Supporting information

Solvent and catalyst-free tandem reaction: Synthesis, photophysical and biological application of isoindoloquinazolinones

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General information:

^{1}H NMR (400 MHz) and ^{1}H NMR (500 MHz) spectra were recorded on a 400 MHz and 500 MHz spectrometer in $CDCl_3$ / DMSO-d^6 solvent using TMS as the internal standard. ^{13}C NMR was recorded in the same MHz instruments. HRMS was measured using a TOF analyzer. 60-120 or 100-200 mesh silica gels (SRL) were used for column chromatographic purification. Progress of the reaction was monitored by using precoated silica gel 60 F254 TLC sheets (Merck). Petroleum ether (boiling range 60-80 °C) or n-hexane was used as the eluent for column chromatographic separation. Solvents were distilled, dried and stored over molecular sieves (4 Å). The UV-Vis absorption spectra were recorded on a Shimadzu UV-2450 UV-Vis spectrophotometer and the fluorescence emission spectra were recorded on Photon Technology International S/N-3201.

General Procedure for the preparation of 1a – 1j:[1]

β-Bromovinyl aldehyde or 2-Bromo Benzaldehyde **1** (1 mmol), Na_2CO_3(4 mmol), Bu_4NBr (1 mmol), $PdCl_2$ (10 mol%), and H_2O (5 mL) were took in a two-neck, round-bottom flask. Acrylic ester (4 mmol) was added, and the mixture stirred for 2 h in 50 °C, diluted with brine solution, and extracted with EtOAc (3 × 25mL). The extracted solution was dried over Na_2SO_4, and the solvent was evaporated. The product was purified by column chromatography using EtOAc–PE as eluent.

Preparation of (E)-3-(2-formylcyclohept-1-en-1-yl)acrylonitrile (1k):

2-bromocyclohept-1-ene-1-carbaldehyde (1 mmol), P(o-tolyl)$_3$ (0.25 mmol), $Pd(OAc)_2$ (10 mol%), triethyl amine (1mL), methanol (1mL), acetonitrile (1mL) were placed in a two-neck, round-bottom flask. Acrylonitrile (2 mmol) was added and the mixture stirred in inert atmosphere for 2 hr in 80 ^{o}C and extracted with EtOAc (3 × 25 mL). The extracted solution was dried over Na_2SO_4, and the solvent was evaporated. The product was purified by column chromatography using EtOAc–PE as eluent.

Preparation of 2-amino-5-nitrobenzamide (2e):

Isatoic anhydride (1 mmol) was dissolved in 5mL conc. H_2SO_4 and it was placed in ice bath. $NaNO_3$ (1 mmol) was taken in another round-bottom flask and it also kept in ice bath. The acidic solution of Isatoic anhydride was added drop wise to the ice cooled $NaNO_3$ and the resulting mixture stirred continuously for 1 hr. Finally the reaction mixture was poured in ice cube , a yellow ppt. was obtained. This ppt. was collected by filtration and dried.

This yellow ppt. was dissolved in 15 mL liq. NH_3. This mixture was allowed to stir in reflux condition at ~ 80 ^oC for 8 hr. Finally this reaction mixture was recovered by filtration. Yellow ppt. was collected and dried.

General Procedure for preparation of (3a – 3t):

Compound **1** (1.0 equiv.) and **2** (1.0 equiv.) were taken in a round-bottom flask and it was placed in a heating oil bath. The heating of the resulting mixture was carried out up to 2 h. in open flask at 120 °C under the neat condition. The progress of the reaction was monitored by TLC. The crude residue was purified by silica-gel (100-200 mesh) column chromatography using ethyl acetate and petroleum ether (1:2) as an eluent to get the desired product **3**.

UV/Vis absorption spectra of 3j:

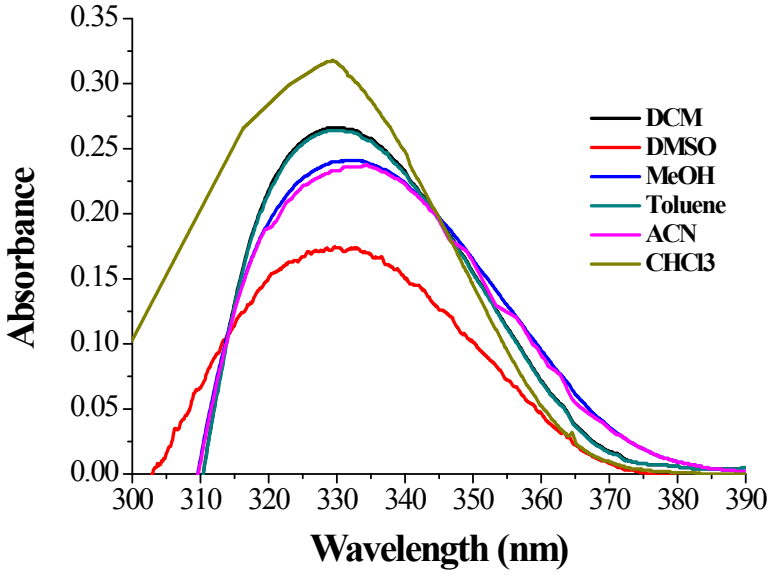
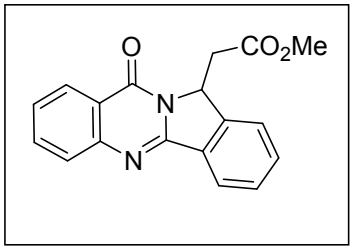


Figure 1: UV-Vis absorption spectra of **3j** in different solvents

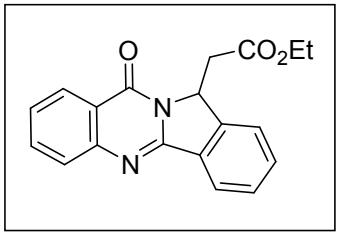
Characterization of data for (3a – 3t):

Methyl 2-(10-oxo-10,12-dihydroisoindolo[1,2-b]quinazolin-12-yl)acetate (3a):[2]



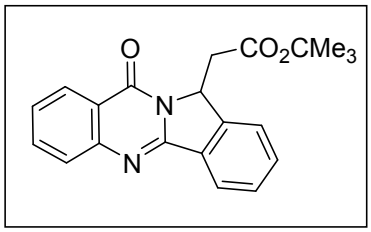
Yellow solid (60.8 mg, 91%), mp. 104 ^{0}C. ^{1}H NMR (400 MHz, Chloroform-*d*): δ 8.36 – 8.32 (m, 1H), 8.16 (d, *J* = 7.0 Hz, 1H), 7.83 – 7.68 (m, 2H), 7.62 – 7.51 (m, 3H), 7.47 (t, *J* = 6.0 Hz, 1H), 5.87 (dd, *J* = 7.8, 3.6 Hz, 1H), 3.72 – 3.67 (m, 1H), 3.66 (s, 3H), 2.98 (dd, *J* = 16.5, 7.9 Hz, 1H). ^{13}C NMR (125 MHz, Chloroform-*d*): δ 170.4, 160.8, 154.4, 149.2, 143.3, 134.4, 132.7, 131.9, 129.4, 127.4, 126.6, 126.5, 123.5, 123.2, 121.0, 58.5, 52.0, 35.8. HRMS calcd. for $C_{18}H_{15}N_2O_3$: $(M+H)^+$ 307.1084, found : 307.1083.

Ethyl 2-(10-oxo-10,12-dihydroisoindolo[1,2-b]quinazolin-12-yl)acetate (3b):



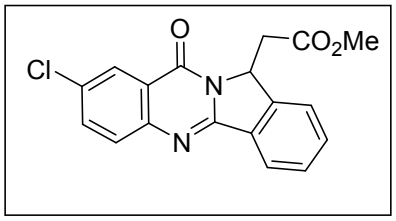
Off white solid (42.4 mg, 85%), mp. 132 ^{0}C. ^{1}H NMR (500 MHz, Chloroform-*d*): δ 8.34 (d, *J* = 7.5 Hz, 1H), 8.16 (d, *J* = 7.5 Hz, 1H), 7.82 – 7.64 (m, 2H), 7.63 – 7.50 (m, 3H), 7.48 (t, *J* = 7.2 Hz, 1H), 5.85 (dd, *J* = 7.7, 3.7 Hz, 1H), 4.08 (q, *J* = 7.2 Hz, 2H), 3.65 (dd, *J* = 16.2, 3.7 Hz, 1H), 3.04 (dd, *J* = 16.2, 7.7 Hz, 1H), 1.12 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (125 MHz, Chloroform-*d*): δ 169.7, 160.7, 154.5, 149.2, 143.3, 134.3, 132.6, 131.9, 129.4, 127.8, 126.6, 126.5, 123.6, 123.3, 121.0, 60.6, 58.6, 35.9, 14.0. HRMS calcd. for $C_{19}H_{17}N_2O_3$: $(M+H)^+$ 321.1241, found : 321.1239.

Tert-butyl 2-(10-oxo-10,12-dihydroisoindolo[1,2-b]quinazolin-12-yl)acetate (3c):



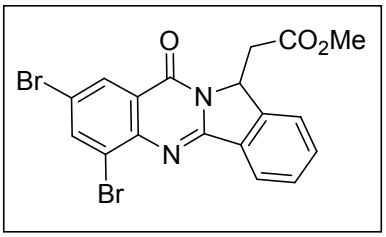
Off white solid (37.7 mg, 77%), mp. 141 ^{0}C. ^{1}H NMR (500 MHz, Chloroform-*d*): δ 8.35 (d, *J* = 7.9 Hz, 1H), 8.17 (d, *J* = 7.4 Hz, 1H), 7.82 – 7.74 (m, 2H), 7.61 – 7.56 (m, 3H), 7.48 (t, *J* = 7.37 Hz, 1H), 5.78 (dd, *J* = 6.9, 3.6 Hz, 1H), 3.46 (dd, *J* = 15.8, 3.6 Hz, 1H), 3.22 – 3.17 (m, 1H), 1.19 (s, 9H). ^{13}C NMR (125 MHz, Chloroform-*d*): δ 168.7, 160.6, 154.6, 149.0, 143.2, 134.3, 132.5, 132.0, 129.3, 127.2, 126.5, 126.4, 123.5, 123.3, 121.0, 81.3, 58.8, 36.6, 27.6 (3C). HRMS calcd. for $C_{21}H_{21}N_2O_3$: $(M+H)^+$ 349.1554, found : 349.1552.

Methyl 2-(8-chloro-10-oxo-10,12-dihydroisoindolo[1,2-b]quinazolin-12-yl)acetate (3d):



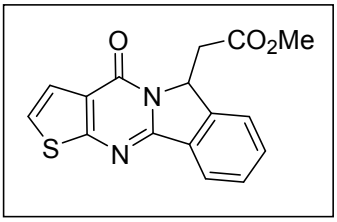
Off white solid (36.2 mg, 72%), mp. 145 ^{0}C. ^{1}H NMR (500 MHz, Chloroform-*d*): δ 8.19 – 8.13 (m, 1H), 8.04 (d, *J* = 6.8 Hz, 1H), 7.75 (d, *J* = 7.5 Hz, 1H), 7.66 – 7.52 (m, 1H), 7.53 – 7.49 (m, 3H), 5.77 – 5.73 (m, 1H), 3.58 (s, 3H), 3.56 (dd, *J* = 14.3, 3.9 Hz, 1H), 2.96 – 2.89 (m, 1H). ^{13}C NMR (125 MHz, Chloroform-*d*): δ 170.1, 159.5, 154.6, 147.5, 143.3, 134.7, 132.8, 131.5, 129.5, 128.8, 126.3, 125.9, 123.6, 123.2, 121.9, 58.7, 51.9, 35.5. HRMS calcd. for $C_{18}H_{14}ClN_2O_3$: $(M+H)^+$ 341.0695, found : 341.0694.

Methyl 2-(6,8-dibromo-10-oxo-10,12-dihydroisoindolo[1,2-b]quinazolin-12-yl)acetate (3e):



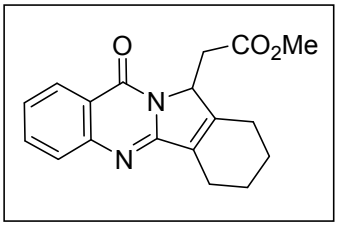
Off white solid (36.1 mg, 70%), mp. 168 ^{0}C. ^{1}H NMR (500 MHz, Chloroform-*d*): δ 8.37 (s, 1H), 8.18 (d, *J* = 7.5 Hz, 1H), 8.11 (s, 1H), 7.63 – 7.54 (m, 2H), 7.45 – 7.42 (m, 1H), 5.81 (dd, *J* = 7.5, 3.5 Hz, 1H), 3.65 (s, 3H), 3.63 – 3.60 (m, 1H), 3.00 (dd, *J* = 16.4, 7.7 Hz, 1H). ^{13}C NMR (125 MHz, Chloroform-*d*): δ 170.0, 158.9, 155.2, 146.0, 143.2, 140.3, 133.1, 131.4, 129.5, 128.7, 124.1, 123.5, 123.1, 121.9, 119.3, 58.8, 52.0, 35.3. HRMS calcd. for $C_{18}H_{13}Br_2N_2O_3$: $(M+H)^+$ 462.9295, found : 462.9294.

Methyl 2-(4-oxo-4,6-dihydrothieno[2',3':4,5]pyrimido[2,1-a]isoindol-6-yl)acetate (3f):



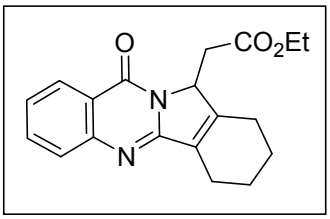
Off white solid (37.2 mg, 78%), mp. 167 ^{0}C. ^{1}H NMR (400 MHz, Chloroform-*d*): δ 8.11 (d, *J* = 6.9 Hz, 1H), 7.81 (d, *J* = 5.3 Hz, 1H), 7.62 – 7.57 (m, 3H), 7.42 (d, *J* = 5.2 Hz, 1H), 5.85 (dd, *J* = 7.9, 3.7 Hz, 1H), 3.73 (dd, *J* = 16.5, 3.7 Hz, 1H), 3.66 (s, 3H), 2.99 (dd, *J* = 16.5, 7.9 Hz, 1H). ^{13}C NMR (100 MHz, Chloroform-*d*): δ 170.1, 168.2, 167.1, 155.7, 151.9, 143.4, 141.1, 133.8, 129.9, 128.7, 125.2, 117.4, 116.5, 61.3, 51.6, 46.4. HRMS calcd. for $C_{16}H_{13}N_2O_3S$: $(M+H)^+$ 313.0649, found : 313.0647.

Methyl 2-(10-oxo-1,2,3,4,10,12-hexahydroisoindolo[1,2-b]quinazolin-12-yl)acetate (3g):



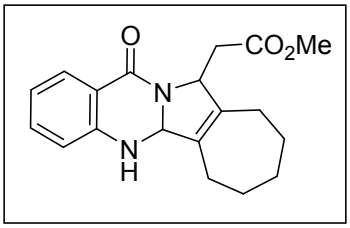
Yellow solid (29.2 mg, 74%), mp. 114 ^{0}C. ^{1}H NMR (400 MHz, Chloroform-*d*): δ 8.29 (d, *J* = 8.1 Hz, 1H), 7.72 – 7.71 (m, 2H), 7.43 – 7.42 (m, 1H), 5.18 (m, 1H), 3.63 (s, 3H), 3.35 (dd, *J* = 15.7, 3.4 Hz, 1H), 3.00 (dd, *J* = 15.1, 7.4 Hz, 1H), 2.51 (m, 2H), 2.36 (m, 2H), 1.85 – 1.74 (m, 2H), 1.32 – 1.24 (m, 2H). ^{13}C NMR (100 MHz, Chloroform-*d*): δ 168.9, 160.8, 151.6, 149.3, 134.5, 134.2, 132.7, 127.6, 126.5, 126.0, 121.0, 59.6, 52.2, 38.2, 22.8, 21.9, 21.6, 21.1. HRMS calcd. for $C_{18}H_{19}N_2O_3$: $(M+H)^+$ 311.1397, found : 311.1396.

Ethyl 2-(10-oxo-1,2,3,4,10,12-hexahydroisoindolo[1,2-b]quinazolin-12-yl)acetate (3h):



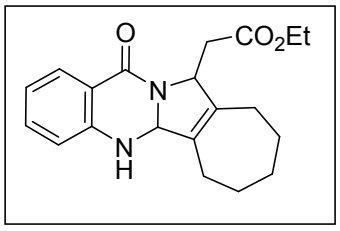
Yellow solid (31.7 mg, 76%), mp. 98 ^{0}C. ^{1}H NMR (400 MHz, Chloroform-*d*): δ 8.29 – 8.22 (m, 1H), 7.71 – 7.69 (m, 2H), 7.43 – 7.39 (m, 1H), 5.15 (m, 1H), 4.08 – 3.98 (m, 2H), 3.26 (dd, *J* = 15.4, 3.8 Hz, 1H), 3.10 (dd, *J* = 15.4, 6.9 Hz, 1H), 2.49 – 2.35 (m, 4H), 1.86 – 1.73 (m, 4H), 1.07 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*): δ 169.6, 160.3, 157.9, 152.3, 149.4, 134.5, 134.1, 131.8, 127.2, 126.5, 126.0, 61.3, 60.9, 33.6, 23.5, 22.1, 21.6, 20.4, 14.1. HRMS calcd. for $C_{19}H_{21}N_2O_3$: $(M+H)^+$ 325.1554, found : 325.1552.

Methyl 2-(13-oxo-5,5a,7,8,9,10,11,13-octahydro-6H-cyclohepta[3,4]pyrrolo[2,1-b]quinazolin-11-yl)acetate (3i):



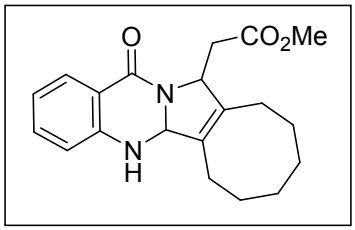
Yellow solid (41.9 mg, 83%), mp. 133 ^{0}C. ^{1}H NMR (400 MHz, Chloroform-*d*): δ 7.99 (d, *J* = 7.5 Hz, 1H), 7.38 (t, *J* = 7.4 Hz, 1H), 6.92 (t, *J* = 7.5 Hz, 1H), 6.59 (d, *J* = 8.3 Hz, 1H), 5.94 (s, 1H), 5.30 (s, 1H), 4.47 (d, *J* = 6.2 Hz, 1H), 3.70 (s, 3H), 2.92 – 2.87 (m, 1H), 2.50 (d, *J* = 17.0 Hz, 1H), 2.26 – 2.09 (m, 2H), 1.78 – 1.77 (m, 2H), 1.51 – 1.32 (m, 4H), 1.27 – 1.24 (m, 2H). ^{13}C NMR (100 MHz, Chloroform-*d*): δ 172.4, 166.0, 148.2, 135.9, 133.9, 129.3, 129.1, 119.4, 118.1, 111.4, 67.1, 53.6, 52.3, 35.1, 33.8, 32.1, 31.0, 26.8, 25.4. HRMS calcd. for $C_{19}H_{23}N_2O_3$: $(M+H)^+$ 327.1710, found : 327.1711.

