Supporting Information for

Catalyst-free synthesis of hydrazino-containing glycine derivatives via a diaziridine *in-situ* formation/ring-opening cascade

Chang-Long Rong,[a] Qiang-Qiang Li*[a] and Jun Xuan*[a]

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1. General

All reactions involving air- or moisture-sensitive reagents or intermediates were carried out in pre-heated glassware under an argon atmosphere using standard Schlenk techniques. All other solvents and reagents were purified according to standard procedures or were used as received from chemical suppliers. The starting materials were synthesized according to literature procedures. The light employed in this work was bought from GeAo Chemical: model H106062, 24 W blue LEDs, λ = 450 ~ 460 nm. All photo-reactions were performed in borosilicate glass irradiation vessel at a distance of ~3 cm from light source. All reactions involving heating are carried out in an oil bath.

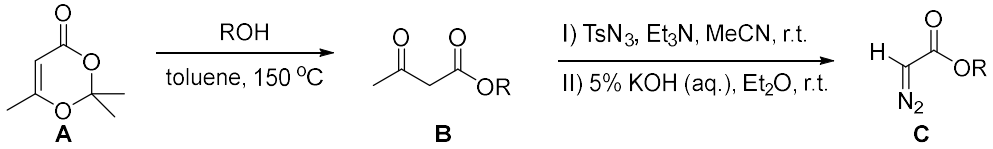
Chromatography: Analytical thin layer chromatography was performed using Qingdao Puke Parting Materials Co. silica gel plates (Silica gel 60 F254). Visualisation was by ultraviolet fluorescence (λ = 254 nm) and/or staining with phosphomolybdic acid or potassium permanganate ($KMnO_4$). Flash column chromatography was performed using 200-300 mesh silica gel.

^{1}H NMR and **^{13}C NMR:** spectra were recorded on a JEOL JNM ECZ400R and ECZ600R at 300 K. Spectra were calibrated relative to solvent's residual proton and carbon chemical shift: $CDCl_3$ (δ = 7.26 for ^{1}H NMR and δ = 77.0 for ^{13}C NMR), d_6-DMSO (δ = 2.50 for ^{1}H NMR and δ = 39.5 for ^{13}C NMR). Data are reported as follows: chemical shift δ/ppm, integration (^{1}H only), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, dd= doublet of doublets, m = multiplet or combinations thereof; ^{13}C signals are singlets unless otherwise stated), coupling constants *J* in Hz, assignment.

High Resolution Mass Spectrometry (HRMS): All were recorded on Thermo Fisher Scientific LTQ Orbitrap XL using an atmospheric-pressure chemical ionization ($APCI^+$) or positive electrospray ionization (ESI^+). Measured values are reported to 4 decimal places of the calculated value. The calculated values are based on the most abundant isotope.

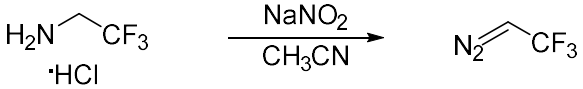
2. Preparation and scope of Starting Materials

Diazo compounds were prepared according to the reported methods[1].



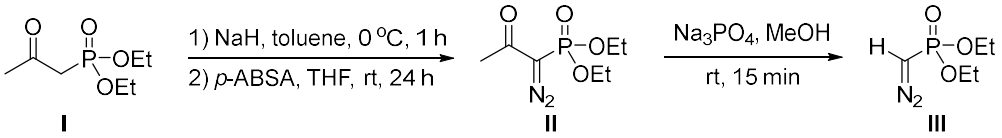
A solution of alcohol (50 mmol) and 2,2,6-trimethyl-4H-1,3-dioxin-4-one **A** (50 mmol) in 10 mL of toluene was placed in a 50 mL flask. The flask was immersed in an oil bath that had been preheated to 150 °C, and the solution was vigorously stirred. The evolution of acetone became apparent within several minutes, heating was continued for a total of 6 hours. The reaction was cooled, and then the toluene was removed, and the product was obtained by distillation.

To a solution of **B** (10 mmol) in acetonitrile (12 mL) was added Et_3N (1.31g, 13 mmol). The reaction mixture was cooled in an ice bath and a solution of tosyl azide (2.17 g, 11 mmol) in acetonitrile (12 mL) was added slowly. The reaction mixture was allowed to warm to r.t. After stirring for 10 h, solvent was removed under reduced pressure. The residue was dissolved in ether (60 mL) and washed with 5% aqueous KOH solution. To a solution of the crude 2-diazo-acetoacetate in ethyl ether was added 5% KOH (50 mL), and the reaction mixture was stirred for 1 h. The organic phase was separated, dried over Na_2SO_4, and concentrated under reduced pressure. Purification by vacuum distillation provided the desired diazo product **C**.



To an oven-dried 25 mL two-necked flask equipped with a stir bar were added $CF_3CH_2NH_2 \cdot HCl$ (271 mg, 2 mmol) and EtOAc (4 mL) under argon atmosphere. The tube was flushed with N_2 three times and sealed with a septum. Subsequently, the mixture was cooled to 0 °C and stirred for 30 min. To this mixture was slowly added a solution of $NaNO_2$ (0.5 mL, 4 M in water, degassed). The reaction mixture was stirred for 1 h at 0 °C, then for an additional 30 min at 10 °C under N_2. The organic layer was

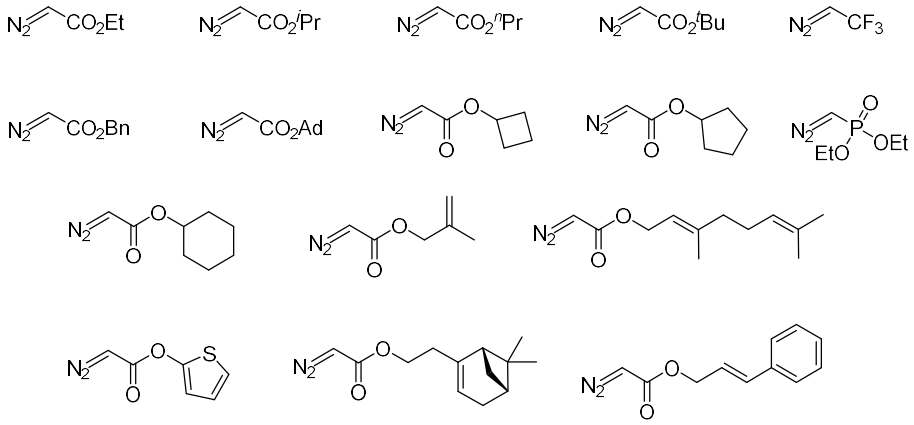
transferred with a Teflon needle to a flame-dried round-bottom flask and dried with Na_2SO_4. The concentration of the stock solution of CF_3CHN_2 is about 0.5 M (^{19}F NMR using trifluorotoluene as an internal standard).



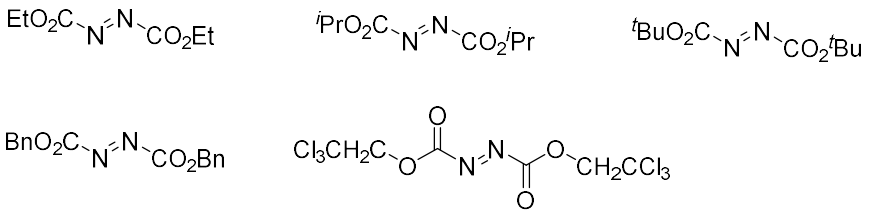
I **II** **III**

The compound **III** was prepared following the literature procedure. At 0 °C, diethyl (2-oxopropyl)phosphonate **I** (582.5 mg, 3 mmol) was dissolved in 10 mL of dry toluene and NaH (60%, 0.144 g, 3.6 mmol) was added portion wise. After stirred for 1 h at the same temperature, a solution of *p*-ABSA (0.648 g, 2.7 mmol) in 5 mL of dry THF was added dropwise, the reaction mixture was stirred at room temperature for 24 h. After the reaction was completed (monitored by TLC analysis), 10 mL petroleum ether was added, then the precipitate was filtered off, and the filter cake was washed with ether (10 mL x 3), the filtrate was evaporated and the residue was purified by column chromatography (silica gel) using PE/EA 2:1 ~ 1:1.6 to give the compound diethyl (3-diazo-2- oxopropyl) phosphonate **II** as a yellow liquid (416 mg, 80% yield). Then, the compound **II** was dissolved in 10 mL of MeOH and stirred with sodium phosphate (411.6 mg, 1.08 mmol) at room temperature for 15 min (monitored by TLC analysis). The precipitate was filtered off. After evaporation of the solvent under reduced pressure, methyl tert-butyl ether (MTBE) was added and the precipitate was filtered off again. Solvent was removed on rotary evaporator and the residue was purified by column chromatography (silica gel) using PE/EA 2:1 ~ 1:1.6 to give the product **III** as a yellow liquid.

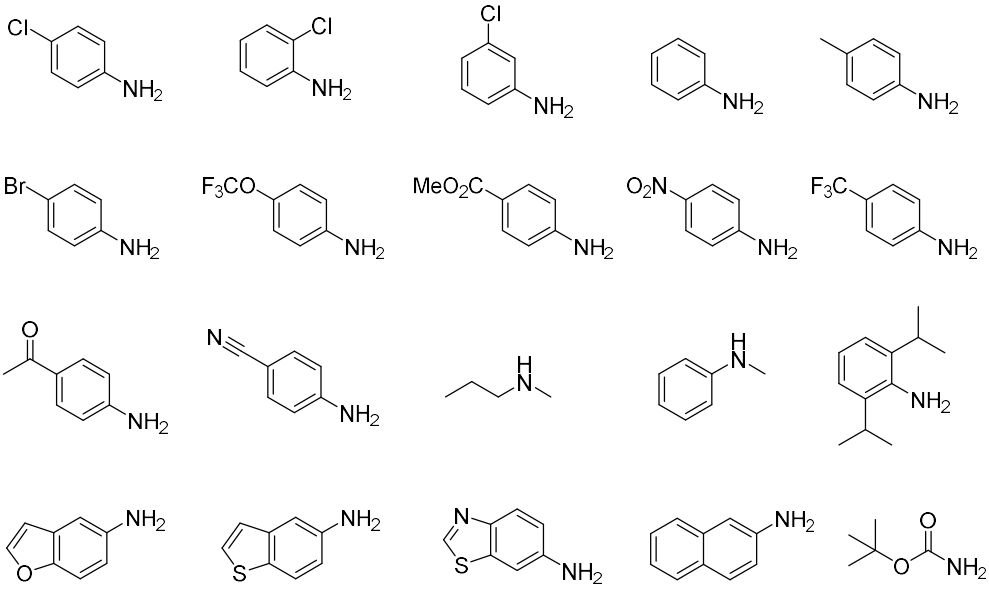
scope of diazoalkane



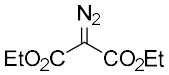
scope of azodicarboxylate

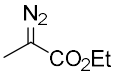


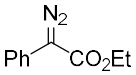
scope of amine



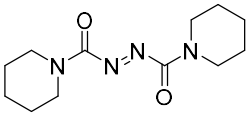
unsuccessful examples of diazo compounds

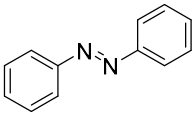




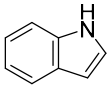


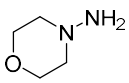
unsuccessful examples of azo compounds

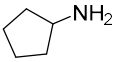


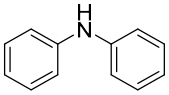


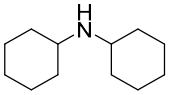
unsuccessful examples of amines

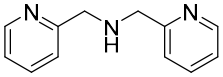


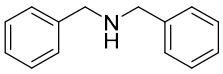




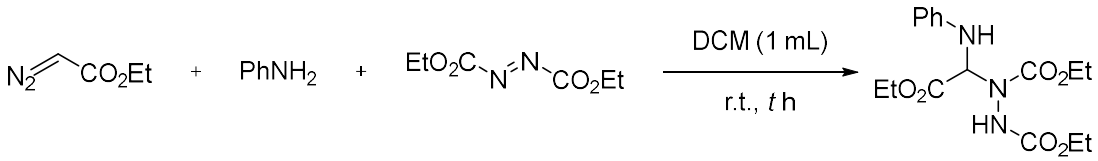








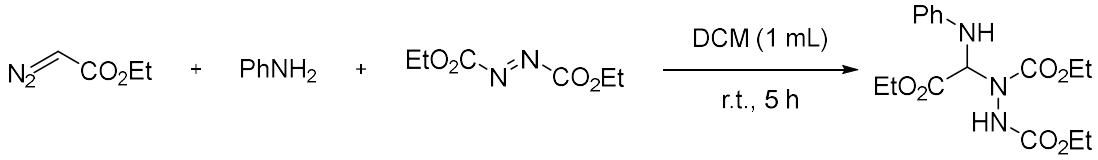
3. The Condition Optimization[a] and General Procedure



1a **2a** **3a** **4a**

Entry	Reaction times (h)	Yield of **4a** (%)[b]
1	4 h	84%
2	5 h	91%
3	6 h	92%
4	7 h	95%
5	12 h	98%
6	6 h, Blue LED	93%

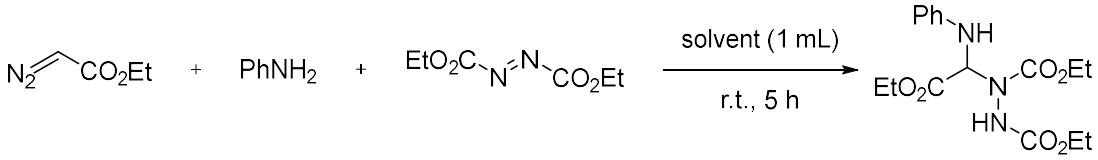
[a] Reaction conditions: 0.4 mmol **1a**, 0.2 mmol **2a** and 0.4 mmol **3a** dissolved in DCM (1 mL) under dark for some hours. [b] Isolated yield.



1a **2a** **3a** **4a**

Entry	Ratio of **1a**:**2a**:**3a**	Yield of **4a** (%)[b]
1	0.4 mmol : 0.2 mmol : 0.4 mmol	91%
2	0.4 mmol : 0.4 mmol : 0.2mmol	63%

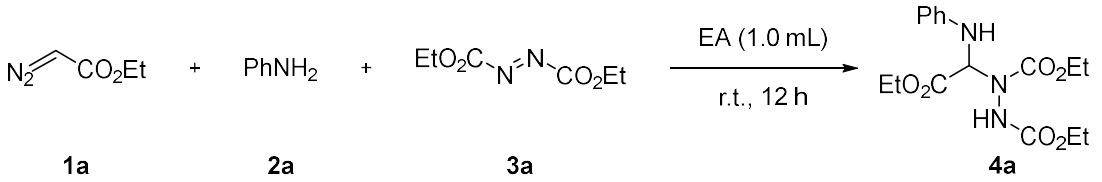
[a] Reaction conditions: **1a**, **2a** and **3a** dissolved in DCM (1 mL) under dark for 5 h. [b] Isolated yield.



1a **2a** **3a** **4a**

Entry	Solvent (1 mL)	Yield of **4a** (%)[b]
1	DCM	91%
2	DCE	84%
3	THF	58%
4	Acetone	70%
5	Toluene	72%
6	EtOAc	64%
7	1,4-dioxane	75%
8	H_2O	29%
9	H_2O:EtOAc = 0.7 mL : 0.3 mL	67%
10	EtOAc, 12 h	96%

[a] Reaction conditions: 0.4 mmol **1a**, 0.2 mmol **2a** and 0.4 mmol **3a** dissolved in solvent (1 mL) under dark for 5 h. [b] Isolated yield.

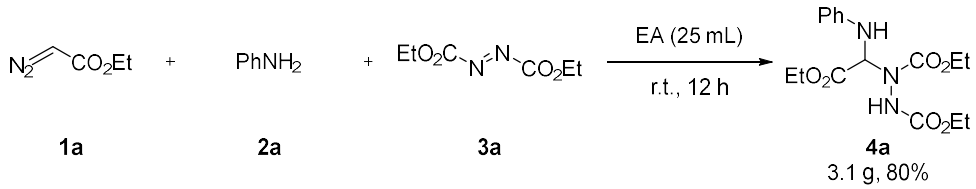


1a **2a** **3a** **4a**

General procedure (*GP*): To a 5 mL dark brown small glass bottle equipped with a magnetic stir bar was added dry EtOAc (1.0 mL), aniline **2a** (18.6 mg, 0.20 mmol, 1.0 equiv), diethyl azodicarboxylate **3a** (69.7 mg, 0.40 mmol, 2.0 equiv) and ethyl diazoacetate **1a** (45.6 mg, 0.40 mmol, 2.0 equiv). The resulting mixture was stirred at room temperature in dark for 12 h. The solvent was removed by vacuum and the crude product was purified by flash chromatography on silica gel silica: 200~300; eluant: petroleum ether/ethyl acetate (10:1~5:1) to provide pure product **4a** as a beige solid in 96% yield (67.8 mg). **^{1}H NMR** (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.19 (t, *J* = 7.8 Hz, 2H), 6.77 (dd, *J* = 28.7, 7.7 Hz, 3H), 6.29 (d, *J* = 38.2 Hz, 2H), 4.37 – 4.00 (m, 6H), 1.43 – 1.15 (m, 9H). **^{13}C NMR** (101 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.6, 155.5, 143.6, 129.4, 119.3, 113.8, 63.0, 62.5, 62.1, 14.4, 14.0. **HRMS** (ESI) calculated for $C_{16}H_{24}N_3O_6^+$[M+H]$^+$: 354.1660; found: 354.1654.

4. Gram-Scale Reaction and Synthetic Applications

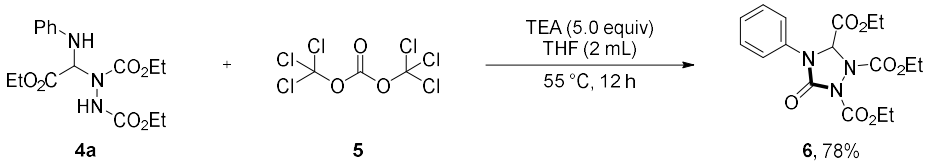
4.1 Gram-scale reaction



1a **2a** **3a** **4a**
3.1 g, 80%

A flame-dried round bottom flask equipped with a magnetic stir bar was charged with 25 mL EtOAc was added **1a** (2.51 g, 22 mmol, 2.0 equiv), **2a** (1.02 g, 11 mmol, 1.0 equiv) and **3a** (3.83 g, 22 mmol, 2.0 equiv). The reaction mixture was then stirred in dark for 12 h. The solvent was removed by vacuum and the crude product were purified by flash chromatography on silica gel silica: 200~300; eluant: petroleum ether/ethyl acetate (20:1~5:1) to provide pure product **4a** as a beige solid in 80% yield (3.1 g).

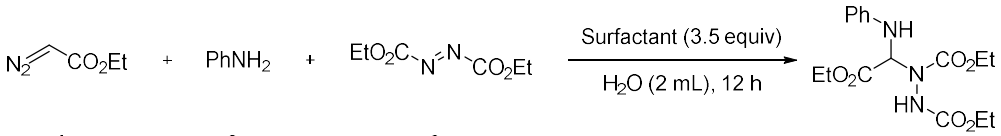
4.2 Cyclization of 6a[2]



4a 5 6, 78%

A flame-dried Schlenk-tube equipped with a magnetic stir bar was charged with **4a** (70.7 mg, 0.20 mmol, 1.0 equiv), 2 mL tetrahydrofuran (THF) and triethylamine (TEA, 101.2 mg, 1.0 mmol, 5.0 equiv) was added triphosgene **5** (BTC, 59.3 mg, 0.20 mmol, 1.0 equiv). The reaction mixture was then stirred in 55 °C for 12 h. The solvent was removed by vacuum and the crude product were purified by flash chromatography on silica gel silica: 200~300; eluant: petroleum ether/ethyl acetate (10:1~5:1) to provide pure product **6** as a yellow oil in 78% yield (59.3 mg). **^{1}H NMR** (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.64 (d, *J* = 7.4 Hz, 2H), 7.55 (t, *J* = 8.0 Hz, 2H), 7.38 (t, *J* = 7.4 Hz, 1H), 6.39 (s, 1H), 4.59 – 4.35 (m, 6H), 1.57 – 1.49 (m, 6H), 1.40 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR** (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 165.5, 156.1, 150.8, 148.8, 135.2, 129.4, 126.0, 120.2, 71.6, 64.7, 63.9, 62.9, 14.2, 14.1, 13.8. **HRMS** (ESI) calculated for $C_{17}H_{22}N_3O_7^+$[M+H]$^+$: 380.1452; found: 380.1442.

4.3 the Reaction in Water[a]



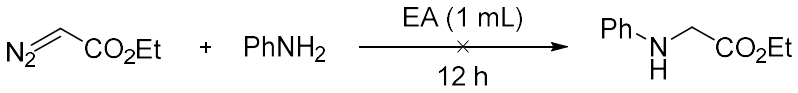
1a 2a 3a 4a

Entry	Surfactant	Yield of **4a** (%)[b]
1	SDS	63
2	CTAC	59
3	DOSS	32
4	DTAC	63
5	Aliquat 336	62
6	w/o	29

[a] Reaction conditions: 0.4 mmol **1a**, 0.2 mmol **2a** and 0.4 mmol **3a** dissolved in H_2O (2 mL) with surfactant (3.5 equiv., 0.7 mmol) for 12 hours. [b] Isolated yield.

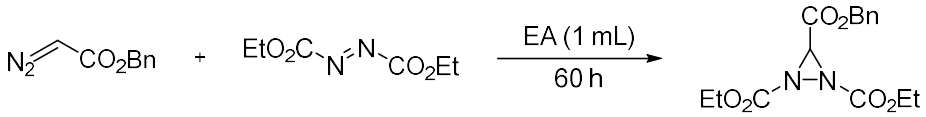
5. Mechanistic Studies

5.1 Key Intermediate Capture



1a **2a** **7**
Not detected

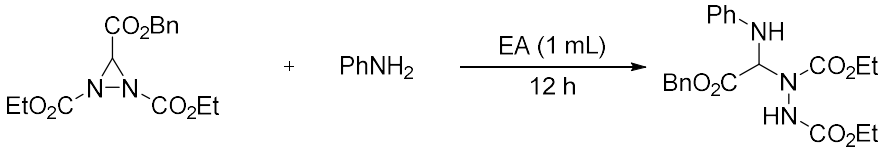
To a 5 mL dark brown small glass bottle equipped with a magnetic stir bar was added dry EtOAc (1.0 mL), aniline **2a** (18.6 mg, 0.20 mmol, 18 μL, 1.0 equiv.) and ethyl diazoacetate **1a** (45.6 mg, 0.40 mmol, 43 μL, 2.0 equiv.). The resulting mixture was stirred at room temperature in dark for 12 h. The desired product **7** was not detected by TLC.



1h **3a** **8**, 69%

To a 5 mL dark brown small glass bottle equipped with a magnetic stir bar was added dry EtOAc (1.0 mL), diethyl azodicarboxylate **3a** (69.7 mg, 0.40 mmol, 1.0 equiv) and diazo compound **1h** (45.6 mg, 0.40 mmol, 1.0 equiv). The resulting mixture was stirred at room temperature in dark for 60 h. The solvent was removed by vacuum and the crude product was purified by flash chromatography on silica gel silica: 200~300; eluant: petroleum ether/ethyl acetate (10:1~5:1) to provide pure product **8** as a colorless oil in 69% yield (89.1 mg). **^{1}H NMR** (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.34 (s, 5H), 6.16 (s, 1H), 5.32 – 5.16 (m, 2H), 4.43 – 4.27 (m, 2H), 4.25 – 4.12 (m, 2H), 1.37 (t, *J* = 7.1 Hz, 3H), 1.23 (t, *J* = 7.2 Hz, 3H). **^{13}C NMR** (101 MHz, Chloroform-*d*, 300K): δ (ppm) = 164.8, 159.4, 134.4, 128.5, 128.2, 87.0, 69.0, 67.9, 62.6, 14.3, 14.0. **HRMS** (ESI) calculated for $C_{15}H_{19}N_2O_6^+$[M+H]$^+$: 323.1238; found: 323.1240.

5.2 Conversion of Key Intermediate

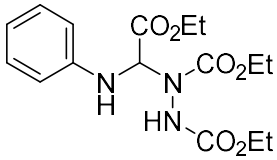


8 **2a** **4h**, 77%

To a 5 mL dark brown small glass bottle equipped with a magnetic stir bar was added dry EtOAc (1.0 mL), **8** (52.4 mg, 0.16 mmol, 1.0 equiv) and aniline **2a** (29.8 mg, 0.32 mmol, 2.0 equiv). The resulting mixture was stirred at room temperature in dark for 12 h. The solvent was removed by vacuum and the crude product was purified by flash chromatography on silica gel silica: 200~300; eluant: petroleum ether/ethyl acetate (10:1~5:1) to provide pure product **4h** as a yellow oil in 77% yield (52.2 mg). **^{1}H NMR** (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.45 – 7.31 (m, 5H), 7.20 (t, *J* = 7.8 Hz, 2H), 6.86 – 6.68 (m, 3H), 6.32 (s, 2H), 5.42 – 4.92 (m, 3H), 4.45 – 3.81 (m, 4H), 1.26 (t, *J* = 7.3 Hz, 6H). **^{13}C NMR** (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.7, 155.6, 143.7, 135.1, 129.5, 128.7, 119.5, 114.0, 68.2, 63.2, 62.3, 14.5. **HRMS** (ESI) calculated for $C_{21}H_{26}N_3O_6^+$[M+H]$^+$: 416.1816; found: 416.1816.

6. Spectral Data of Products

diethyl 1-(2-ethoxy-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4a):



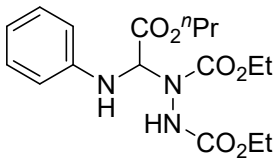
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a beige solid in 96% yield (67.8 mg).

^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.19 (t, *J* = 7.8 Hz, 2H), 6.77 (dd, *J* = 28.7, 7.7 Hz, 3H), 6.29 (d, *J* = 38.2 Hz, 2H), 4.37 – 4.00 (m, 6H), 1.43 – 1.15 (m, 9H).

^{13}C NMR (101 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.6, 155.5, 143.6, 129.4, 119.3, 113.8, 63.0, 62.5, 62.1, 14.4, 14.0.

HRMS (ESI) calculated for $C_{16}H_{24}N_3O_6^+$[M+H]$^+$: 354.1660; found: 354.1654.

diethyl 1-(2-oxo-1-(phenylamino)-2-propoxyethyl)hydrazine-1,2-dicarboxylate (4b):



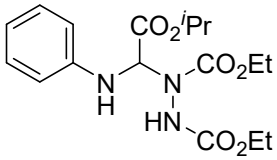
According to *GP* with diazo compound (51.3 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 72% yield (52.9 mg).

^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.17 (t, *J* = 7.7 Hz, 2H), 6.76 (d, *J* = 13.6 Hz, 3H), 6.49 (s, 1H), 6.17 (d, *J* = 53.2 Hz, 1H), 4.17 (d, *J* = 37.9 Hz, 6H), 1.72 (q, *J* = 7.3 Hz, 2H), 1.25 (s, 6H), 0.95 (d, *J* = 7.6 Hz, 3H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.6, 155.4, 143.6, 129.2, 119.2, 113.7, 67.8, 62.8, 62.0, 21.6, 14.3, 10.1.

HRMS (ESI) calculated for $C_{17}H_{26}N_3O_6^+$[M+H]$^+$: 368.1816; found: 368.1817.

diethyl 1-(2-isopropoxy-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4c):



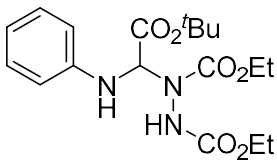
According to *GP* with diazo compound (51.3 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 78% yield (57.3 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.31 (t, *J* = 7.7 Hz, 2H), 6.95 – 6.83 (m, 3H), 6.61 (s, 1H), 6.43 – 6.05 (m, 1H), 5.34 – 5.13 (m, 2H), 4.57 – 3.91 (m, 4H), 1.44 (dd, *J* = 13.0, 6.2 Hz, 12H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.0, 155.4, 143.7, 129.2, 119.1, 113.7, 70.5, 62.8, 61.9, 21.5, 21.4, 14.3.

HRMS (ESI) calculated for $C_{17}H_{26}N_3O_6^+$[M+H]$^+$: 368.1816; found: 368.1814.

diethyl 1-(2-(*tert*-butoxy)-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4d):



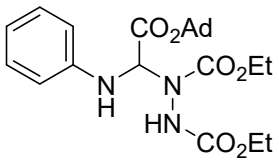
According to *GP* with diazo compound (56.9 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 76% yield (58.0 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.16 (t, *J* = 7.7 Hz, 2H), 6.80 – 6.67 (m, 3H), 6.38 (s, 1H), 6.03 (d, *J* = 74.0 Hz, 1H), 5.02 (d, *J* = 8.1 Hz, 1H), 4.51 – 3.94 (m, 4H), 1.50 (s, 9H), 1.49 – 1.10 (m, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*, 300K): δ (ppm) = 166.5, 155.5, 144.0, 129.2, 119.1, 113.7, 83.5, 62.8, 61.9, 27.7, 14.4, 14.0.

HRMS (ESI) calculated for $C_{18}H_{28}N_3O_6^+$[M+H]$^+$: 382.1973; found: 382.1974.

diethyl 1-(2-(((3*r*)-adamantan-1-yl)oxy)-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4e):



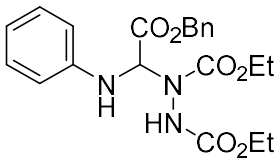
According to *GP* with diazo compound (88.1 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as a yellow solid in 78% yield (71.7 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.15 (t, *J* = 7.7 Hz, 2H), 6.79 – 6.67 (m, 3H), 6.44 (s, 1H), 6.01 (d, *J* = 73.2 Hz, 1H), 5.04 (s, 1H), 4.19 (dd, *J* = 111.4, 59.7 Hz, 4H), 2.17 (s, 4H), 2.13 (s, 6H), 1.65 (s, 5H), 1.41 – 0.85 (m, 6H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 166.0, 155.4, 144.1, 129.1, 118.9, 113.7, 83.4, 62.7, 61.8, 40.9, 35.8, 30.7, 14.3.

HRMS (ESI) calculated for $C_{24}H_{34}N_3O_6^+$[M+H]$^+$: 460.2442; found: 460.2440.

diethyl 1-(2-(benzyloxy)-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4f):



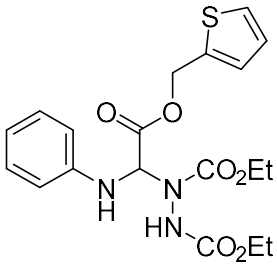
According to *GP* with diazo compound (71.3 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 83% yield (69.0 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.45 – 7.31 (m, 5H), 7.20 (t, *J* = 7.8 Hz, 2H), 6.86 – 6.68 (m, 3H), 6.32 (s, 2H), 5.42 – 4.92 (m, 3H), 4.45 – 3.81 (m, 4H), 1.26 (t, *J* = 7.3 Hz, 6H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.5, 155.4, 143.5, 135.0, 129.3, 128.5, 119.4, 113.8, 68.0, 63.0, 62.2, 14.4.

HRMS (ESI) calculated for $C_{21}H_{26}N_3O_6^+$[M+H]$^+$: 416.1816; found: 416.1816.

diethyl 1-(2-oxo-1-(phenylamino)-2-(thiophen-2-ylmethoxy)ethyl)hydrazine-1,2-dicarboxylate (4g):



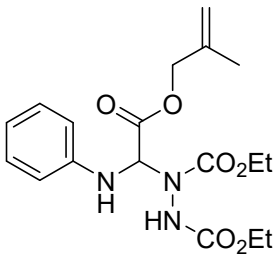
According to *GP* with diazo compound (72.9 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 75% yield (63.2 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.16 (d, *J* = 5.1 Hz, 1H), 7.01 (t, *J* = 7.7 Hz, 2H), 6.97 (s, 1H), 6.84 – 6.79 (m, 1H), 6.62 (t, *J* = 7.4 Hz, 1H), 6.56 (s, 2H), 6.31 (s, 1H), 6.04 (d, *J* = 90.8 Hz, 1H), 5.23 (dd, *J* = 62.0, 45.9 Hz, 2H), 4.94 (s, 1H), 4.30 – 3.59 (m, 4H), 1.35 – 0.66 (m, 6H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.3, 155.3, 143.5, 136.7, 129.2, 128.7, 127.1, 126.8, 119.3, 113.8, 86.9, 68.9, 62.9, 62.2, 14.3.

HRMS (ESI) calculated for $C_{19}H_{24}N_3O_6S^+[M+H]^+$: 422.1380; found: 422.1376.

diethyl 1-(2-((2-methylallyl)oxy)-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4h):



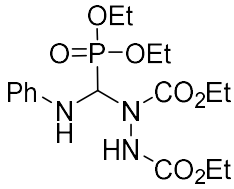
According to *GP* with diazo compound (56.1 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 55% yield (41.7 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.00 (d, *J* = 6.8 Hz, 2H), 6.66 – 6.51 (m, 3H), 6.13 (t, *J* = 105.8 Hz, 2H), 4.86 (s, 1H), 4.79 (s, 1H), 4.56 – 4.32 (m, 2H), 3.99 (d, *J* = 98.9 Hz, 4H), 1.61 (s, 3H), 1.11 (dd, *J* = 78.8, 43.9 Hz, 6H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.3, 155.4, 143.6, 138.9, 129.3, 119.3, 113.8, 113.6, 69.4, 62.9, 62.0, 19.3, 14.3.

HRMS (ESI) calculated for $C_{18}H_{26}N_3O_6^+[M+H]^+$: 380.1816; found: 380.1815.

diethyl 1-((diethoxyphosphoryl)(phenylamino)methyl)hydrazine-1,2-dicarboxylate (4i):



According to *GP* with diazo compound (71.3 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 1:1) afforded the desired product as a yellow oil in 83% yield (69.3 mg).

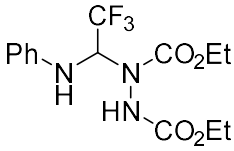
^{1}H NMR (600 MHz, DMSO-d_6, 300K): δ (ppm) = 7.22 (s, 2H), 6.94 (s, 2H), 6.77 (s, 1H), 6.51 – 5.83 (m, 1H), 4.36 – 4.04 (m, 8H), 3.37 (s, 1H), 1.35 – 1.23 (m, 12H).

^{13}C NMR (151 MHz, DMSO-d_6, 300K): δ (ppm) = 169.9, 156.5, 128.6, 117.8, 113.4, 74.2, 68.8, 62.6, 61.9, 60.4, 58.3, 16.2, 14.5.

^{31}P NMR (162 MHz, DMSO-d_6, 300K): δ (ppm) = 17.0 (s).

HRMS (ESI) calculated for $C_{17}H_{29}N_3O_7P^+[M+H]^+$: 418.1738; found: 418.1736.

diethyl 1-(2,2,2-trifluoro-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4j):



According to *GP* with diazo compound (44.0 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as a yellow oil in 56% yield (39.1 mg).

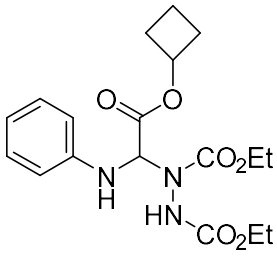
^{1}H NMR (600 MHz, DMSO-d_6, 300K): δ (ppm) = 7.25 (d, J = 7.7 Hz, 2H), 6.92 (d, J = 8.4 Hz, 2H), 6.81 (t, J = 7.3 Hz, 1H), 6.30 (d, J = 55.2 Hz, 1H), 4.51 – 3.73 (m, 4H), 3.37 (s, 1H), 1.26 (dd, J = 18.5, 7.1 Hz, 6H).

^{13}C NMR (151 MHz, DMSO-d_6, 300K): δ (ppm) = 169.9, 155.9, 145.6, 129.0, 128.7(d, J = 45.3 Hz), 118.2, 113.9, 113.5(d, J = 60.4 Hz), 74.2, 68.8, 62.4, 60.8, 60.5(d, J = 45.3 Hz), 58.3, 21.0, 16.4, 14.4, 13.2.

^{19}F NMR (376 MHz, DMSO-d_6, 300K): δ (ppm) = -76.6 (s).

HRMS (ESI) calculated for $C_{14}H_{19}F_3N_3O_4^+[M+H]^+$: 350.3177; found: 350.3180.

diethyl 1-(2-cyclobutoxy-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4k):



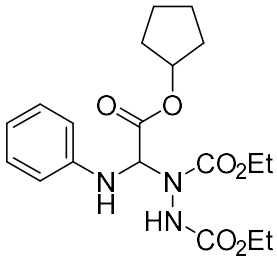
According to *GP* with diazo compound (56.1 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as an orange solid in 71% yield (53.9 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.16 (t, *J* = 7.7 Hz, 2H), 6.75 (d, *J* = 20.4 Hz, 3H), 6.54 (s, 1H), 6.13 (d, *J* = 104.8 Hz, 1H), 5.03 (t, *J* = 7.5 Hz, 1H), 4.13 (d, *J* = 105.4 Hz, 4H), 2.43 – 2.07 (m, 4H), 1.81 (q, *J* = 10.3 Hz, 1H), 1.68 – 1.55 (m, 1H), 1.27 (dd, *J* = 84.6, 41.2 Hz, 6H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 166.8, 155.4, 143.6, 129.2, 119.1, 113.7, 70.8, 62.8, 61.9, 30.1, 29.7, 14.3, 13.4.

HRMS (ESI) calculated for $C_{18}H_{26}N_3O_6^+$[M+H]$^+$: 380.1816; found: 380.1812.

diethyl 1-(2-(cyclopentyloxy)-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4l):



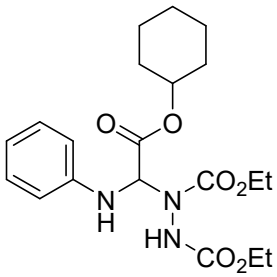
According to *GP* with diazo compound (61.7 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as an orange solid in 76% yield (59.8 mg).

