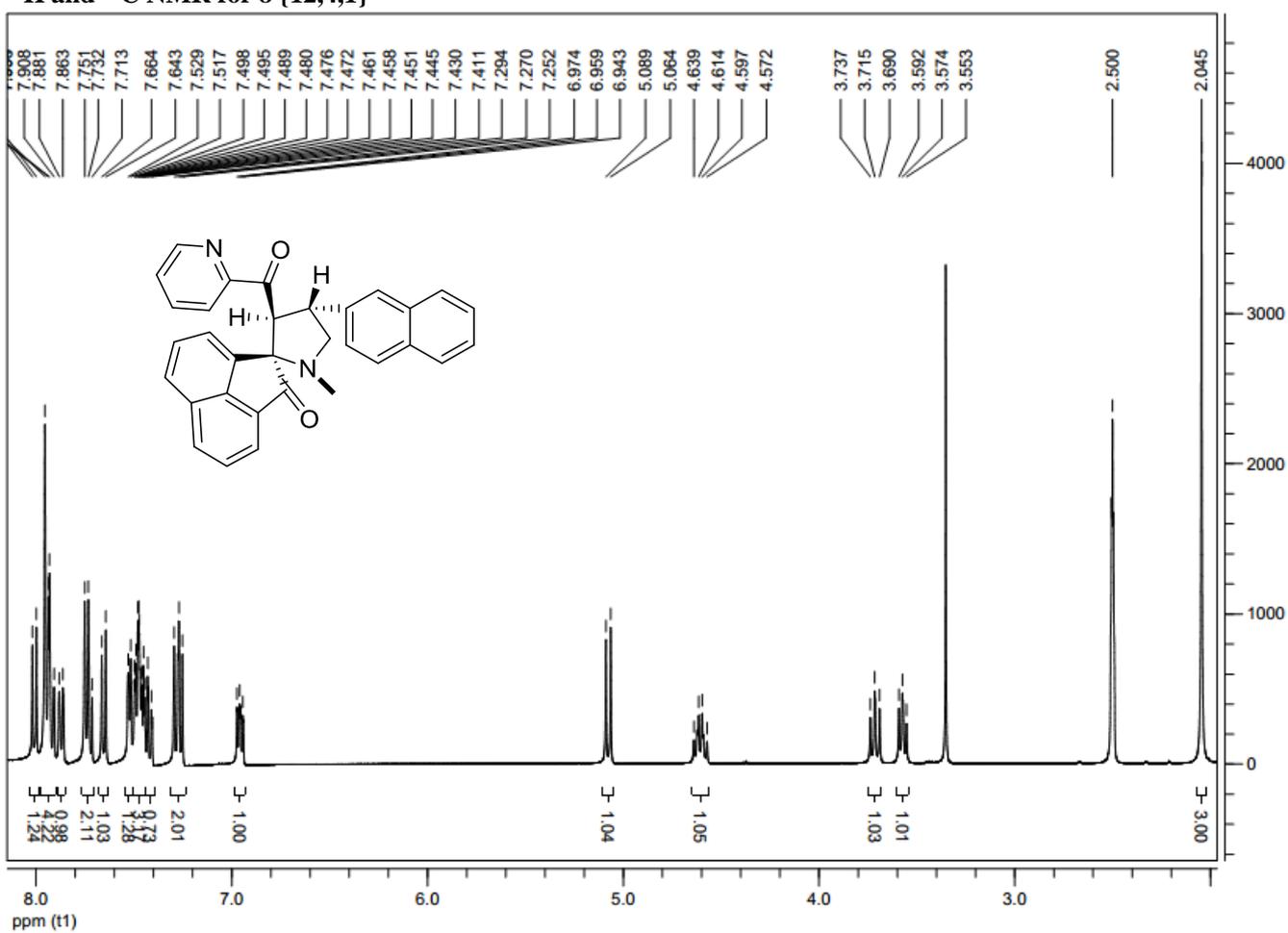
^1H and ^{13}C NMR for 6 {8,1,3}

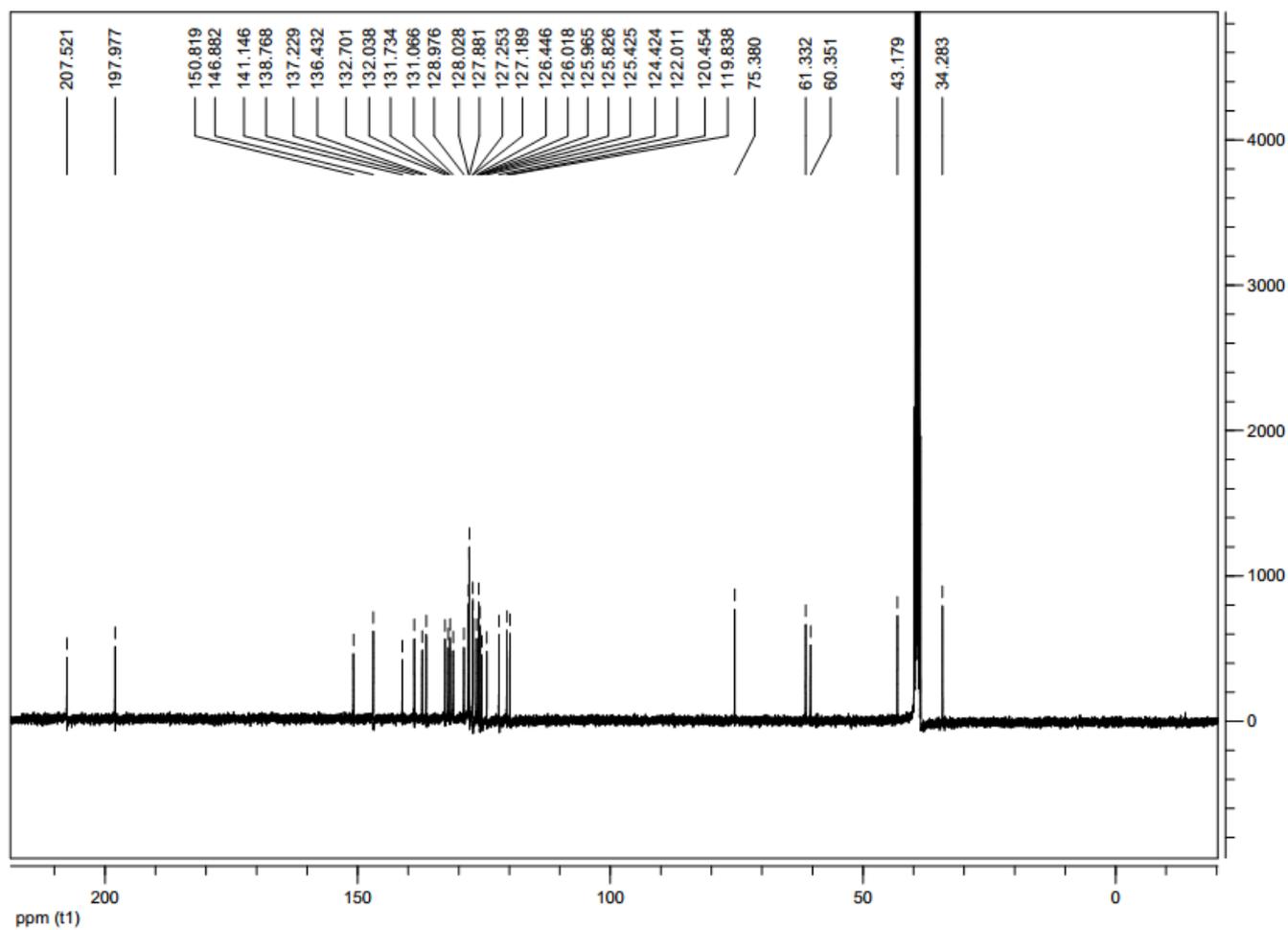
