Supporting information

Bioactive spiropyrrolizidine oxindole alkaloid enantiomers from *Isatis indigotica* Fortune

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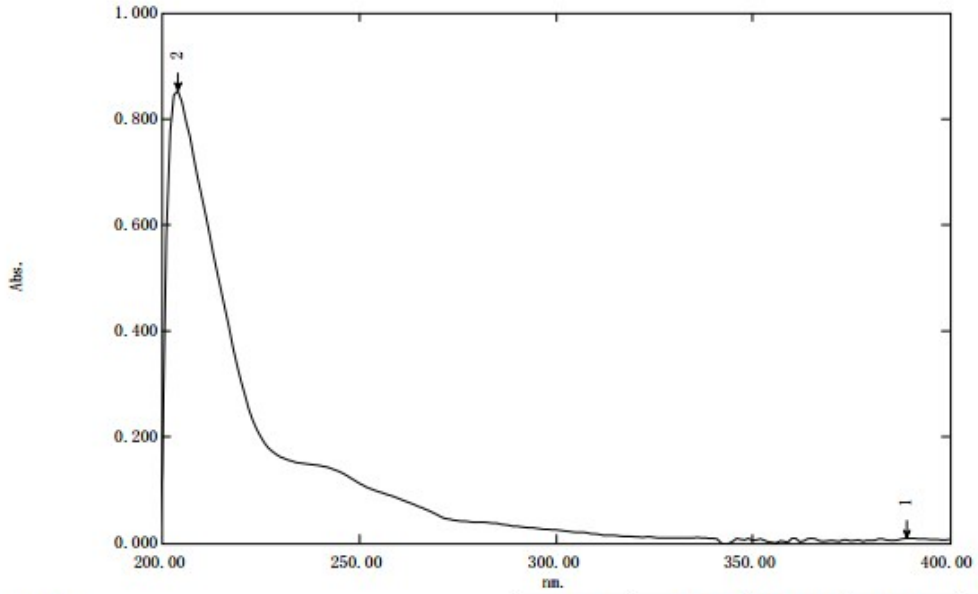
Table S1 Computed ^{13}C NMR chemical shifts for compound **3** at B3LYP/6–311+G(2d,p) basis set with polarizable continuum model PCM in DMSO-d_6 solvent.

Table S2 Computed ^{13}C NMR chemical shifts for compound **3** at B3LYP/6–311+G(d,p) basis set with polarizable continuum model PCM in DMSO-d_6 solvent.



测定属性
波长范围 (nm.): 190.00到400.00
扫描速度: 中速
采样间隔: 1.0
自动采样间隔: 停用
扫描模式: 单一的

No.	P/V	Wavelength	Abs.	描述
1	↑	389.00	.009	
2	↑	204.00	.854	
3	↓	356.00	-.001	

Figure S1.1 The UV spectrum of compound **1**

Mass Spectrum SmartFormula Report

Analysis Info

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Comment			

Acquisition Parameter

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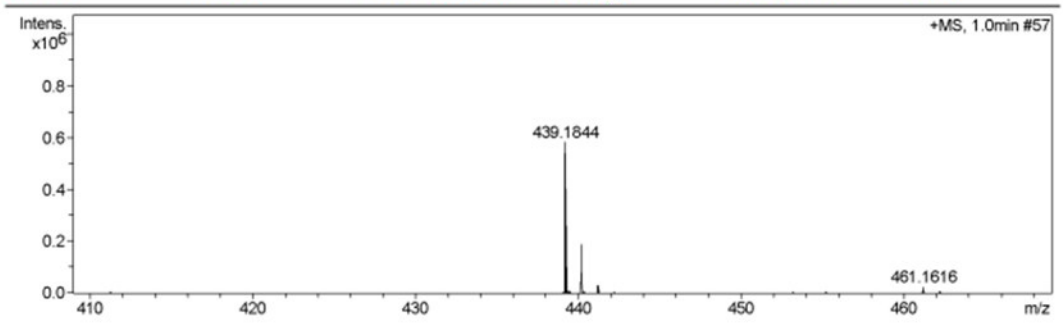


Meas. m/z	#	Formula	m/z	err [ppm]	Mean err [ppm]	rdb	N-Rule	e⁻ Conf	mSigma	Std I	Std Mean m/z	Std I VarNorm	Std m/z Diff	Std Comb Dev
439.1844	1	C 24 H 27 N 2 O 6	439.1864	4.6	5.0	12.5	ok	even	32.25	0.0465	0.0024	0.0203	0.0001	0.8427