^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.16 (t, *J* = 7.9 Hz, 2H), 6.75 (d, *J* = 11.5 Hz, 3H), 6.47 (s, 1H), 6.10 (d, *J* = 45.0 Hz, 1H), 5.18 (d, *J* = 36.7 Hz, 2H), 4.14 (d, *J* = 82.9 Hz, 4H), 1.86 (s, 4H), 1.74 (s, 2H), 1.59 (s, 2H), 1.26 (t, *J* = 48.5 Hz, 6H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.2, 155.4, 143.8, 129.2, 119.1, 113.7, 79.5, 62.7, 61.9, 32.5, 23.5, 14.3, 14.0.

HRMS (ESI) calculated for $C_{19}H_{28}N_3O_6^+[M+H]^+$: 394.1973; found: 394.1967.

diethyl 1-(2-(cyclohexyloxy)-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4m):



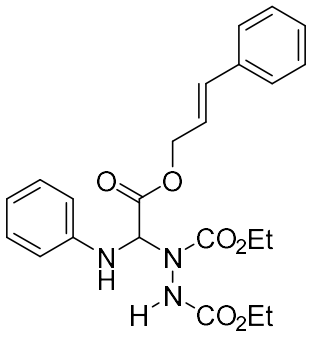
According to *GP* with diazo compound (67.3 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as an orange solid in 78% yield (63.6 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.35 (t, *J* = 7.8 Hz, 2H), 6.94 (dd, *J* = 17.4, 10.0 Hz, 3H), 6.56 (s, 1H), 6.31 (d, *J* = 73.9 Hz, 1H), 5.29 (s, 1H), 5.03 (s, 1H), 4.39 (q, *J* = 63.3, 54.9 Hz, 4H), 2.03 (d, *J* = 36.3 Hz, 2H), 1.90 (s, 2H), 1.69 (s, 4H), 1.55 (d, *J* = 13.0 Hz, 2H), 1.45 (d, *J* = 29.7 Hz, 6H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 166.9, 155.4, 143.8, 129.2, 119.1, 113.8, 87.3, 75.1, 68.9, 62.5, 62.0, 31.2, 25.1, 23.4, 14.4, 14.1.

HRMS (ESI) calculated for $C_{20}H_{30}N_3O_6^+[M+H]^+$: 408.2129; found: 408.2126.

diethyl 1-(2-(cinnamyloxy)-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4n):



According to *GP* with diazo compound (80.9 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as a yellow solid in 73% yield (64.5 mg).

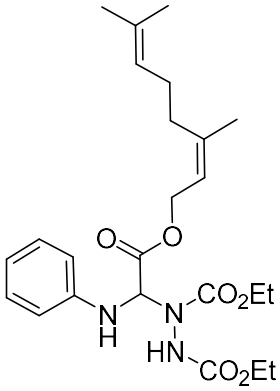
^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.33 (t, *J* = 7.7 Hz, 2H), 7.26 (t, *J* = 7.7 Hz, 2H), 7.23 – 7.10 (m, 3H), 6.77 – 6.60 (m, 3H), 6.47 – 6.09 (m, 2H), 5.09 (d, *J* = 7.6 Hz, 1H), 4.91 – 4.70 (m, 2H), 4.38 – 3.74 (m, 4H), 1.42 – 0.52 (m, 6H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 164.7, 159.4, 135.3, 129.3,

128.5, 126.6, 121.4, 113.8, 87.0, 68.9, 66.8, 62.6, 62.0, 14.4, 14.0.

HRMS (ESI) calculated for $C_{23}H_{28}N_3O_6^+[M+H]^+$: 442.1973; found: 442.1956.

diethyl (*E*)-1-(2-((3,7-dimethylocta-2,6-dien-1-yl)oxy)-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4o):



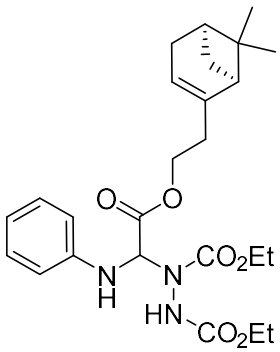
According to *GP* with diazo compound (88.9 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as a yellow solid in 61% yield (56.3 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.35 (t, *J* = 7.7 Hz, 2H), 6.94 (dd, *J* = 17.8, 10.5 Hz, 3H), 6.70 – 6.18 (m, 2H), 5.56 (q, *J* = 8.0, 7.5 Hz, 1H), 5.39 – 5.17 (m, 2H), 4.89 (d, *J* = 102.6 Hz, 2H), 4.60 – 4.00 (m, 4H), 2.35 – 2.21 (m, 4H), 1.94 (s, 3H), 1.85 (s, 3H), 1.77 (s, 3H), 1.43 – 1.01 (m, 6H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.5, 155.4, 132.1, 129.2, 123.4, 119.1, 118.4, 117.9, 113.8, 87.1, 68.8, 62.9, 62.0, 32.1, 26.5, 25.5, 23.3, 17.5, 14.3.

HRMS (ESI) calculated for $C_{24}H_{36}N_3O_6^+[M+H]^+$: 462.2599; found: 462.2582.

diethyl 1-(2-(2-((1*S*,5*R*)-6,6-dimethylbicyclo[3.1.1]hept-2-en-2-yl)ethoxy)-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4p):



According to *GP* with diazo compound (93.7 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as a yellow solid in 55% yield (52.1 mg).

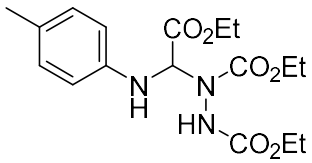
^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.00 (t, *J* = 7.7 Hz, 2H), 6.66 – 6.49 (m, 3H), 5.99 (d, *J* = 74.7 Hz, 2H), 5.12 (d, *J* = 29.8 Hz, 1H), 4.21 – 3.88 (m, 6H),

2.23 – 1.98 (m, 6H), 1.91 (s, 2H), 1.21 (t, *J* = 7.1 Hz, 1H), 1.14 – 1.05 (m, 7H), 0.98 – 0.94 (m, 1H), 0.64 (d, *J* = 8.1 Hz, 3H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.5, 159.4, 155.4, 143.8, 143.2, 129.2, 119.3, 113.8, 87.1, 68.9, 64.3, 62.6, 62.0, 60.2, 45.5, 40.6, 37.9, 35.6, 31.5, 31.2, 26.1, 21.0, 14.5, 14.1.

HRMS (ESI) calculated for $C_{25}H_{36}N_3O_6^+$[M+H]$^+$: 474.2599; found: 474.2585.

diethyl 1-(2-ethoxy-2-oxo-1-(*p*-tolylamino)ethyl)hydrazine-1,2-dicarboxylate (4q):



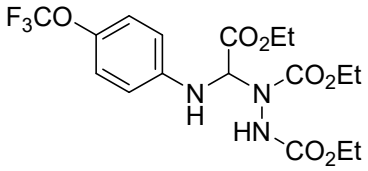
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), *p*-toluidine (21.4 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 96% yield (70.5 mg).

^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 6.73 (d, *J* = 7.9 Hz, 2H), 6.38 (d, *J* = 7.9 Hz, 2H), 6.02 (d, *J* = 56.4 Hz, 2H), 4.71 (s, 1H), 4.14 – 3.70 (m, 6H), 1.97 (s, 3H), 1.16 – 0.84 (m, 9H).

^{13}C NMR (101 MHz, Chloroform- *d*, 300K): δ (ppm) = 167.6, 155.5, 141.1, 129.8, 128.5, 113.9, 62.9, 62.4, 62.1, 20.3, 14.3, 13.9.

HRMS (ESI) calculated for $C_{17}H_{26}N_3O_6^+$[M+H]$^+$: 368.1819; found: 368.1823.

diethyl 1-(2-ethoxy-2-oxo-1-((4-(trifluoromethoxy)phenyl)amino)ethyl)hydrazine-1,2-dicarboxylate (4r):



According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 4-(trifluoromethoxy)aniline (35.4 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 80% yield (70.0 mg).

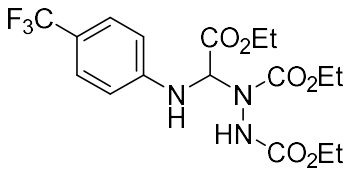
^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 6.80 (d, *J* = 8.4 Hz, 2H), 6.47 (d, *J* = 8.5 Hz, 2H), 6.02 (d, *J* = 63.3 Hz, 2H), 4.92 (s, 1H), 4.17 – 3.66 (m, 6H), 1.18 – 0.79 (m, 9H).

^{13}C NMR (101 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.5, 155.5, 141.8, 122.5, 120.6 (d, *J* = 257.6 Hz), 114.3, 62.7 (t, *J* = 94.9 Hz), 14.4, 14.0.

^{19}F NMR (565 MHz, Chloroform-*d*, 300K): δ (ppm) = -58.4 (s).

HRMS (ESI) calculated for $C_{17}H_{29}F_3N_3O_7^+[M+H]^+$: 438.1483; found: 438.1483.

diethyl 1-(2-ethoxy-2-oxo-1-((4-(trifluoromethyl)phenyl)amino)ethyl)hydrazine-1,2-dicarboxylate (4s):



According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 4-aminobenzotrifluoride (32.2 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 81% yield (68.3 mg).

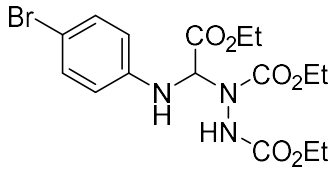
^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.58 (d, *J* = 8.3 Hz, 2H), 6.97 (s, 2H), 6.36 (d, *J* = 99.0 Hz, 1H), 5.76 (d, *J* = 116.5 Hz, 1H), 4.54 – 4.15 (m, 6H), 1.56 – 1.29 (m, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 165.0, 159.4, 126.5, 124.6 (d, *J* = 270.3 Hz), 113.2, 87.1, 68.9, 62.6 (d, *J* = 30.2 Hz), 62.2, 14.4, 13.9.

^{19}F NMR (565 MHz, Chloroform-*d*, 300K): δ (ppm) = -61.3 (s).

HRMS (ESI) calculated for $C_{17}H_{23}F_3N_3O_6^+[M+H]^+$: 422.1533; found: 422.1540.

diethyl 1-(1-((4-bromophenyl)amino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4t):



According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 4-bromoaniline (34.4 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification

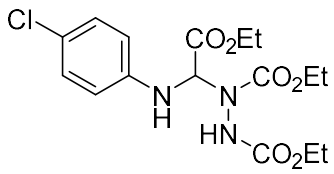
by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 96% yield (83.0 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.27 (d, *J* = 8.2 Hz, 2H), 6.66 (s, 2H), 6.21 (s, 1H), 5.36 (d, *J* = 111.7 Hz, 1H), 4.45 – 3.99 (m, 6H), 1.43 – 1.08 (m, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.3, 155.4, 142.8, 131.8, 115.4, 110.9, 62.9, 62.5, 62.0, 14.2, 13.8.

HRMS (ESI) calculated for $C_{16}H_{23}BrN_3O_6^+[M+H]^+$: 432.0765; found: 432.0774.

diethyl 1-(1-((4-chlorophenyl)amino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4u):



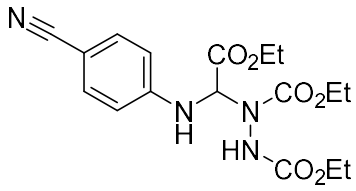
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 4-chloroaniline (25.5 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 95% yield (73.7 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 6.93 (d, *J* = 8.2 Hz, 2H), 6.50 (s, 2H), 5.92 (d, *J* = 106.8 Hz, 1H), 5.00 (s, 1H), 4.24 – 3.80 (m, 6H), 1.14 (t, *J* = 7.2 Hz, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.4, 155.4, 142.4, 129.0, 123.9, 114.9, 63.0, 62.5, 62.1, 14.3, 13.9.

HRMS (ESI) calculated for $C_{16}H_{23}ClN_3O_6^+[M+H]^+$: 388.1270; found: 388.1277.

diethyl 1-(1-((4-cyanophenyl)amino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4v):



According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 4-aminobenzonitrile (29.8 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h.

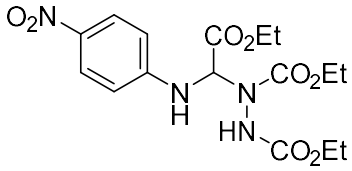
Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as a white solid in 73% yield (55.2 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.30 (d, *J* = 8.7 Hz, 2H), 6.61 (s, 2H), 6.13 (s, 2H), 5.35 (s, 1H), 4.28 – 3.67 (m, 6H), 1.17 (t, *J* = 7.1 Hz, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.1, 155.4, 147.7, 133.5, 119.7, 113.7, 101.2, 63.2, 62.9, 62.2, 14.3, 13.9.

HRMS (ESI) calculated for $C_{17}H_{22}N_4NaO_6^+$[M+Na]$^+$: 401.1432; found: 401.1437.

diethyl 1-(2-ethoxy-1-((4-nitrophenyl)amino)-2-oxoethyl)hydrazine-1,2-dicarboxylate (4w):



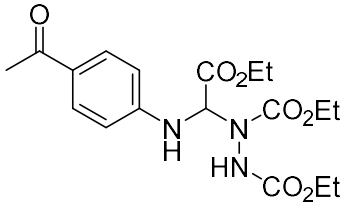
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 4-nitroaniline (27.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as a yellow solid in 48% yield (38.2 mg).

^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.84 (d, *J* = 9.2 Hz, 2H), 6.51 (d, *J* = 7.4 Hz, 2H), 6.11 (d, *J* = 68.5 Hz, 2H), 5.54 (s, 1H), 4.20 – 3.64 (m, 6H), 1.09 (t, *J* = 7.1 Hz, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.0, 155.4, 149.8, 139.7, 125.9, 112.8, 63.4, 63.1, 62.3, 14.3, 13.9.

HRMS (ESI) calculated for $C_{16}H_{23}N_4O_8^+$[M+H]$^+$: 399.1510; found: 399.1519.

diethyl 1-(1-((4-acetylphenyl)amino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4x):



According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 4-aminoacetophenone (27.0 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h.

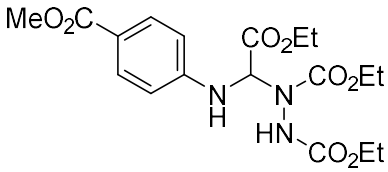
Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a white solid in 70% yield (55.4 mg).

^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.85 (d, *J* = 8.8 Hz, 2H), 6.75 (d, *J* = 8.3 Hz, 2H), 6.30 (s, 2H), 4.43 – 3.94 (m, 6H), 2.50 (s, 3H), 1.35 (t, *J* = 7.2 Hz, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 196.4, 167.2, 155.4, 148.2, 130.4, 128.3, 112.7, 63.0, 62.7, 62.0, 25.8, 13.8.

HRMS (ESI) calculated for $C_{18}H_{26}N_3O_7^+$[M+H]$^+$: 396.1765; found: 396.1770.

diethyl 1-(2-ethoxy-1-((4-(methoxycarbonyl)phenyl)amino)-2-oxoethyl)hydrazine-1,2-dicarboxylate (4y):



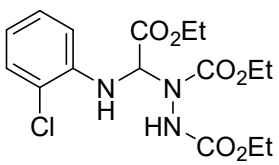
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), methyl 4-aminobenzoate (30.2 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a white solid in 72% yield (59.2 mg).

^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 8.16 (d, *J* = 8.8 Hz, 2H), 7.00 (d, *J* = 8.3 Hz, 2H), 6.56 (s, 2H), 4.69 – 4.25 (m, 6H), 4.12 (s, 3H), 1.60 (q, *J* = 14.8, 11.0 Hz, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 166.9, 155.3, 147.9, 131.3, 120.3, 112.8, 63.0, 62.6, 62.0, 51.4, 13.8.

HRMS (ESI) calculated for $C_{18}H_{26}N_3O_8^+$[M+H]$^+$: 412.1714; found: 412.1717.

diethyl 1-(1-((2-chlorophenyl)amino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4z):



According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 2-chloroaniline (25.5 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1)

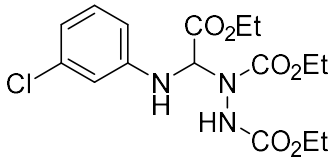
afforded the desired product as a yellow oil in 89% yield (69.0 mg).

^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.55 – 7.50 (m, 1H), 7.39 (t, *J* = 7.8 Hz, 1H), 7.18 – 6.94 (m, 2H), 6.67 – 6.26 (m, 2H), 5.93 (s, 1H), 4.69 – 4.29 (m, 6H), 1.73 – 1.37 (m, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.2, 155.5, 140.2, 129.3, 127.8, 119.4, 112.9, 87.1, 69.0, 63.1, 62.7, 62.1, 14.4, 14.0.

HRMS (ESI) calculated for $C_{16}H_{23}ClN_3O_6^+[M+H]^+$: 388.1270; found: 388.1260.

diethyl 1-(1-((3-chlorophenyl)amino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4aa):



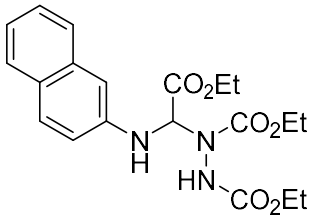
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 3-chloroaniline (25.5 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 96% yield (74.5 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 6.90 (t, *J* = 8.1 Hz, 1H), 6.63 – 6.53 (m, 2H), 6.44 (s, 1H), 5.95 (d, *J* = 106.8 Hz, 1H), 5.17 (d, *J* = 81.2 Hz, 1H), 3.95 (dd, *J* = 180.5, 52.6 Hz, 6H), 1.37 – 0.56 (m, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.4, 155.4, 145.0, 134.9, 130.2, 119.0, 114.0, 111.7, 63.0, 62.6, 62.1, 14.3, 13.9.

HRMS (ESI) calculated for $C_{16}H_{23}ClN_3O_6^+[M+H]^+$: 388.1270; found: 388.1277.

diethyl 1-(2-ethoxy-1-(naphthalen-2-ylamino)-2-oxoethyl)hydrazine-1,2-dicarboxylate (4ab):



According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 2-naphthylamine (28.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by

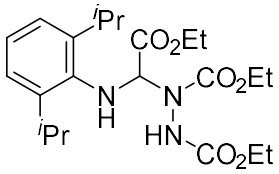
silica gel chromatography (PE:EA = 5:1) afforded the desired product as a brown oil in 73% yield (58.9 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.67 (t, *J* = 8.3 Hz, 2H), 7.61 (s, 1H), 7.36 (t, *J* = 7.7 Hz, 1H), 7.24 (t, *J* = 7.5 Hz, 1H), 7.01 (d, *J* = 9.0 Hz, 2H), 6.65 – 6.05 (m, 2H), 4.48 – 3.97 (m, 6H), 1.50 – 1.03 (m, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.6, 155.5, 141.2, 134.7, 129.2, 128.2, 127.5, 126.3, 122.8, 117.5, 107.0, 63.0, 62.5, 62.1, 14.3, 13.9.

HRMS (ESI) calculated for $C_{20}H_{26}N_3O_6^+$[M+H]$^+$: 404.1816; found: 404.1824.

diethyl 1-(1-((2,6-diisopropylphenyl)amino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4ac):



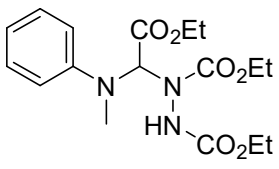
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 2,6-diisopropylaniline (35.5 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 81% yield (70.9 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.05 (q, *J* = 5.6 Hz, 3H), 6.43 (s, 1H), 5.60 (s, 1H), 4.24 (dd, *J* = 13.0, 6.8 Hz, 2H), 4.13 (s, 4H), 3.30 – 3.19 (m, 2H), 1.28 (t, *J* = 7.2 Hz, 3H), 1.19 (t, *J* = 7.4 Hz, 18H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 168.3, 154.9, 142.2, 138.4, 124.3, 123.5, 62.7, 61.9, 27.5, 24.0, 23.7, 14.1, 13.8.

HRMS (ESI) calculated for $C_{22}H_{36}N_3O_6^+$[M+H]$^+$: 438.2599; found: 438.2606.

diethyl 1-(1-(benzo[d]thiazol-6-ylamino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4ad):



According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), *N*-methylaniline (21.4 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.)

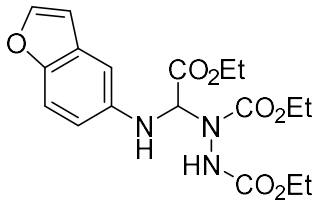
in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as a white solid in 89% yield (65.4 mg).

^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.29 (dd, *J* = 8.8, 7.2 Hz, 2H), 6.97 – 6.82 (m, 3H), 6.74 – 6.13 (m, 2H), 4.46 – 4.06 (m, 6H), 2.98 (s, 3H), 1.44 – 1.18 (m, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 168.1, 155.4, 147.9, 147.6, 128.9, 118.8, 118.4, 113.4, 112.7, 62.7, 62.3, 61.8, 35.6, 14.3, 14.0, 13.3.

HRMS (ESI) calculated for $C_{17}H_{26}N_3O_6^+[M+H]^+$: 368.1816; found: 368.1810.

diethyl 1-(1-(benzofuran-5-ylamino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4ae):



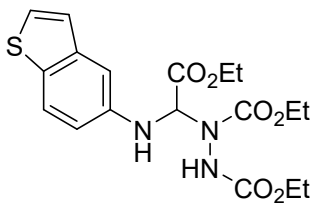
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 1-benzofuran-5-amine (26.6 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as an orange oil in 78% yield (61.4 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.71 (d, *J* = 2.2 Hz, 1H), 7.50 (d, *J* = 8.7 Hz, 1H), 7.09 (s, 1H), 6.92 (d, *J* = 8.7 Hz, 1H), 6.81 (s, 1H), 6.38 (d, *J* = 124.4 Hz, 2H), 4.57 – 4.18 (m, 6H), 1.52 (t, *J* = 7.1 Hz, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.7, 155.6, 149.8, 145.5, 139.5, 128.2, 112.8, 111.8, 106.3, 104.6, 63.0, 62.5, 62.1, 14.3, 14.0.

HRMS (ESI) calculated for $C_{18}H_{24}N_3O_7^+[M+H]^+$: 394.1609; found: 394.1605.

diethyl 1-(1-(benzo[b]thiophen-5-ylamino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4af):



According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 1-benzothiophen-5-amine (29.8 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h.

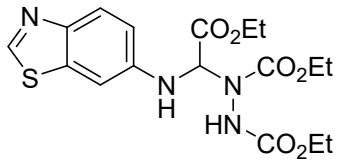
Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as an orange oil in 79% yield (64.7 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.48 (d, *J* = 8.6 Hz, 1H), 7.20 (d, *J* = 5.4 Hz, 1H), 6.97 (d, *J* = 16.5 Hz, 2H), 6.67 (d, *J* = 6.3 Hz, 1H), 6.19 (d, *J* = 51.0 Hz, 2H), 4.29 – 3.78 (m, 6H), 1.18 (t, *J* = 7.2 Hz, 9H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.6, 155.6, 140.8, 131.1, 127.2, 123.3, 123.0, 113.9, 106.8, 63.0, 62.5, 62.1, 14.3, 14.0.

HRMS (APCI) calculated for $C_{18}H_{24}N_3O_6S^+[M+H]^+$: 410.1380; found: 410.1373.

diethyl 1-(1-(benzo[d]thiazol-6-ylamino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4ag):



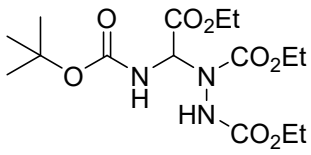
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 6-aminobenzothiazole (30.1 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as a white solid in 84% yield (69.0 mg).

^{1}H NMR (400 MHz, Chloroform-*d*, 300K): δ (ppm) = 8.96 (s, 1H), 8.04 (s, 1H), 7.41 (s, 1H), 7.13 (s, 1H), 6.54 (s, 1H), 5.70 (s, 1H), 4.81 – 4.14 (m, 6H), 1.77 – 1.28 (m, 9H).

^{13}C NMR (101 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.4, 155.6, 150.4, 145.8, 142.2, 135.2, 123.5, 115.1, 103.9, 63.1, 62.6, 62.0, 14.4, 13.9.

HRMS (ESI) calculated for $C_{17}H_{23}N_4O_6S^+[M+H]^+$: 411.1333; found: 411.1329.

diethyl 1-(1-((tert-butoxycarbonyl)amino)-2-ethoxy-2-oxoethyl)hydrazine-1,2-dicarboxylate (4ah):



According to GP with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), *tert*-Butyl carbamate (23.4 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL DCM for 12 h. Purification by silica gel chromatography

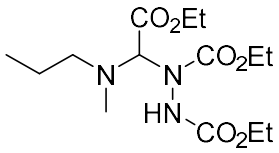
(PE:EA = 5:1) afforded the desired product as a yellow oil in 67% yield (50.6 mg).

^{1}H NMR (600 MHz, DMSO-d_6, 300K): δ (ppm) = 6.46 (s, 1H), 4.34 – 4.27 (m, 2H), 4.35 (q, J = 7.1 Hz, 2H), 4.16 – 4.11 (m, 2H), 1.48 (s, 9H), 1.43 (t, J = 7.1 Hz, 3H), 1.35 – 1.30 (m, 6H).

^{13}C NMR (151 MHz, DMSO-d_6, 300K): δ (ppm) = 165.2, 158.7, 156.2, 86.9, 77.0, 68.9, 62.3, 61.9, 45.5, 28.2, 14.3, 13.9, 13.8.

HRMS (ESI) calculated for $C_{15}H_{28}N_3O_8^+[M+H]^+$: 378.1871; found: 378.1868.

diethyl 1-(2-ethoxy-1-(methyl(propyl)amino)-2-oxoethyl)hydrazine-1,2-dicarboxylate (**4ai**):



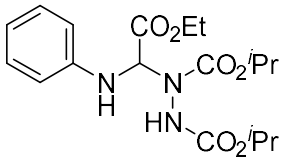
According to GP with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), 6-aminobenzothiazole (30.1 mg, 0.20 mmol, 1.0 equiv.) and diethyl azodicarboxylate (69.7 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL DCM for 12 h. Purification by silica gel chromatography (PE:EA = 3:1) afforded the desired product as a white solid in 40% yield (26.7 mg).

^{1}H NMR (600 MHz, Chloroform-d, 300K): δ (ppm) = 6.60 (s, 1H), 4.36 – 4.11 (m, 6H), 2.53 (s, 5H), 1.46 (d, J = 9.5 Hz, 2H), 1.27 (t, J = 7.1 Hz, 9H), 0.90 (t, J = 7.4 Hz, 3H).

^{13}C NMR (151 MHz, Chloroform-d, 300K): δ (ppm) = 156.8, 62.9, 62.2, 56.9, 41.9, 20.2, 14.5, 14.3, 11.6.

HRMS (APCI) calculated for $C_{14}H_{28}N_3O_6^+[M+H]^+$: 334.1973; found: 334.1964.

diisopropyl 1-(2-ethoxy-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4aj):



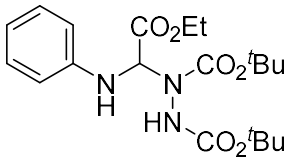
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and diisopropyl azodicarboxylate (80.9 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 69% yield (52.6 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.01 (t, *J* = 7.8 Hz, 2H), 6.60 (dd, *J* = 32.7, 7.8 Hz, 3H), 5.97 (d, *J* = 106.1 Hz, 2H), 4.75 (q, *J* = 80.5, 64.5 Hz, 2H), 4.10 (d, *J* = 44.6 Hz, 2H), 1.33 – 0.69 (m, 15H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.7, 155.1, 143.6, 129.3, 119.2, 113.9, 70.7, 69.9, 62.4, 21.9, 14.0.

HRMS (ESI) calculated for $C_{18}H_{28}N_3O_6^+$[M+H]$^+$: 382.1973; found: 382.1970.

di-*tert*-butyl 1-(2-ethoxy-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4ak):



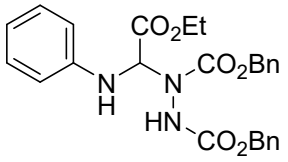
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and di-*tert*-butyl azodicarboxylate (92.1 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow oil in 66% yield (54.1 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.36 (t, *J* = 7.7 Hz, 2H), 6.81 – 6.68 (m, 3H), 6.49 – 6.09 (m, 2H), 5.26 (s, 1H), 4.38 – 4.13 (m, 2H), 1.75 – 1.43 (m, 21H).

^{13}C NMR (101 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.8, 154.5, 143.9, 129.3, 119.0, 113.8, 82.0, 81.2, 62.3, 28.0, 14.0.

HRMS (ESI) calculated for $C_{20}H_{32}N_3O_6^+$[M+H]$^+$: 410.2286; found: 410.2282.

dibenzyl 1-(2-ethoxy-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4al):



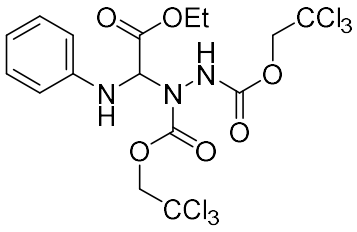
According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and dibenzyl azodicarboxylate (119.3 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as a yellow solid in 68% yield (64.9 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.40 – 7.03 (m, 12H), 6.66 (dd, *J* = 94.6, 23.6 Hz, 4H), 6.17 (d, *J* = 119.5 Hz, 1H), 5.42 – 4.87 (m, 5H), 4.26 (d, *J* = 33.2 Hz, 2H), 1.45 – 0.90 (m, 3H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.5, 155.3, 143.4, 135.4, 129.3, 128.4, 127.9, 127.6, 119.3, 113.8, 68.3, 67.6, 62.5, 13.8.

HRMS (ESI) calculated for $C_{26}H_{28}N_3O_6^+[M+H]^+$: 478.1973; found: 478.1970.

bis(2,2,2-trichloroethyl) 1-(2-ethoxy-2-oxo-1-(phenylamino)ethyl)hydrazine-1,2-dicarboxylate (4am):



According to *GP* with ethyl diazoacetate (45.6 mg, 0.40 mmol, 2.0 equiv.), aniline (18.6 mg, 0.20 mmol, 1.0 equiv.) and bis(2,2,2-trichloroethyl) azodicarboxylate (152.3 mg, 0.40 mmol, 2.0 equiv.) in 1.0 mL EtOAc for 12 h. Purification by silica gel chromatography (PE:EA = 5:1) afforded the desired product as an orange oil in 72% yield (80.6 mg).

^{1}H NMR (600 MHz, Chloroform-*d*, 300K): δ (ppm) = 7.21 (t, *J* = 7.7 Hz, 2H), 6.86 – 6.73 (m, 3H), 6.24 (d, *J* = 49.7 Hz, 1H), 5.00 – 4.57 (m, 4H), 4.30 (d, *J* = 37.7 Hz, 2H), 1.35 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (151 MHz, Chloroform-*d*, 300K): δ (ppm) = 167.1, 153.8, 142.9, 129.5, 119.8, 113.8, 94.6, 75.5, 75.1, 62.9, 14.0.

HRMS (APCI) calculated for $C_{16}H_{18}Cl_6N_3O_6^+[M+H]^+$: 557.9321; found: 557.9327.

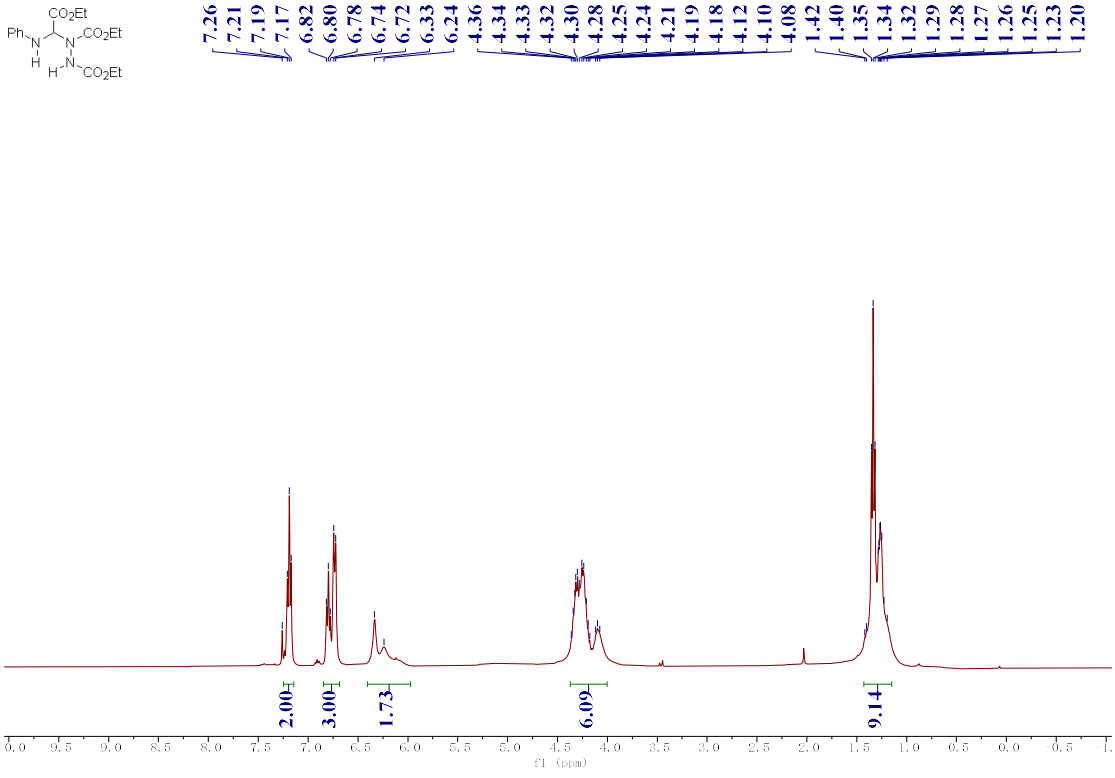
7. References

[1] a) X. Qi, J. M. Ready, *Angew. Chem., Int. Ed.,* 2007, **46**, 3242. b) J. S. Baum, D. A. Shook, H. M. L. Davies, H. D. Smith, *Synth. Commun.,* 1987*,* **17**, 1709. c) A. Alexandre, O. Raphaël, P. Joëlle, *Tetrahedron,* 2021*,* **79**, 131843. d) H.-Y. Guo, S. Zhang, X.-Q. Yu, X.-J. Feng, Y. Yamamoto, M. Bao, *ACS Catal.,* 2021*,* **11**, 10789.

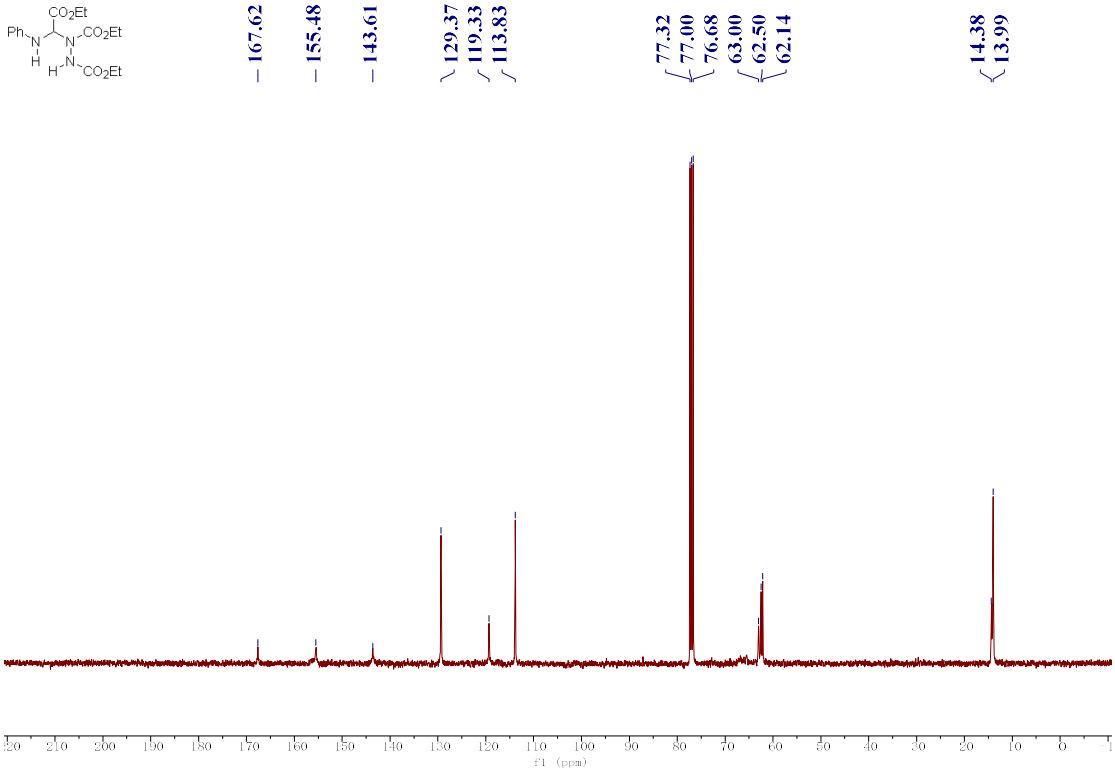
[2] a) H. Cho, I. Shin, E. Ju, S. Choi, W. Hur, H. Kim, E. Hong, N. D. Kim, H. G. Choi, N. S. Gray and T. Sim, *J. Med. Chem.,* 2018*,* **61**, 8353. b) I. Zalessky, J. M. Wootton, J. K. F. Tam, D. E. Spurling, W. C. Glover-Humphreys, J. R. Donald, W. E. Orukotan, L. C. Duff, B. J. Knapper, A. C. Whitwood, T. F. N. Tanner, A. H. Miah, J. M. Lynam and W. P. Unsworth, *J. Am. Chem. Soc.,* 2024*,* **146**, 5702.

