Supplementary Information for

FACILE PREPARATION OF THE NOOTROPIC AGENT IDRA-21 AND RELATED HETEROCYCLES VIA A ONE-POT IRON-MEDIATED REDOX ANNULATION

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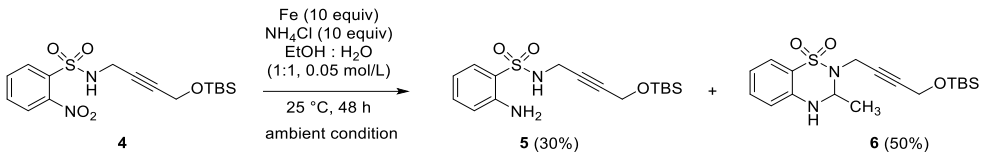
General Information

All reactions were typically conducted in general glassware under appropriate atmosphere. Reagents were used without further purification as purchased from commercial sources. All solvents were used without further distillation as purchased from commercial sources. Flash chromatography was performed on Kanto silica gel 60N (spherical, neutral, 40−50 μm). Melting points were measured using Yanaco micro-melting point apparatus. ^{1}H- and ^{13}C-NMR spectra were recorded using JEOL JNM-ECA-600 or ECZ-400 spectrometers in deuterated solvent. The chemical shifts were reported in ppm (δ) using tetramethylsilane (TMS) or deuterated solvent as an internal control. IR spectra were obtained with PerkinElmer Spectrum 100 FTIR or Shimazu IR-Affinity1S spectrometers. HRMS analyses were performed on JEOL JMS-600, JEOL JMS-T100GCv, or Thermo Scientific Exactive spectrometers.

Experimental Procedures and Compound Characterizations

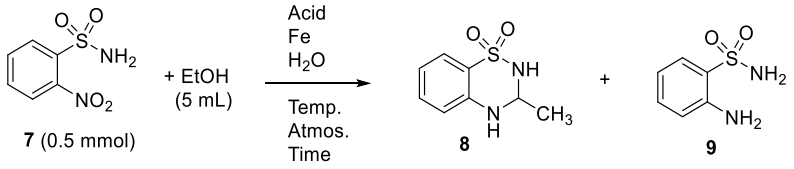


Nitrobenzenesulfonamide derivative **4**[1] (320 mg, 0.831 mmol) was added to the solution of iron powder (466 mg, 10 equiv) and NH_4Cl (445 mg, 10 equiv) in EtOH (8.3 mL) and H_2O (8.3 mL) at 25 °C. The solution was stirred for 48 hours under the ambient conditions. The reaction mixture was then filtrated through Celite Pad using AcOEt to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was purified by silica gel column chromatography using AcOEt:hexane (3:1) to give 88 mg of **5**[2] (30% yield) as colorless oil and 159 mg of **6** (50% yield) as white solid.

5[2] : ^{1}H-NMR (600 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.3 Hz, 1H), 7.32 (dd, *J* = 7.8, 6.9 Hz, 1H), 6.81 (dd, *J* = 8.3, 6.9 Hz, 1H), 6.75 (d, *J* = 7.8 Hz, 1H), 4.90 (t, *J* = 6.2 Hz, 1H), 4.81 (s, 2H), 4.06 (s, 2H), 3.77 (d, *J* = 6.2 Hz, 2H), 0.86 (s, 9H), 0.05 (s, 6H); ^{13}C-NMR (150 MHz, $CDCl_3$) δ 145.3, 134.4, 129.9, 121.7, 118.2, 117.9, 83.4, 78.4, 51.6, 33.5, 25.9, 18.4, -5.2.

6 : Mp 80-82 °C; ^{1}H-NMR (600 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.6 Hz, 1H), 7.28 (dd, *J* = 6.9, 8.3 Hz, 1H), 6.84 (dd, *J* = 7.6, 6.9 Hz, 1H), 6.66 (d, *J* = 8.3 Hz, 1H), 5.56 (dq, *J* = 6.6, 2.8 Hz, 1H), 4.35 (s, 1H), 4.12 (d, *J* = 5.5 Hz, 2H), 3.99-3.96 (m, 2H), 1.68 (d, *J* = 6.6 Hz, 3H), 0.87 (s, 9H), 0.06 (s, 3H), 0.06 (s, 3H); ^{13}C-NMR (150 MHz, $CDCl_3$) δ 142.2, 133.4, 125.7, 121.7, 119.0, 116.1, 82.8, 79.9, 65.4, 51.7, 32.3, 25.9, 19.1, 18.3, -5.09, -5.13; FT-IR (neat) 3373, 2930, 1606, 1485, 1323, 1158 cm^{-1}; HRMS (CI): *m/z* $[M+H]^+$ calcd for $C_{18}H_{28}N_2O_3SiS$: 380.1590; found: 380.1594.

Representative procedure of the optimization of the reaction conditions in **Table 1**



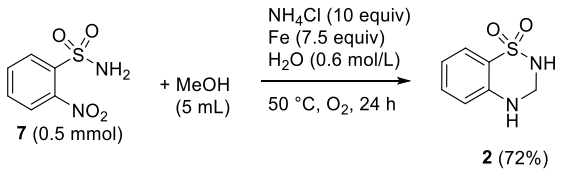
Entry 1) 2-Nitrobenzenesulfonamide (**7**) (101 mg, 0.5 mmol) was added to the solution of Fe (280 mg, 10 equiv) and NH_4Cl (270 mg, 10 equiv) in EtOH (5.0 mL) and H_2O (5.0 mL, 0.1 mol/L) at 25 °C. The solution was stirred for 24 hours under the ambient conditions. The reaction mixture was then

filtrated through Celite Pad using AcOEt and H_2O to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove the low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was 88 mg of white solids, which was estimated the 1:2.6 ratio of DBTD **8**[3]:aminoarene **9** by using ^{1}H-NMR measurement. Therefore, the total yield was 98% including 27% of **8** and 71% of **9**. The mixed products could be partly separated by SiO_2 column chromatography using $CHCl_3$ to identify their characterizations.

8[3]: ^{1}H-NMR (400 MHz, DMSO-d6) δ 7.43-7.35 (m, 2H), 7.23 (dd, *J* = 8.4, 7.5 Hz, 1H), 7.05 (s, 1H), 6.73 (d, *J* = 8.4 Hz, 1H), 6.65 (dd, *J* = 7.7, 7.5 Hz, 1H), 4.84-4.71 (m, 1H), 1.38 (d, *J* = 6.3 Hz, 3H); ^{13}C-NMR (100 MHz, DMSO-d6) δ 144.3, 133.3, 124.2, 121.4, 116.7, 116.2, 62.3, 20.5.

Entry 6) **7** (101 mg, 0.5 mmol) was added to the solution of Fe (210 mg, 7.5 equiv) and AcOH (0.296 mL, 10 equiv) in EtOH (5.0 mL) and H_2O (0.833 mL, 0.6 mol/L) at 25 °C. The solution was stirred for 24 hours under the ambient conditions. The reaction mixture was then filtrated through Celite Pad using AcOEt and H_2O to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove the low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was 95 mg of **8** (96% yield) as light yellow solid, which could be obtained in sufficient pure form by confirming ^{1}H-NMR measurement.

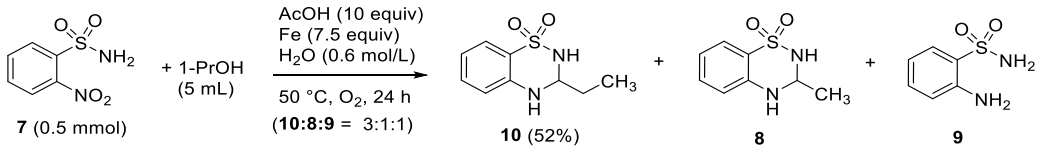
Entry 9) **7** (101 mg, 0.5 mmol) was added to the solution of Fe (280 mg, 10 equiv) and NH_4Cl (270 mg, 10 equiv) in EtOH (5.0 mL) and H_2O (5.0 mL, 0.1 mol/L) at 25 °C. The reaction mixture of the vessel was equipped with argon gas and sealed with argon balloon, which was then stirred for 24 hours under the same conditions. The reaction mixture was then filtrated through Celite Pad using AcOEt and H_2O to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove the low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was 85 mg as white solid, which was estimated 4:100 ratio of **8**:**9** by using ^{1}H-NMR measurement. Therefore, the total yield was 98% including 4% of **8** and 94% of **9**.



7 (101 mg, 0.5 mmol) was added to the solution of Fe (210 mg, 7.5 equiv) and NH_4Cl (270 mg, 10 equiv) in MeOH (5.0 mL) and H_2O (0.833 mL, 0.6 mol/L) at 25 °C. The mixture was equipped with O_2,

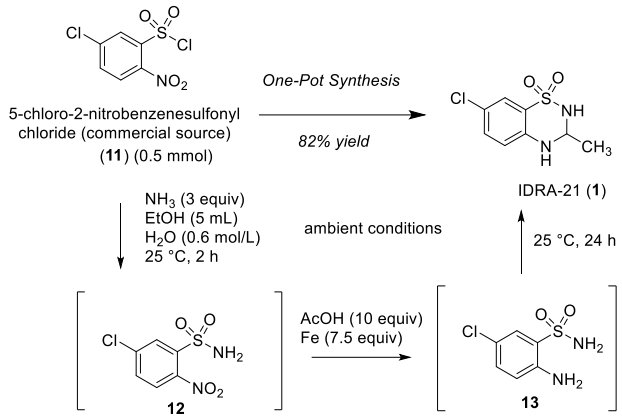
heated to 50 °C in an oil bath and stirred for 24 hours. The reaction mixture was then filtrated through Celite Pad using AcOEt and H_2O to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was 67 mg of **2** (72% yield) as light orange solid in sufficient pure form.

2: Mp 166-168 °C; ^{1}H-NMR (400 MHz, DMSO-d6) δ 7.54 (t, *J* = 8.2 Hz, 1H), 7.41 (d, *J* = 7.7 Hz, 1H), 7.23 (dd, *J* = 8.0, 7.3 Hz, 1H), 7.07 (s, 1H), 6.71 (d, *J* = 8.0 Hz, 1H), 6.65 (dd, *J* = 7.7, 7.3 Hz, 1H), 4.57 (d, *J* = 8.2 Hz, 1H), 4.55 (d, *J* = 8.2 Hz, 1H); ^{13}C-NMR (100 MHz, DMSO-d6) δ 144.2, 133.3, 124.3, 122.2, 116.6, 116.4, 54.8; FT-IR (neat) 3397, 3208, 1605, 1503, 1306, 1155 cm^{-1}; HRMS (EI) *m/z* $[M]^+$ calcd for $C_7H_8N_2O_2S$: 184.0306; found: 184.0306.



7 (101 mg, 0.5 mmol) was added to the solution of AcOH (0.296 mL, 10 equiv) and Fe (210 mg, 7.5 equiv) in EtOH (5.0 mL) and H_2O (0.833 mL, 0.6 mol/L) at 25 °C. The solution was equipped with O_2 and heated to 50 °C in an oil bath. The solution was stirred for 24 hours under the same conditions. The reaction mixture was then filtrated through Celite Pad using AcOEt and H_2O to remove insoluble materials. The filtrate was evaporated under reduced pressure to remove low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was 95 mg as a mixture, which was estimated the 3:1:1 ratio of **10**^{3}:**8**:**9** by using ^{1}H-NMR measurement. The mixed products could be partly separated by using SiO_2 column chromatography with AcOEt:hexane (2:3) to give 55 mg of **10**^{3} (52% yield) as white solid.

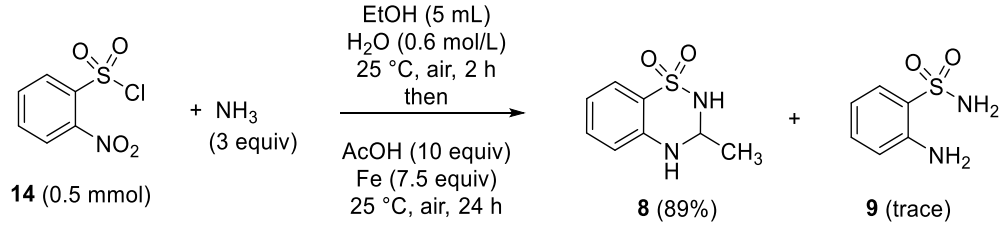
10^3: ^{1}H-NMR (400 MHz, DMSO-d6) δ 7.40 (d, *J* = 7.9 Hz, 1H), 7.31 (d, *J* = 11.8 Hz, 1H), 7.23 (dd, *J* = 8.4, 7.0 Hz, 1H), 6.98 (s, 1H), 6.76 (d, *J* = 8.4 Hz, 1H), 6.65 (dd, *J* = 7.9, 7.0 Hz, 1H), 4.58-4.48 (m, 1H), 1.79-1.63 (m, 2H), 0.96 (t, *J* = 7.4 Hz, 3H); ^{13}C-NMR (100 MHz, DMSO-d6) δ 144.3, 133.2, 124.2, 121.7, 116.7, 116.3, 67.5, 27.3, 9.70.



5-Chloro-2-nitrobenzenesulfonyl chloride (**11**)(128 mg, 0.5 mmol) was added to the solution of 28% NH_3 aqueous solution (91 μL, 3.0 equiv) in EtOH (5 mL) and H_2O (0.833 mL, 0.6 mol/L) at 25 °C. The solution was stirred for 2 hours at the same temperature under air atmosphere. AcOH (0.296 mL, 10 equiv) and Fe (210 mg, 7.5 equiv) were continuously added to the reaction mixture, which were then stirred for 24 hours under the ambient conditions. The reaction mixture was then filtrated through Celite Pad using AcOE and H_2O to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove the low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was 96 mg of IDRA-21 (**1**) (82% yield) as light orange solid, which could be obtained with sufficient purity.