Ethyl 2-(13-oxo-5,5a,7,8,9,10,11,13-octahydro-6H-cyclohepta[3,4]pyrrolo[2,1-b]quinazolin-11-yl)acetate (3j):



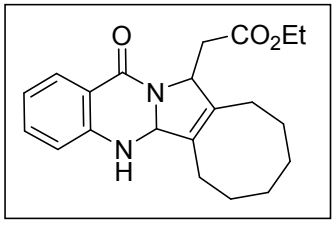
Yellow solid (39.7 mg, 80%), mp. 130 ^{0}C. ^{1}H NMR (400 MHz, DMSO-d^6): δ 8.09 (s, 1H), 7.75 (d, *J* = 6.9 Hz, 1H), 7.38 (t, *J* = 7.8 Hz, 1H), 6.86 (t, *J* = 7.4 Hz, 1H), 6.80 (d, *J* = 8.3 Hz, 1H), 5.05 (s, 1H), 4.75 – 4.74 (m, 1H), 4.10 (q, *J* = 7.1 Hz, 2H), 2.79 – 2.76 (m, 1H), 2.46 (m, 1H), 2.42 – 2.25 (m, 3H), 2.04 – 1.98 (m, 1H), 1.94 – 1.88 (m, 1H), 1.81– 1.78 (m, 1H), 1.61 – 1.55 (m, 4H), 1.15 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*): δ 171.9, 166.0, 148.3, 135.8, 133.8, 129.3, 129.1, 119.3, 118.1, 111.4, 67.1, 61.4, 53.7, 35.2, 33.8, 32.1, 31.0, 26.8, 25.4, 14.4. HRMS calcd. for $C_{20}H_{25}N_2O_3$: $(M+H)^+$ 341.1867, found : 341.1866.

Methyl 2-(14-oxo-5,5a,6,7,8,9,10,11,12,14-decahydrocycloocta[3,4]pyrrolo[2,1-b]quinazolin-12-yl)acetate (3k):



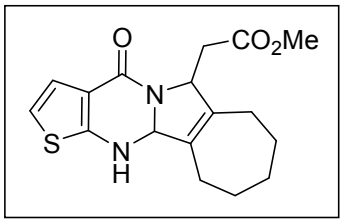
White solid (32.6 mg, 73%), mp. 159 ^{0}C. ^{1}H NMR (400 MHz, DMSO-*d*^{6}): δ 8.24 (s, 1H), 7.75 (d, *J* = 7.5 Hz, 1H), 7.37 (t, *J* = 7.8 Hz, 1H), 6.87 (t, *J* = 7.4 Hz, 1H), 6.80 (d, *J* = 8.3 Hz, 1H), 5.11 (s, 1H), 4.79 (d, *J* = 5.2 Hz, 1H), 3.61 (s, 3H), 2.67 (m, 1H), 2.50 (s, 1H), 2.39 – 2.31 (m, 2H), 2.16 (d, *J* = 14.4 Hz, 1H), 1.87 (d, *J* = 12.2 Hz, 1H), 1.64 – 1.53 (m, 2H), 1.34 (m, 4H), 1.23 – 1.21 (m, 2H). ^{13}C NMR (125 MHz, Chloroform-*d*): δ 172.4, 165.8, 148.3, 133.6, 133.4, 129.2, 126.3, 119.2, 118.2, 111.3, 64.9, 53.8, 52.2, 31.4, 31.3, 29.3, 27.8, 26.2, 25.9, 25.8. HRMS calcd. for $C_{20}H_{25}N_2O_3$: $(M+H)^+$ 341.1867, found : 341.1865.

Ethyl 2-(14-oxo-5,5a,6,7,8,9,10,11,12,14-decahydrocycloocta[3,4]pyrrolo[2,1-b]quinazolin-12-yl)acetate (3l):



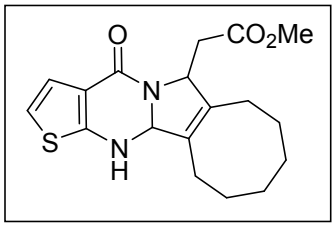
Yellow solid (37.7 mg, 72%), mp. 123 ^{0}C. ^{1}H NMR (400 MHz, Chloroform-*d*): δ 7.97 (dd, *J* = 7.8, 1.6 Hz, 1H), 7.37 (ddd, *J* = 8.3, 7.3, 1.7 Hz, 1H), 6.90 (t, *J* = 8.0 Hz, 1H), 6.58 (d, *J* = 8.0 Hz, 1H), 5.35 (s, 1H), 4.45 (d, *J* = 8.2 Hz, 1H), 4.19 – 4.10 (m, 2H), 2.61 (t, *J* = 17.1 Hz, 2H), 2.41 (t, *J* = 9.9 Hz, 2H), 2.12 (d, *J* = 14.4 Hz, 1H), 1.48 – 1.36 (m, 9H), 1.22 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*): δ 172.0, 166.1, 148.5, 133.9, 133.5, 129.3, 126.2, 119.3, 118.1, 111.5, 65.0, 61.5, 53.9, 31.5, 31.3, 29.4, 27.9, 26.4, 26.0 (2C), 14.3. HRMS calcd. for $C_{21}H_{27}N_2O_3$: $(M+H)^+$ 355.2023, found : 355.2022.

Methyl 2-(4-oxo-6,7,8,9,10,11,11b,12-octahydro-4H-cyclohepta[3,4]pyrrolo[1,2-a]thieno[2,3-d]pyrimidin-6-yl)acetate (3m):



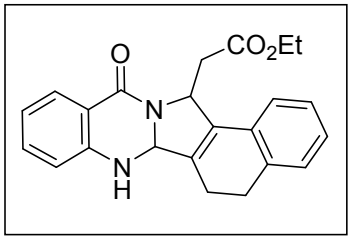
Yellow solid (34.1 mg, 70%), mp. 148 ^{0}C. ^{1}H NMR (400 MHz, DMSO-*d*^{6}): δ 7.72 (d, *J* = 5.3 Hz, 1H), 7.56 (s, 1H), 6.89 (d, *J* = 5.3 Hz, 1H), 5.01 (s, 1H), 4.78 (d, *J* = 5.4 Hz, 1H), 3.62 (s, 3H), 2.73 (m, 1H), 2.49 – 2.22 (m, 3H), 2.04 – 1.91 (m, 2H), 1.78 (m, 1H), 1.61 – 1.59 (m, 3H), 1.20 – 1.13 (m, 2H). ^{13}C NMR (100 MHz, Chloroform-*d*): δ 172.0, 163.6, 154.0, 136.2, 133.7, 129.0, 114.7, 110.2, 68.5, 55.5, 52.5, 35.2, 33.5, 32.1, 29.2, 26.8, 25.4. HRMS calcd. for $C_{17}H_{21}N_2O_3S$: $(M+H)^+$ 333.1275, found : 333.1276.

Methyl 2-(4-oxo-4,6,7,8,9,10,11,12,12b,13-decahydrocycloocta[3,4]pyrrolo[1,2-a]thieno[2,3-d]pyrimidin-6-yl)acetate (3n):



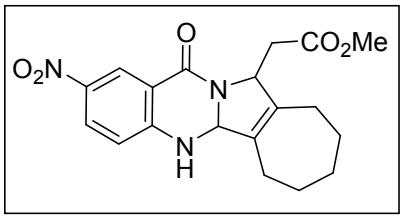
Off white solid (36.2 mg, 73%), mp. 139 ^{0}C. ^{1}H NMR (400 MHz, Chloroform-*d*): δ 7.48 (d, *J* = 5.3 Hz, 1H), 6.53 (d, *J* = 5.2 Hz, 1H), 5.40 (s, 1H), 5.34 (s, 1H), 4.41 (d, *J* = 5.0 Hz, 1H), 3.70 (s, 3H), 2.79 (dd, *J* = 16.8, 5.9 Hz, 1H), 2.58 (d, *J* = 16.8 Hz, 1H), 2.41 – 2.37 (m, 2H), 2.15 – 2.12 (m, 1H), 2.01 – 1.97 (m, 1H), 1.70 – 1.60 (m, 2H), 1.56 – 1.37 (m, 6H). ^{13}C NMR (100 MHz, Chloroform-*d*): δ 172.0, 163.9, 154.7, 139.3, 134.6, 133.9, 125.8, 114.5, 66.6, 55.9, 52.5, 31.7, 31.2, 31.0, 27.8, 26.4, 26.2, 25.9. HRMS calcd. for $C_{18}H_{23}N_2O_3S$: $(M+H)^+$ 347.1431, found : 347.1430.

Ethyl 2-(12-oxo-5,6,6b,7,12,14-hexahydrobenzo[4,5]isoindolo[1,2-b]quinazolin-14-yl)acetate (3o):



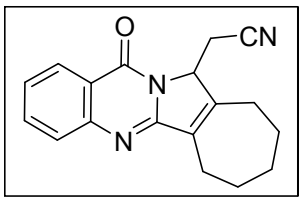
Yellow solid (22.8 mg, 55%), mp. 145 ^{0}C. ^{1}H NMR (400 MHz, Chloroform-*d*): δ 8.02 (d, *J* = 7.8 Hz, 1H), 7.43 (t, *J* = 7.6 Hz, 1H), 7.37 – 7.17 (m, 3H), 6.97 (t, *J* = 7.4 Hz, 1H), 6.68 (d, *J* = 8.0 Hz, 1H), 6.04 (s, 1H), 5.69 (s, 1H), 4.71 – 4.70 (m, 1H), 4.20 – 4.08 (m, 2H), 3.15 – 3.00 (m, 2H), 2.85 – 2.83 (m, 2H), 2.52 – 2.39 (m, 1H), 2.20 – 2.16 (m, 1H), 1.18 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (125 MHz, Chloroform-*d*): δ 171.5, 168.1, 160.8, 149.3, 137.7, 134.5, 134.0, 130.9, 129.9, 128.5, 127.6, 127.1, 126.7, 126.4, 124.7, 122.5, 66.3, 60.9, 53.3, 29.7, 27.8, 18.2, 13.7. HRMS calcd. for $C_{23}H_{23}N_2O_3$: $(M+H)^+$ 375.1710, found : 375.1711.

Methyl 2-(2-nitro-13-oxo-5,5a,7,8,9,10,11,13-octahydro-6H-cyclohepta[3,4]pyrrolo[2,1-b]quinazolin-11-yl)acetate (3p)[a]:



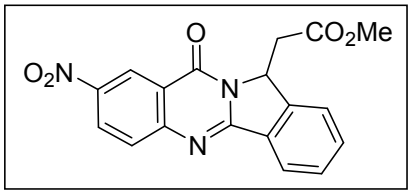
Yellow solid (25 mg, 62%), mp. 168 ^{0}C. ^{1}H NMR (400 MHz, DMSO-*d*^{6}) δ 8.50 (d, *J* = 2.8 Hz, 2H), 8.17 (dd, *J* = 9.3, 2.8 Hz, 1H), 7.10 (d, *J* = 9.6 Hz, 1H), 5.10 (s, 1H), 5.03 (d, *J* = 5.6 Hz, 1H), 3.61 (s, 3H), 2.79 – 2.74 (m, 1H), 2.38 – 2.23 (m, 3H), 2.04 – 1.96 (m, 1H), 1.87 (dd, *J* = 15.1, 6.5 Hz, 1H), 1.78 – 1.74 (m, 2H), 1.60 – 1.50 (m, 4H). ^{13}C NMR (75 MHz, DMSO-*d*^{6}) δ 170.4, 169.3, 162.7, 155.4, 152.4, 129.3, 126.1, 123.9, 116.9, 113.1, 66.2, 53.8, 52.1, 34.1, 32.4, 31.0, 28.8, 26.0,24.0. HRMS calcd. for $C_{19}H_{22}N_3O_5$: $(M+H)^+$ 372.1561, found : 372.1562.

2-(13-oxo-7,8,9,10,11,13-hexahydro-6H-cyclohepta[3,4]pyrrolo[2,1-b]quinazolin-11-yl)acetonitrile (3q):



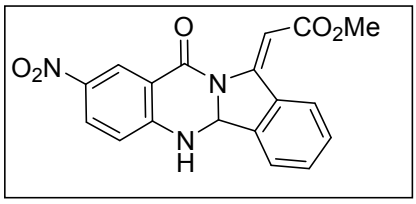
Yellow solid (22 mg, 74%), mp. 134 ^{0}C. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.83 (dd, *J* = 7.7, 1.3 Hz, 1H), 7.25 – 7.23 (m, 1H), 6.78 (t, *J* = 7.3 Hz, 1H), 6.60 (d, *J* = 8.0 Hz, 2H), 2.04 – 1.99 (m, 4H), 1.60 – 1.58 (m, 3H), 1.55 – 1.49 (m, 3H), 1.27 – 1.23 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 164.2, 145.7, 134.0, 132.0, 131.0, 128.9, 128.4, 118.8, 117.7, 115.2, 114.9, 72.6, 41.6 (2C), 29.1 (2C), 21.6 (2C). HRMS calcd. for $C_{18}H_{18}N_3O$: $(M+H)^+$ 292.1452, found : 292.1450.

Methyl 2-(8-nitro-10-oxo-10,12-dihydroisoindolo[1,2-b]quinazolin-12-yl)acetate (3r)[a]:



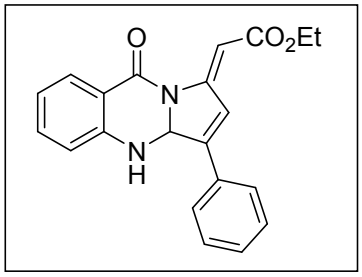
Brown liquid (16 mg, 32%). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 9.19 (d, *J* = 2.6 Hz, 1H), 8.55 (dd, *J* = 9.3, 2.5 Hz, 1H), 8.22 (d, *J* = 7.7 Hz, 1H), 7.93 (d, *J* = 9.0 Hz, 1H), 7.70 – 7.63 (m, 3H), 5.87 (dd, *J* = 7.4, 3.6Hz, 1H), 3.63 (s, 3H), 3.61 – 3.59 (m, 1H), 3.14 – 3.08 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 170.0, 159.6, 157.6, 153.3, 145.4, 143.8, 134.0, 129.9, 128.7, 128.6, 124.4, 123.4, 123.3, 121.6, 121.4, 59.2, 52.2, 35.3. HRMS calcd. for $C_{18}H_{14}N_3O_5$: $(M+H)^+$ 352.0935, found : 352.0937.

Methyl (E)-2-(8-nitro-10-oxo-5,10-dihydroisoindolo[1,2-b]quinazolin-12(4bH)-ylidene)acetate (3s)[a]:



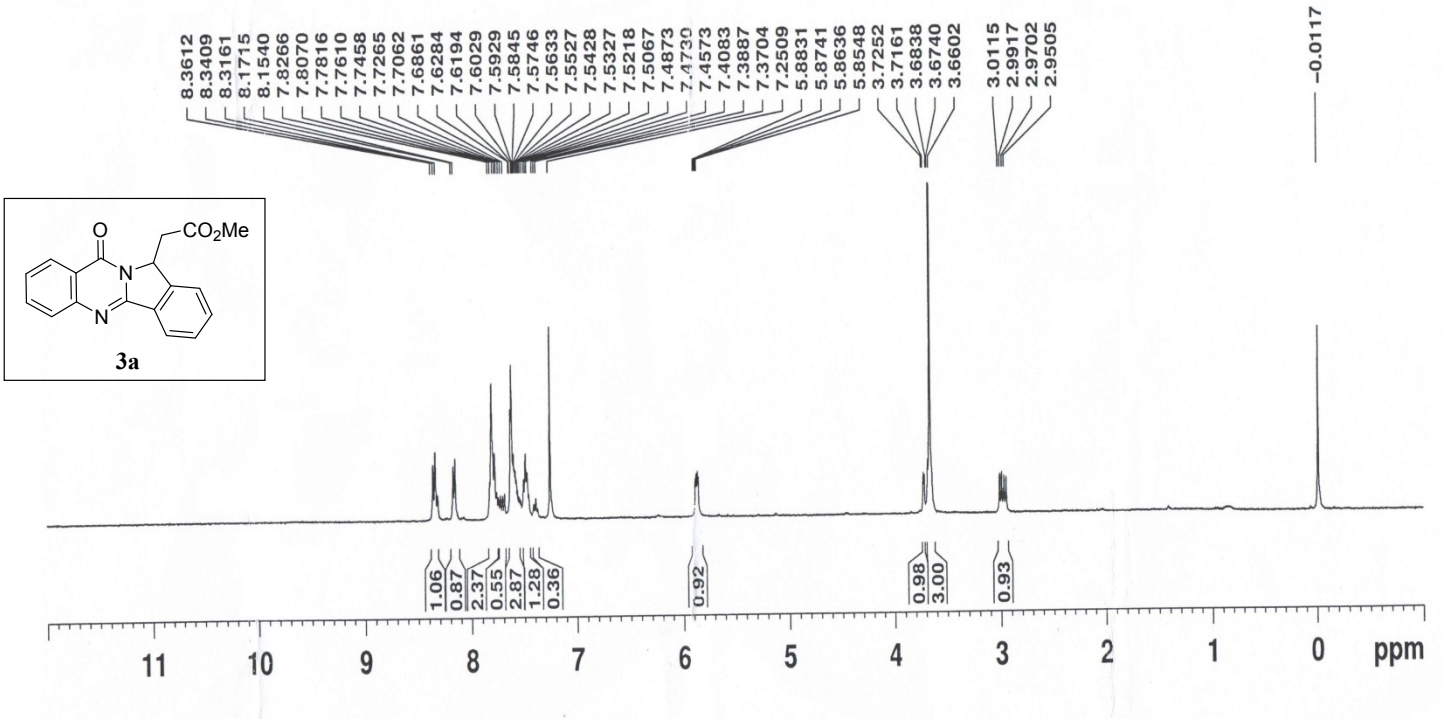
Off white solid (35 mg, 53%), mp. 152 ^{0}C. ^{1}H NMR (500 MHz, 12% DMSO-*d*^{6} in Chloroform-*d*) δ 8.61 (d, *J* = 2.5 Hz, 1H), 8.12 (d, *J* = 15.6 Hz, 1H), 8.00 (dd, *J* = 9.0, 2.6 Hz, 1H), 7.77 (s, 1H), 7.64 (d, *J* = 7.7 Hz, 1H), 7.55 (d, *J* = 7.0 Hz, 1H), 7.43 – 7.37 (m, 2H), 6.73 (d, *J* = 9.0 Hz, 1H), 6.28 (d, *J* = 4.9 Hz, 1H), 3.67 (s, 3H). ^{13}C NMR (126 MHz, 12% DMSO-*d*^{6} in Chloroform-*d*) δ 166.0, 162.1, 152.0, 140.4, 138.0, 137.2, 133.1, 129.8, 129.3, 128.5, 128.0, 126.9, 124.8, 121.0, 114.0, 112.4, 64.6, 51.2. HRMS calcd. for $C_{18}H_{14}N_3O_5$: $(M+H)^+$ 352.0935, found : 352.0934.