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

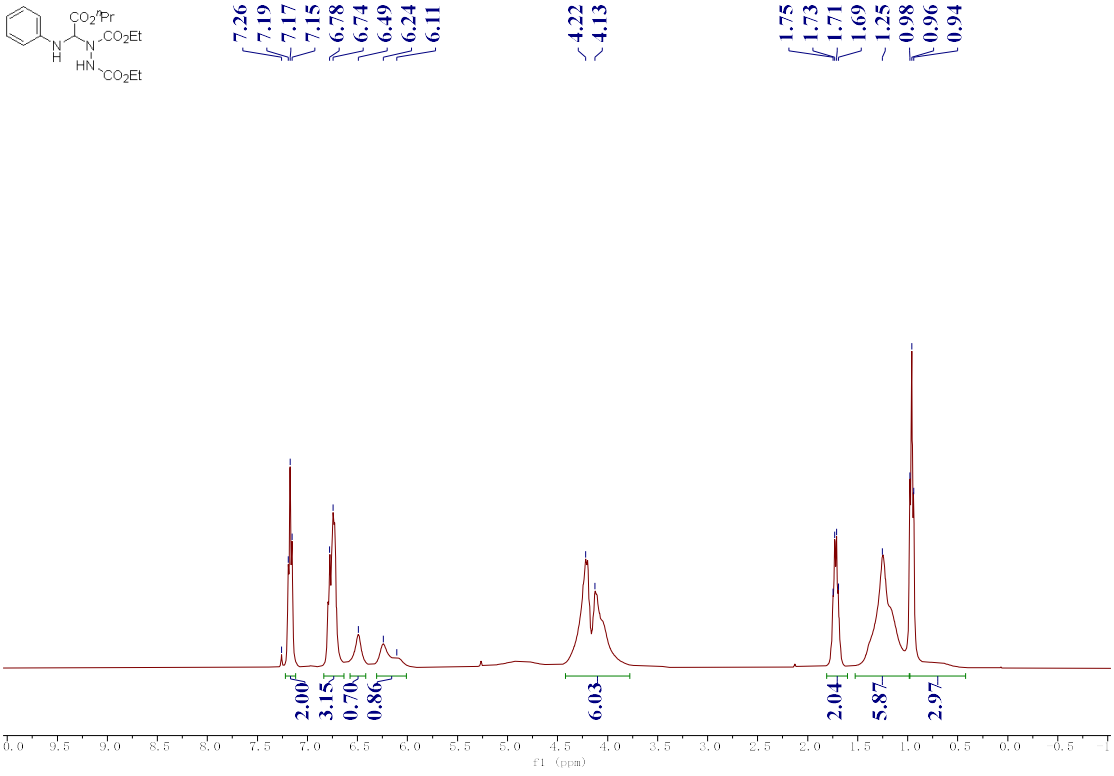
^{1}H NMR (400 MHz) Spectrum of 4a in $CDCl_3$



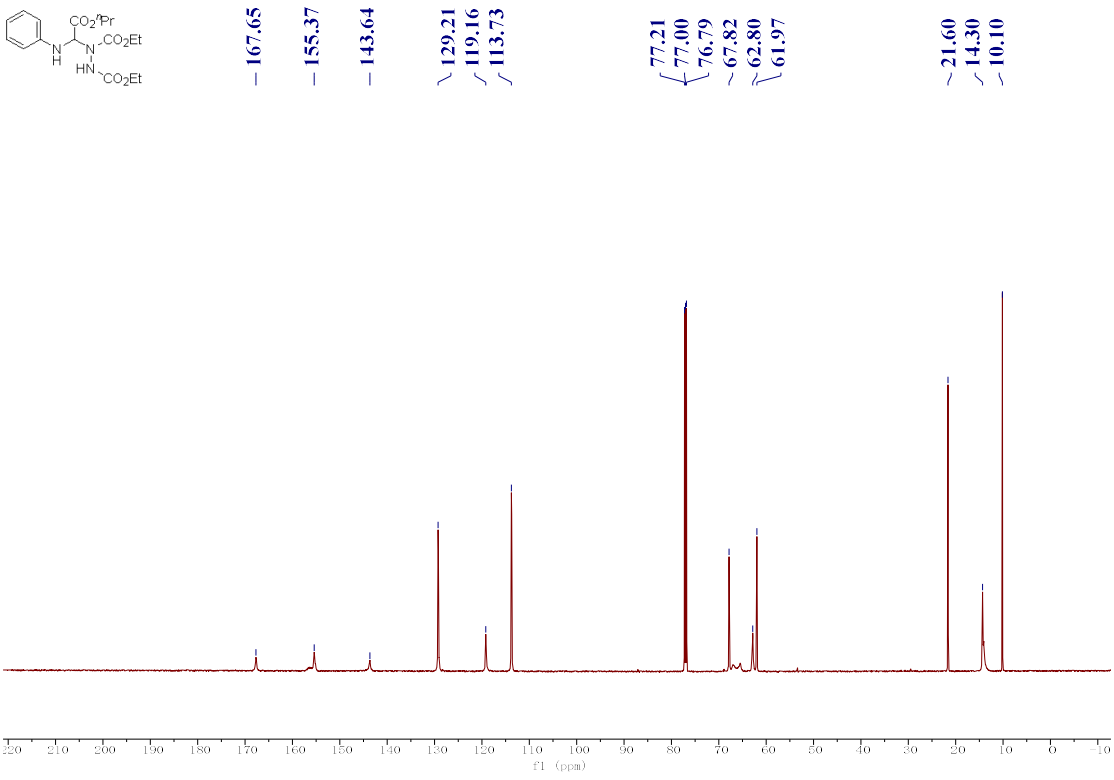
^{13}C NMR (101 MHz) Spectrum of 4a in $CDCl_3$



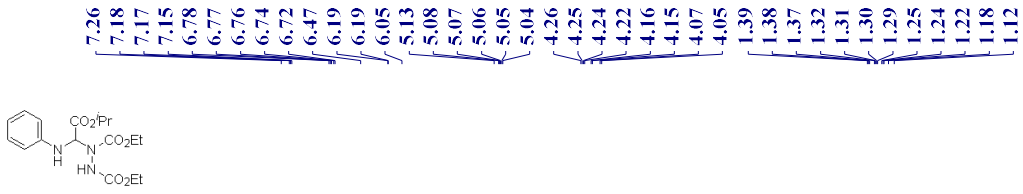
^{1}H NMR (400 MHz) Spectrum of 4b in $CDCl_3$

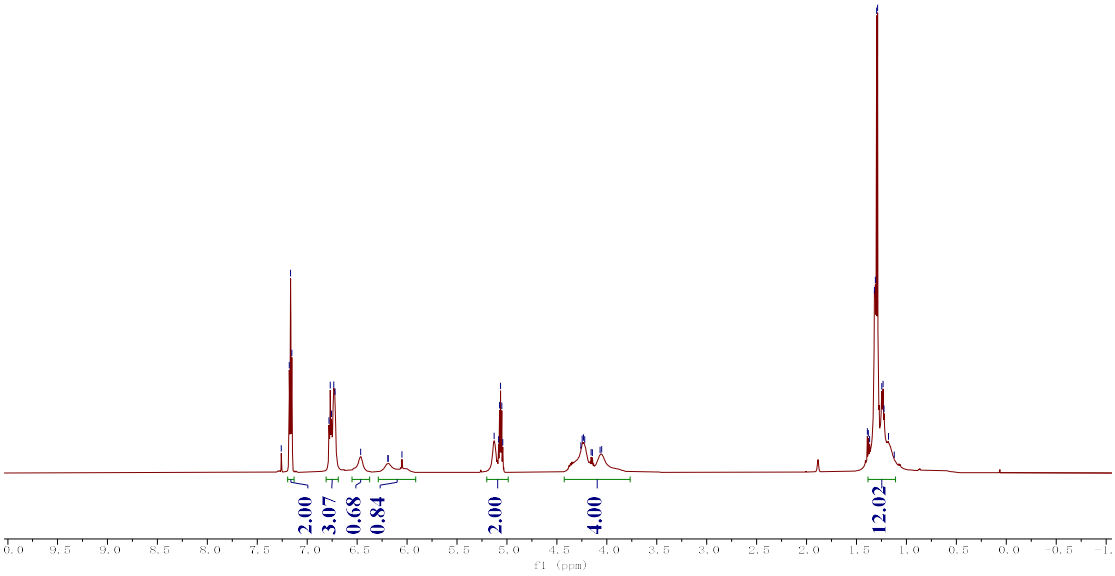


^{13}C NMR (151 MHz) Spectrum of 4b in $CDCl_3$

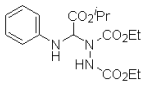


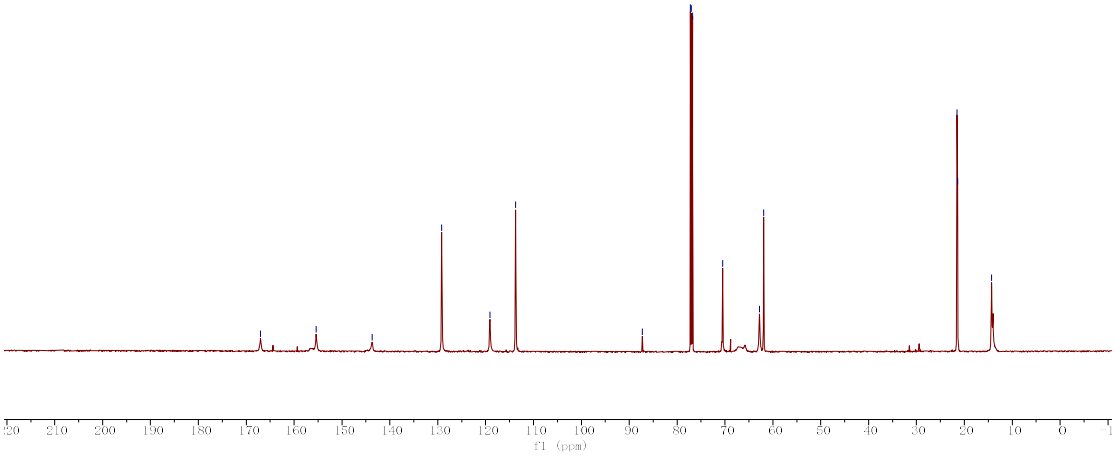
^{1}H NMR (600 MHz) Spectrum of 4c in $CDCl_3$



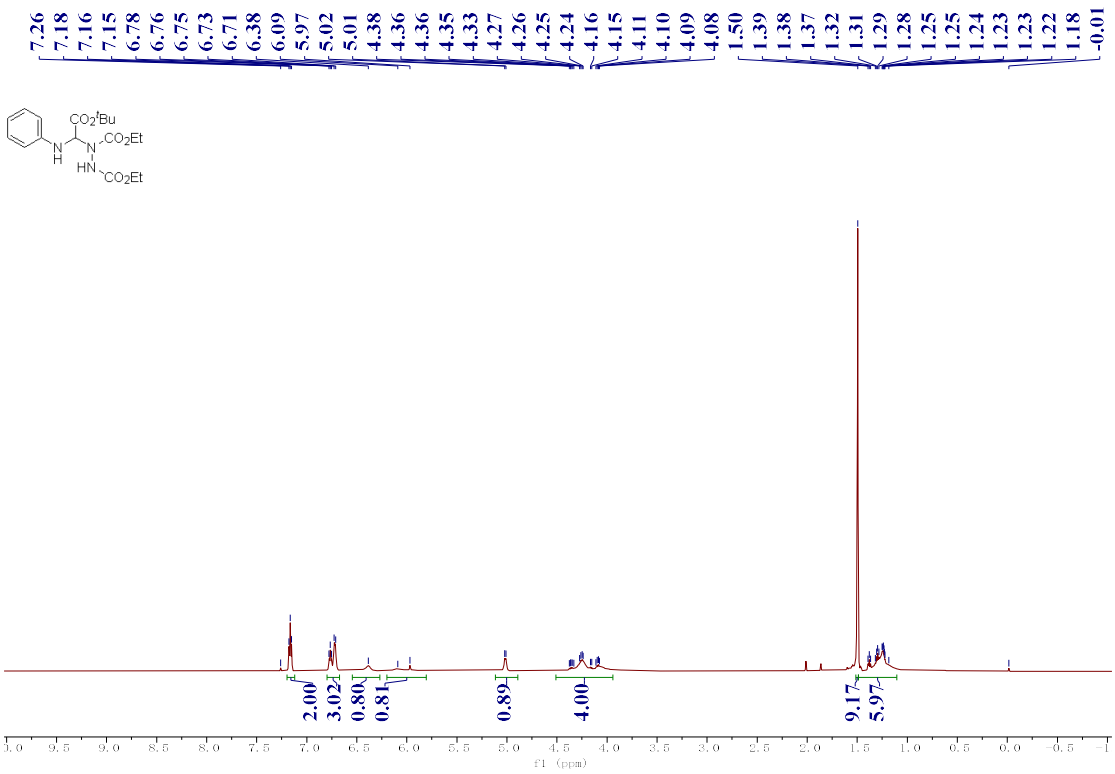


^{13}C NMR (151 MHz) Spectrum of 4c in $CDCl_3$





^{1}H NMR (600 MHz) Spectrum of 4d in $CDCl_3$



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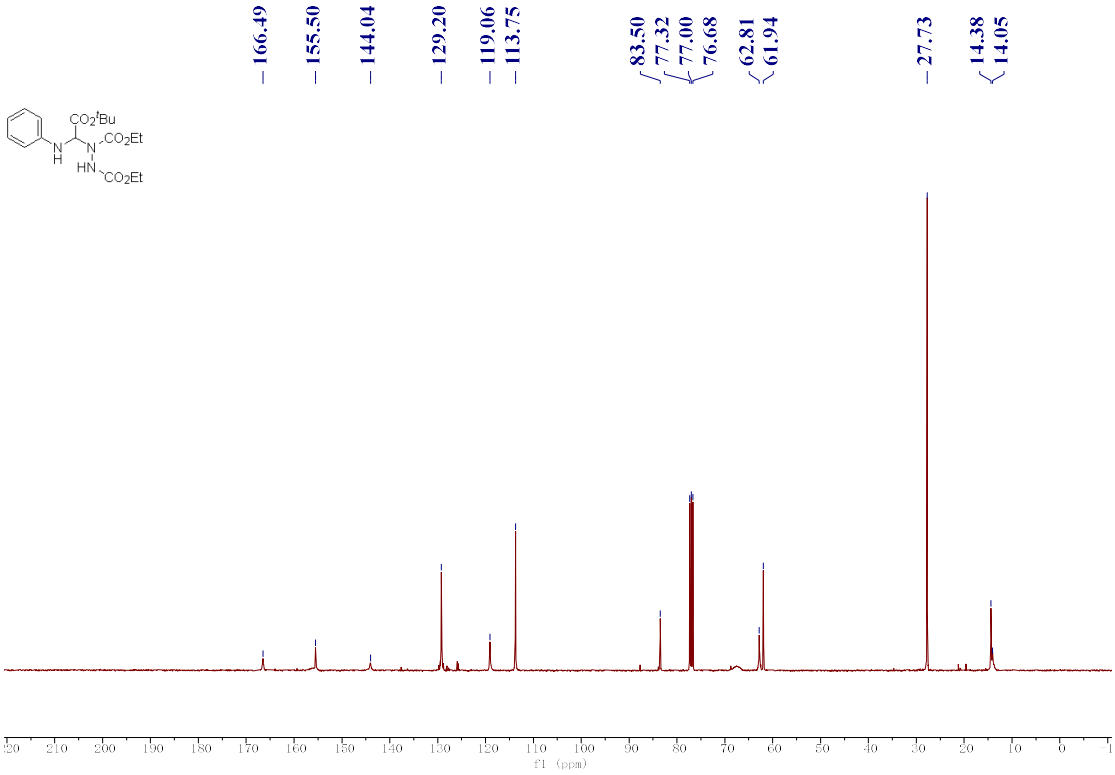

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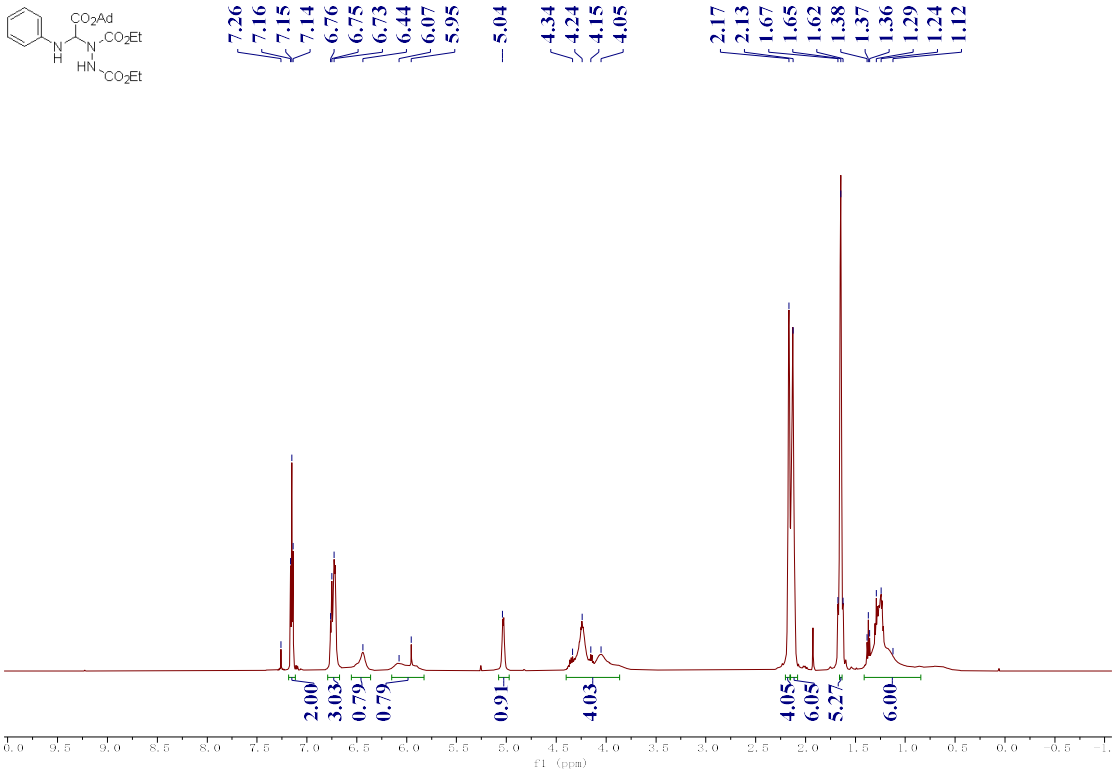
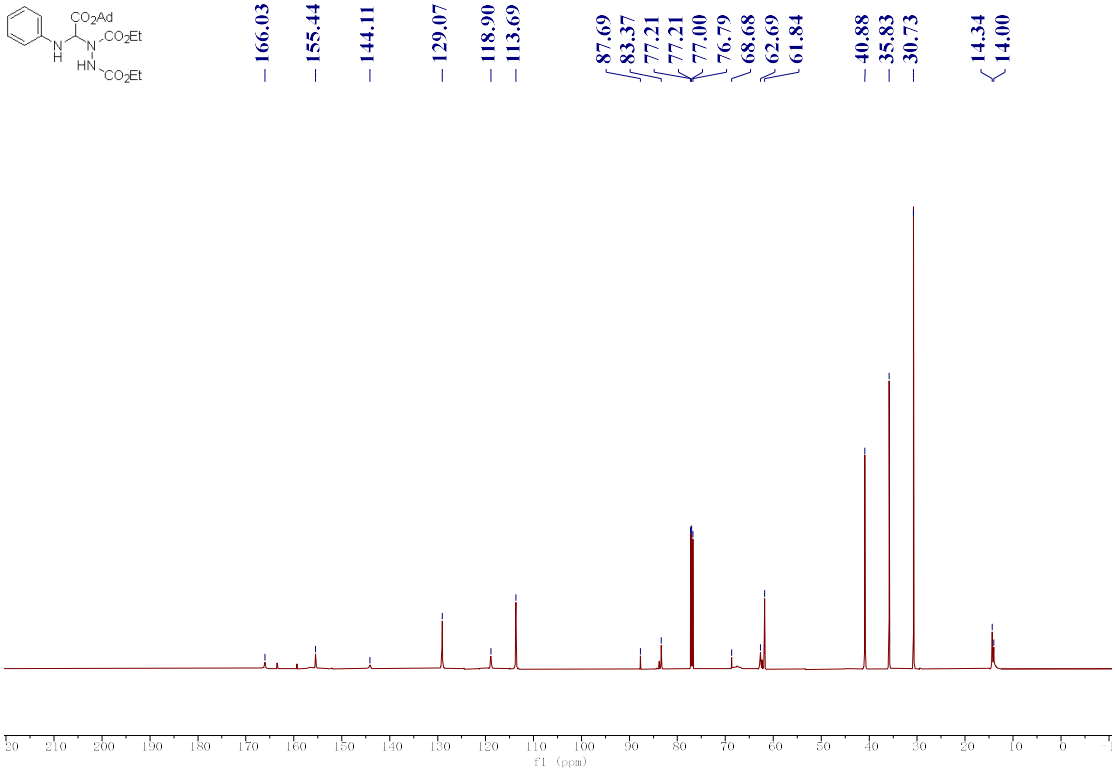
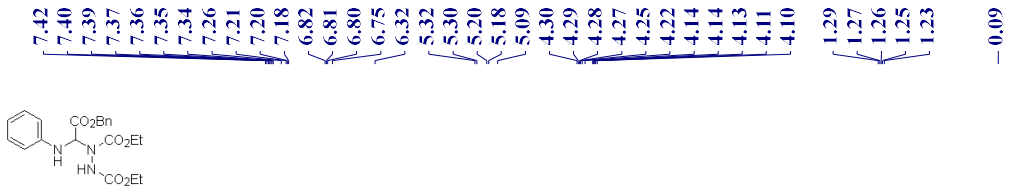
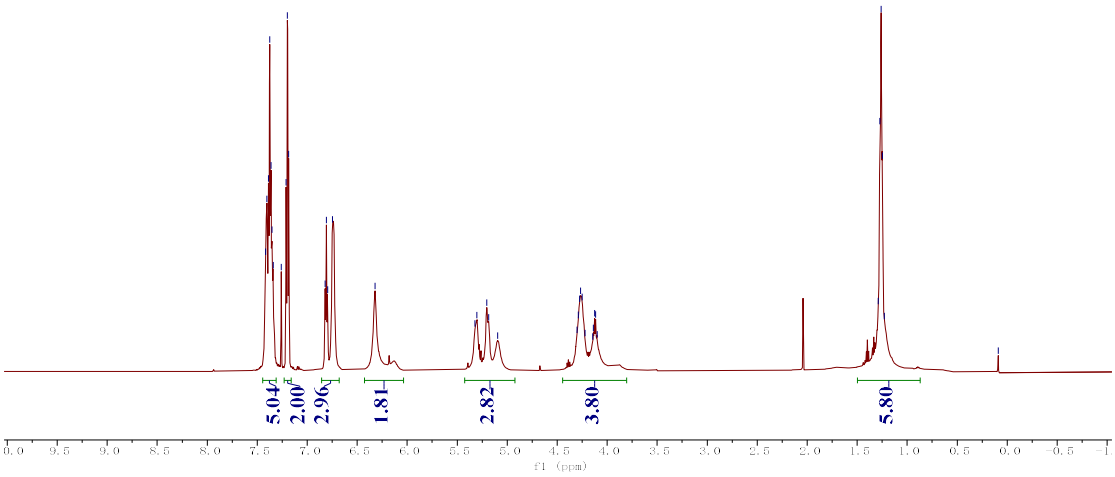


^{13}C NMR (151 MHz) Spectrum of 4e in $CDCl_3$

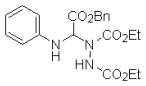


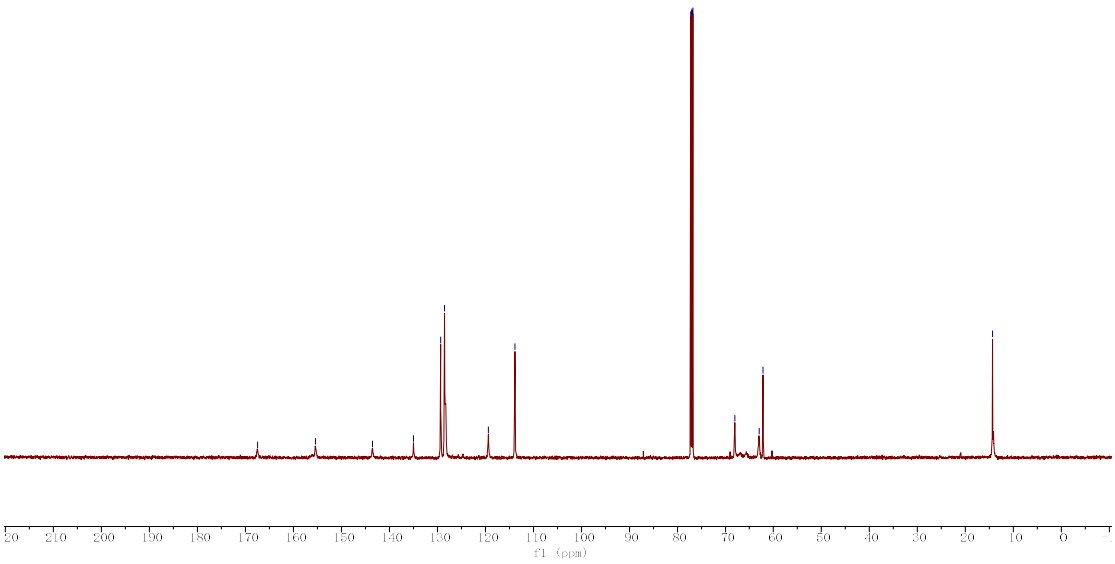
^{1}H NMR (600 MHz) Spectrum of 4f in $CDCl_3$



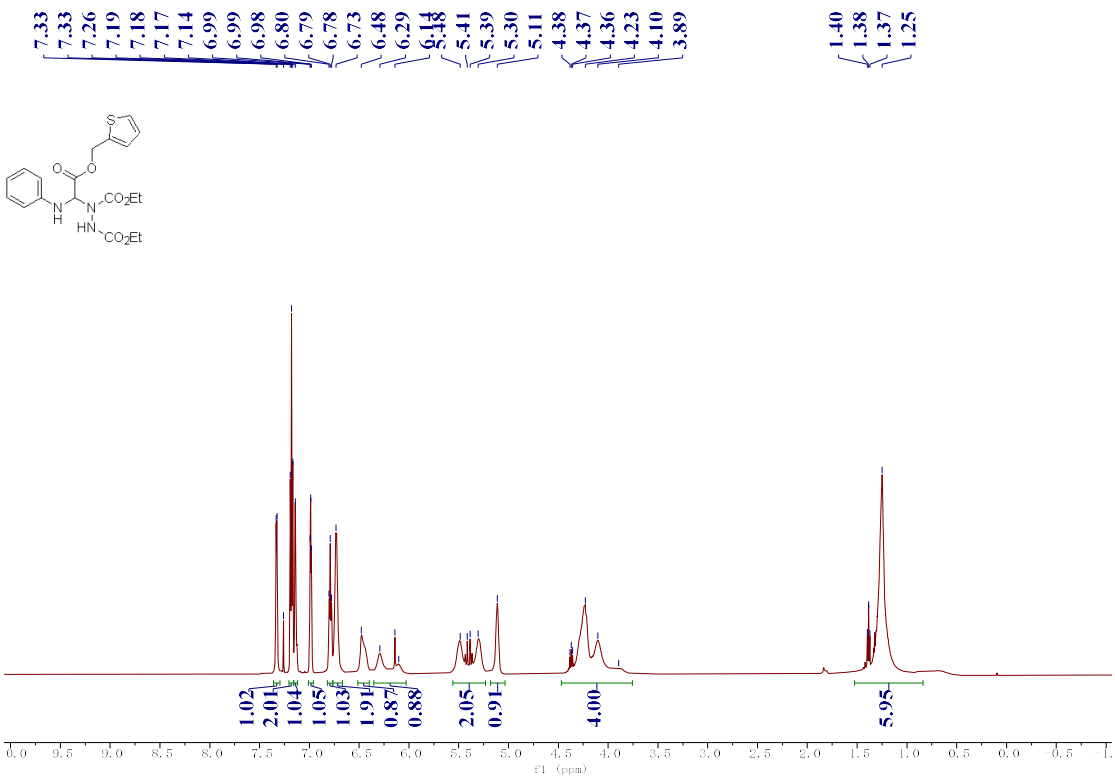


^{13}C NMR (151 MHz) Spectrum of 4f in $CDCl_3$

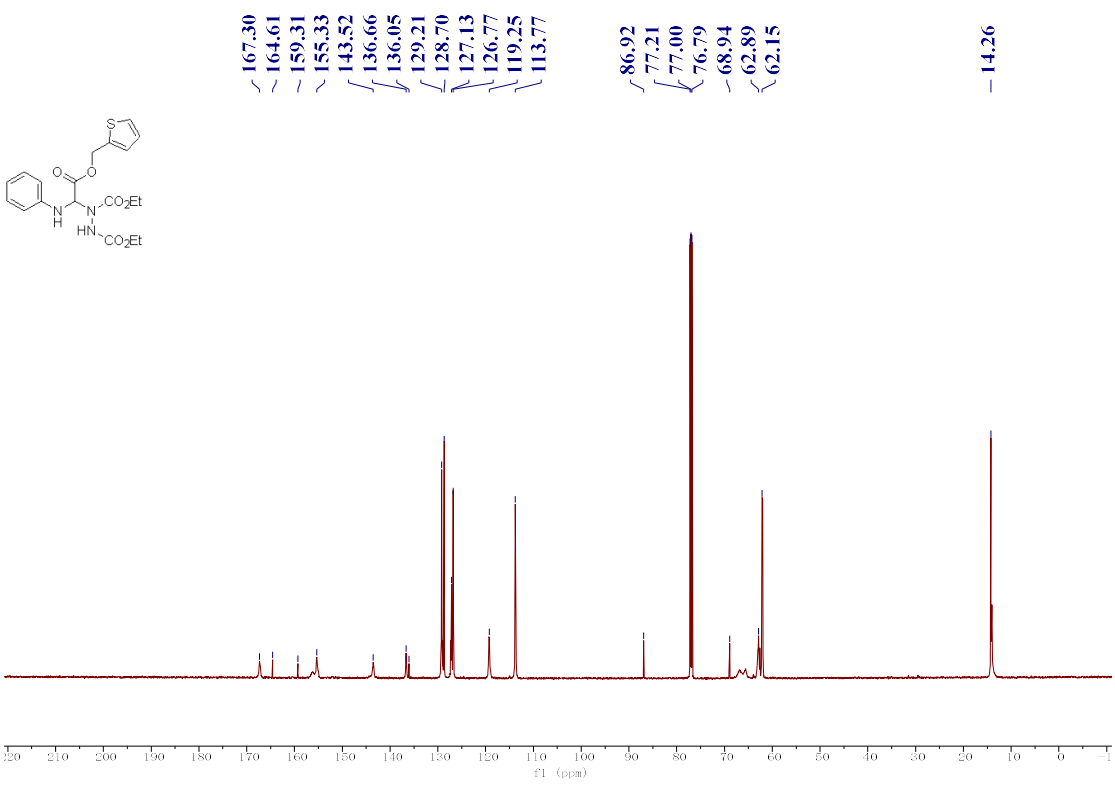




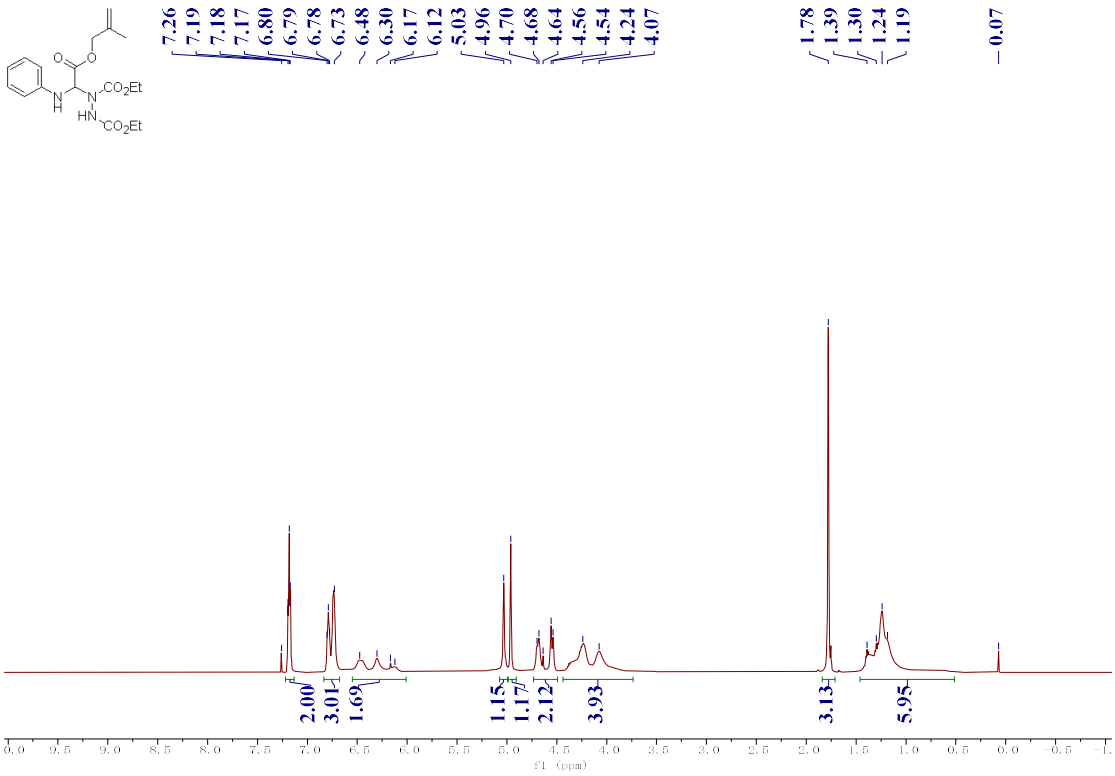
^{1}H NMR (600 MHz) Spectrum of 4g in $CDCl_3$



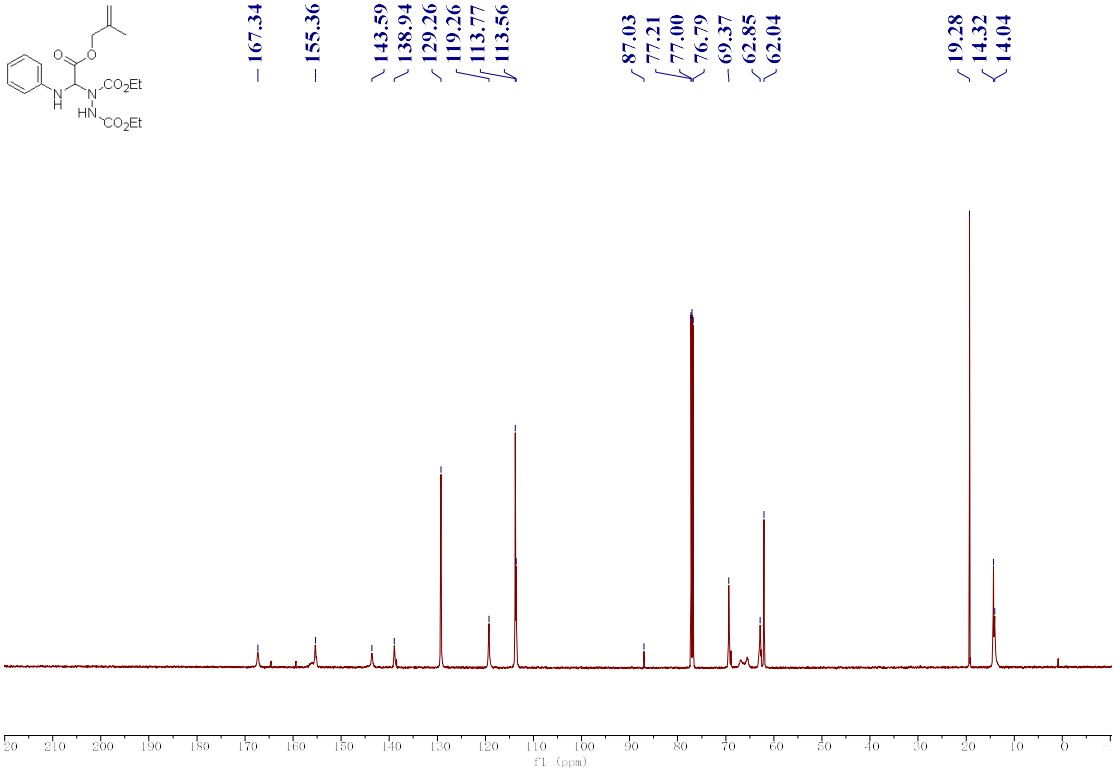
^{13}C NMR (151 MHz) Spectrum of 4g in $CDCl_3$



