# Design and Green Synthesis of Novel Benzotriazoloquinolinyl Spirooxindolopyrrolizidines: Antimycobacterial and Antiproliferative studies

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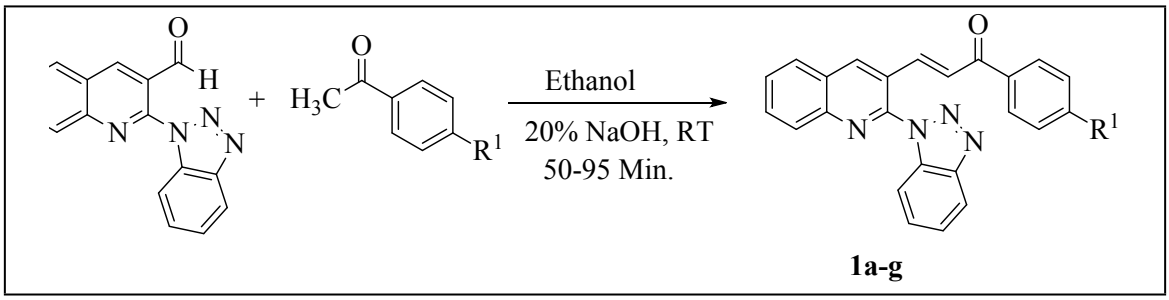
**1. Procedure for the synthesis of the dipolarophiles 1a-g**

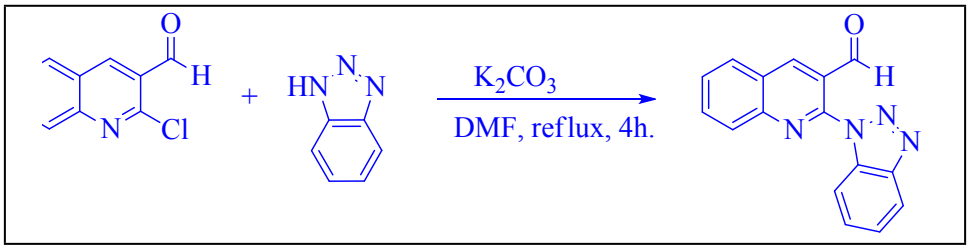
The equal mmol of compound 2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinoline-3-carbaldehyde (1 mmol) and various acetophenones (1 mmol) were mixed in 5 mL of ethanol and added 1 mL of 20% ethanolic sodium hydroxide. Then the reaction was stirred at room temperature for an appropriate time. The progress of the reaction was monitored by TLC. The solid product was formed in the reaction and it was collected by filtration, washed with cold ethanol and dried under vacuum to afford the dipolarophiles **1a-g**.




**Scheme S1: Synthesis of the chalcone 1a-g.**

**1.2. Procedure for the synthesis of the 2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinoline-3-carbaldehyde**

The mixture of compounds 2-chloroquinoline-3-carbaldehyde (1 mmol) and 1*H*-benzo[*d*][1,2,3]triazole (1.5 mmol) and $K_2CO_3$ (2 mmol) were mixed in 5 mL of DMF and refluxed for 2 h. The progress of the reaction was monitored by TLC and after completions of starting materials the mixture was cooled to room temperature and poured on ice cold water results the solid product. It was collected by filtration and dried under vacuum to afford the 2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinoline-3-carbaldehyde.




**Scheme S2: Synthesis of the 2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinoline-3-carbaldehyde.**

### 1.3. Reusability studies of ionic liquid

Although the [Bmim]$BF_4$ working efficiently as a medium and also as a catalyst, further, we have investigated the scope and efficiency with respect to the reusability and catalytic activity. After ensuring the completion of the reaction, the reaction mixture was added to 20 mL of ice-cold water and results in the desired solid product which was isolated by the filtration. The aqueous filtrate was evaporated under the reduced pressure followed by washing with diethyl ether (2 x 20 mL) then reused the [Bmim]$BF_4$ for four subsequent runs without significant change of yields and catalytic activity.

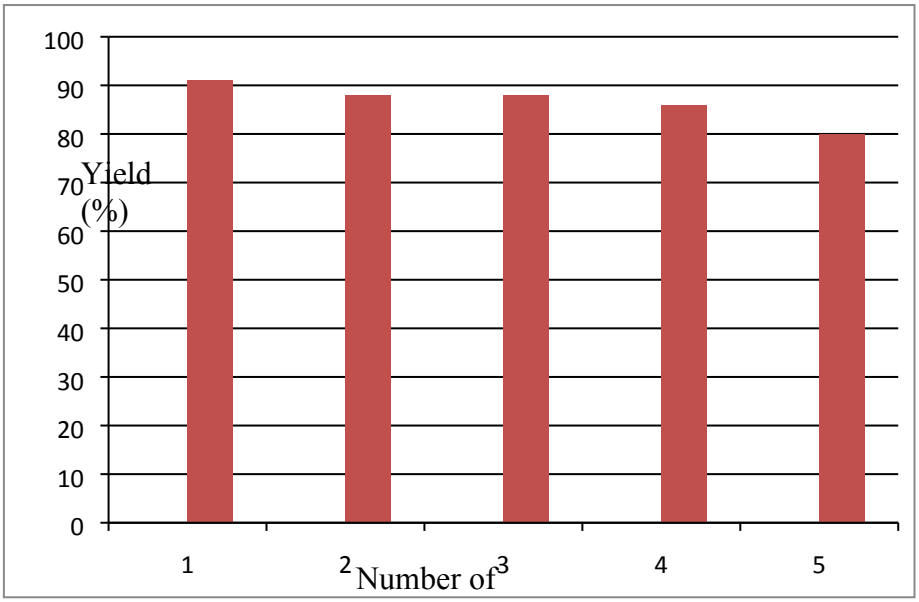



**Figure A**: Reusability study of the [Bmim]$BF_4$ for the synthesis of spirooxindolopyrrolizidine derivatives.

### 2.1. General information

All the chemicals and solvents were purchased from Aldrich/Spectrochem. All melting points were checked by using Stuart SMP30 melting point apparatus (Bibby Scientific Ltd. United Kingdom) and were uncorrected. Ultrasonication irradiation was performed on PCi-Analytics-6.5L200H1DTC ultrasonic cleaner, the frequency of ultrasonic cleaner is 25 kHz, input voltage range of 170–270 VAC at 50 Hz, and output power is 250 W

(Mumbai, India). The reaction progress was checked with TLC plates (E. Merck, Mumbai, India). IR spectra were recorded on KBr disc by using Perkin-Elmer 100S spectrophotometer (Perkin-Elmer Ltd. United Kingdom) from 400-4000 $cm^{-1}$. $^{1}H$ and $^{13}C$ NMR spectra were recorded on Avance-III Bruker-400 MHz spectrometer (Bruker Corporation Ltd., Germany) using DMSO-*d6* as solvent and TMS as an internal standard and chemical shifts values were expressed in ppm. The CHN analysis was recorded on Carlo Erba EA 1108 automatic analyzer (Triad, NJ, USA) and the values are ±0.4% of theoretical values. Mass spectra were determined on a Jeol JMSD-300 spectrometer (Jeol Ltd., Tokyo, Japan).

### 2.2. Protocol for the antimycobacterial activity screening (Microplate Alamar Blue Assay)

The Minimum Inhibitory Concentrations (MIC) of the synthesized compounds tested using *in-vitro* MABA (Microplate Alamar Blue Assay) assay using the reported protocol[36-38]. The *Mycobacterium tuberculosis* H37Rv strain was used for the screening. The inoculum was prepared from fresh L J medium. Stock solutions of test compounds were made as 10 mM DMSO solution and further diluted in Middlebrook 7H9 broth at four-fold the final highest concentration tested was 100 µM. Serial dilution was performed for each compound in 96-well microtitre plates using 100 µl of Middlebrook 7H9 broth. The assay was performed in duplicate for each sample and the readings were compared to standard TB drug ethambutol. Sterile water was added to all perimeter wells to maintain the humidity during the incubation period of 7 days at 37 °C. After the incubation period, Alamar blue solution (30 µL) was added to each well and the plate was pre-incubated overnight. Bacterial growth was observed by a colour change from blue to pink and the minimum concentration that didn't change the colour was taken as its MIC value.

### 2.3. Protocol for antiproliferative studies (MTT assay)

The cytotoxicity study was carried out as described previously [32, 33]. Briefly, $20\times10^3$ of A549 and HeLa S3 cells/well were seeded in 96 well plates and incubated under humidified condition at 5% of $CO_2$ and 95% of air for 24 h. Then, cells were washed twice with PBS and incubated with serially diluted synthesized compounds (100 to 3.125 μM) in DMEM for 24 h. After 24 h treatment, cells were washed with PBS and MTT was added. After incubation of 3-4 h, 100 μL of DMSO was added and the result was measured at 570 nm. The cell viability was calculated by the following formula: Cell viability (%) = [$Abs_{(Test\ sample)} - Abs_{(Blank)} / Abs_{(Control)} - Abs_{(Blank)}$] x 100%

**2.4. Fluorescence imaging**

The $1\times10^5$ of A549 cell line were seeded in 30 mm plate and incubated at 37 °C under 5% $CO_2$, 95% air for 24 h. After attachment of cells, washed twice with PBS and incubated with freshly prepared DMEM contained active compounds (**4c** and **4f**). After 24 h incubation, 20 μL of EB/AO reagent was added (control and treated) and incubated for 10-15 min at dark condition. The cellular level changes were captured by fluorescence microscope (Biorevo, BZ-9000, Keyence) [34].

**2.5. Colony formation studies**

The A549 cell line (500 cells/well) were seeded in 24 well tissue culture plate and incubated under humidified condition. Next day, the cells were treated with active compounds such as **4c** (5, 7.5 and 10 μM) and **4f** (5, 10 and 20 μM) for 24 h. After 24 h treatment, media was removed and incubated with fresh DMEM for 10 days. After 10 days, wells were washed twice with PBS and incubated with crystal violet solution for 15 min. Then, each well washed with tap water and dried. The data was calculated by Image J software using colony area [35].

**2.6. Crystallographic data of compound 4m and 4n**

CCDC 1922304 and CCDC 1922969 contain the supplementary crystallographic data (.cif) of the compounds **4m** and **4n** respectively. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/structures.

### 3.1. Spectral data

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-2'-benzoyl-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4a)**

Color: white; M. P.: 188–190 °C; IR (KBr, $cm^{-1}$): 3434, 1720, 1681; $^1$H NMR (400Hz, DMSO-$d_6$) $\delta$: 1.82 (broad singlet, 4H), 2.36 (broad singlet, 2H), 4.21 (broad singlet, 1H), 4.57 (t, $J$ = 11.2 Hz, 1H), 5.10 (d, $J$ = 11.2 Hz, 1H), 6.43 (d, $J$ = 6.4 Hz, 1H), 6.65 (s, 1H), 6.77 (s, 1H), 7.02 (s, 1H), 7.10 (s, 4H), 7.40 (s, 1H), 7.62-8.05 (m, 6H), 8.24 (d, $J$ = 7.2 Hz, 1H), 8.35 (d, $J$ = 7.2 Hz, 1H), 9.23 (s, 1H), 10.13 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) $\delta$: 195.81, 177.69, 147.57, 144.91, 144.71, 140.48, 138.88, 137.85, 134.70, 133.17, 130.66, 129.25, 128.64, 127.70, 126.03, 124.98, 124.67, 119.19, 112.41, 110.91, 78.85, 72.32, 71.53, 64.67, 46.76, 28.65, 26.86; ESI-MS: *m/z* 578 (M+1); Anal. Calcd. For $C_{36}H_{28}N_6O_2$: C, 74.98; H, 4.89; N, 14.57; Found: C, 74.73; H, 5.01; N, 14.71.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-2'-(4-methylbenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4b)**

Color: white; M. P.: 224–226 °C; IR (KBr, $cm^{-1}$): 3470, 1716, 1673; $^1$H NMR (400 Hz, DMSO-$d_6$) $\delta$: 1.68-1.81 (m, 4H), 2.21 (s, 3H), 2.36 (broad singlet, 2H), 4.18-4.24 (m, 1H), 4.58 (t, $J$ = 11.2 Hz, 1H), 5.07 (d, $J$ = 11.2 Hz, 1H), 6.46 (d, $J$ = 7.6 Hz, 1H), 6.65 (d, $J$ = 7.2 Hz, 1H), 6.77 (t, $J$ = 7.2 Hz, 1H), 6.99-7.04 (m, 3H) 7.14 (d, $J$ = 7.2 Hz, 2H), 7.62 (t, $J$ = 7.2 Hz, 1H), 7.69-7.76 (m, 2H), 7.85 (t, $J$ = 7.6 Hz, 1H), 7.95 (d, $J$ = 8.0 Hz, 1H), 8.04 (d, $J$ = 8.4 Hz, 1H), 8.23 (d, $J$ = 8.4 Hz, 1H), 8.35 (d, $J$ = 8.4 Hz, 1H), 9.22 (s, 1H), 10.16 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) $\delta$: 196.69, 179.14, 148.41, 145.65, 145.39, 143.78, 142.36,

139.46, 134.46, 133.88, 131.34, 129.67, 129.07, 128.45, 128.23, 126.45, 125.41, 124.89, 113.34, 110.18, 76.00, 72.97, 65.38, 47.64, 45.03, 29.36, 27.31, 21.52; ESI-MS: *m/z* 592 (M+1); Anal. Calcd. For $C_{37}H_{30}N_6O_2$: C, 75.24; H, 5.12; N, 14.23; Found: C, 75.47; H, 5.18; N, 14.10.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-2'-(4-ethylbenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4c)**

Color: white; M. P.: 228–230 °C; IR (KBr, $cm^{-1}$): 3185, 1725, 1671; $^1H$ NMR (400 Hz, DMSO-$d_6$) $\delta$: 1.06 (t, $J$ = 8.0 Hz, 3H), 1.71-1.81 (m, 4H), 2.37 (s, 2H), 2.75 (q, $J$ = 8.0 Hz, 2H), 4.18-4.23 (m, 1H), 4.58 (t, $J$ = 11.2 Hz, 1H), 5.07 (d, $J$ = 11.2 Hz, 1H), 6.46 (d, $J$ = 7.6 Hz, 1H), 6.66 (d, $J$ = 7.6 Hz, 1H) 6.77 (t, $J$ = 7.2 Hz, 1H), 7.02 (d, $J$ = 7.2 Hz, 3H), 7.17 (d, $J$ = 7.6 Hz, 2H), 7.62 (t, $J$ = 8.0 Hz, 1H), 7.68-7.76 (m, 2H), 7.85 (t, $J$ = 7.2 Hz, 1H), 7.94 (d, $J$ = 8.4 Hz, 1H), 8.04 (d, $J$ = 8.0 Hz, 1H), 8.23 (d, $J$ = 8.0 Hz, 1H), 8.35 (d, $J$ = 8.0 Hz, 1H), 9.22 (s, 1H), 10.17 (s, 1H); $^{13}C$ NMR (100 MHz, DMSO-$d_6$) $\delta$: 196.61, 179.16, 149.84, 148.40, 145.65, 145.39, 142.36, 139.46, 134.65, 133.97, 131.33, 129.68, 129.29, 128.71, 128.45, 128.33, 128.01, 126.51, 125.39, 124.91, 121.45, 119.89, 113.32, 110.15, 79.67, 72.98, 65.38, 47.64, 45.10, 29.35, 28.46, 27.30, 15.41; ESI-MS: *m/z* 606 (M+1); Anal. Calcd. For $C_{38}H_{32}N_6O_2$: C, 75.48; H, 5.33; N, 13.90; Found: C, 75.69; H, 5.63; N, 13.72.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-2'-(4-methoxybenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4d)**

Color: white; M. P.: 213–215 °C; IR (KBr, $cm^{-1}$); 3271, 1736, 1675; $^1H$ NMR (400 Hz, DMSO-$d_6$) $\delta$: 1.81 (broad singlet, 4H), 2.36 (m, 2H), 3.71 (s, 3H), 4.20 (broad singlet, 1H), 4.60 (t, $J$ = 11.2 Hz, 1H), 5.05 (d, $J$ = 11.2 Hz, 1H), 6.49 (d, $J$ = 7.2 Hz, 1H), 6.66-6.78 (m, 4H), 7.02 (t, $J$ = 7.2 Hz, 1H), 7.26 (d, $J$ = 7.6 Hz, 2H), 7.59-7.86 (m, 4H), 7.95 (d, $J$ = 8.0 Hz, 1H), 8.03 (d, $J$ = 8.4 Hz, 1H), 8.22 (d, $J$ = 7.2 Hz, 1H), 8.34 (d, $J$ = 8.0 Hz, 1H), 9.21 (s, 1H),

10.17 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) $\delta$: 195.14, 179.24, 163.40, 148.42, 145.66, 145.38, 142.32, 139.44, 133.97, 131.32, 130.56, 129.71, 129.30, 128.44, 126.52, 125.40, 124.96, 121.43, 119.92, 113.71, 113.35, 110.14, 73.13, 72.31, 65.12, 55.92, 47.61, 45.10, 29.41, 27.36; ESI-MS: *m/z* 608 (M+1); Anal. Calcd. For $C_{37}H_{30}N_6O_3$: C, 73.25; H, 4.98; N, 13.85; Found: C, 73.04; H, 4.91; N, 13.99.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-2'-(4-fluorobenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4e)**

Color: white; M. P.: 196–198 °C; IR (KBr, cm$^{-1}$): 3455, 1710, 1682; $^1$H NMR (400 Hz, DMSO-$d_6$) $\delta$: 1.68-1.80 (m, 4H), 2.36 (s, 2H), 4.17-4.22 (broad singlet, 1H), 4.56 (t, $J$ = 10.8 Hz, 1H), 5.10 (d, $J$ = 10.8 Hz, 1H), 6.46 (d, $J$ = 7.6 Hz, 1H), 6.64 (d, $J$ = 7.2 Hz, 1H) 6.78 (t, $J$ = 7.2 Hz, 1H), 7.03 (t, $J$ = 8.8 Hz, 3H), 7.26 (t, $J$ = 6.8 Hz, 2H), 7.62 (t, $J$ = 7.6 Hz, 1H), 7.69-7.78 (m, 2H), 7.86 (t, $J$ = 8.0 Hz, 1H), 7.96 (d, $J$ = 8.4 Hz, 1H), 8.05 (d, $J$ = 8.4 Hz, 1H), 8.23 (d, $J$ = 8.0 Hz, 1H), 8.34 (d, $J$ = 8.4 Hz, 1H), 9.23 (s, 1H), 10.14 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) $\delta$: 196.38, 179.09, 148.39, 145.65, 145.40, 142.37, 139.63, 133.96, 133.71, 131.35, 130.99, 129.49, 129.34, 128.72, 128.45, 125.43, 124.78, 121.56, 119.92, 115.61, 113.27, 110.27, 79.67, 72.91, 65.80, 47.63, 44.86, 29.39, 27.33; ESI-MS: *m/z* 596 (M+1); Anal. Calcd. For $C_{36}H_{27}FN_6O_2$: C, 72.71; H, 4.58; N, 14.13; Found: C, 72.46; H, 4.52; N, 14.30.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-2'-(4-chlorobenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4f)**

Color: white; M. P.: 237–239 °C; IR (KBr, cm$^{-1}$): 3174, 1725, 1676; $^1$H NMR (400 Hz, DMSO-$d_6$) $\delta$: 1.67-1.80 (m, 4H), 2.36 (s, 2H), 4.17-4.21 (m, 1H), 4.56 (t, $J$ = 11.2 Hz, 1H), 5.10 (d, $J$ = 11.2 Hz, 1H), 6.47 (d, $J$ = 7.6 Hz, 1H), 6.63 (d, $J$ = 7.6 Hz, 1H) 6.78 (t, $J$ = 7.2 Hz, 1H), 7.04 (t, $J$ = 7.2 Hz, 1H), 7.17 (d, $J$ = 8.0 Hz, 2H), 7.27 (t, $J$ = 7.6 Hz, 2H), 7.62 (t, $J$

= 8.0 Hz, 1H), 7.69-7.78 (m, 2H), 7.87 (t, *J* = 7.6 Hz, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 8.05 (d, *J* = 8.4 Hz, 1H), 8.23 (d, *J* = 8.0 Hz, 1H), 8.34 (d, *J* = 8.4 Hz, 1H), 9.23 (s, 1H), 10.17 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) *δ*: 196.78, 179.02, 148.38, 145.65, 145.41, 142.38, 139.66, 138.27, 135.68, 133.96, 131.36, 129.91, 129.43, 129.35, 128.49, 125.44, 124.73, 120.05, 113.36, 72.86, 72.51, 65.83, 47.63, 44.81, 29.40, 27.32; ESI-MS: *m/z* 612 (M+1); Anal. Calcd. For $C_{36}H_{27}ClN_6O_2$: C, 70.76; H, 4.45; N, 13.75; Found: C, 70.57; H, 4.52; N, 13.60.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-2'-(4-bromobenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4g)**

Color: white; M. P.: 243–245 °C; IR (KBr, cm$^{-1}$): 3174, 1724, 1676: $^1$H NMR (400 Hz, DMSO-$d_6$) *δ*: 1.68-1.80 (m, 4H), 2.36 (s, 2H), 4.16-4.20 (m, 1H), 4.55 (t, *J* = 11.2 Hz, 1H), 5.09 (d, *J* = 11.2 Hz, 1H), 6.47 (d, *J* = 7.6 Hz, 1H), 6.63 (d, *J* = 7.6 Hz, 1H), 6.78 (t, *J* = 7.2 Hz, 1H), 7.03-7.11 (m, 3H), 7.41 (d, *J* = 7.6 Hz, 2H), 7.61 (t, *J* = 7.6 Hz, 1H), 7.68-7.78 (m, 2H), 7.87 (t, *J* = 7.6 Hz, 1H), 7.96 (d, *J* = 8.0 Hz, 1H,), 8.05 (d, *J* = 8.4 Hz, 1H), 8.22 (d, *J* = 8.0 Hz, 1H), 8.34 (d, *J* = 8.4 Hz, 1H), 9.22 (s, 1H), 10.18 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) *δ*: 196.96, 178.99, 148.38, 145.64, 145.41, 142.38, 139.66, 136.00, 133.96, 131.47, 129.98, 129.35, 128.73, 128.45, 127.49, 125.43, 124.72, 119.92, 113.35, 79.10, 72.85, 65.72, 47.58, 44.82, 29.40, 27.33; ESI-MS: *m/z* 657 (M+2); Anal. Calcd. For $C_{36}H_{27}BrN_6O_2$: C, 65.96; H, 4.15; N, 12.82; Found: C, 65.76; H, 4.08; N, 12.95.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-2'-benzoyl-5-chloro-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4h)**

Color: white; M. P.: 192–194 °C; IR (KBr, cm$^{-1}$): 3402, 1721, 1679; $^1$H NMR (400 Hz, DMSO-$d_6$) *δ*: 1.75-1.86 (m, 4H), 2.31-2.42 (m, 2H), 4.16-4.22 (m, 1H), 4.48 (t, *J* = 11.2 Hz, 1H), 5.16 (d, *J* = 11.2 Hz, 1H), 6.46 (d, *J* = 8.4 Hz, 1H), 6.61 (s, 1H), 7.09-2.27 (m, 5H), 7.44 (t, *J* = 7.2 Hz, 1H), 7.61 (t, *J* = 7.6 Hz, 1H), 7.69-7.77 (m, 3H), 7.86 (t, *J* = 8.0 Hz, 1H), 7.96

(d, *J* = 8.4 Hz, 1H), 8.05 (d, *J* = 8.4 Hz, 1H), 8.22 (d, *J* = 8.0 Hz, 1H), 8.34 (d, *J* = 8.0 Hz, 1H), 9.26 (s, 1H), 10.28 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) *δ*: 197.35, 178.58, 148.41, 145.68, 145.46, 141.30, 139.54, 136.77, 133.96, 133.69, 131.38, 129.38, 129.16, 128.76, 128.49, 128.14, 126.94, 125.64, 125.42, 119.95, 113.19, 79.67, 73.06, 65.32, 47.51, 44.96, 29.35, 27.56; ESI-MS: *m/z* 612 (M+1); Anal. Calcd. For $C_{36}H_{27}ClN_6O_2$: C, 70.76; H, 4.45; N, 13.75; Found: C, 70.52; H, 4.56; N, 13.93.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-5-chloro-2'-(4-methylbenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4i)**

Color: white; M. P.: 216–218 °C; IR (KBr, cm$^{-1}$): 3402, 1720, 1673; $^1$H NMR (400 Hz, DMSO-$d_6$) *δ*: 1.85 (Broad singlet, 4H), 2.26 (s, 3H), 2.40 (s, 2H), 4.22-4.28 (m, 1H), 4.62 (t, *J* = 11.2 Hz, 1H), 5.12 (d, *J* = 11.2 Hz, 1H), 6.51 (d, *J* = 7.6 Hz, 1H), 6.70 (d, *J* = 7.2 Hz, 1H), 6.81 (t, *J* = 7.2 Hz, 1H), 7.05 (t, *J* = 7.2 Hz, 2H), 7.18 (d, *J* = 7.2 Hz, 2H), 7.64-7.81(m, 3H), 7.90 (t, *J* = 7.2 Hz, 1H), 7.99 (d, *J* = 8.0 Hz, 1H), 8.08 (d, *J* = 8.4 Hz, 1H), 8.27 (d, *J* = 8.4 Hz, 1H), 8.39 (d, *J* = 8.4 Hz, 1H), 9.26 (s, 1H), 10.21 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) *δ*: 197.36, 179.82, 149.08, 146.32, 146.07, 144.45, 143.03, 140.14, 135.14, 134.56, 132.01, 130.34, 129.74, 129.13, 128.91, 127.12, 126.08, 125.56, 114.01, 110.85, 76.67, 73.64, 66.05, 48.31, 45.70, 30.03, 27.98, 22.19; ESI-MS: *m/z* 626 (M+1); Anal. Calcd. For $C_{37}H_{29}ClN_6O_2$: C, 71.09; H, 4.68; N, 13.44; Found: C, 71.35; H, 4.77; N, 13.27.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-5-chloro-2'-(4-ethylbenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4j)**

Color: white; M. P.: 221–223 °C; $^1$H NMR (400 Hz, DMSO-$d_6$) *δ*: 1.08 (t, J = 8.0 Hz, 3H, $CH_3$), 1.70-1.92 (m, 4H), 2.42 (s, 2H), 2.52 (s, 2H), 4.22-4.27 (m, 1H), 4.63 (t, *J* = 11.2 Hz, 1H), 5.06 (d, *J* = 11.2 Hz, 1H), 6.46 (d, *J* = 7.6 Hz, 1H), 6.69 (d, *J* = 7.6 Hz, 1H) 6.76 (t, *J* = 7.2 Hz, 1H), 7.00 (d, *J* = 7.6 Hz, 2H), 7.17 (d, *J* = 7.6 Hz, 2H), 7.60 (t, *J* = 7.6 Hz, 1H), 7.66-

7.73 (m, 2H), 7.83 (t, *J* = 7.2 Hz, 1H,), 7.94 (d, *J* = 8.4 Hz, 1H,), 8.03 (d, *J* = 8.0 Hz, 1H), 8.21 (d, *J* = 8.0 Hz, 1H), 8.31 (d, *J* = 8.0 Hz, 1H), 9.17 (s, 1H), 10.14 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) *δ*: 197.10, 179.65, 150.33, 148.89, 146.14, 145.88, 142.84, 139.95, 135.13, 134.46, 131.82, 130.16, 129.78, 129.20, 128.93, 128.82, 128.50, 126.99, 125.88, 125.39, 121.94, 120.37, 113.80, 110.64, 80.16, 73.47, 65.86, 48.13, 45.59, 29.84, 28.95, 27.78, 15.90. Anal. Calcd. For $C_{38}H_{31}ClN_6O_2$: C, 71.41; H, 4.89; N, 13.15; Found: C, 71.22; H, 4.82; N, 13.36.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-5-chloro-2'-(4-methoxybenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4k)**

Color: white; M. P.: 236–238 °C; IR (KBr, cm$^{-1}$): 3252, 1738, 1675; $^1$H NMR (400 Hz, DMSO-$d_6$) *δ*: 1.79 (broad singlet, 4H), 2.31-240 (m, 2H), 3.72 (s, 3H), 4.19 (broad singlet, 1H), 4.49 (t, *J* = 11.2 Hz, 1H), 5.10 (d, *J* = 11.2 Hz, 1H), 6.51 (d, *J* = 8.0 Hz, 1H), 6.63 (s, 1H), 6.75 (d, *J* = 8.0 Hz, 2H), 7.10 (t, *J* = 8.0 Hz, 1H), 7.33 (d, *J* = 8.4 Hz, 2H), 7.61 (t, *J* = 7.2 Hz, 1H), 7.69-7.79 (m, 2H), 7.86 (t, *J* = 7.2 Hz, 1H), 7.95 (d, *J* = 8.0 Hz, 1H), 8.05 (d, *J* = 8.8 Hz, 1H), 8.20 (d, *J* = 8.0 Hz, 1H), 8.34 (d, *J* = 8.4 Hz, 1H), 9.24 (s, 1H), 10.24 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) *δ*: 194.91, 178.71, 163.63, 148.41, 145.67, 145.44, 141.26, 139.44, 133.94, 131.39, 130.71, 129.59, 129.37, 129.23, 128.78, 128.44, 127.06, 125.56, 125.40, 119.94, 113.91, 113.16, 79.67, 73.34, 64.68, 55.88, 47.51, 45.12, 29.43, 27.67; ESI-MS: *m/z* 642 (M+1); Anal. Calcd. For $C_{37}H_{29}ClN_6O_3$: C, 69.32; H, 4.56; N, 13.11; Found: C, 69.58; H, 4.62; N, 12.94.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-5-chloro-2'-(4-fluorobenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4l)**

Color: white; M. P.: 204–206 °C; IR (KBr, cm$^{-1}$): 3412, 1722, 1680: $^1$H NMR (400 Hz, DMSO-$d_6$) *δ*: 1.78 (broad singlet, 4H), 2.32 (s, 1H), 2.40 (s, 1H), 4.17 (broad singlet, 1H),

4.46 (t, *J* = 11.6 Hz, 1H), 5.16 (d, *J* = 11.6 Hz, 1H), 6.48 (d, *J* = 8.4 Hz, 1H), 6.60 (s, 1H) 7.05-7.13 (m, 3H), 7.34 (s, 1H), 7.61 (t, *J* = 7.2 Hz, 1H), 7.69-7.89 (m, 3H), 7.87 (t, *J* = 7.2 Hz, 1H), 7.97 (d, *J* = 8.4 Hz, 1H), 8.06 (d, *J*= 8.4 Hz, 1H), 8.21 (d, *J* = 8.0 Hz, 1H), 8.34 (d, *J* = 8.4 Hz, 1H), 9.23 (s, 1H), 10.14 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) *δ*: 197.31, 180.02, 149.32, 146.58, 146.34, 143.31, 140.56, 134.89, 134.64, 132.28, 131.92, 130.43, 130.27, 129.65, 129.38, 126.36, 125.71, 122.49, 120.85, 116.54, 114.20, 111.20, 73.84, 73.46, 66.74, 48.56, 45.79, 30.33, 28.26; Anal. Calcd. For $C_{36}H_{26}ClFN_6O_2$: C, 68.73; H, 4.17; N, 13.36; Found: C, 68.96; H, 4.09; N, 13.52.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-5-chloro-2'-(4-chlorobenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4m)**

Color: white; M. P.: 201–203 °C; IR (KBr, cm$^{-1}$): 3423, 1729, 1673; $^1$H NMR (400 Hz, DMSO-$d_6$) *δ*: 1.78 (Broad singlet, 4H), 2.31 (s, 1H), 2.40 (s, 1H), 4.18 (Broad singlet, 1H), 4.55 (t, *J* = 10.8 Hz, 1H), 5.16 (d, *J* = 11.6 Hz, 1H), 6.49 (d, *J* = 7.6 Hz, 1H), 6.59 (s, 1H), 7.13 (d, *J* = 8.4 Hz, 1H) 7.24-7.33 (m, 4H), 7.61 (t, *J* = 8.0 Hz, 1H), 7.69-7.78 (s, 2H), 7.87 (t, *J* = 7.2 Hz, 1H), 7.96 (d, *J* = 8.4 Hz, 1H), 8.06 (d, *J* = 8.0 Hz, 1H), 8.20 (d, *J* = 8.0 Hz, 1H), 8.33 (d, *J* = 8.4 Hz, 1H), 9.25 (s, 1H), 10.30 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) *δ*: 196.57, 178.44, 148.32, 145.67, 145.47, 141.24, 139.63, 138.61, 135.46, 133.93, 131.42, 130.01, 129.40, 128.46, 126.79, 125.74, 125.42, 119.94, 113.16, 111.67, 79.61, 73.08, 72.29, 65.42, 47.51, 29.40, 27.62; ESI-MS: *m/z* 646 (M+1); Anal. Calcd. For $C_{36}H_{26}Cl_2N_6O_2$: C, 66.98; H, 4.06; N, 13.02; Found: C, 66.72; H, 4.11; N, 13.17.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-2'-(4-bromobenzoyl)-5-chloro-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4n)**

Color: white; M. P.: 235–237 °C; IR (KBr, cm$^{-1}$): 3448, 1727, 1671; $^1$H NMR (400 Hz, DMSO-$d_6$) *δ*: 1.76 (Broad singlet, 4H), 2.30 (s, 1H), 2.39 (s, 1H), 4.19 (Broad singlet, 1H),

4.55 (t, *J* = 11.2 Hz, 1H), 5.15 (d, *J* = 11.2 Hz, 1H), 6.49 (d, *J* = 8.4 Hz, 1H), 6.59 (s, 1H), 7.12-7.18 (m, 3H), 7.45 (d, *J* = 7.6 Hz, 2H) 7.61 (t, *J* = 7.2 Hz, 1H), 7.69-7.78 (m, 2H), 7.87 (t, *J* = 7.2 Hz, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 8.06 (d, *J* = 8.4 Hz, 1H), 8.20 (d, *J* = 8.4 Hz, 1H), 8.33 (d, *J* = 8.4 Hz, 1H), 9.22 (s, 1H), 10.18 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) *δ*: 196.78, 178.45, 148.38, 145.67, 145.47, 141.26, 139.65, 135.78, 133.94, 131.63, 131.42, 130.12, 129.42, 128.95, 128.53, 127.87, 126.80, 125.73, 125.44, 119.94, 113.18, 73.08, 72.22, 65.38, 47.50, 44.82, 29.41, 27.63; ESI-MS: *m/z* 691 (M+2); Anal. Calcd. For $C_{36}H_{26}BrClN_6O_2$: C, 62.67; H, 3.80; N, 12.18; Found: C, 62.86; H, 3.88; N, 12.04.

