Supplementary Information
For

Visible Light-Mediated Arylalkylation of Allylic Alcohols through Concomitant 1,2-Aryl Migration

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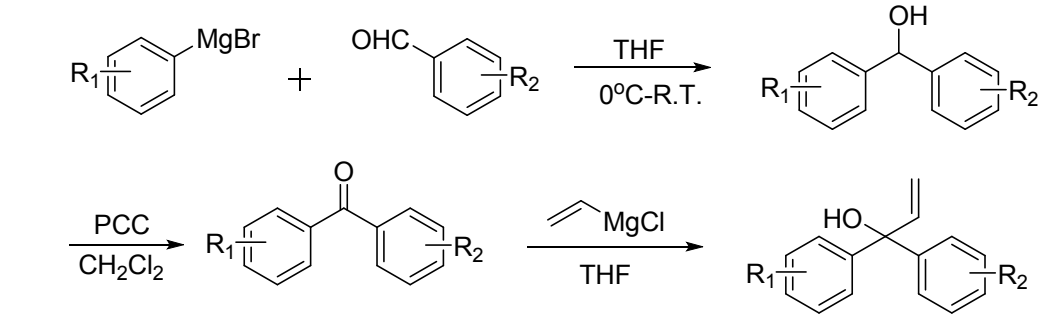
1. General information

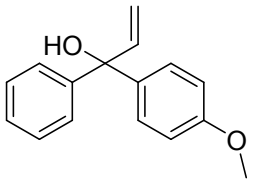
Unless otherwise noted, all reactions were carried out in round bottom flask under a nitrogen atmosphere with dry solvents, and were monitored by TLC and visualized by UV lamp (254 nm) /or by treatment with a solution of 10 g phosphomolybdic acid and 100 mL EtOH followed by heating. Silica gel (200-300 mesh) and silica gel GF_{254} (10-40 μm) were used for Column chromatography (CC) and prepare thin layer chromatography (PTLC), respectively. All reagents were used as received from commercial sources without further purification. Solvents were dried and purified according to the procedure from "Purification of Laboratory Chemicals book". ^{1}H (400 MHz) and ^{13}C NMR (100 MHz) spectra were conducted on Bruker AV-400 instrument internally referenced to SiMe4 or chloroform signals. The following abbreviations (or combinations thereof) were used to explain multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, and m = multiplet. HRMS(ESI) spectra were recorded on a Bruker Esquire LC mass spectrometer using electrospray ionization. GC-MS analysis was performed on 7890A-5975C/Agilent.

2. Preparation and Characterization of Substrates

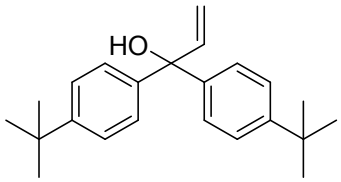
1) Synthesis of **1a**, **1d**, **1g**, **1h**, **1j-1r** and **1t**

Diaryl allylic alcohols **1a**, **1d**, **1g**, **1h**, **1j-1r** and **1t** were synthesized according to ref. *Angew. Chem., Int. Ed.,* 2013, **52**, 6962.[1]

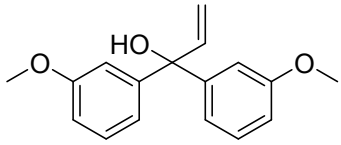




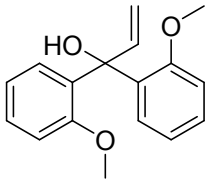
1-(4-Methoxyphenyl)-1-phenylprop-2-en-1-ol (1a)[1]: Pale yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.41 (d, J = 7.2 Hz, 2H), 7.34 (t, J = 8.0 Hz, 2H), 7.33-7.28 (m, 3H), 6.87 (d, J = 8.0 Hz, 2H), 6.50 (dd, J = 17.6, 10.0 Hz, 1H), 5.33 (dd, J = 17.6, 1.2 Hz, 1H), 5.32 (dd, J = 10.0, 1.2 Hz, 1H), 3.81 (s, OCH_3, 3H), 2.30 (s, 1H, -O*H*).



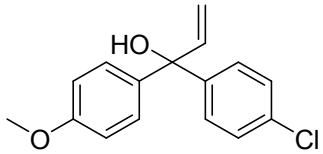
1,1-Bis(4-tert-butylphenyl)prop-2-en-1-ol (1d): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.36 (d, J = 8.8 Hz, 4H), 7.32 (d, J = 8.8 Hz, 4H), 6.52 (dd, J = 17.2, 10.8 Hz, 1H), 5.36 (dd, J = 17.2, 1.2 Hz, 1H), 5.30 (dd, J = 10.8, 1.2 Hz, 1H), 2.26 (s, 1H, -O*H*), 1.33 (s, 6×CH_3, 18H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_c 150.0, 143.8, 142.8, 126.5, 125.0, 113.3, 79.0, 34.4, 31.3; GC-MS (EI): 322.2, 307.2, 265.1, 161.1, 131.1; HRMS(ESI): $[M - H_2O + H]^+$ calcd for $C_{20}H_{29}^+$: 305.2269, found: 305.2286.



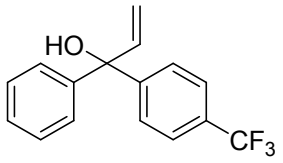
1-(3-Methoxyphenyl)-1-phenylprop-2-en-1-ol (1g): Pale yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.38 (d, J = 7.6 Hz, 2H), 7.29 (t, J = 7.6 Hz, 2H), 7.23 (d, J = 7.6 Hz, 1H), 7.19 (d, J = 7.6 Hz, 1H), 6.99 (d, J = 1.6 Hz, 1H), 6.93 (dd, J = 7.6, 0.8 Hz, 1H), 6.77 (dd, J = 7.6, 1.6 Hz, 1H), 6.48 (dd, J = 17.2, 10.8 Hz, 1H), 5.29 (dd, J = 17.2, 1.2 Hz, 1H), 5.27 (dd, J = 10.8, 1.2 Hz, 1H), 3.75 (s, OCH_3, 3H), 2.43 (s, 1H, -O*H*); ^{13}C NMR (100 MHz, $CDCl_3$): δ_c 159.0, 147.6, 145.8, 143.4, 128.7, 127.7, 126.8, 126.7, 119.3, 113.6, 112.6, 112.0, 78.7, 54.9; GC-MS (EI): 270.1, 135.1, 107.1, 77.1; HRMS(ESI): $[M - H_2O + H]^+$ calcd for $C_{17}H_{17}O_2^+$: 253.1228, found: 253.1231.



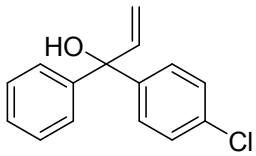
1,1-Bis(2-methoxyphenyl)prop-2-en-1-ol (1h)[1]: Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.48 (dd, J = 8.0, 1.6 Hz, 2H), 7.22 (t, J = 8.0 Hz, 2H), 6.95 (t, J = 8.0 Hz, 2H), 6.83 (d, J = 8.0 Hz, 2H), 6.66 (dd, J = 17.2, 10.6 Hz, 1H), 5.36 (dd, J = 17.2, 1.4 Hz, 1H), 5.23 (dd, J = 10.6, 1.4 Hz, 1H), 4.75 (s, 1H, -O*H*), 3.53 (s, 2×OCH_3, 6H).



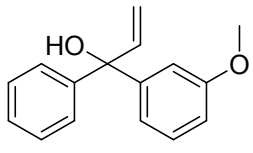
1-(4-Chlorophenyl)-1-(4-methoxyphenyl)prop-2-en-1-ol (1j)[2]: Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.31-7.28 (m, 4H), 7.25 (d, J = 8.6 Hz, 2H), 6.84 (d, J = 8.6 Hz, 2H), 6.42 (dd, J = 17.2, 10.4 Hz, 1H), 5.29 (d, J = 10.4 Hz, 1H), 5.28 (d, J = 17.2 Hz, 1H), 3.78 (s, OCH_3, 3H), 2.30 (br s, 1H, -O*H*).



1-Phenyl-1-(4-(trifluoromethyl)phenyl)prop-2-en-1-ol (1k)[1]: Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.55 (d, J = 7.6 Hz, 2H), 7.48 (d, J = 8.4 Hz, 2H), 7.37-7.24 (m, 5H), 6.46 (dd, J = 17.2, 10.8 Hz, 1H), 5.33 (dd, J = 10.8, 0.8 Hz, 1H), 5.30 (dd, J = 17.2, 0.8 Hz, 1H), 2.44 (s, 1H, -O*H*).

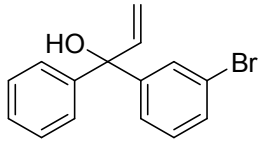


1-(4-Chlorophenyl)-1-phenylprop-2-en-1-ol (1l): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.40-7.36 (m, 4H), 7.33 (d, J = 7.6 Hz, 2H), 7.32 (d, J = 7.6 Hz, 2H), 7.30-7.28 (m, 1H), 6.49 (dd, J = 17.2, 10.4 Hz, 1H), 5.35 (dd, J = 10.4, 1.2 Hz, 1H), 5.33 (dd, J = 17.2, 1.2 Hz, 1H), 2.37 (s, 1H, -O*H*); ^{13}C NMR (100 MHz, $CDCl_3$): δ_c 145.3, 144.1, 143.0, 133.1, 128.3, 128.2, 128.2, 127.5, 126.8, 114.5, 79.0; GC-MS (EI): 244.1, 209.1, 139.0, 105.1, 77.1; HRMS(ESI): $[M - H_2O + H]^+$ calcd for $C_{15}H_{12}Cl^+$: 227.0627, found: 227.0627.

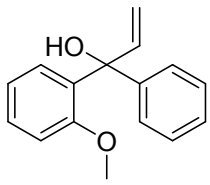


1-(3-Methoxyphenyl)-1-phenylprop-2-en-1-ol (1m): Pale yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.38 (d, J = 7.6 Hz, 2H), 7.29 (t, J = 7.6 Hz, 2H), 7.23 (d, J = 7.6 Hz, 1H), 7.19 (d, J = 7.6 Hz, 1H), 6.99 (d, J = 1.6 Hz, 1H), 6.93 (dd, J = 7.6, 0.8 Hz, 1H), 6.77 (dd, J = 7.6, 1.6 Hz, 1H), 6.48 (dd, J = 17.2, 10.8 Hz, 1H), 5.29 (dd, J =

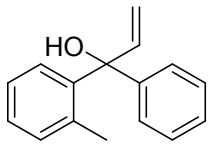
17.2, 1.2 Hz, 1H), 5.27 (dd, J = 10.8, 1.2 Hz, 1H), 3.75 (s, OCH_3, 3H), 2.43 (s, 1H, -O*H*); ^{13}C NMR (100 MHz, $CDCl_3$): δ_c 159.0, 147.6, 145.8, 143.4, 128.7, 127.7, 126.8, 126.7, 119.3, 113.6, 112.6, 112.0, 78.7, 54.9; GC-MS (EI): 240.1, 135.1, 105.1, 77.1; HRMS(ESI): $[M - H_2O + H]^+$ calcd for $C_{16}H_{15}O^+$: 223.1123, found: 223.1119.



1-(3-Bromophenyl)-1-phenylprop-2-en-1-ol (1n): Colorless oil. ^1H NMR (400 MHz, $CDCl_3$): δ_H 7.63 (s, 1H), 7.44-7.29 (m, 7H), 7.21 (t, J = 8.0 Hz, 1H), 6.48 (dd, J = 16.8, 10.4 Hz, 1H), 5.37 (d, J = 10.4 Hz, 1H), 5.35 (d, J = 16.8 Hz, 1H), 2.41 (s, 1H, -O*H*); ^{13}C NMR (100 MHz, $CDCl_3$): δ_c 148.0, 145.1, 142.8, 130.2, 129.8, 129.6, 128.3, 127.5, 126.8, 125.6, 122.4, 114.7, 79.0; GC-MS (EI): 290.0, 288.0, 209.1, 184.9, 182.9, 105.0, 77.1; HRMS(ESI): $[M - H_2O + H]^+$ calcd for $C_{15}H_{12}Br^+$: 271.0122, found: 271.0120.

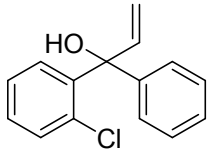


1-(2-Methoxyphenyl)-1-phenylprop-2-en-1-ol (1o)[1]: Colorless oil. ^1H NMR (400 MHz, $CDCl_3$): δ_H 7.32 (d, J = 7.6 Hz, 2H), 7.28 (t, J = 7.6 Hz, 3H), 7.22 (t, J = 7.6 Hz, 2H), 6.95 (t, J = 7.6 Hz, 1H), 6.91 (d, J = 7.6 Hz, 1H), 6.40 (dd, J = 17.2, 10.8 Hz, 1H), 5.28 (dd, J = 10.8, 1.2 Hz, 1H), 5.06 (dd, J = 17.2, 1.2 Hz, 1H), 4.76 (s, 1H, OH), 3.64 (s, OCH_3, 3H).

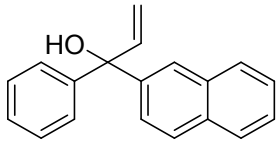


1-Phenyl-1-*o*-tolylprop-2-en-1-ol (1p): Colorless oil. ^1H NMR (400 MHz, $CDCl_3$): δ_H 7.57-7.55 (m, 1H), 7.29 (d, J = 8.0 Hz, 4H), 7.25-7.19 (m, 3H), 7.13-7.11 (m, 1H), 6.52 (dd, J = 17.2, 10.8 Hz, 1H), 5.26 (d, J = 10.8 Hz, 1H), 5.24 (d, J = 17.2 Hz, 1H), 2.72 (s, 1H, -O*H*), 2.03 (s, CH_3, 3H);^{13}C NMR (100 MHz, $CDCl_3$): δ_c 145.4, 143.7, 143.2, 137.3, 132.3, 128.0, 127.6, 127.4, 126.8, 126.2, 125.2, 113.3, 79.8, 21.4; GC-

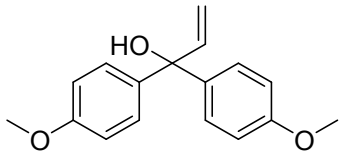
MS (EI): 224.1, 209.1, 119.0, 105.0, 91.1, 77.1; HRMS(ESI): $[M - H_2O + H]^+$ calcd for $C_{16}H_{15}^+$: 207.1173, found: 207.1163.



1-(2-Chlorophenyl)-1-phenylprop-2-en-1-ol (1q): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.72 (dd, J = 7.6, 2.0 Hz, 1H), 7.36-7.29 (m, 8H), 6.62 (dd, J = 17.2, 10.8 Hz, 1H), 5.36 (dd, J = 10.8, 1.2 Hz, 1H), 5.35 (dd, J = 17.2, 1.2 Hz, 1H), 3.24 (s, 1H, -O*H*); ^{13}C NMR (100 MHz, $CDCl_3$): δ_c 144.9, 142.3, 141.3, 132.5, 131.3, 129.2, 129.0, 128.2, 127.4, 126.7, 126.5, 115.0, 79.6; GC-MS (EI): 244.1, 209.1, 139.1, 105.1, 77.1; HRMS(ESI): $[M - H_2O + H]^+$ calcd for $C_{15}H_{12}Cl^+$: 227.0627, found: 227.0623.

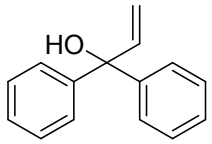


1-(Naphthalen-2-yl)-1-phenylprop-2-en-1-ol (1r): Pale yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.94 (d, J = 8.4 Hz, 1H), 7.78 (d, J = 8.4 Hz, 2H), 7.72 (dd, J = 7.6, 1.2 Hz, 1H), 7.41 (t, J = 7.6 Hz, 1H), 7.34-7.31 (m, 3H), 7.25-7.17 (m, 4H), 6.61 (dd, J = 17.2, 10.4 Hz, 1H), 5.28 (dd, J = 17.2, 0.8 Hz, 1H), 5.27 (dd, J = 10.4, 0.8 Hz, 1H), 2.56 (s, 1H, -O*H*); ^{13}C NMR (100 MHz, $CDCl_3$): δ_c 145.7, 143.9, 140.6, 134.8, 130.6, 129.2, 128.7, 128.2, 127.4, 127.0, 126.3, 125.6, 125.3, 125.2, 124.6, 113.8, 80.2; GC-MS (EI): 260.1, 155.1, 127.1, 105.1, 77.1; HRMS(ESI): $[M - H_2O + H]^+$ calcd for $C_{19}H_{15}^+$: 243.1173, found: 243.1178.

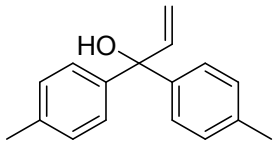


1,1-Bis(4-methoxyphenyl)prop-2-en-1-ol (1t)[3]: Pale yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.30 (d, J = 8.8 Hz, 4H), 6.86 (d, J = 8.8 Hz, 4H), 6.47 (dd, J = 17.2, 10.4 Hz, 1H), 5.30 (d, J = 17.2 Hz, 1H), 5.28 (d, J = 10.4 Hz, 1H), 3.81(s, 2×OCH_3, 6H).

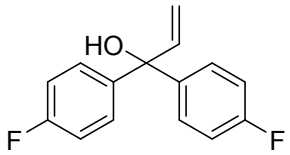
2) **1b**, **1c**, **1e**, **1f**, and **1s** were prepared from vinylmagnesium chloride and the corresponding benzophenone according to ref. *Org. Biomol. Chem.*, 2013, **11**, 2498.[4]



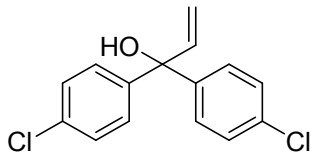
1,1-Diphenylprop-2-en-1-ol (1b)[4]: Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.36 (d, J = 7.6 Hz, 4H), 7.30 (t, J = 7.6 Hz, 4H), 7.24 (t, J = 7.6 Hz, 2H), 6.48 (dd, J = 16.8, 10.8 Hz, 1H), 5.30 (d, J = 16.8 Hz, 1H), 5.29 (d, J = 10.8 Hz, 1H), 2.34 (s, 1H, -O*H*).



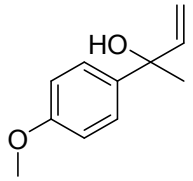
1,1-Di*p*-tolylprop-2-en-1-ol (1c)[1]: Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.23 (d, J = 7.8 Hz, 4H), 7.09 (d, J = 7.8 Hz, 4H), 6.44 (dd, J = 17.2, 10.6 Hz, 1H), 5.27 (d, J = 17.2 Hz, 1H), 5.24 (d, J = 10.6 Hz, 1H), 2.30 (s, 6H, 2×CH_3).



1,1-Bis(4-fluorophenyl)prop-2-en-1-ol (1e)[5]: Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.35 (dd, J = 9.0 Hz, 4H), 7.02 (t, J = 9.0 Hz, 4H), 6.46 (dd, J = 17.2, 10.6 Hz, 1H), 5.34 (d, J = 10.6 Hz, 1H), 5.29 (d, J = 17.2 Hz, 1H), 2.36 (br s, 1H, -O*H*).



1,1-Bis(4-chlorophenyl)prop-2-en-1-ol (1f)[1]: Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.27 (s, 8H), 6.40 (dd, J = 17.2, 10.4 Hz, 1H), 5.32 (d, J = 10.4 Hz, 1H), 5.26 (d, J = 17.2 Hz, 1H), 2.34 (s, 1H, -O*H*).

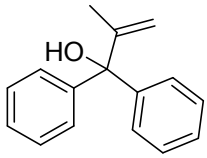


2-(4-Methoxyphenyl)but-3-en-2-ol (1s)[6]: Pale yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.40 (d, J = 9.0 Hz, 2H), 6.88 (d, 2H, J = 9.0 Hz), 6.16 (dd, J = 17.2, 10.8

Hz, 1H), 5.29 (dd, J = 17.2, 0.8 Hz, 1H), 5.13 (dd, J = 10.8, 0.8 Hz, 1H), 3.79 (s, OCH_3, 3H), 1.64 (s, CH_3, 3H).

3) Synthesis of **1i**

1i was prepared from isopropenylmagnesium bromide and benzophenone according to ref. *Org. Lett.,* **2011**, *13*, 3648.[7]

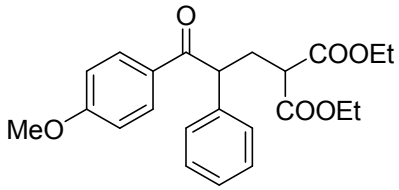


2-Methyl-1,1-diphenylprop-2-en-1-ol (1i)[7]: Pale yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ_H 7.41 (d, J = 6.8 Hz, 4H), 7.36 (t, J = 6.8 Hz, 4H), 7.31 (t, J = 6.8 Hz, 2H), 5.18 (s, 1H), 4.78 (s, 1H), 2.54 (s, 1H, -O*H*), 1.84 (s, CH_3, 3H).

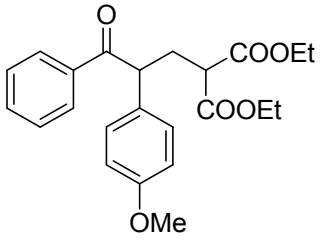
3. General Procedure for Photocatalytic Arylalkylation Reaction

A 10 mL round bottom flask was equipped with magnetic stir bar and was charged with 1-(4-methoxyphenyl)-1-phenylprop-2-en-1-ol **1a** (24.0 mg, 0.1 mmol), **2** (47.4 mg, 0.2 mmol), 2,6-dimethyl pyridine (21.4 mg, 0.2 mmol), DMSO (1 mL) and *fac*-Ir(ppy)$_3$ (3.3 mg, 0.005 mmol). The round bottom flask was evacuated and backfilled with N_2 three times under -78℃. The mixture was irradiated with blue LEDs for 143 h (monitored by TLC). After the reaction was completed, the reaction mixture was quenched with water (3 mL) and was extracted with EtOAc (5 mL × 4). The organic layer was combined, dried ($MgSO_4$), filtered, and concentrated in *vacuo*. The resulting residue was purified by PTLC (petroleum ether/EtOAc) to afford the desired product. The isomer ratio was detected by ^{1}H NMR analysis of the crude product.

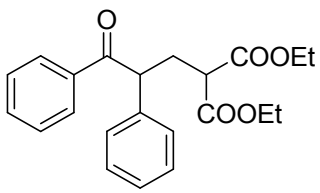
4. Characterization of products



Diethyl 2-(3-(4-methoxyphenyl)-3-oxo-2-phenylpropyl)malonate (3a1): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.86 (d, J = 8.8 Hz, 2H), 7.24-7.19 (m, 4H), 7.16-7.11 (m, 1H), 6.77 (d, J = 8.8 Hz, 2H), 4.59 (t, J = 7.6 Hz, 1H), 4.14 (q, J = 7.2 Hz, 2H), 4.08-4.00 (m, 2H), 3.73 (s, OCH_3, 3H), 3.22 (t, J = 7.6 Hz, 1H), 2.67-2.60 (m, 1H), 2.38-2.31 (m, 1H), 1.19 (t, J = 7.2 Hz, 3H), 1.11 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 197.1, 169.3, 169.2, 163.4, 138.6, 131.0, 129.3, 129.1, 128.3, 127.3, 113.7, 61.4, 55.4, 50.4, 49.7, 32.4, 14.1, 13.9; GC-MS (EI): 398.2, 135.0, 107.0, 92.0, 77.0; HRMS(ESI): $[M + H]^+$ calcd for $C_{23}H_{27}O_6^+$: 399.1808, found: 399.1808.

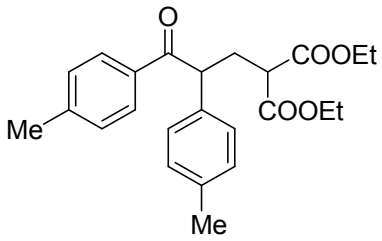


Diethyl 2-(2-(4-methoxyphenyl)-3-oxo-3-phenylpropyl)malonate (3a2): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.93 (d, J = 7.6 Hz, 2H), 7.47 (t, J = 7.6 Hz, 1H), 7.37 (t, J = 7.6 Hz, 2H), 7.19 (d, J = 8.4 Hz, 2H), 6.82 (d, J = 8.4 Hz, 2H), 4.66 (t, J = 7.2 Hz, 1H), 4.22 (q, J = 7.2 Hz, 2H), 4.16-4.08 (m, 2H), 3.75 (s, OCH_3, 3H), 3.28 (t, J = 7.2 Hz, 1H), 2.71-2.64 (m, 1H), 2.44-2.37 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.18 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 198.8, 169.4, 169.2, 158.9, 136.3, 132.9, 130.0, 129.4, 128.7, 128.5, 114.5, 61.4, 55.2, 49.8, 49.6, 32.3, 14.1, 13.9; GC-MS (EI): 398.2, 293.1, 219.1, 145.0, 105.1, 77.0; HRMS(ESI): $[M + H]^+$ calcd for $C_{23}H_{27}O_6^+$: 399.1808, found: 399.1806.

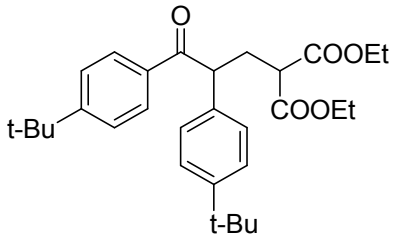


Diethyl 2-(3-oxo-2,3-diphenylpropyl)malonate (3b)[8]: Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.94 (dd, J = 7.2, 1.6 Hz, 2H), 7.47 (t, J = 7.2 Hz, 1H), 7.37 (t , J =

7.2 Hz, 2H), 7.30-7.28 (m, 4H), 7.23-7.19 (m, 1H), 4.72 (t, *J* = 7.2 Hz, 1H), 4.22 (q, *J* = 7.2 Hz, 2H), 4.15-4.07 (m, 2H), 3.30 (t, *J* = 7.2 Hz, 1H), 2.76-2.69 (m, 1H), 2.47-2.40 (m, 1H), 1.27 (t, *J* = 7.2 Hz, 3H), 1.18 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 198.6, 169.3, 169.1, 138.2, 136.3, 132.9, 129.1, 128.7, 128.5, 128.3,127.4, 61.4, 50.7, 32.3, 14.0, 13.9; HRMS(ESI): $[M + H]^+$ calcd for $C_{22}H_{24}O_5^+$: 369.1702, found: 369.1697.

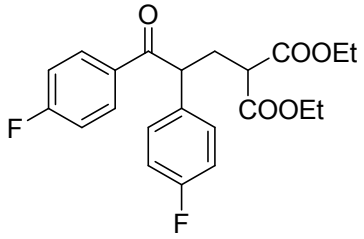


Diethyl 2-(3-oxo-2,3-dip-tolylpropyl)malonate (3c): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.83 (d, *J* = 8.0 Hz, 2H), 7.16 (d, *J* = 8.0 Hz, 2H), 7.15 (d, *J* = 8.0 Hz, 2H), 7.09 (d, *J* = 8.0 Hz, 2H), 4.64 (t, *J* = 7.2 Hz, 1H), 4.21 (q, *J* = 7.2 Hz, 2H), 4.15-4.07 (m, 2H), 3.28 (t, *J* = 7.6 Hz, 1H), 2.72-2.64 (m, 1H), 2.44-2.37 (m, 1H), 2.34 (s, 3H), 2.27 (s, 3H), 1.27 (t, *J* = 7.2 Hz, 3H), 1.18 (t, *J* = 7.2Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 198.3, 169.4, 169.2, 143.7, 137.1, 135.3, 133.9, 129.8, 129.2, 128.9, 128.2, 61.4, 50.2, 49.7, 32.3, 21.6, 21.0, 14.1, 13.9; GC-MS (EI): 396.2, 305.1, 277.1, 185.0, 119.0, 91.0; HRMS(ESI): $[M + Na]^+$ calcd for $C_{24}H_{28}O_5Na^+$: 419.1834, found: 419.1831.

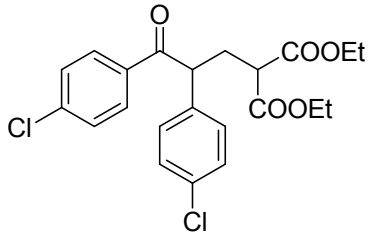


Diethyl 2-(2,3-bis(4-*tert*-butylphenyl)-3-oxopropyl)malonate (3d): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.91 (d, *J* = 8.4 Hz, 2H), 7.40 (d, *J* = 8.4 Hz, 2H), 7.30 (d, *J* = 8.4 Hz, 2H), 7.21 (d, *J* = 8.4 Hz, 2H), 4.67 (t, *J* = 7.2 Hz, 1H), 4.20 (q, *J* = 7.2 Hz, 2H), 4.15-4.06 (m, 2H), 3.29 (t, *J* = 7.2 Hz, 1H), 2.72-2.65 (m, 1H), 2.45-2.38 (m, 1H), 1.29-1.25 (m, 21H), 1.17 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 198.3, 169.4, 169.2, 156.6, 150.2, 135.1, 133.8, 128.7, 127.9, 126.0, 125.5, 61.4, 50.0,

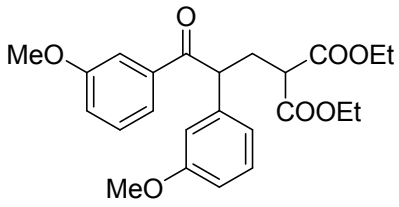
49.7, 35.0, 34.4, 32.5, 31.2, 31.0, 14.1, 13.9; GC-MS (EI): 480.3, 319.2, 161.1, 133.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{30}H_{40}O_5Na^+$: 503.2773, found: 503.2782.



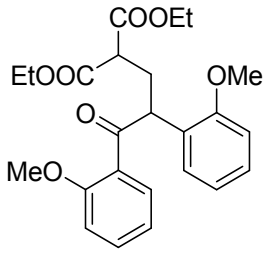
Diethyl 2-(2,3-bis(4-fluorophenyl)-3-oxopropyl)malonate (3e): Colorless oil. ^1H NMR (400 MHz, $CDCl_3$) δ_H 7.96 (d, J = 8.8 Hz, 1H), 7.95 (d, J = 8.8 Hz, 1H), 7.25 (d, J = 8.8 Hz, 1H), 7.24 (d, J = 8.8 Hz, 1H), 7.06 (t, J = 8.8 Hz, 2H), 7.00 (t, J = 8.8 Hz, 2H), 4.69 (t, J = 7.2 Hz, 1H), 4.26-4.18 (m, 2H), 4.16-4.08 (m, 2H), 3.27 (t, 1H, J = 7.2 Hz), 2.73-2.66 (m, 1H), 2.42-2.34 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.19 (t, J = 7.2 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ_c 197.0, 169.2, 169.1, 165.6 (d, J = 254.0 Hz), 162.1 (d, J = 245.4 Hz), 133.7 (d, J = 3.2 Hz), 132.5 (d, J = 3.0 Hz), 131.4 (d, J = 8.7 Hz), 129.9 (d, J = 7.5 Hz), 116.2 (d, J = 21.3 Hz), 115.7 (dd, J = 21.9, 3.3 Hz), 61.5, 49.8, 49.4, 32.3, 14.1, 13.9; GC-MS (EI): 404.2, 281.1, 123.1, 95.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{22}H_{22}F_2O_5Na^+$: 427.1333, found: 427.1327.



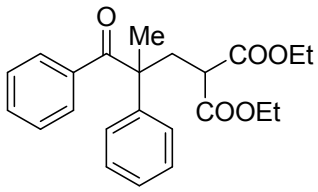
Diethyl 2-(2,3-bis(4-chlorophenyl)-3-oxopropyl)malonate (3f): Colorless oil. ^1H NMR (400 MHz, $CDCl_3$) δ_H 7.85 (d, J = 8.4 Hz, 2H), 7.36 (d, J = 8.4 Hz, 2H), 7.28 (d, J = 8.4 Hz, 2H), 7.20 (d, J = 8.4 Hz, 2H), 4.68 (t, J = 7.2 Hz, 1H), 4.26-4.18 (m, 2H), 4.17-4.08 (m, 2H), 3.26 (t, J = 7.2 Hz, 1H), 2.73-2.66 (m, 1H), 2.41-2.34 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.20 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 197.1, 169.1, 169.0, 139.7, 136.3, 134.4, 133.6, 133.0, 129.6, 129.4, 128.9, 61.5, 50.0, 49.4, 32.1, 14.0, 13.9; GC-MS (EI): 436.1, 297.0, 139.0, 111.0; HRMS(ESI): $[M + H]^+$ calcd for $C_{22}H_{23}Cl_2O_5^+$: 437.0923, found: 437.0923.



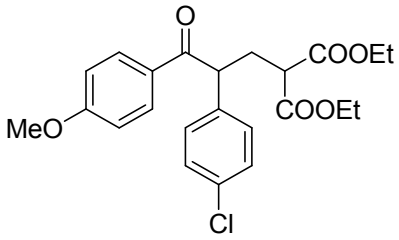
Diethyl 2-(2,3-bis(3-methoxyphenyl)-3-oxopropyl)malonate (3g): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.52 (d, J = 8.0 Hz, 1H), 7.48 (t, J = 2.0 Hz, 1H), 7.27 (t, J = 8.0 Hz, 1H), 7.21 (t, J = 8.0 Hz, 1H), 7.02 (dd, J = 8.0, 2.0 Hz, 1H), 6.87 (d, J = 8.0 Hz, 1H), 6.81 (t, J = 2.0 Hz, 1H), 6.76 (dd, J = 8.0, 2.0 Hz, 1H), 4.66 (t, J = 7.2 Hz, 1H), 4.22 (q, J = 7.2 Hz, 2H), 4.17-4.09 (m, 2H), 3.80 (s, OCH_3, 3H), 3.76 (s, OCH_3, 3H), 3.30 (t, J = 7.2 Hz, 1H), 2.74-2.66 (m, 1H), 2.47-2.39 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.19 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 198.2, 169.3, 169.1, 160.0, 159.6, 139.6, 137.6, 130.1, 129.4, 121.3, 120.7, 119.5, 113.8, 112.9, 112.8, 61.4, 55.3, 55.1, 50.9, 49.5, 32.2, 14.0, 13.9; GC-MS (EI): 428.2, 337.1, 135.1, 107.1, 77.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{24}H_{28}O_7Na^+$: 451.1733, found: 451.1733.



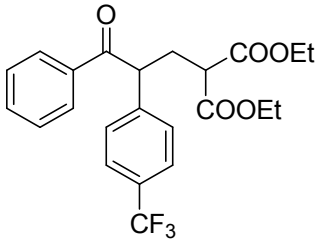
Diethyl 2-(2,3-bis(2-methoxyphenyl)-3-oxopropyl)malonate (3h): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.46 (d, J = 7.6 Hz, 1H), 7.26 (t, J = 7.6 Hz, 1H), 7.13-7.07 (m , 2H), 6.85-6.79 (m, 2H), 6.75-6.70 (m, 2H), 4.96 (t, J = 7.2 Hz, 1H), 4.27-4.15 (m, 2H), 4.09 (q, J = 7.2 Hz, 2H), 3.71 (s, OCH_3, 3H), 3.68 (s, OCH_3, 3H), 3.34 (t, J = 7.2 Hz, 1H), 2.84-2.77 (m, 1H), 2.34-2.27 (m, 1H), 1.26 (t, J = 7.2 Hz, 3H), 1.20 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 202.2, 169.5, 169.2, 157.3, 156.9, 132.3, 130.0, 129.5, 128.6, 128.2, 126.8, 120.4, 120.0, 110.9, 110.3, 61.0, 61.0, 55.0, 54.9, 49.9, 49.0, 30.1, 13.9, 13.8; GC-MS (EI): 428.2, 293.1, 135.1, 77.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{24}H_{28}O_7Na^+$: 451.1733, found: 451.1738.