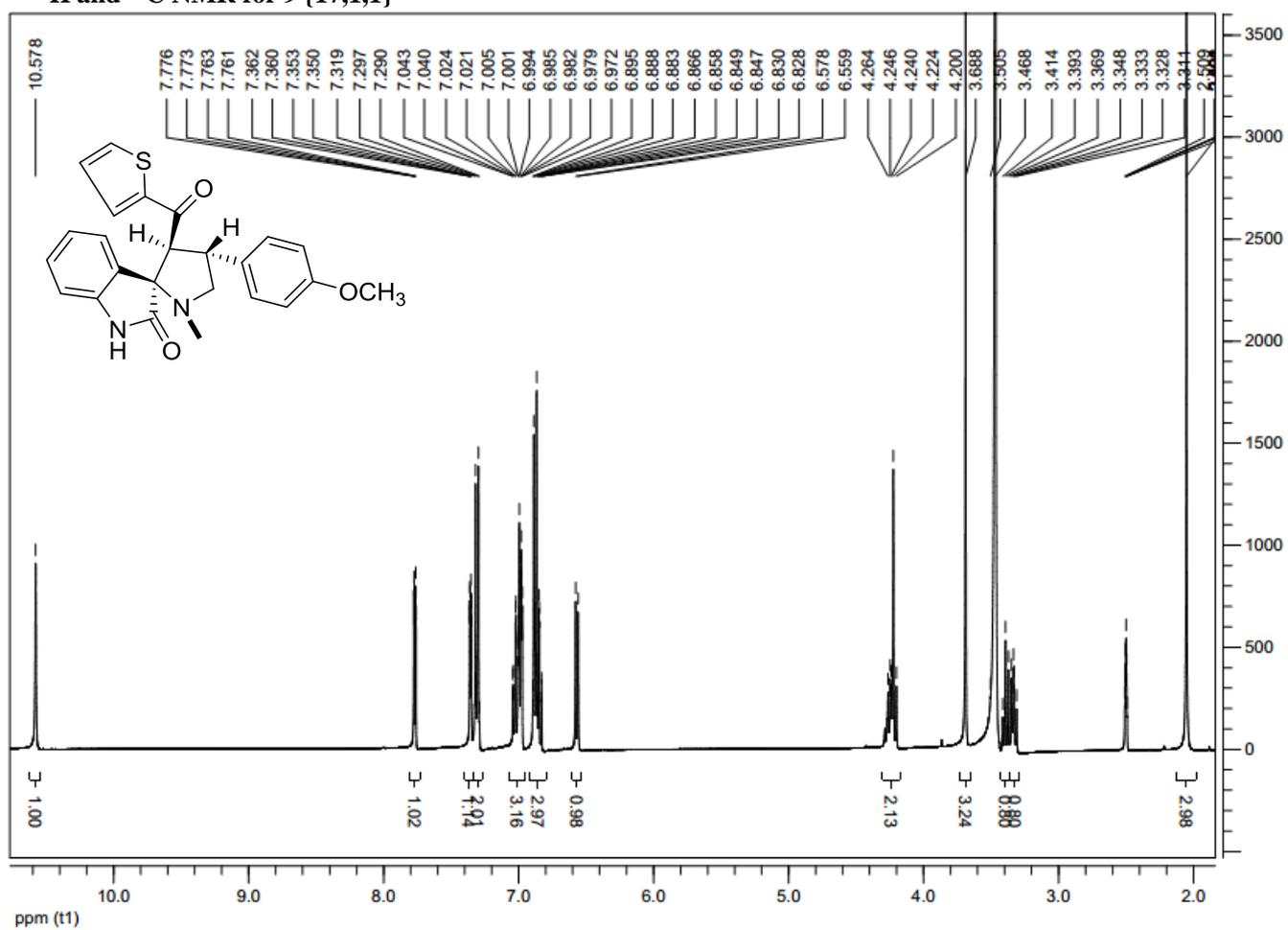


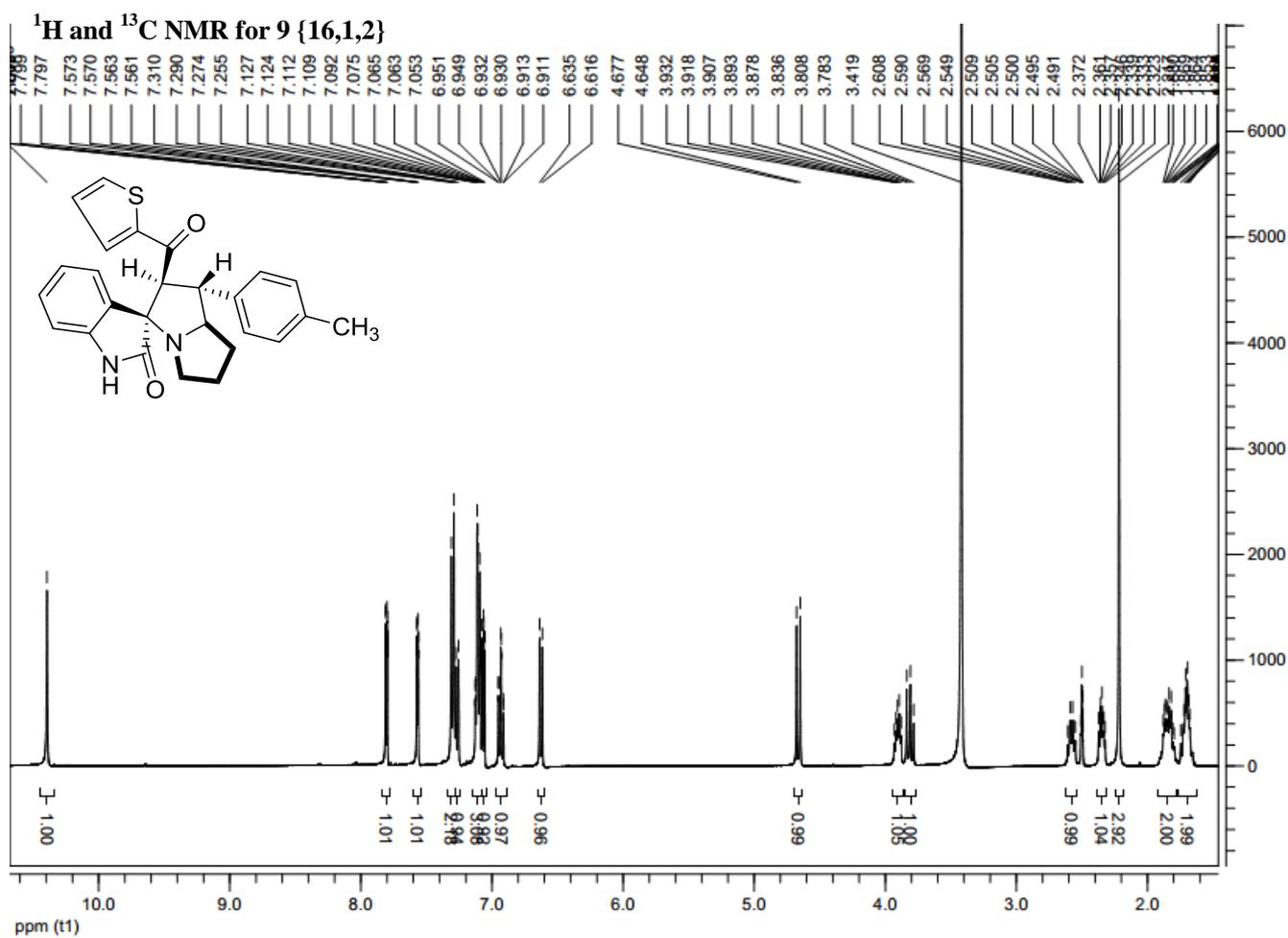
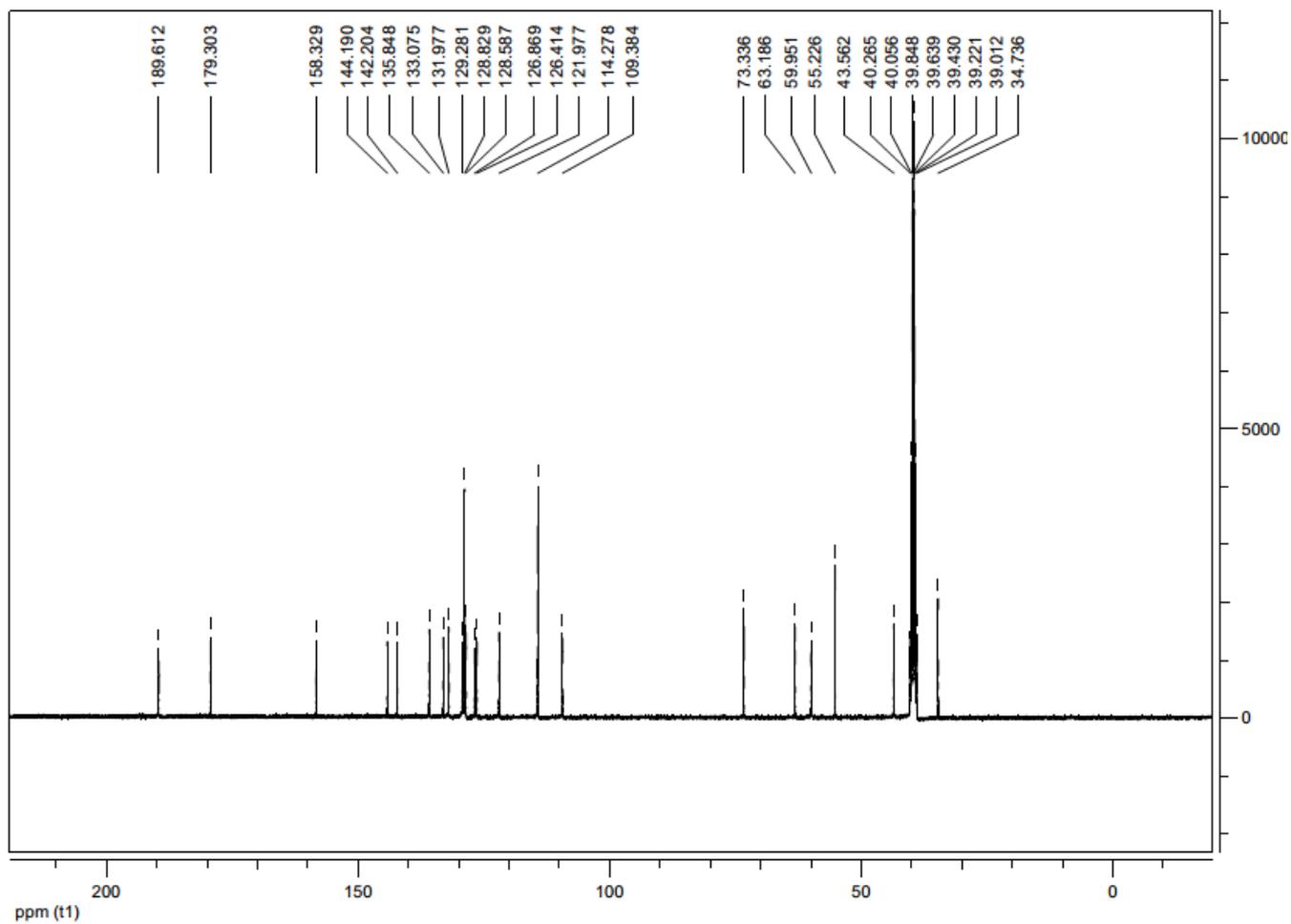