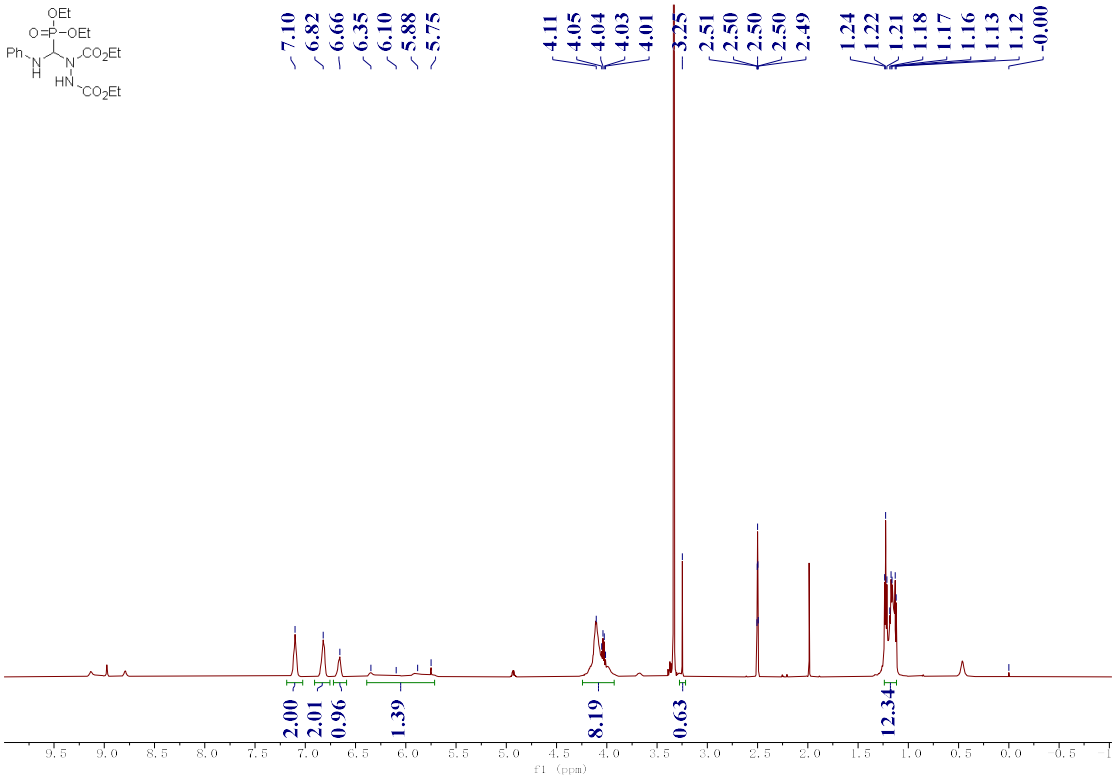
^{1}H NMR (600 MHz) Spectrum of 4h in $CDCl_3$



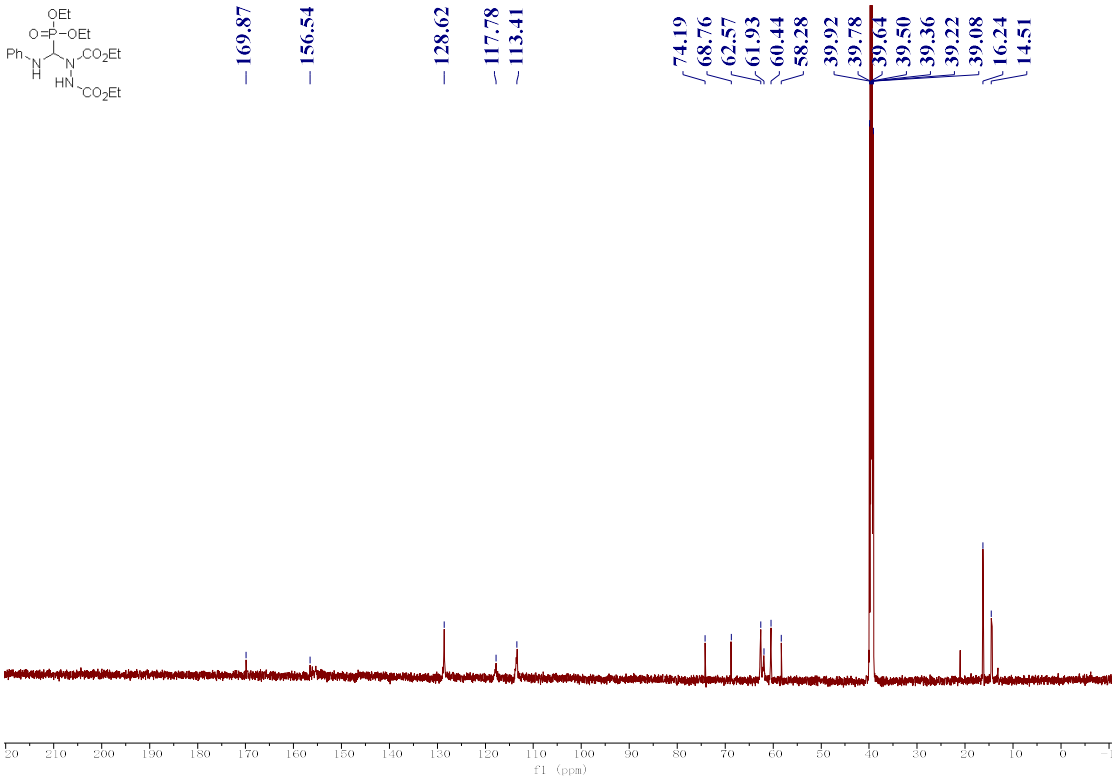
^{13}C NMR (151 MHz) Spectrum of 4h in $CDCl_3$



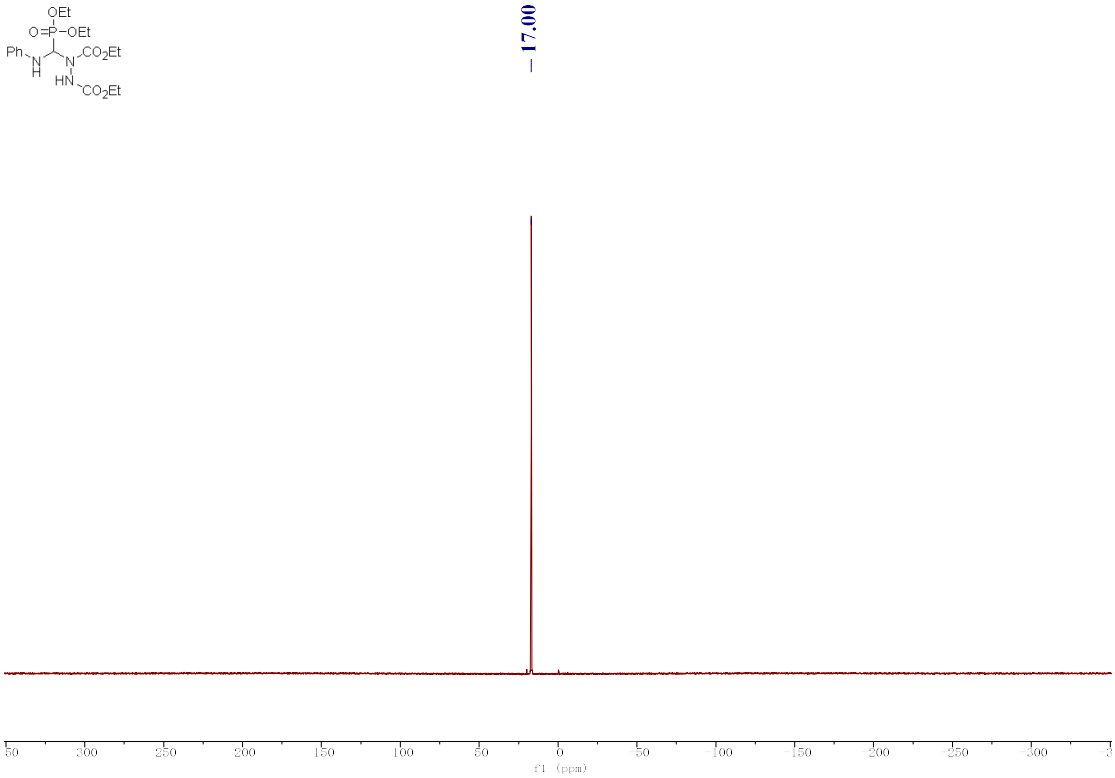
^{1}H NMR (600 MHz) Spectrum of 4i in DMSO-d_6



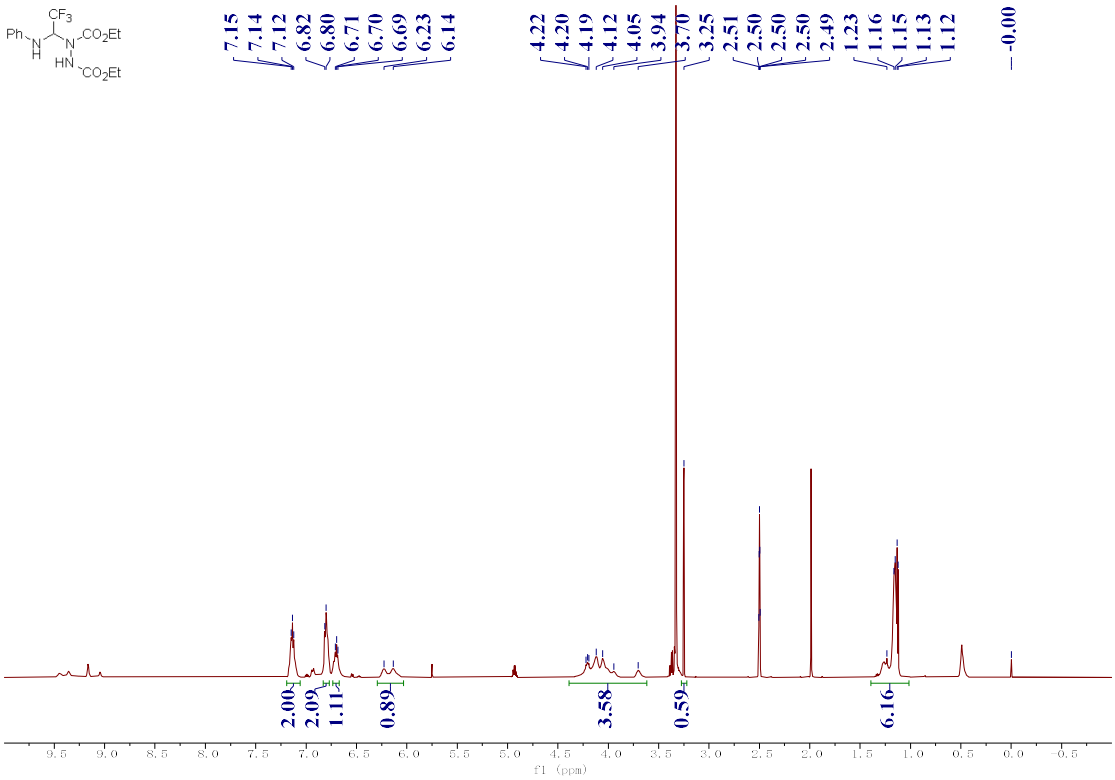
^{13}C NMR (151 MHz) Spectrum of 4i in DMSO-d_6



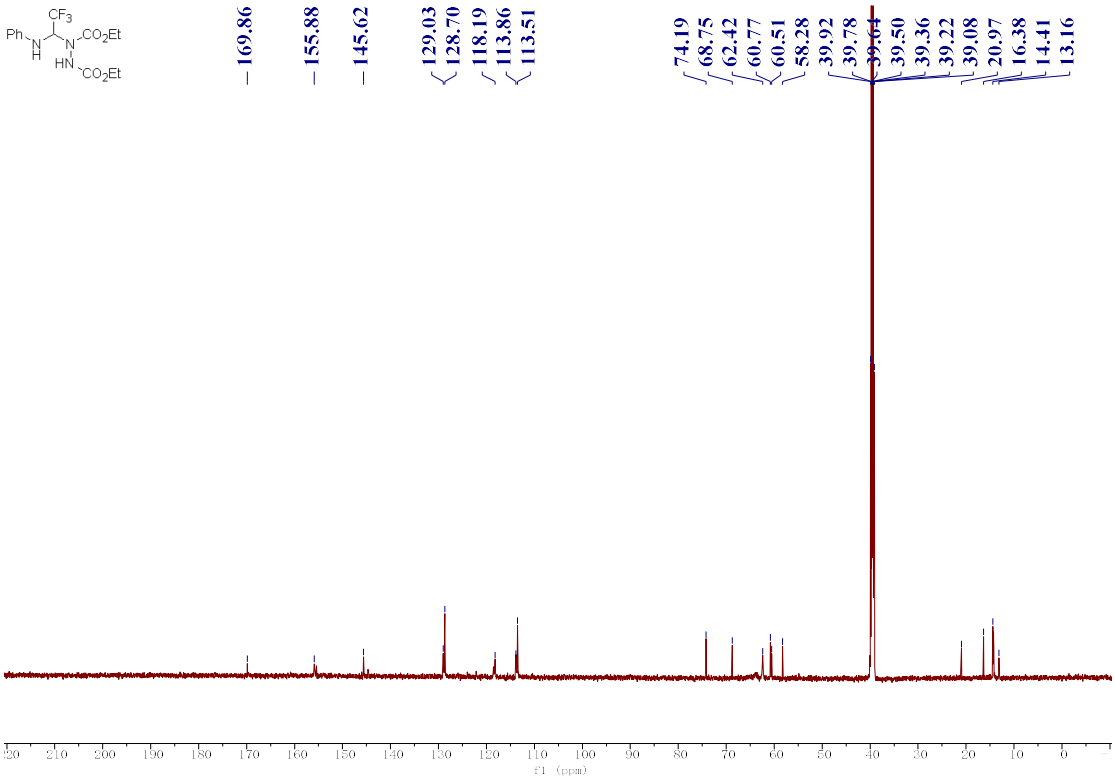
^{31}P NMR (162 MHz) Spectrum of 4i in DMSO-d_6



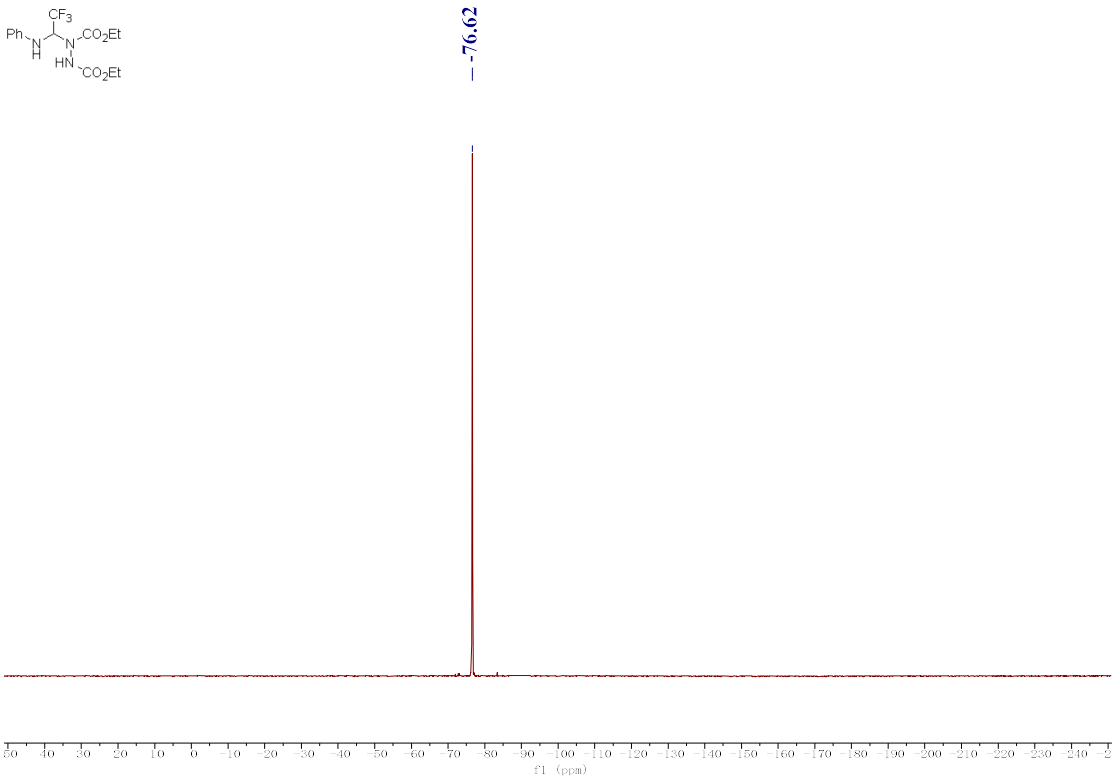
^{1}H NMR (600 MHz) Spectrum of 4j in DMSO-d_6



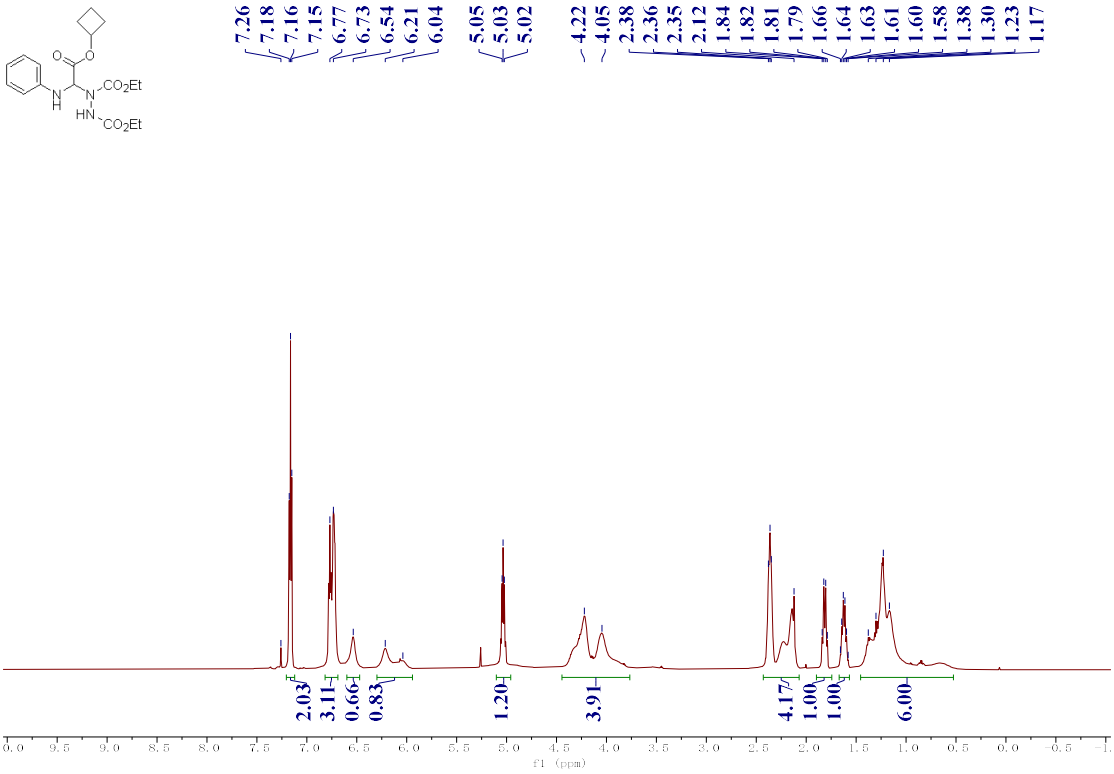
^{13}C NMR (151 MHz) Spectrum of 4j in DMSO-*d*$_6$



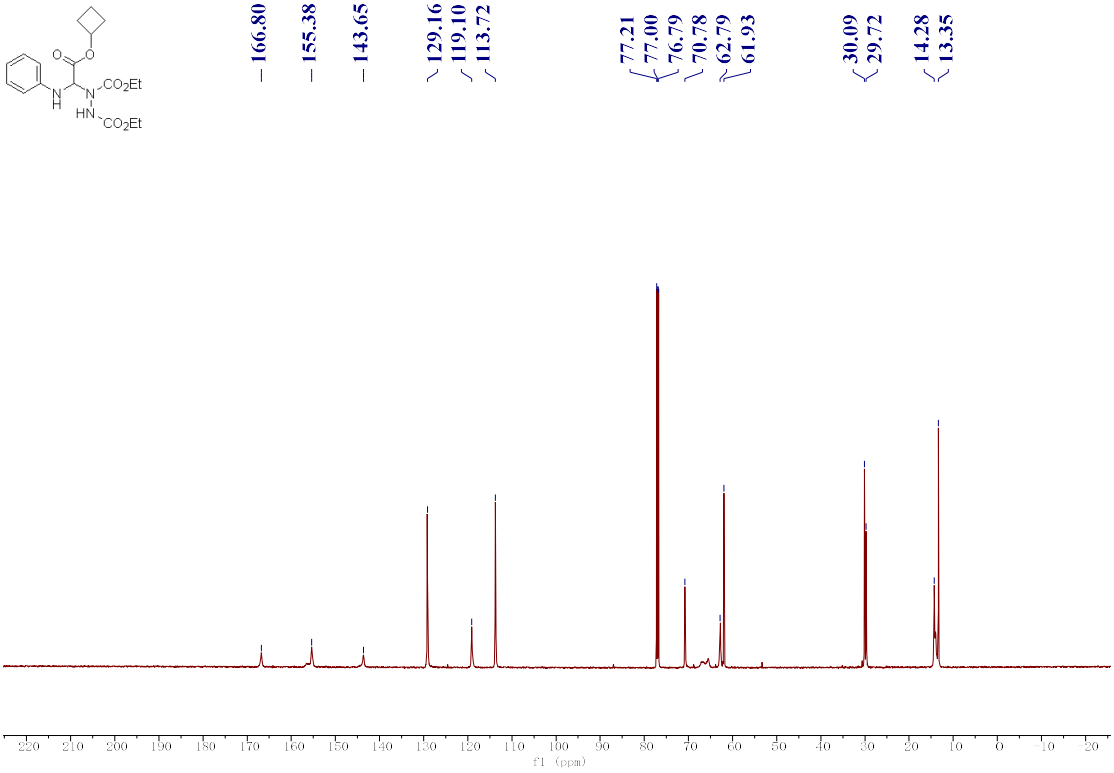
^{19}F NMR (376 MHz) Spectrum of 4j in DMSO-*d*$_6$



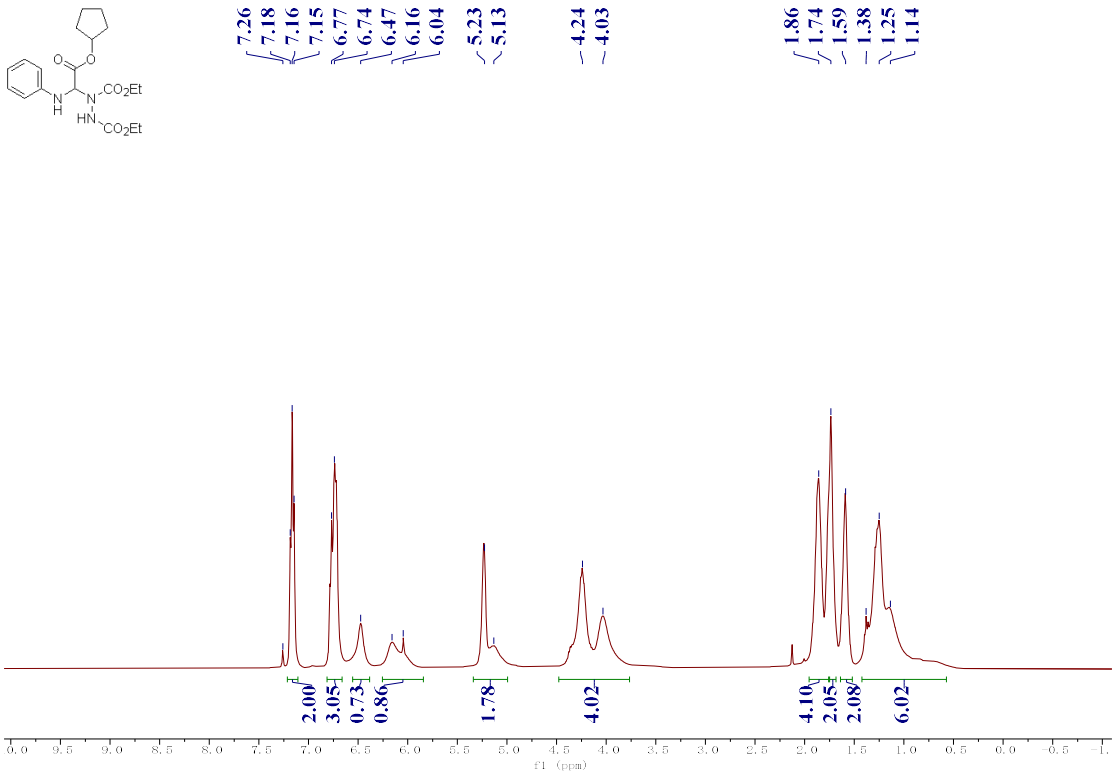
^{1}H NMR (600 MHz) Spectrum of 4k in $CDCl_3$



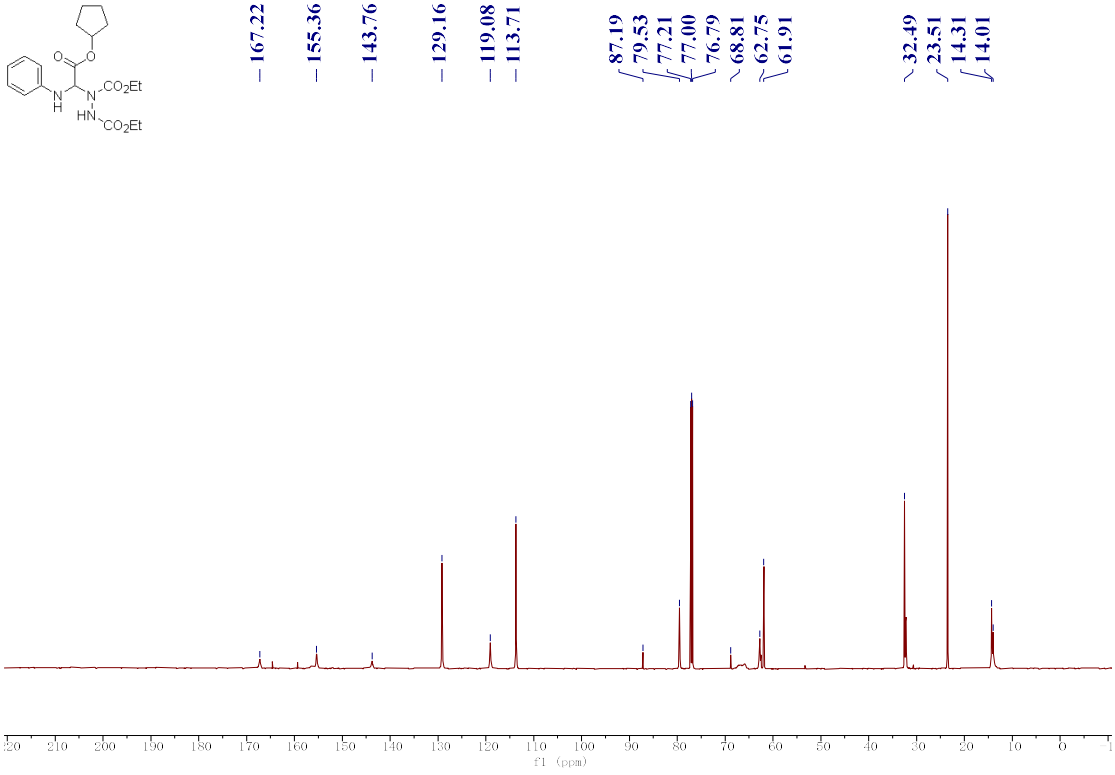
^{13}C NMR (151 MHz) Spectrum of 4k in $CDCl_3$



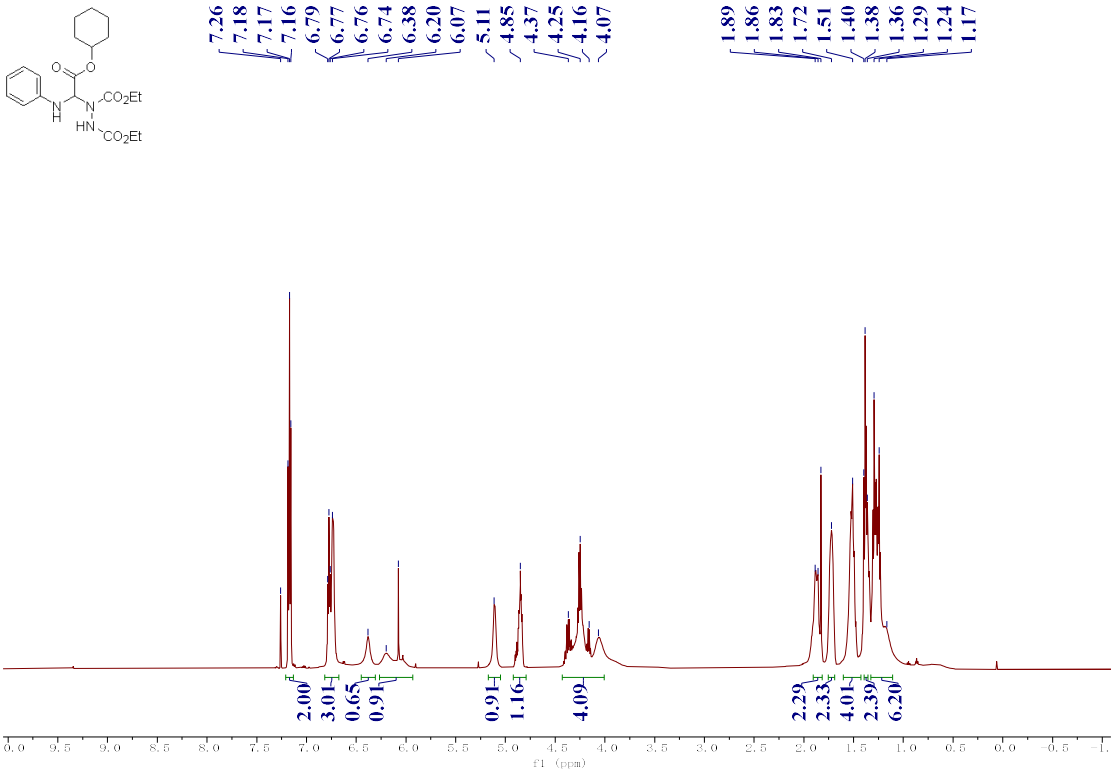
^{1}H NMR (400 MHz) Spectrum of 4l in $CDCl_3$



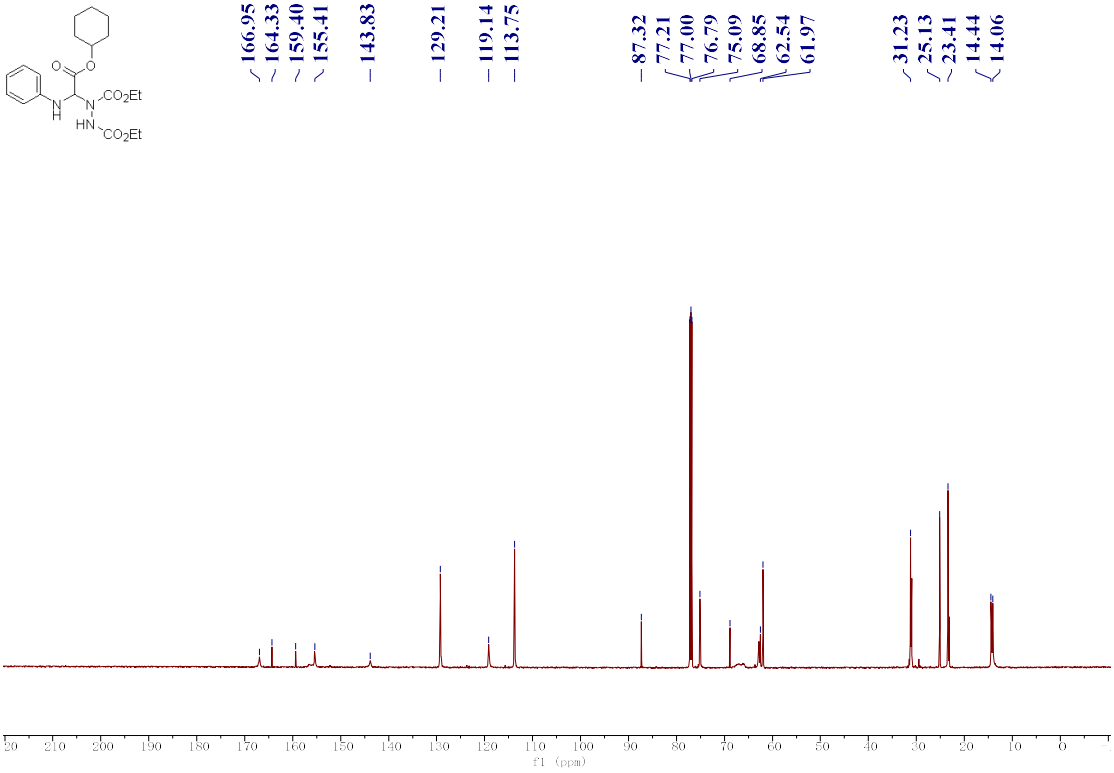
^{13}C NMR (151 MHz) Spectrum of 4l in $CDCl_3$



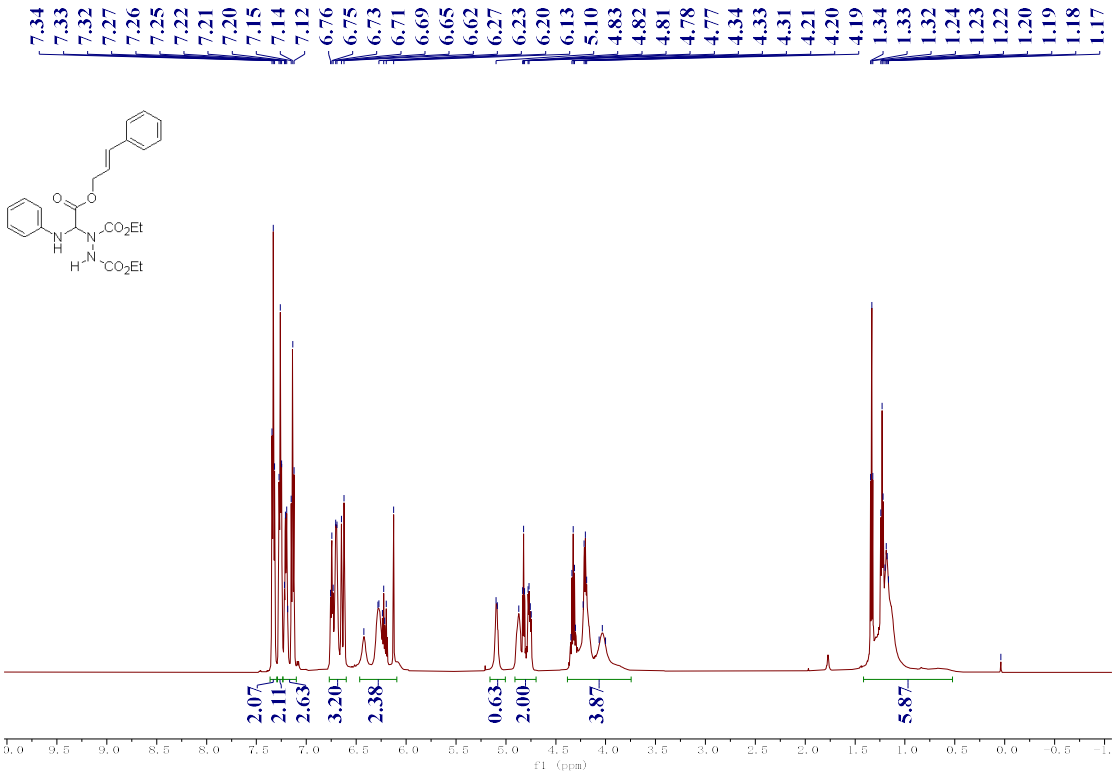
^{1}H NMR (600 MHz) Spectrum of 4m in $CDCl_3$



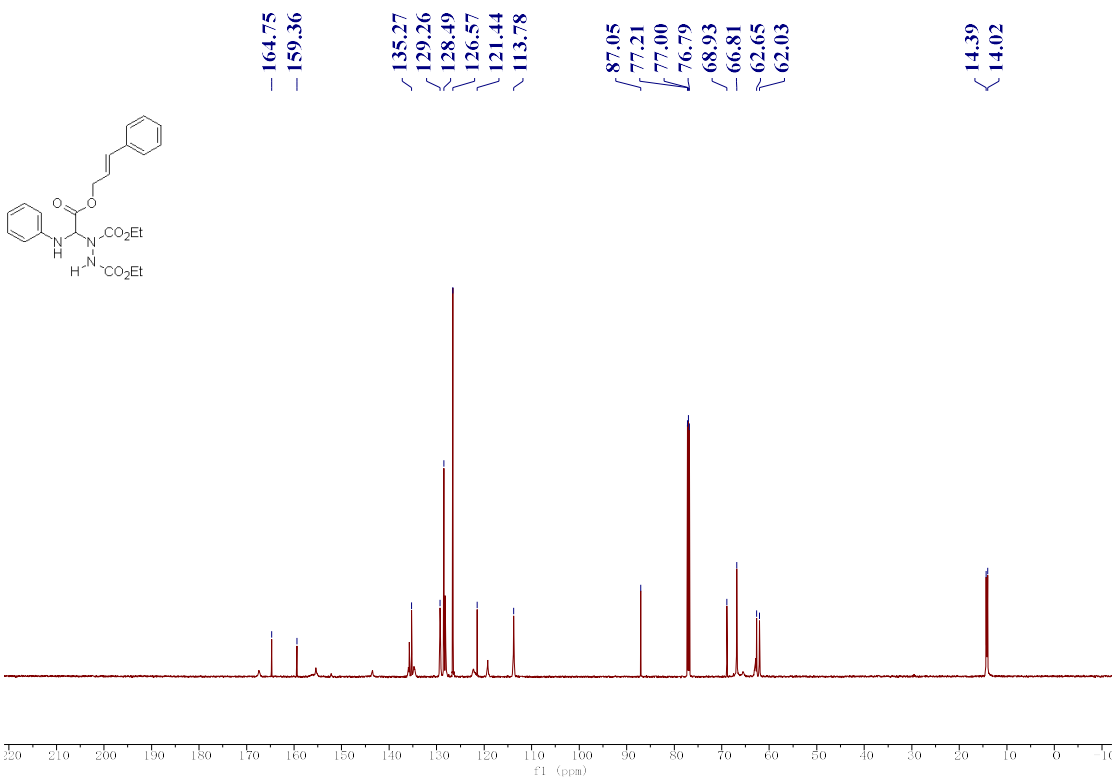
^{13}C NMR (151 MHz) Spectrum of 4m in $CDCl_3$