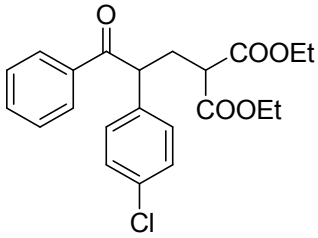
Diethyl 2-(2-methyl-3-oxo-2,3-diphenylpropyl)malonate (3i): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.42 (dd, J = 7.6, 1.6 Hz, 2H), 7.36 (t, J = 7.6 Hz, 3H), 7.32-7.27 (m, 3H), 7.21 (t, J = 7.6 Hz, 2H), 4.11-3.97 (m, 4H), 3.29 (t, J = 6.4 Hz, 1H), 2.78 (dd, J = 6.4, 2.0 Hz, 1H), 2.69 (dd, J = 6.4, 2.0 Hz, 1H), 1.63 (s, CH_3, 3H), 1.19 (t, J = 7.2 Hz, 3H), 1.18 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 202.6, 169.6, 169.6, 142.0, 136.2, 131.8, 129.6, 129.0, 127.9, 127.3, 126.7, 61.4, 61.4, 54.1, 48.6, 39.0, 22.9, 13.9, 13.9; GC-MS (EI): 382.2, 277.1, 185.0, 129.0, 105.0; HRMS(ESI): $[M + Na]^+$ calcd for $C_{23}H_{26}O_5Na^+$: 405.1678, found: 405.1679.



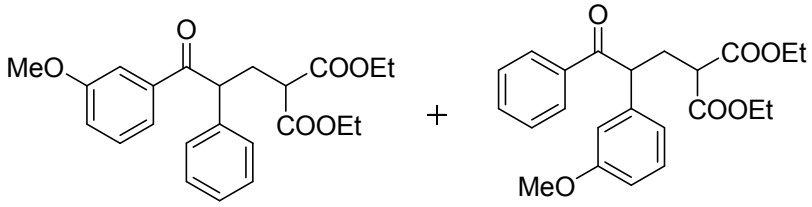
Diethyl 2-(2-(4-chlorophenyl)-3-(4-methoxyphenyl)-3-oxopropyl)malonate (3j): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.91 (d, J = 8.8 Hz, 2H), 7.27 (d, J = 8.8 Hz, 2H), 7.23 (d, J = 8.8 Hz, 2H), 6.86 (d, J = 8.8 Hz, 2H), 4.67 (t, J = 7.2 Hz, 1H), 4.24-4.18 (m, 2H), 4.16-4.08 (m, 2H), 3.82 (s, OCH_3, 3H), 3.27 (t, J = 7.2 Hz, 1H), 2.72-2.65 (m, 1H), 2.41-2.34 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.19 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 196.7, 169.2, 169.1, 163.6, 137.1, 133.3, 131.0, 129.6, 129.2, 129.1, 113.8, 61.5, 55.4, 49.6, 49.6, 32.3, 14.0, 13.9; GC-MS (EI): 432.2, 341.1, 135.1, 77.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{23}H_{25}ClO_6Na^+$: 455.1237, found: 455.1237.



Diethyl 2-(3-oxo-3-phenyl-2-(4-(trifluoromethyl)phenyl)propyl)malonate (3k): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.93 (d, J = 8.0 Hz, 2H), 7.57 (d, J = 8.0 Hz, 2H), 7.51 (t, J = 7.2 Hz, 1H), 7.39-7.44 (m, 4H), 4.84 (t, J = 7.2 Hz, 1H), 4.26-4.18 (m, 2H), 4.16-4.08 (m, 2H), 3.28 (t, J = 7.2 Hz, 1H), 2.79-2.72 (m, 1H), 2.46-2.39 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.18 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 198.0, 169.0, 168.9, 142.3, 136.0, 133.4, 129.8 (q, J = 32.5 Hz), 128.8, 128.7, 128.7, 126.1 (q, J = 3.8 Hz), 124.0 (q, J = 270.7 Hz), 61.6, 61.6, 50.4, 49.5, 32.3, 14.0, 13.9; GC-MS (EI): 436.2, 145.1, 105.1, 77.1; HRMS(ESI): [M + Na]$^+$ calcd for $C_{23}H_{23}F_3O_5Na^+$: 459.1395, found: 459.1397.

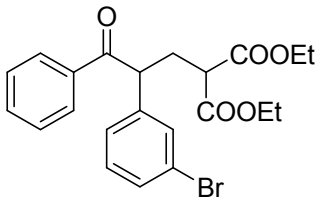


Diethyl 2-(2-(4-chlorophenyl)-3-oxo-3-phenylpropyl)malonate (3l): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.92 (d, J = 7.2 Hz, 2H), 7.50 (t, J = 7.2 Hz, 1H), 7.39 (t, J = 7.2 Hz, 2H), 7.27 (d, J = 8.4 Hz, 2H), 7.23 (d, J = 8.4 Hz, 2H), 4.72 (t, J = 7.2 Hz, 1H), 4.25-4.18 (m, 2H), 4.16-4.08 (m, 2H), 3.27 (t, J = 7.2 Hz, 1H), 2.74-2.67 (m, 1H), 2.43-2.36 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.18 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 198.3, 169.1, 169.0, 136.6, 136.0, 133.4, 133.2, 129.7, 129.3, 128.6, 128.6, 61.5, 49.9, 49.5, 32.2, 14.0, 13.9; GC-MS (EI): 402.2, 297.1, 105.1, 77.1; HRMS(ESI): [M + Na]$^+$ calcd for $C_{22}H_{23}ClO_5Na^+$: 425.1132, found: 425.1142.

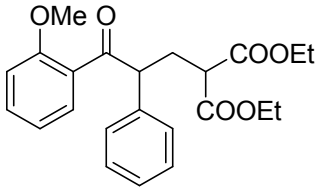


Diethyl 2-(2-(3-methoxyphenyl)-3-oxo-3-phenylpropyl)malonate or diethyl 2-(3-(3-methoxyphenyl)-3-oxo-2-phenylpropyl)malonate (4:1) (3m): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.94 (d, J = 7.6 Hz, 2H), 7.37 (t, J = 7.6 Hz, 2H), 7.30-7.25 (m, 1H), 7.21 (t, J = 8.0 Hz, 1H), 6.87 (d, J = 7.6 Hz, 1H), 6.81 (t, J = 2.0 Hz, 1H), 6.75 (dd, J = 8.0, 2.0 Hz, 1H), 4.70-4.66 (m, 1H), 4.22 (q , J = 7.2 Hz, 2H), 4.16-

4.08 (m, 2H), 3.76 (s, OCH_3, 3H), 3.30 (t, J = 7.2 Hz, 1H), 2.75-2.66 (m, 1H), 2.47-2.39 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.18 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 198.4, 169.3, 169.2, 160.0, 139.6, 136.3, 133.0, 130.1, 128.7, 128.5, 120.7, 113.8, 112.9, 61.4, 55.2, 50.7, 49.5, 32.2, 14.1, 13.9; GC-MS (EI): 398.2, 307.1, 135.1, 105.1, 77.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{23}H_{26}O_6Na^+$: 421.1627, found: 421.1636.

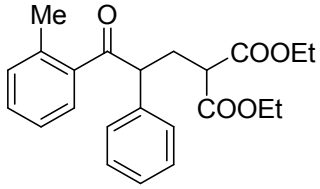


Diethyl 2-(2-(3-bromophenyl)-3-oxo-3-phenylpropyl)malonate (3n): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.93 (d, J = 7.6 Hz, 2H), 7.50 (t, J = 7.6 Hz, 1H), 7.45 (s, 1H), 7.40 (t, J = 7.6 Hz, 2H), 7.36 (d, J = 7.6 Hz, 1H), 7.23 (d, J = 7.6 Hz, 1H), 7.17 (t, J = 7.6 Hz, 1H), 4.72 (t, J = 7.2 Hz, 1H), 4.22 (q , J = 7.2 Hz, 2H), 4.16-4.08 (m, 2H), 3.29 (t, J = 7.2 Hz, 1H), 2.75-2.68 (m, 1H), 2.44-2.37 (m, 1H), 1.28 (t, J = 7.2 Hz, 3H), 1.19 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 198.0, 169.1, 168.9, 140.4, 136.1, 133.3, 131.3, 130.7, 130.6, 128.7, 128.6, 126.9, 123.1, 61.5, 61.5, 50.2, 49.5, 32.3, 14.0, 13.9; GC-MS (EI): 448.1, 446.1, 355.0, 105.1, 77.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{22}H_{23}BrO_5Na^+$: 469.0627, found: 469.0632.

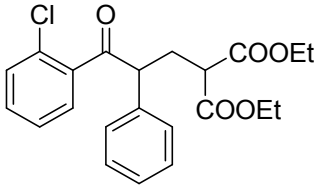


Diethyl 2-(3-(2-methoxyphenyl)-3-oxo-2-phenylpropyl)malonate (3o): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.45 (dd, J = 7.6, 1.6 Hz, 1H), 7.34 (dt, J = 7.6, 1.6 Hz, 1H), 7.26-7.15 (m, 5H), 6.90-6.84 (m, 2H), 4.76 (t, J = 7.6 Hz, 1H), 4.21 (q, J = 7.2 Hz, 2H), 4.17-4.07 (m, 2H), 3.82 (s, OCH_3, 3H), 3.31 (t, J = 7.6 Hz, 1H), 2.78-2.71 (m, 1H), 2.43-2.36 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.21 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 202.0, 169.3, 169.2, 157.7, 138.1, 133.0, 130.5, 128.7, 128.5, 128.5, 127.1, 120.6, 111.4, 61.3, 55.3, 54.9, 49.9, 32.0, 14.0, 13.9; GC-MS (EI):

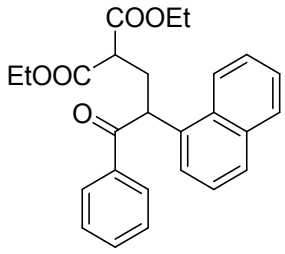
398.2, 293.1, 135.1, 77.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{23}H_{26}O_6Na^+$: 421.1627, found: 421.1636.



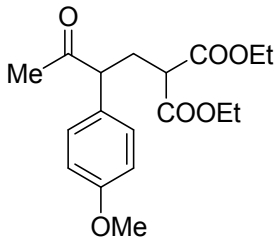
Diethyl 2-(3-oxo-2-phenyl-3-o-tolylpropyl)malonate (3p): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.54 (d, J = 7.6 Hz, 2H),7.29-7.25 (m, 3H), 7.22-7.19 (m, 3H), 7.15 (t, J = 7.6 Hz, 1H), 7.14 (t, J = 7.6 Hz, 1H), 4.55 (t, J = 7.2 Hz, 1H), 4.25-4.18 (m, 2H), 4.17-4.10 (m, 2H), 3.30 (t, J = 7.2 Hz, 1H), 2.79-2.72 (m, 1H), 2.47-2.40 (m, 1H), 2.31 (s, CH_3, 3H), 1.26 (t, J = 7.2 Hz, 3H), 1.21 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 202.6, 169.4, 169.1, 138.2, 138.2, 137.4, 131.6, 131.0, 129.0, 128.5, 128.0, 127.5, 125.4, 61.5, 53.8, 49.7, 31.7, 20.7, 14.1, 14.0; GC-MS (EI): 382.2, 291.1, 119.1, 77.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{23}H_{26}O_5Na^+$: 405.1678, found: 405.1680.



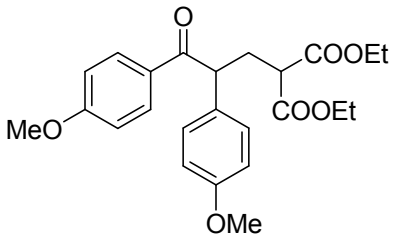
Diethyl 2-(3-(2-chlorophenyl)-3-oxo-2-phenylpropyl)malonate (3q): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.31 (dd, J = 7.6, 1.2 Hz, 1H),7.29-7.22 (m, 4H), 7.17 (dd, J = 7.6, 1.2 Hz, 2H), 7.14 (dt, J = 7.6, 1.2 Hz, 1H), 7.09 (dd, J = 7.6, 1.2 Hz, 1H), 4.56 (t, J = 7.2 Hz, 1H), 4.21 (q, J = 7.2 Hz, 2H), 4.17-4.10 (m, 2H), 3.31 (t, J = 7.2 Hz, 1H), 2.83-2.76 (m, 1H), 2.51-2.44 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.23 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 201.8, 169.2, 169.0, 139.1, 136.2, 131.2, 130.5, 130.2, 129.0, 128.9, 128.8, 127.8, 126.5, 61.4, 55.1, 49.5, 30.9, 14.0, 14.0; GC-MS (EI): 402.2, 263.1, 139.0, 77.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{22}H_{23}ClO_5Na^+$: 425.1132, found: 425.1137.



Diethyl 2-(2-(naphthalen-1-yl)-3-oxo-3-phenylpropyl)malonate (3r): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 8.39 (d, J = 8.0 Hz, 1H), 7.88 (d, J = 8.0 Hz, 1H), 7.85 (d, J = 8.0 Hz, 2H), 7.73 (d, J = 8.0 Hz, 1H), 7.66 (t, J = 7.6 Hz, 1H), 7.54 (t, J = 8.0 Hz, 1H), 7.39 (t, J = 7.6 Hz, 1H), 7.32 (t, J = 7.6 Hz, 1H), 7.25 (t, J = 7.6 Hz, 3H), 5.55 (dd, J = 9.0, 6.0 Hz, 1H), 4.23-4.11 (m, 4H), 3.50 (dd, J = 9.0, 6.0 Hz, 1H), 2.86-2.79 (m, 1H), 2.52-2.45 (m,1H), 1.22 (t, J = 7.2 Hz, 3H), 1.19 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 199.0, 169.6, 169.2, 136.4, 135.0, 134.4, 132.9, 130.9, 129.2, 128.5, 128.1, 127.0, 125.9, 125.7, 122.6, 61.4, 61.4, 49.8, 32.2, 14.0, 13.9; GC-MS (EI): 418.2, 313.1, 165.1, 105.1, 77.1; HRMS(ESI): $[M + Na]^+$ calcd for $C_{26}H_{26}O_5Na^+$: 441.1678, found: 441.1674.



Diethyl 2-(2-(4-methoxyphenyl)-3-oxobutyl)malonate (3s): Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.09 (d, J = 8.8 Hz, 2H), 6.87 (d, J = 8.8 Hz, 2H), 4.19 (q, J = 7.2 Hz, 2H), 4.13 (qd, J = 7.2, 1.2 Hz, 2H), 3.80 (s, OCH_3, 3H), 3.69 (dd, J = 8.4, 6.4 Hz, 1H), 3.17 (dd, J = 8.4, 6.4 Hz, 1H), 2.59-2.52 (m, 1H), 2.26-2.19 (m, 1H), 2.04 (s, CH_3, 3H), 1.26 (t, J = 7.2 Hz, 3H), 1.23 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 207.2, 169.3, 169.1, 159.2, 129.4, 129.4, 114.6, 61.4, 61.4, 55.7, 55.2, 49.5, 30.5, 28.9, 14.0, 14.0; GC-MS (EI): 336.2, 293.1, 219.1, 145.1, 43.1; HRMS(ESI): $[M + H]^+$ calcd for $C_{18}H_{25}O_6^+$: 337.1651, found: 337.1651.



Diethyl 2-(2,3-bis(4-methoxyphenyl)-3-oxopropyl)malonate (3t)[9]: Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ_H 7.92 (d, J = 8.8 Hz, 2H), 7.19 (d, J = 8.8 Hz, 2H), 6.85 (d, J = 8.8 Hz, 2H), 6.82 (d, J = 8.8 Hz, 2H), 4.61 (t, J = 7.2 Hz, 1H), 4.21 (q, J = 7.2 Hz, 2H), 4.16-4.08 (m, 2H), 3.80 (s, OCH_3, 3H), 3.74 (s, OCH_3, 3H), 3.29 (t, J = 7.2 Hz, 1H), 2.70-2.63 (m, 1H), 2.43-2.36 (m, 1H), 1.27 (t, J = 7.2 Hz, 3H), 1.19 (t, 3H, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ_c 197.3, 169.4, 169.2, 163.3, 158.8, 131.0, 130.5, 129.3, 129.3, 114.4, 113.6, 61.3, 55.3, 55.1, 49.6, 49.5, 32.4, 14.0, 13.9 . HRMS(ESI): $[M + H]^+$calcd for $C_{24}H_{29}O_7^+$: 429.1913, found: 429.1917.

Reference:

(1) X. W. Liu, F. Xiong, X. P. Huang, L. Xu, P. F. Li, X. X. Wu. *Angew. Chem., Int. Ed.,* 2013, **52**, 6962.
(2) H. Egami, R. Shimizu, Y. Usuiac, M. Sodeoka. *Chem. Commun.,* 2013, **49**, 7346.
(3) S. Hayashi, H. Yorimitsu, K. Oshima. *J. Am. Chem. Soc.,* 2009, **131**, 2052-2053.
(4) J. J. Zhang, C. S. Yan, Y. Peng, Z. B. Luo, X. B. Xu, Y. W. Wang. *Org. Biomol. Chem.,* 2013, **11**, 2498.
(5) C. Botteghi, M.Marchetti, S. Paganellia, F. Persi-Paoli. *Tetrahedron* 2001, **57**, 1631.
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(8) B. Giese, J. N. He, W. Mehl. *Chem. Ber.,* 1988, **121**, 2063.
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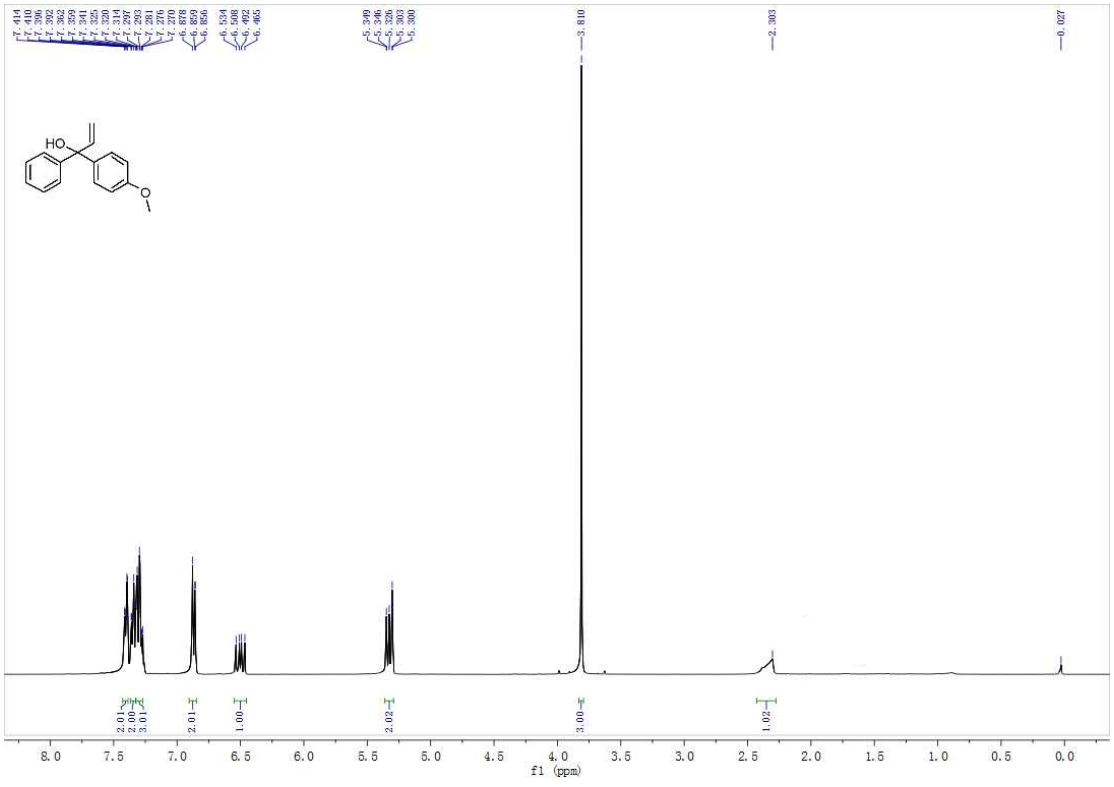
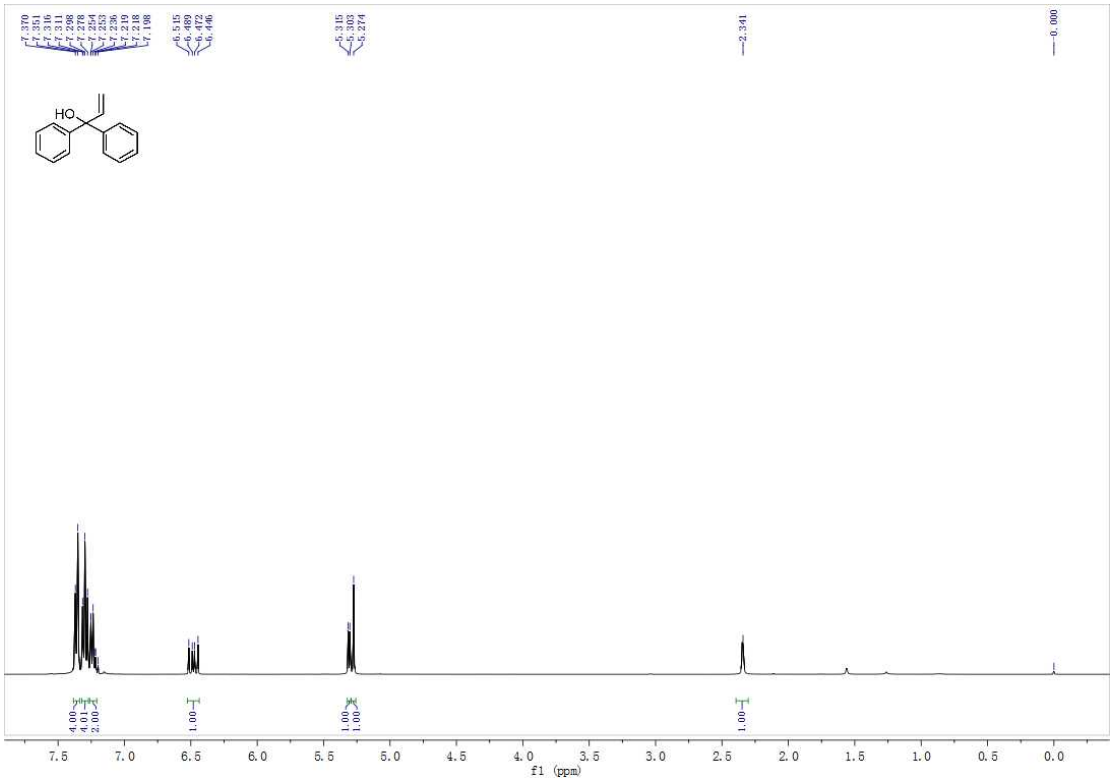
5. *NMR Spectra*

Substrates NMR spectra:

1a ^{1}H NMR



1b ^{1}H NMR



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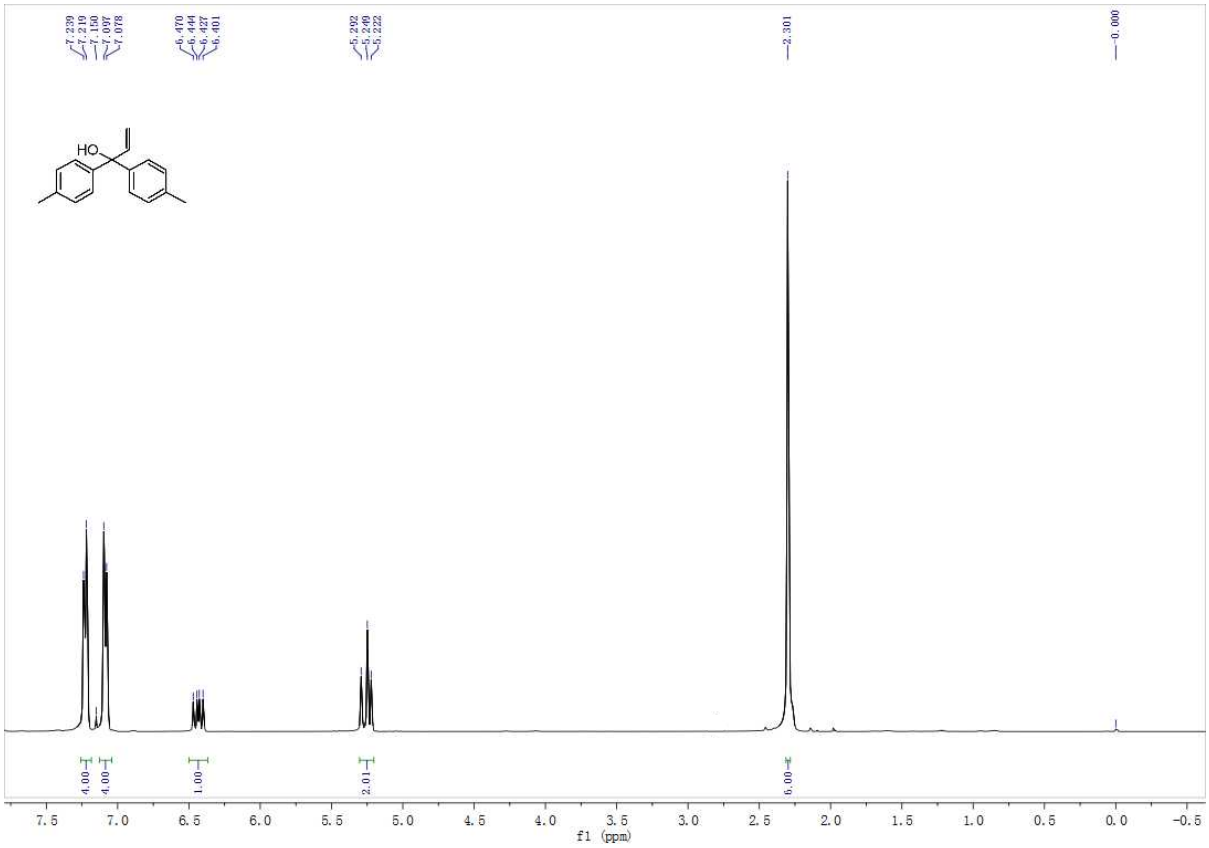

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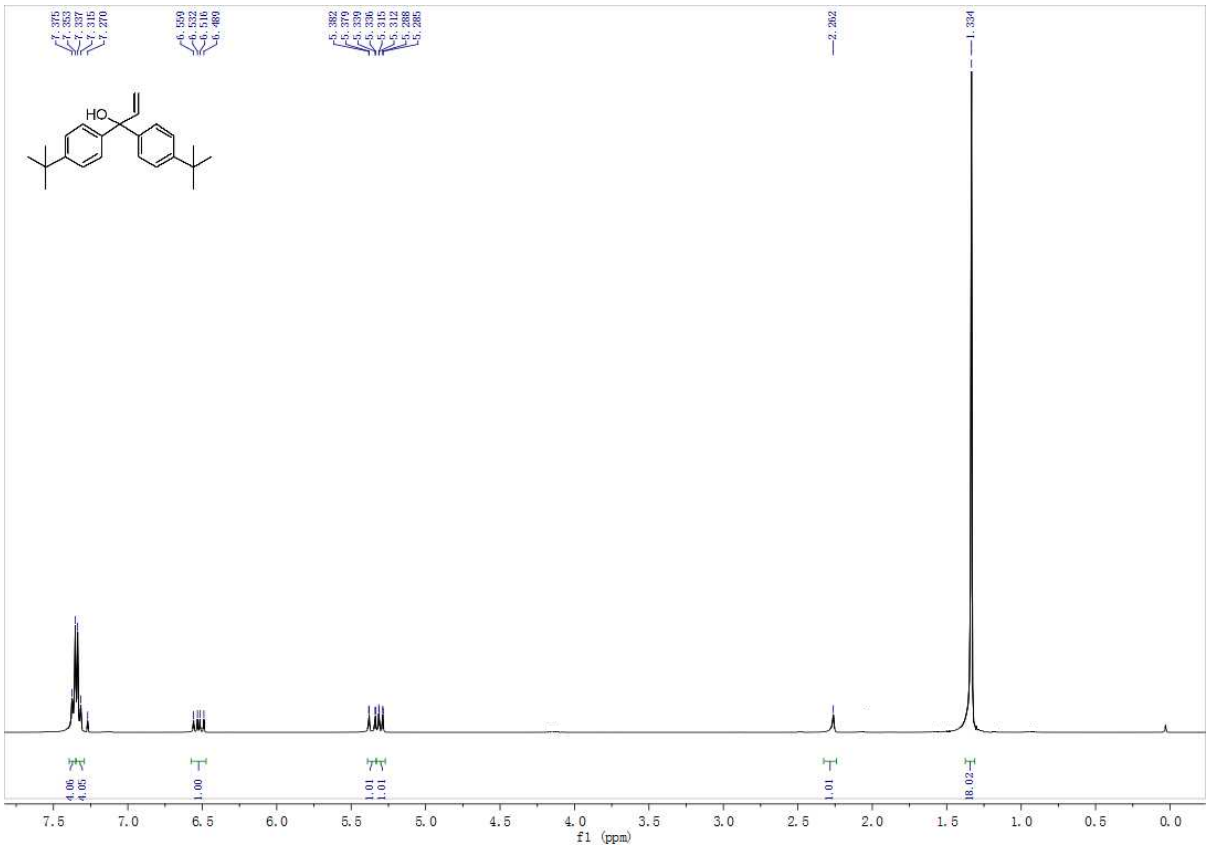
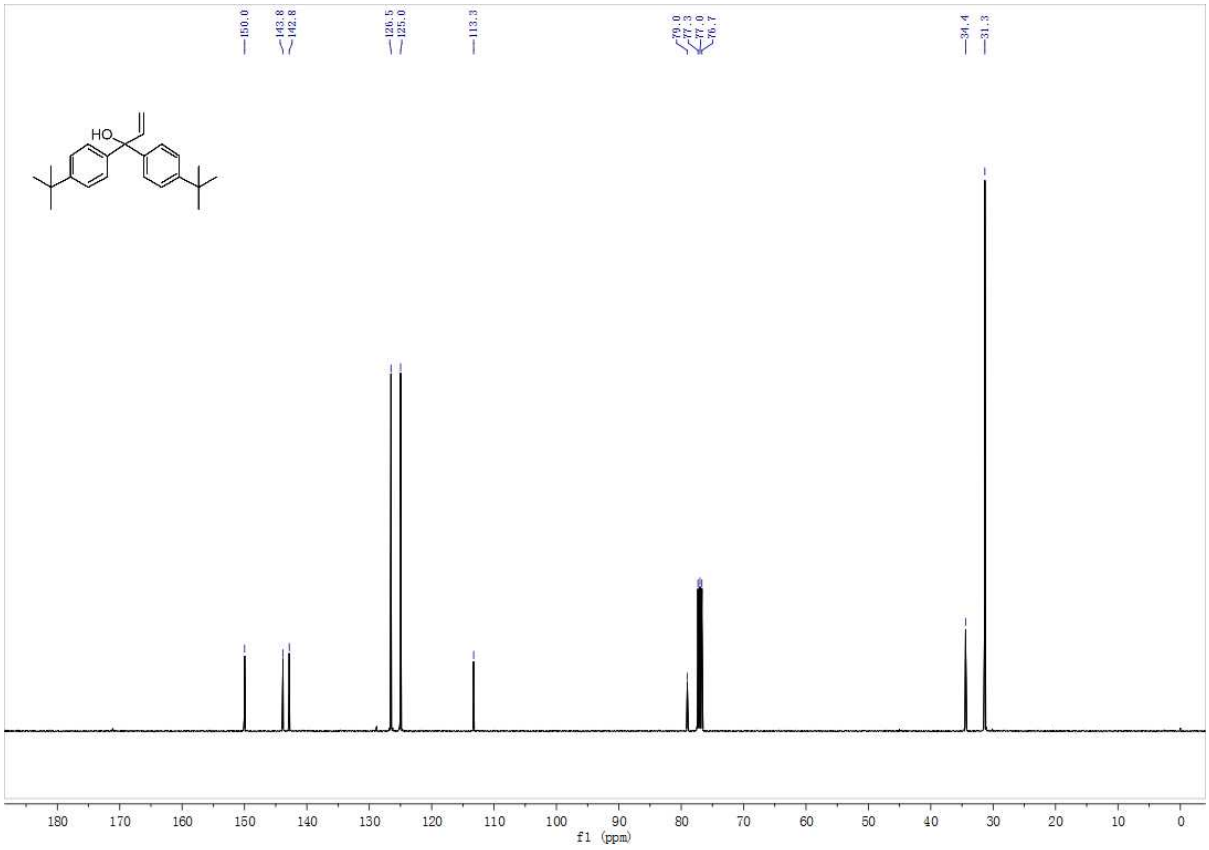
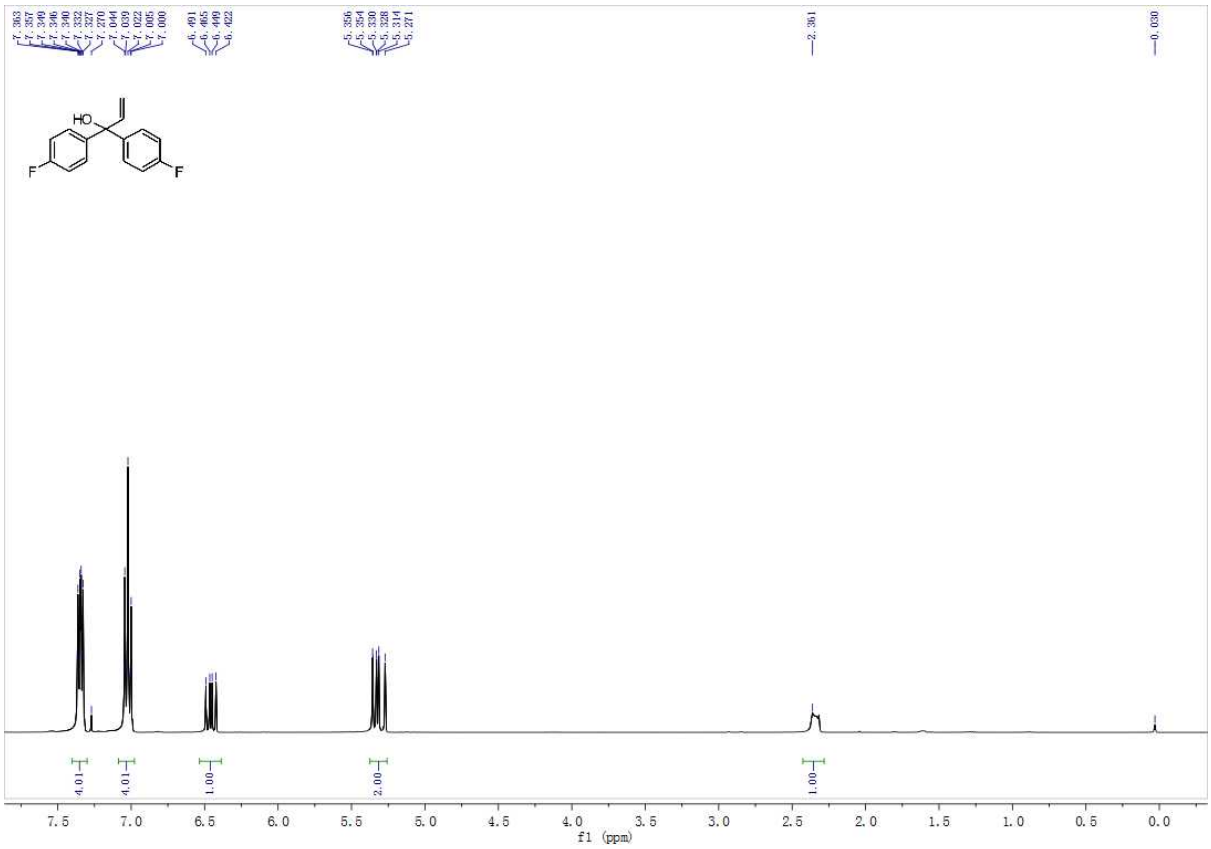


