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Aculeatones A and B, Epimeric Lovastatin Derivatives with a 6/6/3-Tricyclic Carbon Skeleton from *Aspergillus aculeatus* and Their Chemical Transformation

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NO.	**1**		**2**		**3**		**4**		**5**		**6**	
	δ_H	δ_C	δ_H	δ_C	δ_H	δ_C	δ_H	δ_C	δ_H	δ_C	δ_H	δ_C
1	4.79 td (10.7, 4.4)	76.5	4.79 td (10.7, 4.4)	76.5	4.78 td (10.5, 5.0)	74.4	4.78 td (10.5, 5.0)	74.3	4.76 td (10.3, 4.5)	75.1	4.76 td (10.3, 4.5)	75.1
2	1.06 m 2.10 m	40.4	1.04 m 2.10 m	40.5	0.96 m 2.22 m	40.5	0.96 m 2.22 m	40.5	1.06 m 2.13 m	40.8	1.06 m 2.13 m	40.7
3	1.63 m	30.7	1.62 m	30.7	1.55 m	29.4	1.55 m	29.4	1.61 m	30.2	1.61 m	30.2
4	0.76 dd (12.4, 11.5) 1.55 m	40.7	0.76 dd (12.4, 11.5) 1.55 m	40.7	0.84 m 1.61 m	42.0	0.84 m 1.61 m	42.0	0.87 m 1.65 m	41.3	0.87 m 1.65 m	41.3
5	1.57 m	41.3	1.57 m	41.4	1.58 m	40.8	1.58 m	40.8	1.68 m	38.2	1.68 m	38.2
6	1.98 dd (15.5, 13.1) 2.18 m	43.5	1.98 dd (13.0, 2.4) 2.16 dd (13.0, 2.4)	43.4	2.19 m 2.46 dd (10.5, 3.7)	48.4	2.19 m 2.46 dd (10.5, 3.7)	48.4	2.23 m 2.32 m	44.4	2.23 m 2.32 m	44.4
7		209.1		209.1		209.1		209.1		212.1		212.1
8		33.2		33.2	2.39 m	47.4	2.39 m	47.4	2.67 dd (7.3, 5.6)	45.9	2.67 dd (7.3, 5.6)	45.9
9	1.34 dd (5.9, 2.3)	32.3	1.35 dd (6.0, 2.2)	32.3	1.09 m	52.0	1.09 m	52.0	1.57 dd (7.3, 5.6)	45.5	1.57 dd (7.3, 5.6)	45.5
10	1.51 m	47.7	1.52 m	47.7	1.77 m	49.3	1.77 m	49.3	1.70 m	43.5	1.70 m	43.4
11	0.93 d (6.5)	21.8	0.93 d (6.5)	21.8	0.91 d (6.3)	21.7	0.91 d (6.3)	21.7	0.94 d (6.3)	21.8	0.94 d (6.4)	21.8
12	1.15 s	15.7	1.17 s	15.7	1.05 d (6.7)	13.1	1.05 d (6.7)	13.0	1.12 d (7.1)	12.4	1.13 d (7.1)	12.5
13	1.21 dd (8.4,5.9)	37.7	1.22 dd (8.3, 6.0)	37.7	3.00 m	57.9	3.00 dd (7.0, 2.3)	57.9	2.91 dd (7.5, 2.3)	57.6	2.91 dd (7.5, 2.3)	57.7
14	3.22 t (7.1)	73.7	3.24 dd (8.3, 6.0)	73.5	2.77 dd (3.8, 2.3)	61.8	2.77 dd (3.8, 2.3)	61.8	2.79 dd (4.8, 2.3)	60.3	2.79 dd (4.8, 2.3)	60.3
15	4.05 t (5.9)	75.8	4.04 t (6.0)	75.9	4.14 br s	70.3	4.15 br s	70.4	4.02 br s	71.3	4.02 br s	71.4
16	5.85 dd (15.5, 5.9)	128.4	5.87 dd (15.5, 6.0)	128.7	5.97 overlapped	128.6	5.98 overlapped	128.6	5.97 m	128.2	5.97 m	128.1
17	5.94 d (15.5)	134.8	5.98 d (15.5)	135.0	5.97 overlapped	134.3	5.98 overlapped	134.3	5.95 m	134.3	5.95 m	134.4
18		74.6		74.3		74.4		74.4		74.3		74.3
19		175.6		175.6		175.8		175.8		175.9		175.8
20	1.49 s	26.2	1.51 s	26.4	1.48 s	26.4	1.48 s	26.4	1.49 s	26.5	1.49 s	26.5
21	3.79 s	53.1	3.79 s	53.3	3.78 s	53.4	3.78 s	53.4	3.79 s	53.4	3.79 s	53.4
1′		171.4		171.4		170.8		170.8		171.2		171.2
2′	3.10 br s	44.0	3.10 br s	44	3.01 br s	44.0	3.01 br s	44.0	3.03 br s	43.9	3.03 br s	43.9
3′		139.2		139.2		139.4		139.4		139.0		139.0
4′	4.88 br s 4.93 br s	114.7	4.88 br s 4.93 br s	114.8	4.84 br s 4.90 br s	114.5	4.84 br s 4.90 br s	114.5	4.83 br s 4.90 br s	114.7	4.83 br s 4.90 br s	114.7
5′	1.84 br s	22.7	1.84 br s	22.7	1.83 br s	22.7	1.83 br s	22.7	1.82 br s	22.7	1.82 br s	22.7

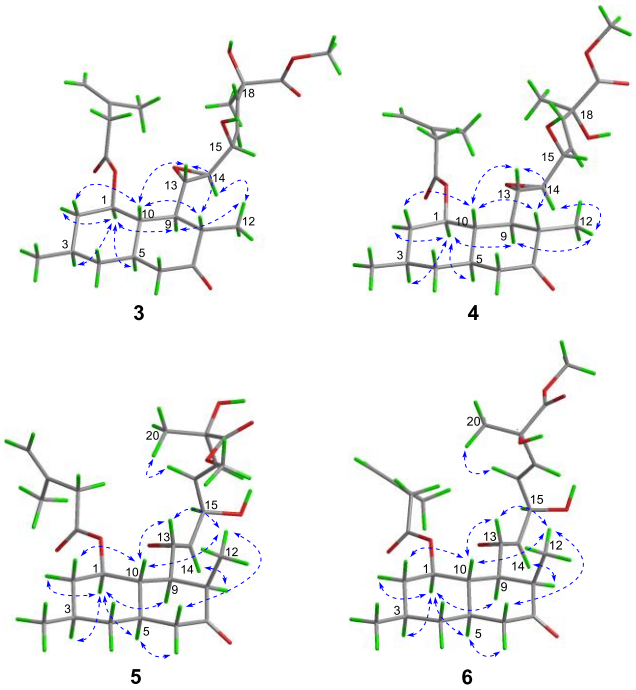


Figure. S1 Key NOESY correlations of compounds **3**–**6**.

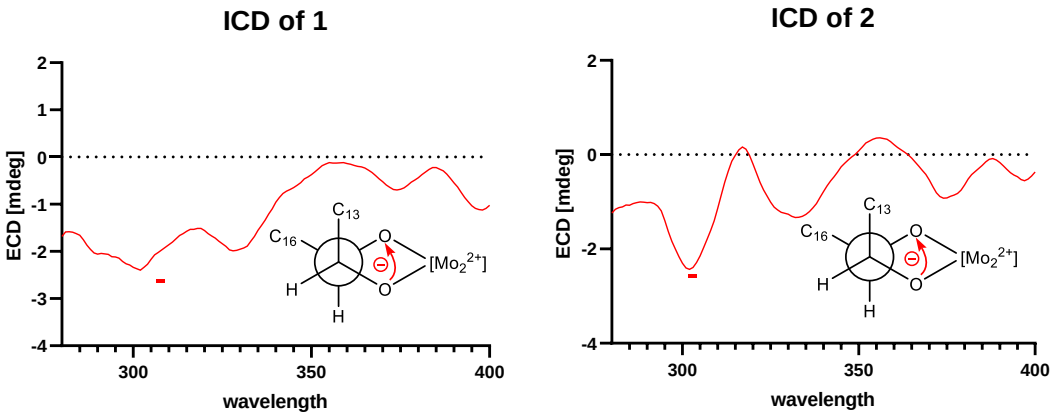


Figure S2. the ICD spectra of Mo-complex of compounds **1** and **2**.

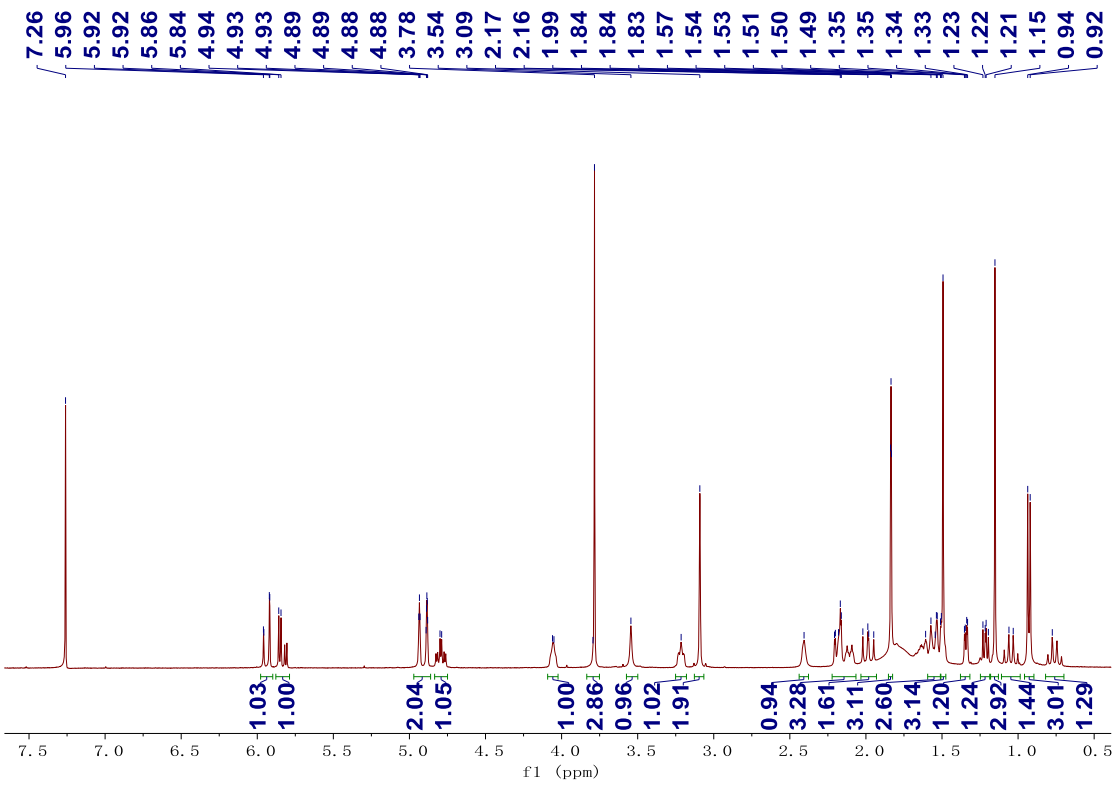
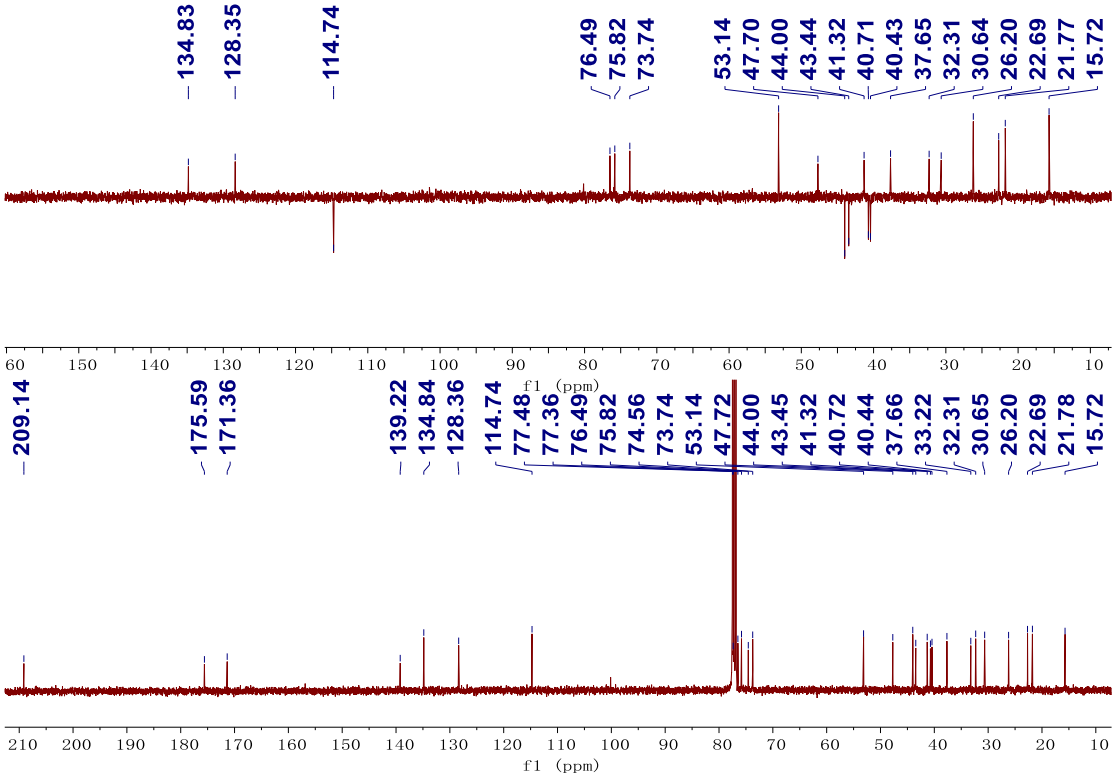


Figure S3. ^{1}H NMR spectrum of compound **1** in $CDCl_3$.



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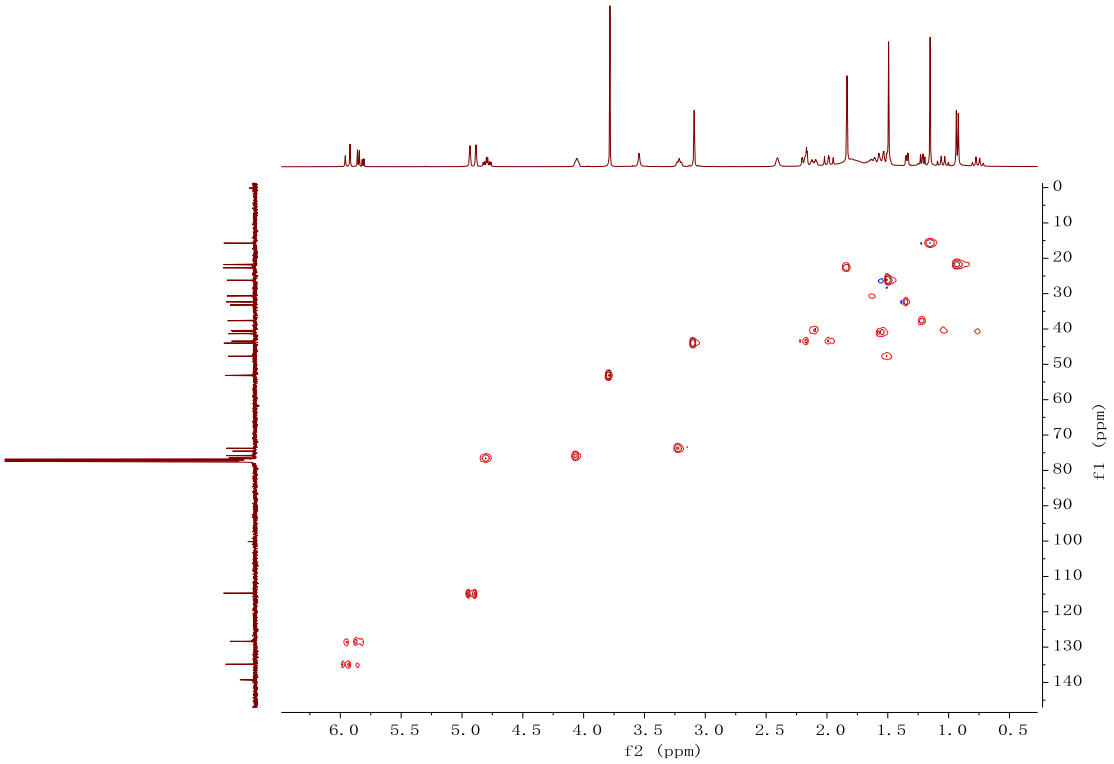

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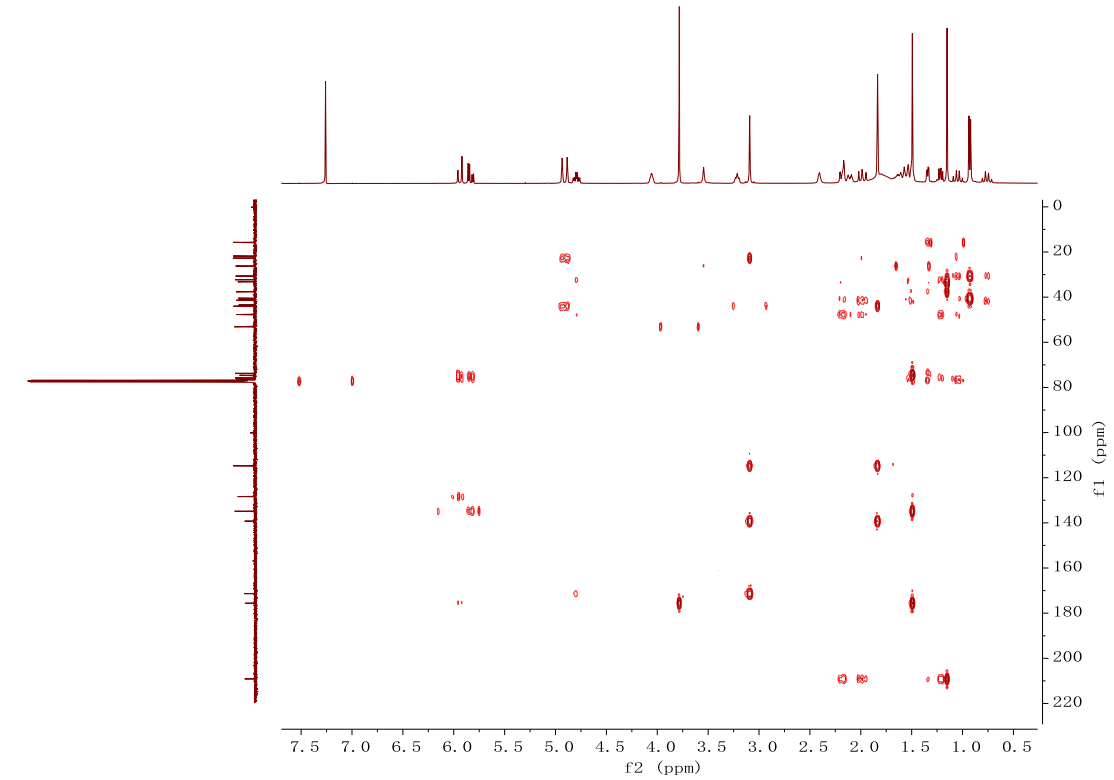
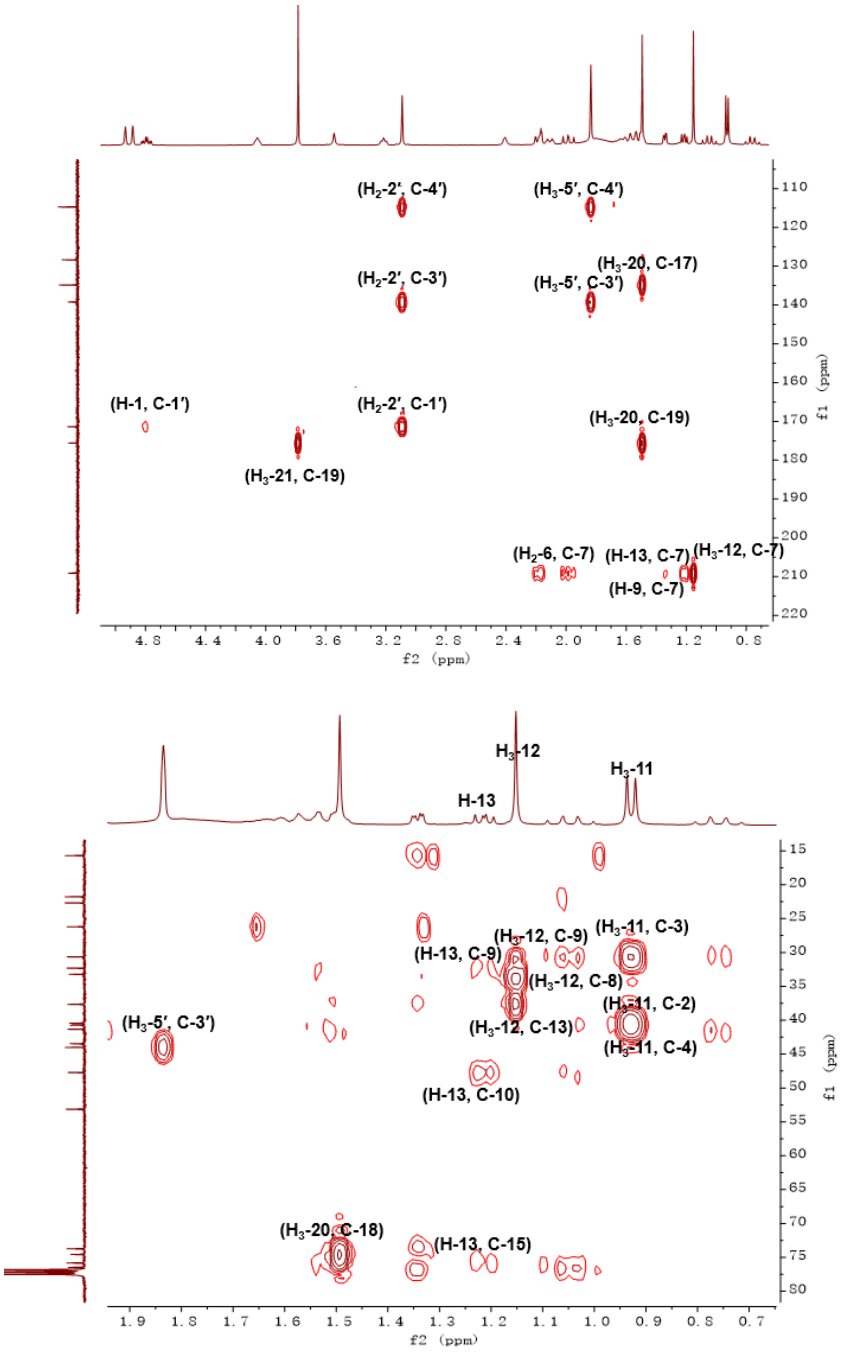


Figure S6. HMBC spectrum of compound **1** in $CDCl_3$.