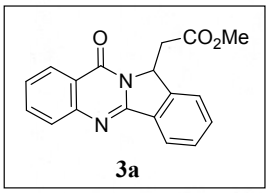
Ethyl (E)-2-(9-oxo-3-phenyl-4,9-dihydropyrrolo[2,1-b]quinazolin-1(3aH)-ylidene)acetate (3t):



Yellow solid (35.8 mg, 72%), mp. 72 ^{0}C. ^{1}H NMR (400 MHz, DMSO-*d*^{6}): δ 8.15 (s, 1H), 7.58 – 7.54 (m, 1H), 7.50 – 7.39 (m, 2H), 7.29 (d, *J* = 6.9 Hz, 2H), 7.24 (t, *J* = 7.1 Hz, 1H), 6.80 (s, 1H), 6.71 – 6.66 (m, 2H), 6.47 (d, *J* = 9.4 Hz, 1H), 5.33 (d, *J* = 15.6 Hz, 1H), 4.89 (d, *J* = 9.5 Hz, 1H), 4.08 (q, *J* = 7.2 Hz, 2H), 1.17 (td, *J* = 7.0, 3.2 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*): δ 166.6, 164.8, 146.6, 146.4, 143.3, 135.3, 134.5, 134.0, 129.0 (2C), 128.9 (2C), 128.7, 128.6, 123.9, 119.5, 115.5, 114.9, 63.2, 60.7, 14.3. HRMS calcd. for $C_{21}H_{19}N_2O_3$: $(M+H)^+$ 347.1397, found : 347.1396.

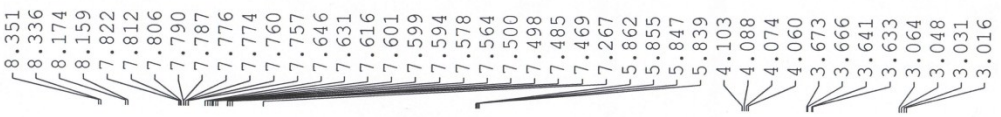
^{1}H and ^{13}C Spectra of (3a – 3t):





3a

3a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8.336
8.174
8.159
7.822
7.812
7.806
7.790
7.787
7.776
7.774
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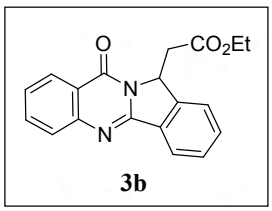
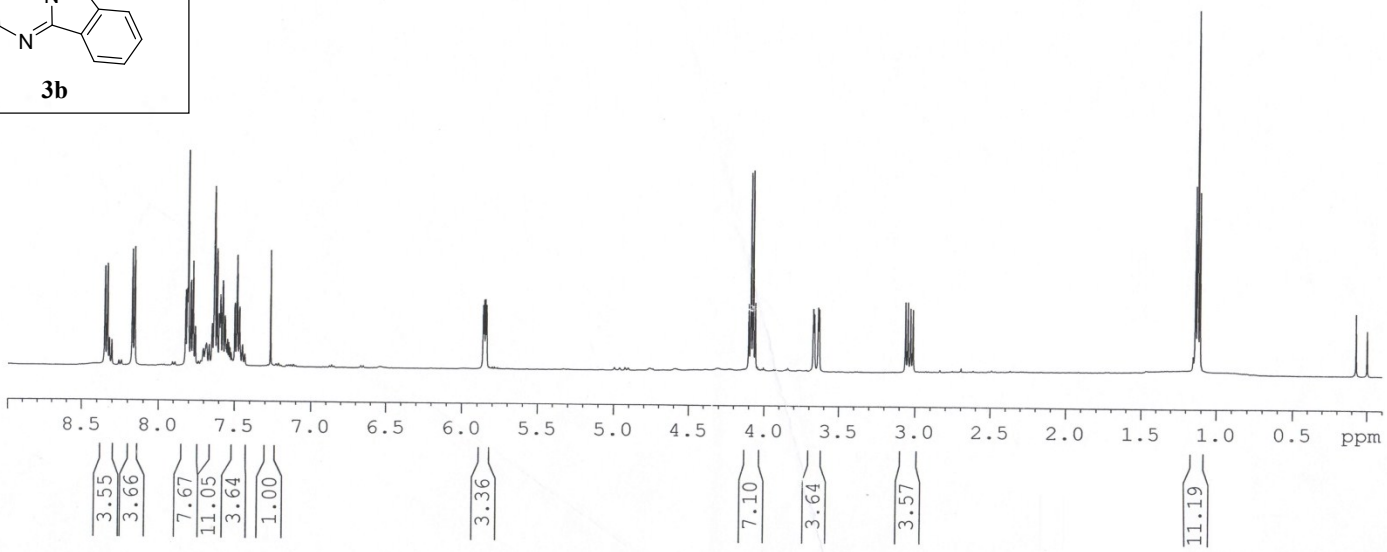
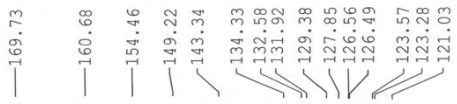
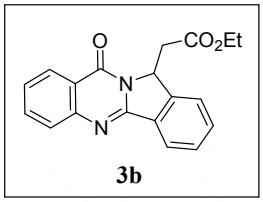
7.757
7.646
7.631
7.616
7.601
7.599
7.594
7.578
7.564
7.500
7.498
7.485
7.469
7.267
5.862
5.855
5.847
5.839
4.103
4.088
4.074
4.060
3.673
3.666
3.641
3.633
3.064
3.048
3.031
3.016
1.139
1.125
1.110
0.073
0.000


O
CO2Et
N
N

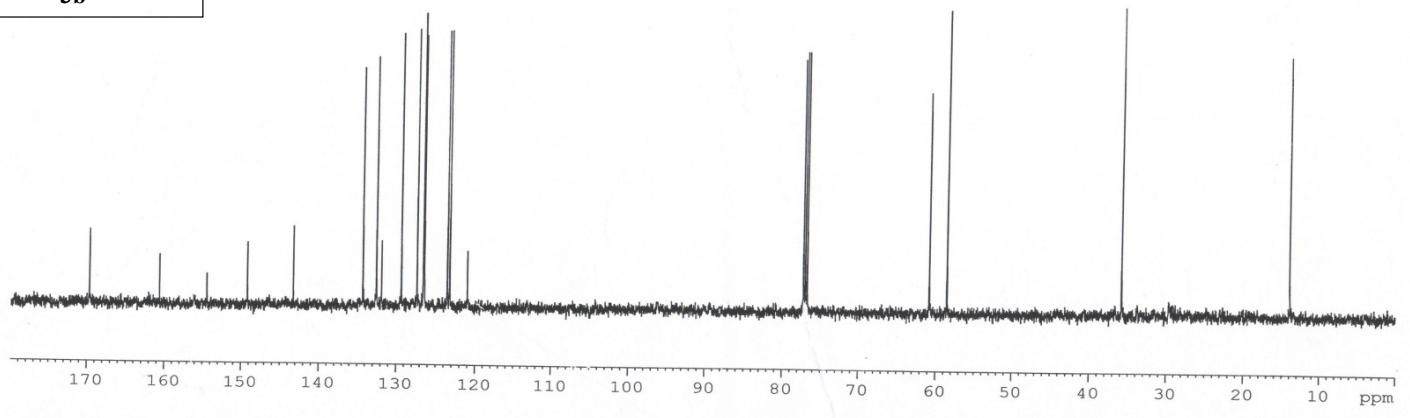
3b


8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
3.55
3.66
7.67
11.05
3.64
1.00
3.36
7.10
3.64
3.57
11.19


169.73
160.68
154.46
149.22
143.34
134.33
132.58
131.92
129.38
127.85
126.56
126.49
123.57
123.28
121.03
77.25
77.00
76.74
60.86
58.58
35.89
14.02


O
CO2Et
N
N

3b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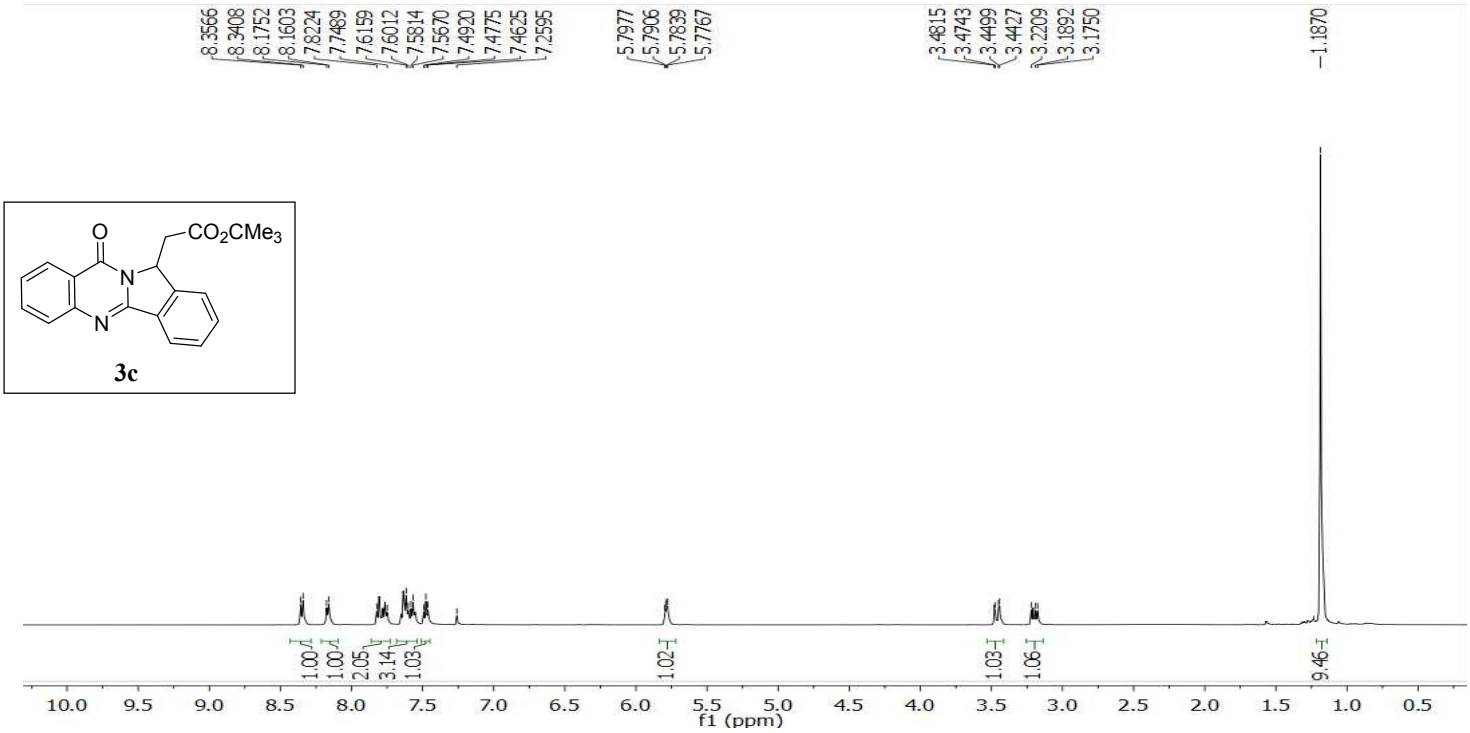
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm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8.1603
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7.6159
7.6012
7.5814
7.5670
7.4920
7.4775
7.4625
7.2595
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5.7906
5.7839
5.7767
3.4815
3.4743
3.4499
3.4427
3.2209
3.1892
3.1750
1.1870
O
N
N
CO2CMe3
3c
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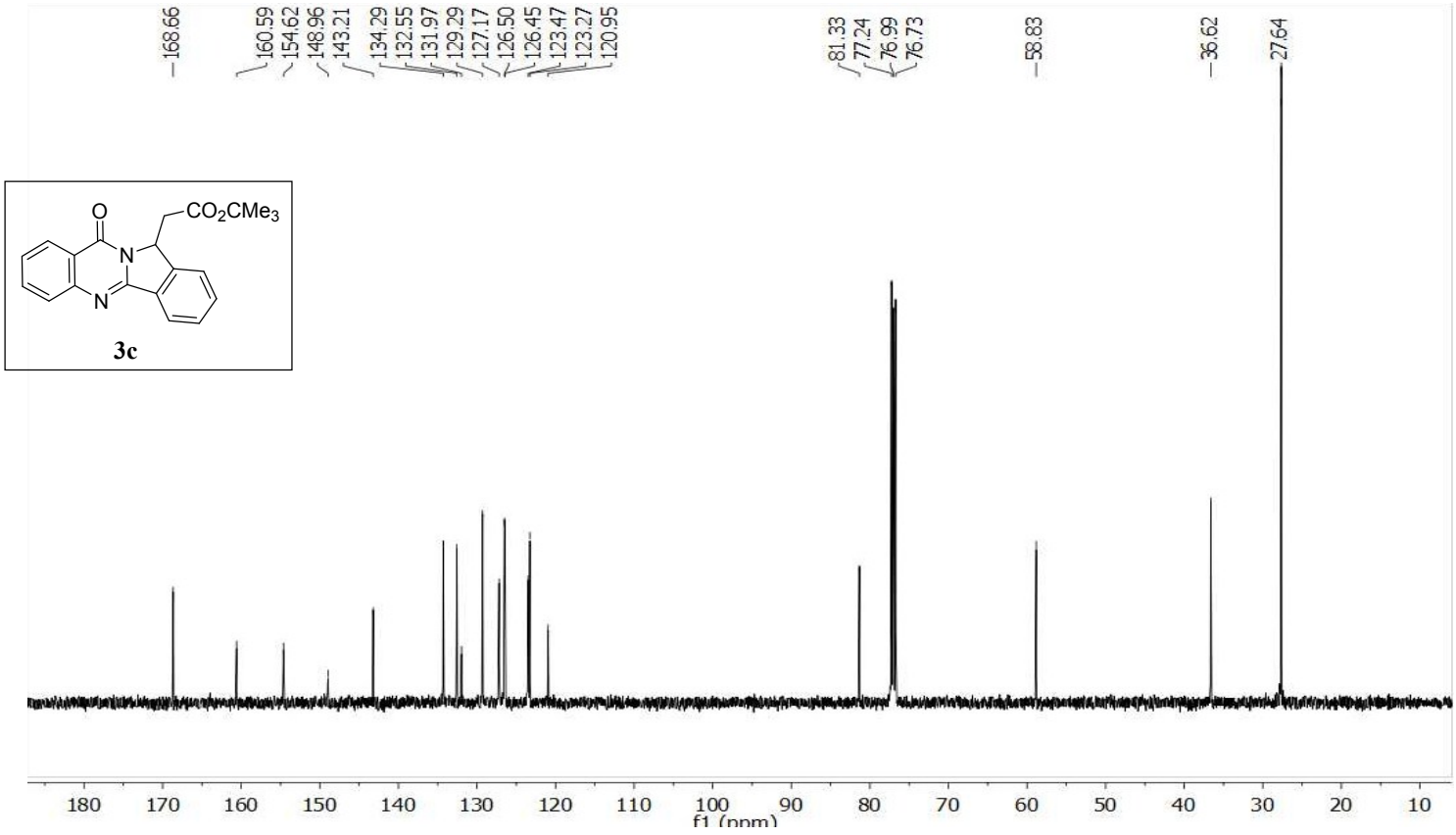
1.00
2.05
3.14
1.03
1.02
1.03
1.06
9.46
f1 (ppm)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143.21
134.29
132.55
131.97
129.29
127.17
126.50
126.45
123.47
123.27
120.95
81.33
77.24
76.99
76.73
58.83
36.62
27.64
O
N
N
CO2CMe3
3c
f1 (ppm)


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8.1700
8.1535
8.1368
8.0438
8.0301
7.7627
7.7477
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7.6438
7.6143
7.5971
7.5295
7.5043
7.4895
7.2786
5.7739
5.7591
5.7523
5.7448
5.7376
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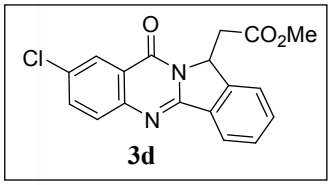
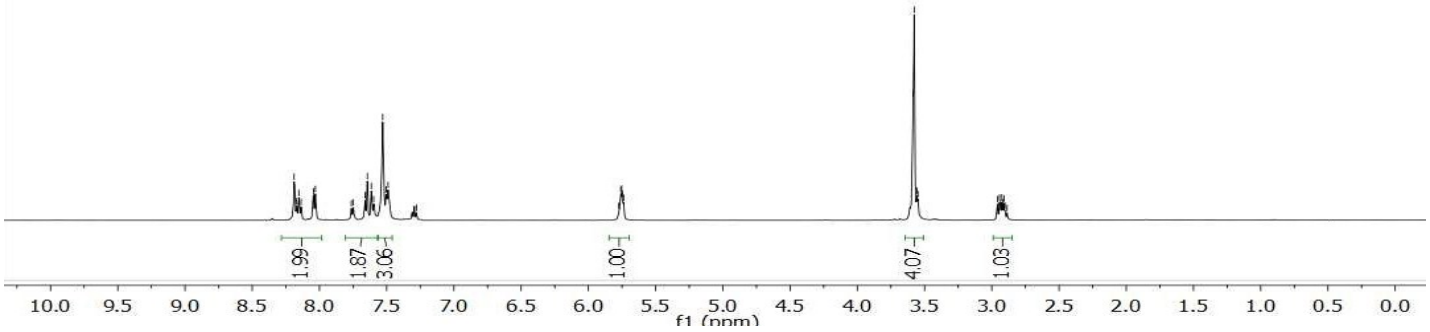
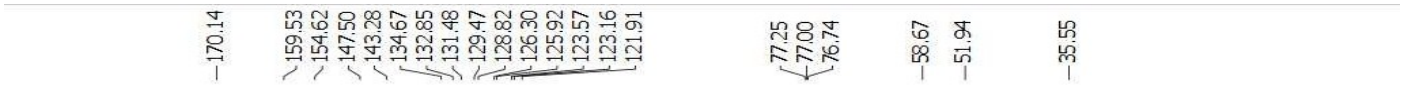
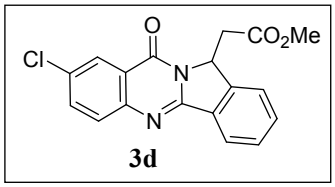
2.8858


