Seven new triterpenoid saponins from *Astragalus membranaceus var. mongholicus* and the inhibition of high-glucose induced SV40 MES 13 cells

Hai-dan Zou, Yan Liu, Zhen-Peng Zhang, Jia-Tong Wu, Jing Wang, Juan Pan, Wei Guan, Hai-xue Kuang*and Bing-you Yang*

Key Laboratory of Basic and Application Research of Beiyao (Heilongjiang University of Chinese Medicine), Ministry of Education

***Corresponding Authors**

Professor Bing-You Yang and Professor Hai-Xue Kuang

College of Pharmacy, Heilongjiang University of Chinese Medicine

24 Heping Road, Xiangfang District, Harbin 150040, P.R. China

E-mail: ybywater@163.com (B.-Y. Yang); hxkuang@yahoo.com (H.-X. Kuang)

Content

Figure S1. HR-ESI-MS spectrum of **1**

Figure S2. ^{1}H NMR spectrum of **1**.

Figure S3. ^{13}C NMR spectrum of **1**.

Figure S4. DEPT 135 spectrum of **1**.

Figure S5. HSQC spectrum of **1**.

Figure S6. ^{1}H-^{1}H COSY spectrum of **1**.

Figure S7. HMBC spectrum of **1**.

Figure S8. NOESY spectrum of **1**.

Figure S9. HR-ESI-MS spectrum of **2**.

Figure S10. ^{1}H NMR spectrum of **2**.

Figure S11. ^{13}C NMR spectrum of **2**.

Figure S12. DEPT 135 spectrum of **2**.

Figure S13. HSQC spectrum of **2**.

Figure S14. ^{1}H-^{1}H COSY spectrum of **2**.

Figure S15. HMBC spectrum of **2**.

Figure S16. NOESY spectrum of **2**.

Figure S17. HR-ESI-MS spectrum of **3**.

Figure S18. ^{1}H NMR spectrum of **3**.

Figure S19. ^{13}C NMR spectrum of **3**.

Figure S20. DEPT 135 spectrum of **3**.

Figure S21. HSQC spectrum of **3**.

Figure S22. ^{1}H-^{1}H COSY spectrum of **3**.

Figure S23. HMBC spectrum of **3**.

Figure S24. NOESY spectrum of **3**.

Figure S25. HR-ESI-MS spectrum of **4**.

Figure S26. ^{1}H NMR spectrum of **4**.

Figure S27. ^{13}C NMR spectrum of **4**.

Figure S28. DEPT 135 spectrum of **4**.

Figure S29. HSQC spectrum of **4**.

Figure S30. ^{1}H-^{1}H COSY spectrum of **4**.

Figure S31. HMBC spectrum of **4**.

Figure S32. NOESY spectrum of **4**.

Figure S33. HR-ESI-MS spectrum of **5**.

Figure S34. ^{1}H NMR spectrum of **5**.

Figure S35. ^{13}C NMR spectrum of **5**.

Figure S36. DEPT 135 spectrum of **5**.

Figure S37. HSQC spectrum of **5**.

Figure S38. ^{1}H-^{1}H COSY spectrum of **5.**

Figure S39. HMBC spectrum of **5.**

Figure S40. NOESY spectrum of **5**.

Figure S41. HR-ESI-MS spectrum of **6**

Figure S42. ^{1}H NMR spectrum of **6**.

Figure S43. ^{13}C NMR spectrum of **6**.

Figure S44. DEPT 135 spectrum of **6**.

Figure S45. HSQC spectrum of **6**.

Figure S46. ^{1}H-^{1}H COSY spectrum of **6**.

Figure S47. HMBC spectrum of **6**.

Figure S48. NOESY spectrum of **6**.

Figure S49. HR-ESI-MS spectrum of **7**

Figure S50. ^{1}H NMR spectrum of **7**.

Figure S51. ^{13}C NMR spectrum of **7**.

Figure S52. DEPT 135 spectrum of **7**.

