Supporting Information

Phosphine-Catalyzed [4+2] Cyclization of *para*-Quinone Methide Derivatives with Allenes

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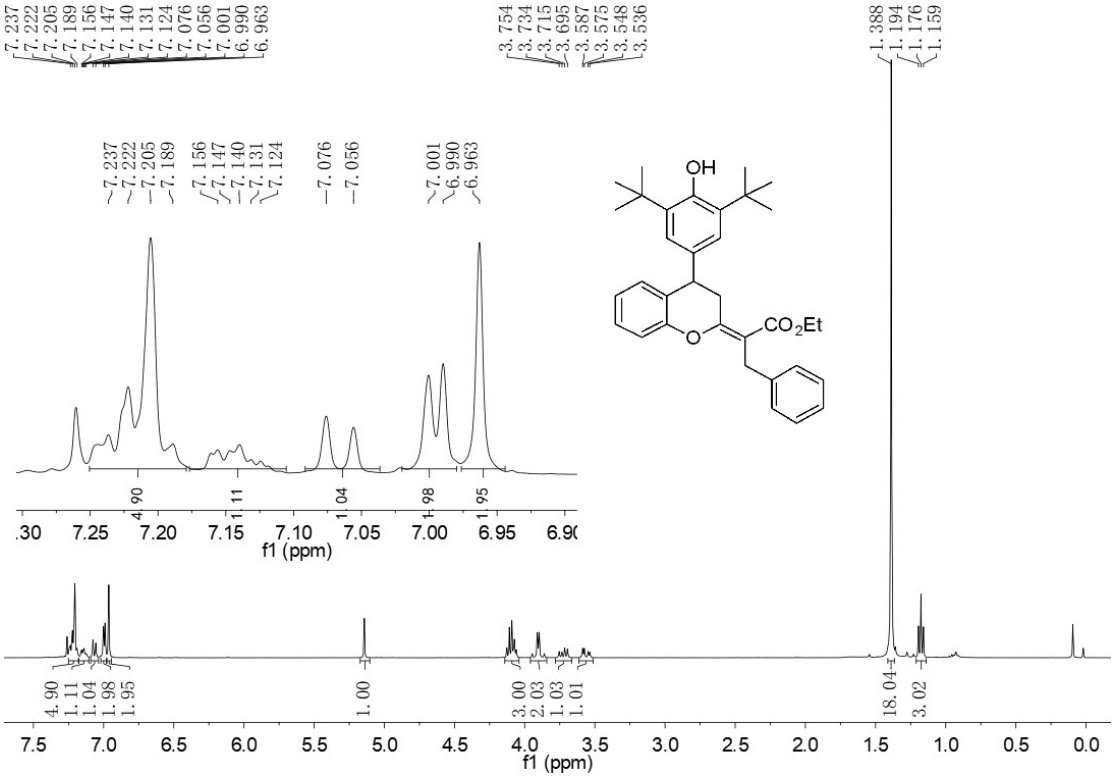
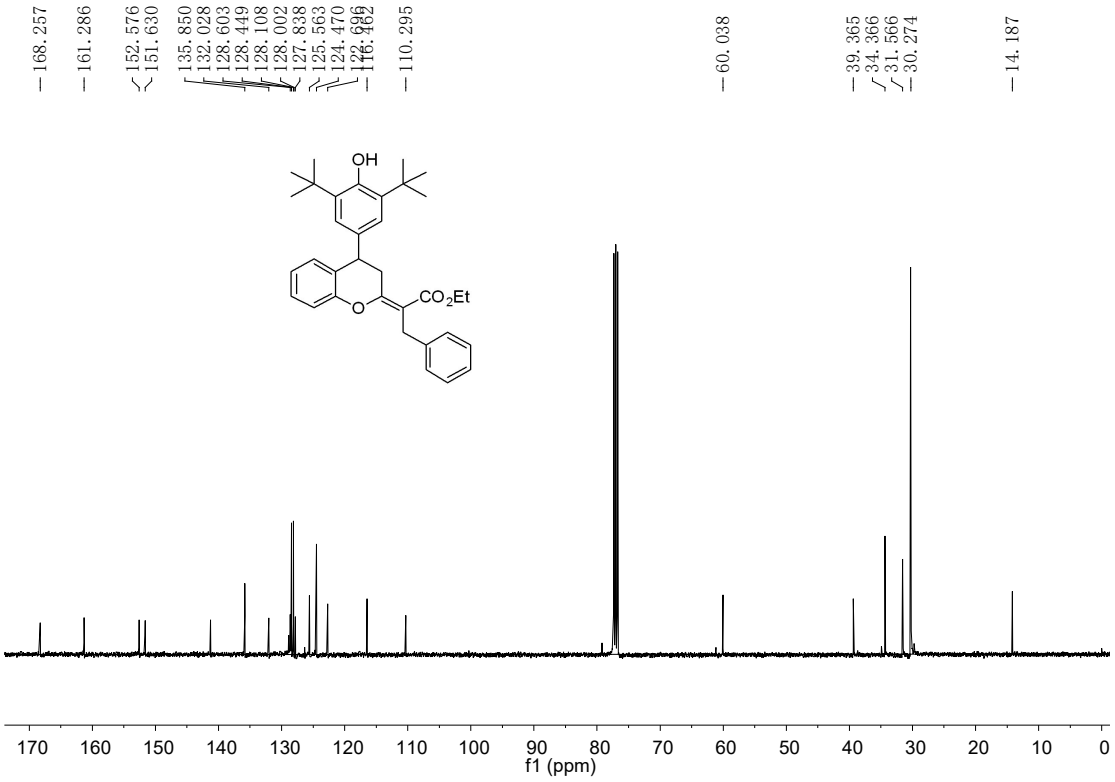
Contents:

1. NMR spectra of products 3

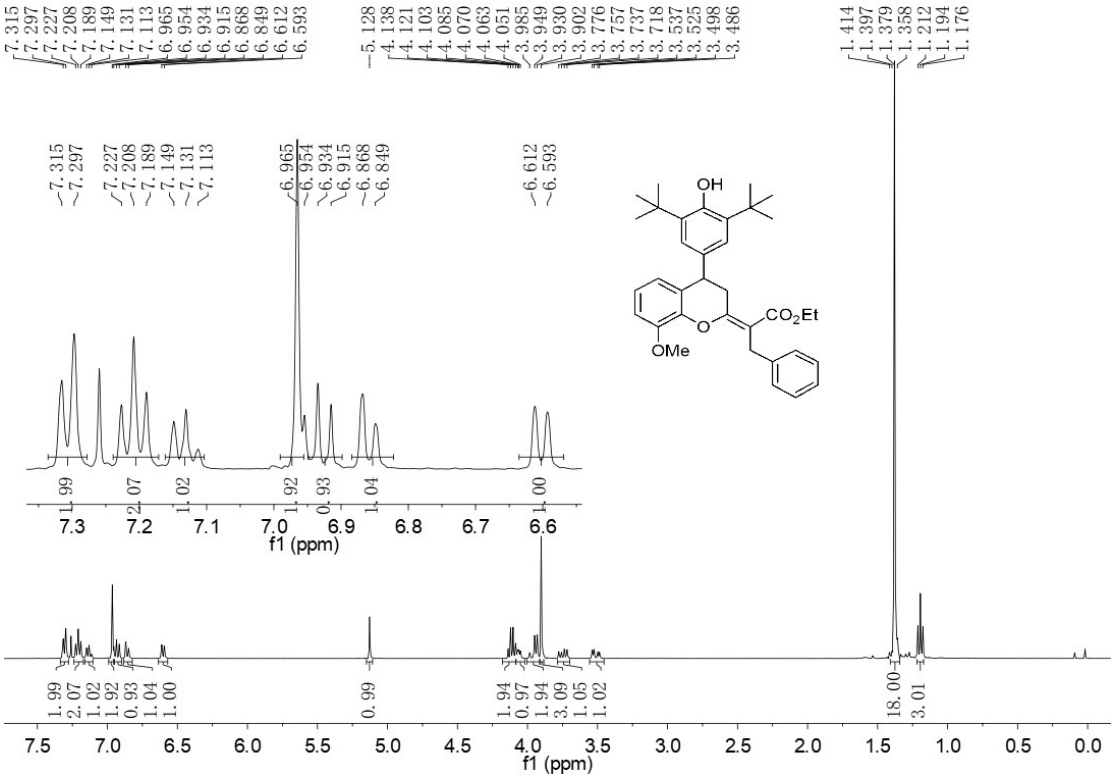
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3aa**



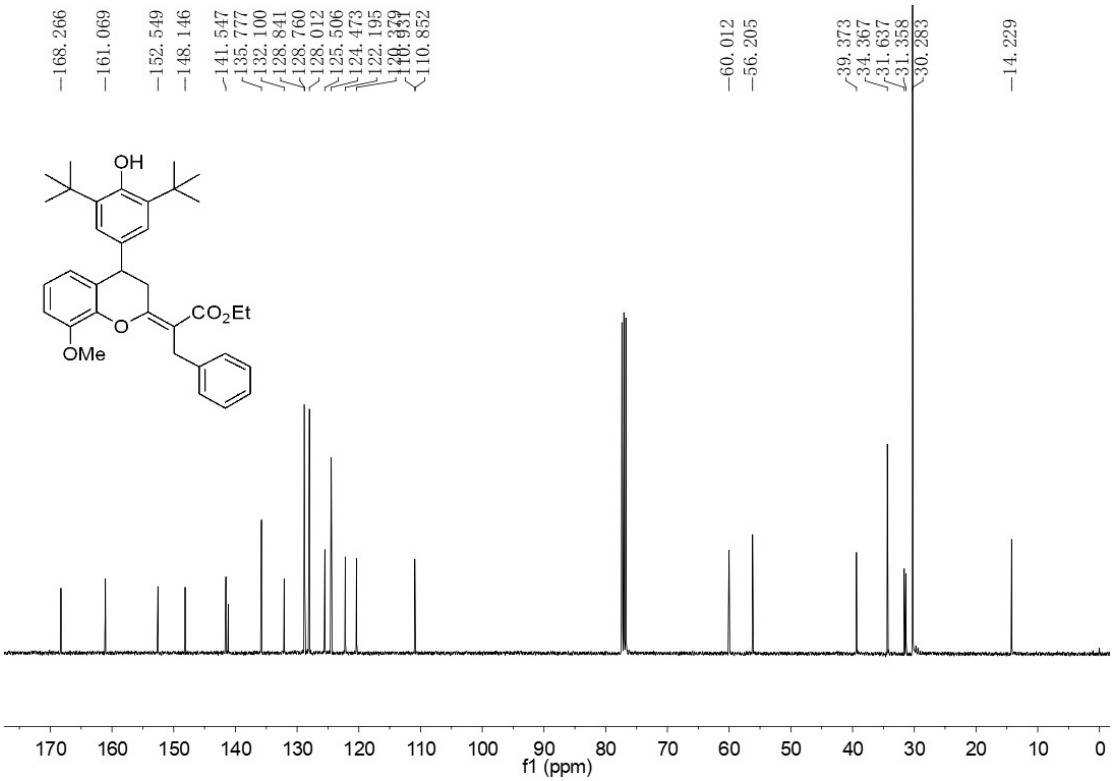
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3aa**



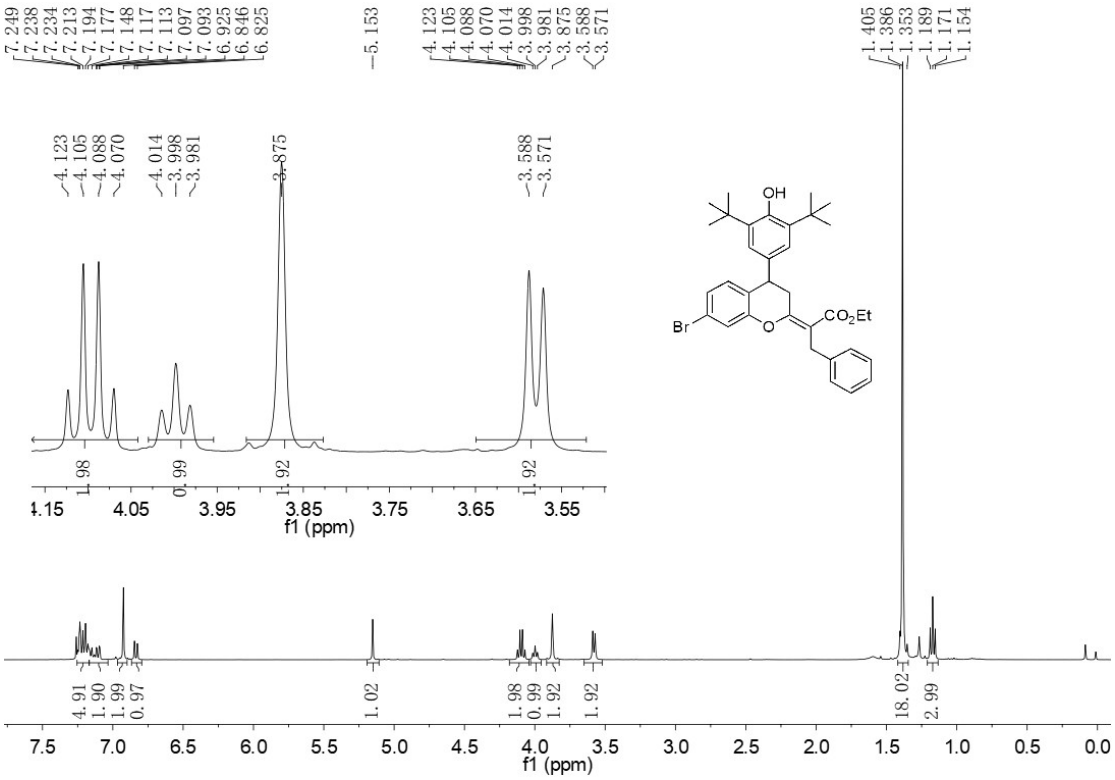
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ba**



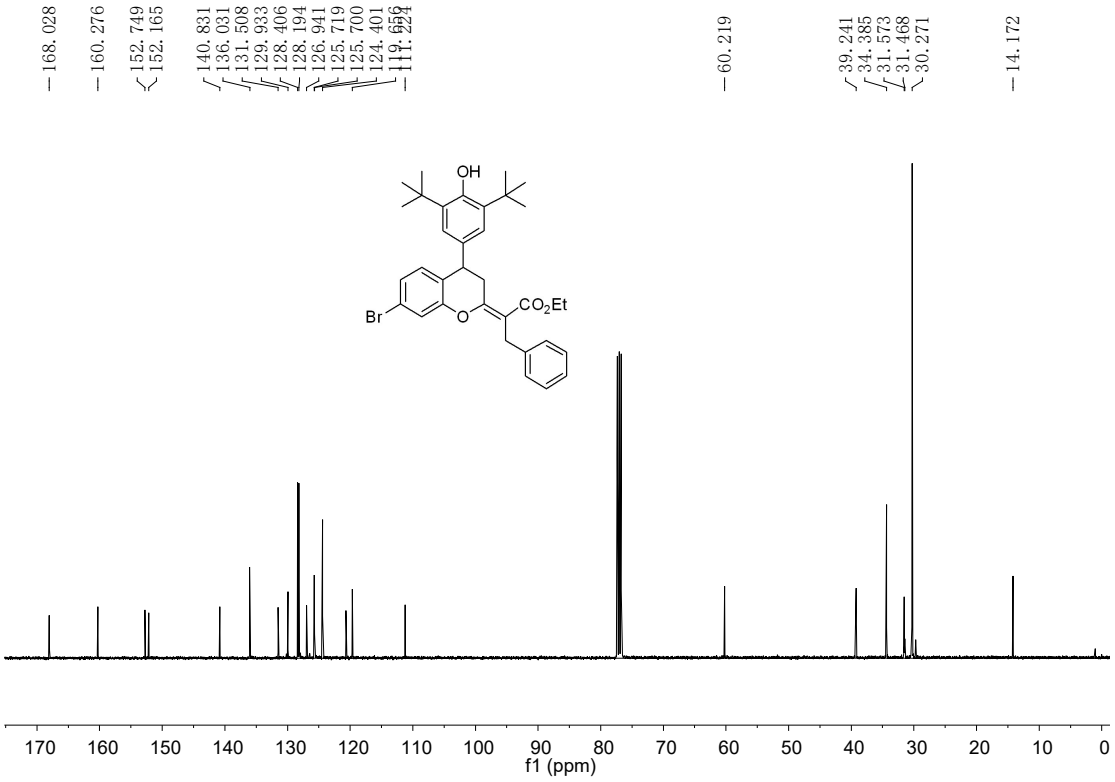
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ba**



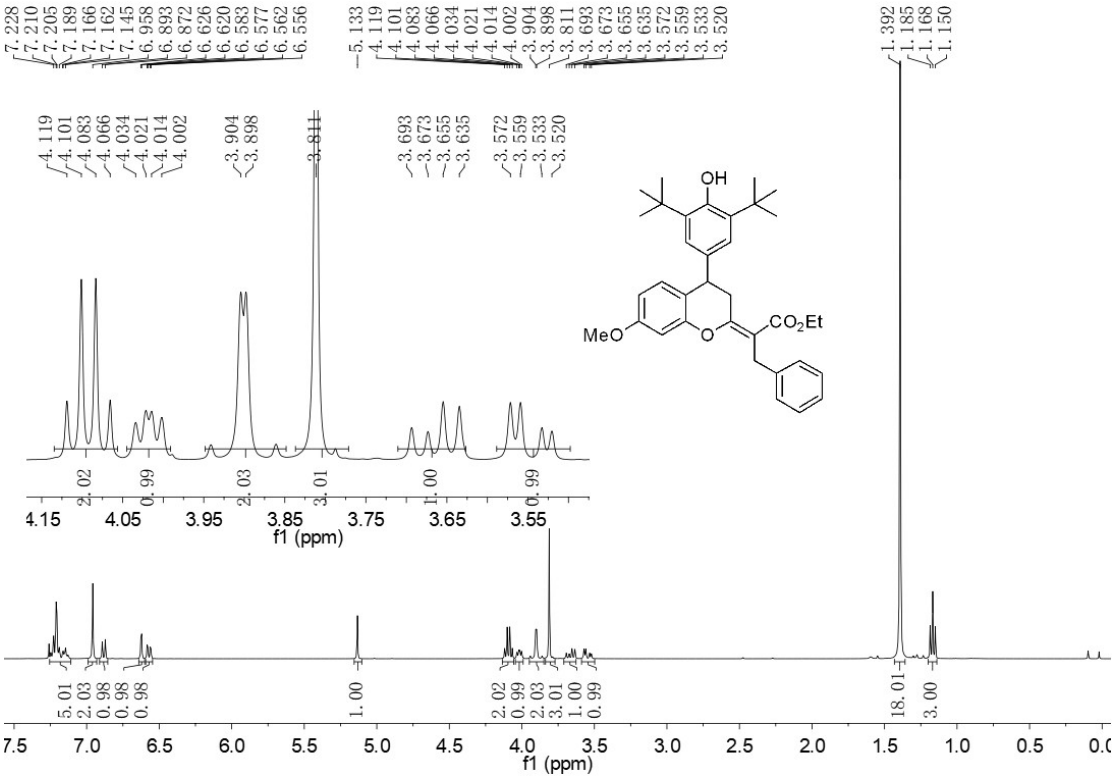
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ca**



