Supporting Information

An I_2-DMSO Catalytic Manifold Enabled Aromatization for C-Ring Editing of Podophyllotoxone

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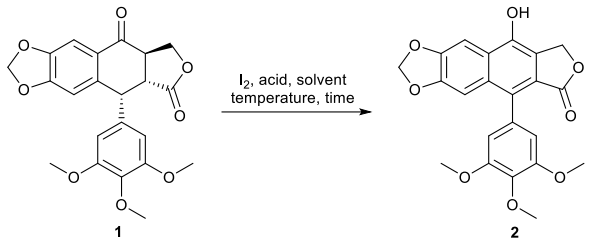
1. General information

NMR spectra were recorded on Bruker AVANCE III HD 600MHz. Chemical shifts (δ) were reported in parts per million (ppm) relative to residual solvent peaks rounded to the nearest 0.01 for proton and 0.1 for carbon (*ref: $CDCl_3$ [^{1}H: 7.26, ^{13}C: 77.16], DMSO-d_6 [^{1}H: 2.5,3.3, ^{13}C: 39.52])*. Coupling constants (*J)* were reported in Hz to the nearest 0.1 Hz. Multiplicities are abbreviated as follows: singlet (s), doublet (d), triplet (t), quartet (q), doublet-doublet (dd), quintet (quint), sextet (sext), septet (sept), multiplet (m), and broad (b). High-resolution mass spectrometry (HRMS) data was obtained on Thermo Scientific Q Exactive instrument (ESI Source, mass analyzer type is orbitrap). LC/MS spectrometry data was obtained on Agilent 1260-Ultivo LC/TQ instrument (ESI Source).

Materials and Methods: Unless otherwise stated, starting materials were purchased from commercial sources. Solvents were purchased in HPLC quality. Reactions were monitored by thin layer chromatography (TLC). Compounds were visualized by UV-light at 254 nm and 365 nm and by dipping the plates in a phosphomolybdic acid ethanol solution followed by heating. Flash column chromatography was performed over silica gel (300-400 mesh). The $CDCl_3$ used in the NMR experiments was stored over anhydrous K_2CO_3 before use.

2. Optimization of the reaction conditions

2.1 Table S1: Screening the temperature of reaction A

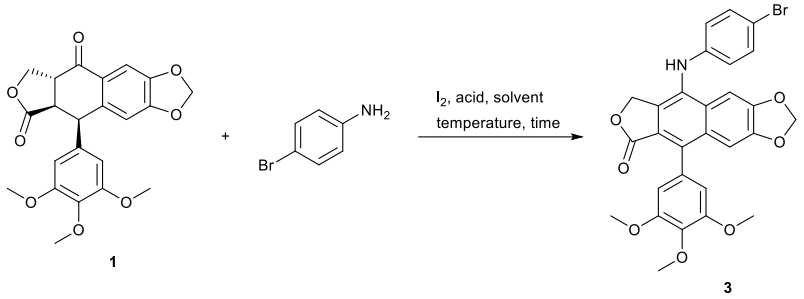


1 2

Entry	I_2 (equiv)	Acid	Acid equiv	Solvent	Temperature (°C)	Yield % of **2**
1	0.1	none	0	DMSO	80	trace
2	0	HI	0.2	DMSO	80	trace
3	0.1	HCl	2.5	DMSO	80	89
4	0.1	HBr	2.5	DMSO	80	83
5	0.1	HI	2.5	DMSO	80	53
6	0.1	H_2SO_4	2.5	DMSO	80	76
7	0.1	$TsOH·H_2O$	2.5	DMSO	80	87
8	0.1	TFA	2.5	DMSO	80	55
9	0.1	TFAA	2.5	DMSO	80	37
10	0.1	$ZrCl_4$	0.2	DMSO	80	31
11	0.1	$In(OTf)_3$	0.2	DMSO	80	trace
12	0.1	$FeCl_3$	0.2	DMSO	80	trace
13	0	HCl	2.5	DMSO	80	trace
14	0.1	HCl	2.5	DMSO	80	95
15	0.2	HCl	2.5	DMSO	80	93
16	0.5	HCl	2.5	DMSO	80	90
17	1.0	HCl	2.5	DMSO	80	89
18	1.5	HCl	2.5	DMSO	80	87
19	0.1	HCl	2.5	DMSO	RT	trace
20	0.1	HCl	2.5	DMSO	40	46
21	0.1	HCl	2.5	DMSO	60	79
22	0.1	HCl	2.5	DMSO	80	93
23	0.1	HCl	2.5	DMSO	100	99
24	0.1	HCl	2.5	DMSO	120	95
25	1.0	HCl	2.5	DMA	100	95
26	1.0	HCl	2.5	NMP	100	91
27	0.1	HCl	2.5	DMA	100	trace
28	0.1	HCl	2.5	NMP	100	trace

Standard Conditions A : **1** (0.5 mmol), HCl (37 wt % aq.), I_2, and solvent (2.5mL, *c* 0.2M) were added to a pressure vessel and stirred at a certain temperature for 2h.

2.2 Table S2: Screening the temperature of reaction B



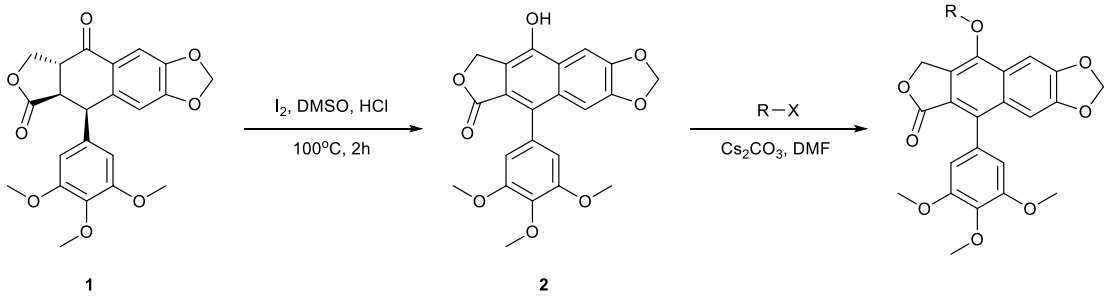
1 3

Entry	Aniline (equiv)	I_2 (equiv)	Acid	Acid equiv	Solvent	Temperature (°C)	Yield % of **3**
1	1.5	0.2	HCl	0.1	DMSO	RT	trace
2	1.5	0.2	HCl	0.1	DMSO	40	trace
3	1.5	0.2	HCl	0.1	DMSO	60	20
4	1.5	0.2	HCl	0.1	DMSO	80	36
5	1.5	0.2	HCl	0.1	DMSO	100	trace
6	1.5	0.2	H_2SO_4	0.1	DMSO	80	29
7	1.5	0.2	TFA	0.1	DMSO	80	66
8	1.5	0.2	TFAA	0.1	DMSO	80	32
9	1.5	0.2	$TsOH·H_2O$	0.1	DMSO	80	45
10	1.5	0.2	HBr	0.1	DMSO	80	21
11	1.5	0.2	HI	0.1	DMSO	80	27
12	1.5	0.2	$ZrCl_4$	0.1	DMSO	80	42
13	1.5	0.2	$In(OTf)_3$	0.1	DMSO	80	trace
14	1.5	0.2	$CuCl_2$	0.1	DMSO	80	28
15	1.5	0	TFA	0.1	DMSO	80	trace
16	1.5	0.1	TFA	0.1	DMSO	80	71
17	1.5	0.2	TFA	0.1	DMSO	80	66
18	1.5	0.5	TFA	0.1	DMSO	80	53
19	1.5	1.0	TFA	0.1	DMSO	80	52
20	1.5	0.1	TFA	0.1	DMSO + NMP	80	trace
21	1.5	0.1	TFA	0.1	DMSO + DMF	80	48
22	1.5	0.1	TFA	0.1	DMSO + DMA	80	52

Standard Conditions B : **1** (0.5 mmol), aniline (0.75 mmol, 1.5 equiv), TFA (0.05mmol, 0.1 equiv), I_2 (0.05mmol, 0.1 equiv), and DMSO (2.5mL, *c* 0.2M) were added to a pressure vessel and stirred at 80 °C for 4-8h.

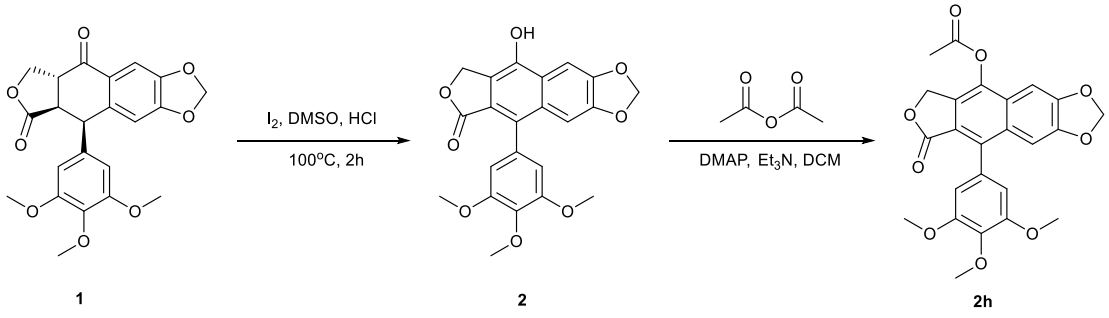
3. General procedure

3.1 General procedure for the synthesis of 2a-2g, 2j-2l



To a flame-dried pressure sealed tube charged with 206.2 mg podophyllotoxone (0.5mmol) and 12.7 mg (0.05 mmol, 10 mol%) iodine was added 2.5 mL (c = 0.2 M) of DMSO. Then 105 μL (1.25 mmol, 2.5 equiv) of 37 wt% hydrochloric acid aqueous solution was added and the pressure tube was quickly closed. The reaction mixture was heated up to 100 °C using a heating block and stirred at the same temperature for 2 hours, and the reaction was monitored by TLC. When the reaction is completed, the reaction was quenched by slow addition of saturated $Na_2S_2O_3$, water and ethyl acetate. The mixture was then poured into a separating funnel. After the phases were separated, and the aqueous phase was extracted three times with ethyl acetate. The combined organic layers were washed with brine, dried over Na_2SO_4, and concentrated by rotary evaporation to get a mixture of tetradehydropodophyllotoxin. Then this mixture was shifted into a new flame-dried pressure sealed tube and dissolved in DMF (2 mL). 325.8 mg Caesium carbonate (1.0 mmol, 2.0 equiv) and alkyl bromide (0.75 mmol, 1.5 equiv) was then added into the solution at room temperature. The mixture was stirred for 1-4 hours, then poured into water, and extracted with ethyl acetate. The extract was washed with brine, dried over Na_2SO_4, and concentrated by rotary evaporation. The crude product can be separated by silica gel column chromatography to obtain the target product **2a-2g** and **2j-2l**.

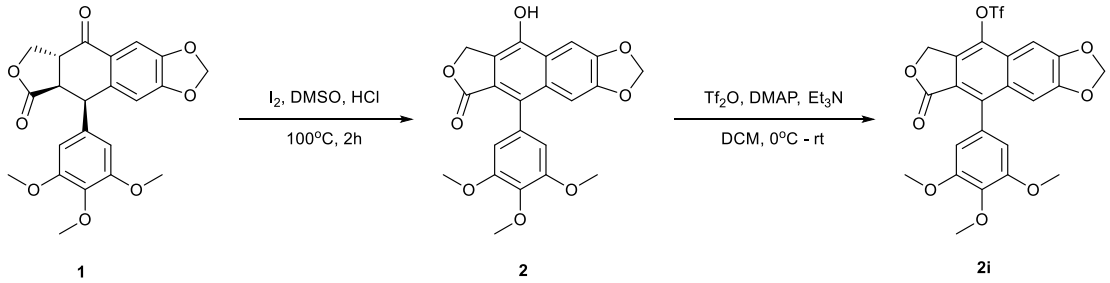
3.2 General procedure for the synthesis of 2h



To a flame-dried pressure sealed tube charged with 206.2 mg podophyllotoxone (0.5mmol) and 12.7 mg (0.05 mmol, 10 mol%) iodine was added 2.5 mL (c = 0.2 M) of DMSO. Then 105 μL (1.25 mmol, 2.5 equiv) of 37 wt% hydrochloric acid aqueous solution was added and the pressure tube was quickly closed. The reaction mixture was heated up to 100 °C using a heating block and stirred at the same temperature for 2 hours, and the reaction was monitored by TLC. When the reaction is completed, the

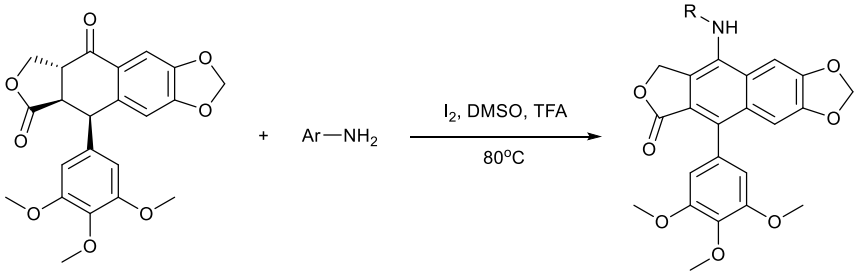
reaction was quenched by slow addition of saturated $Na_2S_2O_3$, water and ethyl acetate. The mixture was then poured into a separating funnel. After the phases were separated, and the aqueous phase was extracted three times with ethyl acetate. The combined organic layers were washed with brine, dried over Na_2SO_4, and concentrated by rotary evaporation to get a mixture of tetradehydropodophyllotoxin. Then this mixture was shifted into a new flame-dried pressure sealed tube and dissolved in DCM (5 mL). 10.0 mg DMAP and 51.2 μL acetanhydride (0.55 mmol, 1.1 equiv), 76.7 μL Et_3N (0.55 mmol, 1.1 equiv) was then added into the solution at room temperature. The mixture was stirred for another 1 hours, then poured into water, and extracted with ethyl acetate. The extract was washed with brine, dried over Na_2SO_4, and concentrated by rotary evaporation. The crude product can be separated by silica gel column chromatography to obtain the target product **2h**.

3.3 General procedure for the synthesis of 2i



To a flame-dried pressure sealed tube charged with 206.2 mg podophyllotoxone (0.5mmol) and 12.7 mg (0.05 mmol, 10 mol%) iodine was added 2.5 mL (c = 0.2 M) of DMSO. Then 105 μL (1.25 mmol, 2.5 equiv) of 37 wt% hydrochloric acid aqueous solution was added and the pressure tube was quickly closed. The reaction mixture was heated up to 100 °C using a heating block and stirred at the same temperature for 2 hours, and the reaction was monitored by TLC. When the reaction is completed, the reaction was quenched by slow addition of saturated $Na_2S_2O_3$, water and ethyl acetate. The mixture was then poured into a separating funnel. After the phases were separated, and the aqueous phase was extracted three times with ethyl acetate. The combined organic layers were washed with brine, dried over Na_2SO_4, and concentrated by rotary evaporation to get a mixture of tetradehydropodophyllotoxin. Then the mixture was shifted into a new flame-dried pressure sealed tube and Et_3N (104.6 μL, 0.75 mmol) and DMAP (6.11 mg, 0.05 mmol) were added and dissolved in CH_2Cl_2 (2.0 M). Then Tf_2O (107.1 μL, 0.75 mmol) was added at 0°C. The resulting mixture was warmed to room temperature and stirred for another 6 hours. The reaction was quenched with aqueous saturated $NaHCO_3$ and extracted with ethyl acetate. The combined organic layer was dried over anhydrous Na_2SO_4 and concentrated under reduced pressure after filtration. The crude product was purified by flash column chromatography on silica gel to provide the pure compound **2i**.

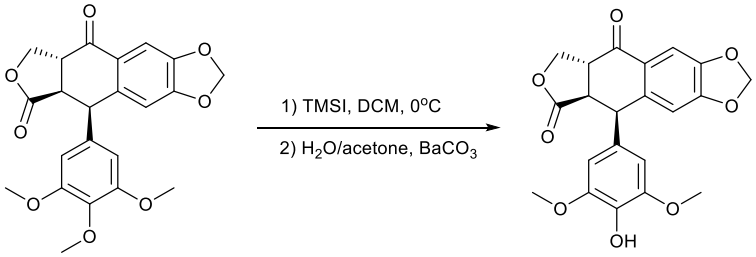
3.4 General procedure for the synthesis of 3a-3i



1 3a - 3i

To a flame-dried pressure sealed tube charged with 206.2 mg podophyllotoxone (0.5mmol), aniline (0.75 mmol, 1.5 equiv) and 12.7 mg (0.05 mmol, 10 mol%) iodine was added 2.5 mL (c = 0.2 M) of DMSO. Then 38 μL (0.05 mmol, 0.1 equiv) of trifluoroacetic acid was added and the pressure tube was quickly closed. The reaction mixture was heated up to 80 °C using a heating block and stirred at the same temperature for several hours, and the reaction was monitored by TLC. When the reaction is completed, the reaction was quenched by slow addition of saturated $Na_2S_2O_3$ solution, water and ethyl acetate. The mixture was then poured into a separating funnel. After the phases were separated, and the aqueous phase was extracted three times with ethyl acetate. The combined organic layers were washed with brine, dried over Na_2SO_4, and concentrated by rotary evaporation. The crude product can be separated by silica gel column chromatography to obtain the target product **3a-3i**.

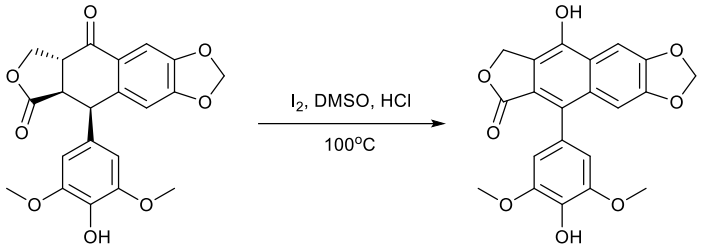
3.5 General procedure for the synthesis of 4



1 4

To a solution of 618.6 mg podophyllotoxone **1** (1.5 mmol) in dry dichloromethane (20 mL) was added at 0°C a solution of TMSI (667.8 μL, 3.0 equiv). The reaction mixture was stirred for 5h at 0°C then a mixture of H_2O/acetone (10 mL:10 mL) and $BaCO_3$ (299.0 mg, 1.01 equiv) were added successively. After 30 min at 40 °C, the resultant mixture was diluted with dichloromethane, then poured into 10% NaS_2O_3 solution. The combined organic layer was dried over anhydrous Na_2SO_4 and concentrated under reduced pressure after filtration. The crude product was purified by flash column chromatography on silica gel to provide the pure compound **4**.

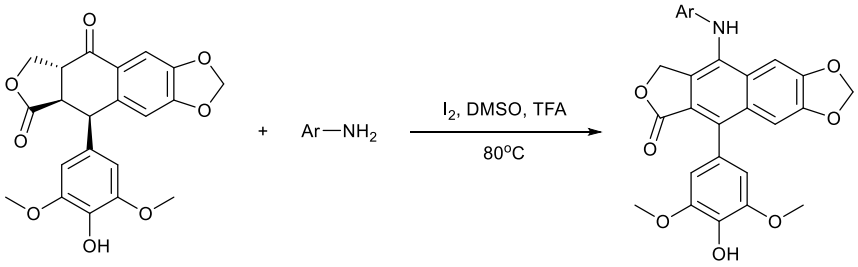
3.6 General procedure for the synthesis of 5



4 **5**

To a flame-dried pressure sealed tube charged with 199.2 mg **4** (0.5mmol) and 12.7 mg (0.05 mmol, 10 mol%) iodine was added 2.5 mL (c = 0.2 M) of DMSO. Then 105 μL (1.25 mmol, 2.5 equiv) of 37 wt% hydrochloric acid aqueous solution was added and the pressure tube was quickly closed. The reaction mixture was heated up to 100 °C using a heating block and stirred at the same temperature for 2 hours, and the reaction was monitored by TLC. When the reaction is completed, the reaction was quenched by slow addition of saturated $Na_2S_2O_3$ solution, water and ethyl acetate. The mixture was then poured into a separating funnel. After the phases were separated, and the aqueous phase was extracted three times with ethyl acetate. The combined organic layers were washed with brine, dried over Na_2SO_4, and concentrated by rotary evaporation. The crude product can be separated by silica gel column chromatography to obtain the target product **5**.

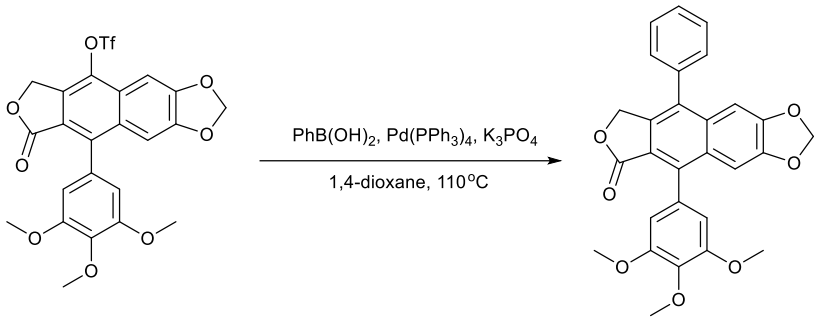
3.7 General procedure for the synthesis of 6a and 6b



4 **6a** and **6b**

To a flame-dried pressure sealed tube charged with 199.2 mg **4** (0.5 mmol), aniline (0.75 mmol, 1.5 equiv) and 12.7 mg (0.05 mmol, 10 mol%) iodine was added 2.5 mL (c = 0.2 M) of DMSO. Then 38 μL (0.05 mmol, 0.1 equiv) of TFA was added and the pressure tube was quickly closed. The reaction mixture was heated up to 80 °C using a heating block and stirred at the same temperature for several hours, and the reaction was monitored by TLC. When the reaction is completed, the reaction was quenched by slow addition of saturated $Na_2S_2O_3$ solution, water and ethyl acetate. The mixture was then poured into a separating funnel. After the phases were separated, and the aqueous phase was extracted three times with ethyl acetate. The combined organic layers were washed with brine, dried over Na_2SO_4, and concentrated by rotary evaporation. The crude product can be separated by silica gel column chromatography to obtain the target product **6a** and **6b**.

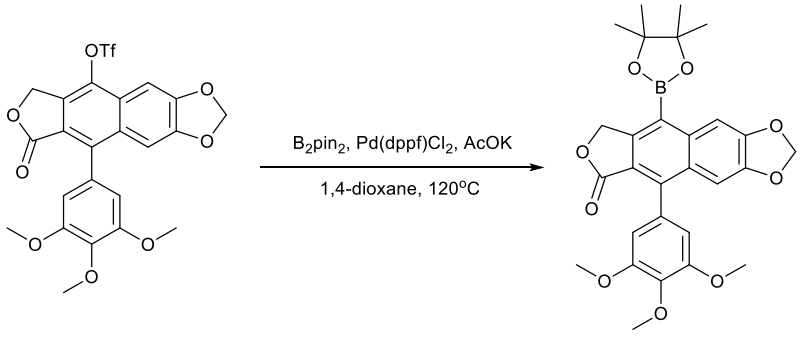
3.8 General procedure for the synthesis of 8a



2i **8a**

The mixture of compound **2i** (271.2 mg, 0.5 mmol), $PhB(OH)_2$ (91.5 mg, 0.75 mmol), K_3PO_4 (159.3 mg, 0.75 mmol), $Pd(PPh_3)_4$ (57.8 mg, 0.05 mmol) in 1,4-dioxane (5 mL) was heated to 110 °C for 8 hours. The reaction was cooled to room temperature and extracted with ethyl acetate. The combined organic layer was dried over anhydrous Na_2SO_4 and filtered. After removing the solvents under reduced pressure, the crude product was purified by flash column chromatography on silica gel to provide the pure compound **8a**.

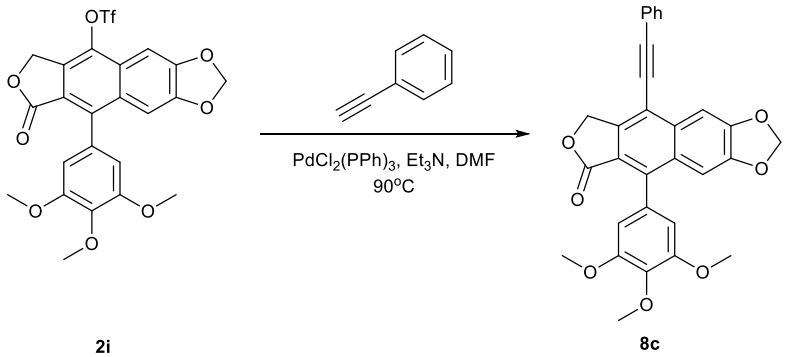
3.9 General procedure for the synthesis of 8b



2i **8b**

The mixture of compound **2i** (271.2 mg, 0.5 mmol), AcOK (98.1 mg, 1 mmol), $Pd(dppf)Cl_2$ (36.6 mg, 0.05 mmol) and bis(pinacolato)diboron (253.9 mg, 1.0 mmol) in 1,4-dioxane (4.0 mL) was stirred in a sealed tube at 120 °C for 6 hours. Then the reaction was cooled to room temperature and extracted with ethyl acetate. The combined organic layer was dried over anhydrous Na2SO4 and filtered. After removing the solvents under reduced pressure, the crude product was purified by flash column chromatography on silica gel to provide the pure compound **8b**.

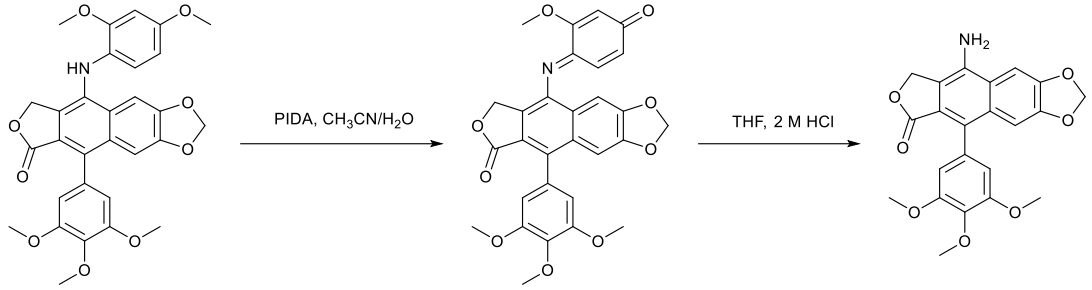
3.10 General procedure for the synthesis of 8c



2i **8c**

The mixture of compound **2i** (271.2 mg, 0.5 mmol), $PdCl_2(PPh)_3$ (10.5 mg, 0.15 mmol) and ethynylbenzene (82.5 µL, 0.75 mmol) and 300 µL Et_3N in DMF (1.5 mL) was stirred in a sealed tube at 90ºC for 18 hours under N_2. Then the reaction was cooled to room temperature and extracted with ethyl acetate. The combined organic layer was dried over anhydrous Na_2SO_4 and filtered. After removing the solvents under reduced pressure, the crude product was purified by flash column chromatography on silica gel to provide the pure compound **8c**.

3.11 General procedure for the synthesis of 9



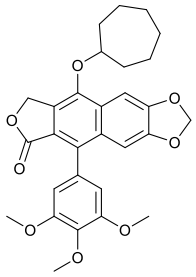
2g **10** **9**

To a stirred solution of compound **3g** (27.3 mg, 0.05 mmol) in CH_3CN (1.5 mL) and H_2O (375 µL) at 0ºC was added PIDA (32.2 mg, 0.1 mmol) in one portion. Then the resulting solution was stirred at 50 ºC for 2h. The reaction was quenched with aqueous saturated $NaHCO_3$ and extracted with CH_2Cl_2. The combined organic layer was dried over anhydrous Na_2SO_4 and concentrated under reduced pressure after filtration. The crude product was purified by flash column chromatography on silica gel to provide the intermediate compound **10**. Intermediate compound **10** was obtained at 61% yield (16.2 mg) as a wine-red solid.

The intermediate **10** (52.9 mg, 0.1mmol) was then dissolved in THF (2 mL) and 2 M HCl (aq) (2 mL) was added. The reaction mixture was stirred at rt and monitored by TLC. After 3 hours, the reaction was quenched with aqueous saturated $NaHCO_3$ and extracted with CH_2Cl_2. The combined organic layer was dried over anhydrous Na_2SO_4 and concentrated under reduced pressure after filtration. The crude product was purified by flash column chromatography on silica gel to provide compound **9** at 70% yield (28.5 mg) as a white solid.

4. Synthesis and characterization data of compounds

9-(cycloheptyloxy)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**2a**)



Compound **2a** was synthesized according to general procedure 3.1 starting from podophyllotoxone and bromocycloheptane. Compound **2a** was obtained in 69% yield (174.8 mg) in 3h as a yellow solid.

mp: 260-261 ºC.

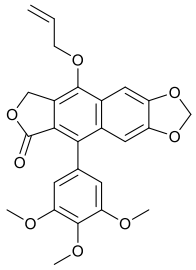
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.56 (s, 1H), 7.04 (s, 1H), 6.51 (s, 2H), 6.07 (s, 2H), 5.39 (s, 2H), 4.38 (tt, *J* = 8.4, 4.5 Hz, 1H), 3.95 (s, 3H), 3.82 (s, 6H), 2.12 – 2.04 (m, 2H), 1.90 (dddd, *J* = 14.2, 10.4, 8.0, 2.5 Hz, 2H), 1.82 – 1.76 (m, 2H), 1.66 – 1.59 (m, 4H), 1.45 (ddd, *J* = 14.7, 6.7, 3.1 Hz, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.6, 152.9, 149.8, 148.8, 146.5, 137.6, 135.0, 132.2, 130.6, 129.2, 127.3, 119.4, 107.5, 104.0, 101.9, 99.2, 83.2, 67.0, 61.1, 56.2, 34.6, 28.5, 22.6.

IR (KBr, cm^{-1}): 2929, 1769, 1584, 1460, 1416, 1344, 1243, 1130, 1081, 1035, 940, 862.

HRMS (ESI) m/z calcd for $C_{29}H_{31}O_8^+$ $(M+H)^+$ 507.2013, found 507.2015.

9-(allyloxy)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**2b**)



Compound **2b** was synthesized according to general procedure 3.1 starting from podophyllotoxone and 3-bromoprop-1-ene. Compound **2b** was obtained in 67% yield (151.0 mg) in 3h as a yellow solid.

mp: 208-210 ºC.

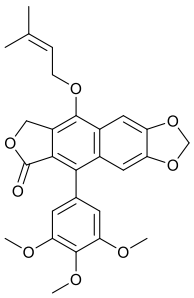
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.56 (s, 1H), 7.06 (s, 1H), 6.51 (s, 2H), 6.22 – 6.10 (m, 1H), 6.08 (s, 2H), 5.48 (dd, *J* = 17.1, 1.5 Hz, 1H), 5.45 (s, 2H), 5.35 (dd, *J* = 10.4, 1.4 Hz, 1H), 4.74 – 4.66 (m, 2H), 3.95 (s, 3H), 3.82 (s, 6H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.4, 153.0, 150.1, 149.0, 147.4, 137.7, 135.7, 133.1, 132.3, 130.5, 128.4, 127.2, 119.4, 118.8, 107.5, 104.1, 102.0, 98.7, 73.7, 66.7, 61.1, 56.2.