1d ^{13}C NMR



1e^{1}H NMR



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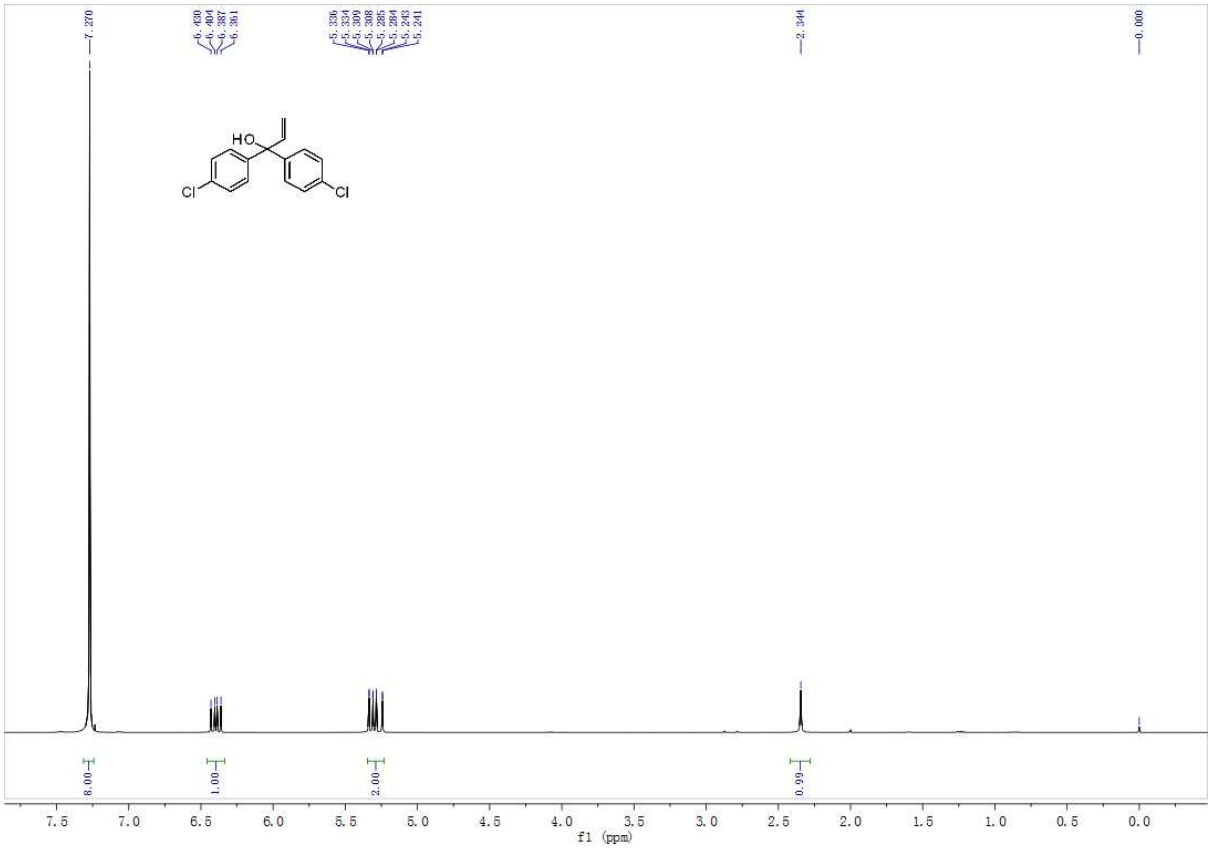

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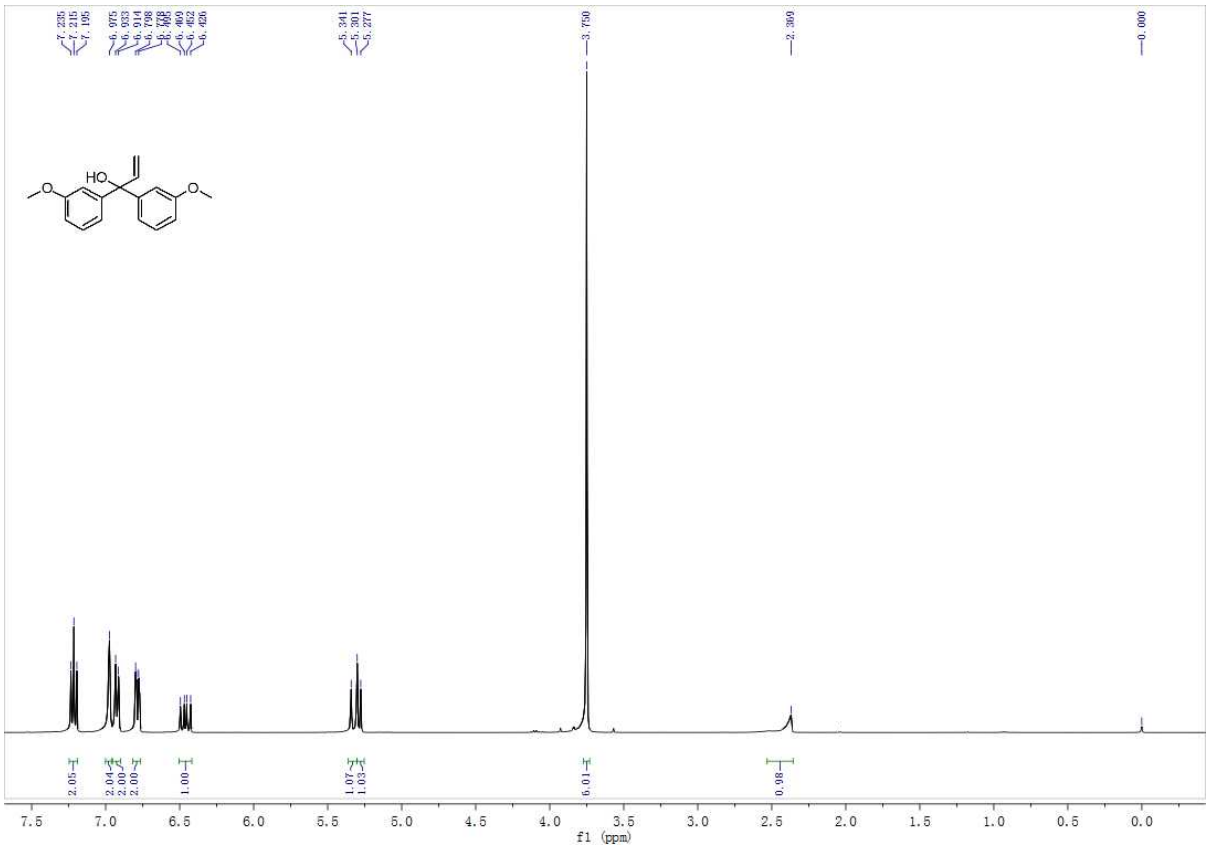

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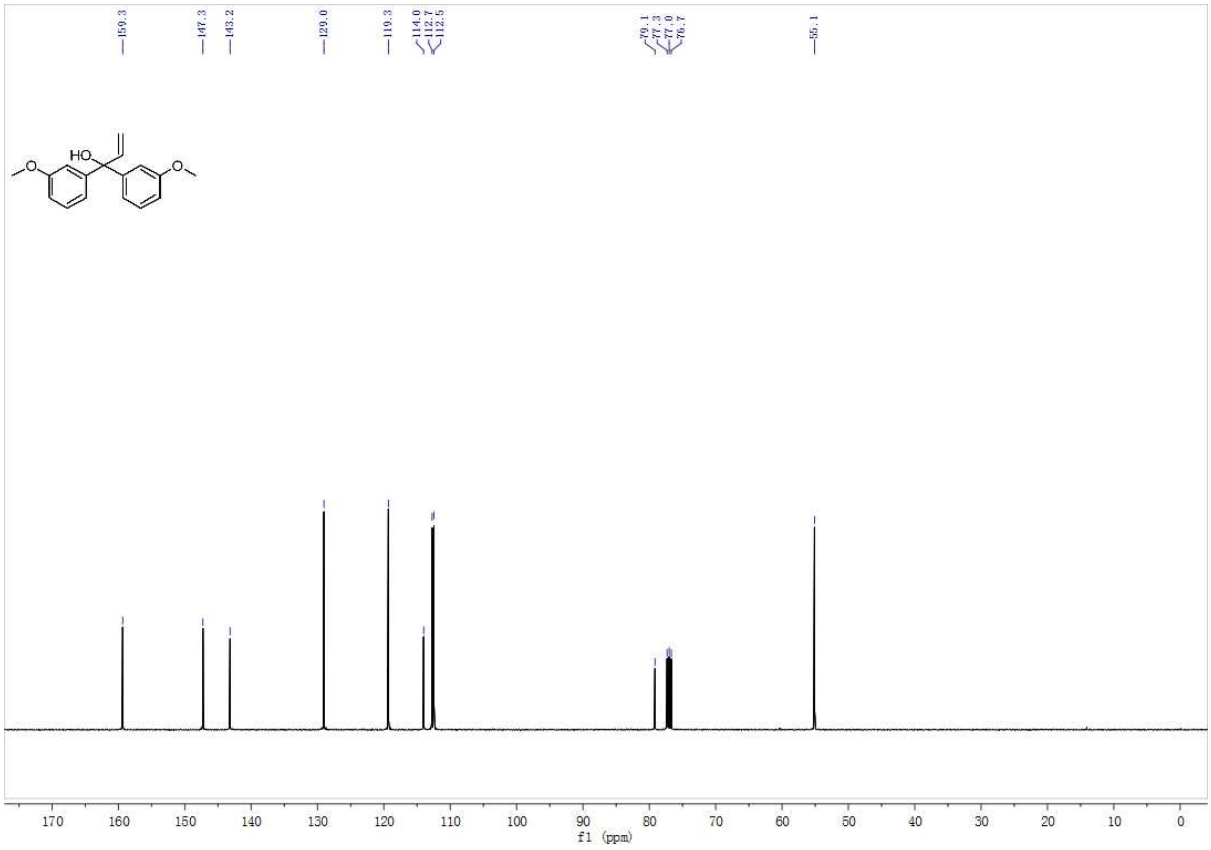
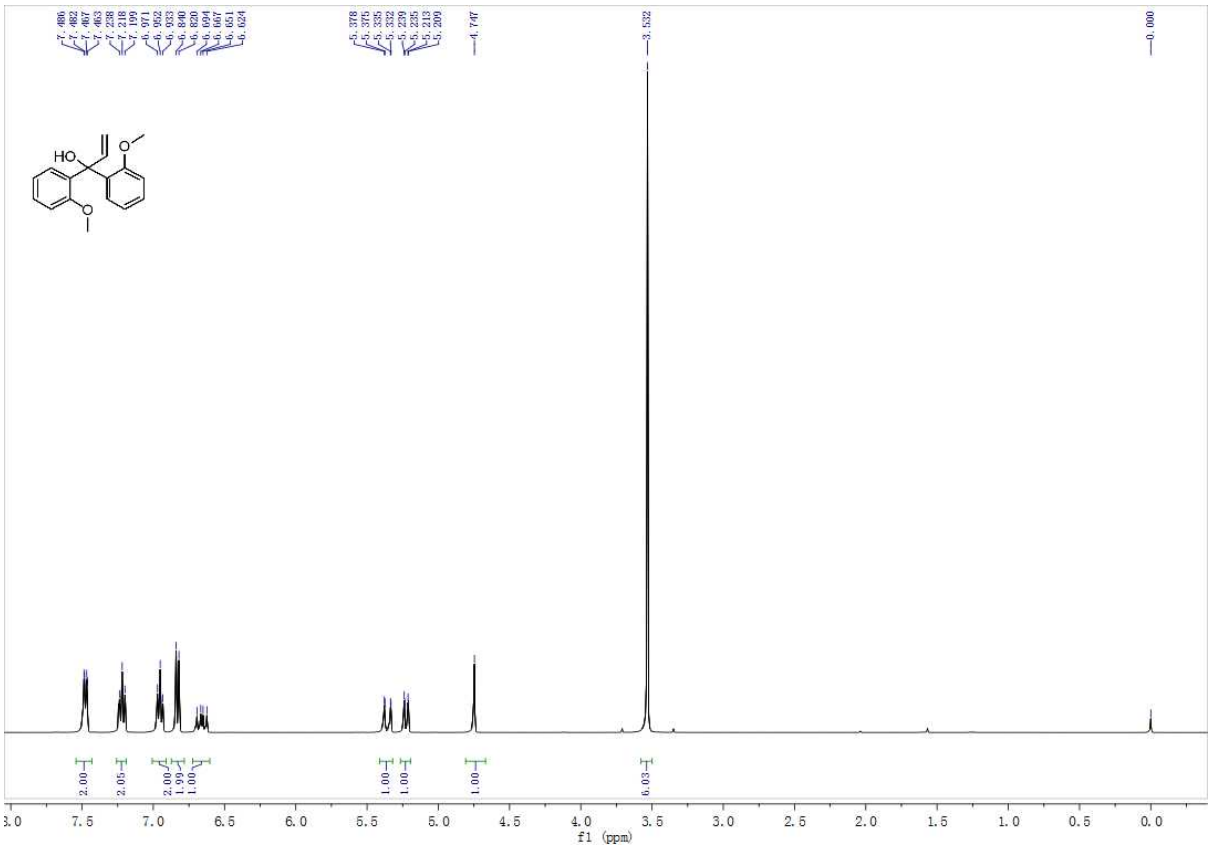


1h ^{1}H NMR



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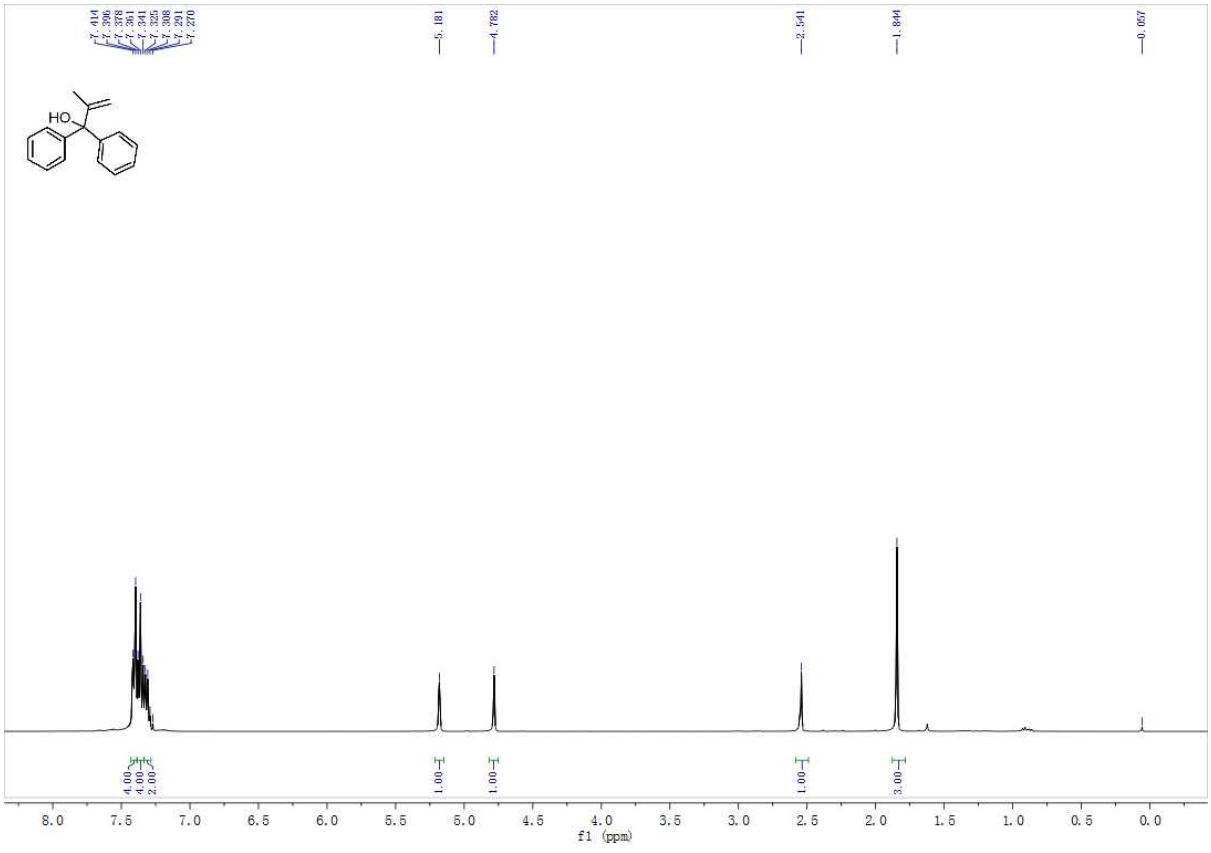

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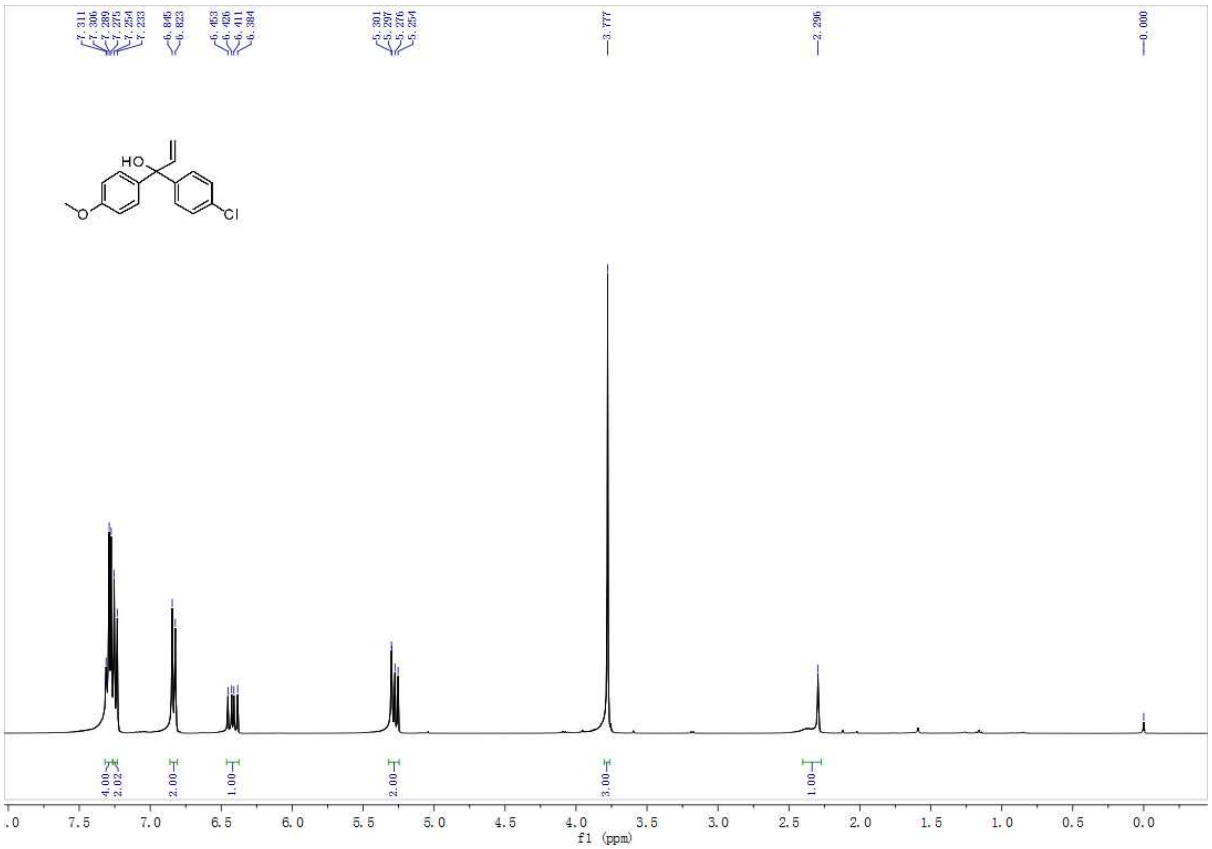
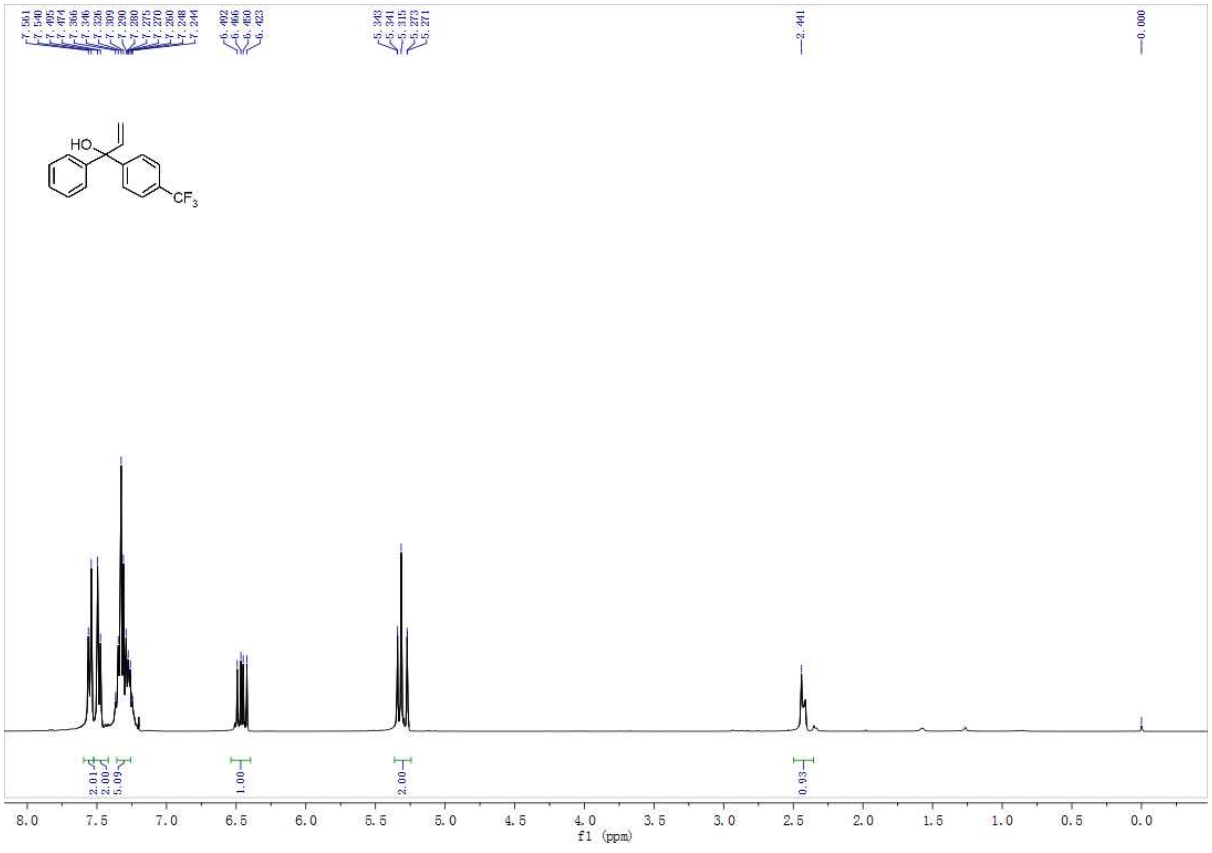


1k ^{1}H NMR



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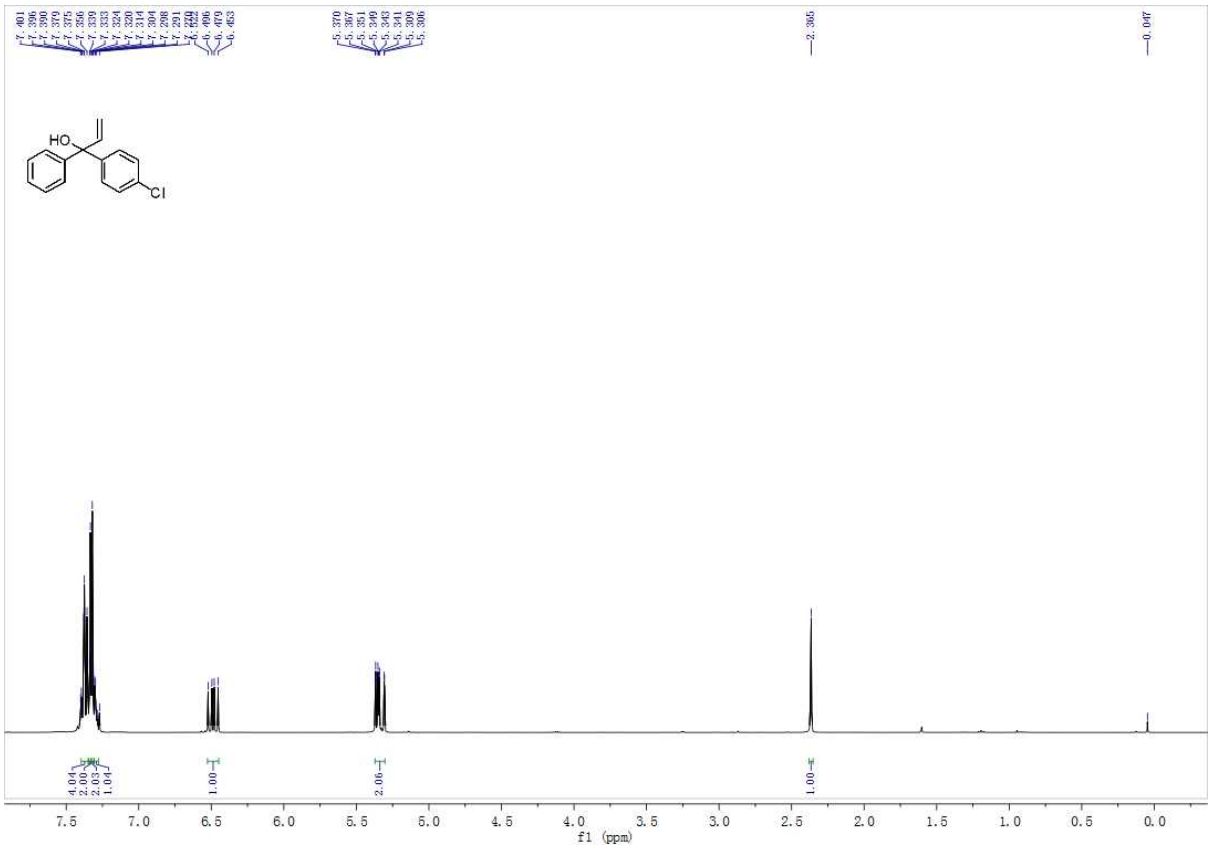

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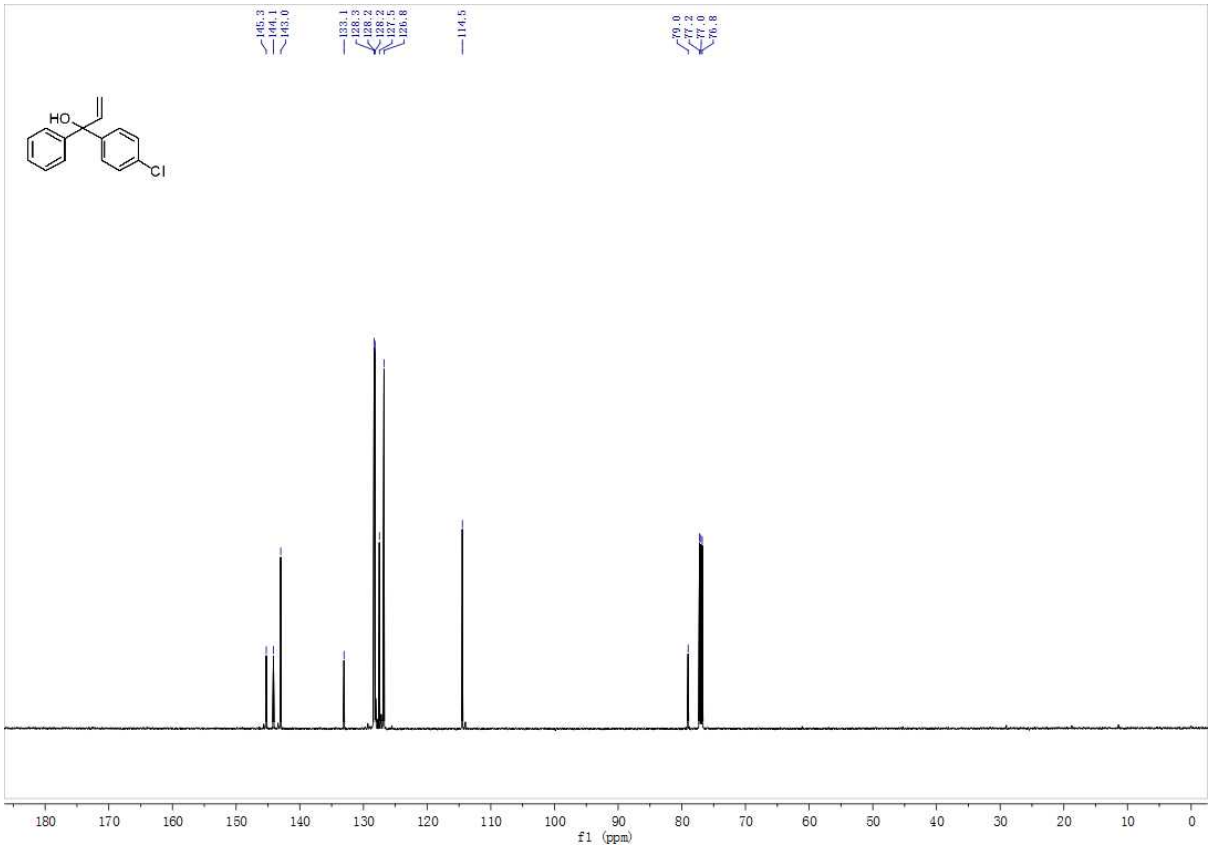
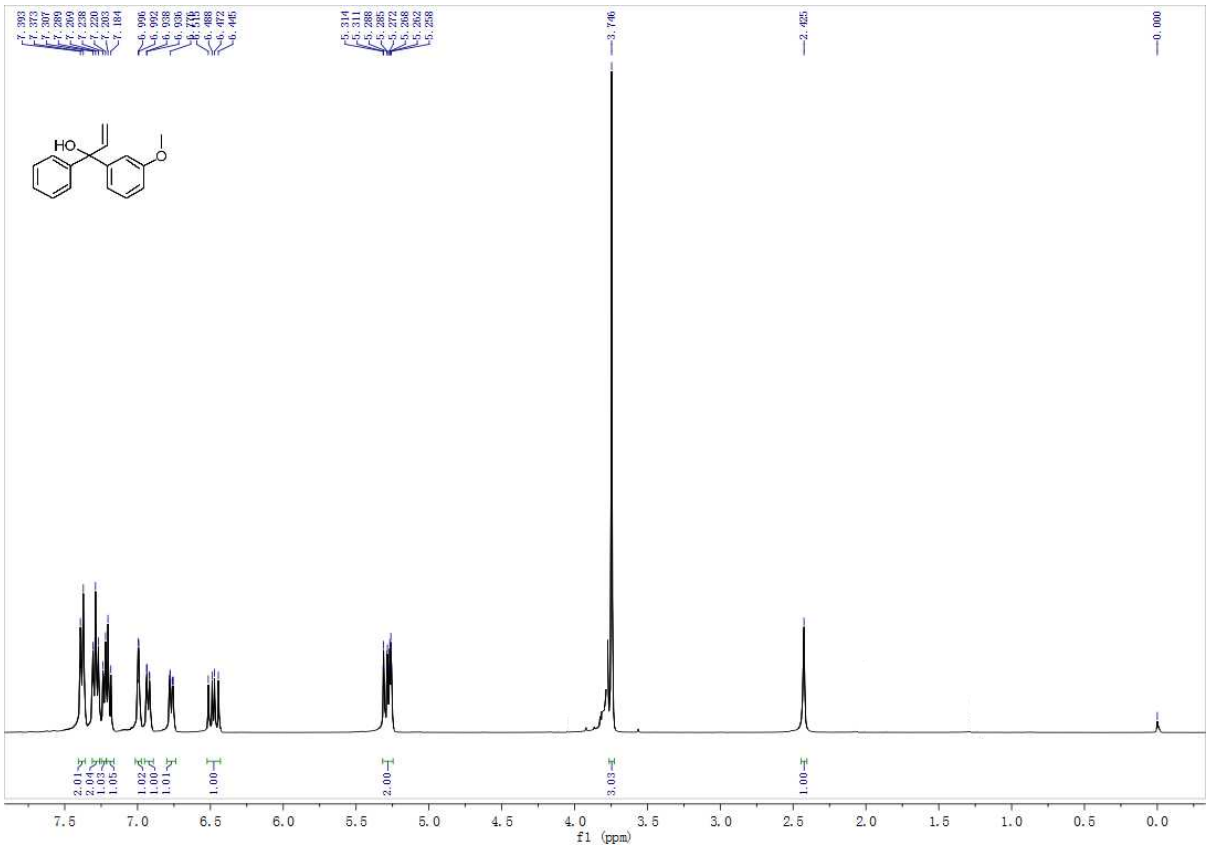
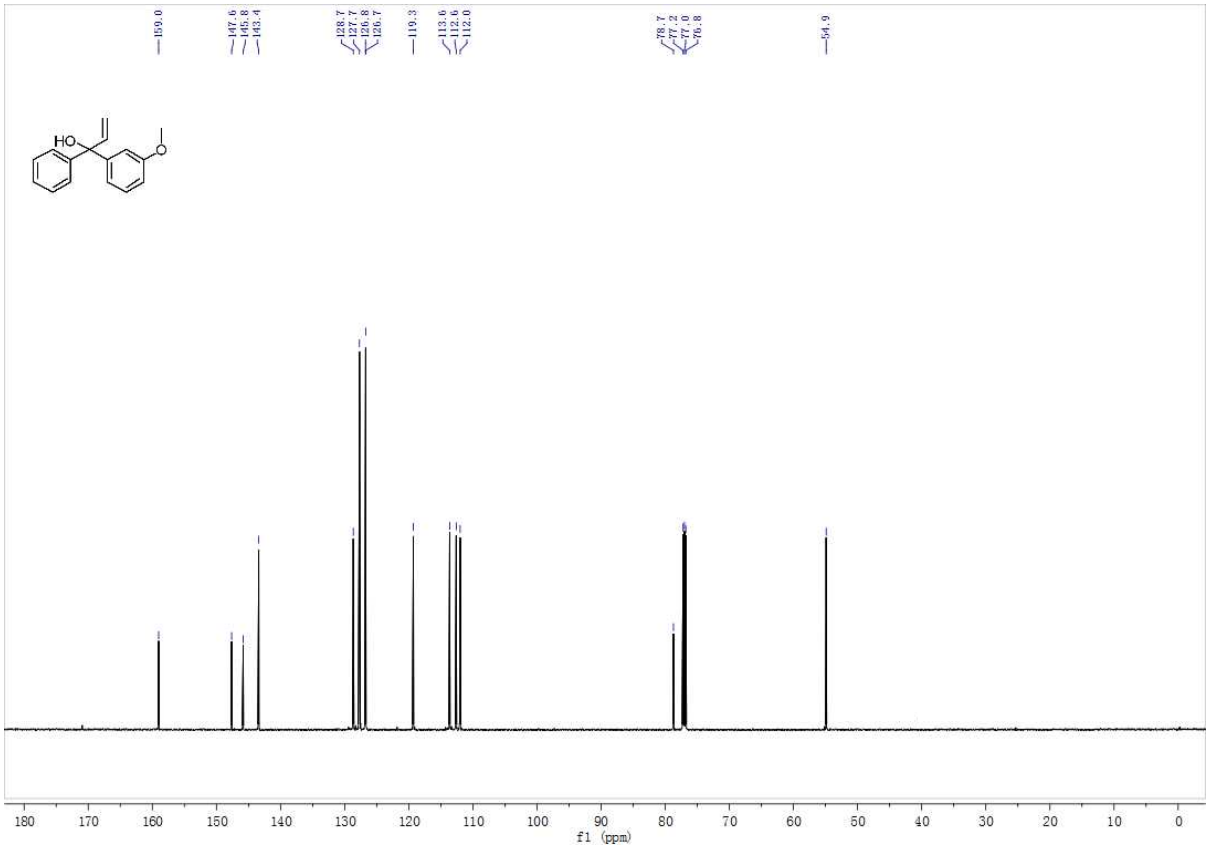