**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-2'-benzoyl-5-bromo-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4o)**

Color: white; M. P.: 218–220 °C; IR (KBr, cm$^{-1}$): 3203, 1723, 1679; $^1$H NMR (400 Hz, DMSO-$d_6$) *δ*: 1.81 (broad singlet, 4H), 2.28-2.39 (m, 2H), 4.20 (broad singlet, 1H), 4.44 (t, *J* = 10.4 Hz, 1H), 5.15 (d, *J* = 12.0 Hz, 1H), 6.41 (d, *J* = 8.4 Hz, 1H), 6.73 (s, 1H), 7.20-2.26 (m, 5H), 7.44 (t, *J* = 6.4 Hz, 1H), 7.62 (t, *J* = 7.2 Hz, 1H), 7.70-7.76 (m, 2H), 7.87 (t, *J* = 8.0 Hz, 1H), 7.96 (d, *J* = 8.4 Hz, 1H), 8.05 (d, *J* = 8.4 Hz, 1H), 8.22 (d, *J* = 8.0 Hz, 1H), 8.34 (d, *J* = 8.4 Hz, 1H), 9.26 (s, 1H), 10.29 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) *δ*: 197.43, 178.42, 148.43, 145.67, 141.67, 139.54, 136.78, 133.96, 133.66, 132.69, 131.39, 129.39, 129.18, 128.77, 128.51, 128.10, 127.35, 125.39, 119.98, 113.14, 111.99, 79.43, 73.02, 65.32, 47.55, 44.94, 29.32, 27.54; ESI-MS: *m/z* 657 (M+1); Anal. Calcd. For $C_{36}H_{27}BrN_6O_2$: C, 65.96; H, 4.15; N, 12.82; Found: C, 65.73; H, 4.22; N, 12.99.

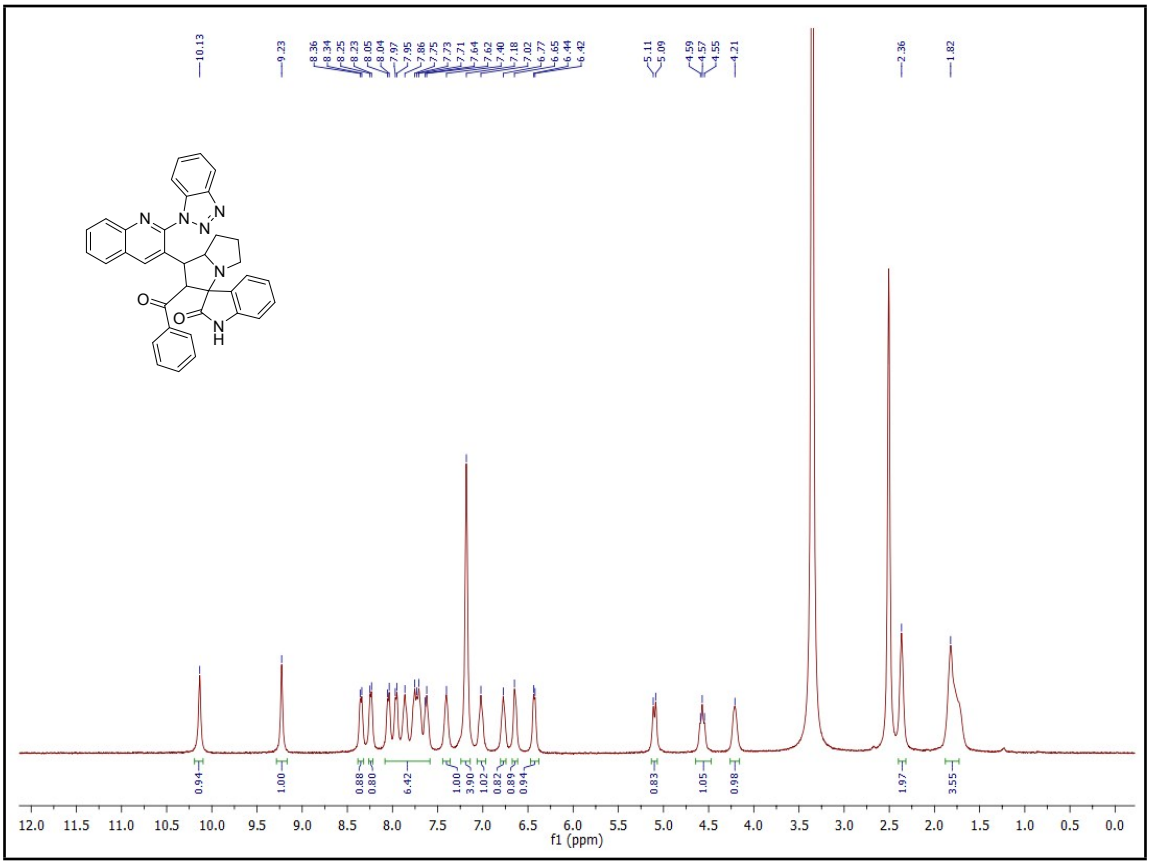
**1'-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-5-bromo-2'-(4-methoxybenzoyl)-1',2',5',6',7',7a'-hexahydrospiro[indoline-3,3'-pyrrolizin]-2-one, (4p)**

Color: white; M. P.: 232–234 °C; IR (KBr, cm$^{-1}$): 3248, 1738, 1675; $^1$H NMR (400 Hz, DMSO-$d_6$) *δ*: 1.79 (broad singlet, 4H), 2.37 (s, 2H), 3.71 (s, 3H), 4.18 (s, 1H), 4.46 (s, 1H),

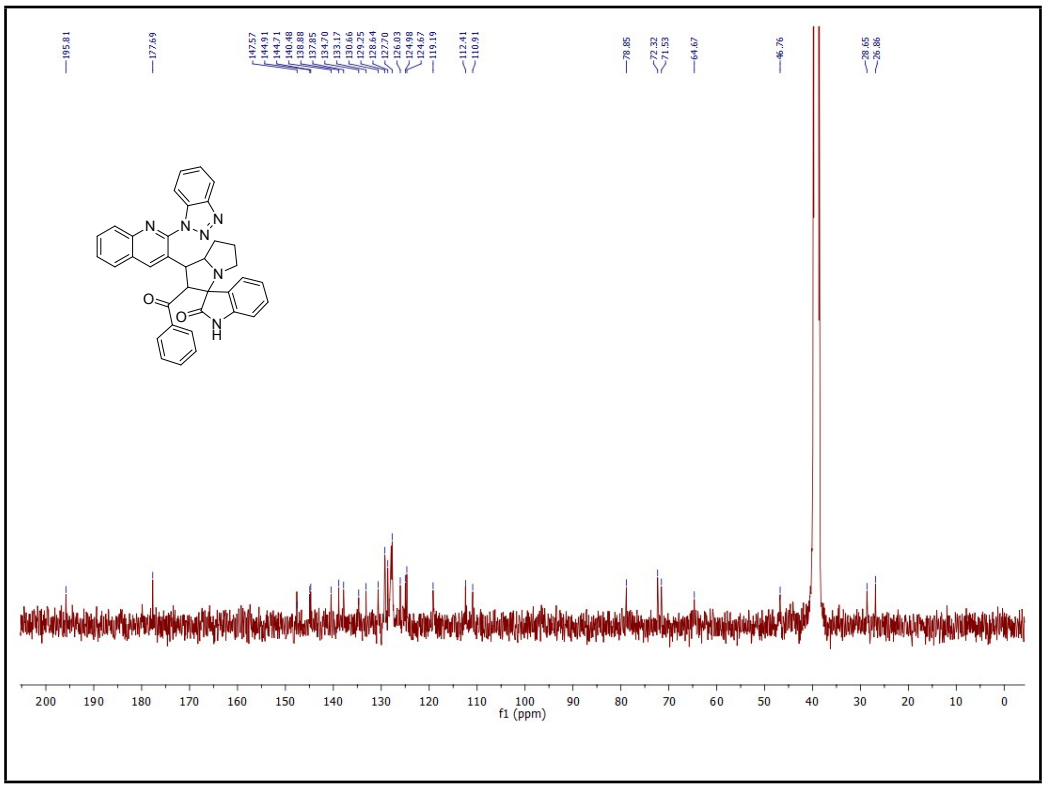
5.09 (s, 1H), 6.46 (s, 1H), 6.75 (s, 2H) 7.23-8.34 (m, 12H), 9.23 (s, 1H), 10.33 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) $\delta$: 194.86, 178.40, 148.45, 145.71, 145.48, 141.71, 139.46, 133.99, 132.44, 131.37, 130.70, 130.60, 129.35, 128.44, 125.40, 125.29, 124.47, 123.14, 119.96, 113.86, 113.36, 113.05, 112.09, 79.56, 73.28, 64.66, 55.94, 48.53, 45.16, 27.74, 21.53; ESI-MS; *m/z* 687 (M+1); Anal. Calcd. For $C_{37}H_{29}BrN_6O_3$: C, 64.82; H, 4.26; N, 12.26; Found: C, 64.60; H, 4.17; N, 12.44.

**3.2.** Copies of the characterization spectra ($^1$H-NMR, $^{13}$C-NMR, mass and IR spectra) of the synthesized compounds **4a-p**.

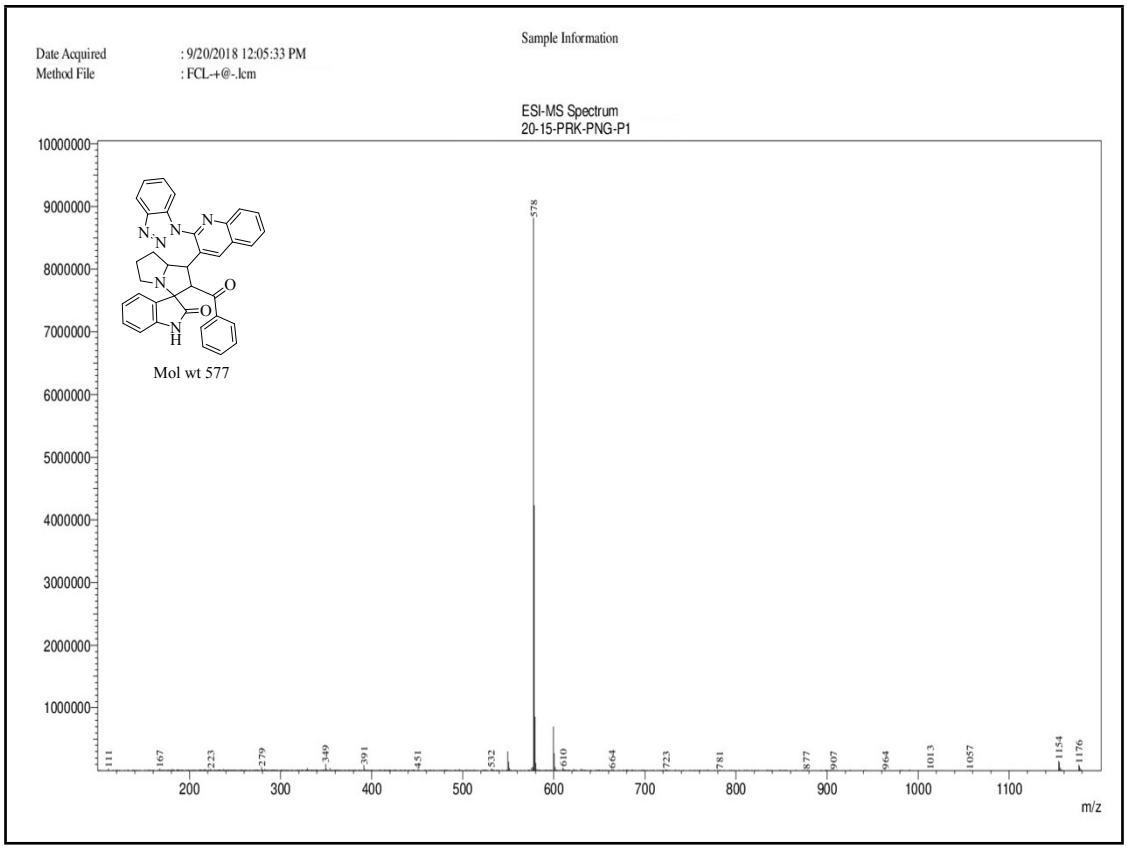
$^1$H NMR Spectrum of compound **4a**



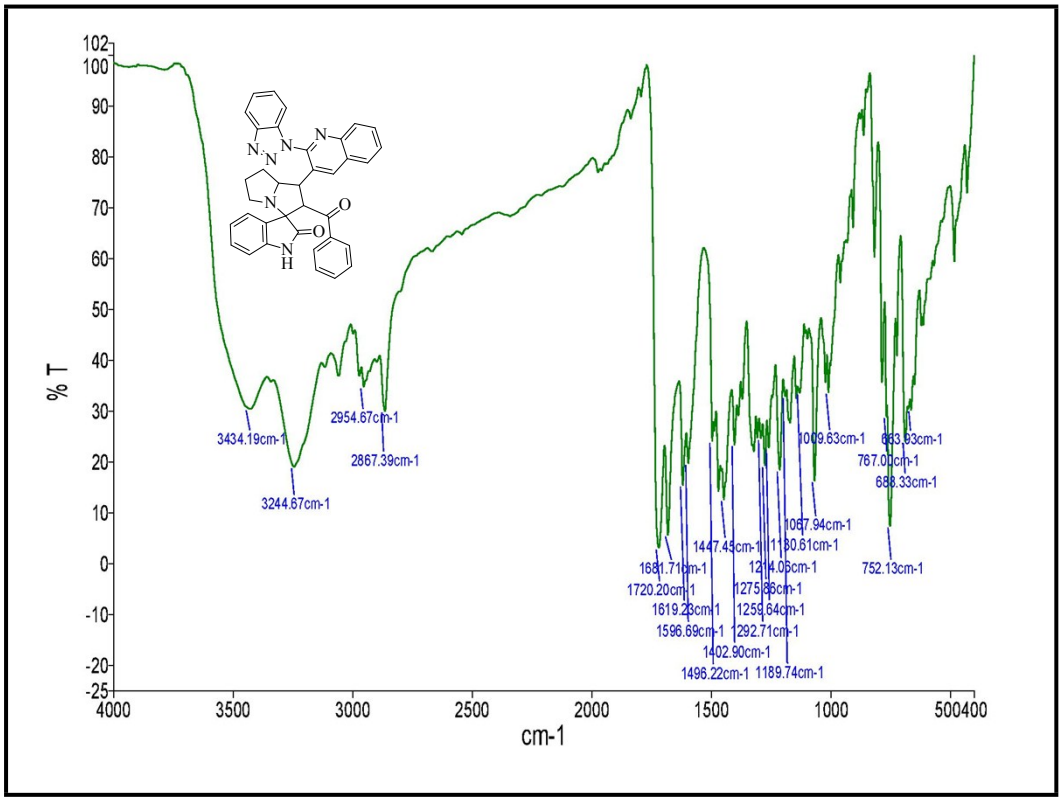
$^{13}$C NMR Spectrum of compound **4a**



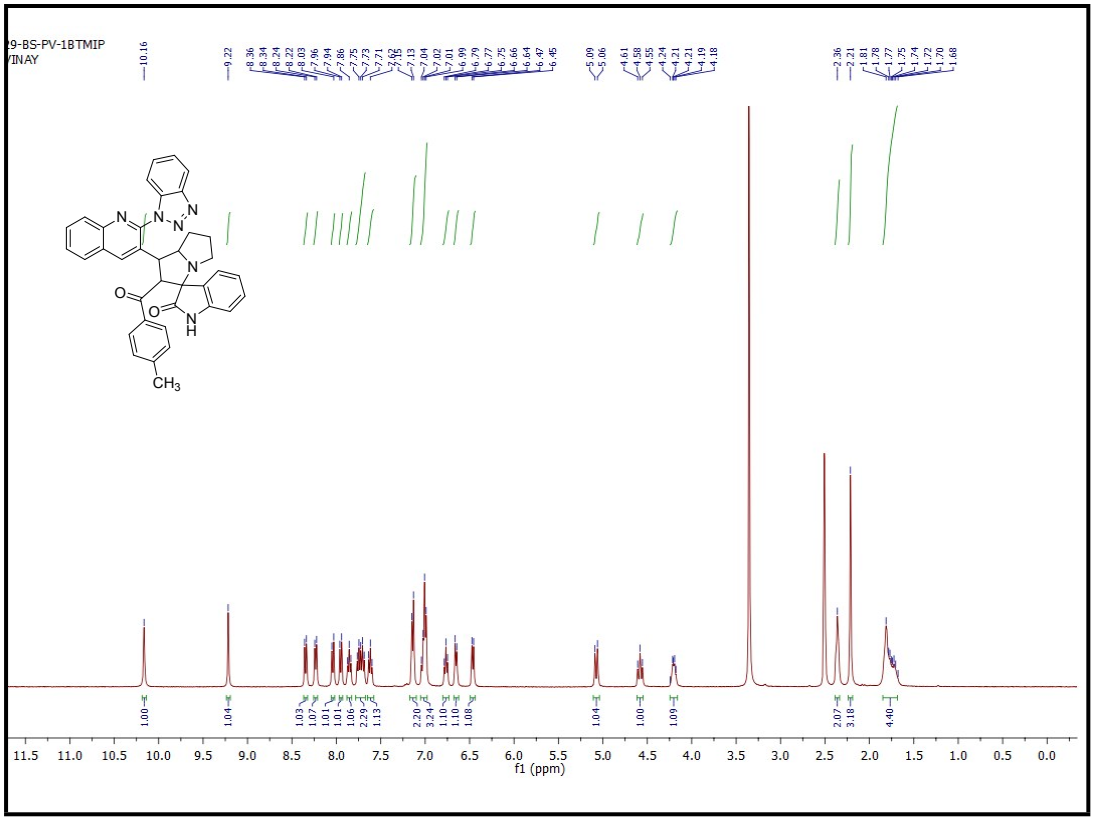

Mass spectrum of compound **4a**



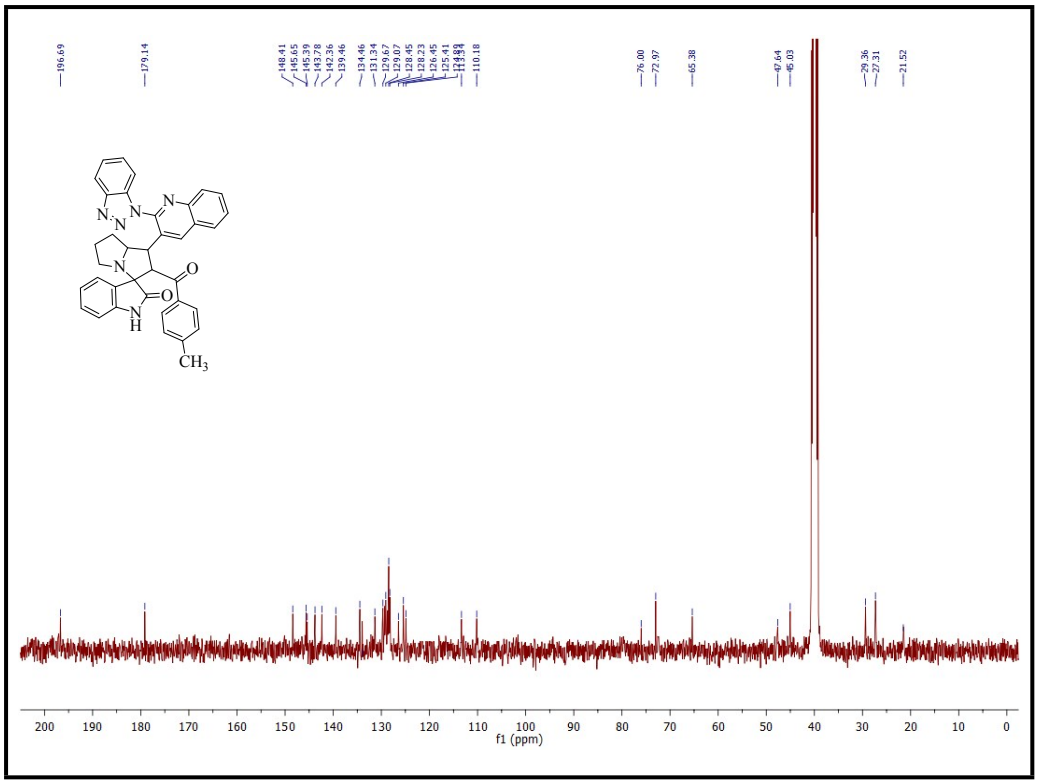
IR Spectrum of compound **4a**



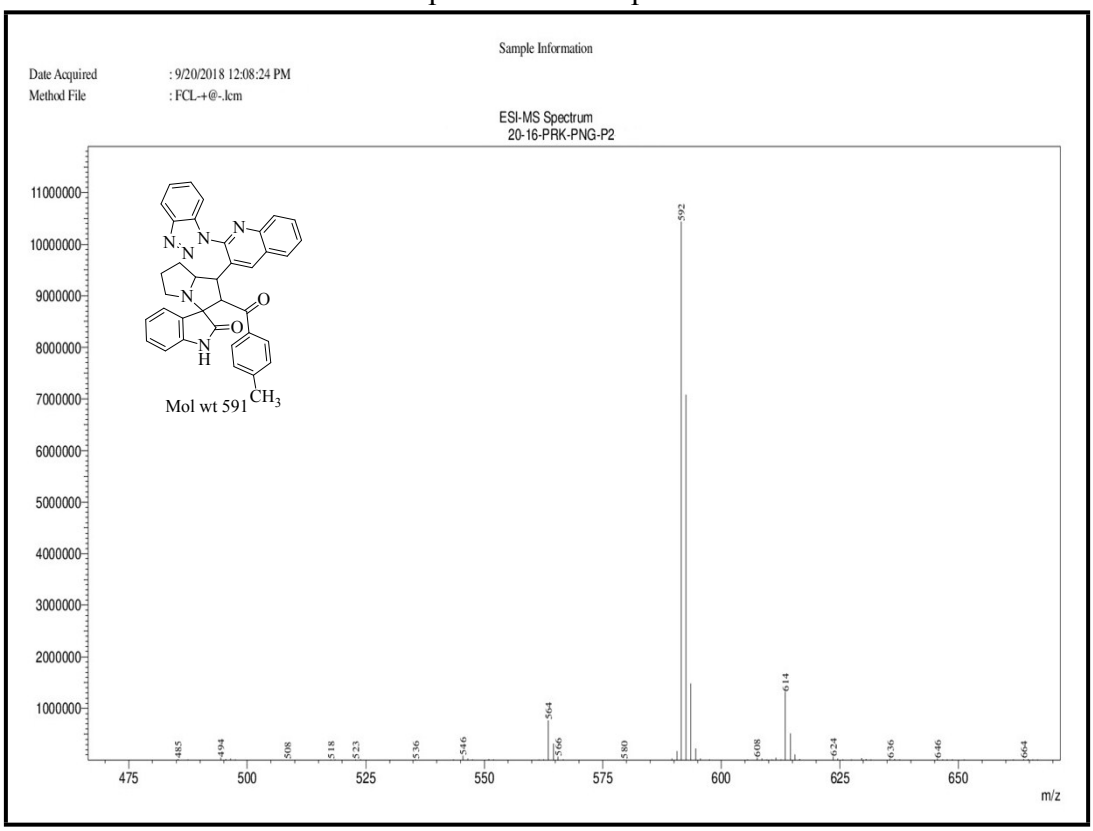

$^{1}$H NMR Spectrum of compound **4b**



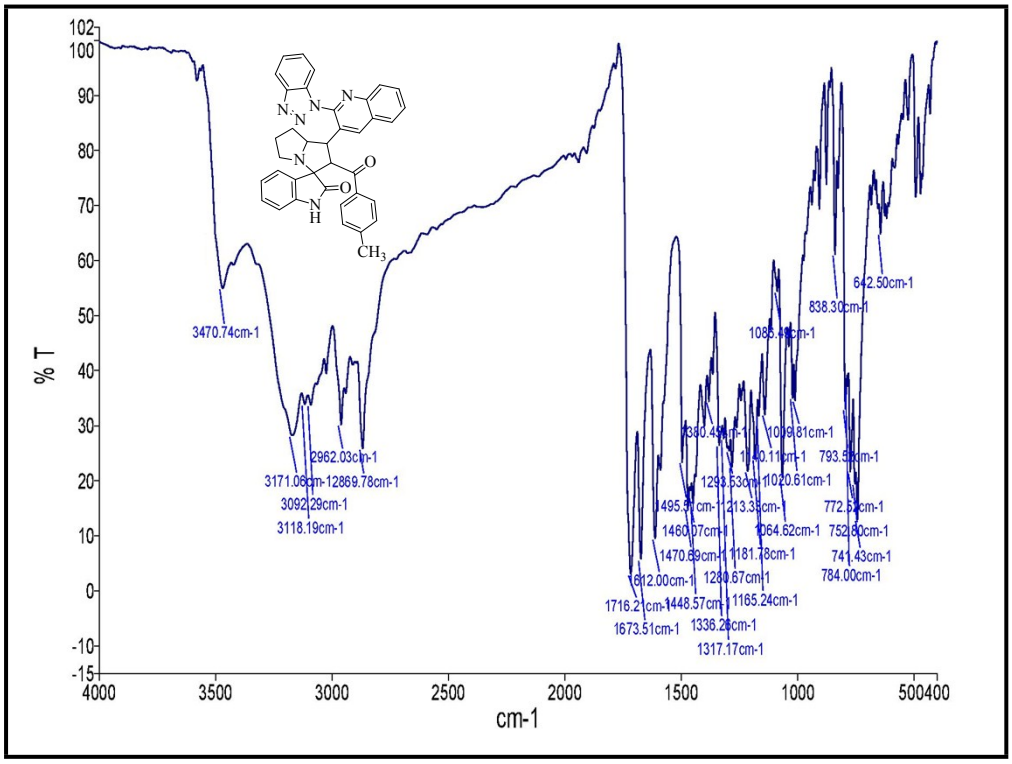
$^{13}$C NMR Spectrum of compound **4b**