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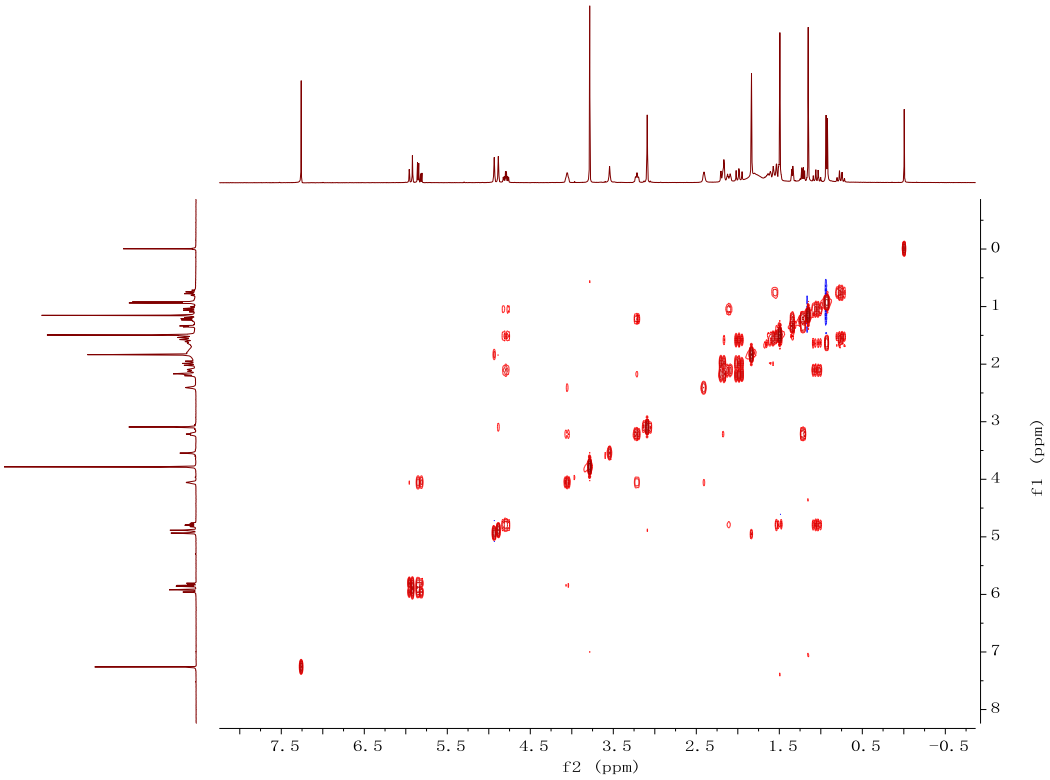
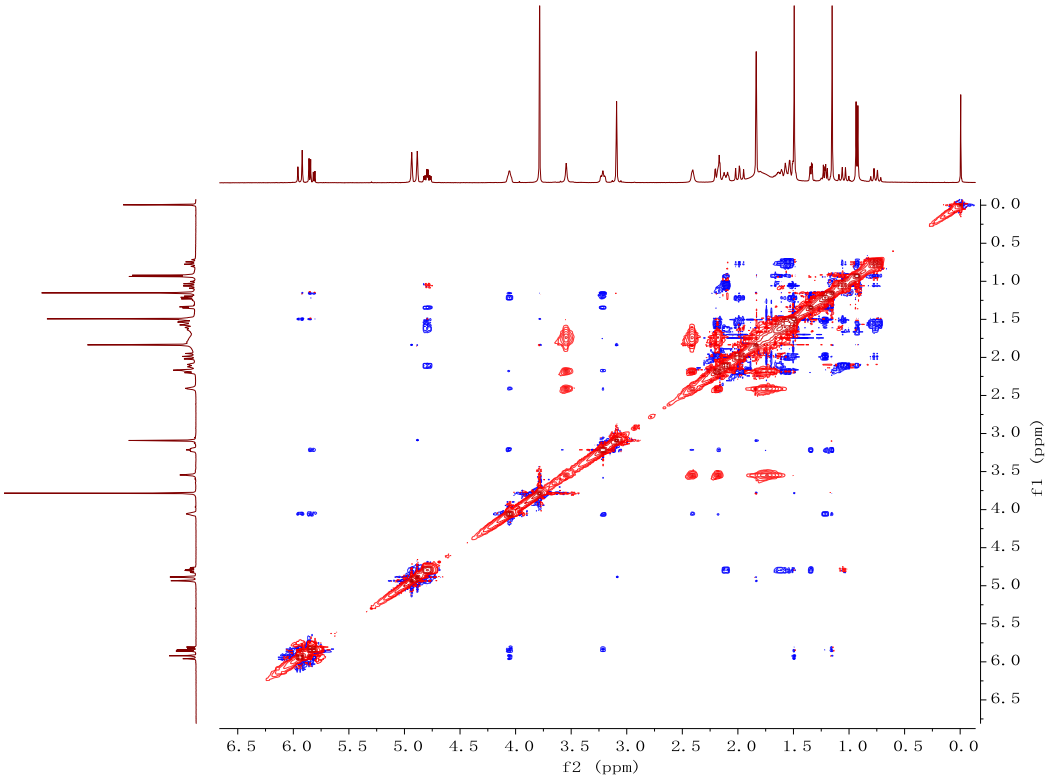


Figure S8. $^{1}H-^{1}H$ COSY spectrum of compound **1** in $CDCl_3$.



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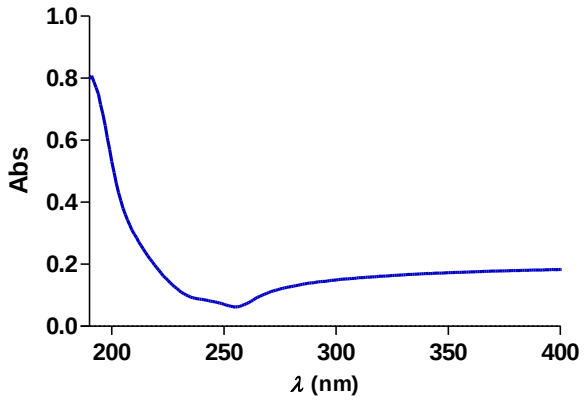
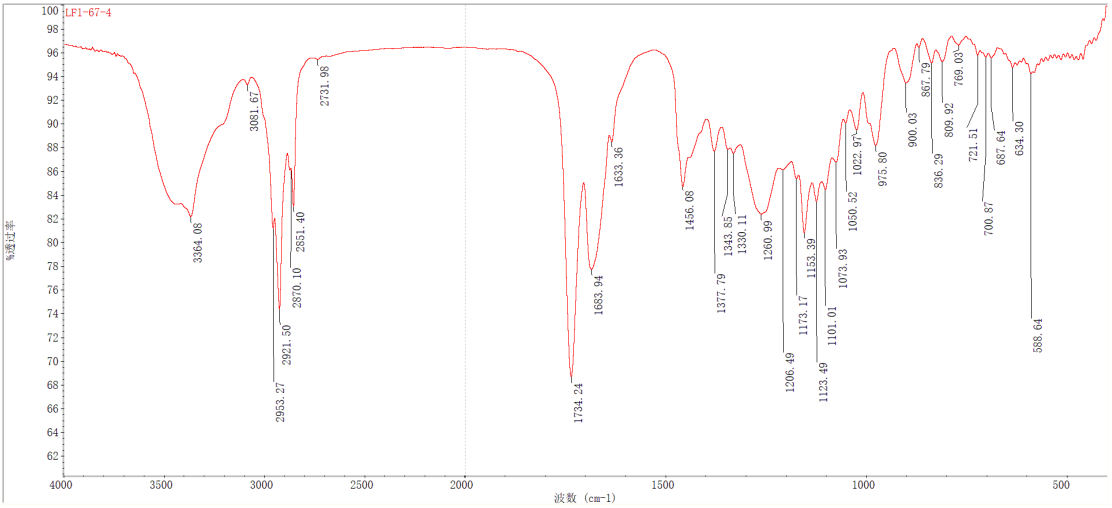


Figure S10. UV spectrum of compound **1**.



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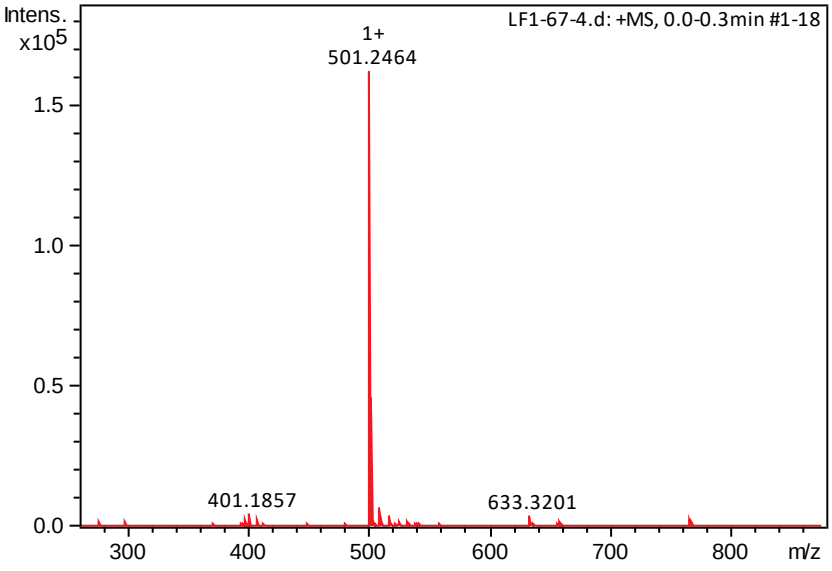


Figure S12. HRESIMS spectrum of compound **1**.

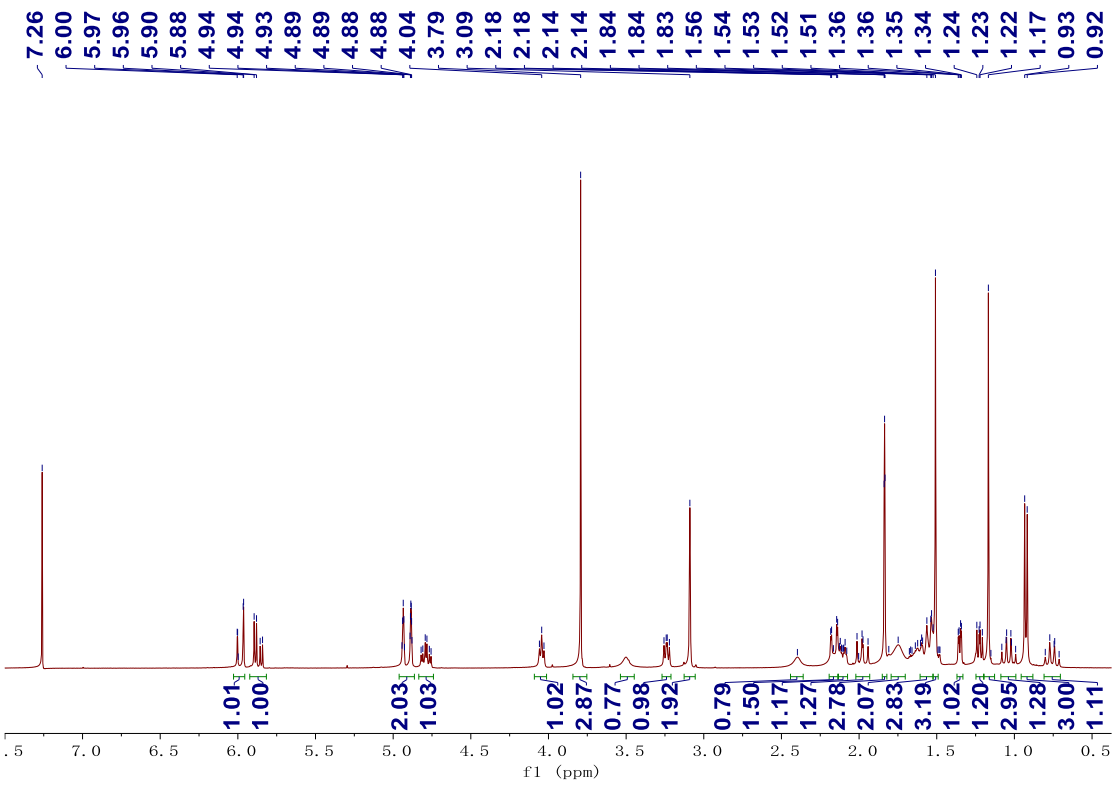
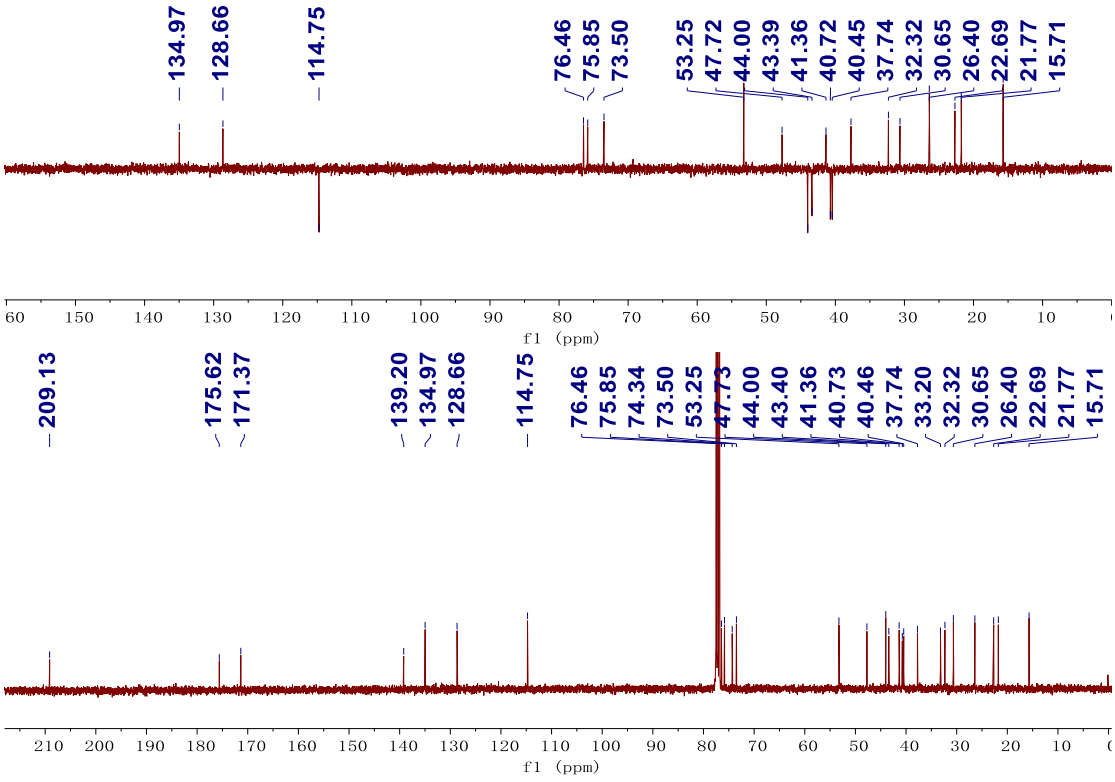


Figure S13. ^{1}H NMR spectrum of compound **2** in $CDCl_3$.



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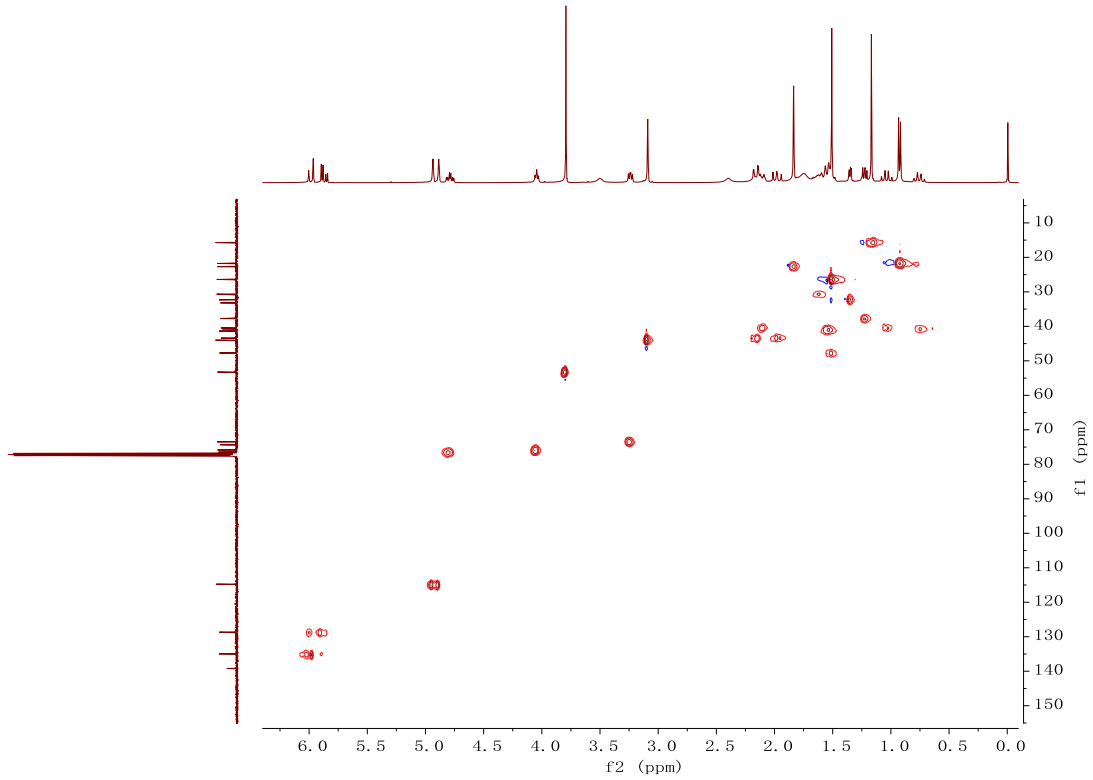


Figure S15. HSQC spectrum of compound **2** in $CDCl_3$

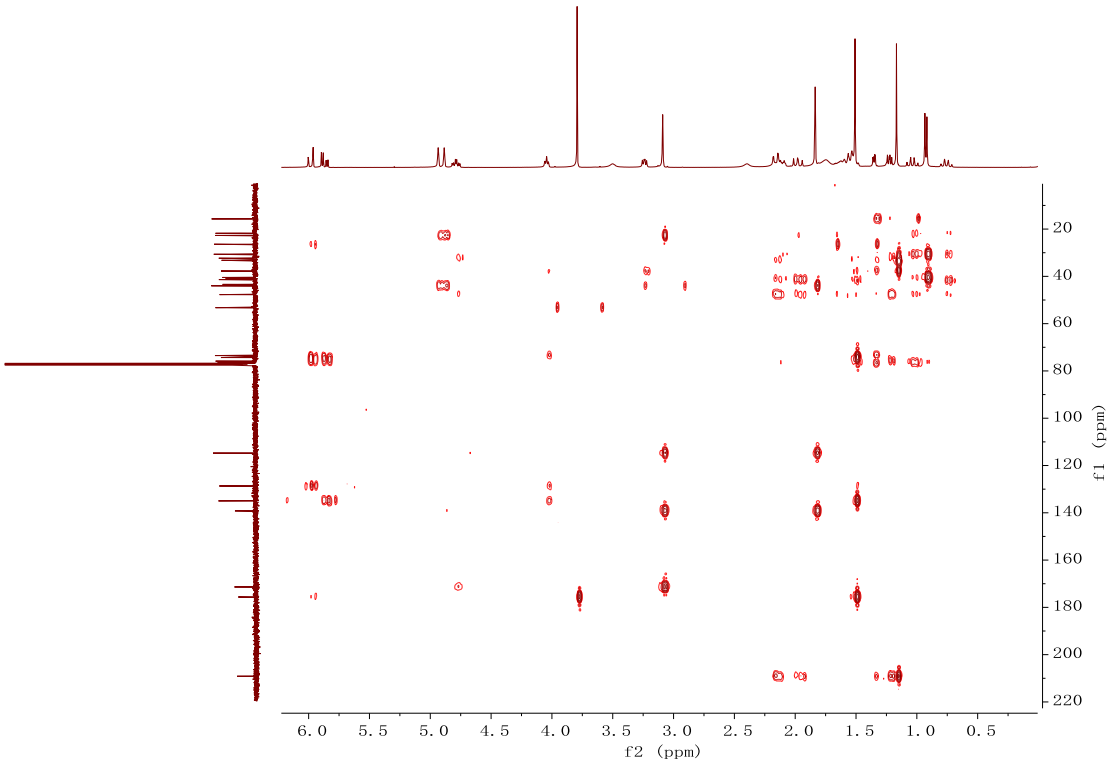


Figure S16. HMBC spectrum of compound **2** in $CDCl_3$.

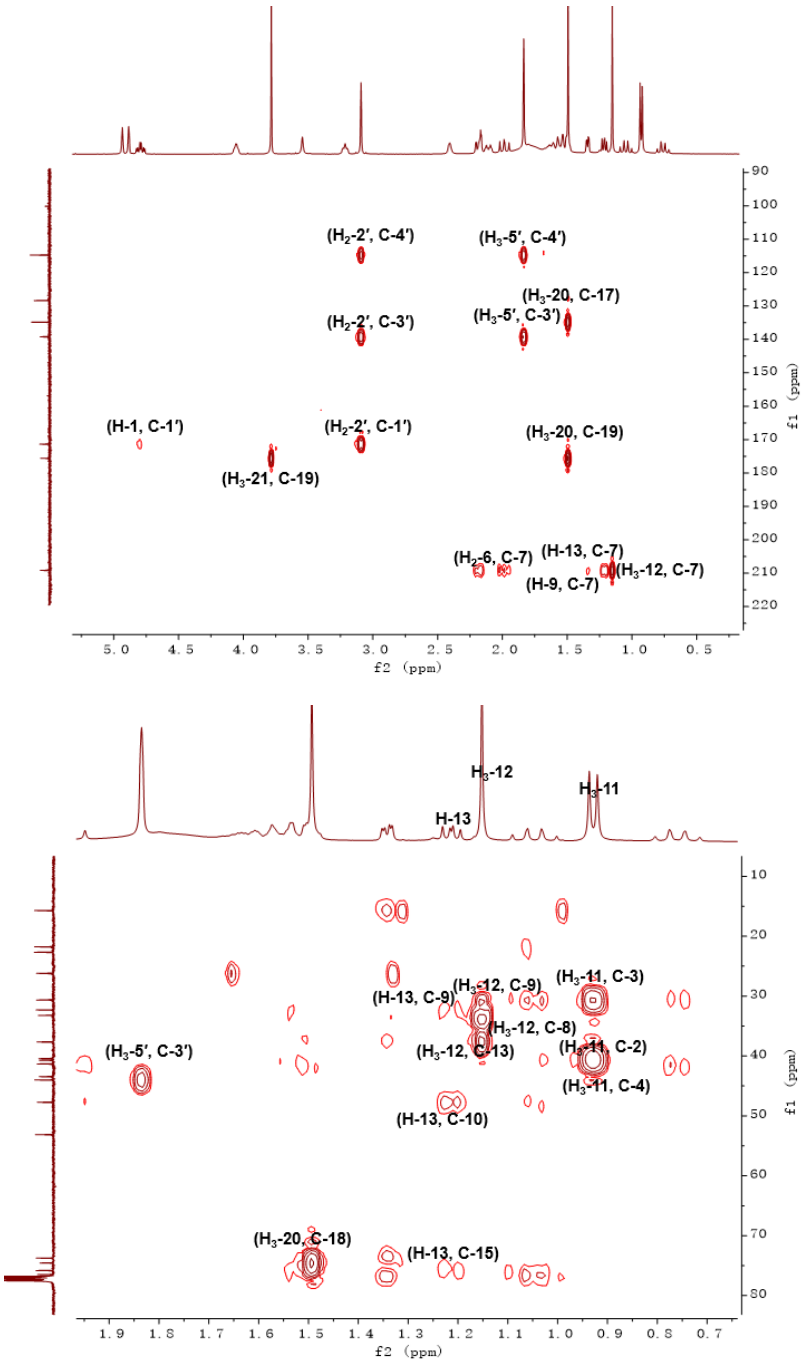


Figure S17. Amplified ^{1}H-^{13}C HMBC spectrum of compound **2** in $CDCl_3$.

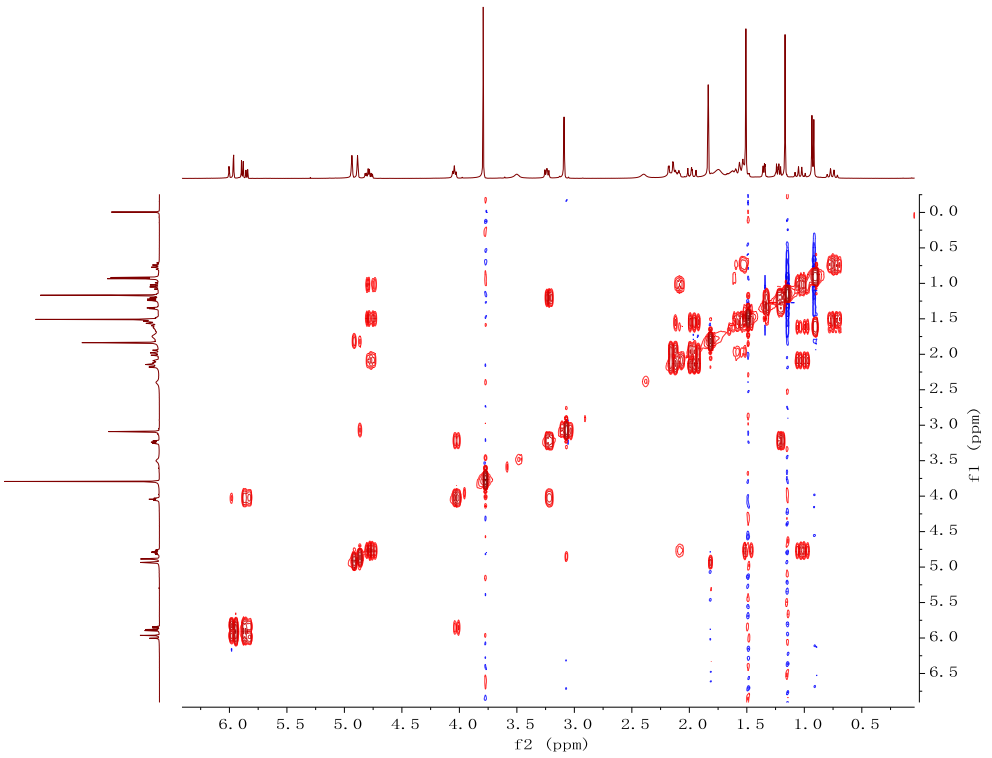


Figure S18. $^{1}H-^{1}H$ COSY spectrum of compound **2** in $CDCl_3$.