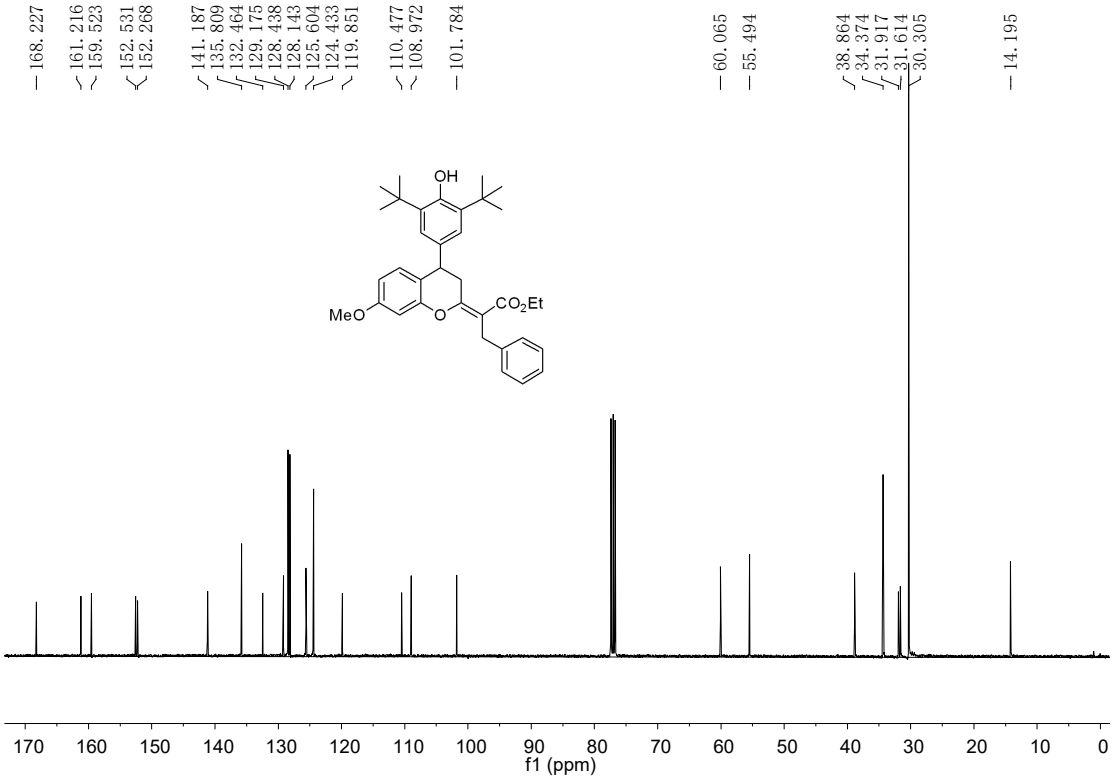
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ca**



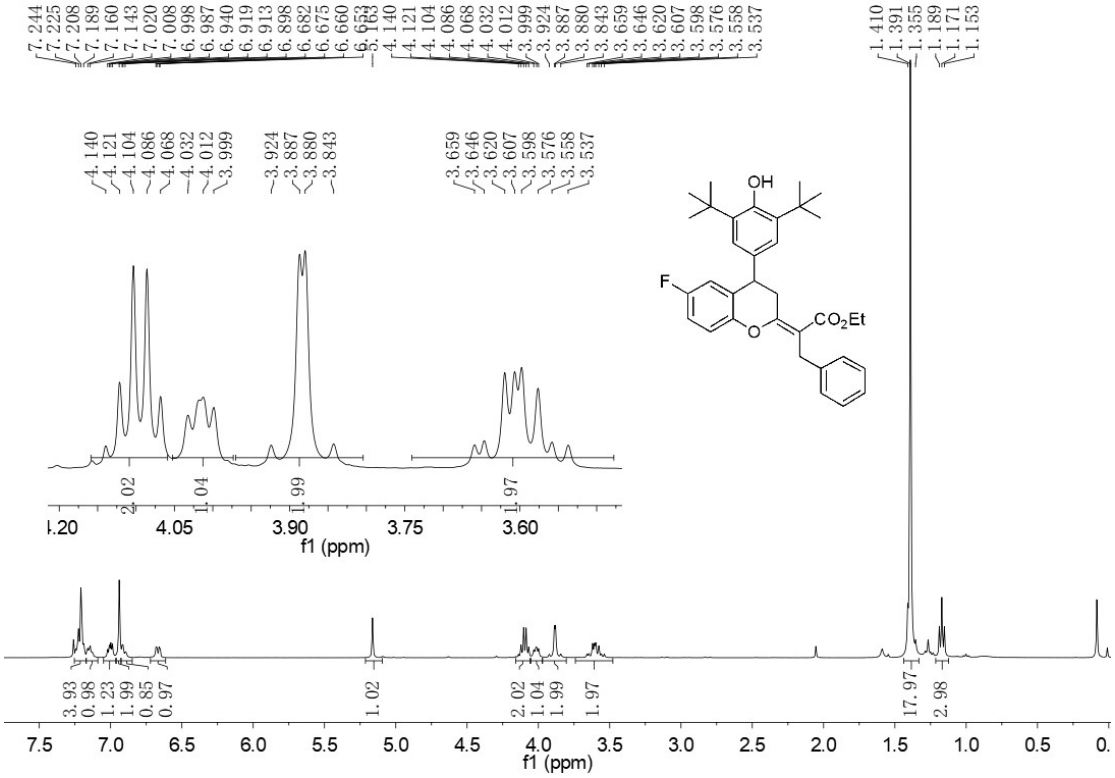
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3da**



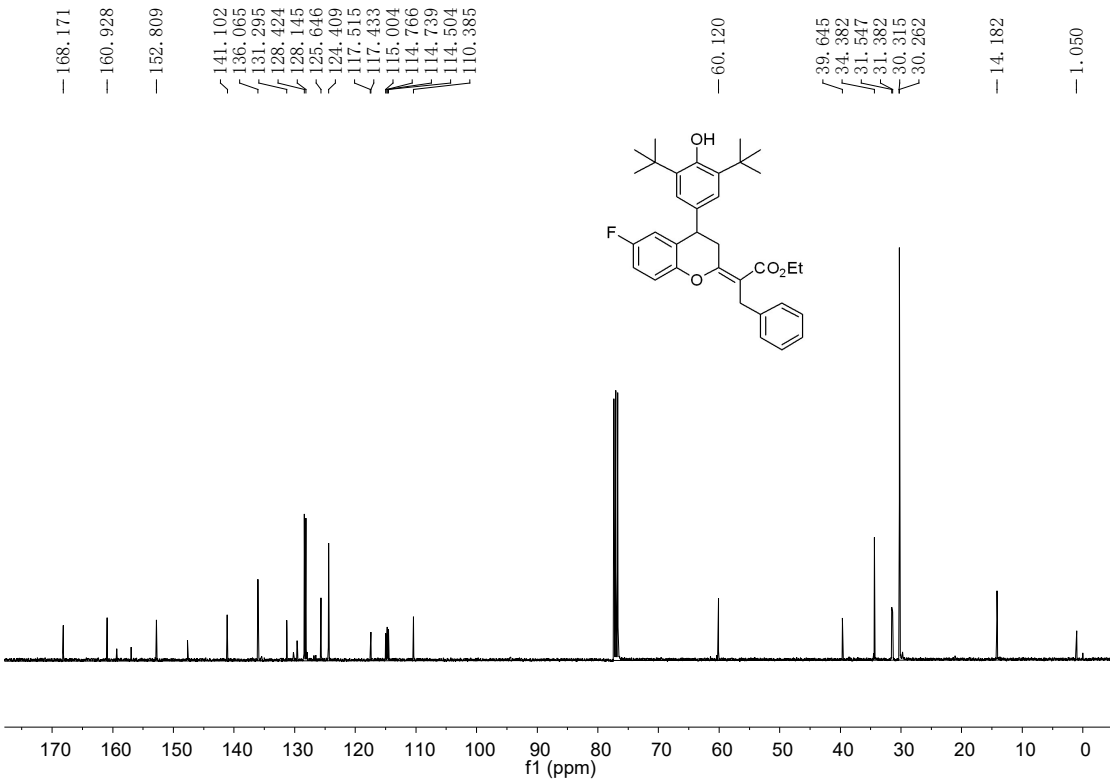
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3da**



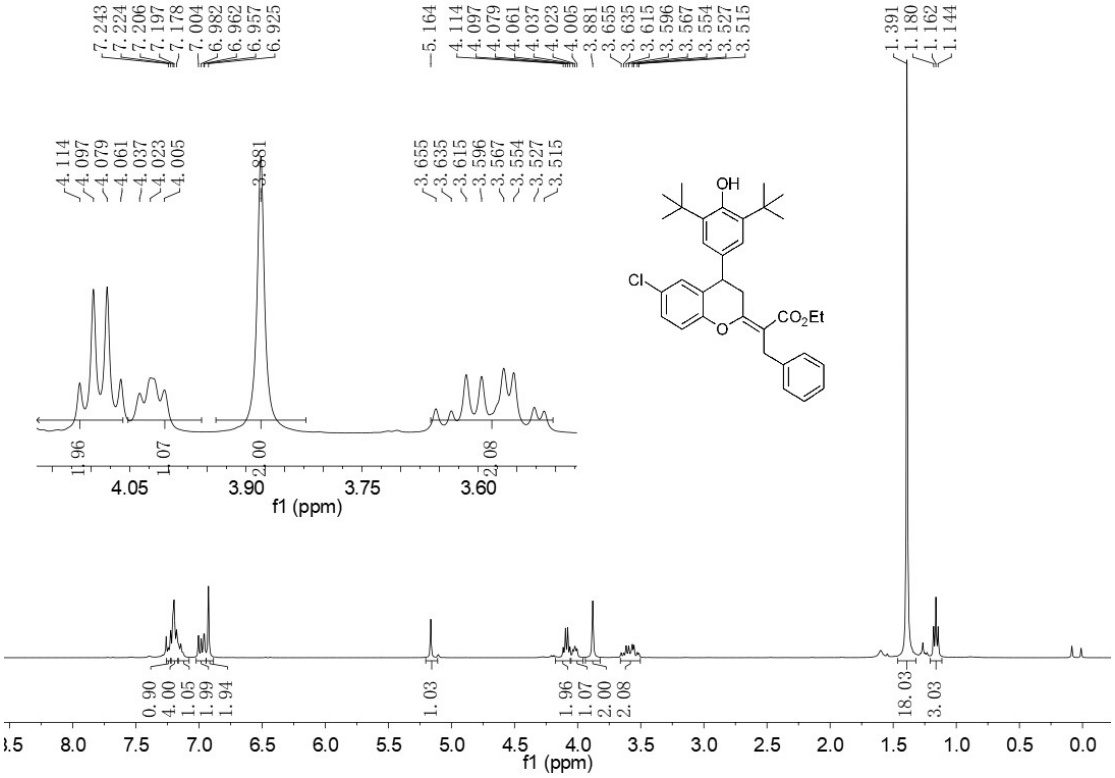
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ea**



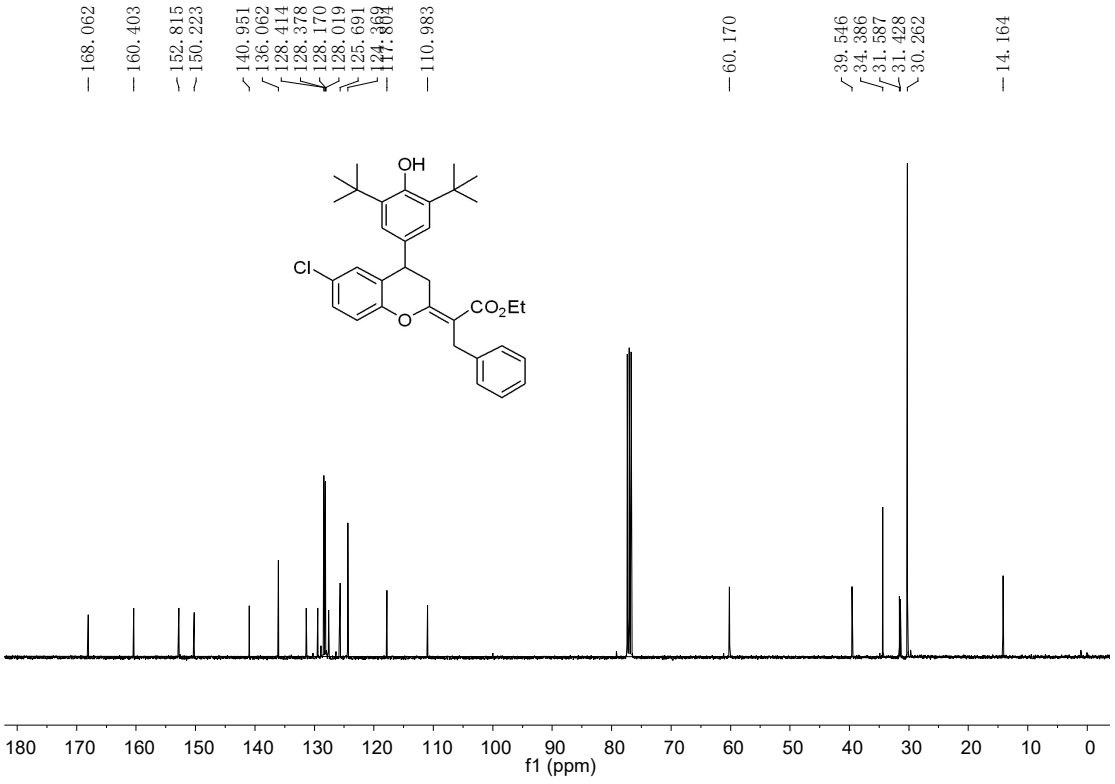
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ea**



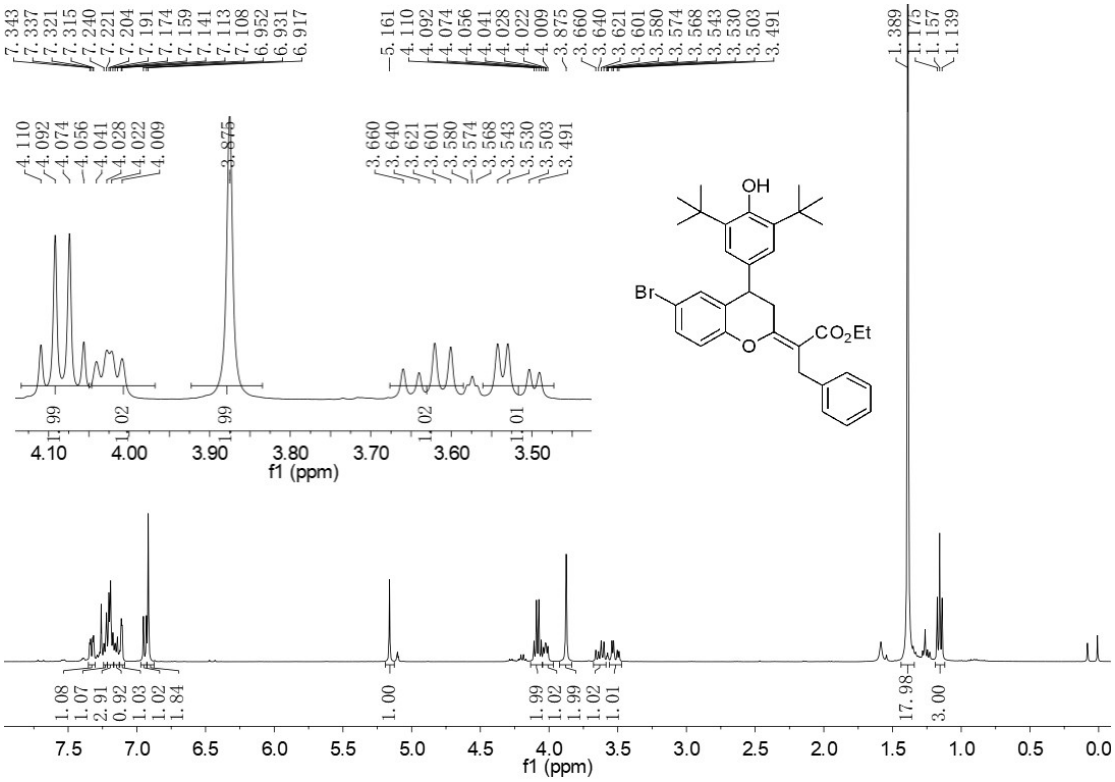
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3fa**



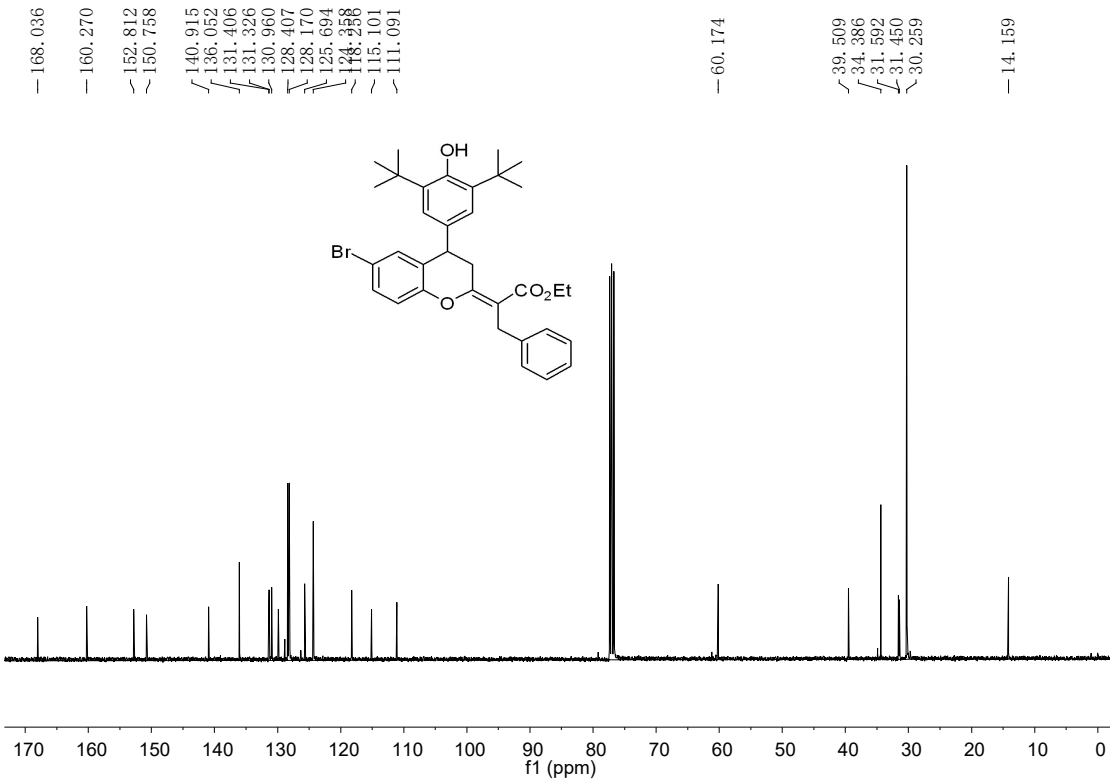
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3fa**