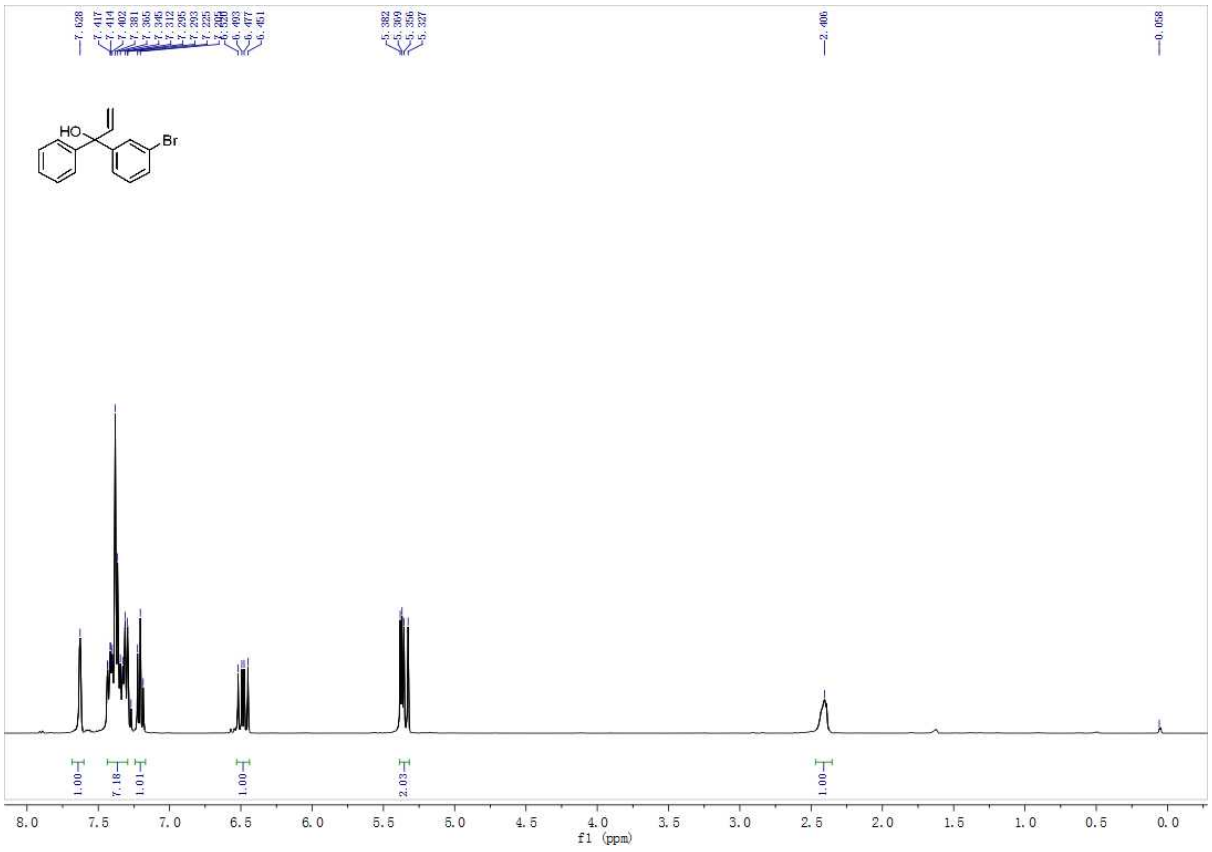
1m ^{1}H NMR



1m ^{13}C NMR



1n ^{1}H NMR



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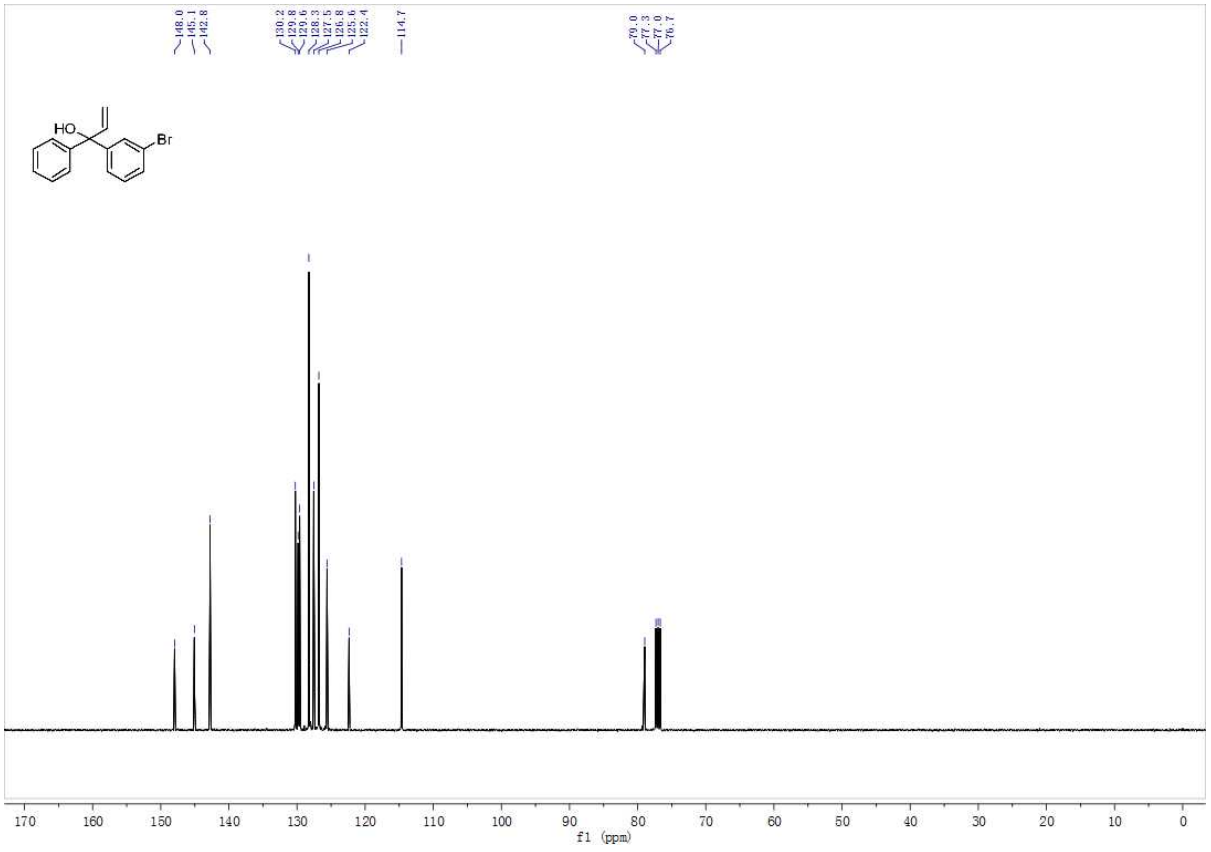
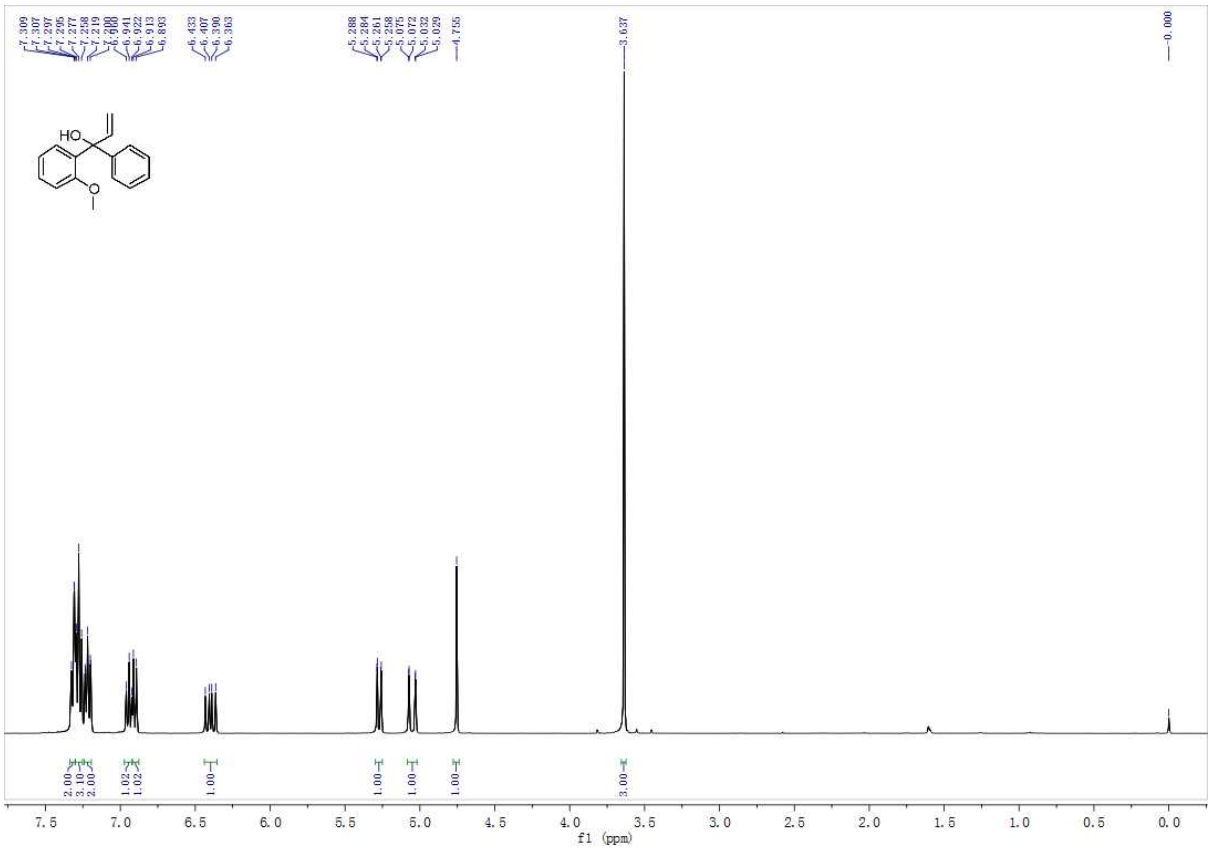
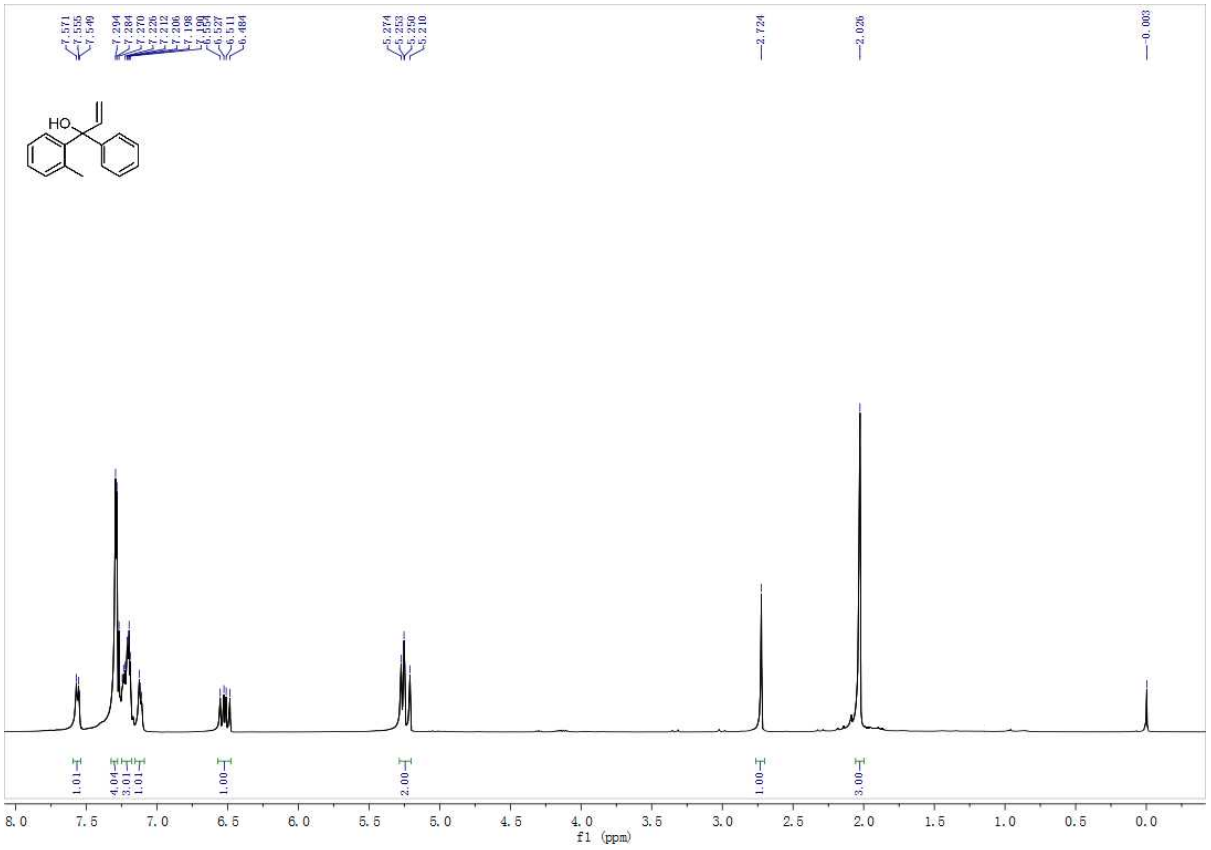


1o ^{1}H NMR



1p ^{1}H NMR



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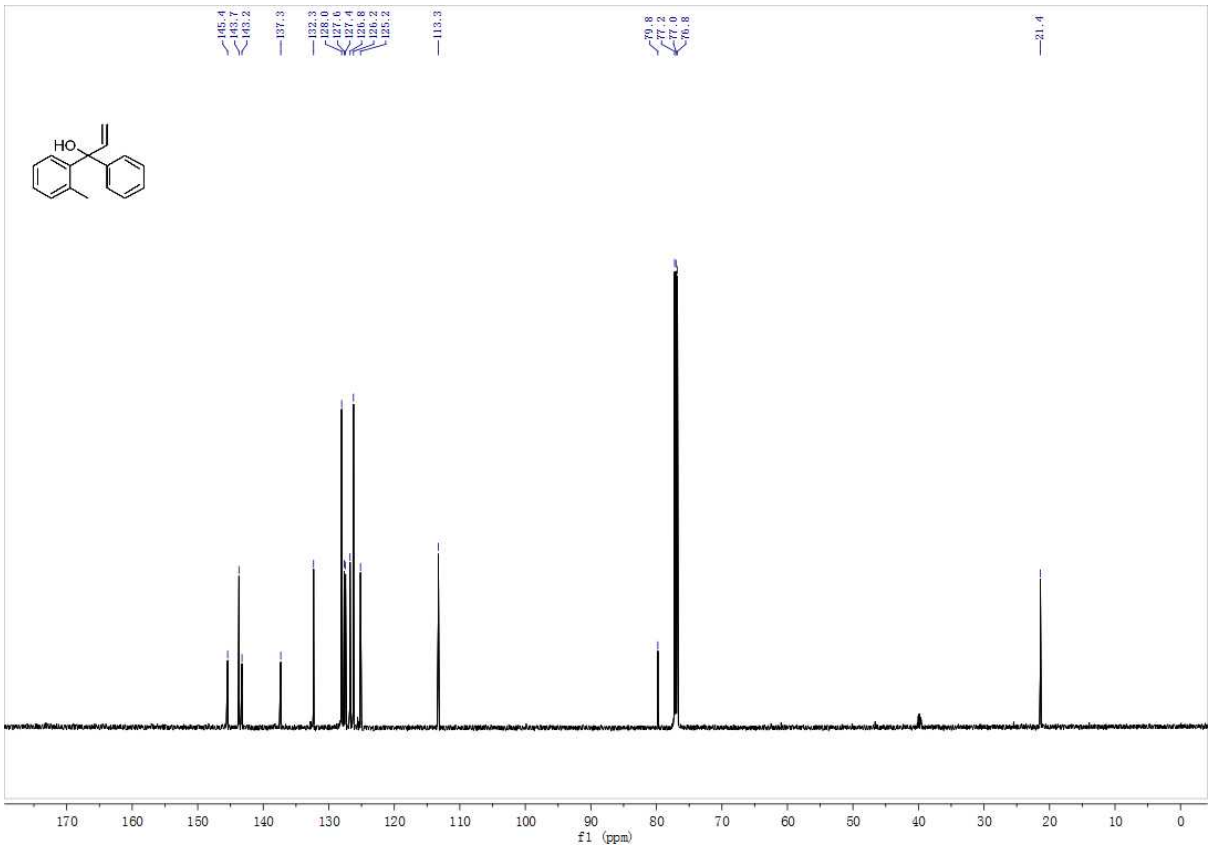
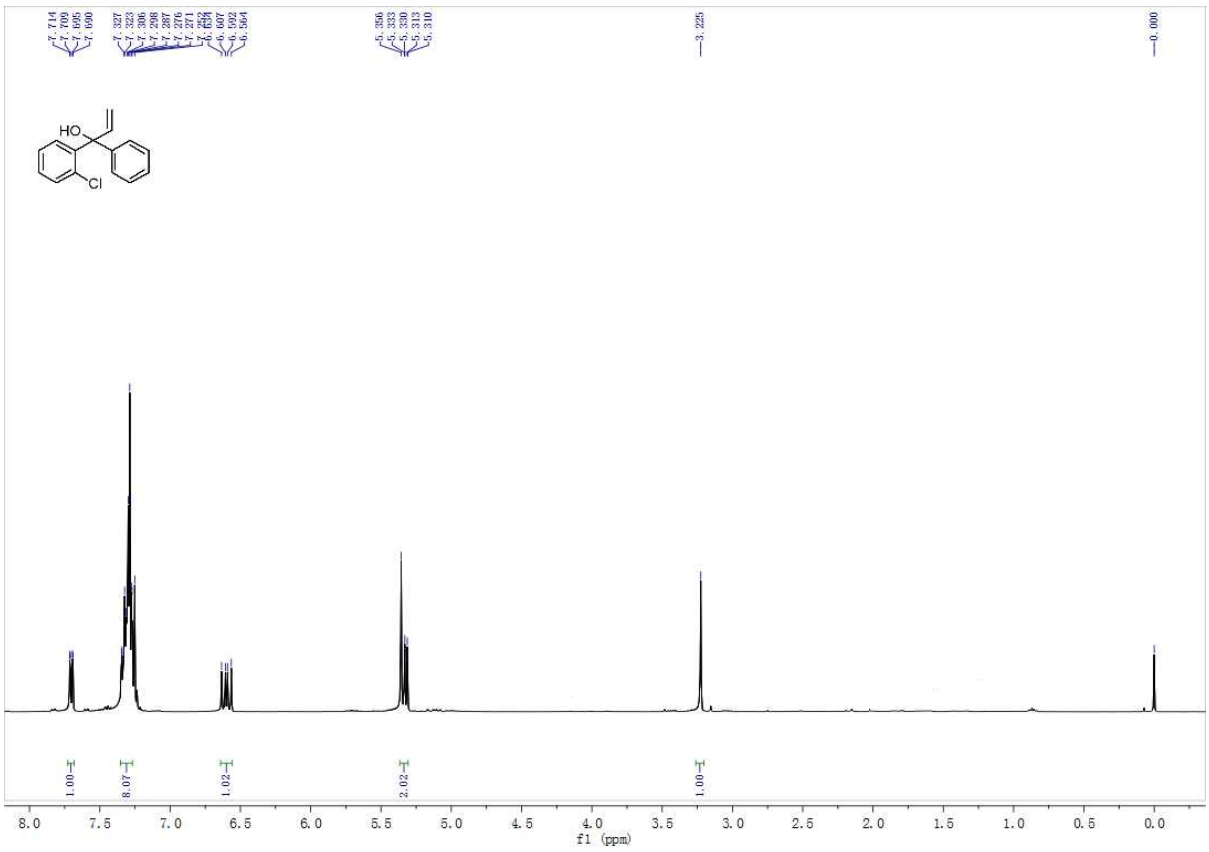
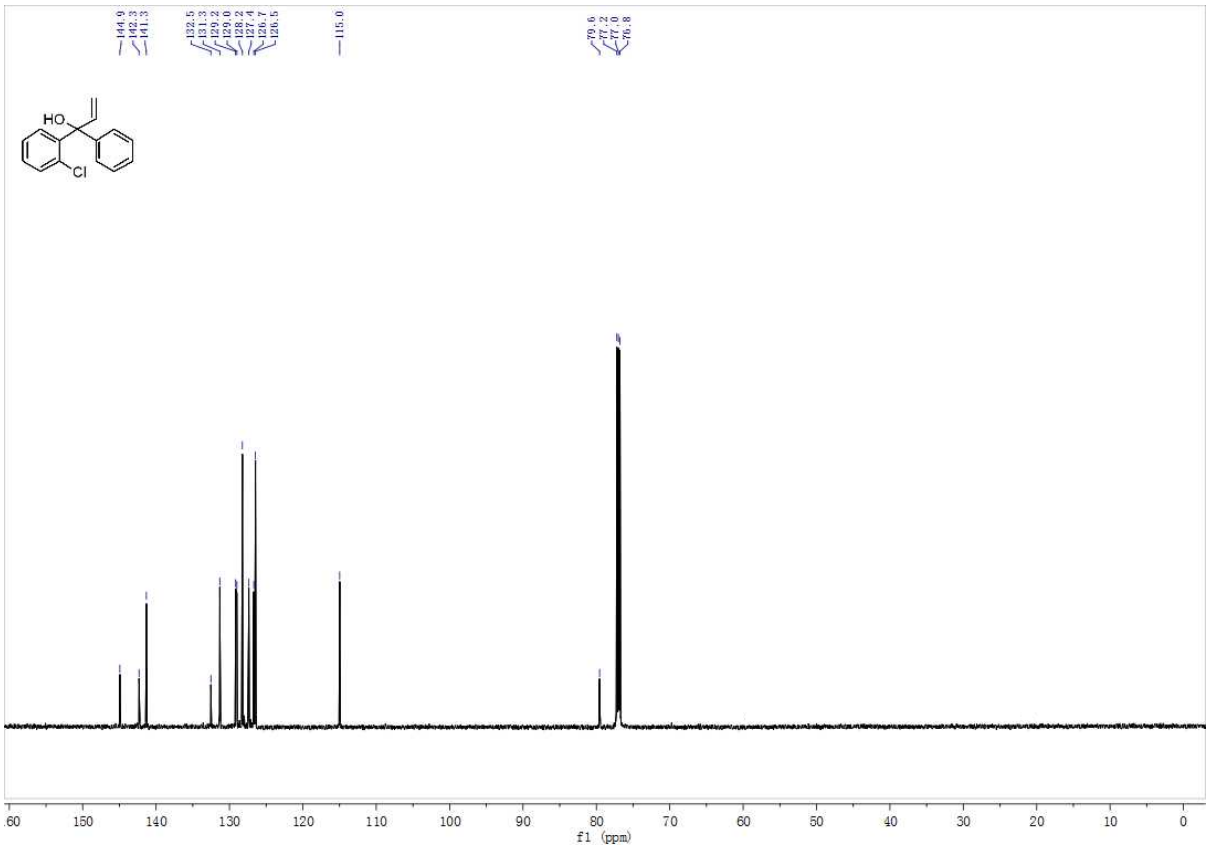


1q ^{1}H NMR



1q ^{13}C NMR



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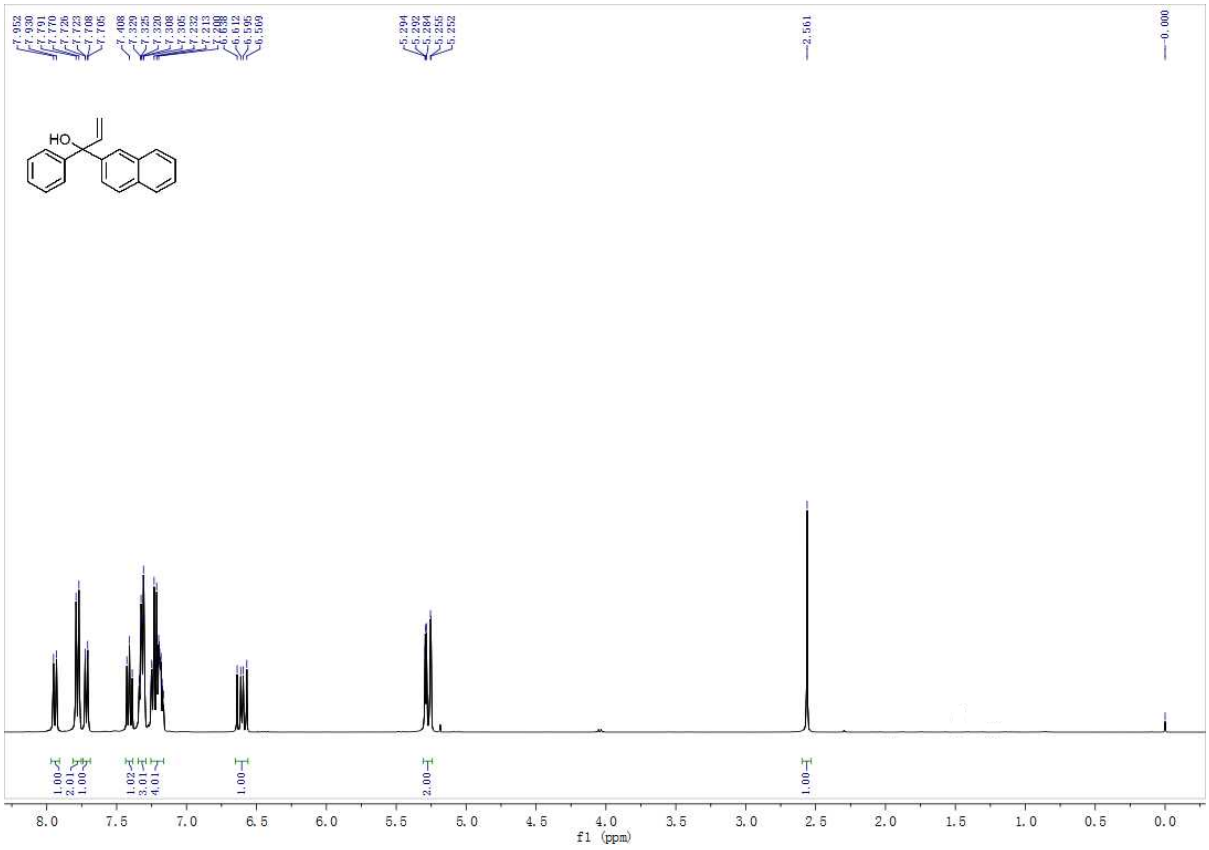
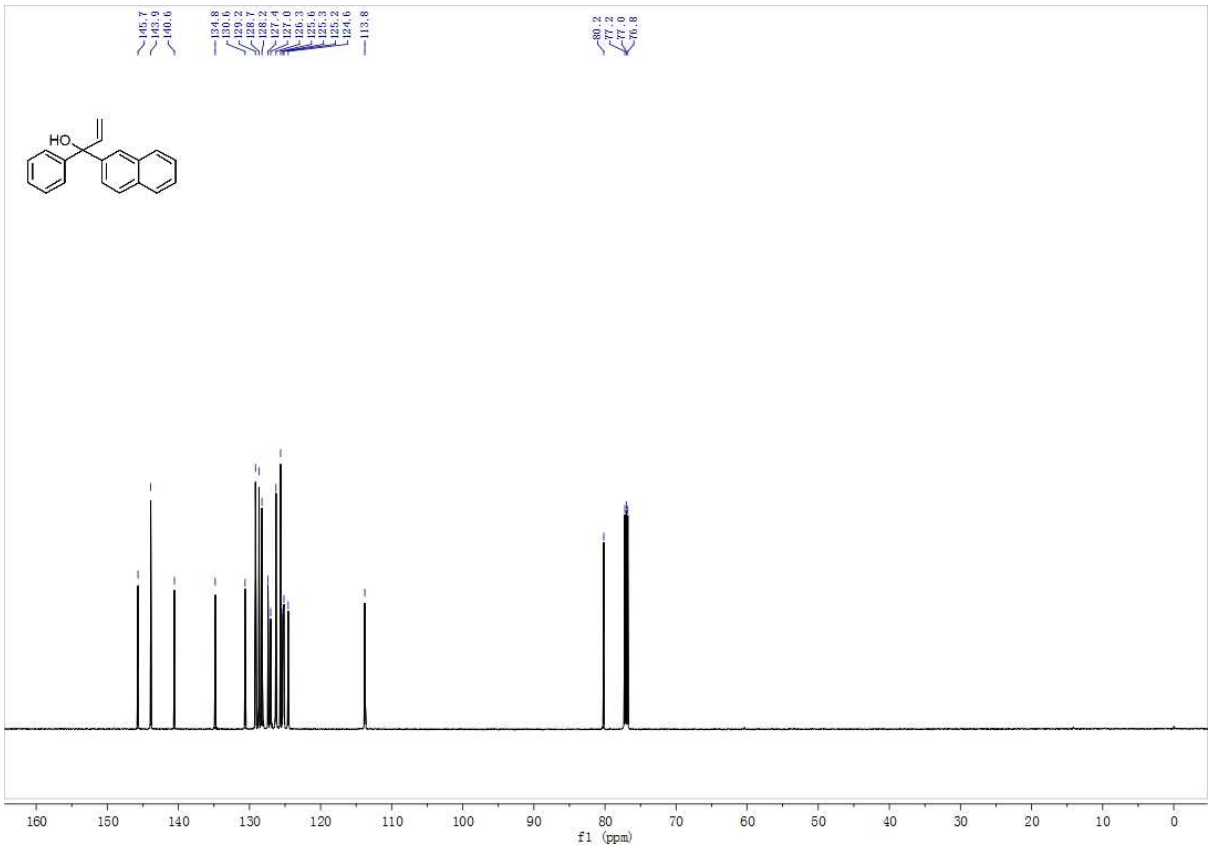
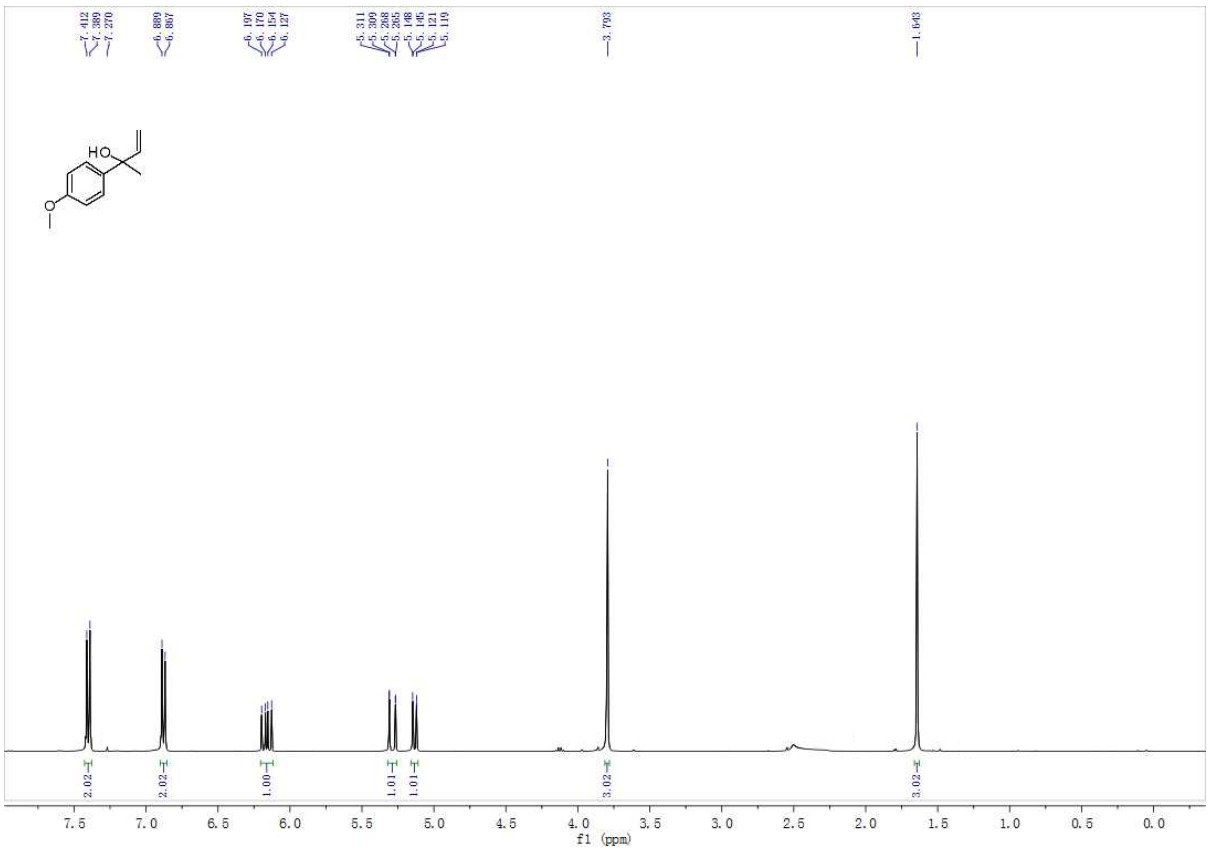


