Supporting Information

Tunable Mono- or 1,1-Double Heck-type Coupling Reaction of Unconjugated Amido-alkenes with Remote Benzylic C(sp^3)-H of *N*-Fluorobenzamides

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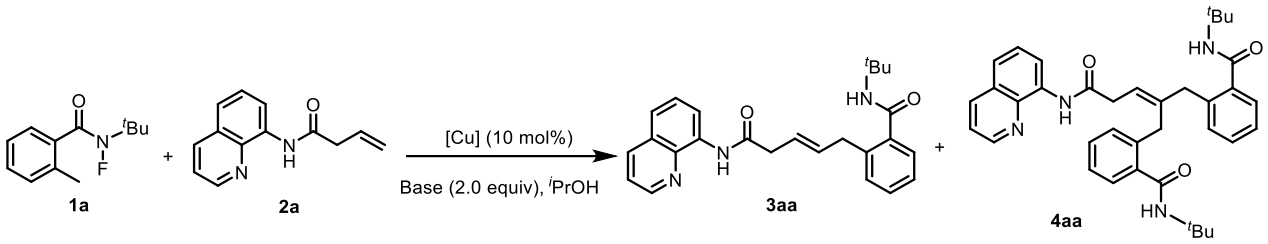
Content

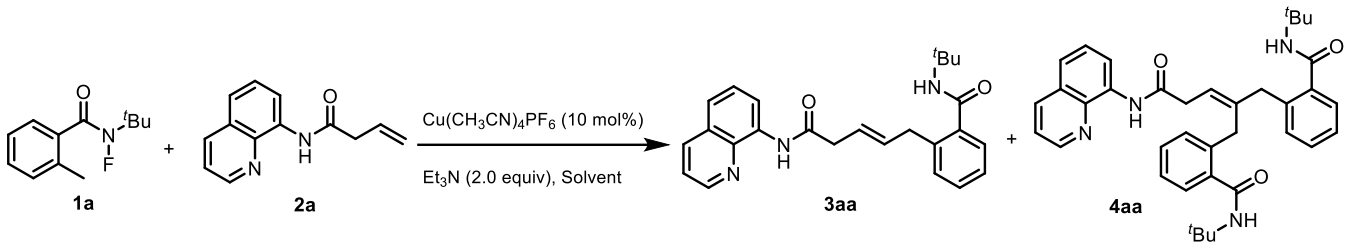
Table S1. Optimization of catalyst and base on the 1,1-double Heck-type cross-coupling reaction of **1a** and **2a**.[a]



Entry	Catalyst	Base	Yield of **3aa** (%)	Yield of **4aa** (%)
1	$Cu(OAc)_2$	/	46	22
2	$Cu(OAc)_2$	Et_3N	4	42
3	$Cu(OAc)_2$	DABCO	11	12
4	$Cu(OAc)_2$	DBU	10	12
5	$Cu(OAc)_2$	DIPEA	30	35
6	$Cu(OAc)_2$	K_3PO_4	trace	Trace
7	$Cu(OAc)_2$	Et_2NH	trace	trace
8	**$Cu(CH_3CN)_4PF_6$**	**Et_3N**	**8**	**55**
9	$Cu(CH_3CN)_4BF_4$	Et_3N	10	45
10	CuCl	Et_3N	trace	5
11	$CuCl_2$	Et_3N	15	10
12	CuI	Et_3N	trace	trace
13	CuBr	Et_3N	trace	trace
14	$Cu(CH_3CN)_4PF_6$ (20 mol%)	Et_3N	15	38
15	$Cu(CH_3CN)_4PF_6$ (5 mol%)	Et_3N	7	52

[a] The yields were determined by ^1H NMR of crude product with C_6H_5CHO as an internal standard sample. DABCO: 1,4-diazabicyclo[2.2.2]octane. DBU: 1,8-diazabicyclo[5.4.0]undec-7-ene. DIPEA: Diisopropylethylamine. N. R.: no reaction.

Table S2. Optimization of solvent and temperature on the 1,1-double Heck-type cross-coupling reaction of **1a** and **2a**.[a]



Entry	Temp (°C)	Solvent	Yield of **3aa** (%)	Yield of **4aa** (%)
1	80	^{i}PrOH	N. R.	N. R.
2	85	^{i}PrOH	22	40
3	95	^{i}PrOH	10	55
4	90	CH_3CN	22	39
5	90	Dioxane	trace	trace
6	90	DMSO	N. R.	N. R.
7	90	DMF	N. R.	N. R.
8	90	DCE	10	12
9	90	CH_3CN/^{i}PrOH=1:1	11	60
10	90	CH_3CN/^{i}PrOH=1:2	12	70
11	**90**	**CH_3CN/^{i}PrOH=1:3**	**9**	**74 (71[b])**

[a] The yields were determined by ^{1}H NMR of crude product with C_6H_5CHO as an internal standard sample. N. R.: no reaction. [b] Isolated yield.

I. General Information

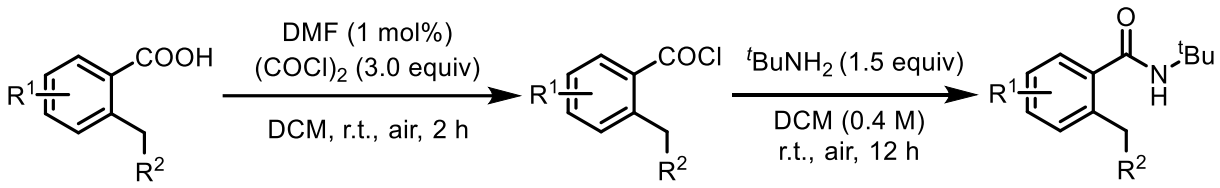
Unless otherwise noted, reagents and solvents were purchased from commercial suppliers (such as Energy Chemical Corporation, J&K Scientific, Tianjin Xiensi Biochemical Technology Co., Ltd. etc.) and

used without further purification. ^{1}H NMR, ^{13}C NMR and ^{19}F NMR spectra were recorded at 25 ºC on Bruker Advance 400M NMR spectrometers ($CDCl_3$). Chemical shifts for ^{1}H NMR spectra were reported as δ in parts per million (ppm) downfield from $SiMe_4$ (δ 0.00) and relative to the signal of $CDCl_3$ residual peak (δ 7.26 singlet). Multiplicities were given as: s (singlet); d (doublet); t (triplet); q (quartet); dd (doublet of doublets); dt (doublet of triplets); m (multiplets) etc. Chemical shifts for ^{13}C NMR spectra were reported as δ in parts per million (ppm) downfield from $SiMe_4$ (δ 0.00) and relative to the signal of $CDCl_3$ (δ 77.2 triplet). Coupling constants were reported as J value in Hz. High-resolution mass spectral analysis (HRMS) was performed on Waters Xevo G2-XS using electrospray ionization (ESI). Chromatography was performed using 200-300 mesh silica gel with the indicated solvent system. Melting points were measured by X-5 Micro Melting Point Detector.

II. Experiment Procedures

(1) Synthesis of Substrates

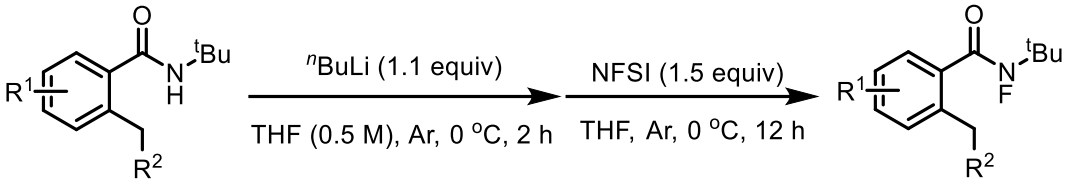
(a) Synthesis of *N*-(*tert*-butyl)amide **S1-3**



S1-1 **S1-2** **S1-3**

To a stirred solution of **S1-1** (10 mmol, 1.0 equiv) and *N*,*N*-Dimethylformamide (DMF, 1 mol%) in dichloromethane (DCM, 10 mL) at room temperature under air atmosphere in a round-bottom flask, $(COCl)_2$ (3.81 g, 30 mmol, 3.0 equiv) was added dropwise and the reaction was stirred for at least 2 h until no bubbles emerge from the system. Then, the solution was filtered and concentrated under reduced pressure directly to remove excess $(COCl)_2$ and DCM. The crude residue (**S1-2**) was directly applied to next step without further purification. DCM (40 mL) was re-added to the crude product and $^{t}BuNH_2$ (1.83 g, 25 mmol, 2.5 equiv) was added dropwise, the reaction was stirred for another 12 h until the complete consumption of starting material. After completion, the mixture was filtered and concentrated under reduced pressure. The residual solid was purified by flash chromatography on silica gel to afford *N*-(*tert*-butyl)amide **S1-3**.

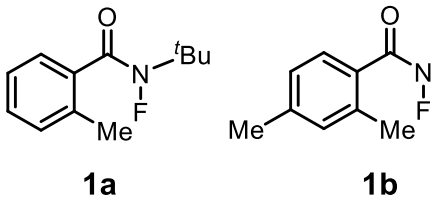
(b) Synthesis of *N*-(*tert*-butyl)-*N*-fluoroamides **1**



S1-3 **1**

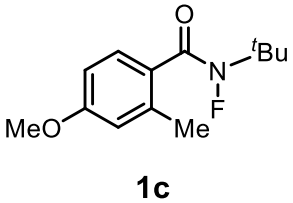
All the following N-F amides **1** (5 mmol) were synthesized according to the reported procedure.[1] To a Schlenk tube containing **S1-3** was added anhydrous THF (50 mL) under argon atmosphere, the mixture was stirred until **S1-3** was completely dissolved and the solution was cooled down to 0 °C with the aid of cryogenic reactors. ^{n}BuLi (1.1 equiv, 2.5 M solution in *n*-hexane) was added dropwise and the reaction was stirred for 2 h. *N*-Fluorobenzenesulfonimide (NFSI) (2.37 g, 1.5 equiv, 0.7 M in THF) was added dropwise (~ 1 drop/sec). The resulting mixture was stirred at 0 °C overnight and then allowed to warm up to room temperature. After 12 h, the reaction was quenched with 1 M HCl aqueous. The resulting mixture was diluted with EA (50 mL) and water (50 mL). The two layers were separated and the aqueous layer was extracted with EA three times (50 mL). The combined organic layers were washed with saturated Na_2CO_3 aqueous and then saturated NaCl aqueous, dried over anhydrous $MgSO_4$ for 30 min, filtered and concentrated under reduced pressure. The expected product *N*-fluoroamides **1** were obtained through purification by column chromatography on silica gel in 23%-37% yield.

List of *N*-fluorobenzamides **1**

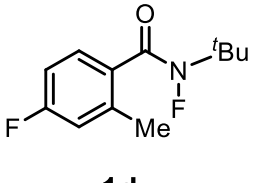


1a

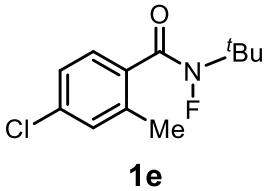
1b



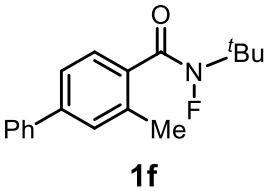
1c



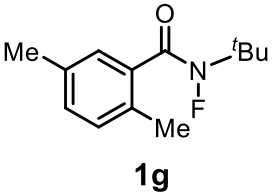
1d



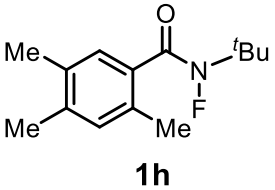
1e



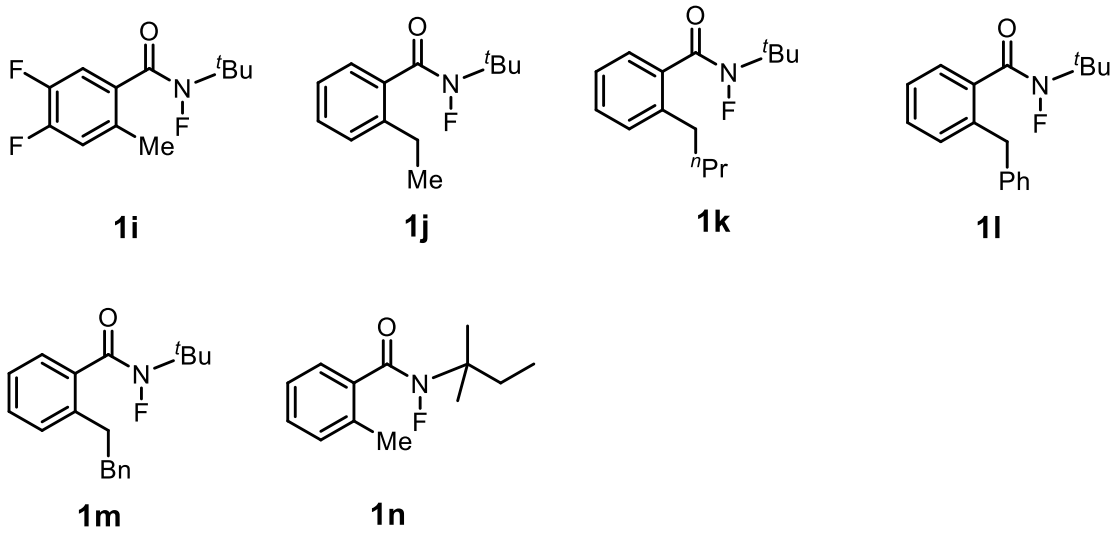
1f



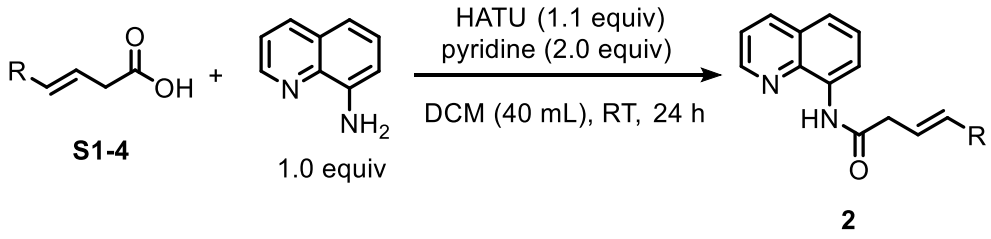
1g



1h

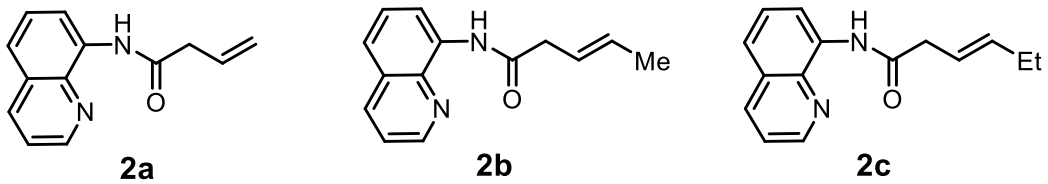


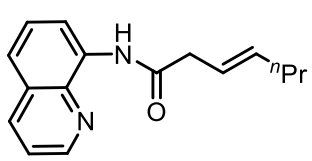
(c) Synthesis of *N*-(quinolin-8-yl)but-3-enamides **2**



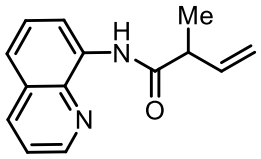
The substrates *N*-(quinolin-8-yl)but-3-enamides **2** were synthesized according to the reported procedure.[2] The acid **S1-4** (5 mmol) was charged into a 100 mL flask containing 20 mL DCM. 8-Aminoquinoline (649 mg, 4.5 mmol, 1.0 equiv), pyridine (0.73 mL, 9.0 mmol, 2.0 equiv), and 2-(7-azabenzotriazol-1-yl)-*N, N, N′, N′*-tetramethyluronium hexafluorophosphate (HATU, 1.90 g, 5.0 mmol, 1.1 equiv) were added sequentially, and the reaction was stirred at ambient temperature for 16 h. The deep brown solution was quenched with sat. $NaHCO_3$ (15 mL) and extracted with DCM. The combined organic layers were washed with brine and dried over anhydrous Na_2SO_4, concentrated in vacuo and purified by column chromatography (PE/EA = 20:1) to afford the desired products **2** in 25%-75% yields.

List of unactivated alkenes **2**

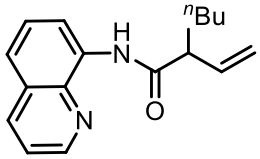




2d



2e



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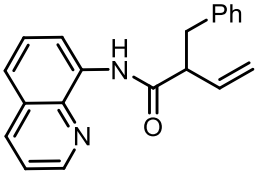
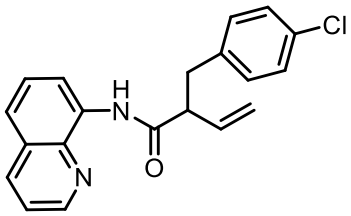
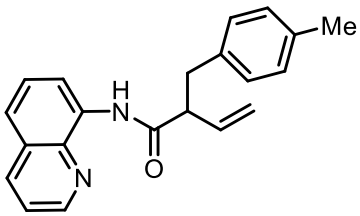


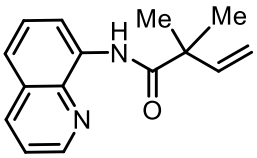
2g



2h

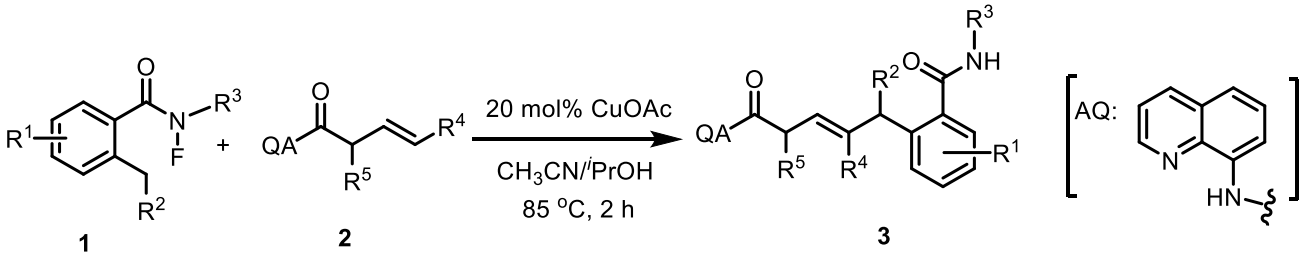


2i



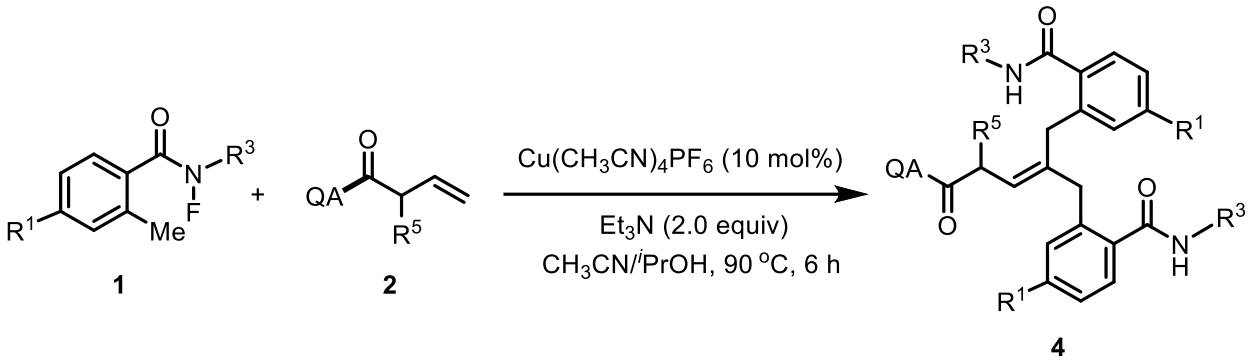
2j

(2) Synthesis of product **3**



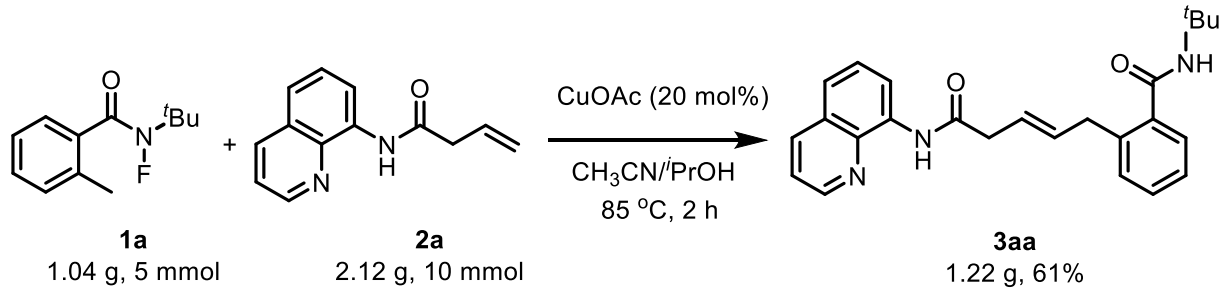
To a reaction tube containing 1 mL of solvent ($CH_3CN/^iPrOH$=1:3) was added unactivated alkene **2** (0.2 mmol, 2.0 equiv), CuOAc (2.5 mg, 0.02 mmol, 20 mol %), the mixture was stirred for 20 min at the room temperature, in that order, the *N*-fluorobenzamide **1** was added (0.1 mmol, 1.0 equiv) and the mixture was reacted for another 2 h at 85 °C. After that process, the resulting mixture was filtrated by a sand core funnel filled with silica gel and wash with dichloromethane (3×5 mL). The combined filtrates were concentrated under vacuum and purified by column chromatography on silica gel to give the product **3**.

(3) Synthesis of product **4**



The unactivated alkene **2** (0.1 mmol, 1.0 equiv), $Cu(MeCN)_4PF_6$ (3.77 mg, 0.01 mmol, 10 mol %) and Et_3N (20.2 mg, 0.2 mmol, 2.0 equiv) were sequentially added into a reaction tube with the solvents (1 mL, $CH_3CN/^iPrOH$=1:3), the mixture was stirred for 20 min at room temperature, and the *N*-fluorobenzamide **1** (0.3 mmol, 3.0 equiv) was then added and stirred for another 6 h at 90 °C. After that process, the resulting mixture was filtrated by a sand core funnel filled with silica gel and wash with DCM (3×5 mL). The combined filtrates were concentrated under vacuum and purified by column chromatography on silica gel to afford the corresponding product **4**.

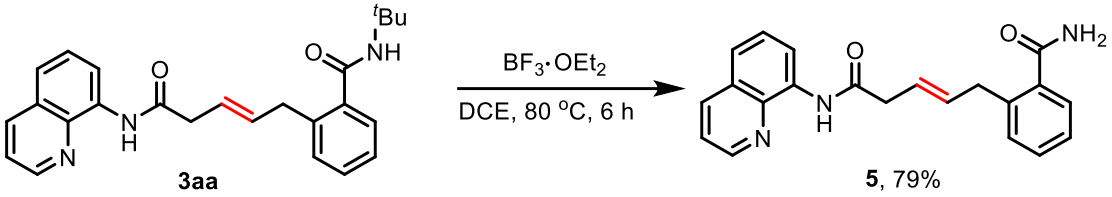
(4) Gram scale reaction



To a Schlenk tube containing 50 mL of the solvent ($CH_3CN/^iPrOH$=1:3) were added **2a** (2.12 g, 10 mmol, 2.0 equiv), CuOAc (122 mg, 1 mmol, 20 mol %), the mixture was stirred for 20 min at room temperature, in that order, the **1a** (1.04 g, 5 mmol, 1.0 equiv) was added and reacted for 2 h at 85 °C. After that process, the resulting mixture was filtrated by a sand core funnel filled with silica gel and wash with DCM (100 mL). The combined filtrates were concentrated under vacuum and purified by column chromatography on silica gel.

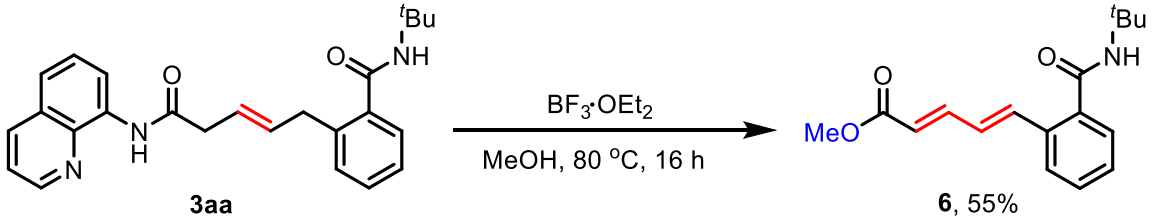
(5) Derivative reactions

(a) The removal experiment of *tert*-butyl protective group



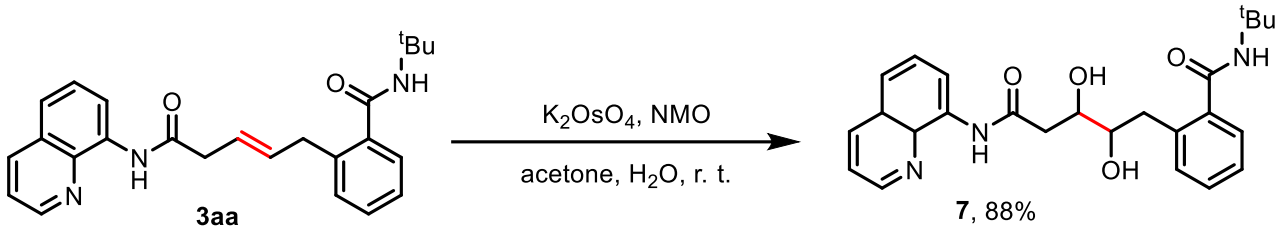
To a Schlenk tube containing 1 mL DCE was added **3aa** (40.1 mg, 0.1 mmol), the mixture was stirred for 20 min at room temperature, in that order, Boron trifluoride etherate (0.5 mmol) was added and reacted for 6 h at the 80 °C. After that process, an excess saturated solution of sodium carbonate was added to quench the reaction, then adding 5 mL dichloromethane to extract the reaction system for three times (3×5 mL), combining the organic phases, washing with saturated brine, drying with anhydrous Na_2SO_4, filtering and concentrating to give the residual, followed by the purification by the silica-gel column chromatography with PE/EA=1:1 to give the compound **5** as a colorless liquid in 79% yield (27.3 mg).

(b) Removal of 8-aminoquinoline directing group



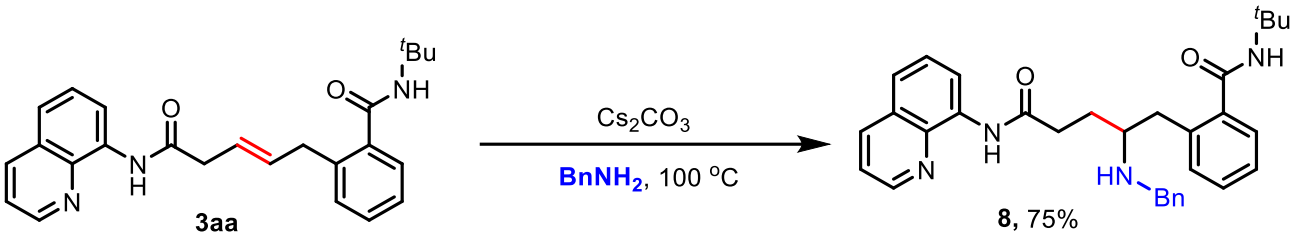
To a Schlenk tube containing 1 mL MeOH was added **3aa** (40.1 mg, 0.1 mmol), the mixture was stirred for 20 min at the room temperature, in that order, Boron trifluoride etherate (70.6 mg, 0.5 mmol) was added and reacted for 16 h at 80 °C. After that process, an excess saturated solution of sodium carbonate was added to quench the reaction, then adding 5 mL dichloromethane to extract the reaction system for three times (3×5 mL), combining the organic phases, washing with saturated brine, drying with anhydrous Na_2SO_4, filtering and concentrating to give the residual, followed by the purification by the silica-gel column chromatography with PE/EA=10:1 to generate the compound **6** as white solid (15.8 mg, yield 55%) with the removal of AQ directing group and the esterification and oxidative dehydrogenation.

(c) Double bond oxidation experiment



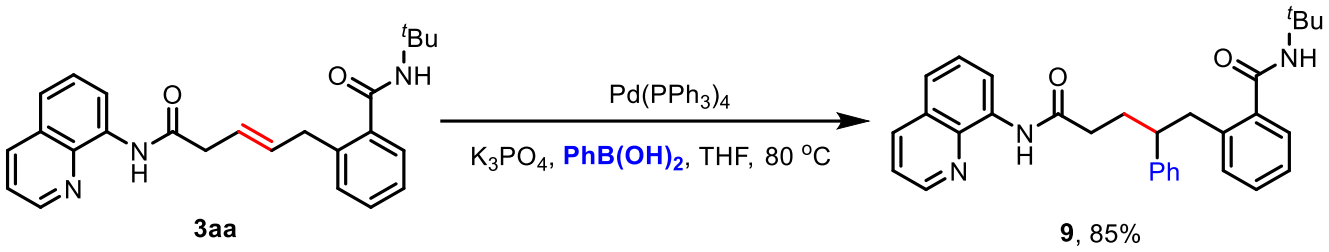
To a Schlenk tube containing 1 mL of the solvent (Acetone/H_2O=1:1) were added **3aa** (40.1 mg, 0.1 mmol), the mixture was stirred for 20 min at room temperature, in that order, added potassium osmate (3.7 mg, 0.01 mmol, 10 mmol %), 4-methylmorpholine *N*-oxide (23.4 mg, 0.2 mmol, 2.0 equiv) and reacted for 16 h at the 80 °C. After that process, add an excess saturated solution of sodium carbonate to quench the reaction, then add 5 mL of dichloromethane to extract the reaction system three times, merge the organic phases, wash with saturated salt water, spin dry, followed by the purification by the silica-gel column chromatography with PE/EA=1:1 to generate the compound **7** as white solid (26.3 mg, yield 88%).

(d) Hydroamination reaction



To a Schlenk tube containing 0.1 mL of the $BnNH_2$ were added **3aa** (0.1 mmol, 20.9 mg), in that order, added Cs_2CO_3 (0.01 mmol, 3.5 mg, 10 mmol %) and reacted for 16 h at the 80 °C. After that process, add an excess saturated solution of sodium carbonate to quench the reaction, then add 5 mL of dichloromethane to extract the reaction system three times, merge the organic phases, wash with saturated salt water, spin dry, and purify the column with PE/EA=5:1 to give the compound **8** as colorless liquid (38.1 mg, yield 75%).

(e) Double bond functionalization experiment

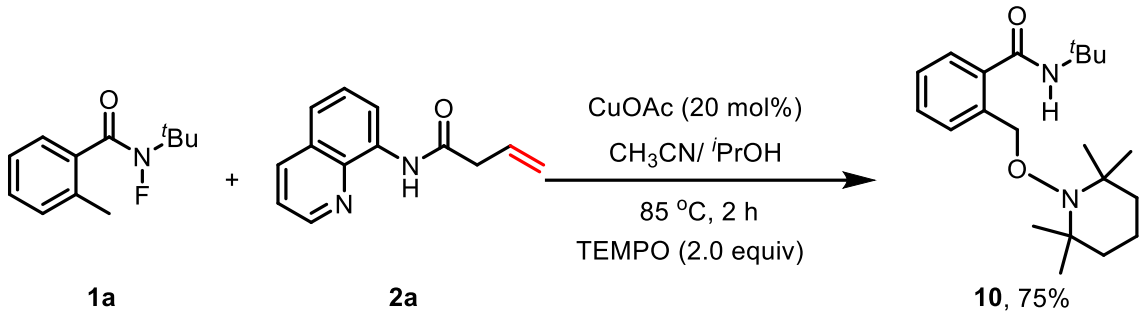


3aa **9**, 85%

To a Schlenk tube containing 1 mL of the THF was added **3aa** (40.1 mg, 0.1 mmol), the mixture was stirred for 20 min at the room temperature, in that order, added $Pd(PPh_3)_4$ (3.5 mg, 0.005 mmol, 5 mmol %), K_3PO_4 (42.4 mg, 0.2 mmol, 2.0 equiv), $PhB(OH)_2$ (18.2 mg, 0.15 mmol, 1.5 equiv) and reacted for 16 h at 80 °C. After that process, add an excess saturated solution of sodium carbonate to quench the reaction, then add 5 mL of dichloromethane to extract the reaction system three times, merge the organic phases, wash with saturated salt water, spin dry, and purify the column with PE/EA=5:1 to generate the compound **9** as a white solid (26.4 mg, yield 85%).

(6) Specific operations of control experiments

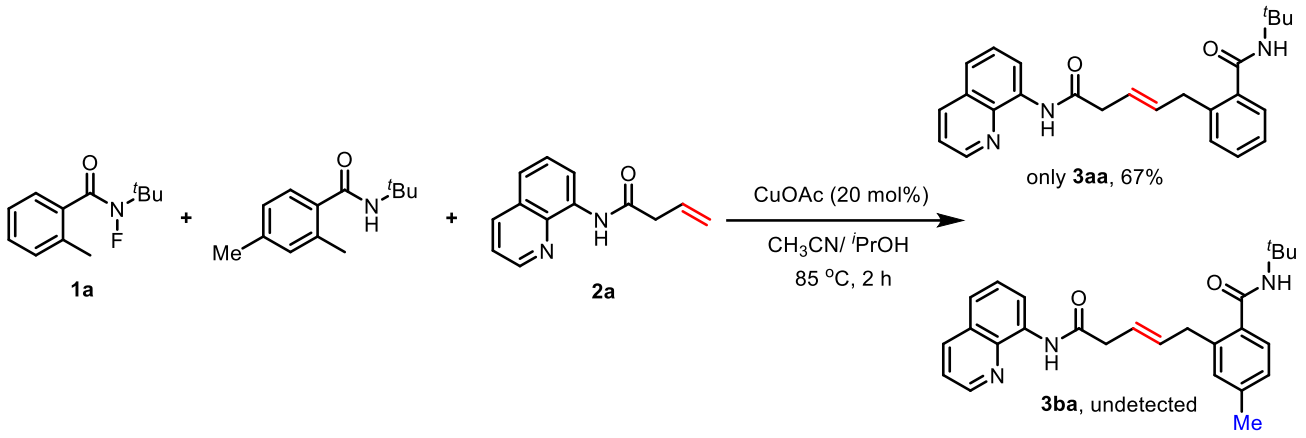
(a) Free radical capture experiment



1a **2a** **10**, 75%

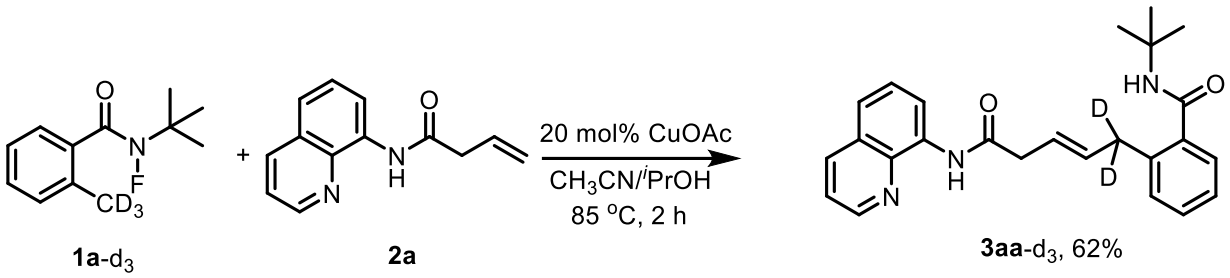
To a Schlenk tube containing 1 mL of the solvent (CH_3CN/^{i}PrOH=1:3) were added **2** (0.2 mmol, 2.0 equiv), CuOAc (2.5 mg, 0.02mmol, 20 mol %), the mixture was stirred for 20 min at the room temperature, in that order, added **1a** (20.9 mg, 0.1 mmol), 2,2,2,6,6-tetramethylpyridine oxide (TEMPO) (31.2 mg, 0.2 mmol, 2.0 equiv) and reacted for 2 h at the 85 °C. After that process, the resulting mixture was filtrated by a sand core funnel filled with silica gel and wash with DCM (5 mL). The combined filtrates were concentrated under vacuum and purified by column chromatography on silica gel. The product resulting from the TEMPO-mediated reaction with **1a** was isolated with a yield of 75% (26.0 mg).

(b) 1,5-HAT validation experiment



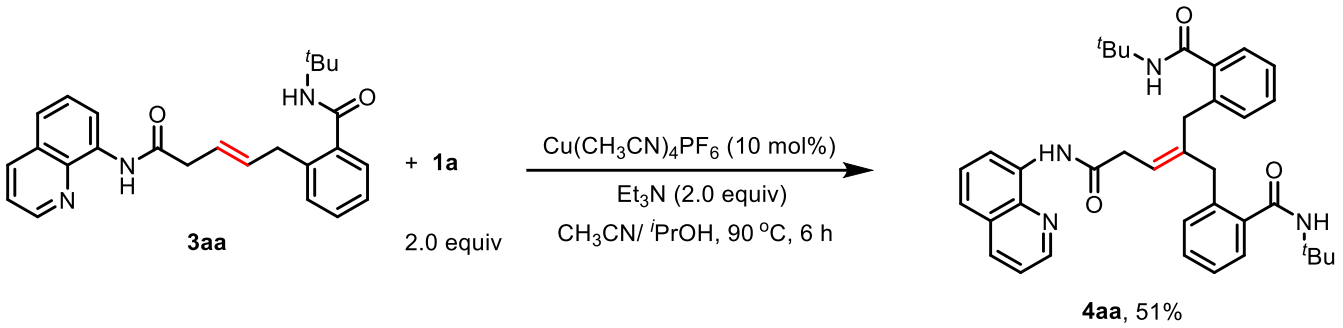
Add 8-aminoquinoline amide **2a** (42.4 mg, 0.2 mmol, 2.0 equiv), *N*-fluoromethylbenzamide **1a** (20.9 mg, 0.1 mmol), 2,4-dimethylbenzamide, and cuprous acetate (2.5 mg, 0.02 mmol, 20 mol%) to a 10 mL Schlenk tube containing a stirring magnet. Finally, add 1 mL of $CH_3CN/^iPrOH$=1:3 solvent and react for 2 h at 85 ° C (oil bath). TLC point plate monitoring reaction, filtration of the reaction system, spin drying, addition of 5 mL of dichloromethane solvent, washing with saturated salt water, organic phase drying, spin drying, column purification with PE/EA=10:1, only 67% yield of **3aa** (26.9 mg) was obtained, and no other product was generated.

(c) Deuterium labeling experiment



To a Schlenk tube containing 1 mL of the solvent ($CH_3CN/^iPrOH$=1:3) were added **2a** (0.2 mmol, 2.0 equiv), CuOAc (2.5 mg, 0.02mmol, 20 mol %), the mixture was stirred for 20 min at the room temperature, in that order, added **1a**-d_3 (21.2 mg, 0.1 mmol) and reacted for 2 h at the 85 °C. After that process, the resulting mixture was filtrated by a sand core funnel filled with silica gel and wash with DCM (5 mL). The combined filtrates were concentrated under vacuum and purified by column chromatography on silica gel, 25.1 mg of **3aa**-d_3 was obtained, with a yield of 62%.