O
CO2Me
Cl
N
N

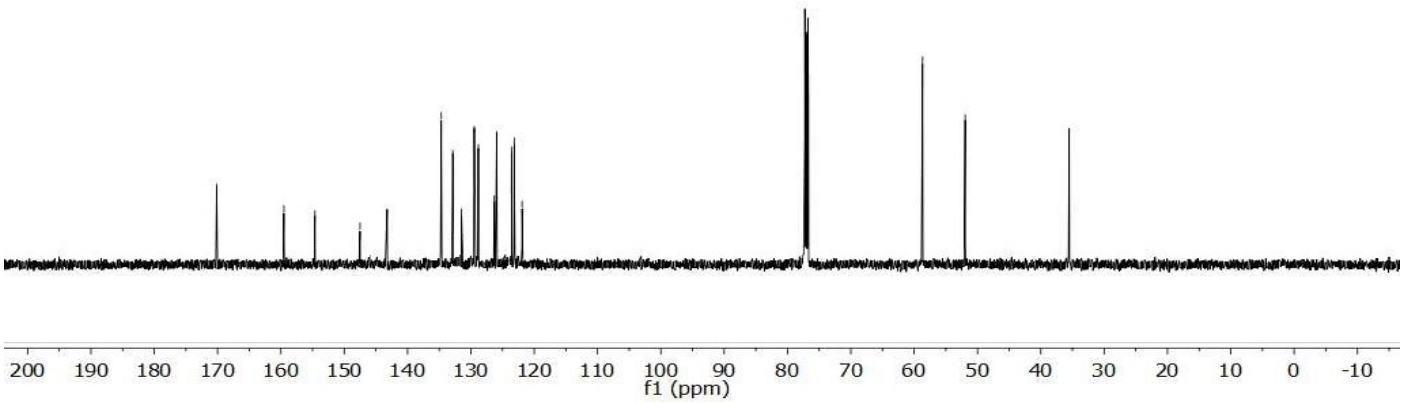
3d


1.99
1.87
3.06
1.00
4.07
1.03
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


170.14
159.53
154.62
147.50
143.28
134.67
132.85
131.48
129.47
128.82
126.30
125.92
123.57
123.16
121.91
77.25
77.00
76.74
58.67
51.94
35.55


O
CO2Me
Cl
N
N

3d


200
190
180
170
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150
140
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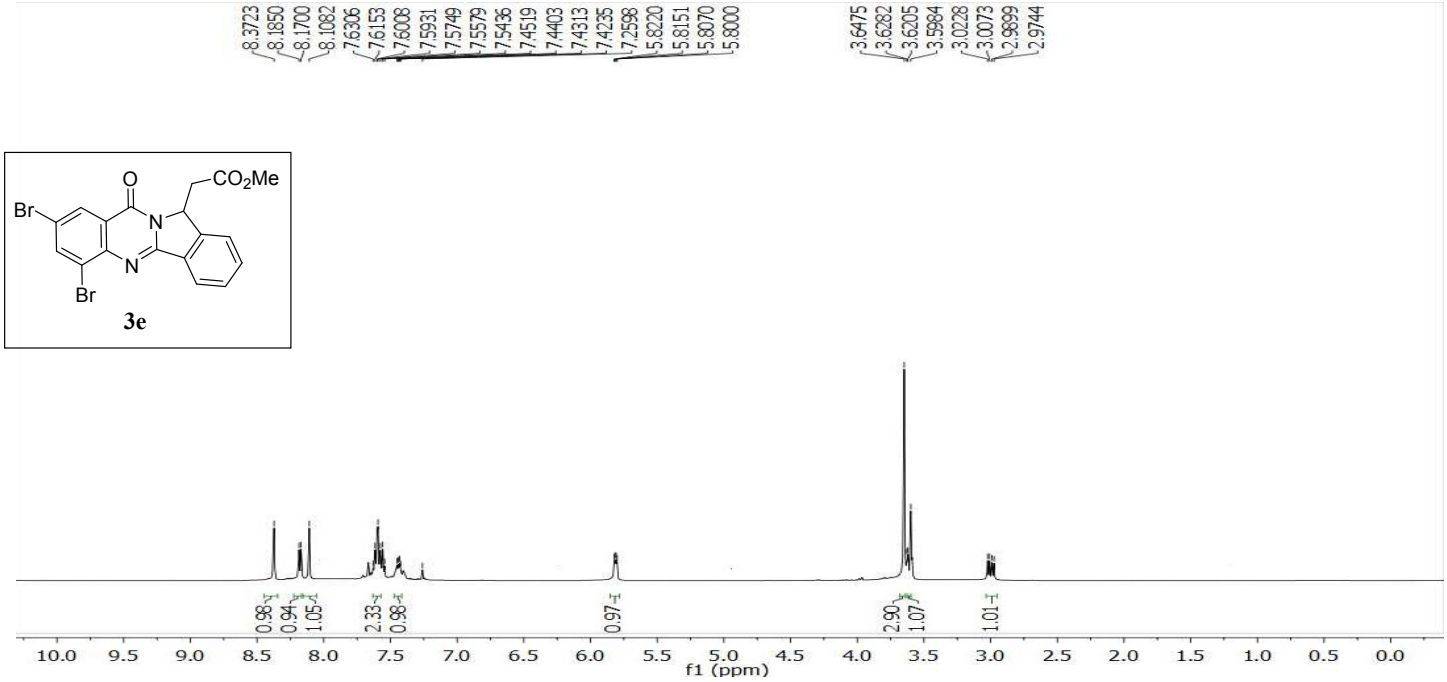
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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7.6008
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7.5749
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7.5436
7.4519
7.4403
7.4313
7.4235
7.2598
5.8220
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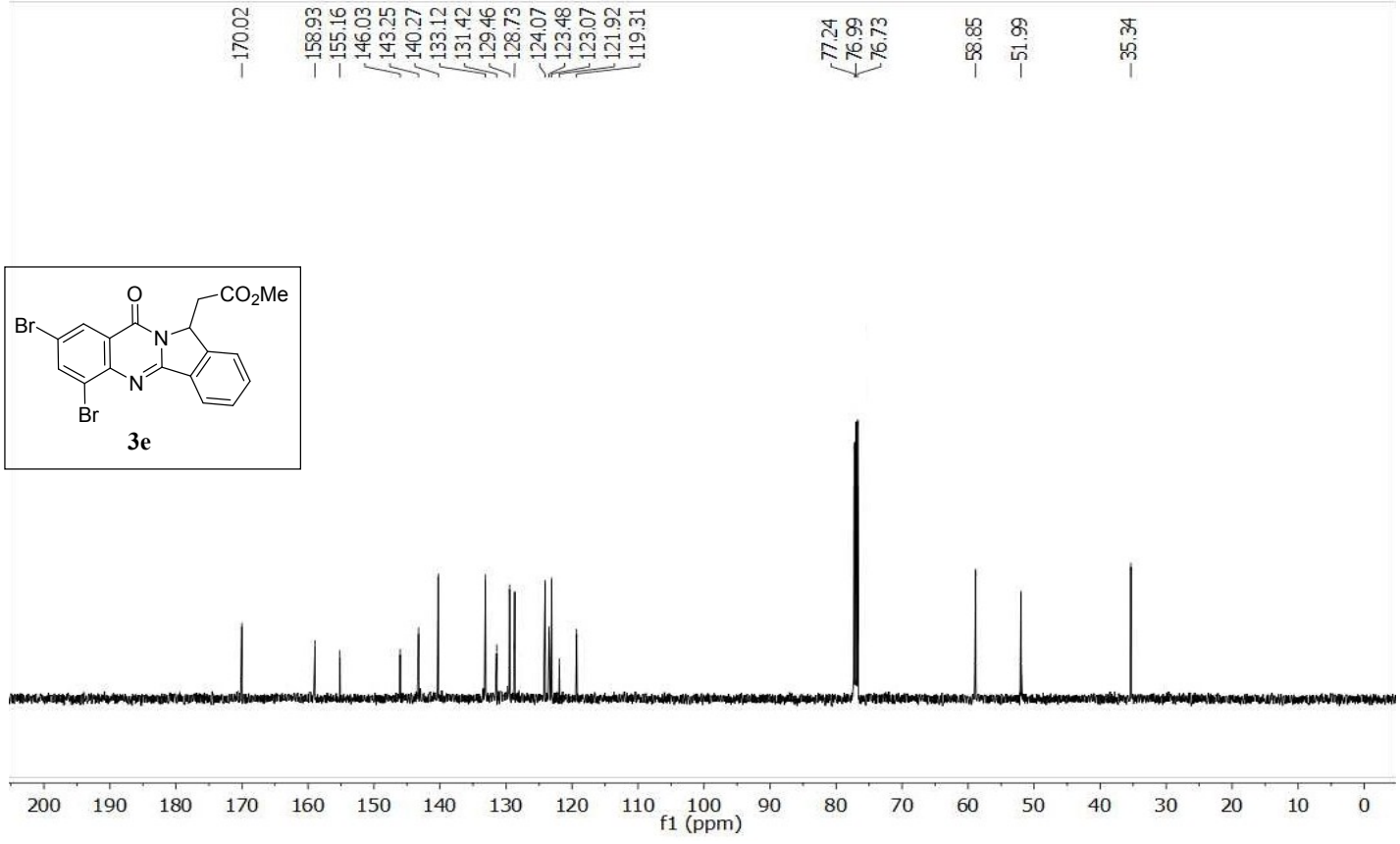
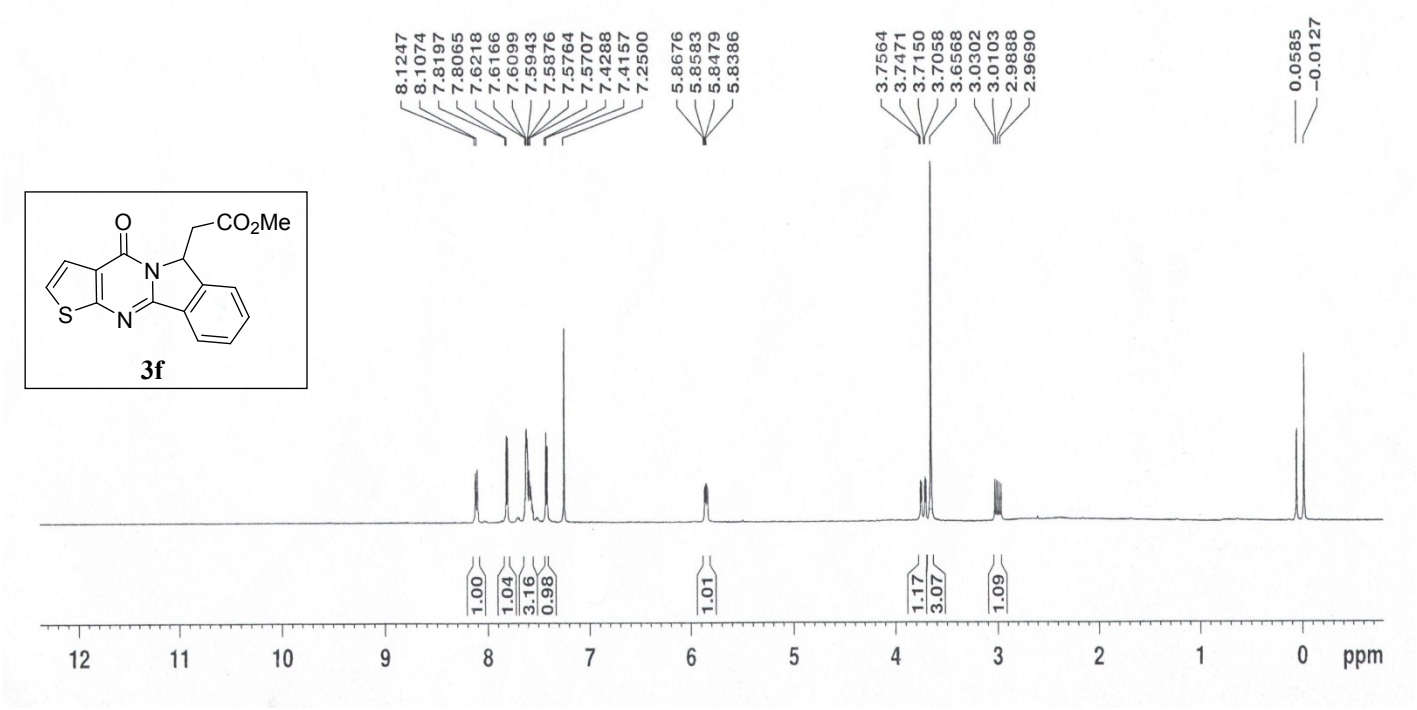
5.8070
5.8000
3.6475
3.6282
3.6205
3.5984
3.0228
3.0073
2.9899
2.9744
O
CO2Me
Br
N
N
Br
3e
0.98
0.94
1.05
2.33
0.98
0.97
2.90
1.07
1.01
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


170.02
158.93
155.16
146.03
143.25
140.27
133.12
131.42
129.46
128.73
124.07
123.48
123.07
121.92
119.31
77.24
76.99
76.73
58.85
51.99
35.34
O
CO2Me
Br
N
N
Br
3e
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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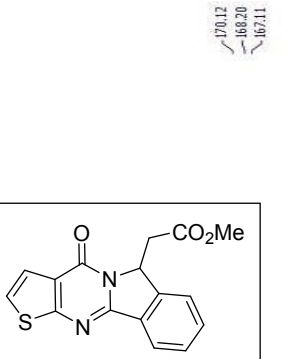
8.1074
7.8197
7.8065
7.6218
7.6166
7.6099
7.5943
7.5876
7.5764
7.5707
7.4288
7.4157
7.2500
5.8676
5.8583
5.8479
5.8386
3.7564
3.7471
3.7150
3.7058
3.6568
3.0302
3.0103
2.9888
2.9690
0.0585
-0.0127
1.00
1.04
3.16
0.98
1.01
1.17
3.07
1.09
12
11
10
9
8
7
6
5
4
3
2
1
0
ppm

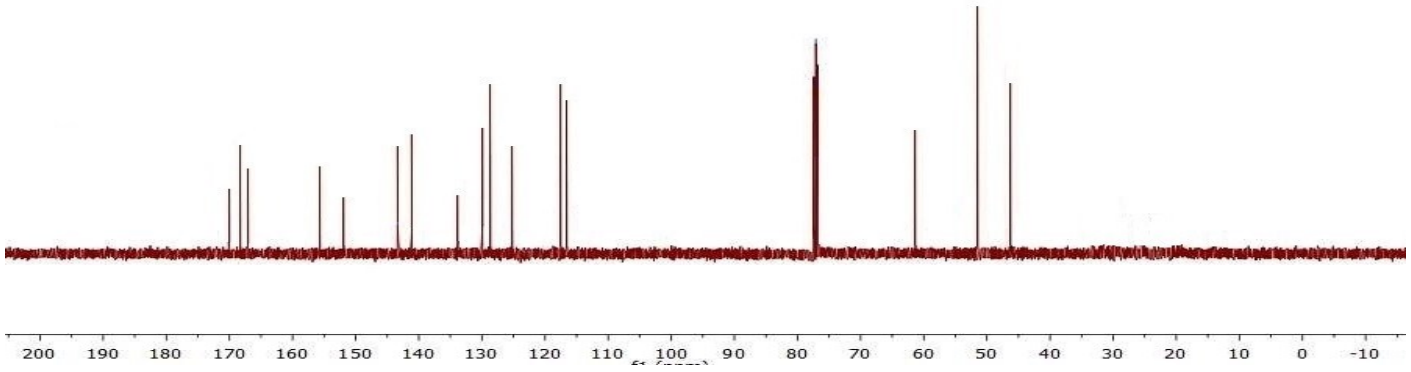

O
CO2Me
N
S
N

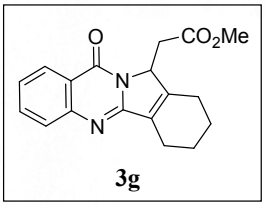
3f


170.12
168.20
167.11
155.66
151.87
143.38
141.06
133.77
129.89
128.74
125.19
117.40
116.54
77.42
77.10
76.78
61.30
51.63
46.45

O
CO2Me
N
S
N

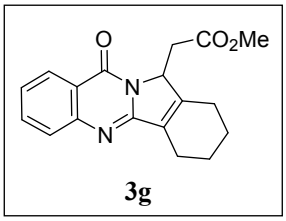
3f


200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10


O
CO2Me
N
N

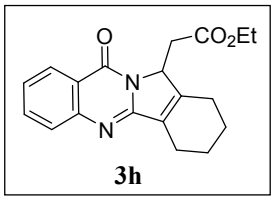
3g

8.3038
8.2836
7.7194
7.7099
7.4287
7.4203
7.2495
5.1841
3.6321
3.3729
3.3644
3.3336
3.3250
3.0306
3.0127
2.9934
2.9744
2.5064
2.3585
1.8469
1.8077
1.7400
1.3180
1.2431
2.00
4.06
1.95
1.97
5.98
1.89
1.87
4.01
3.97
4.02
4.00
11
10
9
8
7
6
5
4
3
2
1
0
ppm