 ^1H and ^{13}C NMR for 8 {5,4,1}

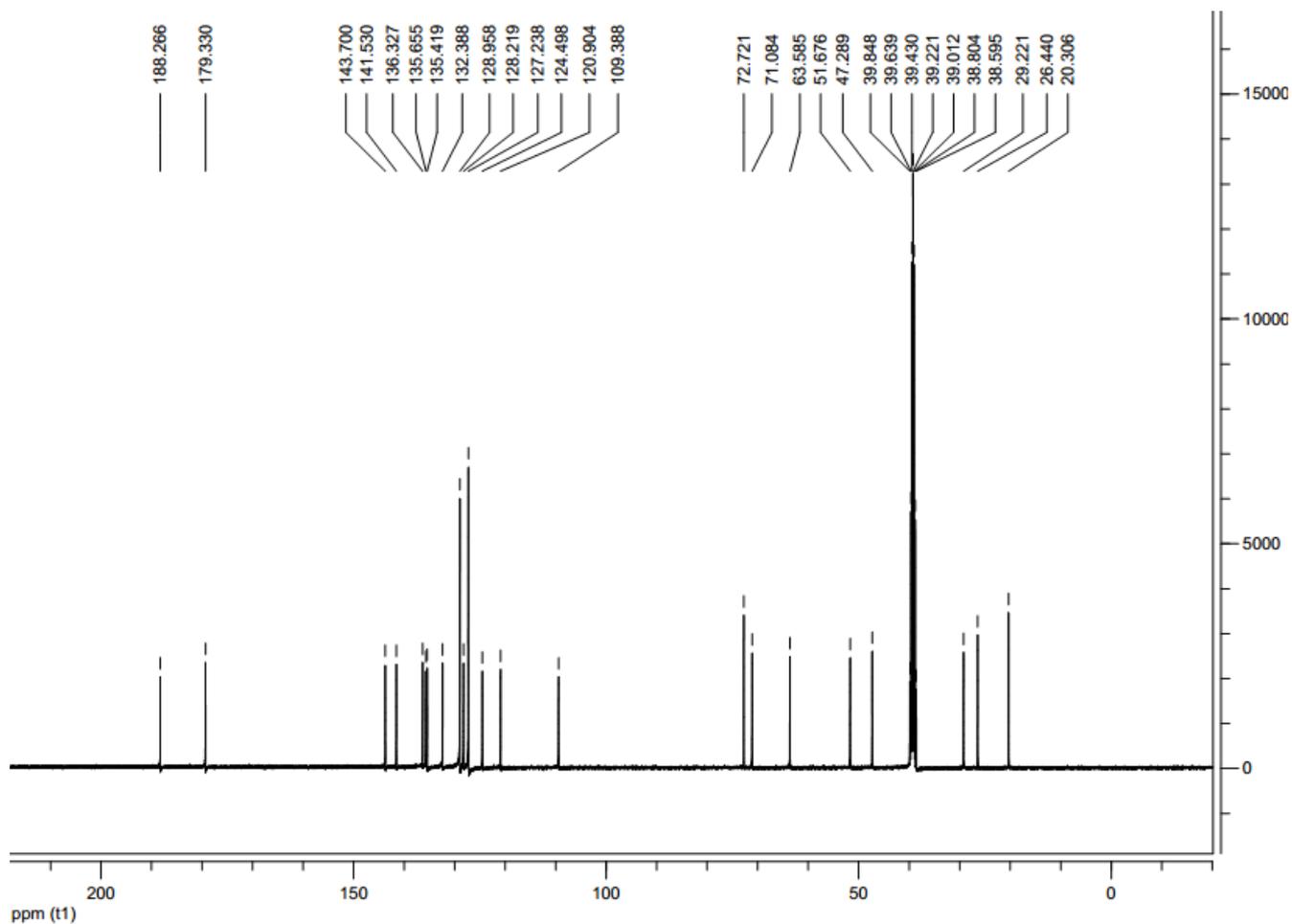


^1H and ^{13}C NMR