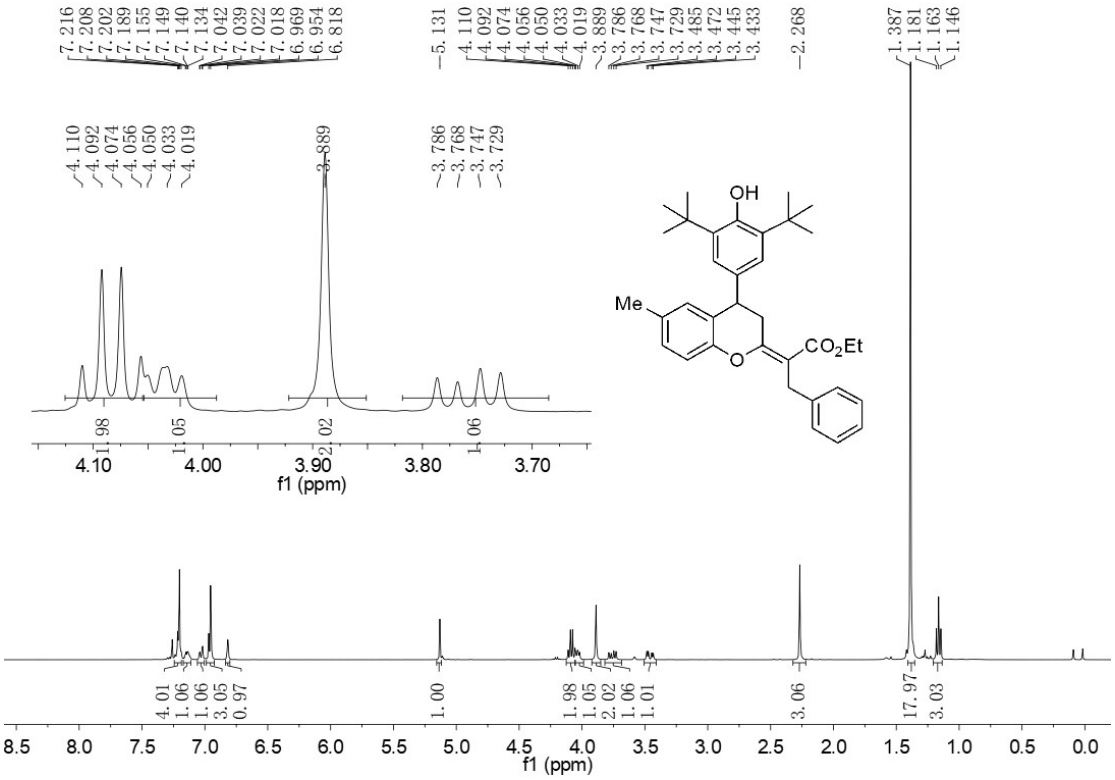
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ga**



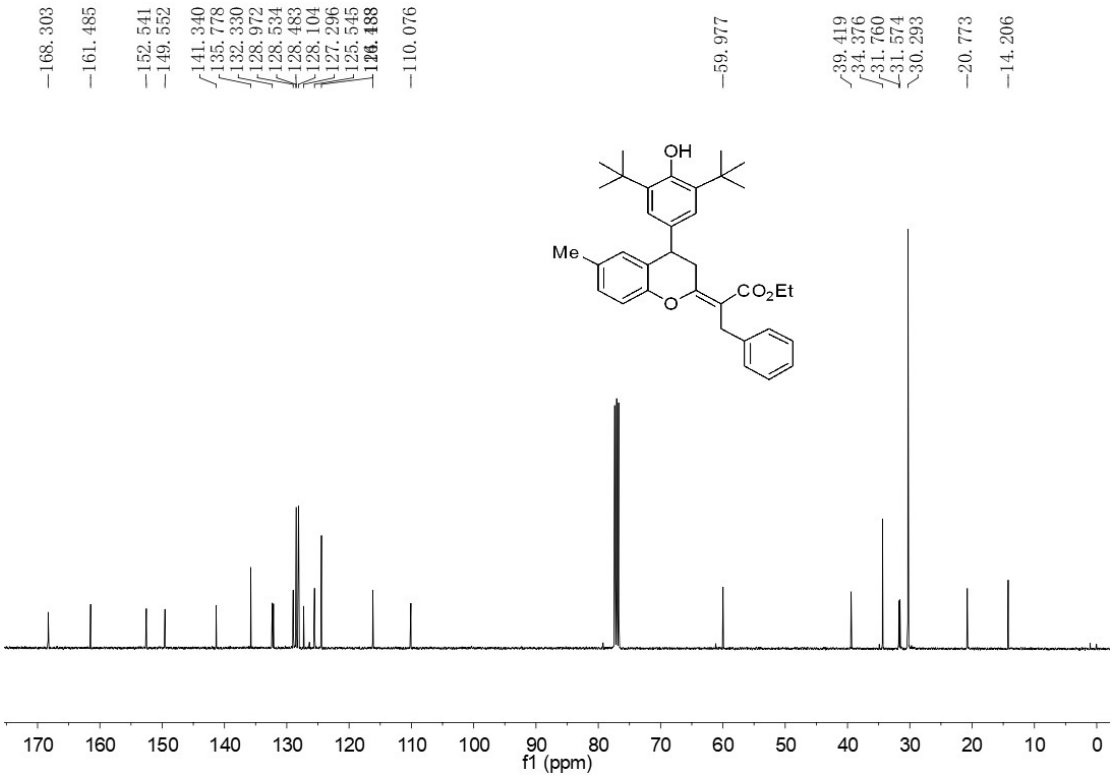
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ga**



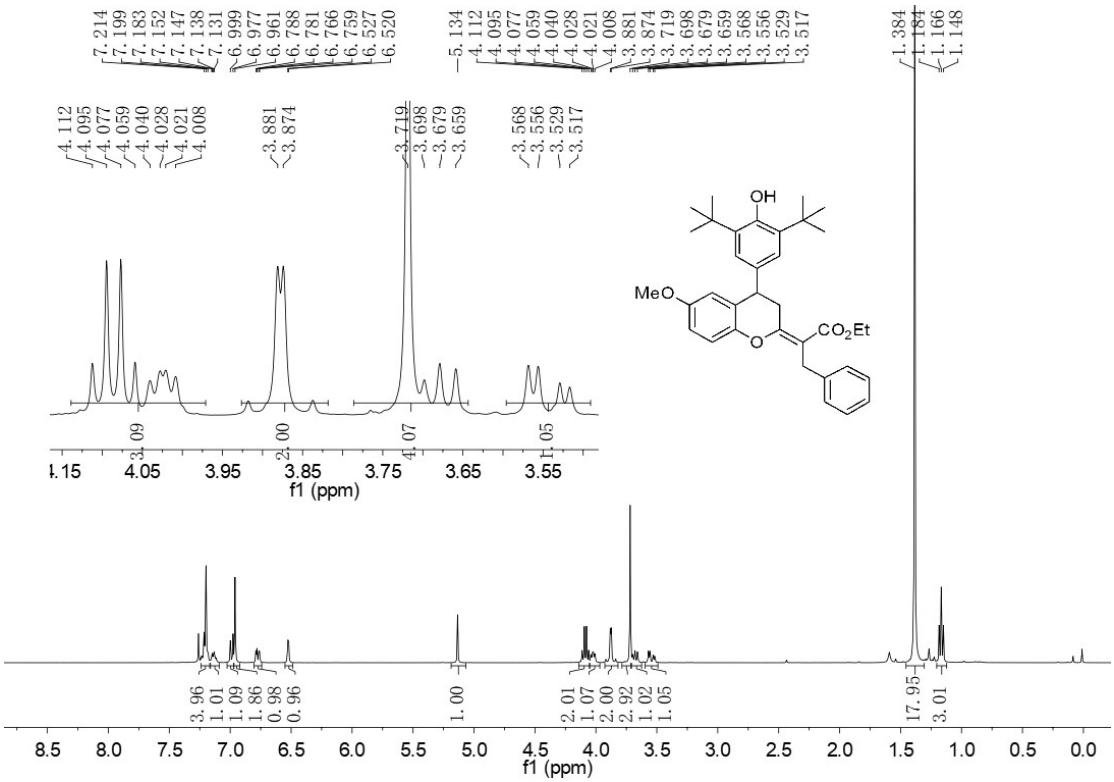
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ha**



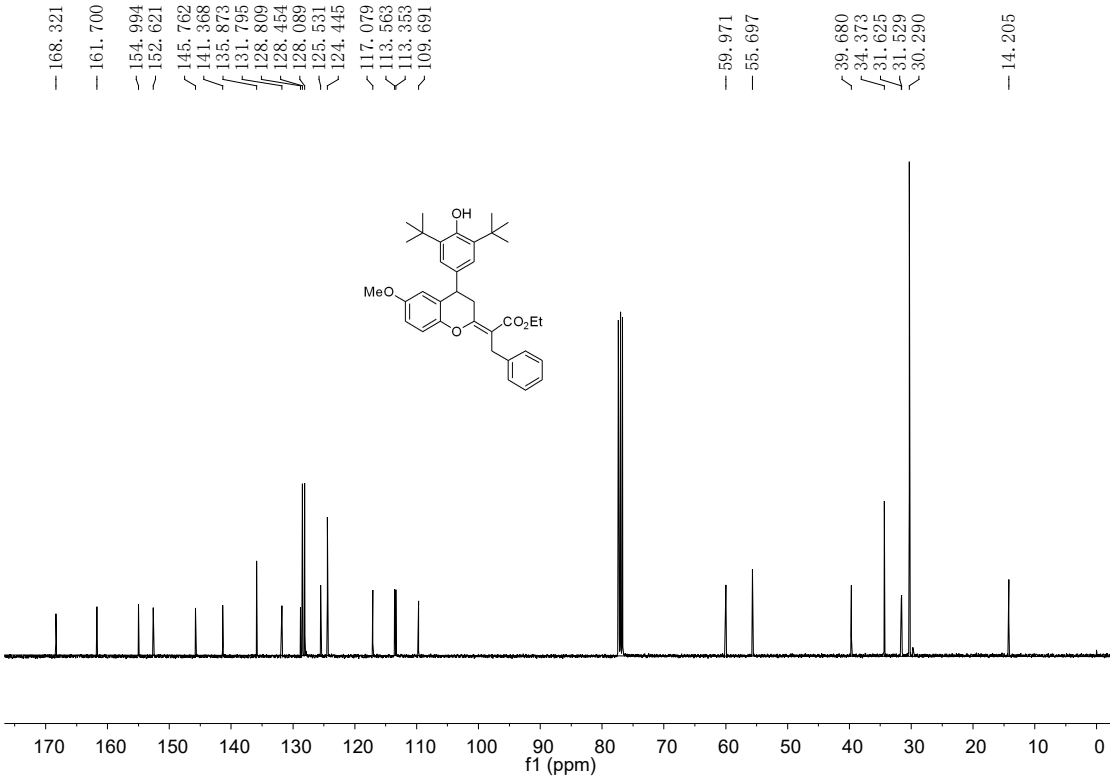
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ha**



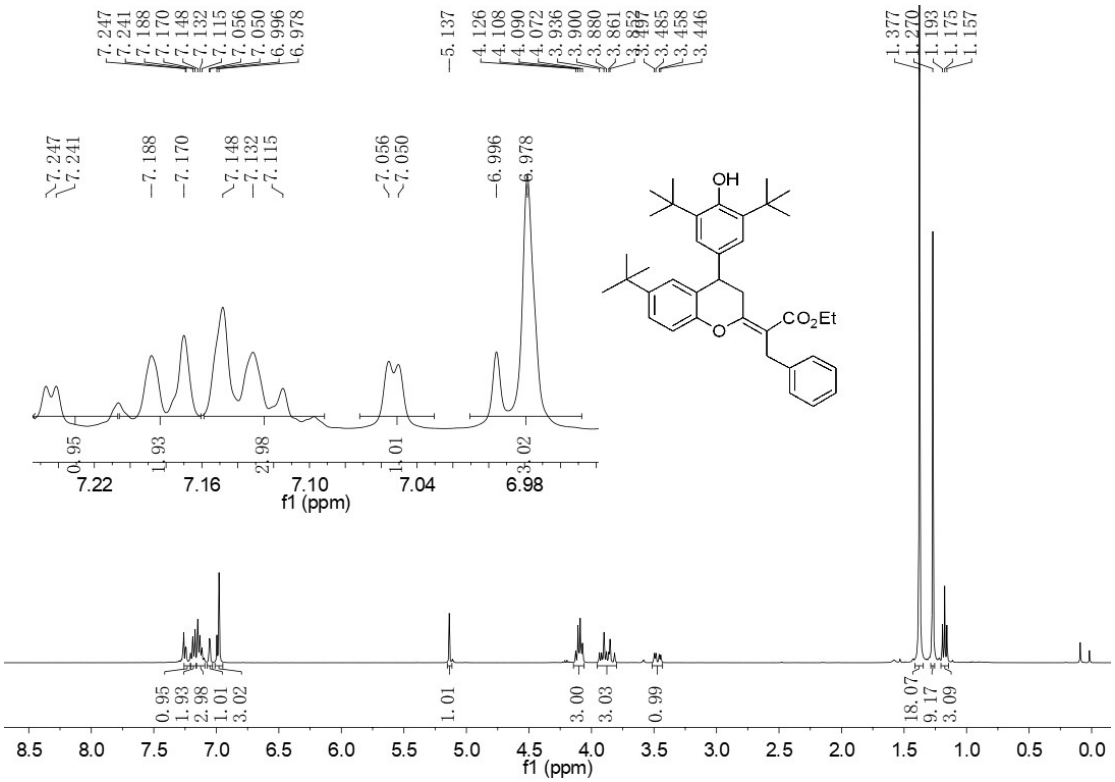
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ia**



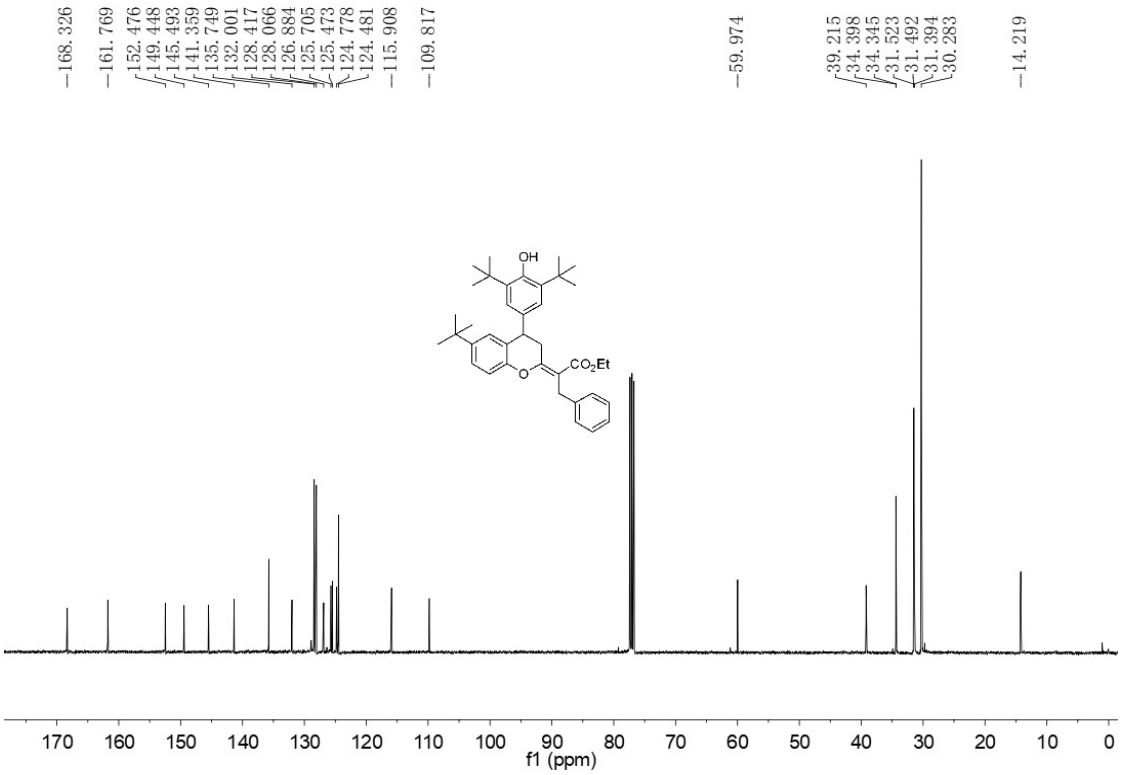
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ia**



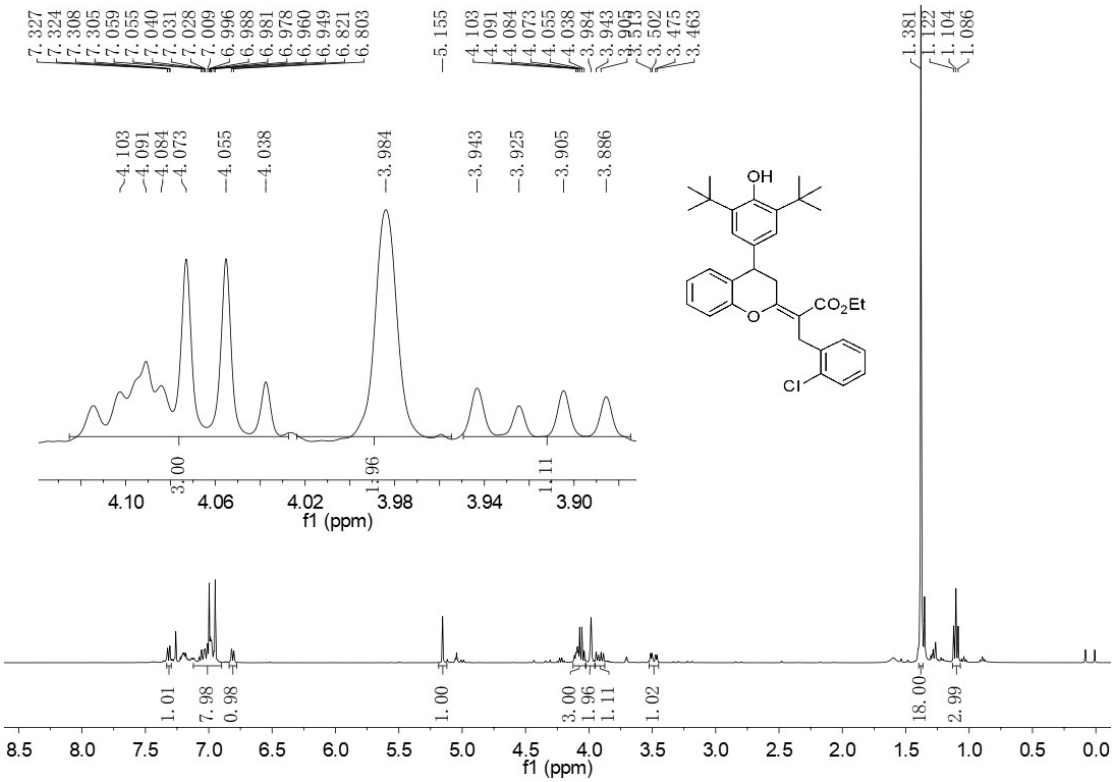
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ja**