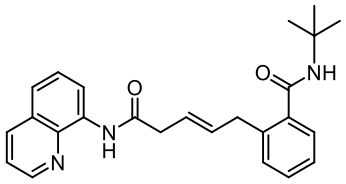
(d) Heck coupling product transformation experiment



To a Schlenk tube containing 1 mL of the solvent (CH_3CN/^{i}PrOH=1:3) were added **3aa** (0.1 mmol, 1.0 equiv), $Cu(MeCN)_4PF_6$ (3.77 mg, 0.01 mmol, 10 mol %) and Et_3N (20.2 mg, 0.2 mmol, 2.0 equiv),the mixture was stirred for 20 min at the room temperature, in that order, added **1a** (41.8 mg, 0.2 mmol) and reacted for 6 h at the 90 °C. After that process, the resulting mixture was filtrated by a sand core funnel filled with silica gel and wash with DCM (5 mL). The combined filtrates were concentrated under vacuum and purified by column chromatography on silica gel, 30.1 mg of **4aa** was obtained, with a yield of 51%.

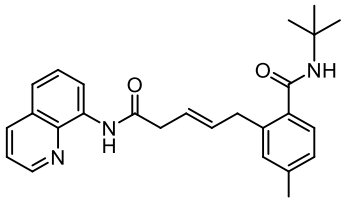
III. Characterization Data of Compounds

(3aa) (*E*)-*N*-*(tert*-butyl)-2-(5-(naphthalen-1-ylamino)-5-oxopent-2-en-1-yl) benzamide



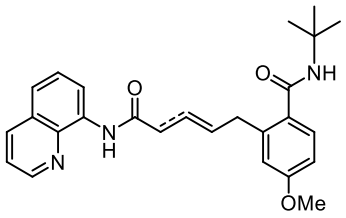
Colorless liquid, 27.7 mg, yield 69%. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.95 (s, 1H), 8.78 – 8.73 (m, 1H), 8.72 – 8.67 (m, 2H), 8.18 – 8.13 (m, 1H), 7.57 – 7.48 (m, 2H), 7.44 (dd, *J* = 7.4, 3.4 Hz, 2H), 7.35 (q, *J* = 7.6 Hz, 3H), 7.28 – 7.21 (m, 2H), 6.04 (td, *J* = 15.4, 5.9 Hz, 1H), 5.82 – 5.70 (m, 2H), 3.66 (d, *J* = 6.4 Hz, 2H), 3.30 (d, *J* = 7.1 Hz, 2H), 1.38 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.7, 169.6, 148.3, 138.6, 138.0, 137.4, 136.5, 135.7, 134.5, 130.6, 129.8, 128.1, 127.5, 127.1, 126.4, 124.0, 121.7, 116.6, 51.9, 42.1, 36.4, 28.9. **HRMS (ESI)** calcd for $C_{25}H_{28}N_3O_2$ $[M+H]^+$: 402.2177; found 402.2178.

(3ba) (*E*)-*N*-*(tert*-butyl)-4-methyl-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



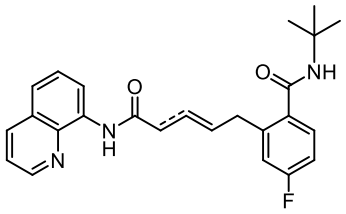
Colorless liquid, 29.6 mg, yield 71%. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.93 (s, 1H), 8.73 (d, *J* = 6.7 Hz, 1H), 8.66 (s, 1H), 8.13 (d, *J* = 7.8 Hz, 1H), 7.53 – 7.46 (m, 2H), 7.42 (dt, *J* = 7.6, 3.4 Hz, 1H), 7.25 (s, 1H), 7.09 (s, 1H), 7.02 (d, *J* = 8.0 Hz, 1H), 6.01 (td, *J* = 15.6, 5.7 Hz, 1H), 5.80 – 5.67 (m, 2H), 3.61 (d, *J* = 4.7 Hz, 2H), 3.28 (d, *J* = 7.2 Hz, 2H), 2.27 (s, 3H), 1.34 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.7, 148.4, 139.8, 138.5, 137.4, 136.5, 135.8, 135.2, 134.5, 131.2, 128.0, 127.5, 127.2, 127.0, 123.8, 121.7, 116.5, 51.8, 42.2, 36.4, 28.9, 21.4. **HRMS (ESI)** calcd for $C_{26}H_{30}N_3O_2$ $[M+H]^+$: 416.2333; found 416.2335.

(3ca) (*E*)-*N*-*(tert*-butyl)-4-methoxy-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



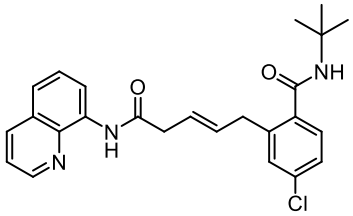
Colorless liquid, 31.1 mg, yield 72%. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.95 (s, 1H), 9.83 (s, 0.19H), 8.84 – 8.79 (m, 0.38H), 8.76 – 8.73 (m, 1H), 8.71 (dd, *J* = 4.3, 1.3 Hz, 1H), 8.19 – 8.11 (m, 1.19H), 7.57 – 7.48 (m, 2.46H), 7.43 (dd, *J* = 8.2, 4.2 Hz, 1.19H), 7.34 (d, *J* = 8.4 Hz, 1H), 7.28 (d, *J* = 8.7 Hz, 0.20H), 7.06 (dd, *J* = 14.9, 7.4 Hz, 0.19H), 6.83 (d, *J* = 2.6 Hz, 1H), 6.77 – 6.69 (m, 1.20H), 6.18 (d, *J* = 15.2 Hz, 0.19H), 6.09 – 5.97 (m, 1H), 5.83 – 5.68 (m, 2H), 5.64 (s, 0.19H), 3.80 (s, 0.58H), 3.75 (d, *J* = 0.9 Hz, 3H), 3.66 (d, *J* = 6.4 Hz, 2H), 3.30 (d, *J* = 7.2 Hz, 2H), 3.01 (t, *J* = 7.7 Hz, 0.38H), 2.63 (q, *J* = 7.5 Hz, 0.38H), 1.46 (s, 1.71H), 1.36 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.7, 169.4, 160.6, 148.4, 148.3, 145.0, 139.7, 138.6, 136.5, 135.5, 134.5, 130.6, 128.9, 128.5, 128.0, 127.6, 127.5, 125.4, 124.1, 121.7, 121.7, 121.6, 116.8, 116.5, 116.1, 115.9, 111.4, 111.3,55.4, 51.8, 42.2, 36.7, 34.1, 32.5, 29.0, 28.9. **HRMS (ESI)** calcd for $C_{26}H_{30}N_3O_3$ $[M+H]^+$: 430.2126; found 430.2129.

(3da) (*E*)-*N*-*(tert*-butyl)-4-fluoro-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



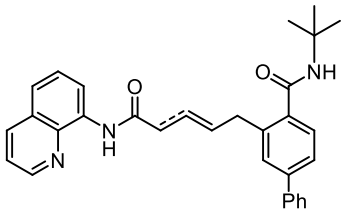
Colorless liquid, 23.1 mg, yield 55%. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.91 (s, 1H), 8.74 (dd, *J* = 6.9, 2.2 Hz, 1H), 8.69 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.15 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.55 – 7.49 (m, 2H), 7.45 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.30 (dd, *J* = 8.5, 5.4 Hz, 1H), 7.08 (dd, *J* = 8.7, 2.8 Hz, 1H), 7.01 (td, *J* = 8.3, 2.8 Hz, 1H), 6.03 – 5.93 (m, 1H), 5.80 – 5.67 (m, 2H), 3.60 (d, *J* = 6.3 Hz, 2H), 3.29 (dd, *J* = 7.2, 1.2 Hz, 2H), 1.37 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.5, 168.2, 161.1 (d, *J* = 245 Hz), 148.3, 139.4 (d, *J* = 6.0 Hz), 138.5, 136.6, 135.4, 134.4, 133.0 (d, *J* = 4.0 Hz), 132.3 (d, *J* = 8.0 Hz), 128.1, 127.5, 124.2, 121.8(d, *J* = 2.0 Hz), 116.6 (d, *J* = 22 Hz), 116.6, 114.2 (d, *J* = 22 Hz), 52.1, 42.0, 35.6, 28.9, 28.8. **HRMS (ESI)** calcd for $C_{25}H_{27}FN_3O_2$ $[M+H]^+$: 420.2082; found 420.2079.

(3ea) (*E*)-*N*-*(tert*-butyl)-4-chloro-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



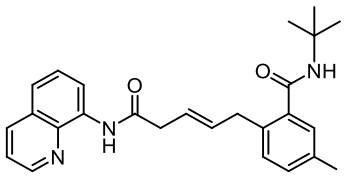
Colorless liquid, 18.3 mg, yield 42%. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.92 (s, 1H), 8.75 (dd, *J* = 6.9, 2.1 Hz, 1H), 8.71 (dd, *J* = 4.3, 1.7 Hz, 1H), 8.15 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.57 – 7.46 (m, 2H), 7.44 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.34 – 7.27 (m, 2H), 7.21 (dd, *J* = 8.2, 2.1 Hz, 1H), 5.99 (td, *J* = 15.2, 6.1 Hz, 1H), 5.83 – 5.70 (m, 2H), 3.63 (d, *J* = 6.2 Hz, 2H), 3.31 (d, *J* = 7.1 Hz, 2H), 1.36 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.5, 168.6, 148.5, 139.6, 138.5, 136.5, 136.4, 135.6, 134.6, 134.4, 130.5, 128.6, 128.1, 127.5, 126.6, 124.7, 121.8, 121.7, 116.6, 52.1, 42.0, 36.2, 28.8. **HRMS (ESI)** calcd for $C_{25}H_{27}ClN_3O_2$ $[M+H]^+$: 436.1787; found 436.1792.

(3fa) (*E*)-*N*-*(tert*-butyl)-3-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)-[1,1'-biphenyl]-4-carboxamide



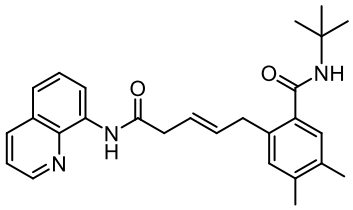
Colorless liquid, 22.9 mg, yield 48%. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.97 (s, 1H), 8.76 (dd, *J* = 7.2, 1.9 Hz, 1H), 8.66 (dd, *J* = 4.3, 1.7 Hz, 1H), 8.14 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.60 – 7.56 (m, 3H), 7.54 – 7.50 (m, 3H), 7.47 – 7.34 (m, 5H), 6.06 (td, *J* = 15.4, 5.9 Hz, 1H), 5.87 – 5.74 (m, 2H), 3.69 (d, *J* = 6.3 Hz, 2H), 3.32 (d, *J* = 7.1 Hz, 2H), 1.39 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.7, 169.6, 148.3, 139.5, 138.5, 136.5, 136.3, 135.5, 134.5, 131.1, 129.0, 128.4, 128.1, 127.7, 127.6, 127.2, 125.9, 124.2, 121.7, 116.6, 52.0, 42.1, 36.1, 28.9. **HRMS (ESI)** calcd for $C_{31}H_{32}N_3O_2$ $[M+H]^+$: 478.2490; found 478.2488.

(3ga) (*E*)-*N*-*(tert*-butyl)-5-methyl-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



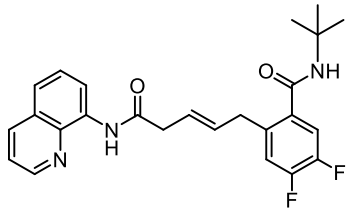
Colorless liquid, 31.0 mg, yield 72%. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.02 (s, 1H), 9.89 (s, 0.14H), 8.93 – 8.84 (m, 0.28H), 8.82 (dd, *J* = 7.0, 2.0 Hz, 1H), 8.76 (dd, *J* = 4.3, 1.6 Hz, 1H), 8.22 (dd, *J* = 8.3, 1.7 Hz, 1.16H), 7.63 – 7.52 (m, 2.29H), 7.51 (dd, *J* = 8.3, 4.2 Hz, 1.15H), 7.34 – 7.28 (m, 1.15H), 7.22 – 7.18 (m, 1.15H), 6.24 (d, *J* = 8.4 Hz, 0.27H), 6.09 (td, *J* = 15.1, 5.6 Hz, 1H), 5.79 (q, *J* = 7.5 Hz, 2H), 5.71 (s, 0.14H), 3.68 (d, *J* = 6.4 Hz, 2H), 3.36 (d, *J* = 7.2 Hz, 2H), 3.02 (t, *J* = 7.7 Hz, 0.28H), 2.68 (q, *J* = 7.4 Hz, 0.28H), 2.40 (s, 3.47H), 1.54 (s, 1.25H), 1.44 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.8, 169.7, 148.3, 145.2, 138.6, 137.9, 136.5, 136.1, 136.0, 134.5, 134.2, 130.5, 130.5, 128.1, 127.8, 127.6, 127.5, 125.3, 123.7, 121.7, 116.8, 116.5, 51.9, 42.1, 36.0, 34.2, 31.8, 29.0, 28.9, 21.0. **HRMS (ESI)** calcd for $C_{26}H_{30}N_3O_2$ $[M+H]^+$: 416.2333; found 416.2331.

(3ha) (*E*)-*N*-*(tert*-butyl)-4,5-dimethyl-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



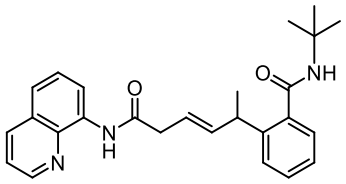
Colorless liquid, 28.0 mg, yield 65 %. **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.8, 148.3, 136.5, 136.1, 134.6, 134.6, 131.8, 128.5, 127.5, 123.6, 121.7, 77.5, 51.6, 42.2, 36.0, 28.9, 19.7, 19.3. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.95 (s, 1H), 8.75 (dd, *J* = 7.0, 1.9 Hz, 1H), 8.69 (dd, *J* = 4.3, 1.7 Hz, 1H), 8.16 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.56 – 7.48 (m, 2H), 7.44 (dd, *J* = 8.2, 4.2 Hz, 1H), 7.14 (s, 1H), 7.05 (s, 1H), 6.02 (td, *J* = 15.4, 6.2 Hz, 1H), 5.78 – 5.69 (m, 2H), 3.60 (d, *J* = 6.3 Hz, 2H), 3.29 (d, *J* = 7.1 Hz, 2H), 2.24 (s, 3H), 2.19 (s, 3H), 1.37 (s, 9H). **HRMS (ESI)** calcd for $C_{27}H_{32}N_3O_2$ $[M+H]^+$: 430.2489; found 430.2489.

(3ia) (*E*)-*N*-*(tert*-butyl)-4,5-difluoro-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



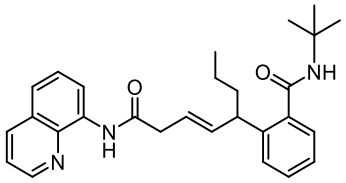
Colorless liquid, 23.7 mg, yield 55 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.90 (s, 1H), 9.82 (s, 0.08H), 8.88 – 8.60 (m, 2.17H), 8.16 (d, *J* = 8.2 Hz, 1.08H), 7.51 (m, 2.15H), 7.45 (dd, *J* = 8.3, 4.3 Hz, 1.08H), 7.18 (ddd, *J* = 21.2, 10.6, 7.7 Hz, 2H), 7.09 – 6.94 (m, 0.18H), 6.16 (d, *J* = 15.2 Hz, 1H), 5.95 (dt, *J* = 14.6, 6.3 Hz, 1H), 5.75 (q, *J* = 9.1, 8.3 Hz, 2.16H), 3.58 (d, *J* = 6.3 Hz, 2H), 3.31 (d, *J* = 7.1 Hz, 2H), 2.95 (t, *J* = 7.7 Hz, 0.16H), 2.59 (q, *J* = 7.1 Hz, 0.16H), 1.46 (s, 0.73H), 1.37 (s, 9H). **^{13}C NMR** (101 MHz, Chloroform-*d*) δ 169.4, 167.3, 151.1 (dd, *J* = 240Hz, 11 Hz), 148.4 (dd, *J* = 245Hz, 11 Hz), 148.4, 144.1, 138.5, 136.6, 134.9 (t, *J* = 4.0 Hz), 134.4, 134.4(t, *J* = 4.0 Hz), 128.1, 127.5, 125.8, 124.9, 121.8, 119.3 (d, *J* = 18 Hz), 119.2, 116.6, 116.5 (d, *J* = 22 Hz), 52.2, 41.9, 35.7, 28.8, 28.8. **HRMS (ESI)** calcd for $C_{25}H_{26}F_2N_3O_2$ $[M+H]^+$: 438.1988; found438.1979.

(3ja) (*E*)-*N*-*(tert*-butyl)-2-(6-oxo-6-(quinolin-8-ylamino)hex-3-en-2-yl)benzamide



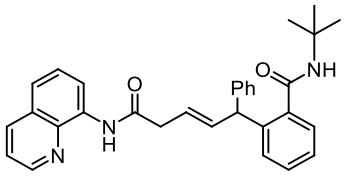
Colourless liquid, 31.6 mg, yield 76 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.01 (s, 1H), 8.79 – 8.72 (m, 1H), 8.66 (s, 1H), 8.15 (dd, *J* = 8.2, 2.4 Hz, 1H), 7.57 – 7.30 (m, 6H), 7.22 (t, *J* = 7.8 Hz, 1H), 6.06 (dd, *J* = 15.7, 6.6 Hz, 1H), 5.81 – 5.69 (m, 2H), 4.11 (p, *J* = 7.2 Hz, 1H), 3.29 (d, *J* = 7.3 Hz, 2H), 1.51 (d, *J* = 5.9 Hz, 3H), 1.38 (s, 9H). **^{13}C NMR** (101 MHz, Chloroform-*d*) δ 169.9, 169.7, 148.3, 142.7, 142.0, 138.6, 137.9, 136.5, 134.5, 129.8, 128.1, 127.5, 126.9, 126.2, 121.7, 121.6, 116.5, 52.0, 42.2, 38.4, 28.9, 21.6. **HRMS (ESI)** calcd for $C_{26}H_{30}N_3O_2$ $[M+H]^+$: 416.2333; found 416.2330.

(3ka) (*E*)-*N*-*(tert*-butyl)-2-(8-oxo-8-(quinolin-8-ylamino)oct-5-en-4-yl)benzamide



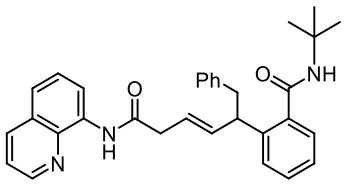
Colorless liquid, 32.3 mg, yield 73 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.95 (s, 1H), 8.76 (dd, *J* = 7.1, 1.9 Hz, 1H), 8.58 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.14 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.56 – 7.45 (m, 2H), 7.47 – 7.38 (m, 2H), 7.35 (t, *J* = 7.4 Hz, 2H), 7.22 (td, *J* = 7.3, 6.7, 1.4 Hz, 1H), 6.01 (dd, *J* = 15.4, 7.8 Hz, 1H), 5.81 – 5.68 (m, 2H), 3.91 (q, *J* = 7.6 Hz, 1H), 3.31 – 3.25 (m, 1H), 1.83 (dtd, *J* = 9.9, 8.0, 7.3, 3.0 Hz, 2H), 1.34 (s, 11H), 0.91 (t, *J* = 7.3 Hz, 3H). **^{13}C NMR** (101 MHz, Chloroform-*d*) δ 169.9, 169.7, 148.2, 141.5, 141.4, 138.5, 138.5, 136.6, 134.4, 129.8, 128.1, 127.6, 127.5, 127.0, 126.1, 122.3, 121.7, 121.7, 116.6, 51.9, 44.5, 42.3, 38.3, 28.8, 20.9, 14.2. **HRMS (ESI)** calcd for $C_{28}H_{33}N_3O_2Na$ $[M+Na]^+$: 466.2465; found 466.2461.

(3la) (*E*)-*N*-*(tert*-butyl)-2-(5-oxo-1-phenyl-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



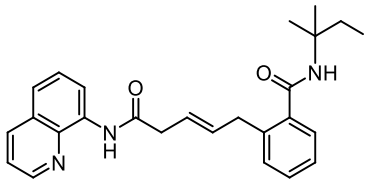
White solid, 35.8 mg, yield 75 %. m.p.: 128 – 131°C. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.02 (s, 1H), 8.76 (dd, *J* = 6.8, 2.2 Hz, 1H), 8.67 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.16 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.57 – 7.46 (m, 2H), 7.44 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.38 (ddd, *J* = 6.9, 5.3, 1.4 Hz, 2H), 7.35 – 7.22 (m, 6H), 7.24 – 7.15 (m, 1H), 6.32 (dd, *J* = 15.4, 6.6 Hz, 1H), 5.63 (dtd, *J* = 15.0, 7.3, 1.5 Hz, 1H), 5.55 – 5.46 (m, 2H), 3.37 (d, *J* = 7.3 Hz, 2H), 1.27 (s, 9H). **^{13}C NMR** (101 MHz, Chloroform-*d*) δ 169.7, 169.5, 148.2, 143.0, 140.2, 139.2, 138.4, 136.5, 134.4, 129.7, 129.0, 128.6, 128.1, 127.5, 127.3, 126.6, 124.9, 121.7, 116.5, 51.8, 49.5, 42.2, 28.7. **HRMS (ESI)** calcd for $C_{31}H_{32}N_3O_2$ $[M+H]^+$: 478.2490; found 478.2488.

(3ma) (*E*)-*N*-*(tert*-butyl)-2-(6-oxo-1-phenyl-6-(quinolin-8-ylamino)hex-3-en-2-yl)benzamide



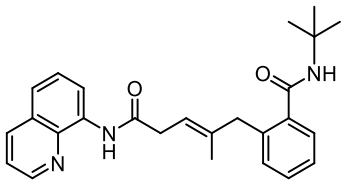
Colorless liquid, 29.5 mg, yield 60 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.00 (s, 1H), 8.76 (dt, *J* = 7.1, 1.6 Hz, 1H), 8.68 (d, *J* = 3.9 Hz, 1H), 8.15 (dt, *J* = 8.3, 1.5 Hz, 1H), 7.56 – 7.47 (m, 3H), 7.43 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.35 (t, *J* = 7.5 Hz, 1H), 7.27 – 7.07 (m, 5H), 7.03 (d, *J* = 7.3 Hz, 2H), 6.10 (dd, *J* = 15.0, 6.8 Hz, 1H), 5.73 (dt, *J* = 15.1, 7.3 Hz, 1H), 5.22 (s, 1H), 4.20 (q, *J* = 7.4 Hz, 1H), 3.35 – 3.07 (m, 4H), 1.29 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.7, 169.6, 148.2, 140.5, 140.1, 139.8, 138.7, 138.6, 136.5, 134.5, 129.6, 129.4, 128.3, 128.3, 128.2, 128.1, 127.5, 126.8, 126.3, 126.1, 123.0, 121.7, 116.5, 51.7, 46.3, 42.5, 42.2, 28.7. **HRMS (ESI)** calcd for $C_{32}H_{34}N_3O_2$ $[M+H]^+$: 492.2646; found 492.2651.

(3na) (*E*)-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)-*N*-(*tert*pentyl)benzamide



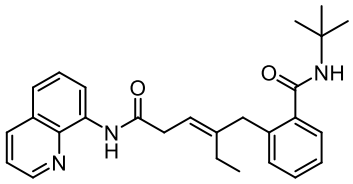
Colorless liquid, 29.5 mg, yield 68 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.96 (s, 1H), 9.83 (s, 0.17H), 8.82 (dd, *J* = 10.6, 5.8 Hz, 0.34H), 8.75 (dd, *J* = 7.0, 1.9 Hz, 1H), 8.70 (dd, *J* = 4.3, 1.6 Hz, 1H), 8.15 (dd, *J* = 8.4, 1.7 Hz, 1.17H), 7.56 – 7.48 (m, 2.37H), 7.44 (dd, *J* = 8.4, 4.3 Hz, 1.16H), 7.39 – 7.31 (m, 3.48H), 7.27 – 7.20 (m, 1H), 7.05 (dd, *J* = 14.8, 7.4 Hz, 0.18H), 6.18 (d, *J* = 15.3 Hz, 0.17H), 6.04 (dt, *J* = 14.8, 6.4 Hz, 1H), 5.76 (dt, *J* = 15.0, 7.2 Hz, 1H), 5.60 (s, 1H), 5.55 (s, 0.17H), 3.67 (d, *J* = 6.4 Hz, 2H), 3.30 (d, *J* = 7.2 Hz, 2H), 3.01 (t, *J* = 7.7 Hz, 0.33H), 2.64 (q, *J* = 7.5 Hz, 0.33H), 1.86 (q, *J* = 7.6 Hz, 0.37H), 1.77 (q, *J* = 7.5 Hz, 2H), 1.41 (s, 0.98H), 1.32 (s, 6H), 0.93 (t, *J* = 7.4 Hz, 0.58H), 0.85 (t, *J* = 7.5 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.7, 169.6, 148.3, 148.2, 145.0, 138.6, 138.0, 136.5, 135.7, 134.5, 130.6, 130.3, 129.8, 128.1, 127.6, 127.5, 127.1, 126.8, 126.4, 126.3, 125.4, 124.0, 121.7, 116.8, 116.5, 54.7, 42.2, 36.3, 34.2, 32.9, 32.2, 26.6, 26.5, 8.6. **HRMS (ESI)** calcd for $C_{26}H_{30}N_3O_2$ $[M+H]^+$: 416.2333; found 416.2337.

(3ab) (*E*)-*N*-(*tert*-butyl)-2-(2-methyl-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



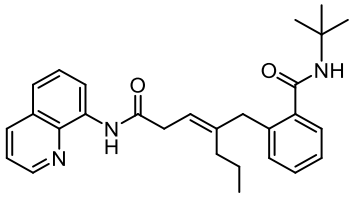
Colorless liquid, 33.3 mg, yield 80 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.00 (s, 1H), 8.75 (d, *J* = 6.8 Hz, 1H), 8.69 (d, *J* = 3.6 Hz, 1H), 8.16 (d, *J* = 8.3 Hz, 1H), 7.55 – 7.48 (m, 2H), 7.45 (dd, *J* = 8.2, 4.2 Hz, 1H), 7.40 (d, *J* = 7.4 Hz, 1H), 7.37 – 7.29 (m, 2H), 7.27 – 7.23 (m, 1H), 5.83 (s, 1H), 5.42 (t, *J* = 7.7 Hz, 1H), 3.67 (s, 2H), 3.32 (d, *J* = 7.6 Hz, 2H), 1.83 (s, 3H), 1.34 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.7, 148.4, 142.0, 138.7, 138.6, 136.6, 136.4, 134.5, 131.2, 129.6, 128.1, 127.6, 127.5, 126.6, 121.7, 118.4, 116.6, 51.8, 42.6, 37.6, 28.8, 17.3. **HRMS (ESI)** calcd for $C_{26}H_{30}N_3O_2$ $[M+H]^+$: 416.2333; found 416.2330.

(3ac) (*E*)-*N*-*(tert*-butyl)-2-(2-ethyl-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



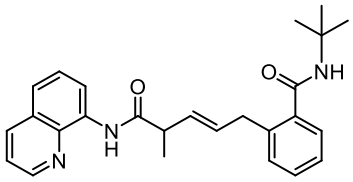
Colorless liquid, 32.2 mg, yield 75 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.06 (s, 0.23H), 9.96 (s, 1H), 8.81 – 8.68 (m,2.43H), 8.13 (d, *J* = 8.3 Hz, 1.22H), 7.53 – 7.46 (m, 2.45H), 7.43 (dd, *J* = 8.3, 4.2 Hz, 1.24H), 7.39 – 7.34 (m, 2.45H), 7.30 – 7.19 (m, 2H), 7.12 (dt, *J* = 15.4, 7.3 Hz, 0.47H), 5.79 (d, *J* = 15.2 Hz, 1.27H), 5.69 (s, 0.23H), 5.27 (t, *J* = 7.7 Hz, 1H), 3.72 (s, 0.45H), 3.67 (s, 2H), 3.37 (d, *J* = 7.6 Hz, 0.46H), 3.30 (d, *J* = 7.6 Hz, 2H), 2.21 (q, *J* = 7.6 Hz, 2H), 2.10 (q, *J* = 7.5 Hz, 0.43H), 1.41 (s, 2H), 1.32 (s, 9H),1.19 – 1.10 (m, 0.81H), 1.08 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 170.0, 169.7, 169.6, 148.2, 147.4, 138.6, 138.5, 137.0, 136.4, 136.2, 134.4, 131.2, 129.6, 129.4, 129.3, 128.0, 127.9, 127.4, 127.3, 126.6, 126.4, 126.0, 121.6, 121.6, 121.4, 117.7, 116.4, 116.3, 51.7, 39.5, 37.6, 37.1, 33.0, 30.0, 28.8, 28.7, 24.3, 13.0. **HRMS (ESI)** calcd for $C_{27}H_{32}N_3O_2$ $[M+H]^+$: 430.2489; found 430.2486.

(3ad) (*E*)-*N*-*(tert*-butyl)-2-(5-oxo-2-propyl-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



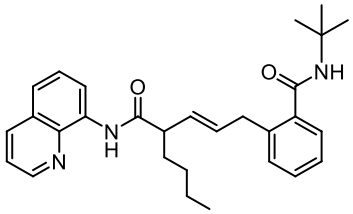
Colorless liquid, 28.8 mg, yield 65 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.95 (s, 1H), 8.73 (dd, *J* = 10.9, 5.4 Hz, 2H), 8.16 (d, *J* = 8.2 Hz, 1H), 7.55 – 7.48 (m, 2H), 7.45 (dd, *J* = 8.2, 4.1 Hz, 1H), 7.41 – 7.35 (m, 2H), 7.30 (t, *J* = 7.4 Hz, 1H), 7.25 (d, *J* = 7.0 Hz, 1H), 5.83 (s, 1H), 5.33 (t, *J* = 7.6 Hz, 1H), 3.67 (s, 2H), 3.33 (d, *J* = 7.6 Hz, 2H), 2.18 (t, *J* = 7.6 Hz, 2H), 1.54 (q, *J* = 7.6 Hz, 2H), 1.33 (s, 9H), 0.95 (t, *J* = 7.3 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.9, 169.7, 148.3, 145.9, 138.8, 136.6, 136.5, 134.5, 131.3, 129.6, 128.1, 127.6, 127.5, 126.5, 121.7, 121.7, 118.6, 116.6, 51.8, 40.1, 37.4, 33.4, 28.8, 21.6, 14.4. **HRMS (ESI)** calcd for $C_{28}H_{34}N_3O_2$ $[M+H]^+$: 444.2646; found 444.2649.

(3ae) (*E*)-*N*-(*tert*-butyl)-2-(4-methyl-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



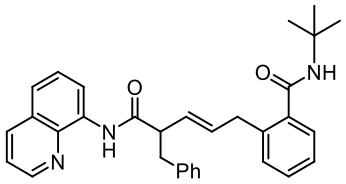
Colorless liquid, 29.9 mg, yield 72 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.02 (s, 1H), 8.76 (dd, *J* = 7.2, 1.8 Hz, 1H), 8.65 (dd, *J* = 4.3, 1.7 Hz, 1H), 8.15 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.56 – 7.47 (m, 2H), 7.43 (dd, *J* = 8.3, 4.3 Hz, 1H), 7.37 – 7.28 (m, 3H), 7.23 (td, *J* = 7.3, 1.7 Hz, 1H), 6.03 (dt, *J* = 14.8, 6.4 Hz, 1H), 5.78 – 5.65 (m, 2H), 3.65 (d, *J* = 6.5 Hz, 2H), 3.34 (p, *J* = 7.1 Hz, 1H), 1.42 (d, *J* = 6.9 Hz, 3H), 1.35 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.7, 148.3, 138.7, 138.0, 137.4, 136.5, 134.6, 132.9, 131.2, 130.5, 129.8, 128.1, 127.6, 127.1, 126.4, 121.7, 121.6, 116.5, 51.9, 46.1, 36.2, 28.9, 17.5. **HRMS (ESI)** calcd for $C_{26}H_{30}N_3O_2$ $[M+H]^+$: 416.2333; found 416.2338.

(3af) (*E*)-*N*-*(tert*-butyl)-2-(1-oxo-1-(quinolin-8-ylamino)non-3-en-5-yl)benzamide



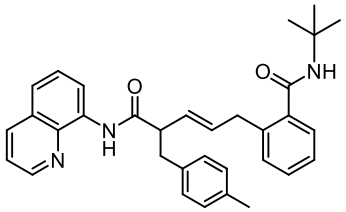
Colorless liquid, 29.7 mg, yield 65 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.95 (s, 1H), 8.77 (dd, *J* = 7.2, 1.8 Hz, 1H), 8.68 (dd, *J* = 4.3, 1.6 Hz, 1H), 8.15 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.57 – 7.45 (m, 2H), 7.43 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.37 – 7.26 (m, 3H), 7.26 – 7.17 (m, 1H), 5.99 (dt, *J* = 15.3, 6.5 Hz, 1H), 5.69 – 5.61 (m, 2H), 3.63 (d, *J* = 6.5 Hz, 2H), 3.15 (q, *J* = 7.7 Hz, 1H), 2.05 – 1.91 (m, 1H), 1.72 – 1.62 (m, 1H), 1.42 – 1.27 (m, 13H), 0.89 (t, *J* = 6.9, 4H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 172.6, 169.7, 148.3, 138.6, 137.9, 137.5, 136.5, 134.6, 133.3, 130.4, 130.3, 129.8, 128.1, 127.5, 127.1, 126.3, 121.7, 121.6, 116.5, 52.4, 51.9, 36.2, 32.0, 29.7, 28.8, 22.7, 14.1. **HRMS (ESI)** calcd for $C_{29}H_{36}N_3O_2$ $[M+H]^+$: 458.2803; found 458.2806.

(3ag) (*E*)-2-(4-benzyl-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)-*N*-(*tert*-butyl)benzamide



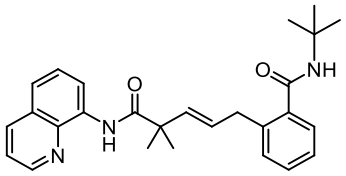
Colorless liquid, 27.1 mg, yield 55 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.98 (s, 1H), 8.83 (dd, *J* = 7.3, 1.7 Hz, 1H), 8.71 (dd, *J* = 4.3, 1.7 Hz, 1H), 8.19 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.62 – 7.51 (m, 2H), 7.47 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.37 (dd, *J* = 7.2, 1.7 Hz, 1H), 7.32 – 7.18 (m, 7H), 7.15 – 7.11 (m, 1H), 5.91 (dt, *J* = 15.3, 6.5 Hz, 1H), 5.74 (dd, *J* = 15.4, 8.7 Hz, 1H), 5.62 (s, 1H), 3.69 – 3.48 (m, 3H), 3.41 (dd, *J* = 13.6, 6.3 Hz, 1H), 3.00 (dd, *J* = 13.6, 8.1 Hz, 1H), 1.37 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 171.6, 169.6, 148.3, 139.4, 138.5, 137.8, 137.3, 136.5, 134.5, 134.1, 130.3, 129.7, 129.6, 129.5, 128.4, 128.0, 127.5, 126.9, 126.3, 126.3, 121.7, 116.6, 54.1, 51.9, 38.4, 36.0, 28.8. **HRMS (ESI)** calcd for $C_{32}H_{34}N_3O_2$ $[M+H]^+$: 492.2646; found 458.2648.

(3ah) (*E*)-*N*-(*tert*-butyl)-2-(4-(4-methylbenzyl)-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



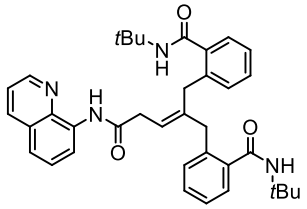
Colorless liquid, 21.5 mg, yield 45 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.92 (s, 1H), 8.77 (dd, *J* = 7.2, 1.3 Hz, 1H), 8.66 (dd, *J* = 4.1, 1.3 Hz, 1H), 8.14 (dd, *J* = 8.2, 1.3 Hz, 1H), 7.55 – 7.47 (m, 2H), 7.42 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.33 – 7.30 (m, 1H), 7.25 – 7.18 (m, 2H), 7.12 – 7.07 (m, 3H), 7.02 (d, *J* = 7.9 Hz, 2H), 5.85 (dt, *J* = 14.7, 6.5 Hz, 1H), 5.68 (dd, *J* = 15.4, 8.8 Hz, 1H), 5.56 (s, 1H), 3.56 (qd, *J* = 15.6, 6.5 Hz, 2H), 3.44 (q, *J* = 8.2 Hz, 1H), 3.31 (dd, *J* = 13.6, 6.3 Hz, 1H), 2.91 (dd, *J* = 13.6, 8.1 Hz, 1H), 2.27 (s, 3H), 1.32 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 171.8, 169.6, 148.3, 138.6, 137.9, 137.3, 136.5, 136.2, 135.7, 134.5, 134.0, 130.3, 129.7, 129.3, 129.1, 128.0, 127.5, 126.9, 126.3, 121.7, 116.6, 54.2, 51.9, 38.0, 36.1, 28.8, 21.2. **HRMS (ESI)** calcd for $C_{33}H_{36}N_3O_2$ $[M+H]^+$: 506.2803; found506.2801.

(3aj) (*E*)-*N*-*(tert*-butyl)-2-(4,4-dimethyl-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



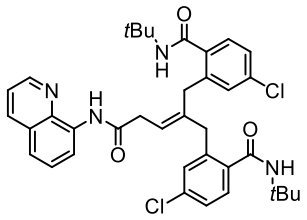
Colorless liquid, 32.2 mg, yield 75 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.21 (s, 1H), 8.76 (dd, *J* = 7.3, 1.6 Hz, 1H), 8.56 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.13 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.55 – 7.43 (m, 2H), 7.45 – 7.37 (m, 2H), 7.40 – 7.26 (m, 2H), 7.24 (t, *J* = 7.3 Hz, 1H), 6.06 (dt, *J* = 15.5, 6.5 Hz, 1H), 5.87 (d, *J* = 15.7 Hz, 1H), 5.72 (s, 1H), 3.71 (d, *J* = 6.5 Hz, 2H), 1.45 (s, 6H), 1.34 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 175.3, 169.7, 148.3, 138.0, 137.5, 136.4, 136.1, 134.7, 130.4, 130.3, 129.8, 128.0, 127.5, 127.1, 126.3, 121.6, 121.5, 116.3, 51.9, 46.3, 36.3, 28.8, 25.6. **HRMS (ESI)** calcd for $C_{27}H_{32}N_3O_2$ $[M+H]^+$: 430.2489; found 430.2485.