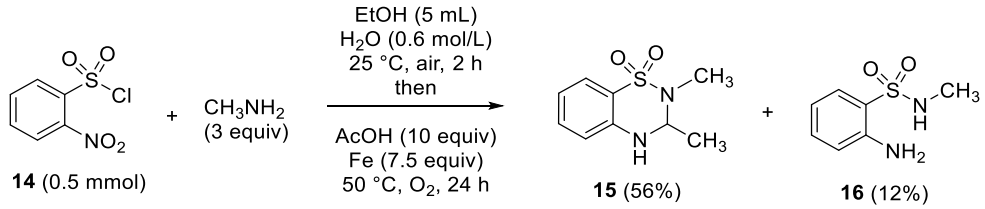
IDRA-21(**1**): Mp 218-219 °C; ^{1}H-NMR (600 MHz, acetone-d6) δ 7.46 (d, J = 2.3 Hz, 1H), 7.26 (dd, J = 8.7, 2.3 Hz, 1H), 6.84 (d, J = 8.7 Hz, 1H), 6.52 (s, 1H), 6.42-6.34 (m, 1H), 4.98 (q, J = 5.1 Hz, 1H), 1.53 (d, J = 5.1 Hz, 3H); ^{13}C-NMR (150 MHz, acetone-d6) δ 142.6, 132.8, 123.3, 122.9, 121.1, 118.0, 62.6, 19.7; FT-IR (neat) 3385, 3229, 1603, 1488, 1315, 1289, 1152 cm^{-1}; HRMS (EI): *m/z* $[M]^+$ calcd for $C_8H_9ClN_2O_2S$: 232.0073; found: 232.0063.

Procedures of synthesis of DBTD derivatives via one-pot protocol in **Table 2**



2-Nitrobenzenesulfonyl chloride (**14**)(111 mg, 0.5 mmol) was added to the solution of 28% NH_3 aqueous solution (91 μL, 3.0 equiv) in EtOH (5 mL) and H_2O (0.833 mL, 0.6 mol/L) at 25 °C. The solution was stirred for 2 hours at the same temperature under air atmosphere. AcOH (0.296 mL, 10 equiv) and Fe (210 mg, 7.5 equiv) were continuously added to the reaction mixture, which were then stirred for 24 hours under the ambient conditions. The reaction mixture was then filtrated through Celite Pad

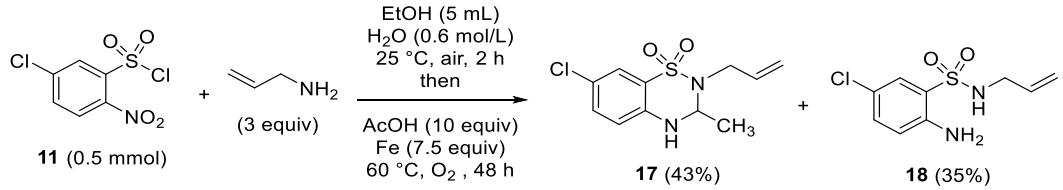
using AcOEt and H_2O to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove the low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was 88 mg of **8**[3] (89% yield) as light orange solid, which could be obtained with sufficient purity together with trace amount of aminoarene **9** by confirming ^{1}H-NMR measurement.



2-Nitrobenzenesulfonyl chloride (**14**)(111 mg, 0.5 mmol) was added to the solution of 40% $MeNH_2$ aqueous solution (125 μL, 3.0 equiv) in EtOH (5 mL) and H_2O (0.833 mL, 0.6 mol/L) at 25 °C. The solution was stirred for 2 hours at the same temperature under air atmosphere. AcOH (0.296 mL, 10 equiv) and Fe (210 mg, 7.5 equiv) were continuously added to the reaction mixture. The reaction mixture was equipped with O_2 and heated to 50 °C in an oil bath. The reaction mixture was stirred for 24 hours under the same reaction conditions. The reaction mixture was then filtrated through Celite Pad using AcOEt and H_2O to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove the low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was purified by using SiO_2 column chromatography with $CHCl_3$ to give 59 mg of **15** (56% yield) as orange solid and 11 mg of **16** (12% yield) as orange oil.

15: Mp 151-153 °C, ^{1}H-NMR (600 MHz, $CDCl_3$) δ 7.64 (d, J = 8.3 Hz, 1H), 7.28 (dd, J = 8.6, 7.3 Hz, 1H), 6.83 (dd, J = 8.3, 7.3 Hz, 1H), 6.66 (d, J = 8.6 Hz, 1H), 5.51 (dq, J = 6.2, 2.1 Hz, 1H), 4.43-4.33 (brs, 1H), 2.62 (s, 3H), 1.52 (d, J = 6.2 Hz, 3H); ^{13}C-NMR (150 MHz, $CDCl_3$) δ 142.0, 133.4, 126.1, 119.7, 118.9, 115.7, 65.0, 27.8, 18.5; FT-IR (neat) 3342, 1605, 1480, 1312, 1151, 1123 cm^{-1}; HRMS (EI): *m/z* $[M]^+$ calcd for $C_9H_{12}N_2O_2S$: 212.0620; found: 212.0615.

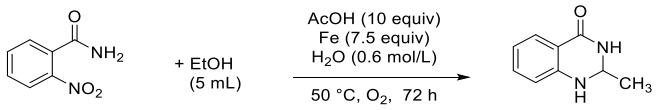
16: ^{1}H-NMR (600 MHz, $CDCl_3$) δ 7.69 (d, J = 8.2 Hz, 1H), 7.34 (dd, J = 8.2, 6.9 Hz, 1H), 6.80 (dd, J = 8.2, 6.9 Hz, 1H), 6.76 (d, J = 8.2 Hz, 1H), 4.85 (s, 2H), 4.71 (s, 1H), 2.56 (d, J = 5.5 Hz, 3H); ^{13}C-NMR (150 MHz, $CDCl_3$) δ 145.2, 134.3, 130.1, 120.5, 118.0, 117.9, 29.5; FT-IR (thin film) 3482, 3376, 1619, 1483, 1316, 1144 cm^{-1}; HRMS (EI): *m/z* $[M]^+$ calcd for $C_7H_{10}N_2O_2S$: 186.0463; found: 186.0462.



5-Chloro-2-nitrobenzenesulfonyl chloride (**11**)(128 mg, 0.5 mmol) was added to the solution of allylamine (113 μL, 3.0 equiv) in EtOH (5 mL) and H_2O (0.833 mL, 0.6 mol/L) at 25 °C. The solution was stirred for 2 hours at the same temperature under air atmosphere. AcOH (0.296 mL, 10 equiv) and Fe (210 mg, 7.5 equiv) were continuously added to the reaction mixture. The reaction mixture was quipped with O_2 and heated to 60 °C in an oil bath. The reaction mixture was stirred for 48 hours under the same reaction conditions. The reaction mixture was then filtrated through Celite Pad using AcOEt and H_2O to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove the low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was purified by using SiO_2 column chromatography with $CHCl_3$:MeOH (5:1) to give 58 mg of **17** (43% yield) as light orange solid and 43 mg of **18** (35% yield) as light orange oil.

17: Mp 128-130 °C; ^{1}H-NMR (400 MHz, $CDCl_3$) δ 7.64 (d, J = 2.3 Hz, 1H), 7.23 (dd, J = 8.6, 2.3 Hz, 1H), 6.62 (d, J = 8.6 Hz, 1H), 5.88 (ddt, J = 10.9, 6.1, 5.8 Hz, 1H), 5.55 (ddt, J = 12.7, 6.1, 2.2 Hz, 1H), 5.37-5.24 (m, 1H), 5.14 (dd, J = 10.2, 1.6 Hz, 1n), 4.38 (s, 1H), 3.84-3.53 (m, 2H), 1.52 (d, J = 6.3 Hz, 3H); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 140.5, 134.8, 133.6, 125.5, 123.8, 122.0, 117.2, 117.0, 65.8, 44.6, 19.2; FT-IR (neat) 3354, 1605, 1483, 1314, 1147 cm^{-1}; HRMS (EI): *m/z* $[M]^+$ calcd for $C_{11}H_{13}ClN_2O_2S$: 272.0386; found: 272.0386.

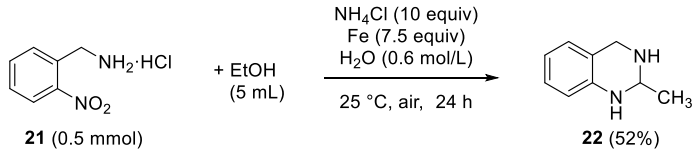
18: ^{1}H-NMR (400 MHz, $CDCl_3$) δ 7.68 (d, J = 2.3 Hz, 1H), 7.26 (dd, J = 8.6, 2.3 Hz, 1H), 6.70 (d, J = 8.6 Hz, 1H), 5.75-5.60 (m, 1H), 5.25-5.12 (m, 1H), 5.12-5.05 (m, 1H), 5.00-4.66 (m, 3H), 3.58-3.50 (m, 2H); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 143.7, 134.2, 132.7, 129.0, 122.9, 122.7, 119.2, 118.0, 45.9; FT-IR (thin film) 3478, 3380, 3290, 1620, 1482, 1311, 1144 cm^{-1}; HRMS (EI): *m/z* $[M]^+$ calcd for $C_9H_{11}ClN_2O_2S$: 246.0230; found: 246.0226.



19 (0.5 mmol) **20** (78%)

2-Nitrobenzamide (**19**)(83 mg, 0.5 mmol) was added to the solution of AcOH (0.296 mL, 10 equiv) and Fe (210 mg, 7.5 equiv) in EtOH (5 mL) and H_2O (0.833 mL, 0.6 mol/L) at 25 °C. The mixture was equipped with O_2 and heated to 50 °C in an oil bath. The mixture was stirred for 72 hours under the same condition. The reaction mixture was then filtrated through Celite Pad using AcOEt and H_2O to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove the low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was purified by using SiO_2 column chromatography with AcOEt:hexane (2:1) to give 61 mg of **20** (78% yield) as white solid, which was identified with the previously reported characterisation[4].

20[4]: ^{1}H-NMR (400 MHz, DMSO-d6) δ 7.85 (s, 1H), 7.60-7.49 (m, 1H), 7.25-7.14 (m, 1H), 6.72-6.60 (m, 2H), 6.57 (s, 1H), 4.78 (q, J = 5.8 Hz, 1H), 1.27 (d, J = 5.8 Hz, 3H); ^{13}C-NMR (100 MHz, DMSO-d6) δ 164.6, 149.3, 133.6, 128.0, 117.7, 115.7, 114.8, 61.4, 21.8.



21 (0.5 mmol) **22** (52%)

2-Nitrobenzylamine hydrochloride (**21**)(94 mg, 0.5 mmol) was added to the solution of NH_4Cl (267 mg, 10 equiv) and Fe (210 mg, 7.5 equiv) in EtOH (5 mL) and H_2O (0.83 mL, 0.6 mol/L) at 25 °C. The mixture was stirred for 24 hours under the ambient conditions. 5% NaOH aqueous solution (5 mL) was added to the reaction mixture. The reaction mixture was filtrated through Celite Pad using AcOEt and H_2O to remove the insoluble materials. The filtrate was evaporated under reduced pressure to remove the low-boiling solvents. The remaining water layer was extracted with AcOEt (x2) and the combining organic layers were washed with brine, dried with $MgSO_4$ and evaporated in vacuo. The remained was purified by using SiO_2 column chromatography with $CHCl_3$:MeOH:28% aqueous NH_3 (100:1:0.1) to give 38 mg of **22** (52% yield) as light yellow oil, which was identified with the previously reported characterisation[5].

22[5]: ^{1}H-NMR (400 MHz, DMSO-d6) δ 6.82 (dd, J = 7.6, 7.4 Hz, 1H), 6.73 (d, J = 7.4 Hz, 1H), 6.46-6.35 (m, 2H), 5.67 (s, 1H), 4.04 (q, J = 5.9 Hz, 1H), 3.84 (d, J = 16.3 Hz, 1H), 3.67 (d, J = 16.3 Hz, 1H), 1.14 (d, J = 5.9 Hz, 3H); 13C-NMR (100 MHz, DMSO-d6) δ 145.2, 127.0, 126.2, 121.0, 116.2, 114.3, 62.7, 46.3, 22.6.