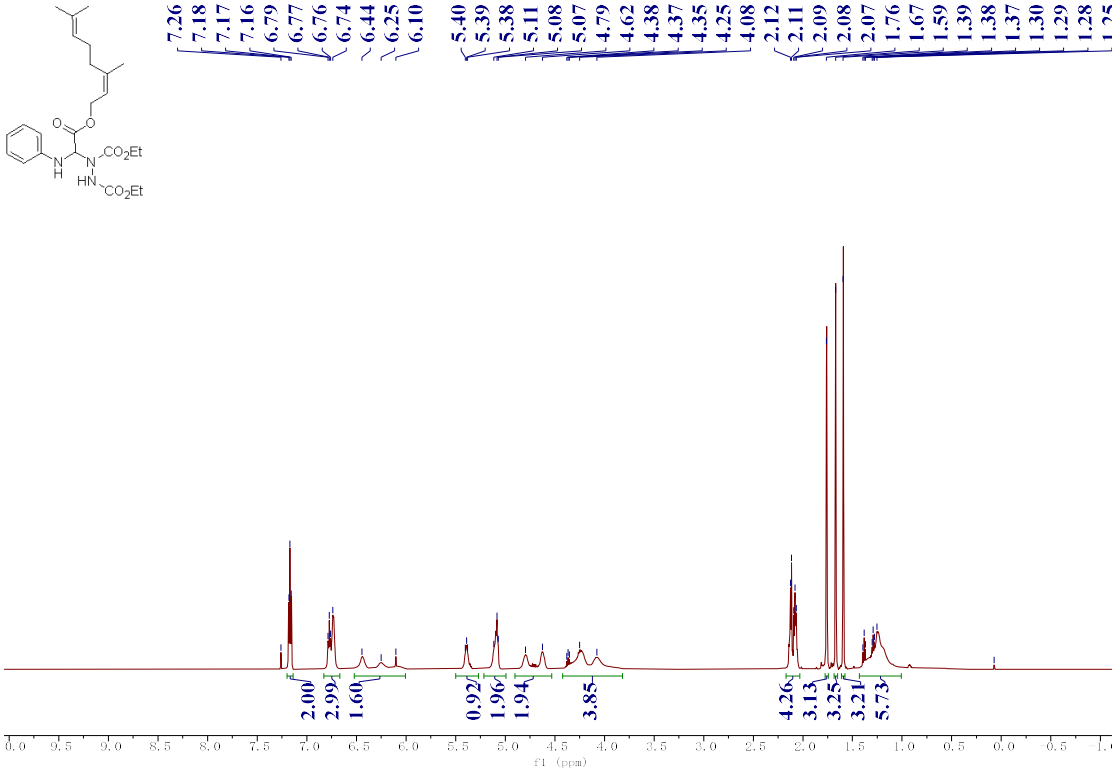
^{1}H NMR (600 MHz) Spectrum of 4n in $CDCl_3$



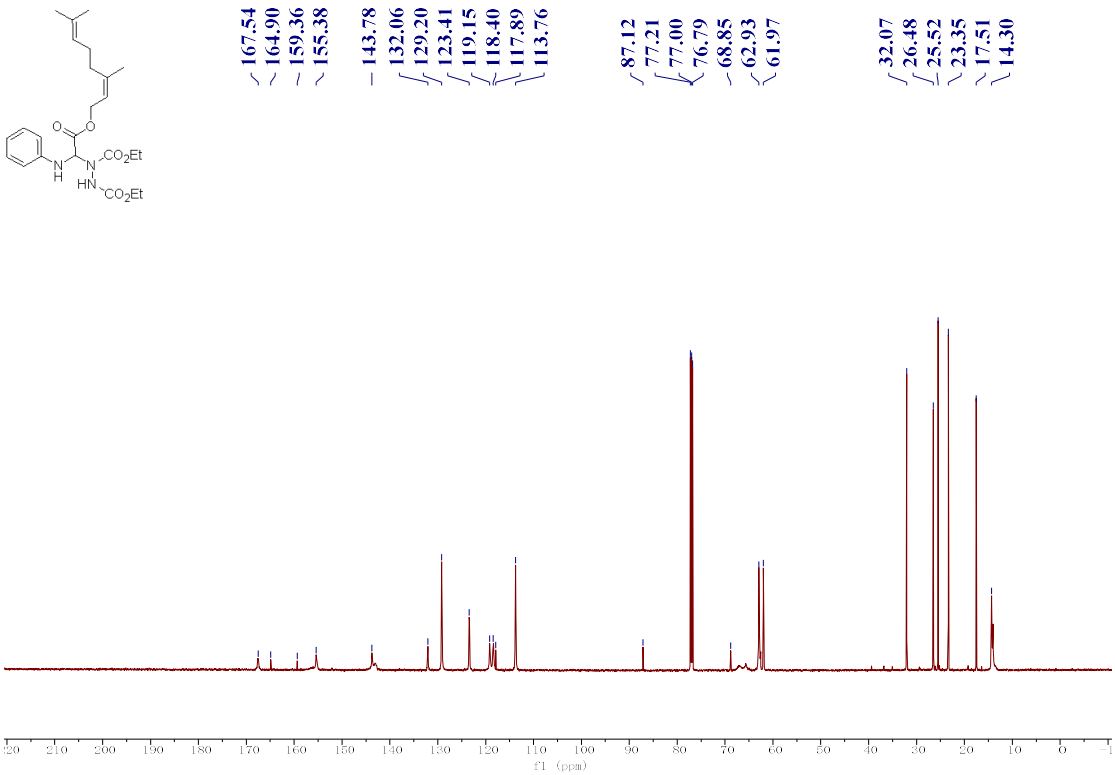
^{13}C NMR (151 MHz) Spectrum of 4n in $CDCl_3$



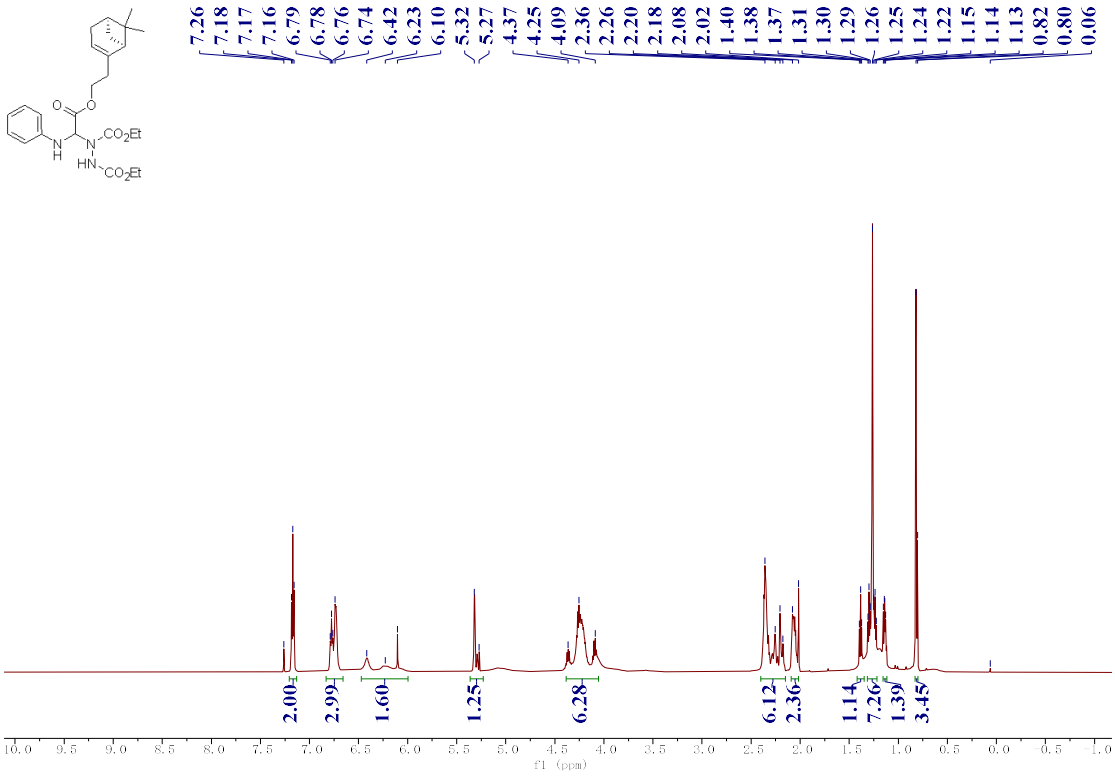
^{1}H NMR (600 MHz) Spectrum of 4o in $CDCl_3$



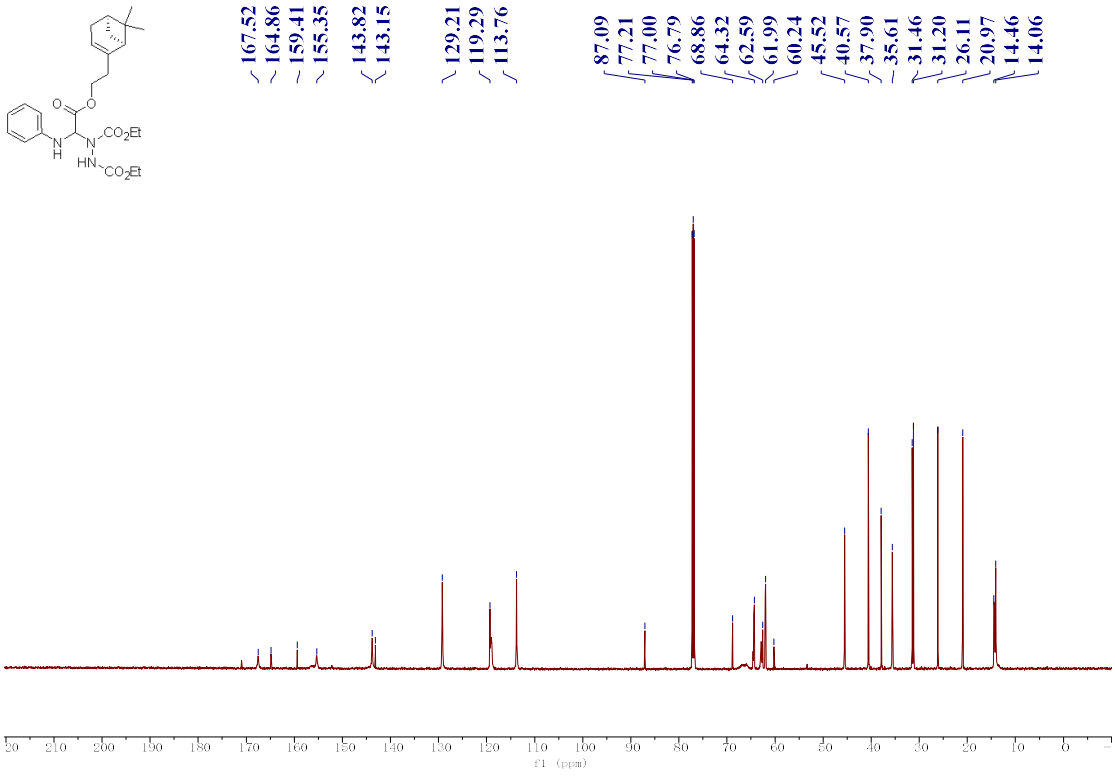
^{13}C NMR (151 MHz) Spectrum of 4o in $CDCl_3$



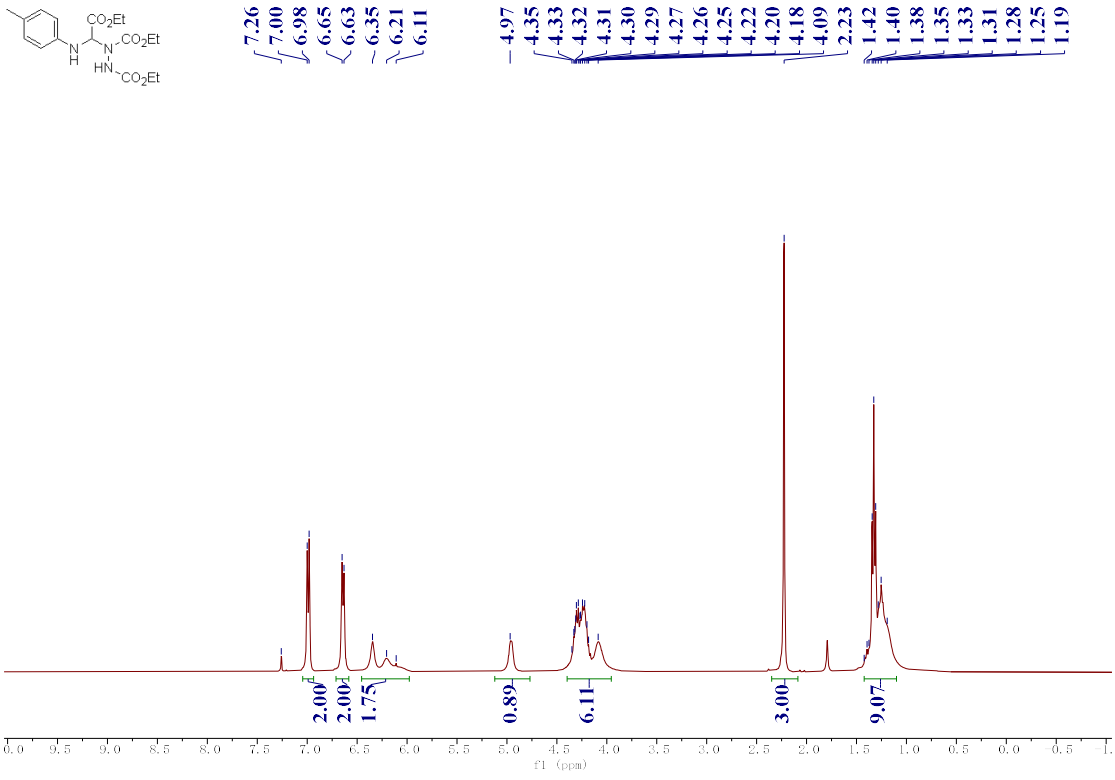
^{1}H NMR (600 MHz) Spectrum of 4p in $CDCl_3$



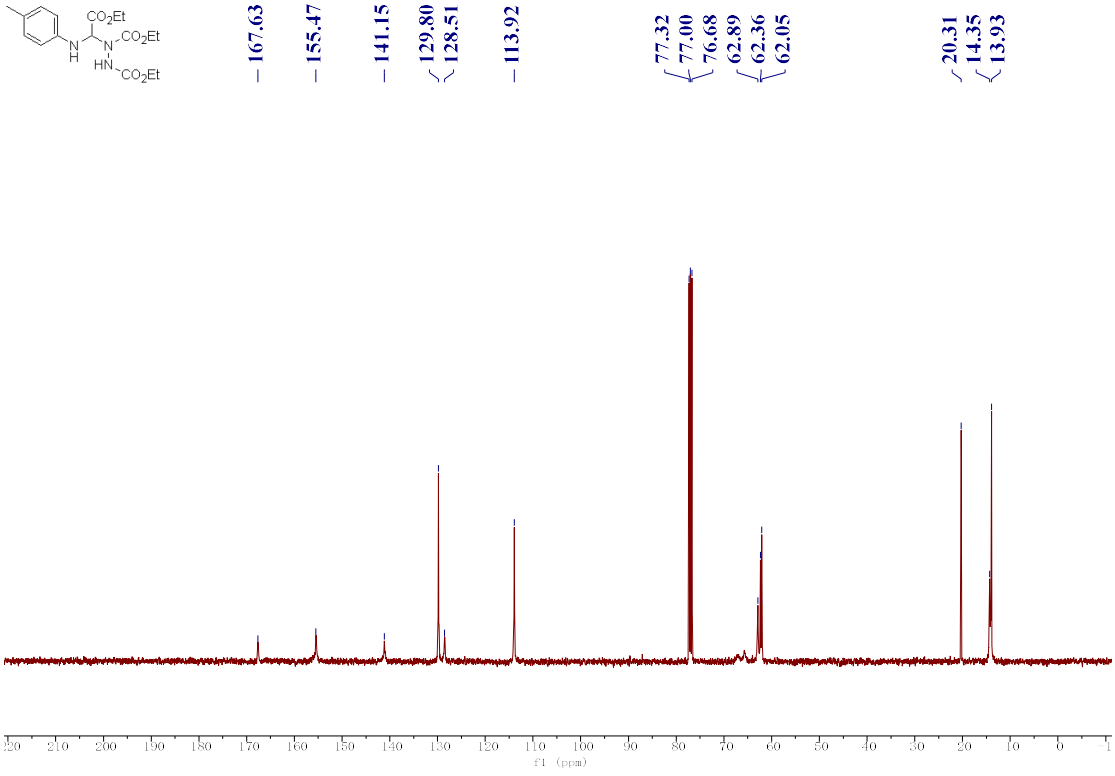
^{13}C NMR (151 MHz) Spectrum of 4p in $CDCl_3$



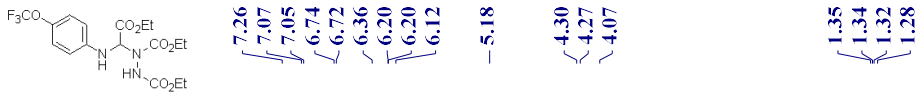
^{1}H NMR (400 MHz) Spectrum of 4q in $CDCl_3$

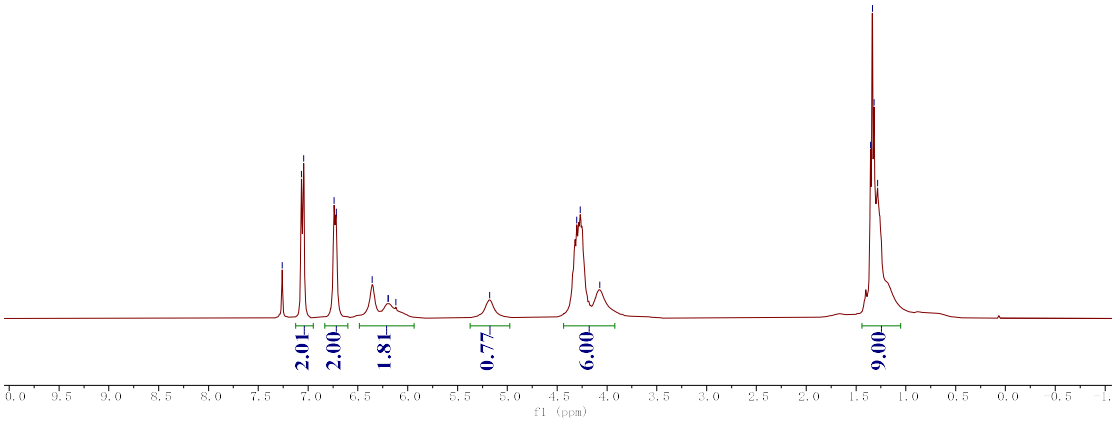


^{13}C NMR (101 MHz) Spectrum of 4q in $CDCl_3$

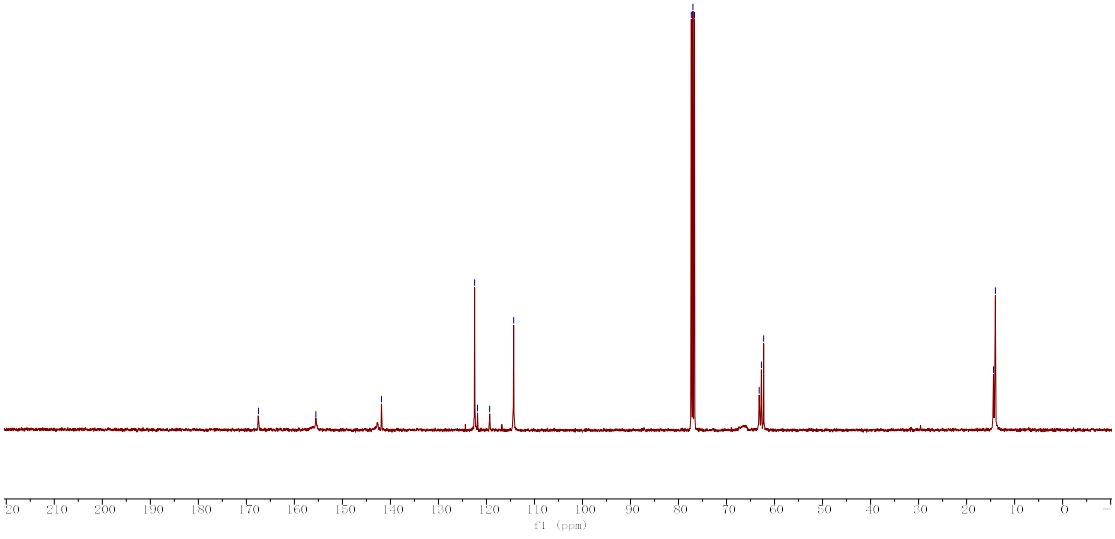


^{1}H NMR (400 MHz) Spectrum of 4r in $CDCl_3$

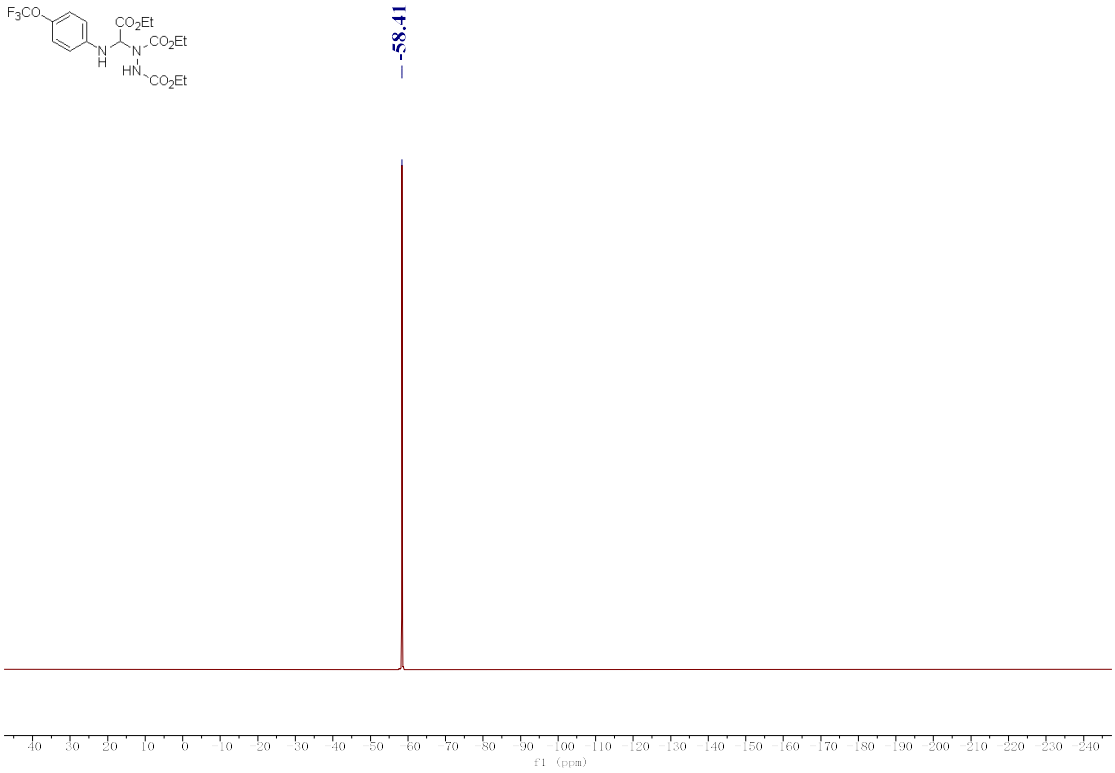




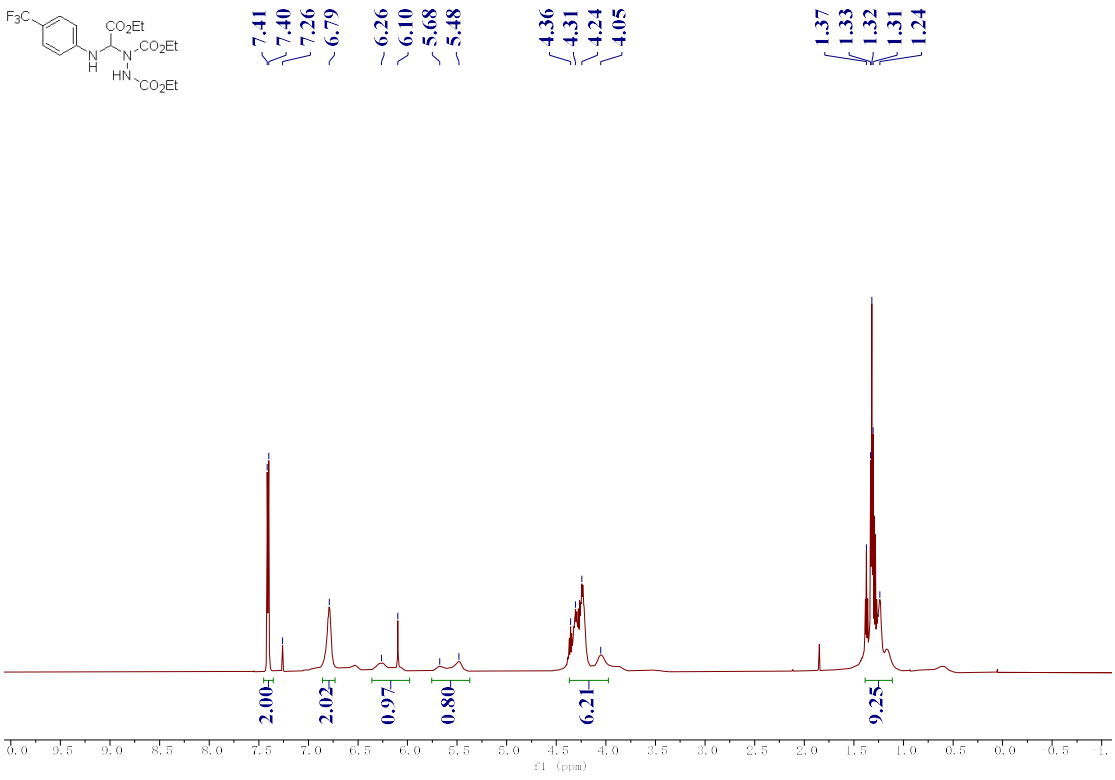
^{13}C NMR (101 MHz) Spectrum of 4r in $CDCl_3$



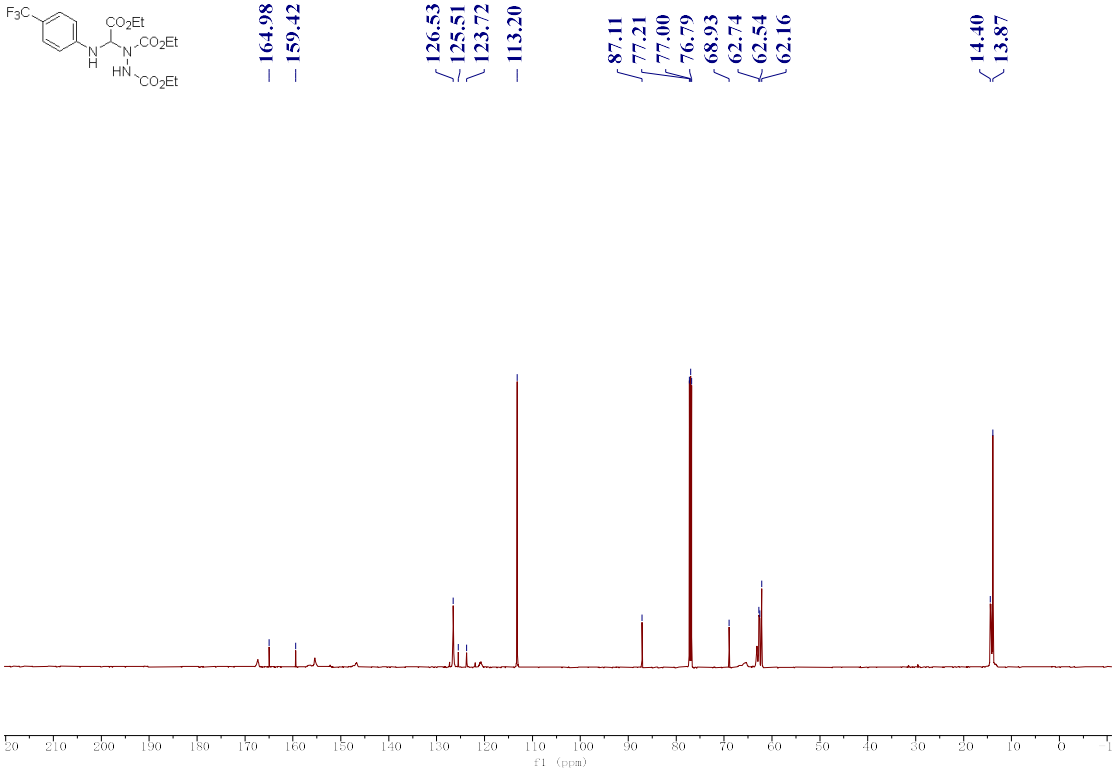
^{19}F NMR (565 MHz) Spectrum of 4r in $CDCl_3$



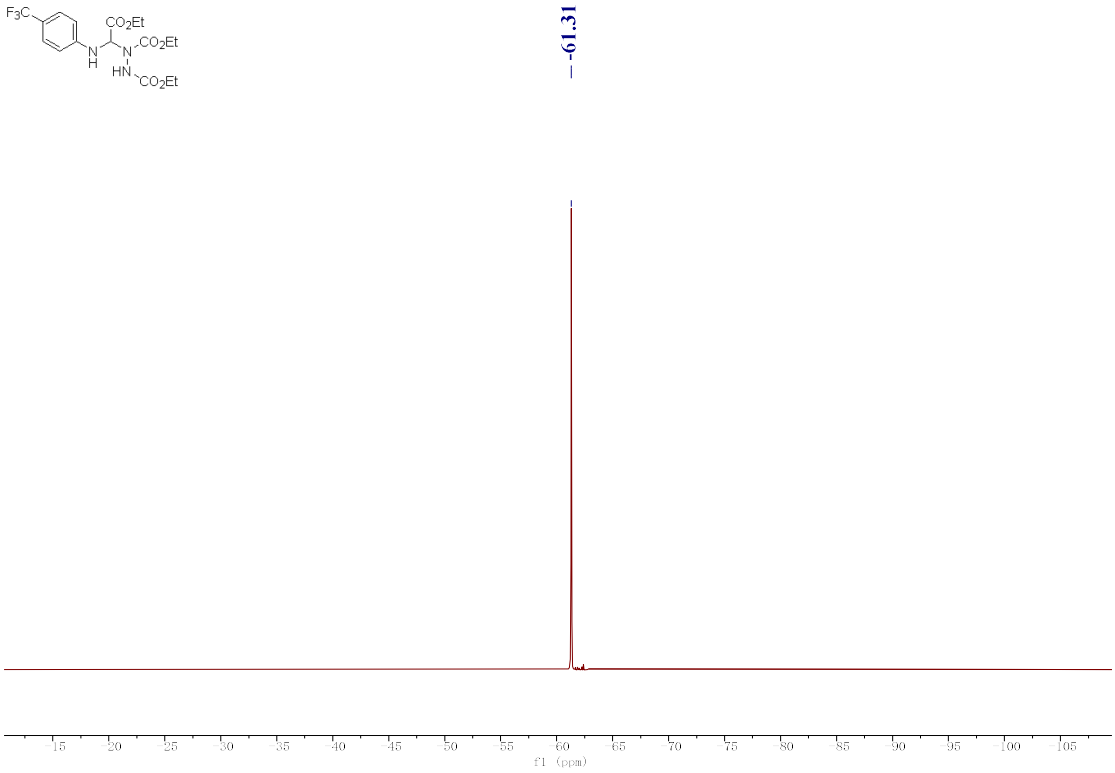
^{1}H NMR (600 MHz) Spectrum of 4s in $CDCl_3$



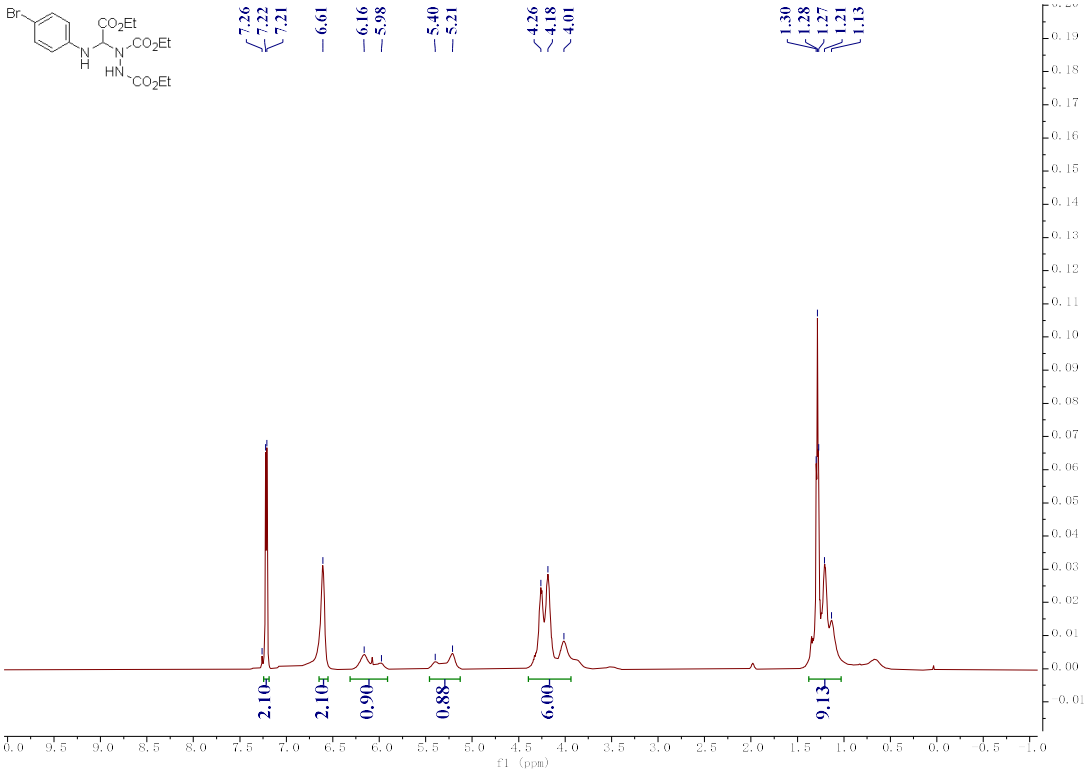
^{13}C NMR (151 MHz) Spectrum of 4s in $CDCl_3$



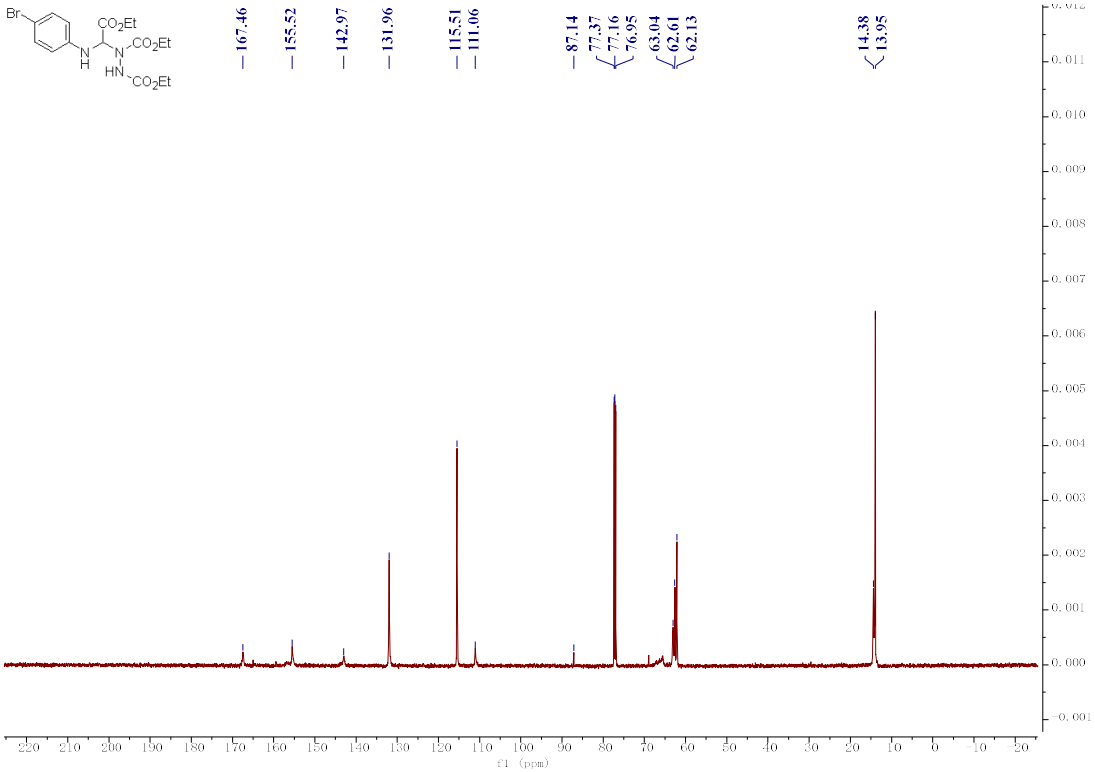
^{19}F NMR (565 MHz) Spectrum of 4s in $CDCl_3$