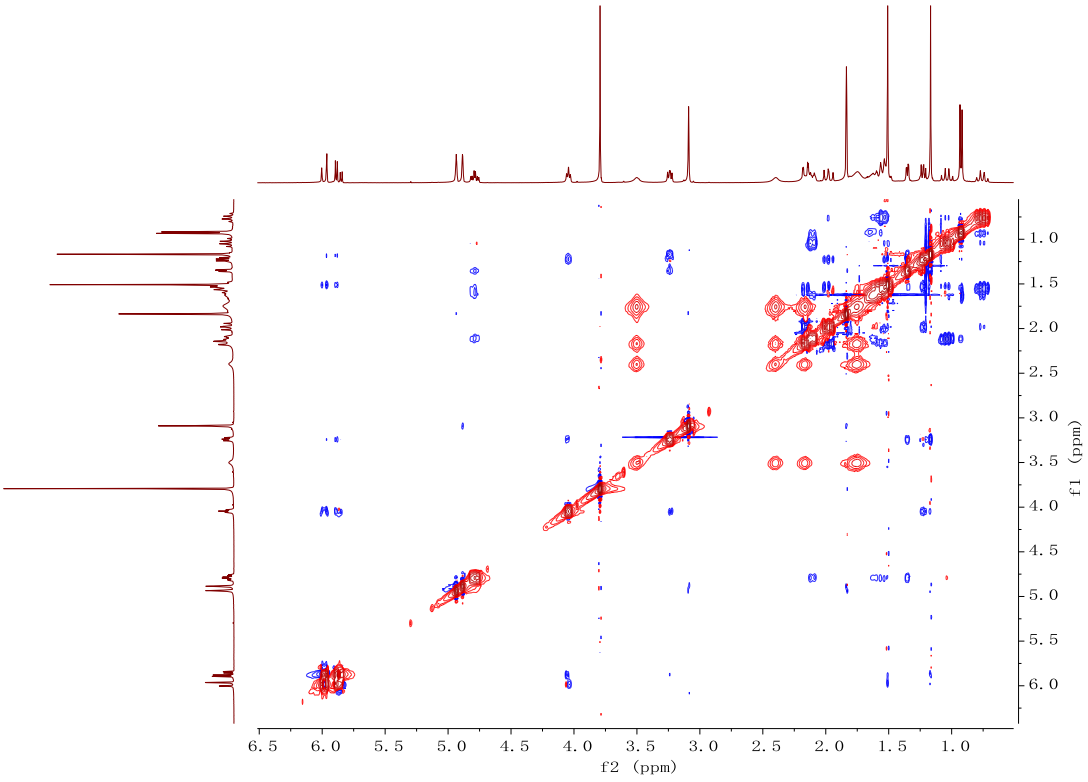


Figure S19. NOESY spectrum of compound **2** in $CDCl_3$.

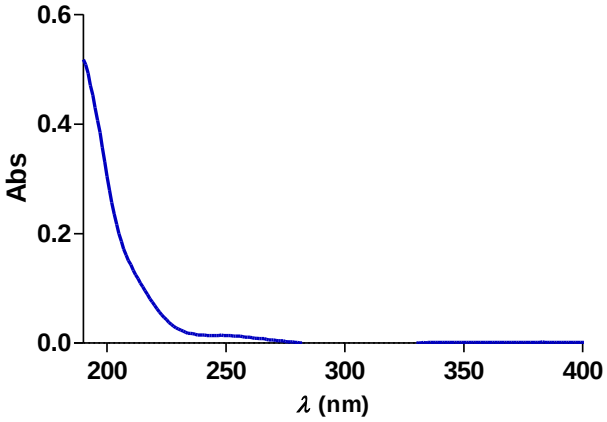


Figure S20. UV spectrum of compound **2**.

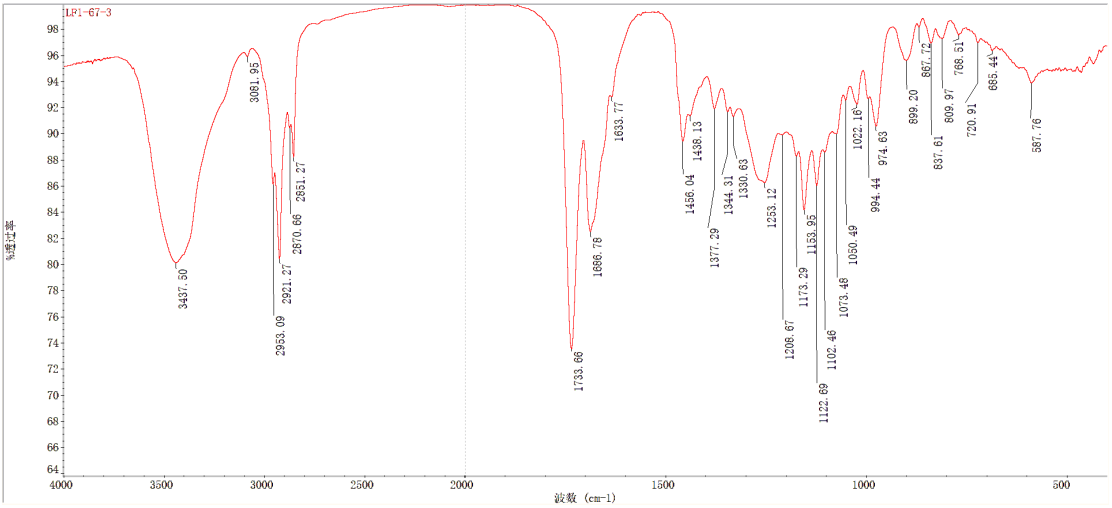


Figure S21. IR spectrum of compound **2**.

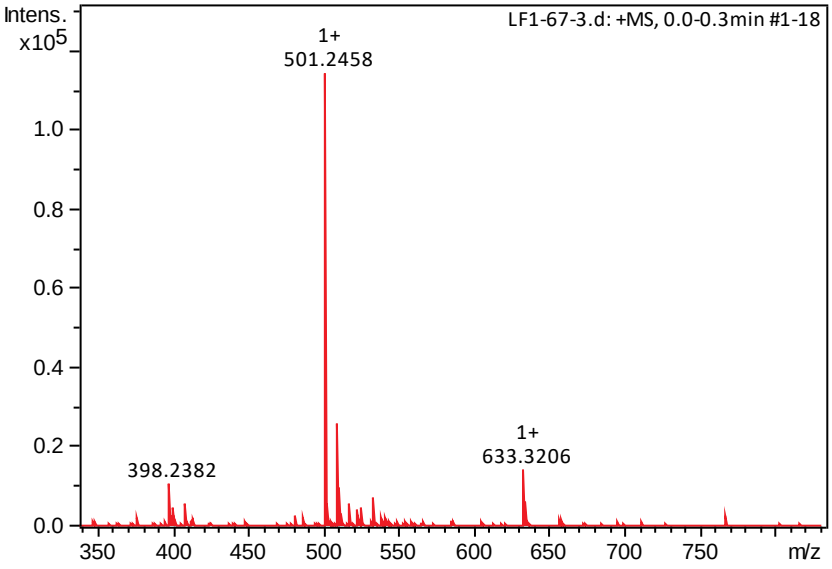


Figure S22. HRESIMS spectrum of compound **2**.

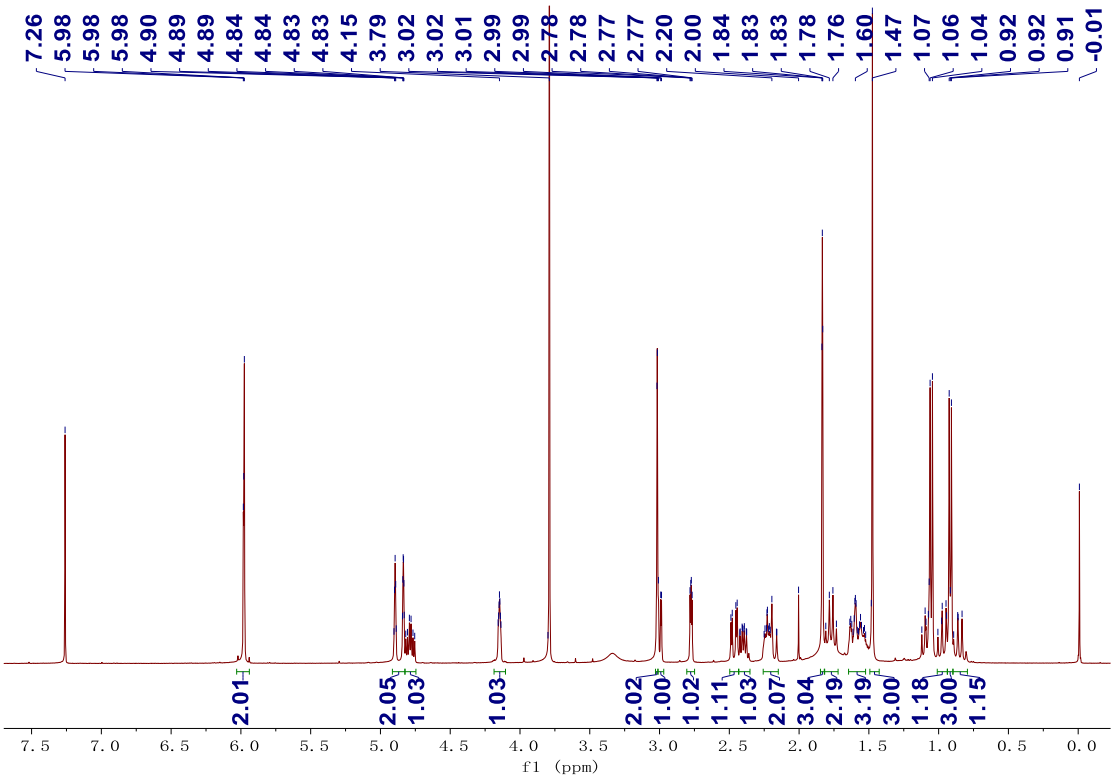


Figure S23. ^{1}H NMR spectrum of compound **3** in $CDCl_3$.

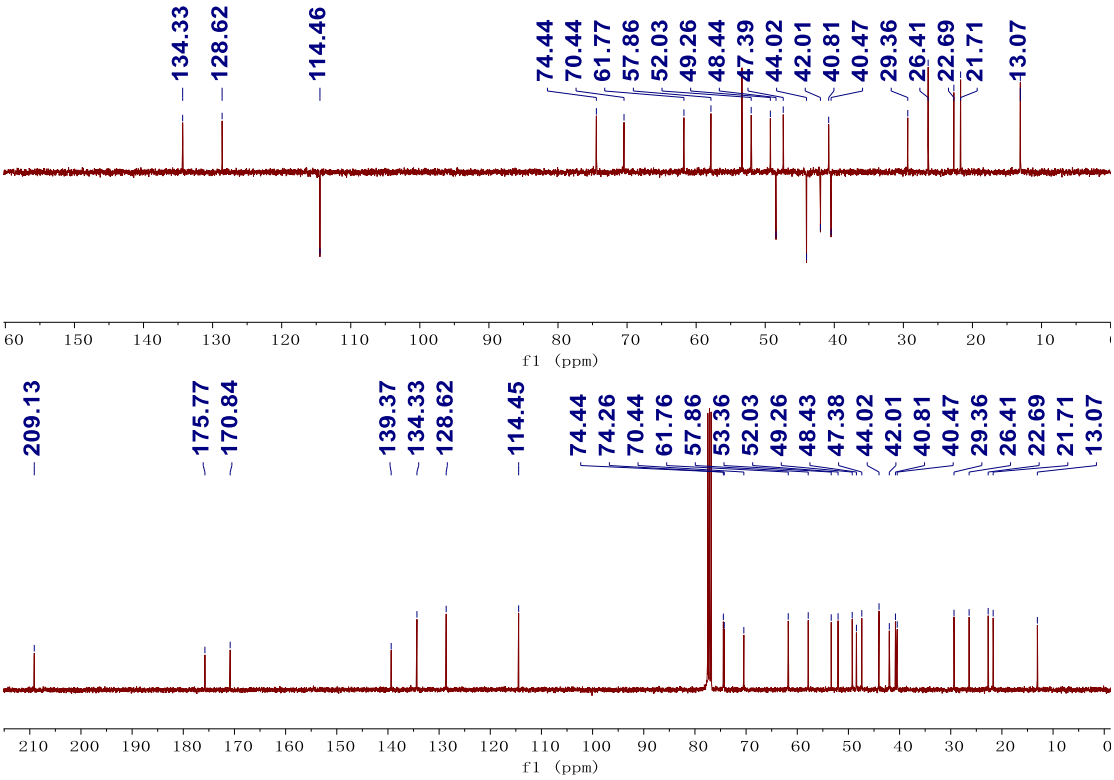


Figure S24. ^{13}C and DEPT NMR spectra of compound **3** in $CDCl_3$.

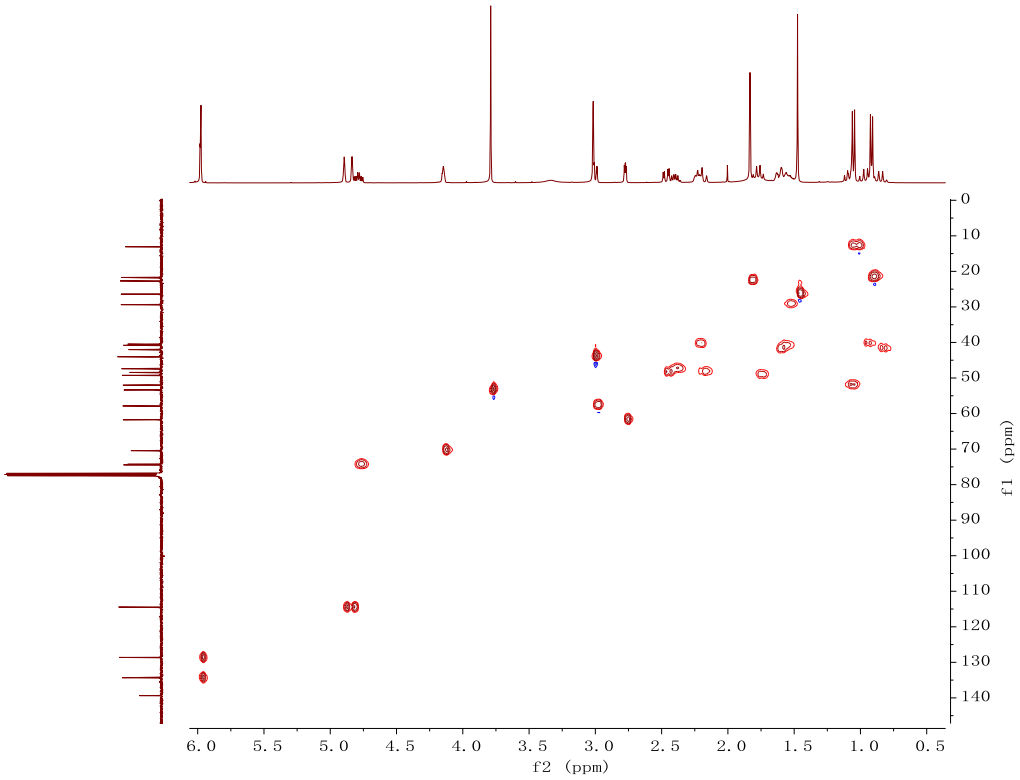


Figure S25. HSQC spectrum of compound **3** in $CDCl_3$.

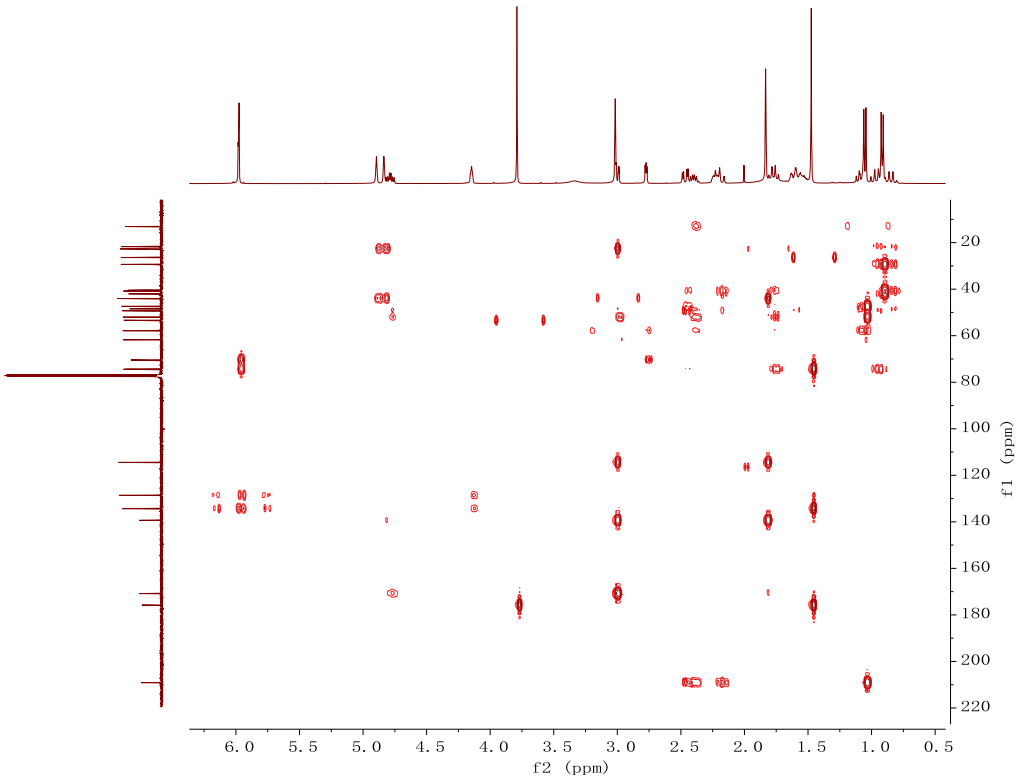


Figure S26. HMBC spectrum of compound **3** in $CDCl_3$.

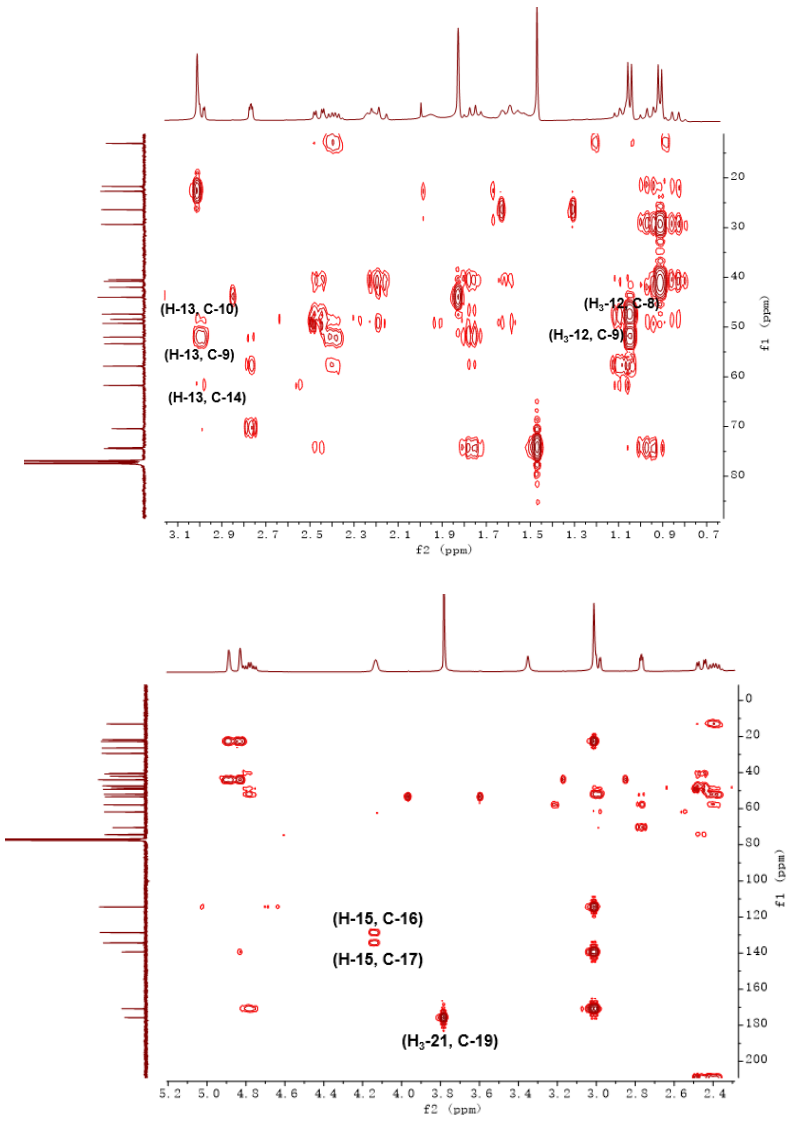


Figure S27. Amplified ^{1}H-^{13}C HMBC spectrum of compound **3** in $CDCl_3$.

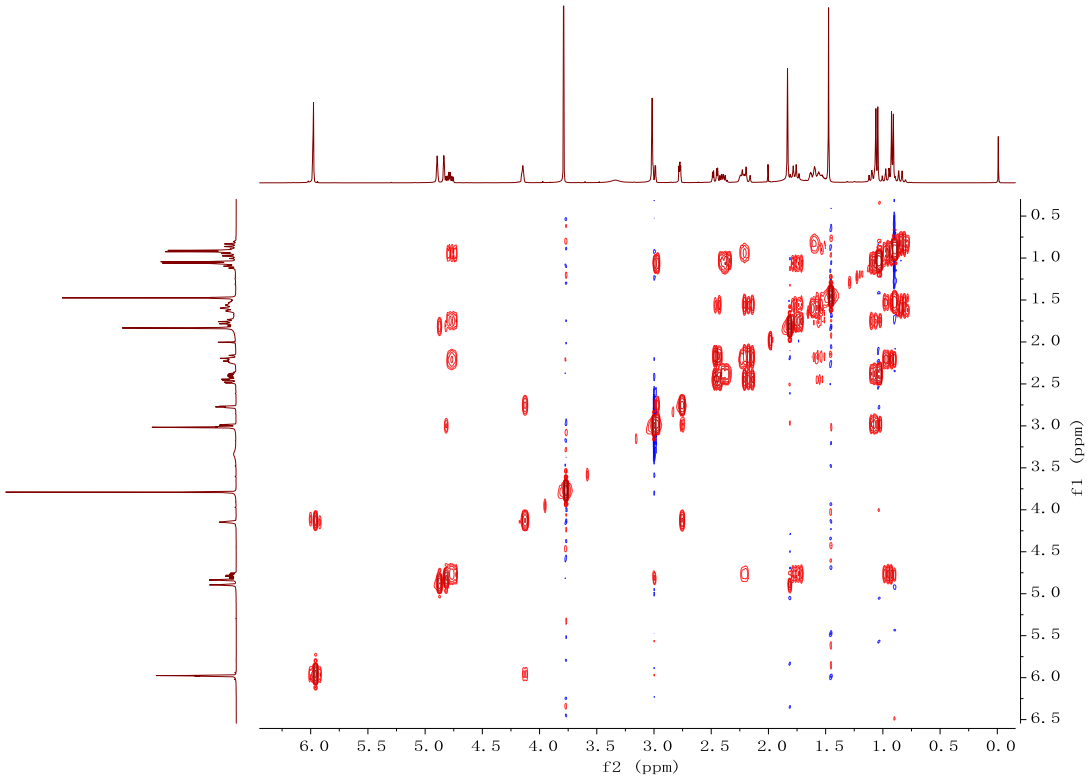


Figure S28. $^{1}H–^{1}H$ COSY spectrum of compound **3** in $CDCl_3$.

