

**Discovery, synthesis, and cytotoxic evaluation of  
isoquinolinequinones produced by *Streptomyces albidoflavus*  
derived from Lichen**

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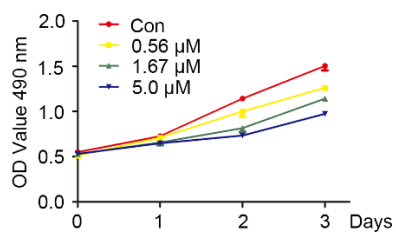
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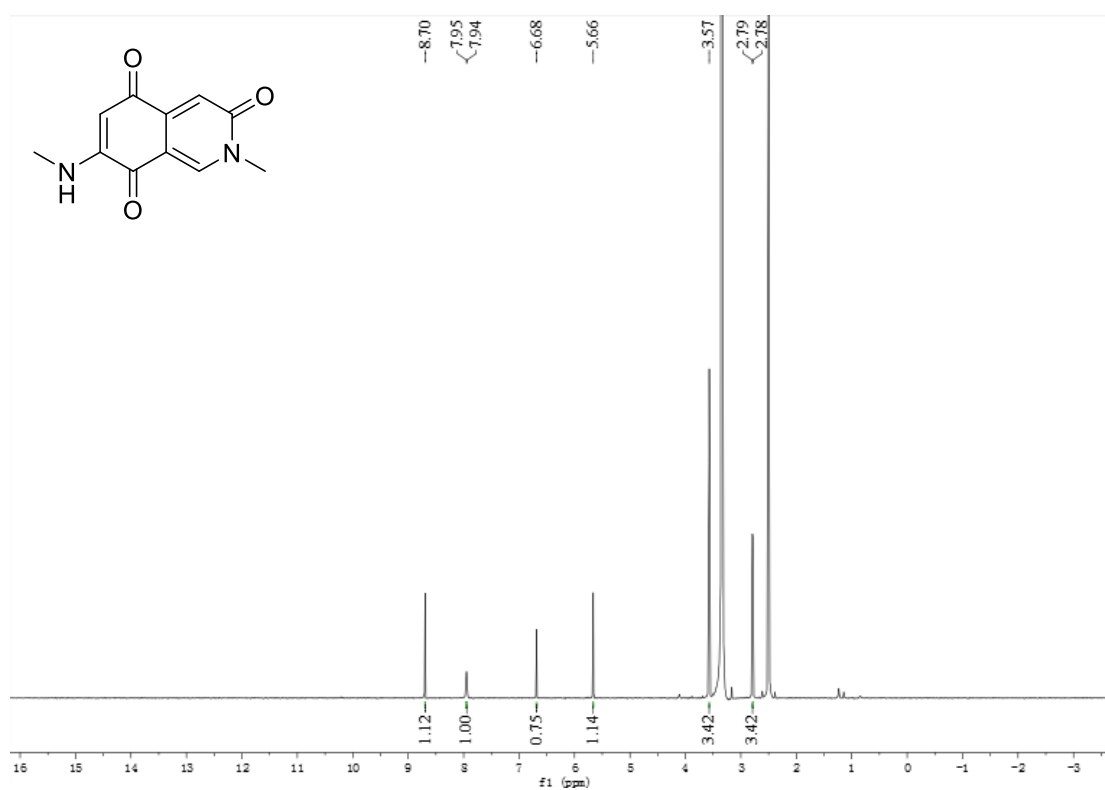
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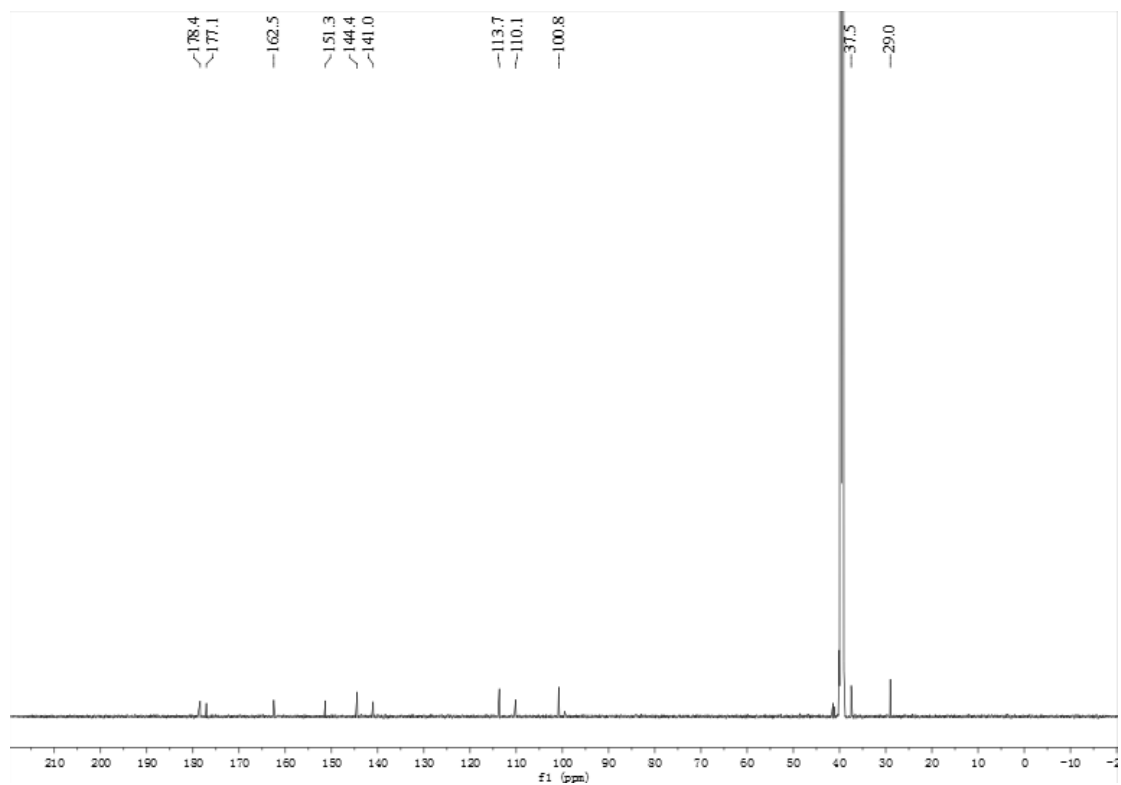
E-mail: jiangyi@ynu.edu.cn (Y. Jiang); E-mail: Muyu@mail.neu.edu.cn (Y. Mu); E-mail:  
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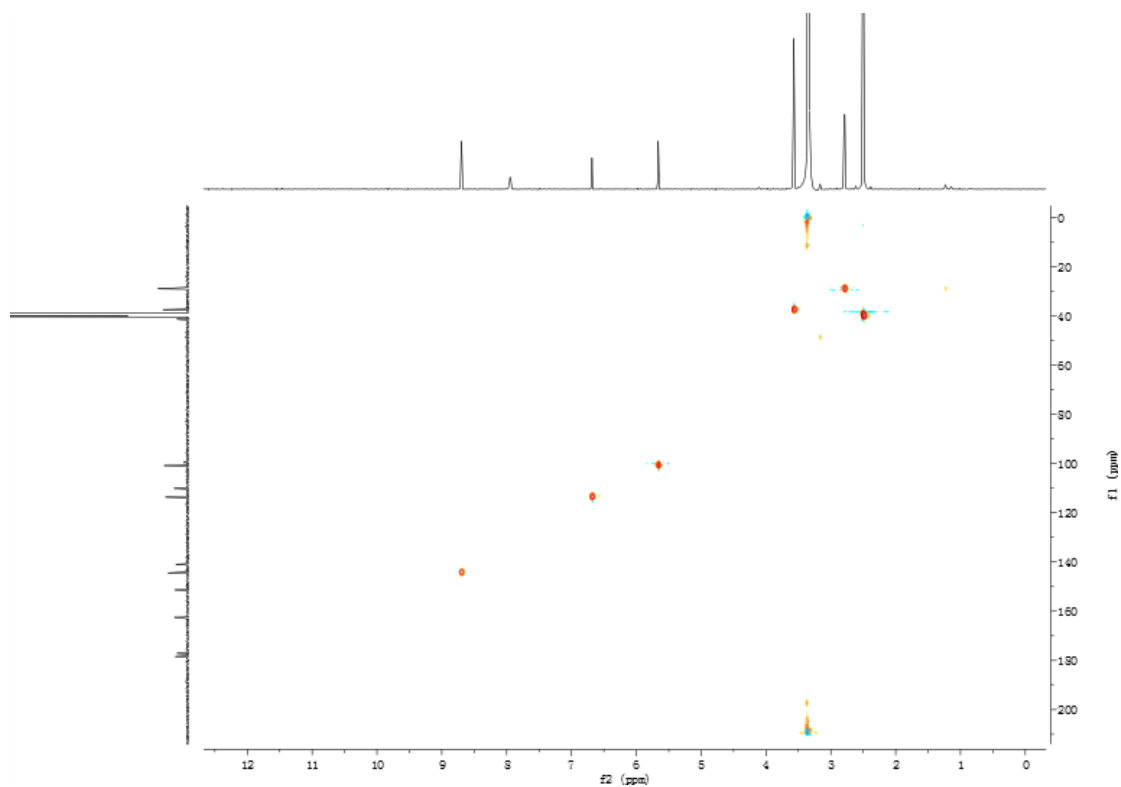
**Figure S1.** Compound **1g** retarded the growth and proliferation of MBA-MB-231 cells. The growth curve of MBA-MB-231 cells treated with vehicle (con group) and various concentrations (0.56, 1.67 and 5.0  $\mu$ M) of **1g** for 3 days was detected by MTT assay.



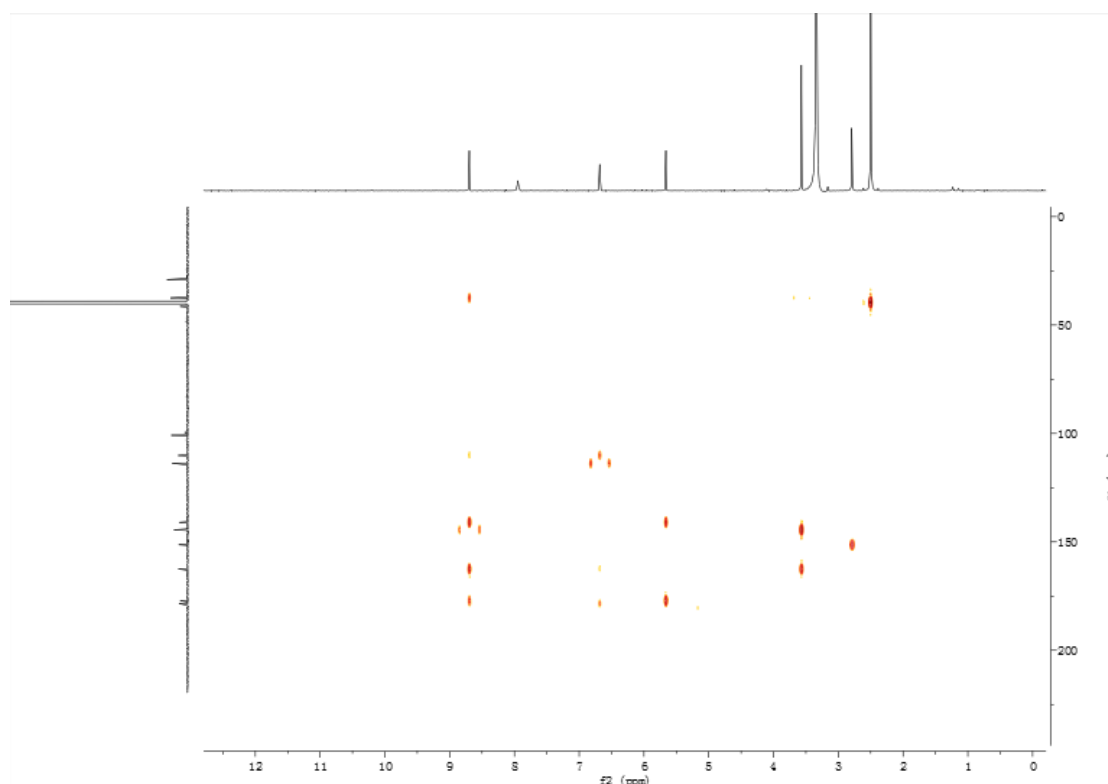
**Figure S2.** The <sup>1</sup>H-NMR (600MHz, DMSO-d<sub>6</sub>) spectrum of compound **1**



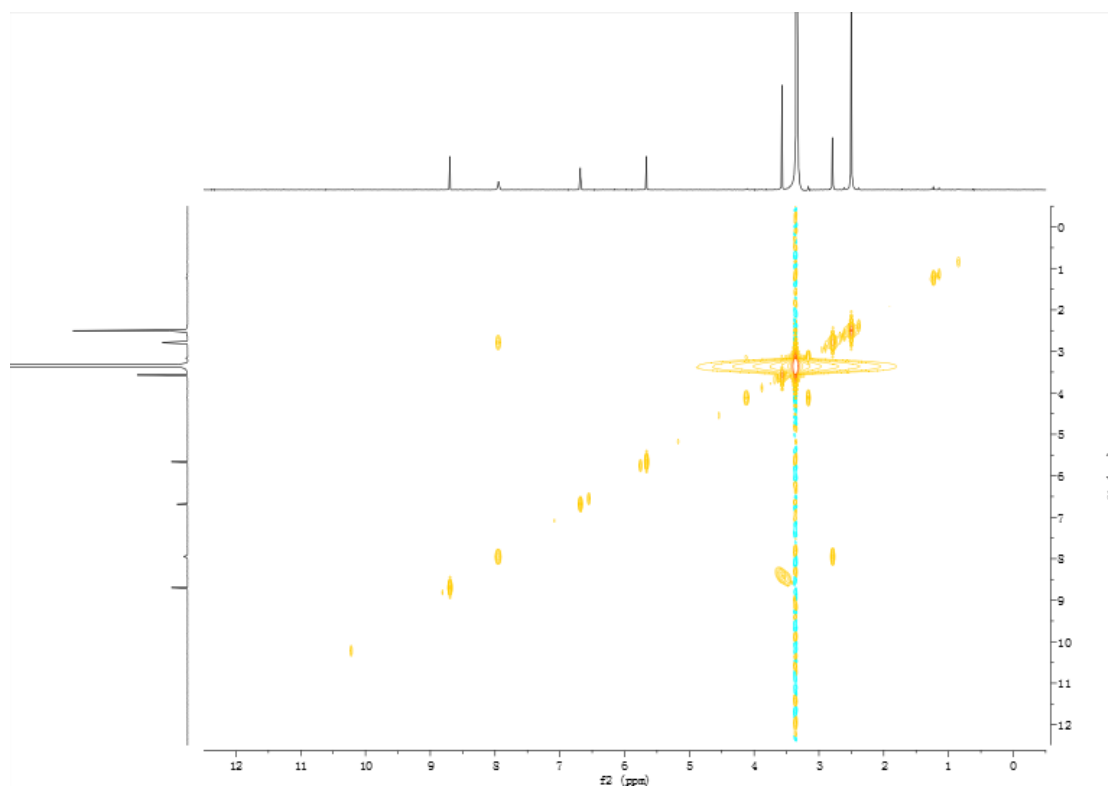
**Figure S3.** The  $^{13}\text{C}$ -NMR (150MHz, DMSO-d<sub>6</sub>) spectrum of compound **1**



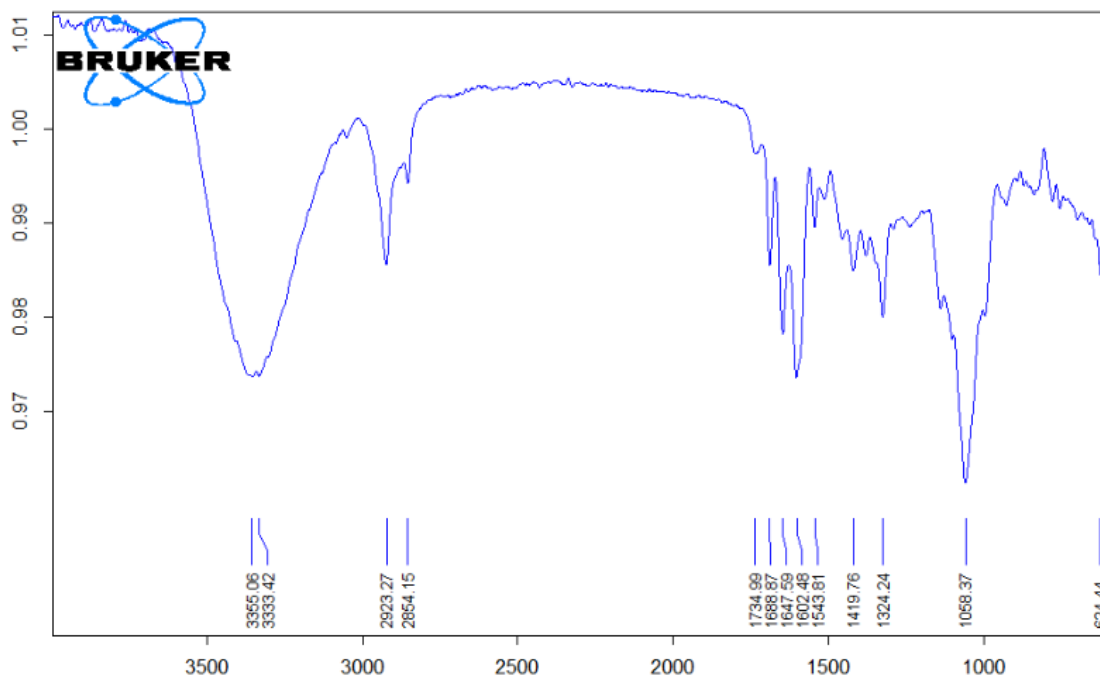
**Figure S4.** The HSQC spectrum of compound **1**



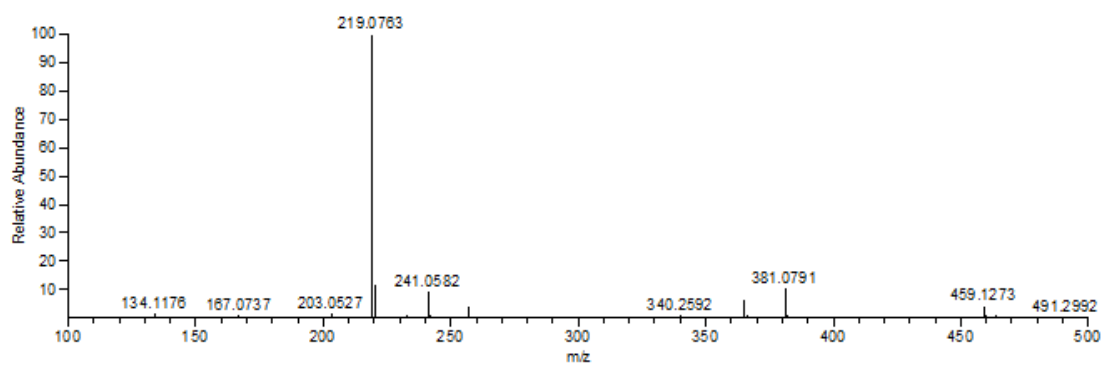
**Figure S5.** The HMBC spectrum of compound **1**



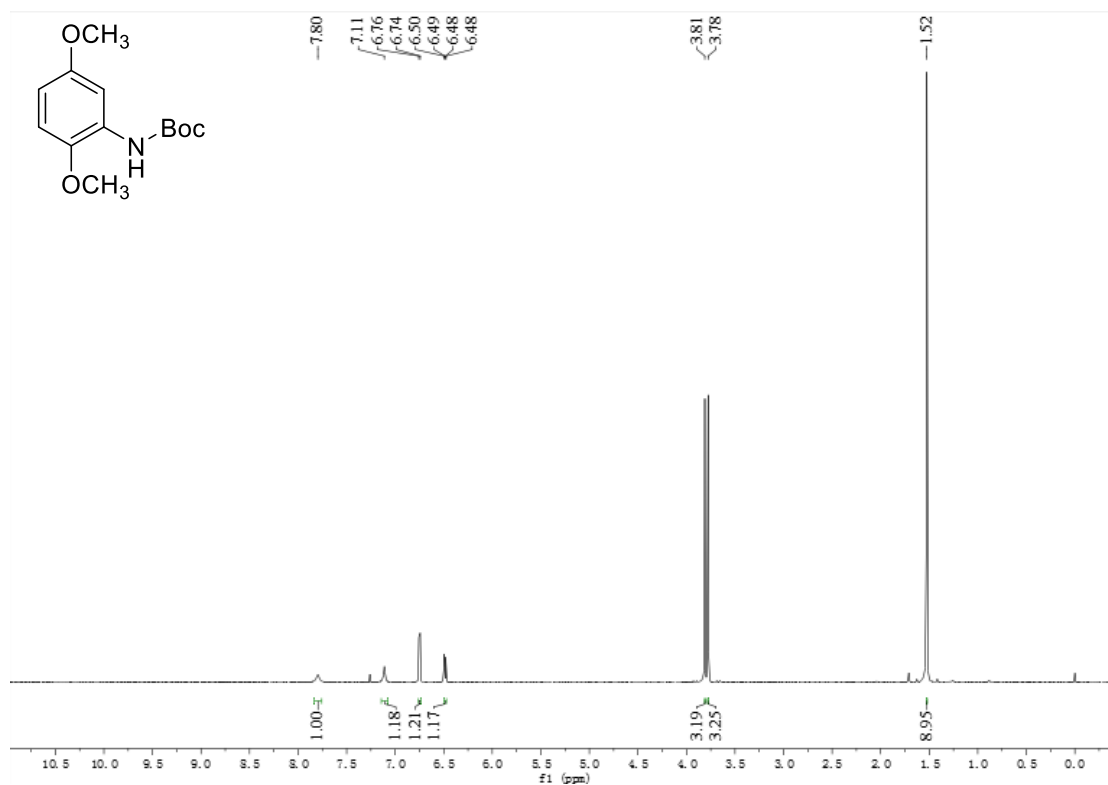
**Figure S6.** The COSY spectrum of compound **1**



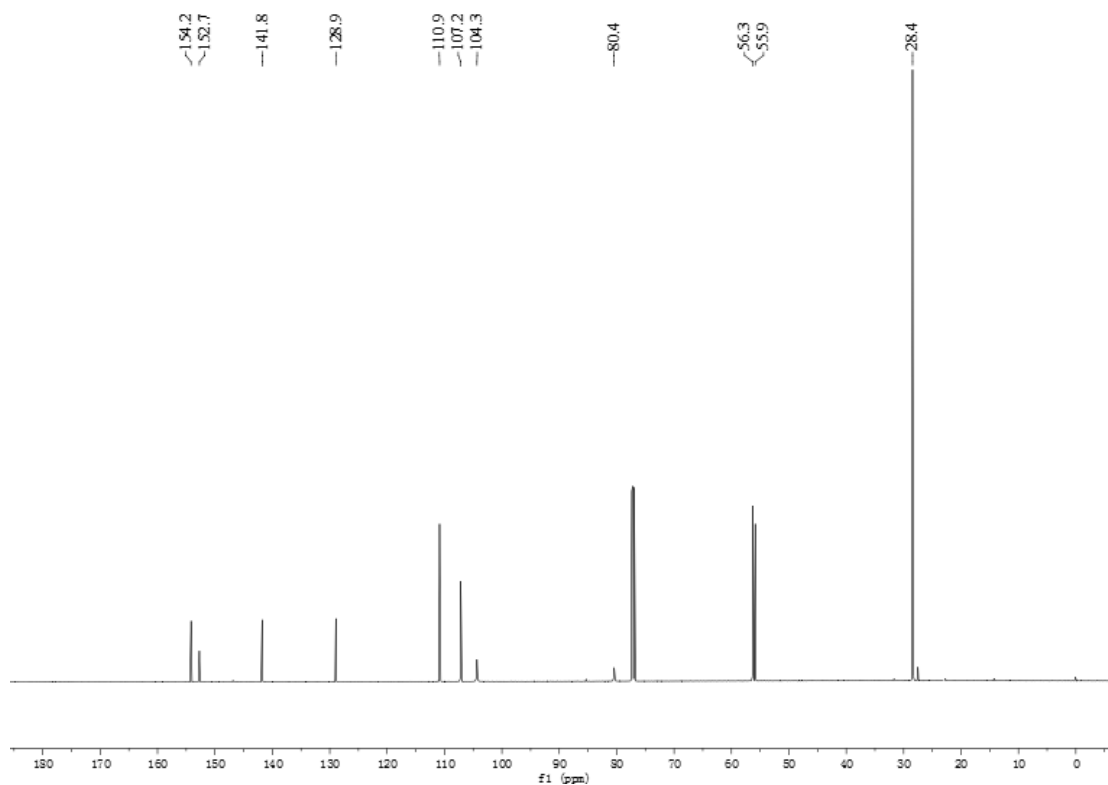
**Figure S7.** The IR spectrum of compound **1**



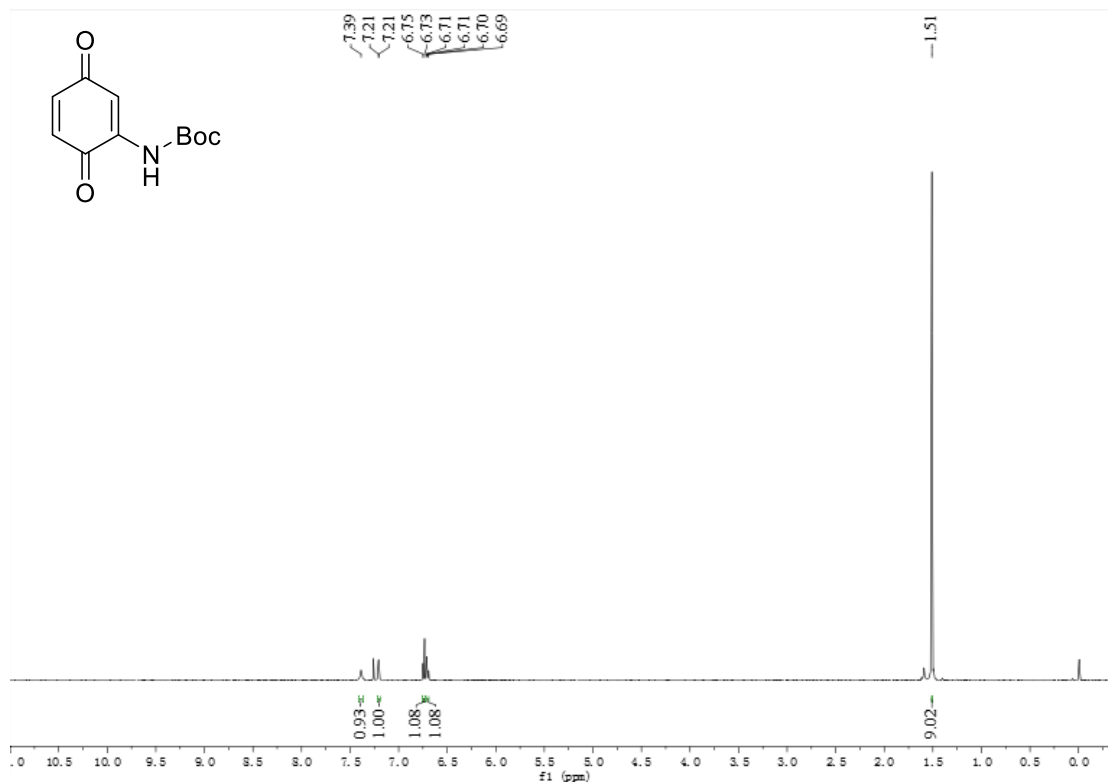
**Figure S8.** The HRESIMS of compound **1**



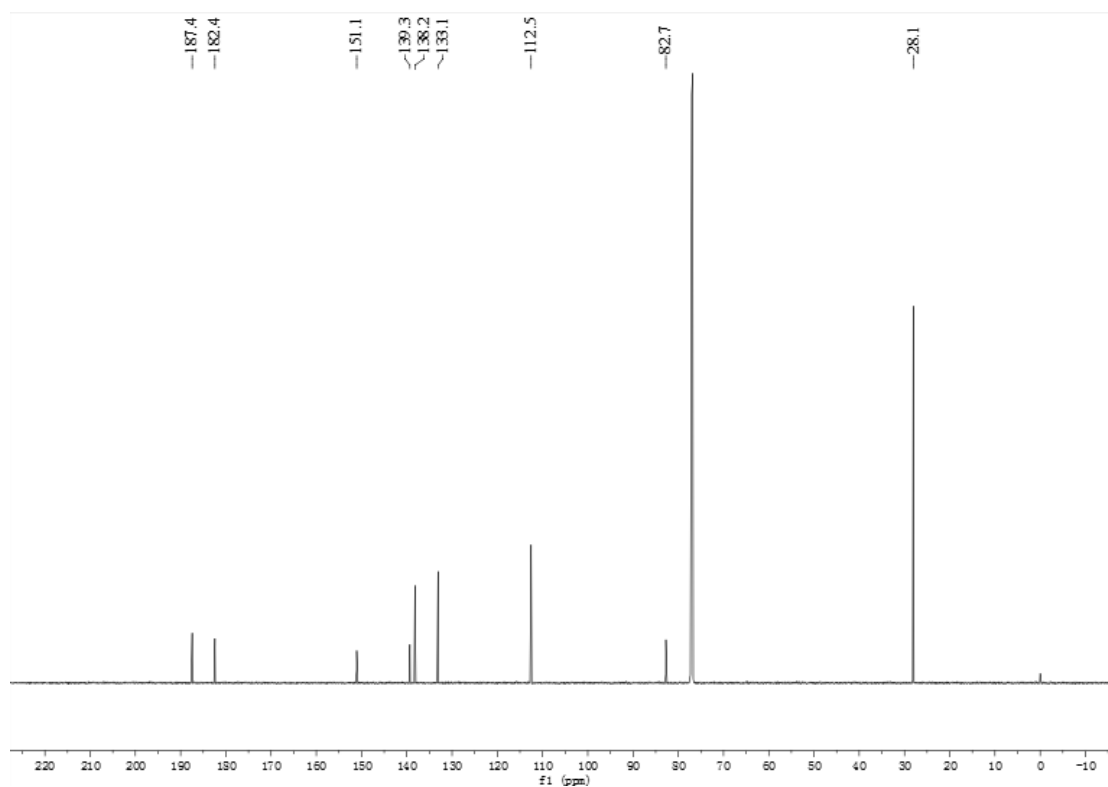
**Figure S9.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound 7



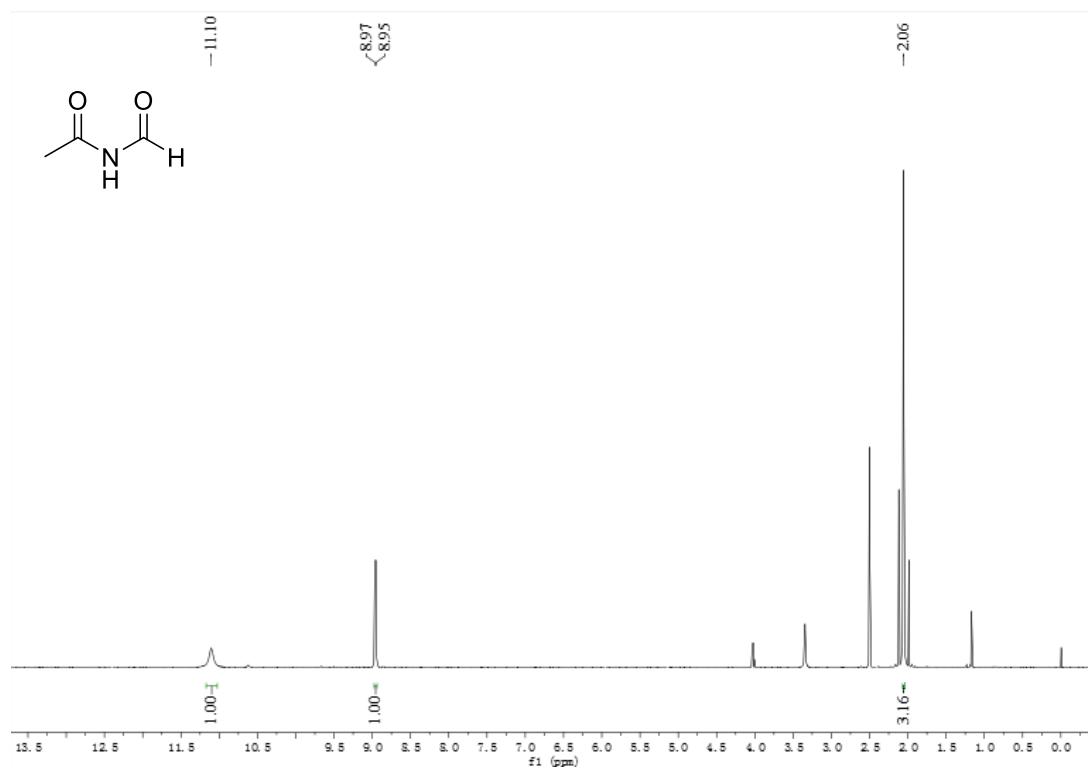
**Figure S10.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound 7



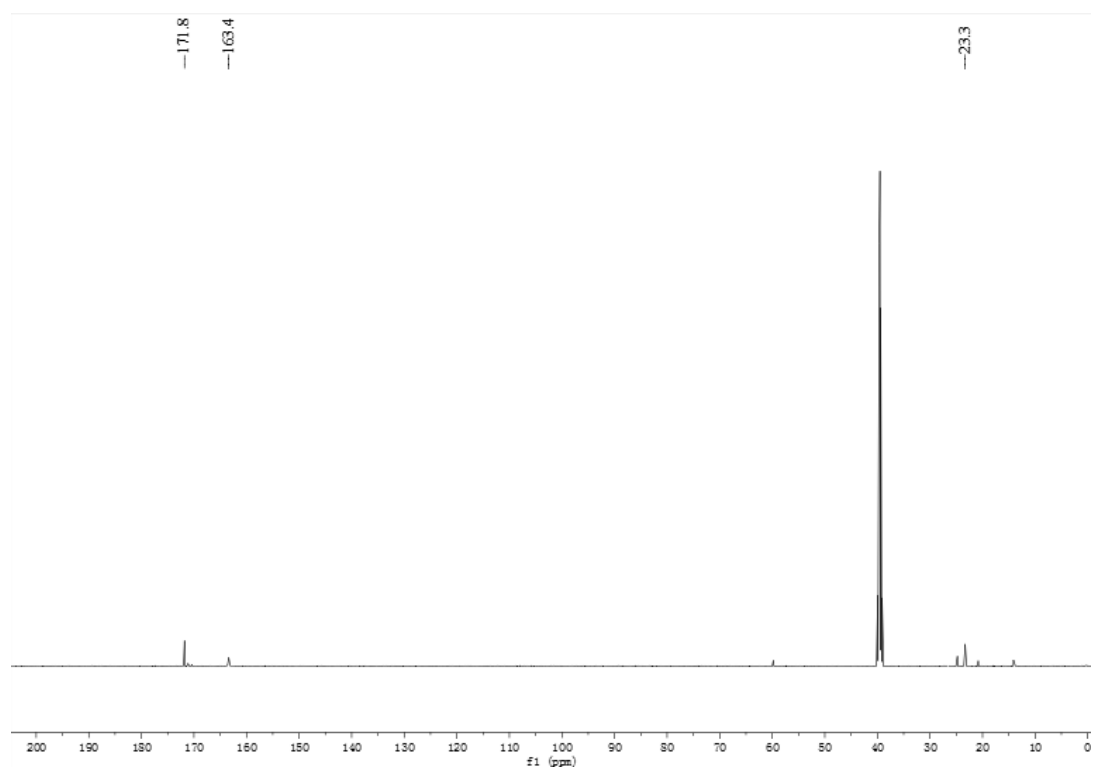
**Figure S11.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **6**