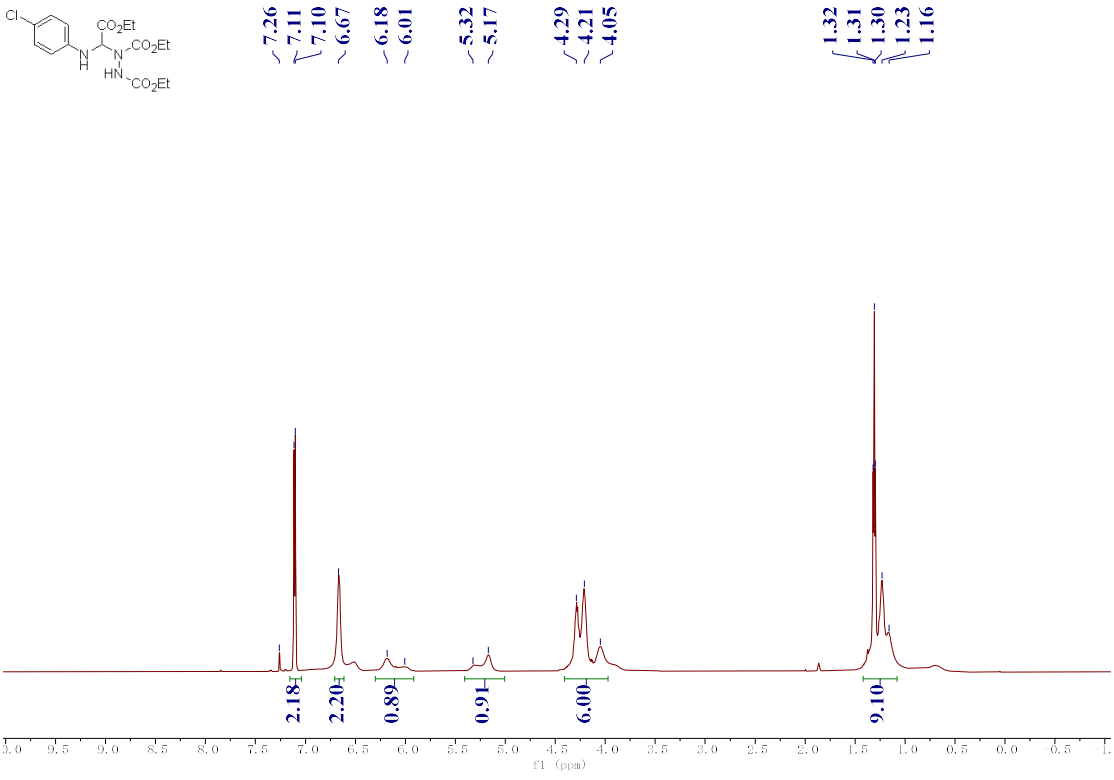
^{1}H NMR (600 MHz) Spectrum of 4t in $CDCl_3$



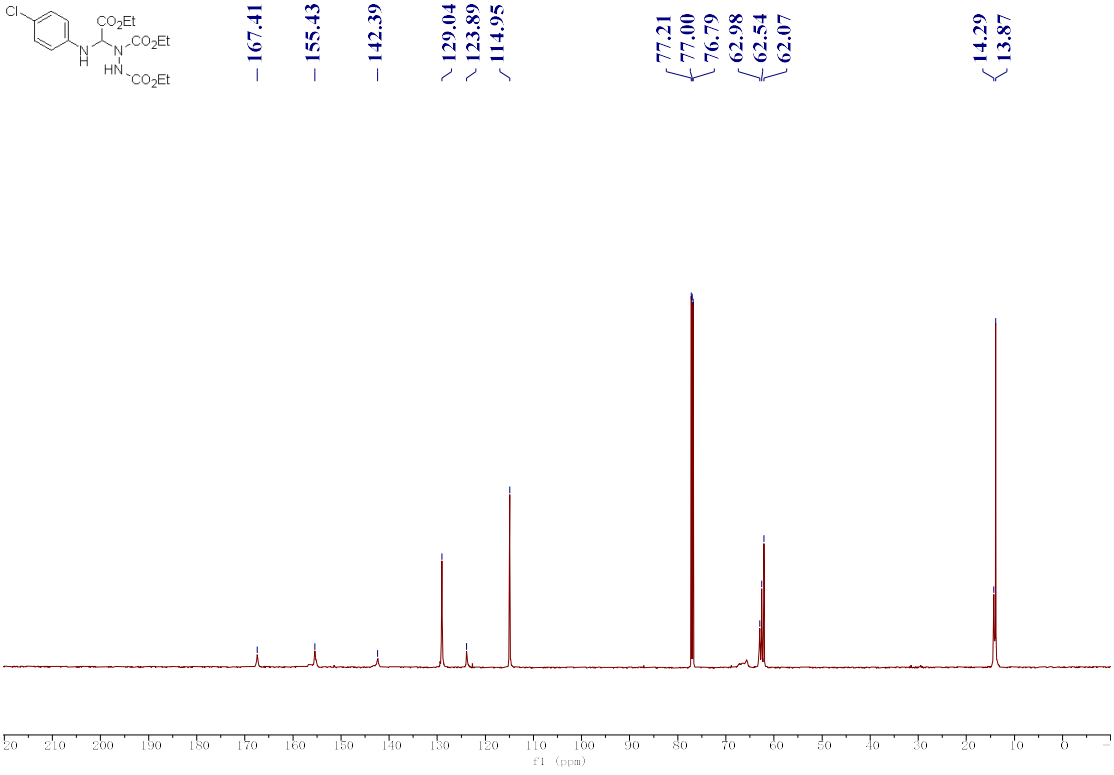
^{13}C NMR (151 MHz) Spectrum of 4t in $CDCl_3$



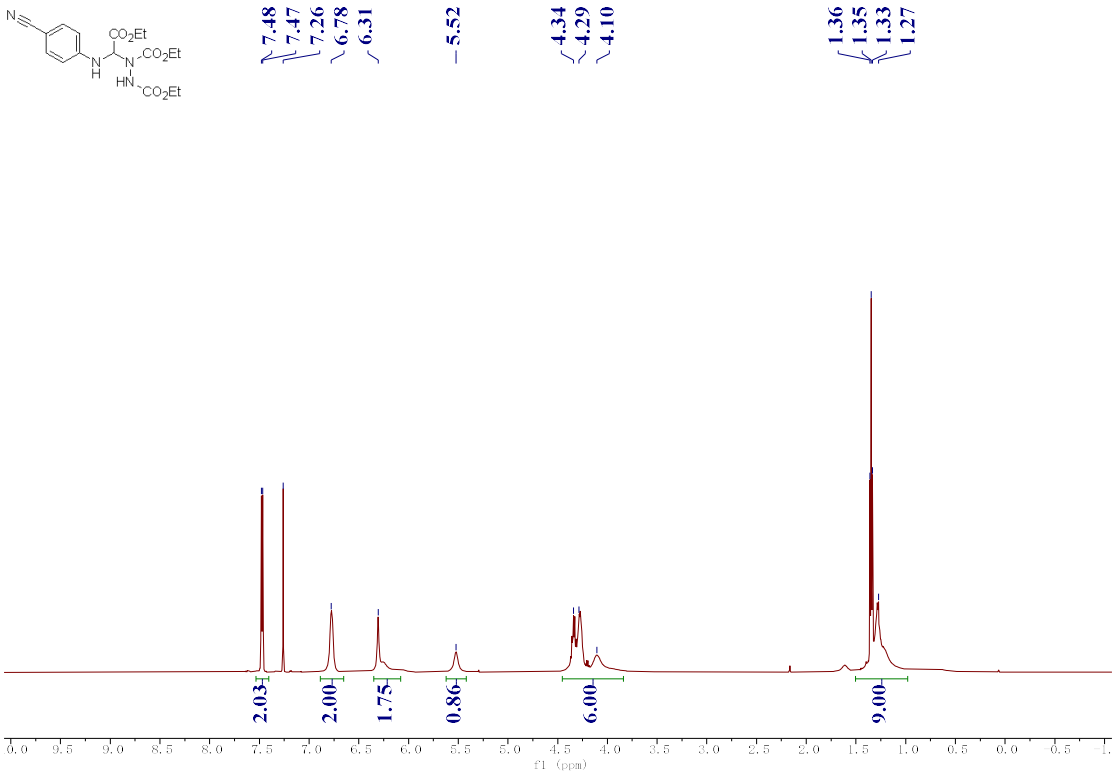
^{1}H NMR (600 MHz) Spectrum of 4u in $CDCl_3$



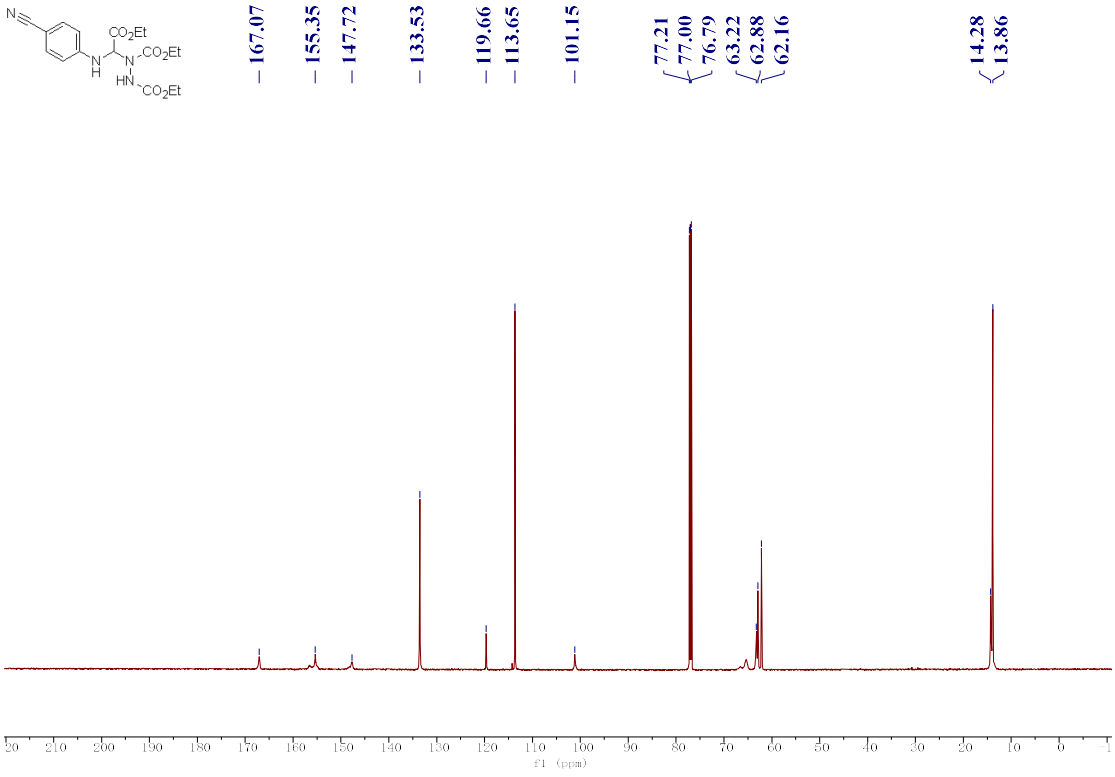
^{13}C NMR (151 MHz) Spectrum of 4u in $CDCl_3$



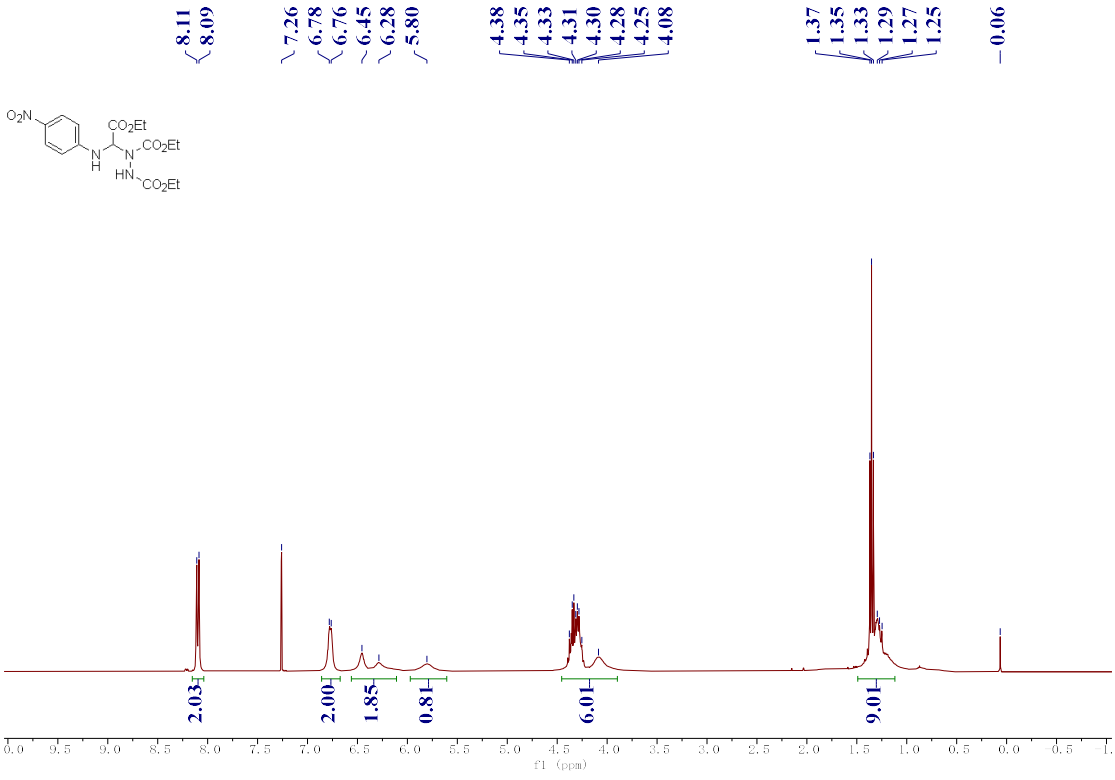
^{1}H NMR (600 MHz) Spectrum of 4v in $CDCl_3$



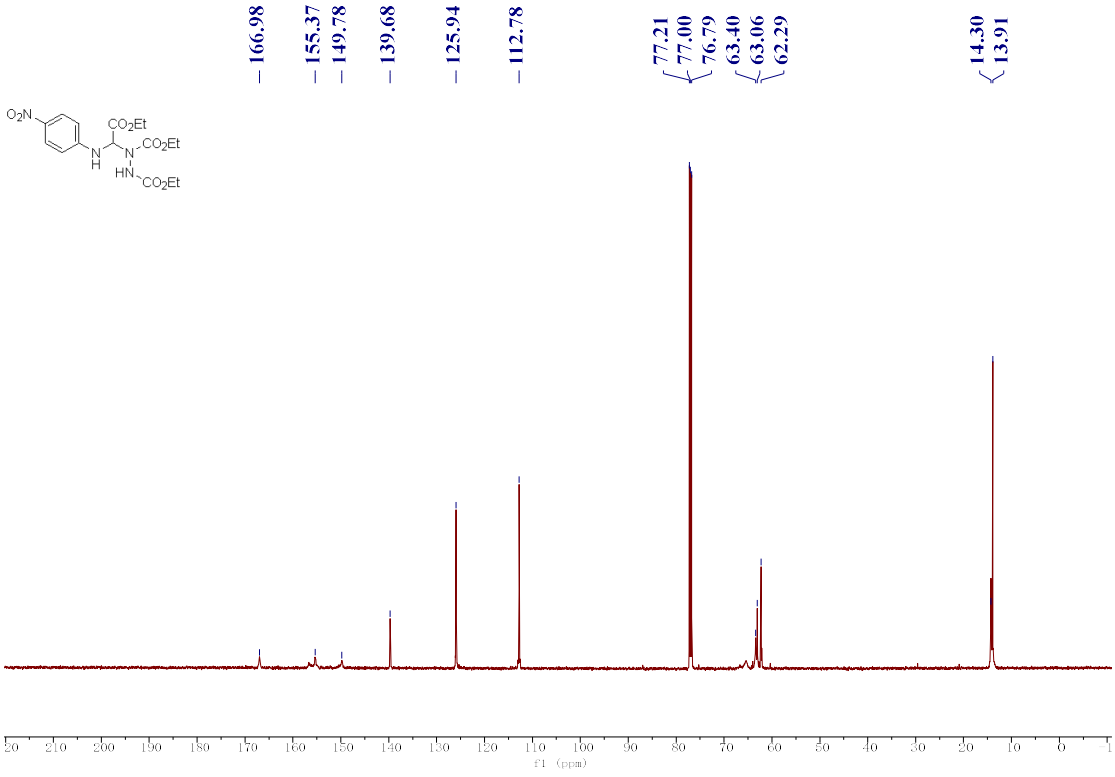
^{13}C NMR (151 MHz) Spectrum of 4v in $CDCl_3$



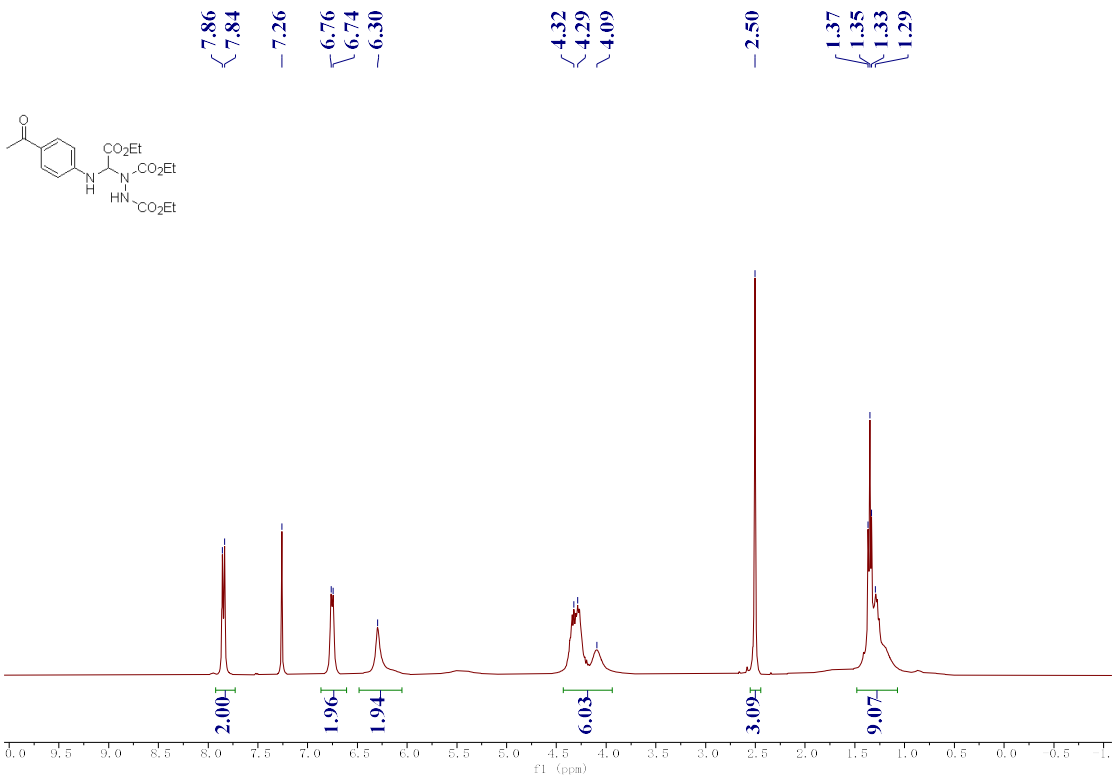
^{1}H NMR (400 MHz) Spectrum of 4w in $CDCl_3$



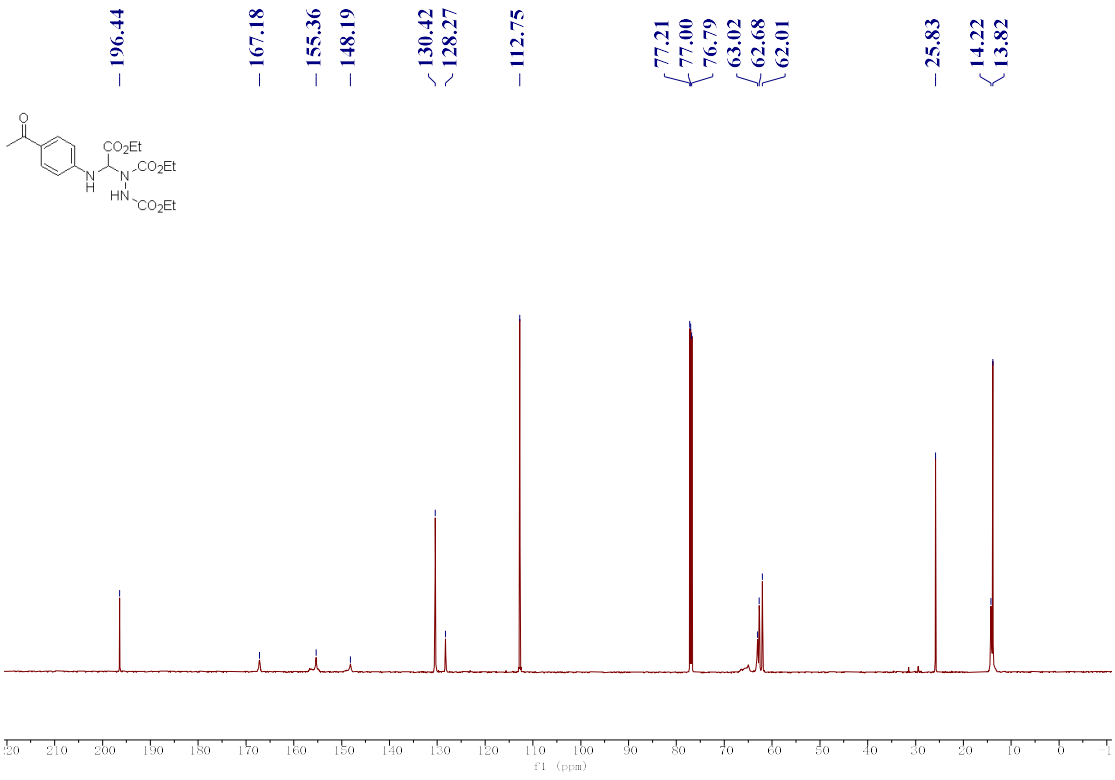
^{13}C NMR (151 MHz) Spectrum of 4w in $CDCl_3$



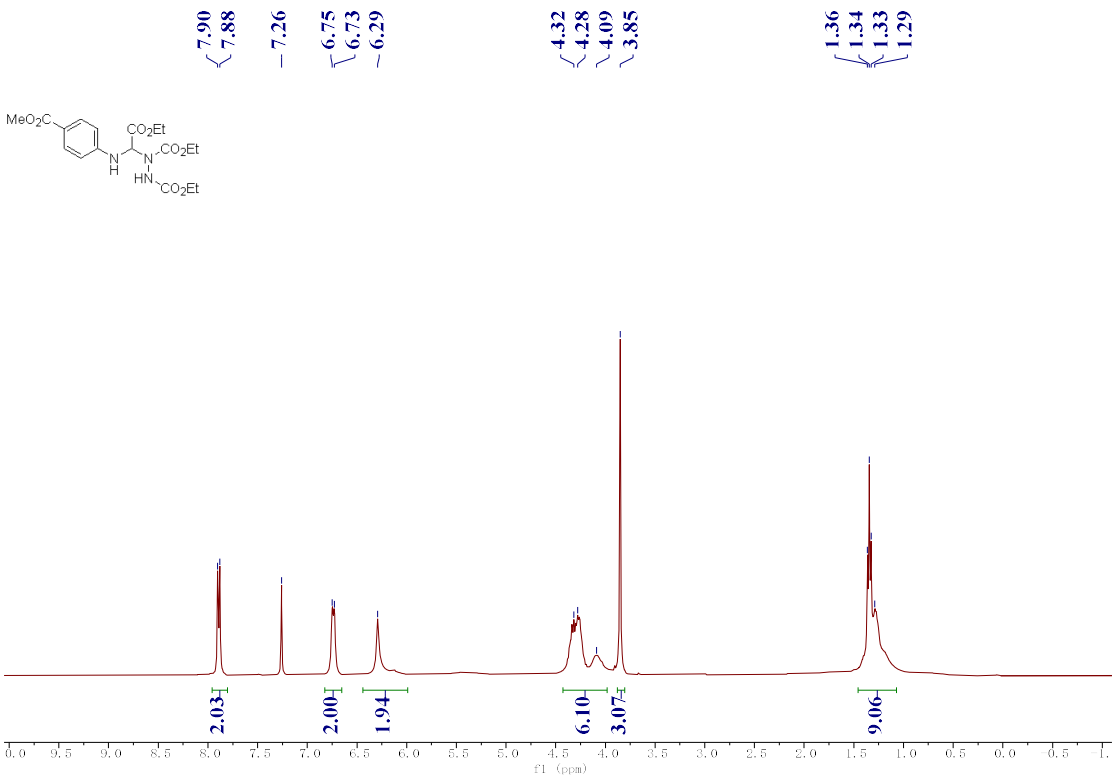
^{1}H NMR (400 MHz) Spectrum of 4x in $CDCl_3$



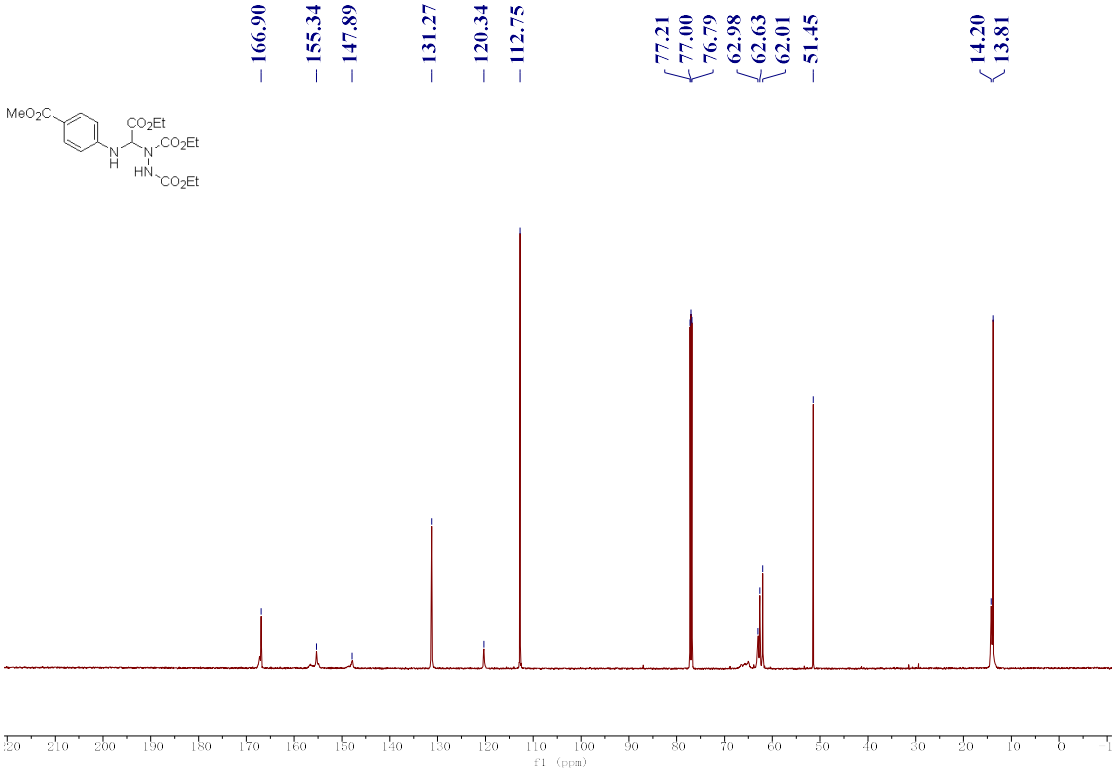
^{13}C NMR (151 MHz) Spectrum of 4x in $CDCl_3$



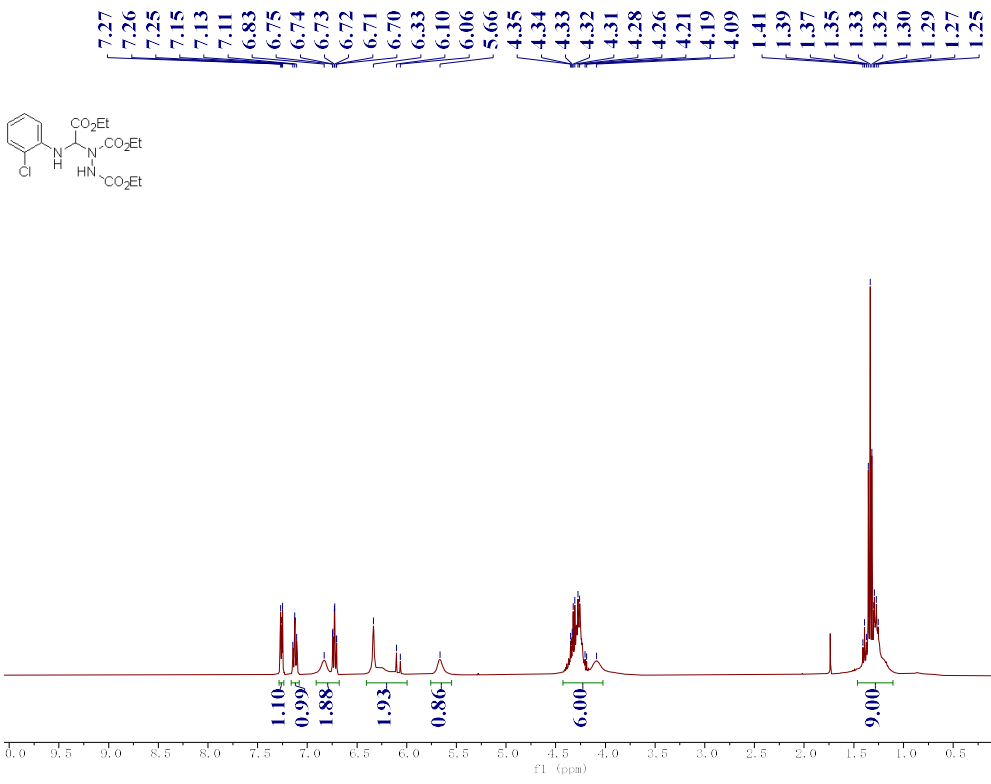
^{1}H NMR (400 MHz) Spectrum of 4y in $CDCl_3$



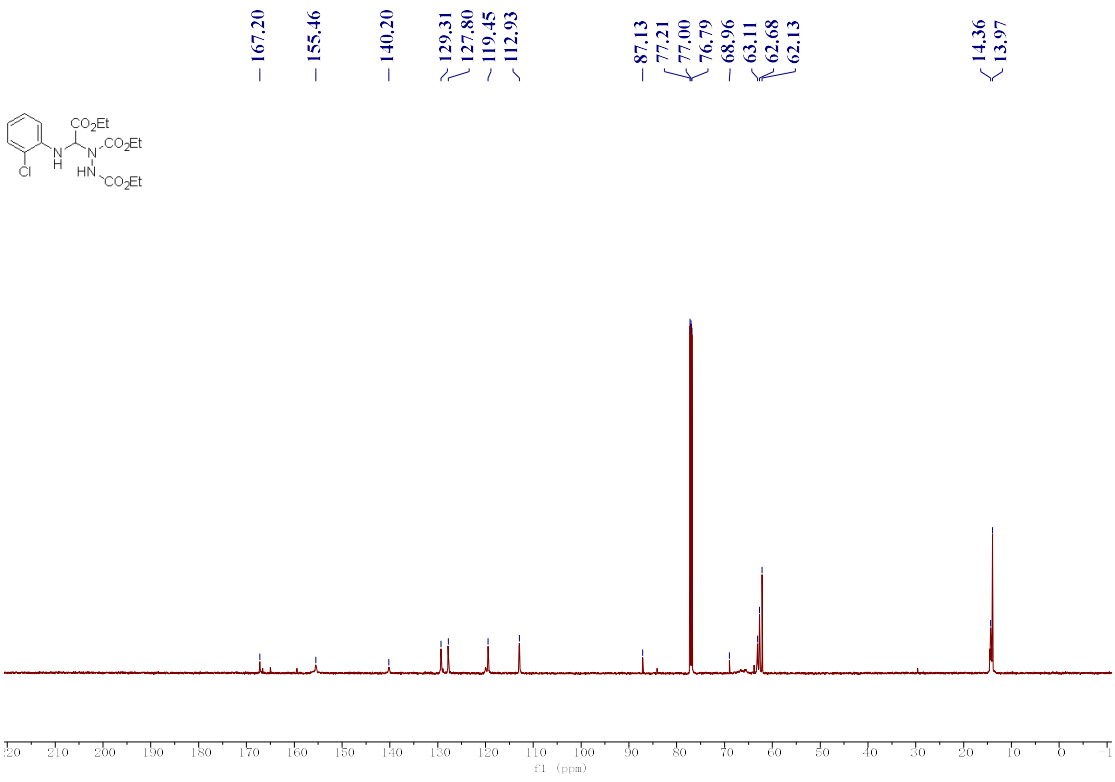
^{13}C NMR (151 MHz) Spectrum of 4y in $CDCl_3$



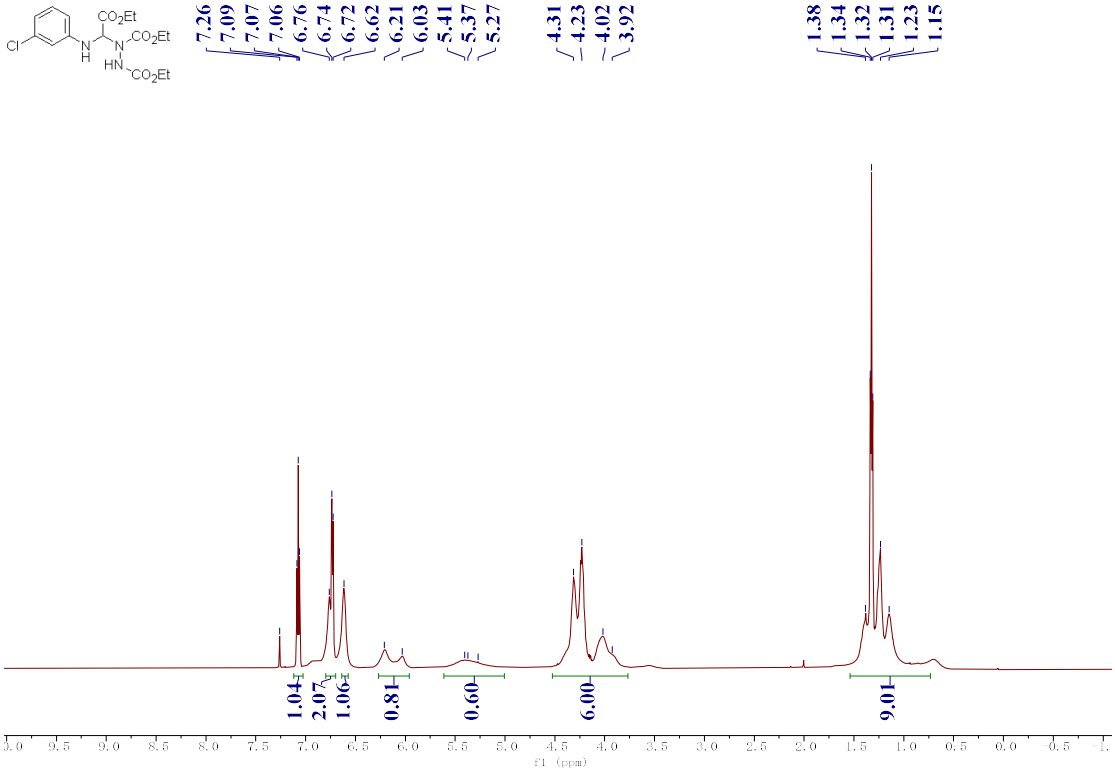
^{1}H NMR (400 MHz) Spectrum of 4z in $CDCl_3$



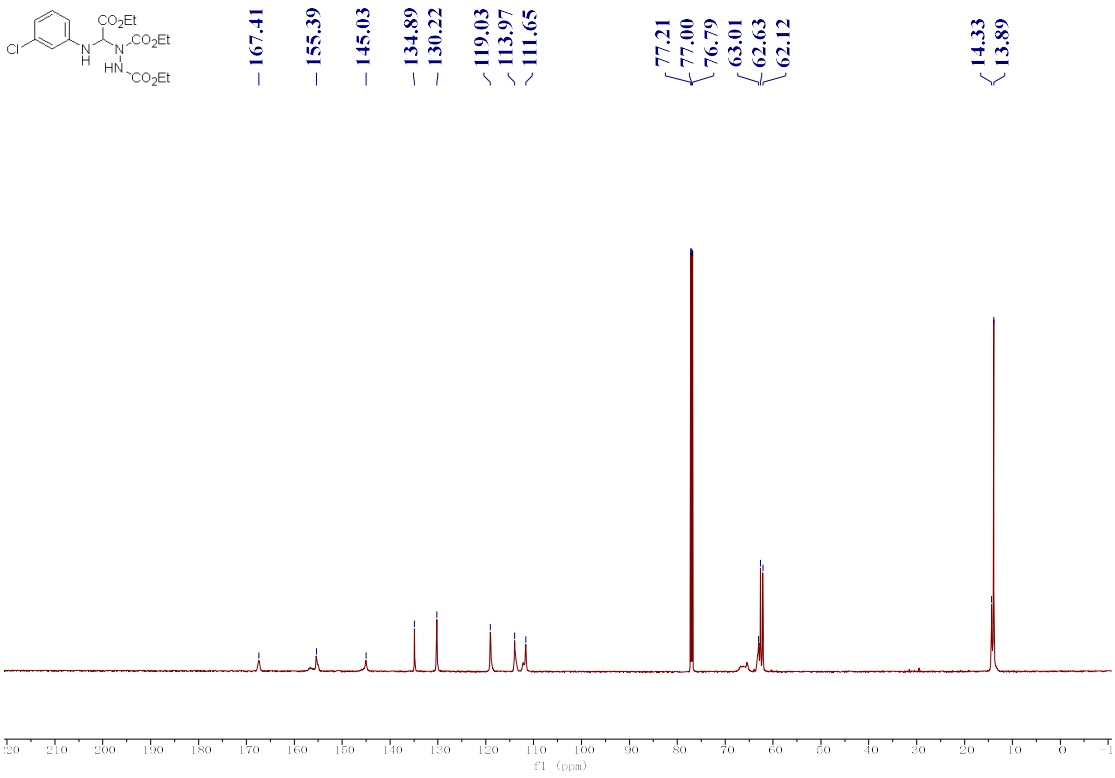
^{13}C NMR (151 MHz) Spectrum of 4z in $CDCl_3$