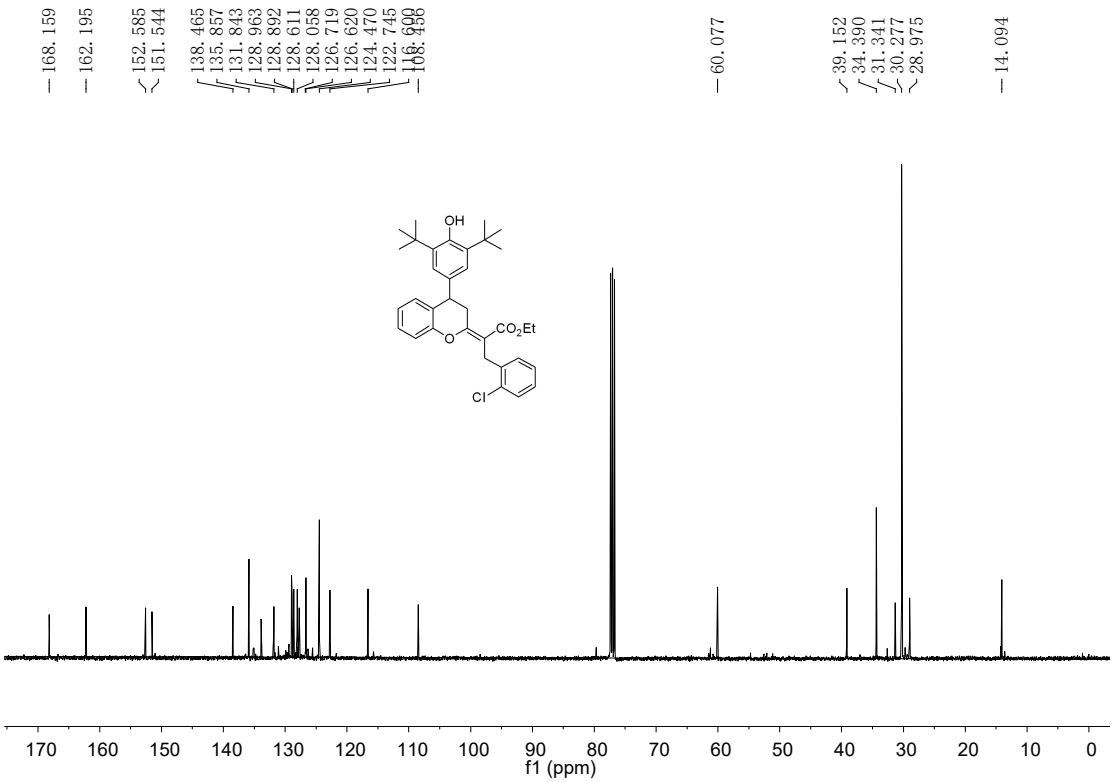
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ja**



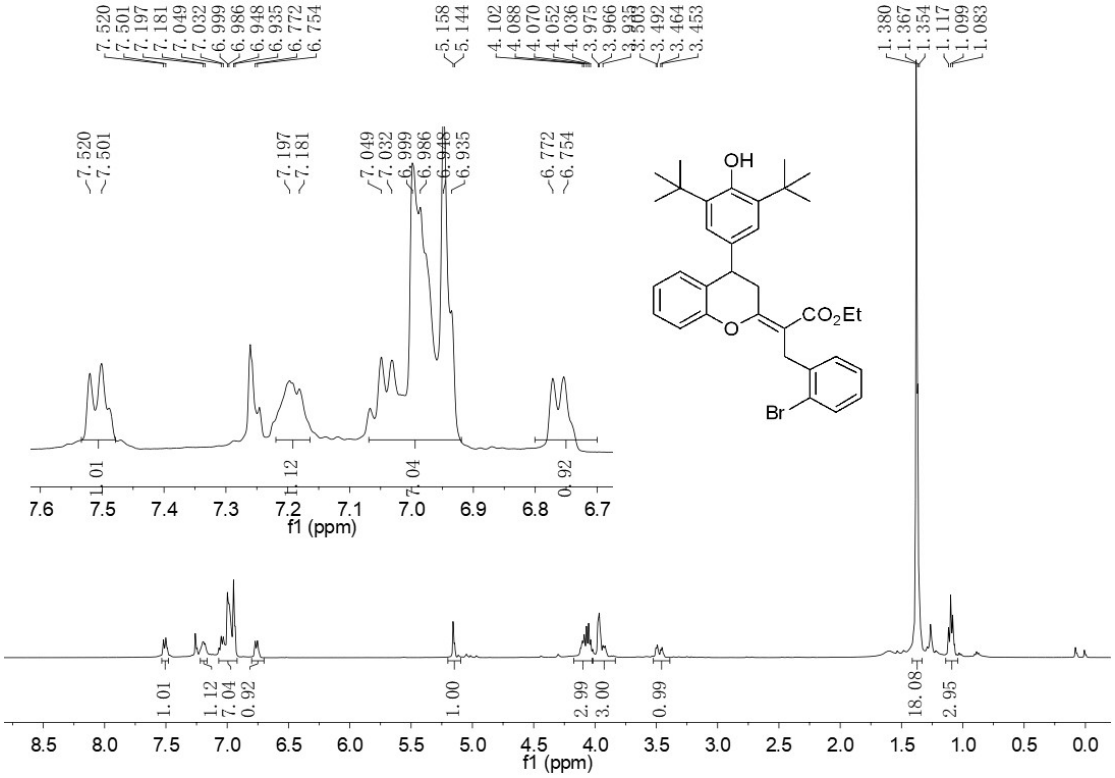
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ab**



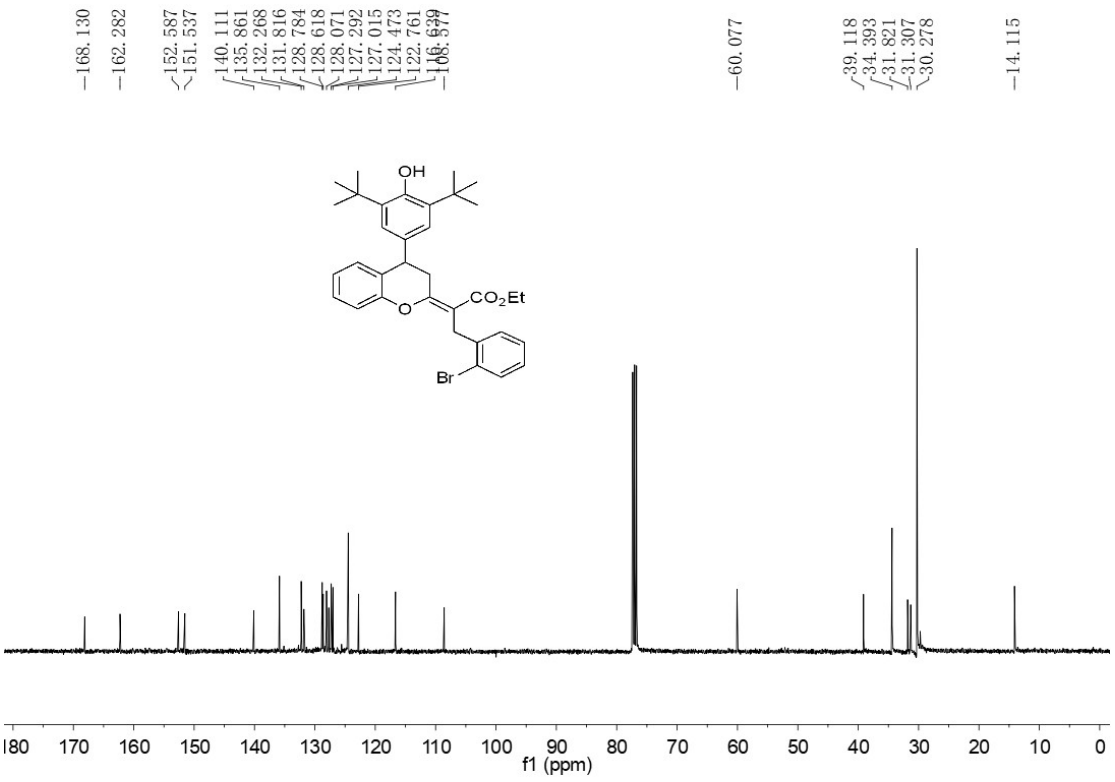
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ab**



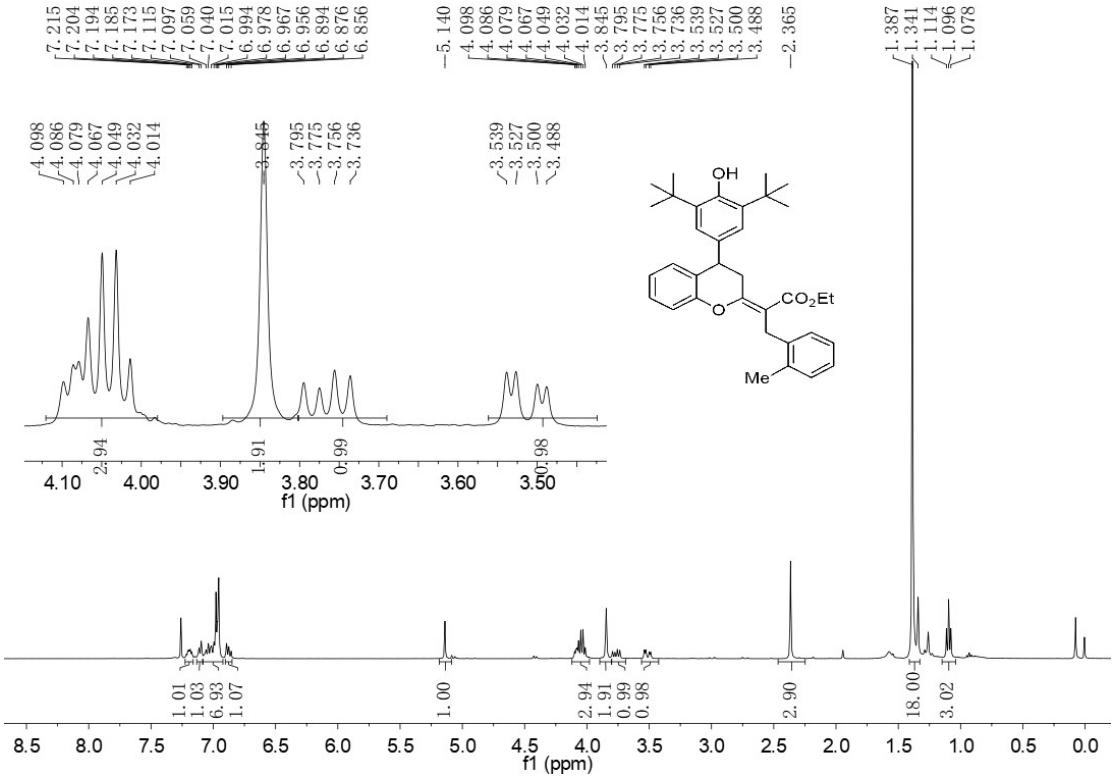
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ac**



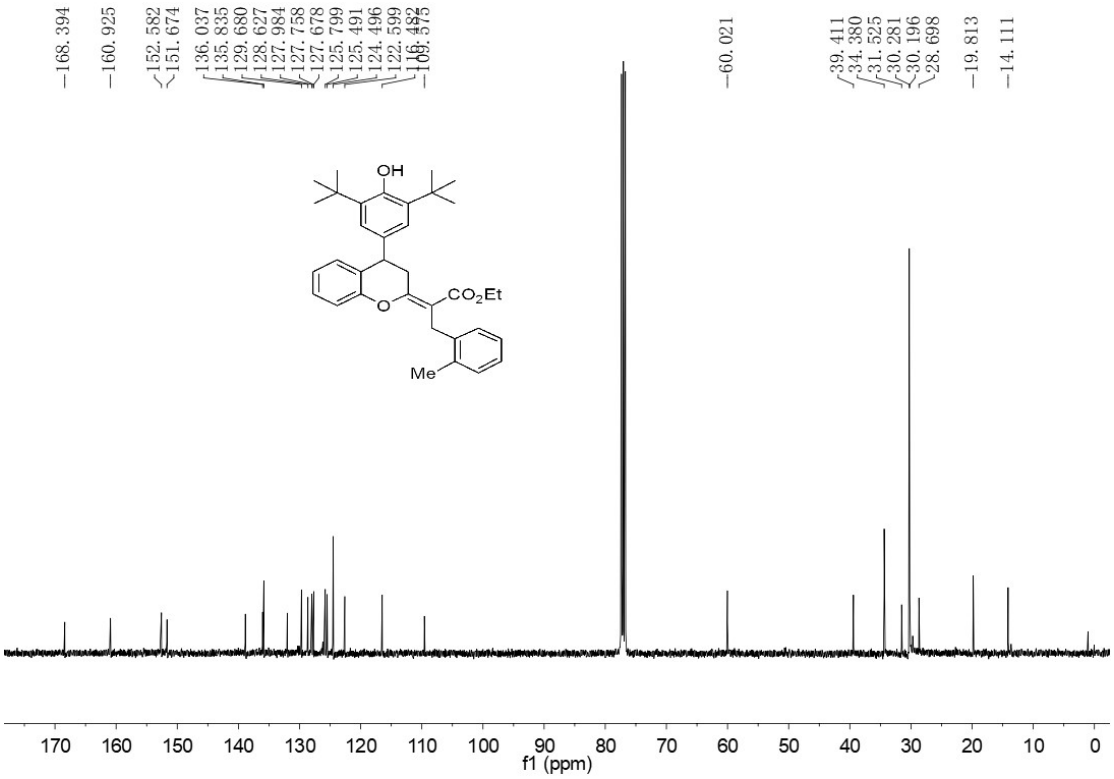
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ac**



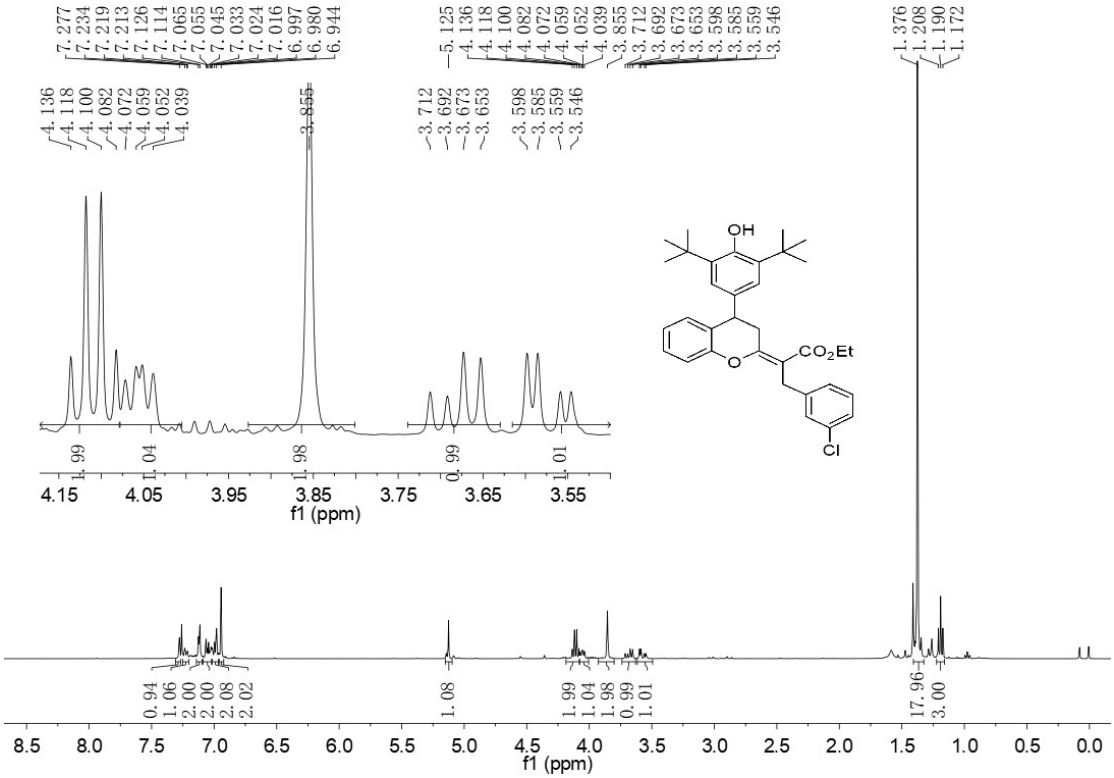
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ad**



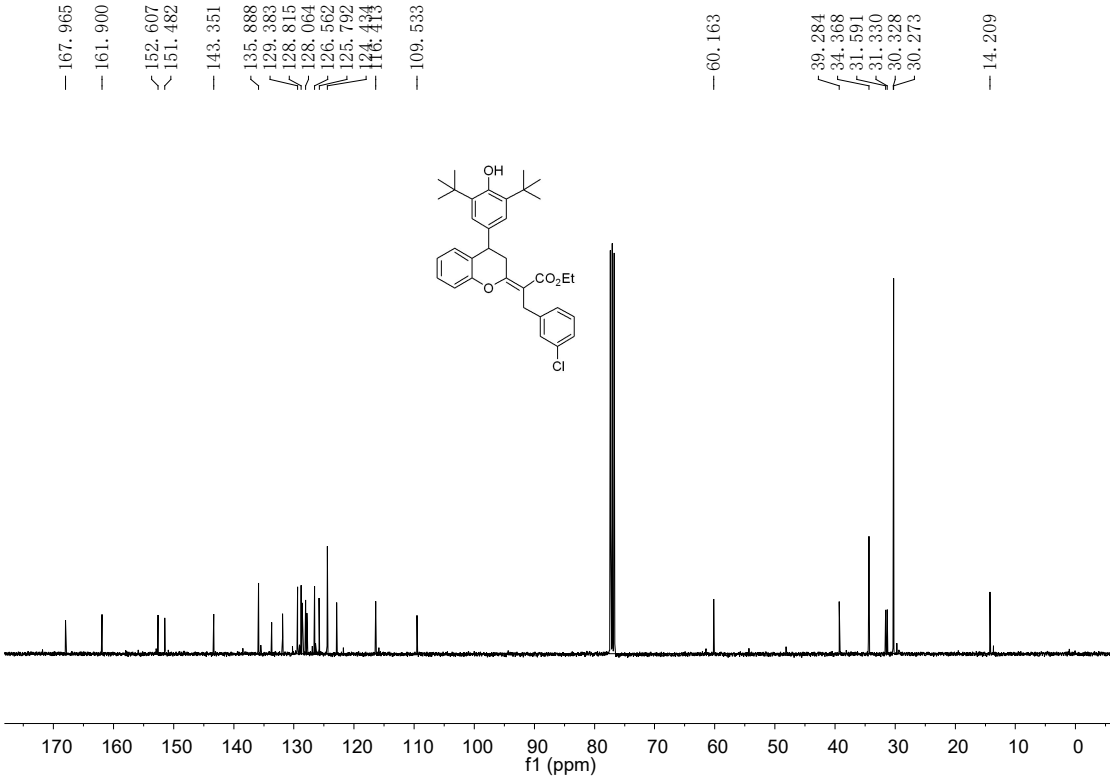
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ad**



