

Supporting Information

Radical-Mediated Photoredox Hydroarylation with Thiosulfonate

Xiaoyuan Wan,[†] Dahan Wang,[‡] Huawen Huang,^{†,*} Guo-Jiang Mao,[§] and Guo-Jun
Deng,^{†,§,*}

[†] Key Laboratory for Green Organic Synthesis and Application of Hunan Province, Key Laboratory of Environmentally Friendly Chemistry and Application of Ministry of Education, College of Chemistry, Xiangtan University, Hunan, Xiangtan 411105, China.

[‡] Department of Food and Chemical Engineering, Shaoyang University, Shaoyang, 422100, China.

[§] School of Chemistry and Chemical Engineering, Henan Normal University, Xinxiang, 453007, China.

E-mail: hwhuang@xtu.edu.cn; gjdeng@xtu.edu.cn

List of Contents

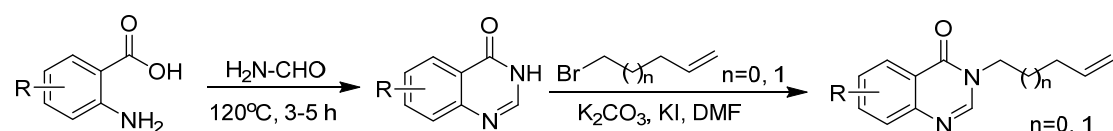
| | |
|---|----|
| 1. General information | 2 |
| 2. Preparation of substrates and characterization data | 2 |
| 3. Optimization of the reaction conditions | 3 |
| 4. General procedure for the reaction of Hydroarylation | 5 |
| 5. Mechanistic studies | 6 |
| 5.1 Stern-volmer quenching | 6 |
| 5.2 Cyclic voltammetry measurements | 7 |
| 5.3 Switch light experiments | 8 |
| 5.4 Radical trapping experiments | 9 |
| 5.5 Control experiments | 10 |
| 5.6 H/D exchange experiments | 11 |
| 5.7 UV-vis absorption | 12 |
| 6. Characterization data of all products | 13 |
| 7. References | 24 |
| 8. Copies of ¹ H NMR and ¹³ C NMR spectra of products | 25 |

1. General information

The reactions via general procedure were carried out under an atmosphere of argon unless otherwise noted. Column chromatography was performed using silica gel (200-300 mesh) and thin layer chromatography was performed using silica gel (GF254). ^1H NMR and ^{13}C NMR spectra were recorded on Bruker-AVANCE-III-HD (400 and 100 MHz, respectively) and processed using MestReNova. ^1H NMR chemical shifts are given in ppm with respect to the residual CDCl_3 peak (δ 7.26 ppm), ^{13}C NMR shifts are given in ppm with respect to CDCl_3 (δ 77.00 ppm) and $\text{DMSO-}d_6$ (δ 39.52 ppm). Mass spectra were measured on Agilent 5977 GC-MS instrument (EI). High-resolution mass spectra (ESI) were obtained with the Thermo Scientific LTQ Orbitrap XL mass spectrometer. The structures of known compounds were further corroborated by comparing their ^1H NMR, ^{13}C NMR data and MS data with those in literature. Melting points were measured with a YUHUA X-5 melting point instrument and were uncorrected. Fluorescence quenching experiments were recorded with PTI-QM40 spectrophotometer. A commercially available blue LED (35W, HIPAR30, luminous flux is not less than 3200 lm, 450 nm wavelength of the peak intensity) was purchased from Shenzhen Jing Feng Times Lighting Technology Co., Ltd as the reaction light source. All irradiation reactions were carried out in glass vessel. The distance from the light source to the irradiation vessel is around 2-3 cm. Unless otherwise noted, all reagents were obtained from commercial suppliers and used without further purification.

2. Preparation of substrates and characterization data

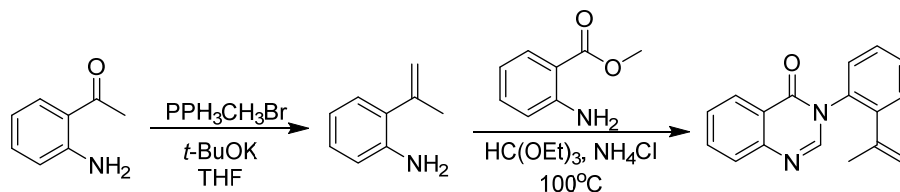
All substrates used were prepared according known methods.^{1,2}



The mixtures of anthranilic acid (1 mmol) and an excess of formamide (10 mmol) in a roundbottom flask were heated at 120 ° C with stirring for 3-5 h. The reaction was checked by TLC. After the starting materials completely disappeared, the resulting mixtures were cooled to room temperature and then poured into ice-cold water. The light or dark brown precipitates were formed. The precipitates were filtered and washed three times with water (20 mL) and dried to give quinazolin-4(3H)-one derivatives. These intermediates were used for the next step without further purification.

A round-bottom flask equipped with a magnetic stirrer bar was charged with quinazolin-4(3H)-one derivatives (1 mmol), potassium carbonate (2 equiv), and DMF (10 mL). The resulting mixture was heated to 80 ° C with stirring for 30 min. KI (16.6 mg, 0.1 mmol) was added and after stirring for further 15 min, brominated olefins (1.2 mmol) diluted with DMF (1 mL) was dropwise added into the mixture. The reaction mixture was heated to 60 ° C in oil bath and stirred for 3 h. After the reaction completed, the resulting mixture was cooled. The reaction mixture was washed

with water and extracted with ethyl acetate three times. The combined organic layer was washed with saturated NaCl solution, dried over anhydrous Na₂SO₄ and filtered. The filtrate was concentrated in vacuo. The crude product was purified by flash column chromatography on silica gel (Petroleum ether/EtOAc) to afford corresponding products.

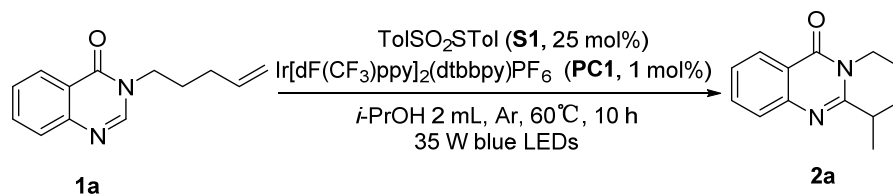


A round-bottom flask was charged with methyltriphenylphosphonium bromide (5.36 g, 15 mmol) and dry THF (20 mL) under Ar atmosphere, followed by the addition of potassium tert-butoxide (1.68 g, 15 mmol) at 0 °C. The reaction mixture was allowed to warm to ambient temperature and stir for 0.5 h. Next, 2-aminoacetophenone (1.21 g, 10 mmol) was added. The reaction mixture was stirred at room temperature overnight. After completion, the reaction was quenched with saturated NaHCO₃ solution, and extracted with ethyl acetate (100 mL). The organic phase was dried over anhydrous Na₂SO₄ and concentrated under reduced pressure. The reaction mixture was purified via column chromatography to give 2-(prop-1-en-2-yl)aniline.

A mixture of 2-amino-benzoic acid esters (5.0 mmol), 2-(prop-1-en-2-yl)aniline (6.0 mmol), ortho esters (7.5 mmol) and NH₄Cl (106.0 mg, 2.0 mmol) was heated with stirring at 100 °C for 2 h. After cooling, H₂O was added and the product was extracted with ethyl acetate (2×30 mL). The organic layer was dried with anhydrous Na₂SO₄ and evaporated, and the residue was purified through flash column chromatography to afford desired products.

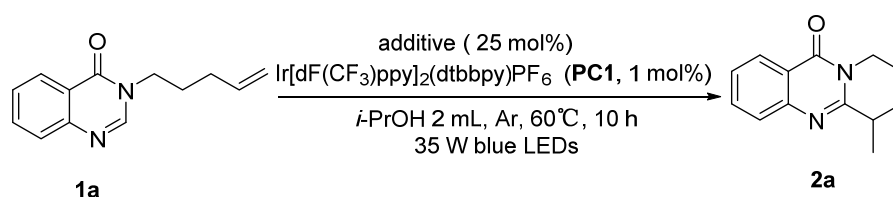
3. Optimization of the reaction conditions

Table S1. Control experiments ^a



| entry | Variation from standard conditions | yield (%) ^b |
|-------|------------------------------------|------------------------|
| 1 | none | 85 |
| 2 | No PC1 | trace |
| 3 | No light | 0 |
| 4 | No S1 | trace |

^a Reaction conditions: **1a** (0.2 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (**PC1**, 1 mol%), TolSO₂STol (**S1**, 25 mol%), *i*-PrOH (0.1 M), at 60 °C under Ar atmosphere and 35 W blue LED (450 nm) irradiation for 10 h. ^b Isolated yield.

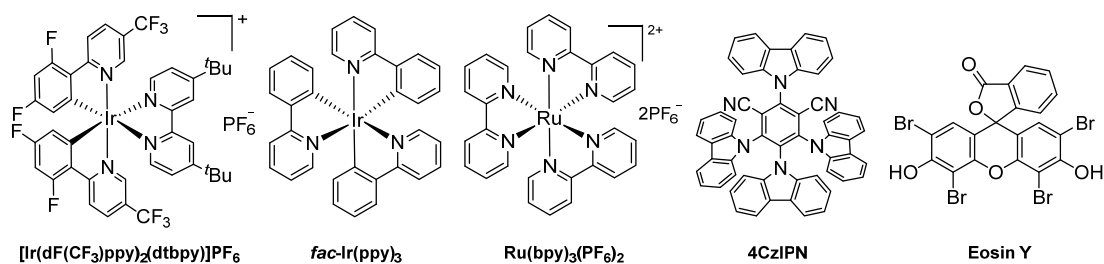
Table S2. Screening of additive ^a

| entry | additive | yield (%) ^b |
|-------|-------------------------|------------------------|
| 1 | S1 | 85 |
| 2 | PhSO ₂ STol | 78 |
| 3 | TolSO ₂ SPMP | 72 |
| 4 | PhSSPh | 25 |
| 5 | TolSH | 10 |
| 6 | TolSO ₂ Na | 0 |

^a Reaction conditions: **1a** (0.2 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (**PC1**, 1 mol%), TolSO₂STol (**S1**, 25 mol%), *i*-PrOH (0.1 M), at 60 °C under Ar atmosphere and 35 W blue LED (450 nm) irradiation for 10 h. ^b Isolated yield.

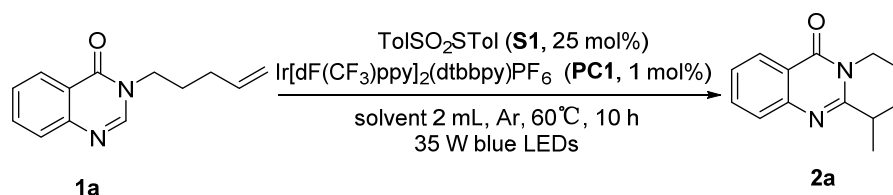
Table S3. Screening of photocatalyst ^a

| entry | photocatalyst | yield (%) ^b |
|-------|--|------------------------|
| 1 | [Ir(dF(CF ₃)ppy) ₂ (dtbbpy)]PF ₆ | 85 |
| 2 | <i>fac</i> -Ir(ppy) ₃ | 0 |
| 3 | Ru(ppy) ₃ (PF ₆) ₂ | 45 |
| 4 | 4CzIPN | 60 |
| 5 | Eosin Y | 25 |



^a Reaction conditions: **1a** (0.2 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (**PC1**, 1 mol%), TolSO₂STol (**S1**, 25 mol%), *i*-PrOH (0.1 M), at 60 °C under Ar atmosphere and 35 W blue LED (450 nm) irradiation for 10 h. ^b Isolated yield.

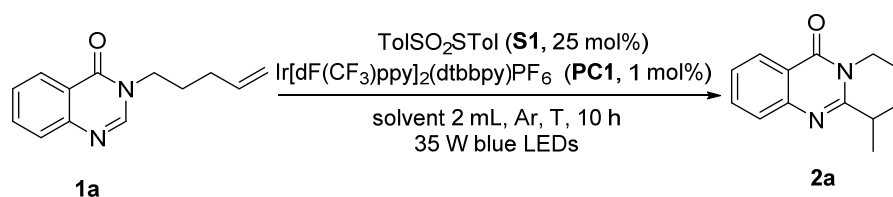
Table S4. Screening of solvent ^a



| entry | solvent | yield (%) ^b |
|-------|----------------|------------------------|
| 1 | <i>i</i> -PrOH | 85 |
| 2 | MeOH | 72 |
| 3 | EtOH | 78 |
| 4 | <i>t</i> -BuOH | 60 |
| 5 | THF | 55 |
| 6 | acetone | 48 |
| 7 | DMF | 40 |
| 8 | DMSO | 30 |

^a Reaction conditions: **1a** (0.2 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (**PC1**, 1 mol%), TolSO₂STol (**S1**, 25 mol%), *i*-PrOH (0.1 M), at 60 °C under Ar atmosphere and 35 W blue LED (450 nm) irradiation for 10 h. ^b Isolated yield.

Table S5. Screening of temperature ^a



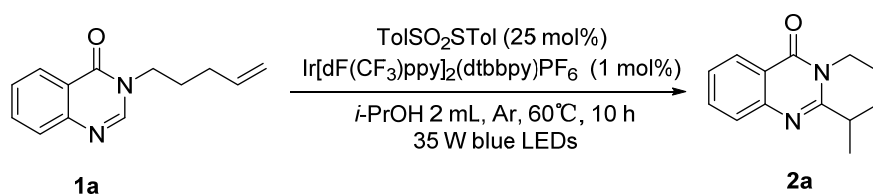
| entry | temperature | yield (%) ^b |
|-------|-------------|------------------------|
| 1 | 40 °C | 50 |
| 2 | 50 °C | 65 |
| 3 | 60 °C | 85 |
| 4 | 70 °C | 85 |

^a Reaction conditions: **1a** (0.2 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (**PC1**, 1 mol%), TolSO₂STol (**S1**, 25 mol%), *i*-PrOH (0.1 M), at 60 °C under Ar atmosphere and 35 W blue LED (450 nm) irradiation for 10 h. ^b Isolated yield.

4. General procedure for the reaction of Hydroarylation

Experimental Procedure: The following reaction was carried out under standard condition without bromide: A 10 mL reaction vessel was charged with 3-(pent-4-en-1-yl)quinazolin-4(3*H*)-one (**1a**, 43 mg, 0.2 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (2.5 mg, 0.002 mmol), TolSO₂STol (**S1**, 14 mg, 0.05 mmol), *i*-PrOH (0.1 M, 2 mL). The atmosphere was exchanged by applying vacuum and backfilling with N₂ (this process was conducted for three times). The resulting mixture was stirred at 2000 RPM for 10 hours under irradiation with a 35 W blue LED. After completion, the residue was purified by flash column chromatography using a mixture of petroleum ether and ethyl acetate

as eluent to give the desired product **1a** in 85% yield.



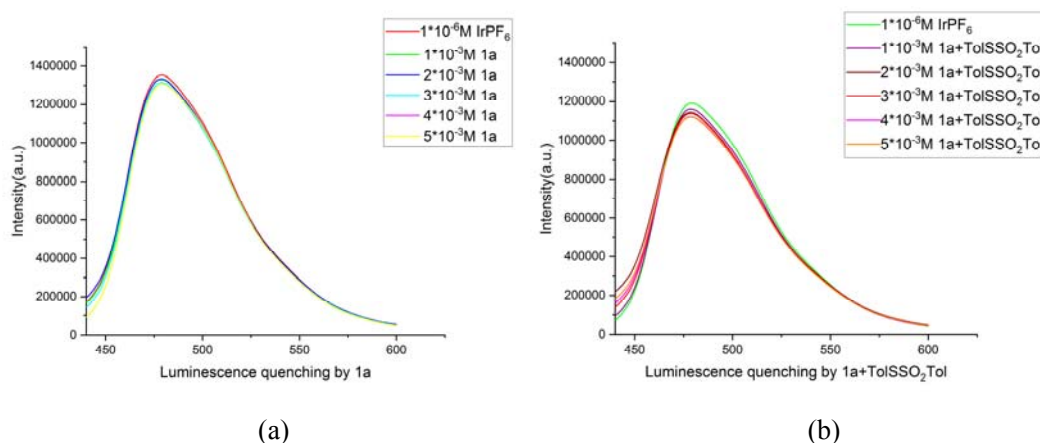
Scale-up experiment: A 50 mL Schlenk tube was added -(pent-4-en-1-yl)quinazolin-4(3*H*)-one (**1a**, 430 mg, 2.0 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (25 mg, 0.02 mmol), TolSO₂STol (**S1**, 140 mg, 0.5 mmol), *i*-PrOH (0.1 M, 20 mL). The atmosphere was exchanged by applying vacuum and backfilling with N₂ (this process was conducted for three times). The resulting mixture was stirred at 2000 RPM for 10 hours under irradiation with a 35 W blue LED. After the reaction was finished, the reaction mixture was washed with brine. After completion, the residue was purified by flash column chromatography using a mixture of petroleum ether and ethyl acetate as eluent to give the desired product **1a** in 80% yield.

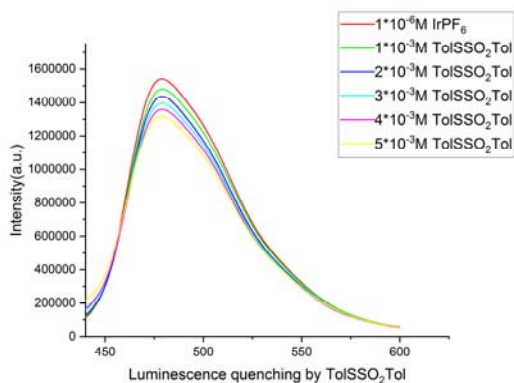
5. Mechanistic studies

5.1 Stern-volmer quenching

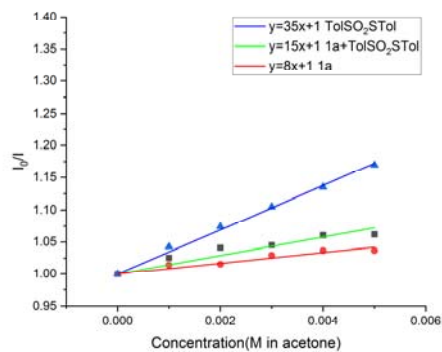
Formulation solution: 3-(pent-4-en-1-yl)quinazolin-4(3*H*)-one (**1a**, 535 mg) was dissolved in acetone in a 25 mL volumetric flask to set the concentration to be 0.1 M. TolSO₂STol (**S1**, 695 mg) was dissolved in acetone in a 25 mL volumetric flask to set the concentration to be 0.1 M.. Photocatalyst [Ir(dF(CF₃)ppy)₂(dtbbpy)]PF₆ ([Ir]PF₆, 2.2 mg) was dissolved in acetone (25.0 mL) to set the concentration to be 0.1 mM.

Experimental procedure: The resulting 0.1 mM solution (20 μL) was added to cuvette to obtain different concentrations of catalyst solution. This solution was then diluted to a volume of 2.0 mL by adding acetone to prepare a 1.0 μM solution. The resulting mixture was sparged with argon for 3 minutes and then irradiated at 400 nm. Fluorescence emission spectra were recorded (3 trials per sample). Into this solution, 20.0 μL of a 3-(pent-4-en-1-yl)quinazolin-4(3*H*)-one solution was successively added and uniformly stirred, and the resulting mixture was bubbled with argon for 3 minutes and irradiated at 400 nm. Fluorescence emission spectra of 0 μL, 20.0 μL, 40.0 μL, 60.0 μL, 80.0 μL 100.0 μL fluorescence intensity. Follow this method and make changes to the amount to obtain the Stern–Volmer relationship in turn. The results were shown in the following Figure S1.





(c)

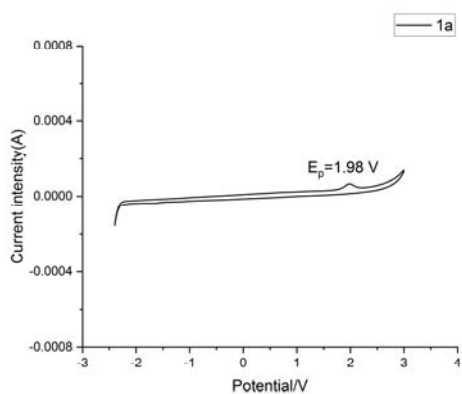


(d)

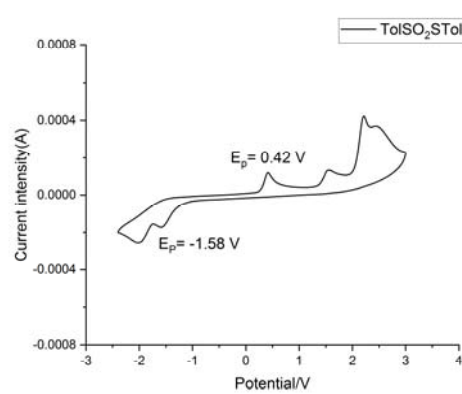
Figure S1. (a) PC1 quenched by **1a** in acetone. (b) PC1 quenched by **1a** + **S1** in acetone. (c) PC1 quenched by **S1** in acetone. (d) Stern–Volmer quenching.

5.2 Cyclic voltammetry measurements

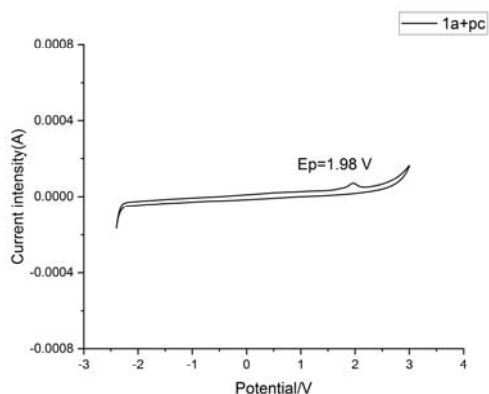
Cyclic voltammograms were taken on a CHI660D electrochemical analyzer/workstation (Shanghai Chen Hua Instrument Co., Ltd) in CH₃CN (Energy Chemical, 99.9%, with molecular sieves, water ≤ 50 ppm (by K.F.)) at room temperature using a glass carbon as working electrode, a platinum auxiliary electrode and 0.1 M NBu₄BF₄ as supporting electrolyte. All potentials are referenced against the Ag/AgCl redox couple. 10 mM 3-(pent-4-en-1-yl)quinazolin-4(3*H*)-one (**1a**) was dissolved in an anhydrous CH₃CN solution containing 0.1 M *n*-Bu₄PF₆. According to the above method, 10.0 mM TolSO₂STol (**S1**), 0.1 mM [Ir(dF(CF₃)ppy)₂(dtbpy)]PF₆ ([Ir]PF₆) were prepared sequentially. The solution was degassed with nitrogen bubbling for 5 min prior to voltammetric studies. The scan rate was 100 mV/s. The surface area of the working electrode of a cylinder with a diameter of 3 mm is 3.5 mm². Using micron-scale alumina powder as the polishing material for the electrode, which was polished to a mirror surface in an "8" shape way on the polishing cloth.



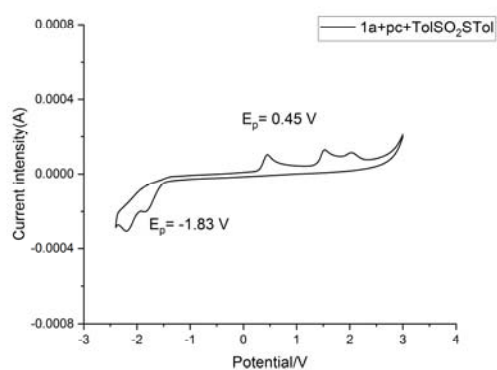
(a)



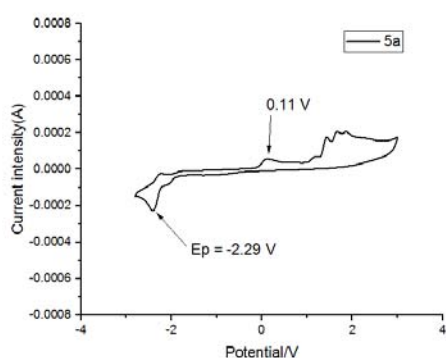
(b)



(c)



(d)



(e)

Figure S2 Cyclic Voltammetry of each reaction component. Using IUPAC as CV plotting convention; 10 mM **1a** in CH₃CN, 10 mM **S1** in CH₃CN, 0.1 mM photocatalyst [Ir]PF₆ in CH₃CN; The initial negative scan 3.0 V to -2.5 V, then backward; The working electrode was a glass carbon electrode, the counter electrode was a platinum wire electrode, the reference electrode was the Ag/AgCl redox couple.

5.3 Switch light experiments

Conducted the relationship of products with light on-off under standard conditions. Subsequent samples (each 20 μ L) taken at regular time intervals and determined by GC. The corresponding experimental results were constructed in **Figure S3**.

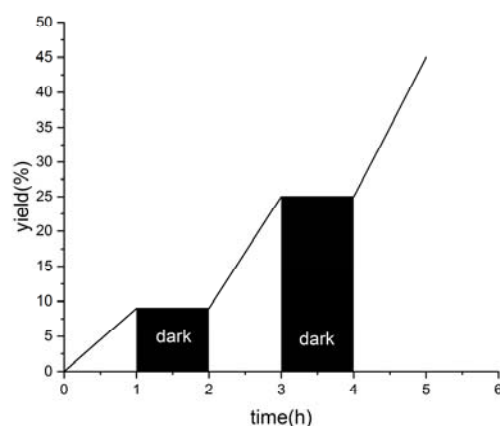


Figure S3 Plot of light on-off experiments

5.4 Radical trapping experiments

The following reaction was carried out under standard condition without bromide: A 10 mL reaction vessel was charged with 3-(pent-4-en-1-yl)quinazolin-4(3*H*)-one (**1a**, 43 mg, 0.2 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (2.5 mg, 0.002 mmol), TolSO₂STol (**S1**, 112 mg, 0.4 mmol), 2,2,6,6-tetramethyl-1-piperidinyloxy (TEMPO) (62.8 mg, 0.4 mmol, 2.0 equiv), or 1,1-diphenylethylene (DPE) (71.0 μL, 0.4 mmol, 2.0 equiv), *i*-PrOH (0.1 M, 2 mL). The atmosphere was exchanged by applying vacuum and backfilling with N₂ (this process was conducted for three times). The resulting mixture was stirred for 10 h under irradiation with a 35 W blue LED at ambient temperature. After completion, the consequence was detected by GC-MS.

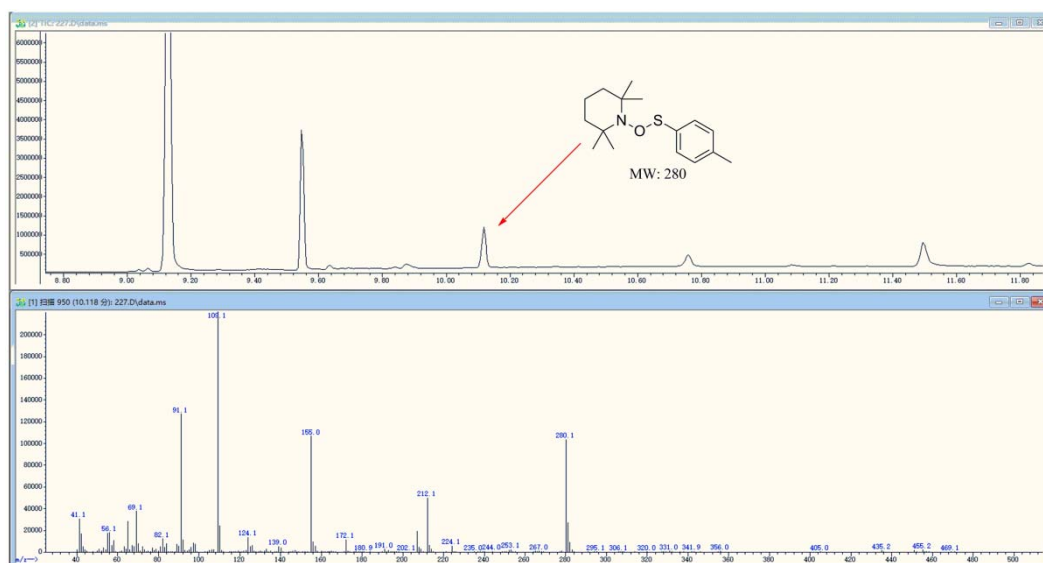
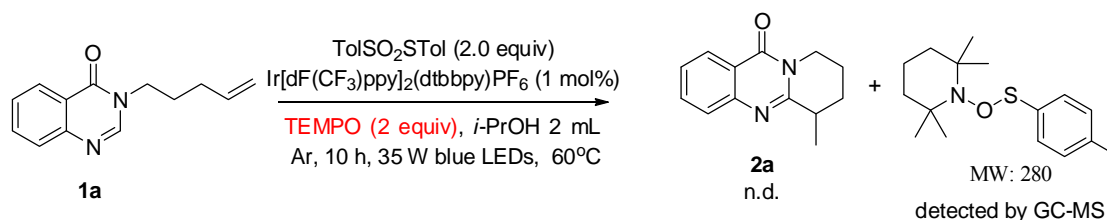


Figure S4

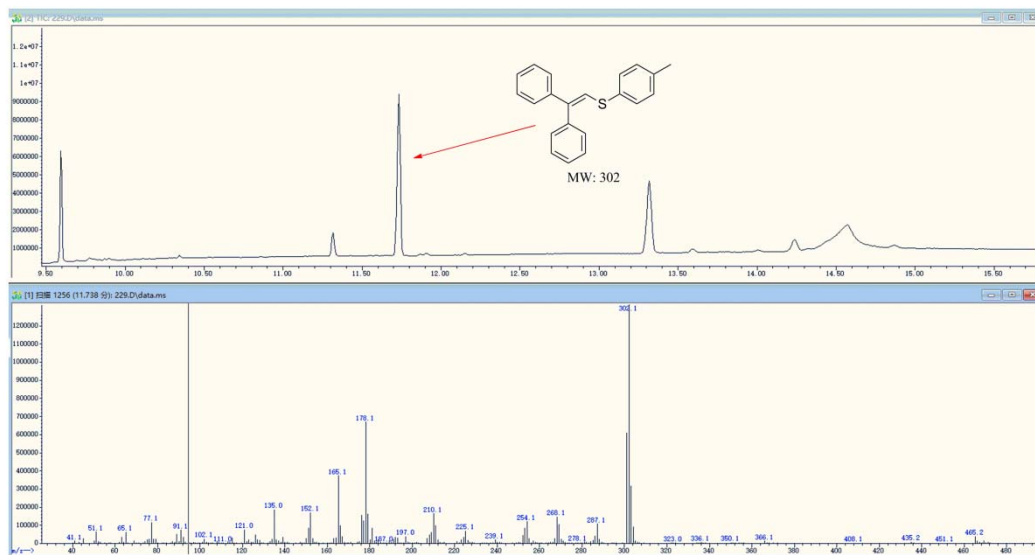
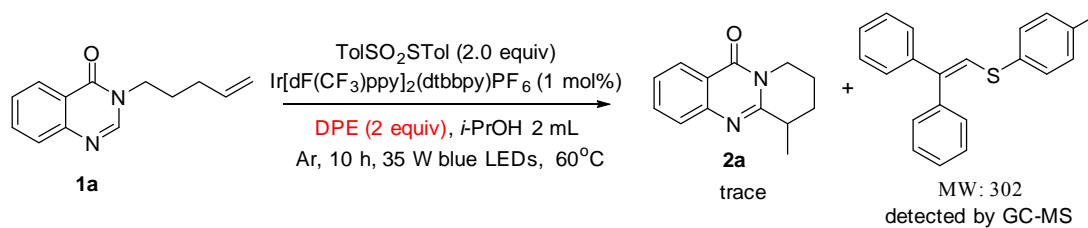
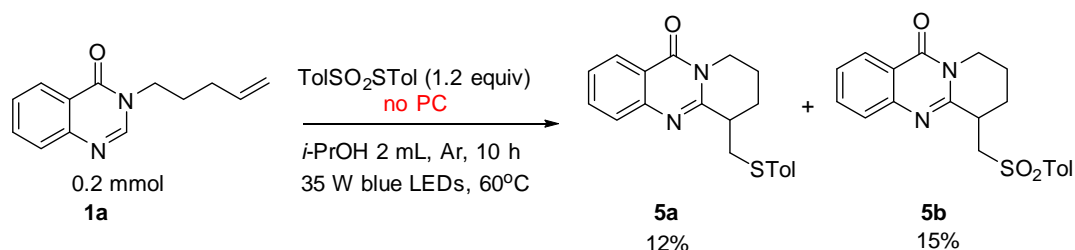


Figure S5

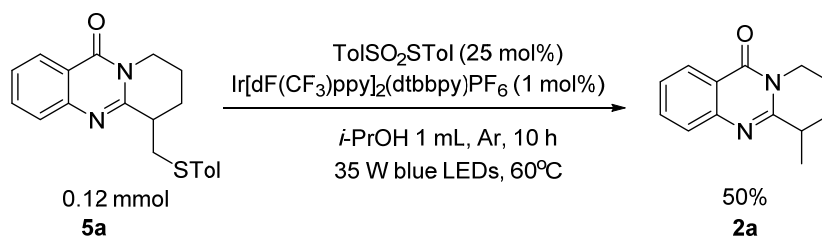
5.5 Control experiments

(a) A 10 mL reaction vessel was charged with 3-(pent-4-en-1-yl)quinazolin-4(3*H*)-one (**1a**, 43 mg, 0.2 mmol) and TolSO₂STol (**S1**, 67 mg, 0.24 mmol, 1.2 equiv), *i*-PrOH (0.1 M, 2 mL). The atmosphere was exchanged by applying vacuum and backfilling with N₂ (this process was conducted for three times). The resulting mixture was stirred for 10 h under irradiation with a 35 W Blue LEDs at 60 °C. After completion, the residue was purified by flash column chromatography using a mixture of petroleum ether and ethyl acetate as eluent to give the product **5a** and **5b**. Raw material recovery rate is 50%.