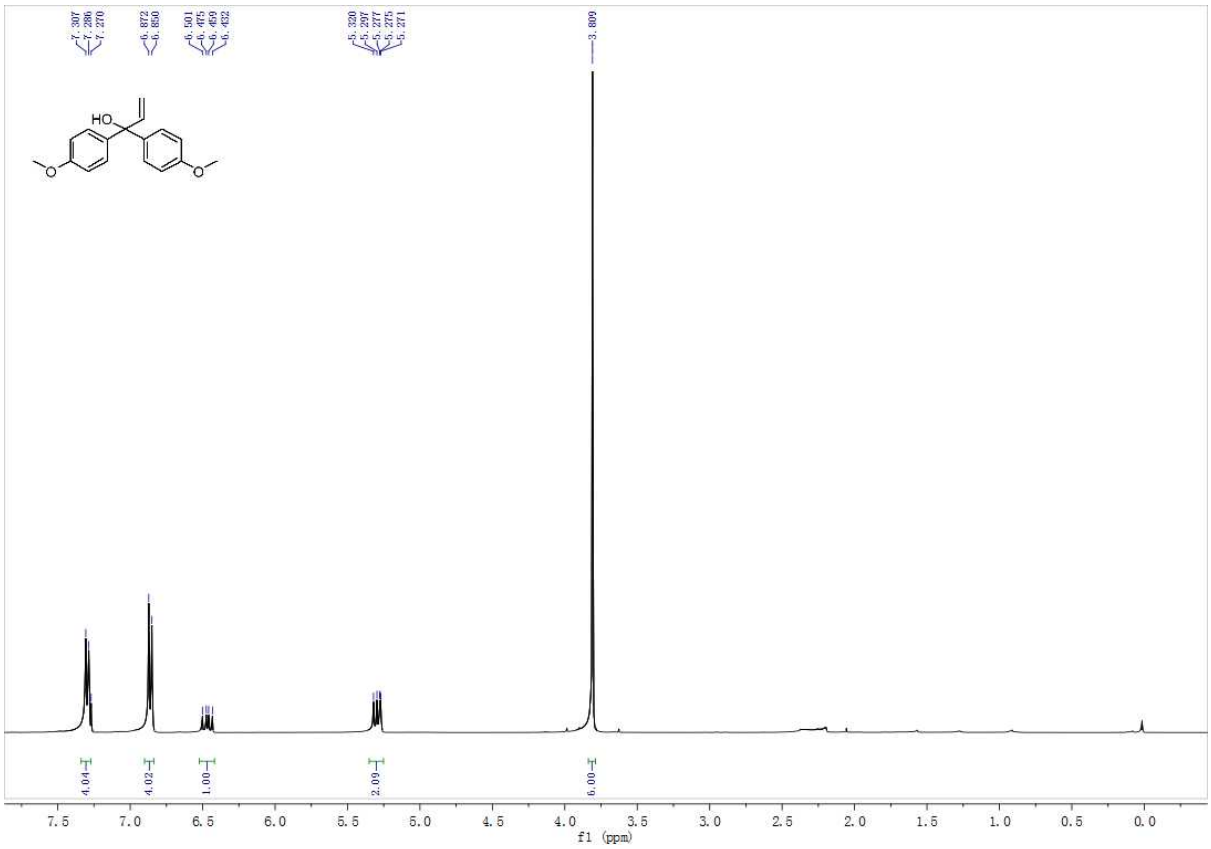
1r ^{13}C NMR



1s ^{1}H NMR

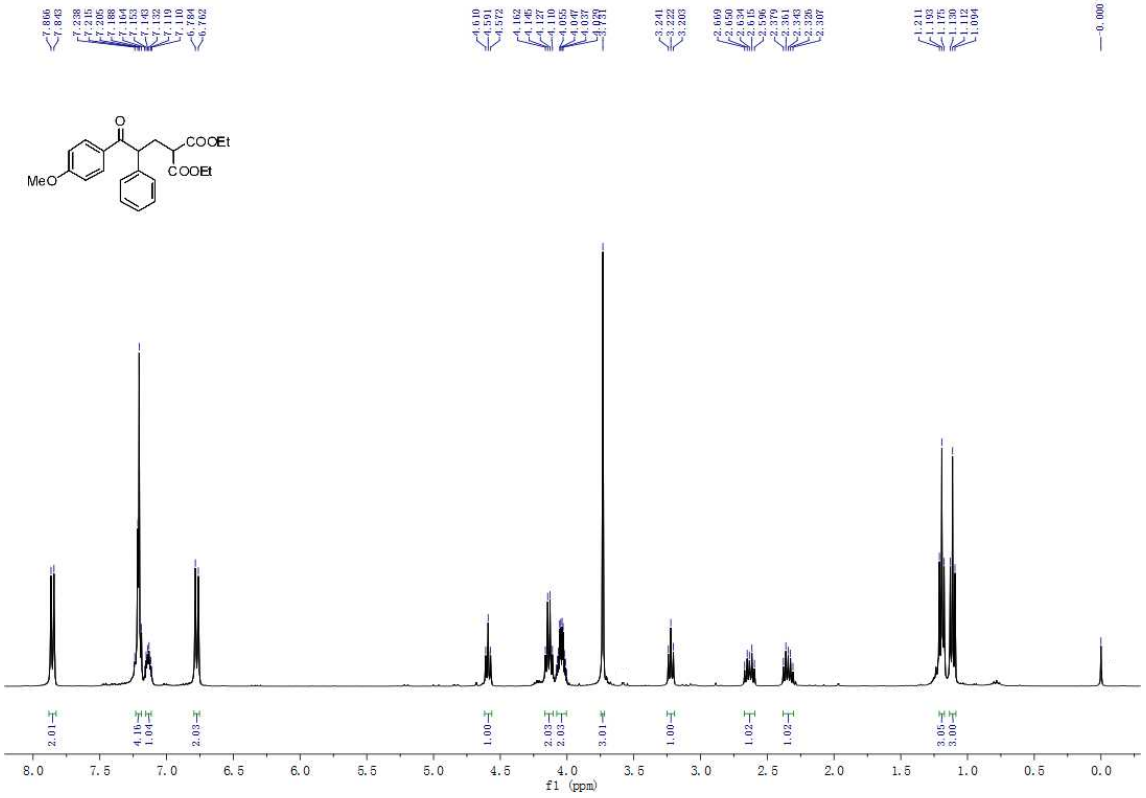


1t ^{1}H NMR

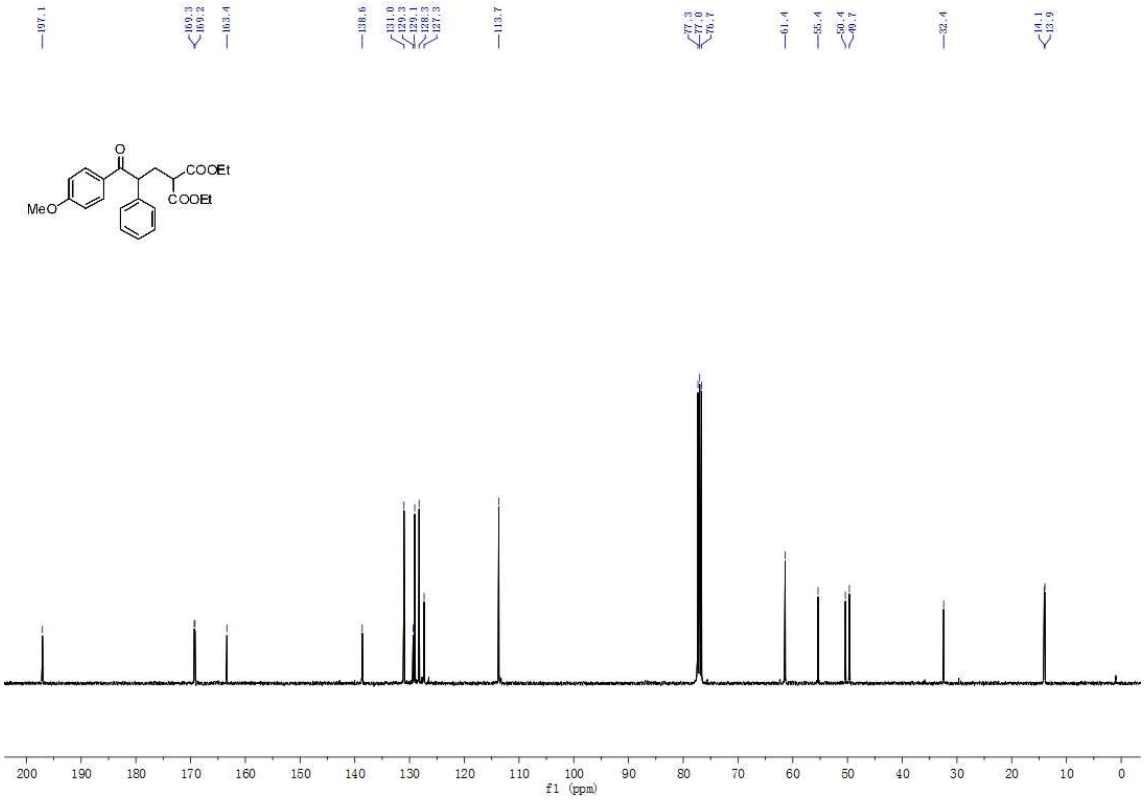


Products NMR spectra:

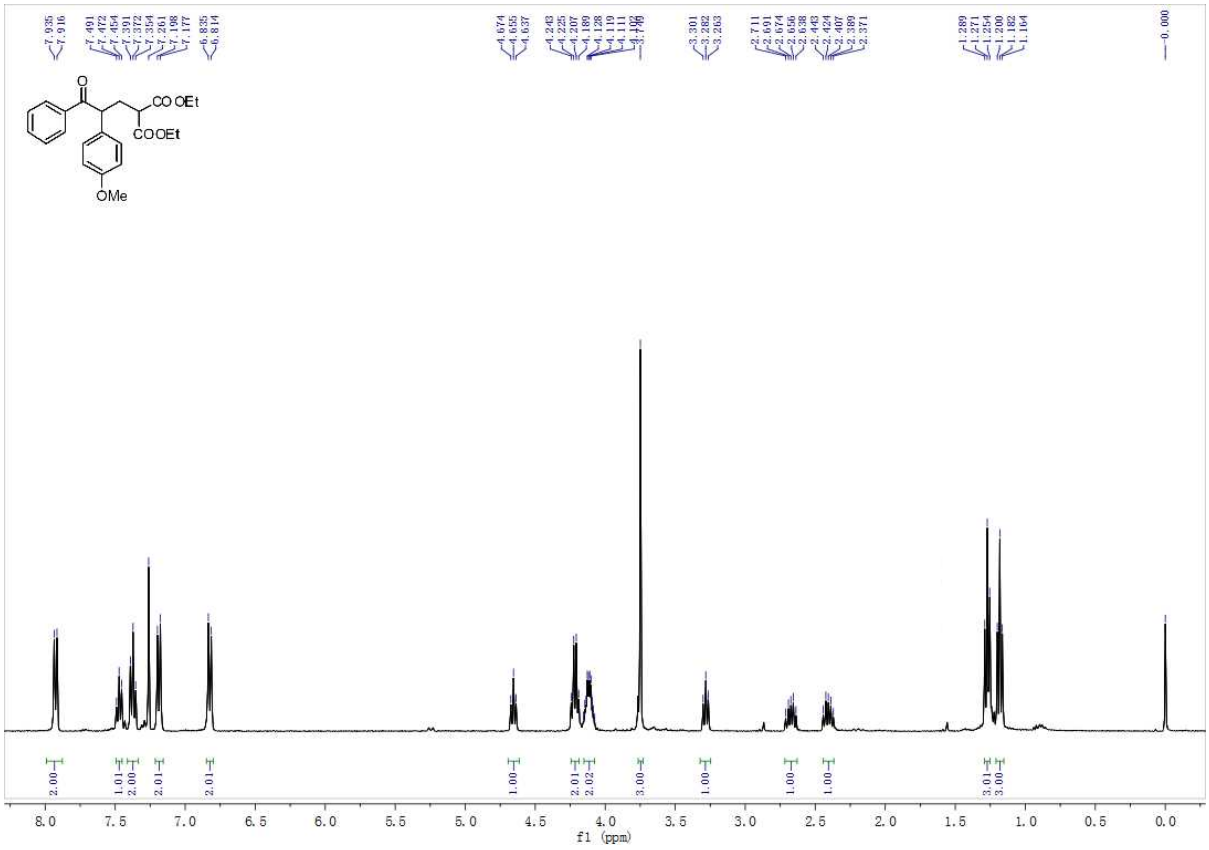
3a1 ^{1}H NMR



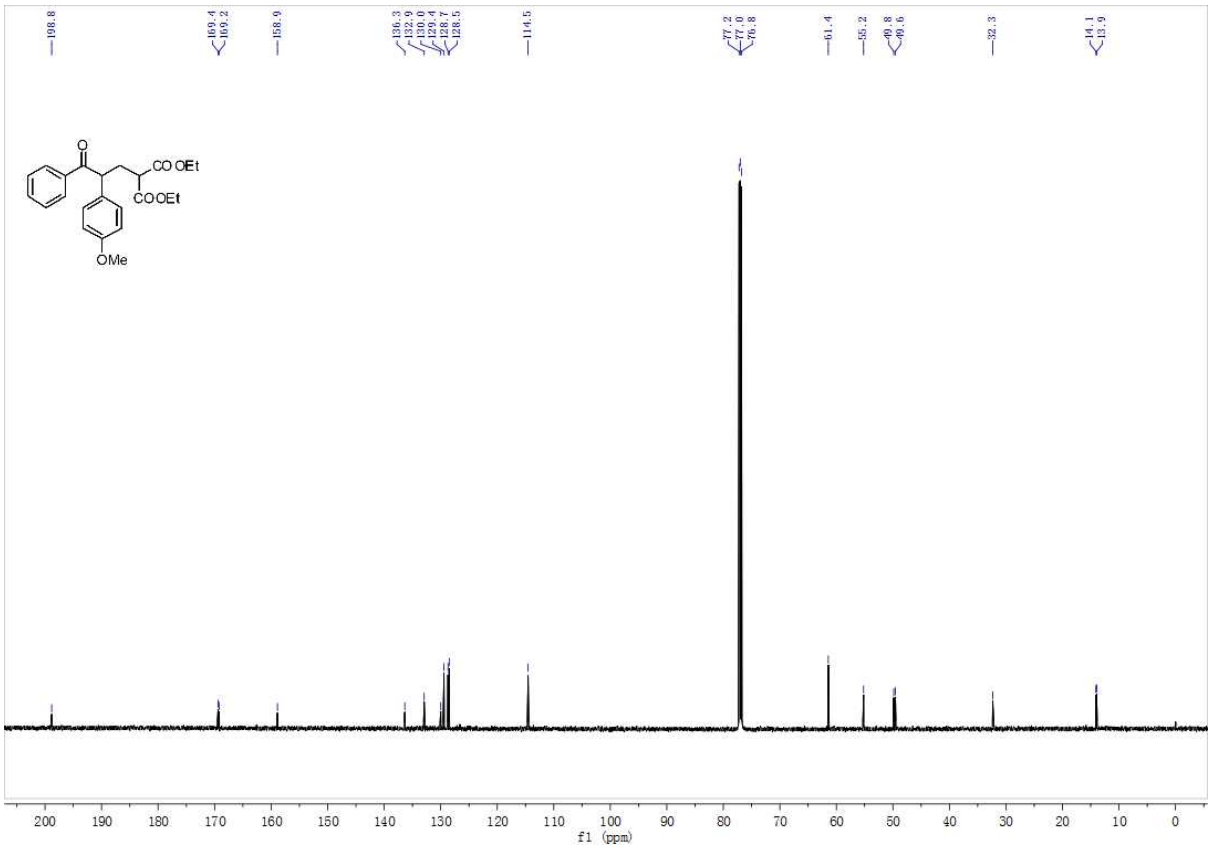
3a1 ^{13}C NMR



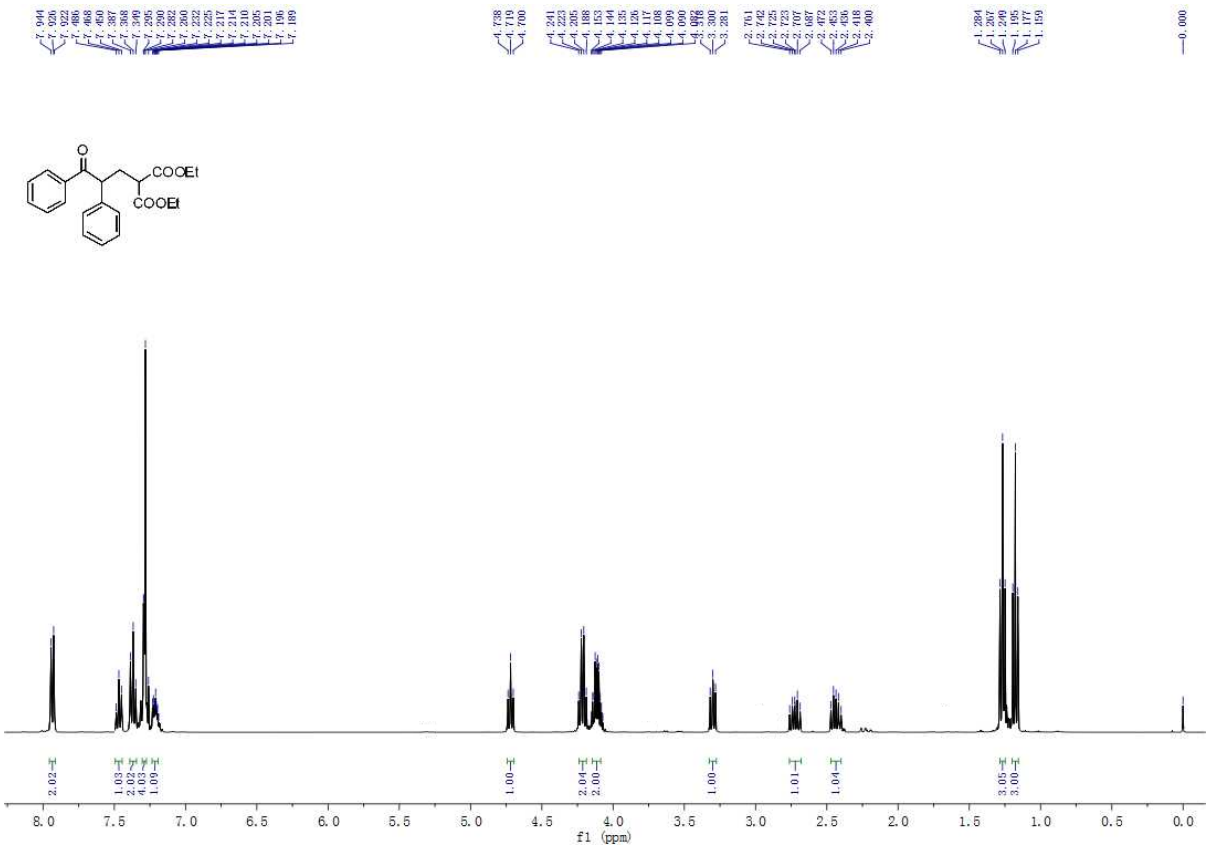
3a2 ^{1}H NMR



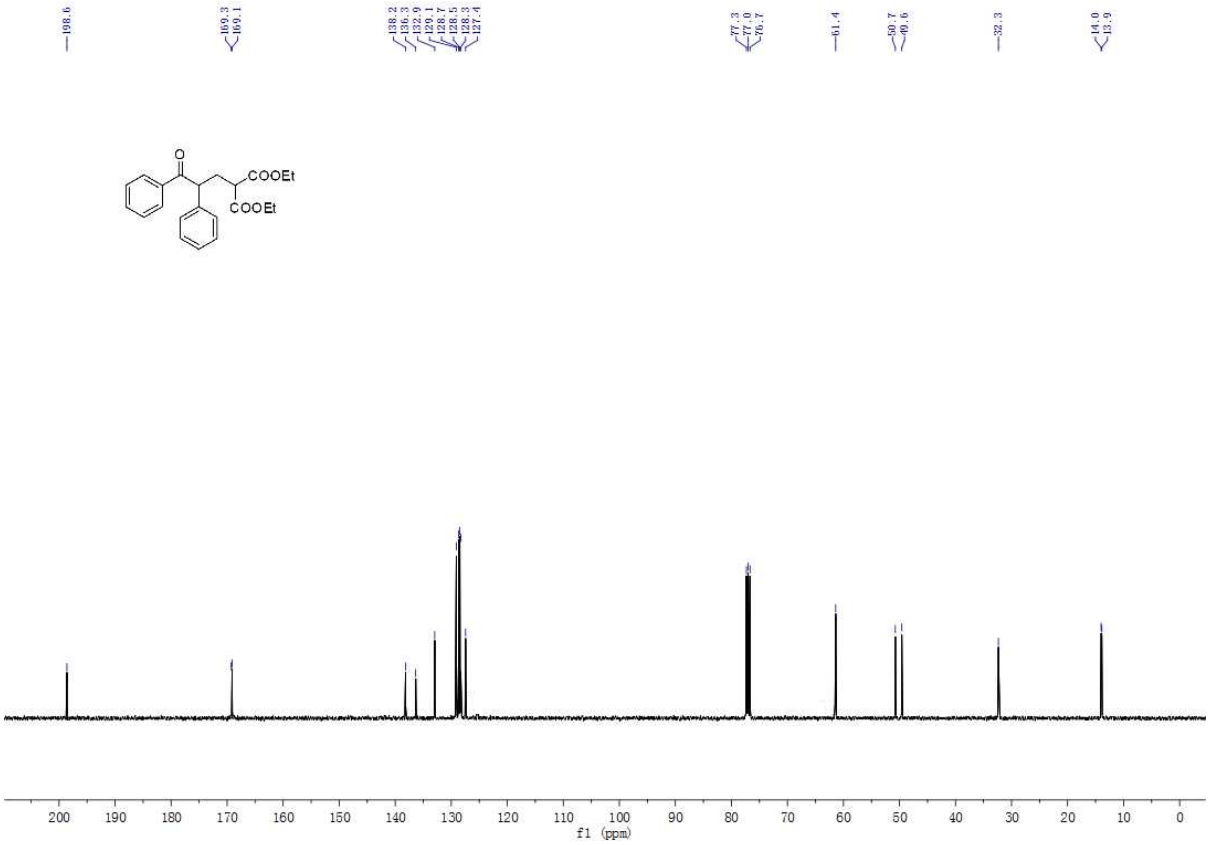
3a2 ^{13}C NMR



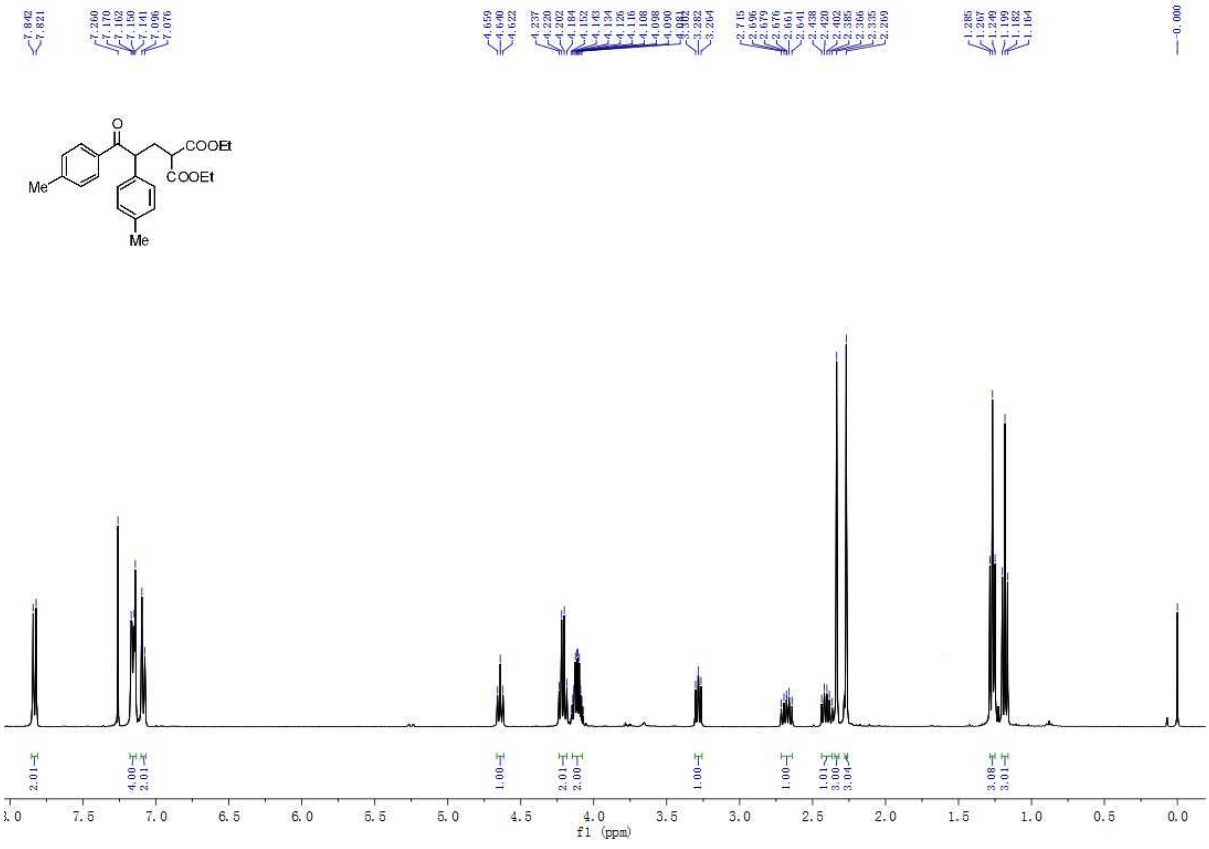
3b ^{1}H NMR



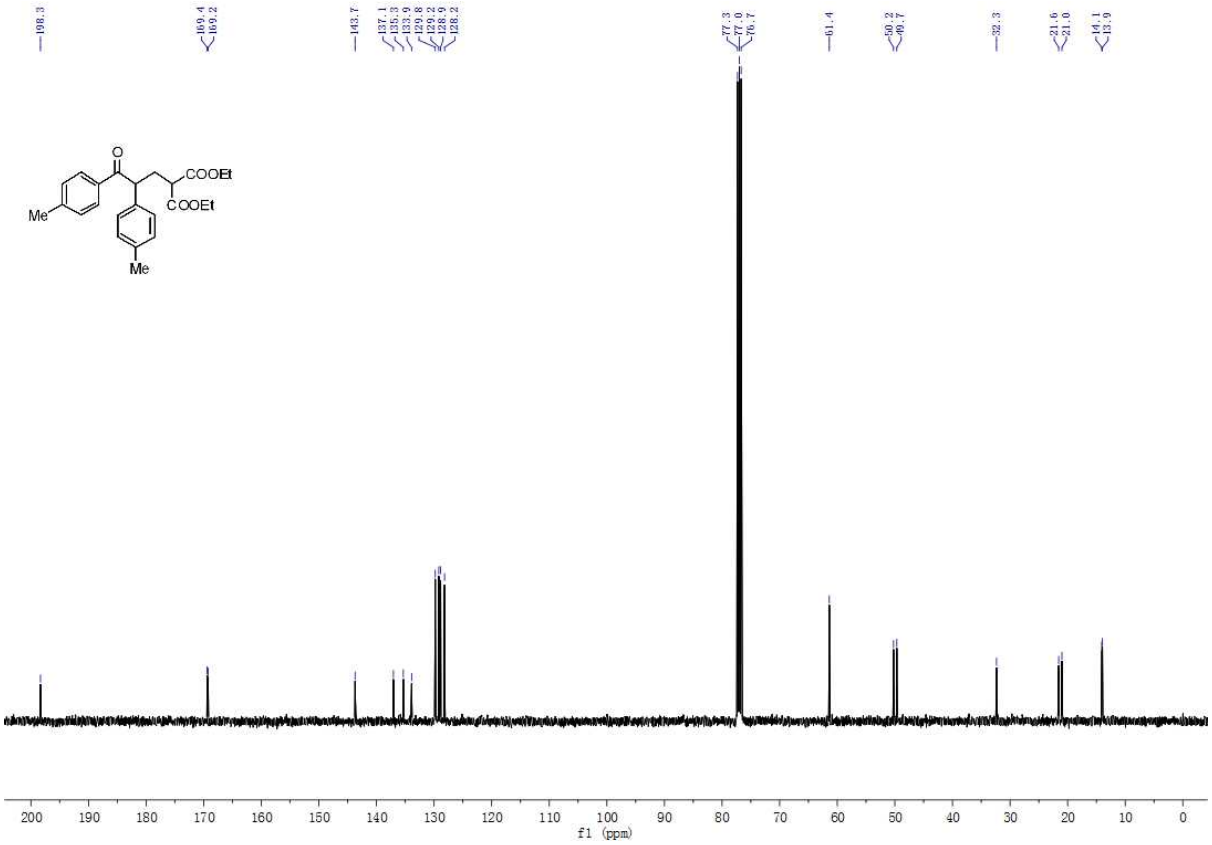
3b ^{13}C NMR



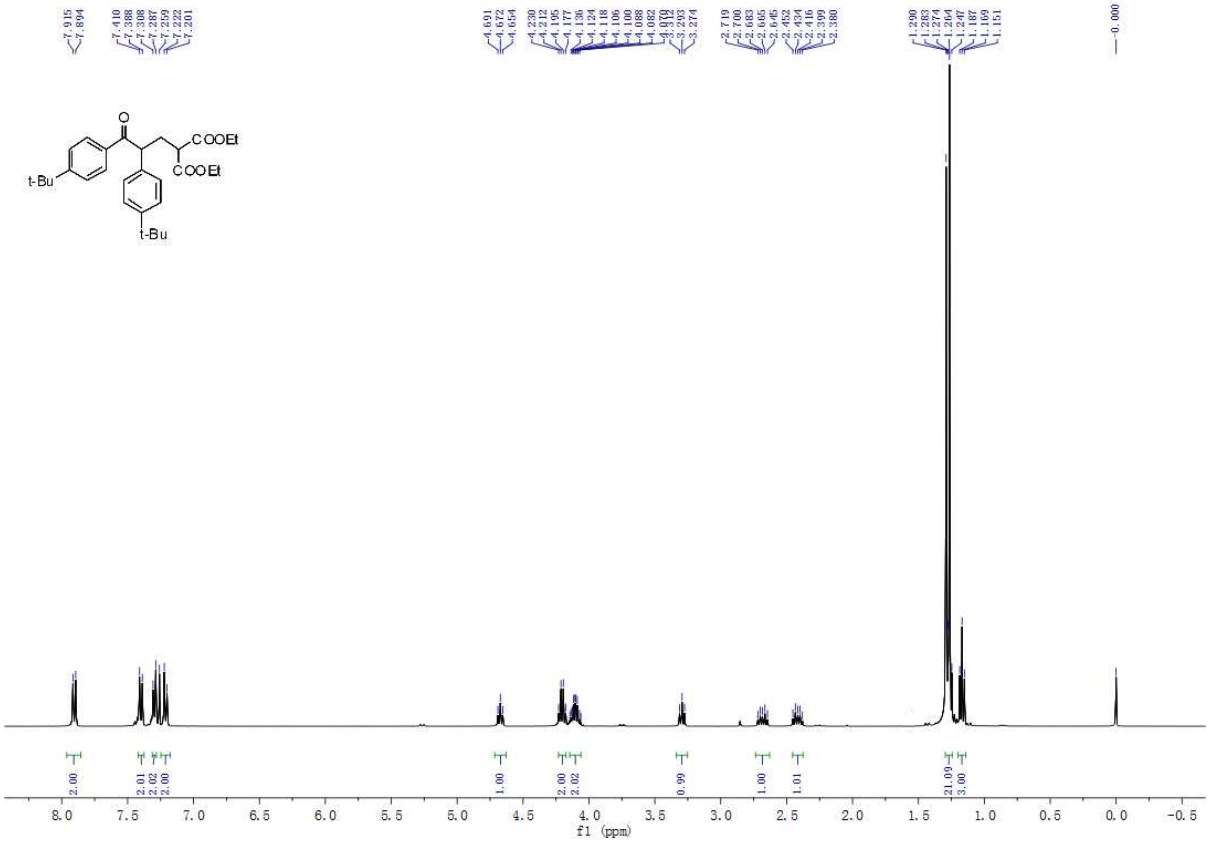
3c ^{1}H NMR



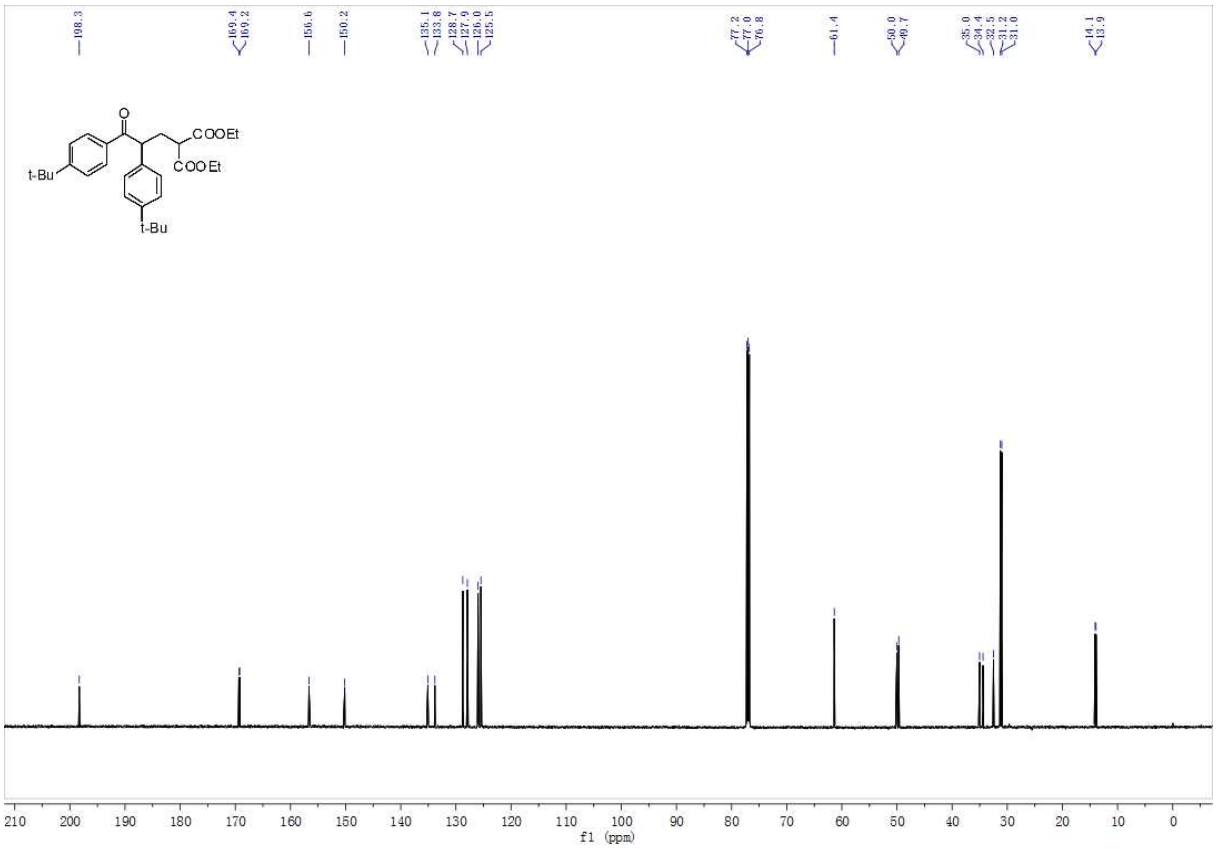
3c ^{13}C NMR



3d ^{1}H NMR



3d ^{13}C NMR



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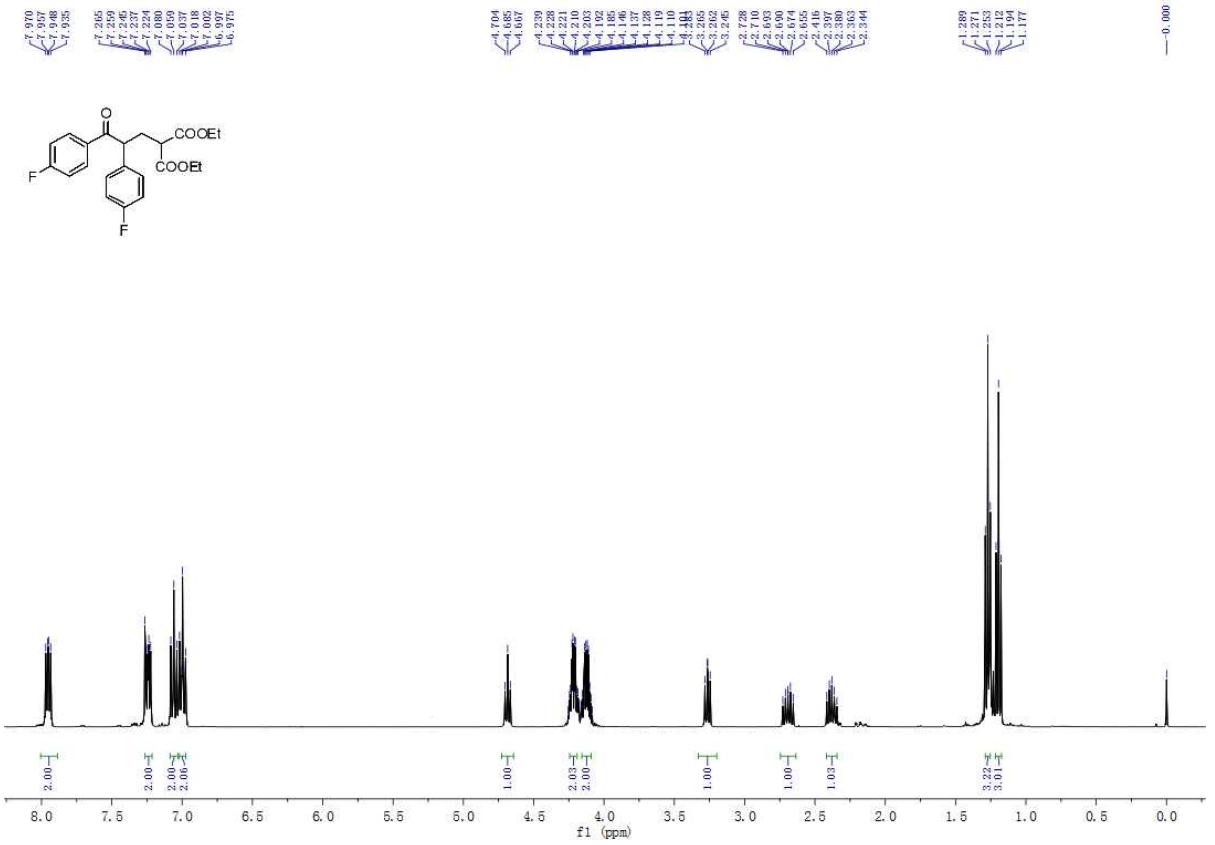
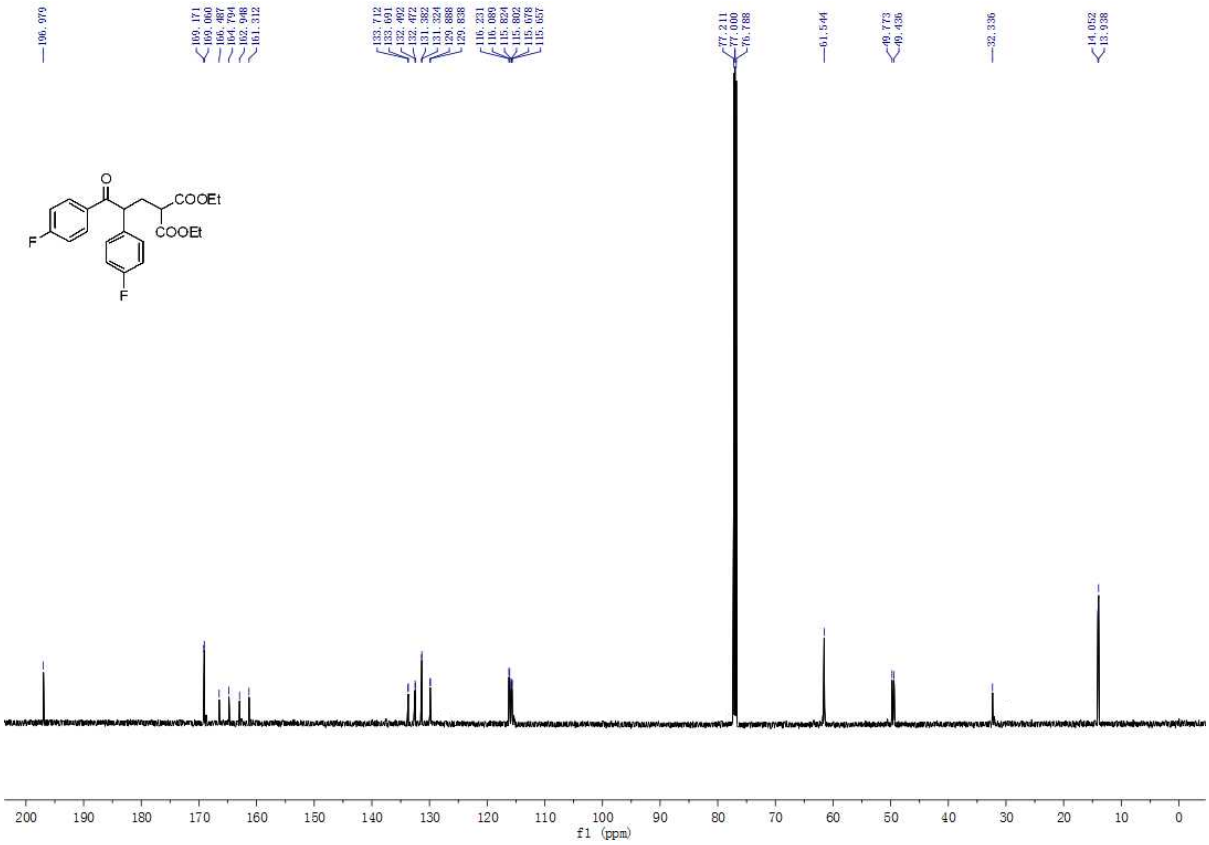
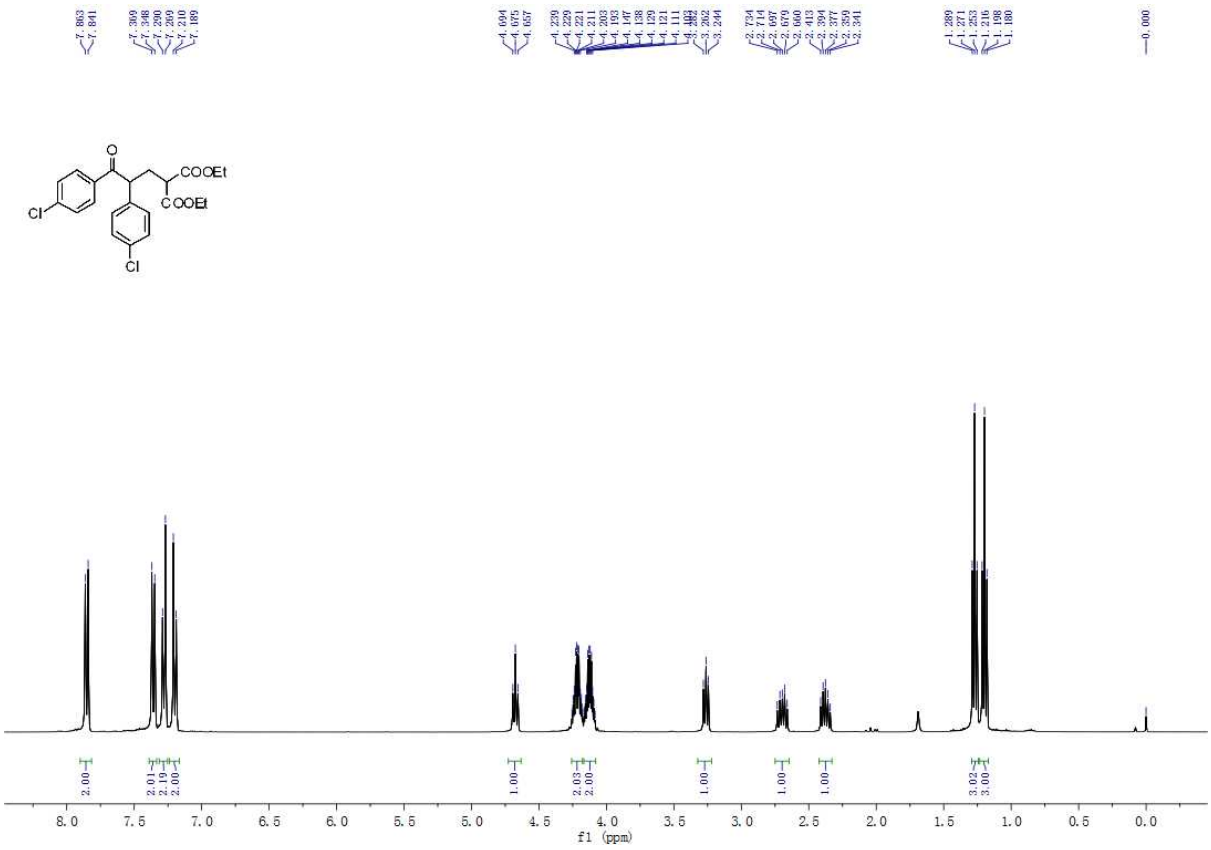


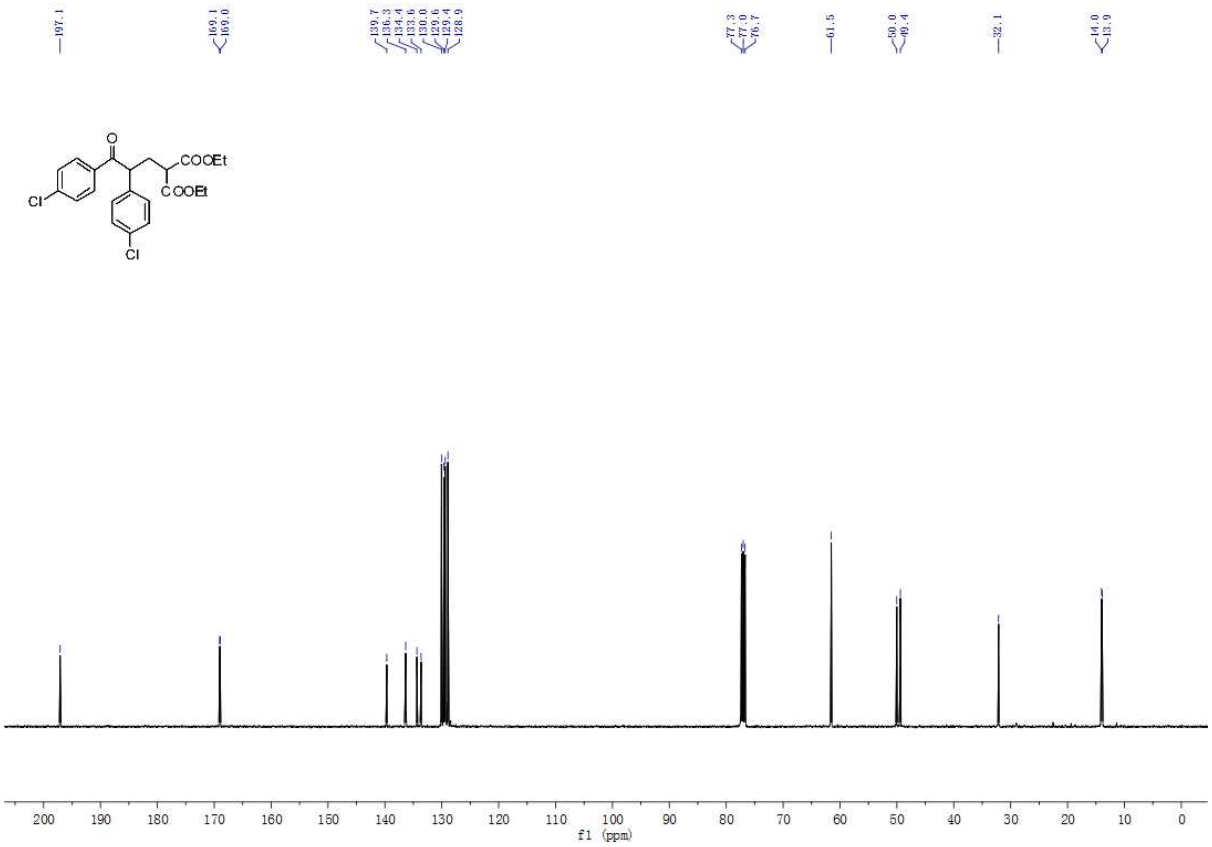
3e ^{13}C NMR



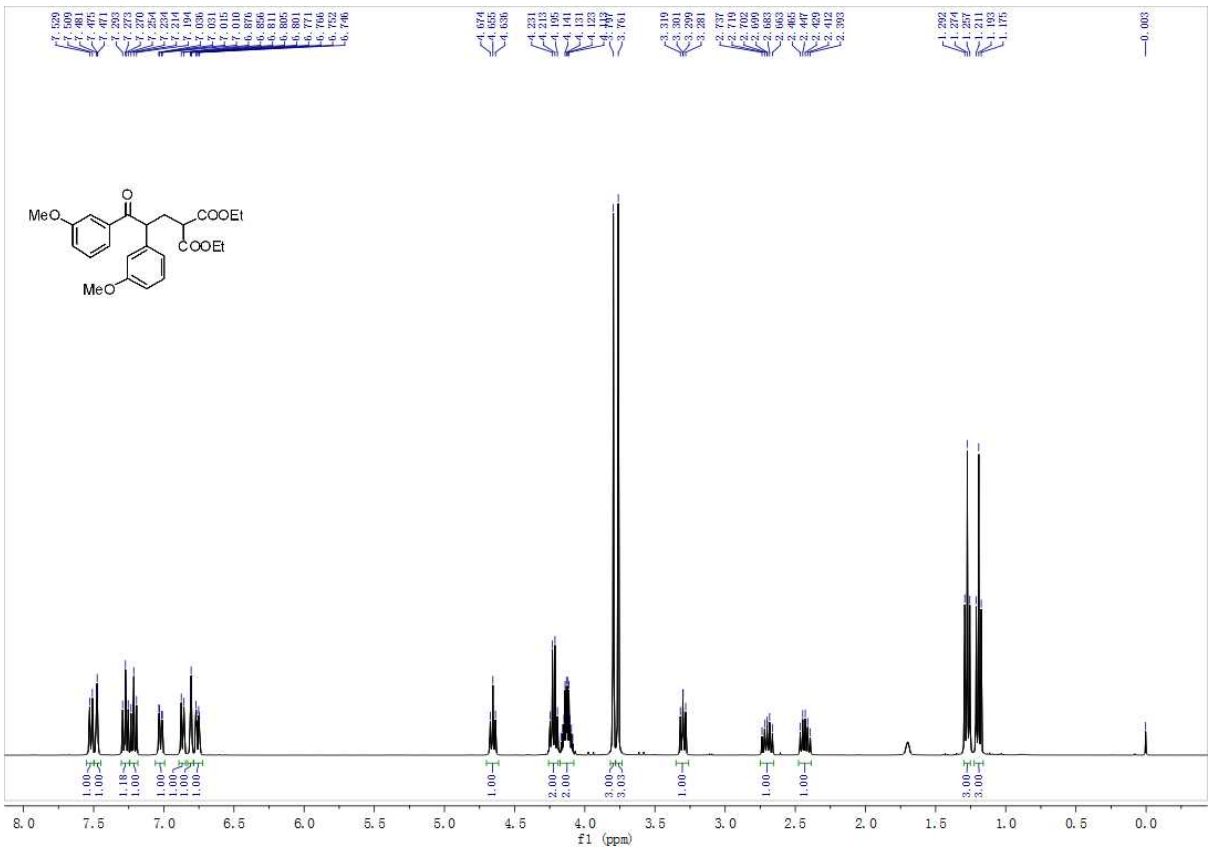
3f ^{1}H NMR



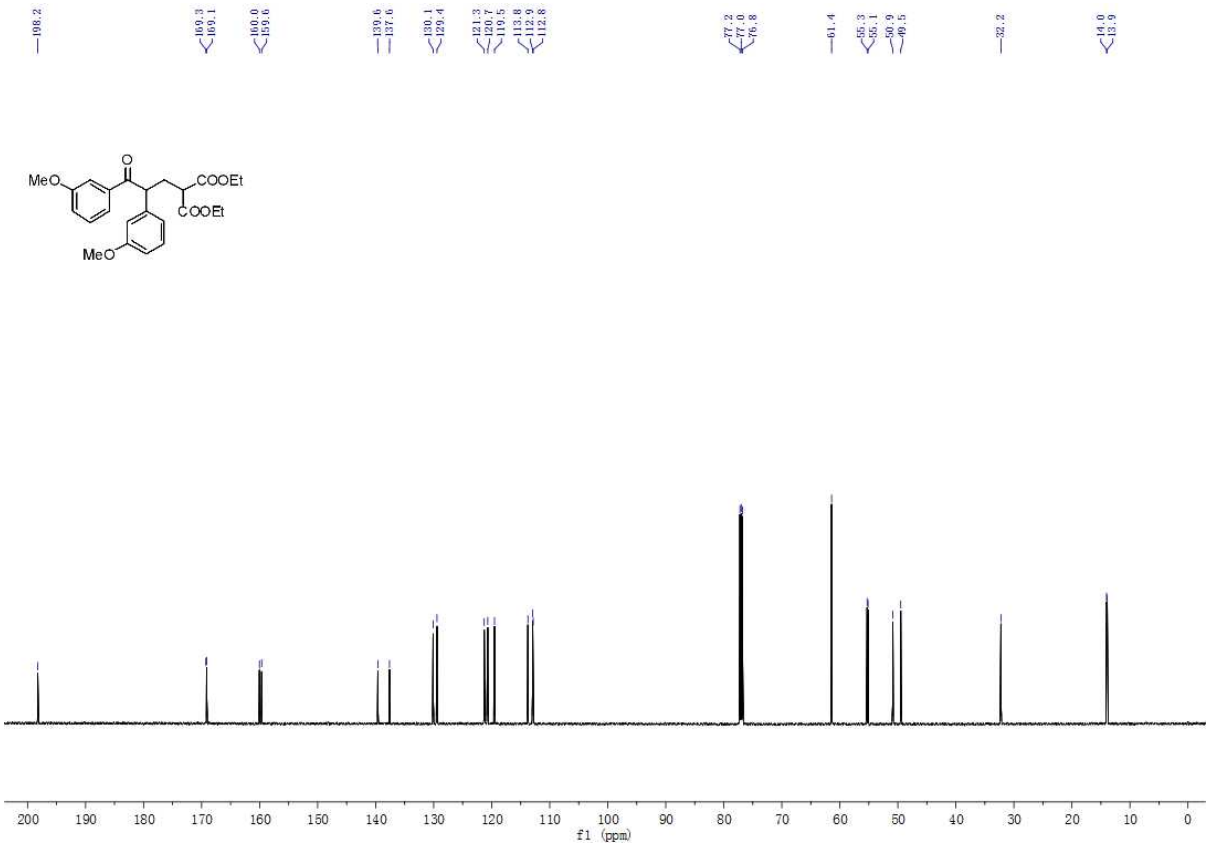
3f ^{13}C NMR



3g ^{1}H NMR



3g ^{13}C NMR



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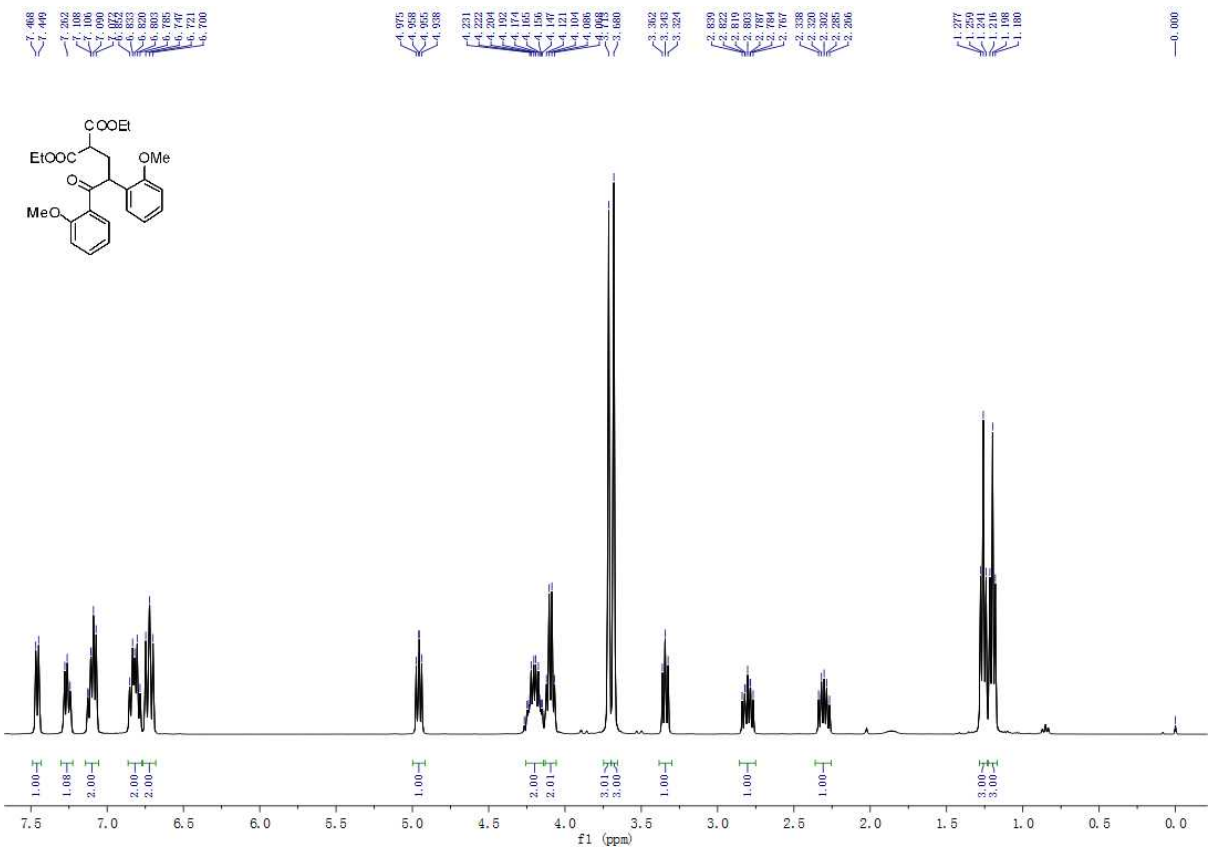
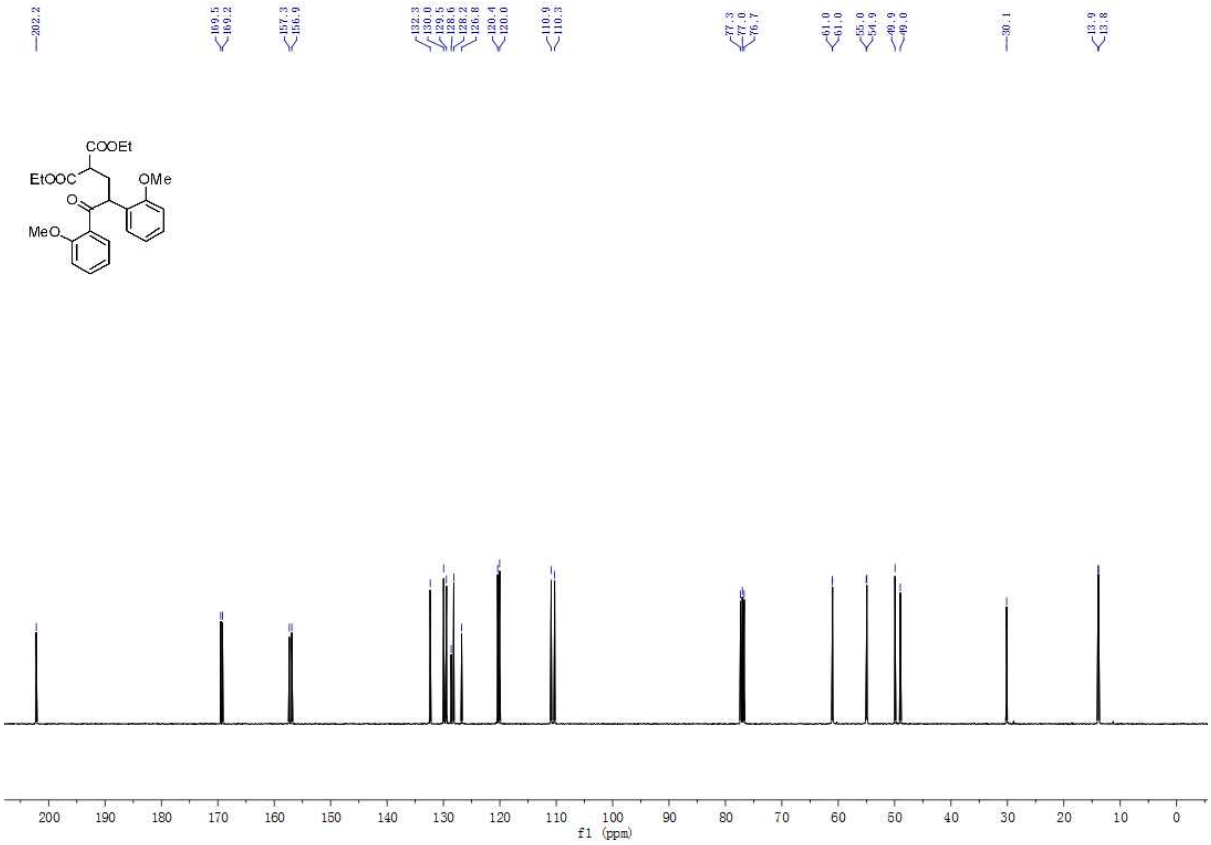
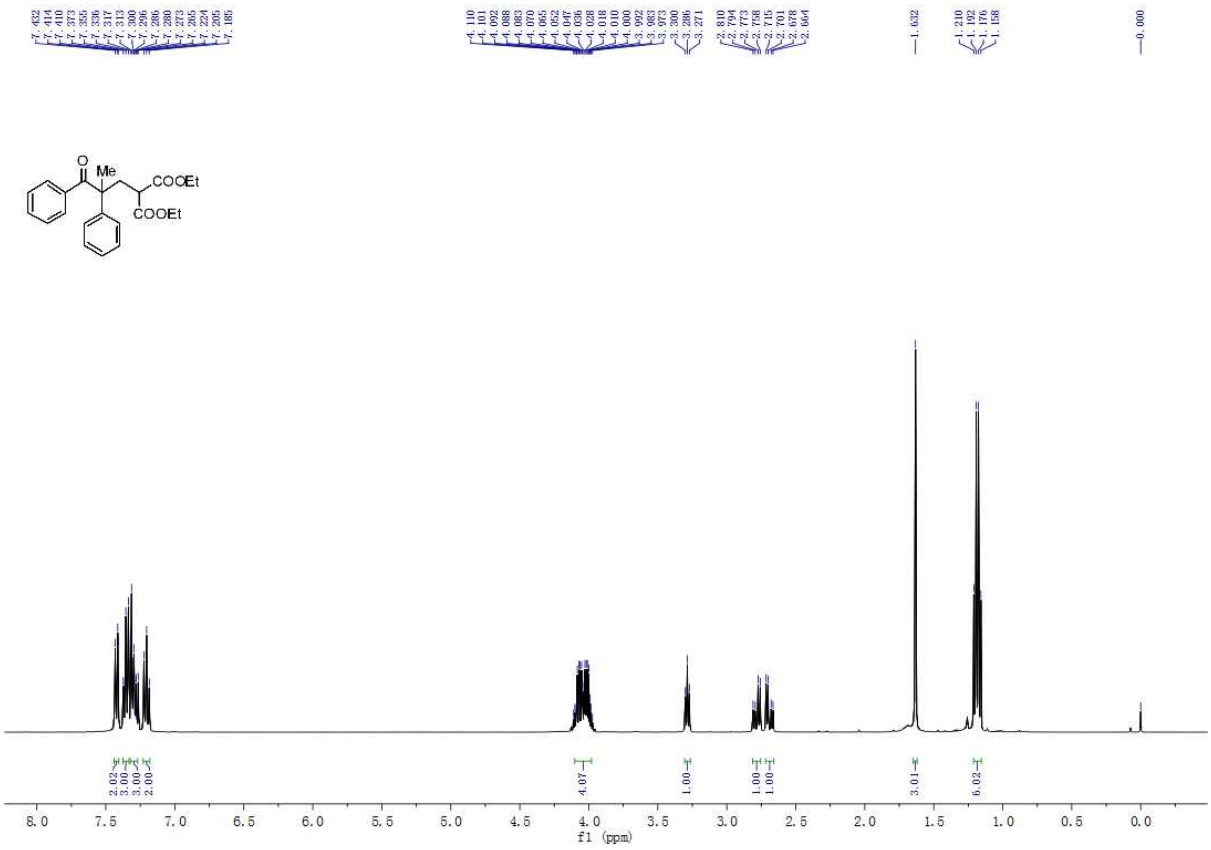


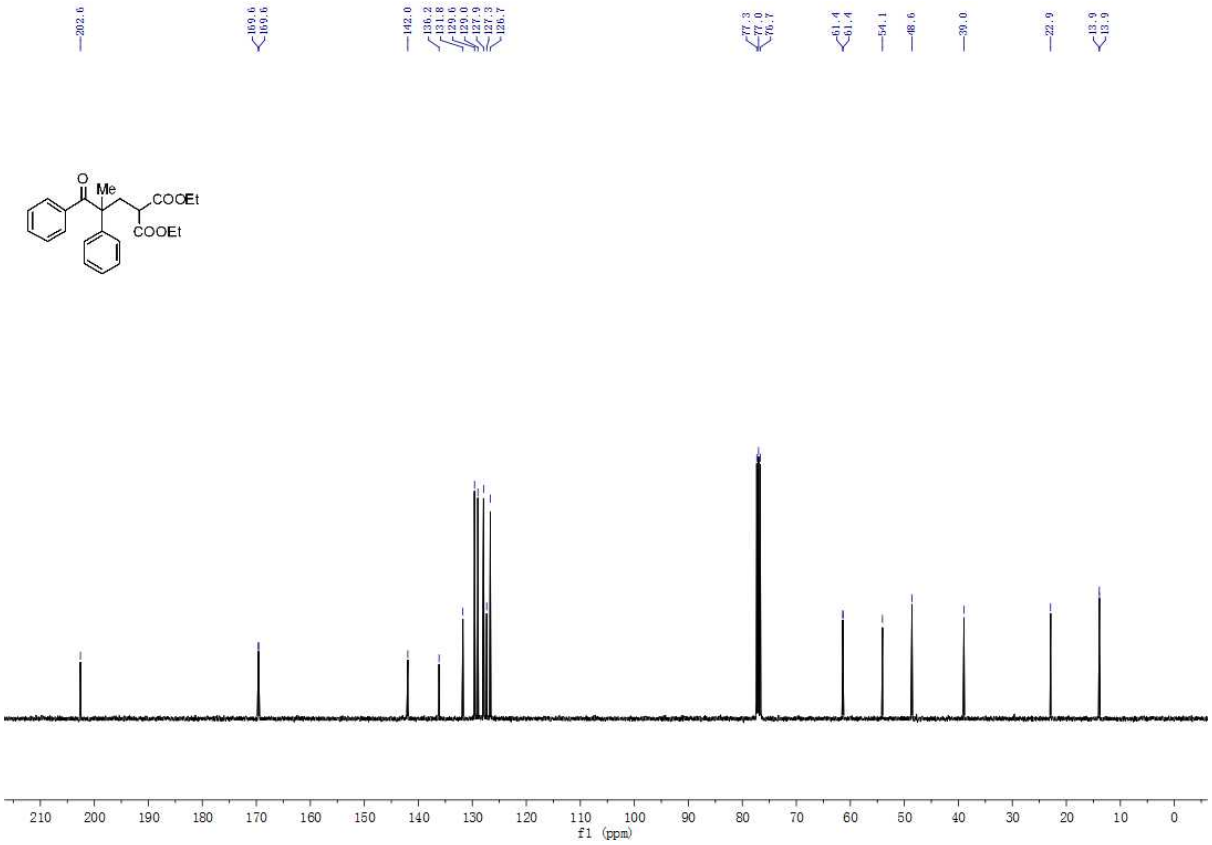
3h ^{13}C NMR



3i ^{1}H NMR



3i ^{13}C NMR



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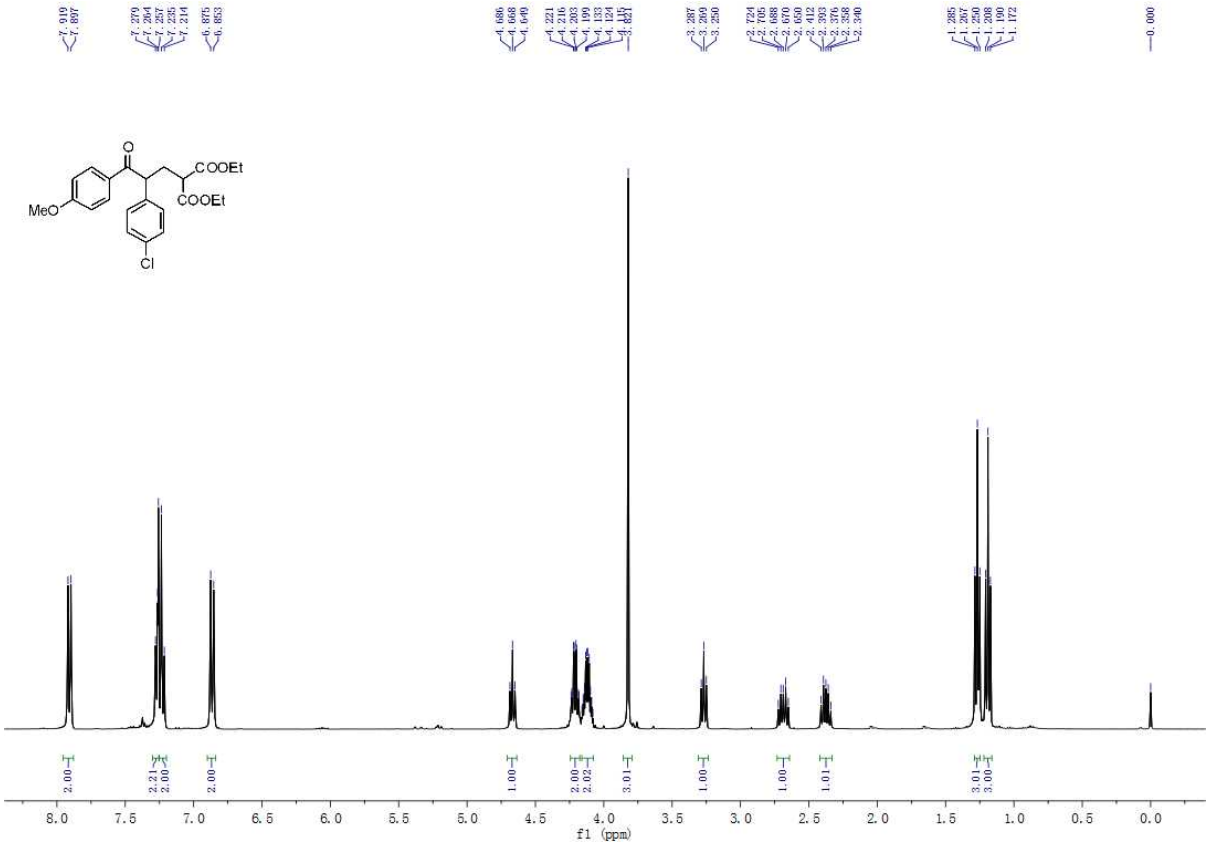