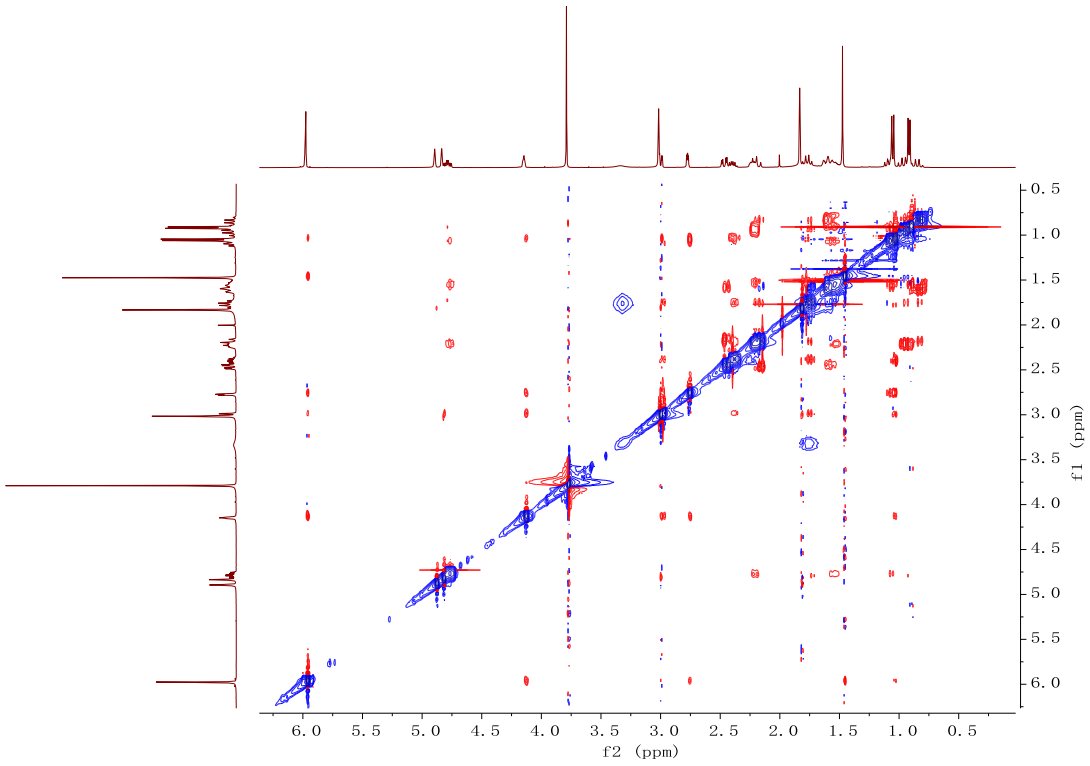


Figure S29. NOESY spectrum of compound **3** in $CDCl_3$.

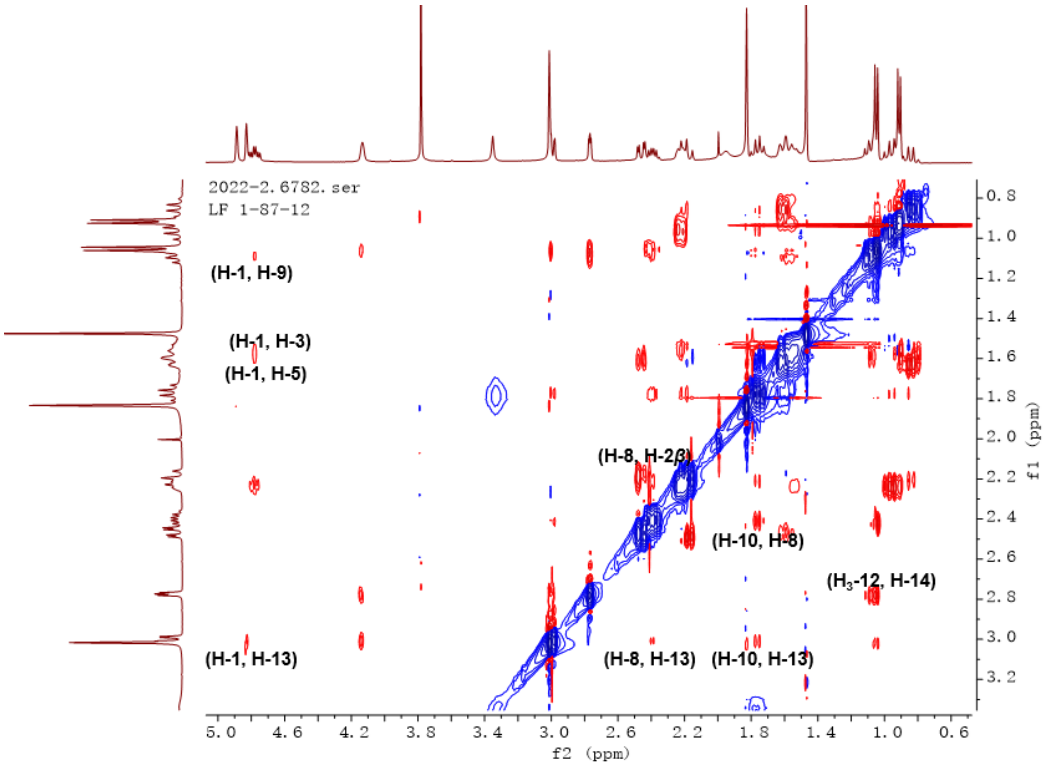


Figure S30. Amplified NOESY spectrum of compound **3** in $CDCl_3$.

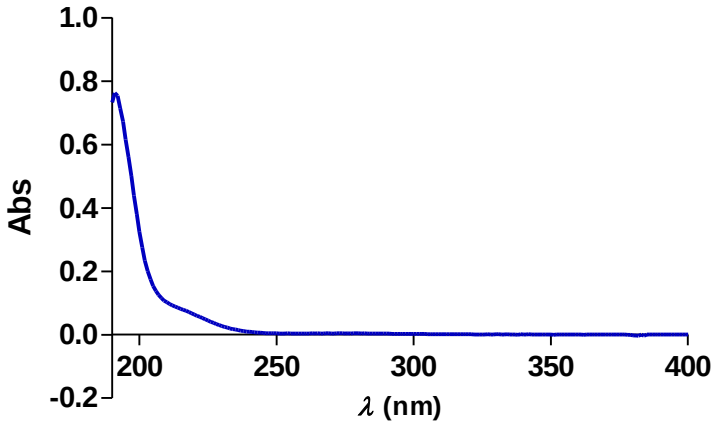


Figure S31. UV spectrum of compound **3**.

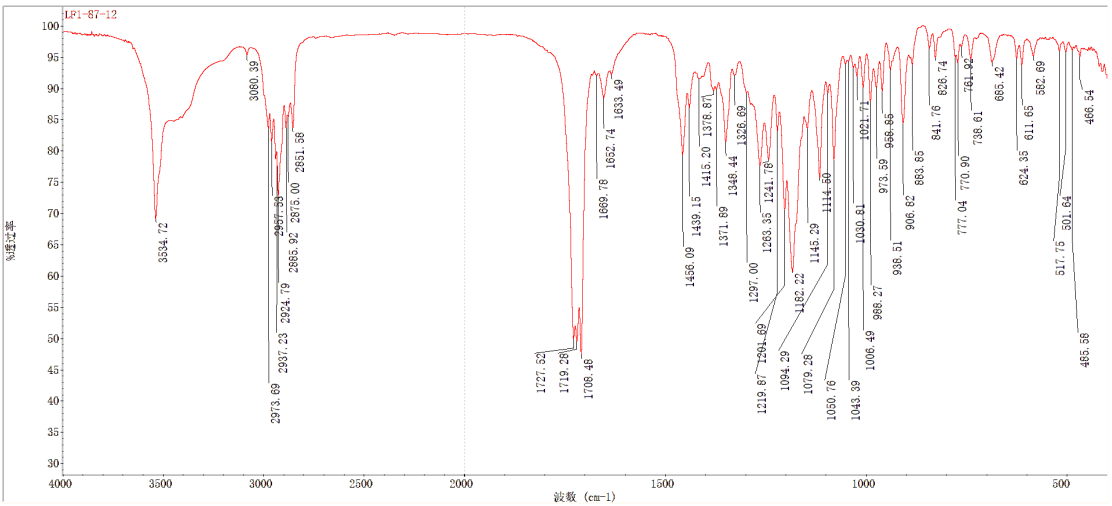


Figure S32. IR spectrum of compound **3**.

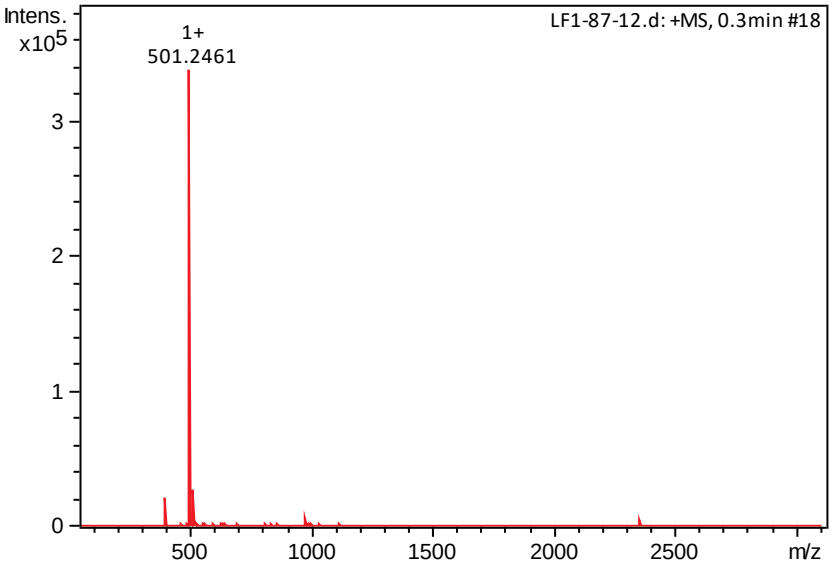


Figure S33. HRESIMS spectrum of compound **3**.

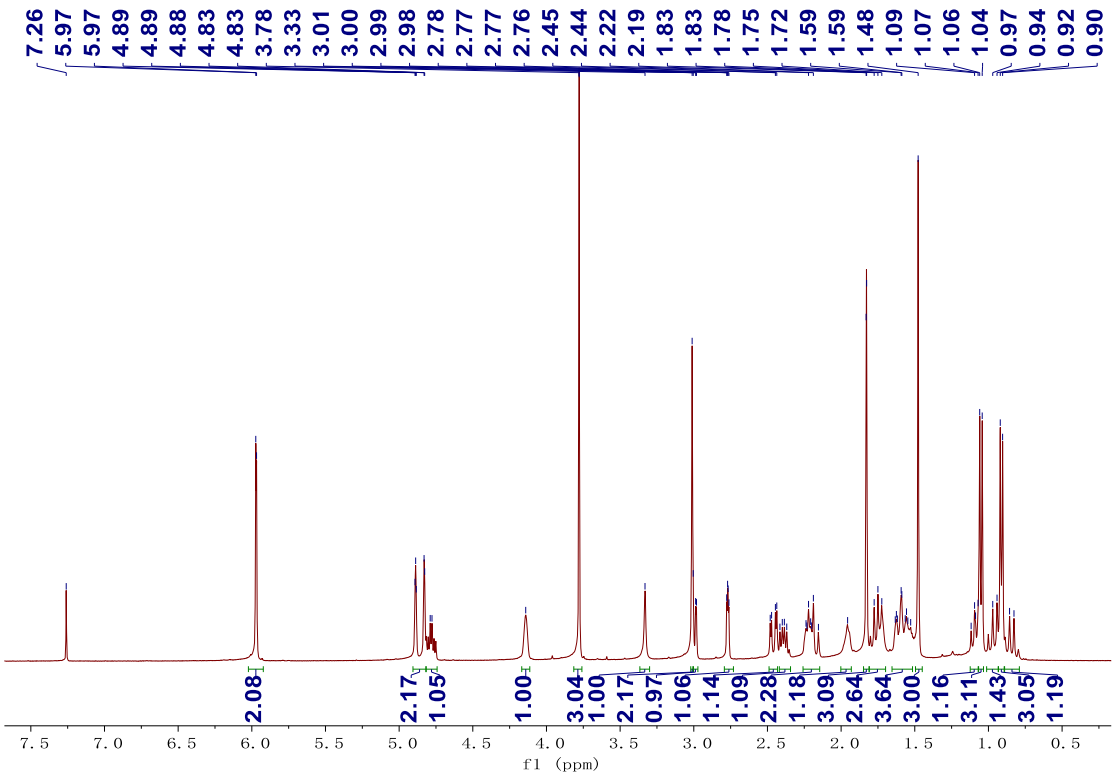


Figure S34. ^{1}H NMR spectrum of compound **4** in $CDCl_3$.

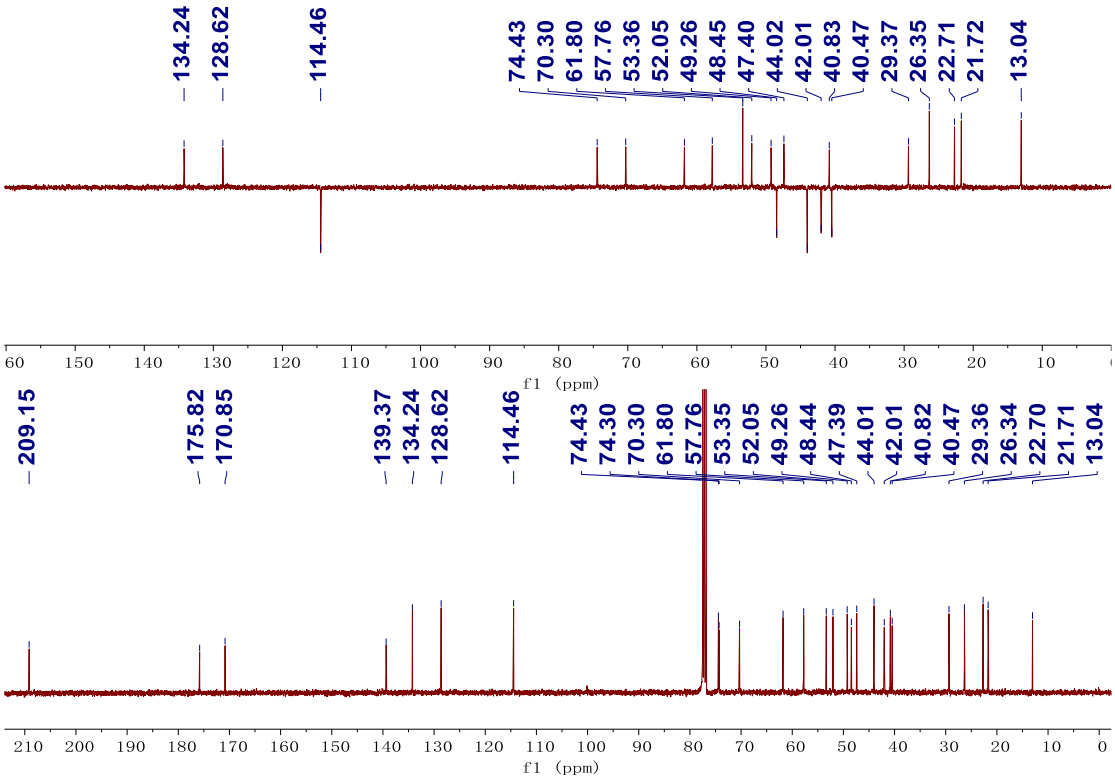


Figure S35. ^{13}C and DEPT NMR spectra of compound **4** in $CDCl_3$.

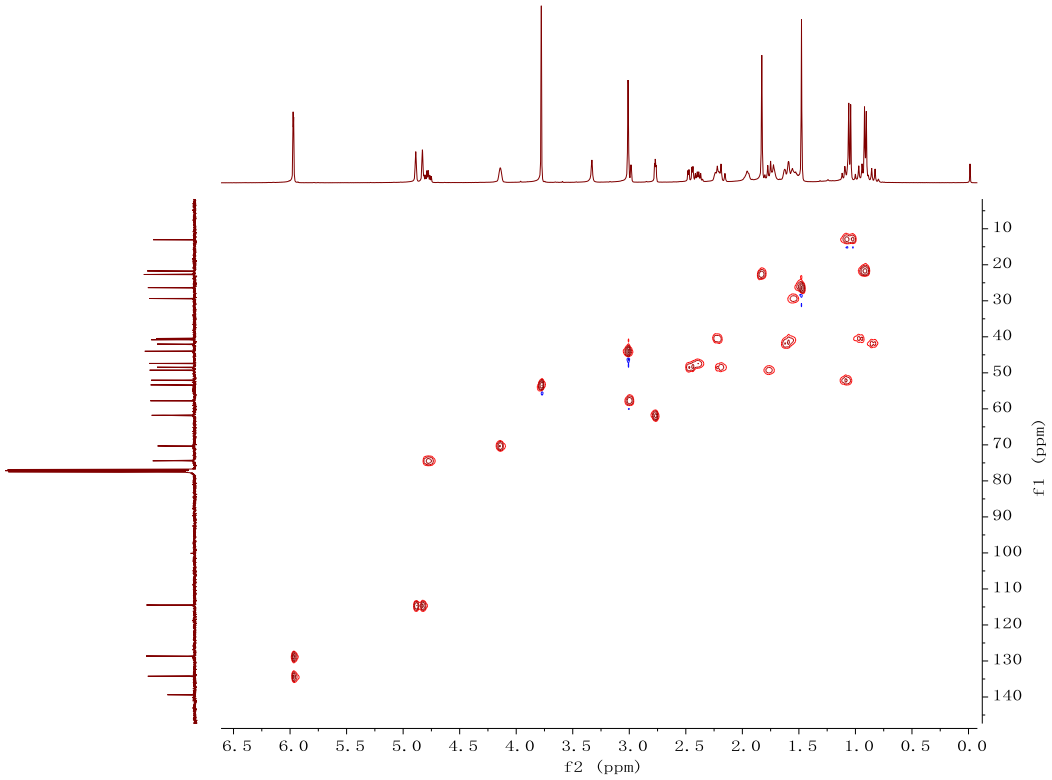


Figure S36. HSQC spectrum of compound **4** in $CDCl_3$.

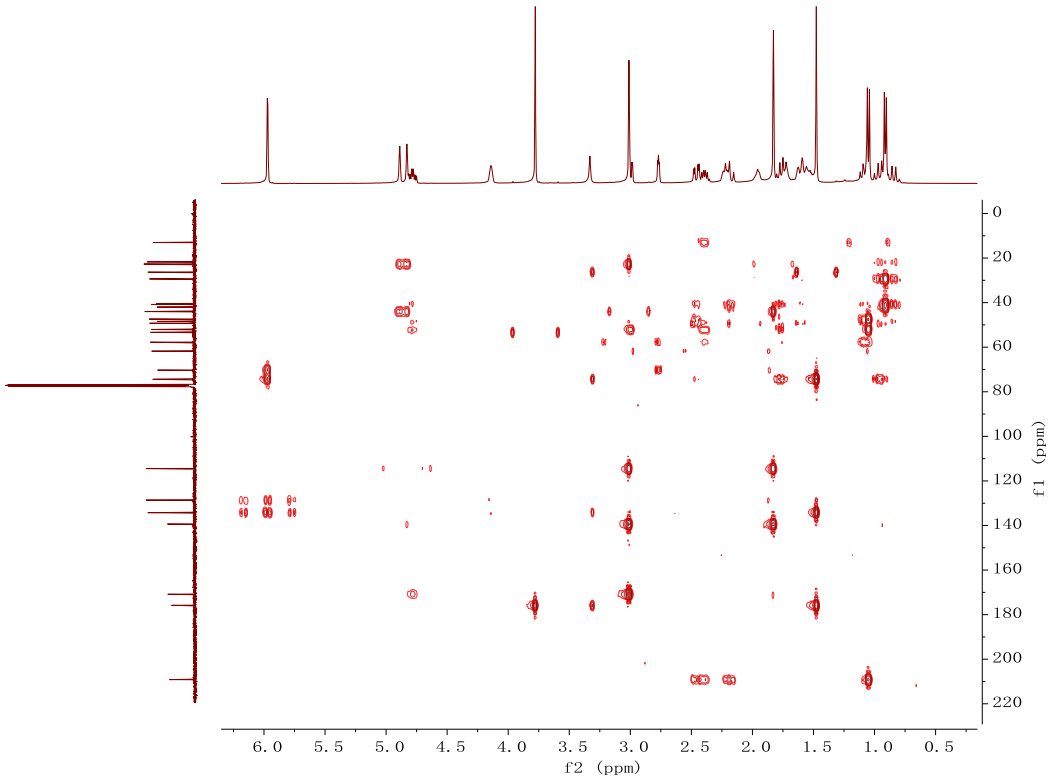


Figure S37. HMBC spectrum of compound **4** in $CDCl_3$.

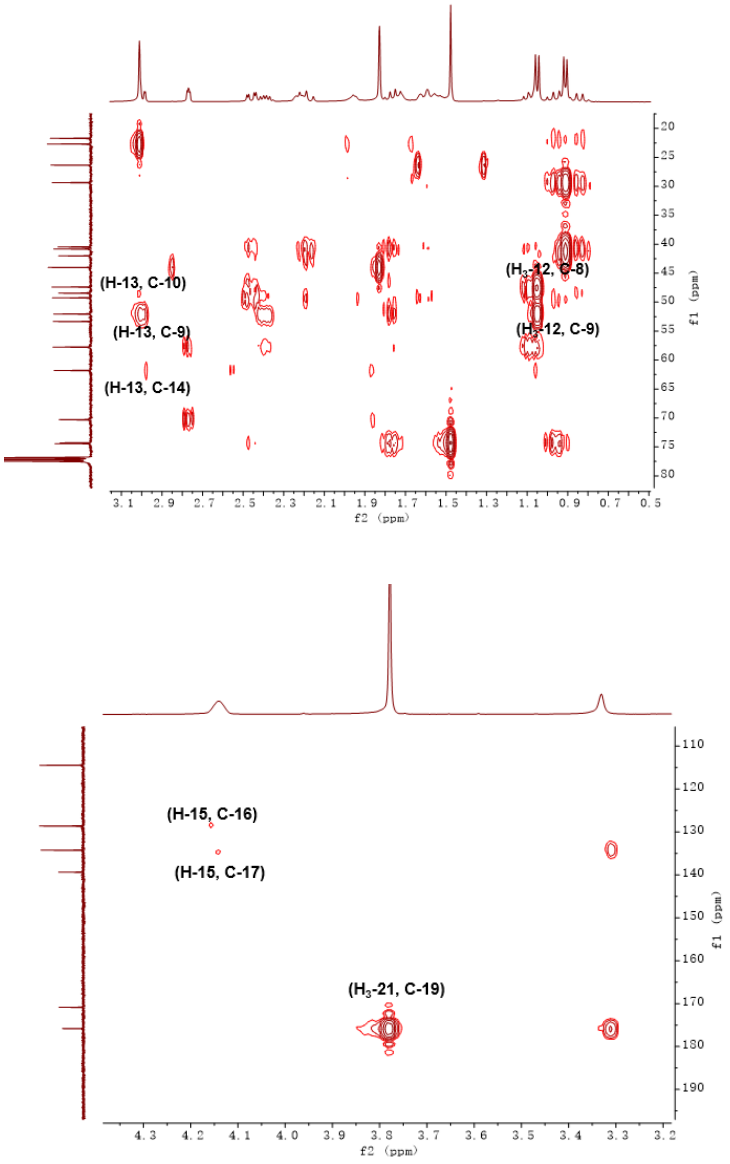


Figure S38. Amplified ^{1}H-^{13}C HMBC spectrum of compound **4** in $CDCl_3$.

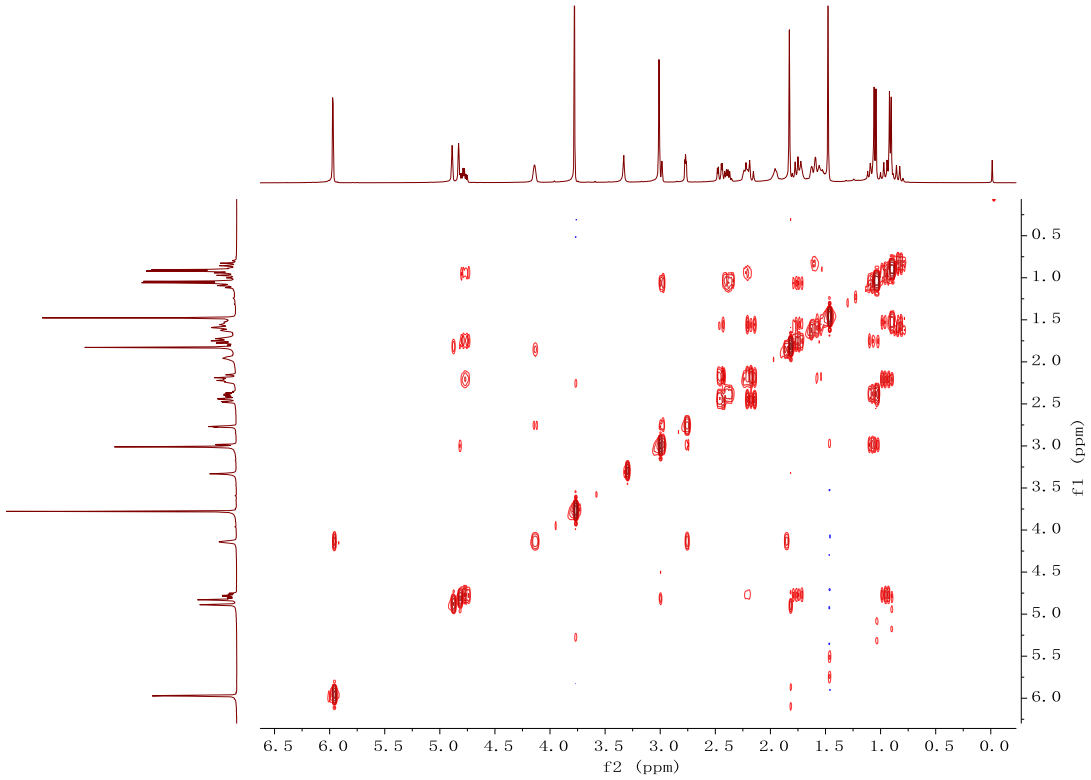


Figure S39. $^{1}H-^{1}H$ COSY spectrum of compound **4** in $CDCl_3$.