Figure S53. HSQC spectrum of **7**.

Figure S54. ^{1}H-^{1}H COSY spectrum of **7**.

Figure S55. HMBC spectrum of **7**.

Figure S56. NOESY spectrum of **7**.

Figure S57. IR spectrums of **1-7**.

Figure S58. GC-MS chromatogram of the sugars of **1-7** after hydrolysis**.**

Figure S59. Structure of published compounds **8-22**.

Table S1 ^{13}C NMR data of compounds **8-22**.

Figure S1. HR-ESI-MS spectrum of **1**

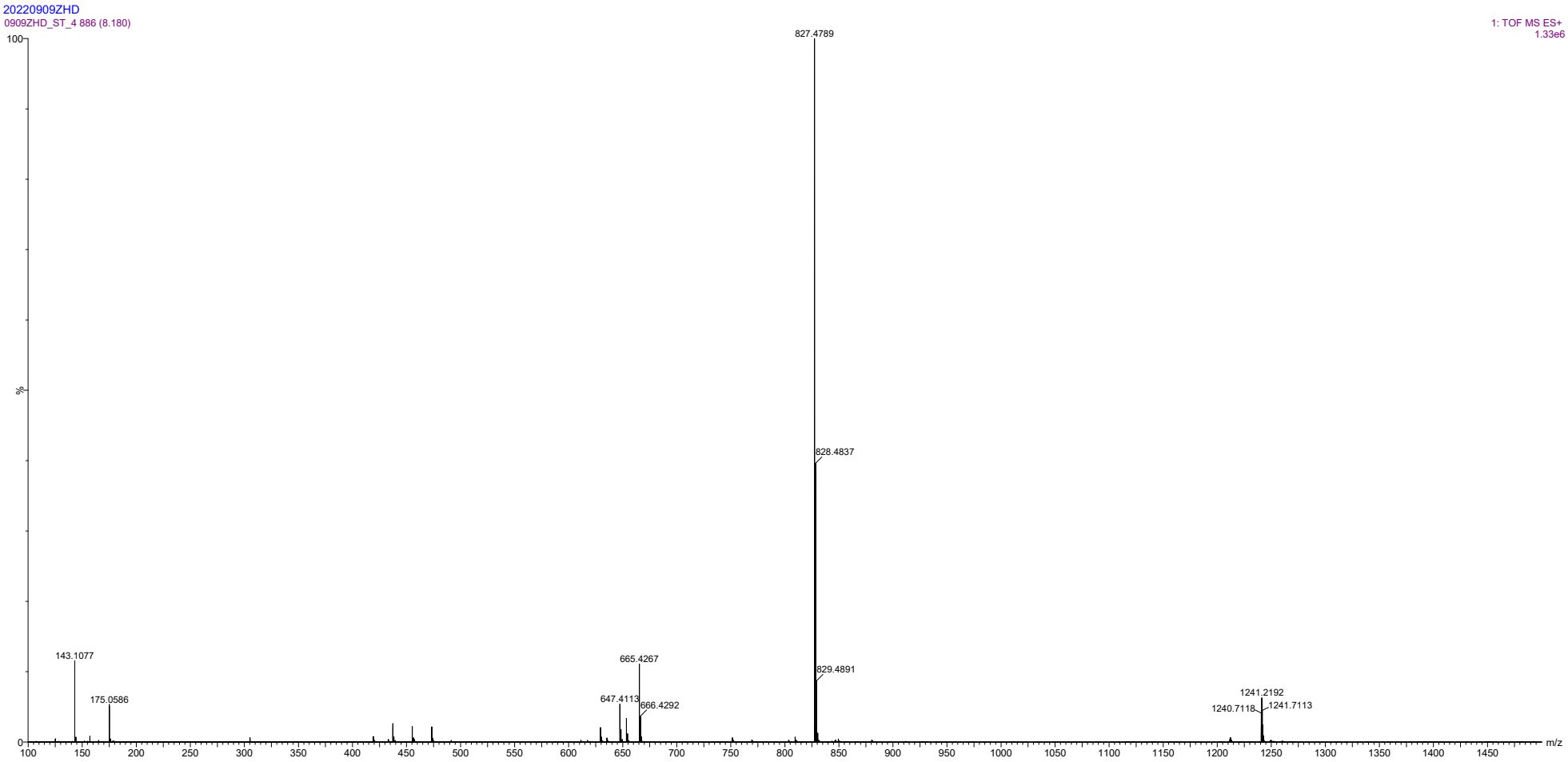

Figure S2. ^{1}H NMR spectrum of **1**.

