

Supplementary Information for

Unusual prenylated phenols with antioxidant and immunosuppressive activities from the Edible Mushroom *Lentinula edodes*

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Contents

1. Spectral Figures.....	2
Fig. S1. ¹ H NMR spectrum of 1 (600 MHz, CD ₃ OD).....	2
Fig. S2. ¹ H NMR spectrum of 1 (500 MHz, DMSO- <i>d</i> ₆).....	2
Fig. S3. ¹³ C and DEPT NMR spectra of 1 (150 MHz, CD ₃ OD).....	3
Fig. S4. ¹³ C NMR spectrum of 1 (125 MHz, DMSO- <i>d</i> ₆).....	3
Fig. S5. HSQC spectrum of 1	4
Fig. S6. HMBC spectrum of 1	4
Fig. S7. ROESY spectrum of 1	5
Fig. S8. HRESIMS report of 1	6
Fig. S9. IR spectrum of 1	7
Fig. S10. UV spectrum of 1	7
Fig. S11. ¹ H NMR spectrum of 2 (600 MHz, CD ₃ OD).....	8
Fig. S12. ¹³ C and DEPT NMR spectra of 2 (150 MHz, CD ₃ OD).....	8
Fig. S13. HSQC spectrum of 2	9
Fig. S14. HMBC spectrum of 2	9
Fig. S15. ROESY spectrum of 2	10
Fig. S16. HRESIMS report of 2	11
Fig. S17. IR spectrum of 2	12
Fig. S18. UV spectrum of 2	12
2. Single crystal X-ray diffraction data for 6	13
3. Chiral phase HPLC analysis results of compounds 1 and 2	14
4. Computational details for compounds 1 and 4	14
Reference.....	15

1. Spectral Figures

Fig. S1. ¹H NMR spectrum of 1 (600 MHz, CD₃OD)

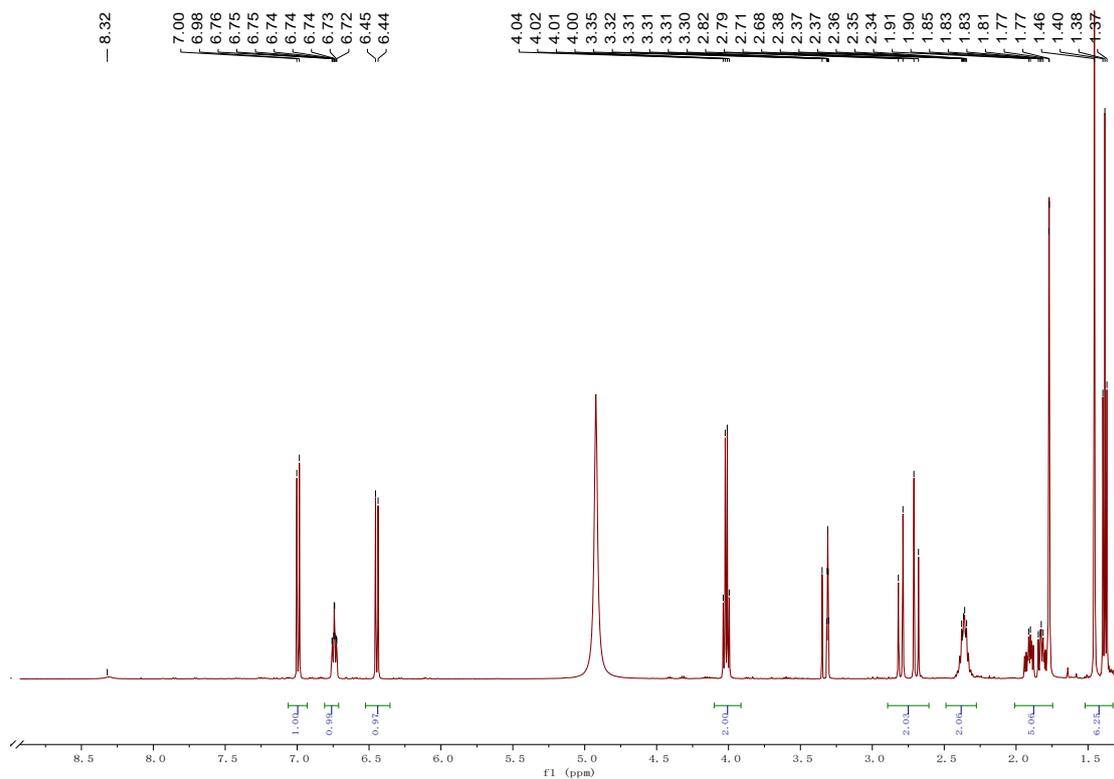


Fig. S2. ¹H NMR spectrum of 1 (500 MHz, DMSO-*d*₆)

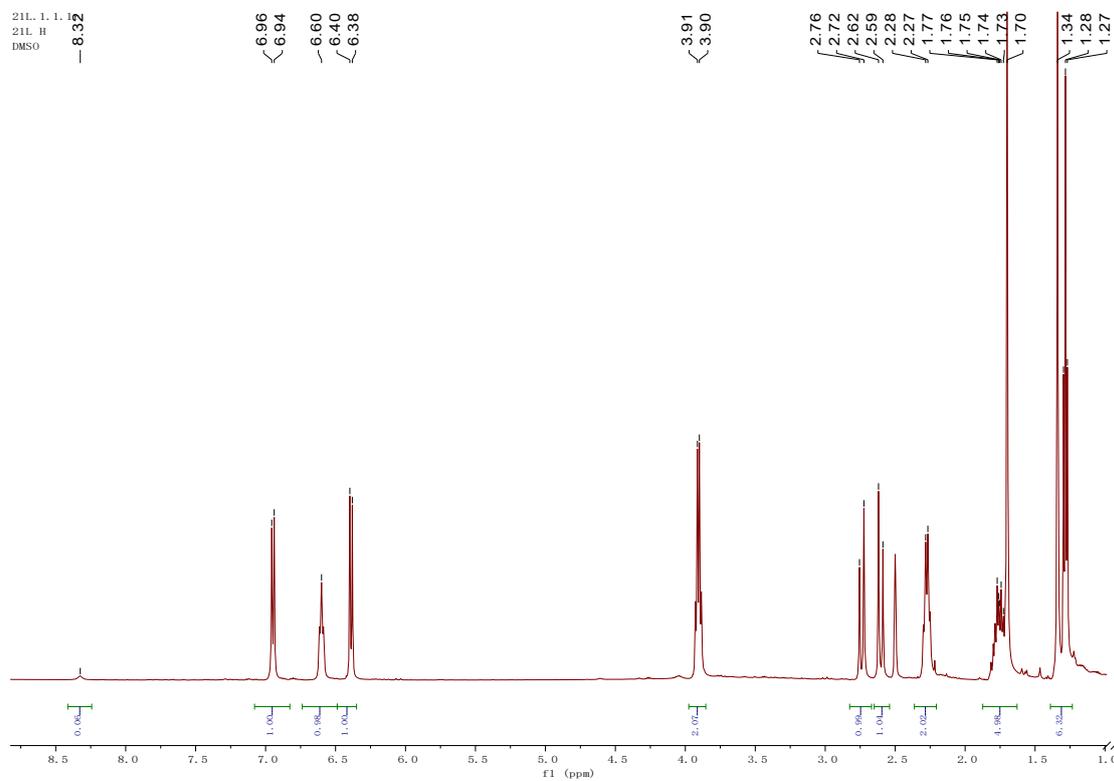


Fig. S3. ^{13}C and DEPT NMR spectra of **1** (150 MHz, CD_3OD)

