Metal-free C(sp^3)–H functionalization (C–C and C–N bond formation) of 1,2,3,4-tetrahydroacridines using Deep Eutectic solvent as catalyst and reaction medium

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1. *General:* All the solvents and required chemicals were procured from SD-Fine, Sigma-Aldrich, and Spectrochem, and used without purification and distillation. ^{1}H and ^{13}C-NMR spectra were recorded on Bruker Avance 400 MHz spectrometers using $CDCl_3$ and DMSO-d_6 as solvents and reported in δ ppm. The mass spectra of all the compounds were record using Agilent Technologies-6530.

2. Experimental section:

Synthesis of 1,2,3,4- tetrahydroacridine derivatives (1a-1p, 1r, 1s,1u)

General procedure for synthesis of compound (1a):[1]

In a round bottom flask equipped with a magnetic stir bar, 2-nitrobenzaldehyde (5.0 mmol) was dissolved in EtOH (15 mL). Iron powder (4.0 equiv) and 0.1 N HCl (5.0 mol %, 2.5 mL) were added and the mixture was stirred at 95 °C for 40 min. The contents were cooled to room temperature and cyclohexanone (1.0 equiv) was added followed by addition of powdered KOH (1.2 equiv). Heating was continued at 95 °C for another 30 min. The reaction mixture was then filtered through celite pad. The resulting filtrate was diluted with water and extracted using dichloromethane (310 mL). The combined organic layers were further washed with brine, dried over Na_2SO_4 and concentrated under reduced pressure. Purification by silica gel chromatography (hexane/EtOAc) afforded **1a** as yellow solid in 90% yield.

General procedure for synthesis of compound (1b-1f, 1n,1o,1q,1r):[2]

1.53g of Deep Eutectic Solvent (DES) was prepared by heating *N,N'*-dimethyl urea (0.975g) + L-tartaric acid (0.555g) at 80 °C for 30 min. To this melt, 2- aminoacetophenone/2-aminobenzophenone derivatives (0.231g, 1 mmol) and cyclohexanone/1,3-cyclohexadione/ 1,3-diketone was added and heating continued for another 1-2 h at 80 °C to give the (1b-1f,1n,1o,1q,1r)

General procedure for synthesis of compound (1g-1i):[3]

$POCl_3$ (25 mL) was added dropwise using a constant pressure dropping funnel to an ice-cooled mixture of anthranilic acid (3.2 g, 23.3 mmol) and cyclohexanone (2.65 mL, 27 mmol). Then, the reaction mixture was heated at 100 °C for 3 h. After the reaction was completed, the reaction mixture was cold to rt. Then the solvent was reduced in a vacuum and the ethyl acetate was

added to residue and neutralized with 1 N K_2CO_3 solution, and brine, and the organic layer was dried over anhydrous Na_2SO_4. The residue was purified by silica gel chromatography to yield the desired product (4) as a yellow solid.

General procedure for synthesis of compound (1j-1l): [4]

1,2,3,4-tetrahydroacridine-9-carboxylic acid (0.98 g, 3 mmol) and potassium carbonate (2.07 g, 15 mmol) were weighed into a round-bottom flask. Methyl iodide / propargylbromide/ benzylbromide (3 equiv) and acetone (4 mL) were added. The reaction mixture was stirred at room temperature. The progress of the reaction was monitored by TLC. The reaction was completed after 5 h. The solvent was evaporated in vacuo and water was added to the remaining mixture. The product was collected by suction filtration and air-dried. The crude product was separated on a silica gel column to obtain desired product (1j-1l).

General procedure for synthesis of compound (1m): [5]

To a solution of 1,2,3,4-tetrahydroacridine-9-carboxylic acid (3.2 mmol) in DMF (10 mL) DMAP (9.7 mmol) was added and cooled to 0 °C. Then EDC. HCl (6.5 mml), HOBt (6.5 mmol) and toluidine (4.9 mmol) were added and resulting mixture was stirred at room temperature for 30 minutes.

General procedure for synthesis of compound (1p): [6]

In a 25-mL round-bottom flask, the mixture of isatins (1.0 g, 6.8 mmol), cyclohexanone (2.15 g, 13.6 mmol), conc.H_2SO_4 (1.0 mL, l8.4 mmol), and EtOH (10 mL) was stirred at 80 °C for 1.5 h, and monitored by thin-layer chromatography (TLC) until the staring material to show complete consumption. The mixture was cooled to room temperature, the alcohols were evaporated in vacuo, and then water was added. The mixture was extracted with ethyl acetate (EtOAc). The organic phase was washed with brine, dried with sodium sulfate (Na_2SO_4), and concentrated. The residue was purified by column chromatography on silica gel (5–25% ethyl acetate in petroleum ether) to get the desired product.

General procedure for synthesis of compound (3):

Deep eutectic solvent was prepared by heating Cholinechloride + L-tartaric acid (1:2 ratio) at 80 °C for 30 min. To this, 1,2,3,4- tetrahydro acridine **1** (0.545 mmol) and dialkylazodicarboxylate **2** (0.545 mmol) were added and heating continued for another 30 min to 2 hours at 80 °C. The completion of reaction was monitored by TLC. After completion of reaction the crude products obtained were purified by column chromatography on silica gel using petroleum ether-ethyl acetate as eluent to give the compound **3**.

General procedure for synthesis of compound (5):

Deep eutectic solvent was prepared by heating *N, N'*-dimethyl urea + L-tartaric acid (3:1 ratio) at 80 °C for 30 min. To this, compound **1** (0.545 mmol) and N- phenyl maleimide (0.545 mmol) were added and heating continued 2 hours at 80 °C. The completion of reaction was monitored by TLC. After completion of reaction the crude products obtained were purified by column chromatography on silica gel using petroleum ether-ethyl acetate as eluent to give the compound **5**.

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3. D. Wang, M. Hu, X. Li, D. Zhang, C. Chen, J. Fu, S. Shao, G. Shi, Y. Zhou, S. Wu, T. Zhang, *Eur. J. Med. Chem*., 2019, **168**, 207-220.
4. Y. Wu, Z. Chen, Y. Liu, L. Yu, L. Zhou, S. Yang, L. Lai, *Bioorg. Med. Chem.,* 2011, **19**, 3361–3366.
5. X. Lu, H. Zhang, X. Li, G. Chen, Q. S. Li, Y. Luo, B. F. Ruan, X.-W. Chen, H.-L. Zhu, *Bioorg. Med. Chem.,* 2011, **19**, 6827–6832.
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3. Recycling experiments

To check the recyclability of DES [i.e., ChCl/L-(+)-TA (1:2) or DMU/ L-(+)-TA (3:1)], experiments were conducted to extract DES from the reaction mixture using liquid-to-liquid extraction method and this was followed by evaporation of aqueous layer. The recovered DES was then vacuum-dried and utilized to conduct the model reaction in the subsequent run. Interestingly it was noted that DES was stable even after four consecutive runs to give the desired products **3e** or **5e** with relatively good yields.

General procedure for the recycling the DES:

After completion of the reaction [monitored by the TLC (both C-N and C-C bond formations)], water (5 mL) was added and the mixture was stirred for 5 minutes at room temperature. Then EtOAc (10 mL) was added the round bottom flask. The mixture was transferred to the separating funnel and organic layer was separated (Two times). The aqueous layer concentrated under vacuum (to remove the water). The thick liquid (DES) obtained was reused for the next cycle of reaction.

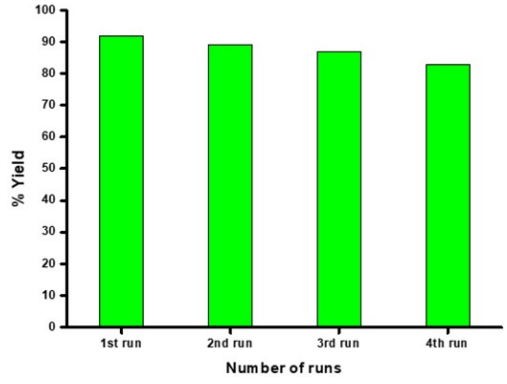


Fig.1 Bar graph showing the recyclability of ChCl/L-(+)-TA for the synthesis of compound **3e**.

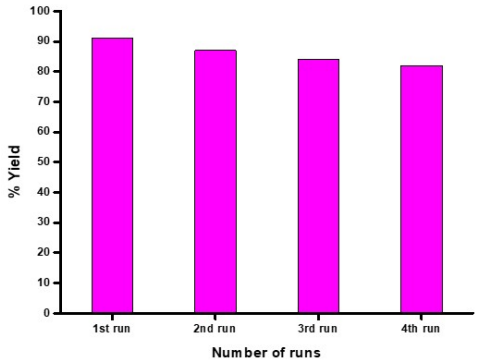
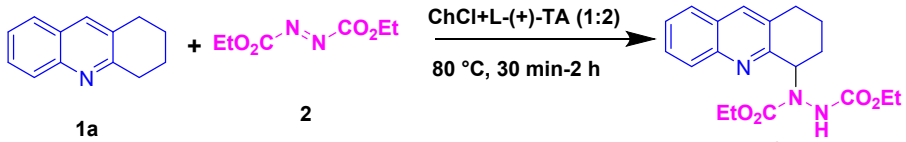


Fig.2 Bar graph showing the recyclability of DMU/L-(+)-TA for the synthesis of compound **5e.**

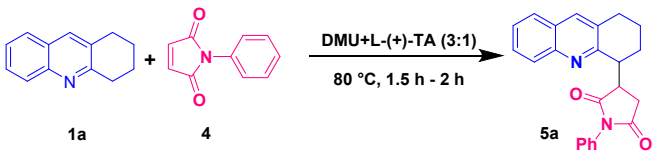
4. Green metrics calculations



	1a	2	3a
MW:	183.25	174.1560	357.4100
mmol	0.545	0.545	0.5
Amount	0.1g	0.095g	0.179g

S. No.	Parameters	Formula	Characteristics	Ideal Value	Calculated value for compound 3a
1	Environmental (*E*) factor	Amount of waste (in Grams)/ Amount of product (in Grams)	E-factor signifies the total amount of waste generated in a chemical reaction.	0	0.0166 / 0.179 = 0.09
2.	Atom economy (AE %)	[MW of product] / Sum of MW of reactants) × 100	Atom economy signifies the percentage of atoms wasted in chemical reaction. Higher the value of AE, greener is the reaction.	100%	[357.41/ (183.254+174.156)] × 100 = 100
3.	Mass intensity (MI)	∑ (mass of stoichiometric reactants)/[mass of stoichiometry product]	Mass intensity (MI), defined as the mass ratio of total input of materials (excluding water) to final product. MI takes into account reaction efficiency.	1	(0.1+0.095)/0.179 = 1.09
4.	Reaction mass efficiency (RME %)	[mass of product/∑ (mass of stoichiometric reactants)] × 100	RME accounts into atom economy, chemical yield and stoichiometry.	100%	[0.179/ (0.1+0.095)] × 100 = 91.79
5.	Carbon efficiency (CE %)	[Amount of carbon in product/ Total carbon present in reactants] x 100	CE signifies the percentage of carbons in the reactants that is remain in the product.	100%	[0.5 × 19/ (0.545 × 13 + 0.545 × 6)] × 100 = [3.401/ (7.085+3.27) = 91.74%

S. No.	Compound No.	*E*-Factor	Atom economy (%)	Mass intensity	Reaction mass efficiency (%)	Carbon efficiency (%)
1	3a	0.09	100	1.09	91.79	91.74
2	3b	0.11	100	1.11	89.89	89.9
3	3c	0.075	100	1.075	92.9	92.9
4	3d	0.096	100	1.096	90.7	90.5
5	3e	0.046	100	1.046	95.59	95.5
6	3f	0.089	100	1.089	91.8	91.8
7	3g	0.139	100	1.139	87.78	87.3
8	3h	0.074	100	1.074	92.9	93
9	3i	0.058	100	1.058	94.5	94.55
10	**3j**	**0.044**	**100**	**1.044**	**95.78**	**95.78**
11	3k	0.052	100	1.052	95	95
12	3l	0.099	100	1.099	90.9	90.8
13	3m	0.087	100	1.087	91.96	91.9
14	3n	0.11	100	1.11	89.77	89.6
15	3o	0.129	100	1.129	88.5	88.5
16	3p	0.2	100	1.2	82.9	82.8
17	3q	0.15	100	1.15	86.7	86.68
18	3r	0.1	100	1.11	90	90
19	3s	0.219	100	1.219	82	81.9
20	3t	0.17	100	1.17	85	84.94
21	3u	0.2	100	1.2	83	83
22	3v	0.19	100	1.19	83.9	83.7
23	3w	0.42	100	1.42	70	70
24	3x	0.216	100	1.216	82	82



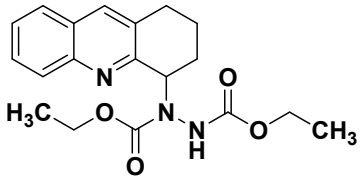
	1a	4	5a
MW:	183.25	173.1710	356.4250
mmol	0.545	0.545	0.49
Amount	0.1g	0.0945g	0.175g

S. No.	Parameters	Formula	Characteristics	Ideal Value	Calculated value for compound 5a
1	Environmental (*E*) factor	Amount of waste (in Grams)/ Amount of product (in Grams)	E-factor signifies the total amount of waste generated in a chemical reaction.	0	0.0195 / 0.175 = 0.11
2.	Atom economy (AE %)	[MW of product] / Sum of MW of reactants) × 100	Atom economy signifies the percentage of atoms wasted in chemical reaction. Higher the value of AE, greener is the reaction.	100%	[356.425/(183.254+173.171)] × 100 = 100
3.	Process mass intensity (PMI)	∑ (mass of stoichiometric reactants)/[mass of stoichiometry product]	Mass intensity (MI), defined as the mass ratio of total input of materials (excluding water) to final product. MI takes into account reaction efficiency.	1	(0.1+0.0945)/0.175 = 1.111
4.	Reaction mass efficiency (RME %)	[mass of product/∑ (mass of stoichiometric reactants)] × 100	RME accounts into atom economy, chemical yield and stoichiometry.	100%	[0.175/ (0.1+0.0945)] × 100 = 89.97%
5.	Carbon efficiency (CE %)	[Amount of carbon in product/ Total carbon present in reactants] x 100	CE signifies the percentage of carbons in the reactants that is remain in the product.	100%	[0.49 × 23/ (0.545 × 13 + 0.545 × 10)] × 100 = [11.27/ (7.085+5.45) = 89.9 %

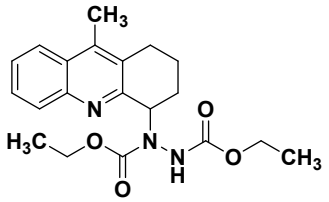
S. No.	Compound No.	*E*-Factor	Atom economy (%)	Mass intensity	Reaction mass efficiency (%)	Carbon efficiency (%)
1	**5a**	0.11	100	1.11	89.97	89.9
2	**5b**	0.149	100	1.149	87	87
3	**5c**	0.098	100	1.098	91	90.9
4	**5d**	0.11	100	1.11	90	89.6
5	**5e**	0.063	100	1.063	94	93.8
6	**5f**	0.19	100	1.19	83.9	83.4
7	**5g**	0.053	100	1.053	94.9	94.8
8	**5h**	0.11	100	1.11	90	89.3
9	**5i**	0.098	100	1.098	91	90.8
10	**5j**	**0.042**	**100**	**1.042**	**95.9**	**96**
11	**5k**	0.053	100	1.053	94.9	94.9
12	**5l**	0.2	100	1.2	82	81.9
13	**5m**	0.1	100	1.1	90.9	90.4
14	**5n**	0.25	100	1.25	79.9	79.7
15	**5o**	0.13	100	1.13	87.9	87.8
16	**5p**	0.25	100	1.25	79.8	79.7
17	**5q**	0.12	100	1.12	89	88.9
18	**5r**	0.32	100	1.32	75.7	75.4
19	**5s**	0.26	100	1.26	79	78.8
20	**5t**	0.3	100	1.3	75	74.8
21	**5u**	0.26	100	1.26	79	78.6

5. Characterization Data for synthesized compounds

Diethyl 1-(1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate(3a): Yield = 92%, white solid; M. P: 99.2 -99.8 °C; **IR (KBr, cm^{-1})**: 3055, 2928, 2862, 1757, 1623, 1545, 1247, 1141, 1056, 945, 742; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.94 (d, *J* = 10.6 Hz, 1H), 7.86 (d, *J* = 9.0 Hz, 1H), 7.73 (dd, *J* = 13.6, 7.5 Hz, 1H), 7.64 – 7.58 (m, 1H), 7.51 – 7.42 (m, 1H), 6.61 (m, 1H), 4.24 (d, *J* = 7.1 Hz, 2H), 4.21 – 4.02 (m, 2H), 3.04 – 2.87 (m, 2H), 2.44 (d, *J* = 33.5 Hz, 1H), 2.04 (d, *J* = 32.4 Hz, 2H), 1.72 (s, 1H), 1.39 – 1.25 (m, 6H). ^{13}C NMR (101 MHz, DMSO) δ 156.85, 156.30, 152.37, 146.60, 135.32, 132.02, 129.21, 128.81, 127.37, 127.09, 126.53, 63.65, 62.02, 61.14, 28.64, 27.69, 21.24, 14.74, 14.35. **HRMS (ESI-MS):** m/z Calculated for $C_{19}H_{23}N_3O_4$ $[M+H]^+$: 358.1761; Observed: 358. 1766.

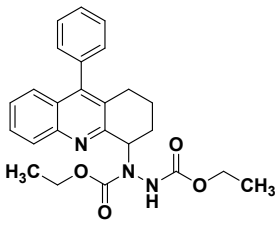


Diethyl 1-(9-methyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3b): Yield = 90%, White solid; M. P: 119-119.9 °C; **IR (KBr, cm^{-1})**: 3025, 2948, 2884, 1753, 1645, 1510, 1275, 1112, 1071, 954, 798; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.96 (d, *J* = 8.4 Hz, 1H), 7.93 (d, *J* = 8.0 Hz, 1H), 7.60 (t, *J* = 8.4 Hz, 1H), 7.49 (t, *J* = 8.4 Hz, 1H), 6.73 – 6.38 (m, 1H), 5.51 (m, 1H), 4.30 (q, *J* = 7.2 Hz, 4H), 2.99 (d, *J* = 16.8 Hz, 1H), 2.84 – 2.75 (m, 1H), 2.54 (s, 3H), 2.51 – 2.41 (m, 1H), 2.17 (s, 1H), 1.96 (d, *J* = 6.0 Hz, 2H), 1.32 (t, *J* = 7.2 Hz, 6H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 158.43, 157.66, 156.90, 155.23, 152.23, 145.85, 142.02, 129.88, 129.25, 128.20, 127.20, 126.03, 123.28, 64.08, 62.61, 62.48, 61.66, 26.99, 26.58, 21.43, 14.58, 14.40, 14.13, 13.77. **HRMS (ESI-MS):** m/z Calculated for $C_{20}H_{25}N_3O_4$ $[M+H]^+$: 372.1918; Observed: 372.1920.



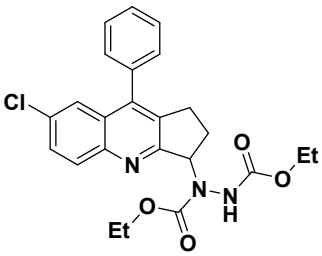
Diethyl 1-(9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3c):

Yield = 93%, white solid; M. P: 121.9 – 121.5 °C; **IR (KBr, cm^{-1})**: 3055, 2984, 2873, 1756, 1672, 1531, 1274, 1142, 1049, 959, 763; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.99 (d, *J* = 8.8 Hz, 1H), 7.59 (d, *J* = 5.6 Hz, 1H), 7.54 – 7.50 (m, 2H), 7.49 – 7.46 (m, 1H), 7.34 (d, *J* = 5.6 Hz, 2H), 7.22 (d, *J* = 6.8 Hz, 2H), 6.87 – 6.50 (m, 1H), 5.58 (m, 1H), 4.35 (s, 2H), 4.20 (q, *J* = 7.2 Hz, 2H), 2.62 (d, *J* = 8.4 Hz, 2H), 2.46 (s, 1H), 1.97 (s, 3H), 1.43 – 1.25 (m, 6H). **^{13}C NMR (101 MHz, DMSO) δ** 156.88, 156.18, 146.59, 146.23, 136.84, 130.62, 129.59, 129.40, 129.34, 129.27, 129.17, 129.07, 128.72, 128.39, 126.90, 126.64, 125.58, 62.05,



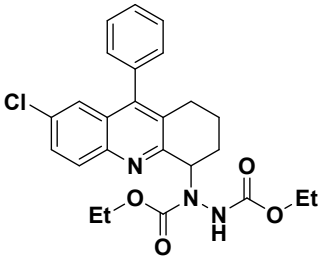
61.15, 27.52, 27.18, 21.16, 14.85, 14.79. **HRMS (ESI-MS):** m/z Calculated for $C_{25}H_{27}N_3O_4$ $[M+H]^+$: 434.2075; Observed: 434.2068.

Diethyl 1-(7-chloro-9-phenyl-2,3-dihydro-1H-cyclopenta[b]quinolin-3-yl)hydrazine-1,2-dicarboxylate (3d):



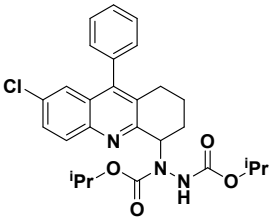
Yield = 91%, White solid; M. P: 198.1- 198.4 °C; **IR (KBr, cm^{-1})**: 3255, 2978, 2928, 2852, 1743, 1682, 1522, 1228, 1159, 1060, 942, 759; **^{1}H NMR (400 MHz, $CDCL_3$+DMSO) δ** 8.04 (d, *J* = 8.8 Hz, 1H), 7.73 (s, 1H), 7.59 (dd, *J* = 6.4, 2.3 Hz, 2H), 7.56 (d, *J* = 2.4 Hz, 2H), 7.52 (d, *J* = 7.1 Hz, 1H), 7.35 (q, *J* = 7.5 Hz, 2H), 5.84 (s, 1H), 4.31 – 4.22 (m, 2H), 4.18 – 4.07 (m, 2H), 2.84 (t, *J* = 7.3 Hz, 2H), 2.55 – 2.48 (m, 1H), 2.26 (s, 1H), 1.31 (t, *J* = 6.8 Hz, 3H), 1.21 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, $CDCL_3$+DMSO) δ** 163.73, 156.85, 156.00, 152.31, 146.91, 142.39, 135.51, 134.21, 131.68, 131.46, 129.35, 129.13, 129.05, 128.81, 127.60, 124.21, 63.49, 62.12, 61.16, 27.81, 27.40, 14.68, 14.29. **HRMS (ESI-MS):** m/z Calculated for $C_{24}H_{24}ClN_3O_4$ $[M+H]^+$: 454.1528; Observed: 454.1529.

Diethyl 1-(7-chloro-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3e):



Yield = 96%, White solid; M. P: 186.9 – 187.3 °C; **IR (KBr, cm^{-1})**: 3367, 2979, 1801, 1759, 1516, 1240, 1173, 1050, 837, 762; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.94 (d, *J* = 8.8 Hz, 1H), 7.58 – 7.53 (m, 3H), 7.52 (dt, *J* = 6.8, 1.6 Hz, 1H), 7.30 (d, *J* = 1.6 Hz, 1H), 7.22 (d, *J* = 7.2 Hz, 2H), 6.84 – 6.50 (m, 1H), 5.57 (m, 1H), 4.41 – 4.30 (m, 2H), 4.27 – 4.16 (m, 2H), 2.66 – 2.58 (m, 2H), 2.46 (s, 1H), 2.05 – 1.85 (m, 3H), 1.43 – 1.27 (m, 6H). **^{13}C NMR (101 MHz, DMSO) δ** 157.03, 156.91, 145.71, 144.75, 136.11, 131.98, 131.28, 130.54, 129.38, 129.32, 129.23, 128.73, 127.68, 124.07, 62.06, 61.14, 27.60, 27.07, 21.01, 14.85, 14.80. **HRMS (ESI-MS):** m/z Calculated for $C_{25}H_{26}ClN_3O_4$$[M+H]^+$: 468.1685; Observed: 468.1686.

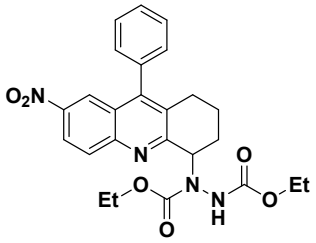
Diisopropyl 1-(7-chloro-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3f)



Yield = 92%, White solid; M. P: 150.9-151.3 °C; **IR (KBr, cm^{-1})**: 3304, 2981, 2934, 1730, 1674, 1469, 1262, 1097, 831, 762; **^{1}H NMR (400**

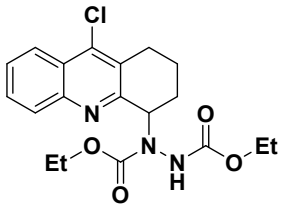
MHz, $CDCl_3$) δ 8.19 (d, *J* = 9.2 Hz, 1H), 7.90 (d, *J* = 9.2 Hz, 1H), 7.71 – 7.65 (m, 1H), 7.62 (m, 1H), 7.55 – 7.50 (m, 2H), 7.49 – 7.41 (m, 1H), 7.20 (d, *J* = 6.6 Hz, 1H), 6.78 – 6.24 (m, 1H), 5.52 (m, 1H), 5.11 – 5.03 (m, 1H), 4.99 (q, *J* = 6.0 Hz, 1H), 2.52 (m, 2H), 2.19 (m, 1H), 2.02 – 1.72 (m, 3H), 1.30 (dd, *J* = 16.4, 6.0 Hz, 12H). **^{13}C NMR (101 MHz, DMSO) δ** 157.18, 156.54, 155.67, 152.01, 145.68, 144.75, 136.11, 135.02, 132.68, 131.84, 131.56, 131.28, 130.56, 128.68, 127.67, 124.78, 124.09, 71.64, 69.59, 27.60, 27.12, 22.27, 22.21, 22.15, 21.86, 21.06. **HRMS (ESI-MS):** m/z Calculated for $C_{27}H_{30}ClN_3O_4[M+H]^+$: 496.1998; Observed: 496.1999.

Diethyl 1-(7-nitro-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3g):



Yield = 88%, Yellow solid; M. P: 176.2 – 177.0 °C; **IR (KBr, cm^{-1})**: 3420, 2924, 2853, 1751, 1715, 1545, 1374, 1292, 1054, 706; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.37 (dd, *J* = 9.2, 2.4 Hz, 1H), 8.29 (d, *J* = 2.4 Hz, 1H), 8.10 (d, *J* = 9.0 Hz, 1H), 7.59 (d, *J* = 2.4 Hz, 1H), 7.58 – 7.55 (m, 2H), 7.25 – 7.23 (m, 1H), 7.22 (m, 1H), 6.81 – 6.47 (m, 1H), 5.57 (m, 1H), 4.34 (s, 2H), 4.27 – 4.19 (m, 2H), 2.66 (m, 2H), 2.50 (s, 1H), 2.03 (m, 3H), 1.40 (s, 2H), 1.32 – 1.26 (m, 4H).**^{13}C NMR (101 MHz, $CDCl_3$) δ** 156.70, 150.96, 148.76, 148.10, 146.94, 135.28, 134.44, 133.37, 130.97, 130.30, 129.32, 129.18, 129.00, 128.86, 127.76, 122.83, 62.89, 62.28, 61.97, 40.08, 28.02, 22.25, 14.42. **HRMS (ESI-MS):** m/z Calculated for $C_{25}H_{26}N_4O_6[M+H]^+$: 479.1925; Observed: 479.1930.

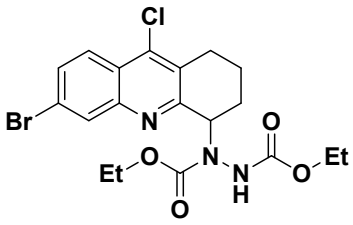
Diethyl 1-(9-chloro-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3h):



Yield = 93%, White solid; M. P: 153.8 – 154.9 °C; **IR (KBr, cm^{-1})**: 3251, 2979, 2934, 2868, 1749, 1682, 1512, 1317, 1217, 1132, 1056, 915,753; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.19 (dd, *J* = 8.8, 1.8 Hz, 1H), 7.97 (d, *J* = 8.8 Hz, 1H), 7.69 (ddd, *J* = 8.4, 6.8, 1.6 Hz, 1H), 7.60 (ddd, *J* = 8.4, 6.8, 1.6 Hz, 1H), 6.68 – 6.33 (m, 1H), 5.54 (m, 1H), 4.34 (s, 2H), 4.25 – 4.11 (m, 2H), 3.20 (d, *J* = 16.0 Hz, 1H), 2.90 (m, 1H), 2.49 (s, 1H), 2.22 (s, 1H), 2.01 (s, 2H), 1.40 – 1.23 (m, 6H). **^{13}C NMR (101 MHz, DMSO) δ** 158.38, 156.87, 156.78, 147.19, 140.59, 131.97, 130.95, 130.75, 125.61, 124.35, 123.00, 62.08, 61.09, 27.28, 26.87, 20.42, 14.82, 14.78. **HRMS (ESI-MS):** m/z Calculated for $C_{19}H_{22}ClN_3O_4[M+H]^+$: 392.1372; Observed: 392.1372.

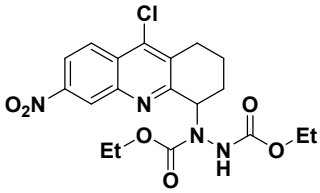
Diethyl 1-(6-bromo-9-chloro-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3i):

Yield = 95%, white solid; M. P: 169.4-169.9 °C; **IR (KBr, cm^{-1})**: 3253, 3062, 2977, 2933, 2869, 1750, 1682, 1509, 12290, 1094, 805; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.11 (s, 1H), 7.98 (d, *J* = 8.8 Hz, 1H), 7.62 (d, *J* = 7.2 Hz, 1H), 6.76 – 6.30 (m, 1H), 5.48 (m, 1H), 4.38 – 4.26 (m, 2H), 4.23 – 4.10 (m, 2H), 3.19 – 3.13 (m, 1H), 2.89 – 2.77 (m, 1H), 2.46 (s, 1H), 2.20 (s, 1H), 2.01 – 1.94 (m, 2H), 1.40 – 1.21 (m, 6H). **^{13}C NMR (101 MHz, DMSO) δ** 156.82, 146.72, 140.43, 130.03, 129.98, 129.82, 128.01, 125.42, 123.49, 62.06, 61.13, 27.30, 27.00, 20.48, 14.81, 14.76. **HRMS (ESI-MS):** m/z Calculated for $C_{19}H_{21}BrClN_3O_4[M+H]^+$: 470.0477; Observed: 470.0477.



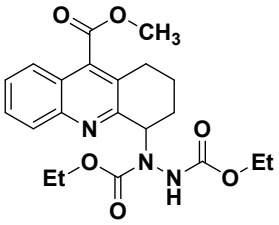
Diethyl 1-(9-chloro-6-nitro-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3j):

Yield = 96%, light Yellow solid; M. P: 158.2 – 158.9 °C; **IR (KBr, cm^{-1})**:3246, 3021, 2931, 1749, 1677, 1528, 1346, 1226, 1163, 1068, 901, 885;**^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.83 (s, 1H), 8.32 (s, 2H), 6.70 – 6.25 (m, 1H), 5.53 (m, 1H), 4.39 – 4.26 (m, 2H), 4.25 – 4.09 (m, 2H), 3.23 (m, 1H), 2.93 (m, 1H), 2.51 (s, 1H), 2.25 (s, 1H), 2.04 (d, *J* = 6.4 Hz, 2H), 1.25 (d, *J* = 6.0 Hz, 6H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 159.54, 157.13, 156.31, 148.05, 145.39, 141.86, 133.25, 128.85, 125.76, 125.58, 120.59, 62.97, 62.01, 27.46, 26.46, 20.74, 14.55, 14.42. **HRMS (ESI-MS):** m/z Calculated for $C_{19}H_{21}ClN_4O_6[M+H]^+$: 437.1223; Observed: 437.1228.

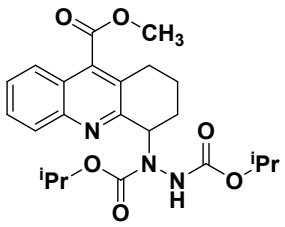


Diethyl 1-(9-(methoxycarbonyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3k):

Yield = 95%, white solid; M. P: 147.8 -148.6 °C; **IR (KBr, cm^{-1})**: 3253, 2978, 2933, 1744, 1683, 1435, 1316, 1194, 1059, 957, 758; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.98 (d, *J* = 8.4 Hz, 1H), 7.70 – 7.63 (m, 2H), 7.55 – 7.49 (m, 1H), 6.60 (m, 1H), 5.52 (m, 1H), 4.32 (s, 2H), 4.24 – 4.11 (m, 2H), 4.06 (s, 3H), 2.94 (q, *J* = 5.2 Hz, 2H), 2.30 (m, 2H), 2.02 (m, 2H), 1.41 – 1.21 (m, 6H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 172.56, 161.67, 161.57, 161.22, 151.00, 142.81, 134.66, 134.21, 132.92, 132.55, 129.13, 127.94, 66.78, 65.85, 57.81, 31.96, 31.31, 25.47, 19.57, 19.53. **HRMS (ESI-MS):** m/z Calculated for $C_{21}H_{25}N_3O_6[M+H]^+$: 416.1816; Observed: 416.1839.

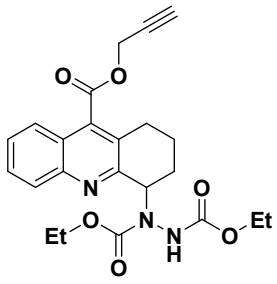


Diisopropyl 1-(9-(methoxycarbonyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3l):



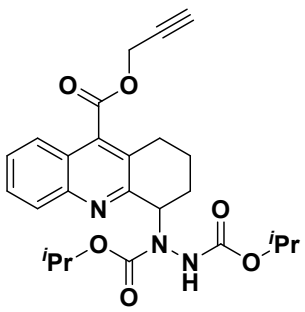
Yield = 91%, White solid; M. P: 119.2 -119.9 °C; **IR (KBr, cm^{-1})**: 3273, 2977, 2938, 1728, 1671, 1231, 1026, 962, 761; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.96 (d, *J* = 8.4 Hz, 1H), 7.66 (m, 2H), 7.55 – 7.49 (m, 1H), 6.47 (s, 1H), 5.50 (m, 1H), 5.02 (m, 2H), 4.05 (s, 3H), 2.98 – 2.92 (m, 2H), 2.53 – 1.95 (m, 4H), 1.44 – 1.18 (m, 12H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 172.56, 161.37, 161.29, 161.15, 151.00, 142.76, 134.60, 134.21, 132.89, 132.52, 129.14, 127.93, 74.27, 73.32, 57.82, 31.99, 31.33, 27.01, 26.99, 26.96, 26.93, 25.48. **HRMS (ESI-MS):** m/z Calculated for $C_{23}H_{29}N_3O_6$ $[M+H]^+$: 444.2129; Observed: 444.2127.

Diethyl 1-(9-((prop-2-yn-1-yloxy)carbonyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3m):



Yield = 92%, White solid; M. P: 110.1-110.5 °C; **IR (KBr, cm^{-1})**:3273, 2977, 2938, 1728, 1671, 1231, 1026, 962, 761; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 (d, *J* = 8.8 Hz, 1H), 7.73 (d, *J* = 8.4 Hz, 1H), 7.69 – 7.64 (m, 1H), 7.56 – 7.52 (m, 1H), 6.55 (s, 1H), 5.53 (m, 1H), 5.06 (s, 2H), 4.31 (dd, *J* = 6.8, 2.0 Hz, 2H), 4.20 (dd, *J* = 6.8, 2.4 Hz, 2H), 3.02 – 2.95 (m, 2H), 2.62 (t, *J* = 2.4 Hz, 1H), 2.49 (s, 1H), 2.06 (m, 3H), 1.35 – 1.25 (m, 6H). ^{13}C NMR (101 MHz, DMSO) δ 166.65, 156.95, 156.88, 156.80, 156.55, 146.26, 136.99, 129.96, 129.56, 128.40, 127.89, 124.09, 123.14, 78.68, 78.26, 62.03, 61.11, 60.91, 53.69, 27.18, 26.45, 20.66, 14.89, 14.77. **HRMS (ESI-MS):** m/z Calculated for $C_{23}H_{25}N_3O_6$ $[M+H]^+$: 440.1816; Observed: 440.1816.

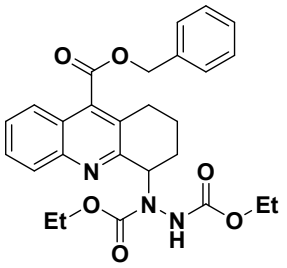
Diisopropyl 1-(9-((prop-2-yn-1-yloxy)carbonyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3n)



Yield = 90%, White solid; M. P: 94.8-95.2 °C; **IR (KBr, cm^{-1})**:3273, 2977, 2938, 1728, 1671, 1231, 1026, 962, 761;^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 8.4 Hz, 1H), 7.73 (d, *J* = 8.4 Hz, 1H), 7.66 (ddd, *J* = 8.4, 6.8, 1.6 Hz, 1H), 7.53 (ddd, *J* = 8.4, 6.8, 1.2 Hz, 1H), 6.45 (s, 1H), 5.62 (s, 1H), 5.06 (d, *J* = 2.4 Hz, 2H), 5.03 – 4.89 (m, 2H), 3.01 – 2.95 (m, 2H), 2.62 (t, *J* = 2.4 Hz, 1H), 2.49 (s, 1H), 2.08 (m, 3H), 1.31 – 1.23 (m, 12H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.80, 166.21,

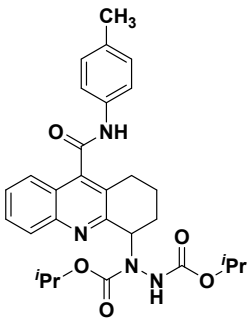
156.14, 146.19, 137.11, 132.46, 131.83, 129.58, 129.26, 127.47, 124.05, 123.97, 123.33, 77.24, 76.85, 75.97, 70.24, 69.51, 52.99, 29.69, 27.19, 26.29, 21.98, 21.95. **HRMS (ESI-MS):** m/z Calculated for $C_{25}H_{29}N_3O_6$ $[M+H]^+$: 468.2129; Observed: 468.2126.

Diethyl 1-(9-((benzyloxy)carbonyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3o):



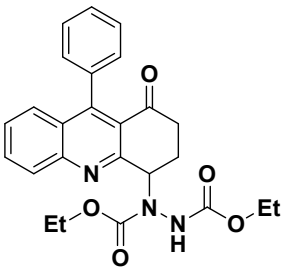
Yield = 89%, white solid; M. P: 145.5 – 146.3 °C; **IR (KBr, cm^{-1})**:3250, 2979, 2933, 1745, 1683, 1513, 1093, 956; **^{1}H NMR (400 MHz, DMSO) δ** 8.54 (s, 1H), 7.71 (s, 1H), 7.48 (t, *J* = 8.4 Hz, 1H), 7.44 (d, *J* = 7.0 Hz, 1H), 7.33 (t, *J* = 8.4 Hz, 1H), 7.30 – 7.24 (m, 2H), 7.21 – 7.11 (m, 3H), 5.29 (s, 2H), 5.15 (s, 1H), 4.03 – 3.70 (m, 4H), 3.13 (s, 3H), 2.57 (t, *J* = 6.4 Hz, 2H), 1.86 (m, 2H), 1.67 (m, 2H), 1.02 – 0.84 (m, 6H). **^{13}C NMR (101 MHz, DMSO) δ** 167.22, 156.87, 156.81, 156.53, 146.27, 137.80, 135.81, 129.94, 129.46, 129.14, 129.00, 128.94, 128.16, 127.78, 124.19, 123.20, 67.87, 62.03, 61.11, 27.16, 26.47, 20.69, 14.80, 14.76. **HRMS (ESI-MS):** m/z Calculated for $C_{27}H_{29}N_3O_6$ $[M+H]^+$: 492.2129; Observed: 492.2129.

Diisopropyl 1-(9-(p-tolylcarbamoyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3p):



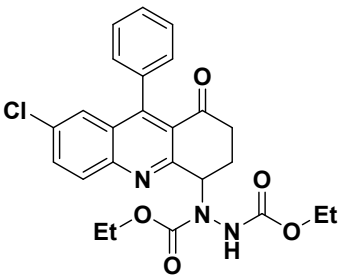
Yield = 83%, White solid; M. P: 238.4- 238.9 °C; ^{1}H NMR (400 MHz, DMSO) δ 10.98 (s, 1H), 10.13 (s, 1H), 8.21 (s, 1H), 8.12 (s, 1H), 8.01 (d, *J* = 8.0 Hz, 1H), 7.92 (t, *J* = 7.6 Hz, 2H), 7.71 (d, *J* = 8.8 Hz, 2H), 7.24 (d, *J* = 8.8 Hz, 2H), 4.94 – 4.88 (m, 2H), 4.88 – 4.75 (m, 2H), 4.35 (s, 1H), 2.33 (s, 3H), 1.79 (m, 2H), 1.54 (s, 1H), 1.22 (d, *J* = 6.4 Hz, 12H). ^{13}C NMR (101 MHz, DMSO) δ 164.91, 155.41, 153.92, 147.94, 142.07, 140.13, 139.90, 136.58, 134.05, 130.97, 130.31, 129.67, 127.89, 125.59, 122.75, 122.48, 120.74, 71.12, 70.22, 69.04, 22.27, 22.14, 22.01, 20.91. **HRMS (ESI-MS):** m/z Calculated for $C_{29}H_{34}N_4O_5$ $[M+H]^+$: 519.2602; Observed: 519.2596.

Diethyl 1-(1-oxo-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3q):



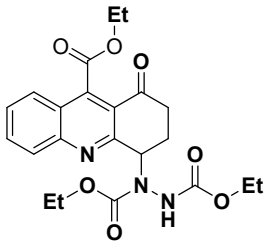
Yield = 87%, light Yellow solid; M. P: 121.3 – 122.1 °C; **IR (KBr, cm^{-1})**: 3275, 2988, 1750, 1682, 1610, 1505, 1387, 1221, 1061, 952, 757; **^{1}H NMR (400 MHz, DMSO) δ** 8.89 (s, 1H), 8.08 (d, *J* = 8.4 Hz, 1H), 7.87 (ddd, *J* = 8.4, 6.8, 1.6 Hz, 1H), 7.55 (t, *J* = 6.8 Hz, 1H), 7.52 – 7.46 (m, 3H), 7.36 (d, *J* = 6.8 Hz, 1H), 7.18 (d, *J* = 5.6 Hz, 2H), 5.79 (s, 1H), 4.13 (m, 4H), 2.99 – 2.64 (m, 2H), 2.32 (m, 2H), 1.29 – 1.16 (m, 6H). **^{13}C NMR (101 MHz, DMSO) δ** 196.32, 158.79, 156.91, 150.78, 148.41, 137.62, 131.89, 129.81, 128.82, 128.30, 127.81, 127.65, 127.57, 124.40, 62.25, 61.24, 38.30, 29.36, 25.62, 14.85, 14.78. **HRMS (ESI-MS):** m/z Calculated for $C_{25}H_{25}N_3O_5[M+H]^+$: 448.1867; Observed: 448.1869.

Diethyl 1-(7-chloro-1-oxo-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3r):



Yield = 90%, light Yellow solid; M. P: 181.2 – 181.6 °C; **IR (KBr, cm^{-1})**: 3309, 2982 1750, 1678, 1548, 1482,1312, 1284, 1024, 945,856; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.00 (s, 1H), 7.71 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.52 (m, 3H), 7.44 (d, *J* = 2.0 Hz, 1H), 7.22 – 7.16 (m, 1H), 7.14 – 7.09 (m, 1H), 6.56 (s, 1H), 5.74 (m, 1H), 4.43 – 4.31 (m, 2H), 4.22 (m, 2H), 2.83 (m, 2H), 2.62 (s, 1H), 2.39 (s, 1H), 1.42 (m, 2H), 1.28 (m, 4H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 195.82, 158.70, 156.75, 151.58, 146.73, 136.27, 133.26, 132.83, 130.86, 128.65, 128.46, 128.35, 128.21, 128.13, 127.73, 126.74, 63.05, 62.22, 38.92, 25.63, 14.59, 14.43. **HRMS (ESI-MS):** m/z Calculated for $C_{25}H_{24}ClN_3O_5[M+H]^+$: 482.1477; Observed: 482.1479.

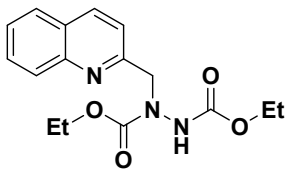
Diethyl 1-(9-(ethoxycarbonyl)-1-oxo-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3s):



Yield = 82%, white solid; M. P: 170.3 – 170.9 °C; **IR (KBr, cm^{-1})**: 3350, 2924, 1725, 1689, 1356, 1227, 1024, 759; **^{1}H NMR (400 MHz, DMSO) δ** 8.93 (s, 1H), 8.11 (d, *J* = 8.8 Hz, 1H), 7.98 (ddd, *J* = 8.4, 6.8, 1.4 Hz, 1H), 7.83 (d, *J* = 6.8 Hz, 1H), 7.76 (ddd, *J* = 8.4, 6.8, 1.2 Hz, 1H), 5.89 (s, 1H), 4.53 (q, *J* = 7.2 Hz, 2H), 4.20 (q, *J* = 7.0 Hz, 2H), 4.09 – 3.98 (m, 2H), 3.15 – 2.79 (m, 2H), 2.46 – 2.19 (m, 2H), 1.38 (t, *J* = 7.2 Hz, 3H), 1.28 – 1.20 (m, 3H), 1.12 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, DMSO) δ** 195.89, 167.26, 158.78, 156.88, 156.74, 149.12, 141.55, 132.99, 130.08, 128.83, 126.14, 123.28, 121.91, 62.25, 62.22, 61.22, 36.89, 25.70,

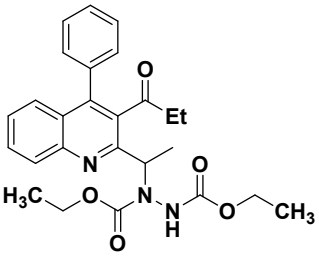
14.80, 14.74, 14.24. **HRMS (ESI-MS):** m/z Calculated for $C_{22}H_{25}N_3O_7[M+H]^+$: 444.1766; Observed: 444.1764.

Diethyl 1-(quinolin-2-ylmethyl)hydrazine-1,2-dicarboxylate (3t):



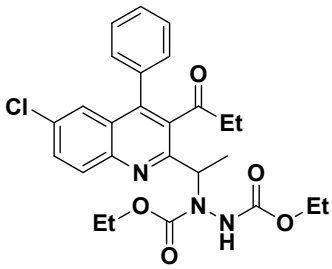
Yield = 85%, white solid; M. P: 77.9- 78.2 °C; **IR (KBr, cm^{-1})**: 3263, 2978, 2874, 1754, 1645, 1502, 1325, 1219, 1132, 1058, 915; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.18 – 8.04 (m, 1H), 7.99 (s, 1H), 7.74 (s, 2H), 7.65 (s, 1H), 7.51 – 7.47 (m, 1H), 7.33 (d, *J* = 8.4 Hz, 1H), 5.01 (s, 2H), 4.24 – 4.15 (m, 4H), 1.23 (t, *J* = 7.2 Hz, 6H). **^{13}C NMR (101 MHz, DMSO) δ** 157.88, 156.57, 156.19, 147.61, 136.90, 129.85, 129.08, 128.12, 127.58, 126.62, 120.47, 62.35, 61.23, 56.81, 14.75, 14.46. **HRMS (ESI-MS):** m/z Calculated for $C_{16}H_{19}N_3O_4[M+H]^+$: 318.1449; Observed: 318.1454.

Diethyl 1-(1-(4-phenyl-3-propionylquinolin-2-yl)ethyl)hydrazine-1,2-dicarboxylate (3u):



Yield = 83%, white solid; M. P: 127.1 – 127.6 °C;**IR (KBr, cm^{-1})**: 3351, 2978, 2934, 1744, 1707, 1559, 1314, 1257, 1140, 1028, 954, 755; **^{1}H NMR (400 MHz, DMSO) δ** 8.86 (s, 1H), 7.94 (s, 1H), 7.57 (t, *J* = 7.2 Hz, 1H), 7.39 (s, 1H), 7.33 (d, *J* = 8.8 Hz, 2H), 7.31 – 7.28 (m, 2H), 7.23 (s, 1H), 6.92 (s, 1H), 5.52 – 5.13 (m, 1H), 3.81 (m, 4H), 1.84 (s, 2H), 1.27 (s, 3H), 0.90 (m, 6H), 0.42 – 0.38 (m, 3H). **^{13}C NMR (101 MHz, DMSO) δ** 207.81, 156.60, 155.93, 147.03, 135.35, 130.45, 130.34, 129.90, 129.31, 129.22, 128.90, 127.84, 126.00, 125.68, 62.18, 61.08, 37.74, 16.84, 14.70, 7.51. **HRMS (ESI-MS):** m/z Calculated for $C_{26}H_{29}N_3O_5[M+H]^+$: 464.218; Observed: 464.2183.

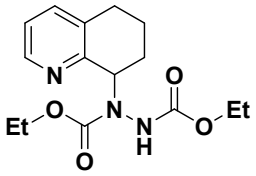
Diethyl 1-(1-(6-chloro-4-phenyl-3-propionylquinolin-2-yl)ethyl)hydrazine-1,2-dicarboxylate (3v):



Yield = 84%, white solid; M. P: 129.2 - 130 °C;**IR (KBr, cm^{-1})**: 3274, 2981, 2929, 1749, 1731, 1702, 1682, 1226, 1058, 768; **^{1}H NMR (400 MHz, DMSO) δ** 9.15 (s, 1H), 8.23 (s, 1H), 7.83 (dd, *J* = 8.8, 2.4 Hz, 1H), 7.66 – 7.62 (m, 1H), 7.56 (td, *J* = 4.0, 2.0 Hz, 2H), 7.49 – 7.43 (m, 2H), 7.16 (s, 1H), 5.56 (m, 1H), 4.02 (s, 4H), 2.08 (s, 1H), 1.50 (m, 3H), 1.22 – 1.07 (m, 6H), 0.64 (m, 4H). **^{13}C NMR (101 MHz, DMSO) δ** 207.41, 156.62, 155.88, 145.49, 143.51, 134.63, 132.61, 132.10, 131.01, 130.40, 130.18, 129.62, 129.39, 129.09,

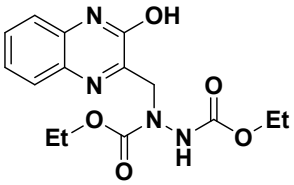
126.64, 124.57, 62.22, 61.08, 37.67, 16.70, 14.71, 14.68, 7.43. **HRMS (ESI-MS):** m/z Calculated for $C_{26}H_{28}ClN_3O_5[M+H]^+$: 498.179; Observed: 498.1799.

Diethyl 1-(5,6,7,8-tetrahydroquinolin-8-yl)hydrazine-1,2-dicarboxylate (3w):



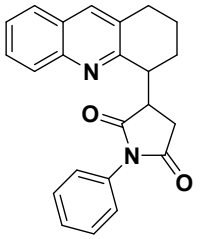
Yield = 70%, colourless oil; **IR (KBr, cm^{-1})**: 3274, 2981, 2929, 1749, 1731, 1702, 1682, 1226, 1058, 768 **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.38 (d, *J* = 5.2 Hz, 1H), 7.40 (d, *J* = 7.6 Hz, 1H), 7.09 (dd, *J* = 7.8, 4.8 Hz, 1H), 6.53 (s, 1H), 5.58 – 5.26 (m, 1H), 4.23 (q, *J* = 7.2 Hz, 4H), 2.83 – 2.71 (m, 2H), 2.04 – 1.81 (m, 4H), 1.28 (m, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 156.36, 154.24, 147.18, 137.27, 122.21, 63.10, 62.61, 61.77, 31.88, 28.32, 21.32, 14.45. **HRMS (ESI-MS):** m/z Calculated for $C_{15}H_{21}N_3O_4[M+H]^+$: 308.1605; Observed: 308.1605.

Diethyl 1-((3-hydroxyquinoxalin-2-yl)methyl)hydrazine-1,2-dicarboxylate (3x):



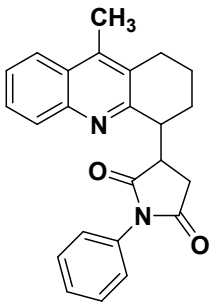
Yield = 82%, white solid; M. P: 128.5 – 128.9 °C; **IR (KBr, cm^{-1})**: 3274, 2982, 2929, 1728, 1481, 1380, 1236, 1060, 763; **^{1}H NMR (400 MHz, DMSO) δ** 12.39 (s, 1H), 8.99 (m, 1H), 7.85 – 7.58 (m, 1H), 7.55 – 7.48 (m, 1H), 7.36 – 7.21 (m, 2H), 4.15 – 3.98 (m, 4H), 1.23 – 1.08 (m, 6H). **^{13}C NMR (101 MHz, DMSO) δ** 155.99, 155.46, 154.04, 132.79, 131.54, 130.95, 129.26, 123.43, 115.71, 62.61, 61.32, 14.56, 14.53. **HRMS (ESI-MS):** m/z Calculated for $C_{15}H_{18}N_4O_5[M+H]^+$: 335.135; Observed: 335.1349.

1-Phenyl-3-(1,2,3,4-tetrahydroacridin-4-yl)pyrrolidine-2,5-dione (5a):



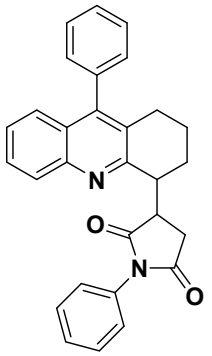
Yield = 90%, white solid; M. P: 154.5 – 155.1 °C; **IR (KBr, cm^{-1})**: 3034, 2982, 2855, 1759, 1699, 1454, 1392, 1132, 758; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.83 (s, 1H), 7.70 – 7.63 (m, 2H), 7.63 – 7.51 (m, 4H), 7.50 – 7.28 (m, 3H), 4.04 (m, 1H), 3.26 (s, 1H), 3.00 (m, 2H), 2.84 (m, 1H), 2.51 – 2.40 (m, 1H), 2.24 (m, 1H), 2.03 (m, 2H), 1.74 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 179.33, 176.53, 157.47, 146.13, 135.19, 132.95, 131.20, 129.07, 128.75, 128.70, 128.09, 127.33, 126.80, 126.31, 126.15, 44.02, 43.16, 31.23, 29.32, 28.75, 22.56. **HRMS (ESI-MS):** m/z Calculated for $C_{23}H_{20}N_2O_2[M+H]^+$: 357.1598; Observed: 357.1597.

3-(9-Methyl-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5b):



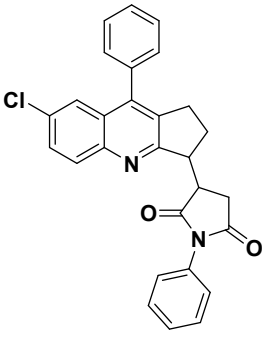
Yield = 87%, white solid; M. P: 180.9 – 181.9 °C; **IR (KBr, cm^{-1})**: 3068, 2924, 2858, 1770, 1705, 1498, 1181, 785; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.96 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.83 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.56 (ddd, *J* = 8.4, 6.8, 1.6 Hz, 1H), 7.47 (ddd, *J* = 8.3, 6.8, 1.6 Hz, 1H), 7.41 – 7.33 (m, 2H), 7.33 – 7.28 (m, 1H), 7.17 – 7.08 (m, 2H), 3.96 – 3.86 (m, 1H), 3.69 – 3.60 (m, 1H), 3.16 – 3.06 (m, 2H), 3.06 – 2.99 (m, 1H), 2.90 – 2.80 (m, 1H), 2.55 (s, 3H), 2.22 – 2.15 (m, 2H), 2.11 (m, 1H), 1.90 – 1.82 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 179.31, 176.99, 157.85, 145.52, 141.40, 132.36, 129.58, 128.98, 128.85, 128.29, 128.17, 127.04, 126.64, 125.82, 123.30, 44.75, 43.89, 35.15, 29.72, 27.10, 22.80, 13.74. **HRMS (ESI-MS):** m/z Calculated for $C_{24}H_{22}N_2O_2[M+H]^+$: 371.1754; Observed: 371.1754.

1-Phenyl-3-(9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)pyrrolidine-2,5-dione (5c):



Yield = 91%, white solid; M. P: 208.4 - 209.2 °C; **IR (KBr, cm^{-1})**: 3060, 2927, 2861, 1702, 1572, 1485, 1186, 770; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.71 (d, *J* = 8.4 Hz, 1H), 7.65 – 7.60 (m, 2H), 7.59 – 7.54 (m, 2H), 7.54 – 7.50 (m, 2H), 7.48 (dd, *J* = 8.4, 4.4 Hz, 2H), 7.45 – 7.41 (m, 1H), 7.29 (dd, *J* = 4.4, 1.2 Hz, 2H), 7.22 (dt, *J* = 6.4, 1.2 Hz, 2H), 4.13 – 4.08 (m, 1H), 3.29 (m, 1H), 2.89 (m, 1H), 2.73 – 2.62 (m, 2H), 2.61 – 2.56 (m, 1H), 2.25 – 2.19 (m, 1H), 1.98 – 1.87 (m, 2H), 1.78 – 1.70 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 179.42, 176.67, 157.30, 146.77, 145.75, 136.92, 132.99, 129.11, 129.08, 129.00, 128.84, 128.71, 128.68, 128.53, 128.08, 127.88, 126.77, 126.34, 125.99, 125.75, 44.08, 43.52, 31.34, 28.87, 27.41, 22.53. **HRMS (ESI-MS):** m/z Calculated for $C_{29}H_{24}N_2O_2[M+H]^+$: 433.1911; Observed: 433.1910.

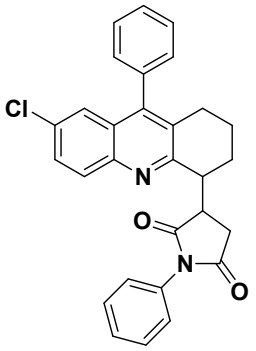
3-(7-Chloro-9-phenyl-2,3-dihydro-1H-cyclopenta[b]quinolin-3-yl)-1-phenylpyrrolidine-2,5-dione (5d):



Yield = 90%, white solid; M. P: 198.9-199.4 °C; **IR (KBr, cm^{-1})**: 3072, 2954, 1706, 1556, 1475, 1150, 945, 762; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.81 (d, *J* = 8.8 Hz, 1H), 7.59 (d, *J* = 3.5 Hz, 3H), 7.58 (d, *J* = 1.6 Hz, 2H), 7.54 (dd, *J* = 8.8, 4.4 Hz, 2H), 7.51 (d, *J* = 1.6 Hz, 1H), 7.50 – 7.44 (m, 2H), 7.37 – 7.32 (m, 2H), 4.24 (m, 1H), 3.47 – 3.41 (m, 1H), 2.99 – 2.79 (m, 3H), 2.51 (m, 2H), 1.94 – 1.85 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 178.65, 176.01, 164.98, 146.46, 142.55, 135.53, 134.38, 132.68, 131.96, 130.86, 129.32,

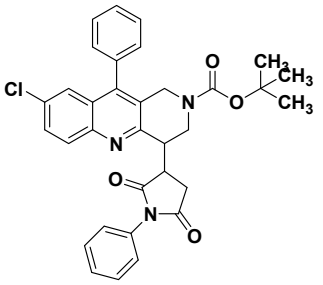
129.20, 128.51, 127.18, 126.58, 124.54, 46.74, 41.72, 31.30, 29.43, 28.74. **HRMS (ESI-MS):** m/z Calculated for $C_{28}H_{21}ClN_2O_2[M+H]^+$: 453.1359; Observed: 453.1359.

3-(7-Chloro-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5e):



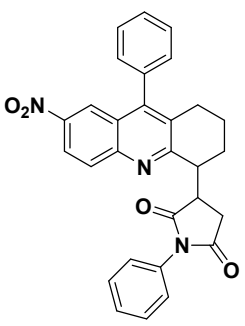
Yield = 94%, white solid; M. P: 200 – 200.8 °C; **IR (KBr, cm^{-1})**: 3065, 2957, 2874, 1734, 1589, 1498, 1167, 860, 770; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.63 (d, *J* = 8.8 Hz, 1H), 7.60 (s, 1H), 7.58 (s, 2H), 7.56 (s, 1H), 7.55 – 7.49 (m, 3H), 7.48 – 7.44 (m, 1H), 7.42 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.26 (s, 1H), 7.20 (dt, *J* = 6.4, 2.0 Hz, 2H), 4.08 (m, 1H), 3.34 – 3.28 (m, 1H), 2.91 (m, 1H), 2.69 – 2.64 (m, 1H), 2.64 – 2.59 (m, 1H), 2.59 – 2.52 (m, 1H), 2.27 – 2.20 (m, 1H), 1.98 – 1.94 (m, 1H), 1.94 – 1.69 (m, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 179.32, 176.59, 157.77, 146.08, 144.07, 136.10, 132.87, 131.89, 130.40, 129.86, 129.53, 129.14, 128.98, 128.94, 128.90, 128.24, 128.18, 127.51, 126.21, 124.56, 43.94, 43.51, 31.31, 28.70, 27.45, 22.38. **HRMS (ESI-MS):** m/z Calculated for $C_{29}H_{23}ClN_2O_2[M+H]^+$: 467.1521; Observed: 467.1527.

tert-Butyl 8-chloro-4-(2,5-dioxo-1-phenylpyrrolidin-3-yl)-10-phenyl-3,4-dihydrobenzo[b][1,6]naphthyridine-2(1H)-carboxylate (5f):



Yield = 84%, white solid; M. P: 202.1- 202.7 °C; **IR (KBr, cm^{-1})**: **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.70 (d, *J* = 8.8 Hz, 1H), 7.58 (s, 2H), 7.56 (s, 1H), 7.54 (s, 3H), 7.53 – 7.47 (m, 2H), 7.45 (t, *J* = 8.4 Hz, 1H), 7.36 (s, 1H), 7.23 (d, *J* = 7.6 Hz, 2H), 4.54 (m, 2H), 4.30 – 4.19 (m, 2H), 3.32 (m, 2H), 2.99 – 2.82 (m, 1H), 2.74 – 2.53 (m, 1H), 1.43 (m, 9H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 178.33, 176.05, 154.37, 144.64, 134.40, 132.68, 132.61, 130.53, 130.38, 129.20, 128.87, 128.38, 127.34, 126.27, 124.73, 80.73, 44.04, 41.21, 31.13, 29.71, 28.35. **HRMS (ESI-MS):** m/z Calculated for $C_{33}H_{30}ClN_3O_4[M+H]^+$: 568.1998; Observed: 568.1995.

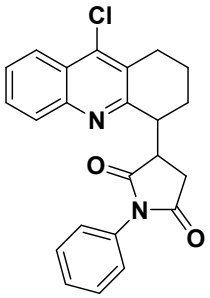
3-(7-Nitro-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5g):



Yield= 95%, light Yellow solid; M. P: 201.4 - 202.2 °C; **IR (KBr, cm^{-1})**: 3032, 1770, 1704, 1596, 1344, 1283, 1182, 1092, 781; **^{1}H**

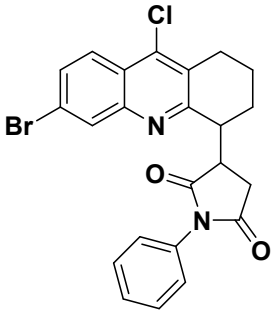
NMR (400 MHz, $CDCl_3$) δ 8.30 – 8.21 (m, 2H), 7.81 (d, *J* = 8.8 Hz, 1H), 7.58 (d, *J* = 4.0 Hz, 5H), 7.57 – 7.50 (m, 2H), 7.46 (dt, *J* = 8.8, 4.0 Hz, 1H), 7.23 (m, 2H), 4.14 – 4.08 (m, 1H), 3.36 (m, 1H), 2.96 (m, 1H), 2.76 – 2.63 (m, 2H), 2.58 (m, 1H), 2.27 (m, 1H), 1.98 (m, 2H), 1.81 – 1.74 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 179.07, 176.38, 161.82, 148.79, 147.58, 145.32, 135.08, 132.76, 131.28, 130.46, 129.21, 129.15, 128.92, 128.85, 128.83, 128.30, 126.10, 122.91, 122.18, 43.81, 43.76, 31.35, 28.36, 27.41, 22.15. **HRMS (ESI-MS):** m/z Calculated for $C_{29}H_{23}N_3O_4[M+H]^+$: 478.1762; Observed: 478.1689.