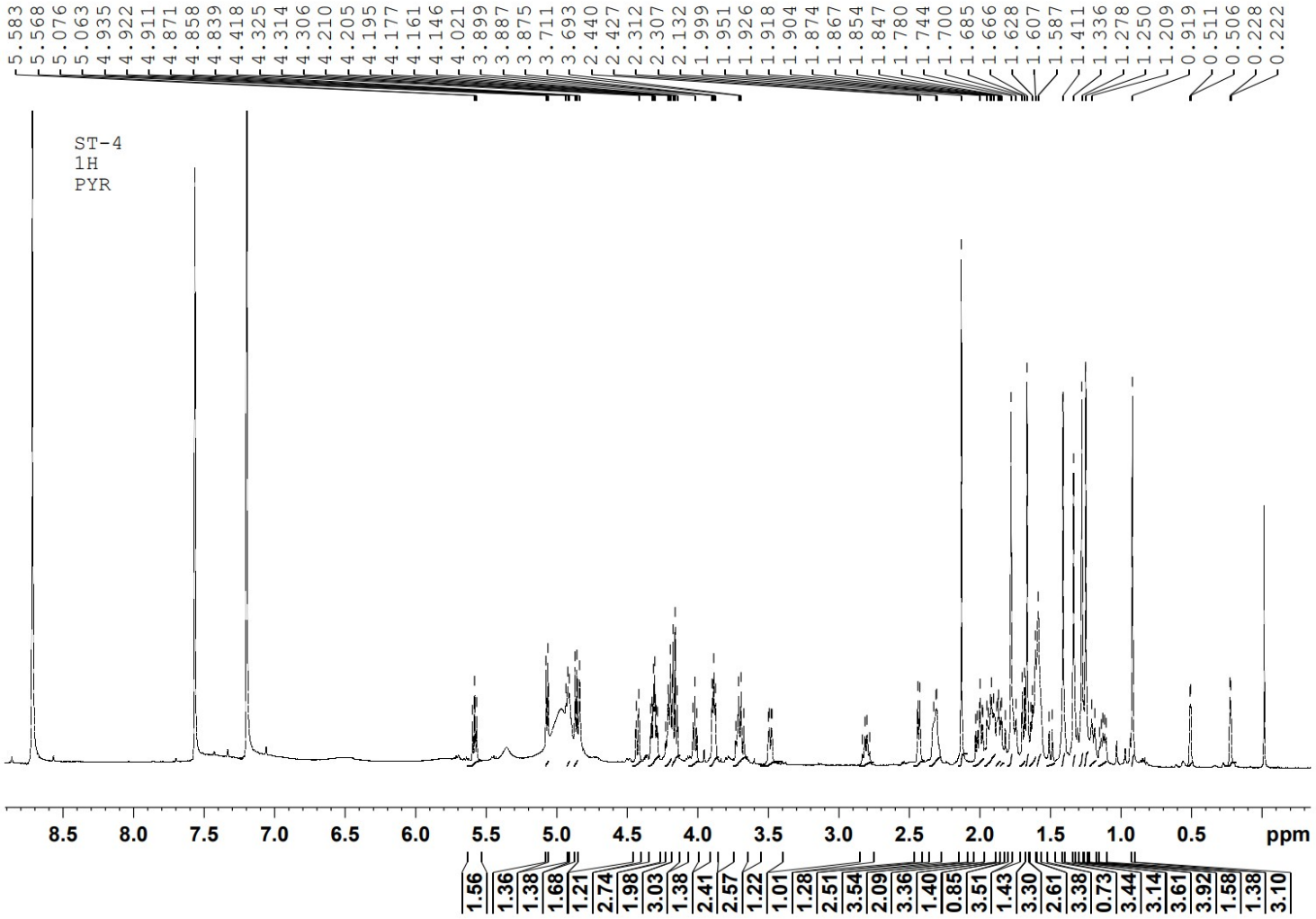

Figure S3. ^{13}C NMR spectrum of **1**.