References

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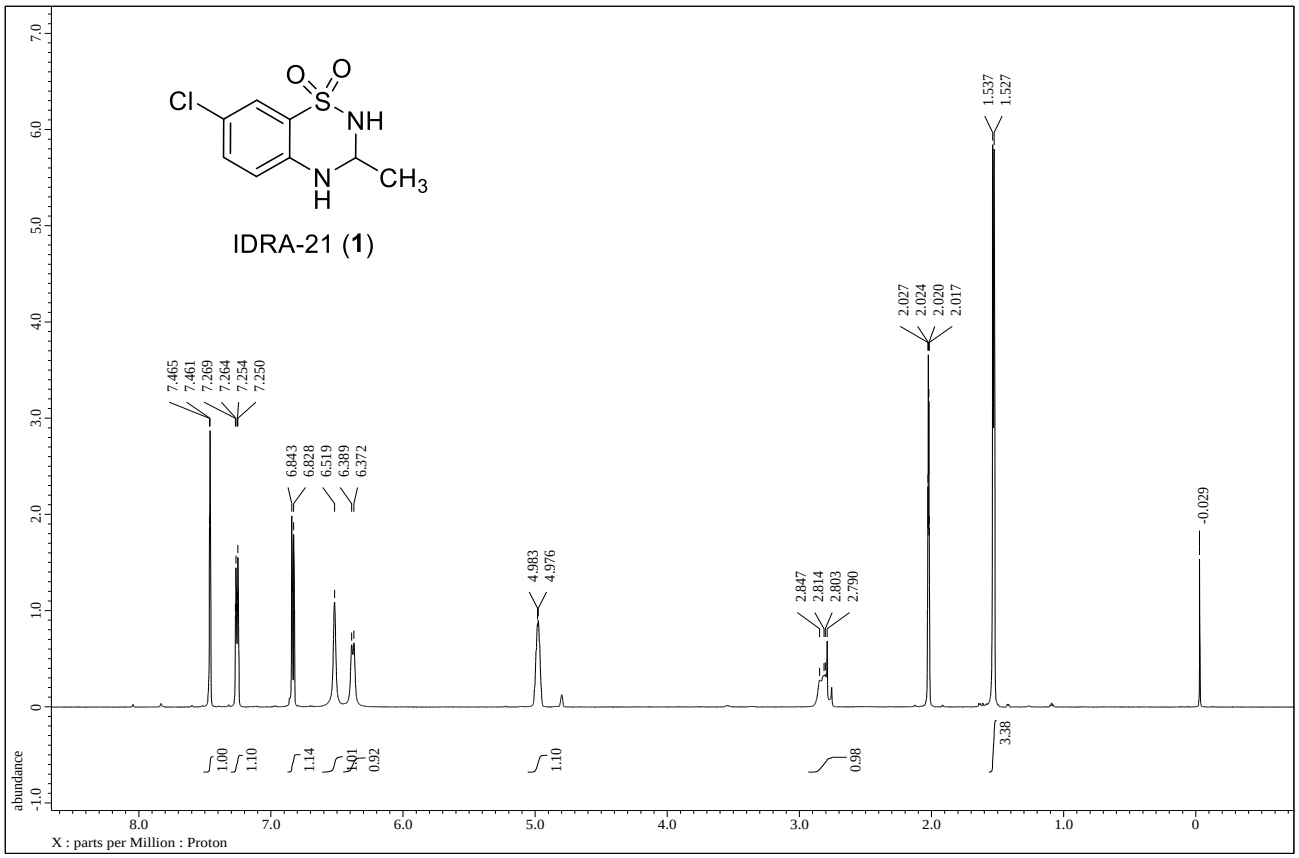
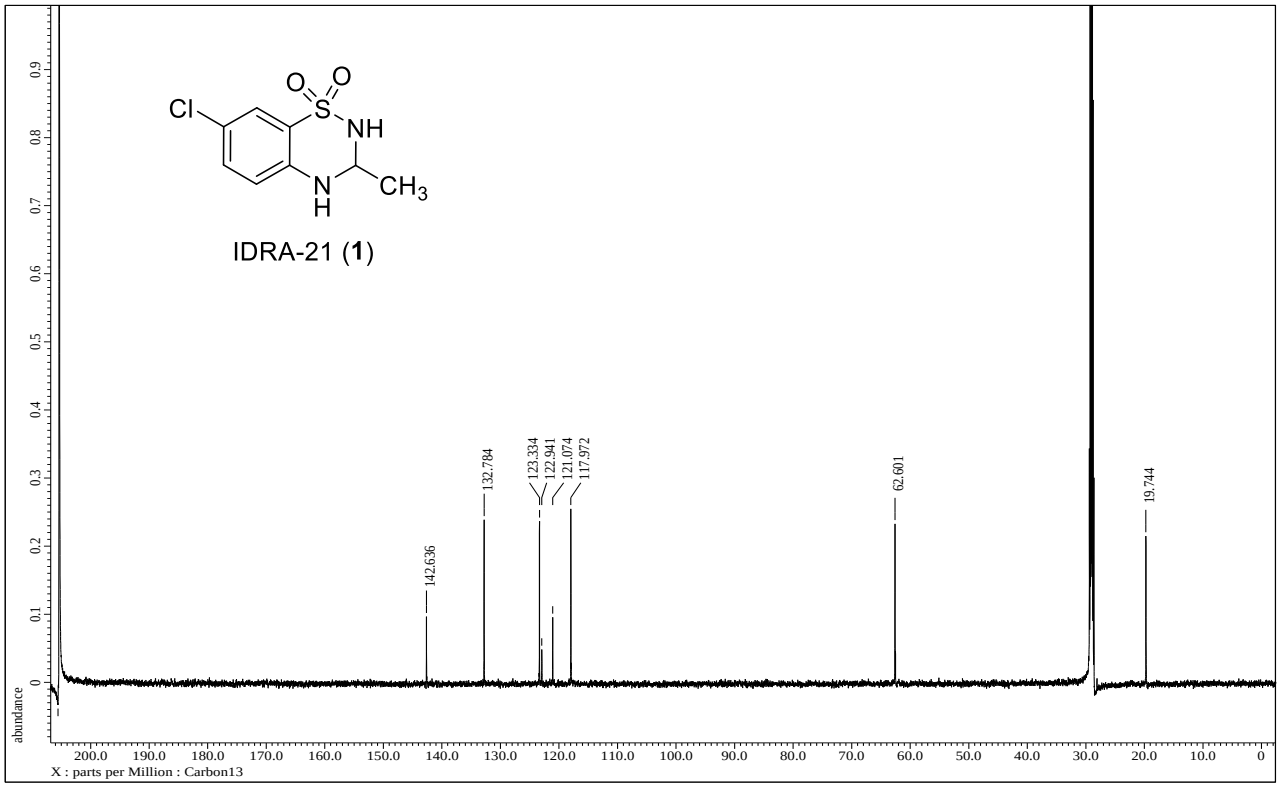
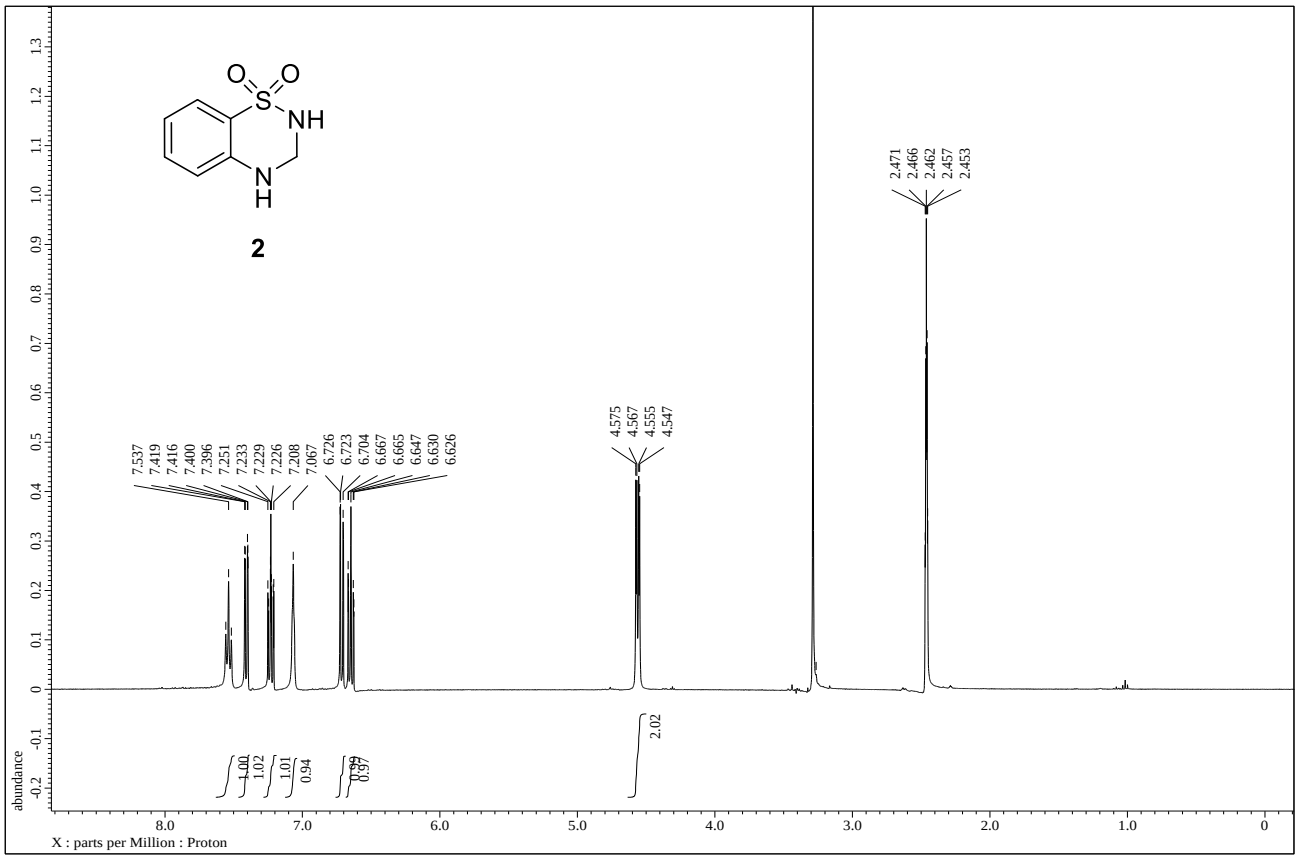
^{1}H-NMR spectrum of **1** (600 MHz, acetone-d6)



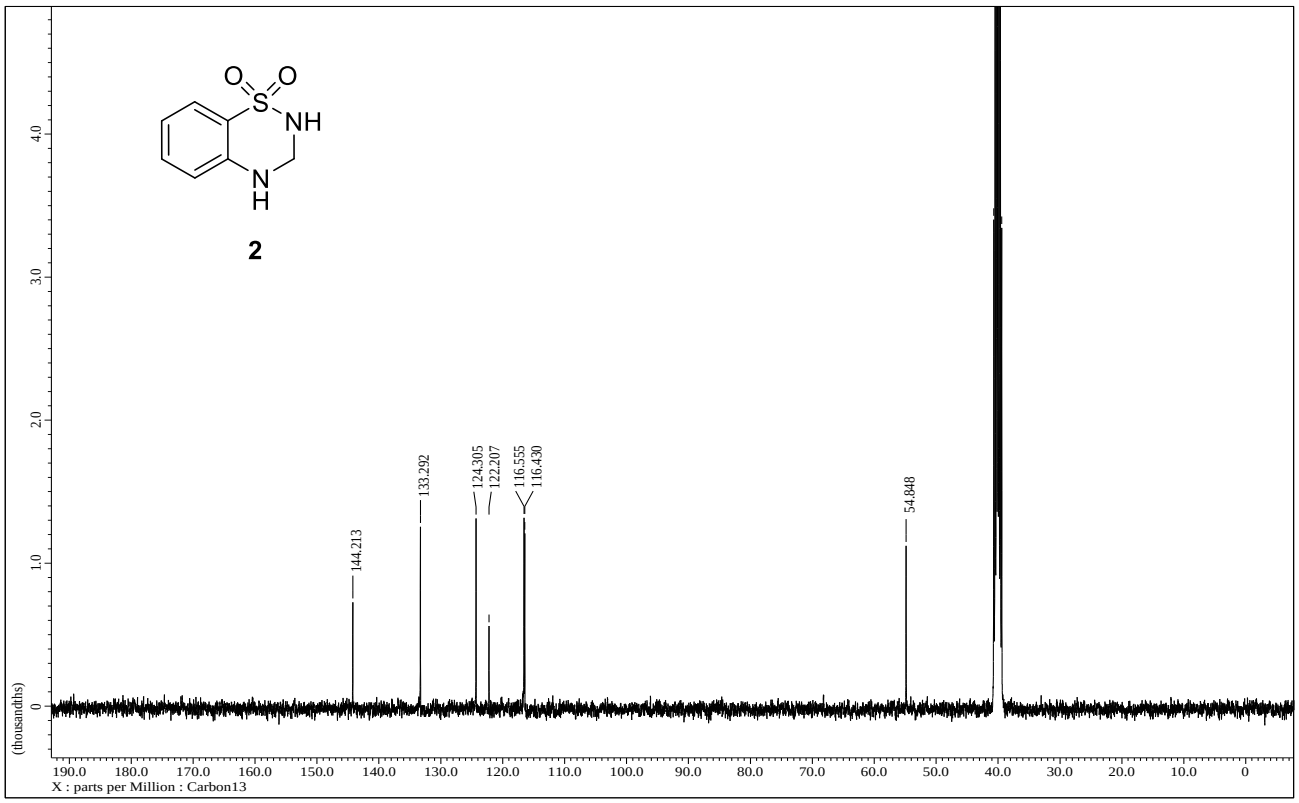
^{13}C-NMR spectrum of **1** (150 MHz, acetone-d6)



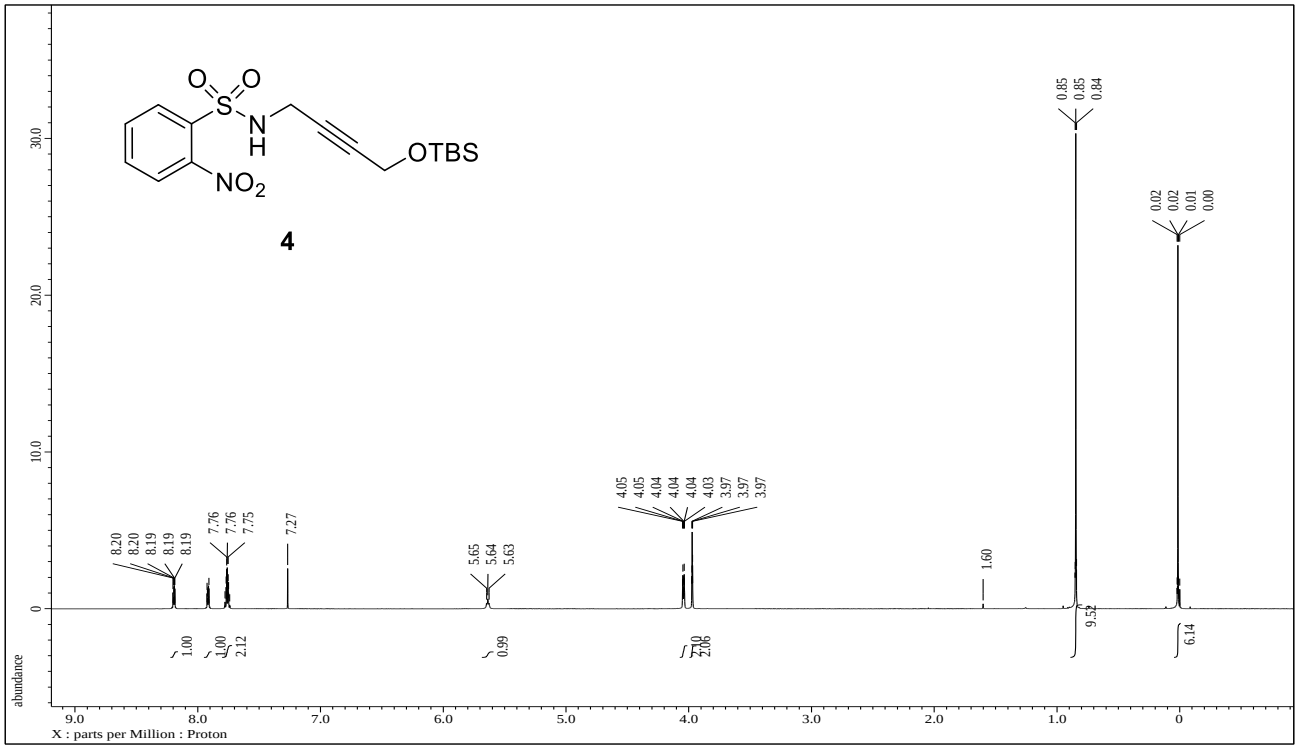
^{1}H-NMR spectrum of **2** (400 MHz, DMSO-d6)