3-(9-Chloro-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5h):



Yield = 90%, White solid; M. P: 166.2 – 167.0 °C; **IR (KBr, cm^{-1})**: 3063, 2923, 2854, 1770, 1705, 1595, 1480, 1158, 919, 857; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.14 (dd, *J* = 8.0, 3.2 Hz, 1H), 7.67 (dd, *J* = 7.2, 1.6 Hz, 1H), 7.60 (dd, *J* = 8.8, 1.6 Hz, 2H), 7.58 – 7.55 (m, 2H), 7.55 – 7.50 (m, 2H), 7.47 – 7.40 (m, 1H), 4.06 (m, 1H), 3.30 – 3.26 (m, 1H), 3.26 – 3.19 (m, 1H), 2.96 – 2.80 (m, 2H), 2.38 (m, 1H), 2.23 (m, 2H), 2.05 – 1.95 (m, 1H), 1.73 (td, *J* = 12.8, 9.4 Hz, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 179.09, 176.31, 157.60, 146.13, 141.86, 132.85, 129.54, 129.10, 128.12, 127.17, 126.18, 125.45, 123.66, 44.04, 43.69, 31.09, 28.97, 27.34, 22.30. **HRMS (ESI-MS):** m/z Calculated for $C_{23}H_{19}ClN_2O_2[M+H]^+$: 391.1208; Observed: 391.1214.

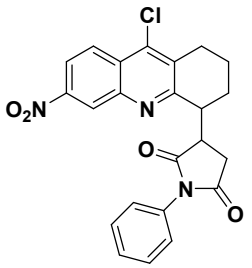
3-(6-Bromo-9-chloro-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5i):



Yield = 91%, white solid; M. P: 186.5 – 187.2 °C; **IR (KBr, cm^{-1})**: 3054, 2924, 2853, 1710, 1599, 1458, 1382, 1179, 821, 816; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.00 (d, *J* = 8.8 Hz, 1H), 7.88 (d, *J* = 2.0 Hz, 1H), 7.63 – 7.59 (m, 1H), 7.58 (d, *J* = 6.0 Hz, 4H), 7.49 – 7.41 (m, 1H), 4.06 – 4.01 (m, 1H), 3.30 (m, 1H), 3.25 – 3.17 (m, 1H), 2.86 (m, 2H), 2.38 – 2.32 (m, 1H), 2.27 – 2.21 (m, 2H), 2.01 – 1.95 (m, 1H), 1.77 – 1.71 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 178.82, 176.03, 158.87, 146.53, 142.00, 132.68, 131.28, 130.68, 129.71, 129.15, 128.27, 126.06, 125.19, 124.23, 123.80, 43.89, 43.64, 31.11, 28.72, 27.39, 22.14. **HRMS (ESI-MS):** m/z Calculated for $C_{23}H_{18}BrClN_2O_2[M+H]^+$: 469.0313; Observed: 469.0317.

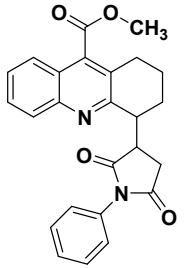
3-(9-Chloro-6-nitro-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5j):

Yield = 96%, white solid; M. P: 184.2 – 185.2 °C; **IR (KBr, cm^{-1})**: 3069, 2953, 2824, 1732, 1549, 1452, 1361, 1182, 825; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.63 (s, 1H), 8.30 (s, 2H), 7.63 (s, 1H), 7.62 (d, *J* = 2.6 Hz, 3H), 7.48 (dd, *J* = 6.2, 3.4 Hz, 1H), 4.08 (m, 1H), 3.40 – 3.36 (m, 1H), 3.33 – 3.27 (m, 1H), 2.90 (m, 2H), 2.32 (d, *J* = 5.6 Hz, 1H), 2.28 (t, *J* = 5.6 Hz, 2H), 2.04 – 1.99 (m, 1H), 1.78 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 178.67, 175.80, 160.71, 148.13, 144.86, 142.04, 132.86, 132.49, 129.37, 128.57, 128.45, 125.93, 125.76, 125.17, 120.59, 43.77, 31.14, 29.71, 28.45, 27.78, 21.97. **HRMS (ESI-MS):** m/z Calculated for $C_{23}H_{18}ClN_3O_4[M+H]^+$: 436.1059; Observed: 436.1056.



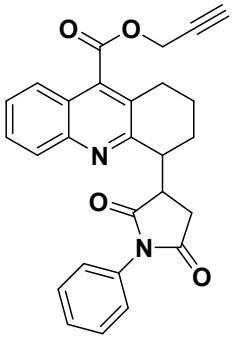
Methyl-4-(2,5-dioxo-1-phenylpyrrolidin-3-yl)-1,2,3,4-tetrahydroacridine-9-carboxylate (5k):

Yield = 95%, White solid; M. P: 134.6-135.2 °C; **IR (KBr, cm^{-1})**: 3045, 2937, 1770, 1736, 1596, 1440, 1384, 1228, 1182, 1092, 985, 781; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.88 (d, *J* = 8.0 Hz, 1H), 7.67 (d, *J* = 9.2 Hz, 1H), 7.62 (ddd, *J* = 8.0, 6.8, 1.6 Hz, 1H), 7.51 (ddd, *J* = 8.0, 6.8, 1.6 Hz, 1H), 7.41 – 7.36 (m, 2H), 7.34 (d, *J* = 7.2 Hz, 1H), 7.16 (d, *J* = 1.6 Hz, 1H), 7.14 (s, 1H), 4.05 (s, 3H), 3.94 (d, *J* = 8.0 Hz, 1H), 3.70 – 3.64 (m, 1H), 3.13 (m, 1H), 3.01 (m, 2H), 2.97 (d, *J* = 4.8 Hz, 1H), 2.22 – 2.14 (m, 2H), 2.14 – 2.08 (m, 1H), 1.95 – 1.85 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 178.91, 176.68, 168.13, 158.43, 145.83, 137.88, 132.25, 129.26, 129.20, 129.04, 128.40, 127.54, 127.20, 126.57, 124.13, 123.12, 52.58, 44.37, 43.51, 34.77, 29.70, 26.71, 22.17. **HRMS (ESI-MS):** m/z Calculated for $C_{25}H_{22}N_2O_4[M+H]^+$: 415.1653; Observed: 415.1654.



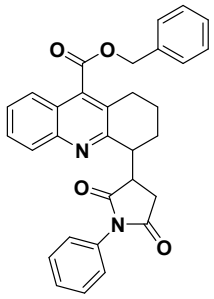
Prop-2-yn-1-yl 4-(2,5-dioxo-1-phenylpyrrolidin-3-yl)-1,2,3,4-tetrahydroacridine-9-carboxylate (5l):

Yield = 82%, white solid; M. P: 170.1-171 °C; **IR (KBr, cm^{-1})**: 3229, 2932, 2865, 1741, 1701, 1498, 1397, 1206,1026, 947, 769; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (m, 1H), 7.69 (m,1H), 7.59 – 7.56 (m, 3H), 7.54 (dd, *J* = 7.2, 1.6 Hz, 2H), 7.51 – 7.47 (m, 1H), 7.45 – 7.41 (m, 1H), 5.05 (s, 2H),



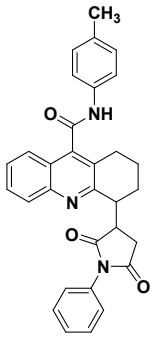
4.09 – 4.04 (m, 1H), 3.30 – 3.26 (m, 1H), 3.04 – 2.98 (m, 2H), 2.86 (m, 1H), 2.61 (s, 1H), 2.44 (m, , 1H), 2.28 – 2.22 (m, 1H), 2.16 – 2.10 (m, 1H), 2.05 – 1.97 (m, 1H), 1.81 – 1.74 (m, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 179.03, 176.27, 166.82, 157.43, 145.68, 137.05, 132.84, 129.41, 129.09, 128.13, 127.86, 127.38, 126.20, 123.95, 123.01, 76.89, 75.95, 52.99, 43.98, 43.41, 31.12, 28.79, 26.38, 22.13. **HRMS (ESI-MS):** m/z Calculated for $C_{27}H_{22}N_2O_4[M+H]^+$: 439.1653; Observed: 439.1658.

Benzyl 4-(2,5-dioxo-1-phenylpyrrolidin-3-yl)-1,2,3,4-tetrahydroacridine-9-carboxylate (5m):



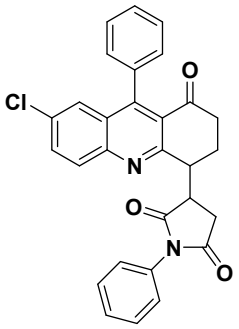
Yield = 91%, white solid; M. P: 138.7-139.3 °C; **IR (KBr, cm^{-1})**: 3060, 2935, 2852, 1730, 1705, 1498, 1337, 1178, 1023, 766; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.68 (d, *J* = 8.0 Hz, 1H), 7.59 (d, *J* = 2.0 Hz, 1H), 7.57 (d, *J* = 2.0 Hz, 3H), 7.55 – 7.53 (m, 1H), 7.53 – 7.50 (m, 1H), 7.47 (dd, *J* = 8.0, 2.0 Hz, 2H), 7.45 – 7.42 (m, 2H), 7.41 – 7.37 (m, 3H), 5.50 (s, 2H), 4.04 (dd, *J* = 5.2, 2.4 Hz, 1H), 3.26 (dd, *J* = 5.2, 2.4 Hz, 1H), 2.96 – 2.88 (m, 2H), 2.84 (m, 1H), 2.42 (m, 1H), 2.26 – 2.19 (m, 1H), 2.08 (m, 1H), 2.01 – 1.92 (m, 1H), 1.75 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 179.06, 176.30, 167.47, 157.39, 145.69, 137.97, 135.00, 132.84, 129.29, 129.09, 128.79, 128.12, 127.52, 127.23, 126.20, 124.01, 123.06, 67.67, 43.98, 43.41, 31.12, 28.80, 26.35, 22.14. **HRMS (ESI-MS):** m/z Calculated for $C_{31}H_{26}N_2O_4[M+H]^+$: 491.1966; Observed: 491.1966.

4-(2,5-Dioxo-1-phenylpyrrolidin-3-yl)-N-(p-tolyl)-1,2,3,4-tetrahydroacridine-9-carboxamide (5n):



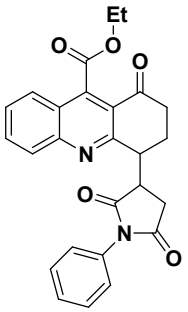
Yield = 80%, white solid; M. P: 227.9 – 228.3 °C; **IR (KBr, cm^{-1})**: 3441, 3296, 2926, 2858, 1706, 1670, 1534, 1392, 1185, 819, 763; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.66 (s, 1H), 7.80 (q, *J* = 8.4 Hz, 2H), 7.59 (d, *J* = 7.6 Hz, 1H), 7.54 (m, 3H), 7.52 (d, *J* = 2.4 Hz, 2H), 7.50 (m, 2H), 7.42 (t, *J* = 7.2 Hz, 2H), 7.15 (d, *J* = 8.4 Hz, 2H), 3.05 (m, 3H), 2.82 (s, 1H), 2.62 (s, 2H), 2.35 (s, 3H), 2.06 (m, 2H), 1.84 (s, 1H), 1.58 (s, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 176.43, 165.52, 157.49, 145.66, 141.56, 135.17, 134.73, 132.71, 129.69, 129.56, 129.29, 129.10, 128.87, 128.26, 127.13, 126.19, 124.39, 123.40, 120.00, 43.85, 43.23, 30.88, 28.64, 26.04, 22.03, 20.96. **HRMS (ESI-MS):** m/z Calculated for $C_{31}H_{27}N_3O_3[M+H]^+$: 490.2125; Observed: 490.2124.

3-(7-Chloro-1-oxo-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5o):



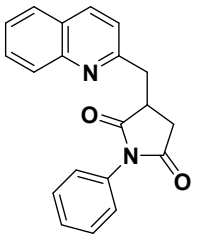
Yield = 88%, white solid; M. P: 241.2-241.9 °C; **IR (KBr, cm^{-1})**: 3072, 2954, 1706, 1556, 1475, 1386, 1150, 945, 762; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.85 (d, *J* = 8.8 Hz, 1H), 7.67 (dd, *J* = 8.8, 2.4 Hz, 1H), 7.58 – 7.51 (m, 3H), 7.49 – 7.45 (m, 2H), 7.45 – 7.38 (m, 2H), 7.26 (s, 1H), 7.25 – 7.19 (m, 2H), 7.19 – 7.13 (m, 1H), 3.85 – 3.74 (m, 2H), 3.36 – 3.20 (m, 2H), 2.88 (m, 1H), 2.82 – 2.70 (m, 2H), 2.35 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 196.55, 178.51, 176.47, 161.04, 151.09, 146.15, 136.37, 133.14, 132.80, 132.24, 130.50, 129.15, 128.55, 128.53, 128.47, 128.37, 128.26, 128.10, 127.71, 126.81, 126.47, 124.38, 44.62, 43.28, 40.31, 35.15, 26.59. **HRMS (ESI-MS):** m/z Calculated for $C_{29}H_{21}ClN_2O_3[M+H]^+$: 481.1314; Observed: 481.1312.

Ethyl 4-(2,5-dioxo-1-phenylpyrrolidin-3-yl)-1-oxo-1,2,3,4-tetrahydroacridine-9-carboxylate (5p):



Yield = 80%, light Yellow solid; M. P: 204.1- 204.5 °C; **IR (KBr, cm^{-1})**: 3084, 2924, 1731, 1708, 1691, 1571, 1498, 1287, 1181, 784, 755; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 8.0 Hz, 1H), 7.87 – 7.80 (m, 2H), 7.65 (t, *J* = 7.2 Hz, 1H), 7.46 – 7.41 (m, 2H), 7.39 (d, *J* = 7.2 Hz, 1H), 7.24 – 7.18 (m, 2H), 4.66 (q, *J* = 7.2 Hz, 2H), 3.87 (d, *J* = 2.4 Hz, 1H), 3.87 – 3.82 (m, 1H), 3.29 (m, 1H), 3.13 (m, 1H), 3.07 – 3.00 (m, 1H), 2.90 – 2.81 (m, 1H), 2.77 – 2.67 (m, 1H), 2.41 – 2.35 (m, 1H), 1.50 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 195.79, 178.27, 176.30, 167.64, 160.42, 148.66, 142.40, 132.89, 132.15, 129.31, 129.11, 128.52, 128.22, 126.49, 126.37, 123.35, 121.44, 62.54, 44.01, 43.07, 39.11, 34.78, 29.70, 26.40, 14.08. **HRMS (ESI-MS):** m/z Calculated for $C_{26}H_{22}N_2O_5[M+H]^+$: 443.1602; Observed: 443.1603.

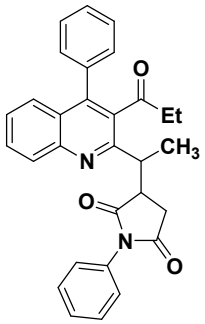
1-Phenyl-3-(quinolin-2-ylmethyl)pyrrolidine-2,5-dione (5q):



Yield = 89%, white solid; M. P: 123.4 -124 °C; **IR (KBr, cm^{-1})**: 3084, 2924, 1731, 1708, 1691, 1571, 1498, 1287, 1181, 784, 755; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.4 Hz, 1H), 7.85 (d, *J* = 8.8 Hz, 1H), 7.74 (d, *J* = 8.4

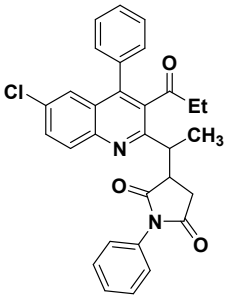
Hz, 1H), 7.61 (t, *J* = 7.6 Hz, 1H), 7.49 – 7.45 (m, 2H), 7.43 (s, 1H), 7.39 – 7.35 (m, 2H), 7.34 (s, 1H), 7.25 (t, *J* = 2.4 Hz, 1H), 3.69 (m, 1H), 3.53 – 3.44 (m, 2H), 3.05 – 2.90 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 179.24, 176.47, 157.42, 147.47, 136.60, 132.57, 129.69, 129.13, 129.04, 128.39, 127.56, 126.84, 126.55, 126.28, 121.59, 38.34, 37.23, 34.09. **HRMS (ESI-MS):** m/z Calculated for $C_{20}H_{16}N_2O_2[M+H]^+$: 317.1285; Observed: 317.1284.

1-Phenyl-3-(1-(4-phenyl-3-propionylquinolin-2-yl)ethyl)pyrrolidine-2,5-dione (5r):



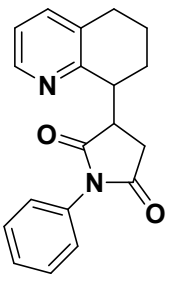
Yield = 76%, white solid; M. P: 172.1-172.8 °C; **IR (KBr, cm^{-1})**: 3060, 2927, 2861, 1702, 1572, 1498, 1186, 770, 756; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (dd, *J* = 9.0, 1.2 Hz, 1H), 7.67 (ddd, *J* = 8.4, 6.8, 1.6 Hz, 1H), 7.61 (dd, *J* = 9.0, 1.6 Hz, 1H), 7.51 – 7.46 (m, 3H), 7.46 – 7.43 (m, 1H), 7.39 – 7.35 (m, 1H), 7.35 – 7.30 (m, 3H), 7.30 – 7.26 (m, 1H), 7.07 – 7.00 (m, 2H), 4.15 – 3.88 (m, 1H), 3.75 – 3.63 (m, 1H), 3.41 (m, 1H), 3.01 (m, 1H), 2.48 (m, 1H), 2.24 – 2.09 (m, 1H), 1.55 (t, *J* = 7.2 Hz, 3H), 0.83 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.59, 179.11, 177.20, 158.49, 146.97, 144.65, 135.06, 134.68, 132.30, 130.65, 130.17, 129.99, 129.22, 129.04, 128.92, 128.83, 128.40, 128.37, 126.99, 126.60, 126.12, 125.25, 45.17, 38.59, 38.36, 33.05, 20.08, 7.59. **HRMS (ESI-MS):** m/z Calculated for $C_{30}H_{26}N_2O_3[M+H]^+$: 463.2016; Observed: 463.2027.

3-(1-(3-Acetyl-6-chloro-4-phenylquinolin-2-yl)ethyl)-1-phenylpyrrolidine-2,5-dione (5s):



Yield = 79%, White solid; M. P: 162.3-163 °C; **IR (KBr, cm^{-1})**:3057, 2973, 2925, 1775, 1705, 1478, 1392, 1184, 1074, 965, 835; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 8.8 Hz, 1H), 7.64 (dd, *J* = 8.8, 2.4 Hz, 1H), 7.60 (d, *J* = 2.4 Hz, 1H), 7.57 – 7.52 (m, 3H), 7.52 – 7.49 (m, 1H), 7.39 – 7.35 (m, 3H), 7.34 (d, *J* = 7.6 Hz, 1H), 7.33 – 7.30 (m, 1H), 7.04 (dd, *J* = 4.8, 2.4 Hz, 1H), 3.90 (d, *J* = 4.8 Hz, 1H), 3.76 – 3.67 (m, 1H), 3.46 – 3.40 (m, 1H), 3.05 (d, *J* = 8.1 Hz, 1H), 2.50 (m, 1H), 2.15 (m, 1H), 1.57 (d, *J* = 7.2 Hz, 3H), 0.85 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.15, 178.95, 177.08, 158.94, 145.33, 143.91, 135.41, 134.32, 133.03, 132.16, 131.11, 130.75, 130.59, 129.81, 129.25, 129.10, 129.03, 128.65, 128.45, 126.45, 126.09, 124.94, 45.08, 38.59, 38.26, 32.95, 20.01, 7.49. **HRMS (ESI-MS):** m/z Calculated for $C_{30}H_{25}ClN_2O_3[M+H]^+$: 497.1627; Observed: 497.1627.

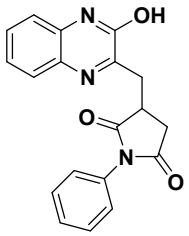
1-Phenyl-3-(5,6,7,8-tetrahydroquinolin-8-yl)pyrrolidine-2,5-dione (5t):



Yield = 75%, light Yellow solid; M. P: 129.1-130.2 °C; **IR (KBr, cm^{-1})**: 3010, 2967, 2903, 2852, 1714, 1665, 1598, 1215, 1177, 1094, 880, 760; ^{1}H

NMR (400 MHz, $CDCl_3$) δ 8.34 (dd, *J* = 4.6, 1.8 Hz, 1H), 7.47 – 7.43 (m, 2H), 7.38 (dd, *J* = 7.6, 2.3 Hz, 2H), 7.24 (d, *J* = 1.3 Hz, 1H), 7.23 – 7.21 (m, 1H), 7.07 (ddd, *J* = 7.7, 4.6, 1.0 Hz, 1H), 4.06 (ddd, *J* = 9.7, 4.8, 3.4 Hz, 1H), 3.67 – 3.60 (m, 1H), 2.93 (dd, *J* = 18.5, 9.6 Hz, 1H), 2.83 – 2.80 (m, 2H), 2.67 (dd, *J* = 18.5, 4.7 Hz, 1H), 2.10 – 2.02 (m, 2H), 1.83 – 1.75 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 179.12, 176.47, 156.44, 146.76, 136.91, 133.18, 129.11, 128.47, 126.53, 121.75, 43.11, 42.51, 33.28, 28.82, 25.63, 22.06. **HRMS (ESI-MS):** m/z Calculated for $C_{19}H_{18}N_2O_2$ $[M+H]^+$: 307.1441; Observed: 307.1441.

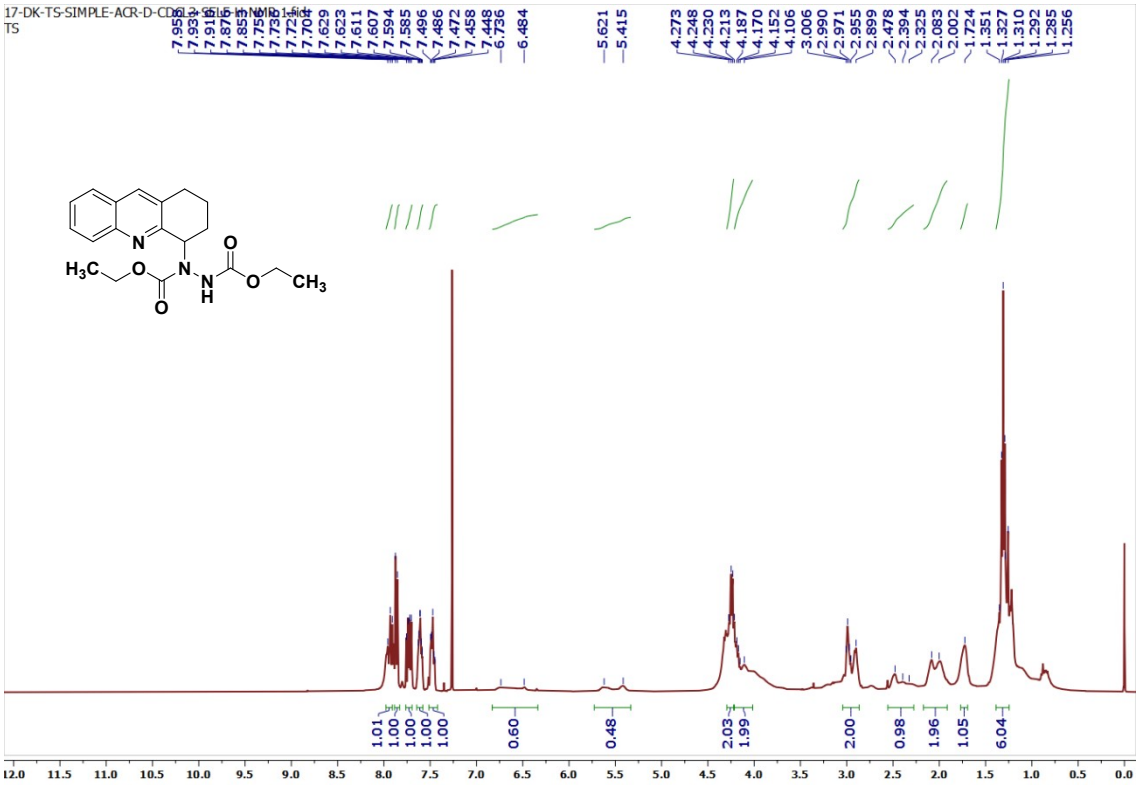
3-((3-Hydroxyquinoxalin-2-yl)methyl)-1-phenylpyrrolidine-2,5-dione (5u):

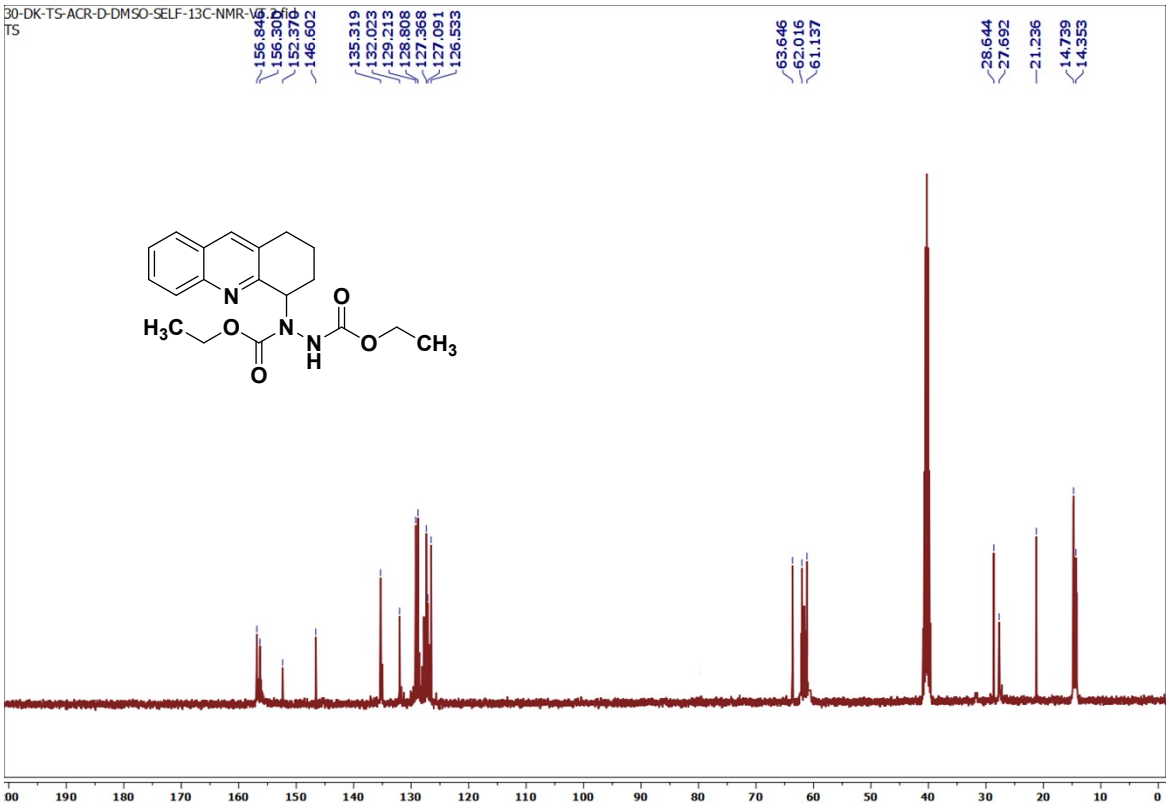


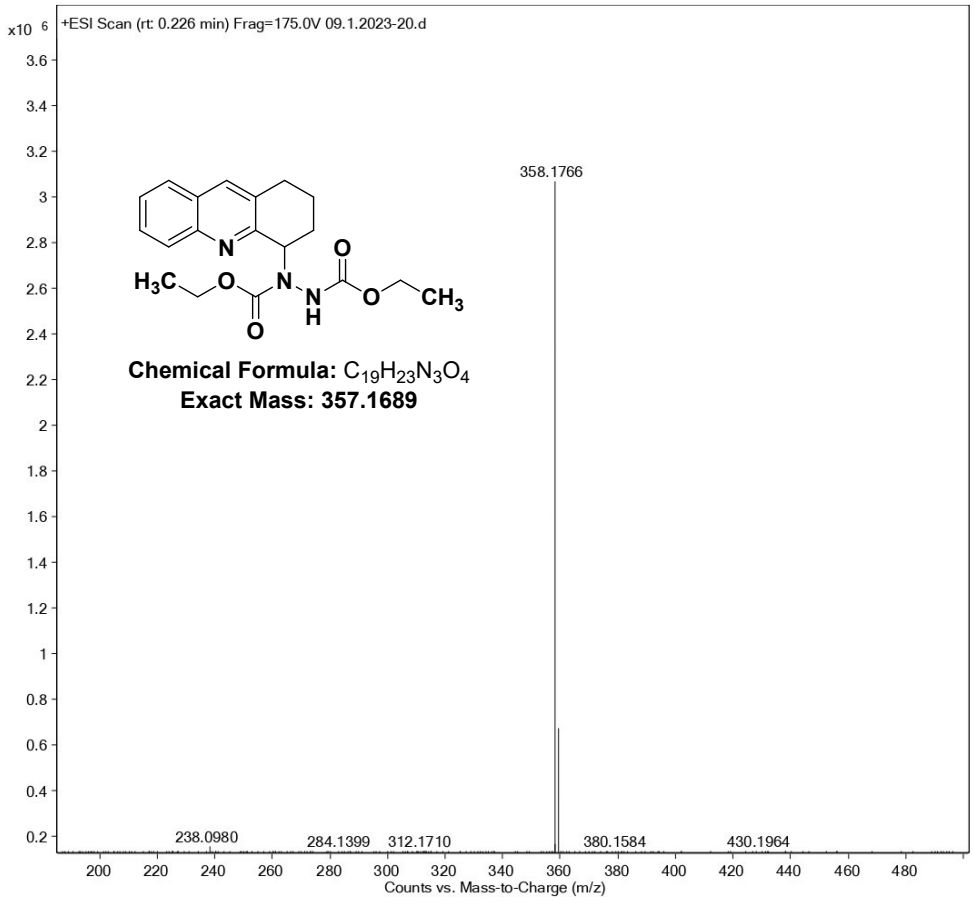
Yield = 79%, white solid; M. P: 234.5-234.9 °C; **IR (KBr, cm^{-1})**: 3010, 2967, 2903, 2852, 1714, 1665, 1598, 1215, 1177, 1094, 880, 760; ^1H NMR (400 MHz, DMSO) δ 12.41 (s, 1H), 7.57 – 7.52 (m, 2H), 7.49 (d, *J* = 8.8 Hz, 2H), 7.42 (t, *J* = 7.6 Hz, 1H), 7.32 (t, *J* = 8.0 Hz, 3H), 7.27 (t, *J* = 7.6 Hz, 1H), 3.56 (q, *J* = 5.0 Hz, 1H), 3.43 (d, *J* = 4.4 Hz, 1H), 3.30 (m, 1H), 3.04 (m, 1H), 2.77 (m, 1H). ^{13}C NMR (101 MHz, DMSO) δ 179.58, 176.79, 159.26, 155.14, 133.36, 132.29, 131.65, 130.17, 129.30, 128.53, 127.33, 123.65, 115.86, 37.02, 34.43, 33.03. **HRMS (ESI-MS):** m/z Calculated for $C_{19}H_{15}N_3O_3[M+H]^+$: 334.1186; Observed: 334.1188.

6. Spectral Data

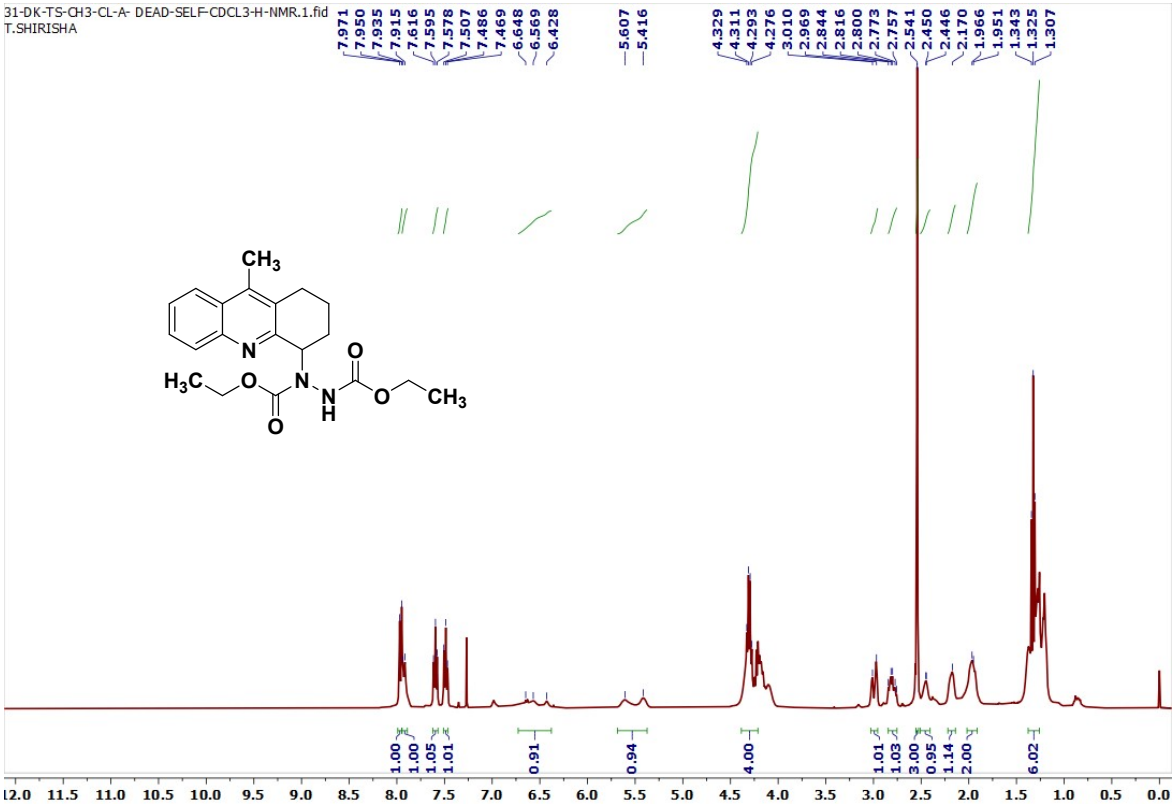
Diethyl 1-(1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3a):

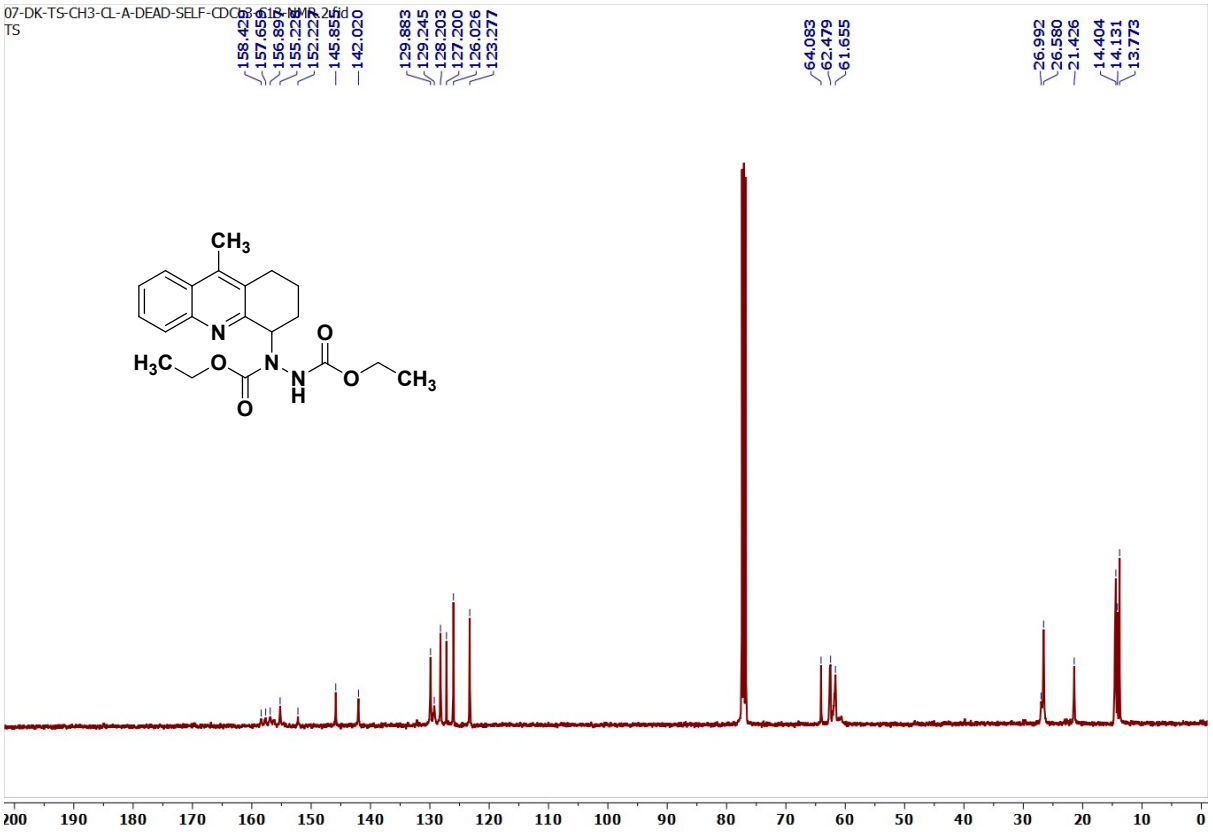

17-DK-TS-SIMPLE-ACR-D-CDCl3-SELF-1H-NMR-1.fid
TS
7.955
7.934
7.916
7.876
7.855
7.755
7.733
7.722
7.704
7.629
7.623
7.611
7.607
7.594
7.585
7.496
7.486
7.472
7.458
7.448
6.736
6.484
5.621
5.415
4.273
4.248
4.230
4.213
4.187
4.170
4.152
4.106
3.006
2.990
2.971
2.955
2.899
2.478
2.394
2.325
2.083
2.002
1.724
1.351
1.327
1.310
1.292
1.285
1.256
1.01
1.00
1.00
1.00
1.00
0.60
0.48
2.03
1.99
2.00
0.98
1.96
1.05
6.04

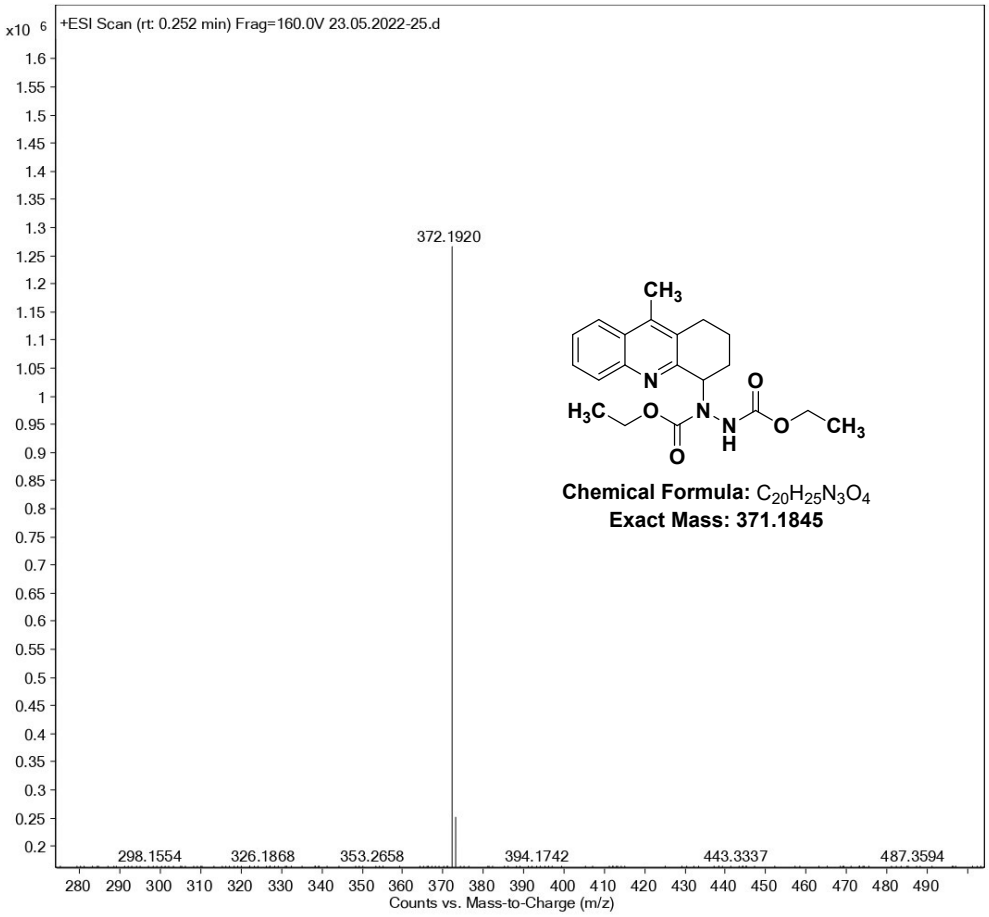

30-DK-TS-ACR-D-DMSO-SELF-13C-NMR-V6.2.fid
TS
156.845
156.305
152.376
146.602
135.319
132.023
129.213
128.808
127.368
127.091
126.533
63.646
62.016
61.137
28.644
27.692
21.236
14.739
14.353



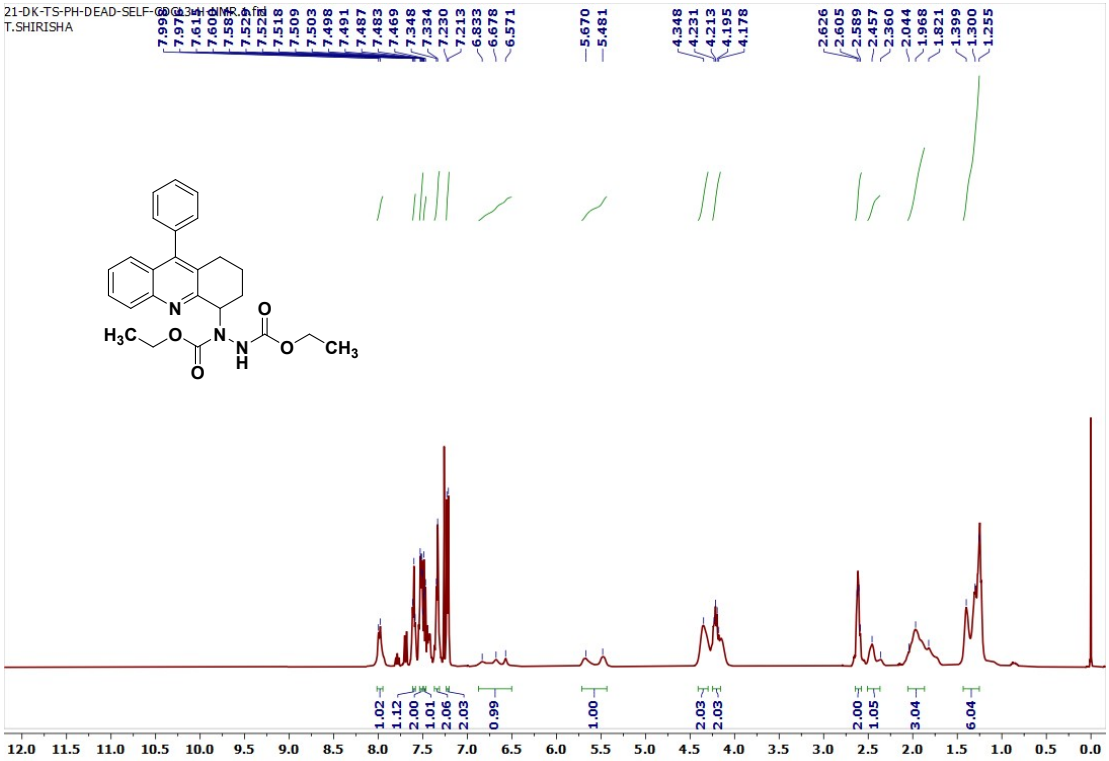
Diethyl 1-(9-methyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3b):

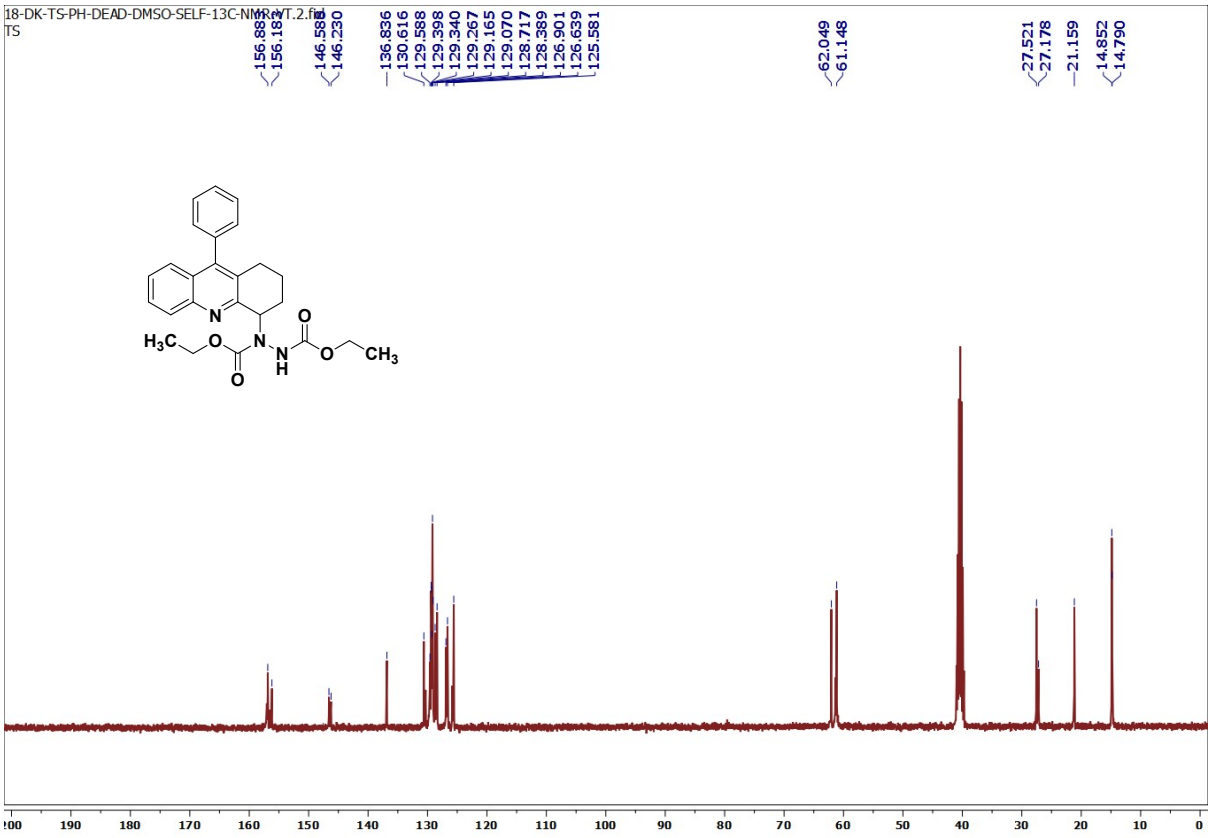


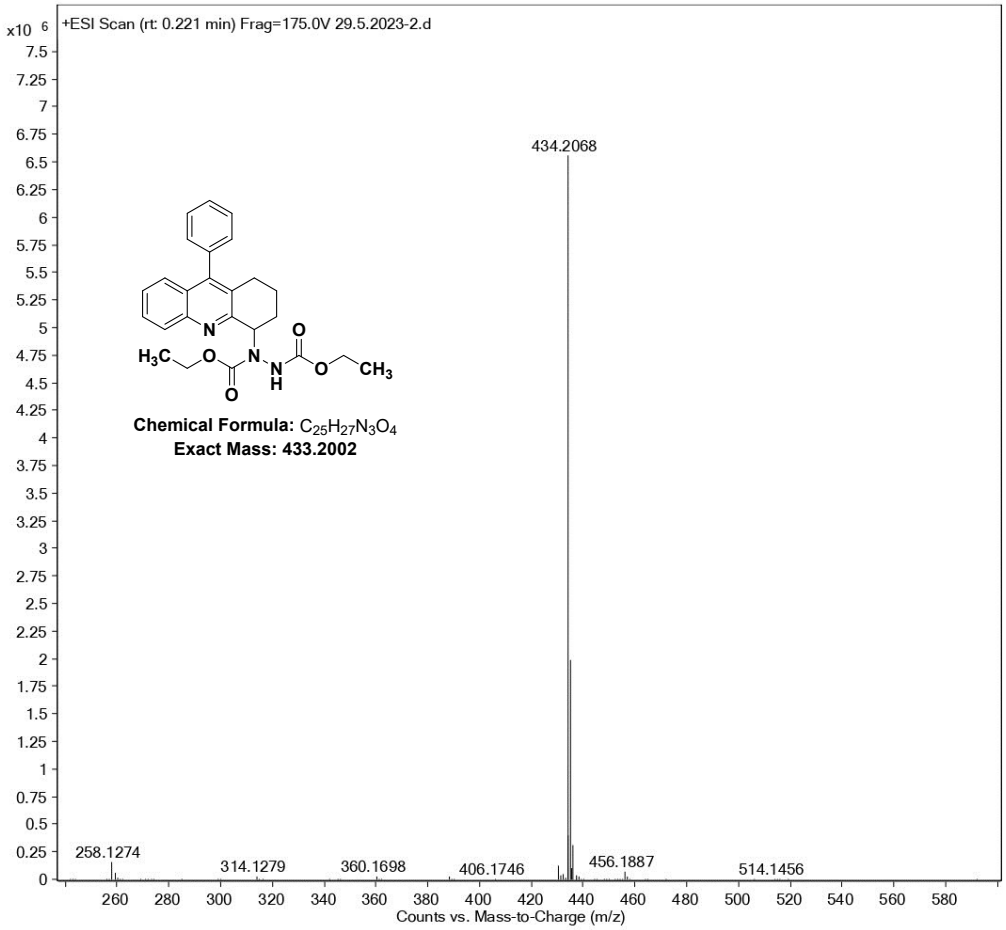

07-DK-TS-CH3-CL-A-DEAD-SELF-CDCl3-6-18-NMR.2.fid
TS
158.422
157.655
156.891
155.228
152.222
145.855
142.020
129.883
129.245
128.203
127.200
126.026
123.277
64.083
62.479
61.655
26.992
26.580
21.426
14.404
14.131
13.773
CH3
N
O
H3C
O
N
N
H
O
O
CH3
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 6
+ESI Scan (rt: 0.252 min) Frag=160.0V 23.05.2022-25.d
1.6
1.55
1.5
1.45
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
372.1920
298.1554
326.1868
353.2658
394.1742
443.3337
487.3594
280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490
Counts vs. Mass-to-Charge (m/z)
CH3
N
O
H3C
O
N
N
H
O
O
CH3
Chemical Formula: C20H25N3O4
Exact Mass: 371.1845

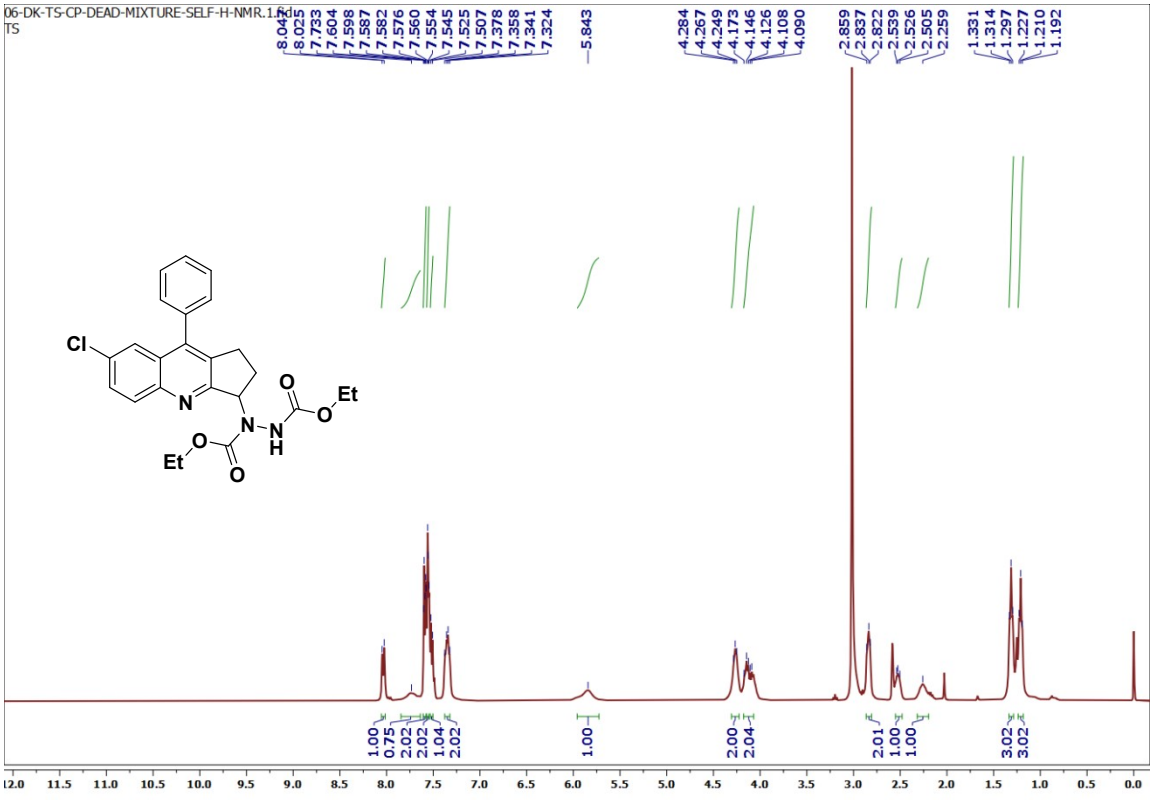
Diethyl 1-(9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3c):

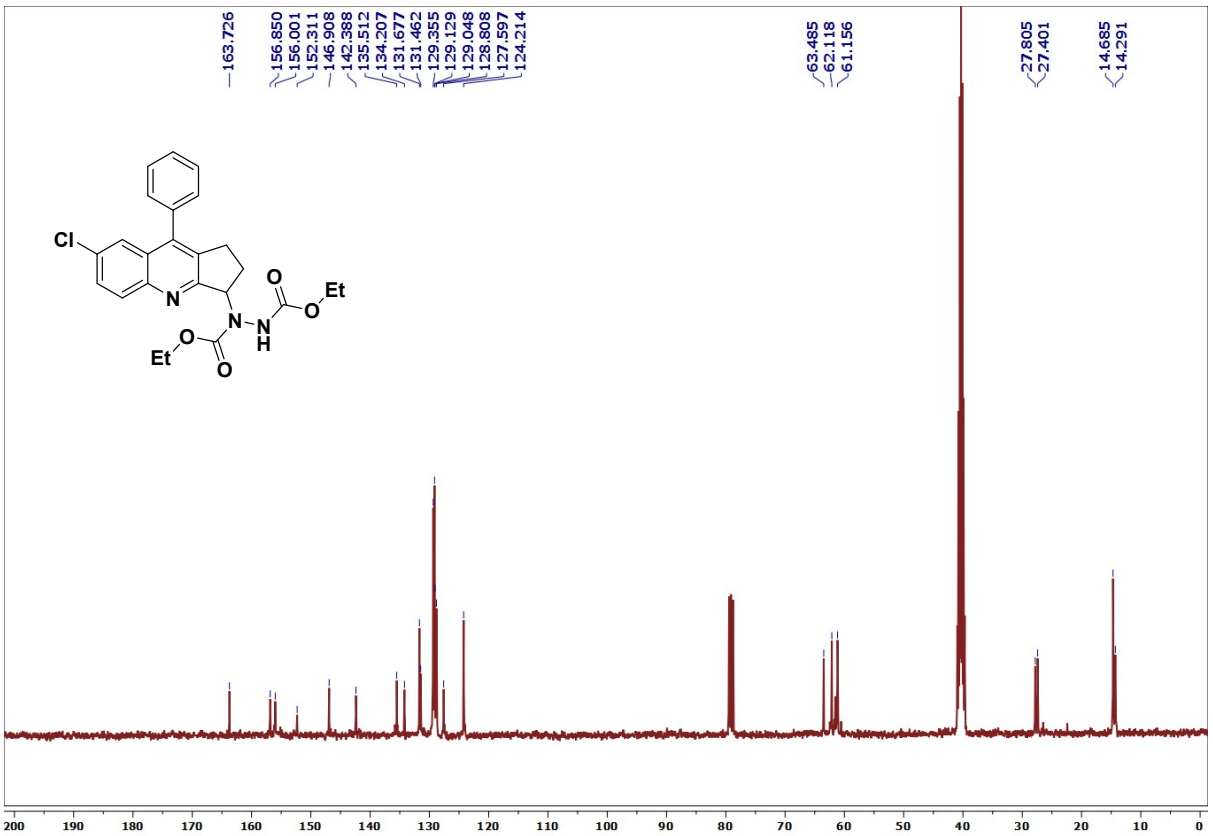


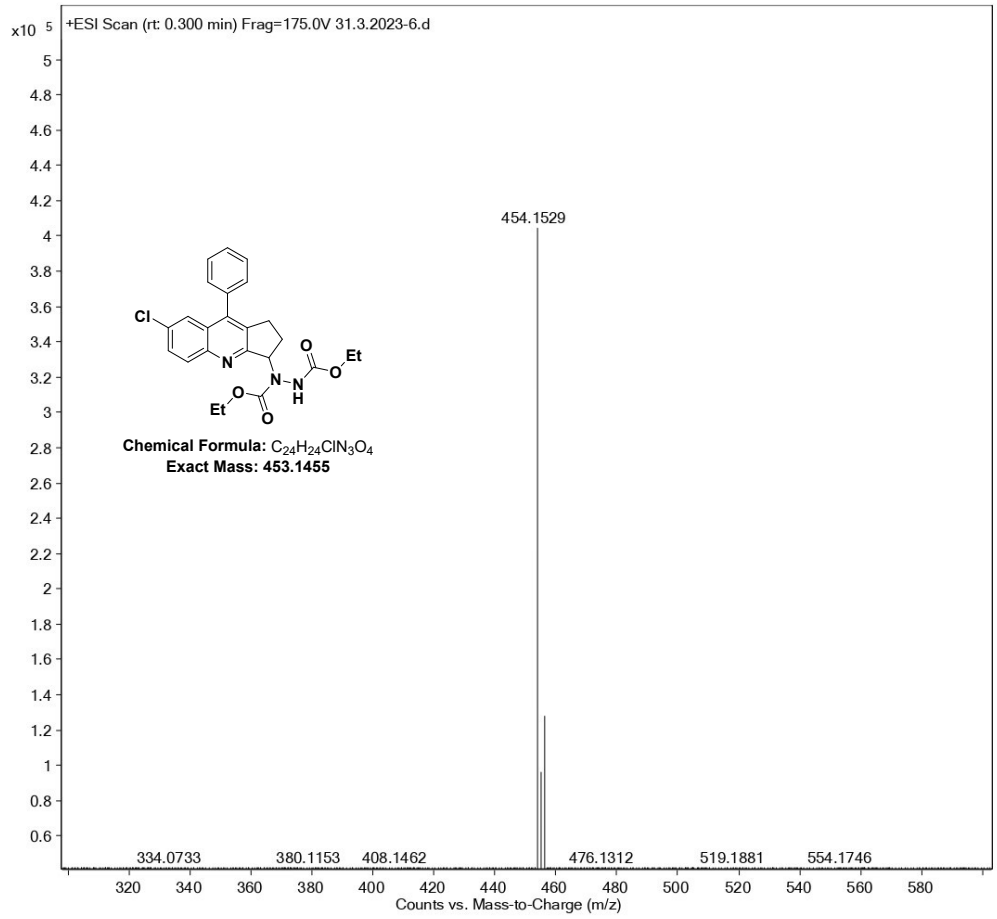




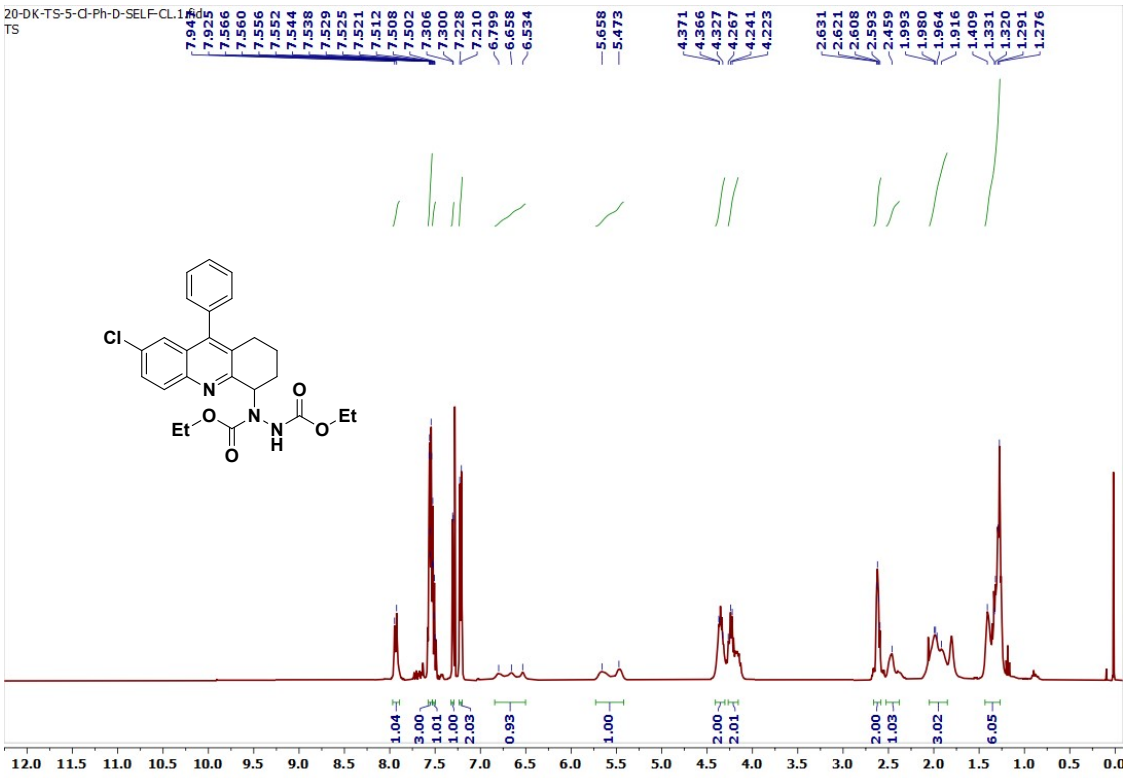
Diethyl 1-(7-Chloro-9-phenyl-2,3-dihydro-1H-cyclopenta[b]quinolin-3-yl)hydrazine-1,2-dicarboxylate (3d):

