Cascade reaction of *o*-enoyl arylisocyanide and *o*-hydroxy aromatic aldimine: a diastereoselective access to polycyclic spirobenzoxazine chromeno[4,3-*b*]pyrrole derivative

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Supporting Information

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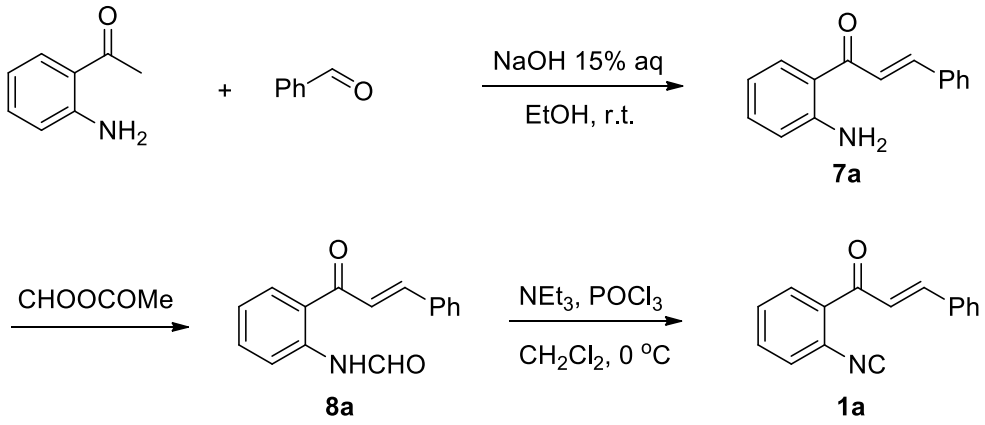
1. General Information

The NMR spectra were recorded on Bruker AC-400 spectrometer (400 MHz for ^{1}H NMR and 101 MHz for ^{13}C NMR) with $CDCl_3$ as the solvent and TMS as internal reference. ^{1}H NMR spectral data were reported as follows: chemical shift (δ, ppm), multiplicity, integration, and coupling constant (Hz). ^{13}C NMR spectral data were reported in terms of the chemical shift. The following abbreviations were used to indicate multiplicities: s = singlet; d = doublet; t = triplet; q = quartet; m = multiplet. High-resolution mass spectra (HRMS) were recorded on a Bruker Daltonics, Inc. APEXIII 7.0 TESLA FTMS instrument. Melting points were obtained on an X-4 digital melting point apparatus without correction. Purification of products was accomplished by column chromatography packed with silica gel. Unless otherwise stated, all reagents were commercially purchased and used without further purification.

2. General Procedure

2.1 General procedure for the synthesis of *o*-enoyl arylisocyanide 1



To a solution of 1-(2-aminophenyl)ethanone (1.22 mL, 10 mmol) and benzaldehyde (1.02 mL, 10 mmol) in EtOH (10 mL) was added NaOH (15% aq) (EtOH: NaOH aq = 1:1), the reaction mixture was stirred at room temperature for about 4 h. Upon the consumption of the substrate (monitored by TLC), the reaction was poured slowly into water (50 mL) under stirring, the precipitation was collected by filtration to give **7a** (74% yield) as a yellow solid, it was used in the formylation step directly.

To a solution of **7a** (10 mmol) in DCM (50 mL) was added acetic formic anhydride (25 mmol), the reaction mixture was stirred at room temperature for about 20 minutes. Upon the consumption of the substrate (monitored by TLC), the mixture was washed by saturated aqueous sodium bicarbonate solution and then extracted with CH_2Cl_2 (3 × 20 mL), the combined organic phase was dried over Na_2SO_4, and concentrated in vacuo to give **8a** (96% yield), which was used in the next step without purification.

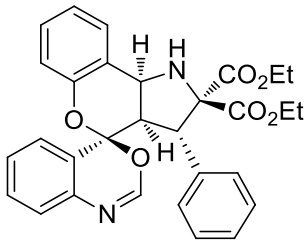
A solution of **8a** and NEt_3 (3.5 equiv) in CH_2Cl_2 was cooled at 0 °C, then $POCl_3$ (1.5 equiv) was added dropwise. After the reaction was completed (monitored by TLC), a saturated Na_2HCO_3 solution was added at 0 °C to quench the reaction. Then the mixture was extracted with CH_2Cl_2 (3 × 20 mL), the combined organic phase was dried over Na_2SO_4, and concentrated in vacuo. The residue was subjected to column chromatography on silica-gel [eluant: petroleum ether/ethyl ether = 20:1] to give *o*-enoyl arylisocyanide (**1a**, 72% yield) as a pale yellow solid.

2.2 General procedure for the synthesis of product 3

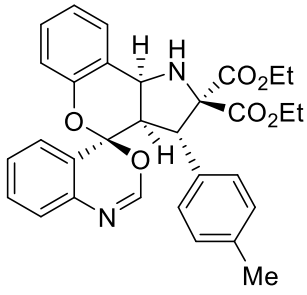
Under air atmosphere, a sealable reaction tube equipped with a magnetic stir bar was charged with *o*-enoyl arylisocyanide **1** (0.5 mmol), *o*-hydroxy aromatic aldimine **2** (0.6 mmol) and NaOH (1 mmol) in 5 mL of DCM at room temperature. After completion of the reaction, the reaction mixture was concentrated under vacuum. The residue was purified by thin layer chromatography [eluant: petroleum ether/ethyl acetate = 2:1] to afford the desired product **3**.

3. Characterization Data

Spectroscopic Data of All Compounds

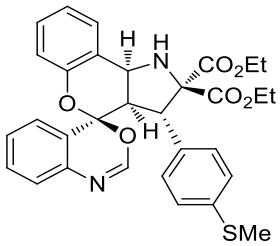


(**3a**) 250 mg, 98% yield, yellow solid: m. p. 156-158 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.56 (dd, *J* = 7.7, 1.7 Hz, 1H), 7.41-7.32 (m, 2H), 7.25-7.17 (m, 4H), 7.15-7.09 (m, 4H), 7.02 (ddd, *J* = 8.5, 5.7, 3.2 Hz, 1H), 6.90 (t, *J* = 8.0 Hz, 2H), 5.28 (d, *J* = 7.7 Hz, 1H), 4.42 (d, *J* = 3.8 Hz, 1H), 4.25 (dq, *J* = 10.6, 7.1 Hz, 1H), 4.08 (dq, *J* = 10.8, 7.2 Hz, 1H), 3.75 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.58 (dd, *J* = 7.8, 3.9 Hz, 1H), 3.46 (s, 1H), 3.35 (dq, *J* = 10.8, 7.2 Hz, 1H), 1.20 (t, *J* = 7.1 Hz, 3H), 0.73 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.02, 169.06, 150.11, 147.86, 140.06, 138.07, 130.77, 129.58, 129.45, 128.54, 128.47, 127.61, 127.34, 125.95, 124.62, 123.13, 123.02, 122.62, 118.10, 98.40, 78.15, 62.23, 61.75, 56.32, 53.36, 50.52, 13.98, 13.43. HRMS (ESI): Calcd. for $C_{30}H_{29}N_2O_6$ $[M + H]^+$ 513.2020, Found: 513.2024.

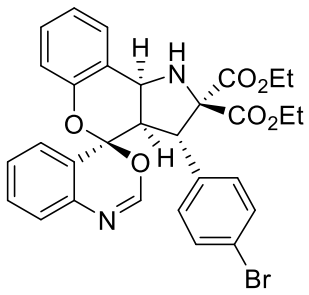


(**3b**) 236 mg, 90% yield, yellow solid: m. p. 160-162 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.56 (dd, *J* = 7.8, 1.7 Hz, 1H), 7.40-7.33 (m, 2H), 7.23 (dd, *J* = 7.8, 1.7 Hz, 1H), 7.12 (d, *J* = 7.9 Hz, 2H), 7.05 (ddd, *J* = 8.4, 6.1, 2.4 Hz, 1H), 7.01-6.99 (m, 4H), 6.91 (dd, *J* = 16.7, 7.9 Hz, 2H), 5.27 (d, *J* = 7.7 Hz, 1H), 4.39 (d, *J* = 3.7 Hz, 1H), 4.25 (dq, *J* = 10.9, 7.2 Hz, 1H), 4.08 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.74 (dq, *J* = 10.6, 7.1 Hz, 1H), 3.56 (dd, *J* = 7.8, 3.8 Hz, 1H), 3.43 (d, *J* = 4.4 Hz, 1H), 3.38 (dq, *J* = 10.6, 7.1 Hz, 1H), 2.28 (s, 3H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.75 (t, *J* =

7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.06, 169.15, 150.12, 147.87, 138.08, 136.94, 136.89, 130.75, 129.56, 129.50, 129.08, 128.38, 127.65, 125.93, 124.64, 123.10, 123.06, 122.63, 118.08, 98.45, 78.20, 62.20, 61.73, 56.34, 53.07, 50.38, 21.12, 13.99, 13.41. HRMS (ESI): Calcd. for $C_{31}H_{31}N_2O_6$ $[M + H]^+$ 527.2177, Found: 527.2178.

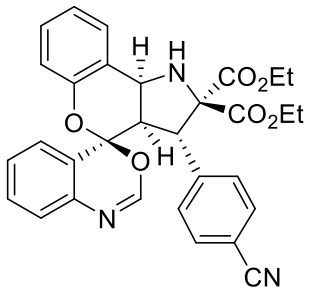


(**3c**) 256 mg, 92% yield, yellow oil. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.55 (dd, *J* = 7.7, 1.7 Hz, 1H), 7.39-7.34 (m, 2H), 7.26-7.17 (m, 2H), 7.12 (dd, *J* = 7.5, 1.2 Hz, 1H), 7.10-7.05 (m, 5H), 6.91 (ddd, *J* = 17.9, 7.9, 1.3 Hz, 2H), 5.25 (d, *J* = 7.8 Hz, 1H), 4.37 (d, *J* = 4.0 Hz, 1H), 4.24 (dq, *J* = 10.7, 7.2 Hz, 1H), 4.08 (dq, *J* = 10.7, 7.2 Hz, 1H), 3.77 (dq, *J* = 10.7, 7.2 Hz, 1H), 3.54 (dd, *J* = 7.8, 3.9 Hz, 1H), 3.44-3.39 (m, 2H), 2.43 (s, 3H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.78 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.92, 169.05, 150.10, 147.79, 138.04, 137.51, 136.73, 130.79, 129.59, 129.45, 129.26, 129.01, 127.71, 126.53, 126.43, 125.97, 124.59, 123.13, 123.01, 122.55, 118.09, 98.38, 78.13, 62.25, 61.82, 56.34, 52.99, 50.42, 15.84, 13.98, 13.49. HRMS (ESI): Calcd. for $C_{31}H_{31}N_2O_6S$ $[M + H]^+$ 559.1897, Found: 559.1902.

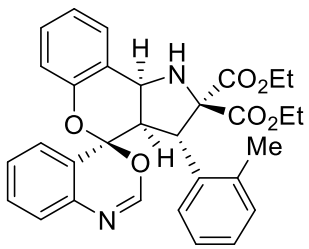


(**3d**) 259 mg, 88% yield, yellow oil. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.53 (dd, *J* = 7.6, 1.7 Hz, 1H), 7.37-7.30 (m, 4H), 7.22 (td, *J* = 7.8, 1.7 Hz, 1H), 7.12-7.08 (m, 2H), 7.07-6.99 (m, 3H), 6.89 (ddd, *J* = 14.5, 8.0, 1.3 Hz, 2H), 5.23 (d, *J* = 7.8 Hz, 1H), 4.37 (d, *J* = 4.1 Hz, 1H), 4.24 (dq, *J* = 10.8, 7.1 Hz, 1H),

4.07 (dq, *J* = 10.9, 7.1 Hz, 1H), 3.79 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.51 (dd, *J* = 7.9, 4.0 Hz, 1H), 3.43 (dq, *J* = 10.8, 7.1 Hz, 1H), 1.18 (t, *J* = 7.1 Hz, 3H), 0.78 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.74, 168.89, 150.04, 147.75, 139.04, 137.98, 131.53, 130.87, 130.31, 129.63, 129.38, 127.74, 126.01, 124.52, 123.19, 122.90, 122.47, 121.30, 118.11, 98.26, 77.98, 62.34, 61.89, 56.29, 52.87, 50.55, 13.98, 13.48. HRMS (ESI): Calcd. for $C_{30}H_{28}BrN_2O_6$ $[M + H]^+$ 591.1125, Found: 591.1128.

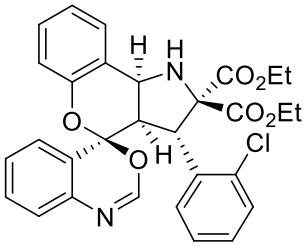


(**3e**) 249 mg, 93% yield, yellow oil. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.55-7.48 (m, 3H), 7.39-7.33 (m, 2H), 7.25 (t, *J* = 8.1 Hz, 3H), 7.14-7.09 (m, 2H), 7.03 (ddd, *J* = 7.8, 6.8, 1.9 Hz, 1H), 6.88 (ddd, *J* = 7.5, 5.5, 1.1 Hz, 2H), 5.26 (d, *J* = 7.9 Hz, 1H), 4.44 (d, *J* = 4.3 Hz, 1H), 4.26 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.09 (dq, *J* = 10.8, 7.2 Hz, 1H), 3.81 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.54 (dd, *J* = 7.9, 4.3 Hz, 1H), 3.41 (dq, *J* = 10.7, 7.1 Hz, 1H), 1.20 (t, *J* = 7.1 Hz, 3H), 0.78 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.43, 168.63, 149.97, 147.66, 145.44, 137.93, 132.20, 131.01, 129.84, 129.75, 129.50, 129.27, 127.74, 126.15, 124.37, 123.32, 122.75, 122.31, 118.56, 118.19, 111.29, 98.07, 77.97, 62.54, 61.95, 56.32, 53.38, 50.82, 13.98, 13.54. HRMS (ESI): Calcd. for $C_{31}H_{28}N_3O_6$ $[M + H]^+$ 538.1973, Found: 538.1969.

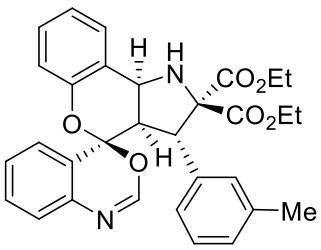


(**3f**) 226 mg, 86% yield, yellow solid: m. p. 169-171 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.56 (dd, *J* = 7.6, 1.6 Hz, 1H), 7.44-7.37 (m, 2H), 7.25-7.22 (m, 1H),

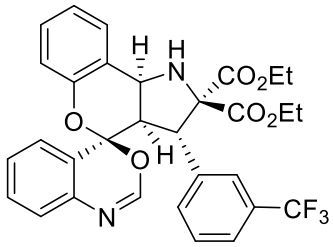
7.18-7.10 (m, 4H), 7.08-7.03 (m, 2H), 6.95 (d, *J* = 7.5 Hz, 1H), 6.92-6.88 (m, 2H), 5.26 (d, *J* = 7.6 Hz, 1H), 4.76 (d, *J* = 3.0 Hz, 1H), 4.29-4.19 (m, 1H), 4.08-4.00 (m, 1H), 3.78-3.67 (m, 1H), 3.55 (s, 1H), 3.43 (dd, *J* = 7.7, 3.1 Hz, 1H), 3.32-3.22 (m, 1H), 1.85 (s, 3H), 1.17 (td, *J* = 7.2, 0.8 Hz, 3H), 0.69 (td, *J* = 7.2, 0.8 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.27, 169.18, 150.18, 148.13, 139.84, 138.20, 137.74, 130.82, 130.13, 129.64, 129.59, 127.68, 127.07, 126.84, 126.32, 125.98, 124.69, 123.12, 123.10, 122.57, 118.13, 98.35, 78.47, 62.21, 61.74, 56.77, 53.21, 47.92, 19.46, 13.93, 13.32. HRMS (ESI): Calcd. for $C_{31}H_{31}N_2O_6$ $[M + H]^+$ 527.2177, Found: 527.2175.



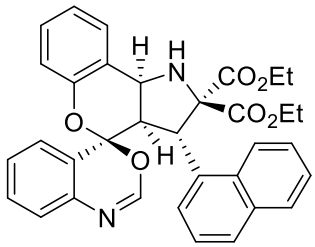
(**3g**) 245 mg, 90% yield, yellow solid: m. p. 202-204 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.56 (dd, *J* = 7.7, 1.6 Hz, 1H), 7.42-7.34 (m, 2H), 7.30 (dd, *J* = 8.2, 1.7 Hz, 1H), 7.25-7.17 (m, 3H), 7.14-7.03 (m, 4H), 6.89 (ddd, *J* = 7.7, 5.0, 1.2 Hz, 2H), 5.21 (d, *J* = 8.0 Hz, 1H), 5.16 (d, *J* = 3.5 Hz, 1H), 4.21 (dq, *J* = 10.8, 7.2 Hz, 1H), 4.07 (dq, *J* = 10.6, 7.1 Hz, 1H), 3.81 (dq, *J* = 10.6, 7.1 Hz, 1H), 3.54 (s, 1H), 3.45-3.33 (m, 2H), 1.17 (t, *J* = 7.1 Hz, 3H), 0.76 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.83, 168.58, 150.17, 147.74, 138.92, 138.13, 135.32, 130.81, 129.63, 129.58, 129.52, 128.56, 128.40, 127.63, 127.02, 126.12, 124.42, 123.11, 122.93, 122.45, 118.17, 98.06, 78.16, 62.29, 61.82, 56.60, 53.51, 48.50, 13.96, 13.42. HRMS (ESI): Calcd. for $C_{30}H_{28}ClN_2O_6$ $[M + H]^+$ 547.1630, Found: 547.1629.



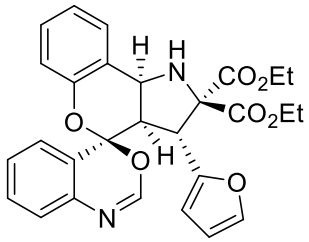
(**3h**) 241 mg, 92% yield, yellow solid: m. p. 210-212 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.57 (dd, *J* = 7.7, 1.7 Hz, 1H), 7.43-7.31 (m, 2H), 7.27-7.19 (m, 1H), 7.17-7.00 (m, 4H), 6.99 (d, *J* = 7.6 Hz, 1H), 6.97-6.85 (m, 4H), 5.27 (d, *J* = 7.7 Hz, 1H), 4.39 (d, *J* = 3.8 Hz, 1H), 4.32-4.20 (m, 1H), 4.16-4.04 (m, 1H), 3.79-3.71 (m, 1H), 3.57 (dd, *J* = 7.8, 3.9 Hz, 1H), 3.49-3.32 (m, 2H), 2.25 (s, 3H), 1.20 (td, *J* = 7.0, 0.8 Hz, 3H), 0.74 (td, *J* = 7.1, 0.7 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.03, 169.11, 150.15, 147.85, 140.00, 138.10, 137.94, 130.73, 129.56, 129.48, 129.23, 128.33, 128.00, 127.60, 125.93, 125.54, 124.67, 123.09, 122.64, 118.09, 98.45, 78.16, 62.19, 61.70, 56.36, 53.30, 50.52, 21.41, 13.98, 13.40. HRMS (ESI): Calcd. for $C_{31}H_{31}N_2O_6$ $[M + H]^+$ 527.2177, Found: 527.2174.



(**3i**) 278 mg, 96% yield, yellow solid: m. p. 189-191 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.55 (dt, *J* = 6.0, 3.2 Hz, 1H), 7.45 (dt, *J* = 6.7, 1.9 Hz, 1H), 7.40-7.30 (m, 5H), 7.27-7.21 (m, 1H), 7.16-7.08 (m, 2H), 7.05-6.98 (m, 1H), 6.93-6.86 (m, 2H), 5.33-5.26 (m, 1H), 4.47-4.45 (m, 1H), 4.32-4.20 (m, 1H), 4.16-4.06 (m, 1H), 3.82-3.73 (m, 1H), 3.59-3.55 (m, 1H), 3.49-3.44 (m, 1H), 3.44-3.37 (m, 1H), 1.20 (td, *J* = 7.1, 3.8 Hz, 3H), 0.74 (td, *J* = 7.1, 3.8 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.62, 168.80, 150.03, 147.68, 140.97, 137.96, 132.16, 130.91, 130.75(q, *J* = 32.3 Hz), 129.65, 129.29, 129.01, 127.67, 126.09, 125.25 (q, *J* = 5.1 Hz), 124.47, 124.21 (q, *J* = 4.0 Hz), 123.94(q, *J* = 273.7 Hz), 123.26, 122.82, 118.17, 98.17, 77.93, 62.42, 61.87, 56.19, 53.17, 50.87, 13.96, 13.32. HRMS (ESI): Calcd. for $C_{31}H_{28}F_3N_2O_6$ $[M + H]^+$ 581.1894, Found: 581.1899.

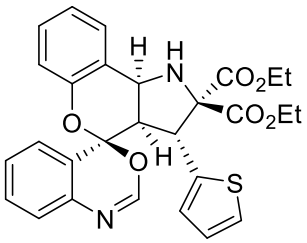


(**3j**) 266 mg, 95% yield, yellow solid: m. p. 201-203 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 8.06 (d, *J* = 8.6 Hz, 1H), 7.72 (ddd, *J* = 10.2, 8.1, 1.4 Hz, 2H), 7.60 (dd, *J* = 7.4, 1.6 Hz, 1H), 7.45-7.35 (m, 3H), 7.34-7.25 (m, 4H), 7.19 (td, *J* = 7.6, 1.8 Hz, 1H), 7.15 (d, *J* = 5.0 Hz, 2H), 6.92 (d, *J* = 8.0 Hz, 1H), 6.83-6.73 (m, 2H), 5.45 (d, *J* = 3.2 Hz, 1H), 5.38 (d, *J* = 7.6 Hz, 1H), 4.24 (dq, *J* = 10.9, 7.2 Hz, 1H), 4.06 (dq, *J* = 10.9, 7.1 Hz, 1H), 3.65 (dd, *J* = 7.7, 3.2 Hz, 1H), 3.51 (dq, *J* = 10.8, 7.1 Hz, 1H), 2.93 (dq, *J* = 10.5, 7.1 Hz, 1H), 1.16 (t, *J* = 7.2 Hz, 3H), 0.22 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.08, 169.31, 150.33, 148.00, 138.10, 137.98, 133.44, 132.43, 130.64, 129.67, 128.19, 128.00, 127.63, 126.33, 125.90, 125.77, 125.08, 124.63, 124.37, 123.89, 123.10, 123.00, 122.50, 118.13, 98.57, 78.69, 62.30, 61.46, 56.92, 53.58, 46.67, 13.93, 12.79. HRMS (ESI): Calcd. for $C_{34}H_{31}N_2O_6$ $[M + H]^+$ 563.2177, Found: 563.2180.

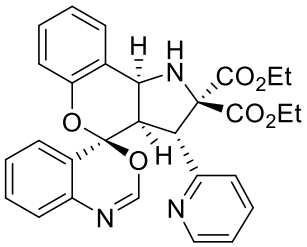


(**3k**) 218 mg, 87% yield, yellow solid: m. p. 160-162 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.51 (dt, *J* = 7.7, 2.8 Hz, 1H), 7.43-7.32 (m, 2H), 7.30-7.27 (m, 1H), 7.25-7.18 (m, 1H), 7.18-7.07 (m, 3H), 7.05-7.02 (m, 1H), 6.90-6.84 (m, 1H), 6.21-6.18 (m, 1H), 5.96-5.94 (m, 1H), 5.21-5.18 (m, 1H), 4.47-4.45 (m, 1H), 4.31-4.19 (m, 1H), 4.14-3.96 (m, 2H), 3.81-3.70 (m, 2H), 3.47 (s, 1H), 1.23-1.17 (m, 3H), 1.03-0.97 (m, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.65, 168.59, 151.68, 149.93, 147.75, 141.88, 137.99, 130.83, 129.43, 129.10, 127.56, 125.98, 124.54, 123.22, 123.04, 122.94, 118.11, 110.76, 108.48, 97.85, 75.84, 62.34, 62.31,

55.07, 47.27, 46.90, 13.98, 13.77. HRMS (ESI): Calcd. for $C_{28}H_{27}N_2O_7$ $[M + H]^+$ 503.1813, Found: 503.1825.

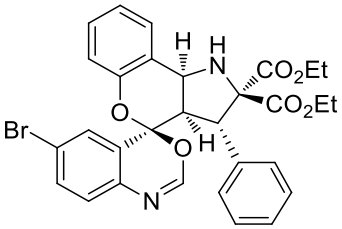


(**3l**) 217 mg, 84% yield, yellow solid: m. p. 157-159 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.58-7.51 (m, 1H), 7.43-7.33 (m, 2H), 7.26-7.21 (m, 1H), 7.14-7.07 (m, 5H), 6.89 (dd, *J* = 8.2, 1.4 Hz, 1H), 6.86-6.81 (m, 2H), 5.28 (d, *J* = 7.7 Hz, 1H), 4.64 (d, *J* = 4.3 Hz, 1H), 4.26 (dqd, *J* = 10.8, 7.1, 1.2 Hz, 1H), 4.12 (dqd, *J* = 10.8, 7.2, 1.2 Hz, 1H), 3.88 (dqd, *J* = 10.7, 7.1, 1.2 Hz, 1H), 3.68-3.59 (m, 2H), 3.45 (s, 1H), 1.22 (td, *J* = 7.1, 1.3 Hz, 3H), 0.90 (td, *J* = 7.2, 1.3 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.64, 169.00, 150.01, 147.58, 142.28, 137.95, 130.87, 129.57, 129.37, 127.71, 126.90, 126.29, 126.03, 124.68, 124.45, 123.19, 122.94, 122.63, 118.10, 98.16, 77.98, 62.34, 62.02, 55.58, 51.79, 48.68, 14.00, 13.62. HRMS (ESI): Calcd. for $C_{28}H_{27}N_2O_6S$ $[M + H]^+$ 519.1584, Found: 519.1599.

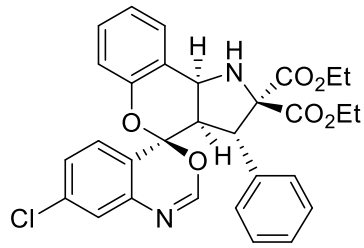


(**3m**) 230 mg, 90% yield, yellow solid: m. p. 178-180 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 8.54-8.50 (m, 1H), 7.54-7.47 (m, 1H), 7.44-7.37 (m, 1H), 7.33-7.27 (m, 2H), 7.25-7.13 (m, 2H), 7.12-7.04 (m, 2H), 7.02-6.91 (m, 2H), 6.90-6.83 (m, 2H), 5.30-5.24 (m, 1H), 4.52-4.45 (m, 1H), 4.29-4.19 (m, 1H), 4.13-4.01 (m, 2H), 3.91-3.80 (m, 1H), 3.57-3.56 (m, 1H), 3.51-3.40 (m, 1H), 1.18 (dt, *J* = 9.4, 7.1 Hz, 3H), 0.75 (dt, *J* = 9.5, 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.55, 168.90, 158.90, 150.02, 149.28, 148.19, 138.11, 136.31, 130.64, 129.24, 129.05, 127.32, 125.82, 125.06, 124.80, 123.49, 123.17, 123.14, 122.13, 118.09,

98.20, 76.93, 62.25, 61.78, 55.26, 54.41, 48.55, 13.96, 13.51. HRMS (ESI): Calcd. for $C_{29}H_{28}N_3O_6$ $[M + H]^+$ 514.1973, Found: 514.1985.

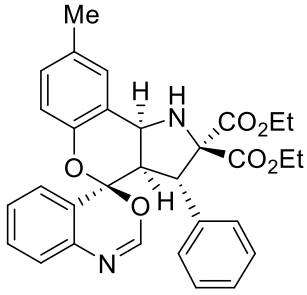


(**3n**) 268 mg, 91% yield, yellow solid: m. p. 185-187 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.56-7.51 (m, 1H), 7.45 (dt, *J* = 8.4, 1.5 Hz, 1H), 7.26-7.19 (m, 5H), 7.15-7.11 (m, 4H), 7.00 (d, *J* = 2.1 Hz, 1H), 6.88 (dd, *J* = 8.1, 1.2 Hz, 1H), 5.29 (d, *J* = 8.0 Hz, 1H), 4.37 (d, *J* = 4.3 Hz, 1H), 4.25 (dq, *J* = 10.7, 7.1 Hz, 1H), 4.07 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.79 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.51 (dd, *J* = 8.1, 4.4 Hz, 1H), 3.47 (s, 1H), 3.40 (dq, *J* = 10.7, 7.1 Hz, 1H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.72 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.11, 168.89, 149.79, 148.30, 139.60, 137.20, 133.81, 129.60, 129.23, 128.63, 128.41, 128.09, 127.58, 127.49, 124.60, 123.41, 122.89, 120.39, 118.10, 97.71, 77.70, 62.23, 61.81, 55.69, 52.94, 50.69, 13.96, 13.42. HRMS (ESI): Calcd. for $C_{30}H_{28}BrN_2O_6$ $[M + H]^+$ 591.1125, Found: 591.1136.

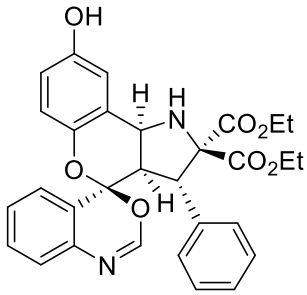


(**3o**) 256 mg, 94% yield, yellow solid: m. p. 177-179 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.54 (dd, *J* = 7.6, 1.7 Hz, 1H), 7.33-7.27 (m, 2H), 7.26-7.19 (m, 4H), 7.15-7.10 (m, 4H), 6.90-6.84 (m, 2H), 5.28 (d, *J* = 8.0 Hz, 1H), 4.38 (d, *J* = 4.4 Hz, 1H), 4.25 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.07 (dq, *J* = 10.8, 7.2 Hz, 1H), 3.78 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.53-3.43 (m, 2H), 3.38 (dq, *J* = 10.7, 7.1 Hz, 1H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.72 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.09, 168.92, 149.82, 148.15, 139.61, 136.77, 132.70, 130.86, 129.59, 129.26, 128.60,

128.41, 127.55, 127.24, 125.09, 124.36, 123.39, 122.84, 118.08, 97.87, 77.76, 62.22, 61.79, 55.77, 52.96, 50.76, 13.96, 13.41. HRMS (ESI): Calcd. for $C_{30}H_{28}ClN_2O_6$ [M + H]$^+$ 547.1630, Found: 547.1641.

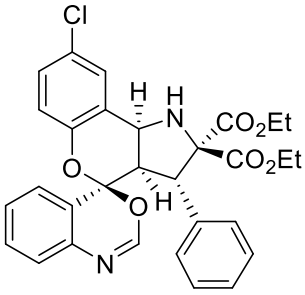


(**4a**) 239 mg, 91% yield, yellow solid: m. p. 193-195 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.39-7.32 (m, 3H), 7.22-7.15 (m, 3H), 7.15-7.09 (m, 3H), 7.05-6.97 (m, 2H), 6.90 (d, *J* = 7.8 Hz, 1H), 6.78 (d, *J* = 8.2 Hz, 1H), 5.24 (d, *J* = 7.8 Hz, 1H), 4.41 (d, *J* = 3.8 Hz, 1H), 4.24 (dq, *J* = 10.6, 7.1 Hz, 1H), 4.08 (dq, *J* = 10.5, 7.1 Hz, 1H), 3.74 (dq, *J* = 10.5, 7.1 Hz, 1H), 3.56 (dd, *J* = 7.9, 3.9 Hz, 1H), 3.42 (d, *J* = 7.3 Hz, 1H), 3.34 (dq, *J* = 10.6, 7.1 Hz, 1H), 2.33 (s, 3H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.73 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.95, 169.06, 147.87, 140.08, 138.09, 132.54, 130.69, 130.18, 129.69, 128.54, 128.43, 127.54, 127.30, 125.90, 124.64, 123.13, 122.30, 117.82, 98.48, 78.23, 62.17, 61.69, 56.41, 53.50, 50.65, 20.71, 13.98, 13.44. HRMS (ESI): Calcd. for $C_{31}H_{31}N_2O_6$ [M + H]$^+$ 527.2177, Found: 527.2188.