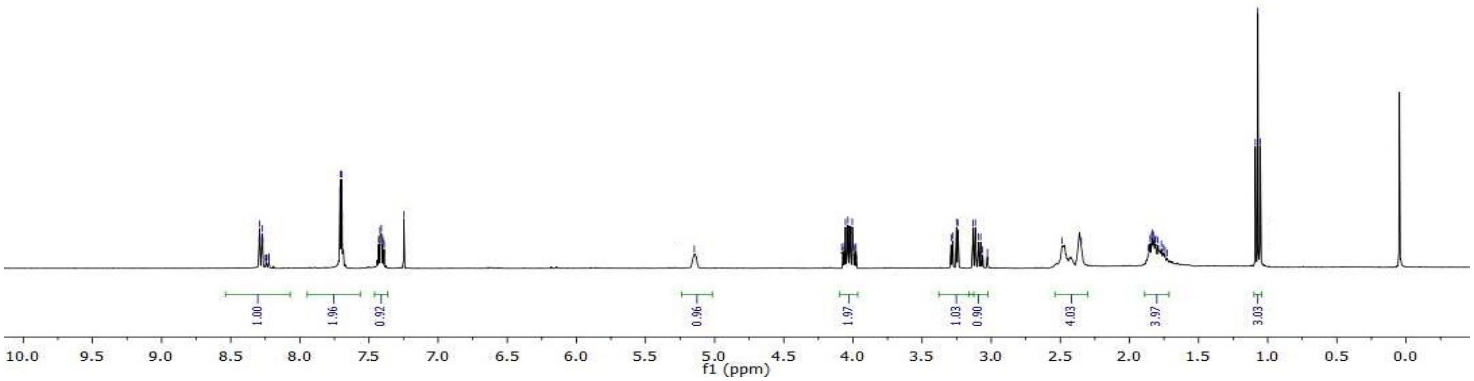

O
CO2Me
N
N

3g

168.94
160.84
151.56
149.27
134.52
134.18
132.75
127.65
126.51
126.05
121.02
77.43
77.11
76.79
59.59
52.19
38.22
22.79
21.87
21.63
21.14
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


O
CO2Et
N
N

3h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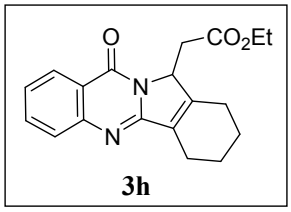
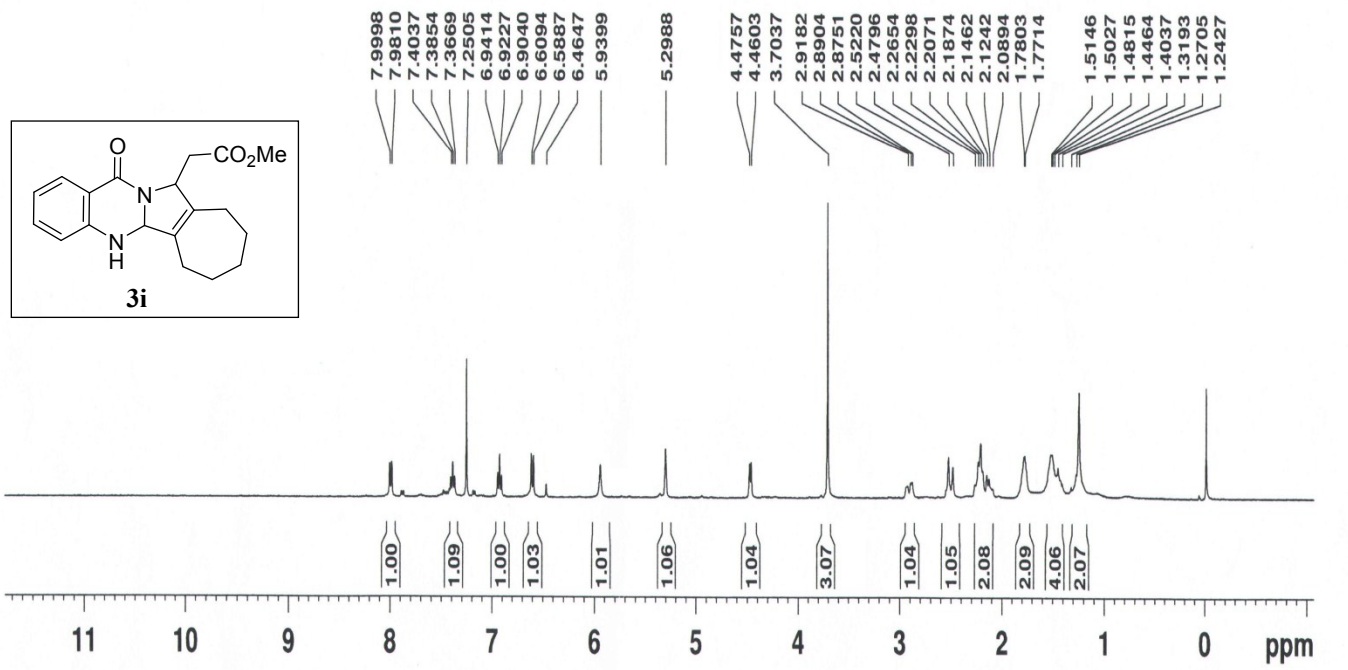
1.96
0.92
0.96
1.97
1.03
0.90
4.03
3.97
3.03
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


O
CO2Et
N
N

3h

200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10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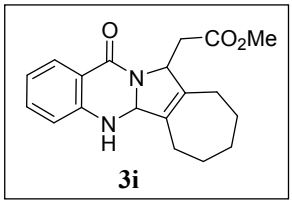
7.9810
7.4037
7.3854
7.3669
7.2505
6.9414
6.9227
6.9040
6.6094
6.5887
6.4647
5.9399
5.2988
4.4757
4.4603
3.7037
2.9182
2.8904
2.8751
2.5220
2.4796
2.2654
2.2298
2.2071
2.1874
2.1462
2.1242
2.0894
1.7803
1.7714
1.5146
1.5027
1.4815
1.4464
1.4037
1.3193
1.2705
1.2427
1.00
1.09
1.00
1.03
1.01
1.06
1.04
3.07
1.04
1.05
2.08
2.09
4.06
2.07
11
10
9
8
7
6
5
4
3
2
1
0
ppm

O
CO2Me
N
N
H

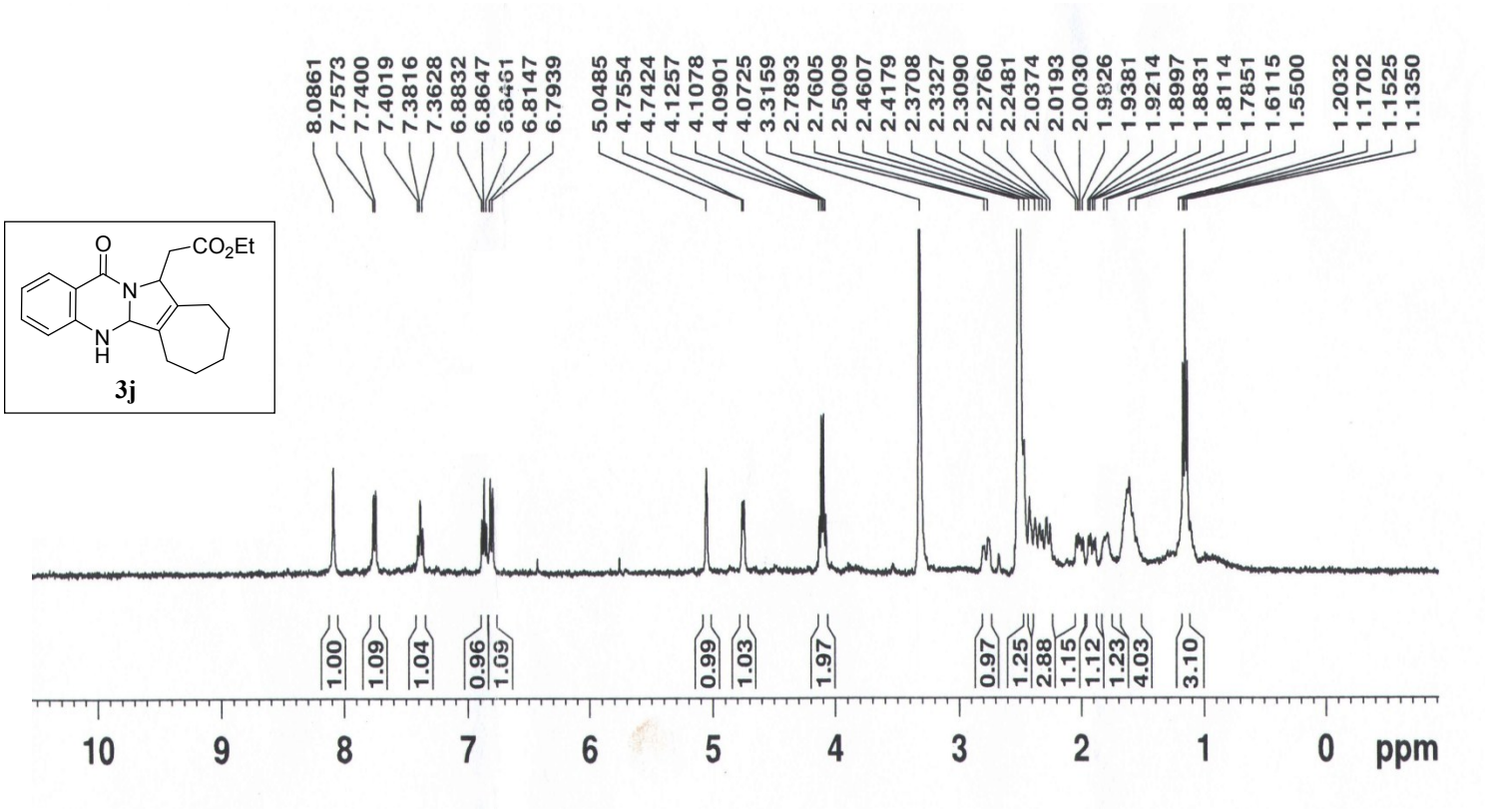
3i


172.43
165.97
148.19
135.89
133.88
129.32
129.15
119.37
118.11
111.38
77.45
77.13
76.81
67.14
53.61
52.33
35.15
33.76
32.12
30.98
26.81
25.41


O
CO2Me
N
N
H

3i

200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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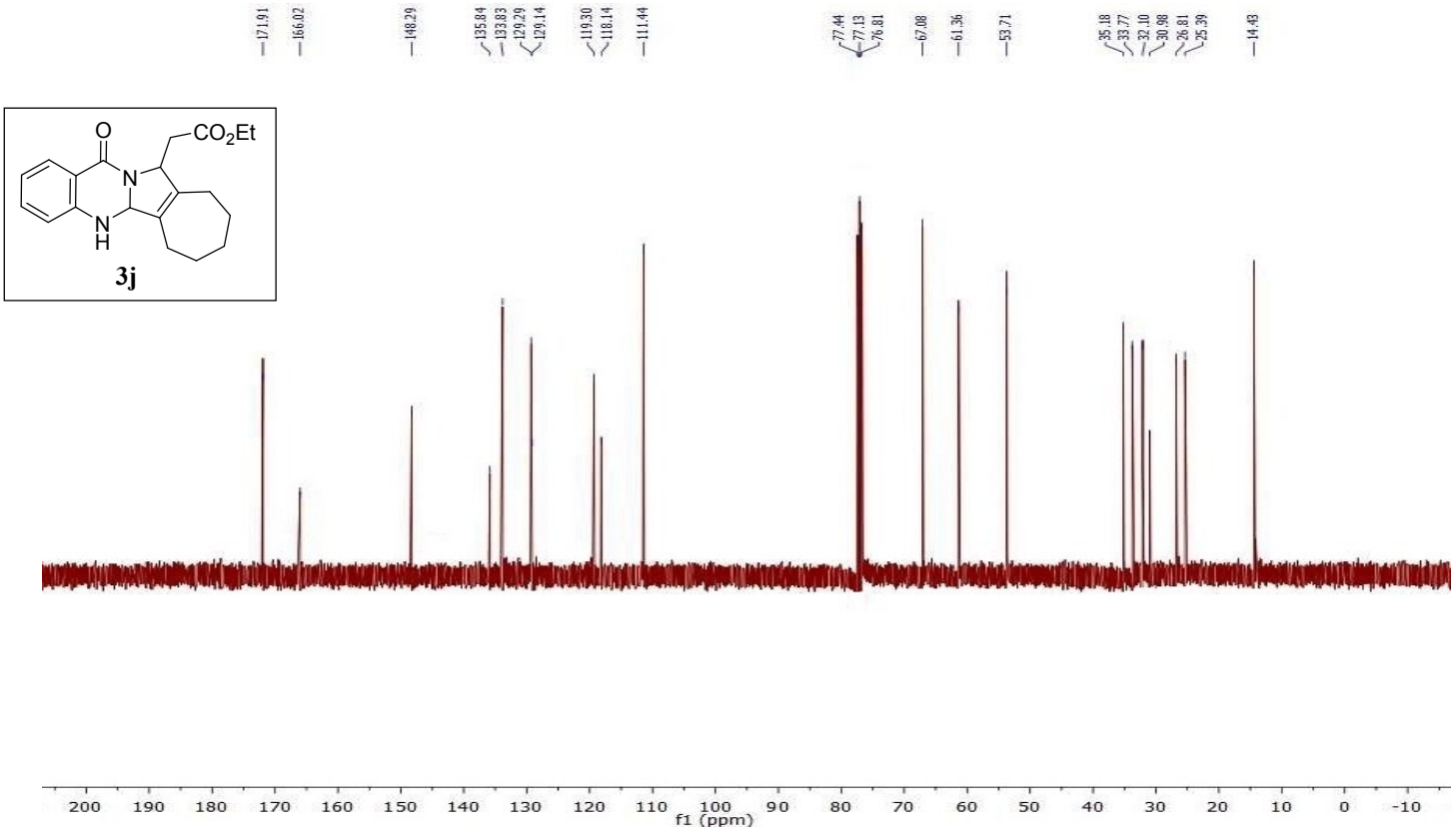
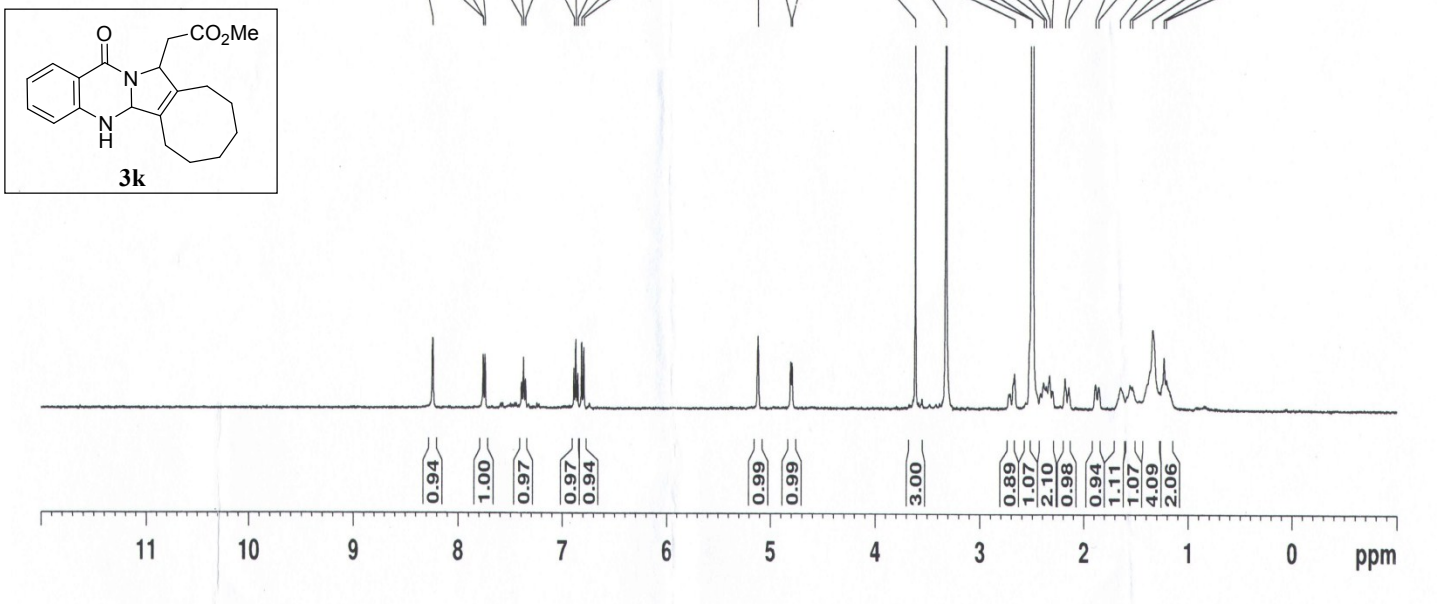
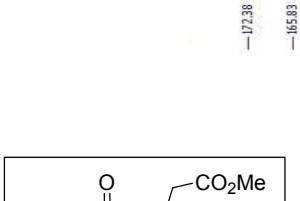
7.7400
7.4019
7.3816
7.3628
6.8832
6.8647
6.8461
6.8147
6.7939
5.0485
4.7554
4.7424
4.1257
4.1078
4.0901
4.0725
3.3159
2.7893
2.7605
2.5009
2.4607
2.4179
2.3708
2.3327
2.3090
2.2760
2.2481
2.0374
2.0193
2.0030
1.9826
1.9381
1.9214
1.8997
1.8831
1.8114
1.7851
1.6115
1.5500
1.2032
1.1702
1.1525
1.1350
1.00
1.09
1.04
0.96
1.09
0.99
1.03
1.97
0.97
1.25
2.88
1.15
1.12
1.23
4.03
3.10
10
9
8
7
6
5
4
3
2
1
0
ppm
O
CO2Et
N
N
H
3j

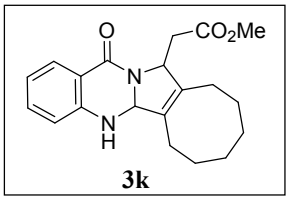

171.91
166.02
148.29
135.84
133.83
129.29
129.14
119.30
118.14
111.44
77.44
77.13
76.81
67.08
61.36
53.71
35.18
33.77
32.10
30.98
26.81
25.39
14.43
O
CO2Et
N
N
H
3j
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


8.2378
7.7608
7.7578
7.7420
7.3962
7.3751
7.3572
6.8856
6.8671
6.8485
6.8119
6.7911
5.1150
4.8052
4.7922
3.6117
3.3179
2.6688
2.5034
2.5000
2.3898
2.3649
2.3316
2.3070
2.1810
2.1451
1.8844
1.8538
1.6465
1.5534
1.5299
1.3394
1.2347
1.2117
0.94
1.00
0.97
0.97
0.94
0.99
0.99
3.00
0.89
1.07
2.10
0.98
0.94
1.11
1.07
4.09
2.06
11
10
9
8
7
6
5
4
3
2
1
0
ppm