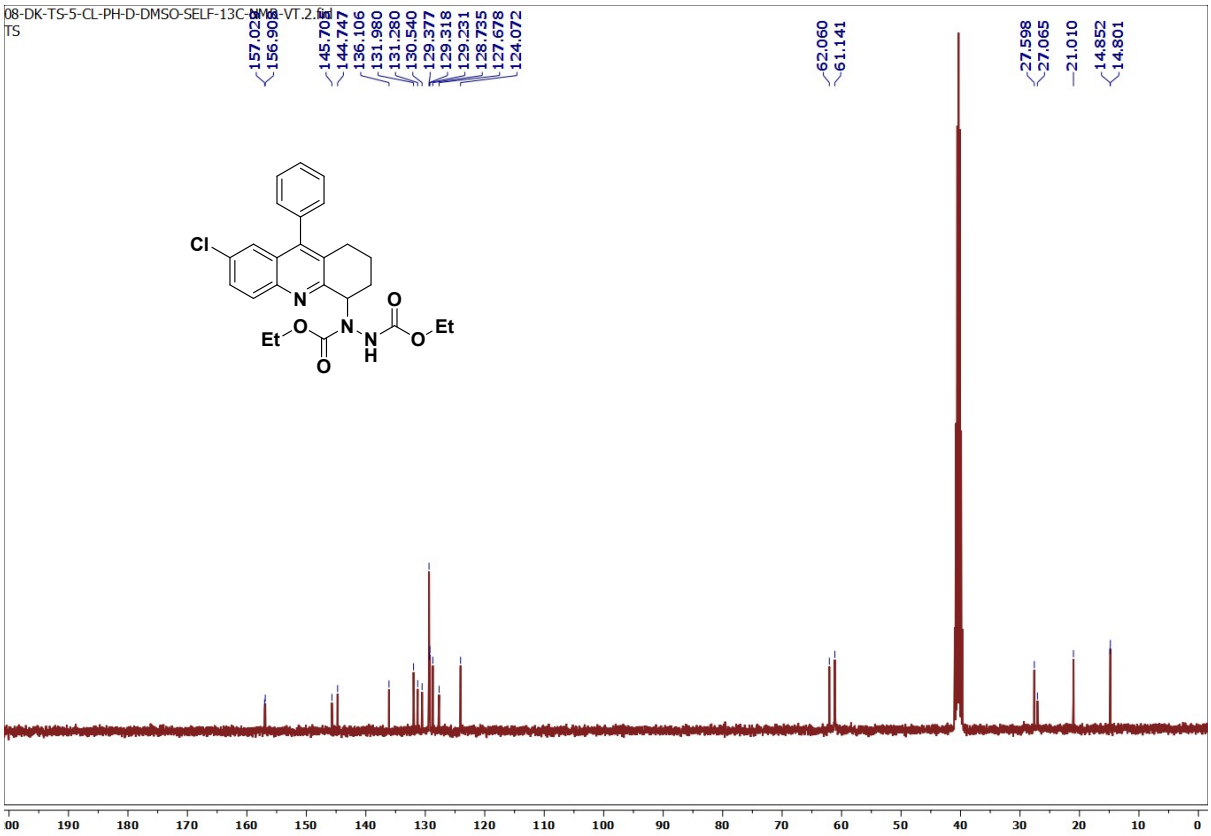


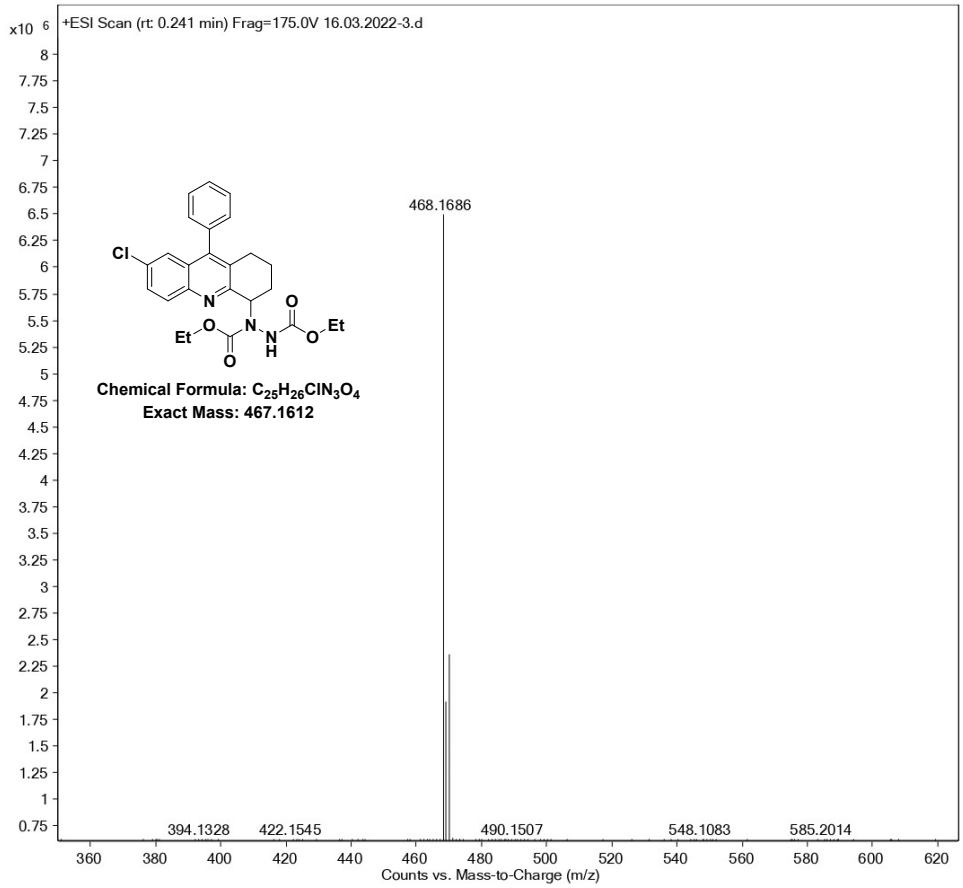

163.726
156.850
156.001
152.311
146.908
142.388
135.512
134.207
131.677
131.462
129.355
129.129
129.048
128.808
127.597
124.214
63.485
62.118
61.156
27.805
27.401
14.685
14.291
Cl
N
N
N
H
O
O
Et
O
Et
O
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


x10 5
+ESI Scan (rt: 0.300 min) Frag=175.0V 31.3.2023-6.d
454.1529
Cl
N
N
N
H
O
O
Et
O
Et
O
Chemical Formula: C24H24ClN3O4
Exact Mass: 453.1455
334.0733
380.1153
408.1462
476.1312
519.1881
554.1746
Counts vs. Mass-to-Charge (m/z)

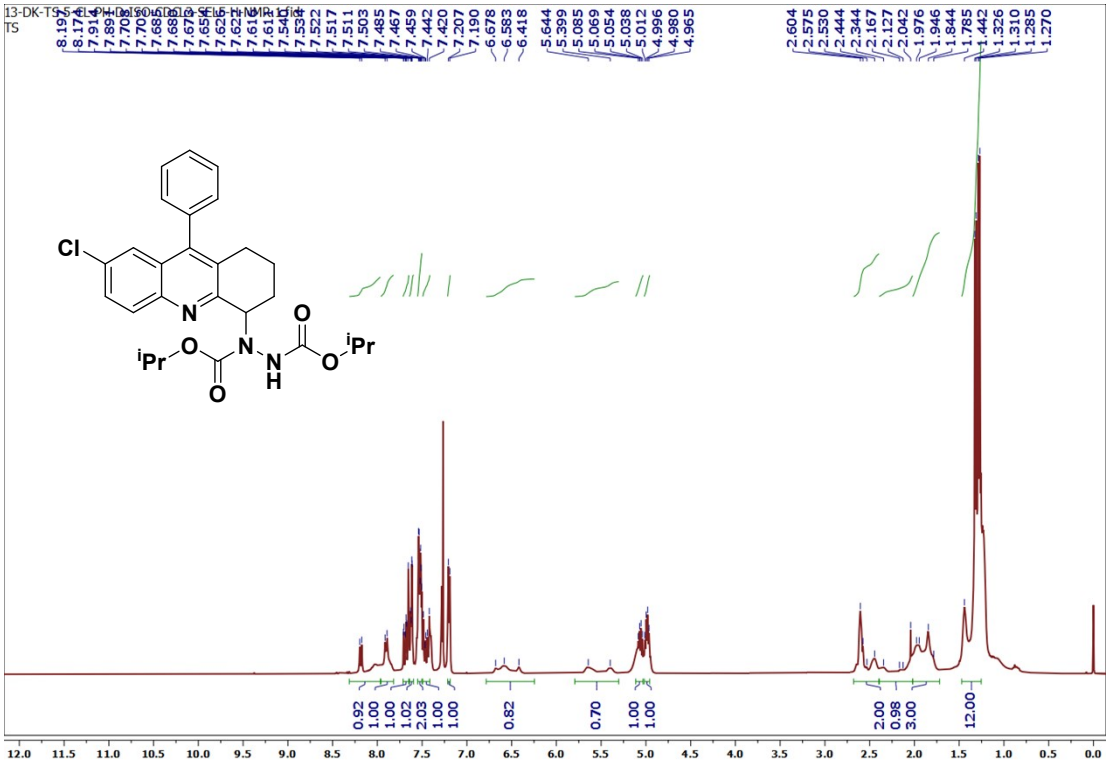
Diethyl 1-(7-chloro-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3e):

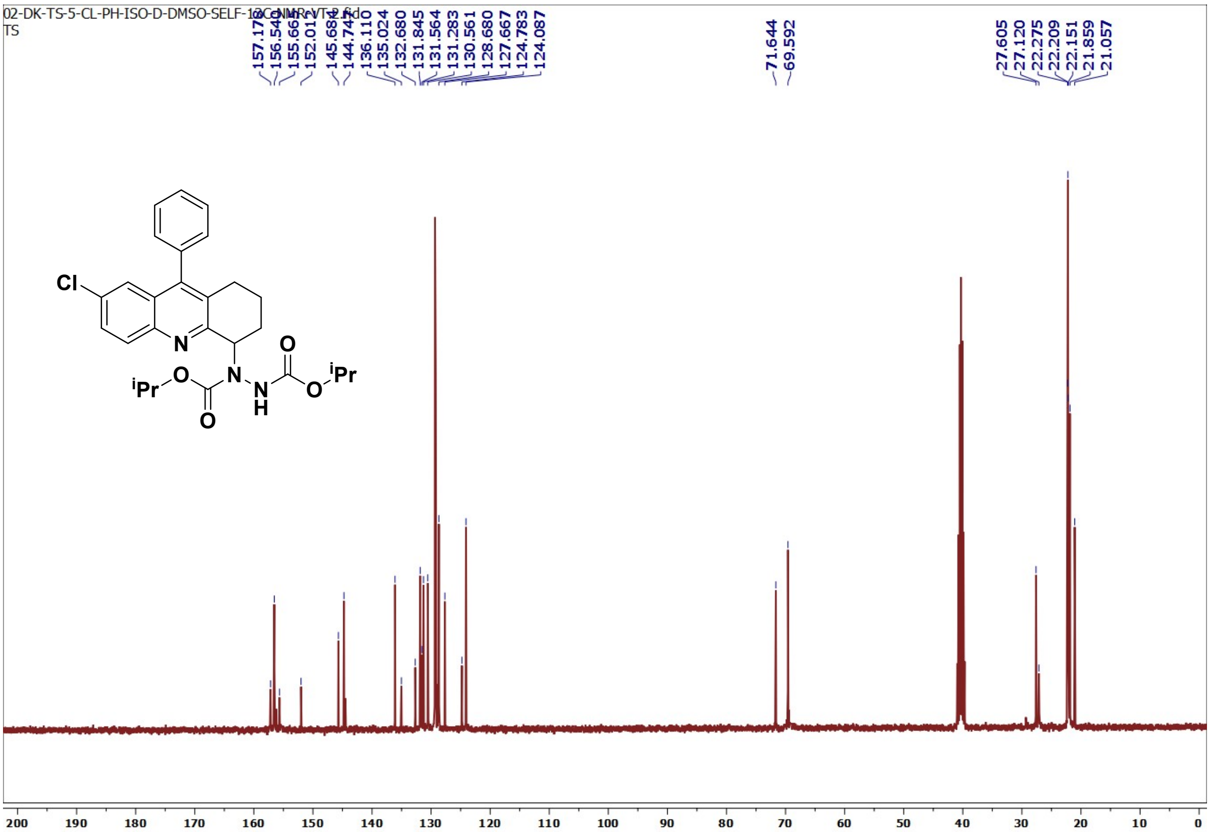


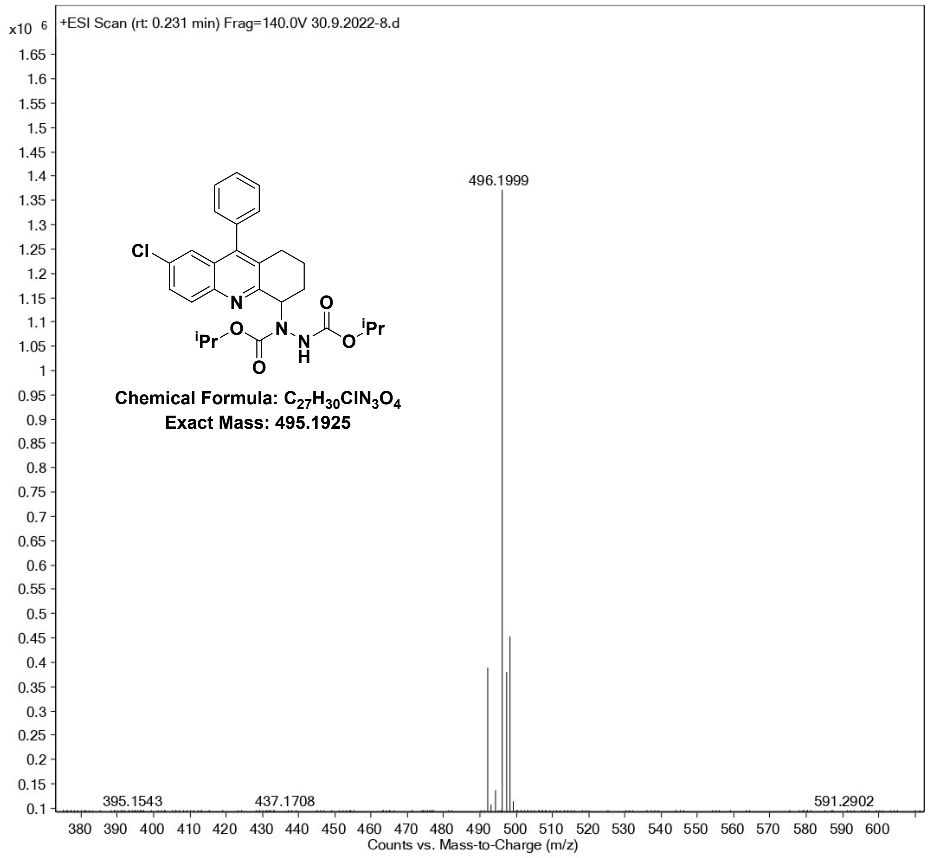




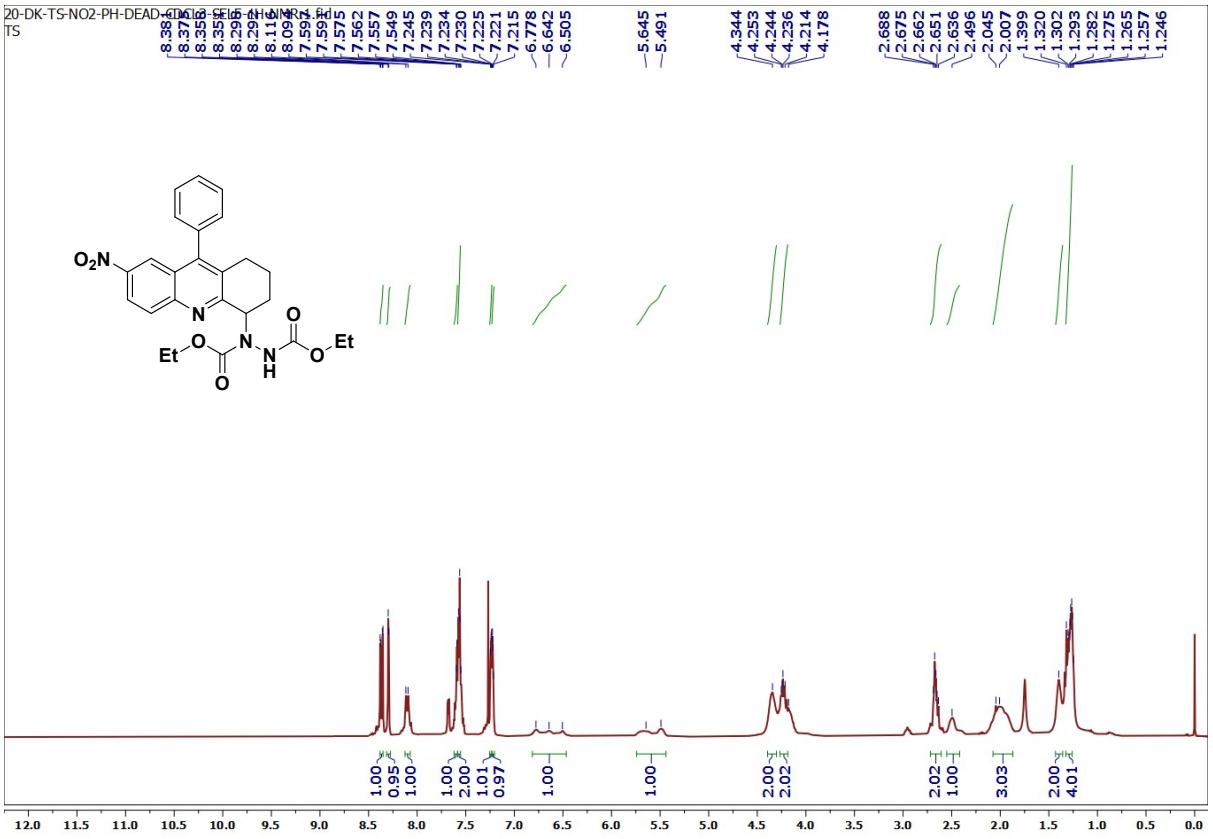
Diisopropyl 1-(7-chloro-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3f)

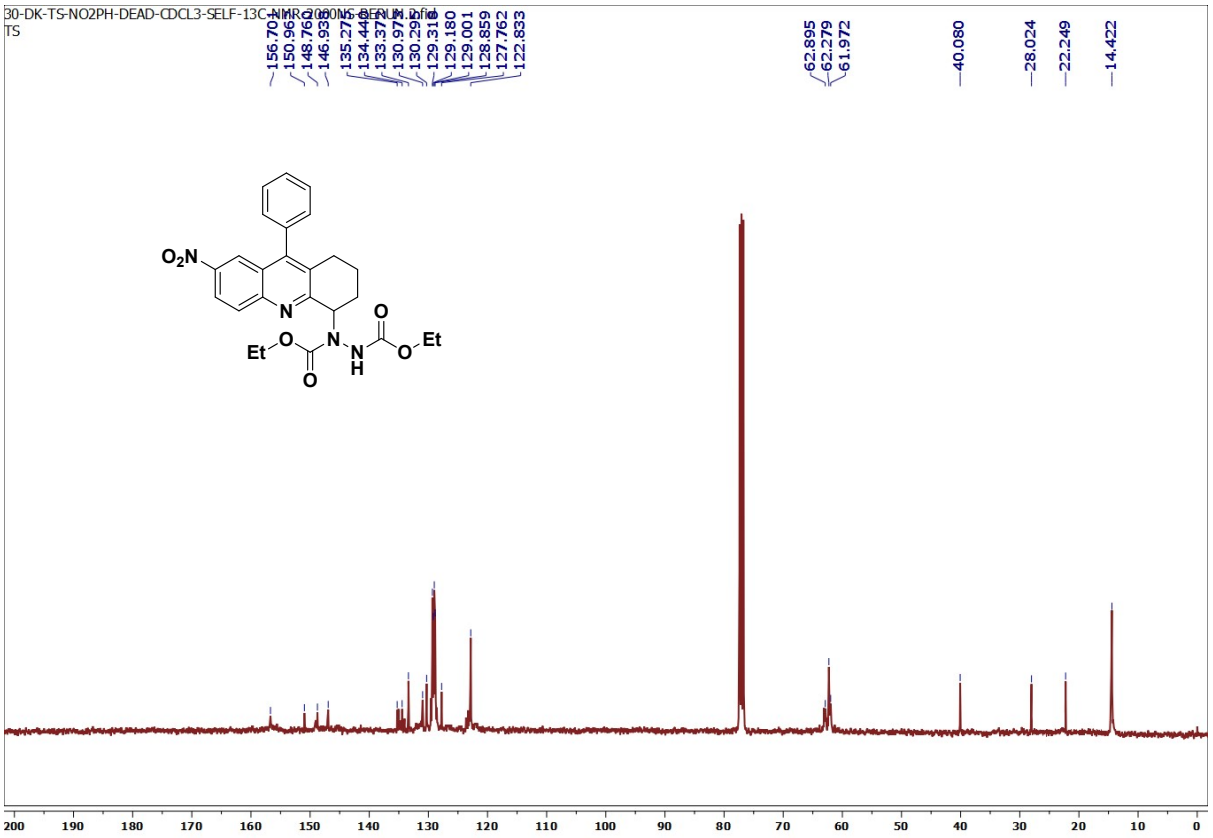


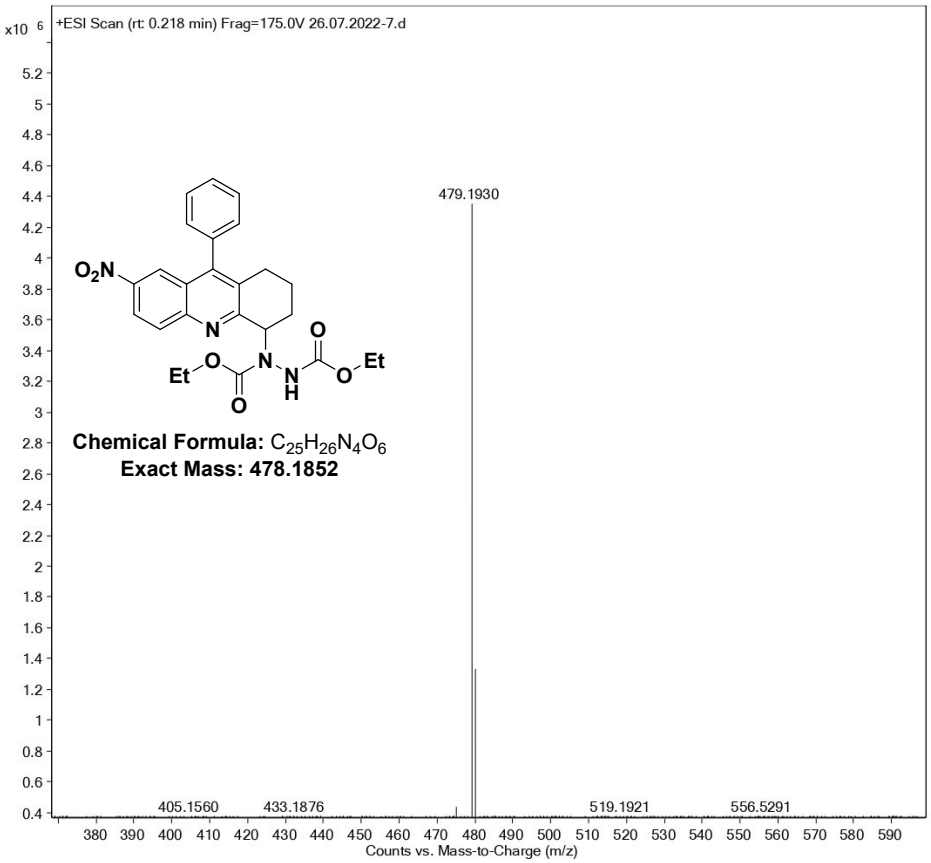

02-DK-TS-5-CL-PH-ISO-D-DMSO-SELF-13C-NMR-VT-2.fid
TS
157.176
156.540
155.663
152.011
145.684
144.743
136.110
135.024
132.680
131.845
131.564
131.283
130.561
128.680
127.667
124.783
124.087
71.644
69.592
27.605
27.120
22.275
22.209
22.151
21.859
21.057
Cl
N
N
N
H
O
O
O
O
iPr
iPr
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


x10 6
+ESI Scan (rt: 0.231 min) Frag=140.0V 30.9.2022-8.d
496.1999
395.1543
437.1708
591.2902
Chemical Formula: C27H30ClN3O4
Exact Mass: 495.1925
Counts vs. Mass-to-Charge (m/z)

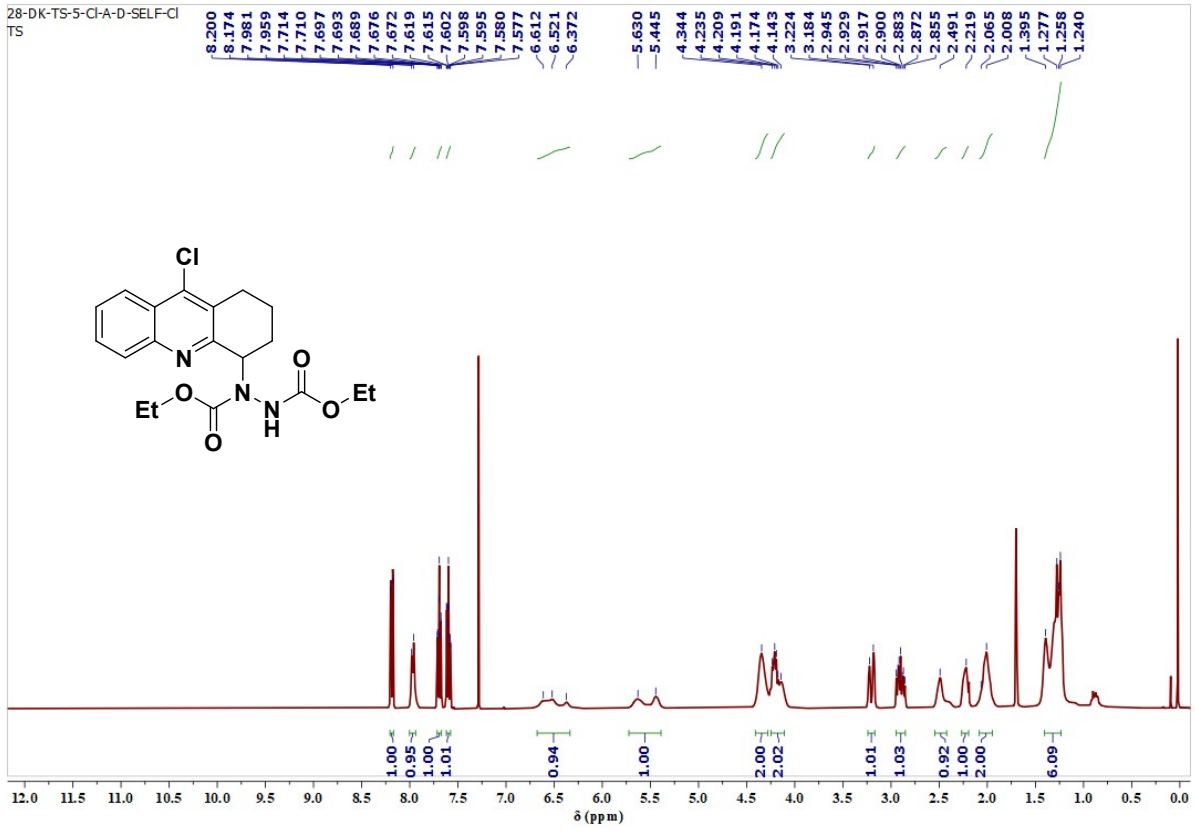
Diethyl 1-(7-nitro-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3g):

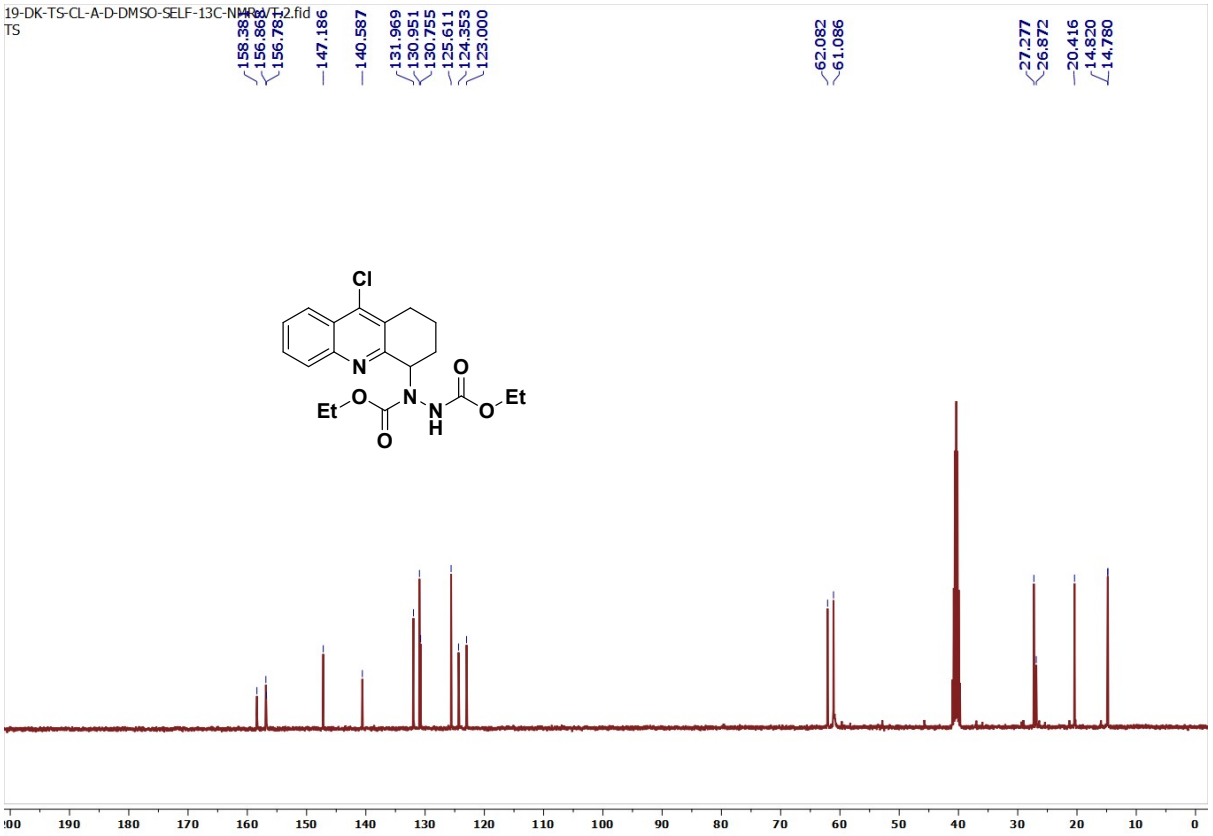


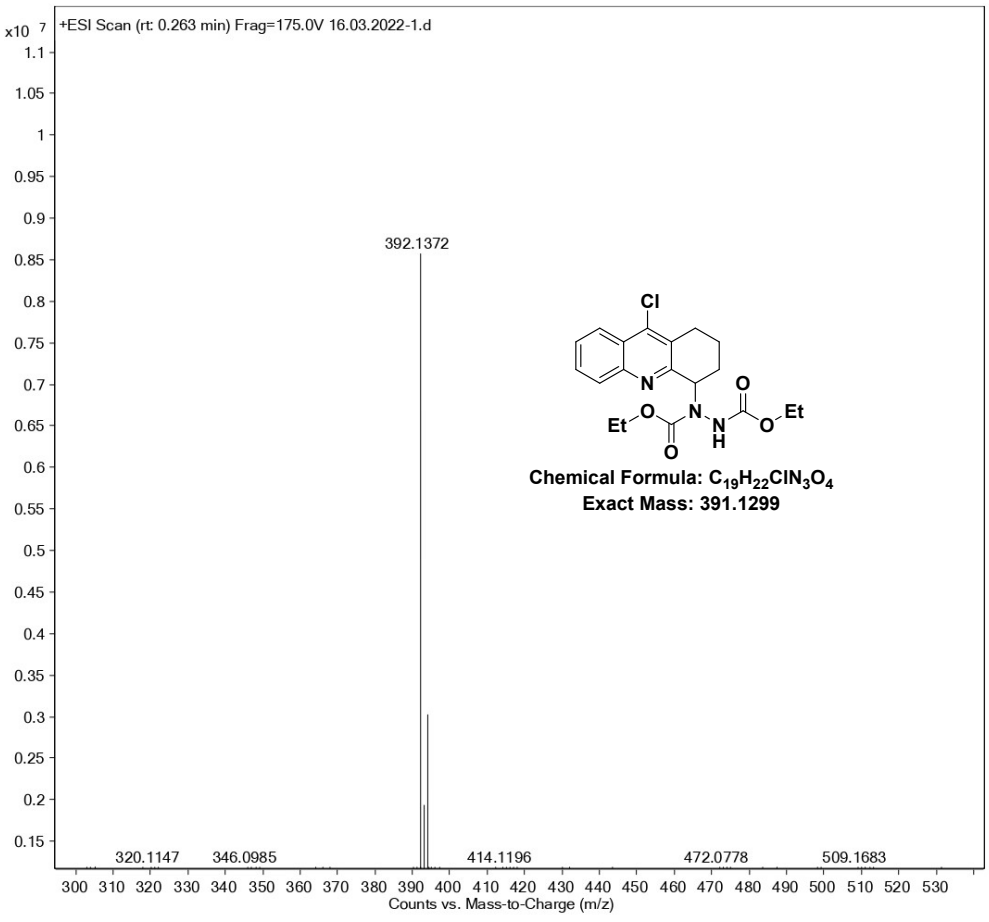




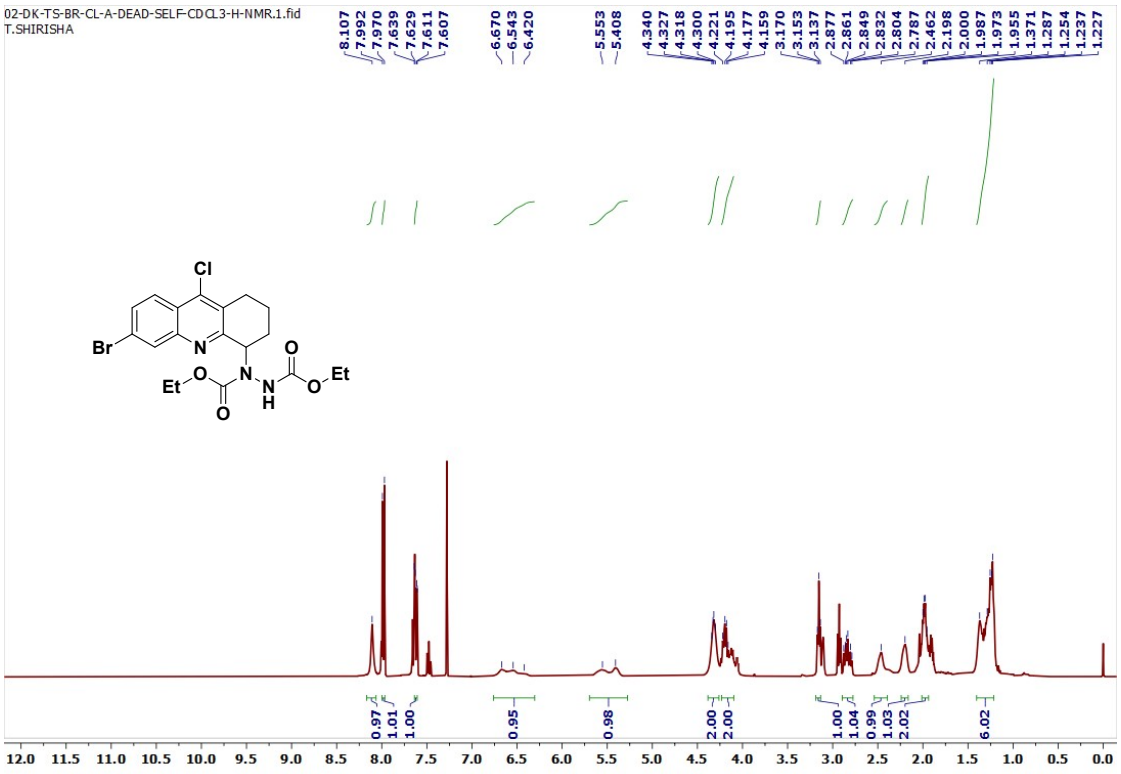
Diethyl 1-(9-chloro-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3h):

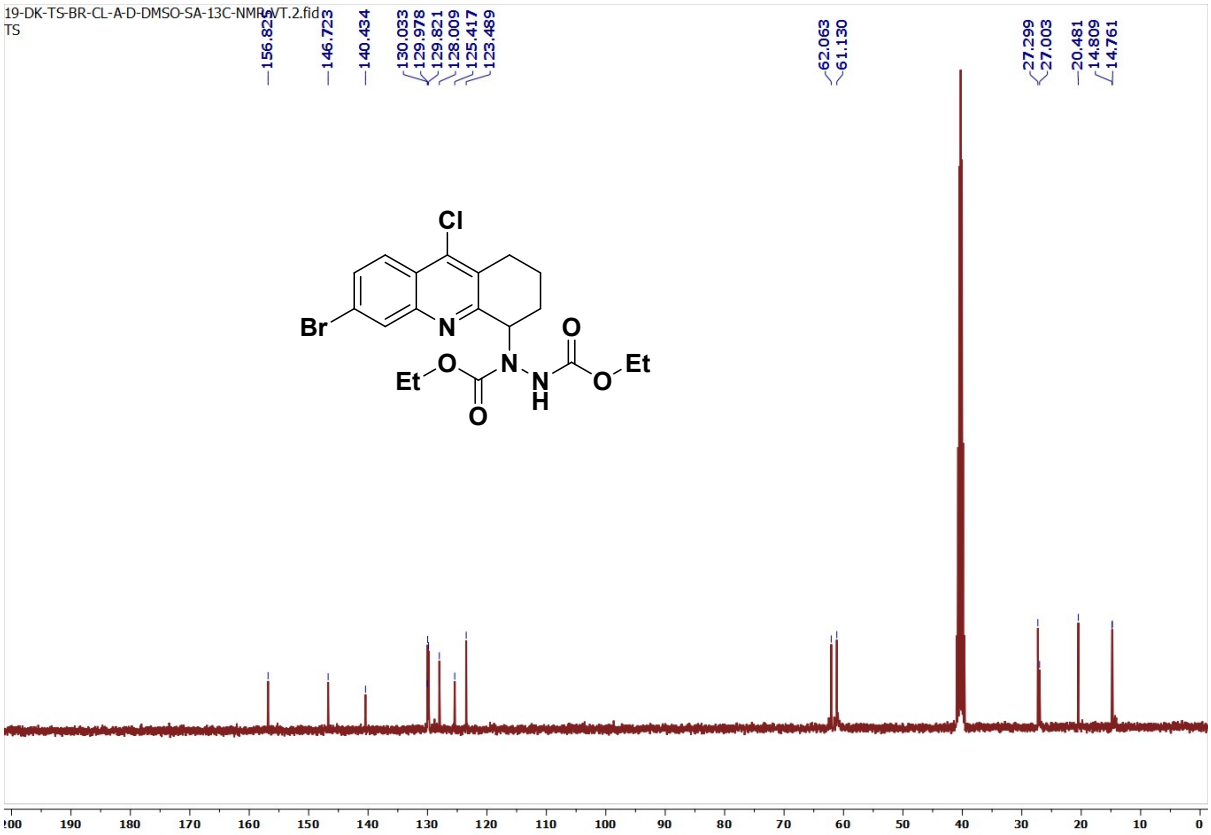


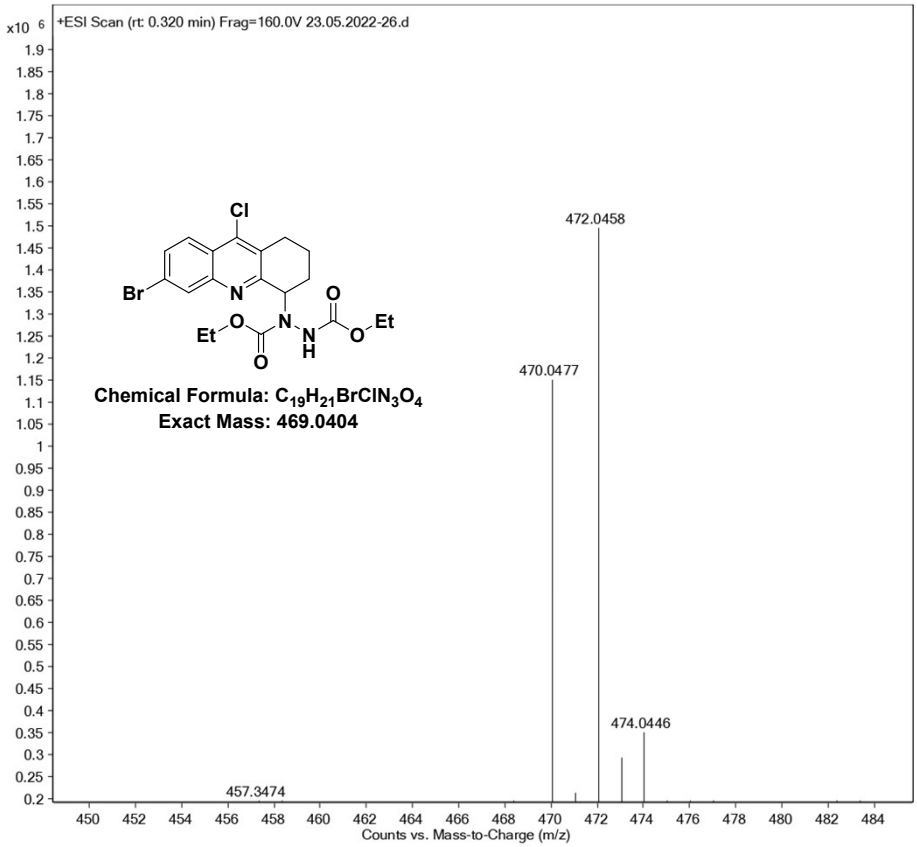

19-DK-TS-CL-A-D-DMSO-SELF-13C-NMR-1-2.fid
TS
158.381
156.866
156.781
147.186
140.587
131.969
130.951
130.755
125.611
124.353
123.000
62.082
61.086
27.277
26.872
20.416
14.820
14.780
Cl
N
O
Et
O
N
N
H
O
O
Et
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 7
+ESI Scan (rt: 0.263 min) Frag=175.0V 16.03.2022-1.d
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
392.1372
320.1147
346.0985
414.1196
472.0778
509.1683
300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490 500 510 520 530
Counts vs. Mass-to-Charge (m/z)
Cl
N
O
Et
O
N
N
H
O
O
Et
Chemical Formula: C19H22ClN3O4
Exact Mass: 391.1299

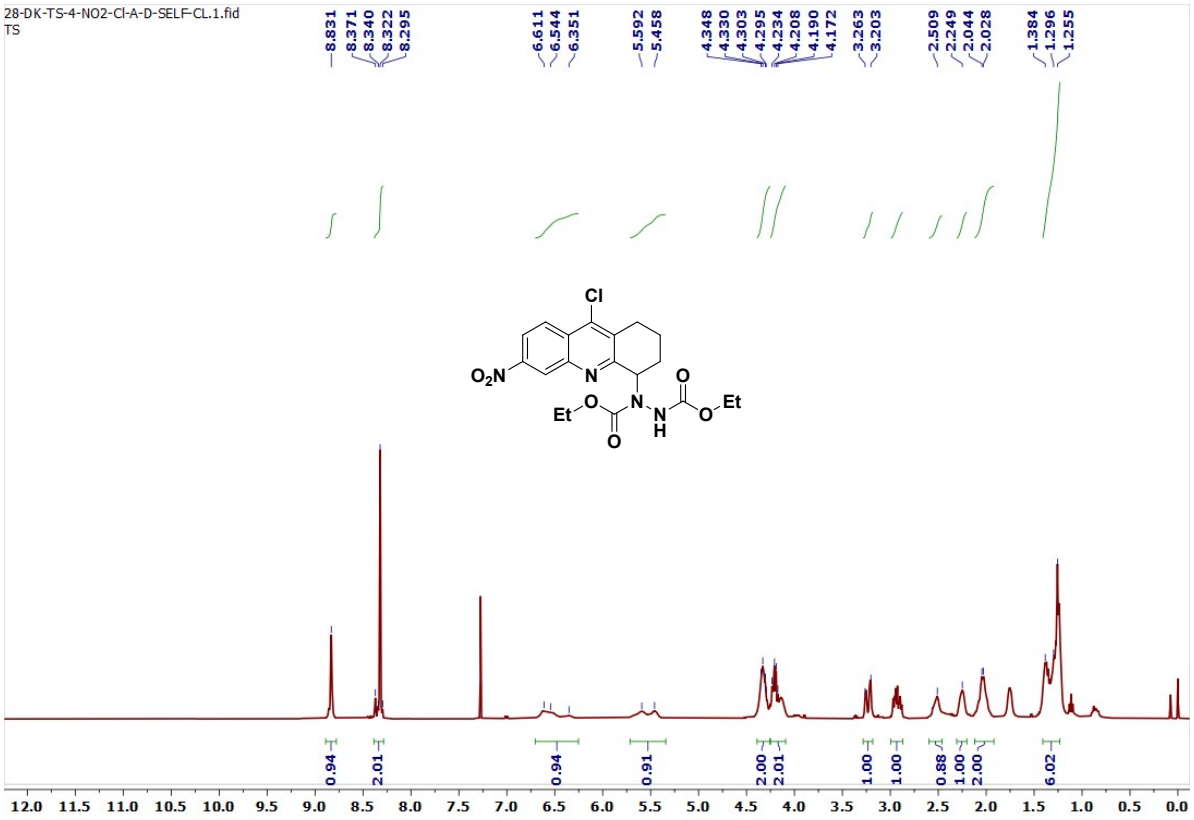
Diethyl 1-(6-bromo-9-chloro-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3i):

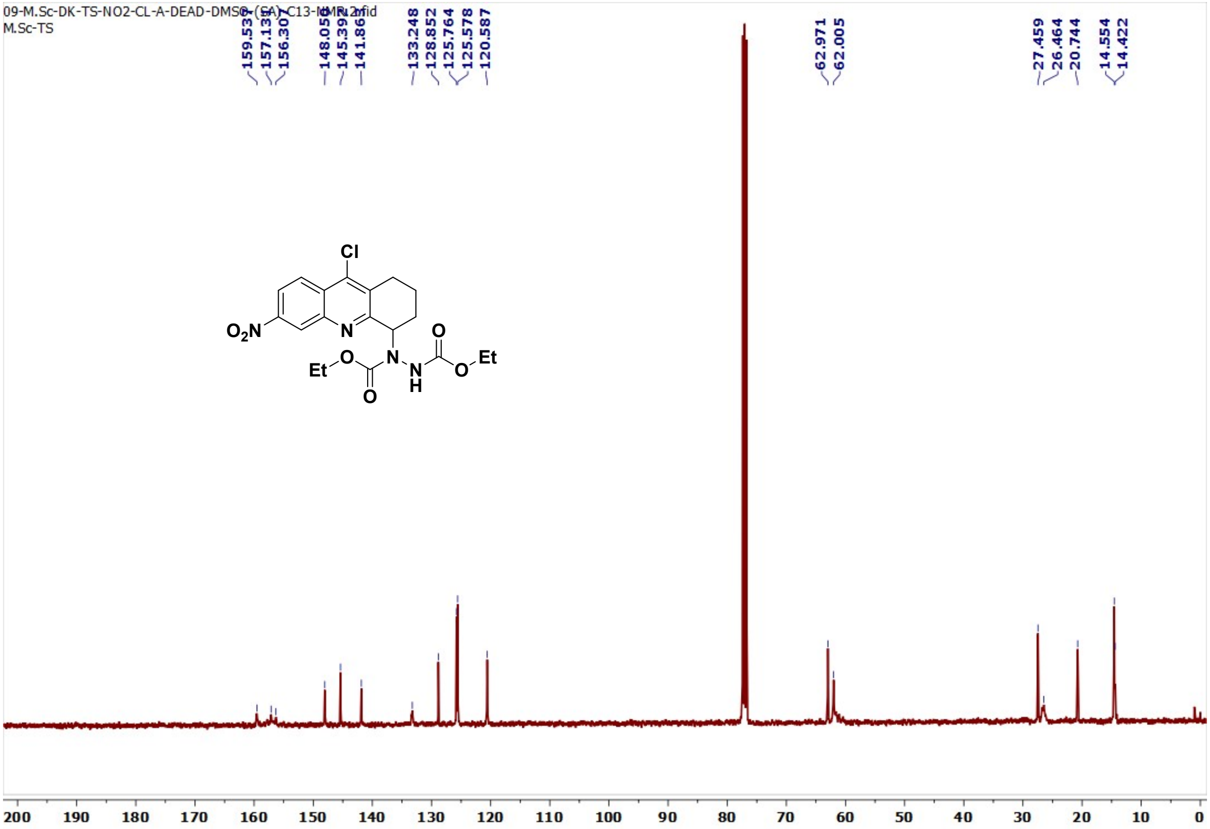


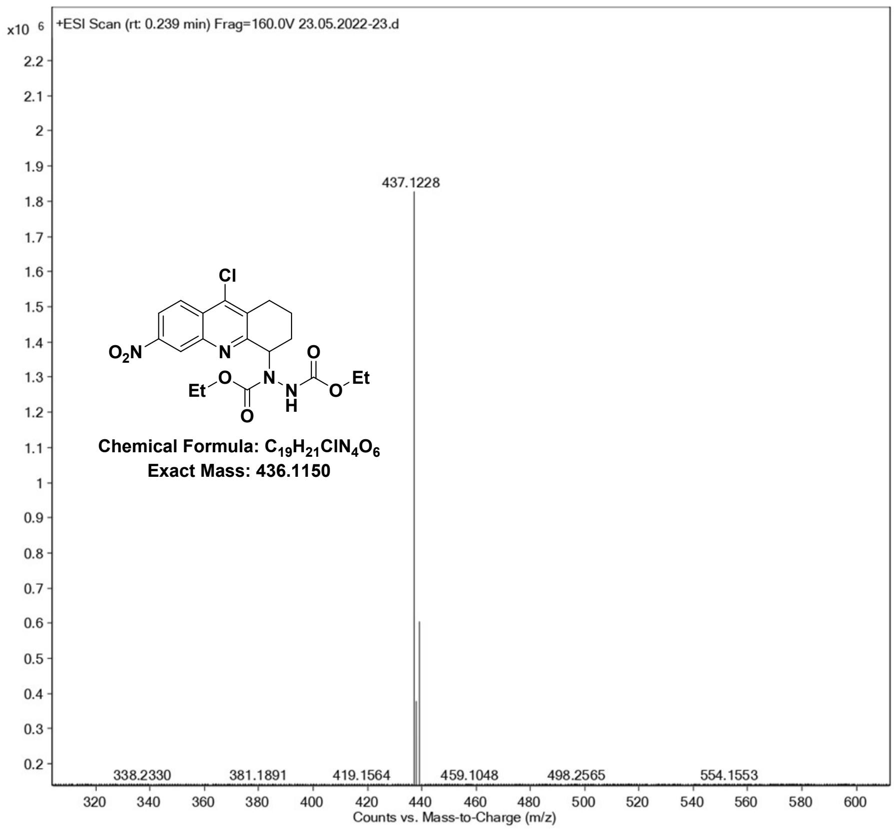




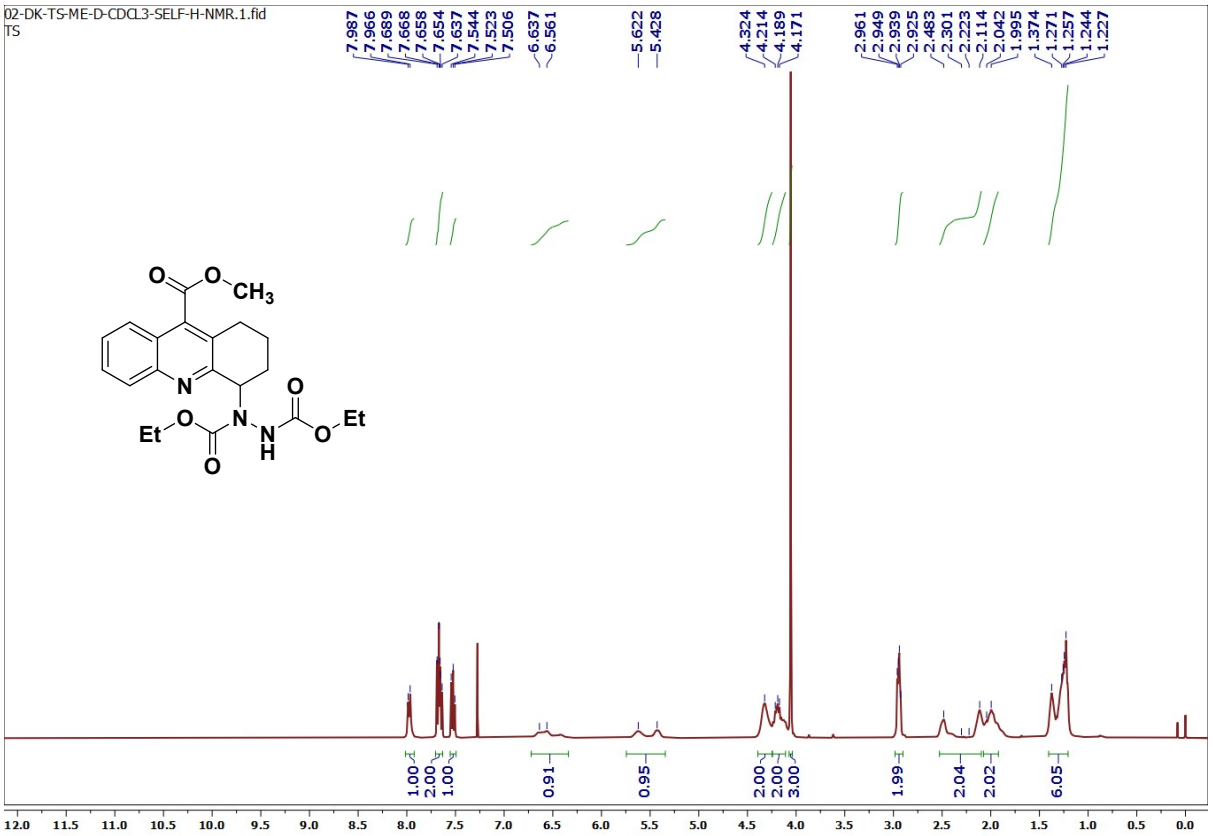
Diethyl 1-(9-chloro-6-nitro-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3j):

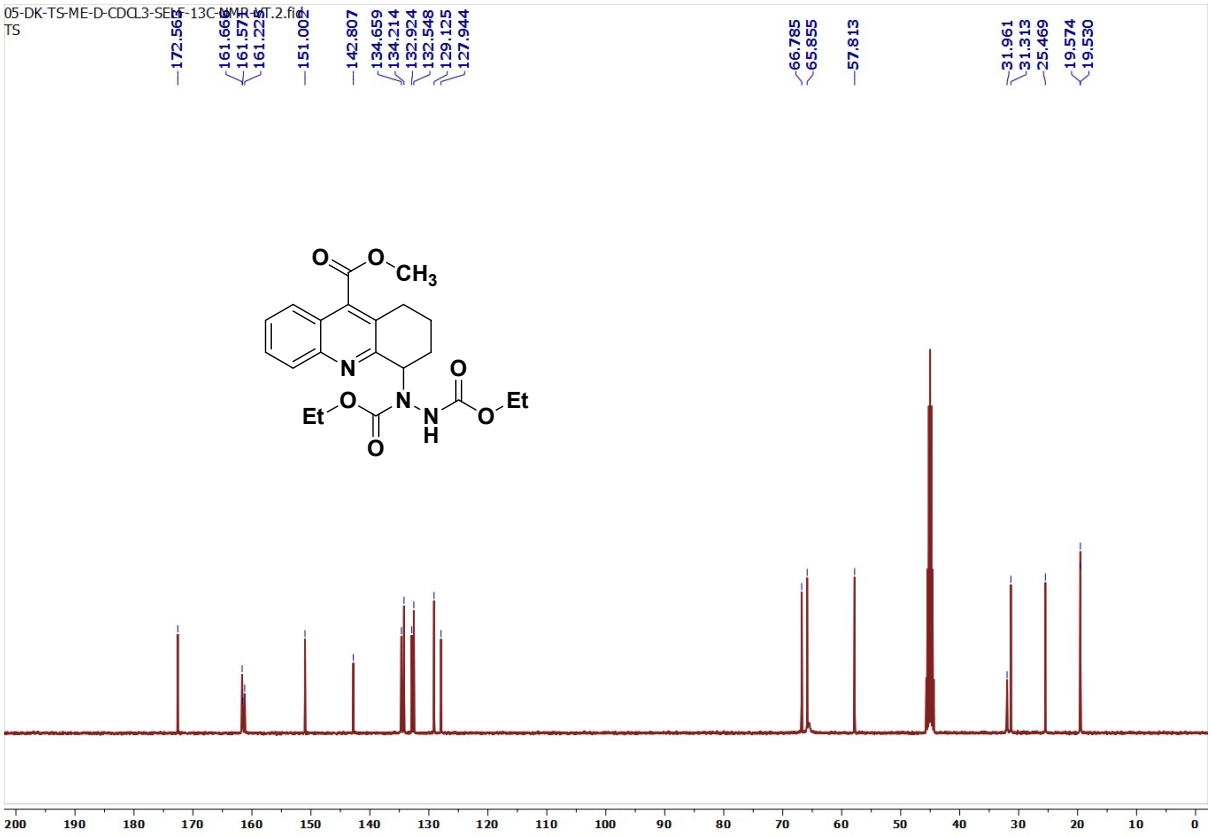


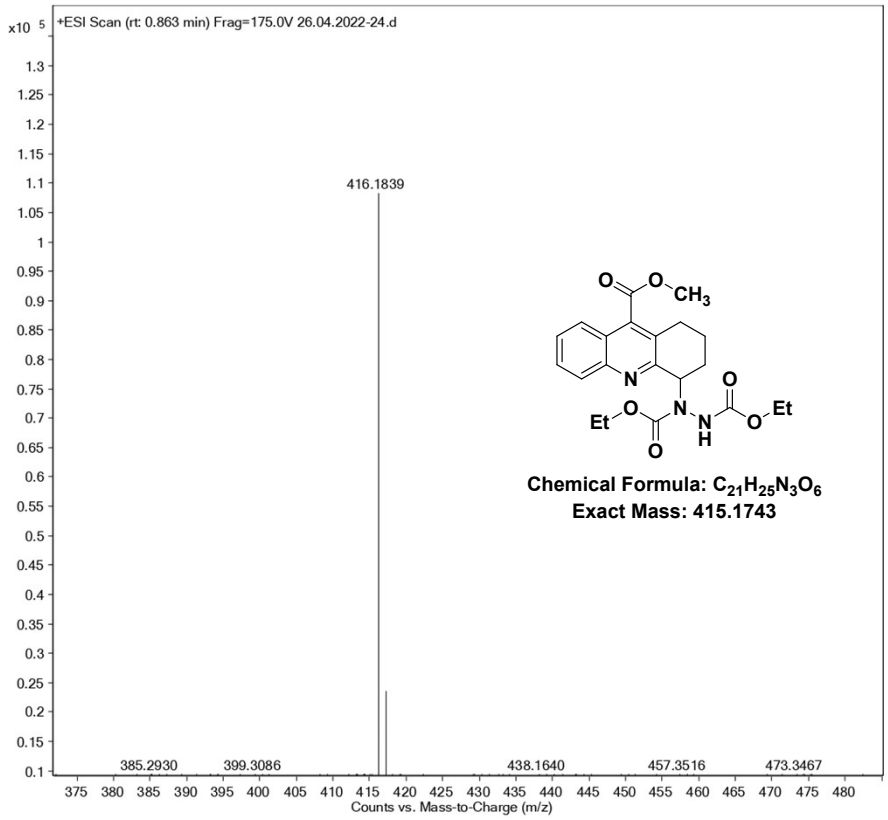

09-M.Sc-DK-TS-NO2-CL-A-DEAD-DMSO-(SA)-C13-NMR.2.fid
M.Sc-TS
159.537
157.131
156.307
148.056
145.393
141.865
133.248
128.852
125.764
125.578
120.587
62.971
62.005
27.459
26.464
20.744
14.554
14.422
Cl
O_2N
N
O
Et
O
N
N
H
O
O
Et
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


x10 6
+ESI Scan (rt: 0.239 min) Frag=160.0V 23.05.2022-23.d
437.1228
338.2330
381.1891
419.1564
459.1048
498.2565
554.1553
Chemical Formula: $C_{19}H_{21}ClN_4O_6$
Exact Mass: 436.1150
Counts vs. Mass-to-Charge (m/z)

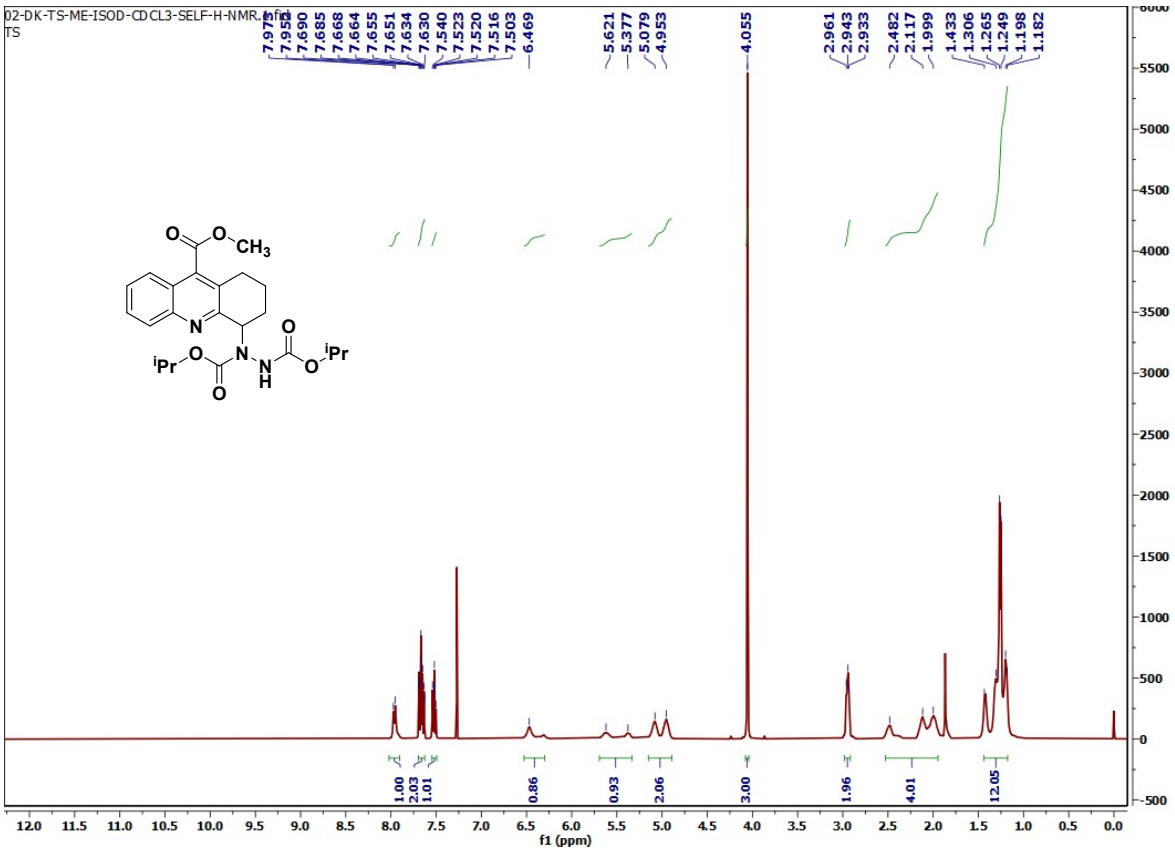
Diethyl 1-(9-(methoxycarbonyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3k):