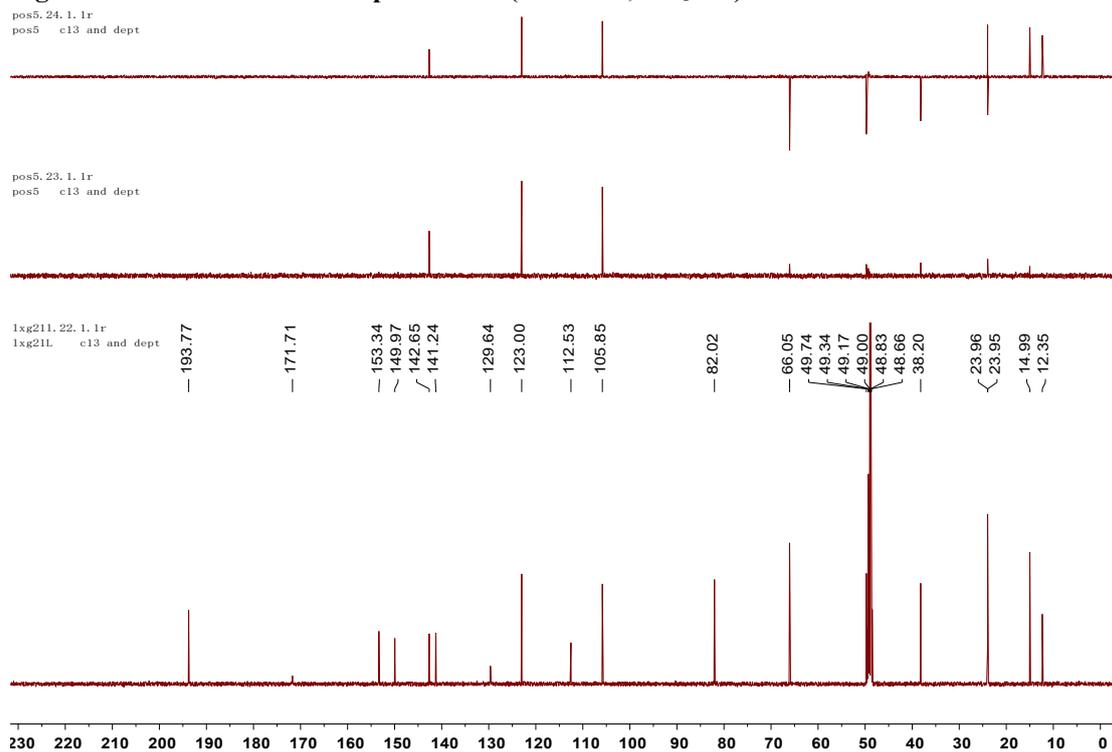


Fig. S4. ^{13}C NMR spectrum of **1** (125 MHz, $\text{DMSO}-d_6$)