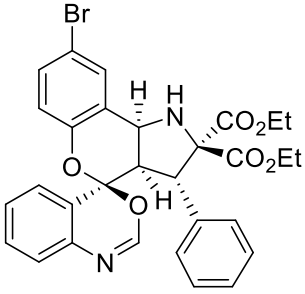


(**4b**) 221 mg, 84% yield, yellow solid: m. p. 130-132 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.36 (dd, *J* = 4.0, 1.0 Hz, 2H), 7.22-7.18 (m, 3H), 7.15-7.10 (m, 3H), 7.05-6.99 (m, 2H), 6.91 (d, *J* = 7.8 Hz, 1H), 6.74 (d, *J* = 1.7 Hz, 2H), 5.23 (d, *J* = 7.8 Hz, 1H), 4.41 (d, *J* = 3.7 Hz, 1H), 4.31-4.22 (m, 1H), 4.16-4.06 (m, 1H), 3.81-3.71 (m, 1H), 3.55 (dd, *J* = 8.0, 3.6 Hz, 1H), 3.39-3.29 (m, 1H), 1.19 (td, *J* = 7.1, 1.3 Hz, 3H), 0.72 (td, *J* = 7.1, 1.2 Hz, 3H). ^{13}C NMR (101 MHz,

CHLOROFORM-*D*) δ 171.06, 169.01, 152.01, 148.28, 143.40, 139.97, 137.87, 134.42, 130.78, 128.82, 128.65, 128.51, 128.01, 127.65, 127.41, 125.80, 124.64, 123.06, 118.93, 117.25, 115.62, 98.48, 78.18, 62.41, 61.95, 56.57, 53.42, 50.46, 13.98, 13.39. HRMS (ESI): Calcd. for $C_{30}H_{29}N_2O_7$ $[M + H]^+$ 529.1969, Found: 529.1987.

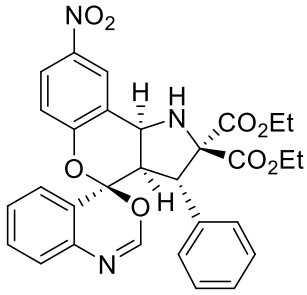


(**4c**) 253 mg, 93% yield, yellow solid: m. p. 200-202 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.55 (d, *J* = 2.6 Hz, 1H), 7.42-7.34 (m, 2H), 7.23-7.17 (m, 4H), 7.11 (dd, *J* = 7.4, 2.2 Hz, 2H), 7.08 (s, 1H), 7.03 (ddd, *J* = 8.6, 6.5, 2.1 Hz, 1H), 6.92-6.89 (m, 1H), 6.83 (d, *J* = 8.7 Hz, 1H), 5.23 (d, *J* = 7.9 Hz, 1H), 4.41 (d, *J* = 4.3 Hz, 1H), 4.26 (dq, *J* = 10.9, 7.1 Hz, 1H), 4.09 (dq, *J* = 10.9, 7.3 Hz, 1H), 3.76 (dq, *J* = 10.6, 7.1 Hz, 1H), 3.58 (dd, *J* = 7.9, 4.3 Hz, 1H), 3.46 (s, 1H), 3.36 (dq, *J* = 10.9, 7.3 Hz, 1H), 1.21 (t, *J* = 7.2 Hz, 3H), 0.73 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.93, 168.97, 148.76, 147.58, 139.75, 137.96, 130.91, 129.56, 129.09, 128.51, 128.08, 127.67, 127.43, 126.01, 124.58, 124.54, 122.73, 119.52, 98.45, 77.92, 62.31, 61.86, 55.92, 53.04, 50.45, 13.97, 13.42. HRMS (ESI): Calcd. for $C_{30}H_{28}ClN_2O_6$ $[M + H]^+$ 547.1630, Found: 547.1636.

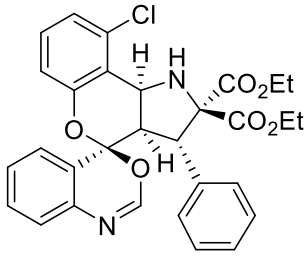


(**4d**) 265 mg, 90% yield, yellow solid: m. p. 196-198 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.74-7.65 (m, 1H), 7.37-7.31 (m, 3H), 7.20-7.17 (m, 3H), 7.14-7.09 (m, 2H), 7.08-6.98 (m, 2H), 6.93-6.88 (m, 1H), 6.77 (dd, *J* = 8.6, 2.1 Hz, 1H), 5.22 (d, *J* = 8.0 Hz, 1H), 4.40 (d, *J* = 4.2 Hz, 1H), 4.25 (dqd, *J* = 10.7, 7.1, 1.3 Hz, 1H), 4.09 (dqd, *J* = 10.8, 7.1, 1.5 Hz, 1H), 3.75 (dqd, *J* = 10.7, 7.2, 1.4 Hz,

1H), 3.57 (dd, *J* = 8.1, 4.3 Hz, 1H), 3.46 (s, 1H), 3.35 (dqd, *J* = 10.7, 7.2, 1.2 Hz, 1H), 1.20 (td, *J* = 7.1, 1.5 Hz, 3H), 0.72 (td, *J* = 7.2, 1.4 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.87, 168.97, 149.32, 147.52, 139.73, 137.97, 132.43, 132.04, 130.90, 128.50, 127.66, 127.42, 126.01, 125.13, 124.54, 122.74, 119.92, 115.43, 98.42, 77.93, 62.29, 61.83, 55.86, 53.07, 50.50, 13.98, 13.42. HRMS (ESI): Calcd. for $C_{30}H_{28}BrN_2O_6$ $[M + H]^+$ 591.1125, Found: 591.1138.

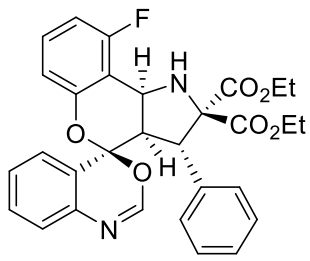


(**4e**) 236 mg, 85% yield, yellow solid: m. p. 222-224 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 8.50 (d, *J* = 2.7 Hz, 1H), 8.14 (dd, *J* = 9.0, 2.7 Hz, 1H), 7.42-7.36 (m, 2H), 7.23-7.19 (m, 3H), 7.13-7.10 (m, 2H), 7.09-7.04 (m, 2H), 7.00 (d, *J* = 8.9 Hz, 1H), 6.92 (dd, *J* = 7.9, 1.3 Hz, 1H), 5.31 (d, *J* = 7.5 Hz, 1H), 4.43 (d, *J* = 4.4 Hz, 1H), 4.25 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.08 (dq, *J* = 10.8, 7.2 Hz, 1H), 3.79 (dq, *J* = 10.6, 7.1 Hz, 1H), 3.65-3.61 (m, 2H), 3.37 (dq, *J* = 10.7, 7.2 Hz, 1H), 1.20 (t, *J* = 7.1 Hz, 3H), 0.73 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.93, 168.86, 155.44, 147.09, 143.22, 139.43, 137.87, 131.24, 128.60, 128.44, 127.87, 127.58, 126.22, 125.60, 125.26, 124.51, 124.22, 122.02, 118.98, 98.82, 77.63, 62.39, 62.01, 55.54, 52.68, 50.28, 13.94, 13.40. HRMS (ESI): Calcd. for $C_{30}H_{28}N_3O_8$ $[M + H]^+$ 558.1871, Found: 558.1885.

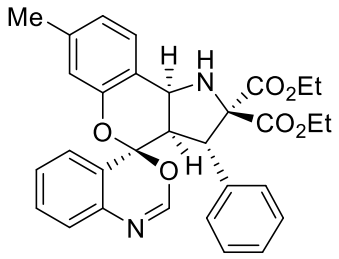


(**4f**) 253 mg, 93% yield, yellow solid: m. p. 159-161 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.41-7.36 (m, 2H), 7.23-7.15 (m, 6H), 7.13-7.08 (m, 2H), 7.05-6.99 (m, 1H),

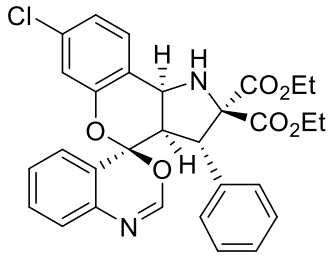
6.90-6.86 (m, 1H), 6.81 (dd, *J* = 7.0, 2.4 Hz, 1H), 5.41 (d, *J* = 7.9 Hz, 1H), 4.45 (d, *J* = 3.2 Hz, 1H), 4.30 (dq, *J* = 10.7, 7.1 Hz, 1H), 4.25 (s, 1H), 4.04 (dq, *J* = 10.8, 7.2 Hz, 1H), 3.76 (dq, *J* = 10.6, 7.2 Hz, 1H), 3.52 (dd, *J* = 7.8, 3.2 Hz, 1H), 3.33 (dq, *J* = 10.6, 7.2 Hz, 1H), 1.18 (t, *J* = 7.1 Hz, 3H), 0.71 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.73, 168.91, 151.52, 148.10, 140.47, 138.34, 135.07, 130.93, 130.03, 128.58, 127.58, 127.38, 126.05, 124.68, 123.77, 122.30, 121.60, 116.88, 97.79, 77.35, 62.23, 61.84, 54.83, 51.46, 49.71, 13.91, 13.41. HRMS (ESI): Calcd. for $C_{30}H_{28}ClN_2O_6$ $[M + H]^+$ 547.1630, Found: 547.1632.



(**4g**) 238 mg, 90% yield, yellow oil. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.37-7.34 (m, 2H), 7.22-7.15 (m, 5H), 7.09 (dd, *J* = 7.3, 2.3 Hz, 2H), 6.98 (ddd, *J* = 7.8, 4.9, 3.7 Hz, 1H), 6.87-6.81 (m, 2H), 6.69 (d, *J* = 8.3 Hz, 1H), 5.45 (d, *J* = 8.2 Hz, 1H), 4.42 (d, *J* = 3.8 Hz, 1H), 4.27 (dq, *J* = 10.8, 7.1 Hz, 0H), 4.04 (dq, *J* = 10.7, 7.2 Hz, 1H), 3.84 (s, 1H), 3.77 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.55 (dd, *J* = 8.1, 3.7 Hz, 1H), 3.33 (dq, *J* = 10.6, 7.2 Hz, 1H), 1.18 (t, *J* = 7.1 Hz, 3H), 0.70 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.60, 168.89, 161.80 (d, *J* = 246.3 Hz, ArF), 148.00, 140.19, 138.20, 130.90, 129.89 (d, *J* = 10.2 Hz, ArF), 128.84, 128.54, 127.44 (d, *J* = 14.1 Hz, ArF), 126.00, 124.74, 122.30, 113.74 (d, *J* = 3.1 Hz, ArF), 112.05 (d, *J* = 21.5 Hz, ArF), 109.46 (d, *J* = 20.9 Hz, ArF), 98.04, 77.42, 62.17, 61.78, 51.81, 51.48, 49.47, 13.91, 13.41. HRMS (ESI): Calcd. for $C_{30}H_{28}FN_2O_6$ $[M + H]^+$ 531.1926, Found: 531.1911.

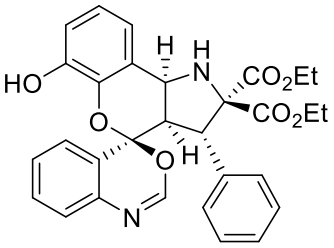


(**4h**) 236 mg, 90% yield, yellow solid: m. p. 175-177 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.44 (dd, *J* = 7.8, 1.6 Hz, 1H), 7.36-7.34 (m, 2H), 7.21-7.09 (m, 6H), 7.04-6.99 (m, 1H), 6.92 (ddd, *J* = 12.3, 8.1, 1.5 Hz, 2H), 6.71 (d, *J* = 2.1 Hz, 1H), 5.23 (d, *J* = 7.6 Hz, 1H), 4.41 (d, *J* = 3.7 Hz, 1H), 4.24 (dqd, *J* = 10.8, 7.1, 1.3 Hz, 1H), 4.09 (dqd, *J* = 10.8, 7.1, 1.3 Hz, 1H), 3.73 (dqd, *J* = 10.7, 7.1, 1.4 Hz, 1H), 3.55 (dd, *J* = 7.8, 3.8 Hz, 1H), 3.40-3.31 (m, 2H), 2.29 (d, *J* = 1.9 Hz, 3H), 1.19 (td, *J* = 7.1, 1.4 Hz, 3H), 0.72 (td, *J* = 7.1, 1.4 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.94, 169.11, 149.94, 147.86, 140.13, 139.83, 138.09, 130.69, 129.22, 128.63, 128.55, 128.43, 127.57, 127.29, 125.91, 124.61, 124.03, 123.16, 119.50, 118.38, 98.52, 78.29, 62.18, 61.69, 56.29, 53.50, 50.65, 21.30, 13.98, 13.43. HRMS (ESI): Calcd. for $C_{31}H_{31}N_2O_6$ $[M + H]^+$ 527.2177, Found: 527.2170.

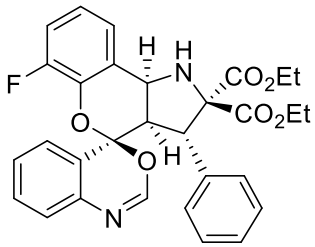


(**4i**) 232 mg, 85% yield, yellow solid: m. p. 169-171 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.48 (dd, *J* = 8.2, 0.7 Hz, 1H), 7.40-7.34 (m, 2H), 7.21-7.17 (m, 3H), 7.13-7.08 (m, 4H), 7.05-7.00 (m, 1H), 6.90 (dd, *J* = 8.3, 1.6 Hz, 2H), 5.23 (d, *J* = 7.8 Hz, 1H), 4.40 (d, *J* = 4.0 Hz, 1H), 4.25 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.09 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.74 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.57 (dd, *J* = 7.8, 4.0 Hz, 1H), 3.43 (s, 1H), 3.34 (dq, *J* = 10.7, 7.2 Hz, 1H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.72 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.94, 168.96, 150.82, 147.50, 139.83, 138.00, 134.69, 130.93, 130.36, 128.72, 128.50, 127.69, 127.42, 126.05, 124.57,

123.42, 122.57, 121.42, 118.40, 98.48, 78.03, 62.28, 61.82, 55.86, 53.19, 50.42, 13.97, 13.41. HRMS (ESI): Calcd. for $C_{30}H_{28}ClN_2O_6$ $[M + H]^+$ 547.1630, Found: 547.1637.

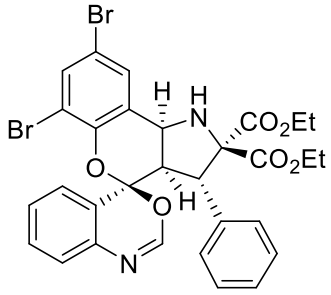


(**4j**) 227mg, 86% yield, yellow oil. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.21-7.14 (m, 5H), 7.11-7.05 (m, 4H), 7.00 (t, *J* = 7.8 Hz, 1H), 6.94 (ddd, *J* = 8.5, 5.6, 3.0 Hz, 1H), 6.91-6.84 (m, 2H), 5.29 (d, *J* = 7.9 Hz, 1H), 4.36 (d, *J* = 4.0 Hz, 1H), 4.23 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.04 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.73 (dq, *J* = 10.7, 7.2 Hz, 1H), 3.60 (dd, *J* = 7.8, 4.0 Hz, 1H), 3.32 (dq, *J* = 10.7, 7.2 Hz, 1H), 1.17 (t, *J* = 7.1 Hz, 3H), 0.70 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.07, 168.89, 147.99, 146.06, 139.95, 137.64, 137.47, 130.90, 128.46, 127.49, 127.34, 125.67, 124.72, 123.42, 123.20, 122.25, 119.99, 115.69, 98.51, 77.91, 62.21, 61.74, 56.19, 53.07, 50.64, 13.94, 13.40. HRMS (ESI): Calcd. for $C_{30}H_{29}N_2O_7$ $[M + H]^+$ 529.1969, Found: 529.1968.

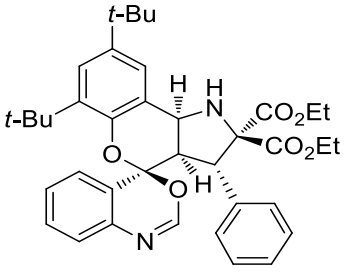


(**4k**) 233 mg, 88% yield, yellow oil. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.41-7.32 (m, 3H), 7.20-7.16 (m, 3H), 7.12-7.07 (m, 3H), 7.06-6.98 (m, 3H), 6.93-6.91 (m, 1H), 5.29 (d, *J* = 7.9 Hz, 1H), 4.40 (d, *J* = 4.0 Hz, 1H), 4.25 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.17 (dq, *J* = 10.7, 7.2 Hz, 1H), 3.75 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.59 (dd, *J* = 7.9, 4.1 Hz, 1H), 3.48 (s, 1H), 3.34 (dq, *J* = 10.7, 7.2 Hz, 1H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.71 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.07, 168.92, 152.24 (d, *J* = 248.0 Hz, ArF), 147.38, 139.81, 138.03, 130.92, 128.74 (d, *J* = 6.2 Hz, ArF), 128.49, 128.46, 127.68, 127.41, 126.04, 125.46, 124.83, 124.23 (d, *J* = 3.7 Hz, ArF),

122.79, 122.72, 122.30, 116.05 (d, *J* = 18.1 Hz, ArF), 98.26, 77.84, 62.27, 61.83, 55.90 (d, *J* = 2.8 Hz), 53.07, 50.73, 13.96, 13.40. HRMS (ESI): Calcd. for $C_{30}H_{28}FN_2O_6$ $[M + H]^+$ 531.1926, Found: 531.1792.

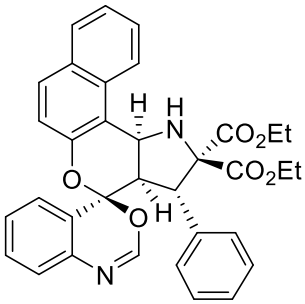


(**4l**) 297 mg, 89% yield, yellow solid: m. p. 220-222 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.67-7.58 (m, 2H), 7.39-7.32 (m, 2H), 7.18 (dd, *J* = 5.2, 1.9 Hz, 3H), 7.10-7.07 (m, 2H), 7.06-6.99 (m, 2H), 6.95-6.88 (m, 1H), 5.23 (d, *J* = 8.1 Hz, 1H), 4.38 (d, *J* = 4.8 Hz, 1H), 4.24 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.09 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.76 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.65 (dd, *J* = 8.1, 4.8 Hz, 1H), 3.48 (s, 1H), 3.35 (dq, *J* = 10.6, 7.1 Hz, 1H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.71 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 170.90, 168.89, 147.01, 146.48, 139.31, 137.94, 135.14, 131.01, 130.95, 128.52, 128.47, 127.71, 127.50, 127.04, 126.06, 124.65, 122.34, 115.43, 113.40, 98.70, 77.74, 62.31, 61.93, 55.97, 52.70, 50.65, 13.99, 13.41. HRMS (ESI): Calcd. for $C_{30}H_{27}Br_2N_2O_6$ $[M + H]^+$ 669.0230, Found: 669.0235.

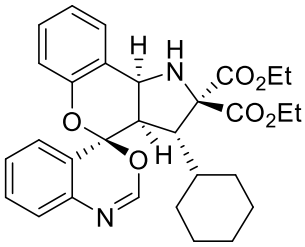


(**4m**) 255 mg, 82% yield, yellow solid: m. p. 147-149 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.39-7.33 (m, 3H), 7.28 (d, *J* = 2.4 Hz, 1H), 7.21-7.16 (m, 4H), 7.11 (dd, *J* = 7.4, 2.2 Hz, 2H), 7.02-6.98 (m, 1H), 6.92 (d, *J* = 7.9 Hz, 1H), 5.31 (d, *J* = 8.0 Hz, 1H), 4.41 (d, *J* = 3.7 Hz, 1H), 4.27 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.08 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.75 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.55 (dd, *J* = 8.0, 3.7 Hz, 1H), 3.47 (s, 1H), 3.34 (dq, *J* = 10.7, 7.2 Hz, 1H), 1.34 (s, 9H), 1.19 (m, 12H),

0.72 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.39, 168.97, 148.26, 146.08, 144.83, 140.26, 138.46, 137.94, 130.49, 128.53, 128.42, 127.49, 127.25, 125.85, 124.77, 124.21, 123.84, 123.20, 121.91, 97.82, 77.94, 62.19, 61.71, 56.87, 53.18, 50.21, 35.10, 34.64, 31.67, 29.96, 13.95, 13.43. HRMS (ESI): Calcd. for $C_{38}H_{45}N_2O_6$ $[M + H]^+$ 625.3272, Found: 625.3287.

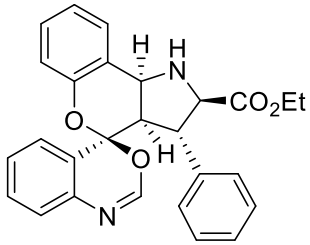


(**4n**) 238 mg, 85% yield, yellow solid: m. p. 177-179 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 8.46 (d, *J* = 8.4 Hz, 1H), 7.83 (dd, *J* = 8.2, 1.3 Hz, 1H), 7.76 (d, *J* = 8.9 Hz, 1H), 7.66 (ddd, *J* = 8.3, 6.9, 1.3 Hz, 1H), 7.49-7.40 (m, 3H), 7.26-7.18 (m, 5H), 7.17 (s, 1H), 7.12-7.04 (m, 2H), 6.99 (d, *J* = 7.8 Hz, 1H), 5.69 (d, *J* = 7.1 Hz, 1H), 4.49 (d, *J* = 2.7 Hz, 1H), 4.26 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.08 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.76 (dq, *J* = 10.6, 7.1 Hz, 1H), 3.71-3.61 (m, 2H), 3.42 (dq, *J* = 10.6, 7.2 Hz, 1H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.79 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.17, 169.13, 147.93, 147.90, 140.37, 138.31, 132.79, 130.88, 130.51, 130.22, 128.57, 128.53, 127.79, 127.70, 127.40, 126.12, 124.62, 123.64, 122.93, 118.75, 114.30, 98.52, 78.65, 62.31, 61.78, 55.11, 53.43, 49.79, 14.01, 13.50. HRMS (ESI): Calcd. for $C_{34}H_{31}N_2O_6$ $[M + H]^+$ 563.2177, Found: 563.2186.



(**3'a**) 222 mg, 86%, yellow solid: m. p. 161-163 °C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.49 (dd, *J* = 7.7, 1.7 Hz, 1H), 7.46-7.38 (m, 2H), 7.36-7.32 (m, 1H), 7.29 (dd, *J* = 7.8, 1.3 Hz, 1H), 7.26-7.21 (m, 1H), 7.10-7.06 (m, 1H), 6.99 (s, 1H), 6.92 (dd, *J* = 8.2, 1.2 Hz, 1H), 4.66 (d, *J* = 7.0 Hz, 1H), 4.32-4.19 (m, 3H), 4.13 (dq, *J* = 10.7, 7.1

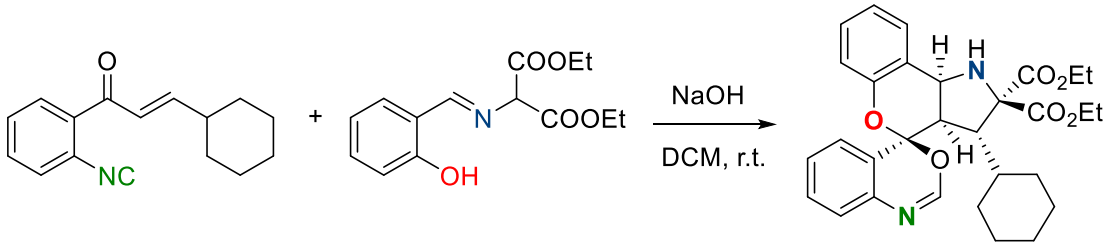
Hz, 1H), 3.34 (s, 1H), 2.95 (dd, *J* = 7.1, 2.6 Hz, 1H), 2.83 (dd, *J* = 4.8, 2.6 Hz, 1H), 1.74-1.65 (m, 1H), 1.60 (d, *J* = 11.5 Hz, 2H), 1.51 (t, *J* = 15.6 Hz, 2H), 1.30 (t, *J* = 7.1 Hz, 3H), 1.24 (t, *J* = 7.1 Hz, 3H), 1.14-1.00 (m, 3H), 0.97-0.88 (m, 1H), 0.68-0.54 (m, 1H), 0.51-0.42 (m, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 171.75, 170.44, 150.12, 147.77, 137.99, 130.80, 130.01, 129.41, 127.56, 126.58, 125.76, 123.23, 122.78, 121.73, 117.81, 99.44, 75.83, 62.26, 62.14, 56.27, 54.25, 47.96, 38.34, 33.51, 30.12, 26.90, 26.68, 26.20, 14.15, 14.04. HRMS (ESI): Calcd. for $C_{30}H_{35}N_2O_6$ [M + H]$^+$ 519.2490, Found: 519.2494.



(**6a**) 204 mg, 93% yield, red solid: m. p. 164-166 ^{o}C. ^{1}H NMR (400 MHz, CHLOROFORM-*D*) δ 7.65 (dd, *J* = 7.6, 1.7 Hz, 1H), 7.45-7.36 (m, 2H), 7.29-7.21 (m, 4H), 7.19 (s, 1H), 7.16-7.09 (m, 2H), 6.99-6.95 (m, 3H), 6.91 (dd, *J* = 8.2, 1.2 Hz, 1H), 4.68 (d, *J* = 7.3 Hz, 1H), 4.17-4.06 (m, 2H), 3.99 (d, *J* = 7.4 Hz, 1H), 3.30 (ddd, *J* = 15.5, 7.4, 3.4 Hz, 2H), 3.14 (s, 1H), 1.14 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-*D*) δ 172.24, 150.33, 147.79, 142.98, 137.97, 130.90, 130.13, 129.62, 128.97, 127.83, 127.24, 127.13, 125.92, 125.14, 122.99, 122.89, 121.88, 118.03, 98.83, 69.35, 61.35, 57.91, 55.17, 53.64, 14.25. HRMS (ESI): Calcd. for $C_{27}H_{25}N_2O_4$ [M + H]$^+$ 441.1809, Found: 441.1818.

4. Synthetic applications

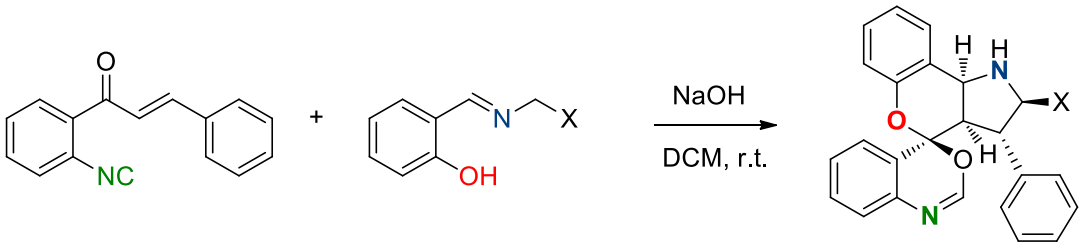
a) Reaction with substituted isocyanide 1'a



1'a **2a** **3'a**, 86% yield

Under air atmosphere, a sealable reaction tube equipped with a magnetic stir bar was charged with isocyanide **1'a** (0.5 mmol, 119.5 mg), *o*-hydroxy aromatic aldimine **2a** (0.6 mmol, 167.4 mg) and NaOH (1 mmol, 40 mg) in 5 mL of DCM at room temperature. After completion of the reaction, the reaction mixture was concentrated under vacuum. The residue was purified by thin layer chromatography [eluant: petroleum ether/ethyl acetate = 2 : 1] to afford the desired product **3'a.** 207 mg, 86% yield, yellow solid.

b) Reaction with other aldimine esters



1a

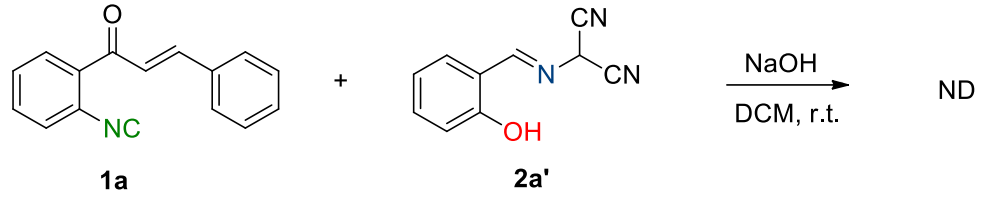
5a: **X** = COOEt
5b: = CN

6a: 93% yield
6b: ND

Under air atmosphere, a sealable reaction tube equipped with a magnetic stir bar was charged with *o*-enoyl arylisocyanide **1a** (0.5 mmol, 116.5 mg), aldimine ester **5a** (0.6 mmol, 124.2 mg) and NaOH (1 mmol, 40 mg) in 5 mL of DCM at room temperature. After completion of the reaction, the reaction mixture was concentrated

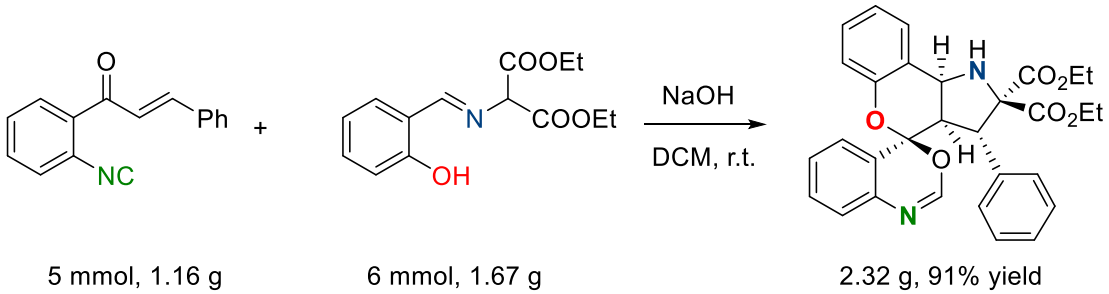
under vacuum. The residue was purified by thin layer chromatography [eluant: petroleum ether/ethyl acetate = 2 : 1] to afford the desired product **6a.** 204.6 mg, 93% yield, yellow solid.

c) Reaction with derivative of aldimine ester



Under air atmosphere, a sealable reaction tube equipped with a magnetic stir bar was charged with *o*-enoyl arylisocyanide **1a** (0.5 mmol, 116.5 mg), derivative of aldimine ester **2a'** (0.6 mmol, 92.5 mg) and NaOH (1 mmol, 40 mg) in 5 mL of DCM at room temperature. After completion of the reaction, the reaction mixture was concentrated under vacuum.