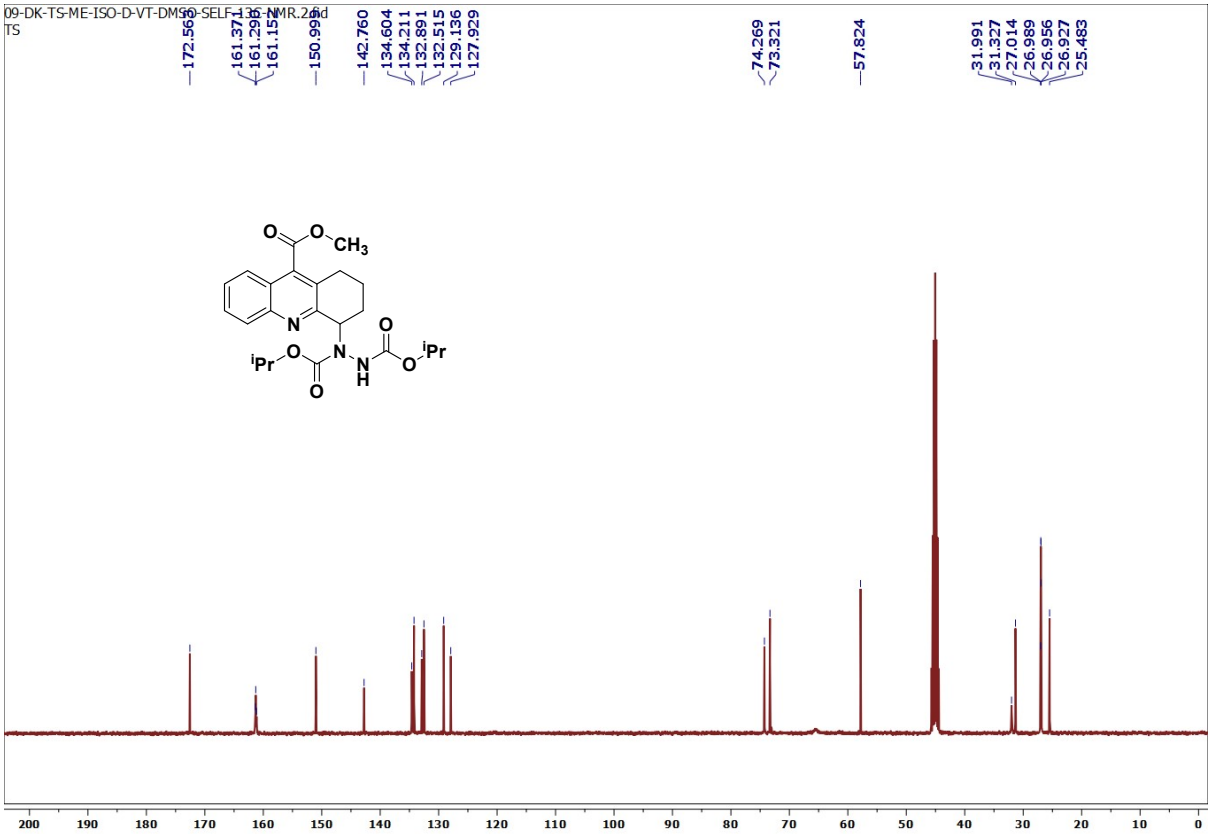


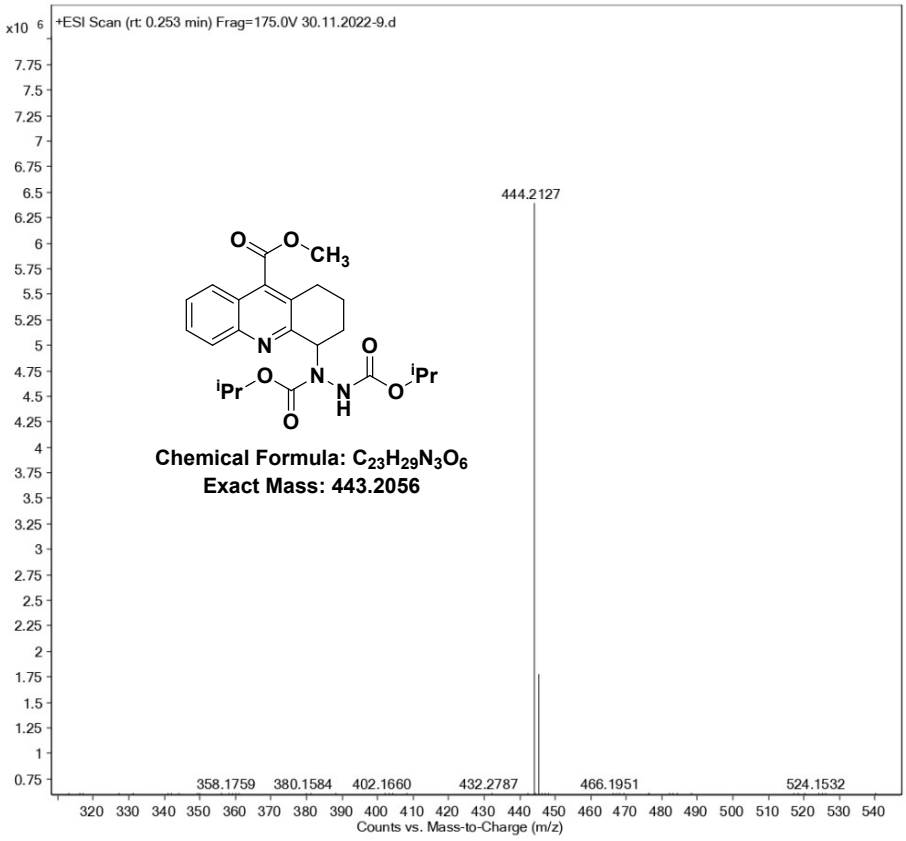




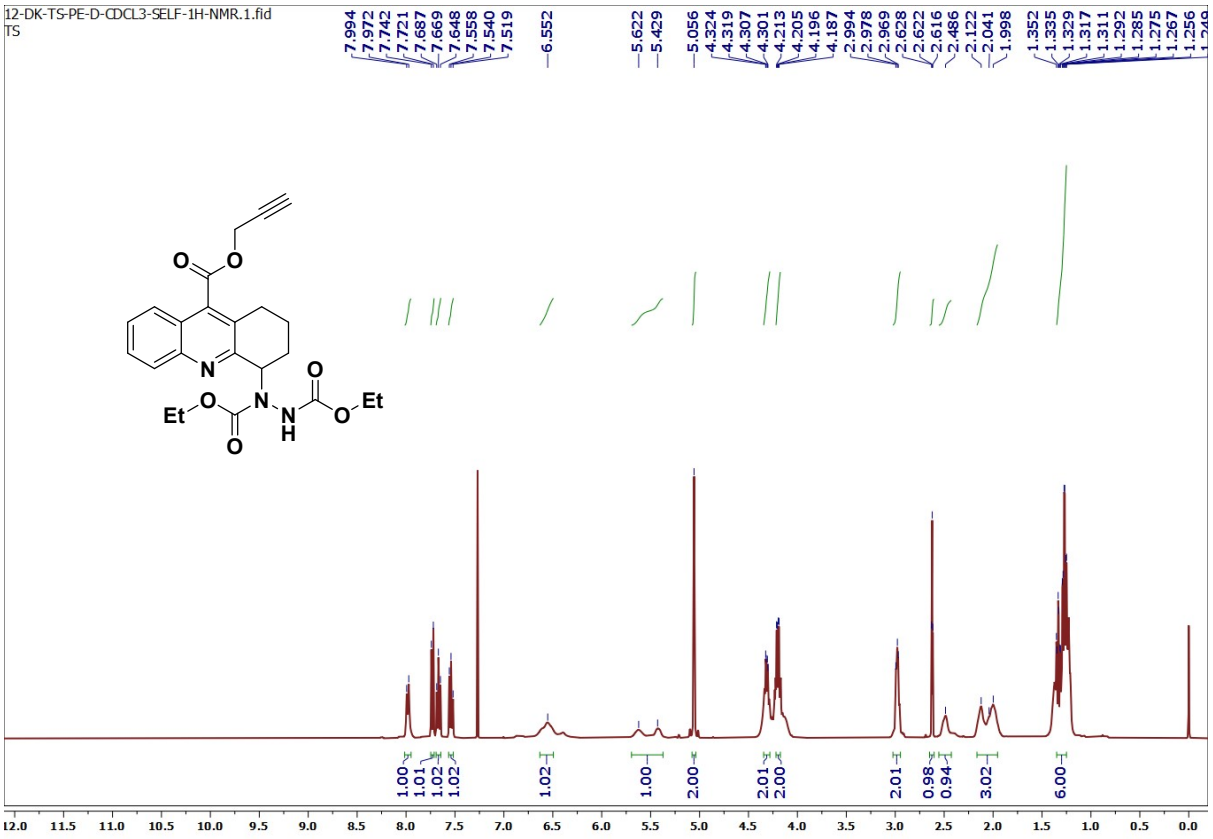
Diisopropyl 1-(9-(methoxycarbonyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3l):

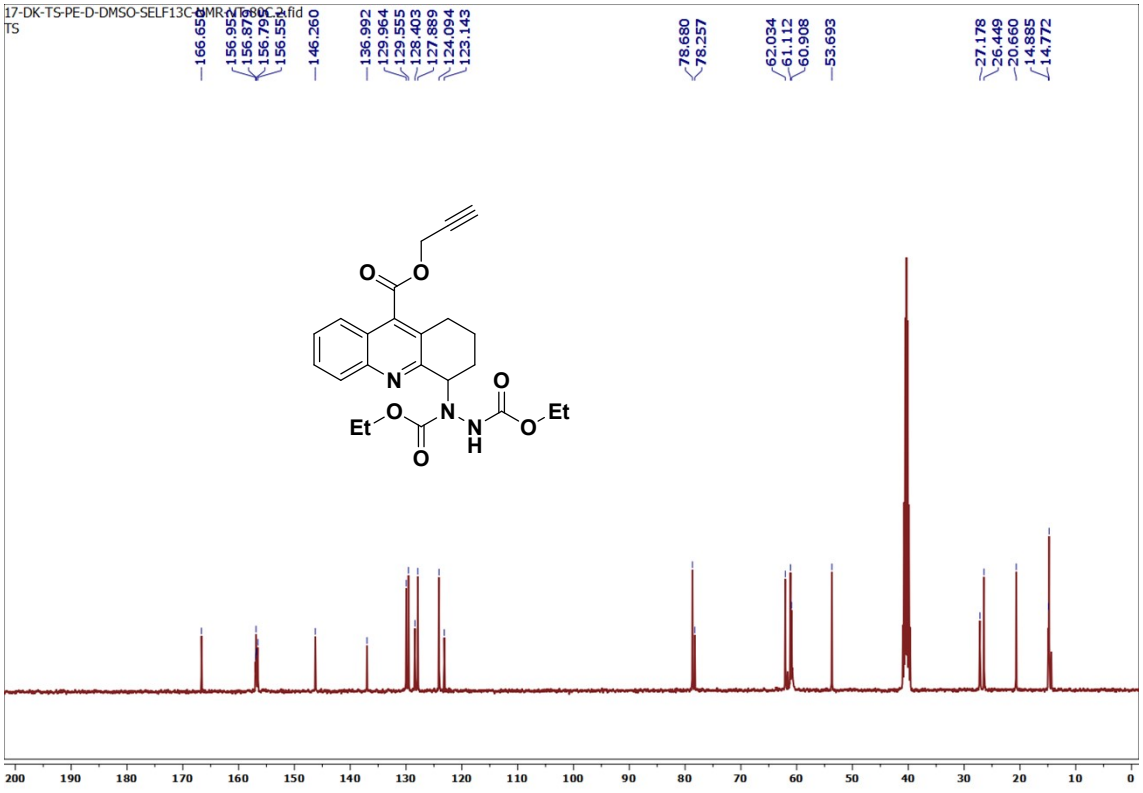


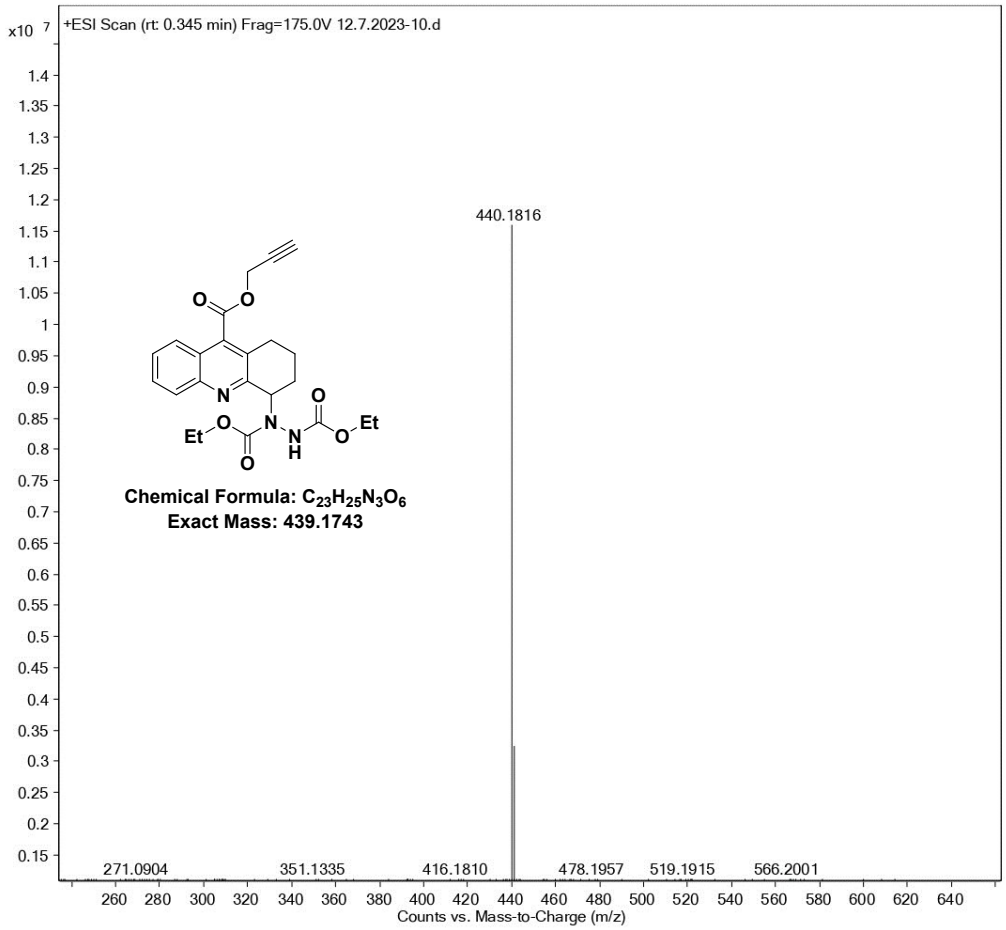

09-DK-TS-ME-ISO-D-VT-DMSO-SELF-13C-NMR.2dd
TS
172.560
161.371
161.296
161.151
150.991
142.760
134.604
134.211
132.891
132.515
129.136
127.929
74.269
73.321
57.824
31.991
31.327
27.014
26.989
26.956
26.927
25.483
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 6
+ESI Scan (rt: 0.253 min) Frag=175.0V 30.11.2022-9.d
444.2127
Chemical Formula: C23H29N3O6
Exact Mass: 443.2056
358.1759
380.1584
402.1660
432.2787
466.1951
524.1532
Counts vs. Mass-to-Charge (m/z)

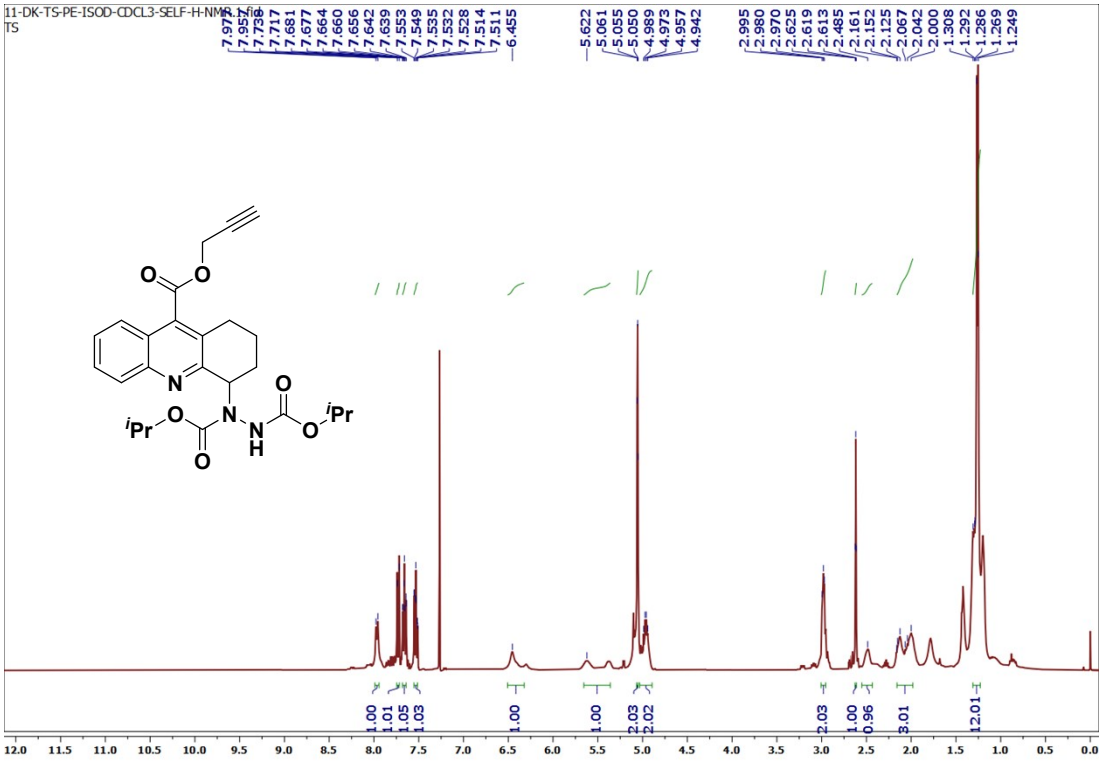
Diethyl 1-(9-((prop-2-yn-1-yloxy)carbonyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3m):

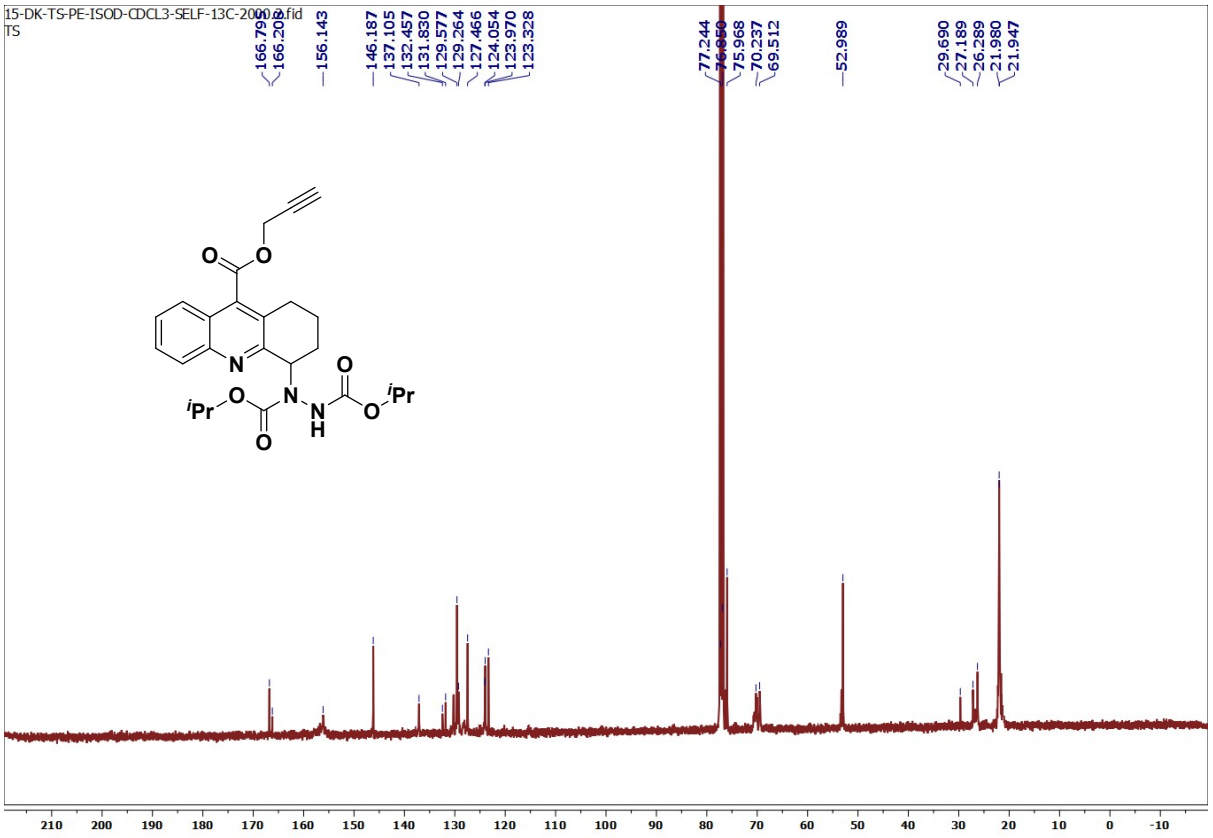


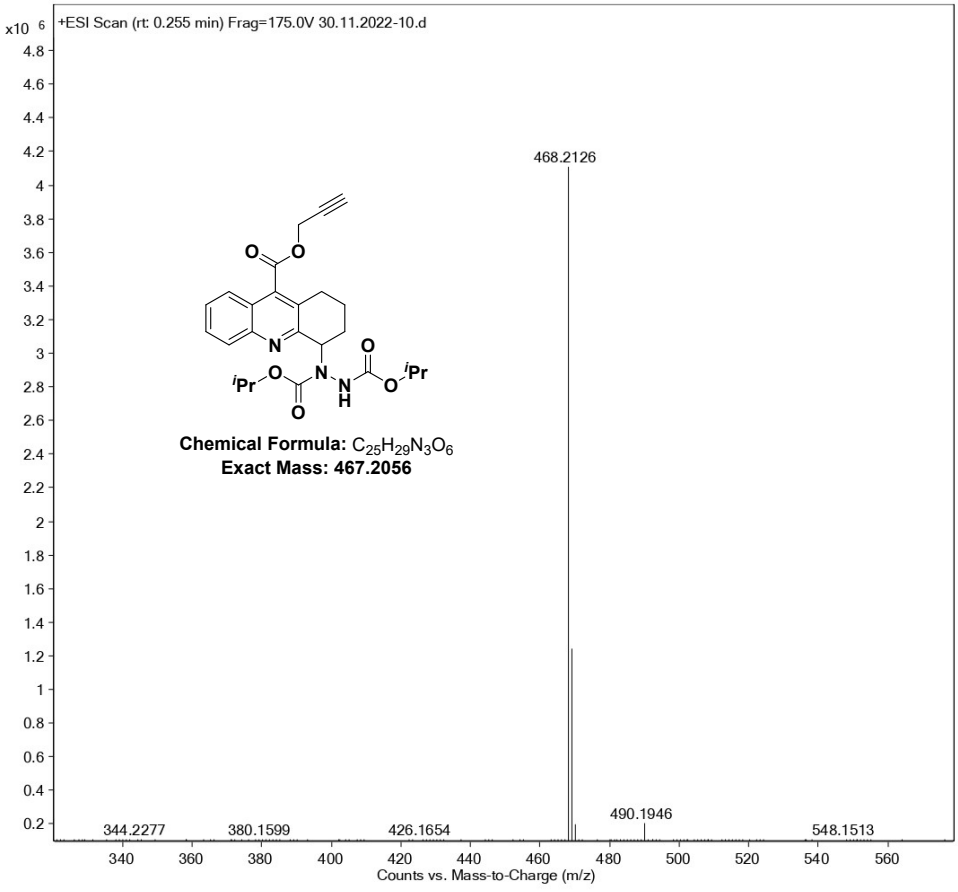




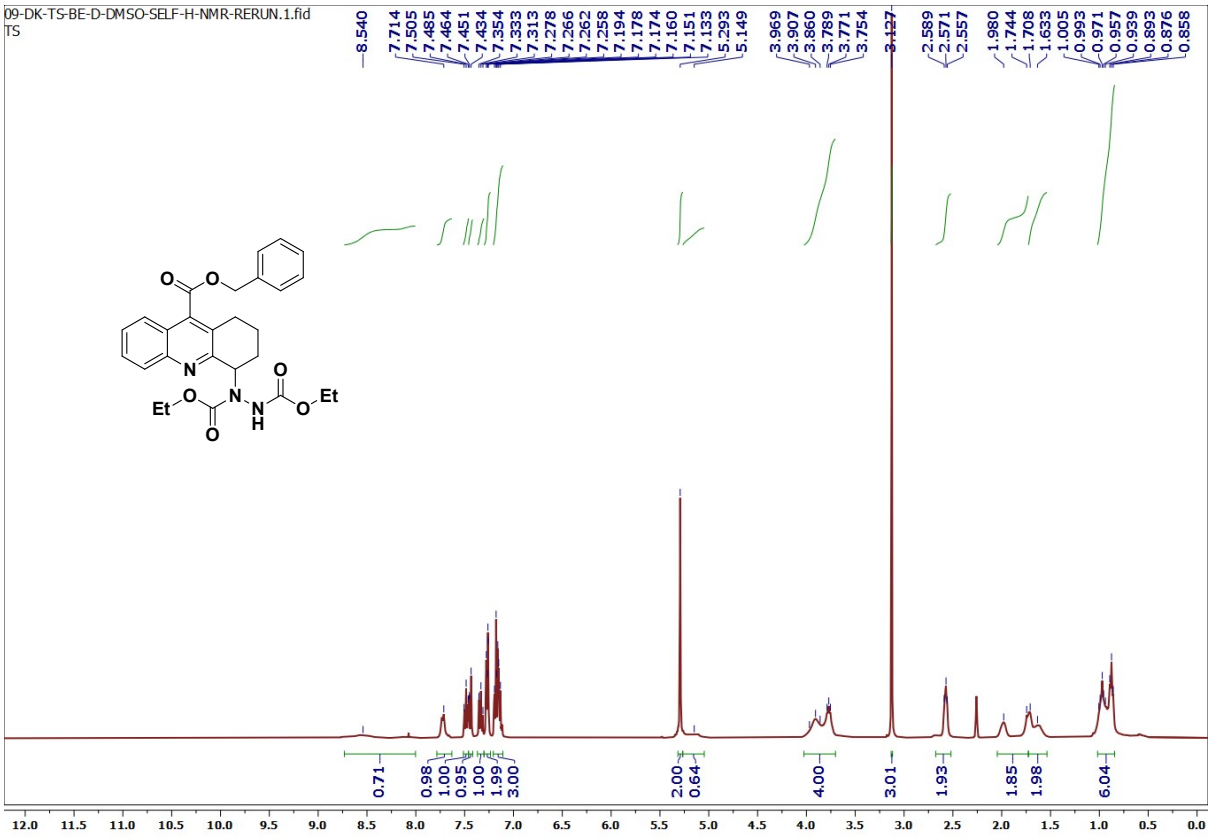
Diisopropyl 1-(9-((prop-2-yn-1-yloxy)carbonyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3n)

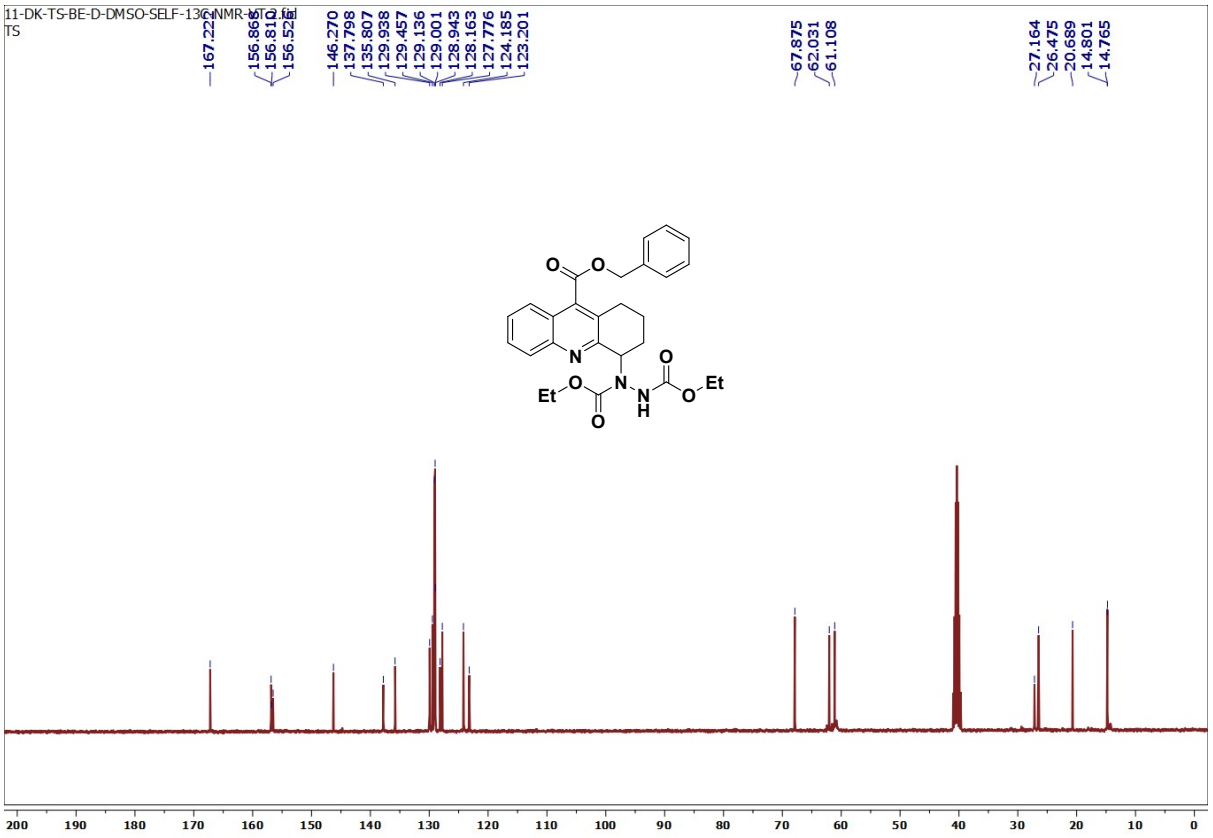


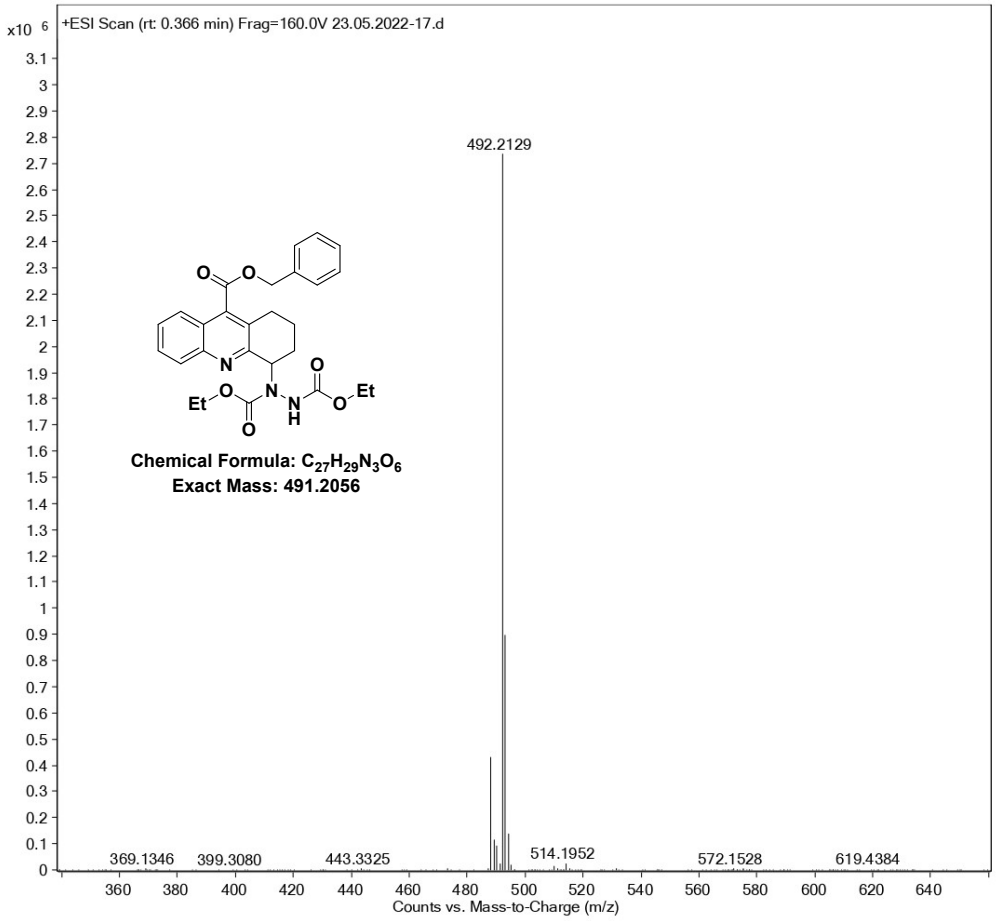

15-DK-TS-PE-ISOD-CDCL3-SELF-13C-2000.fid
TS
166.798
166.208
156.143
146.187
137.105
132.457
131.830
129.577
129.264
127.466
124.054
123.970
123.328
77.244
76.880
75.968
70.237
69.512
52.989
29.690
27.189
26.289
21.980
21.947
iPr
iPr


+ESI Scan (rt: 0.255 min) Frag=175.0V 30.11.2022-10.d
x10 6
468.2126
490.1946
344.2277
380.1599
426.1654
548.1513
Chemical Formula: C25H29N3O6
Exact Mass: 467.2056
Counts vs. Mass-to-Charge (m/z)

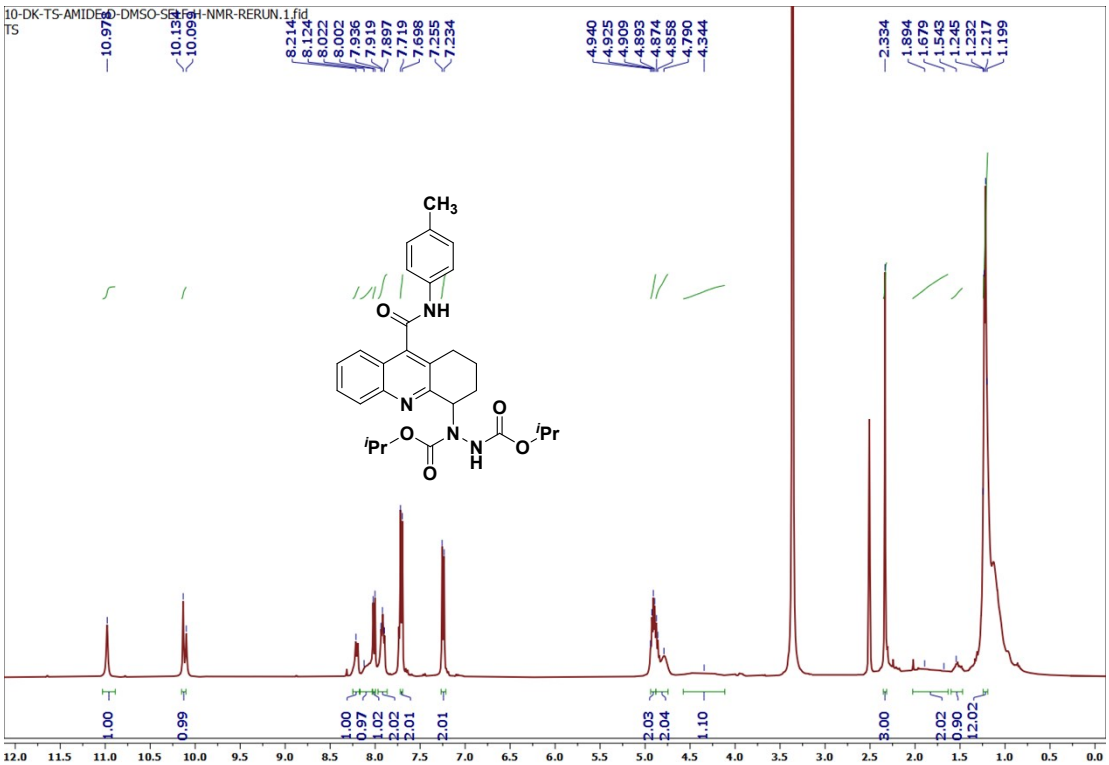
Diethyl 1-(9-((benzyloxy)carbonyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3o):

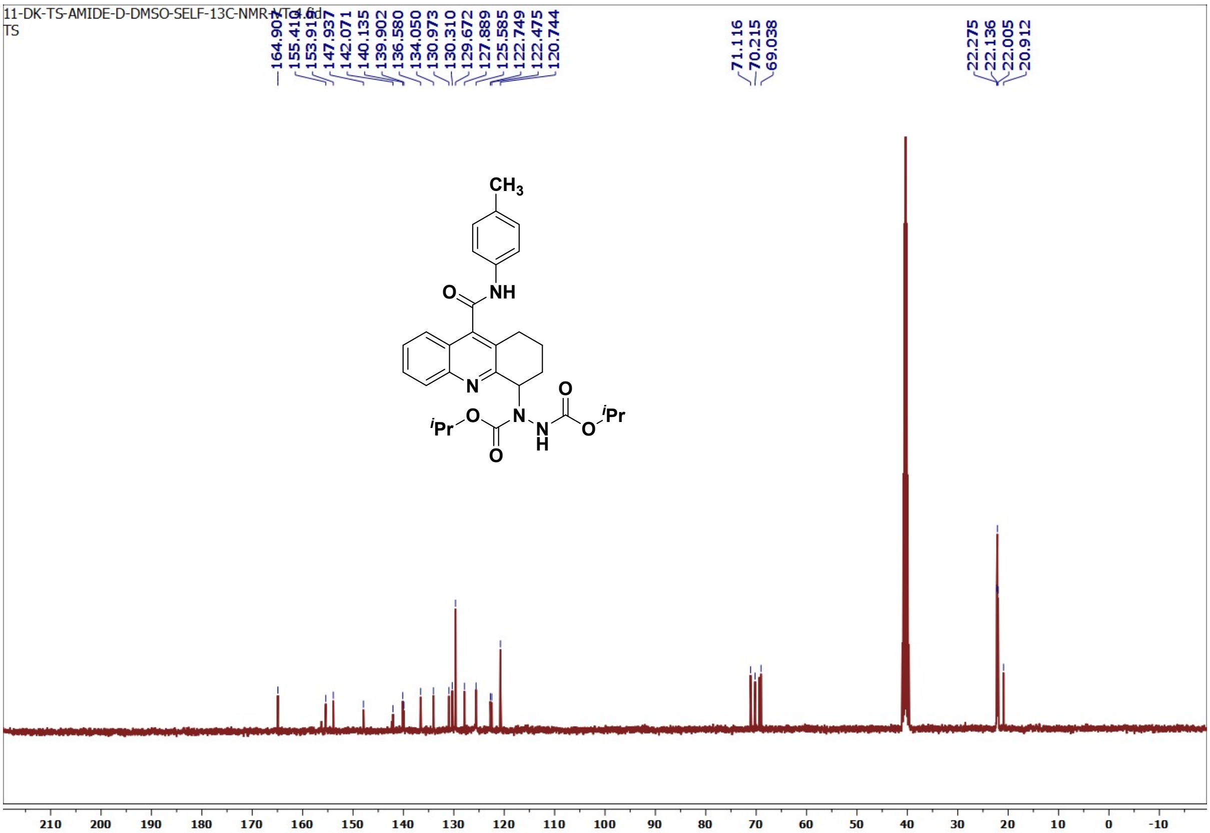




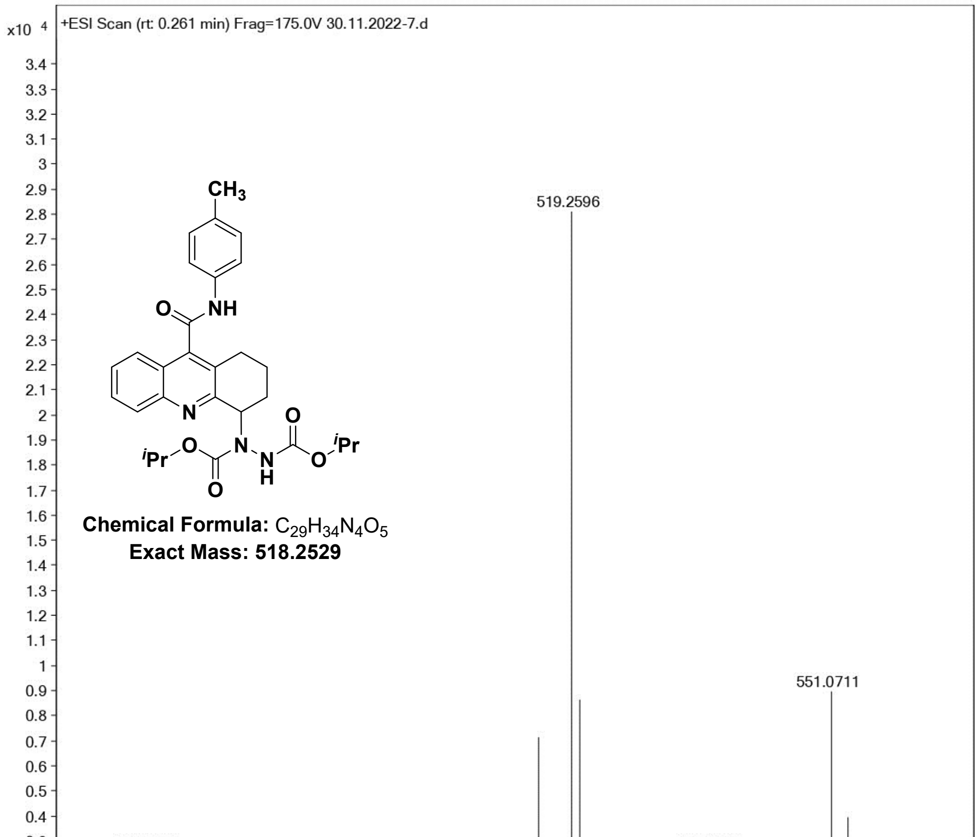


Diisopropyl 1-(9-(p-tolylcarbamoyl)-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3p):



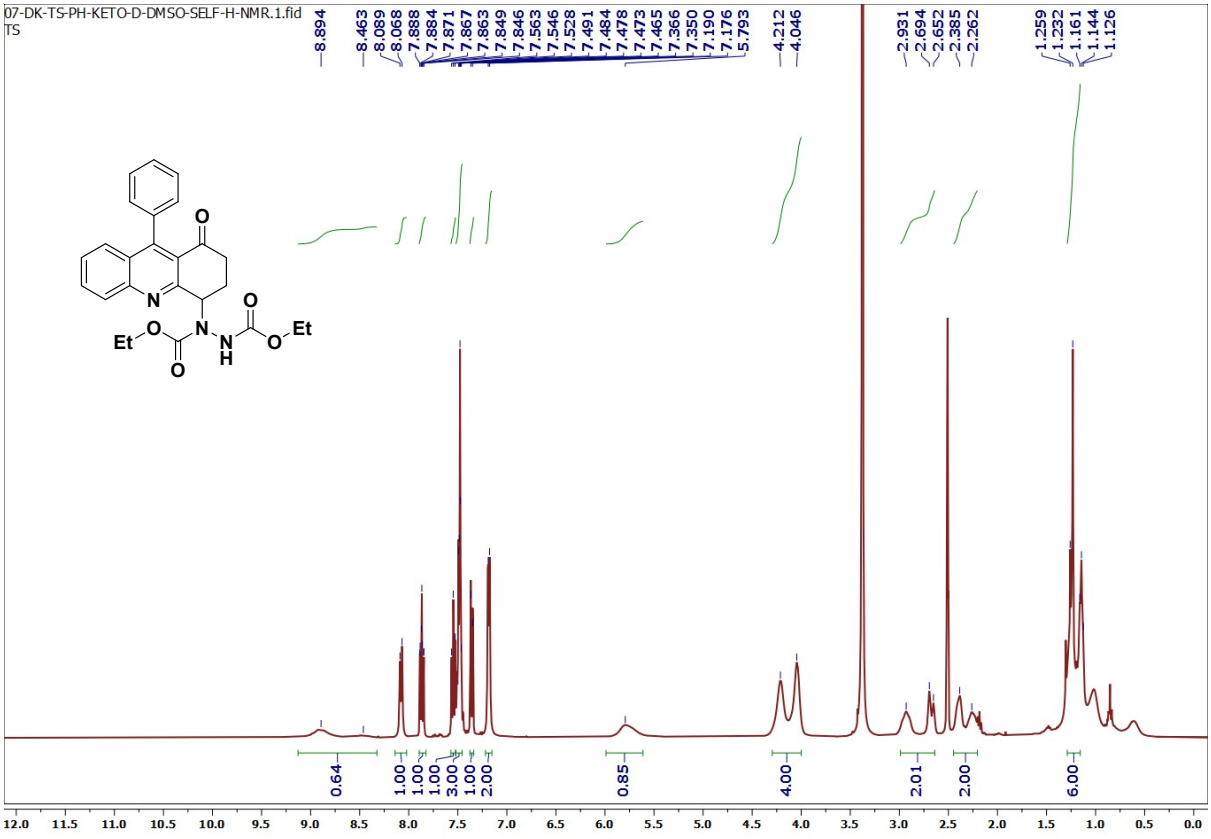


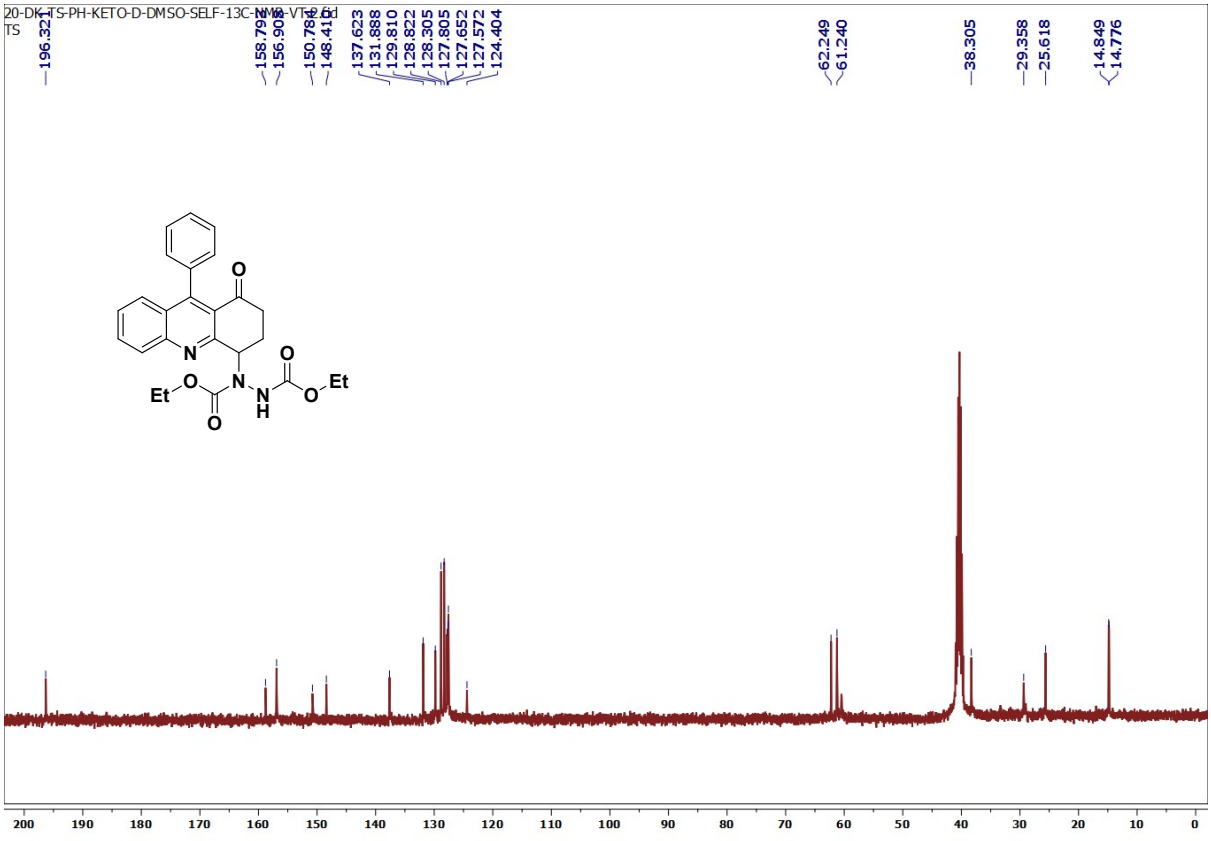
11-DK-TS-AMIDE-D-DMSO-SELF-13C-NMR-NT-1.fid
TS
164.902
155.416
153.916
147.937
142.071
140.135
139.902
136.580
134.050
130.973
130.310
129.672
127.889
125.585
122.749
122.475
120.744
71.116
70.215
69.038
22.275
22.136
22.005
20.912
CH3
O
NH
N
N
N
H
O
O
iPr
O
O
iPr
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

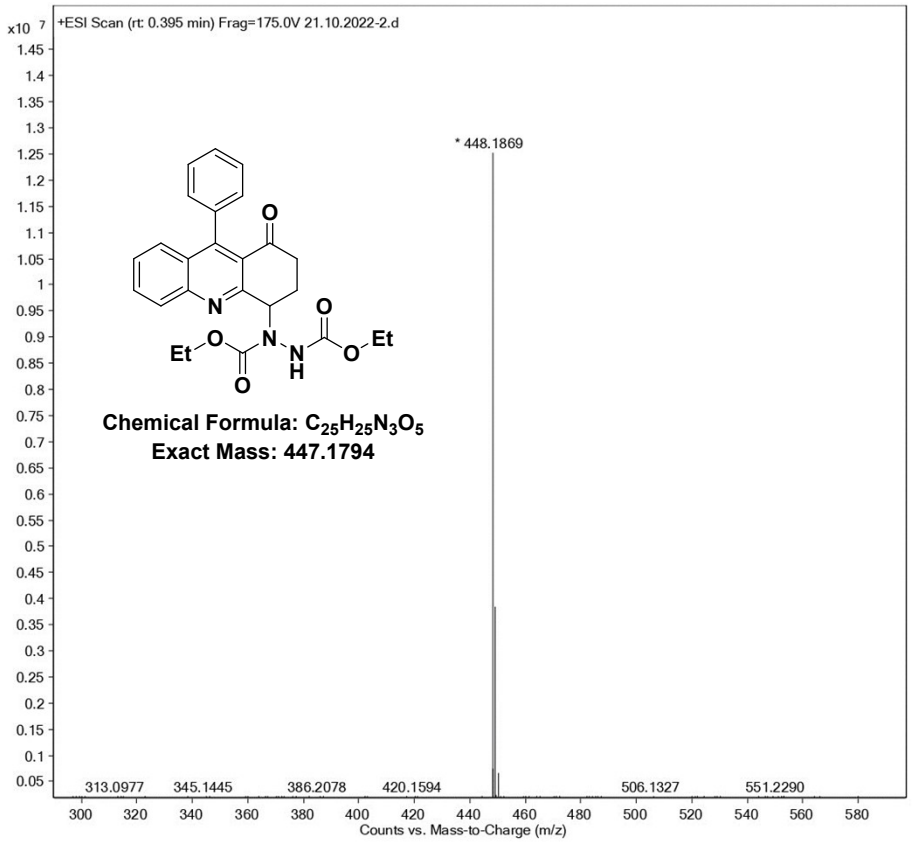


x10 4
+ESI Scan (rt: 0.261 min) Frag=175.0V 30.11.2022-7.d
519.2596
551.0711
467.2288
536.1632
Chemical Formula: C29H34N4O5
Exact Mass: 518.2529
Counts vs. Mass-to-Charge (m/z)

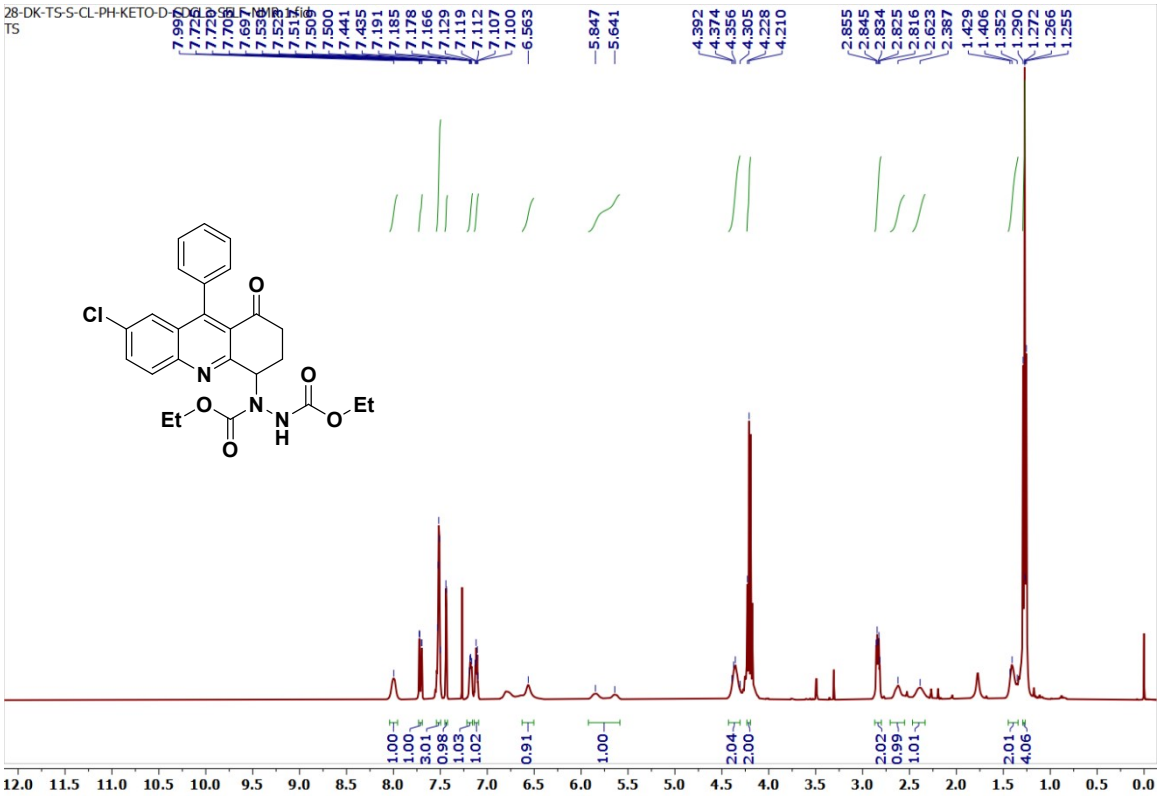
Diethyl 1-(1-oxo-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3q):

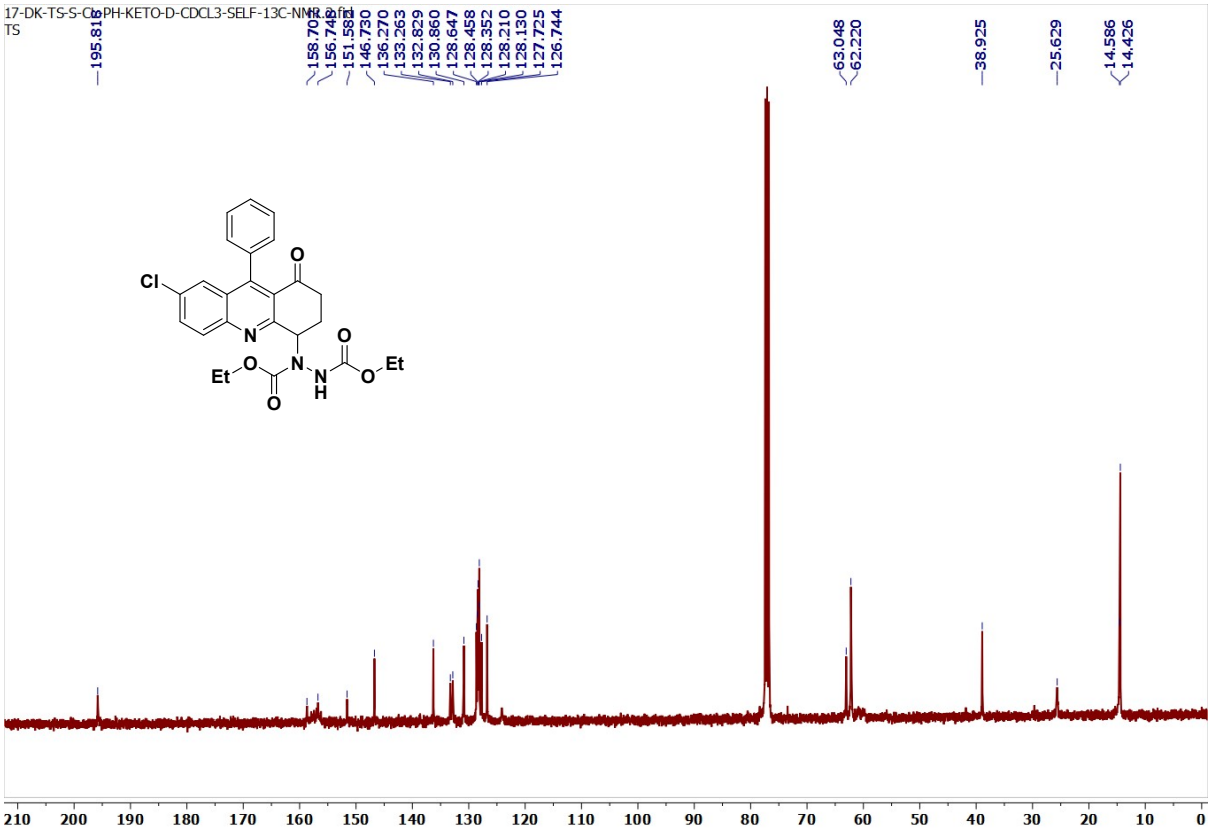


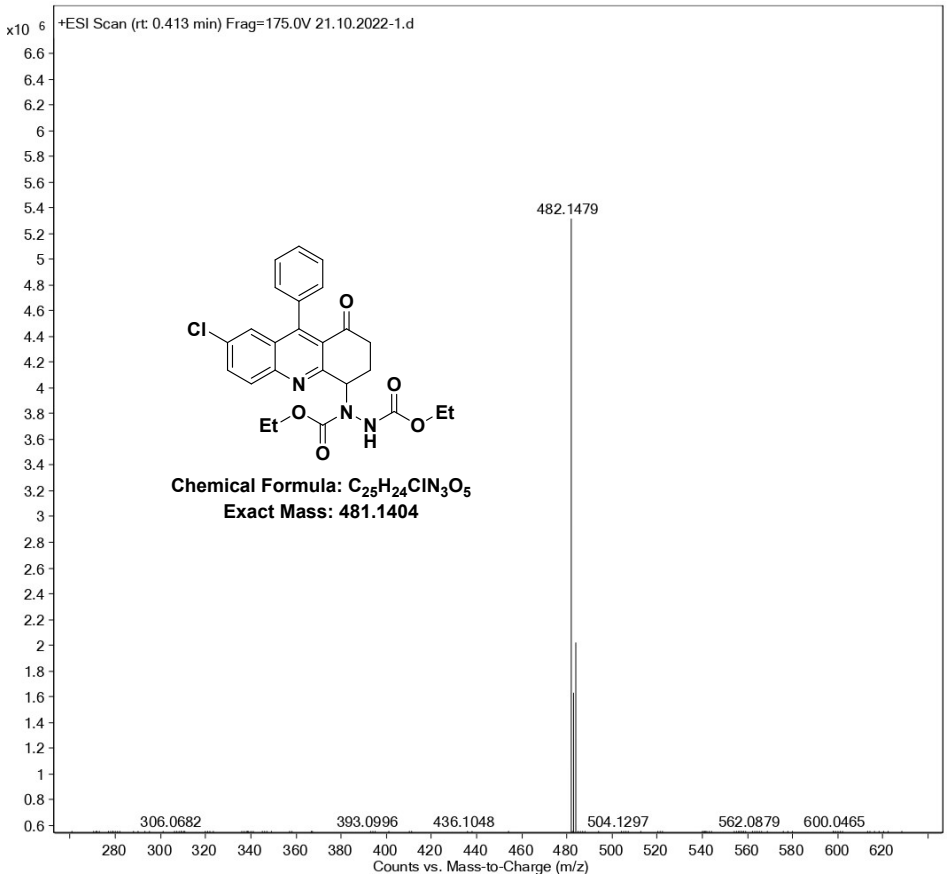




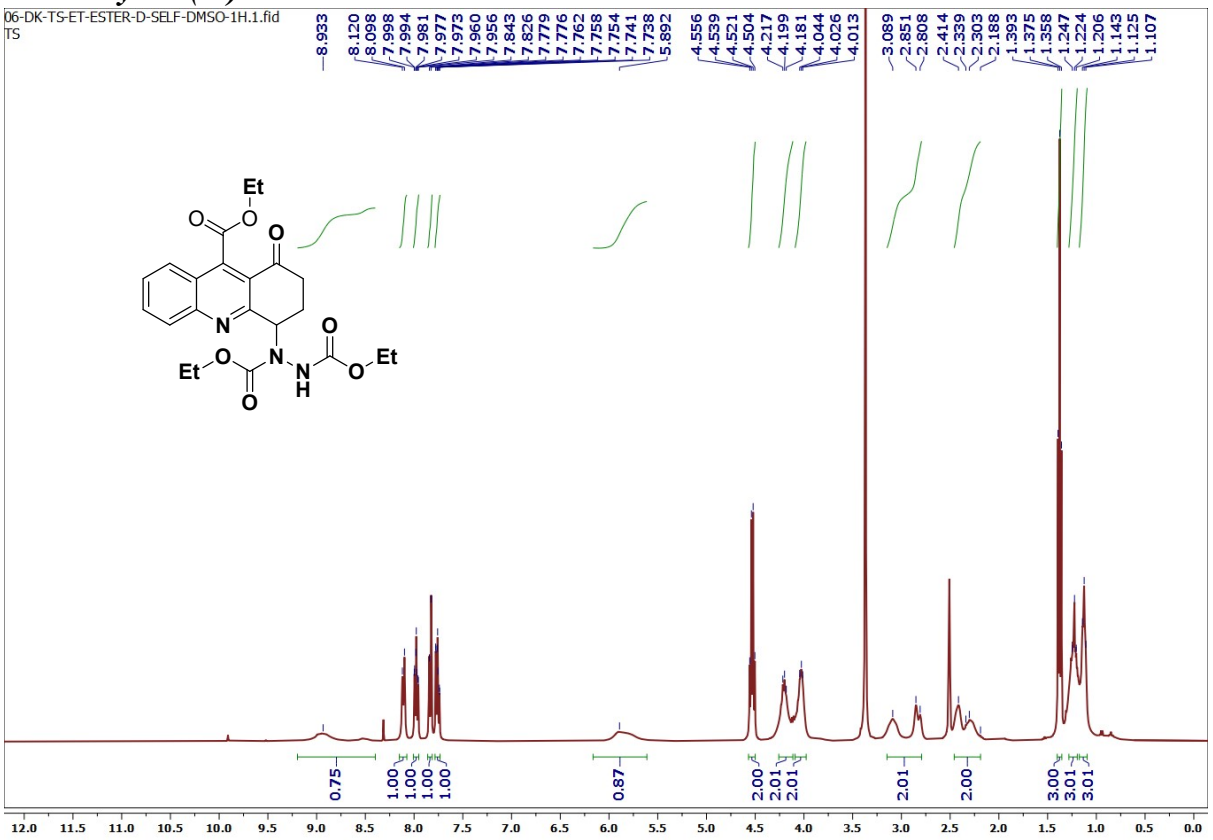
Diethyl 1-(7-chloro-1-oxo-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3r):