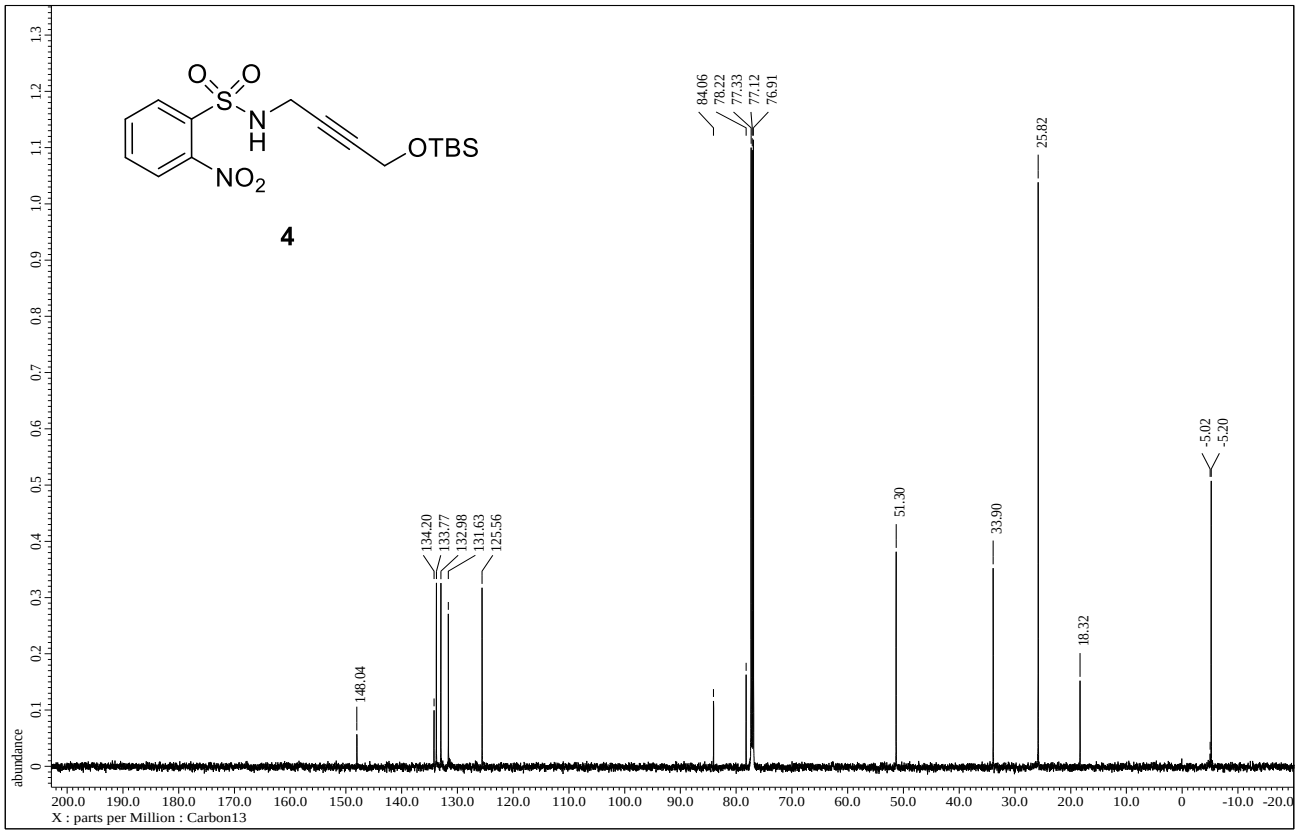
^{13}C-NMR spectrum of **2** (100 MHz, DMSO-d6)



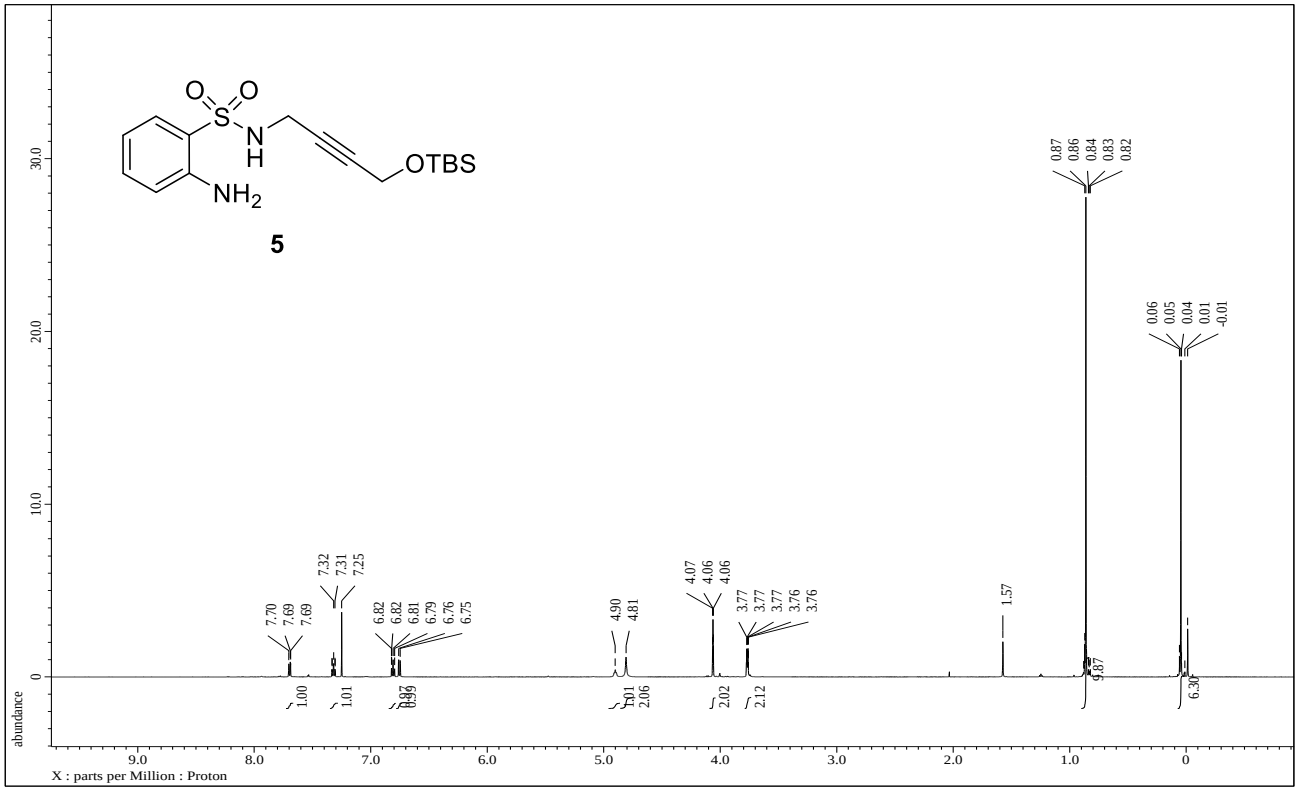
^{1}H-NMR spectrum of **4** (600 MHz, $CDCl_3$)



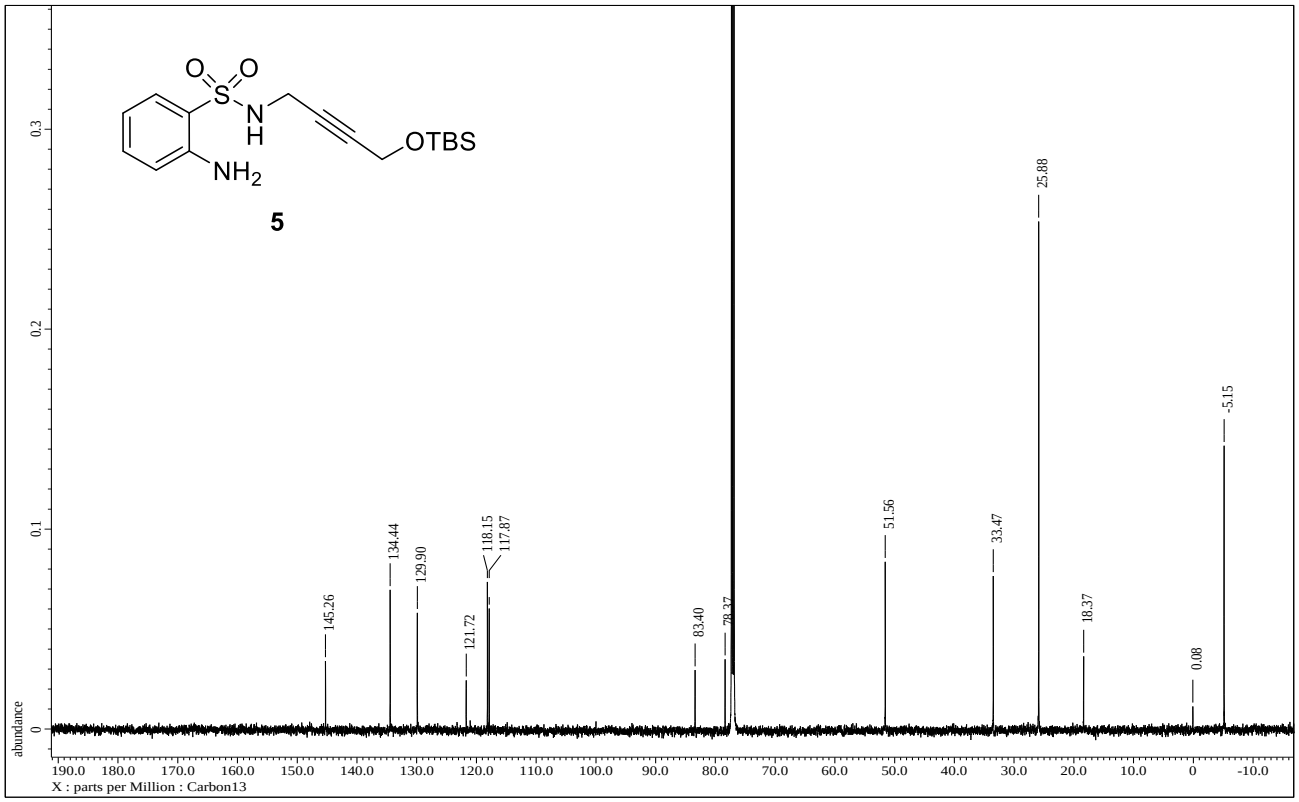
^{13}C-NMR spectrum of **4** (150 MHz, $CDCl_3$)



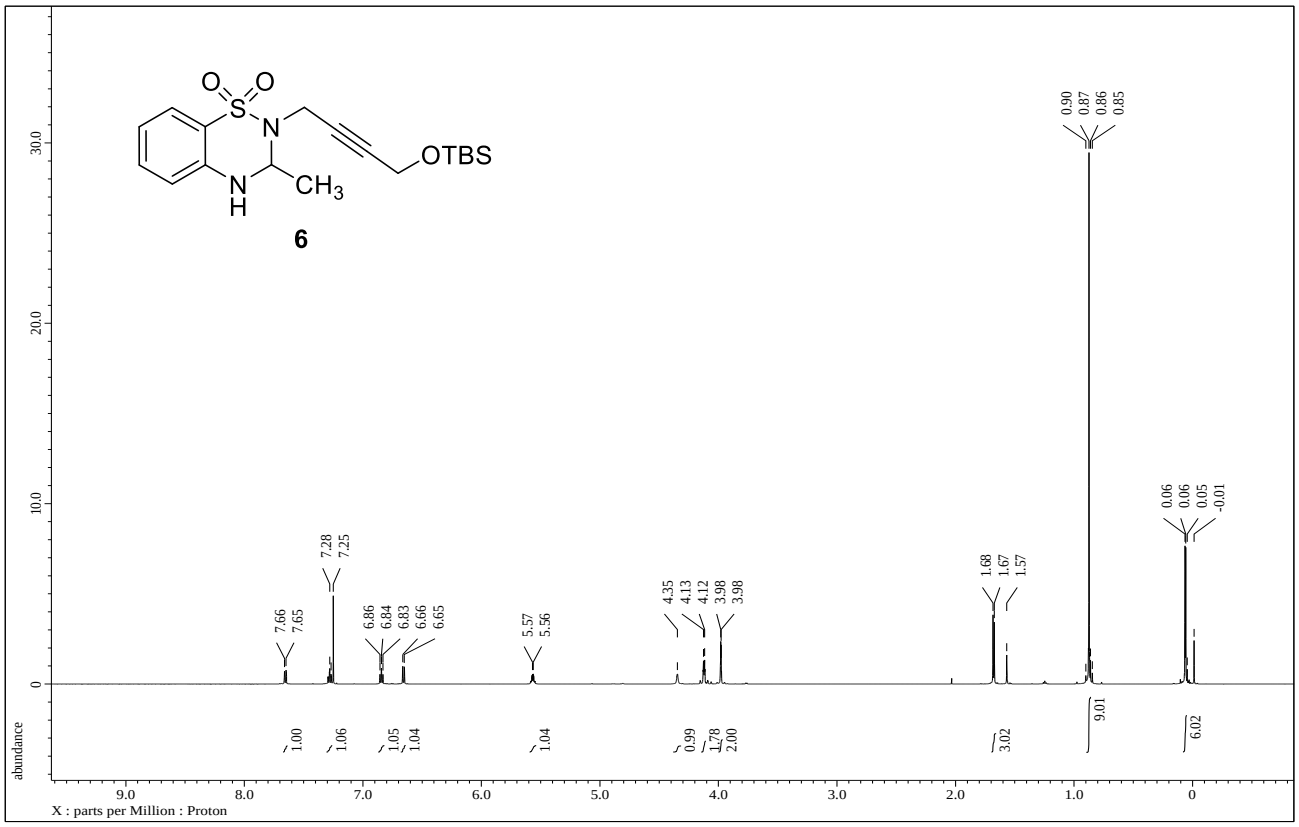
^{1}H-NMR spectrum of **5** (600 MHz, $CDCl_3$)