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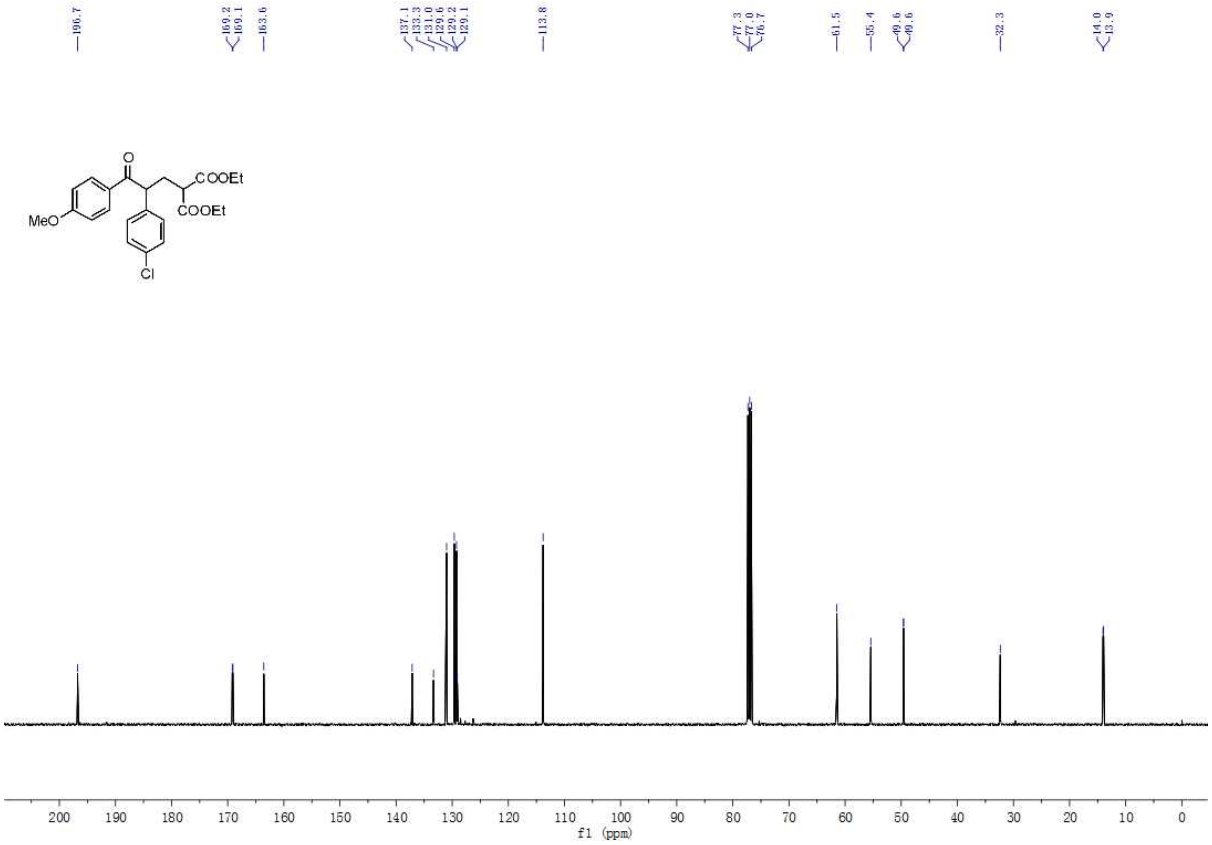

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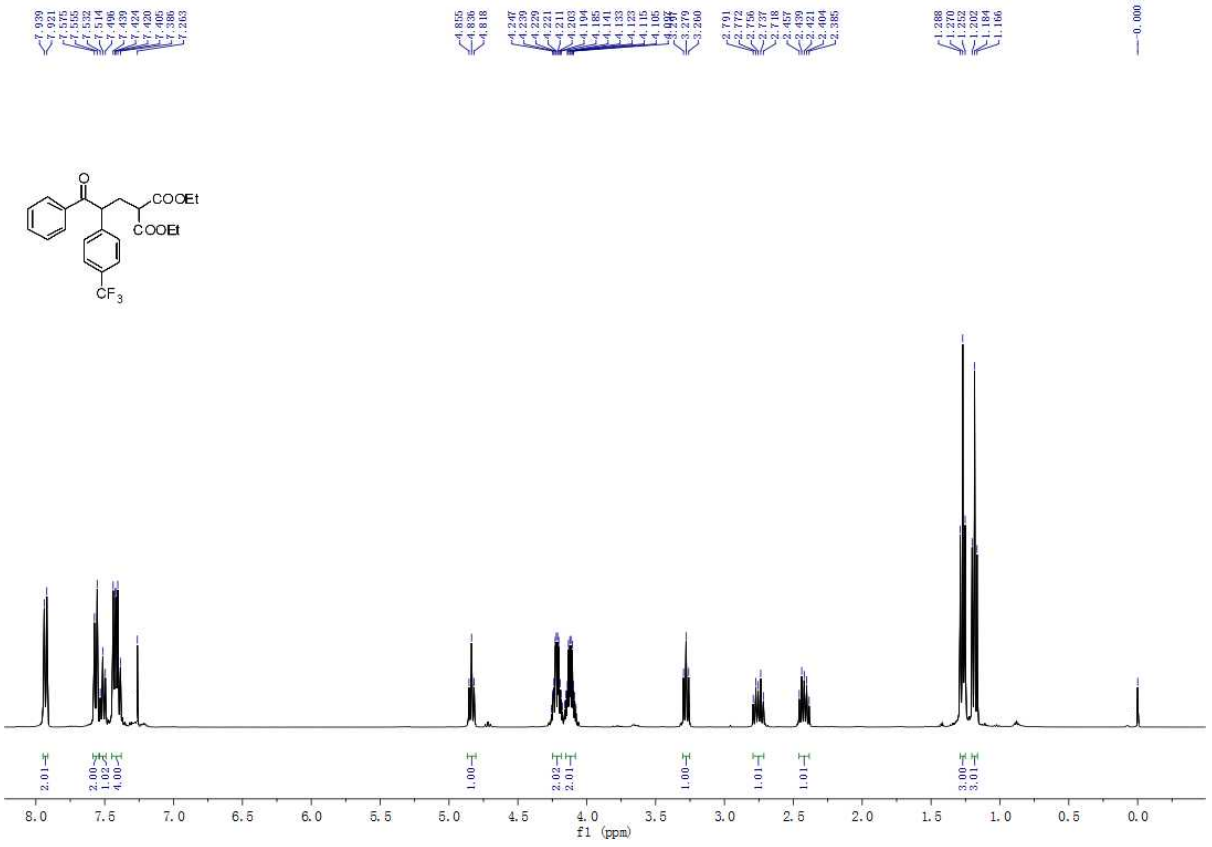

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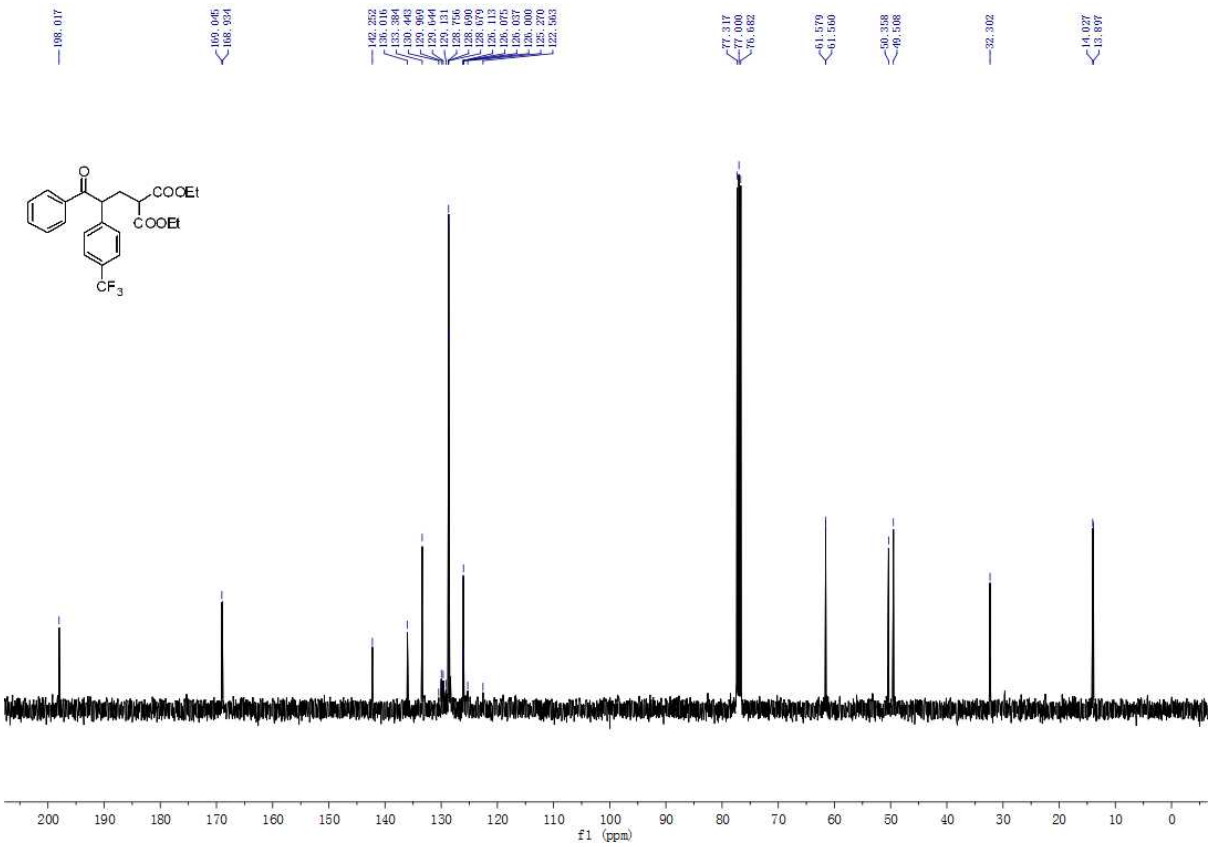

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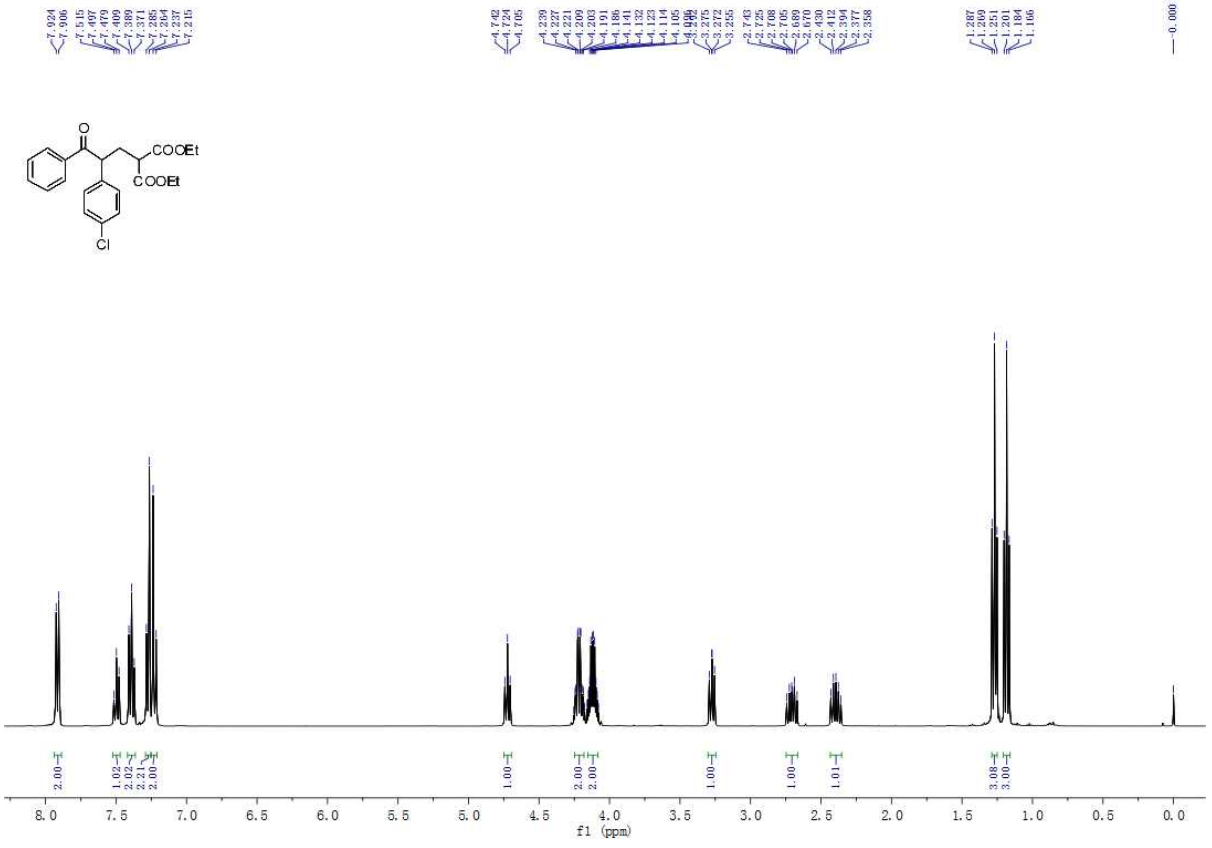

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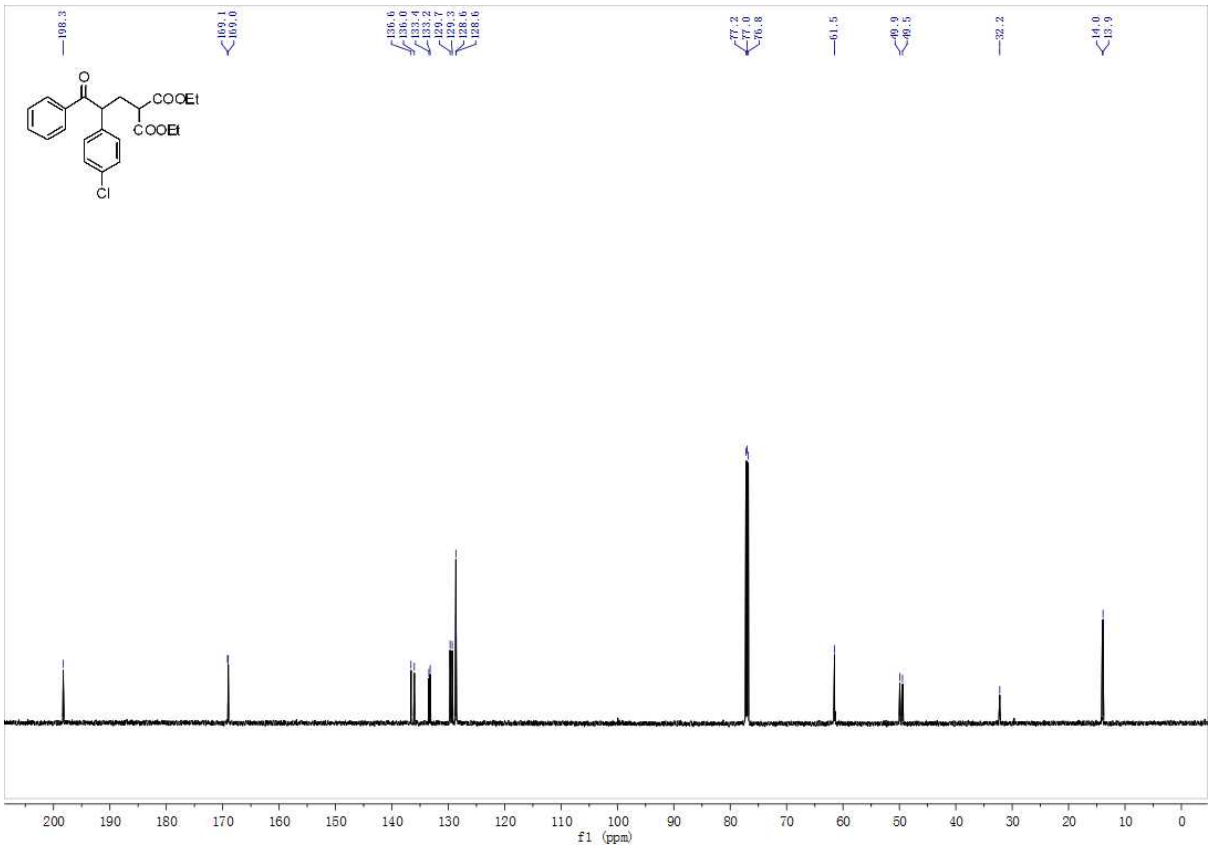
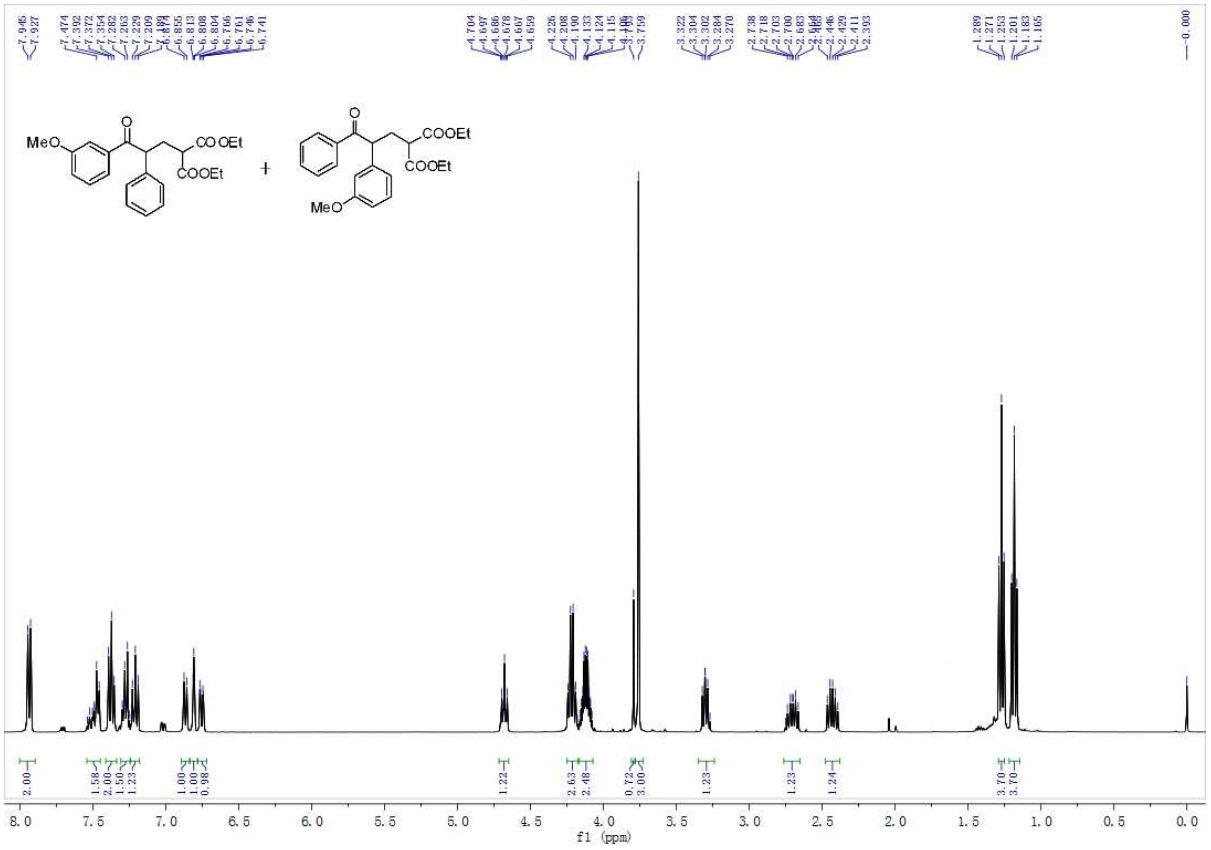


3m ^{1}H NMR



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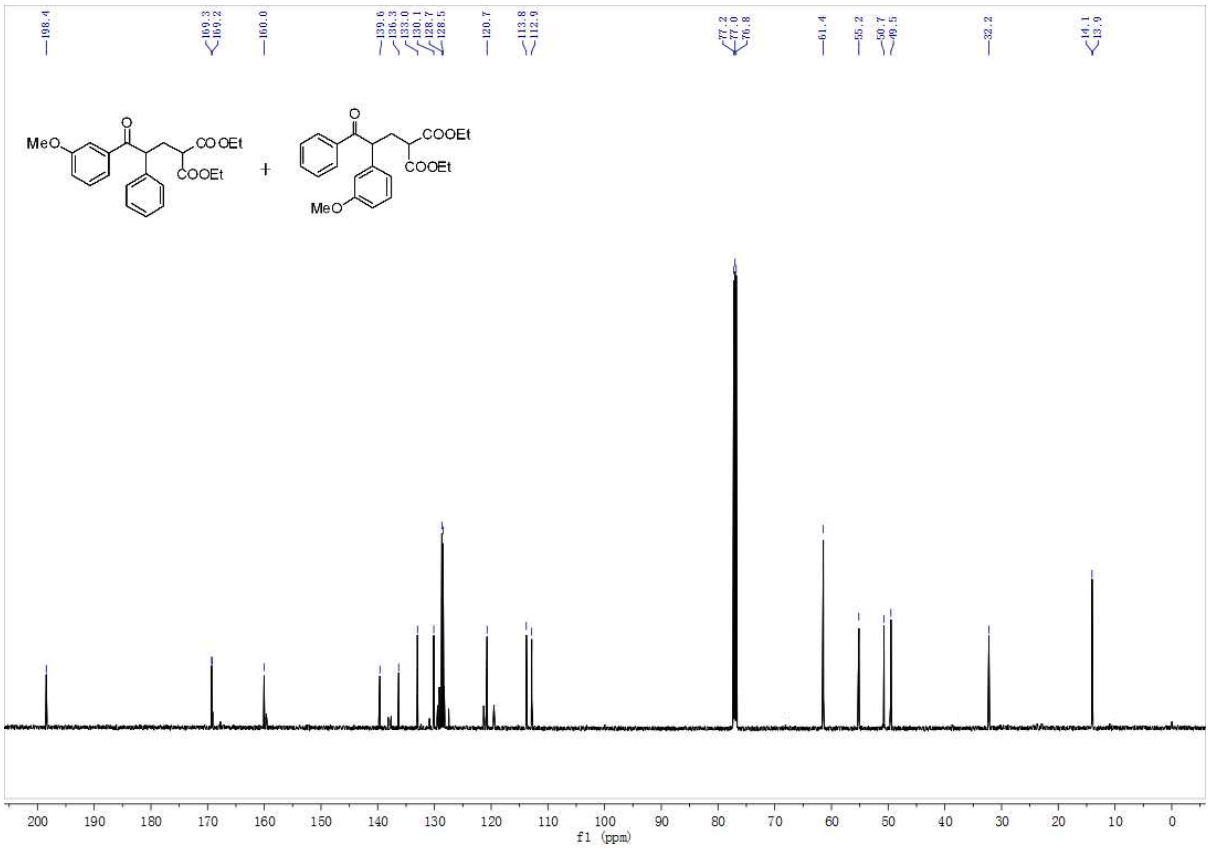

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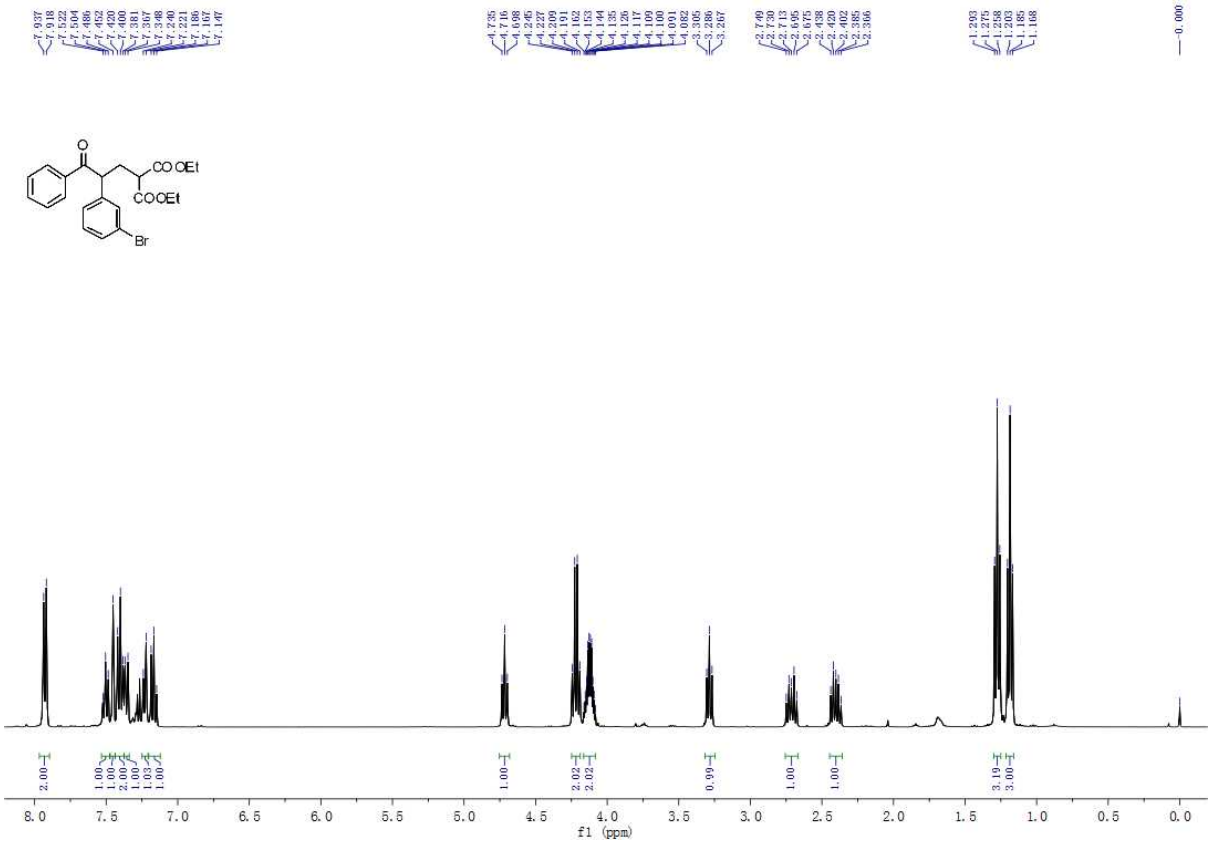

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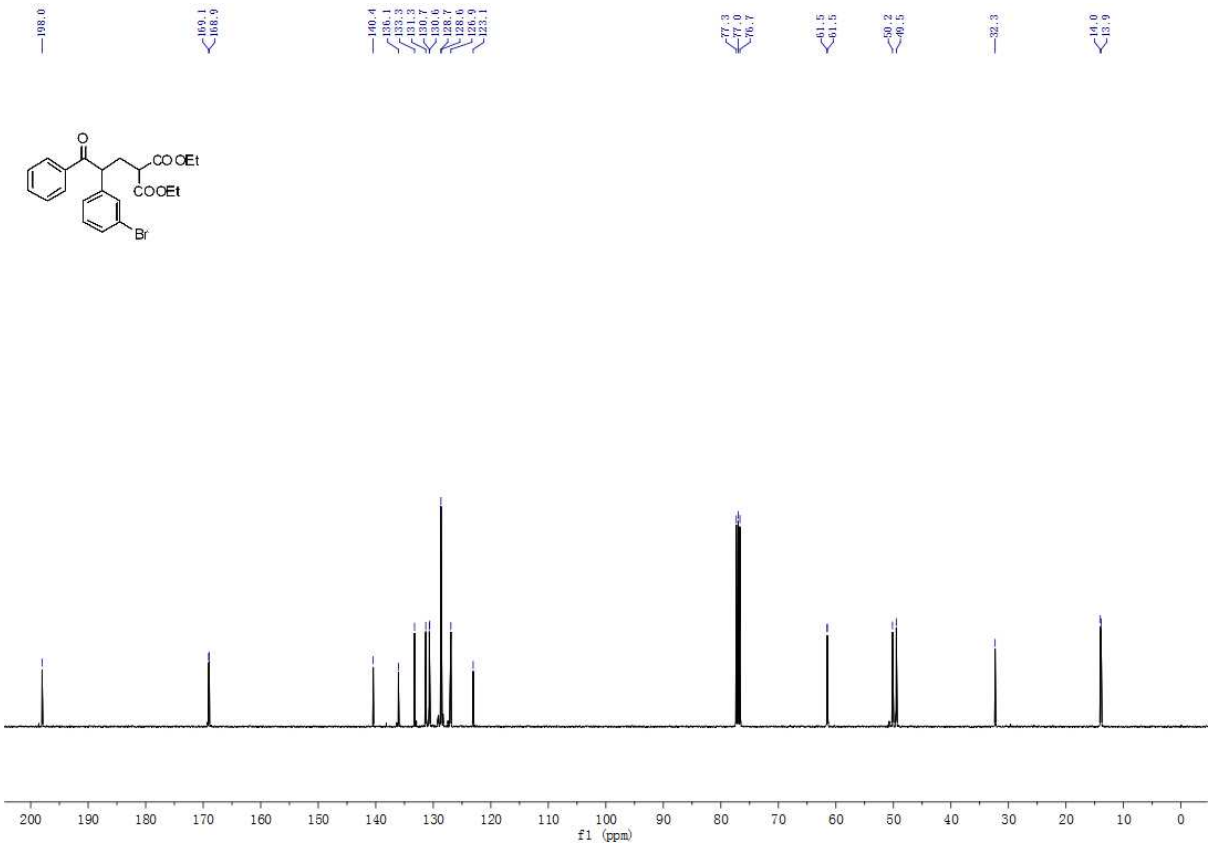

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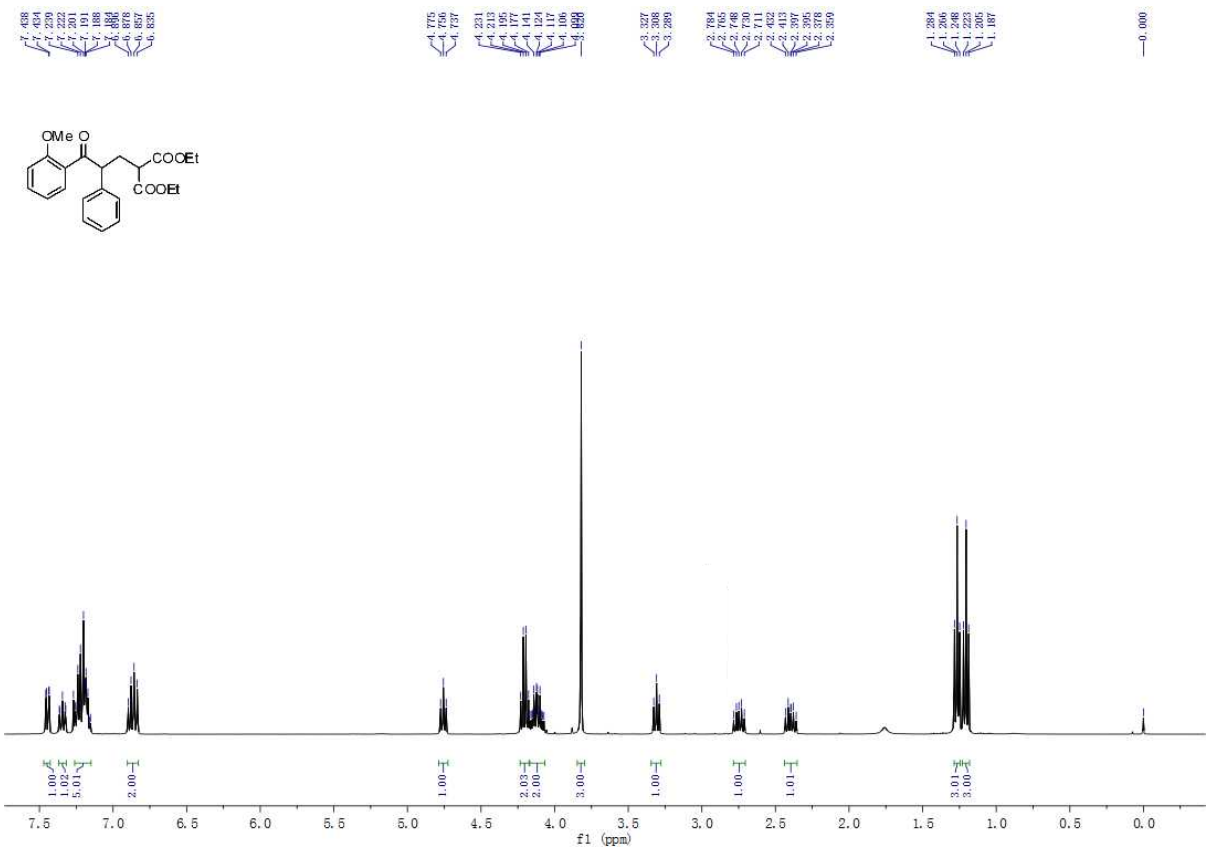
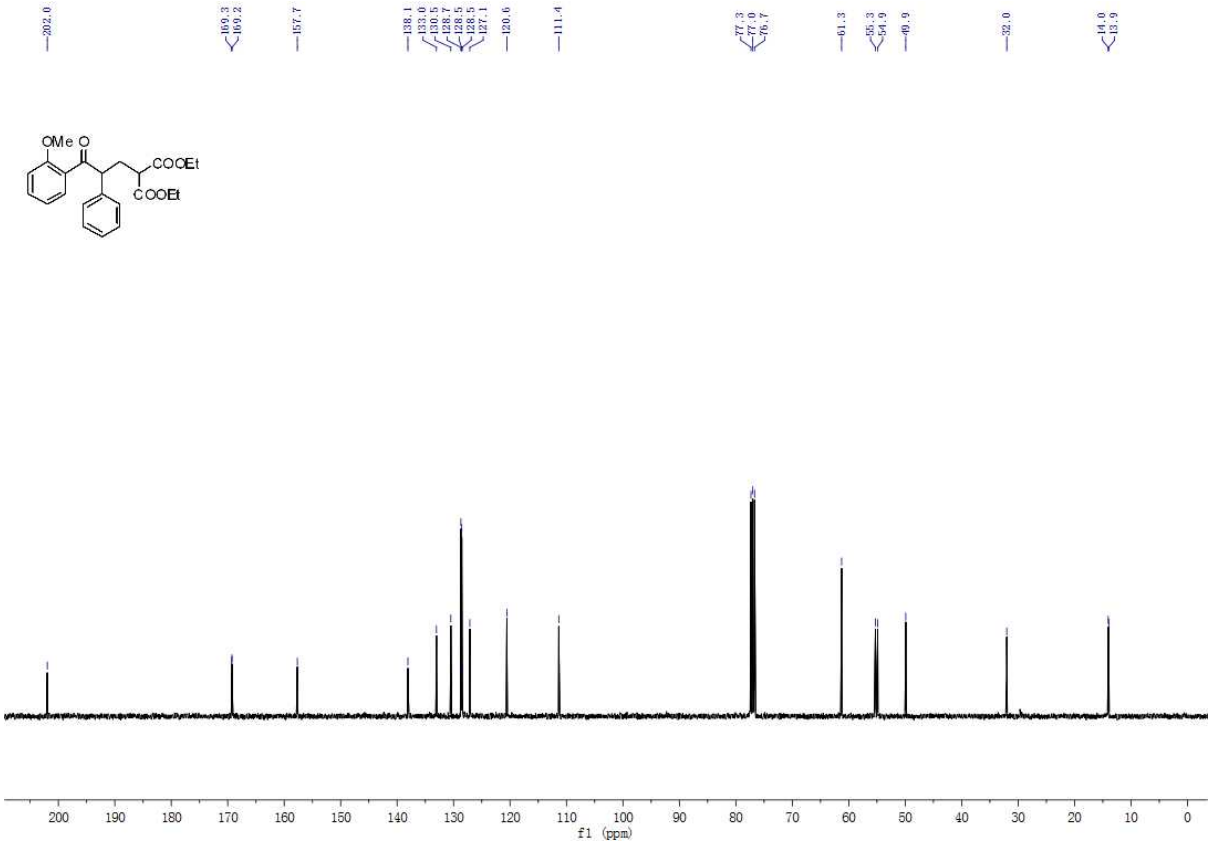