O
CO2Me
N
N
H

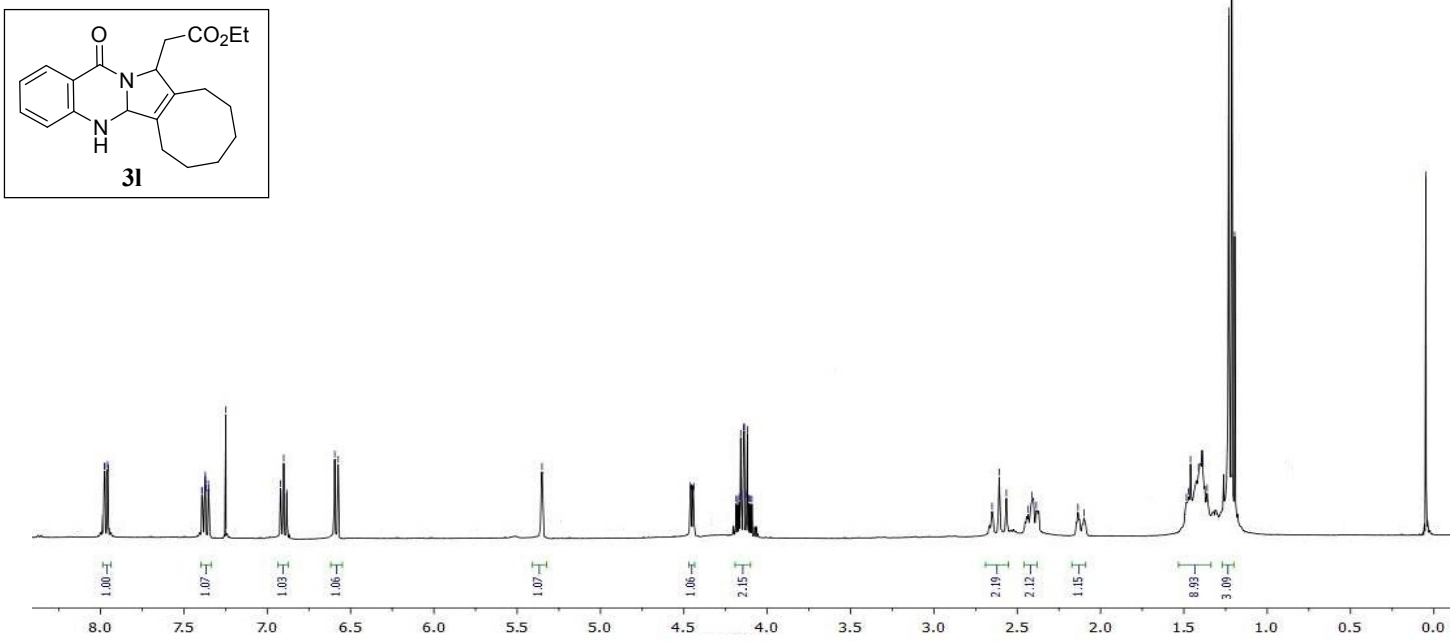
3k

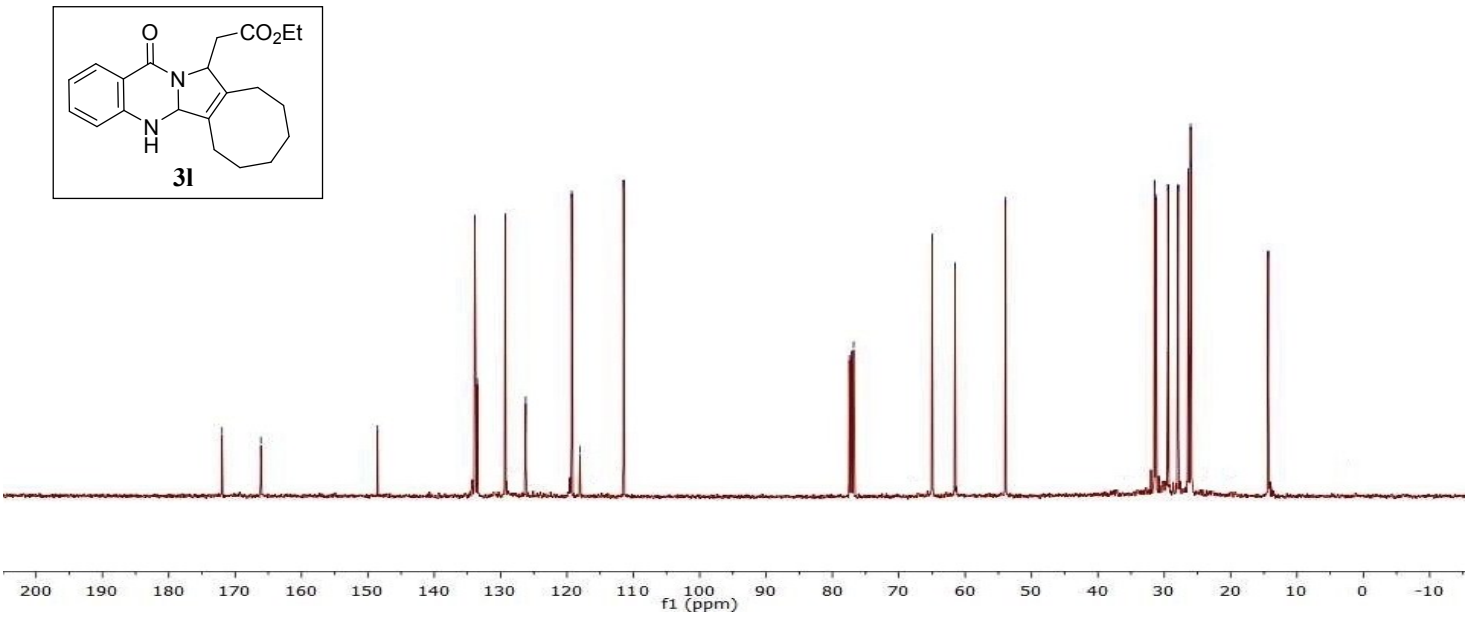

172.38
165.83
148.30
133.65
133.36
129.23
126.31
119.16
118.19
111.26
77.25
77.00
76.74
64.91
53.80
52.16
31.37
31.30
29.35
27.76
26.20
25.93
25.87

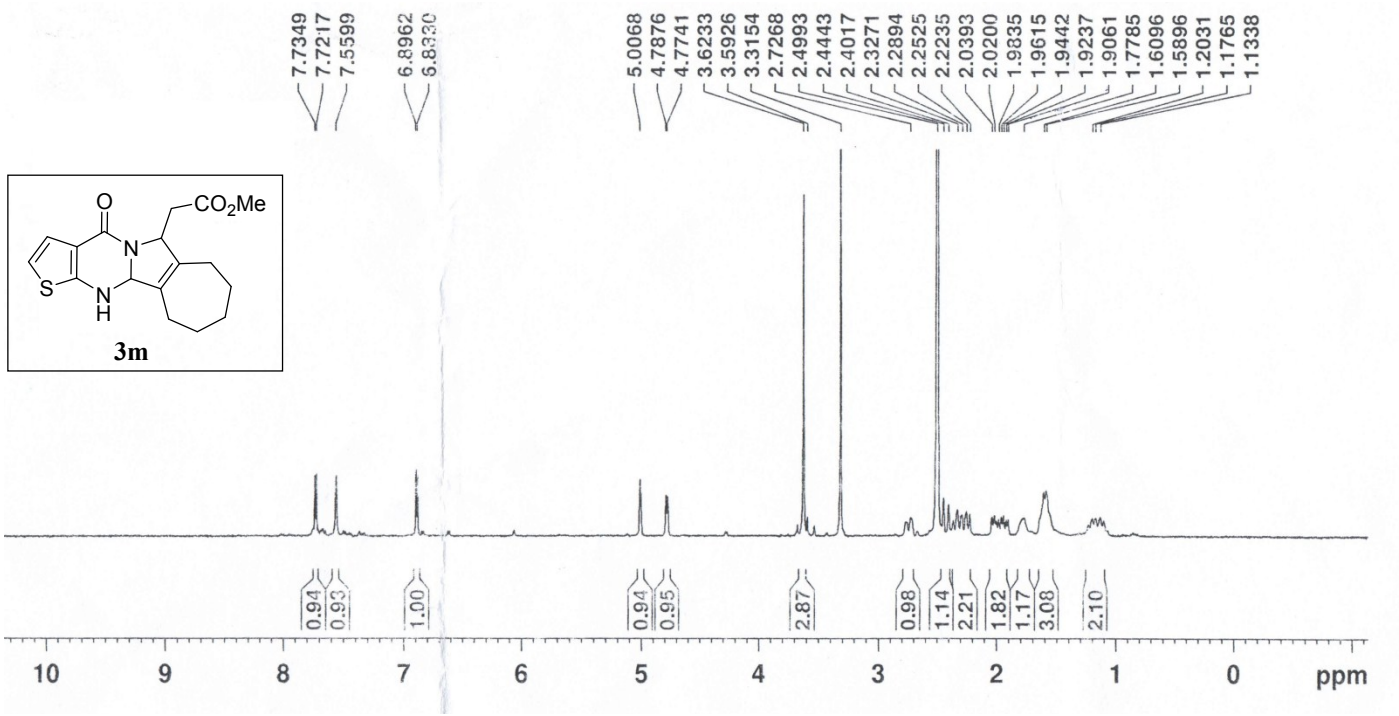

O
CO2Me
N
N
H

3k

200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


O
CO2Et
N
N
H
3l


O
CO2Et
N
N
H
3l
f1 (ppm)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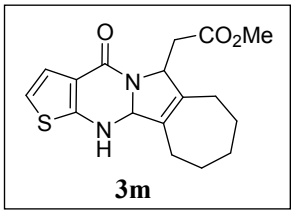
7.5599
6.8962
6.8330
5.0068
4.7876
4.7741
3.6233
3.5926
3.3154
2.7268
2.4993
2.4443
2.4017
2.3271
2.2894
2.2525
2.2235
2.0393
2.0200
1.9835
1.9615
1.9442
1.9237
1.9061
1.7785
1.6096
1.5896
1.2031
1.1765
1.1338
0.94
0.93
1.00
0.94
0.95
2.87
0.98
1.14
2.21
1.82
1.17
3.08
2.10
10
9
8
7
6
5
4
3
2
1
0
ppm

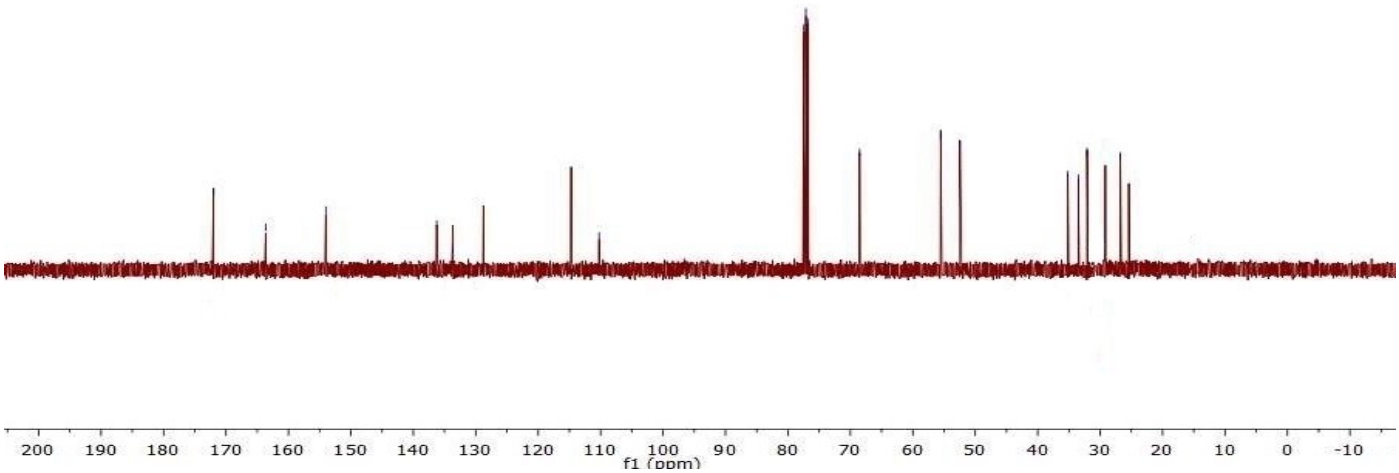
O
CO2Me
N
S
N
H

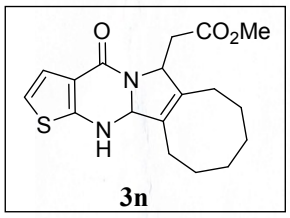
3m


171.98
163.63
154.01
136.25
133.66
128.96
114.69
110.25
77.45
77.13
76.81
68.52
55.54
52.46
35.16
33.49
32.09
29.25
26.76
25.43


O
CO2Me
N
S
N
H

3m

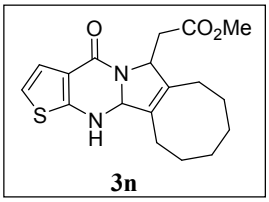

200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


O
CO2Me
N
S
N
H

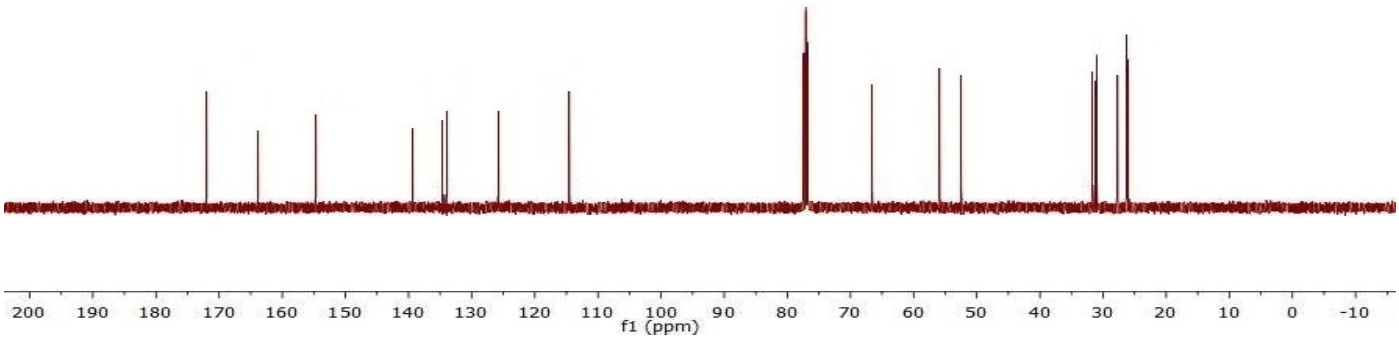
3n

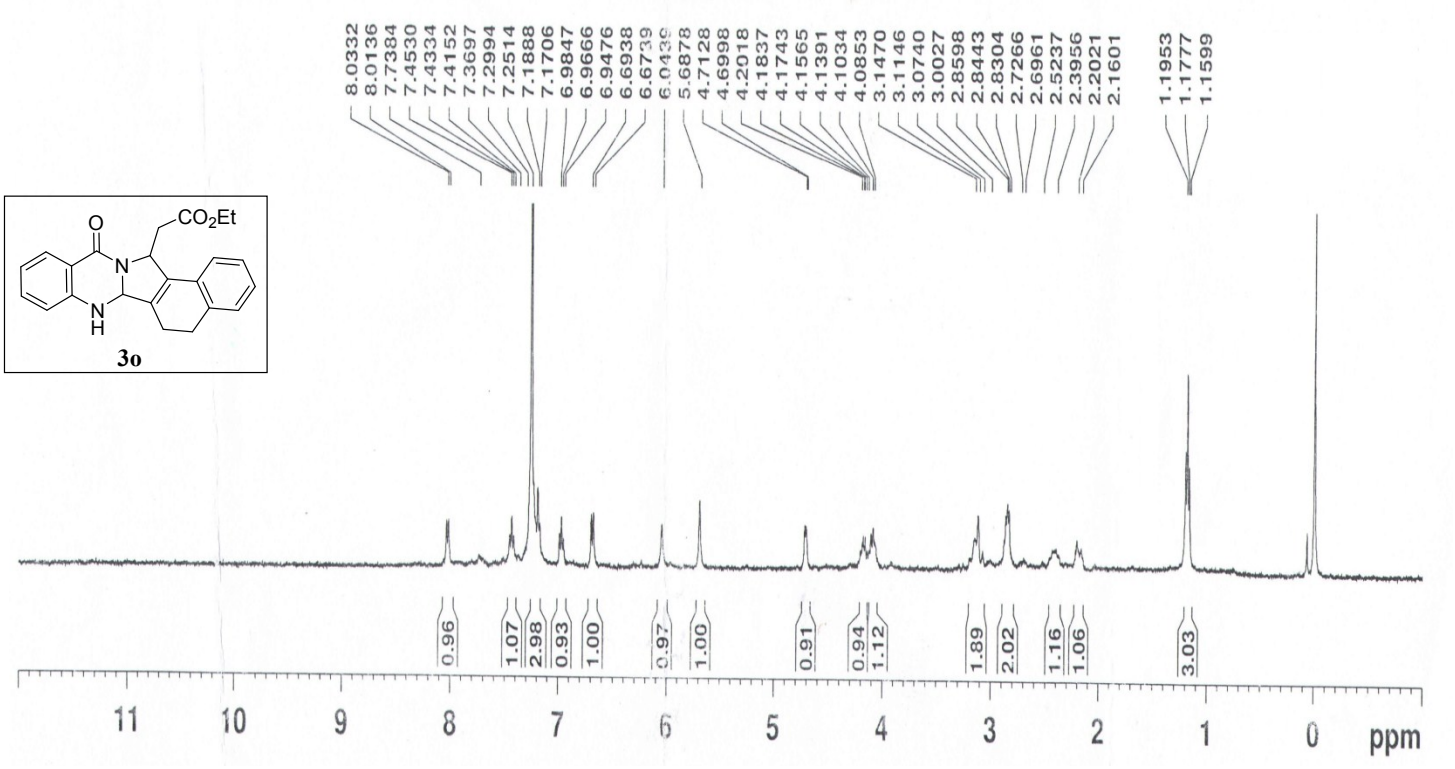
7.4858
7.4726
7.2505
6.5270
5.4000
5.3395
4.4186
4.4061
3.6960
3.4922
2.8149
2.8009
2.7581
2.6055
2.5635
2.4156
2.3958
2.3882
2.3662
2.1520
2.1167
2.0115
2.0029
1.9923
1.9793
1.9701
1.6982
1.6643
1.6493
1.6349
1.6241
1.6032
1.5649
1.5356
1.5148
1.4868
1.4819
1.4752
1.4646
1.4401
1.4112
1.3751
1.00
1.02
0.91
1.09
1.08
3.00
1.09
1.11
2.04
1.05
1.09
2.16
6.07
12
11
10
9
8
7
6
5
4
3
2
1
0
ppm