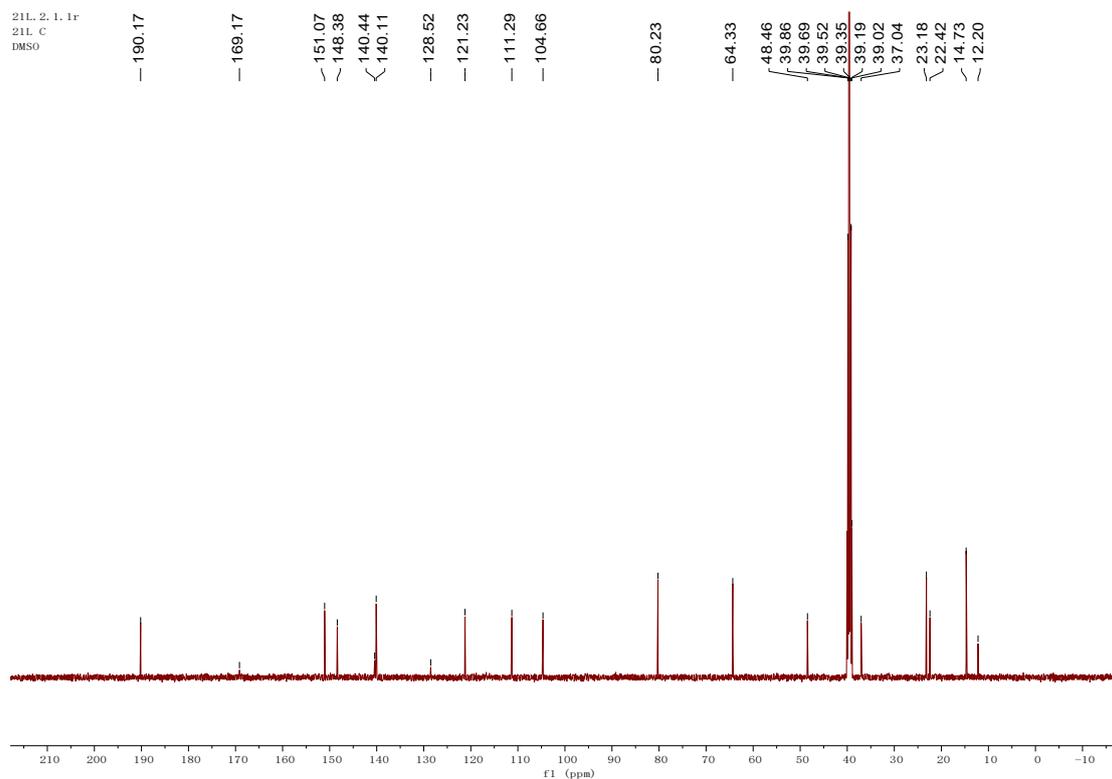


Fig. S5. HSQC spectrum of 1

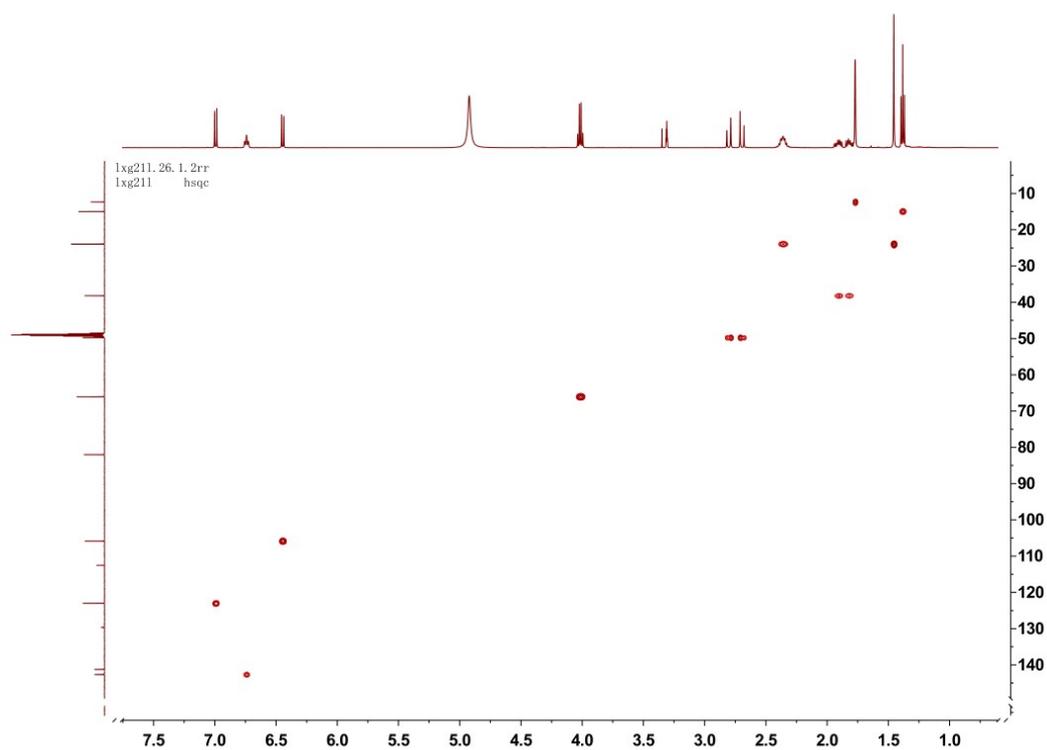


Fig. S6. HMBC spectrum of 1

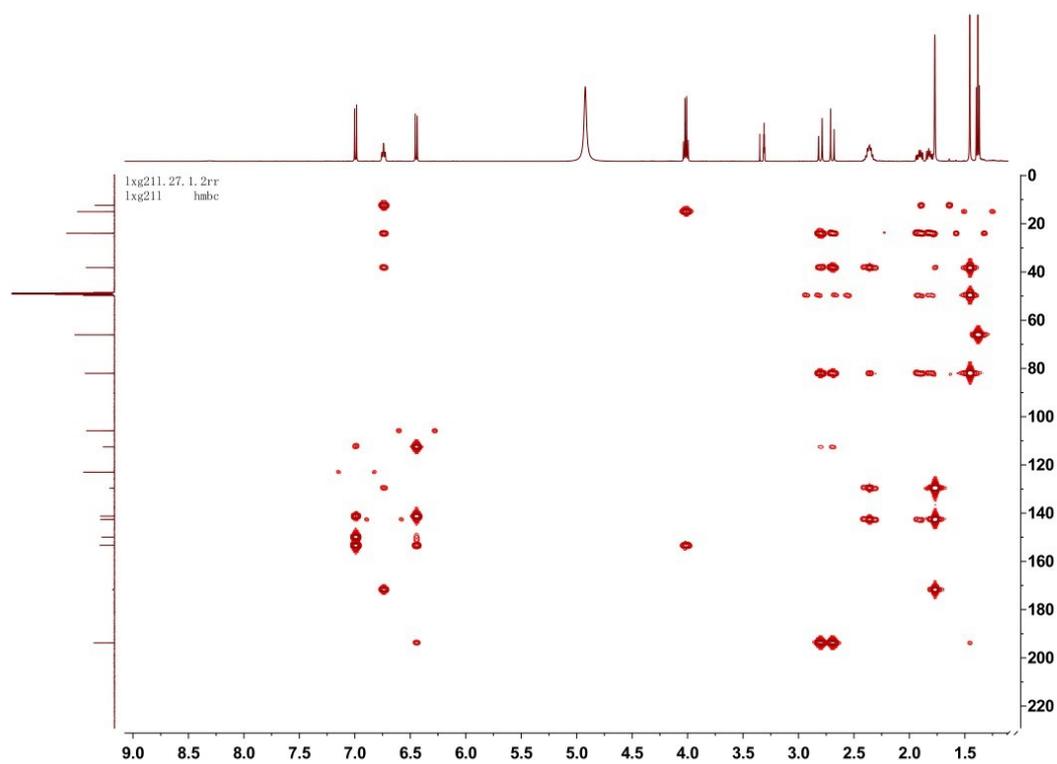


Fig. S7. ROESY spectrum of 1

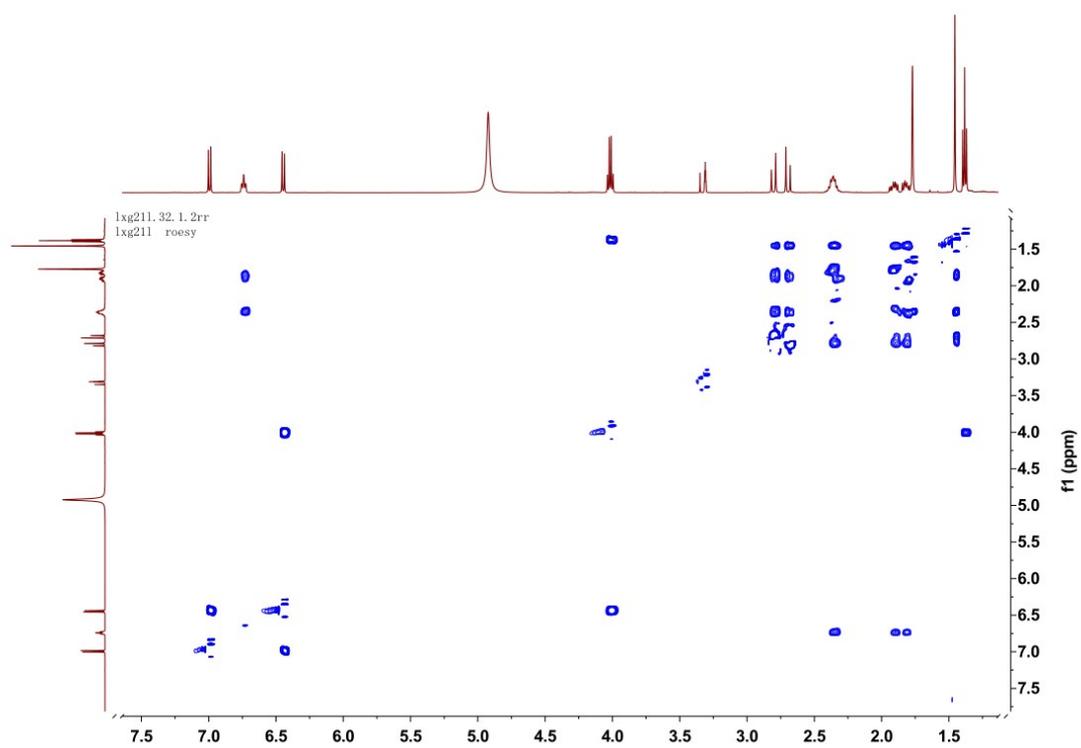
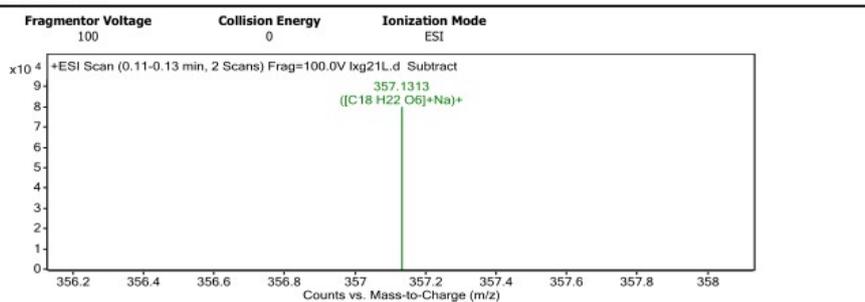