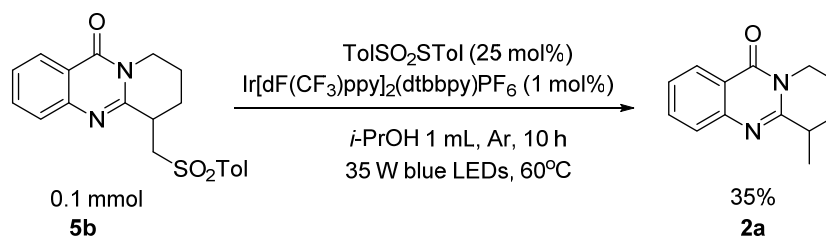


(b) A 10 mL reaction vessel was charged with 6-(*p*-tolylthio)methyl)-6,7,8,9-tetrahydro-11*H*-pyrido[2,1-*b*]quinazolin-11-one (**5a**, 41 mg, 0.12 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (1.1 mg, 0.001 mmol) and TolSO₂STol (**S1**, 9 mg, 0.03 mmol), *i*-PrOH (0.1 M, 1 mL). The atmosphere was exchanged by applying vacuum and backfilling with N₂ (this process was conducted for three times). The resulting mixture was stirred for 10 h under irradiation with a 35 W Blue LEDs at 60 °C. After completion, the residue was purified by flash column chromatography using a mixture of

petroleum ether and ethyl acetate as eluent to give the desired product **2a**.



(c) A 10 mL reaction vessel was charged with 6-(tosylmethyl)-6,7,8,9-tetrahydro-11*H*-pyrido[2,1-*b*]quinazolin-11-one (**5b**, 37 mg, 0.1 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (1.1 mg, 0.001 mmol) and TolSO₂STol (**S1**, 7 mg, 0.025 mmol), *i*-PrOH (0.1 M, 1 mL). The atmosphere was exchanged by applying vacuum and backfilling with N₂ (this process was conducted for three times). The resulting mixture was stirred for 10 h under irradiation with a 35 W Blue LEDs at 60 °C. After completion, the residue was purified by flash column chromatography using a mixture of petroleum ether and ethyl acetate as eluent to give the desired product **2a**.

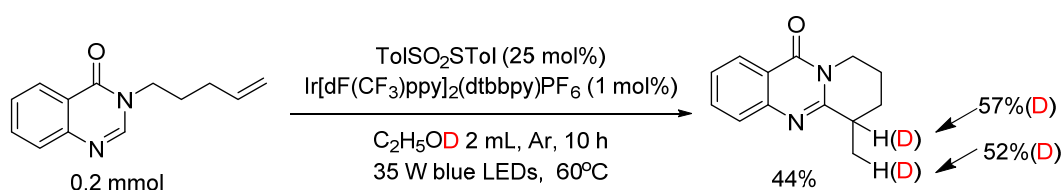


(d) A 10 mL reaction vessel was charged with 3-(pent-4-en-1-yl)quinazolin-4(3*H*)-one (**1a**, 43 mg, 0.2 mmol) and TolSO₂STol (**S1**, 67 mg, 0.24 mmol, 1.2 equiv), *i*-PrOH (0.1 M, 2 mL). The atmosphere was exchanged by applying vacuum and backfilling with N₂ (this process was conducted for three times). Wrap the vessel in tin foil to protect it from light, then stir the mixture for 10 hours at 60 °C.



5.6 H/D exchange experiments

A 10 mL reaction vessel was charged with 3-(pent-4-en-1-yl)quinazolin-4(3*H*)-one (**1a**, 43 mg, 0.2 mmol), Ir[dF(CF₃)ppy]₂(dtbbpy)PF₆ (4.5 mg, 0.002 mmol) and TolSO₂STol (**S1**, 14 mg, 0.05 mmol, 25mol%), ethanol-*d* (0.1 M, 2 mL). under Ar atmosphere. The resulting mixture was stirred for 10 h under irradiation with a 35 W Blue LEDs at 60 °C. After completion, the residue was purified by flash column chromatography using a mixture of petroleum ether and ethyl acetate as eluent to give the product.



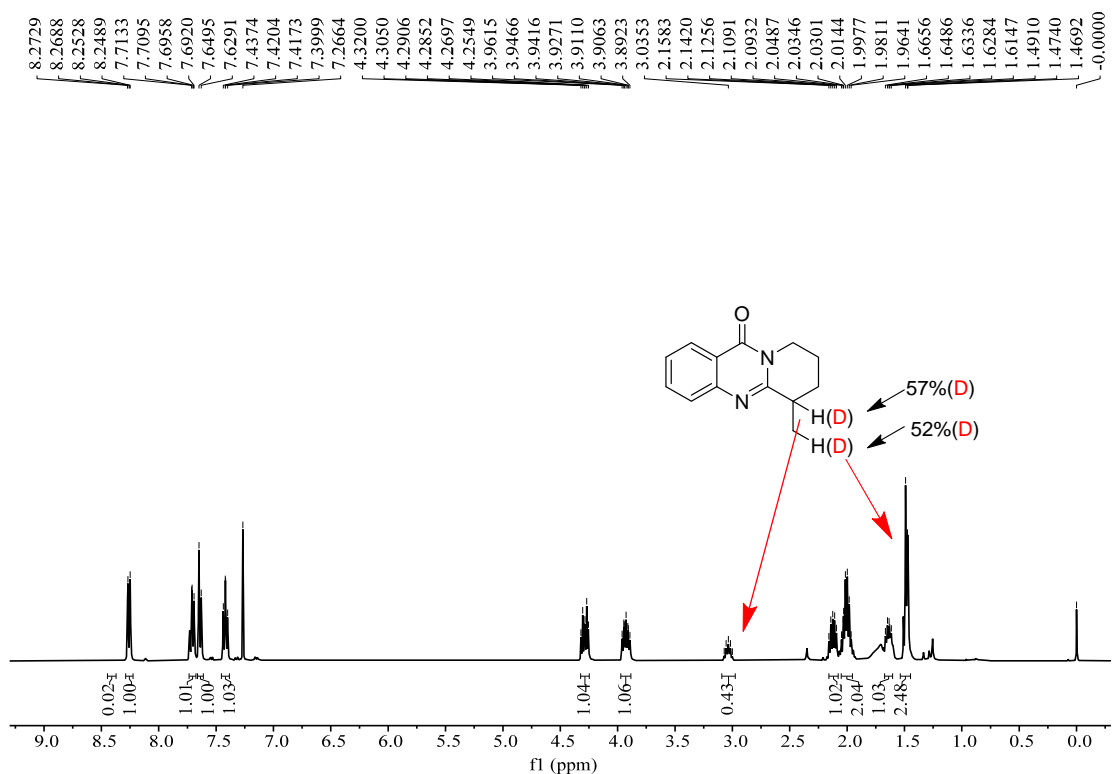


Figure S6

5.7 UV-vis absorption

UV-Vis analysis was performed on an Agilent Cary 60 spectrophotometer. Experiment was recorded using a cuvette equipped with septa-lined screw cap. Stock solution of TolSO₂STol (S1, 2.0×10^{-3} M) was prepared in acetone.

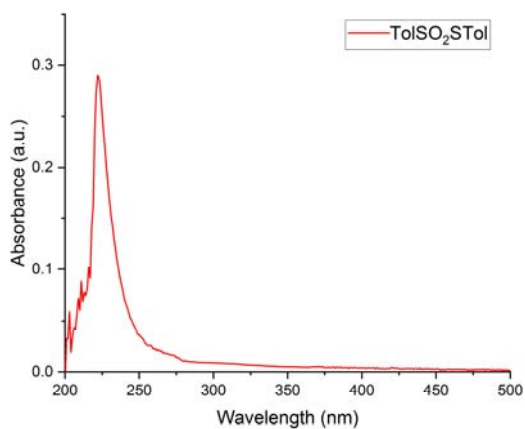
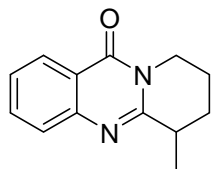


Figure S7

6. Characterization data of all products

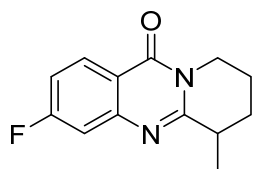
6-methyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-b]quinazolin-11-one (2a)³



Yield: 36.4 mg, 85%; White solid; mp 87-89 °C.

¹H NMR (400 MHz, Chloroform-*d*) δ 8.26 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.71 (ddd, *J* = 8.4, 6.9, 1.6 Hz, 1H), 7.64 (dd, *J* = 8.3, 1.5 Hz, 1H), 7.44 – 7.39 (m, 1H), 4.32 – 4.24 (m, 1H), 3.96 – 3.88 (m, 1H), 3.08 – 2.98 (m, 1H), 2.15 – 2.09 (m, 1H), 2.03 – 1.95 (m, 2H), 1.67 – 1.59 (m, 1H), 1.50 (d, *J* = 7.0, 1.6 Hz, 3H); ¹³C NMR (100 MHz, Chloroform-*d*) δ 162.19, 158.40, 147.35, 133.97, 126.65, 126.50, 126.00, 120.08, 42.09, 35.42, 27.53, 20.09, 19.45.

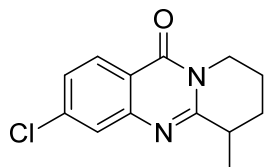
3-fluoro-6-methyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-b]quinazolin-11-one (2b)



Yield: 33.4 mg, 72%; White solid; mp 95-97 °C.

¹H NMR (400 MHz, Chloroform-*d*) δ 8.25 (dd, *J* = 8.9, 6.2 Hz, 1H), 7.29 – 7.25 (m, 1H), 7.16 – 7.10 (m, 1H), 4.30 – 4.22 (m, 1H), 3.95 – 3.87 (m, 1H), 3.06 – 2.97 (m, 1H), 2.17 – 2.09 (m, 1H), 2.04 – 1.98 (m, 2H), 1.67 – 1.59 (m, 1H), 1.49 (d, *J* = 7.0 Hz, 3H); ¹³C NMR (100 MHz, Chloroform-*d*) δ 166.28 (d, *J* = 251.5 Hz), 161.47, 159.80, 149.48 (d, *J* = 13.1 Hz), 129.24 (d, *J* = 10.7 Hz), 116.84 (d, *J* = 1.25 Hz), 114.86 (d, *J* = 23.5 Hz), 111.79 (d, *J* = 31.4 Hz), 42.09, 35.50, 27.44, 20.07, 19.31. HRMS (ESI) *m/z* calcd for C₁₃H₁₃FN₂NaO⁺ (M+Na)⁺ 255.0904, found 255.0914.

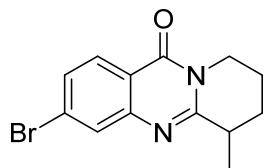
3-chloro-6-methyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-b]quinazolin-11-one (2c)



Yield: 37.2 mg, 75%; White solid; mp 90-92 °C.

¹H NMR (400 MHz, Chloroform-*d*) δ 8.09 (d, *J* = 8.5 Hz, 1H), 7.82 (t, *J* = 2.3 Hz, 1H), 7.51 (dd, *J* = 8.5, 2.0 Hz, 1H), 4.30 – 4.22 (m, 1H), 3.94 – 3.85 (m, 1H), 3.05 – 2.96 (m, 1H), 2.17 – 2.09 (m, 1H), 2.04 – 1.96 (m, 2H), 1.66 – 1.58 (m, 1H), 1.48 (d, *J* = 6.9 Hz, 3H); ¹³C NMR (100 MHz, Chloroform-*d*) δ 161.71, 159.76, 148.38, 129.47, 129.35, 128.59, 128.04, 118.91, 42.15, 35.54, 27.45, 20.12, 19.23. HRMS (ESI) *m/z* calcd for C₁₀H₇ClN₃⁺ (M+H)⁺ 249.0789, found 249.0797.

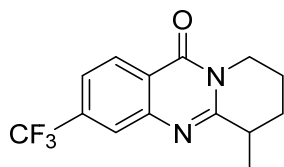
3-bromo-6-methyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-b]quinazolin-11-one (2d)



Yield: 40.9 mg, 70%; White solid; mp 87-89 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.16 (dd, $J = 8.6, 2.0$ Hz, 1H), 7.63 (d, $J = 2.0$ Hz, 1H), 7.36 (dd, $J = 8.5, 1.9$ Hz, 1H), 4.29 – 4.22 (m, 1H), 3.94 – 3.86 (m, 1H), 3.06 – 2.96 (m, 1H), 2.16 – 2.09 (m, 1H), 2.03 – 1.97 (m, 2H), 1.66 – 1.59 (m, 1H), 1.48 (d, $J = 7.0, 1.3$ Hz, 3H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.57, 159.79, 148.30, 140.03, 128.01, 126.60, 126.24, 118.53, 42.14, 35.51, 27.43, 20.09, 19.25. HRMS (ESI) m/z calcd for $\text{C}_{13}\text{H}_{14}\text{BrN}_2\text{O}^+$ ($\text{M}+\text{H}$) $^+$ 293.0284, found 293.0281.

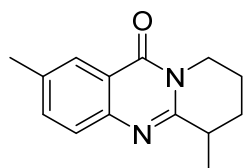
6-methyl-3-(trifluoromethyl)-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2e)



Yield: 42.3 mg, 75%; White solid; mp 75-77 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.35 (d, $J = 8.3$ Hz, 1H), 7.93 (d, $J = 1.8$ Hz, 1H), 7.60 (dd, $J = 8.4, 1.7$ Hz, 1H), 4.33 – 4.26 (m, 1H), 3.97 – 3.89 (m, 1H), 3.08 – 2.99 (m, 1H), 2.20 – 2.12 (m, 1H), 2.06 – 1.98 (m, 2H), 1.68 – 1.60 (m, 1H), 1.51 (d, $J = 6.9$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 161.39, 159.97, 147.31, 135.46 (q, $J = 32.5$ Hz), 127.69, 124.43 (q, $J = 4.1$ Hz), 123.50 (q, $J = 271.6$ Hz), 122.32, 121.85 (q, $J = 3.5$ Hz), 42.26, 35.56, 27.43, 20.13, 19.10. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{14}\text{F}_3\text{N}_2\text{O}^+$ ($\text{M}+\text{H}$) $^+$ 283.1053, found 283.1064.

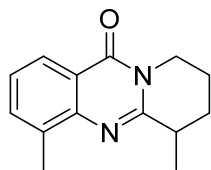
2,6-dimethyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2f)



Yield: 31.0 mg, 68%; White solid; mp 81-83 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.03 (s, 1H), 7.54 – 7.49 (m, 2H), 4.31 – 4.23 (m, 1H), 3.95 – 3.87 (m, 1H), 3.06 – 2.97 (m, 1H), 2.46 (s, 3H), 2.15 – 2.07 (m, 1H), 2.03 – 1.94 (m, 2H), 1.65 – 1.58 (m, 1H), 1.48 (d, $J = 6.9$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.09, 157.43, 145.32, 135.95, 135.40, 126.41, 125.75, 119.74, 41.96, 35.26, 27.53, 21.16, 20.09, 19.35. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{17}\text{N}_2\text{O}^+$ ($\text{M}+\text{H}$) $^+$ 229.1335, found 229.1342.

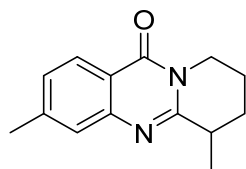
4,6-dimethyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2g)



Yield: 25.1 mg, 55%; White solid; mp 45-47 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.09 (dd, $J = 8.0, 1.6$ Hz, 1H), 7.54 – 7.50 (m, 1H), 7.28 (t, $J = 7.6$ Hz, 1H), 4.29 – 4.21 (m, 1H), 3.97 – 3.88 (m, 1H), 3.02 – 2.92 (m, 1H), 2.58 (s, 3H), 2.14 – 2.09 (m, 1H), 2.02 – 1.92 (m, 2H), 1.61 – 1.53 (m, 1H), 1.49 (d, $J = 6.8$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.46, 156.78, 145.82, 135.23, 134.24, 125.41, 124.03, 119.91, 41.77, 35.58, 27.70, 20.54, 18.93, 17.01. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{17}\text{N}_2\text{O}^+$ (M+H) $^+$ 229.1335, found 229.1340.

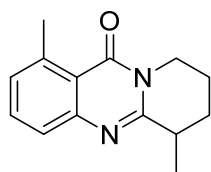
3,6-dimethyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2h)



Yield: 36.0 mg, 79%; White solid; mp 55-57 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.13 (d, $J = 8.1$ Hz, 1H), 7.44 (s, 1H), 7.24 (dd, $J = 8.1, 1.6$ Hz, 1H), 4.31 – 4.24 (m, 1H), 3.94 – 3.87 (m, 1H), 3.05 – 2.98 (m, 1H), 2.48 (s, 3H), 2.16 – 2.09 (m, 1H), 2.03 – 1.96 (m, 2H), 1.65 – 1.59 (m, 1H), 1.48 (d, $J = 6.9$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.14, 158.47, 147.50, 144.86, 127.65, 126.38, 126.35, 117.75, 41.96, 35.42, 27.60, 21.82, 20.16, 19.43. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{17}\text{N}_2\text{O}^+$ (M+H) $^+$ 229.1335, found 229.1338.

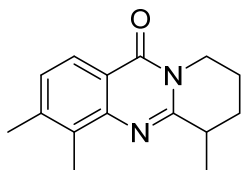
1,6-dimethyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2i)



Yield: 33.8 mg, 74%; White solid; mp 70-72 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.53 (t, $J = 7.7$ Hz, 1H), 7.46 (dd, $J = 8.2, 1.4$ Hz, 1H), 7.17 – 7.13 (m, 1H), 4.21 – 4.14 (m, 1H), 3.91 – 3.84 (m, 1H), 3.03 – 2.97 (m, 1H), 2.87 (s, 3H), 2.13 – 2.06 (m, 1H), 2.04 – 1.94 (m, 2H), 1.66 – 1.58 (m, 1H), 1.48 (d, $J = 7.0$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.78, 158.02, 148.92, 140.68, 133.07, 128.55, 124.86, 118.69, 42.00, 35.34, 27.60, 23.11, 20.25, 19.51. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{17}\text{N}_2\text{O}^+$ (M+H) $^+$ 229.1335, found 229.1339.

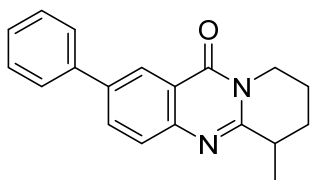
3,4,6-trimethyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2j)



Yield: 42.6 mg, 88%; White solid; mp 68-70 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.00 (d, J = 8.1 Hz, 1H), 7.21 (d, J = 8.1 Hz, 1H), 4.28 – 4.20 (m, 1H), 3.97 – 3.88 (m, 1H), 3.02 – 2.92 (m, 1H), 2.53 (s, 3H), 2.40 (s, 3H), 2.16 – 2.07 (m, 1H), 2.01 – 1.94 (m, 2H), 1.62 – 1.54 (m, 1H), 1.50 (d, J = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.58, 156.56, 145.54, 142.59, 133.07, 127.93, 123.23, 117.96, 41.65, 35.63, 27.81, 20.79, 20.63, 18.94, 12.67. HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_{18}\text{N}_2\text{NaO}^+$ ($\text{M}+\text{Na}$) $^+$ 265.1311, found 265.1320.

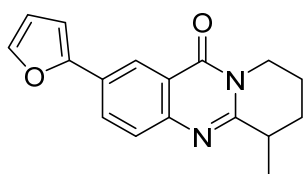
6-methyl-2-phenyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2k)



Yield: 45.8 mg, 79%; White solid; mp 137-138 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.49 (d, J = 2.2 Hz, 1H), 7.97 (dd, J = 8.5, 2.3 Hz, 1H), 7.72 – 7.66 (m, 3H), 7.46 (t, J = 7.5 Hz, 2H), 7.39 – 7.34 (m, 1H), 4.37 – 4.24 (m, 1H), 3.98 – 3.87 (m, 1H), 3.13 – 2.99 (m, 1H), 2.17 – 2.09 (m, 1H), 2.05 – 1.96 (m, 2H), 1.67 – 1.60 (m, 1H), 1.51 (d, J = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.25, 158.39, 146.60, 139.73, 138.79, 132.90, 128.86, 127.59, 127.21, 127.06, 124.36, 120.31, 42.17, 35.46, 27.56, 20.13, 19.45. HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{18}\text{N}_2\text{NaO}^+$ ($\text{M}+\text{Na}$) $^+$ 313.1311, found 313.1323.

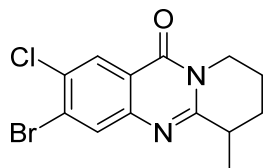
2-(furan-2-yl)-6-methyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2l)



Yield: 36.4 mg, 65%; Brown solid; mp 122-124 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.51 (d, J = 2.1 Hz, 1H), 8.01 (dd, J = 8.6, 2.1 Hz, 1H), 7.64 (d, J = 8.5 Hz, 1H), 7.50 (d, J = 1.8 Hz, 1H), 6.77 (d, J = 3.4 Hz, 1H), 6.50 (dd, J = 3.4, 1.8 Hz, 1H), 4.32 – 4.25 (m, 1H), 3.97 – 3.89 (m, 1H), 3.07 – 2.98 (m, 1H), 2.16 – 2.09 (m, 1H), 2.05 – 1.97 (m, 2H), 1.67 – 1.59 (m, 1H), 1.49 (d, J = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.07, 158.27, 153.01, 146.47, 142.47, 129.56, 128.72, 127.20, 121.06, 120.37, 111.86, 105.88, 42.17, 35.45, 27.56, 20.14, 19.38. HRMS (ESI) m/z calcd for $\text{C}_{17}\text{H}_{17}\text{N}_2\text{O}_2^+$ ($\text{M}+\text{H}$) $^+$ 281.1285, found 281.1294.

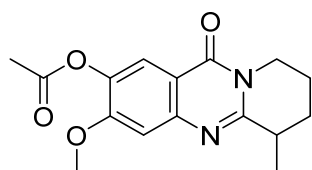
3-bromo-2-chloro-6-methyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2m)



Yield: 29.4 mg, 45%; White solid; mp 128-130 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.27 (s, 1H), 7.94 (s, 1H), 4.29 – 4.22 (m, 1H), 3.92 – 3.85 (m, 1H), 3.03 – 2.96 (m, 1H), 2.17 – 2.10 (m, 1H), 2.04 – 1.97 (m, 2H), 1.65 – 1.59 (m, 1H), 1.47 (d, $J = 6.9$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 160.75, 159.98, 146.43, 131.96, 131.92, 128.82, 127.37, 120.14, 42.26, 35.58, 27.40, 20.13, 19.09. HRMS (ESI) m/z calcd for $\text{C}_{13}\text{H}_{12}\text{BrClN}_2\text{NaO}^+$ ($\text{M}+\text{Na}$) $^+$ 348.9714, found 348.9722.

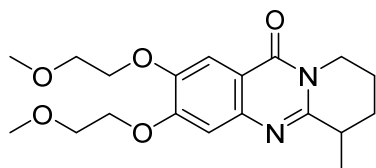
3-methoxy-6-methyl-11-oxo-6,8,9,11-tetrahydro-7H-pyrido[2,1-*b*]quinazolin-2-yl acetate (2n)



Yield: 42.9 mg, 71%; White solid; mp 114-116 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.87 (s, 1H), 7.10 (s, 1H), 4.28 – 4.22 (m, 1H), 3.93 (s, 3H), 3.90 – 3.85 (m, 1H), 3.04 – 2.99 (m, 1H), 2.34 (s, 3H), 2.15 – 2.09 (m, 1H), 2.02 – 1.95 (m, 2H), 1.66 – 1.59 (m, 1H), 1.48 (d, $J = 7.0$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 168.81, 161.17, 159.02, 156.37, 147.52, 138.98, 119.77, 113.41, 108.00, 56.18, 42.01, 35.38, 27.48, 20.49, 20.01, 19.48. HRMS (ESI) m/z calcd for $\text{C}_{16}\text{H}_{18}\text{N}_2\text{NaO}_4^+$ ($\text{M}+\text{Na}$) $^+$ 325.1159, found 325.1174.

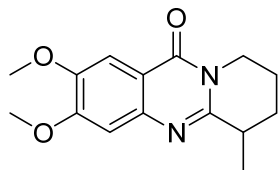
2,3-bis(2-methoxyethoxy)-6-methyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2o)



Yield: 53.6 mg, 74%; Clear liquid.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.57 (s, 1H), 7.03 (s, 1H), 4.28 – 4.23 (m, 5H), 3.94 – 3.88 (m, 1H), 3.87 – 3.83 (m, 4H), 3.48 (s, 6H), 3.04 – 2.97 (m, 1H), 2.14 – 2.07 (m, 1H), 2.02 – 1.94 (m, 2H), 1.65 – 1.58 (m, 1H), 1.47 (d, $J = 6.9$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 161.36, 157.08, 154.24, 147.81, 143.62, 113.33, 107.99, 106.91, 70.52, 70.33, 68.26, 68.10, 59.12, 59.06, 41.95, 35.15, 27.49, 20.02, 19.37. HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{26}\text{N}_2\text{NaO}_5^+$ ($\text{M}+\text{H}$) $^+$ 385.1734, found 385.1750.

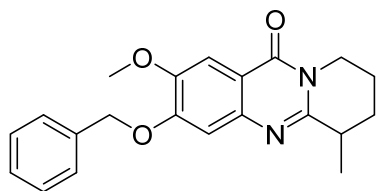
2,3-dimethoxy-6-methyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2p)



Yield: 40.0 mg, 73%; White solid; mp 130-132 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.57 (s, 1H), 7.05 (s, 1H), 4.32 – 4.25 (m, 1H), 4.00 (d, J = 2.0 Hz, 6H), 3.96 – 3.89 (m, 1H), 3.05 – 2.98 (m, 1H), 2.16 – 2.09 (m, 1H), 2.05 – 1.97 (m, 2H), 1.67 – 1.60 (m, 1H), 1.49 (d, J = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 161.46, 157.13, 154.72, 148.48, 143.69, 113.35, 107.01, 105.33, 56.16, 42.05, 35.25, 29.59, 27.60, 20.12, 19.46. HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_{19}\text{N}_2\text{O}_3^+$ ($\text{M}+\text{H}$) $^+$ 275.1390, found 275.1403.

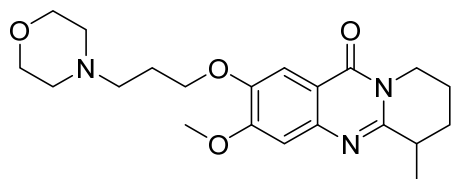
3-(benzyloxy)-2-methoxy-6-methyl-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2q)



Yield: 56.7 mg, 81%; White solid; mp 87-89 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.59 (s, 1H), 7.47 (d, J = 7.1 Hz, 2H), 7.38 (t, J = 7.3 Hz, 2H), 7.35 – 7.30 (m, 1H), 7.09 (s, 1H), 5.25 (s, 2H), 4.30 – 4.22 (m, 1H), 3.98 (s, 3H), 3.94 – 3.87 (m, 1H), 3.05 – 2.94 (m, 1H), 2.13 – 2.05 (m, 1H), 2.02 – 1.92 (m, 2H), 1.65 – 1.57 (m, 1H), 1.46 (d, J = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 161.46, 157.00, 153.88, 148.87, 143.52, 135.91, 128.56, 128.03, 127.29, 113.54, 108.49, 105.61, 70.63, 56.18, 42.04, 35.24, 27.59, 20.11, 19.48. HRMS (ESI) m/z calcd for $\text{C}_{21}\text{H}_{22}\text{N}_2\text{NaO}_3^+$ ($\text{M}+\text{Na}$) $^+$ 373.1523, found 373.1538.

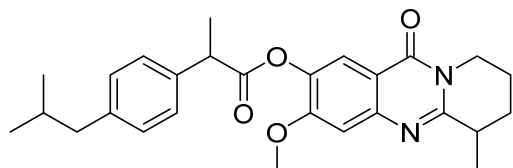
3-methoxy-6-methyl-2-(3-morpholinopropoxy)-6,7,8,9-tetrahydro-11H-pyrido[2,1-*b*]quinazolin-11-one (2r)



Yield: 38.7 mg, 50%; White solid; mp 135-137 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.59 (s, 1H), 7.04 (s, 1H), 4.31 – 4.25 (m, 1H), 4.20 (t, J = 6.6 Hz, 2H), 3.98 (s, 3H), 3.94 – 3.88 (m, 1H), 3.73 (t, J = 4.7 Hz, 4H), 3.05 – 2.98 (m, 1H), 2.54 (d, J = 7.1 Hz, 2H), 2.48 (t, J = 4.7 Hz, 4H), 2.11 – 2.06 (m, 3H), 2.03 – 1.96 (m, 2H), 1.66 – 1.59 (m, 1H), 1.49 (d, J = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 161.53, 157.11, 155.06, 147.92, 143.65, 113.35, 107.15, 106.55, 67.40, 66.91, 56.14, 55.34, 53.64, 42.08, 35.30, 27.65, 26.05, 20.17, 19.51. HRMS (ESI) m/z calcd for $\text{C}_{21}\text{H}_{30}\text{N}_3\text{O}_4^+$ ($\text{M}+\text{H}$) $^+$ 388.2231, found 388.2241.

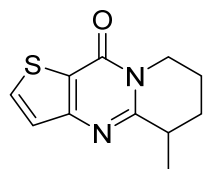
3-methoxy-6-methyl-11-oxo-6,8,9,11-tetrahydro-7H-pyrido[2,1-*b*]quinazolin-2-yl 2-(4-isobutylphenyl)propanoate (2s)



Yield: 70.0 mg, 68%; White solid; mp 140-141 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.79 (s, 1H), 7.33 (d, J = 8.1 Hz, 2H), 7.15 (d, J = 8.0 Hz, 2H), 7.04 (s, 1H), 4.27 – 4.20 (m, 1H), 3.99 (t, J = 7.1 Hz, 1H), 3.90 – 3.84 (m, 1H), 3.80 (s, 3H), 3.04 – 2.97 (m, 1H), 2.48 (d, J = 7.2 Hz, 2H), 2.14 – 2.07 (m, 1H), 2.02 – 1.94 (m, 2H), 1.91 – 1.84 (m, 1H), 1.62 (d, J = 7.1 Hz, 4H), 1.47 (d, J = 7.0 Hz, 3H), 0.92 (d, J = 6.7 Hz, 6H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 172.64, 161.23, 158.96, 156.55, 147.49, 140.70, 139.26, 137.12, 129.33, 127.35, 119.67, 113.38, 107.88, 55.98, 45.04, 44.91, 42.05, 35.42, 30.17, 27.53, 22.38, 20.06, 19.51, 18.65. HRMS (ESI) m/z calcd for $\text{C}_{27}\text{H}_{32}\text{N}_2\text{NaO}_4^+$ ($\text{M}+\text{Na}$) $^+$ 449.2435, found 449.2429.

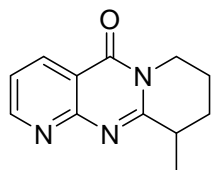
5-methyl-5,6,7,8-tetrahydro-10H-pyrido[1,2-*a*]thieno[3,2-*d*]pyrimidin-10-one (2t)



Yield: 26.4 mg, 60%; White solid; mp 126-128 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.74 (d, J = 5.3 Hz, 1H), 7.28 (d, J = 5.2 Hz, 1H), 4.41 – 4.32 (m, 1H), 3.95 – 3.85 (m, 1H), 3.10 – 3.00 (m, 1H), 2.18 – 2.10 (m, 1H), 2.02 – 1.97 (m, 2H), 1.67 – 1.58 (m, 1H), 1.48 (d, J = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 160.10, 158.39, 156.17, 133.86, 124.76, 120.71, 41.86, 35.30, 27.53, 20.10, 19.46. HRMS (ESI) m/z calcd for $\text{C}_{11}\text{H}_{13}\text{N}_2\text{OS}^+$ ($\text{M}+\text{H}$) $^+$ 221.0743, found 221.0743.

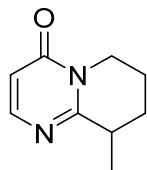
10-methyl-7,8,9,10-tetrahydro-5H-dipyrido[1,2-*a*:2',3'-*d*]pyrimidin-5-one (2u)



Yield: 18.1 mg, 42%; White solid; mp 95-97 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.95 (dd, J = 4.5, 2.1 Hz, 1H), 8.59 (dd, J = 7.9, 2.1 Hz, 1H), 7.39 (dd, J = 7.9, 4.5 Hz, 1H), 4.33 – 4.26 (m, 1H), 3.97 – 3.89 (m, 1H), 3.14 – 3.06 (m, 1H), 2.21 – 2.13 (m, 1H), 2.06 – 2.00 (m, 2H), 1.69 – 1.62 (m, 1H), 1.57 (d, J = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.49, 162.43, 157.35, 155.98, 136.25, 121.68, 115.11, 42.33, 35.79, 27.43, 20.16, 19.08. HRMS (ESI) m/z calcd for $\text{C}_{13}\text{H}_{14}\text{N}_3\text{O}_2^+$ ($\text{M}+\text{H}$) $^+$ 216.1131, found 216.1139.