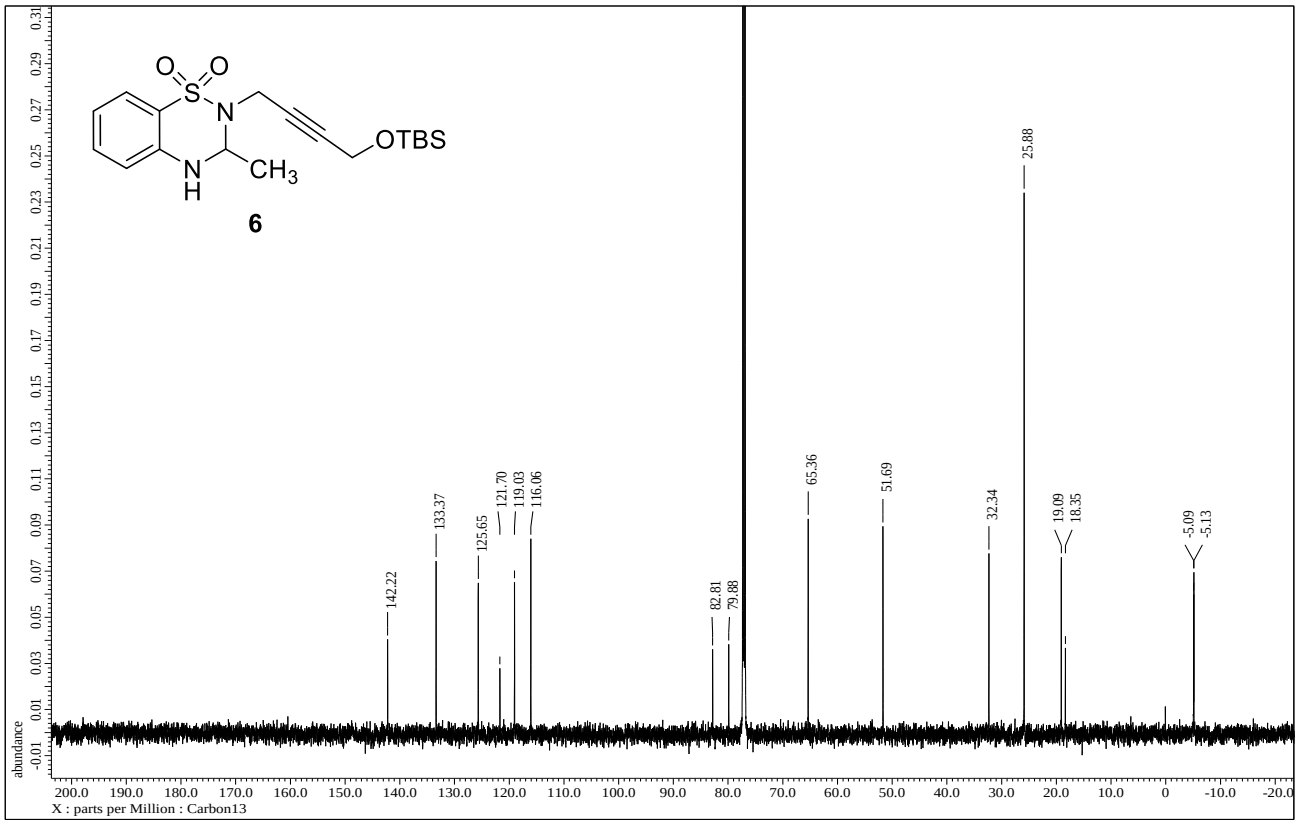
^{13}C-NMR spectrum of **5** (150 MHz, $CDCl_3$)



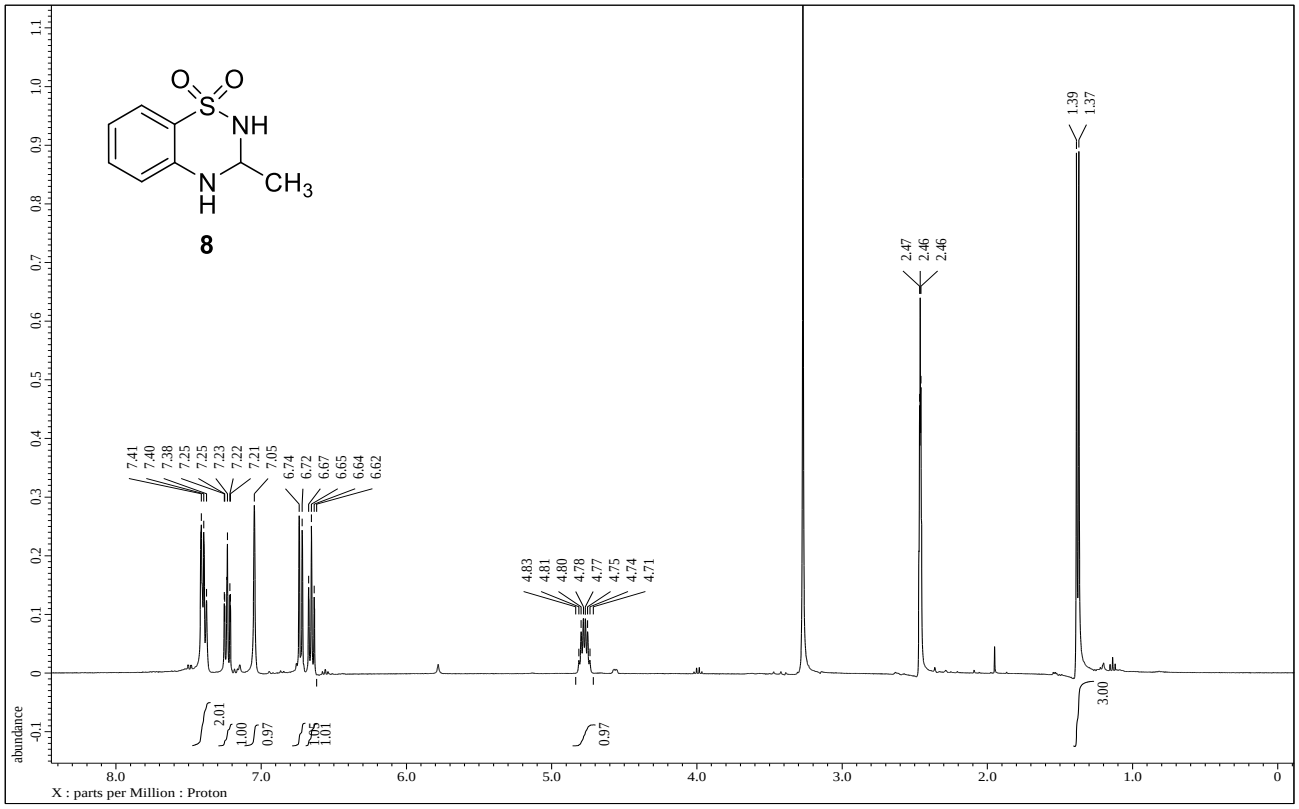
^{1}H-NMR spectrum of **6** (600 MHz, $CDCl_3$)



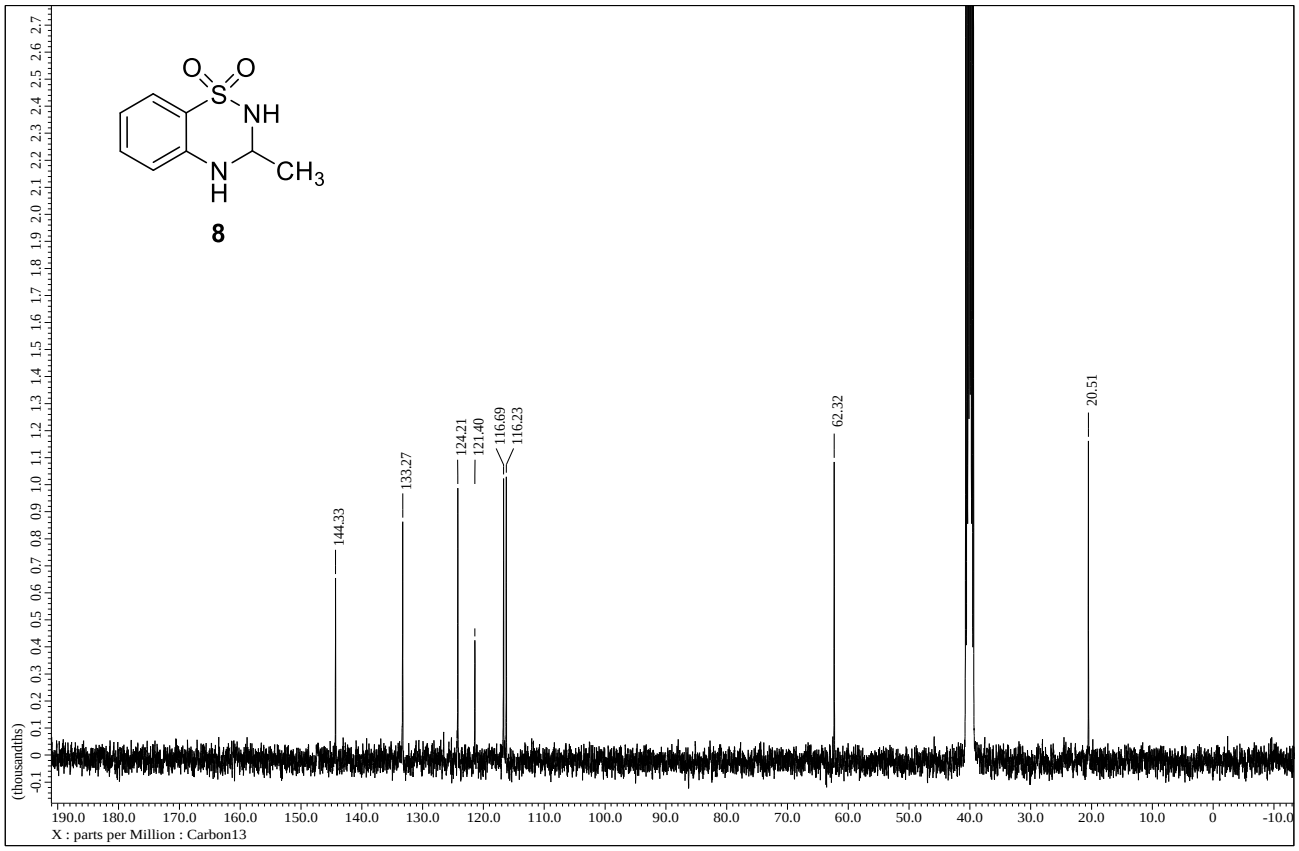
^{13}C-NMR spectrum of **6** (150 MHz, $CDCl_3$)



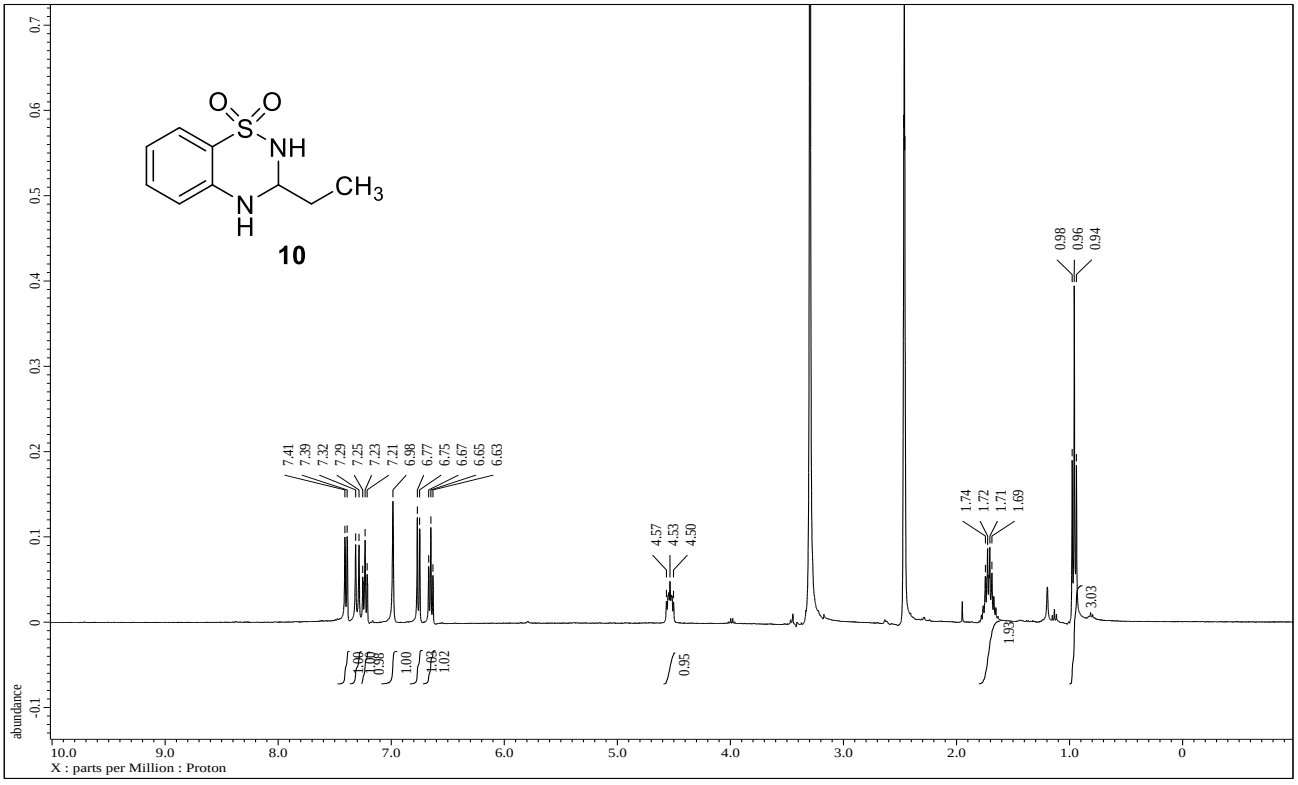
^{1}H-NMR spectrum of **8** (400 MHz, DMSO-d6)