(4aa) 2,2'-(2-(3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-*(tert*-butyl)benzamide)



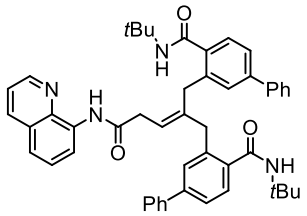
Colorless liquid, 41.8 mg, yield 71 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.00 (s, 1H), 8.80 – 8.73 (m, 1H), 8.18 – 8.07 (m, 1H), 7.56 – 7.48 (m, 2H), 7.43 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.39 – 7.36 (m, 1H), 7.27 – 7.11 (m, 7H), 6.33 (s, 1H), 6.09 (s, 1H), 5.86 (t, *J* = 7.3 Hz, 1H), 3.54 (s, 2H), 3.50 – 3.44 (m, 4H), 1.24 (s, 9H), 1.16 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 170.0, 169.9, 169.7, 148.4, 142.0, 136.5, 135.9, 135.3, 129.8, 129.5, 129.4, 128.5, 127.5, 127.1, 127.0, 126.4, 126.3, 122.2, 121.7, 116.6, 51.7, 51.7, 39.8, 37.7, 32.2, 28.7, 28.6. **HRMS (ESI)** calcd for $C_{37}H_{43}N_4O_3$ $[M+H]^+$: 591.3330; found 591.3336.

(4ea) 2,2'-(2-(3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-(*tert*-butyl)-4-chloro-benzamide)



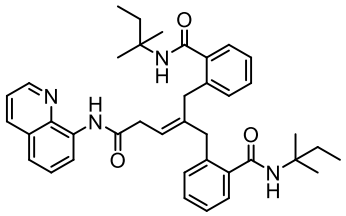
Colorless liquid, 42.8 mg, yield 65 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.99 (s, 1H), 8.73 (t, *J* = 5.7 Hz, 2H), 8.14 (d, *J* = 8.3 Hz, 1H), 7.54 – 7.35 (m, 4H), 7.30 – 7.10 (m, 7H), 6.20 (s, 1H), 5.95 (s, 1H), 5.84 (t, *J* = 7.4 Hz, 1H), 3.57 (s, 2H), 3.48 (s, 2H), 3.45 (d, *J* = 7.5 Hz, 2H), 1.62 (dq, *J* = 28.8, 7.4 Hz, 4H), 1.18 (s, 6H), 1.11 (s, 6H), 0.75 (dt, *J* = 15.6, 7.4 Hz, 6H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 170.0, 169.8, 169.7, 148.3, 142.0, 139.2, 139.1, 136.5, 135.9, 135.4, 134.5, 130.0, 129.5, 129.4, 128.5, 128.1, 127.5, 127.1, 126.9, 126.4, 126.2, 122.2, 121.7, 116.6, 54.5, 39.8, 37.7, 32.7, 32.7, 32.4, 26.3, 26.2, 8.6, 8.5. **HRMS (ESI)** calcd for $C_{37}H_{41}Cl_2N_4O_3$ $[M+H]^+$: 659.2551; found 659.2554.

(4fa) 3,3''-(2-(3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-(*tert*-butyl)-[1,1'-bi-phenyl]-4-carboxamide)



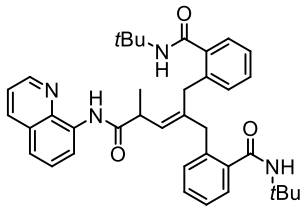
White solid, 33.4 mg, yield 45 %. m.p.: 138 – 140°C. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.01 (s, 1H), 8.83 – 8.62 (m, 2H), 8.16 (d, *J* = 8.2 Hz, 1H), 7.61 – 7.37 (m, 3H), 7.29 (d, *J* = 1.7 Hz, 1H), 7.23 – 7.09 (m, 5H), 6.44 (s, 1H), 6.10 (s, 1H), 5.98 (t, *J* = 7.4 Hz, 1H), 3.69 – 3.32 (m, 6H), 1.27 (s, 9H), 1.21 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.3, 169.0, 168.8, 148.6, 139.9, 138.1, 137.5, 137.5, 137.4, 136.4, 135.4, 135.3, 134.4, 129.6, 128.5, 128.5, 128.4, 127.4, 126.7, 126.5, 123.8, 121.8, 121.8, 116.6, 77.5, 52.0, 39.7, 37.6, 32.1, 28.7, 28.6. **HRMS (ESI)** calcd for $C_{49}H_{51}N_4O_3$ $[M+H]^+$: 743.3956; found 743.3961.

(4na) 2,2'-(2-(3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-*(tert*-pentyl)benzamide)



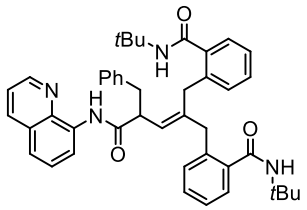
Colorless liquid, 52.7 mg, yield 76 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.04 (s, 1H), 8.79 (dd, *J* = 7.1, 1.9 Hz, 1H), 8.61 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.13 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.55 – 7.47 (m, 2H), 7.40 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.33 – 7.24 (m, 5H), 7.21 – 7.15 (m, 1H), 6.73 (d, *J* = 8.8 Hz, 1H), 5.64 (s, 1H), 3.78 (s, 3H), 3.21 (ddt, *J* = 15.2, 9.7, 5.4 Hz, 2H), 3.02 – 2.93 (m, 1H), 2.90 – 2.74 (m, 2H), 2.11 – 1.92 (m, 2H), 1.41 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.9, 169.7, 159.3, 148.2, 139.4, 138.5, 138.0, 136.3, 134.7, 133.3, 130.5, 129.6, 128.0, 127.5, 126.8, 126.1, 121.7, 121.6, 116.7, 115.9, 113.8, 89.7, 55.4, 51.9, 36.7, 31.2, 29.5, 28.9. **HRMS (ESI)** calcd for $C_{39}H_{47}N_4O_3$ $[M+H]^+$: 619.3643; found 619.3640.

(4ae) 2,2'-(2-(2-methyl-3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-*(tert*-butyl)benzamide)



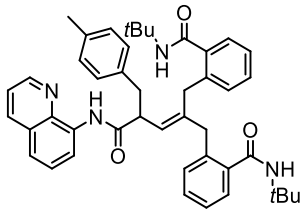
Colorless liquid, 45.3 mg, yield 75 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.11 (s, 1H), 8.80 (d, *J* = 6.6 Hz, 1H), 8.74 – 8.69 (m, 1H), 8.19 (d, *J* = 8.2 Hz, 1H), 7.60 – 7.51 (m, 2H), 7.47 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.43 – 7.39 (m, 1H), 7.32 – 7.11 (m, 7H), 6.59 (s, 1H), 5.98 (s, 1H), 5.85 (d, *J* = 9.7 Hz, 1H), 3.77 – 3.66 (m, 1H), 3.59 (d, *J* = 3.4 Hz, 2H), 3.47 (dd, *J* = 15.2, 9.4 Hz, 2H), 1.52 (d, *J* = 6.9 Hz, 3H), 1.26 (s, 9H), 1.17 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 173.1, 170.1, 169.8, 148.3, 139.8, 139.4, 139.1, 136.4, 135.8, 135.2, 134.7, 130.4, 129.5, 129.5, 129.4, 128.1, 128.1, 127.5, 127.1, 126.9, 126.3, 126.2, 121.7, 121.6, 116.5, 51.7, 51.7, 42.0, 39.6, 32.0, 28.7, 28.6, 18.7. **HRMS (ESI)** calcd for $C_{38}H_{45}N_4O_3$ $[M+H]^+$: 605.3487; found 605.3479.

(4af) 2,2'-(2-(2-benzyl-3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-*(tert*-butyl)benzamide)



Colorless liquid, 44.2 mg, yield 65 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.07 (s, 1H), 8.80 (d, *J* = 7.2 Hz, 1H), 8.62 (d, *J* = 4.2 Hz, 1H), 8.15 (d, *J* = 8.3 Hz, 1H), 7.59 – 7.49 (m, 2H), 7.42 (dd, *J* = 8.9, 4.1 Hz, 1H), 7.32 – 7.01 (m, 11H), 6.87 (t, *J* = 7.6 Hz, 1H), 6.64 (d, *J* = 7.7 Hz, 1H), 6.39 (s, 1H), 6.03 (s, 1H), 5.83 (d, *J* = 9.9 Hz, 1H), 3.85 (td, *J* = 9.5, 5.3 Hz, 1H), 3.50 (dd, *J* = 13.4, 5.1 Hz, 1H), 3.44 – 3.24 (m, 4H), 3.03 (dd, *J* = 13.2, 9.5 Hz, 1H), 1.18 (s, 9H), 1.09 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 171.8, 170.0, 169.9, 148.4, 141.2, 139.3, 139.1, 139.0, 136.3, 135.6, 134.9. 134.5, 129.6, 129.4, 129.4, 129.3, 128.6, 128.2, 128.0, 127.4, 126.9, 126.7, 126.5, 126.2, 126.0, 121.8, 121.7, 116.6, 51.6, 50.0, 39.5, 39.3, 31.7, 28.6, 28.5. **HRMS (ESI)** calcd for $C_{44}H_{49}N_4O_3$ $[M+H]^+$: 681.3880; found 681.3883.

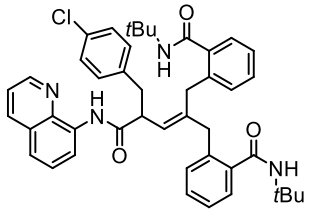
(4ag) 2,2'-(2-(2-(4-methylbenzyl)-3-oxo-3-(quinolin-8-ylamino)propylidene) propane-1,3-diyl)bis(*N*-*(tert*-butyl)benzamide)



Colorless liquid, 49.9 mg, yield 72 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.05 (s, 1H), 8.80 (dd, *J* = 7.2, 1.7 Hz, 1H), 8.63 (dd, *J* = 4.2, 1.6 Hz, 1H), 8.15 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.60 – 7.47 (m, 2H), 7.42 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.24 – 7.10 (m, 5H), 7.06 (ddd, *J* = 14.0, 11.8, 7.5 Hz, 5H), 6.87 (t, *J* = 7.6 Hz, 1H), 6.68 (d, *J* = 7.8 Hz, 1H), 6.37 (s, 1H), 6.03 (s, 1H), 5.81 (d, *J* = 10.0 Hz, 1H), 3.83 (td, *J* = 9.6, 5.3 Hz, 1H), 3.50 – 3.22 (m, 5H), 2.99 (dd, *J* = 13.5, 9.3 Hz, 1H), 2.33 (s, 3H), 1.18 (s, 9H), 1.09 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 171.9, 170.0, 169.9, 148.4, 141.1, 139.1, 139.1, 138.6, 136.3, 136.1, 135.9, 135.6, 134.9, 134.6, 129.5, 129.4, 129.3, 129.3, 129.2, 128.7, 128.3, 128.0, 127.4, 127.0, 126.7, 126.2, 126.0, 121.7, 121.7,

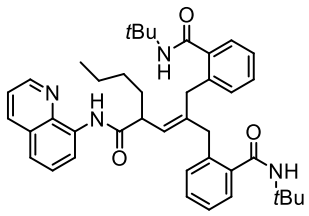
116.6, 51.6, 50.1, 39.5, 38.9, 31.7, 28.6, 28.5, 21.2. **HRMS (ESI)** calcd for $C_{45}H_{51}N_4O_3$ $[M+H]^+$: 695.3956; found 695.3960.

(4ai) 2,2'-(2-(2-(4-chlorobenzyl)-3-oxo-3-(quinolin-8-ylamino)propylidene) propane-1,3-diyl)bis(*N*-*(tert*-butyl)benzamide)



Colorless liquid, 39.3 mg, yield 55 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.04 (s, 1H), 8.77 (dd, *J* = 6.9, 2.0 Hz, 1H), 8.61 (dd, *J* = 4.3, 1.6 Hz, 1H), 8.15 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.60 – 7.49 (m, 2H), 7.42 (dd, *J* = 8.3, 4.1 Hz, 1H), 7.28 – 7.00 (m, 10H), 6.93 (t, *J* = 7.5 Hz, 1H), 6.63 (d, *J* = 7.8 Hz, 1H), 6.42 (s, 1H), 5.94 (s, 1H), 5.79 (d, *J* = 10.0 Hz, 1H), 3.81 (td, *J* = 9.5, 5.5 Hz, 1H), 3.50 – 3.24 (m, 5H), 2.99 (dd, *J* = 13.5, 9.1 Hz, 1H), 1.19 (s, 9H), 1.10 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 171.4, 170.0, 169.8, 148.4, 141.5, 139.2, 139.0, 138.6, 137.9, 136.3, 135.5, 134.8, 134.4, 132.4, 131.0, 129.3, 128.8, 128.3, 128.0, 128.0, 127.4, 127.0, 126.8, 126.3, 126.1, 121.9, 121.7, 116.6, 51.6, 49.8, 39.5, 38.5, 31.8, 28.6, 28.5. **HRMS (ESI)** calcd for $C_{44}H_{48}ClN_4O_3$ $[M+H]^+$: 715.3410; found 715.3415.

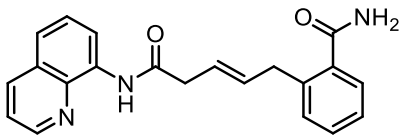
(4af) 2,2'-(2-(2-(quinolin-8-ylcarbamoyl)hexylidene)propane-1,3-diyl)bis(*N*-*(tert*-butyl)benzamide)



Colorless liquid, 48.4 mg, yield 75 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.99 (s, 1H), 8.78 (d, *J* = 7.1 Hz, 1H), 8.68 (d, *J* = 4.3 Hz, 1H), 8.15 (d, *J* = 8.2 Hz, 1H), 7.57 – 7.49 (m, 2H), 7.43 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.36 – 7.31 (m, 1H), 7.22 (ddd, *J* = 26.9, 9.1, 4.6 Hz, 5H), 7.11 – 6.99 (m, 2H), 6.64 (s, 1H), 5.90 (s, 1H), 5.81 (d, *J* = 9.7 Hz, 1H), 3.63 – 3.36 (m, 5H), 1.75 (d, *J* = 13.0 Hz, 2H), 1.51 – 1.34 (m, 4H), 1.23 (s, 9H), 1.13 (s, 9H), 0.91 (t, *J* = 6.9 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 172.8, 170.2, 169.8, 148.4, 140.0, 139.3, 136.3, 135.9,

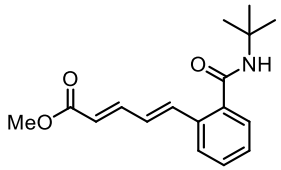
135.2, 134.6, 129.8, 129.4, 129.4, 129.3, 128.1, 128.0, 127.4, 127.1, 126.8, 126.3, 126.1, 121.7, 121.6, 116.6, 51.7, 51.6, 48.1, 39.7, 33.4, 32.0, 29.8, 28.7, 28.5, 22.9, 14.2. **HRMS (ESI)** calcd for $C_{41}H_{51}N_4O_3$ $[M+H]^+$: 647.3956; found 647.3959.

(5) (*E*)-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide



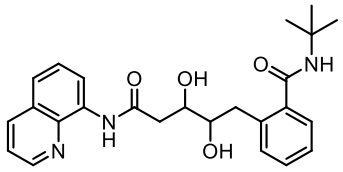
Colorless liquid, 27.3 mg, yield 79 %. **^{1}H NMR** (400 MHz, Chloroform-d) δ 9.89 (s, 1H), 8.78 – 8.69 (m, 2H), 8.16 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.55 – 7.47 (m, 6H), 7.45 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.39 – 7.35 (m, 2H), 7.30 – 7.23 (m, 2H), 6.19 (s, 1H), 6.01 (dt, *J* = 14.0, 6.1 Hz, 1H), 5.80 (s, 1H), 5.69 (dt, *J* = 15.0, 7.2 Hz, 1H), 3.70 (d, *J* = 6.2 Hz, 2H), 3.31 (d, *J* = 7.2 Hz, 2H). **^{13}C NMR** (101 MHz, CDCl3) δ 172.05, 169.86, 148.38, 138.54, 136.58, 135.87, 135.63, 134.41, 130.88, 130.53, 128.11, 127.60, 127.54, 126.62, 124.14, 121.81, 121.76, 116.67, 77.48, 77.16, 76.84, 41.90, 36.60. **HRMS (ESI)** calcd for $C_{21}H_{20}N_3O_2$ $[M+H]^+$: 346.1551; found 346.1554.

(6) methyl(2*E*,4*E*)-5-(2-(tert-butylcarbamoyl)phenyl)penta-2,4-dienoate



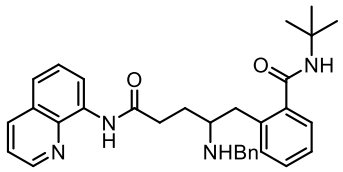
White solid, M.P: 119 - 121 °C, 15.8 mg, yield 55%. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 7.60 (d, *J* = 7.7 Hz, 1H), 7.47 – 7.36 (m, 3H), 7.31 (td, *J* = 7.3, 1.2 Hz, 1H), 7.22 (d, *J* = 15.6 Hz, 1H), 6.84 (dd, *J* = 15.5, 11.1 Hz, 1H), 6.00 (d, *J* = 15.3 Hz, 1H), 5.60 (s, 1H), 3.77 (s, 3H), 1.47 (s, 9H).**^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.8, 167.5, 144.8, 137.7, 137.6, 133.9, 129.9, 128.8, 128.5, 127.5, 126.5, 121.7, 52.3, 51.8, 29.0. **HRMS (ESI)** calcd for $C_{17}H_{22}NO_3$ $[M+H]^+$: 288.1595; found 288.1594.

(7) *N*-(*tert*-butyl)-2-(2,3-dihydroxy-5-oxo-5-(quinolin-8-ylamino)pentyl)be



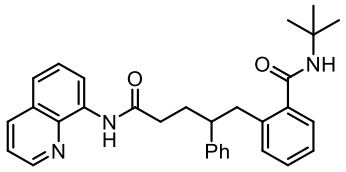
White solid, M.P: 146 - 148 °C, yield 88 %. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 10.41 (s, 1H), 8.87 – 8.84 (m, 1H), 8.79 (dd, *J* = 7.0, 2.0 Hz, 1H), 8.19 – 8.10 (m, 1H), 7.57 – 7.50 (m, 2H), 7.45 (dd, *J* = 8.2, 4.2 Hz, 1H), 7.41 – 7.33 (m, 3H), 7.25 (t, *J* = 7.4 Hz, 1H), 6.01 (s, 1H), 5.20 – 5.07 (m, 1H), 4.41 (s, 1H), 4.10 (d, *J* = 9.0 Hz, 1H), 3.84 – 3.76 (m, 1H), 3.10 – 2.97 (m,2H), 2.97 – 2.89 (m, 1H), 2.82 – 2.77 (m, 1H), 1.48 (d, *J* = 1.7 Hz, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 170.8, 148.5, 138.7, 137.4, 137.2, 136.3, 134.8, 131.2, 130.7, 128.1, 127.4, 126.9, 126.7, 121.7, 121.7, 116.9, 75.5, 70.9, 52.5, 42.0, 36.9, 28.8. **HRMS (ESI)** calcd for $C_{25}H_{30}N_3O_4$ $[M+H]^+$: 436.2331; found 436.2330.

(8) 2-(2-(benzylamino)-5-oxo-5-(quinolin-8-ylamino)pentyl)-*N*-(tert-butyl) benzamide



Colorless liquid, 38.1 mg, yield 75%. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 11.09 (s, 1H), 8.80 (dd, *J* = 7.3, 1.7 Hz, 1H), 8.66 (dd, *J* = 4.3, 1.7 Hz, 1H), 8.25 – 8.03 (m, 1H), 7.55 – 7.45 (m, 4H), 7.40 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.27 (ddd, *J* = 10.8, 5.2, 3.0 Hz, 5H), 7.20 – 7.13 (m, 2H), 5.70 (s, 1H), 4.01 – 3.86 (m, 2H), 3.21 (dt, *J* = 6.9, 3.2 Hz, 1H), 2.98 – 2.83 (m, 2H), 2.83 – 2.58 (m, 2H), 2.05 – 1.88 (m, 3H), 1.39 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 171.0, 169.8, 148.3, 139.9, 139.0, 137.7, 136.2, 135.3, 130.3, 129.7, 128.5, 128.4, 128.1, 127.4, 127.0, 126.8, 126.1, 121.5, 117.1, 55.0, 51.8, 51.2, 42.2, 36.1, 29.8, 28.9. **HRMS (ESI)** calcd for $C_{32}H_{37}N_4O_2$ $[M+H]^+$: 509.2912; found 509.2916.

(9) *N*-(*tert*-butyl)-2-(5-oxo-2-phenyl-5-(quinolin-8-ylamino)pentyl)benzamide



White solid, M.P: 133 - 136 °C, 26.4 mg, yield 85%. **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.61 (s, 1H), 8.75 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.72 (dd, *J* = 7.2, 1.9 Hz, 1H), 8.14 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.56 – 7.46 (m, 2H), 7.43 (dd, *J* = 8.2, 4.2 Hz, 1H), 7.30 – 7.23 (m, 4H), 7.18 (dt, *J* = 7.7, 1.6 Hz, 3H), 7.12 (td, *J* = 7.4, 1.3 Hz, 1H), 7.04 (d, *J* = 7.5 Hz, 1H), 5.57 (s, 1H), 3.19 – 3.10 (m, 2H), 3.09 – 3.02 (m, 1H), 2.36 (pt, *J* = 9.0, 5.1 Hz, 2H), 2.28 – 2.17 (m, 1H), 2.10 (ddt, *J* = 13.6, 9.4, 4.8 Hz, 1H), 1.44 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 171.7, 170.1, 148.2, 144.2, 138.4, 138.3, 138.2, 136.4, 134.7, 131.2, 129.3, 128.6, 128.1, 128.0, 127.5, 126.8, 126.5, 126.1, 121.7, 121.4, 116.5, 51.9, 46.9, 41.0, 36.2, 31.0, 28.9. **HRMS (ESI)** calcd for $C_{31}H_{34}N_3O_2$ $[M+H]^+$: 480.2646; found 480.2646.

IV. NMR spectra of synthesized compounds

(3aa) (*E*)-*N*-*(tert*-butyl)-2-(5-(naphthalen-1-ylamino)-5-oxopent-2-en-1-yl) benzamide

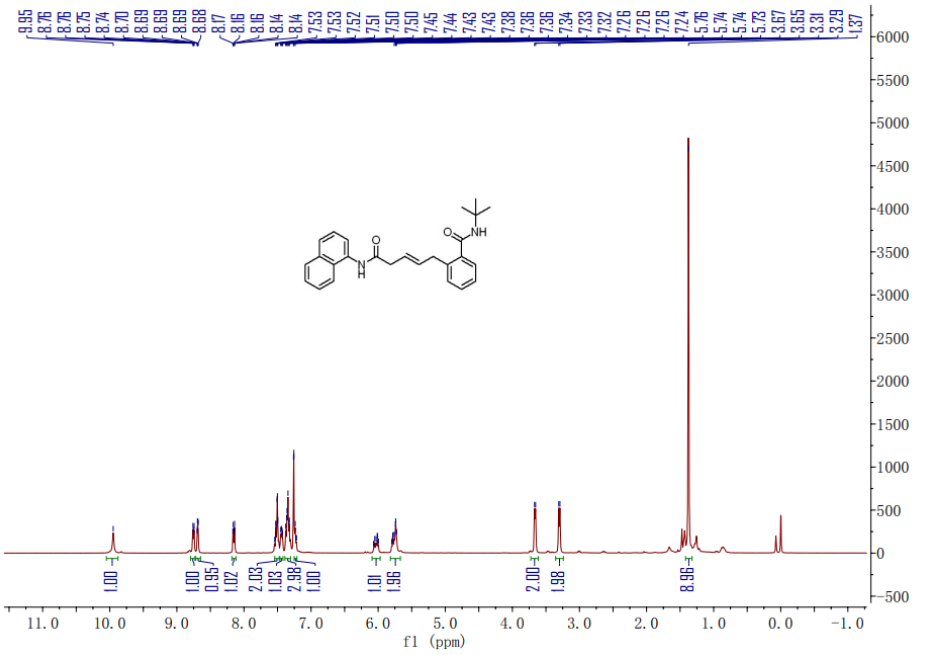


Figure S1. ^{1}H NMR (400 MHz, $CDCl_3$) spectra of compound **3aa**

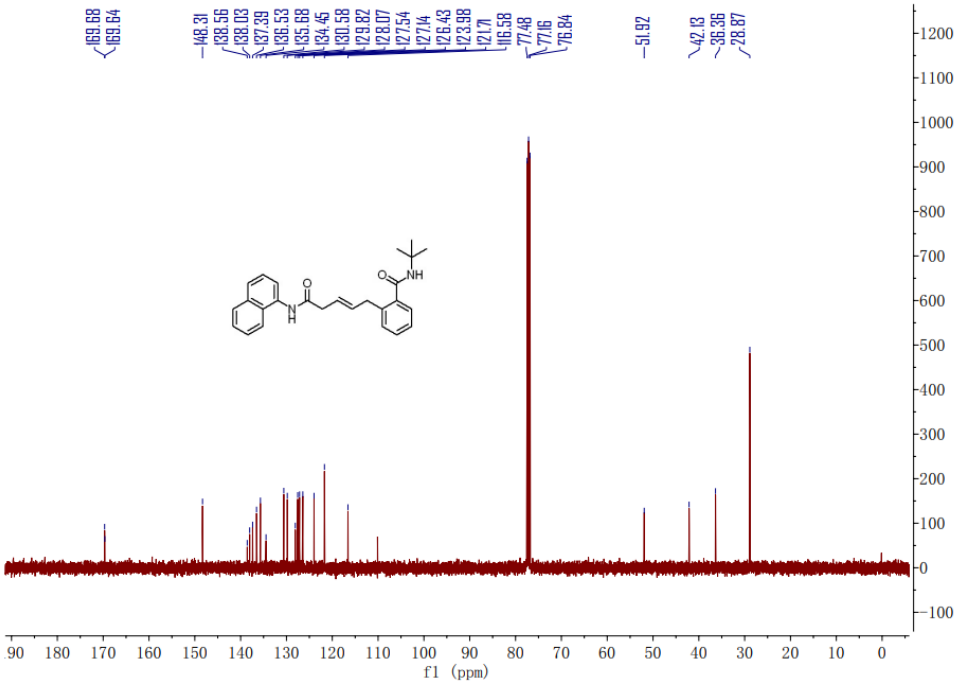


Figure S2. ^{13}C NMR (101 MHz, $CDCl_3$) spectra of compound **3aa**

(3ba) (*E*)-*N*-(*tert*-butyl)-4-methyl-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

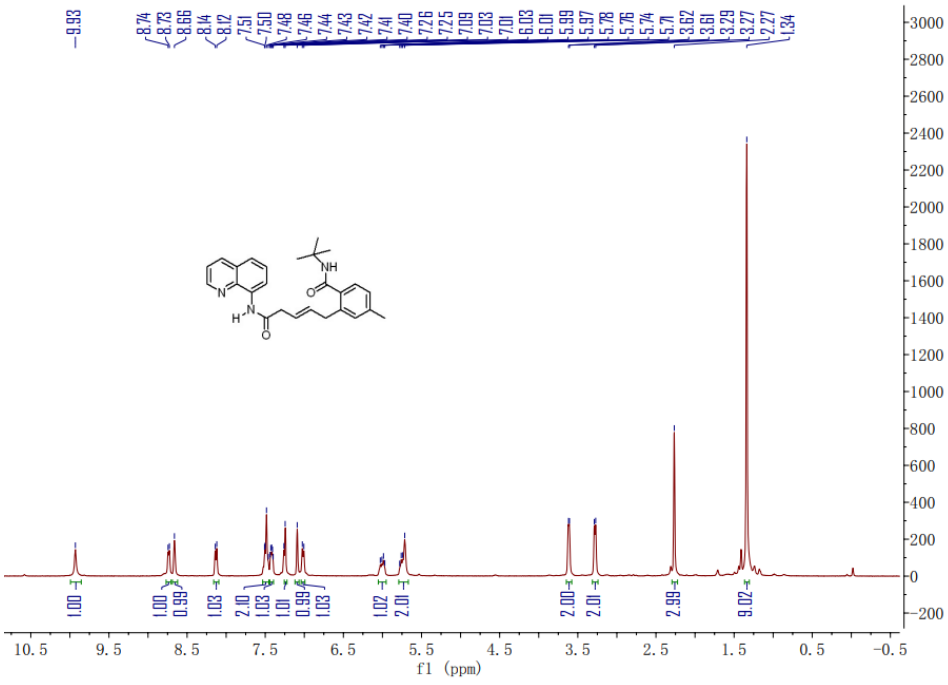


Figure S3. ^{1}H NMR (400 MHz, $CDCl_3$) spectra of compound **3ba**

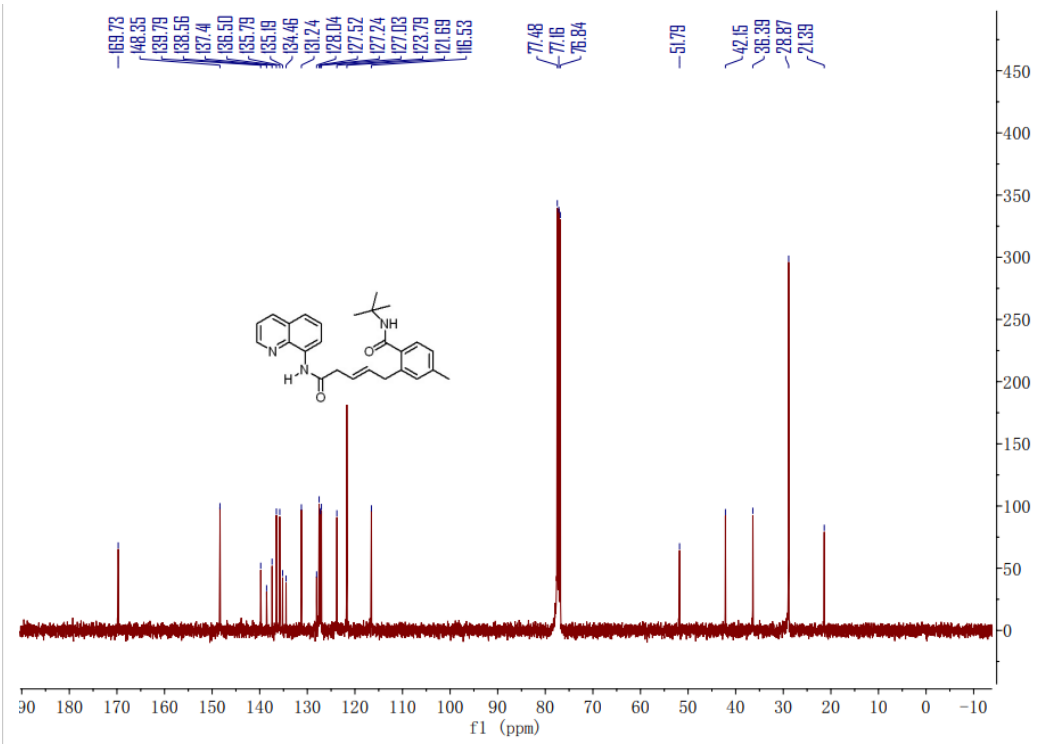


Figure S4.^{13}C NMR (101 MHz, $CDCl_3$) spectra of compound **3ba**

(3ca) (*E*)-*N*-*(tert*-butyl)-4-methoxy-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

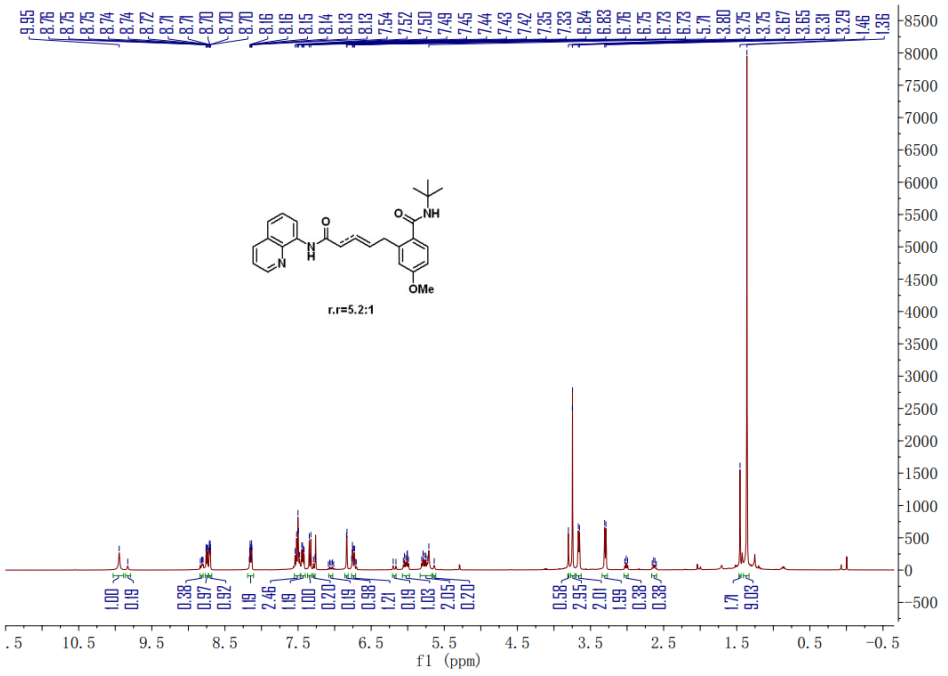


Figure S5. ^{1}H NMR (400 MHz, $CDCl_3$) spectra of compound **3ca**

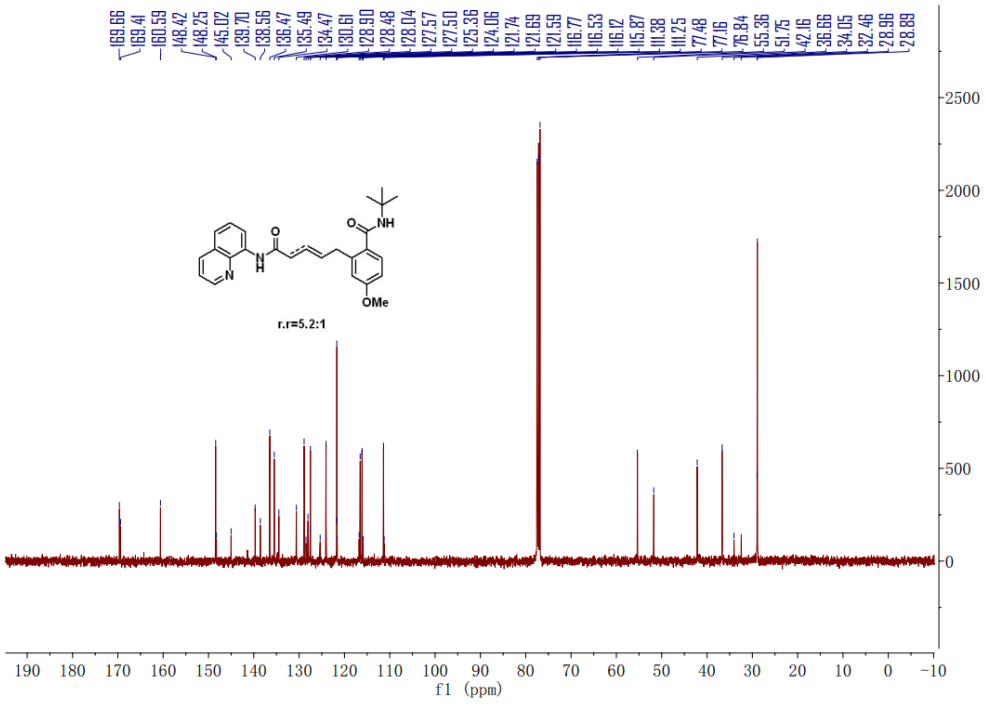


Figure S6. ^{13}C NMR (101 MHz, $CDCl_3$) spectra of compound **3ca**

(3da) (*E*)-*N*-(*tert*-butyl)-4-fluoro-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1- yl)benzamide

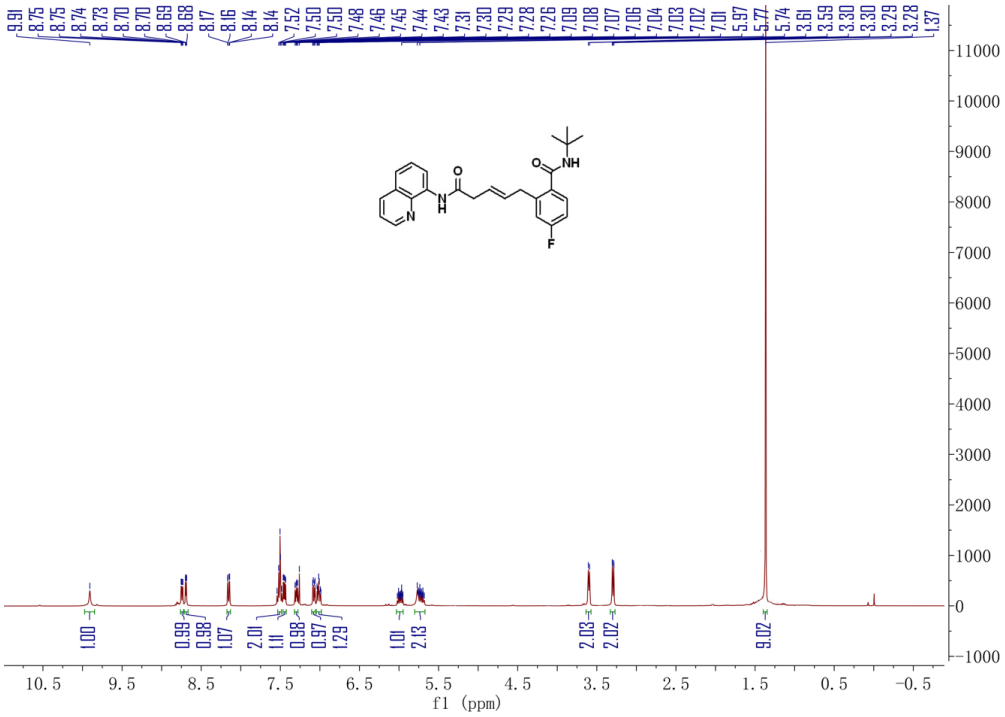


Figure S7. ^{1}H NMR (400 MHz, $CDCl_3$) spectra of compound **3da**

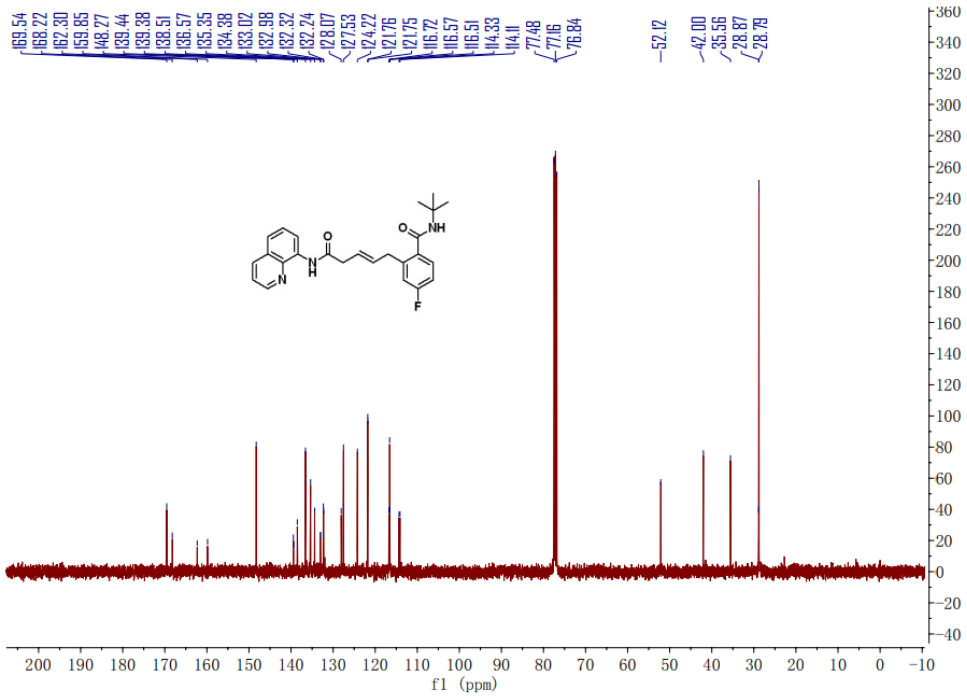


Figure S8. ^{13}C NMR (101 MHz, $CDCl_3$) spectra of compound **3da**

(3ea) (*E*)-*N*-*(tert*-butyl)-4-chloro-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