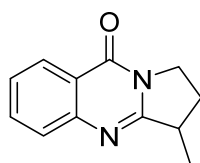
9-methyl-6,7,8,9-tetrahydro-4H-pyrido[1,2-*a*]pyrimidin-4-one (2v)



Yield: 15.4 mg, 47%; Clear liquid.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.87 (d, J = 6.5 Hz, 1H), 6.32 (d, J = 6.5 Hz, 1H), 4.17 – 4.09 (m, 1H), 3.89 – 3.81 (m, 1H), 3.01 – 2.90 (m, 1H), 2.12 – 2.06 (m, 1H), 2.03 – 1.93 (m, 2H), 1.65 – 1.57 (m, 1H), 1.42 (d, J = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 164.05, 162.27, 152.32, 111.98, 42.36, 35.34, 27.28, 19.81, 19.31. HRMS (ESI) m/z calcd for $\text{C}_9\text{H}_{13}\text{N}_2\text{O}^+$ ($\text{M}+\text{H}$) $^+$ 165.1022, found 165.1028.

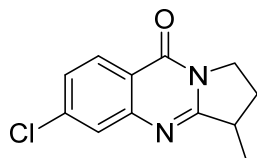
3-methyl-2,3-dihydropyrrolo[2,1-*b*]quinazolin-9(1H)-one (3a)



Yield: 27.2 mg, 68%; White solid; mp 126-128 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.29 (dd, J = 7.9, 1.5 Hz, 1H), 7.75 – 7.68 (m, 2H), 7.46 – 7.42 (m, 1H), 4.31 – 4.25 (m, 1H), 4.05 – 3.98 (m, 1H), 3.36 – 3.29 (m, 1H), 2.53 – 2.46 (m, 1H), 1.91 – 1.83 (m, 1H), 1.49 (d, J = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.33, 160.99, 149.28, 134.03, 126.93, 126.31, 126.13, 120.61, 44.51, 38.72, 28.55, 17.16. HRMS (ESI) m/z calcd for $\text{C}_{12}\text{H}_{13}\text{N}_2\text{O}^+$ ($\text{M}+\text{H}$) $^+$ 201.1022, found 201.1029.

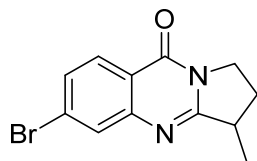
6-chloro-3-methyl-2,3-dihydropyrrolo[2,1-*b*]quinazolin-9(1H)-one (3b)



Yield: 38.8 mg, 83%; White solid; mp 67-69 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.21 (d, J = 8.5 Hz, 1H), 7.69 (d, J = 2.0 Hz, 1H), 7.39 (dd, J = 8.6, 2.0 Hz, 1H), 4.30 – 4.23 (m, 1H), 4.03 – 3.95 (m, 1H), 3.36 – 3.27 (m, 1H), 2.54 – 2.46 (m, 1H), 1.93 – 1.84 (m, 1H), 1.48 (d, J = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 163.68, 160.42, 150.37, 140.22, 127.77, 126.77, 126.63, 119.17, 44.65, 38.87, 28.54, 17.06. HRMS (ESI) m/z calcd for $\text{C}_{12}\text{H}_{11}\text{ClN}_2\text{NaO}^+$ ($\text{M}+\text{Na}$) $^+$ 257.0452, found 257.0463.

6-bromo-3-methyl-2,3-dihydropyrrolo[2,1-*b*]quinazolin-9(1H)-one (3c)

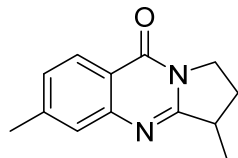


Yield: 31.1 mg, 56%; White solid; mp 102-104 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.12 (d, J = 8.5 Hz, 1H), 7.87 (d, J = 1.9 Hz, 1H), 7.54 (dd, J = 8.5, 1.9 Hz, 1H), 4.30 – 4.22 (m, 1H), 4.02 – 3.94 (m, 1H), 3.36 – 3.26 (m, 1H), 2.55 – 2.45 (m, 1H),

1.90 – 1.84 (m, 1H), 1.47 (d, $J = 7.0$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 163.62, 160.49, 150.36, 129.76, 129.48, 128.69, 127.75, 119.49, 44.65, 38.84, 28.51, 17.03. HRMS (ESI) m/z calcd for $\text{C}_{12}\text{H}_{12}\text{BrN}_2\text{O}^+$ ($\text{M}+\text{H}$) $^+$ 297.0128, found 297.0130.

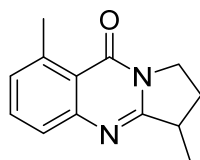
3,6-dimethyl-2,3-dihydropyrrolo[2,1-*b*]quinazolin-9(1*H*)-one (3d)



Yield: 36.4 mg, 85%; White solid; mp 81-83 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.16 (d, $J = 8.2$ Hz, 1H), 7.49 (s, 1H), 7.28 – 7.25 (m, 1H), 4.29 – 4.20 (m, 1H), 4.04 – 3.94 (m, 1H), 3.35 – 3.24 (m, 1H), 2.49 (s, 1H), 2.52 – 2.45 (m, 3H), 1.89 – 1.79 (m, 1H), 1.47 (d, $J = 7.0$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.40, 160.98, 149.45, 144.97, 127.71, 126.74, 126.13, 118.22, 44.44, 38.71, 28.58, 21.82, 17.17. HRMS (ESI) m/z calcd for $\text{C}_{13}\text{H}_{14}\text{N}_2\text{NaO}^+$ ($\text{M}+\text{Na}$) $^+$ 237.0998, found 237.1008.

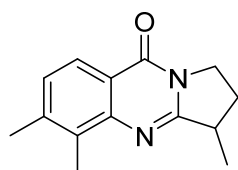
3,8-dimethyl-2,3-dihydropyrrolo[2,1-*b*]quinazolin-9(1*H*)-one (3e)



Yield: 25.9 mg, 69%; White solid; mp 95-97 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.57 – 7.48 (m, 2H), 7.17 (dd, $J = 6.7, 1.9$ Hz, 1H), 4.26 – 4.17 (m, 1H), 4.00 – 3.92 (m, 1H), 3.35 – 3.23 (m, 1H), 2.88 (s, 3H), 2.51 – 2.41 (m, 1H), 1.90 – 1.79 (m, 1H), 1.46 (d, $J = 7.0$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 161.87, 161.70, 150.94, 140.82, 133.08, 128.74, 125.09, 119.08, 44.45, 38.62, 28.39, 22.93, 17.15. HRMS (ESI) m/z calcd for $\text{C}_{13}\text{H}_{14}\text{N}_2\text{NaO}^+$ ($\text{M}+\text{Na}$) $^+$ 237.0998, found 237.1009.

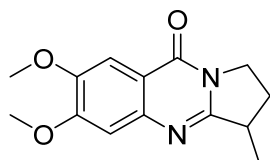
3,5,6-trimethyl-2,3-dihydropyrrolo[2,1-*b*]quinazolin-9(1*H*)-one (3f)



Yield: 39.2 mg, 86%; White solid; mp 88-89 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.03 (d, $J = 8.1$ Hz, 1H), 7.23 (d, $J = 8.1$ Hz, 1H), 4.29 – 4.22 (m, 1H), 3.99 – 3.91 (m, 1H), 3.34 – 3.25 (m, 1H), 2.55 (s, 3H), 2.51 – 2.44 (m, 1H), 2.41 (s, 3H), 1.88 – 1.79 (m, 1H), 1.48 (d, $J = 7.0$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 161.49, 160.59, 147.64, 142.81, 133.32, 127.90, 123.02, 118.42, 44.24, 38.68, 28.69, 20.86, 17.13, 13.01. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{17}\text{N}_2\text{O}^+$ ($\text{M}+\text{H}$) $^+$ 229.1335, found 229.1344.

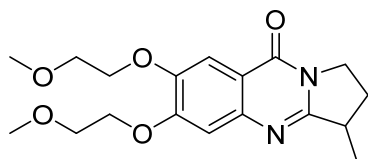
6,7-dimethoxy-3-methyl-2,3-dihydropyrrolo[2,1-*b*]quinazolin-9(1*H*)-one (3g)



Yield: 28.6 mg, 55%; White solid; mp 152-154 °C.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.61 (s, 1H), 7.11 (s, 1H), 4.31 – 4.25 (m, 1H), 4.01 – 3.98 (m, 1H), 4.00 (s, 6H), 3.34 – 3.27 (m, 1H), 2.52 – 2.45 (m, 1H), 1.85 (d, $J = 3.7$ Hz, 1H), 1.48 (d, $J = 7.0$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 161.15, 160.41, 154.68, 148.53, 145.55, 113.82, 107.48, 105.33, 56.25, 56.21, 44.58, 38.65, 28.69, 17.17. HRMS (ESI) m/z calcd for $\text{C}_{14}\text{H}_{16}\text{N}_2\text{NaO}_3^+$ ($\text{M}+\text{Na}$) $^+$ 283.1053, found 283.1068.

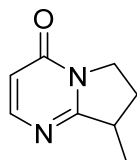
6,7-bis(2-methoxyethoxy)-3-methyl-2,3-dihydropyrrolo[2,1-*b*]quinazolin-9(1*H*)-one (3h)



Yield: 25.1 mg, 36%; Clear liquid.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.61 (s, 1H), 7.10 (s, 1H), 4.29 – 4.23 (m, 5H), 4.02 – 3.94 (m, 1H), 3.87 – 3.82 (m, 4H), 3.48 (s, 6H), 3.34 – 3.25 (m, 1H), 2.52 – 2.43 (m, 1H), 1.91 – 1.82 (m, 1H), 1.47 (d, $J = 7.0$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 161.17, 160.41, 154.30, 147.97, 145.59, 113.91, 108.62, 107.08, 70.66, 70.47, 68.48, 68.27, 59.26, 59.20, 44.56, 38.65, 28.68, 17.17. HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{24}\text{N}_2\text{NaO}_5^+$ ($\text{M}+\text{Na}$) $^+$ 371.1577, found 371.1598.

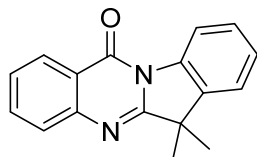
8-methyl-7,8-dihydropyrrolo[1,2-*a*]pyrimidin-4(6*H*)-one (3i)



Yield: 12.0 mg, 40%; Clear liquid.

^1H NMR (400 MHz, Chloroform-*d*) δ 7.90 (dd, $J = 6.7, 1.1$ Hz, 1H), 6.33 – 6.27 (m, 1H), 4.27 – 4.19 (m, 1H), 3.98 – 3.91 (m, 1H), 3.34 – 3.23 (m, 1H), 2.52 – 2.44 (m, 1H), 1.89 – 1.80 (m, 1H), 1.42 (d, $J = 7.0, 1.1$ Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 167.52, 161.29, 154.25, 112.74, 45.06, 38.99, 28.04, 16.88. HRMS (ESI) m/z calcd for $\text{C}_8\text{H}_{11}\text{N}_2\text{O}^+$ ($\text{M}+\text{H}$) $^+$ 151.0866, found 151.0872.

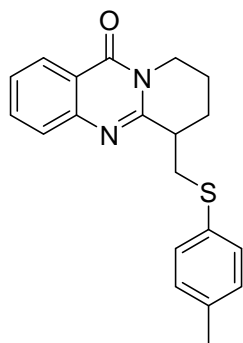
6,6-dimethylindolo[2,1-*b*]quinazolin-12(6*H*)-one (4a)



Yield: 34.1 mg, 65%; White solid; mp 135-137 °C.

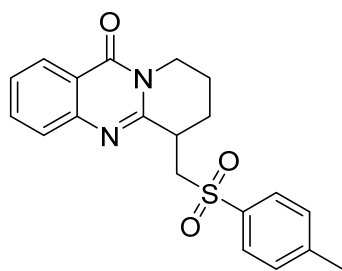
^1H NMR (400 MHz, Chloroform-*d*) δ 8.62 (dd, $J = 7.6, 1.7$ Hz, 1H), 8.45 – 8.41 (m, 1H), 7.80 – 7.75 (m, 2H), 7.53 – 7.48 (m, 1H), 7.44 (dd, $J = 8.2, 6.8$ Hz, 2H), 7.35 (dd, $J = 8.4, 6.4$ Hz, 1H), 1.65 (s, 6H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 164.58, 160.20, 147.65, 138.32, 137.86, 134.25, 128.37, 127.30, 126.81, 126.63, 126.56, 122.35, 121.42, 117.23, 45.12, 26.68. HRMS (ESI) m/z calcd for $\text{C}_{17}\text{H}_{15}\text{N}_2\text{O}^+$ ($\text{M}+\text{H}$) $^+$ 263.1179, found 263.1192.

6-((p-tolylthio)methyl)-6,7,8,9-tetrahydro-11H-pyrido[2,1-b]quinazolin-11-one (5a)



Yield: 9.0 mg, 12%; Clear liquid.

^1H NMR (400 MHz, Chloroform-*d*) δ 8.23 (dd, $J = 8.0, 1.6$ Hz, 1H), 7.74 – 7.65 (m, 1H), 7.59 (d, $J = 8.1$ Hz, 1H), 7.46 – 7.37 (m, 1H), 7.35 – 7.27 (m, 2H), 7.04 (d, $J = 8.0$ Hz, 2H), 4.16 – 4.06 (m, 1H), 4.07 – 3.98 (m, 1H), 3.86 – 3.77 (m, 1H), 3.35 – 3.25 (m, 1H), 3.20 – 3.12 (m, 1H), 2.31 – 2.23 (m, 1H), 2.25 (s, 3H), 2.10 – 2.01 (m, 1H), 1.95 – 1.84 (m, 2H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 162.09, 155.86, 147.08, 136.40, 133.95, 132.16, 130.22, 129.70, 126.82, 126.51, 126.24, 120.20, 42.25, 40.67, 38.39, 24.32, 20.95, 20.52. HRMS (ESI) m/z calcd for $\text{C}_{20}\text{H}_{20}\text{N}_2\text{OS}^+$ ($\text{M}+\text{H}$) $^+$ 337.1369, found 337.1376.



6-(tosylmethyl)-6,7,8,9-tetrahydro-11H-pyrido[2,1-b]quinazolin-11-one (5b)⁴

Yield: 12.0 mg, 15%; White solid; mp 158-160 °C.

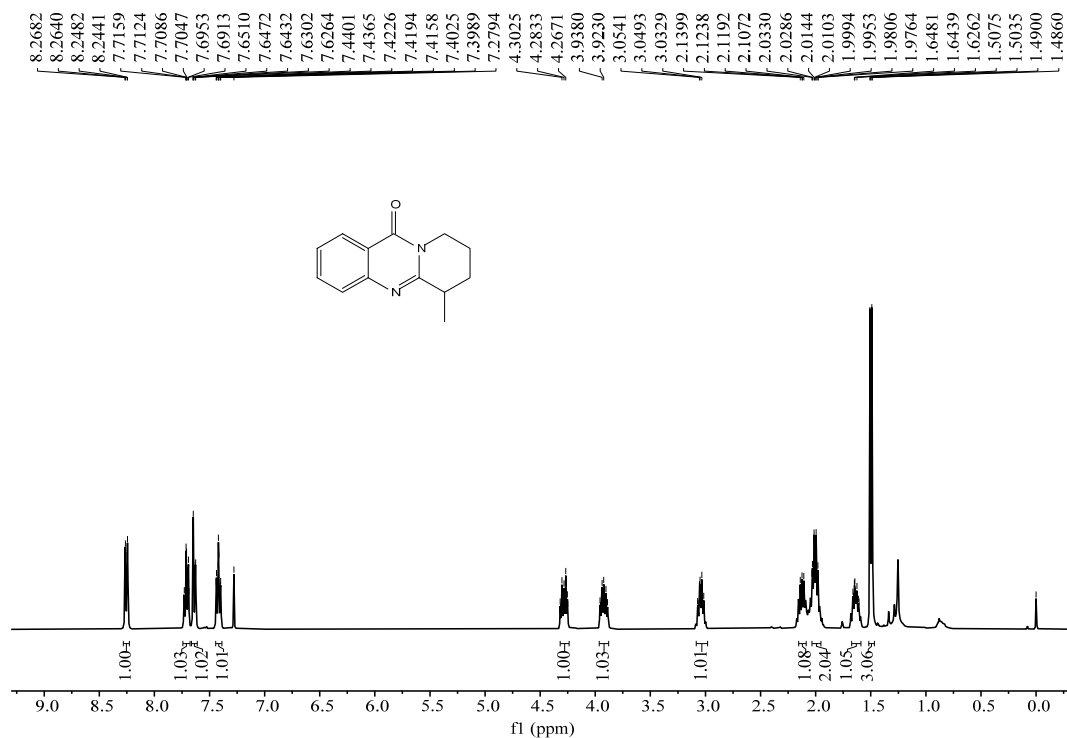
^1H NMR (400 MHz, Chloroform-*d*) δ 8.22 (dd, $J = 8.0, 1.6$ Hz, 1H), 7.88 – 7.81 (m, 2H), 7.70 – 7.65 (m, 1H), 7.48 – 7.39 (m, 2H), 7.34 (d, $J = 8.0$ Hz, 2H), 4.44 – 4.37 (m, 1H), 4.32 – 4.23 (m, 1H), 4.00 – 3.91 (m, 1H), 3.50 – 3.37 (m, 2H), 2.68 – 2.59 (m, 1H), 2.42 (s, 3H), 2.06 – 1.97 (m, 2H), 1.88 – 1.79 (m, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 161.73, 154.04, 146.57, 144.78, 137.01, 134.03, 129.88, 127.87, 126.74, 126.61, 126.52, 120.16, 58.09, 41.16, 36.03, 25.29, 21.56, 20.71.

7. References

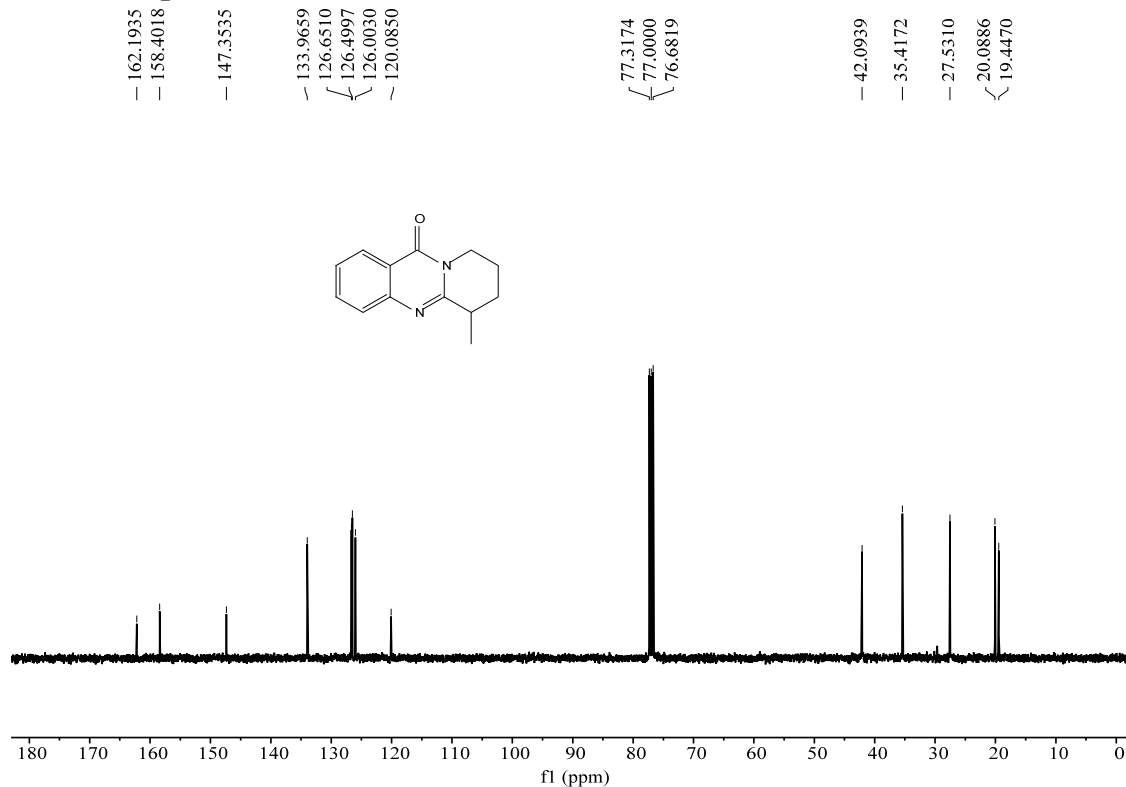
1. Huana, L.; Trana, P.; Phuong, C.; Duca, P.; Anh, D.; Hai, P.; Huong, L.; Thuan, N.; Lee, H.; Park, E.; Kang, J.; Linh, N.; Hieu, T.; Oanh, D.; Hanc, S.; Nam, N. *Bioorg. Chem.*, **2019**, *92*, 103202.
2. Huang, G.; Liu, B. ; Teng, M.; Chen, Y. *Synth Commun*, **2014**, *44*, 1786.
3. Miranda, L. D.; García-Ramírez, J. *Synthesis*. **2020**, *53*, 1471-1477.
4. Sun, B.; Ding, H.; Tian, H.-X.; Huang, P.-Y.; Jin, C.; Wu, C.-L.; Shen, R.-P. *Adv. Synth. Catal.* **2022**, *364*, 766-772.

8. Copies of ^1H NMR and ^{13}C NMR spectra of products

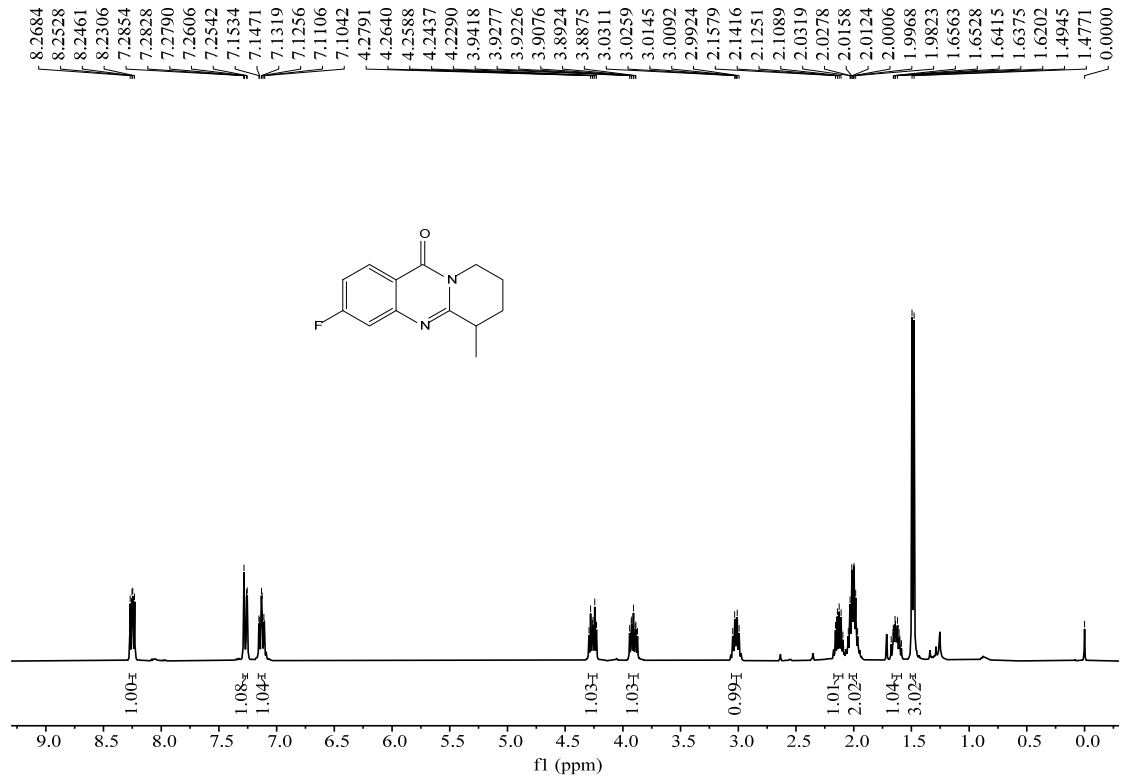
^1H NMR spectra of 2a (CDCl_3 , 400 MHz)



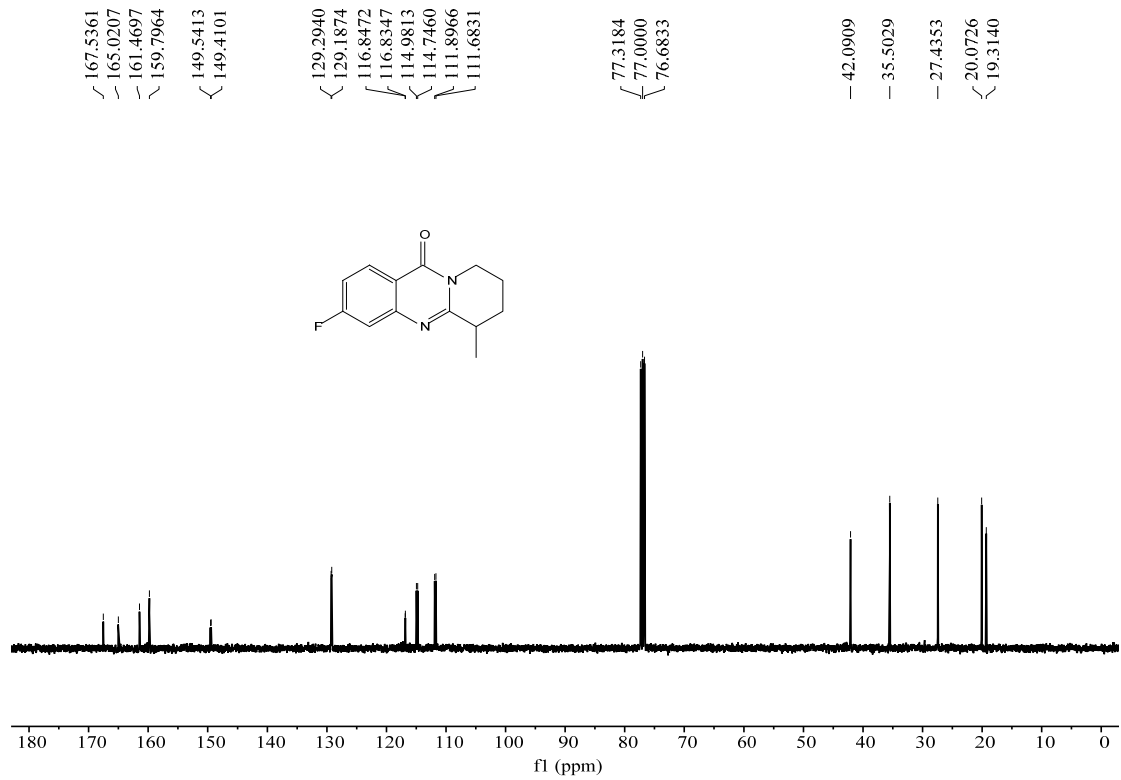
^{13}C NMR spectra of 2a (CDCl_3 , 100 MHz)



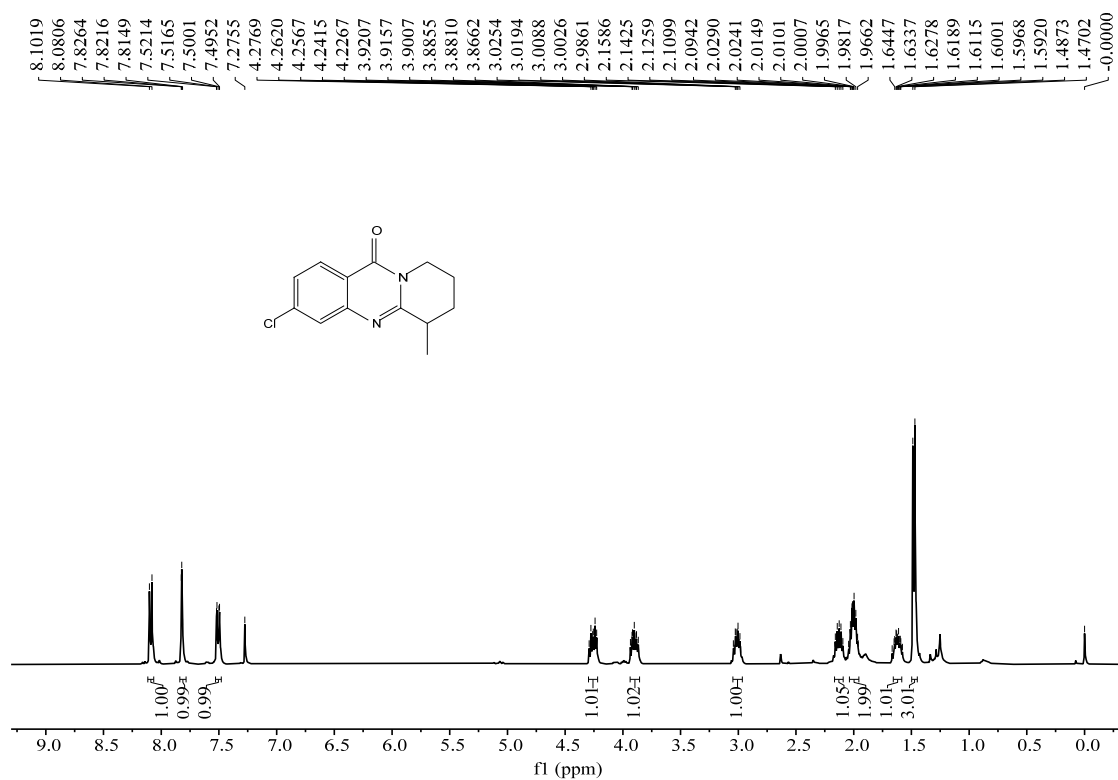
¹H NMR spectra of 2b (CDCl₃, 400 MHz)



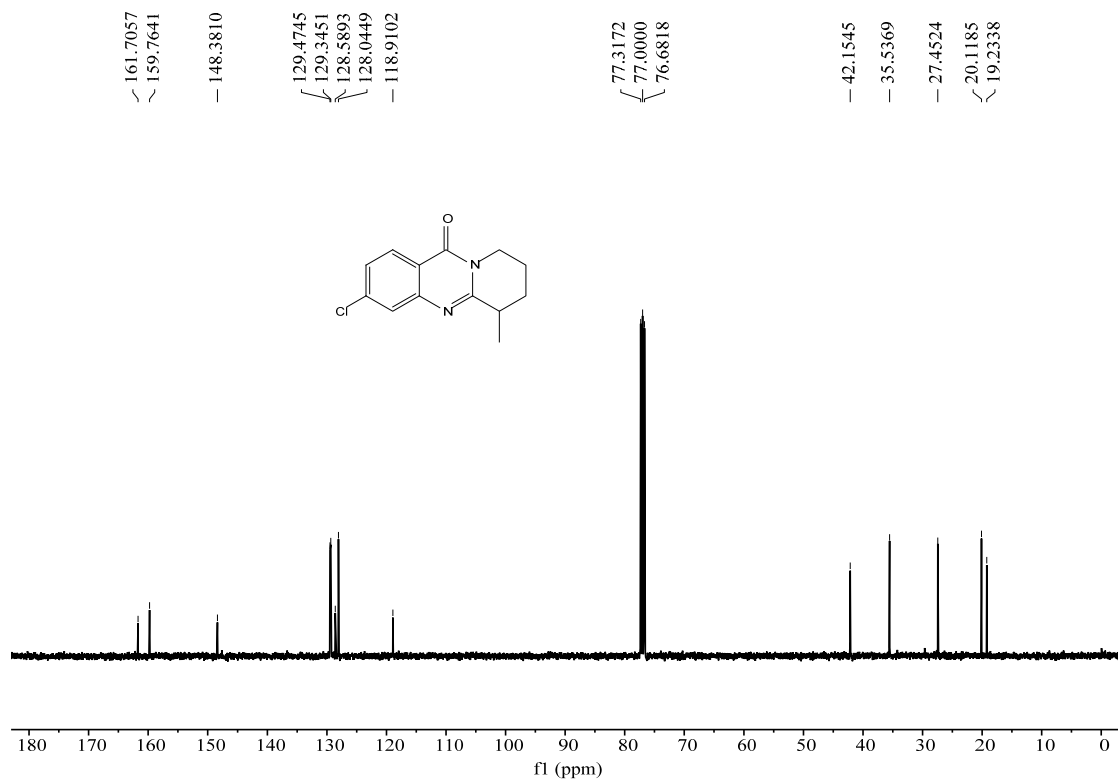
¹³C NMR spectra of 2b (CDCl₃, 100 MHz)



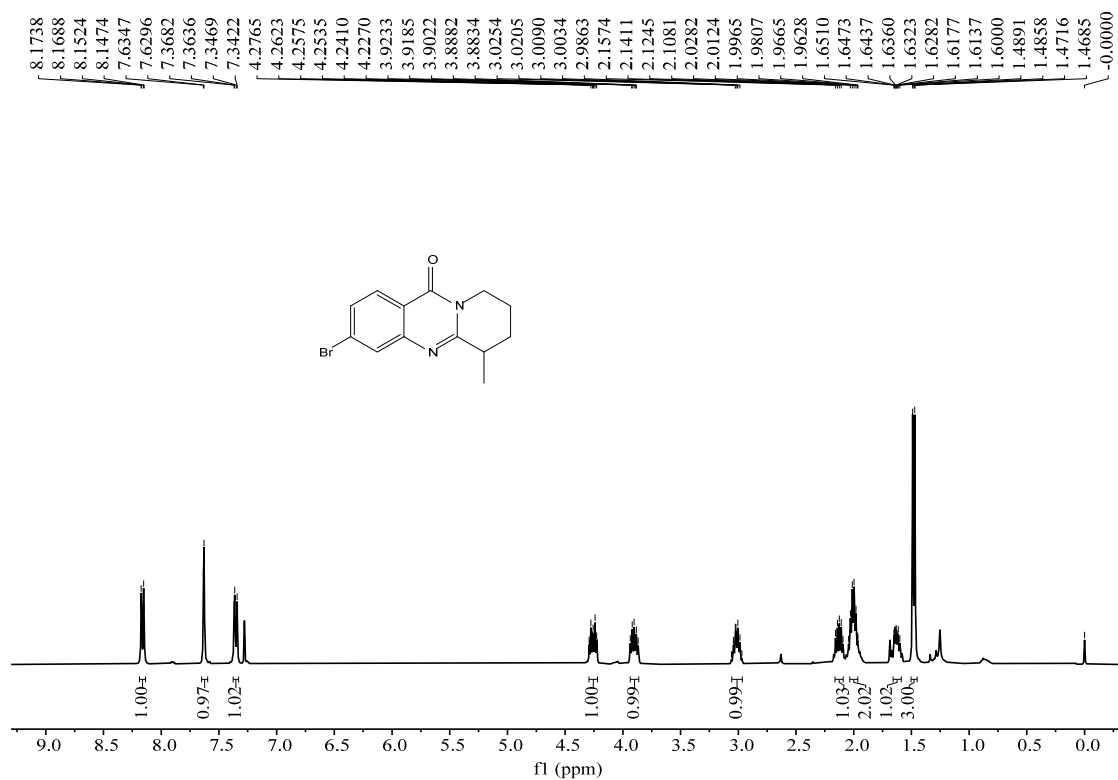
¹H NMR spectra of 2c (CDCl₃, 400 MHz)