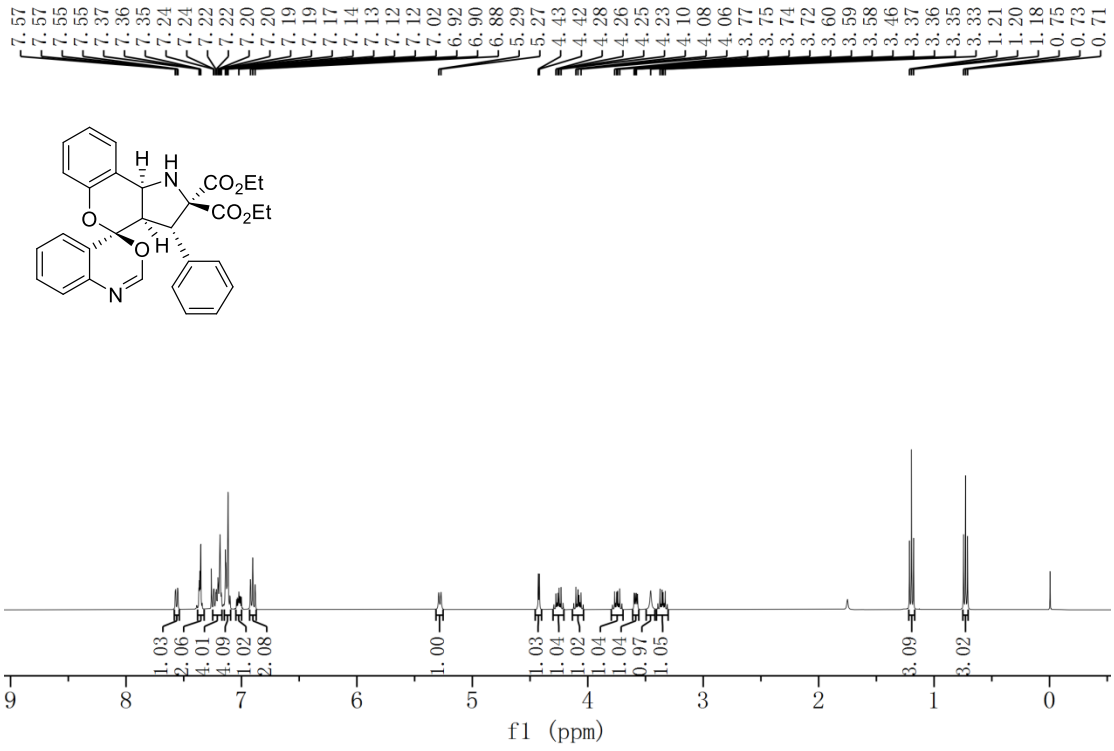
d) Gram-scale reaction

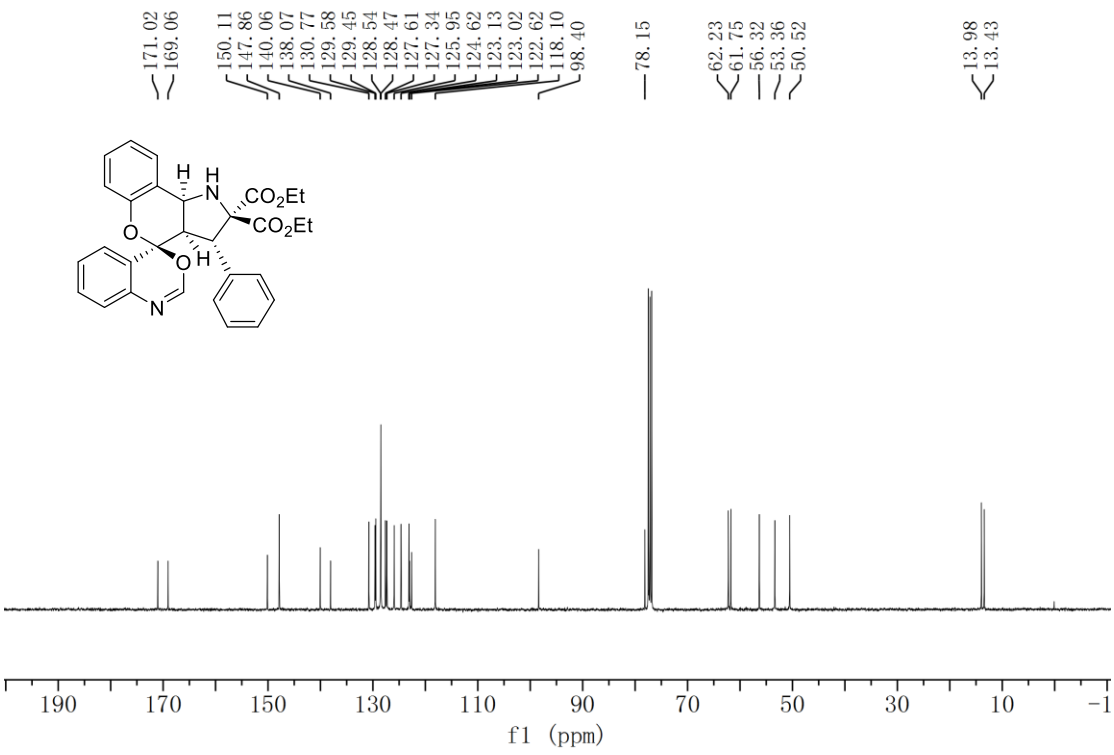


Under air atmosphere, a sealable reaction tube equipped with a magnetic stir bar was charged with *o*-enoyl arylisocyanide **1a** (5 mmol, 1.16 g), *o*-hydroxy aromatic aldimine **2a** (6 mmol, 1.67 g) and NaOH (10 mmol, 0.4 g) in 50 mL of DCM at room temperature. After completion of the reaction, the reaction mixture was concentrated under vacuum. The residue was purified by recrystallization to afford the desired product **3a.** 2.32 g, 91% yield, yellow solid.

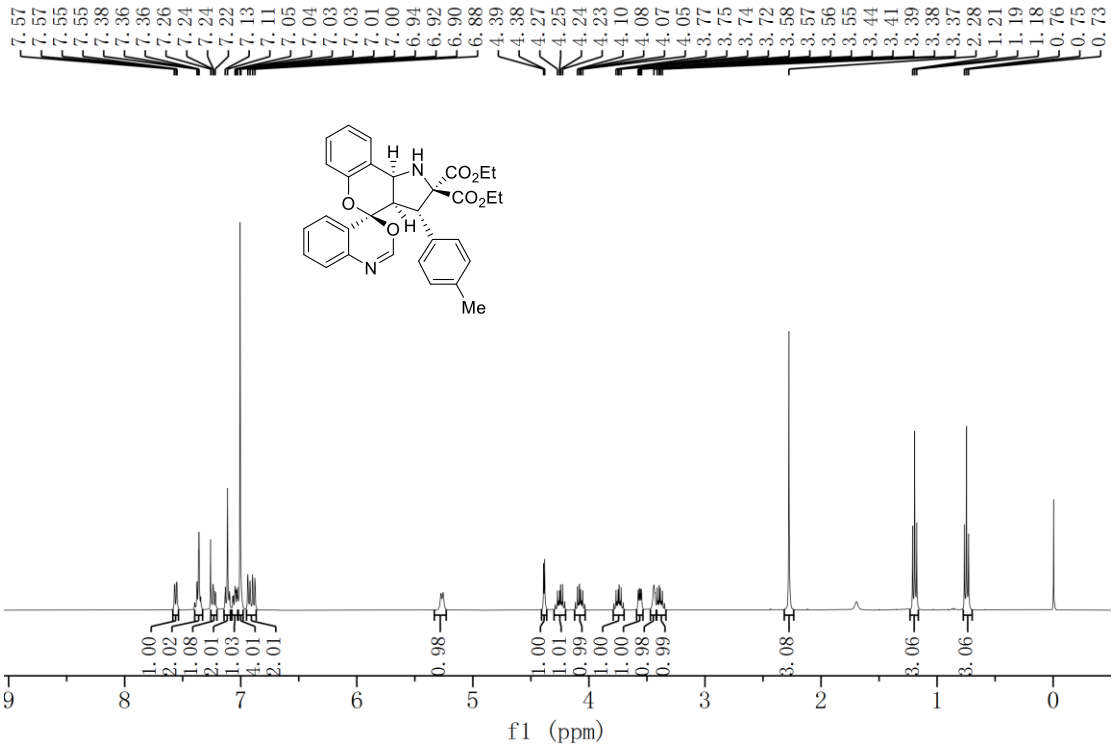
5. ^{1}H NMR and ^{13}C NMR Spectra of All Compounds

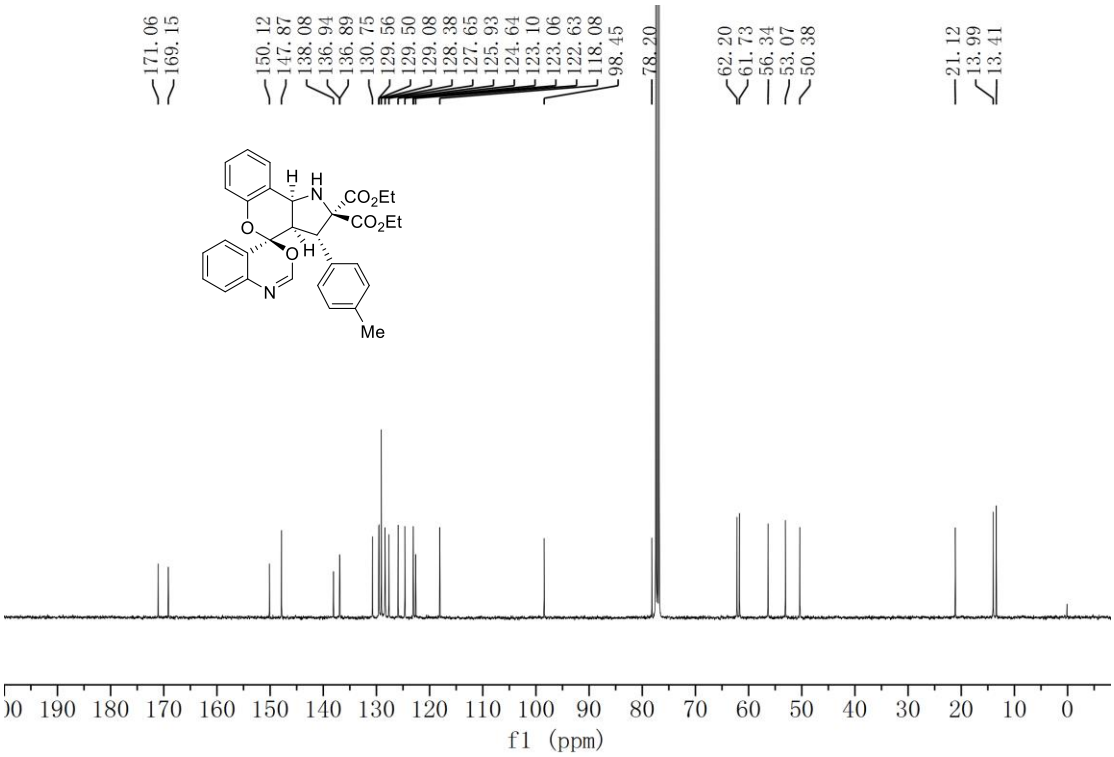
Compound **3a**



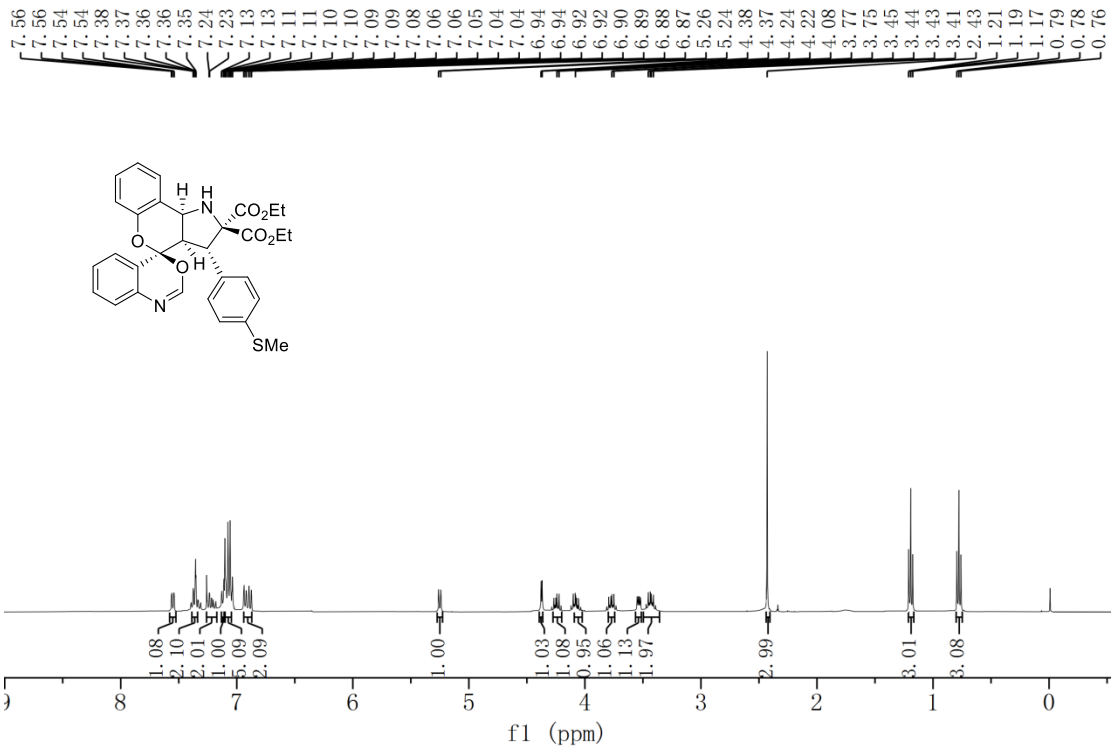


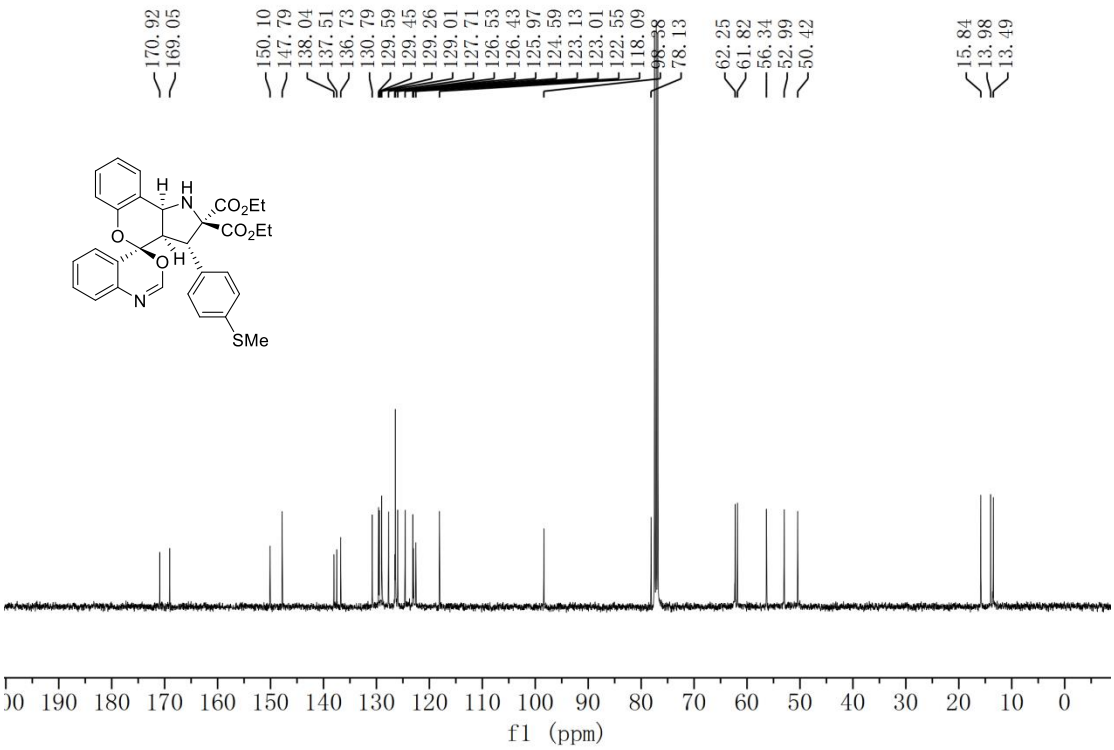
Compound **3b**


7.57 7.57 7.55 7.55 7.38 7.36 7.36 7.26 7.24 7.24 7.22 7.13 7.11 7.05 7.04 7.03 7.03 7.01 7.00 6.94 6.92 6.90 6.88 4.39 4.38 4.27 4.25 4.24 4.23 4.10 4.08 4.07 4.05 3.77 3.75 3.74 3.72 3.58 3.57 3.56 3.55 3.44 3.41 3.39 3.38 3.37 2.28 1.21 1.19 1.18 0.76 0.75 0.73
H H N CO2Et CO2Et O O H N Me
1.00 2.02 1.08 2.01 1.03 4.01 2.01 0.98 1.00 1.01 0.99 1.00 1.00 0.98 0.99 3.08 3.06 3.06
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

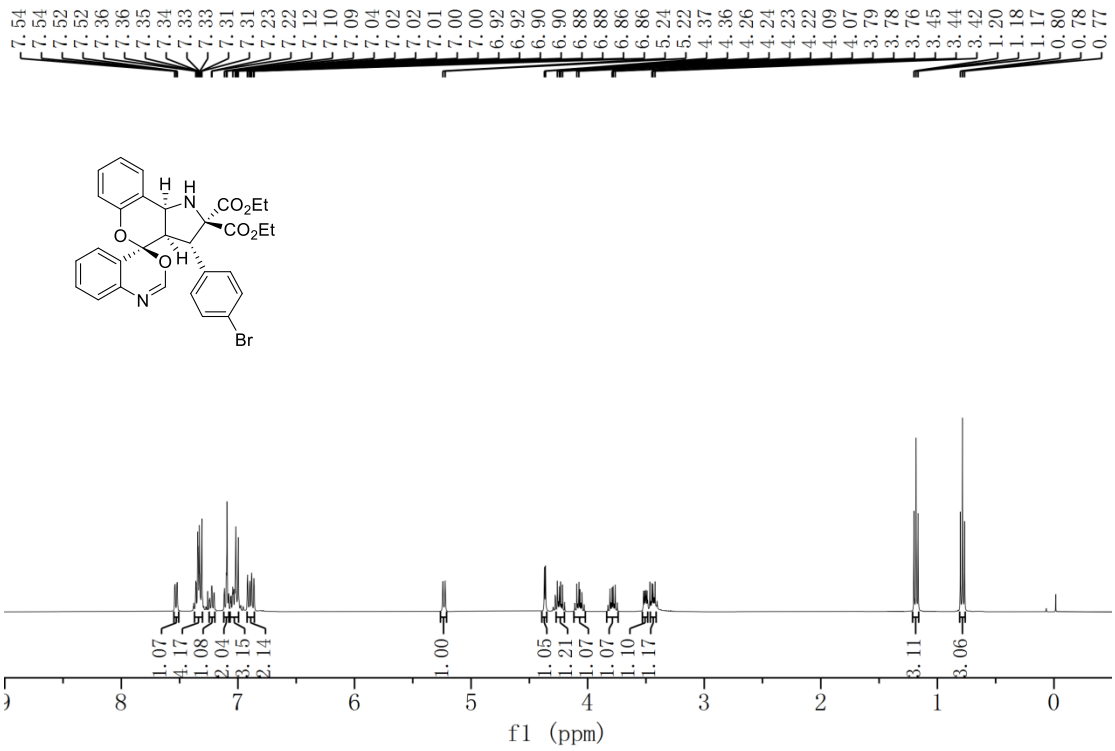

171.06 169.15 150.12 147.87 138.08 136.94 136.89 130.75 129.56 129.50 129.08 128.38 127.65 125.93 124.64 123.10 123.06 122.63 118.08 98.45 78.20 62.20 61.73 56.34 53.07 50.38 21.12 13.99 13.41
H H N CO2Et CO2Et O O H N Me
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

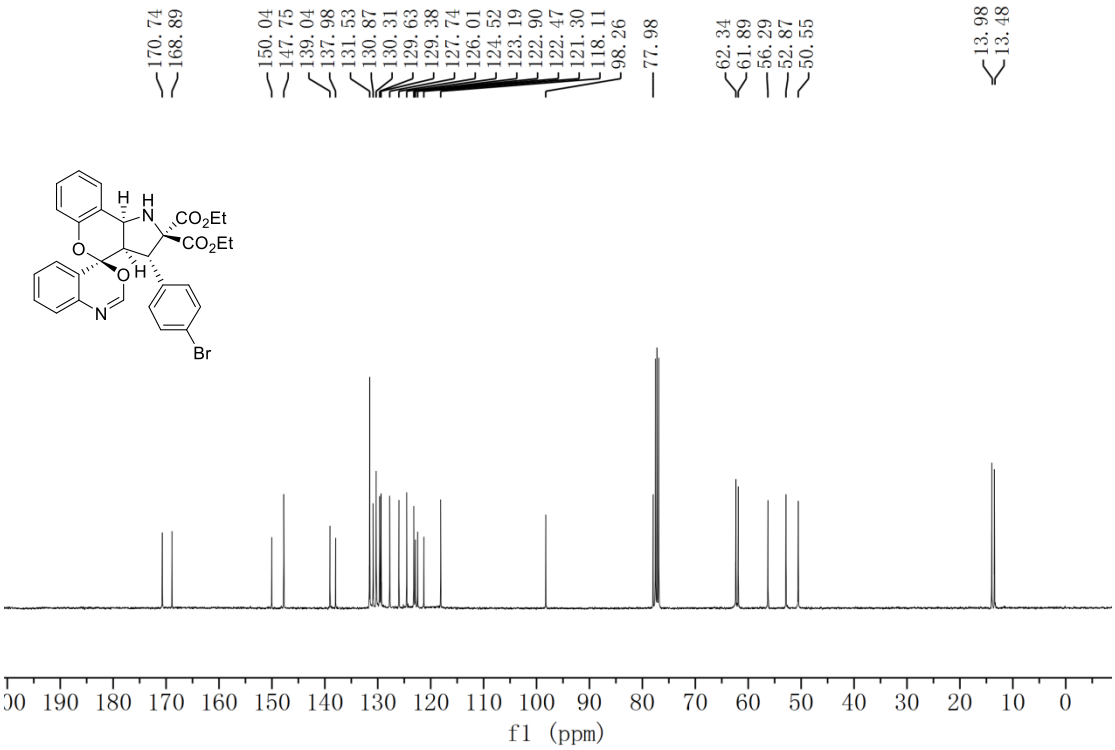
Compound **3c**


7.56 7.56 7.54 7.54 7.38 7.37 7.36 7.36 7.35 7.24 7.23 7.13 7.13 7.11 7.11 7.10 7.10 7.09 7.09 7.08 7.06 7.06 7.05 7.04 7.04 6.94 6.94 6.92 6.92 6.90 6.89 6.88 6.87 5.26 5.24 4.38 4.37 4.24 4.22 4.08 3.77 3.75 3.45 3.44 3.43 3.41 2.43 1.21 1.19 1.17 0.79 0.78 0.76
H
H
N
CO2Et
CO2Et
O
O
H
N
SMe
1.08 2.10 2.01 1.00 5.09 2.09 1.00 1.03 1.08 0.95 1.06 1.13 1.97 2.99 3.01 3.08
f1 (ppm)

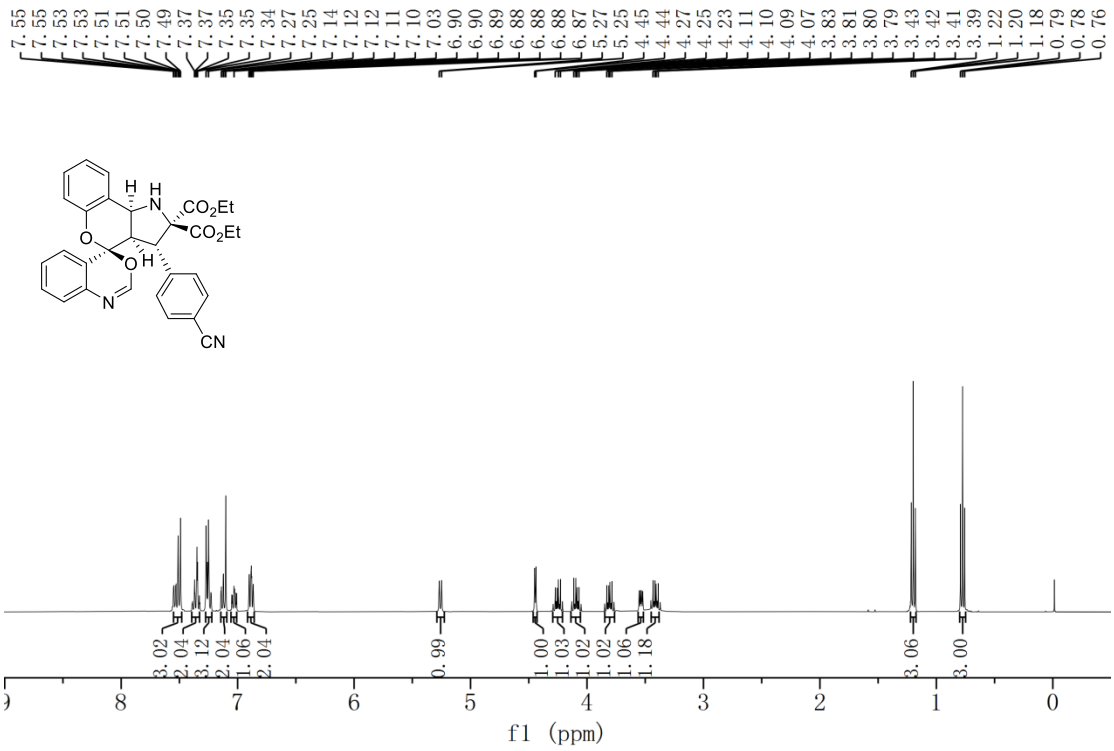

170.92 169.05 150.10 147.79 138.04 137.51 136.73 130.79 129.59 129.45 129.26 129.01 127.71 126.53 126.43 125.97 124.59 123.13 123.01 122.55 118.09 98.38 78.13 62.25 61.82 56.34 52.99 50.42 15.84 13.98 13.49
H
H
N
CO2Et
CO2Et
O
O
H
N
SMe
f1 (ppm)

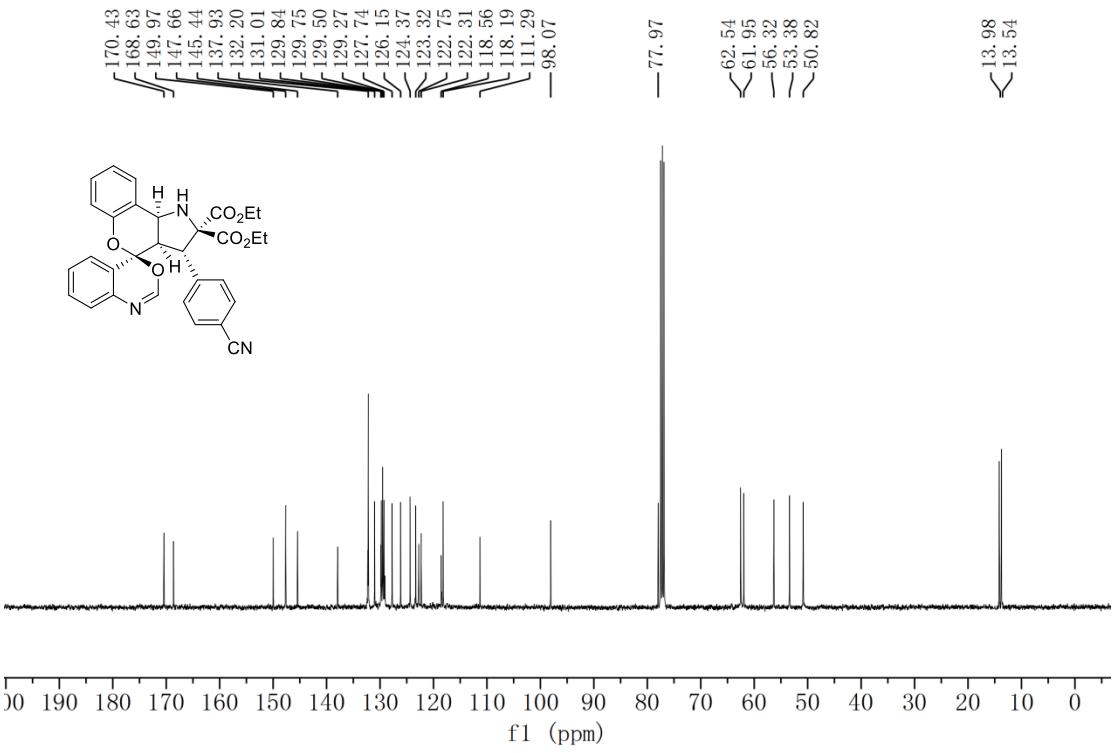
Compound **3d**


7.54 7.54 7.52 7.52 7.36 7.36 7.35 7.34 7.33 7.33 7.31 7.31 7.23 7.22 7.12 7.10 7.09 7.04 7.02 7.02 7.01 7.00 7.00 6.92 6.92 6.90 6.90 6.88 6.88 6.86 6.86 5.24 5.22 4.37 4.36 4.26 4.24 4.23 4.22 4.09 4.07 3.79 3.78 3.76 3.45 3.44 3.42 1.20 1.18 1.17 0.80 0.78 0.77
H
H
N
CO2Et
CO2Et
O
O
H
N
Br
1.07 4.17 1.08 2.04 3.15 2.14 1.00 1.05 1.21 1.07 1.07 1.10 1.17 3.11 3.06
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

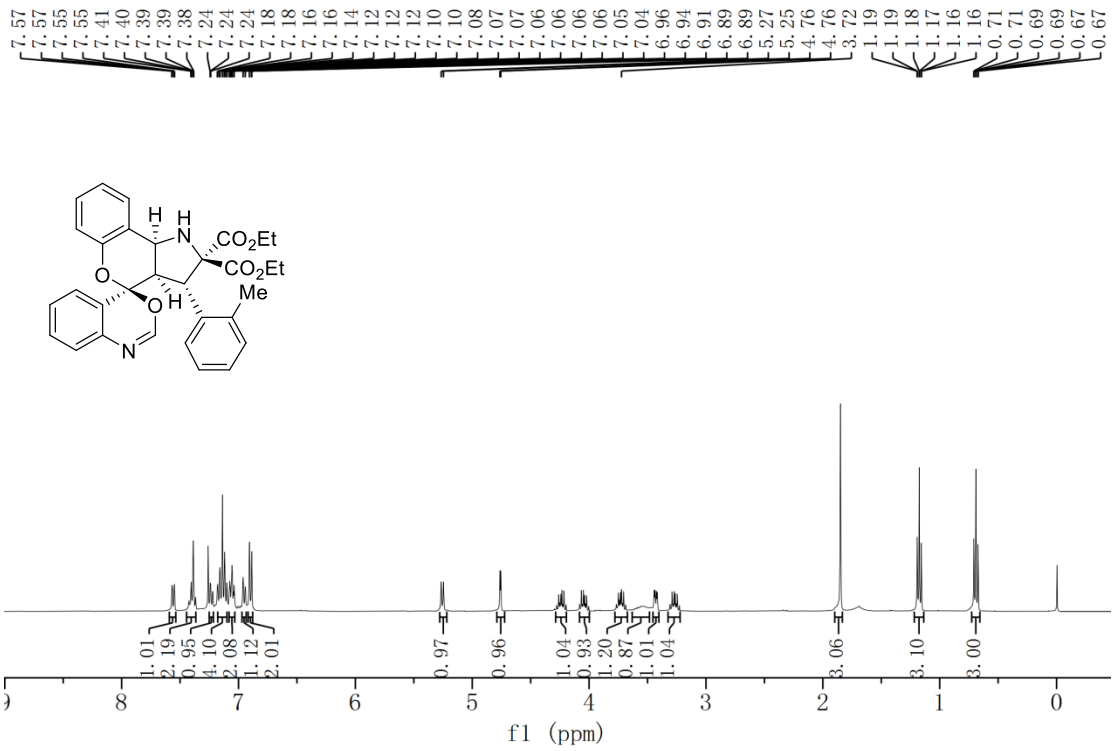

170.74 168.89 150.04 147.75 139.04 137.98 131.53 130.87 130.31 129.63 129.38 127.74 126.01 124.52 123.19 122.90 122.47 121.30 118.11 98.26 77.98 62.34 61.89 56.29 52.87 50.55 13.98 13.48
H
H
N
CO2Et
CO2Et
O
O
H
N
Br
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