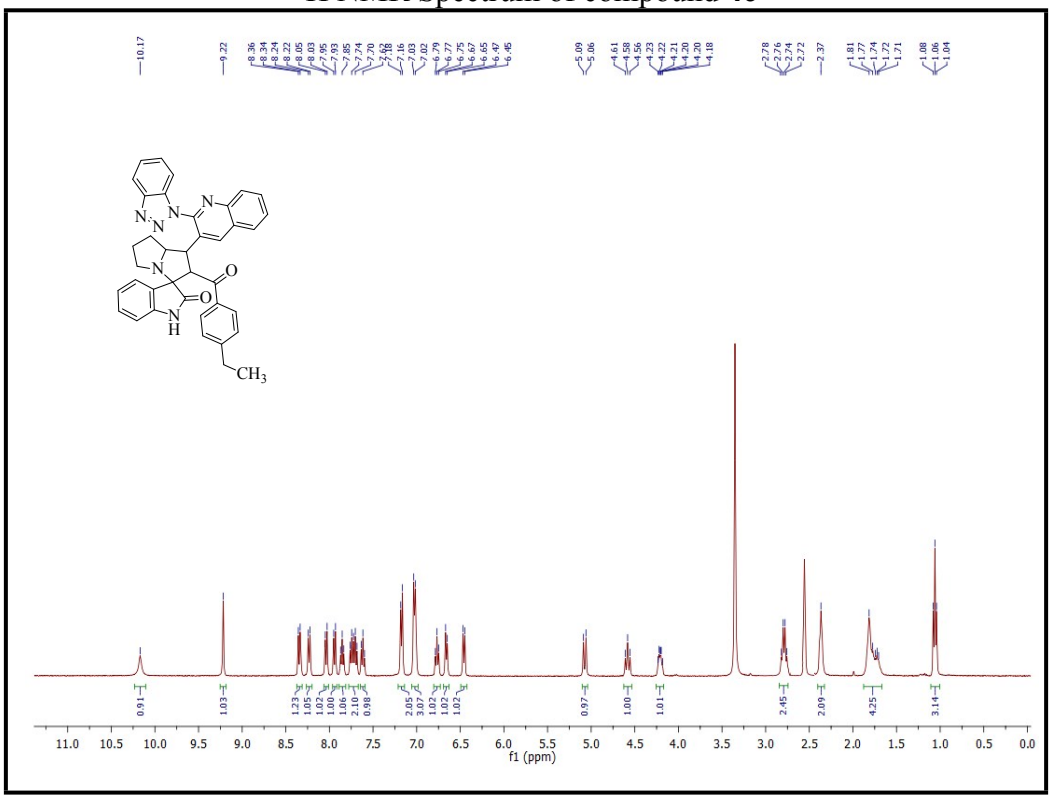

Mass spectrum of compound **4b**



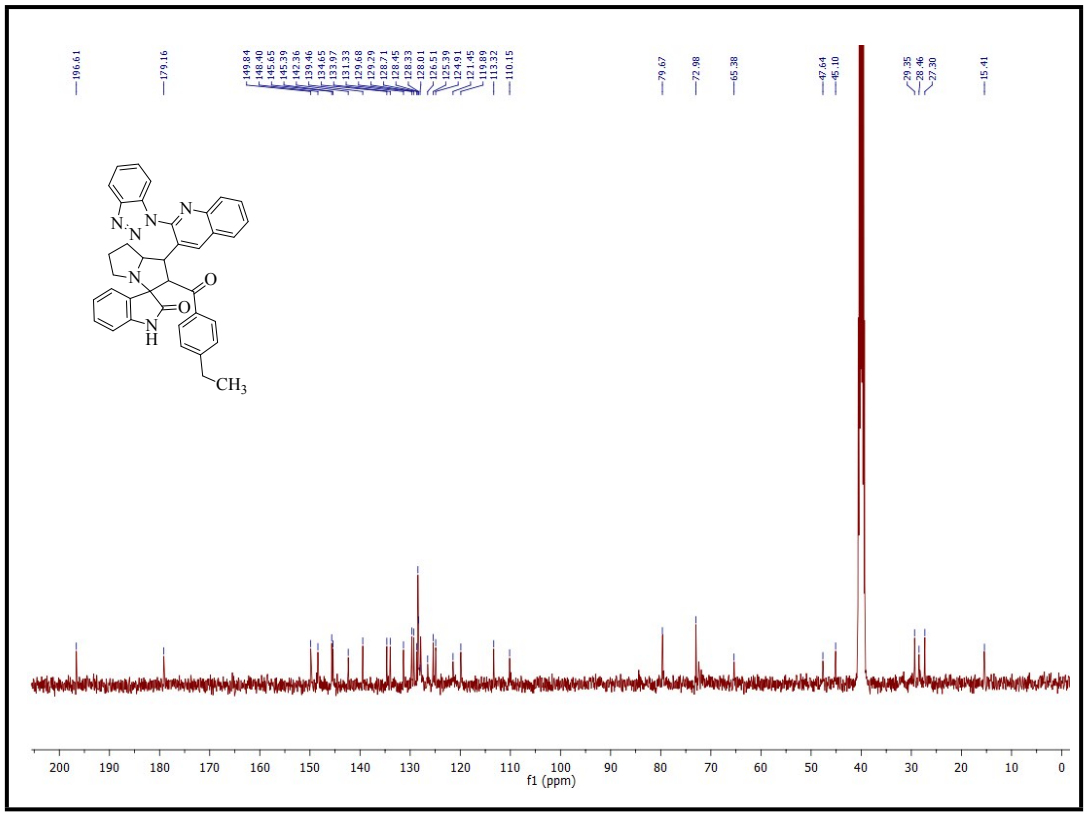
IR Spectrum of compound **4b**



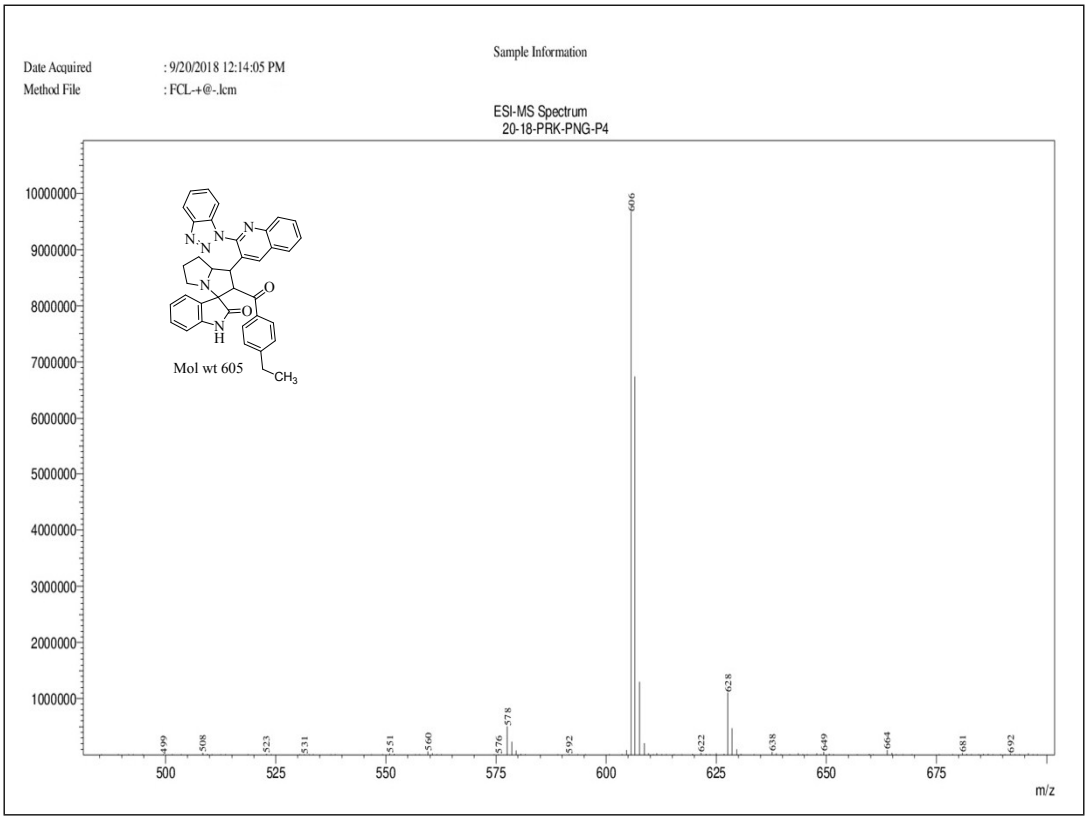

$^{1}$H NMR Spectrum of compound **4c**



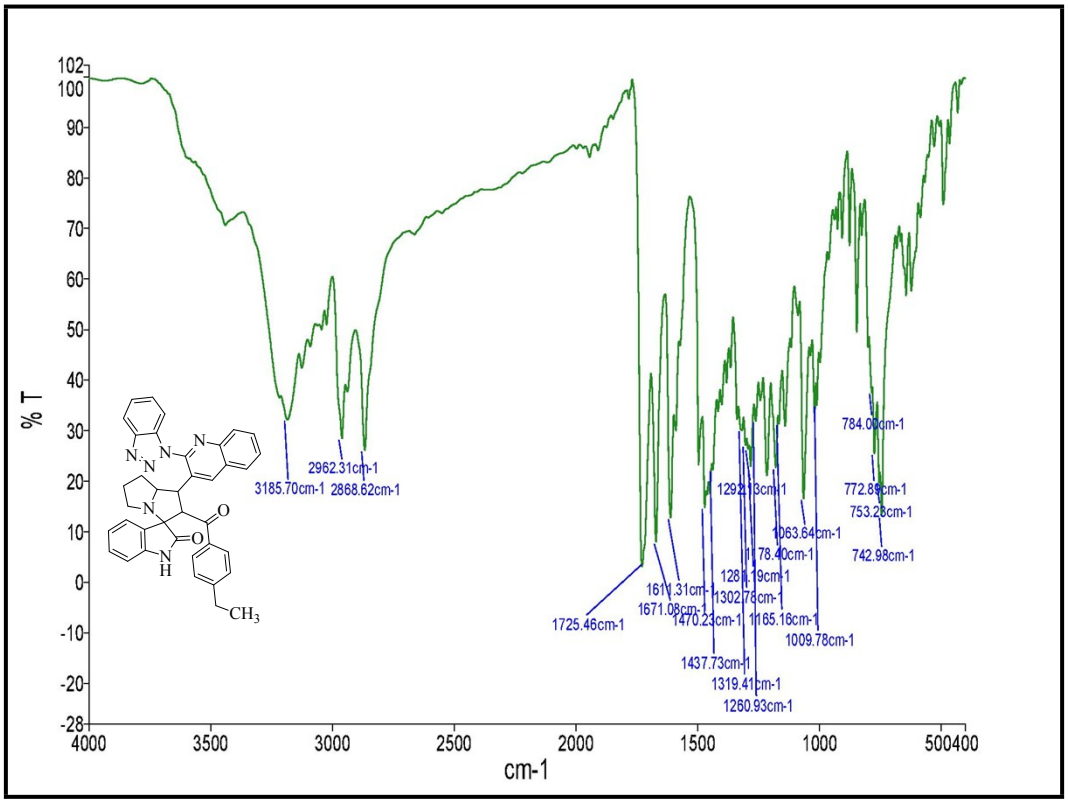
$^{13}$C NMR Spectrum of compound **4c**



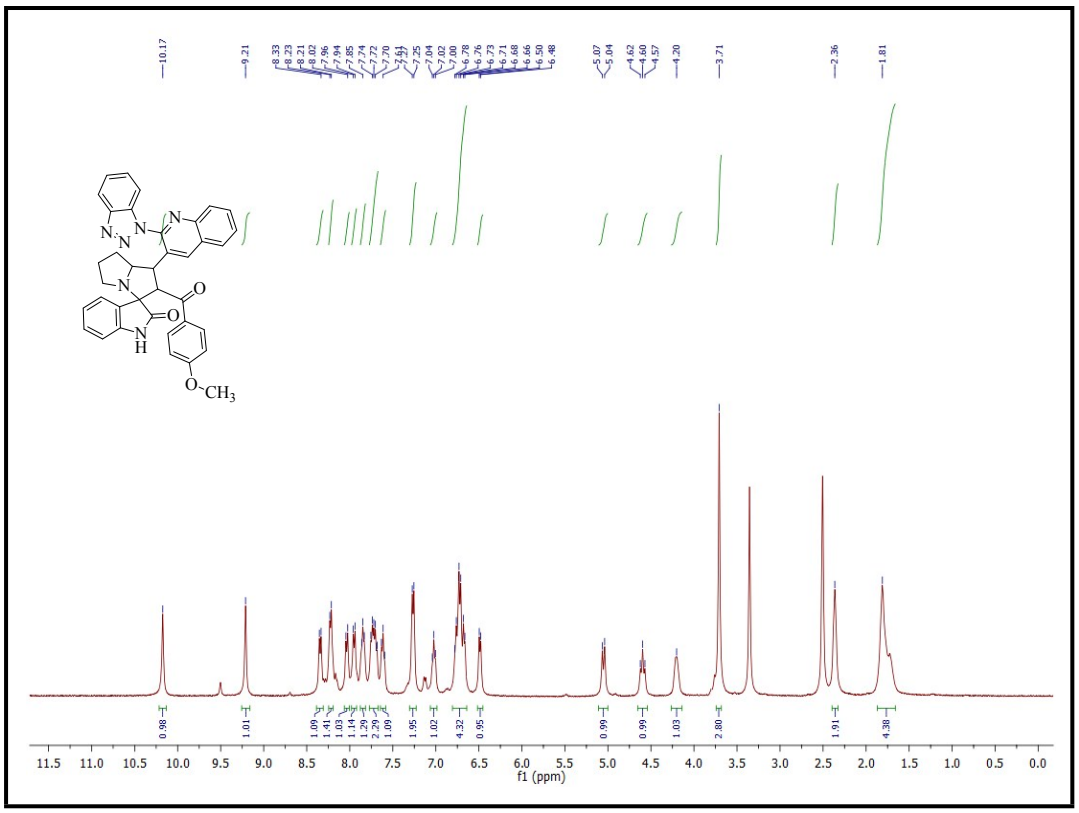

Mass spectrum of compound **4c**



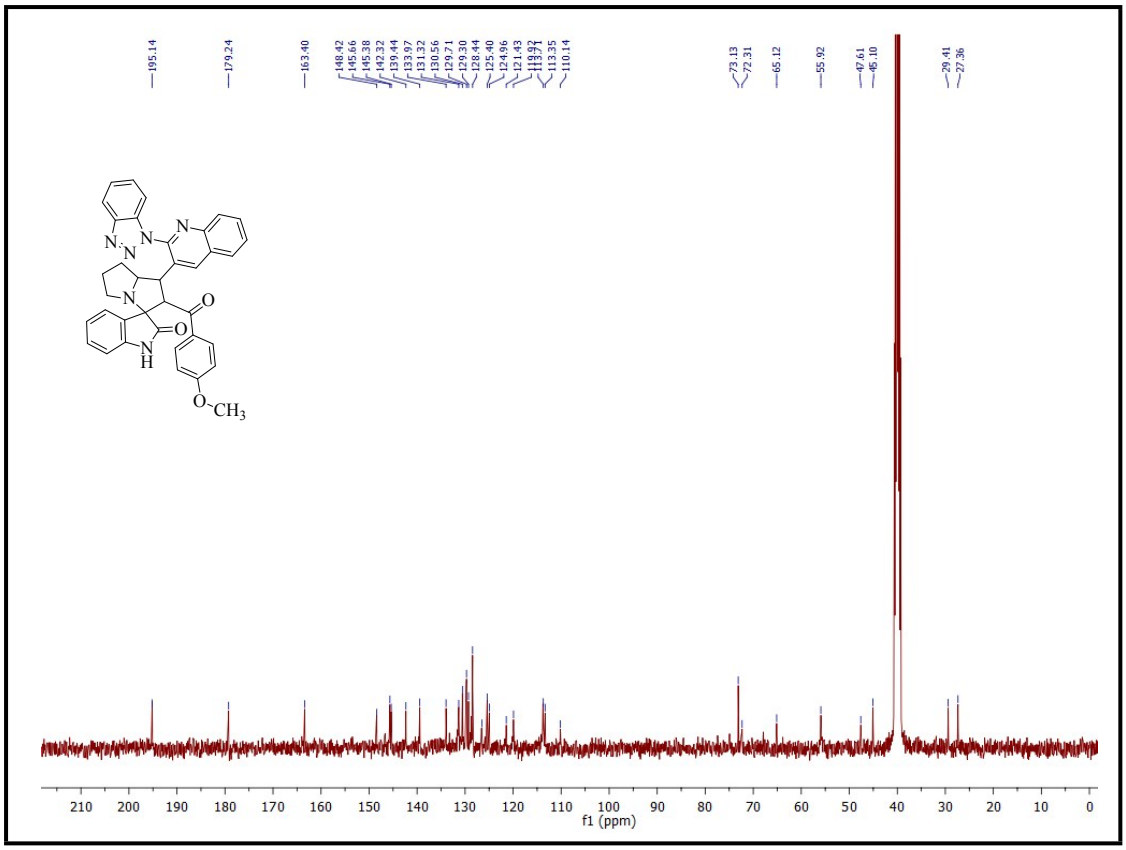
IR Spectrum of compound **4c**



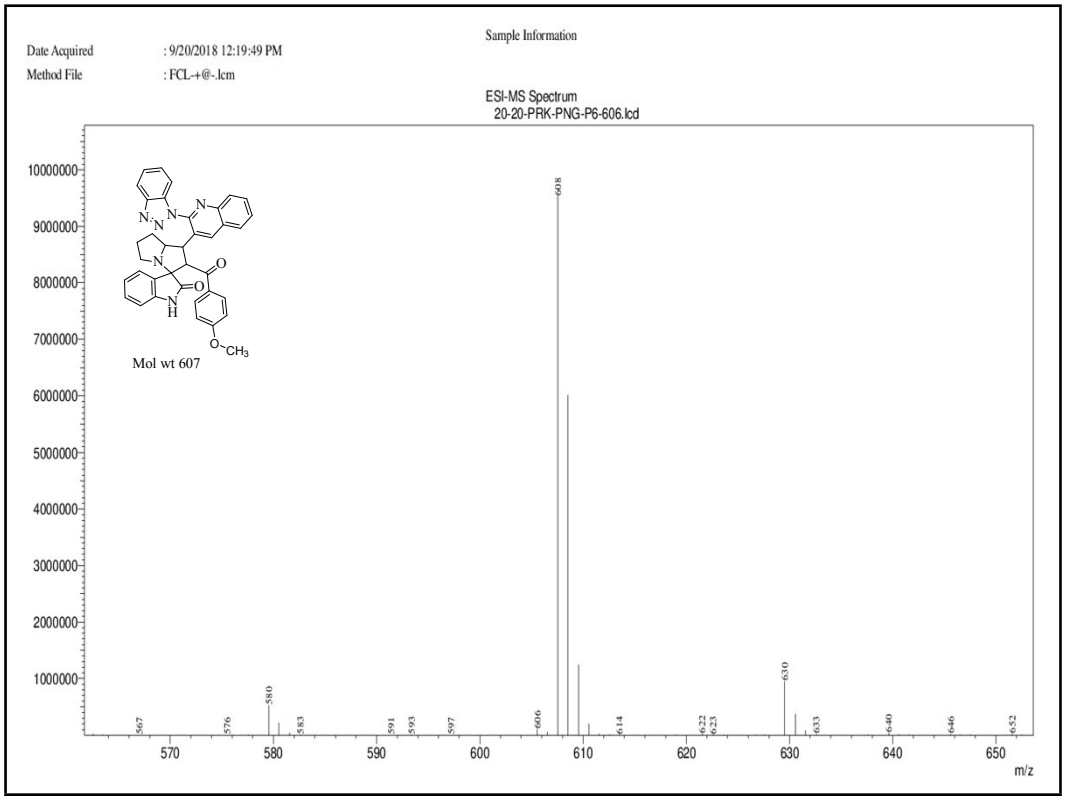

$^{1}$H NMR Spectrum of compound **4d**



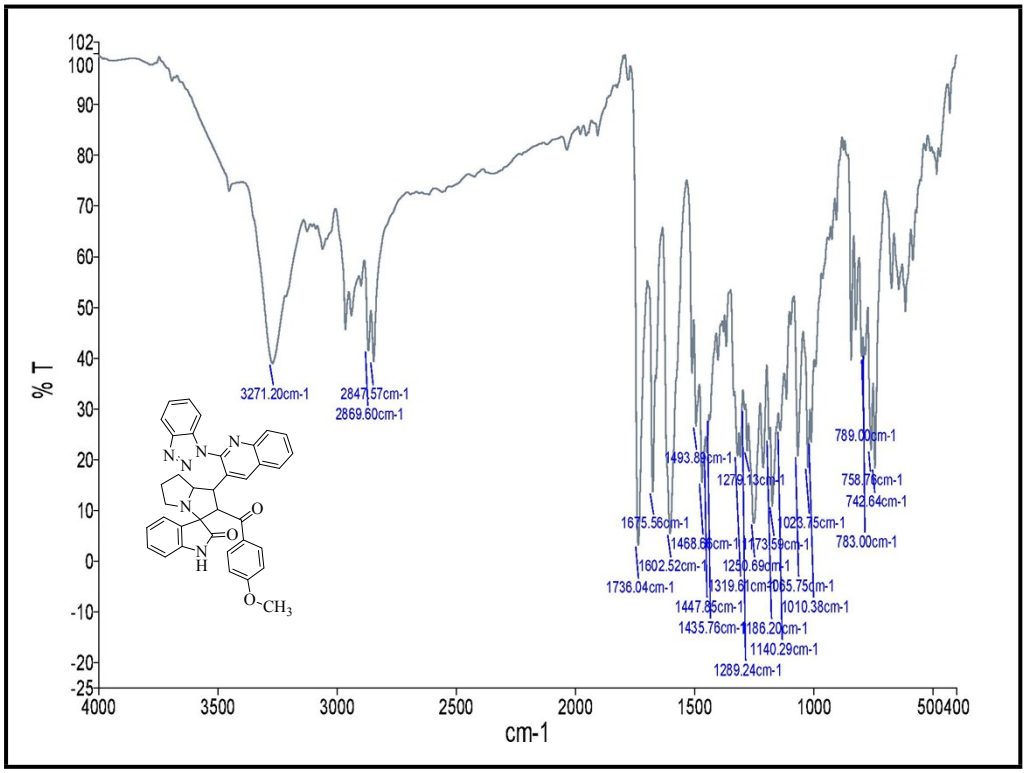
$^{13}$C NMR Spectrum of compound **4d**



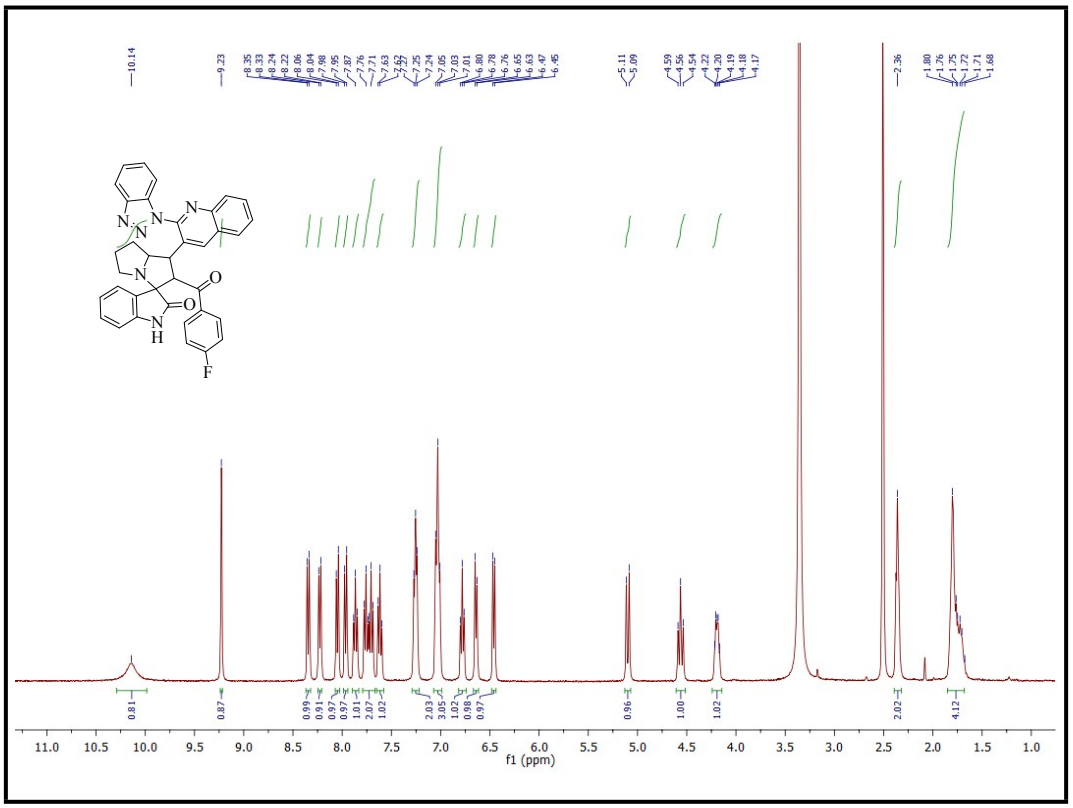

Mass spectrum of compound **4d**



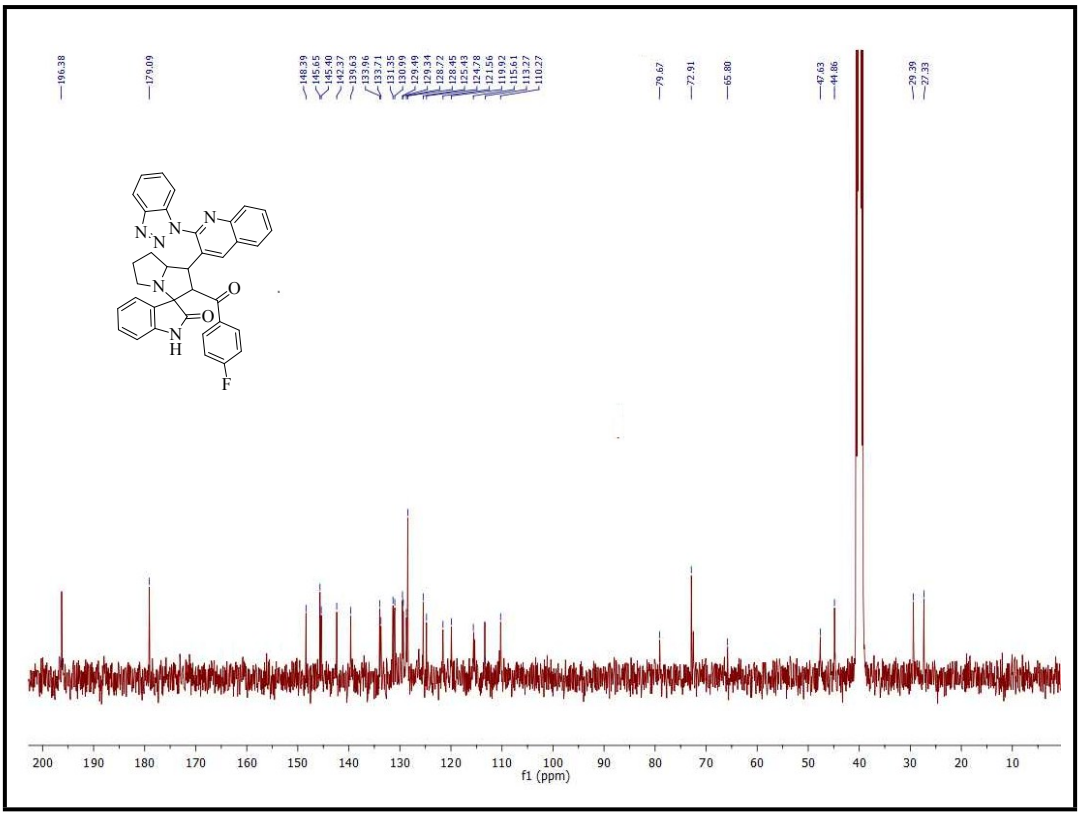
IR Spectrum of compound **4d**



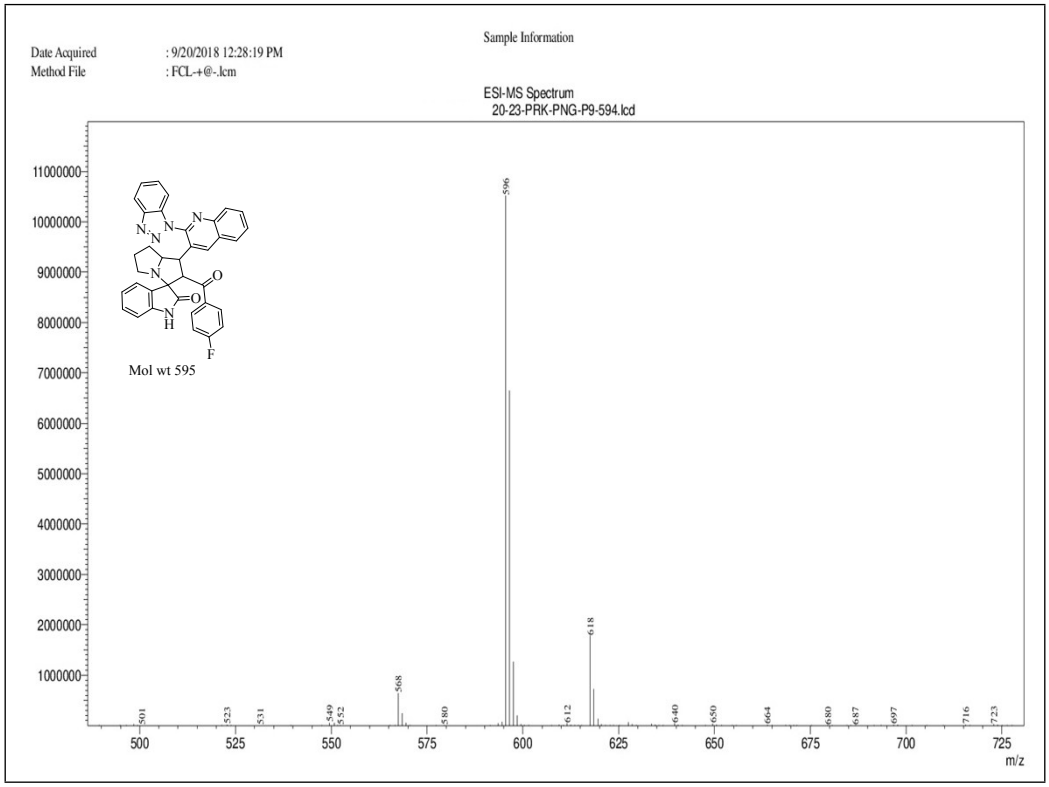

$^{1}$H NMR Spectrum of compound **4e**



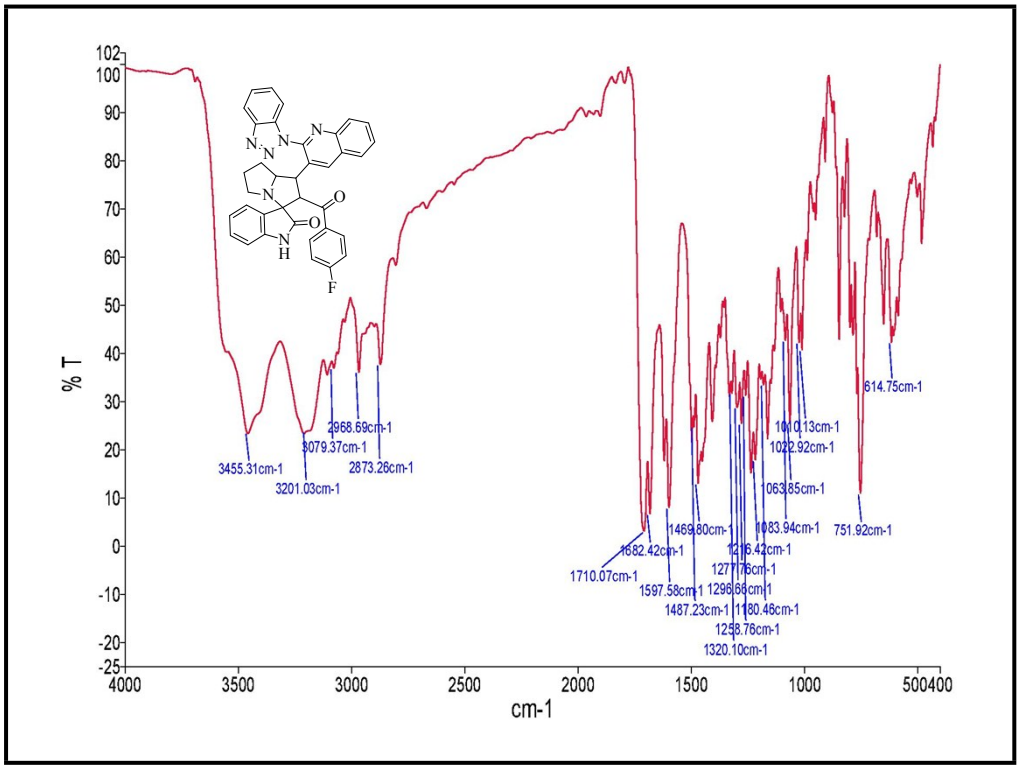
$^{13}$C NMR Spectrum of compound **4e**