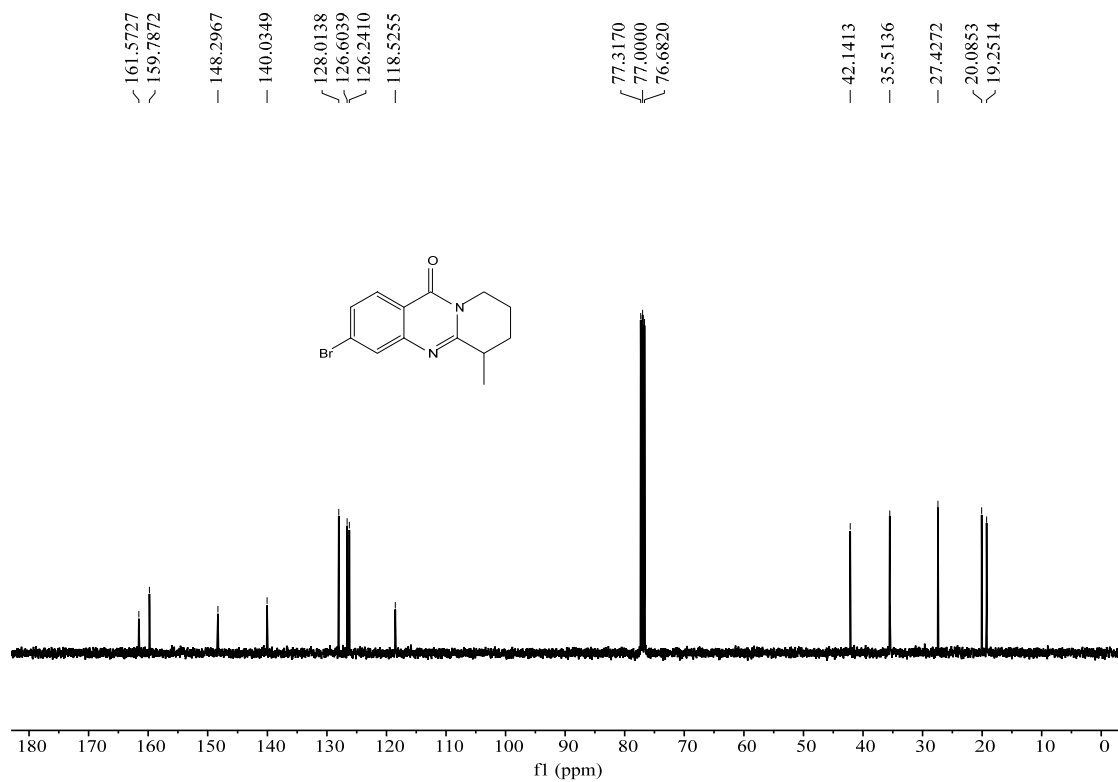
¹³C NMR spectra of 2c (CDCl₃, 100 MHz)



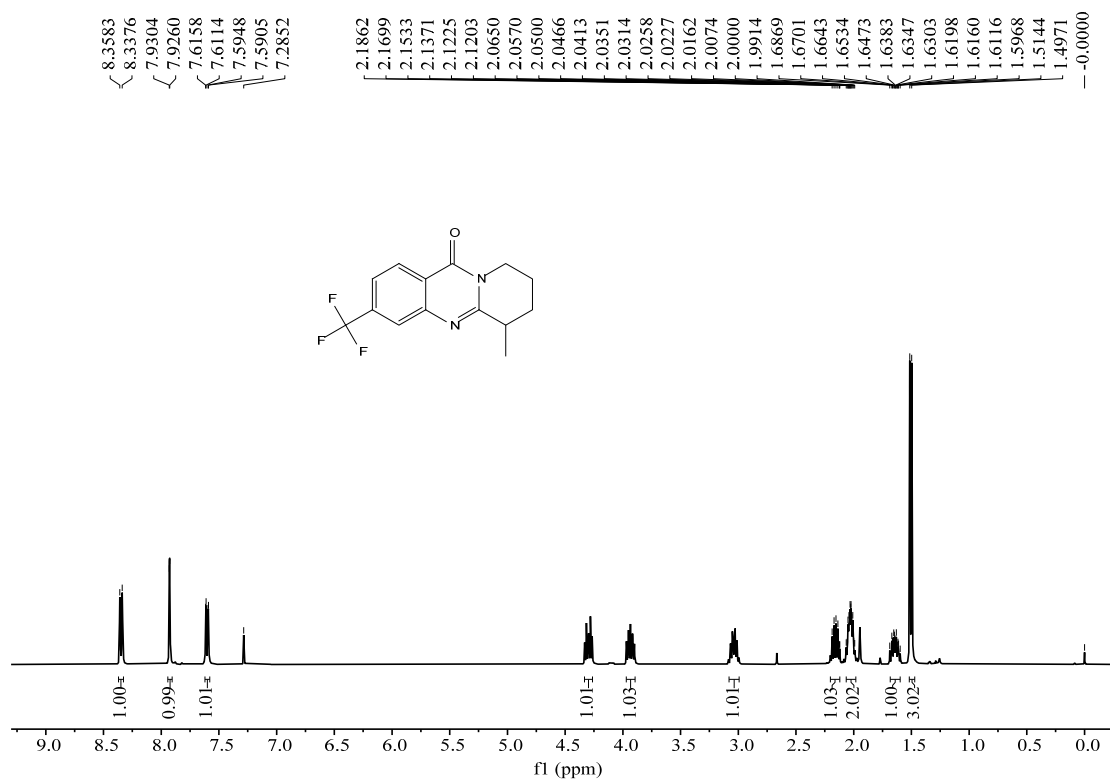
¹H NMR spectra of 2d (CDCl₃, 400 MHz)



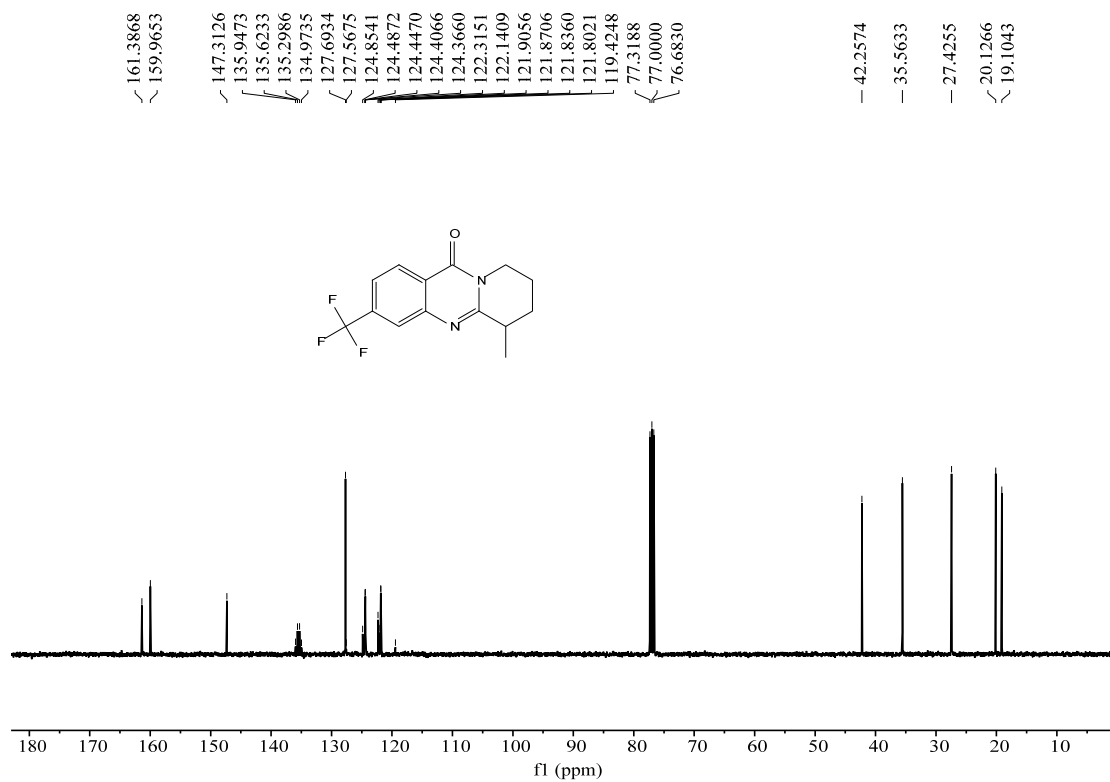
¹³C NMR spectra of 2d (CDCl₃, 100 MHz)



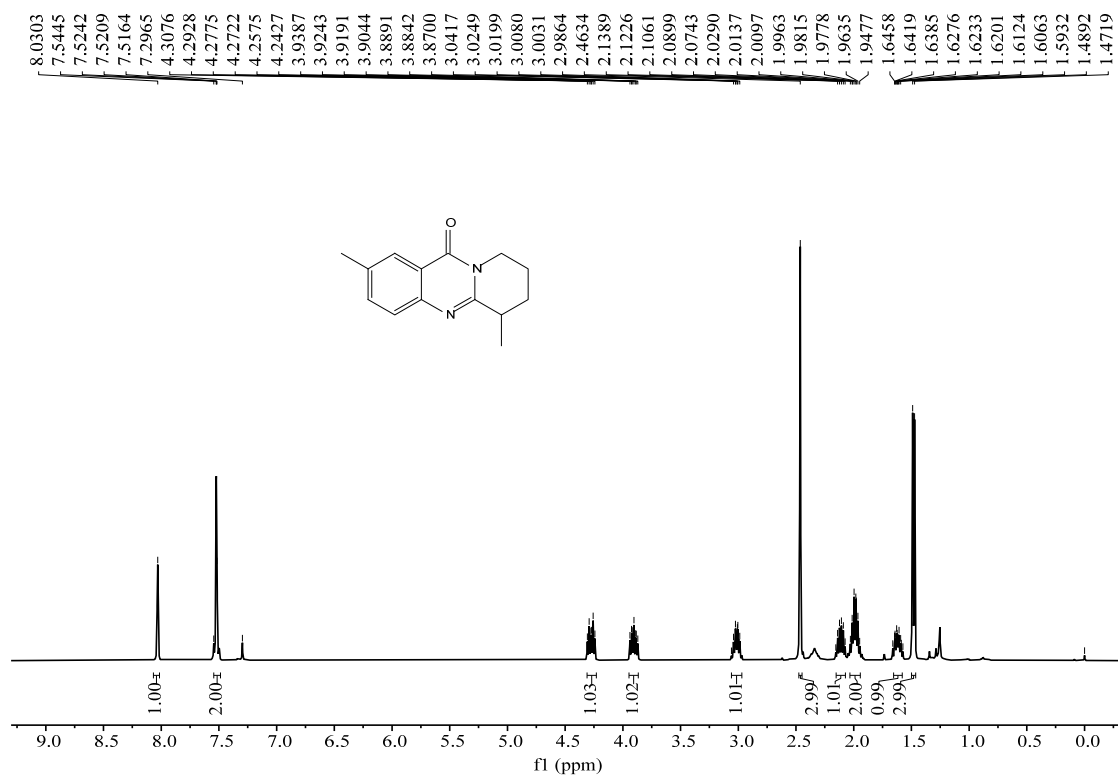
¹H NMR spectra of 2e (CDCl₃, 400 MHz)



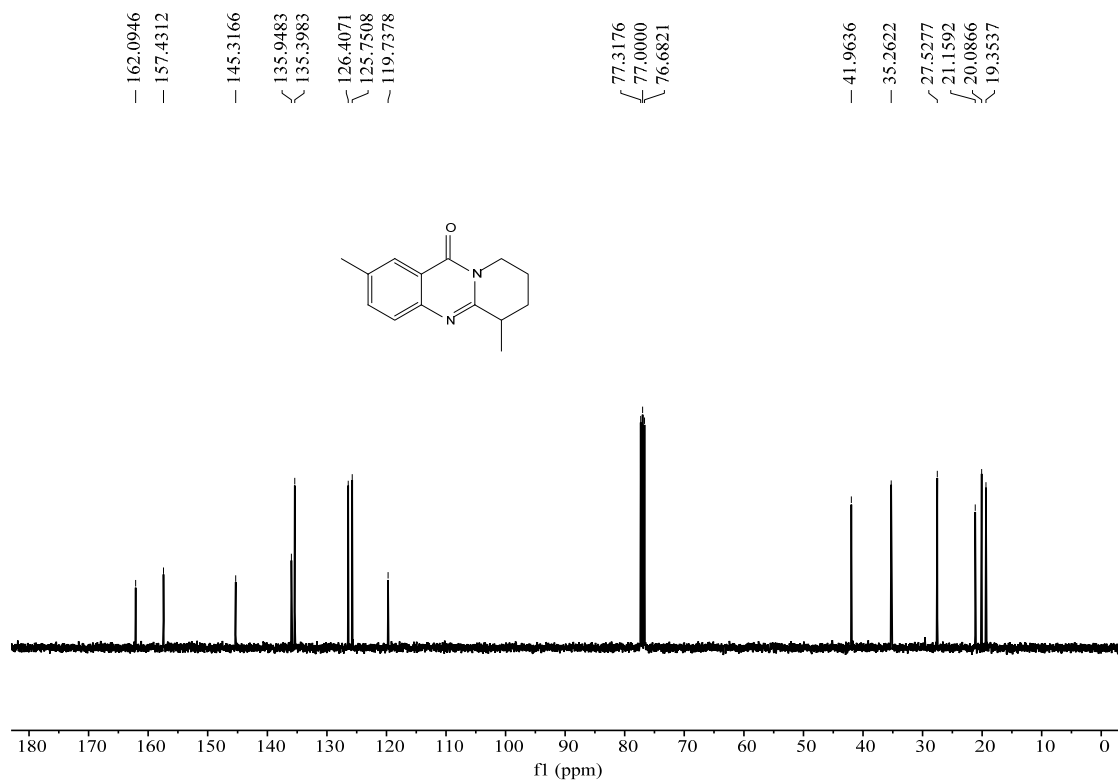
¹³C NMR spectra of 2e (CDCl₃, 100 MHz)



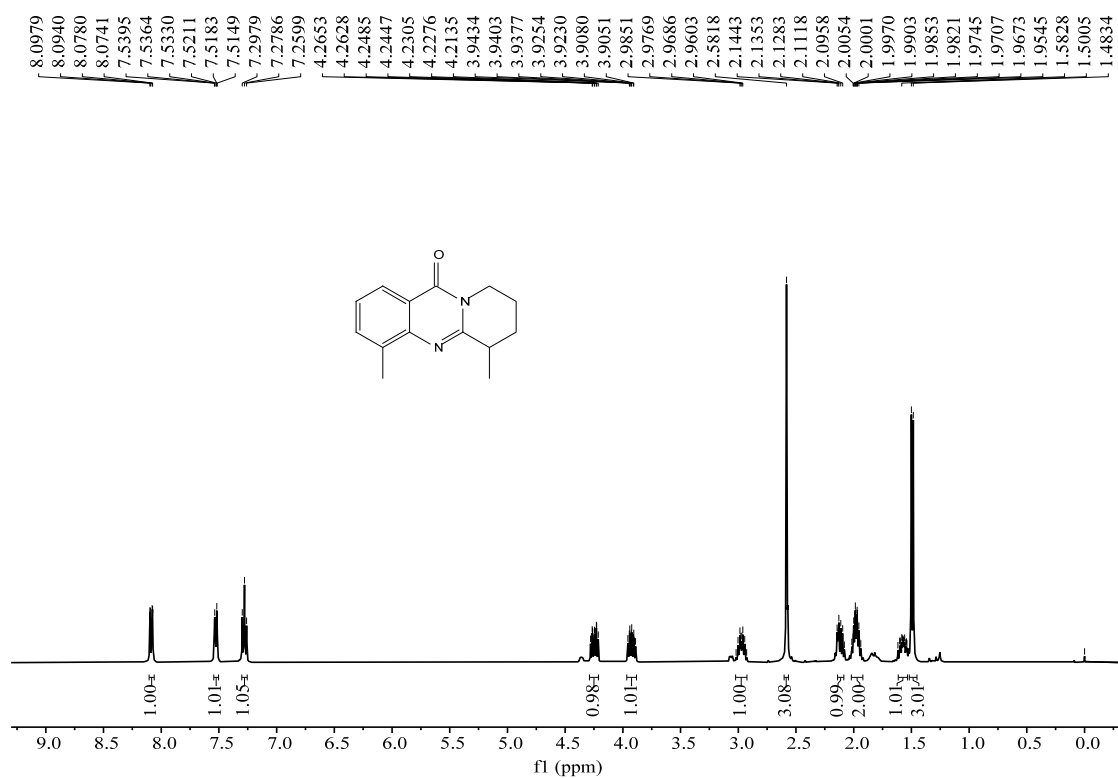
¹H NMR spectra of 2f (CDCl₃, 400 MHz)



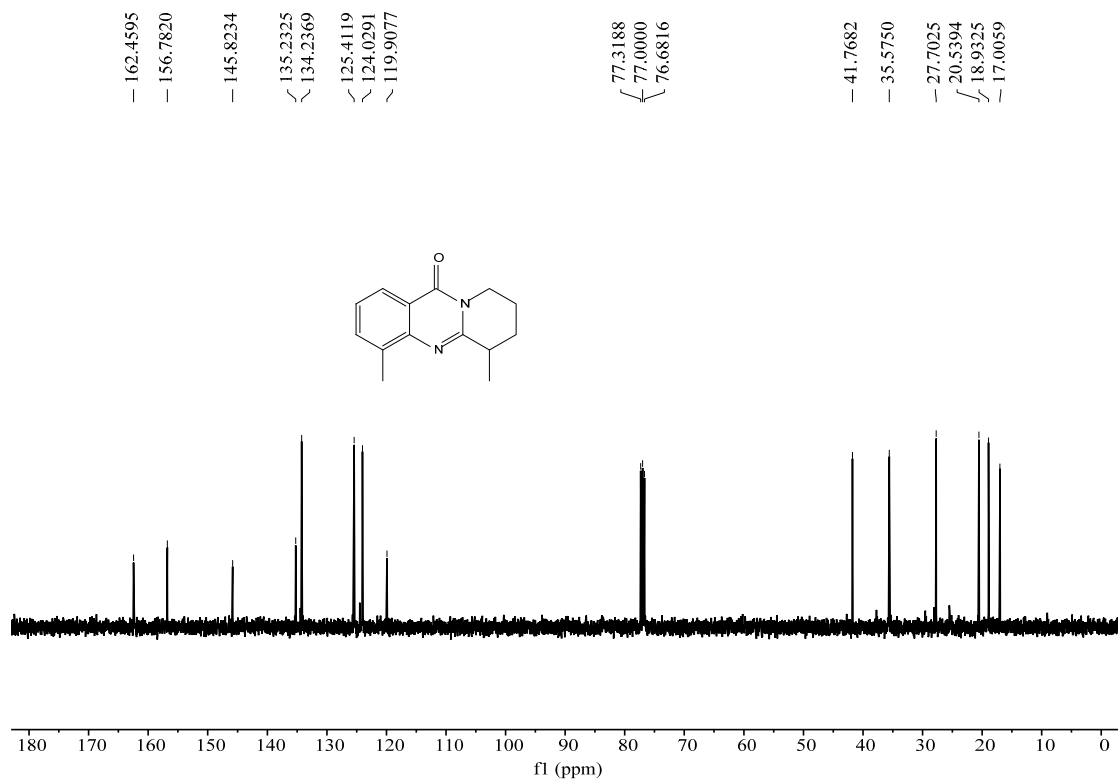
¹³C NMR spectra of 2f (CDCl₃, 100 MHz)



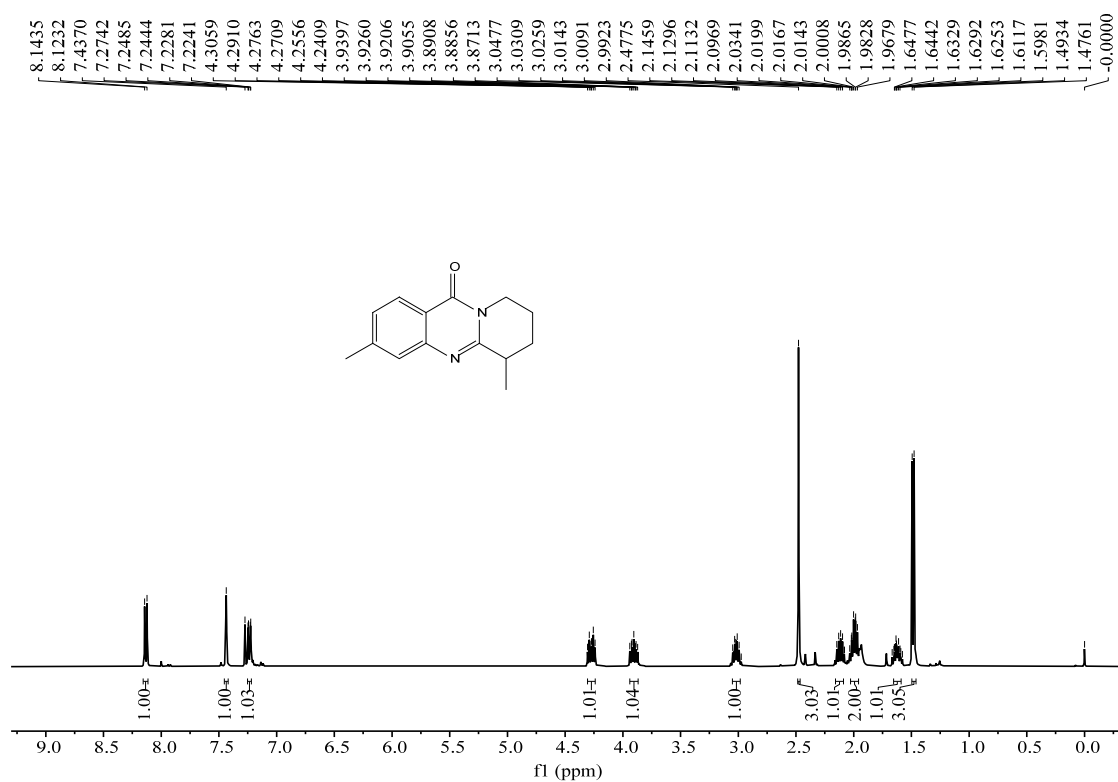
¹H NMR spectra of 2g (CDCl₃, 400 MHz)



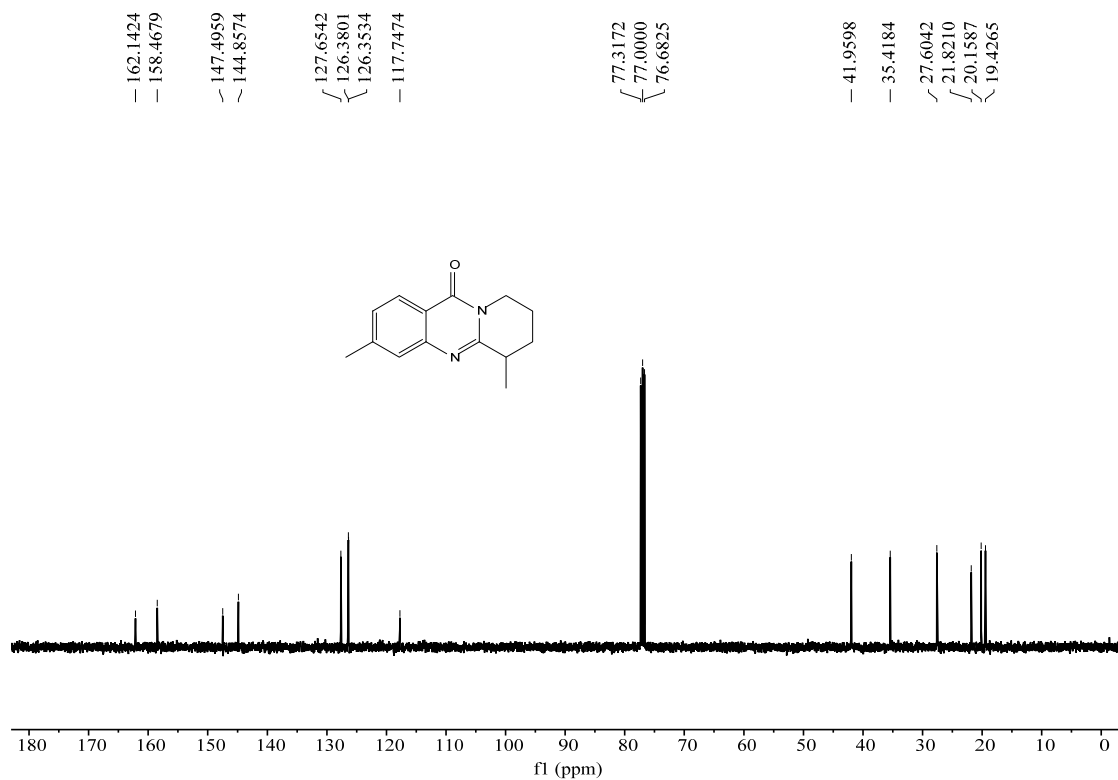
¹³C NMR spectra of 2g (CDCl₃, 100 MHz)



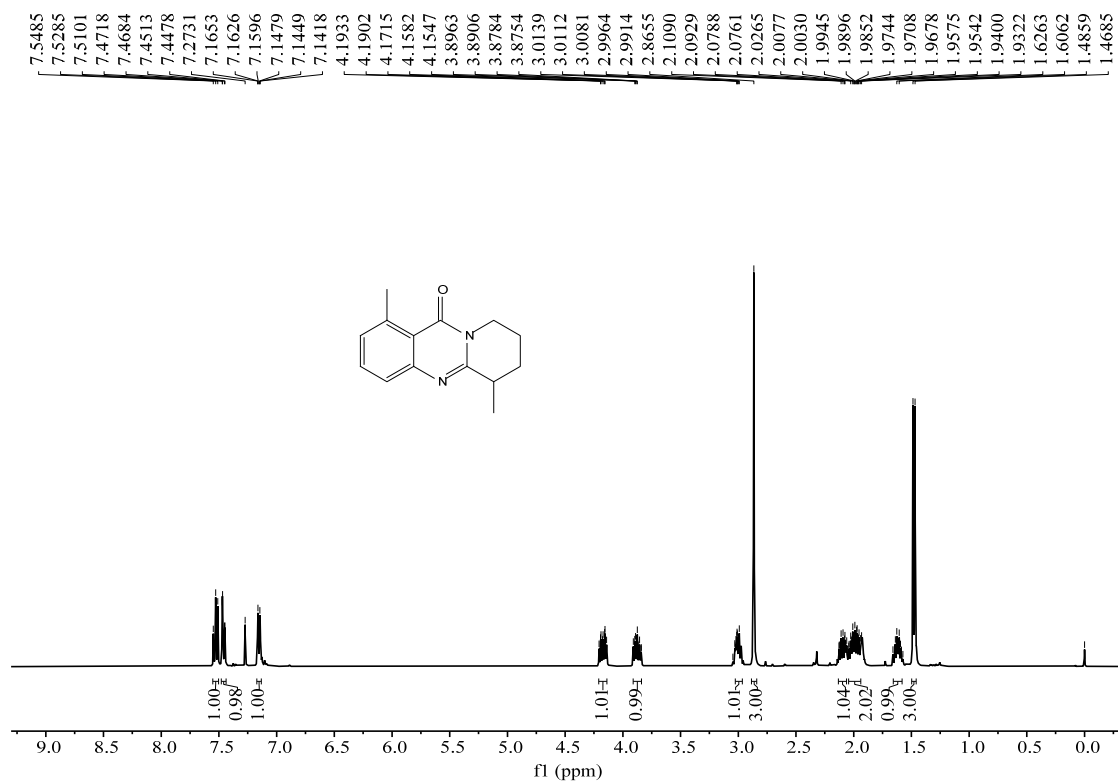
¹H NMR spectra of 2h (CDCl₃, 400 MHz)



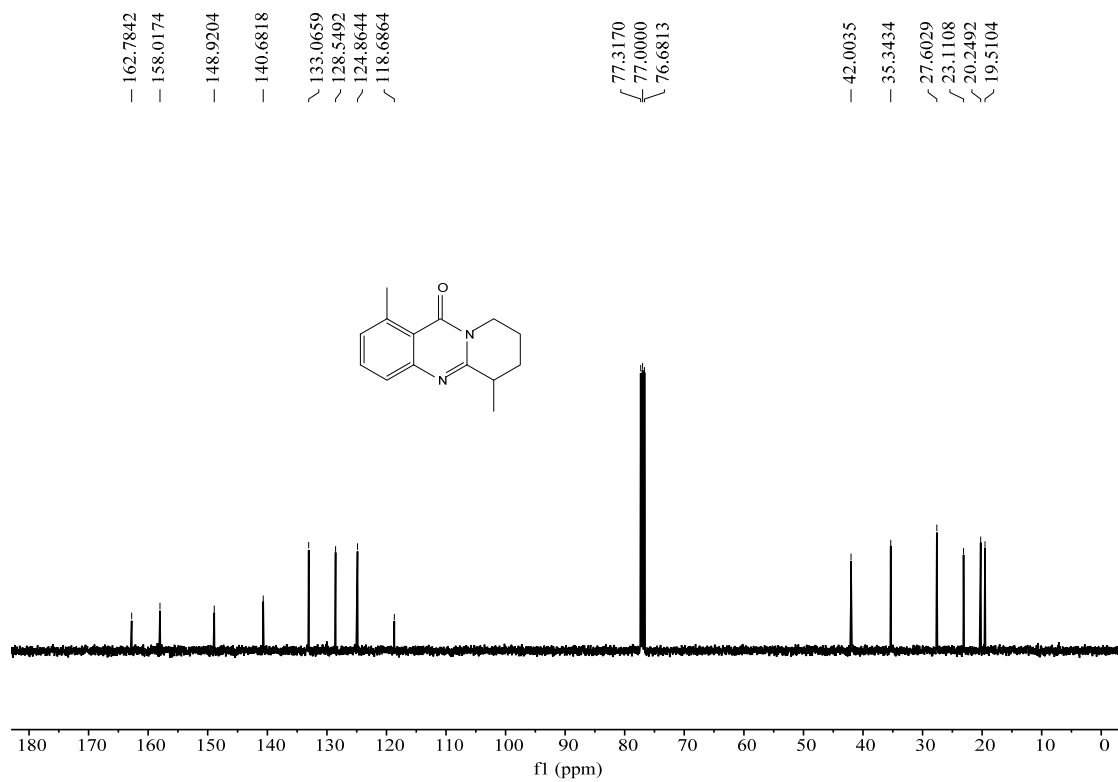
¹³C NMR spectra of 2h (CDCl₃, 100 MHz)



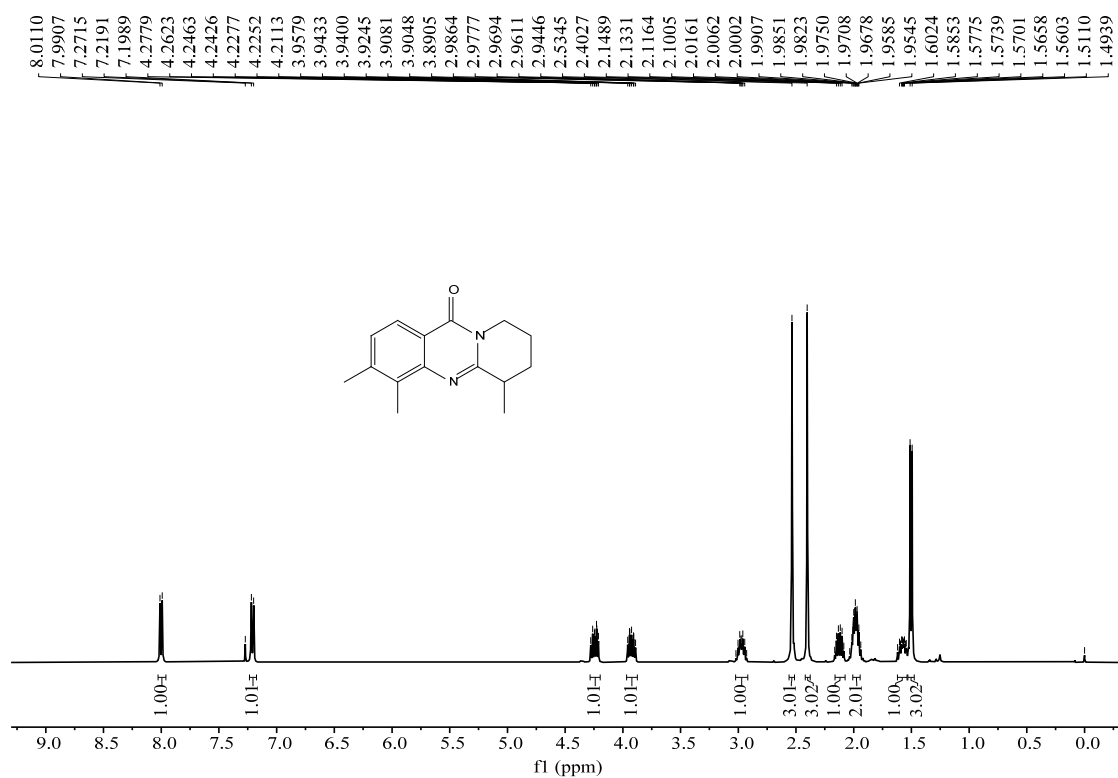
¹H NMR spectra of 2i (CDCl₃, 400 MHz)