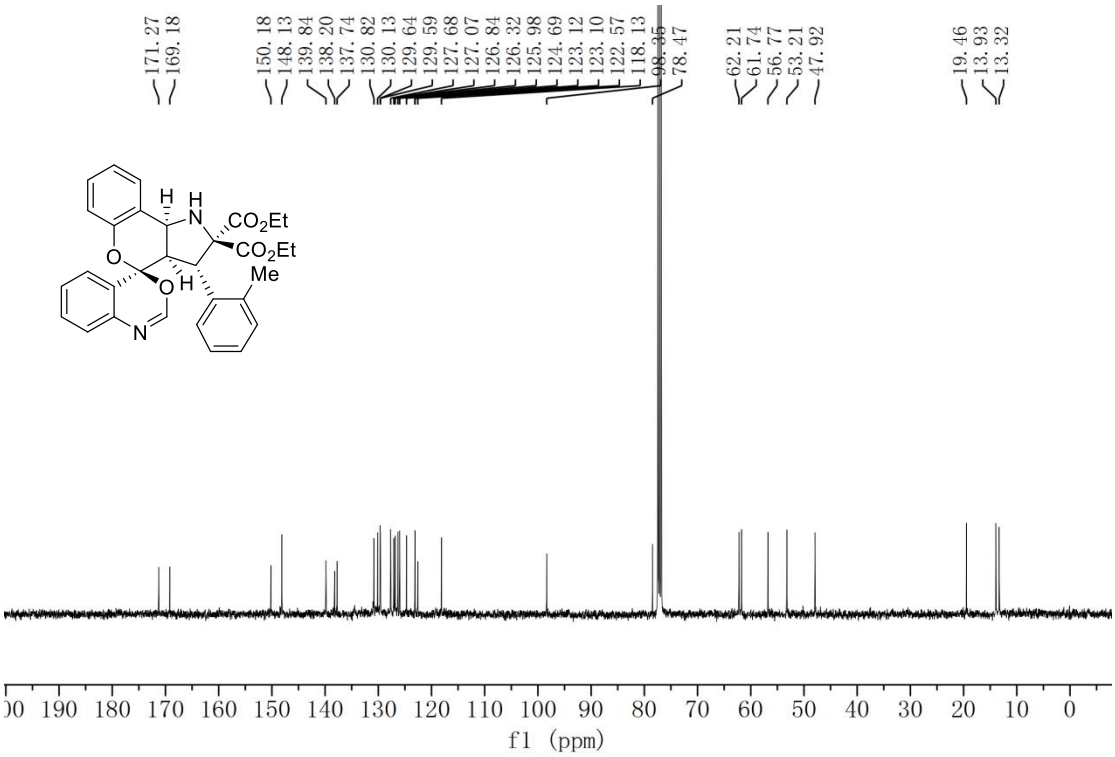
Compound **3e**


7.55 7.55 7.53 7.53 7.51 7.51 7.50 7.49 7.37 7.37 7.35 7.34 7.27 7.25 7.14 7.12 7.12 7.11 7.10 7.03 6.90 6.90 6.89 6.88 6.88 6.88 6.87 5.27 5.25 4.45 4.44 4.27 4.25 4.23 4.11 4.10 4.09 4.07 3.83 3.81 3.80 3.79 3.43 3.42 3.41 3.39 1.22 1.20 1.18 0.79 0.78 0.76
H H N CO2Et CO2Et O O H N CN
3.02 2.04 3.12 2.04 1.06 2.04 0.99 1.00 1.03 1.02 1.02 1.06 1.18 3.06 3.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

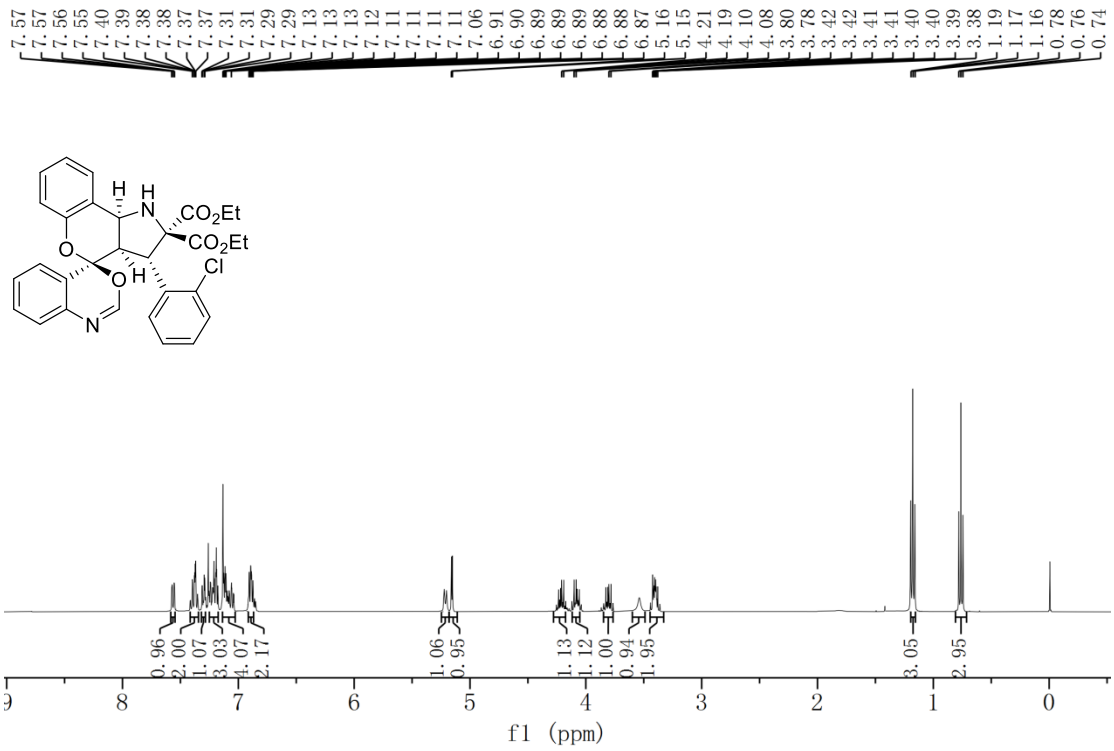

170.43 168.63 149.97 147.66 145.44 137.93 132.20 131.01 129.84 129.75 129.50 129.27 127.74 126.15 124.37 123.32 122.75 122.31 118.56 118.19 111.29 98.07 77.97 62.54 61.95 56.32 53.38 50.82 13.98 13.54
H H N CO2Et CO2Et O O H N CN
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

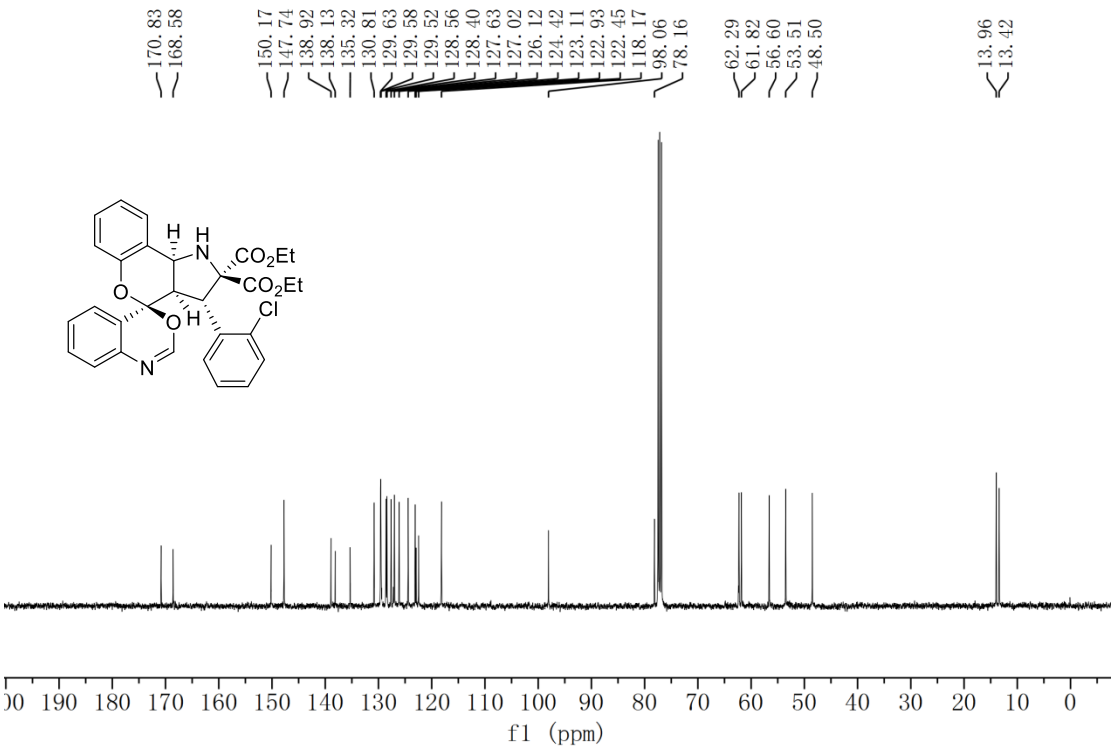
Compound **3f**


7.57 7.57 7.55 7.55 7.41 7.40 7.39 7.39 7.38 7.24 7.24 7.24 7.18 7.18 7.16 7.16 7.14 7.12 7.12 7.12 7.10 7.10 7.08 7.07 7.07 7.06 7.06 7.06 7.06 7.05 7.04 6.96 6.94 6.91 6.89 6.89 5.27 5.25 4.76 3.72 1.19 1.19 1.18 1.17 1.16 1.16 0.71 0.71 0.69 0.69 0.67 0.67
H
H
N
CO2Et
CO2Et
O
O
H
Me
N
1.01 2.19 0.95 4.10 2.08 1.12 2.01 0.97 0.96 1.04 0.93 1.20 0.87 1.01 1.04 3.06 3.10 3.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

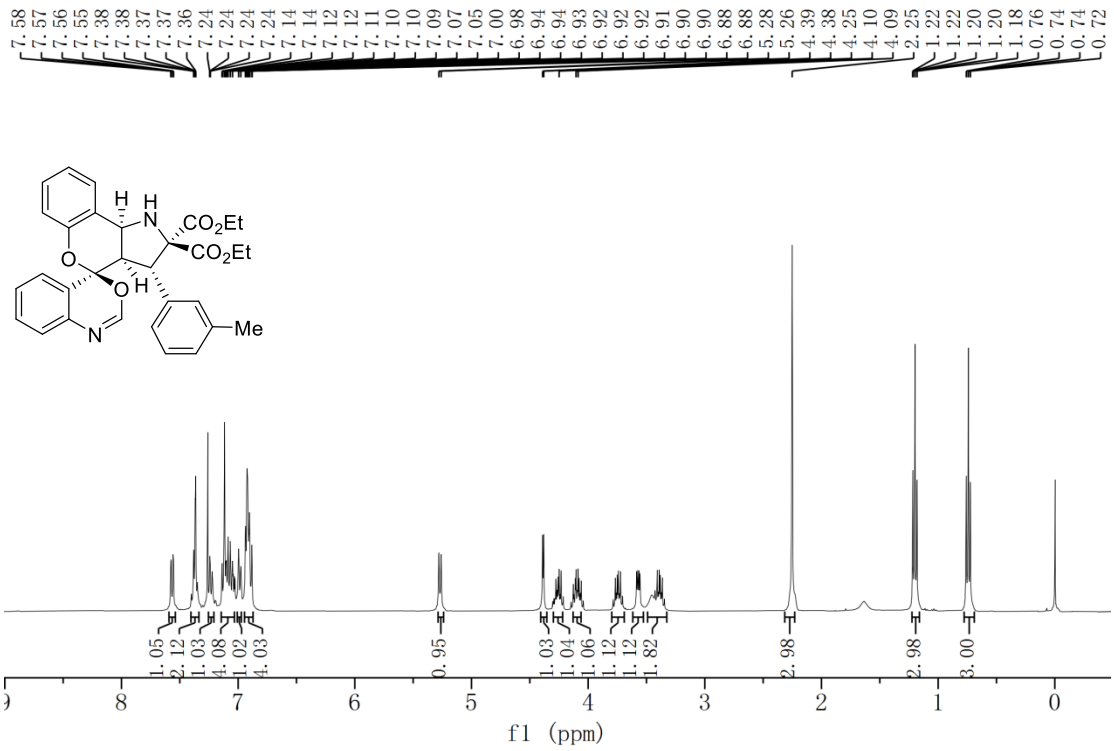

171.27 169.18 150.18 148.13 139.84 138.20 137.74 130.82 130.13 129.64 129.59 127.68 127.07 126.84 126.32 125.98 124.69 123.12 123.10 122.57 118.13 98.35 78.47 62.21 61.74 56.77 53.21 47.92 19.46 13.93 13.32
H
H
N
CO2Et
CO2Et
O
O
H
Me
N
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

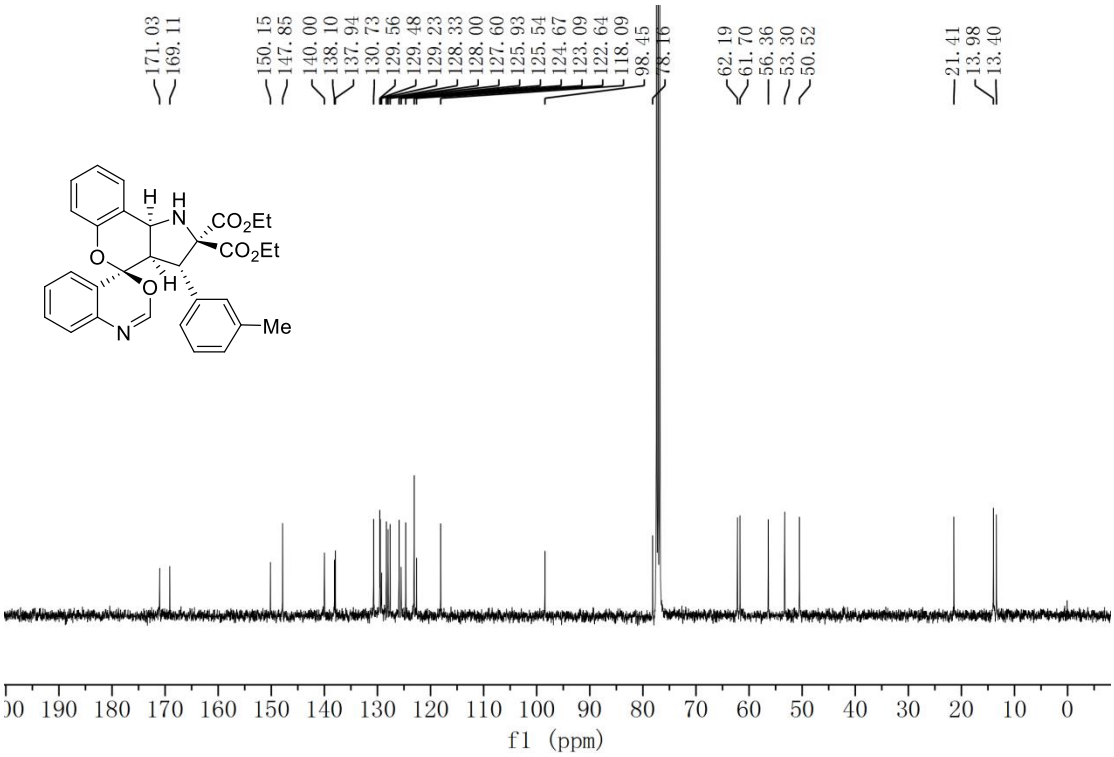
Compound **3g**


7.57 7.57 7.56 7.55 7.40 7.39 7.38 7.38 7.37 7.37 7.31 7.31 7.29 7.29 7.13 7.13 7.13 7.12 7.11 7.11 7.11 7.11 7.06 6.91 6.90 6.89 6.89 6.89 6.88 6.88 6.87 5.16 5.15 4.21 4.19 4.10 4.08 3.80 3.78 3.42 3.42 3.41 3.41 3.40 3.40 3.39 3.38 1.19 1.17 1.16 0.78 0.76 0.74
H
H
N
CO2Et
CO2Et
O
O
H
Cl
N
0.96 2.00 1.07 3.03 4.07 2.17 1.06 0.95 1.13 1.12 1.00 0.94 0.95 3.05 2.95
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

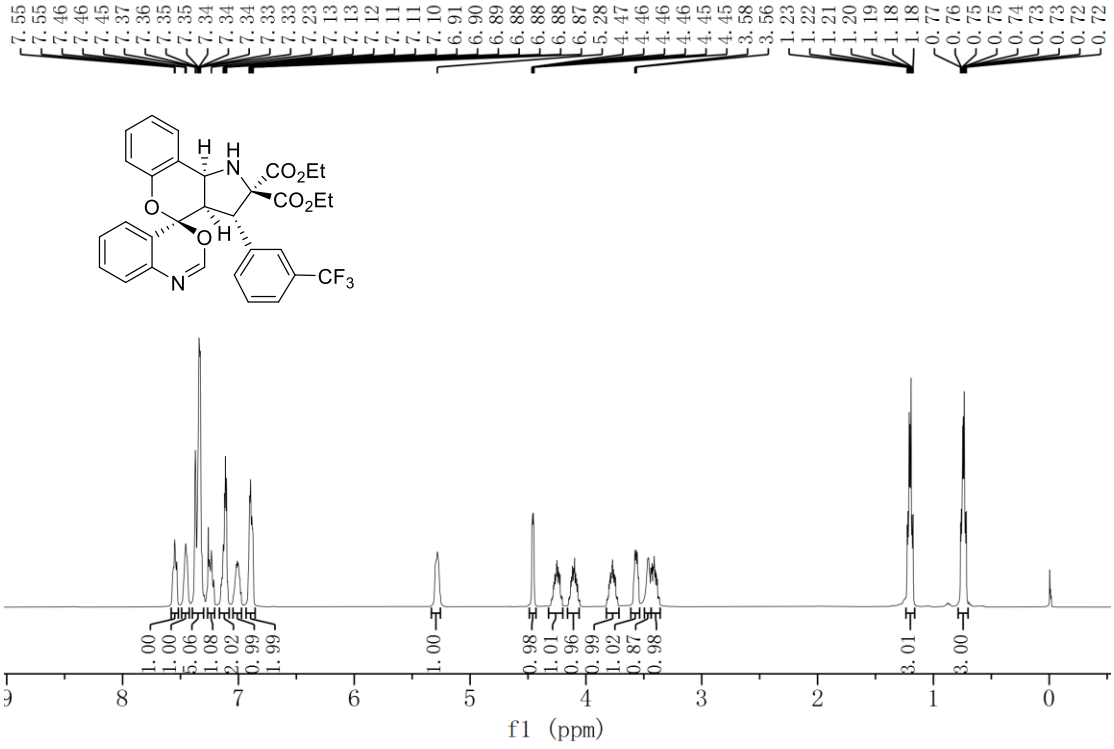

170.83 168.58 150.17 147.74 138.92 138.13 135.32 130.81 129.63 129.58 129.52 128.56 128.40 127.63 127.02 126.12 124.42 123.11 122.93 122.45 118.17 98.06 78.16 62.29 61.82 56.60 53.51 48.50 13.96 13.42
H
H
N
CO2Et
CO2Et
O
O
H
Cl
N
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

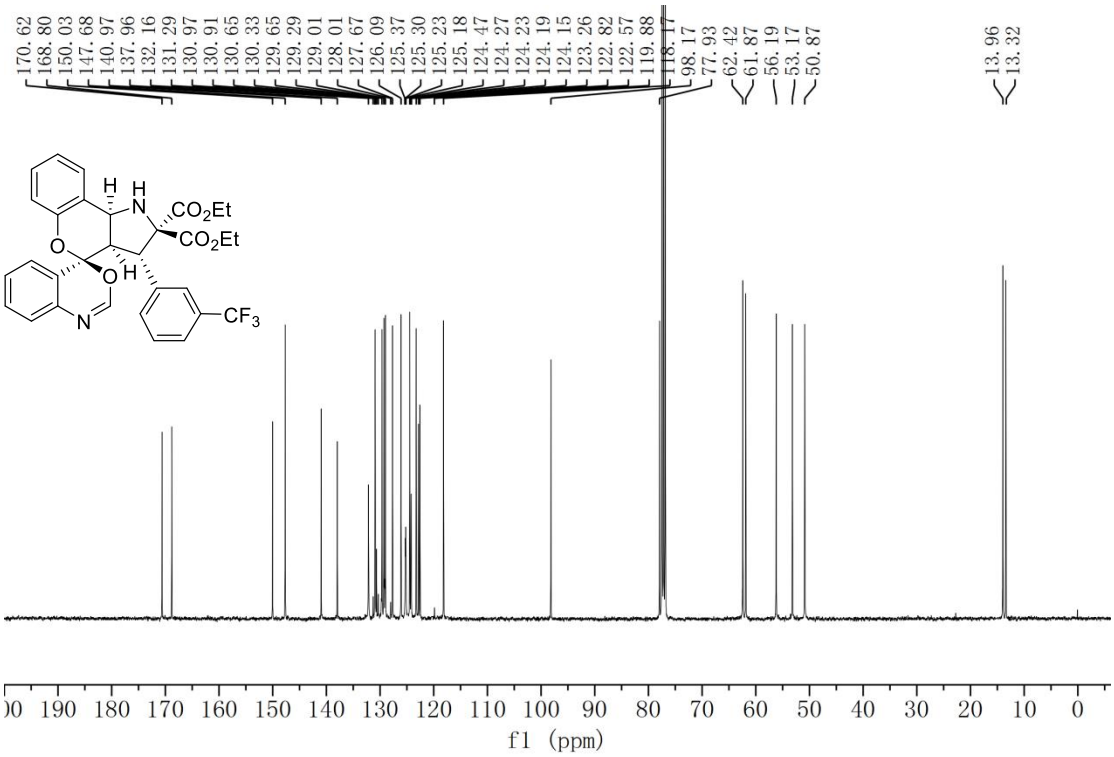
Compound **3h**


7.58 7.57 7.56 7.55 7.38 7.38 7.37 7.37 7.36 7.24 7.24 7.24 7.24 7.14 7.14 7.12 7.12 7.11 7.10 7.10 7.09 7.07 7.05 7.00 6.98 6.94 6.94 6.93 6.92 6.92 6.92 6.91 6.90 6.90 6.88 6.88 5.28 5.26 4.39 4.38 4.25 4.10 4.09 2.25 1.22 1.22 1.20 1.20 1.18 0.76 0.74 0.74 0.72
H
H
N
CO2Et
CO2Et
O
O
H
N
Me
1.05 2.12 1.03 4.08 1.02 4.03 0.95 1.03 1.04 1.06 1.12 1.12 1.82 2.98 2.98 3.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

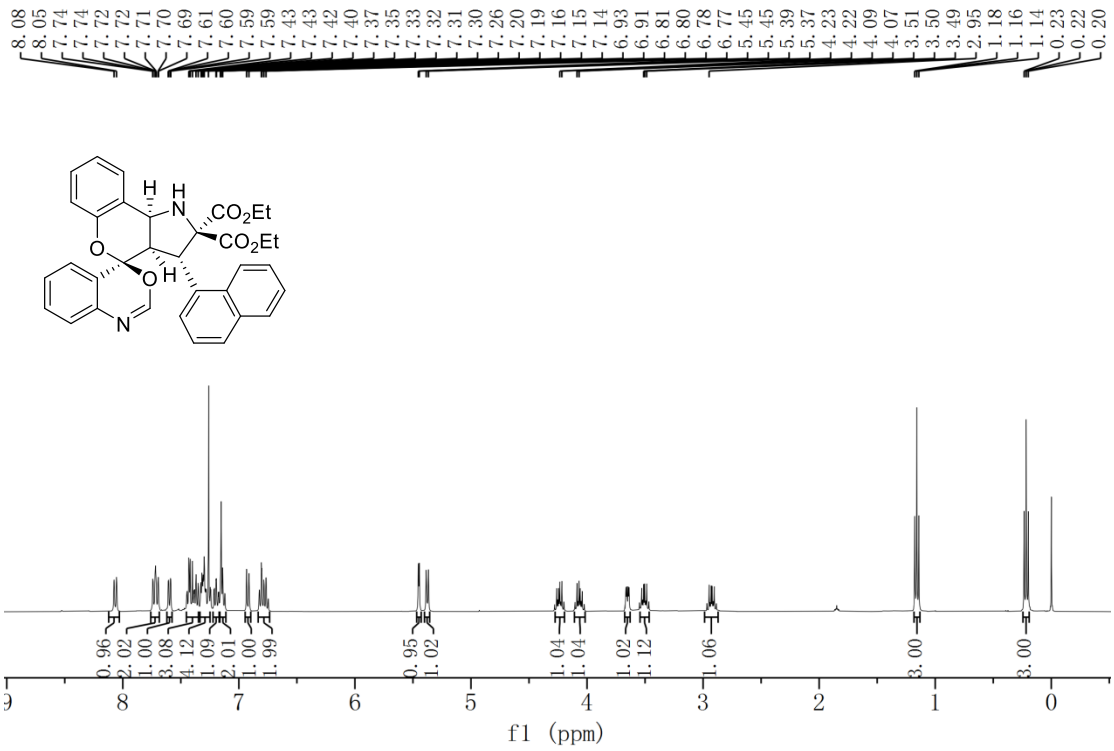

171.03 169.11 150.15 147.85 140.00 138.10 137.94 130.73 129.56 129.48 129.23 128.33 128.00 127.60 125.93 125.54 124.67 123.09 122.64 118.09 98.45 78.16 62.19 61.70 56.36 53.30 50.52 21.41 13.98 13.40
H
H
N
CO2Et
CO2Et
O
O
H
N
Me
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

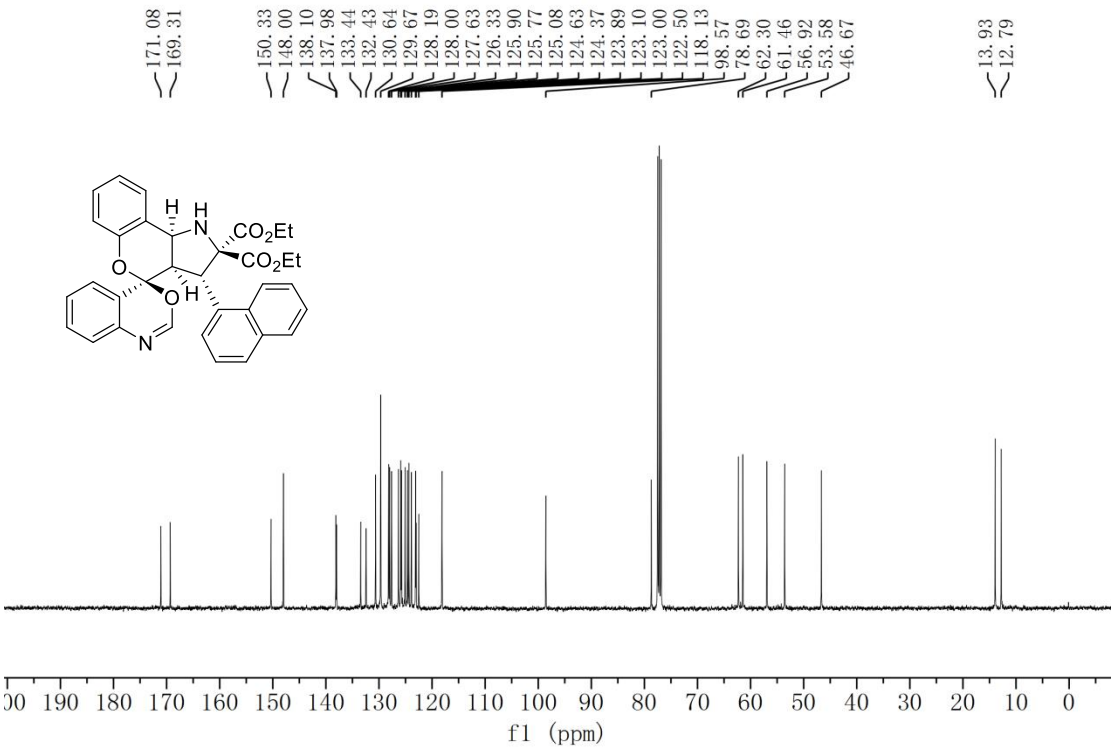
Compound **3i**


7.55 7.55 7.46 7.46 7.45 7.37 7.36 7.35 7.35 7.34 7.34 7.34 7.33 7.33 7.23 7.13 7.13 7.12 7.11 7.11 7.10 6.91 6.90 6.89 6.88 6.88 6.88 6.87 5.28 4.47 4.46 4.46 4.46 4.45 4.45 3.58 3.56 1.23 1.22 1.21 1.20 1.19 1.18 1.18 0.77 0.76 0.75 0.75 0.74 0.73 0.73 0.72 0.72
H
H
N
CO2Et
CO2Et
O
O
H
N
CF3
1.00 1.00 5.06 1.08 2.02 0.99 1.99 1.00 0.98 1.01 0.96 0.99 1.02 0.87 0.98 3.01 3.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

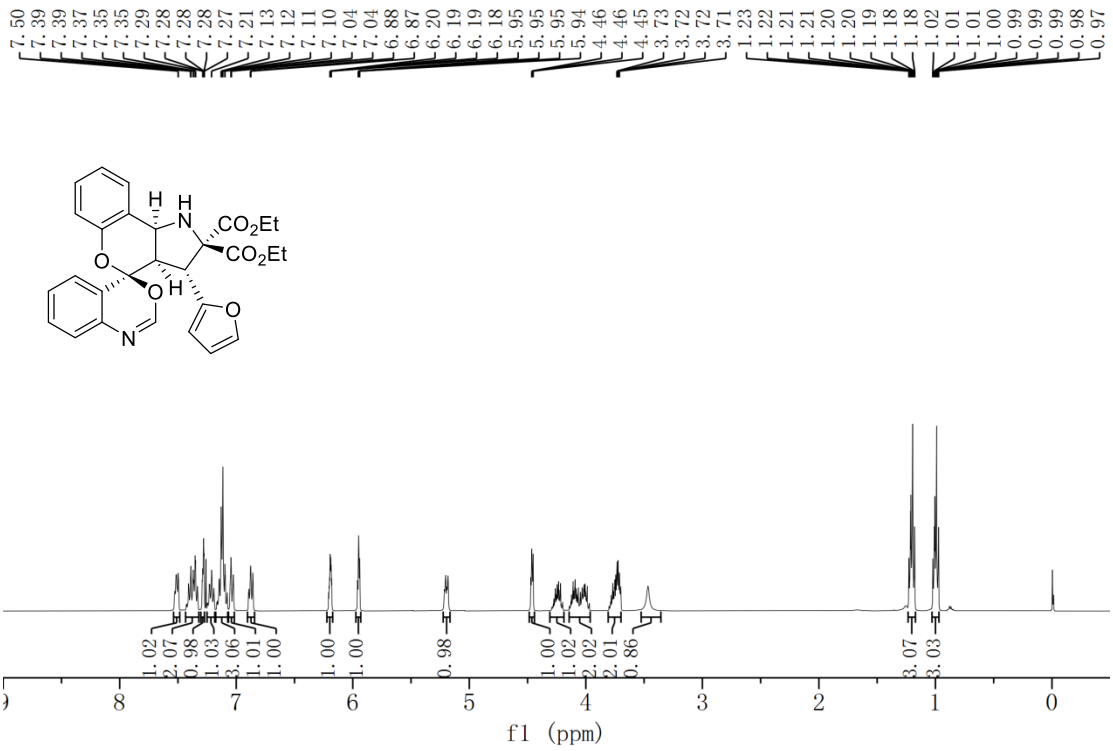

170.62 168.80 150.03 147.68 140.97 137.96 132.16 131.29 130.97 130.91 130.65 130.33 129.65 129.29 129.01 128.01 127.67 126.09 125.37 125.30 125.23 125.18 124.47 124.27 124.23 124.19 124.15 123.26 122.82 122.57 119.88 118.17 98.17 77.93 62.42 61.87 56.19 53.17 50.87 13.96 13.32
H
H
N
CO2Et
CO2Et
O
O
H
N
CF3
90 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