Figure S1.2 The HRESIMS spectrum of compound **1**

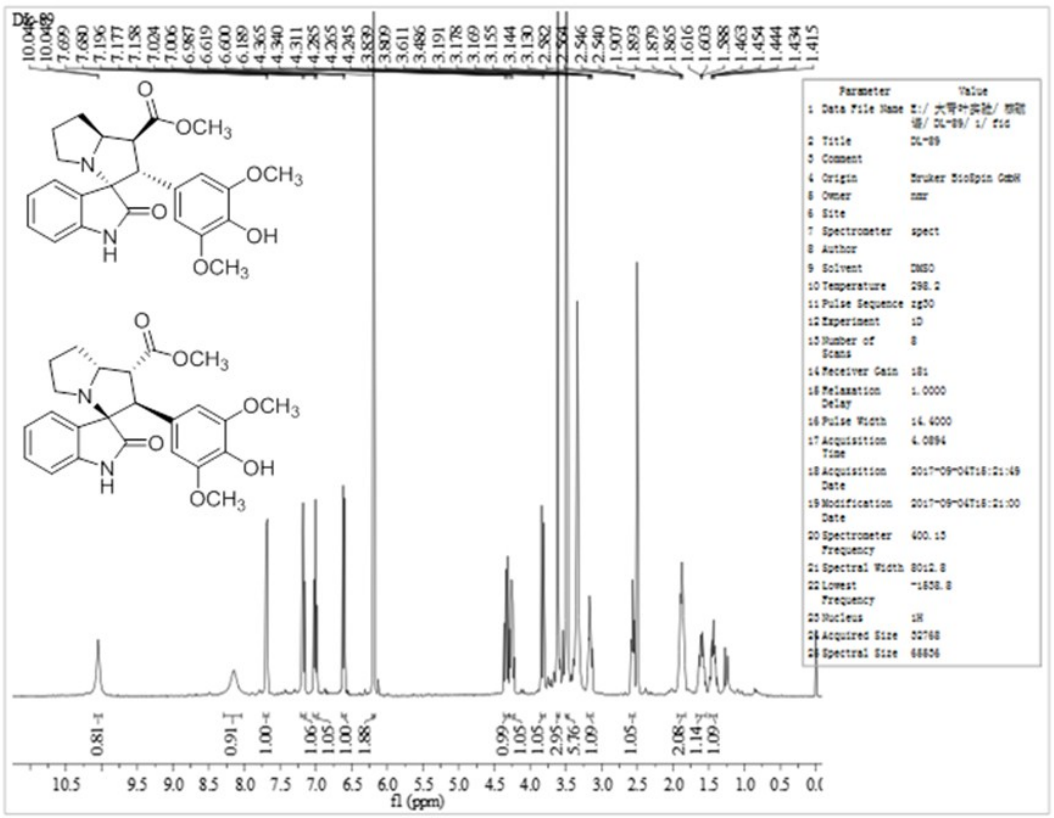


Figure S1.3 The ^{1}H NMR spectrum (400 MHz, DMSO-d_6) of compound **1**

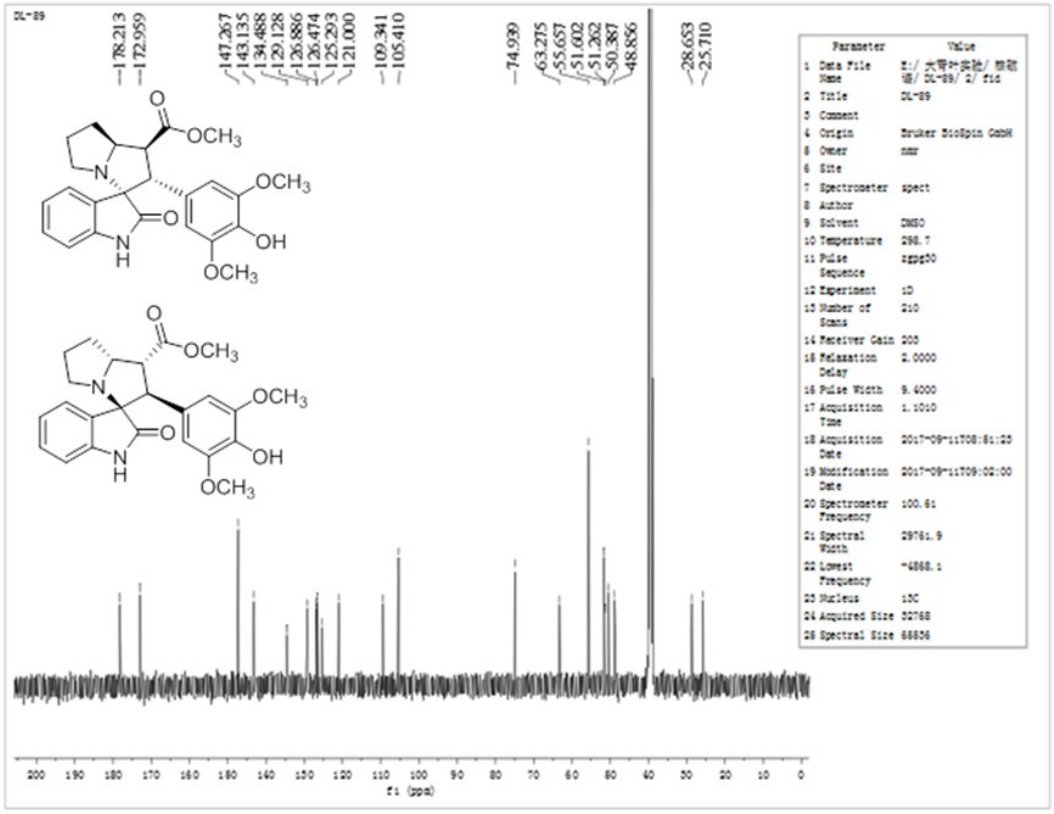


Figure S1.4 The ^{13}C NMR spectrum (100 MHz, DMSO-d_6) of compound **1**

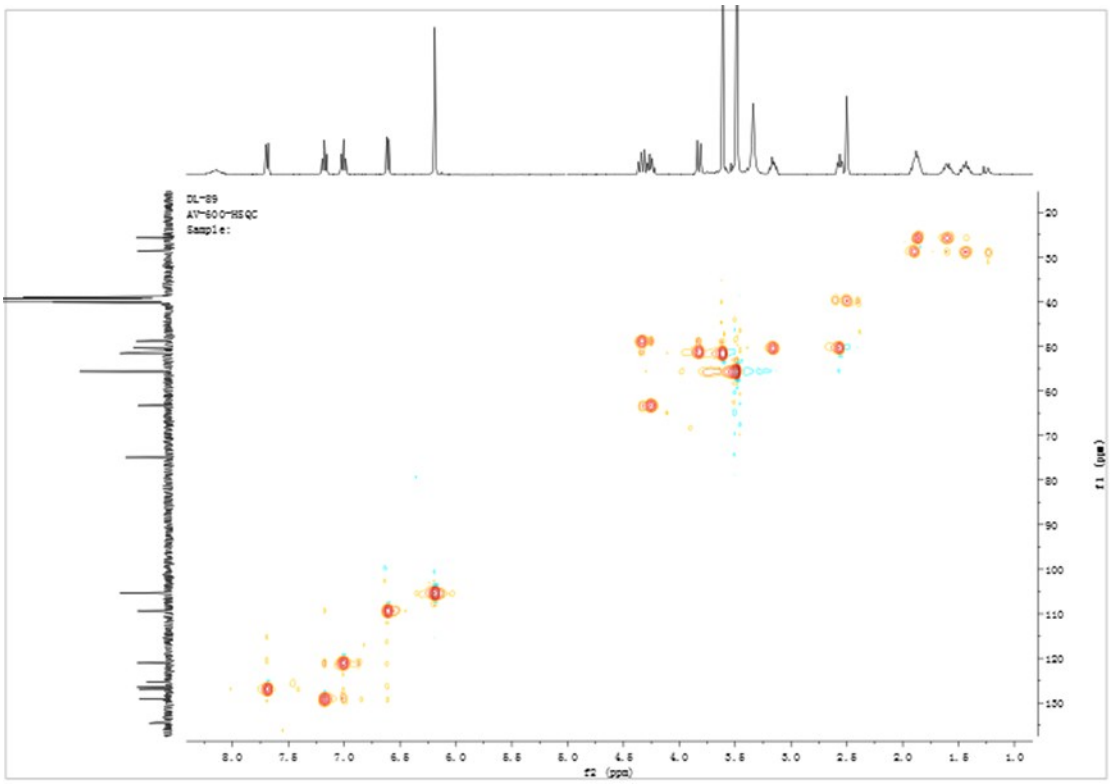


Figure S1.5 The HSQC spectrum of compound **1**

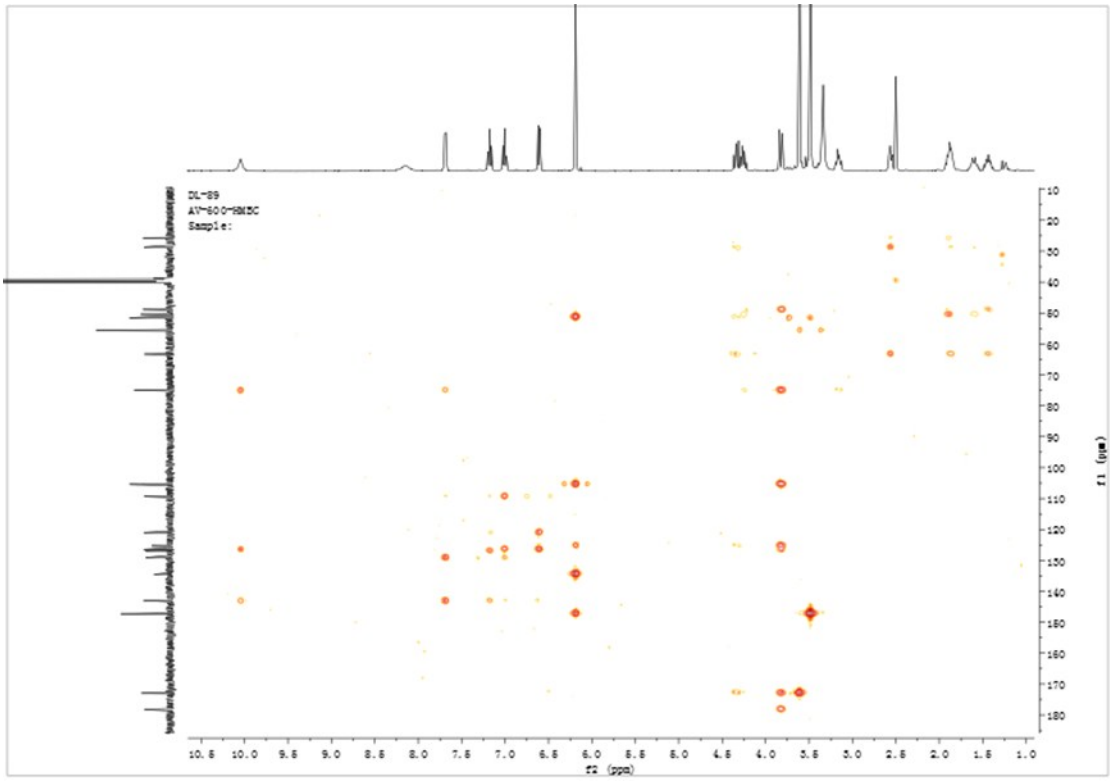


Figure S1.6 The HMBC spectrum of compound **1**

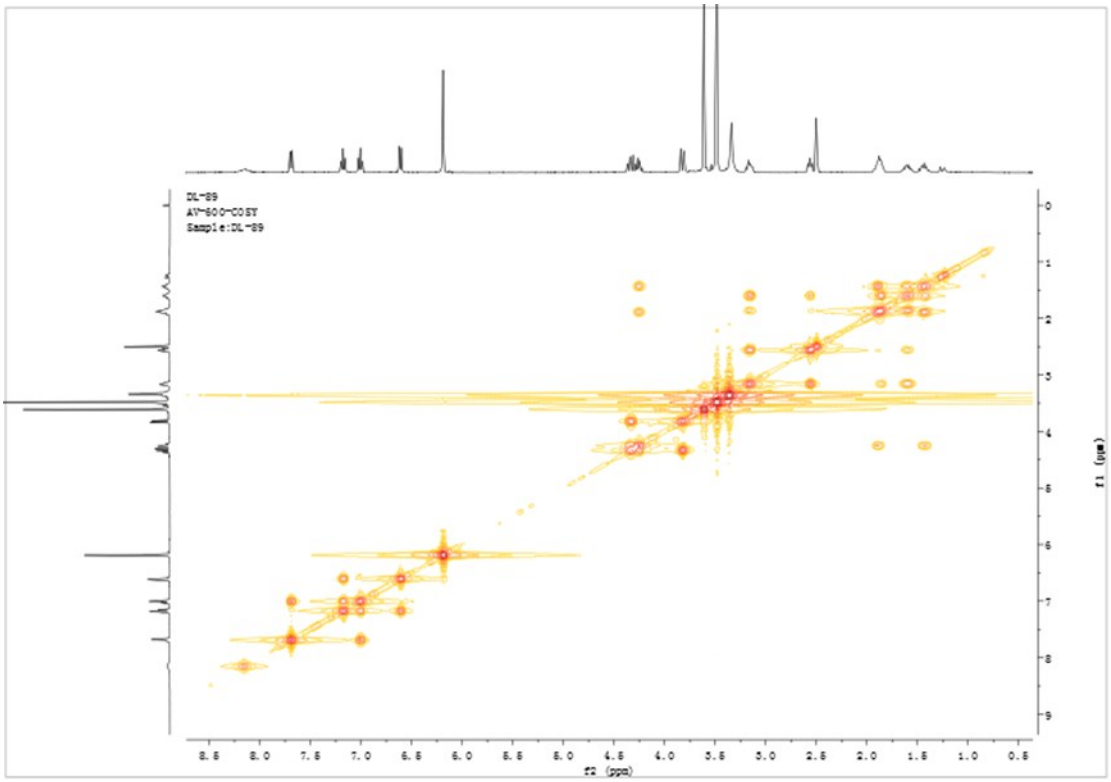


Figure S1.7 The ^{1}H-^{1}H COSY spectrum of compound **1**

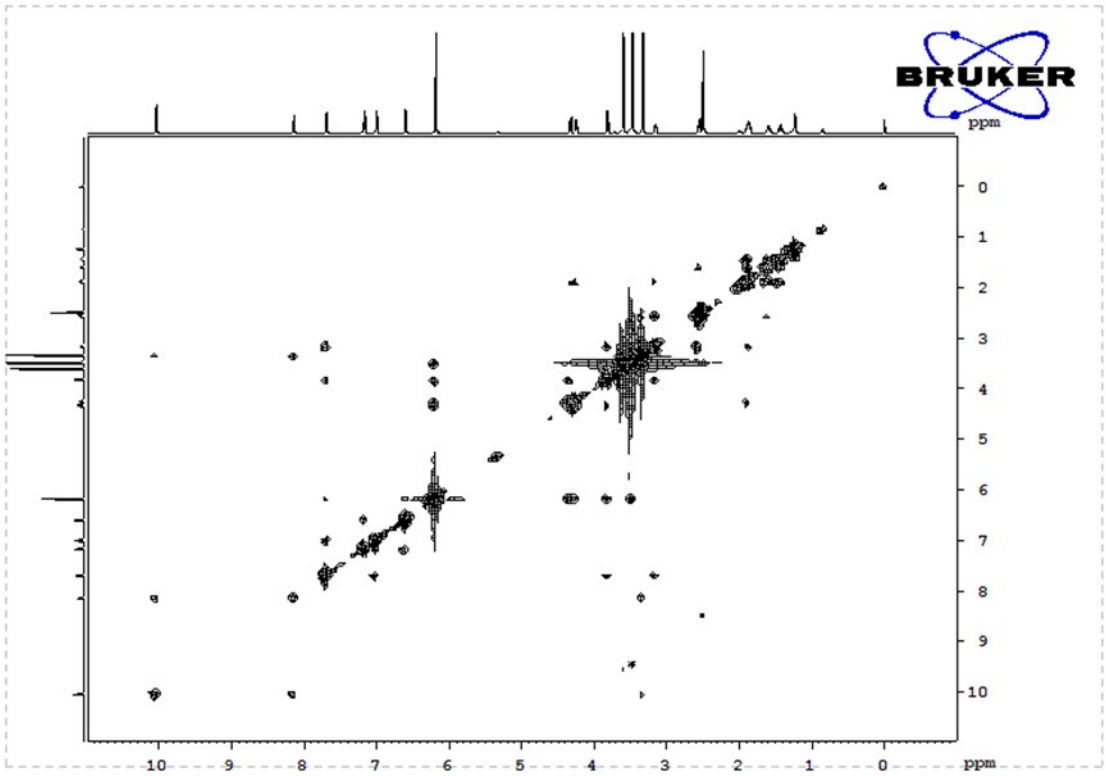


Figure S1.8 The ROESY spectrum of compound **1**

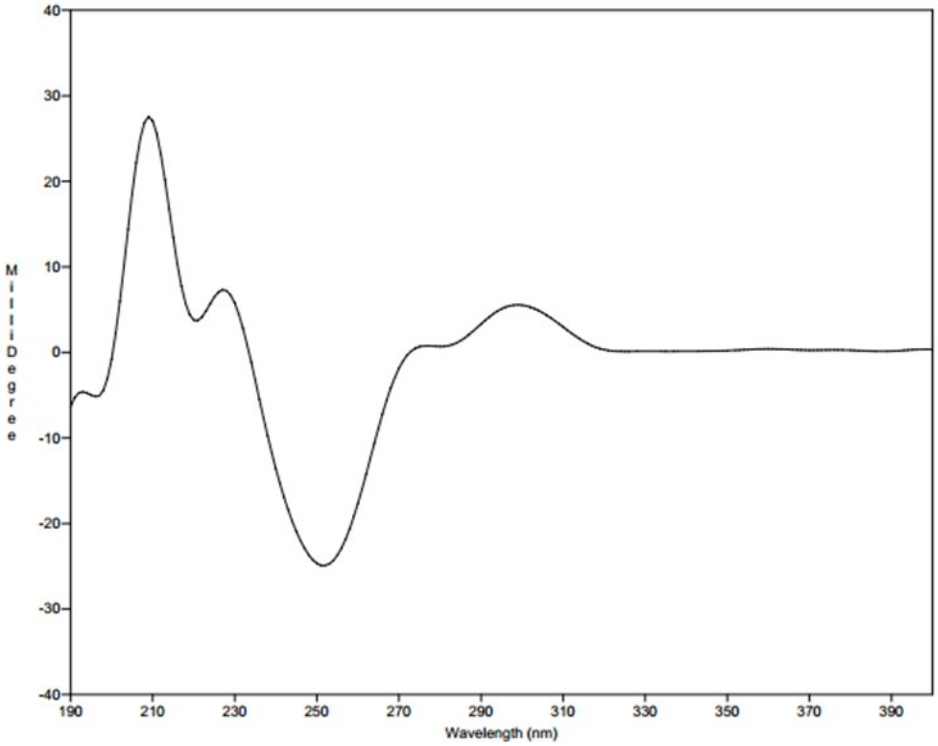


Figure S1.9 The ECD spectrum of compound **1a**

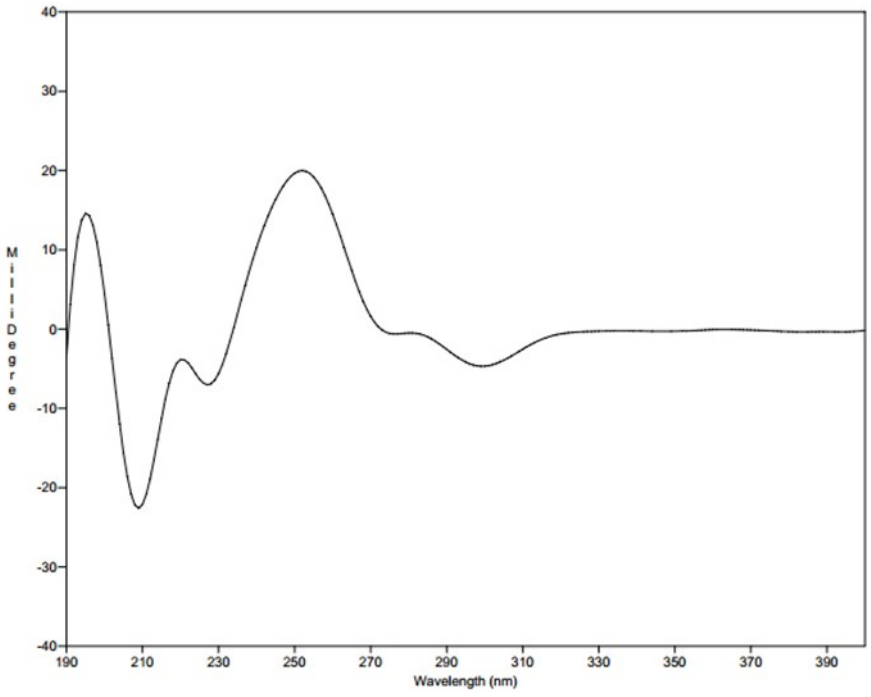


Figure S1.10 The ECD spectrum of compound **1b**

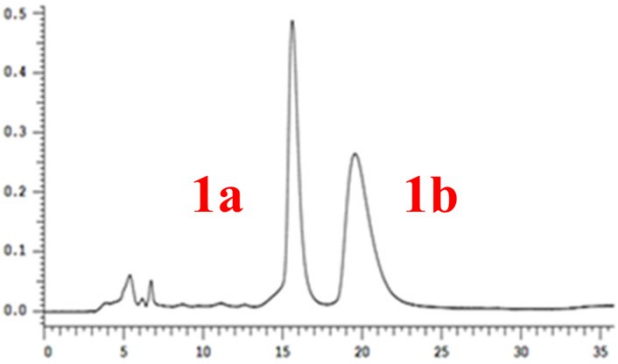


Figure S1.11 The chiral HPLC chromatogram of compounds **1a** and **1b**

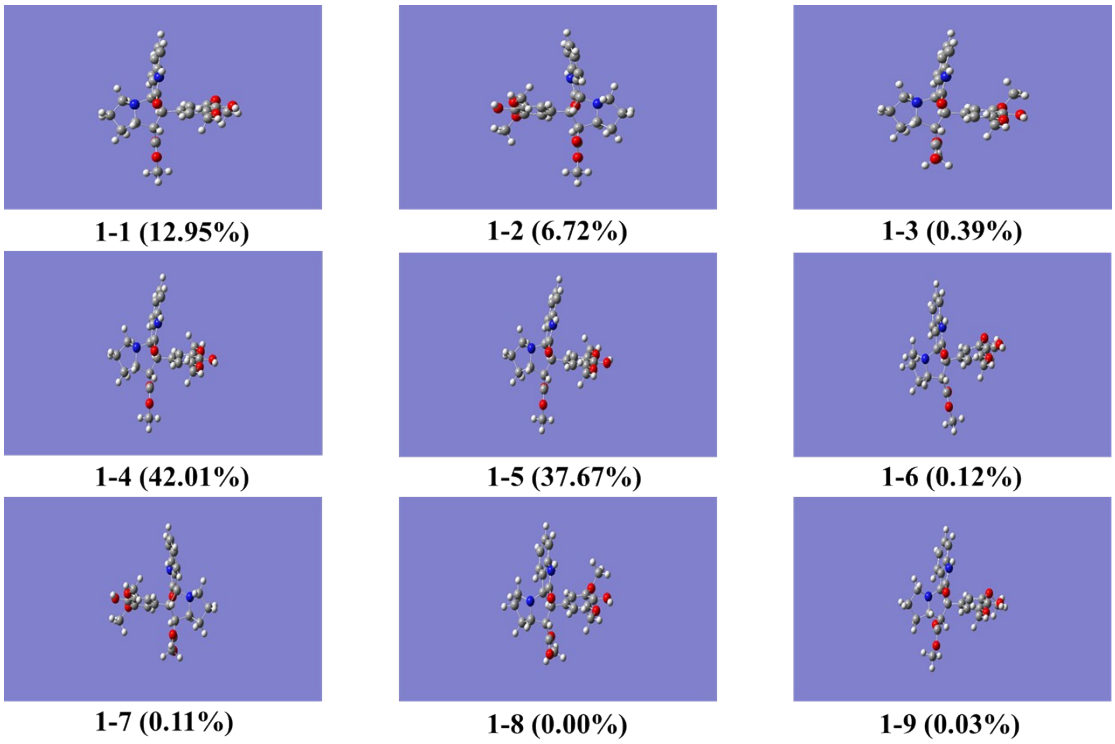
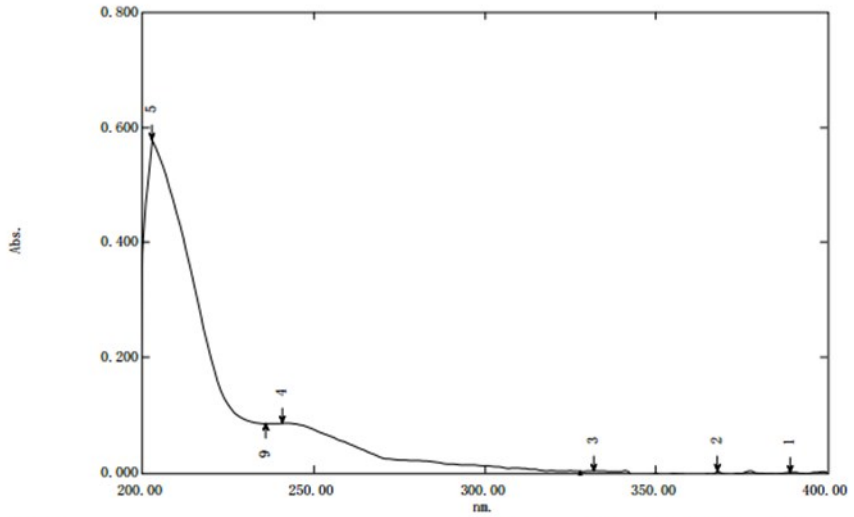