Fig. S8. HRESIMS report of 1

Qualitative Analysis Report

Data Filename	lxg21L.d	Sample Name	lxg21L
Sample Type	Sample	Position	P1-A3
Instrument Name	Instrument 1	User Name	
Acq Method	s.m	Acquired Time	5/3/2018 10:08:04 AM
IRM Calibration Status	Success	DA Method	Default.m
Comment			
Sample Group		Info.	
Acquisition SW	6200 series TOF/6500 series		
Version	Q-TOF B.05.01 (B5125.2)		

User Spectra



Peak List

m/z	z	Abund	Formula	Ion
260.1106		2905.77		
335.1462	1	7859.19		
357.1313	1	80481.74	C18 H22 O6	(M+Na)+
358.1344	1	14847.64	C18 H22 O6	(M+Na)+
373.1051	1	17647.83		
374.1071	1	3133.83		
592.2538	1	3695.99		
691.2742	1	2807.16		

Formula Calculator Element Limits

Element	Min	Max
C	3	60
H	0	120
O	0	30
N	0	3

Formula Calculator Results

Formula	CalculatedMass	CalculatedMz	Mz	Diff. (mDa)	Diff. (ppm)	DBE
C18 H22 O6	334.1416	357.1309	357.1313	-0.40	-1.12	8.0000

--- End Of Report ---

Fig. S9. IR spectrum of 1

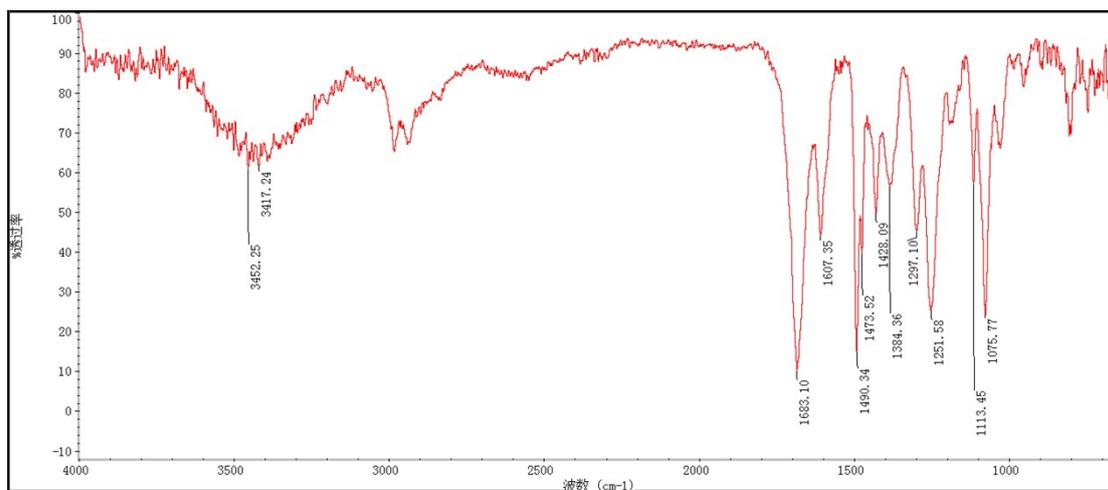
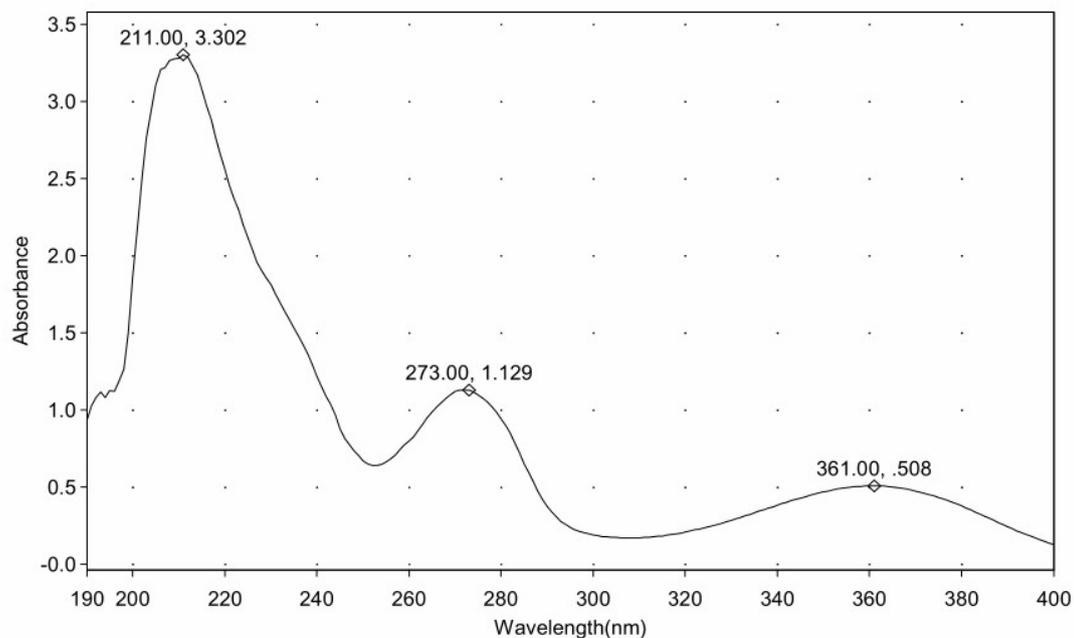


Fig. S10. UV spectrum of 1

Scan Graph



Results Table - XG-F-21L.sre,XG-F-21L,Cycle01

nm	A	Manual Method
211.00	3.302	Report Values at 3 Wavelengths
273.00	1.129	211.00 nm 273.00 nm 361.00 nm
361.00	.508	Sort By Wavelength

Fig. S11. ^1H NMR spectrum of 2 (600 MHz, CD_3OD)