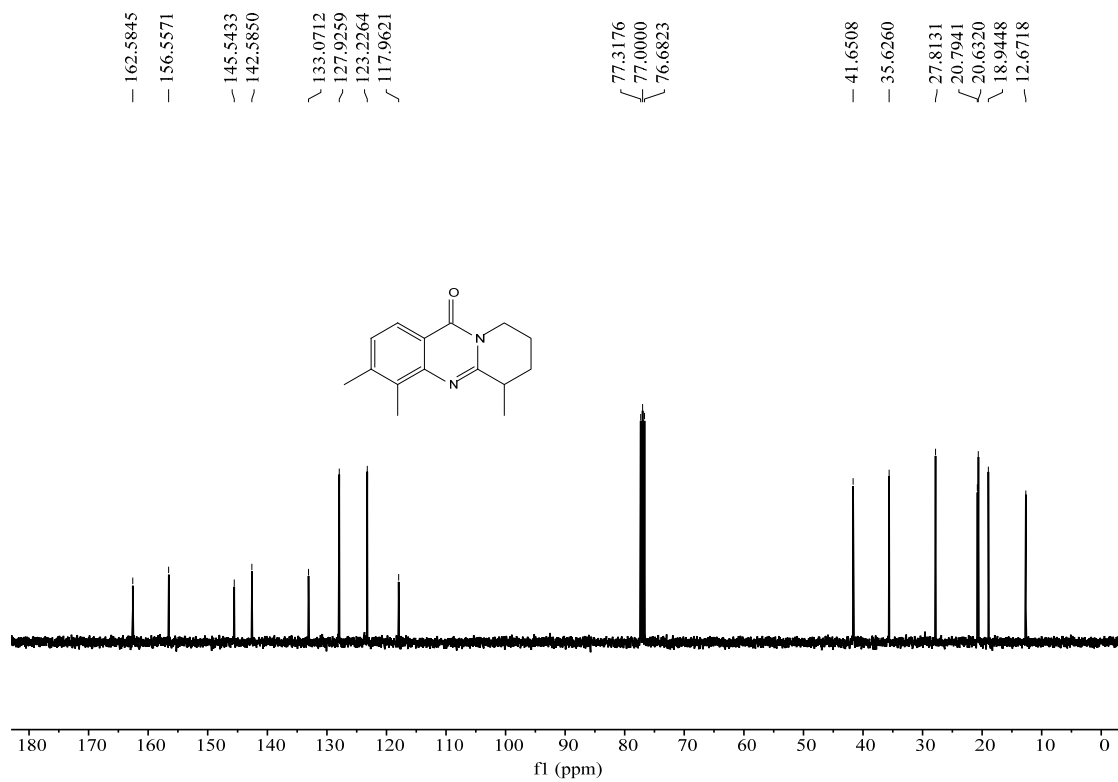
¹³C NMR spectra of 2i (CDCl₃, 100 MHz)



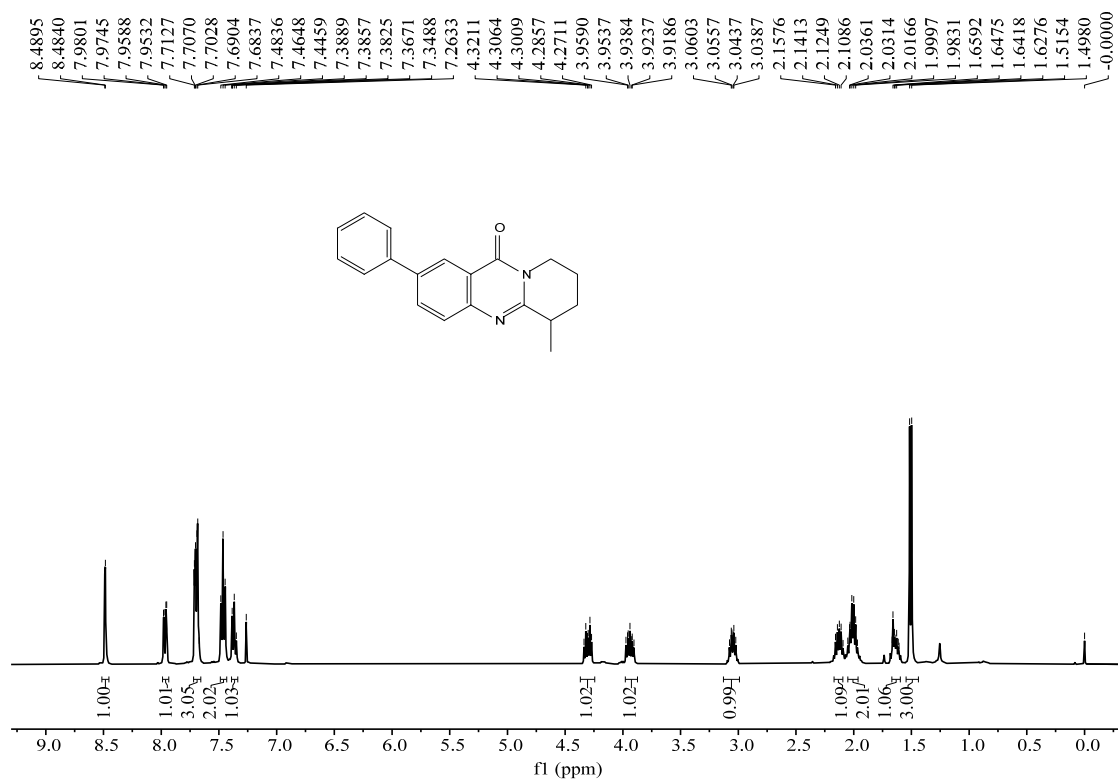
¹H NMR spectra of 2j (CDCl₃, 400 MHz)



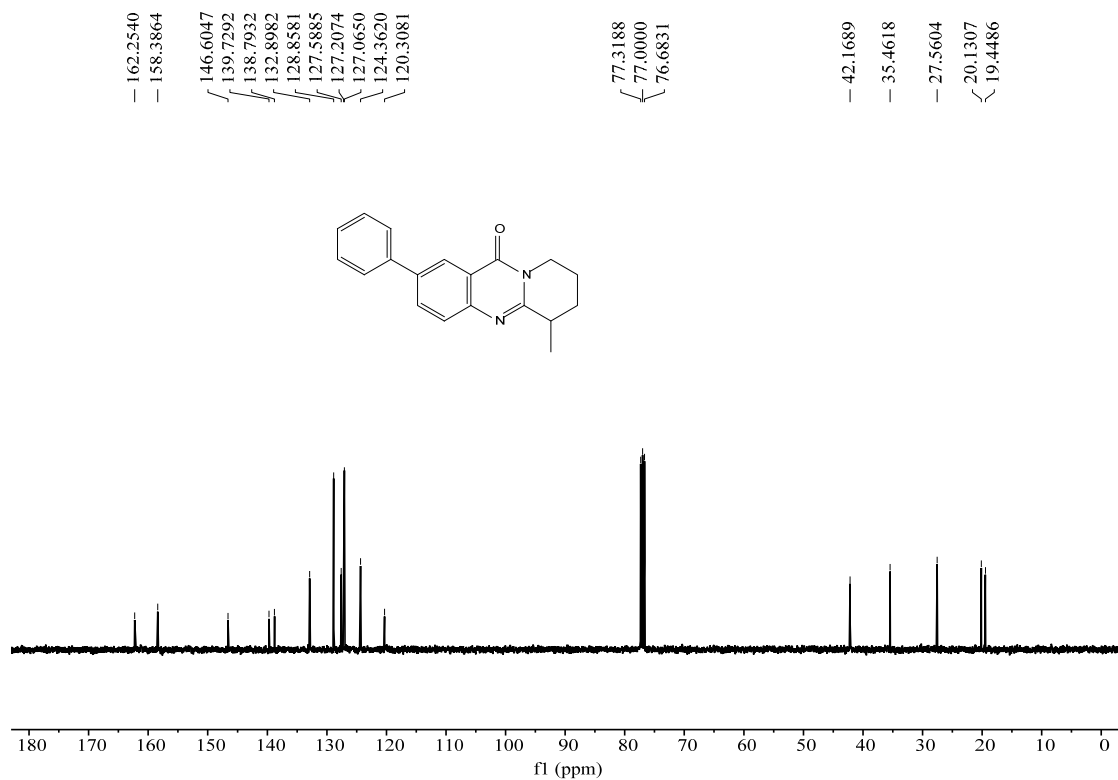
¹³C NMR spectra of 2j (CDCl₃, 100 MHz)



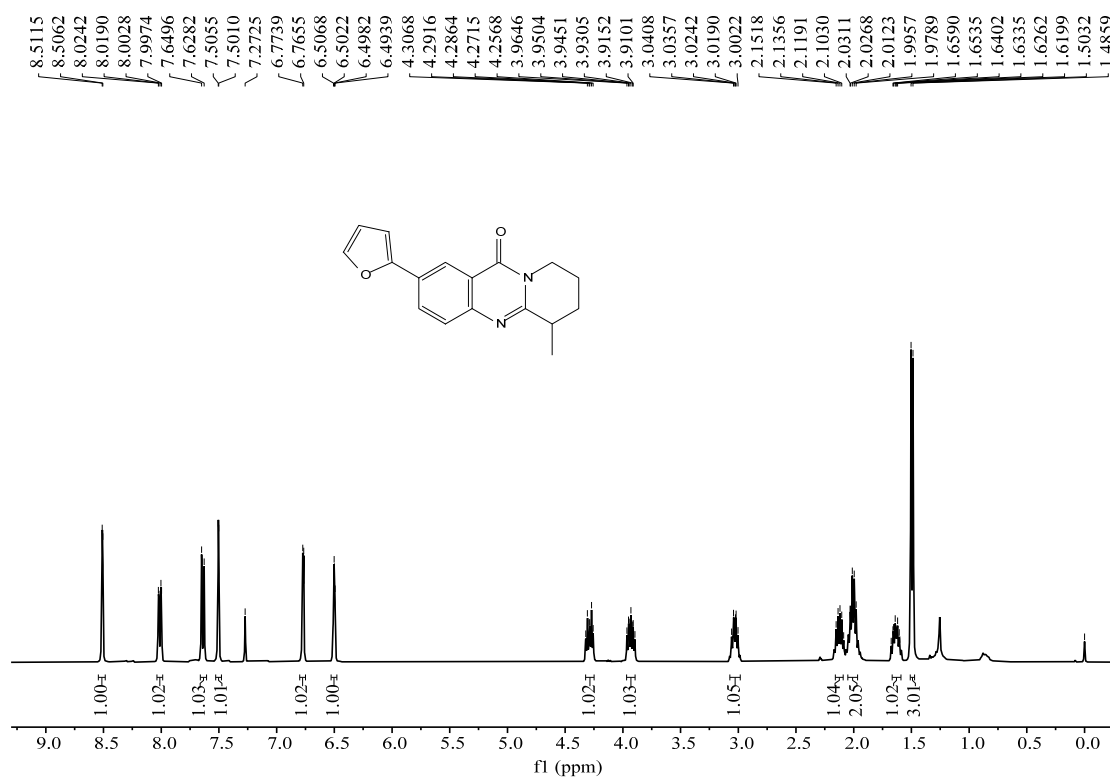
¹H NMR spectra of 2k (CDCl₃, 400 MHz)



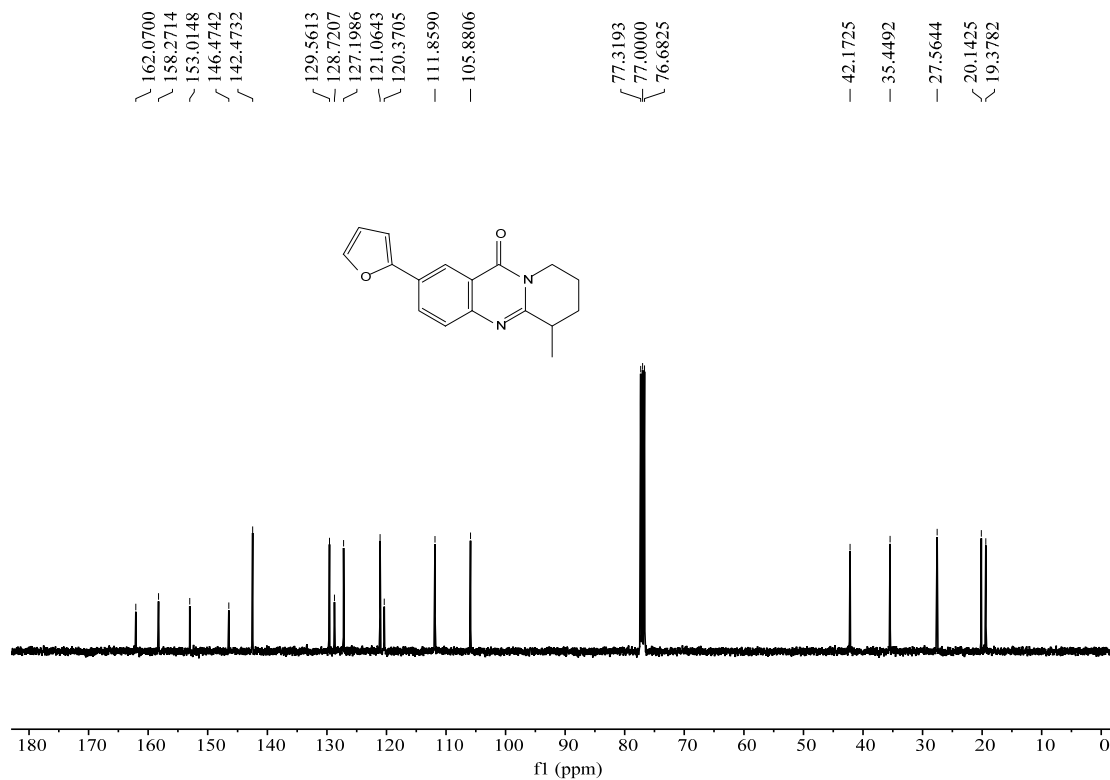
¹³C NMR spectra of 2k (CDCl₃, 100 MHz)



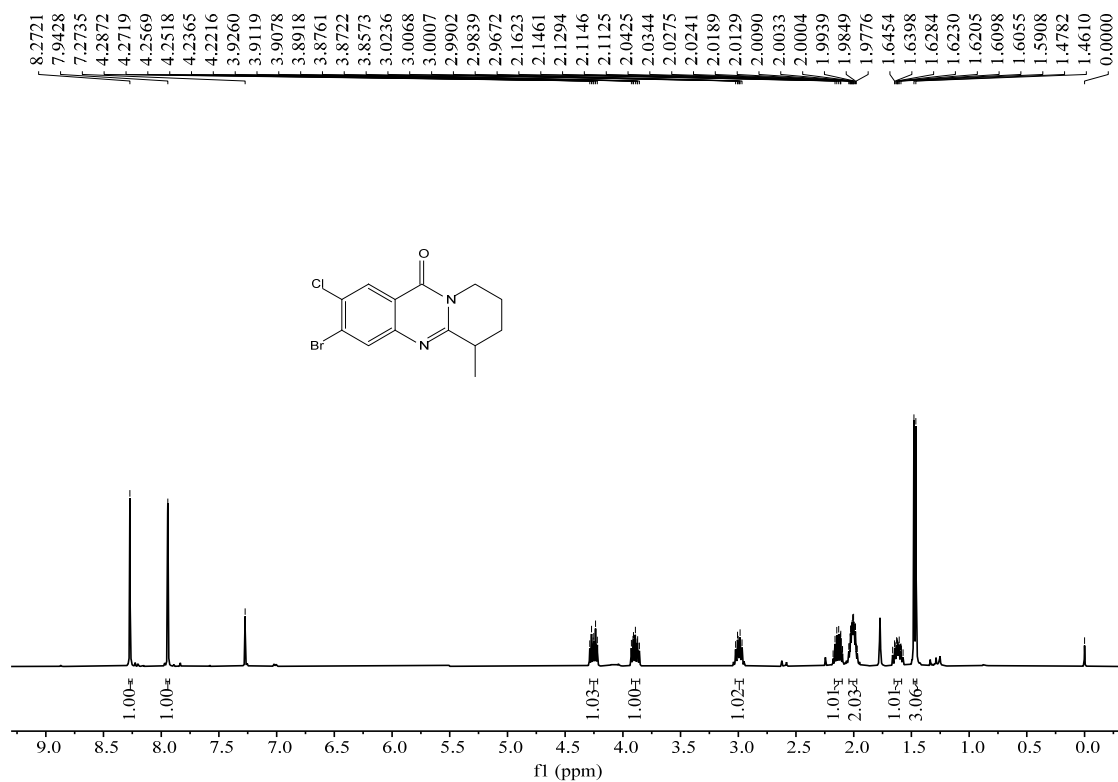
¹H NMR spectra of 2l (CDCl₃, 400 MHz)



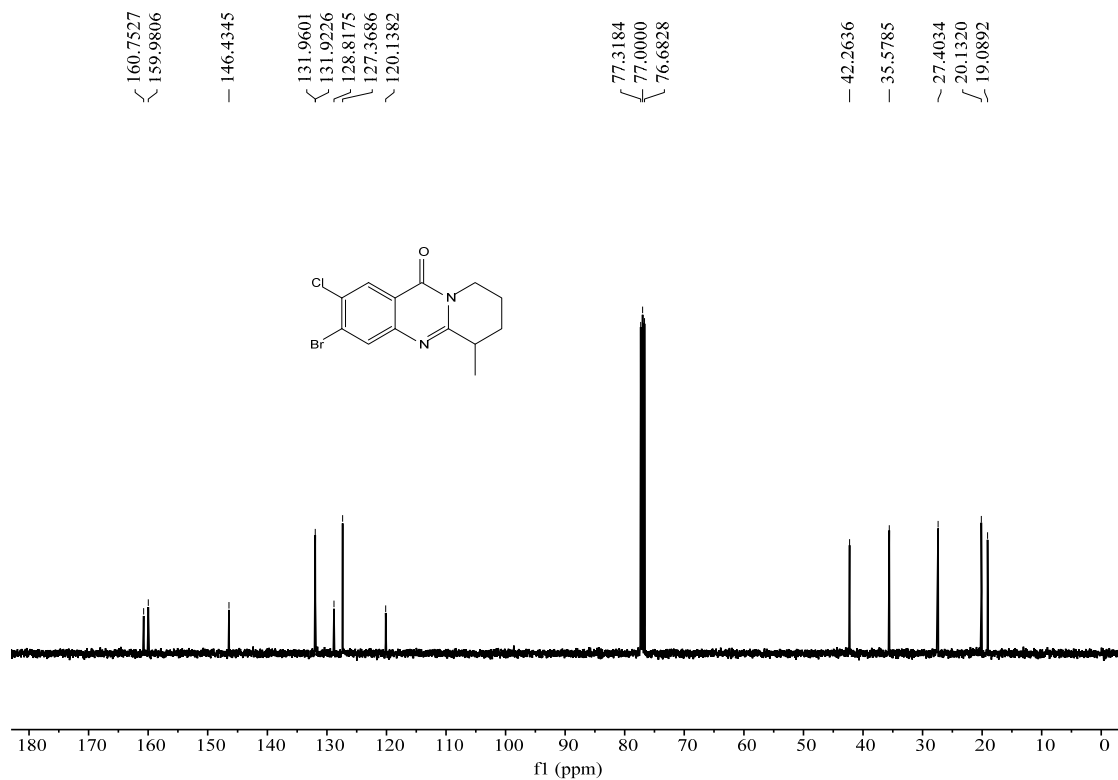
¹³C NMR spectra of 2l (CDCl₃, 100 MHz)



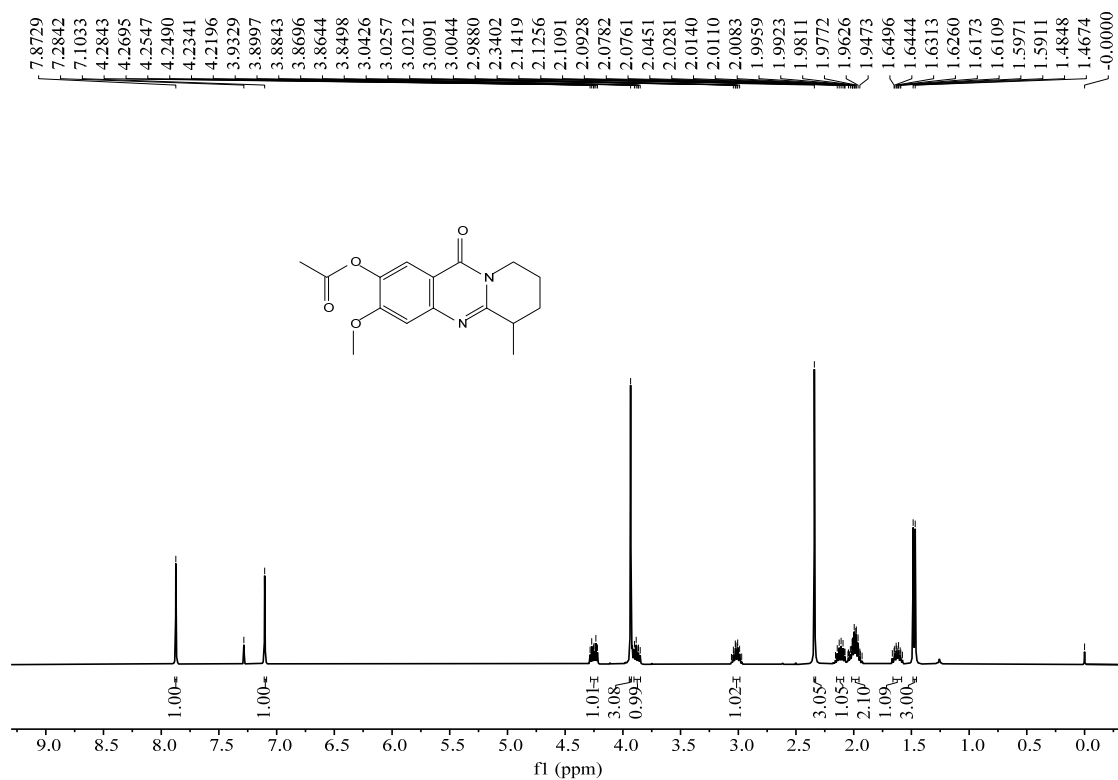
¹H NMR spectra of 2m (CDCl₃, 400 MHz)



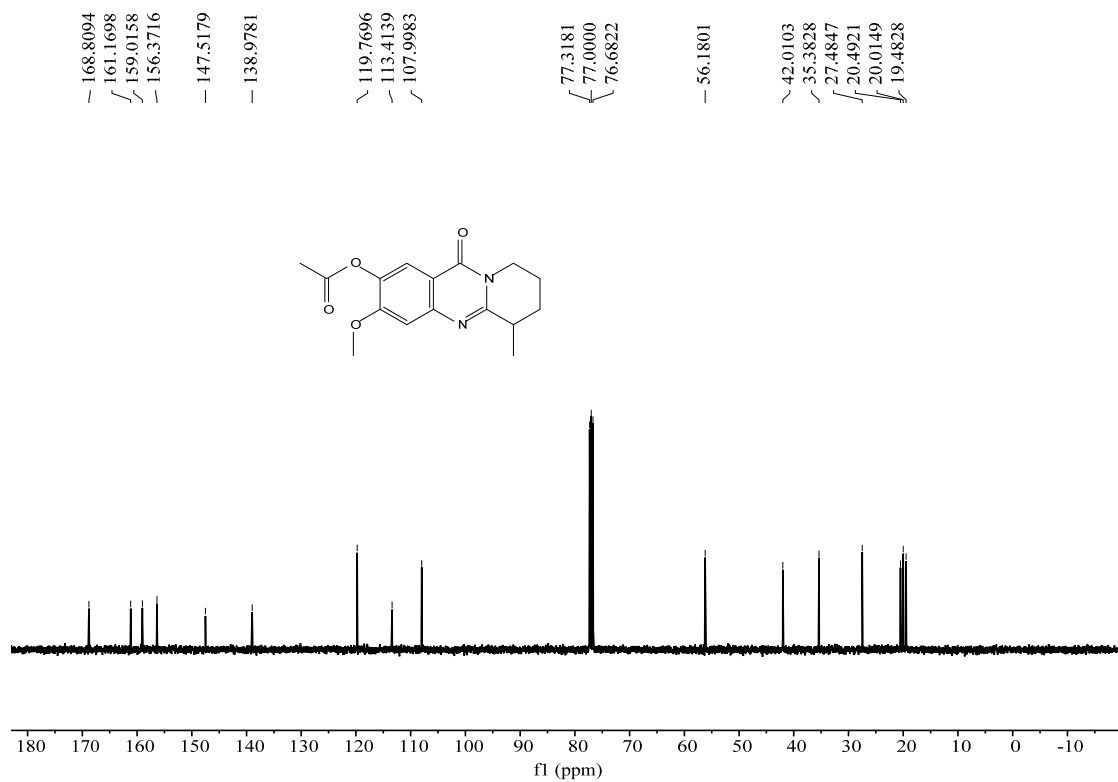
¹³C NMR spectra of 2m (CDCl₃, 100 MHz)



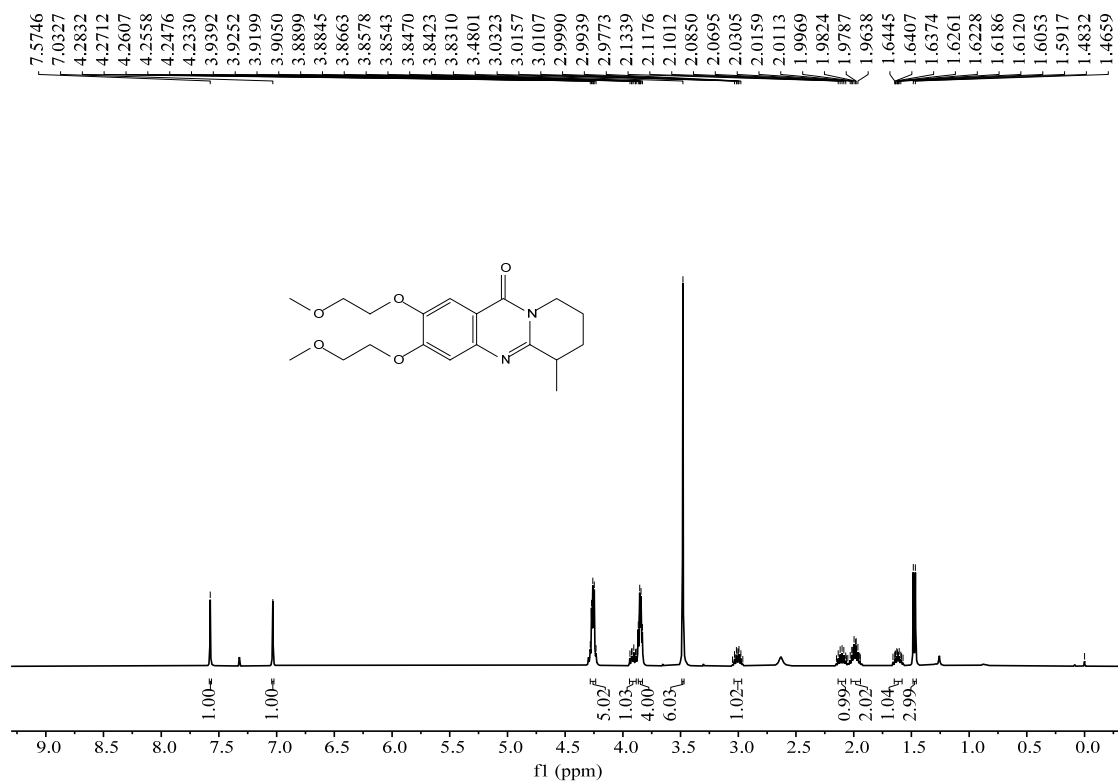
¹H NMR spectra of 2n (CDCl₃, 400 MHz)



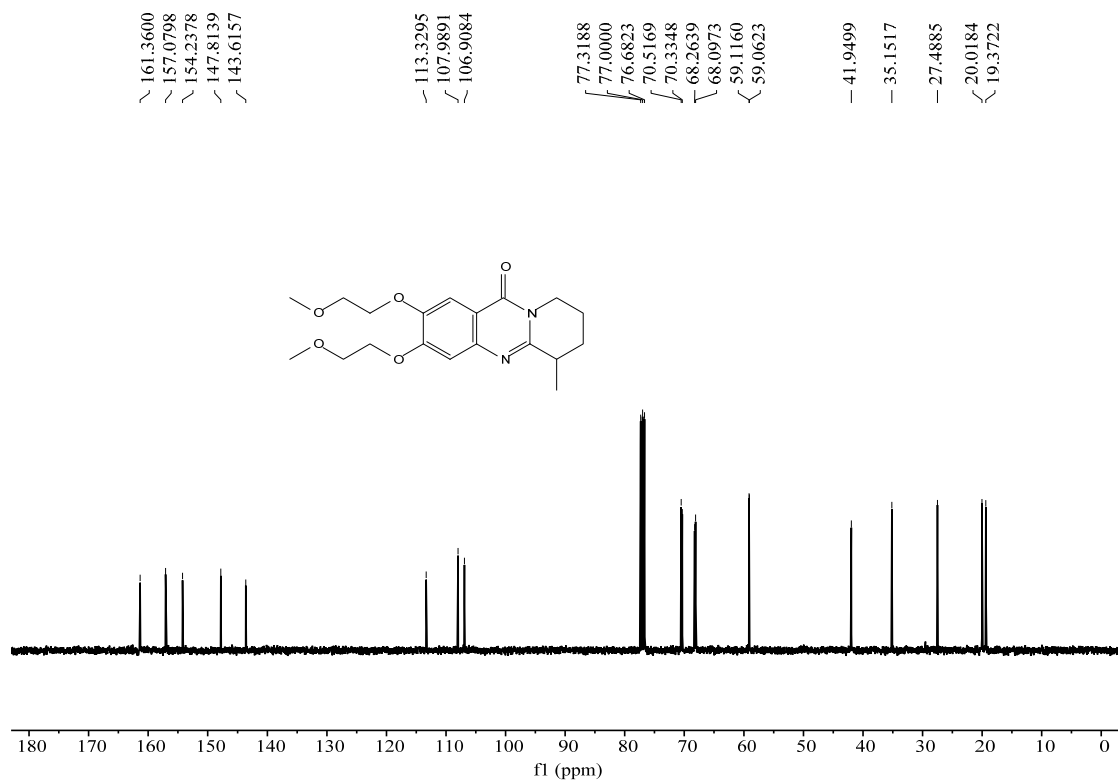
¹³C NMR spectra of 2n (CDCl₃, 100 MHz)



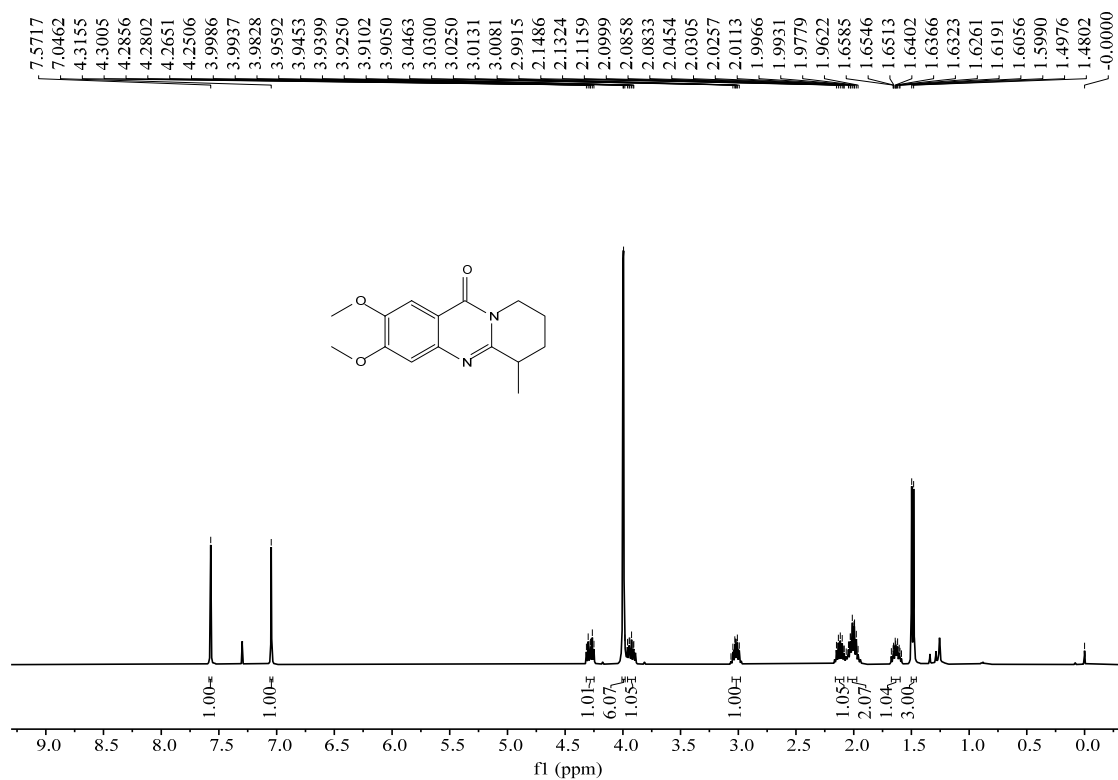
¹H NMR spectra of 2o (CDCl₃, 400 MHz)