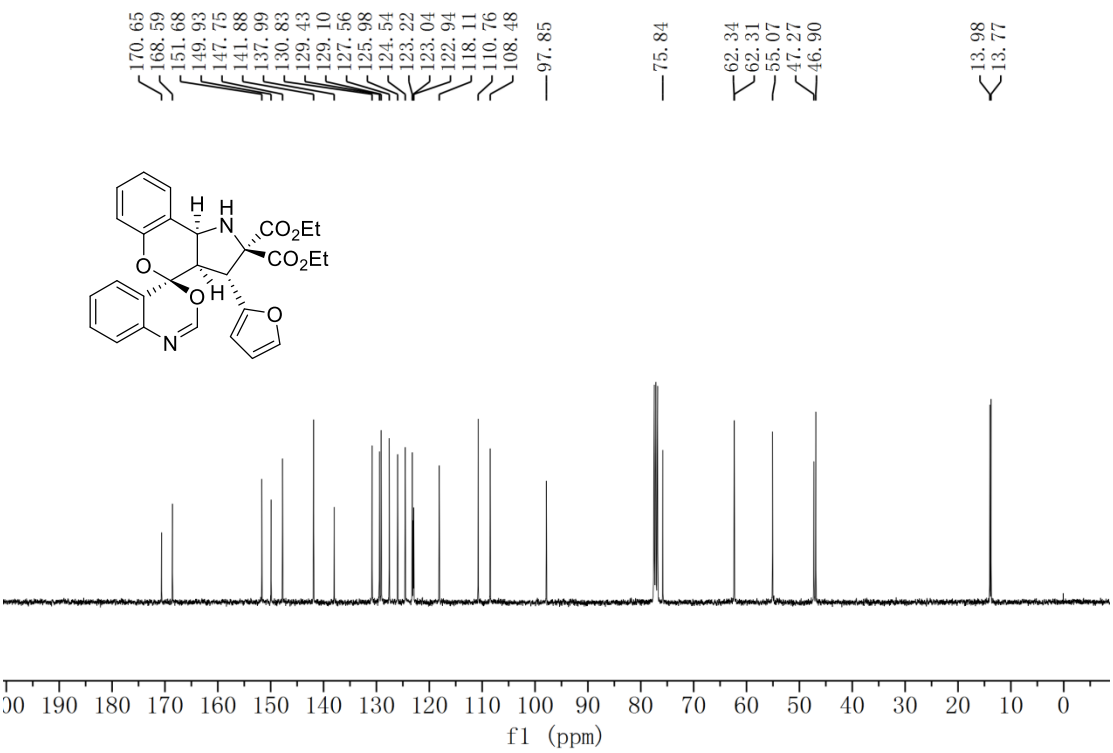
Compound **3j**


8.08 8.05 7.74 7.74 7.72 7.72 7.71 7.70 7.69 7.61 7.60 7.59 7.59 7.43 7.43 7.42 7.40 7.37 7.35 7.33 7.32 7.31 7.30 7.26 7.20 7.19 7.16 7.15 7.14 6.93 6.91 6.81 6.80 6.78 6.77 5.45 5.45 5.39 5.37 4.23 4.22 4.09 4.07 3.51 3.50 3.49 2.95 1.18 1.16 1.14 0.23 0.22 0.20
H
H
N
CO2Et
CO2Et
O
O
H
N
0.96 2.02 1.00 3.08 4.12 1.09 2.01 1.00 1.99 0.95 1.02 1.04 1.04 1.02 1.12 1.06 3.00 3.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

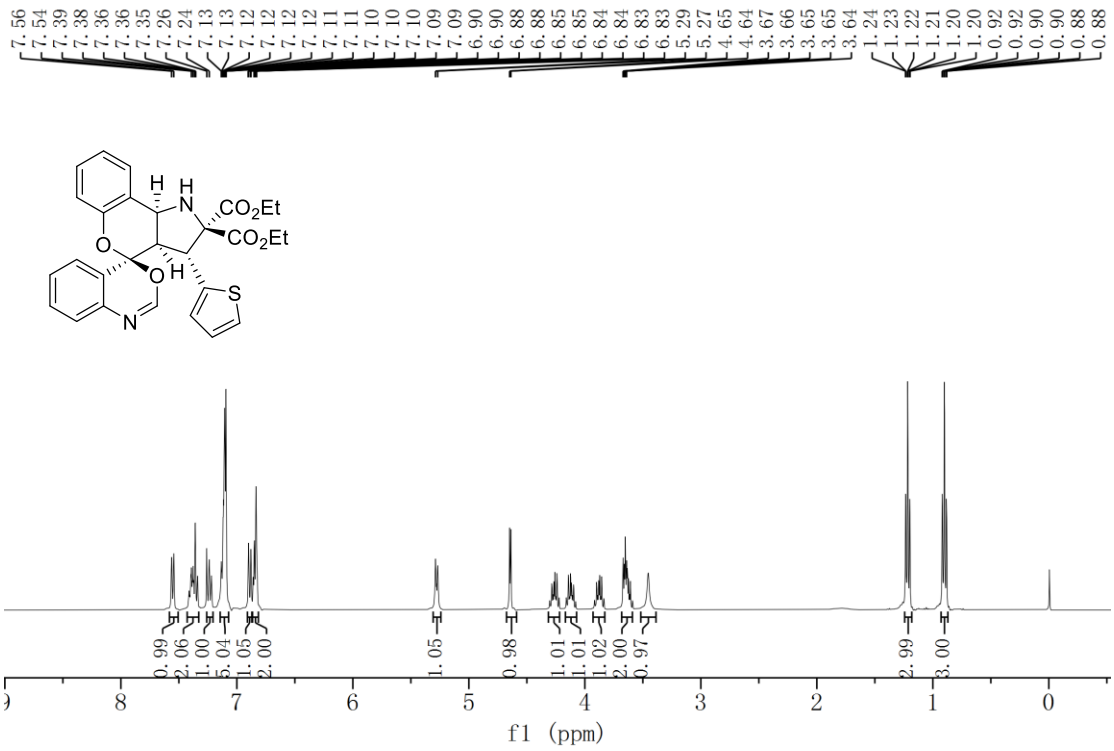

171.08 169.31 150.33 148.00 138.10 137.98 133.44 132.43 130.64 129.67 128.19 128.00 127.63 126.33 125.90 125.77 125.08 124.63 124.37 123.89 123.10 123.00 122.50 118.13 98.57 78.69 62.30 61.46 56.92 53.58 46.67 13.93 12.79
H
H
N
CO2Et
CO2Et
O
O
H
N
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

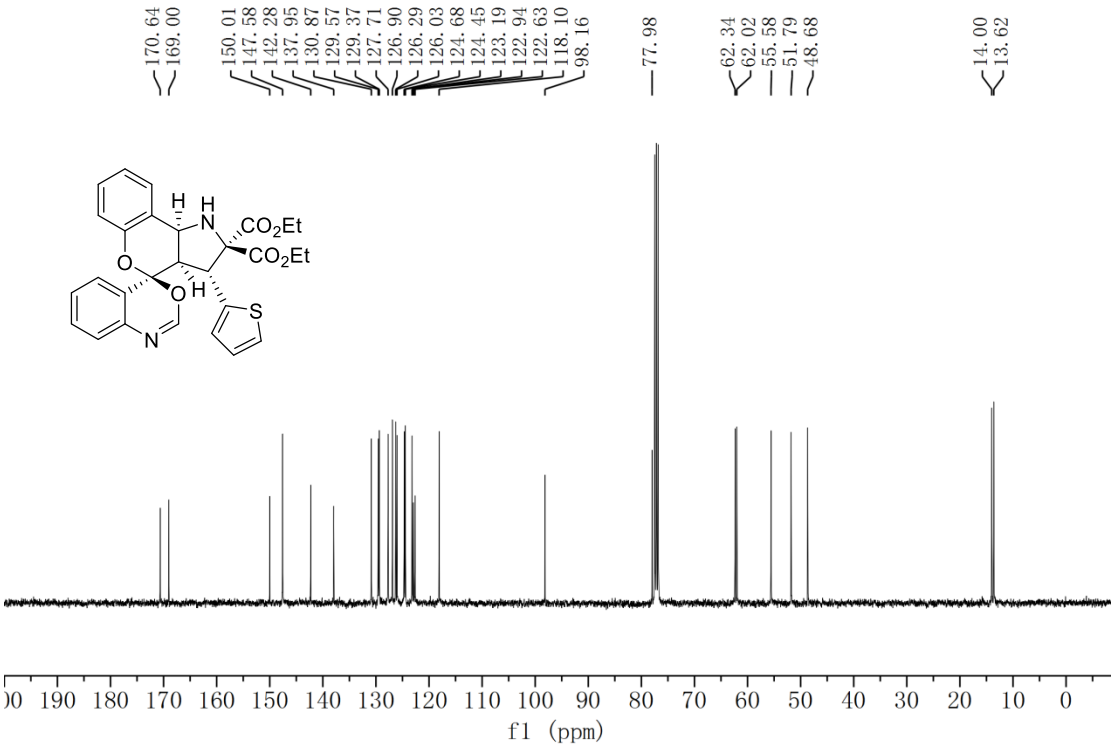
Compound **3k**


7.50 7.39 7.39 7.37 7.35 7.35 7.29 7.28 7.28 7.28 7.27 7.21 7.13 7.12 7.11 7.10 7.04 7.04 6.88 6.87 6.20 6.19 6.19 6.18 5.95 5.95 5.95 5.94 4.46 4.46 4.45 3.73 3.72 3.72 3.71 1.23 1.22 1.21 1.21 1.20 1.20 1.19 1.18 1.18 1.02 1.01 1.01 1.00 0.99 0.99 0.99 0.98 0.97
H
H
N
CO2Et
CO2Et
O
O
H
O
N
1.02 2.07 0.98 1.03 3.06 1.01 1.00 1.00 1.00 0.98 1.00 1.02 2.02 2.01 0.86 3.07 3.03
f1 (ppm)

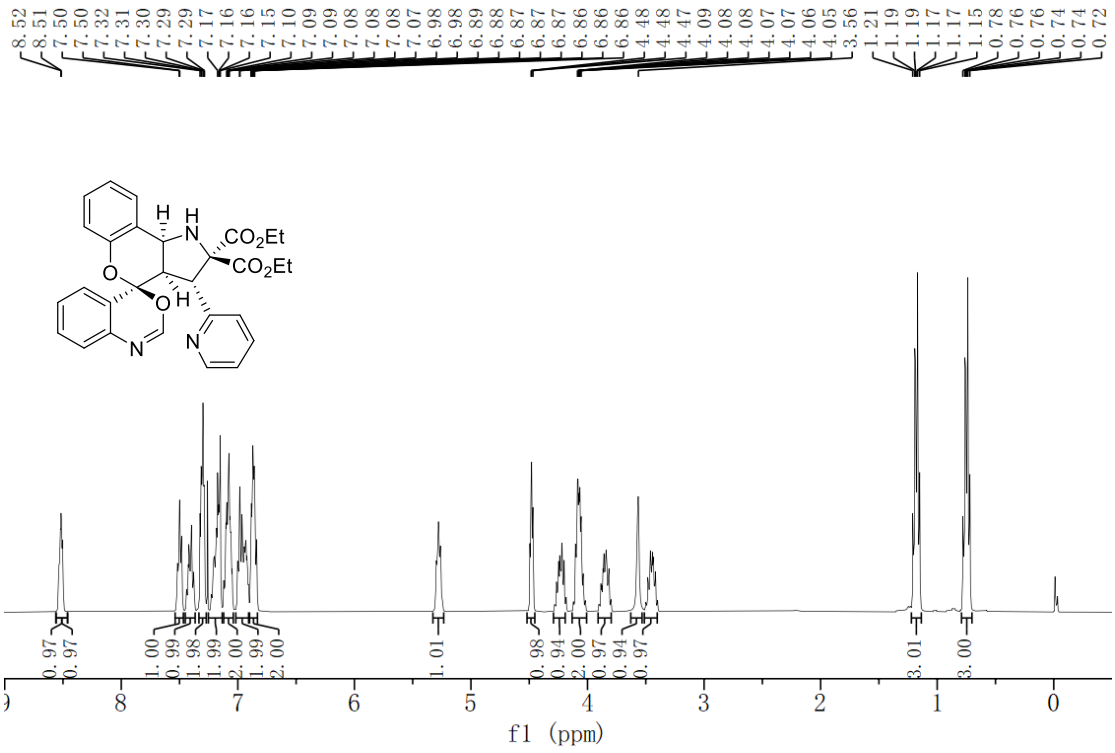

170.65 168.59 151.68 149.93 147.75 141.88 137.99 130.83 129.43 129.10 127.56 125.98 124.54 123.22 123.04 122.94 118.11 110.76 108.48 97.85 75.84 62.34 62.31 55.07 47.27 46.90 13.98 13.77
H
H
N
CO2Et
CO2Et
O
O
H
O
N
f1 (ppm)

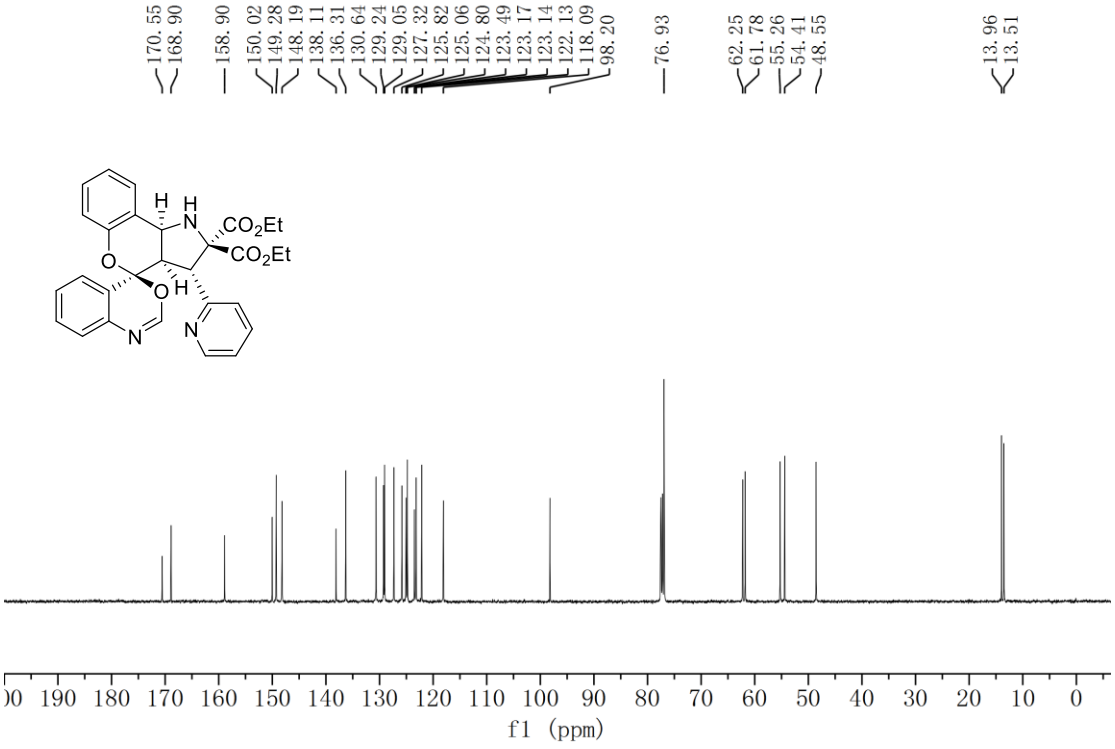
Compound **3l**


7.56 7.54 7.39 7.38 7.36 7.36 7.35 7.26 7.24 7.13 7.13 7.12 7.12 7.12 7.12 7.11 7.11 7.10 7.10 7.10 7.09 7.09 6.90 6.90 6.88 6.88 6.85 6.84 6.84 6.83 6.83 5.29 5.27 4.65 4.64 3.67 3.66 3.65 3.64 1.24 1.23 1.22 1.21 1.20 1.20 0.92 0.92 0.90 0.90 0.88 0.88
H H N CO2Et CO2Et O O H S N
0.99 2.06 1.00 5.04 1.05 2.00 1.05 0.98 1.01 1.01 1.02 2.00 0.97 2.99 3.00
f1 (ppm)

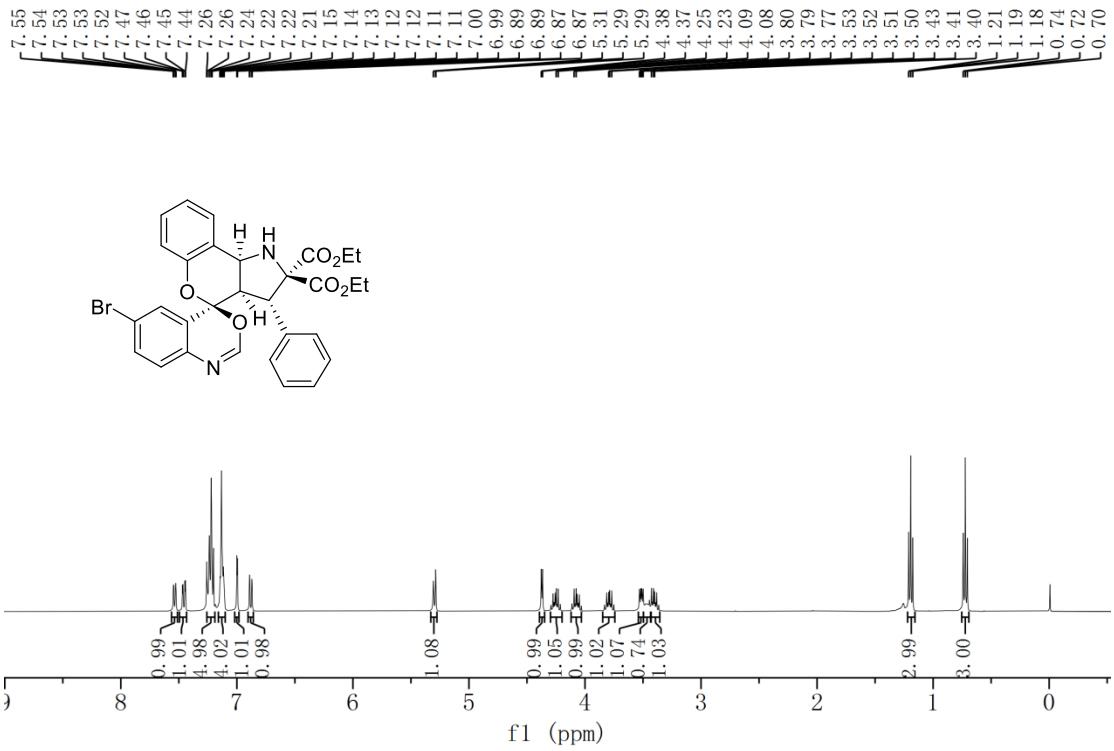

170.64 169.00 150.01 147.58 142.28 137.95 130.87 129.57 129.37 127.71 126.90 126.29 126.03 124.68 124.45 123.19 122.94 122.63 118.10 98.16 77.98 62.34 62.02 55.58 51.79 48.68 14.00 13.62
H H N CO2Et CO2Et O O H S N
f1 (ppm)

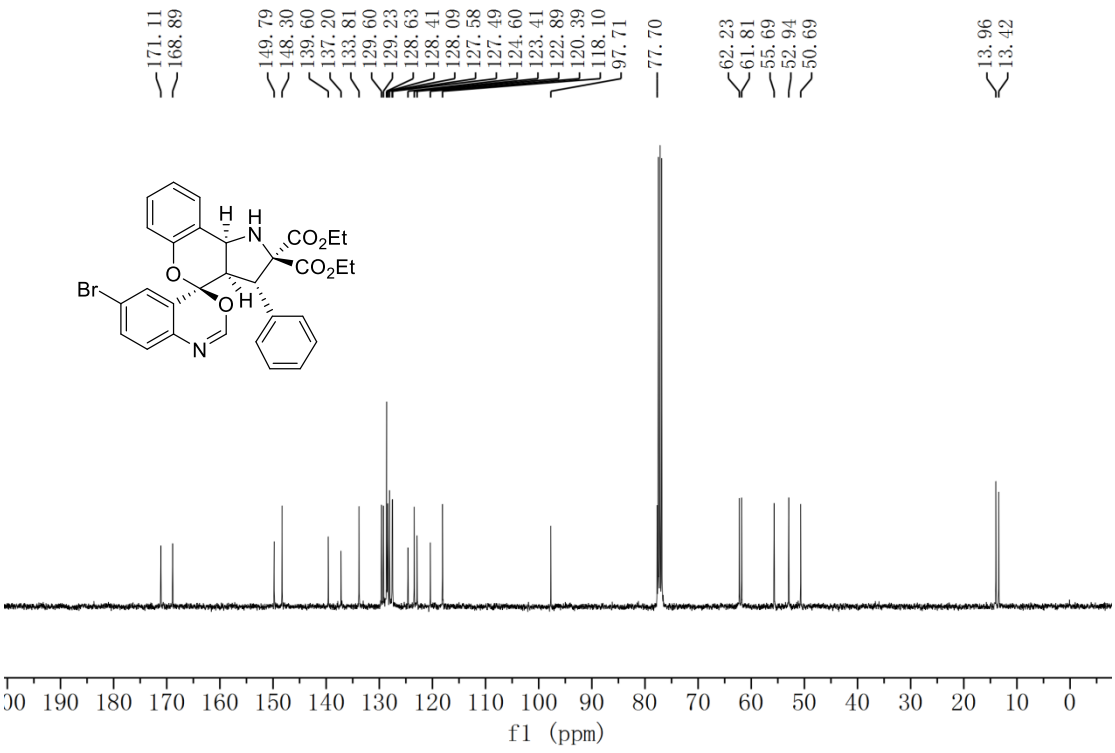
Compound **3m**


8.52
8.51
7.50
7.50
7.32
7.31
7.30
7.29
7.29
7.17
7.16
7.16
7.15
7.10
7.09
7.09
7.08
7.08
7.08
7.07
6.98
6.98
6.89
6.88
6.87
6.87
6.87
6.86
6.86
6.86
6.86
4.48
4.48
4.47
4.09
4.08
4.08
4.07
4.07
4.06
4.05
3.56
1.21
1.19
1.19
1.17
1.17
1.15
0.78
0.76
0.76
0.74
0.74
0.72
CO2Et
CO2Et
0.97
0.97
1.00
0.99
1.98
1.99
2.00
1.99
2.00
1.01
0.98
0.94
2.00
0.97
0.94
0.97
3.01
3.00
f1 (ppm)

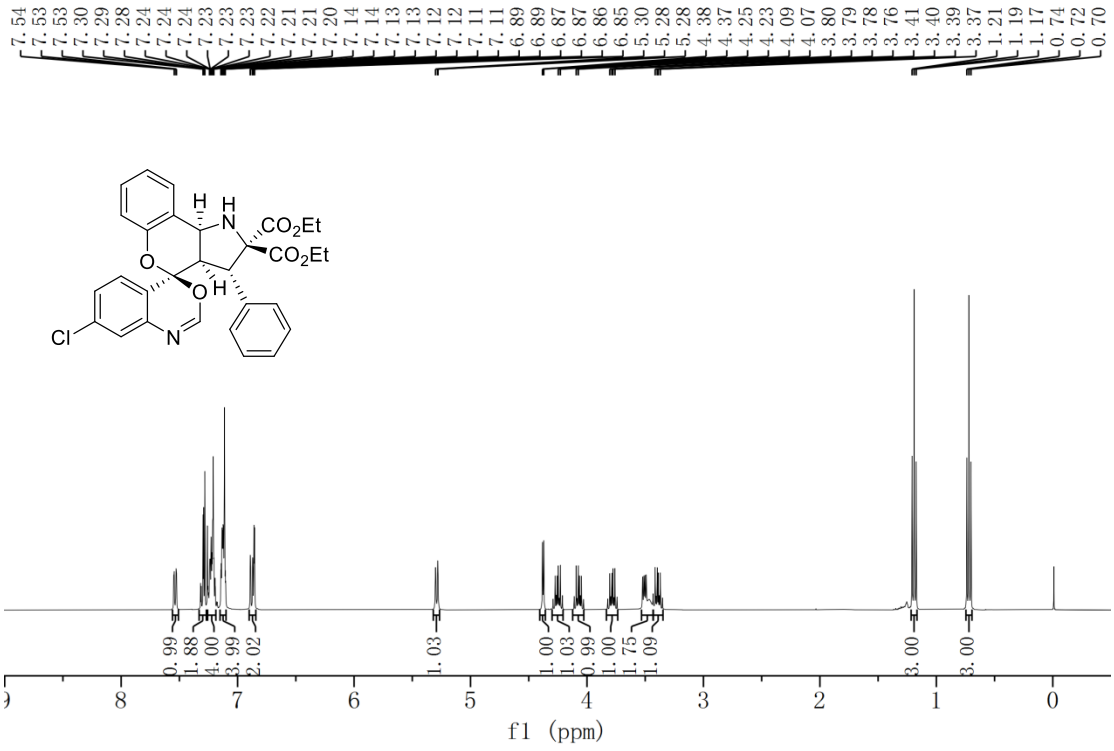

170.55
168.90
158.90
150.02
149.28
148.19
138.11
136.31
130.64
129.24
129.05
127.32
125.82
125.06
124.80
123.49
123.17
123.14
122.13
118.09
98.20
76.93
62.25
61.78
55.26
54.41
48.55
13.96
13.51
CO2Et
CO2Et
f1 (ppm)

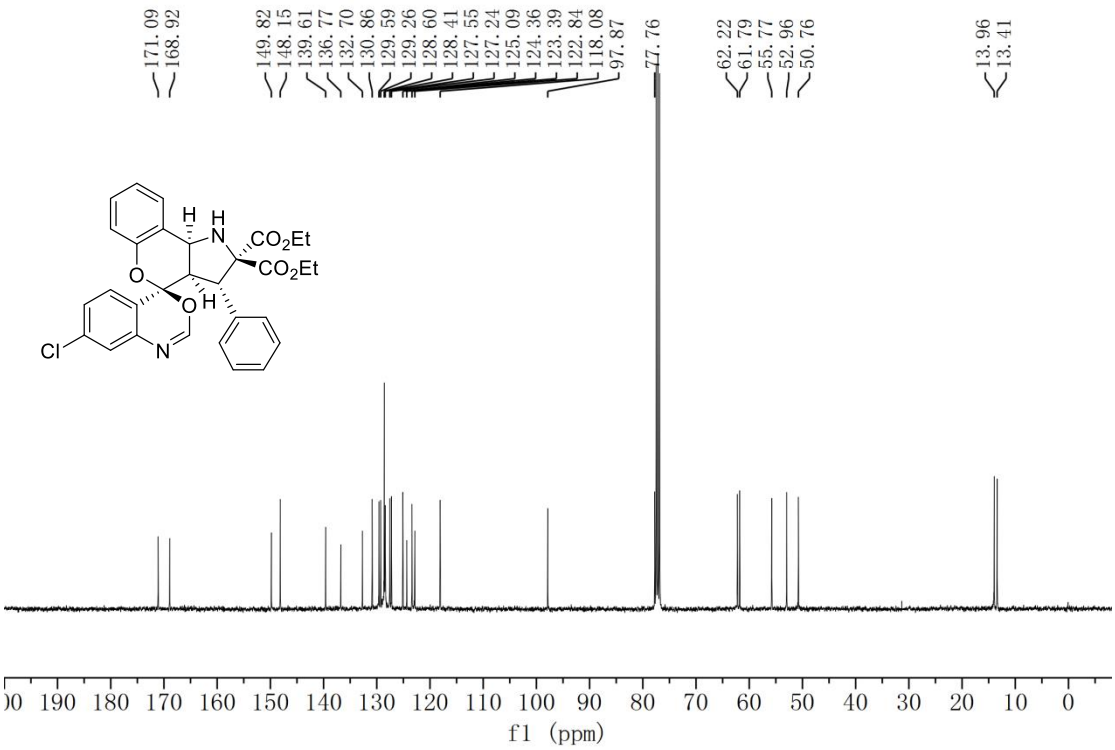
Compound **3n**


7.55 7.54 7.53 7.53 7.52 7.47 7.46 7.45 7.44 7.26 7.26 7.24 7.22 7.22 7.21 7.15 7.14 7.13 7.12 7.12 7.11 7.11 7.00 6.99 6.89 6.89 6.87 5.31 5.29 5.29 4.38 4.37 4.25 4.23 4.09 4.08 3.80 3.79 3.77 3.53 3.52 3.51 3.50 3.43 3.41 3.40 1.21 1.19 1.18 0.74 0.72 0.70
H
H
N
CO2Et
CO2Et
O
O
H
Br
N
0.99 1.01 4.98 4.02 1.01 0.98 1.08 0.99 1.05 0.99 1.02 1.07 0.74 1.03 2.99 3.00
f1 (ppm)

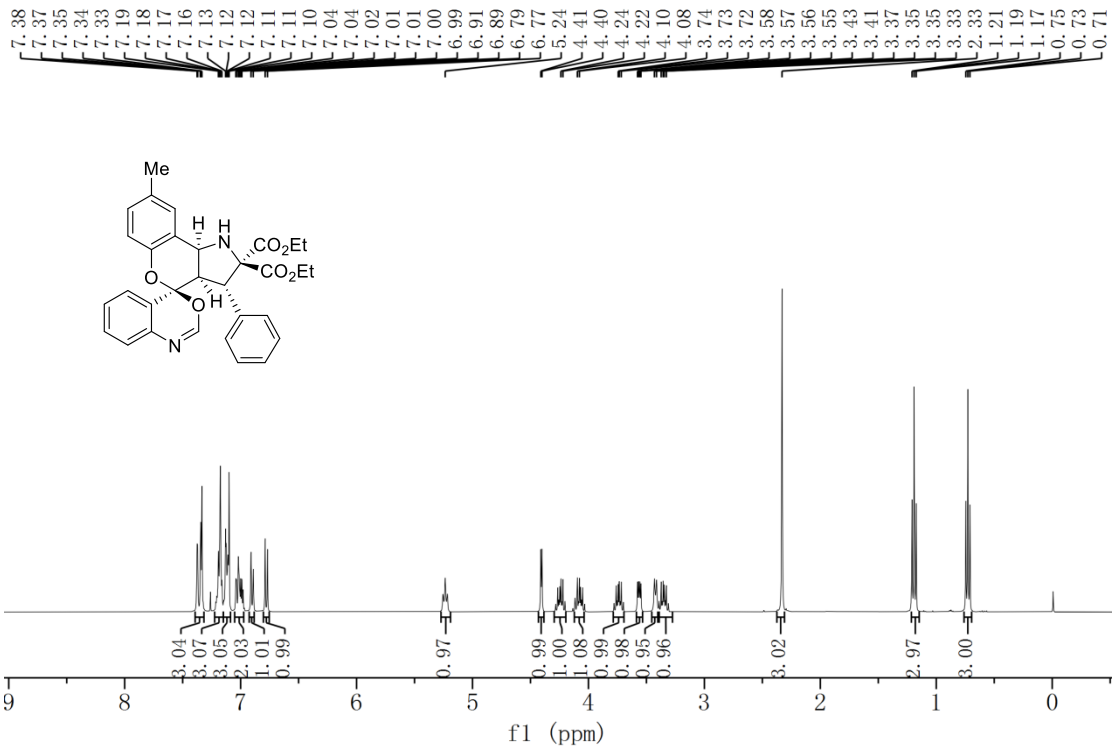

171.11 168.89 149.79 148.30 139.60 137.20 133.81 129.60 129.23 128.63 128.41 128.09 127.58 127.49 124.60 123.41 122.89 120.39 118.10 97.71 77.70 62.23 61.81 55.69 52.94 50.69 13.96 13.42
H
H
N
CO2Et
CO2Et
O
O
H
Br
N
f1 (ppm)