Figure S1.12 Most stable conformers of **1** in solvated model calculations at the B3LYP/6-311+G (2d, p) level



测定属性
波长范围（nm.）： 190.00到400.00
扫描速度： 中速
采样间隔： 1.0
自动采样间隔: 停用
扫描模式： 单一的

试样准备属性
重量:
体积 :
稀释:

No.	P/V	Wavelength	Abs.	描述
1	↑	389.00	.001	
2	↑	368.00	.003	
3	↑	332.00	.004	
4	↑	241.00	.086	
5	↑	203.00	.578	
6	↓	372.00	-.005	
7	↓	344.00	-.015	
8	↓	328.00	.002	
9	↓	236.00	.085	

Figure S2.1 The UV spectrum of compound **2**

Mass Spectrum SmartFormula Report

Analysis Info

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Comment		Instrument / Ser#	micrOTOF-Q 125

Acquisition Parameter

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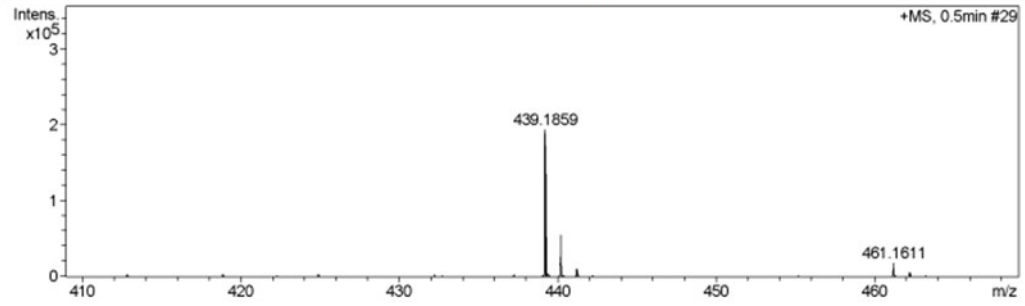


Meas. m/z	#	Formula	m/z	err [ppm]	Mean err [ppm]	rdb	N-Rule	e⁻ Conf	mSigma	Std I	Std Mean m/z	Std I VarNorm	Std m/z Diff	Std Comb Dev
439.1859	1	C 24 H 27 N 2 O 6	439.1864	1.1	3.7	12.5	ok	even	9.16	0.0146	0.0027	0.0065	0.0041	0.8427