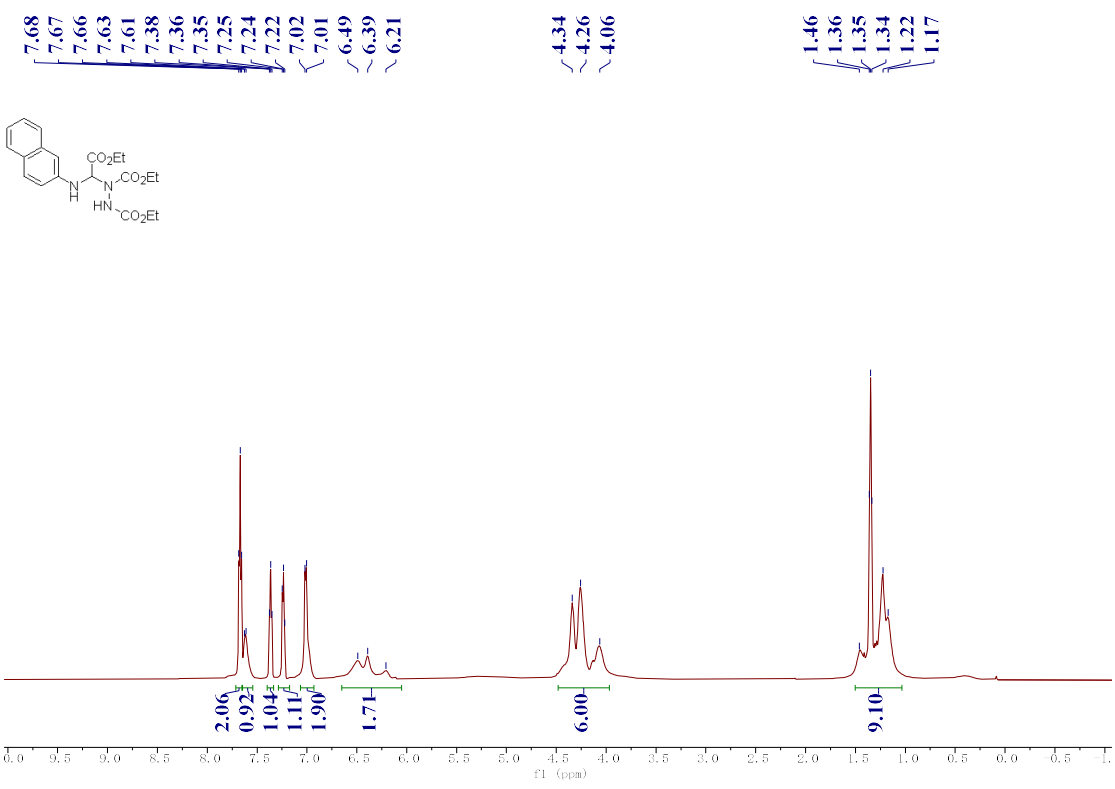
^{1}H NMR (600 MHz) Spectrum of 4aa in $CDCl_3$



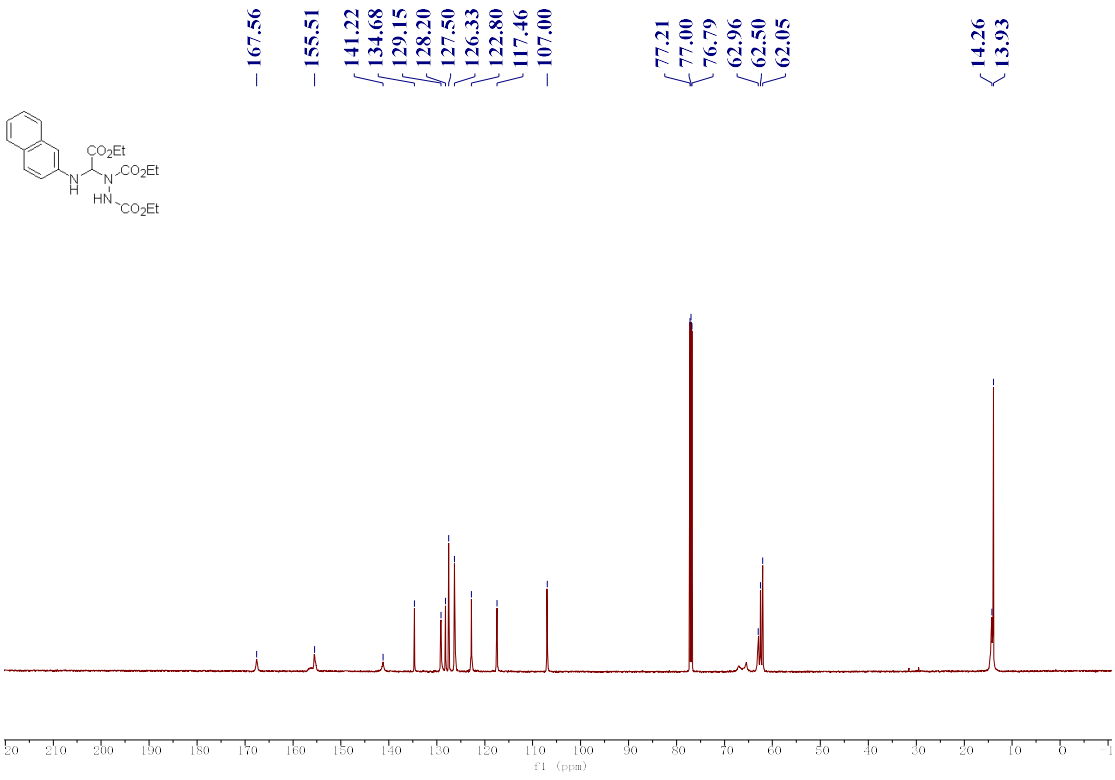
^{13}C NMR (151 MHz) Spectrum of 4aa in $CDCl_3$



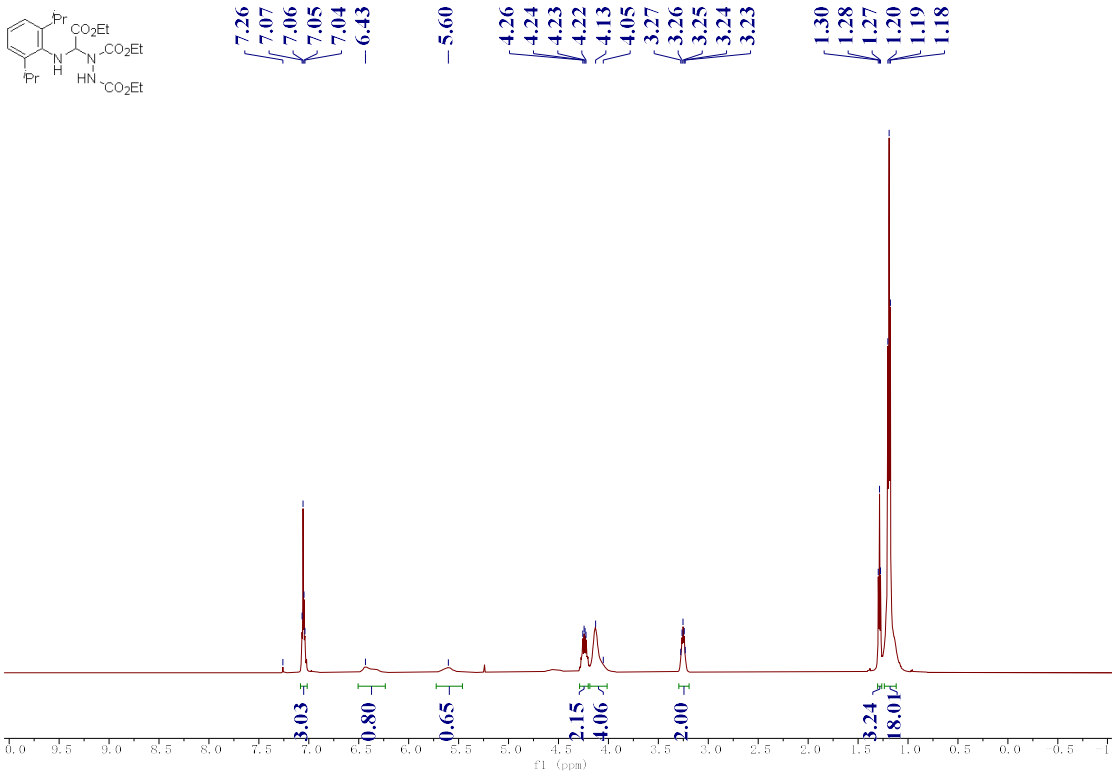
^{1}H NMR (600 MHz) Spectrum of 4ab in $CDCl_3$



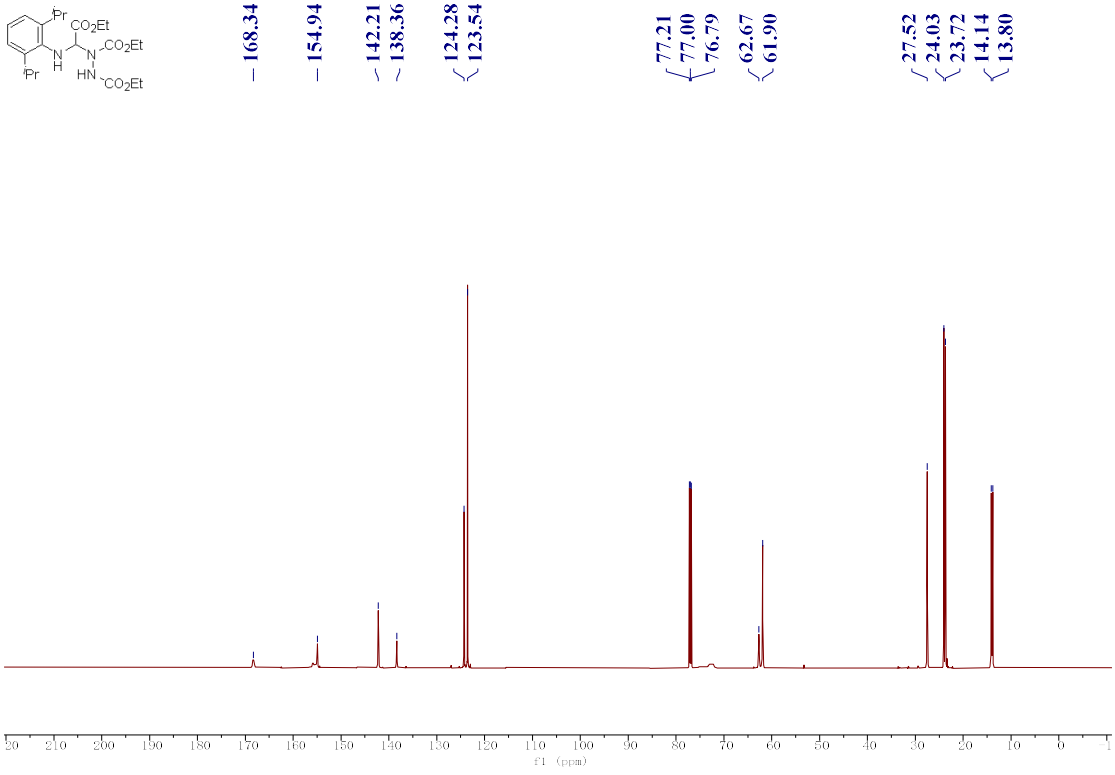
^{13}C NMR (151 MHz) Spectrum of 4ab in $CDCl_3$



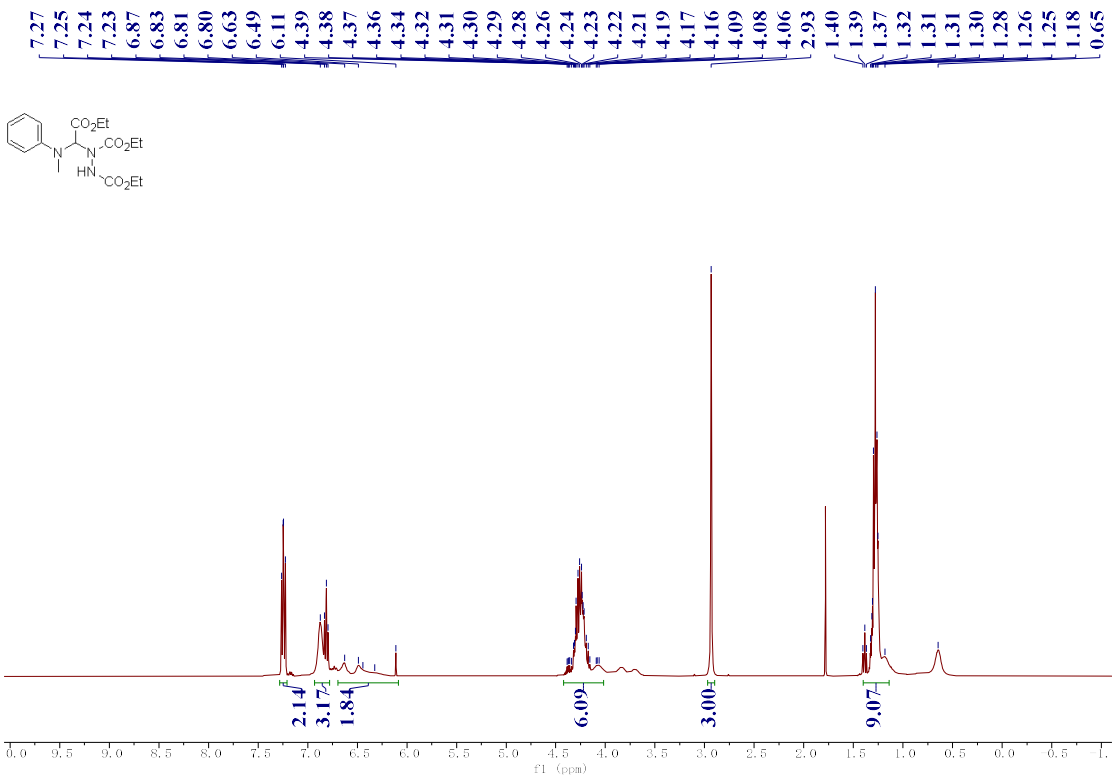
^{1}H NMR (600 MHz) Spectrum of 4ac in $CDCl_3$



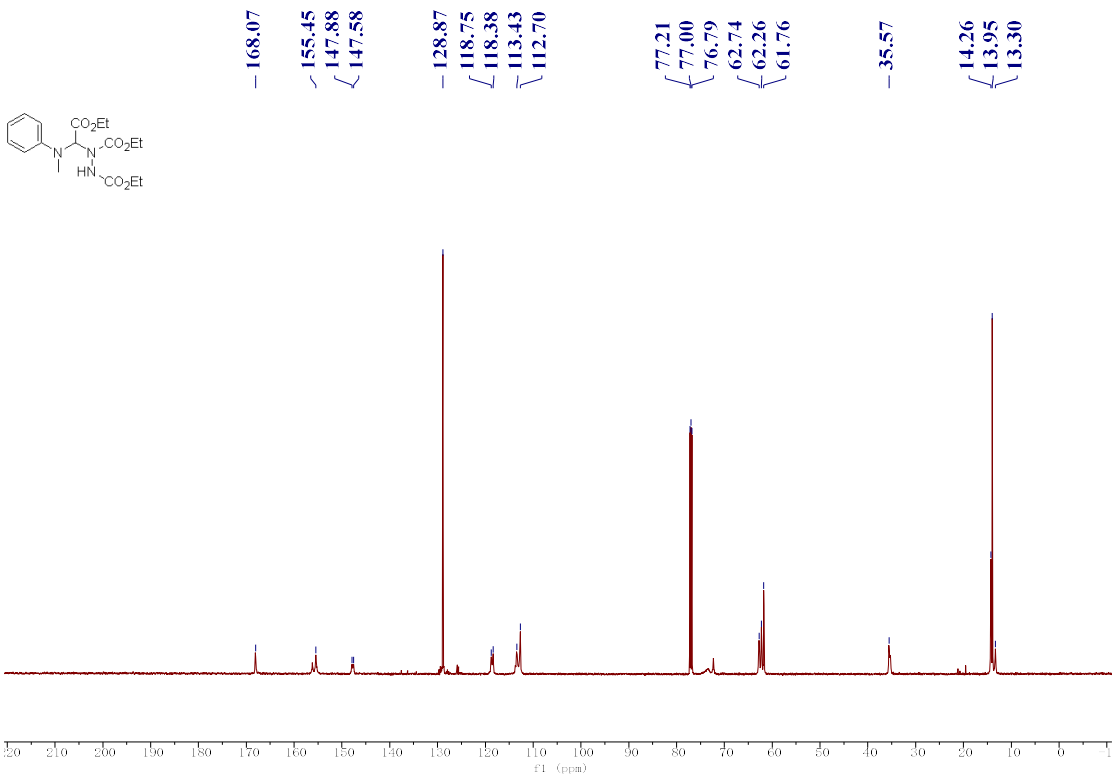
^{13}C NMR (151 MHz) Spectrum of 4ac in $CDCl_3$



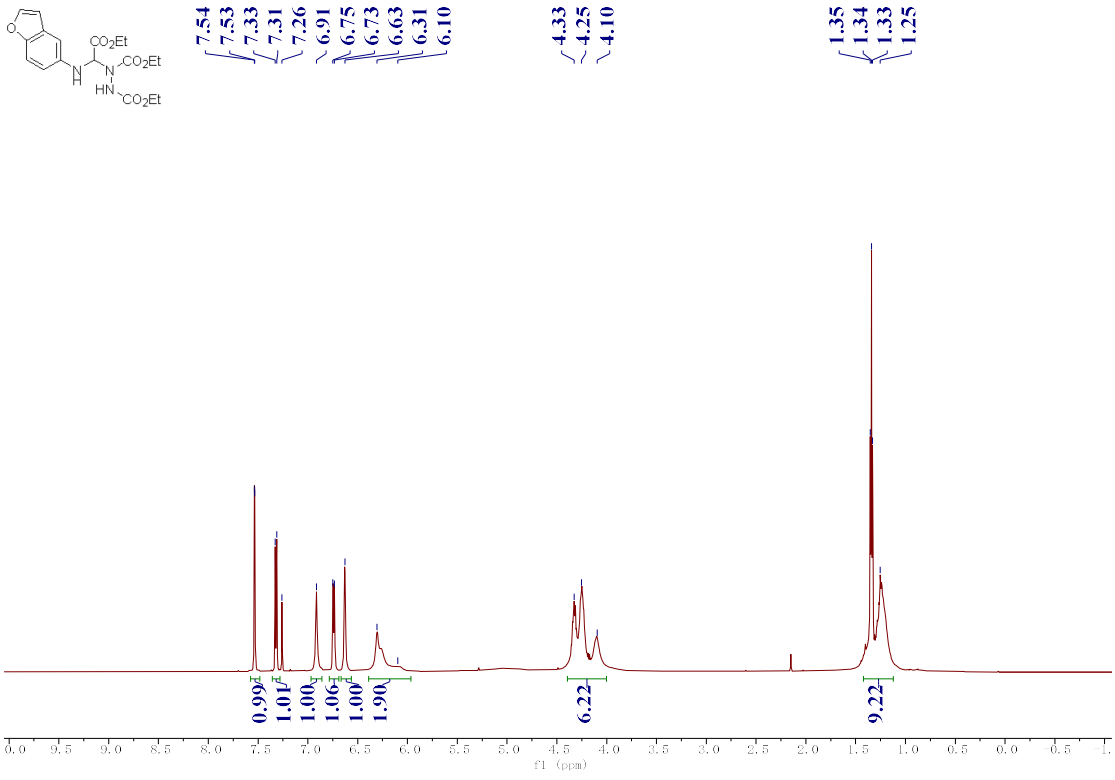
^{1}H NMR (400 MHz) Spectrum of 4ad in $CDCl_3$



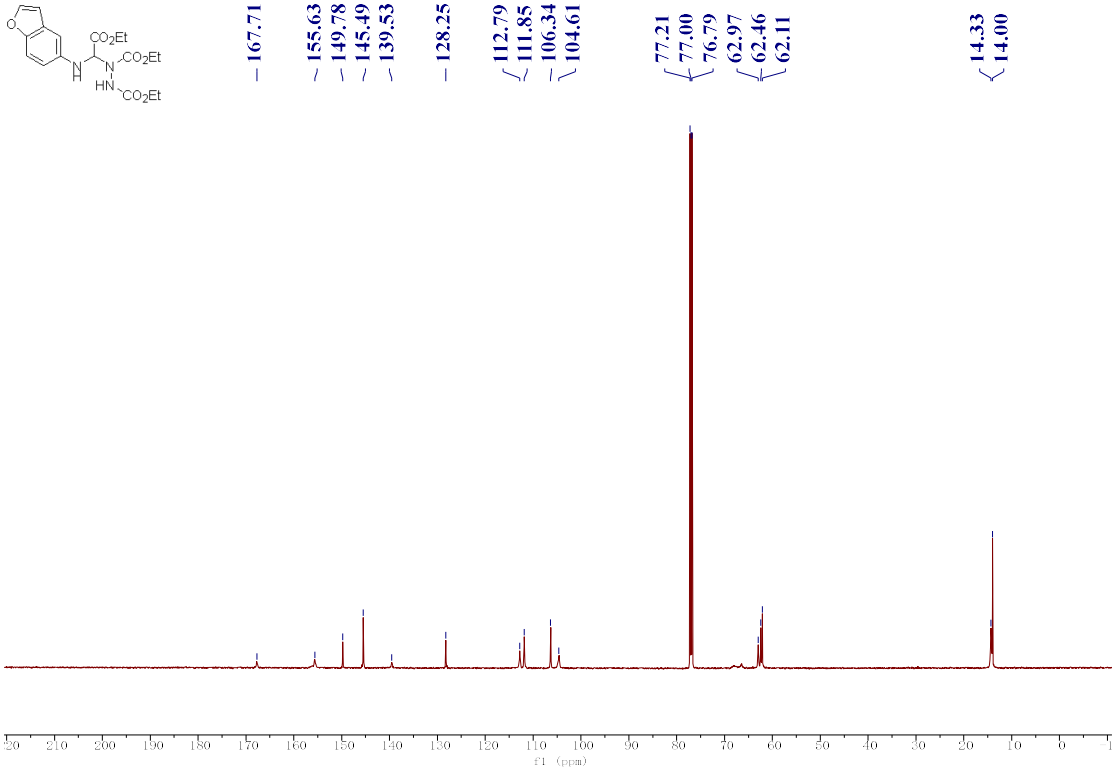
^{13}C NMR (151 MHz) Spectrum of 4ad in $CDCl_3$



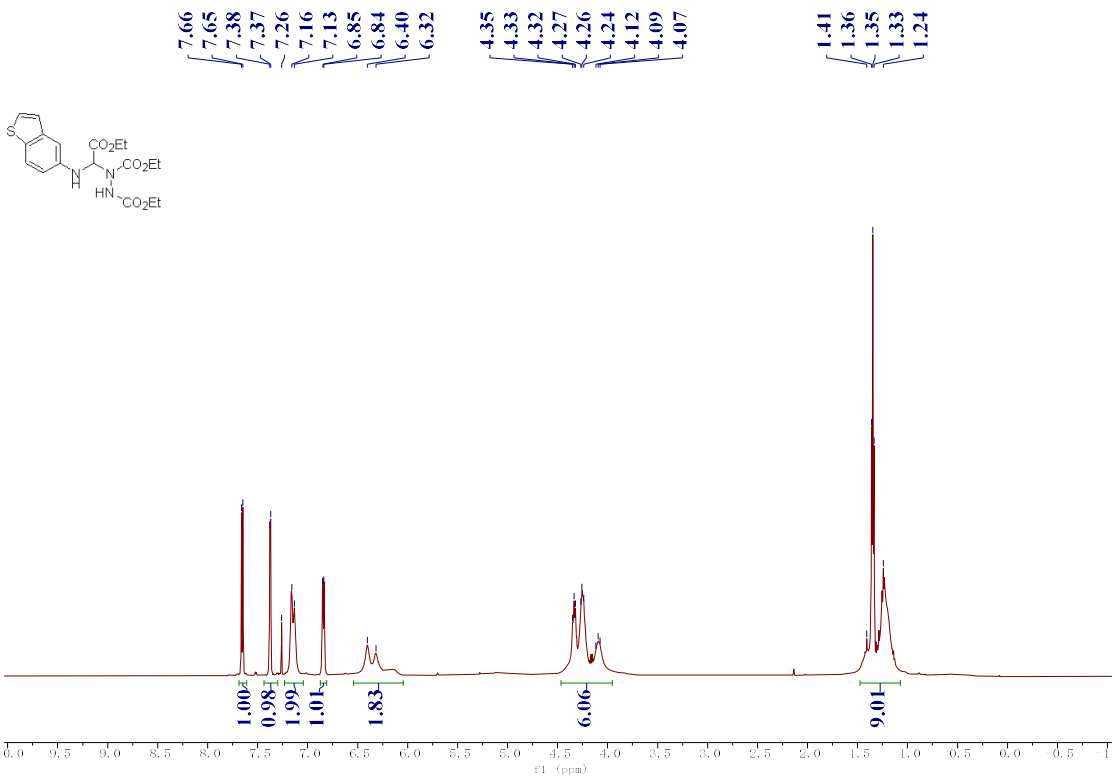
^{1}H NMR (600 MHz) Spectrum of 4ae in $CDCl_3$



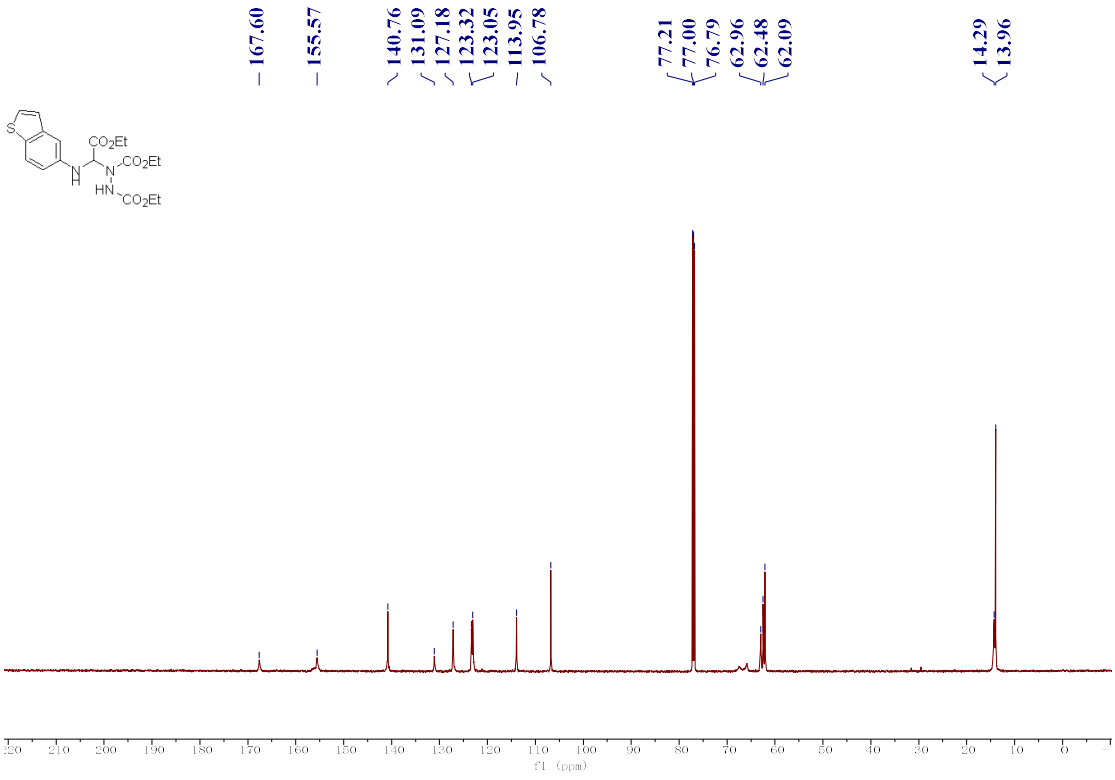
^{13}C NMR (151 MHz) Spectrum of 4ae in $CDCl_3$



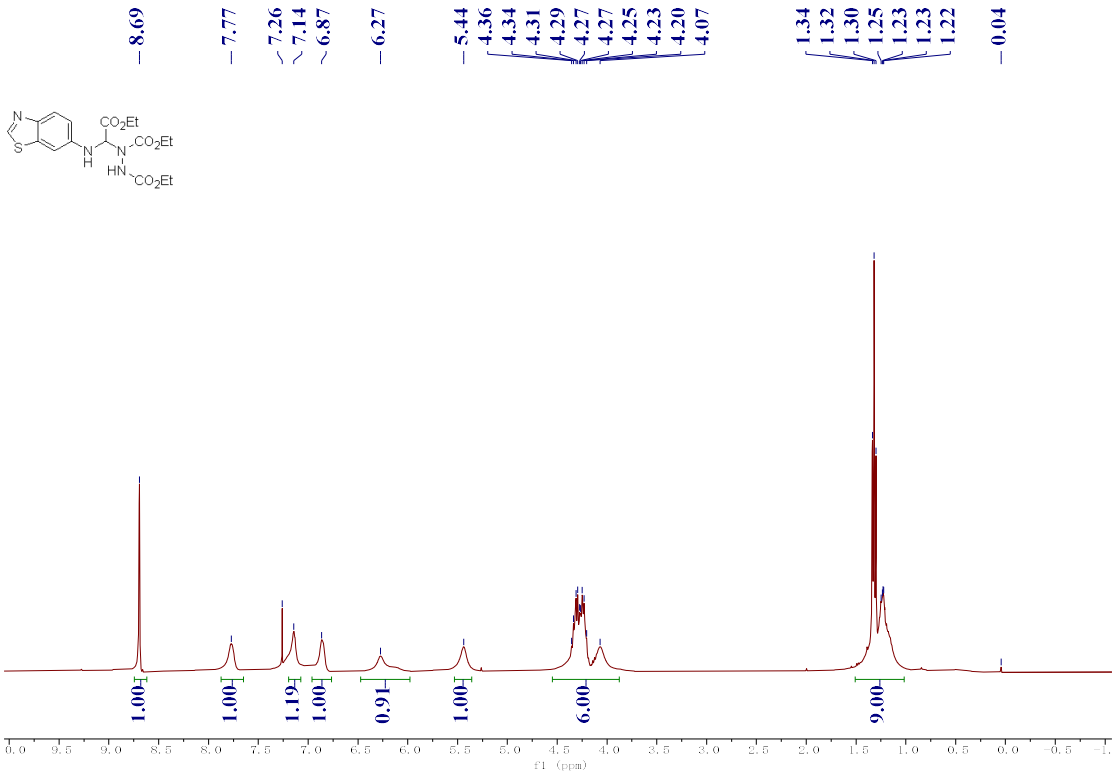
^{1}H NMR (600 MHz) Spectrum of 4af in $CDCl_3$



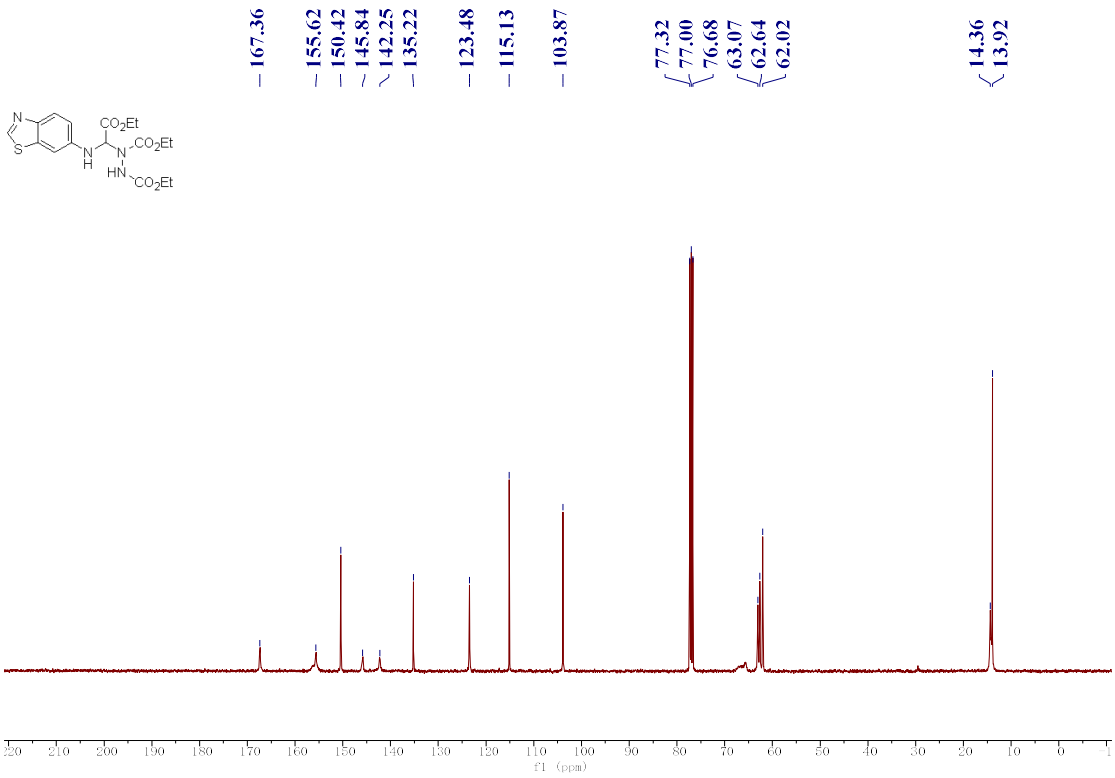
^{13}C NMR (151 MHz) Spectrum of 4af in $CDCl_3$



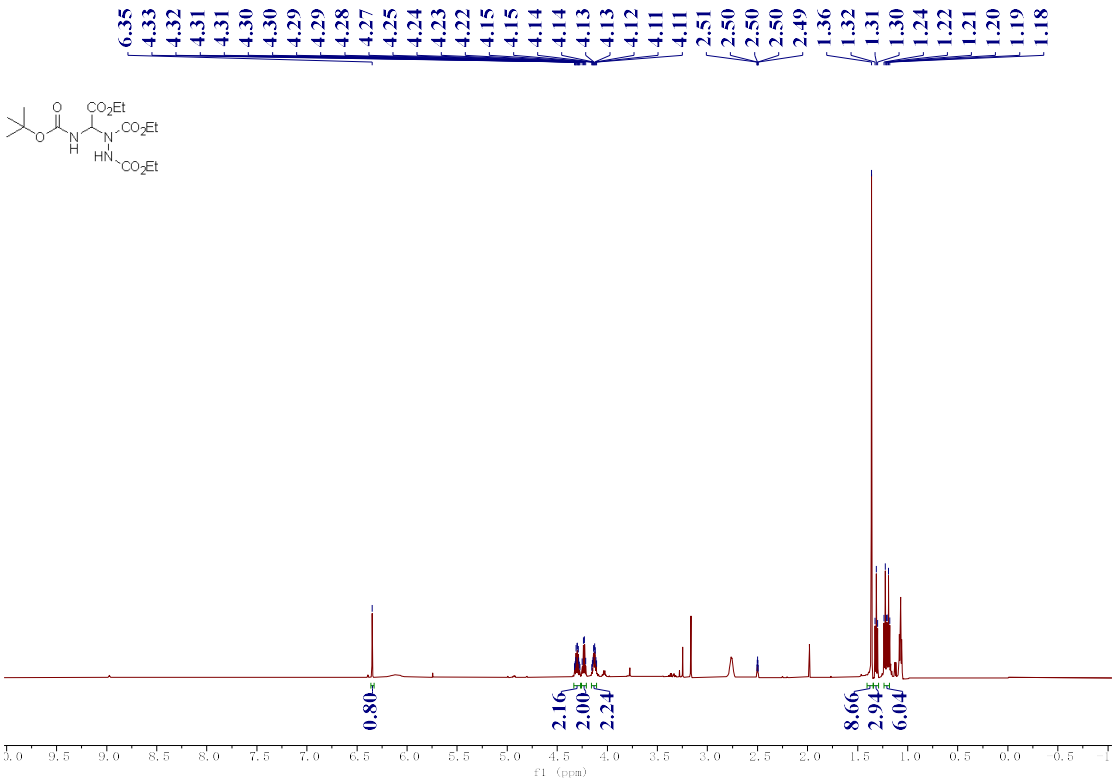
^{1}H NMR (400 MHz) Spectrum of 4ag in $CDCl_3$