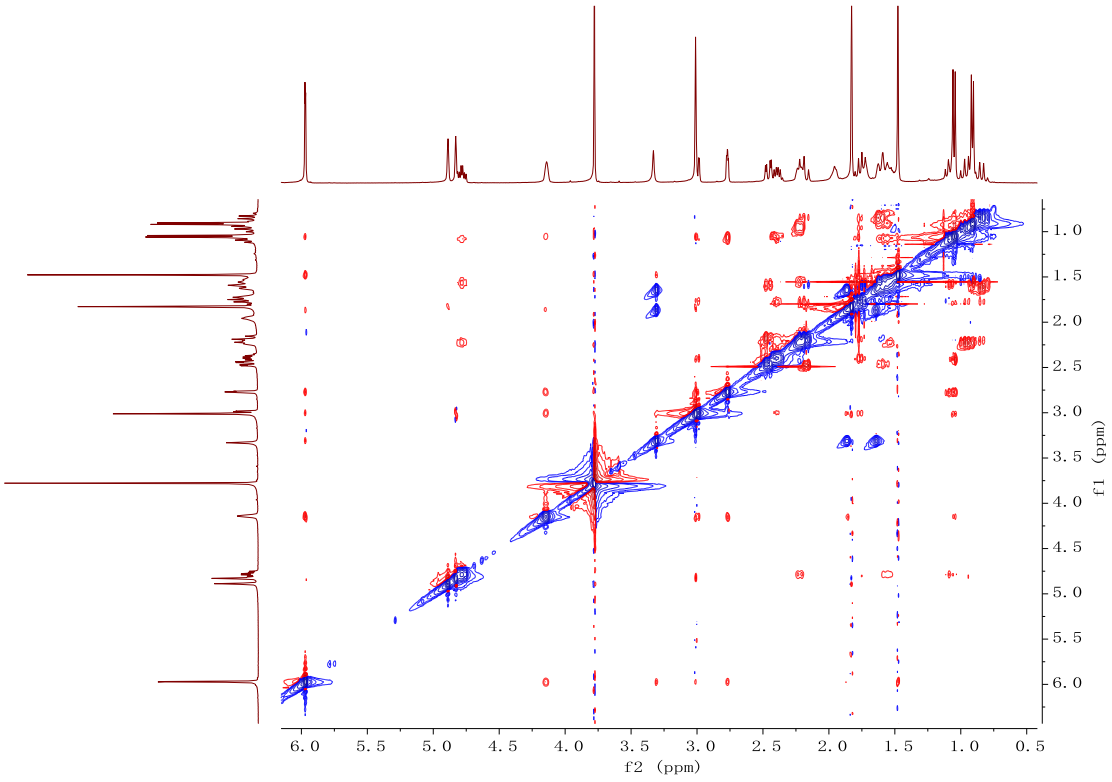


Figure S40. NOESY spectrum of compound **4** in $CDCl_3$.

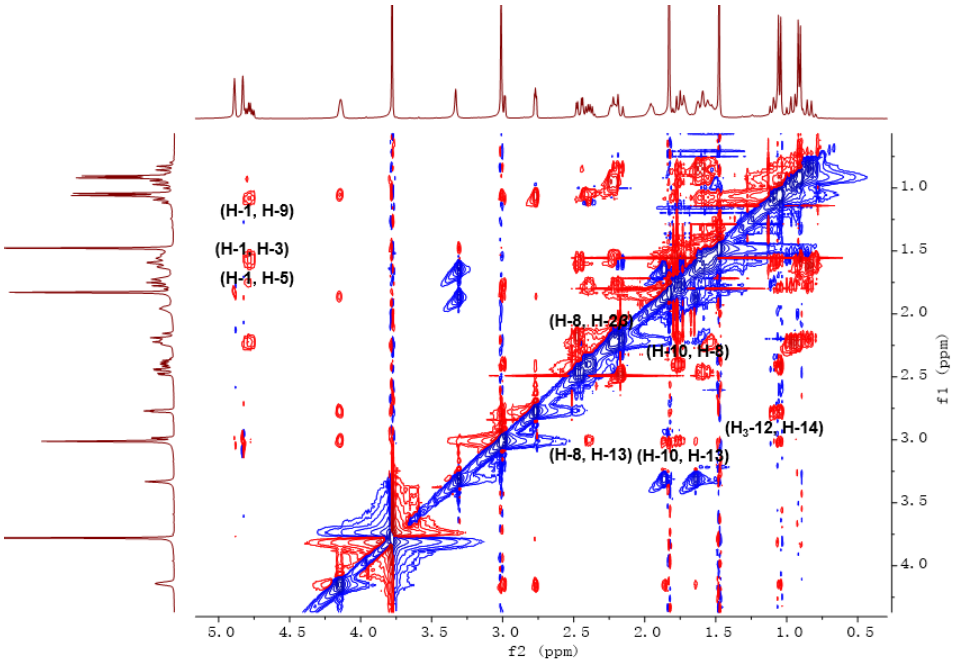


Figure S41. Amplified NOESY spectrum of compound **4** in $CDCl_3$.

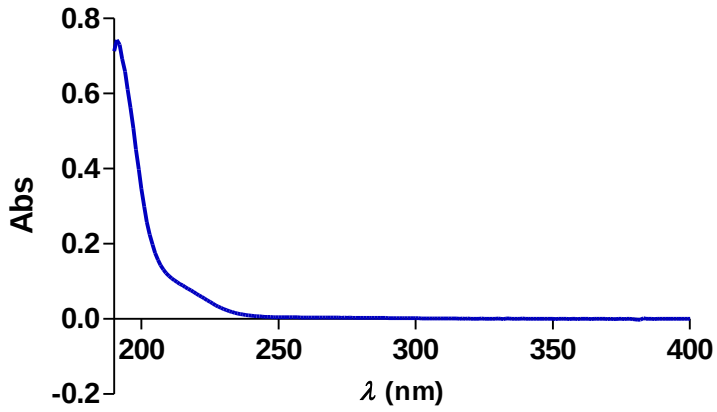


Figure S42. UV spectrum of compound **4**.

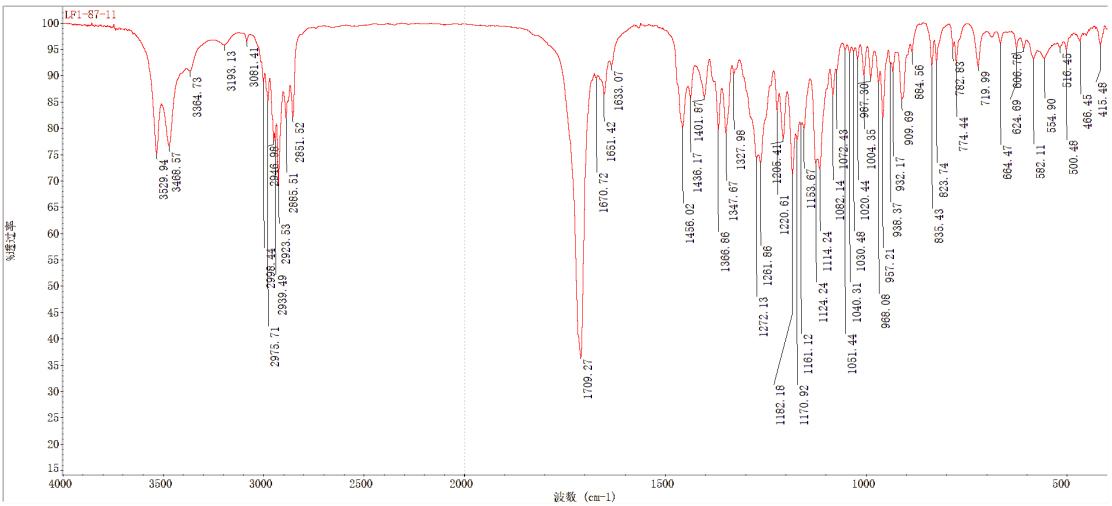


Figure S43. IR spectrum of compound **4**.

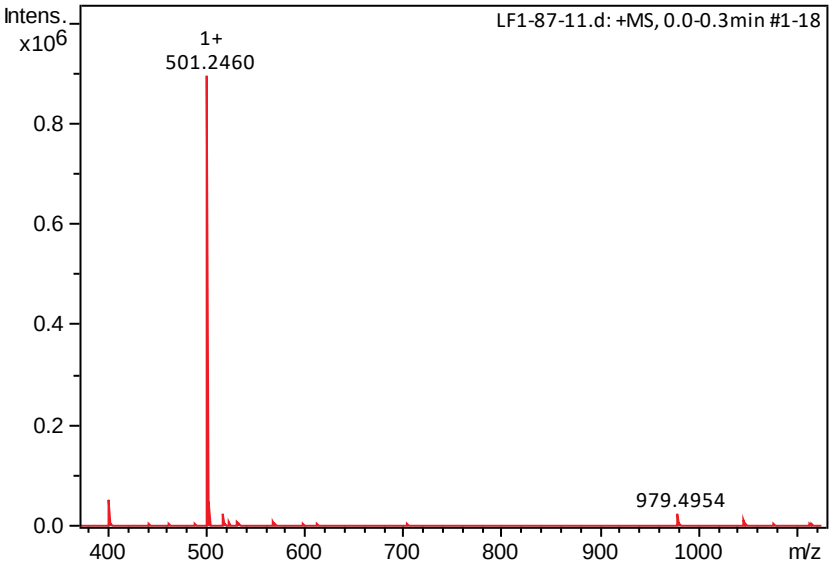


Figure S44. HRESIMS spectrum of compound **4**.

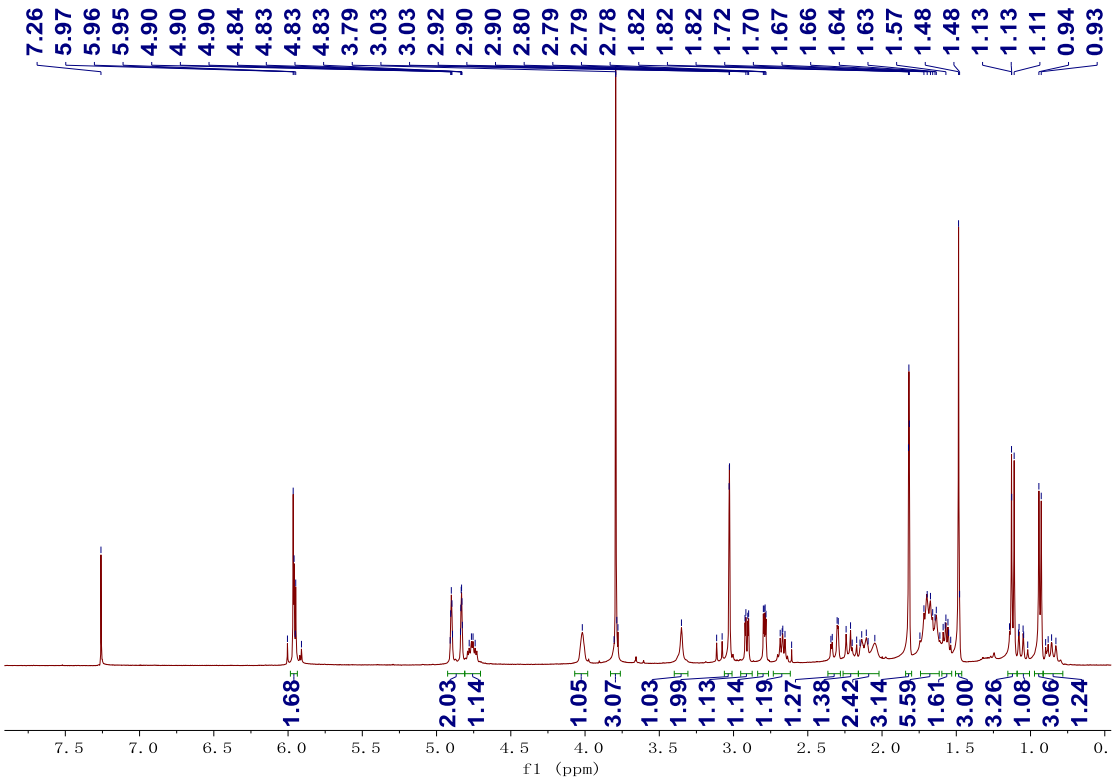


Figure S45. ^{1}H NMR spectrum of compound **5** in $CDCl_3$.

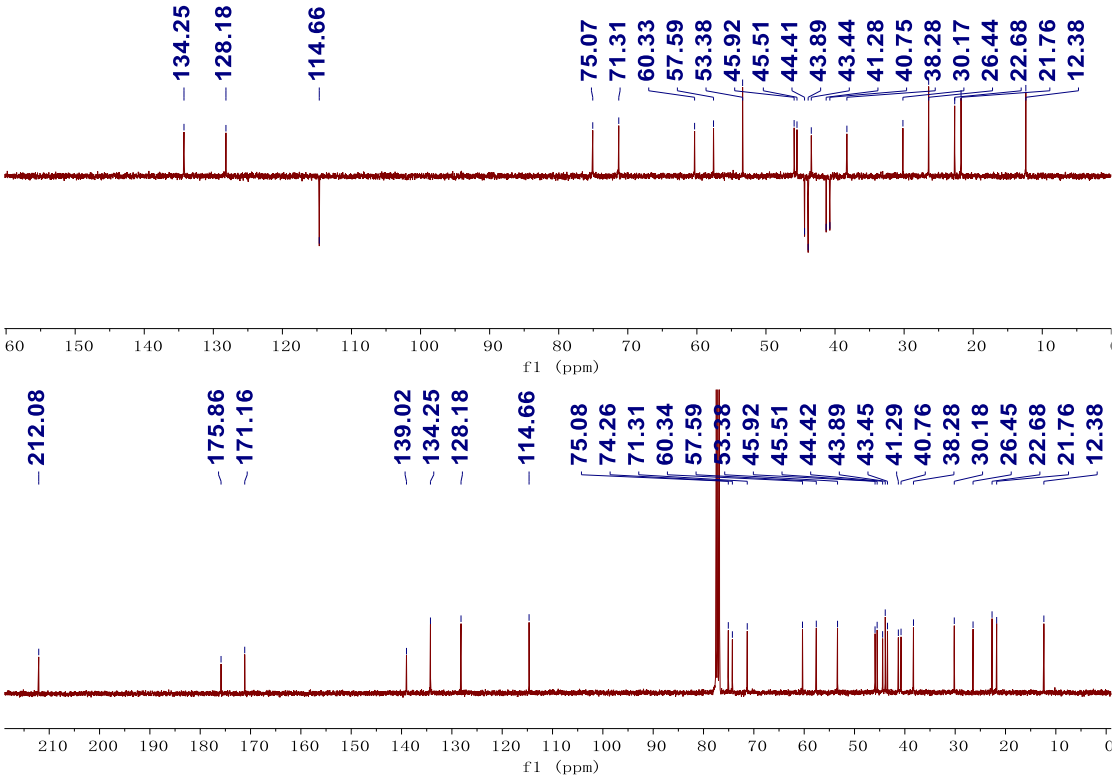


Figure S46. ^{13}C and DEPT NMR spectra of compound **5** in $CDCl_3$.

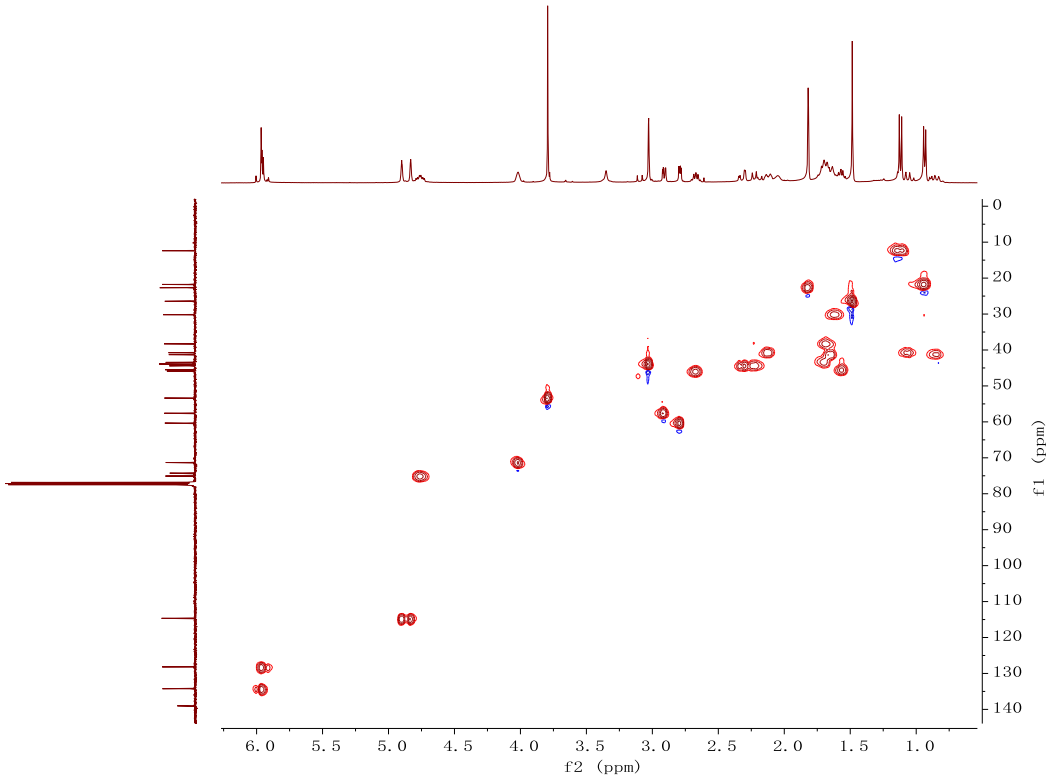


Figure S47. HSQC spectrum of compound **5** in $CDCl_3$.

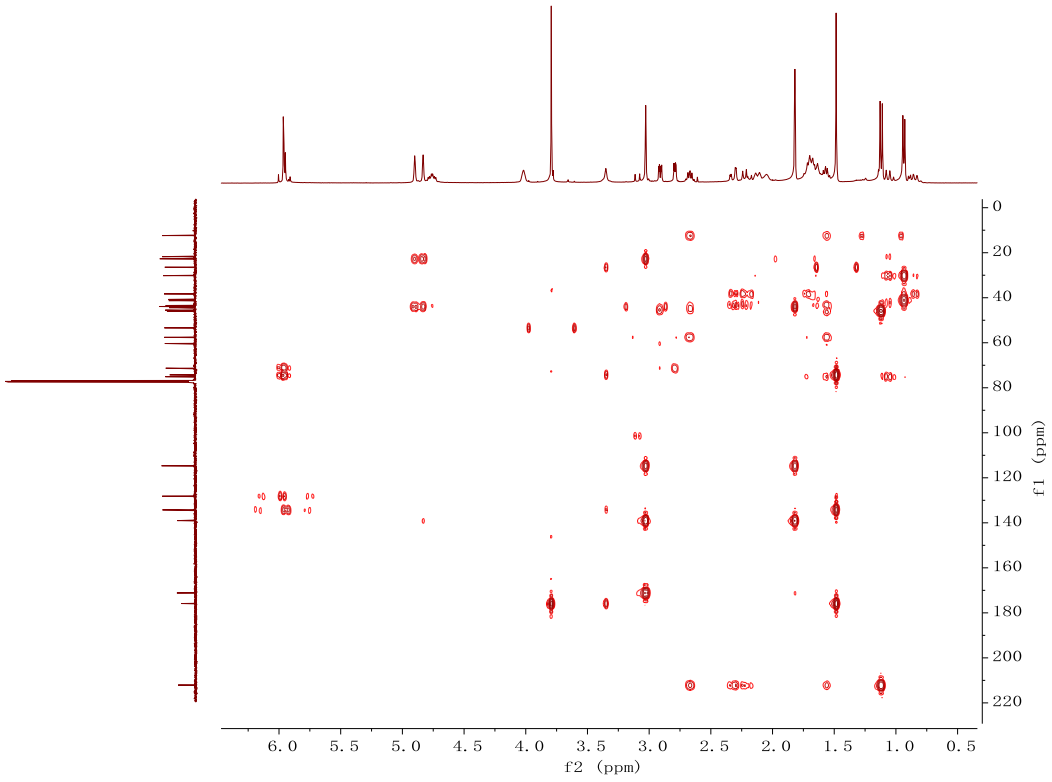


Figure S48. HMBC spectrum of compound **5** in $CDCl_3$.

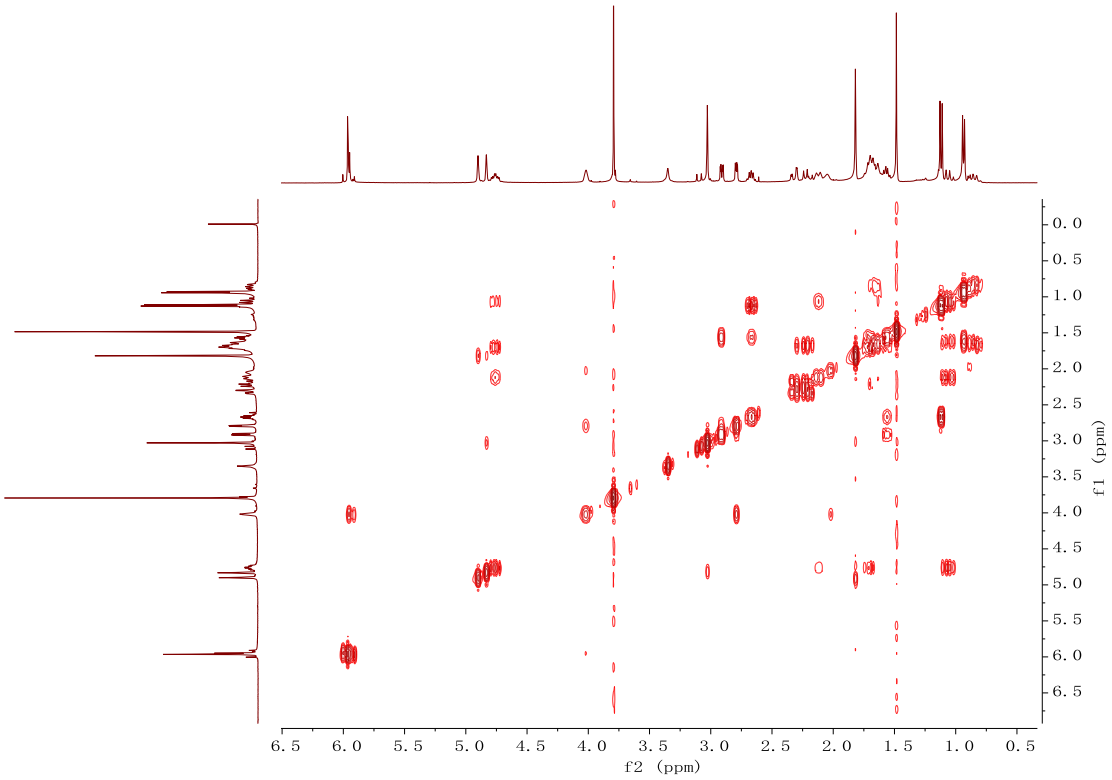


Figure S49. $^{1}H-^{1}H$ COSY spectrum of compound **5** in $CDCl_3$.