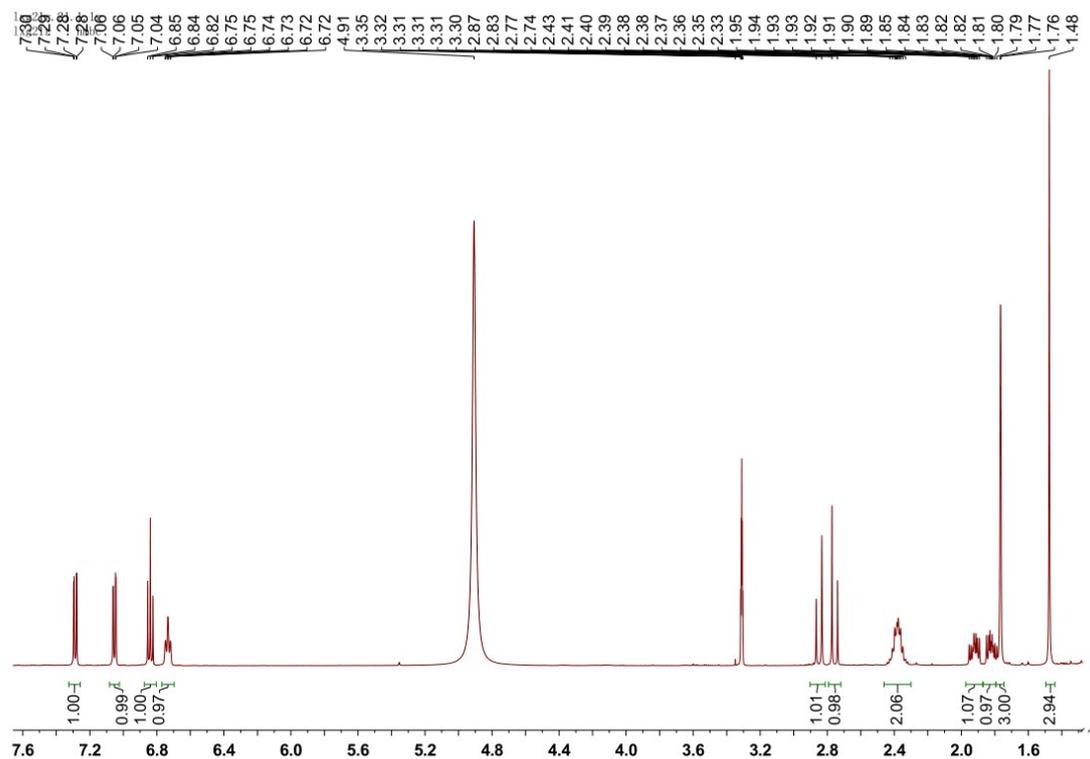


Fig. S12. ^{13}C and DEPT NMR spectra of 2 (150 MHz, CD_3OD)