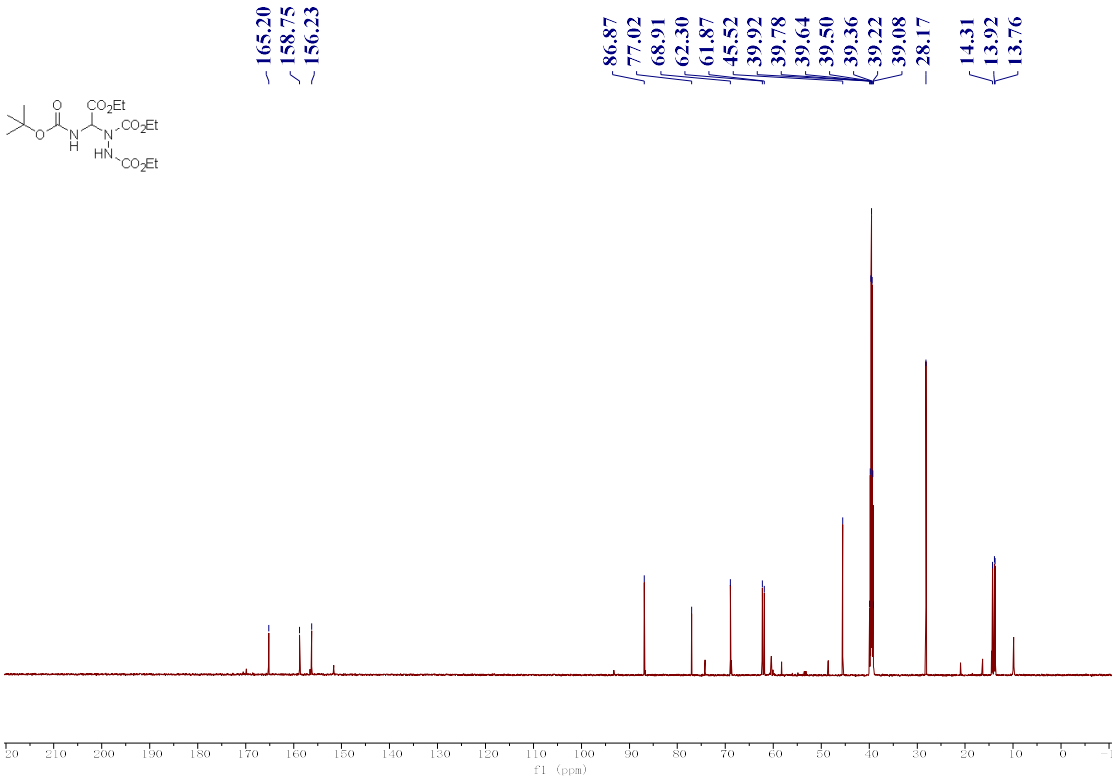
^{13}C NMR (101 MHz) Spectrum of 4ag in $CDCl_3$



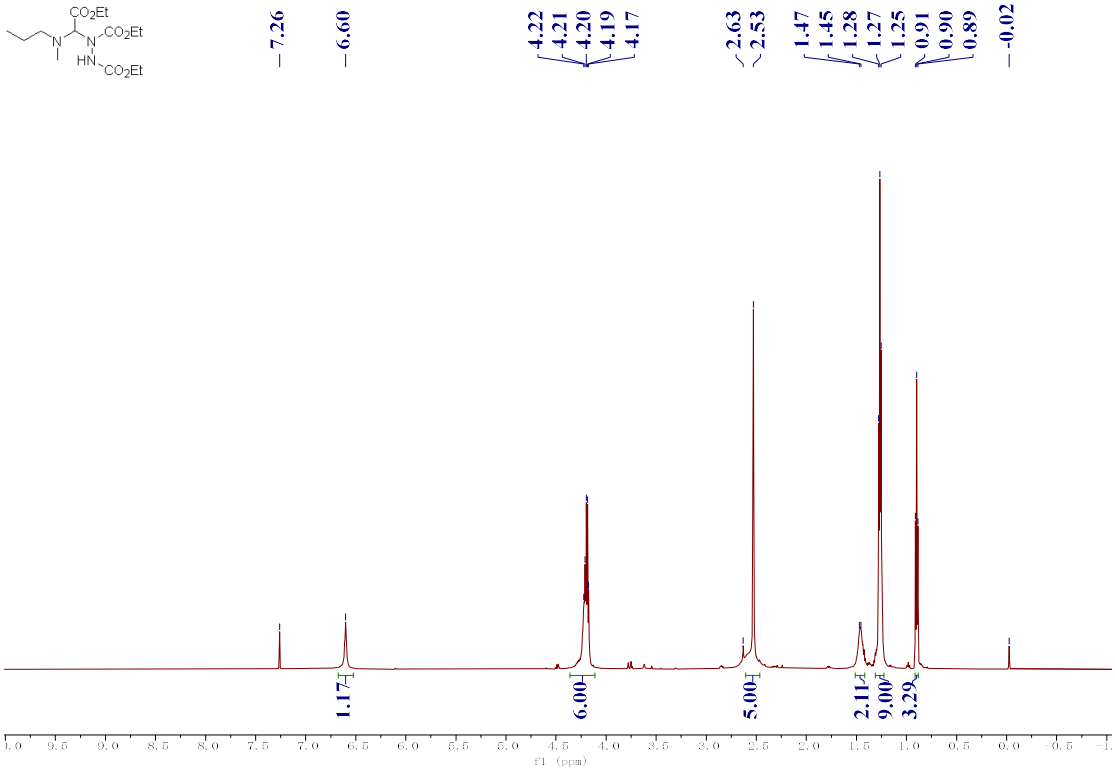
^{1}H NMR (600 MHz) Spectrum of 4ah in DMSO-d_6



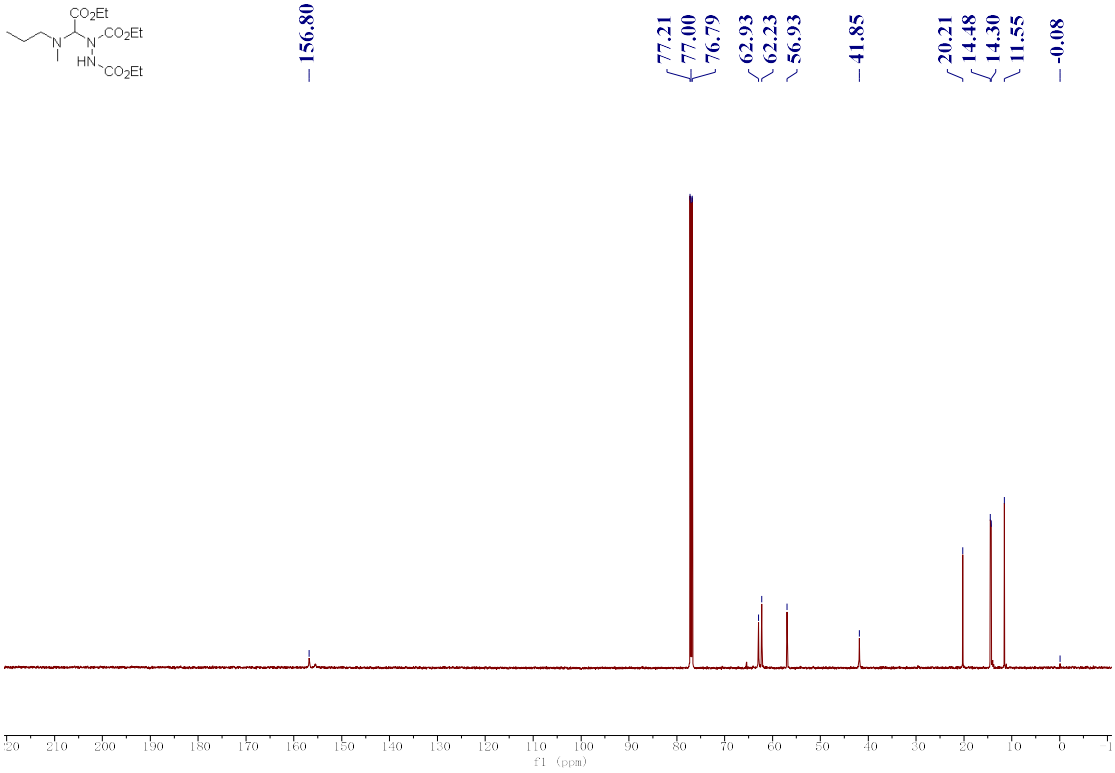
^{13}C NMR (151 MHz) Spectrum of 4ah in DMSO-d_6



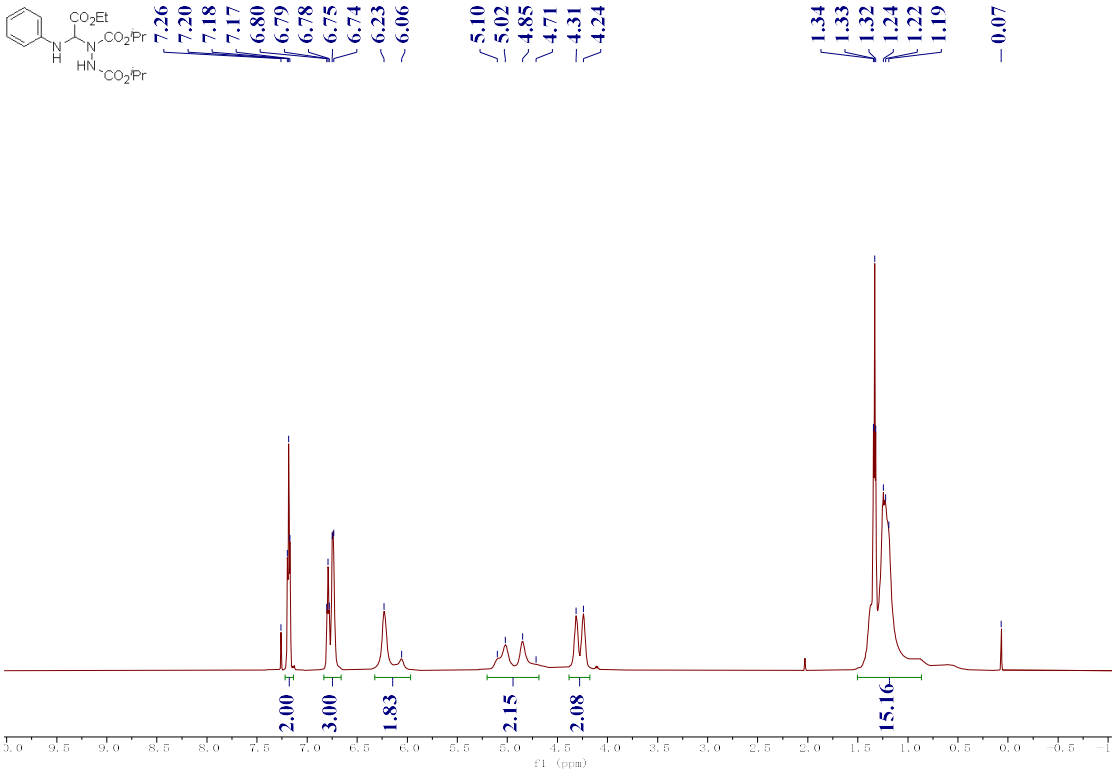
^{1}H NMR (600 MHz) Spectrum of 4ai in $CDCl_3$



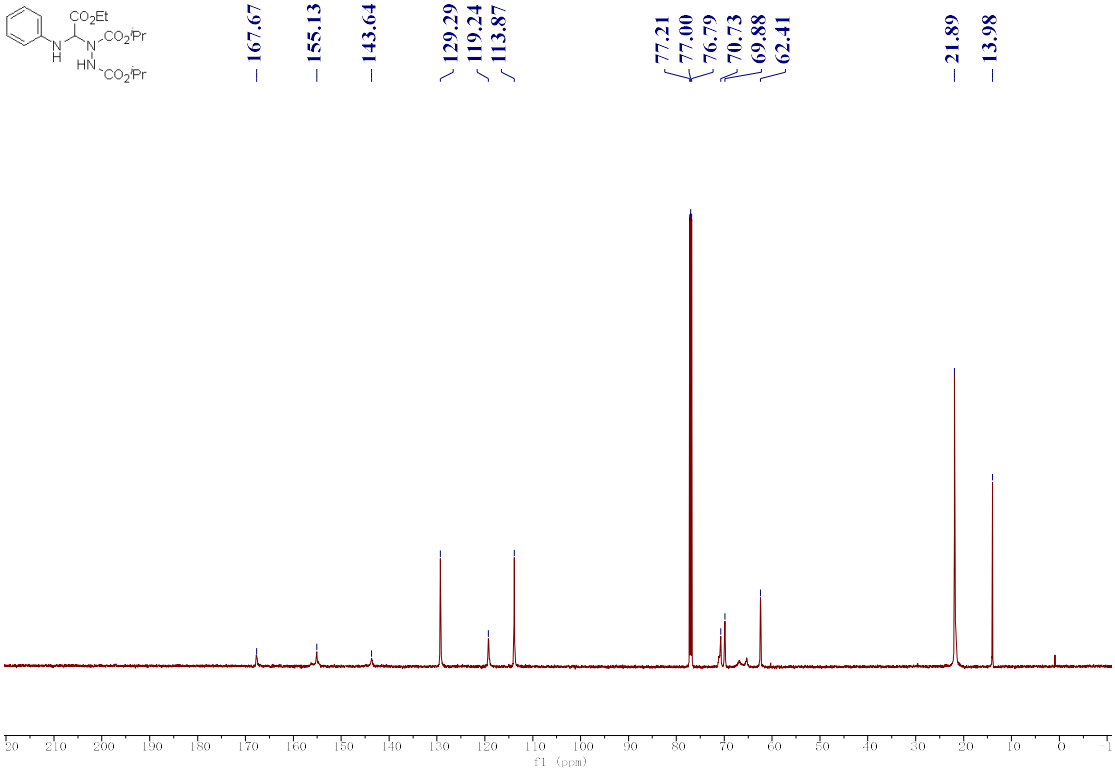
^{13}C NMR (151 MHz) Spectrum of 4ai in $CDCl_3$



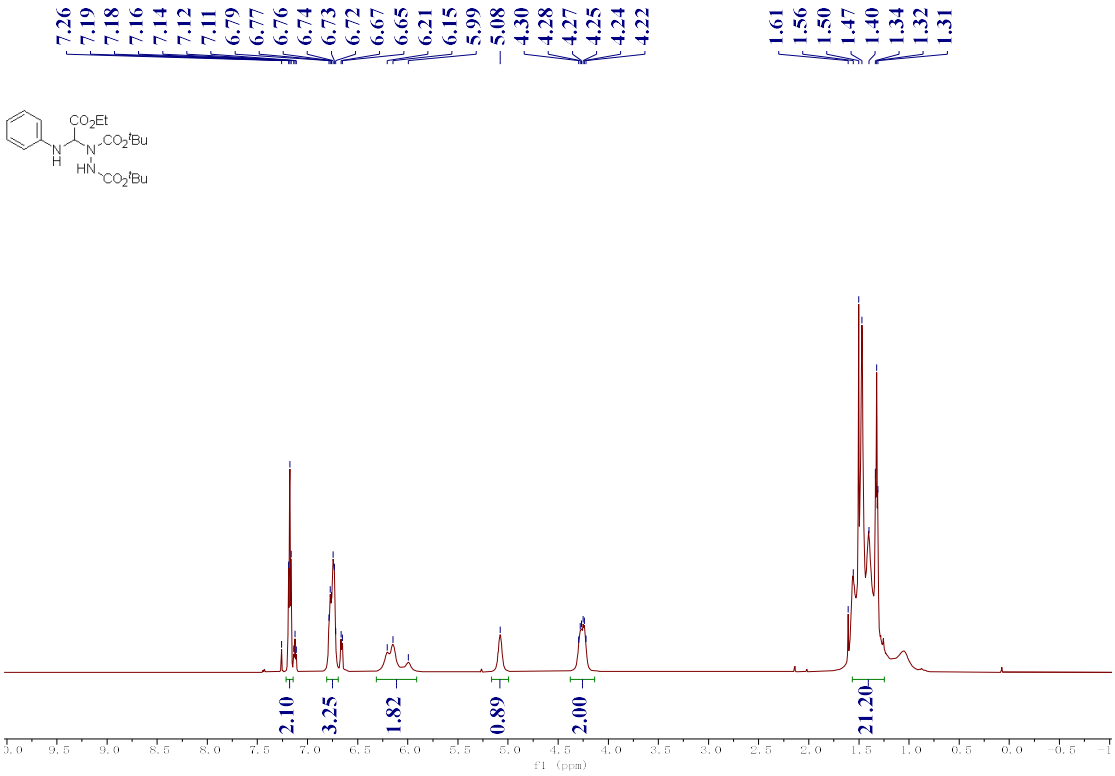
^{1}H NMR (600 MHz) Spectrum of 4aj in $CDCl_3$



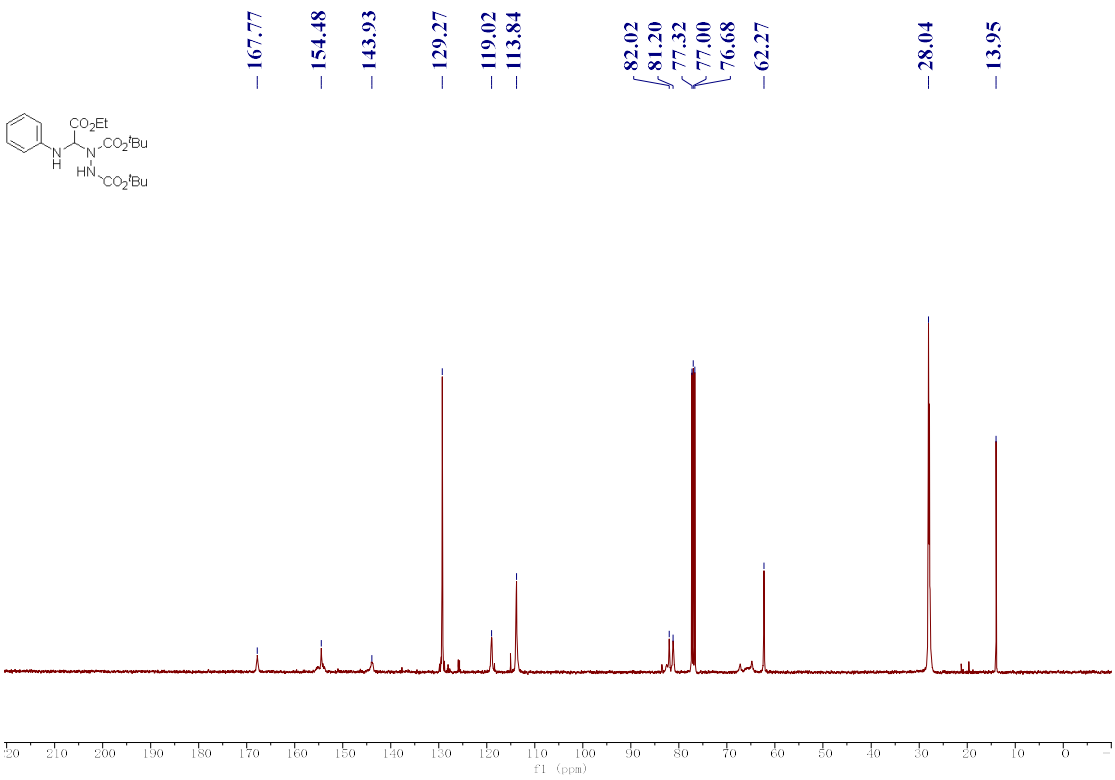
^{13}C NMR (151 MHz) Spectrum of 4aj in $CDCl_3$



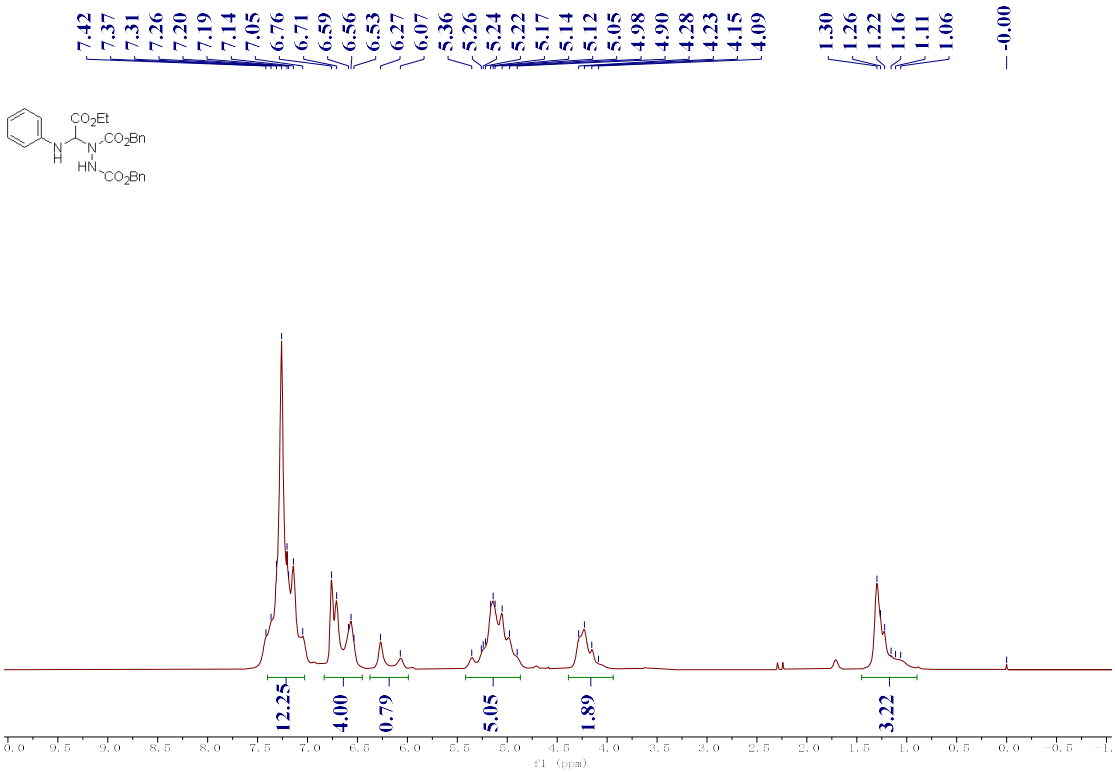
^{1}H NMR (600 MHz) Spectrum of 4ak in $CDCl_3$



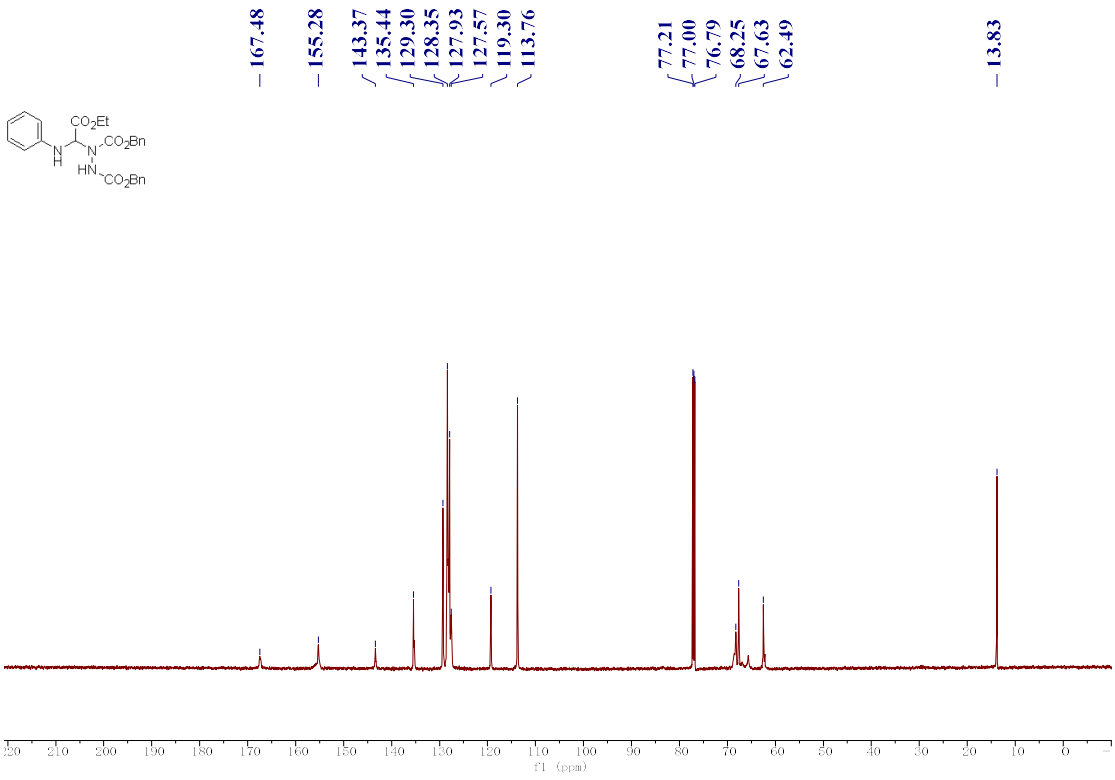
^{13}C NMR (151 MHz) Spectrum of 4ak in $CDCl_3$



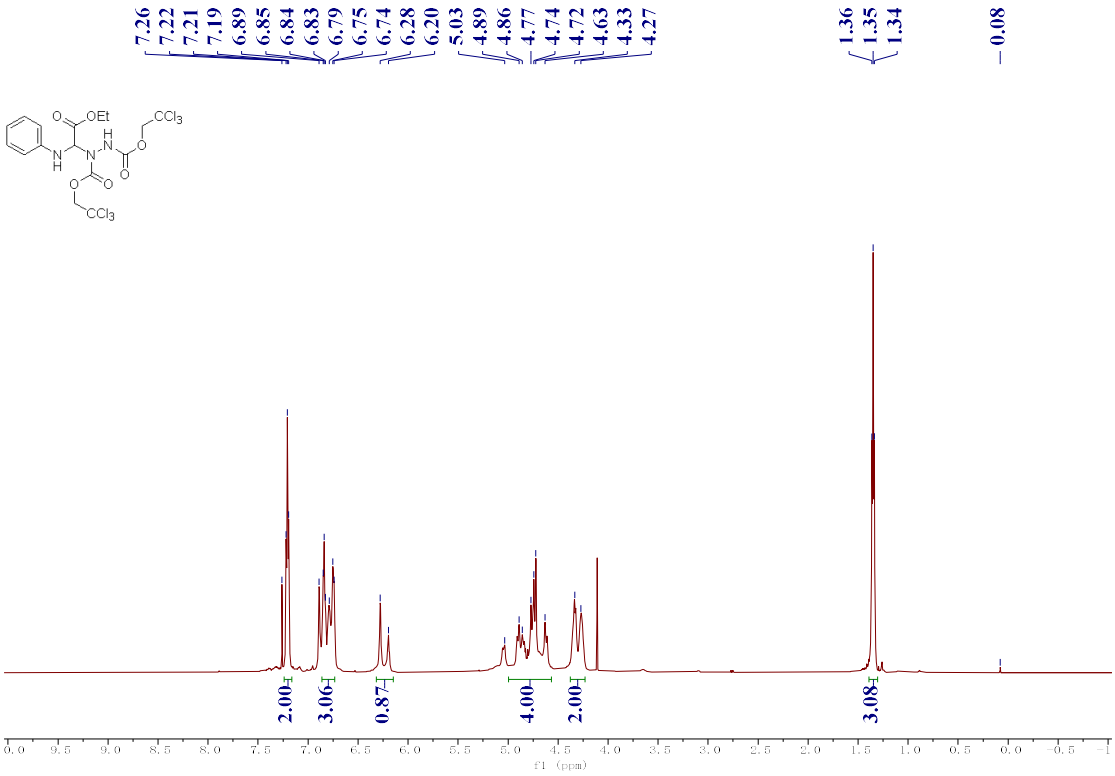
^{1}H NMR (600 MHz) Spectrum of 4al in $CDCl_3$



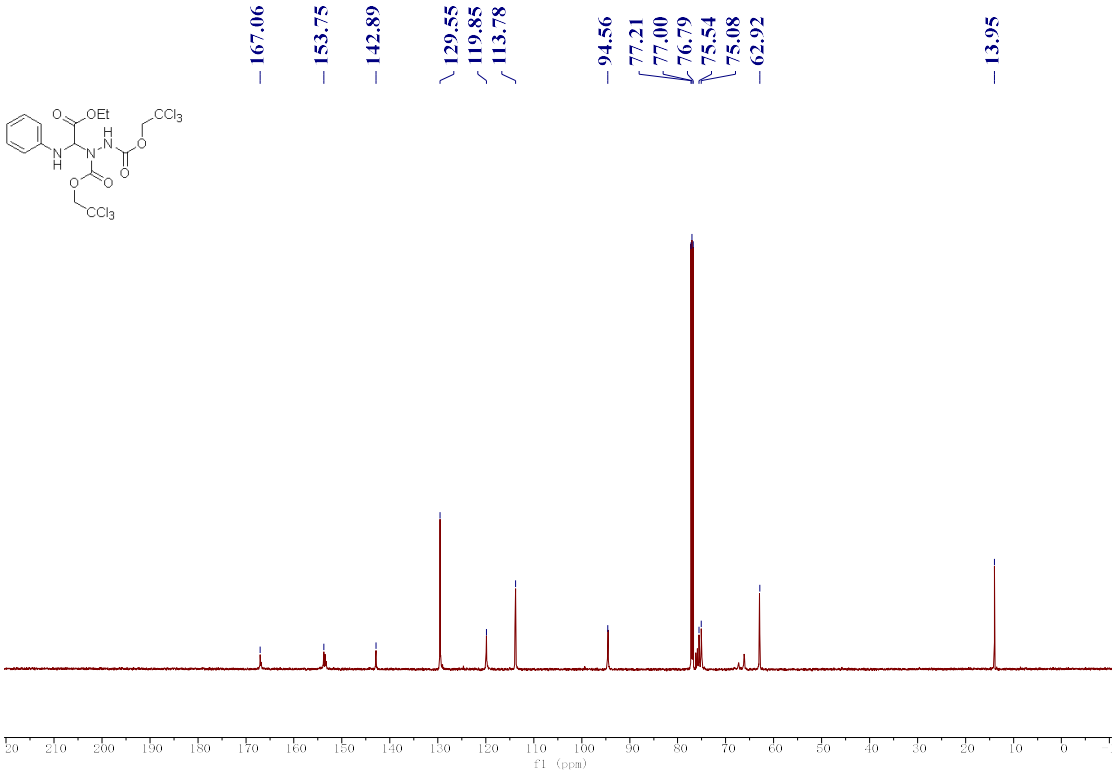
^{13}C NMR (151 MHz) Spectrum of 4al in $CDCl_3$



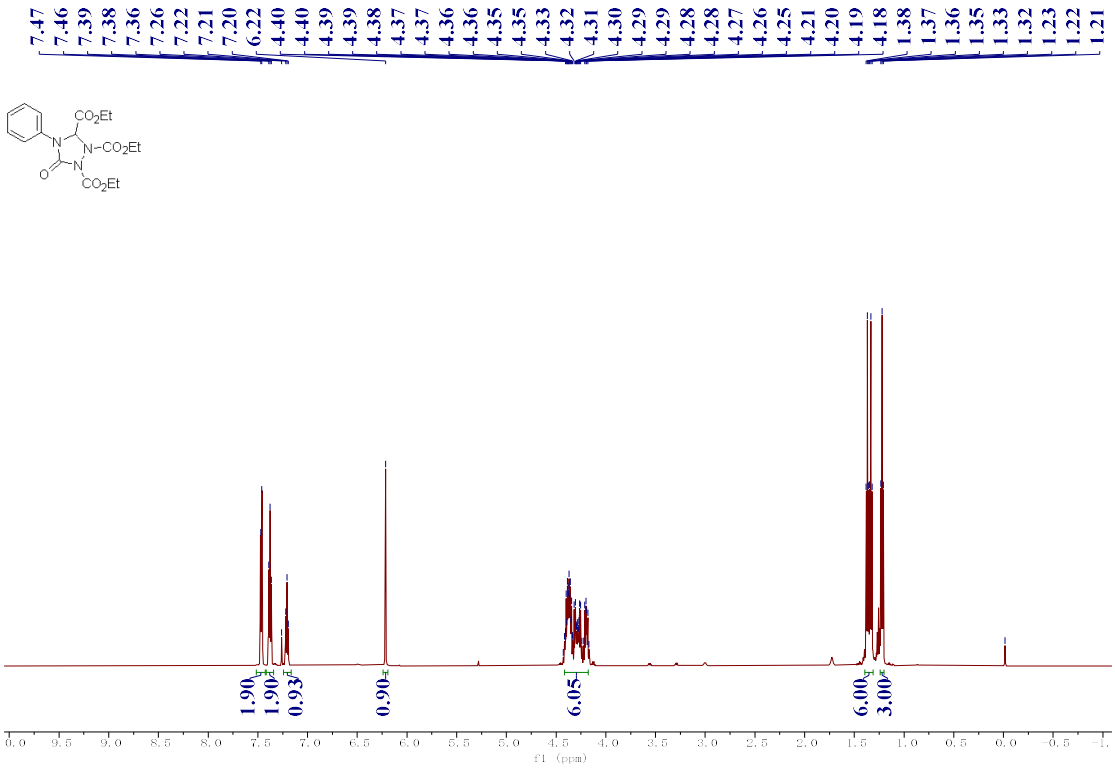
^{1}H NMR (600 MHz) Spectrum of 4am in $CDCl_3$



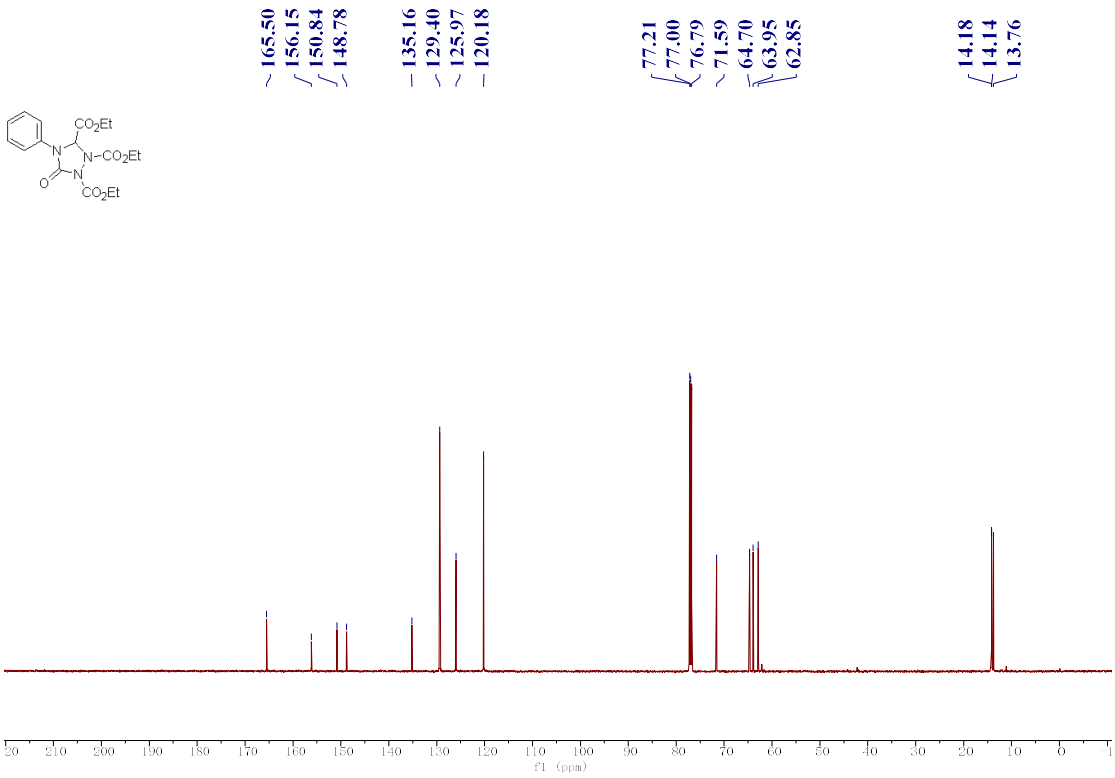
^{13}C NMR (151 MHz) Spectrum of 4am in $CDCl_3$



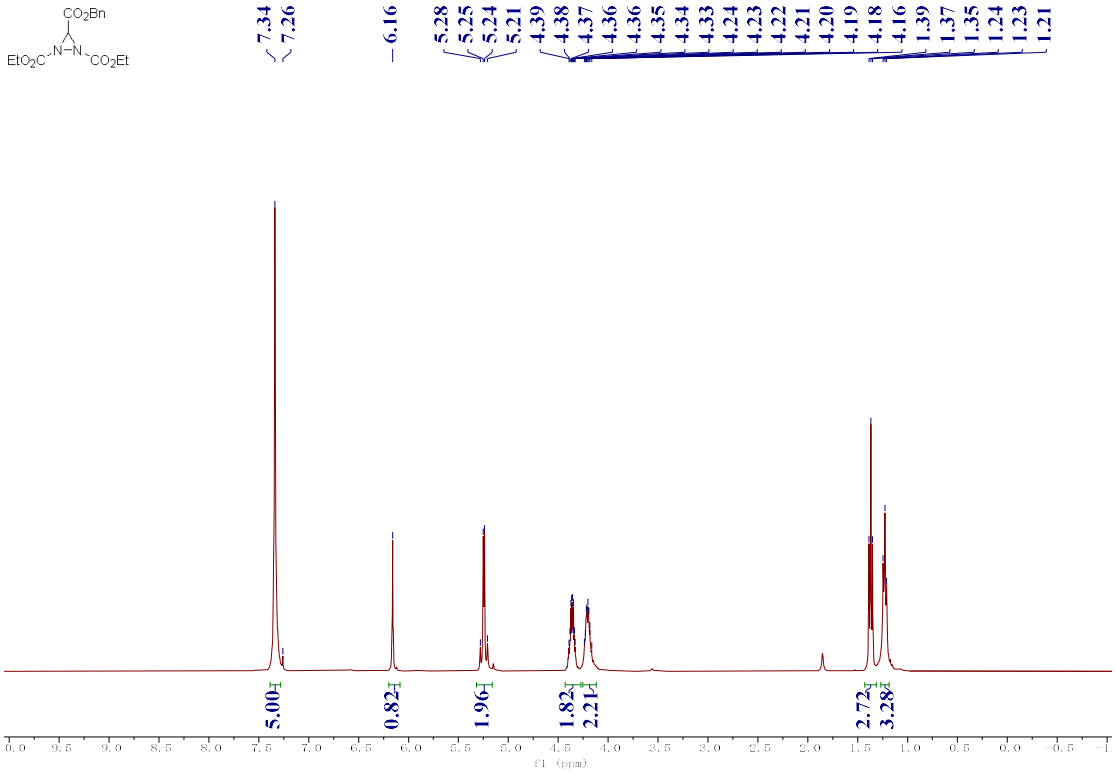
^{1}H NMR (600 MHz) Spectrum of 6 in $CDCl_3$



^{13}C NMR (151 MHz) Spectrum of 6 in $CDCl_3$



^{1}H NMR (400 MHz) Spectrum of 8 in $CDCl_3$



^{13}C NMR (101 MHz) Spectrum of 8 in $CDCl_3$