Figure S2.2 The HRESIMS spectrum of compound **2**

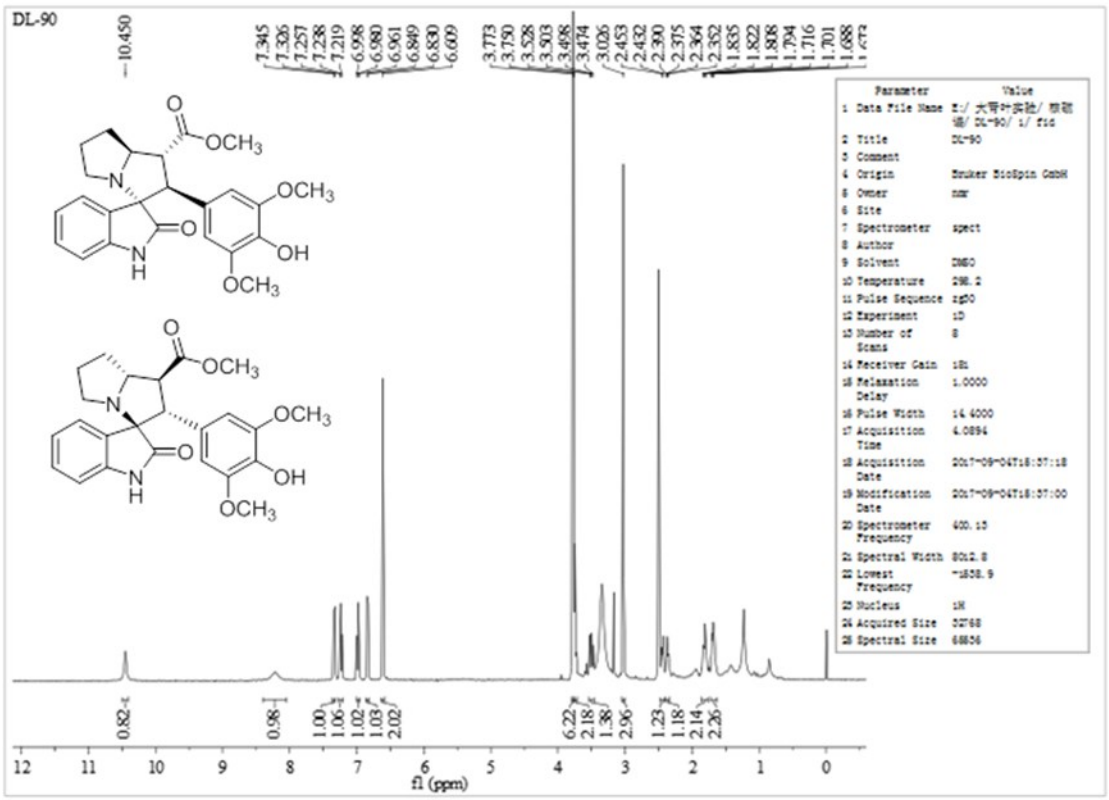


Figure S2.3 The ^{1}H NMR spectrum (400 MHz, DMSO-d_6) of compound **2**

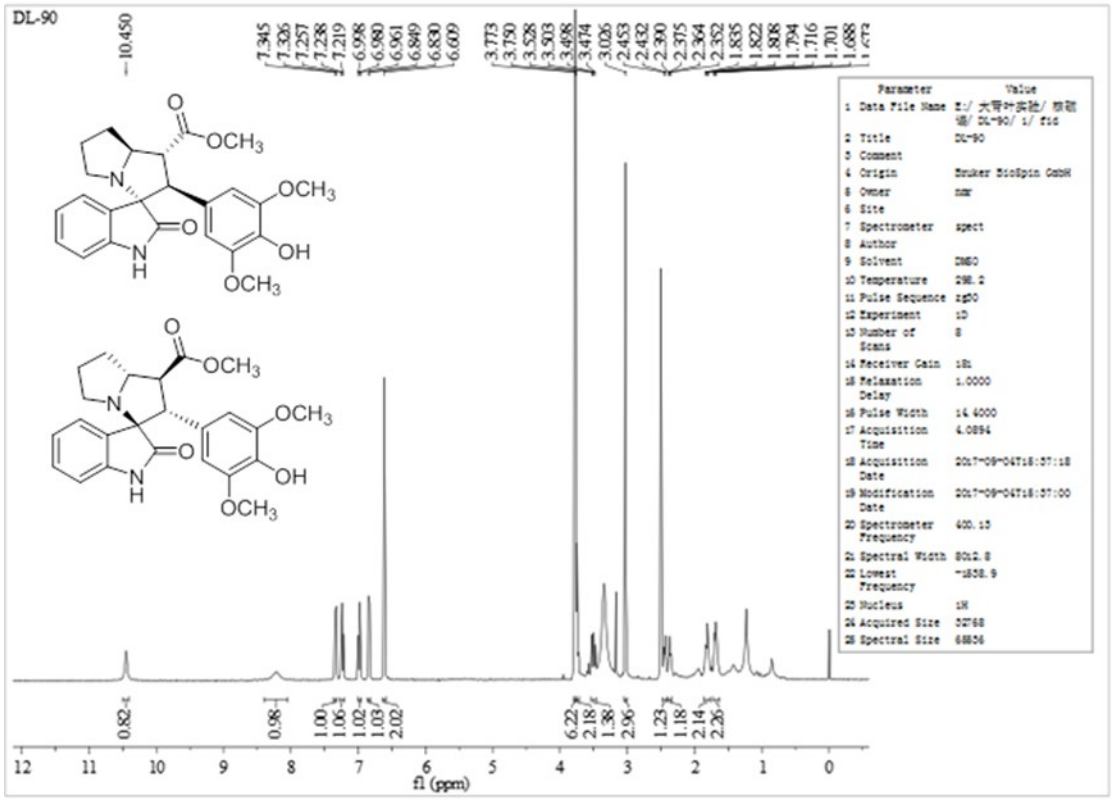


Figure S2.4 The ^{13}C NMR spectrum (100 MHz, DMSO-d_6) of compound **2**

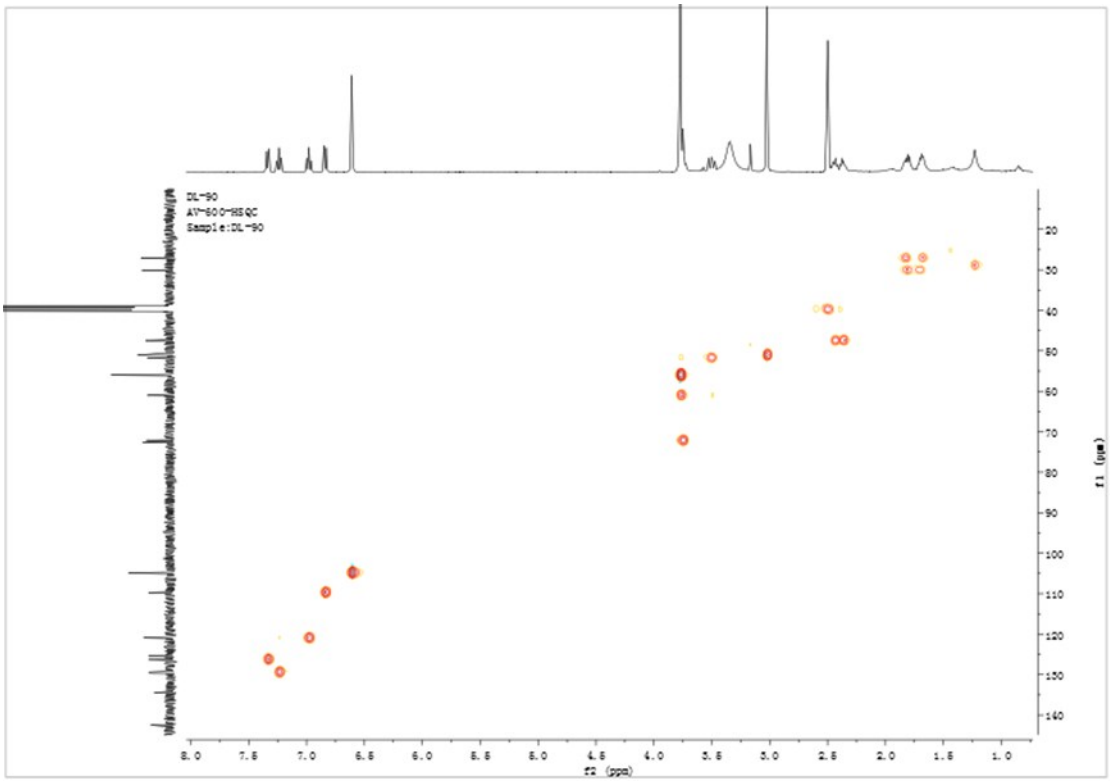


Figure S2.5 The HSQC spectrum of compound **2**

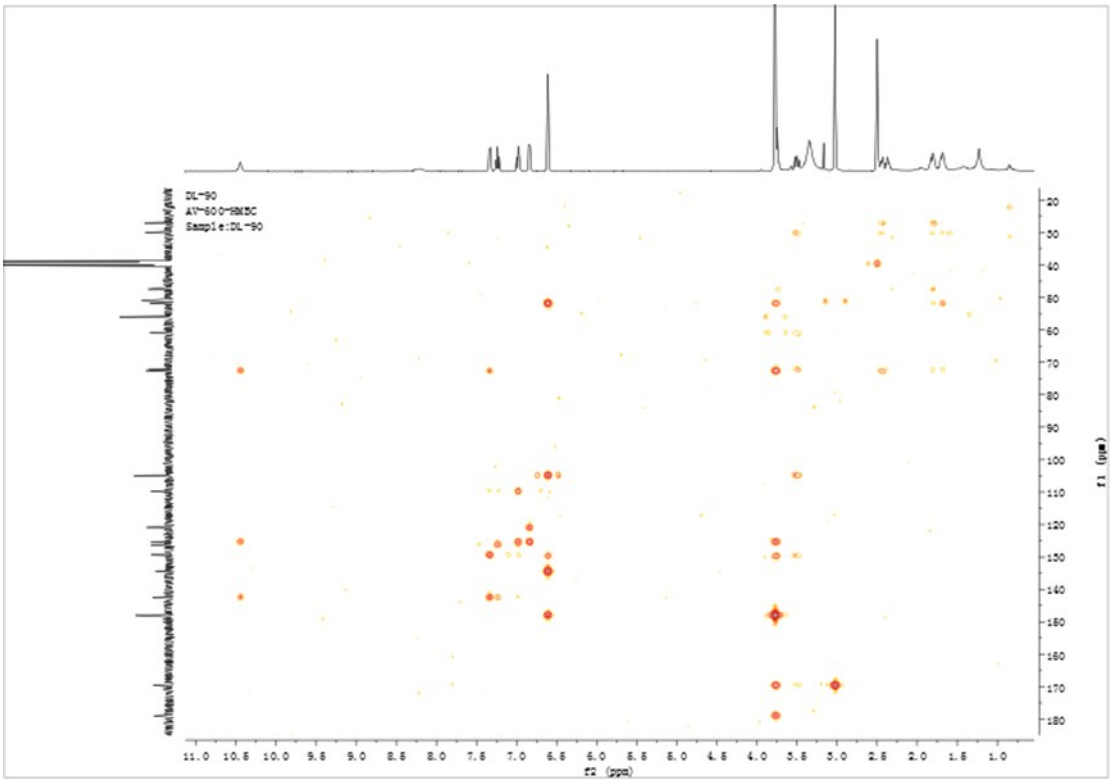


Figure S2.6 The HMBC spectrum of compound **2**

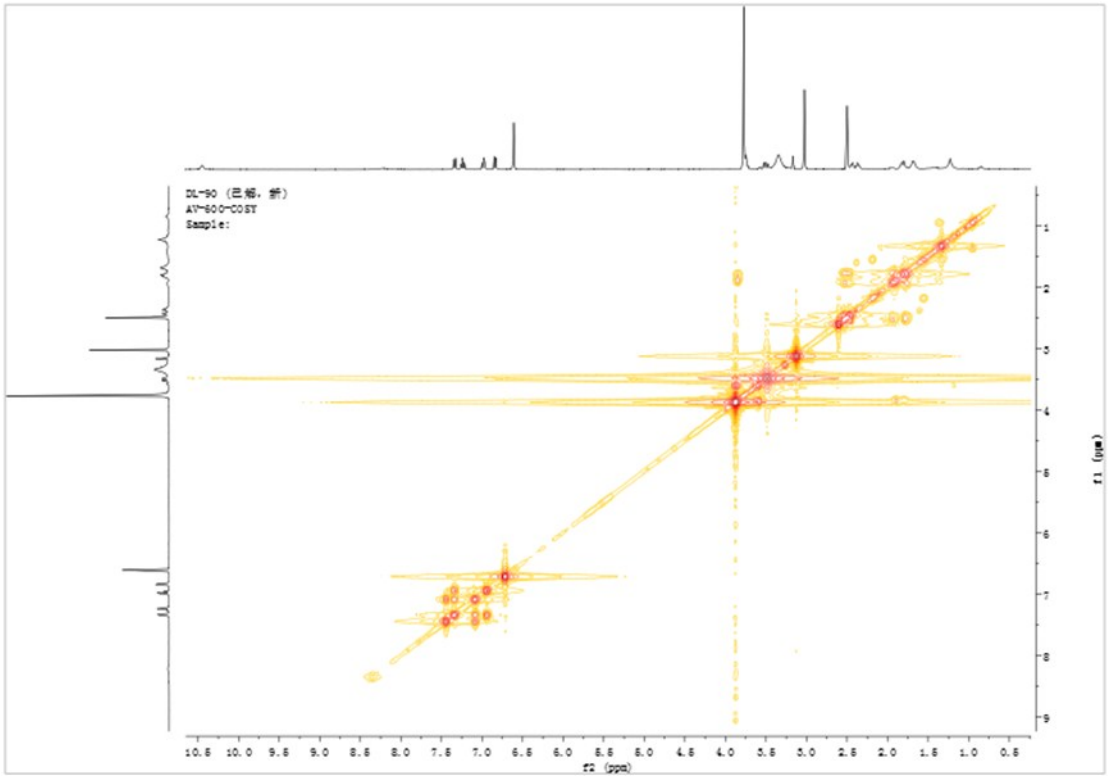


Figure S2.7 The ^{1}H-^{1}H COSY spectrum of compound **2**

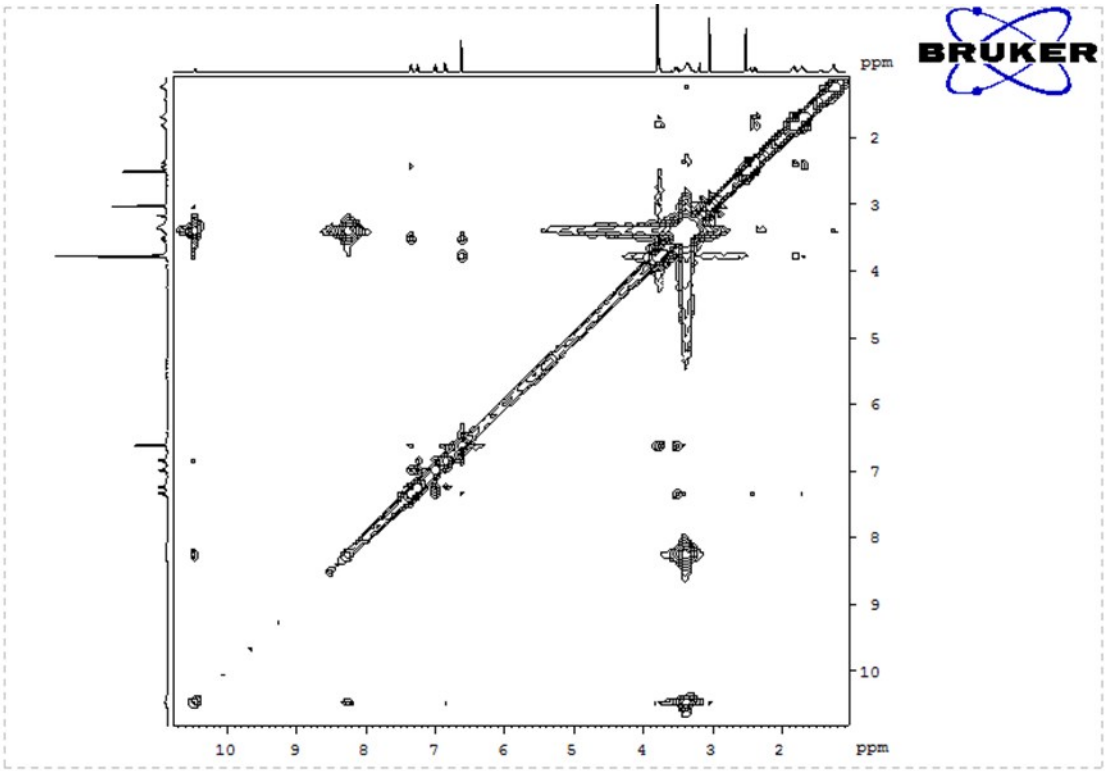


Figure S2.8 The NOESY spectrum of compound **2**

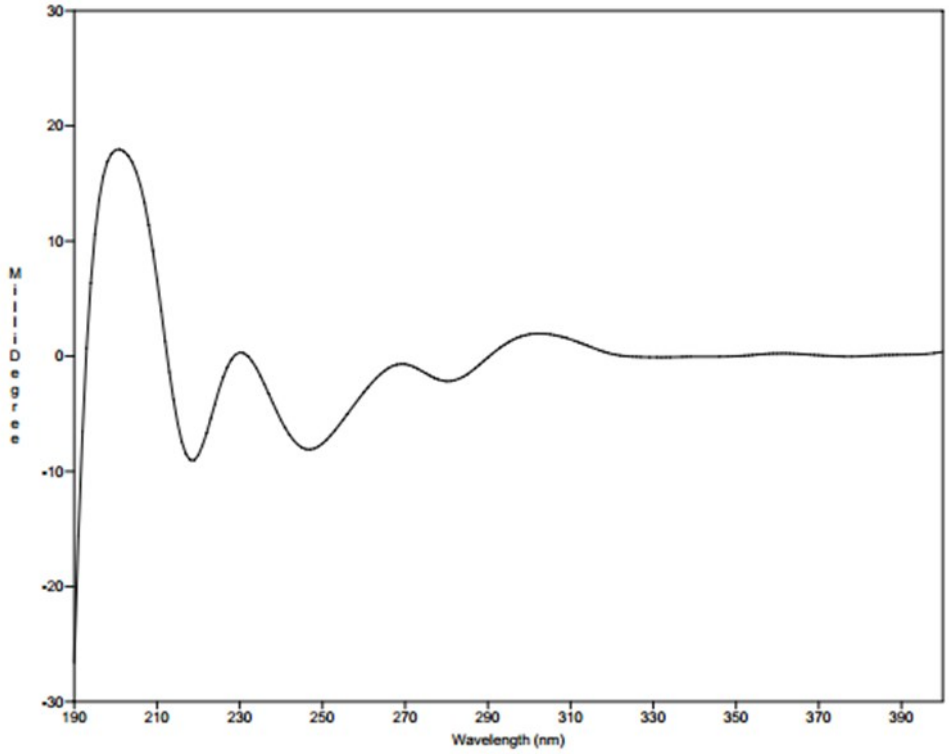


Figure S2.9 The ECD spectrum of compound **2a**

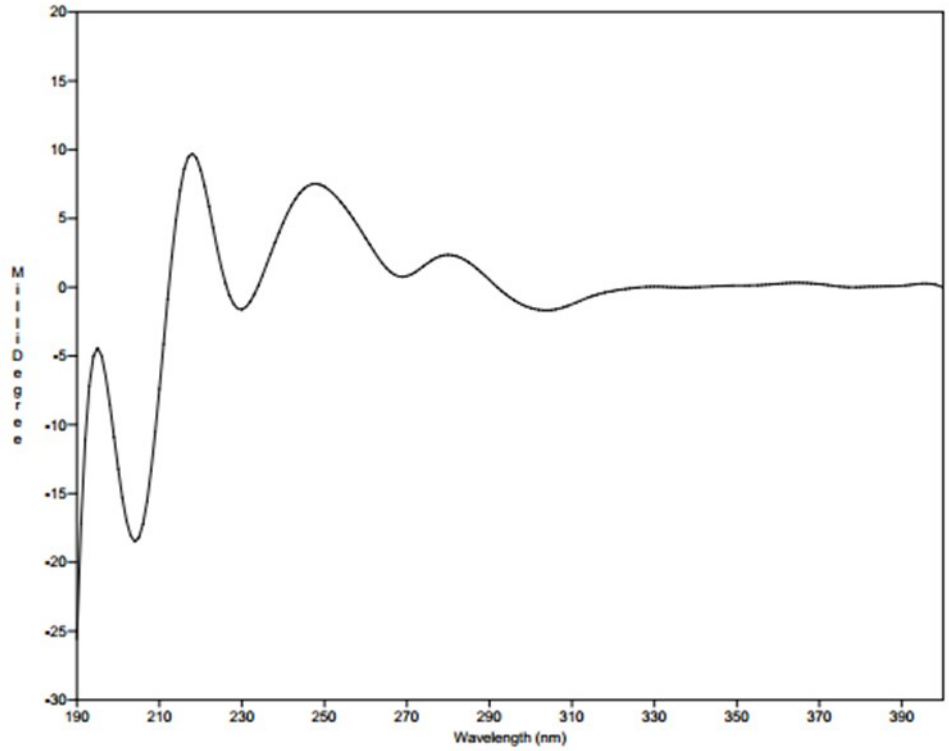


Figure S2.10 The ECD spectrum of compound **2b**

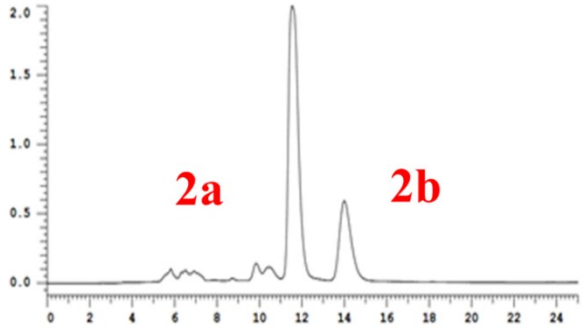


Figure S2.11 The chiral HPLC chromatogram of compounds **2a** and **2b**

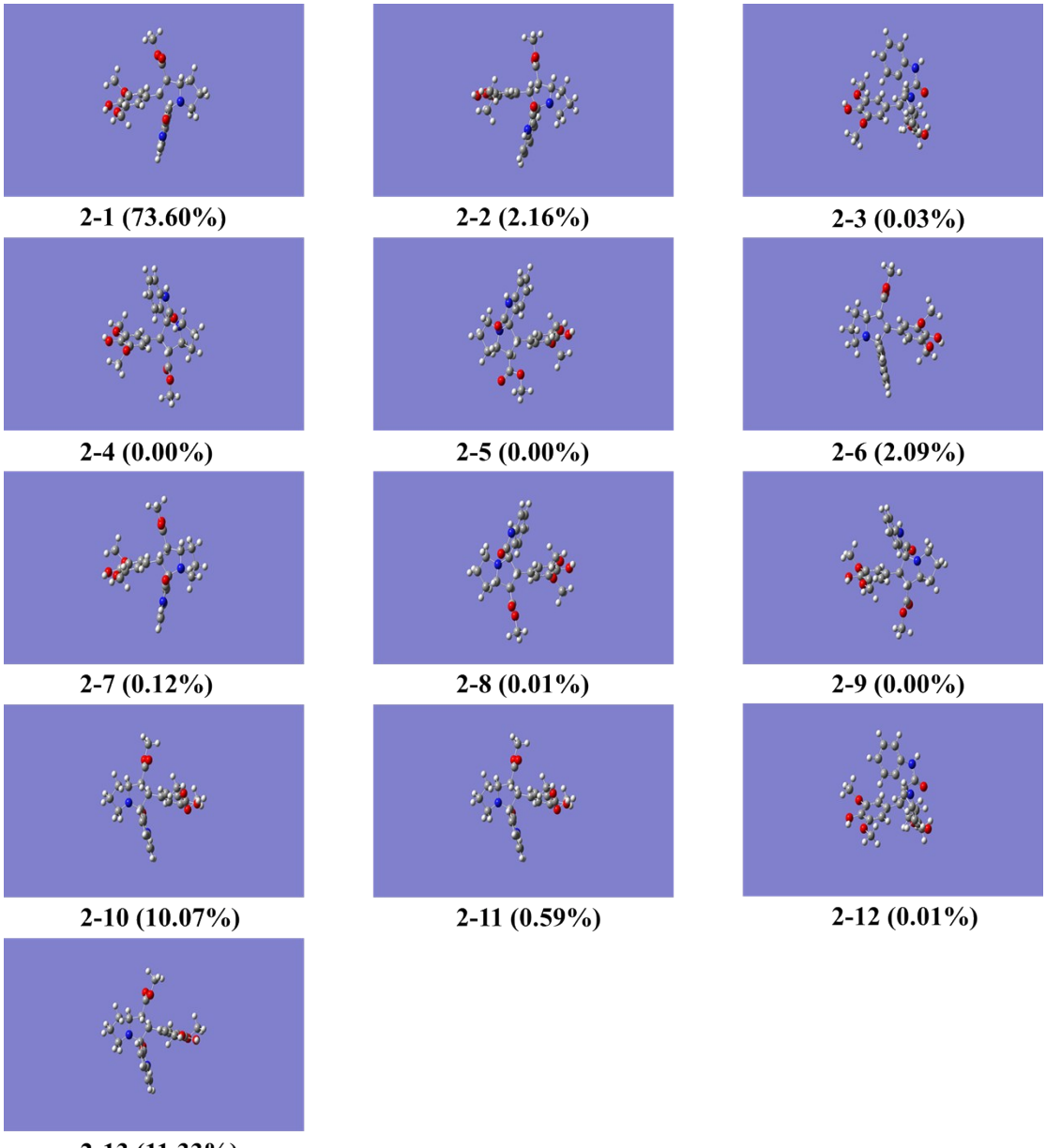
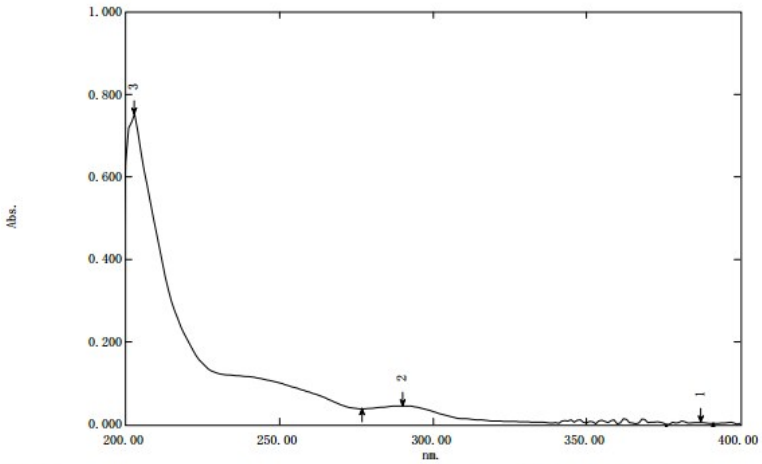