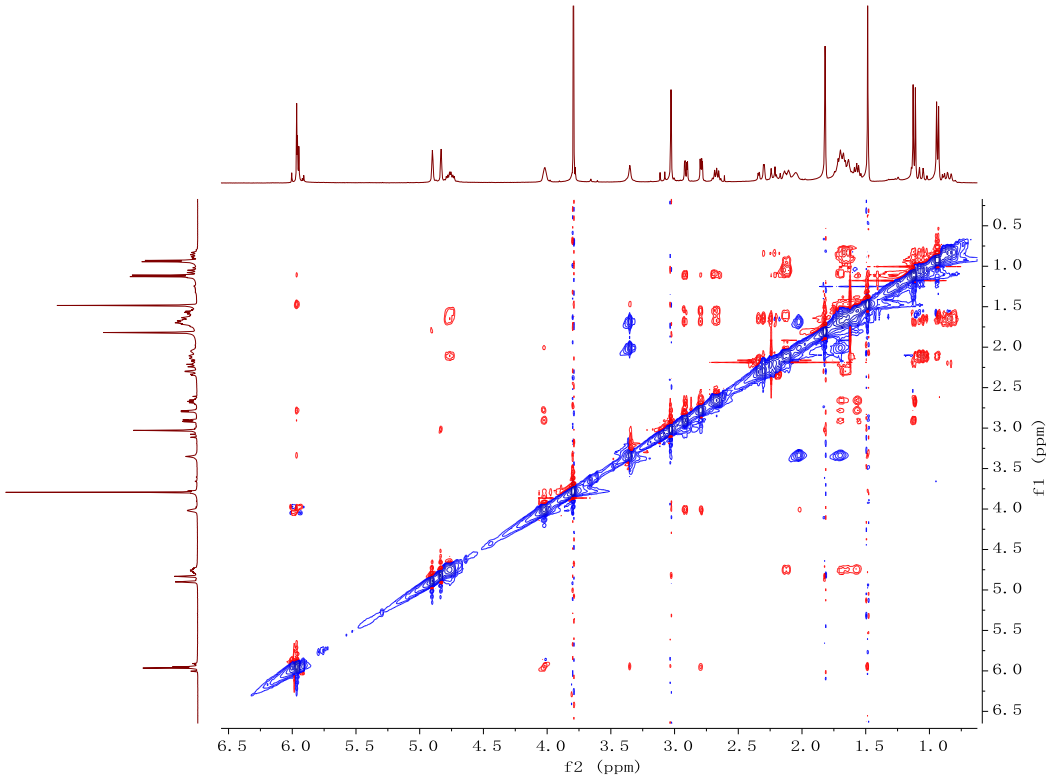


Figure S50. NOESY spectrum of compound **5** in $CDCl_3$.

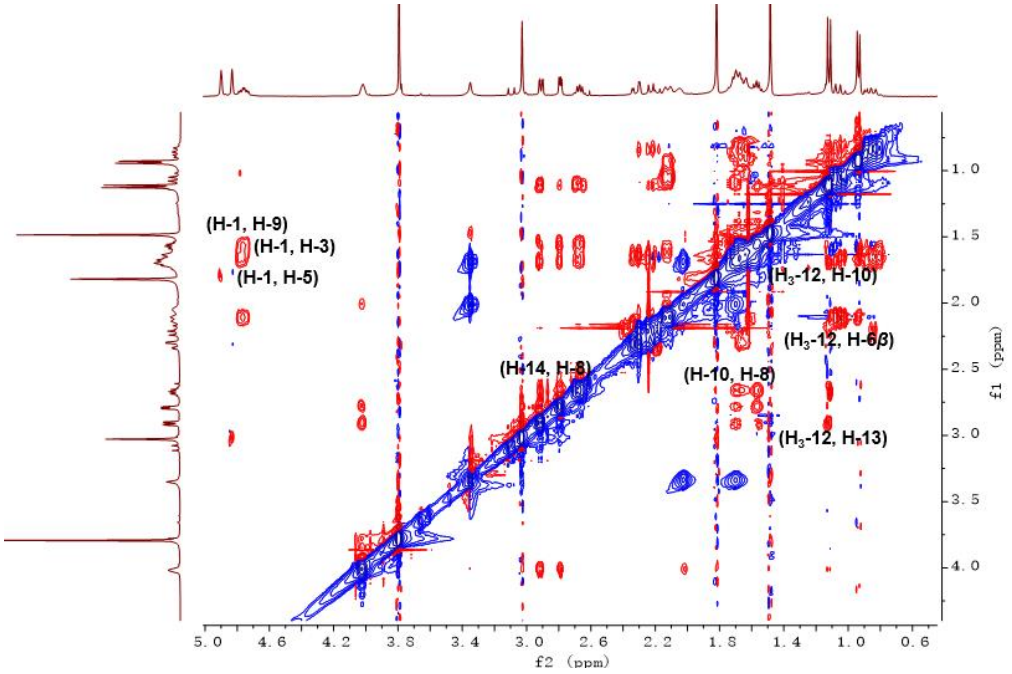


Figure S51. Amplified NOESY spectrum of compound **5** in $CDCl_3$.

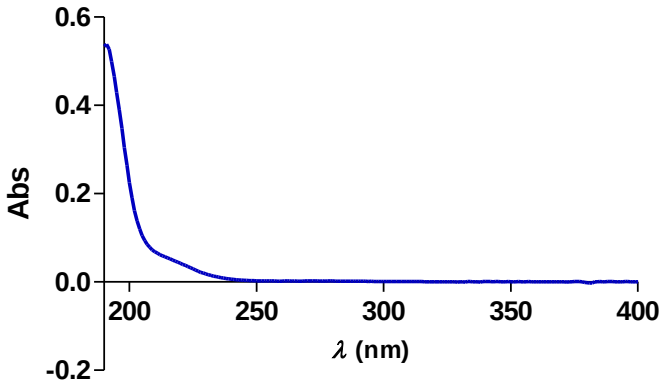


Figure S52. UV spectrum of compound **5**.

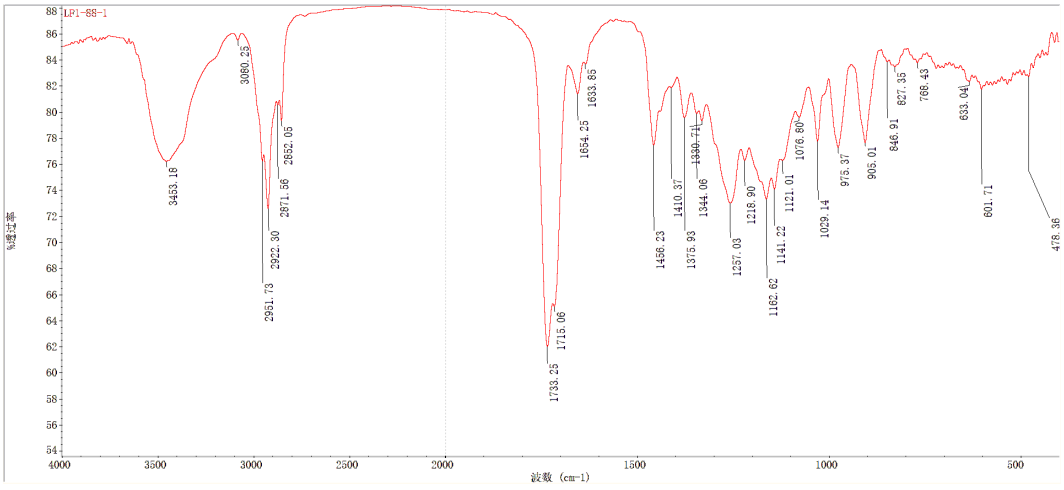


Figure S53. IR spectrum of compound **5**.

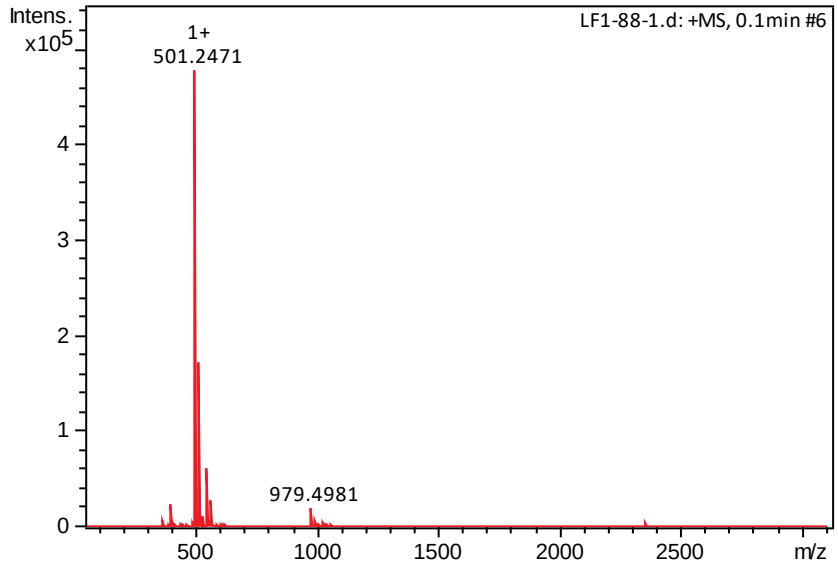


Figure S54. HRESIMS spectrum of compound **5**.

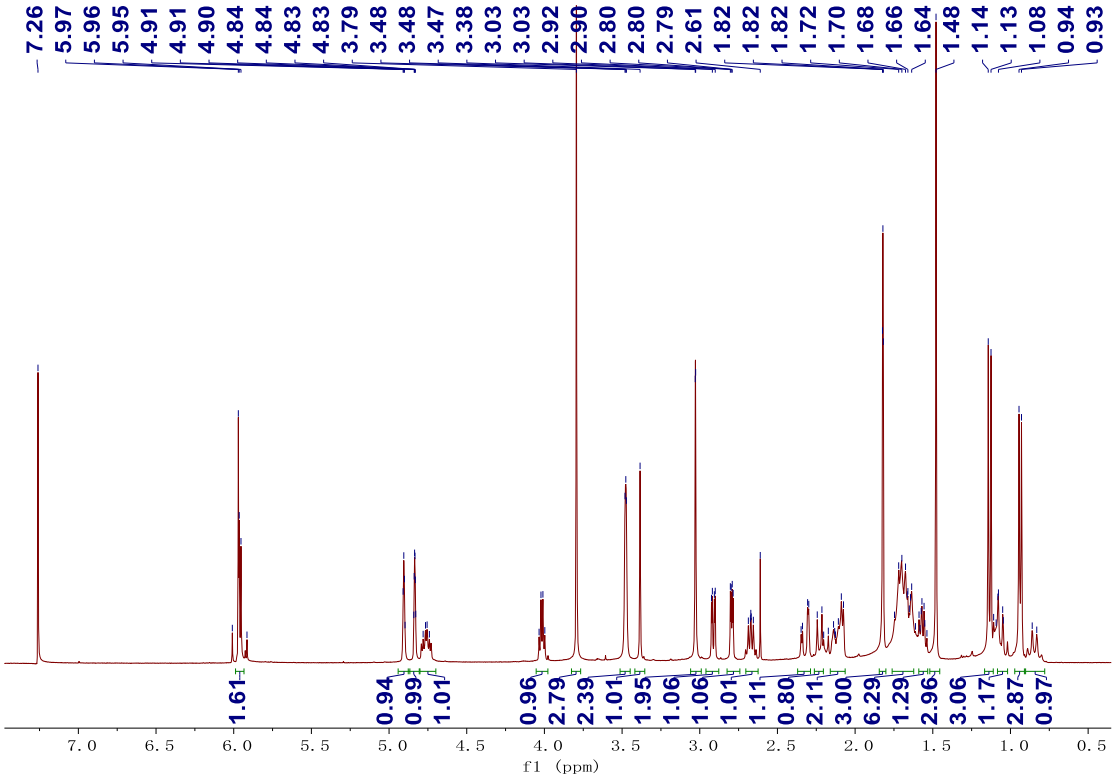


Figure S55. ^{1}H NMR spectrum of compound **6** in $CDCl_3$.

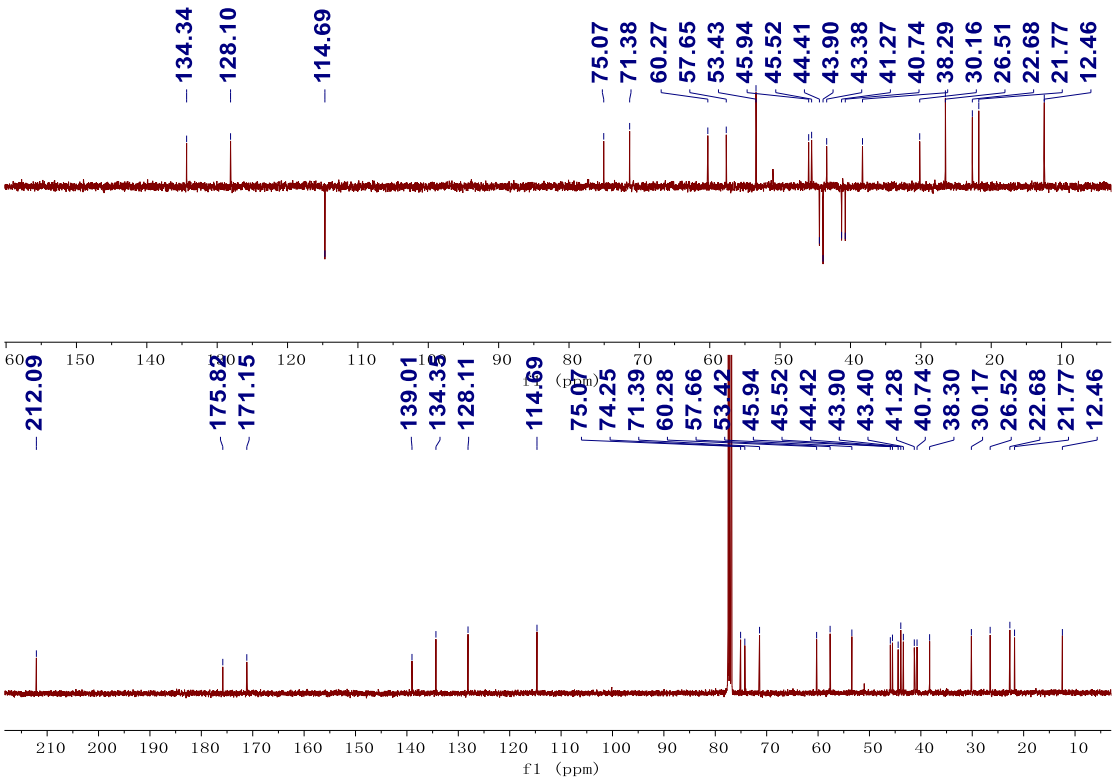


Figure S56. ^{13}C and DEPT NMR spectrum of compound **6** in $CDCl_3$.

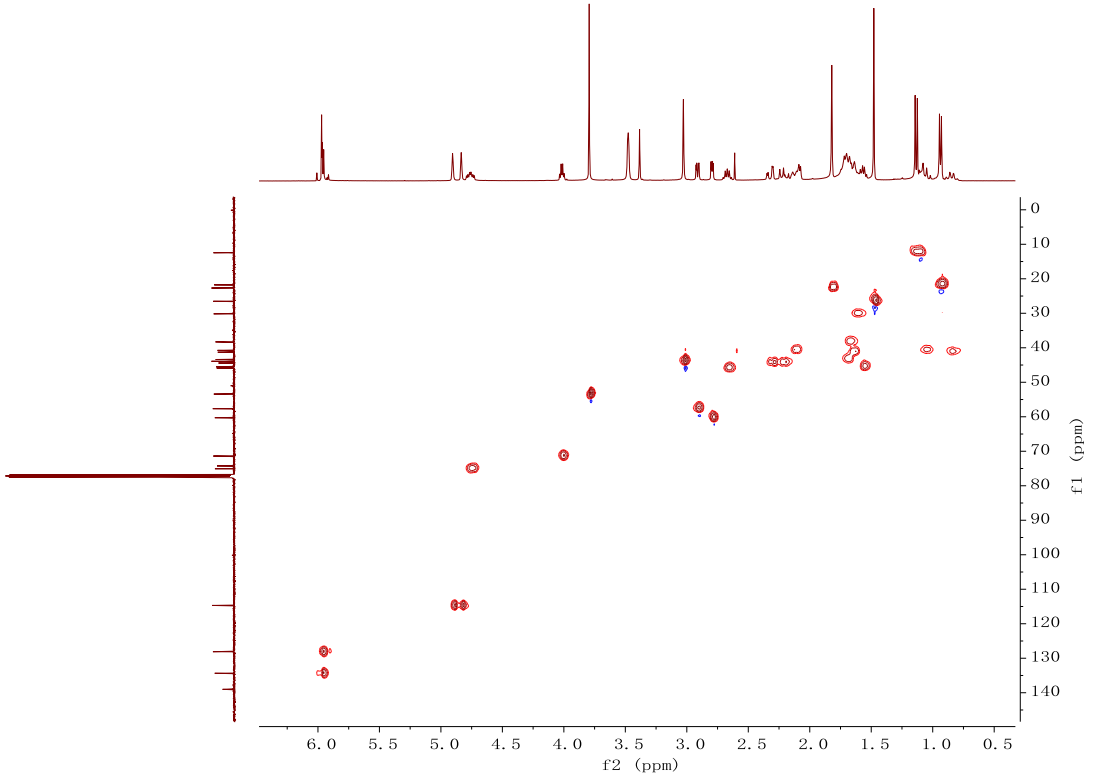


Figure S57. HSQC spectrum of compound **6** in $CDCl_3$.

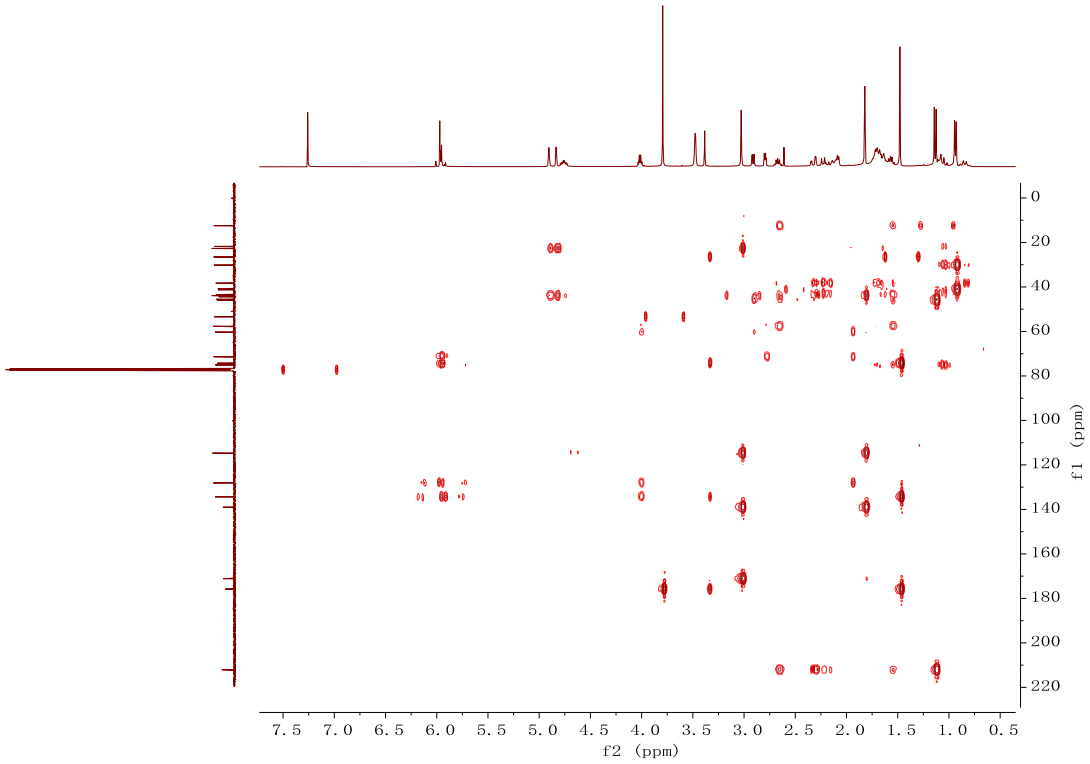


Figure S58. HMBC spectrum of compound **6** in $CDCl_3$.

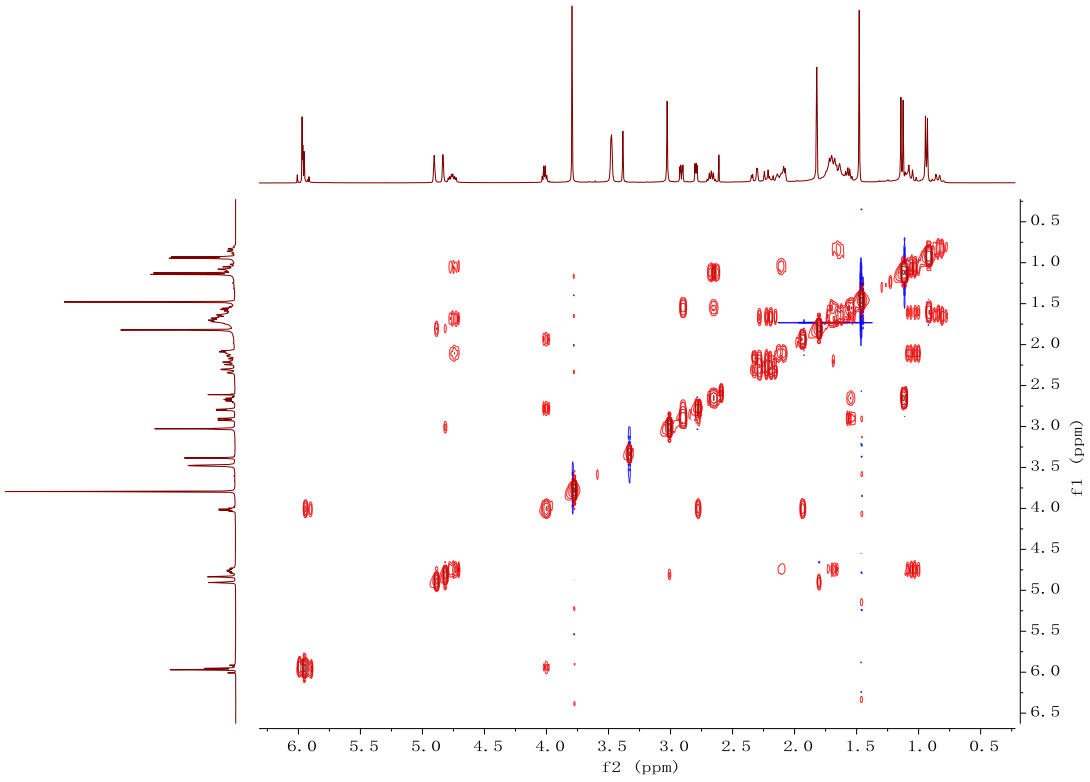


Figure S59. $^{1}H-^{1}H$ COSY spectrum of compound **6** in $CDCl_3$.

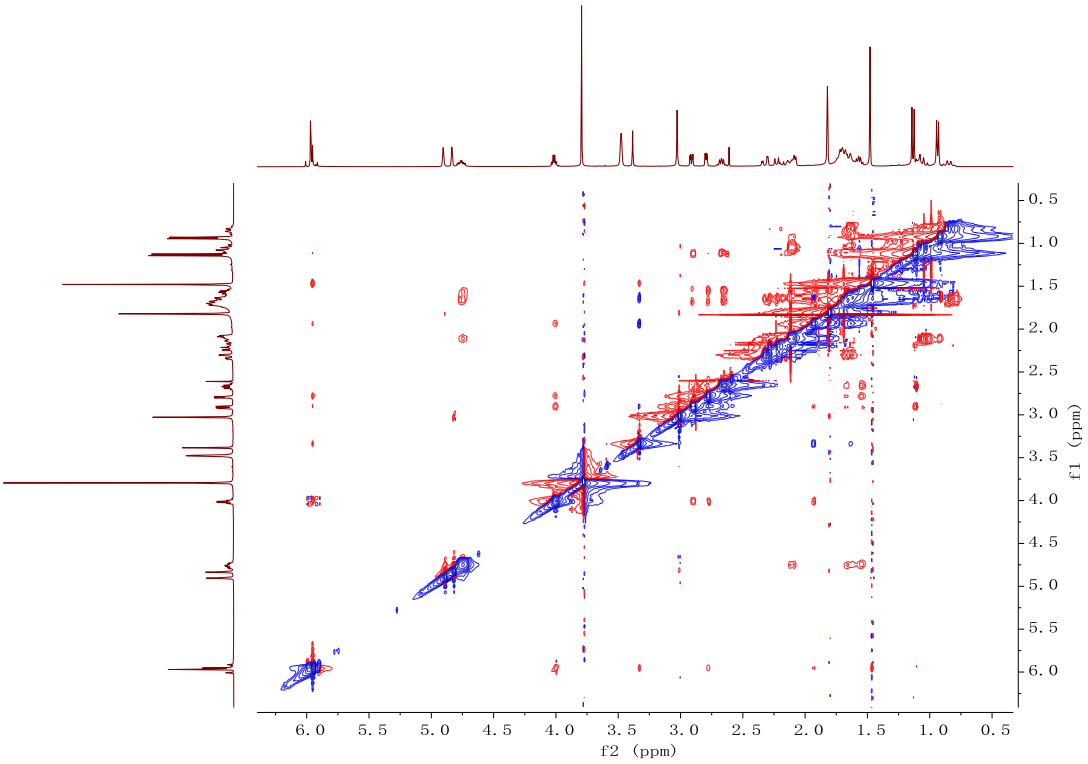


Figure S60.NOESY spectrum of compound **6** in $CDCl_3$.