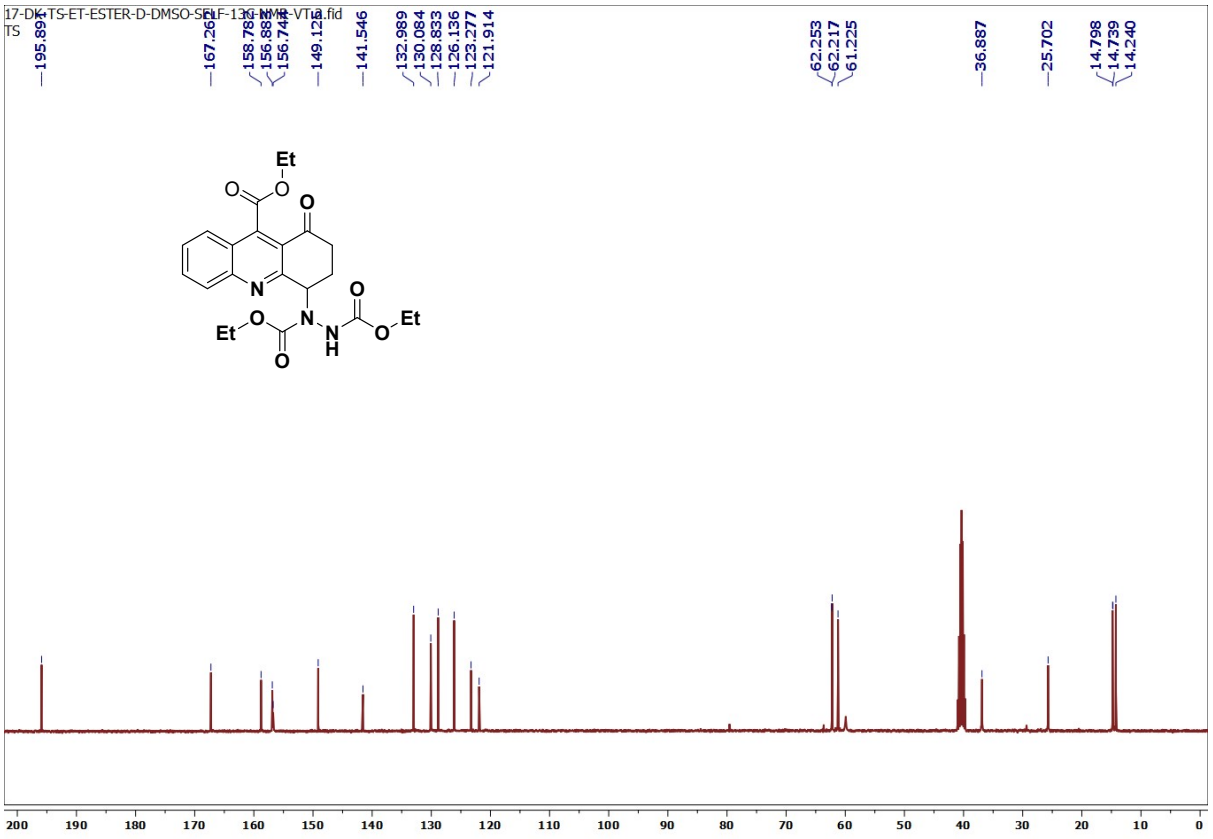


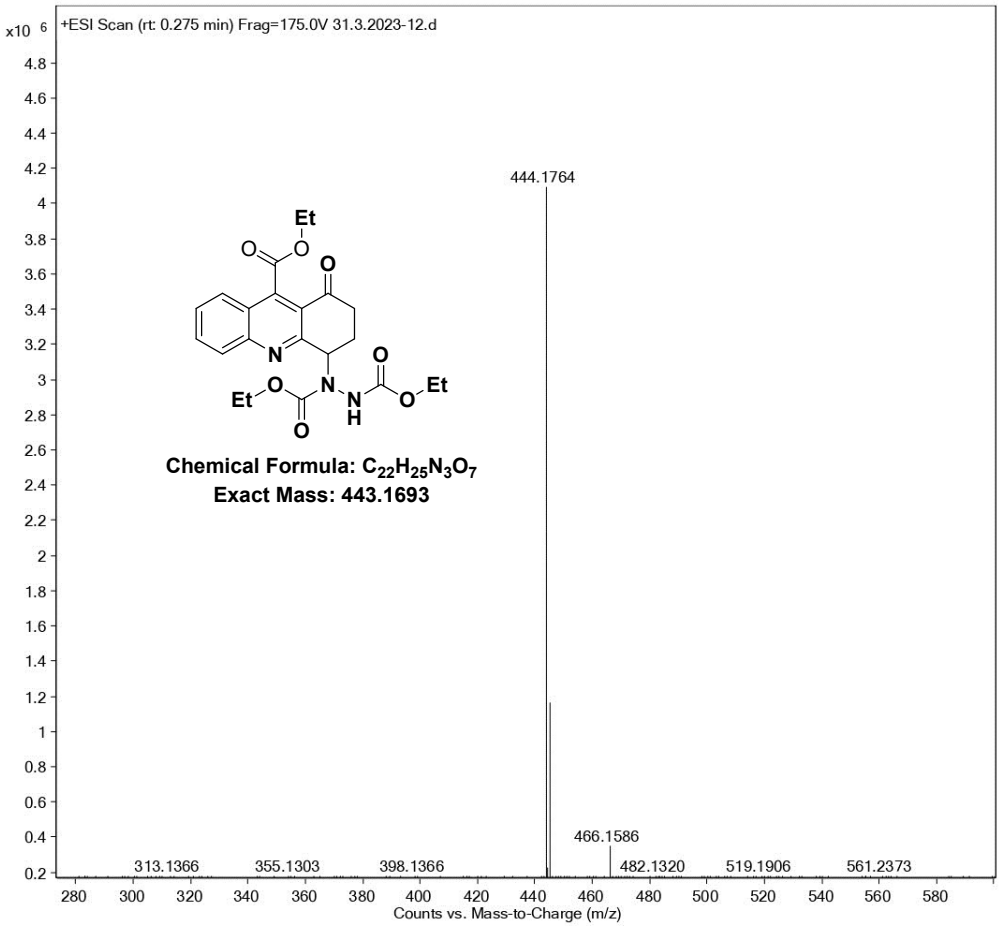

17-DK-TS-S-C6PH-KETO-D-CDCL3-SELF-13C-NMR-2.fid
TS
195.818
158.707
156.748
151.588
146.730
136.270
133.263
132.829
130.860
128.647
128.458
128.352
128.210
128.130
127.725
126.744
63.048
62.220
38.925
25.629
14.586
14.426
Cl
O
N
O
Et
O
N
N
H
O
Et
O
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 6
+ESI Scan (rt: 0.413 min) Frag=175.0V 21.10.2022-1.d
482.1479
Cl
O
N
O
Et
O
N
N
H
O
Et
O
Chemical Formula: C25H24ClN3O5
Exact Mass: 481.1404
306.0682
393.0996
436.1048
504.1297
562.0879
600.0465
Counts vs. Mass-to-Charge (m/z)

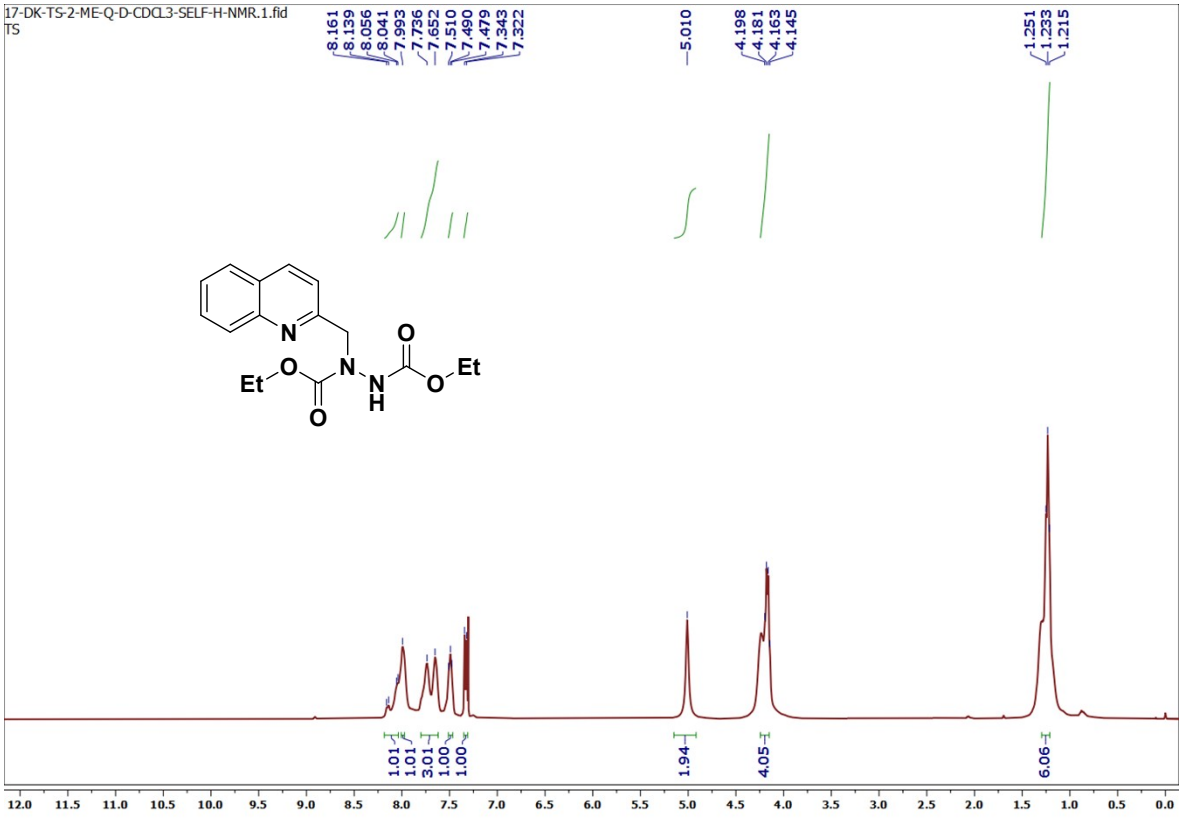
Diethyl 1-(9-(ethoxycarbonyl)-1-oxo-1,2,3,4-tetrahydroacridin-4-yl)hydrazine-1,2-dicarboxylate (3s):

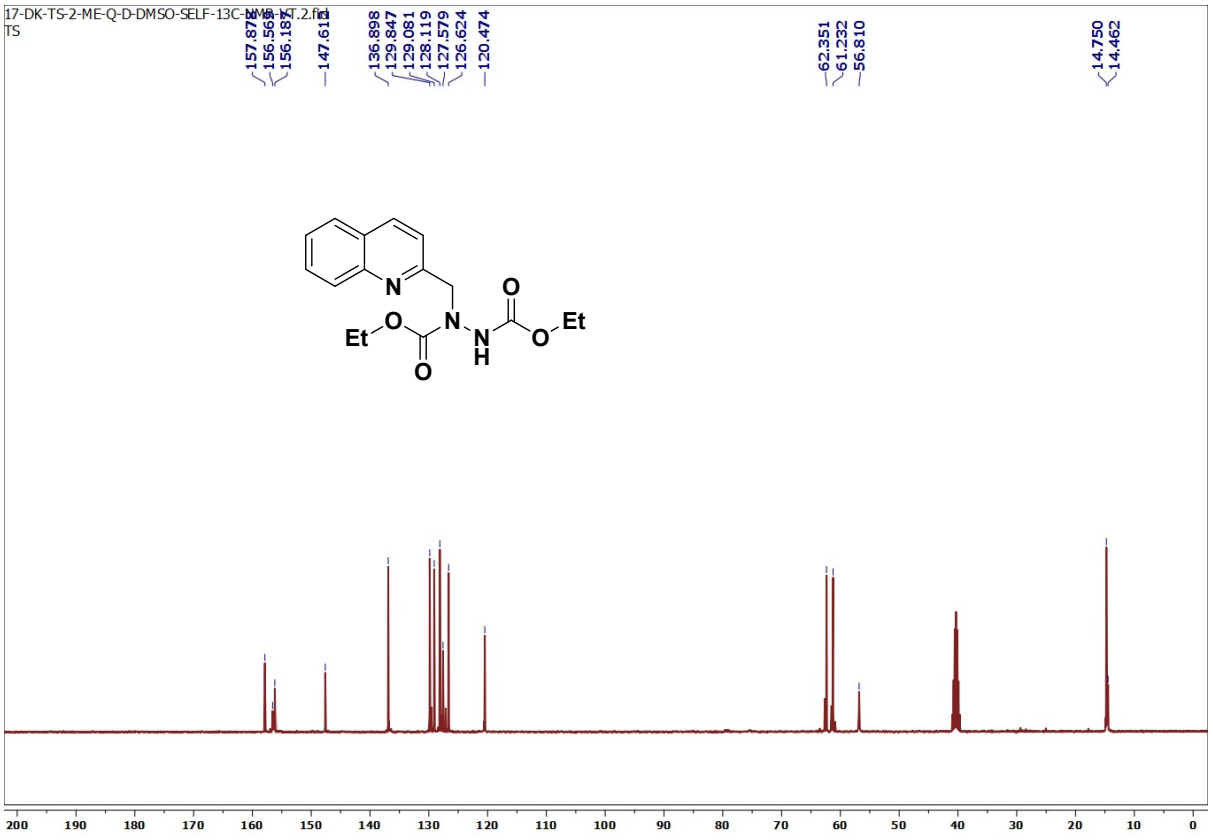


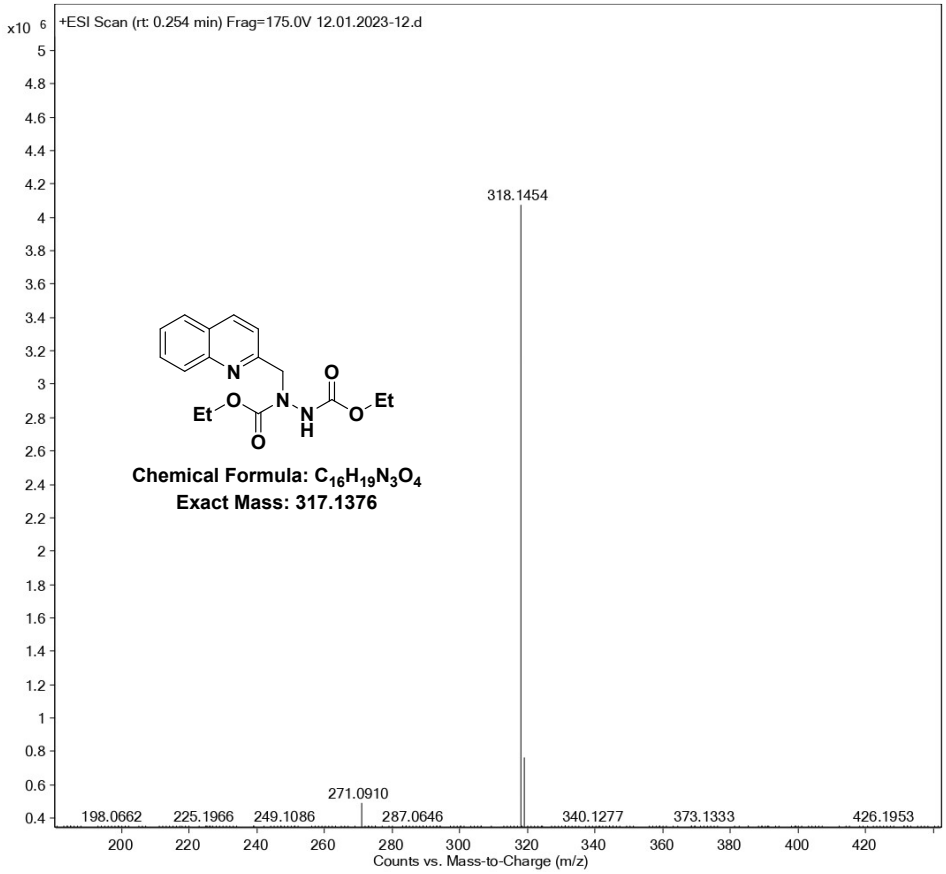




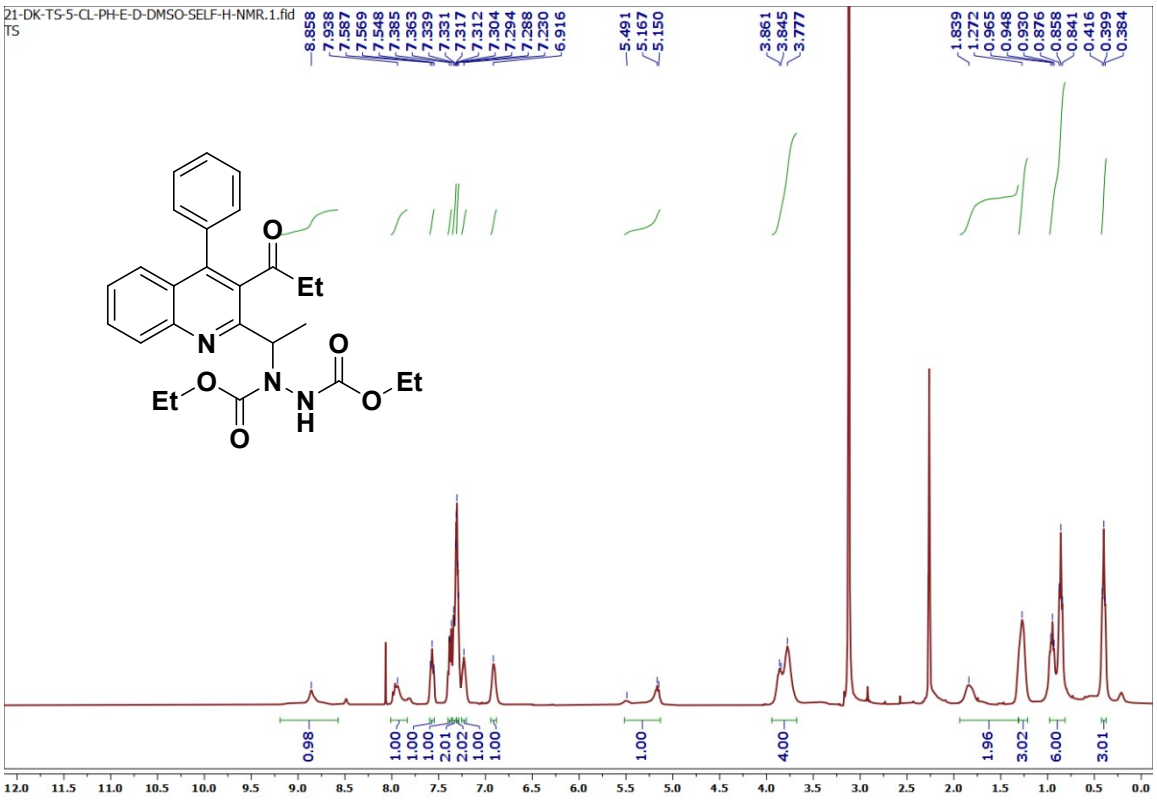
Diethyl 1-(quinolin-2-ylmethyl)hydrazine-1,2-dicarboxylate (3t):

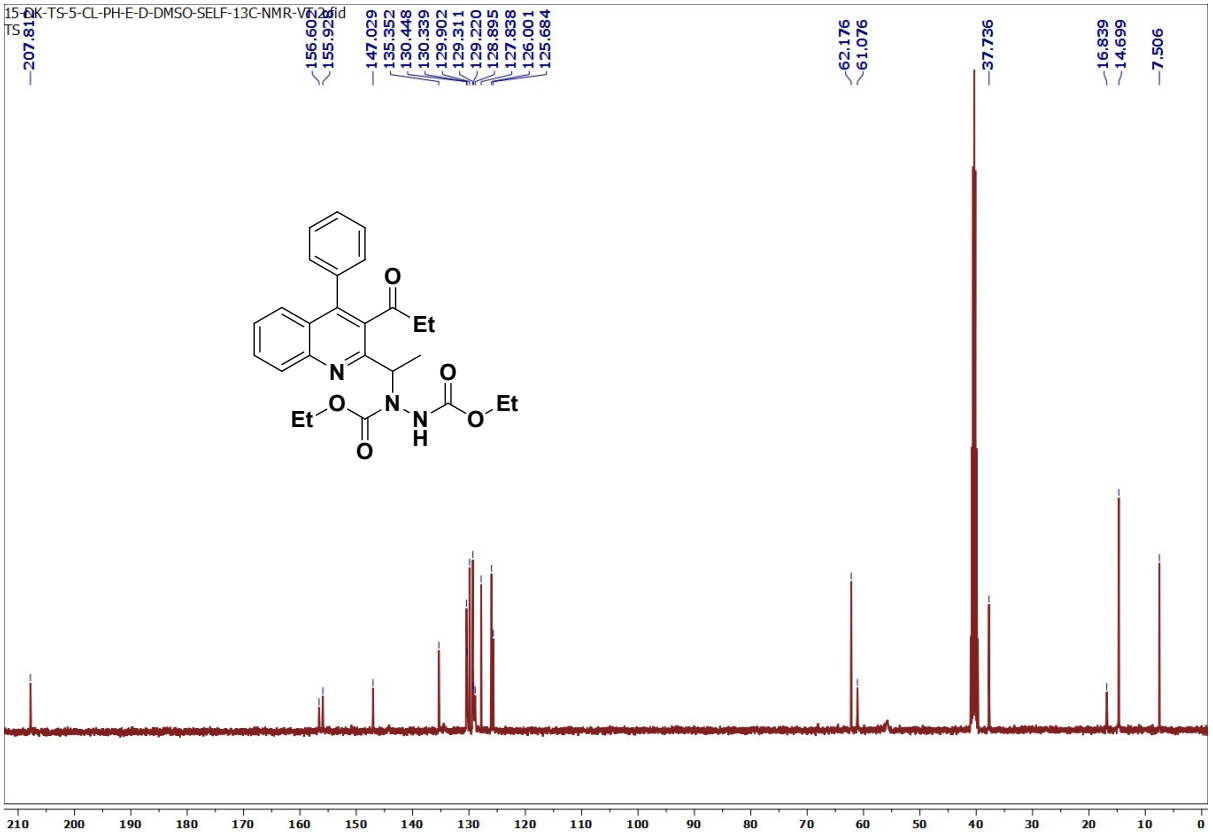


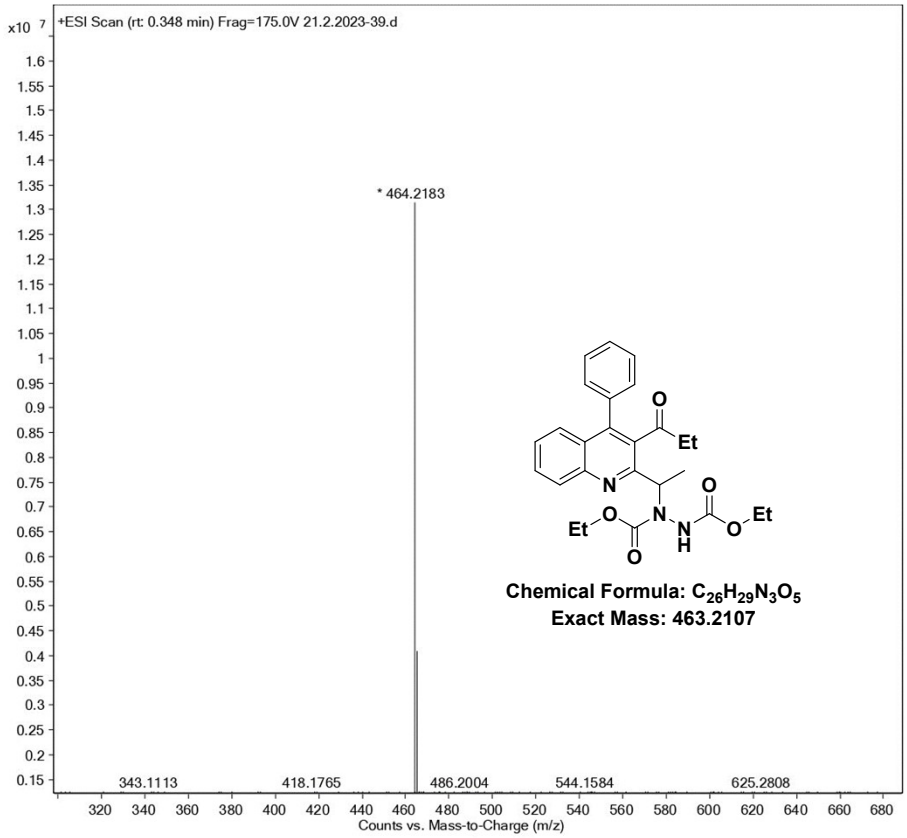

17-DK-TS-2-ME-Q-D-DMSO-SELF-13C-NMR-EXT.2.fid
TS
157.871
156.567
156.187
147.618
136.898
129.847
129.081
128.119
127.579
126.624
120.474
62.351
61.232
56.810
14.750
14.462
N
O
Et
O
N
N
H
O
Et
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 6
+ESI Scan (rt: 0.254 min) Frag=175.0V 12.01.2023-12.d
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
318.1454
271.0910
198.0662
225.1966
249.1086
287.0646
340.1277
373.1333
426.1953
200 220 240 260 280 300 320 340 360 380 400 420
Counts vs. Mass-to-Charge (m/z)
N
O
Et
O
N
N
H
O
Et
O
Chemical Formula: C16H19N3O4
Exact Mass: 317.1376

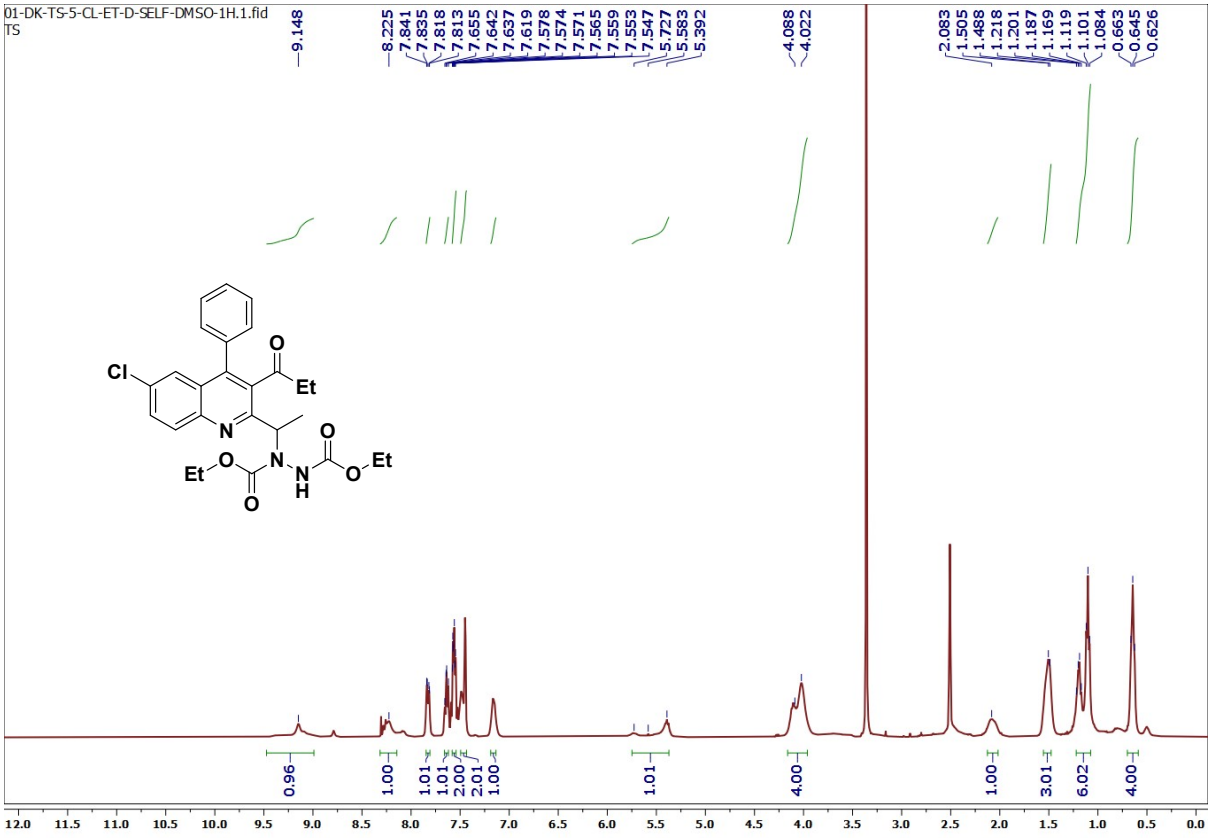
Diethyl 1-(1-(4-phenyl-3-propionylquinolin-2-yl)ethyl)hydrazine-1,2-dicarboxylate (3u):

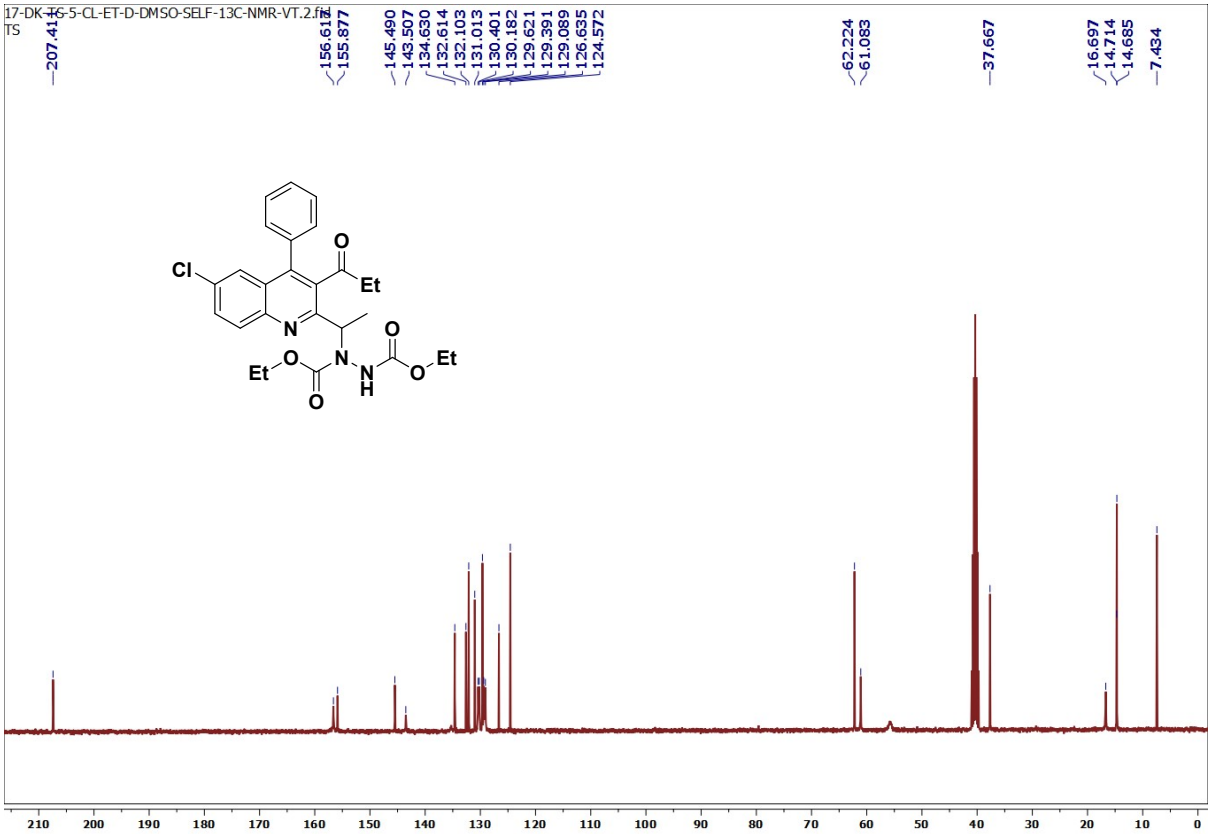


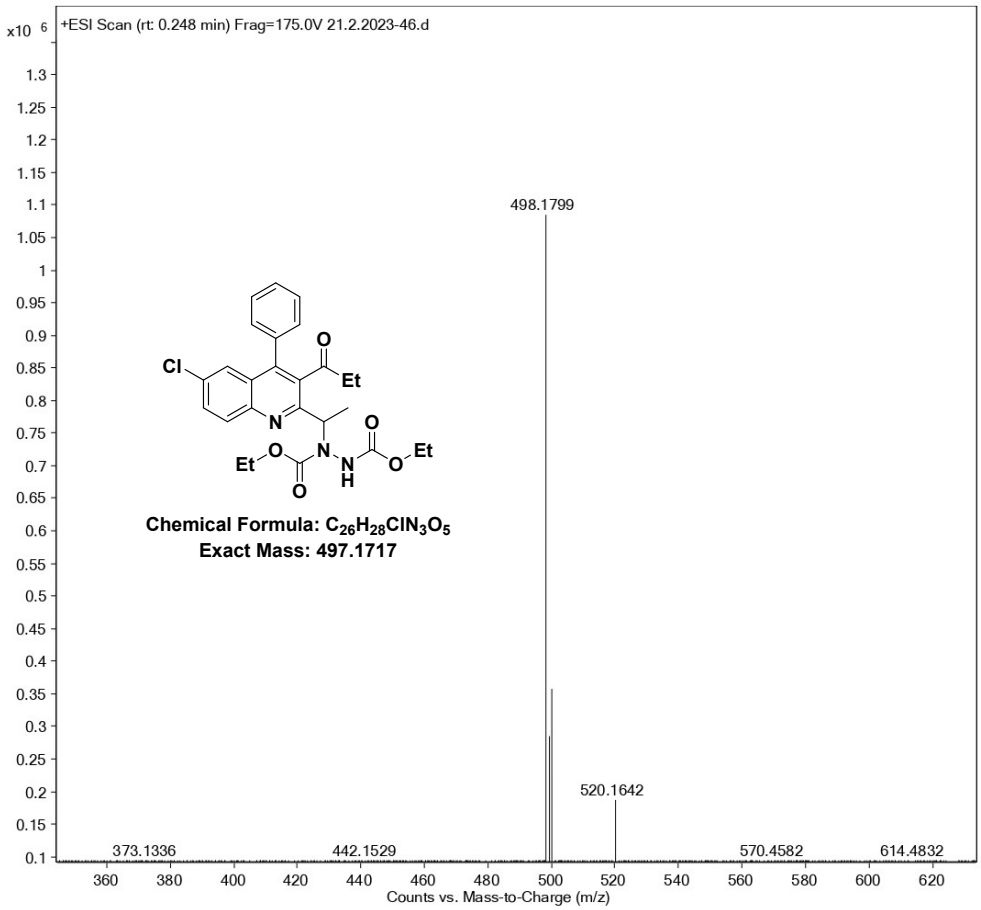




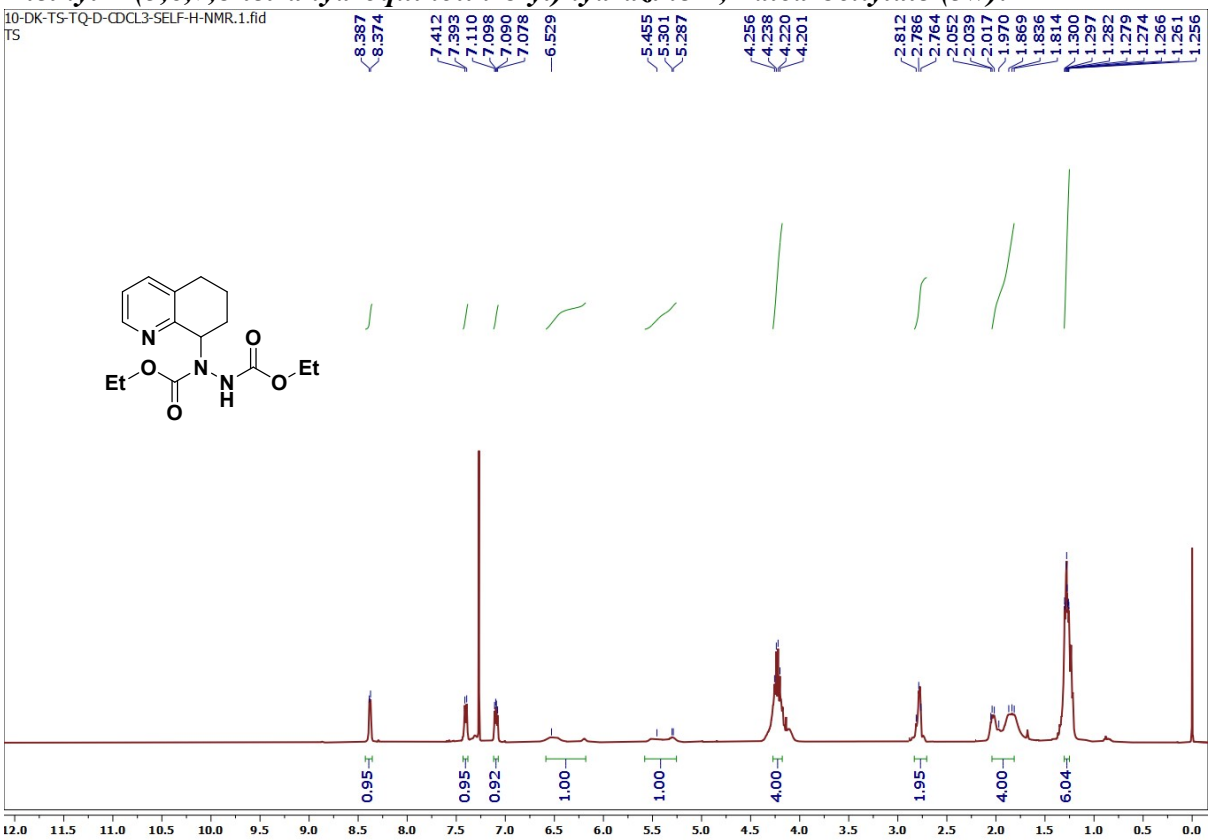
Diethyl 1-(1-(6-chloro-4-phenyl-3-propionylquinolin-2-yl)ethyl)hydrazine-1,2-dicarboxylate (3v):

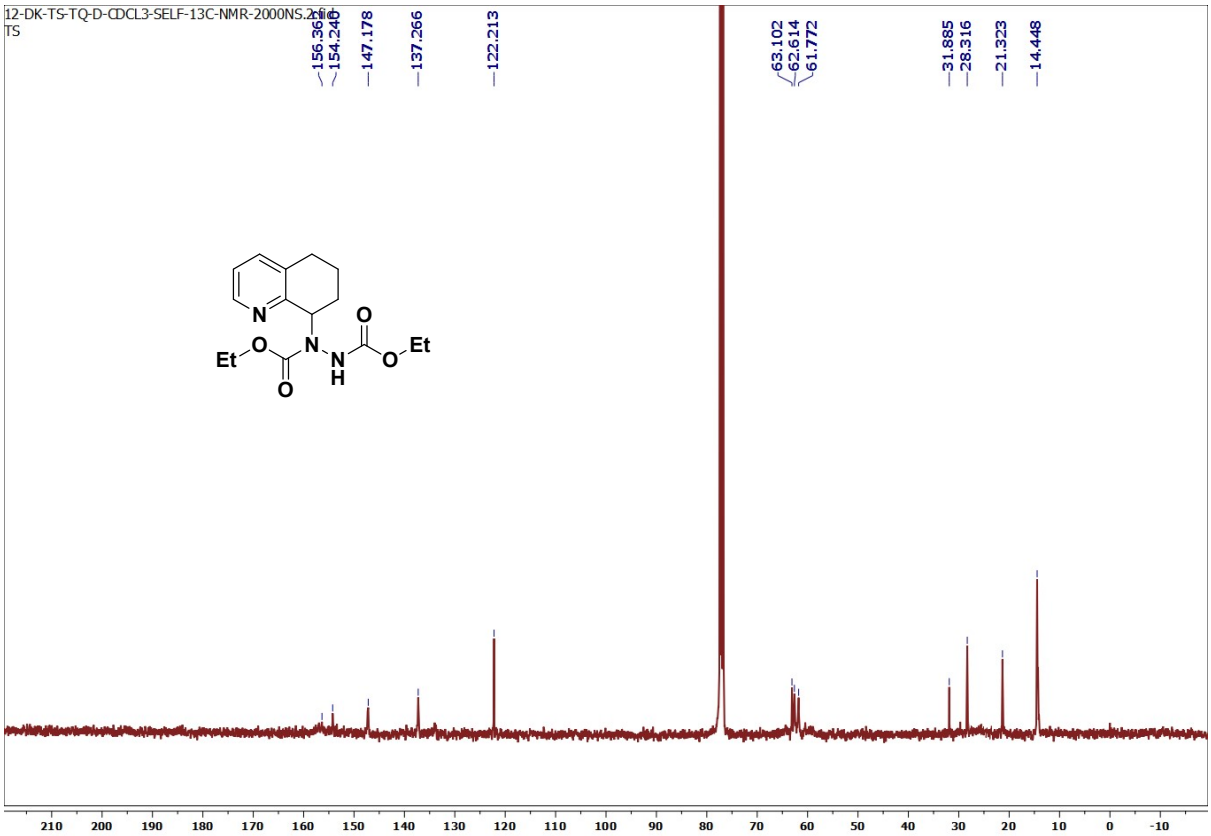


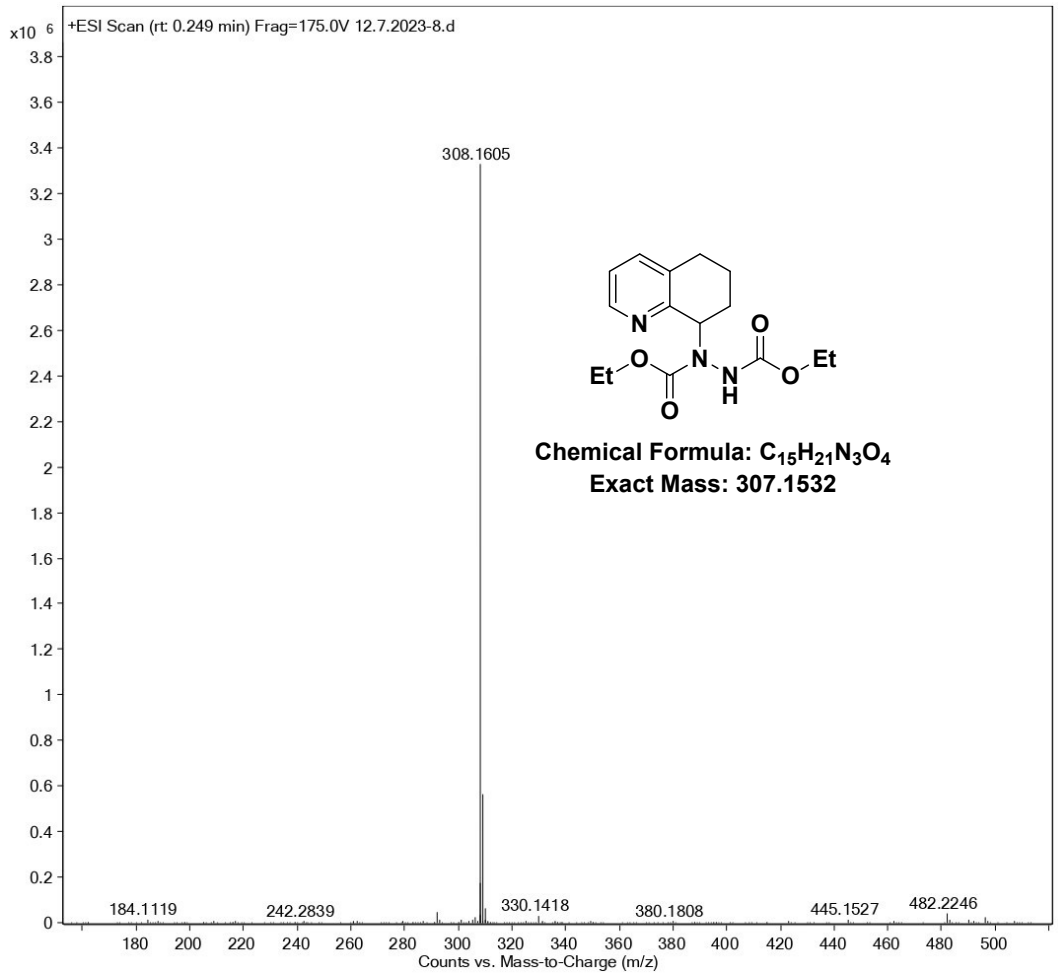

17-DK-TG-5-CL-ET-D-DMSO-SELF-13C-NMR-VT.2.fid
TS
207.411
156.618
155.877
145.490
143.507
134.630
132.614
132.103
131.013
130.401
130.182
129.621
129.391
129.089
126.635
124.572
62.224
61.083
37.667
16.697
14.714
14.685
7.434
Cl
O
Et
N
O
Et
O
N
N
H
Et
O
O
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


x10 6
+ESI Scan (rt: 0.248 min) Frag=175.0V 21.2.2023-46.d
498.1799
520.1642
373.1336
442.1529
570.4582
614.4832
Cl
O
Et
N
O
Et
O
N
N
H
Et
O
O
Chemical Formula: C26H28ClN3O5
Exact Mass: 497.1717
Counts vs. Mass-to-Charge (m/z)

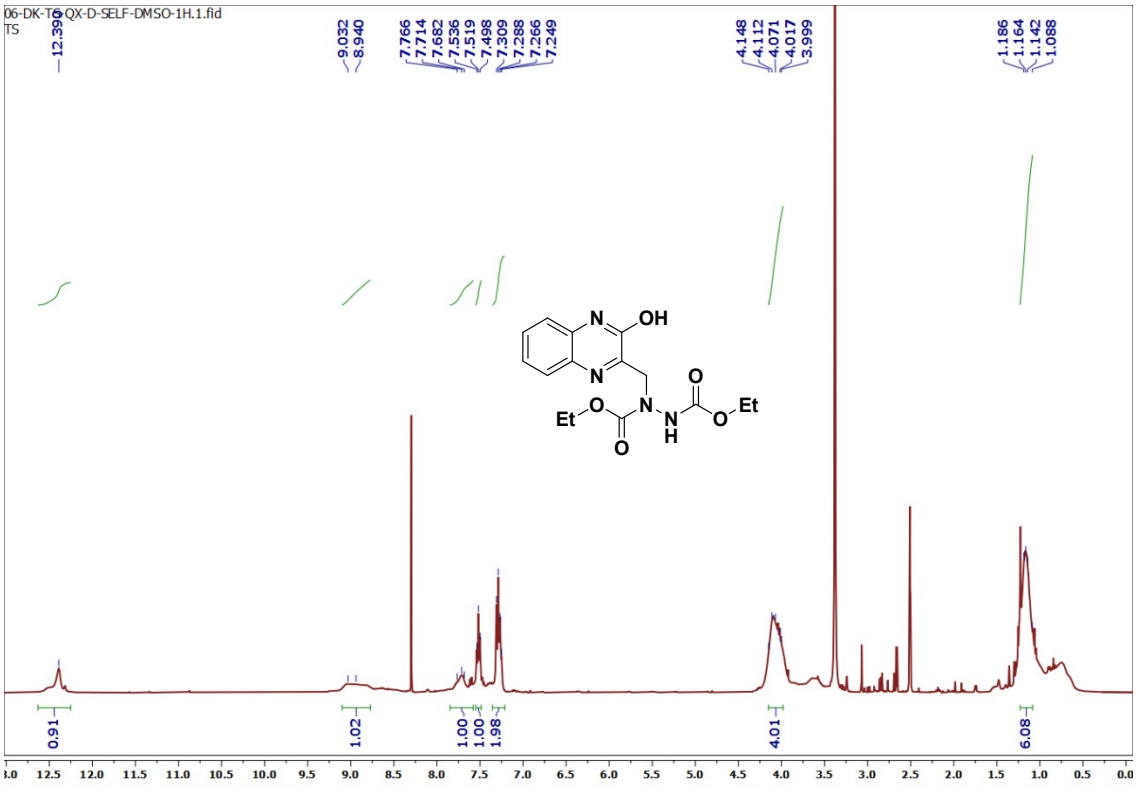
Diethyl 1-(5,6,7,8-tetrahydroquinolin-8-yl)hydrazine-1,2-dicarboxylate (3w):

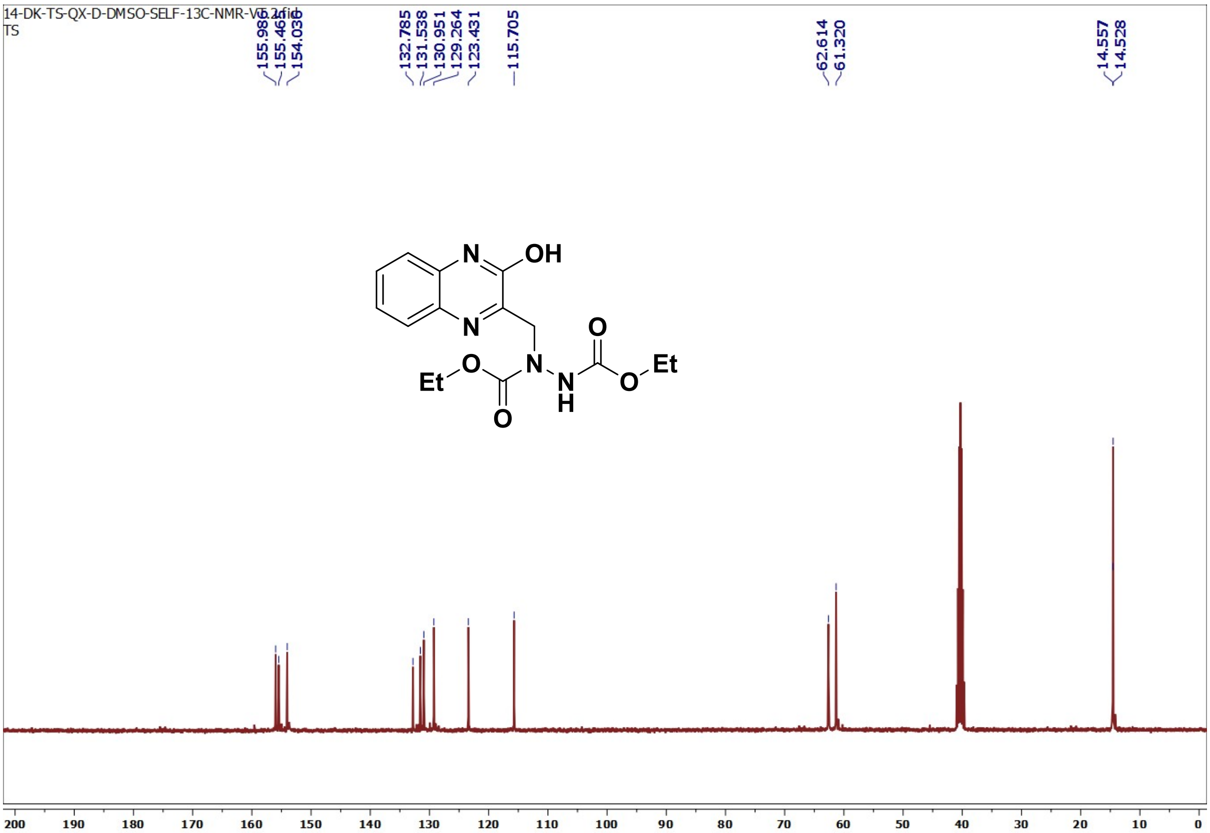


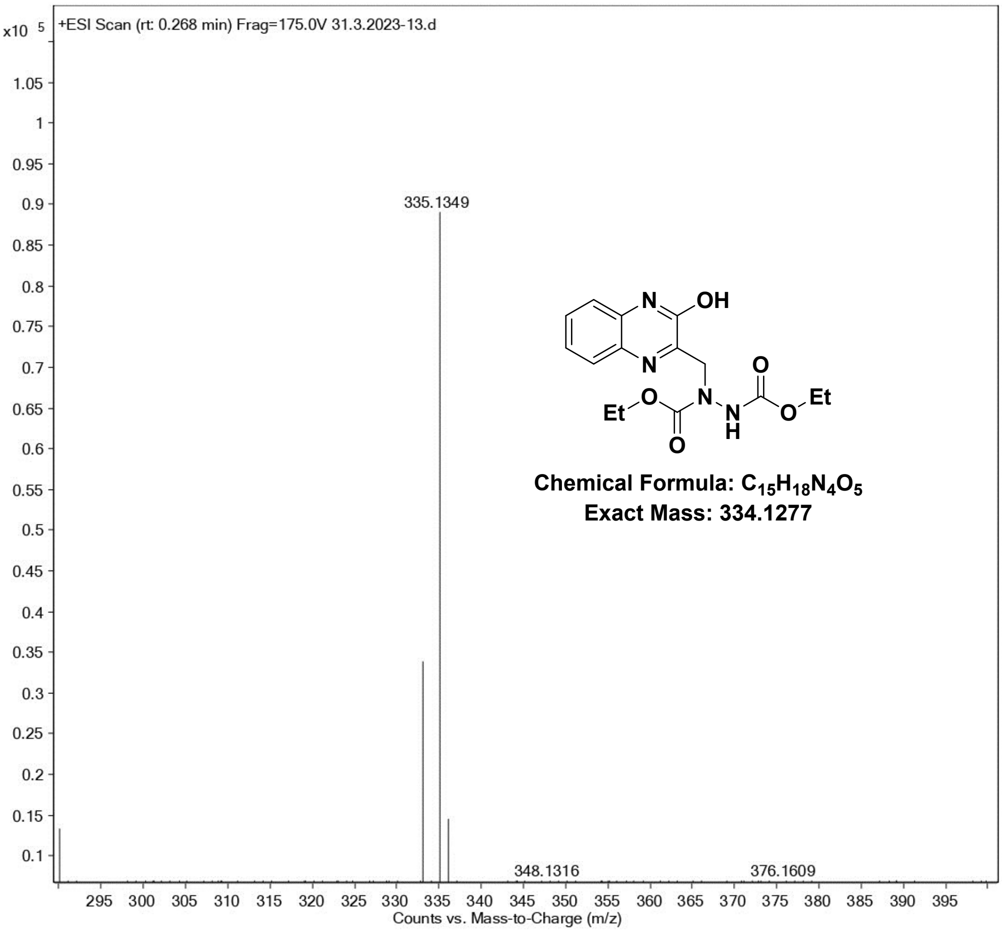




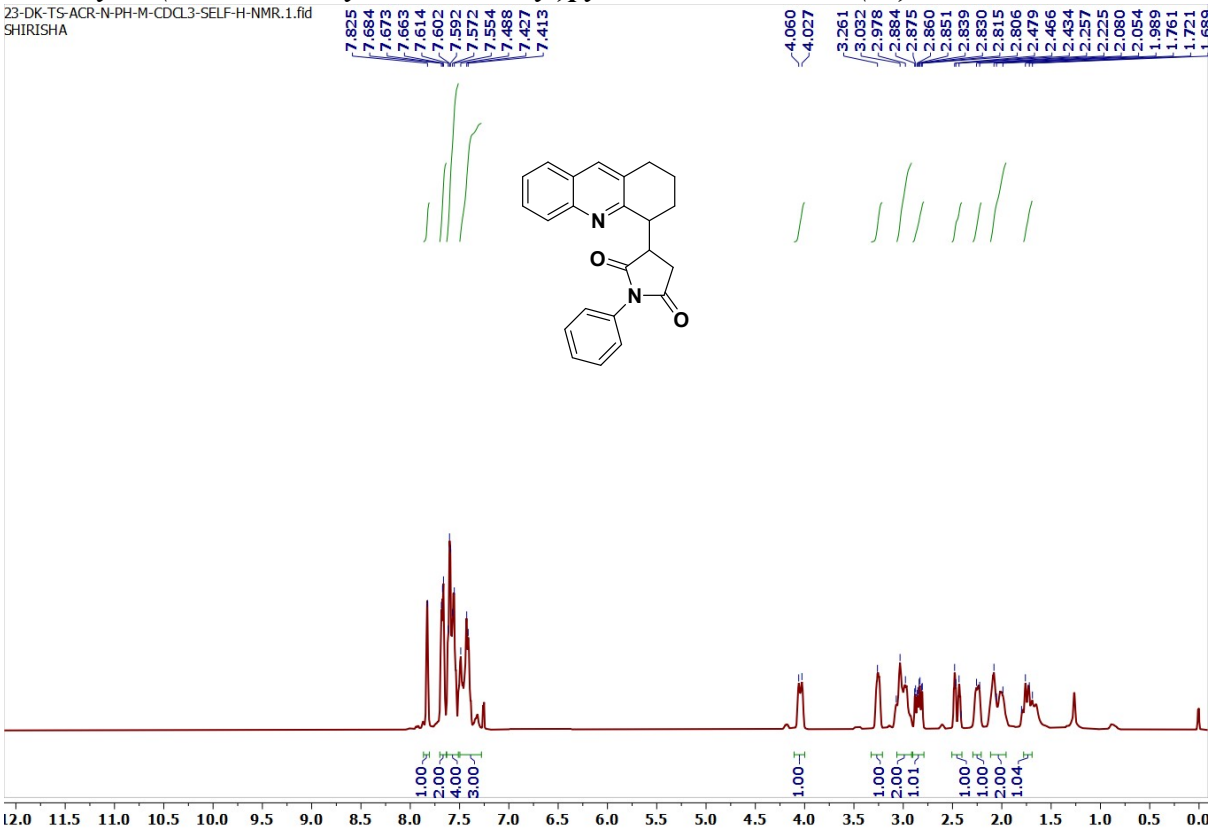
Diethyl 1-((3-hydroxyquinoxalin-2-yl)methyl)hydrazine-1,2-dicarboxylate (3x):

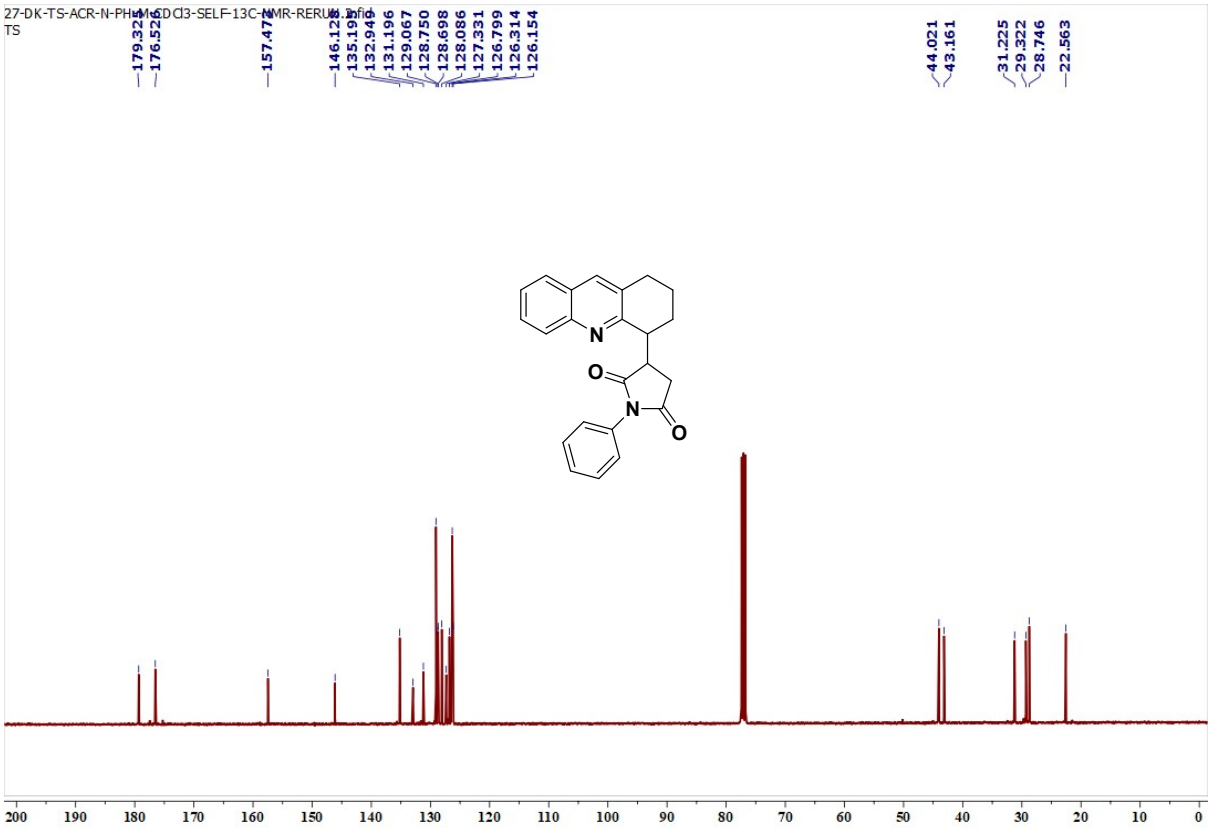


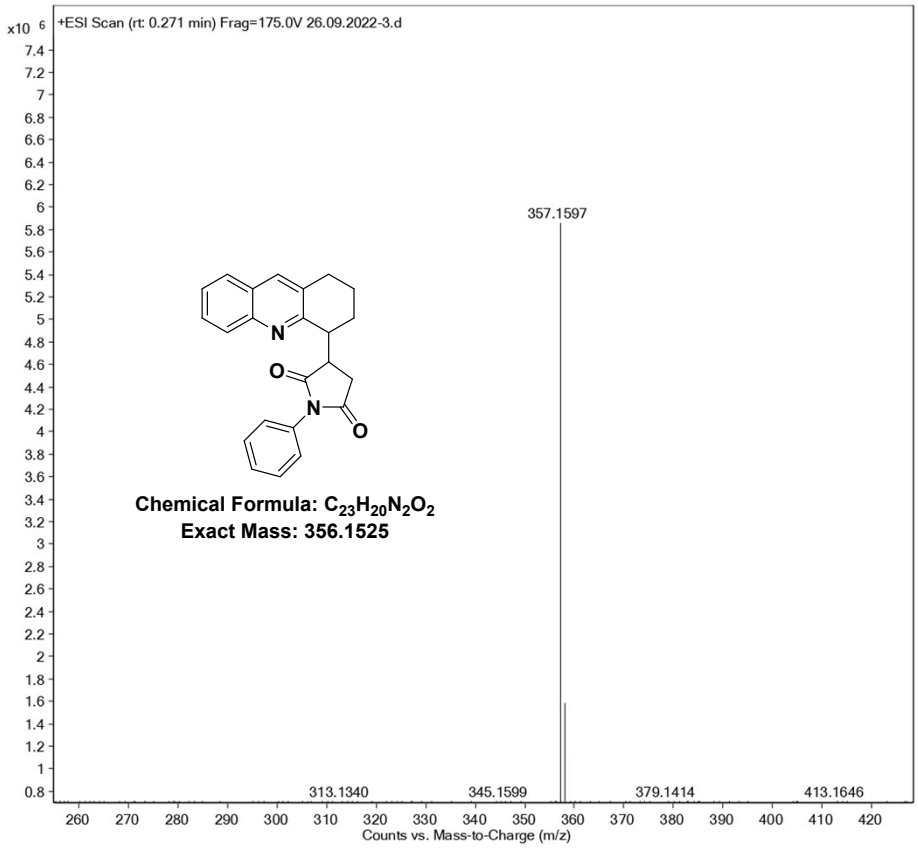

14-DK-TS-QX-D-DMSO-SELF-13C-NMR-V6.2.fid
TS
155.461
154.036
132.785
131.538
130.951
129.264
123.431
115.705
62.614
61.320
14.557
14.528
N
OH
N
O
Et
O
N
N
H
O
O
Et
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 5
+ESI Scan (rt: 0.268 min) Frag=175.0V 31.3.2023-13.d
335.1349
348.1316
376.1609
N
OH
N
O
Et
O
N
N
H
O
O
Et
Chemical Formula: $C_{15}H_{18}N_4O_5$
Exact Mass: 334.1277
Counts vs. Mass-to-Charge (m/z)