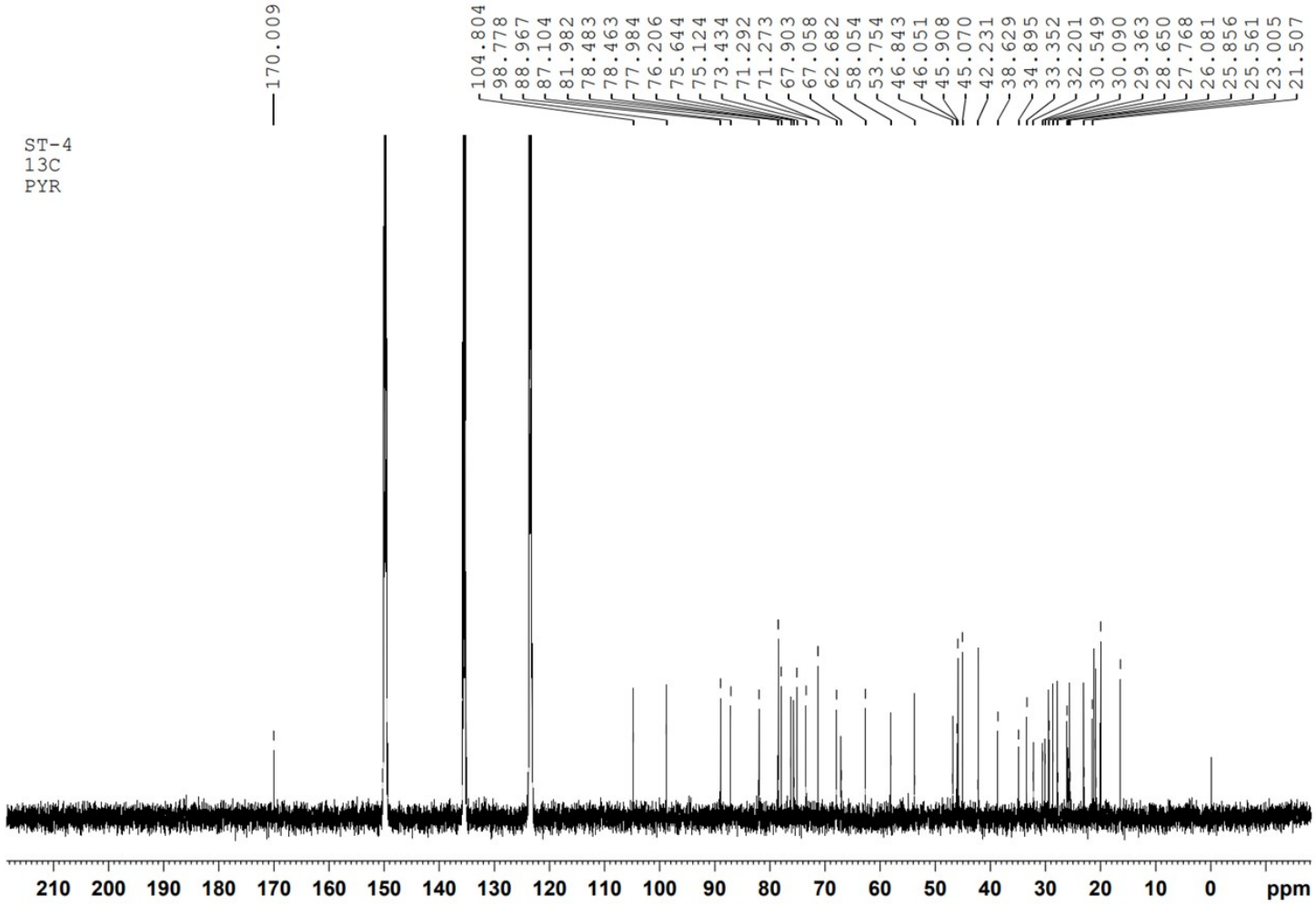

Figure S4. DEPT 135 spectrum of **1**.