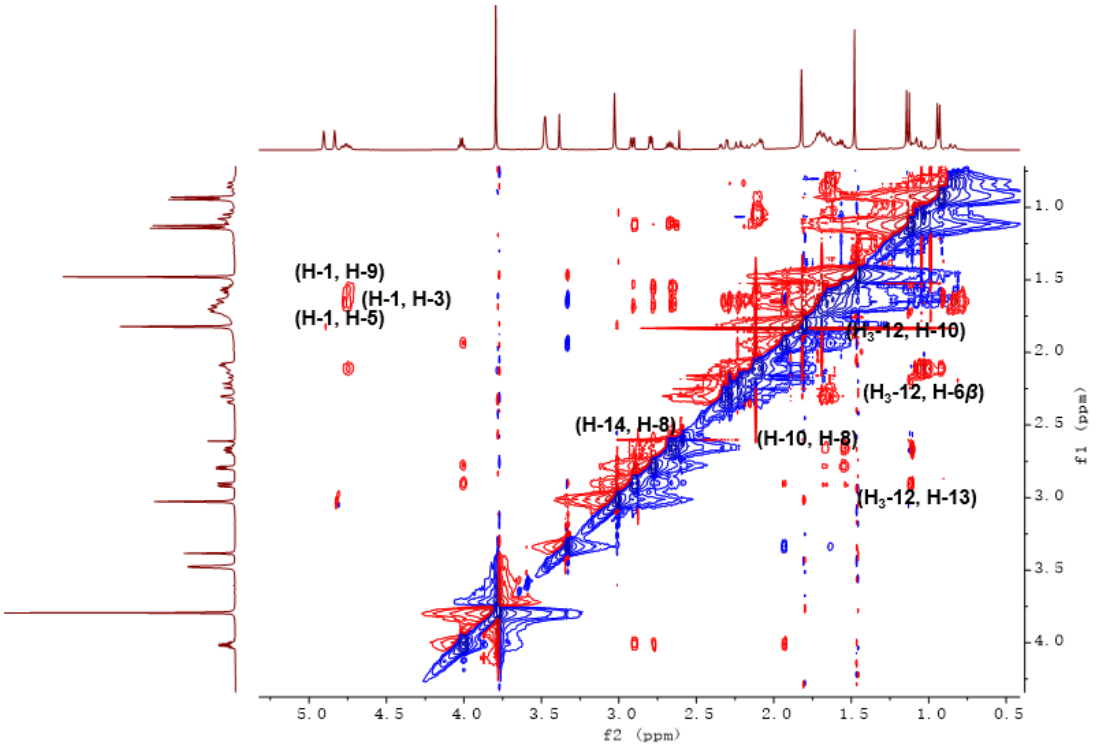


Figure S61. Amplified NOESY spectrum of compound **6** in $CDCl_3$.

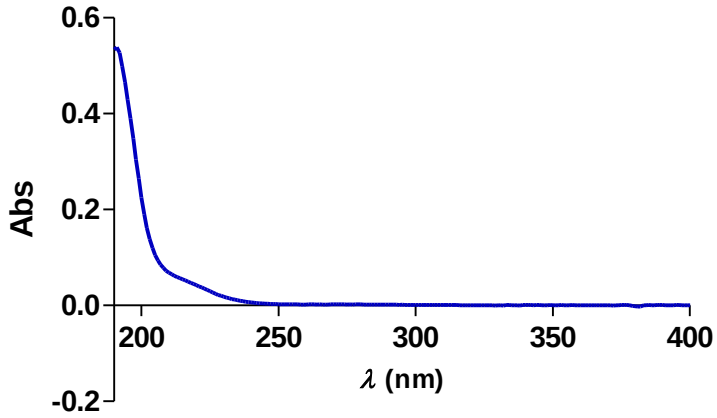


Figure S62. UV spectrum of compound **6**.

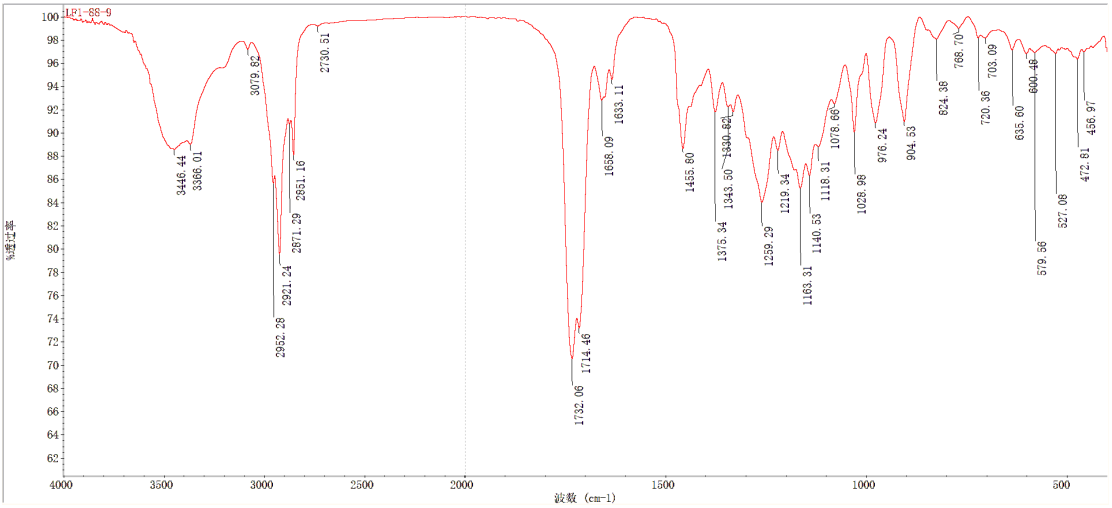


Figure S63. IR spectrum of compound **6**.

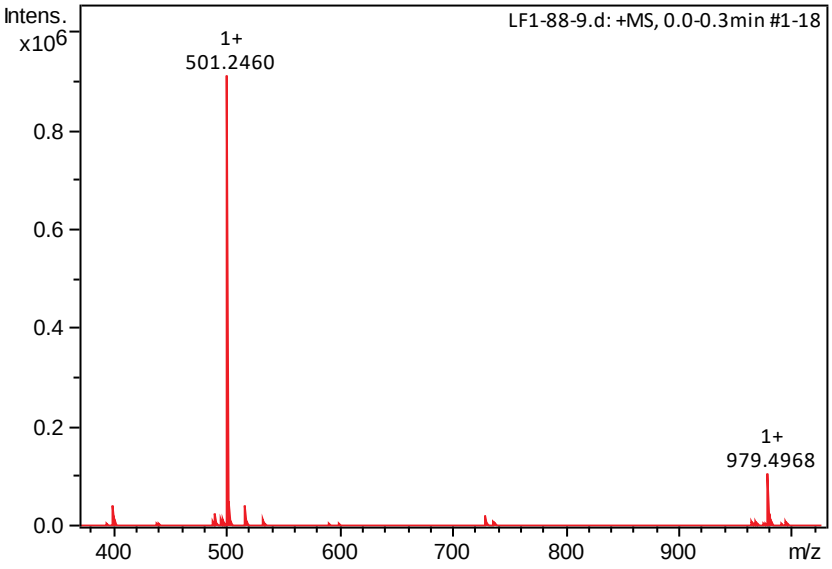


Figure S64. HRESIMS spectrum of compound **6**.

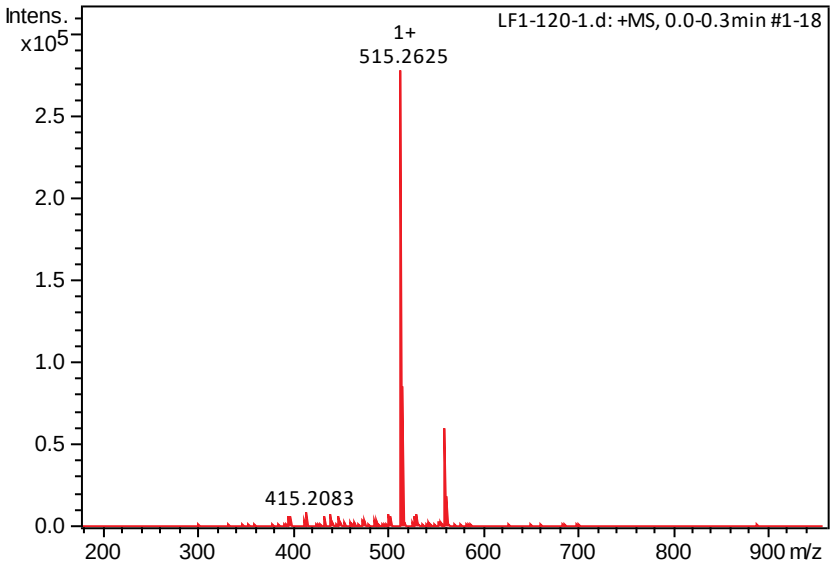


Figure S65. HRESIMS spectrum of the reaction product of **3** treated with *o*-phosphoric acid in EtOH.

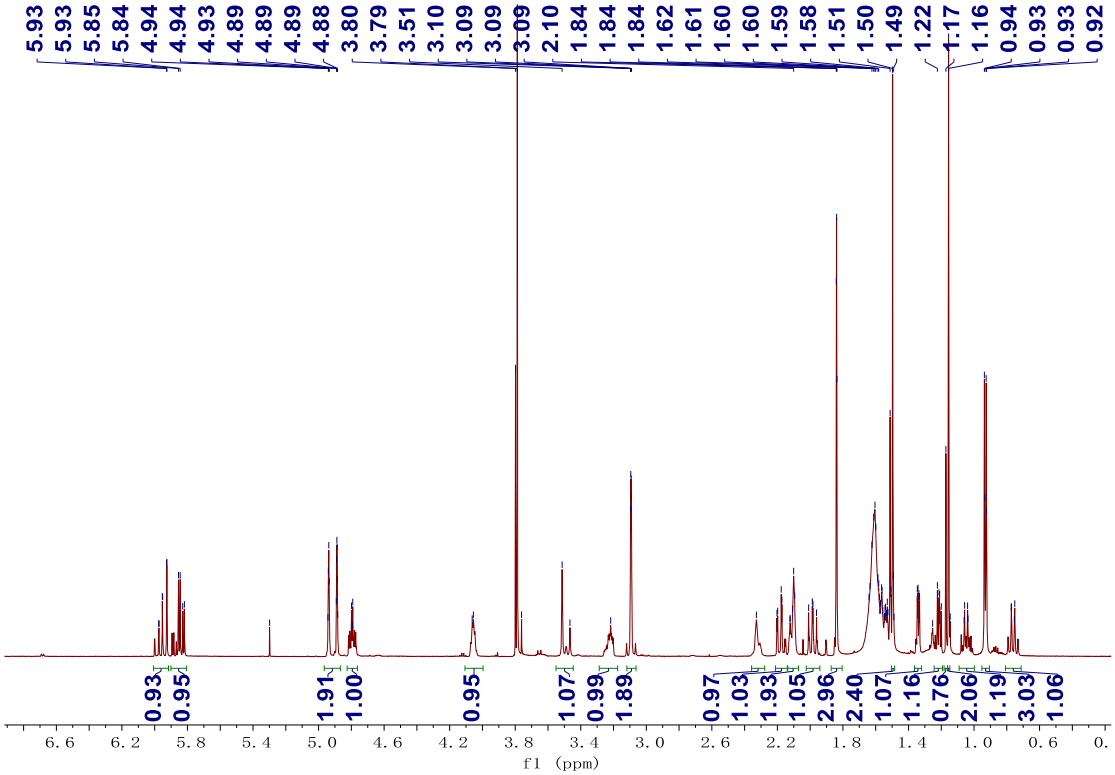


Figure S66. ^{1}H NMR spectrum of *syn*-**1** in $CDCl_3$.

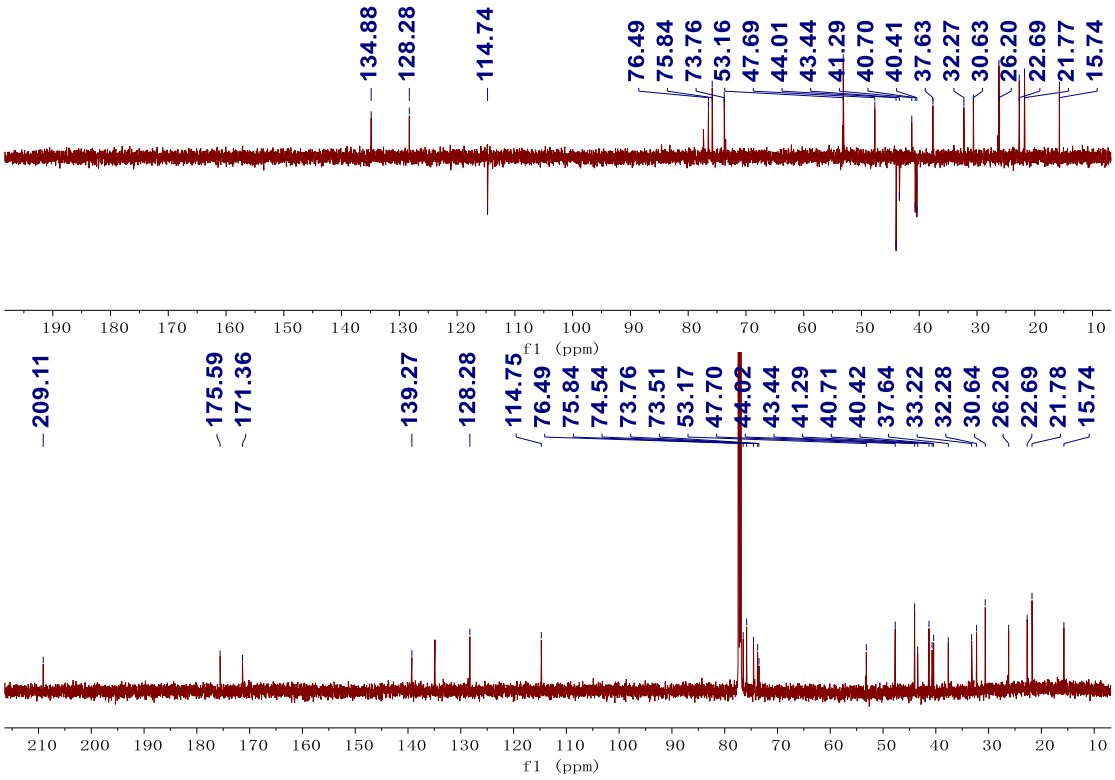


Figure S67. ^{13}C and DEPT NMR spectrum of *syn*-**1** in $CDCl_3$.

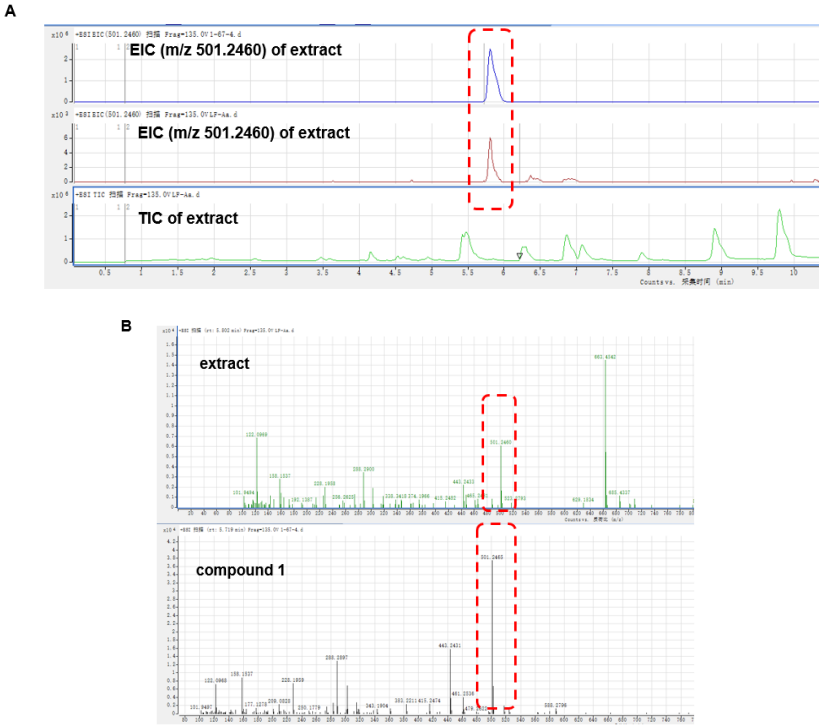
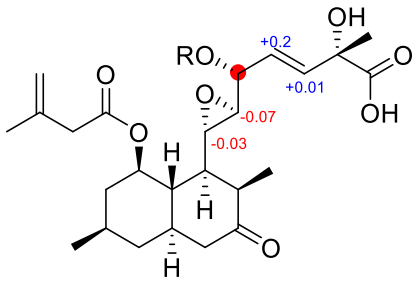


Figure S68. (A) The UPLC-MS spectra of compound **1** and an extract of *A. aculeatus.* (B) HRMS spectra of *m/z* 501.1460 in extract (top) and **1** (bottom).

Preparation of (*S*)- and (*R*)-MTPA esters of 5.

The anhydrous CH_2Cl_2 approximately 2 mL was used to dissolve a sample of compound **5** (0.7 mg). Then, dimethylaminopyridine (30 mg) was added to the transparent solution. Subsequently, triethylamine was taken, followed by (*S*)-MTPA chloride (20 μL) to the solution . After mixing, it was reacted fully at room temperature, and was detected by thin layer analysis (approximately 3 h), and then was quenched by methanol. Solvents were removed to obtain the residue. Finally, the (*R*)- MTPA ester of **5** (0.9 mg, t_R 17.0 min) was obtained from the residue by using RP HPLC (MeCN, 93%). By using the same method, the (*S*)-MTPA ester was also obtained.



5*R* R=(*R*)-MTPA
5*S* R=(*S*)-MTPA

Figure S69. $\Delta\delta_{RS}$ values ($\delta_R - \delta_S$, in ppm) for **5*R*** and **5*S***.

NMR calculation details

1. Methods

In general, conformational analyses were carried out via random searching in the Sybyl-X 2.0 using the MMFF94S force field with an energy cutoff of 5.0 kcal/mol. [1] The results showed twenty-three lowest energy conformers. Subsequently, the conformers were re-optimized at the B3LYP-D3(BJ)/6-31G* level in PCM DMSO by the GAUSSIAN09 program.[2] All conformers used for property calculations in this work were characterized to be stable point on potential energy surface (PES) with no imaginary frequencies. NMR shielding constants were computed using the GIAO method at the mPW1PW91/6-311+G** level in PCM DMSO by the GAUSSIAN09 program.[2] Gibbs free energies for conformers were determined by using thermal correction at B3LYP-D3(BJ)/6-31G* level and electronic energies evaluated at the wB97M-V/def2-TZVP level in CPCM DMSO using ORCA [3][4] Boltzmann weights

were computed using relative gibbs free energies. [5] The unscaled chemical shifts(δ_u) were computed using TMS (Tetramethylsilane) as a reference standard according to $\delta_u = \sigma_0 - \sigma_x$, where σ_x is the Boltzmann averaged shielding tensor (over all significantly populated conformations) and σ_0 is the shielding tensor of the TMS computed at the same level of theory employed for σ_x. The scaled chemical shifts(δ_s) were calculated as $\delta_s = (\delta_u - b) / m$, where m and b are the slope and intercept, respectively, deduced from a linear regression calculation on a plot of δ_u against δ_{exp}.

[1].Sybyl Software, version X 2.0; Tripos Associates Inc.: St. Louis, MO, 2013.

[2].Gaussian 09, Revision E.01, M. J. Frisch, G. W. Trucks, H. B. Schlegel, G. E. Scuseria, M. A. Robb, J. R. Cheeseman, G. Scalmani, V. Barone, B. Mennucci, G. A. Petersson, H. Nakatsuji, M. Caricato, X. Li, H. P. Hratchian, A. F. Izmaylov, J. Bloino, G. Zheng, J. L. Sonnenberg, M. Hada, M. Ehara, K. Toyota, R. Fukuda, J. Hasegawa, M. Ishida, T. Nakajima, Y. Honda, O. Kitao, H. Nakai, T. Vreven, J. A. Montgomery, Jr., J. E. Peralta, F. Ogliaro, M. Bearpark, J. J. Heyd, E. Brothers, K. N. Kudin, V. N. Staroverov, R. Kobayashi, J. Normand, K. Raghavachari, A. Rendell, J. C. Burant, S. S. Iyengar, J. Tomasi, M. Cossi, N. Rega, J. M. Millam, M. Klene, J. E. Knox, J. B. Cross, V. Bakken, C. Adamo, J. Jaramillo, R. Gomperts, R. E. Stratmann, O. Yazyev, A. J. Austin, R. Cammi, C. Pomelli, J. W. Ochterski, R. L. Martin, K. Morokuma, V. G. Zakrzewski, G. A. Voth, P. Salvador, J. J. Dannenberg, S. Dapprich, A. D. Daniels, ?. Farkas, J. B. Foresman, J. V. Ortiz, J. Cioslowski, and D. J. Fox, Gaussian, Inc., Wallingford CT, 2009.

[3]. Neese, F. (2012) The ORCA program system, Wiley Interdiscip. Rev.: Comput. Mol. Sci., 2, 73-78

[4]. Neese, F. (2017) Software update: the ORCA program system, version 4.0, Wiley Interdiscip. Rev.: Comput. Mol. Sci., 8, e1327.

[5]. Nicolás Grimblat, María M. Zanardi, and Ariel M. Sarotti J. Org. Chem. 2015, 80, 12526−12534

2. Results

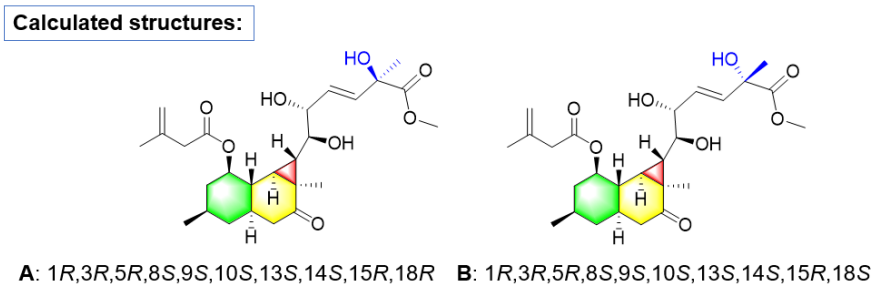


Figure S70. Structures (**A** and **B**) used for NMR DP4+ calculation.

Table S2. Gibbs free energies[a] and equilibrium populations[b] of low-energy conformers of **A** and **B**.

Conformers	ΔG(a.u.)	P(%)/100	G(a.u.)
A-1	0.00266	2.99	-1614.930704
A-2	0.01326	0.0	-1614.920109
A-3	0.00557	0.14	-1614.927796
A-4	0.00253	3.44	-1614.930838
A-5	0.00216	5.07	-1614.931204
A-6	0.00514	0.22	-1614.928229
A-7	0.00138	11.65	-1614.93199
A-8	0.00606	0.08	-1614.927303
A-9	0.00474	0.33	-1614.928623
A-10	0.00221	4.8	-1614.931153
A-11	0.00302	2.04	-1614.930346
A-12	0.00105	16.52	-1614.93232
A-13	0.00299	2.12	-1614.93038
A-14	0.0	50.12	-1614.933367
A-15	0.01295	0.0	-1614.920421
A-16	0.00457	0.4	-1614.928799
A-17	0.00597	0.09	-1614.927397
B-1	0.00208	5.04	-1614.928983
B-2	0.00233	3.85	-1614.928727
B-3	0.00817	0.01	-1614.922888
B-4	0.00099	15.98	-1614.930072
B-5	0.00293	2.04	-1614.928129
B-6	0.00811	0.01	-1614.922949
B-7	0.00631	0.06	-1614.924747
B-8	0.00203	5.3	-1614.92903
B-9	0.00532	0.16	-1614.925744
B-10	0.00297	1.97	-1614.928093
B-11	0.00485	0.27	-1614.926209
B-12	0.00164	8.02	-1614.929421
B-13	0.00831	0.01	-1614.922749
B-14	0.00644	0.05	-1614.924621
B-15	0.00867	0.01	-1614.922387
B-16	0.00768	0.01	-1614.923382
B-17	0.0	45.46	-1614.931059
B-18	0.00947	0.0	-1614.921587
B-19	0.00128	11.76	-1614.929782

[a]wB97M-V/def2-TZVP, in a.u.

[b]From ΔG values at 298.15K.

Table S3. Cartesian coordinates for the low-energy reoptimized random reseach conformers of **A** and **B** at B3LYP-D3(BJ)/6-31G* level of theory in chloroform.