**Figure S12.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **6**

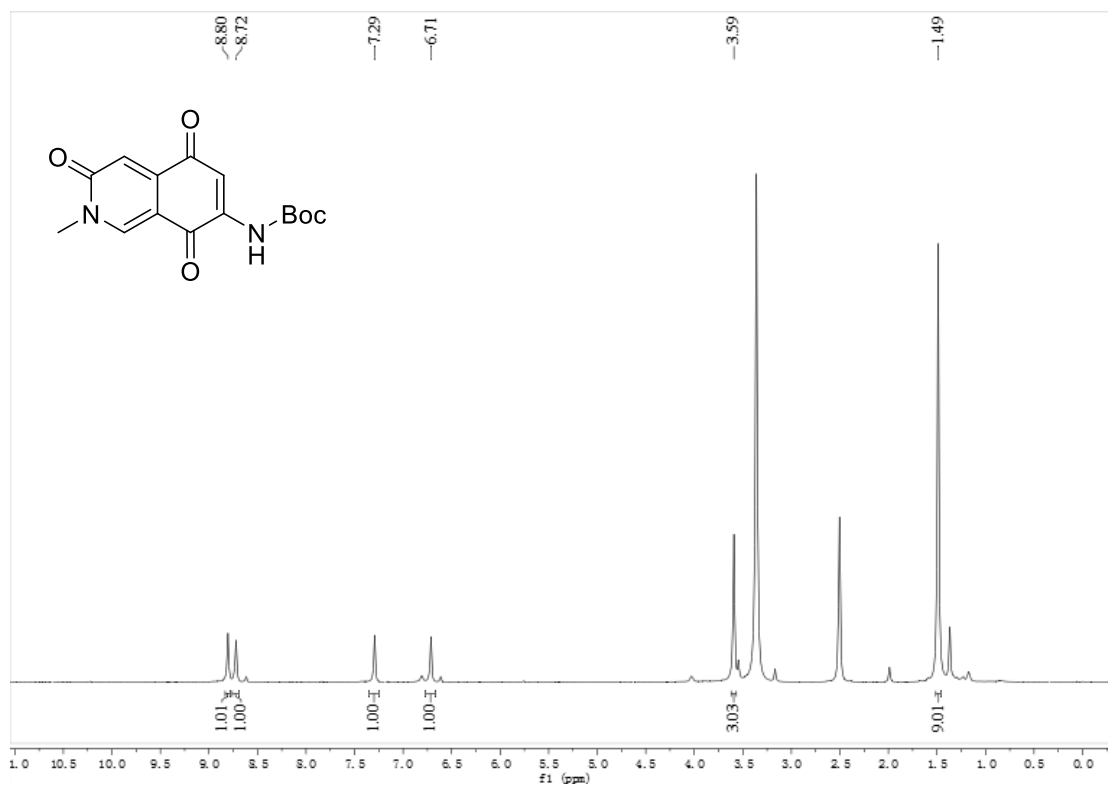


**Figure S13.** The <sup>1</sup>H-NMR (600MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **9**

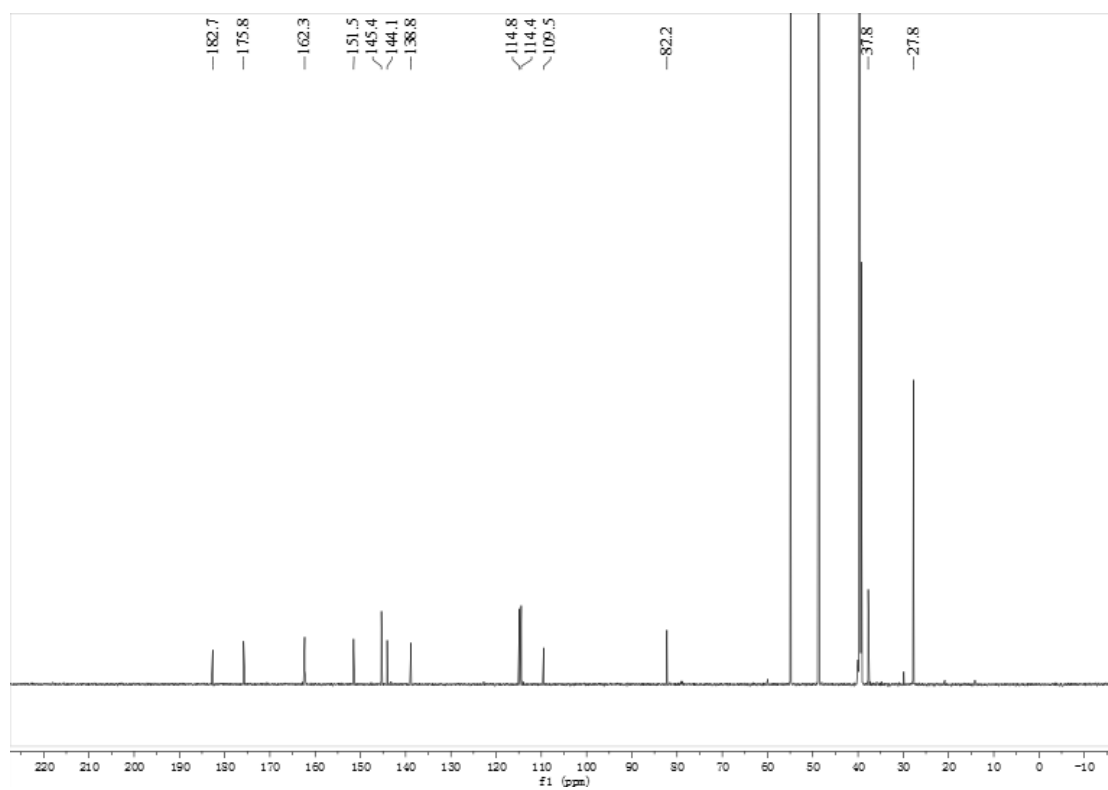


**Figure S14.** The <sup>13</sup>C-NMR (150MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **9**

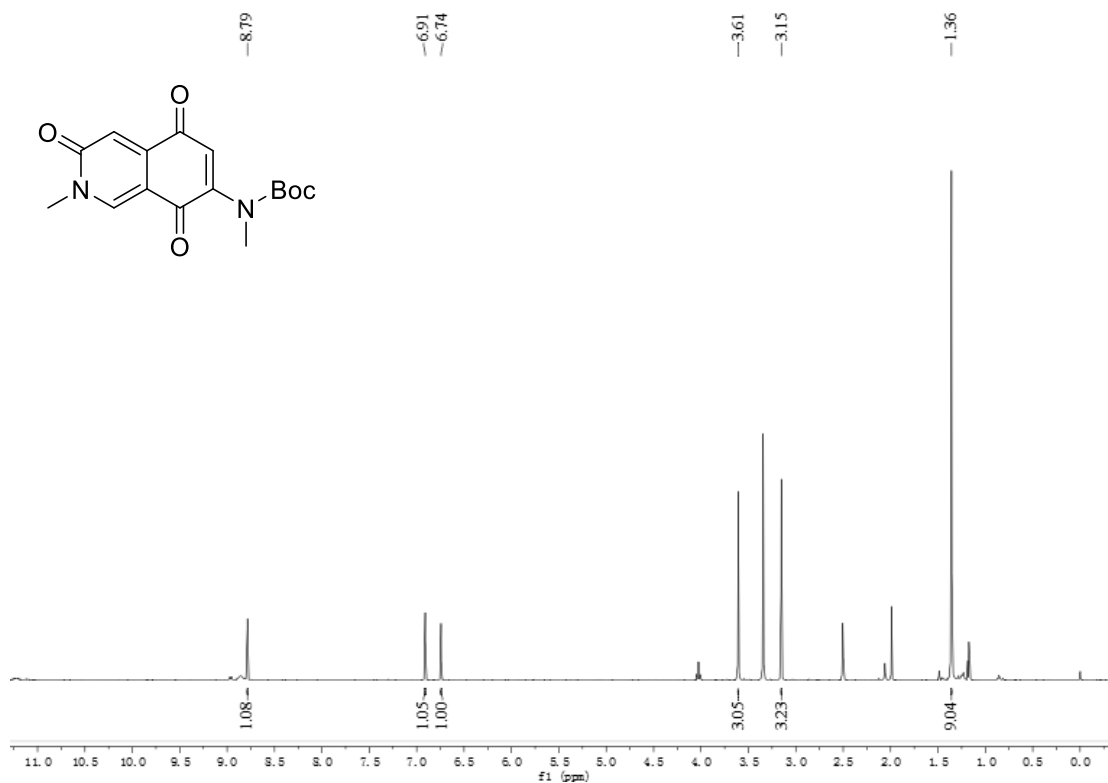




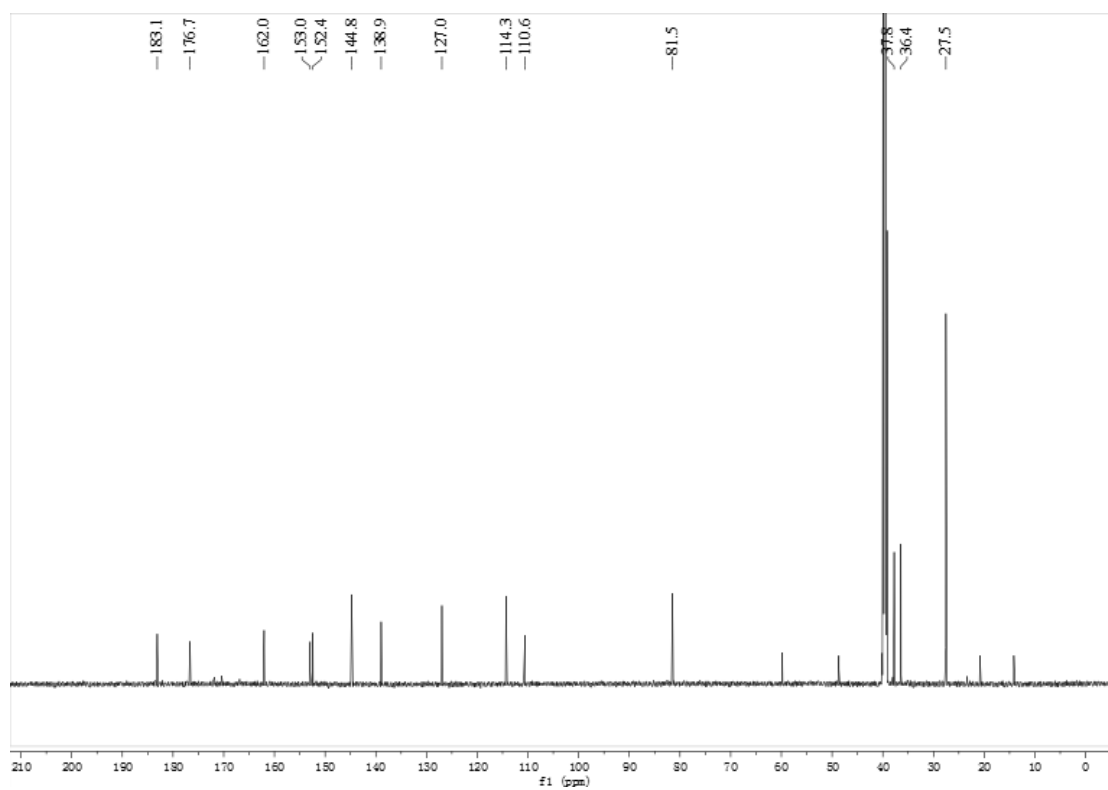
**Figure S15.** The <sup>1</sup>H-NMR (600MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **11**



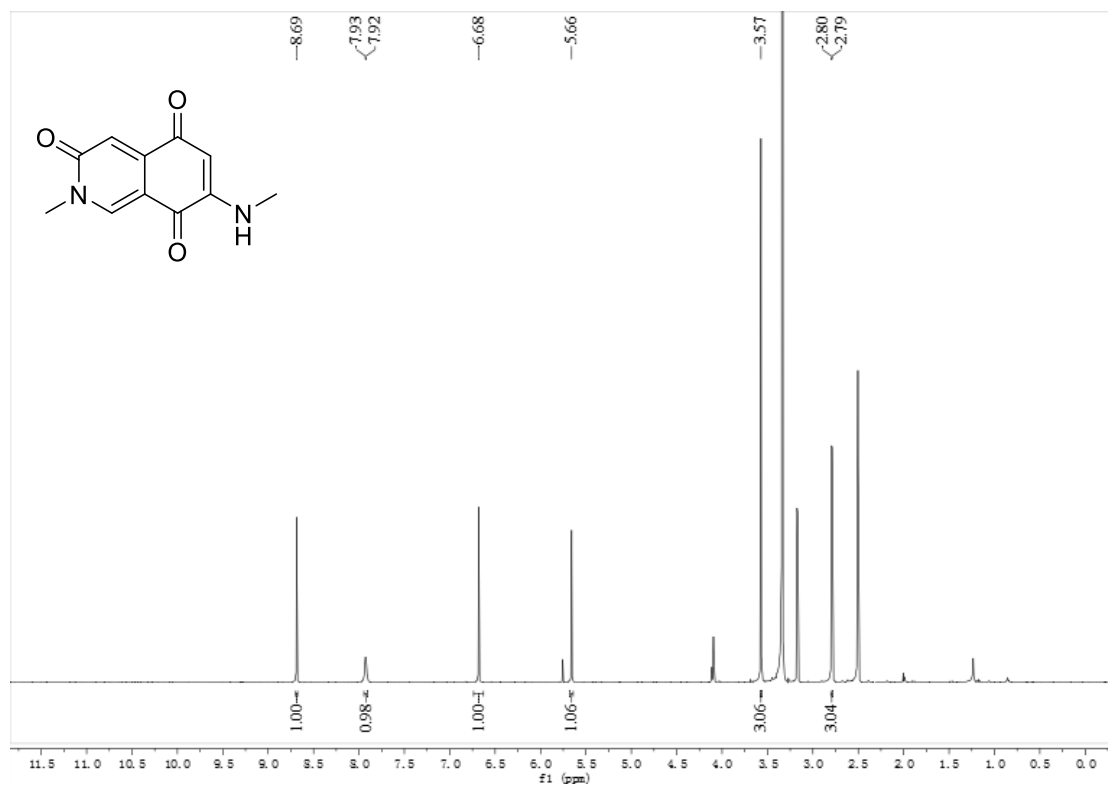
**Figure S16.** The <sup>13</sup>C-NMR (150MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **11**



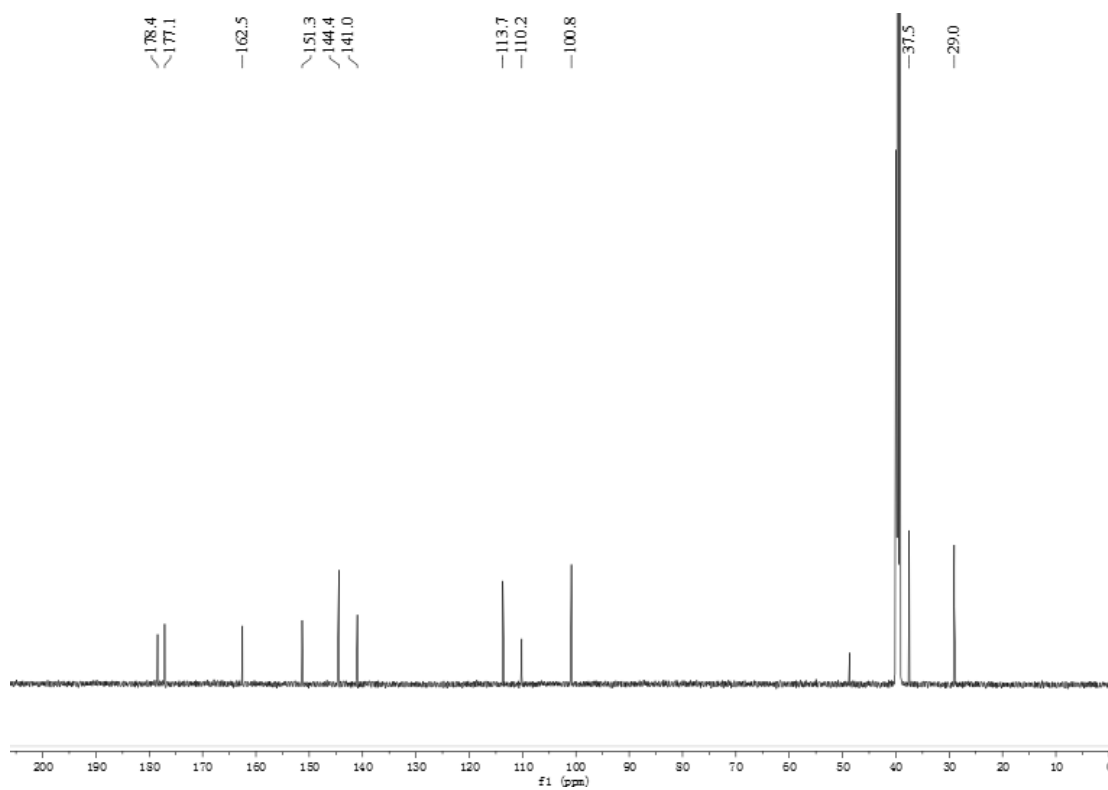
**Figure S17.** The  $^1\text{H-NMR}$  (600MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **12**



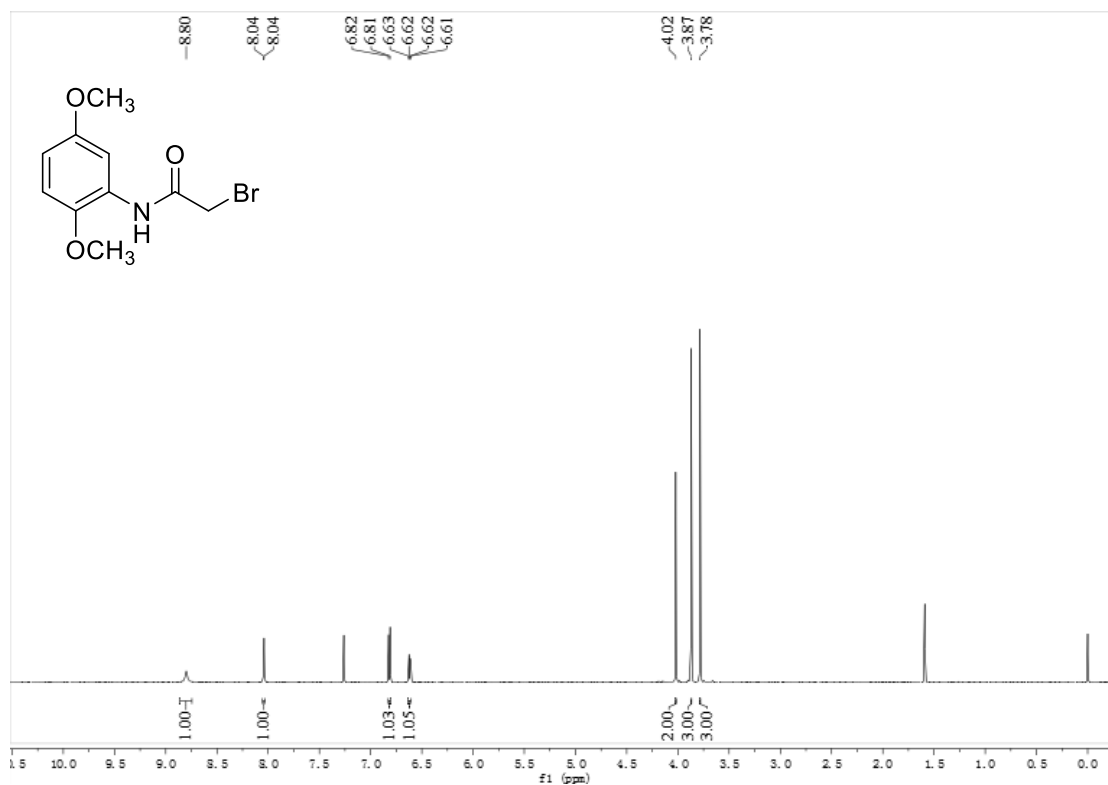
**Figure S18.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **12**



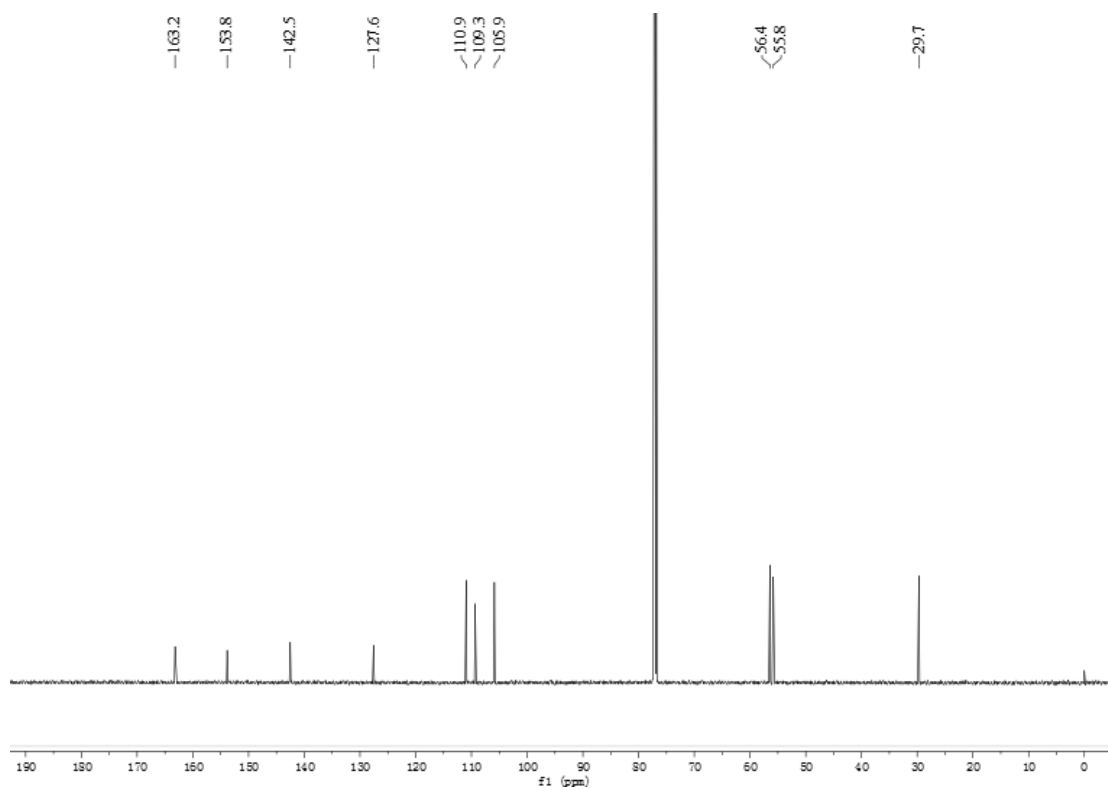
**Figure S19.** The  $^1\text{H-NMR}$  (600MHz,  $\text{DMSO-}d_6$ ) spectrum of synthesized compound **1**



**Figure S20.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{DMSO-}d_6$ ) spectrum of synthesized compound **1**



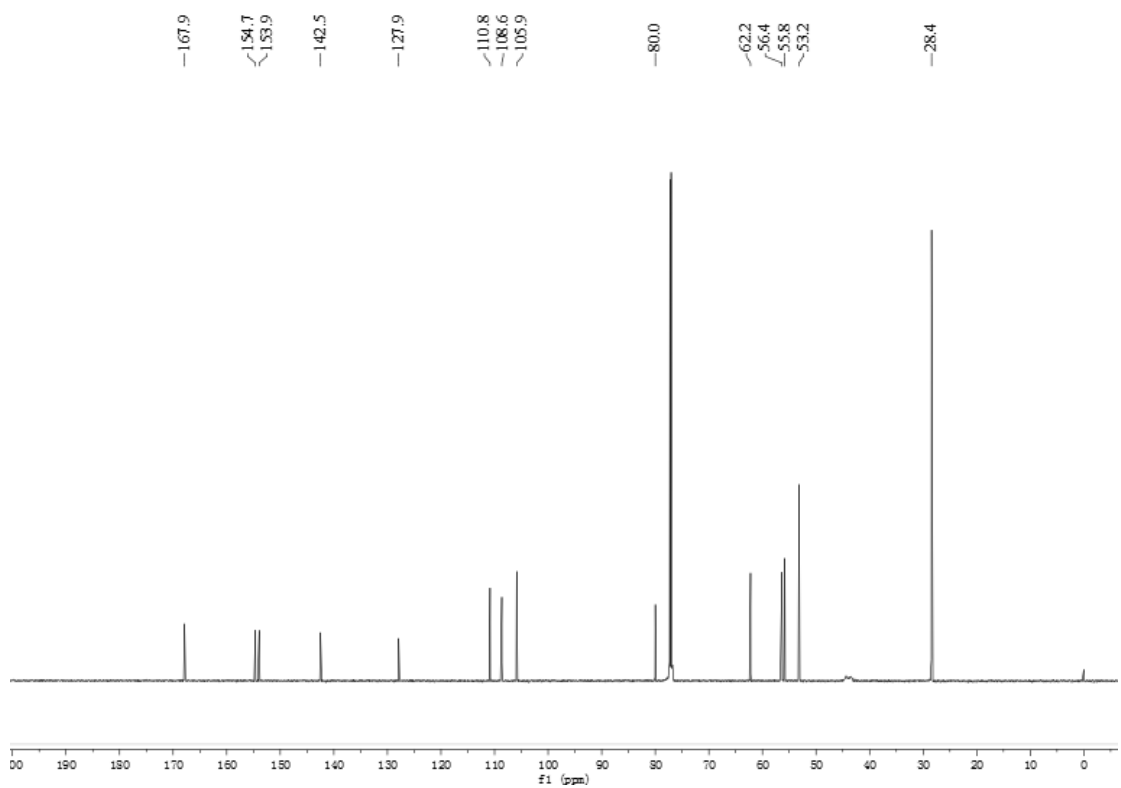
**Figure S21.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **13**



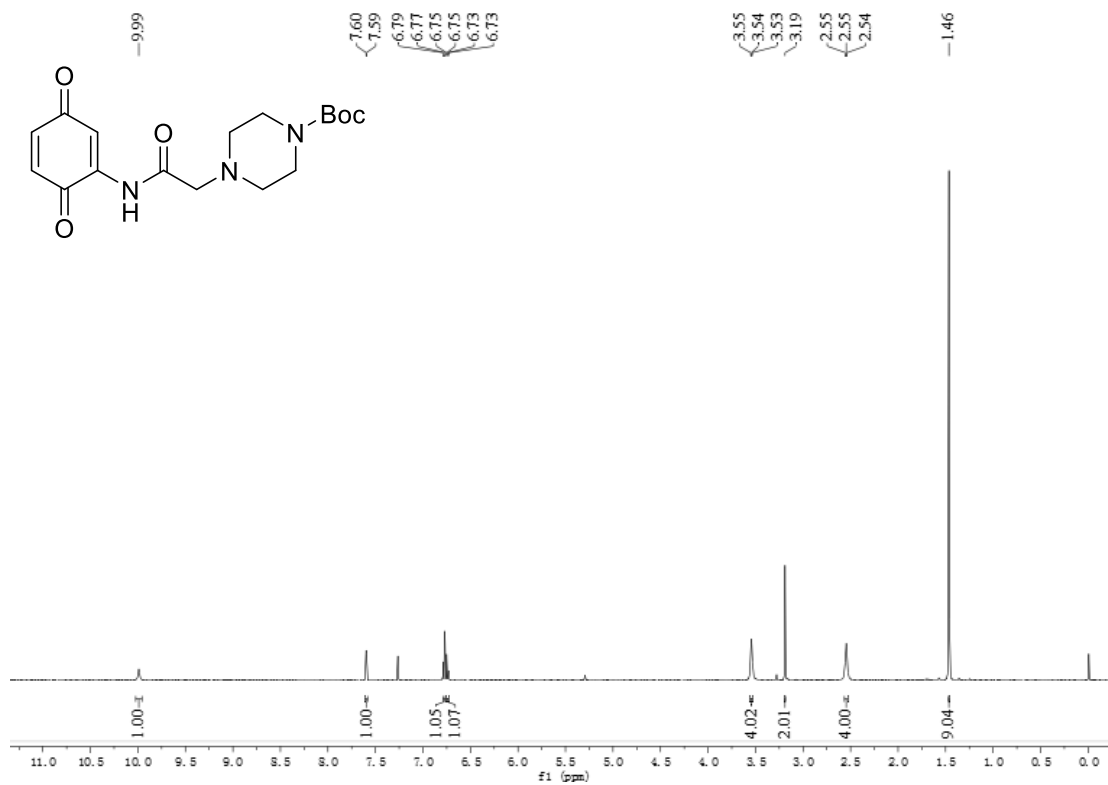
**Figure S22.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **13**



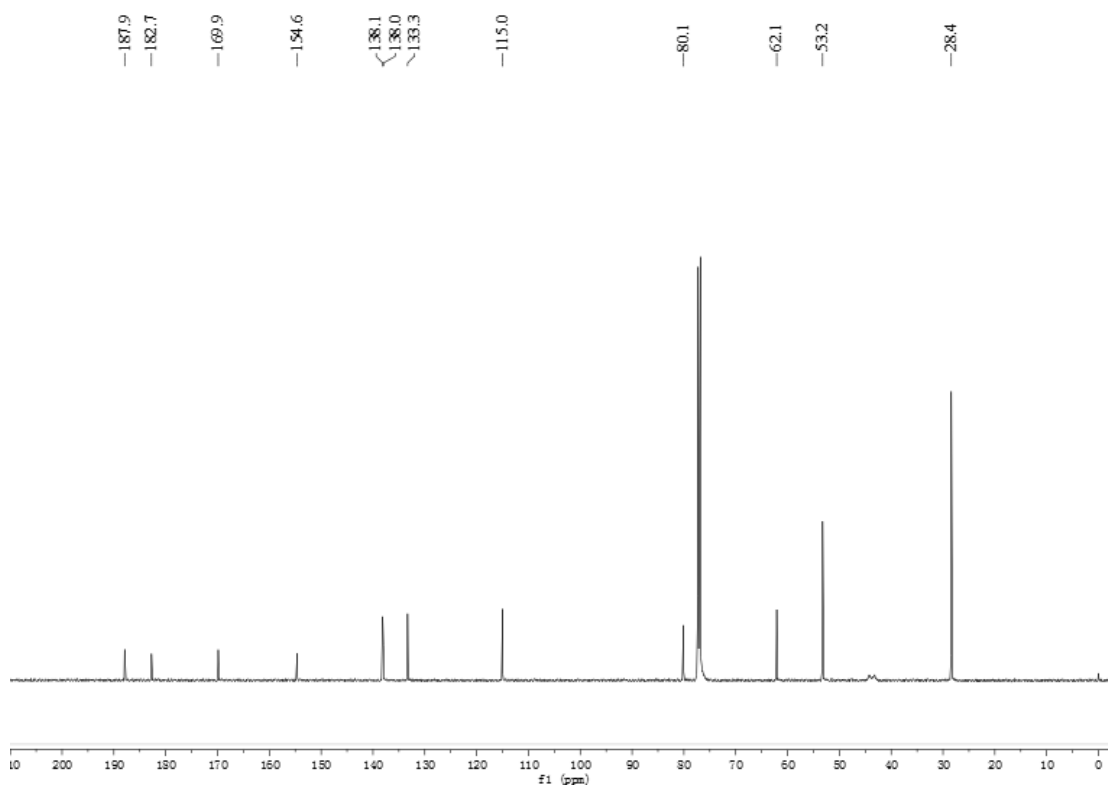
**Figure S23.** The  $^1\text{H-NMR}$  (600MHz,  $\text{CDCl}_3$ ) spectrum of compound 14



**Figure S24.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{CDCl}_3$ ) spectrum of compound 14



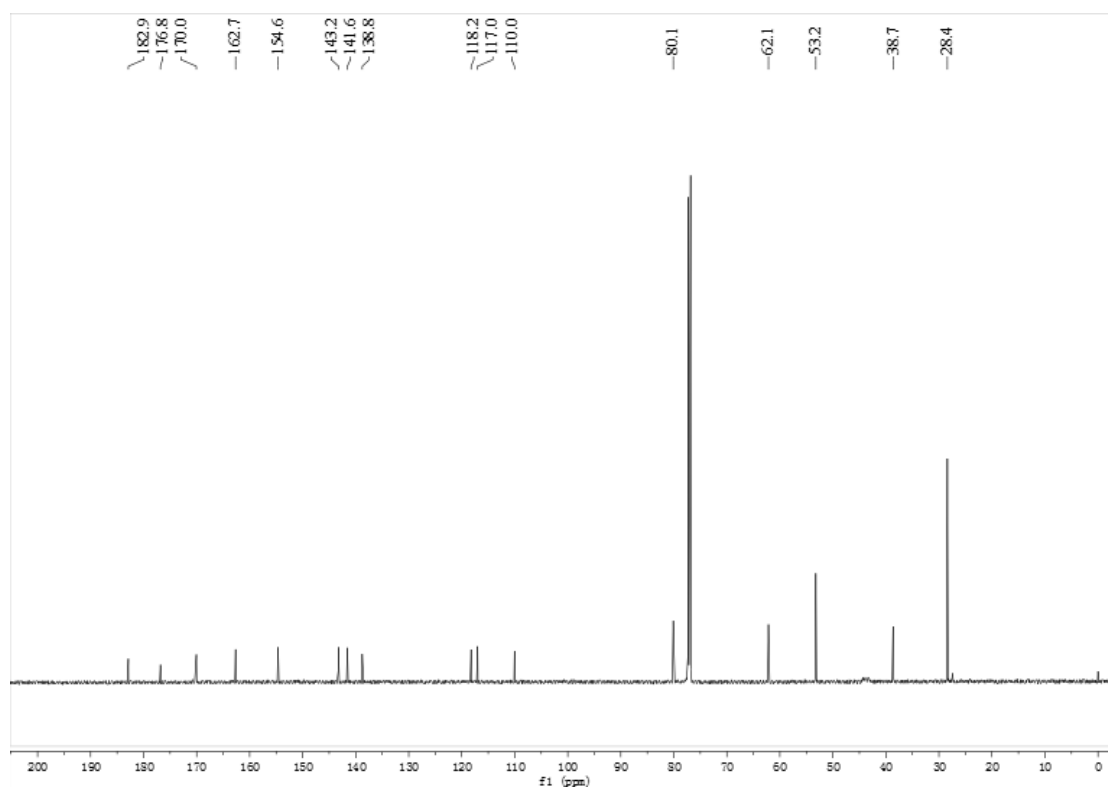
**Figure S25.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **15**