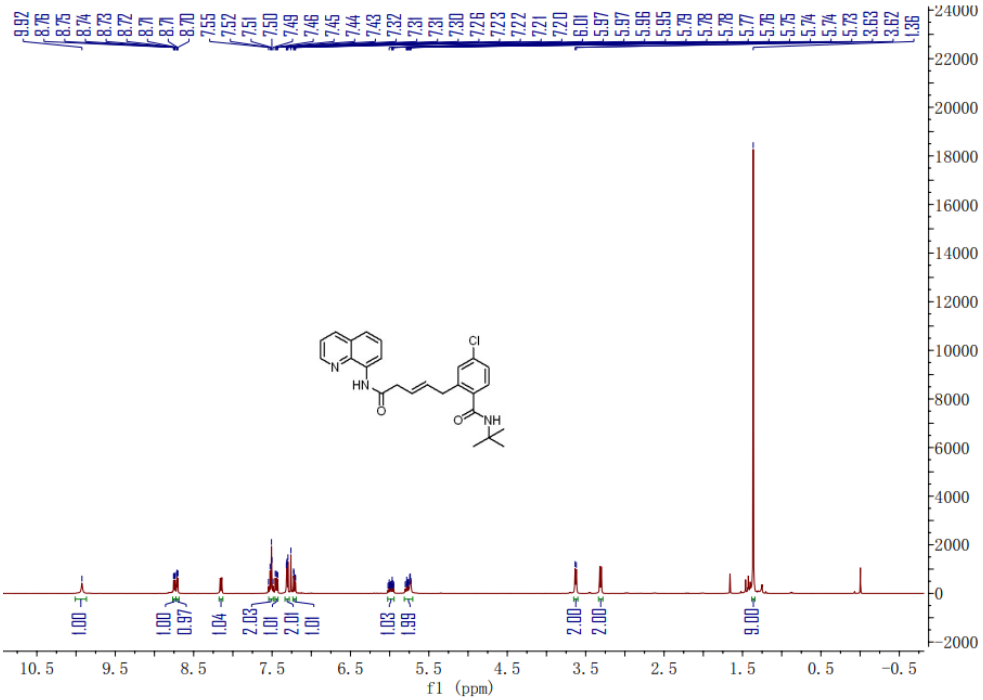


Figure S9. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ea**

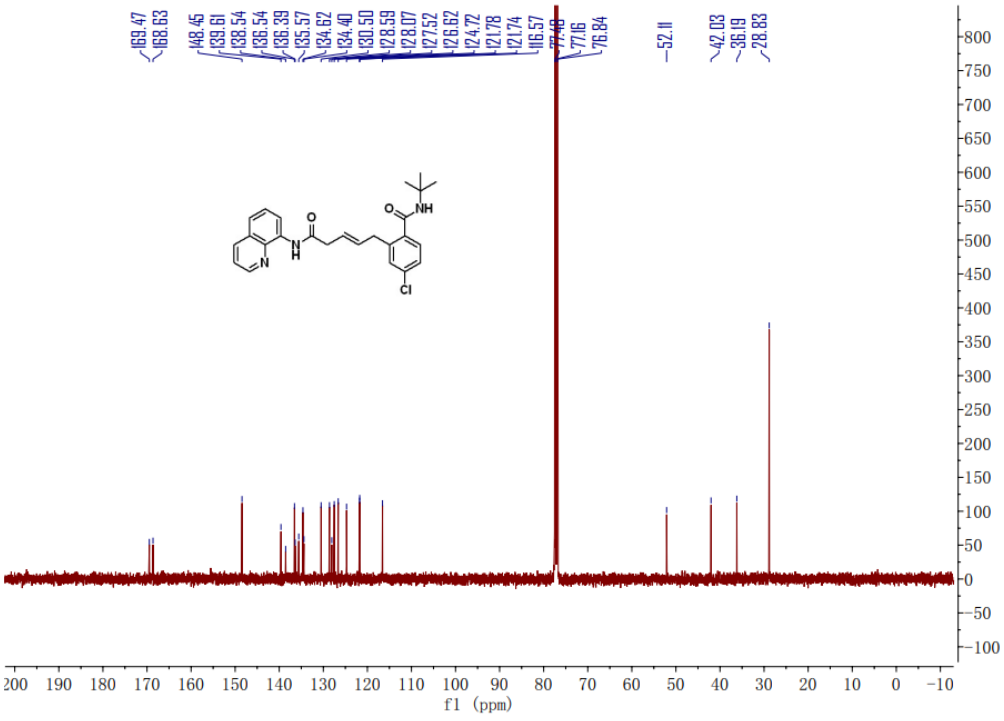


Figure S10. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ea**

(3fa) (*E*)-*N*-(*tert*-butyl)-3-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)-[1,1'-biphenyl]-4-carboxamide

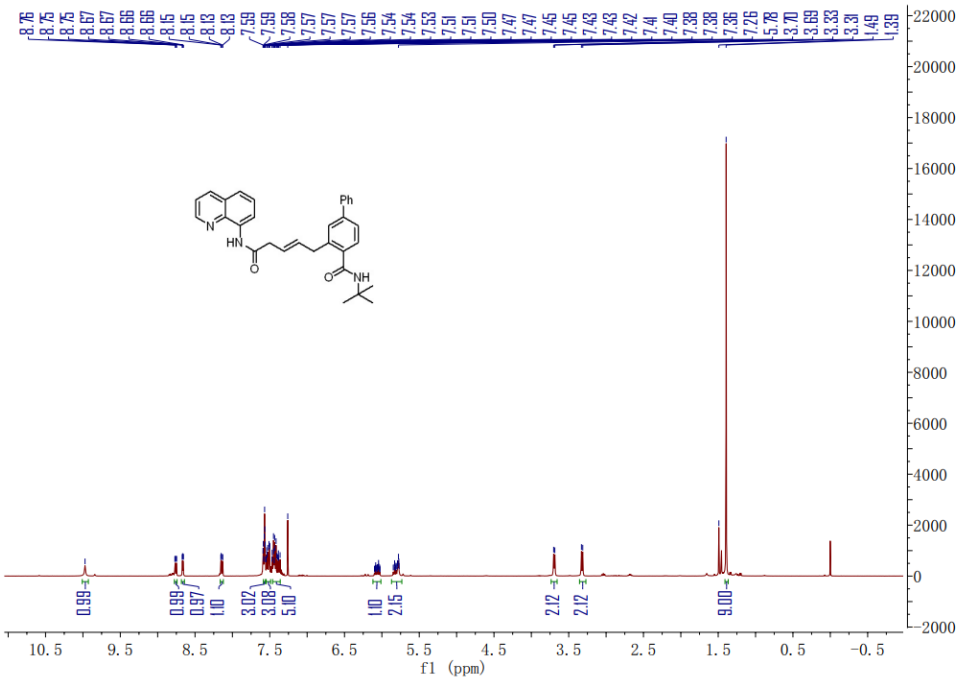


Figure S11. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3fa**

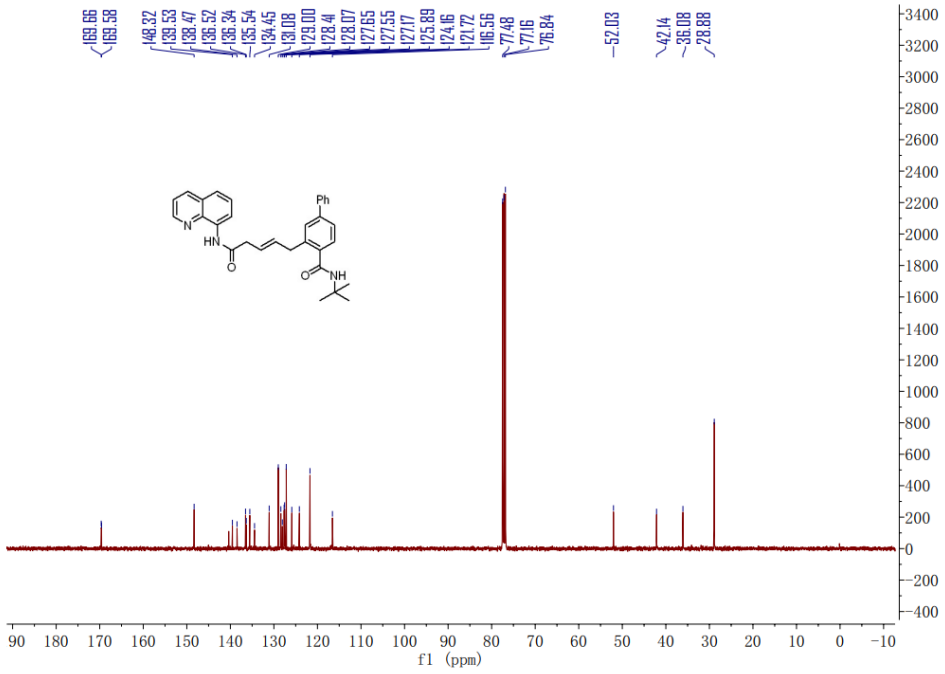


Figure S12. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3fa**

(3ga) (*E*)-*N*-*(tert*-butyl)-5-methyl-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

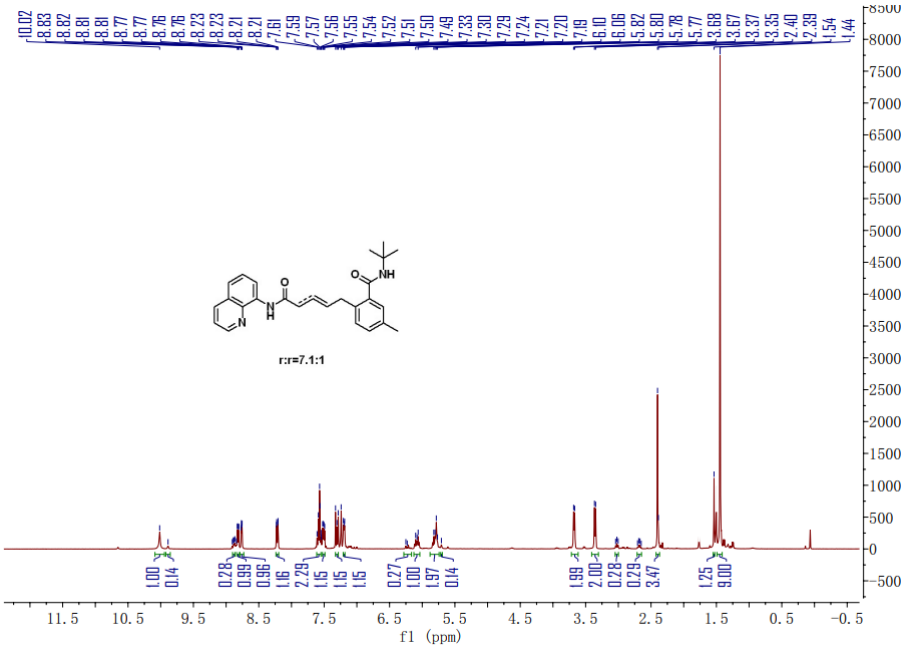


Figure S13. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ga**

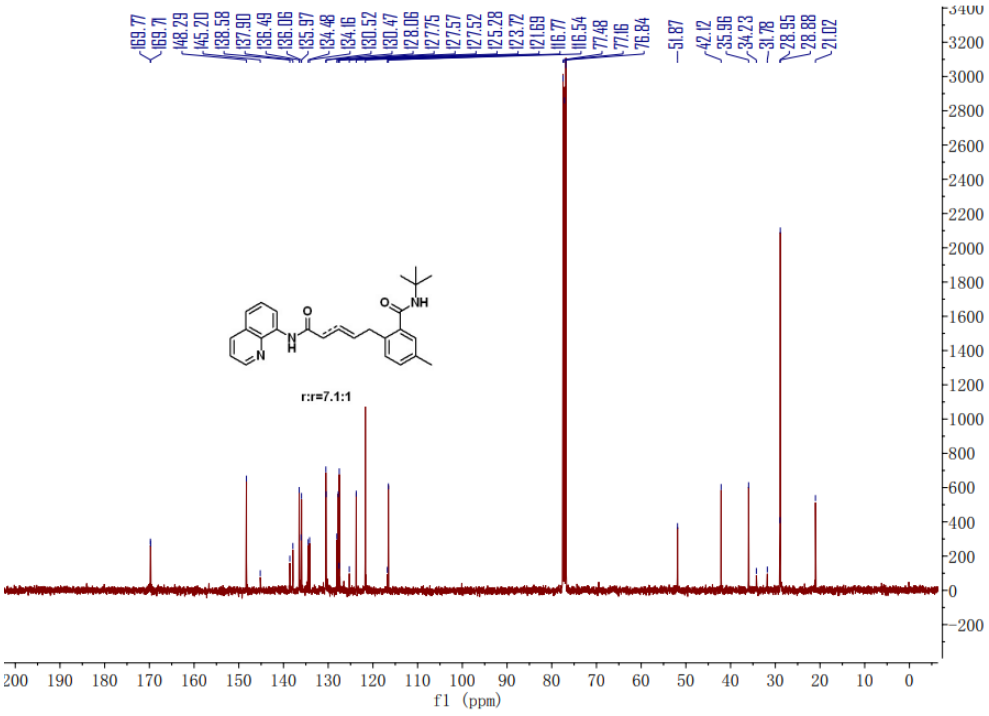


Figure S14. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3g**

(3ha) (*E*)-*N*-(*tert*-butyl)-4,5-dimethyl-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

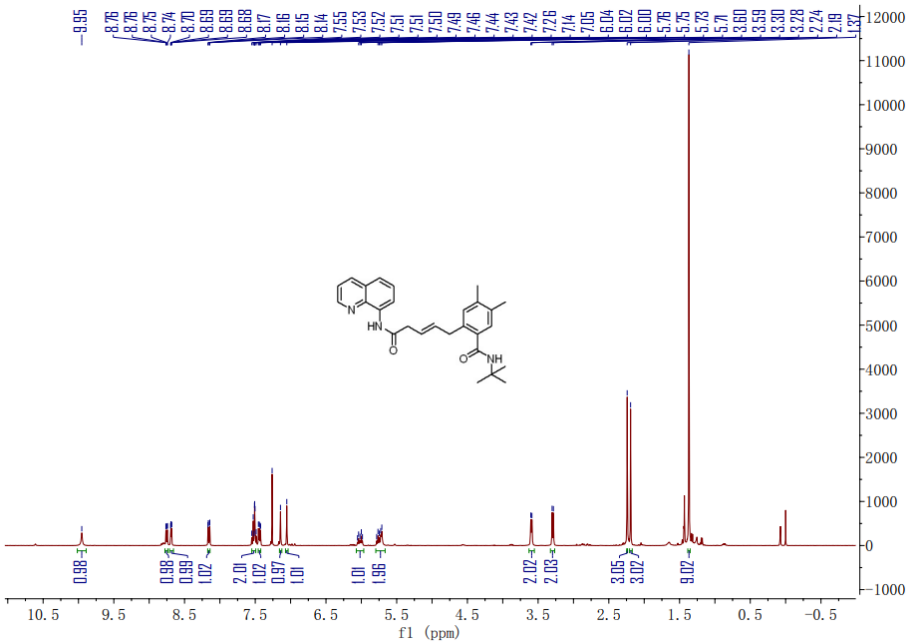


Figure S15. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ha**

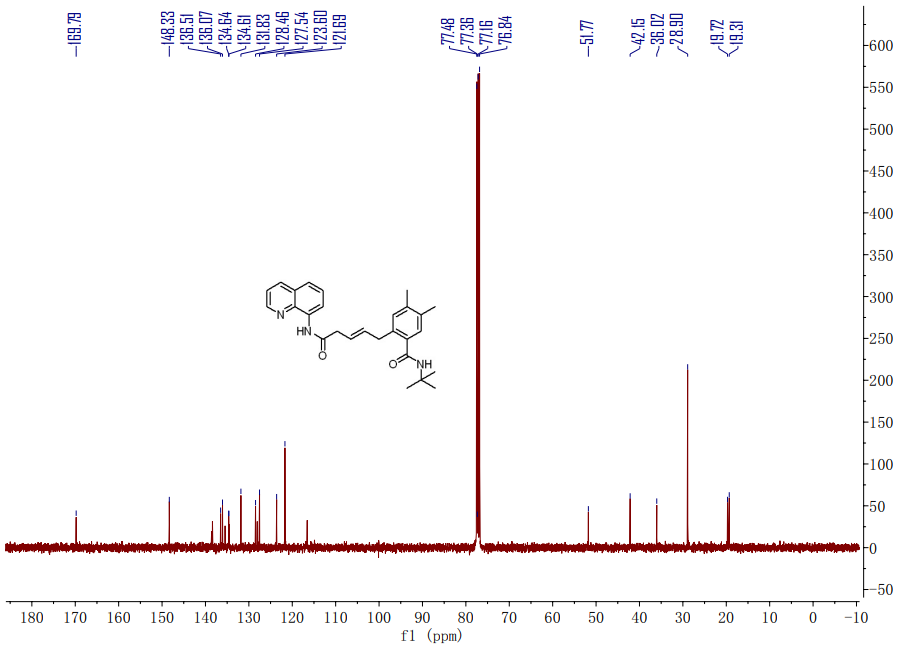


Figure S16. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ha**

(3ia) (*E*)-*N*-(*tert*-butyl)-4,5-difluoro-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

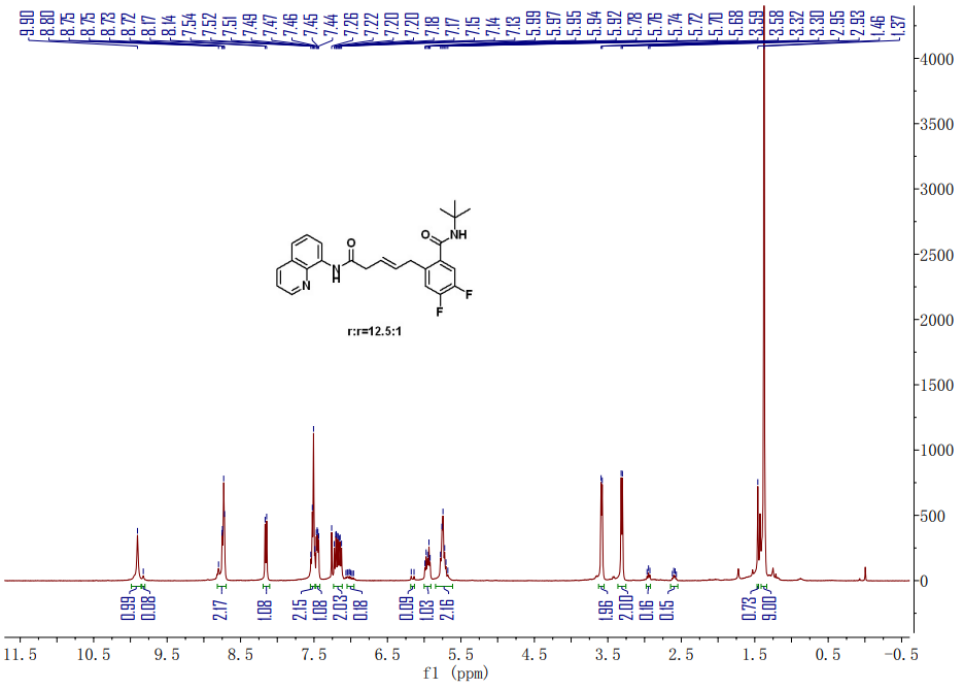


Figure S17. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ia**

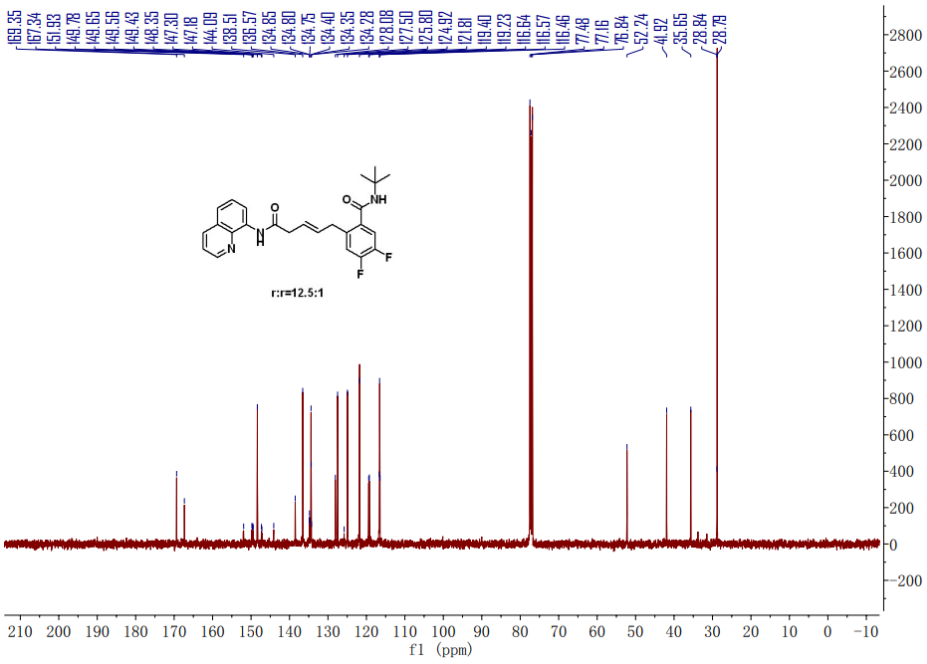


Figure S18. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ia**

(3ja) (*E*)-*N*-*(tert*-butyl)-2-(3-4-oxo-6-(quinolin-8-ylamino)hex-3-en-2-yl)benzamide

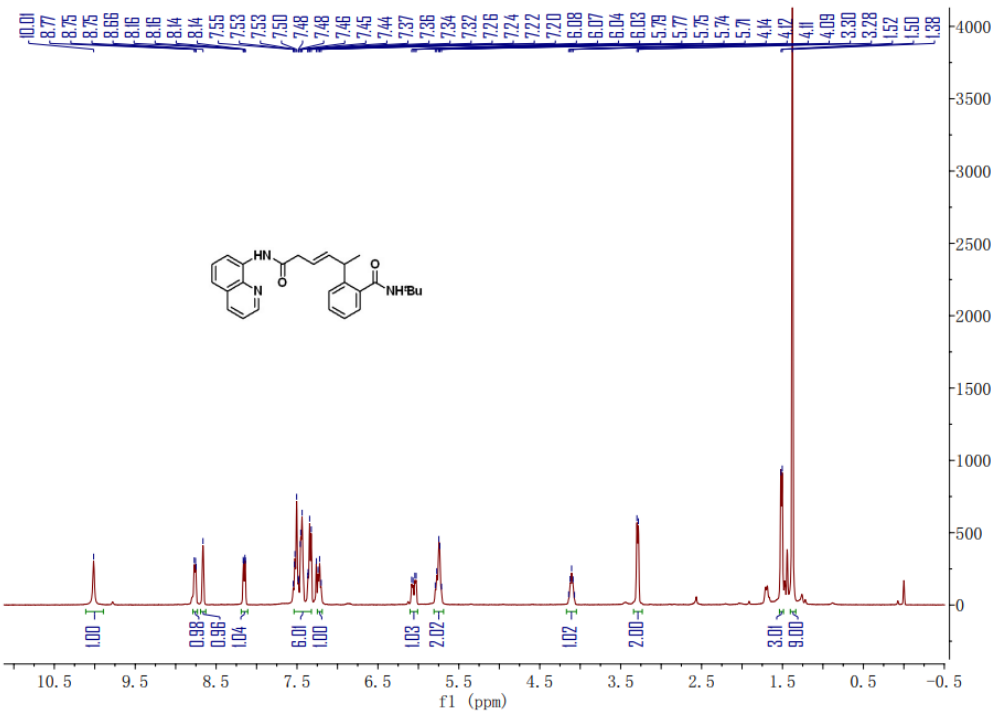


Figure S19. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ja**

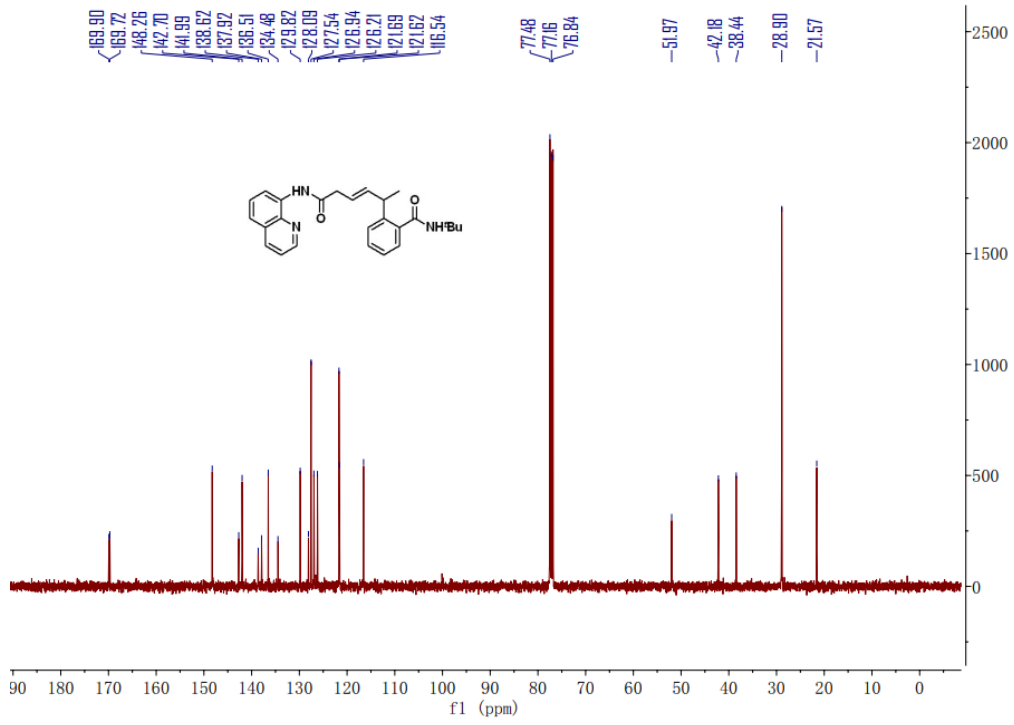


Figure S20. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ja**

(3ka) (*E*)-*N*-*(tert*-butyl)-2-(8-oxo-8-(quinolin-8-ylamino)oct-5-en-4-yl)benzamide

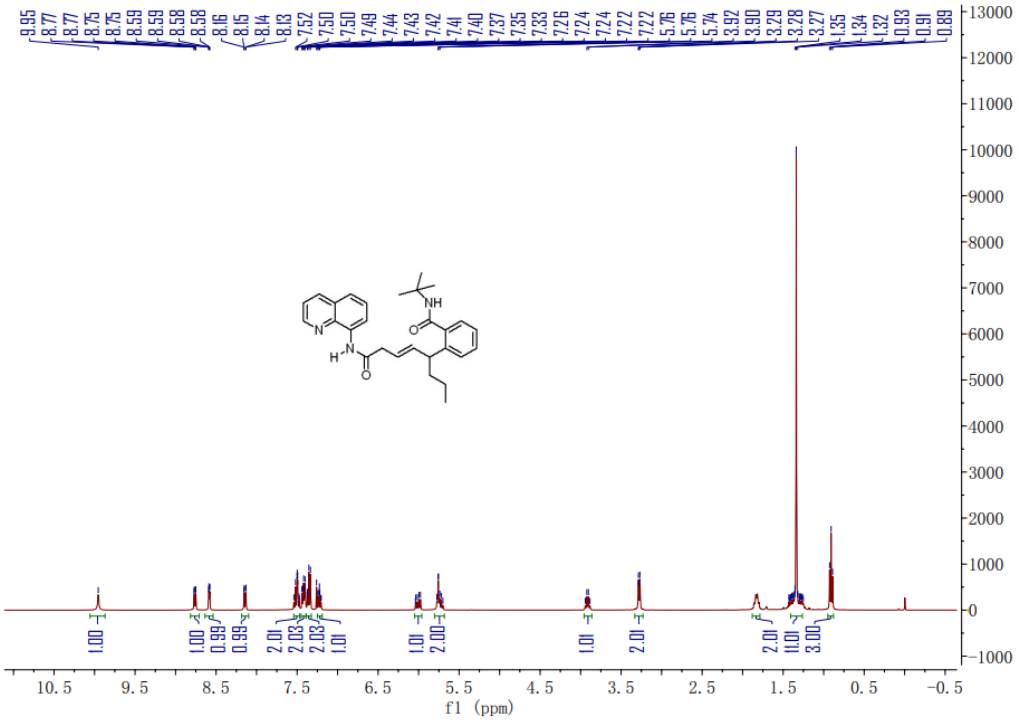


Figure S21. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ka**

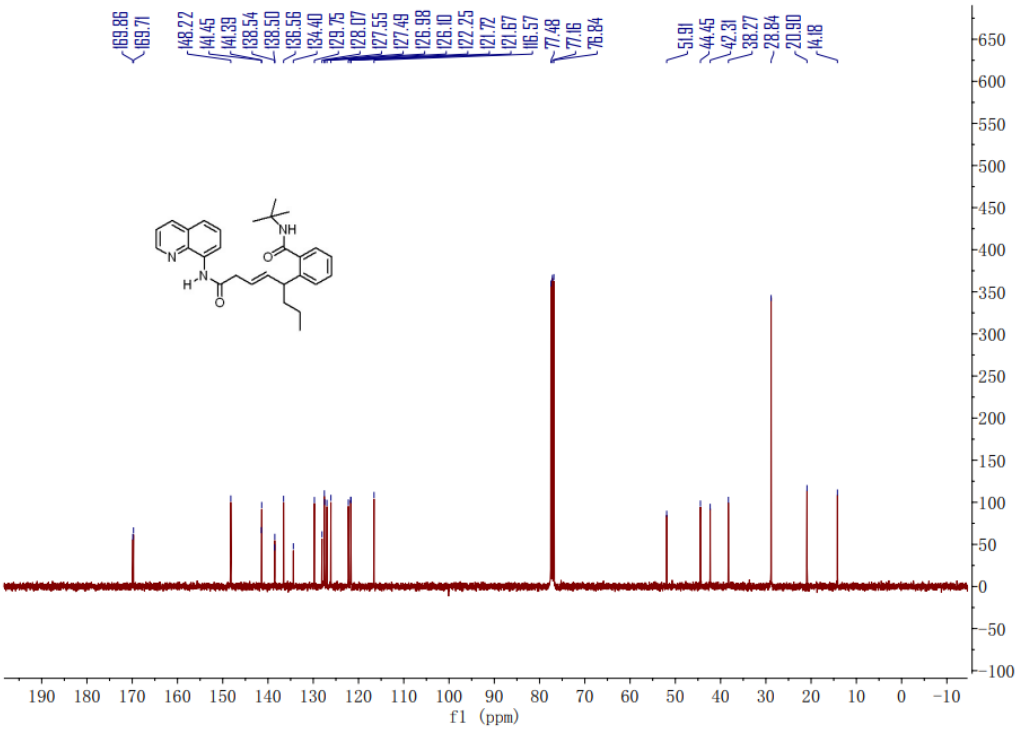


Figure S22. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ka**

(3la) (*E*)-*N*-*(tert*-butyl)-2-(5-oxo-1-phenyl-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

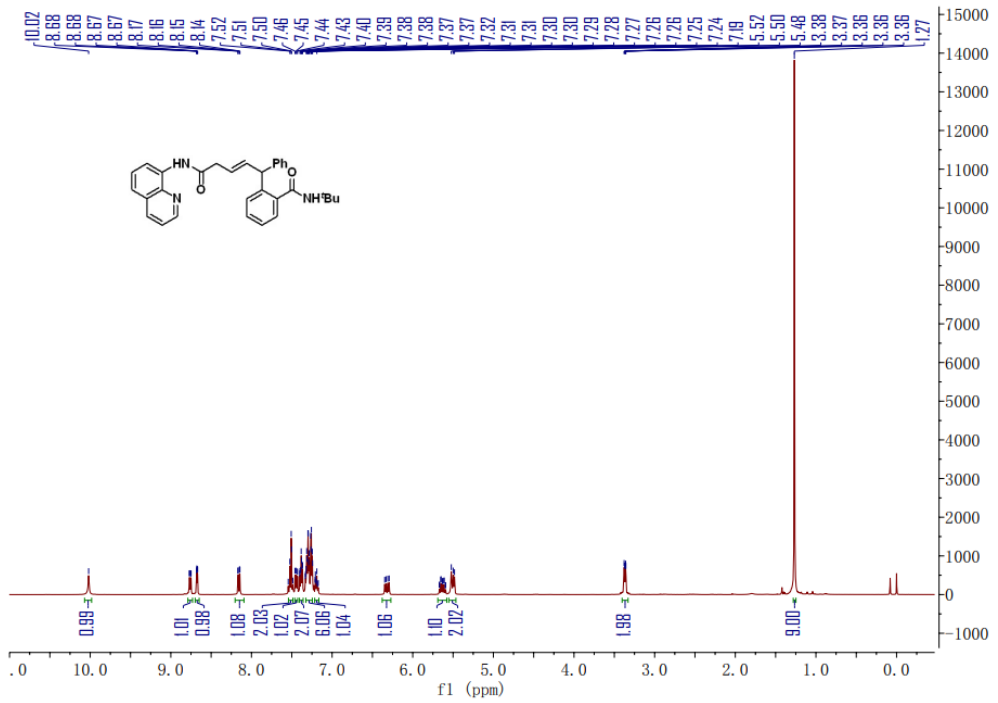


Figure S23. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3la**

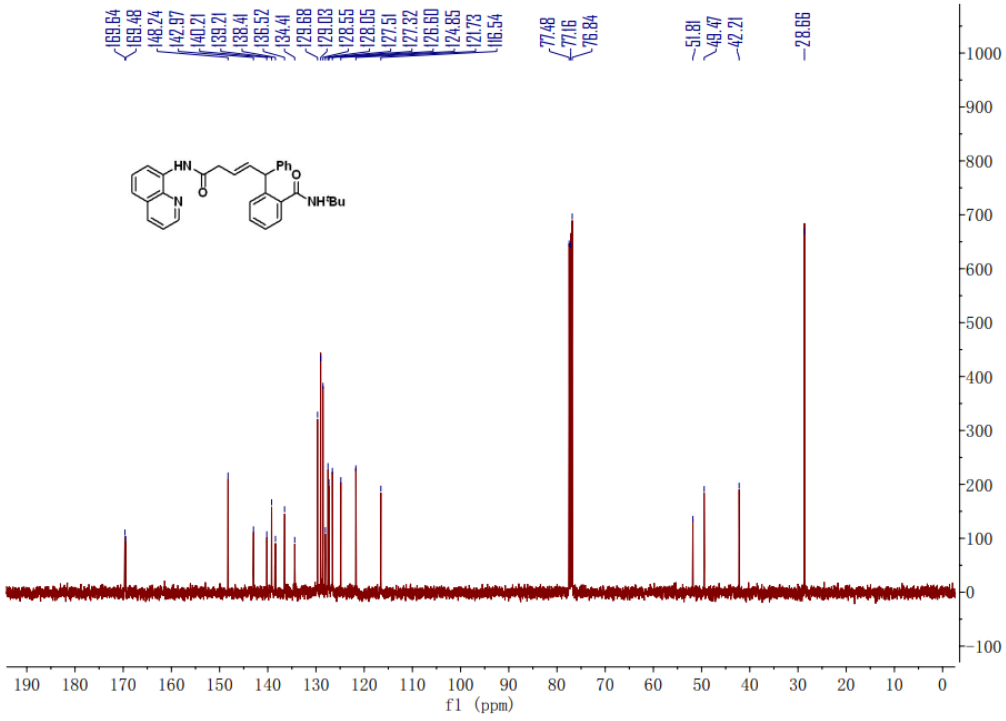


Figure S24. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3la**

(3ma) (*E*)-*N*-(*tert*-butyl)-2-(3-4-oxo-1-phenyl-6-(quinolin-8-ylamino)hex-3-en-2-yl)benzamide

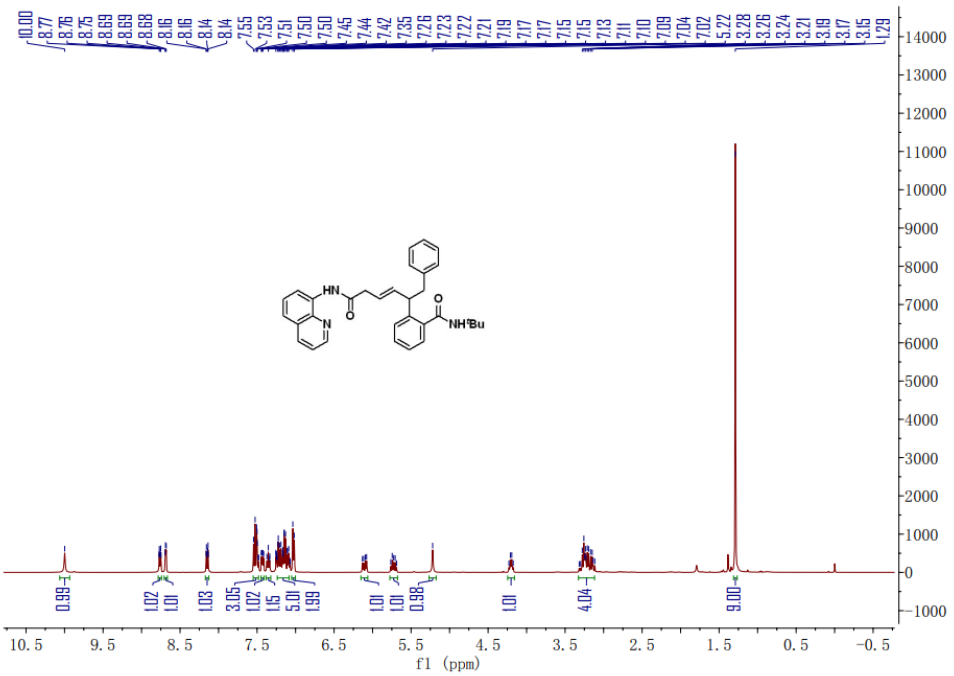


Figure S25. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ma**

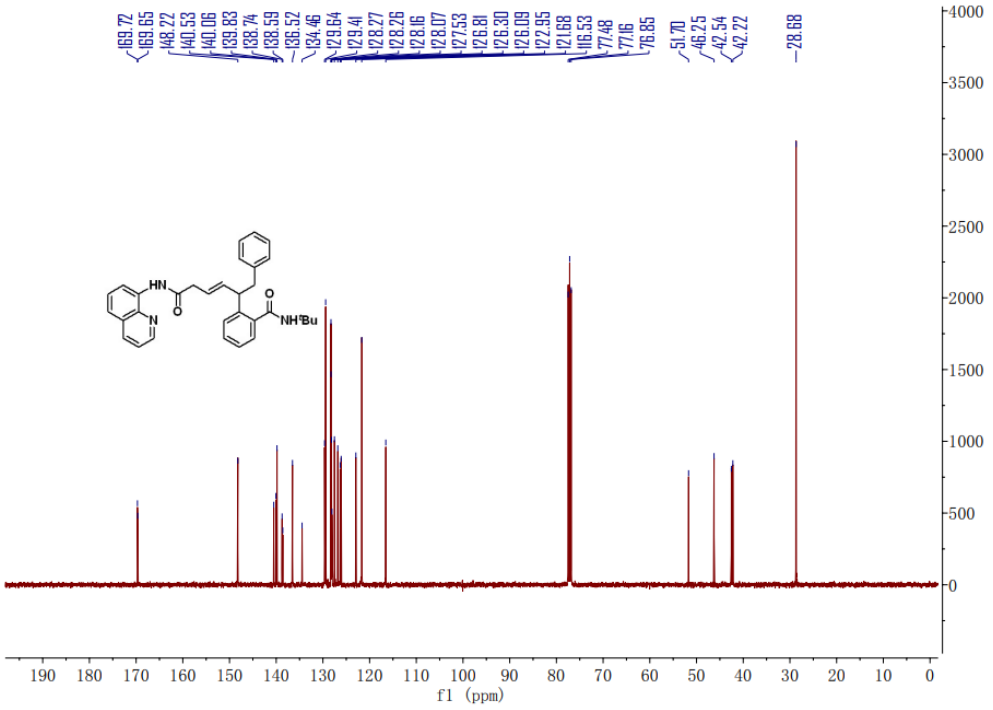


Figure S26. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ma**

(3na) (*E*)-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)-*N*-(*tert*pentyl)benzamide