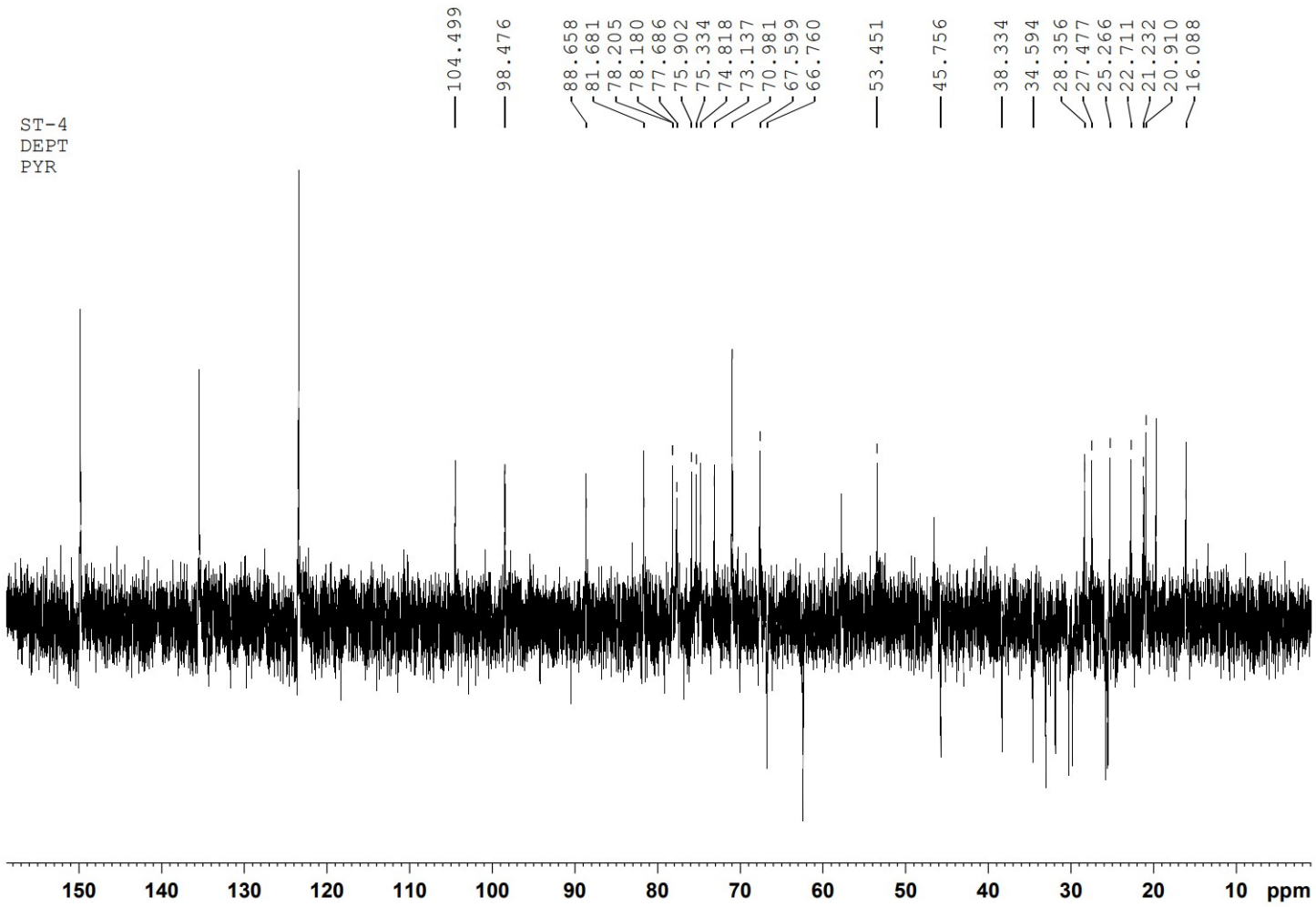

Figure S5. HSQC spectrum of **1**.