171.99
163.86
154.74
139.35
134.57
133.95
125.82
114.52
77.41
77.09
76.77
66.57
55.87
52.54
31.67
31.19
31.00
27.85
26.36
26.20
25.94


O
CO2Me
N
S
N
H

3n


200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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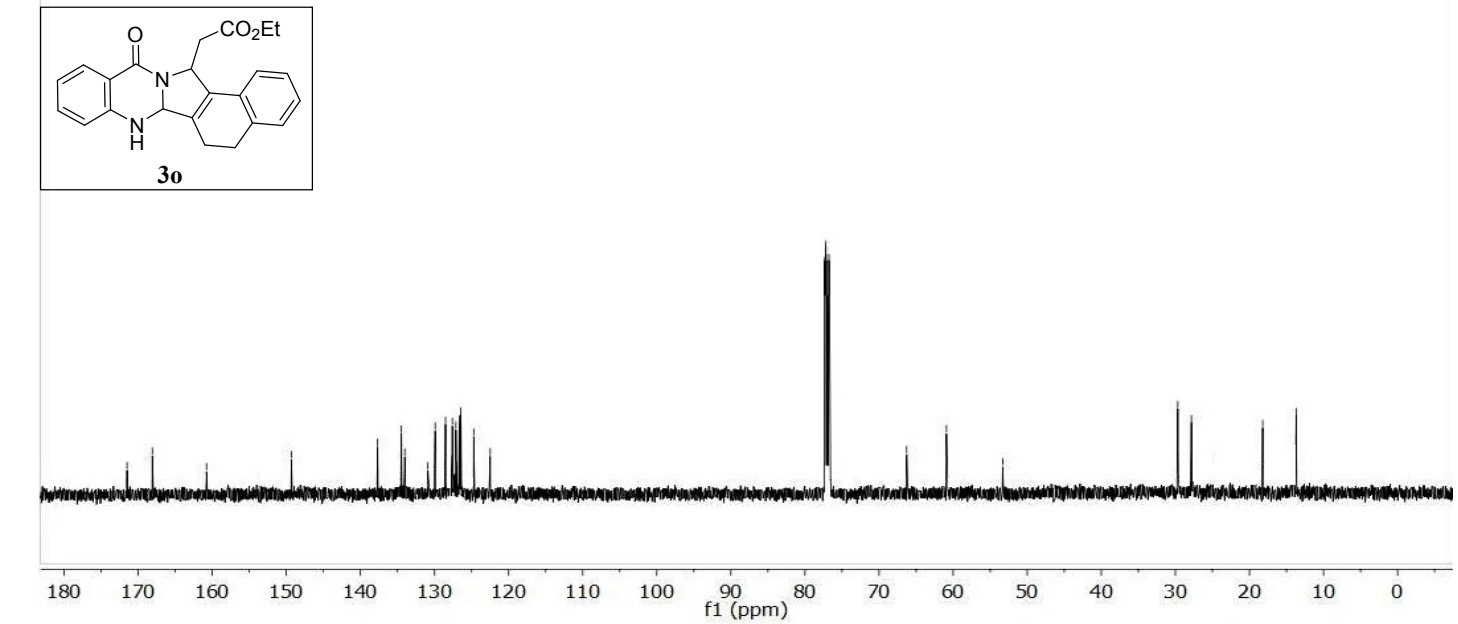
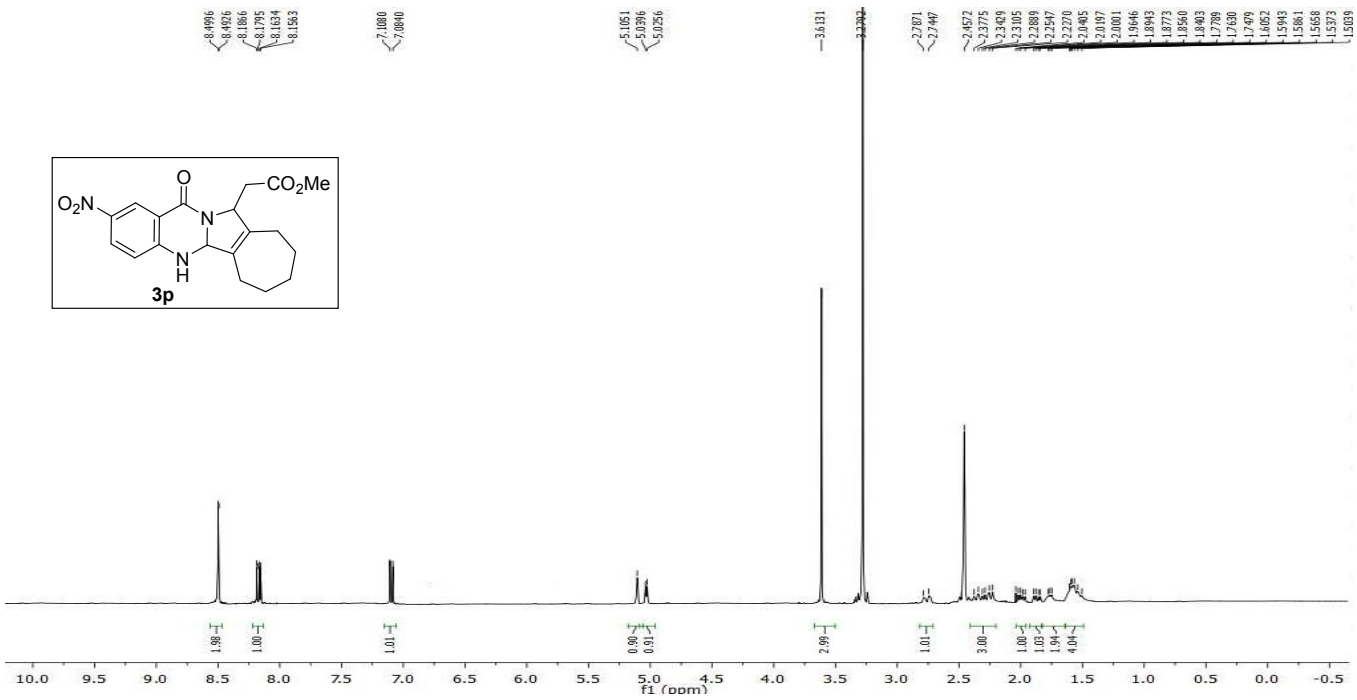
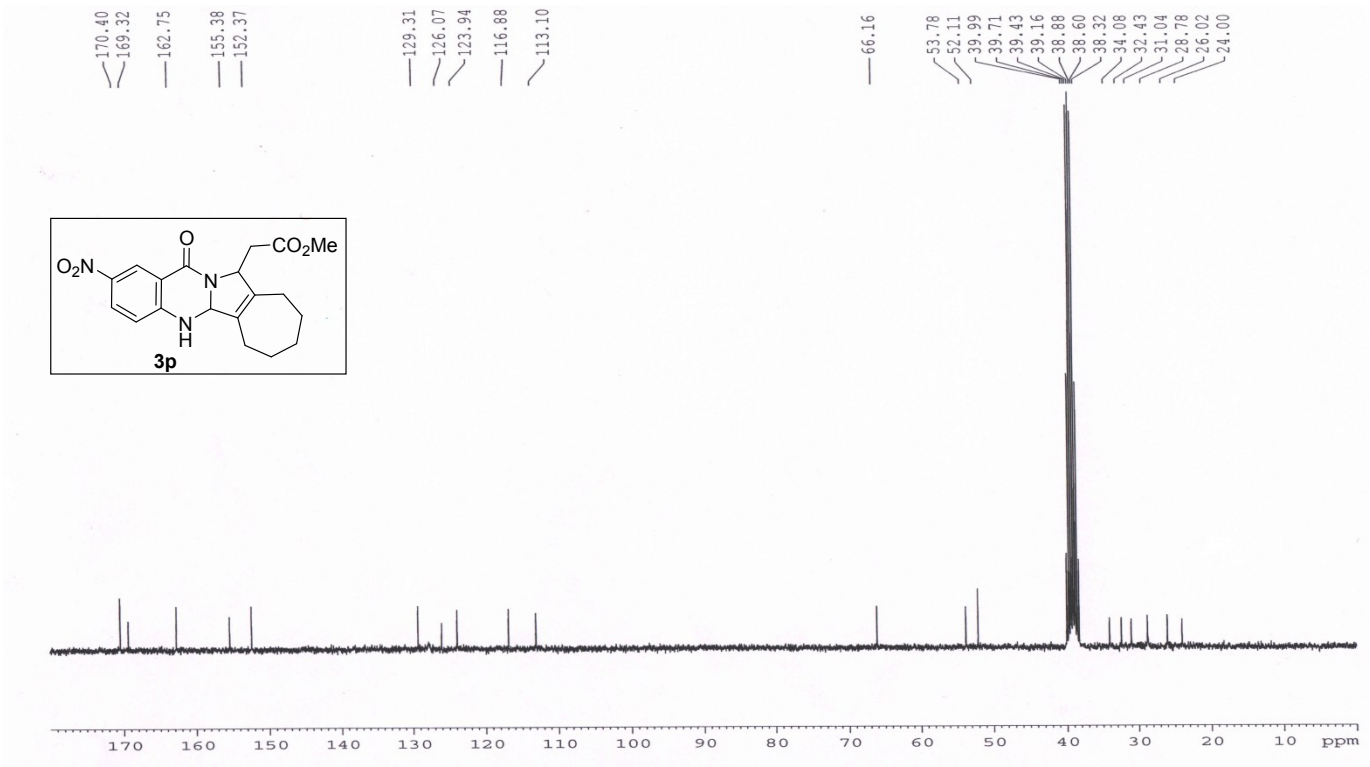
8.0136
7.7384
7.4530
7.4334
7.4152
7.3697
7.2994
7.2514
7.1888
7.1706
6.9847
6.9666
6.9476
6.6938
6.6739
6.0439
5.6878
4.7128
4.6998
4.2018
4.1837
4.1743
4.1565
4.1391
4.1034
4.0853
3.1470
3.1146
3.0740
3.0027
2.8598
2.8443
2.8304
2.7266
2.6961
2.5237
2.3956
2.2021
2.1601
1.1953
1.1777
1.1599
0.96
1.07
2.98
0.93
1.00
0.97
1.00
0.91
0.94
1.12
1.89
2.02
1.16
1.06
3.03
11
10
9
8
7
6
5
4
3
2
1
0
ppm

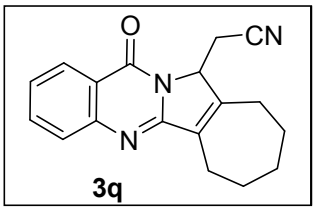

171.51
168.09
160.78
149.31
137.69
134.47
134.01
130.90
129.91
128.51
127.59
127.12
126.67
126.45
124.71
122.49
77.26
77.01
76.75
66.28
60.90
53.30
29.67
27.84
18.21
13.69
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

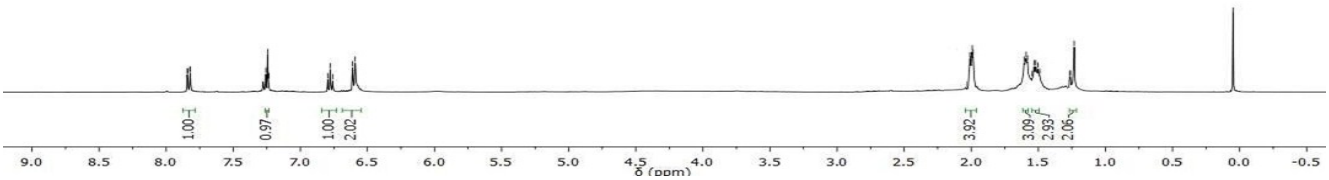

O2N
O
CO2Me
N
N
H
3p
f1 (ppm)


O2N
O
CO2Me
N
N
H
3p
ppm


7.8424
7.8389
7.8228
7.8198
7.2564
7.2442
7.2395
7.2355
6.7960
6.7776
6.7593
6.6114
6.5914


2.0386
2.0098
2.0050
1.9923
1.9862
1.6056
1.5910
1.5808
1.5460
1.5321
1.5190
1.5025
1.4897
1.2670
1.2611
1.2327
0.0489

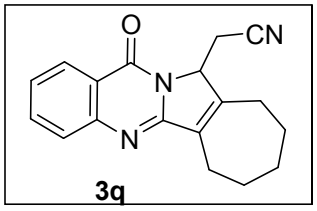

O
CN
N
N
3q

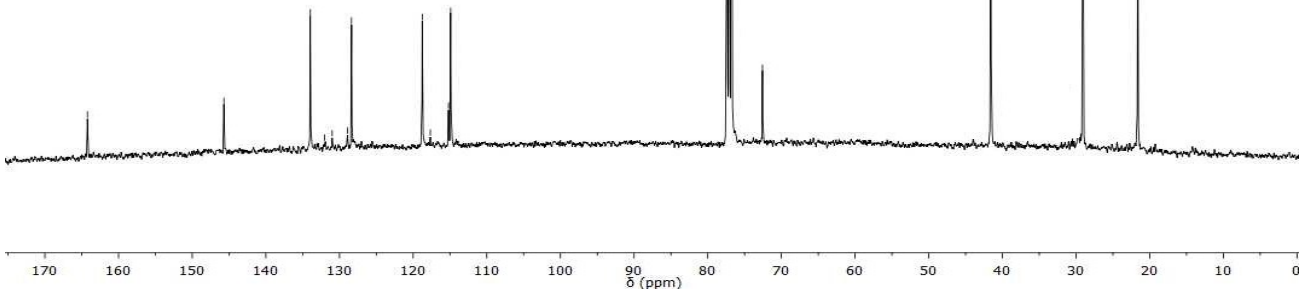

1.00
0.97
1.00
2.02
3.92
3.09
2.93
2.06
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
δ (ppm)