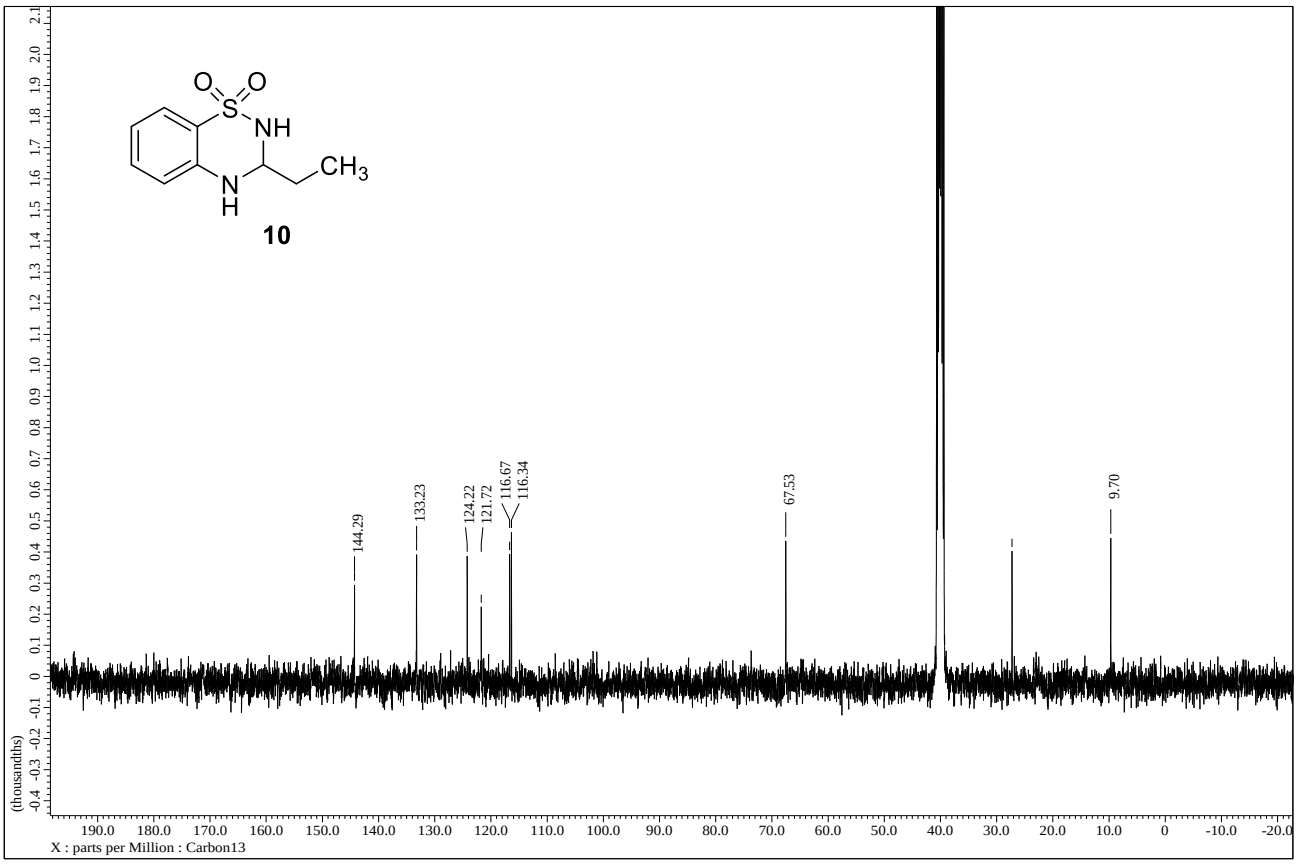
^{13}C-NMR spectrum of **8** (100 MHz, DMSO-d6)



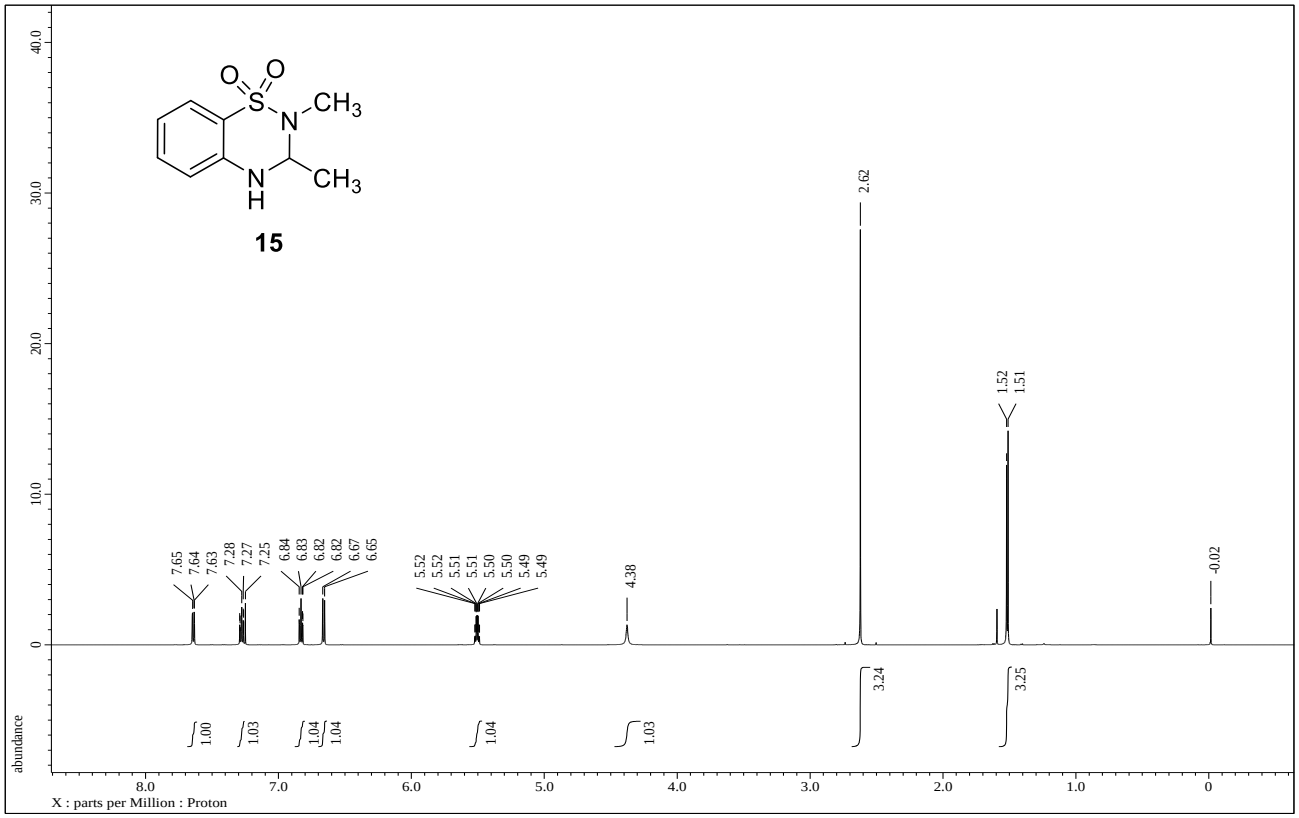
^{1}H-NMR spectrum of **10** (400 MHz, DMSO-d6)



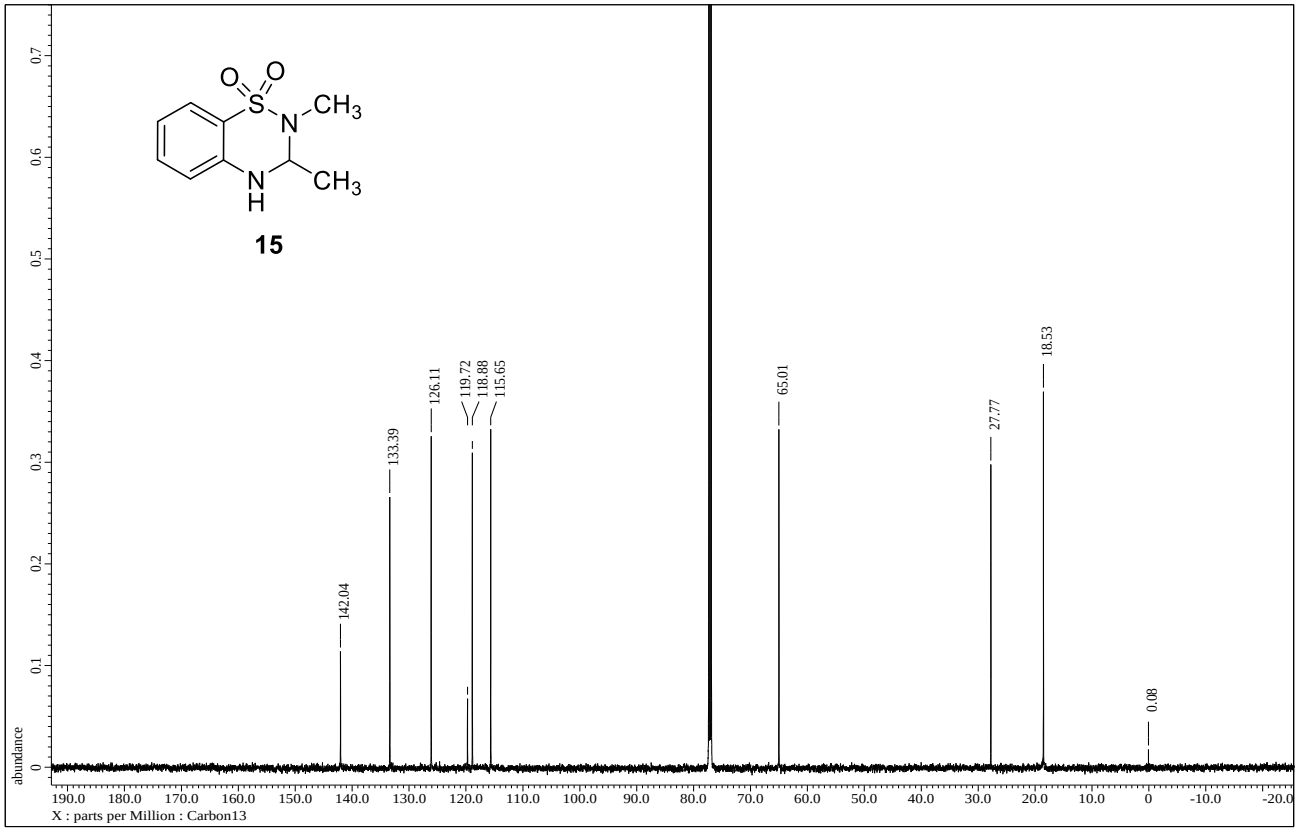
^{13}C-NMR spectrum of **10** (100 MHz, DMSO-d6)



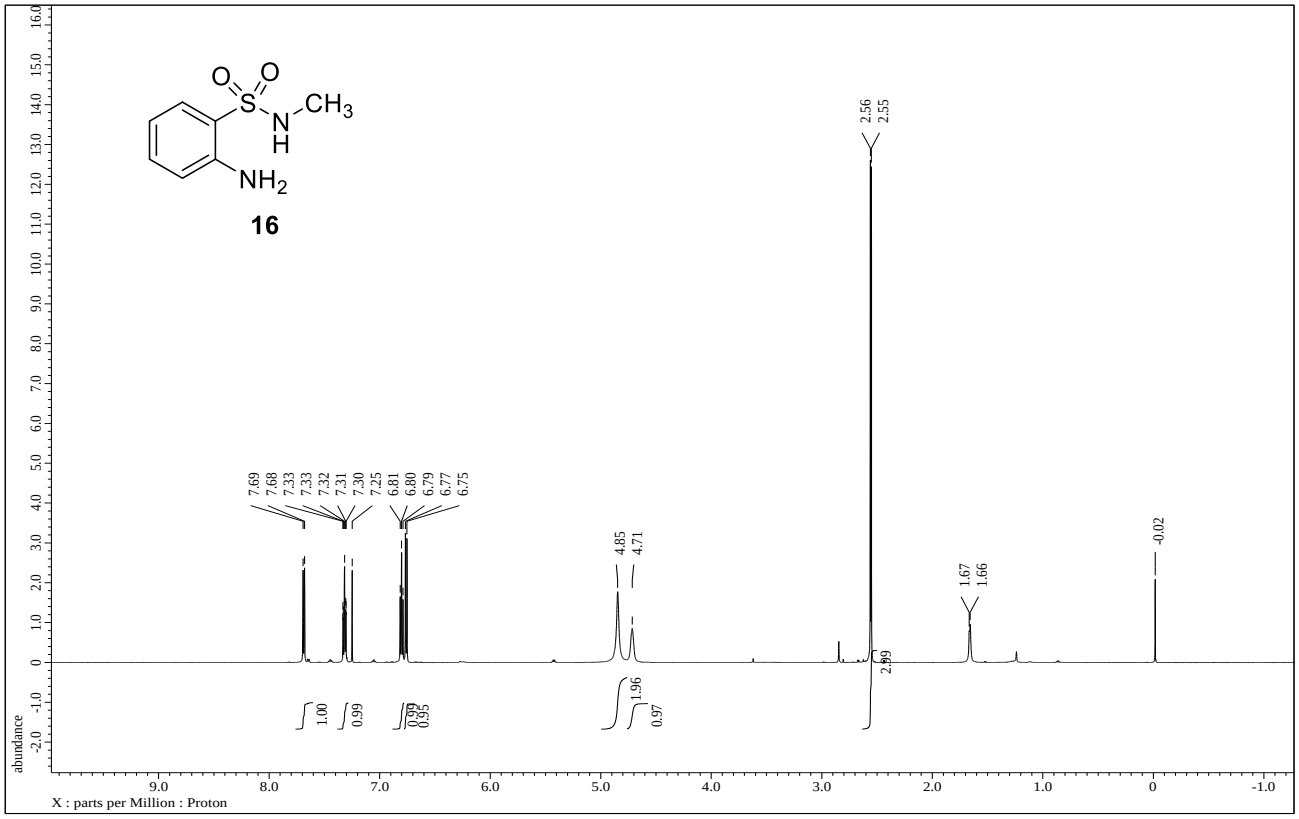
^{1}H-NMR spectrum of **15** (600 MHz, $CDCl_3$)