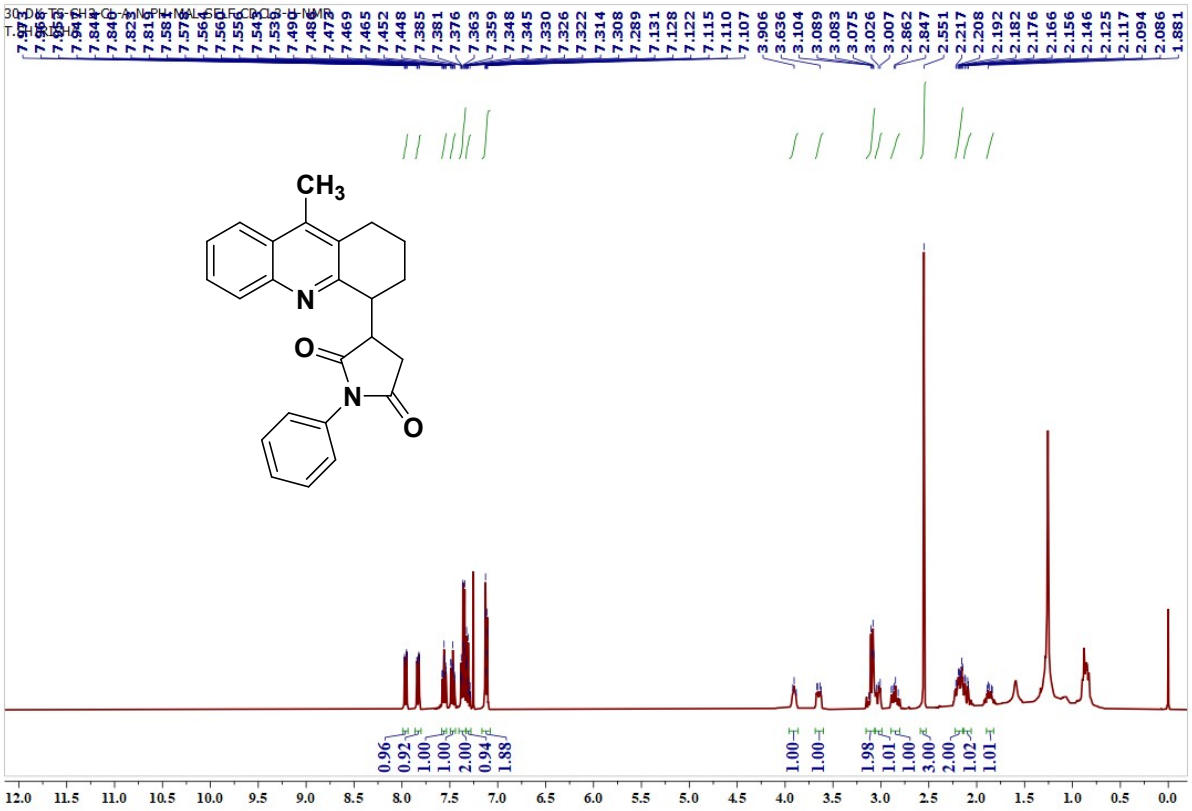
1-Phenyl-3-(1,2,3,4-tetrahydroacridin-4-yl)pyrrolidine-2,5-dione (5a):

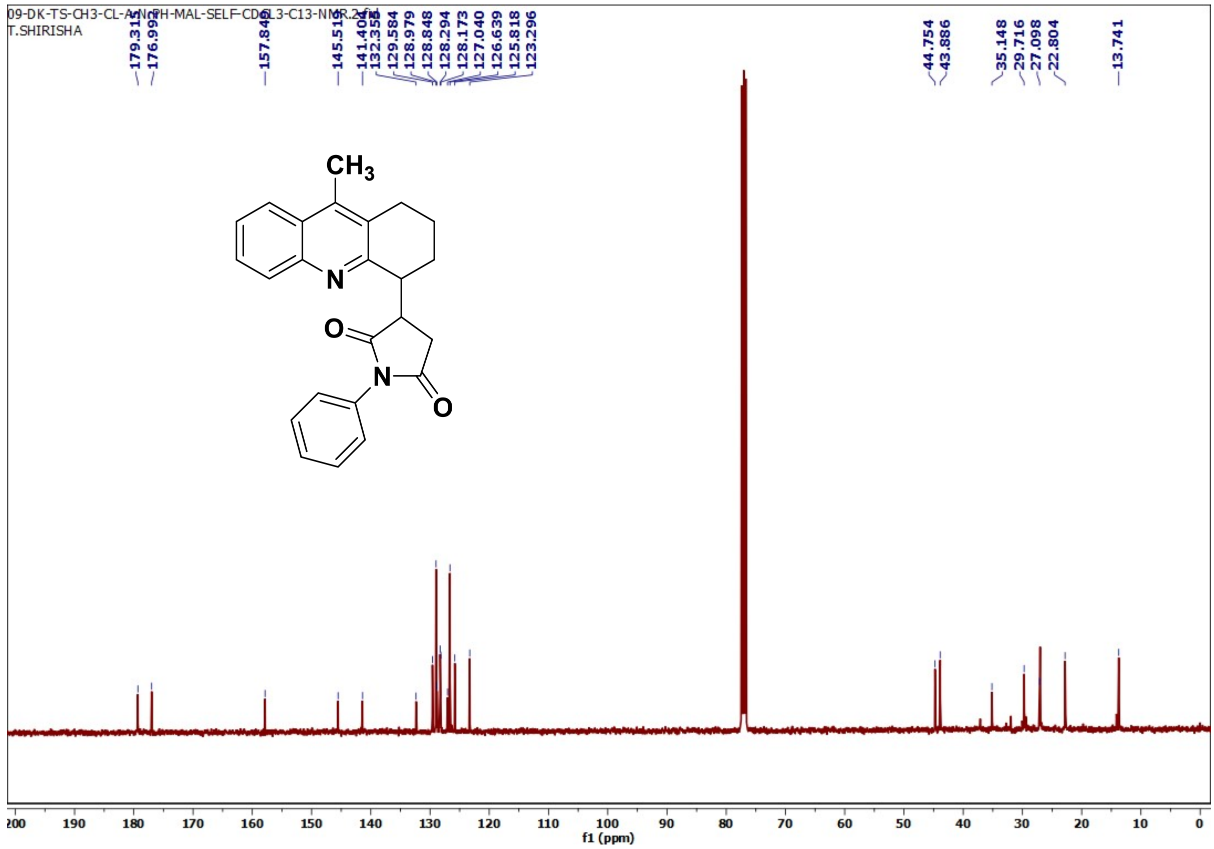


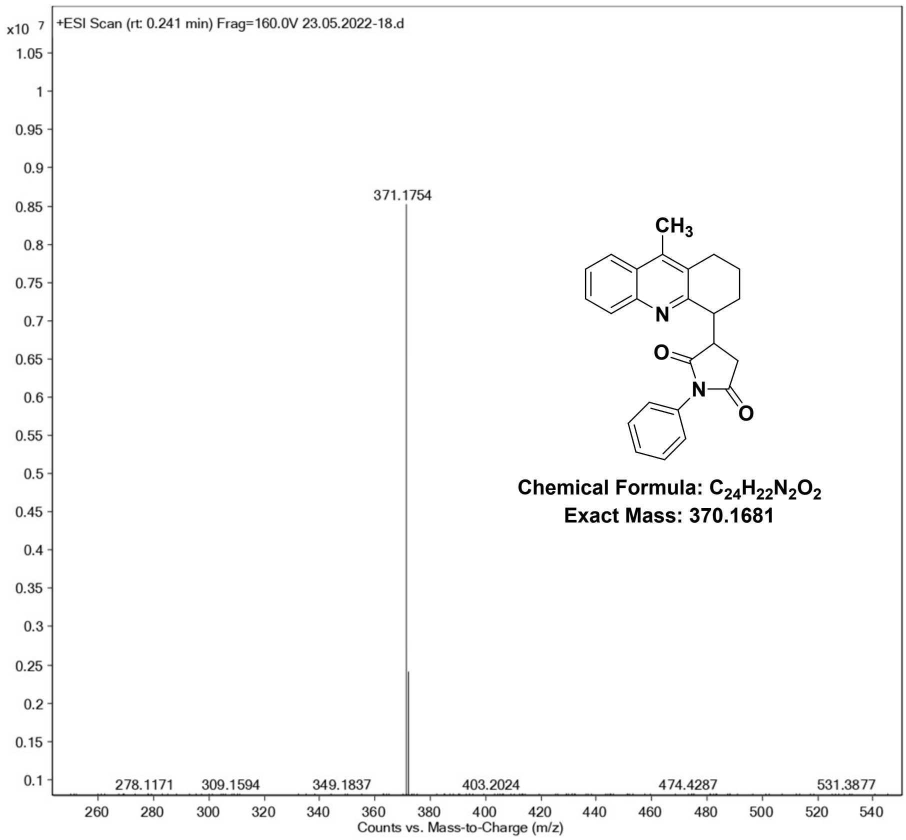




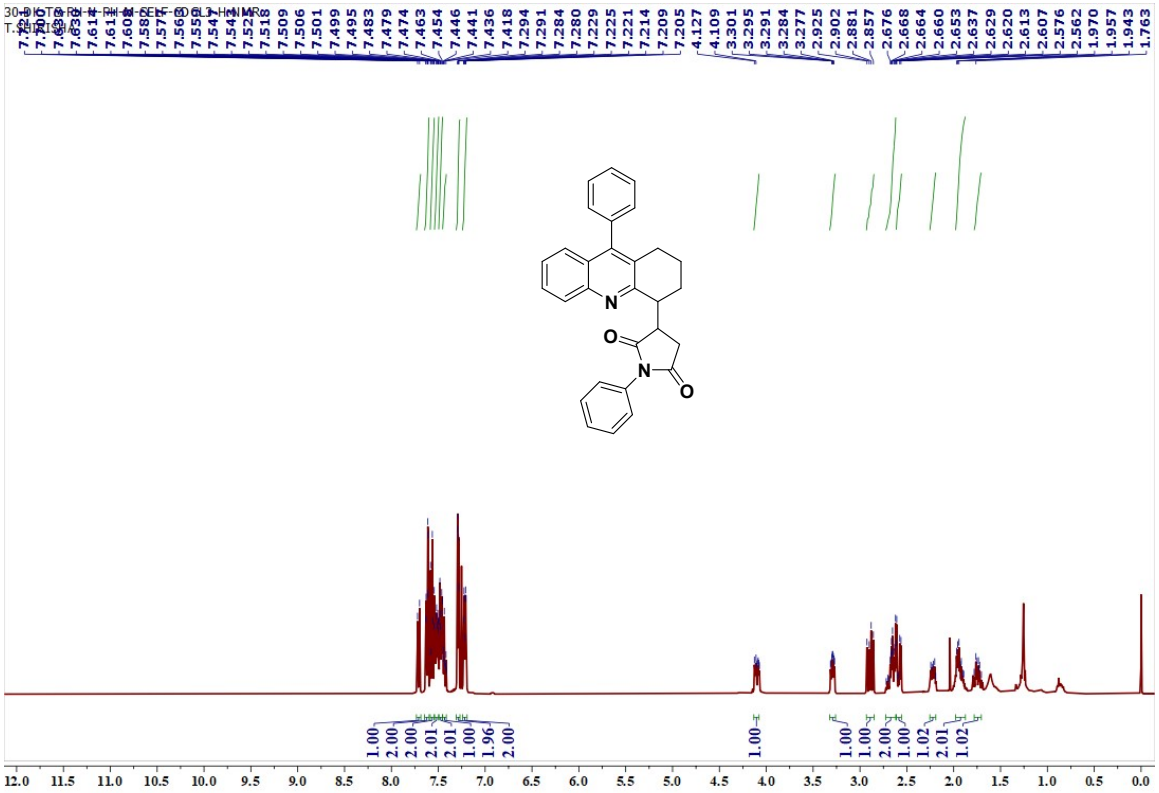
3-(9-Methyl-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5b):

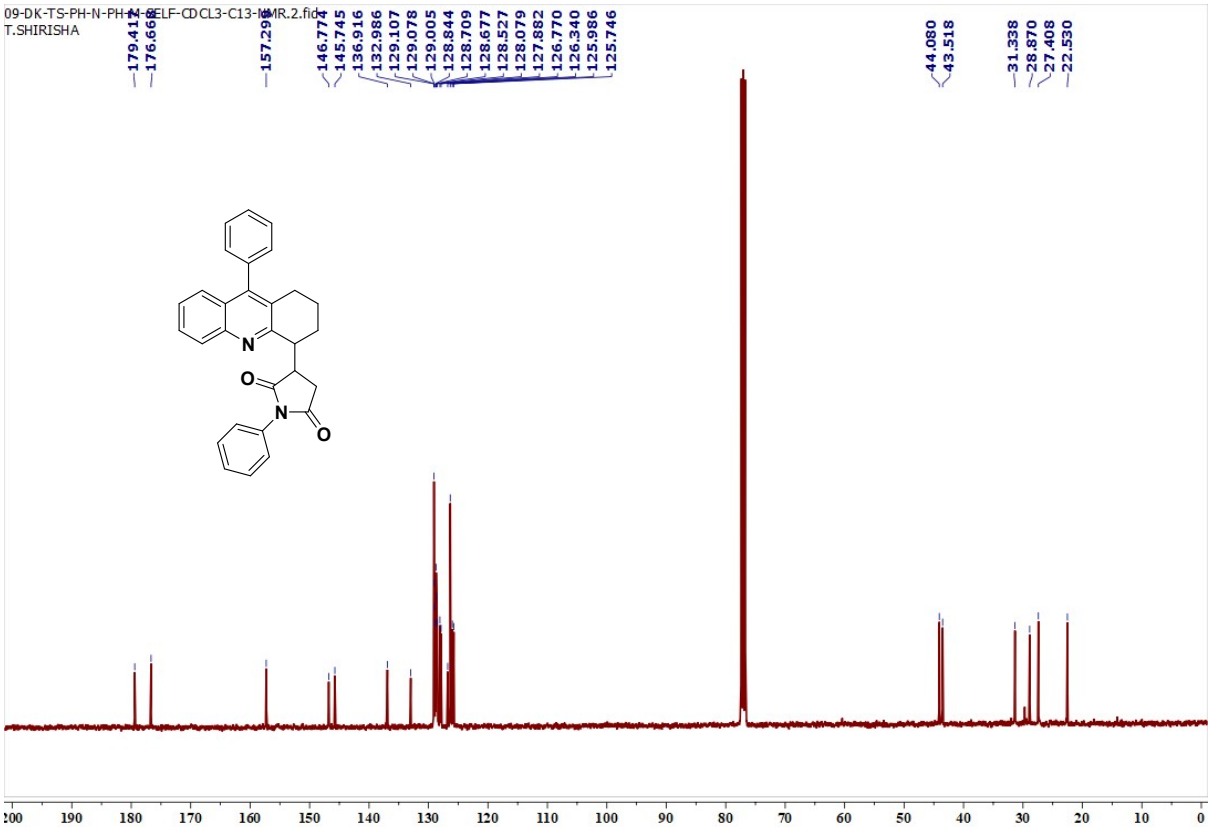


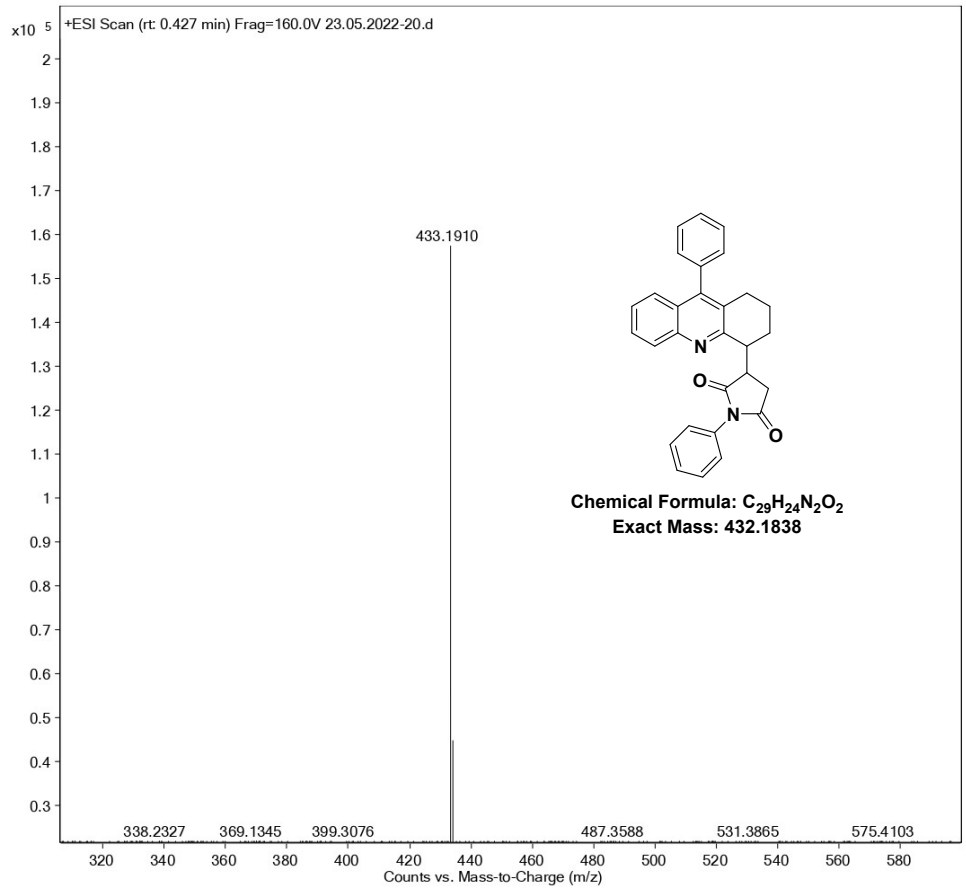

09-DK-TS-CH3-CL-A-N-PH-MAL-SELF-CDCL3-C13-NMR.2.fid
T.SHIRISHA
179.313
176.993
157.849
145.519
141.403
132.358
129.584
128.979
128.848
128.294
128.173
127.040
126.639
125.818
123.296
44.754
43.886
35.148
29.716
27.098
22.804
13.741
CH3
N
O
N
O
f1 (ppm)


+ESI Scan (rt: 0.241 min) Frag=160.0V 23.05.2022-18.d
x10 7
371.1754
278.1171
309.1594
349.1837
403.2024
474.4287
531.3877
Counts vs. Mass-to-Charge (m/z)
CH3
N
O
N
O
Chemical Formula: C24H22N2O2
Exact Mass: 370.1681

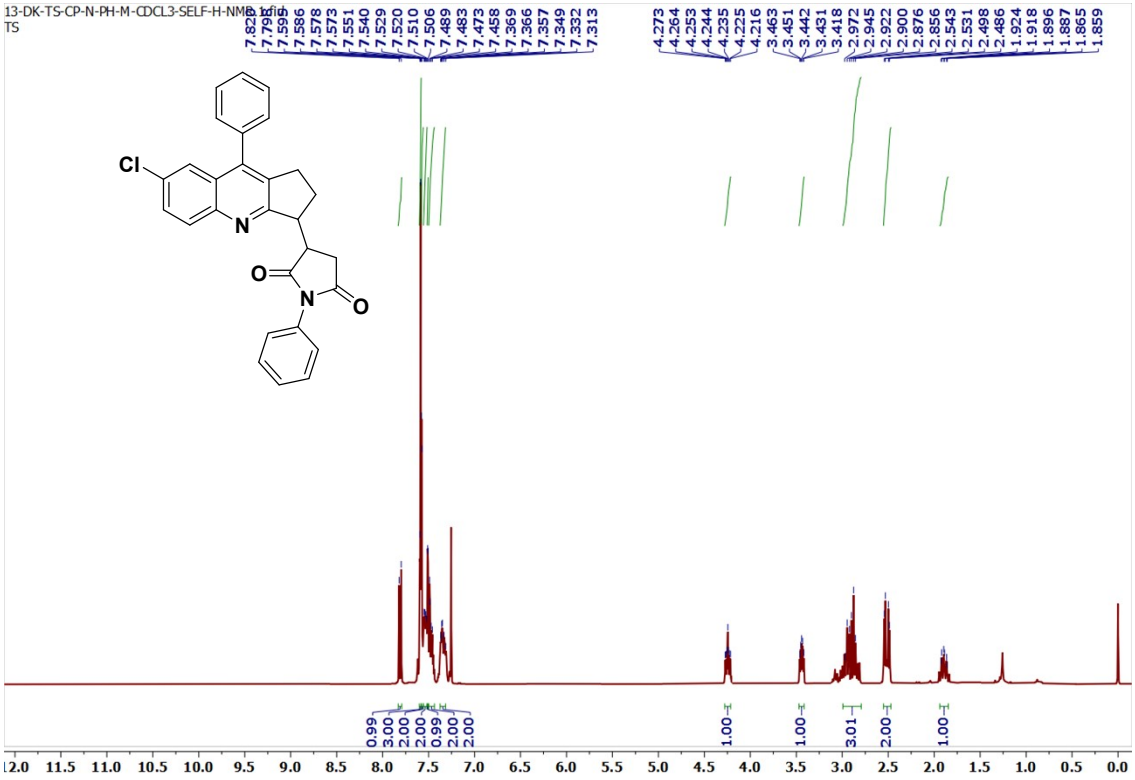
1-Phenyl-3-(9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)pyrrolidine-2,5-dione (5c):

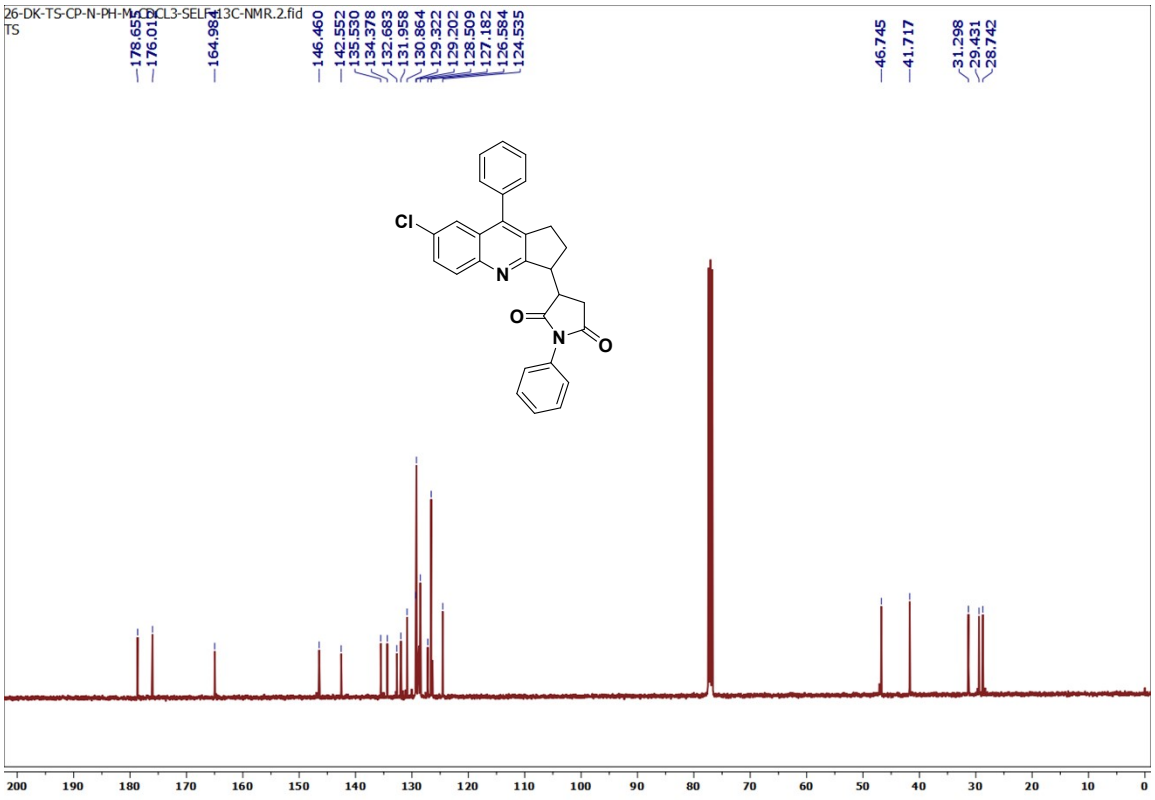


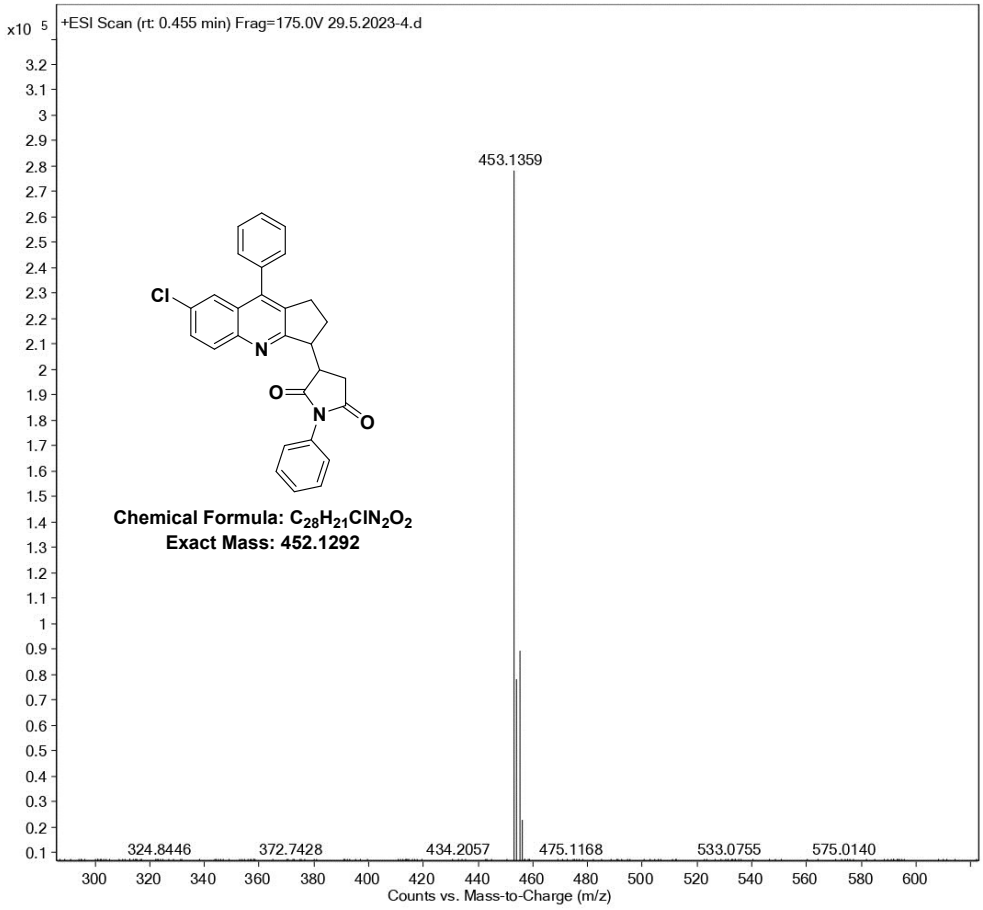




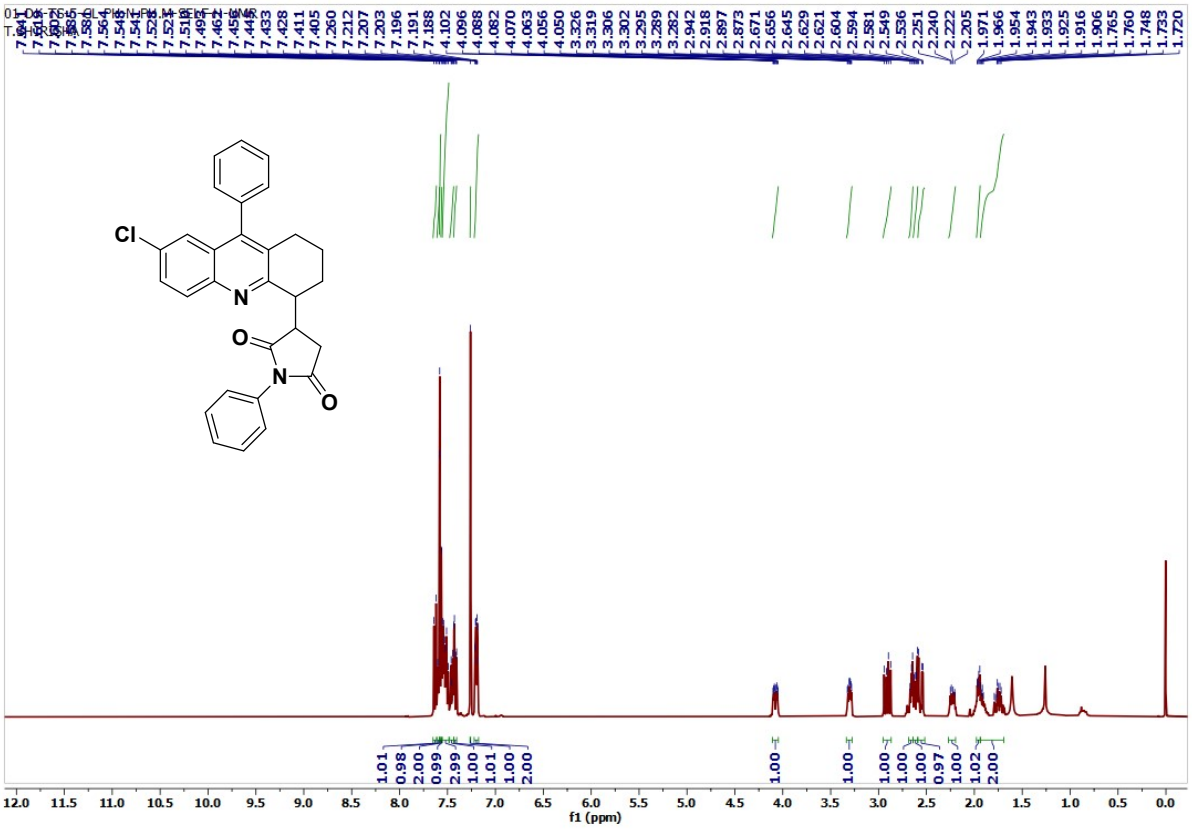
3-(7-Chloro-9-phenyl-2,3-dihydro-1H-cyclopenta[b]quinolin-3-yl)-1-phenylpyrrolidine-2,5-dione (5d):

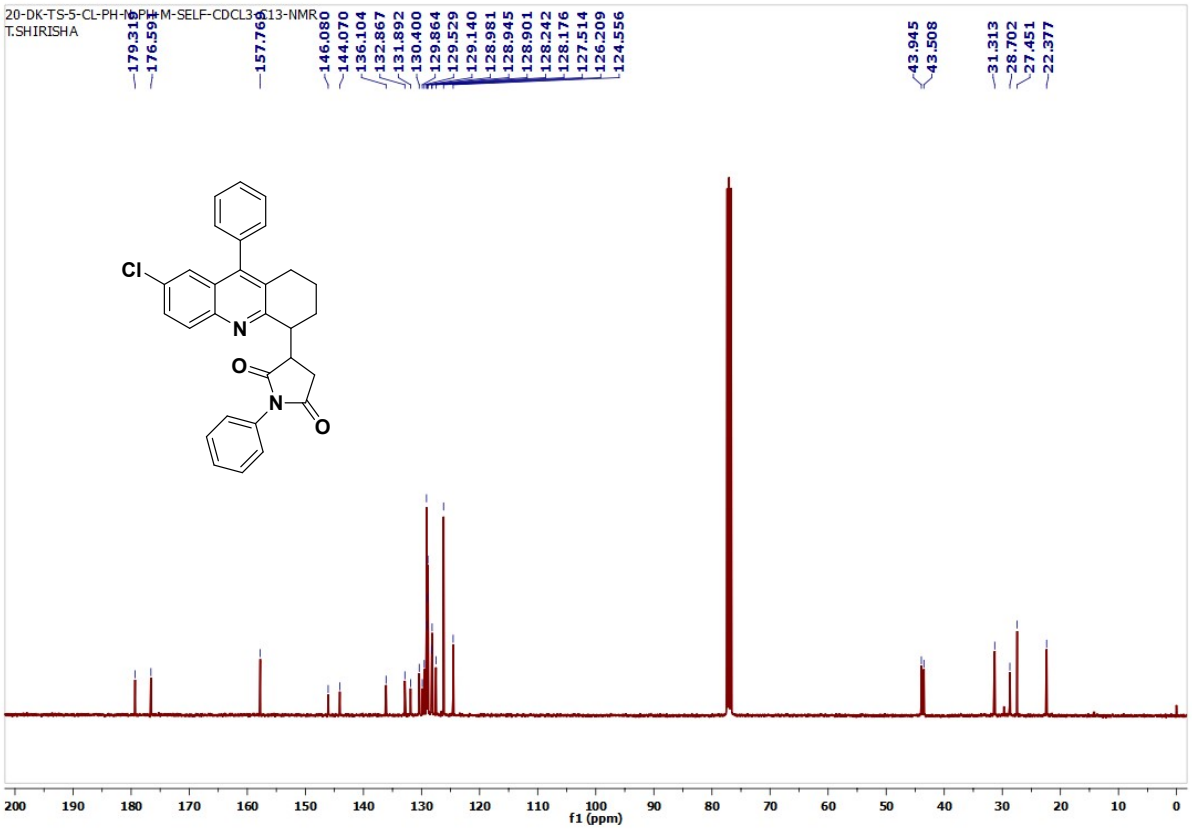


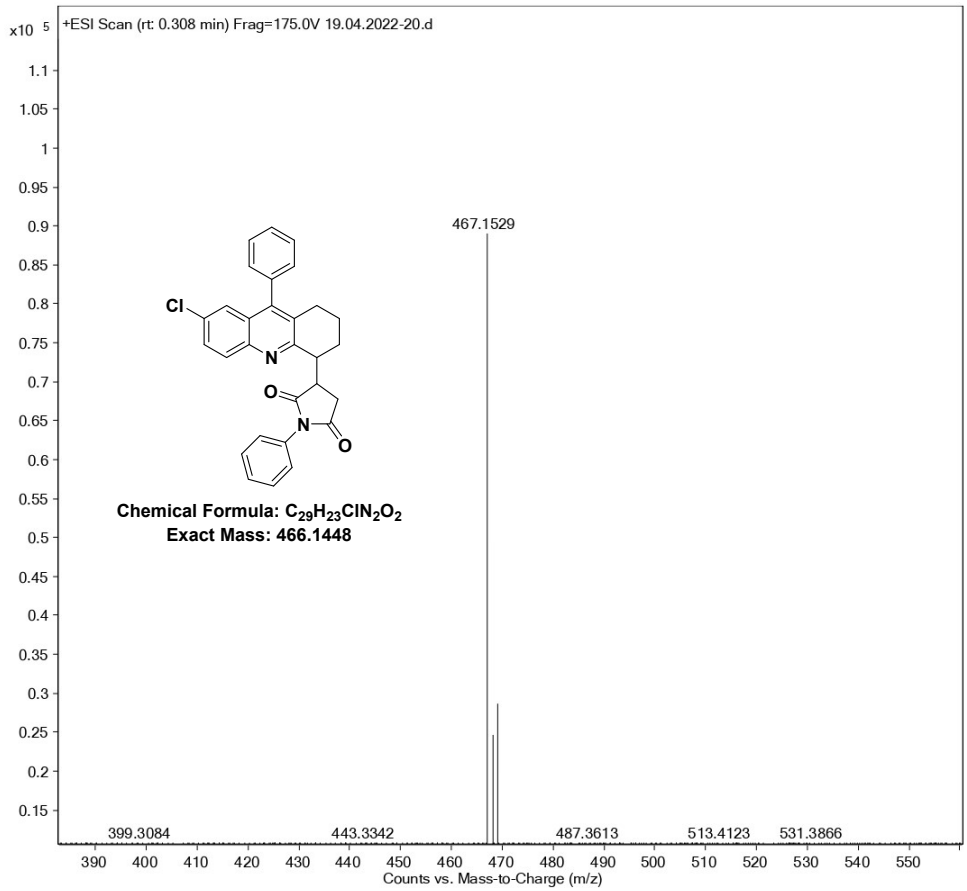

26-DK-TS-CP-N-PH-M...CDCL3-SELF-13C-NMR.2.fid
TS
178.655
176.011
164.984
146.460
142.552
135.530
134.378
132.683
131.958
130.864
129.322
129.202
128.509
127.182
126.584
124.535
46.745
41.717
31.298
29.431
28.742
Cl
N
O
O
N
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 5
+ESI Scan (rt: 0.455 min) Frag=175.0V 29.5.2023-4.d
453.1359
Cl
N
O
O
N
O
Chemical Formula: C28H21ClN2O2
Exact Mass: 452.1292
324.8446
372.7428
434.2057
475.1168
533.0755
575.0140
Counts vs. Mass-to-Charge (m/z)

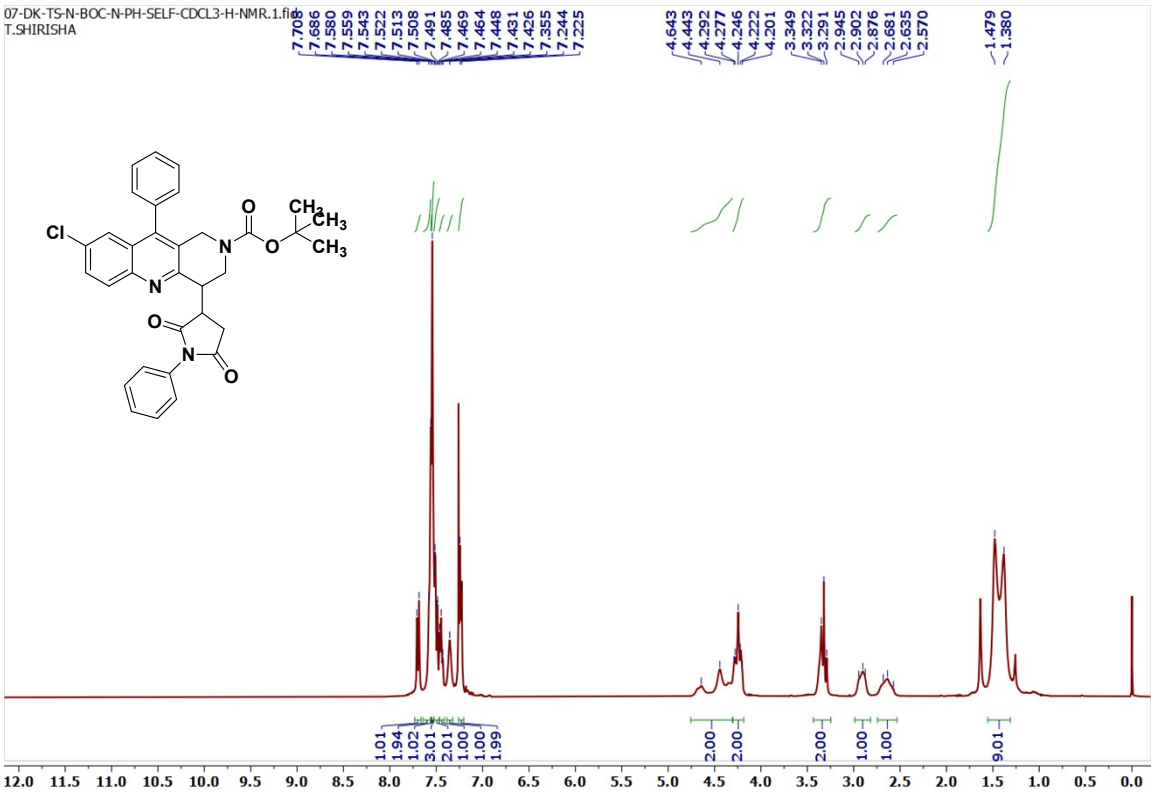
3-(7-Chloro-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5e):

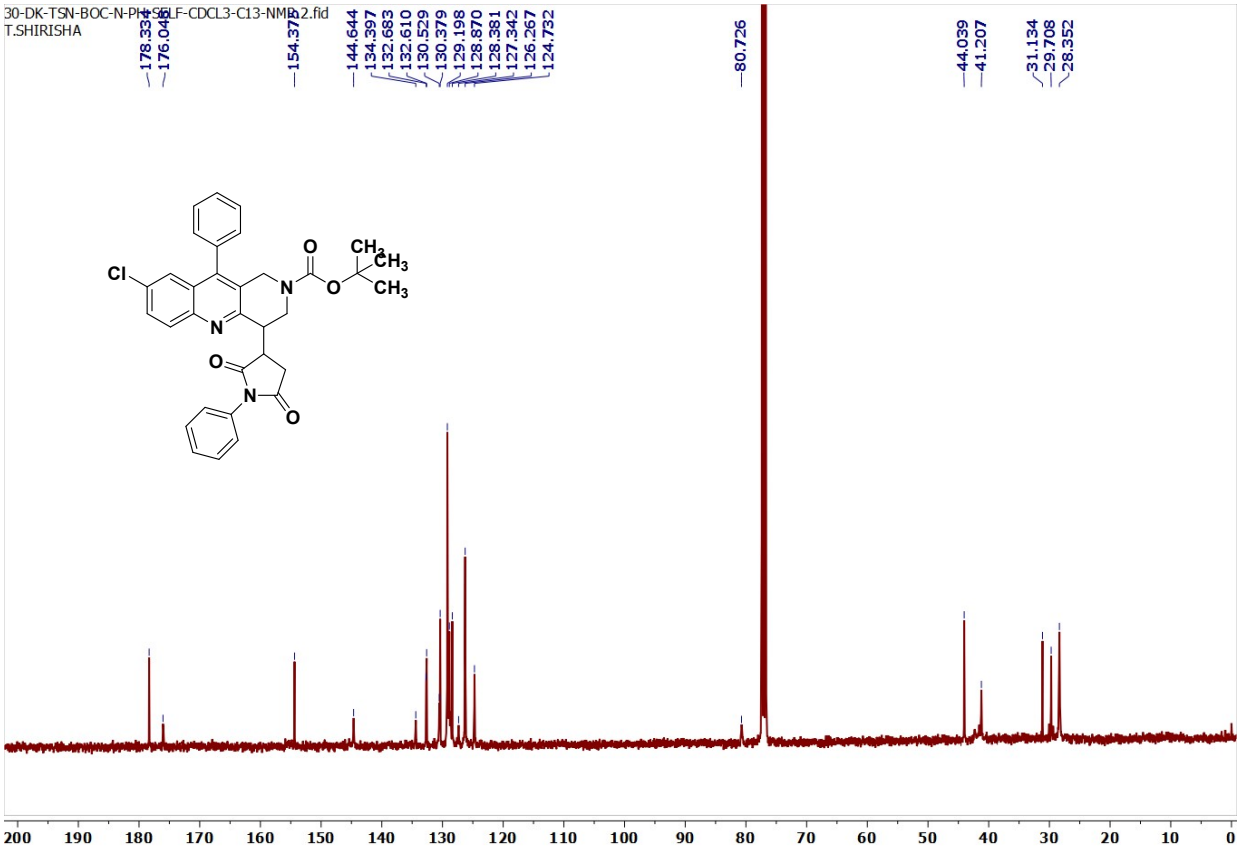


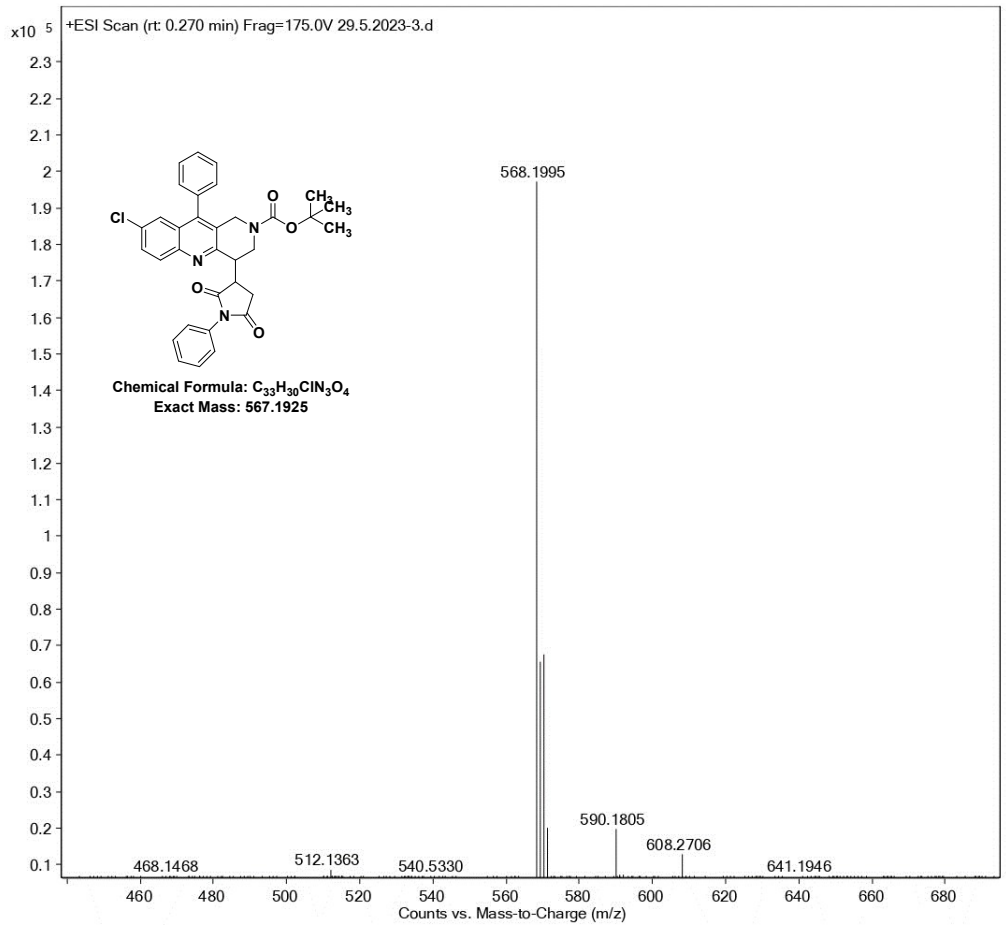




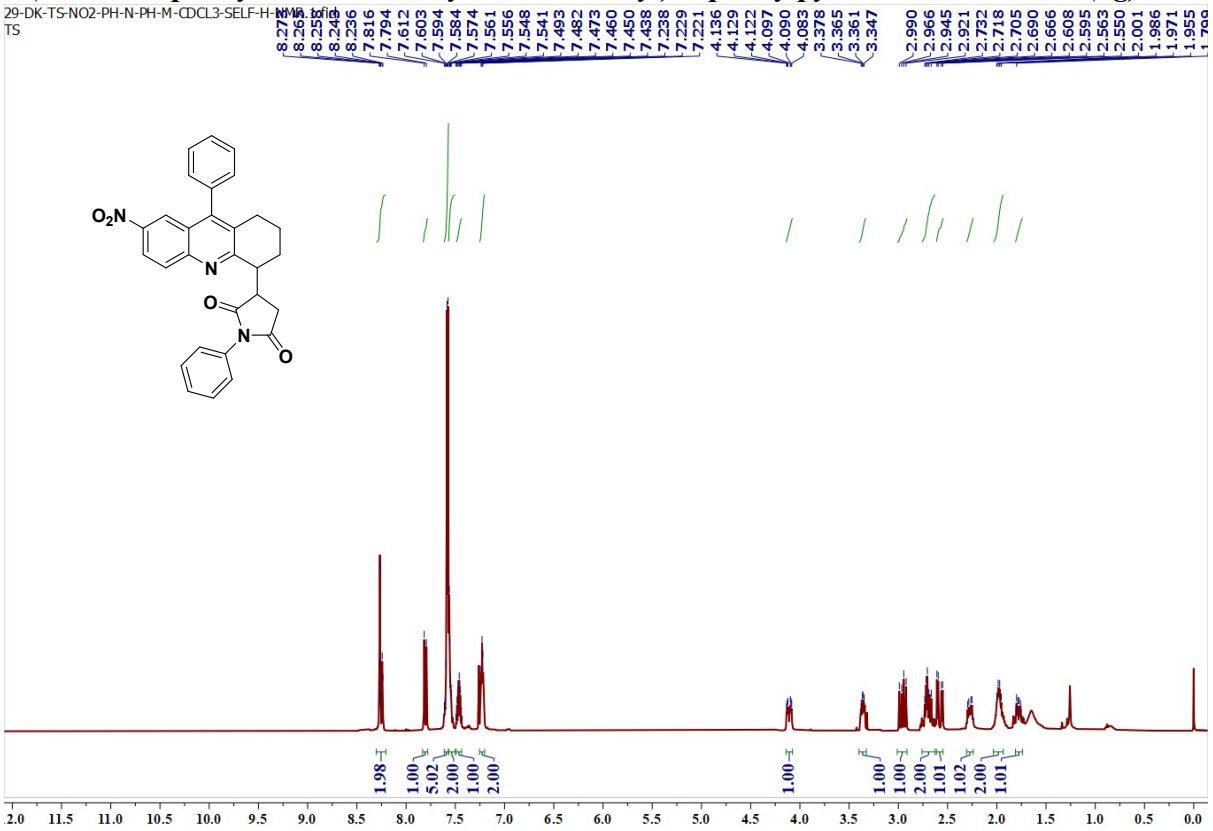
tert-Butyl 8-chloro-4-(2,5-dioxo-1-phenylpyrrolidin-3-yl)-10-phenyl-3,4-dihydrobenzo[b][1,6]naphthyridine-2(1H)-carboxylate (5f):

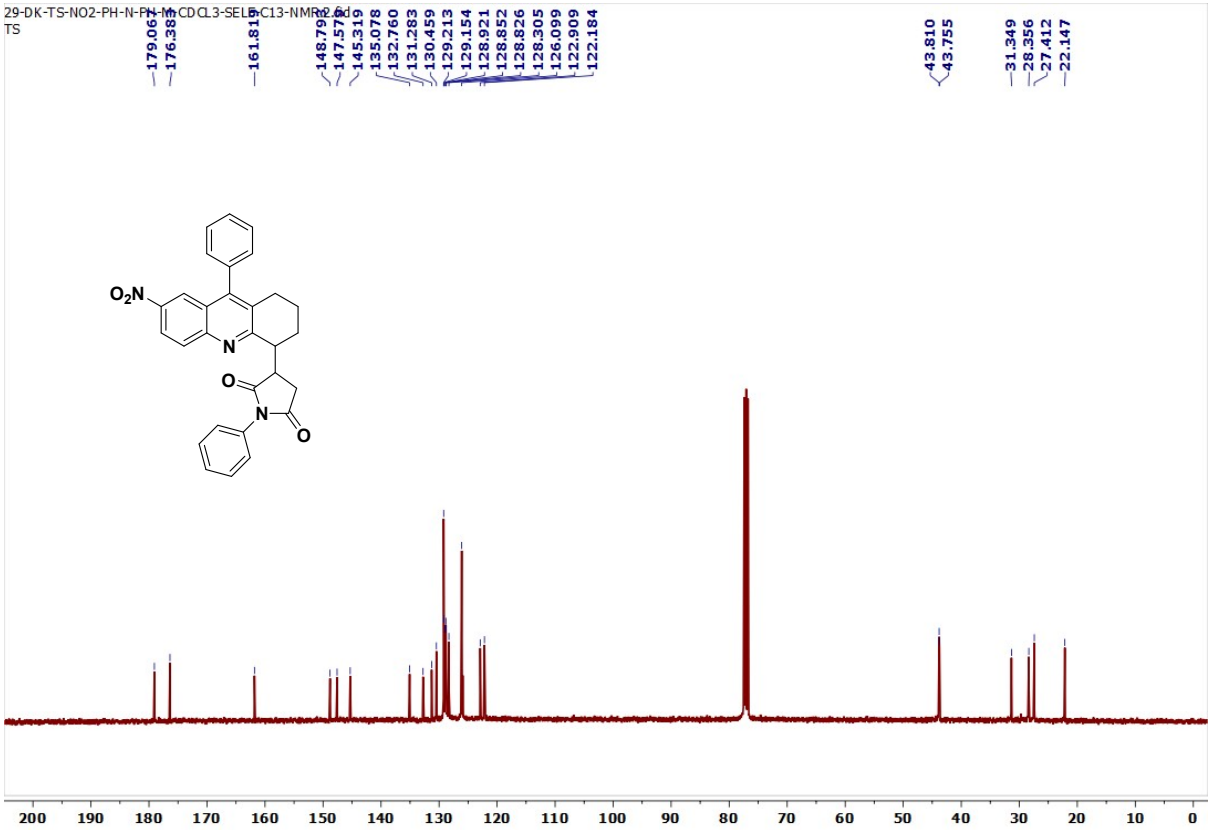


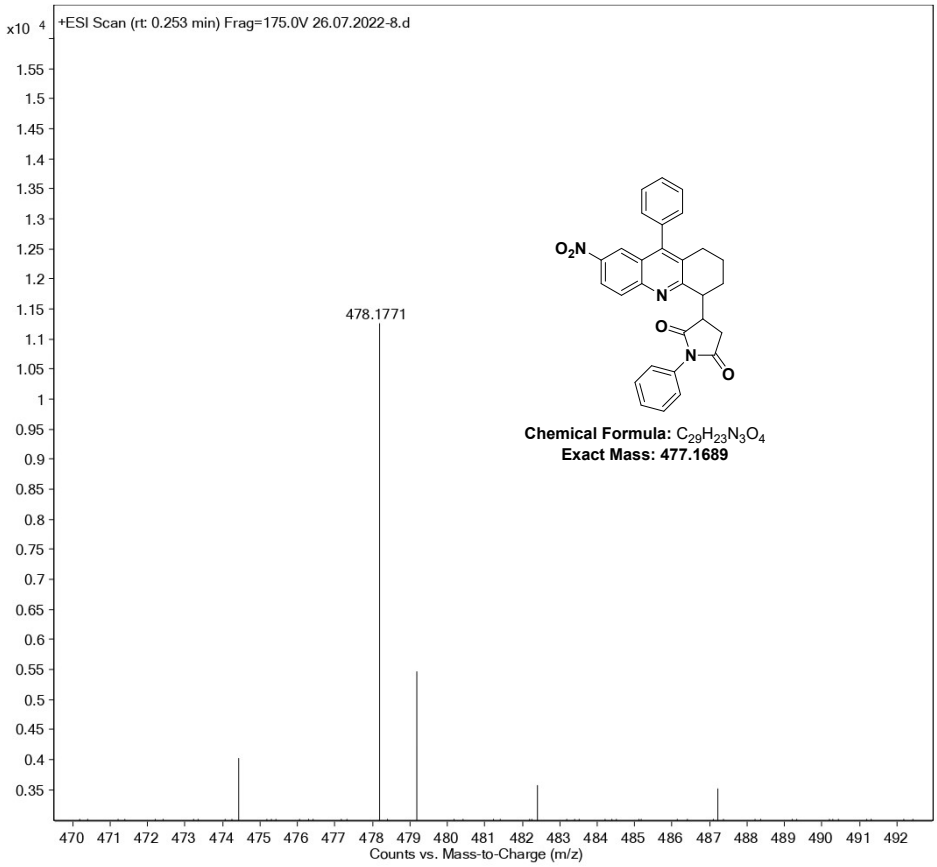

30-DK-TSN-BOC-N-PH-SELF-CDCL3-C13-NMR-2.fid
T.SHIRISHA
178.333
176.046
154.377
144.644
134.397
132.683
132.610
130.529
130.379
129.198
128.870
128.381
127.342
126.267
124.732
80.726
44.039
41.207
31.134
29.708
28.352
Cl
N
O
O
N
O
O
N
O
CH3
CH3
CH3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 5
+ESI Scan (rt: 0.270 min) Frag=175.0V 29.5.2023-3.d
Cl
N
O
O
N
O
O
N
O
CH3
CH3
CH3
Chemical Formula: C33H30ClN3O4
Exact Mass: 567.1925
568.1995
590.1805
608.2706
641.1946
468.1468
512.1363
540.5330
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
460 480 500 520 540 560 580 600 620 640 660 680
Counts vs. Mass-to-Charge (m/z)

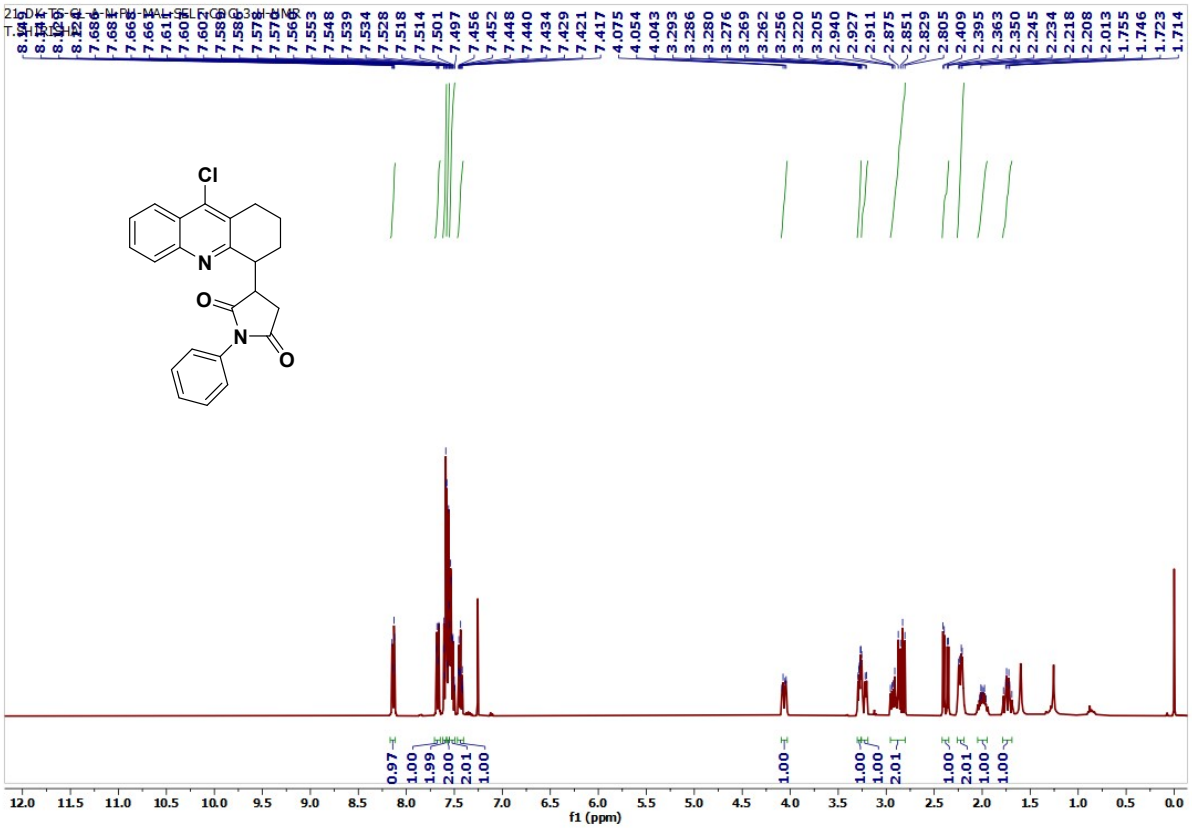
3-(7-Nitro-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5g):