IR (KBr, cm^{-1}): 1768, 1584, 1503, 1493, 1433, 1413, 1382, 1369, 1344, 1243, 1159, 1125, 1077, 1034, 1019, 980, 935, 855.

HRMS (ESI) m/z calcd for $C_{25}H_{22}O_8Na^+$ $(M+Na)^+$ 473.1207, found 473.1209.

9-((3-methylbut-2-en-1-yl)oxy)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**2c**)



Compound **2c** was synthesized according to general procedure 3.1 starting from podophyllotoxone and 1-bromo-3-methylbut-2-ene. Compound **2c** was obtained in 92% yield (219.7 mg) in 3h as a white solid.

mp: 208-210 °C.

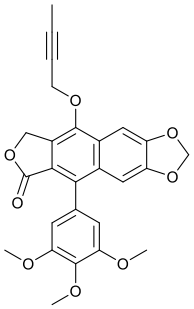
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.54 (s, 1H), 7.04 (s, 1H), 6.51 (s, 2H), 6.05 (s, 2H), 5.58 (ddd, *J* = 7.1, 5.6, 1.5 Hz, 1H), 5.43 (s, 2H), 4.67 (d, *J* = 7.0 Hz, 2H), 3.93 (s, 3H), 3.81 (s, 6H), 1.81 (d, *J* = 1.5 Hz, 3H), 1.71 (d, *J* = 1.5 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.5, 152.9, 149.9, 148.8, 147.6, 139.6, 137.6, 135.4, 132.1, 130.5, 128.5, 127.4, 119.6, 119.3, 107.5, 107.4, 104.0, 101.9, 98.7, 69.6, 66.7, 61.0, 56.1, 25.9, 18.2.

IR (KBr, cm^{-1}): 2940, 1769, 1584, 1464, 1410, 1380, 1346, 1245, 1128, 1034, 856, 799.

HRMS (ESI) m/z calcd for $C_{27}H_{26}O_8Na^+$ $(M+Na)^+$ 501.1520, found 501.1521.

9-(but-2-yn-1-yloxy)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**2d**)



Compound **2d** was synthesized according to general procedure 3.1 starting from podophyllotoxone and 1-bromobut-2-yne. Compound **2d** was obtained in 93% yield (215.0 mg) in 3h as a white solid.

mp: 210-212 °C.

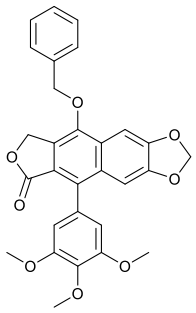
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.55 (s, 1H), 7.08 (s, 1H), 6.53 (s, 2H), 6.09 (s, 2H), 5.54 (s, 2H), 4.81 (s, 2H), 3.96 (s, 3H), 3.84 (s, 6H), 1.87 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.5, 153.1, 150.2, 149.0, 146.8, 137.9, 136.4, 132.5, 130.4, 128.7, 128.6, 119.5, 107.6, 104.3, 102.0, 98.7, 85.2, 74.4, 67.0, 61.3, 61.2, 56.3, 3.8.

IR (KBr, cm^{-1}): 2921, 2242, 1768, 1586, 1491, 1462, 1347, 1246, 1122, 1032, 856.

HRMS (ESI) m/z calcd for $C_{26}H_{23}O_8^+$ $(M+H)^+$ 463.1387, found 463.1389.

9-(benzyloxy)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**2e**)



Compound **2e** was synthesized according to general procedure 3.1 starting from podophyllotoxone and (bromomethyl)benzene. Compound **2e** was obtained in 90% yield (224.0 mg) in 3h as a white solid.

mp: 258-260 ºC.

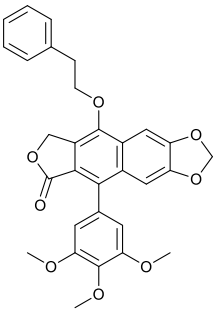
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.59 (s, 1H), 7.48 – 7.40 (m, 5H), 7.09 (s, 1H), 6.53 (s, 2H), 6.08 (s, 2H), 5.21 (s, 2H), 5.21 (s, 2H), 3.96 (s, 3H), 3.83 (s, 6H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.4, 153.0, 150.1, 149.0, 147.3, 137.7, 136.6, 135.9, 132.4, 130.4, 129.0, 128.9, 128.4, 128.1, 127.8, 119.4, 107.5, 104.2, 102.0, 98.7, 75.1, 66.7, 61.1, 56.2.

IR (KBr, cm^{-1}): 2921, 2242, 1768, 1586, 1491, 1462, 1347, 1246, 1122, 1032, 856.

HRMS (ESI) m/z calcd for $C_{29}H_{24}O_8Na^+$ $(M+Na)^+$ 523.1363, found 523.1367.

9-phenethoxy-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**2f**)



Compound **2f** was synthesized according to general procedure 3.1 starting from podophyllotoxone and (2-bromoethyl)benzene. Compound **2f** was obtained in 70% yield (179.0 mg) in 3h as a white solid.

mp: 225-227 ºC.

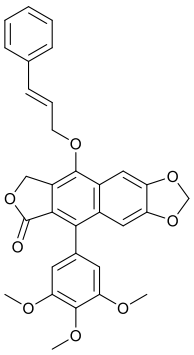
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.41 – 7.28 (m, 6H), 7.04 (s, 1H), 6.50 (s, 2H), 6.06 (s, 2H), 5.25 (s, 2H), 4.37 (t, *J* = 6.5 Hz, 2H), 3.95 (s, 3H), 3.82 (s, 6H), 3.20 (t, *J* = 6.5 Hz, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.4, 152.9, 149.9, 148.9, 147.6, 137.9, 137.6, 135.5, 132.2, 130.5, 129.2, 128.8, 128.3, 127.0, 126.8, 119.4, 107.4, 107.4, 104.0, 101.9, 98.6, 73.7, 66.4, 61.1, 56.1, 36.8.

IR (KBr, cm^{-1}): 2938, 1771, 1581, 1463, 1352, 1240, 1128, 1035, 865, 758, 703.

HRMS (ESI) m/z calcd for $C_{30}H_{27}O_8^+$ $(M+H)^+$ 515.1700, found 515.1703.

9-(cinnamyloxy)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**2g**)



Compound **2g** was synthesized according to general procedure 3.1 starting from podophyllotoxone and (Z)-(3-bromoprop-1-en-1-yl)benzene. Compound **2g** was obtained in 75% yield (197.5 mg) in 3h as a yellow solid.

mp: 188-190 °C.

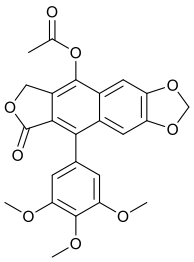
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.61 (s, 1H), 7.43 (d, *J* = 7.2 Hz, 2H), 7.35 (t, *J* = 7.5 Hz, 2H), 7.29 (t, *J* = 7.3 Hz, 1H), 7.08 (s, 1H), 6.78 (d, *J* = 15.8 Hz, 1H), 6.53 (s, 2H), 6.50 (dt, *J* = 15.9, 6.0 Hz, 1H), 6.08 (s, 2H), 5.48 (s, 2H), 4.87 – 4.83 (m, 2H), 3.96 (s, 3H), 3.83 (s, 6H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.4, 152.9, 150.1, 148.9, 147.3, 137.6, 135.9, 135.7, 134.1, 132.3, 130.4, 128.8, 128.4, 127.4, 126.7, 123.9, 119.4, 107.4, 107.4, 104.1, 102.0, 98.6, 73.6, 66.7, 61.0, 56.1.

IR (KBr, cm^{-1}): 2932, 1766, 1586, 1491, 1465, 1350, 1243, 1128, 1035, 969, 856, 798, 752, 697.

HRMS (ESI) m/z calcd for $C_{31}H_{27}O_8^+$ $(M+H)^+$ 527.1700, found 527.1703.

8-oxo-9-(3,4,5-trimethoxyphenyl)-6,8-dihydrofuro[3',4':6,7]naphtho[2,3-d][1,3]dioxol-5-yl acetate (**2h**)



Compound **2h** was synthesized according to general procedure 3.2 starting from podophyllotoxone and acetic anhydride. Compound **2h** was obtained in 94% yield (212.7 mg) in 1h as a yellow solid.

mp: 271-273 °C.

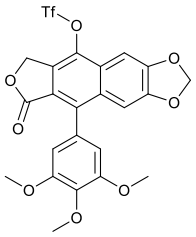
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.23 (s, 1H), 7.11 (s, 1H), 6.54 (s, 2H), 6.09 (s, 2H), 5.25 (s, 2H), 3.96 (s, 3H), 3.83 (s, 6H), 2.51 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.0, 168.1, 153.1, 150.7, 149.2, 138.8, 138.6, 138.0, 132.3, 130.8, 129.9, 127.8, 119.4, 107.4, 104.4, 102.3, 97.4, 66.4, 61.1, 56.3, 20.8.

IR (KBr, cm^{-1}): 2938, 1771, 1583, 1508, 1468, 1419, 1367, 1344, 1252, 1191, 1124, 1072, 1038, 1023, 945, 865, 795.

HRMS (ESI) m/z calcd for $C_{24}H_{21}O_9^+$ $(M+H)^+$ 453.1180, found 453.1180.

9-oxo-9-(3,4,5-trimethoxyphenyl)-6,8-dihydrofuro[3',4':6,7]naphtho[2,3-d][1,3]dioxol-5-yl trifluoromethanesulfonate (**2i**)



Compound **2i** was synthesized according to general procedure 3.3 starting from podophyllotoxone and trifluoromethanesulfonic anhydride. Compound **2i** was obtained in 79% yield (212.8 mg) in 6h as a white solid.

mp: 224-226 ºC.

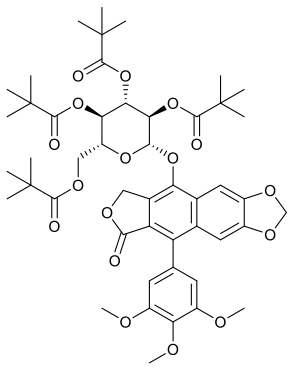
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.42 (s, 1H), 7.14 (s, 1H), 6.52 (s, 2H), 6.15 (s, 2H), 5.47 (s, 2H), 3.96 (s, 3H), 3.83 (s, 6H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 167.9, 153.3, 151.9, 149.8, 141.3, 138.3, 136.4, 133.2, 131.8, 129.1, 128.1, 119.9, 118.7 (d, *J* = 319.9 Hz), 107.2, 104.7, 102.7, 97.5, 65.8, 61.1, 56.31.

IR (KBr, cm^{-1}): 2973, 2900, 1769, 1468, 1407, 1246, 1227, 1126, 1062, 1037, 818, 761.

HRMS (ESI) m/z calcd for $C_{23}H_{18}F_3O_{10}S^+$ $(M+H)^+$ 543.0567, found 543.0569.

(2S,3R,4S,5R,6R)-2-((8-oxo-9-(3,4,5-trimethoxyphenyl)-6,8-dihydrofuro[3',4':6,7]naphtho[2,3-d][1,3] dioxol-5-yl)oxy)-6-((pivaloyloxy)methyl)tetrahydro-2H-pyran-3,4,5-triyl tris(2,2-dimethylpropanoate) (**2j**)



Compound **2j** was synthesized according to general procedure 3.1 starting from podophyllotoxone and (2R,3R,4S,5R,6R)-2-bromo-6-((pivaloyloxy)methyl)tetrahydro-2H-pyran-3,4,5-triyl tris(2,2-dimethylpropanoate). Compound **2j** was obtained in 61% yield (277.0 mg) in 4h as a white solid.

mp: 282-284 ºC.

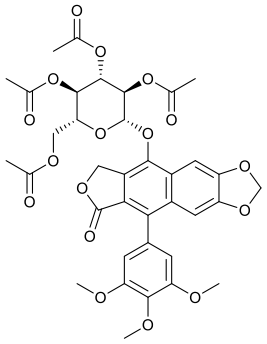
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.47 (s, 1H), 7.07 (s, 1H), 6.46 (s, 2H), 6.08 (s, 2H), 5.53 (dd, *J* = 9.6, 8.0 Hz, 1H), 5.48 (d, *J* = 14.9 Hz, 1H), 5.45 – 5.39 (m, 2H), 5.26 – 5.14 (m, 2H), 4.12 (dd, *J* = 12.5, 2.0 Hz, 1H), 4.01 (dd, *J* = 12.4, 5.8 Hz, 1H), 3.92 (s, 3H), 3.80 (s, 3H), 3.79 (s, 3H), 3.68 – 3.63 (m, 1H), 1.27 (s, 9H), 1.15 (s, 9H), 1.12 (s, 9H), 1.07 (s, 9H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 177.8, 177.2, 176.7, 176.5, 169.2, 153.0, 152.9, 150.5, 149.0, 143.5, 137.8, 137.5, 132.3, 131.4, 130.1, 127.8, 119.5, 107.3, 107.2, 104.4, 102.2, 101.3, 97.7, 72.7, 72.2, 71.7, 67.8, 67.1, 61.6, 61.0, 56.1, 56.1, 39.0, 38.8, 38.8, 38.8, 27.4, 27.3, 27.1, 27.0.

IR (KBr, cm^{-1}): 2973, 1760, 1740, 1583, 1465, 1353, 1246, 1136, 1084, 1038, 940, 890, 766, 746.

HRMS (ESI) m/z calcd for $C_{48}H_{61}O_{17}^+$ $(M+H)^+$ 909.3903, found 909.3909.

(2R,3R,4S,5R,6S)-2-(acetoxymethyl)-6-((8-oxo-9-(3,4,5-trimethoxyphenyl)-6,8-dihydrofuro[3',4':6,7]naphtho[2,3-d][1,3]dioxol-5-yl)oxy)tetrahydro-2H-pyran-3,4,5-triyl triacetate (**2k**)



Compound **2k** was synthesized according to general procedure 3.1 starting from podophyllotoxone and (2R,3R,4S,5R,6R)-2-(acetoxymethyl)-6-bromotetrahydro-2H-pyran-3,4,5-triyl triacetate. Compound **2k** was obtained in 60% yield (222.1 mg) in 4h as a yellow solid.

mp: 260-262 ºC.

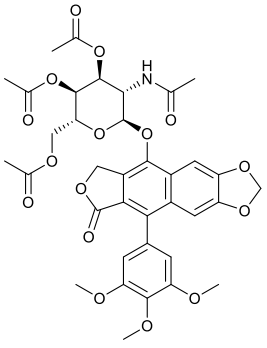
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.49 (s, 1H), 7.09 (s, 1H), 6.50 (d, *J* = 4.2 Hz, 2H), 6.10 (d, *J* = 6.9 Hz, 2H), 5.51 (d, *J* = 15.1 Hz, 1H), 5.47 – 5.39 (m, 2H), 5.29 (t, *J* = 9.5 Hz, 1H), 5.18 (t, *J* = 9.7 Hz, 1H), 5.05 (d, *J* = 7.9 Hz, 1H), 4.22 (dd, *J* = 12.3, 5.8 Hz, 1H), 4.16 (dd, *J* = 12.4, 2.5 Hz, 1H), 3.94 (s, 3H), 3.82 (s, 6H), 3.73 – 3.67 (m, 1H), 2.24 (s, 3H), 2.06 (s, 6H), 2.04 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 170.5, 170.4, 169.4, 169.4, 169.2, 153.1, 153.0, 150.5, 149.0, 144.3, 137.9, 137.9, 132.4, 130.8, 130.1, 128.2, 119.6, 107.5, 107.3, 104.4, 102.2, 102.0, 97.7, 72.7, 72.4, 71.8, 68.2, 67.3, 62.0, 61.1, 56.3, 56.2, 20.9, 20.7, 20.7, 20.7.

IR (KBr, cm^{-1}): 2944, 1760, 1581, 1465, 1373, 1237, 1128, 1035, 937, 902, 862, 792.

HRMS (ESI) m/z calcd for $C_{36}H_{37}O_{17}^+$ $(M+H)^+$ 741.2025, found 741.2026.

(2R,3S,4S,5S,6R)-5-acetamido-2-(acetoxymethyl)-6-((8-oxo-9-(3,4,5-trimethoxyphenyl)-6,8-dihydrofuro[3',4':6,7]naphtho[2,3-d][1,3]dioxol-5-yl)oxy)tetrahydro-2H-pyran-3,4-diyl diacetate (**2l**)



Compound **2l** was synthesized according to general procedure 3.1 starting from podophyllotoxone and 2-Acetamido-3,4,6-tri-O-acetyl-2-deoxy-α-D-glucopyranosyl chloride. Compound **2l** was obtained in 82% yield (302.4 mg) in 4h as a white solid.

mp: decomposed.

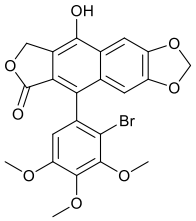
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 8.36 (d, *J* = 9.2 Hz, 1H), 7.54 (s, 1H), 6.89 (s, 1H), 6.56 (d, *J* = 32.7 Hz, 2H), 6.21 (d, *J* = 13.6 Hz, 2H), 5.55 (dd, *J* = 82.3, 15.2 Hz, 2H), 5.33 – 5.22 (m, 2H), 4.99 (t, *J* = 9.5 Hz, 1H), 4.40 – 4.06 (m, 4H), 3.77 (s, 3H), 3.74 (s, 3H), 3.73 (s, 3H), 2.04 (s, 3H), 2.02 (s, 3H), 1.99 (s, 3H), 1.86 (s, 3H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 170.0, 169.9, 169.7, 169.4, 168.6, 152.6, 152.5, 149.9, 148.8, 145.1, 137.1, 135.5, 131.0, 130.2, 127.5, 127.2, 119.4, 107.4, 107.4, 102.7, 102.4, 101.0, 98.0, 71.9, 71.1, 68.6, 67.1, 62.1, 60.1, 55.9, 53.5, 22.7, 20.5, 20.4.

IR (KBr, cm^{-1}): 3294, 2944, 1772, 1763, 1659, 1466, 1376, 1347, 1240, 1128, 1079, 1038, 937, 905.

HRMS (ESI) m/z calcd for $C_{36}H_{38}NO_{16}^+$ $(M+H)^+$ 740.2185, found 740.2184.

5-(2-bromo-3,4,5-trimethoxyphenyl)-9-hydroxyfuro[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**2m**)



Compound **2m** was synthesized according to first part of general procedure 3.1 starting from 9-(2-bromo-3,4,5-trimethoxyphenyl)-5a,6,8a,9-tetrahydrofuro[3',4':6,7]naphtho[2,3-d][1,3]dioxole-5,8-dione (*Bioorg. Med. Chem. Lett.*, 2018, ***28***, 1410-1416.). Compound **2m** was obtained in 99% yield (242.3 mg) in 2h as a white solid.

mp: 254-257 ºC.

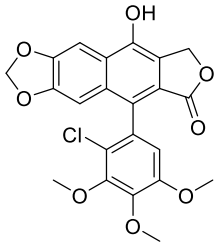
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 10.59 (s, 1H), 7.62 (s, 1H), 6.74 (s, 1H), 6.60 (s, 1H), 6.17 (d, *J* = 4.8 Hz, 2H), 5.45 – 5.35 (m, 2H), 3.88 (s, 3H), 3.84 (s, 3H), 3.73 (s, 3H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.2, 152.4, 150.2, 148.9, 148.7, 146.0, 142.1, 132.1, 130.5, 128.5, 124.7, 122.2, 119.6, 110.9, 110.2, 102.1, 102.0, 98.3, 67.0, 60.9, 60.8, 56.1.

IR (KBr, cm^{-1}): 3422, 1724, 1466, 1458, 1428, 1384, 1359, 1244, 1140, 1102, 1036, 998.

HRMS (ESI) m/z calcd for $C_{22}H_{18}BrO_8^+$ $(M+H)^+$ 489.0181, found 489.0161.

6-(2-chloro-3,4,5-trimethoxyphenyl)-9-hydroxyfuro[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**2n**)



Compound **2n** was synthesized according to first part of general procedure 3.1 starting from 9-(2-chloro-3,4,5-trimethoxyphenyl)-5a,6,8a,9-tetrahydrofuro[3',4':6,7]naphtho[2,3-d][1,3]dioxole-5,8-dione (*Nat. Catal.*, 2020, ***3***, 107-115). Compound **2n** was obtained in 96% yield (212.9 mg) in 2h as a white solid.

mp: decomposed at 245 °C

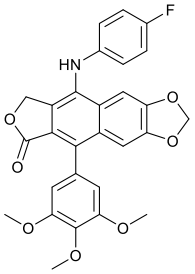
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 10.59 (s, 1H), 7.62 (s, 1H), 6.73 (s, 1H), 6.64 (s, 1H), 6.17 (d, *J* = 3.1 Hz, 2H), 5.45 – 5.34 (m, 2H), 3.89 (s, 3H), 3.86 (s, 3H), 3.73 (s, 3H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.3, 151.8, 149.3, 148.9, 148.7, 146.0, 142.3, 130.6, 129.9, 126.6, 124.7, 122.2, 119.8, 119.2, 110.7, 102.1, 102.0, 98.3, 67.0, 61.0, 60.8, 56.1.

IR (KBr, cm^{-1}): 3437, 1725, 1390, 1358, 1245, 1140, 1106, 1036, 1010.

HRMS (ESI) m/z calcd for $C_{22}H_{18}ClO_8^+$ $(M+H)^+$ 445.0685, found 445.0665.

9-((4-fluorophenyl)amino)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**3a**)



Compound **3a** was synthesized according to general procedure 3.4 starting from podophyllotoxone and 4-fluoroaniline. Compound **3a** was obtained in 49% yield (123.1 mg) in 3h as a yellow solid.

mp: 228-230 °C.

^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 8.21 (s, 1H), 7.44 (s, 1H), 7.02 (t, *J* = 8.6 Hz, 2H), 6.95 (s, 1H), 6.73 – 6.65 (m, 2H), 6.61 (s, 2H), 6.17 (s, 2H), 5.09 (s, 2H), 3.77 (s, 3H), 3.74 (s, 6H).

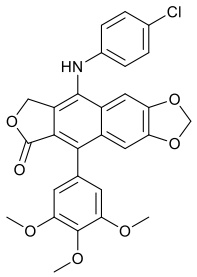
^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.12, 152.5, 149.1 (d, *J* = 196.3 Hz), 141.6, 137.0, 135.2, 133.4, 131.2, 131.0, 130.6, 129.9, 119.2, 116.4, 116.3, 115.7, 115.6, 107.5, 103.2, 102.3, 99.5, 67.3, 60.1, 55.9.

^{19}F NMR (565 MHz, DMSO-*d*$_6$) δ -125.55 (tt, *J* = 8.4, 4.5 Hz).

IR (KBr, cm^{-1}): 2912, 1766, 1668, 1581, 1509, 1463, 1246, 1130, 1038, 937, 859, 821.

HRMS (ESI) m/z calcd for $C_{28}H_{23}FNO_7^+$ $(M+H)^+$ 504.1453, found 504.1457.

9-((4-chlorophenyl)amino)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**3b**)



Compound **3b** was synthesized according to general procedure 3.4 starting from podophyllotoxone and 4-chloroaniline. Compound **3b** was obtained in 46% yield (119.2 mg) in 7h as a yellow solid.

mp: 244-246 ºC.

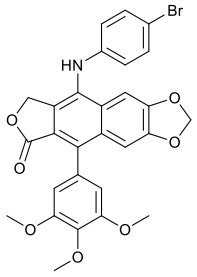
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 8.39 (s, 1H), 7.40 (s, 1H), 7.20 (d, *J* = 8.8 Hz, 2H), 6.97 (s, 1H), 6.66 (d, *J* = 8.8 Hz, 2H), 6.63 (s, 2H), 6.18 (s, 2H), 5.15 (s, 2H), 3.79 (s, 3H), 3.75 (s, 6H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.1, 152.5, 149.8, 148.5, 1443, 137.0, 136.0, 134.5, 131.0, 130.5, 130.4, 128.9, 121.9, 119.2, 115.9, 107.5, 103.3, 102.4, 99.4, 67.3, 60.1, 55.9.

IR (KBr, cm^{-1}): 2938, 1766, 1584, 1497, 1465, 1246, 1125, 1032, 940.

HRMS (ESI) m/z calcd for $C_{28}H_{23}ClNO_7^+$ $(M+H)^+$520.1158, found 520.1158.

10-((4-bromophenyl)amino)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**3c**)



Compound **3c** was synthesized according to general procedure 3.4 starting from Podophyllotoxone and 4-bromoaniline. Compound **3c** was obtained in 71% yield (200.4 mg) in 5h as a yellow solid.

mp: 269-270 ºC

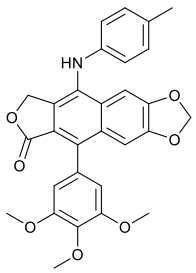
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 8.40 (s, 1H), 7.41 (s, 1H), 7.30 (d, *J* = 7.6 Hz, 2H), 6.99 (s, 1H), 6.64 (s, 2H), 6.61 (d, *J* = 7.6 Hz, 2H), 6.17 (s, 2H), 5.16 (s, 2H), 3.79 (s, 3H), 3.76 (s, 6H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.1, 152.6, 149.8, 148.5, 144.7, 137.0, 136.1, 134.6, 131.8, 131.1, 130.5, 130.5, 130.1, 119.2, 116.4, 109.4, 107.5, 103.3, 102.4, 99.4, 67.3, 60.1, 56.0.

IR (KBr, cm^{-1}):1761, 1581, 1493, 1413, 1160, 1070, 1004.

HRMS (ESI) m/z calcd for $C_{28}H_{22}BrNO_7Na^+$ $(M+Na)^+$ 586.0472, found 586.0472.

11-(p-tolylamino)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**3d**)



Compound **3d** was synthesized according to general procedure 3.4 starting from podophyllotoxone and p-toluidine. Compound **3d** was obtained in 42% yield (104.5 mg) in 5h as a yellow solid.

mp: 247-249 ºC.

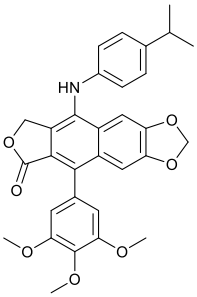
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 8.11 (s, 1H), 7.46 (s, 1H), 7.00 (d, *J* = 8.1 Hz, 2H), 6.95 (s, 1H), 6.62 (d, *J* = 8.7 Hz, 4H), 6.17 (s, 2H), 5.08 (s, 2H), 3.78 (s, 3H), 3.75 (s, 6H), 2.21 (s, 3H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.2, 152.5, 149.5, 148.3, 142.5, 136.9, 134.7, 132.9, 131.5, 131.0, 130.7, 129.8, 129.5, 127.7, 119.2, 115.5, 107.6, 103.1, 102.2, 99.6, 67.4, 60.1, 56.0, 20.2.

IR (KBr, cm^{-1}): 2941, 1754, 1581, 1512, 1465, 1413, 1361, 1240, 1128, 1035.

HRMS (ESI) m/z calcd for $C_{29}H_{26}NO_7^+$ $(M+H)^+$ 500.1704, found 500.1705.

10-((4-isopropylphenyl)amino)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**3e**)



Compound **3e** was synthesized according to general procedure 3.4 starting from podophyllotoxone and 4-isopropylaniline. Compound **3e** was obtained in 34% yield (90.1 mg) in 7h as a brown solid.

mp: 246-248 ºC.

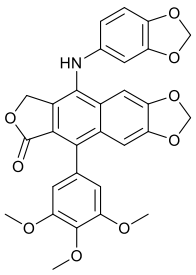
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 8.13 (s, 1H), 7.47 (s, 1H), 7.06 (d, *J* = 8.2 Hz, 2H), 6.96 (s, 1H), 6.64 (d, *J* = 7.9 Hz, 4H), 6.17 (s, 2H), 5.10 (s, 2H), 3.79 (s, 3H), 3.75 (s, 6H), 2.78 (p, *J* = 6.9 Hz, 1H), 1.16 (d, *J* = 6.9 Hz, 6H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.3, 152.5, 149.5, 148.4, 142.9, 139.0, 136.9, 134.9, 133.1, 131.5, 139.0, 130.7, 129.9, 126.9, 119.2, 115.3, 107.6, 103.1, 102.3, 99.7, 67.4, 60.1, 55.9, 32.6, 24.2.

IR (KBr, cm^{-1}): 2954, 1765, 1585, 1512, 1458, 1246, 1129, 1030, 942, 863, 818.

HRMS (ESI) m/z calcd for $C_{31}H_{30}NO_7^+$ $(M+H)^+$ 528.2017, found 528.2019.

9-(benzo[d][1,3]dioxol-5-ylamino)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**3f**)



Compound **3f** was synthesized according to general procedure 3.4 starting from podophyllotoxone and benzo[d][1,3]dioxol-5-amine. Compound **3f** was obtained in 66% yield (175.0 mg) in 7h as a yellow solid.

mp: 243-245 ºC.

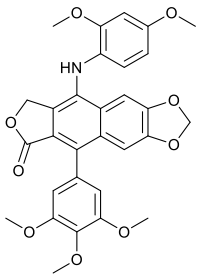
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 8.04 (s, 1H), 7.49 (s, 1H), 6.95 (s, 1H), 6.75 (d, *J* = 8.3 Hz, 1H), 6.62 (s, 2H), 6.41 (s, 1H), 6.17 (s, 2H), 6.14 (d, *J* = 8.0 Hz, 1H), 5.93 (s, 2H), 5.07 (s, 2H), 3.78 (s, 3H), 3.75 (s, 6H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.2, 152.5, 149.5, 148.3, 147.9, 140.6, 140.1, 136.9, 134.5, 132.4, 132.0, 131.0, 130.8, 129.4, 119.3, 108.4, 108.0, 107.6, 103.1, 102.2, 100.7, 99.6, 98.8, 67.4, 60.1, 55.9.

IR (KBr, cm^{-1}): 2922, 1760, 1506, 1462, 1243, 1126, 1037, 935.

HRMS (ESI) m/z calcd for $C_{29}H_{24}NO_9^+$ $(M+H)^+$ 530.1446, found 530.1449.

.9-((2,4-dimethoxyphenyl)amino)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**3g**)



Compound **3g** was synthesized according to general procedure 3.4 starting from podophyllotoxone and 2,4-dimethoxyaniline. Compound **3g** was obtained in 62% yield (169.7 mg) in 8h as a brown solid.

mp: 241-243 ºC.