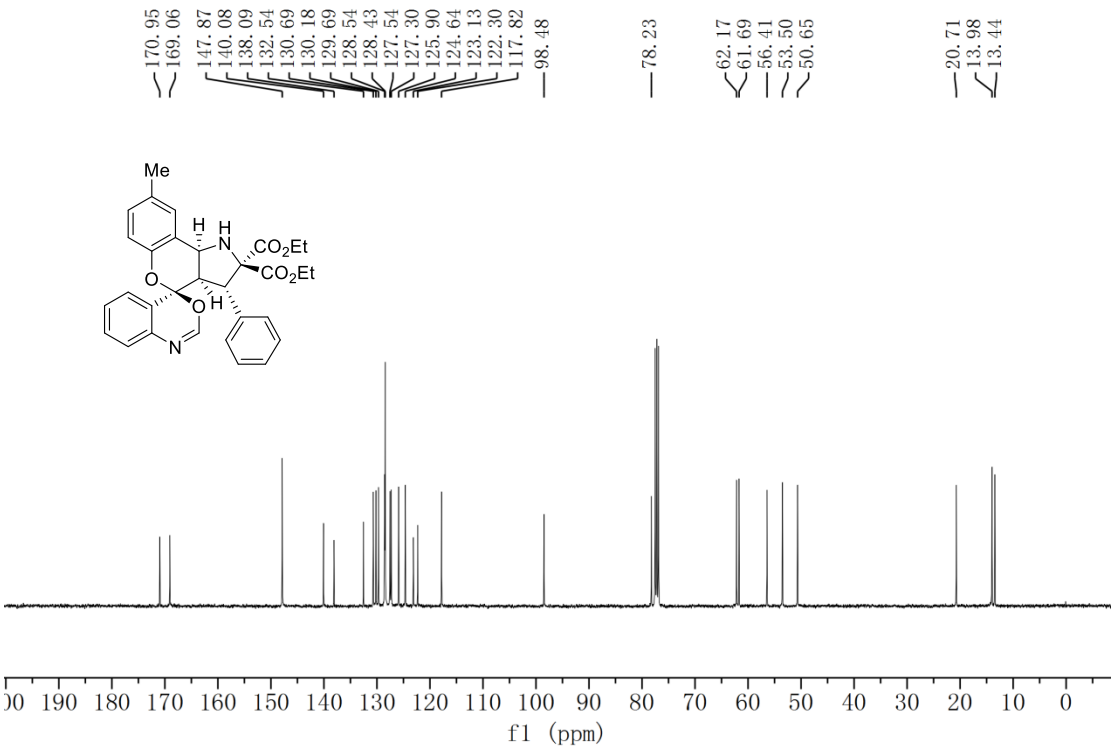
Compound **3o**


7.54 7.53 7.53 7.30 7.29 7.28 7.24 7.24 7.24 7.23 7.23 7.23 7.22 7.21 7.21 7.20 7.14 7.14 7.13 7.13 7.12 7.12 7.11 7.11 6.89 6.89 6.87 6.87 6.86 6.85 5.30 5.28 5.28 4.38 4.37 4.25 4.23 4.09 4.07 3.80 3.79 3.78 3.76 3.41 3.40 3.39 3.37 1.21 1.19 1.17 0.74 0.72 0.70
H
H
N
CO2Et
CO2Et
O
O
H
Cl
N
0.99 1.88 4.00 3.99 2.02 1.03 1.00 1.03 0.99 1.00 1.75 1.09 3.00 3.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

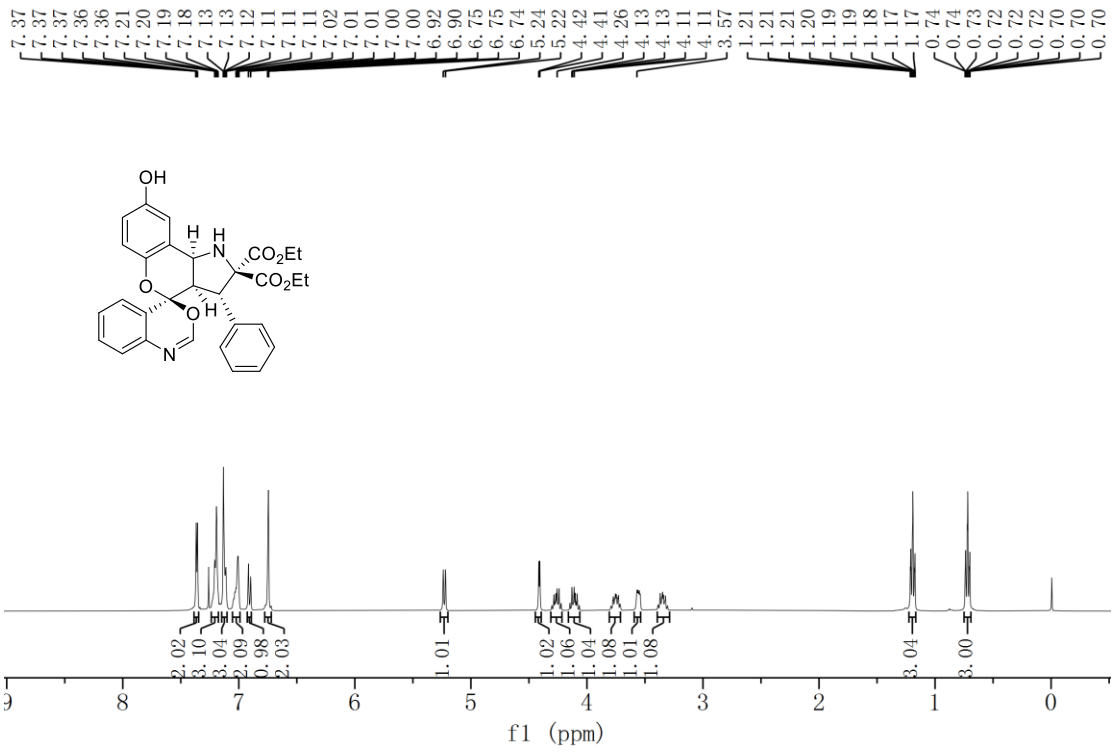

171.09 168.92 149.82 148.15 139.61 136.77 132.70 130.86 129.59 129.26 128.60 128.41 127.55 127.24 125.09 124.36 123.39 122.84 118.08 97.87 77.76 62.22 61.79 55.77 52.96 50.76 13.96 13.41
H
H
N
CO2Et
CO2Et
O
O
H
Cl
N
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

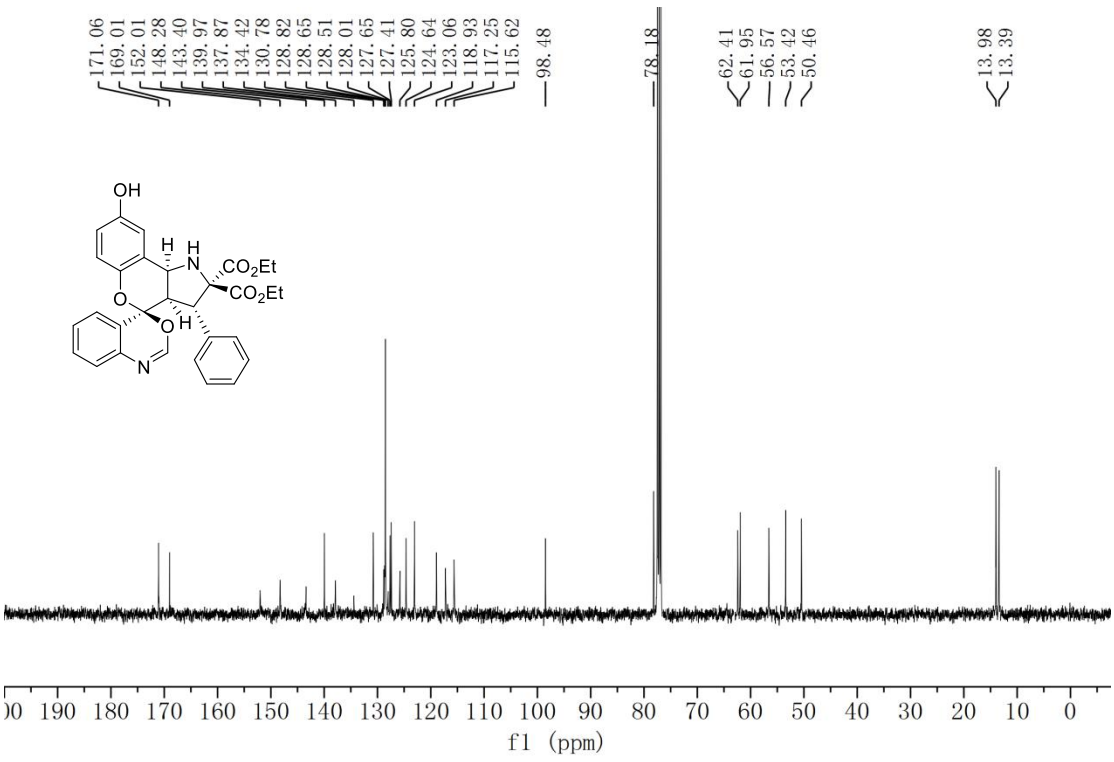
Compound **4a**


7.38 7.37 7.35 7.34 7.33 7.19 7.18 7.17 7.16 7.13 7.12 7.12 7.11 7.11 7.10 7.04 7.04 7.02 7.01 7.01 7.00 6.99 6.91 6.89 6.79 6.77 5.24 4.41 4.40 4.24 4.22 4.10 4.08 3.74 3.73 3.72 3.58 3.57 3.56 3.55 3.43 3.41 3.37 3.35 3.35 3.33 2.33 1.21 1.19 1.17 0.75 0.73 0.71
Me
H
H
N
CO2Et
CO2Et
O
O
H
N
3.04 3.07 3.05 2.03 1.01 0.99 0.97 0.99 1.00 1.08 0.99 0.98 0.95 0.96 3.02 2.97 3.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

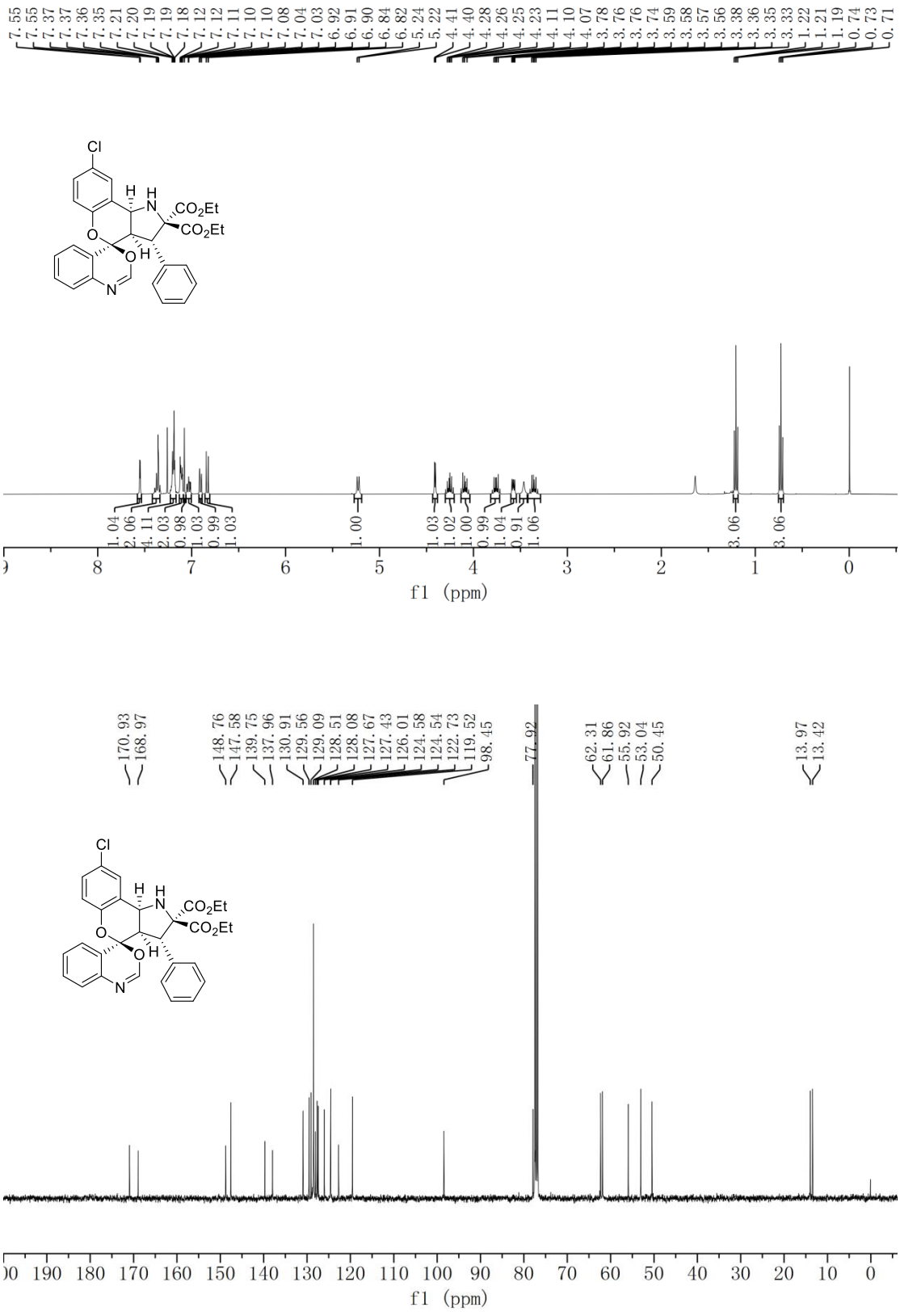

170.95 169.06 147.87 140.08 138.09 132.54 130.69 130.18 129.69 128.54 128.43 127.54 127.30 125.90 124.64 123.13 122.30 117.82 98.48 78.23 62.17 61.69 56.41 53.50 50.65 20.71 13.98 13.44
Me
H
H
N
CO2Et
CO2Et
O
O
H
N
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

Compound **4b**

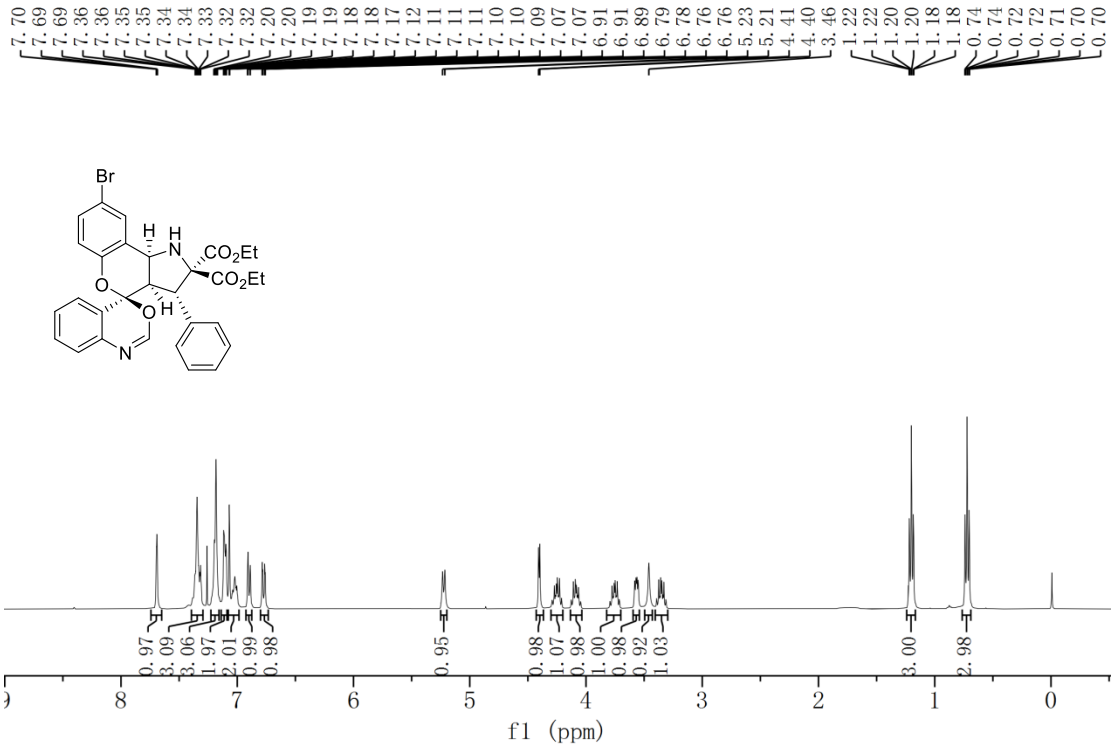

7.37
7.37
7.37
7.36
7.36
7.21
7.20
7.19
7.18
7.13
7.13
7.12
7.11
7.11
7.11
7.02
7.01
7.01
7.00
7.00
6.92
6.90
6.75
6.75
6.74
5.24
5.22
4.42
4.41
4.26
4.13
4.13
4.11
4.11
3.57
1.21
1.21
1.21
1.20
1.19
1.19
1.18
1.17
1.17
0.74
0.74
0.73
0.72
0.72
0.72
0.70
0.70
0.70
OH
H
H
N
CO2Et
CO2Et
O
O
H
N
2.02
3.10
3.04
2.09
0.98
2.03
1.01
1.02
1.06
1.04
1.08
1.01
1.08
3.04
3.00
9
8
7
6
5
4
3
2
1
0
f1 (ppm)

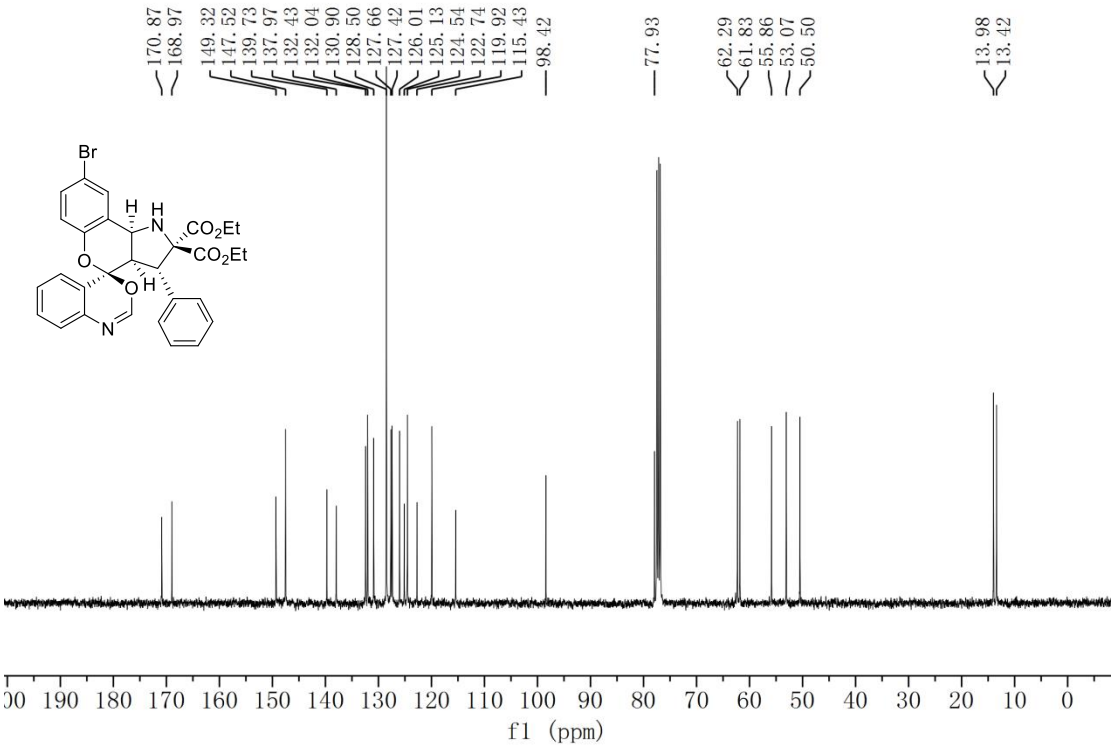

171.06
169.01
152.01
148.28
143.40
139.97
137.87
134.42
130.78
128.82
128.65
128.51
128.01
127.65
127.41
125.80
124.64
123.06
118.93
117.25
115.62
98.48
78.18
62.41
61.95
56.57
53.42
50.46
13.98
13.39
OH
H
H
N
CO2Et
CO2Et
O
O
H
N
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

Compound **4c**

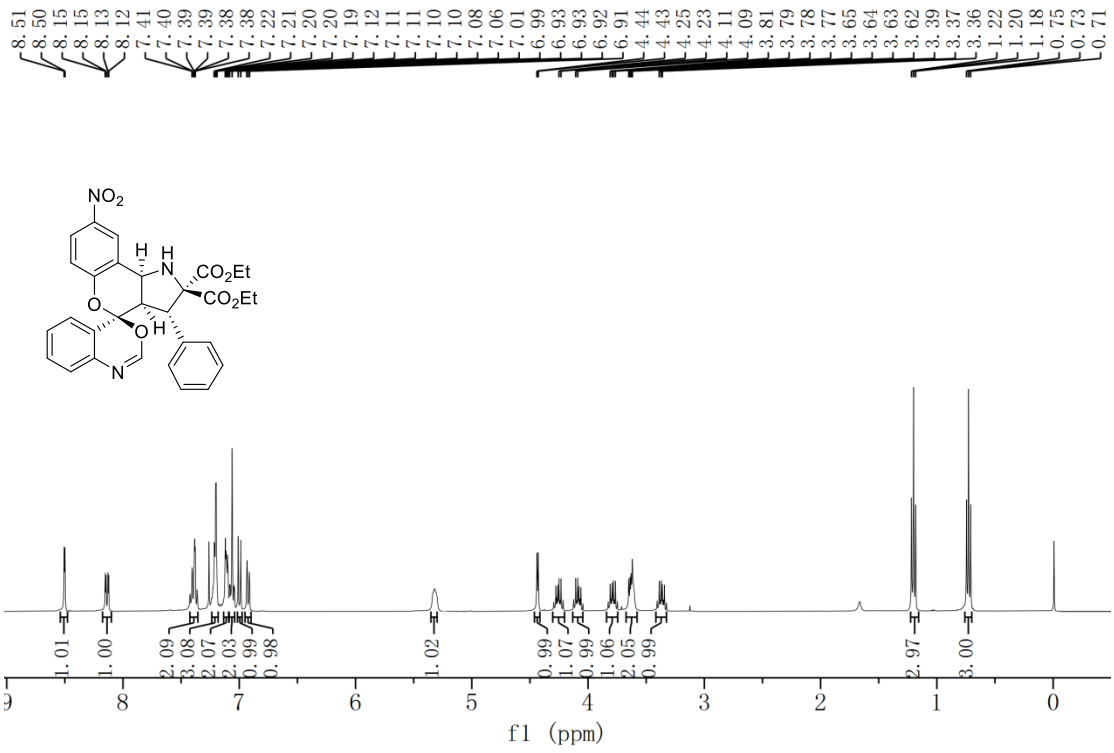

7.55
7.55
7.37
7.37
7.36
7.35
7.21
7.20
7.19
7.19
7.18
7.12
7.12
7.11
7.10
7.10
7.08
7.04
7.03
6.92
6.91
6.90
6.84
6.82
5.24
5.22
4.41
4.40
4.28
4.26
4.25
4.23
4.11
4.10
4.07
3.78
3.76
3.76
3.74
3.59
3.58
3.57
3.56
3.38
3.36
3.35
3.33
1.22
1.21
1.19
0.74
0.73
0.71
Cl
H
H
N
CO2Et
CO2Et
O
O
H
N
1.04
2.06
4.11
2.03
0.98
1.03
0.99
1.03
1.00
1.03
1.02
1.00
0.99
1.04
0.91
1.06
3.06
3.06
f1 (ppm)
170.93
168.97
148.76
147.58
139.75
137.96
130.91
129.56
129.09
128.51
128.08
127.67
127.43
126.01
124.58
124.54
122.73
119.52
98.45
77.92
62.31
61.86
55.92
53.04
50.45
13.97
13.42
f1 (ppm)

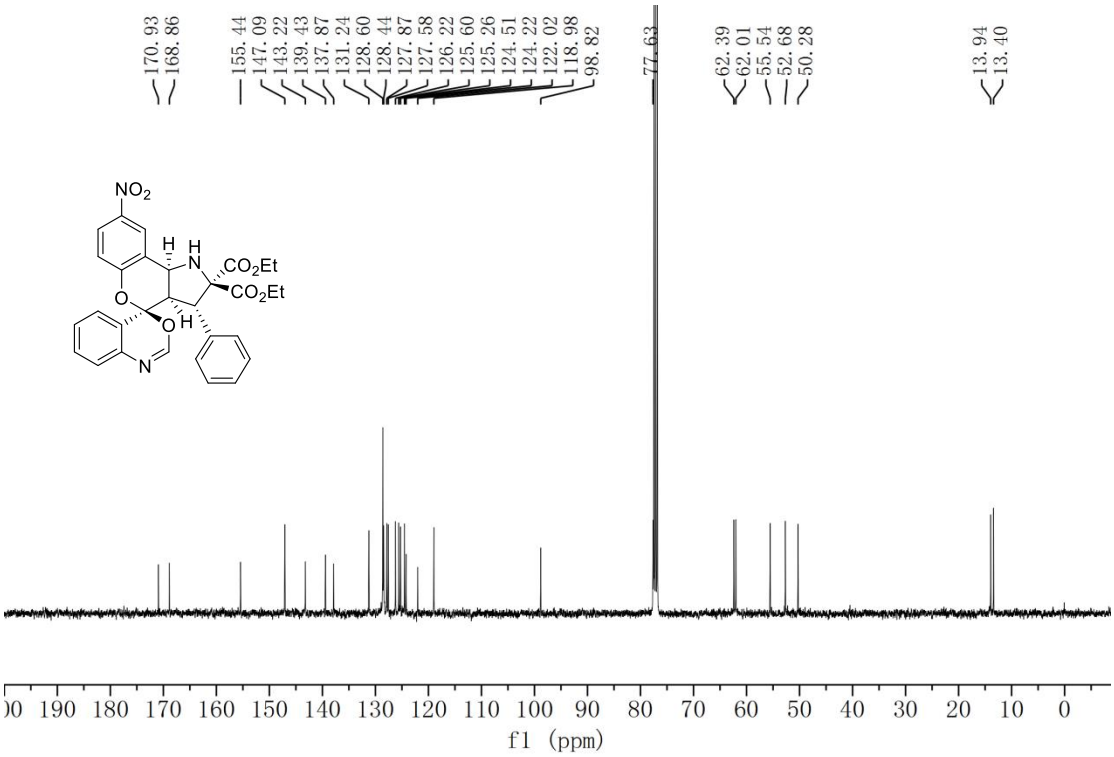
Compound **4d**


7.70 7.69 7.69 7.36 7.36 7.35 7.35 7.34 7.34 7.33 7.32 7.32 7.20 7.20 7.19 7.19 7.18 7.18 7.17 7.12 7.11 7.11 7.11 7.10 7.10 7.09 7.07 7.07 6.91 6.91 6.89 6.79 6.78 6.76 6.76 5.23 5.21 4.41 4.40 3.46 1.22 1.22 1.20 1.20 1.18 1.18 0.74 0.74 0.72 0.72 0.71 0.70 0.70
Br
H
H
N
CO2Et
CO2Et
O
O
H
N
0.97 3.09 3.06 1.97 2.01 0.99 0.98 0.95 0.98 1.07 0.98 1.00 0.98 0.92 1.03 3.00 2.98
8 7 6 5 4 3 2 1 0
f1 (ppm)

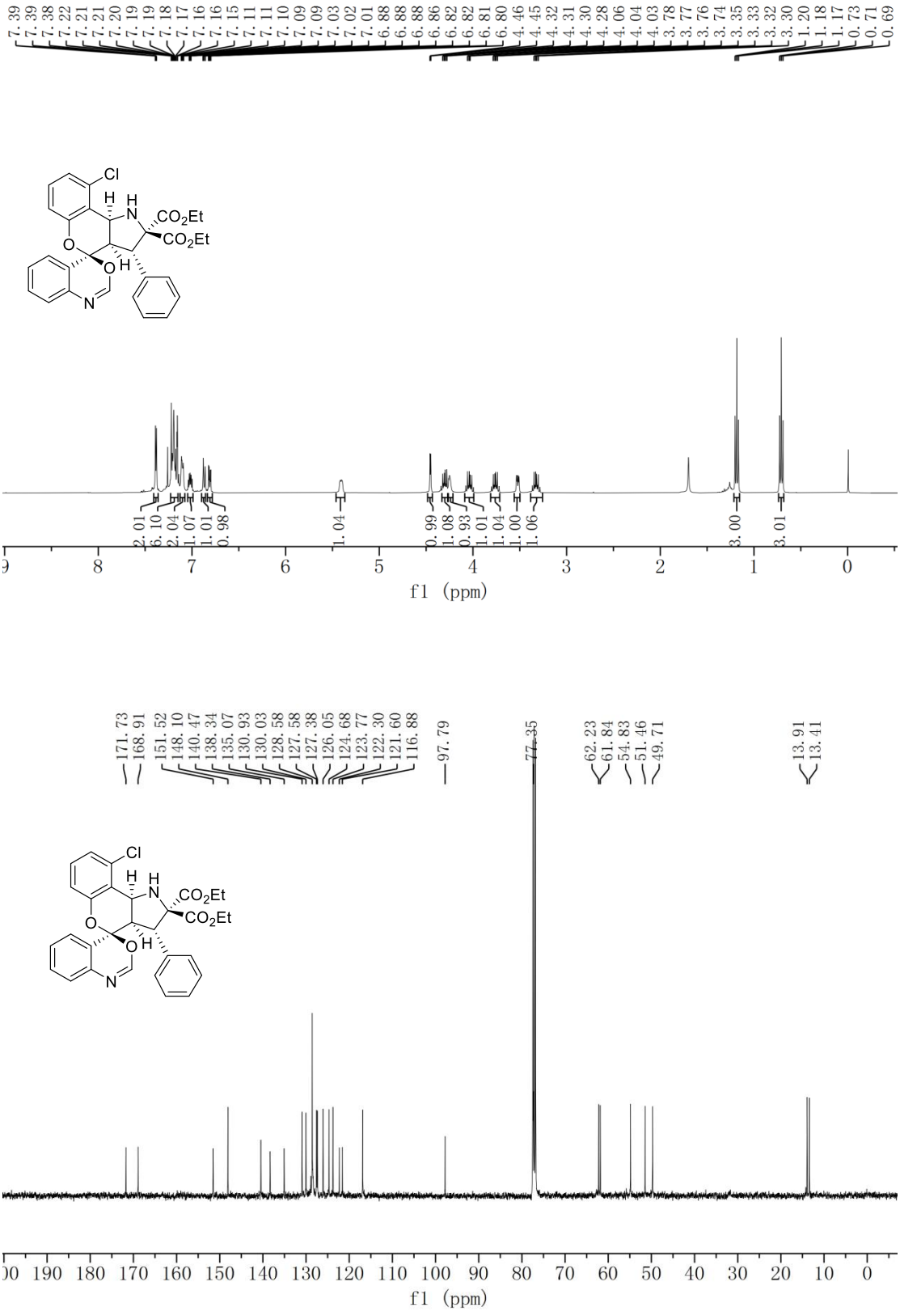

170.87 168.97 149.32 147.52 139.73 137.97 132.43 132.04 130.90 128.50 127.66 127.42 126.01 125.13 124.54 122.74 119.92 115.43 98.42 77.93 62.29 61.83 55.86 53.07 50.50 13.98 13.42
Br
H
H
N
CO2Et
CO2Et
O
O
H
N
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