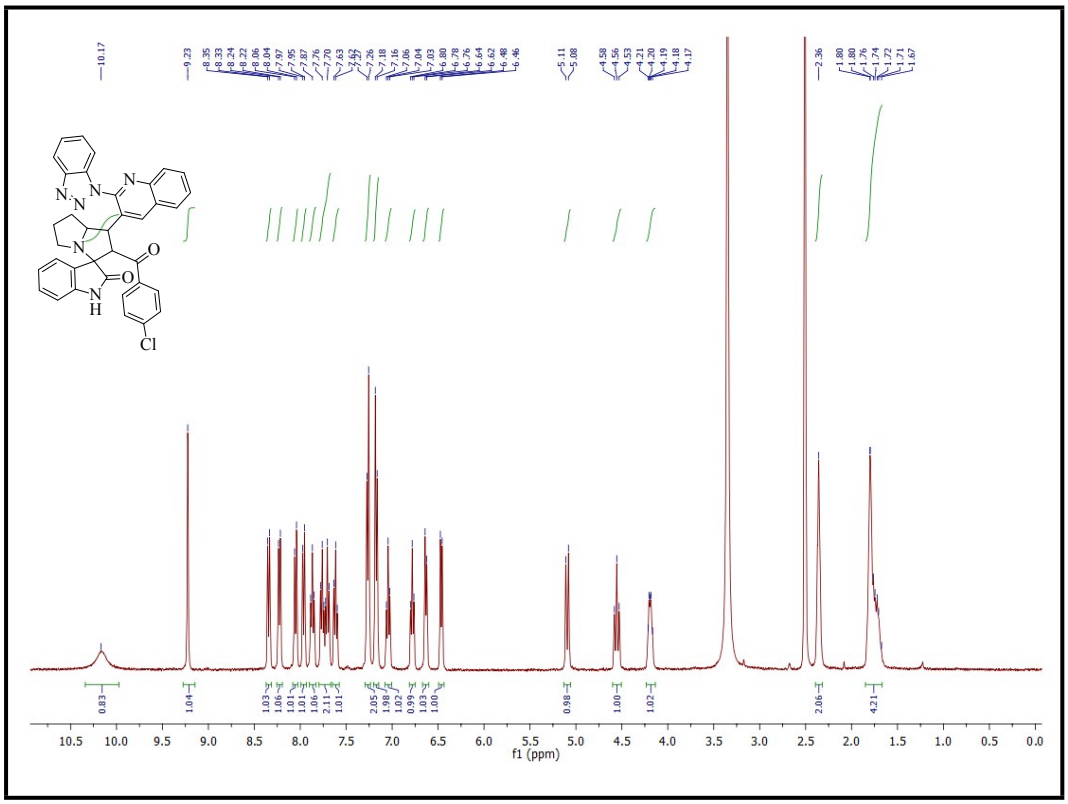

Mass spectrum of compound **4e**



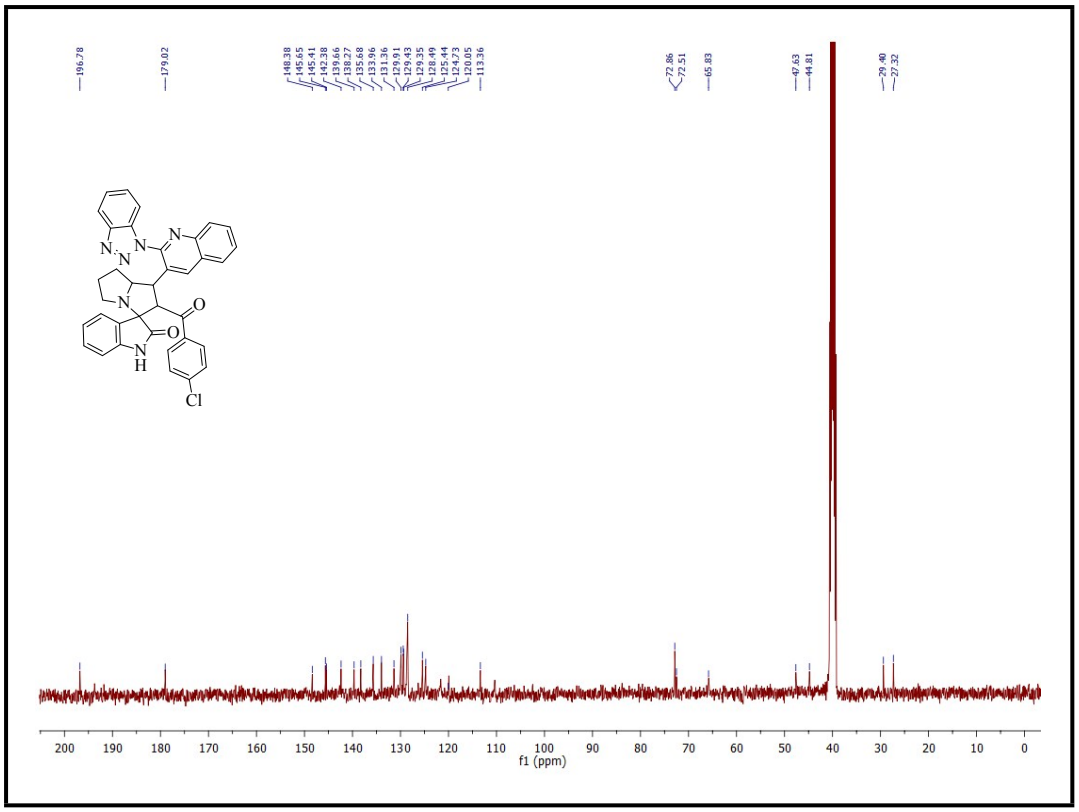
IR Spectrum of compound **4e**



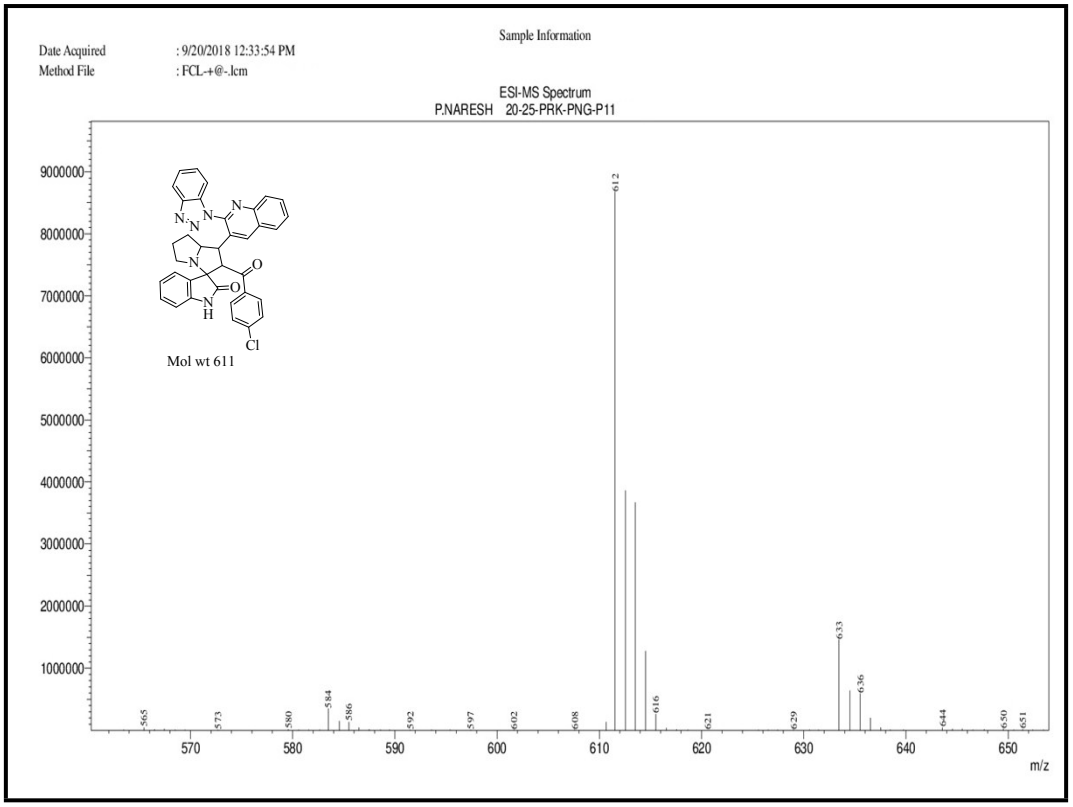

$^{1}$H NMR Spectrum of compound **4f**



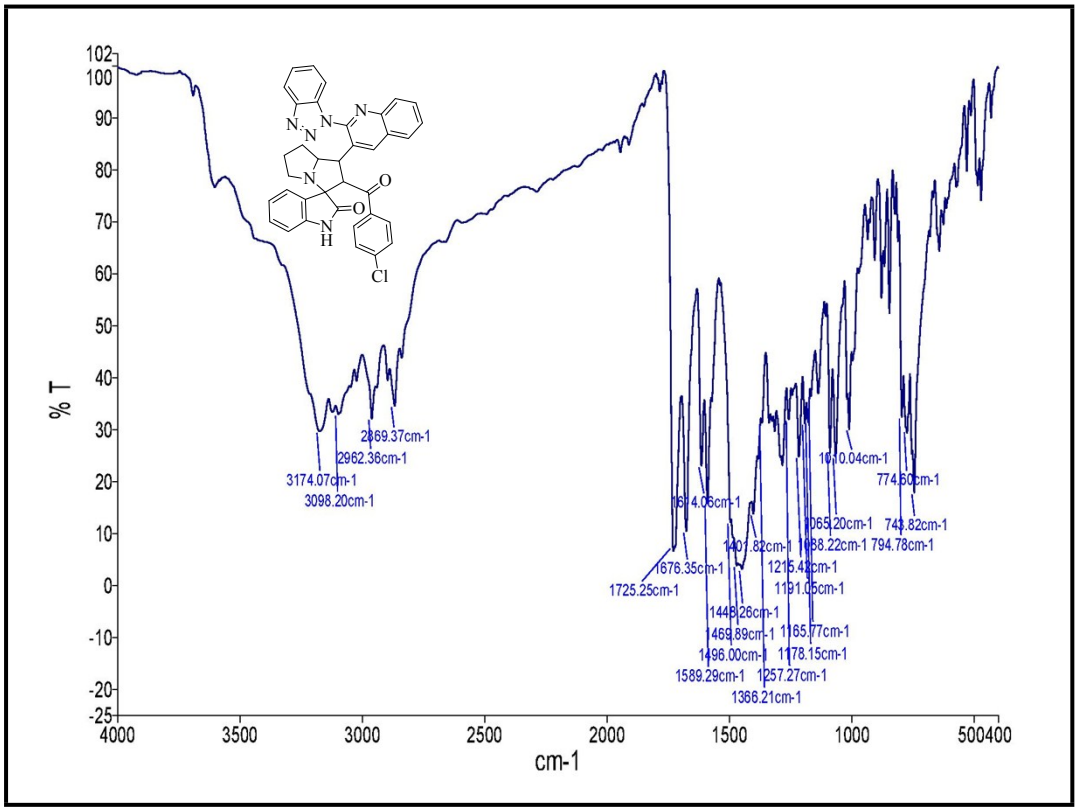
$^{13}$C NMR Spectrum of compound **4f**



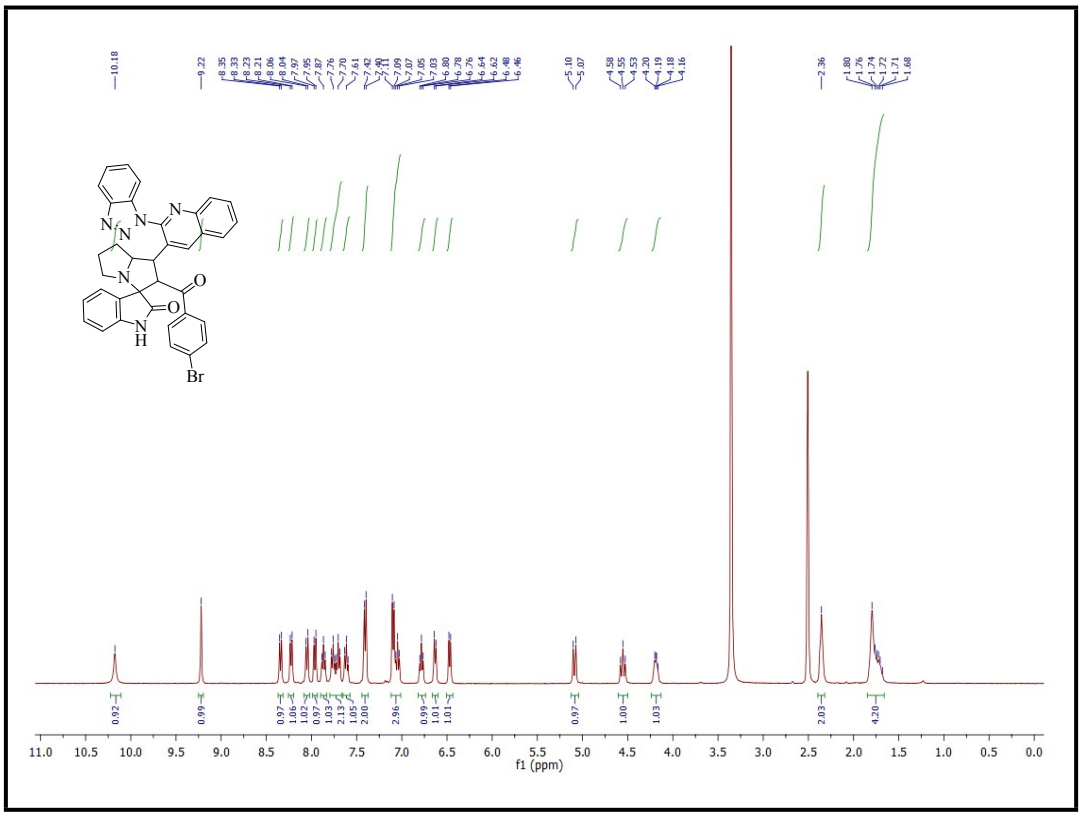

Mass spectrum of compound **4f**



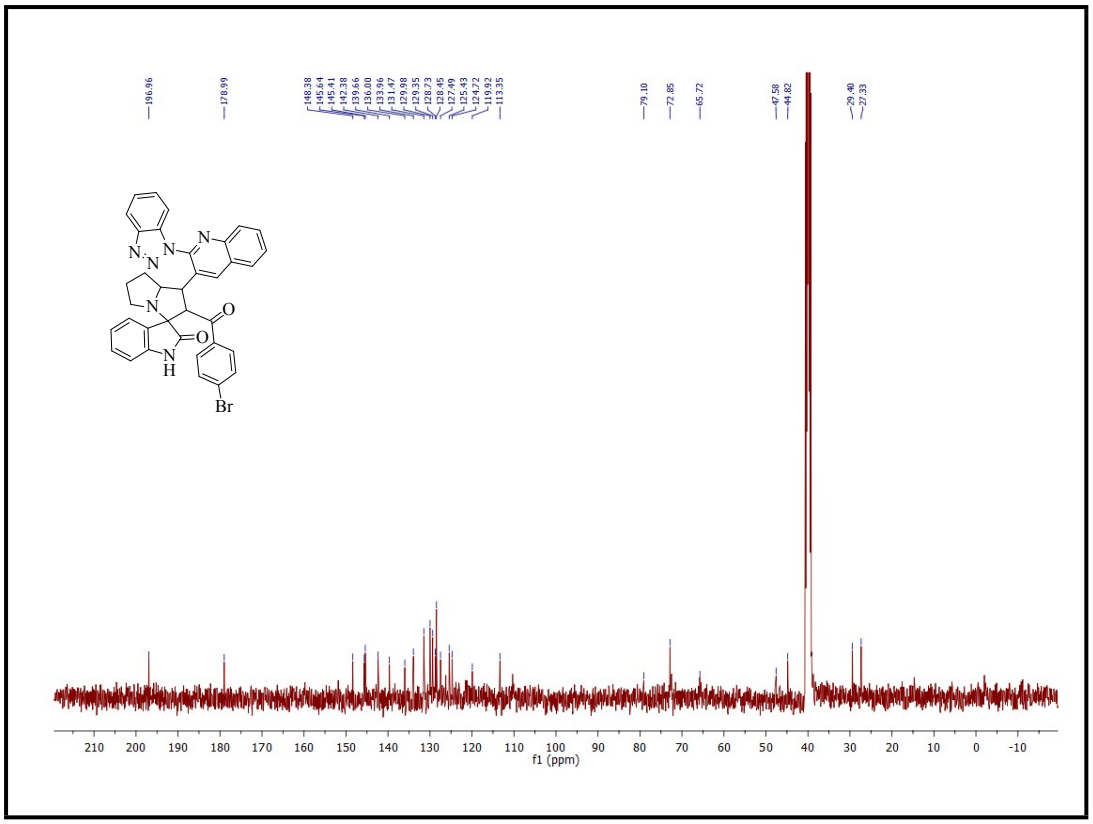
IR Spectrum of compound **4f**



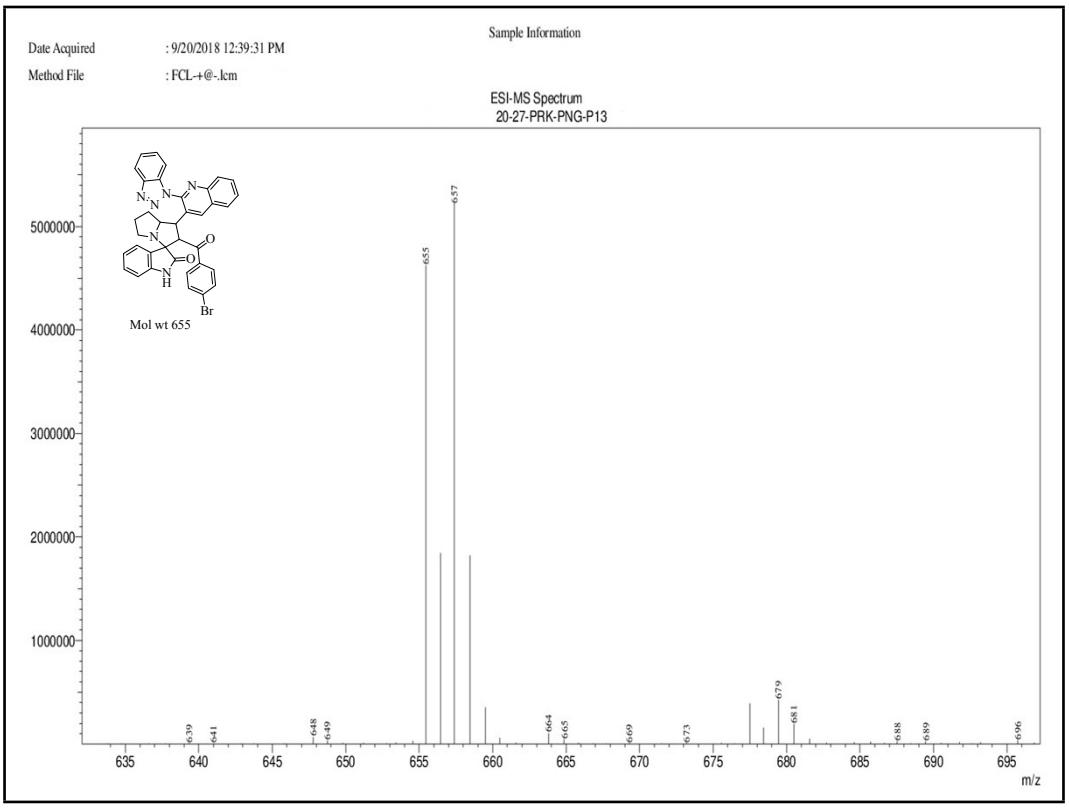

$^{1}$H NMR Spectrum of compound **4g**



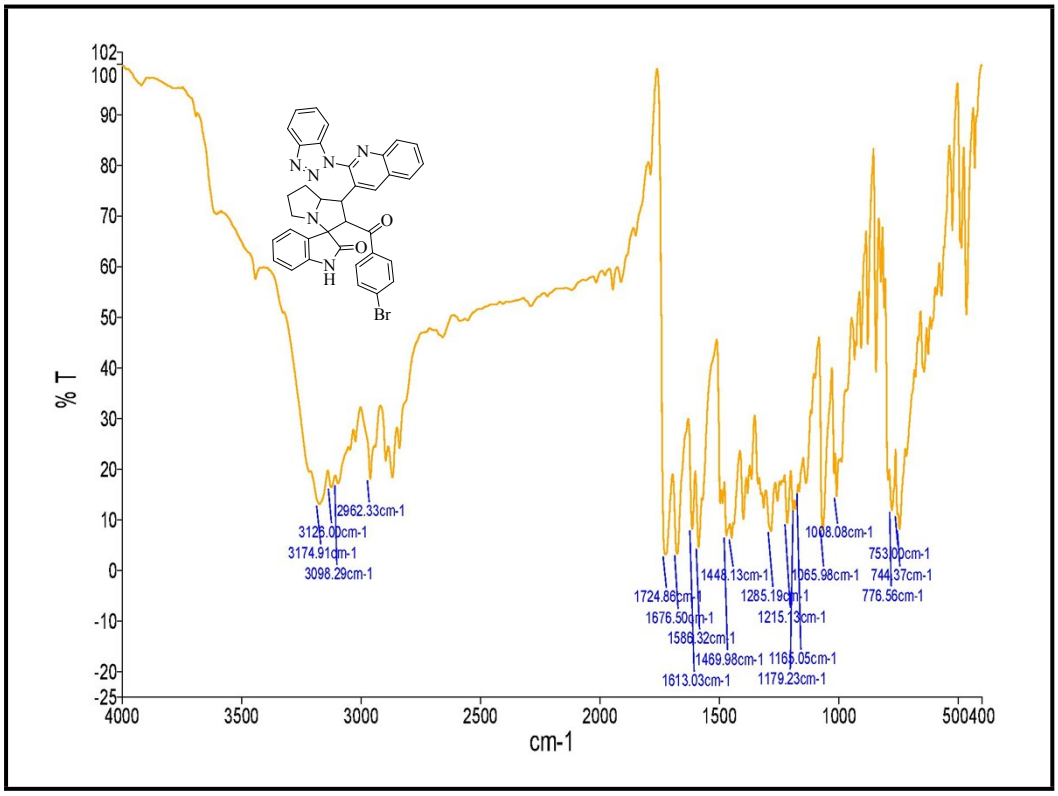
$^{13}$C NMR Spectrum of compound **4g**



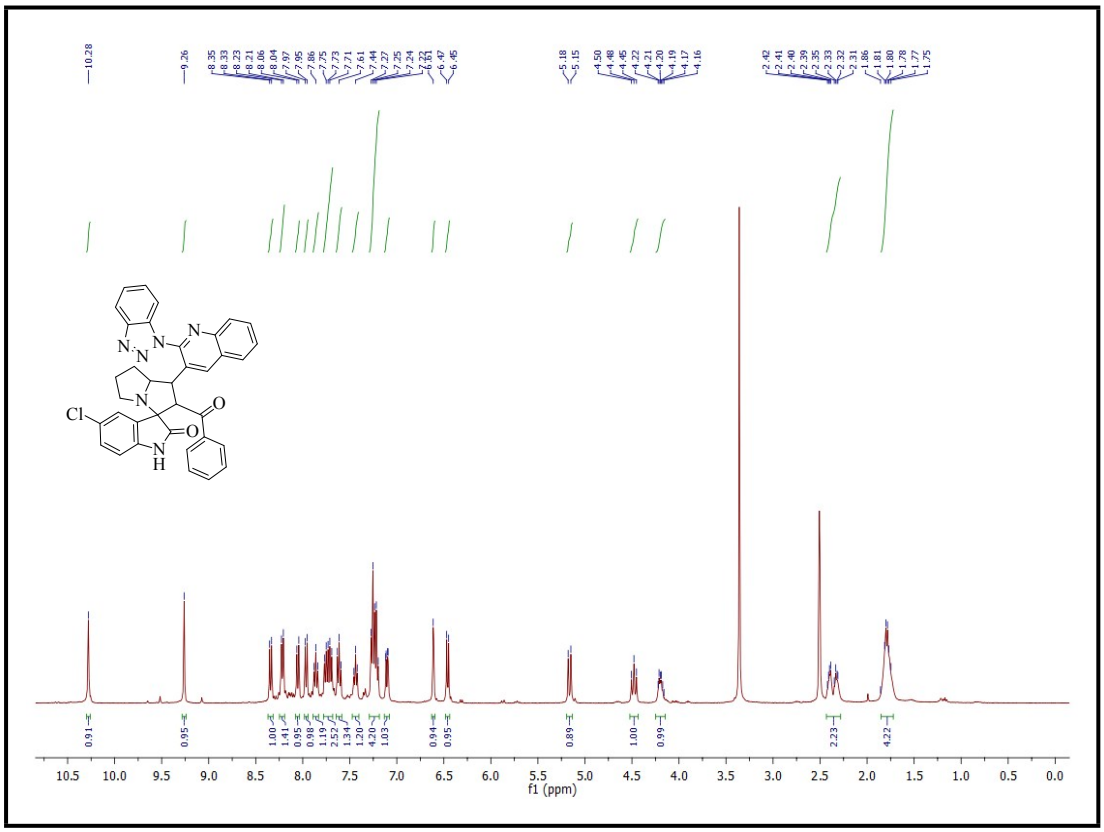

Mass spectrum of compound **4g**



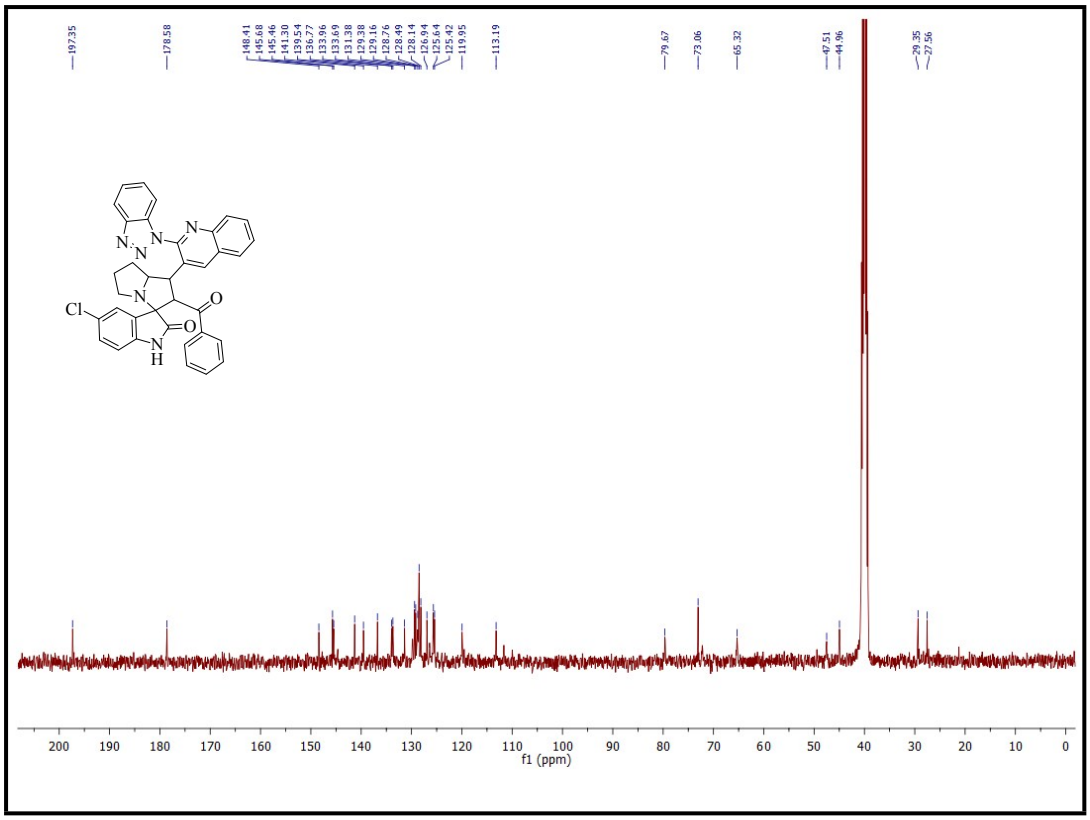
IR Spectrum of compound **4g**



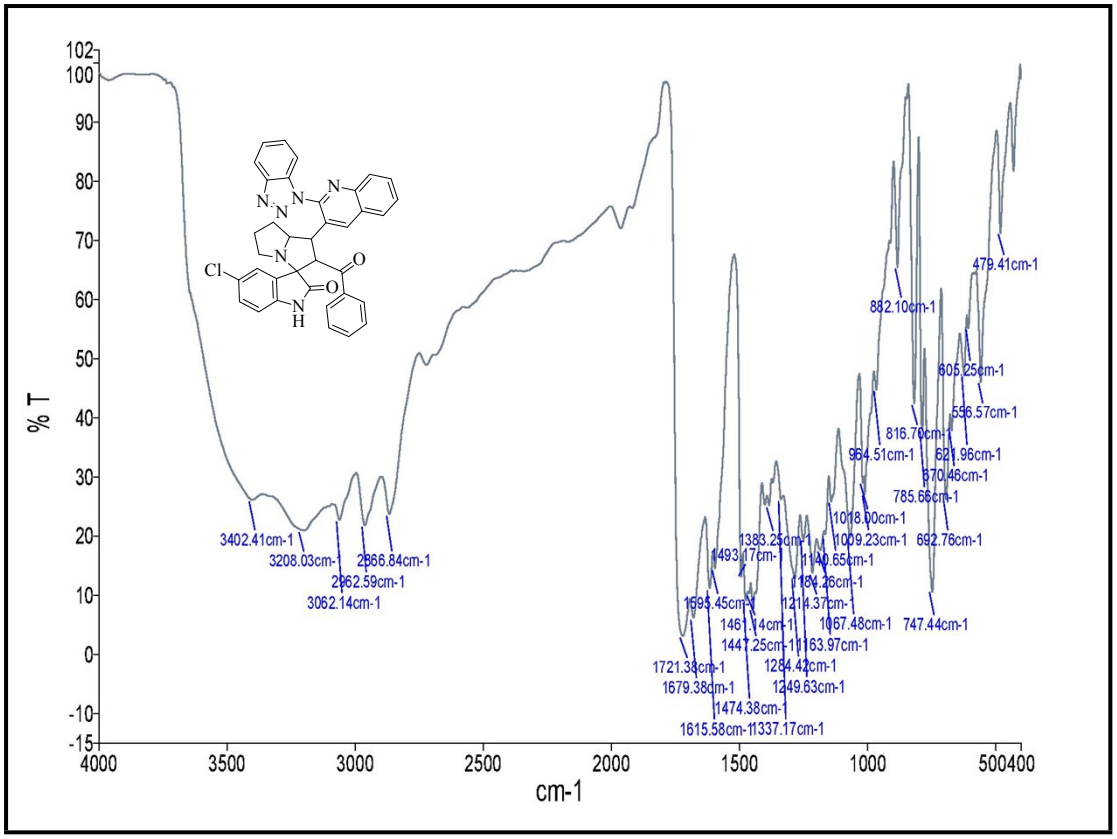

$^{1}$H NMR Spectrum of compound **4h**



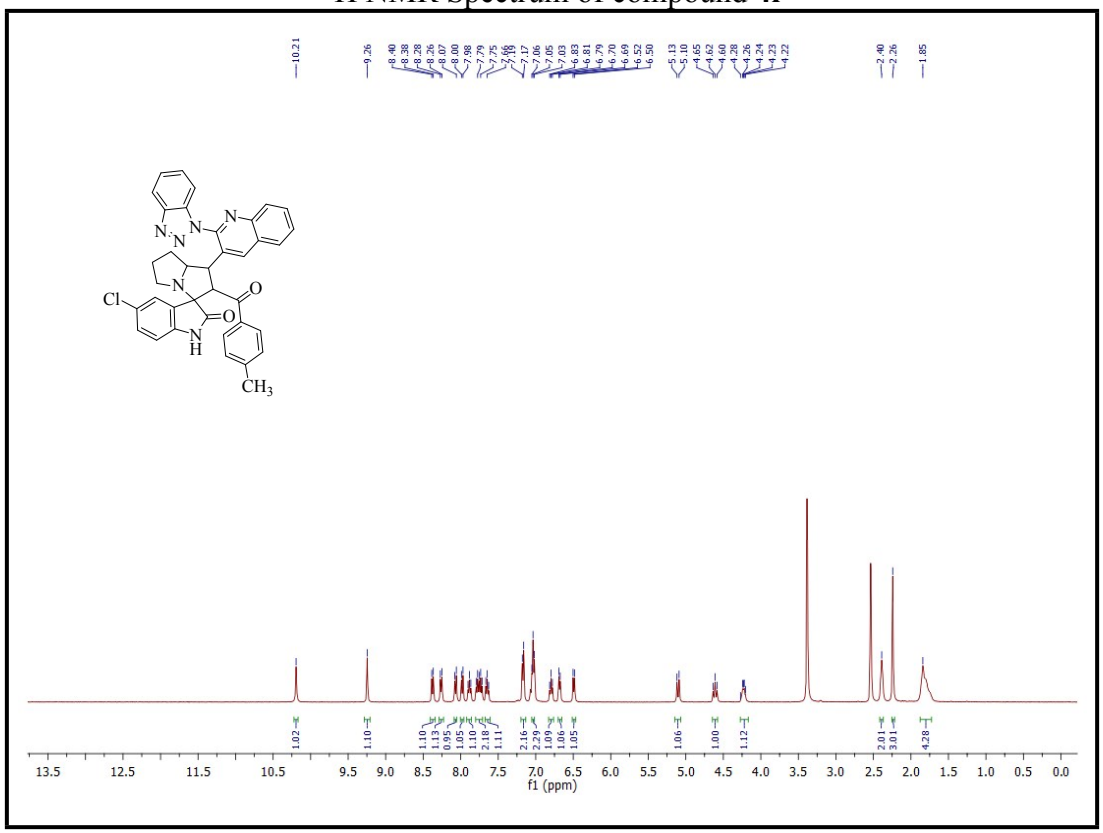
$^{13}$C NMR Spectrum of compound **4h**