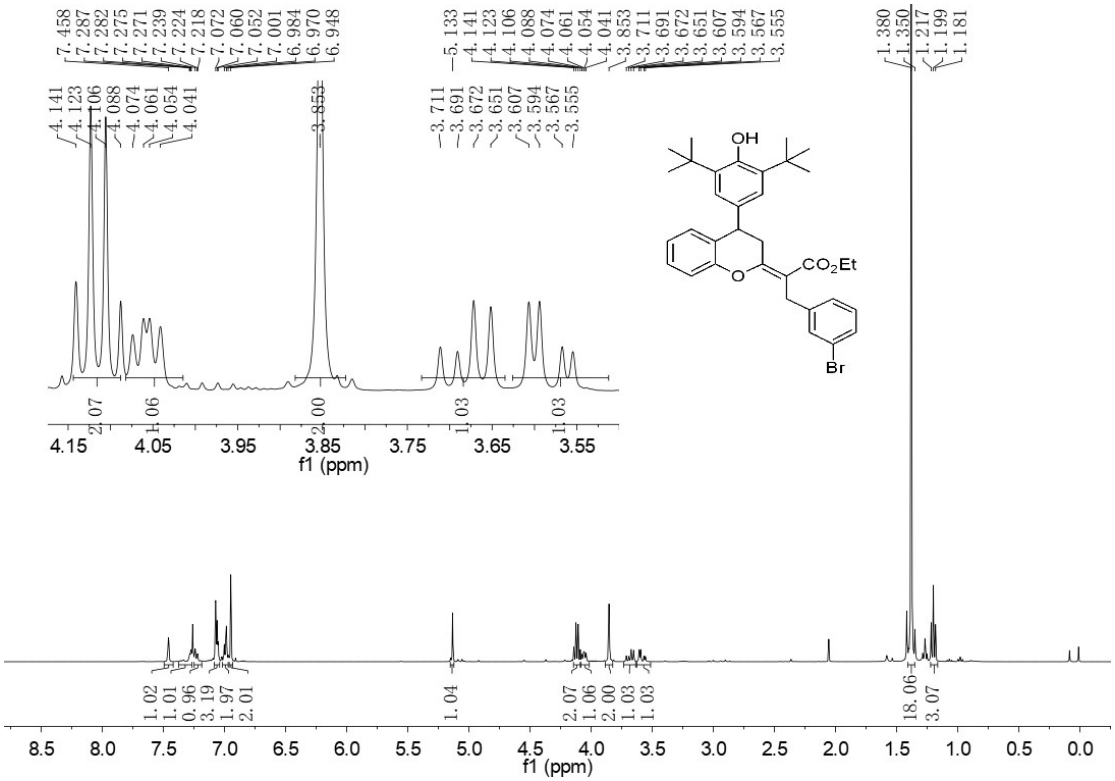
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ae**



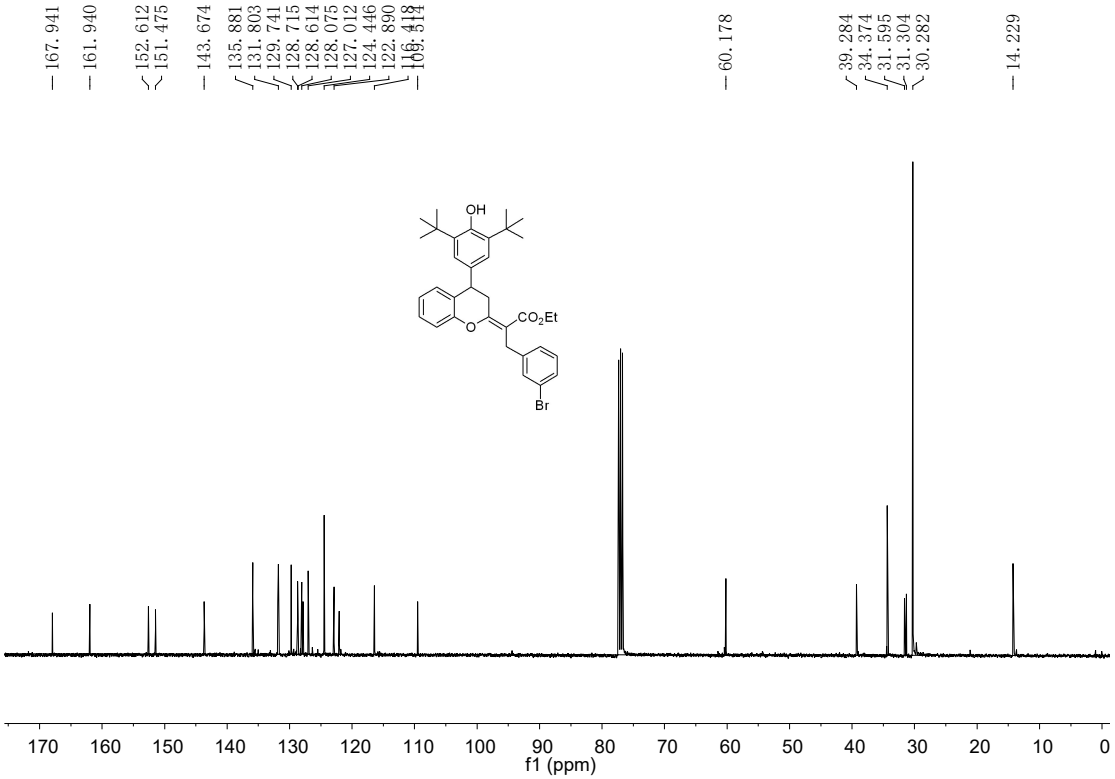
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ae**



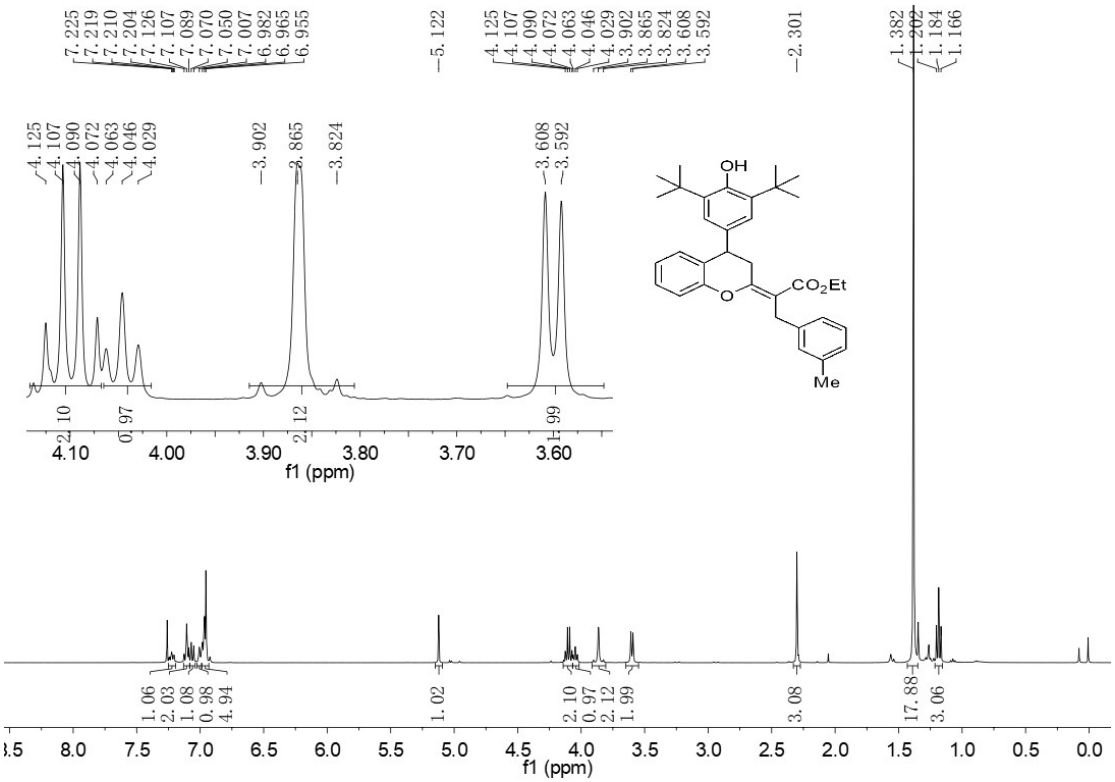
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3af**



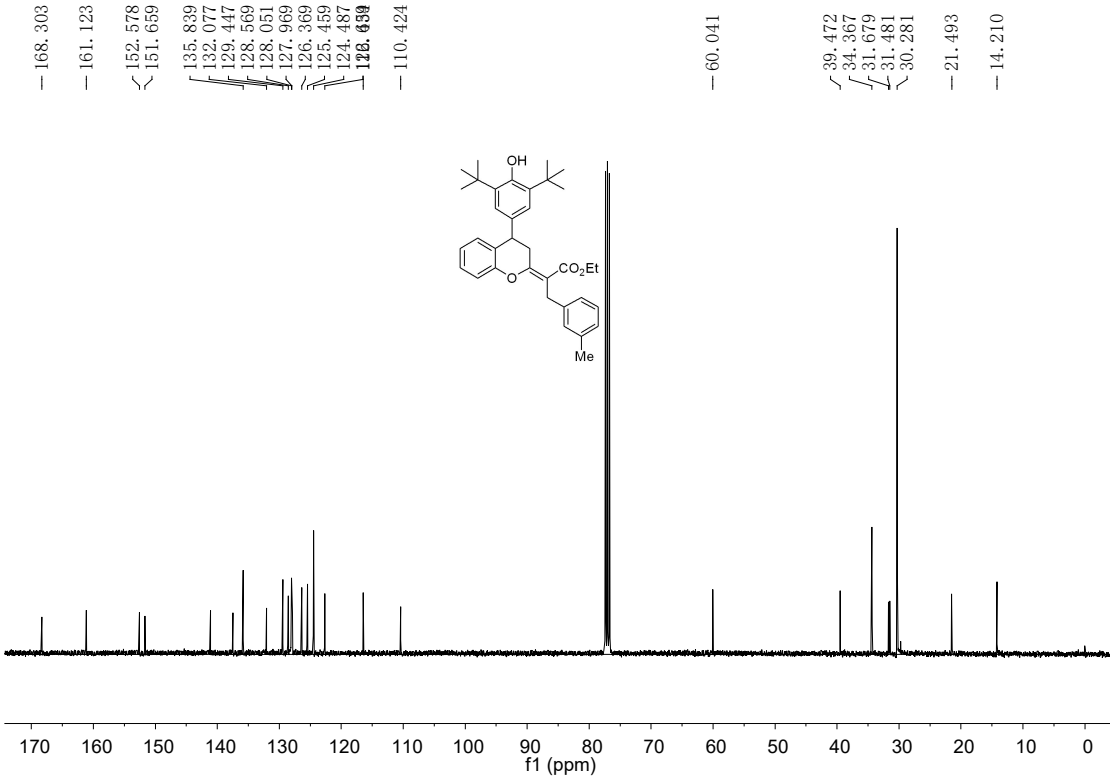
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3af**



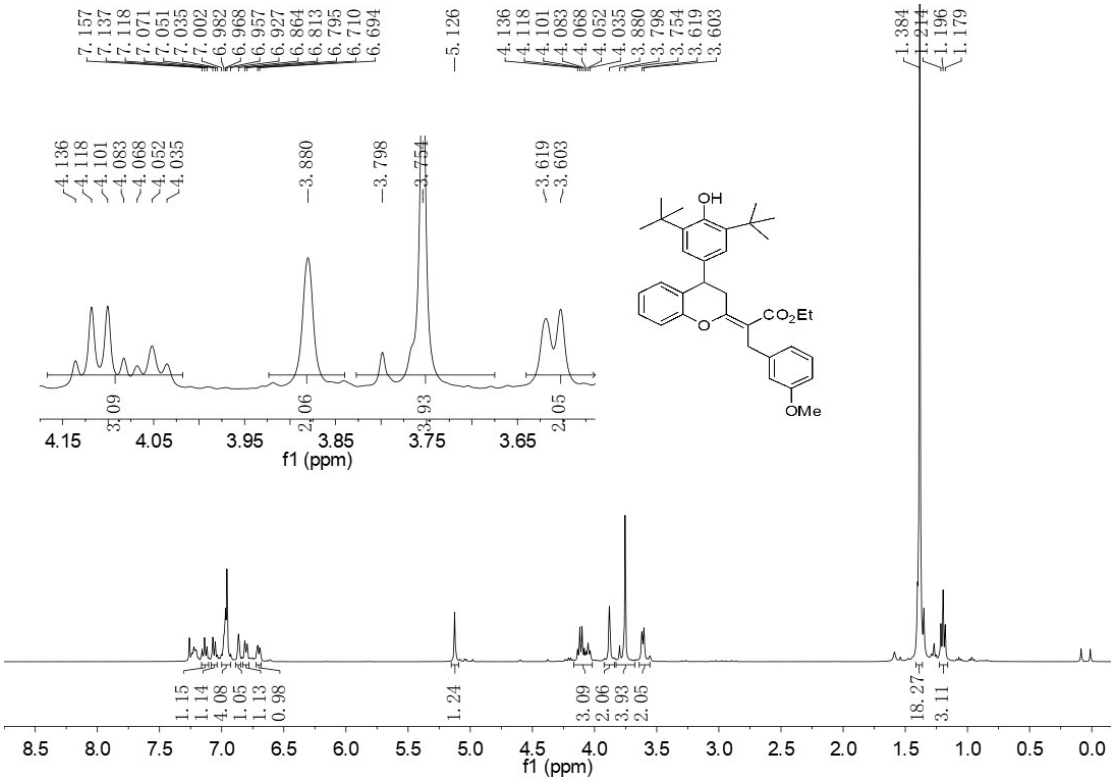
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ag**



^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ag**



^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ah**



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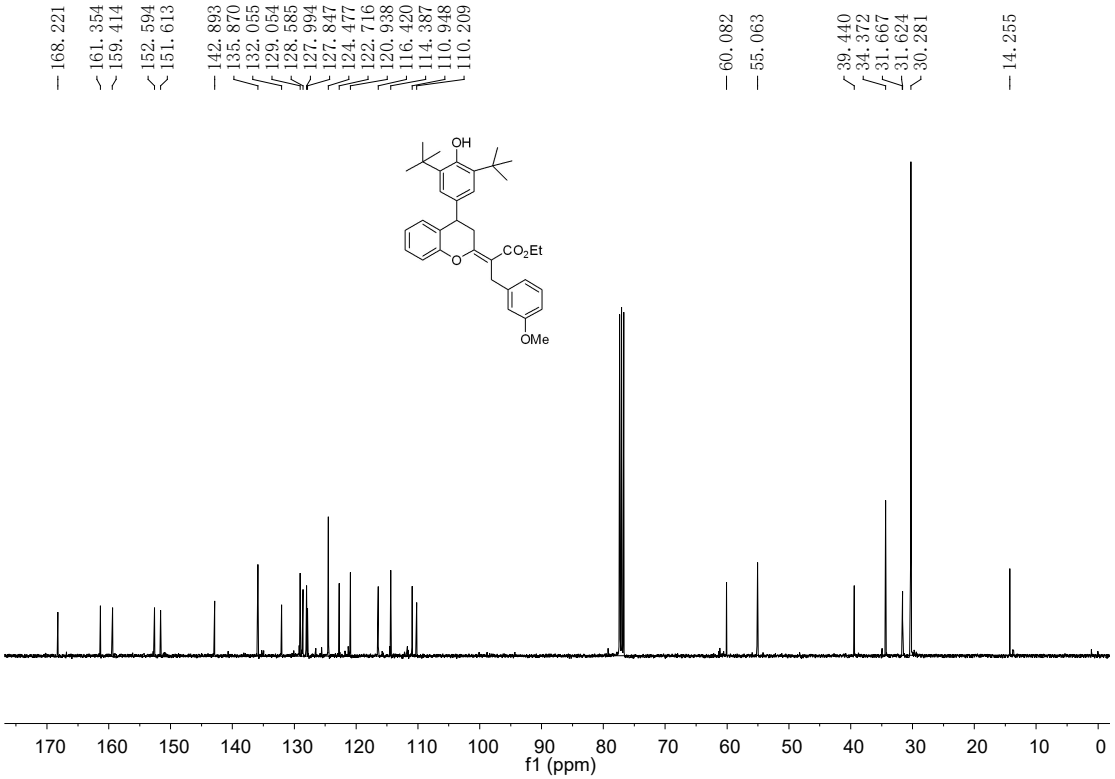