for 8 {12,4,1}



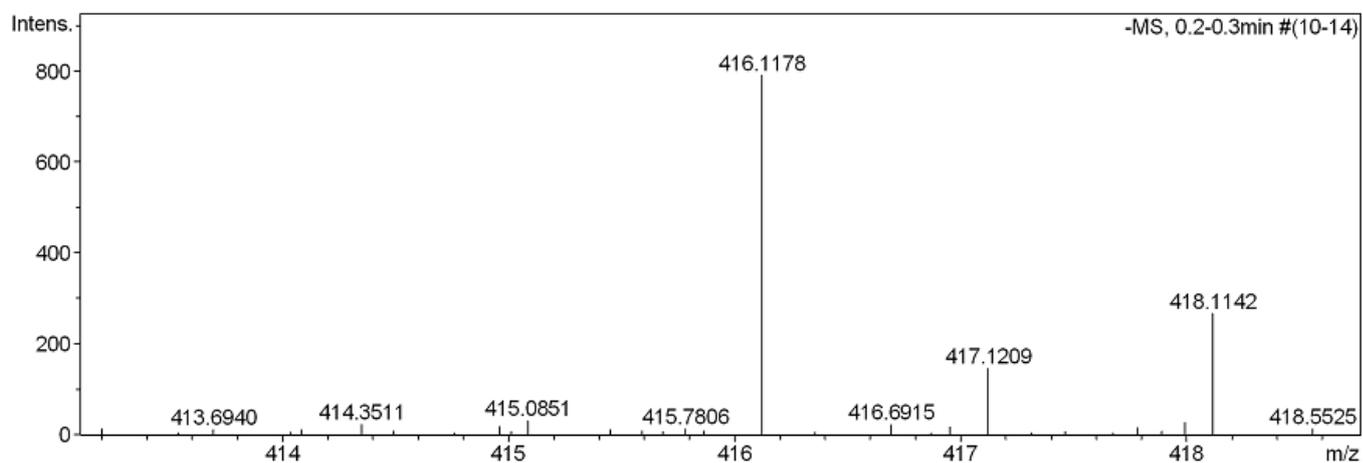
 ^1H and ^{13}C NMR for 9 {17,1,1}