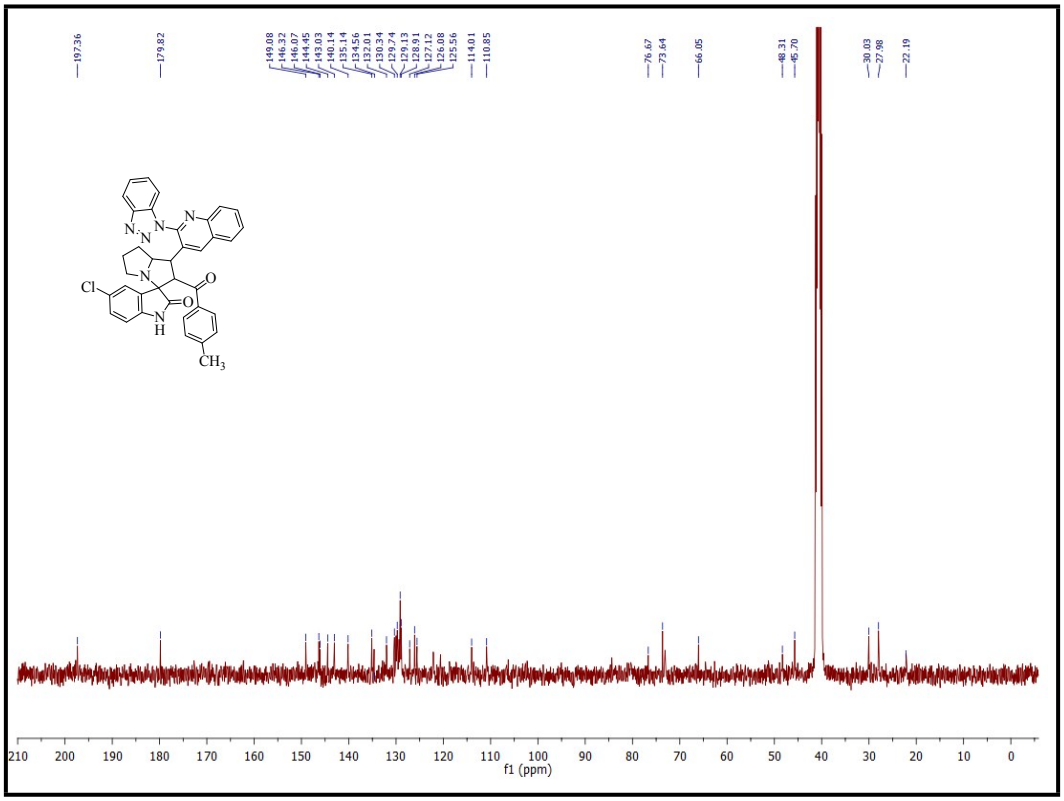

IR Spectrum of compound **4h**



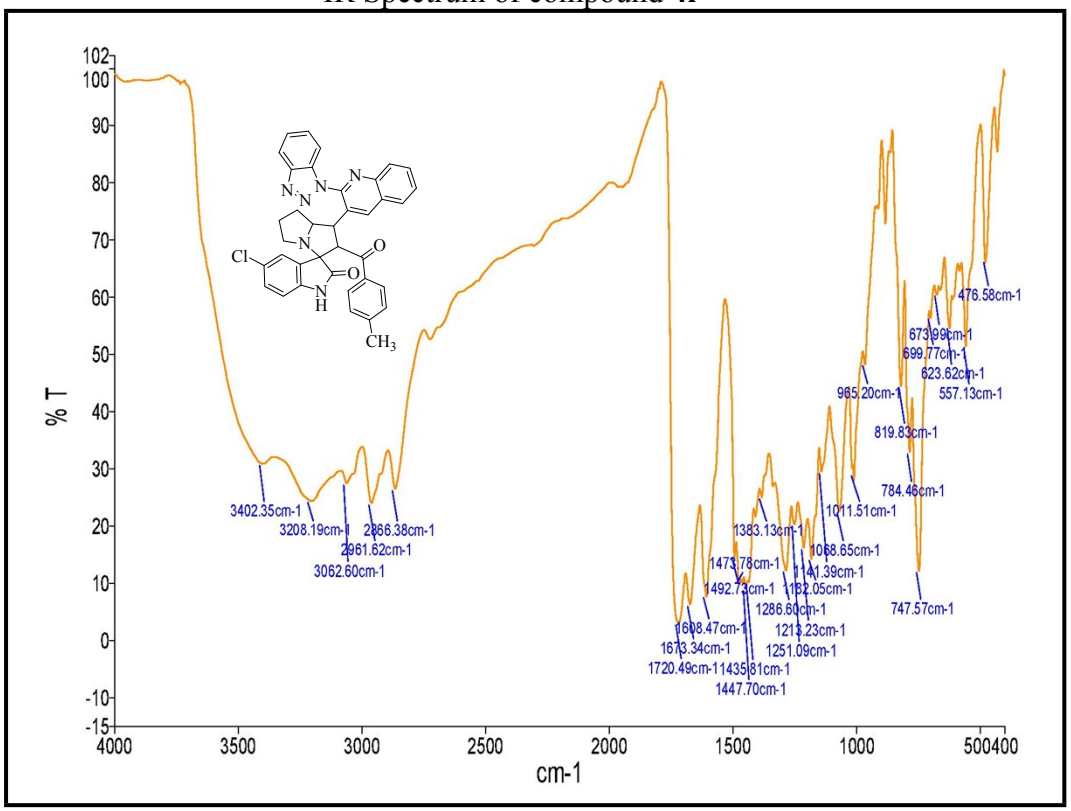
$^{1}$H NMR Spectrum of compound **4i**



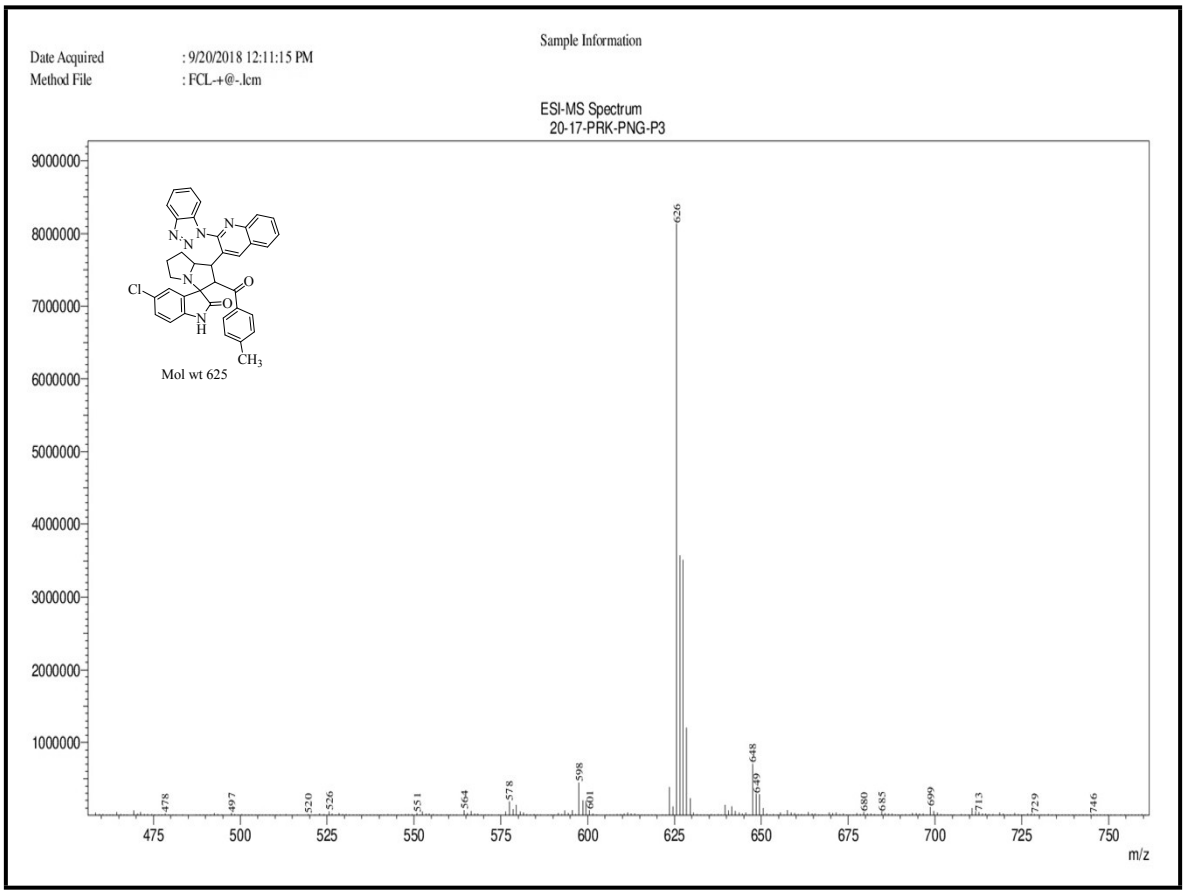

$^{13}$C NMR Spectrum of compound **4i**



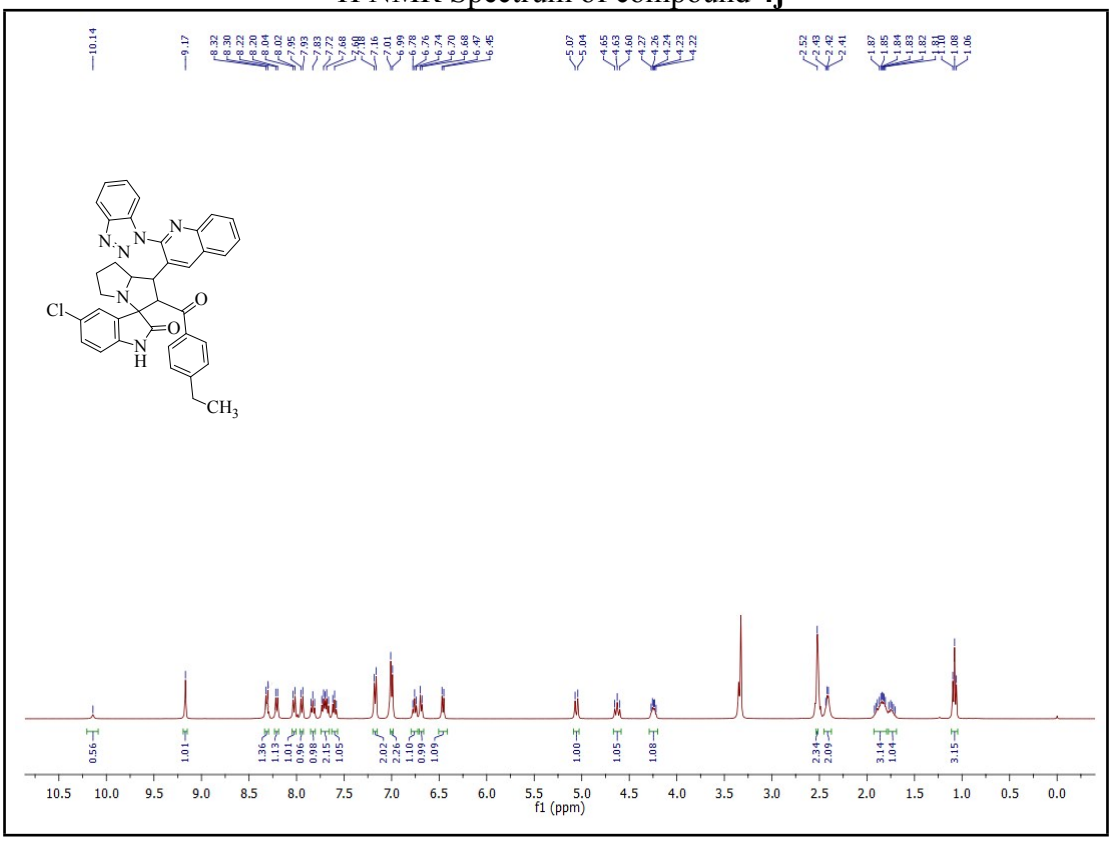
IR Spectrum of compound **4i**



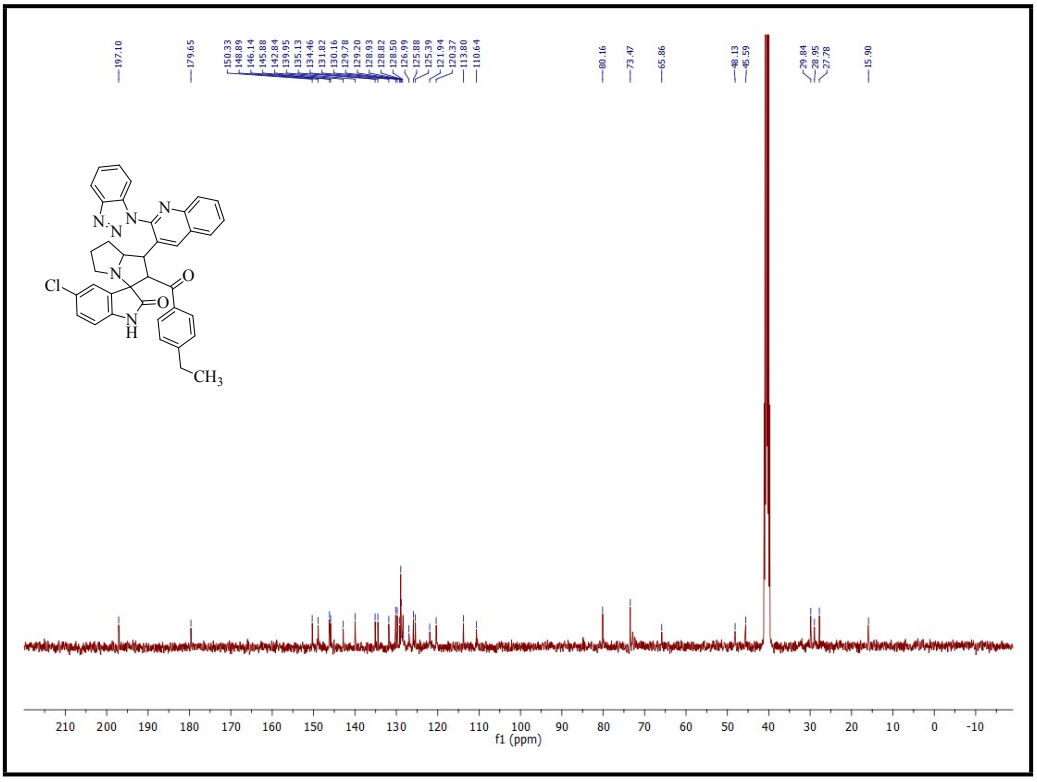

Mass spectrum of compound **4i**



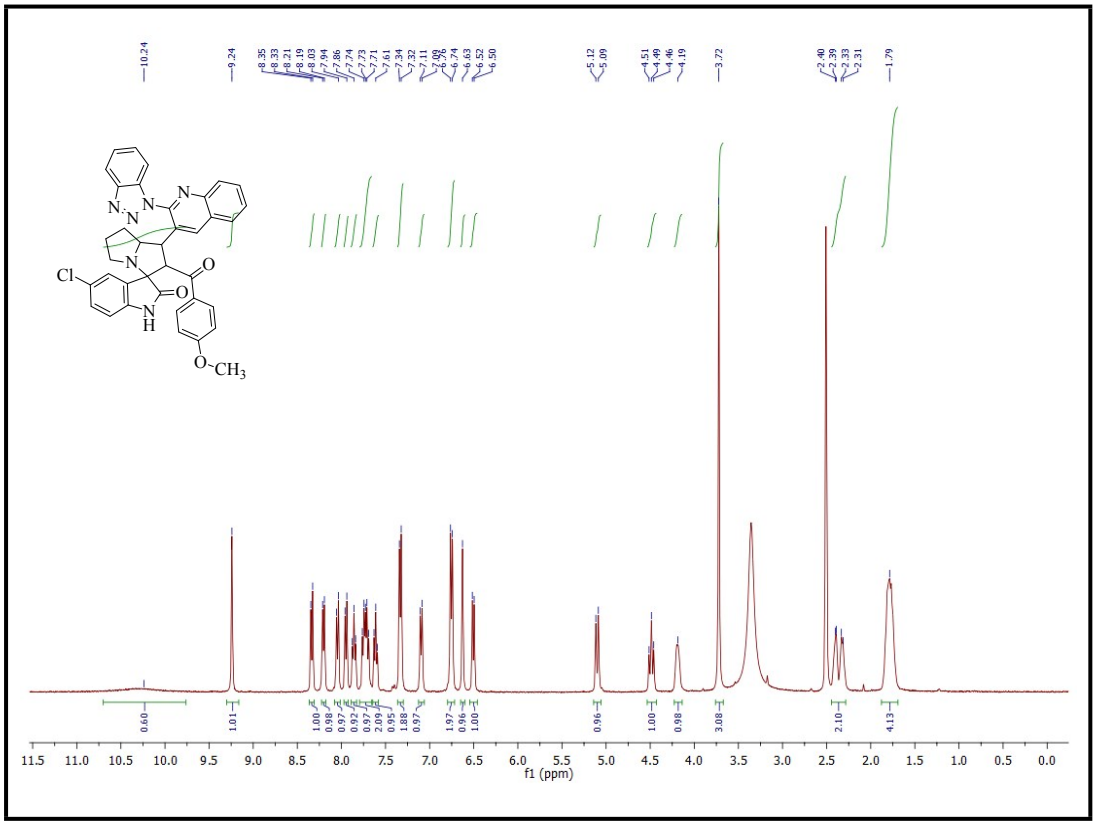
$^{1}$H NMR Spectrum of compound **4j**



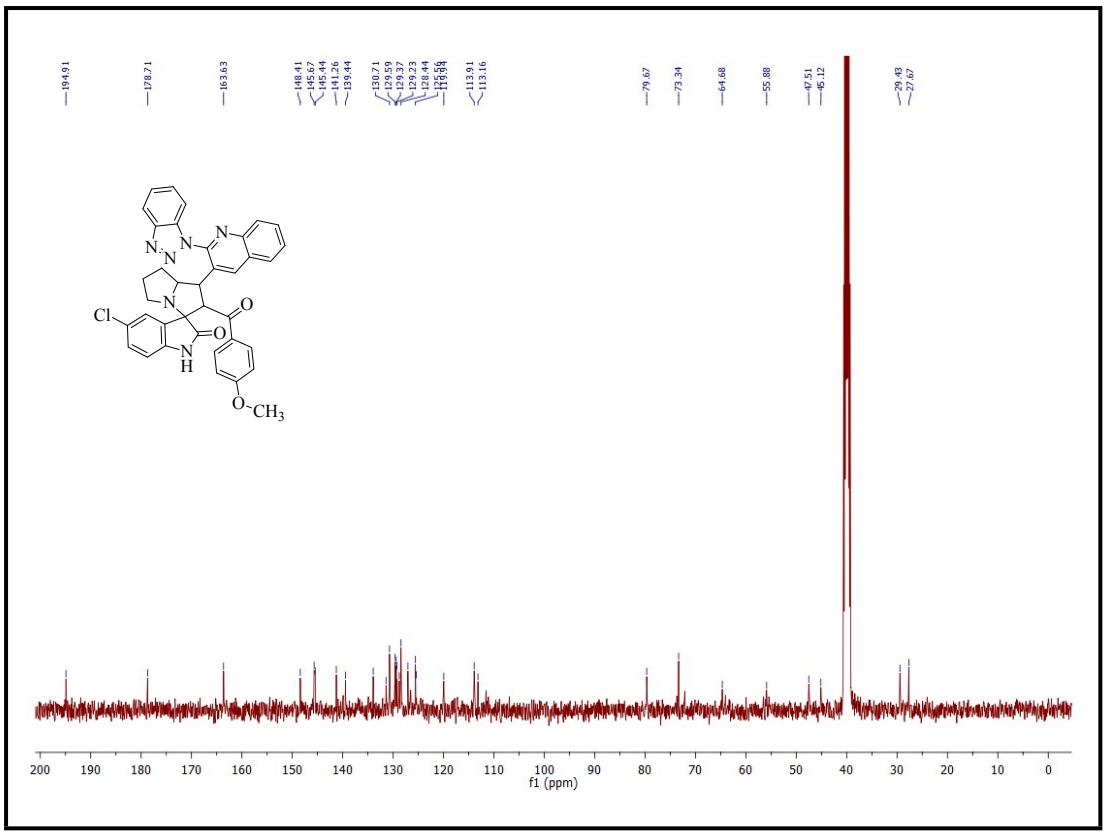

$^{13}$C NMR Spectrum of compound **4j**



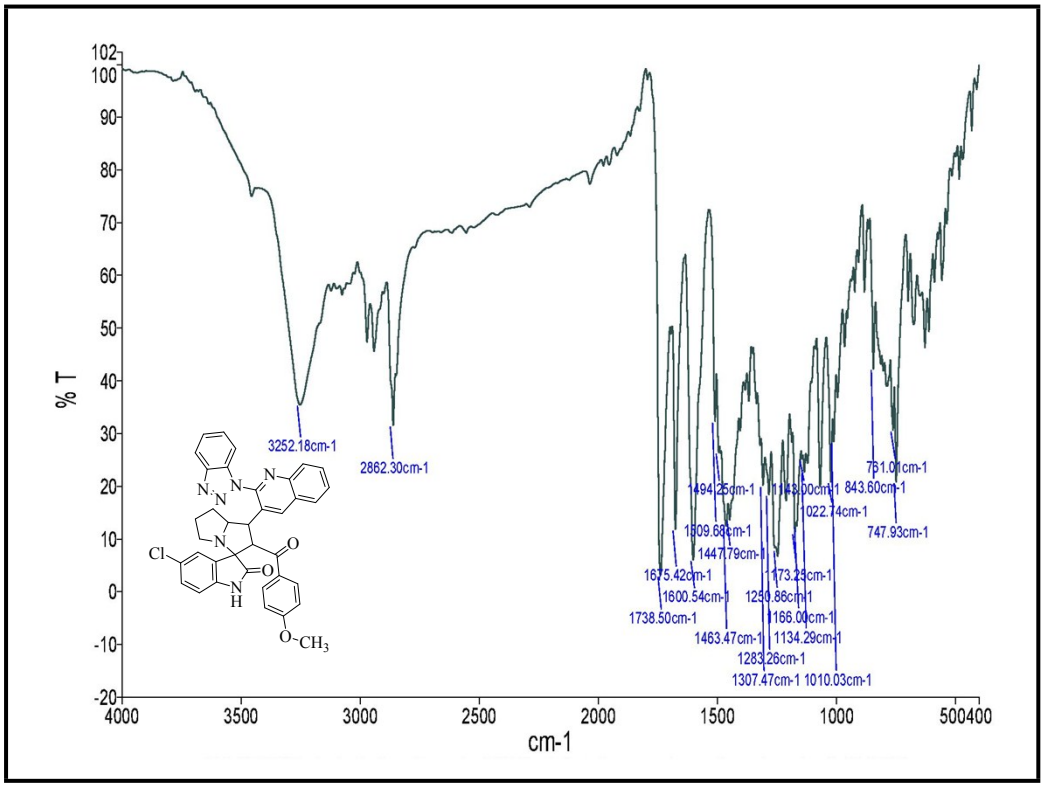
$^{1}$H NMR Spectrum of compound **4k**



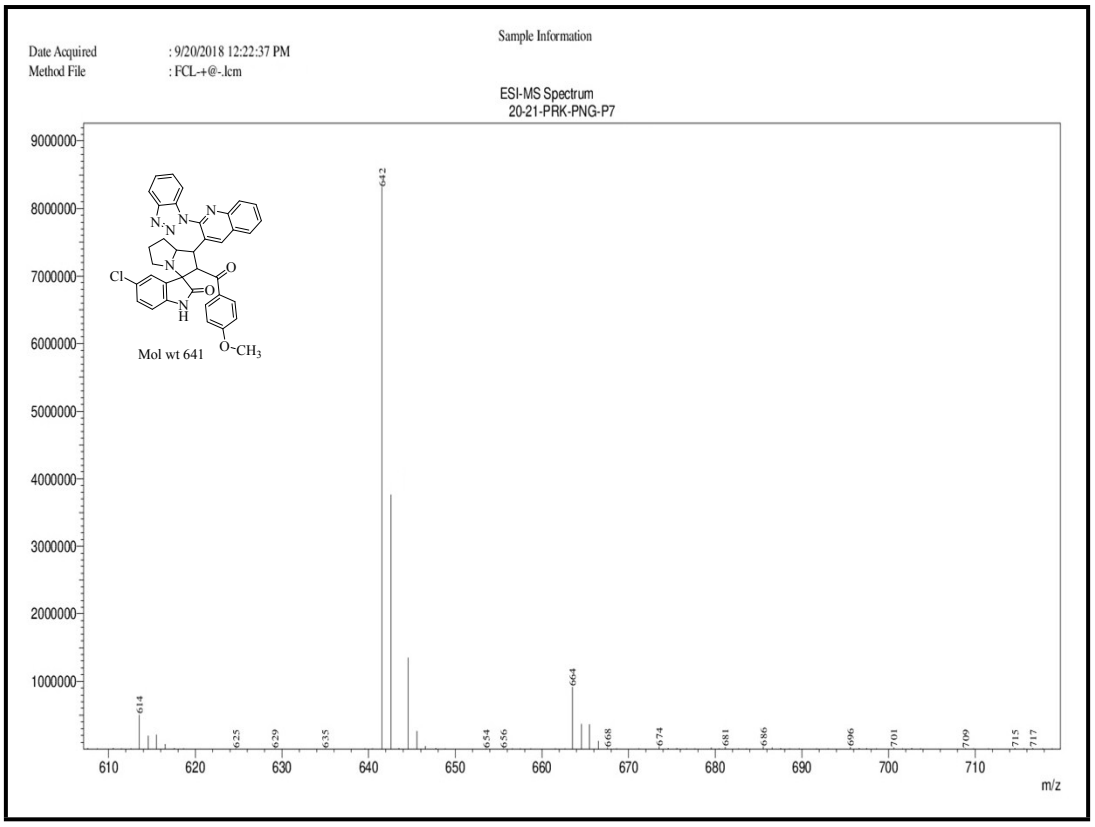

$^{13}$C NMR Spectrum of compound **4k**



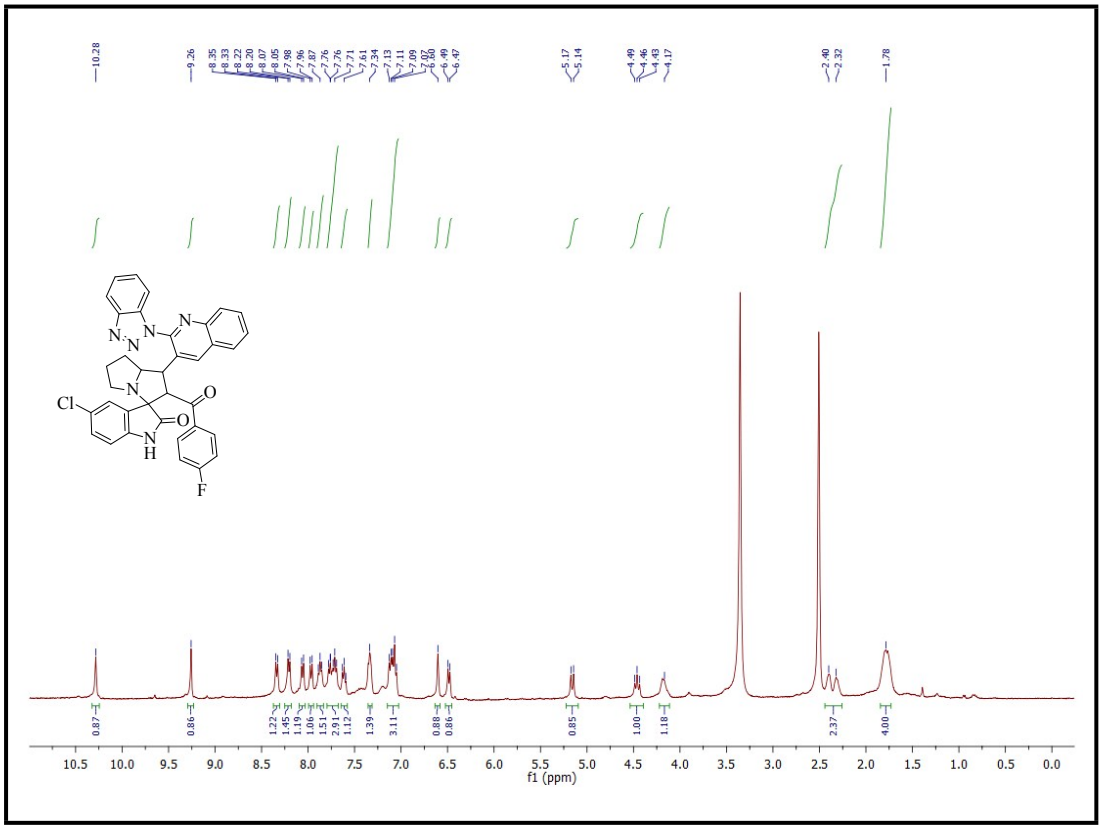
IR Spectrum of compound **4k**