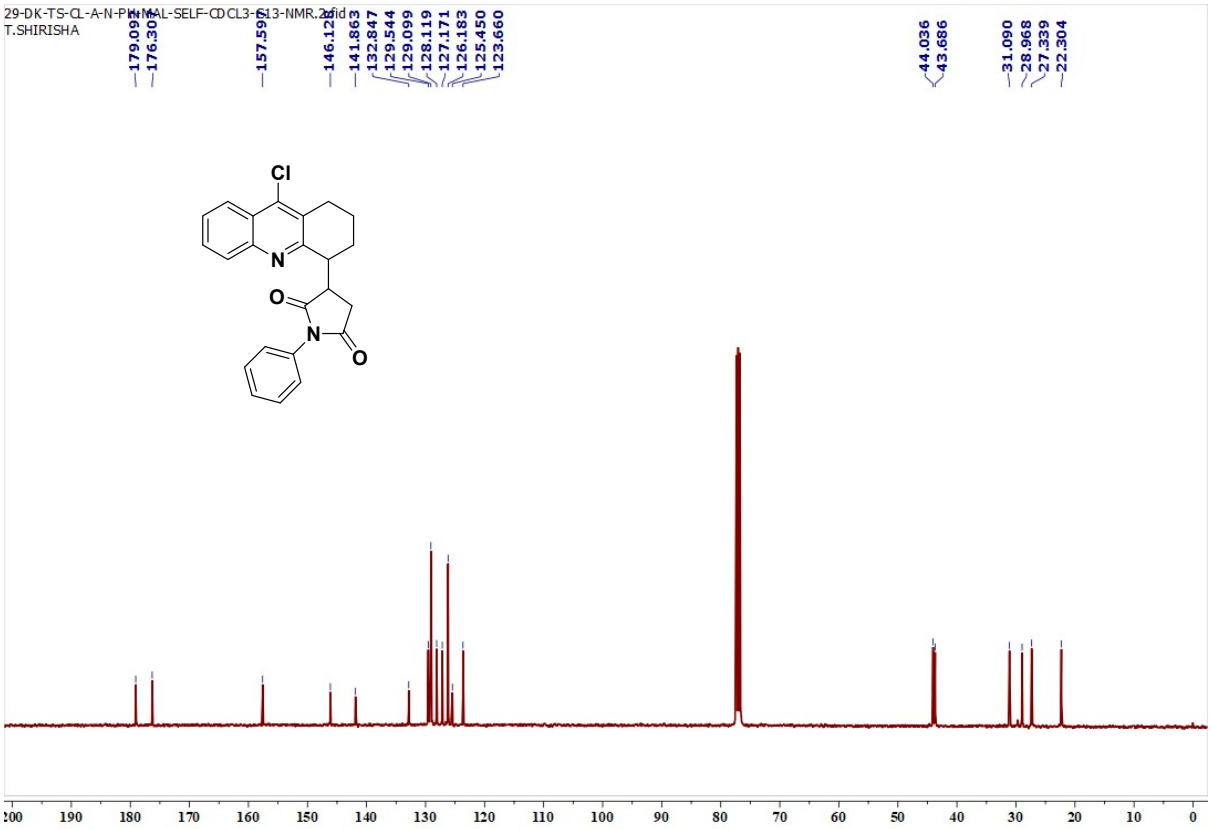


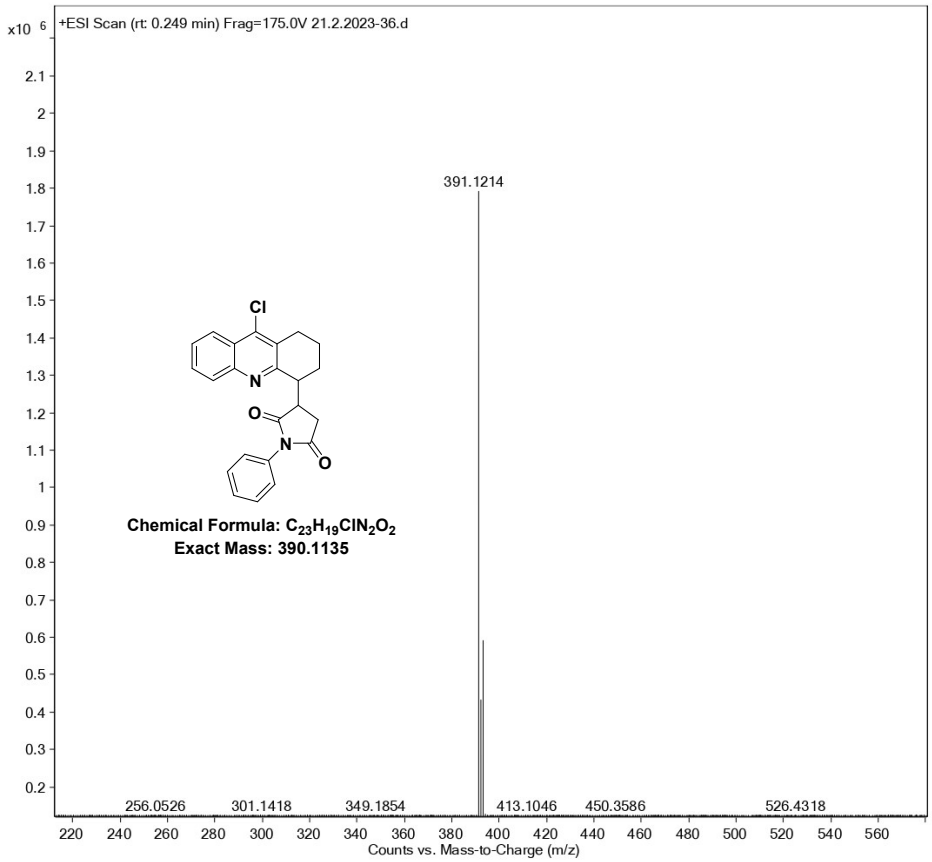




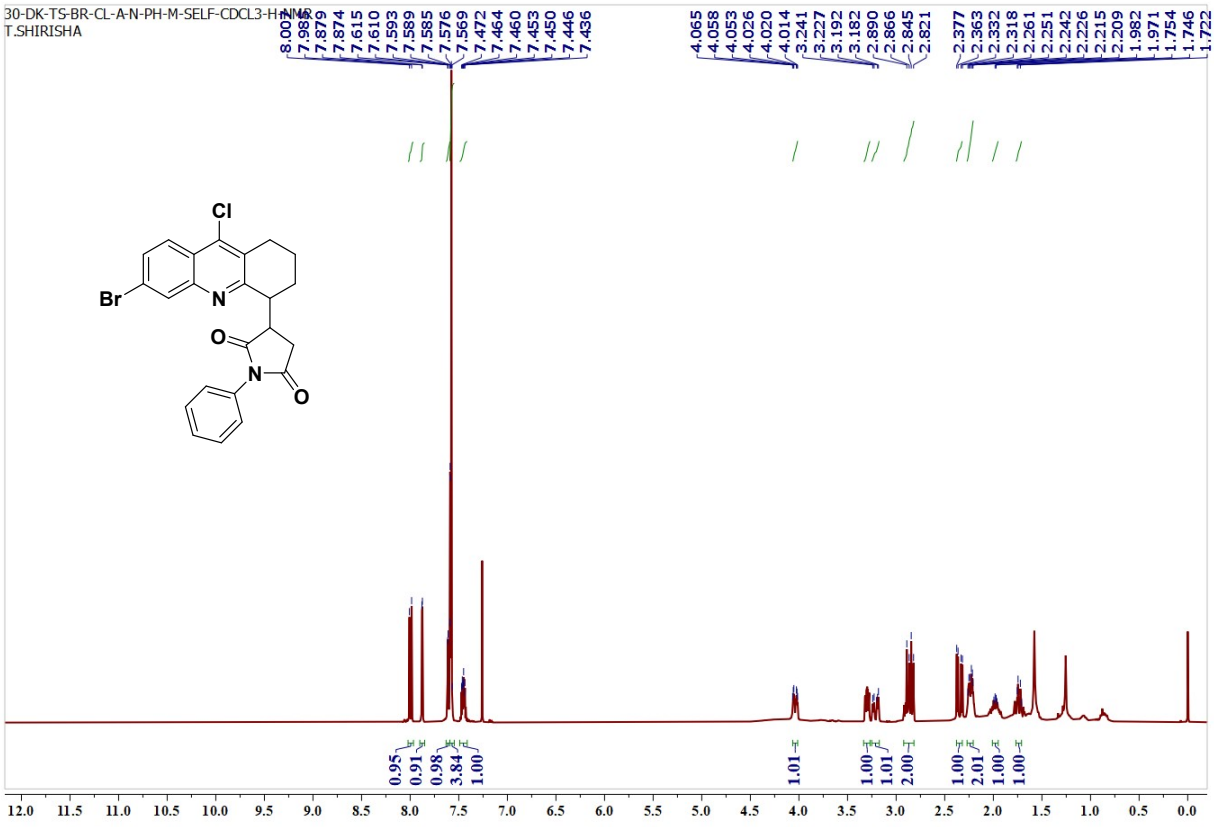
3-(9-Chloro-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5h):

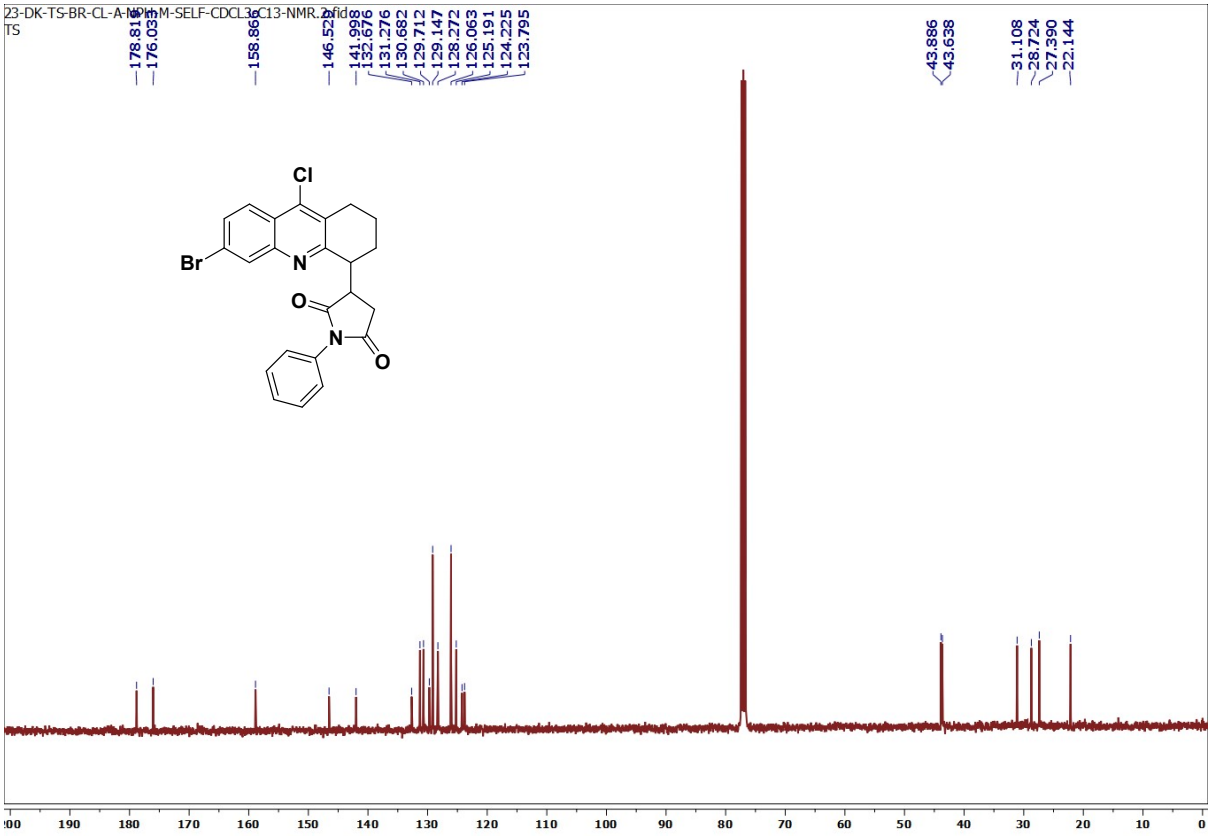


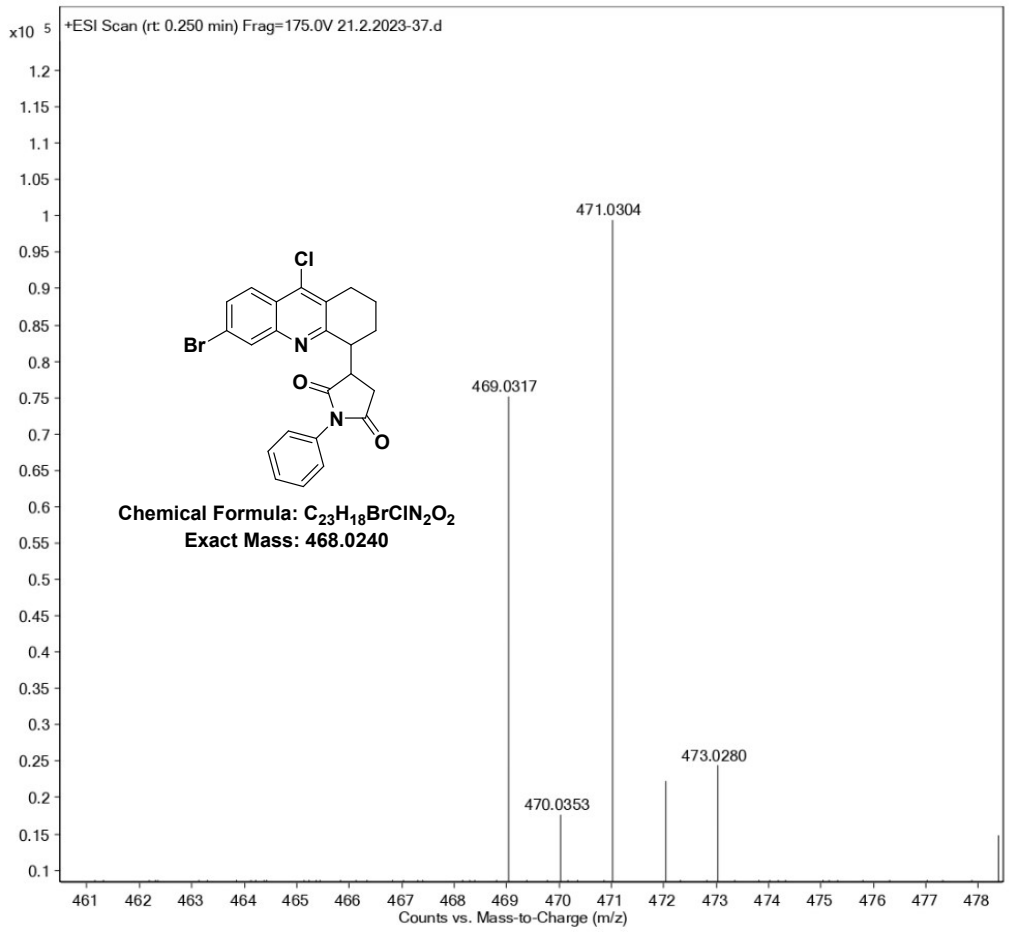

29-DK-TS-CL-A-N-PHTHAL-SELF-CDCL3-C13-NMR.2.fid
T.SHIRISHA
179.094
176.301
157.591
146.121
141.863
132.847
129.544
129.099
128.119
127.171
126.183
125.450
123.660
44.036
43.686
31.090
28.968
27.339
22.304
Cl
N
O
N
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 6
+ESI Scan (rt: 0.249 min) Frag=175.0V 21.2.2023-36.d
391.1214
Cl
N
O
N
O
Chemical Formula: C23H19ClN2O2
Exact Mass: 390.1135
256.0526
301.1418
349.1854
413.1046
450.3586
526.4318
Counts vs. Mass-to-Charge (m/z)

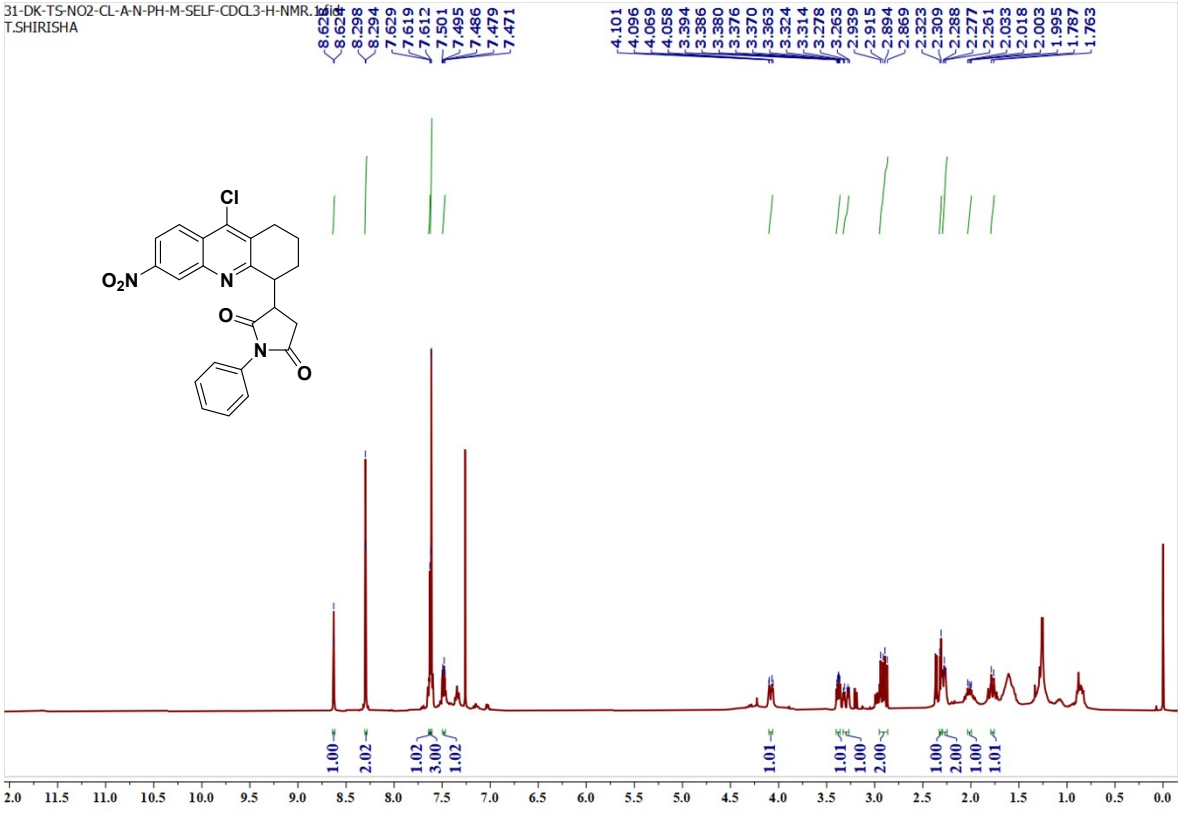
3-(6-Bromo-9-chloro-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5i):

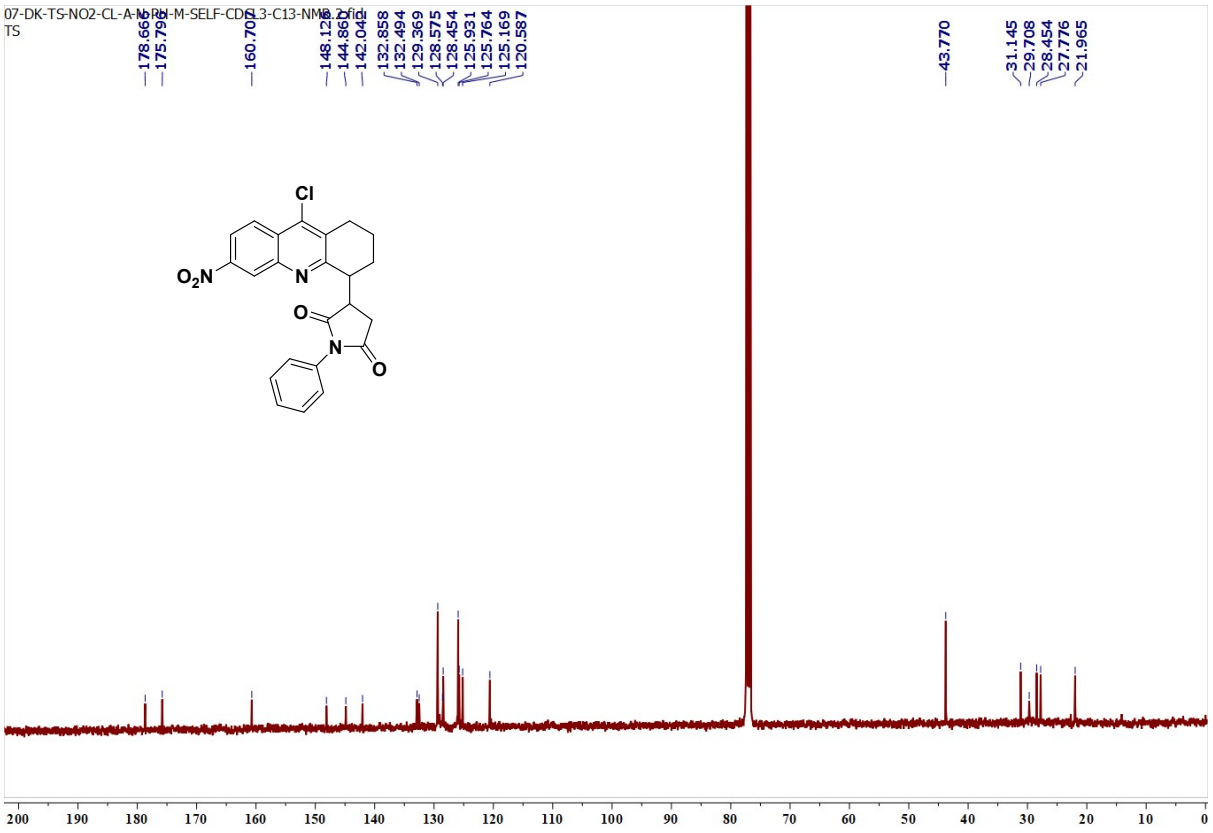


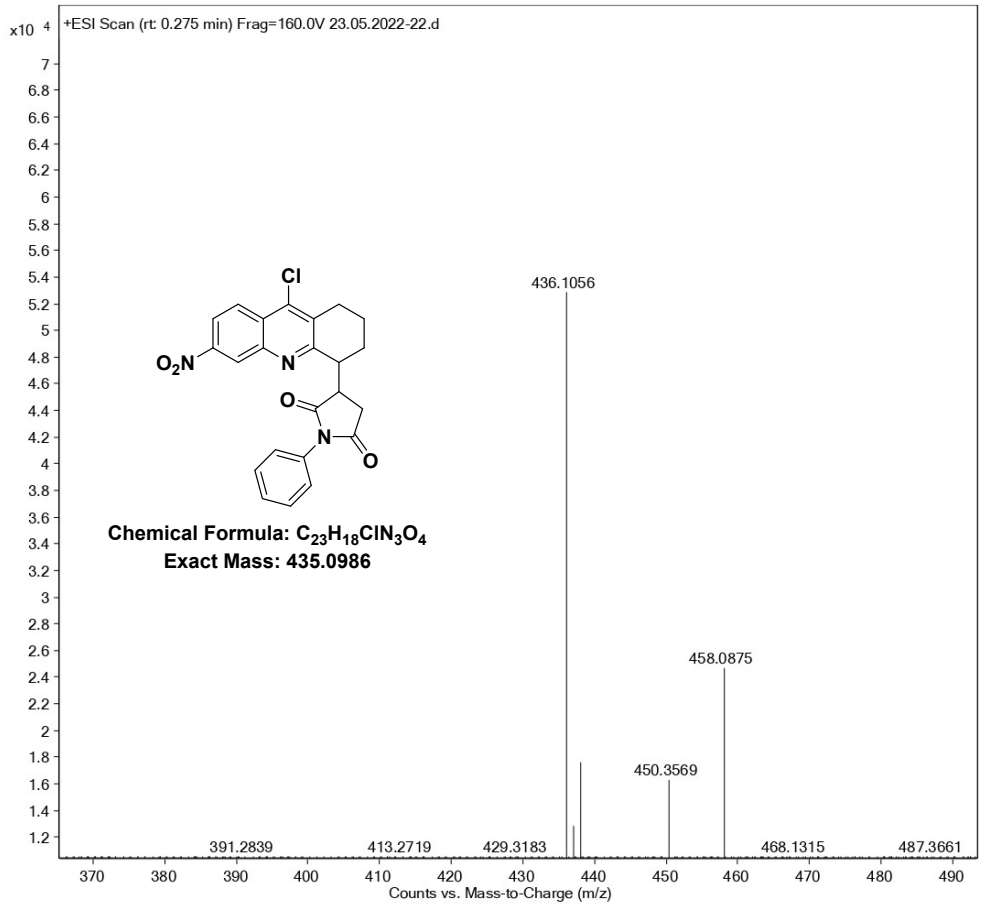




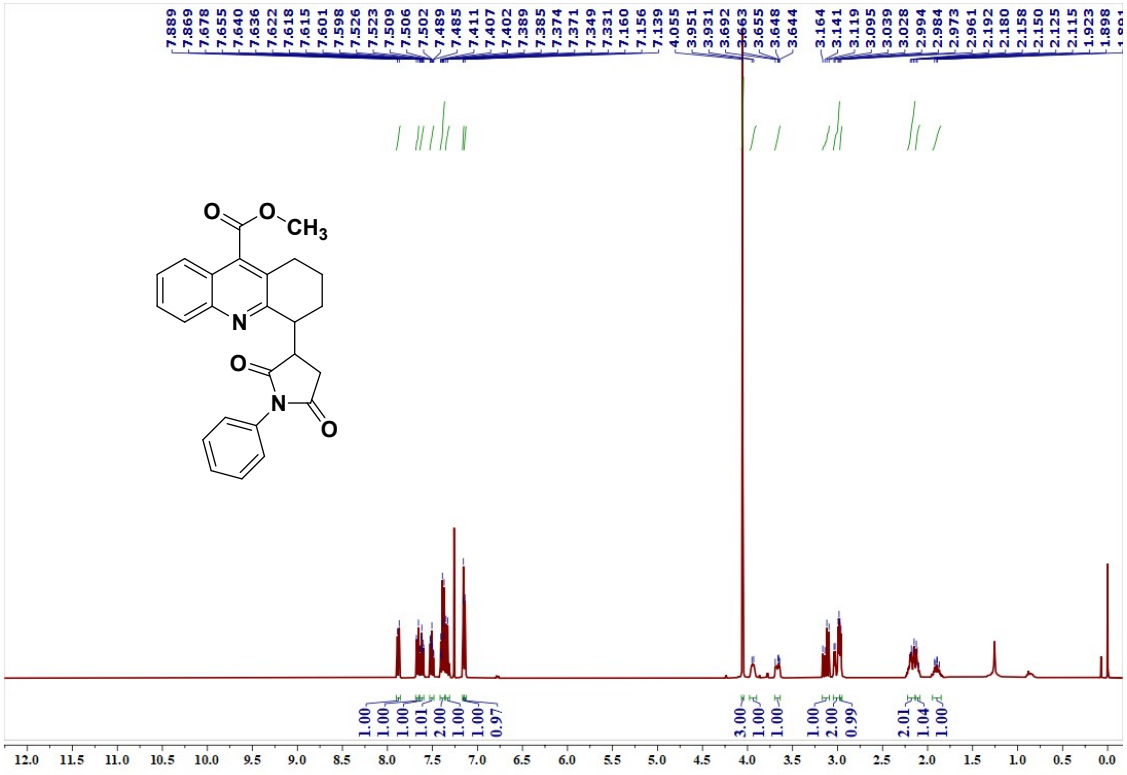
3-(9-Chloro-6-nitro-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5j):

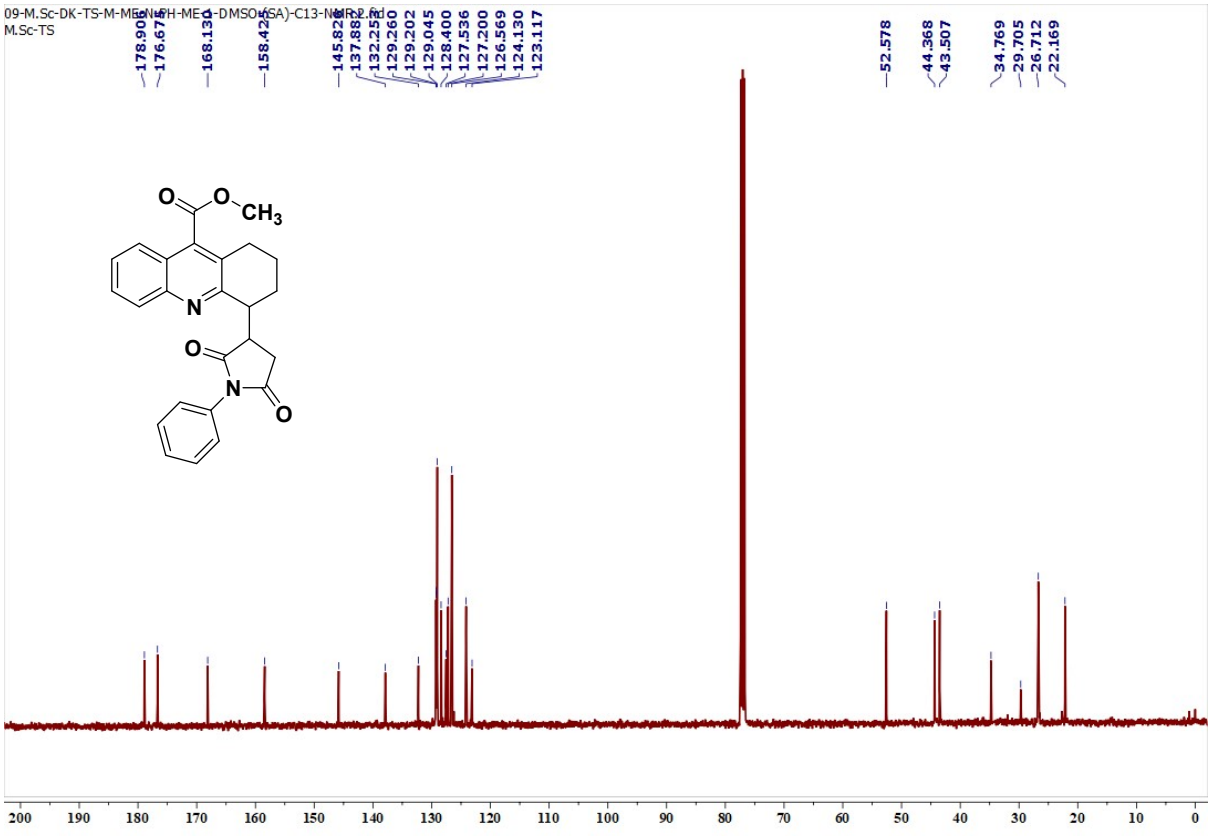


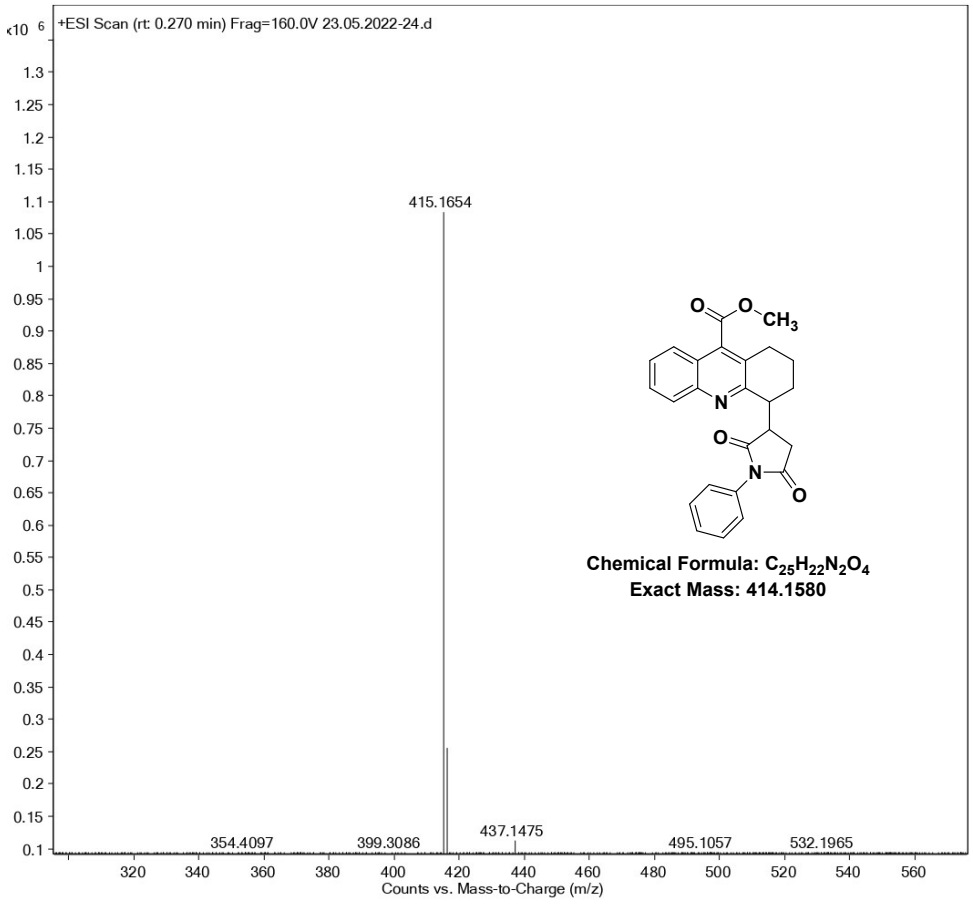

07-DK-TS-NO2-CL-A-NORL-M-SELF-CDCL3-C13-NMR-2.fid
TS
178.667
175.798
160.705
148.128
144.865
142.042
132.858
132.494
129.369
128.575
128.454
125.931
125.764
125.169
120.587
43.770
31.145
29.708
28.454
27.776
21.965
Cl
O2N
N
O
N
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 4
+ESI Scan (rt: 0.275 min) Frag=160.0V 23.05.2022-22.d
Cl
O2N
N
O
N
O
Chemical Formula: C23H18ClN3O4
Exact Mass: 435.0986
436.1056
458.0875
450.3569
391.2839
413.2719
429.3183
468.1315
487.3661
Counts vs. Mass-to-Charge (m/z)

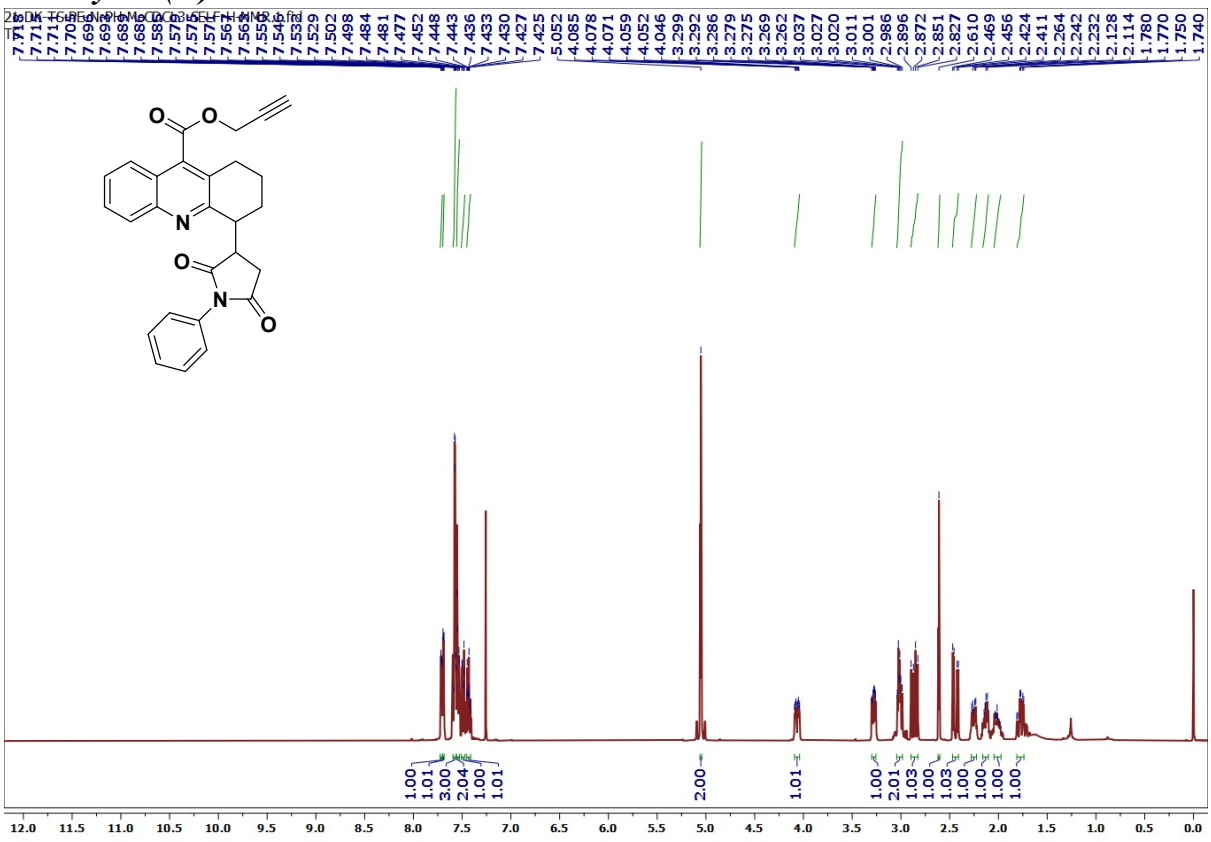
Methyl 4-(2,5-dioxo-1-phenylpyrrolidin-3-yl)-1,2,3,4-tetrahydroacridine-9-carboxylate (5k):

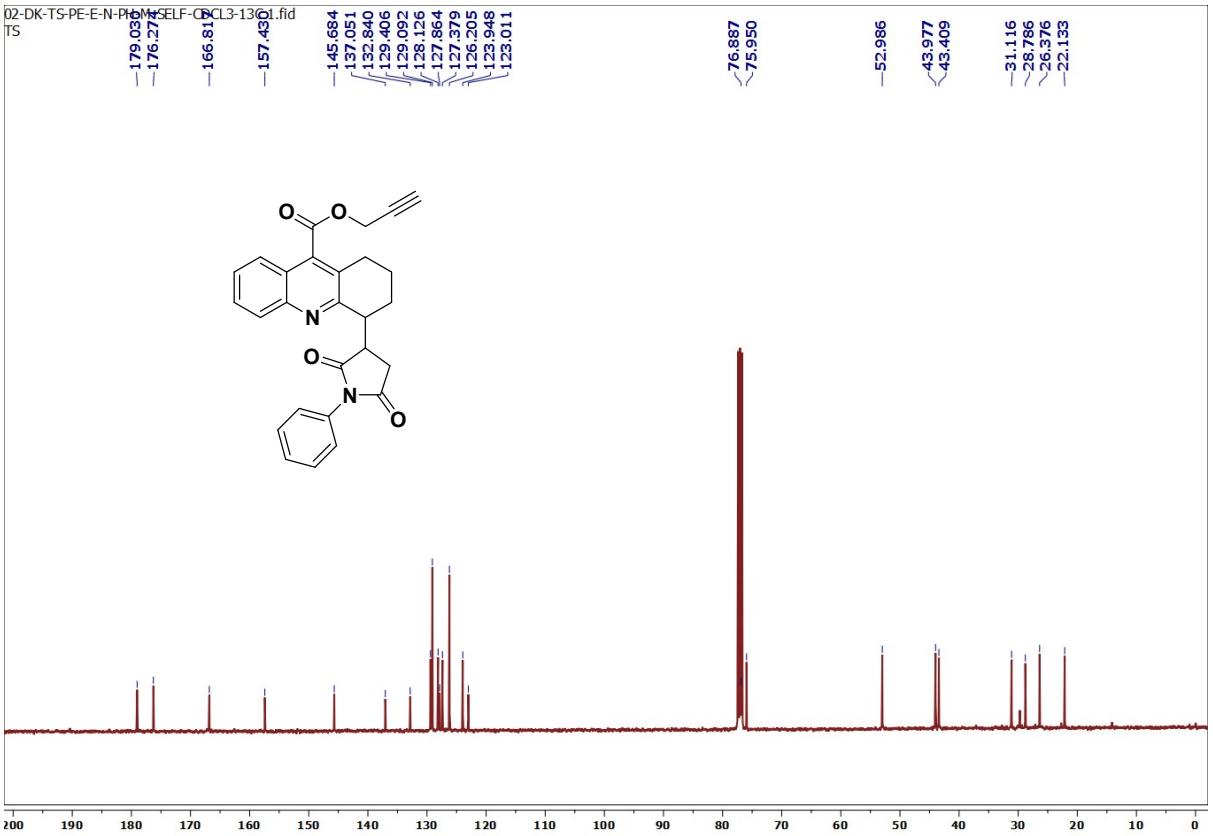


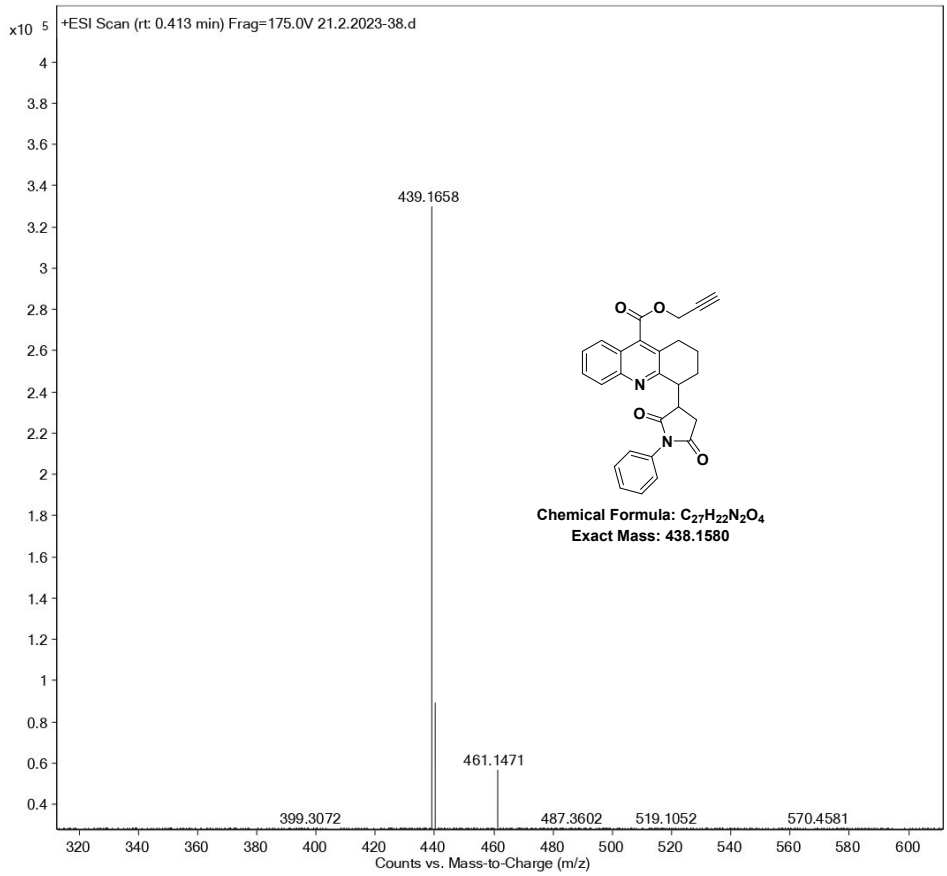




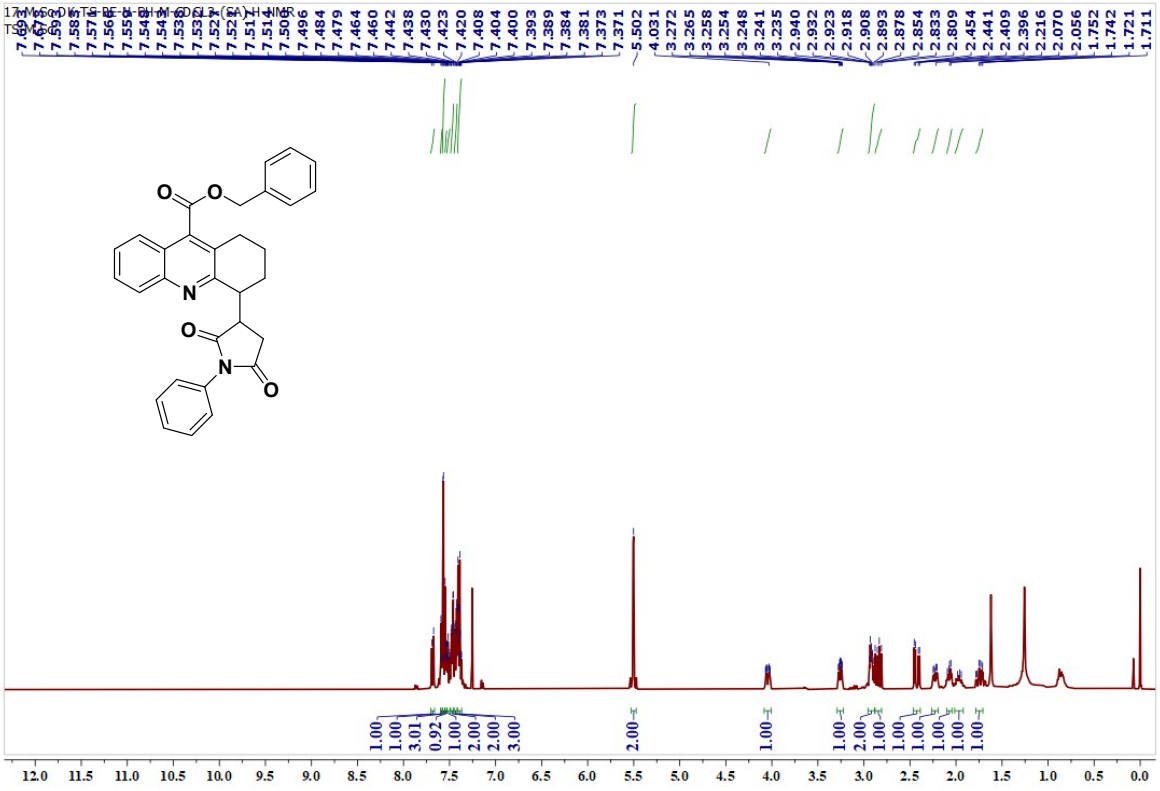
Prop-2-yn-1-yl 4-(2,5-dioxo-1-phenylpyrrolidin-3-yl)-1,2,3,4-tetrahydroacridine-9-carboxylate (5l)

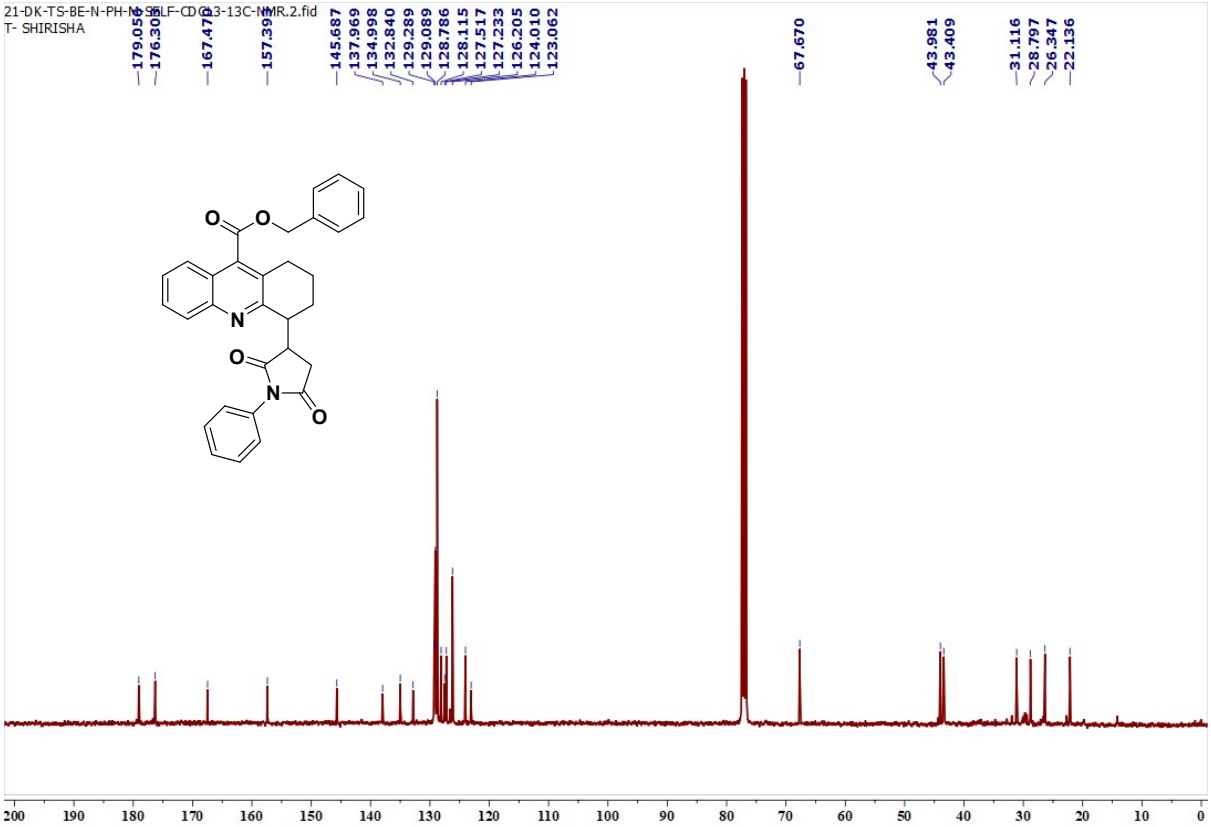


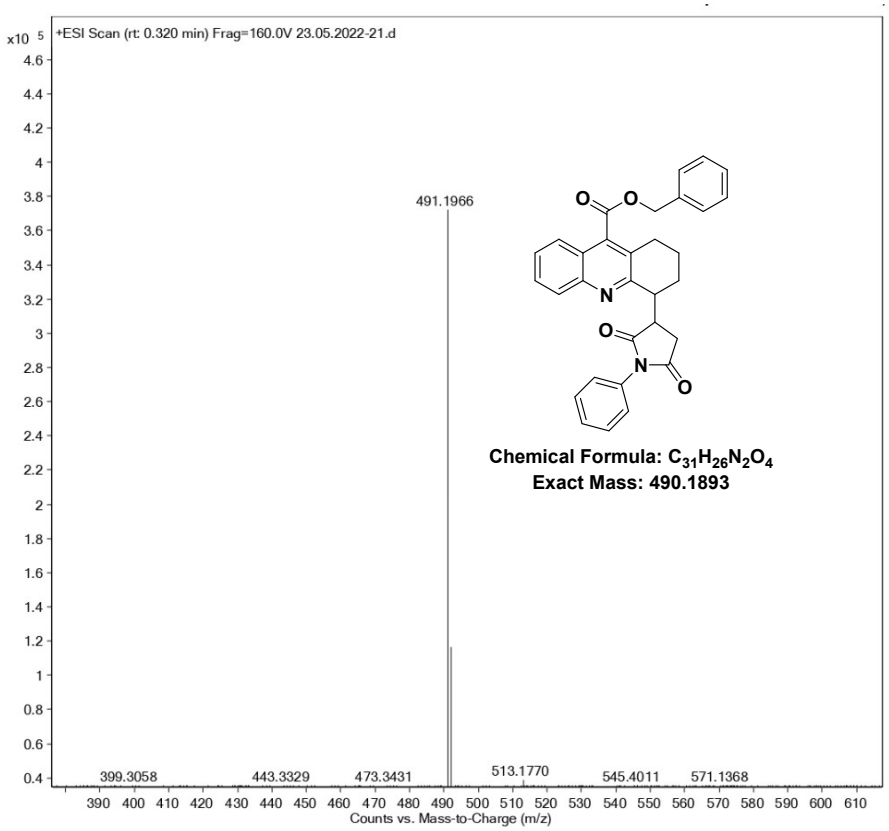

02-DK-TS-PE-E-N-PHOMSELF-CDCL3-13C-1.fid
TS
179.033
176.277
166.817
157.430
145.684
137.051
132.840
129.406
129.092
128.126
127.864
127.379
126.205
123.948
123.011
76.887
75.950
52.986
43.977
43.409
31.116
28.786
26.376
22.133


+ESI Scan (rt: 0.413 min) Frag=175.0V 21.2.2023-38.d
x10 5
439.1658
461.1471
399.3072
487.3602
519.1052
570.4581
Counts vs. Mass-to-Charge (m/z)
Chemical Formula: C27H22N2O4
Exact Mass: 438.1580

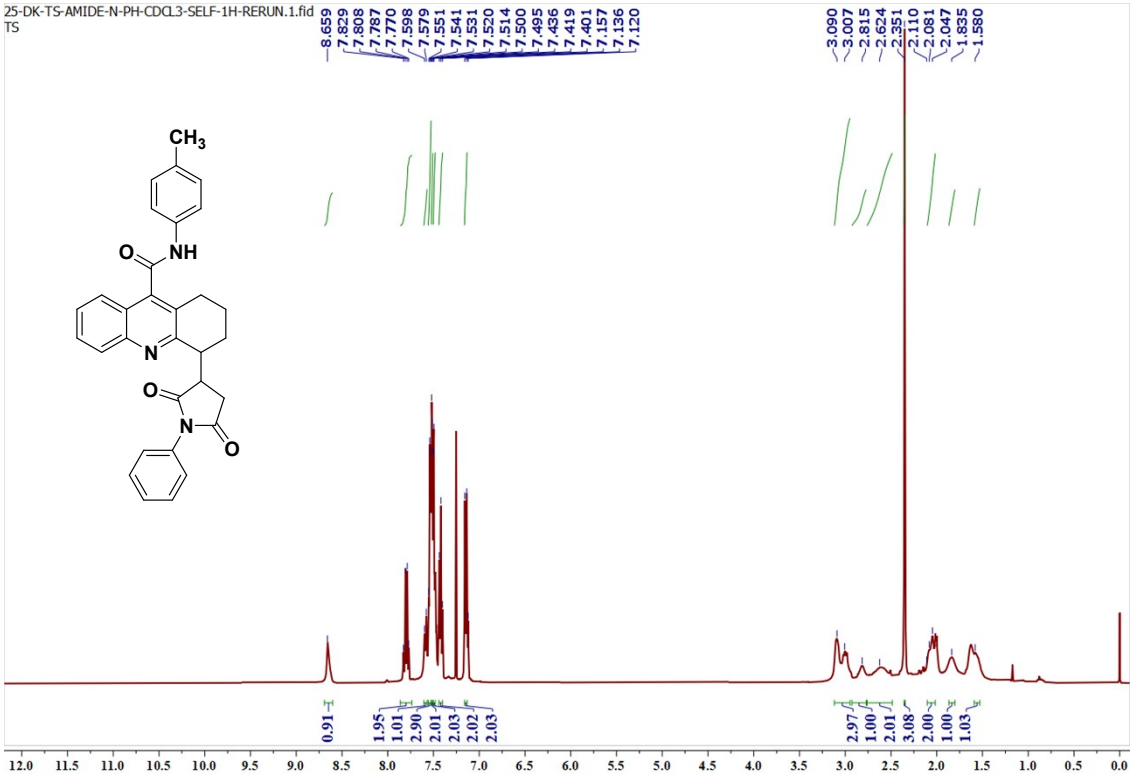
Benzyl 4-(2,5-dioxo-1-phenylpyrrolidin-3-yl)-1,2,3,4-tetrahydroacridine-9-carboxylate (5m):

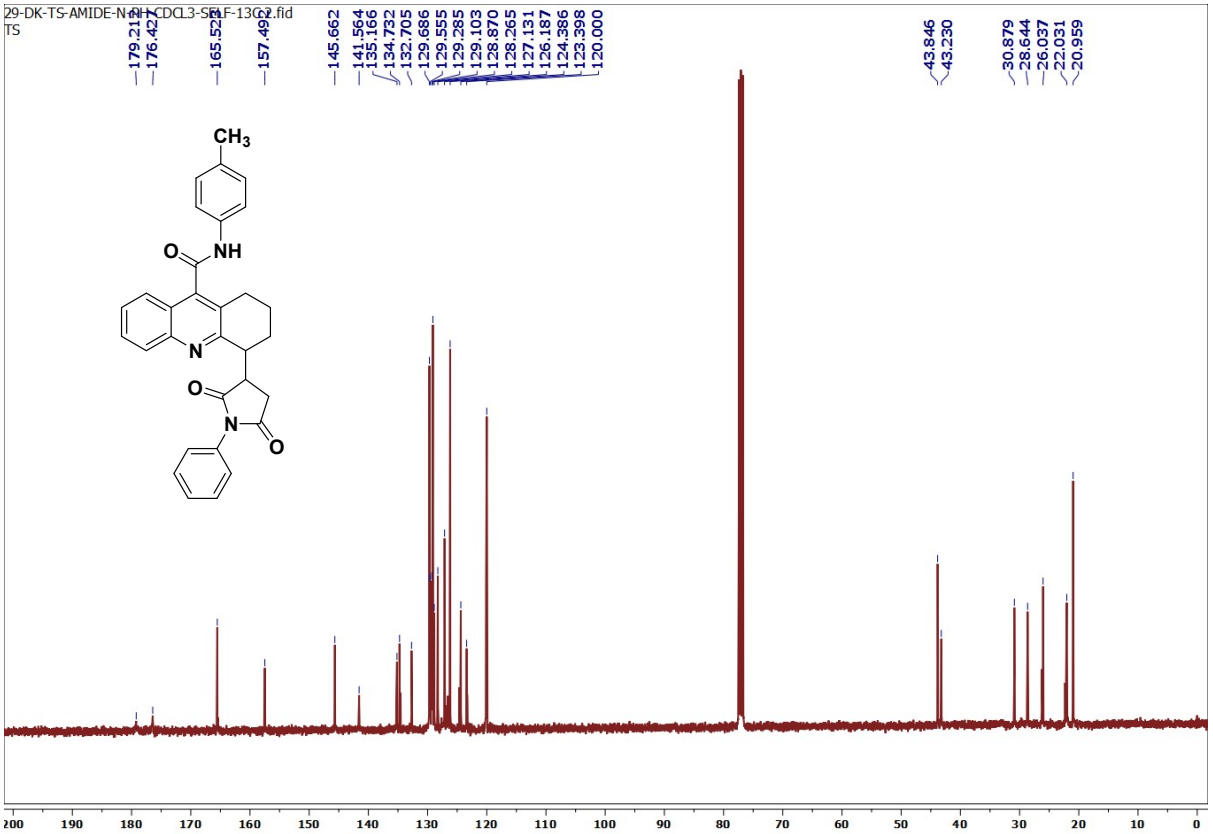


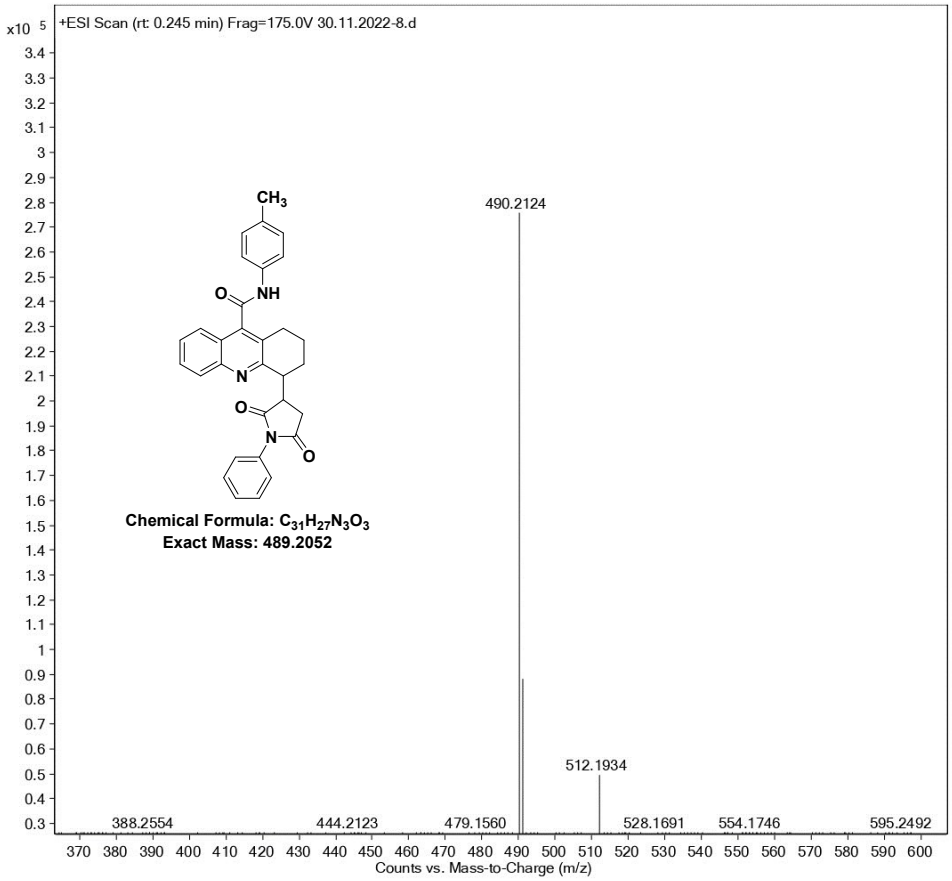




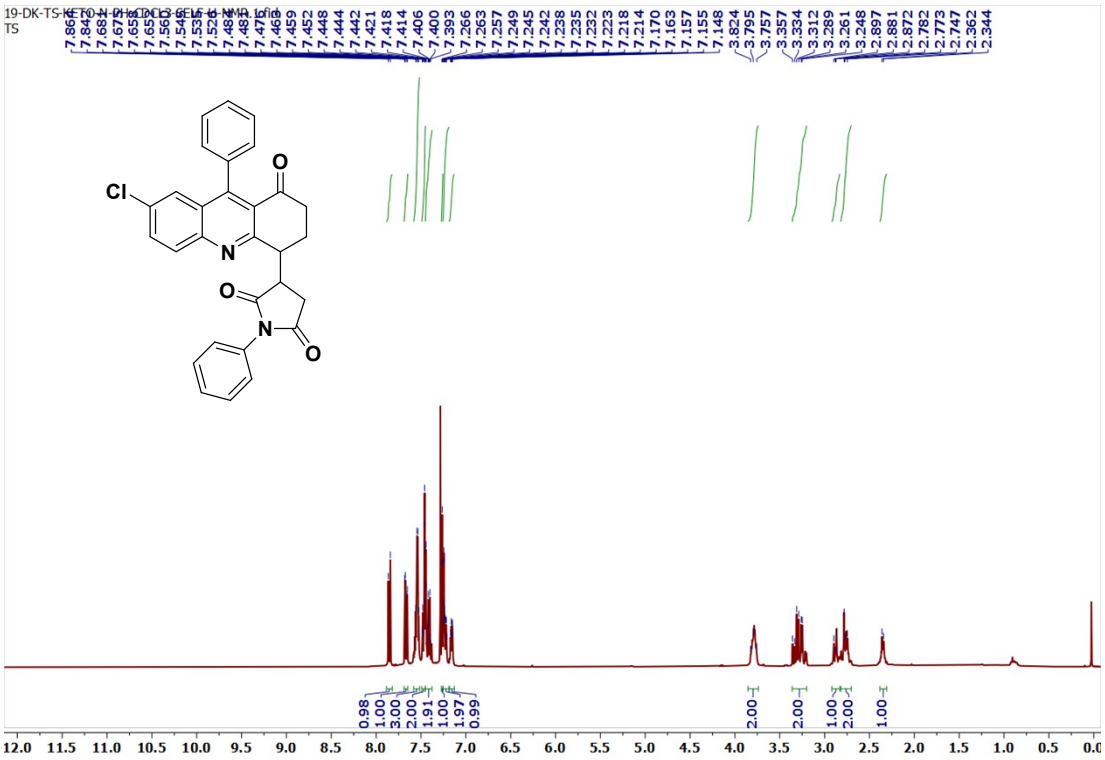
4-(2,5-Dioxo-1-phenylpyrrolidin-3-yl)-N-(p-tolyl)-1,2,3,4-tetrahydroacridine-9-carboxamide (5n):