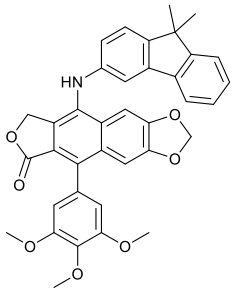
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 7.59 (s, 1H), 7.40 (s, 1H), 6.89 (s, 1H), 6.67 (d, *J* = 2.7 Hz, 1H), 6.58 (d, *J* = 5.2 Hz, 2H), 6.39 (dd, *J* = 8.6, 2.7 Hz, 1H), 6.16 (s, 2H), 4.81 (s, 2H), 3.84 (s, 3H), 3.77 (s, 3H), 3.74 (d, 9H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.3, 155.6, 152.5, 152.3, 149.1, 148.1, 136.8, 134.2, 132.2, 131.1, 130.9, 128.4, 127.3, 126.1, 120.9, 119.2, 107.7, 104.2, 103.0, 102.1, 99.7, 99.4, 67.1, 60.1, 55.9, 55.7, 55.4.

IR (KBr, cm^{-1}) 2973, 2913, 1756, 1594, 1502, 1465, 1253, 1123, 1034, 939, 806.

HRMS (ESI) m/z calcd for $C_{30}H_{28}NO_9^+$ $(M+H)^+$ 546.1759, found 546.1760.

10-((9,9-dimethyl-9H-fluoren-3-yl)amino)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**3h**)



Compound **3h** was synthesized according to general procedure 3.2 starting from podophyllotoxone and 9,9-dimethyl-9H-fluoren-3-amine. Compound **3h** was obtained in 57% yield (171.3 mg) in 7h as a yellow solid.

mp: 268-270 °C.

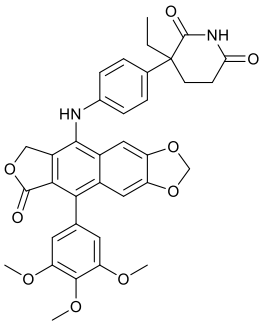
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 8.48 (s, 1H), 7.64 (d, *J* = 7.5 Hz, 1H), 7.61 (d, *J* = 8.2 Hz, 1H), 7.56 (s, 1H), 7.46 (d, *J* = 7.4 Hz, 1H), 7.26 (td, *J* = 7.4, 1.2 Hz, 1H), 7.19 (td, *J* = 7.4, 1.2 Hz, 1H), 6.98 (s, 1H), 6.95 (d, *J* = 2.1 Hz, 1H), 6.68 (d, *J* = 2.1 Hz, 1H), 6.65 (s, 2H), 6.18 (s, 2H), 5.11 (s, 2H), 3.79 (s, 3H), 3.77 (s, 6H), 1.40 (s, 6H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.3, 154.8, 152.6, 152.5, 149.5, 148.4, 144.5, 139.0, 137.0, 134.8, 132.7, 131.0, 130.9, 130.7, 130.0, 129.6, 126.9, 125.7, 122.5, 120.9, 119.3, 118.7, 114.3, 109.7, 107.6, 103.2, 102.3, 99.8, 67.6, 60.1, 55.9, 46.3, 27.0.

IR (KBr, cm^{-1}) 2958, 2916, 1766, 1462, 1360, 1246, 1129, 1130, 945, 875.

MS (ESI) m/z calcd for $C_{37}H_{31}NO_7Na^+$ $(M+Na)^+$ 624.2, found 624.1.

3-ethyl-3-(4-((8-oxo-9-(3,4,5-trimethoxyphenyl)-6,8-dihydrofuro[3',4':6,7]naphtho[2,3-d][1,3]dioxol-5-yl)amino)phenyl)piperidine-2,6-dione (**3i**)



Compound **3i** was synthesized according to general procedure 3.4 starting from podophyllotoxone and 3-(4-aminophenyl)-3-ethylpiperidine-2,6-dione. Compound **3i** was obtained in 51% yield (160.0 mg) in 7h as a white solid.

mp: 241-243 °C.

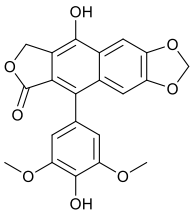
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 10.81 (s, 1H), 7.46 (s, 1H), 7.11 (d, *J* = 8.3 Hz, 2H), 6.96 (s, 1H), 6.69 (d, *J* = 8.3 Hz, 2H), 6.63 (s, 2H), 6.18 (s, 2H), 5.10 (s, 2H), 3.78 (s, 3H), 3.75 (s, 6H), 2.47 – 2.40 (m, 1H), 2.29 – 2.24 (m, 1H), 2.19 – 2.11 (m, 2H), 1.86 (q, *J* = 7.4, 6.8 Hz, 1H), 1.79 (q, *J* = 7.4, 6.8 Hz, 1H), 0.76 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 176.0, 172.9, 169.2, 152.5, 149.7, 148.4, 144.0, 137.0, 135.3, 133.7, 131.0, 130.9, 130.6, 130.2, 129.6, 127.0, 119.2, 115.1, 107.6, 103.1, 102.3, 99.6, 67.4, 60.1, 56.0, 49.5, 32.3, 29.2, 26.0, 9.0.

IR (KBr, cm^{-1}) 2974, 1763, 1680, 1516, 1465, 1246, 1129, 1037, 942, 831.

HRMS (ESI) m/z calcd for $C_{35}H_{33}N_2O_9^+$ $(M+H)^+$ 625.2186, found 625.2181.

9-hydroxy-5-(4-hydroxy-3,5-dimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**5**)



Compound **5** was synthesized according to general procedure 3.6 starting from compound **4**. Compound **5** was obtained in 64% yield (126.8 mg) in 4h as a white solid.

mp: ＞300ºC.

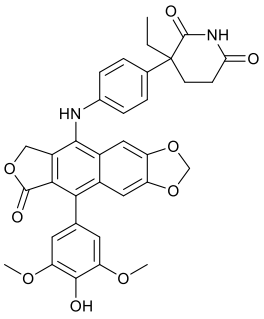
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 10.36 (s, 1H), 8.47 (s, 1H), 7.60 (s, 1H), 6.90 (s, 1H), 6.48 (s, 2H), 6.16 (s, 2H), 5.34 (s, 2H), 3.71 (s, 6H).

^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 169.4, 148.7, 148.3, 147.6, 145.2, 135.0, 131.2, 131.0, 125.2, 124.6, 122.4, 119.1, 107.9, 102.8, 102.0, 98.0, 66.5, 56.0.

IR (KBr, cm^{-1}) 2974, 2900, 1756, 1465, 1249, 1097, 1030, 1011, 736.

HRMS (ESI) m/z calcd for $C_{21}H_{17}O_8^+$ $(M+H)^+$ 397.0918, found 397.0918.

3-ethyl-3-(4-((9-(4-hydroxy-3,5-dimethoxyphenyl)-8-oxo-6,8-dihydrofuro[3',4':6,7]naphtho[2,3-d][1,3]dioxol-5-yl)amino)phenyl)piperidine-2,6-dione (**6a**)



Compound **6a** was synthesized according to general procedure 3.7 starting from compound **4** and 3-(4-aminophenyl)-3-ethylpiperidine-2,6-dione. Compound **6a** was obtained in 44% yield (134.0 mg) in 7h as a yellow solid.

mp: 268-270 ºC.

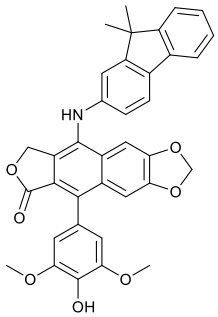
^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 10.79 (s, 1H), 8.52 (s, 1H), 8.25 (s, 1H), 7.44 (s, 1H), 7.10 (d, *J* = 8.5 Hz, 2H), 7.01 (s, 1H), 6.68 (d, *J* = 8.5 Hz, 2H), 6.57 (s, 2H), 6.17 (s, 2H), 5.09 (s, 2H), 3.74 (s, 6H), 2.45 (d, *J* = 17.0 Hz, 1H), 2.27 (d, *J* = 12.5 Hz, 1H), 2.22 – 2.09 (m, 2H), 1.85 (dq, *J* = 14.6, 7.3 Hz, 1H), 1.78 (dq, *J* = 14.4, 7.3 Hz, 1H), 0.76 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (151 MHz, DMSO-d_6) δ 176.0, 172.9, 169.2, 149.6, 148.3, 147.6, 144.1, 136.1, 135.3, 134.0, 131.2, 130.5, 130.3, 129.5, 127.0, 124.8, 119.2, 114.9, 107.8, 103.3, 102.2, 99.5, 67.1, 56.1, 49.4, 32.2, 29.1, 26.0, 8.9.

IR (KBr, cm^{-1}) 2973, 2913, 1760, 1700, 1512, 1458, 1240, 1199, 1040, 834, 749.

HRMS (ESI) m/z calcd for $C_{34}H_{31}N_2O_9^+$ $(M+H)^+$ 611.2024, found 611.2025.

9-((9,9-dimethyl-9H-fluoren-2-yl)amino)-5-(4-hydroxy-3,5-dimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**6b**)



Compound **6b** was synthesized according to general procedure 3.7 starting from compound **4** and 9,9-dimethyl-9H-fluoren-3-amine. Compound **6b** was obtained in 55% yield (161.8 mg) in 7h as a yellow solid.

mp: 222-224 ºC.

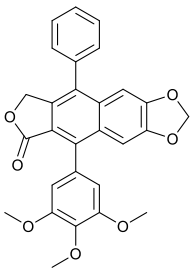
^{1}H NMR (600 MHz, DMSO-d_6) δ 8.53 (s, 1H), 8.43 (s, 1H), 7.64 (d, *J* = 7.5 Hz, 1H), 7.61 (d, *J* = 8.2 Hz, 1H), 7.54 (s, 1H), 7.46 (d, *J* = 7.4 Hz, 1H), 7.27 (td, *J* = 7.5, 0.9 Hz, 1H), 7.19 (td, *J* = 7.4, 0.9 Hz, 1H), 7.03 (s, 1H), 6.93 (d, *J* = 2.0 Hz, 1H), 6.66 (dd, *J* = 8.2, 2.1 Hz, 1H), 6.60 (s, 2H), 6.17 (s, 2H), 5.10 (s, 2H), 3.75 (s, 6H), 1.40 (s, 6H).

^{13}C NMR (151 MHz, DMSO-d_6) δ 169.3, 154.8, 152.6, 149.5, 148.3, 147.6, 144.6, 139.0, 135.5, 135.3, 133.0, 131.3, 130.6, 129.9, 129.7, 126.9, 125.6, 124.9, 122.4, 120.8, 119.3, 118.7, 114.1, 109.5, 107.8, 103.3, 102.2, 99.7, 67.4, 56.1, 46.2, 27.0.

IR (KBr, cm^{-1}) 2973, 2906, 1766, 1674, 1614, 1522, 1487, 1458, 1246, 1218, 1116, 1034.

HRMS (ESI) m/z calcd for $C_{36}H_{30}NO_7^+$ $(M+H)^+$ 588.2023, found 588.2017.

9-phenyl-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**8a**)



Compound **8a** was synthesized according to general procedure 3.8 starting from compound **2i**. Compound **8a** was obtained in 37% (92% brsm) yield (86.8 mg) in 1h as a yellow solid.

mp: 285-287 ºC

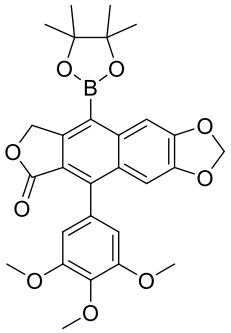
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.57 (t, *J* = 7.4 Hz, 2H), 7.51 (t, *J* = 7.4 Hz, 1H), 7.38 (d, *J* = 7.4 Hz, 2H), 7.17 (s, 1H), 7.05 (s, 1H), 6.60 (s, 2H), 6.05 (s, 2H), 5.13 (s, 2H), 3.98 (s, 3H), 3.86 (s, 6H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 170.0, 153.1, 150.2, 148.5, 139.8, 138.5, 137.9, 136.4, 133.4, 132.5, 131.1, 130.6, 129.4, 129.4, 128.6, 118.5, 107.4, 104.1, 102.1, 102.0, 68.1, 61.2, 56.3.

IR (KBr, cm^{-1}) 2970, 2904, 1766, 1753, 1462, 1243, 1129, 1034, 942, 859, 796, 758, 707.

HRMS (ESI) m/z calcd for $C_{28}H_{23}O_7^+$ $(M+H)^+$ 471.1438, found 471.1440.

9-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**8b**)



Compound **8b** was synthesized according to general procedure 3.9 starting from compound **2i**. Compound **8b** was obtained in 86% yield (223.9 mg) in 6h as a white solid.

mp: 285-288 ºC.

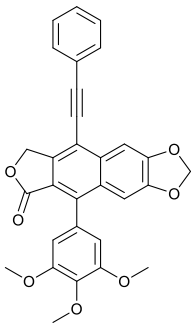
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.37 (s, 1H), 7.09 (s, 1H), 6.51 (s, 2H), 6.08 (s, 2H), 5.53 (s, 2H), 3.96 (s, 3H), 3.83 (s, 6H), 1.43 (s, 12H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 170.2, 153.0, 150.5, 149.9, 148.0, 143.3, 139.2, 137.8, 130.8, 130.3, 118.3, 107.1, 105.1, 103.9, 101.8, 84.3, 70.7, 61.1, 56.2, 25.2.

IR (KBr, cm^{-1}) 2970, 2903, 1763, 1462, 1243, 1126, 1053, 1034, 942, 815.

HRMS (ESI) m/z calcd for $C_{28}H_{30}BO_9^+$ $(M+H)^+$ 520.2014, found 520.2020.

10-(phenylethynyl)-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**8c**)



Compound **8c** was synthesized according to general procedure 3.10 starting from compound **2i**. Compound **8c** was obtained in 93% yield (229.8 mg) in 18h as a yellow solid.

mp: 273-275 ºC.

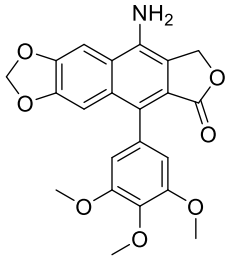
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.79 (s, 1H), 7.65 – 7.61 (m, 2H), 7.44 – 7.40 (m, 5H), 7.15 (s, 1H), 6.56 (s, 2H), 6.11 (s, 2H), 5.45 (s, 2H), 3.97 (s, 3H), 3.84 (s, 6H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.5, 153.1, 150.9, 149.0, 143.1, 140.a, 138.0, 134.5, 131.8, 130.5, 130.0, 129.3, 128.7, 122.4, 118.7, 113.3, 107.4, 104.3, 102.3, 102.2, 100.1, 82.9, 68.2, 61.1, 56.3.

IR (KBr, cm^{-1}) 2970, 2904, 1769, 1582, 1490, 1468, 1252, 1129, 1034, 942, 850, 796, 755.

HRMS (ESI) m/z calcd for $C_{30}H_{23}O_7^+$ $(M+H)^+$ 495.1438, found 495.1439.

9-amino-5-(3,4,5-trimethoxyphenyl)furo[3',4':6,7]naphtho[2,3-d][1,3]dioxol-6(8H)-one (**9**)



Compound **9** was synthesized according to general procedure 3.11 starting from compound **3g**. Compound **9** was obtained in 43 % yield (28.5 mg within two steps) in 3h as a white solid.

mp: ›300 ºC.

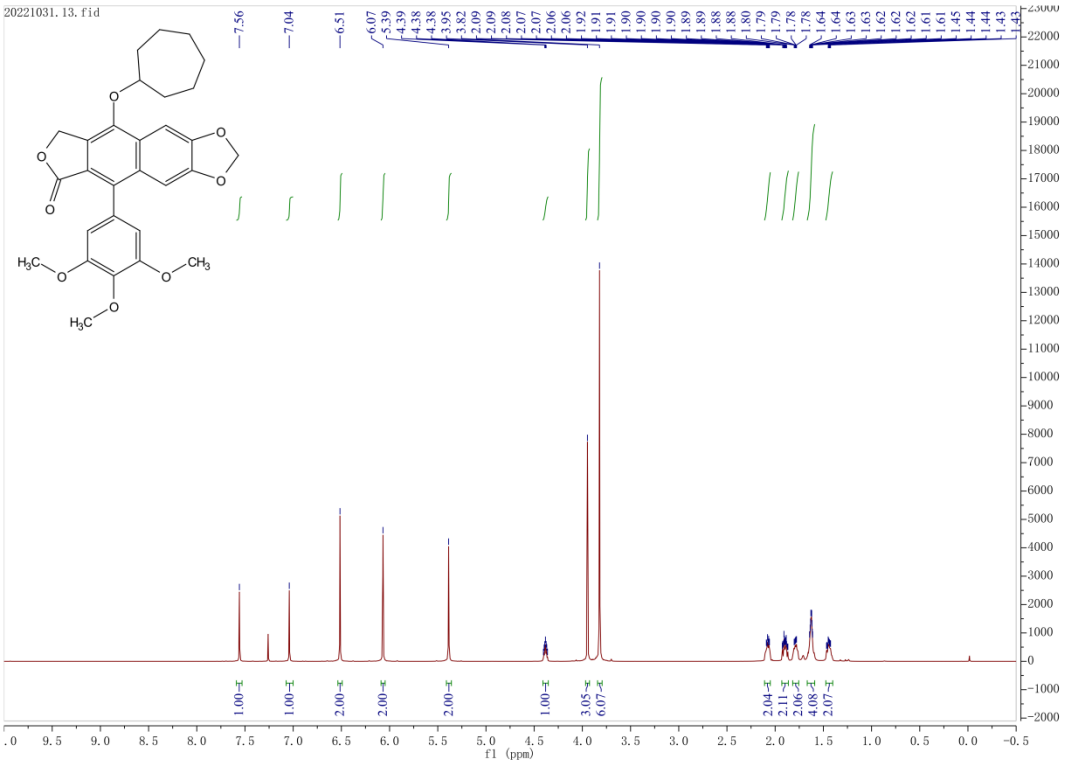
^{1}H NMR (600 MHz, DMSO-d_6) δ 7.72 (s, 1H), 6.83 (s, 1H), 6.50 (s, 2H), 6.14 (s, 2H), 5.99 (s, 2H), 5.23 (s, 2H), 3.76 (s, 3H), 3.72 (s, 6H).

^{13}C NMR (151 MHz, DMSO-d_6) δ 170.0, 152.3, 148.1, 147.8, 137.4, 136.6, 131.5, 130.5, 126.2, 121.1, 120.3, 118.7, 108.1, 102.8, 101.8, 98.7, 67.2, 60.1, 55.9.

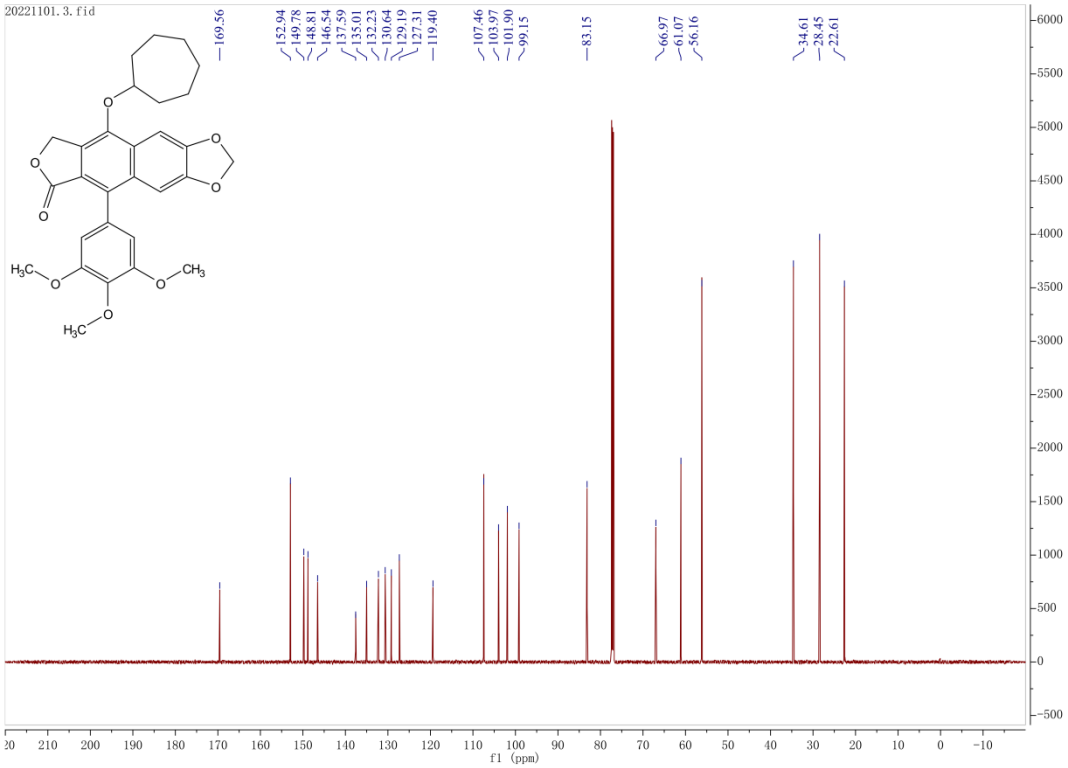
IR (KBr, cm^{-1}) 3442, 3371, 1768, 1582, 1468, 1414, 1362, 1241, 1138, 1120, 1032.

MS (ESI) m/z calcd for $C_{22}H_{19}NO_7Na^+$ $(M+Na)^+$ 432.1, found 432.1.

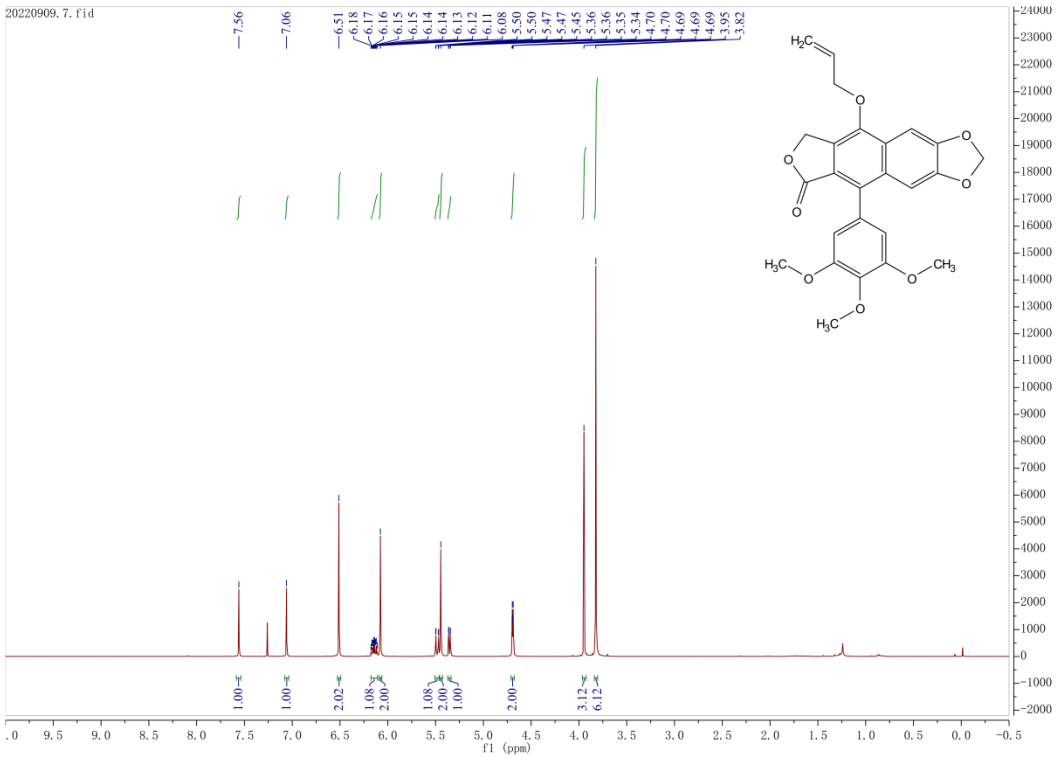
5. Copies of the ^{1}H, ^{19}F and ^{13}C spectra



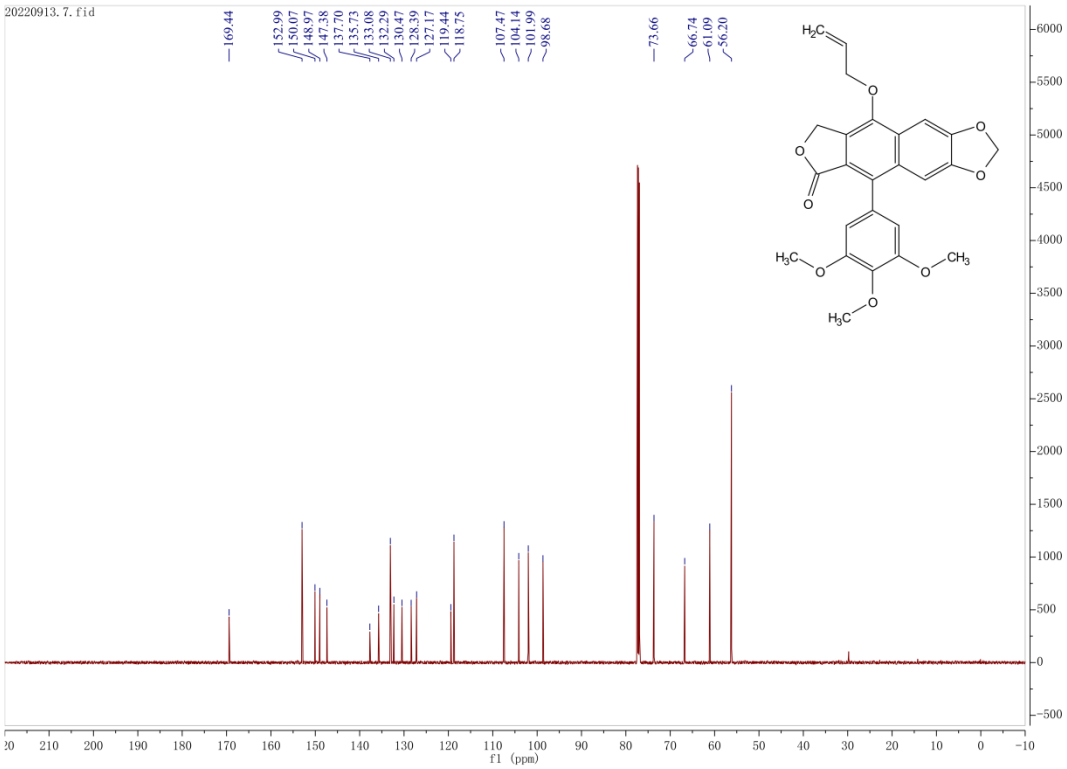
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2a**



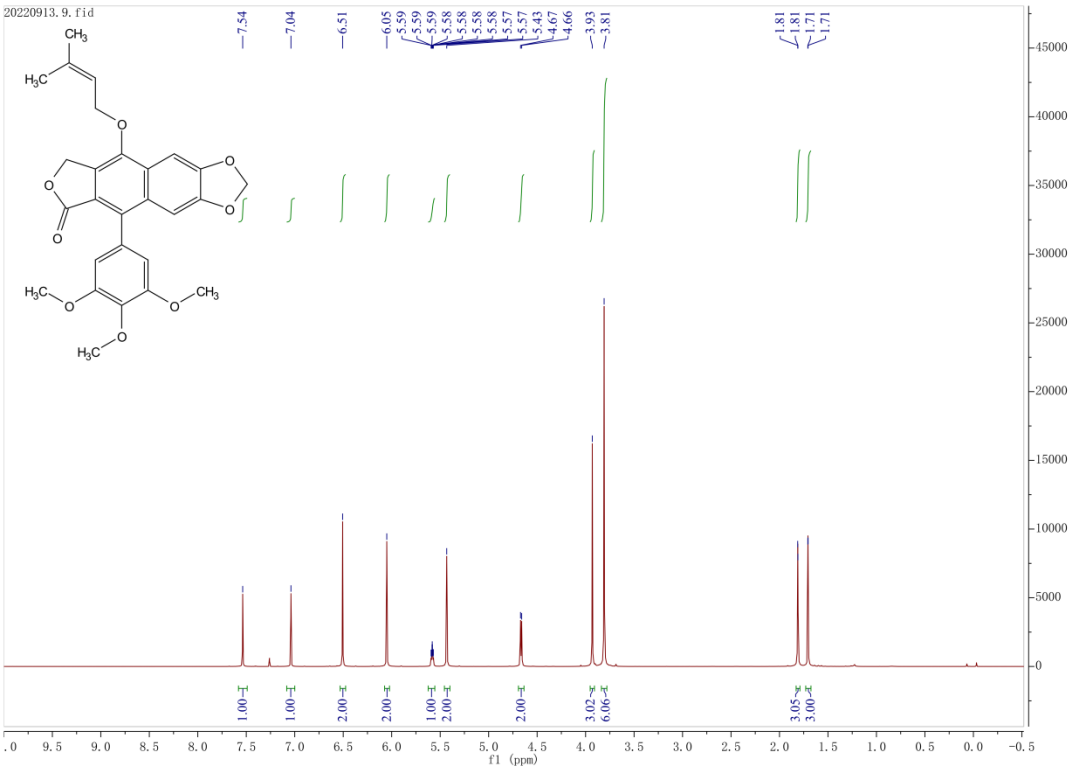
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2a**



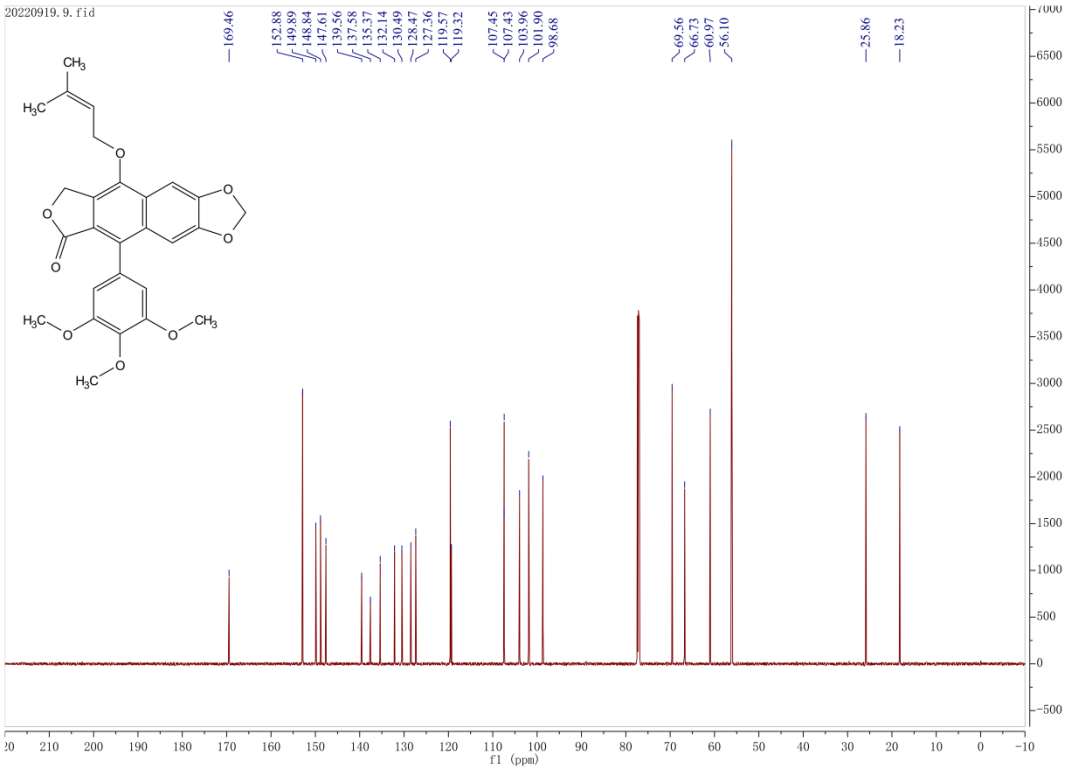
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2b**