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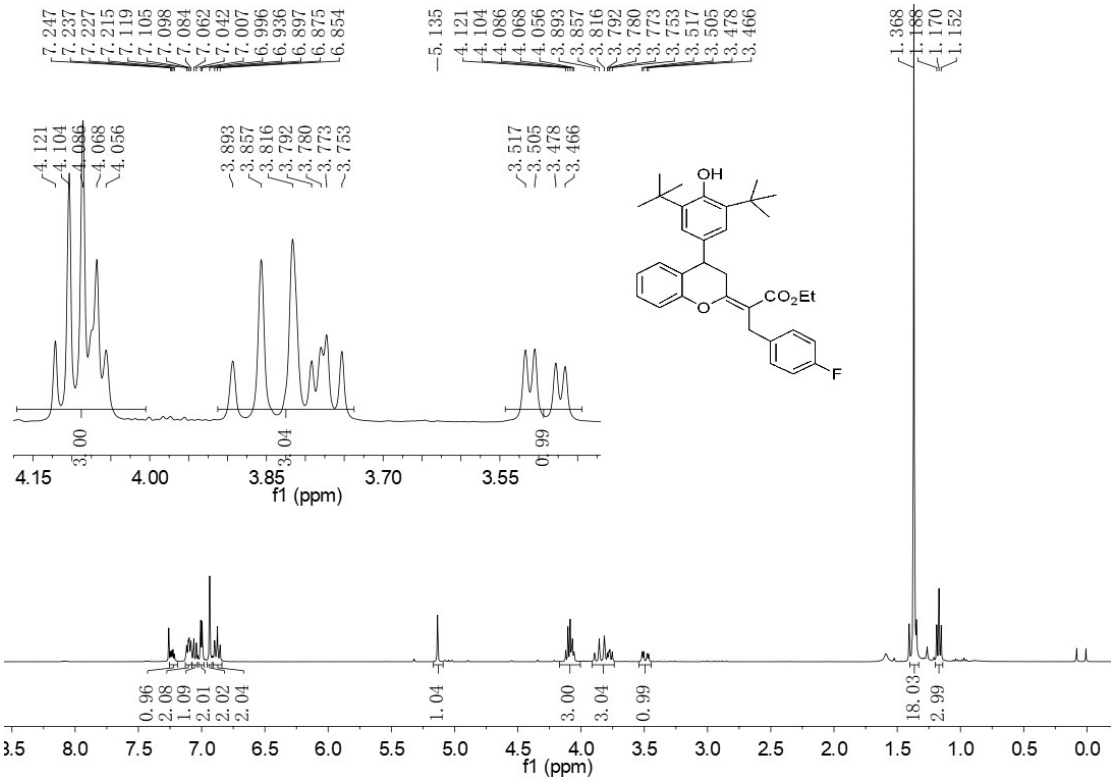
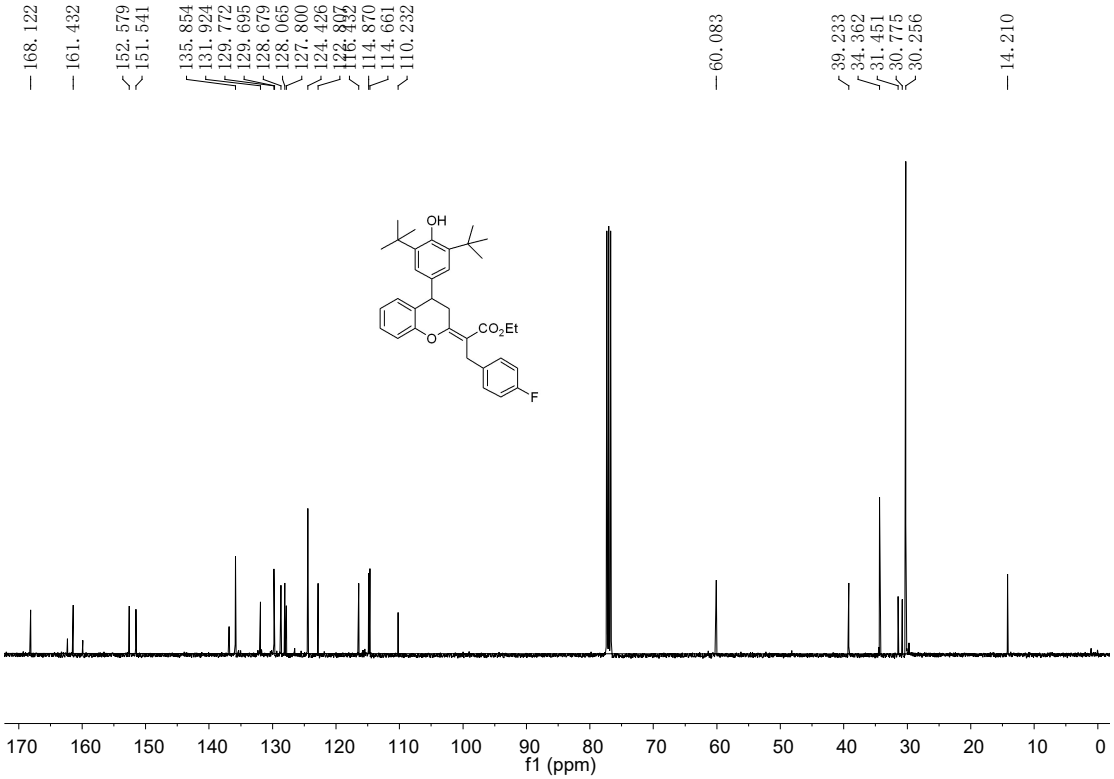
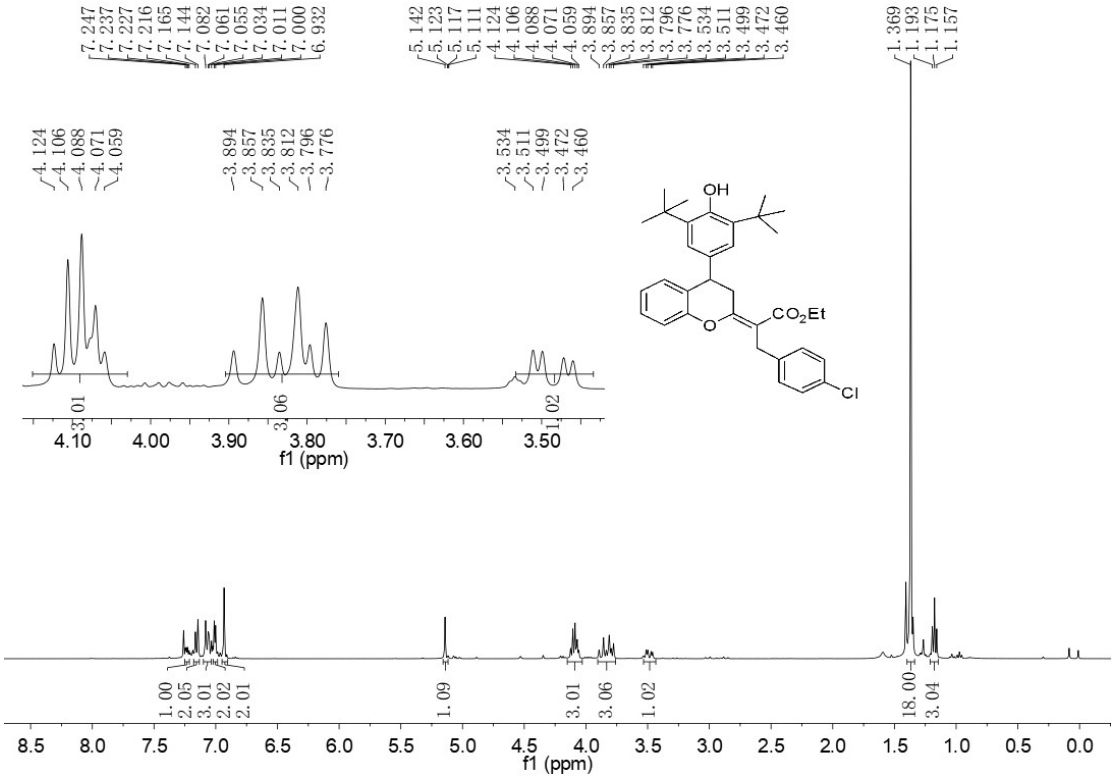


^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ai**



^{1}H NMR (400 MHz, $CDCl_3$) of compound **3aj**



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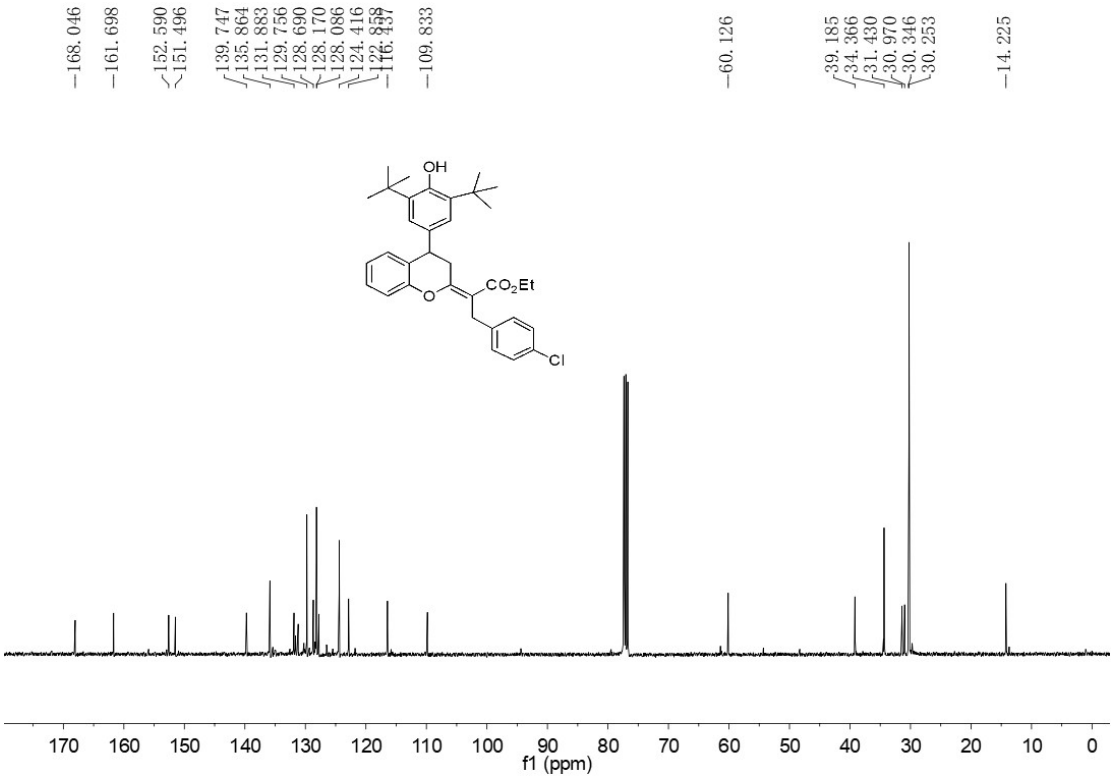

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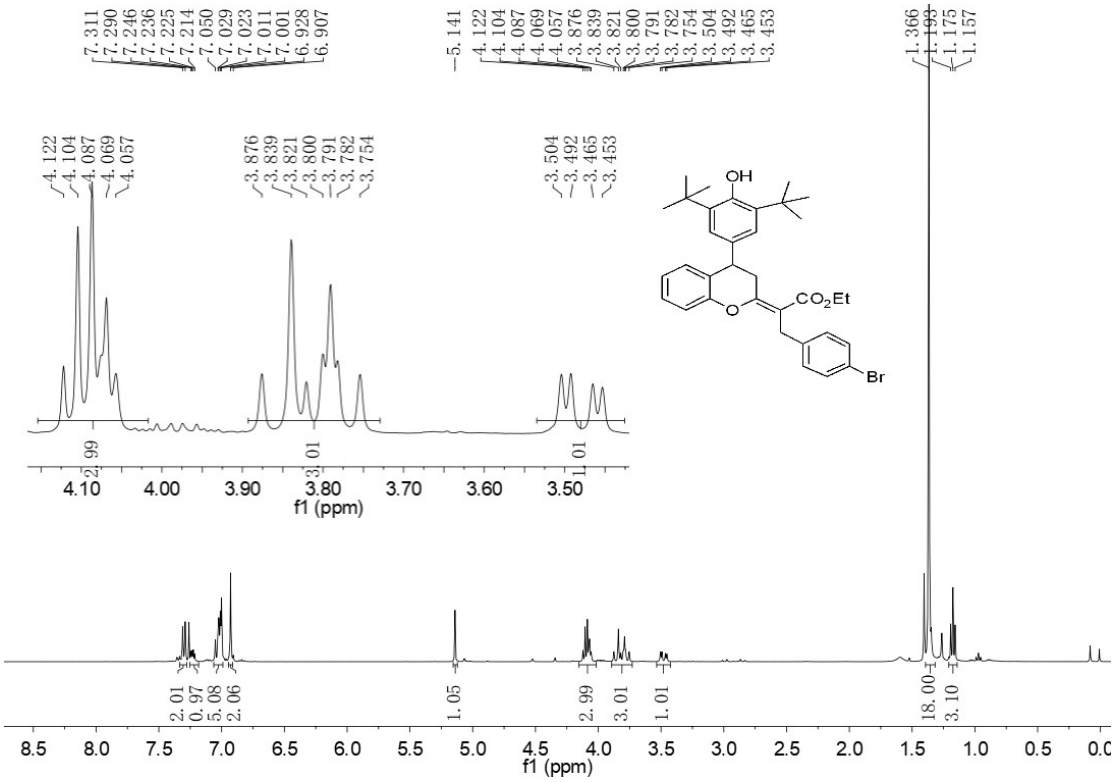
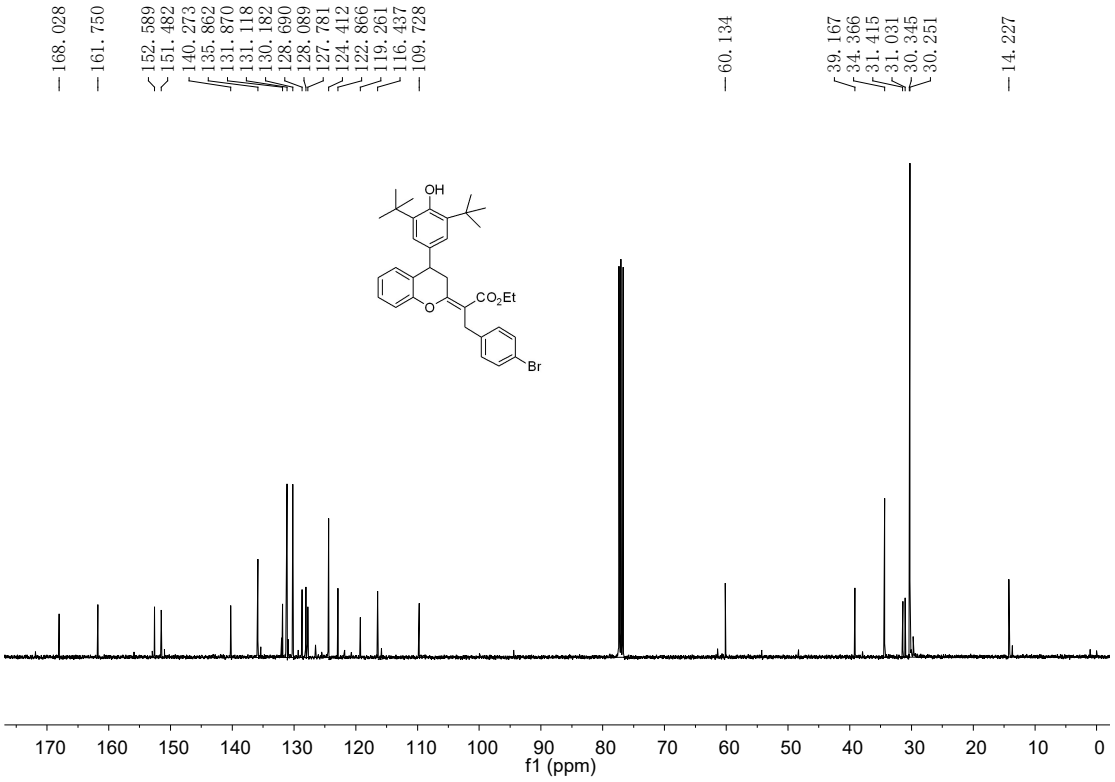


^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ak**



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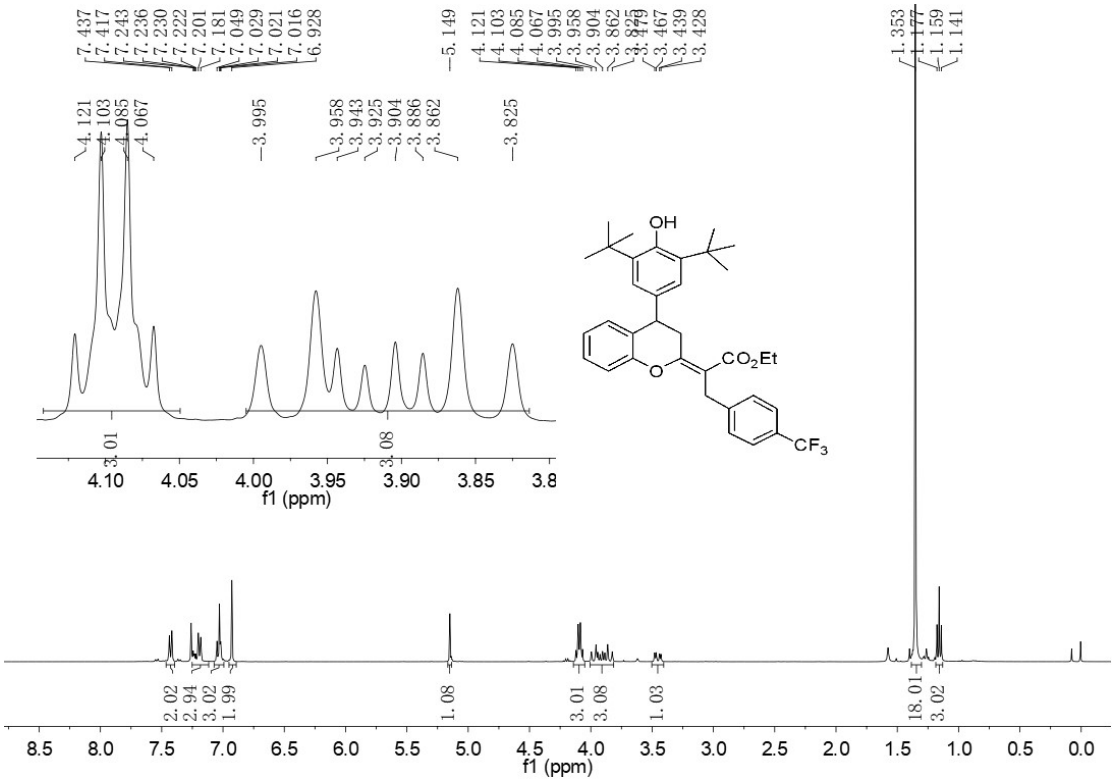
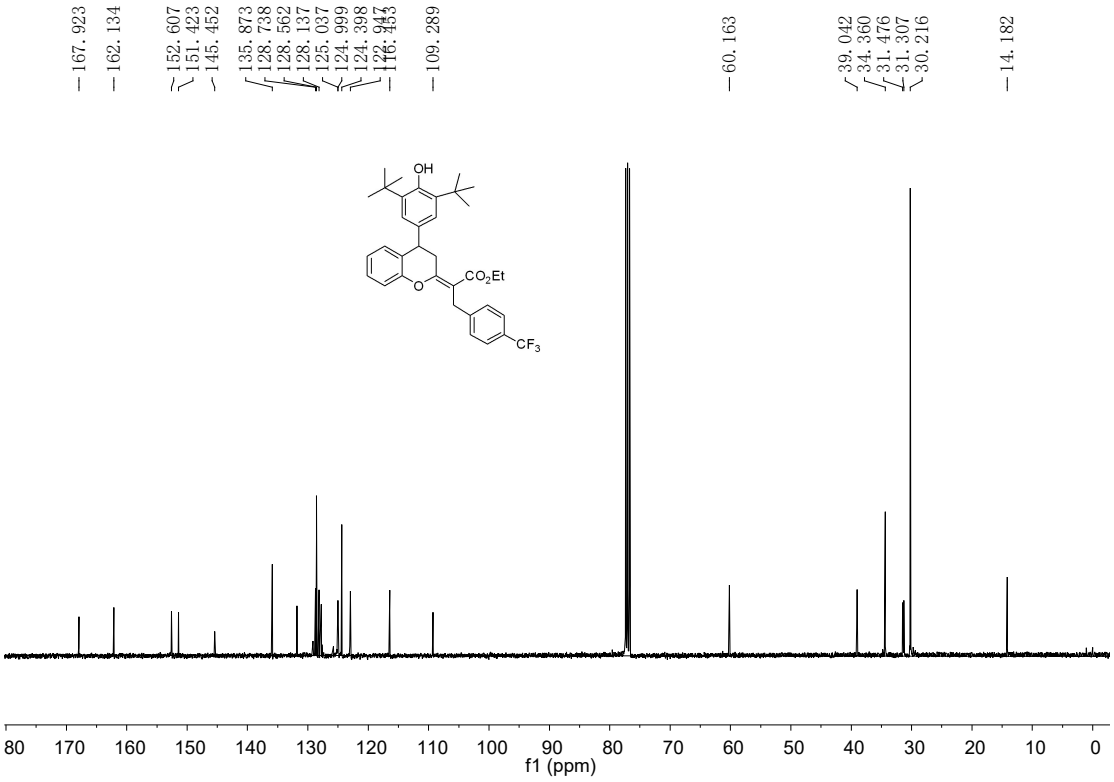
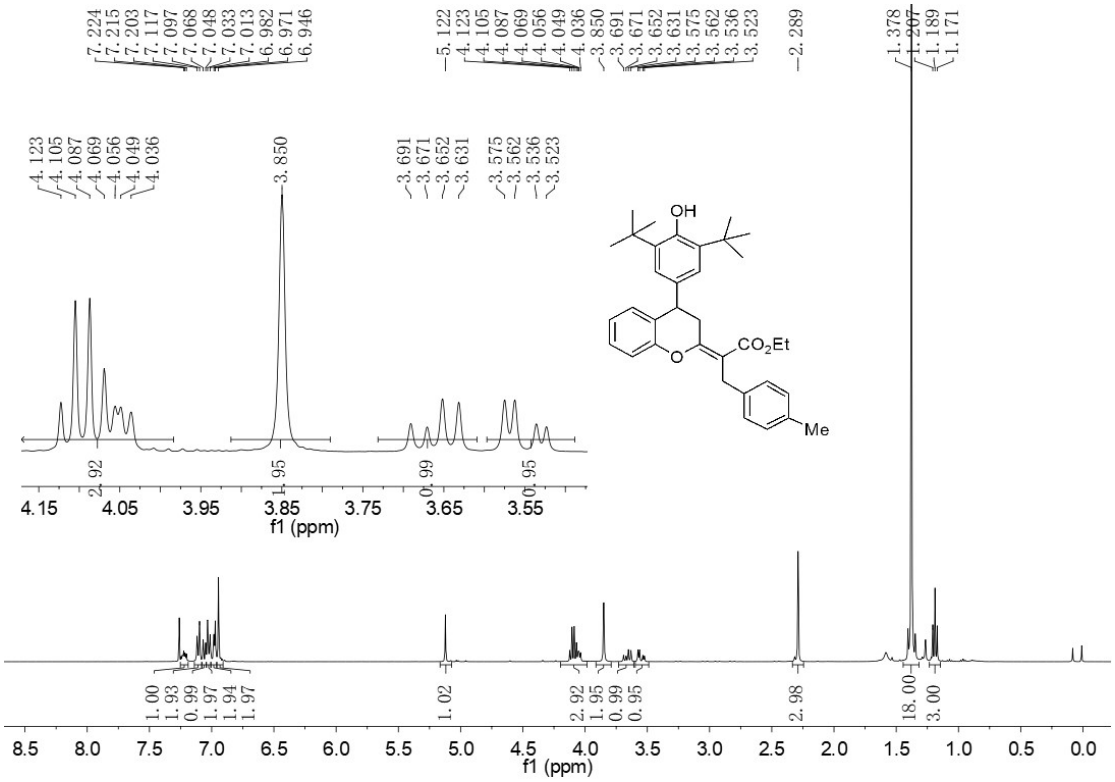