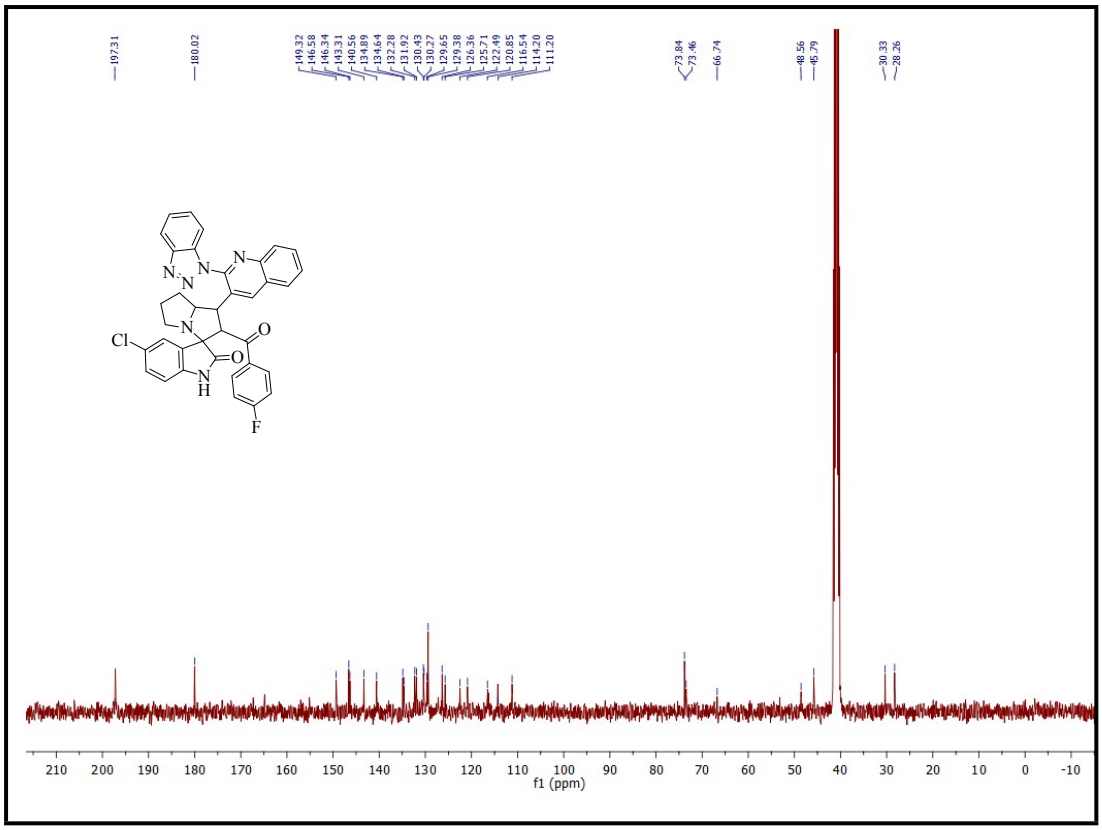

Mass spectrum of compound **4k**



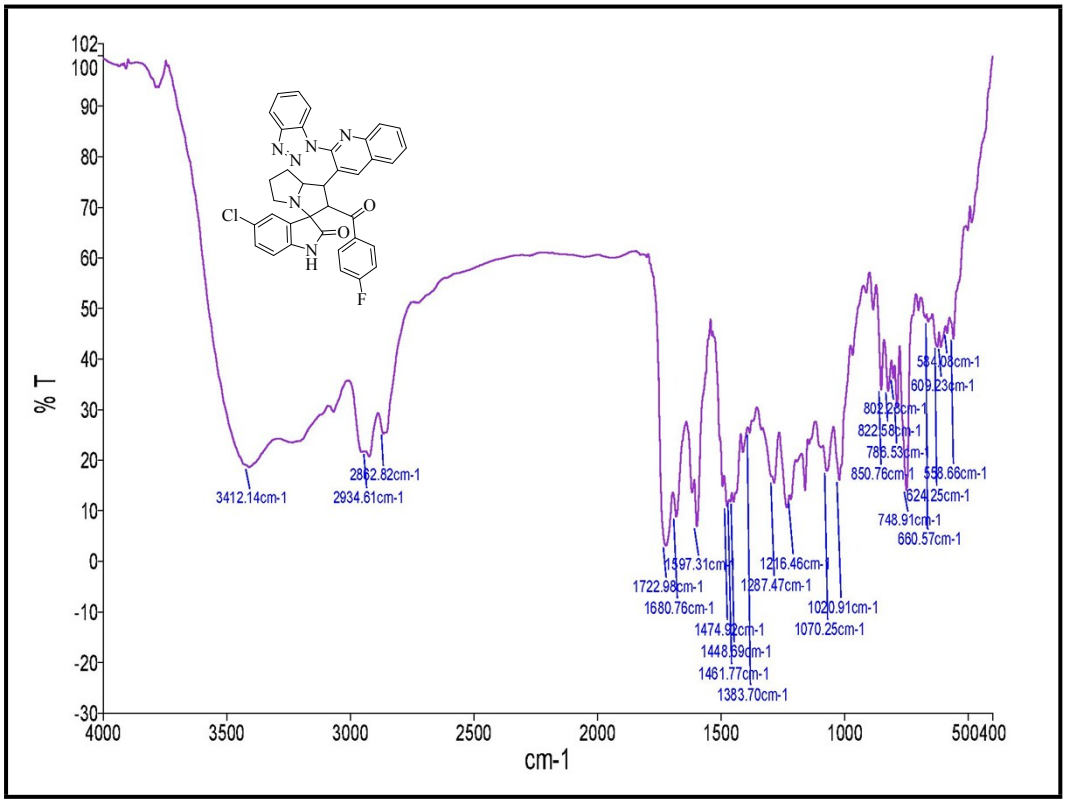
$^{1}$H NMR Spectrum of compound **4l**



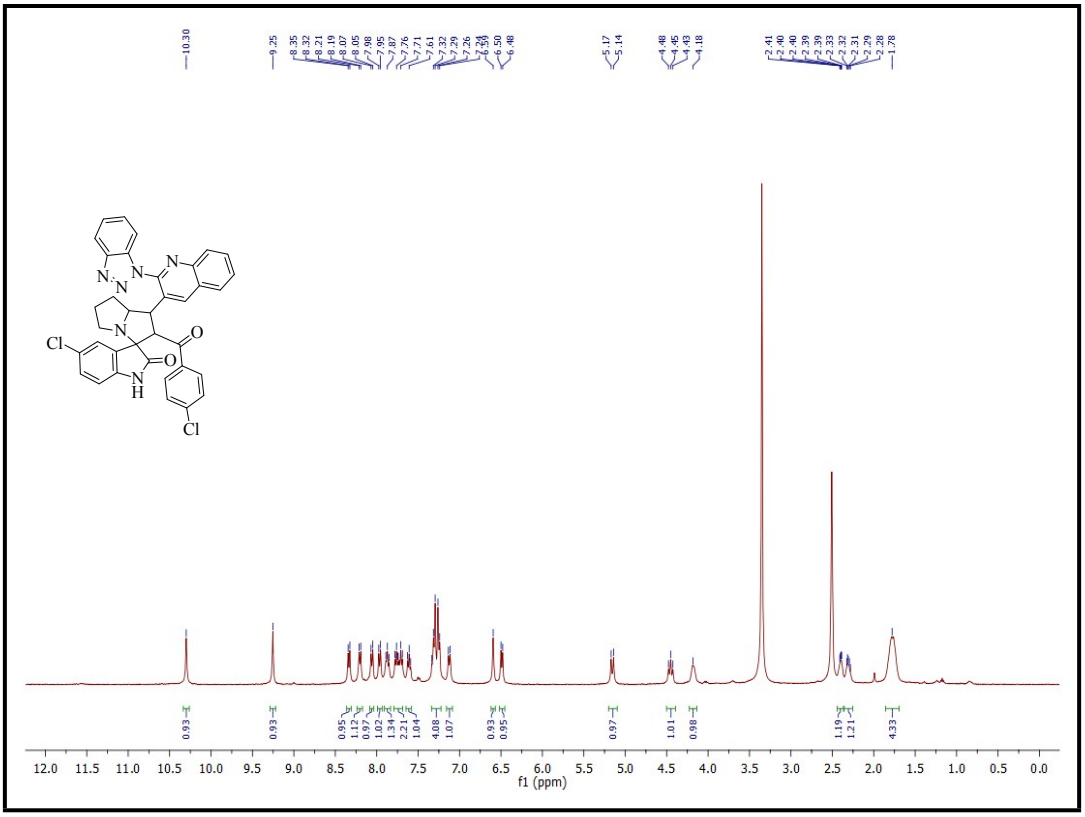

$^{13}$C NMR Spectrum of compound **4l**



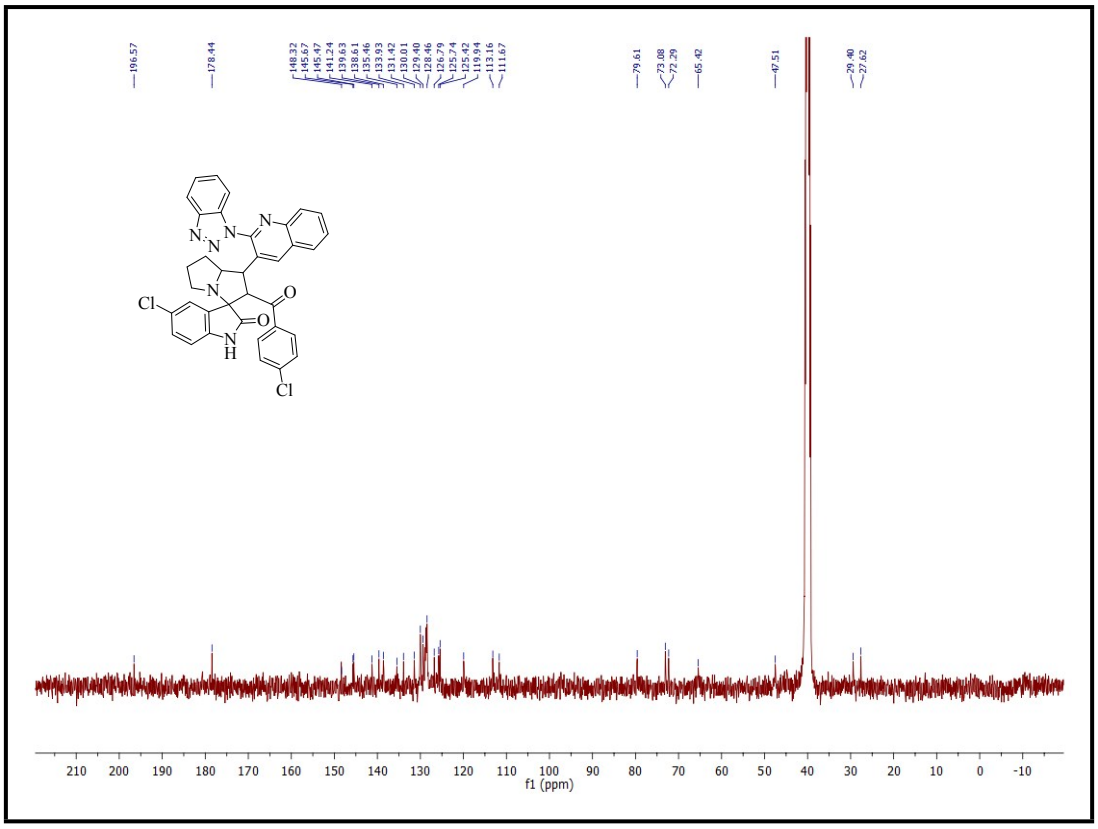
IR Spectrum of compound **4l**



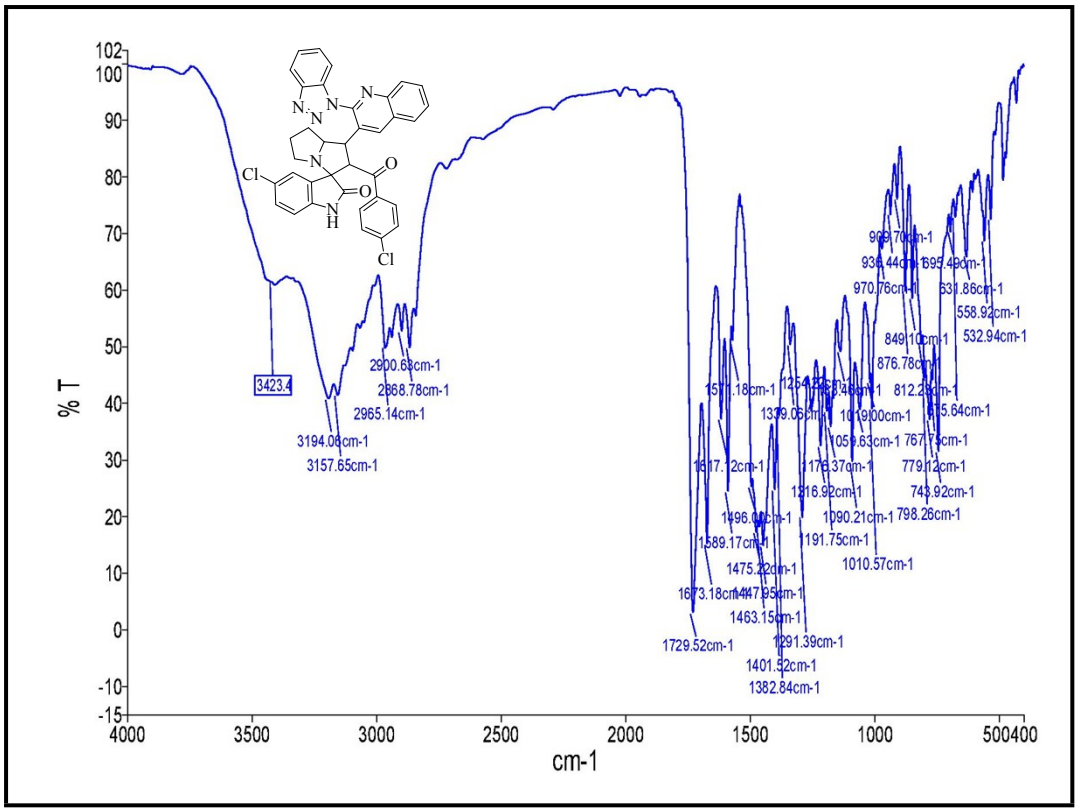

$^{1}$H NMR Spectrum of compound **4m**



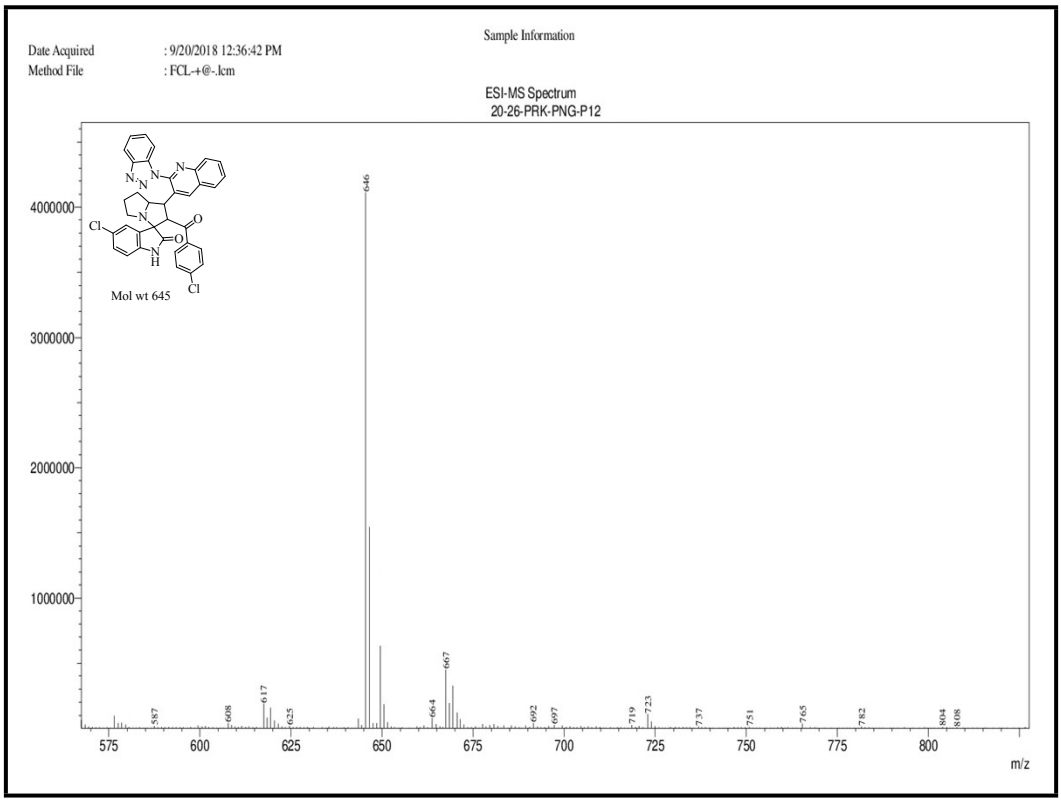
$^{13}$C NMR Spectrum of compound **4m**



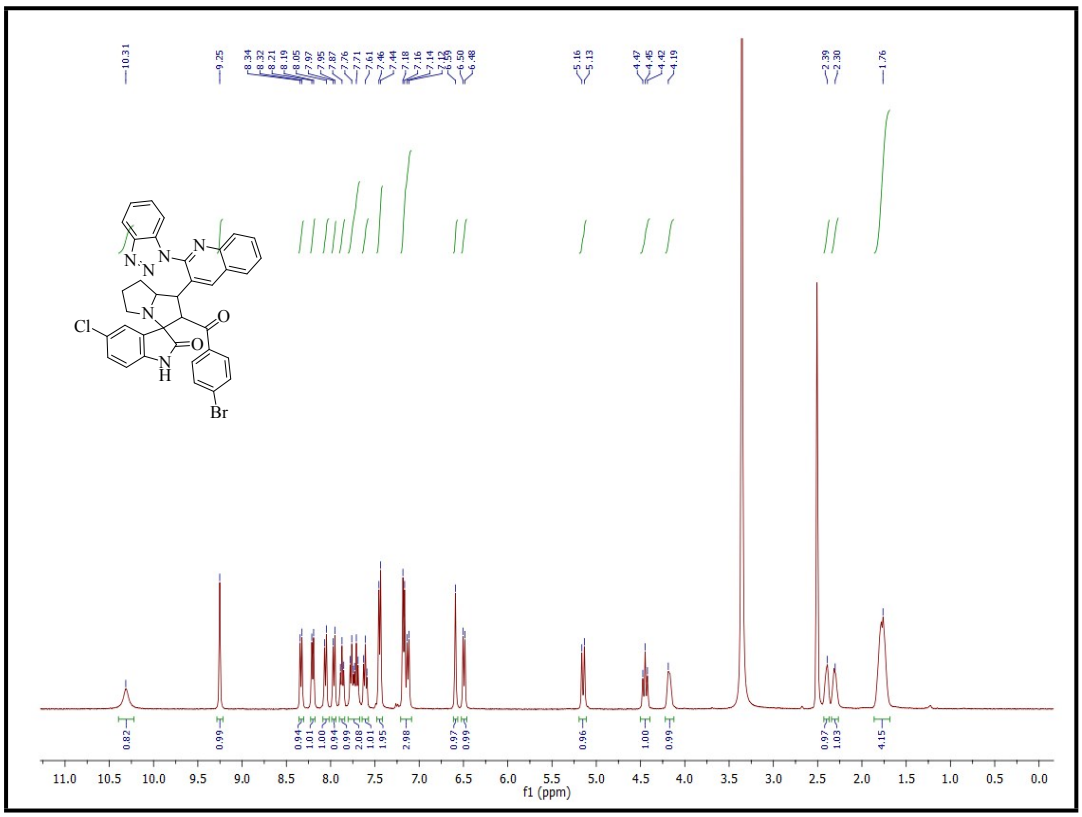

IR Spectrum of compound **4m**



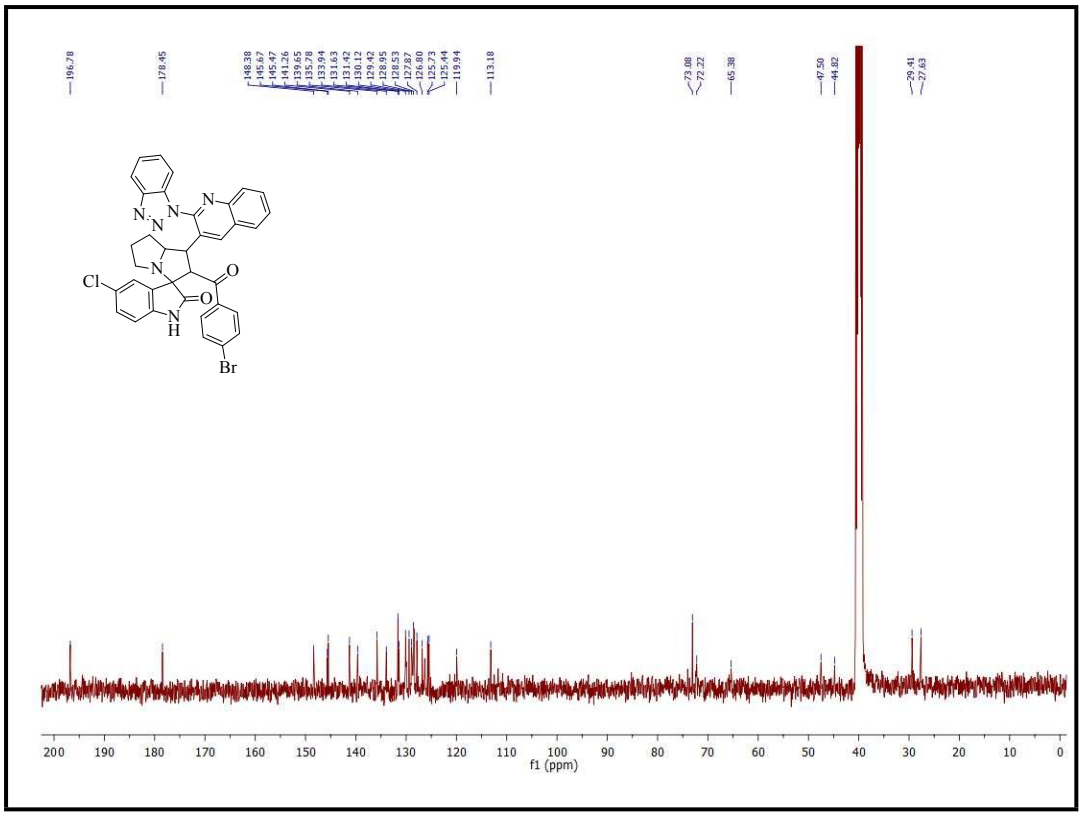
Mass spectrum of compound **4m**



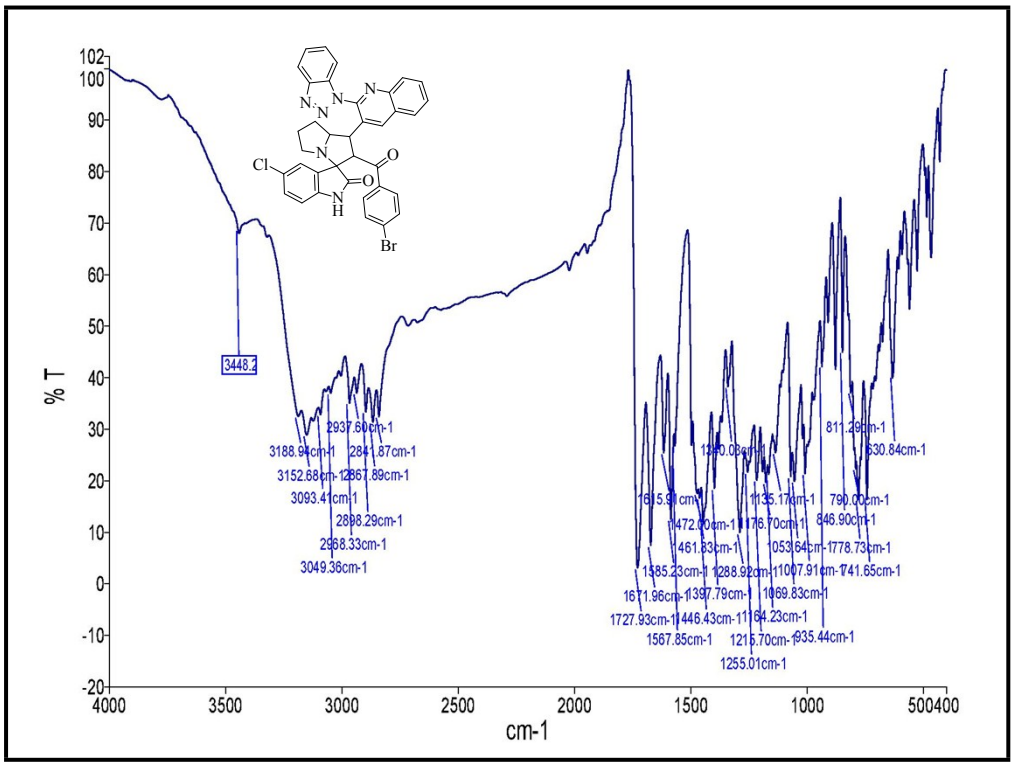

$^{1}$H NMR Spectrum of compound **4n**



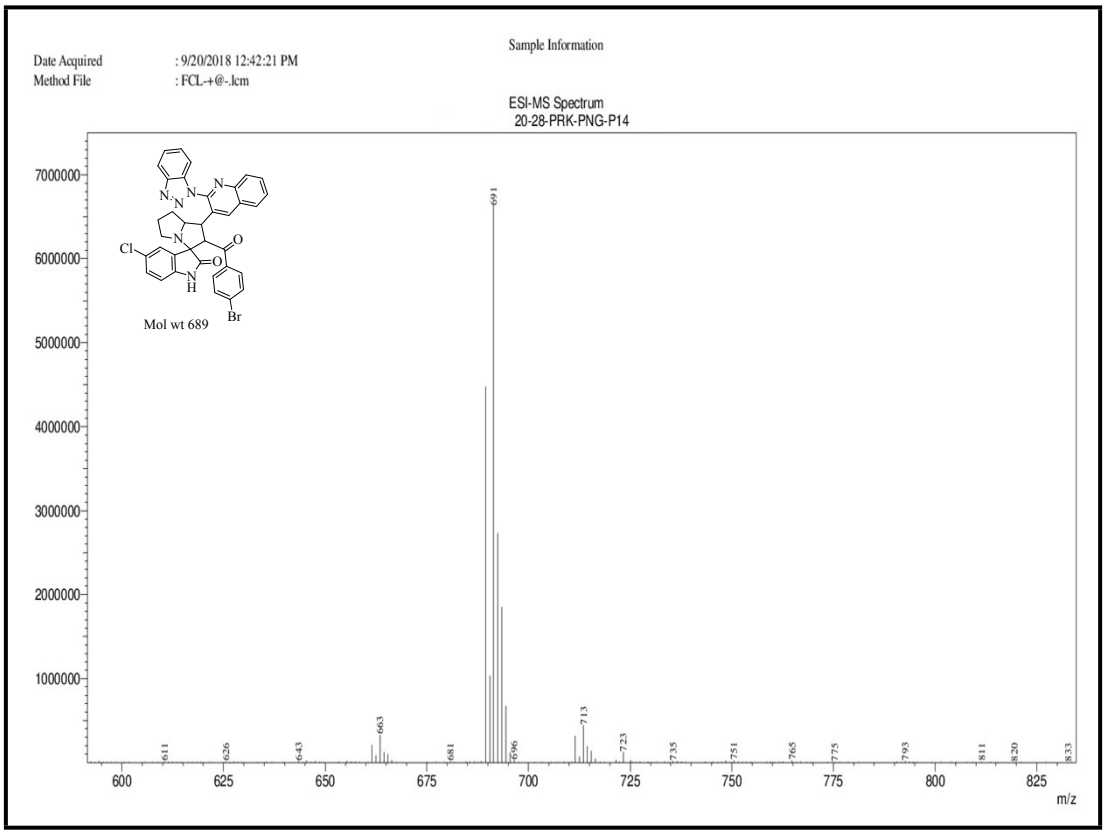
$^{13}$C NMR Spectrum of compound **4n**