Compound **4e**

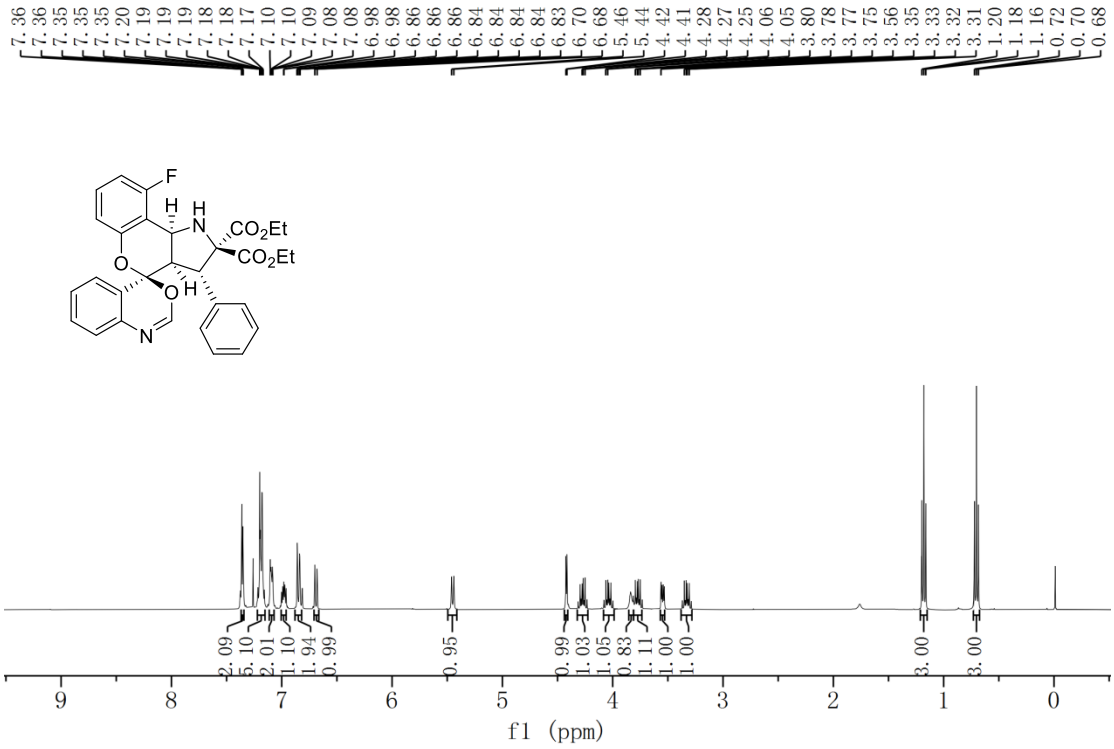

8.51
8.50
8.15
8.15
8.13
8.12
7.41
7.40
7.39
7.39
7.38
7.38
7.22
7.21
7.20
7.20
7.19
7.12
7.11
7.11
7.10
7.10
7.08
7.06
7.01
6.99
6.93
6.93
6.92
6.91
4.44
4.43
4.25
4.23
4.11
4.09
3.81
3.79
3.78
3.77
3.65
3.64
3.63
3.62
3.39
3.37
3.36
1.22
1.20
1.18
0.75
0.73
0.71
NO2
H
H
N
CO2Et
CO2Et
O
O
H
N
1.01
1.00
2.09
3.08
2.07
2.03
0.99
0.98
1.02
0.99
1.07
0.99
1.06
2.05
0.99
2.97
3.00
f1 (ppm)

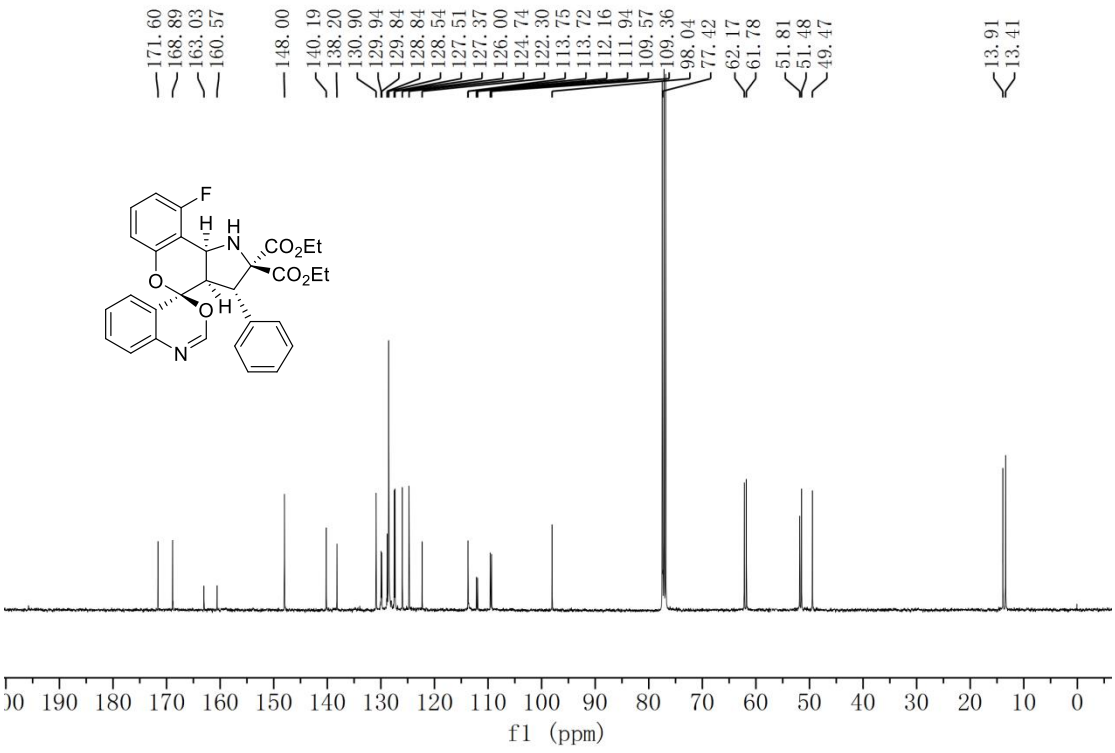

170.93
168.86
155.44
147.09
143.22
139.43
137.87
131.24
128.60
128.44
127.87
127.58
126.22
125.60
125.26
124.51
124.22
122.02
118.98
98.82
77.63
62.39
62.01
55.54
52.68
50.28
13.94
13.40
NO2
H
H
N
CO2Et
CO2Et
O
O
H
N
f1 (ppm)

Compound **4f**

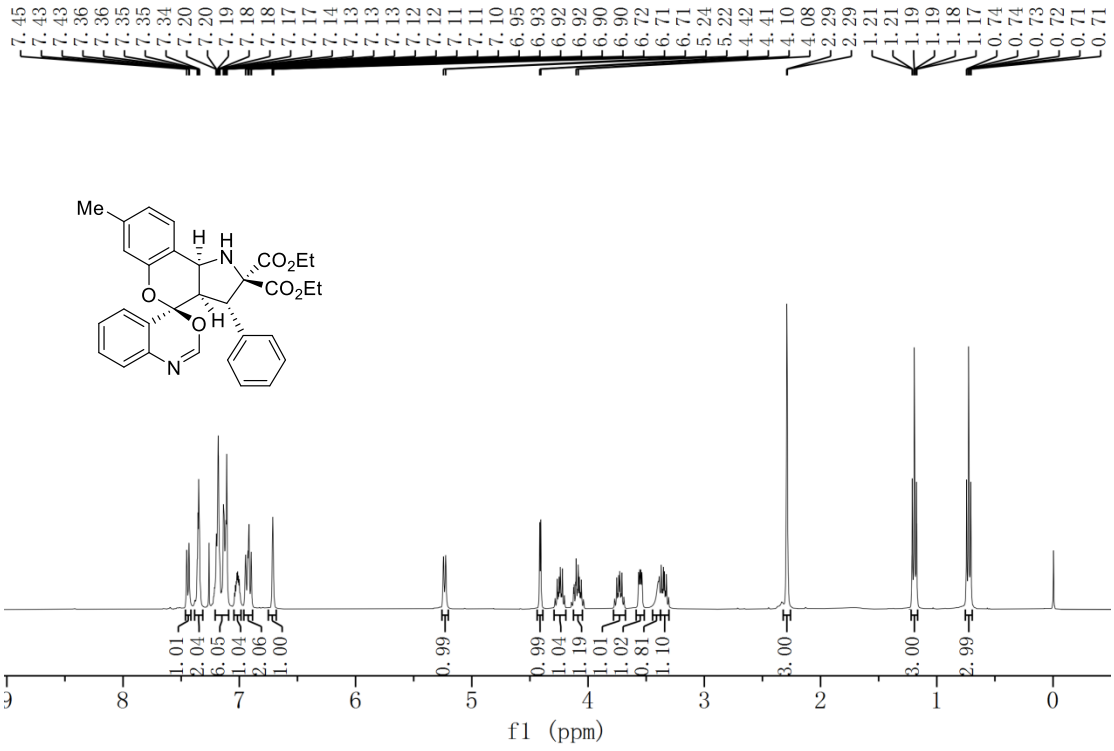

7.39 7.39 7.38 7.22 7.21 7.21 7.20 7.19 7.19 7.18 7.17 7.16 7.16 7.15 7.11 7.11 7.10 7.09 7.09 7.03 7.02 7.01 6.88 6.88 6.88 6.86 6.82 6.82 6.81 6.80 4.46 4.45 4.32 4.31 4.30 4.28 4.06 4.04 4.03 3.78 3.77 3.76 3.74 3.35 3.33 3.32 3.30 1.20 1.18 1.17 0.73 0.71 0.69
Cl
H
H
N
CO2Et
CO2Et
O
O
H
N
2.01 6.10 2.04 1.07 1.01 0.98 1.04 0.99 1.08 0.93 1.01 1.04 1.00 1.06 3.00 3.01
f1 (ppm)
171.73 168.91 151.52 148.10 140.47 138.34 135.07 130.93 130.03 128.58 127.58 127.38 126.05 124.68 123.77 122.30 121.60 116.88 97.79 77.35 62.23 61.84 54.83 51.46 49.71 13.91 13.41
f1 (ppm)

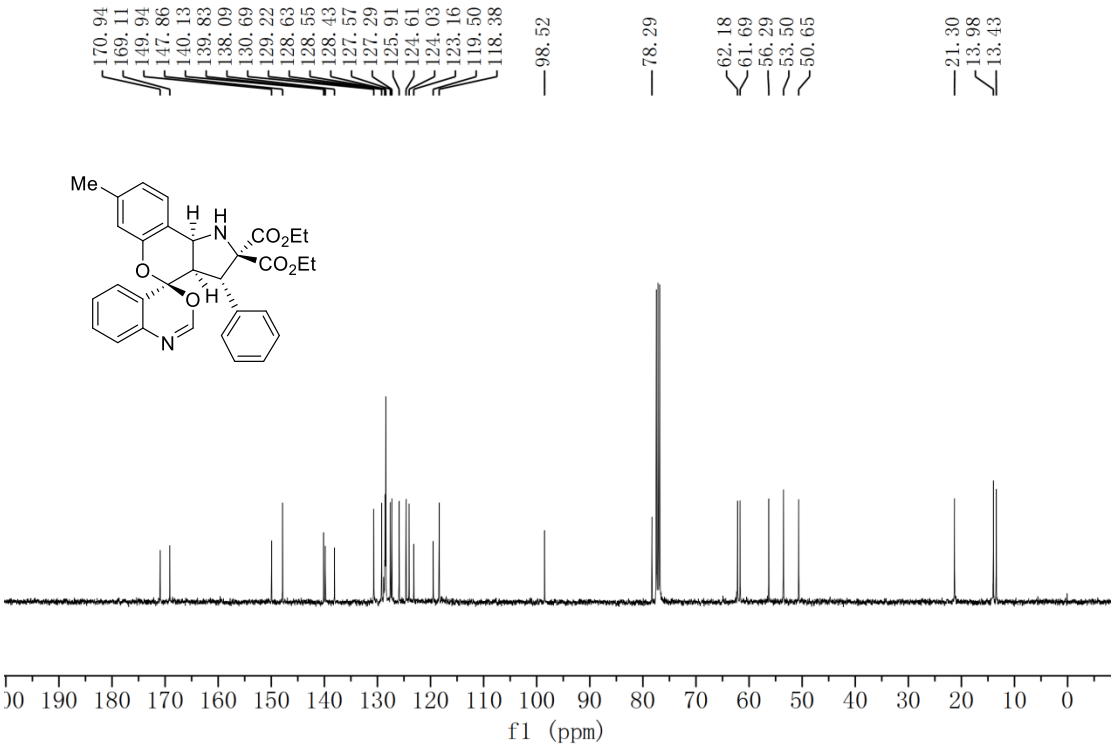
Compound **4g**


7.36 7.36 7.35 7.35 7.35 7.20 7.19 7.19 7.19 7.18 7.18 7.17 7.10 7.10 7.09 7.08 7.08 6.98 6.98 6.86 6.86 6.86 6.84 6.84 6.84 6.84 6.83 6.70 6.68 5.46 5.44 4.42 4.41 4.28 4.27 4.25 4.06 4.05 3.80 3.78 3.77 3.75 3.56 3.35 3.33 3.32 3.31 1.20 1.18 1.16 0.72 0.70 0.68
F
H
H
N
CO2Et
CO2Et
O
O
H
N
2.09 6.10 2.01 1.10 1.94 0.99 0.95 0.99 1.03 1.05 0.83 1.11 1.00 1.00 3.00 3.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

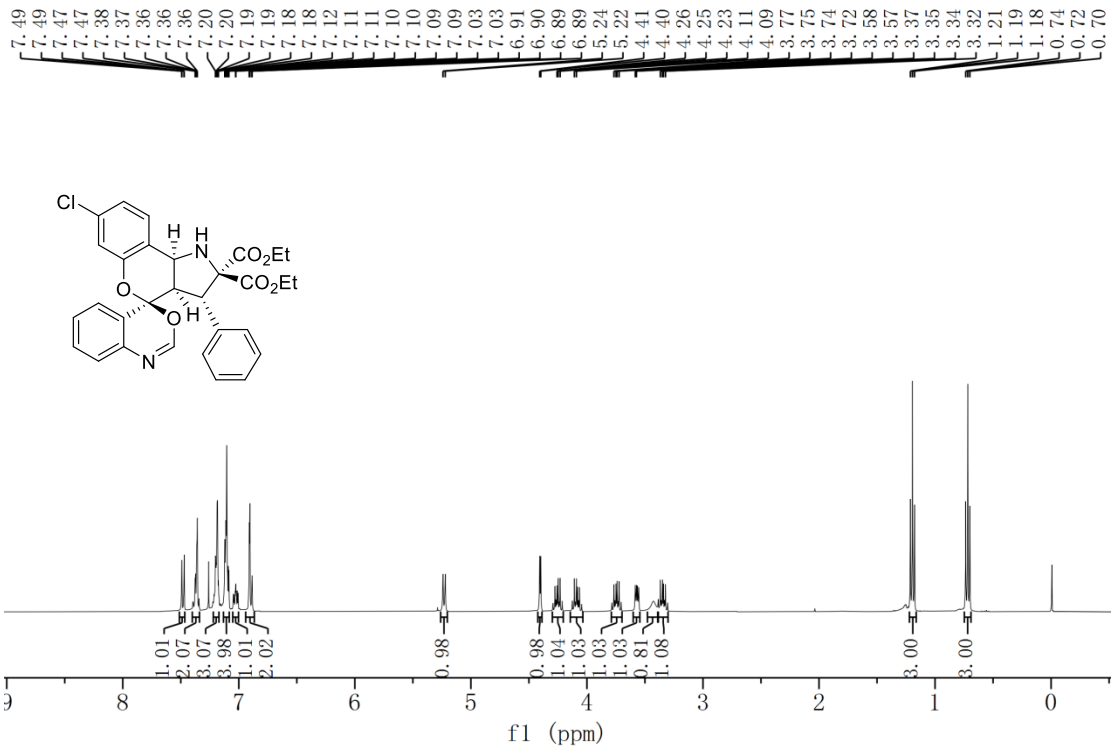

171.60 168.89 163.03 160.57 148.00 140.19 138.20 130.90 129.94 129.84 128.84 128.54 127.51 127.37 126.00 124.74 122.30 113.75 113.72 112.16 111.94 109.57 109.36 98.04 77.42 62.17 61.78 51.81 51.48 49.47 13.91 13.41
F
H
H
N
CO2Et
CO2Et
O
O
H
N
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

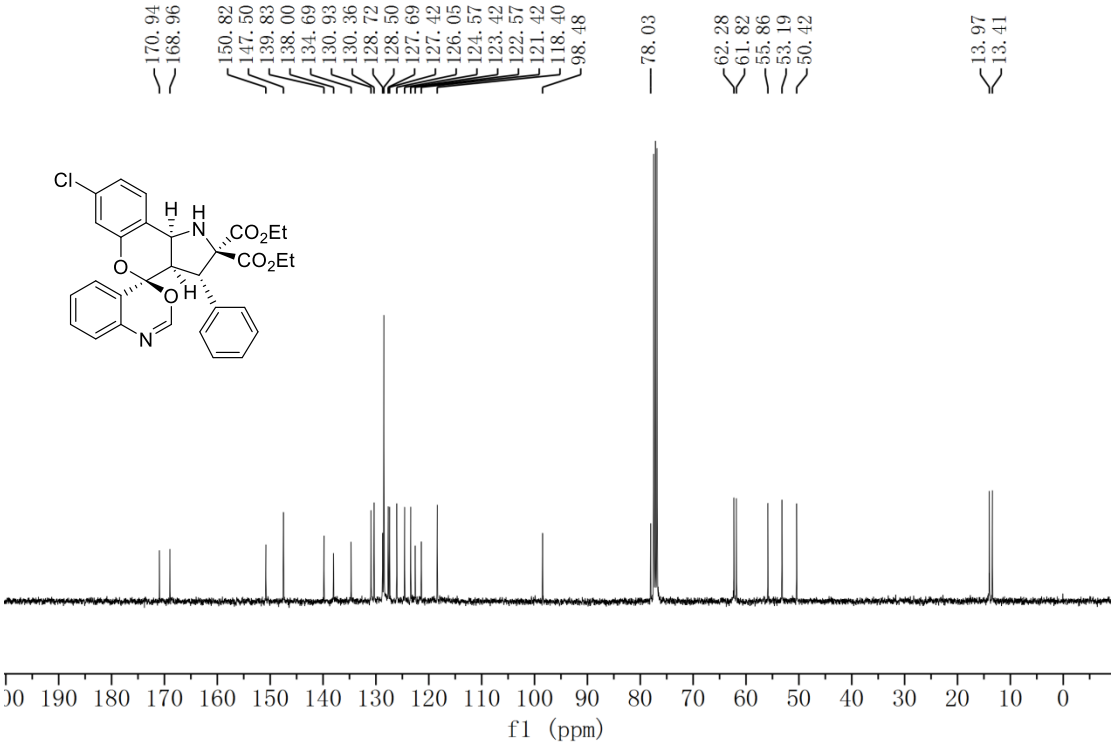
Compound **4h**


7.45 7.43 7.43 7.36 7.36 7.35 7.35 7.34 7.20 7.20 7.19 7.18 7.18 7.17 7.17 7.14 7.13 7.13 7.13 7.12 7.12 7.11 7.11 7.10 6.95 6.93 6.92 6.92 6.90 6.90 6.72 6.71 6.71 5.24 5.22 4.42 4.41 4.10 4.08 2.29 2.29 1.21 1.21 1.19 1.19 1.18 1.17 0.74 0.74 0.73 0.72 0.71 0.71
Me
H
H
N
CO2Et
CO2Et
O
O
H
N
1.01 2.04 6.05 1.04 2.06 1.00 0.99 0.99 1.04 1.19 1.01 1.02 0.81 1.10 3.00 3.00 2.99
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

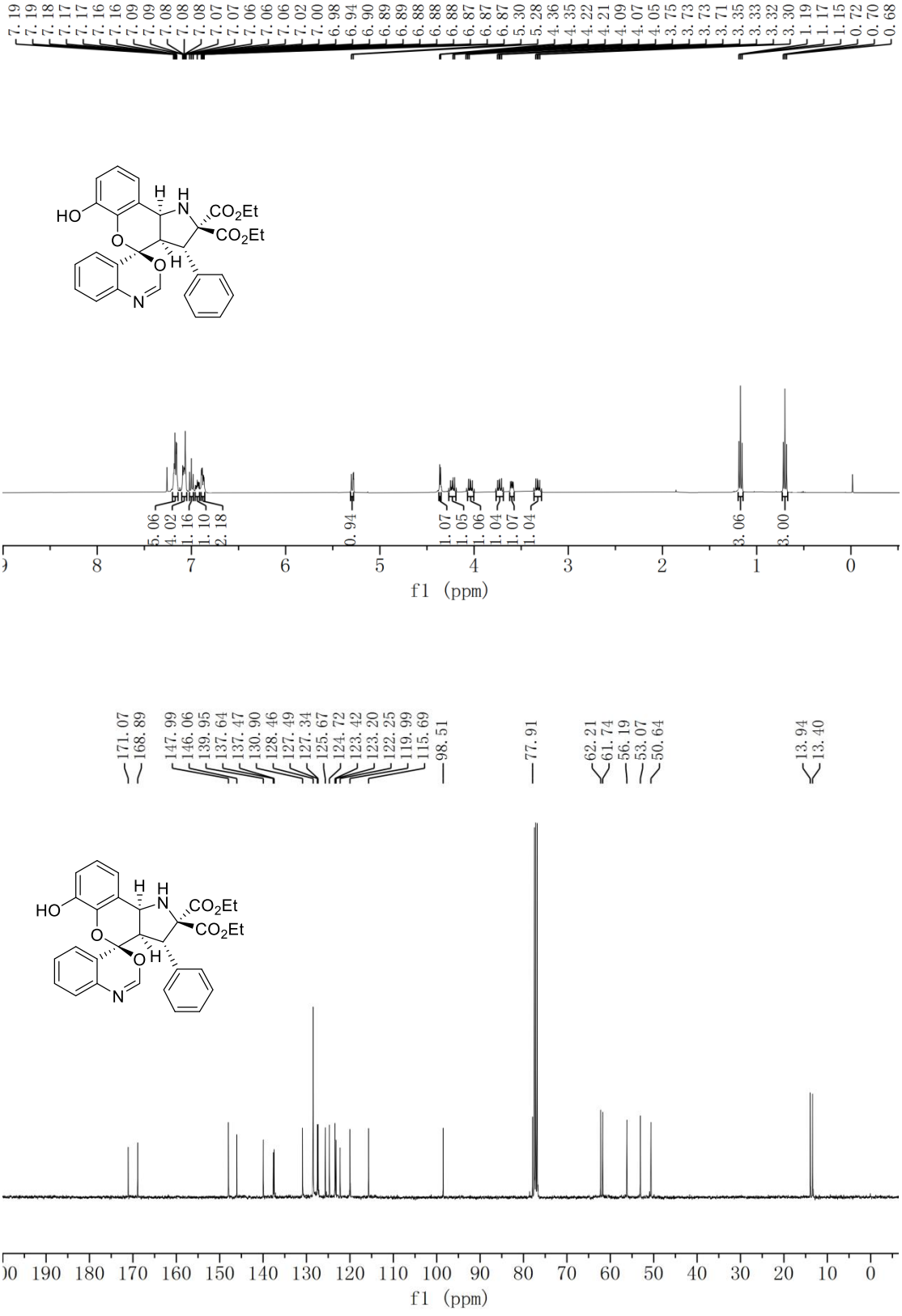

170.94 169.11 149.94 147.86 140.13 139.83 138.09 130.69 129.22 128.63 128.55 128.43 127.57 127.29 125.91 124.61 124.03 123.16 119.50 118.38 98.52 78.29 62.18 61.69 56.29 53.50 50.65 21.30 13.98 13.43
Me
H
H
N
CO2Et
CO2Et
O
O
H
N
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

Compound **4i**

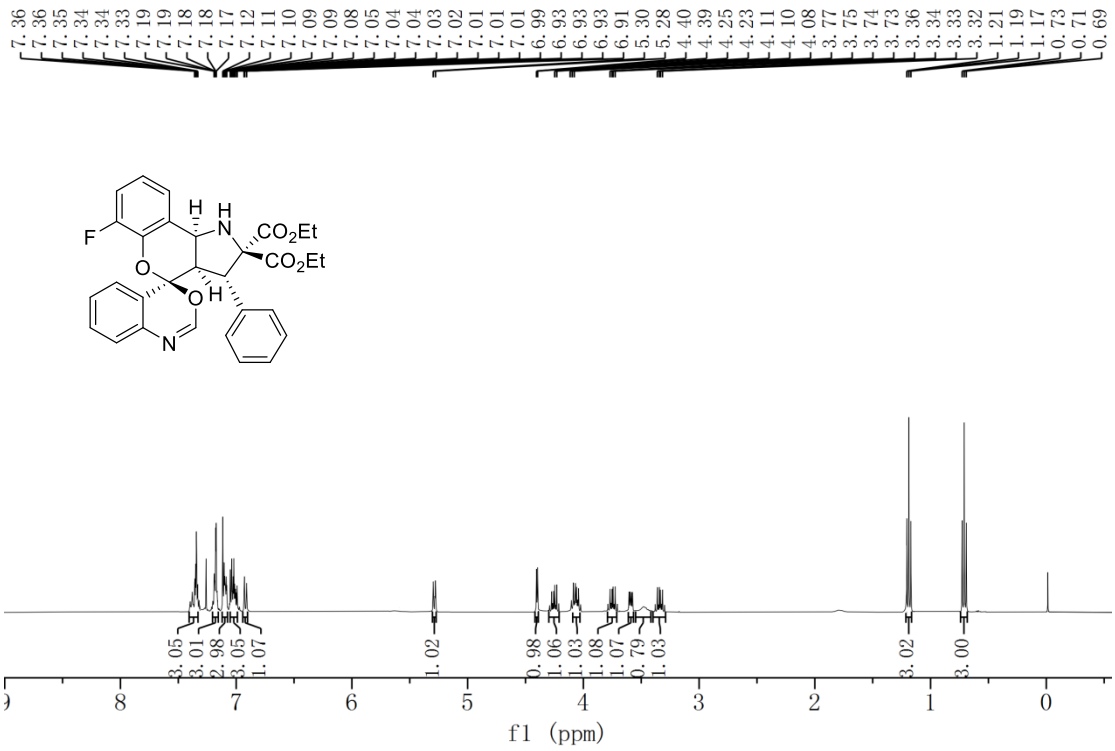

7.49
7.49
7.47
7.47
7.38
7.37
7.36
7.36
7.36
7.20
7.20
7.19
7.19
7.18
7.18
7.12
7.11
7.11
7.10
7.10
7.09
7.09
7.03
7.03
6.91
6.90
6.89
6.89
5.24
5.22
4.41
4.40
4.26
4.25
4.23
4.11
4.09
3.77
3.75
3.74
3.72
3.58
3.57
3.37
3.35
3.34
3.32
1.21
1.19
1.18
0.74
0.72
0.70
Cl
H
H
N
CO2Et
CO2Et
O
O
H
N
1.01
2.07
3.07
3.98
1.01
2.02
0.98
0.98
1.04
1.03
1.03
0.81
1.08
3.00
3.00
f1 (ppm)

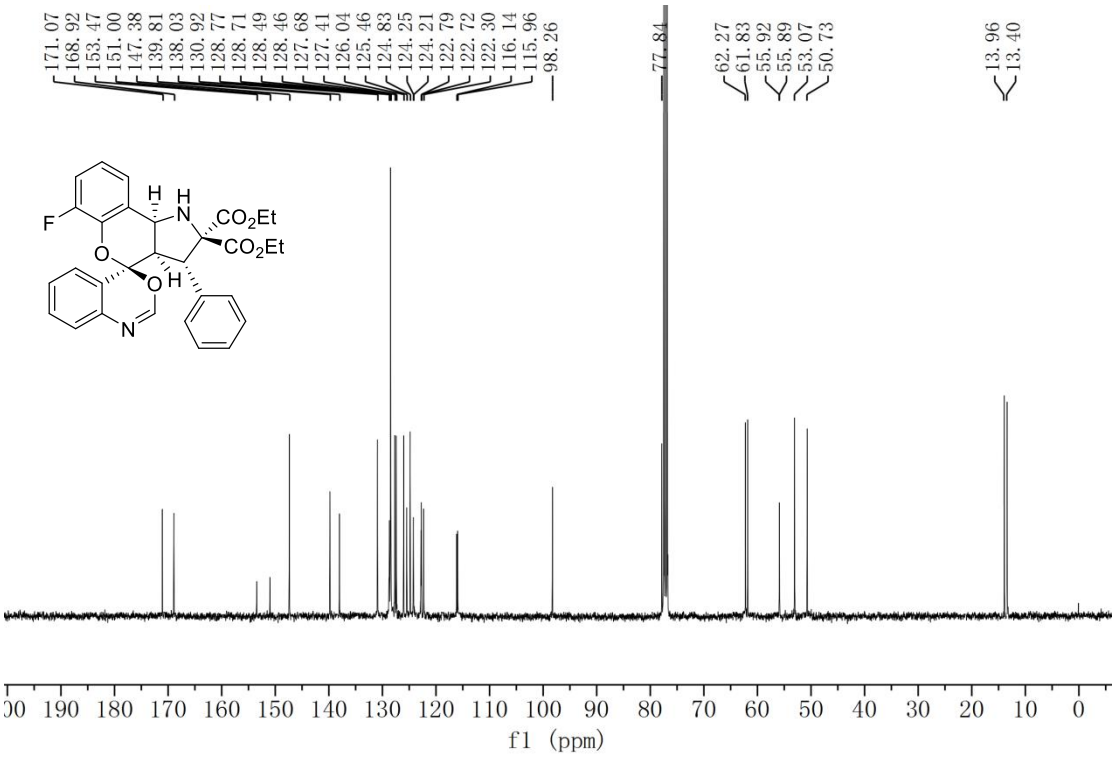

170.94
168.96
150.82
147.50
139.83
138.00
134.69
130.93
130.36
128.72
128.50
127.69
127.42
126.05
124.57
123.42
122.57
121.42
118.40
98.48
78.03
62.28
61.82
55.86
53.19
50.42
13.97
13.41
Cl
H
H
N
CO2Et
CO2Et
O
O
H
N
f1 (ppm)

Compound **4j**

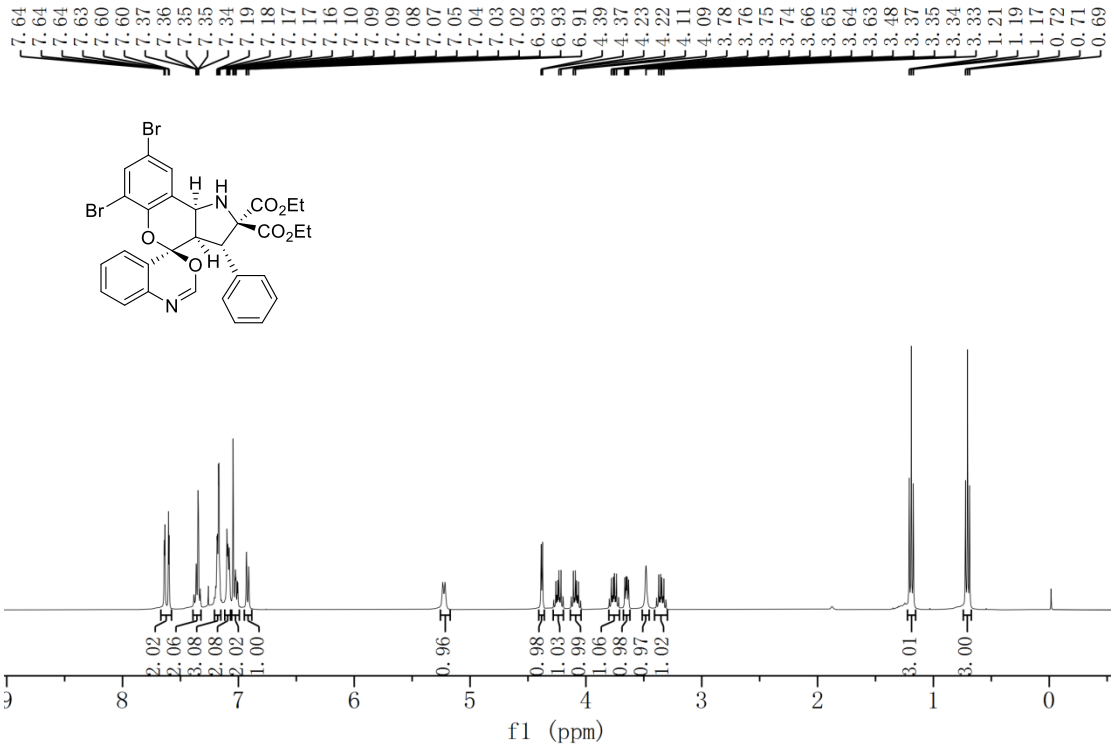

7.19 7.19 7.18 7.17 7.17 7.16 7.16 7.09 7.09 7.08 7.08 7.08 7.07 7.07 7.06 7.06 7.06 7.02 7.00 6.98 6.94 6.90 6.89 6.89 6.88 6.88 6.88 6.87 6.87 6.87 5.30 5.28 4.36 4.35 4.22 4.21 4.09 4.07 4.05 3.75 3.73 3.73 3.71 3.35 3.33 3.32 3.30 1.19 1.17 1.15 0.72 0.70 0.68
HO
H
H
N
CO2Et
CO2Et
O
O
H
N
5.06 4.02 1.16 1.10 2.18 0.94 1.07 1.05 1.06 1.04 1.07 1.04 3.06 3.00
f1 (ppm)
171.07 168.89 147.99 146.06 139.95 137.64 137.47 130.90 128.46 127.49 127.34 125.67 124.72 123.42 123.20 122.25 119.99 115.69 98.51 77.91 62.21 61.74 56.19 53.07 50.64 13.94 13.40
f1 (ppm)