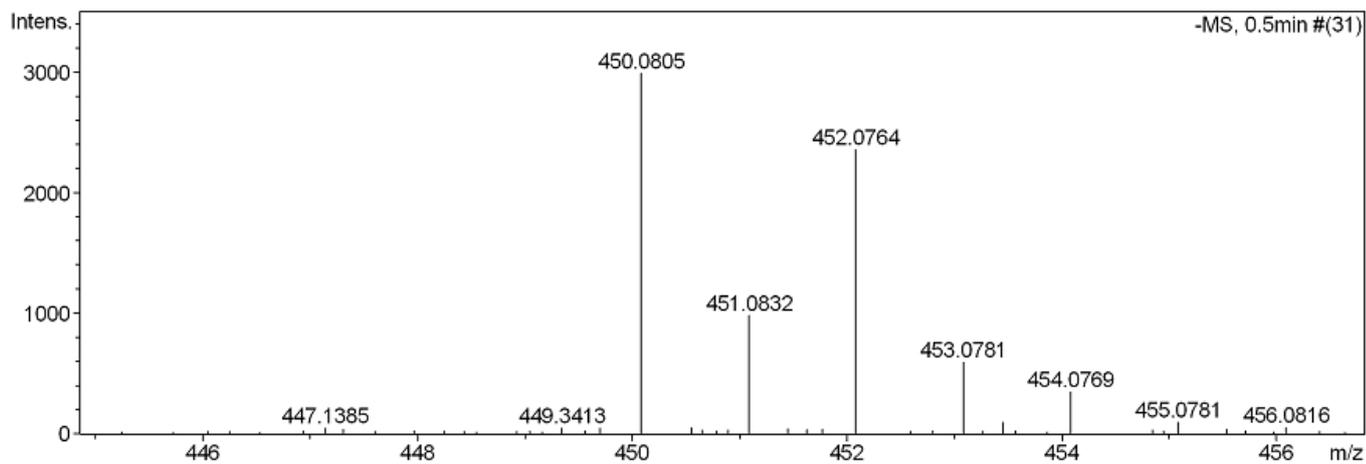
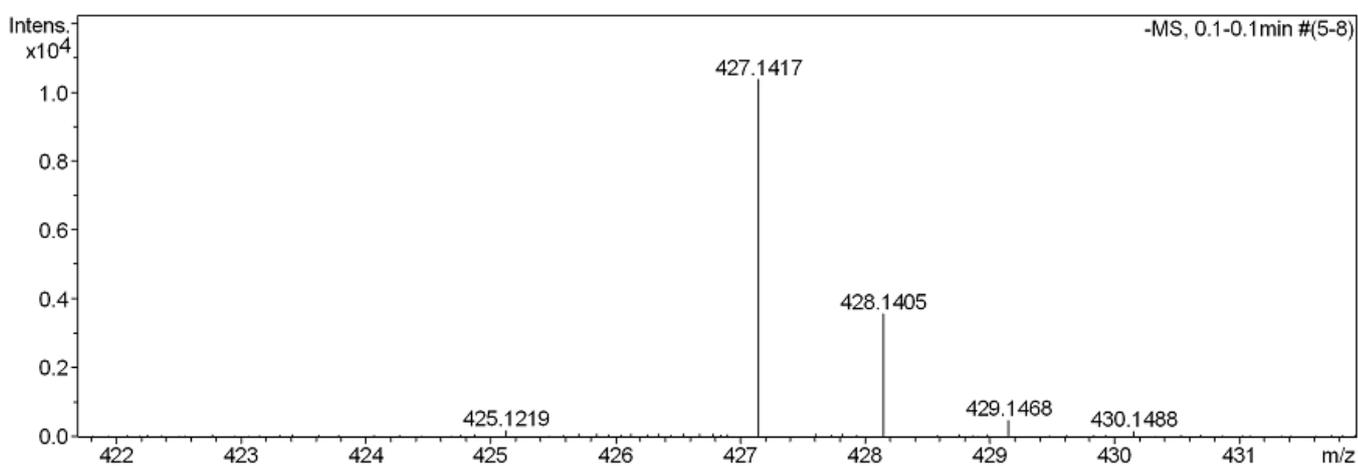


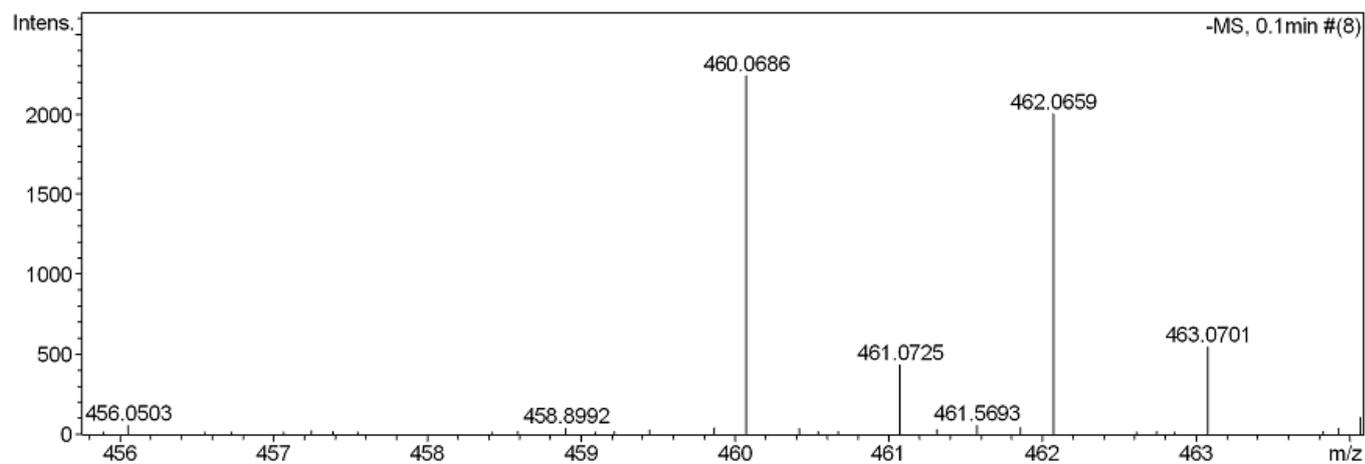