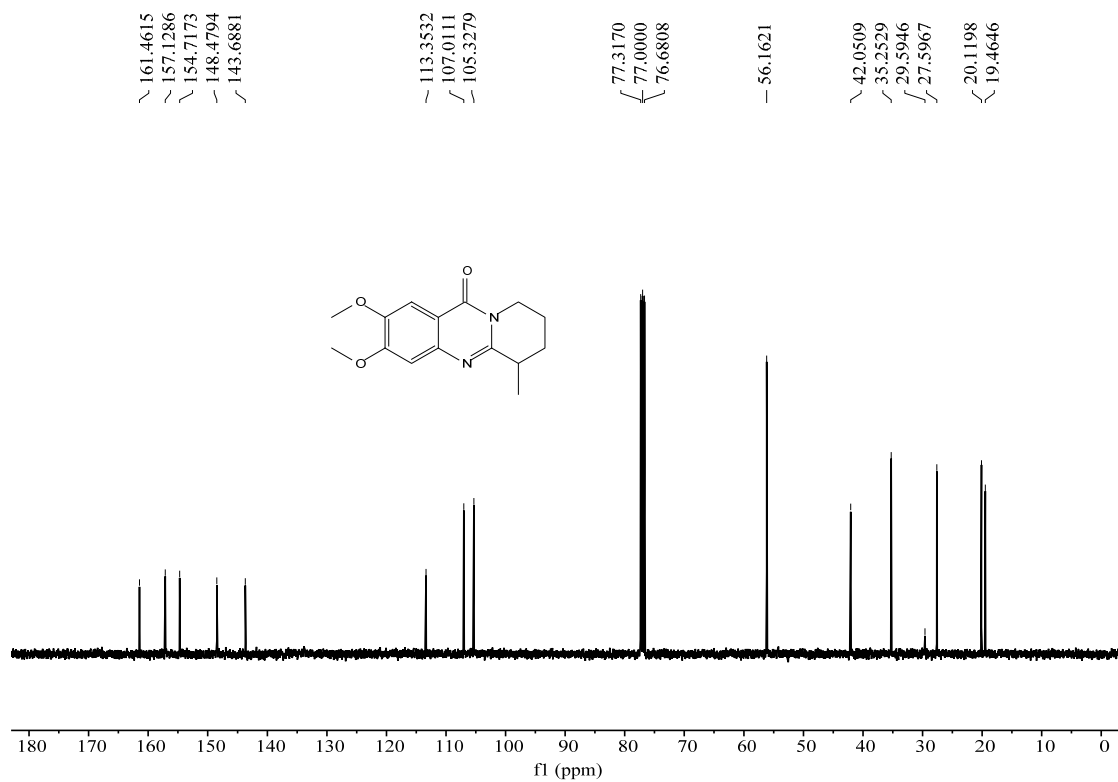
¹³C NMR spectra of 2o (CDCl₃, 100 MHz)



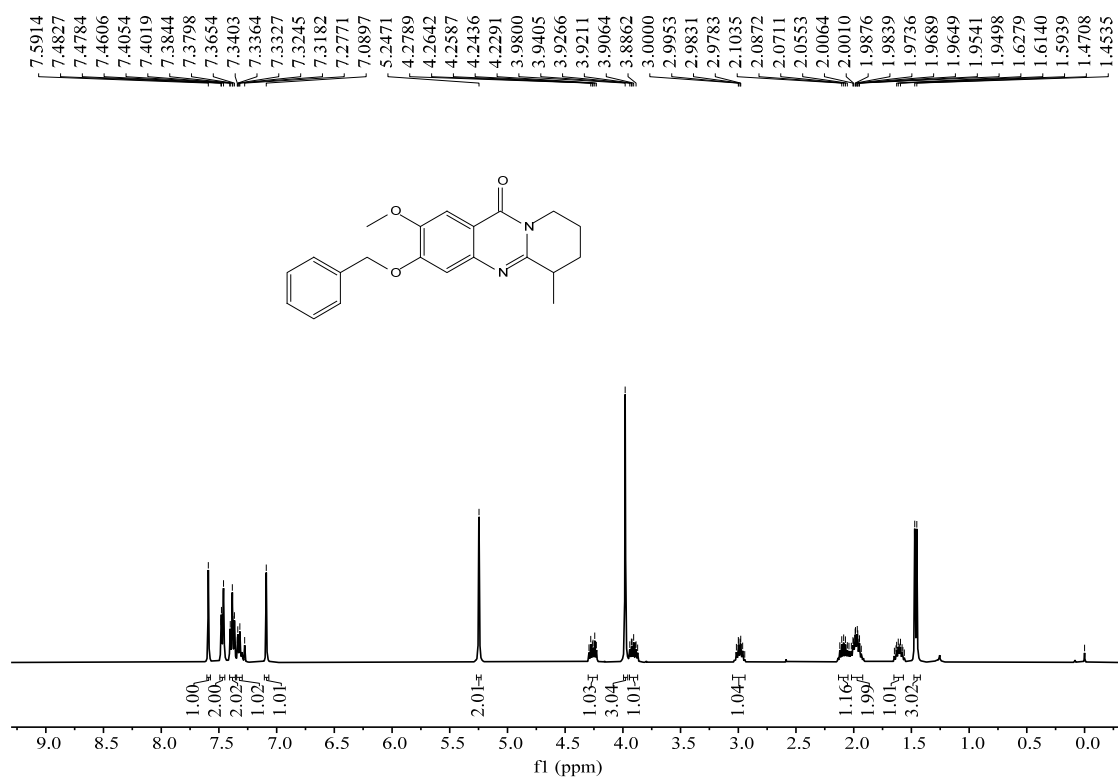
¹H NMR spectra of 2p (CDCl₃, 400 MHz)



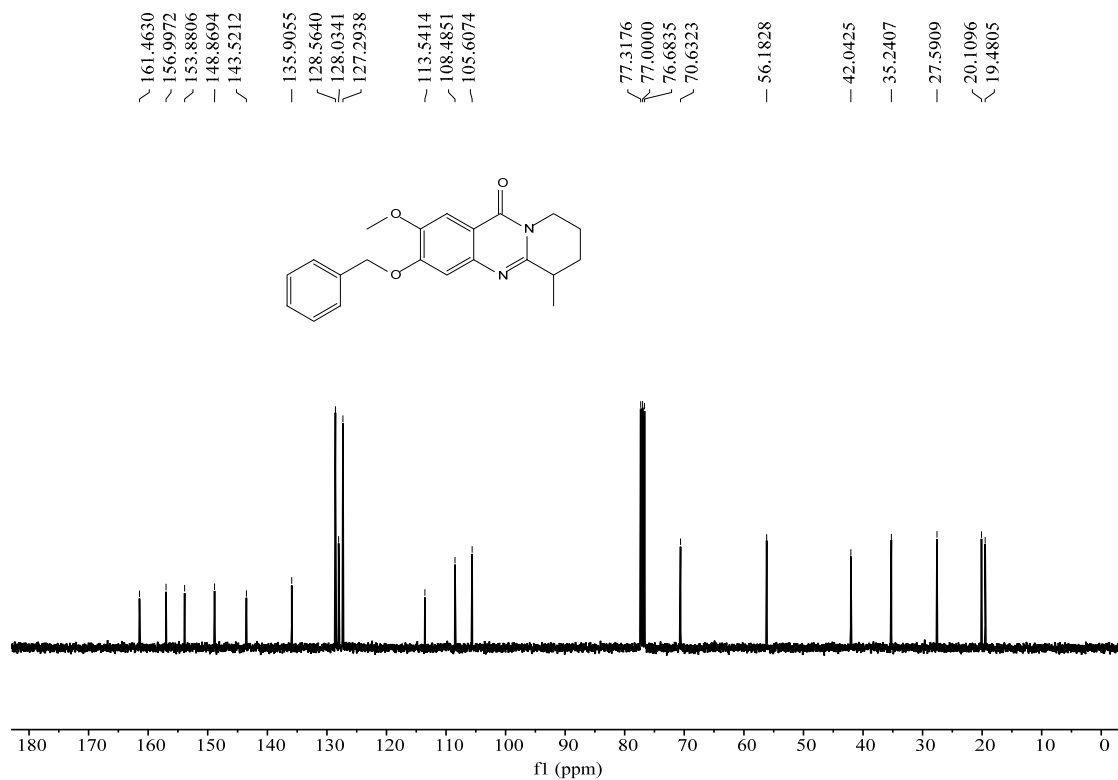
¹³C NMR spectra of 2p (CDCl₃, 100 MHz)



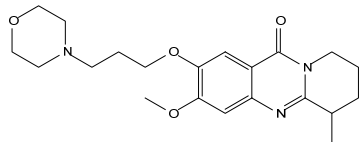
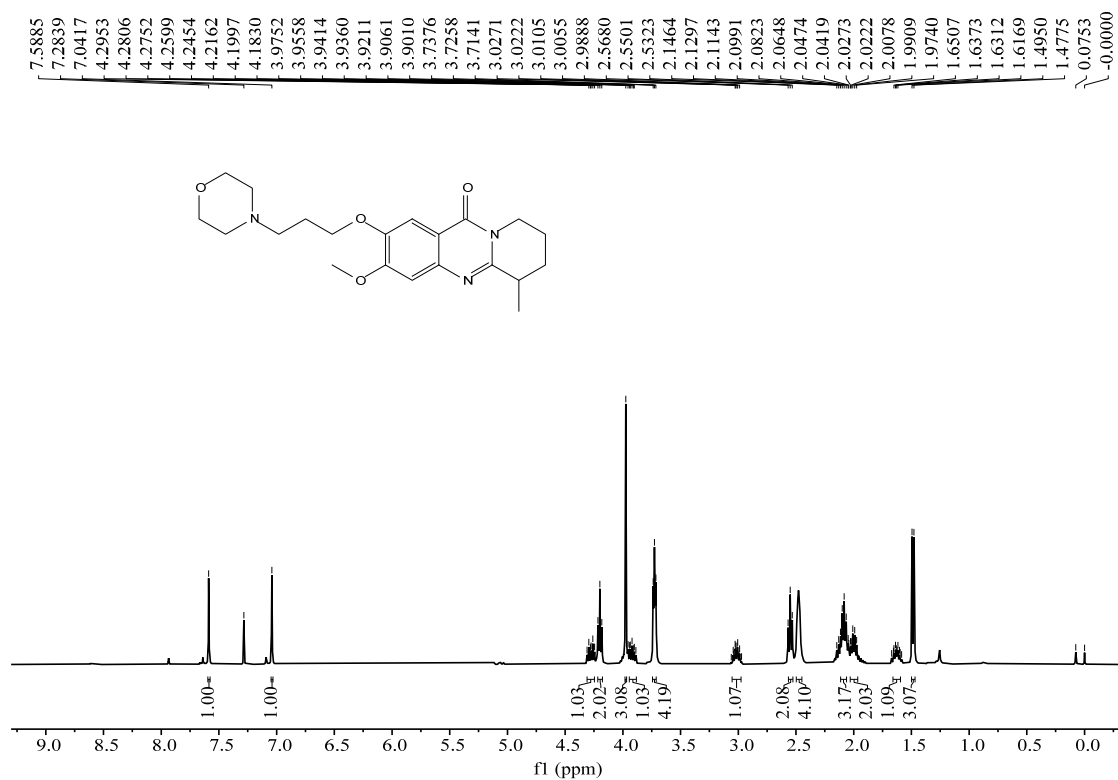
¹H NMR spectra of 2q (CDCl₃, 400 MHz)



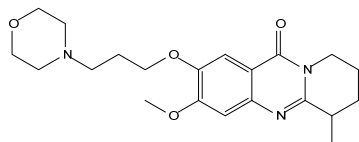
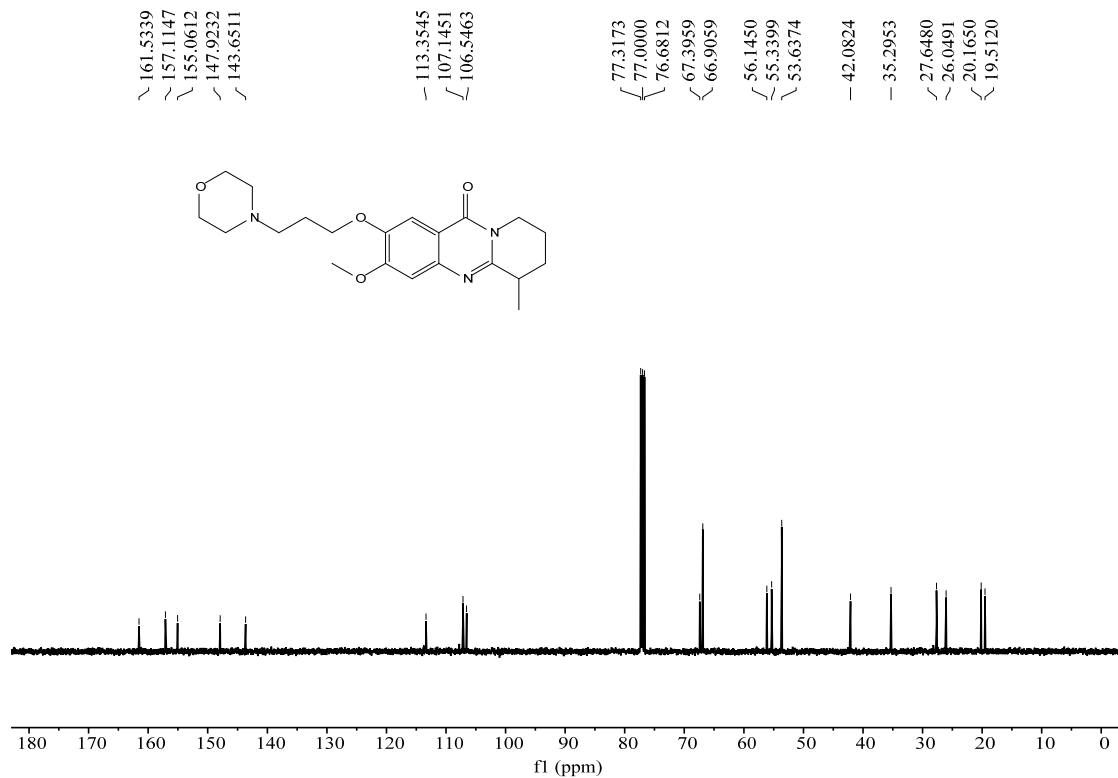
¹³C NMR spectra of 2q (CDCl₃, 100 MHz)



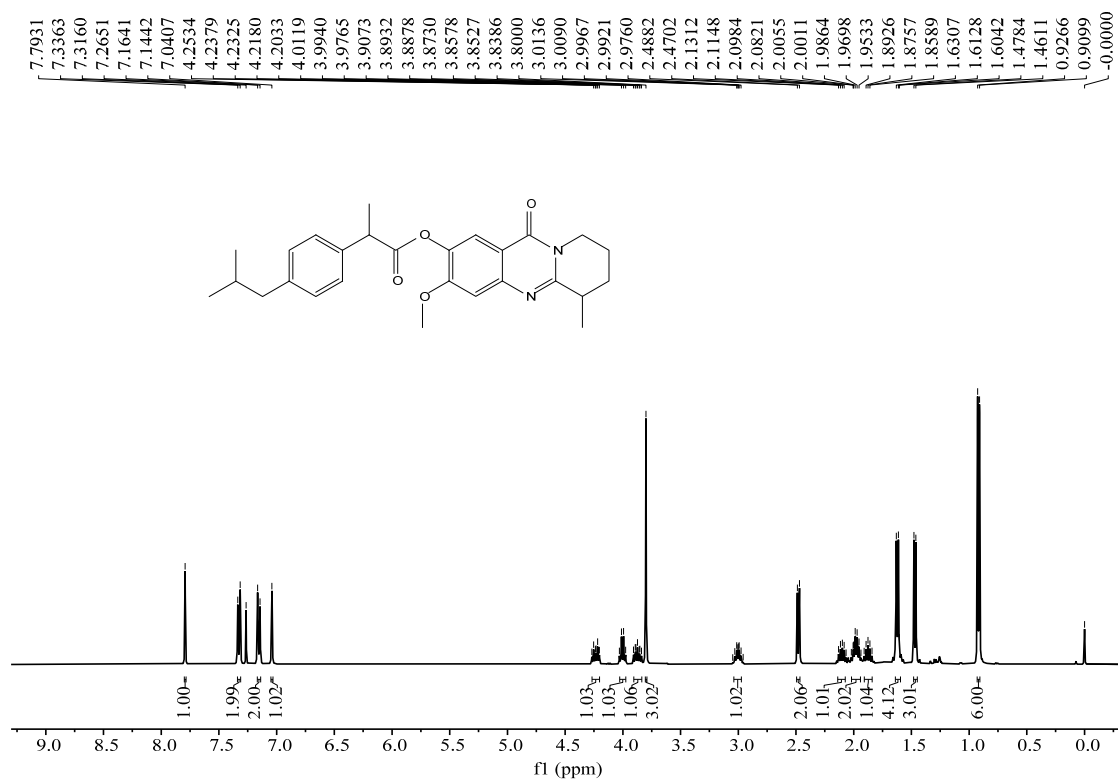
¹H NMR spectra of 2r (CDCl₃, 400 MHz)



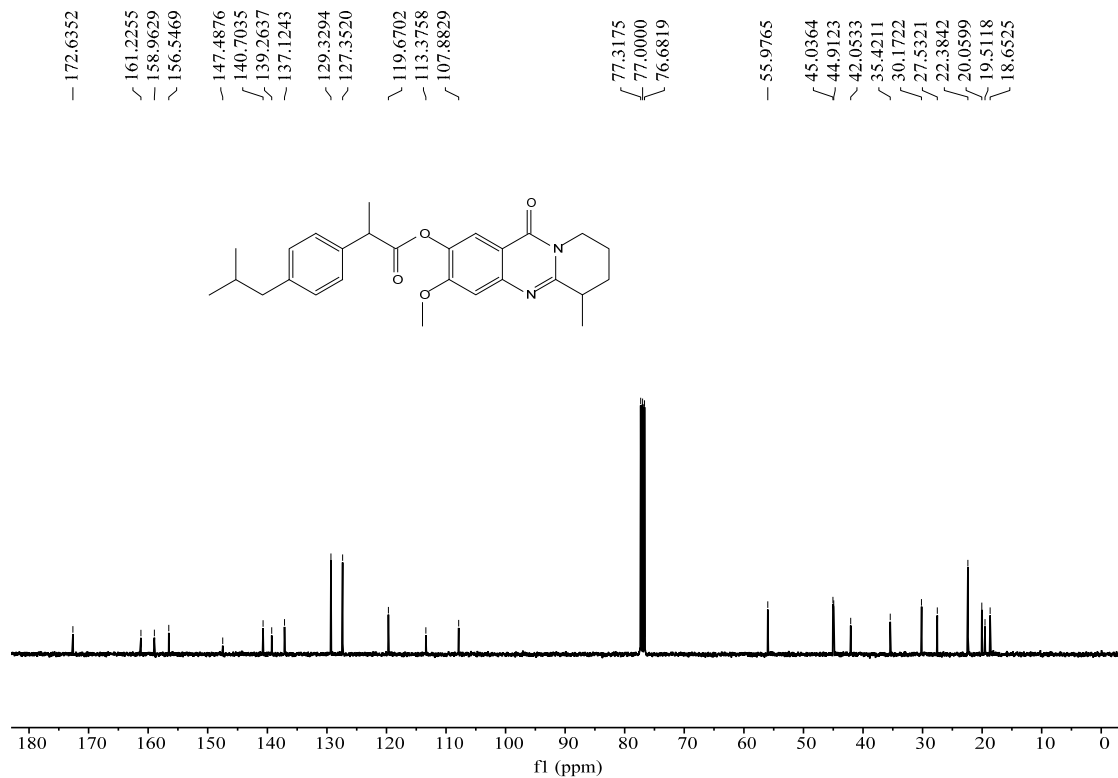
¹³C NMR spectra of 2r (CDCl₃, 100 MHz)



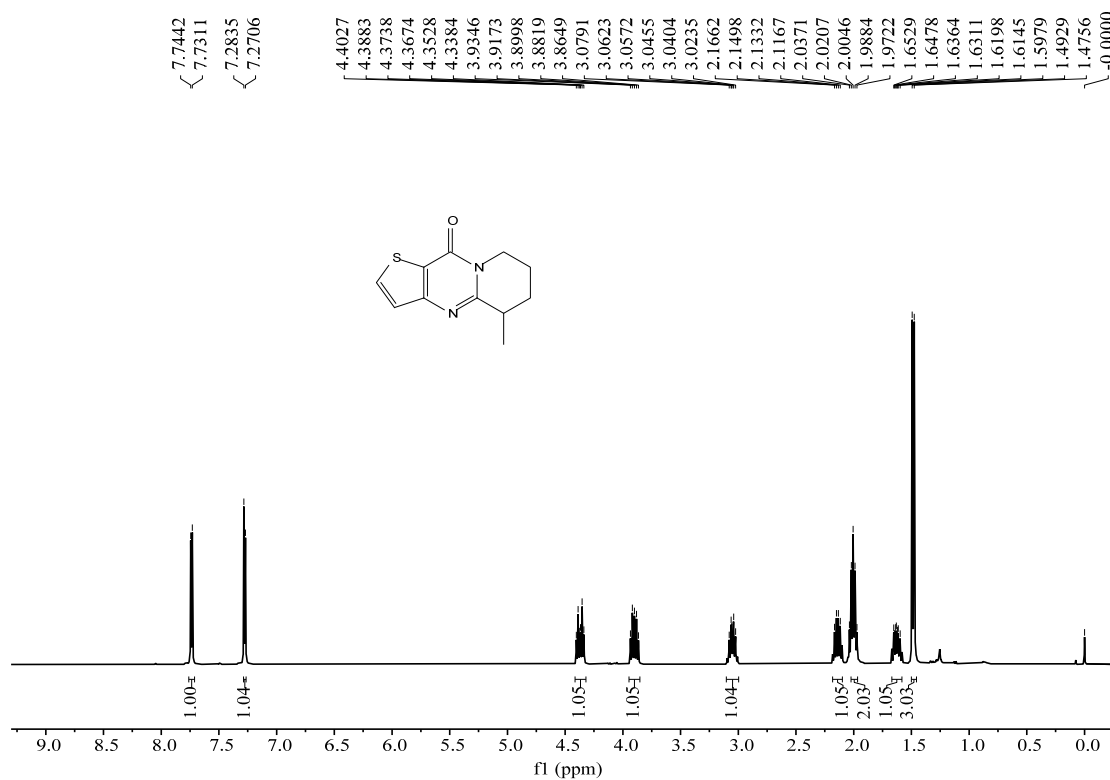
¹H NMR spectra of 2s (CDCl₃, 400 MHz)



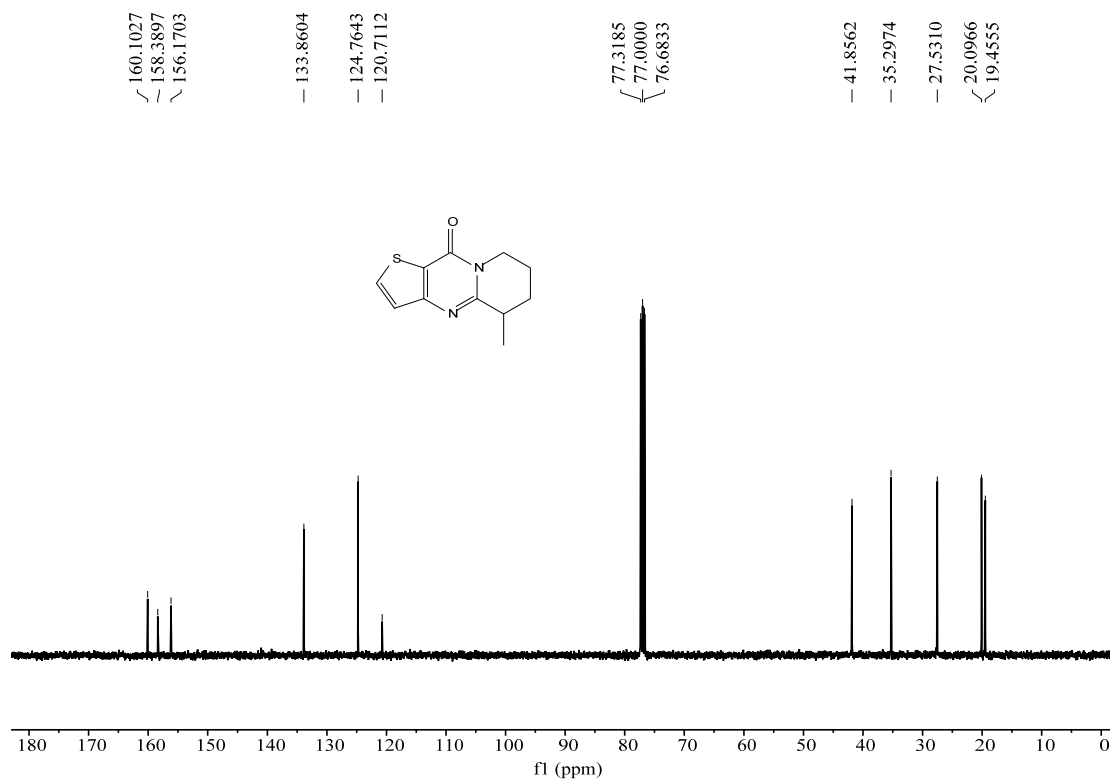
¹³C NMR spectra of 2s (CDCl₃, 100 MHz)



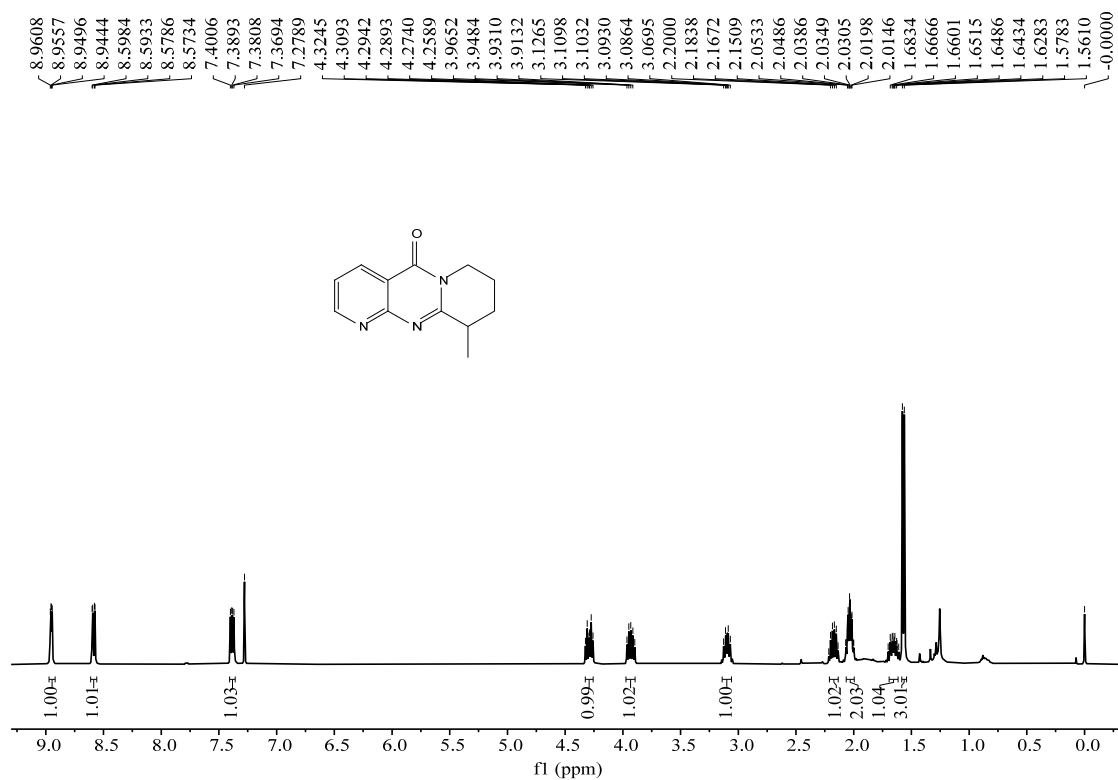
¹H NMR spectra of 2t (CDCl₃, 400 MHz)



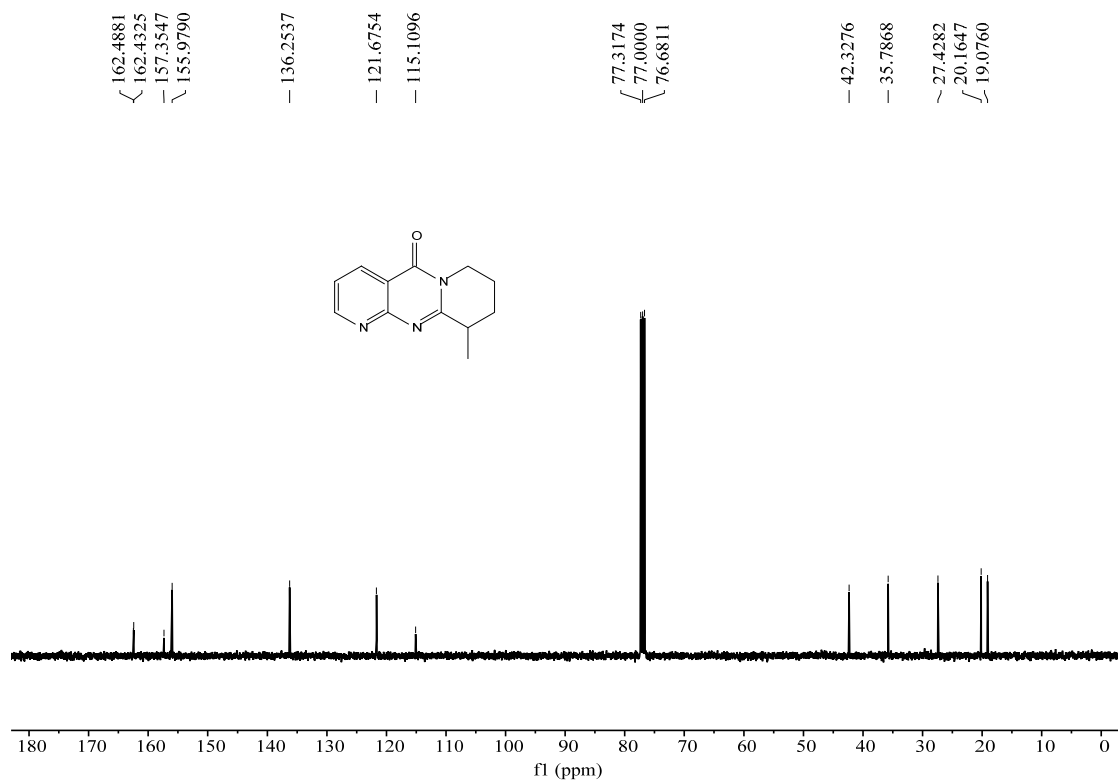
¹³C NMR spectra of 2t (CDCl₃, 100 MHz)



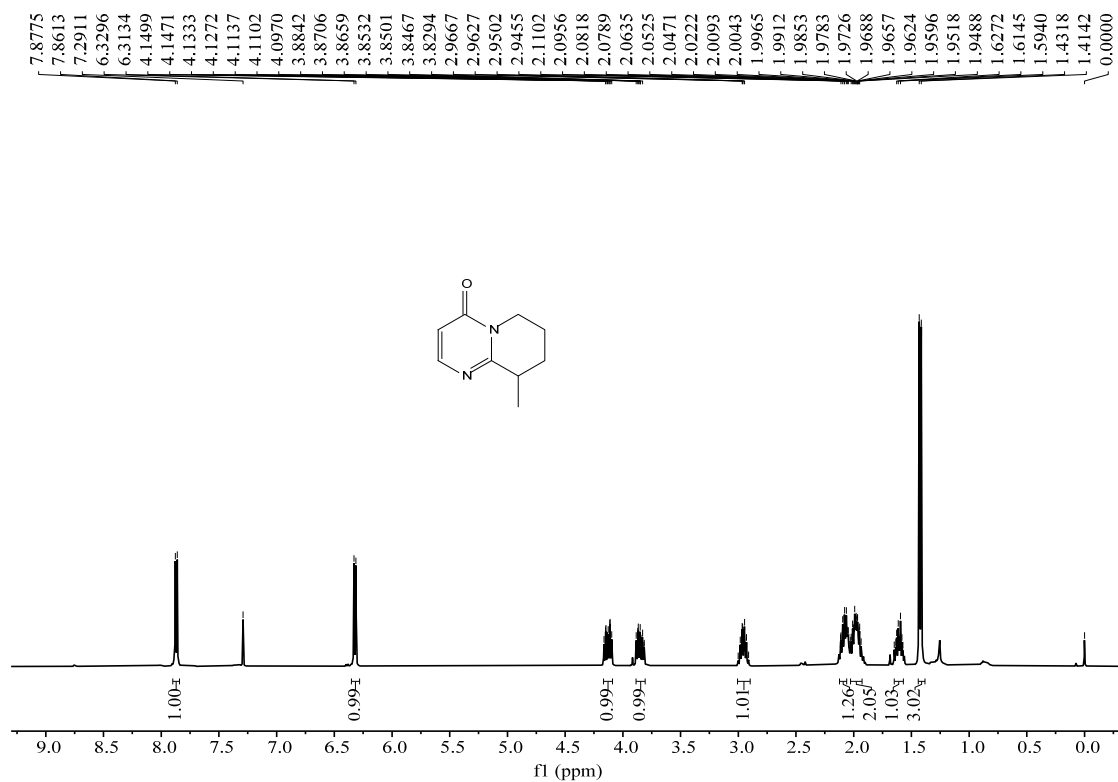
¹H NMR spectra of 2u (CDCl₃, 400 MHz)