3o ^{13}C NMR



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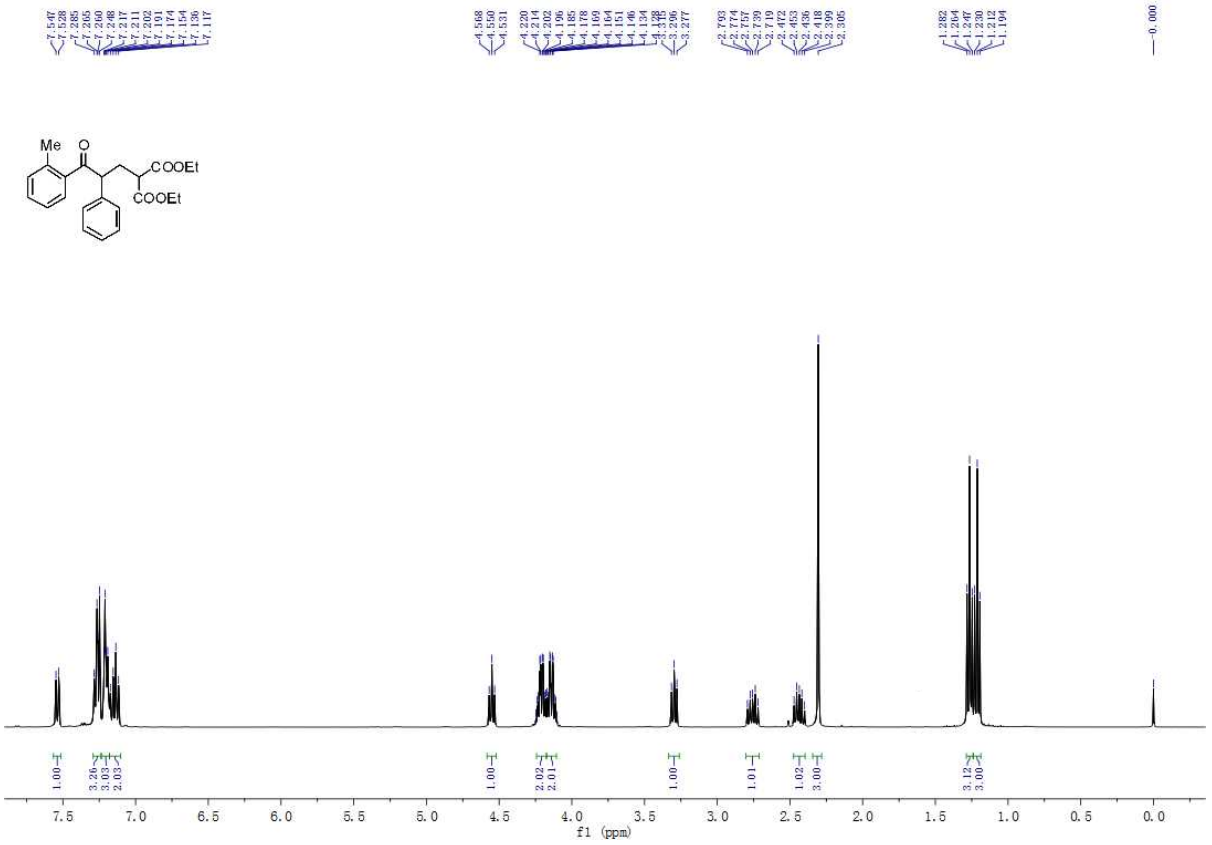
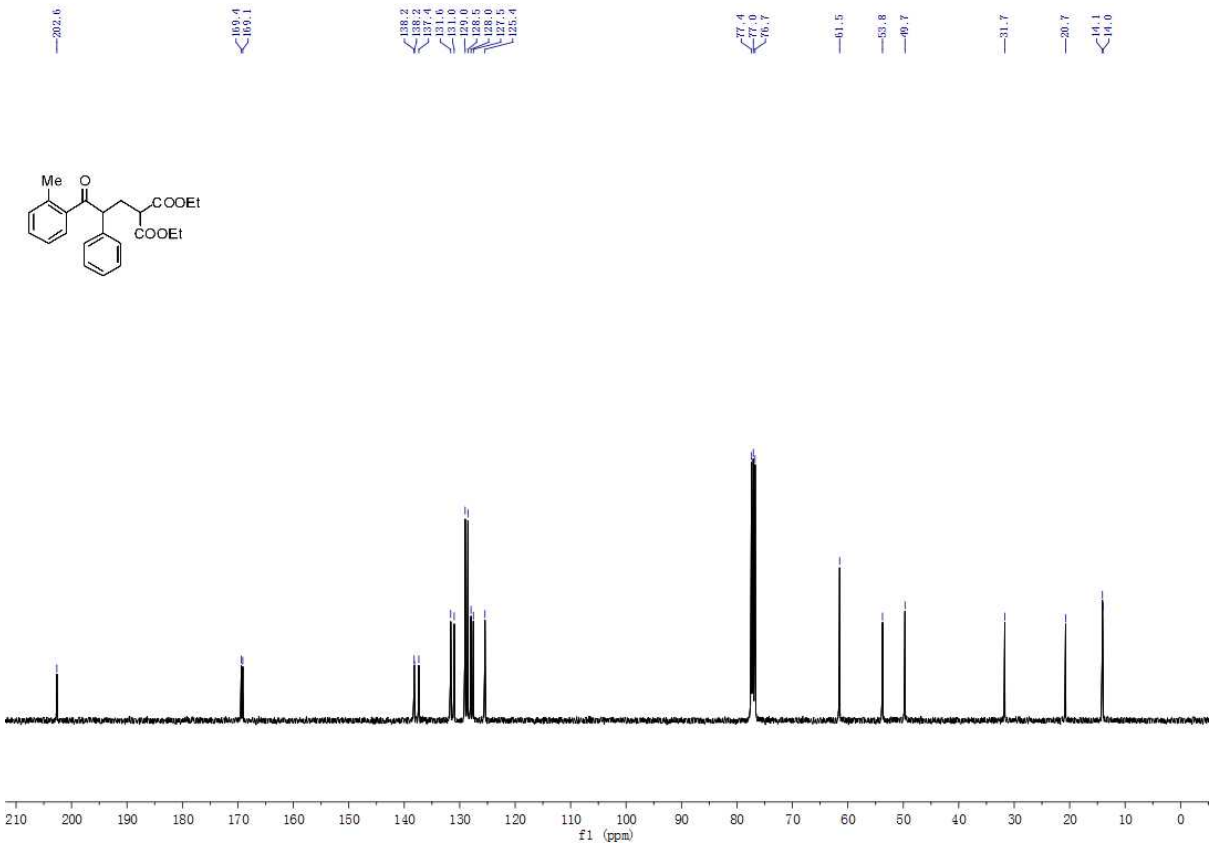
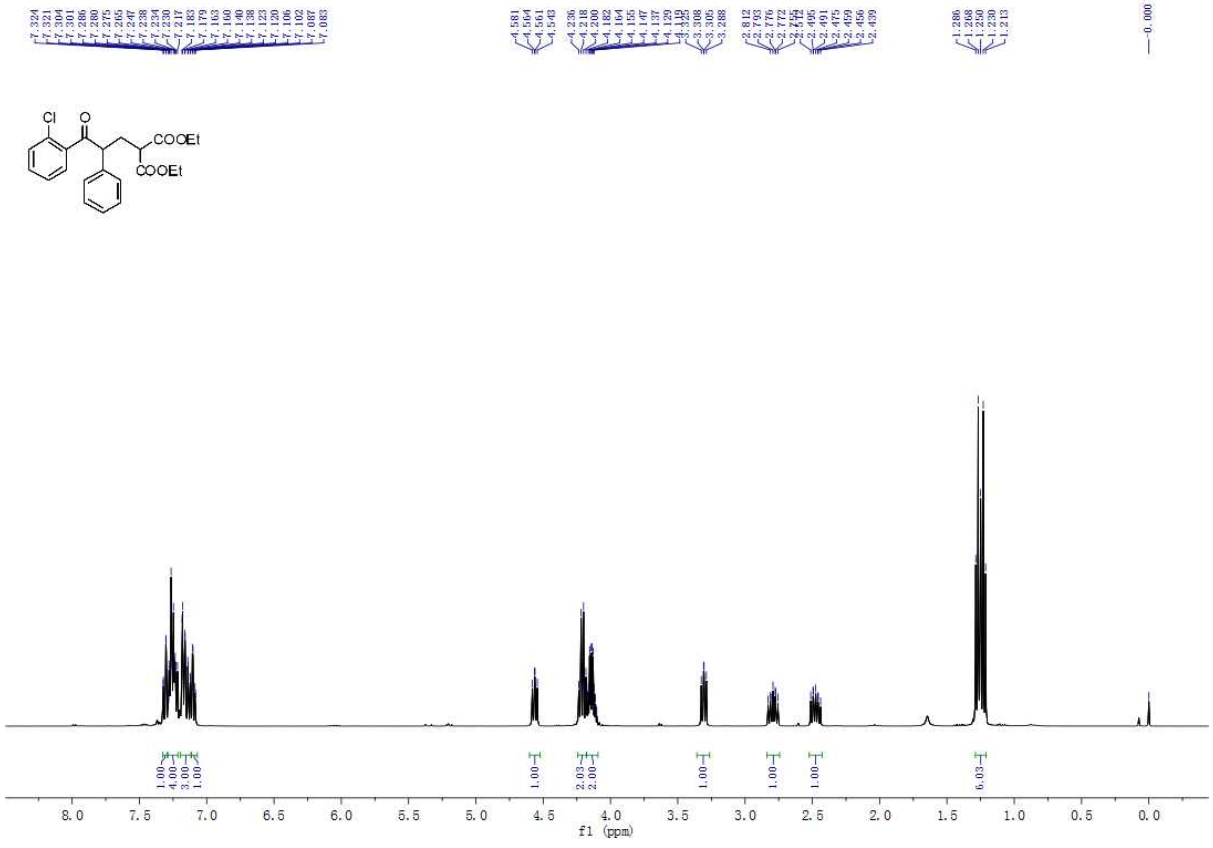


3p ^{13}C NMR



3q ^{1}H NMR



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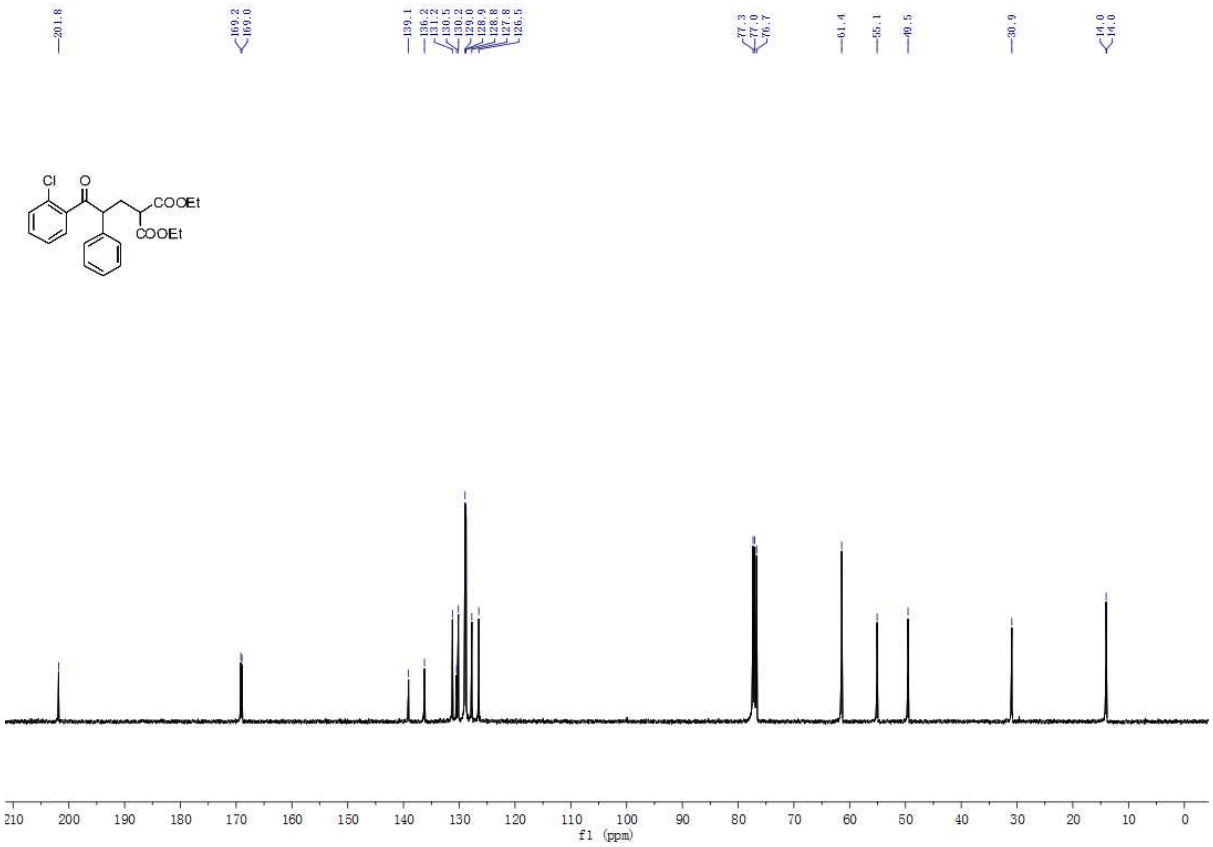

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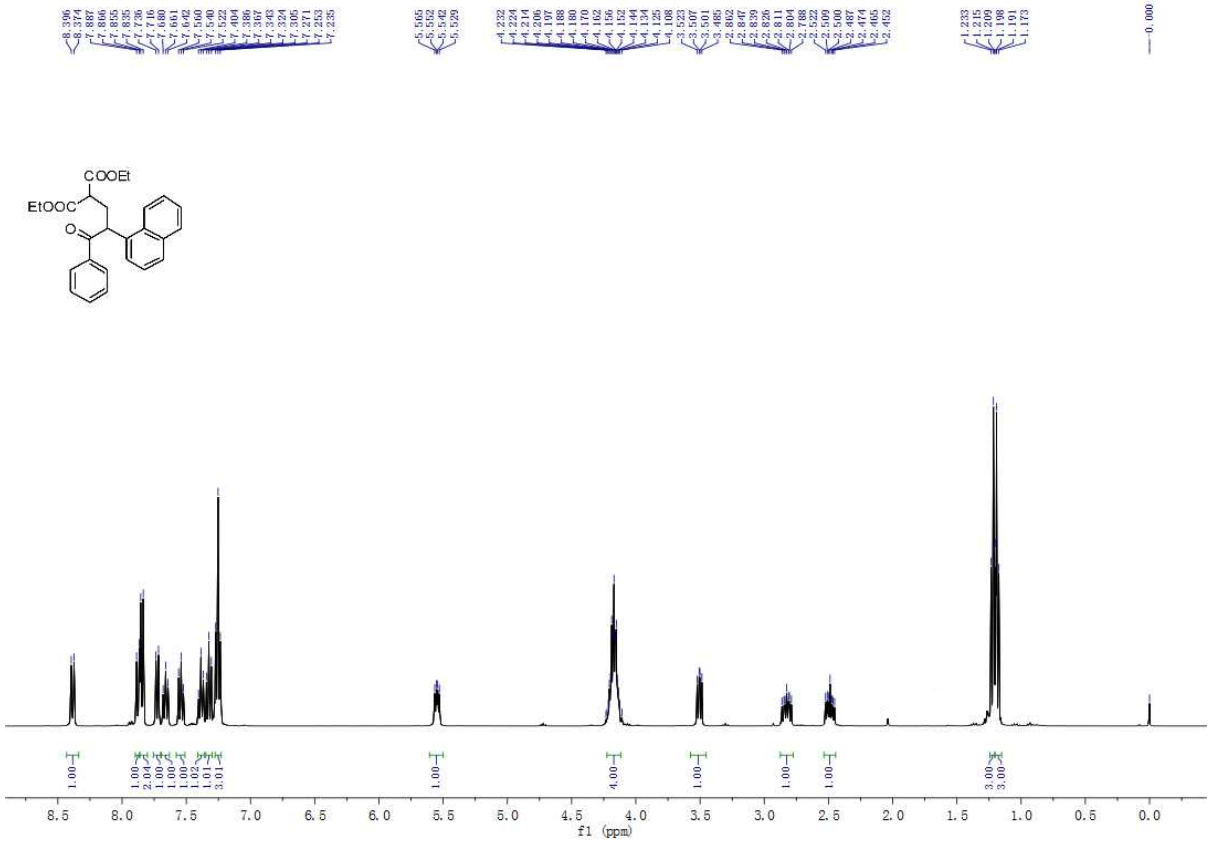

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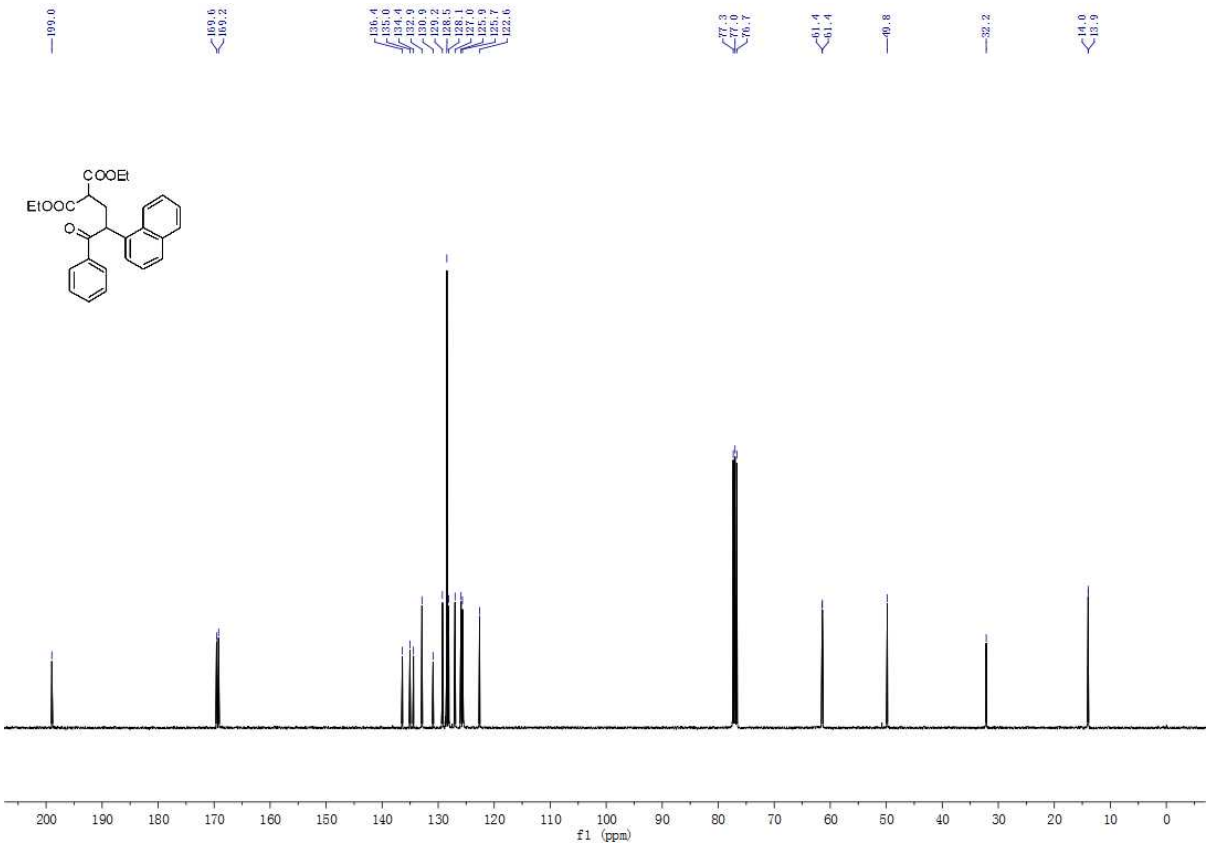
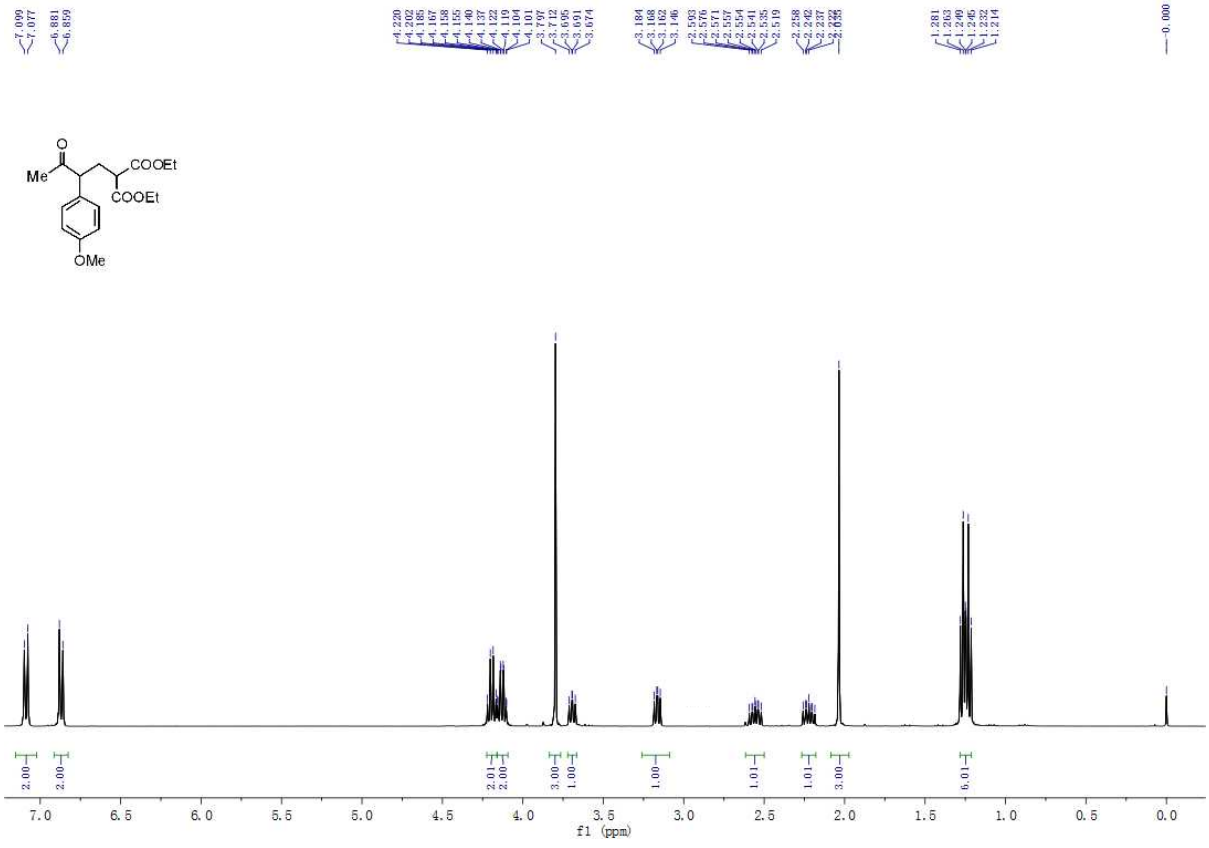


3s ^{1}H NMR



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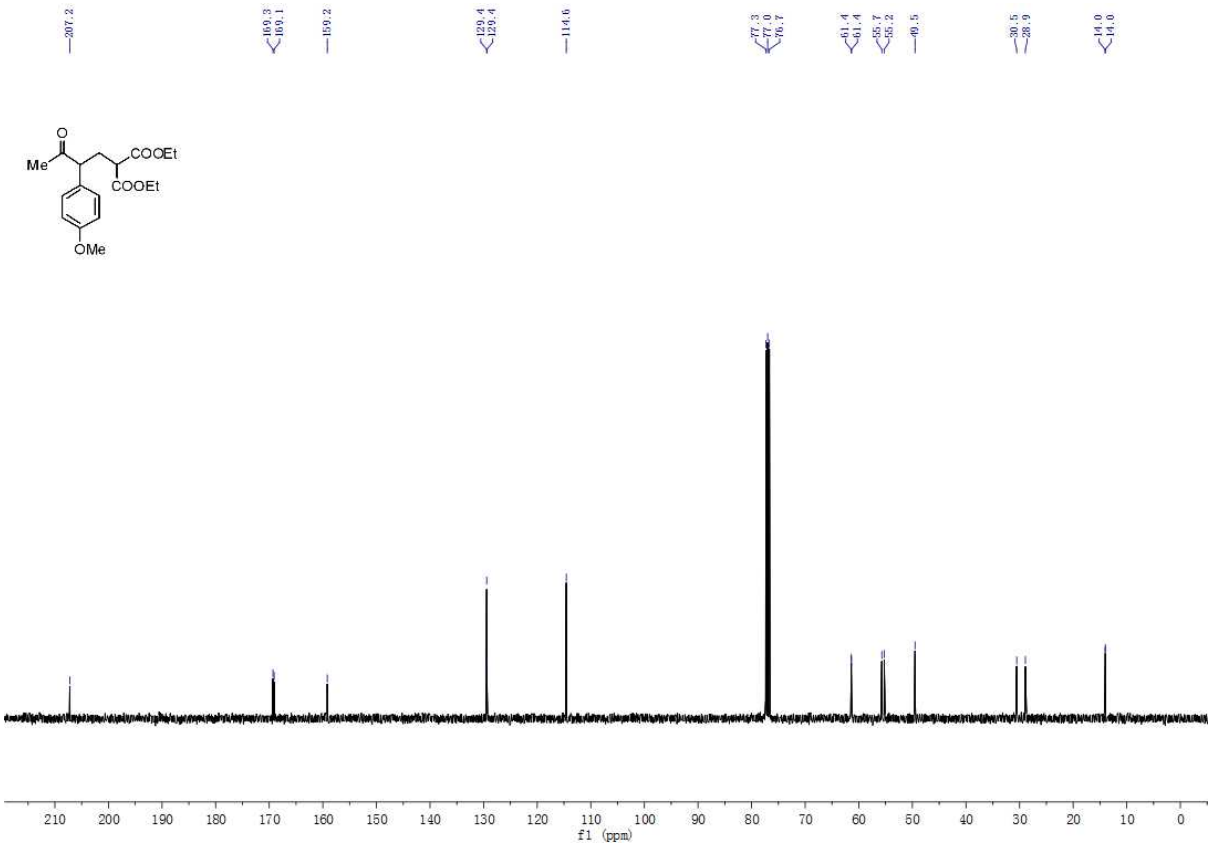

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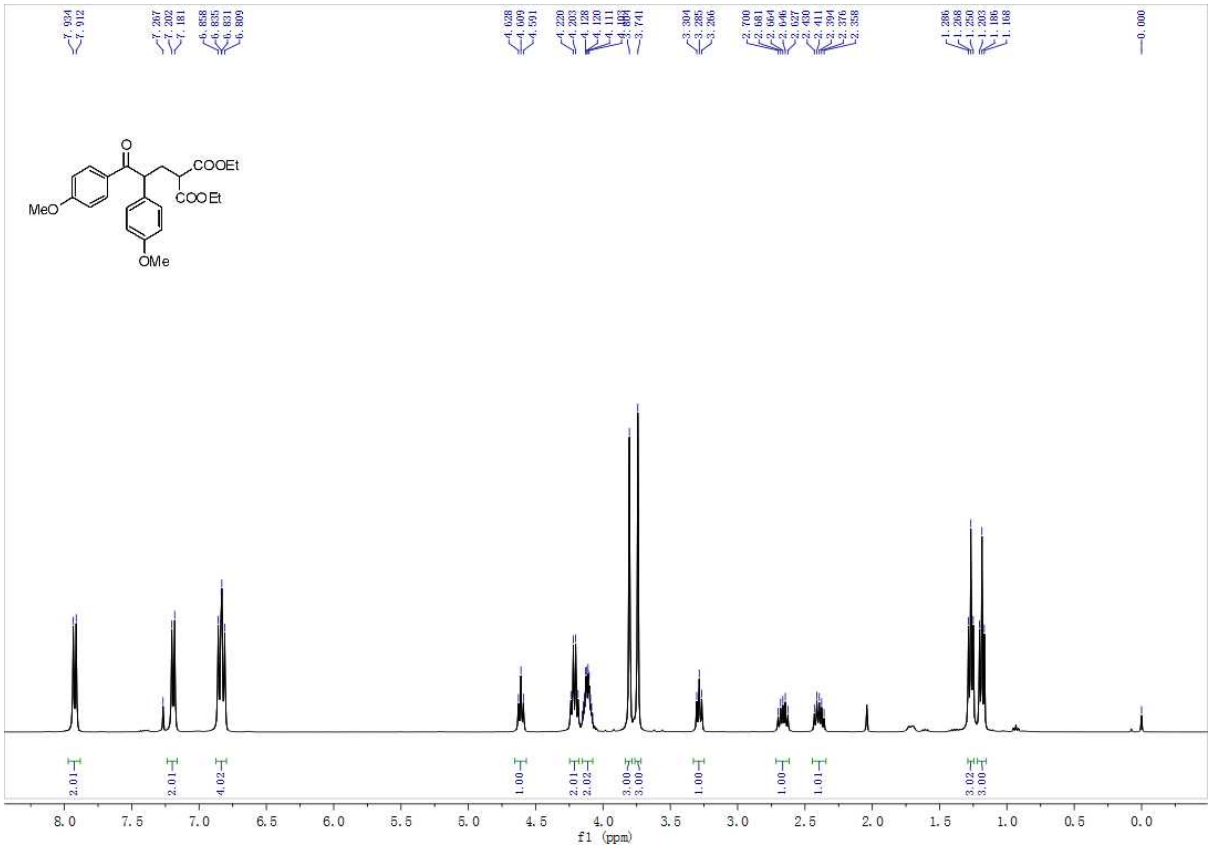
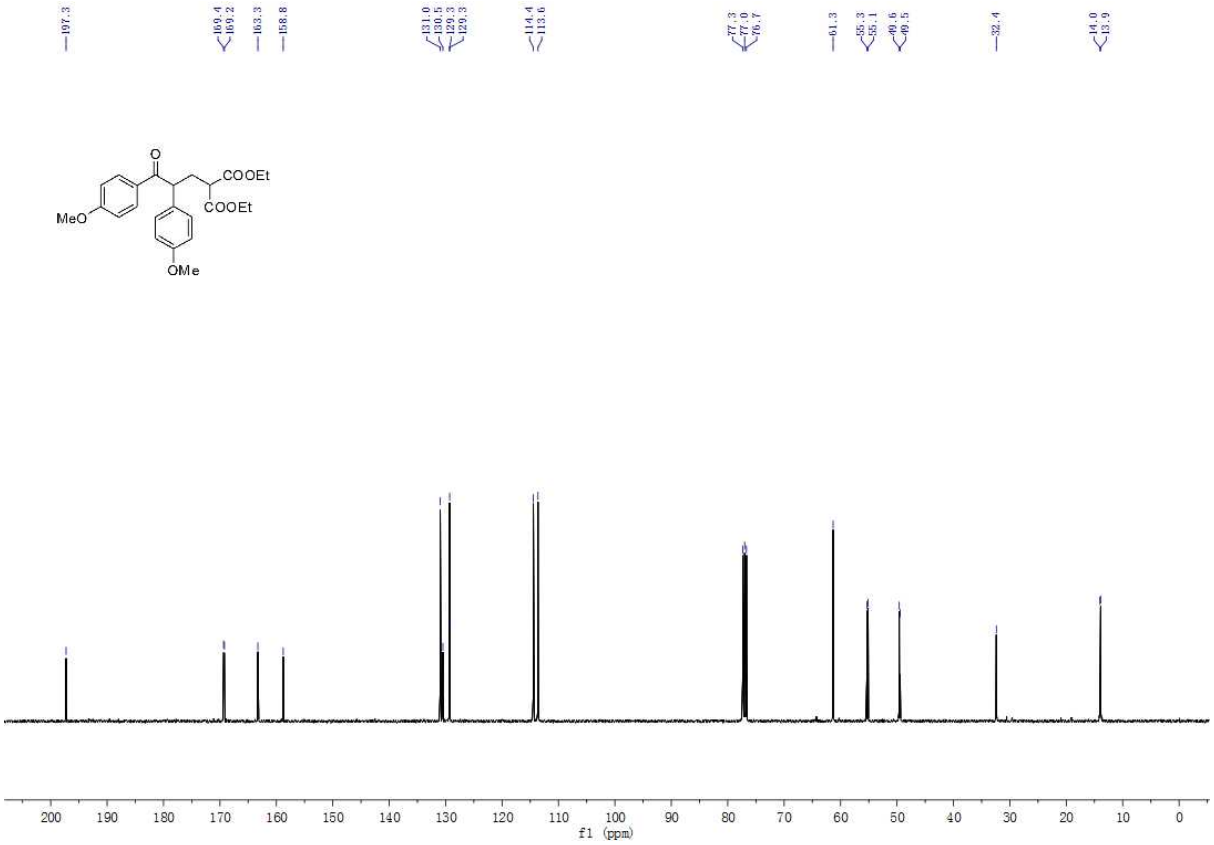


3t ^{13}C NMR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100
90
80
70
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50
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30
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10
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f1 (ppm)