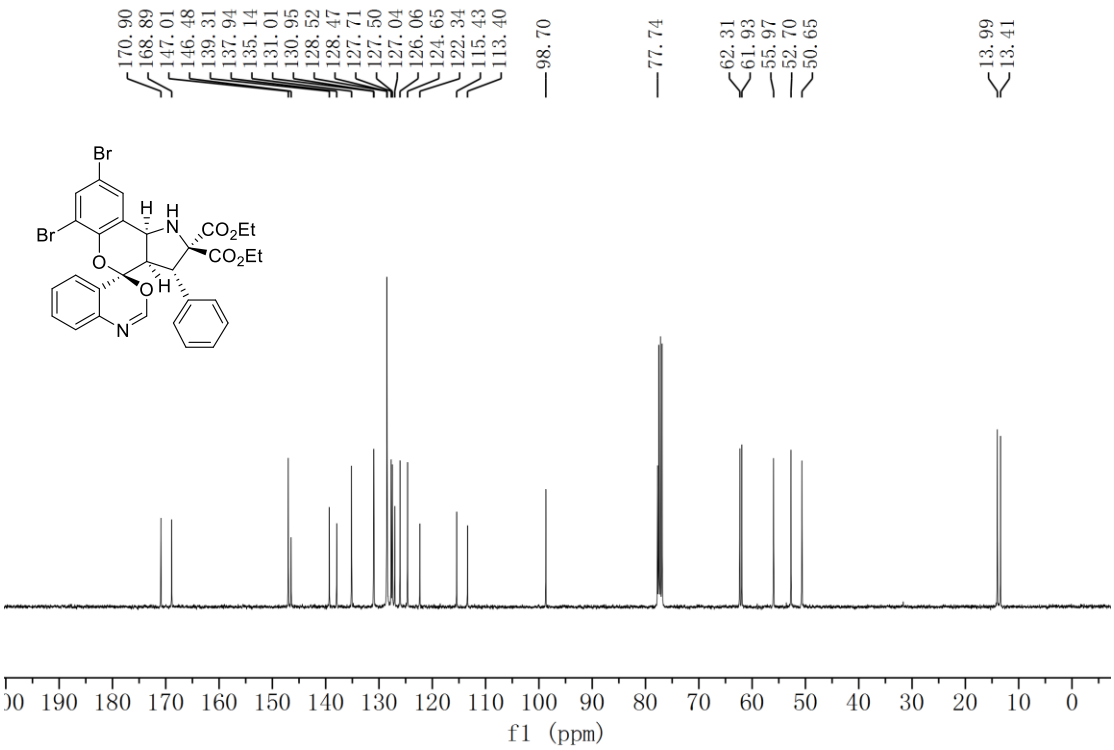
Compound **4k**


7.36 7.36 7.35 7.34 7.34 7.33 7.19 7.19 7.18 7.18 7.17 7.12 7.11 7.10 7.09 7.09 7.08 7.05 7.04 7.04 7.03 7.02 7.01 7.01 7.01 6.99 6.93 6.93 6.93 6.91 5.30 5.28 4.40 4.39 4.25 4.23 4.11 4.10 4.08 3.77 3.75 3.74 3.73 3.36 3.34 3.33 3.32 1.21 1.19 1.17 0.73 0.71 0.69
F
H
H
N
CO2Et
CO2Et
O
O
H
N
3.05 3.01 2.98 3.05 1.07 1.02 0.98 1.06 1.03 1.08 1.07 0.79 1.03 3.02 3.00
f1 (ppm)

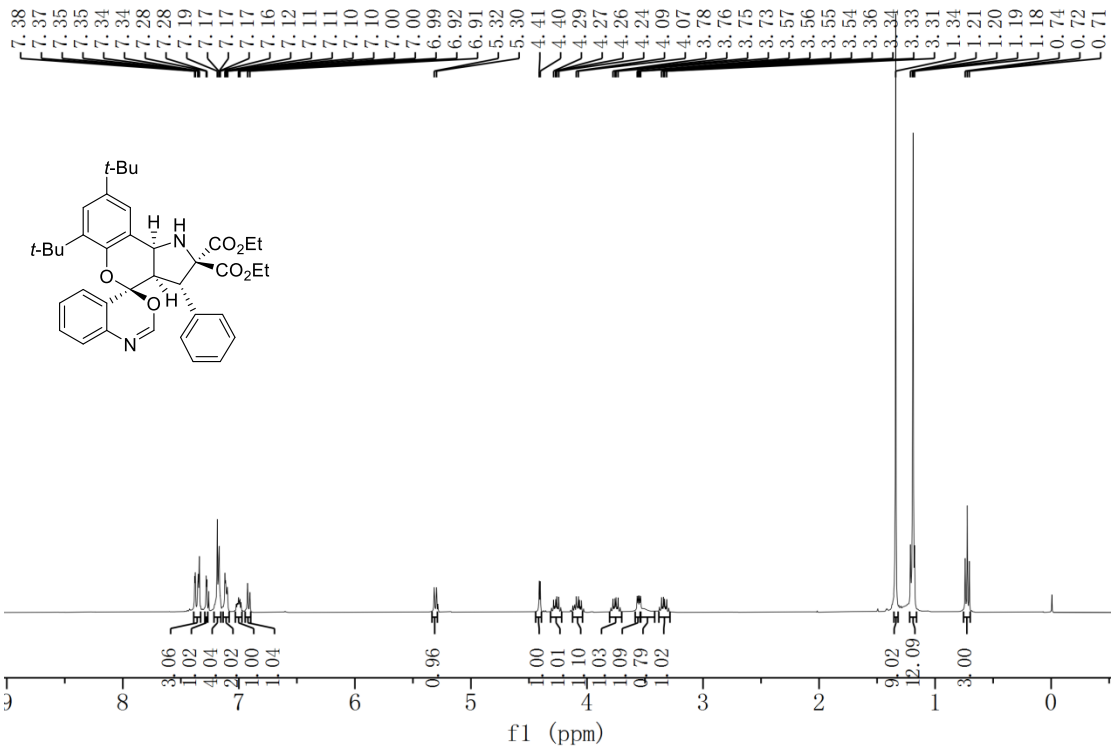

171.07 168.92 153.47 151.00 147.38 139.81 138.03 130.92 128.77 128.71 128.49 128.46 127.68 127.41 126.04 125.46 124.83 124.25 124.21 122.79 122.72 122.30 116.14 115.96 98.26 77.84 62.27 61.83 55.92 55.89 53.07 50.73 13.96 13.40
F
H
H
N
CO2Et
CO2Et
O
O
H
N
f1 (ppm)

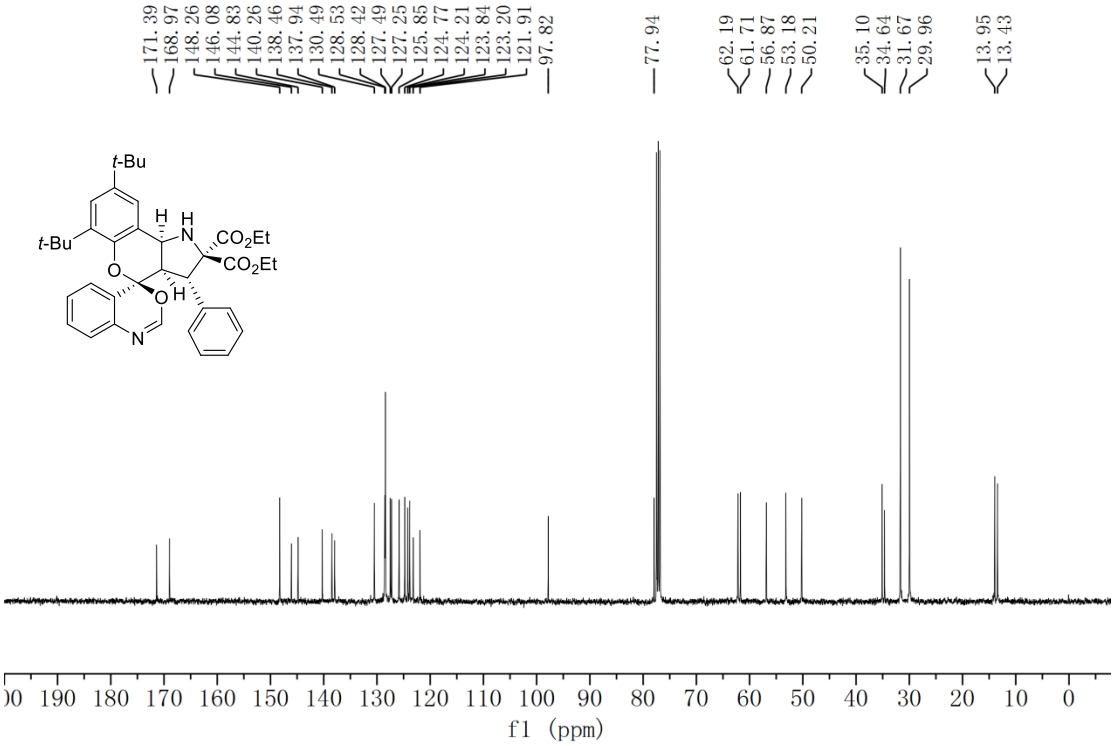
Compound **4l**


7.64 7.64 7.64 7.63 7.60 7.60 7.37 7.36 7.35 7.35 7.34 7.19 7.18 7.17 7.17 7.16 7.10 7.09 7.09 7.08 7.07 7.05 7.04 7.03 7.02 6.93 6.93 6.91 4.39 4.37 4.23 4.22 4.11 4.09 3.78 3.76 3.75 3.74 3.66 3.65 3.64 3.63 3.48 3.37 3.35 3.34 3.33 1.21 1.19 1.17 0.72 0.71 0.69
Br
Br
H
H
N
CO2Et
CO2Et
O
O
H
N
2.02 2.06 3.08 2.08 2.02 1.00 0.96 0.98 1.03 0.99 1.06 0.98 0.97 1.02 3.01 3.00
f1 (ppm)

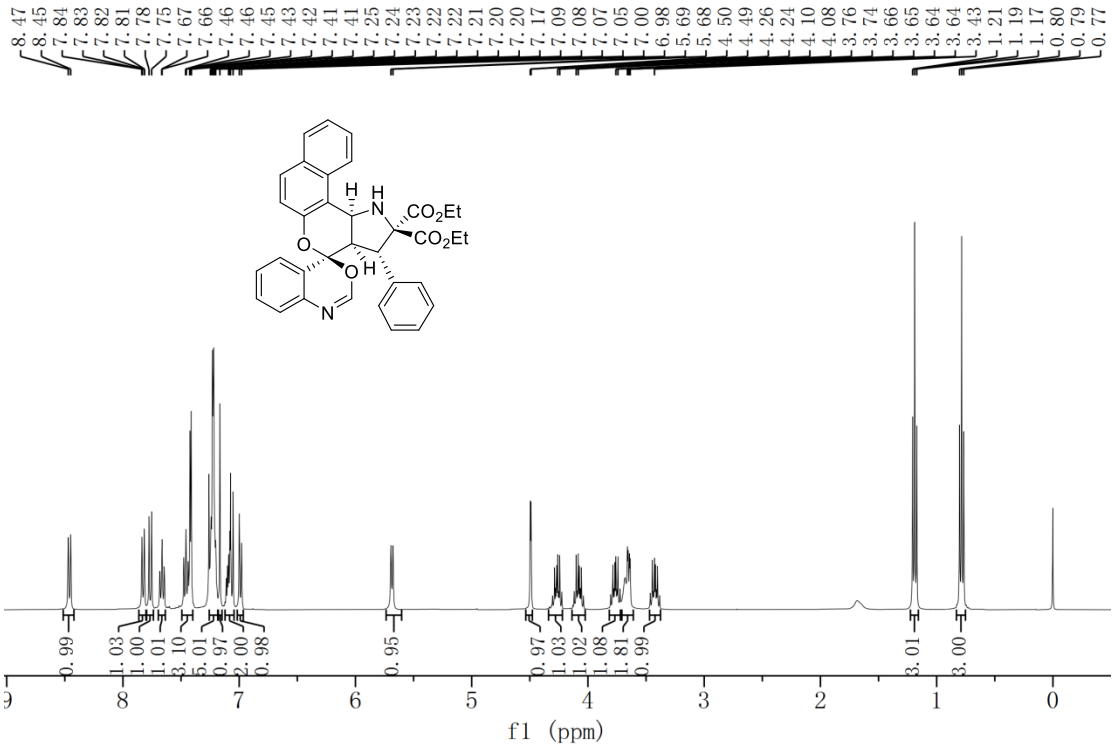

170.90 168.89 147.01 146.48 139.31 137.94 135.14 131.01 130.95 128.52 128.47 127.71 127.50 127.04 126.06 124.65 122.34 115.43 113.40 98.70 77.74 62.31 61.93 55.97 52.70 50.65 13.99 13.41
Br
Br
H
H
N
CO2Et
CO2Et
O
O
H
N
f1 (ppm)

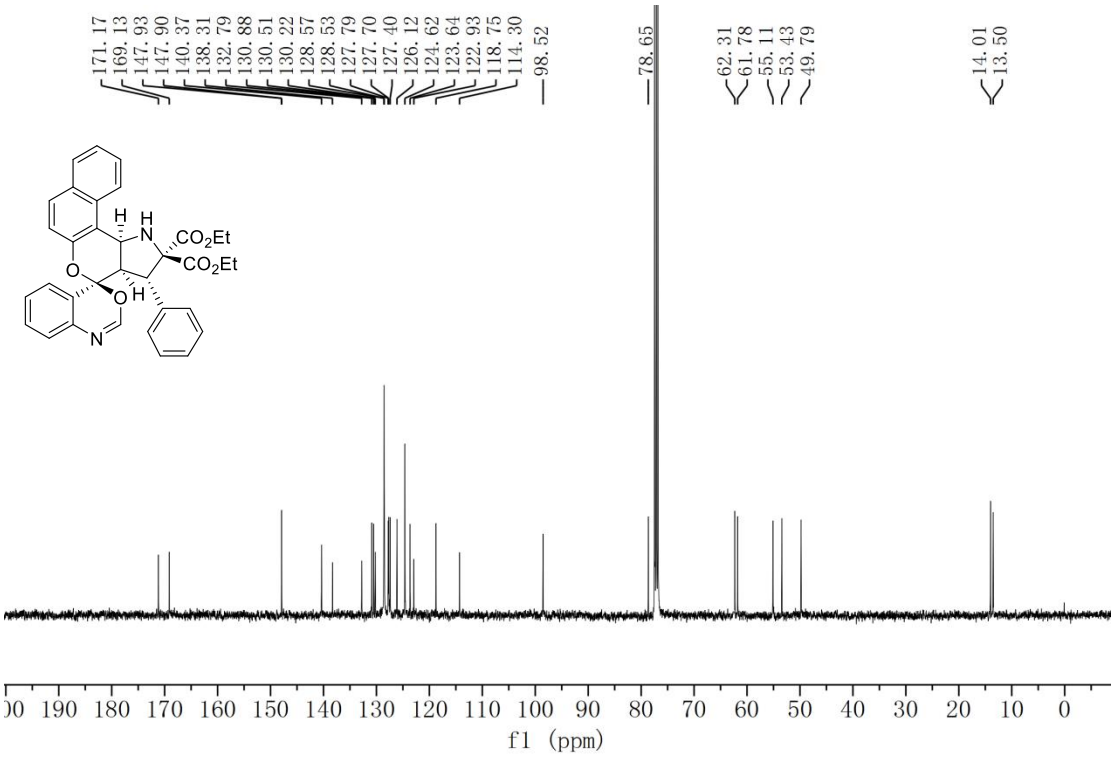
Compound **4m**


7.38 7.37 7.35 7.35 7.34 7.34 7.28 7.28 7.19 7.17 7.17 7.17 7.16 7.12 7.11 7.11 7.10 7.10 7.00 7.00 6.99 6.92 6.91 5.32 5.30 4.41 4.40 4.29 4.27 4.26 4.24 4.09 4.07 3.78 3.76 3.75 3.73 3.57 3.56 3.55 3.54 3.36 3.34 3.33 3.31 1.34 1.21 1.20 1.19 1.18 0.74 0.72 0.71
t-Bu
t-Bu
H
H
N
CO2Et
CO2Et
O
O
H
N
3.06 1.02 4.04 2.02 1.00 1.04 0.96 1.00 1.01 1.10 1.03 1.09 0.79 1.02 9.02 12.09 3.00
f1 (ppm)

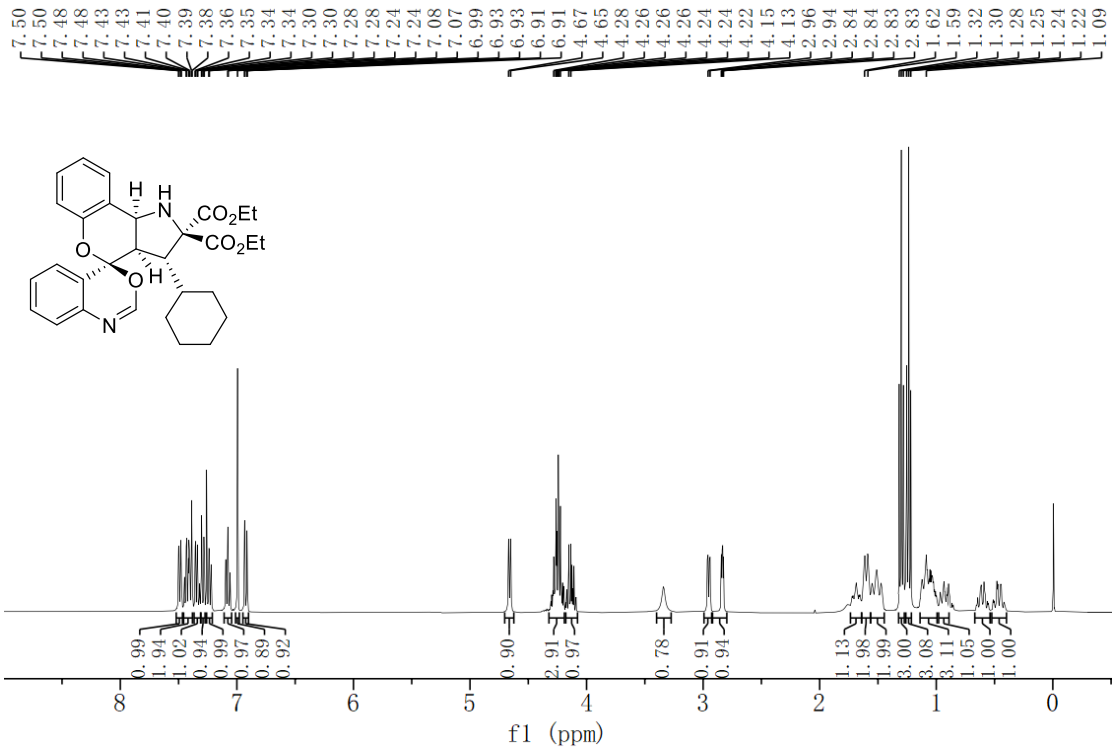

171.39 168.97 148.26 146.08 144.83 140.26 138.46 137.94 130.49 128.53 128.42 127.49 127.25 125.85 124.77 124.21 123.84 123.20 121.91 97.82 77.94 62.19 61.71 56.87 53.18 50.21 35.10 34.64 31.67 29.96 13.95 13.43
t-Bu
t-Bu
H
H
N
CO2Et
CO2Et
O
O
H
N
f1 (ppm)

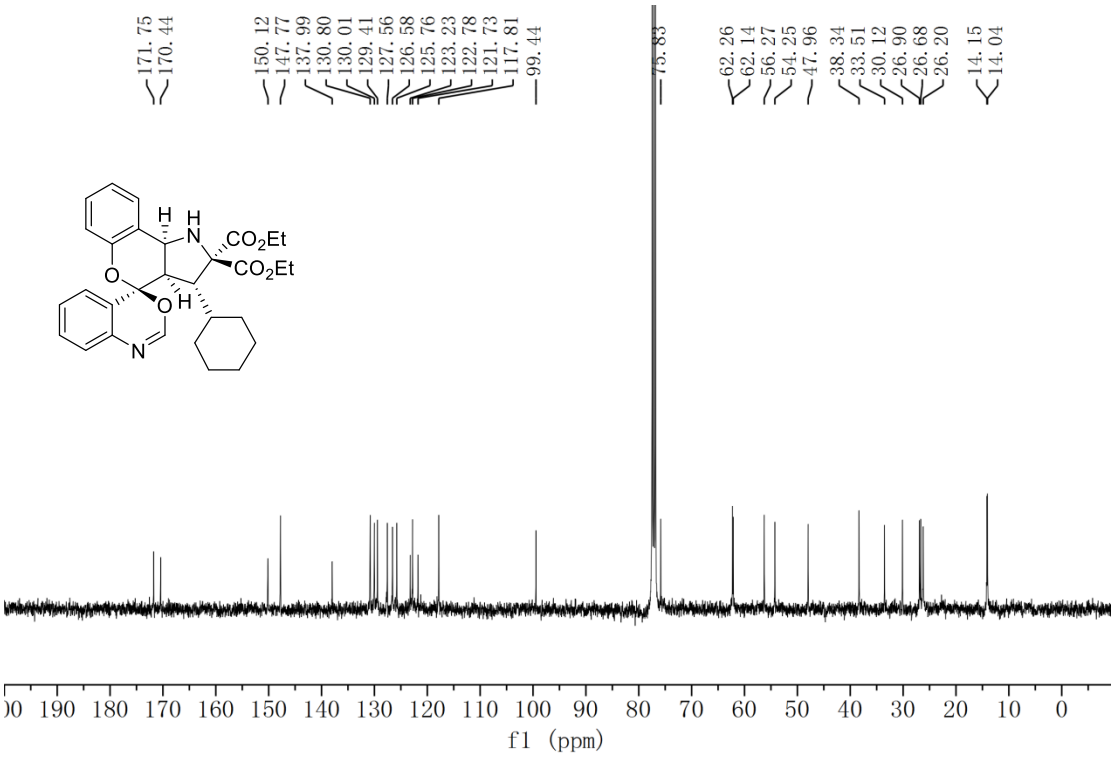
Compound **4n**


8.47 8.45 7.84 7.83 7.82 7.81 7.78 7.75 7.67 7.66 7.46 7.46 7.45 7.43 7.42 7.41 7.41 7.25 7.24 7.23 7.22 7.22 7.21 7.20 7.20 7.17 7.09 7.08 7.07 7.05 7.00 6.98 5.69 5.68 4.50 4.49 4.26 4.24 4.10 4.08 3.76 3.74 3.66 3.65 3.64 3.64 3.43 1.21 1.19 1.17 0.80 0.79 0.77
H
H
N
CO2Et
CO2Et
O
O
H
N
0.99 1.03 1.00 1.01 3.10 5.01 0.97 2.00 0.98 0.95 0.97 1.03 1.02 1.08 1.81 0.99 3.01 3.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

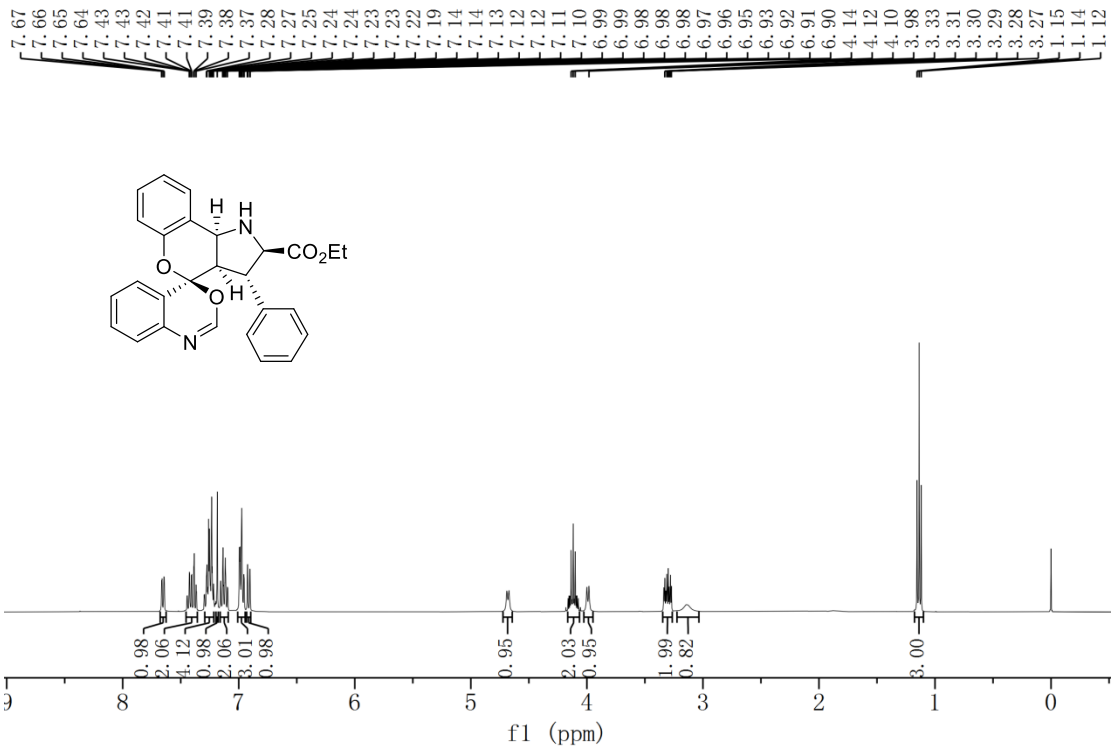

171.17 169.13 147.93 147.90 140.37 138.31 132.79 130.88 130.51 130.22 128.57 128.53 127.79 127.70 127.40 126.12 124.62 123.64 122.93 118.75 114.30 98.52 78.65 62.31 61.78 55.11 53.43 49.79 14.01 13.50
H
H
N
CO2Et
CO2Et
O
O
H
N
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

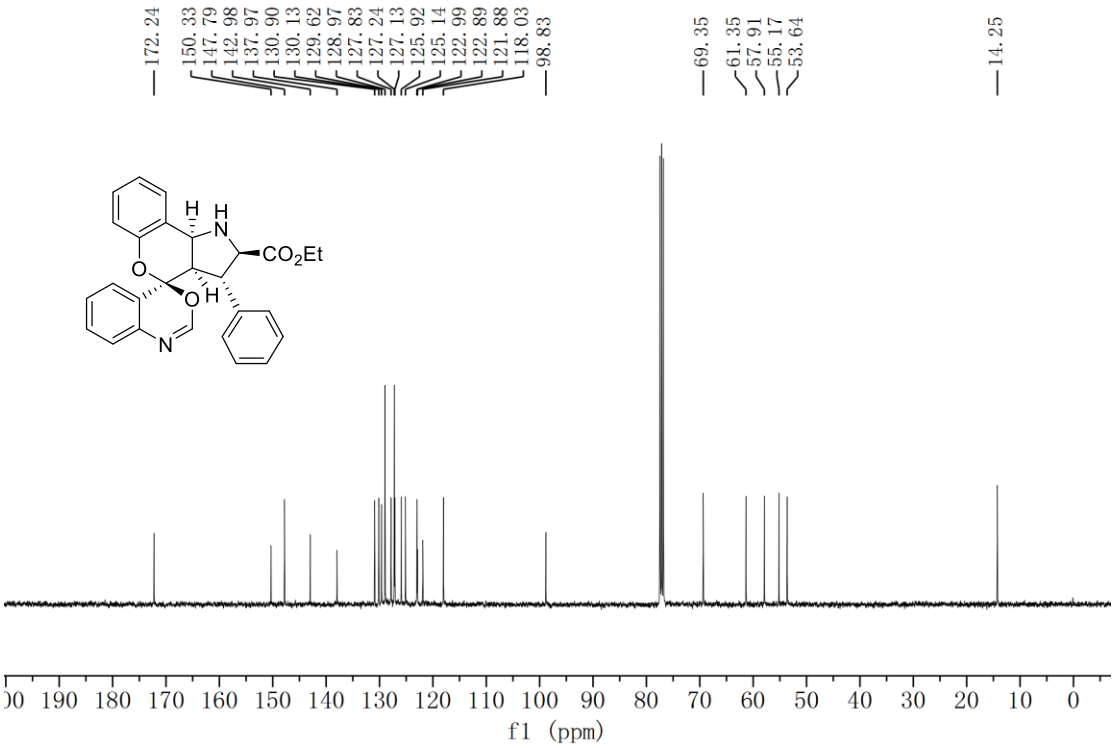
Compound **3'a**


7.50 7.50 7.48 7.48 7.43 7.43 7.41 7.40 7.39 7.38 7.36 7.35 7.34 7.34 7.30 7.30 7.28 7.28 7.24 7.24 7.08 7.07 6.99 6.93 6.91 6.91 4.67 4.65 4.28 4.26 4.26 4.26 4.24 4.24 4.22 4.15 4.13 2.96 2.94 2.84 2.84 2.83 2.83 1.62 1.59 1.32 1.30 1.28 1.25 1.24 1.22 1.09
H H N CO2Et CO2Et O O H N
0.99 1.94 1.02 0.94 0.99 0.97 0.89 0.92 0.90 2.91 0.97 0.78 0.91 0.94 1.13 1.98 1.99 3.00 3.08 3.11 1.05 1.00 1.00
8 7 6 5 4 3 2 1 0
f1 (ppm)


171.75 170.44 150.12 147.77 137.99 130.80 130.01 129.41 127.56 126.58 125.76 123.23 122.78 121.73 117.81 99.44 75.83 62.26 62.14 56.27 54.25 47.96 38.34 33.51 30.12 26.90 26.68 26.20 14.15 14.04
H H N CO2Et CO2Et O O H N
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

Compound **6a**


7.67 7.66 7.65 7.64 7.43 7.43 7.42 7.41 7.41 7.39 7.38 7.37 7.28 7.27 7.25 7.24 7.24 7.23 7.23 7.22 7.19 7.14 7.14 7.13 7.12 7.12 7.11 7.10 6.99 6.99 6.98 6.98 6.98 6.97 6.96 6.95 6.93 6.92 6.91 6.90 4.14 4.12 4.10 3.98 3.33 3.31 3.30 3.29 3.28 3.27 1.15 1.14 1.12
H
H
N
CO2Et
O
O
H
N
0.98 2.06 4.12 0.98 2.06 3.01 0.98 0.95 2.03 0.95 1.99 0.82 3.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)


172.24 150.33 147.79 142.98 137.97 130.90 130.13 129.62 128.97 127.83 127.24 127.13 125.92 125.14 122.99 122.89 121.88 118.03 98.83 69.35 61.35 57.91 55.17 53.64 14.25
H
H
N
CO2Et
O
O
H
N
00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)