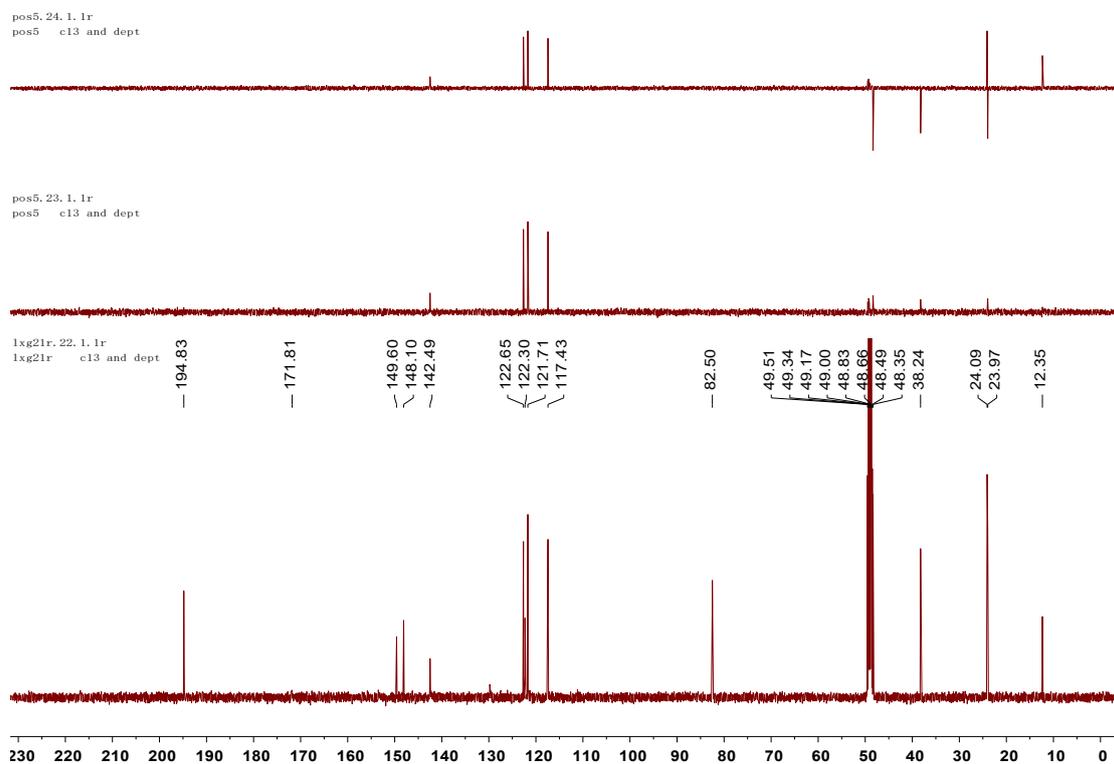


Fig. S13. HSQC spectrum of 2

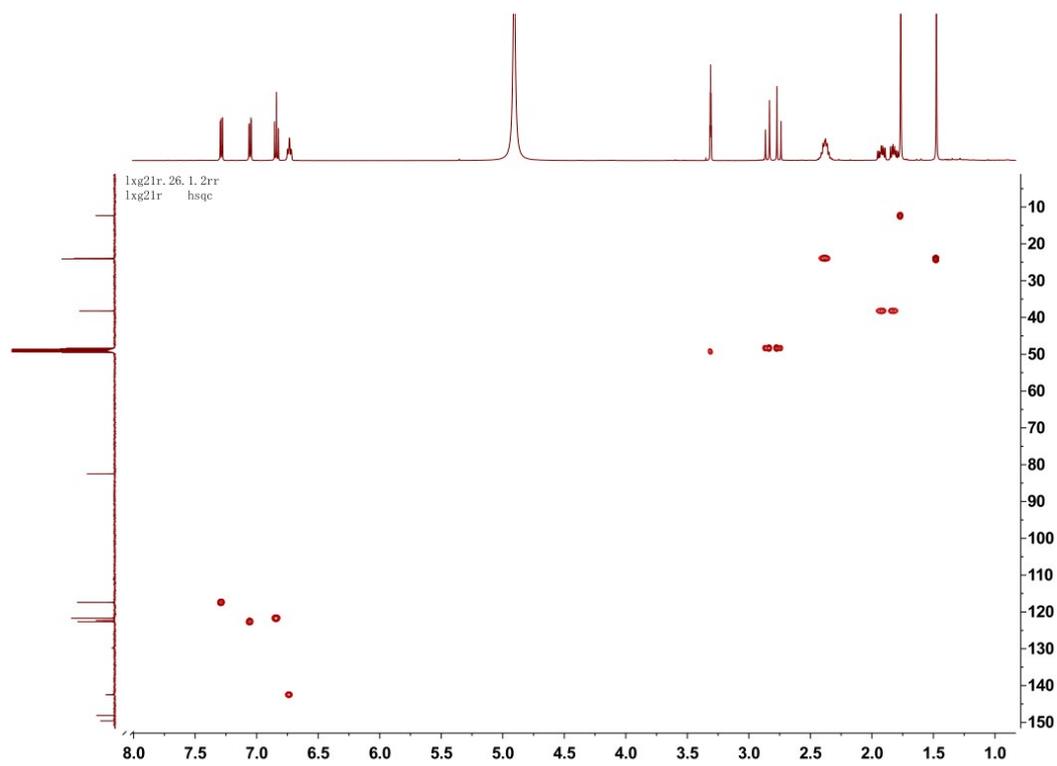


Fig. S14. HMBC spectrum of 2

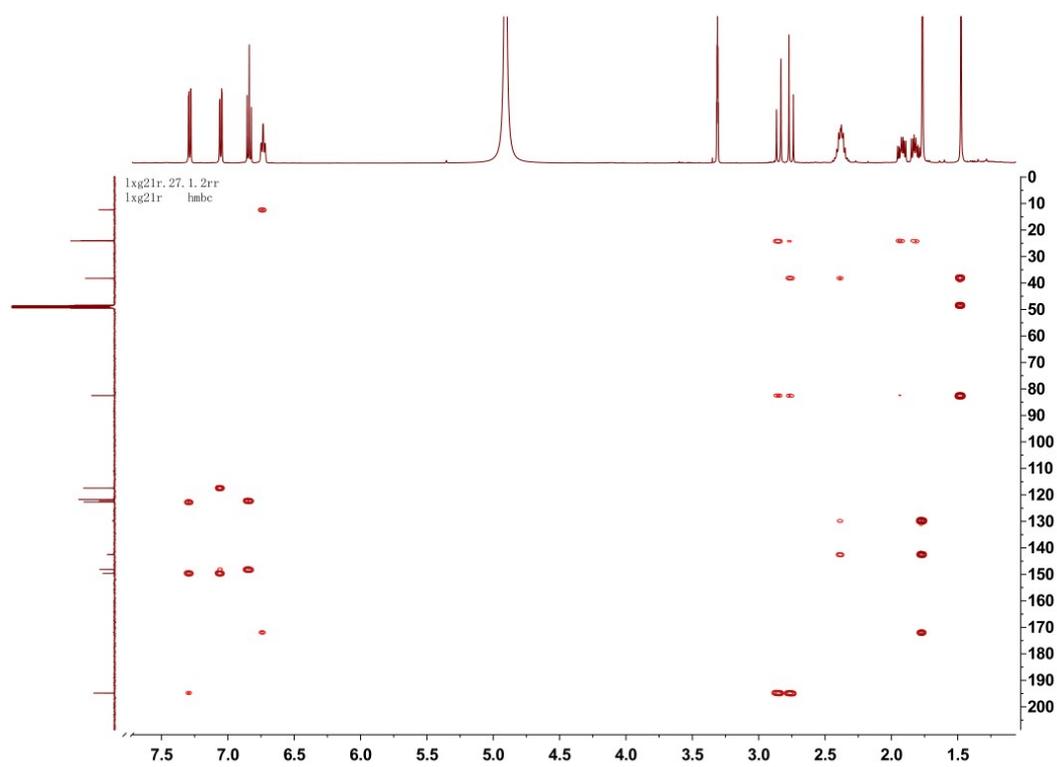


Fig. S15. ROESY spectrum of 2

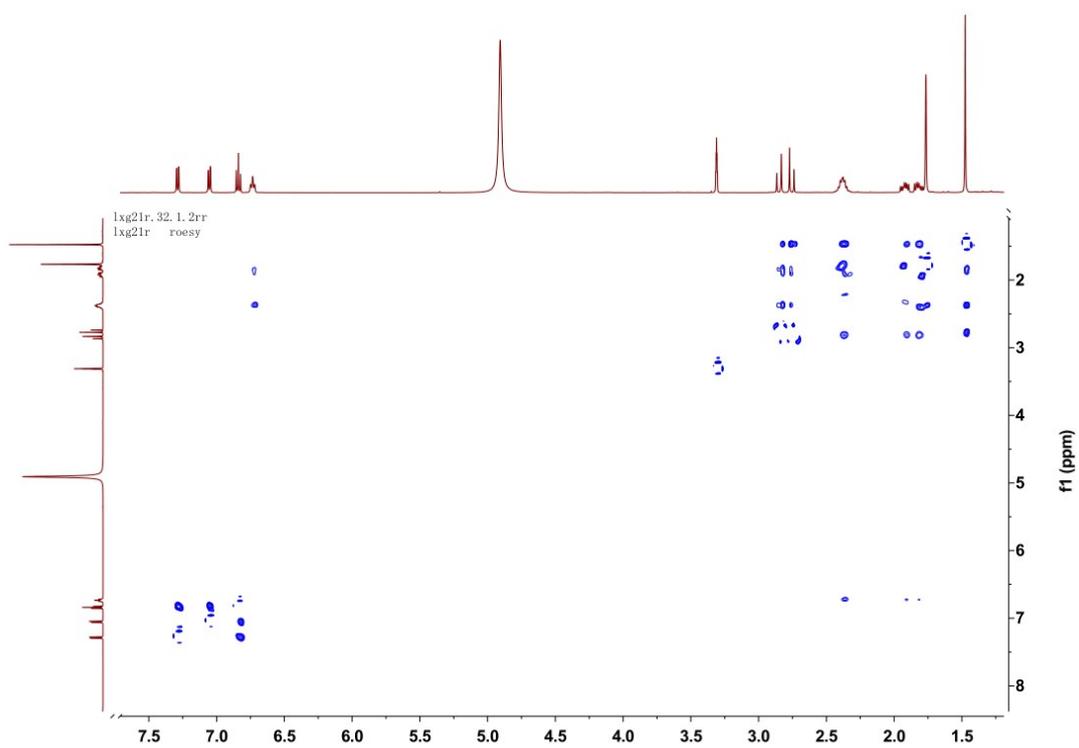
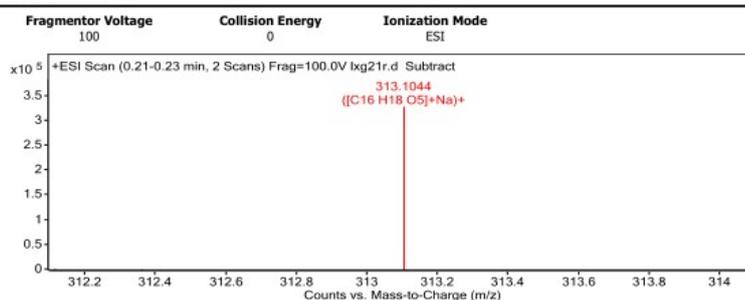


Fig. S16. HRESIMS report of 2

Qualitative Analysis Report

Data Filename	lxg21r.d	Sample Name	lxg21r
Sample Type	Sample	Position	P1-A4
Instrument Name	Instrument 1	User Name	
Acq Method	s.m	Acquired Time	5/3/2018 10:09:17 AM
IRM Calibration Status	Success	DA Method	Default.m
Comment			
Sample Group		Info.	
Acquisition SW	6200 series TOF/6500 series		
Version	Q-TOF B.05.01 (B5125.2)		

User Spectra



Peak List

m/z	z	Abund	Formula	Ion
81.5213	2	101576.25		
102.1275		54285.1		
313.1044	1	328904.41	C16 H18 O5	(M+Na)+
314.1075	1	54608.57	C16 H18 O5	(M+Na)+
329.0782	1	168297		
370.0958	1	123186.73		
603.2167	1	109863.8		
619.1864	2	65081.77		

Formula Calculator Element Limits

Element	Min	Max
C	3	60
H	0	120
O	0	30
N	0	3

Formula Calculator Results

Formula	CalculatedMass	CalculatedMz	Mz	Diff. (mDa)	Diff. (ppm)	DBE
C16 H18 O5	290.1154	313.1046	313.1044	0.20	0.64	8.0000