Figure S2.12 Most stable conformers of **2** in solvated model calculations at the B3LYP/6-311+G (2d, p) level



测定属性
波长范围（nm.）： 190.00到400.00
扫描速度： 中速
采样间隔： 1.0
自动采样间隔: 停用
扫描模式： 单一的

试样准备属性

No.	P/V	Wavelength	Abs.	描述
1	↑	387.00	.005	
2	↑	290.00	.045	
3	↑	203.00	.754	
4	↓	391.00	.003	
5	↓	376.00	.000	
6	↓	277.00	.038	

Figure S3.1 The UV spectrum of compound **3**

Mass Spectrum SmartFormula Report

Analysis Info

Analysis Name	D:\Data\20170919CEYANG\DL-78_1-C,3_01_10412.d	Acquisition Date	9/19/2017 11:29:36 AM
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Sample Name	DL-78	Instrument / Ser#	micrOTOF-Q 125
Comment			

Acquisition Parameter

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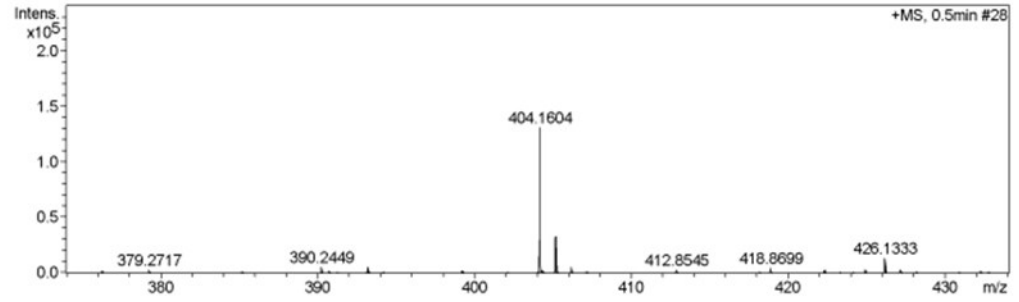


Meas. m/z	#	Formula	m/z	err [ppm]	Mean err [ppm]	rdb	N-Rule	e⁻ Conf	mSigma	Std I	Std Mean m/z	Std I VarNorm	Std m/z Diff	Std Comb Dev
404.1604	1	C 23 H 22 N 3 O 4	404.1605	0.1	4.1	14.5	ok	even	5.20	0.0070	0.0035	0.0037	0.0068	0.8427