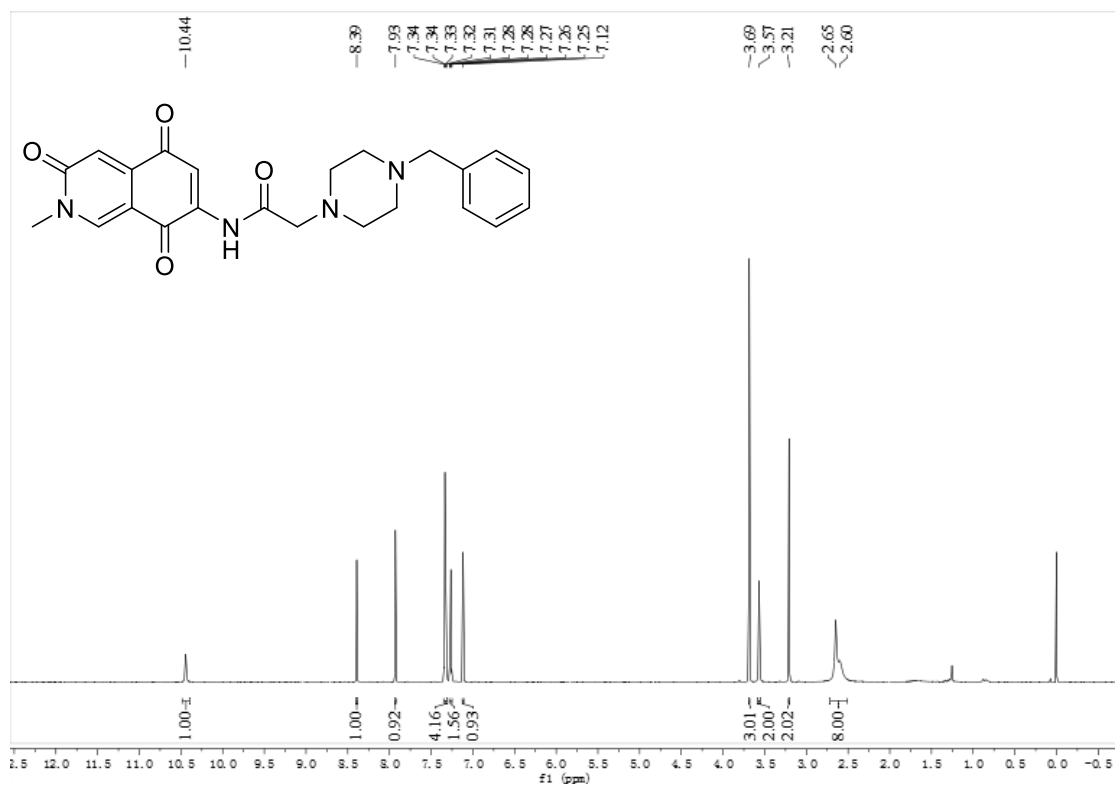
**Figure S26.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **15**



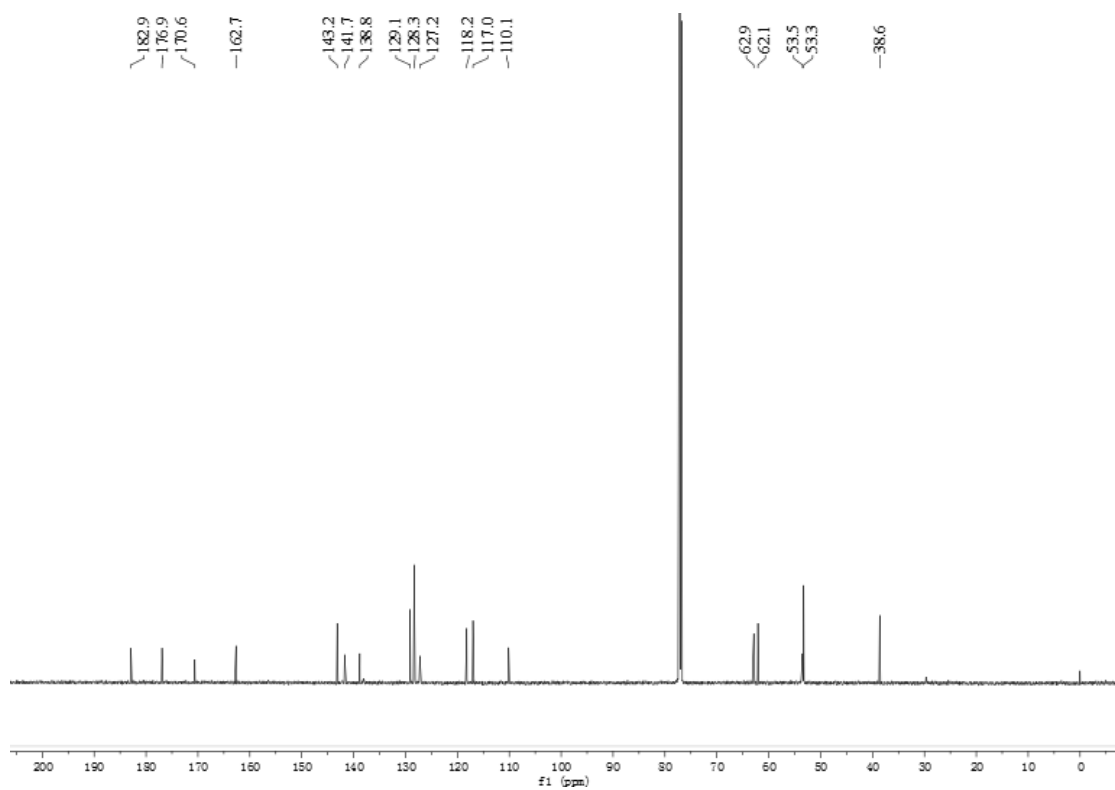
**Figure S27.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **16**



**Figure S28.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **16**



**Figure S29.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **1a**



**Figure S30.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **1a**



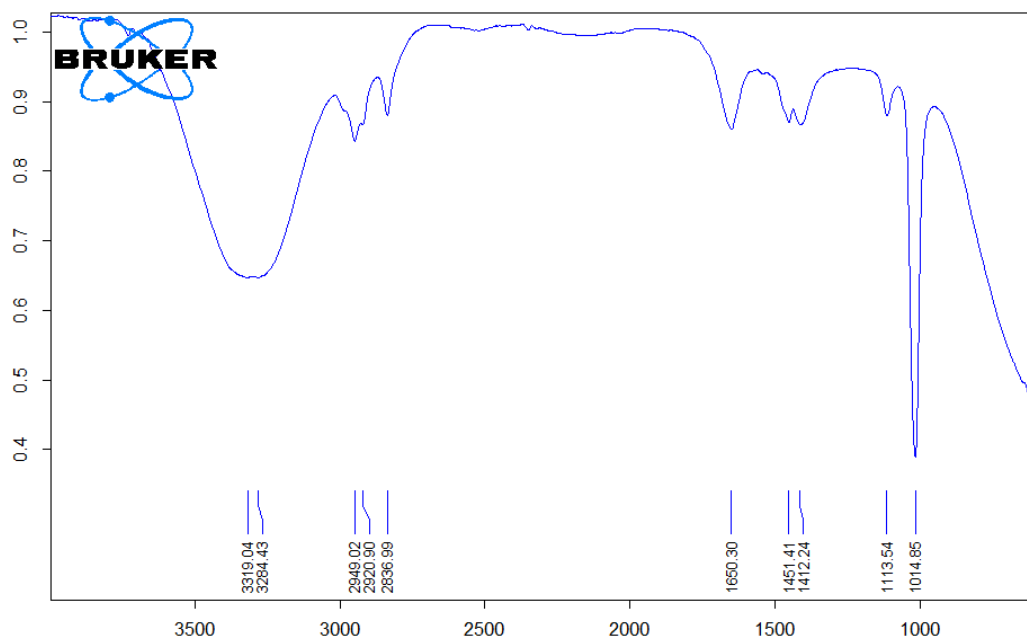


Figure S31. The IR spectrum of compound 1a

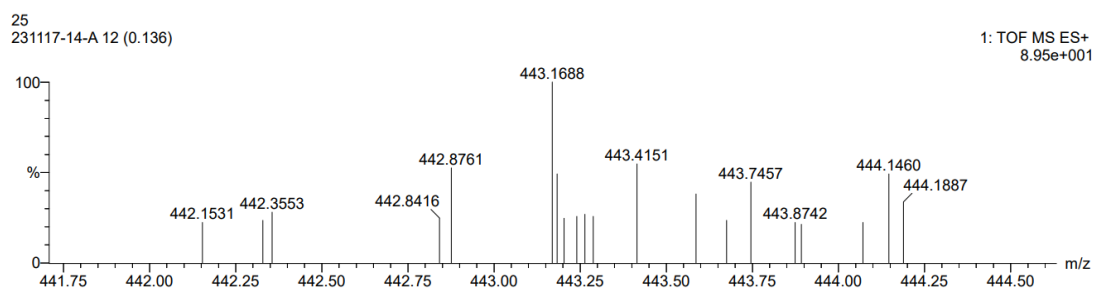
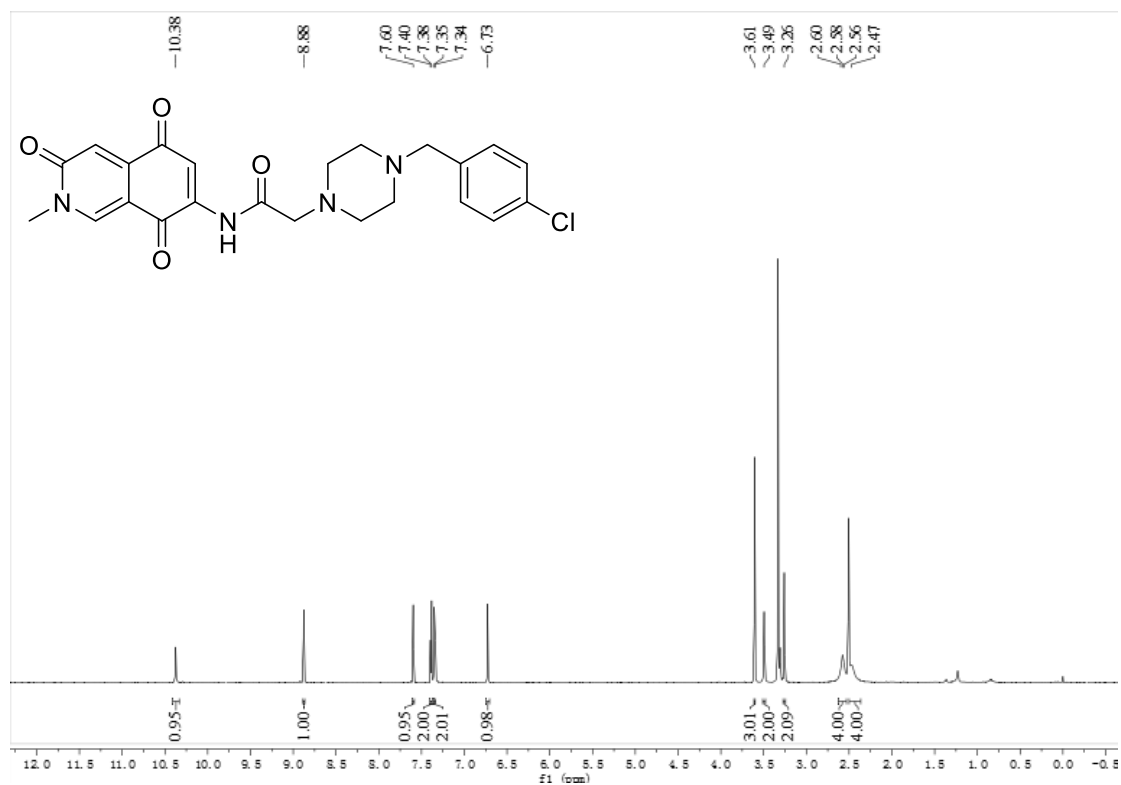
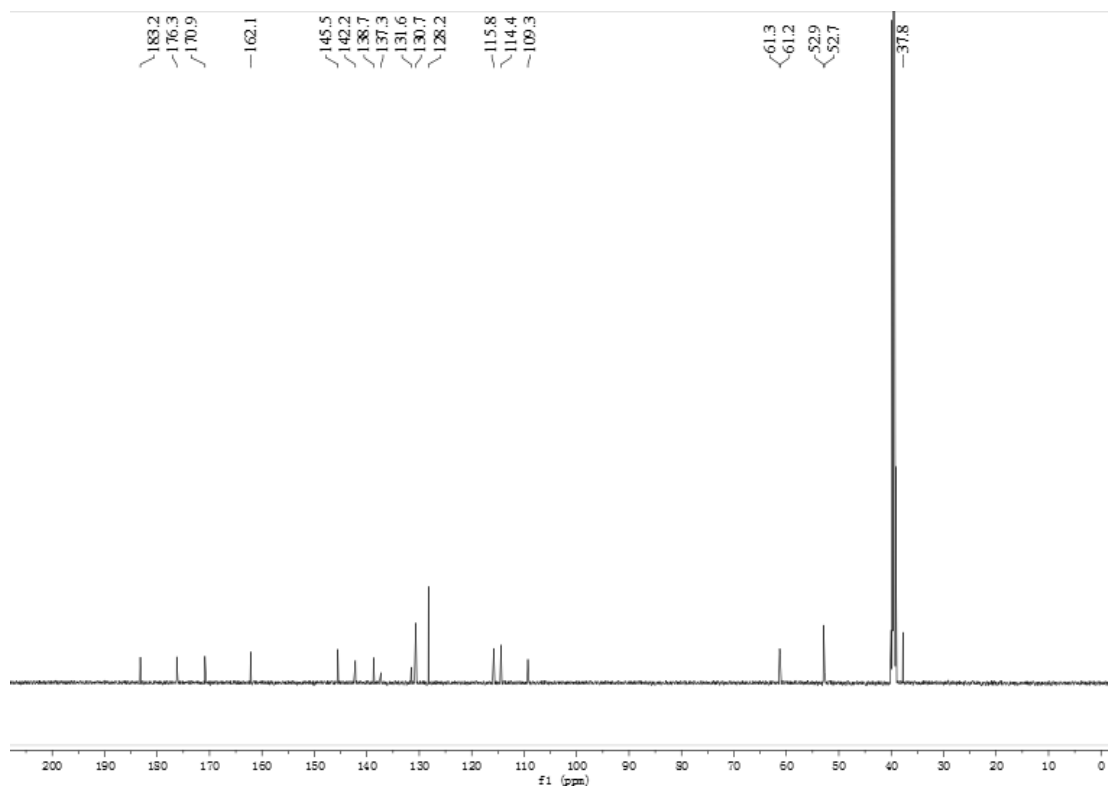


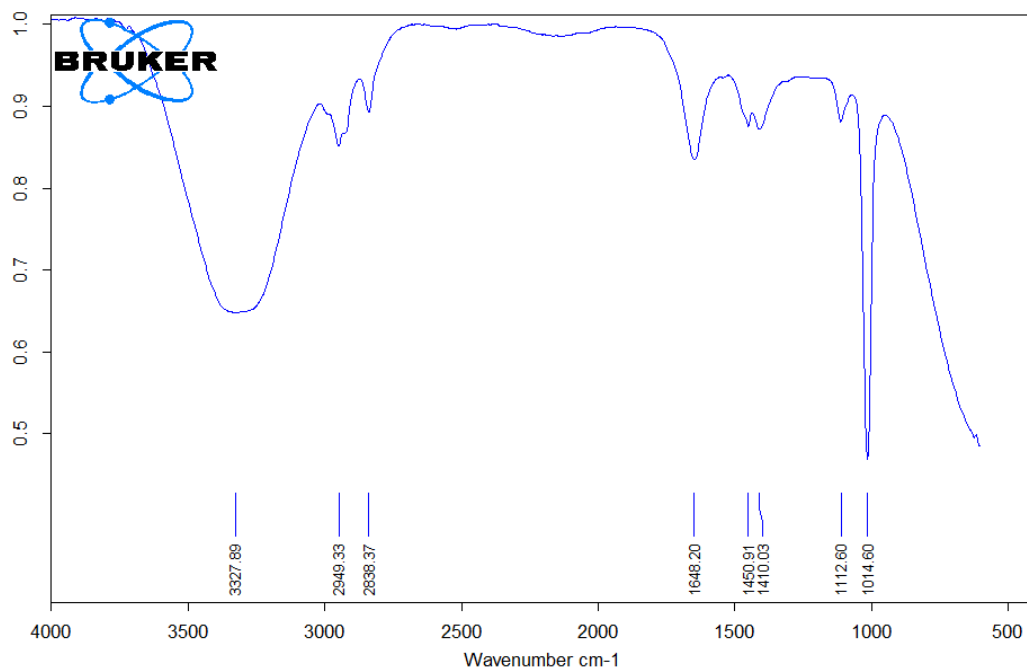
Figure S32. The HRMS of compound 1a



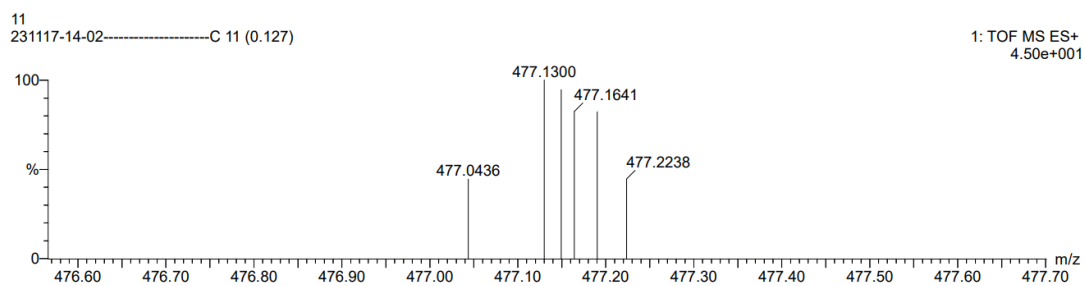
**Figure S33.** The <sup>1</sup>H-NMR (600MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1b**



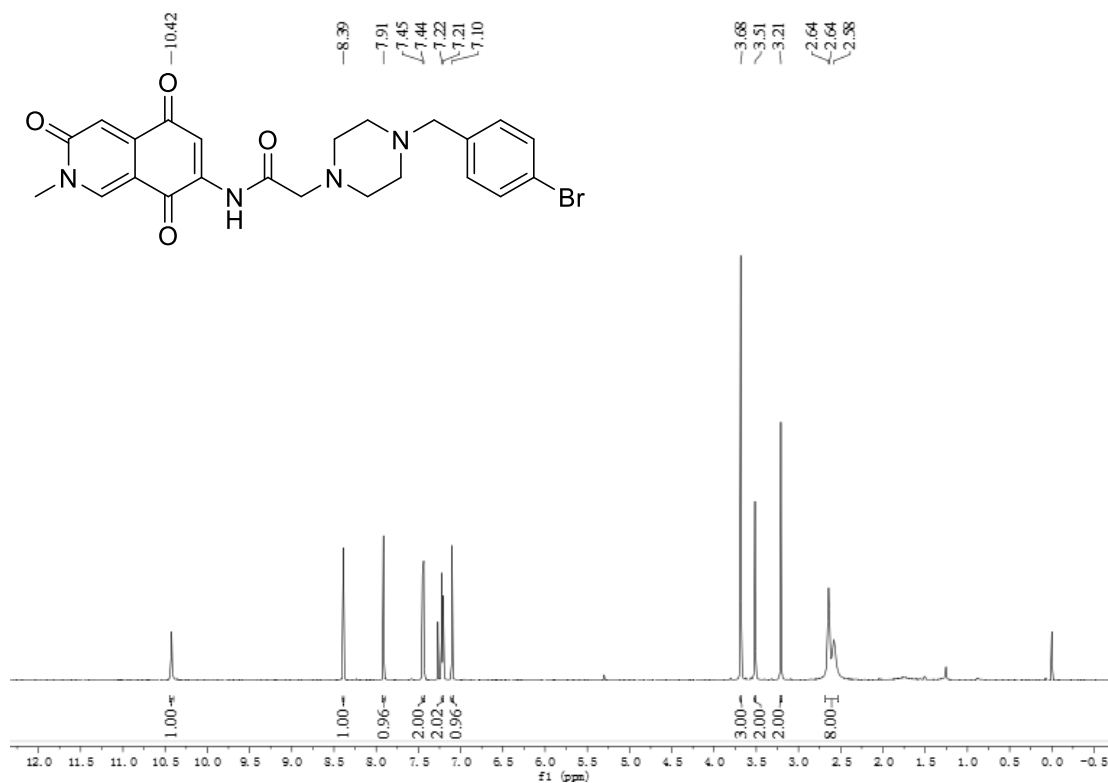
**Figure S34.** The <sup>13</sup>C-NMR (150MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1b**



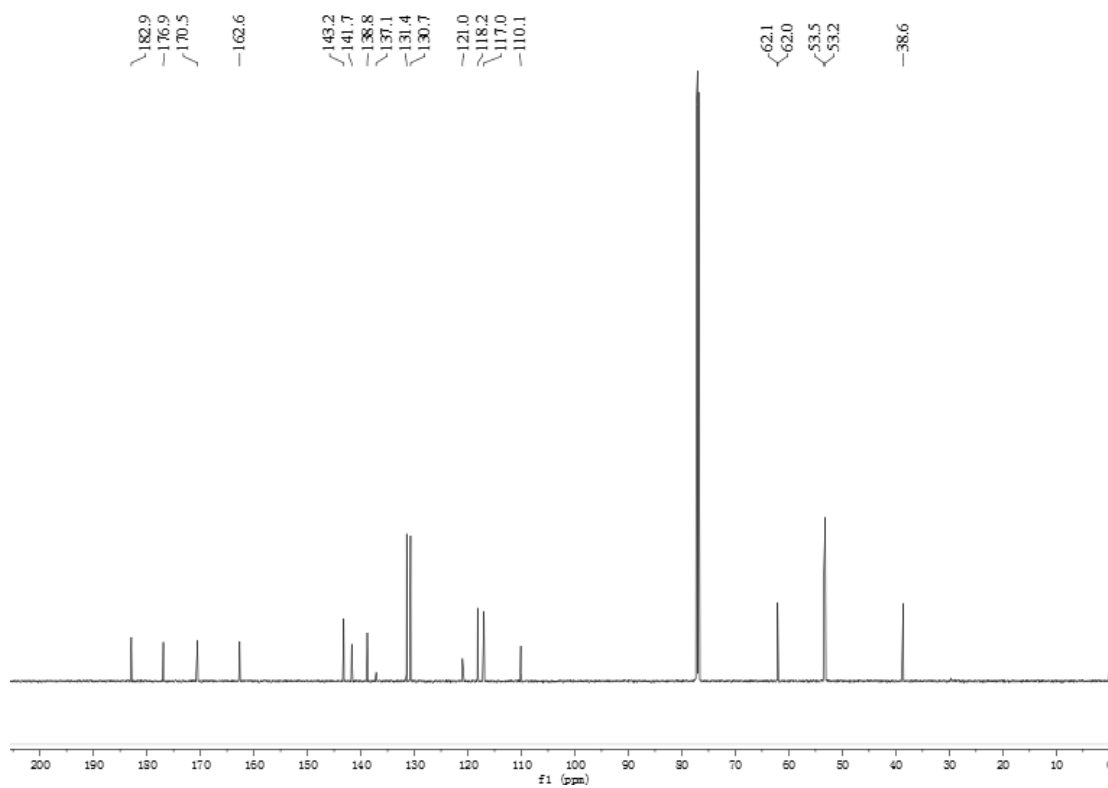
**Figure S35.** The IR spectrum of compound **1b**



**Figure S36.** The HRESIMS of compound **1b**



**Figure S37.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **1c**



**Figure S38.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **1c**

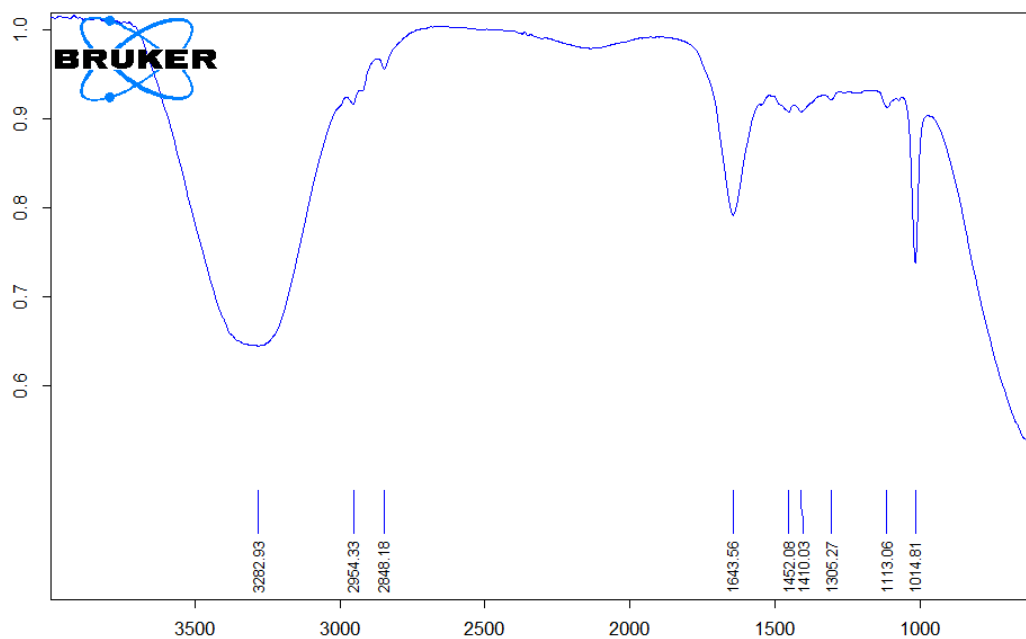


Figure S39. The IR spectrum of compound 1c

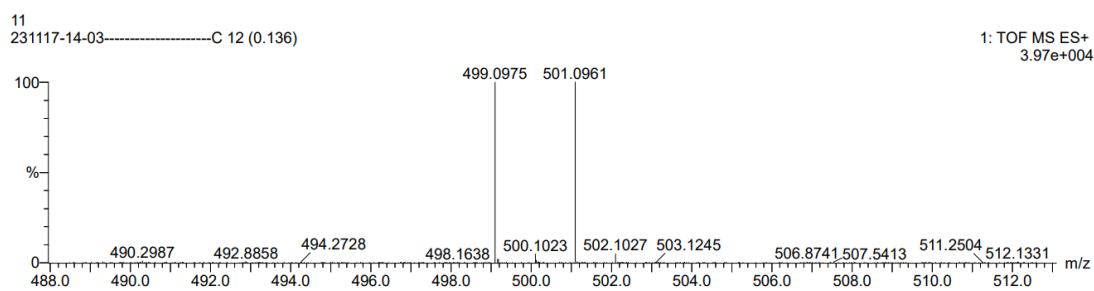
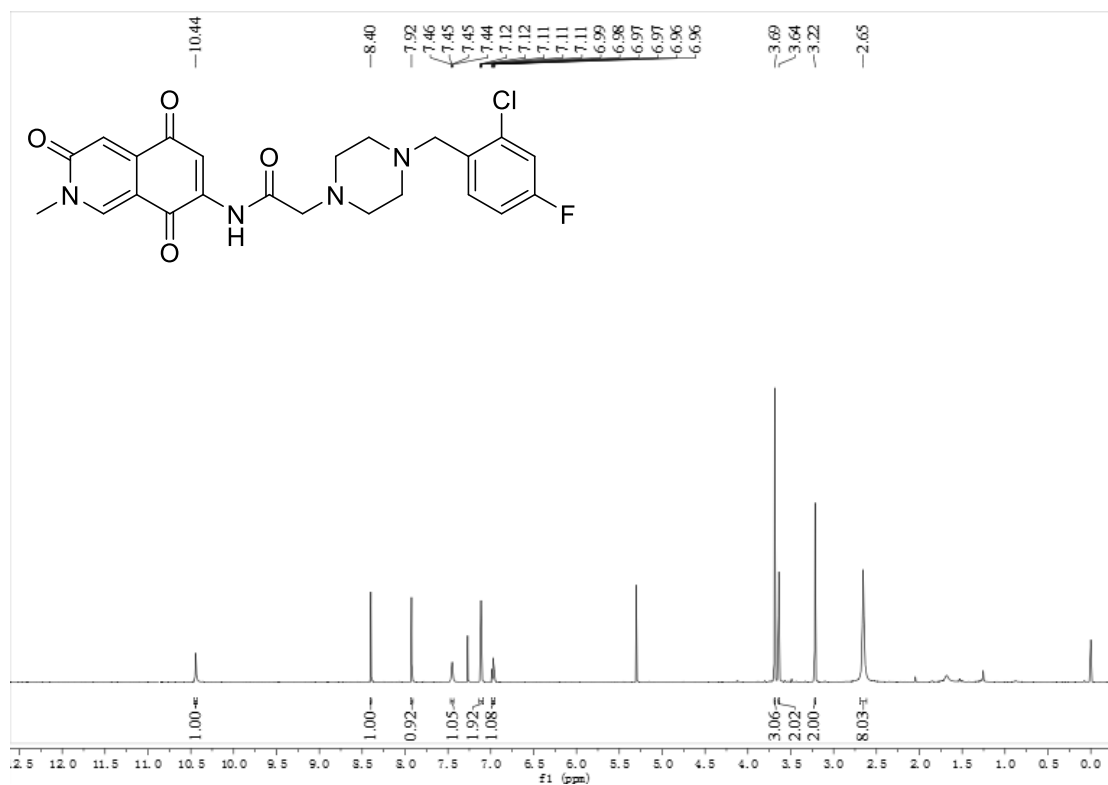
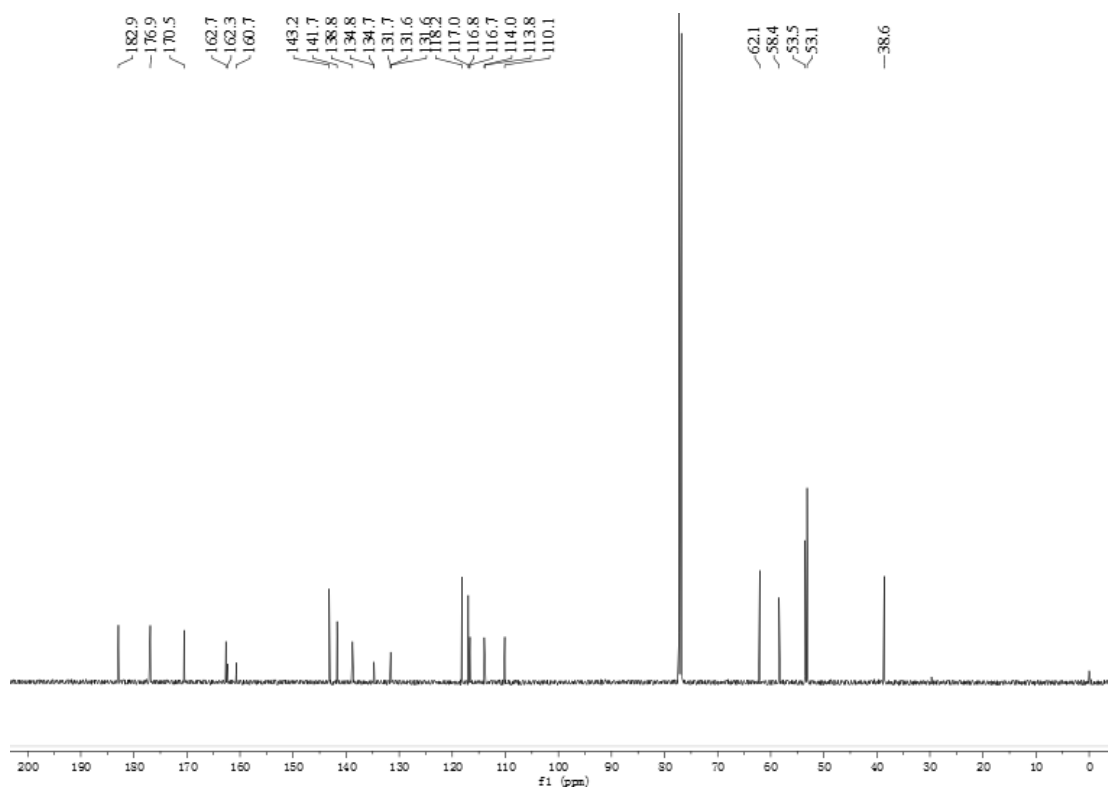


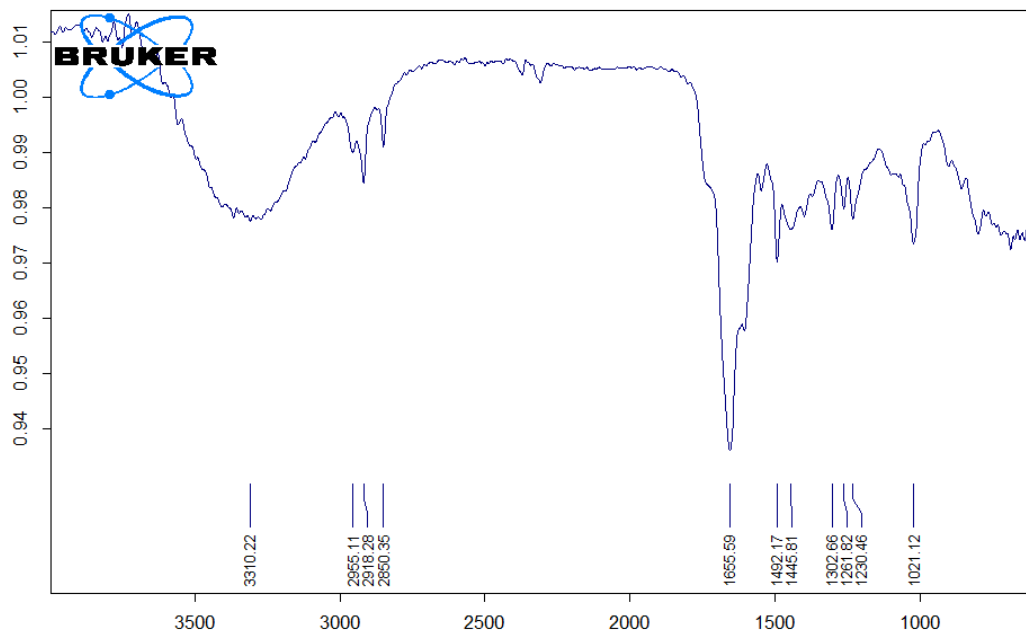
Figure S40. The HRESIMS of compound 1c



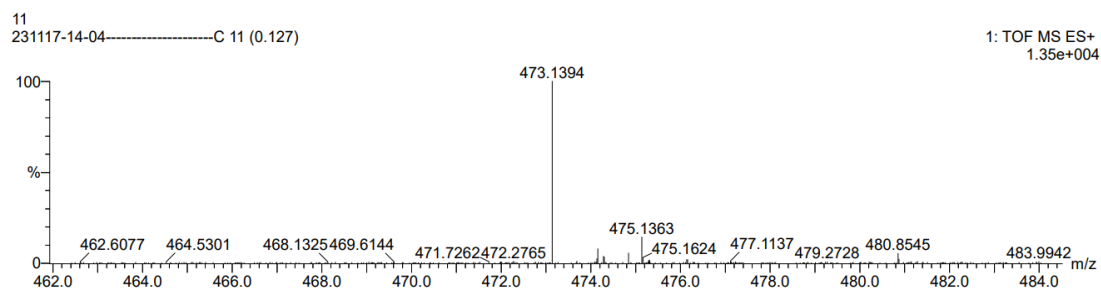
**Figure S41.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **1d**