--- End Of Report ---

Fig. S17. IR spectrum of 2

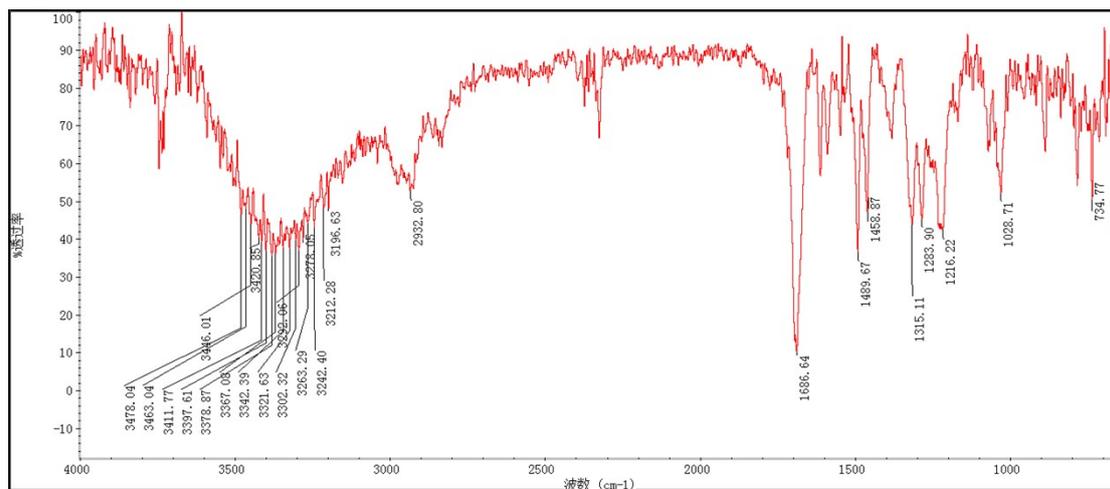
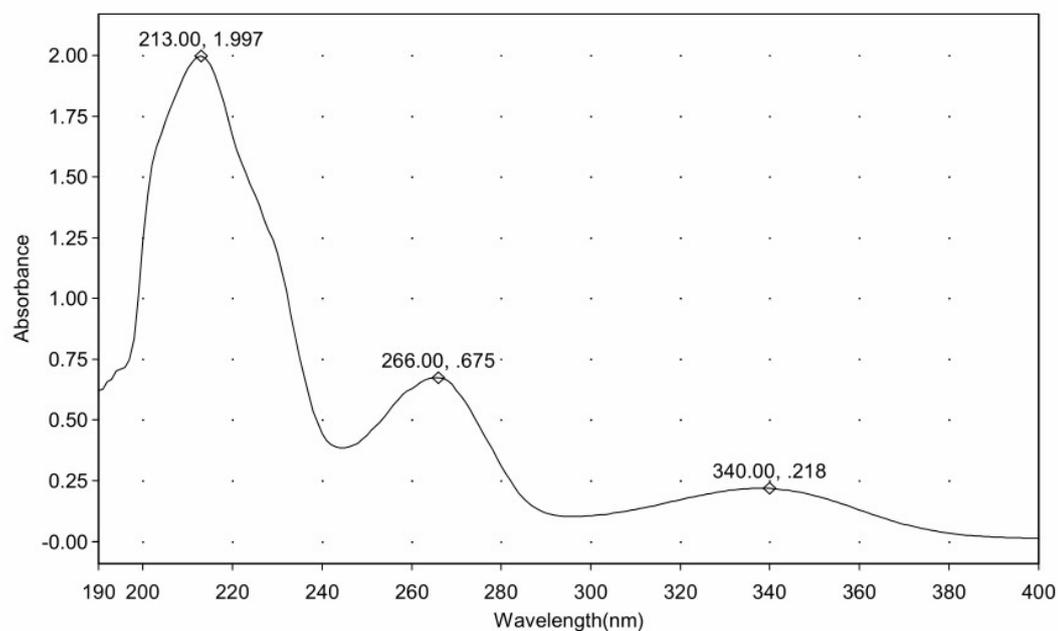


Fig. S18. UV spectrum of 2

Scan Graph



Results Table - XG-F-21RA.sre,XG-F-21RA,Cycle01

nm	A	Manual Method
213.00	1.997	Report Values at 3 Wavelengths
266.00	.675	213.00 nm 266.00 nm 340.00 nm
340.00	.218	Sort By Wavelength

2. Single crystal X-ray diffraction data for 6

Table S1. Crystal data and structure refinement for cu_6_0m.

Identification code	cu_6_0m	
Empirical formula	C ₁₃ H ₁₆ O ₄	
Formula weight	236.26	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Monoclinic	
Space group	P2 ₁	
Unit cell dimensions	a = 4.86620(10) Å	α = 90°.
	b = 11.8867(3) Å	β = 96.2720(10)°.
	c = 10.8940(3) Å	γ = 90°.
Volume	626.37(3) Å ³	
Z	2	
Density (calculated)	1.253 Mg/m ³	
Absorption coefficient	0.765 mm ⁻¹	
F(000)	252	
Crystal size	1.700 x 0.100 x 0.080 mm ³	
Theta range for data collection	4.082 to 69.944°.	
Index ranges	-4 ≤ h ≤ 5, -14 ≤ k ≤ 13, -12 ≤ l ≤ 12	
Reflections collected	6684	
Independent reflections	2125 [R(int) = 0.0207]	
Completeness to theta = 67.679°	97.0 %	
Absorption correction	Semi-empirical from equivalents	
Refinement method	Full-matrix least-squares on F ²	
Data / restraints / parameters	2125 / 1 / 156	
Goodness-of-fit on F ²	1.086	
Final R indices [I > 2σ(I)]	R1 = 0.0357, wR2 = 0.0979	
R indices (all data)	R1 = 0.0358, wR2 = 0.0979	
Absolute structure parameter	0.17(3)	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.405 and -0.395 e.Å ⁻³	

3. Chiral phase HPLC analysis results of compounds 1 and 2

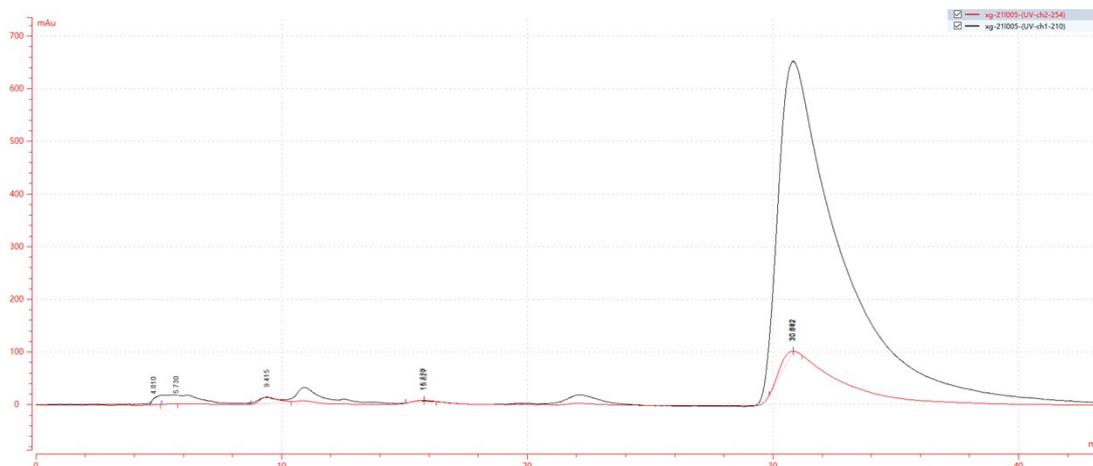


Fig S19. Chiral phase HPLC analysis results of **1** (n-hexane/isopropanol: 70:30, isocratic, 60 min, 1 mL min⁻¹)