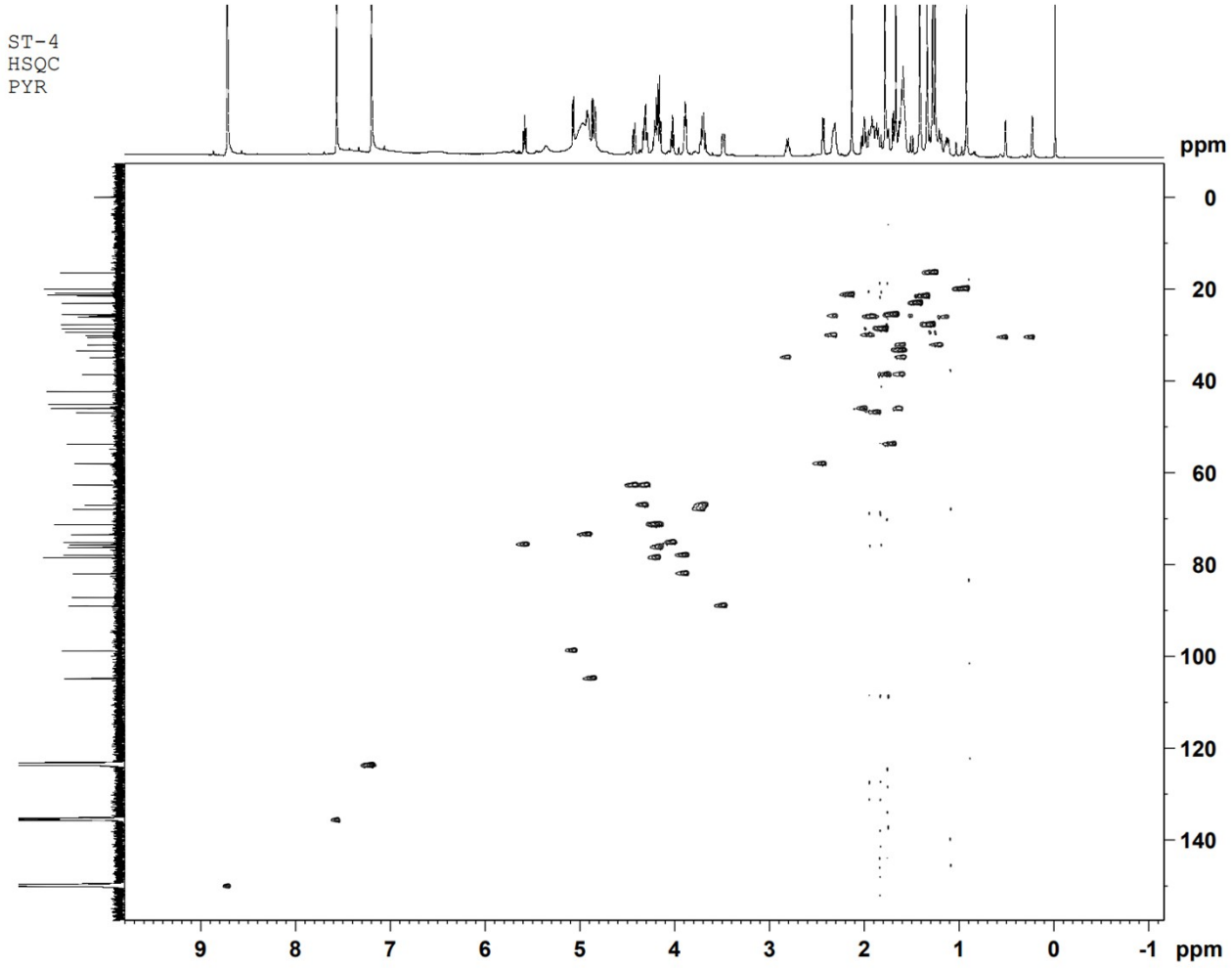

Figure S6. ^{1}H-^{1}H COSY spectrum of **1**.