A-14		Standard Orientation (A.U.)			
Center number	Atomic number	Atomic Type	X	Y	Z
0	6	C	0.473255	5.970939	0.908457
1	6	C	2.96975	7.39718	0.503905
2	6	C	4.752113	5.824773	-1.161872
3	6	C	5.141943	3.182645	-0.05572
4	6	C	2.606649	1.76284	0.181843
5	6	C	0.880202	3.30152	1.918779
6	6	C	7.056443	1.581363	-1.543513
7	6	C	7.73055	-0.739493	0.003027
8	6	C	5.585857	-2.184909	1.132921
9	6	C	2.96838	-0.959924	1.08133
10	6	C	3.547658	-2.995002	-0.780506
11	8	O	9.927625	-1.333716	0.418937
12	6	C	6.30863	-3.884243	3.325228
13	6	C	2.489261	10.021006	-0.613471
14	8	O	-1.607545	2.116489	2.053838
15	6	C	-2.241325	0.870971	4.186754
16	8	O	-0.80888	0.552992	5.95664
17	6	C	-4.96909	-0.010146	4.061609
18	6	C	-5.460209	-2.490049	5.404964
19	6	C	-6.14041	-4.5286	4.074934
20	6	C	-5.231571	-2.508708	8.240604
21	6	C	2.400742	-5.602356	-0.655185
22	6	C	0.329067	-5.962615	-2.6729
23	8	O	1.412223	-5.662908	-5.110666
24	6	C	-1.889753	-4.235453	-2.340758
25	6	C	-2.554556	-2.46349	-3.997872
26	6	C	-4.967943	-0.953747	-3.849983
27	6	C	-4.408873	1.839919	-3.259838
28	6	C	-6.318571	-1.01133	-6.437269
29	8	O	-6.559995	-2.026251	-1.961747
30	8	O	-2.602312	3.016054	-4.036039
31	8	O	-6.318745	2.845601	-1.913694
32	8	O	4.235872	-7.507392	-1.276221
33	6	C	-6.15514	5.488054	-1.276032
34	1	H	1.807442	-1.528142	2.674599
35	1	H	5.90498	3.415914	1.867384
36	1	H	1.70315	1.722793	-1.686133
37	1	H	3.865372	-2.381435	-2.714108
38	1	H	-0.743448	7.017925	2.220576
39	1	H	-0.528139	5.829081	-0.898253
40	1	H	3.888935	7.634405	2.354518
41	1	H	3.956852	5.665064	-3.075567
42	1	H	6.57911	6.78817	-1.345959
43	1	H	1.655134	3.334229	3.832487
44	1	H	6.248765	1.04475	-3.378923
45	1	H	8.802184	2.625427	-1.909162
46	1	H	4.686169	-4.948614	4.031659
47	1	H	7.802362	-5.214433	2.79479

48	1	H	7.045525	-2.744181	4.886805
49	1	H	1.259228	11.146298	0.616098
50	1	H	1.57023	9.870593	-2.465837
51	1	H	4.26329	11.059263	-0.866704
52	1	H	-6.096283	1.507268	4.932316
53	1	H	-5.522213	-0.128509	2.081671
54	1	H	-6.537377	-6.318706	5.002619
55	1	H	-6.346963	-4.461558	2.034105
56	1	H	-3.31772	-1.985257	8.822538
57	1	H	-6.516171	-1.112251	9.084853
58	1	H	-5.691286	-4.367369	9.020766
59	1	H	1.594829	-5.96905	1.22178
60	1	H	-0.350809	-7.922048	-2.444389
61	1	H	2.993385	-6.602646	-5.023533
62	1	H	-3.034749	-4.577317	-0.672145
63	1	H	-1.39945	-2.127076	-5.657216
64	1	H	-5.118499	-0.207173	-7.916496
65	1	H	-8.081278	0.070258	-6.351598
66	1	H	-6.756121	-2.973596	-6.913652
67	1	H	-7.859305	-0.783524	-1.591573
68	1	H	5.841867	-6.994508	-0.55969
69	1	H	-4.884676	5.714269	0.329912
70	1	H	-5.459458	6.569544	-2.887613
71	1	H	-8.069172	6.05836	-0.775916

B-17		Standard Orientation (A.U.)			
Center number	Atomic number	Atomic Type	X	Y	Z
0	6	C	6.097137	3.485001	1.432664
1	6	C	8.501863	2.279305	2.532031
2	6	C	9.090783	-0.209387	1.157816
3	6	C	6.863491	-2.052473	1.271772
4	6	C	4.439694	-0.831015	0.243465
5	6	C	3.853002	1.67755	1.526492
6	6	C	7.351369	-4.492191	-0.237217
7	6	C	5.27089	-6.436109	0.168386
8	6	C	2.60292	-5.503882	0.31806
9	6	C	2.202168	-2.648364	0.365144
10	6	C	1.548353	-4.074136	-1.980945
11	8	O	5.767331	-8.669413	0.504196
12	6	C	0.860814	-7.187127	1.849734
13	6	C	10.729207	4.120266	2.409779
14	8	O	1.741449	2.739519	0.098903
15	6	C	0.38236	4.618965	1.195594
16	8	O	0.693263	5.299098	3.361065
17	6	C	-1.442957	5.774638	-0.686279
18	6	C	-0.031409	7.246489	-2.702764
19	6	C	0.068006	6.415136	-5.084287
20	6	C	1.246599	9.634589	-1.830015
21	6	C	-1.114821	-4.397381	-2.975984
22	6	C	-2.285395	-1.8217	-3.738918
23	8	O	-0.456752	-0.140616	-4.822243
24	6	C	-3.585198	-0.584186	-1.540699
25	6	C	-6.042278	-0.06686	-1.395122
26	6	C	-7.201761	1.286452	0.861753
27	6	C	-8.762836	-0.664165	2.341376

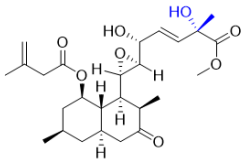
28	6	C	-8.865546	3.498733	-0.010163
29	8	O	-5.31195	2.222087	2.513787
30	8	O	-8.187741	-1.346277	4.463238
31	8	O	-10.733095	-1.534917	1.038225
32	8	O	-1.102221	-5.93693	-5.194022
33	6	C	-12.242041	-3.440681	2.281141
34	1	H	0.655724	-2.066402	1.583473
35	1	H	6.543001	-2.567159	3.261185
36	1	H	4.810568	-0.371469	-1.749913
37	1	H	2.868995	-3.782285	-3.527661
38	1	H	5.627043	5.219193	2.456107
39	1	H	6.428886	4.002408	-0.550666
40	1	H	8.138017	1.831024	4.53029
41	1	H	9.540829	0.200583	-0.830845
42	1	H	10.775955	-1.094769	1.97956
43	1	H	3.22207	1.394236	3.475142
44	1	H	7.47854	-4.019924	-2.257896
45	1	H	9.139587	-5.382979	0.294262
46	1	H	0.579262	-9.013066	0.920278
47	1	H	1.680809	-7.55388	3.713015
48	1	H	-0.98443	-6.302692	2.132715
49	1	H	10.309665	5.870952	3.433324
50	1	H	11.159736	4.62118	0.444377
51	1	H	12.432484	3.284121	3.239376
52	1	H	-2.554451	4.266675	-1.547793
53	1	H	-2.715468	6.999145	0.38715
54	1	H	1.085177	7.457438	-6.533902
55	1	H	-0.826464	4.656355	-5.6524
56	1	H	-0.132024	10.962375	-1.028822
57	1	H	2.619896	9.24071	-0.32478
58	1	H	2.238692	10.5764	-3.379201
59	1	H	-2.352573	-5.24313	-1.54065
60	1	H	-3.646442	-2.21663	-5.245184
61	1	H	0.420872	0.697146	-3.437332
62	1	H	-2.391567	-0.008062	0.023782
63	1	H	-7.341934	-0.588937	-2.900272
64	1	H	-10.329768	2.860066	-1.318573
65	1	H	-7.674068	4.891739	-0.964635
66	1	H	-9.759927	4.400014	1.621551
67	1	H	-5.392332	1.169219	4.027658
68	1	H	-0.288765	-7.520401	-4.750533
69	1	H	-11.081237	-5.090745	2.714575
70	1	H	-13.048022	-2.68162	4.022329
71	1	H	-13.725094	-3.92204	0.938833

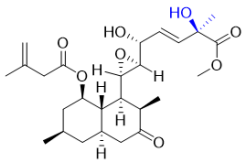
Table S4. $MAE_{\Delta\Delta\delta}$ analysisbased on the calculated NMR chemical shifts of **A** and **B** as well as the experimental NMR chemical shifts of **1** and **2**.

NO.	δ_{exp}-**1**	δ_{calc}-**A**	δ_{calc}-**B**	δ_{exp}-**2**	$\Delta\delta_{exp}$(**1-2**)	$\Delta\delta_{calc}$(**A-B**)	$\boldsymbol{\Delta\Delta\delta_{calc_A-B/exp\ 1-2}}$	$\boldsymbol{\Delta\Delta\delta_{calc_A-B/exp\ 2-1}}$
1	76.5	74.82	77.62	76.5	0	-2.81	2.80517	2.80517
2	40.4	38.96	36.80	40.5	-0.1	2.16	2.256589	2.056589
3	30.7	32.12	31.32	30.7	0	0.80	0.798494	0.798494

4	40.7	39.45	39.14	40.7	0	0.31	0.310091	0.310091
5	41.3	42.59	41.52	41.4	-0.1	1.07	1.173763	0.973763
6	43.5	43.25	44.01	43.4	0.1	-0.77	0.868726	0.668726
7	209.1	208.72	208.13	209.1	0	0.59	0.590684	0.590684
8	33.2	35.64	35.18	33.2	0	0.46	0.460659	0.460659
9	32.3	36.11	34.26	32.3	0	1.86	1.8553	1.8553
10	47.7	45.48	46.35	47.7	0	-0.87	0.868336	0.868336
11	21.8	20.66	20.35	21.8	0	0.31	0.309207	0.309207
12	15.7	14.36	15.29	15.7	0	-0.93	0.927909	0.927909
13	37.7	40.34	42.01	37.7	0	-1.67	1.673333	1.673333
14	73.7	73.11	72.02	73.5	0.2	1.09	0.891468	1.291468
15	75.8	72.34	75.96	75.9	-0.1	-3.62	3.523341	3.723341
16	128.4	130.16	131.69	128.7	-0.3	-1.52	1.221621	1.821621
17	134.8	132.91	132.19	135	-0.2	0.72	0.923771	0.523771
18	74.6	75.04	74.01	74.3	0.3	1.04	0.737604	1.337604
19	175.6	174.15	174.62	175.6	0	-0.48	0.478526	0.478526
20	26.2	26.74	24.48	26.4	-0.2	2.25	2.452322	2.052322
21	53.1	51.91	51.77	53.3	-0.2	0.14	0.338601	0.061399
1′	171.4	171.70	170.34	171.4	0	1.36	1.362201	1.362201
2′	44	42.95	46.26	44	0	-3.31	3.310957	3.310957
3′	139.2	143.52	142.16	139.2	0	1.37	1.367188	1.367188
4′	114.7	114.41	115.09	114.8	-0.1	-0.68	0.582764	0.782764
5′	22.7	23.29	22.17	22.7	0	1.12	1.120631	1.120631
MAE$_{\Delta\Delta\delta}$							1.2772	1.2897

Calculated structures:





C: 1*R*,3*R*,5*R*,8*R*,9*R*,10*S*,13*S*,14*S*,15*R*,18*S* **D**: 1*R*,3*R*,5*R*,8*R*,9*R*,10*S*,13*S*,14*S*,15*R*,18*R*

Figure S71. Structures (**C** and **D**) used for NMR DP4+ calculation.

Table S5. Gibbs free energies[a] and equilibrium populations[b] of low-energy conformers of **C** and **D**.

Conformers	ΔG(a.u.)	P(%)/100	G(a.u.)
C-1	0.00438	0.95	-1614.920462
C-2	0.00444	0.89	-1614.920405
C-3	0.01402	0.0	-1614.910818
C-4	0.00842	0.01	-1614.916424
C-5	0.0	98.05	-1614.924841
C-6	0.00727	0.04	-1614.91757
C-7	0.00714	0.05	-1614.917701
D-1	0.00263	5.52	-1614.917885
D-2	0.00374	1.71	-1614.916778
D-3	0.00649	0.09	-1614.914023
D-4	0.0	89.45	-1614.920514
D-5	0.00373	1.72	-1614.916784

D-6	0.00386	1.5	-1614.916657

[a]wB97M-V/def2-TZVP, in a.u.

[b]From ΔG values at 298.15K.

Table S6. Cartesian coordinates for the low-energy reoptimized random reseach conformers of **C** and **D** at B3LYP-D3(BJ)/6-31G* level of theory in chloroform.

C-5		Standard Orientation (A.U.)			
Center number	Atomic number	Atomic Type	X	Y	Z
0	6	C	0.566163	9.979494	17.794446
1	1	H	0.820851	7.922228	18.012245
2	1	H	0.909992	10.86253	19.64289
3	1	H	2.034076	10.608484	16.46195
4	6	C	-2.026406	10.59609	16.804845
5	6	C	-2.679639	9.541778	14.236466
6	1	H	-2.490528	7.46813	14.183538
7	1	H	-4.665811	9.949602	13.755189
8	6	C	-1.078194	10.616757	12.112071
9	6	C	0.238637	9.871757	7.865297
10	1	H	1.869426	10.983416	8.523147
11	6	C	-1.453898	11.52415	6.216163
12	1	H	-1.965164	13.226378	7.297434
13	1	H	-3.219695	10.476207	5.840045
14	6	C	-0.2149	12.246129	3.706201
15	1	H	1.496728	13.367723	4.133063
16	6	C	0.630856	9.841793	2.339152
17	1	H	1.599035	10.326349	0.55839
18	1	H	-1.054866	8.72521	1.807269
19	6	C	2.375015	8.204457	3.963557
20	1	H	4.073907	9.341338	4.405482
21	6	C	1.159965	7.477178	6.518455
22	1	H	-0.529792	6.312123	6.130157
23	6	C	3.054578	5.908004	8.098298
24	1	H	4.733018	7.108218	8.407417
25	6	C	3.958487	3.504366	6.674413
26	1	H	5.579964	2.705374	7.702387
27	6	C	4.966954	4.184789	4.065144
28	6	C	3.255112	5.856323	2.498269
29	1	H	1.576862	4.739535	1.950563
30	1	H	4.259149	6.377263	0.75603
31	6	C	-1.968752	13.861999	2.077972
32	1	H	-3.706416	12.814661	1.598951
33	1	H	-1.049983	14.412192	0.292842
34	1	H	-2.533525	15.601425	3.071799
35	6	C	1.930501	1.431184	6.447997
36	1	H	1.408768	0.695898	8.320908
37	1	H	0.194184	2.116717	5.531995
38	1	H	2.65662	-0.163883	5.327896
39	6	C	2.122051	5.15417	10.69431
40	1	H	0.215127	4.36023	10.787897
41	6	C	3.894126	4.39301	12.684679
42	1	H	5.931807	4.455212	12.291287
43	6	C	3.0971	2.595572	14.795453
44	1	H	3.409192	0.645138	14.107844

45	6	C	4.708081	3.018275	17.111496
46	1	H	6.761087	2.9866	16.858025
47	6	C	3.77855	3.464739	19.40896
48	1	H	1.736993	3.477838	19.720375
49	6	C	5.420803	3.976454	21.707345
50	6	C	4.790767	6.580492	22.832287
51	1	H	5.316967	8.036922	21.448011
52	1	H	5.892747	6.888073	24.568726
53	1	H	2.766972	6.751035	23.261451
54	6	C	4.882157	1.885485	23.648968
55	6	C	1.835993	-0.063023	26.226793
56	1	H	2.99418	0.084729	27.946216
57	1	H	2.129448	-1.940299	25.384532
58	1	H	-0.165935	0.226994	26.672279
59	6	CC	-3.695419	11.977283	18.109438
60	1	H	-3.235948	12.737749	19.975229
61	1	H	-5.570322	12.408077	17.353589
62	8	O	0.089281	12.569122	12.194392
63	8	O	-1.193631	9.116166	10.053166
64	8	O	6.990733	3.427155	3.312088
65	8	O	2.692097	6.806451	12.766036
66	8	O	0.488375	2.821725	15.271579
67	1	H	0.175237	4.614436	15.495556
68	8	O	8.007783	3.879448	21.117325
69	1	H	8.662502	2.381763	21.959903
70	8	O	6.480693	0.397038	24.327241
71	8	O	2.501298	1.877407	24.465499

D-4		Standard Orientation (A.U.)			
Center number	Atomic number	Atomic Type	X	Y	Z
0	6	C	3.897449	0.894977	7.293954
1	1	H	3.157884	0.021828	9.029372
2	1	H	5.141206	-0.495095	6.37405
3	1	H	2.284983	1.246387	6.028868
4	6	C	5.379603	3.322615	7.903885
5	1	H	6.871373	2.837147	9.268837
6	6	C	6.765466	4.245327	5.554063
7	6	C	5.140851	5.611667	3.637212
8	1	H	3.859648	4.215183	2.758636
9	1	H	6.375813	6.359258	2.143615
10	6	C	3.538171	7.708311	4.848917
11	1	H	4.853895	9.126764	5.644341
12	6	C	1.956473	6.675932	7.076193
13	1	H	0.664812	5.211145	6.334507
14	6	C	3.735178	5.464334	9.054092
15	1	H	5.03665	6.962434	9.698797
16	6	C	2.425714	4.487221	11.399023
17	1	H	0.722076	3.355744	11.09677
18	6	C	3.832724	4.022632	13.740882
19	1	H	5.860239	4.457037	13.807554
20	6	C	2.919514	2.073396	15.659562
21	1	H	3.5985	0.19635	15.055034
22	6	C	3.929407	2.648623	18.257845
23	1	H	3.255467	4.392554	19.148003
24	6	C	5.582409	1.196381	19.48655

25	1	H	6.295579	-0.550548	18.631478
26	6	C	6.618091	1.804849	22.102229
27	6	C	9.445092	2.400429	21.959292
28	1	H	10.179143	2.789885	23.864364
29	1	H	9.71647	4.085509	20.776606
30	1	H	10.48889	0.802962	21.146143
31	6	C	6.217327	-0.616856	23.670539
32	6	C	3.474271	-2.637351	26.545265
33	1	H	1.744764	-2.157731	27.579912
34	1	H	5.000478	-3.130319	27.867012
35	1	H	3.143435	-4.254079	25.281373
36	6	C	1.915018	9.046921	2.866937
37	1	H	0.629669	7.655607	1.981941
38	1	H	3.140521	9.767974	1.343285
39	6	C	0.350224	11.198368	4.000232
40	1	H	1.681835	12.596004	4.802637
41	6	C	-1.263723	10.159735	6.162757
42	1	H	-2.319822	11.693144	7.091582
43	1	H	-2.669052	8.820555	5.394901
44	6	C	0.286373	8.77954	8.165734
45	1	H	1.455198	10.147249	9.210399
46	6	C	-2.160449	9.010198	11.955927
47	6	C	-4.026742	7.535157	13.565631
48	1	H	-5.860499	7.630554	12.580345
49	1	H	-3.466234	5.528725	13.538215
50	6	C	-4.261545	8.530527	16.227864
51	6	C	-1.999183	8.149926	17.909337
52	1	H	-2.241245	9.094069	19.743393
53	1	H	-0.271221	8.872475	17.003709
54	1	H	-1.69274	6.117979	18.283144
55	6	C	-1.26498	12.531293	2.012043
56	1	H	-0.089267	13.307848	0.479717
57	1	H	-2.3491	14.099987	2.846286
58	1	H	-2.626921	11.205463	1.155922
59	8	O	9.005785	3.890098	5.252436
60	8	O	2.220572	6.18044	13.508216
61	8	O	0.245415	1.987713	15.654056
62	1	H	-0.296465	3.739559	15.595515
63	8	O	5.406789	3.900298	23.207606
64	1	H	3.790751	3.323239	23.841553
65	8	O	4.134152	-0.441275	25.116145
66	8	O	7.517263	-2.480124	23.542672
67	8	O	-1.44836	7.636806	9.927983
68	8	O	-1.45492	11.1349	12.361998
69	6	C	-6.379603	9.661703	17.018813
70	1	H	-6.556096	10.390294	18.944475
71	1	H	-8.004289	9.911692	15.76609

Table S7. $MAE_{\Delta\Delta\delta}$ analysisbased on the calculated NMR chemical shifts of **C** and **D** as well as the experimental NMR chemical shifts of **5** and **6**.

NO.	δ_{exp}-**5**	δ_{calc}-**C**	δ_{calc}-**D**	δ_{exp}-**6**	$\Delta\delta_{exp}$(**5-6**)	$\Delta\delta_{calc}$(**C-D**)	$\Delta\Delta\delta_{calc_C-D/exp_5-6}$	$\Delta\Delta\delta_{calc_C-D/exp_6-5}$
1	75.08	77.1993	77.1334	75.07	0.01	0.0659	0.0559	0.0759
2	40.76	43.43872	43.04618	40.74	0.02	0.392541	0.372541	0.412541
3	30.18	34.09979	34.02893	30.17	0.01	0.070858	0.060858	0.080858
4	41.29	44.75652	44.96464	41.28	0.01	-0.20812	0.21812	0.19812
5	38.28	45.06449	44.881	38.3	-0.02	0.183491	0.203491	0.163491
6	44.42	48.93513	49.12157	44.42	0	-0.18644	0.186442	0.186442
7	212.08	222.3643	222.4453	212.09	-0.01	-0.08099	0.070985	0.090985
8	45.92	54.37209	54.4769	45.94	-0.02	-0.1048	0.084805	0.124805
9	45.51	52.66819	52.32203	45.52	-0.01	0.346158	0.356158	0.336158
10	43.45	45.89726	45.7512	43.4	0.05	0.146056	0.096056	0.196056
11	21.76	24.52049	24.63474	21.77	-0.01	-0.11426	0.104258	0.124258
12	12.38	16.76554	16.81309	12.46	-0.08	-0.04755	0.032449	0.127551
13	57.59	59.75757	59.75669	57.66	-0.07	0.000872	0.070872	0.069128
14	60.34	63.38961	63.18418	60.28	0.06	0.205423	0.145423	0.265423
15	71.31	71.86564	73.03313	71.39	-0.08	-1.16749	1.087486	1.247486
16	128.18	141.5121	139.838	128.11	0.07	1.674101	1.604101	1.744101
17	134.25	141.311	145.657	134.35	-0.1	-4.34608	4.246076	4.446076
18	74.26	78.76283	81.19511	74.25	0.01	-2.43228	2.442278	2.422278
19	175.86	185.5925	181.2218	175.82	0.04	4.370762	4.330762	4.410762
20	26.45	30.371	28.05306	26.52	-0.07	2.317937	2.387937	2.247937
21	53.38	56.07188	55.63288	53.42	-0.04	0.439002	0.479002	0.399002
1′	171.16	178.1848	177.9866	171.15	0.01	0.198287	0.188287	0.208287
2′	43.89	48.29926	48.3115	43.9	-0.01	-0.01224	0.002244	0.022244
3′	139.02	152.6968	152.1855	139.01	0.01	0.511297	0.501297	0.521297
4′	22.68	29.1458	27.00546	22.68	0	2.140339	2.140339	2.140339
5′	114.66	123.2339	123.4377	114.69	-0.03	-0.20381	0.173806	0.233806
$MAE_{\Delta\Delta\delta}$							0.8324	0.8650

Theory and ECD calculation details.

In general, conformational analyses were carried out via random searching in the Sybyl-X 2.0 using the MMFF94S force field with an energy cutoff of 5 kcal/mol.[1] The results showed eight lowest energy conformer for both compounds. Subsequently, geometry optimizations and frequency analyses were implemented at the B3LYP-D3(BJ)/6-31G* level in PCM methanol using ORCA5.0.1[2] All conformers used for property calculations in this work were characterized to be stable point on potential energy surface (PES) with no imaginary frequencies. The excitation energies, oscillator strengths, and rotational strengths (velocity) of the first 60 excited states were calculated using the TD-DFT methodology at the PBE0/def2-TZVP level in PCM

methanol using ORCA5.0.1.[2] The ECD spectra were simulated by the overlapping Gaussian function (half the bandwidth at 1/e peak height, sigma = 0.30 for all).[3] Gibbs free energies for conformers were determined by using thermal correction at B3LYP-D3(BJ)/6-31G* level and electronic energies evaluated at the wB97M-V/def2-TZVP level in PCM methanol using ORCA5.0.1[2] To get the final spectra, the simulated spectra of the conformers were averaged according to the boltzmann distribution theory and their relative Gibbs free energy (ΔG). By comparing the experiment spectra with the calculated model molecules, the absolute configuration of the only chiral center was determined to be.

[1]. Sybyl Software, version X 2.0; Tripos Associates Inc.: *St. Louis, MO*, 2013.

[2]. Neese, F. (2012) The ORCA program system, Wiley Interdiscip. Rev.: *Comput. Mol. Sci*., 2, 73-78.

[3]. Stephens, P. J.; Harada, N. ECD cotton effect approximated by the Gaussian curve and other methods. *Chirality* 2010, 22, 229–233.