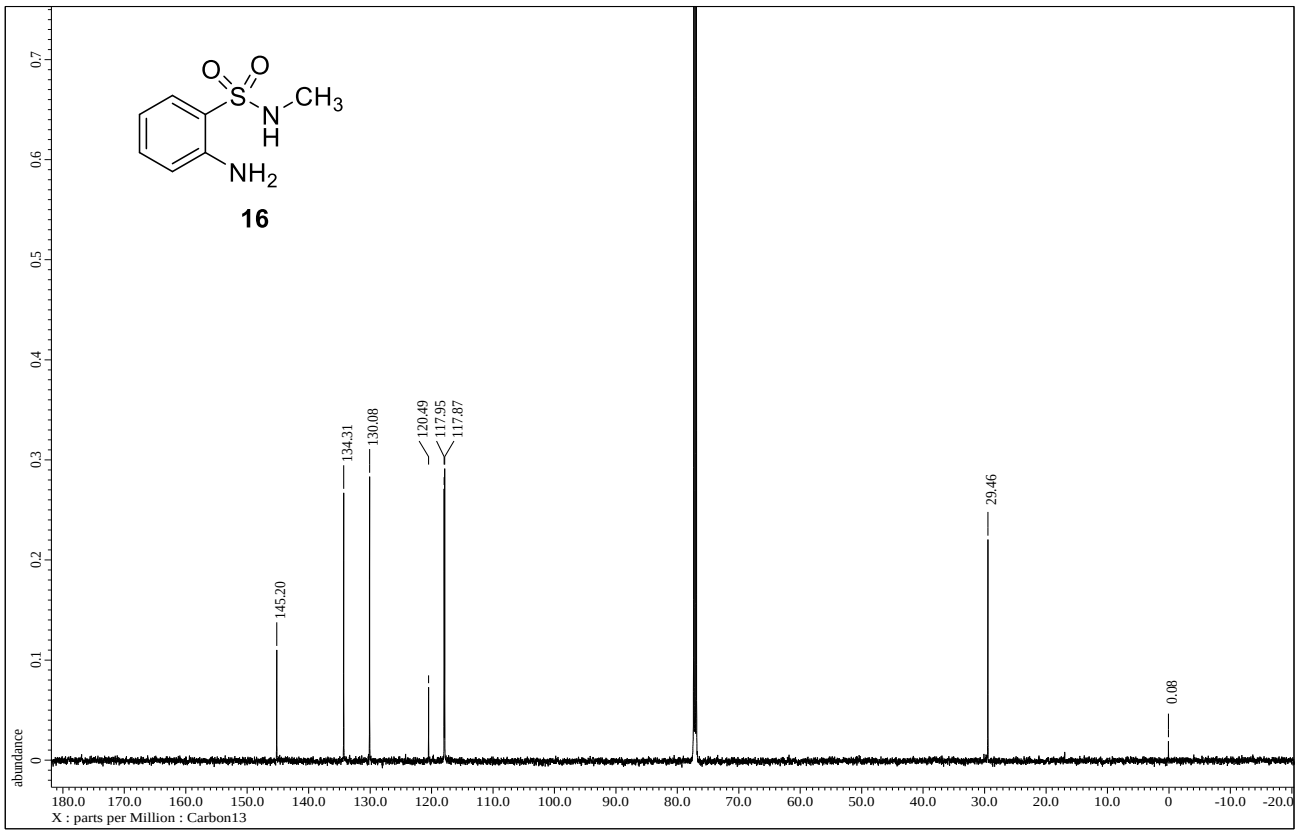
^{13}C-NMR spectrum of **15** (150 MHz, $CDCl_3$)



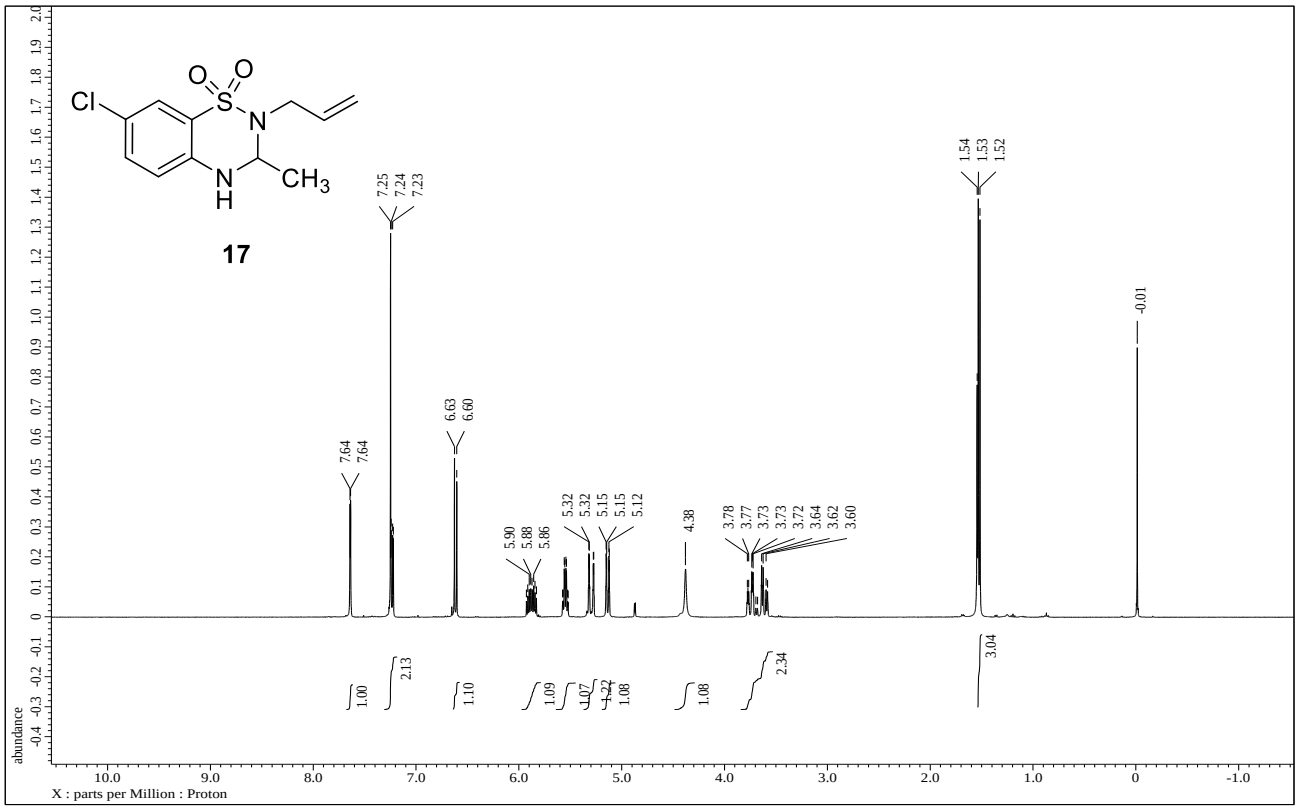
^{1}H-NMR spectrum of **16** (600 MHz, $CDCl_3$)



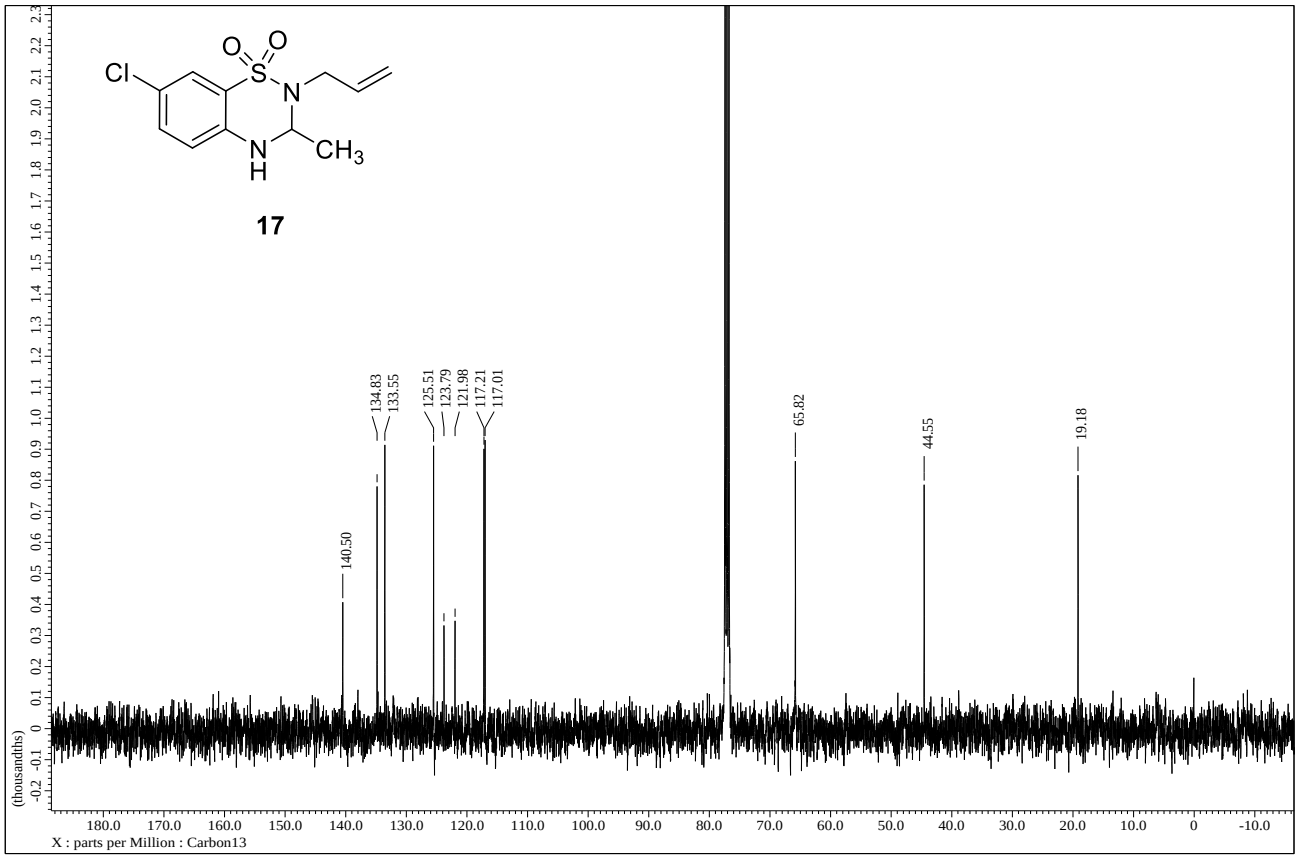
^{13}C-NMR spectrum of **16** (150 MHz, $CDCl_3$)



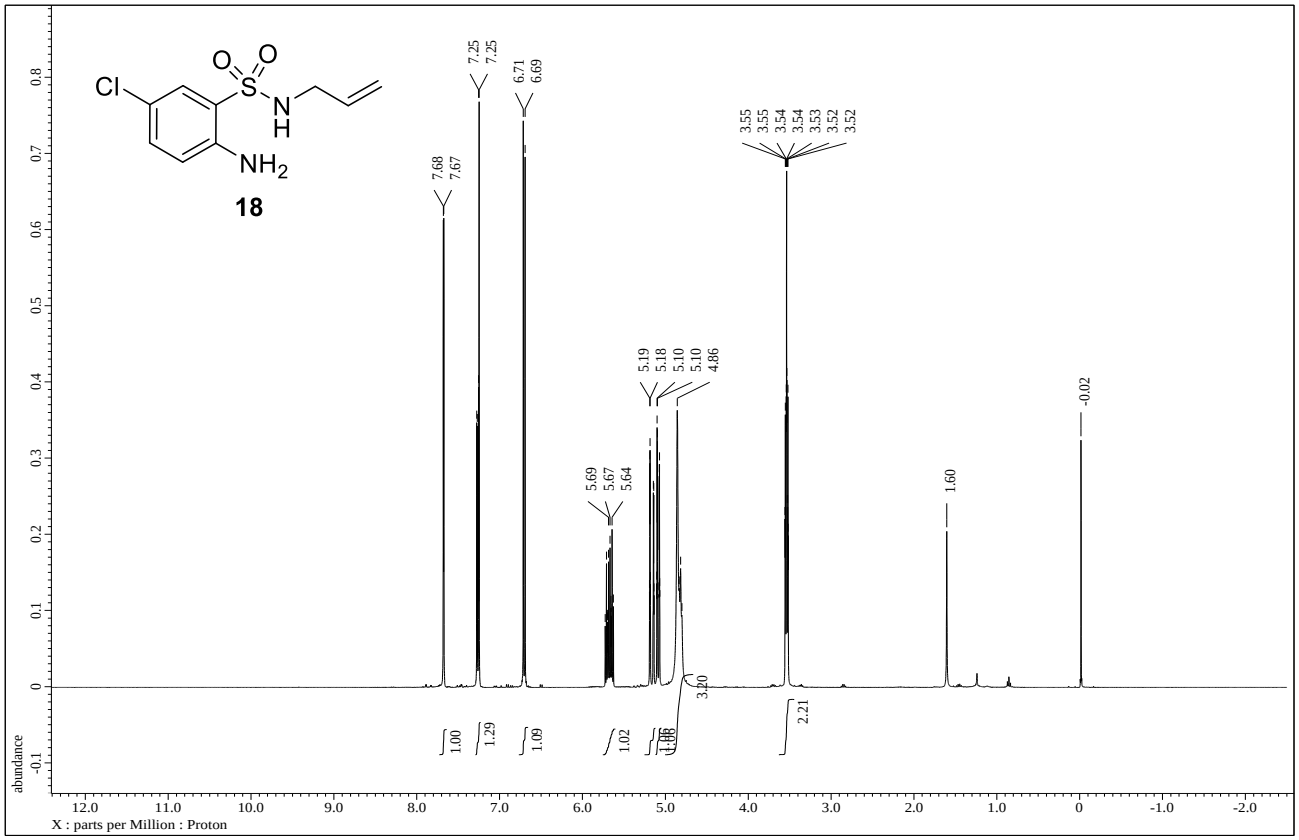
^{1}H-NMR spectrum of **17** (400 MHz, $CDCl_3$)