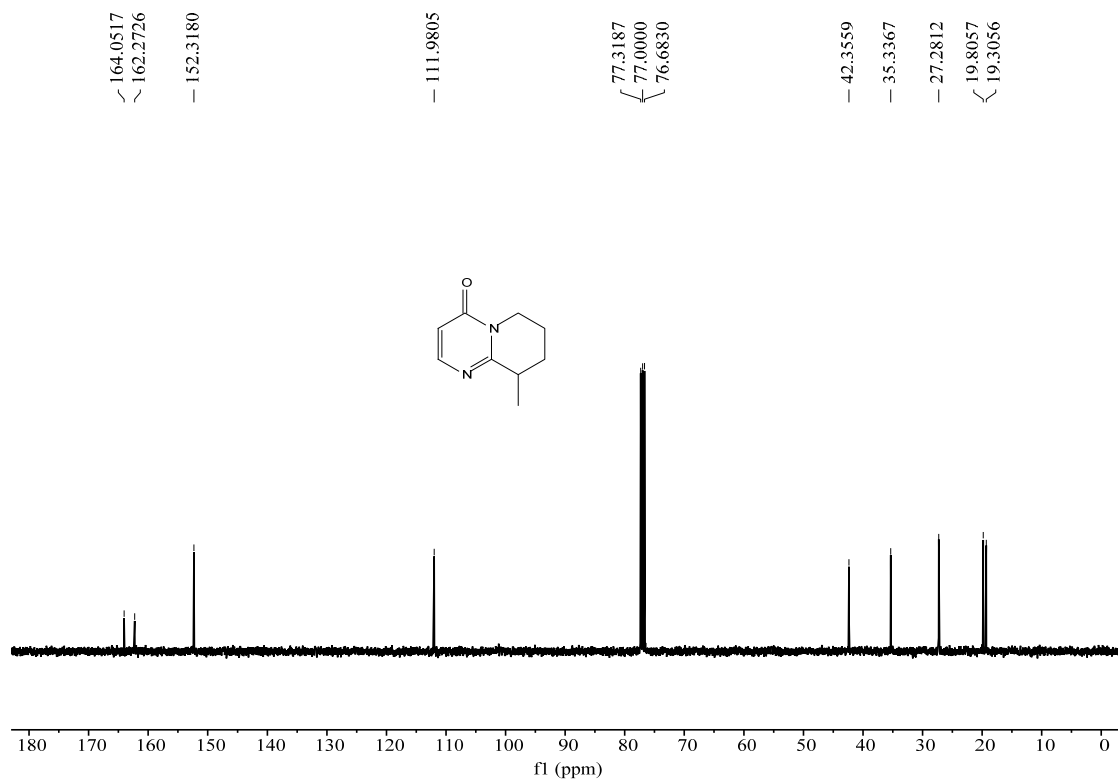
¹³C NMR spectra of 2u (CDCl₃, 100 MHz)



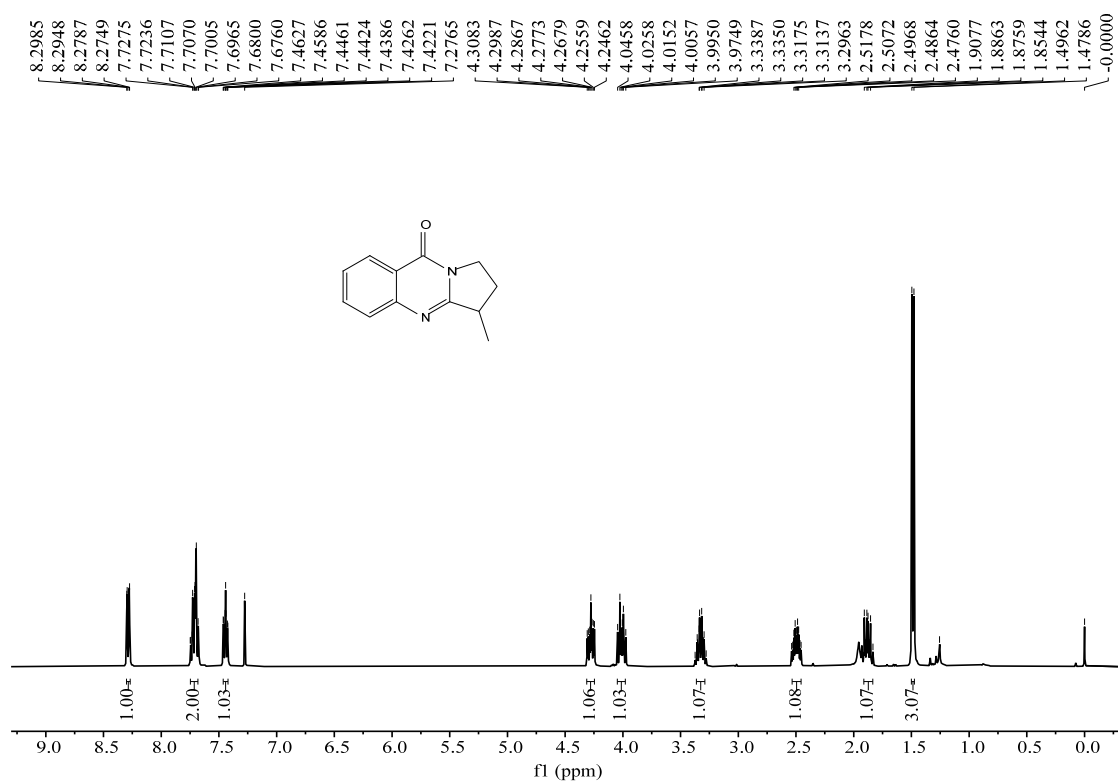
¹H NMR spectra of 2v (CDCl₃, 400 MHz)



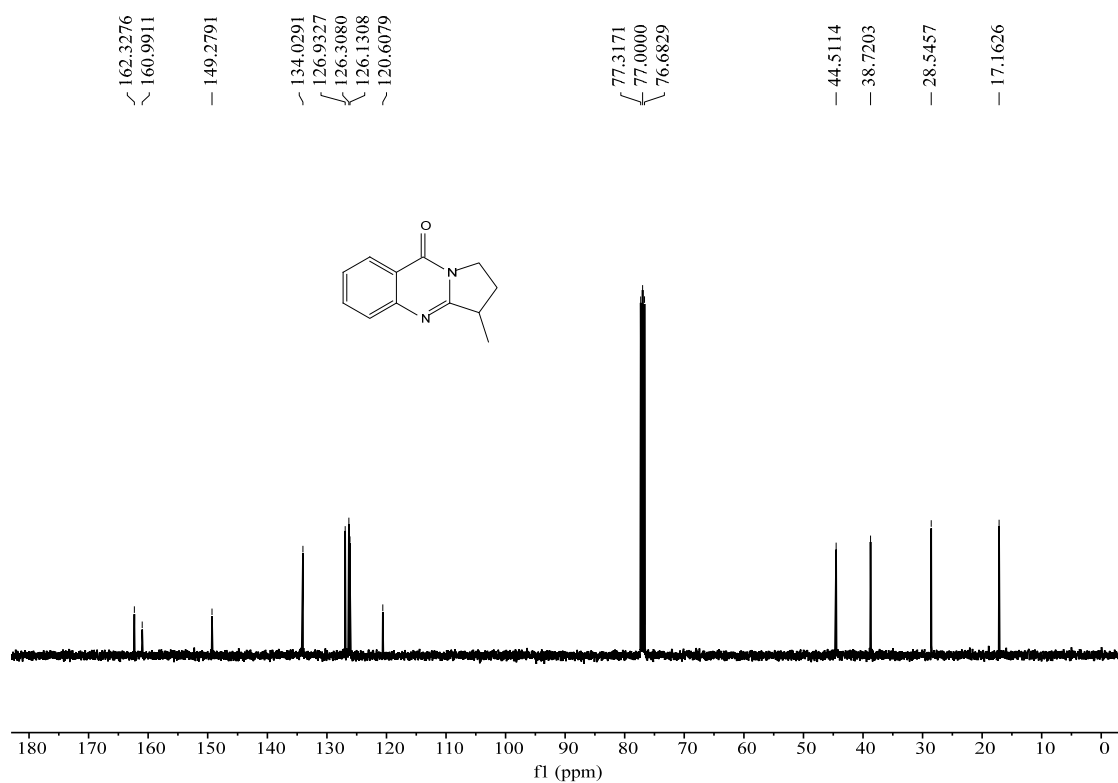
¹³C NMR spectra of 2v (CDCl₃, 100 MHz)



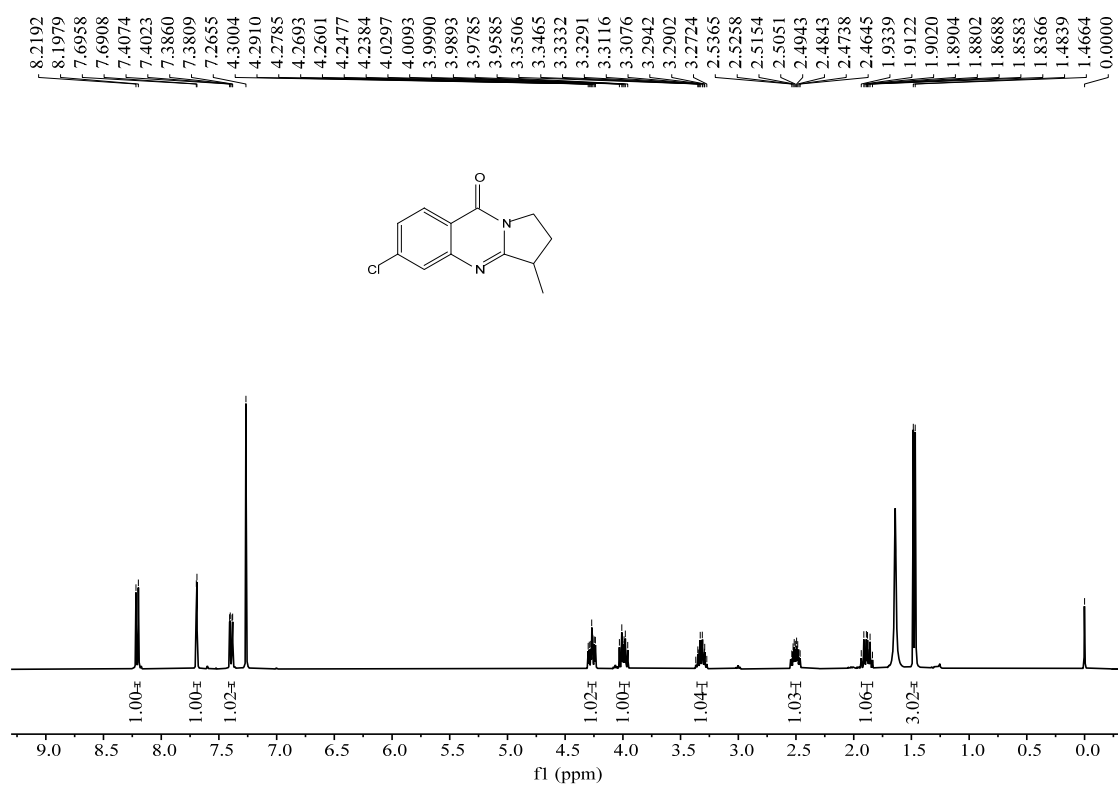
¹H NMR spectra of 3a (CDCl₃, 400 MHz)



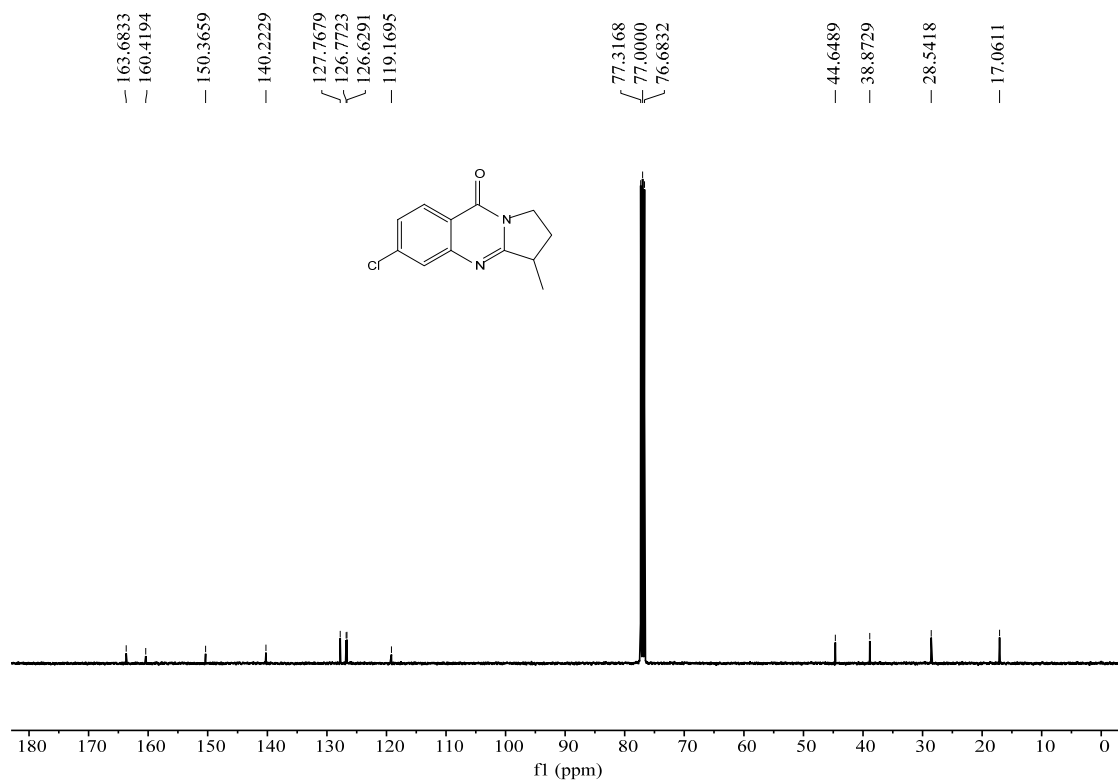
¹³C NMR spectra of 3a (CDCl₃, 100 MHz)



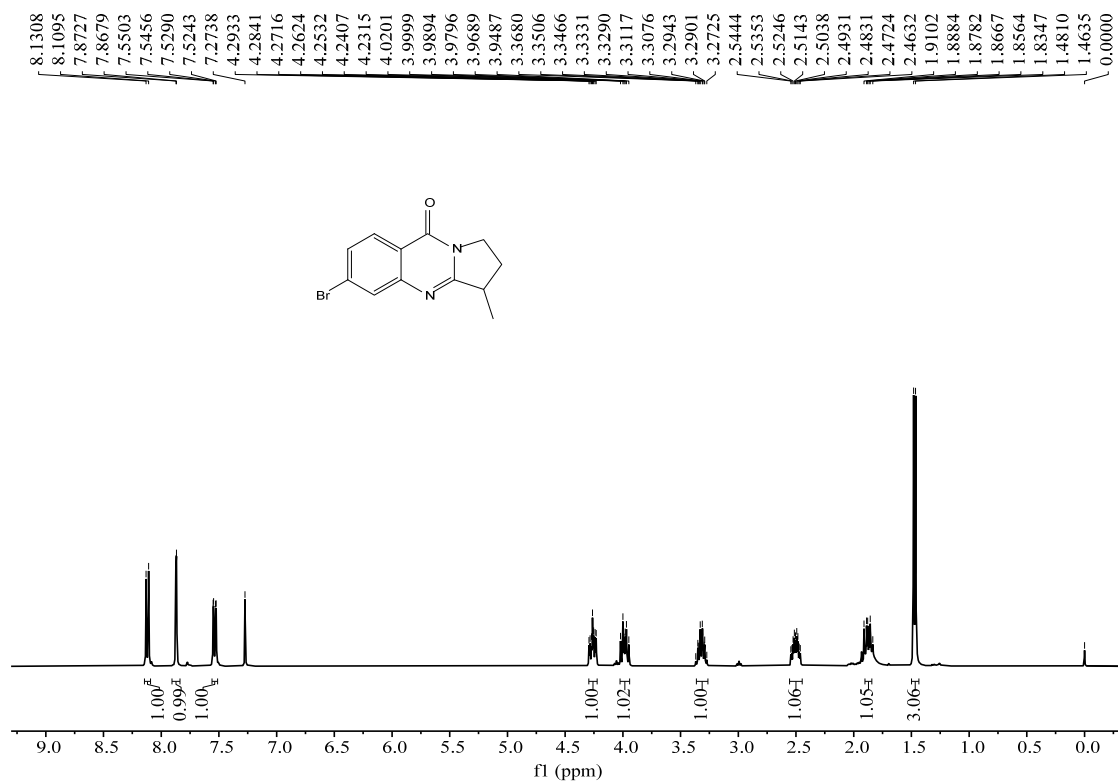
¹H NMR spectra of 3b (CDCl₃, 400 MHz)



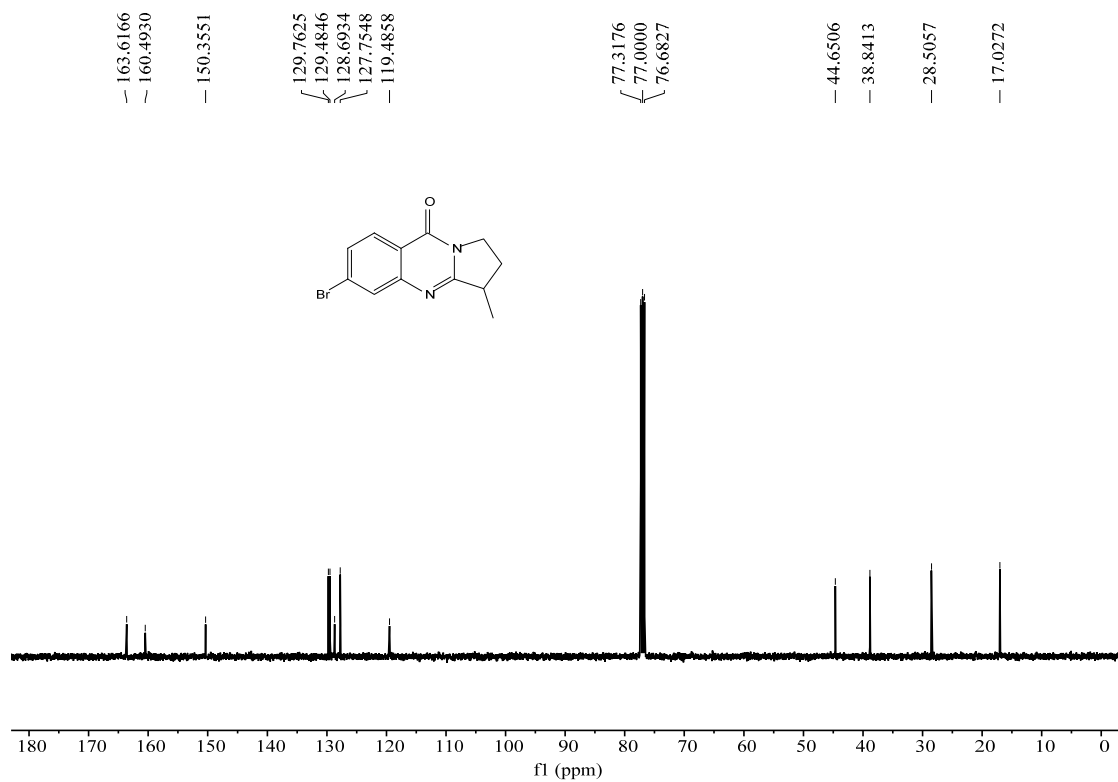
¹³C NMR spectra of 3b (CDCl₃, 100 MHz)



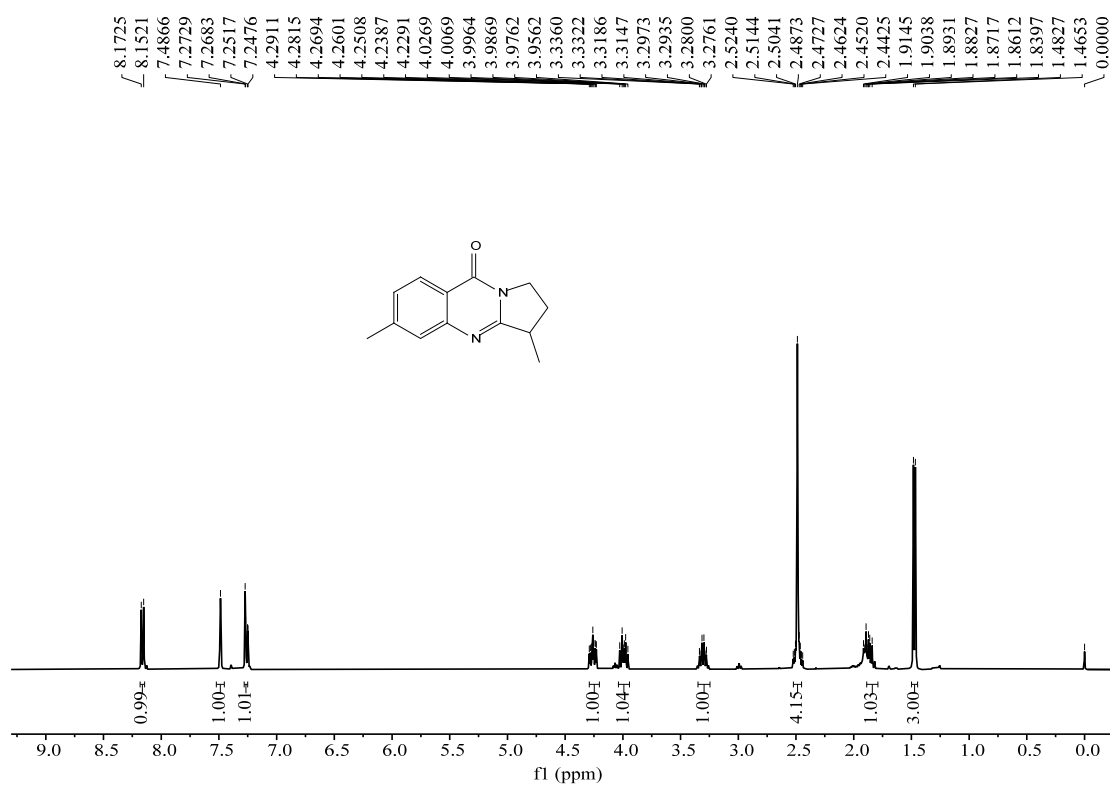
¹H NMR spectra of 3c (CDCl₃, 400 MHz)



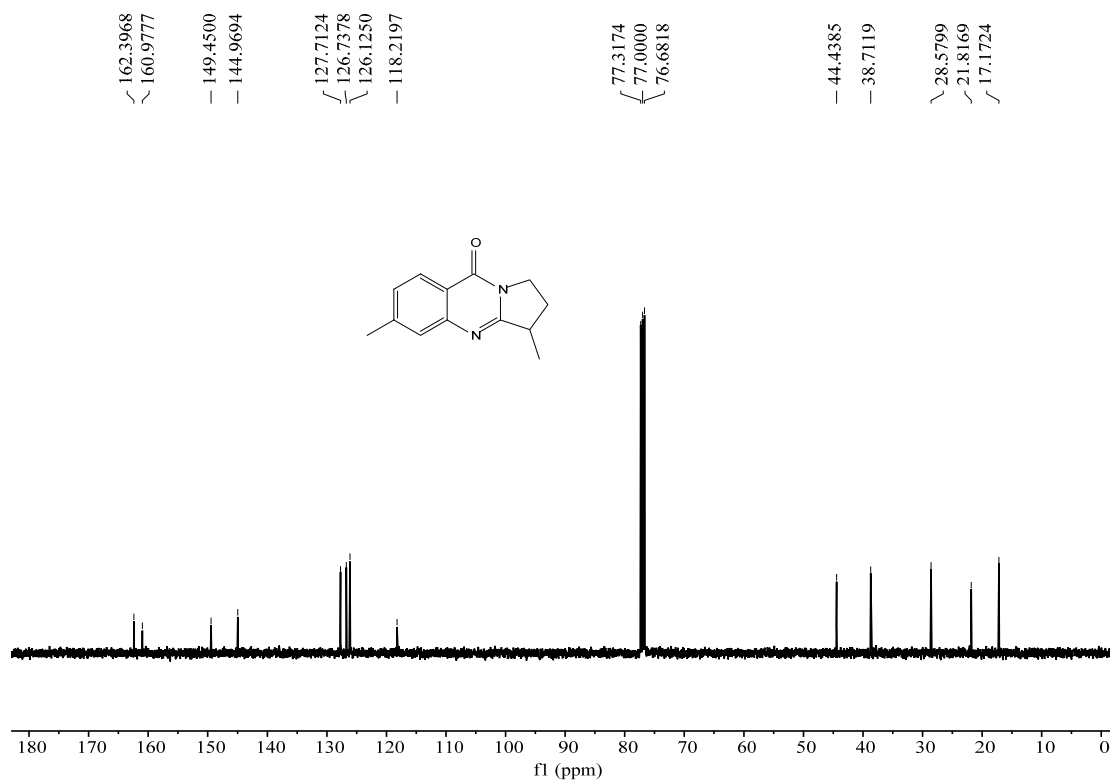
¹³C NMR spectra of 3c (CDCl₃, 100 MHz)



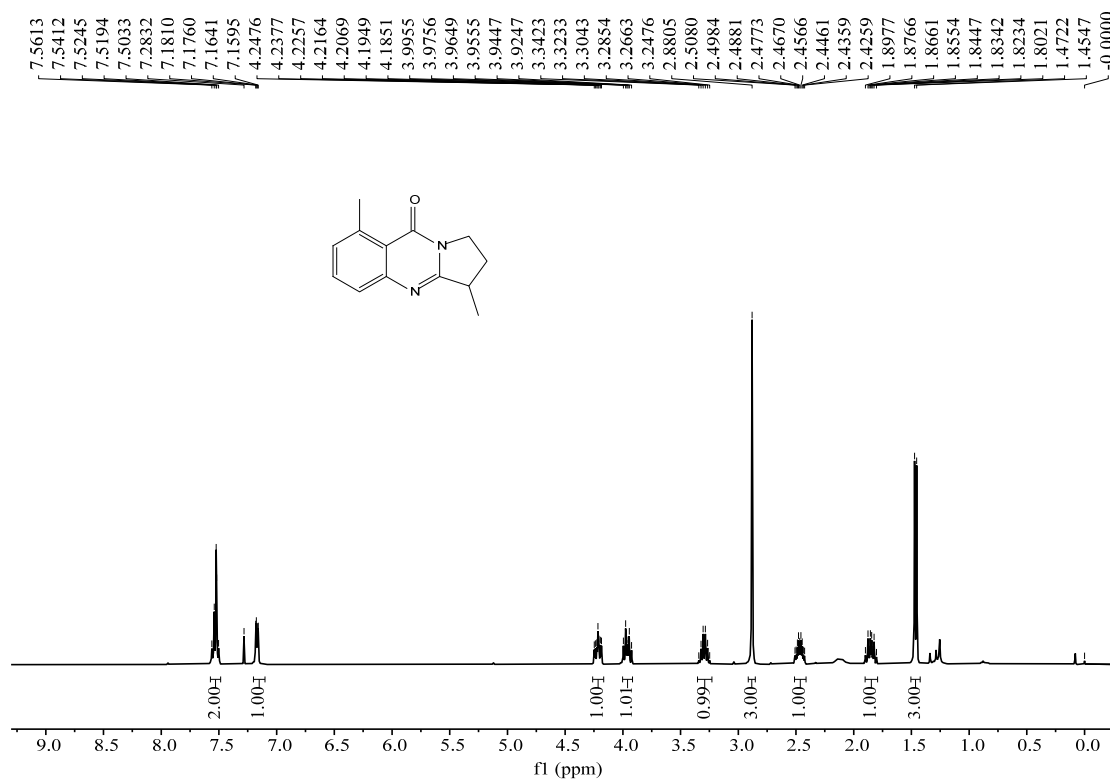
¹H NMR spectra of 3d (CDCl₃, 400 MHz)



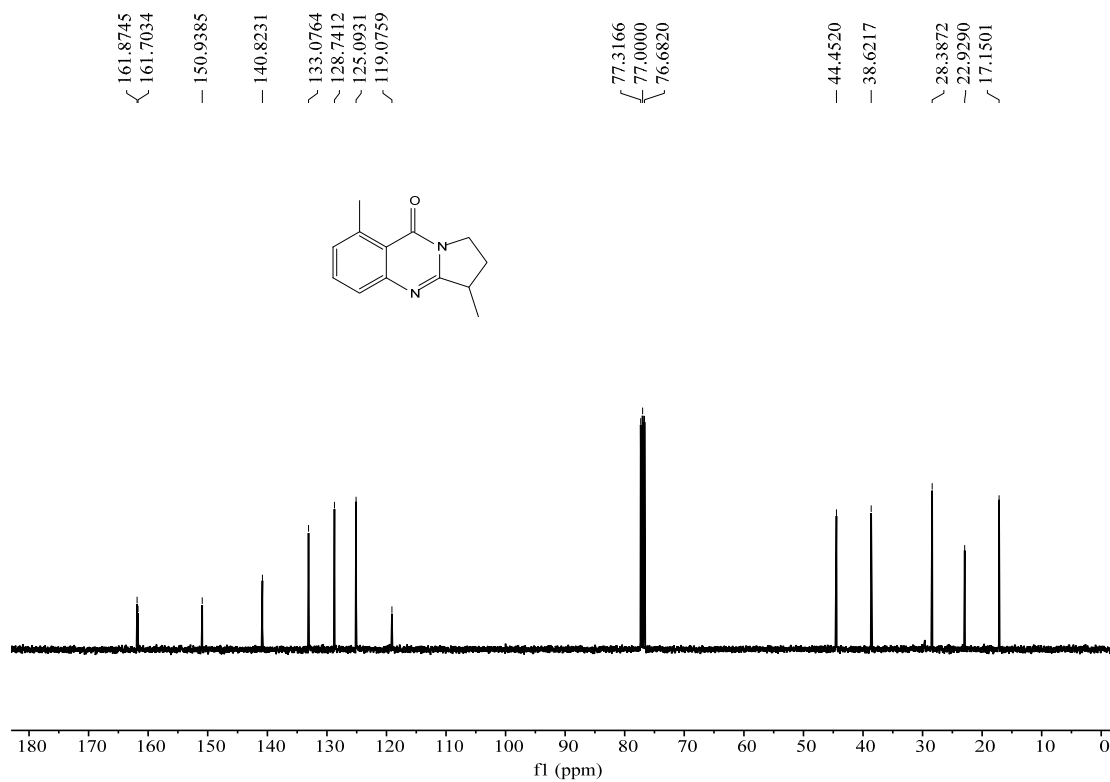
¹³C NMR spectra of 3d (CDCl₃, 100 MHz)



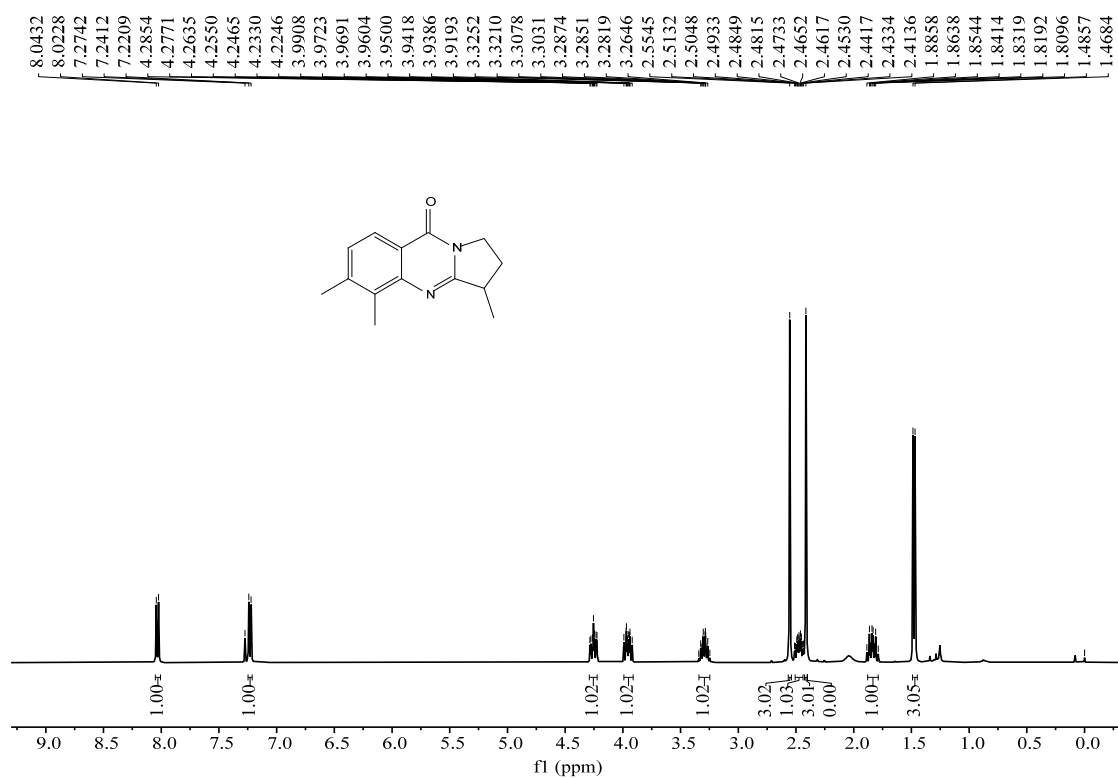
¹H NMR spectra of 3e (CDCl₃, 400 MHz)