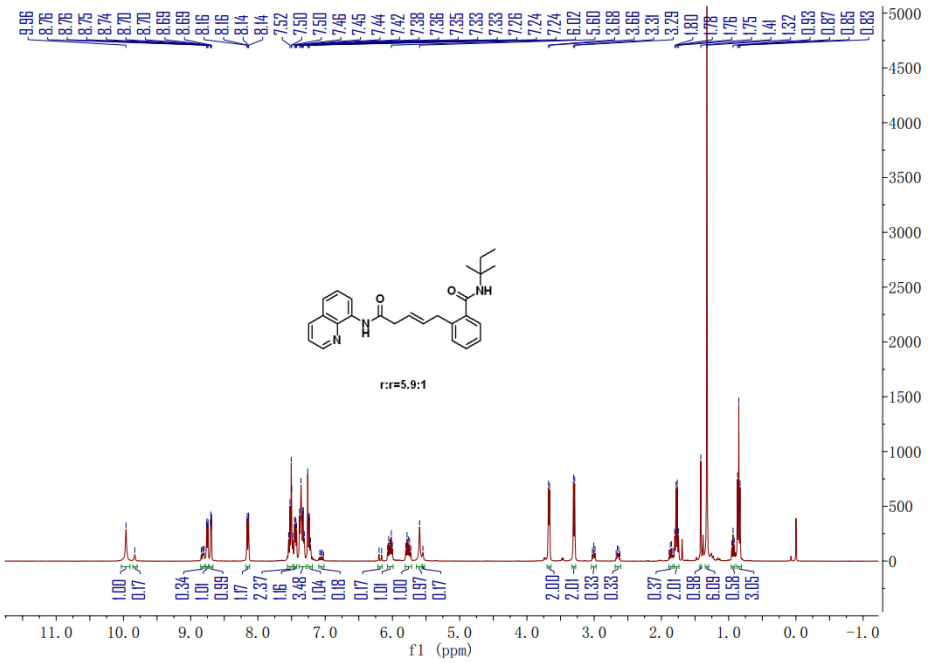


Figure S27. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3na**

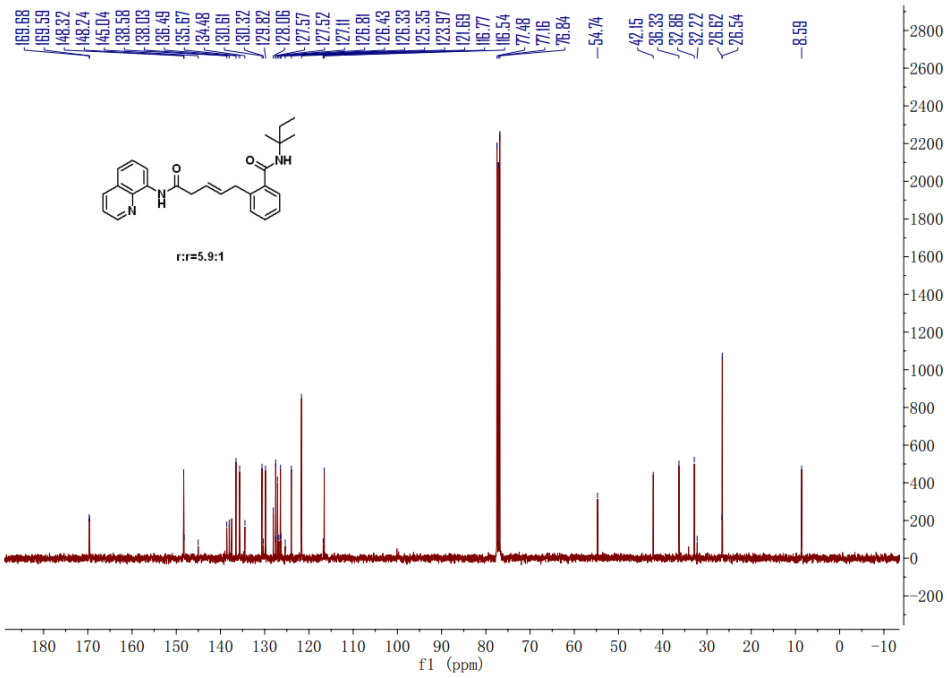


Figure S28. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3na**

(3ab) (*E*)-*N*-*(tert*-butyl)-2-(2-methyl-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

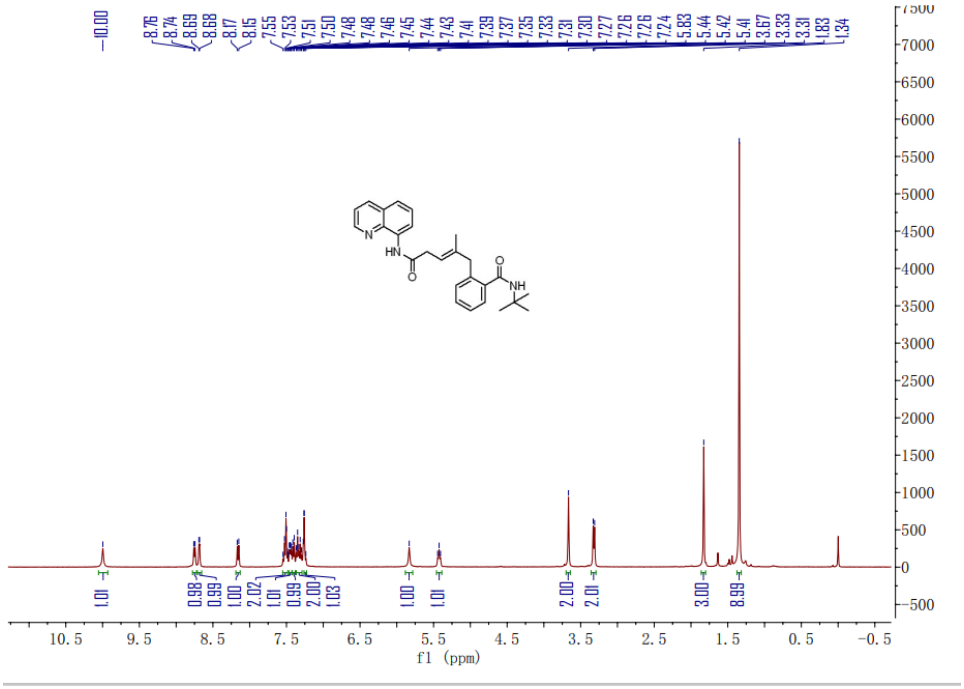


Figure S29. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ab**

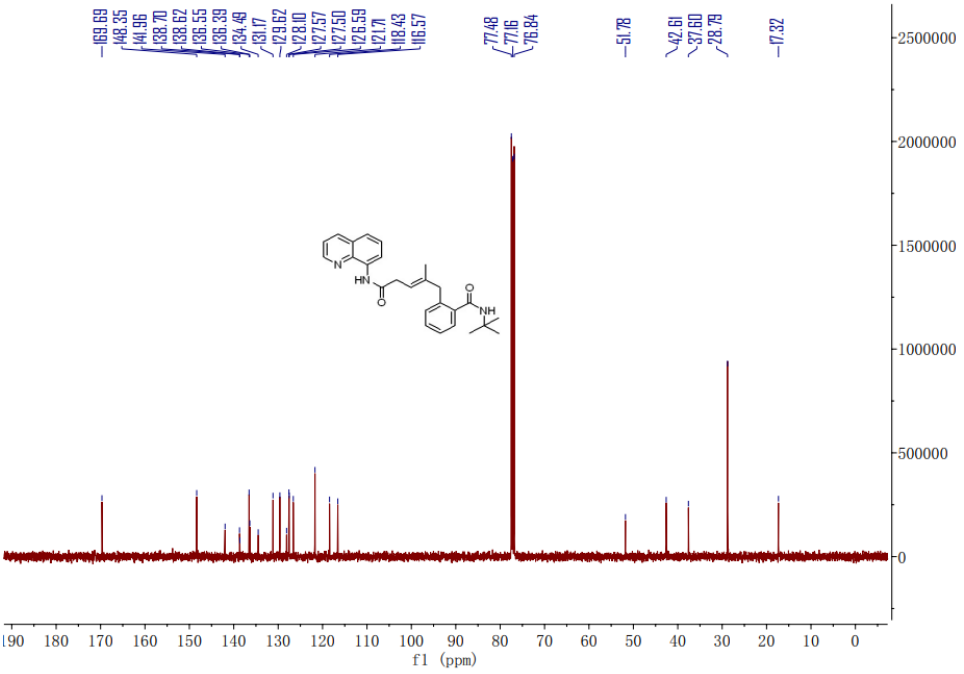


Figure S30. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ab**

(3ac) (*E*)-*N*-*(tert*-butyl)-2-(2-ethyl-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

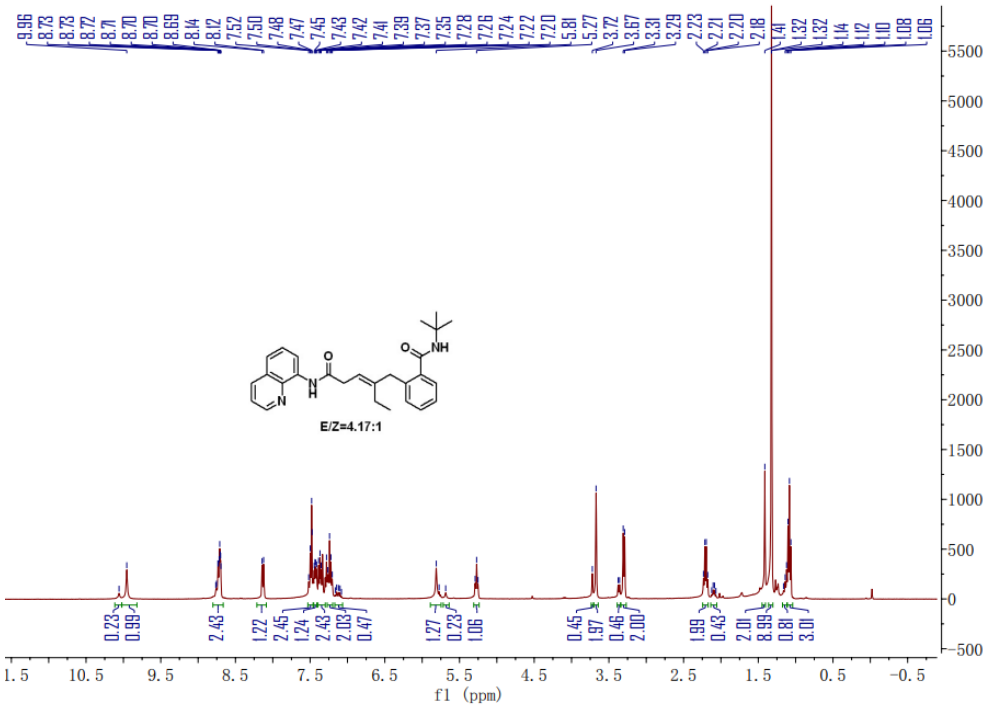


Figure S31. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ac**

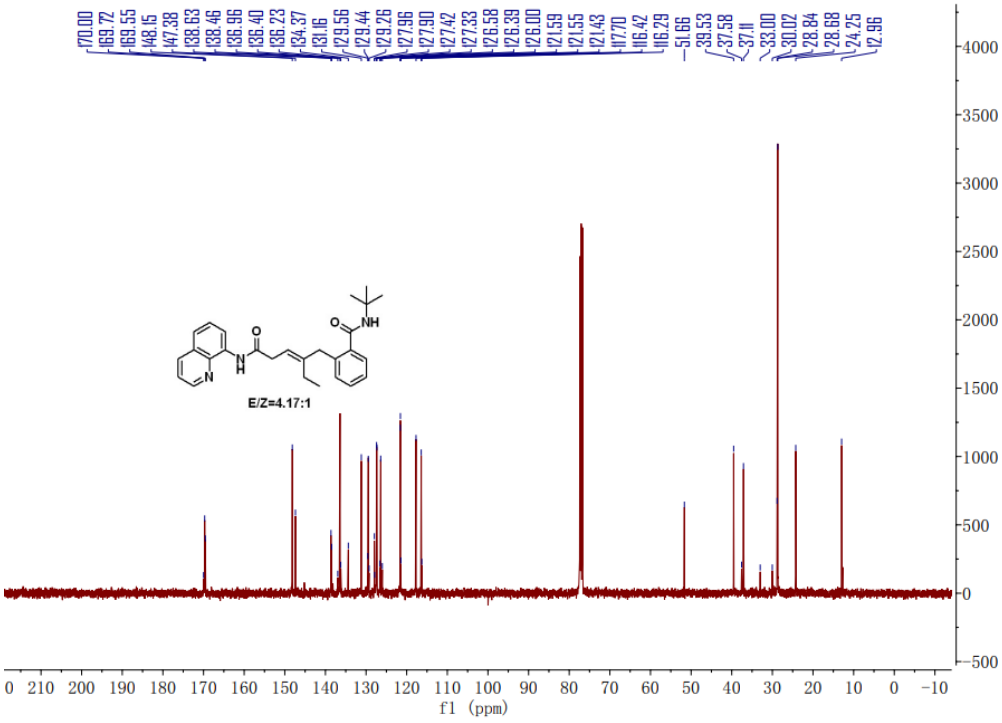


Figure S32. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ac**

(3ad) (*E*)-*N*-*(tert*-butyl)-2-(5-oxo-2-propyl-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

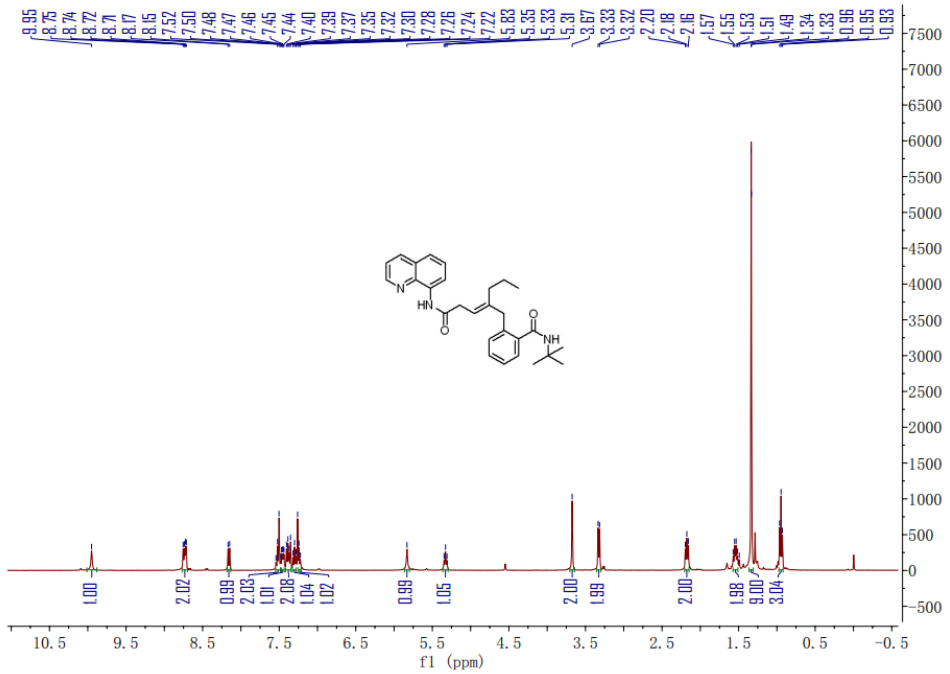


Figure S33. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ad**

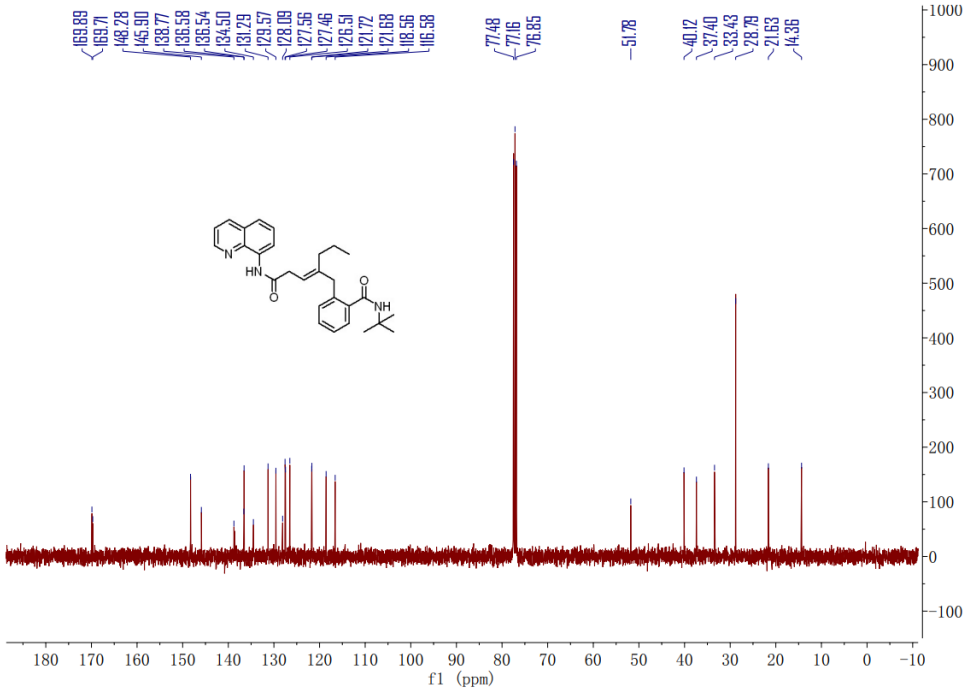


Figure S34. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ad**

(3ae) (*E*)-*N*-(*tert*-butyl)-2-(4-methyl-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

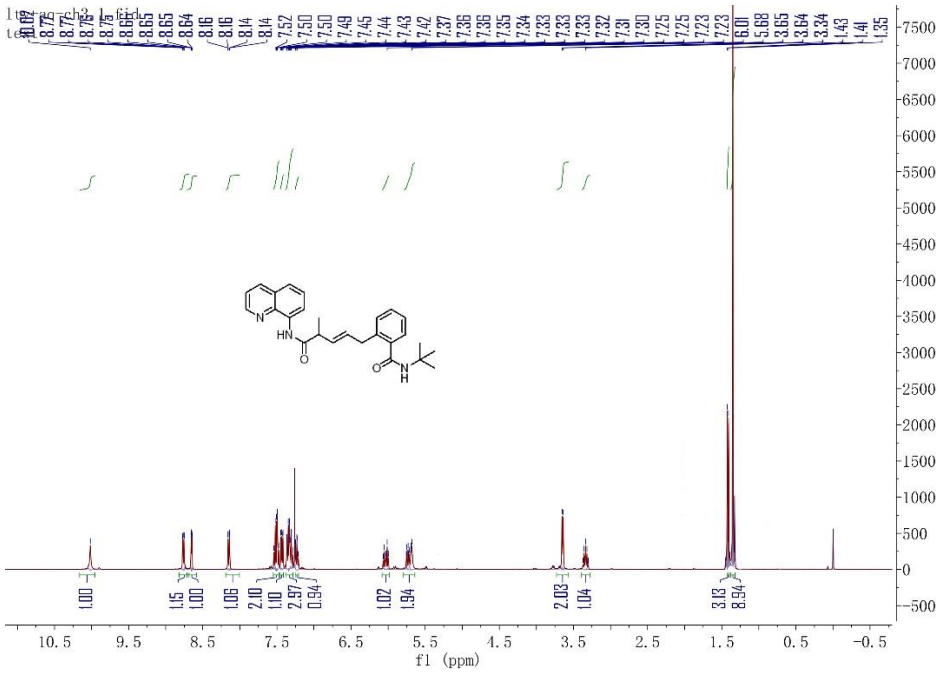


Figure S35. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ae**

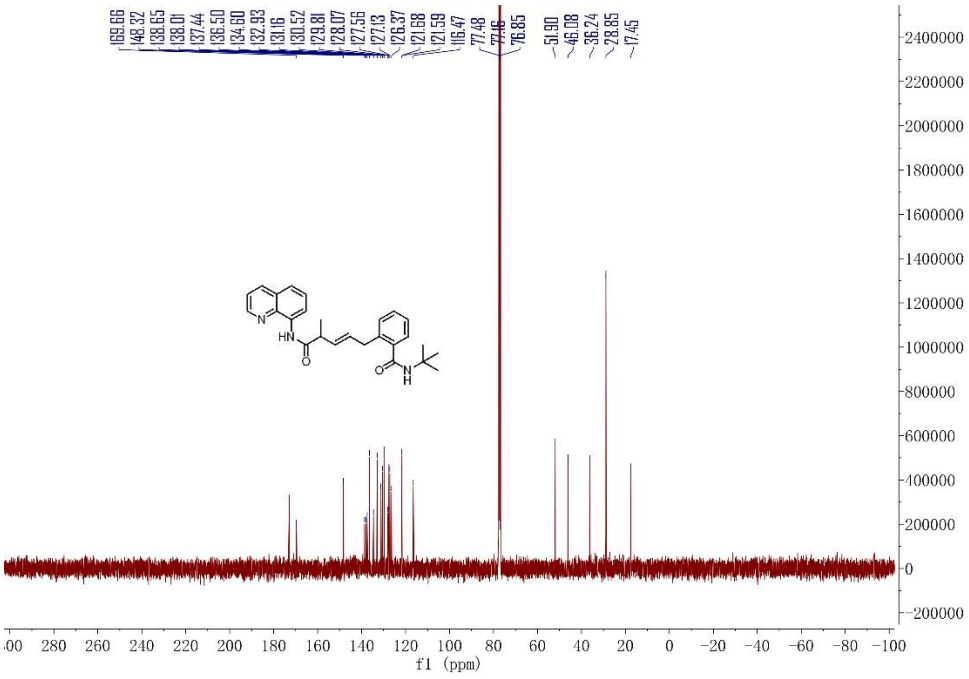


Figure S36. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ae**

(3af) (*E*)-*N*-*(tert*-butyl)-2-(1-oxo-1-(quinolin-8-ylamino)non-3-en-5-yl)benzamid

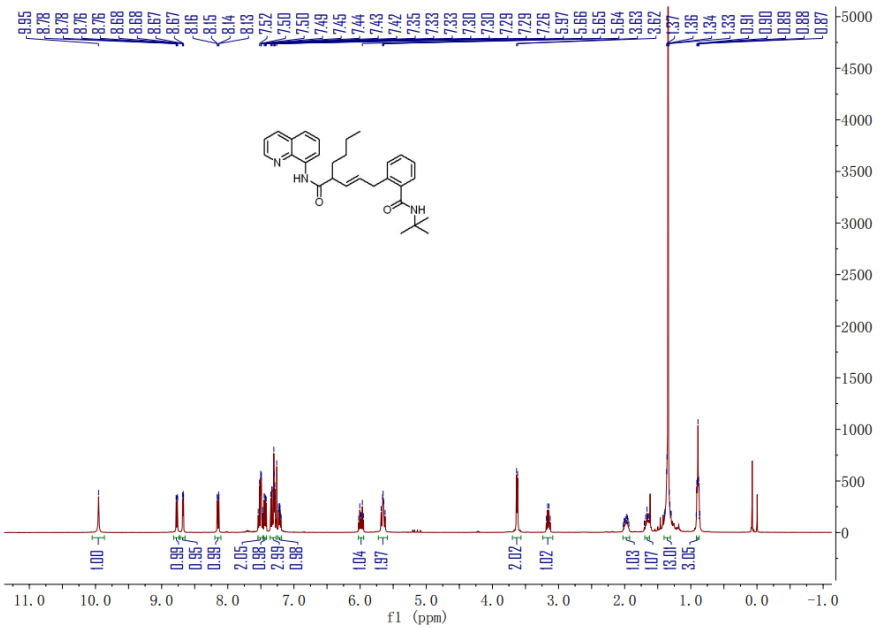


Figure S37. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3af**

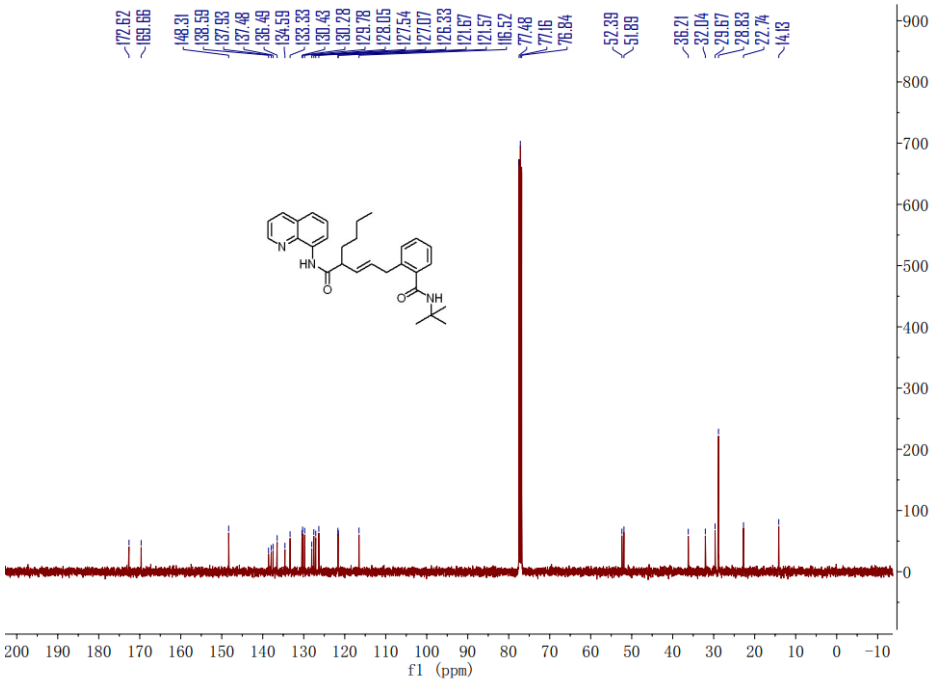


Figure S38. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3af**

(3ag) (*E*)-2-(4-benzyl-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)-*N*-(*tert*-butyl)benzamide

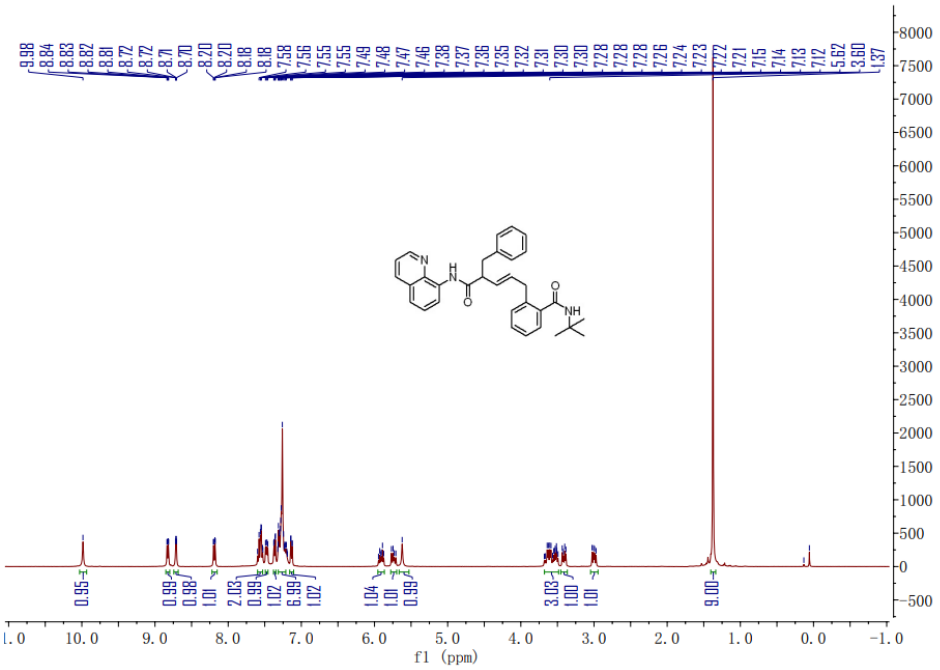


Figure S39. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ag**

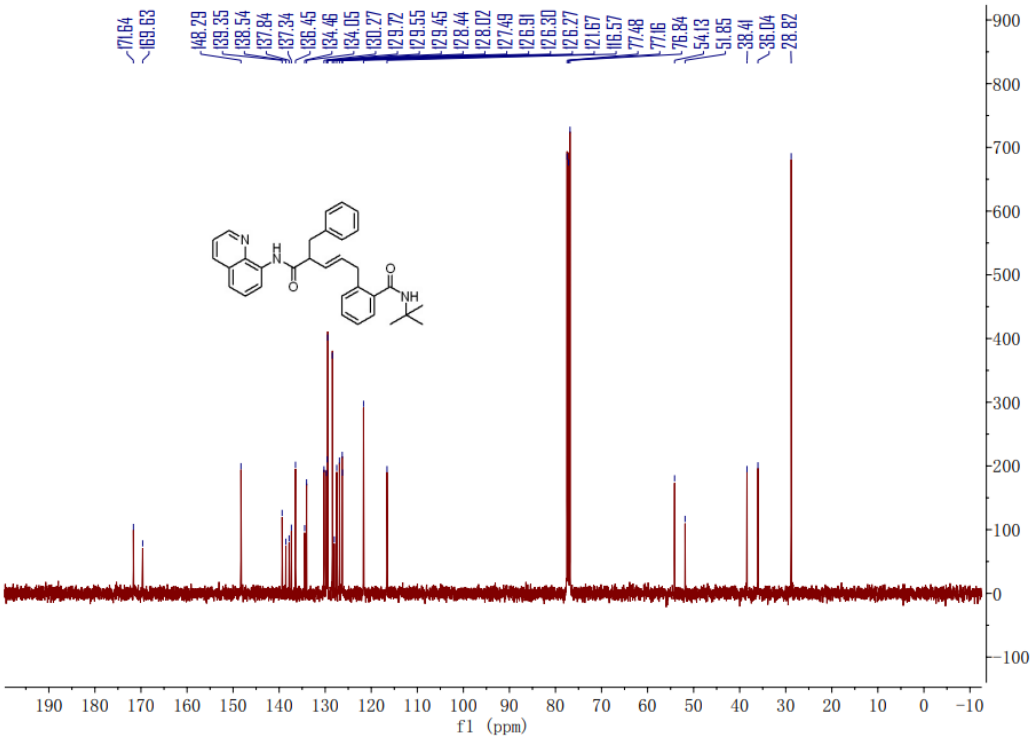


Figure S40. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ag**

(3ah) (*E*)-*N*-(*tert*-butyl)-2-(4-(4-methylbenzyl)-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

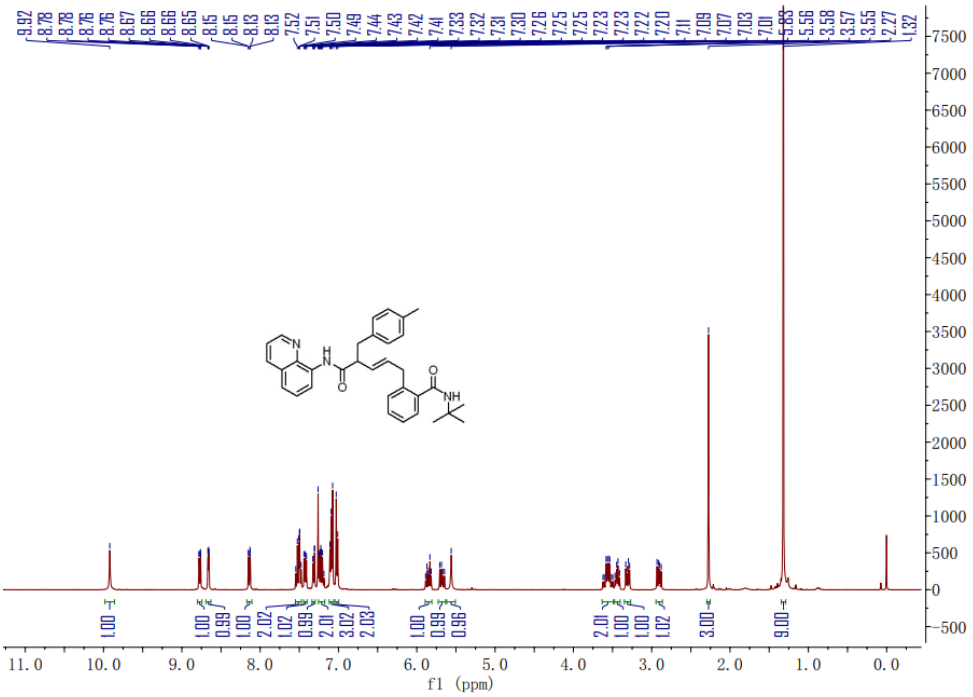


Figure S41. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3ah**

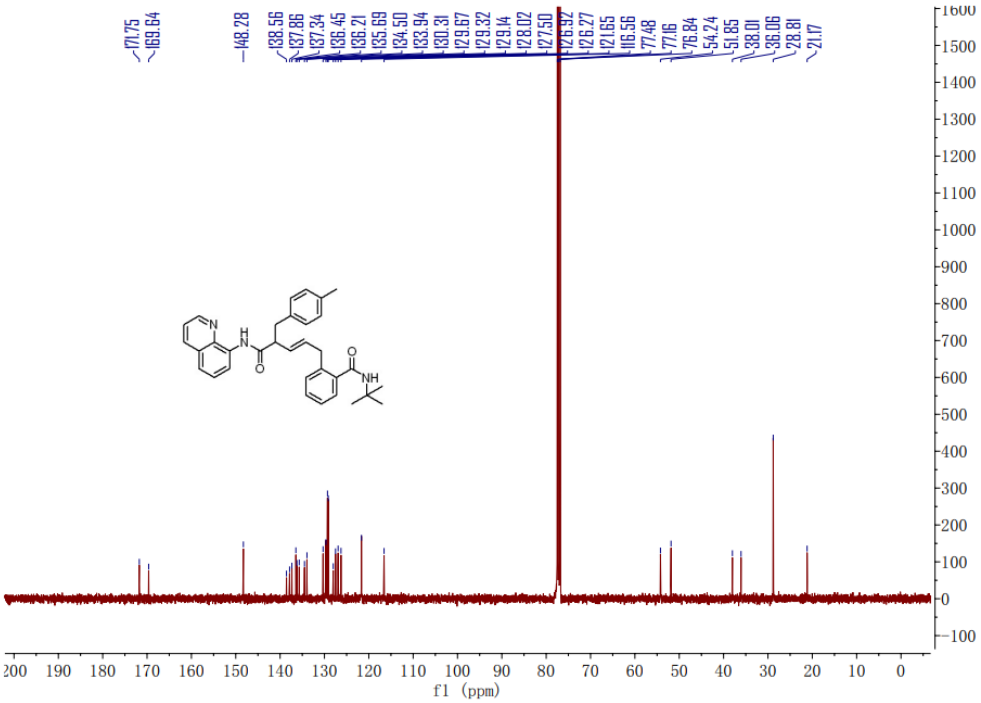


Figure S42. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3ah**

(3aj) (*E*)-*N*-*(tert*-butyl)-2-(4,4-dimethyl-5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide