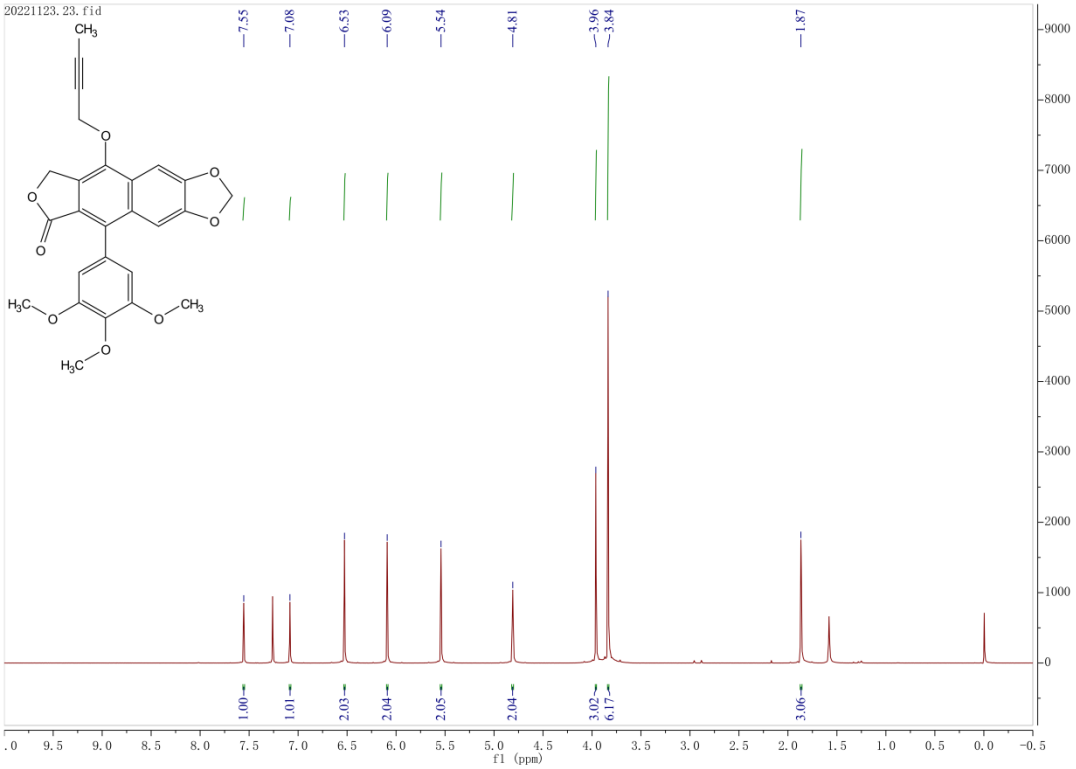
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2b**



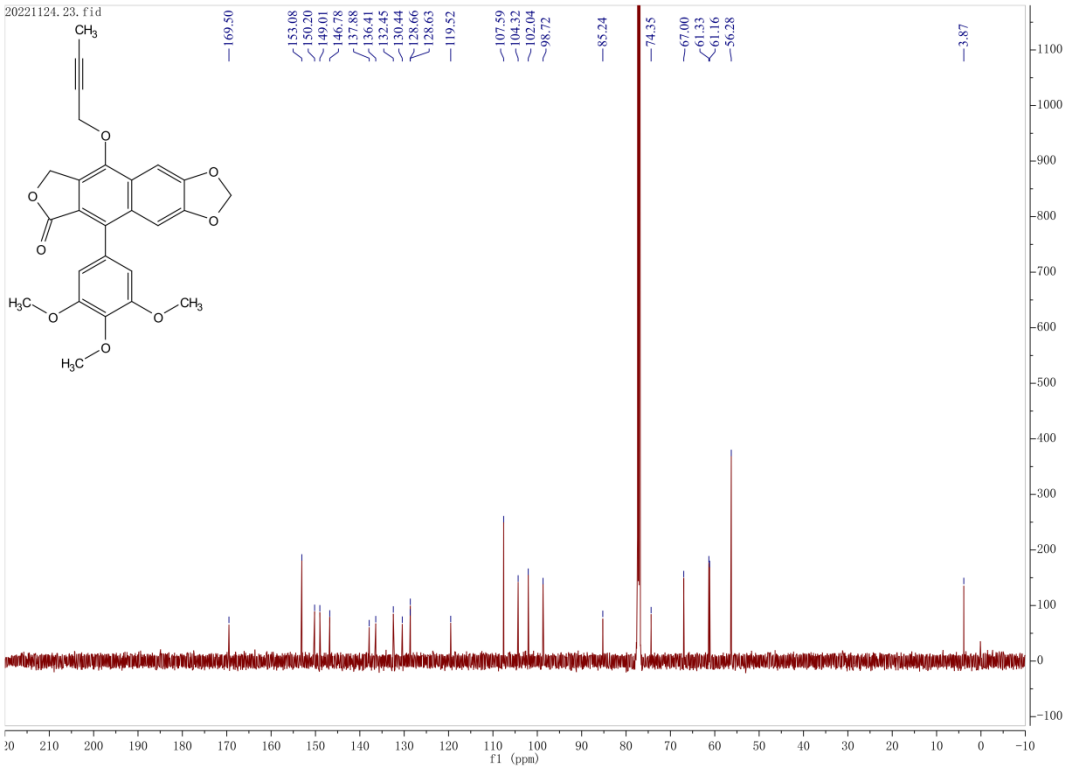
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2c**



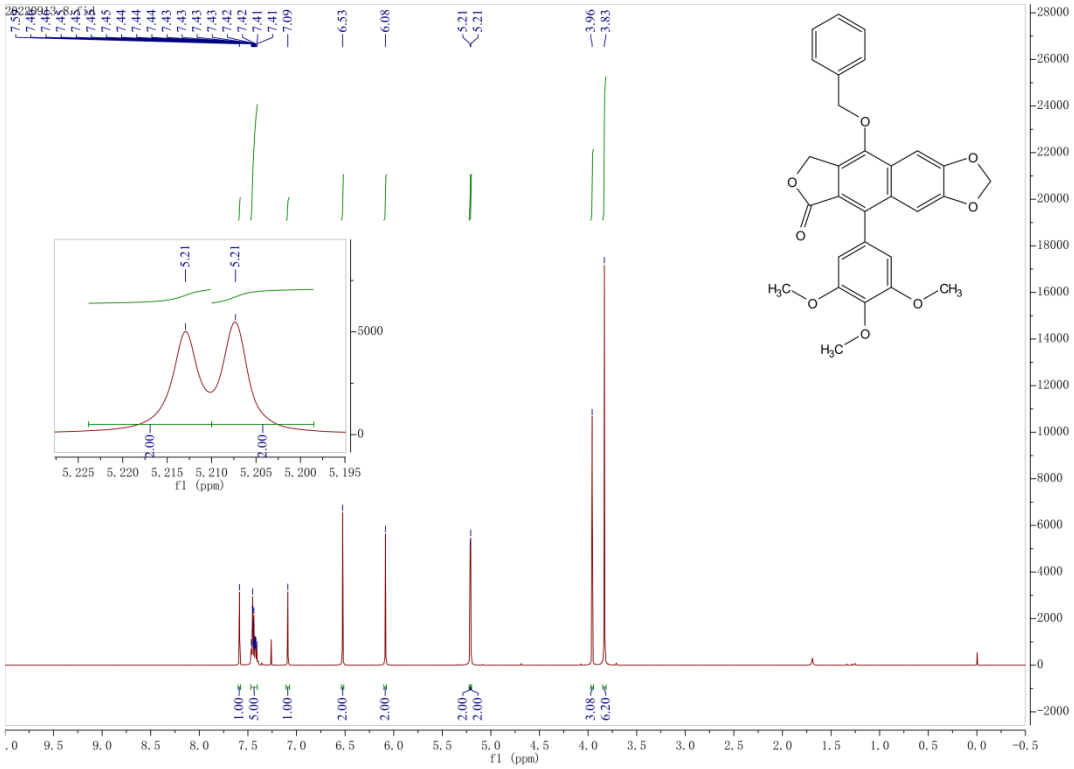
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2c**



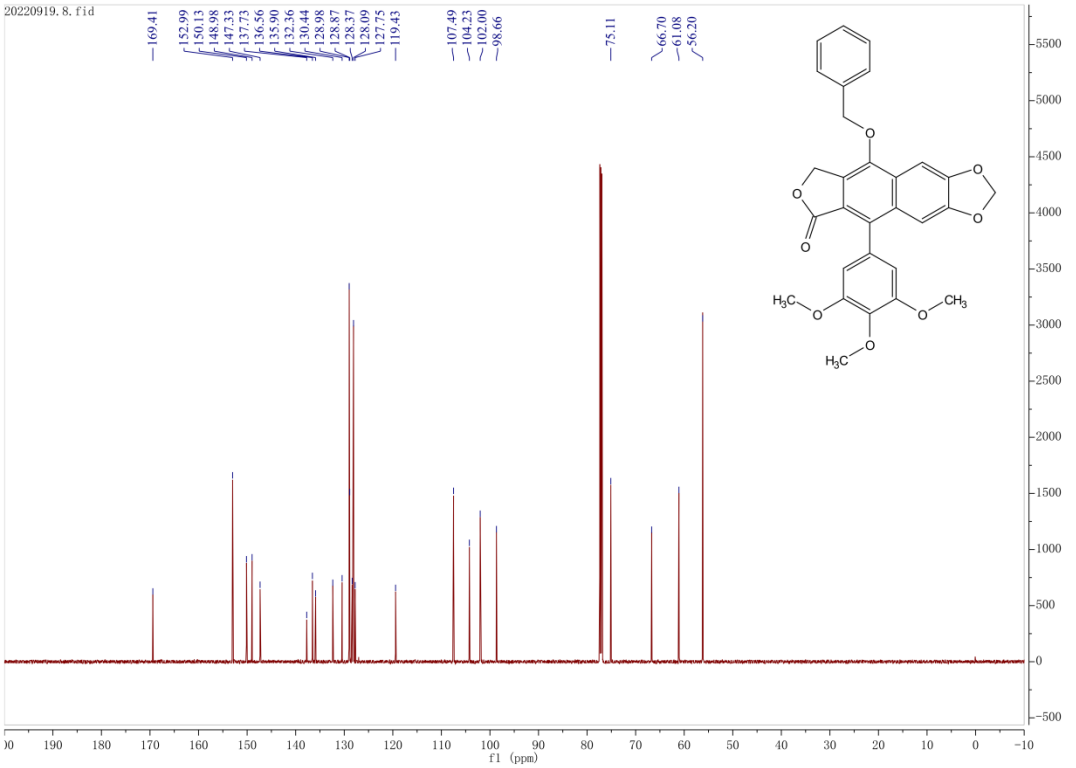
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2d**



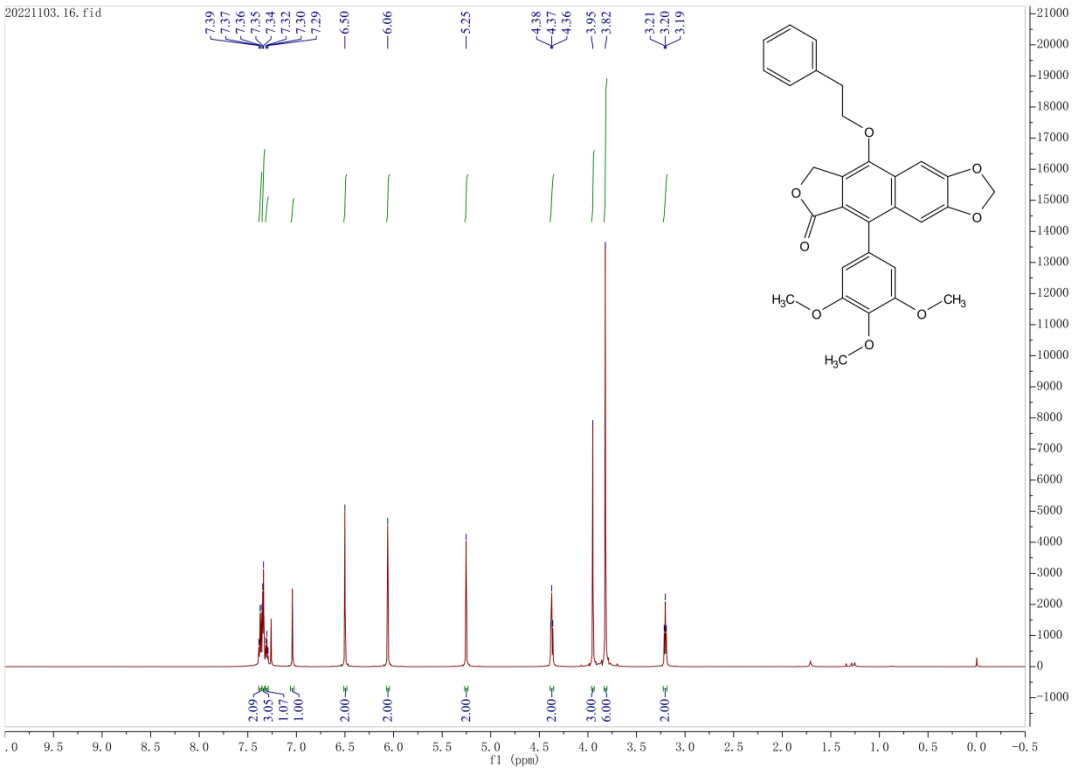
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2d**



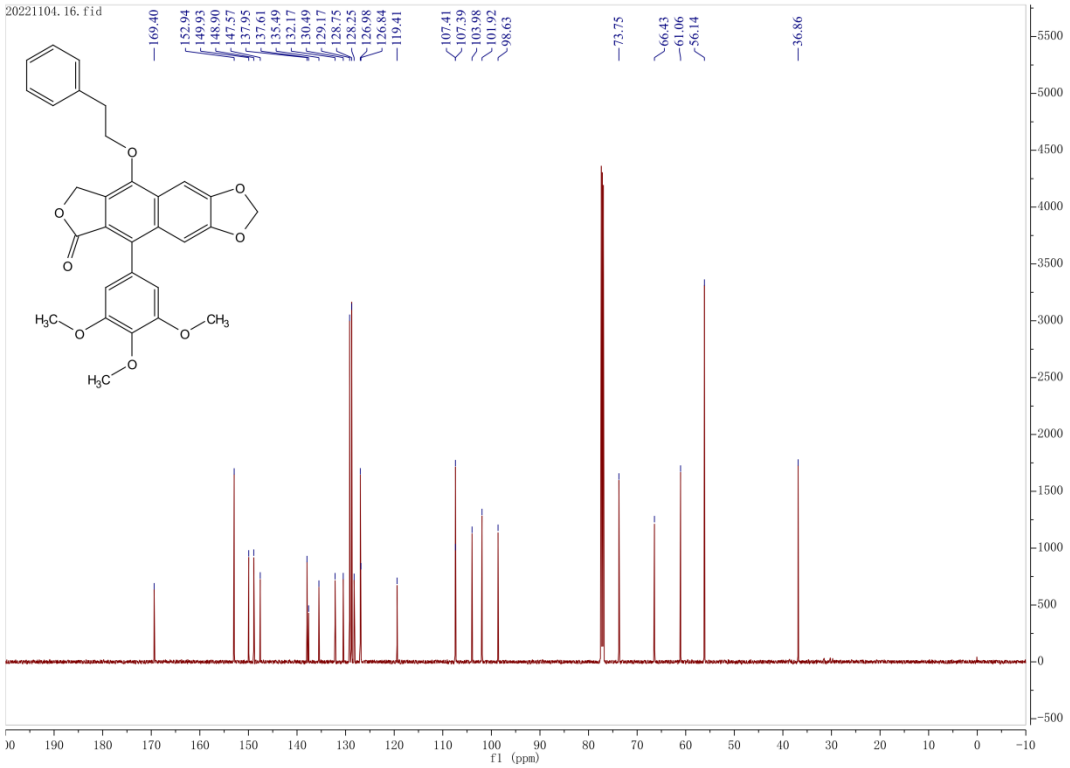
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2e**



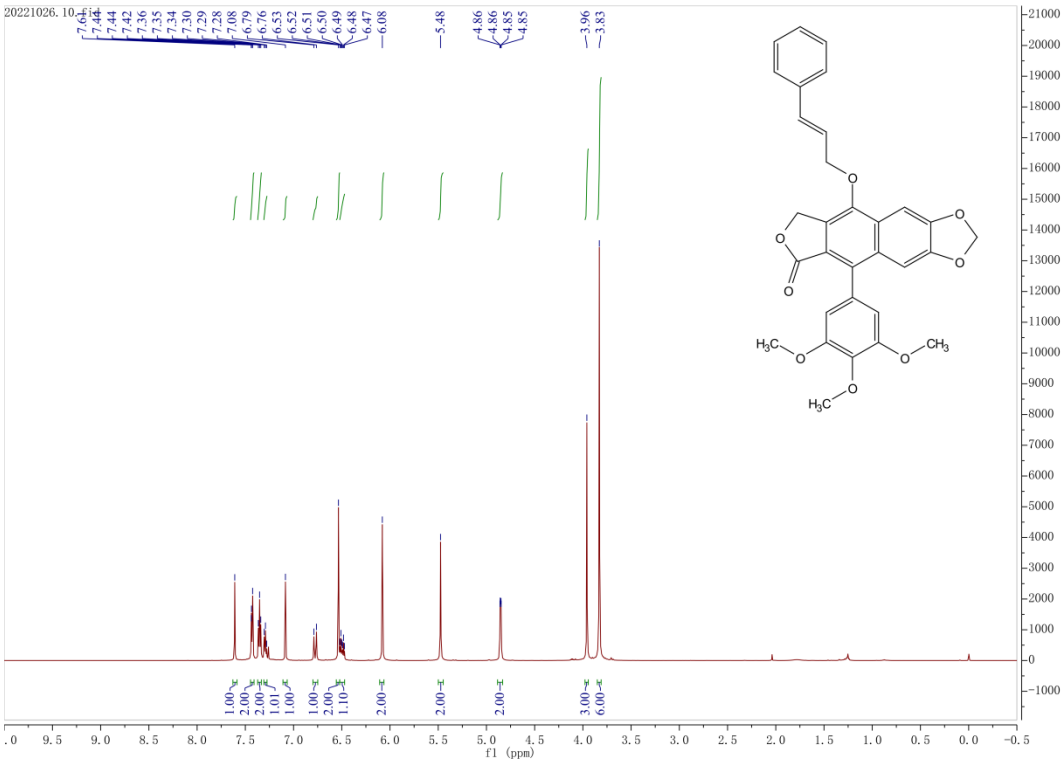
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2e**



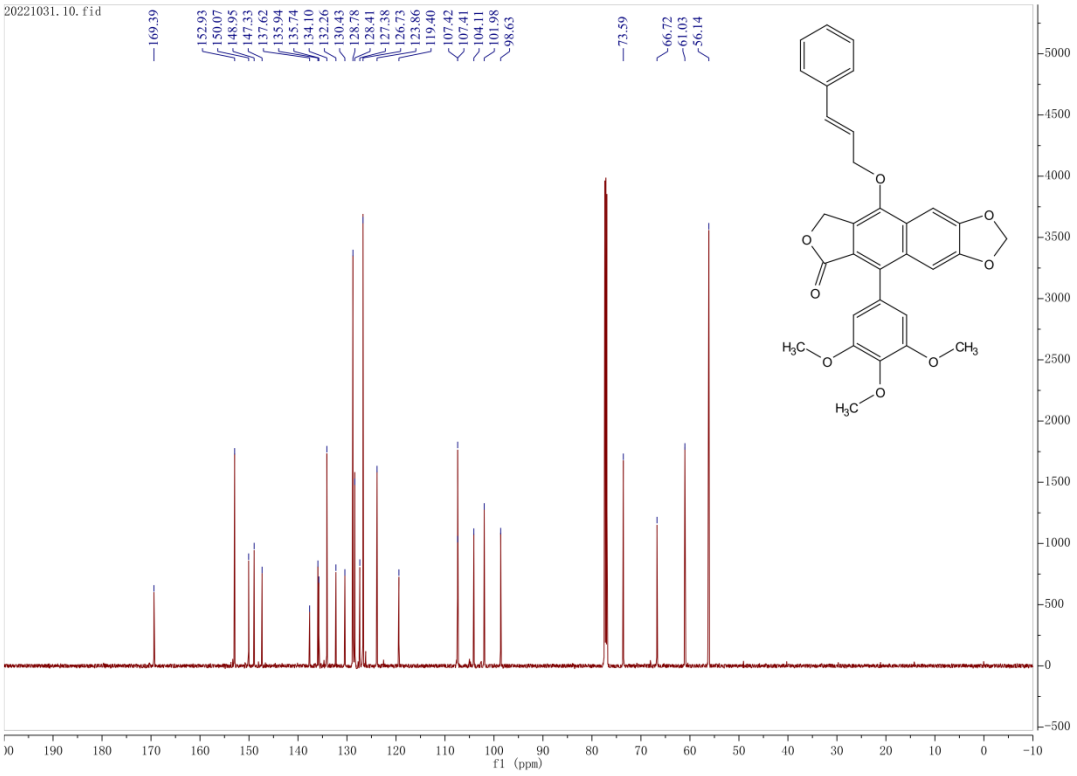
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2f**



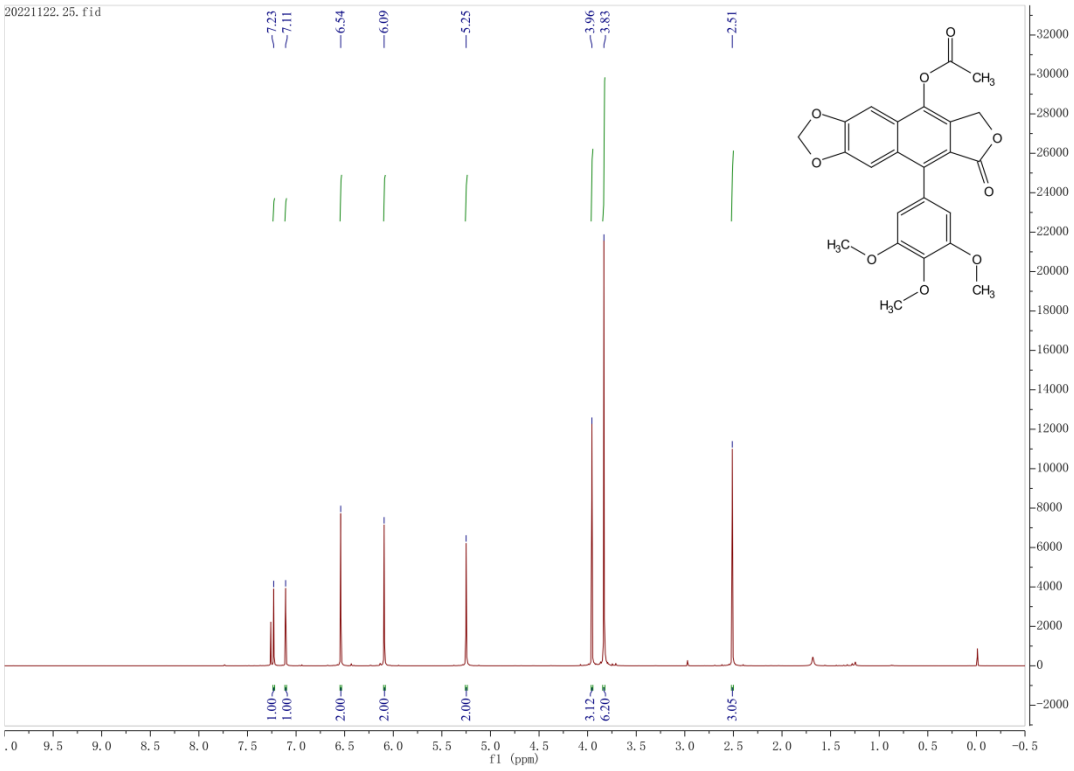
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2f**



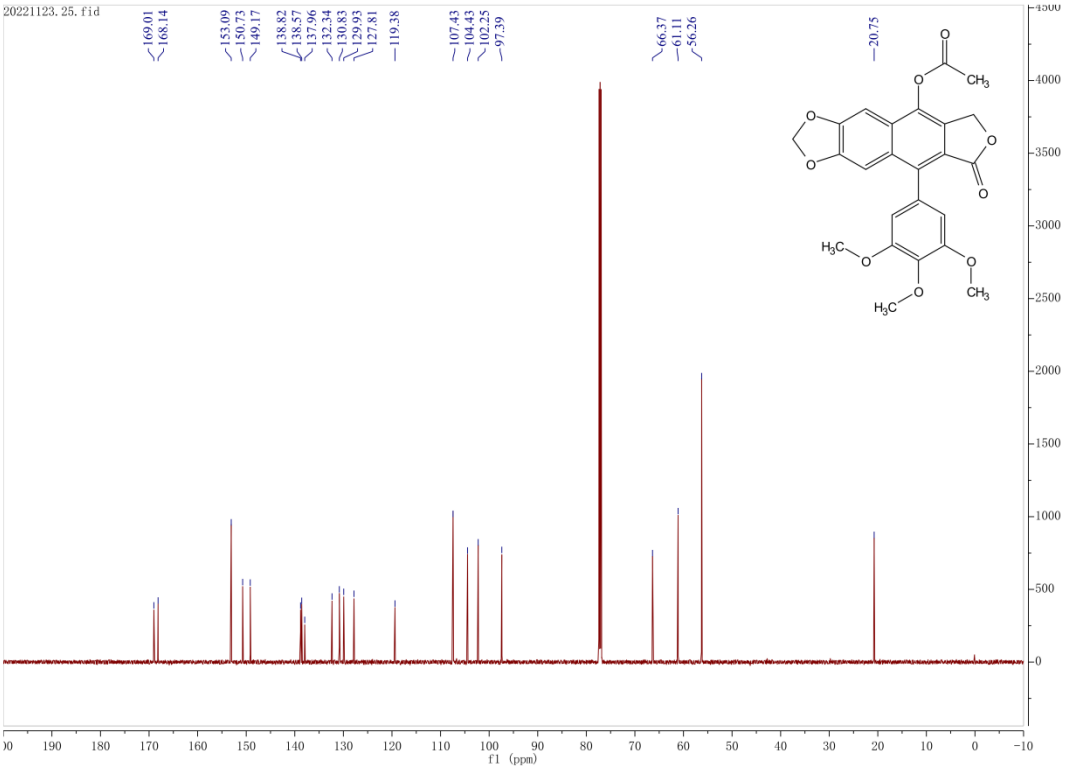
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2g**



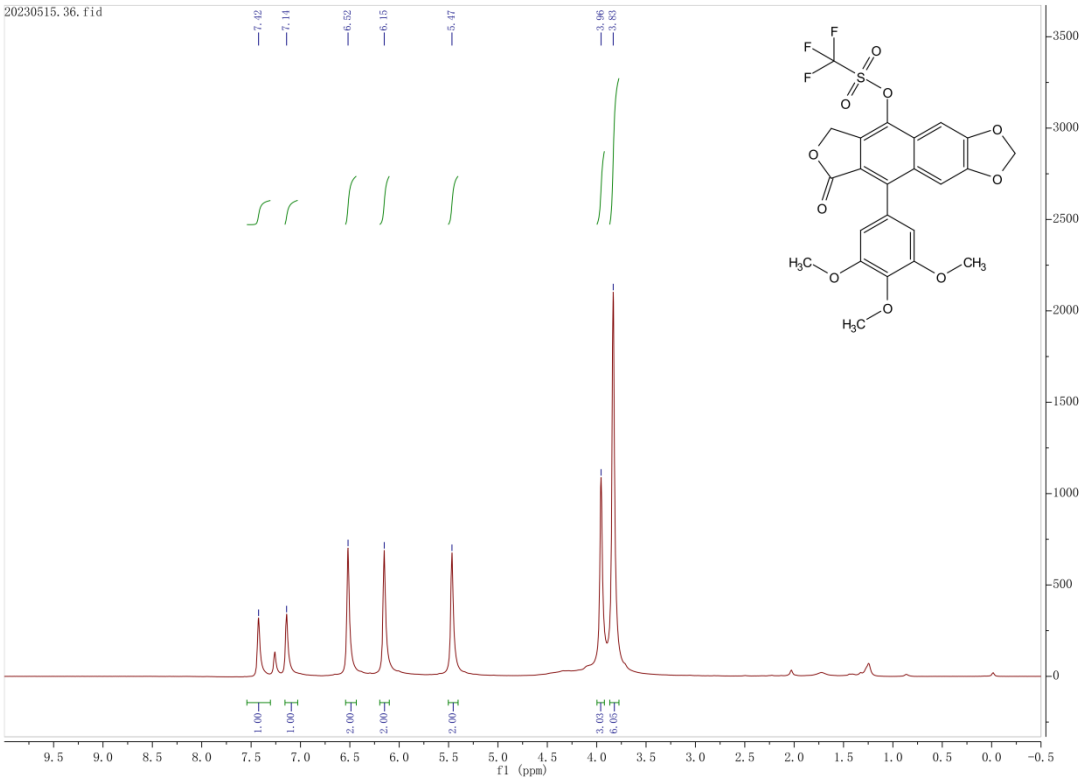
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2g**



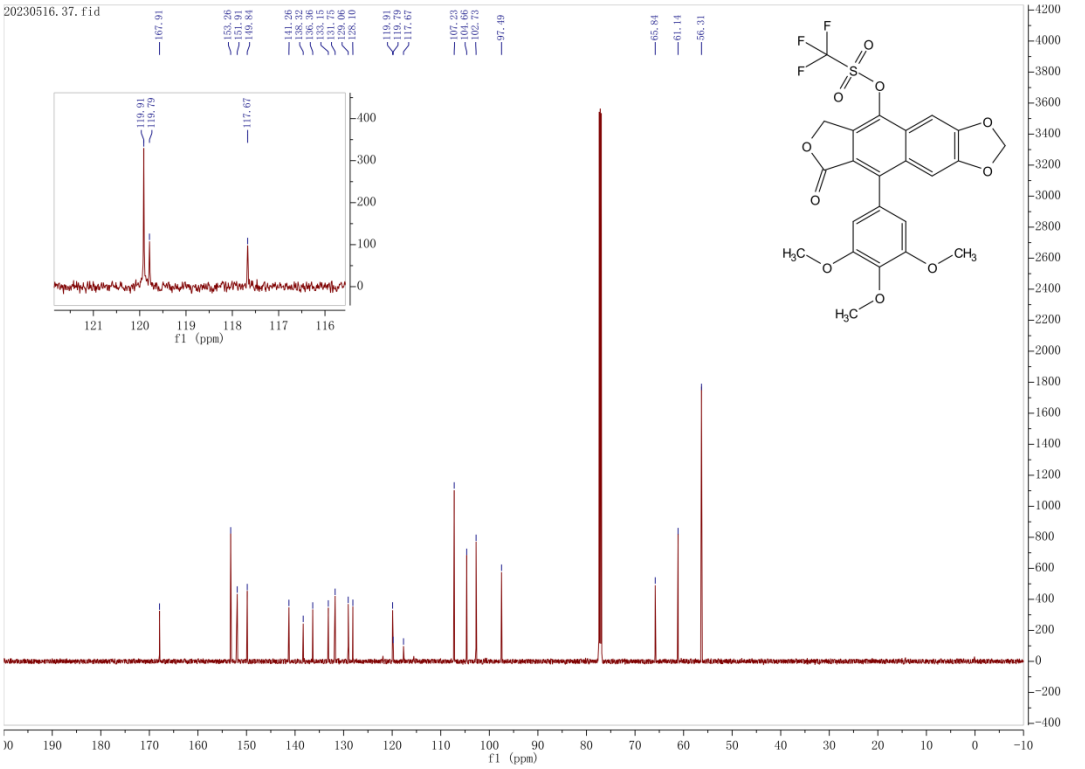
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2h**