Figure S3.2 The HRESIMS spectrum of compound **3**

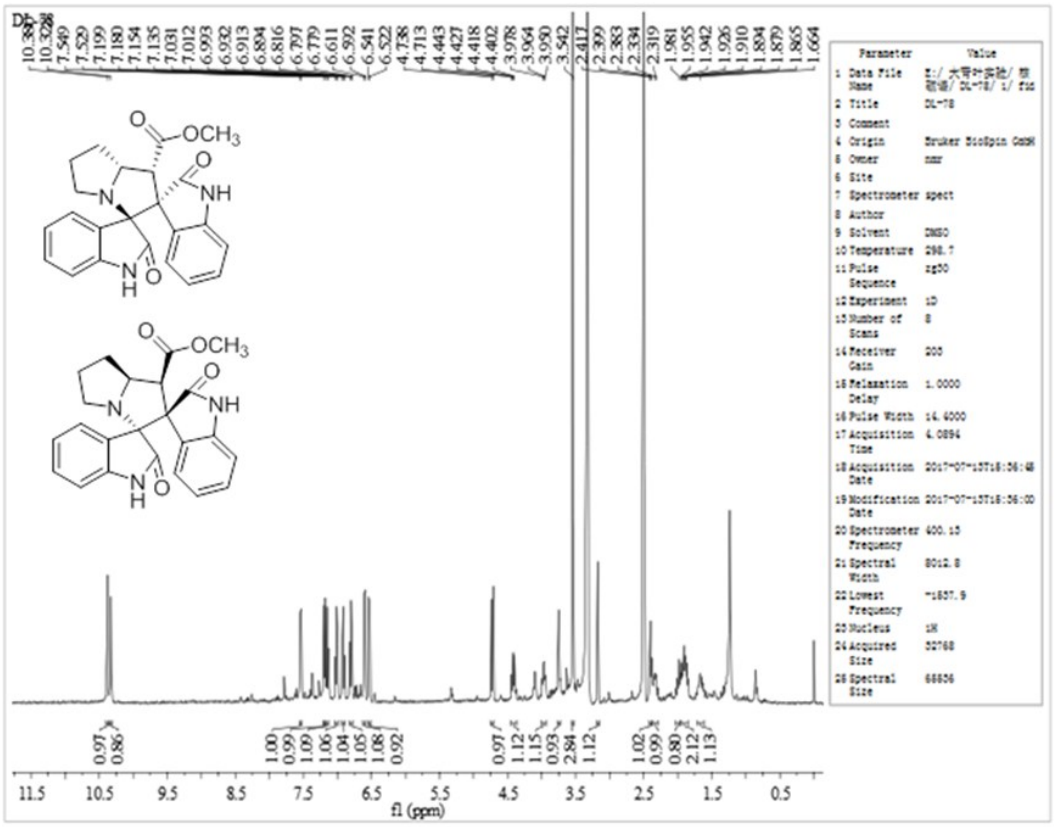


Figure S3.3 The ^{1}H NMR spectrum (400 MHz, DMSO-d_6) of compound **3**

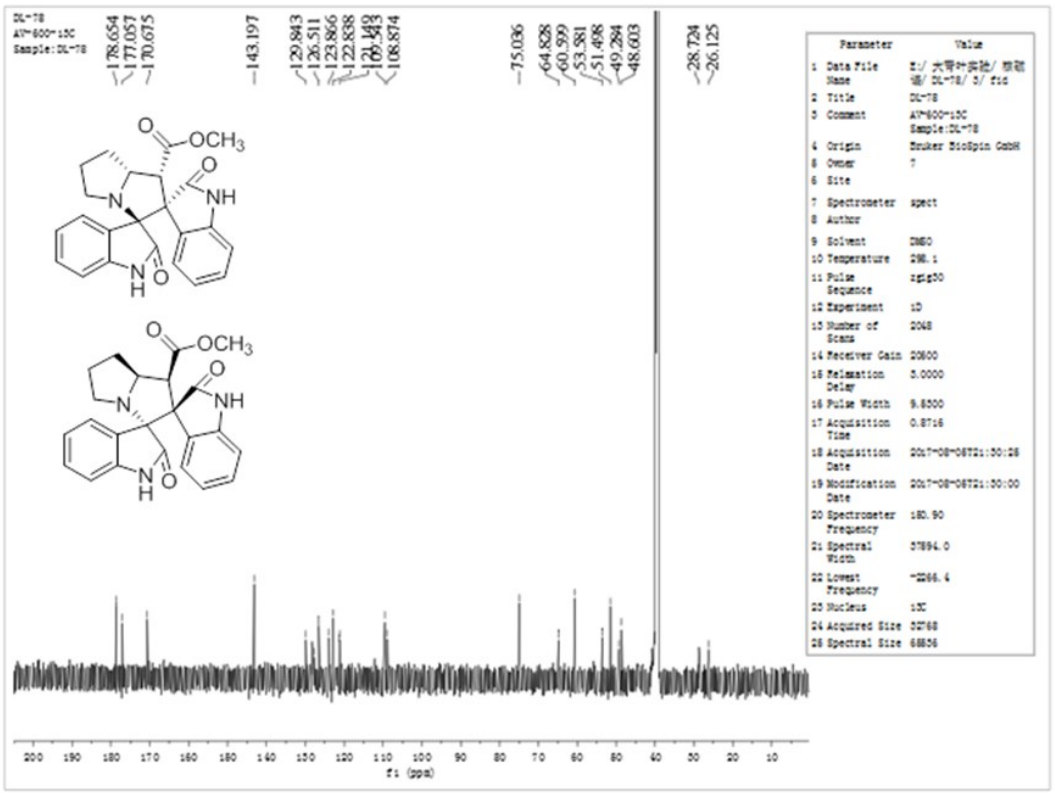


Figure S3.4 The ^{13}C NMR spectrum (100 MHz, DMSO-d_6) of compound **3**

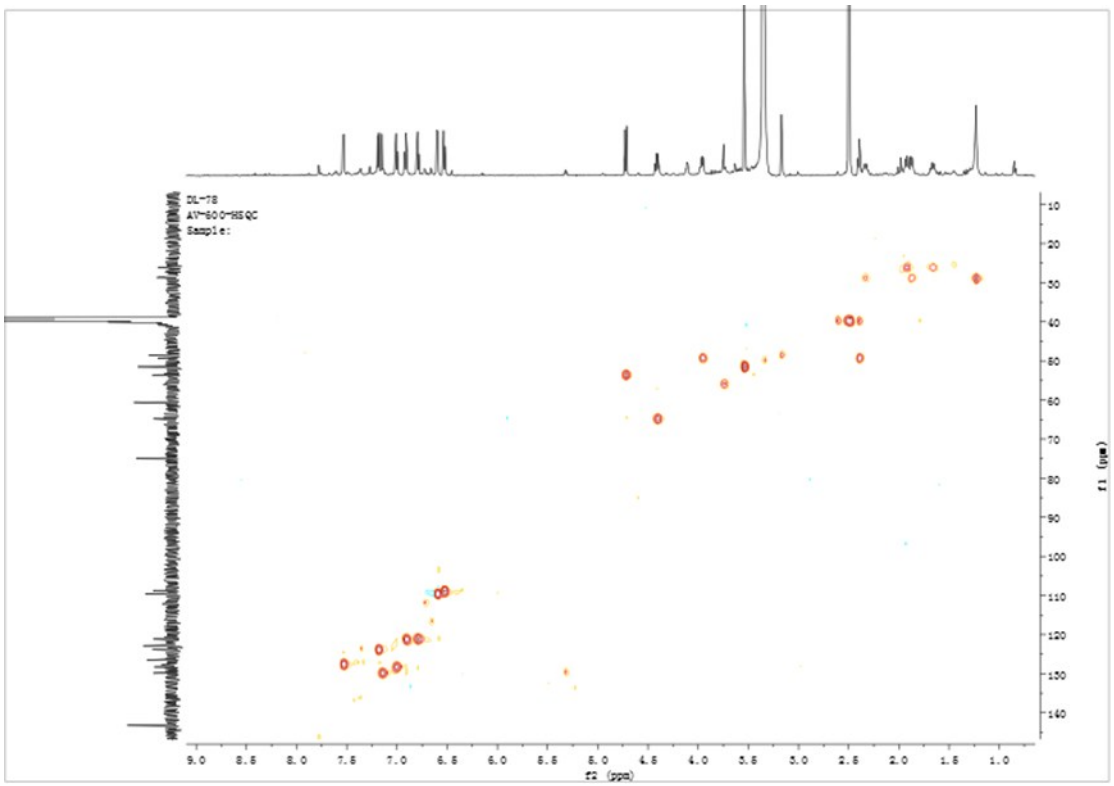


Figure S3.5 The HSQC spectrum of compound **3**

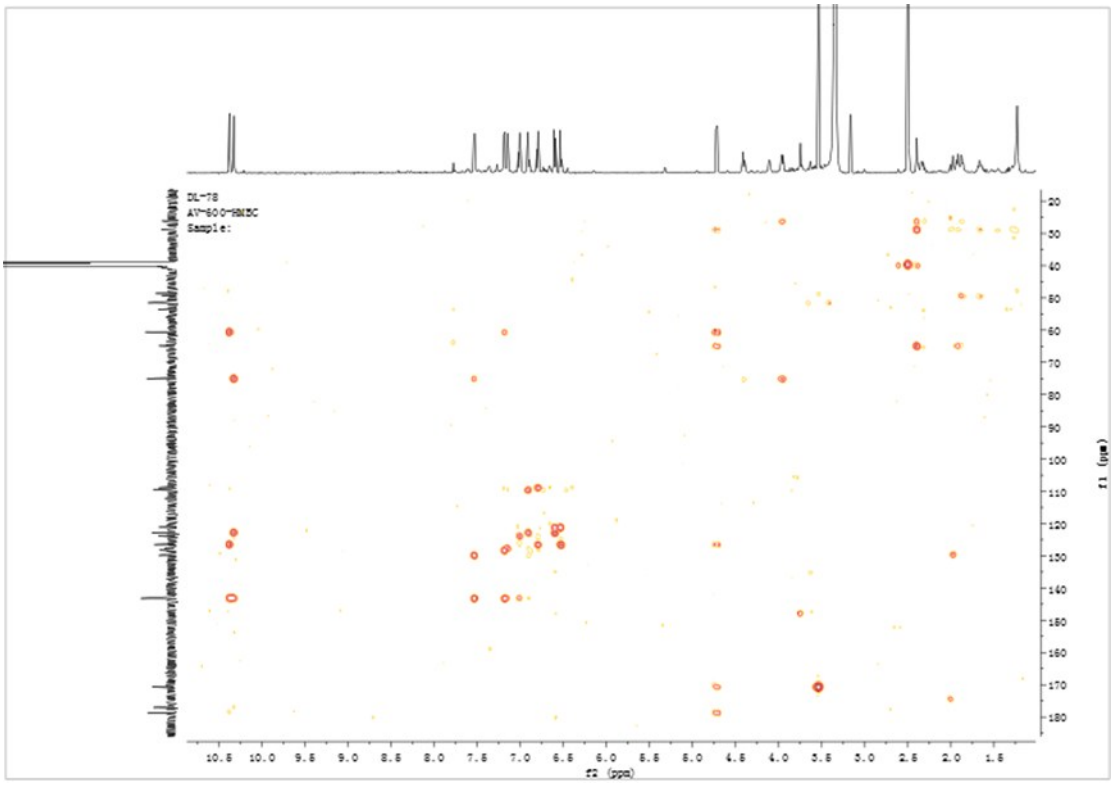


Figure S3.6 The HMBC spectrum of compound **3**

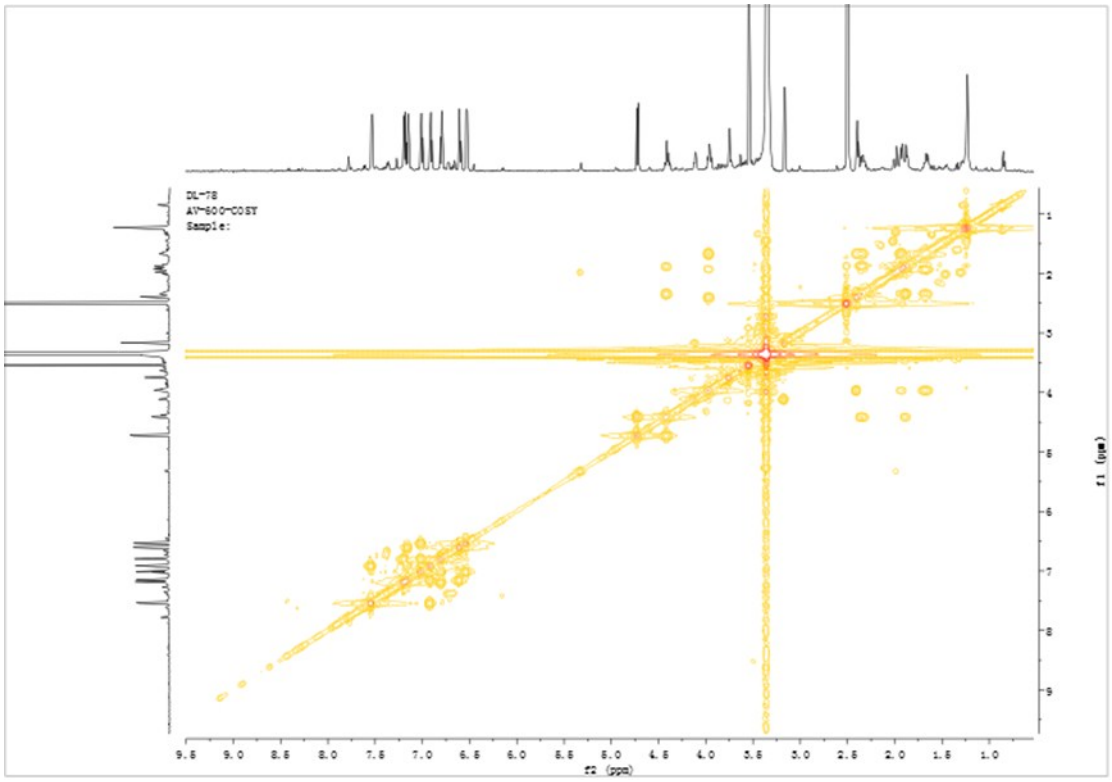


Figure S3.7 The ^{1}H-^{1}H COSY spectrum of compound **3**

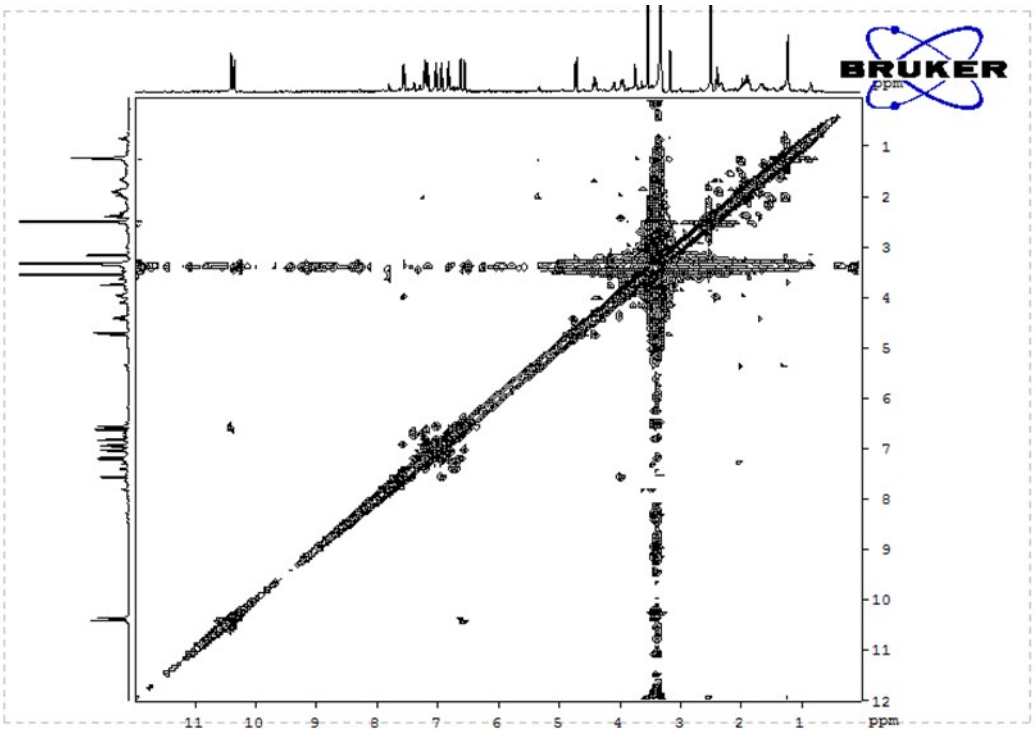


Figure S3.8 The NOESY spectrum of compound **3**

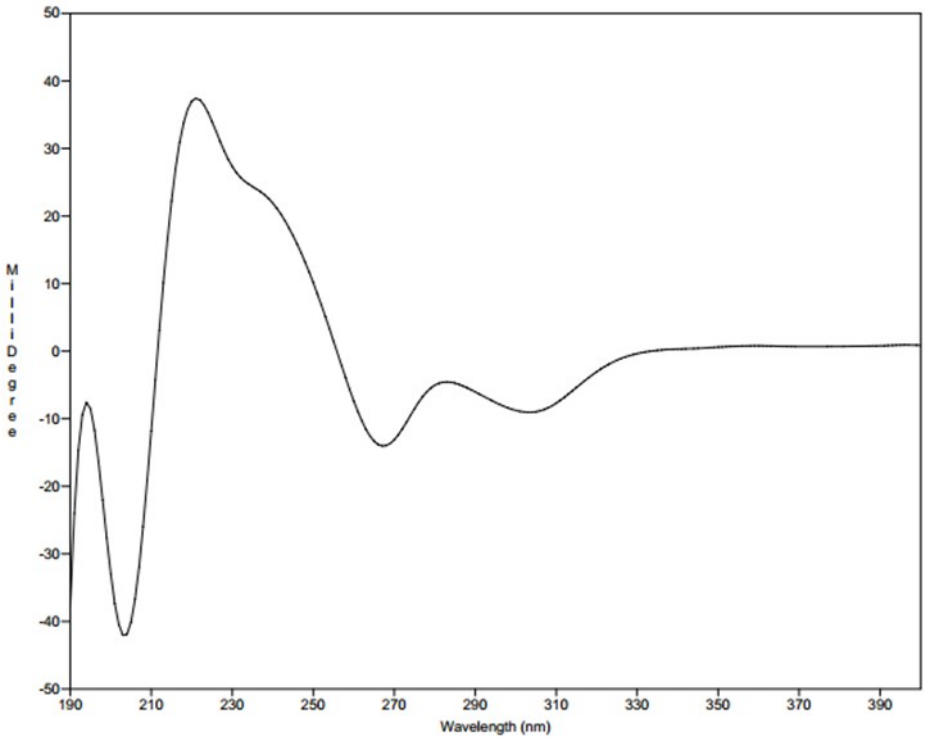


Figure S3.9 The ECD spectrum of compound **3a**

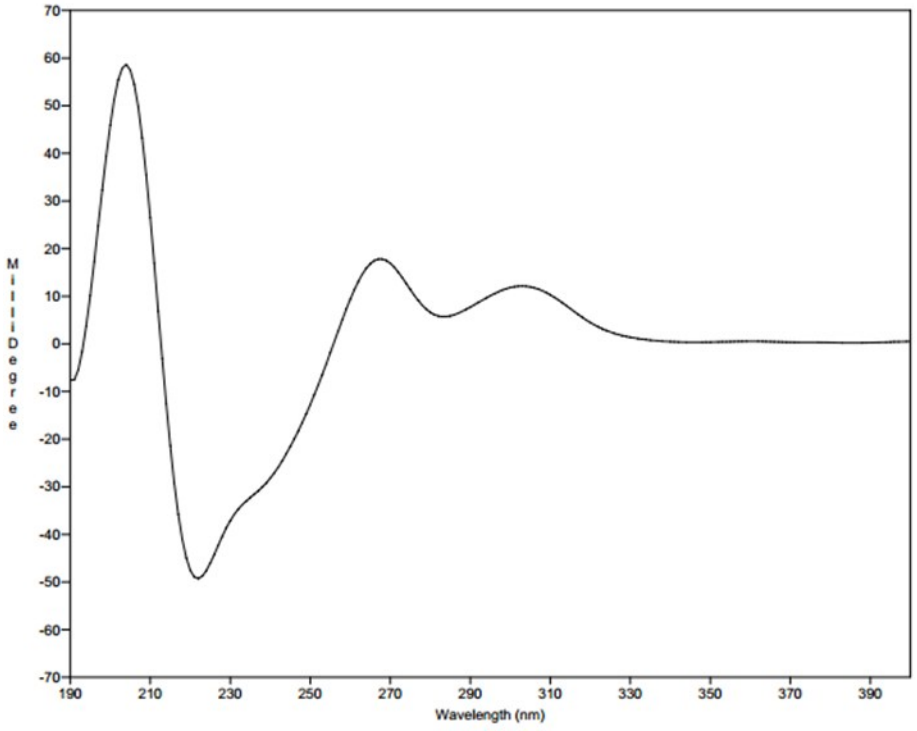


Figure S3.10 The ECD spectrum of compound **3b**

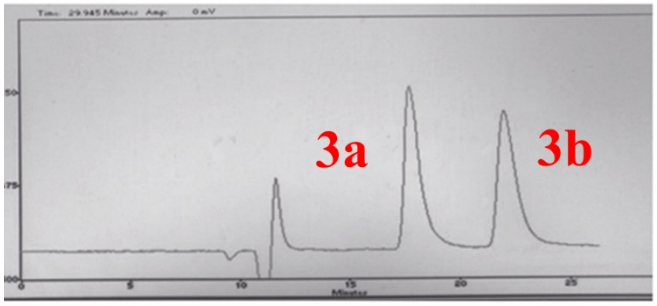


Figure S3.11 The chiral HPLC chromatogram of compounds **3a** and **3b**

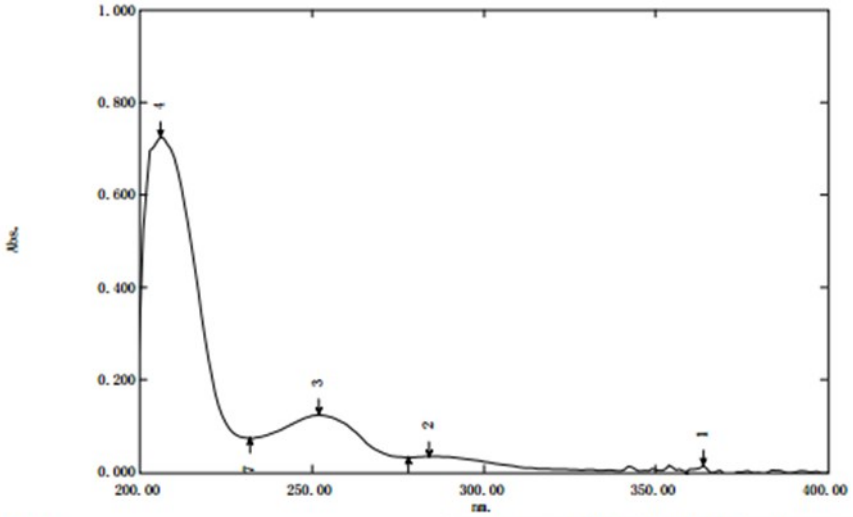
Functional	Solvent?	Basis Set	Type of Data
B3LYP	PCM	6-311+G(d,p)	Unscaled Shifts

		DP4+	100.00%	0.00%	-	-	-
Nuclei	sp2?	xperiment	Isomer 1	Isomer 2	Isomer 3	Isomer 4	Isomer 5
C	x	177.1	185.6	185.7			
C		75	84.2	83.6			
C	x	122.8	132.4	132.4			
C	x	127.6	136.6	135.0			
C	x	121.2	128.1	126.9			
C	x	129.8	137.5	137.7			
C	x	109.5	115.2	114.8			
C	x	143.2	152.1	151.8			
C		64.8	72.9	71.4			
C		28.7	33.7	33.9			
C		26.1	31.9	31.8			
C		49.3	54.76	50.35			
C	x	178.7	188.52	184.79			
C		60.6	69.52	73.94			
C	x	126.5	136.31	139.67			
C	x	123.9	132.48	135.07			
C	x	121.1	128.28	127.88			
C	x	128.3	135.83	136.48			
C	x	108.9	115.02	115.56			
C	x	143.2	151.21	151.33			
C		53.6	63.97	59.85			
C	x	170.7	184.14	183.55			
C		51.5	55.27	55.56			
H		10.33	6.77	6.73			
H	x	7.54	7.88	6.75885084			
H	x	6.91	7.23	6.91097558			
H	x	7.15	7.56	7.52351694			
H	x	6.6	6.92	6.98903396			
H		4.41	4.73	4.91340004			
H		2.33	1.96	2.27575578			
H		1.87	2.52	2.53735606			
H		1.92	2.01	2.10836712			
H		1.66	1.91	2.323393			
H		3.96	4.07	2.700506			
H		2.4	2.59	3.63779178			
H		10.38	7.07	6.87266482			
H	x	7.19	7.51	8.04331778			
H	x	6.8	7.07	7.39262602			
H	x	7.01	7.35	7.62329222			
H	x	6.53	6.9	6.98667378			
H		4.73	5.15	5.10987944			
H		3.54	3.7	3.61684674			
H		3.54	3.66	3.2723467			
H		3.54	3.64	3.37781042			