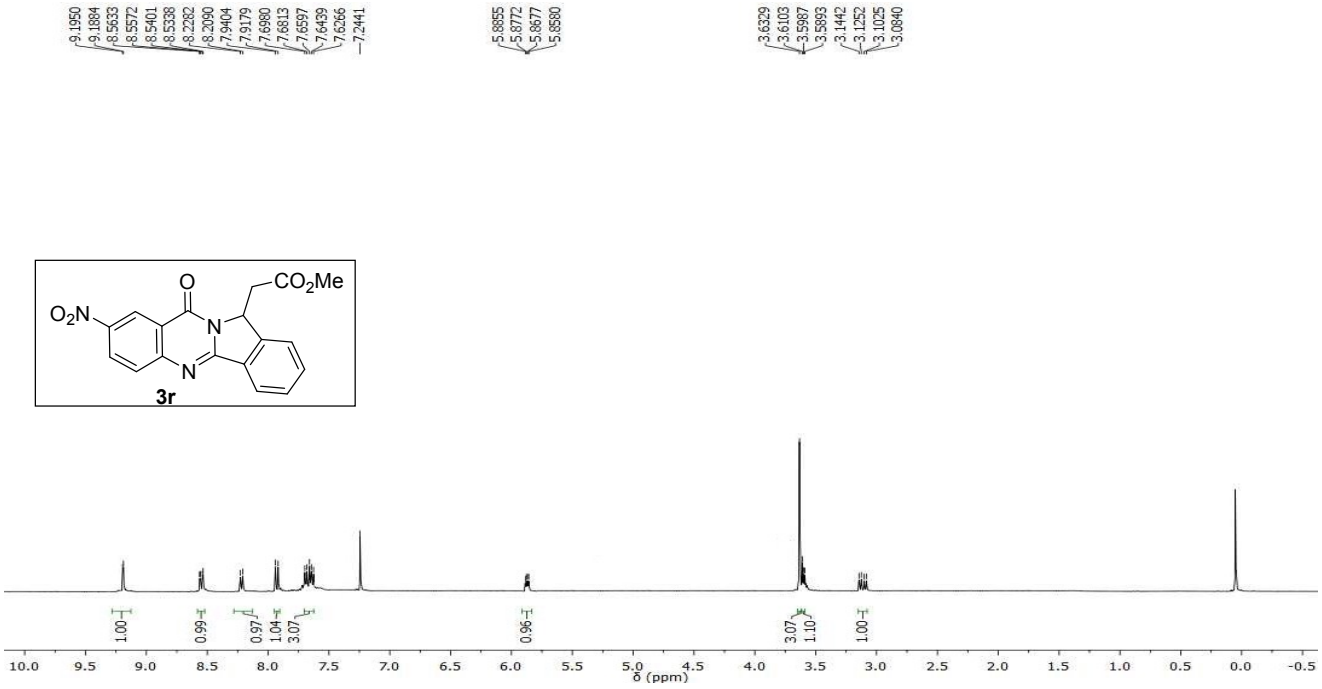

164.22
145.69
133.96
132.03
130.99
128.91
128.37
118.76
117.67
115.20
114.91

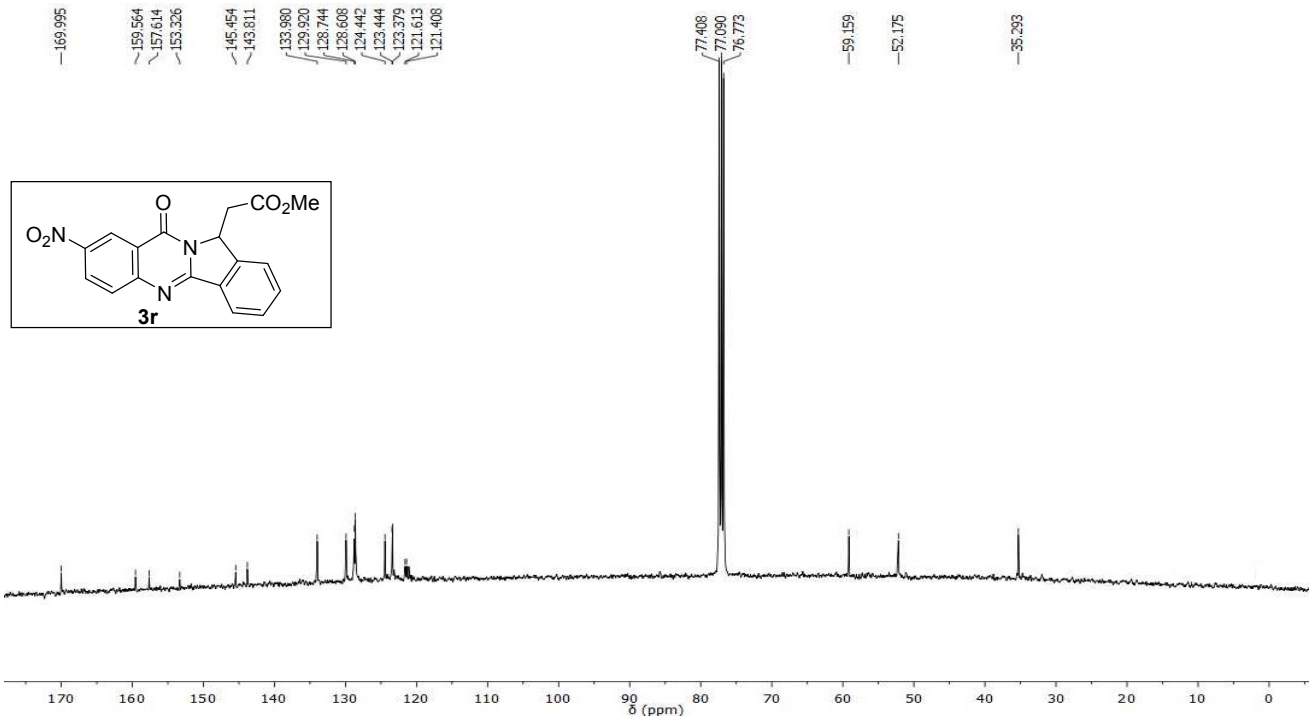

77.42
77.10
76.79
72.57

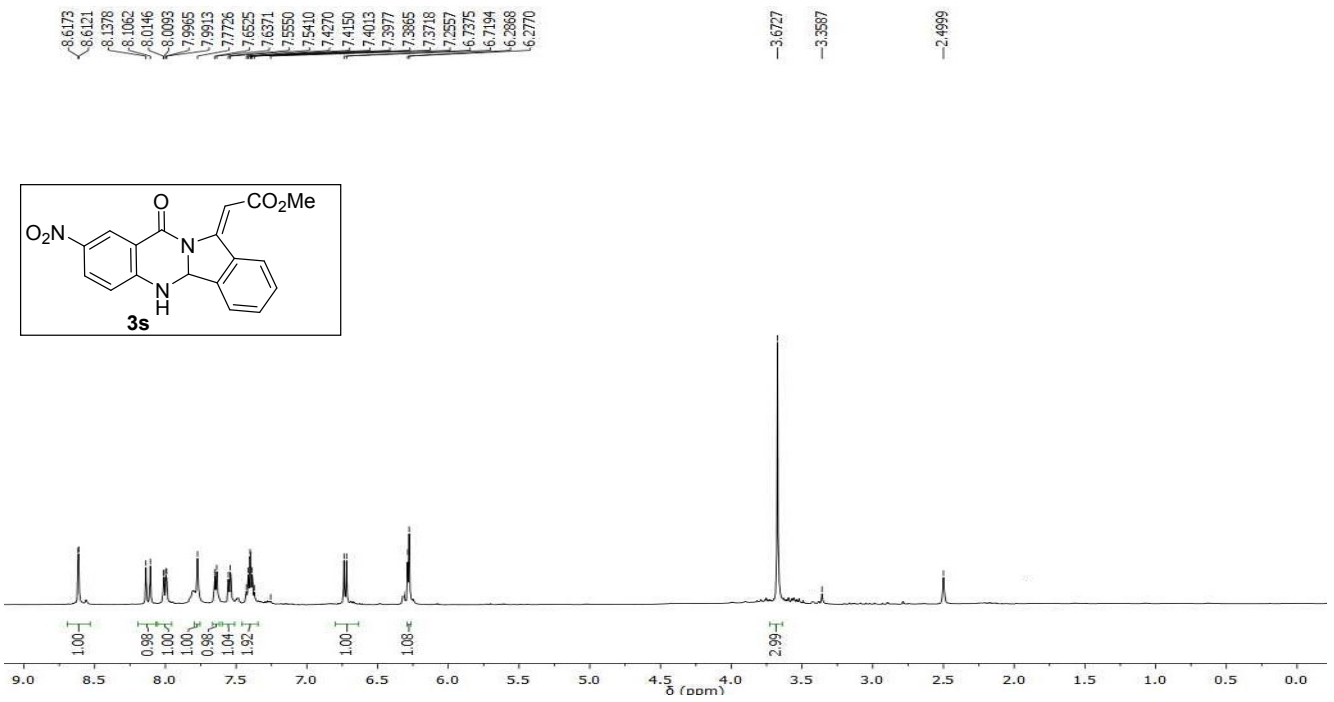

41.57
29.06
21.62

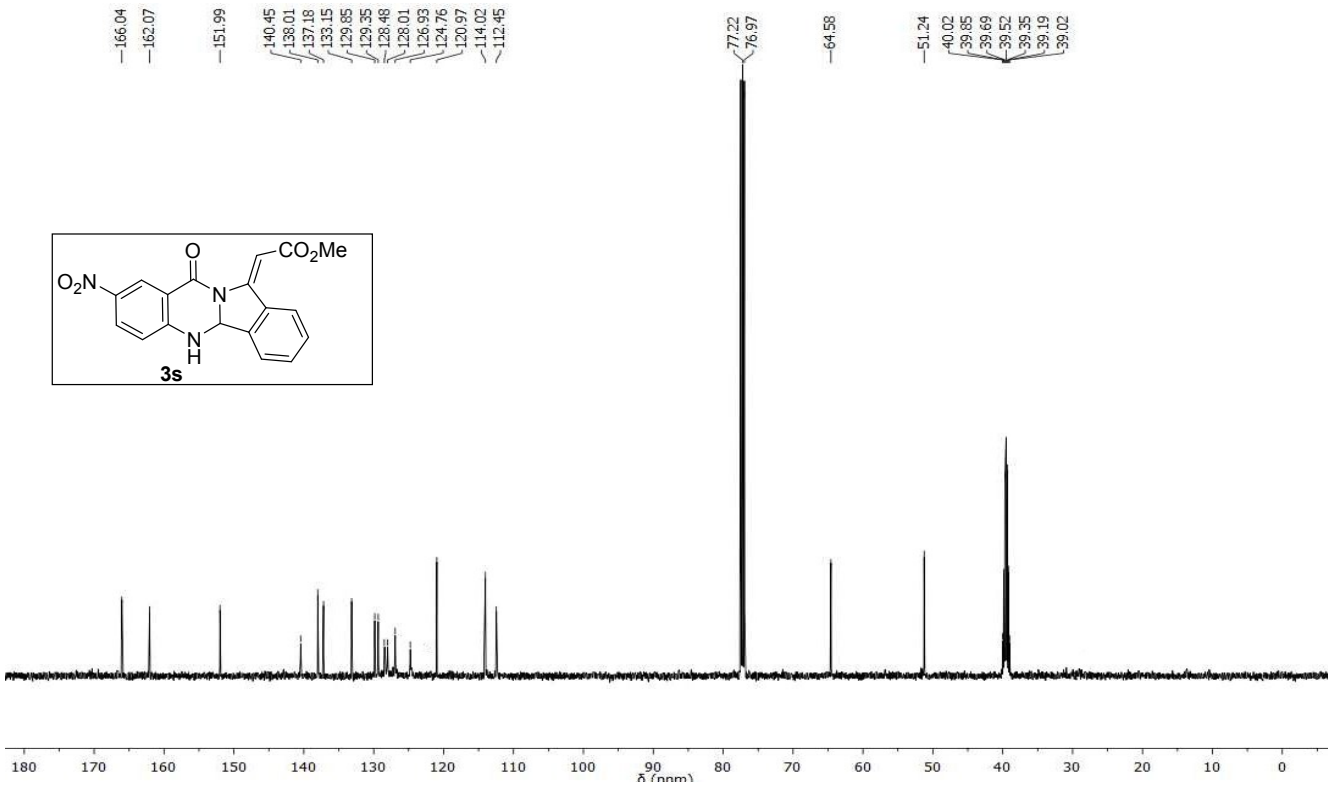

O
CN
N
N
3q

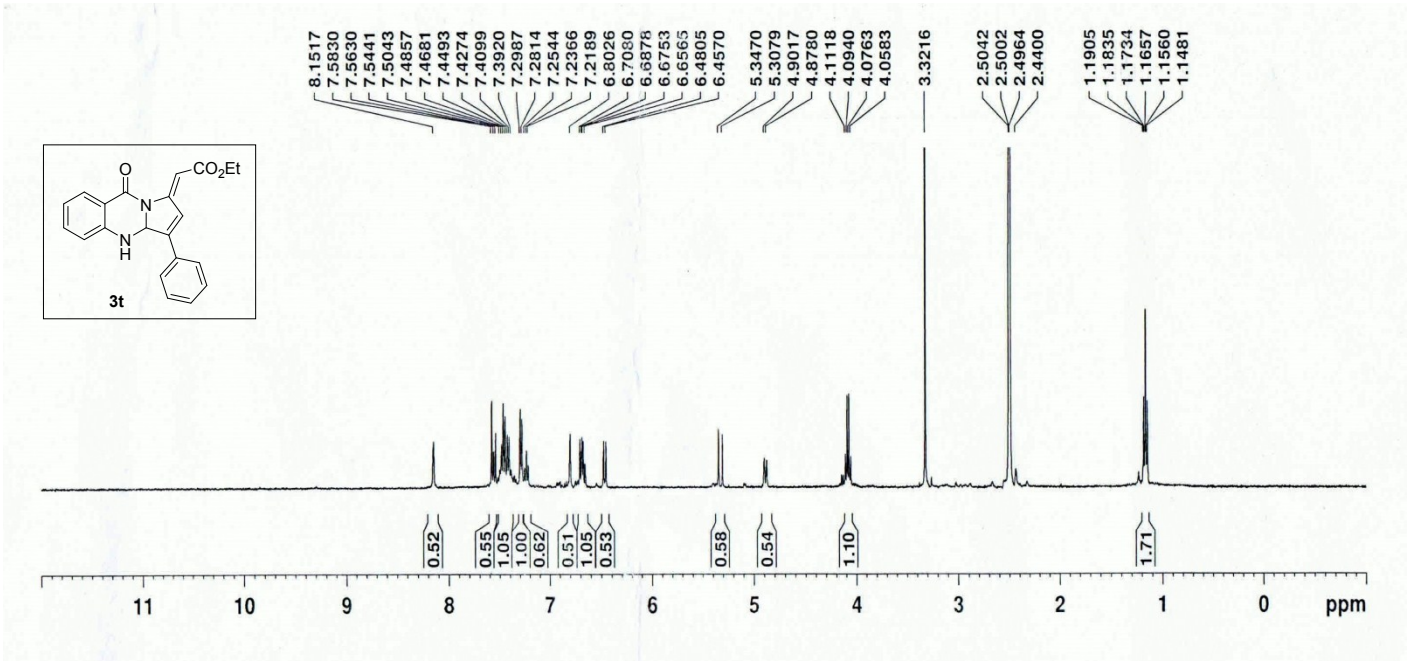

170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
δ (ppm)


9.1950
9.1884
8.5633
8.5572
8.5401
8.5338
8.2282
8.2090
7.9404
7.9179
7.6980
7.6813
7.6597
7.6439
7.6266
7.2441
5.8855
5.8772
5.8677
5.8580
3.6329
3.6103
3.5987
3.5893
3.1442
3.1252
3.1025
3.0840
O
CO2Me
O2N
N
N
3r
1.00
0.99
0.97
1.04
3.07
0.96
3.07
1.10
1.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
δ (ppm)


169.995
159.564
157.614
153.326
145.454
143.811
133.980
129.920
128.744
128.608
124.442
123.444
123.379
121.613
121.408
77.408
77.090
76.773
59.159
52.175
35.293
O
CO2Me
O2N
N
N
3r
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
δ (ppm)


8.6173
8.6121
8.1378
8.1062
8.0146
8.0093
7.9965
7.9913
7.7726
7.6525
7.6371
7.5550
7.5410
7.4270
7.4150
7.4013
7.3977
7.3865
7.3718
7.2557
6.7375
6.7194
6.2868
6.2770
3.6727
3.3587
2.4999
O2N
O
CO2Me
N
N
H
3s
1.00
0.98
1.00
1.00
0.98
1.04
1.92
1.00
1.08
2.99
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
δ (ppm)


166.04
162.07
151.99
140.45
138.01
137.18
133.15
129.85
129.35
128.48
128.01
126.93
124.76
120.97
114.02
112.45
77.22
76.97
64.58
51.24
40.02
39.85
39.69
39.52
39.35
39.19
39.02
O2N
O
CO2Me
N
N
H
3s
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
δ (ppm)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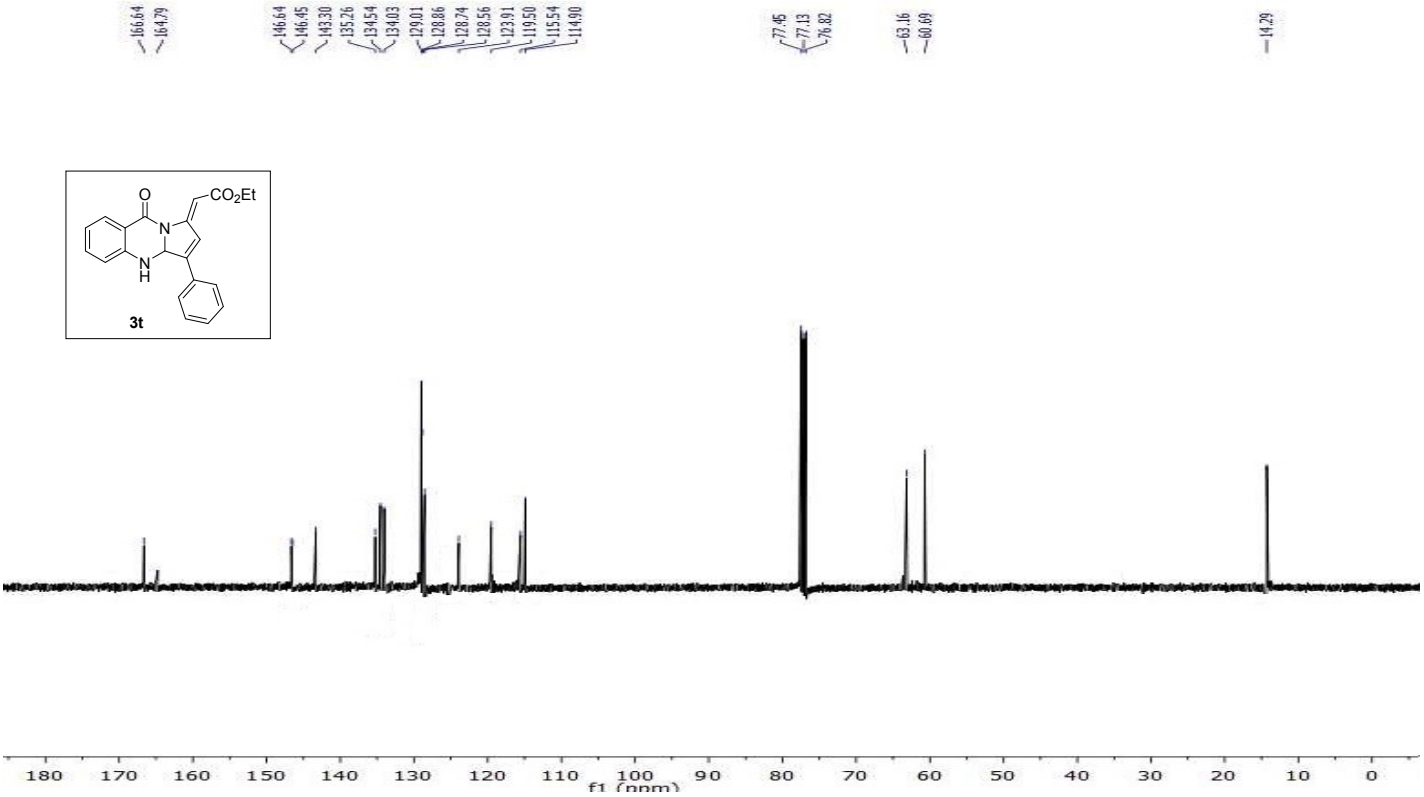
7.5830
7.5630
7.5441
7.5043
7.4857
7.4681
7.4493
7.4274
7.4099
7.3920
7.2987
7.2814
7.2544
7.2366
7.2189
6.8026
6.7080
6.6878
6.6753
6.6565
6.4805
6.4570
5.3470
5.3079
4.9017
4.8780
4.1118
4.0940
4.0763
4.0583
3.3216
2.5042
2.5002
2.4964
2.4400
1.1905
1.1835
1.1734
1.1657
1.1560
1.1481
CO2Et
O
N
H
3t
0.52
0.55
1.05
1.00
0.62
0.51
1.05
0.53
0.58
0.54
1.10
1.71
11
10
9
8
7
6
5
4
3
2
1
0
ppm


166.64
164.79
146.64
146.45
143.30
135.26
134.54
134.03
129.01
128.86
128.74
128.56
123.91
119.50
115.54
114.90
77.45
77.13
76.82
63.16
60.69
14.29
CO2Et
O
N
H
3t
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

References:

1. (a) S. K. Manna, A. Mandal, S. K. Mondal, A. K. Adak, A. Jana, S. Das, S. Chattopadhyay, S. Roy, S. K. Ghorai, S. Samanta, M. Hossain and M. Baidya, *Org. Biomol. Chem*., 2015, **13**, 8037; (b) S. K. Manna**,** S. K. Mondal, A. Ahmed, A. Mandal, A. Jana, M. Ikbal, S. Samanta and J. K. Ray, *RSC Adv*., 2014, **4**, 2474; (c) S. K. Mondal, S. K. Manna, A. Mandal, S. Samanta and J. K. Ray, *Tetrahedron Lett*., 2014, **55**, 6411; (d) A. Jana, S. K. Manna, S. K. Mondal, A. Mandal, A. Jana, B. K. Senapati, M. Jana and S. Samanta, *Tetrahedron Lett*., 2016, **57**, 3722; (e) S. K. Mondal, A. Mandal, S. K. Manna, Sk. A. Ali, M. Hossain, V. Venugopal, A. Jana and S. Samanta, *Org. Biomol. Chem*., 2017, **15**, 2411; (f) S. K. Mondal, S. A. Ali, S. K. Manna, A. Mandal, B. K. Senapati, M. Hossain and S. Samanta, *ChemSelect*., 2017, **2**, 9312.
2. Y. Zheng, W-B. Song, S-W. Zhang and L-J. Xuan, *Org. Biomol. Chem.*, 2015, **13**, 6474.