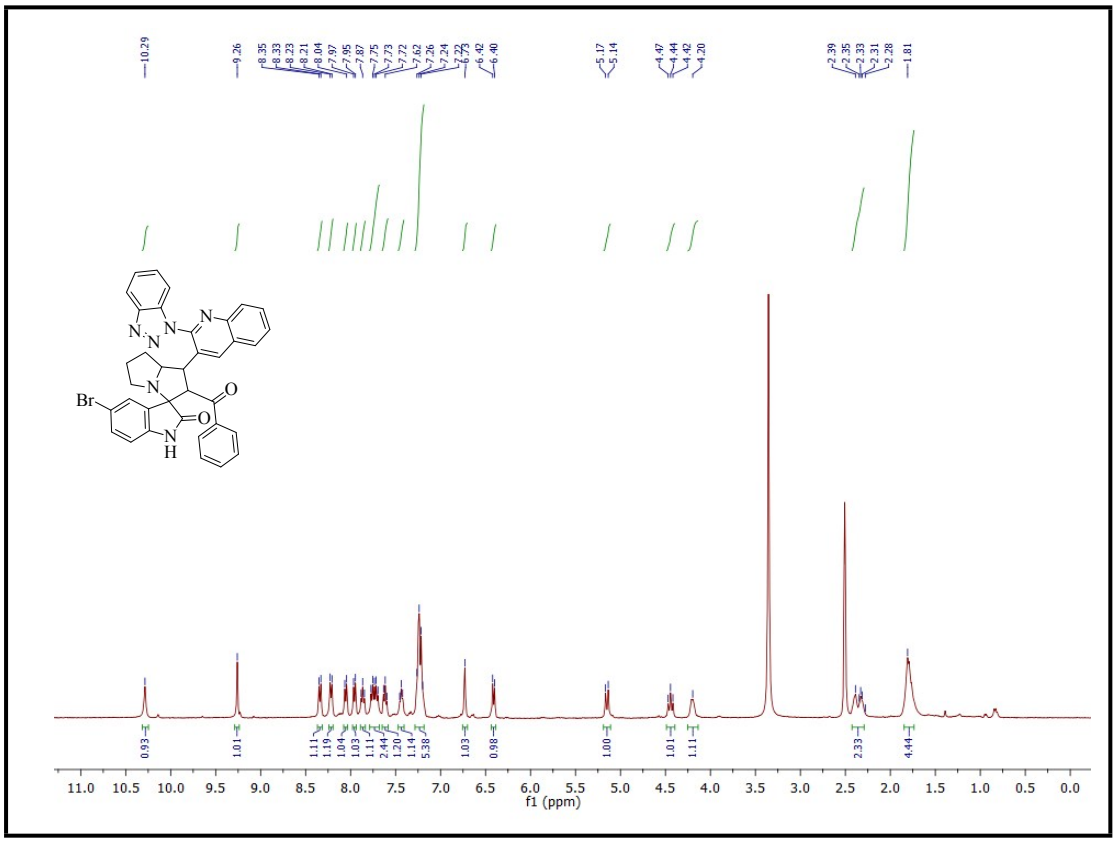

IR Spectrum of compound **4n**



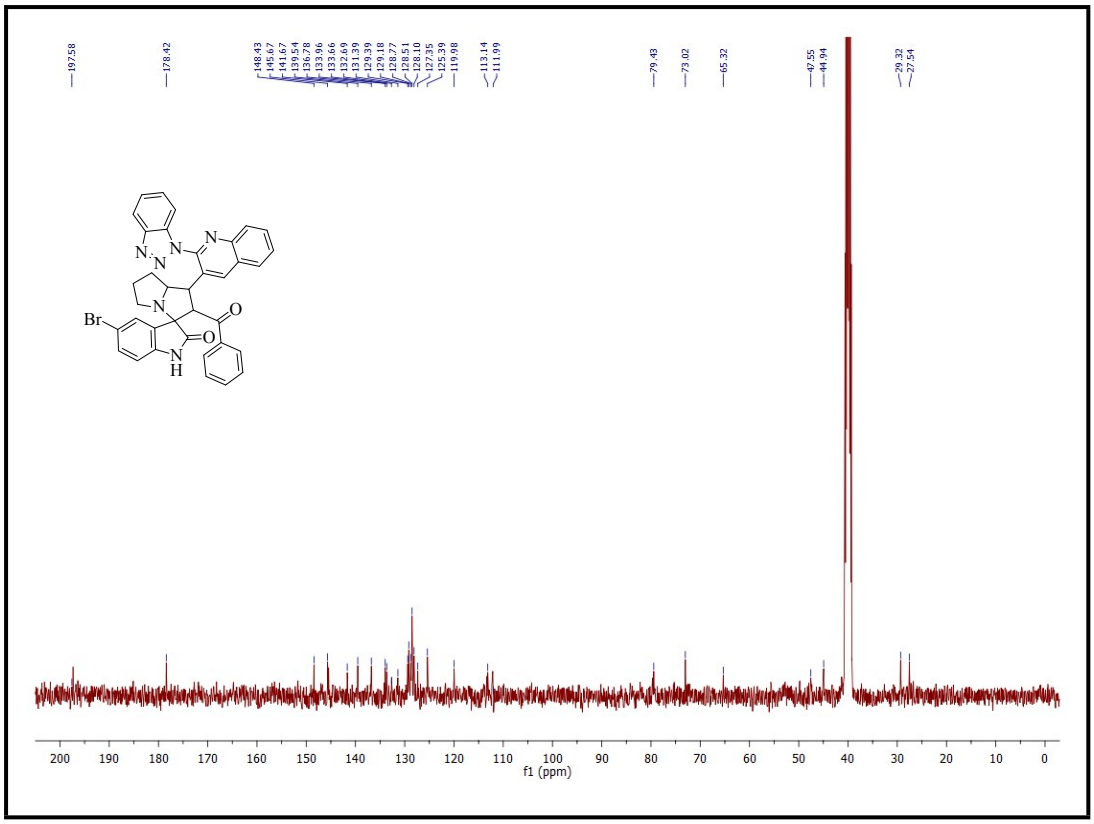
Mass spectrum of compound **4n**



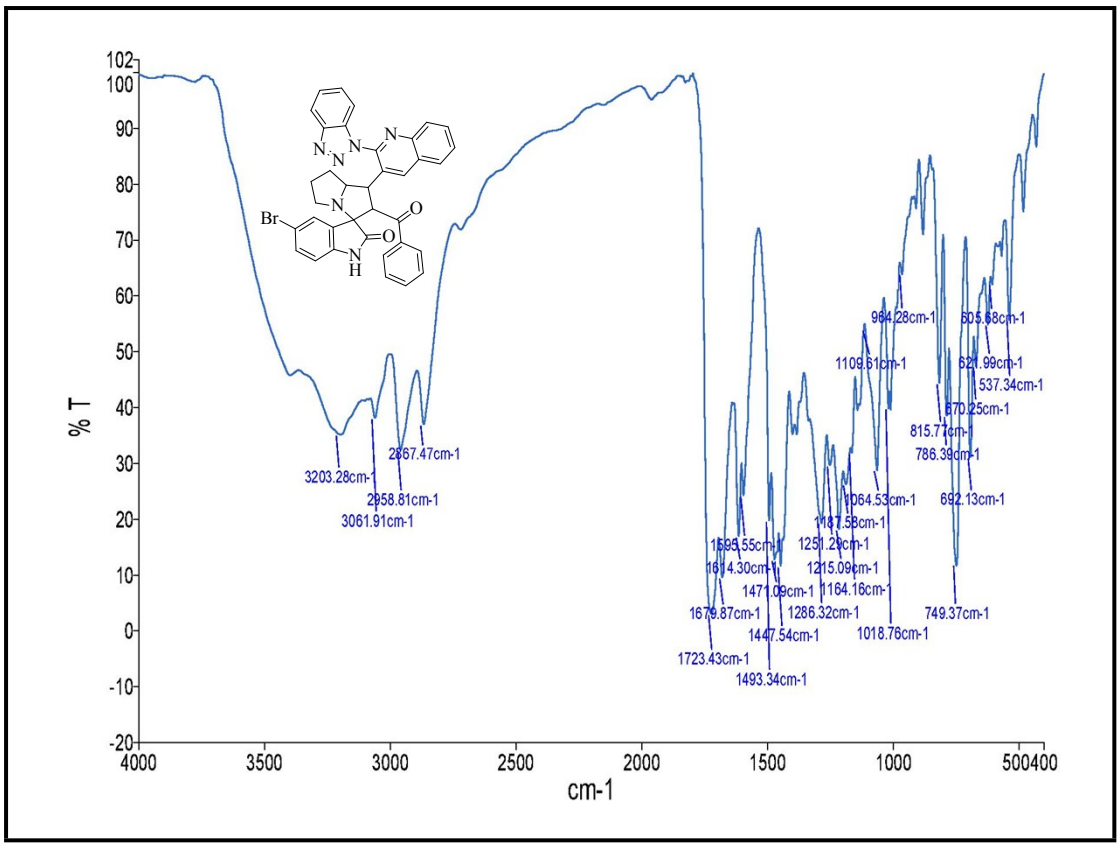

$^{1}$H NMR Spectrum of compound **4o**



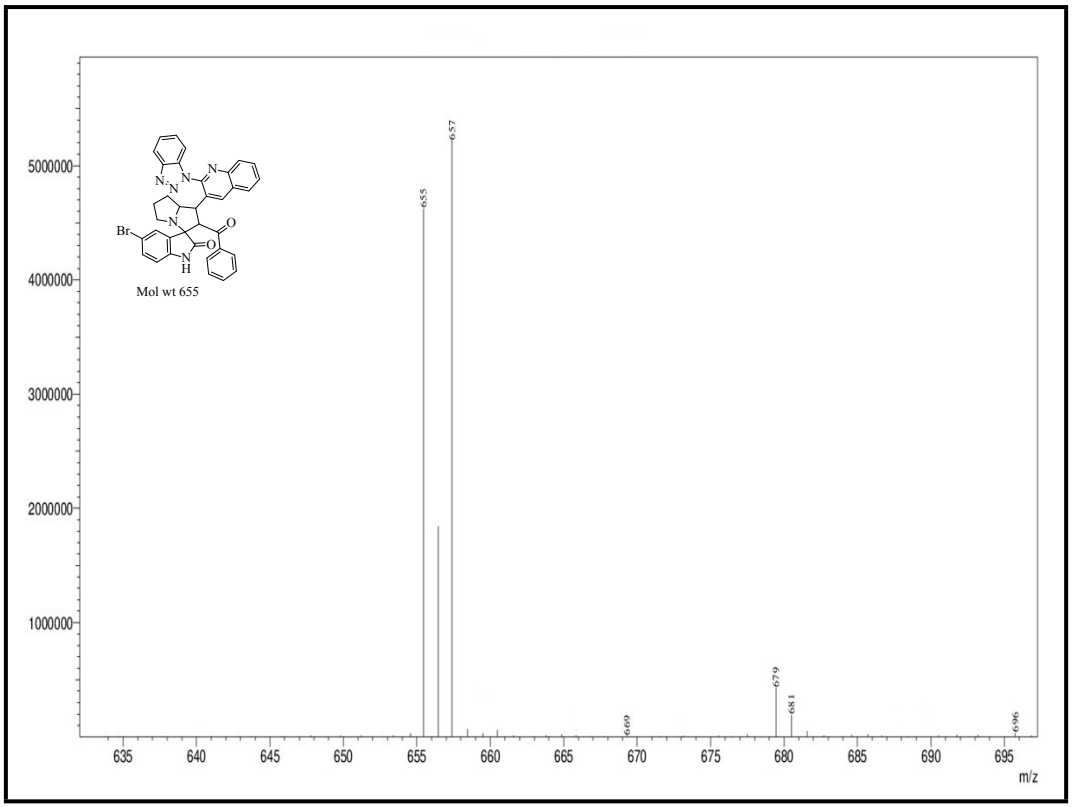
$^{13}$C NMR Spectrum of compound **4o**



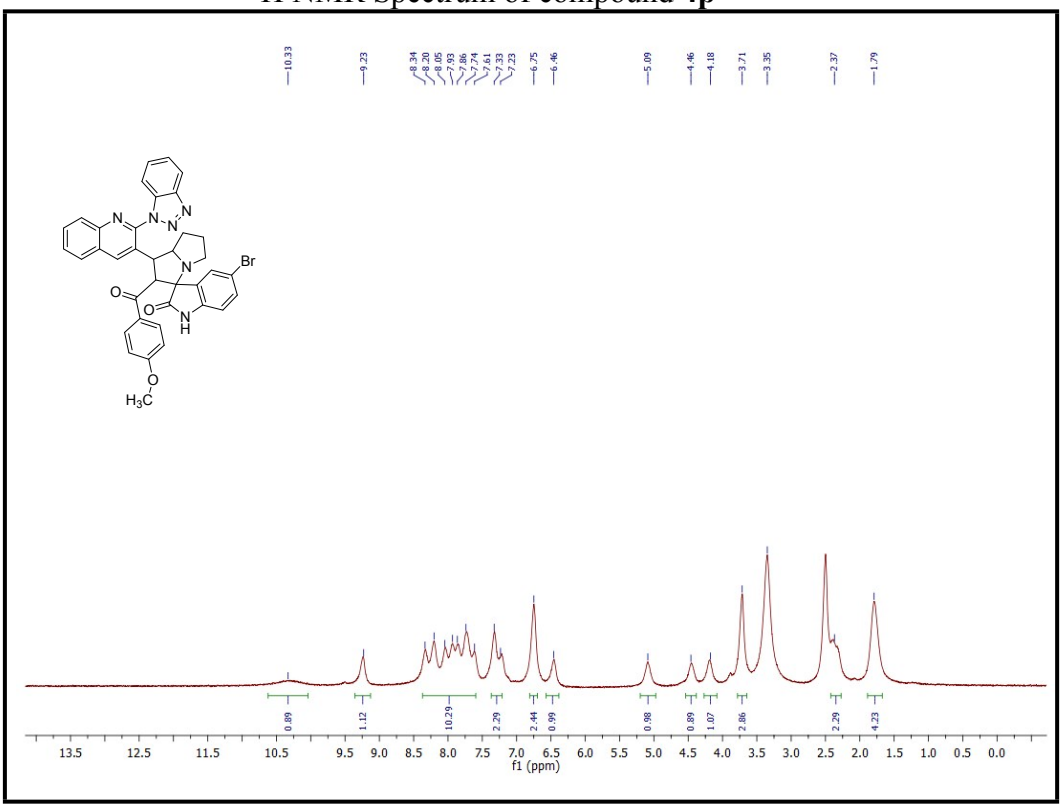

IR Spectrum of compound **4o**



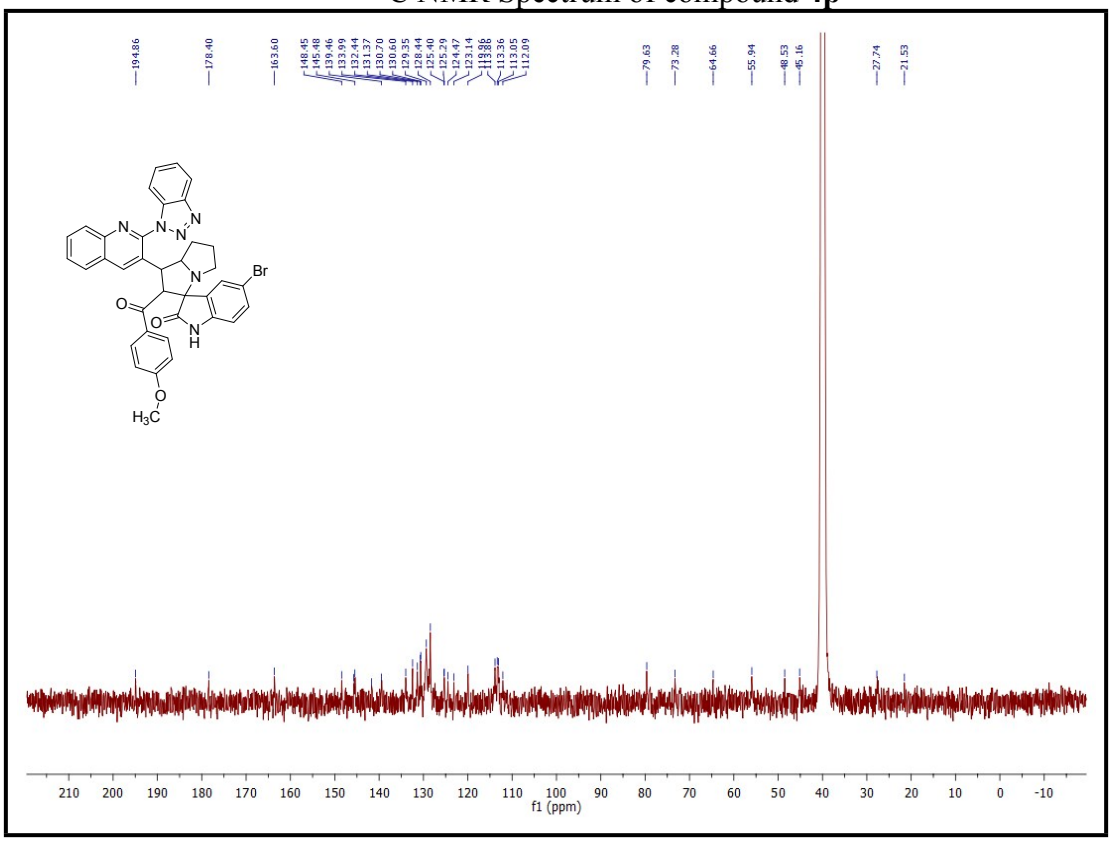
Mass spectrum of compound **4o**



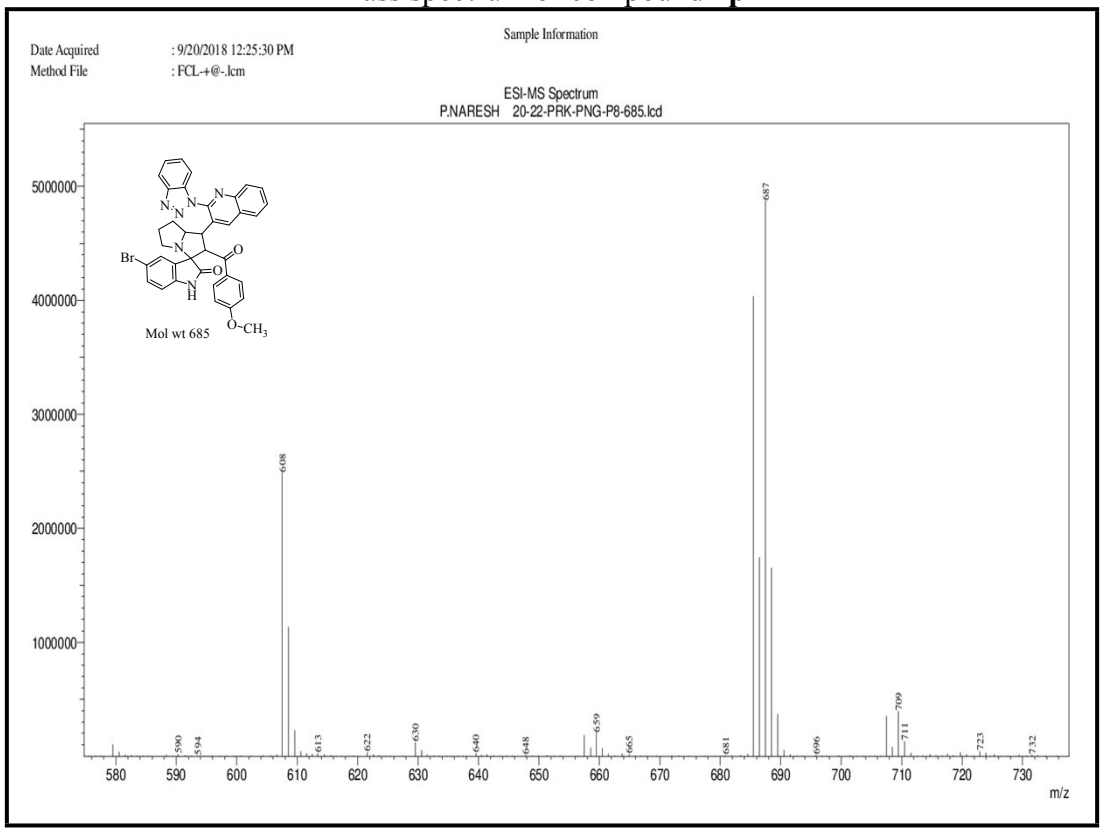

$^{1}$H NMR Spectrum of compound **4p**



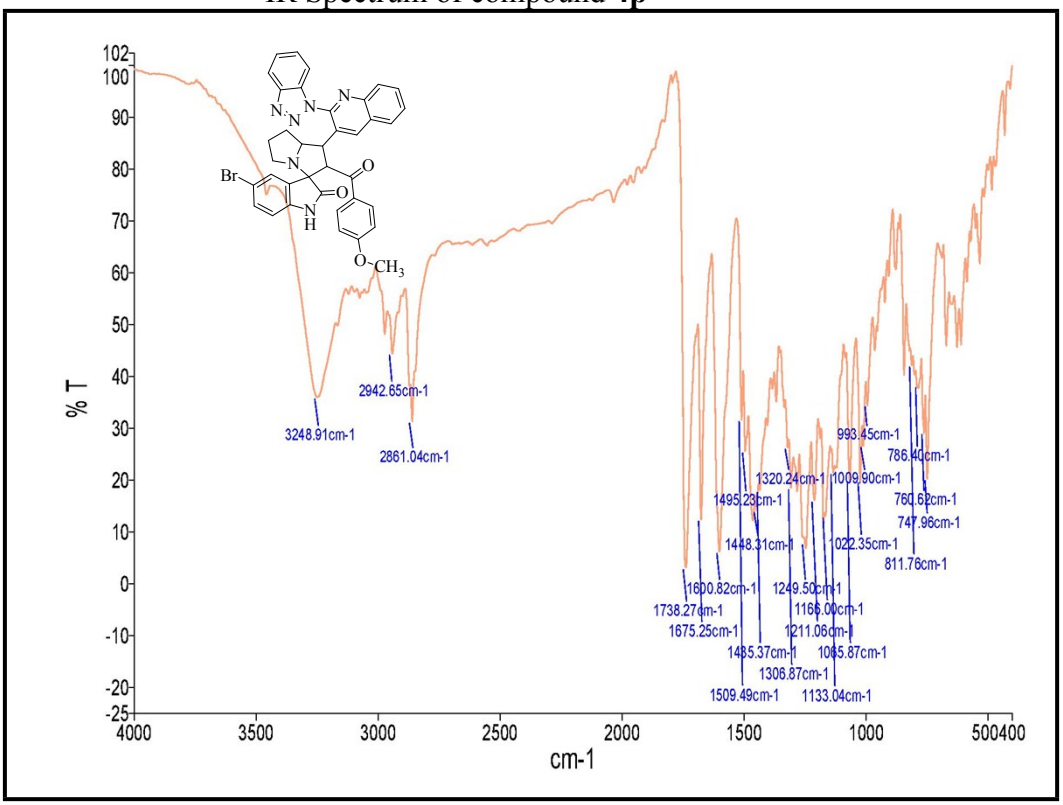
$^{13}$C NMR Spectrum of compound **4p**




Mass spectrum of compound **4p**



IR Spectrum of compound **4p**




## 4.1. Spectral data for the compounds 1a-g.

**3-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-1-phenylprop-2-en-1-one (1a)**

Color: white; Yield: 80%. Reaction time: 80 min. M.P. 206–208 ˚C; $^{1}$H NMR (400 MHz, DMSO-d$_6$) $\delta$: 7.62 (s, 3H), 7.71-7.77 (m, 2H), 7.84 (s, 1H), 7.96 (d, $J$ = 15.2 Hz, 2H), 8.13-8.20 (m, 4H), 8.25 (d, $J$ = 6.8 Hz, 2H), 8.30 (d, $J$ = 8.0 Hz, 1H), 9.50 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-d$_6$) $\delta$: 189.51, 147.47, 146.69, 145.76, 139.82, 139.41, 137.67, 133.93, 133.24, 132.69, 129.70, 129.35, 129.14, 128.94, 128.89, 127.81, 125.89, 124.23, 120.02, 113.93.

**3-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-1-(p-tolyl)prop-2-en-1-one (1b)**

Color: white; Yield: 75%. Reaction time: 90 min. M.P. 189–191 ˚C; $^{1}$H NMR (400 MHz, DMSO-d$_6$) $\delta$: 2.43 (s, 3H), 7.38 (d, $J$ = 8.0 Hz, 2H), 7.59 (t, $J$ = 8.0 Hz, 1H), 7.73 (t, $J$ = 8.0 Hz, 1H), 7.79 (t, $J$ = 7.2 Hz, 1H), 7.93-7.99 (m, 2H), 8.08-8.14 (m, 3H), 8.21-8.25 (m, 4H), 9.44 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-d$_6$) $\delta$: 188.81, 147.45, 146.66, 145.75, 144.47,

139.75, 138.94, 135.15, 133.25, 132.64, 129.92, 129.69, 129.28, 129.09, 128.93, 128.87, 127.83, 125.82, 124.30, 120.02, 113.89, 21.71.

**3-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-1-(4-ethylphenyl)prop-2-en-1-one (1c)**

Color: white; Yield: 74%. Reaction time: 86 min. M.P. 170–172 ˚C; $^{1}$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 1.24 (t, $J$ = 7.6 Hz, 3H), 2.72 (d, $J$ = 7.6 Hz, 2H), 7.26 (d, $J$ = 8.0 Hz, 1H), 7.44 (d, $J$ = 8.0 Hz, 1H), 7.62 (t, $J$ = 7.6 Hz, 1H), 7.74-7.85 (m, 3H), 7.91-8.00 (m, 2H), 8.11-8.16 (m, 3H), 8.24 (d, $J$ = 7.6 Hz, 2H), 8.29 (d, $J$ = 8.0 Hz, 1H), 9.49 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) $\delta$: 188.89, 150.48, 147.46, 146.67, 145.75, 139.76, 138.95, 136.60, 135.43, 133.26, 132.66, 129.70, 129.39, 129.09, 128.94, 128.88, 128.75, 128.54, 128.42, 127.84, 125.89, 124.32, 120.02, 113.89, 28.72, 15.65.

**3-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-1-(4-methoxyphenyl)prop-2-en-1-one (1d)**

Color: yellow; Yield: 76%. Reaction time: 82 min. M.P. 195–197 ˚C; $^{1}$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 3.90 (s, 3H), 7.10 (d, $J$ = 8.0 Hz, 2H), 7.60 (t, $J$ = 7.6 Hz, 1H), 7.74 (t, $J$ = 7.2 Hz, 1H), 7.81 (t, $J$ = 6.8 Hz, 1H), 7.90-7.98 (m, 3H), 8.12-8.23 (m, 6H), 9.46 (s, 1H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) $\delta$: 187.50, 163.96, 147.45, 146.64, 145.74, 139.67, 138.34, 133.27, 132.60, 131.57, 130.55, 129.69, 127.86, 125.86, 124.44, 120.02, 114.61, 113.84, 56.12.

**3-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-1-(4-fluorophenyl)prop-2-en-1-one (1e)**

Color: white; Yield: 79%. Reaction time: 78 min. M.P. 244–246 ˚C; $^{1}$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 7.67 (d, $J$ = 6.0 Hz, 1H), 7.79-7.89 (m, 4H), 8.01-8.10 (m, 2H), 8.16-8.33 (m, 7H) 9.52 (s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$+ DMSO-$d_6$) $\delta$: 188.87, 146.43, 140.40,

139.57, 133.11, 131.53, 130.10, 129.92, 129.60, 129.27, 128.34, 126.30, 126.00, 124.62, 123.63, 120.56, 114.49.

**3-(2-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)quinolin-3-yl)-1-(4-chlorophenyl)prop-2-en-1-one (1f)**

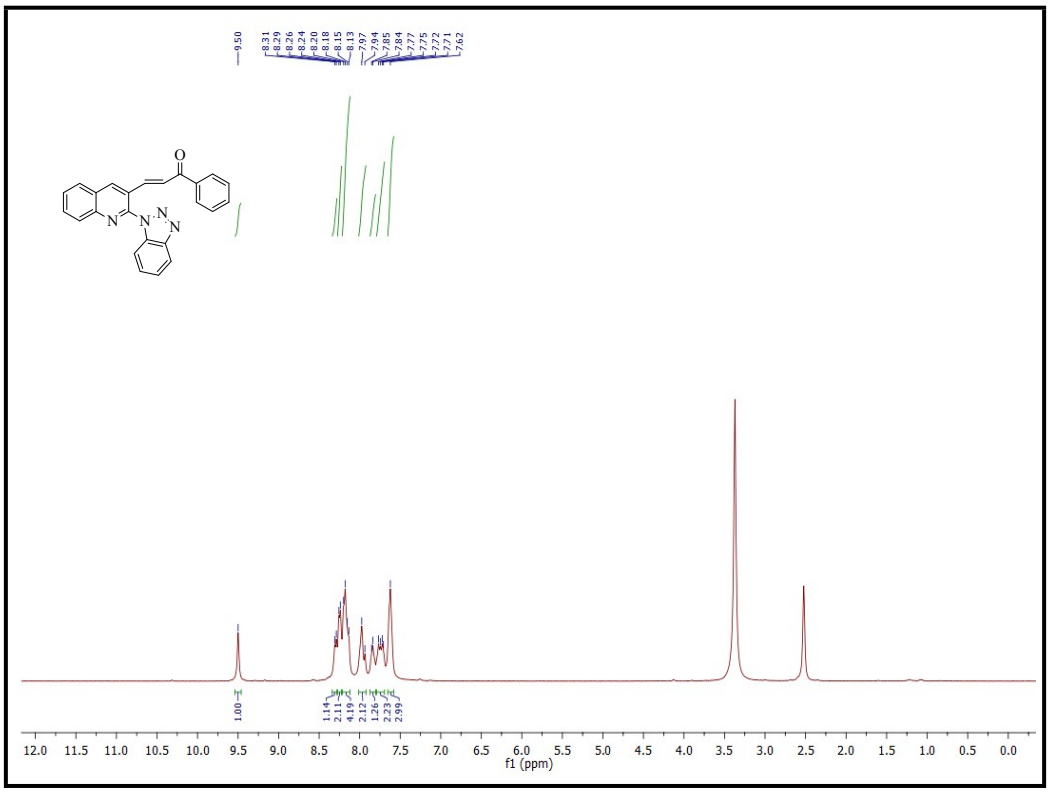
Color: white; Yield: 86%. Reaction time: 60 min. M.P. 214–216 ˚C; $^{1}$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 7.59-7.66 (m, 3H), 7.75 (t, $J$ = 7.6 Hz, 1H), 7.84 (t, $J$ = 7.6 Hz, 1H), 7.96 (d, $J$ = 6.0 Hz, 1H), 8.00 (s, 1H), 8.11-8.16 (m, 2H), 8.19-8.26 (m, 5H), 9.47 (s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$+ DMSO-$d_6$) $\delta$: 188.26, 145.81, 139.79, 138.96, 132.50, 130.92, 129.49, 129.31, 128.99, 128.65, 127.72, 125.69, 125.39, 124.01, 123.02, 119.95, 113.88.

**3-(2-(1H-benzo[d][1,2,3]triazol-1-yl)quinolin-3-yl)-1-(4-bromophenyl)prop-2-en-1-one (1g)**

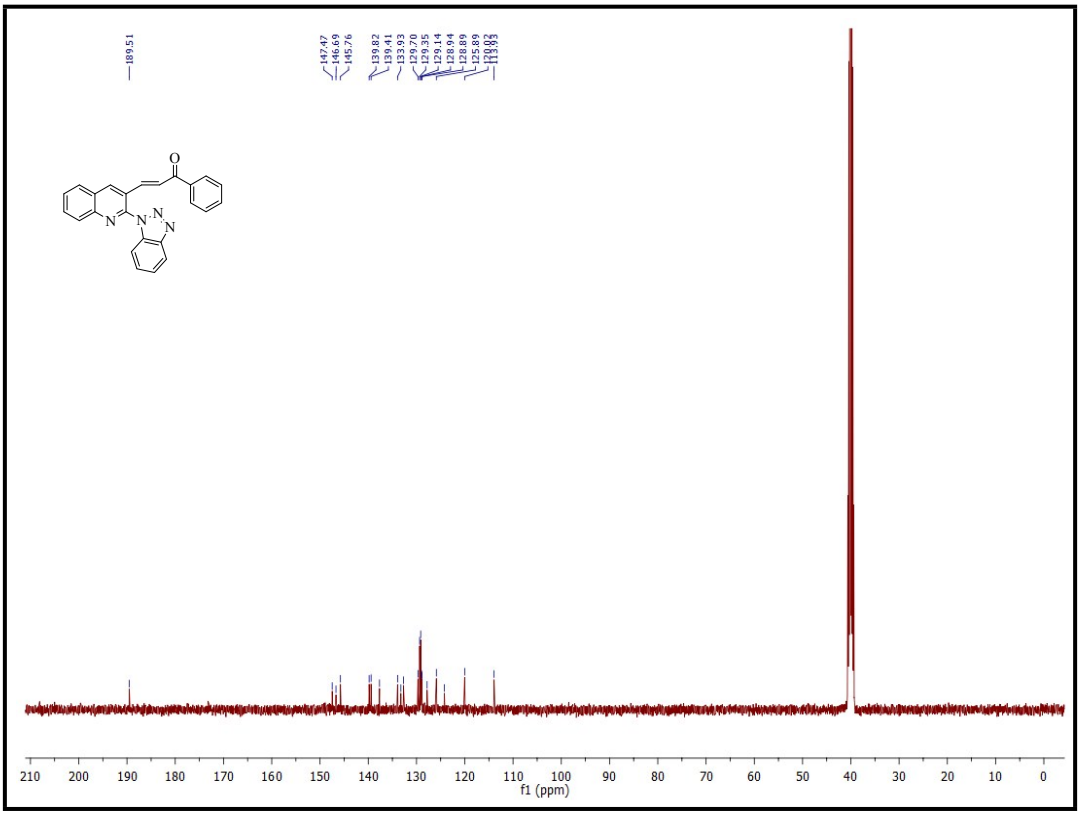
Color: yellow; Yield: 84%. Reaction time: 65 min. M.P. 209–211 ˚C; $^{1}$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 7.60 (d, $J$ = 6.0 Hz, 1H), 7.72-7.82 (m, 3H), 7.94-8.03 (m, 2H), 8.09-8.26 (m, 8H) 9.43 (s, 1H). $^{13}$C NMR (100 MHz, DMSO-$d_6$) $\delta$: 189.19, 146.74, 140.72, 139.89, 133.43, 131.85, 130.42, 130.24, 129.92, 129.58, 128.65, 126.62, 126.32, 124.94, 123.95, 120.88, 114.81.