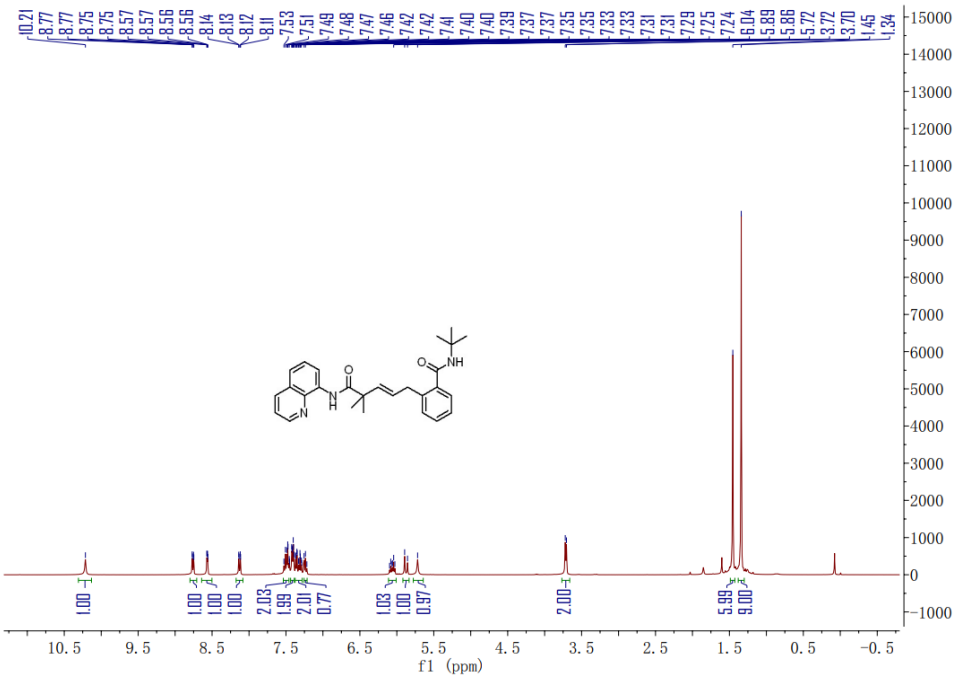


Figure S43. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **3aj**

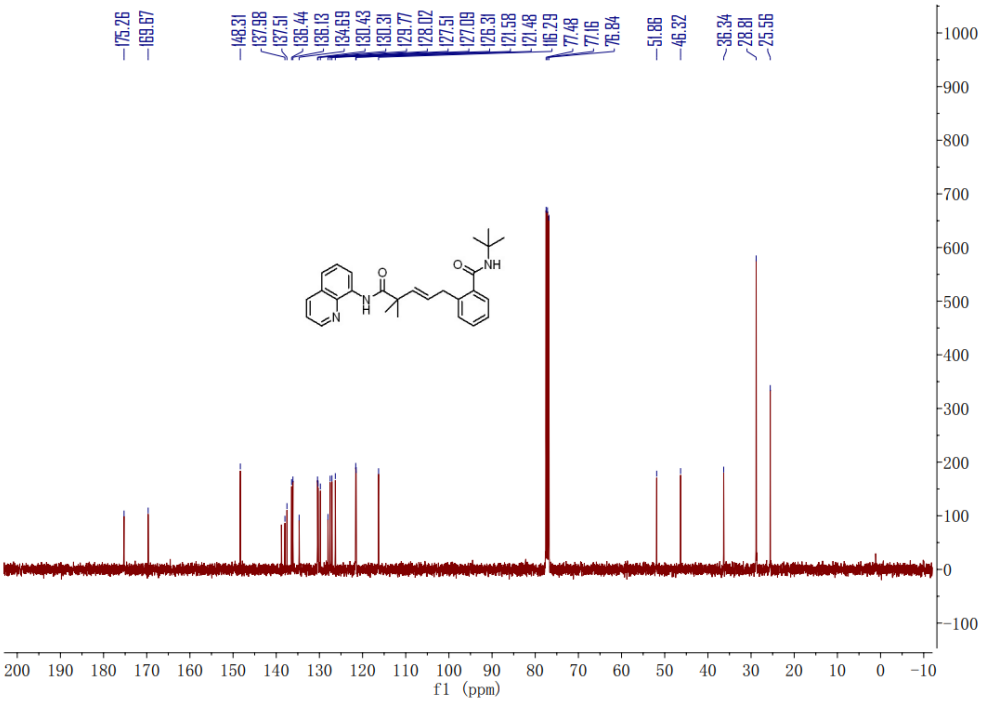


Figure S44. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **3aj**

(4aa) 2,2'-(2-(2-3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-(*tert*-butyl)benzamide)

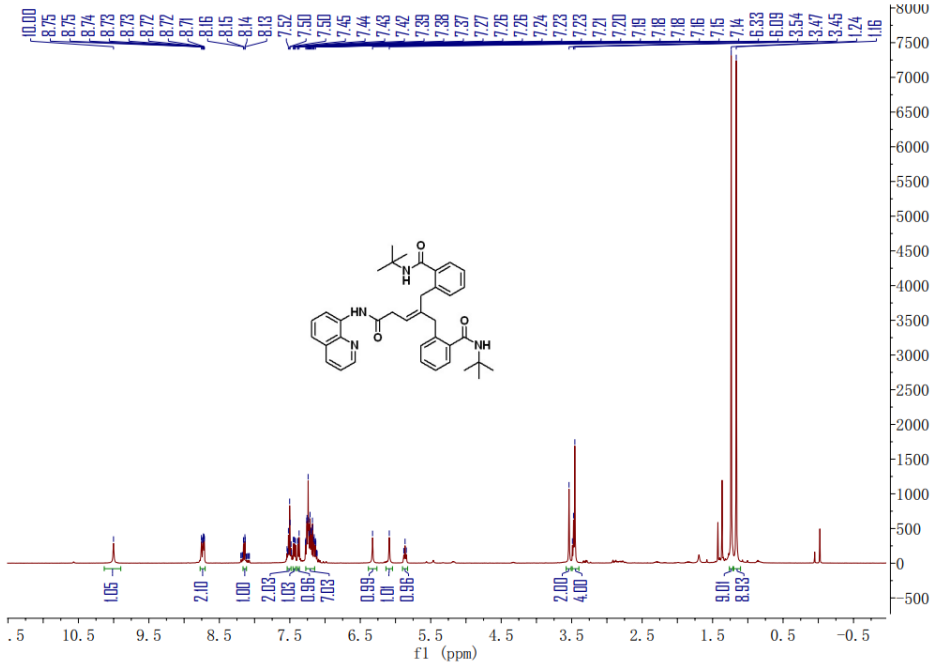


Figure S45. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **4aa**

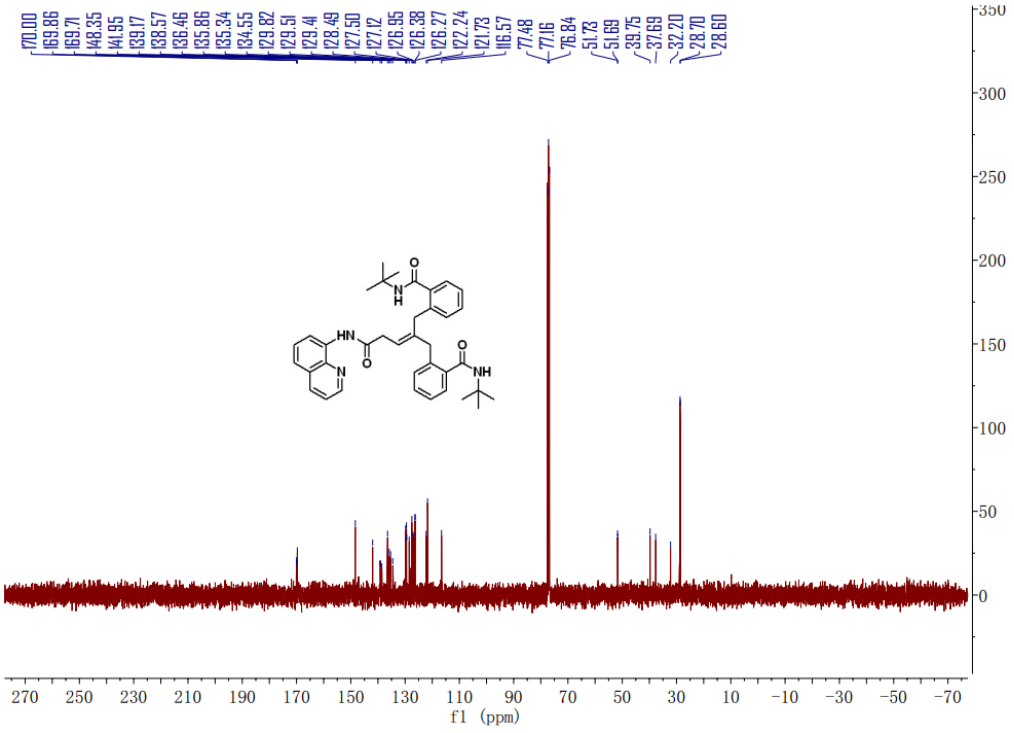


Figure S46. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **4aa**

(4ea) 2,2'-(2-(2-3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-(*tert*-butyl)-4-chlorobenzamide)

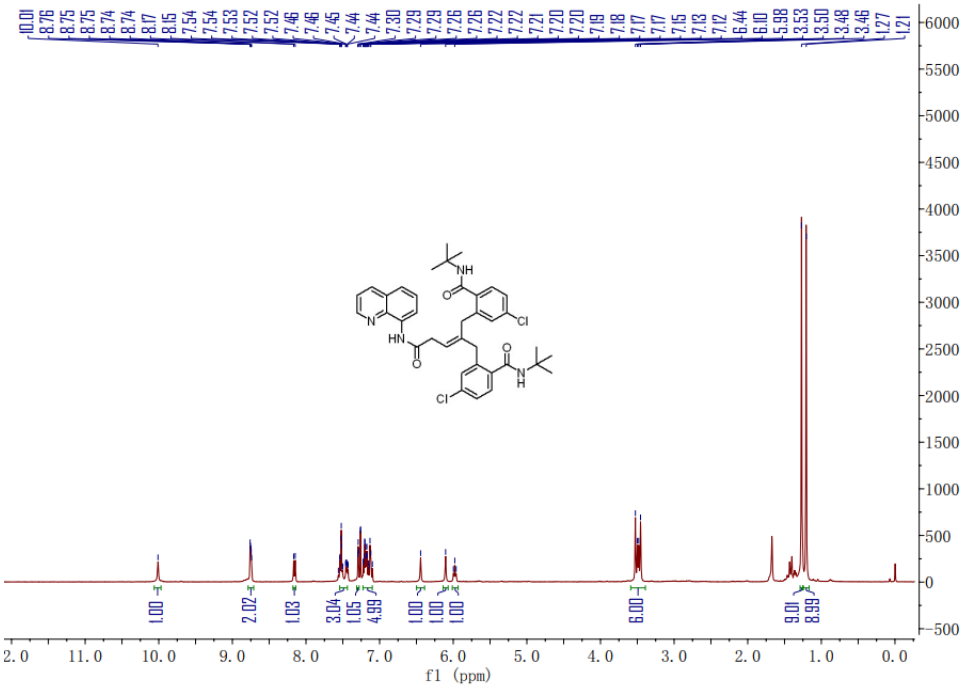


Figure S47. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **4ea**

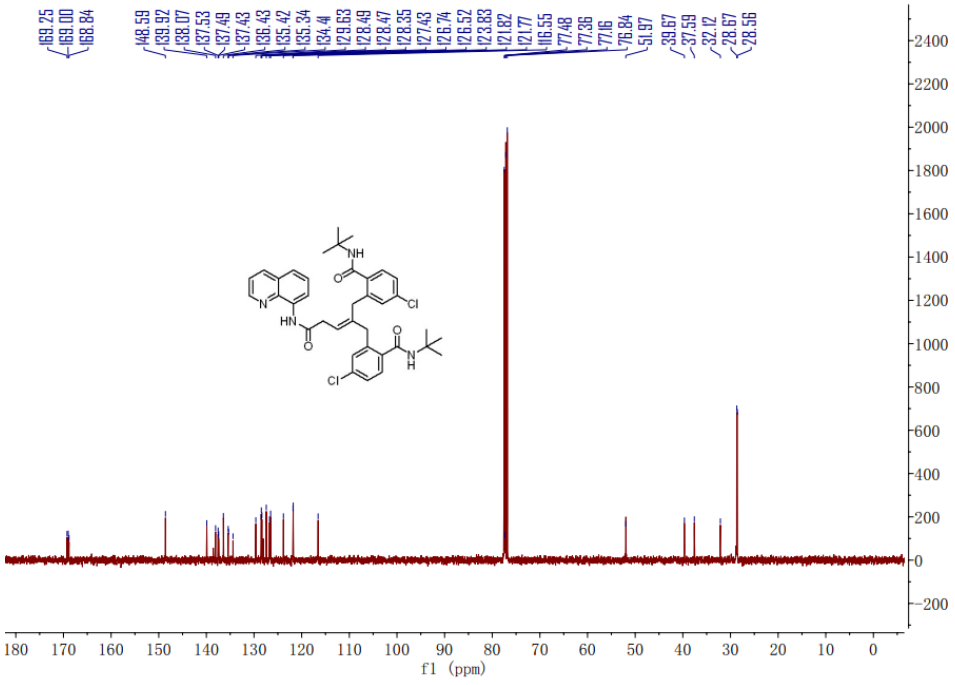


Figure S48. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **4ea**

(4fa) 3,3''-(2-(2-3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-(*tert*-butyl)-[1,1'-biphenyl]-4-carboxamide)

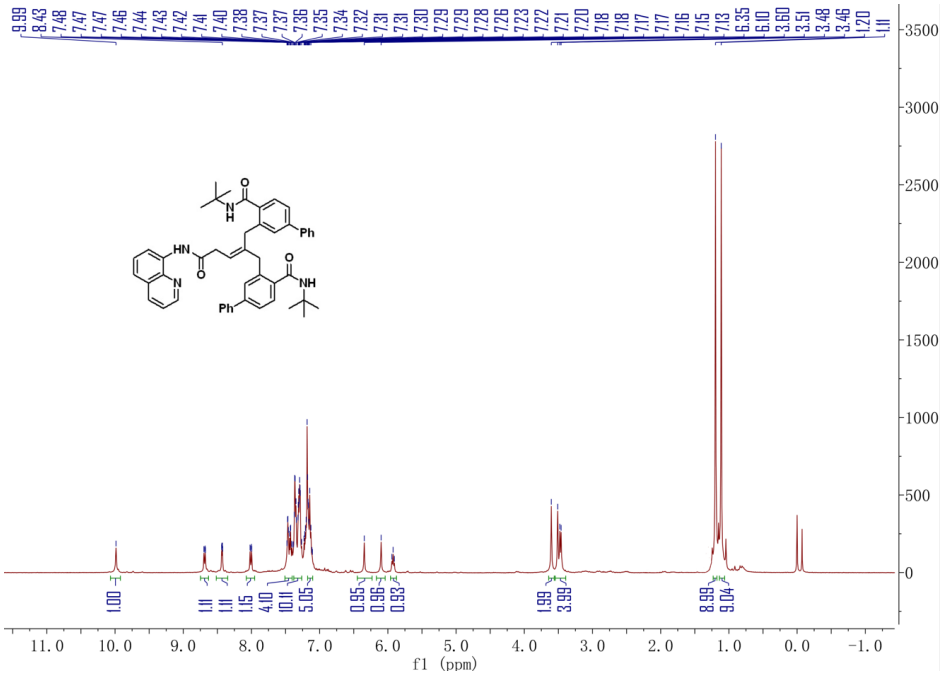


Figure S49. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **4fa**

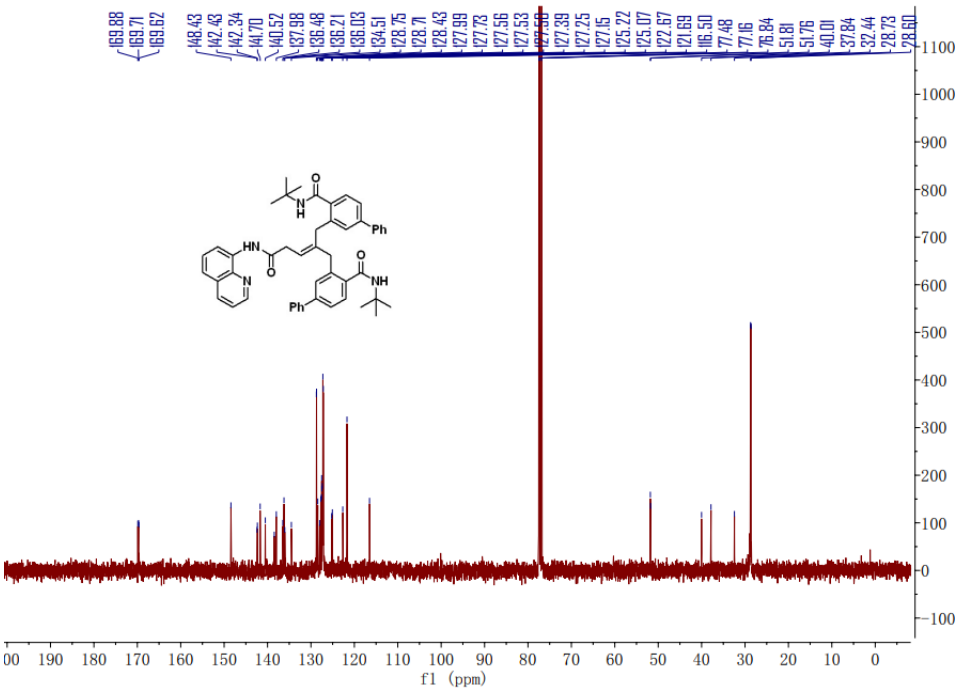


Figure S50. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **4fa**

(4na) 2,2'-(2-(2-3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-(*tert*-pentyl)benzamide)

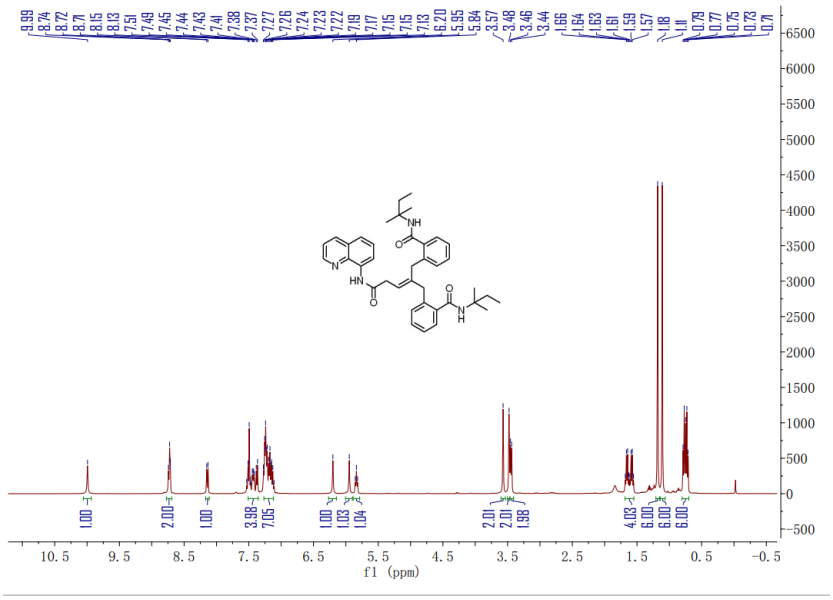


Figure S51. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **4na**

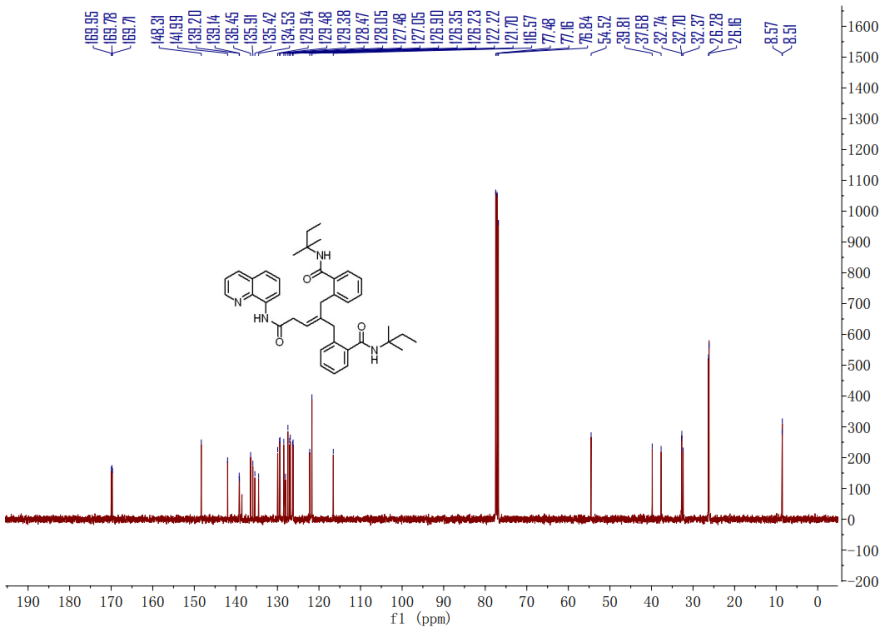


Figure S52. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **4na**

(4ae) 2,2'-(2-(2-methyl-3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-*(tert*-butyl)benzamide)

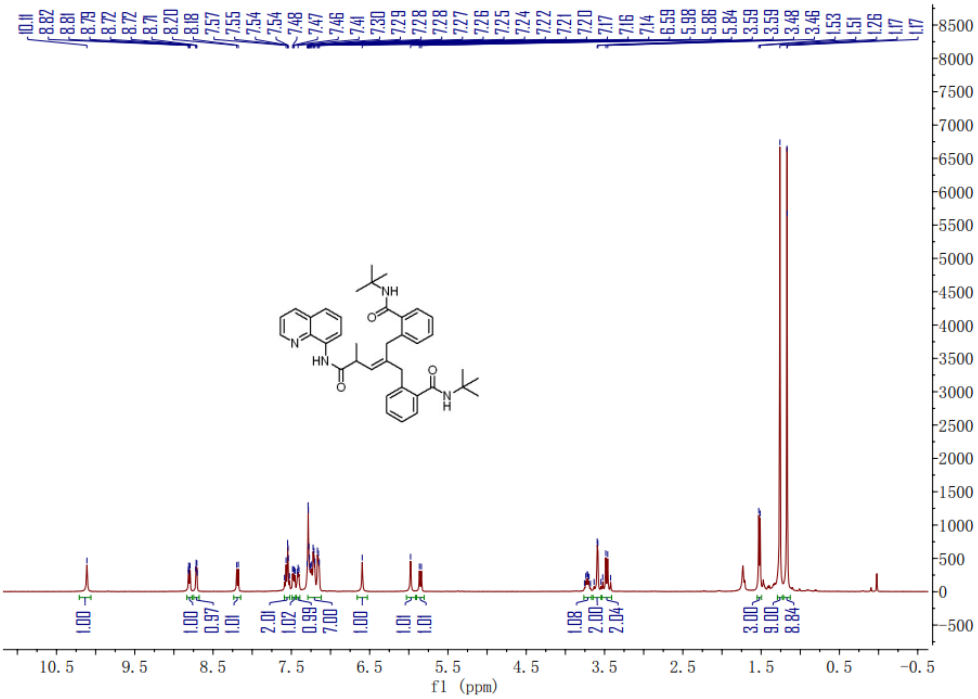


Figure S53. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **4ae**

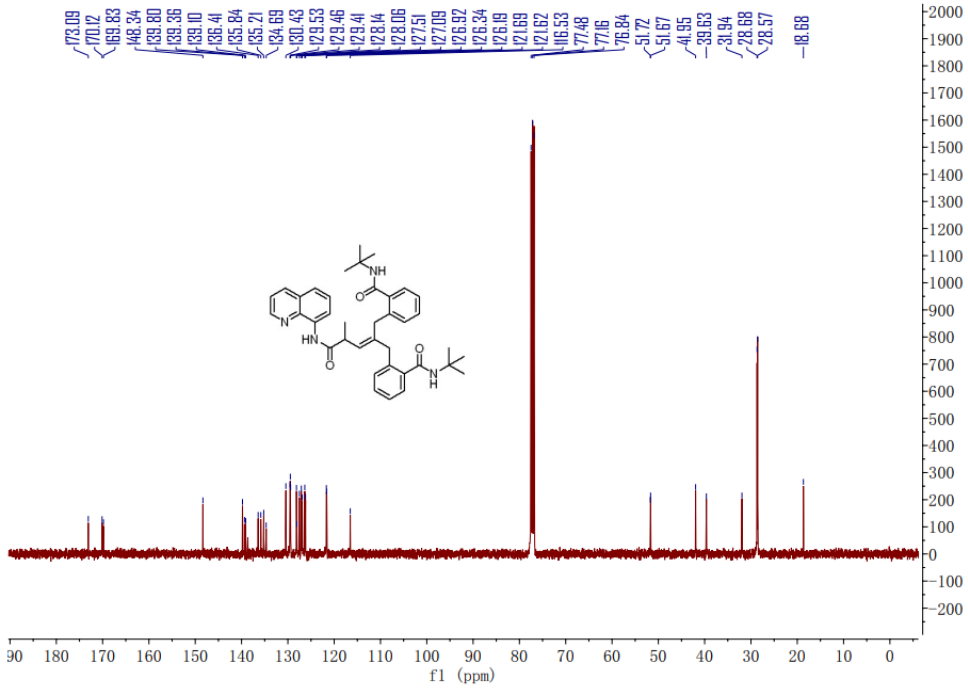


Figure S54. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **4ae**

(4af) 2,2'-(2-(2-(quinolin-8-ylcarbamoyl)hexylidene)propane-1,3-diyl)bis(*N-(tert*-butyl)benzamide)

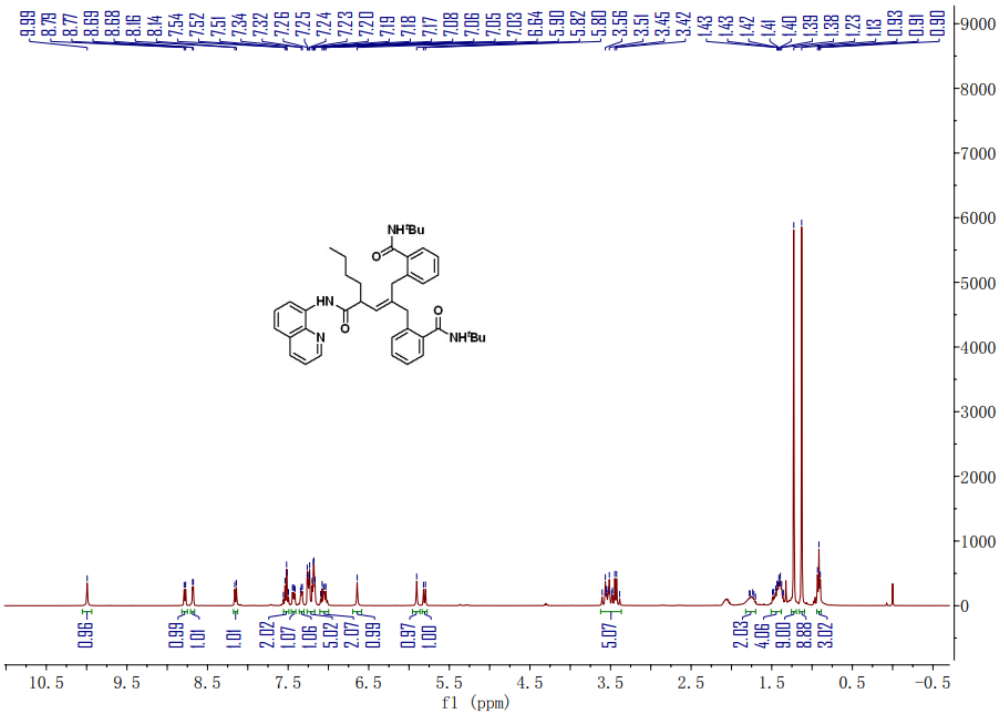


Figure S55. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **4af**

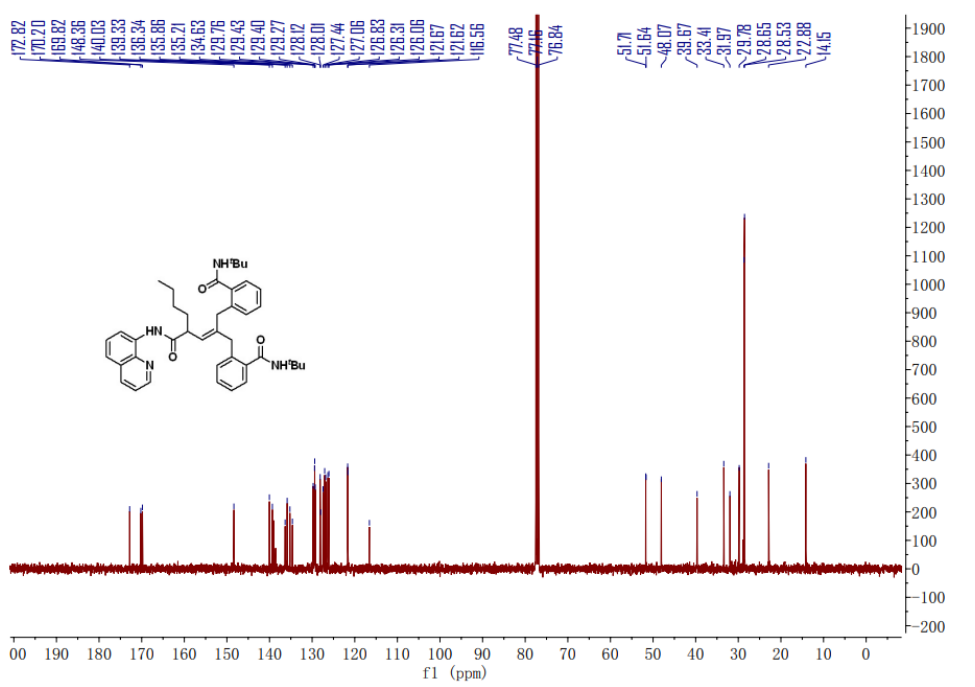


Figure S56. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **4af**

(4ag) 2,2'-(2-(2-benzyl-3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-(*tert*-butyl)benzamide)

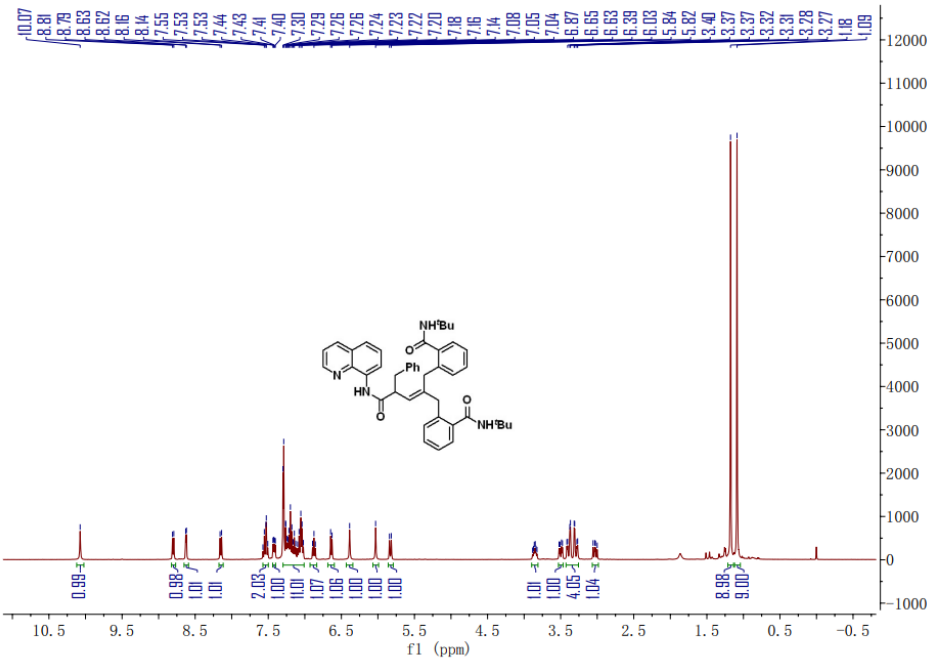


Figure S57. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **4ag**

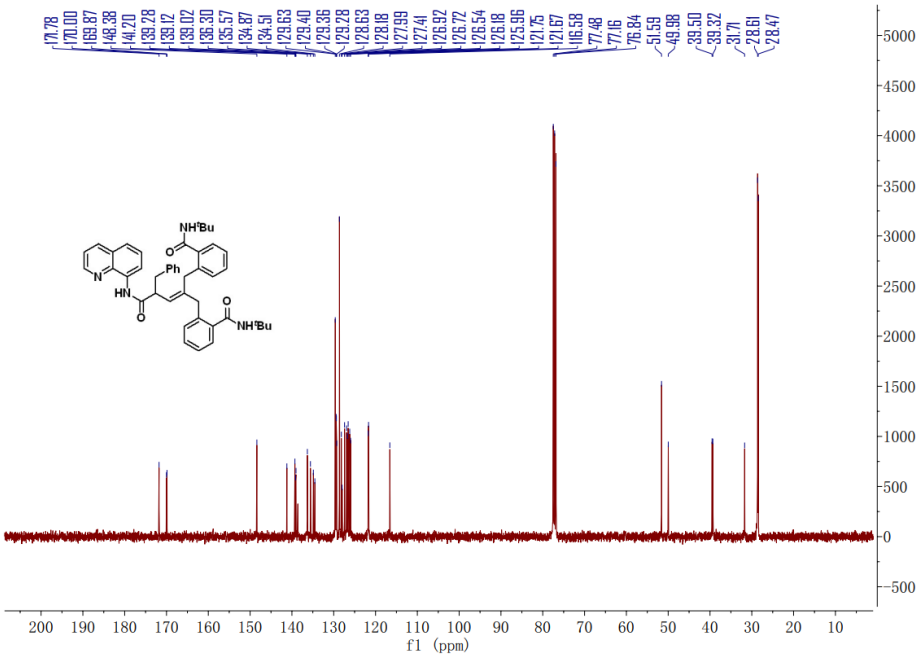


Figure S58. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **4ag**

(4ah) 2,2'-(2-(2-(4-methylbenzyl)-3-oxo-3-(quinolin-8-ylamino)propylidene)propane-1,3-diyl)bis(*N*-*(tert*-butyl)benzamide)

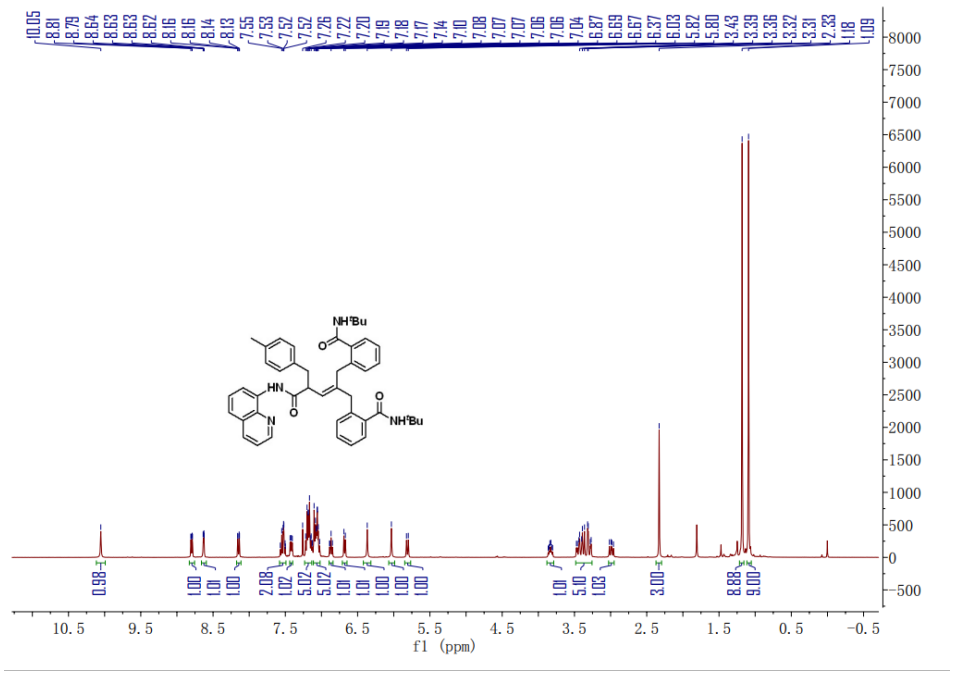


Figure S59. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **4ah**

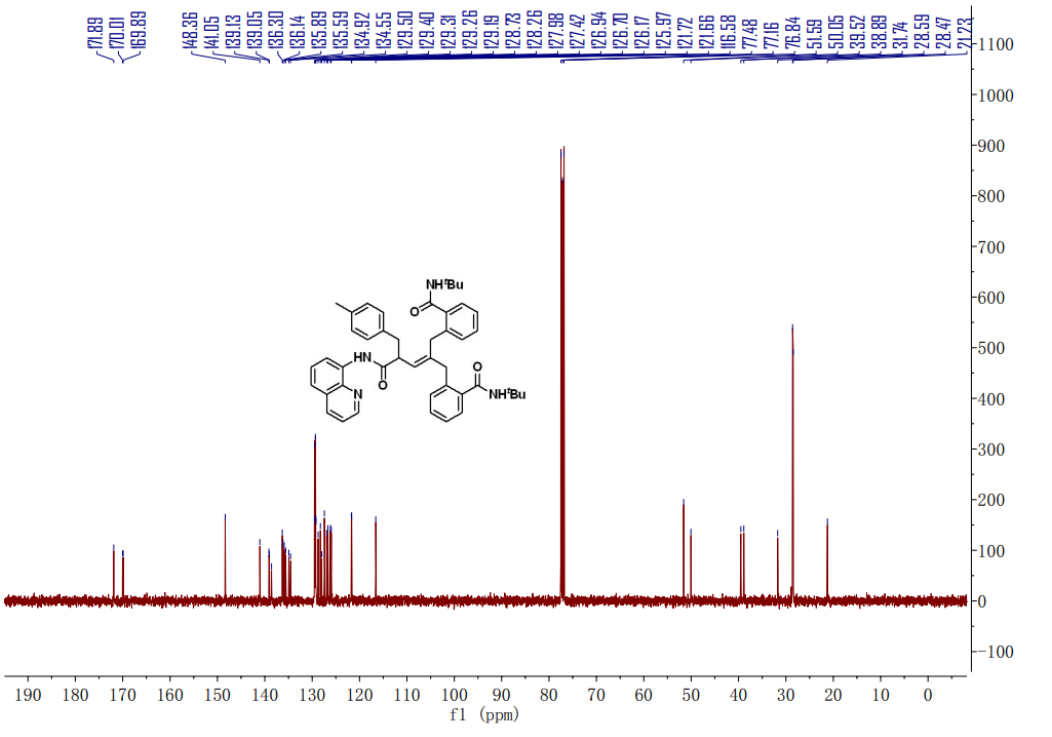


Figure S60. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **4ah**

(4ai) 2,2'-(2-(2-(4-chlorobenzyl)-3-oxo-3-(quinolin-8-ylamino)propylidene) propane-1,3-diyl)bis(*N*-*(tert*-butyl)benzamide)

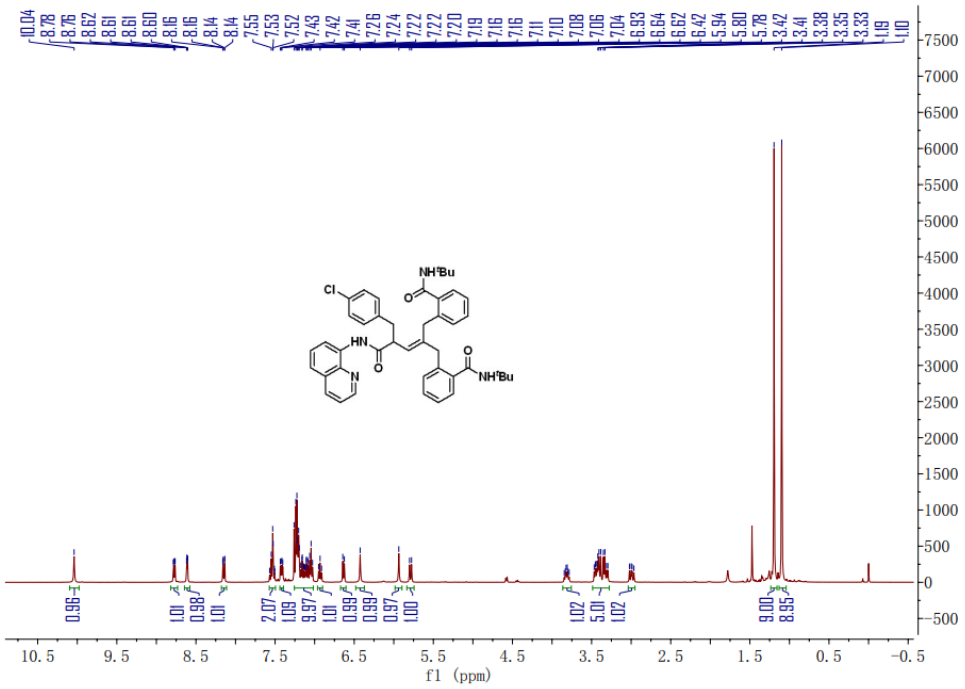


Figure S61. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **4ai**

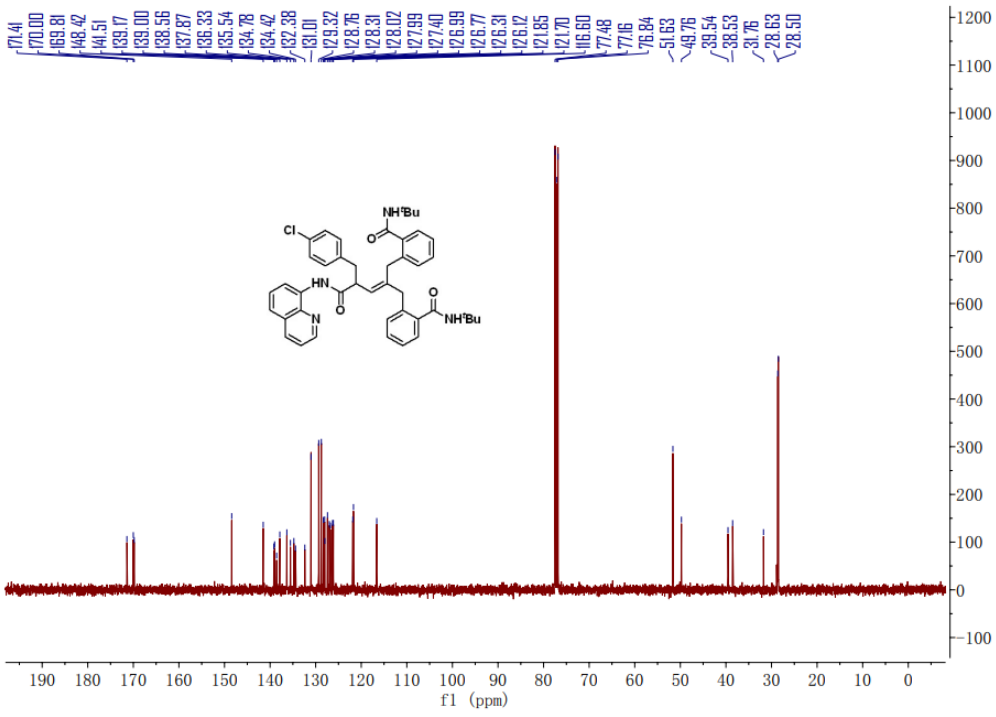


Figure S62. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **4ai**

(5) (*E*)-2-(5-oxo-5-(quinolin-8-ylamino)pent-2-en-1-yl)benzamide.