Figure S3.12 The DP4+ probability analysis of compound **3**

3-1 (95.15%) **3-2 (4.85%)**

Figure S3.13 Most stable conformers of **3** in solvated model calculations at the B3LYP/6-311+G (2d, p) level



测定属性
波长范围（nm.）： 190.00到400.00
扫描速度： 中速
采样间隔： 1.0
自动采样间隔: 停用
扫描模式： 单一的

试样准备属性

No.	P/V	Wavelength	Abs.	描述
1	↑	364.00	.014	
2	↑	284.00	.034	
3	↑	252.00	.124	
4	↑	206.00	.726	
5	↓	359.00	.001	
6	↓	278.00	.032	
7	↓	232.00	.074	

Figure S4.1 The UV spectrum of compound **4**

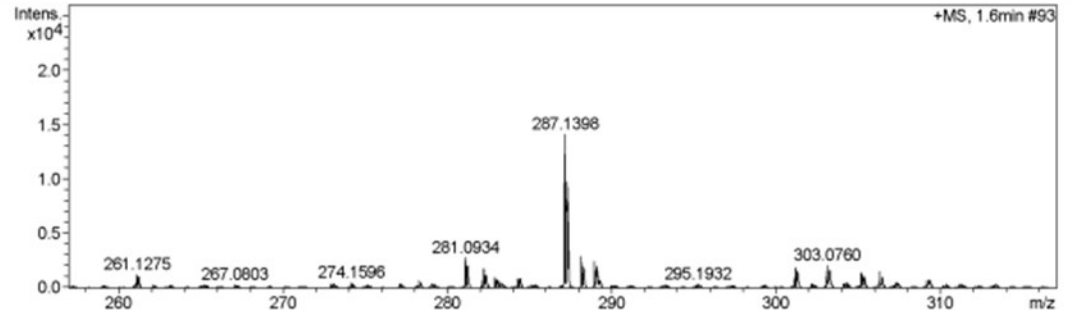
Mass Spectrum SmartFormula Report

Analysis Info

Analysis Name	D:\Data\20170613CEYANG\C3-4-2_1-F,1_01_9961.d	Acquisition Date	6/13/2017 2:30:13 PM
Method	20131026_ceyang b-ch3oh.m	Operator	Bruker Customer
Sample Name	C3-4-2	Instrument / Ser#	micrOTOF-Q 125
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	1.2 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	180 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	8.0 l/min
Scan End	1500 m/z	Set Collision Cell RF	400.0 Vpp	Set Divert Valve	Source



Meas. m/z	#	Formula	m/z	err [ppm]	Mean err [ppm]	rdb	N-Rule	e⁻ Conf	mSigma	Std I	Std Mean m/z	Std I VarNorm	Std m/z Diff	Std Comb Dev
287.1398	1	C 16 H 19 N 2 O 3	287.1390	-2.7	-1.9	8.5	ok	even	18.45	0.0297	0.0007	0.0177	0.0012	0.8427