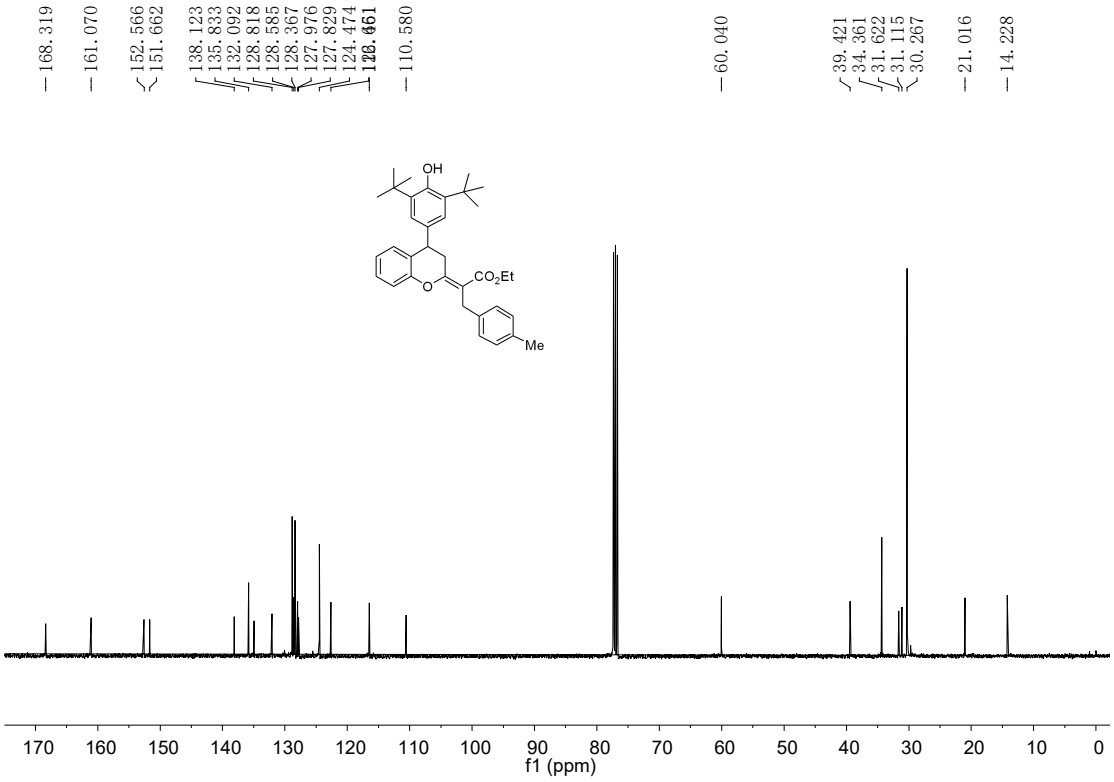
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3al**



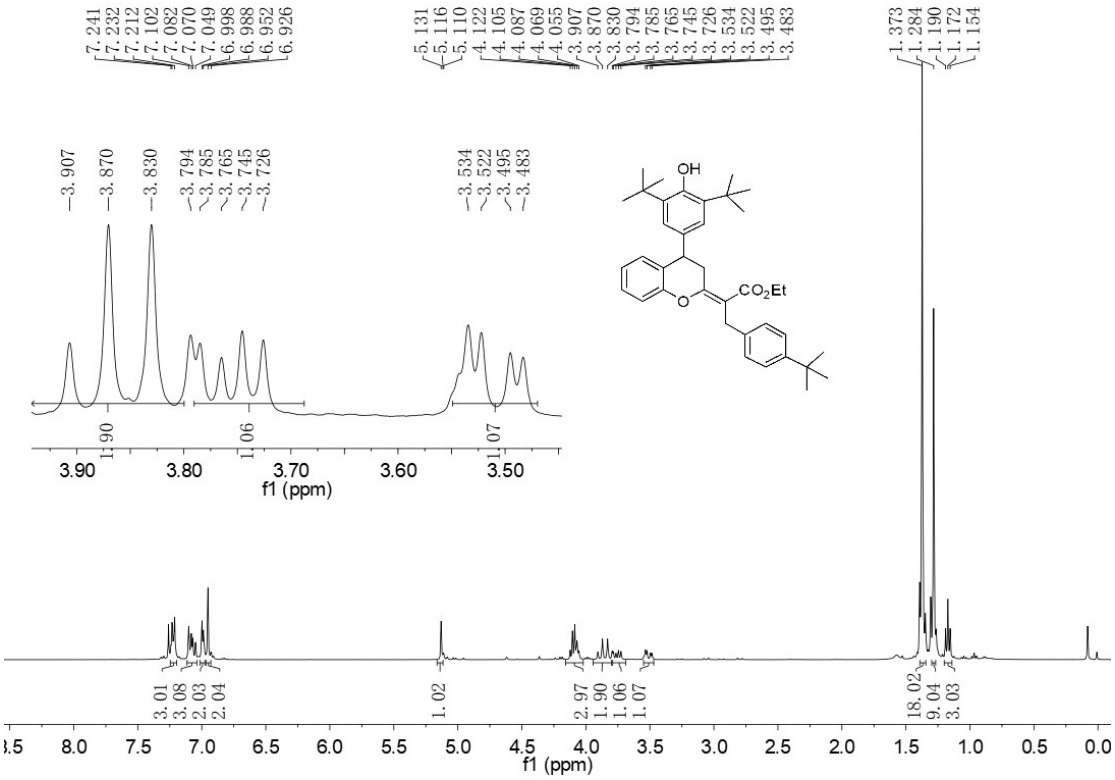
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3am**



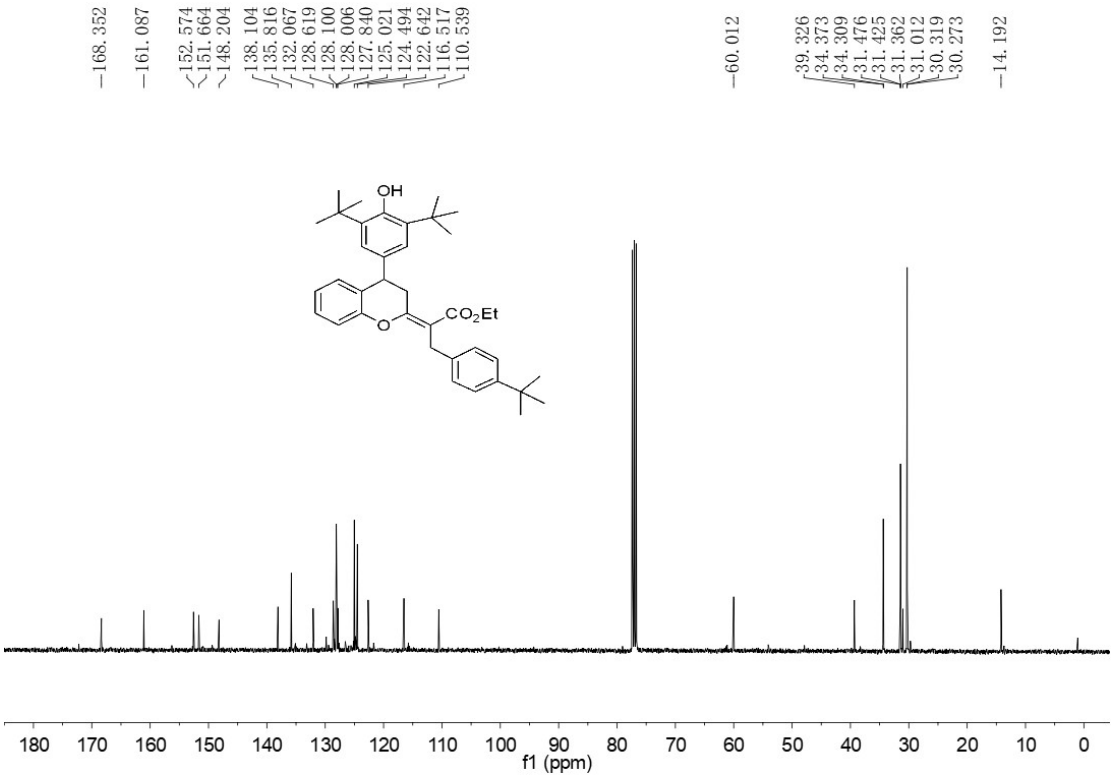
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3am**



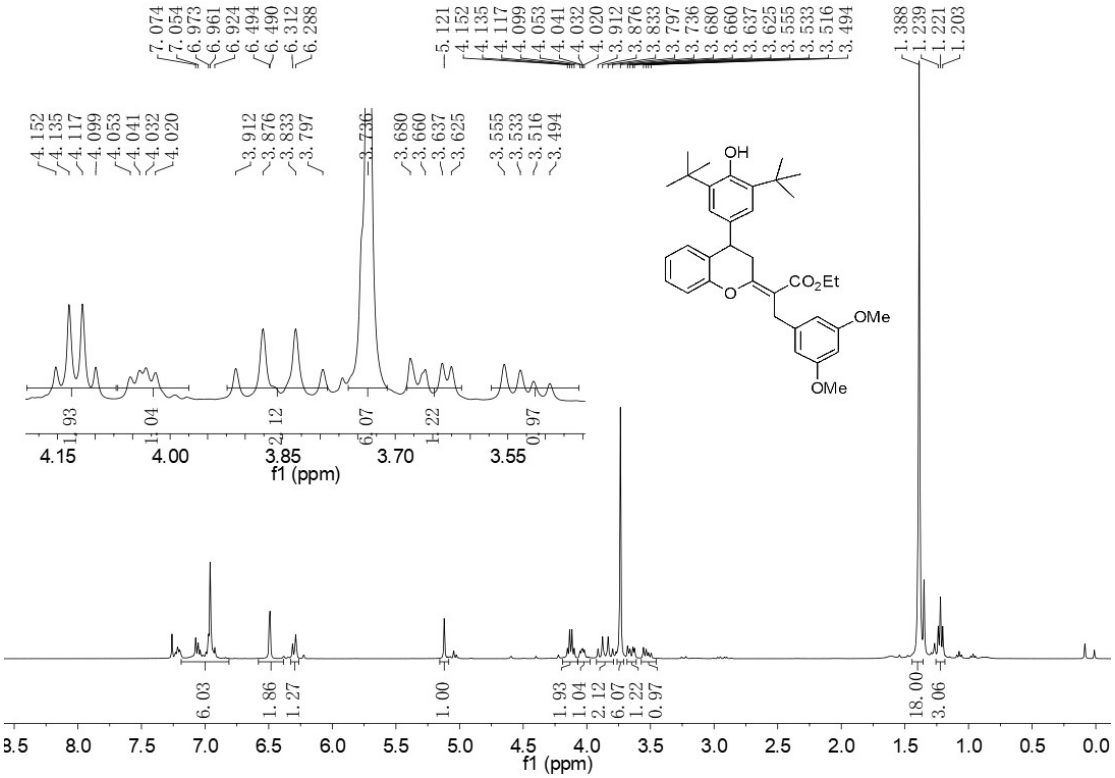
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3an**



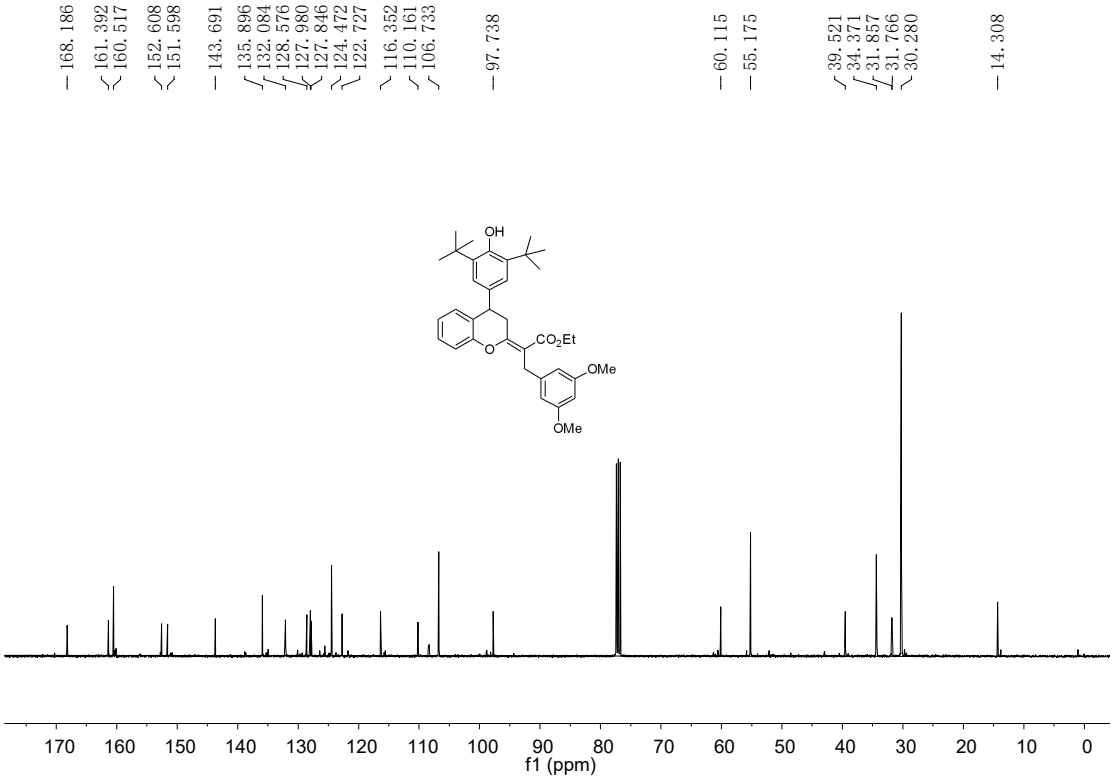
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3an**



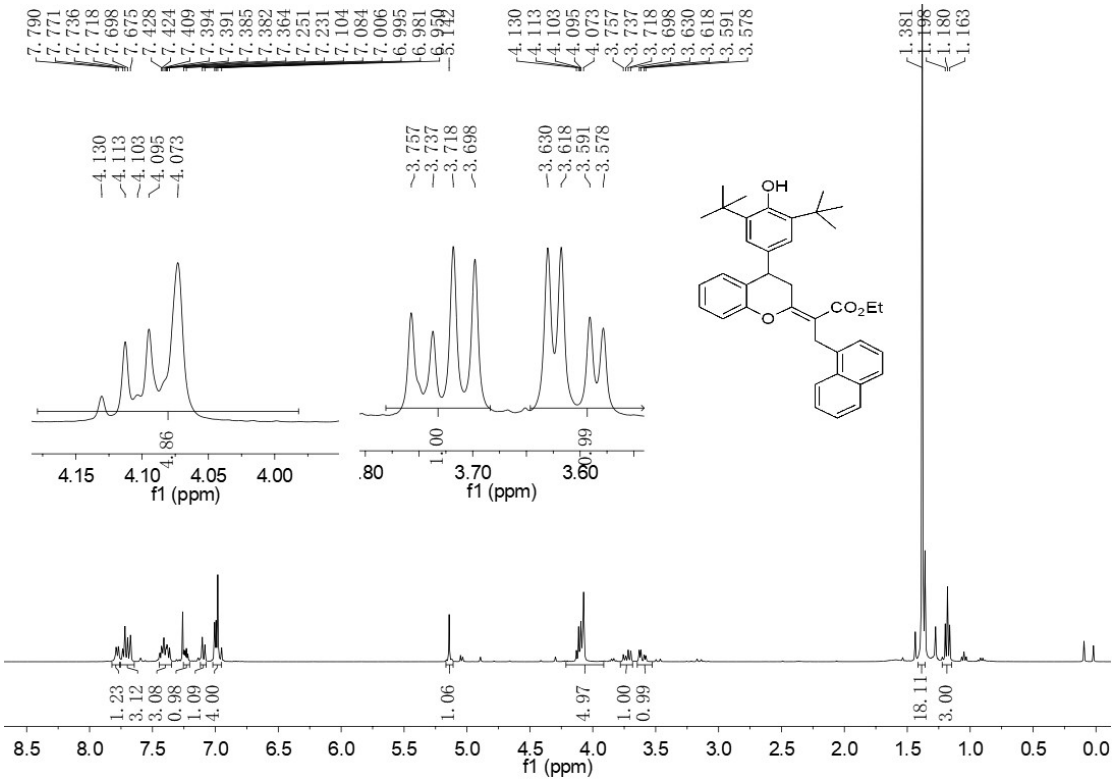
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ao**