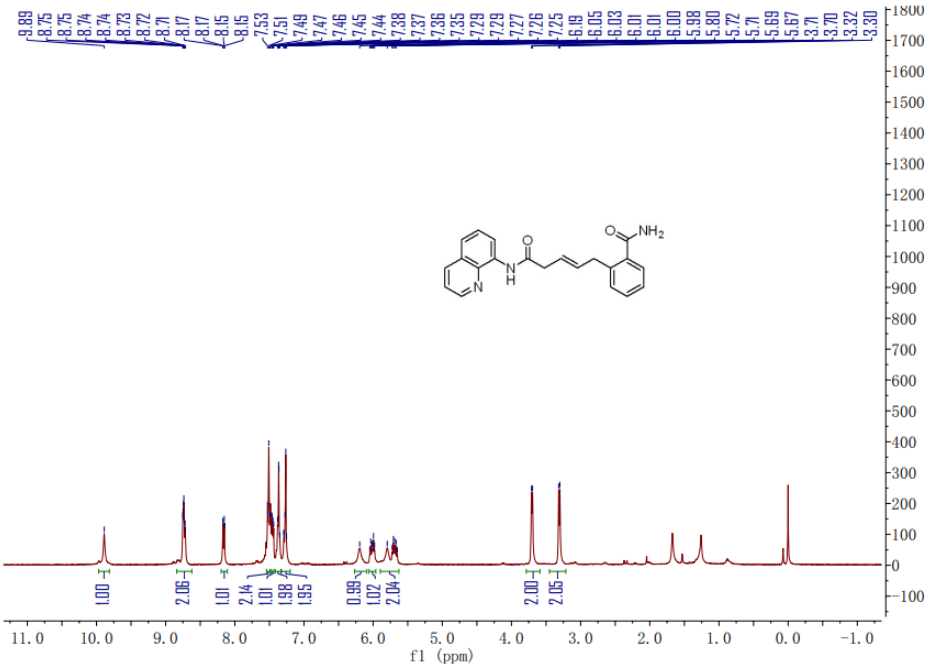


Figure S63. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **5**

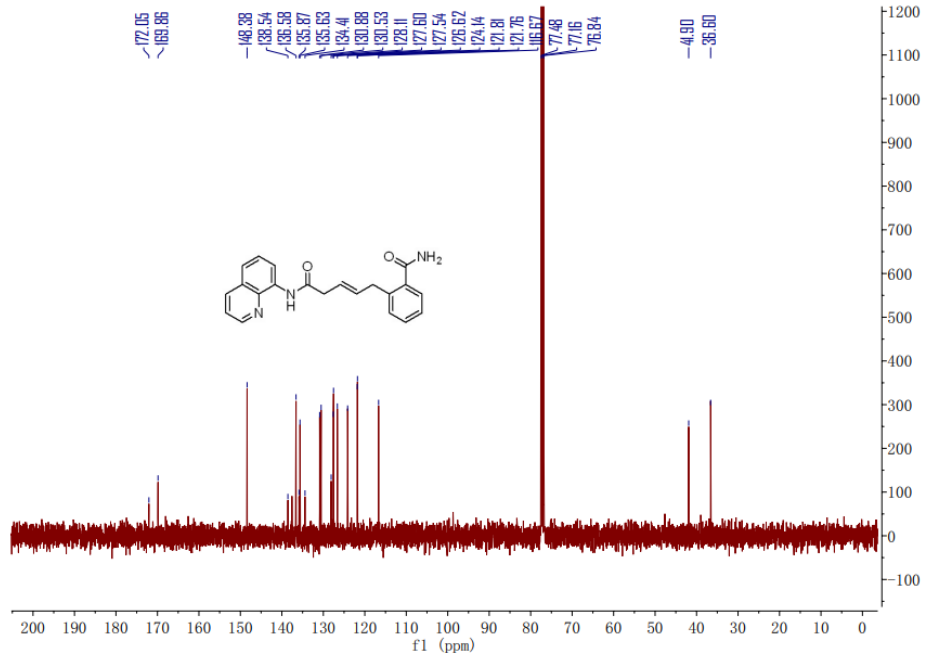


Figure S64. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **5**

(6) methyl(2*E*,4*E*)-5-(2-(*tert*-butylcarbamoyl)phenyl)penta-2,4-dienoate.

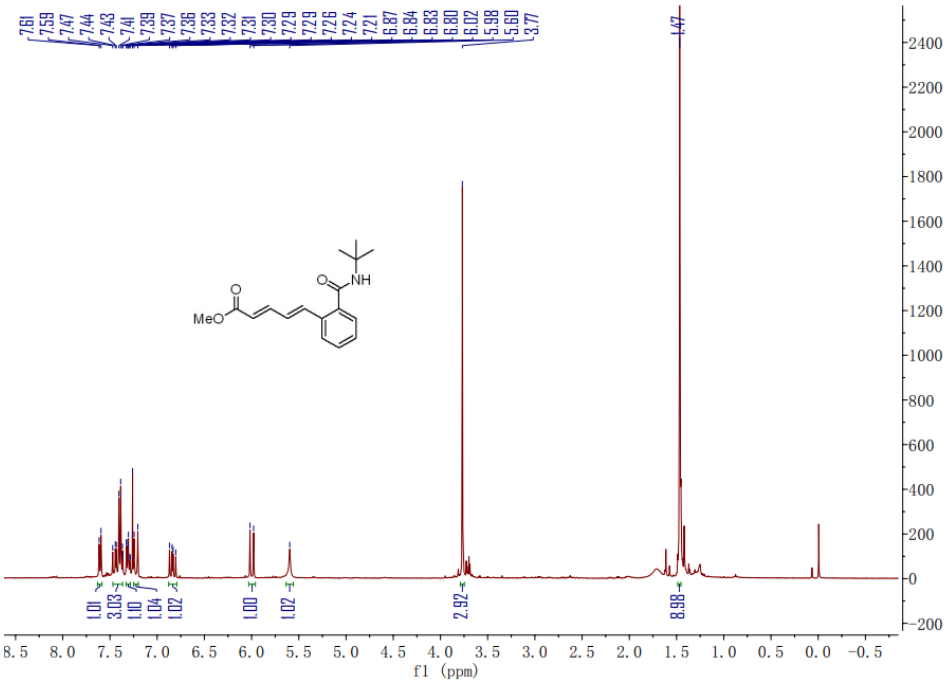


Figure S65. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **6**

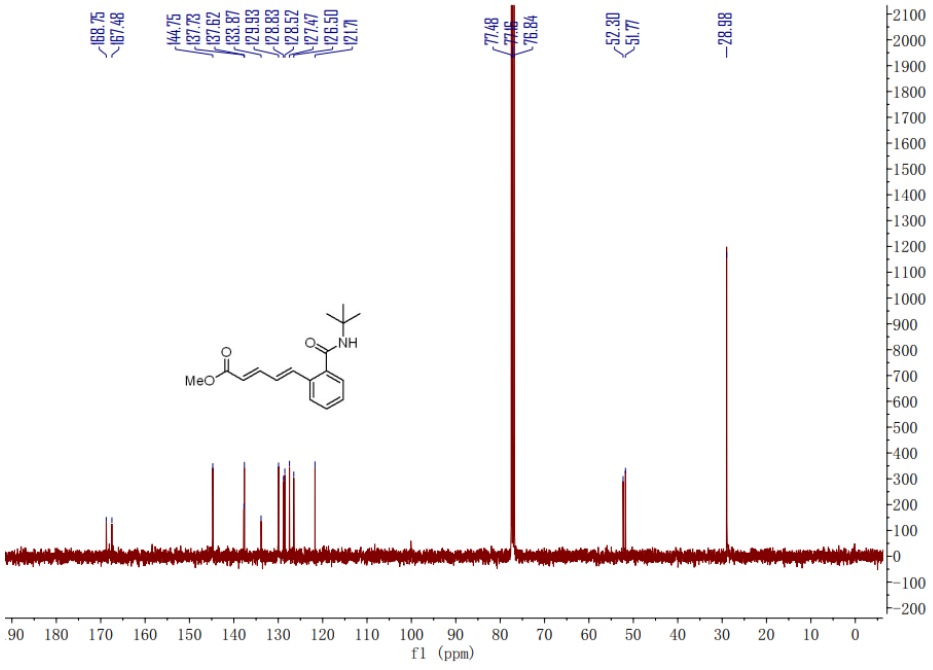


Figure S66. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **6**

(7) *N*-(*tert*-butyl)-2-(2,3-dihydroxy-5-oxo-5-(quinolin-8-ylamino)pentyl)be.

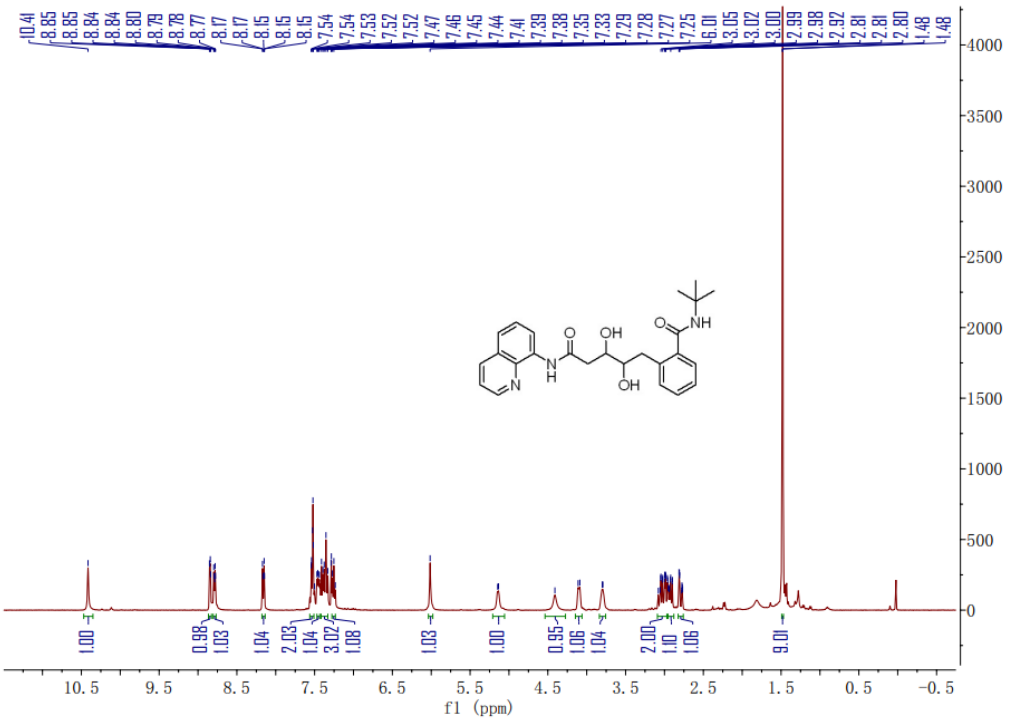


Figure S67. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **7**

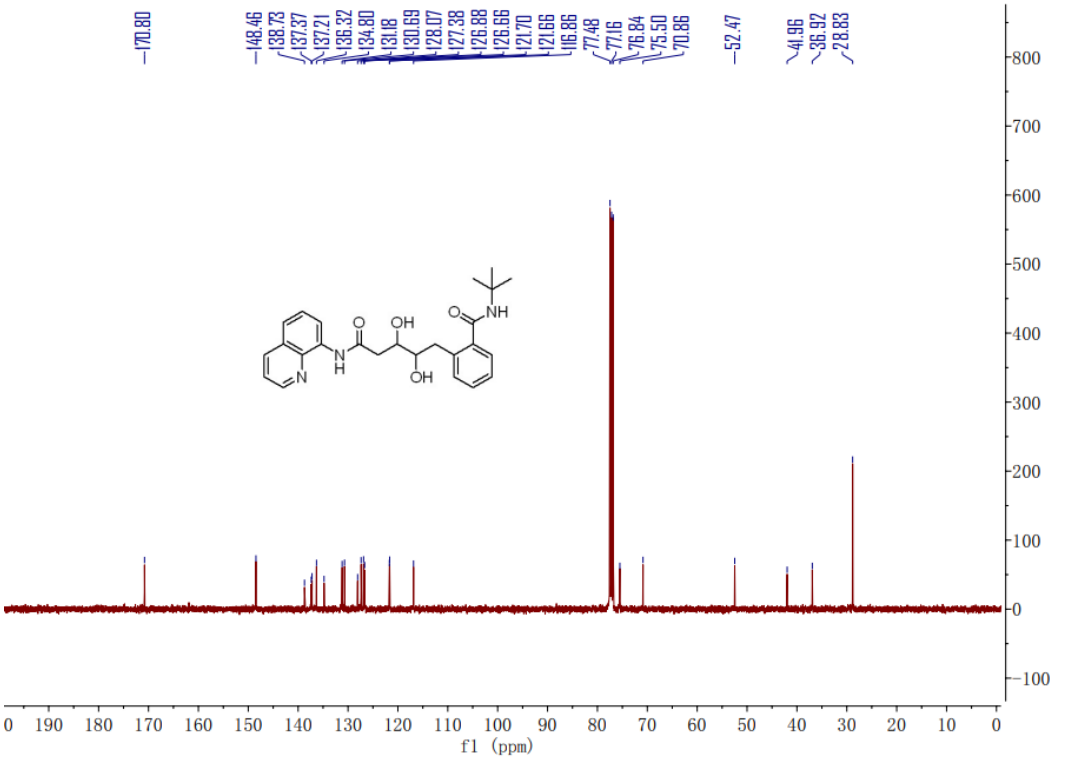


Figure S68. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **7**

(8) 2-(2-(benzylamino)-5-oxo-5-(quinolin-8-ylamino)pentyl)-*N*-(tert-butyl) benzamide.

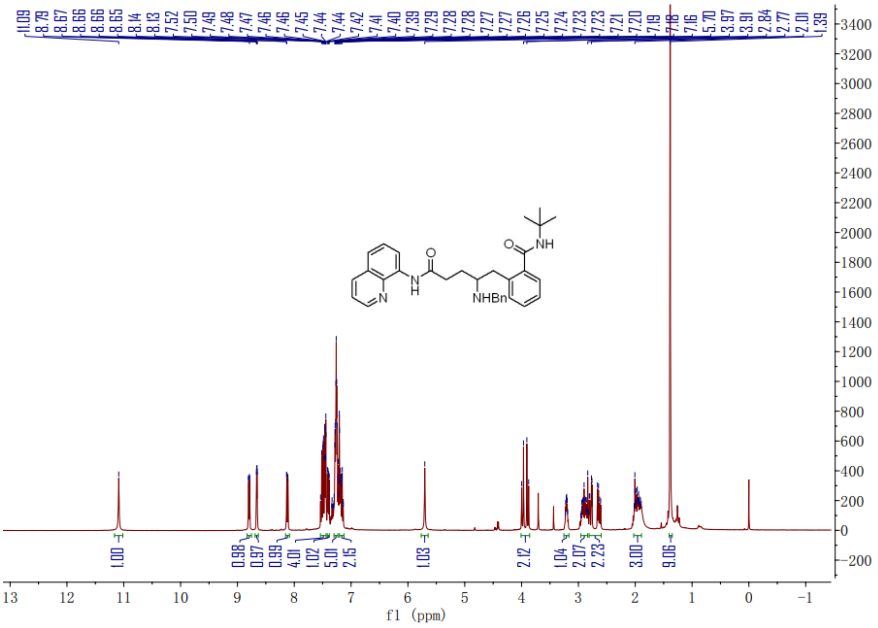


Figure S69. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **8**

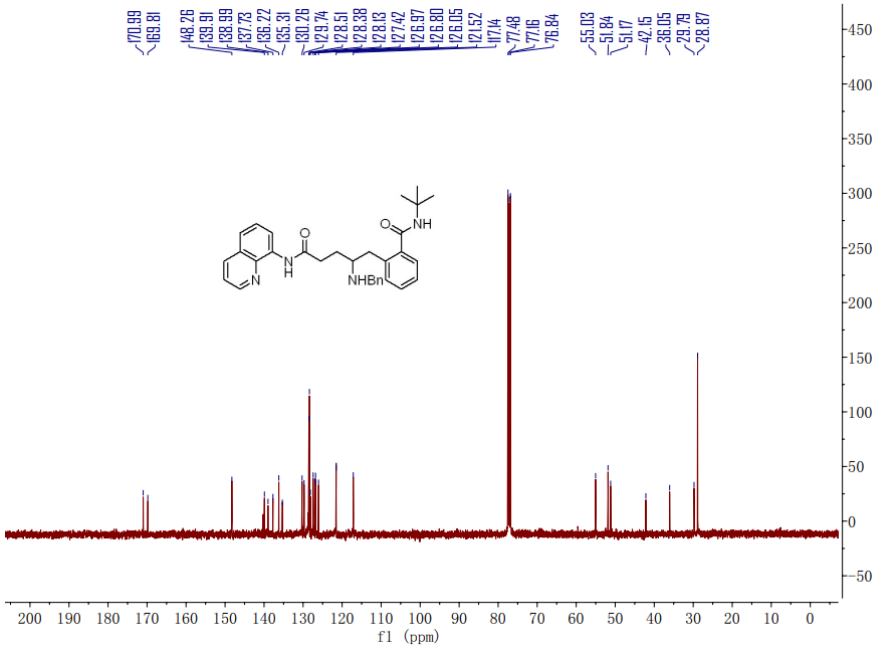


Figure S70. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **8**

(9) *N*-(*tert*-butyl)-2-(5-oxo-2-phenyl-5-(quinolin-8-ylamino)pentyl)benzamide.

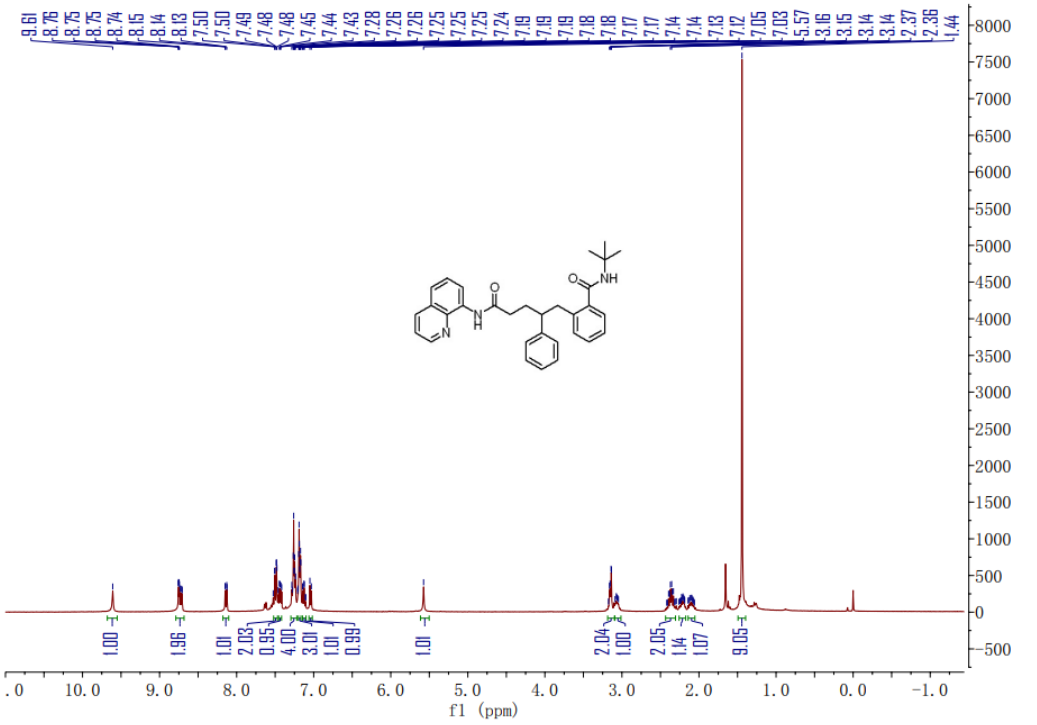


Figure S71. ^{1}H NMR (400 MHz, Chloroform-*d*) spectra of compound **9**

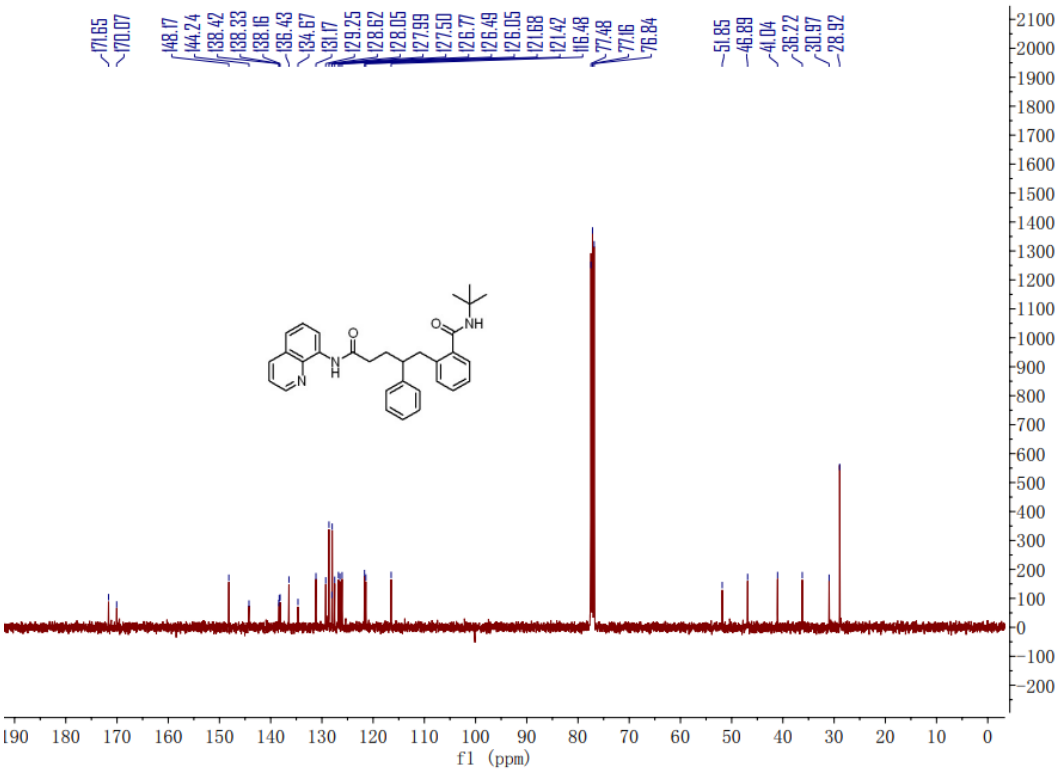
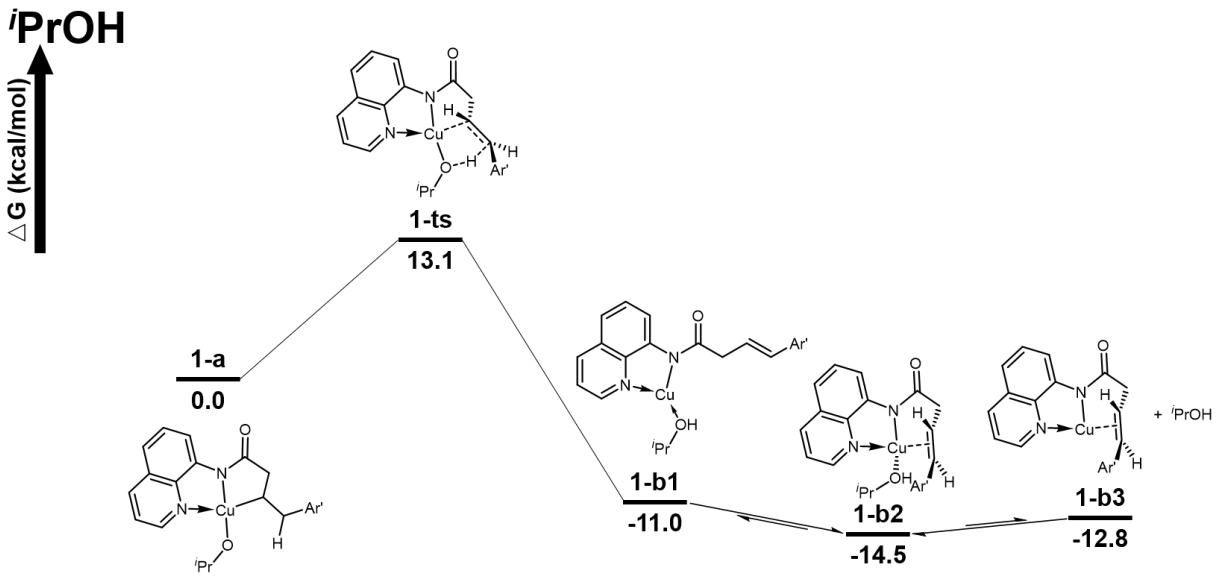


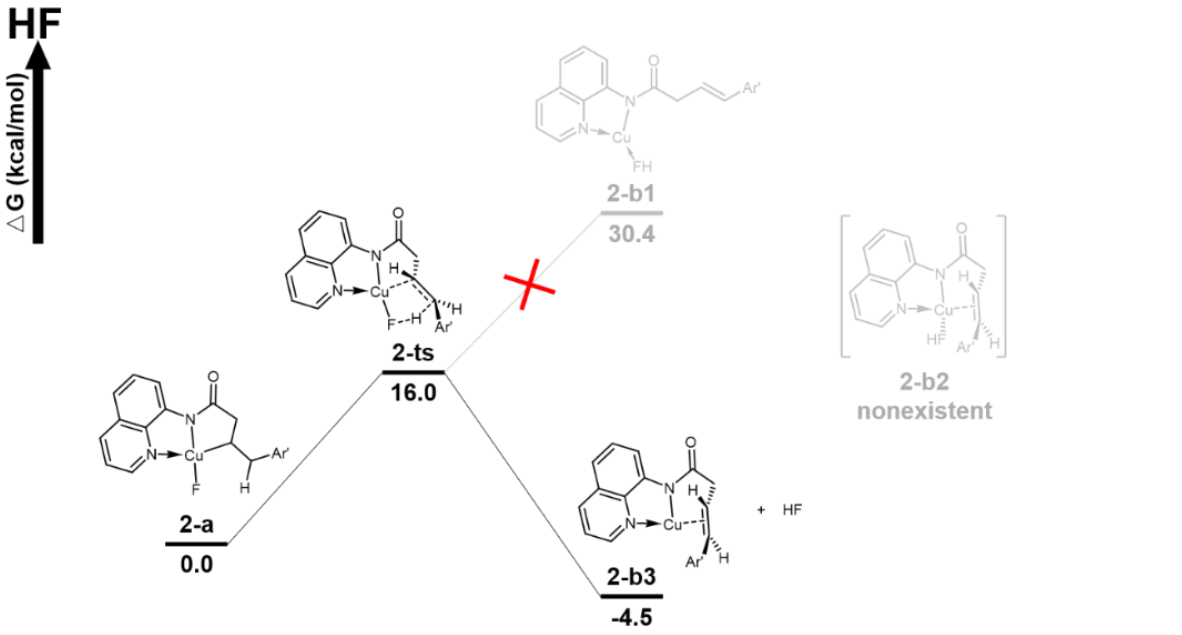
Figure S72. ^{13}C NMR (101 MHz, Chloroform-*d*) spectra of compound **9**

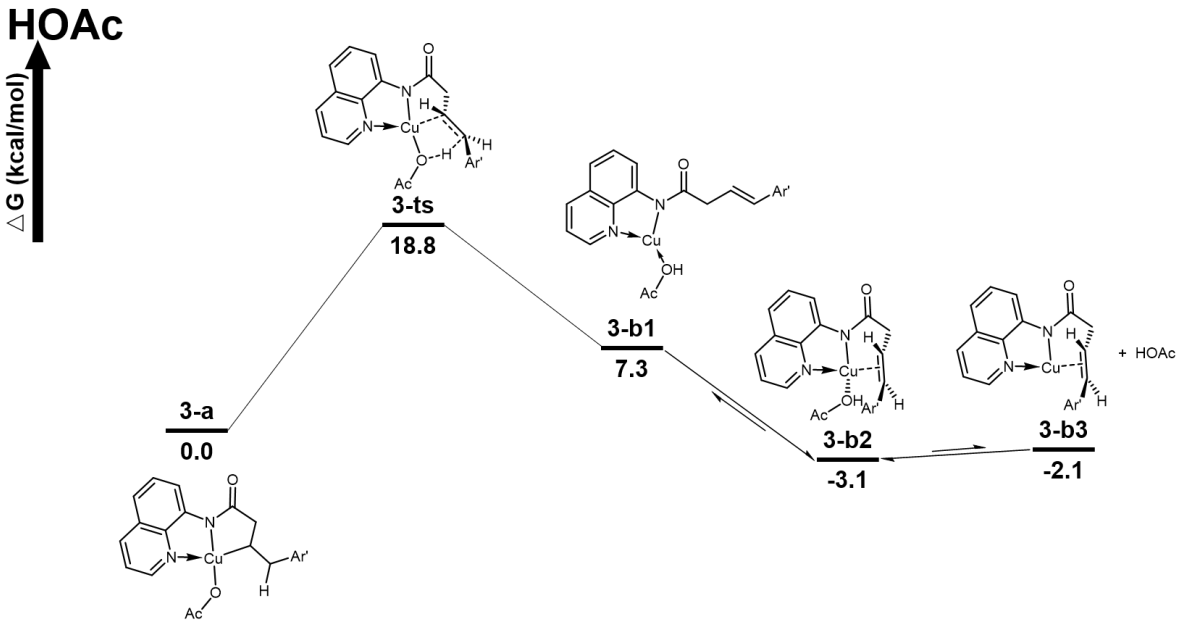
V. The Oretical Calculation Data

(1) Computational details

All the calculations were carried out by Gaussian 09 programs[6] using B3LYP-D3(BJ) functional[7] theory level. The optimized structures were obtained via the basis set 6-31G(d,p) for non-metallic atoms, SDD for Cu atom. The single point energy calculations were obtained via the basis set 6-311G(d,p)/SDD(Cu). And the SMD solvation model[8] was used to stimulate the solvation effect of the (MeCN/^{i}PrOH=1:3, eps=23.37, epsinf=1.875055). Also, the geometry optimizations of molecule ^{i}PrOH, F^{-}, H^{+} were carried out under explicit solvation model. Vibrational frequency analyses were carried out to make sure that the reactants, and products have no imaginary frequencies while the transition states have only one imaginary frequency. The Gibbs free energies were obtained by the addition of thermal correction of free energy and single point energy of each calculated geometries. The GaussView (Version 6)[9] software was employed to present the optimized structures.







(2) Cartesian Coordinates

3iPrOH

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C	1.35308353	-0.87928335	-0.54447000
H	1.82760453	-1.43231135	0.28075100

H	-0.56754547	-0.78712535	0.45694800
H	0.47322853	0.61750665	0.76102900
H	-0.34530447	0.44039565	-0.80796500
C	2.39823653	0.01164365	-1.19903700
H	3.24057653	-0.59176635	-1.55256200
H	1.96649053	0.54415065	-2.05431800
H	2.77891853	0.75035665	-0.48637300
O	0.91633553	-1.82131235	-1.54694300
H	2.36232253	-2.80100135	-1.88621800
H	0.30862553	-2.46092335	-1.10701400
O	3.18412153	-3.32584935	-1.75925600
C	2.88967653	-4.28750835	-0.73700500
C	4.21847853	-4.86011735	-0.26229600
C	1.94642453	-5.36514435	-1.27200500
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H	4.06964853	-5.59032235	0.54002200
H	4.73516353	-5.35867635	-1.09124800
H	1.01625353	-4.91501235	-1.63373900
H	2.41328153	-5.90084435	-2.10692300
H	1.69162753	-6.09363935	-0.49327400

O	-0.84648547	-3.47426935	-0.28712600
C	-1.91896947	-3.89672335	-1.16733000
C	-2.41704647	-2.64157135	-1.86853900
C	-3.00196147	-4.60318135	-0.36205600
H	-1.50747047	-4.59022935	-1.91467100
H	-1.60238247	-2.14788835	-2.40701700
H	-3.20351247	-2.89646135	-2.58564600
H	-2.82955147	-1.93287135	-1.14153100
H	-2.59776047	-5.48702135	0.14463200
H	-3.41633747	-3.92956635	0.39644700
H	-3.81621847	-4.93341535	-1.01608900
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2iPrOH+HOAc

C	-0.14501160	0.16241299	0.00000000
C	-1.40310660	0.65801799	-0.69927500
H	-2.00846860	1.23189699	0.02157800
H	0.44266040	1.00624399	0.37753200
H	-0.39741560	-0.48812201	0.84391900
H	0.48046040	-0.40584801	-0.69873700
C	-2.25482560	-0.48200601	-1.25658300
H	-3.12592660	-0.08491901	-1.78897800

H	-1.67053260	-1.08636601	-1.96075600
H	-2.61536560	-1.13628401	-0.45425500
O	-0.97562760	1.53069599	-1.75816100
H	-1.78805160	1.94365299	-2.11029900
O	-3.54180460	2.61097599	-2.00784900
C	-3.70053560	3.44208999	-1.11105600
O	-4.89645060	3.72036799	-0.60142000
H	-5.57978560	3.11744199	-1.03487400
C	-2.59032460	4.24647599	-0.50047900
H	-1.62430360	3.83862599	-0.79757700
H	-2.67221060	5.28340599	-0.84547400
H	-2.68710360	4.25209799	0.58875100
O	-6.41610760	1.86968399	-1.68545300
H	-5.84579360	1.74367199	-2.46233900
C	-6.20485360	0.74039399	-0.79142300
C	-6.65586060	-0.54487801	-1.47085600
C	-6.97585660	1.05655999	0.47921500
H	-5.13225860	0.67951199	-0.56195400
H	-6.10423860	-0.70818301	-2.40361300
H	-6.47660060	-1.40608501	-0.81837200
H	-7.72542560	-0.50151801	-1.70525900

H	-6.60759060	1.98292799	0.93225300
H	-8.04302860	1.17578799	0.26053200
H	-6.85901360	0.24746999	1.20681700

3iPrOH+HF

C	-0.42923434	0.33642691	0.00000000
C	-1.16526034	0.27535591	-1.32931400
H	-1.57226034	-0.73826809	-1.47140100
H	-1.11111634	0.11590691	0.82842700
H	0.38686166	-0.39263809	0.02351000
H	-0.00855434	1.33623091	0.15788700
C	-0.28019834	0.62644591	-2.52063200
H	-0.85825634	0.58045991	-3.45092500
H	0.12138866	1.64077291	-2.41351500
H	0.55771766	-0.07376109	-2.60725400
O	-2.26444634	1.20702291	-1.23257300
H	-2.68477934	1.24632091	-2.10876700
F	-3.76164334	0.57520691	-3.52318700
H	-4.01400334	-0.07174209	-2.78883400
O	-4.32717034	-0.77107109	-1.59281400
C	-5.77307634	-0.86501509	-1.38300200
C	-6.04453434	-1.37634609	0.02161800

C	-6.29003834	-1.77841209	-2.48017600
H	-6.19378234	0.13828891	-1.51406900
H	-5.62941334	-0.69519409	0.77300600
H	-7.12343934	-1.44870309	0.19359200
H	-5.60076534	-2.36752709	0.16563600
H	-6.03335434	-1.37518209	-3.46540900
H	-5.85587834	-2.77993809	-2.38802800
H	-7.37932434	-1.86232509	-2.41787900
H	-3.92753234	-0.18723609	-0.92044600
H	-5.01919834	1.80566691	-2.98508100
O	-5.69944934	2.33215591	-2.52785800
C	-5.10133634	2.89136791	-1.34569300
C	-6.23509134	3.48228591	-0.51877400
C	-4.04569134	3.93171391	-1.71589000
H	-4.61983634	2.08963691	-0.76738500
H	-6.97001234	2.71189091	-0.26173800
H	-5.85298734	3.91629891	0.41087000
H	-6.74860334	4.27060691	-1.08170600
H	-3.25193534	3.48758291	-2.32515000
H	-4.50205934	4.74890391	-2.28660800
H	-3.57916134	4.35313191	-0.81823400

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C	0.00580046	0.83526681	0.00000000
C	-0.58702954	-1.33605619	-0.60498400
C	-1.97261054	-1.01685219	-0.60110300
C	-2.32658654	0.31603181	-0.26850800
C	-1.34572454	1.23568881	0.03800600
H	0.81079846	1.52327581	0.23787500
C	-0.11927554	-2.65676319	-0.89564600
C	-2.90714554	-2.03627419	-0.92036300
H	-3.37625054	0.59729081	-0.25379400
H	-1.59187754	2.25795681	0.30447300
C	-2.44673054	-3.30170319	-1.21442200
C	-1.06794654	-3.62663119	-1.20312000
H	-3.96809954	-1.80477719	-0.92729500
H	-3.15515554	-4.08798119	-1.46117400
H	-0.75165654	-4.63446319	-1.42991000
N	0.36495646	-0.39834819	-0.31831200
N	1.27189946	-2.80042719	-0.80746200
C	1.95638746	-3.96104919	-1.02198800
O	1.46519146	-5.04610419	-1.36448200
C	3.43040946	-3.78562019	-0.71904500