**4.2. Spectrums of compounds 1a-g.**

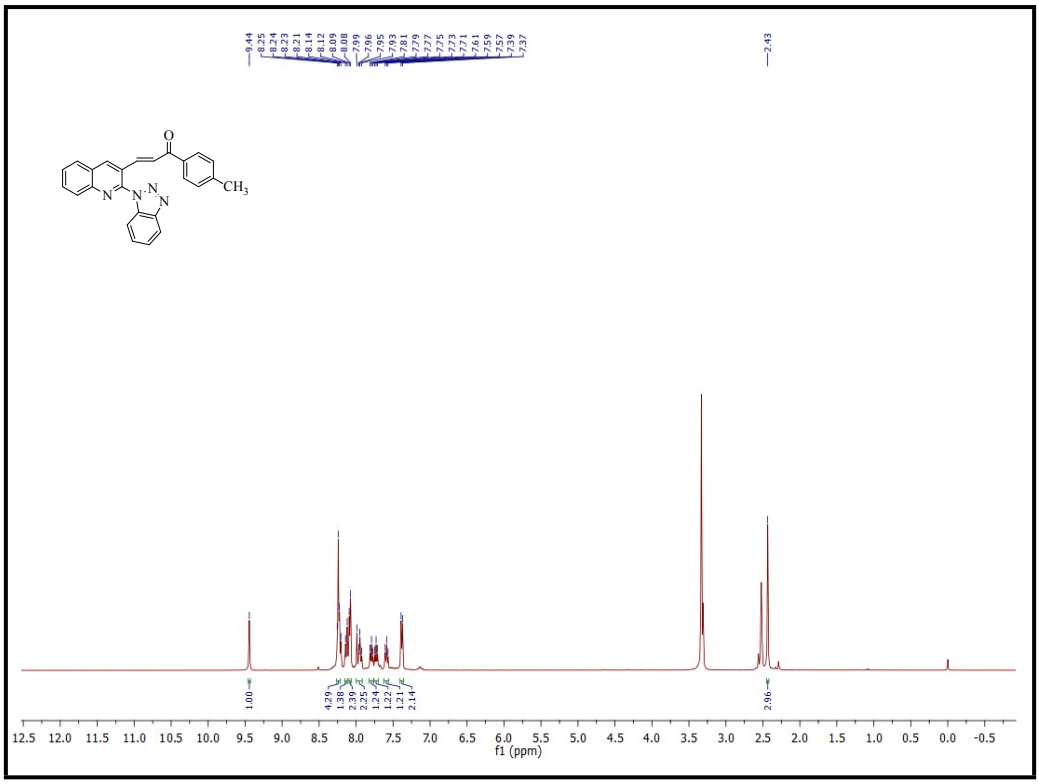
$^{1}$H NMR Spectrum of compound **1a**



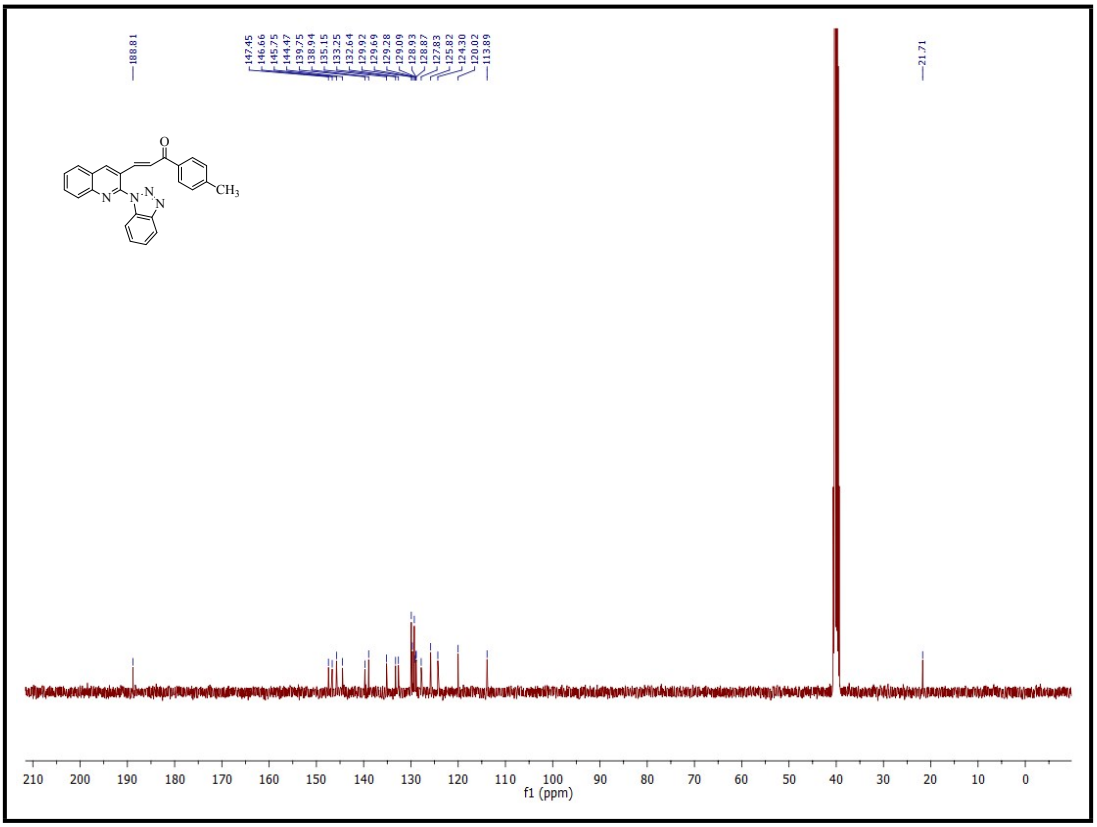

$^{13}$C NMR Spectrum of compound **1a**



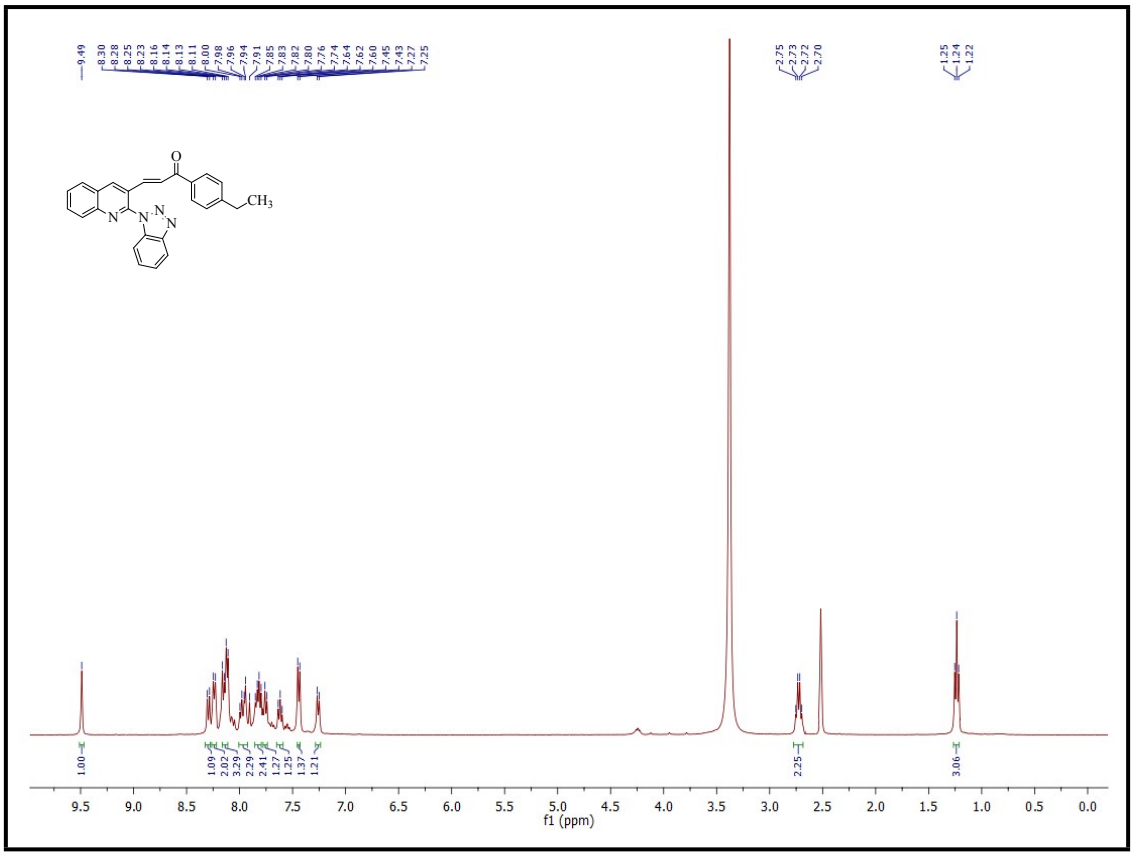
$^{1}$H NMR Spectrum of compound **1b**



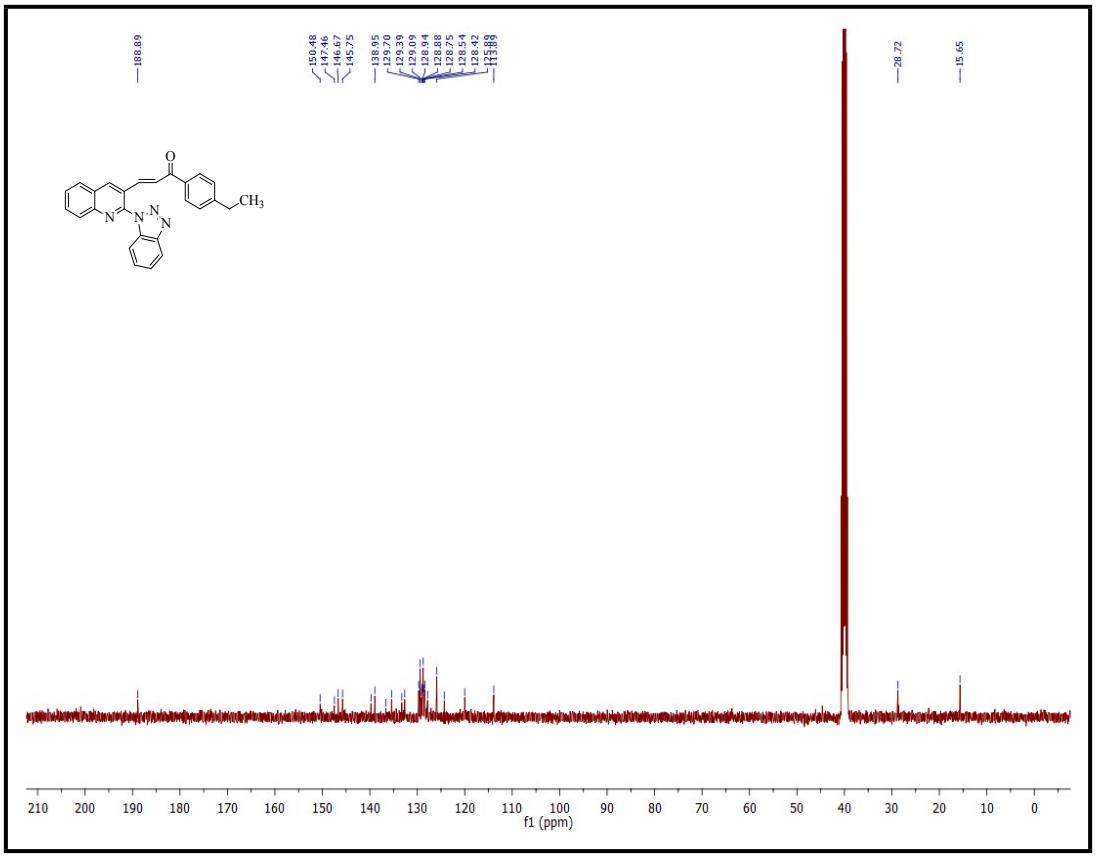

$^{13}$C NMR Spectrum of compound **1b**



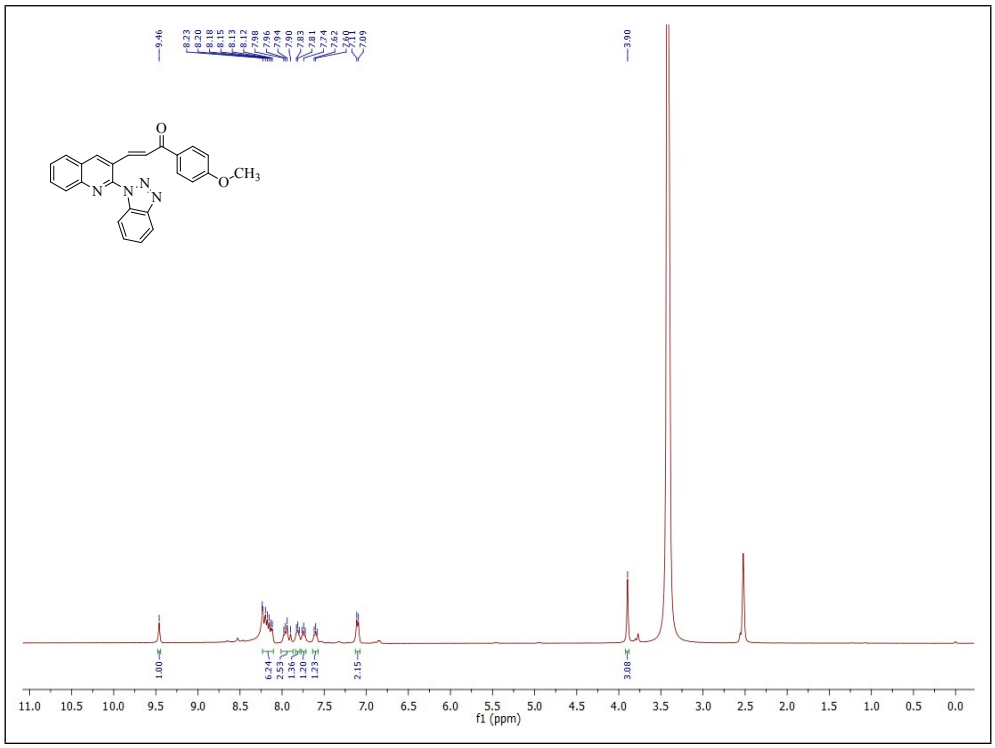
$^{1}$H NMR Spectrum of compound **1c**



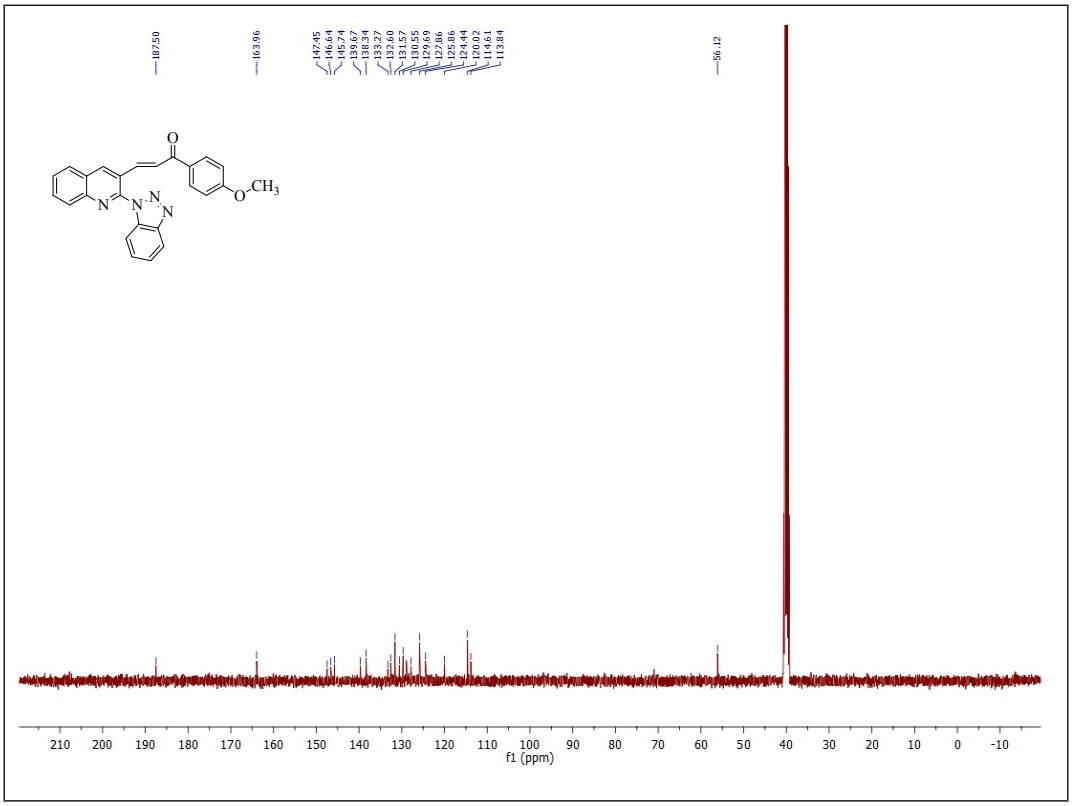

$^{13}$C NMR Spectrum of compound **1c**



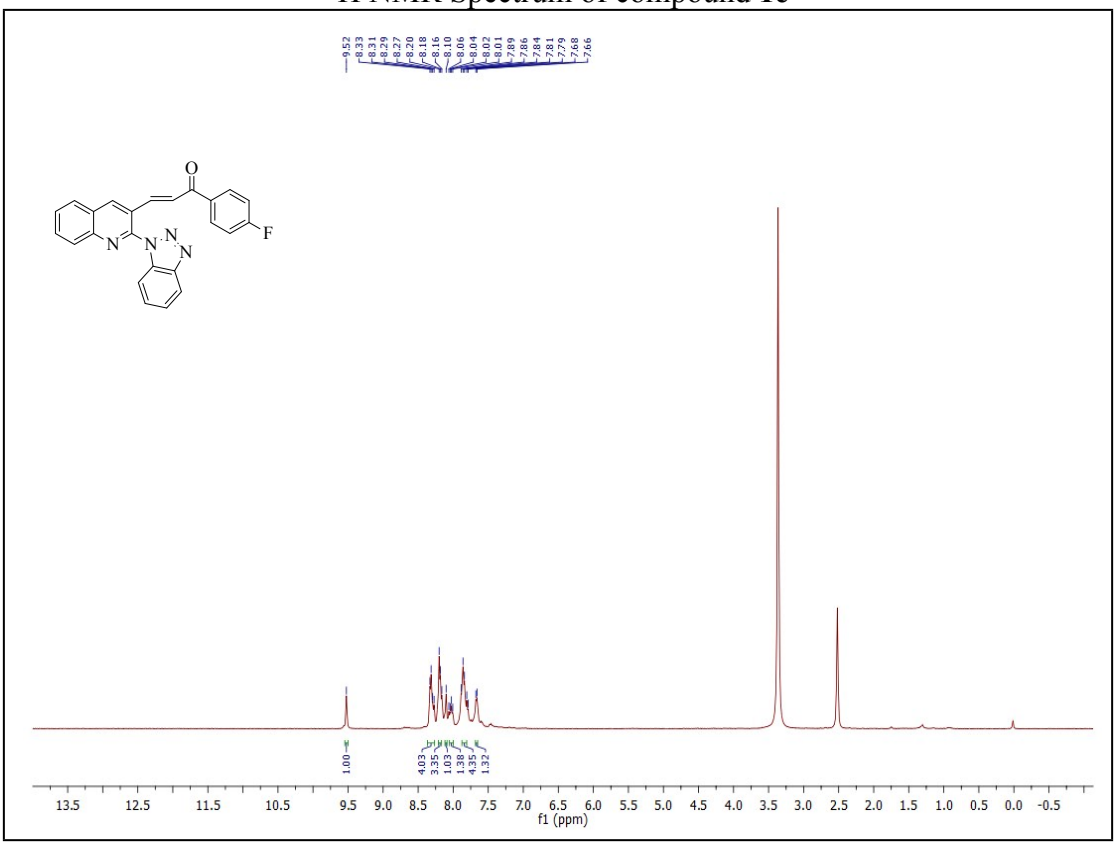
$^{1}$H NMR Spectrum of compound **1d**



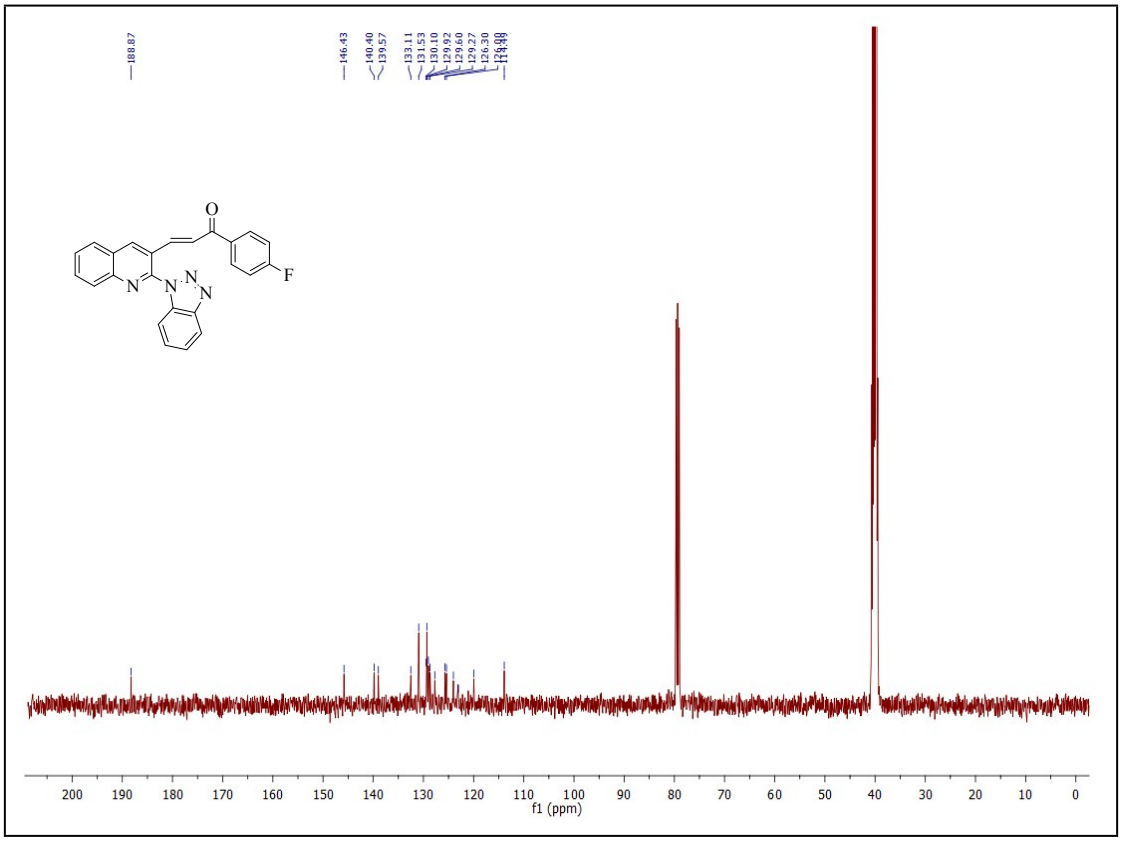

$^{13}$C NMR Spectrum of compound **1d**



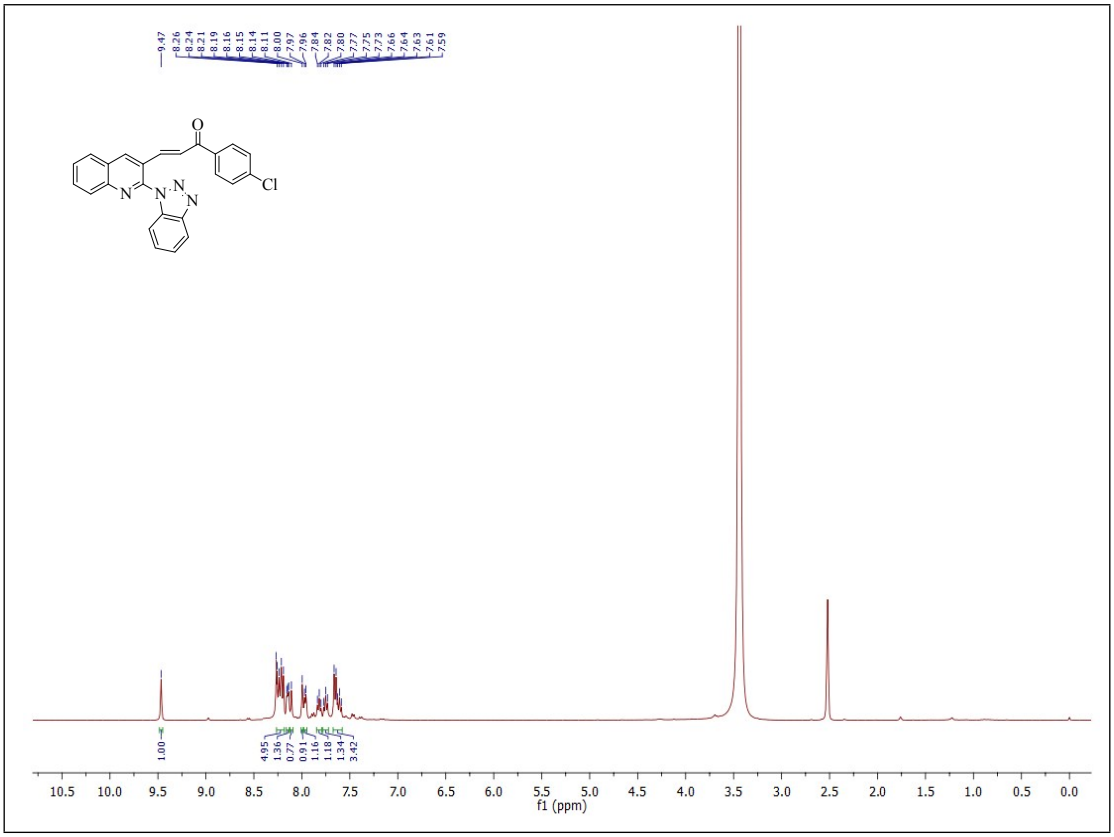
$^{1}$H NMR Spectrum of compound **1e**



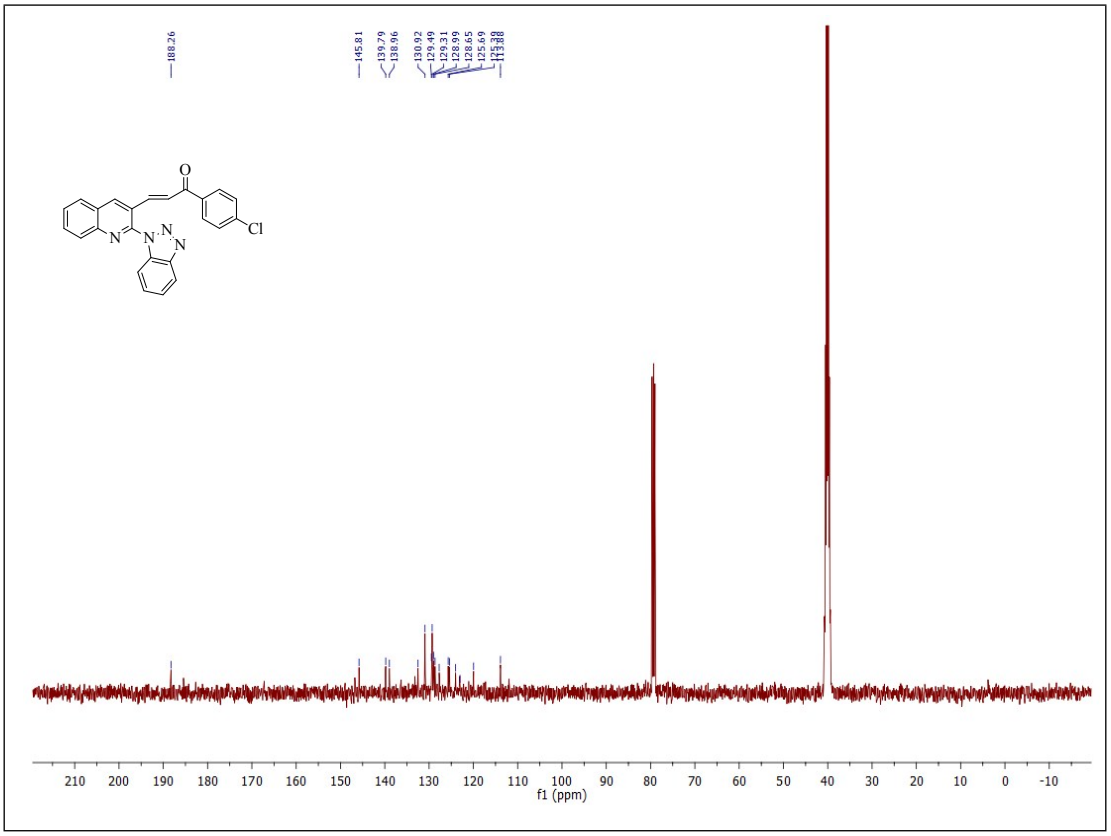

$^{13}$C NMR Spectrum of compound **1e**



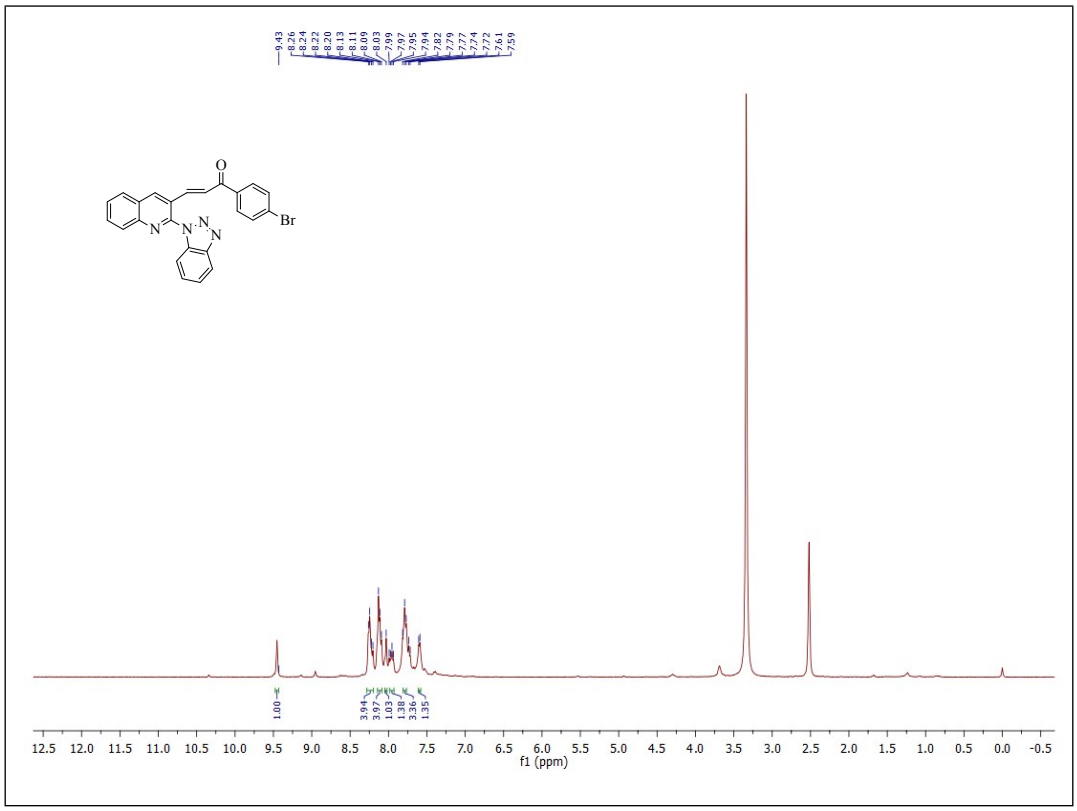

$^{1}$H NMR Spectrum of compound **1f**




$^{13}$C NMR Spectrum of compound **1f**



$^{1}$H NMR Spectrum of compound **1g**




$^{13}$C NMR Spectrum of compound **1g**