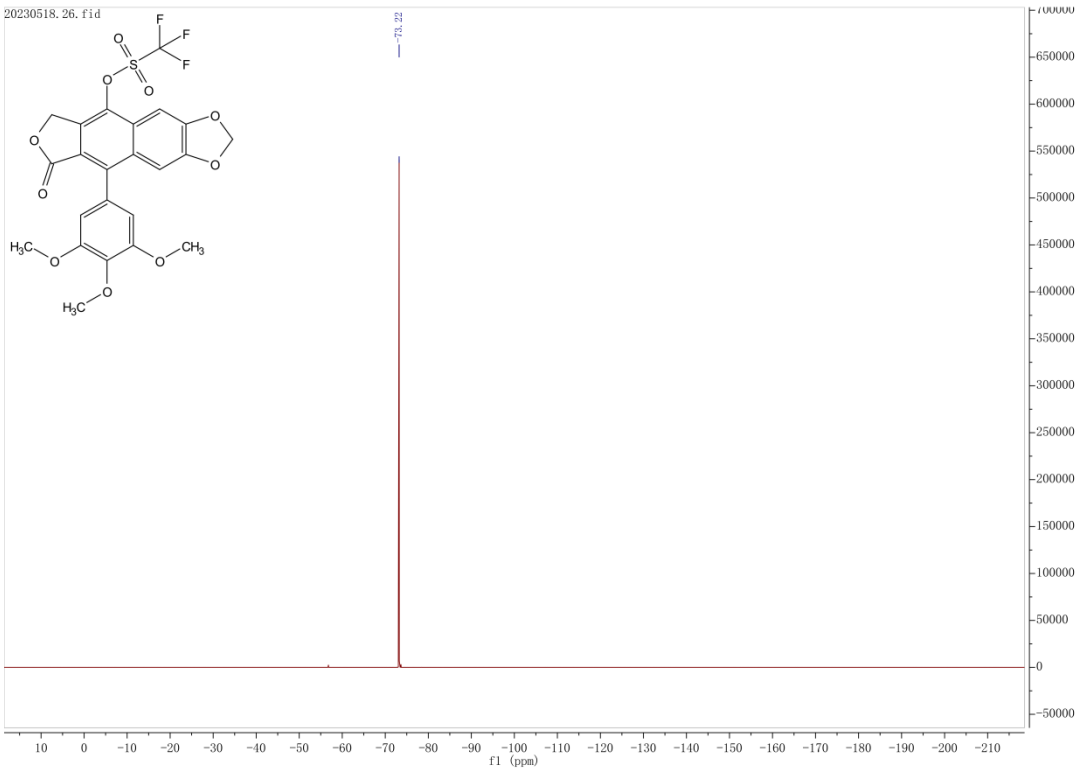
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2h**



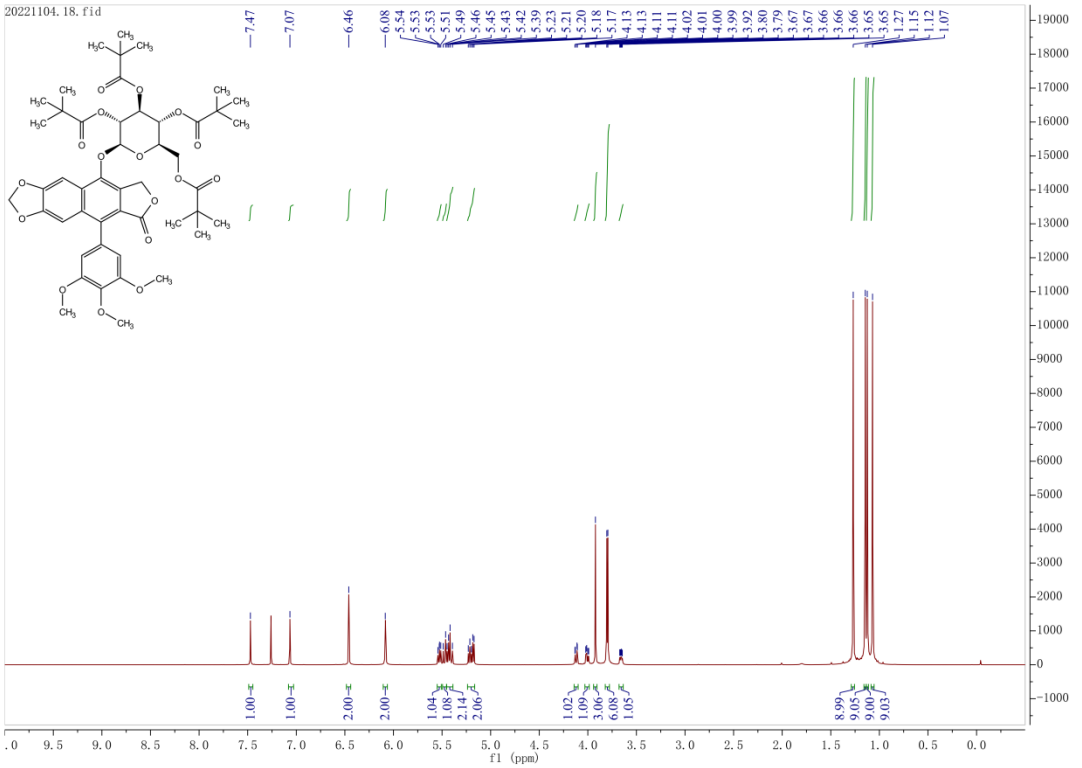
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2i**



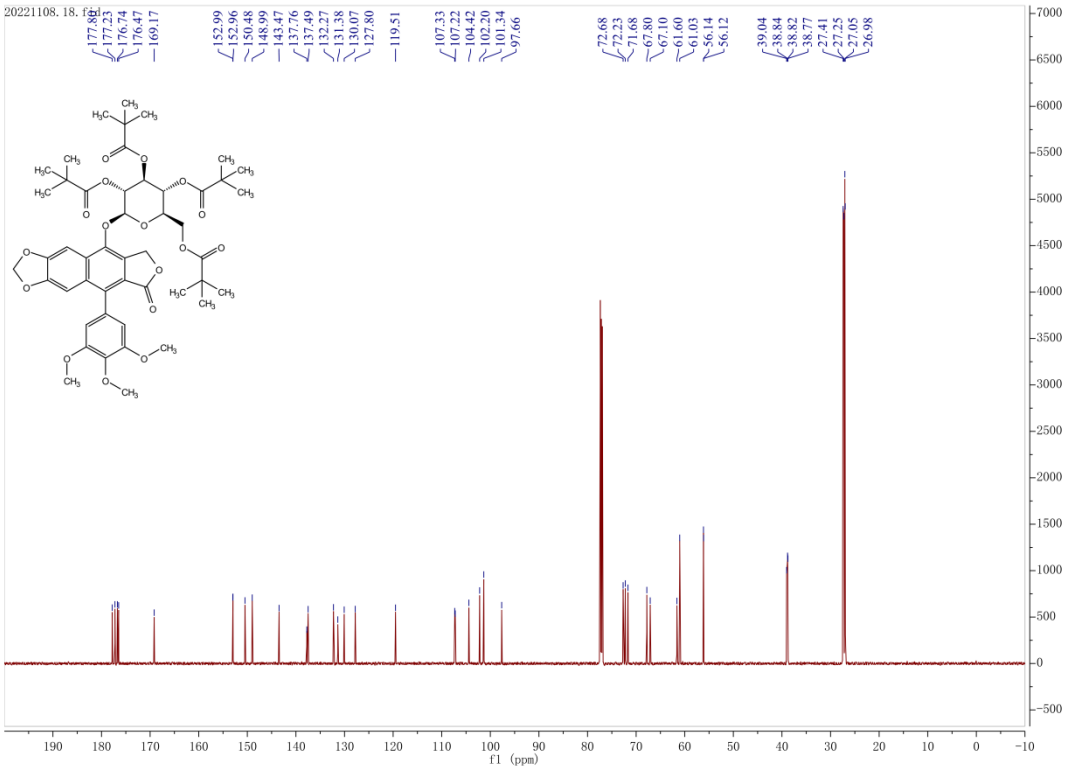
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2i**



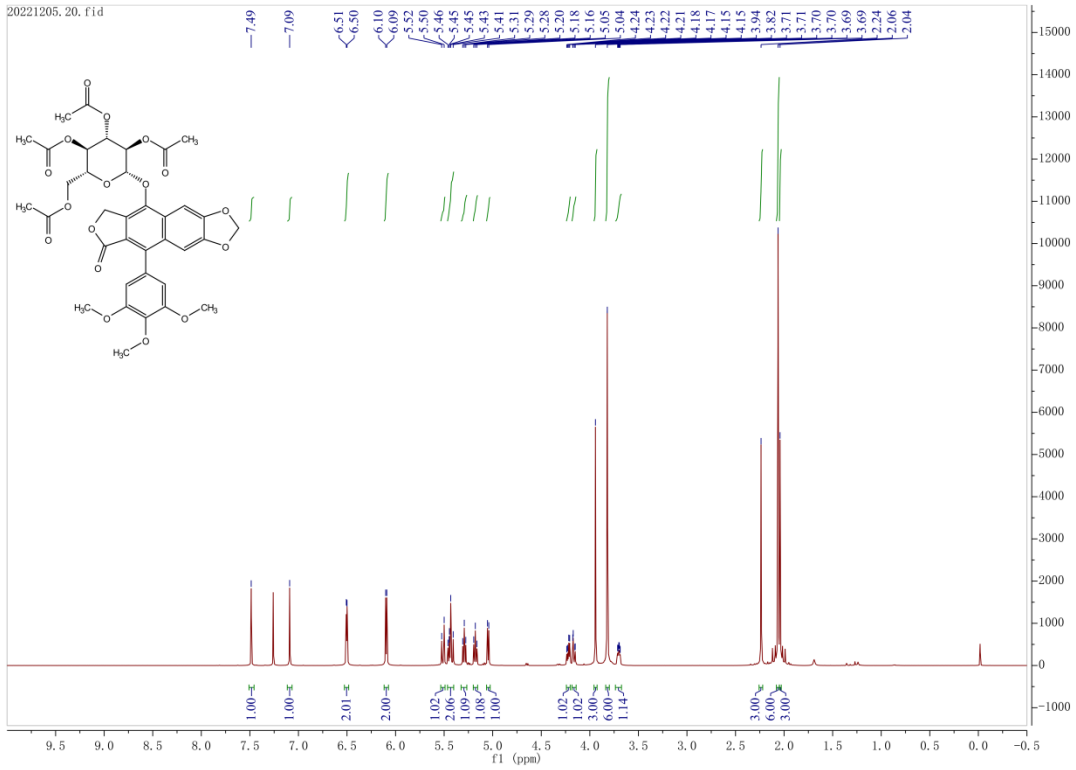
^{19}F NMR (565 MHz, $CDCl_3$) Spectrum of **2i**



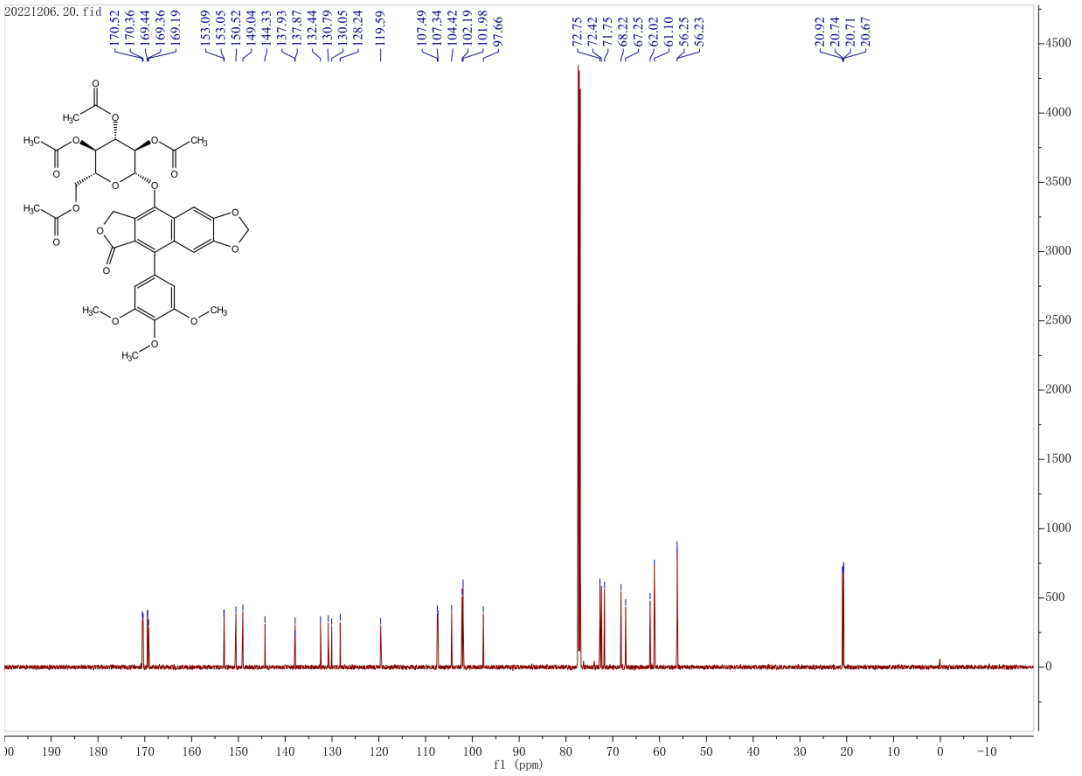
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2j**



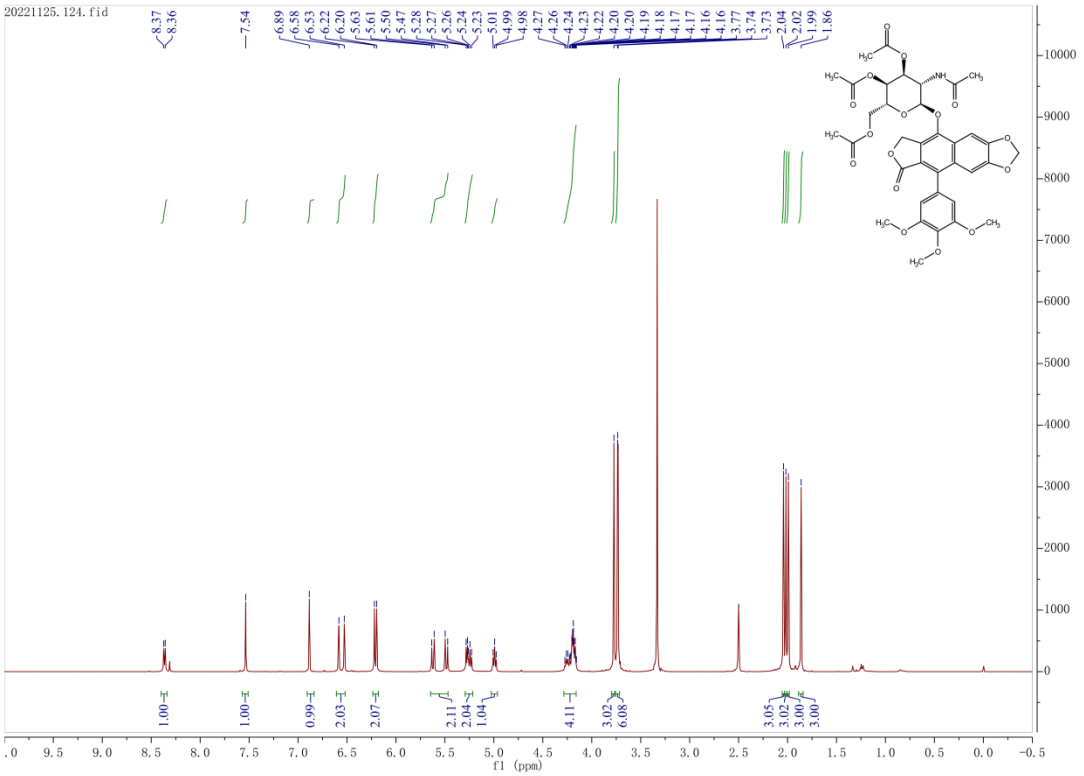
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2j**



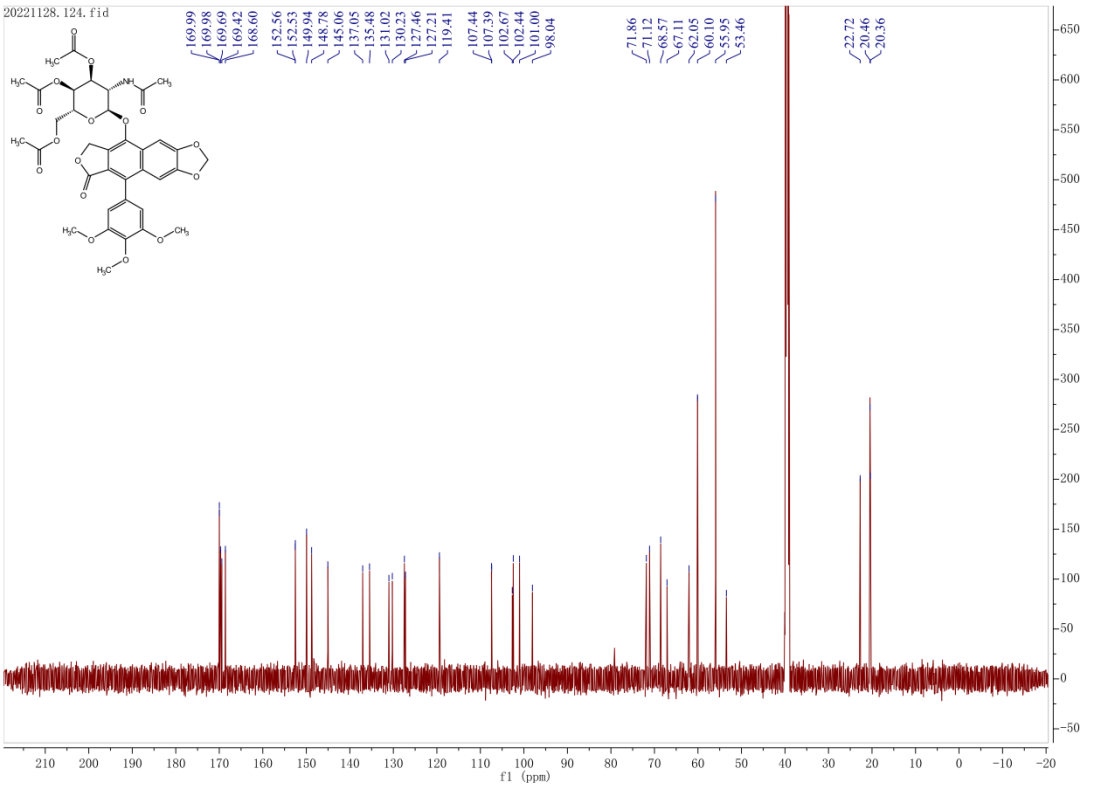
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2k**



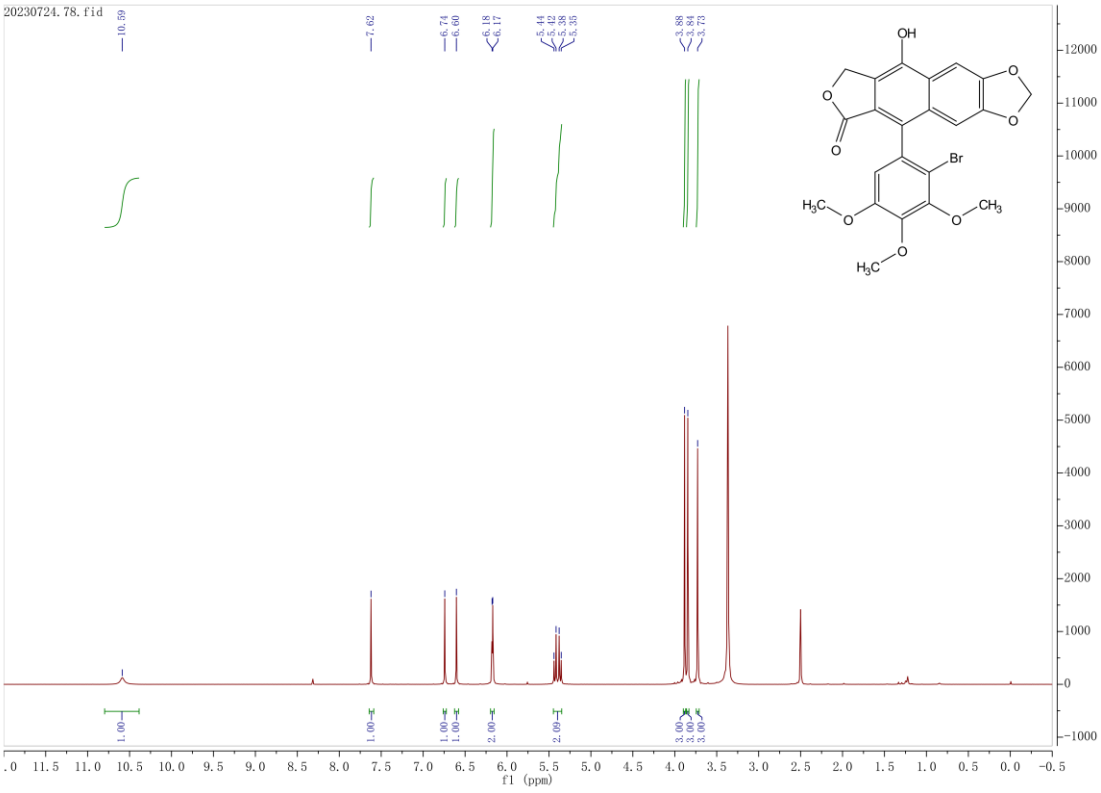
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2k**



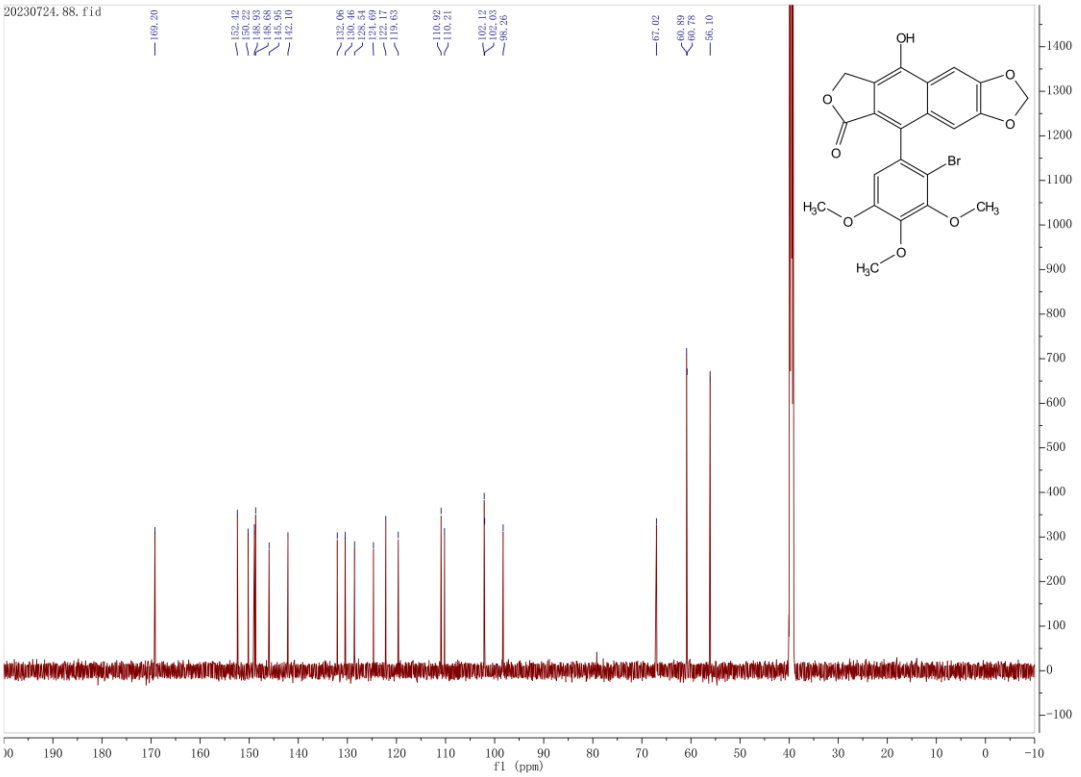
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **2l**



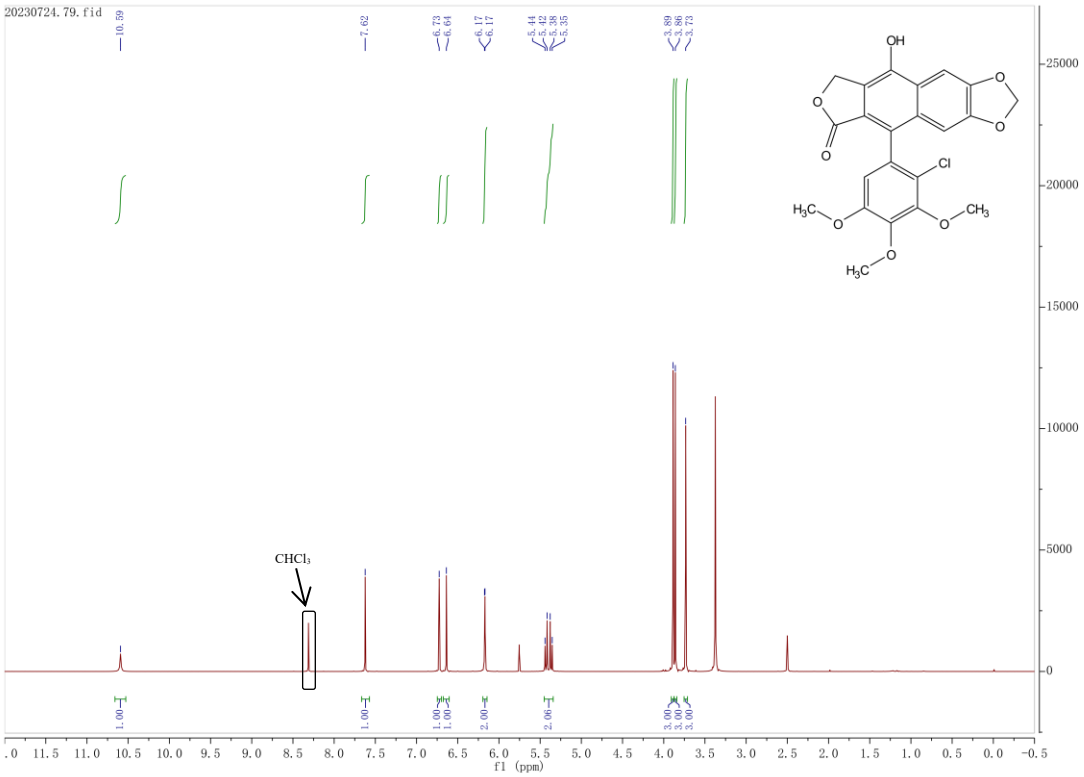
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **2l**



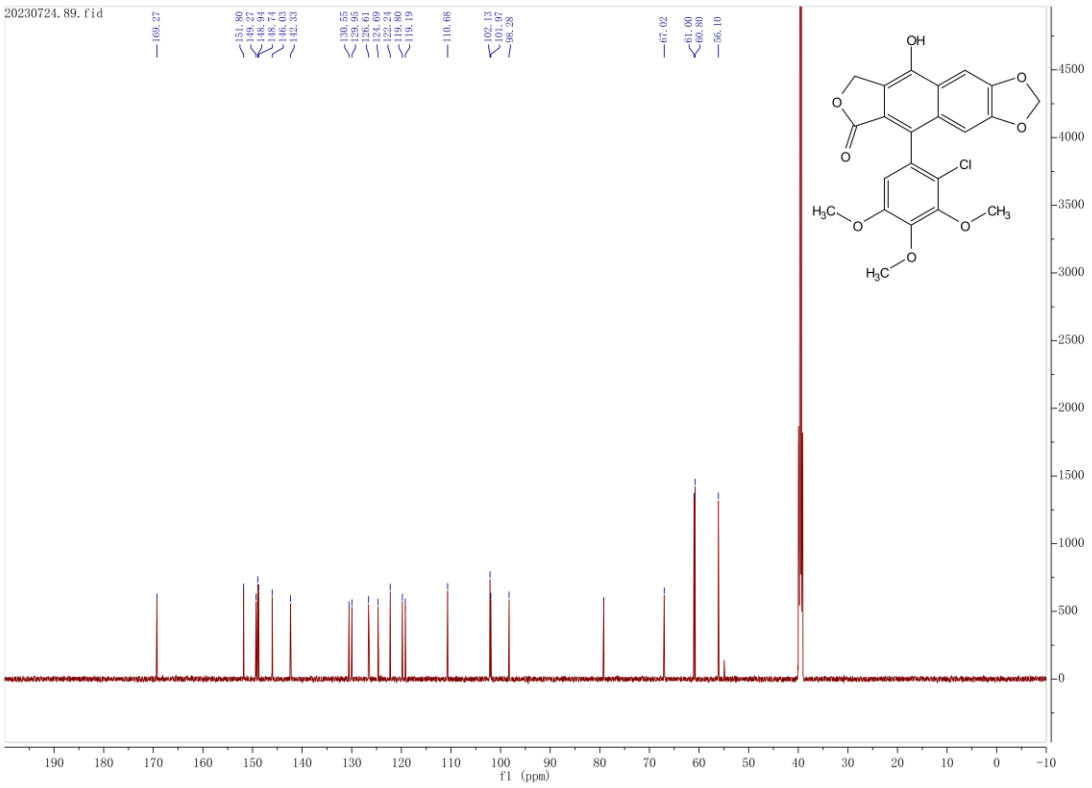
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **2m**