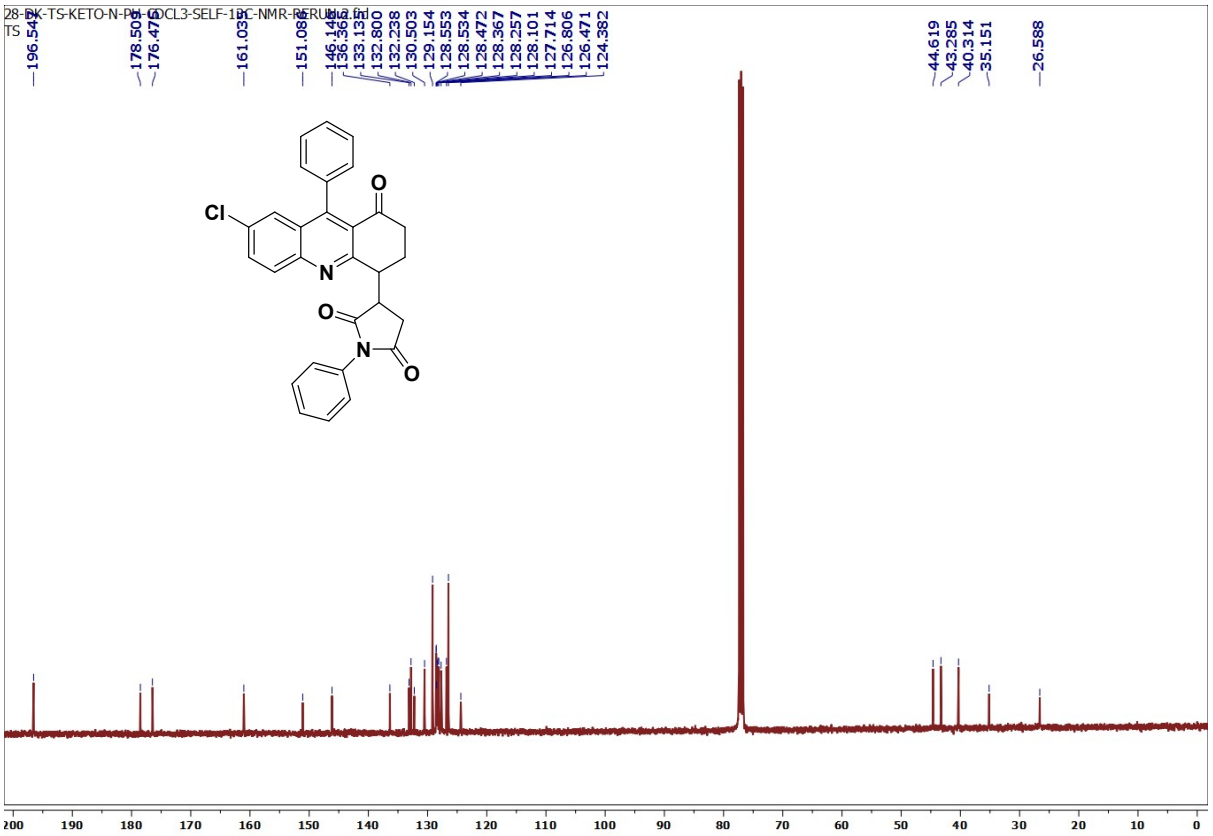


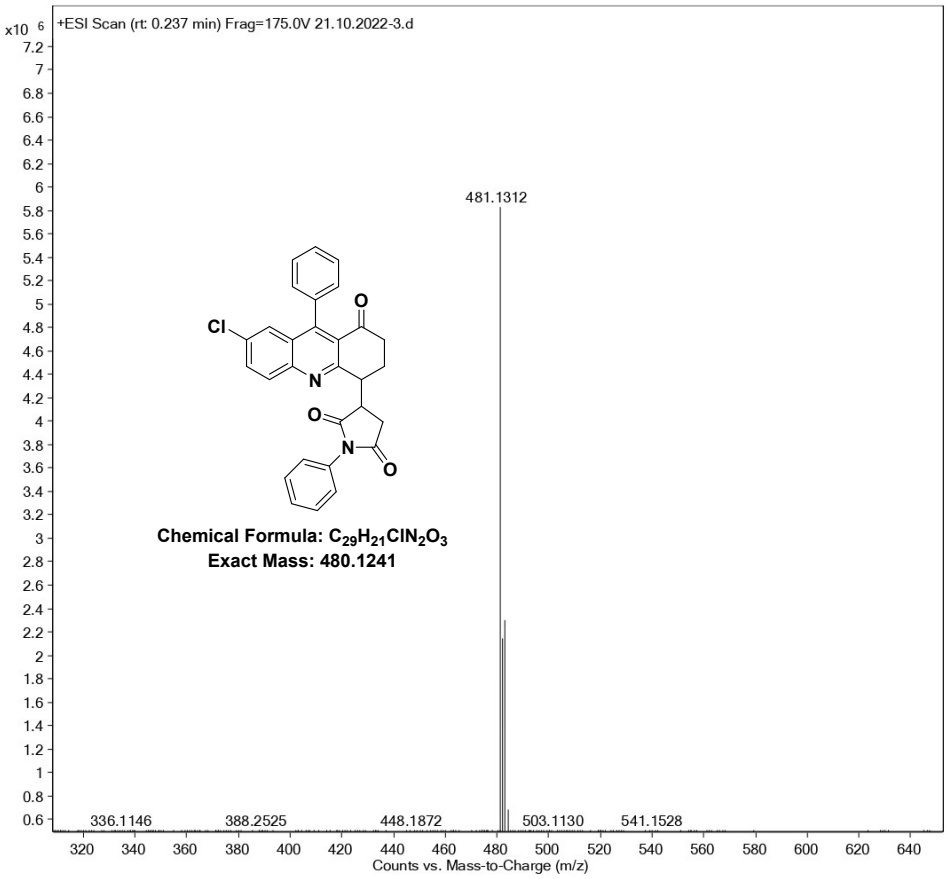

29-DK-TS-AMIDE-NaH-CDCl3-SELF-13C-2.fid
TS
179.210
176.427
165.523
157.494
145.662
141.564
135.166
134.732
132.705
129.686
129.555
129.285
129.103
128.870
128.265
127.131
126.187
124.386
123.398
120.000
43.846
43.230
30.879
28.644
26.037
22.031
20.959
CH3
NH
O
N
O
N
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


x10 5
+ESI Scan (rt: 0.245 min) Frag=175.0V 30.11.2022-8.d
CH3
NH
O
N
O
N
O
Chemical Formula: C31H27N3O3
Exact Mass: 489.2052
490.2124
512.1934
388.2554
444.2123
479.1560
528.1691
554.1746
595.2492
3.4 3.3 3.2 3.1 3 2.9 2.8 2.7 2.6 2.5 2.4 2.3 2.2 2.1 2 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1 0.9 0.8 0.7 0.6 0.5 0.4 0.3
370 380 390 400 410 420 430 440 450 460 470 480 490 500 510 520 530 540 550 560 570 580 590 600
Counts vs. Mass-to-Charge (m/z)

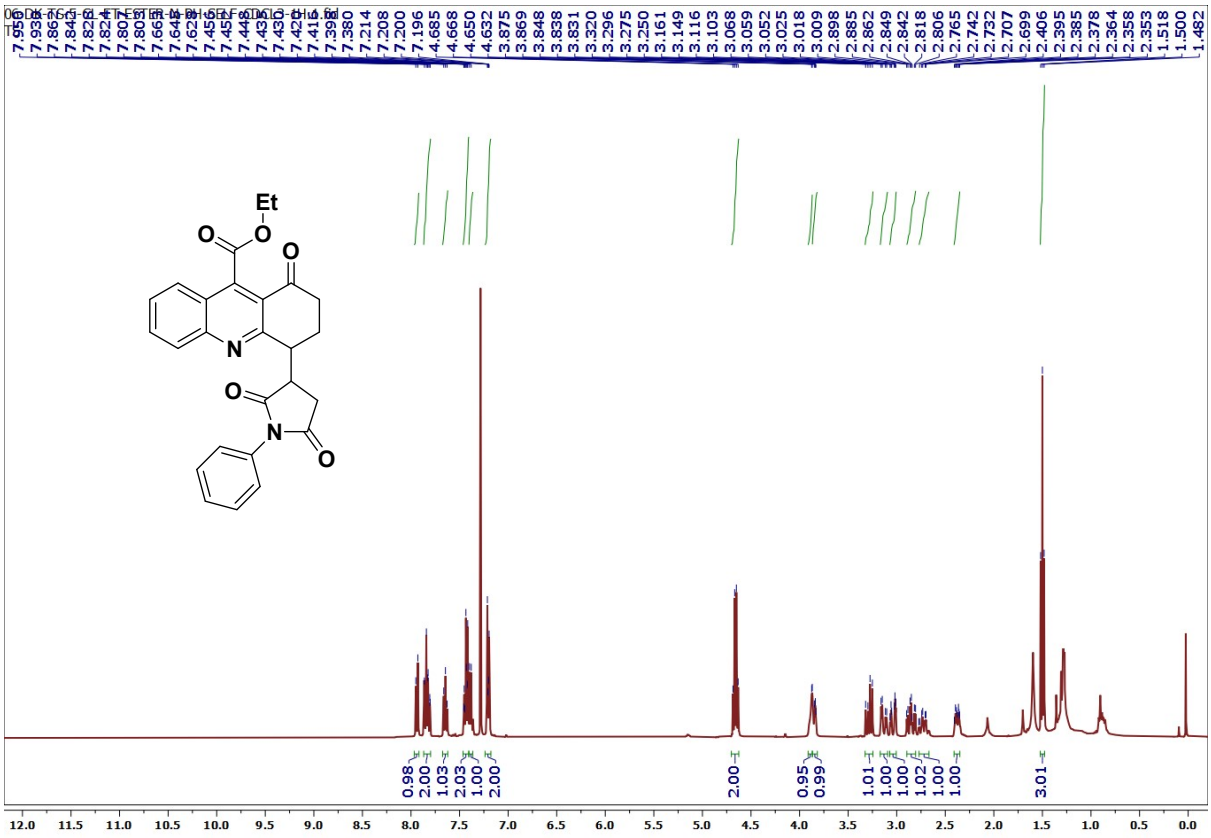
3-(7-Chloro-1-oxo-9-phenyl-1,2,3,4-tetrahydroacridin-4-yl)-1-phenylpyrrolidine-2,5-dione (5o):

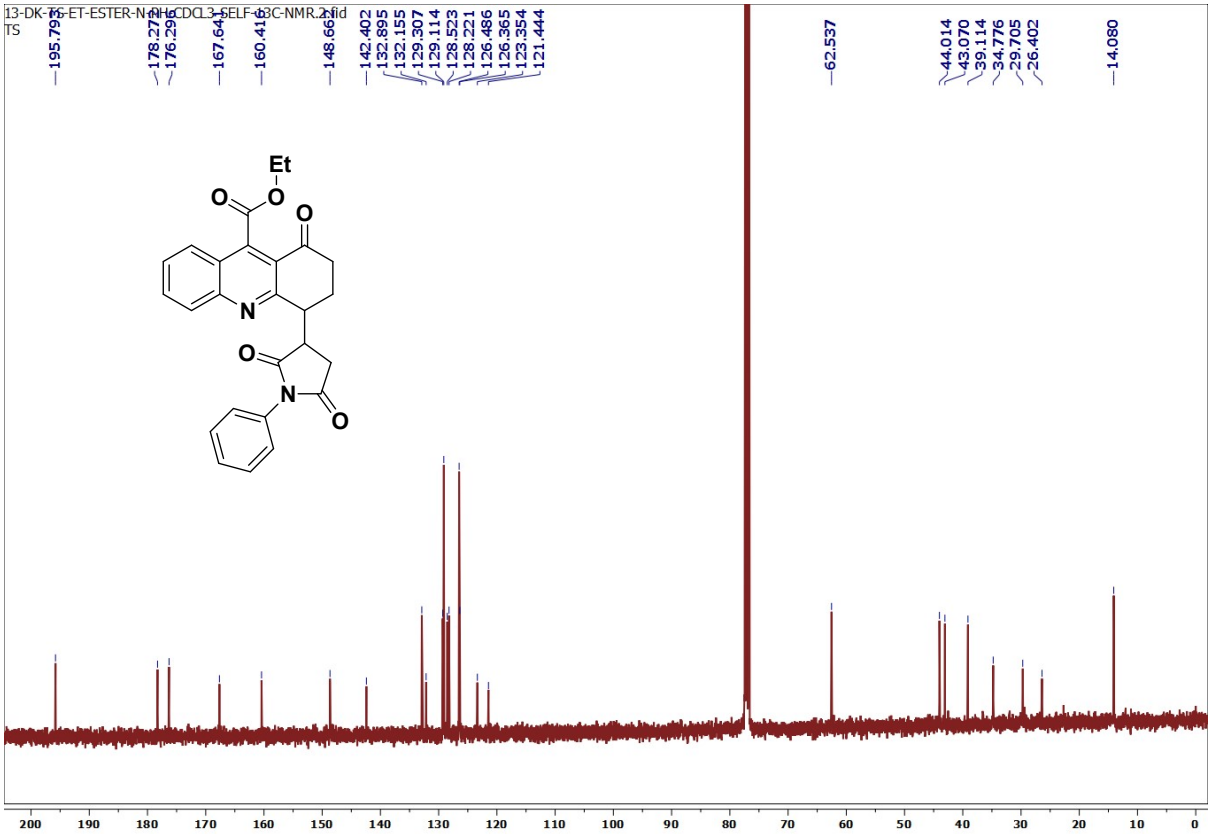


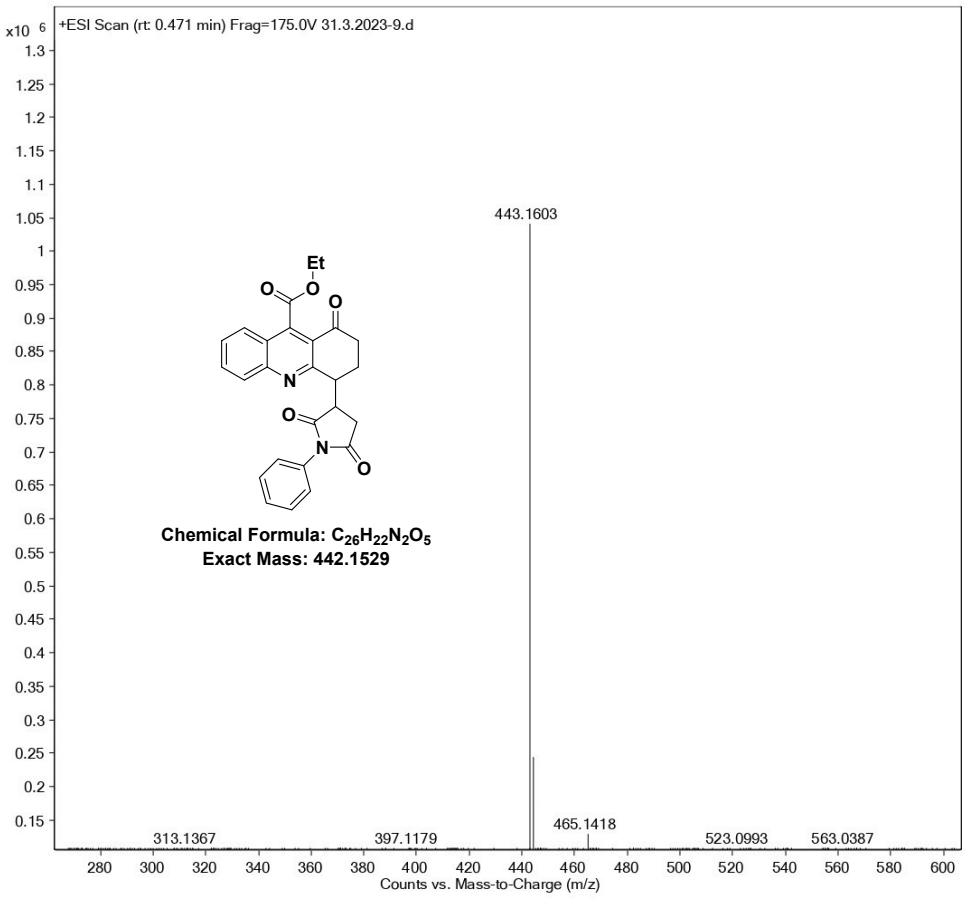




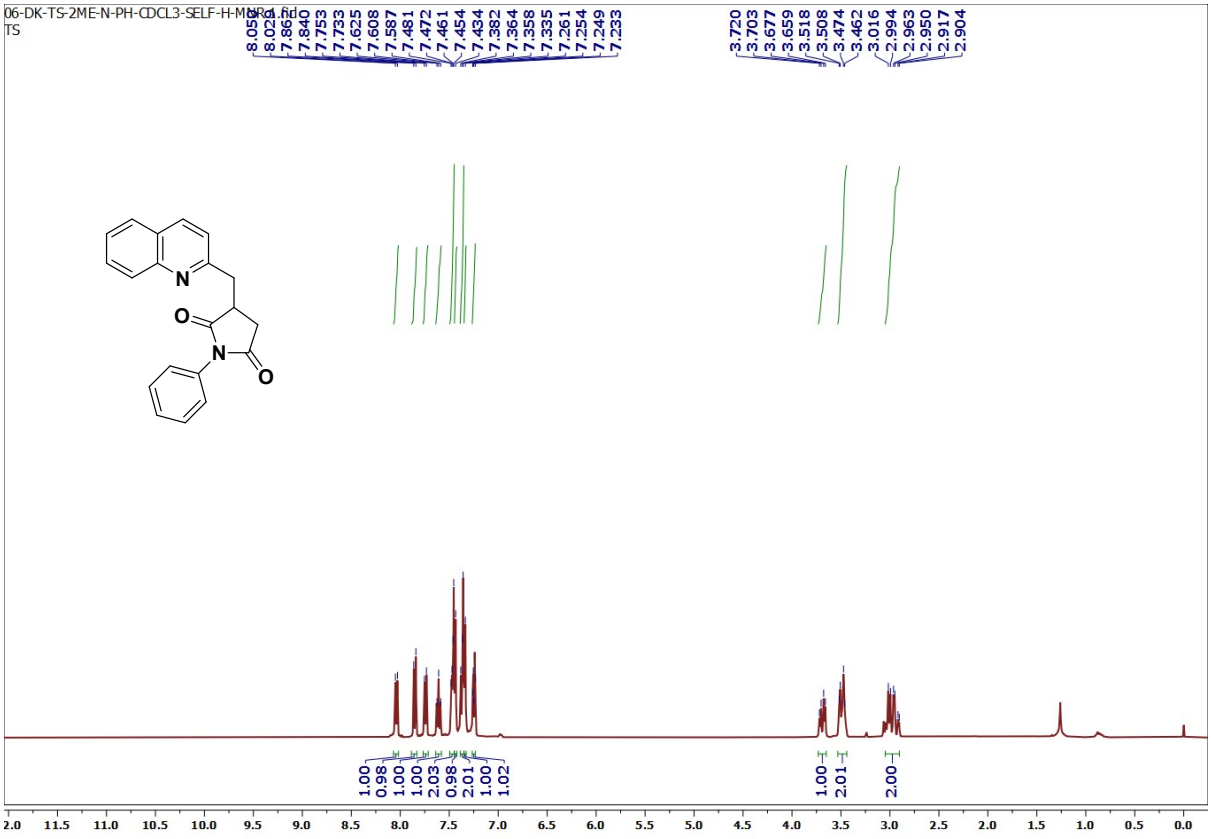
Ethyl 4-(2,5-dioxo-1-phenylpyrrolidin-3-yl)-1-oxo-1,2,3,4-tetrahydroacridine-9-carboxylate (5p):

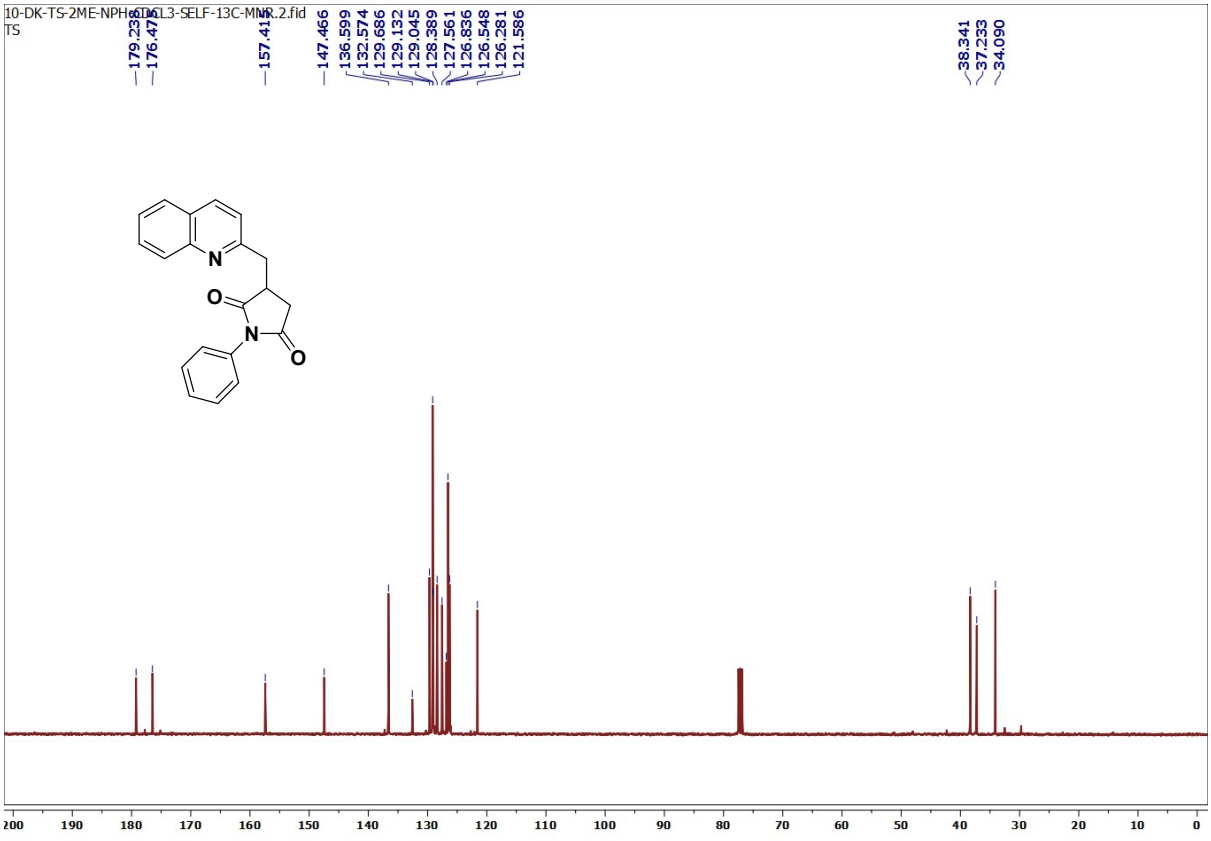


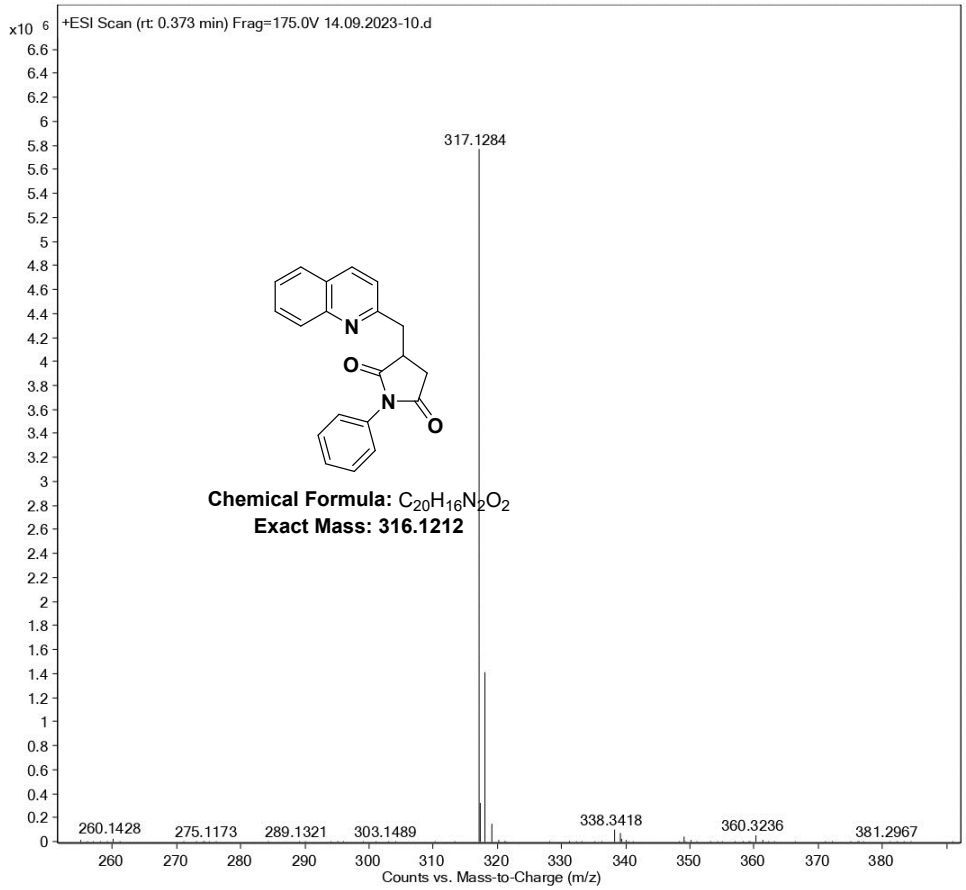

13-DK-TS-ET-ESTER-N-PH-CDCL3-SELF-13C-NMR.2.fid
TS
195.791
178.271
176.296
167.643
160.411
148.661
142.402
132.895
132.155
129.307
129.114
128.523
128.221
126.486
126.365
123.354
121.444
62.537
44.014
43.070
39.114
34.776
29.705
26.402
14.080
Et
O
O
O
N
O
N
O
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


x10 6
+ESI Scan (rt: 0.471 min) Frag=175.0V 31.3.2023-9.d
443.1603
Et
O
O
O
N
O
N
O
Chemical Formula: C26H22N2O5
Exact Mass: 442.1529
313.1367
397.1179
465.1418
523.0993
563.0387
Counts vs. Mass-to-Charge (m/z)

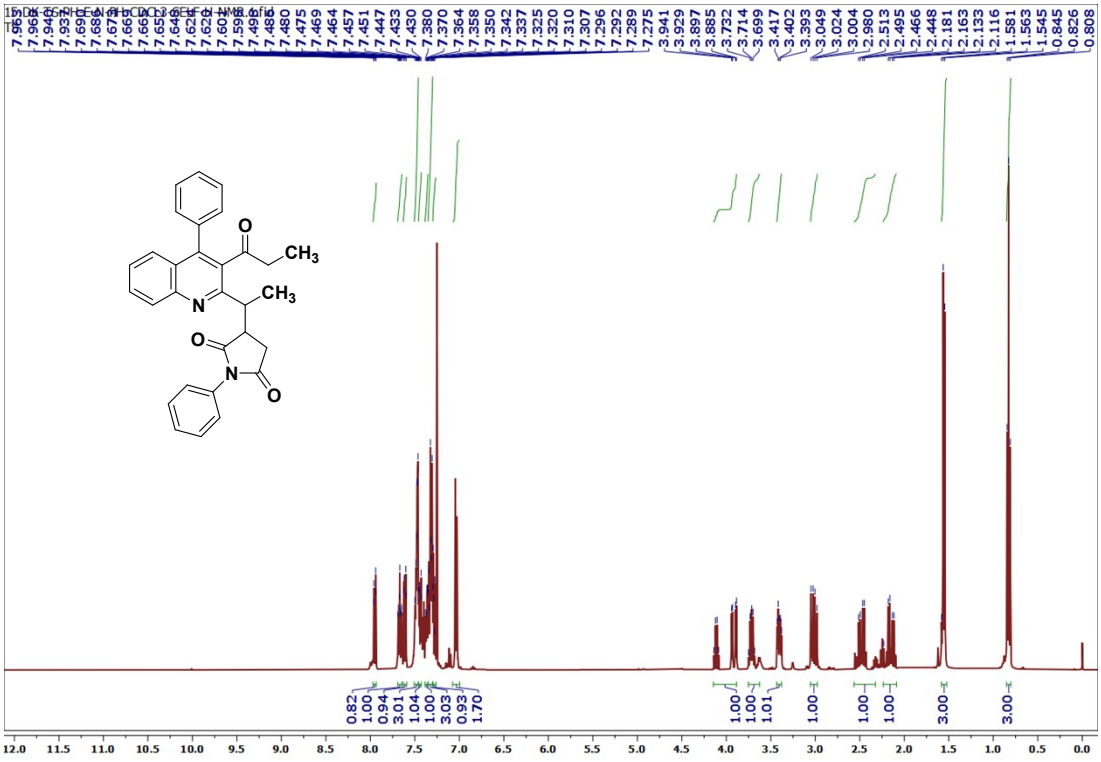
1-Phenyl-3-(quinolin-2-ylmethyl)pyrrolidine-2,5-dione (5q):

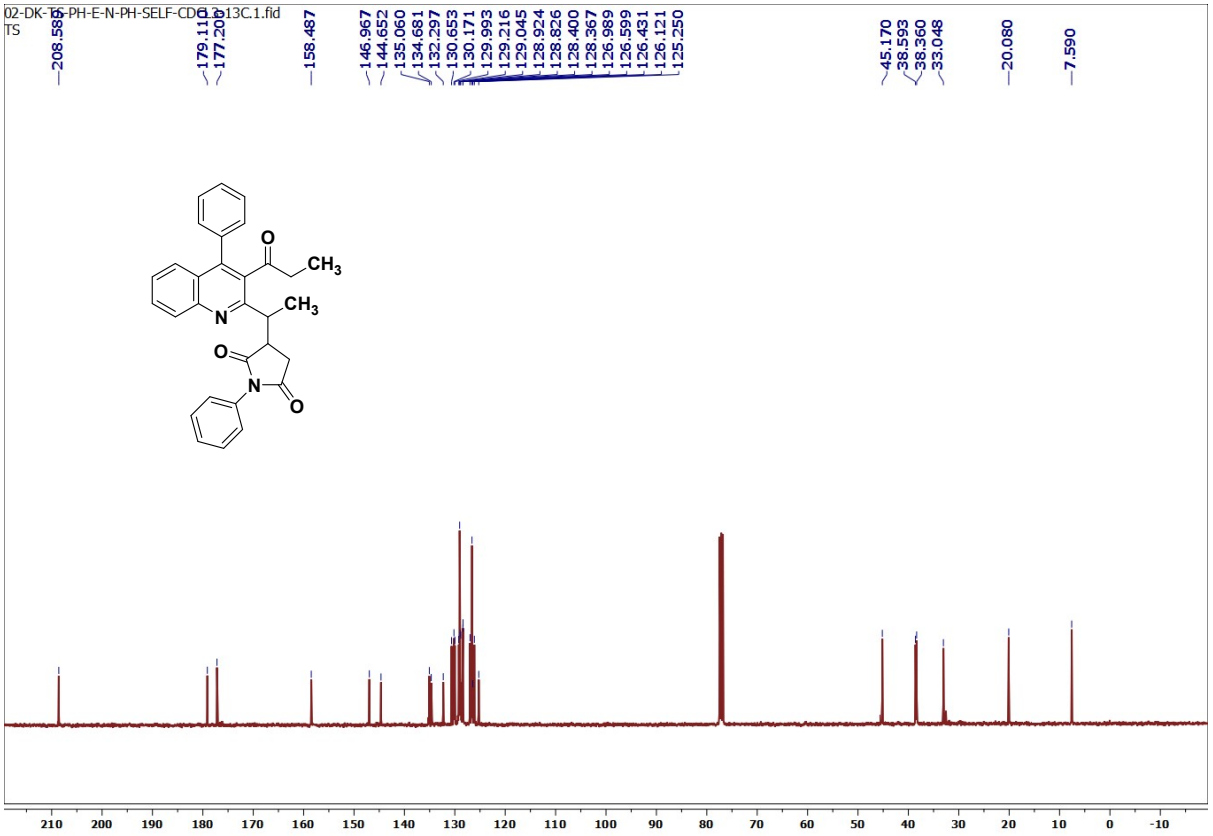


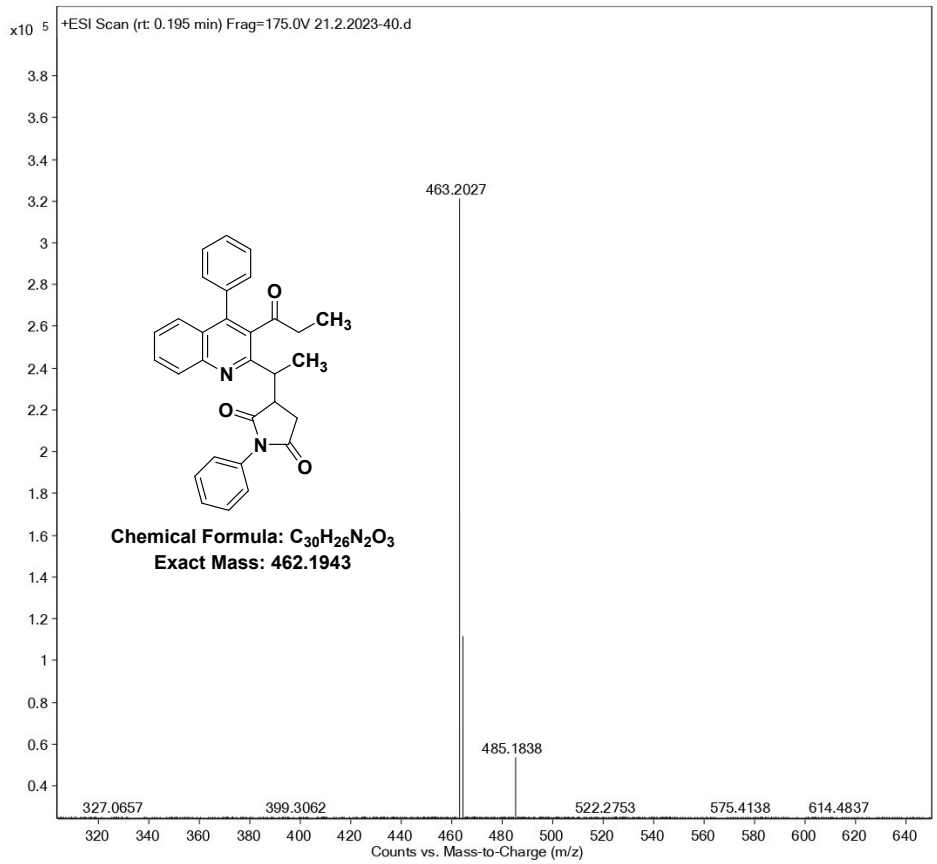




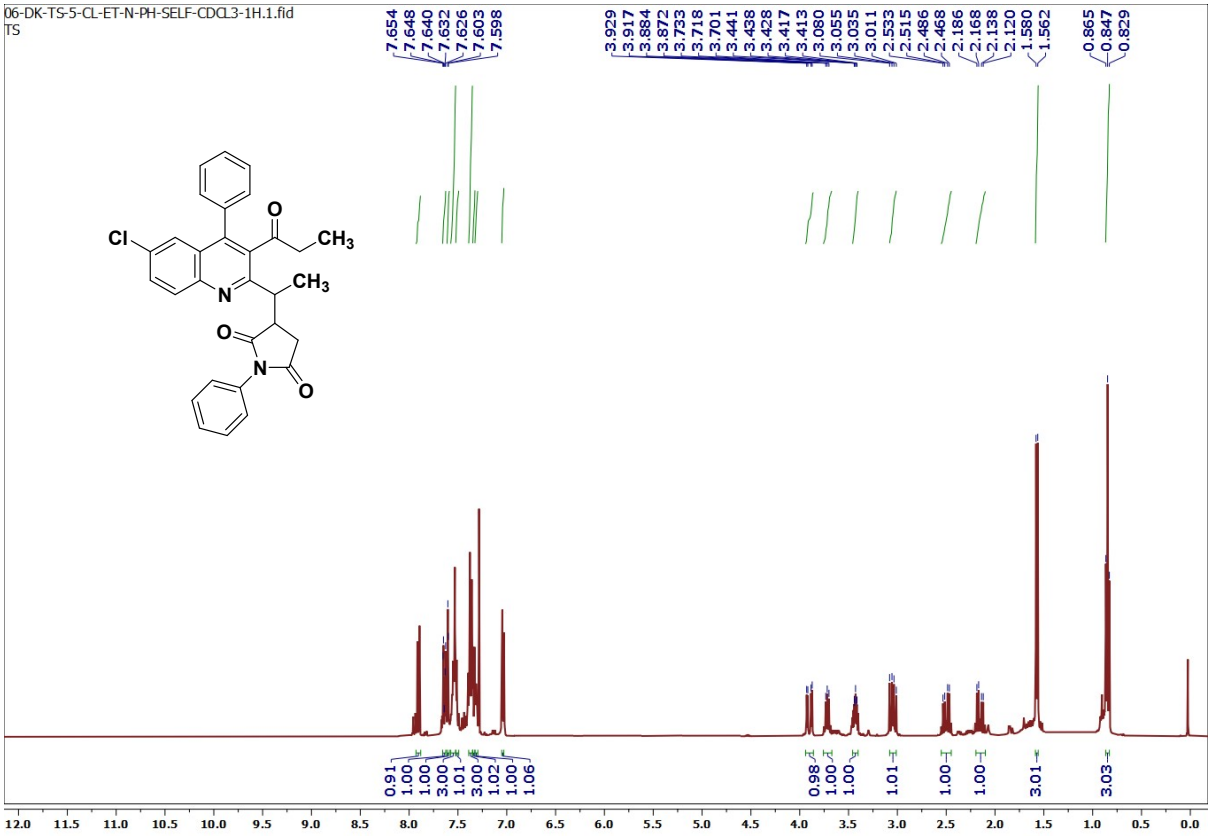
1-Phenyl-3-(1-(4-phenyl-3-propionylquinolin-2-yl)ethyl)pyrrolidine-2,5-dione (5r):

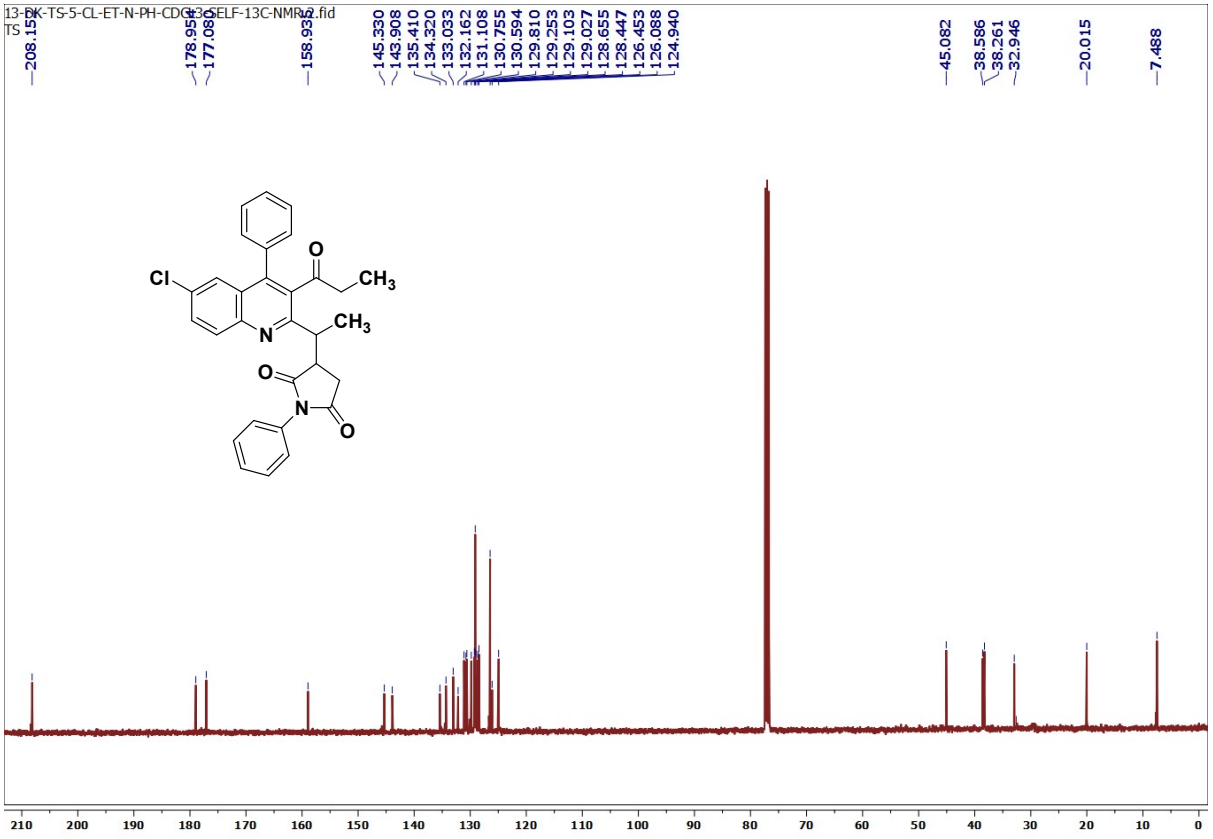


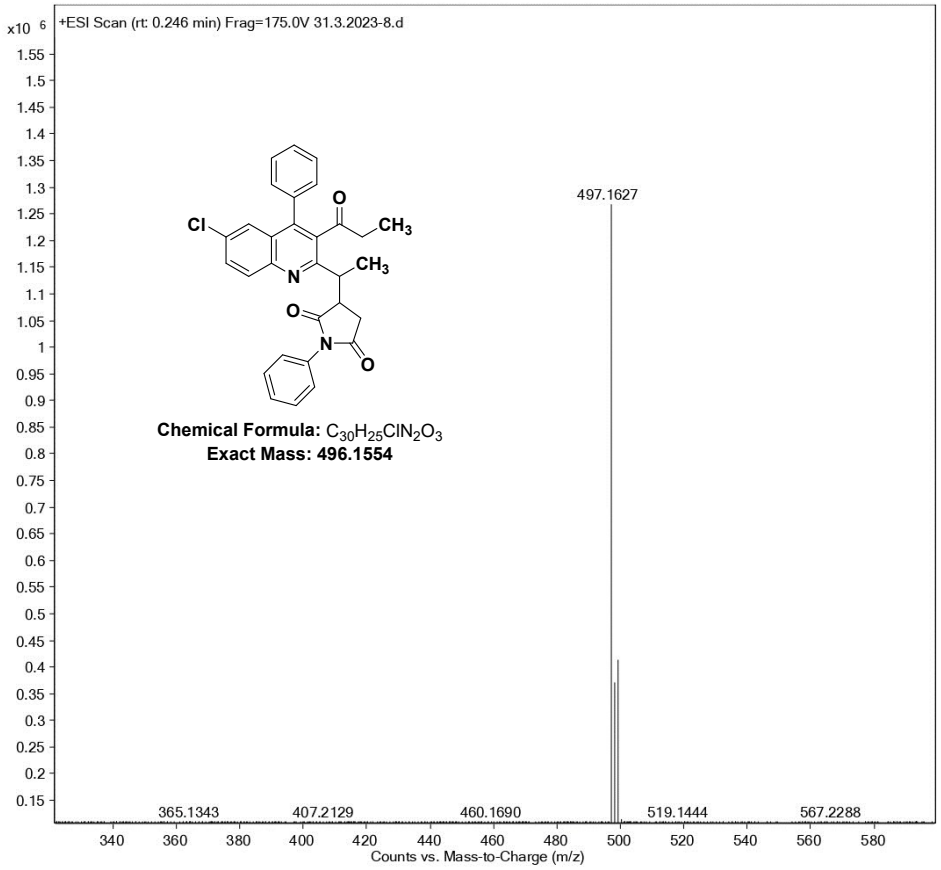

02-DK-TS-PH-E-N-PH-SELF-CDCL3-13C.1.fid
TS
208.589
179.111
177.200
158.487
146.967
144.652
135.060
134.681
132.297
130.653
130.171
129.993
129.216
129.045
128.924
128.826
128.400
128.367
126.989
126.599
126.431
126.121
125.250
45.170
38.593
38.360
33.048
20.080
7.590
O
CH3
N
CH3
O
N
O


x10 5
+ESI Scan (rt: 0.195 min) Frag=175.0V 21.2.2023-40.d
463.2027
485.1838
327.0657
399.3062
522.2753
575.4138
614.4837
Counts vs. Mass-to-Charge (m/z)
Chemical Formula: C30H26N2O3
Exact Mass: 462.1943

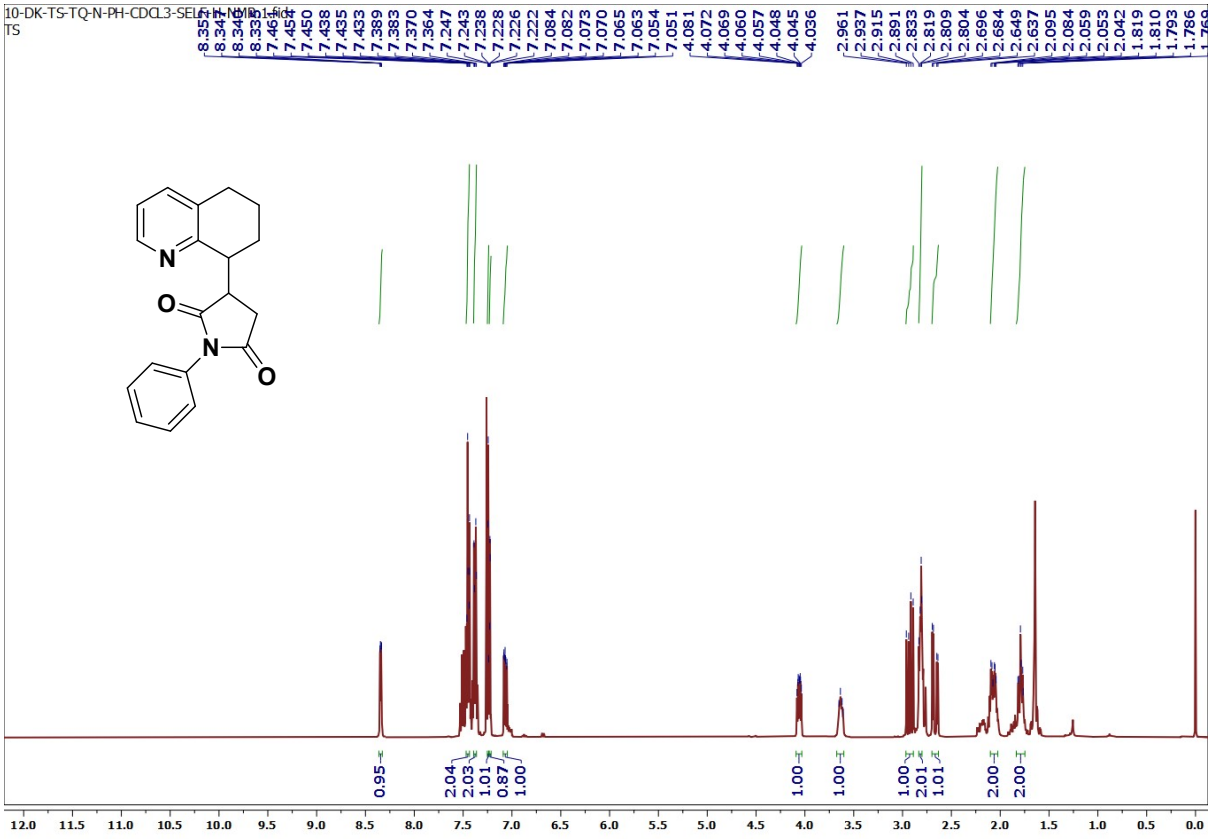
3-(1-(3-Acetyl-6-chloro-4-phenylquinolin-2-yl)ethyl)-1-phenylpyrrolidine-2,5-dione (5s):

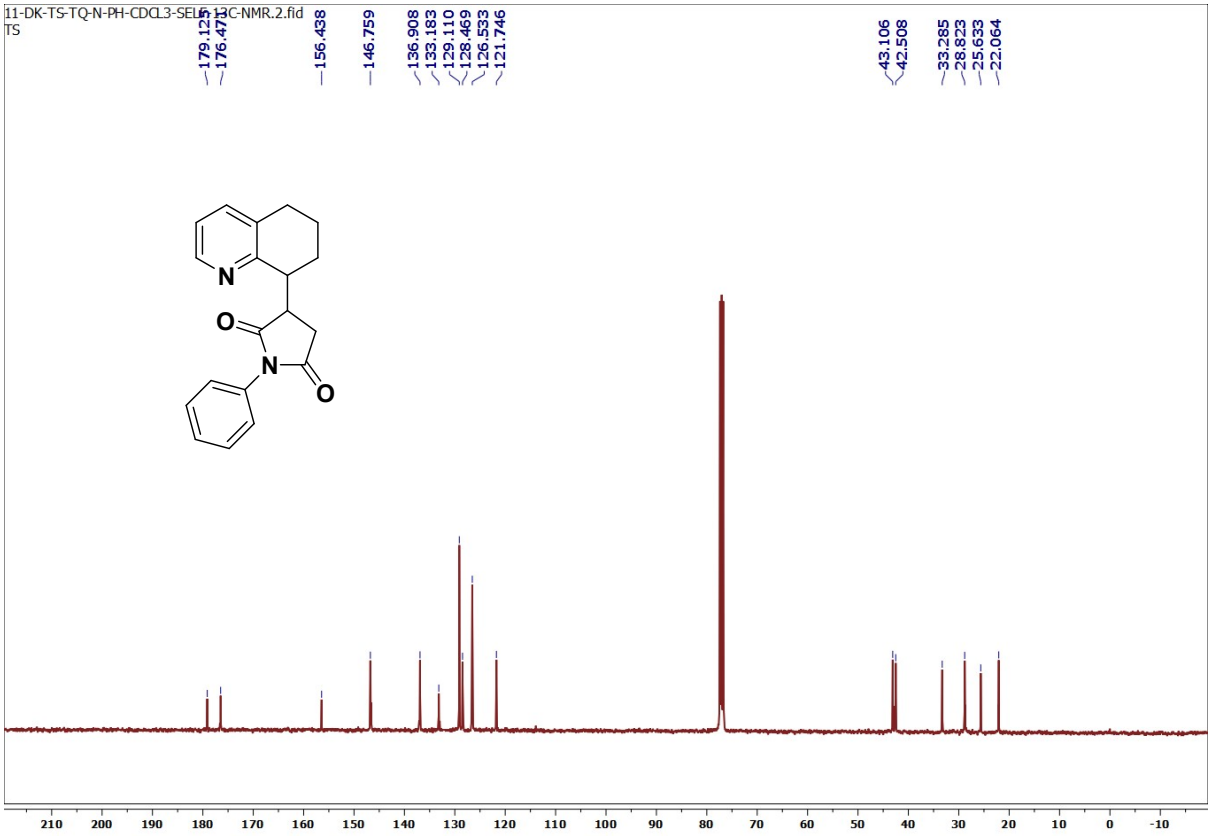


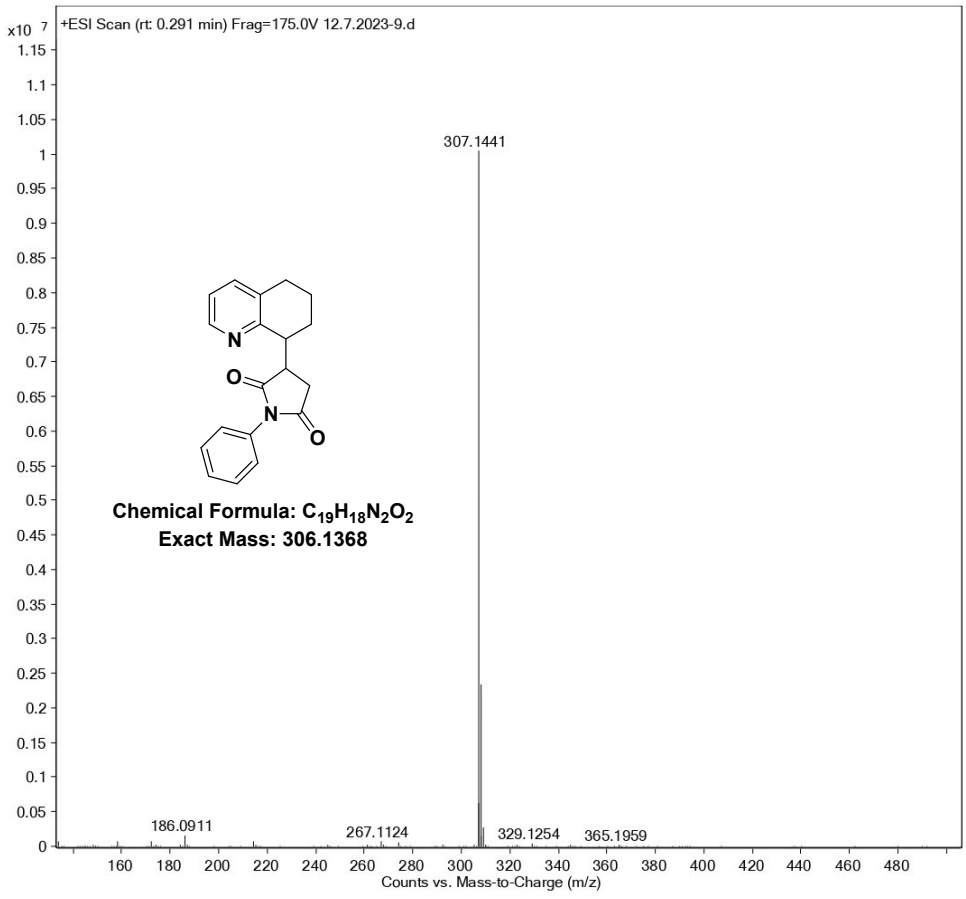




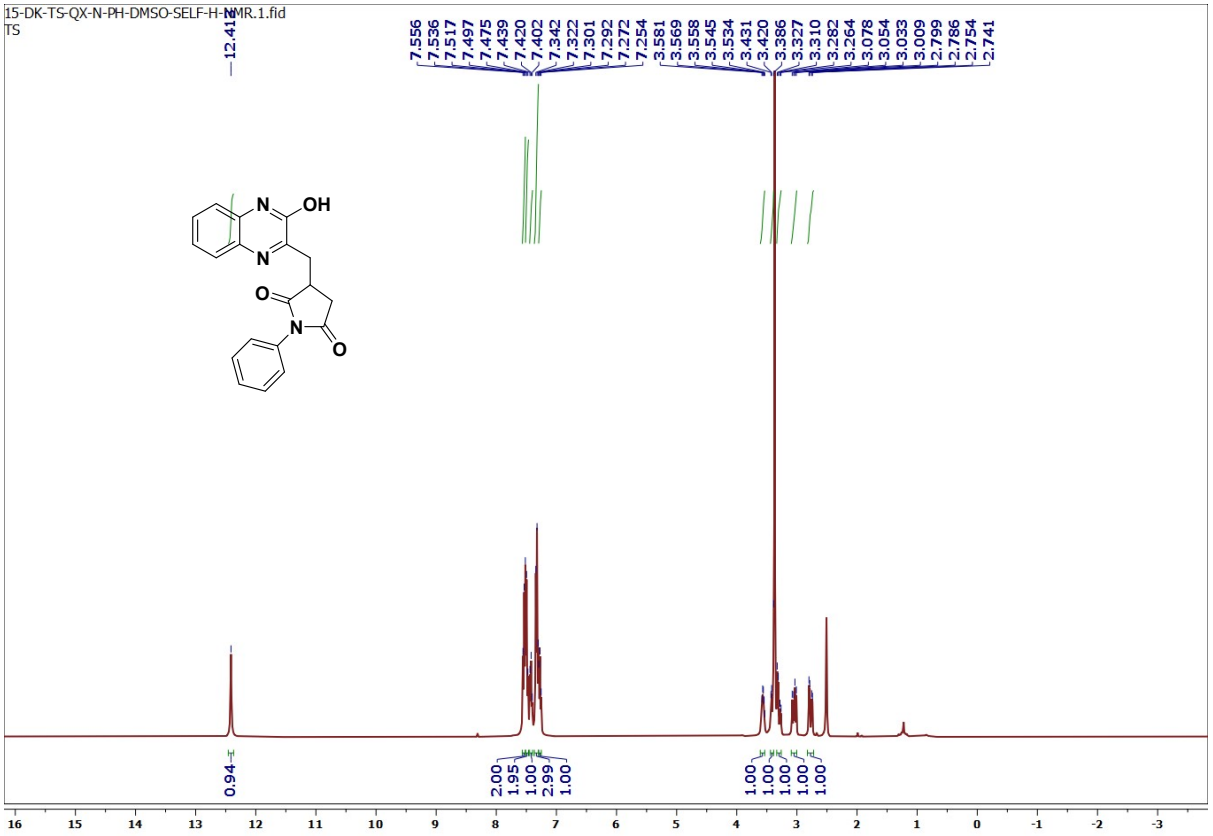
1-Phenyl-3-(5,6,7,8-tetrahydroquinolin-8-yl)pyrrolidine-2,5-dione (5t):

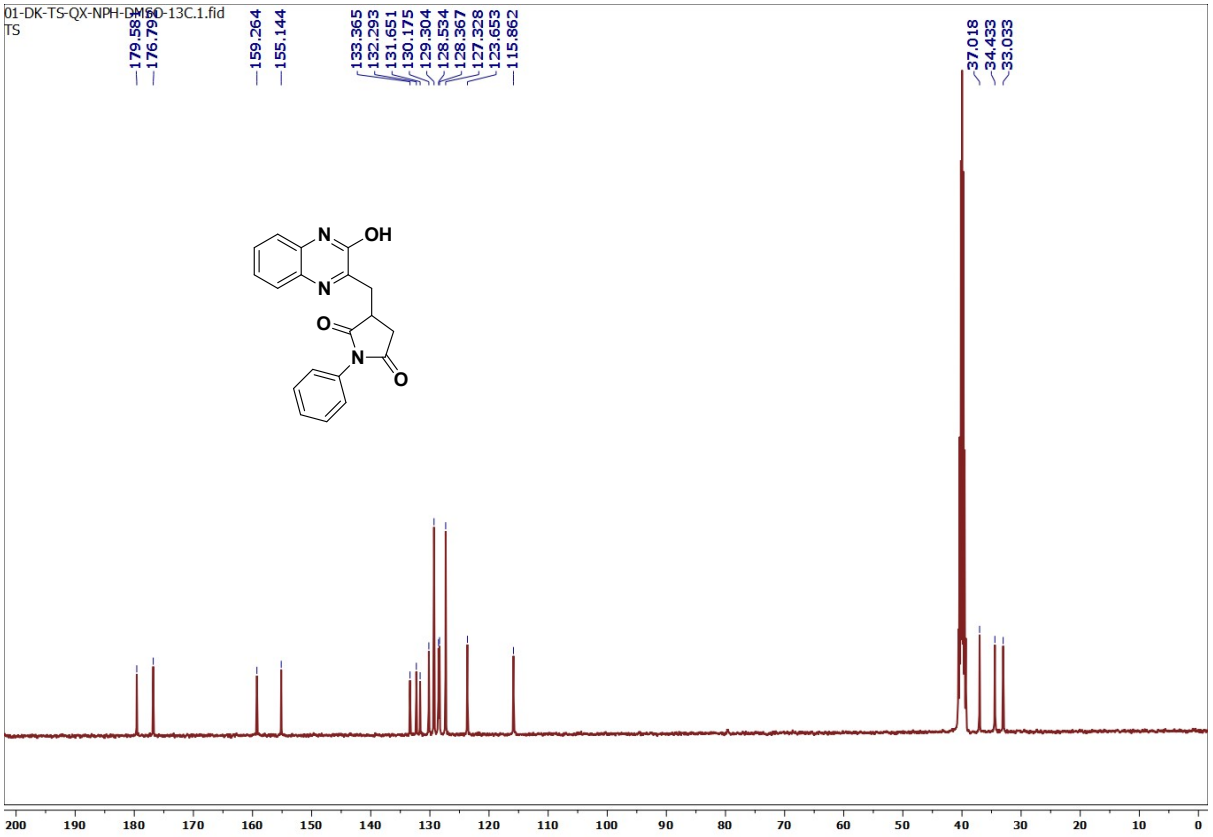


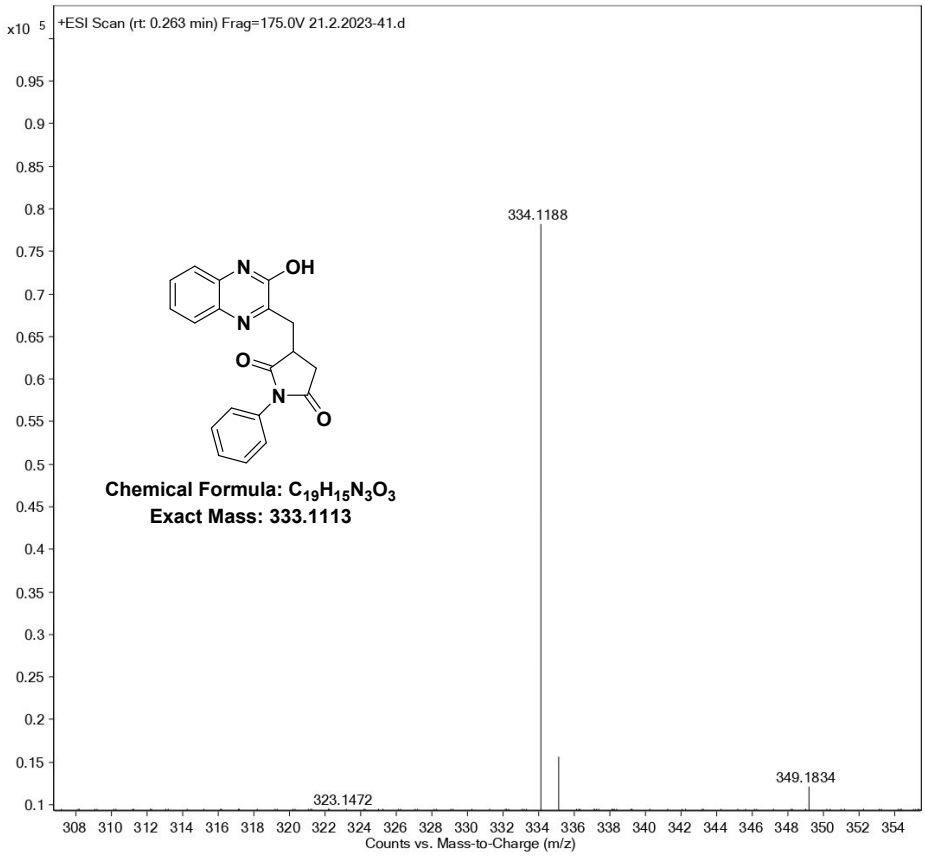

11-DK-TS-TQ-N-PH-CDCL3-SEL-13C-NMR.2.fid
TS
179.125
176.471
156.438
146.759
136.908
133.183
129.110
128.469
126.533
121.746
43.106
42.508
33.285
28.823
25.633
22.064
N
O
N
O
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10


x10 7
+ESI Scan (rt: 0.291 min) Frag=175.0V 12.7.2023-9.d
307.1441
N
O
N
O
Chemical Formula: C19H18N2O2
Exact Mass: 306.1368
186.0911
267.1124
329.1254
365.1959
Counts vs. Mass-to-Charge (m/z)

3-((3-Hydroxyquinoxalin-2-yl)methyl)-1-phenylpyrrolidine-2,5-dione (5u):







7. X-ray Crystallography.

X-ray data for the compound was collected at room temperature on a Bruker D8 QUEST instrument with an IμS Mo microsource (λ = 0.7107 A) and a PHOTON-III detector. The raw data frames were reduced and corrected for absorption effects using the Bruker Apex 3 software suite programs [1]. The structure was solved using intrinsic phasing method [2] and further refined with the SHELXL [2] program and expanded using Fourier techniques. Anisotropic displacement parameters were included for all non-hydrogen atoms. All C bound H atoms were positioned geometrically and treated as riding on their parent C atoms [C-H = 0.93-0.97 Å, and Uiso(H) = 1.5Ueq(C) for methyl H or 1.2Ueq(C) for other H atoms].

Crystal structure determination of (5i)

Crystal Data for $C_{23}H_{18}N_2O_2ClBr$ (M =469.75 g/mol): monoclinic, space group $P2_1/c$ (no. 14), a = 12.9798(5) Å, b = 8.3982(3) Å, c = 18.9108(8) Å, β = 104.1125(19)°, V = 1999.19(14) Å^3, Z = 4, T = 294.15 K, μ(MoKα) = 2.212 mm^{-1}, $Dcalc$ = 1.561 g/cm^3, 30943 reflections measured (4.442° ≤ 2Θ ≤ 54.998°), 4574 unique (R_{int} = 0.0730, R_{sigma} = 0.0503) which were used in all calculations. The final R_1 was 0.0392 (I > 2σ(I)) and wR_2 was 0.1040

(all data). **CCDC 2294878** deposition number contains the supplementary crystallographic data for this paper which can be obtained free of charge at https://www.ccdc.cam.ac.uk/structures/

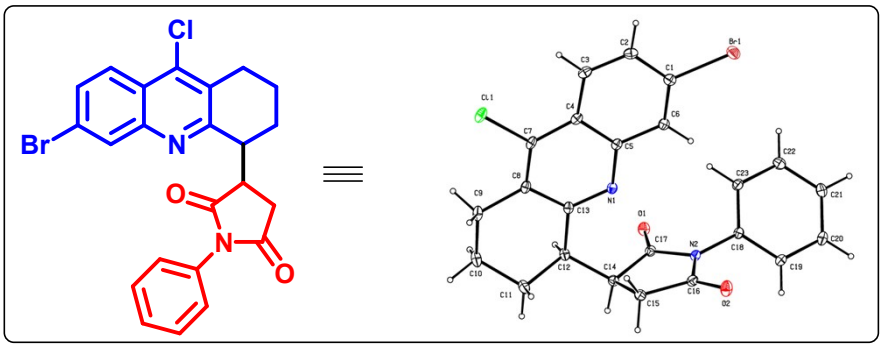


Figure caption: ORTEP diagram of **5i** compound with the atom-numbering. Displacement ellipsoids are drawn at the 30% probability level and H atoms are shown as small spheres of arbitrary radius.

1. Bruker (2016). APEX3, SAINT and SADABS. Bruker AXS, Inc., Madison, Wisconsin, USA.
2. Sheldrick G. M. (2015).ActaCrystallogr C71: 3-8.