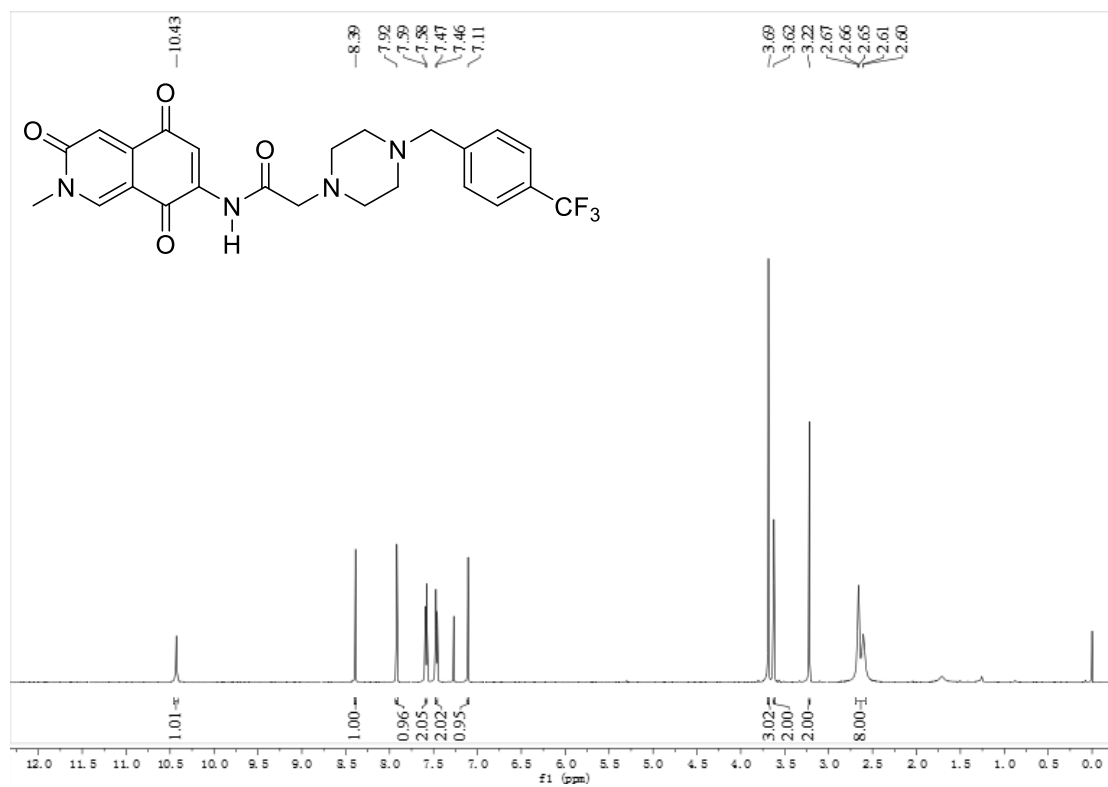
**Figure S42.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **1d**



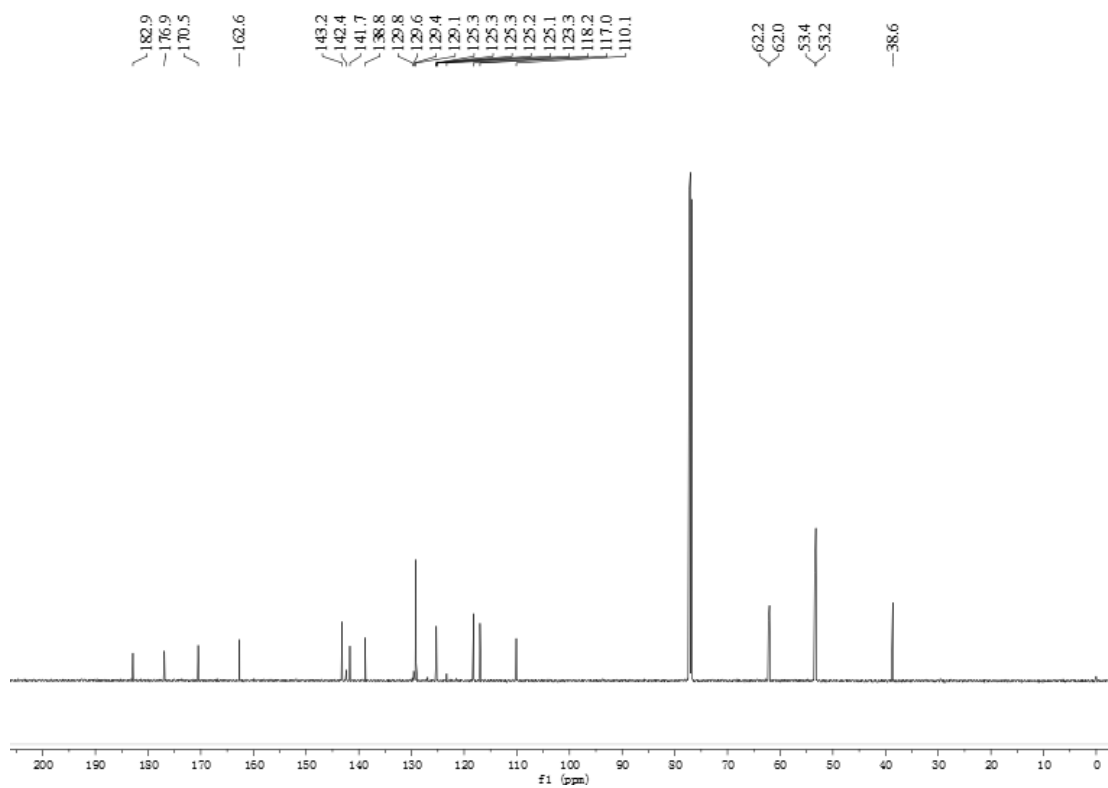
**Figure S43.** The IR spectrum of compound **1d**



**Figure S44.** The HRESIMS of compound **1d**

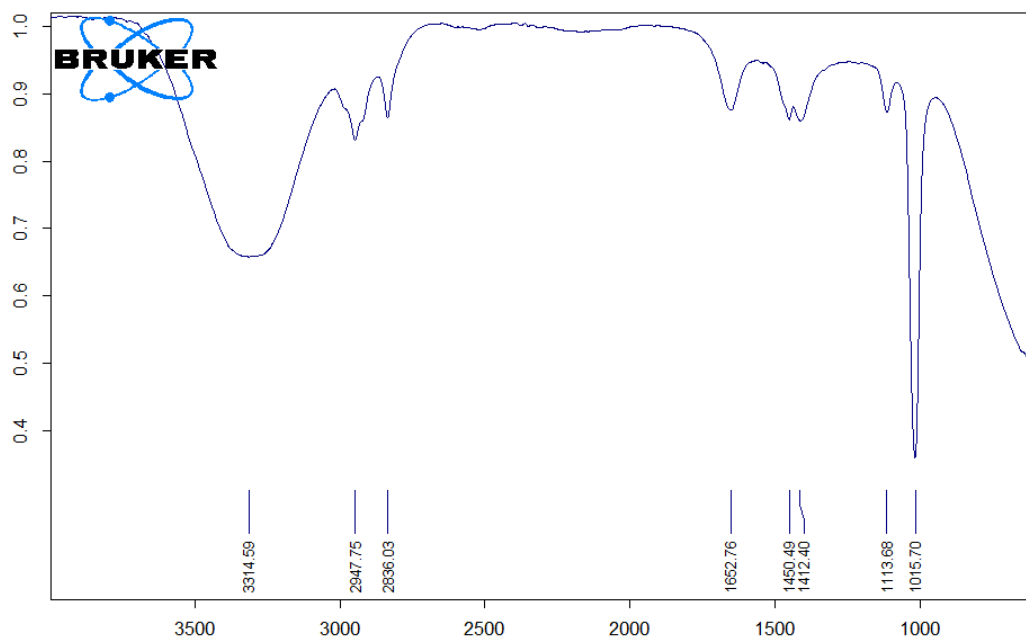


**Figure S45.** The  $^1\text{H-NMR}$  (600MHz,  $\text{CDCl}_3$ ) spectrum of compound **1e**

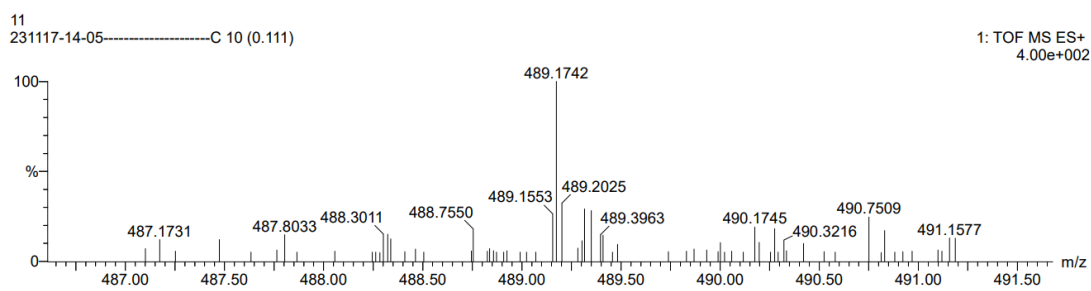


**Figure S46.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{CDCl}_3$ ) spectrum of compound **1e**

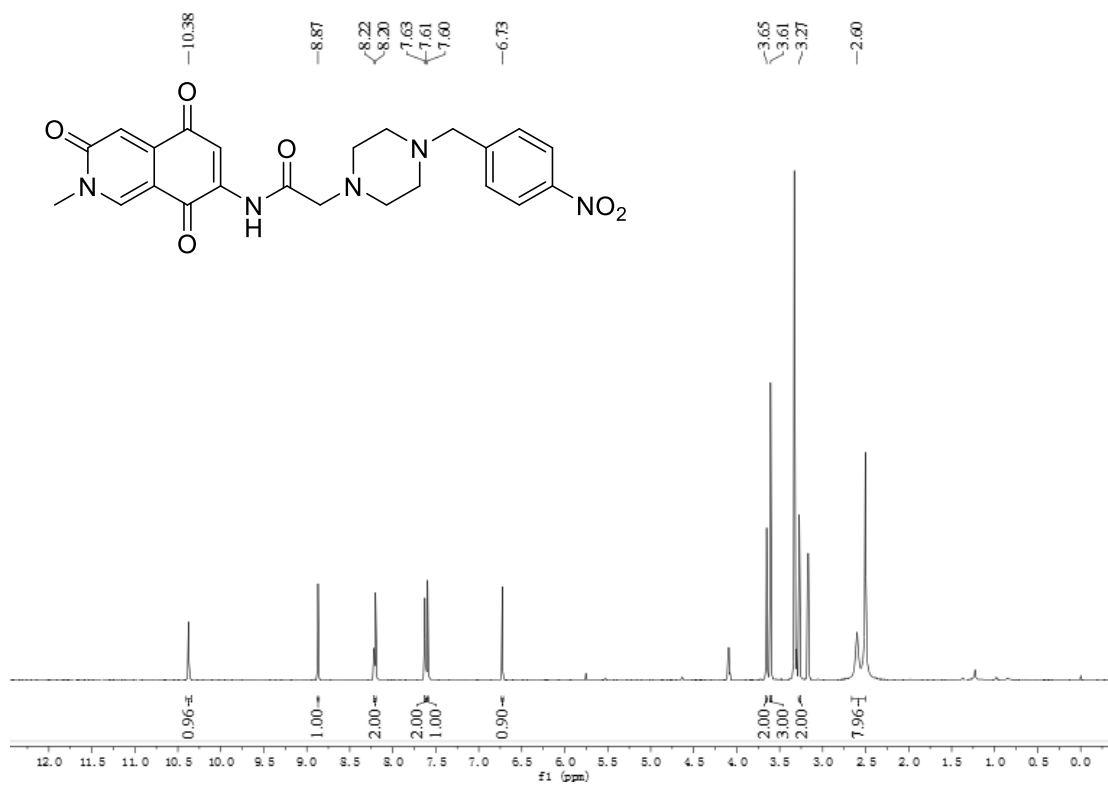




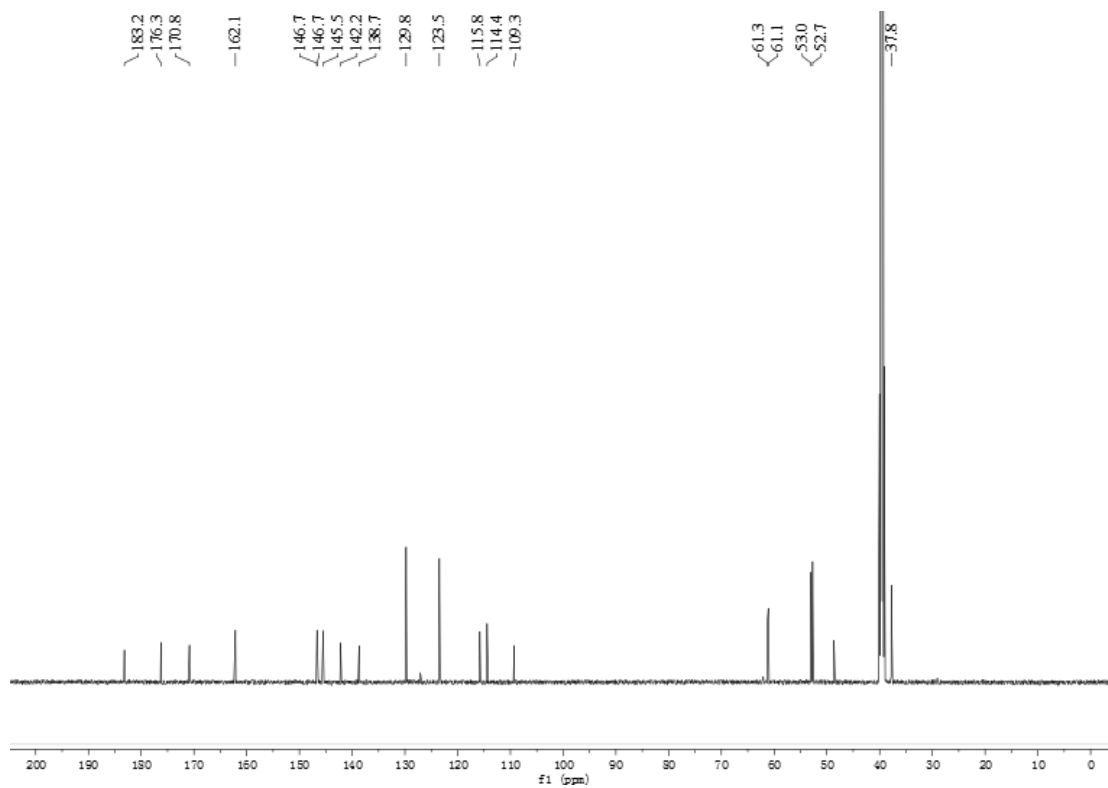
**Figure S47.** The IR spectrum of compound **1e**



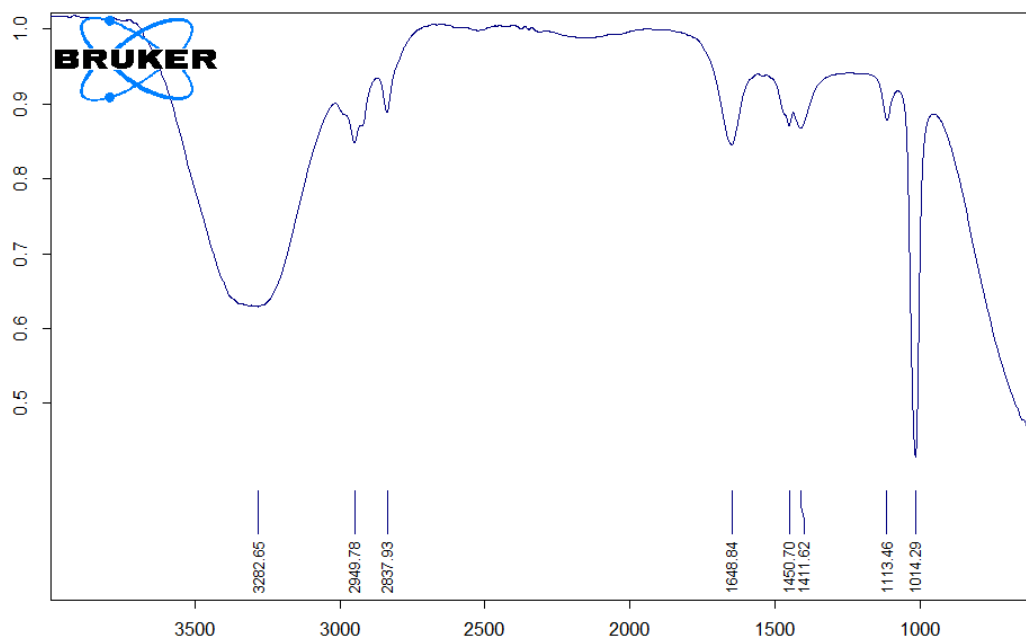
**Figure S48.** The HRMS of compound **1e**



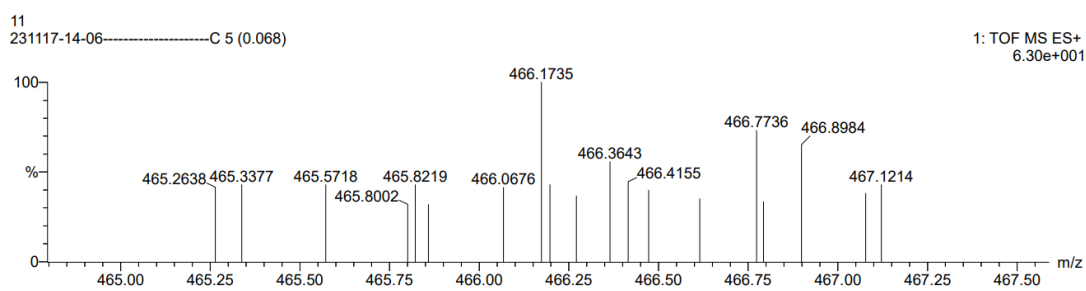
**Figure S49.** The  $^1\text{H-NMR}$  (600MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1f**



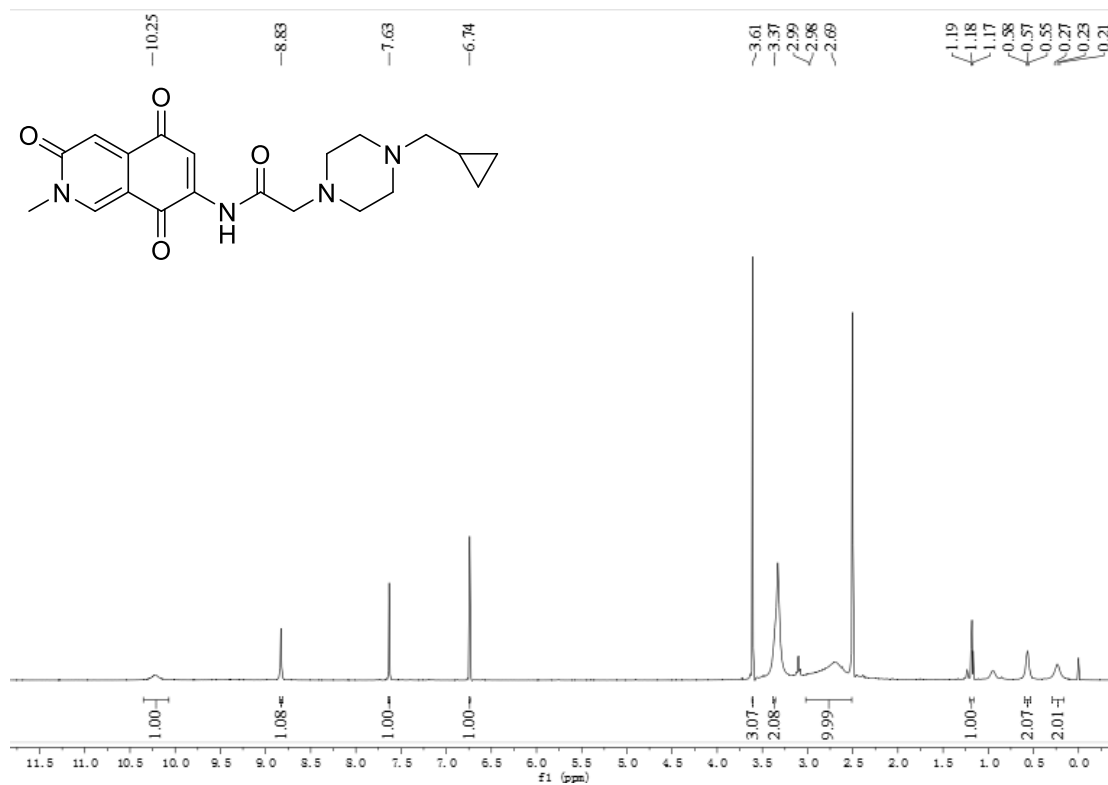
**Figure S50.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1f**



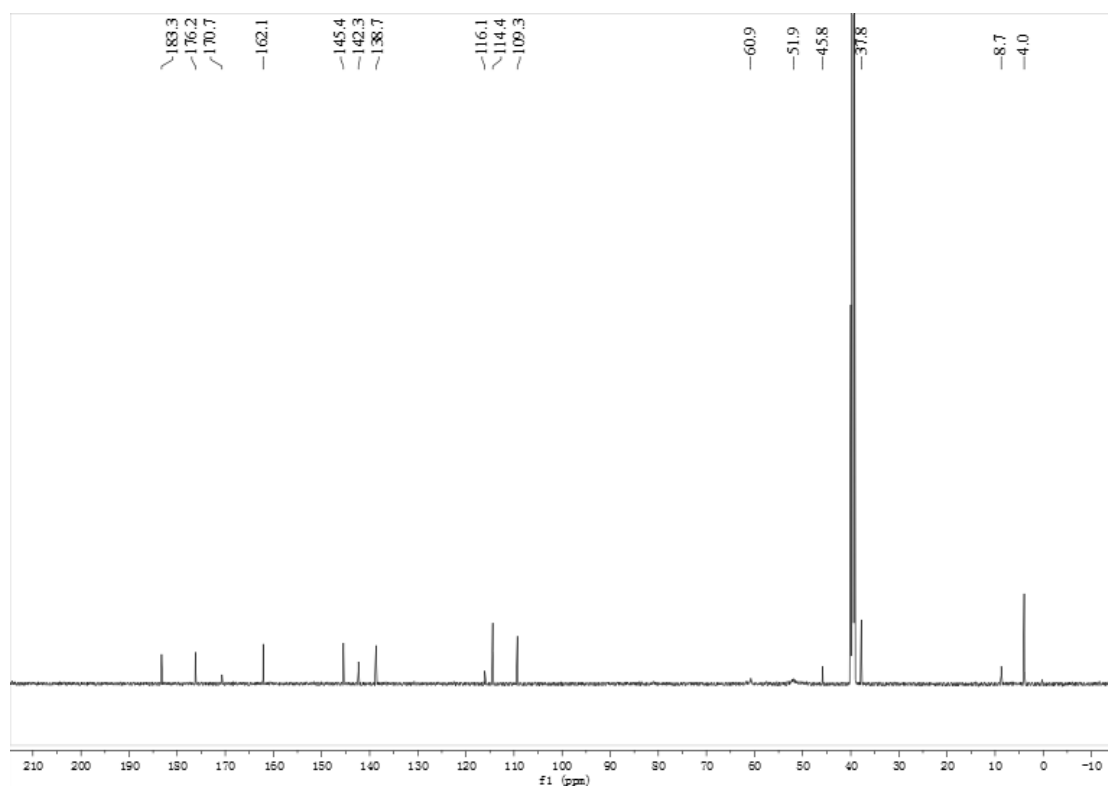
**Figure S51.** The IR spectrum of compound **1f**



**Figure S52.** The HRESIMS of compound **1f**



**Figure S53.** The <sup>1</sup>H-NMR (600MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1g**



**Figure S54.** The <sup>13</sup>C-NMR (150MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1g**

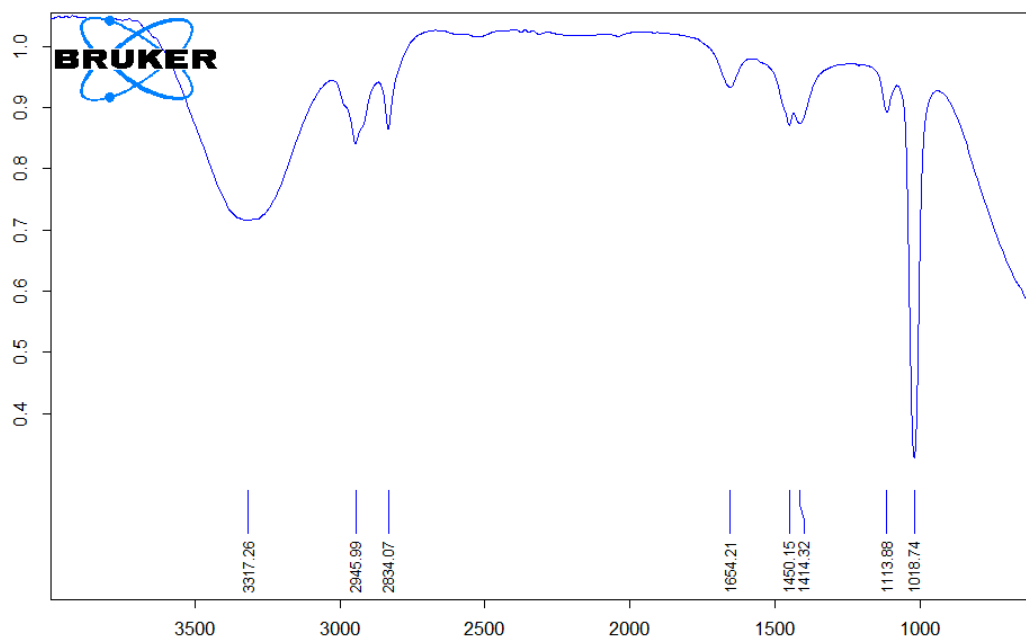


Figure S55. The IR spectrum of compound **1g**

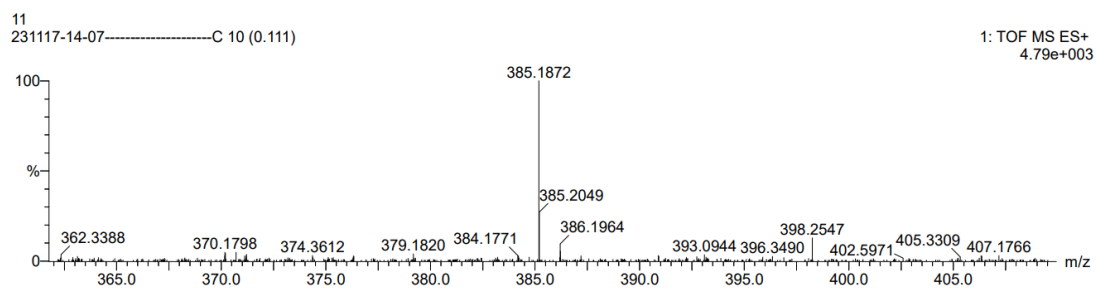
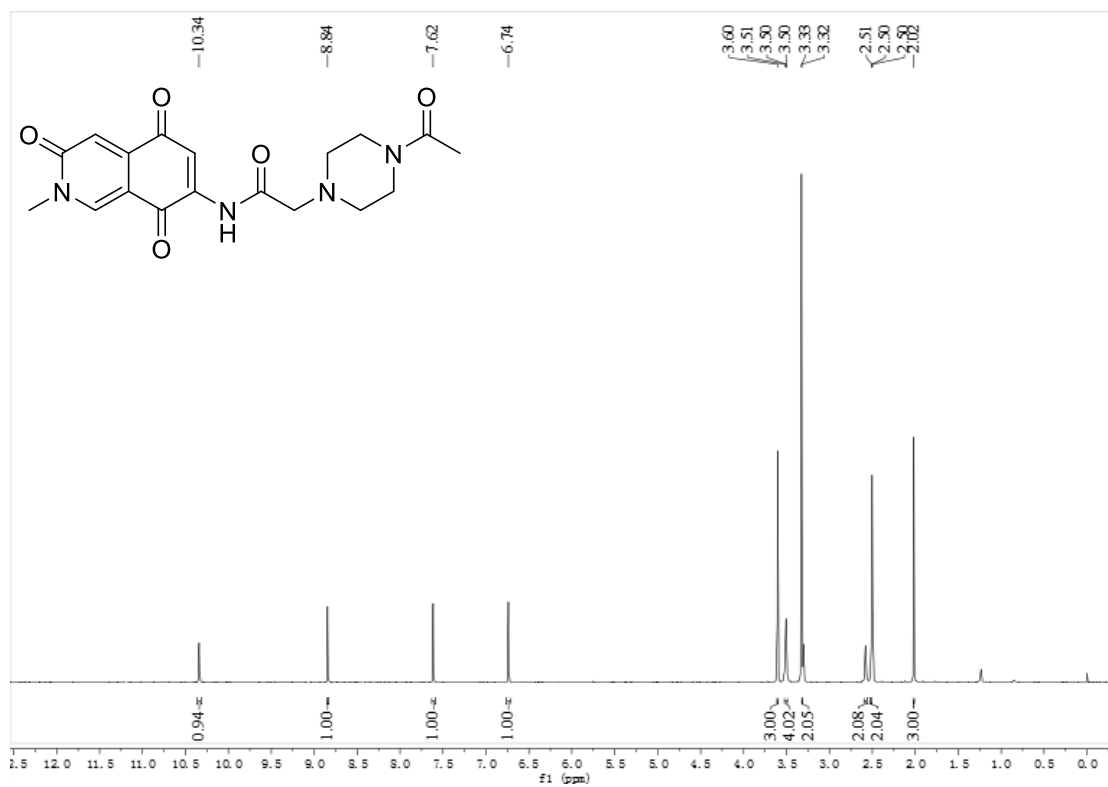
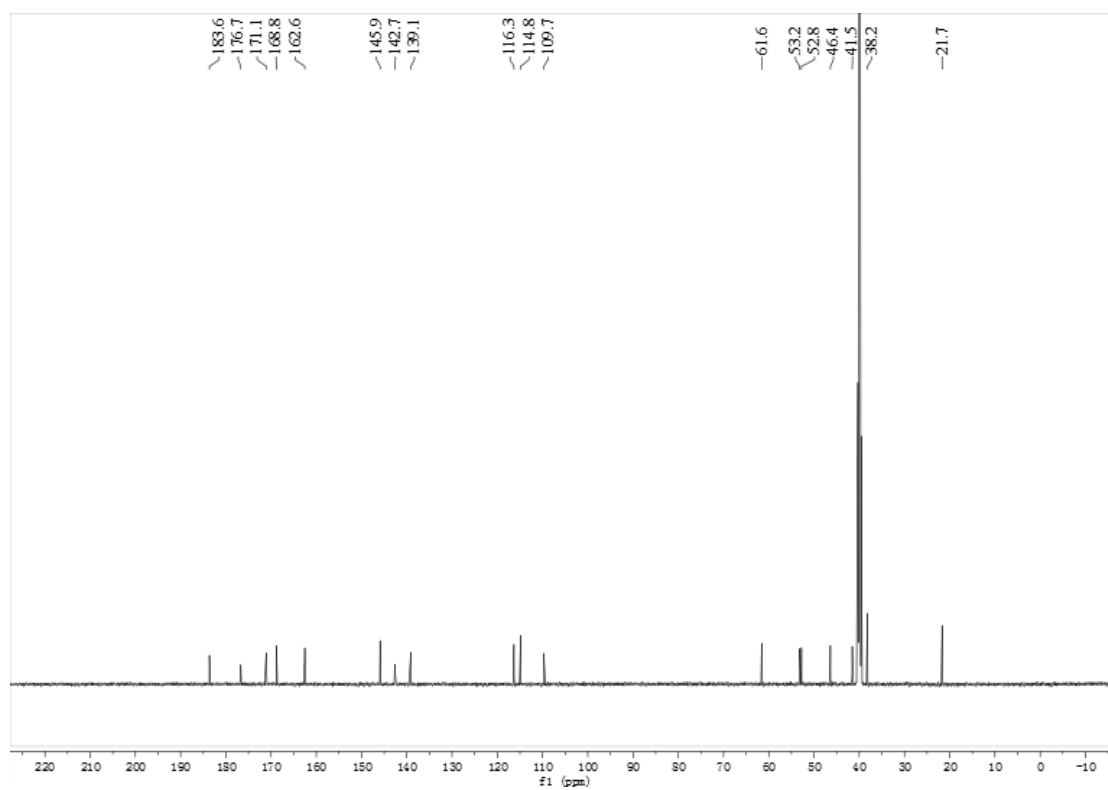