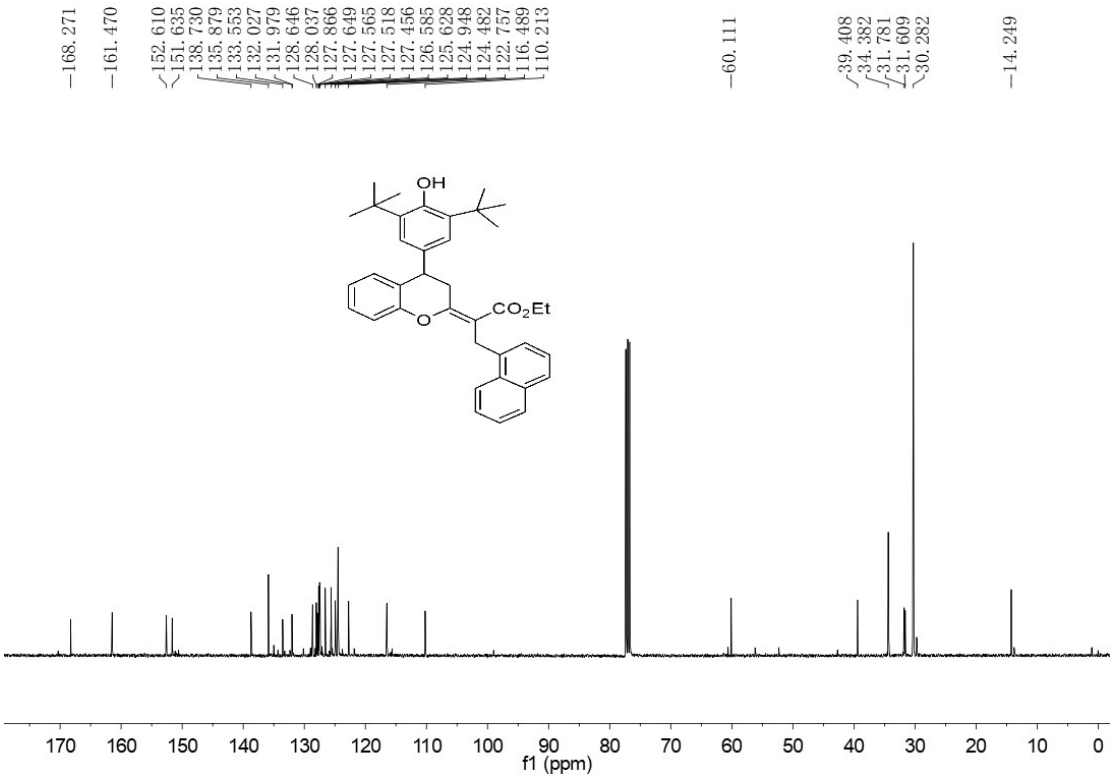
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ao**



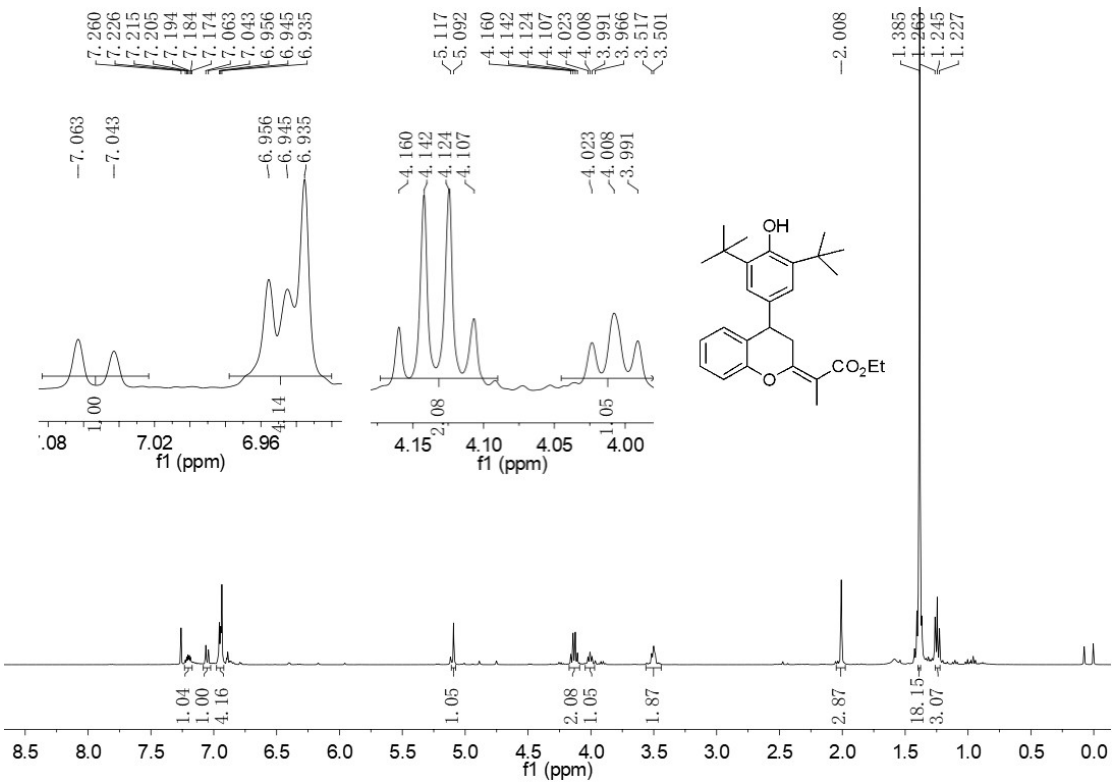
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3ap**



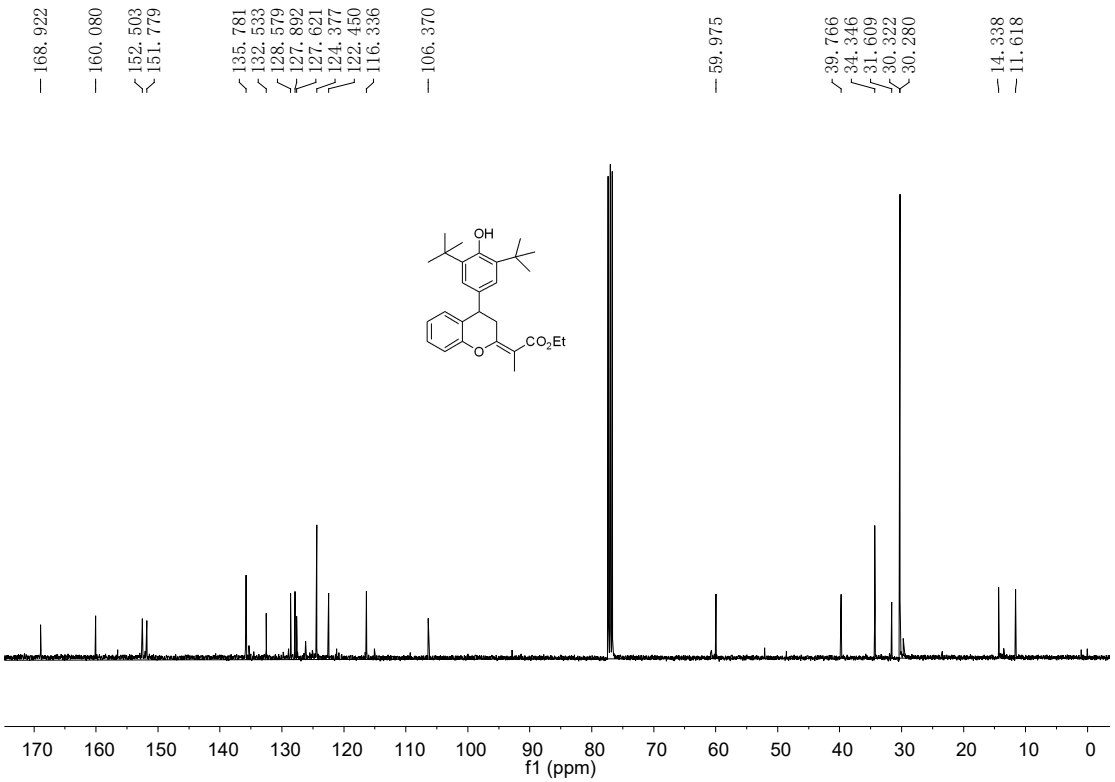
^{13}C NMR (100 MHz, $CDCl_3$) of compound **3ap**



^{1}H NMR (400 MHz, $CDCl_3$) of compound **3aq**

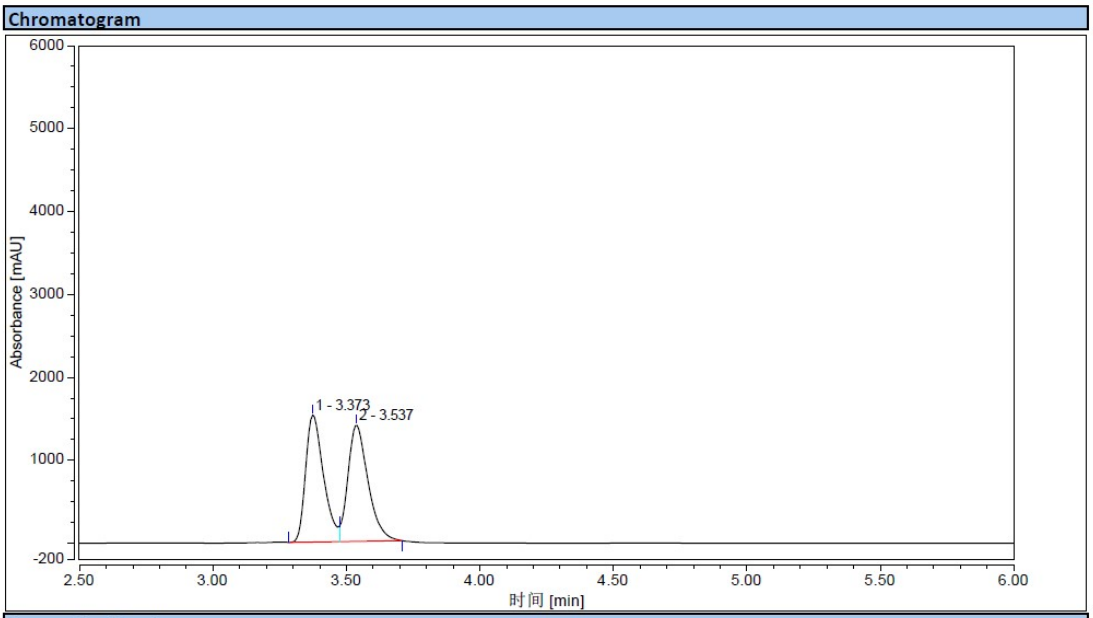


^{13}C NMR (100 MHz, $CDCl_3$) of compound **3aq**



2. HPLC spectra of product 3aa

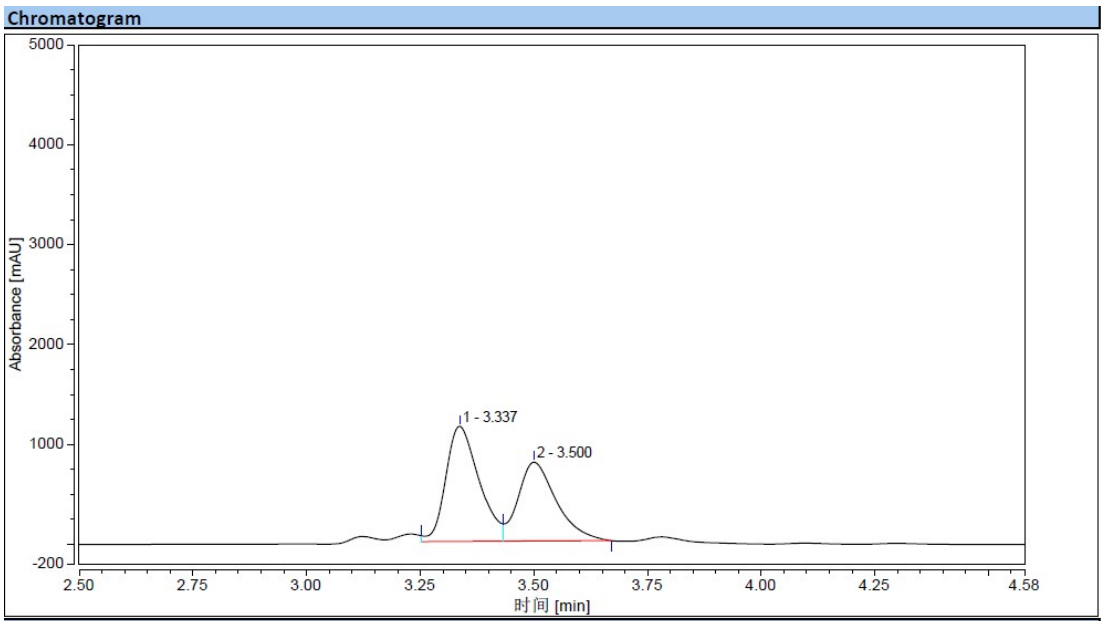
Racemic:



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		3.373	118.742	1531.452	49.24	52.15	n.a.
2		3.537	122.414	1405.069	50.76	47.85	n.a.
Total:			**241.156**	**2936.522**	**100.00**	**100.00**	

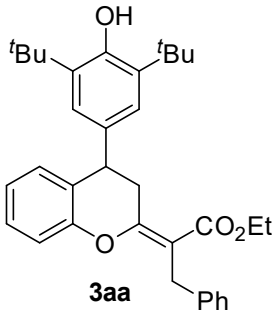
Enantioselective: 12% ee



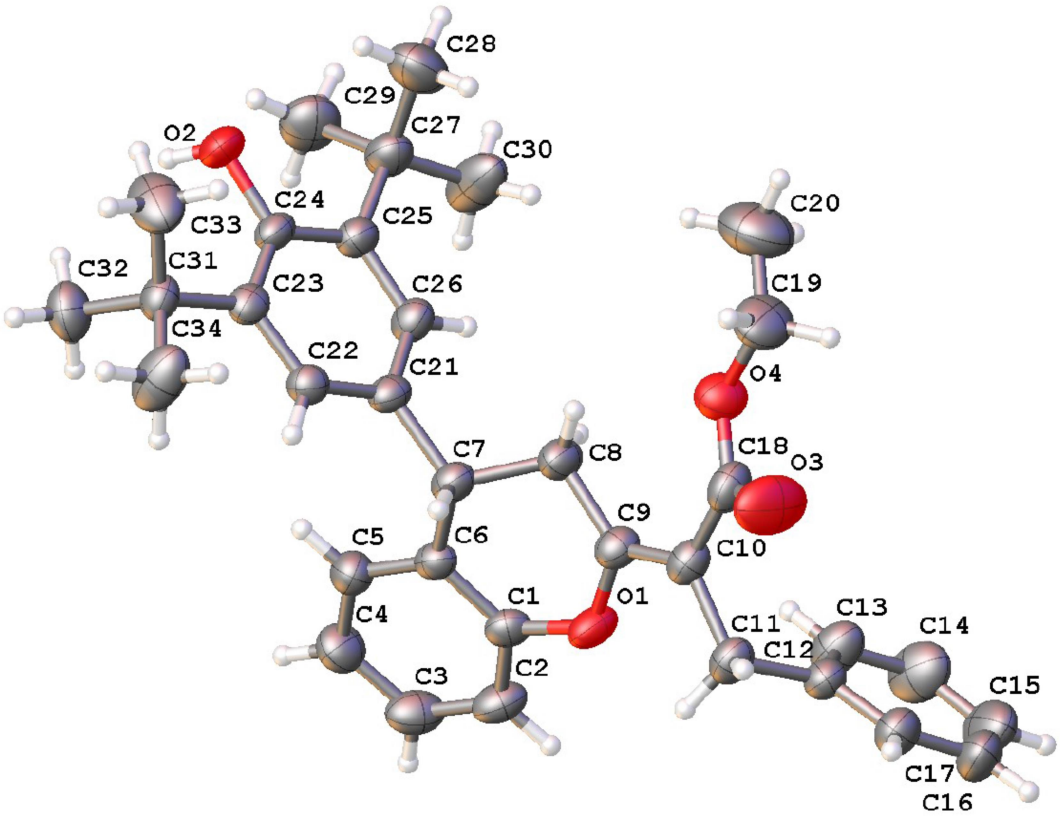
Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		3.337	97.774	1152.586	56.03	59.34	n.a.
2		3.500	76.744	789.723	43.97	40.66	n.a.
Total:			**174.518**	**1942.309**	**100.00**	**100.00**	

3. X-ray single crystal data for compound 3aa



3aa



The thermal ellipsoid was drawn at the 30% probability level.

Empirical formula	C17 H20 O2	
Formula weight	256.33	
Temperature	296.15 K	
Wavelength	0.71073 Å	
Crystal system	Triclinic	
Space group	P-1	
Unit cell dimensions	a = 12.090(3) Å	α= 63.859(3)°.
	b = 12.294(3) Å	β= 70.176(3)°.
	c = 12.543(3) Å	γ = 61.173(3)°.
Volume	1447.2(6) Å^3	
Z	4	

Density (calculated)	1.176 Mg/m^3
Absorption coefficient	0.075 mm^{-1}
F(000)	552
Crystal size	0.3 x 0.3 x 0.1 mm^3
Theta range for data collection	2.882 to 26.991°.
Index ranges	-15<=h<=12, -15<=k<=9, -16<=l<=15
Reflections collected	8425
Independent reflections	6083 [R(int) = 0.0265]
Completeness to theta = 25.242°	97.9 %
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	0.7455 and 0.6316
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	6083 / 0 / 351
Goodness-of-fit on F^2	1.018
Final R indices [I>2sigma(I)]	R1 = 0.0680, wR2 = 0.1447
R indices (all data)	R1 = 0.1393, wR2 = 0.1806
Extinction coefficient	n/a
Largest diff. peak and hole	0.203 and -0.254 $e.Å^{-3}$