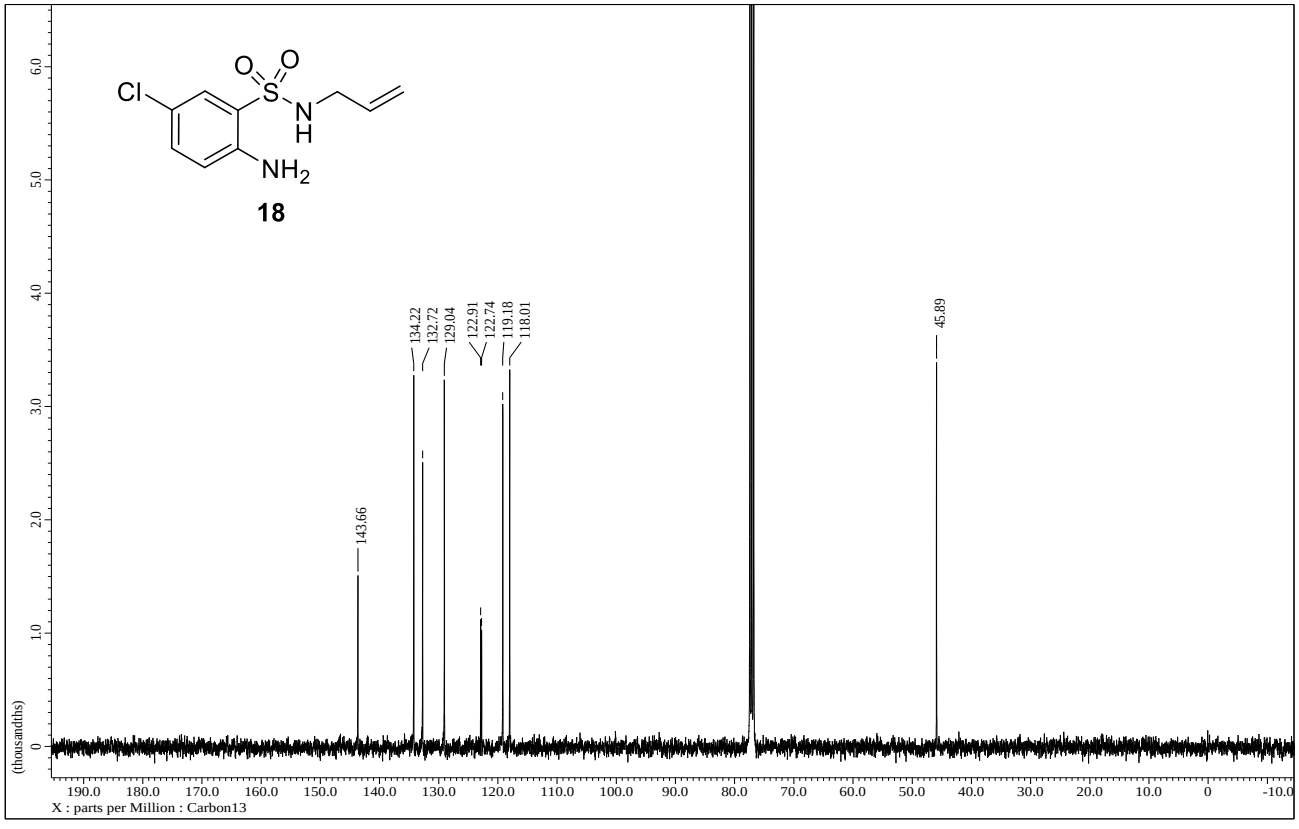
^{13}C-NMR spectrum of **17** (100 MHz, $CDCl_3$)



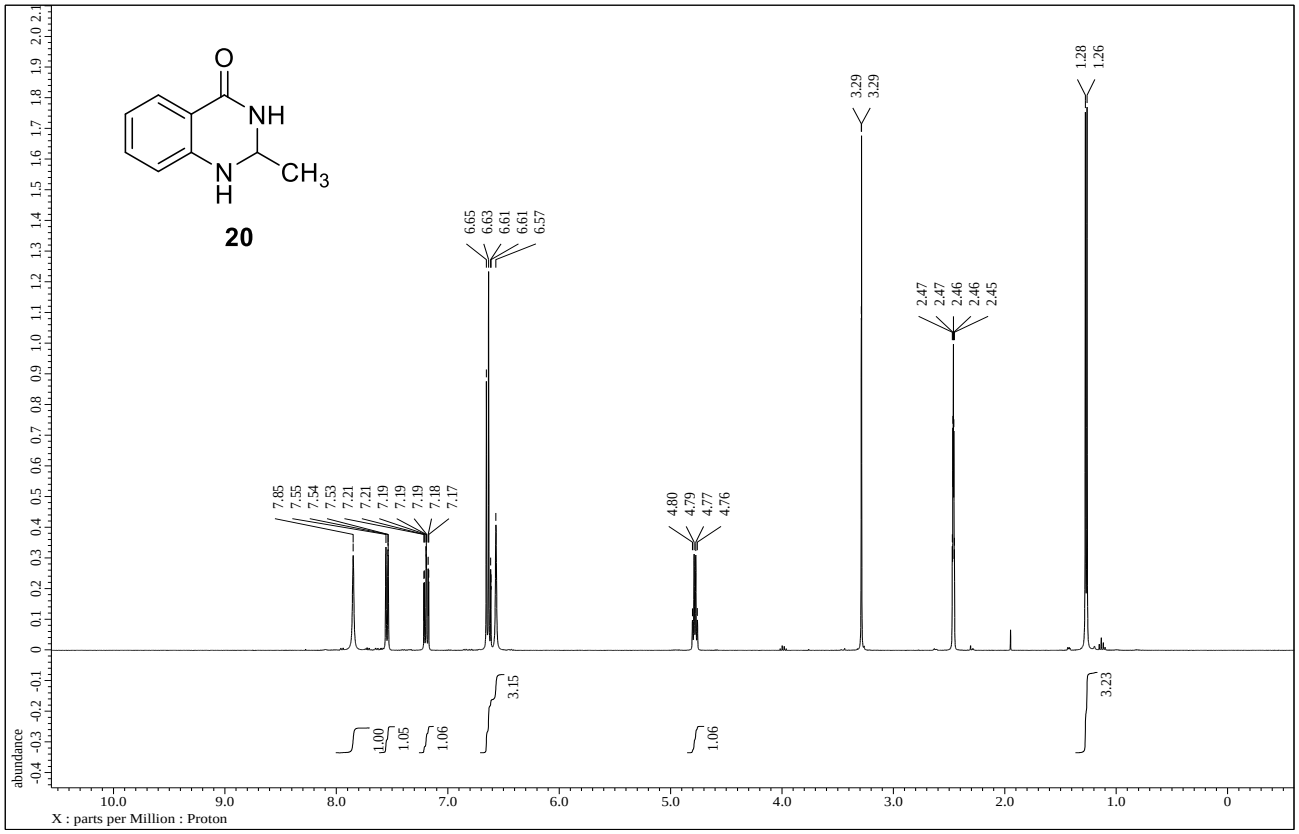
^{1}H-NMR spectrum of **18** (400 MHz, $CDCl_3$)



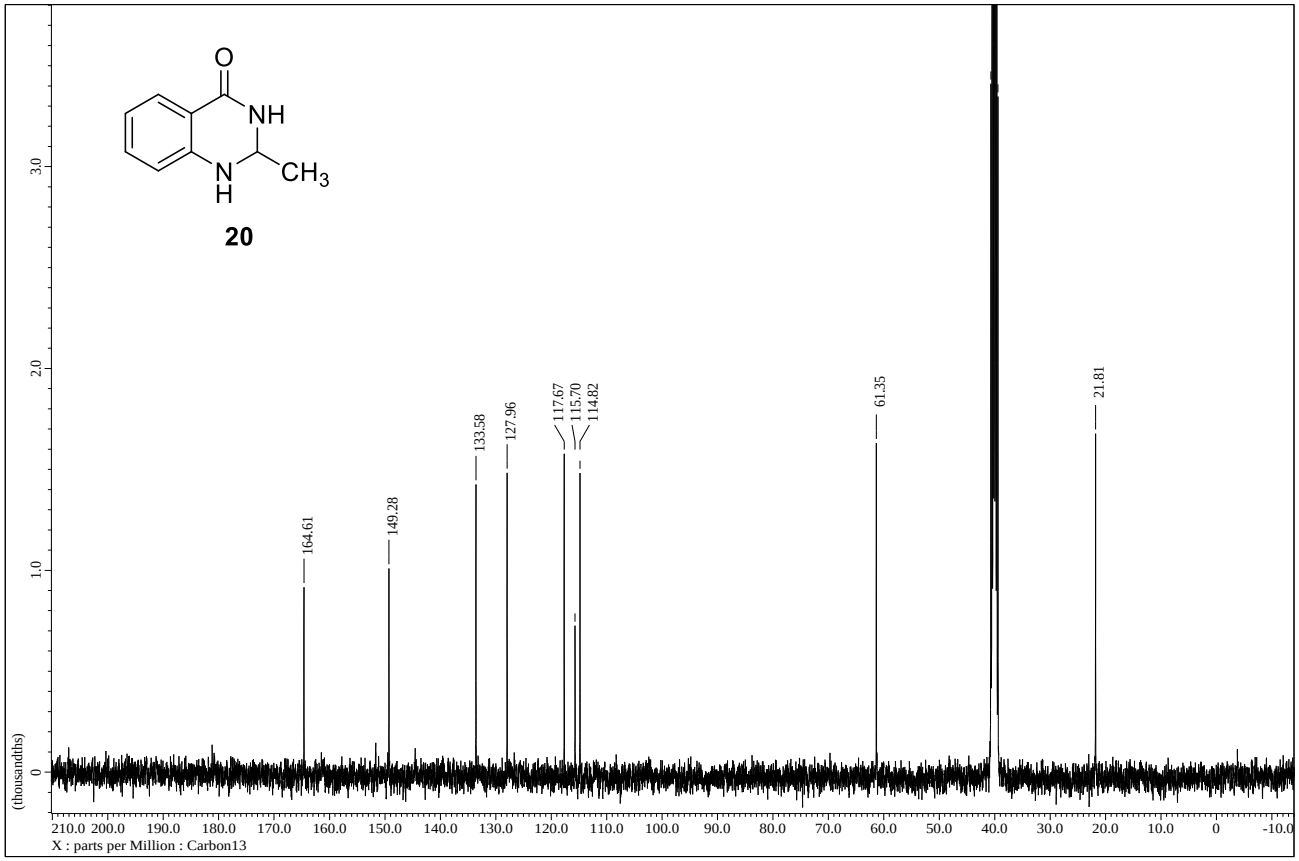
^{13}C-NMR spectrum of **18** (100 MHz, $CDCl_3$)



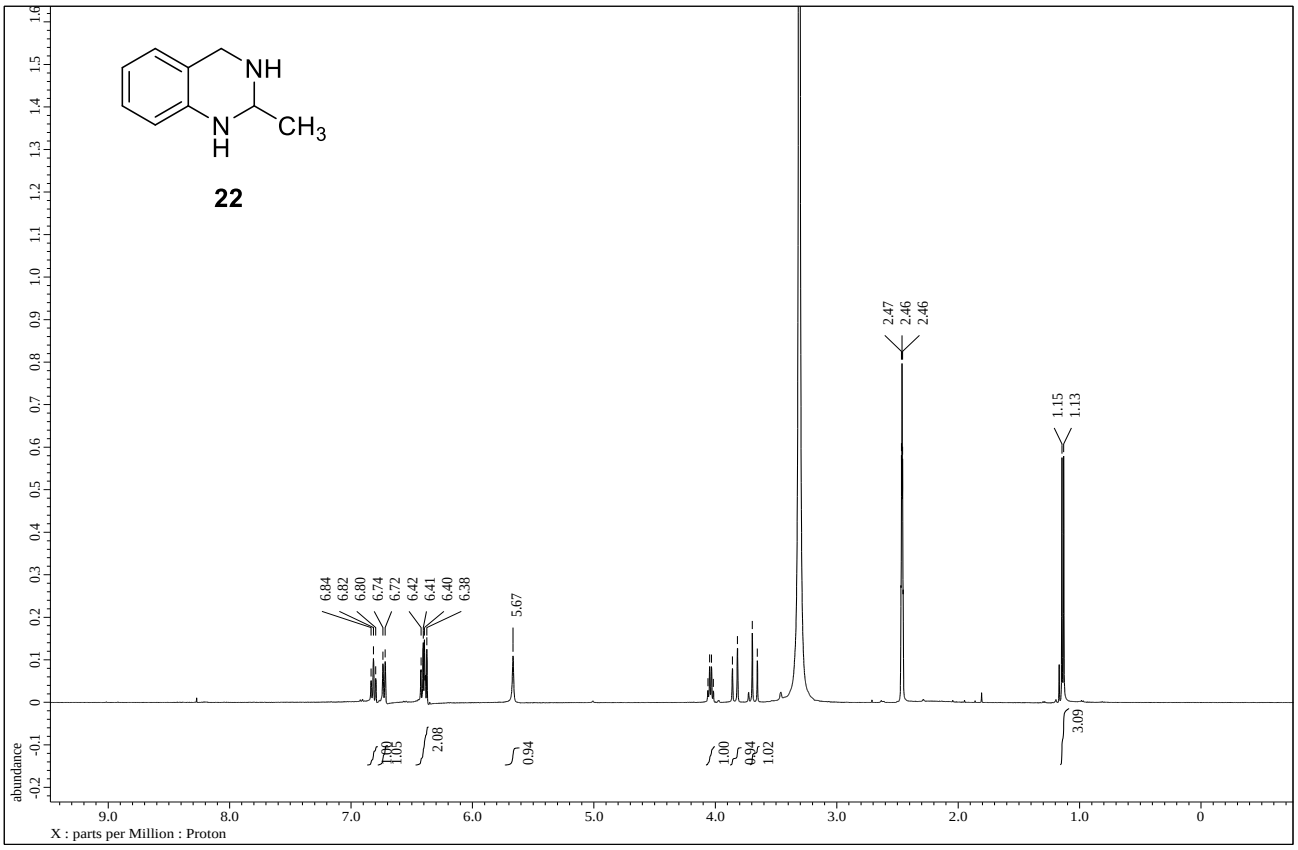
^{1}H-NMR spectrum of **20** (400 MHz, DMSO-d6)



^{13}C-NMR spectrum of **20** (100 MHz, DMSO-d6)



^{1}H-NMR spectrum of **22** (400 MHz, DMSO-d6)



^{13}C-NMR spectrum of **22** (100 MHz, DMSO-d6)