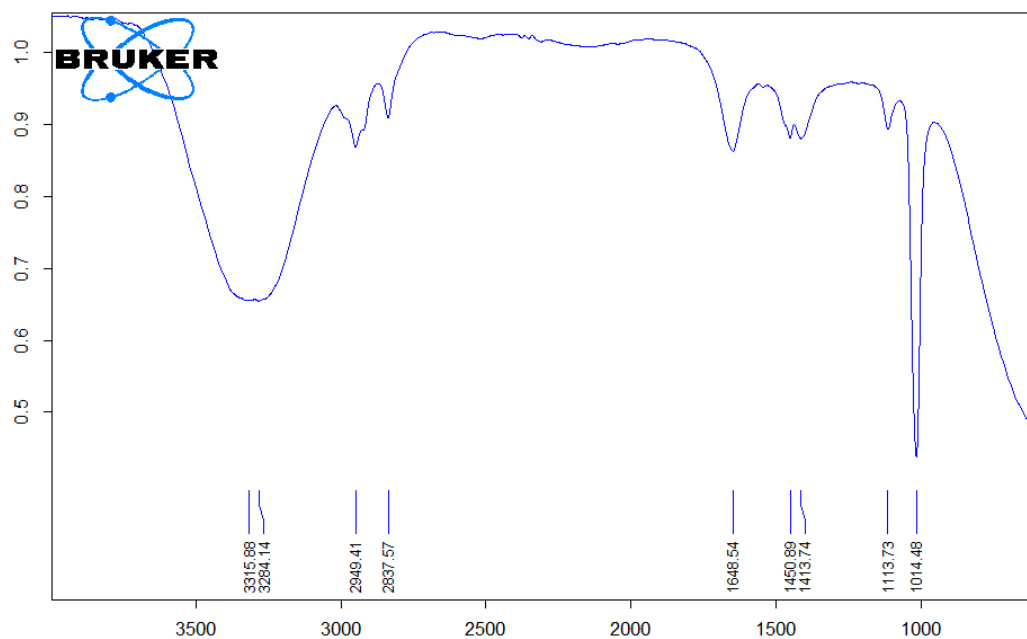
Figure S56 The HRESIMS of compound **1g**



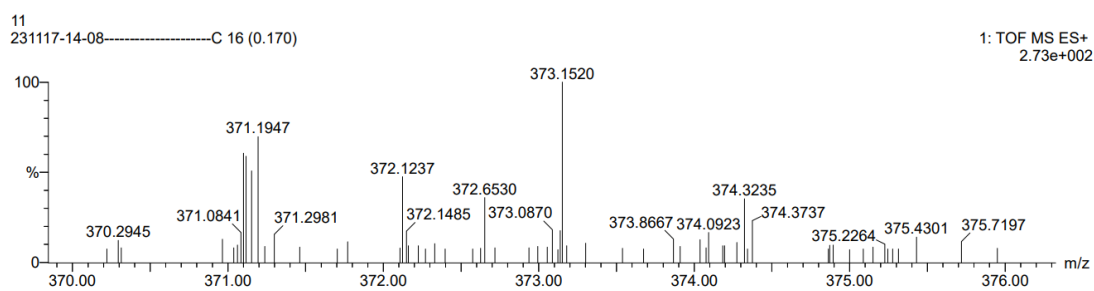
**Figure S57.** The <sup>1</sup>H-NMR (600MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1h**



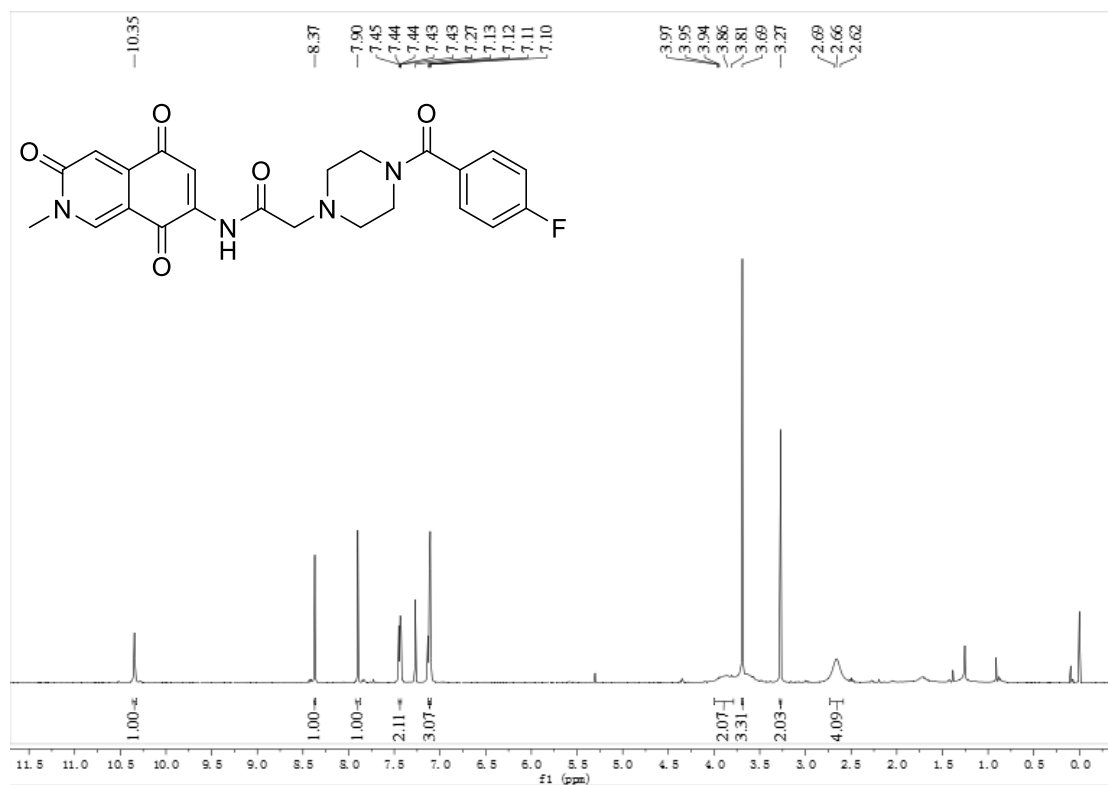
**Figure S58.** The <sup>13</sup>C-NMR (150MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1h**



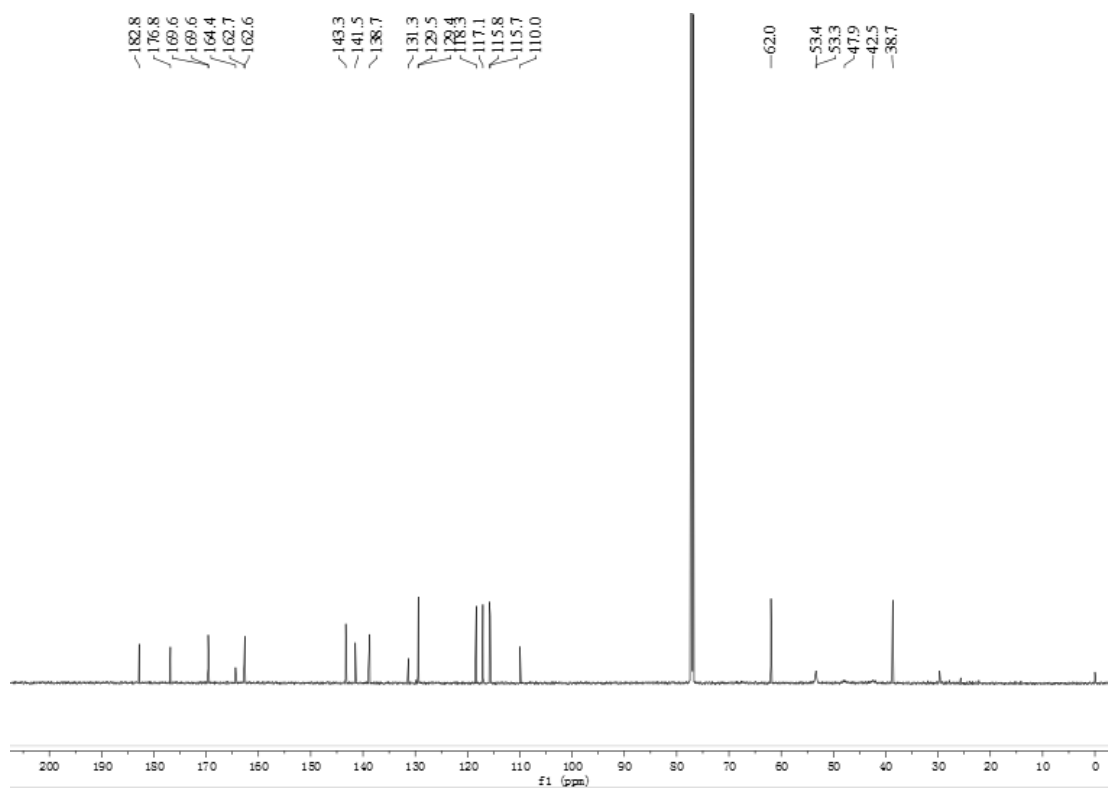
**Figure S59.** The IR spectrum of compound **1h**



**Figure S60.** The HRESIMS of compound **1h**

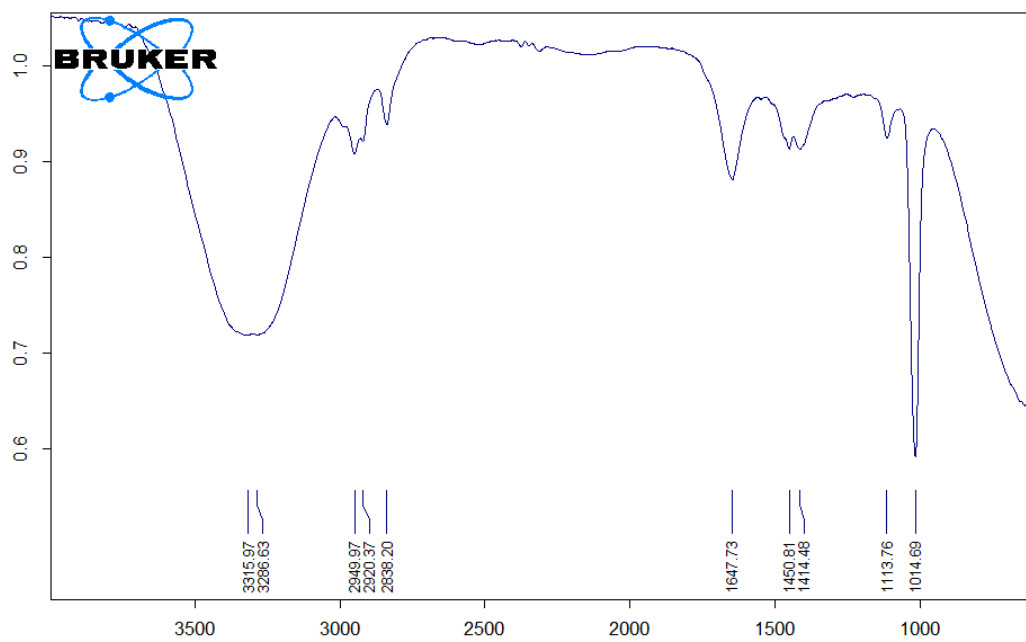


**Figure S61.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **1i**

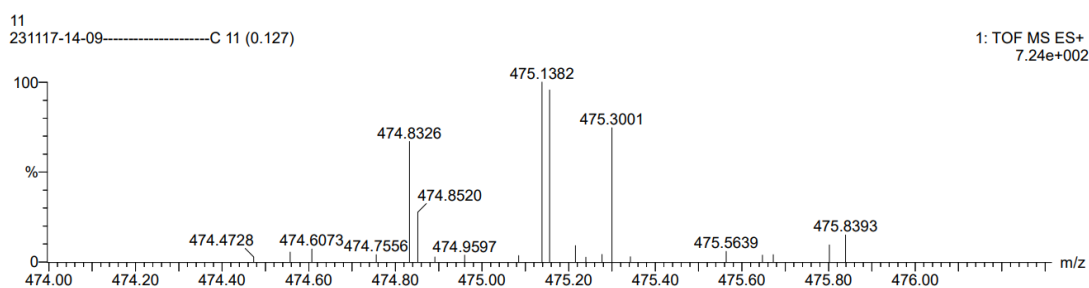


**Figure S62.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **1i**

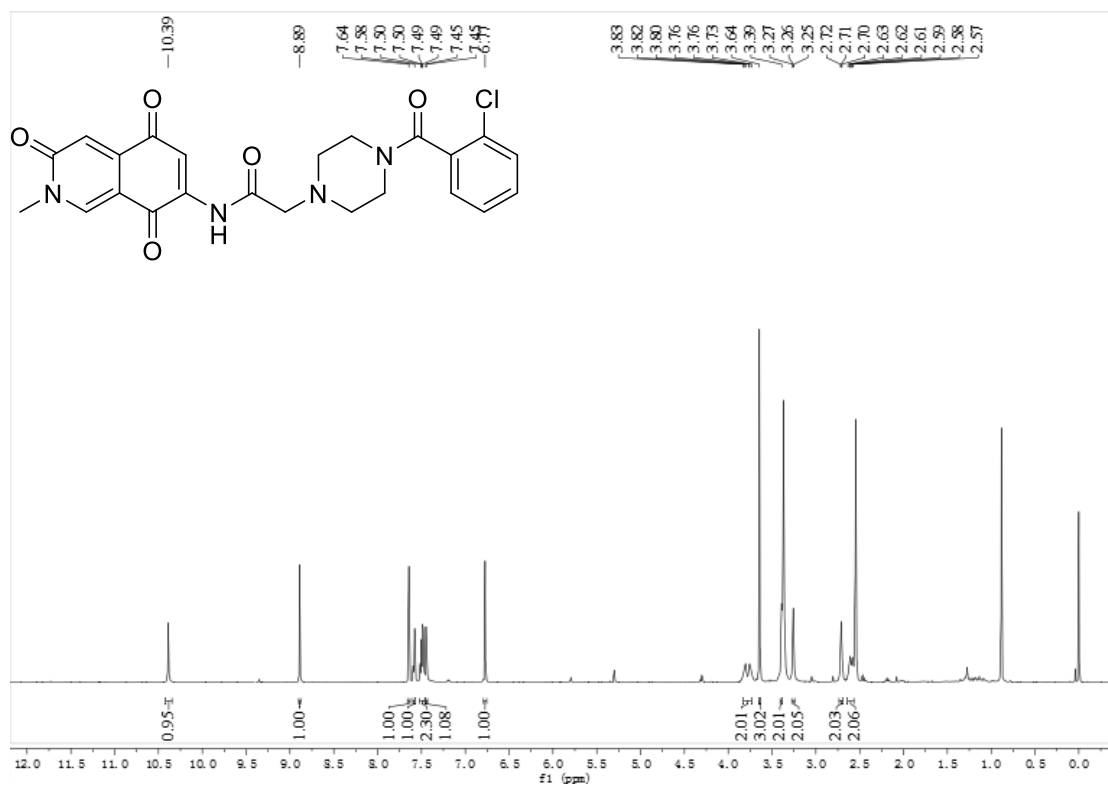




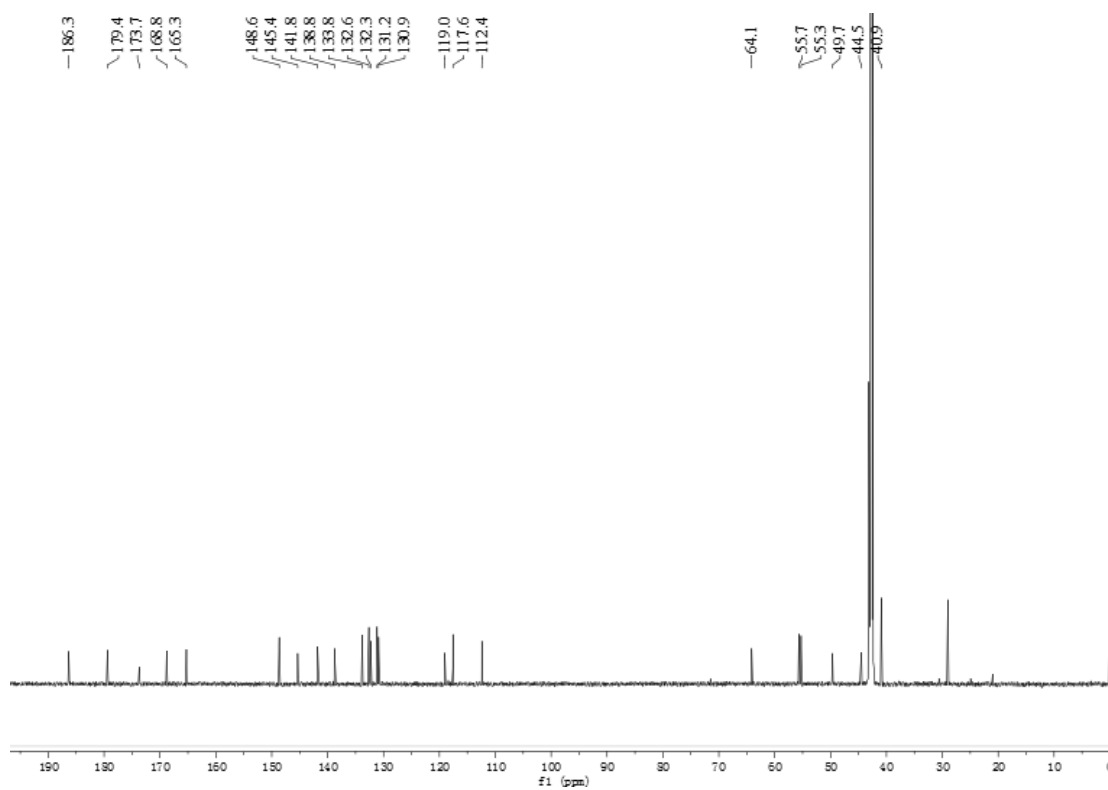
**Figure S63.** The IR spectrum of compound **1i**



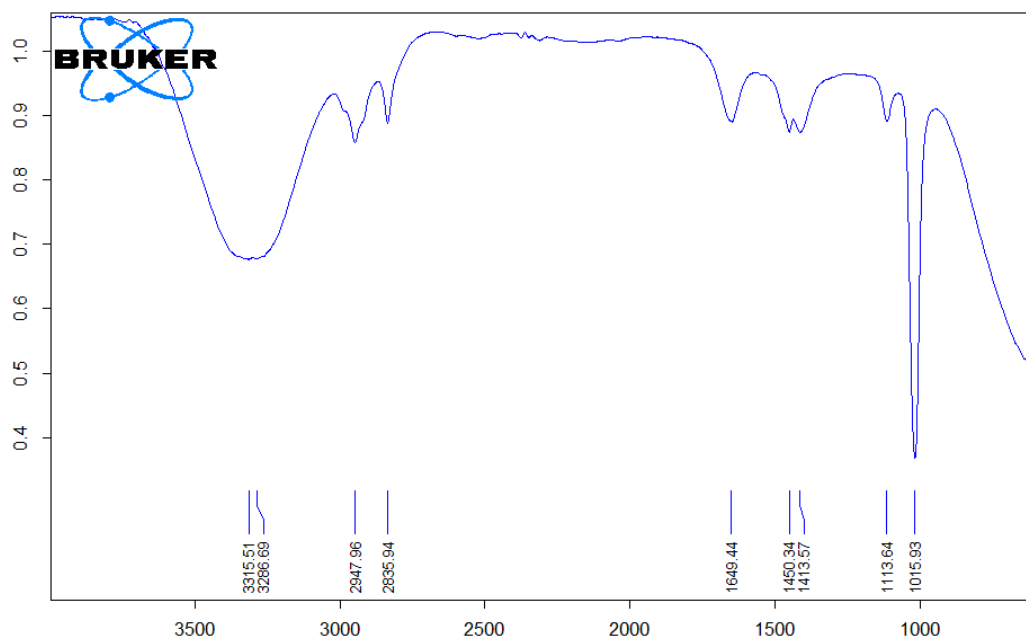
**Figure S64.** The HRESIMS of compound **1i**



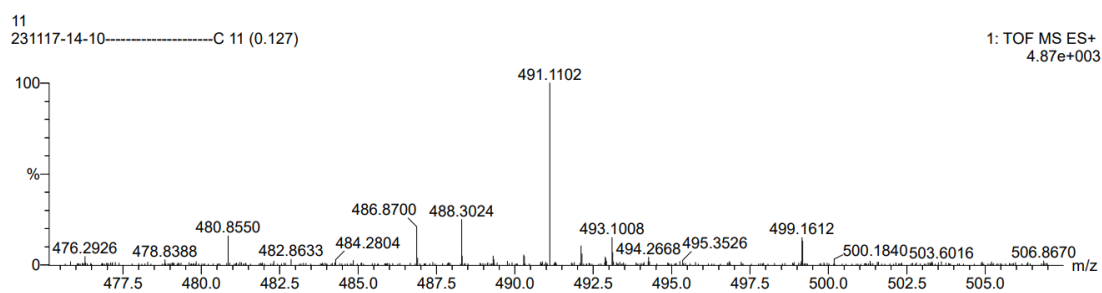
**Figure S65.** The <sup>1</sup>H-NMR (600MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1j**



**Figure S66.** The <sup>13</sup>C-NMR (150MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1j**



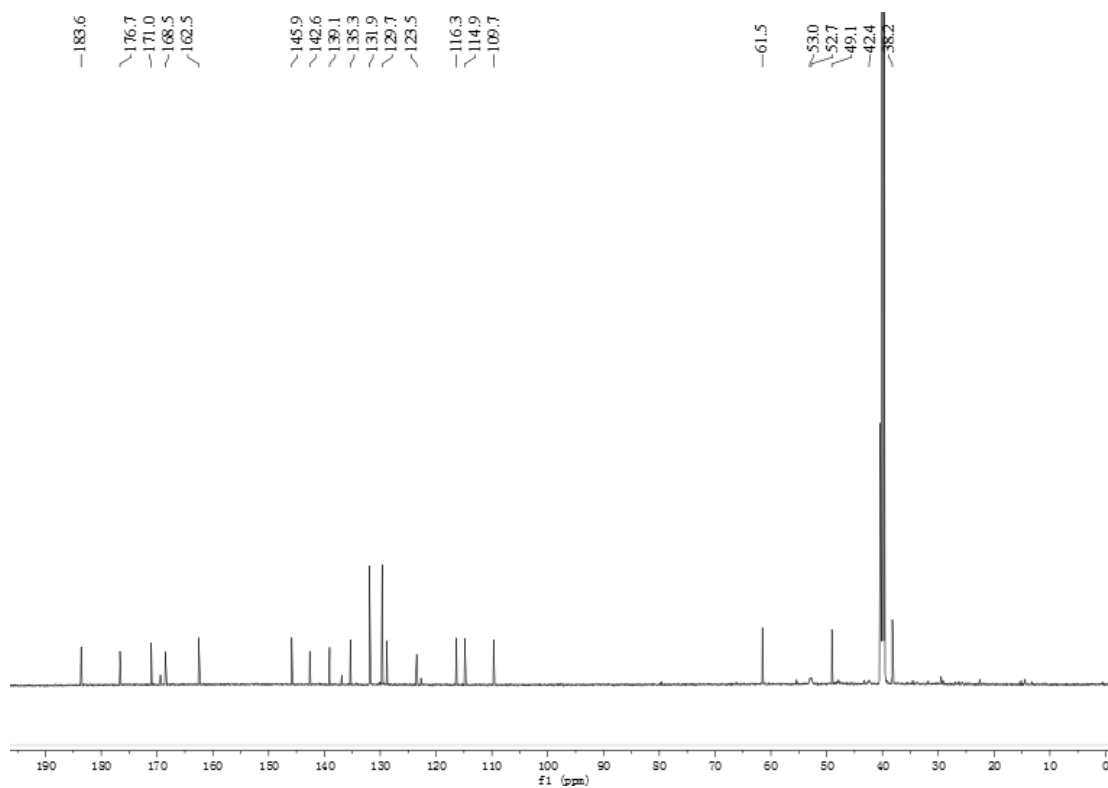
**Figure S67.** The IR spectrum of compound **1j**



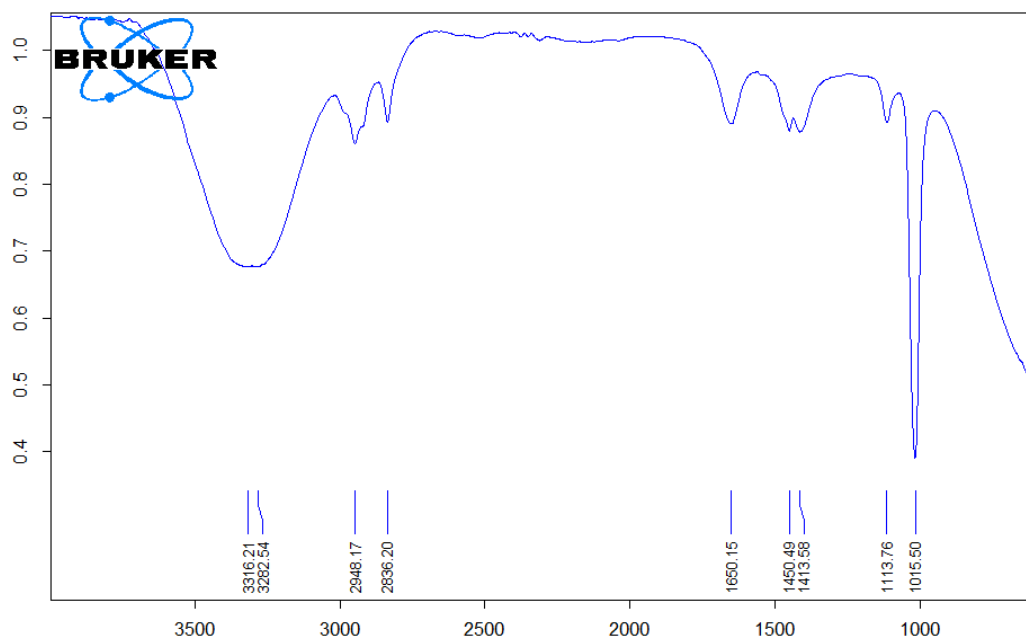
**Figure S68.** The HRESIMS of compound **1j**



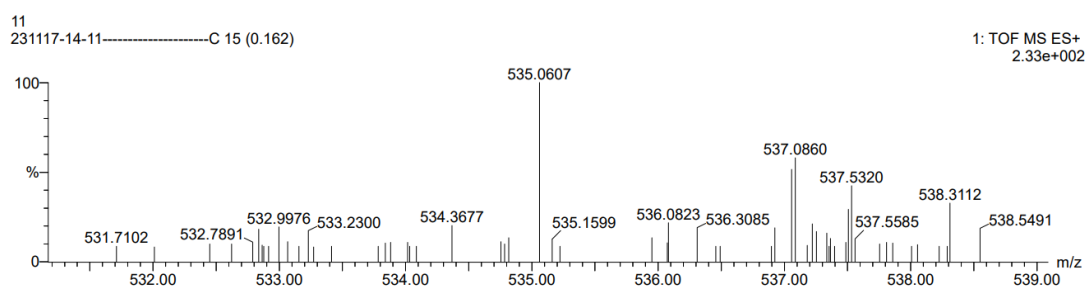
**Figure S69.** The  $^1\text{H}$ -NMR (600MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1k**



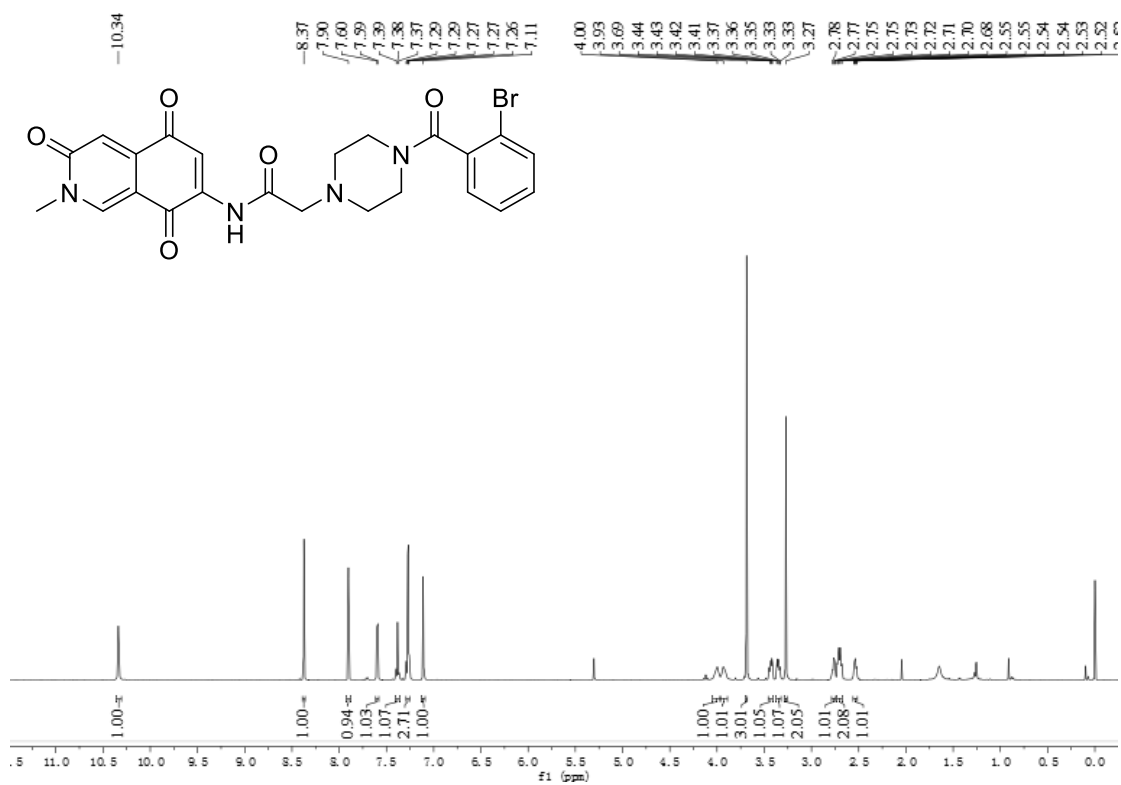
**Figure S70.** The  $^{13}\text{C}$ -NMR (150MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1k**



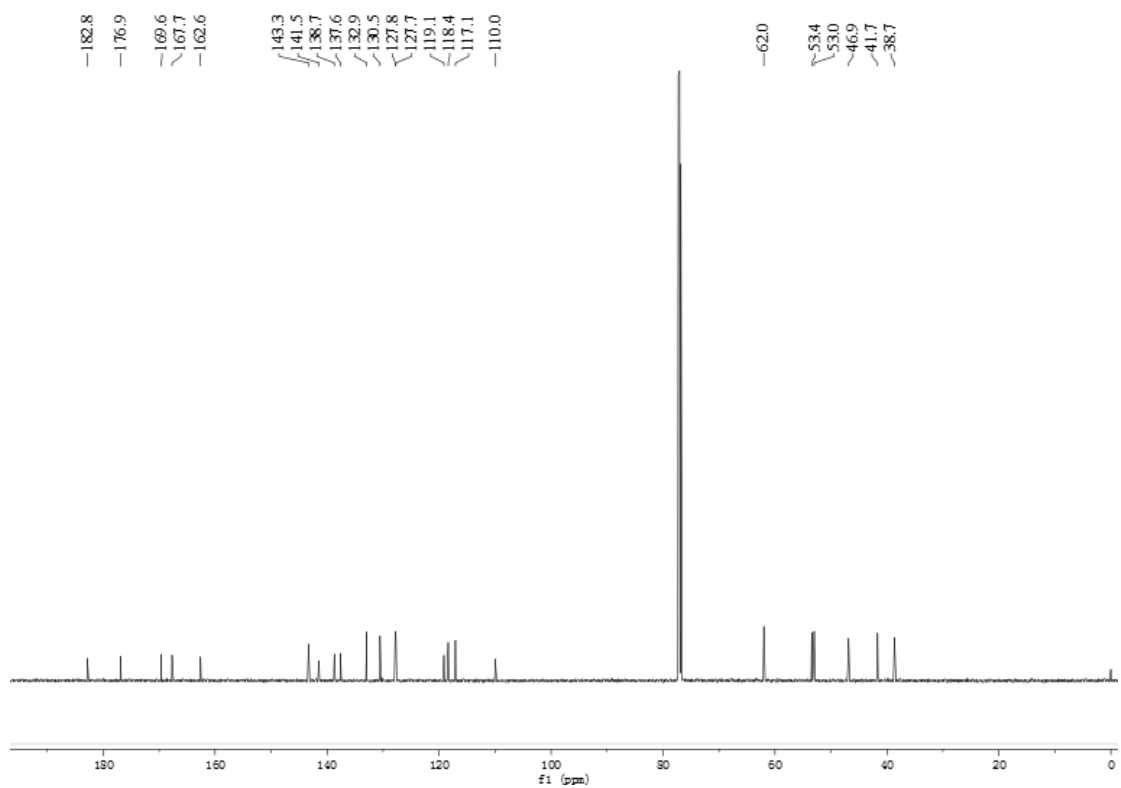
**Figure S71.** The IR spectrum of compound **1k**



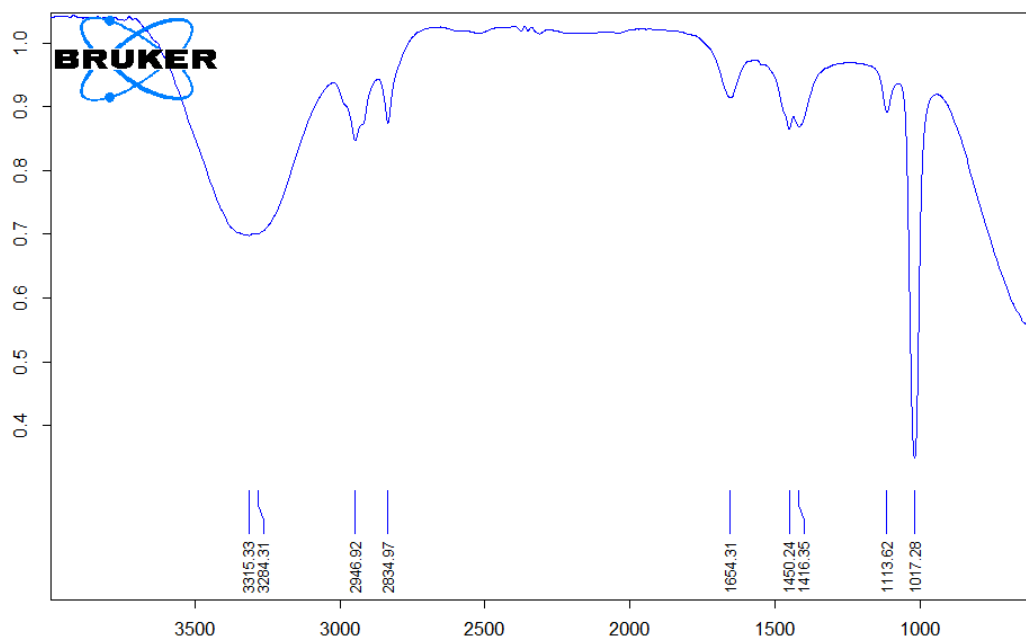
**Figure S72.** The HRESIMS of compound **1k**