Figure S4.2 The HRESIMS spectrum of compound **4**

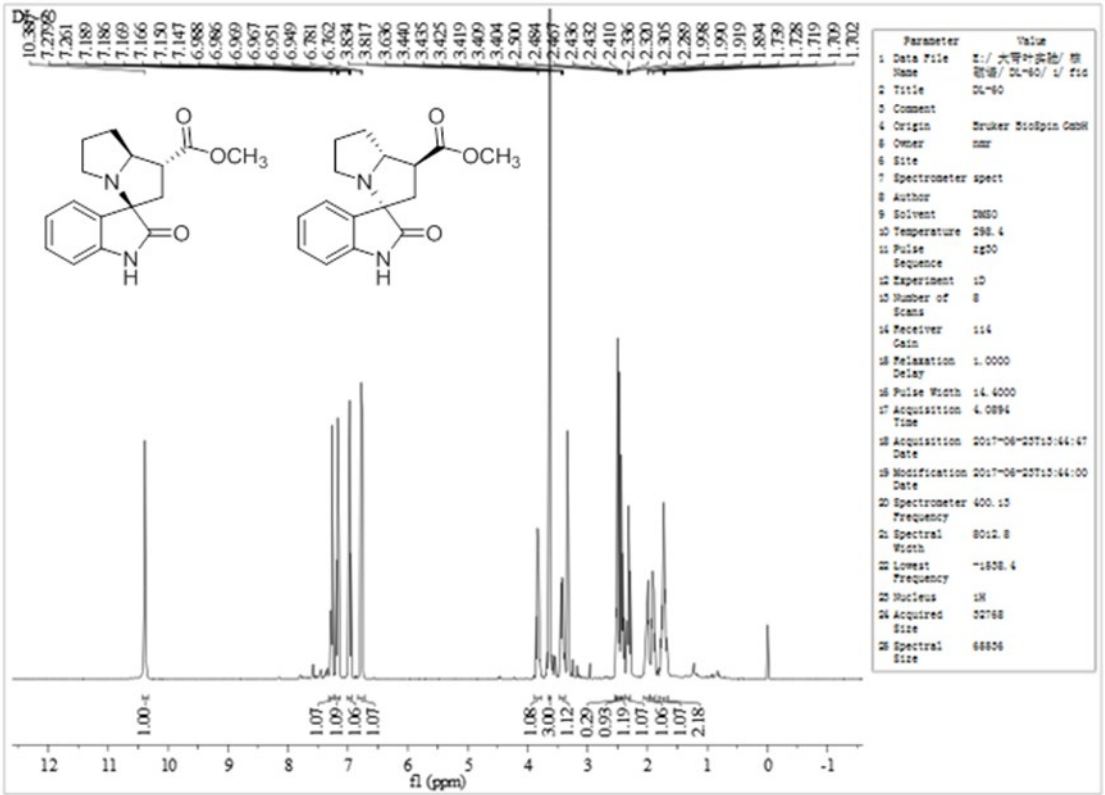


Figure S4.3 The ^{1}H NMR spectrum (400 MHz, DMSO-d_6) of compound **4**

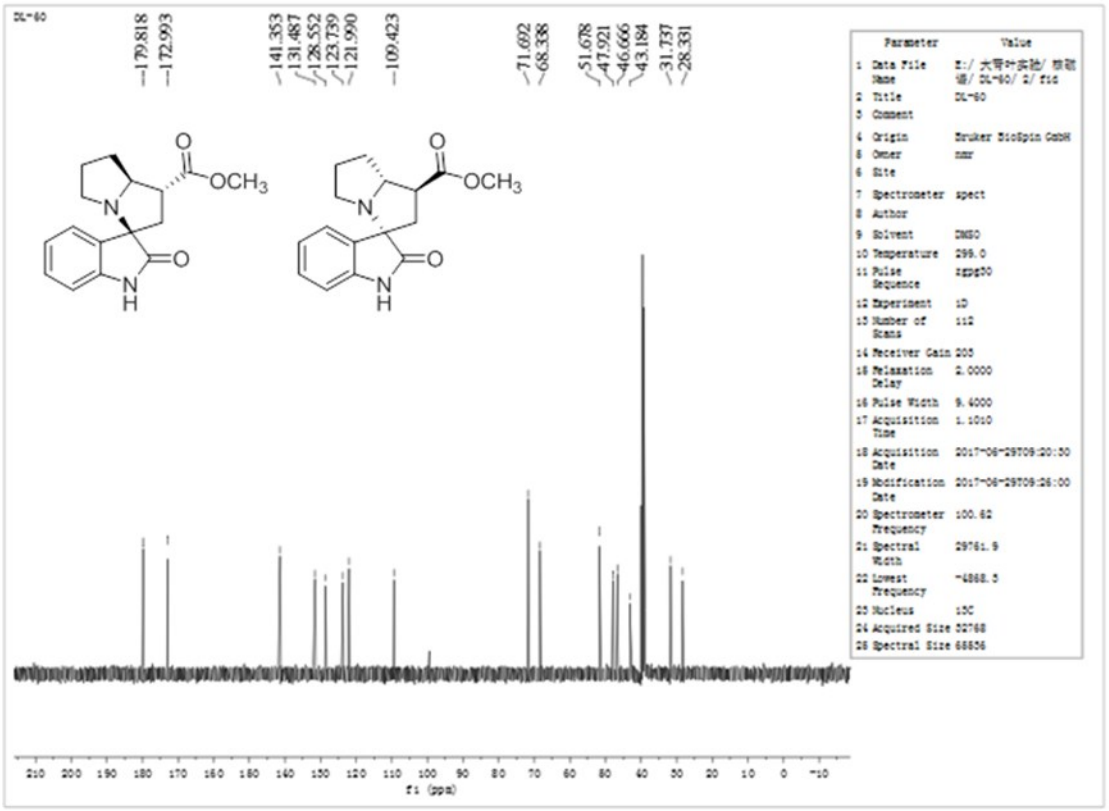


Figure S4.4 The ^{13}C NMR spectrum (100 MHz, DMSO-d_6) of compound **4**

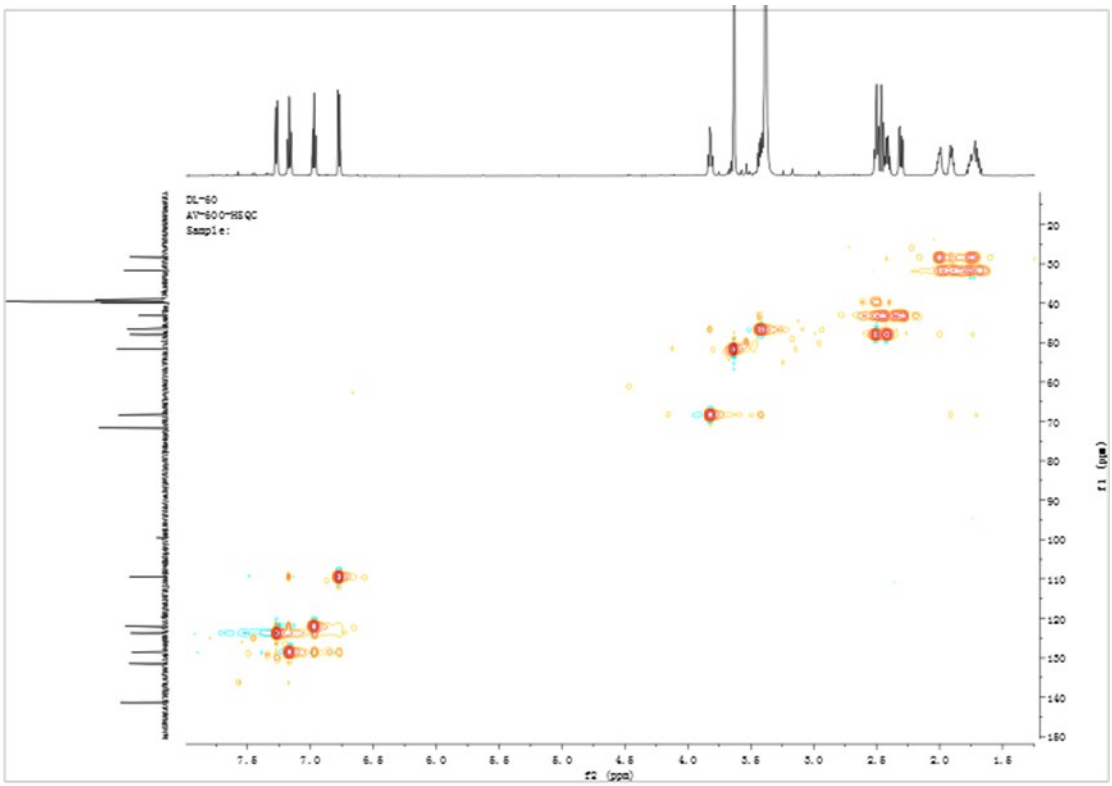


Figure S4.5 The HSQC spectrum of compound **4**

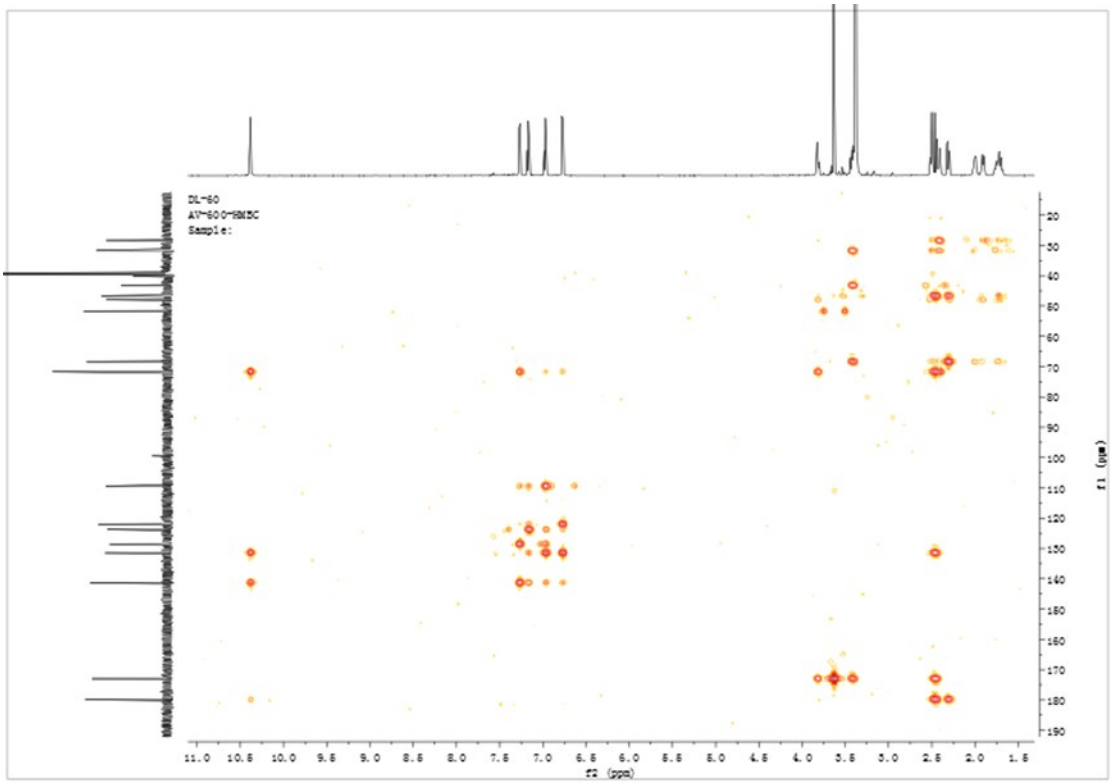


Figure S4.6 The HMBC spectrum of compound **4**

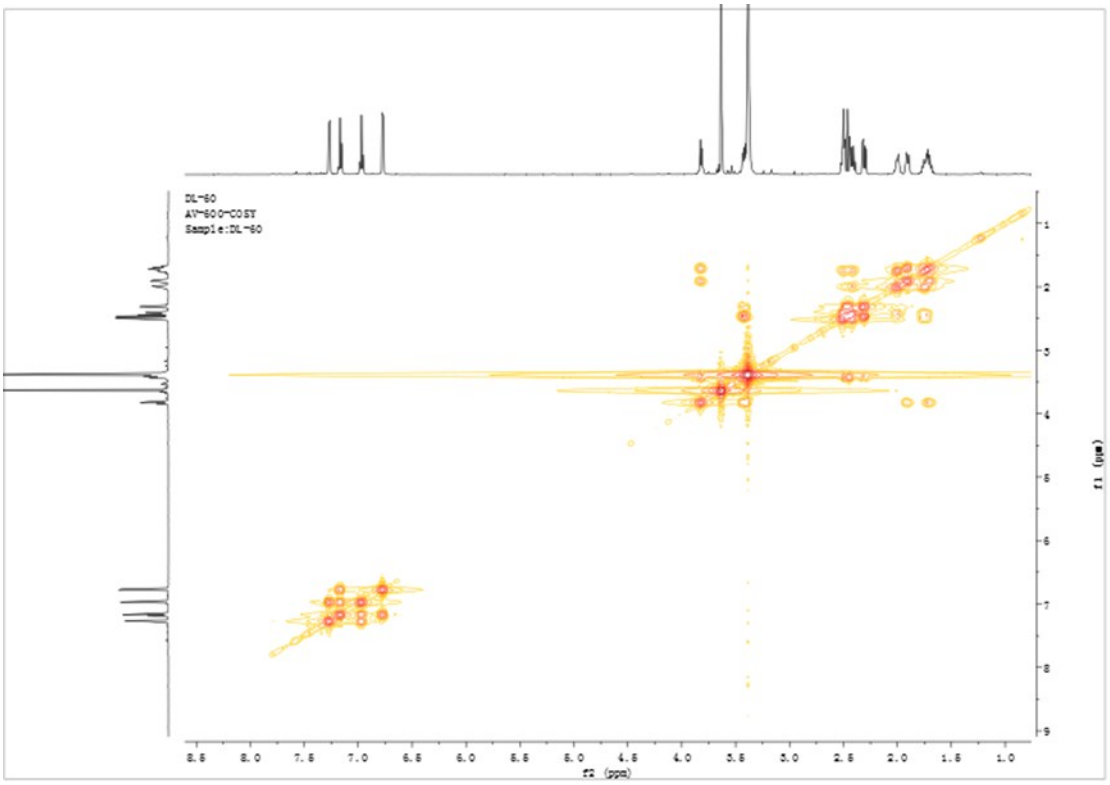


Figure S4.7 The ^{1}H-^{1}H COSY spectrum of compound **4**

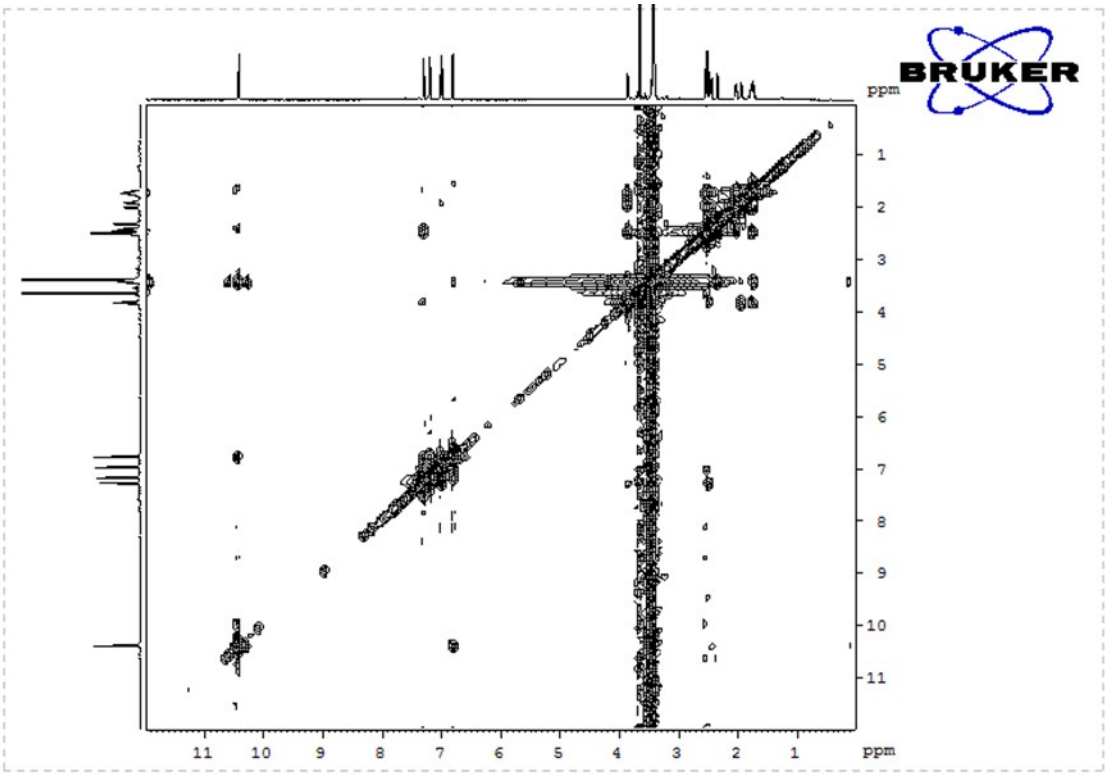


Figure S4.8 The NOESY spectrum of compound **4**

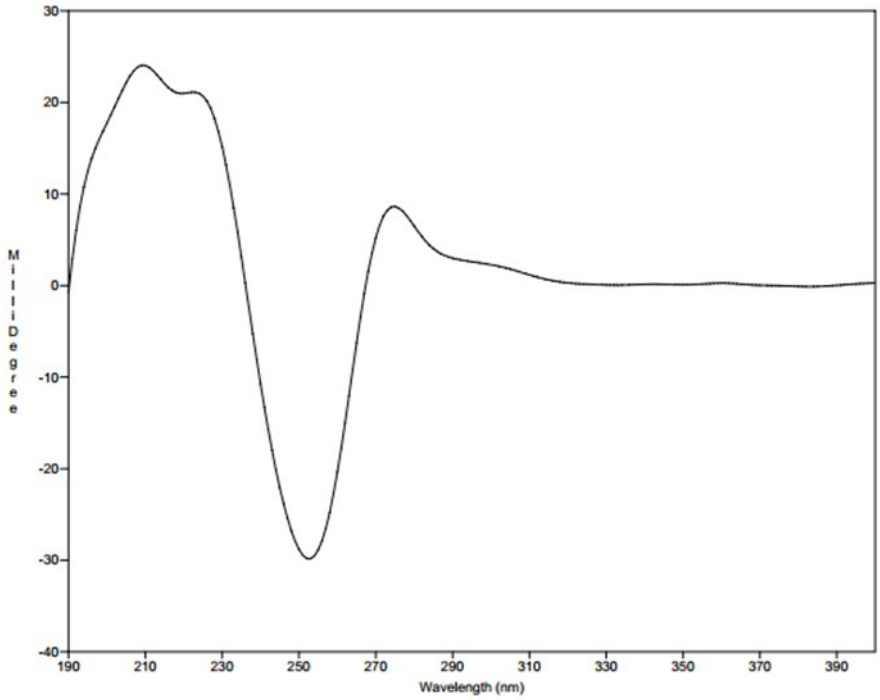


Figure S4.9 The ECD spectrum of compound **4a**

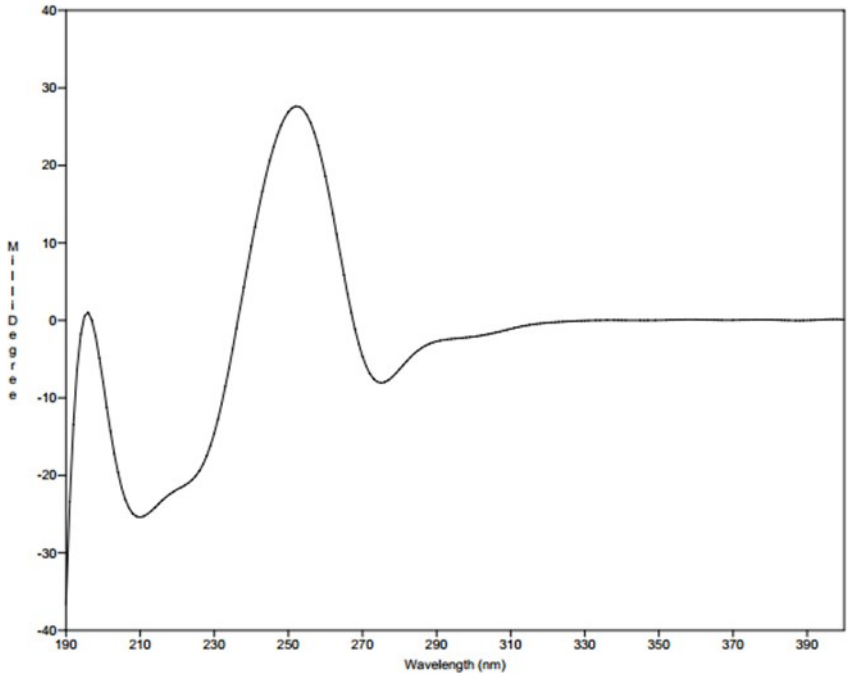


Figure S4.10 The ECD spectrum of compound **4b**

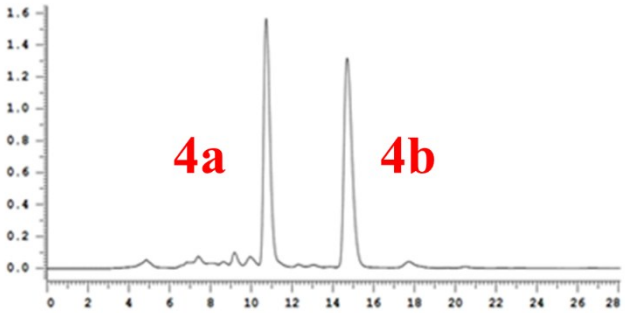


Figure S4.11 The chiral HPLC chromatogram of compounds **4a** and **4b**

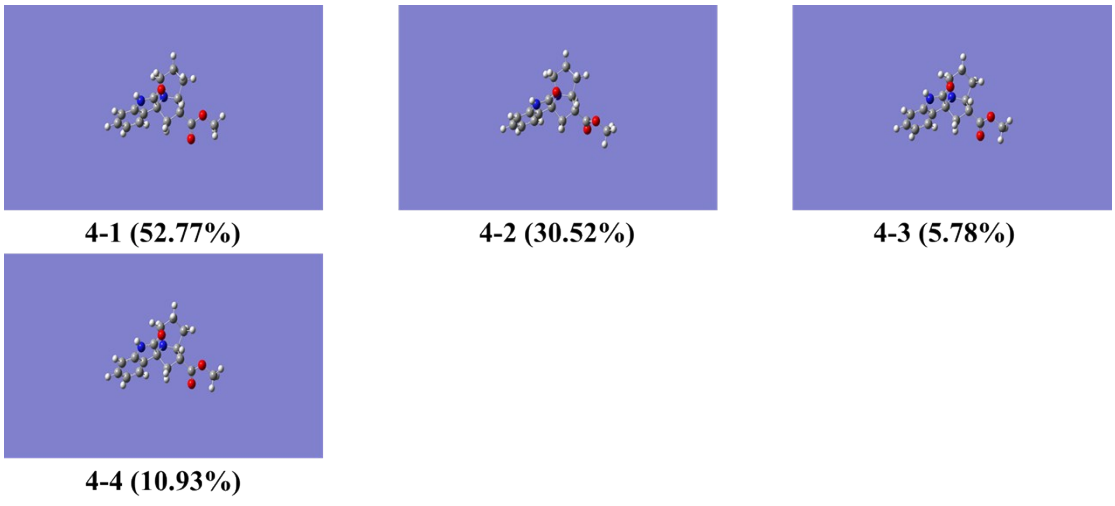


Figure S4.12 Most stable conformers of **4** in solvated model calculations at the B3LYP/6-311+G (2d, p) level

Table S1

Computed ^{13}C NMR chemical shifts for compound **3** at B3LYP/6–311+G(2d,p) basis set with polarizable continuum model PCM in DMSO-d_6 solvent (δ in ppm).

Position	Scal. calc. (QCP-1)	Scal. calc. (QCP-2)
2	176.2	176.3
3	77.1	78.0
3a	124.3	124.6
4	128.0	126.6
5	119.2	118.7
6	128.7	129.0
7	106.7	106.8
7a	142.9	143.2
2′	66.0	65.0
3′	27.5	28.4
4′	26.2	26.0
5′	48.5	46.1
2″	179.5	175.6
3″	63.2	65.7
3″a	127.8	131.3
4″	124.1	126.3
5″	119.6	119.6
6″	126.7	128.4
7″	106.9	107.3
7″a	142.2	142.7
1‴	56.8	54.2
2‴	174.6	174.1
AveDev	1.5	1.8
MaxDev	4.0	5.1
R^2	0.9984	0.9972

Table S2

Computed ^{13}C NMR chemical shifts for compound **3** at B3LYP/6–311+G(d,p) basis set with polarizable continuum model PCM in DMSO-d_6 solvent (δ in ppm).

Position	Scal. calc. (QCP-1)	Scal. calc. (QCP-2)
2	185.6	185.7
3	84.2	83.6
3a	132.4	132.4
4	136.6	135.0
5	128.1	126.9
6	137.5	137.7
7	115.2	114.8
7a	152.1	151.8
2′	72.9	71.4
3′	33.7	33.9
4′	31.9	31.8
5′	54.8	50.3
2″	188.5	184.8
3″	69.5	73.9
3″a	136.3	139.7
4″	132.5	135.1
5″	128.3	127.9
6″	135.8	136.5
7″	115.0	115.6
7″a	151.2	151.3
1‴	64.0	59.8
2‴	184.1	183.5
2‴-OCH_3	55.3	55.6
R^2	0.9989	0.9984