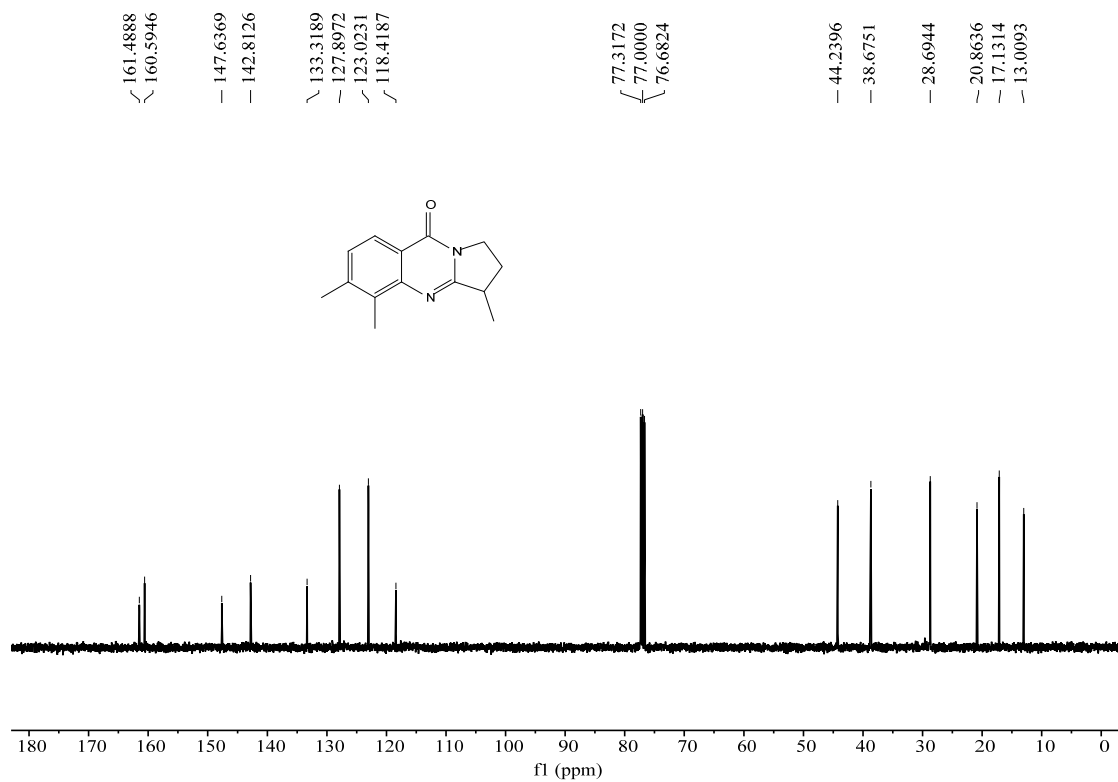
¹³C NMR spectra of 3e (CDCl₃, 100 MHz)



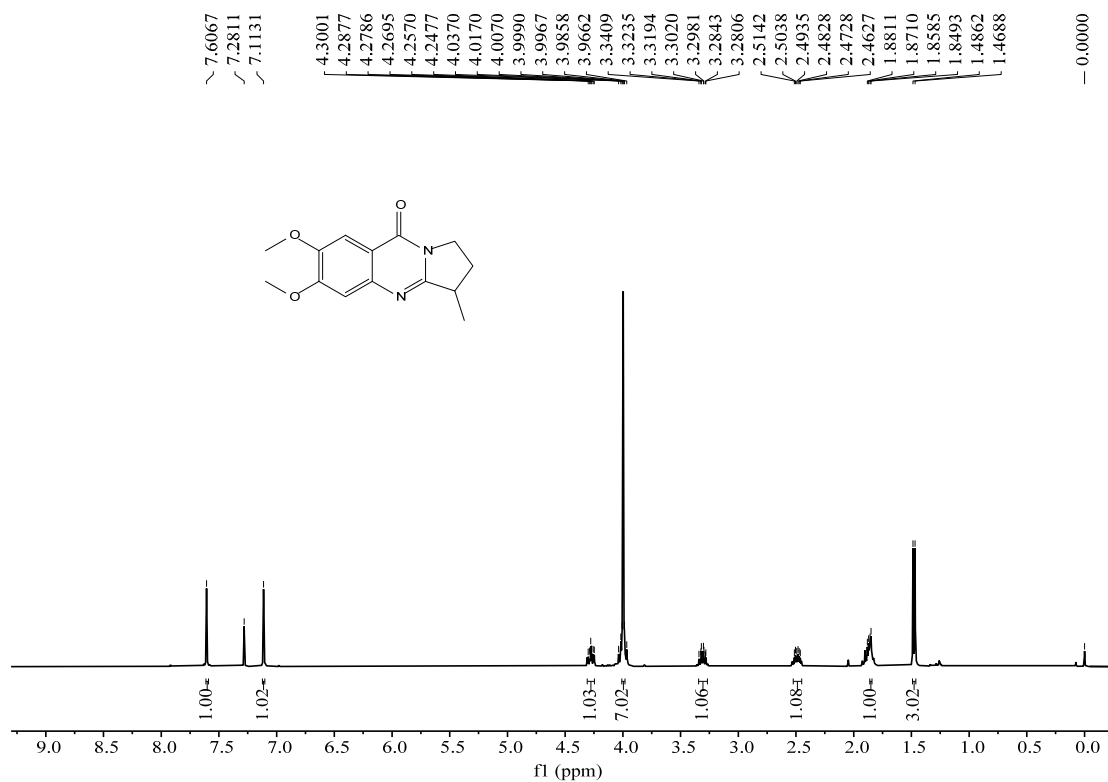
¹H NMR spectra of 3f (CDCl₃, 400 MHz)



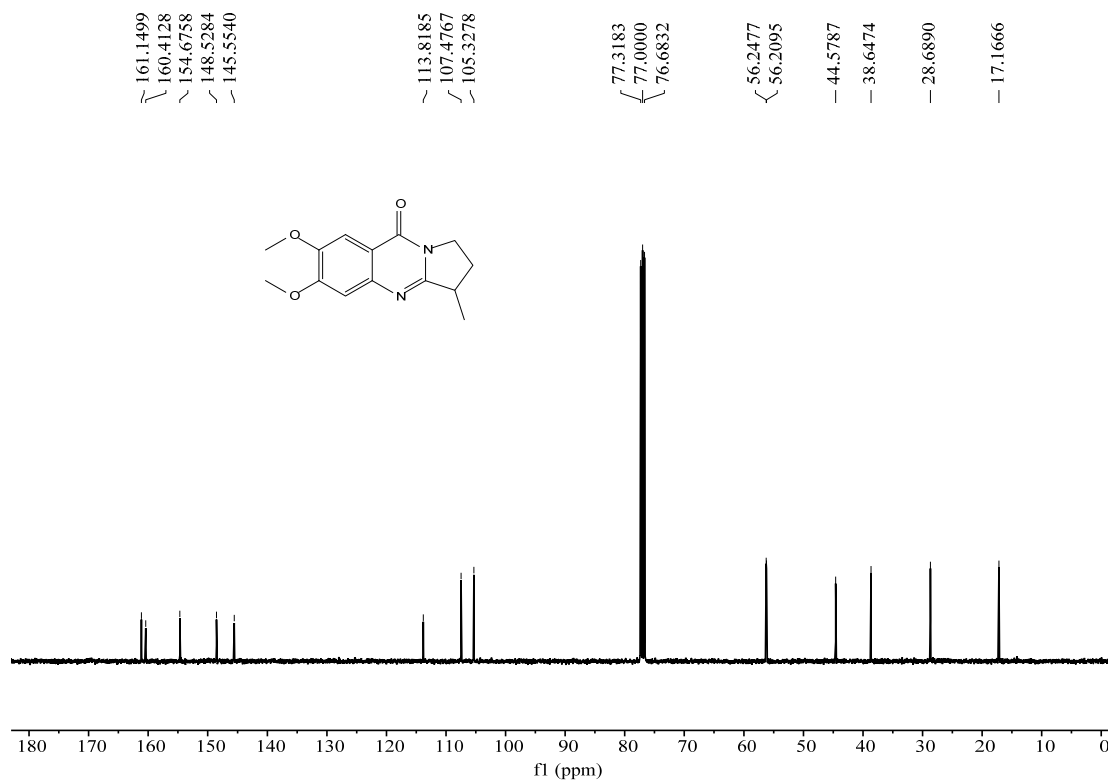
¹³C NMR spectra of 3f (CDCl₃, 100 MHz)



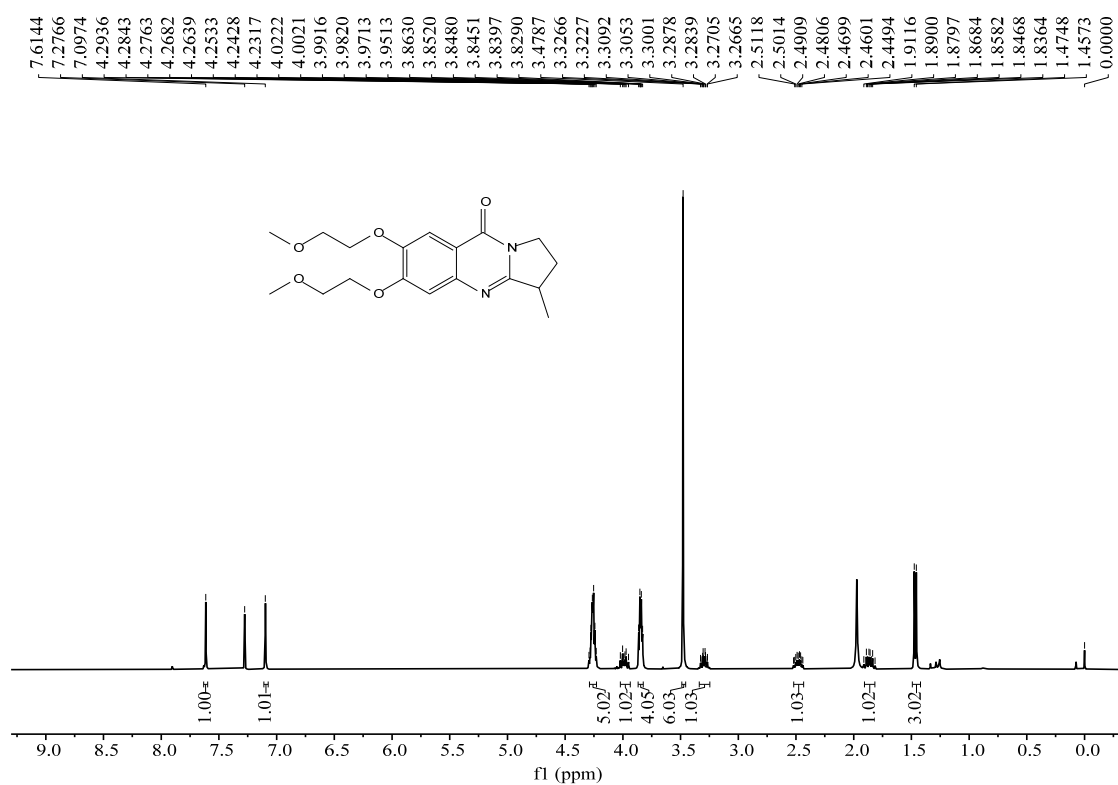
¹H NMR spectra of 3g (CDCl₃, 400 MHz)



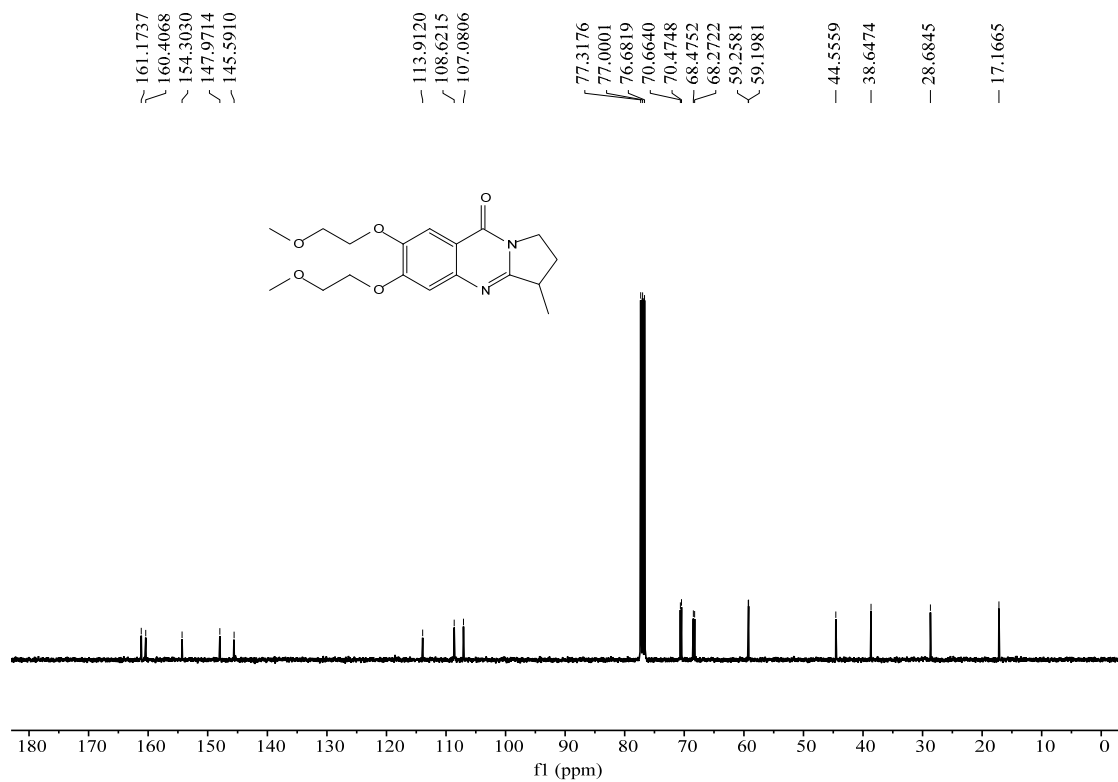
¹³C NMR spectra of 3g (CDCl₃, 100 MHz)



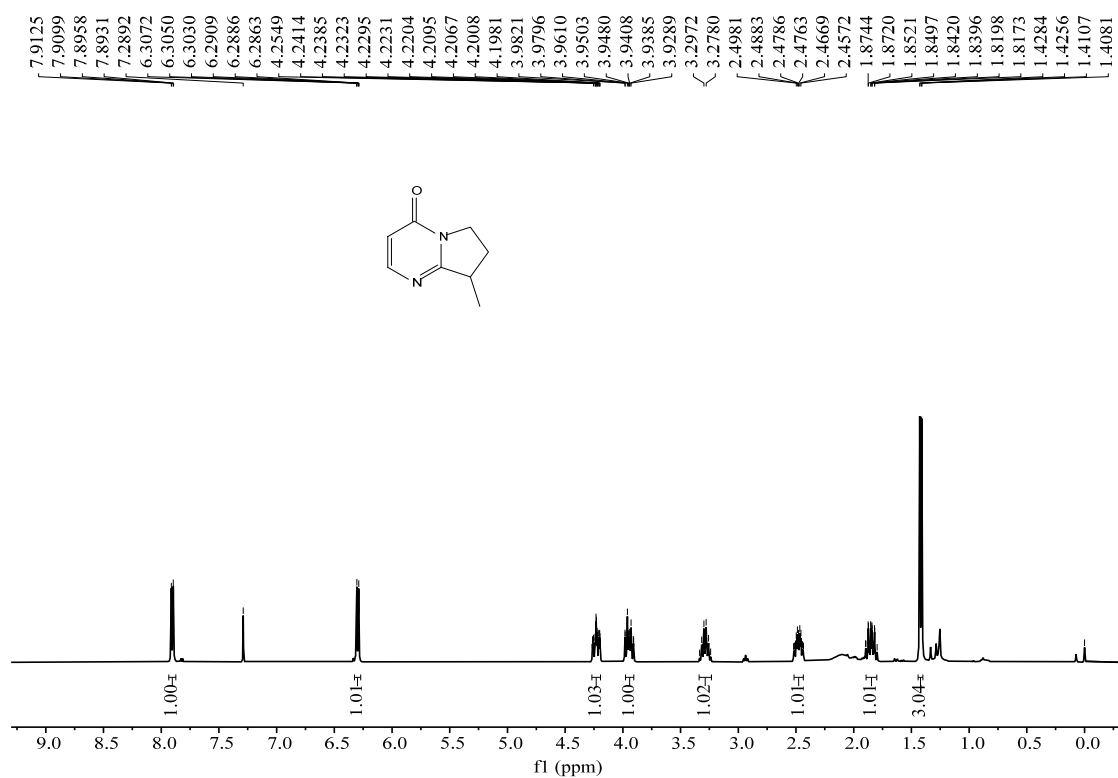
¹H NMR spectra of 3h (CDCl₃, 400 MHz)



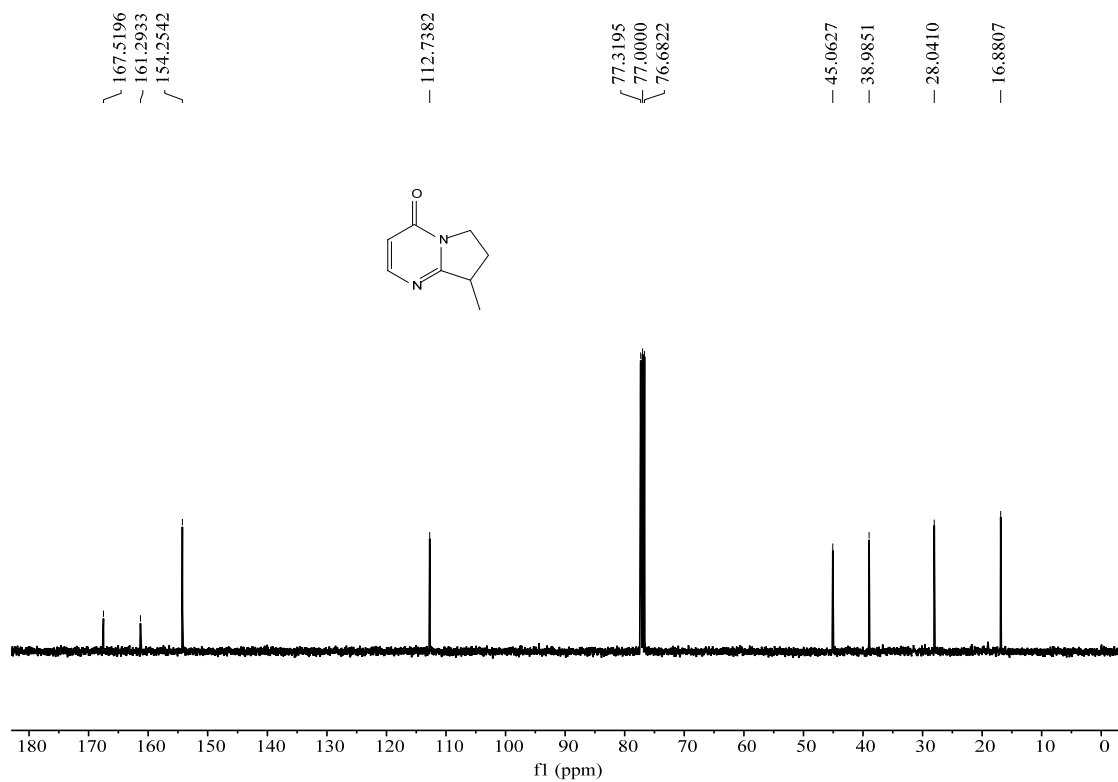
¹³C NMR spectra of 3h (CDCl₃, 100 MHz)



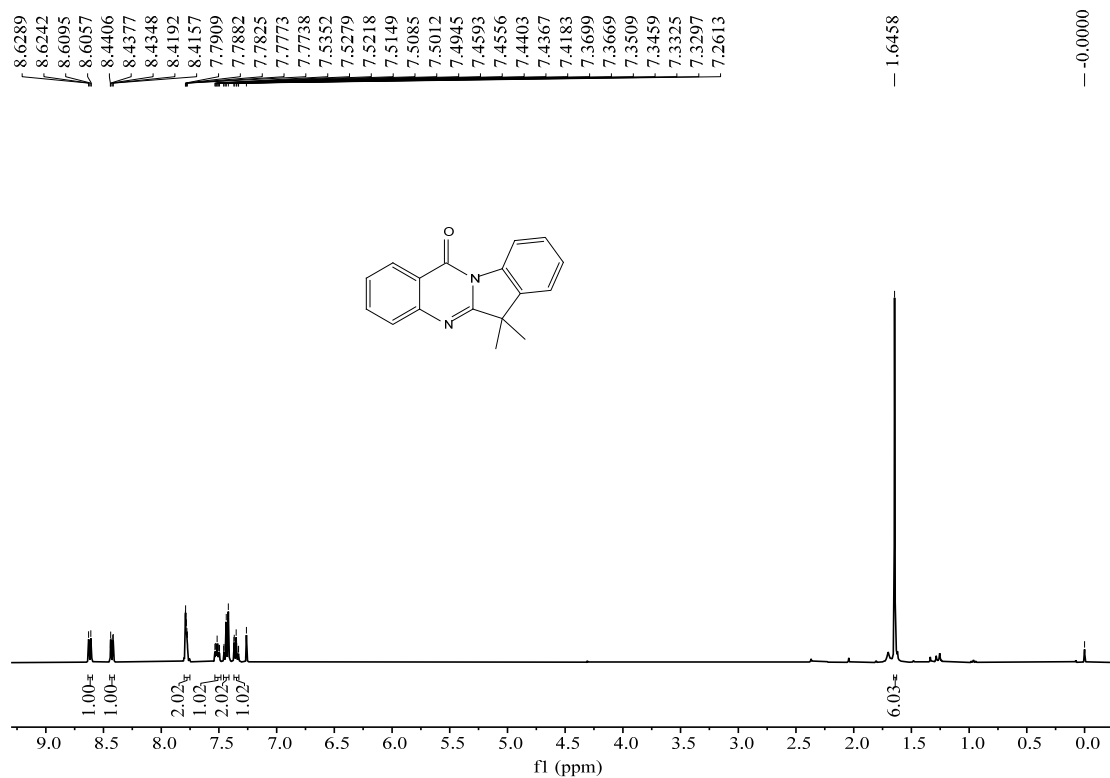
¹H NMR spectra of 3i (CDCl₃, 400 MHz)



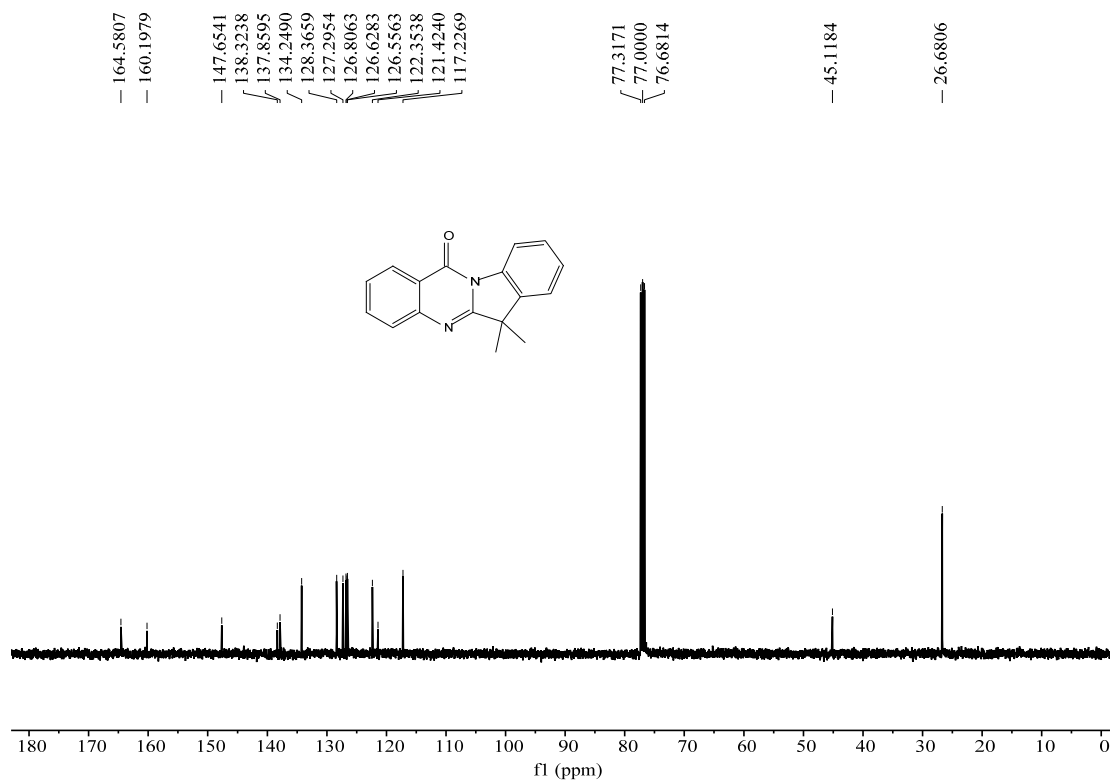
¹³C NMR spectra of 3i (CDCl₃, 100 MHz)



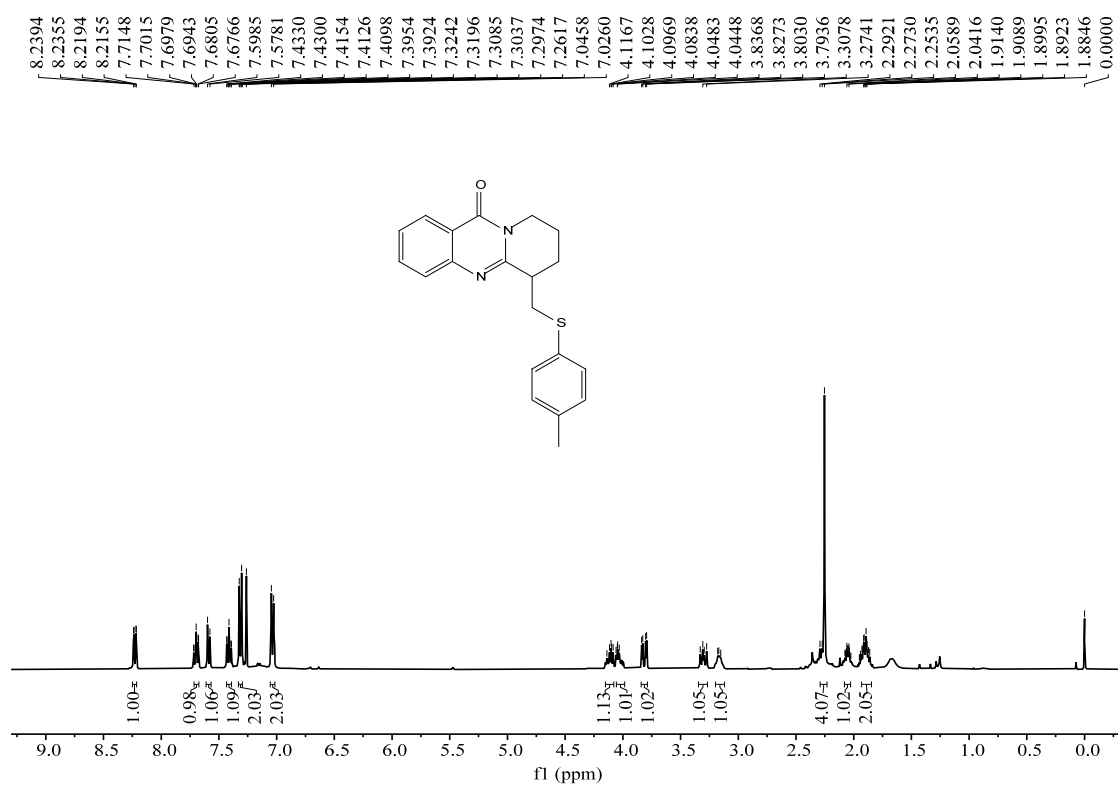
¹H NMR spectra of 4a (CDCl₃, 400 MHz)



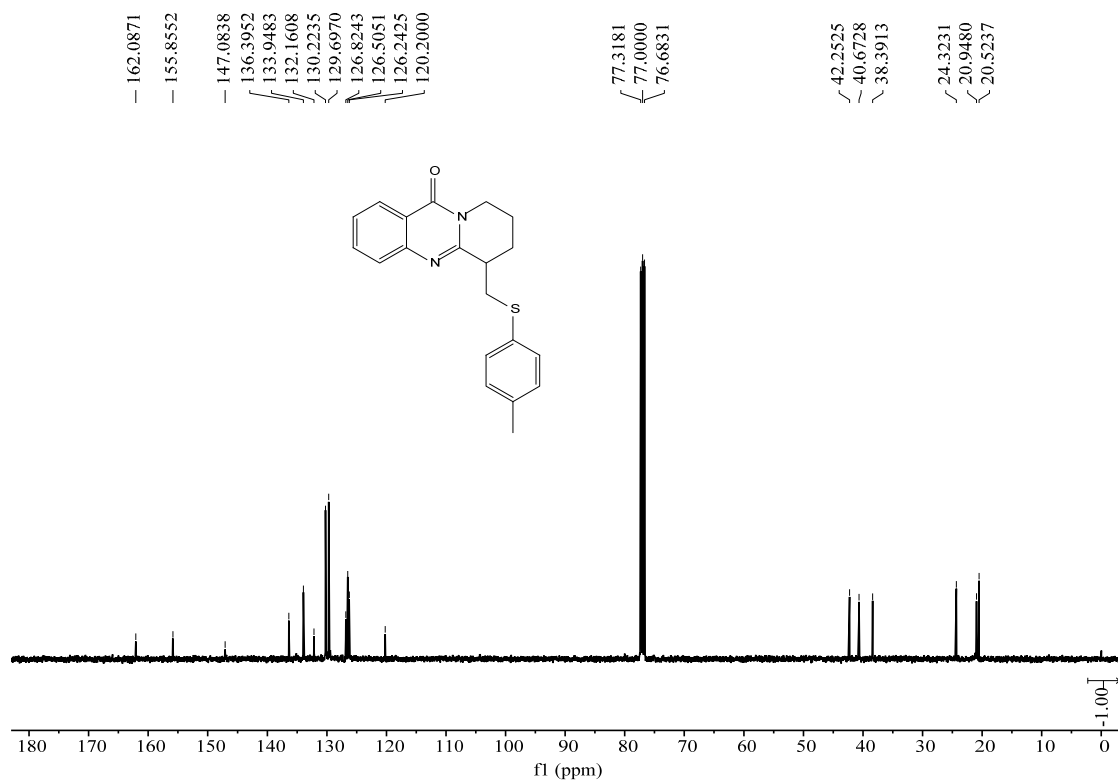
¹³C NMR spectra of 4a (CDCl₃, 100 MHz)



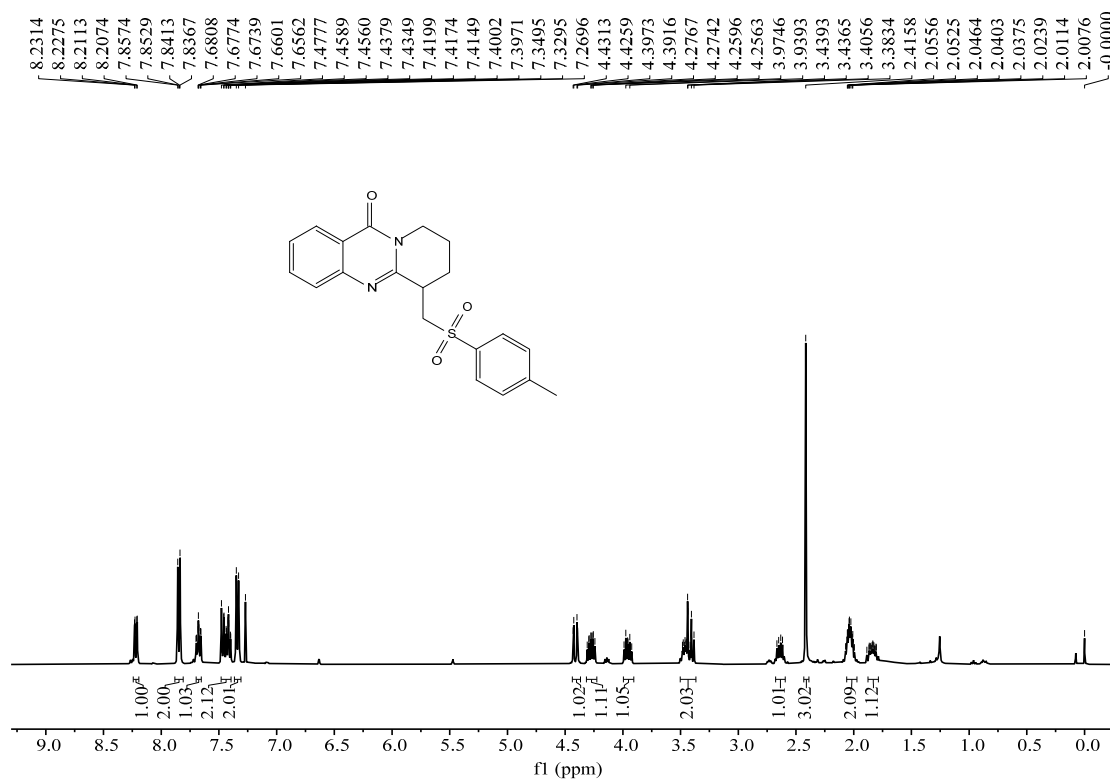
¹H NMR spectra of 5a (CDCl₃, 400 MHz)



¹³C NMR spectra of 5a (CDCl₃, 100 MHz)



¹H NMR spectra of 5b (CDCl₃, 400 MHz)



¹³C NMR spectra of 5b (CDCl₃, 100 MHz)