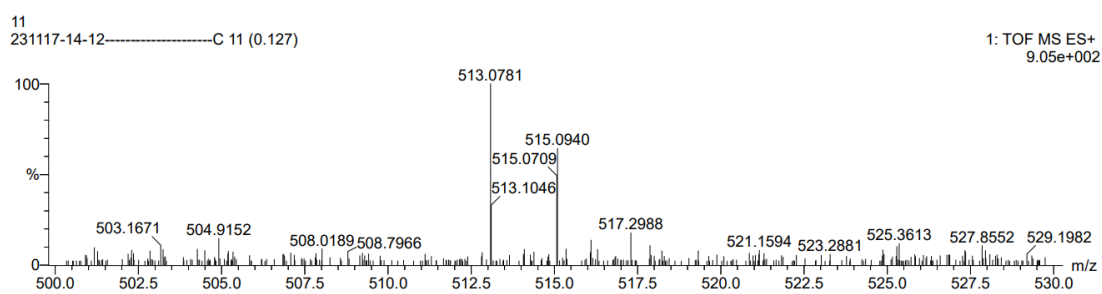
**Figure S73.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **11**



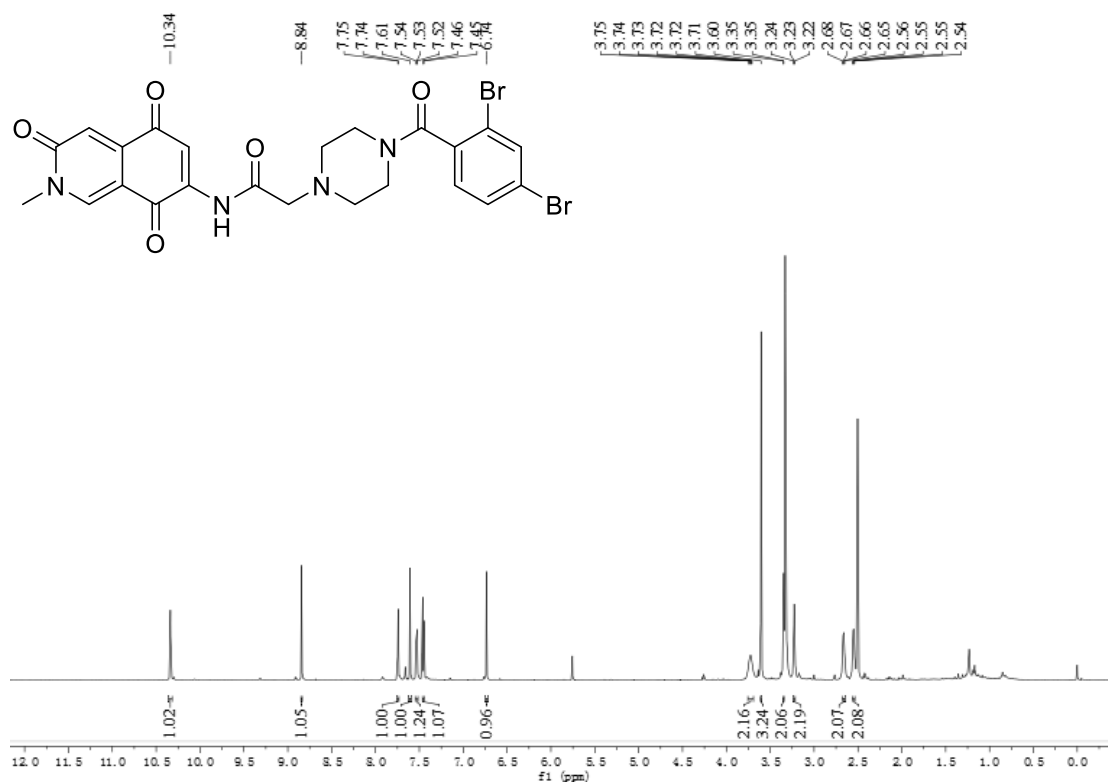
**Figure S74.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **11**



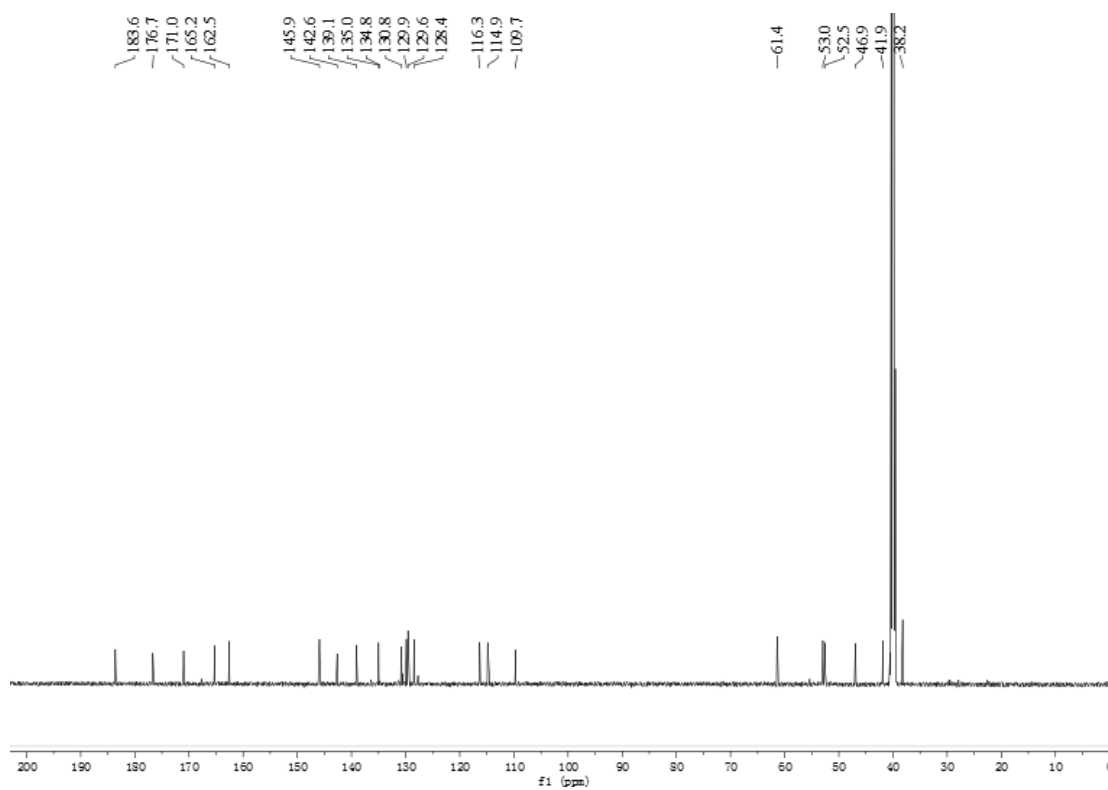
**Figure S75.** The IR spectrum of compound **11**



**Figure S76.** The HRESIMS of compound **11**



**Figure S77.** The <sup>1</sup>H-NMR (600MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1m**



**Figure S78.** The <sup>13</sup>C-NMR (150MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1m**



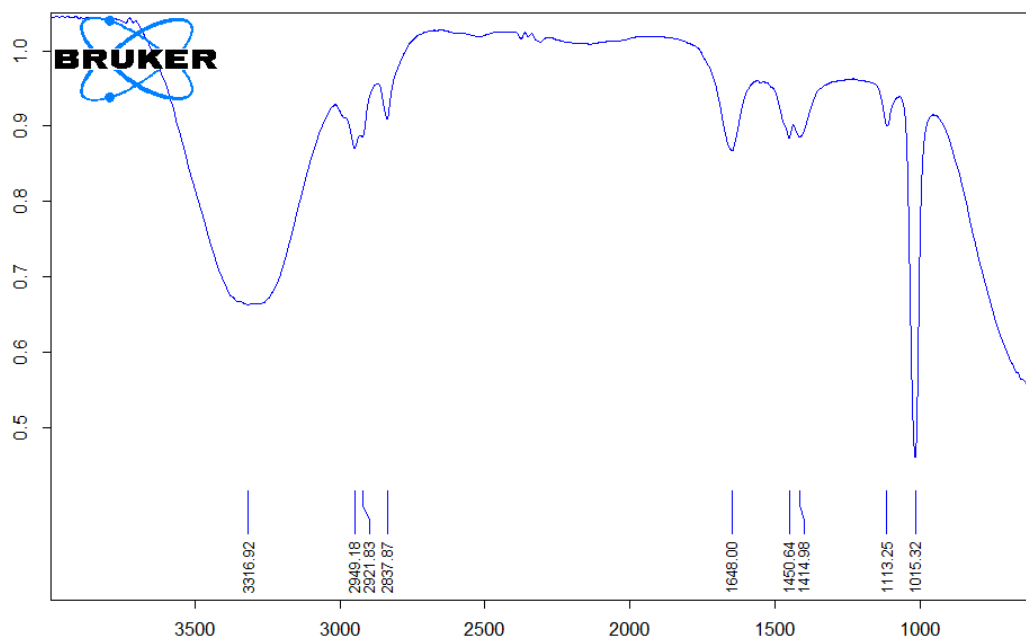


Figure S79. The IR spectrum of compound 1m

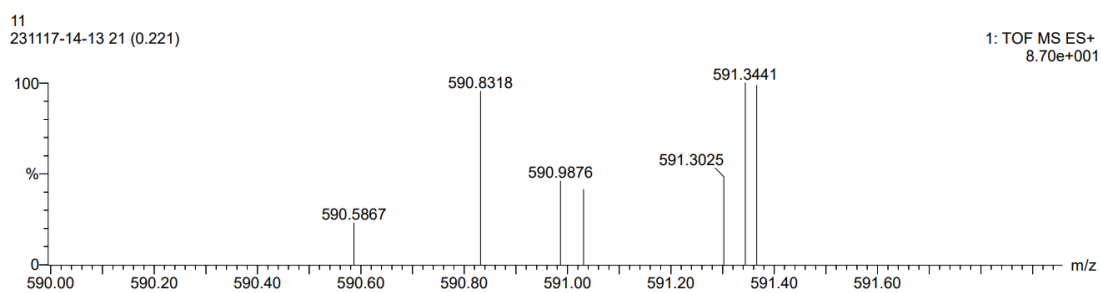
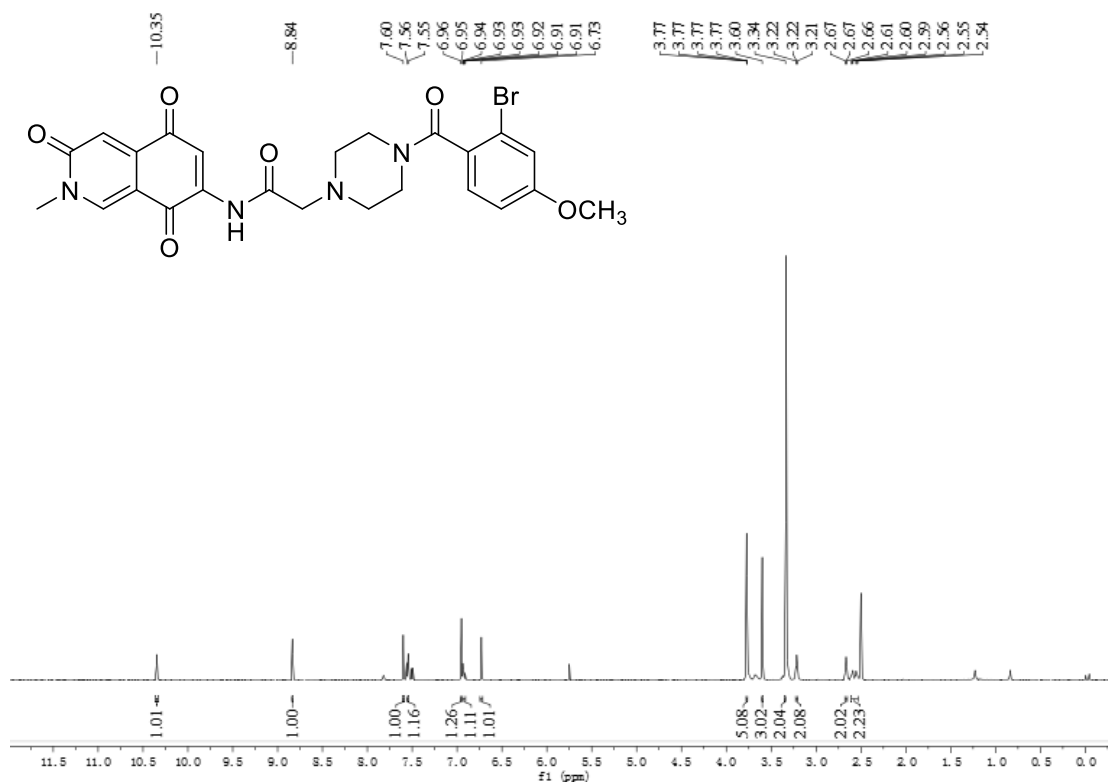
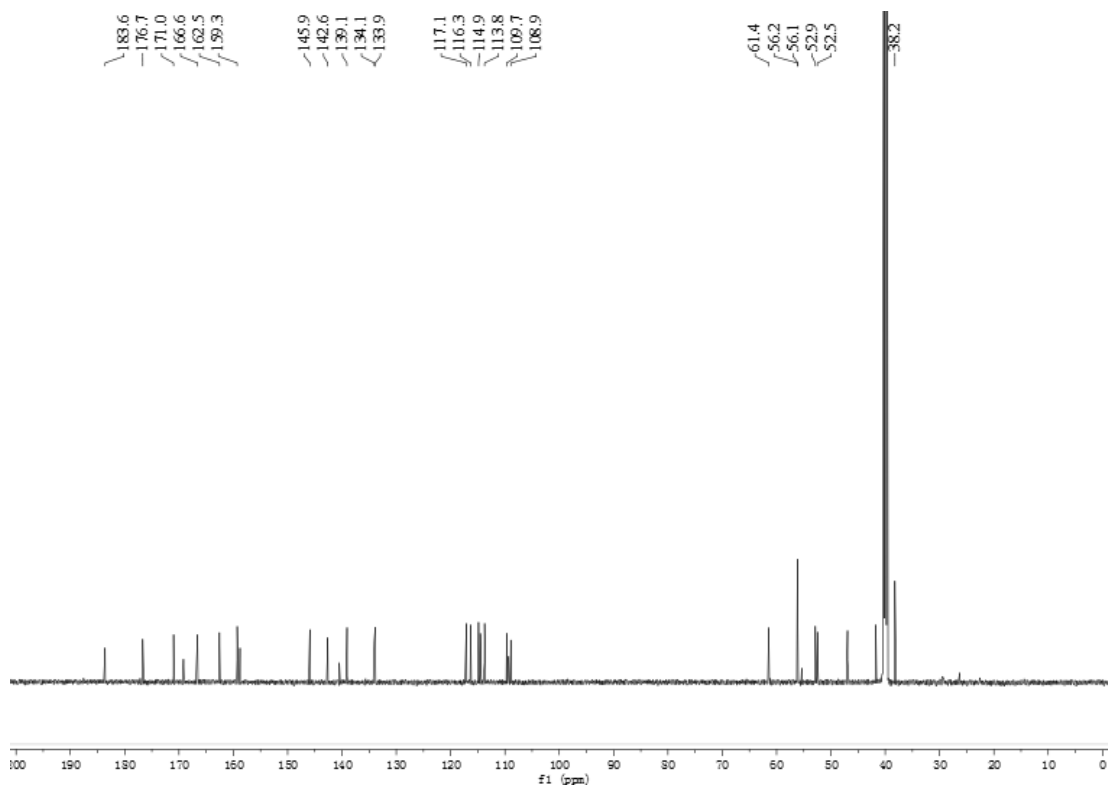


Figure S80. The HRESIMS of compound 1m



**Figure S81.** The  $^1\text{H-NMR}$  (600MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1n**



**Figure S82.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1n**

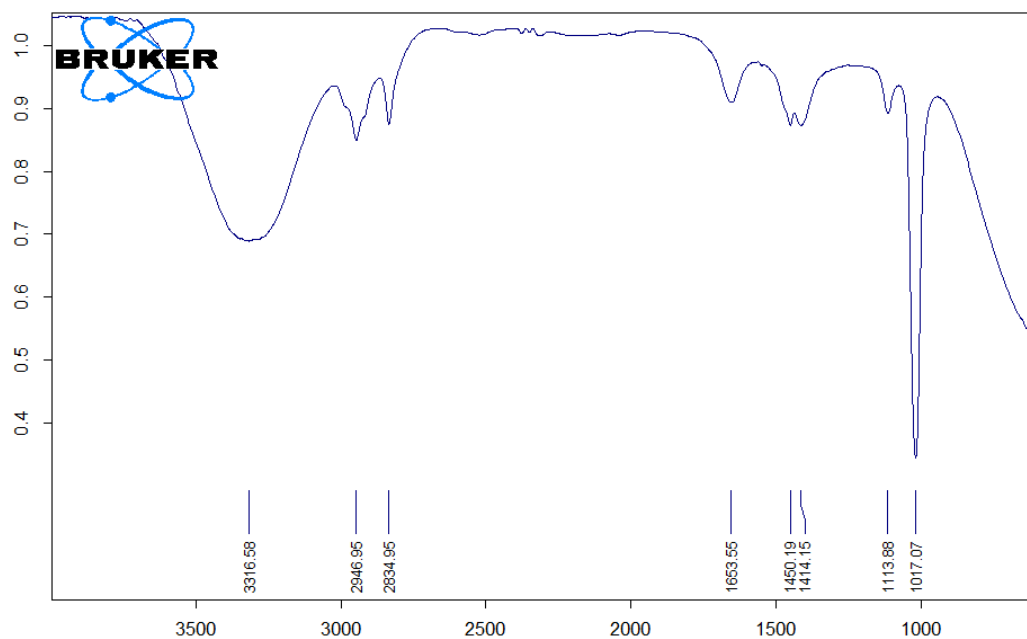


Figure S83. The IR spectrum of compound **1n**

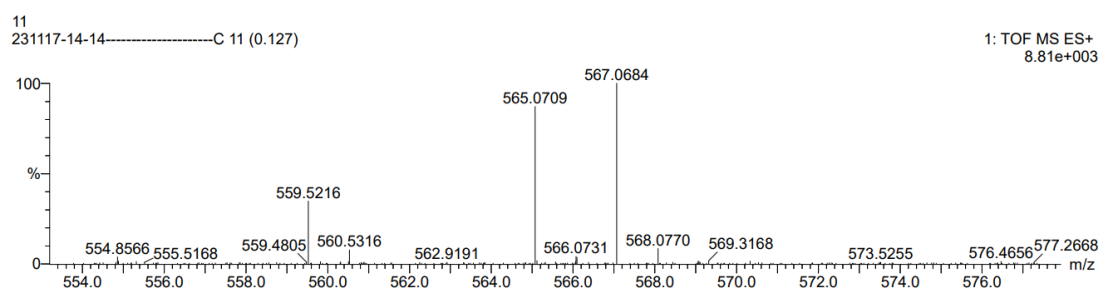
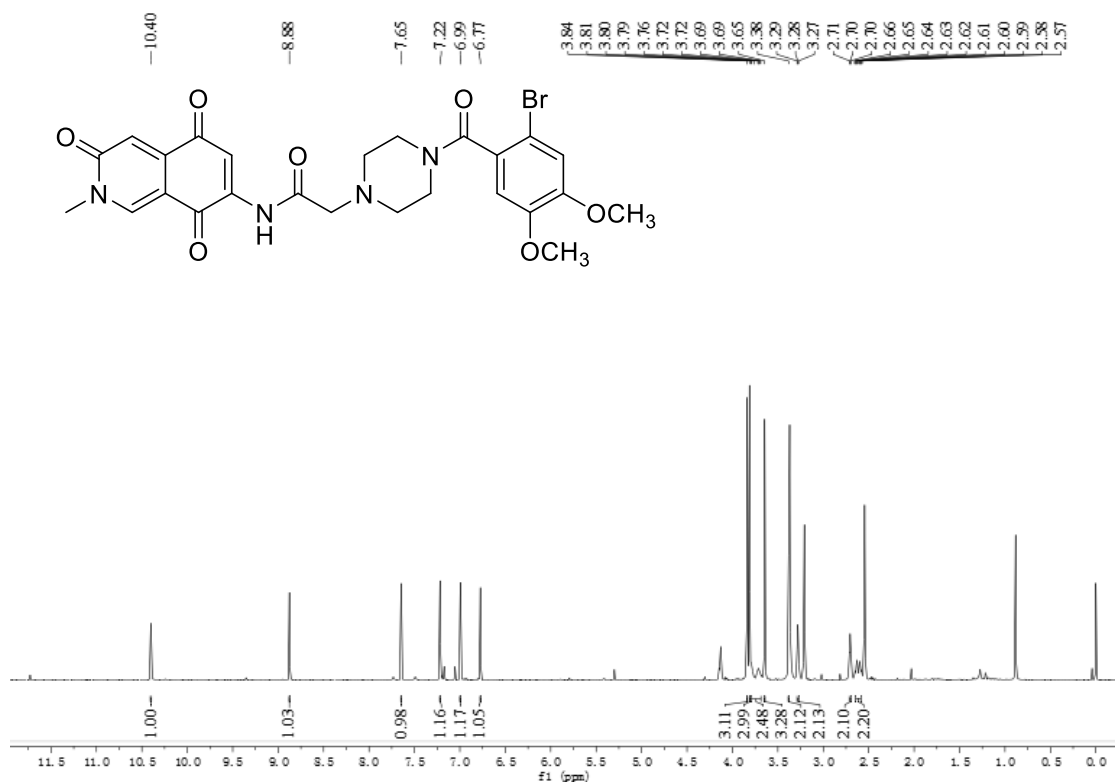
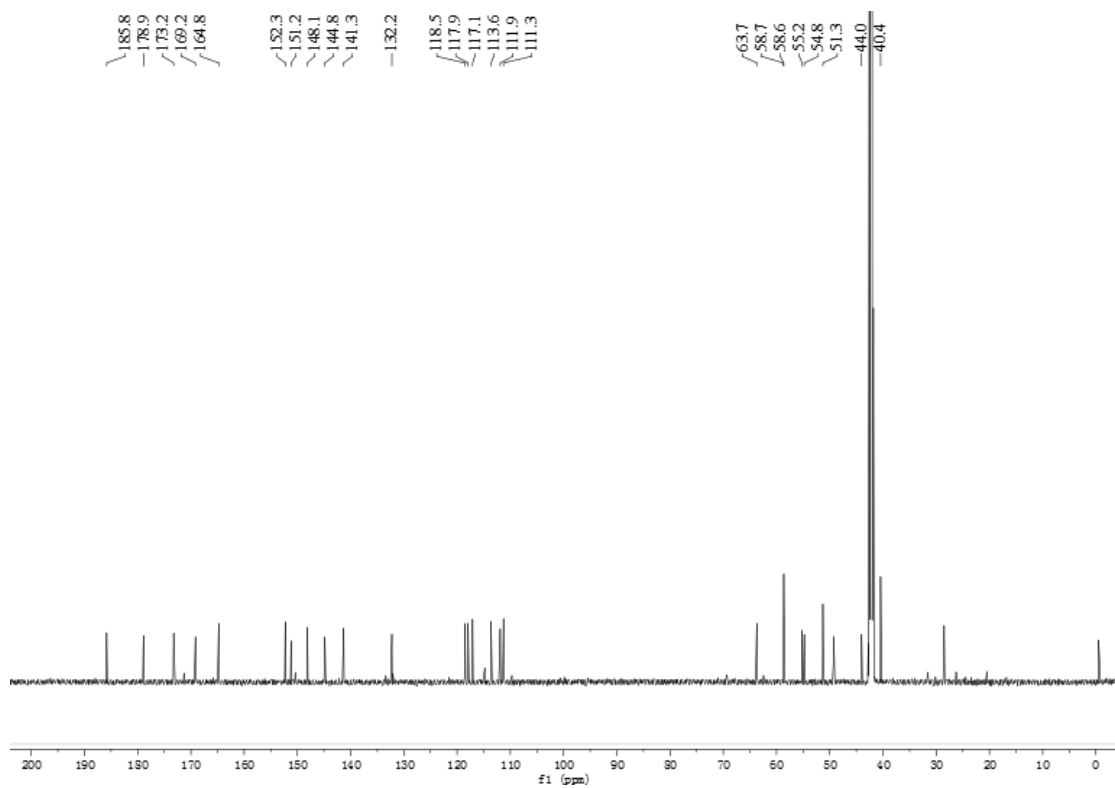


Figure S84. The HRESIMS of compound **1n**



**Figure S85** The  $^1\text{H-NMR}$  (600MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1o**



**Figure S86.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1o**

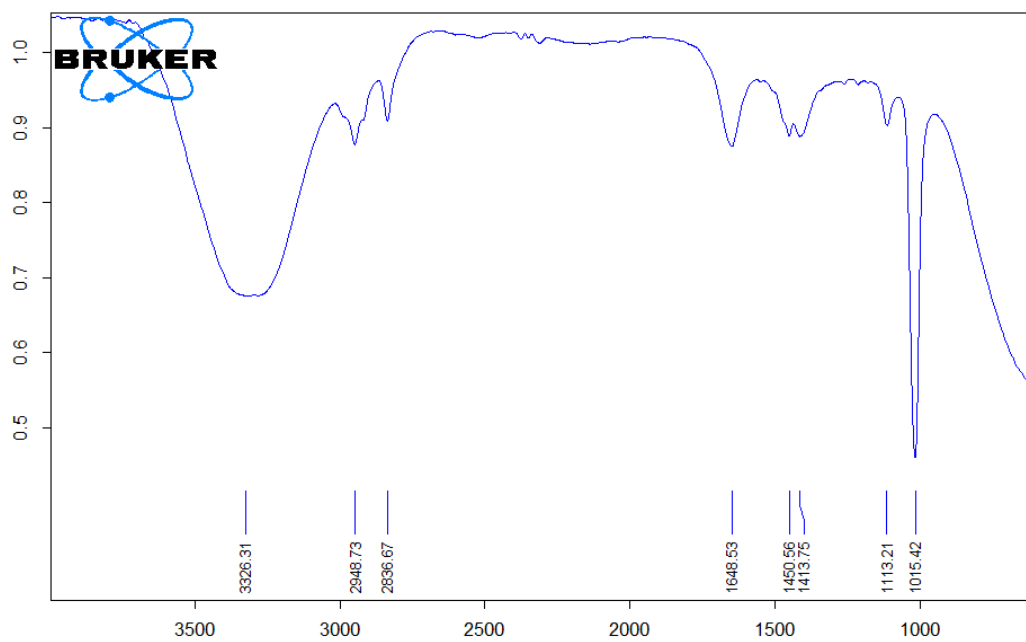


Figure S87. The IR spectrum of compound **10**

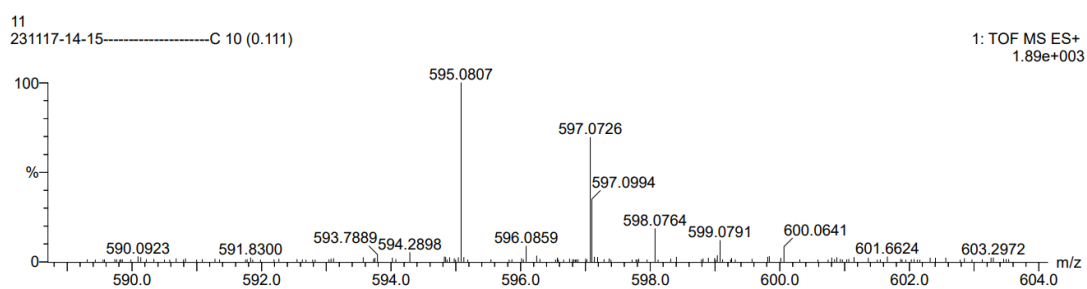
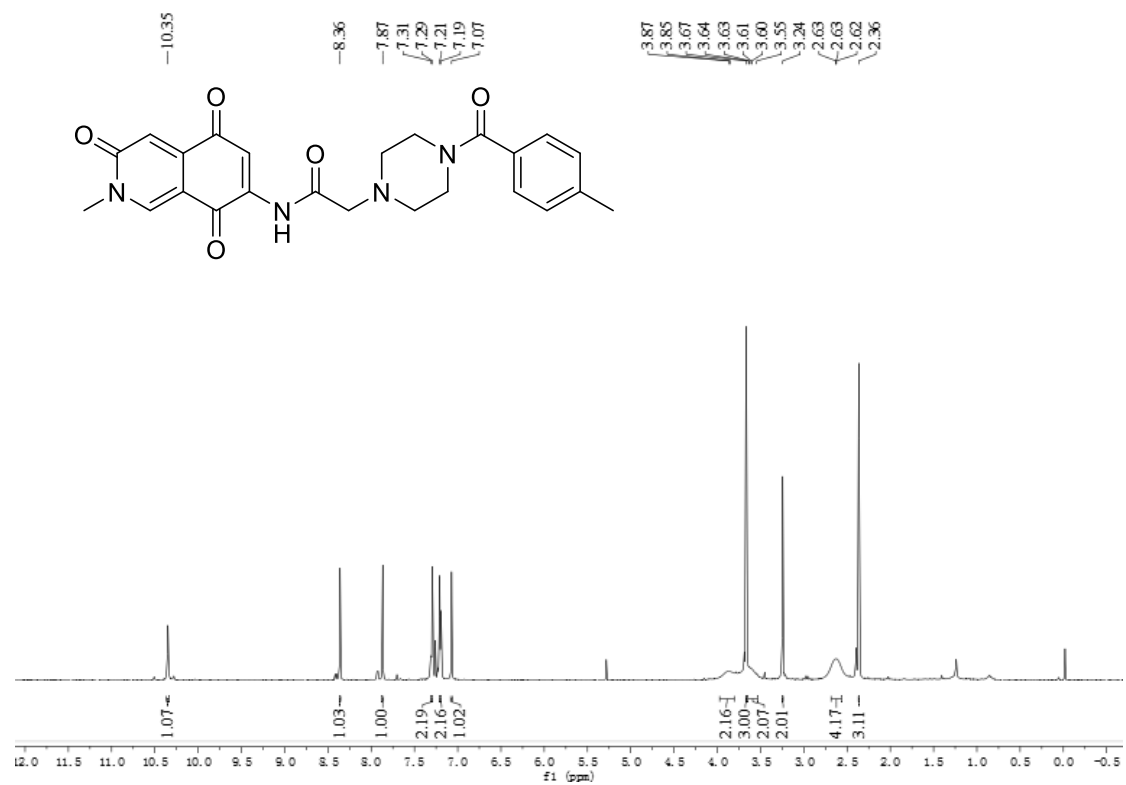
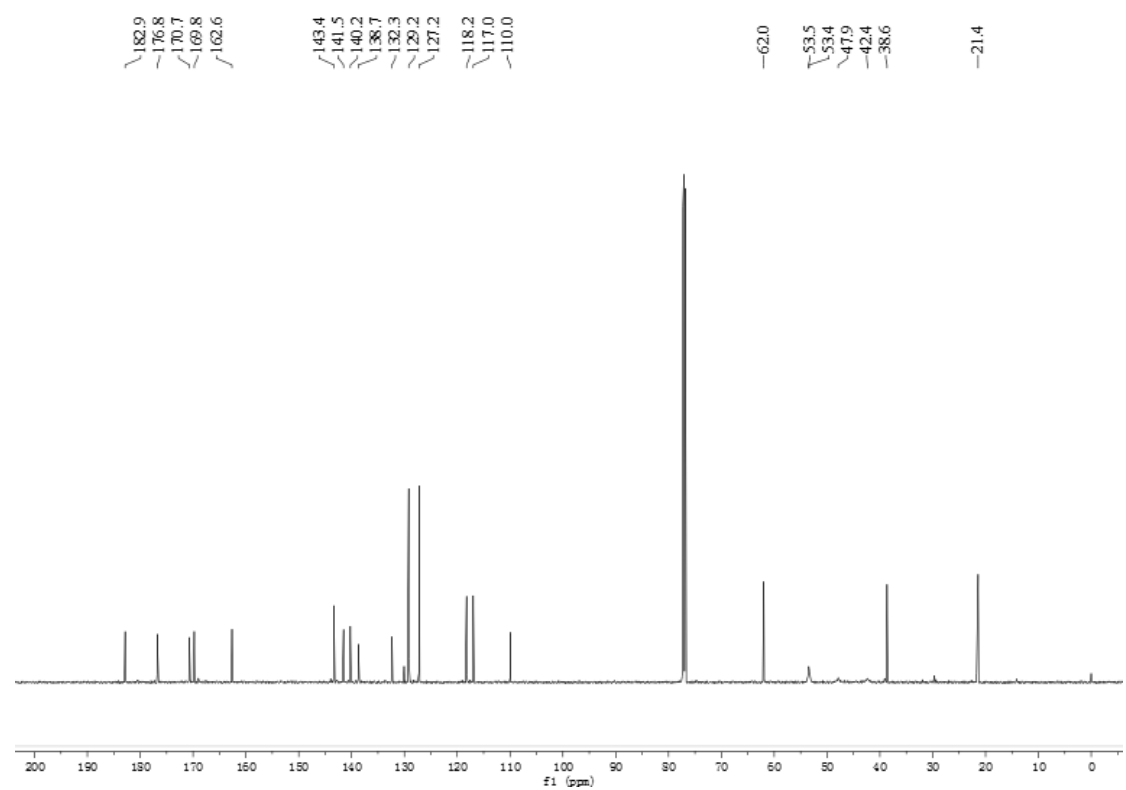


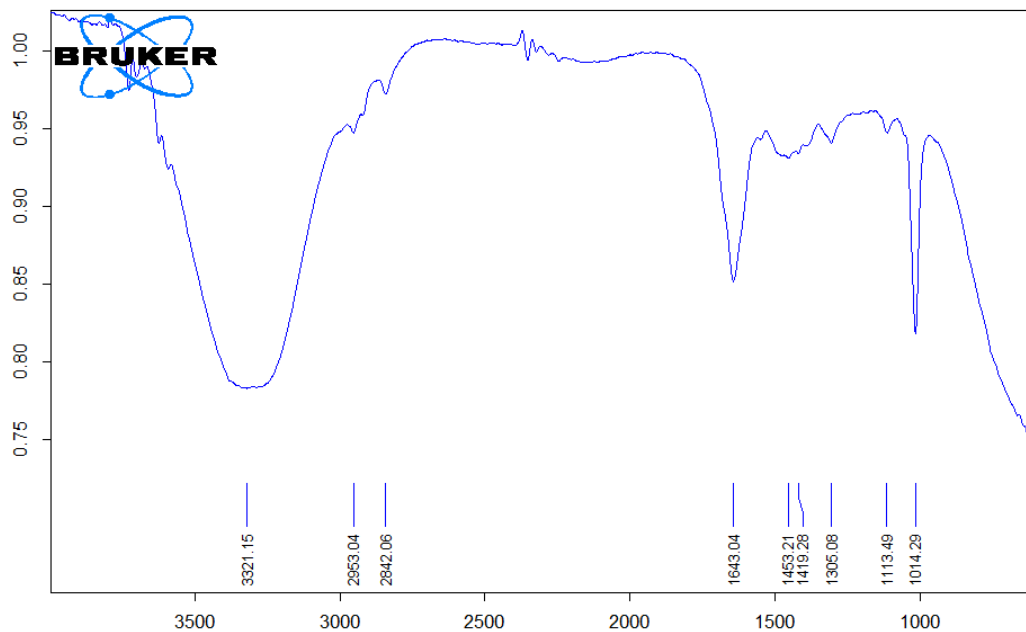
Figure S88. The HRESIMS of compound **10**