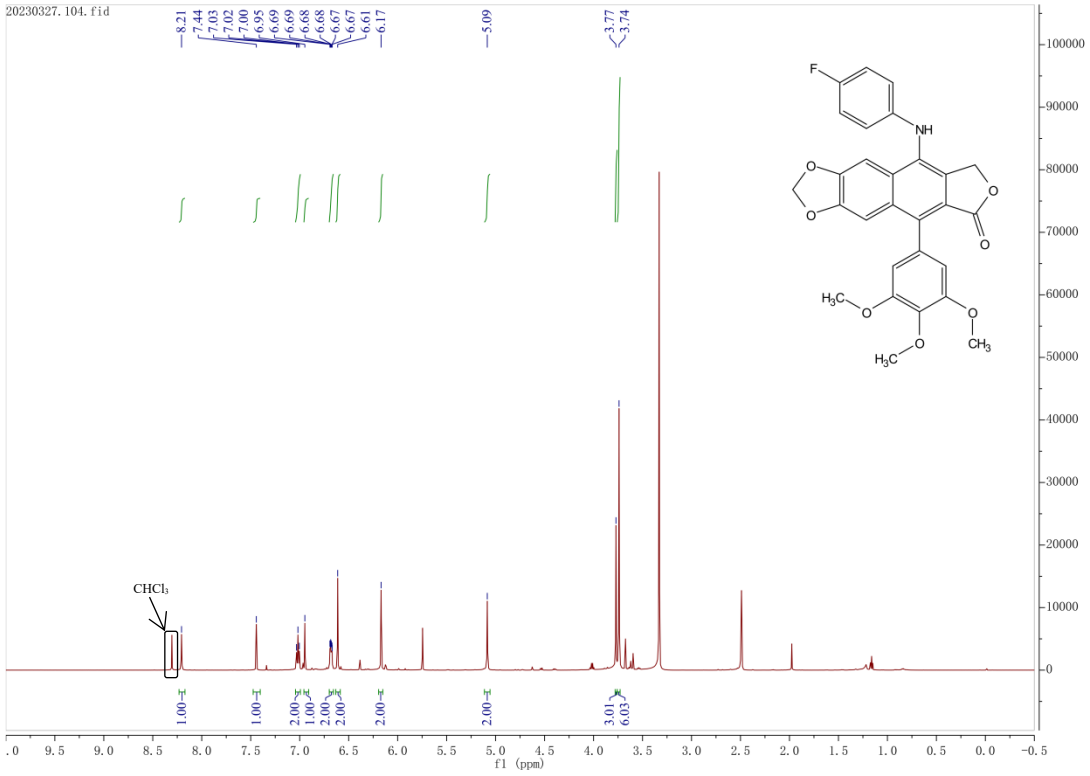
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **2m**



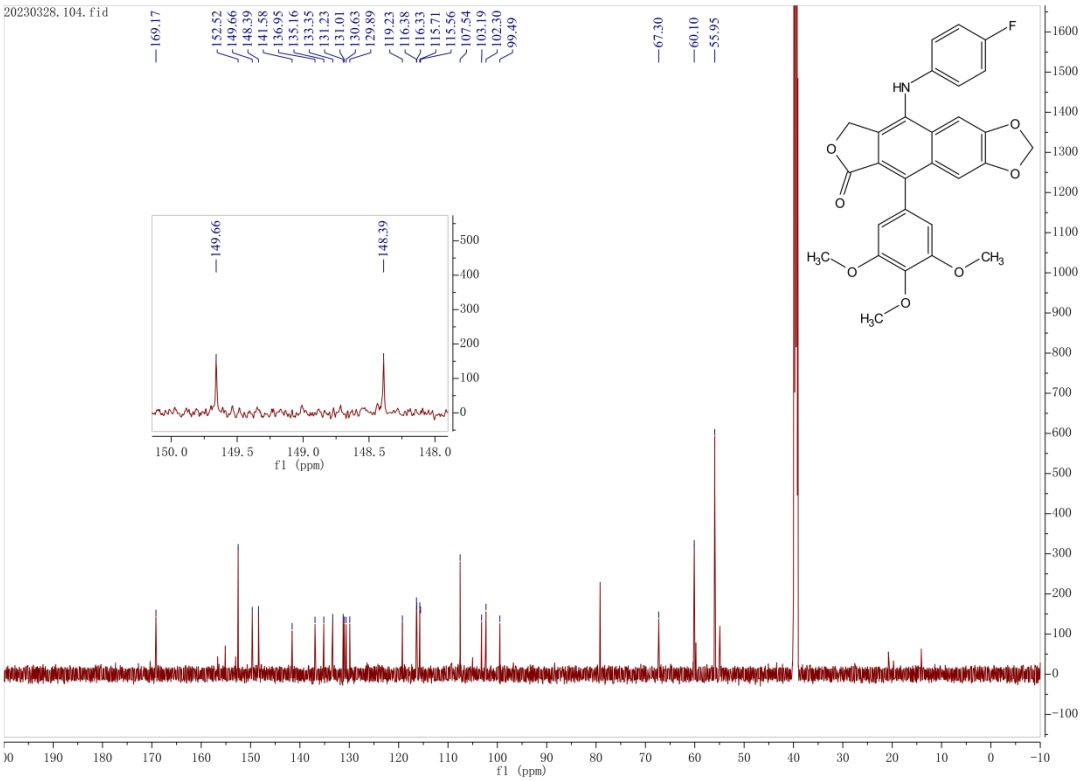
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **2n**



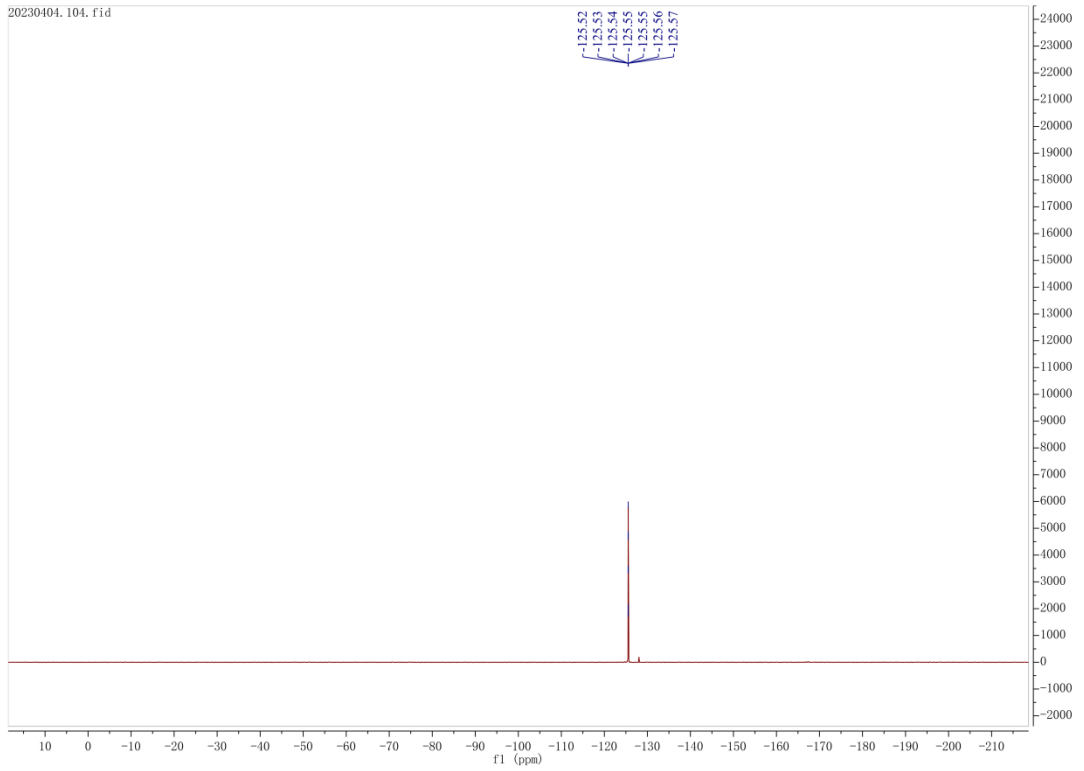
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **2n**



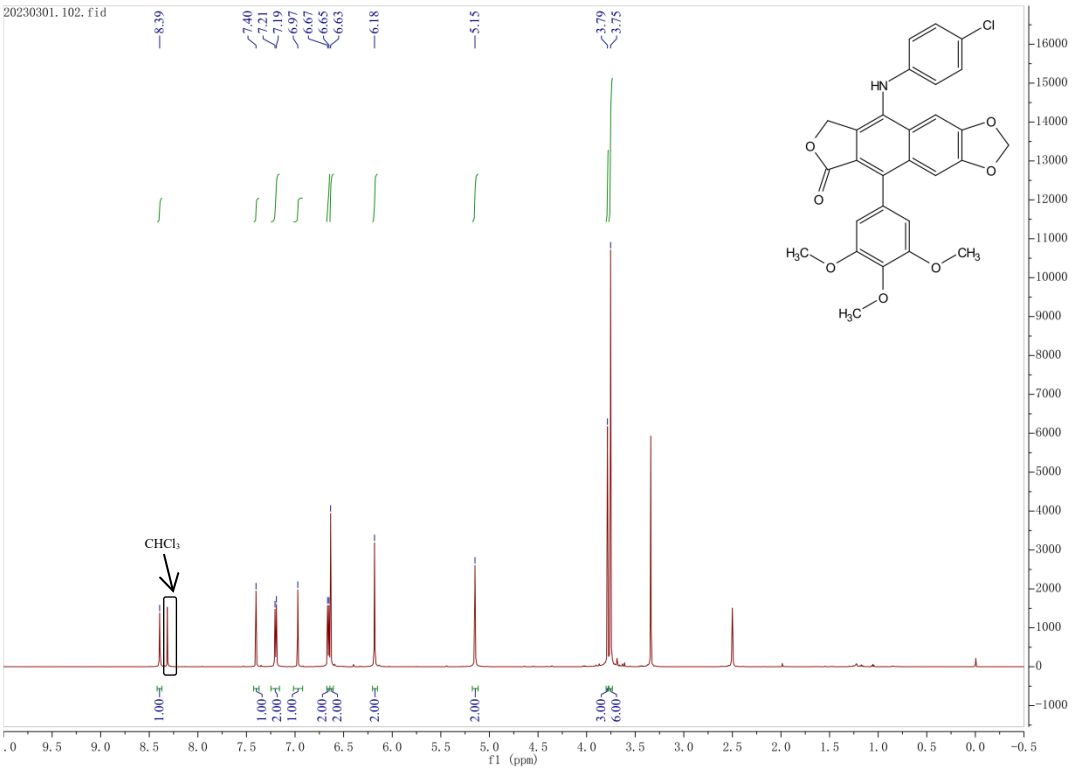
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **3a**



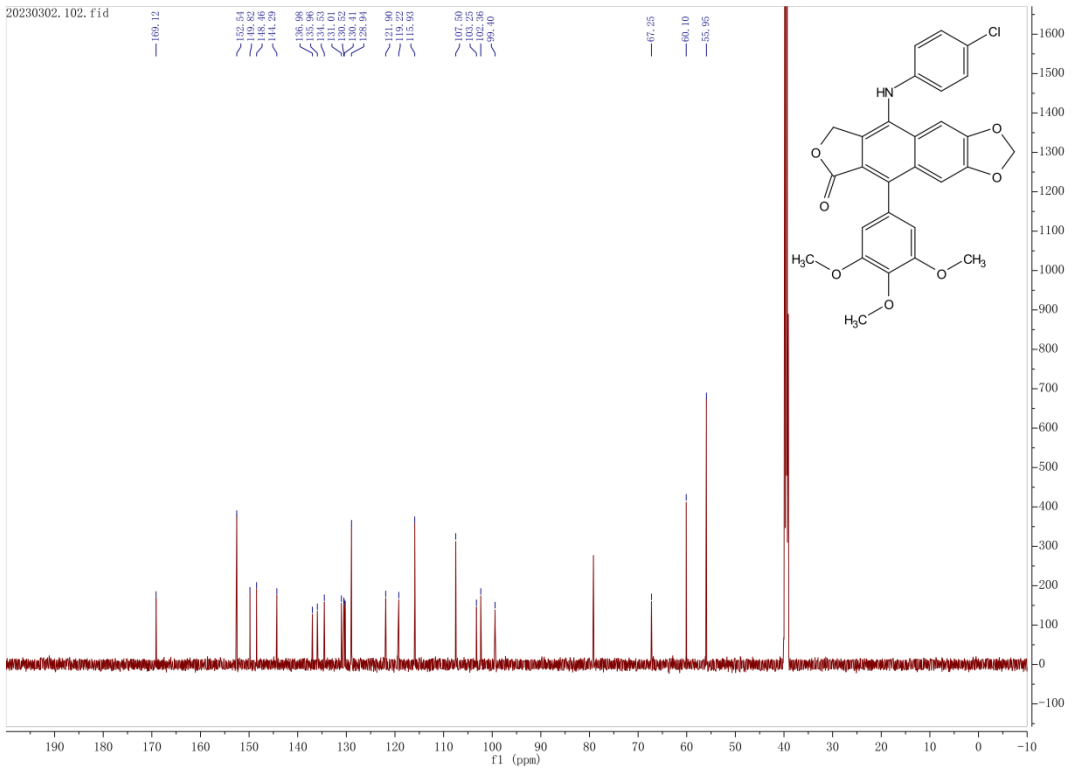
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **3a**



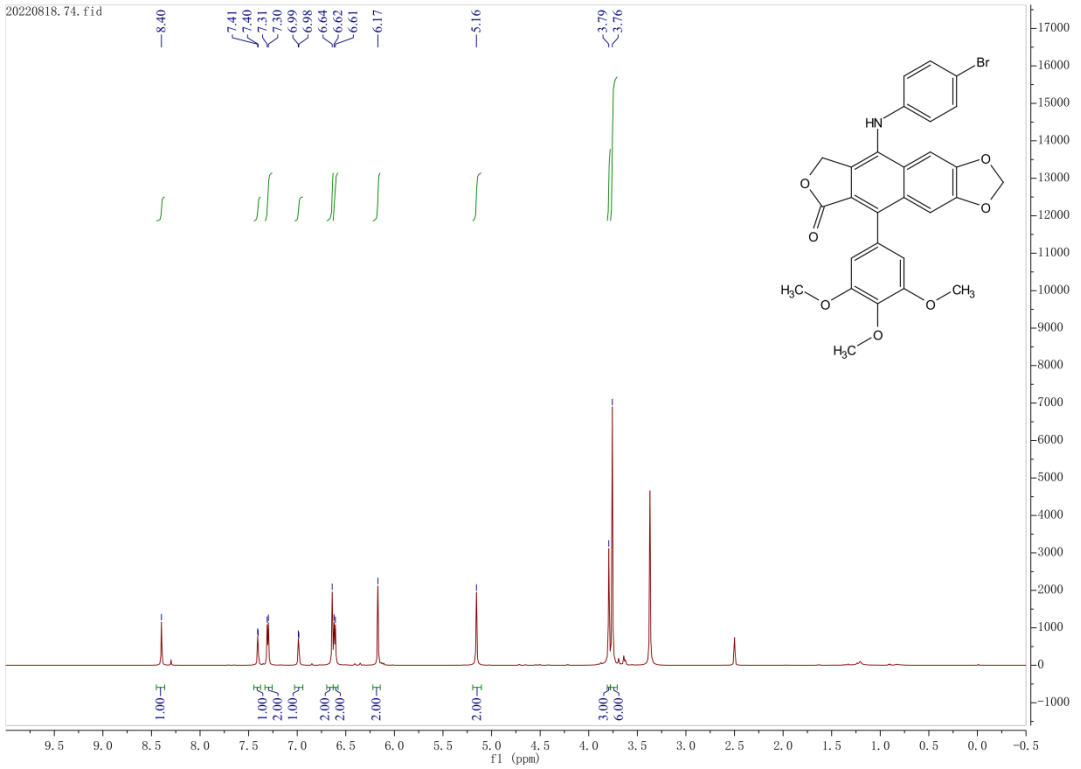
^{19}F NMR (565 MHz, DMSO-d_6) Spectrum of **3a**



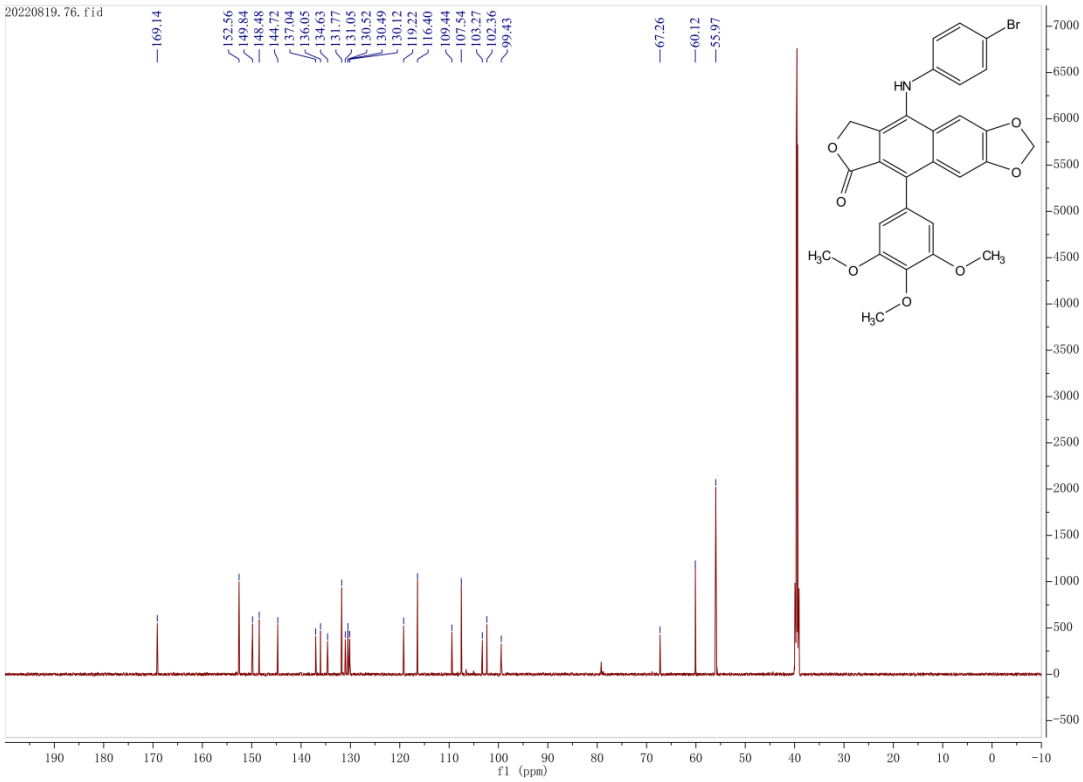
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **3b**



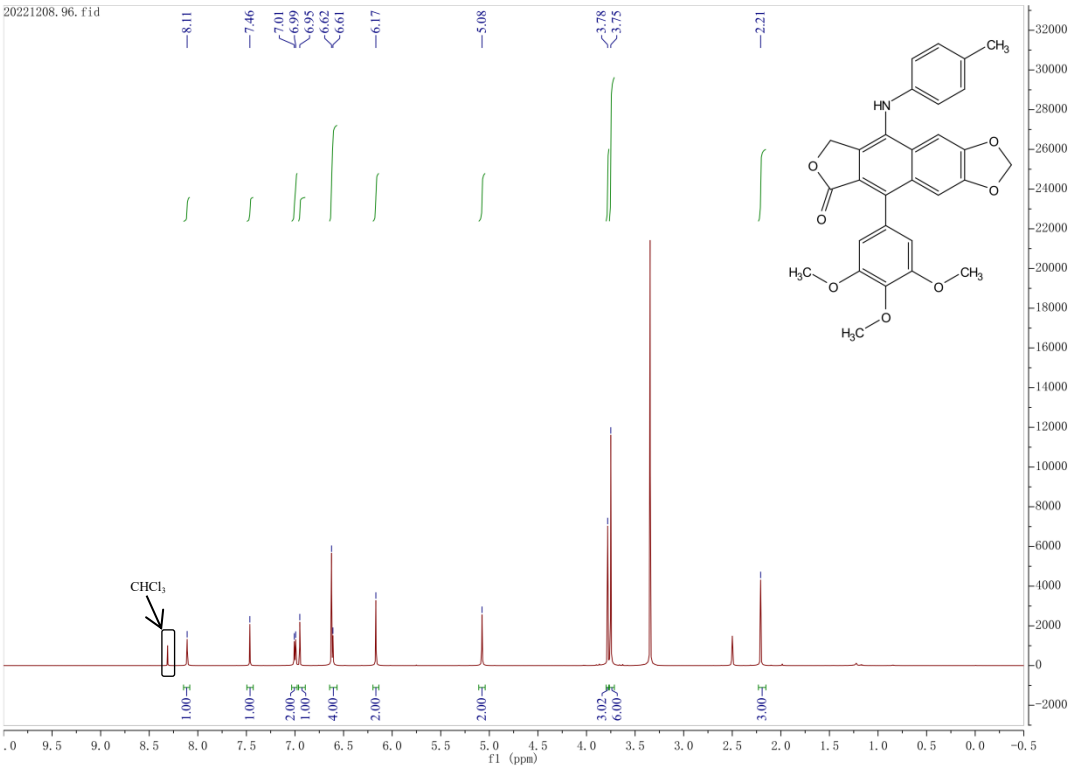
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **3b**



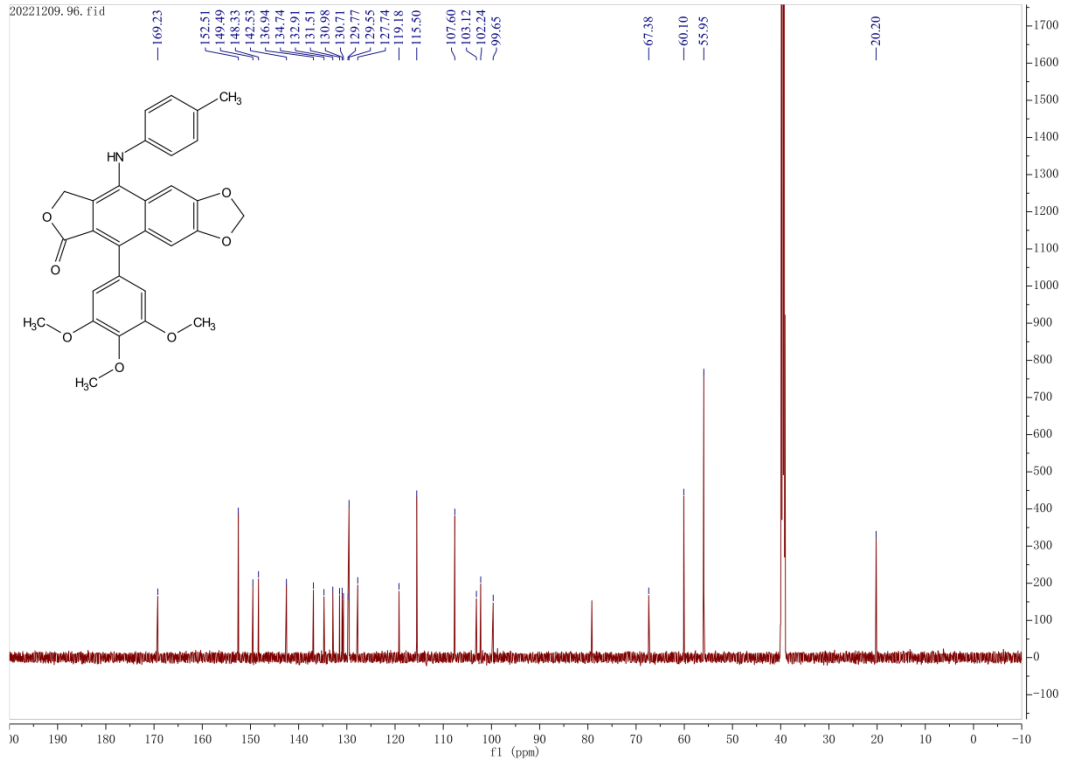
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **3c**



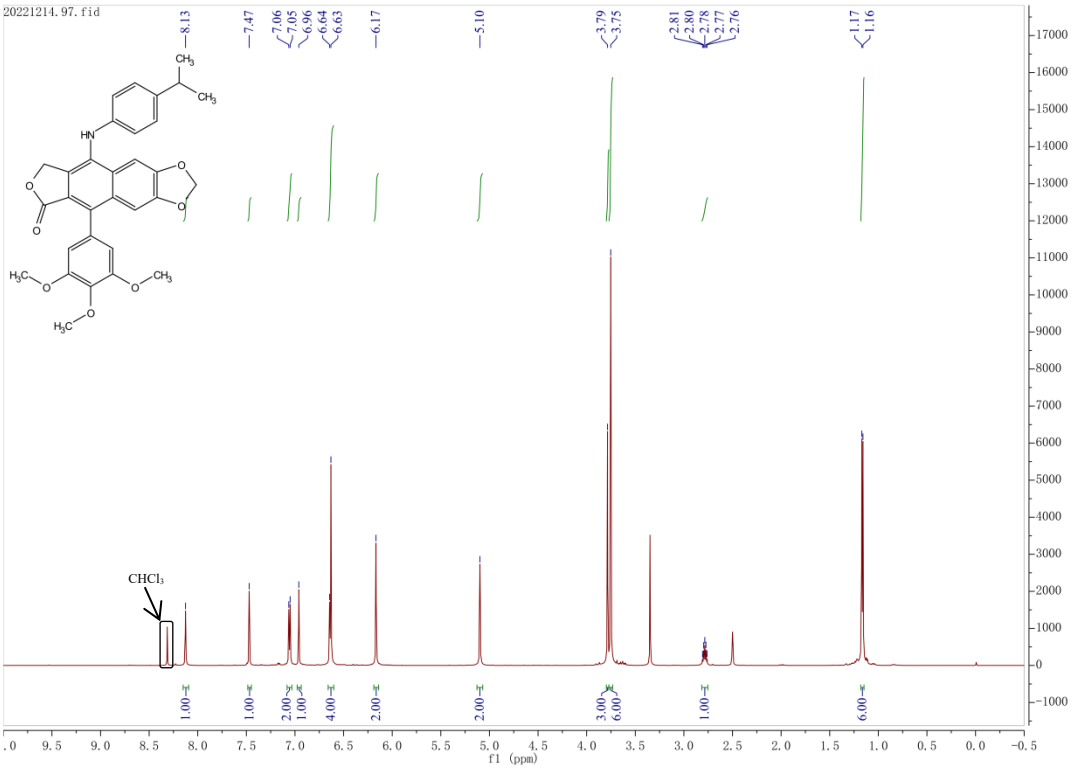
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **3c**



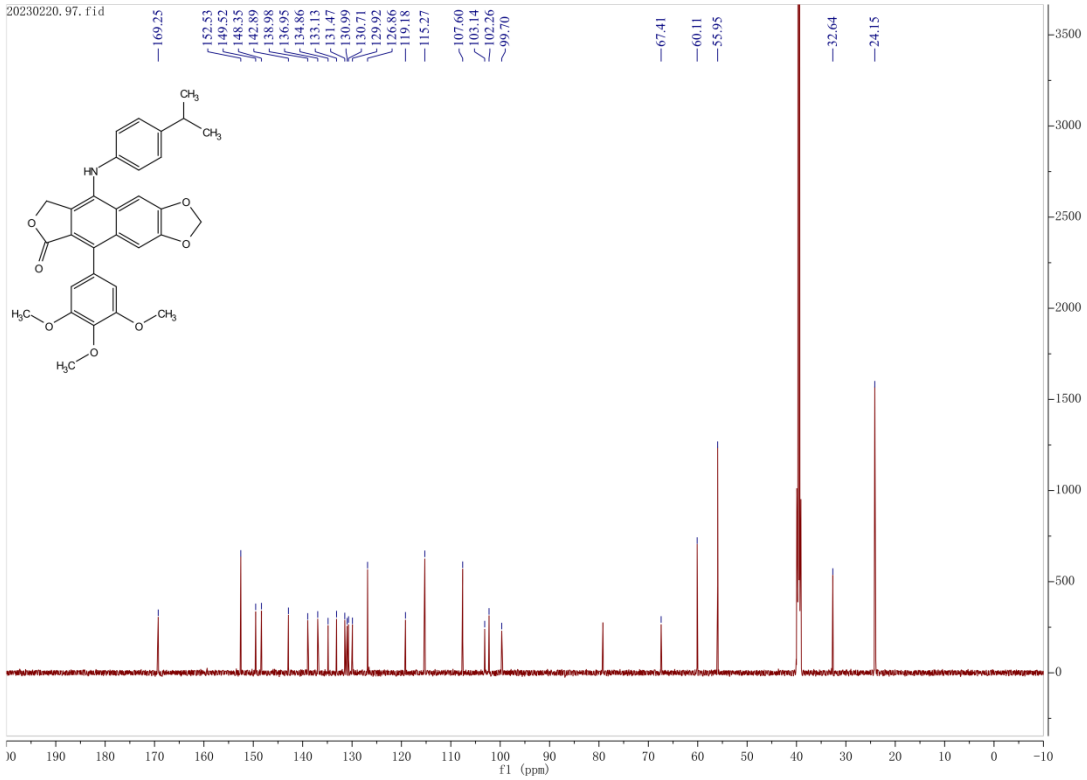
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **3d**



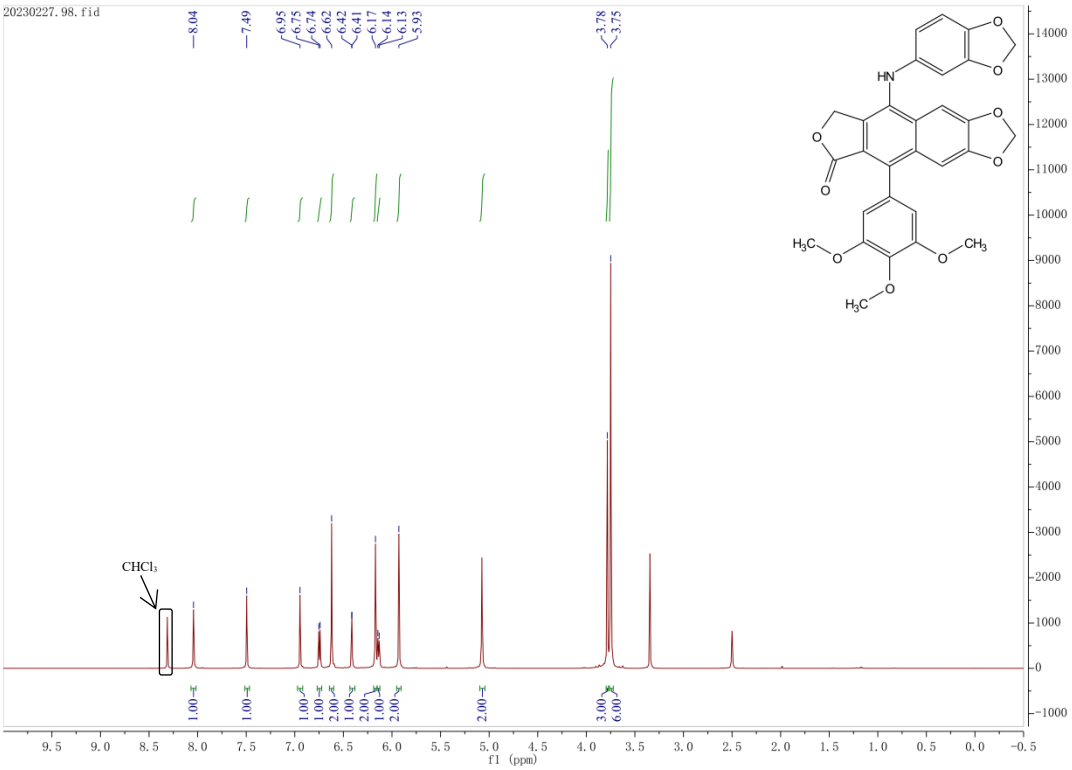
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **3d**