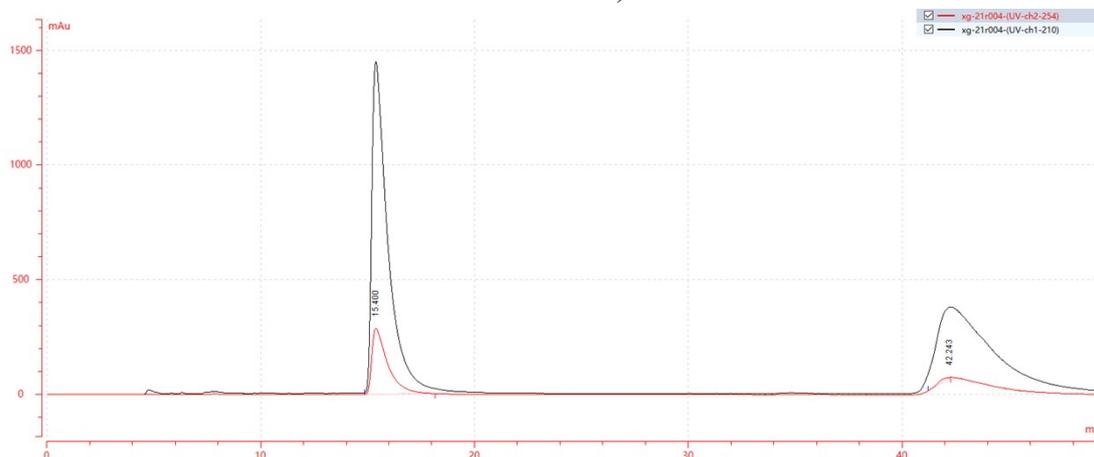


Fig S20. Chiral phase HPLC analysis results of compound **2** (n-hexane/isopropanol: 80:20, isocratic, 60 min, 1 mL min⁻¹)

4. Computational details for compounds 1 and 4

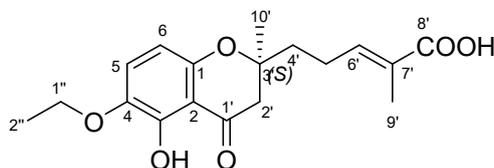


Fig. S21. Structure of compound (3'*S*)-**1**.

A conformation search based on molecular mechanics with MMFF94s force fields was performed for (3'*S*)-**1**, giving 6 conformers with distributions higher than 1% (Table S2).^{1,2} All these conformers were further optimized by the density functional theory method at the B3LYP/6-31G(d,p) level in the Gaussian 16 program package,³ leading to 6 conformers within a 3 kcal/mol energy threshold from the global minimum, respectively (Table S2). The predominant conformers were subjected to theoretical calculation of ECD using time-dependent density functional theory

(TDDFT) at B3LYP/6-31G(d,p) level with CPCM model in methanol. The calculated ECD curves for **1** were weighted using SpecDis 1.71 with $\sigma = 0.3$ eV, and UV shift 6 nm, respectively.⁴

Optimized conformers of **1** were subjected to theoretical calculation of optical rotations using the Ground state at B3LYP/6-31G(d,p) level with the CPCM model in methanol. The average value of **1** was weighted using Excel (Table S2).

Table S2. Energy analysis and calculated rotations for conformers of (3'S)-**1**

Species	Gibbs free energy	ΔE (kcal/mol)	$P_E\%$	Calculated [α]
(3'S)- 1-1	-1150.321774	0.00	39.9	-25.04
(3'S)- 1-2	-1150.321725	0.03	37.9	200.33
(3'S)- 1-3	-1150.319727	1.28	4.6	113.72
(3'S)- 1-4	-1150.320113	1.04	6.9	22.96
(3'S)- 1-5	-1150.320113	1.04	6.9	22.96
(3'S)- 1-6	-1150.319591	1.37	4.0	6.0
Averaged [α]				74.4
Experimental [α]				26.3

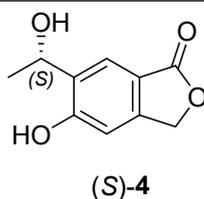


Fig. S22. Structure of compound (S)-**4**.

A conformation search based on molecular mechanics with MMFF94s force fields was performed for (S)-**4**, giving one conformer with distributions higher than 1% (Table S2).^{1,2} All these conformers were further optimized by the density functional theory method at the B3LYP/6-31G(d,p) level in the Gaussian 16 program package,³ leading to one conformer within a 3 kcal/mol energy threshold from the global minimum (Table S3). The conformer was subjected to theoretical calculation of optical rotations using the Ground state at B3LYP/6-31G(d,p) level with the CPCM model in methanol. The average value of **1** was weighted using Excel (Table S3).

Table S3. Energy analysis and calculated rotations for conformers of (S)-**4**

Species	Gibbs free energy	ΔE (kcal/mol)	$P_E\%$	Calculated [α]
(S)- 4	-687.837239	0.00	100	-87.49
Averaged [α]				-87.49
Experimental [α]				-30.7

Reference

- (1) Goto, H.; Osawa, E.; *J. Am. Chem. Soc.* 1989, *111*, 8950–8951.
- (2) Goto, H.; Osawa, E.; *J. Chem. Soc., Perkin Trans. 2*, 1993, 187–198.
- (3) Frisch, M. J.; Trucks, G. W.; Schlegel, H. B.; Scuseria, G. E.; Robb, M. A.; Cheeseman, J. R.; Scalmani, G.; Barone, V.; Mennucci, B.; Petersson, G. A.; Nakatsuji, H.; Caricato, M.; Li, X.; Hratchian, H. P.; Izmaylov, A. F.; Bloino, J.; Zheng, G.; Sonnenberg, J. L.; Hada, M.; Ehara, M.; Toyota, K.; Fukuda, R.; Hasegawa, J.; Ishida, M.; Nakajima, T.; Honda, Y.; Kitao, O.; Nakai, H.; Vreven, T.; Montgomery, J. A., Jr.; Peralta, J. E.; Ogliaro, F.; Bearpark, M.; Heyd, J. J.; Brothers, E.; Kudin, K. N.; Staroverov, V. N.; Keith, T.; Kobayashi, R.; Normand, J.; Raghavachari, K.; Rendell, A.; Burant, J. C.; Iyengar, S. S.; Tomasi, J.; Cossi, M.; Rega, N.; Millam, J. M.; Klene, M.;

Knox, J. E.; Cross, J. B.; Bakken, V.; Adamo, C.; Jaramillo, J.; Gomperts, R.; Stratmann, R. E.; Yazyev, O.; Austin, A. J.; Cammi, R.; Pomelli, C.; Ochterski, J. W.; Martin, R. L.; Morokuma, K.; Zakrzewski, V. G.; Voth, G. A.; Salvador, P.; Dannenberg, J. J.; Dapprich, S.; Daniels, A. D.; Farkas, O.; Foresman, J. B.; Ortiz, J. V.; Cioslowski, J.; and Fox, D. J.; *Gaussian 16*, Revision B.01, Gaussian, Inc., Wallingford CT, 2016.

(4) Bruhn, T.; Schaumlöffel, A.; Hemberger, Y.; Bringmann, G. *Spec Dis*, version 1.71, University of Würzburg, Germany, 2017