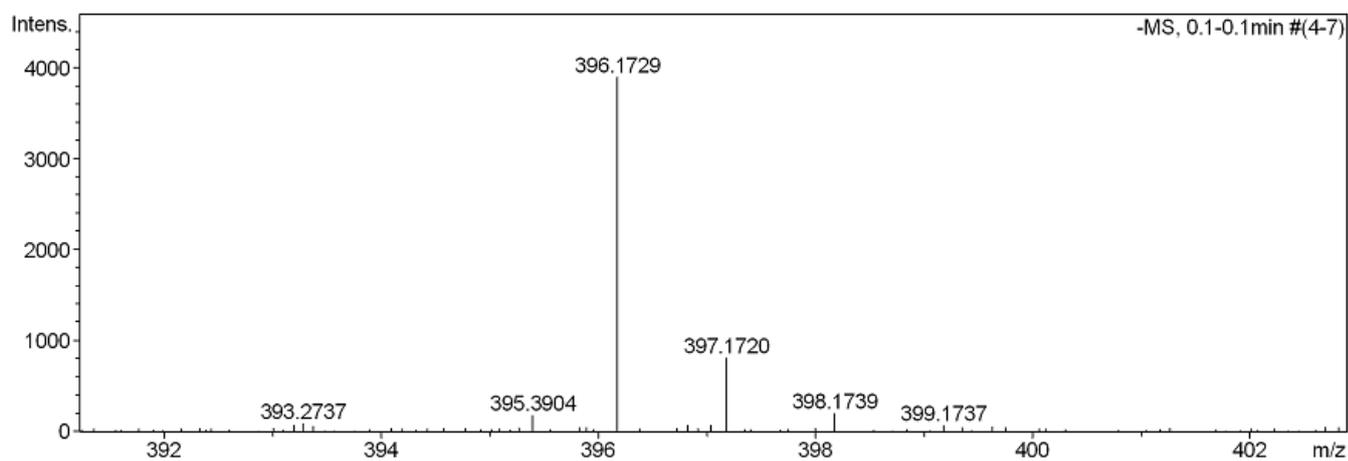
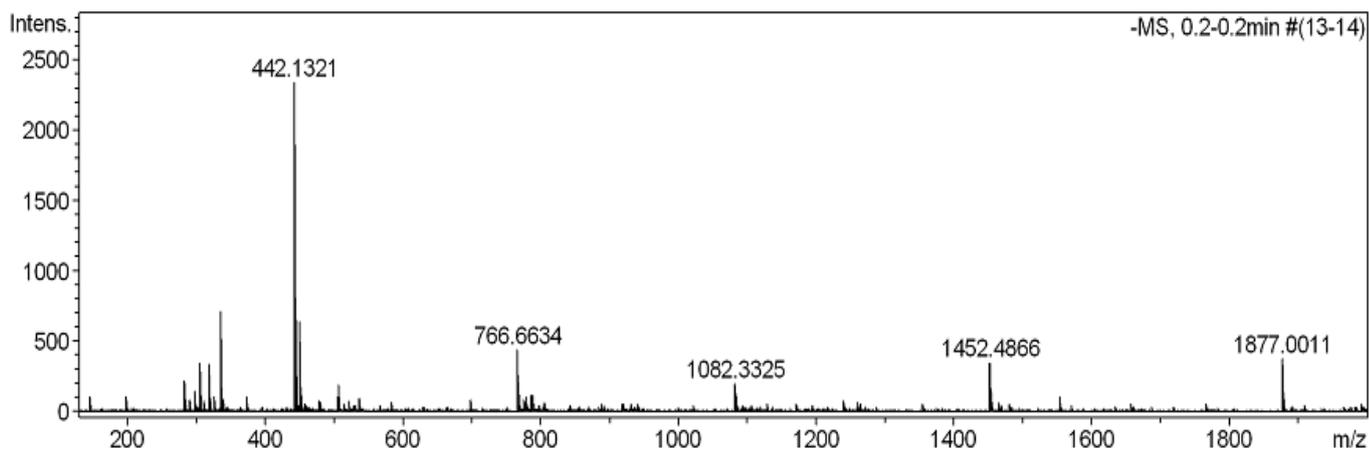


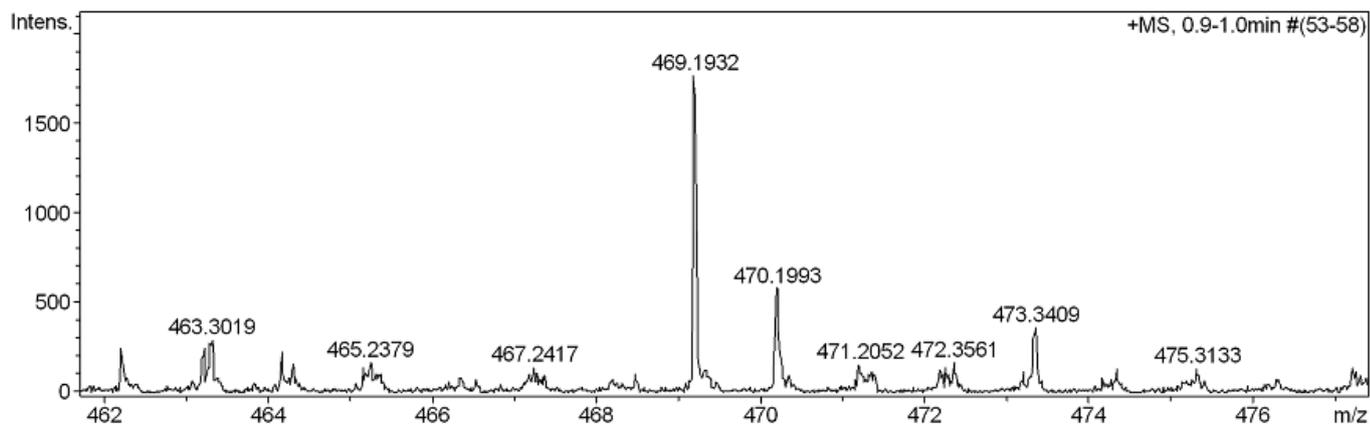
5. HRMS spectra of some representative compounds

HRMS for 4 {1,1,1}



HRMS for 4 {3,1,1}**HRMS for 4 {5,1,1}**

HRMS for 4 {6,1,1}**HRMS for 4 {7,1,1}****HRMS for 5 {1,1,2}**

HRMS for 8{12,4,1}**HRMS for 9{16,1,2}**