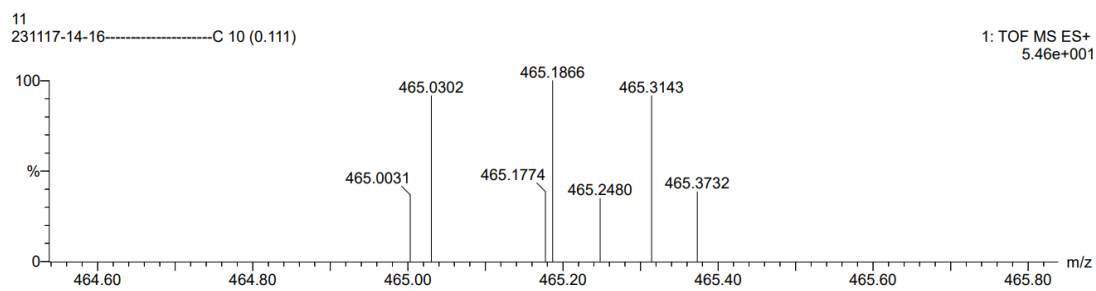
**Figure S89.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **1p**



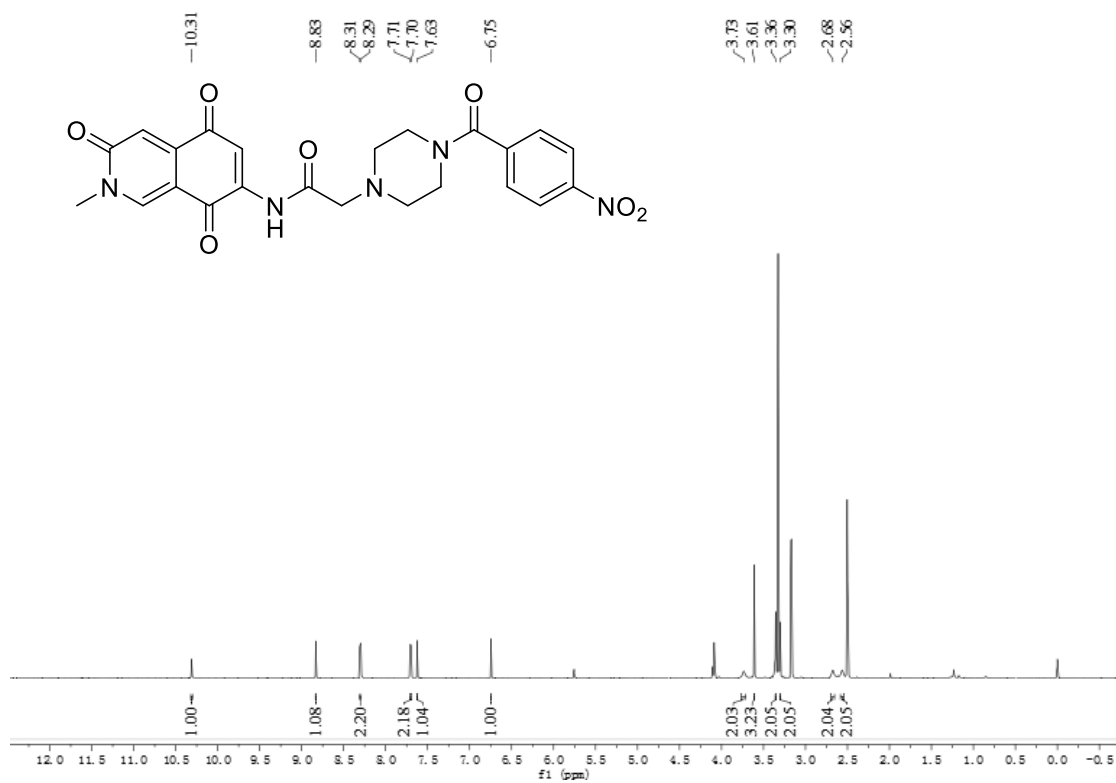
**Figure S90.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **1p**



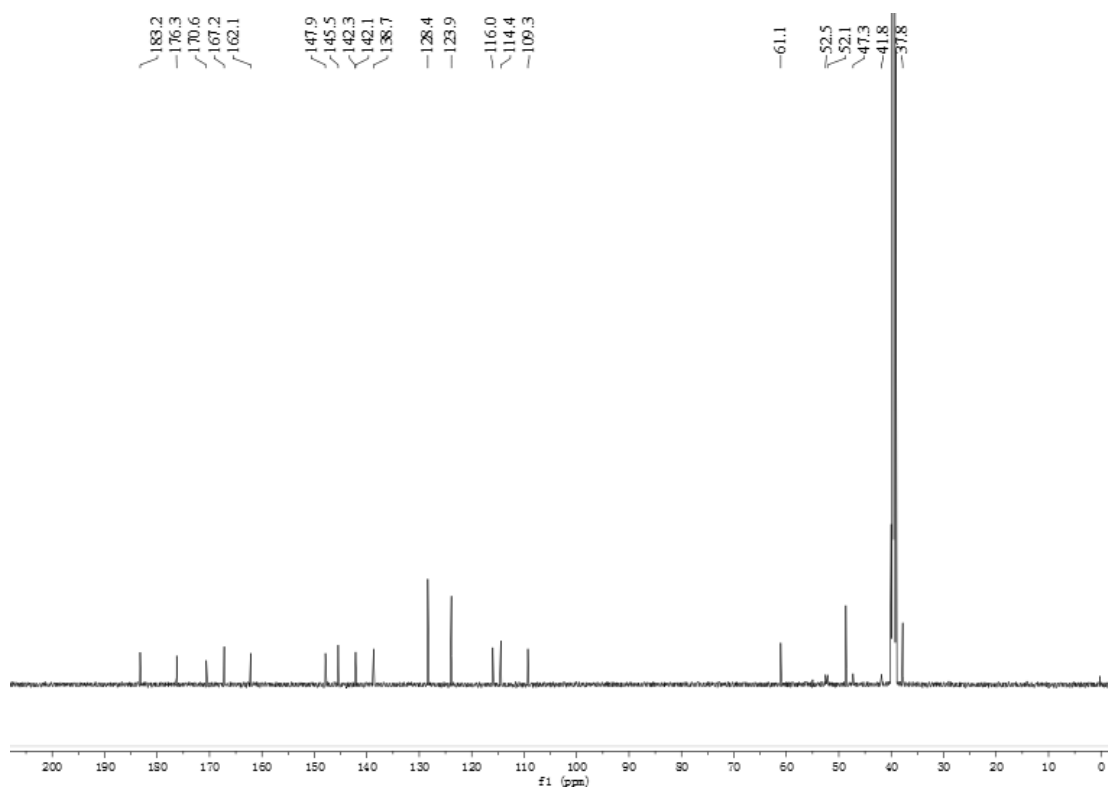
**Figure S91.** The IR spectrum of compound **1p**



**Figure S92.** The HRESIMS of compound **1p**



**Figure S93.** The <sup>1</sup>H-NMR (600MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1q**



**Figure S94.** The <sup>13</sup>C-NMR (150MHz, DMSO-*d*<sub>6</sub>) spectrum of compound **1q**



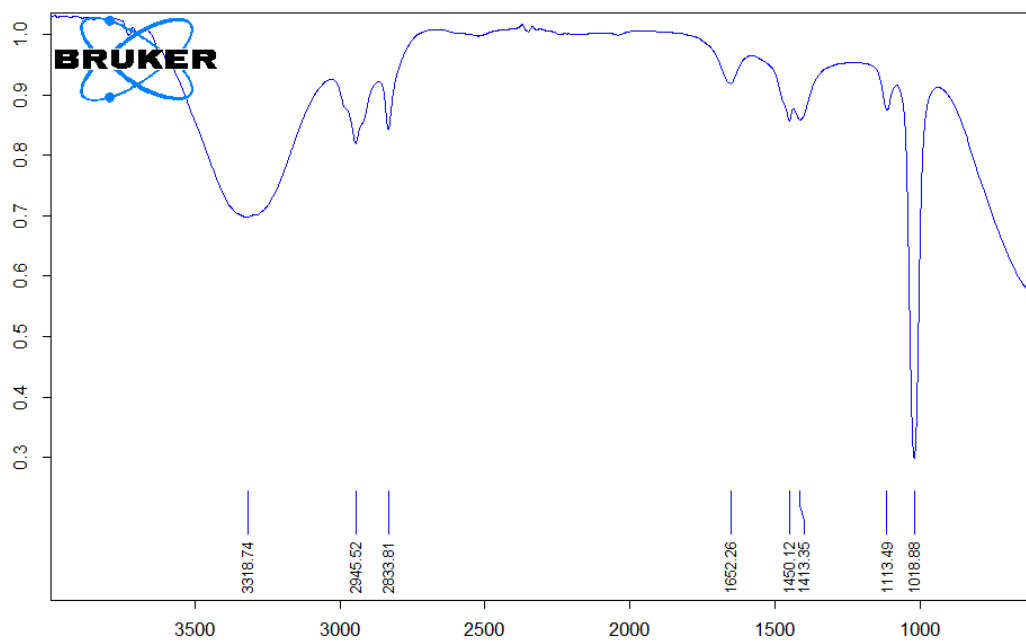


Figure S95. The IR spectrum of compound **1q**

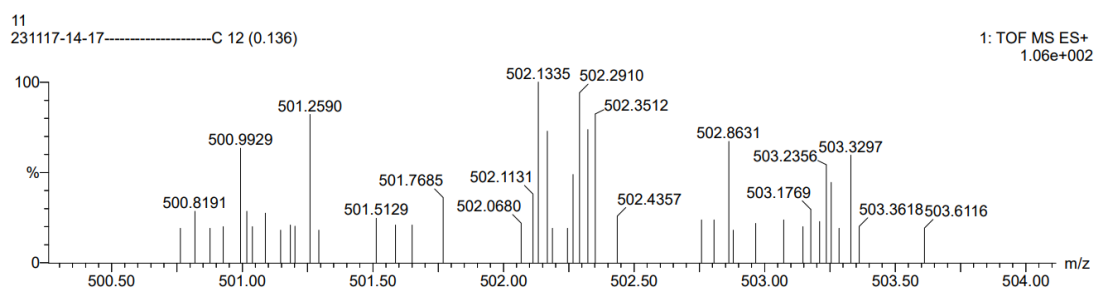
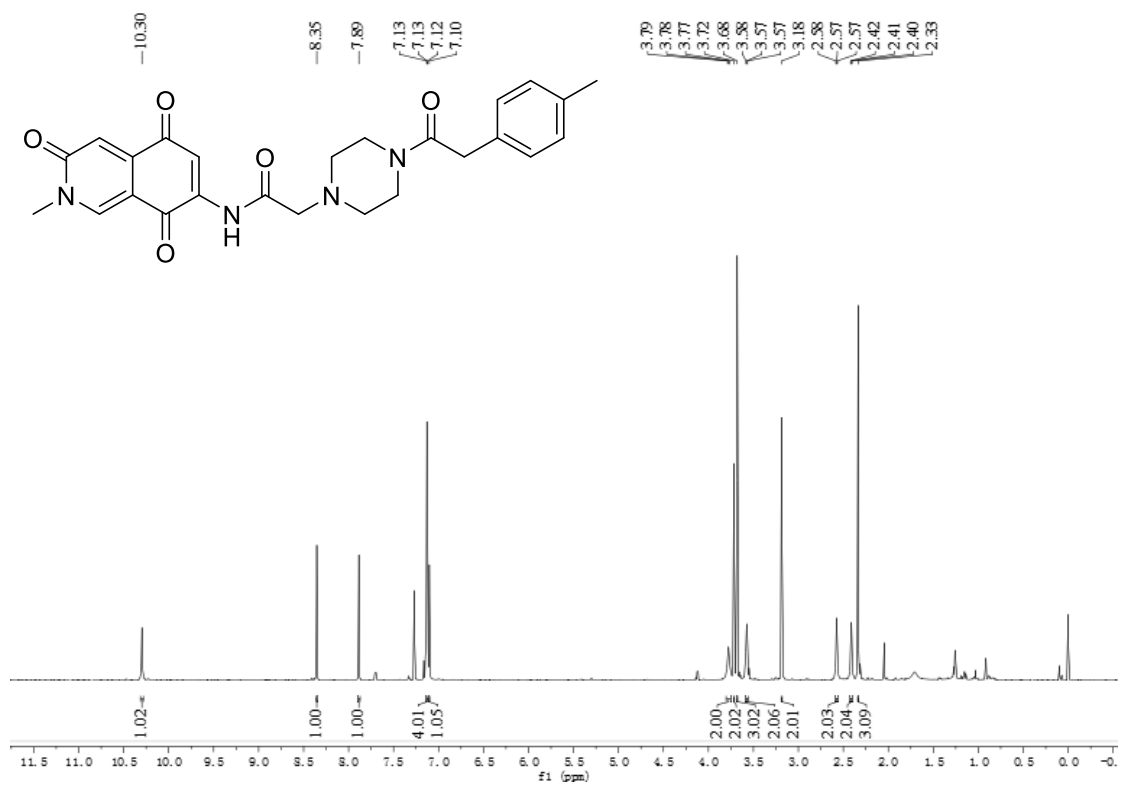
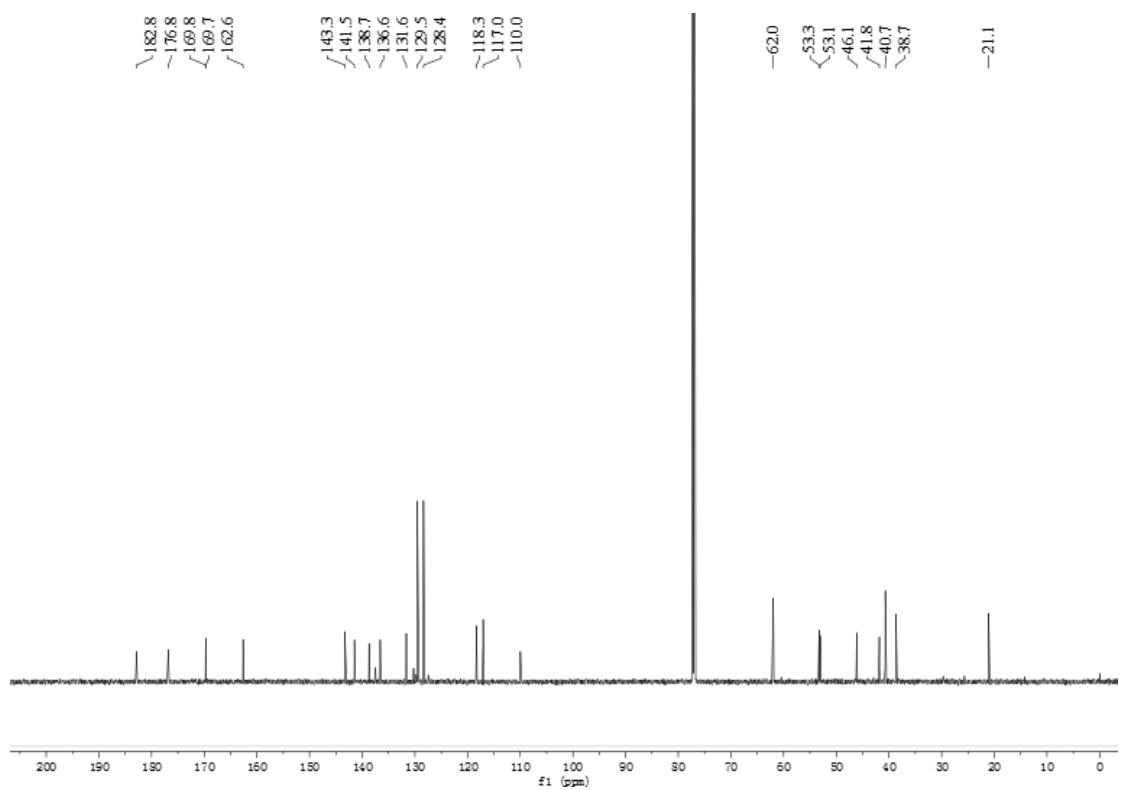


Figure S96. The HRMS of compound **1q**



**Figure S97.** The <sup>1</sup>H-NMR (600MHz, CDCl<sub>3</sub>) spectrum of compound **1r**



**Figure S98.** The <sup>13</sup>C-NMR (150MHz, CDCl<sub>3</sub>) spectrum of compound **1r**

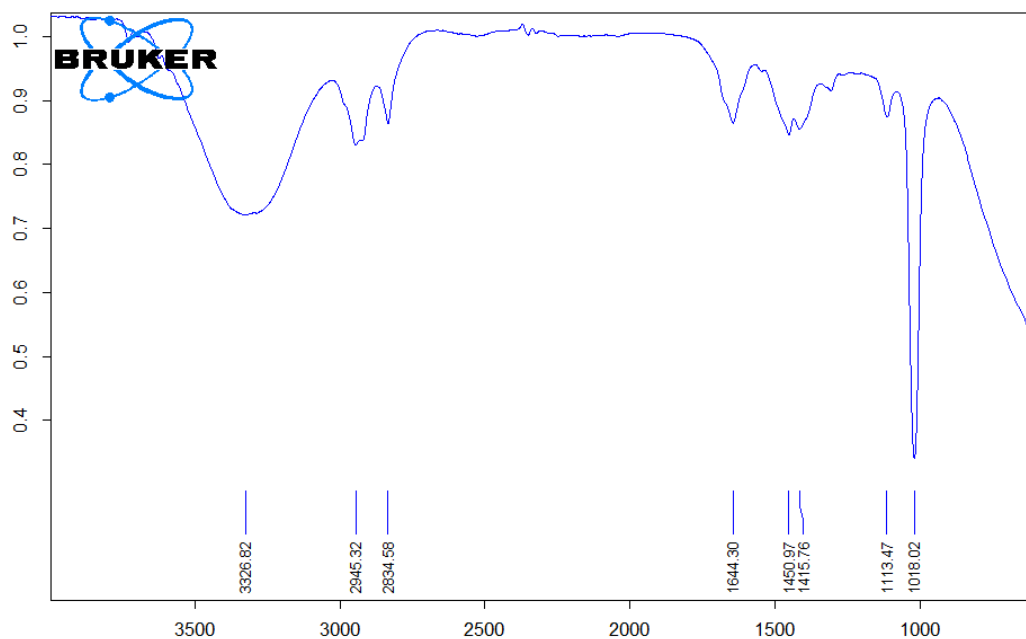


Figure S99. The IR spectrum of compound **1r**

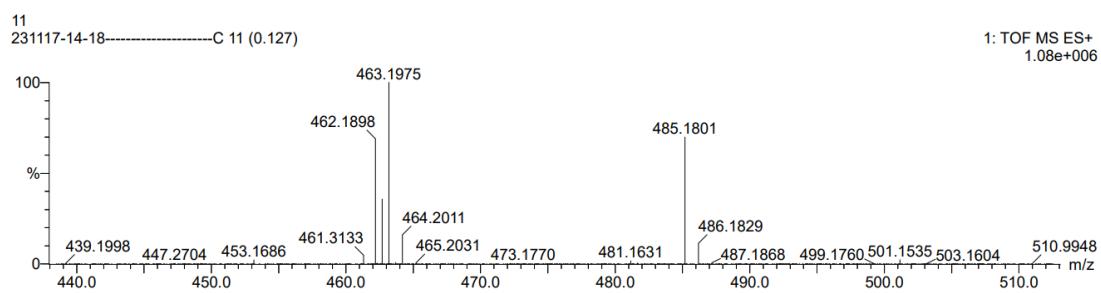
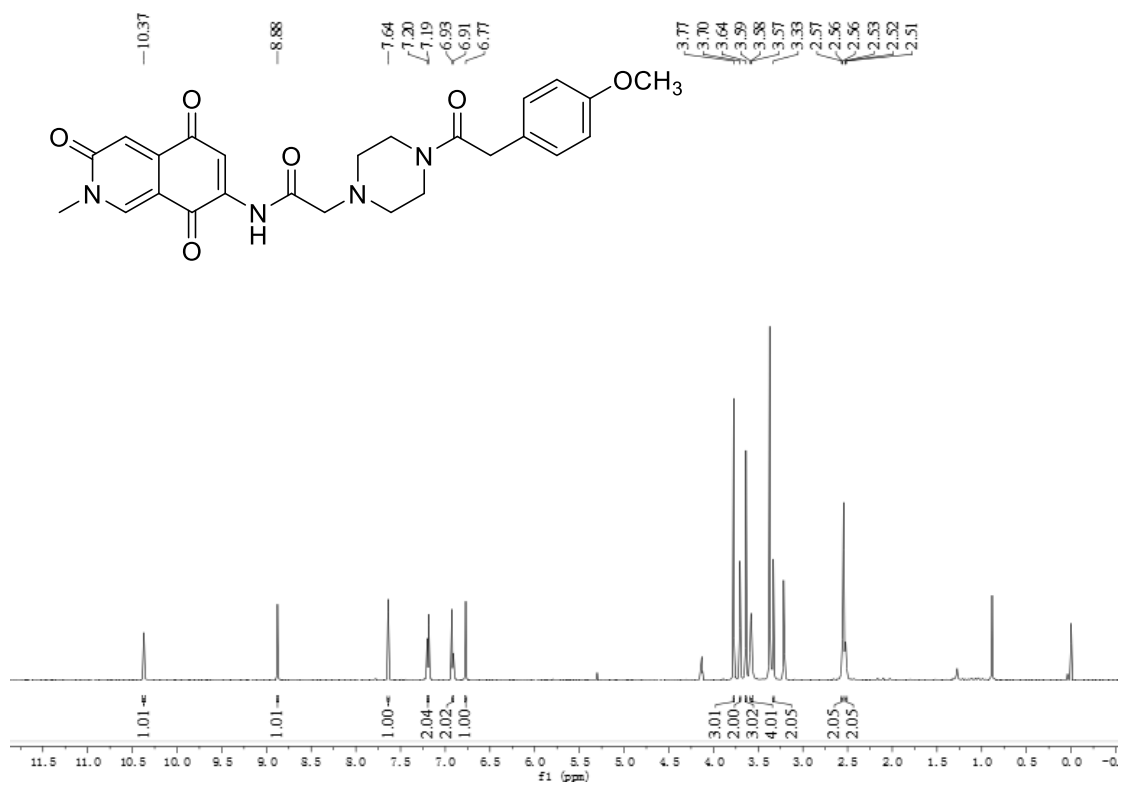
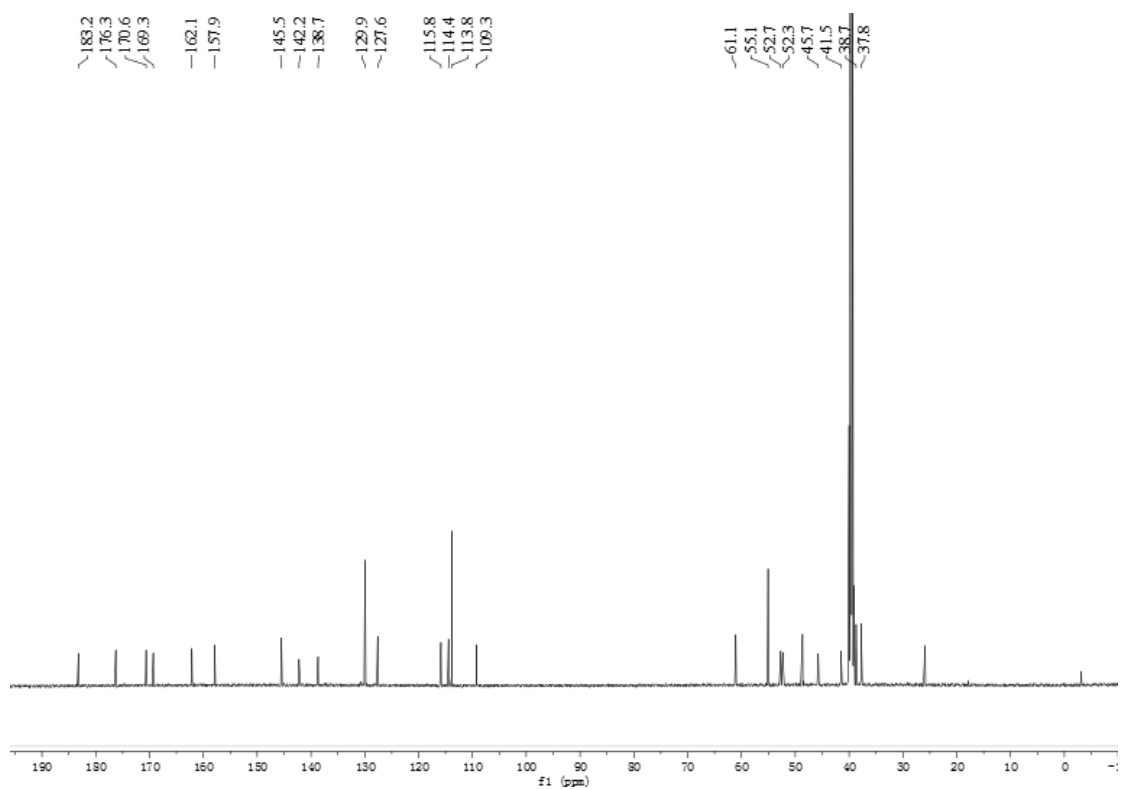


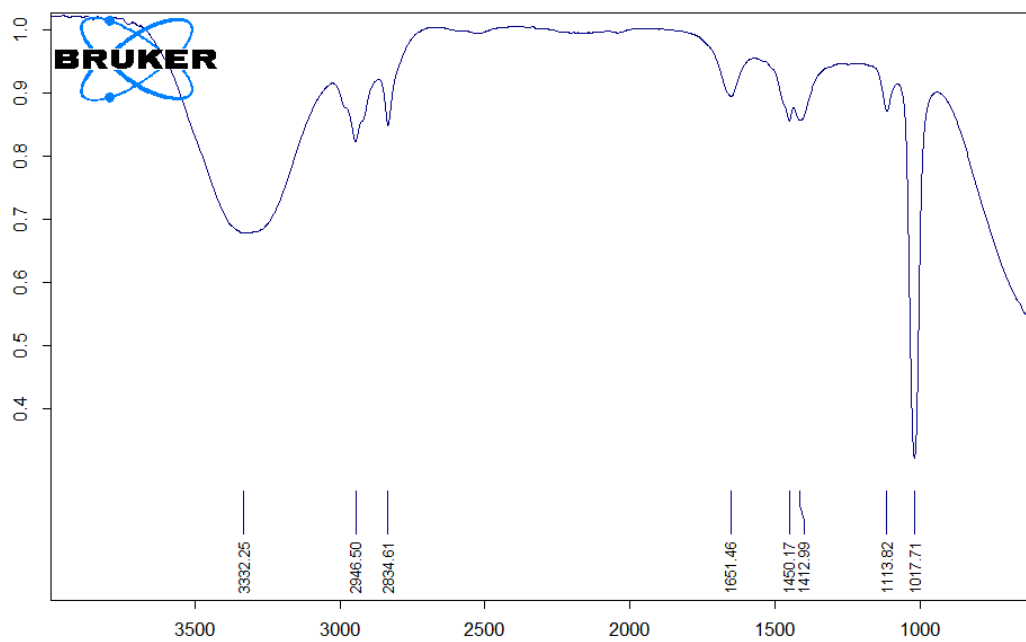
Figure S100. The HRESIMS of compound **1r**



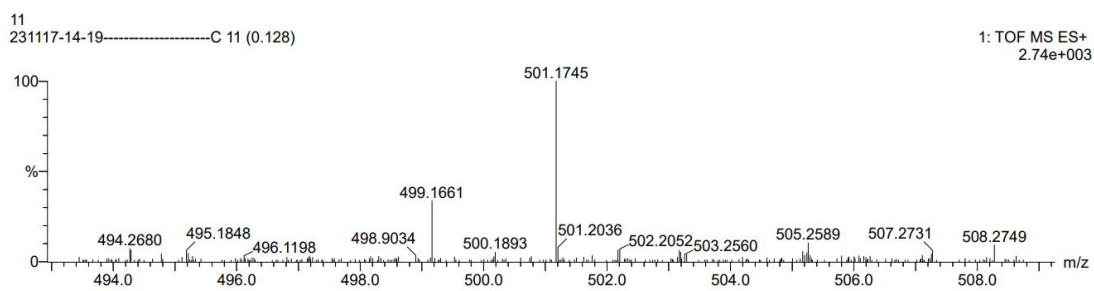
**Figure S101.** The  $^1\text{H-NMR}$  (600MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1s**



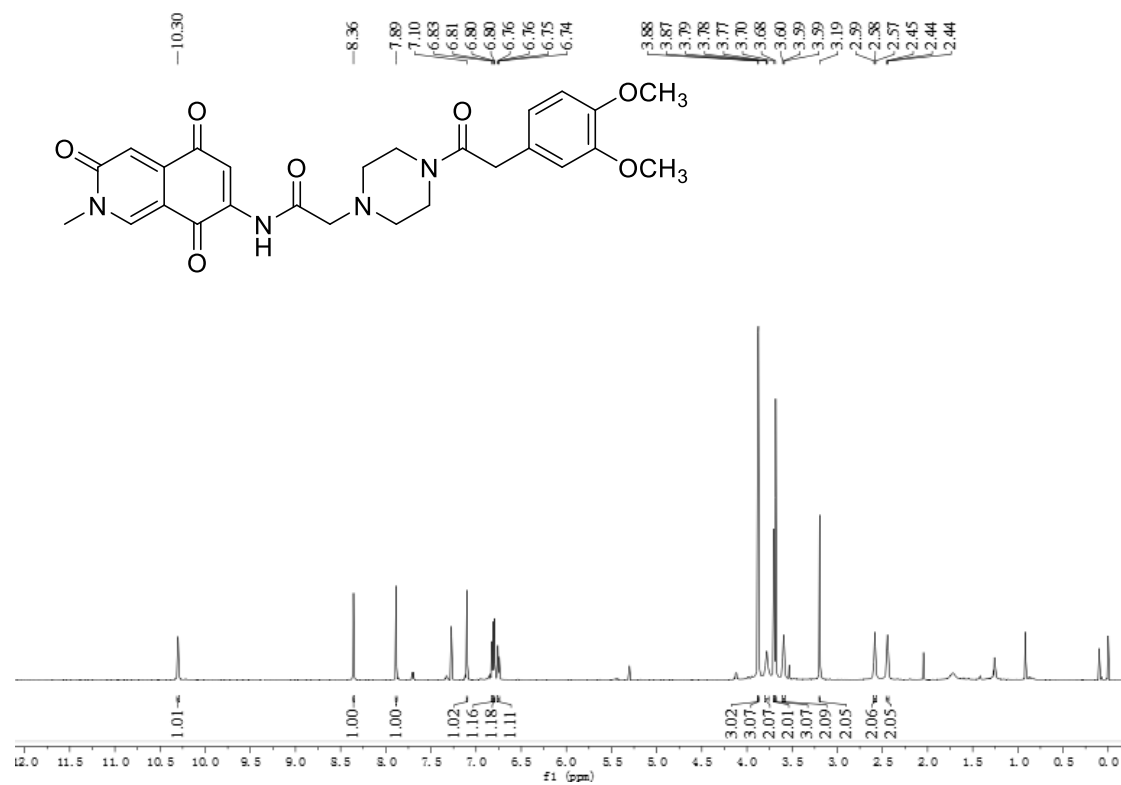
**Figure S102.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1s**



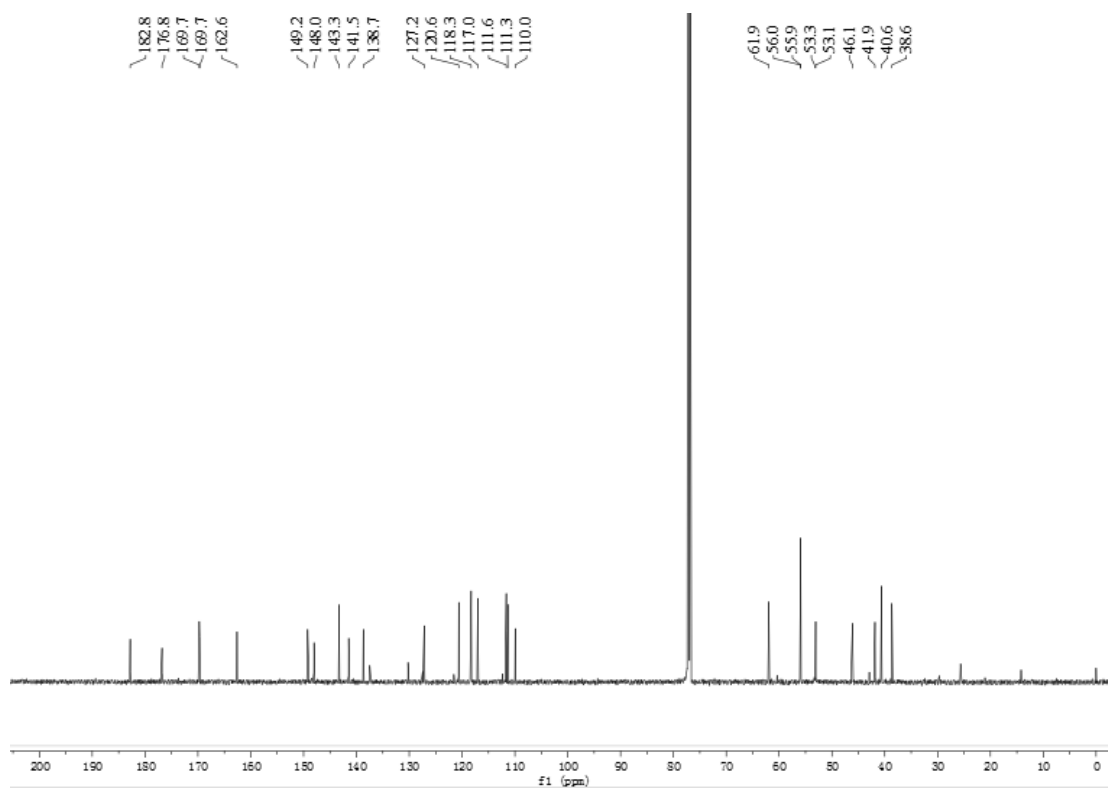
**Figure S103.** The IR spectrum of compound **1s**