H	3.58592546	-4.17803819	0.29511000
H	4.01694446	-4.41710119	-1.39688700
C	3.87782646	-2.33306719	-0.79329300
H	4.10975346	-2.02621419	-1.81688600
Cu	2.24795746	-1.20632619	-0.52401000
C	4.95533146	-1.93537619	0.18566200
H	5.14469646	-0.86584919	0.11632700
H	4.63821046	-2.15825819	1.21218500
C	6.28003646	-2.69404119	-0.11106700
H	6.15109546	-3.76431319	0.08490600
H	6.51139946	-2.59179219	-1.17725000
C	7.41021146	-2.14869519	0.73078300
C	8.21200146	-1.08196819	0.27920700
C	7.65252746	-2.66580919	2.01035200
C	9.19731446	-0.53371419	1.10863800
C	8.64527646	-2.12985619	2.83300200
H	7.04879946	-3.49875619	2.36410600
C	9.41632646	-1.05510019	2.38498600
H	9.79215946	0.30301581	0.75270200
H	8.81302946	-2.54839919	3.82218900
H	10.18449646	-0.62456119	3.02186700

C	7.92296046	-0.43261519	-1.04737500
O	6.97431146	0.37377881	-1.12605100
N	8.68422846	-0.69604419	-2.13154300
H	8.37058246	-0.16986119	-2.94259300
C	9.77216946	-1.68260619	-2.40320800
C	11.04638046	-1.34634119	-1.61181400
C	9.31198046	-3.11702119	-2.09826500
C	10.06220346	-1.55210119	-3.90766800
H	11.34772246	-0.30610019	-1.77864400
H	10.90890646	-1.50088719	-0.53905700
H	11.86491646	-1.99713719	-1.94087800
H	8.40290946	-3.36397119	-2.65736100
H	10.09686946	-3.82270919	-2.39405100
H	9.11716646	-3.26372819	-1.03281000
H	10.85529946	-2.24925819	-4.19590700
H	9.17180046	-1.78521319	-4.50440700
H	10.39390646	-0.53737019	-4.16040200
O	3.21219646	0.34696281	-0.30335800
C	3.21697746	1.27008081	-1.37990600
C	3.81124946	0.68161781	-2.66478500
C	4.01093646	2.49308681	-0.90891900

H	2.18489046	1.59446481	-1.61020200
H	3.22213446	-0.18071019	-2.99807900
H	3.80306046	1.42586581	-3.47033100
H	4.84527246	0.35901781	-2.50205100
H	3.56779546	2.91055081	0.00212500
H	5.04430846	2.20302581	-0.68632300
H	4.02258246	3.27626581	-1.67609100

1-ts

Value of imaginary frequency = -1007.03 cm-1

C	2.48484848	1.38787877	0.00000000
C	3.28415448	3.56759577	0.19910700
C	4.62782148	3.13794377	-0.01070400
C	4.84554648	1.75188477	-0.22133500
C	3.78110148	0.87782377	-0.21862000
H	1.62150748	0.72801777	0.00768500
C	2.97638348	4.95918177	0.41575000
C	5.67409748	4.09667677	-0.00220800
H	5.85906648	1.39460077	-0.38402900
H	3.91916348	-0.18611123	-0.38009400
C	5.36772248	5.42306077	0.20827500
C	4.03894548	5.86085777	0.41530000

H	6.69761348	3.77039177	-0.16318900
H	6.16134848	6.16593477	0.21565100
H	3.84086248	6.91020977	0.57872600
N	2.24526948	2.67509377	0.20202400
N	1.62164548	5.24451077	0.60089200
C	1.12615448	6.45410177	0.96513400
O	1.76943248	7.50244077	1.16371600
C	-0.38324952	6.42482477	1.19143400
H	-0.56074052	6.19830977	2.25116200
H	-0.78299452	7.43520177	1.01964600
C	-1.12752352	5.45237077	0.32089500
H	-0.89999552	5.51040577	-0.74548200
Cu	0.44137348	3.73507877	0.49655000
C	-2.37027552	4.86602277	0.69703000
H	-1.96777852	3.69658777	0.89248300
H	-2.73709452	5.17565377	1.67915100
C	-3.48026152	4.67523877	-0.36466800
H	-3.11752752	5.00612077	-1.34449900
H	-3.72538052	3.61266677	-0.46848600
C	-4.72456752	5.45128677	0.00669700
C	-5.71381052	4.88065977	0.83239000

C	-4.89924552	6.77252877	-0.42427500
C	-6.82348652	5.63341777	1.23474900
C	-6.01242552	7.51982077	-0.03440200
H	-4.14702752	7.21929077	-1.07077700
C	-6.97503752	6.95256577	0.80376400
H	-7.56509952	5.18614477	1.89055400
H	-6.12520352	8.54397577	-0.38123700
H	-7.83915352	7.53070777	1.12025200
C	-5.50337052	3.50698877	1.40871100
O	-4.65934552	3.36283477	2.31606900
N	-6.23340052	2.45222277	0.98265200
H	-5.98732052	1.60594577	1.48894600
C	-7.09344252	2.23238577	-0.21904600
C	-8.42101652	2.99989477	-0.11455300
C	-6.34923652	2.61727977	-1.50770800
C	-7.37933152	0.72172377	-0.23086000
H	-8.92358452	2.78764077	0.83591400
H	-8.27226952	4.07919977	-0.19600000
H	-9.08642252	2.69264077	-0.92976700
H	-5.40871252	2.06220777	-1.59575800
H	-6.97193052	2.37591677	-2.37715000

H	-6.12821452	3.68724877	-1.54355300
H	-8.00803852	0.46686277	-1.08942900
H	-6.44920752	0.14602877	-0.30916500
H	-7.90551052	0.41105677	0.67935000
O	-1.09598552	2.64211777	0.73010100
C	-1.08614452	1.56518077	1.66989100
C	-2.34309652	0.71944177	1.47127100
C	-0.97344652	2.10868377	3.09496200
H	-0.20028252	0.94750477	1.45399800
H	-2.41508652	0.37449477	0.43387200
H	-2.33485652	-0.16009923	2.12521400
H	-3.23448352	1.31297677	1.70396300
H	-0.07453252	2.72959077	3.19031600
H	-1.84708752	2.72718977	3.33281100
H	-0.91450552	1.29893577	3.83151600

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C	-0.41818181	-0.32121212	0.00000000
C	0.67165419	-2.30596012	0.54391900
C	-0.53592081	-3.05311912	0.37040100
C	-1.70328881	-2.34099012	-0.00899900
C	-1.64984681	-0.97891312	-0.19776400

H	-0.34121381	0.75407488	-0.13933100
C	1.90541219	-2.96754012	0.92300000
C	-0.53557281	-4.45553212	0.57918400
H	-2.63294981	-2.88764812	-0.14648800
H	-2.52621081	-0.40873512	-0.48904600
C	0.63756619	-5.07220912	0.95148200
C	1.83961919	-4.35015312	1.12092700
H	-1.45616881	-5.01637112	0.44420300
H	0.65384919	-6.14611012	1.12176000
H	2.73445719	-4.88071512	1.40847400
N	0.69091419	-0.95162612	0.35720700
N	3.02892819	-2.14962712	1.07412000
C	4.28106519	-2.64186912	1.25355100
O	4.62091819	-3.84520312	1.29488000
C	5.36560419	-1.56390612	1.40529600
H	5.38773019	-0.95669012	0.49188500
H	5.04517419	-0.88278112	2.20783600
C	6.72695519	-2.12006712	1.70792900
H	6.78453719	-2.81723012	2.54445900
Cu	2.68433519	-0.21802912	0.85042800
C	7.83753719	-1.79928312	1.03961000

H	7.78717719	-1.10379912	0.20127700
C	9.22329019	-2.29816112	1.37531000
H	9.16965119	-3.04068712	2.18015900
H	9.65431119	-2.80431812	0.50205800
C	10.12383319	-1.14988412	1.80395100
C	10.93192319	-0.45640312	0.88383300
C	10.12863419	-0.73069712	3.14087300
C	11.69033819	0.64674688	1.29592400
C	10.89841419	0.35677788	3.55679000
H	9.51284819	-1.26427112	3.86166400
C	11.67641319	1.05510788	2.63018400
H	12.28683419	1.18778688	0.56665200
H	10.88618119	0.66093388	4.60043600
H	12.26896319	1.91123488	2.94153600
C	10.87164619	-0.80305912	-0.57815100
O	9.86230019	-0.47270912	-1.23109500
N	11.90285419	-1.43265112	-1.18557800
H	11.71606719	-1.57774612	-2.17393400
C	13.10754819	-2.14731212	-0.66588800
C	14.15659319	-1.16289612	-0.12429400
C	12.72222419	-3.17048612	0.41471300

C	13.68841419	-2.88669612	-1.88332600
H	14.38922719	-0.39021512	-0.86568200
H	13.81789719	-0.67519012	0.79271500
H	15.08164319	-1.70306912	0.10848300
H	11.97420919	-3.87613712	0.03677500
H	13.60986619	-3.74033712	0.71280900
H	12.32246719	-2.68527612	1.30895000
H	14.58411519	-3.44382312	-1.59061800
H	12.96485219	-3.60089112	-2.29554700
H	13.97119419	-2.18294312	-2.67601100
O	3.05305719	1.73257988	0.86639800
H	3.93261019	1.93515488	0.50800100
C	2.07245819	2.62967588	0.25418700
C	1.96961719	2.35339188	-1.23767800
C	2.44251819	4.06671788	0.58662200
H	1.13833519	2.35539888	0.75318200
H	1.74361819	1.29749188	-1.41638100
H	1.17505219	2.96019188	-1.68451500
H	2.91217219	2.59870488	-1.74166100
H	2.52336519	4.20570888	1.66938700
H	3.40070619	4.33585988	0.12579200

H	1.67907419	4.75311888	0.20593000

1-b2

C	-0.37122970	0.26682134	0.00000000
C	0.92048230	1.79153734	1.17981200
C	2.11511530	1.06020434	0.89517800
C	1.98930030	-0.13091466	0.13390600
C	0.74993030	-0.53289466	-0.31048100
H	-1.36076870	-0.02026166	-0.34929700
C	0.97565330	3.00286034	1.97145400
C	3.36281730	1.53941534	1.37441100
H	2.87963030	-0.71330466	-0.09008200
H	0.62120230	-1.43891966	-0.89413700
C	3.40183930	2.70587534	2.10759600
C	2.22863730	3.43476634	2.40686700
H	4.26743530	0.97886634	1.15507800
H	4.35411130	3.07902734	2.47697800
H	2.29592430	4.34356834	2.99020000
N	-0.29816270	1.38201034	0.71053500
N	-0.24928470	3.59464634	2.22510600
C	-0.42605470	4.89497234	2.52114700
O	0.44570230	5.77158834	2.72516600

C	-1.92029070	5.27385334	2.59123800
H	-2.27684670	5.06083434	3.60753200
H	-1.99932570	6.35563934	2.43459200
C	-2.75904070	4.52188234	1.58271300
H	-2.57799070	4.77519334	0.53588800
Cu	-1.98071470	2.54892634	1.79067000
C	-3.80859070	3.69536934	1.89095700
H	-4.10772670	3.58636534	2.93315400
C	-4.78183970	3.12960834	0.87356900
H	-4.38136070	3.27394234	-0.13629000
H	-4.87526870	2.04898334	1.02540800
C	-6.15333670	3.77349434	0.98327700
C	-7.12696470	3.27429534	1.86984500
C	-6.46577670	4.90379534	0.21766900
C	-8.36231070	3.91937834	2.00283400
C	-7.70456070	5.53681234	0.33557600
H	-5.72377570	5.29113134	-0.47721200
C	-8.65505070	5.04707134	1.23416000
H	-9.09275070	3.53640934	2.71040700
H	-7.92516070	6.41175234	-0.27072900
H	-9.61788170	5.53996334	1.33931500

C	-6.78322170	2.14419634	2.80235400
O	-6.13522370	2.40967934	3.83528500
N	-7.16217770	0.87420034	2.54514700
H	-6.85262870	0.23687534	3.27417900
C	-7.87359370	0.23012834	1.40189400
C	-9.32550170	0.72459034	1.29872900
C	-7.12857370	0.46602734	0.07920000
C	-7.87049370	-1.27315366	1.72365600
H	-9.84161970	0.62177034	2.26005400
H	-9.37481170	1.77050434	0.98665000
H	-9.86465270	0.12786734	0.55396100
H	-6.09934070	0.09481834	0.13832900
H	-7.63812470	-0.07287266	-0.72785200
H	-7.10458970	1.52501634	-0.19023400
H	-8.37210970	-1.82583966	0.92296500
H	-6.84692170	-1.65823966	1.81008900
H	-8.39924970	-1.47962466	2.66215400
O	-2.75445470	0.62078134	2.38134000
C	-3.31849970	0.49390934	3.71991700
C	-2.17013070	0.72796134	4.68514200
C	-3.97484170	-0.87135066	3.87088600

H	-4.07347870	1.27707834	3.84829500
H	-1.71786070	1.70998534	4.50769900
H	-2.52945870	0.69618634	5.71853800
H	-1.39584970	-0.03798466	4.56056600
H	-4.75916970	-1.01205766	3.11815300
H	-3.23824770	-1.67504066	3.75836300
H	-4.44010970	-0.96157766	4.85837500
H	-3.44424970	0.40232134	1.73608200

2-a

C	0.48143852	0.44083526	0.00000000
C	1.19180452	2.65225426	-0.21803700
C	2.56089652	2.27178726	-0.20565800
C	2.84317752	0.88672826	-0.08321200
C	1.81239152	-0.02441774	0.01745800
H	-0.36601948	-0.23369174	0.07637500
C	0.78819852	4.01759726	-0.34553400
C	3.54811452	3.28513226	-0.31819600
H	3.87834152	0.55631826	-0.07158400
H	2.00485252	-1.08796574	0.10935500
C	3.15073252	4.59952626	-0.43656900
C	1.78575752	4.97986126	-0.45434200

H	4.59889152	3.01102926	-0.31018700
H	3.90020852	5.38190426	-0.52151600
H	1.52038252	6.02234826	-0.55195900
N	0.19220652	1.72753626	-0.11134400
N	-0.60438448	4.20778326	-0.33035100
C	-1.23577748	5.41796826	-0.41094500
O	-0.68042848	6.51280626	-0.55918400
C	-2.73309448	5.26918926	-0.22992200
H	-2.95859048	5.60866726	0.78959700
H	-3.24618648	5.95507526	-0.91437000
C	-3.20037448	3.83813626	-0.42716900
H	-3.36971048	3.58904926	-1.48105900
Cu	-1.62180948	2.64400926	-0.19070000
C	-4.30288548	3.36341226	0.48495500
H	-4.47707948	2.29829826	0.34083000
H	-4.01610648	3.52514026	1.53136800
C	-5.63222348	4.12475926	0.20467400
H	-5.48914948	5.19684826	0.37972800
H	-5.89422248	4.00248226	-0.85206800
C	-6.73440048	3.60785726	1.10164100
C	-7.60251248	2.57225526	0.70123900

C	-6.88225448	4.13497326	2.39188500
C	-8.54982748	2.05786926	1.59548800
C	-7.83792148	3.63371326	3.27734700
H	-6.23175248	4.94870426	2.70518200
C	-8.66794348	2.58225426	2.88339600
H	-9.18868648	1.23716826	1.28254400
H	-7.92945448	4.06001726	4.27321500
H	-9.40399948	2.17333326	3.57042900
C	-7.43661548	1.92277126	-0.64402000
O	-6.42182848	1.23306926	-0.86307300
N	-8.39716348	2.04331026	-1.59172900
H	-8.15181948	1.51819426	-2.42678200
C	-9.52660648	3.00634526	-1.77572700
C	-10.72199748	2.66235726	-0.87254500
C	-9.06678548	4.45231326	-1.53110200
C	-9.94893148	2.85047026	-3.24674000
H	-11.00724148	1.60993626	-0.98191600
H	-10.50407948	2.85669726	0.18005600
H	-11.58317148	3.28036426	-1.15286400
H	-8.21403448	4.70420126	-2.17165300
H	-9.88653748	5.14080726	-1.76726800

H	-8.78113248	4.61879126	-0.48909100
H	-10.78137348	3.52594726	-3.46888300
H	-9.12199448	3.09557926	-3.92428000
H	-10.27934848	1.82572926	-3.45702500
F	-2.59651148	1.13550826	-0.11688200

2-ts

Value of imaginary frequency = -1138.98 cm-1

C	-0.52410901	0.05241090	0.00000000
C	-1.64113901	1.45787990	1.48644200
C	-2.66625801	0.48670690	1.69242300
C	-2.55354501	-0.74482610	0.99639000
C	-1.48555901	-0.96679110	0.15603300
H	0.32855599	-0.08190610	-0.66016900
C	-1.67641701	2.72767090	2.17303800
C	-3.74027501	0.78127890	2.57152300
H	-3.31868501	-1.50402310	1.13743000
H	-1.37178101	-1.89956010	-0.38665200
C	-3.76975101	2.00092390	3.21108500
C	-2.75591701	2.96788990	3.02214000
H	-4.52093701	0.04176390	2.72530600
H	-4.58902301	2.23767490	3.88519600

H	-2.81733401	3.91274690	3.54249400
N	-0.59692401	1.21441490	0.63348800
N	-0.59597701	3.57634690	1.92056200
C	-0.53854601	4.87478390	2.30318300
O	-1.40931201	5.52482090	2.91573700
C	0.74708199	5.57710590	1.85915600
H	0.56943499	6.06056090	0.88975300
H	0.96049099	6.38745990	2.57258600
C	1.94852999	4.69018990	1.79534000
H	2.05137499	3.96113890	2.59871500
Cu	0.70807899	2.84987890	0.67748900
C	3.05949499	4.90367090	0.96435800
H	2.63412999	4.09084690	0.02669600
H	3.06560899	5.84665390	0.41093100
C	4.43804499	4.35837790	1.39623200
H	5.16700899	5.17196490	1.30912800
H	4.40165999	4.09053390	2.45660800
C	4.92257799	3.17326090	0.58116900
C	4.68736299	1.84728590	0.98999800
C	5.58795899	3.38303490	-0.63404000
C	5.06965999	0.77358790	0.17580000

C	5.98744799	2.31428290	-1.43777000
H	5.78855199	4.40323690	-0.95437700
C	5.72178599	1.00301490	-1.03611800
H	4.85741099	-0.24276910	0.49703000
H	6.50328799	2.50477890	-2.37557100
H	6.02117699	0.16380490	-1.65831500
C	3.89217899	1.54910690	2.23116100
O	2.64684299	1.48091090	2.14206700
N	4.49528499	1.35141790	3.41995300
H	3.82254999	1.12771290	4.14892500
C	5.92653299	1.26839090	3.84068700
C	6.61506999	0.05441090	3.19533100
C	6.69181299	2.55924590	3.51235400
C	5.88106099	1.08325290	5.36637500
H	6.04047899	-0.86155410	3.37399400
H	6.73151999	0.18606990	2.11635800
H	7.61404899	-0.07741410	3.62686900
H	6.20601999	3.43040390	3.96471200
H	7.70852599	2.48763890	3.91578400
H	6.77375999	2.72360490	2.43541000
H	6.89854499	1.02173290	5.76506600

H	5.37520899	1.92699190	5.85121300
H	5.35427099	0.16022190	5.63885200
F	2.08607899	3.19087790	-0.64092100

2-b1

C	-0.52410901	0.05241090	0.00000000
C	-1.64113901	1.45787990	1.48644200
C	-2.66625801	0.48670690	1.69242300
C	-2.55354501	-0.74482610	0.99639000
C	-1.48555901	-0.96679110	0.15603300
H	0.32855599	-0.08190610	-0.66016900
C	-1.67641701	2.72767090	2.17303800
C	-3.74027501	0.78127890	2.57152300
H	-3.31868501	-1.50402310	1.13743000
H	-1.37178101	-1.89956010	-0.38665200
C	-3.76975101	2.00092390	3.21108500
C	-2.75591701	2.96788990	3.02214000
H	-4.52093701	0.04176390	2.72530600
H	-4.58902301	2.23767490	3.88519600
H	-2.81733401	3.91274690	3.54249400
N	-0.59692401	1.21441490	0.63348800
N	-0.59597701	3.57634690	1.92056200

C	-0.53854601	4.87478390	2.30318300
O	-1.40931201	5.52482090	2.91573700
C	0.74708199	5.57710590	1.85915600
H	0.56943499	6.06056090	0.88975300
H	0.96049099	6.38745990	2.57258600
C	1.94852999	4.69018990	1.79534000
H	2.05137499	3.96113890	2.59871500
Cu	0.70807899	2.84987890	0.67748900
C	3.05949499	4.90367090	0.96435800
H	2.63412999	4.09084690	0.02669600
H	3.06560899	5.84665390	0.41093100
C	4.43804499	4.35837790	1.39623200
H	5.16700899	5.17196490	1.30912800
H	4.40165999	4.09053390	2.45660800
C	4.92257799	3.17326090	0.58116900
C	4.68736299	1.84728590	0.98999800
C	5.58795899	3.38303490	-0.63404000
C	5.06965999	0.77358790	0.17580000
C	5.98744799	2.31428290	-1.43777000
H	5.78855199	4.40323690	-0.95437700
C	5.72178599	1.00301490	-1.03611800

H	4.85741099	-0.24276910	0.49703000
H	6.50328799	2.50477890	-2.37557100
H	6.02117699	0.16380490	-1.65831500
C	3.89217899	1.54910690	2.23116100
O	2.64684299	1.48091090	2.14206700
N	4.49528499	1.35141790	3.41995300
H	3.82254999	1.12771290	4.14892500
C	5.92653299	1.26839090	3.84068700
C	6.61506999	0.05441090	3.19533100
C	6.69181299	2.55924590	3.51235400
C	5.88106099	1.08325290	5.36637500
H	6.04047899	-0.86155410	3.37399400
H	6.73151999	0.18606990	2.11635800
H	7.61404899	-0.07741410	3.62686900
H	6.20601999	3.43040390	3.96471200
H	7.70852599	2.48763890	3.91578400
H	6.77375999	2.72360490	2.43541000
H	6.89854499	1.02173290	5.76506600
H	5.37520899	1.92699190	5.85121300
H	5.35427099	0.16022190	5.63885200
F	2.08607899	3.19087790	-0.64092100

3-a

C	-0.08700696	0.17401392	0.00000000
C	-0.84565096	-1.91691308	-0.70805500
C	-2.20359596	-1.55604708	-0.49539700
C	-2.45437396	-0.24757908	-0.00723200
C	-1.40500996	0.61290892	0.24025100
H	0.77360904	0.81229492	0.17791400
C	-0.47550996	-3.20763408	-1.19965800
C	-3.21300396	-2.51167208	-0.78146800
H	-3.48062896	0.06388292	0.16819200
H	-1.57271496	1.61750592	0.61332800
C	-2.84786396	-3.75361108	-1.25448000
C	-1.49444196	-4.11474208	-1.46764800
H	-4.25536196	-2.25039508	-0.62480100
H	-3.61445696	-4.49115908	-1.47620400
H	-1.25306796	-5.09985708	-1.83979200
N	0.17307904	-1.04208308	-0.45354100
N	0.91102304	-3.39355808	-1.34007600
C	1.50584304	-4.50571408	-1.86831300
O	0.91433404	-5.49969008	-2.30347100
C	3.01999304	-4.40511308	-1.83362900

H	3.36605504	-5.17833108	-1.13626300
H	3.40281704	-4.67674008	-2.82398400
C	3.51793504	-3.03278708	-1.40750200
H	3.84535404	-2.41025508	-2.24423500
Cu	1.95430704	-1.90225508	-0.90488300
C	4.47922604	-2.99904208	-0.24460300
H	4.64590404	-1.97101408	0.07478000
H	4.07896304	-3.56365008	0.60575800
C	5.85232604	-3.60798208	-0.66555600
H	5.76332304	-4.69610808	-0.75452400
H	6.11732904	-3.22840308	-1.65825500
C	6.92506904	-3.24970008	0.33587600
C	7.69089204	-2.07502408	0.19201500
C	7.14782204	-4.05585708	1.45957100
C	8.61806804	-1.70891208	1.17435700
C	8.08403304	-3.69863608	2.43243700
H	6.57510204	-4.97388708	1.57196100
C	8.81554904	-2.51694908	2.29574300
H	9.18314504	-0.78812708	1.05959900
H	8.23851204	-4.33975208	3.29670700
H	9.53738204	-2.22510808	3.05393200

C	7.41448104	-1.13569008	-0.95088400
O	6.37721204	-0.44559408	-0.92339500
N	8.28757904	-1.01272608	-1.97644200
H	7.95638504	-0.33678908	-2.65966100
C	9.43576904	-1.85123408	-2.43583200
C	10.63808904	-1.74030308	-1.48483300
C	9.01254404	-3.32021808	-2.59888800
C	9.82693404	-1.27612508	-3.80734500
H	10.89480504	-0.69153808	-1.29803300
H	10.44648804	-2.22769308	-0.52616900
H	11.50750704	-2.23042108	-1.93828300
H	8.16312404	-3.40886608	-3.28537000
H	9.84688304	-3.90027808	-3.01021700
H	8.73384904	-3.76804408	-1.64117700
H	10.66060004	-1.84810708	-4.22692800
H	8.98982004	-1.32896708	-4.51459200
H	10.14315204	-0.22925708	-3.72179900
O	3.00271404	-0.39156508	-0.49298800
C	3.38592404	0.36455192	-1.48331200
O	3.18260404	0.10653592	-2.68080100
C	4.07244704	1.64725392	-1.05982800

H	4.61757604	1.51186192	-0.12418600
H	4.75091504	1.98503092	-1.84568600
H	3.30620104	2.41709992	-0.90755800

3-ts

Value of imaginary frequency = -1373.96 cm-1

C	1.07966455	0.92243186	0.00000000
C	2.10192855	1.23230286	2.07297300
C	3.18612555	1.94283686	1.47785700
C	3.15528055	2.12419086	0.07051900
C	2.10908755	1.61744186	-0.66814000
H	0.23988755	0.49672986	-0.54246500
C	2.05924755	1.00429386	3.49759100
C	4.23409155	2.43148186	2.30071000
H	3.96667455	2.66414486	-0.41090000
H	2.06268955	1.74037786	-1.74526700
C	4.18241455	2.20771986	3.65923900
C	3.11400555	1.50276386	4.26014000
H	5.05936255	2.97290586	1.84713900
H	4.97970155	2.57912386	4.29823000
H	3.11375355	1.34535486	5.32950900
N	1.07383155	0.74142086	1.31291600

N	0.93075755	0.32409786	3.96091200
C	0.82531155	-0.22596814	5.19367400
O	1.69090455	-0.24202914	6.09224000
C	-0.51425845	-0.93120314	5.42964900
H	-0.42329245	-1.98247414	5.12693400
H	-0.71126045	-0.94002514	6.51227100
C	-1.68257045	-0.28319014	4.75599600
H	-1.65803845	0.80561586	4.70611700
Cu	-0.35988845	-0.12353614	2.57707400
C	-2.89393045	-0.90972114	4.43784000
H	-2.59038845	-1.13685114	3.15547100
H	-3.00503745	-1.94580414	4.77177400
C	-4.17283945	-0.05589714	4.45889900
H	-4.68890445	-0.25201014	5.40838100
H	-3.88664045	0.99992286	4.48285000
C	-5.14147045	-0.30021514	3.31971200
C	-5.26170745	0.60724186	2.25000300
C	-5.96017045	-1.43745814	3.32210400
C	-6.15574245	0.35345886	1.20136500
C	-6.85682445	-1.68786614	2.28219200
H	-5.89201145	-2.13434914	4.15467800

C	-6.95330745	-0.79204114	1.21439100
H	-6.22209745	1.05415486	0.37373100
H	-7.47809545	-2.57953714	2.30583000
H	-7.64346445	-0.98138614	0.39667100
C	-4.33524045	1.78931386	2.14993200
O	-3.15016745	1.59619886	1.81046100
N	-4.77822145	3.04213486	2.38914300
H	-4.03680845	3.72584086	2.25951000
C	-6.01799045	3.57849886	3.02870600
C	-7.25077945	3.38107286	2.13210500
C	-6.24586445	2.93821986	4.40724400
C	-5.75405645	5.08330786	3.20297200
H	-7.06966245	3.77116886	1.12423600
H	-7.53213145	2.32839686	2.05305200
H	-8.10305345	3.92188686	2.55976000
H	-5.36885345	3.07234086	5.04992800
H	-7.10382645	3.41391386	4.89649100
H	-6.45886545	1.86885586	4.32646300
H	-6.61673945	5.56114786	3.67788300
H	-4.87692445	5.25997886	3.83776100
H	-5.58661545	5.57035786	2.23443300

O	-1.92838445	-1.12229814	2.04894000
C	-2.27525345	-1.51345114	0.82932100
O	-1.59594245	-1.21564814	-0.15200600
C	-3.54404945	-2.31707514	0.73692400
H	-3.67546345	-2.95485714	1.61363200
H	-4.38993645	-1.62416314	0.68848200
H	-3.53362245	-2.91725814	-0.17521600

3-b1

C	0.24848484	0.22424242	0.00000000
C	0.74018284	-1.87599258	0.89897700
C	-0.59959816	-2.31770958	0.66755400
C	-1.50805916	-1.40046458	0.07933600
C	-1.09041616	-0.13167158	-0.25236600
H	0.61575084	1.21426942	-0.25402200
C	1.71784184	-2.75771358	1.50937900
C	-0.97884816	-3.63652758	1.02673800
H	-2.53268016	-1.71533358	-0.10220900
H	-1.76306916	0.59194042	-0.70116900
C	-0.04235316	-4.46926558	1.59809800
C	1.28269684	-4.04599758	1.83946300
H	-1.99811816	-3.96566858	0.84578400

H	-0.31938016	-5.48335558	1.87684400
H	1.98529684	-4.72989358	2.29255600
N	1.12839784	-0.60601958	0.54985000
N	2.98402084	-2.21709558	1.69909900
C	3.99929384	-2.87795258	2.30172100
O	4.00272984	-4.05413858	2.73598800
C	5.25099184	-2.01245658	2.47825900
H	5.33475484	-1.33570858	1.62580500
H	5.06302384	-1.36955558	3.35287200
C	6.54308884	-2.75311458	2.66050100
H	6.59704484	-3.48167958	3.46942500
Cu	3.08021284	-0.27206958	0.94540400
C	7.60923384	-2.50277558	1.89611700
H	7.52247484	-1.77001258	1.09490500
C	8.99331384	-3.07823558	2.07084800
H	8.98566184	-3.87646358	2.82197800
H	9.33334984	-3.52260458	1.12679300
C	9.95715684	-1.98079758	2.50058600
C	10.54848484	-1.10485758	1.56961600
C	10.22513084	-1.77987558	3.86131000
C	11.35139084	-0.04276058	2.00458400

C	11.04399984	-0.73568158	4.29448200
H	9.77682584	-2.45160458	4.58988600
C	11.60460384	0.14243642	3.36425200
H	11.77947584	0.63708342	1.27257200
H	11.23820484	-0.60500158	5.35615600
H	12.23411084	0.96552142	3.69196600
C	10.21409384	-1.19520958	0.10509900
O	9.16415284	-0.65913858	-0.30676800
N	11.03792184	-1.82067058	-0.76132900
H	10.68360984	-1.77320158	-1.71297600
C	12.31576784	-2.57666958	-0.59936200
C	13.45493684	-1.65354858	-0.13708100
C	12.14972884	-3.75549858	0.37235800
C	12.63869684	-3.11775458	-2.00205100
H	13.54039084	-0.77872458	-0.79174800
H	13.30451084	-1.30776358	0.88852800
H	14.40466584	-2.20014358	-0.16947400
H	11.34336984	-4.42149658	0.04628400
H	13.07942284	-4.33537658	0.40353200
H	11.93434884	-3.41759358	1.38928500
H	13.56970284	-3.69269458	-1.97470300

H	11.84108484	-3.77799558	-2.36419200
H	12.76651284	-2.29963358	-2.72186600
O	4.75749684	0.90981342	0.64592100
H	5.18991584	0.88580542	-0.22518900
C	5.58778284	1.32906842	1.65631100
O	5.13661284	1.34457542	2.78094400
C	6.97558284	1.71735742	1.24598200
H	7.51044384	0.84717542	0.84686500
H	6.93625684	2.47555742	0.45646900
H	7.50957984	2.10692942	2.11274600

3-b2

C	0.67865430	0.24361949	0.00000000
C	-0.74090270	1.90878349	-0.78757500
C	-1.88993870	1.09159649	-0.55987600
C	-1.67603470	-0.20929851	-0.03464700
C	-0.39652570	-0.63784051	0.23993000
H	1.70083230	-0.05912651	0.21290800
C	-0.88240370	3.23838249	-1.34500400
C	-3.18122970	1.59919649	-0.86127700
H	-2.53181270	-0.85529251	0.14500700
H	-0.20224070	-1.62822651	0.63912500

C	-3.30318770	2.87394949	-1.37139700
C	-2.17520670	3.69005749	-1.61434400
H	-4.05271370	0.97501049	-0.68444400
H	-4.28931570	3.26863649	-1.60416400
H	-2.30841470	4.68273049	-2.02308900
N	0.51877230	1.46726049	-0.48299700
N	0.30781530	3.90751549	-1.55921000
C	0.43419530	5.23499749	-1.72748900
O	-0.46892270	6.09836749	-1.82011200
C	1.91440230	5.66758049	-1.80639100
H	2.25392330	5.52702449	-2.84094000
H	1.96109230	6.74024149	-1.58715200
C	2.80278330	4.89174549	-0.86099300
H	2.64273130	5.08738349	0.20139100
Cu	2.06928930	2.87727649	-1.13883400
C	3.85626030	4.10080449	-1.23221300
H	4.12040230	4.02687349	-2.28724200
C	4.86729330	3.50816049	-0.26947900
H	4.54675730	3.69561149	0.76169300
H	4.89920830	2.42209149	-0.40094500
C	6.24844930	4.09360749	-0.50097800

C	7.15820030	3.48914349	-1.38887000
C	6.63136630	5.27541849	0.14565000
C	8.40308230	4.08058149	-1.63791500
C	7.87717930	5.85851049	-0.09235700
H	5.93888530	5.74316549	0.84210500
C	8.76463830	5.26388549	-0.99250100
H	9.08722830	3.61112849	-2.33913000
H	8.15283230	6.77556549	0.42209000
H	9.73286130	5.71575749	-1.19076100
C	6.74742030	2.28405649	-2.19059300
O	5.94197930	2.43745849	-3.13076300
N	7.27841330	1.06685649	-1.93664400
H	6.91949130	0.36659249	-2.57939500
C	7.97967030	0.50242549	-0.74333900
C	9.39508230	1.07828849	-0.58397200
C	7.15304130	0.73561849	0.53143700
C	8.08045330	-1.00667151	-1.01834000
H	9.96826330	0.96961149	-1.51134300
H	9.37776330	2.13461149	-0.30693000
H	9.92138530	0.53426349	0.20896000
H	6.14163230	0.32918149	0.41797900

H	7.63117830	0.23284649	1.38009000
H	7.07783130	1.79953549	0.77259200
H	8.58350030	-1.50532651	-0.18376100
H	7.08648730	-1.45744851	-1.13070300
H	8.65686130	-1.20507951	-1.93002400
O	3.21653530	1.06734849	-1.84040600
C	3.47493130	0.88415849	-3.02838300
C	4.22862730	-0.29619651	-3.55451700
H	3.52282030	-0.97208551	-4.05080900
H	4.96366330	0.03138349	-4.29262700
H	4.71461130	-0.82062651	-2.73165700
O	3.06286430	1.71610949	-3.98978000
H	2.55706630	2.44751949	-3.58352200

1-b3, 2-b3, 3-b3 without small molecule

C	-0.17979898	-0.15081206	0.00235369
C	1.36229302	-1.89831606	-0.14410831
C	2.45223802	-0.97945206	-0.17972231
C	2.15016702	0.40494194	-0.10984431
C	0.84065202	0.82038594	-0.01787831
H	-1.22317698	0.14332994	0.06555869
C	1.60549102	-3.32456806	-0.21261731

C	3.77970102	-1.47416306	-0.28475631
H	2.96304302	1.12643594	-0.13206831
H	0.57905802	1.87199794	0.03431469
C	3.99478402	-2.83403006	-0.35508231
C	2.92530102	-3.75747906	-0.32026131
H	4.60604102	-0.76959906	-0.30876731
H	5.00954602	-3.21543906	-0.43615731
H	3.12321802	-4.82061106	-0.37533131
N	0.05967902	-1.45573206	-0.05710631
N	0.46128302	-4.09299806	-0.15463331
C	0.30664002	-5.37700406	-0.52474031
O	1.18589202	-6.19574606	-0.86869031
C	-1.18814798	-5.77138706	-0.59578631
H	-1.46698798	-5.71794206	-1.65636031
H	-1.29164498	-6.81874306	-0.28909231
C	-2.10786198	-4.88856806	0.22824869
H	-2.07720298	-5.07367906	1.30518169
Cu	-1.24092998	-3.03868806	0.01538369
C	-3.09530698	-4.05177106	-0.25030931
H	-3.27154098	-3.99146006	-1.32482631
C	-4.18647098	-3.45473906	0.62229269

H	-3.94472298	-3.62546906	1.67756469
H	-4.22838798	-2.37053806	0.47745969
C	-5.53516498	-4.06975606	0.29253269
C	-6.38874598	-3.48453306	-0.66214331
C	-5.94088798	-5.25728406	0.91365369
C	-7.59789098	-4.10255106	-1.00357131
C	-7.15370798	-5.86586306	0.58474169
H	-5.29333198	-5.71004806	1.66130469
C	-7.98209298	-5.29221606	-0.38255431
H	-8.23408898	-3.65326706	-1.76067831
H	-7.44903598	-6.78705206	1.08052569
H	-8.92188698	-5.76586106	-0.65329931
C	-5.93521298	-2.26720006	-1.41962931
O	-5.02955398	-2.39066506	-2.26834831
N	-6.51709998	-1.06417106	-1.21273931
H	-6.11895498	-0.35373706	-1.82065931
C	-7.37890398	-0.53000606	-0.11475431
C	-8.81817998	-1.05930206	-0.21730131
C	-6.78203498	-0.85471606	1.26433869
C	-7.38368498	0.99439594	-0.31896931
H	-9.23012298	-0.88688406	-1.21806831

H	-8.87245998	-2.12826806	0.00178369
H	-9.45317598	-0.53792506	0.50845169
H	-5.75396098	-0.48355906	1.34214369
H	-7.37978798	-0.37045206	2.04508569
H	-6.78086698	-1.92938906	1.46447869
H	-7.99735498	1.47187994	0.45148669
H	-6.36942898	1.40635194	-0.24875231
H	-7.80017798	1.26190394	-1.29785431

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