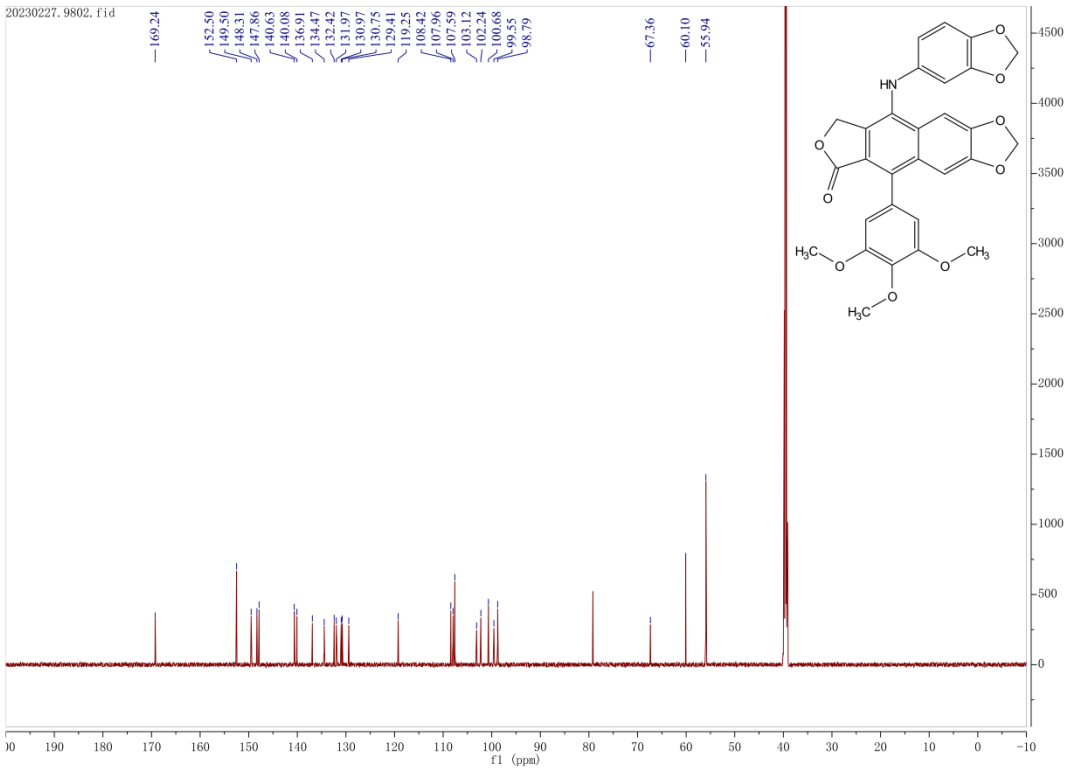
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **3e**



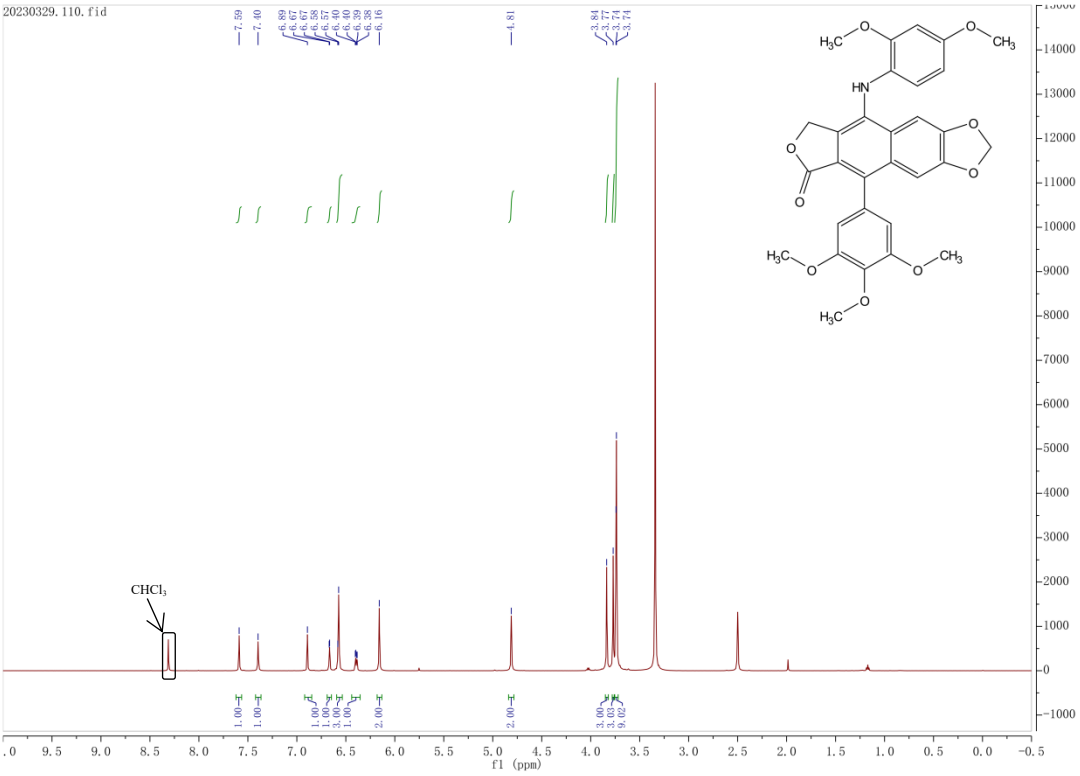
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **3e**



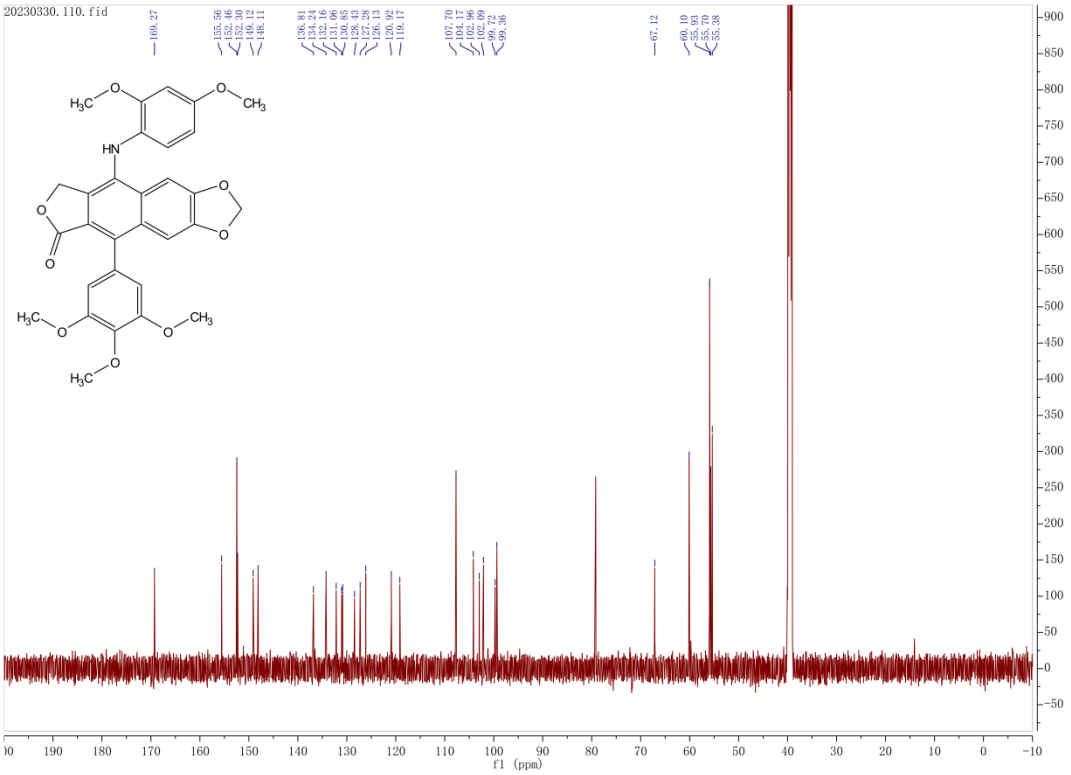
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **3f**



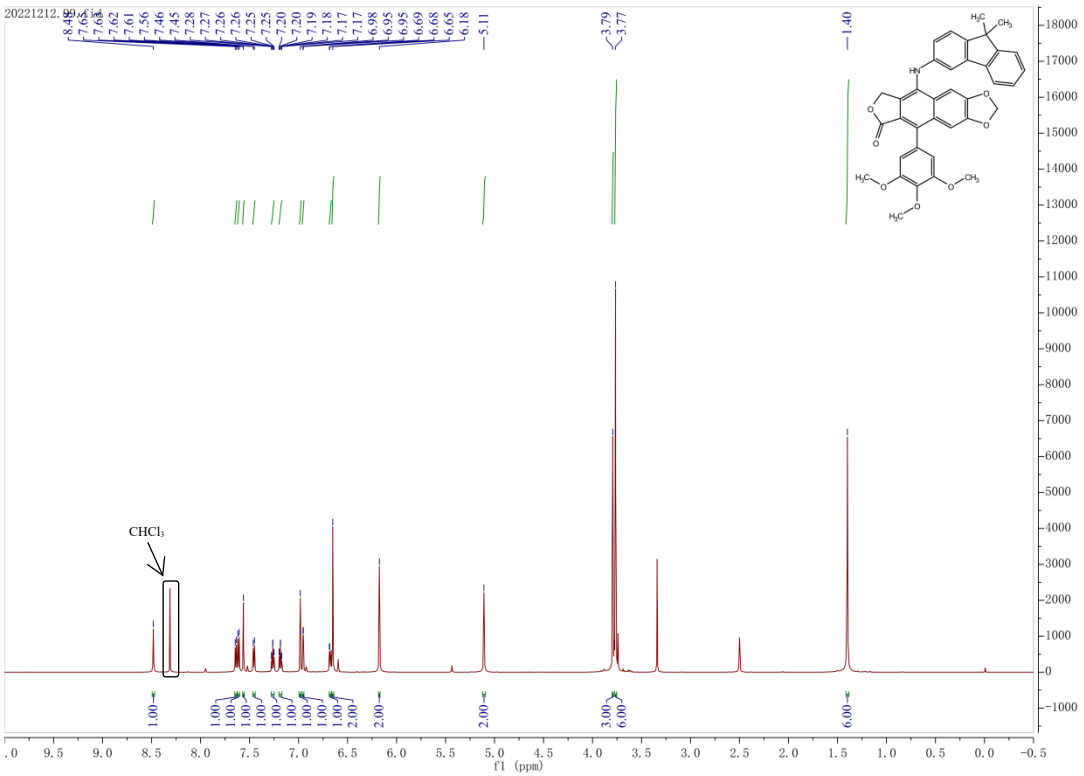
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **3f**



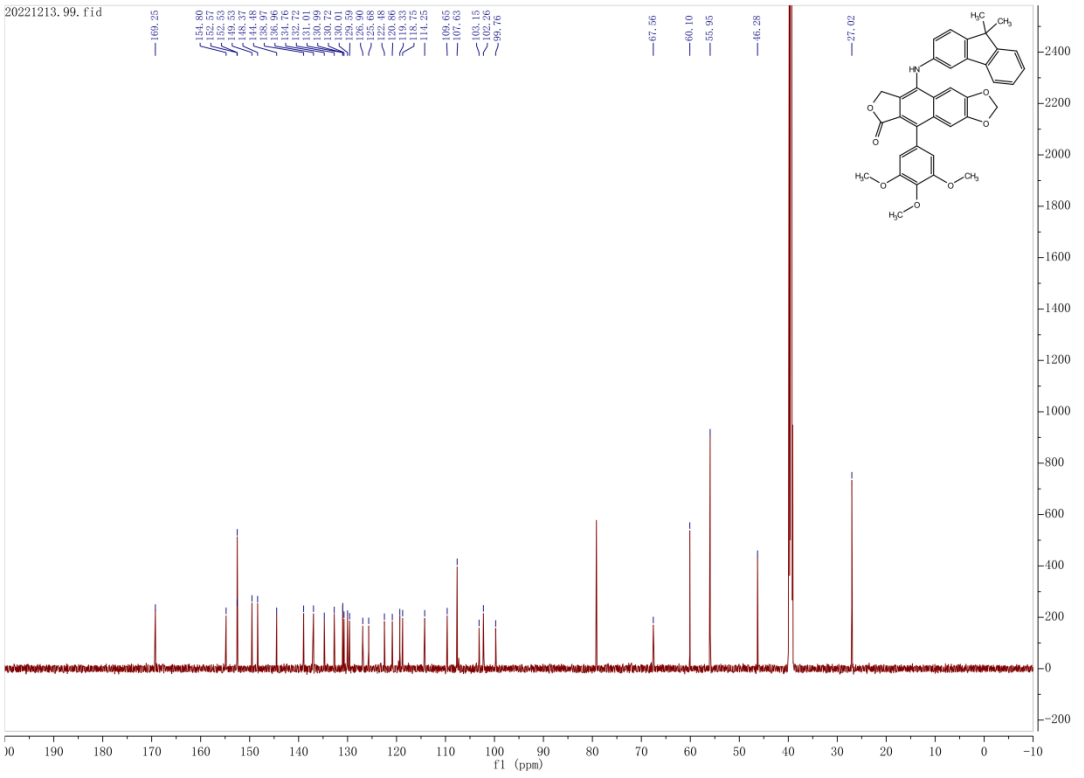
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **3g**



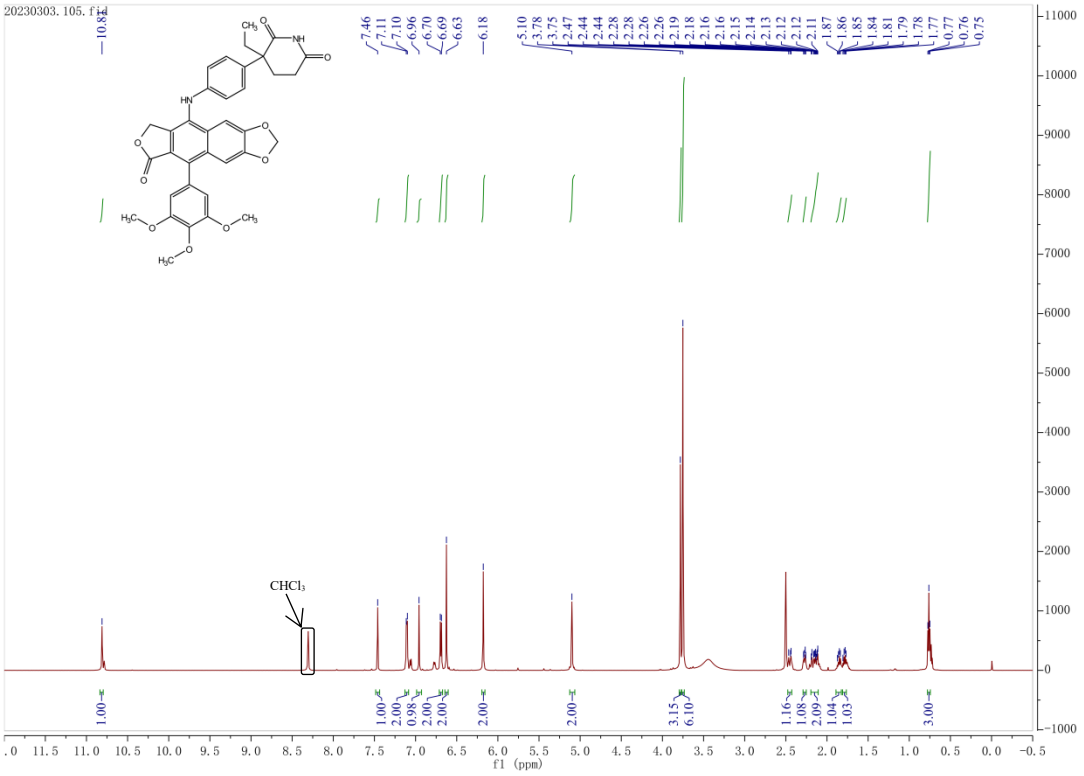
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **3g**



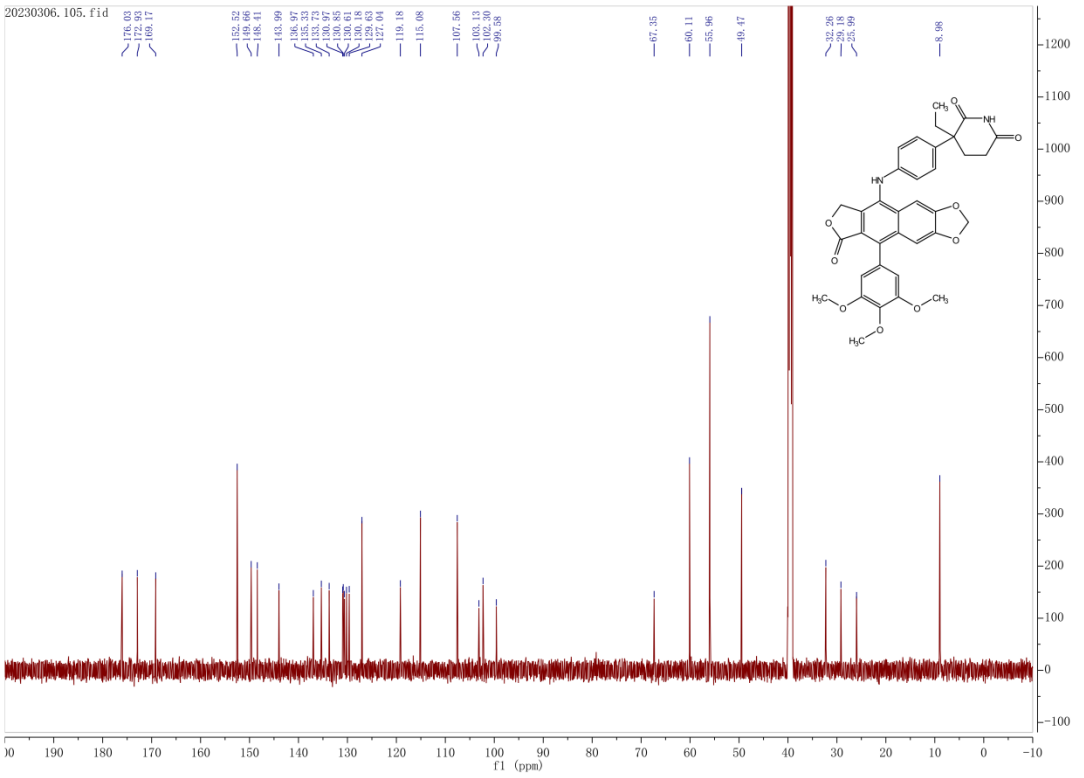
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **3h**



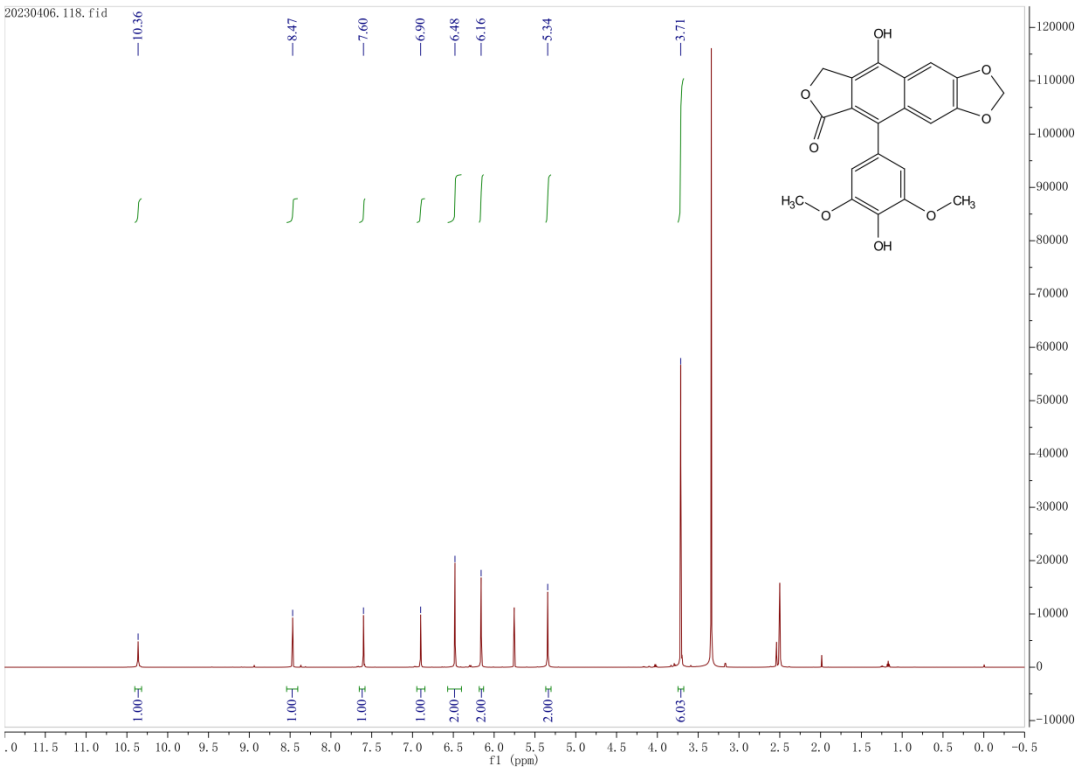
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **3h**



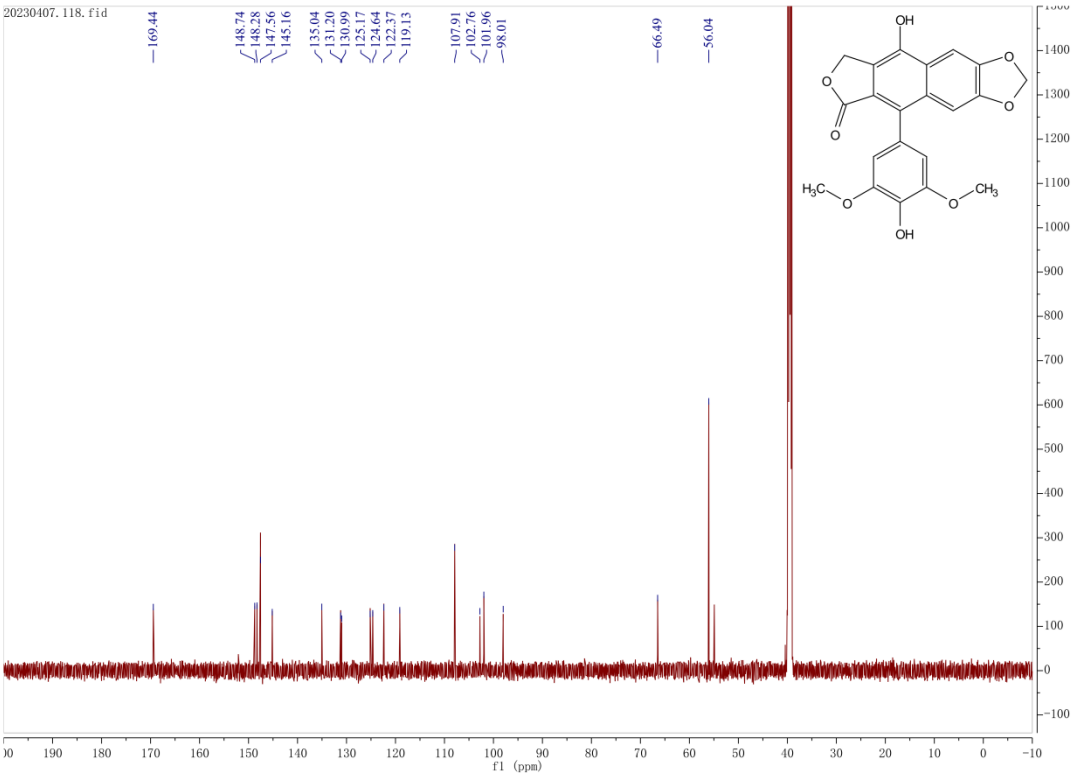
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **3i**



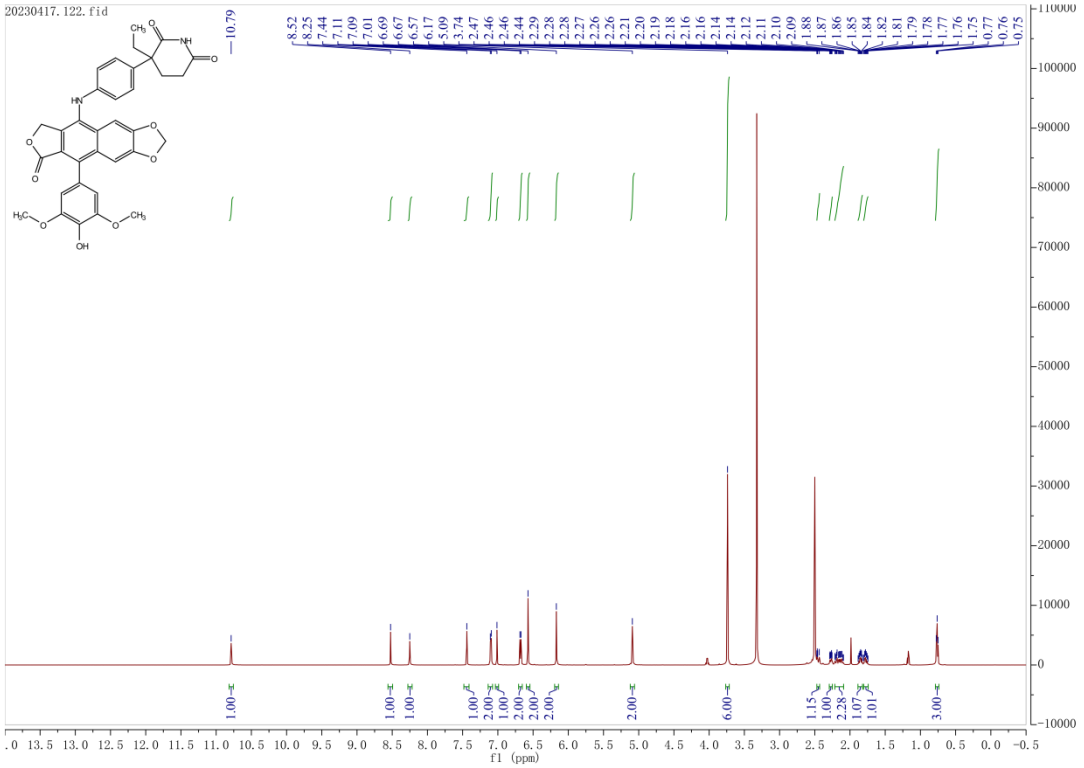
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **3i**



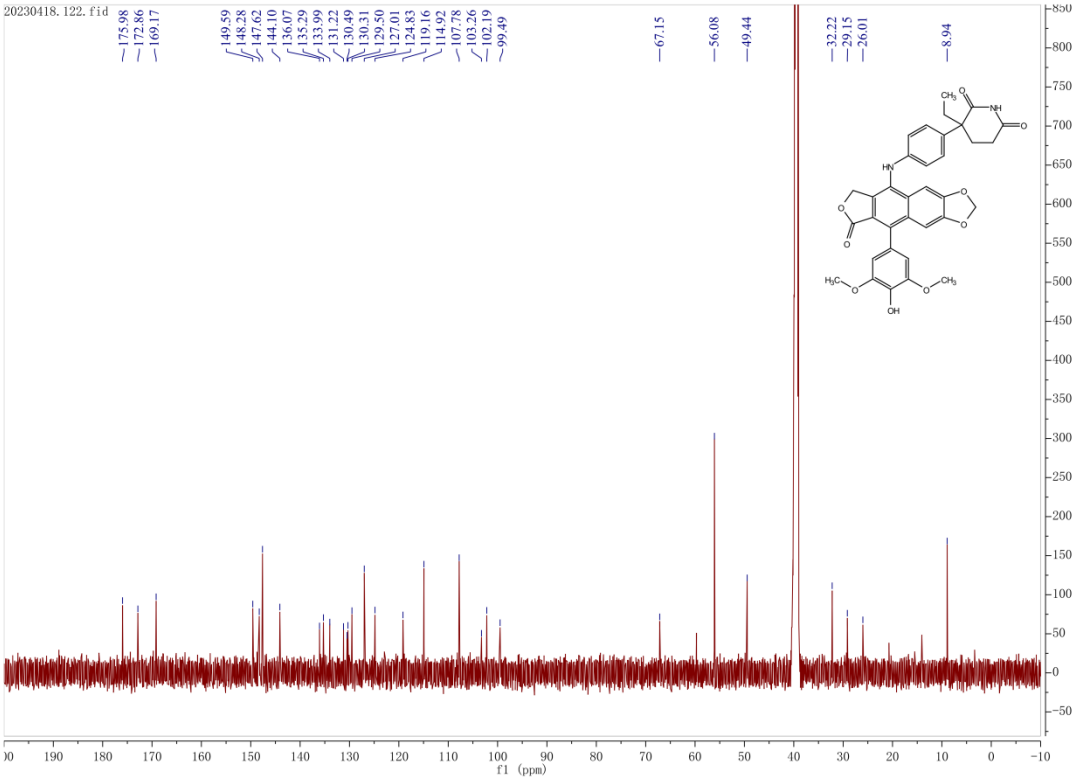
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **5**