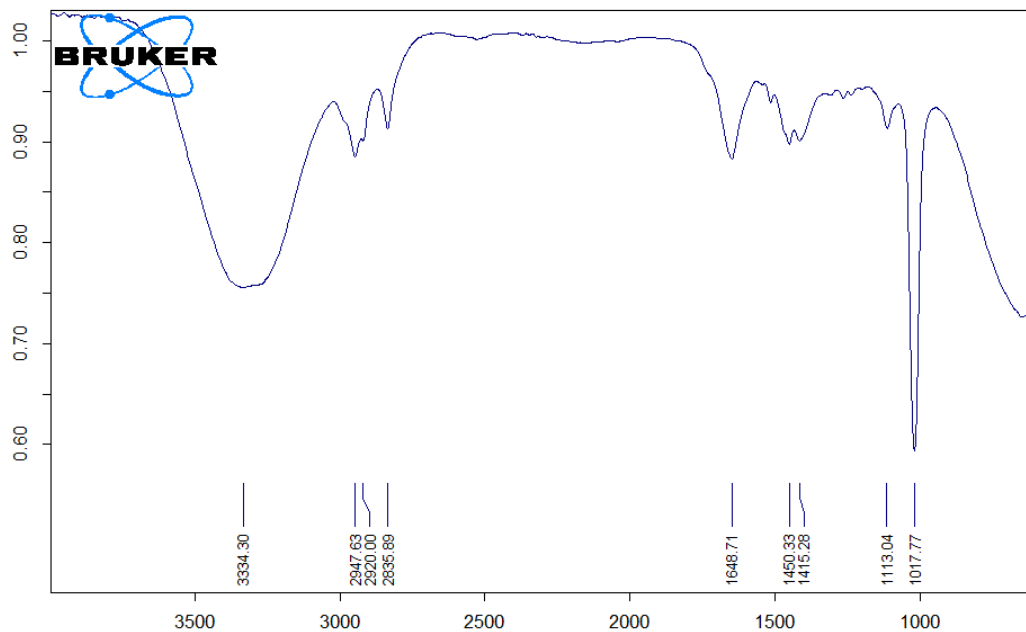
**Figure S104.** The HRESIMS of compound **1s**



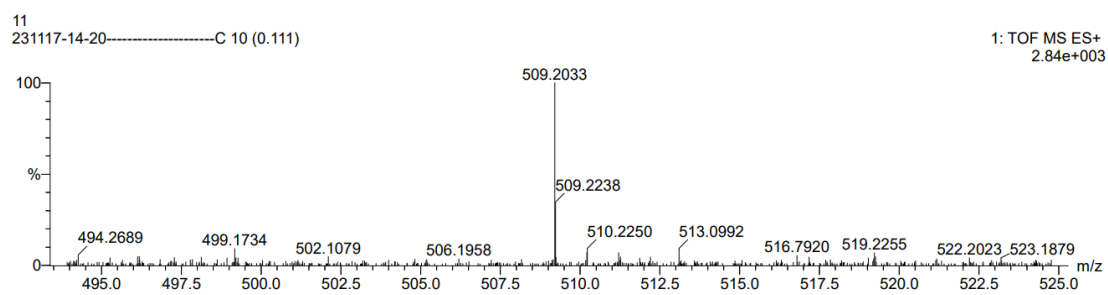
**Figure S105.** The  $^1\text{H-NMR}$  (600MHz,  $\text{CDCl}_3$ ) spectrum of compound **1t**



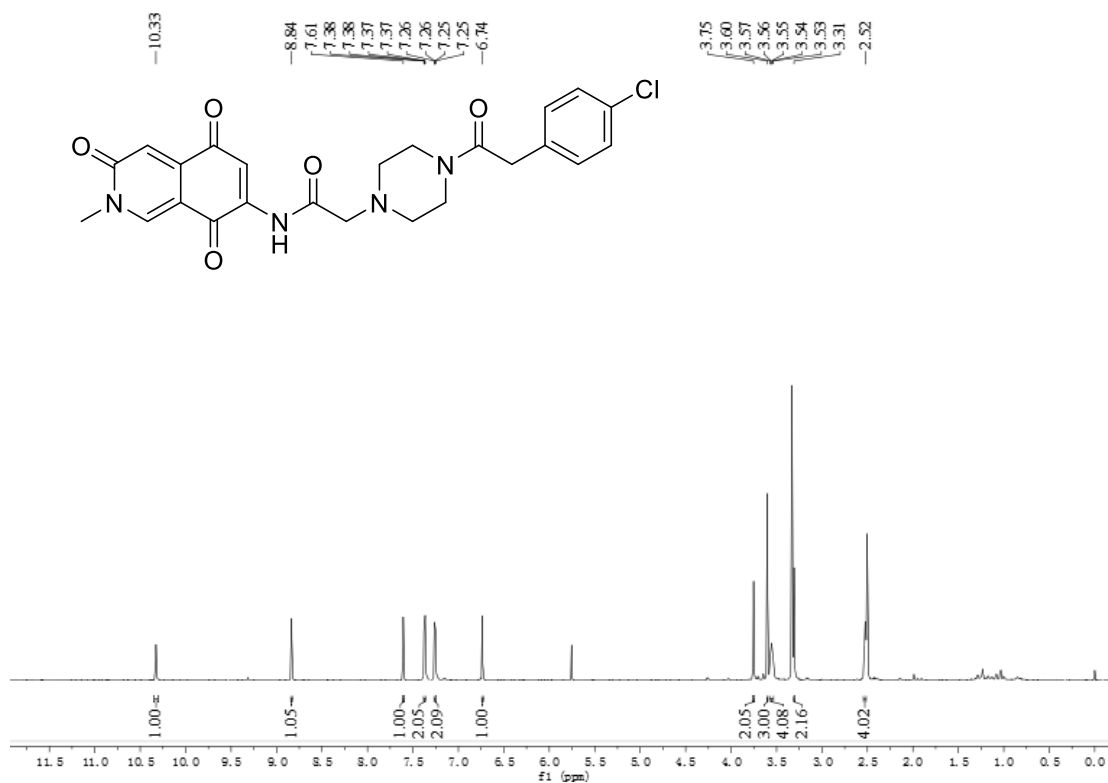
**Figure S106.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{CDCl}_3$ ) spectrum of compound **1t**



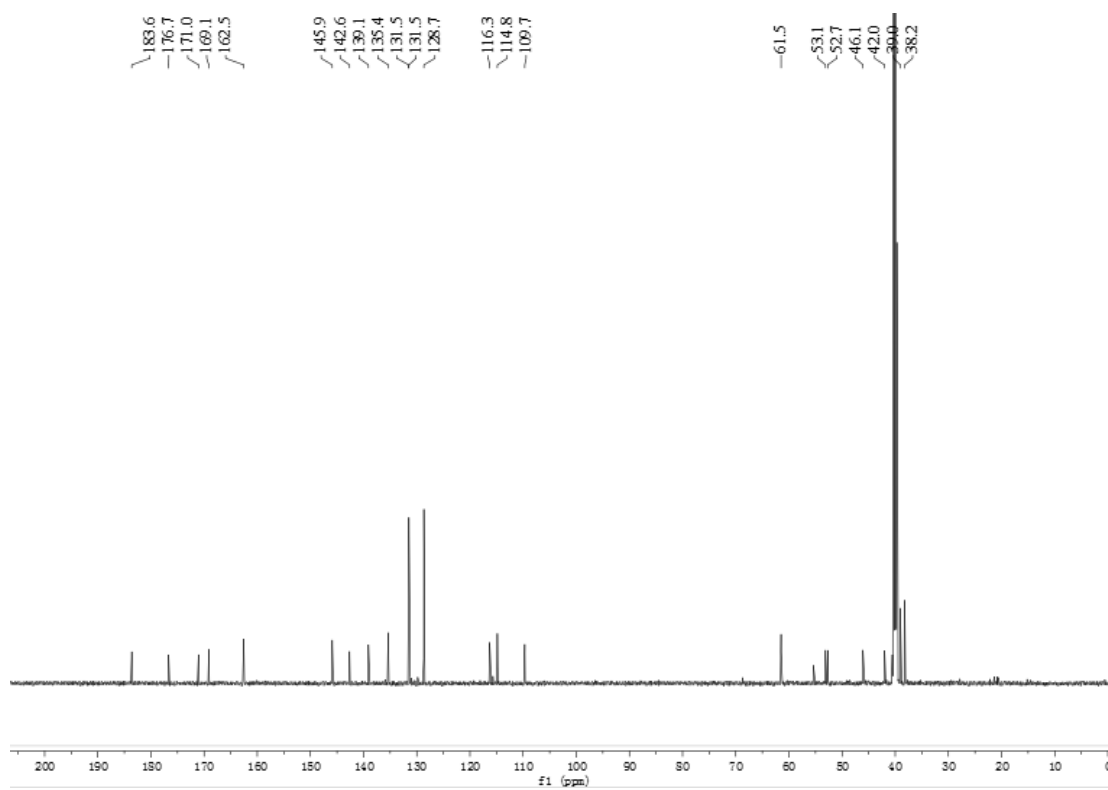
**Figure S107.** The IR spectrum of compound **1t**



**Figure S108.** The HRESIMS of compound **1t**

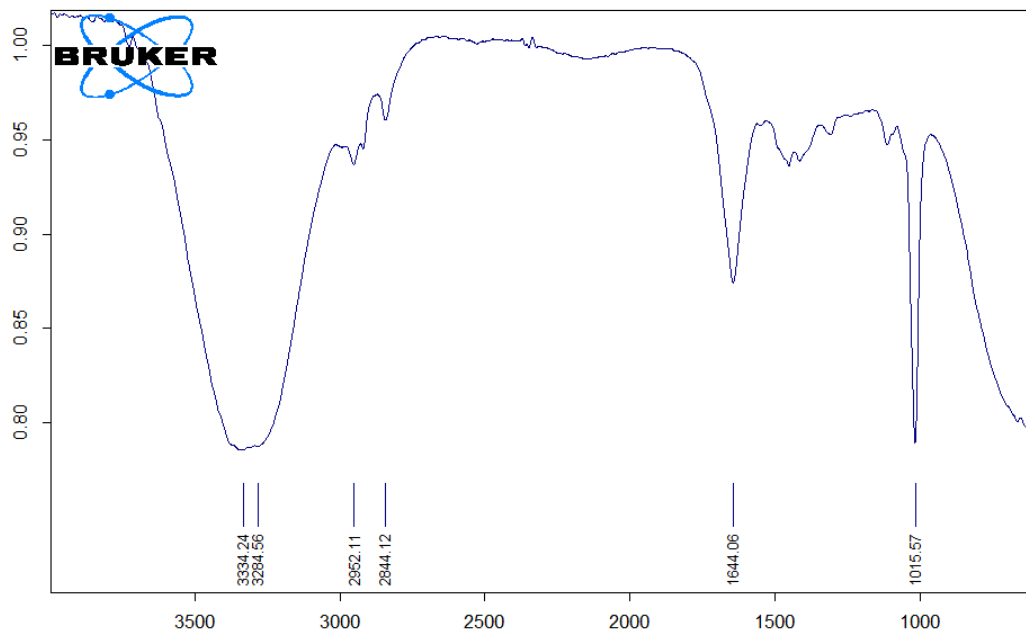


**Figure S109.** The  $^1\text{H-NMR}$  (600MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1u**

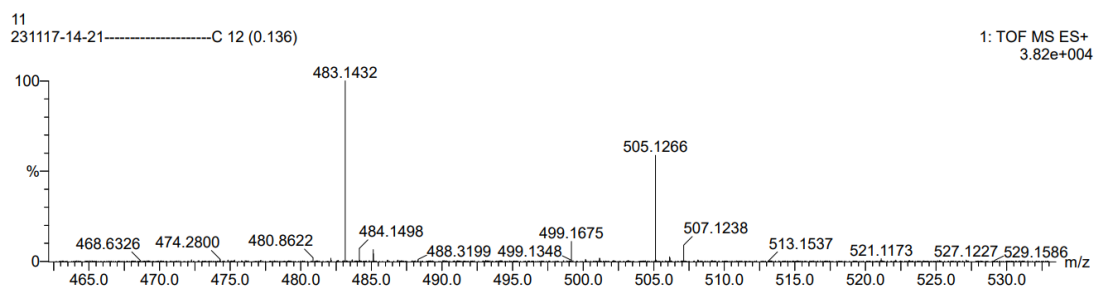


**Figure S110.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1u**

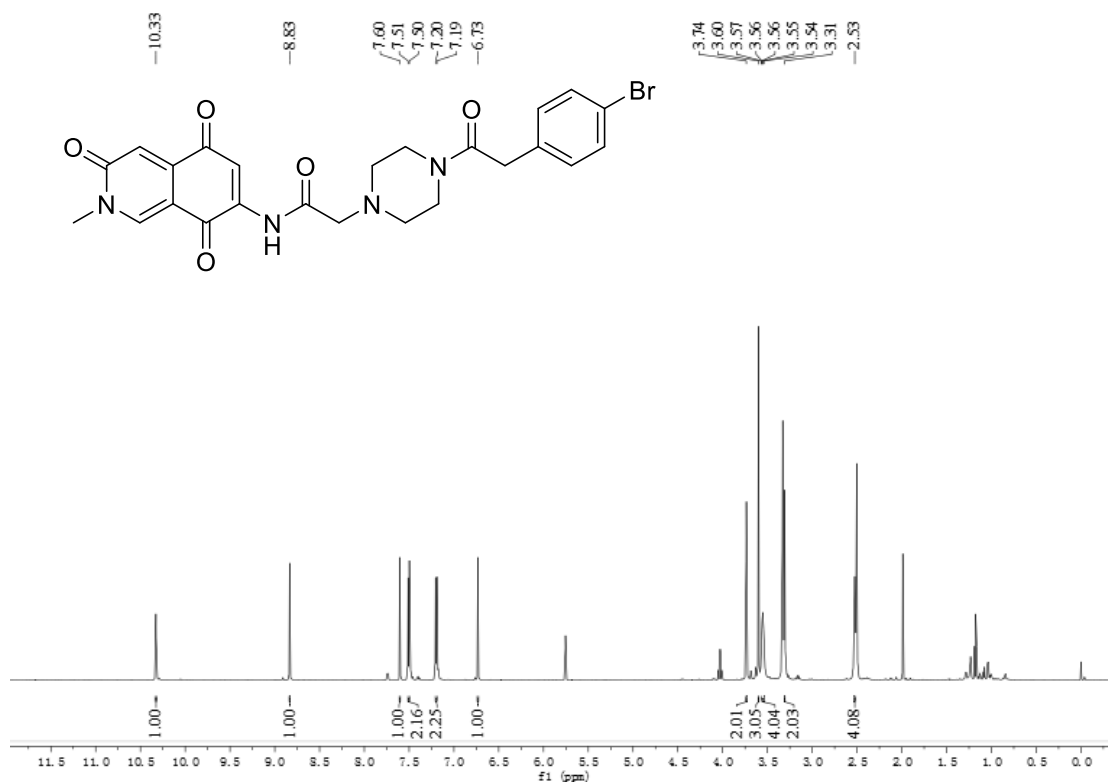




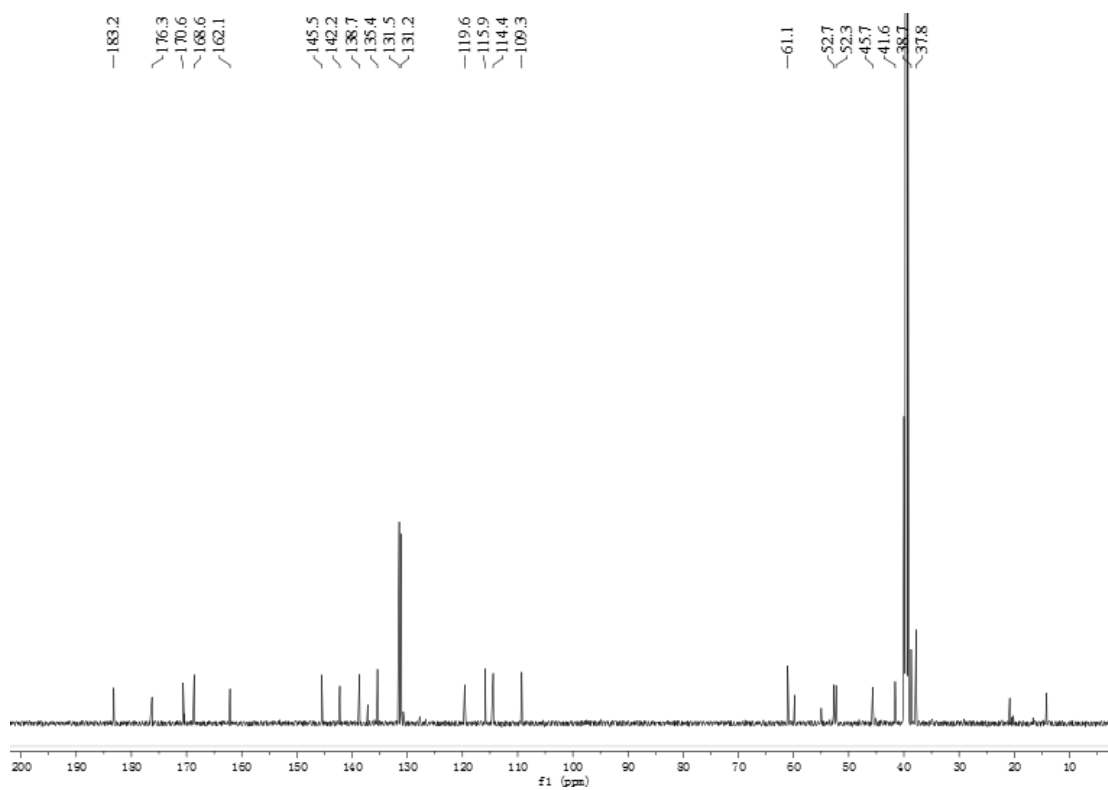
**Figure S111.** The IR spectrum of compound **1u**



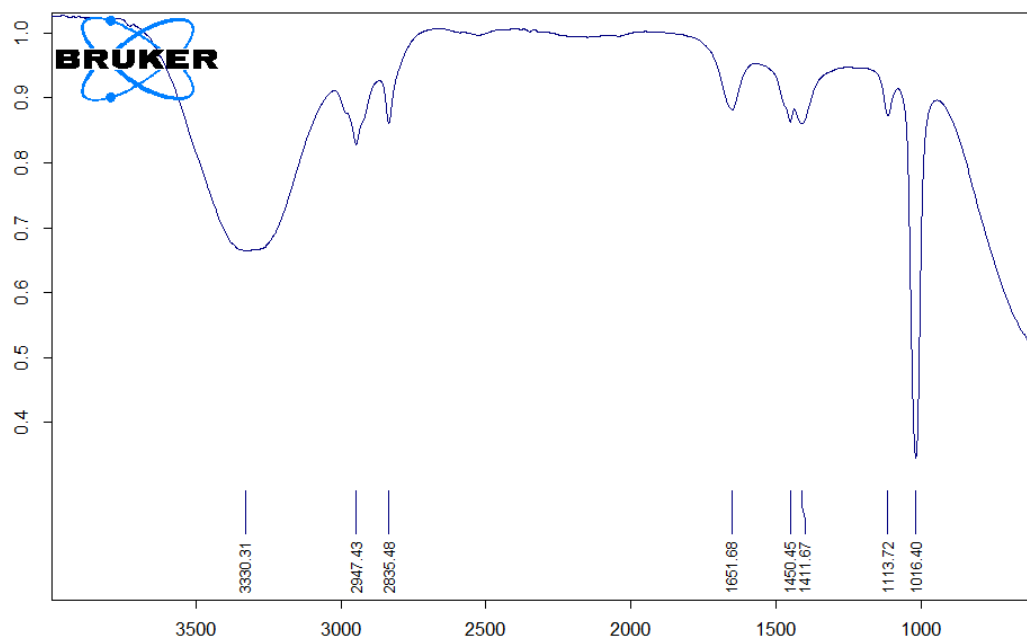
**Figure S112.** The HRESIMS of compound **1u**



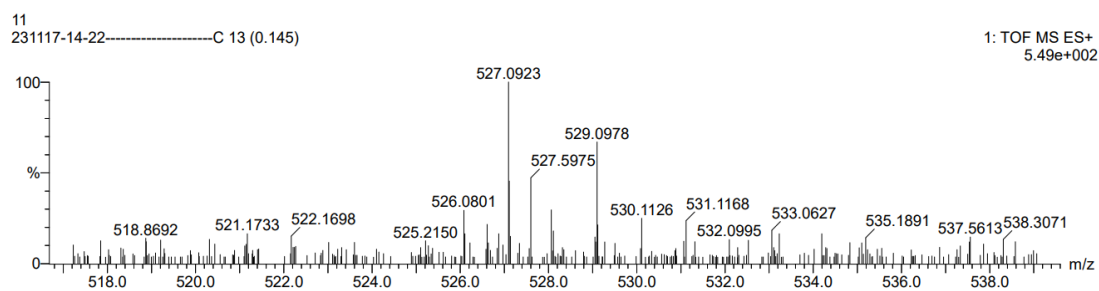
**Figure S113.** The  $^1\text{H-NMR}$  (600MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1v**



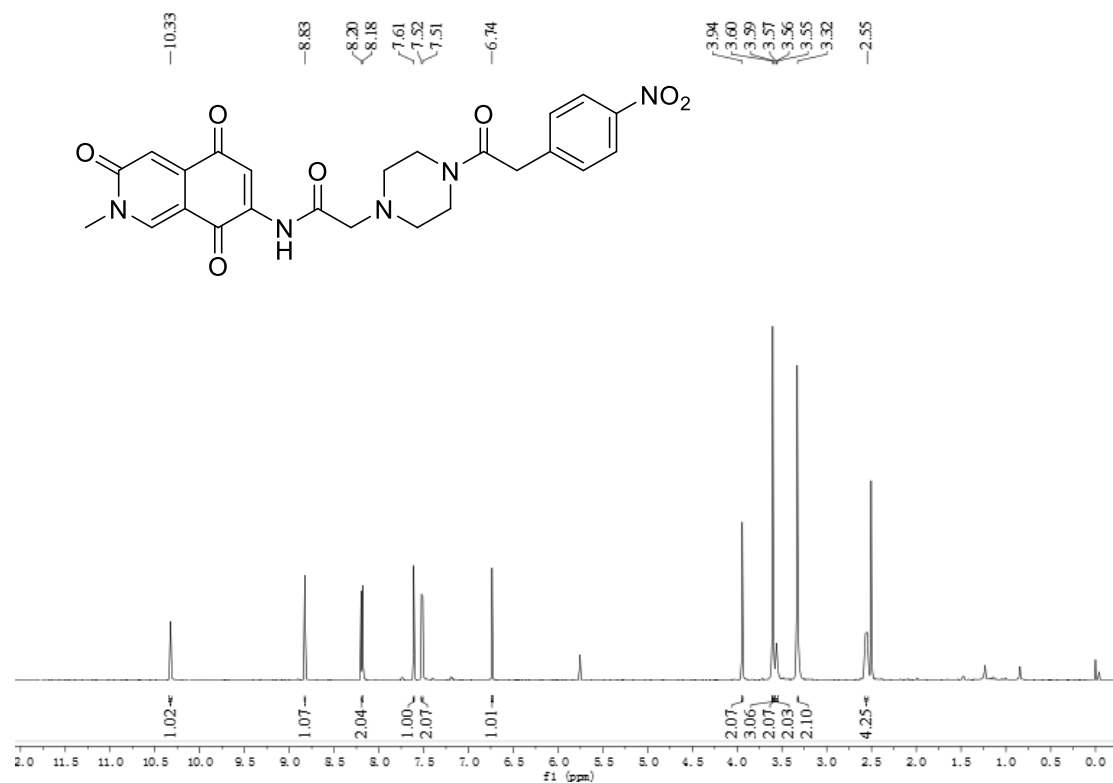
**Figure S114.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1v**



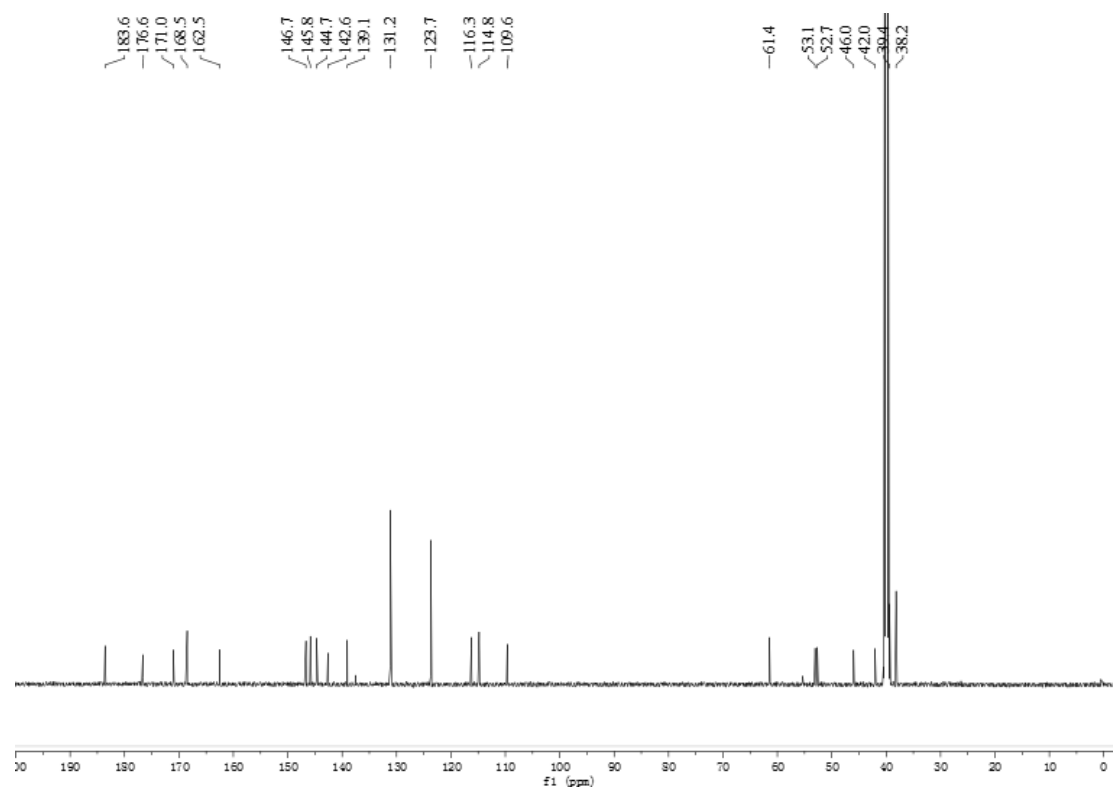
**Figure S115.** The IR spectrum of compound **1v**



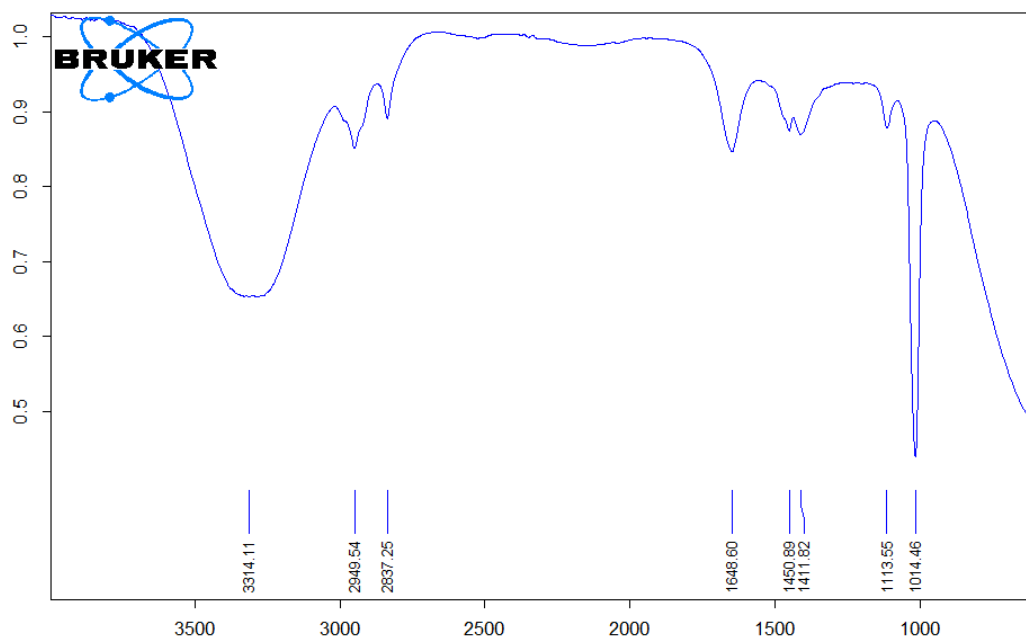
**Figure S116.** The HRESIMS of compound **1v**



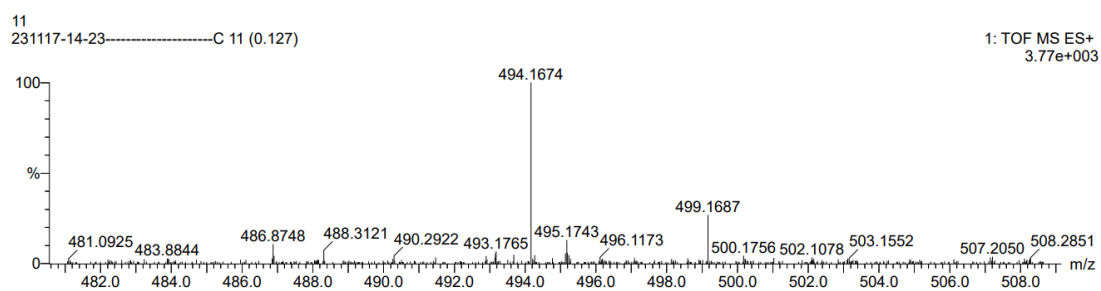
**Figure S117.** The  $^1\text{H-NMR}$  (600MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1w**



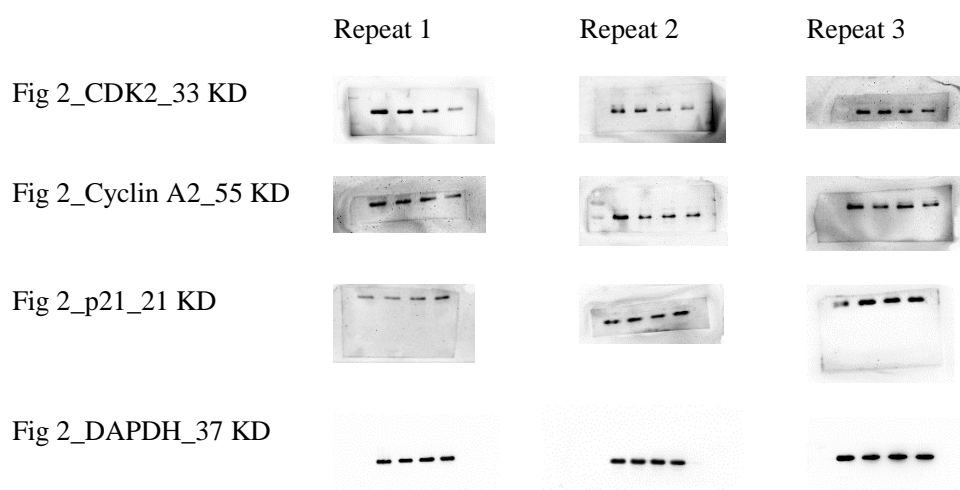
**Figure S118.** The  $^{13}\text{C-NMR}$  (150MHz,  $\text{DMSO-}d_6$ ) spectrum of compound **1w**



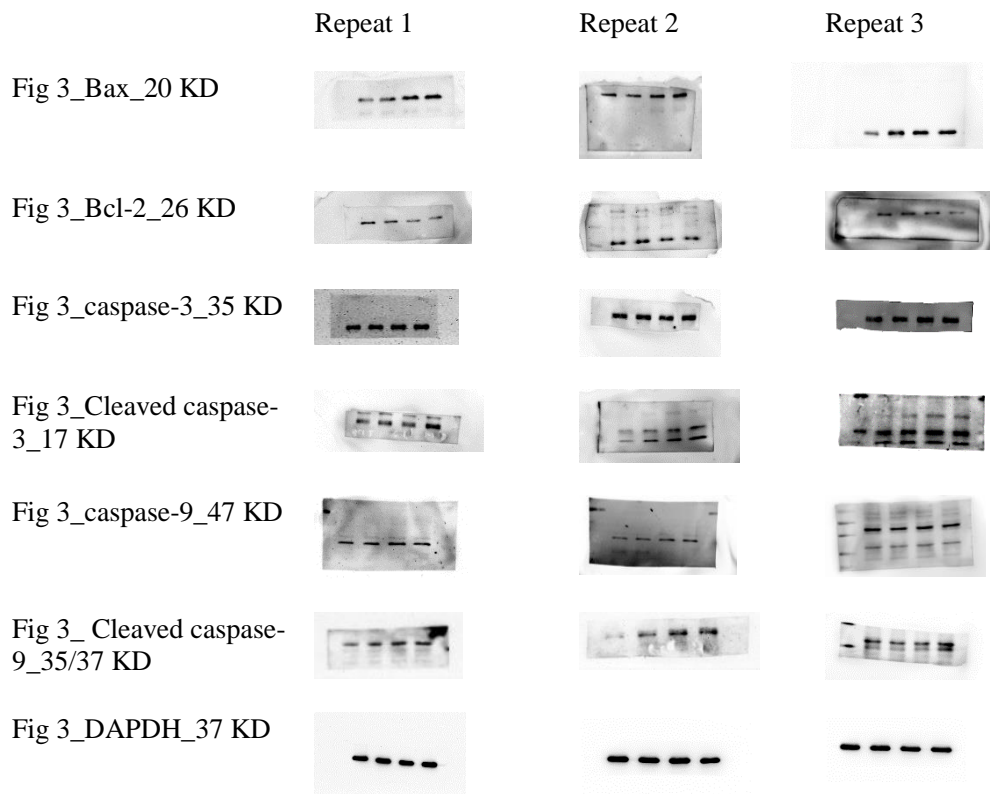
**Figure S119.** The IR spectrum of compound **1w**



**Figure S120.** The HRESIMS of compound **1w**



**Figure S121** Un-cropped images of the original Western blots for three repeats in **Figure 2**



**Figure S122** Un-cropped images of the original Western blots for three repeats in **Figure 3**

**Table S1** List of primary antibodies

primary antibodies	species	corporation
GAPDH	Rabbit	Cell Signaling Technology (USA)
p21	Rabbit	Cell Signaling Technology (USA)
CDK2	Rabbit	Cell Signaling Technology (USA)
Cyclin A2	Rabbit	Cell Signaling Technology (USA)
Caspase-3	Rabbit	Cell Signaling Technology (USA)
Caspase-9	Mouse	Cell Signaling Technology (USA)
Bcl-2	Rabbit	Cell Signaling Technology (USA)
Bax	Rabbit	Cell Signaling Technology (USA)