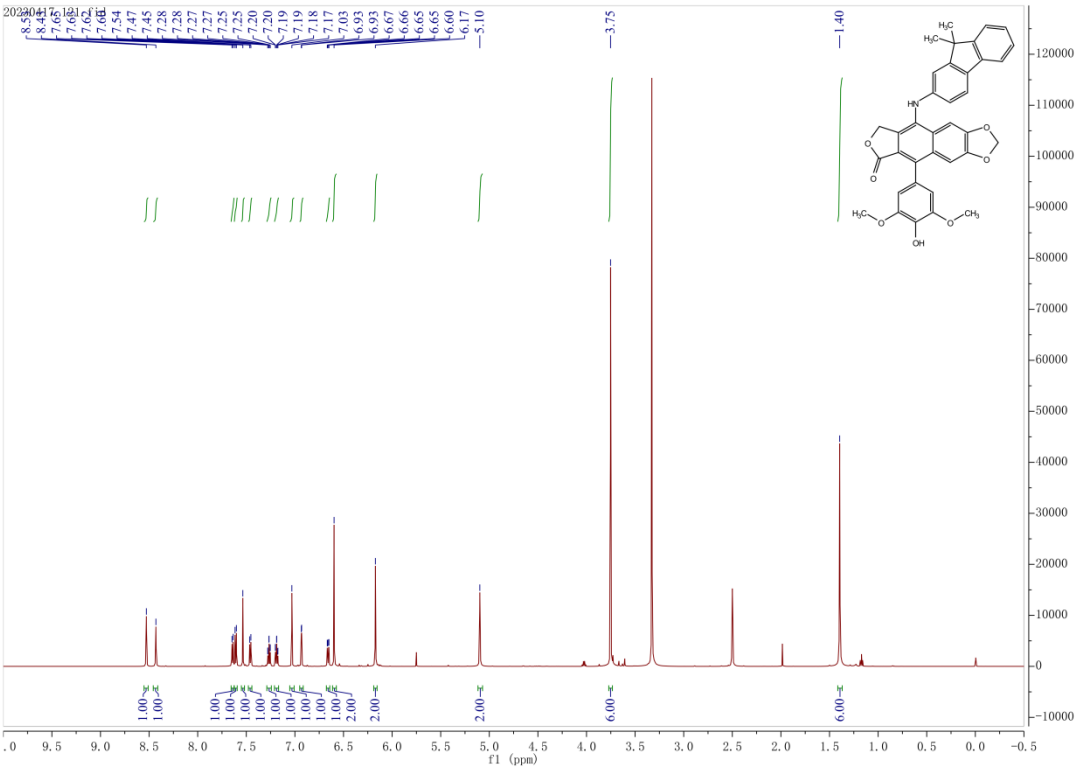
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **5**



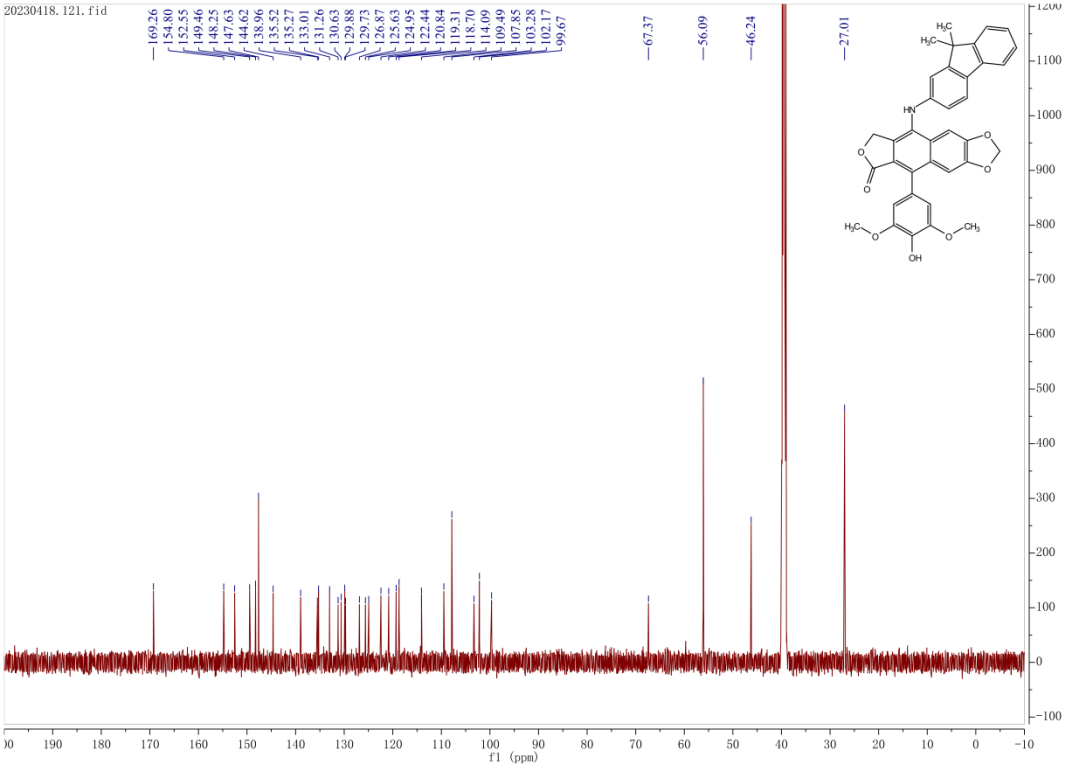
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **6a**



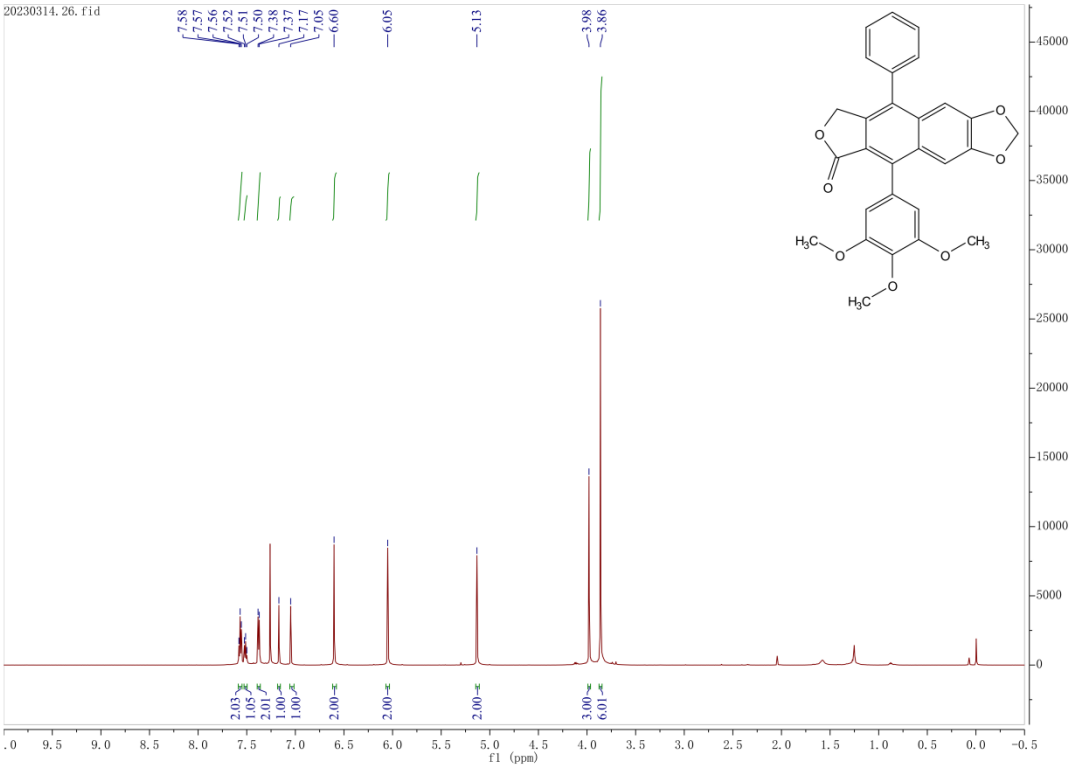
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **6a**



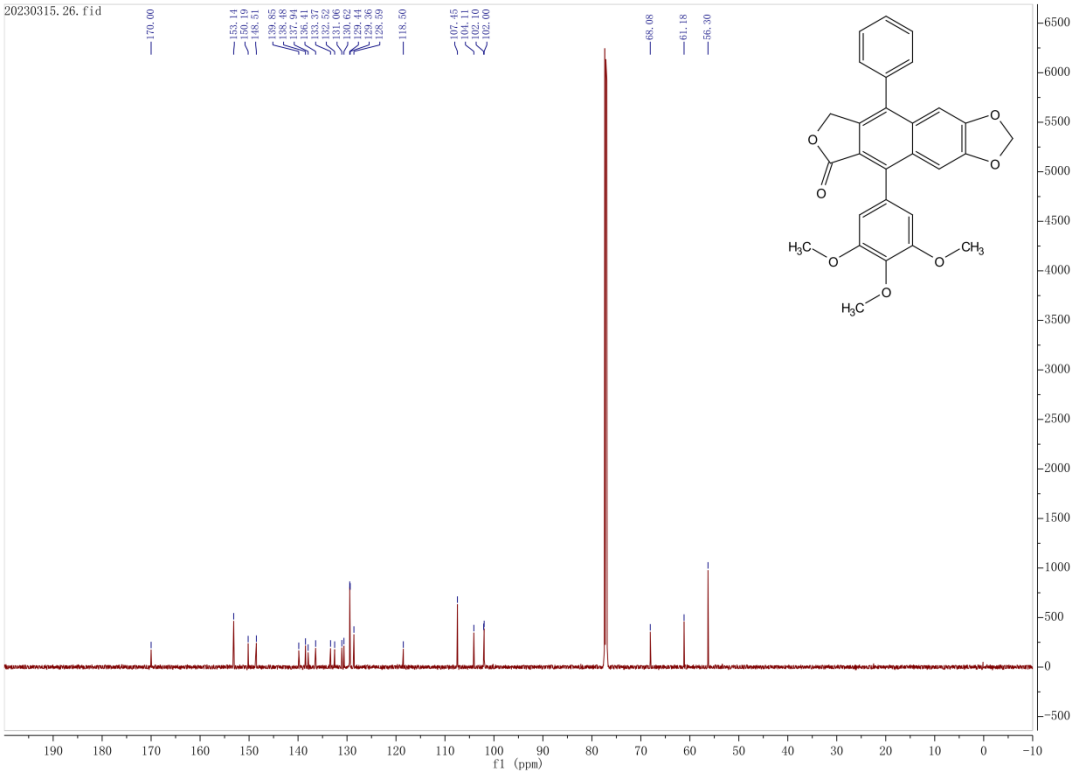
^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **6b**



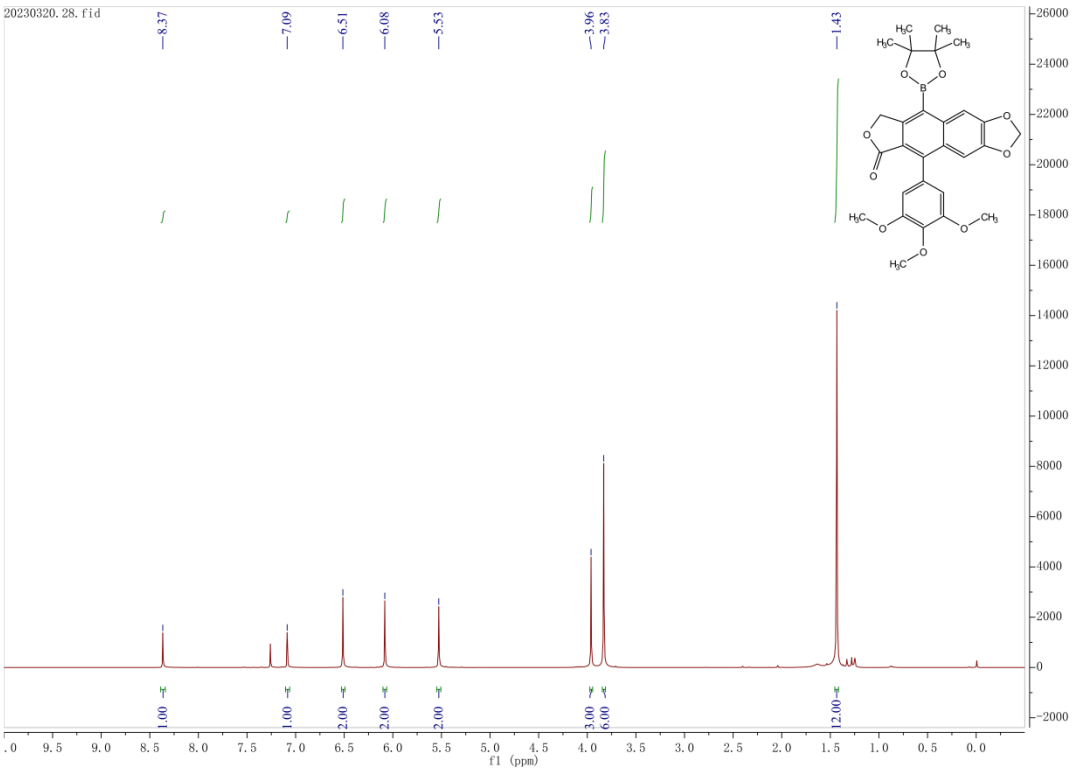
^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **6b**



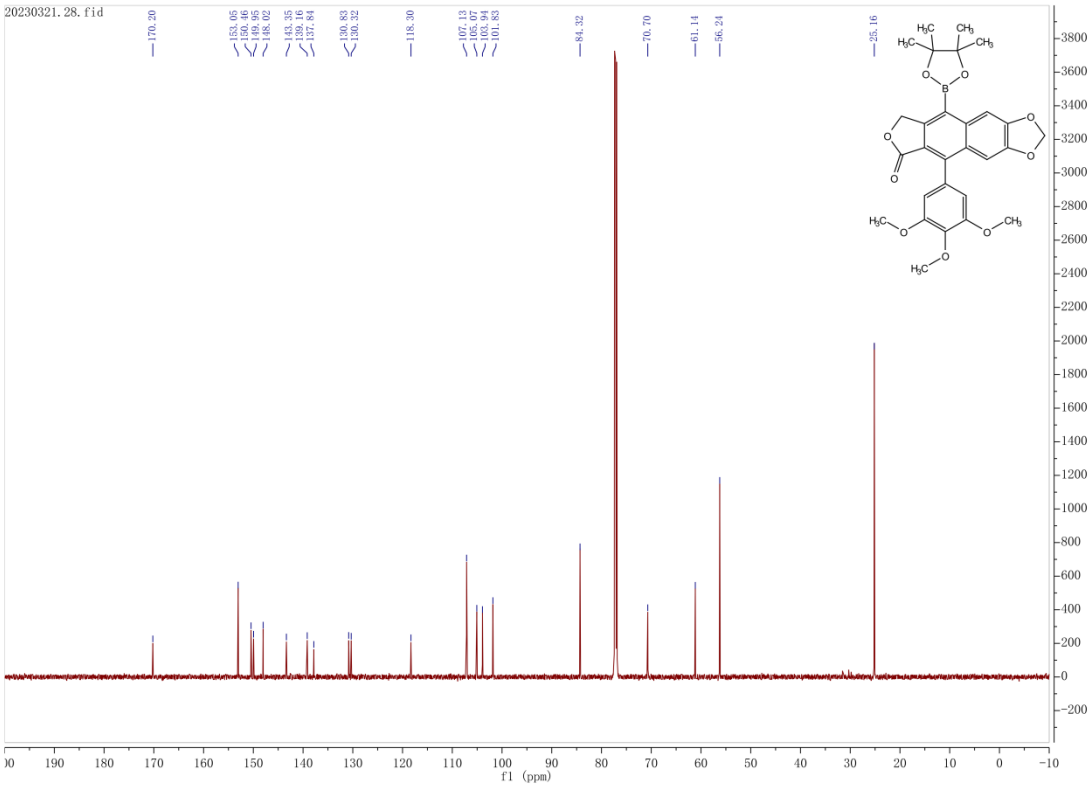
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **8a**



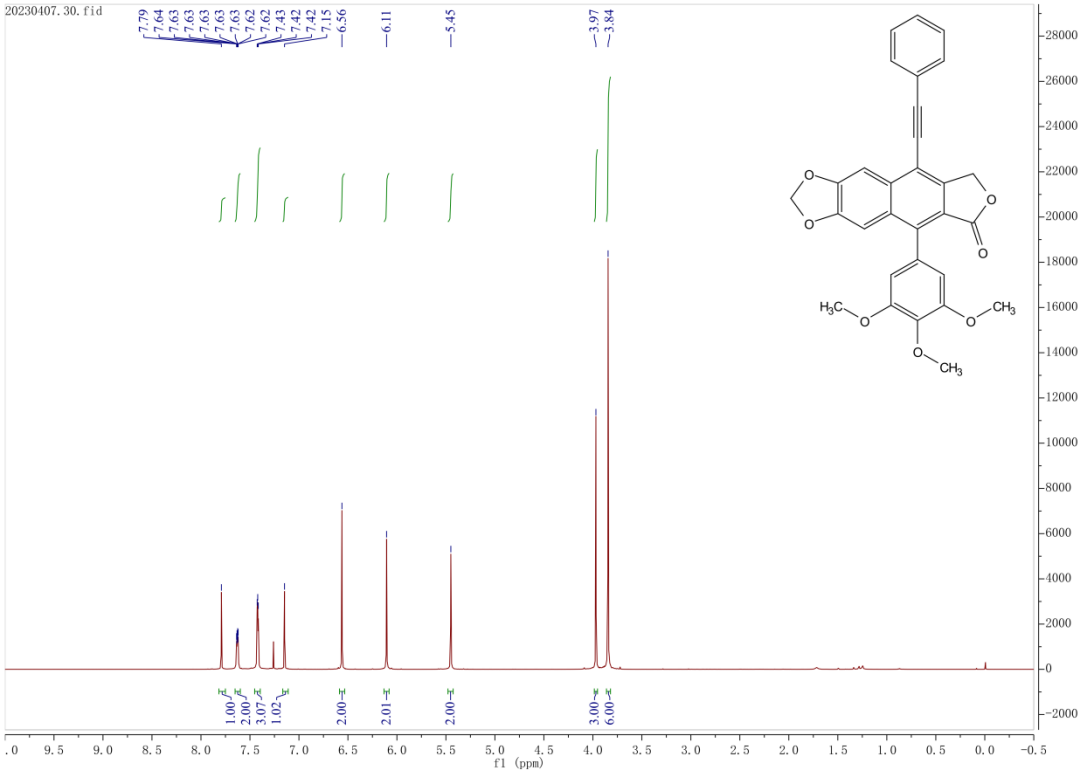
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **8a**



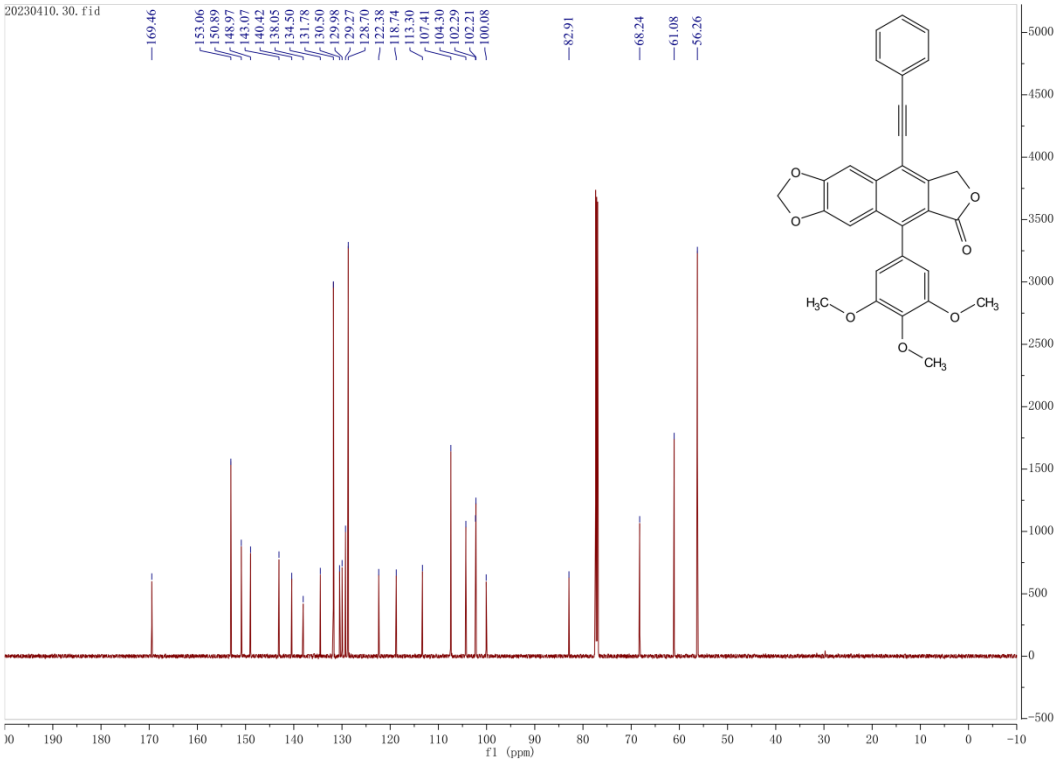
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **8b**



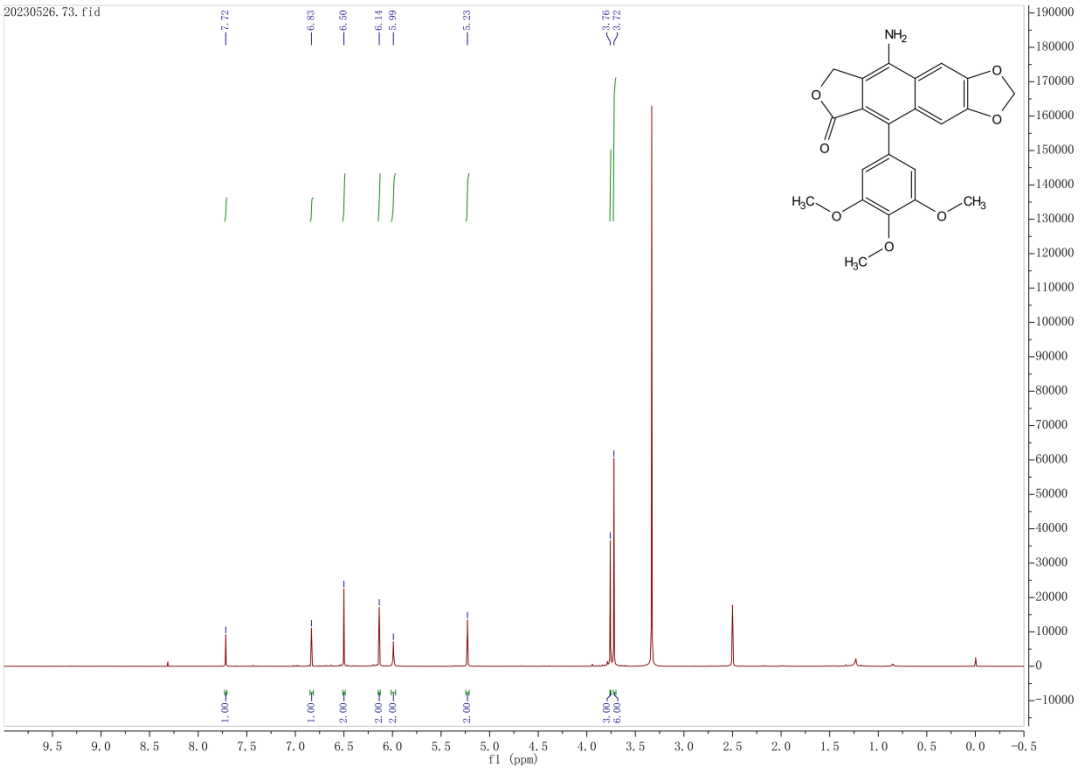
^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **8b**



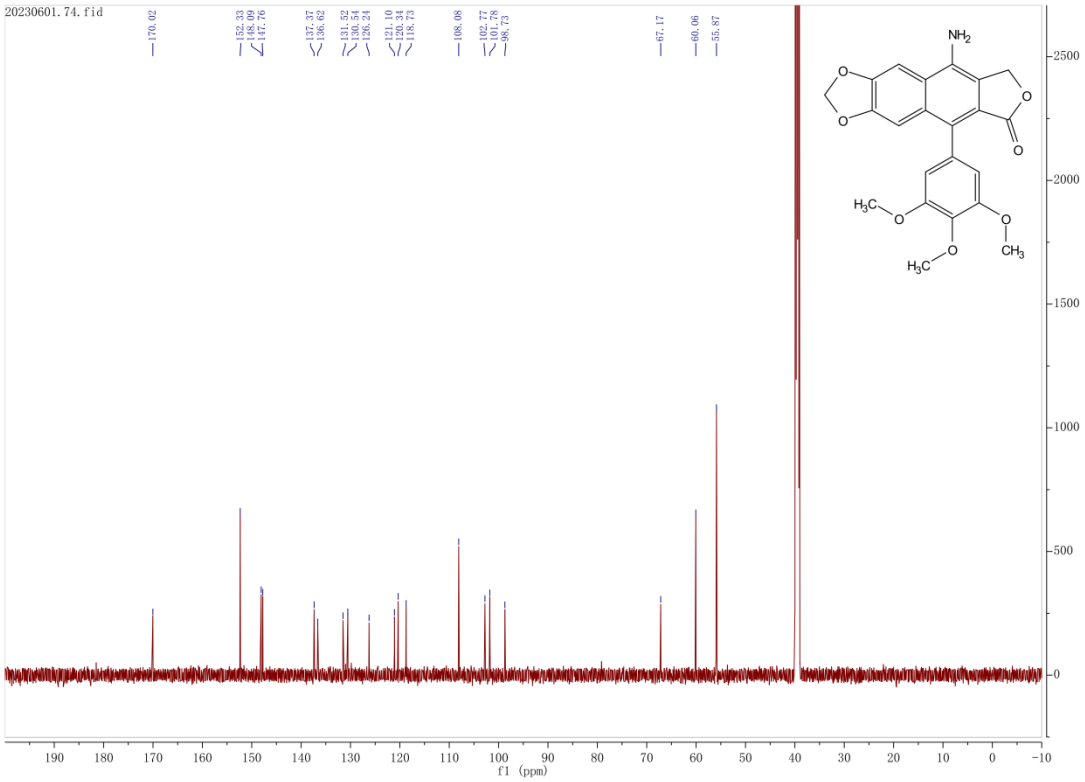
^{1}H NMR (600 MHz, $CDCl_3$) Spectrum of **8c**



^{13}C NMR (151 MHz, $CDCl_3$) Spectrum of **8c**



^{1}H NMR (600 MHz, DMSO-d_6) Spectrum of **9**



^{13}C NMR (151 MHz, DMSO-d_6) Spectrum of **9**

Single crystal structure of 3b (CCDC 2262413)

Datablock: mo_0428_2_0m

Bond precision: C-C = 0.0082 A Wavelength=0.71073

Cell: a=5.7924(3) b=11.1413(5) c=12.0240(6)
alpha=110.796(2) beta=90.433(2) gamma=91.711(2)
Temperature: 150 K

	Calculated	Reported
Volume	724.95(6)	724.95(6)
Space group	P 1	P 1
Hall group	P 1	P 1
Moiety formula	C28 H22 Cl N O7, C H Cl3	C28 H22 Cl N O7, C H Cl3
Sum formula	C29 H23 Cl4 N O7	C29 H23 Cl4 N O7
Mr	639.28	639.28
Dx,g cm-3	1.464	1.464
Z	1	1
Mu (mm-1)	0.456	0.456
F000	328.0	328.0
F000'	328.74	
h,k,lmax	6,13,14	6,13,14
Nref	5106[2553]	5060
Tmin,Tmax	0.952,0.969	0.011,0.028
Tmin'	0.951	

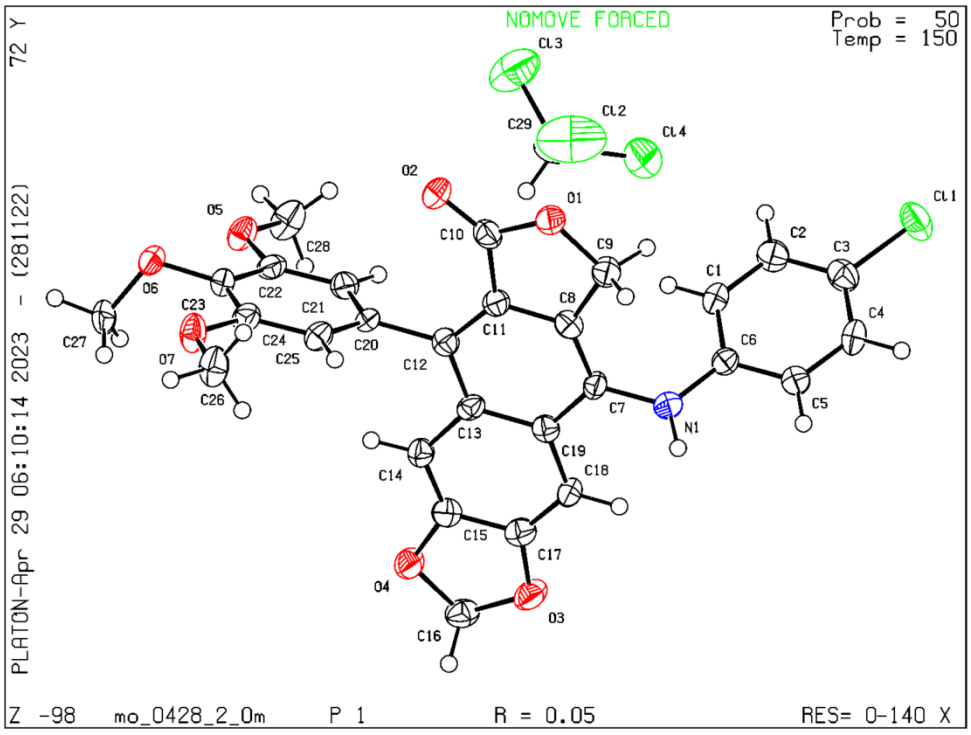
Correction method= # Reported T Limits: Tmin=0.011 Tmax=0.028
AbsCorr = NONE

Data completeness= 1.98/0.99 Theta(max)= 25.003

R(reflections)= 0.0526(4393) wR2(reflections)= 0.1408(5060)

S = 1.112 Npar= 373

Datablock mo_0428_2_0m - ellipsoid plot



Single crystal structure of 10 (CCDC 2268279)

Datablock: 1_a

```
Bond precision:   C-C = 0.0058 A          Wavelength=1.54178

Cell:             a=23.6452(6)     b=12.0393(3)      c=24.3383(6)
                  alpha=90         beta=93.136(2)    gamma=90
Temperature:      300 K

                  Calculated                  Reported
Volume            6918.1(3)                   6918.0(3)
Space group       C 2/c                       C 2/c
Hall group        -C 2yc                      -C 2yc
Moiety formula    C29 H23 N O9, 2(C H Cl3)    ?
Sum formula       C31 H25 Cl6 N O9            C31 H25 Cl6 N O9
Mr                768.22                      768.22
Dx,g cm-3         1.475                       1.475
Z                 8                           8
Mu (mm-1)         4.990                       4.990
F000              3136.0                      3136.0
F000'             3161.71
h,k,lmax          28,14,29                    28,14,29
Nref              6371                        6341
Tmin,Tmax         0.577,0.671                 0.864,0.864
Tmin'             0.523

Correction method= # Reported T Limits: Tmin=0.864 Tmax=0.864
AbsCorr = MULTI-SCAN

Data completeness= 0.995          Theta(max)= 68.575

R(reflections)= 0.0892( 3699)                wR2(reflections)=
                                             0.3066( 6341)
S = 1.080                 Npar= 429
```

Datablock 1_a - ellipsoid plot