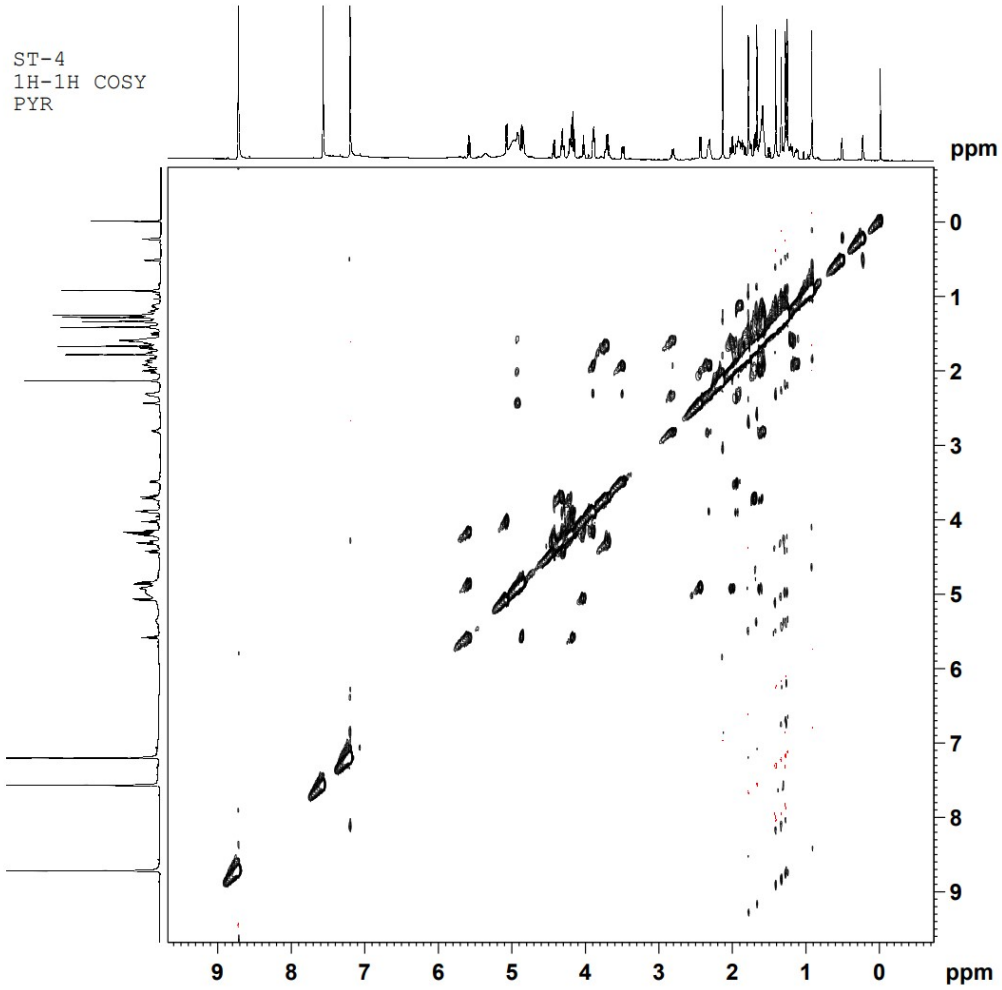

Figure S7. HMBC spectrum of **1**.

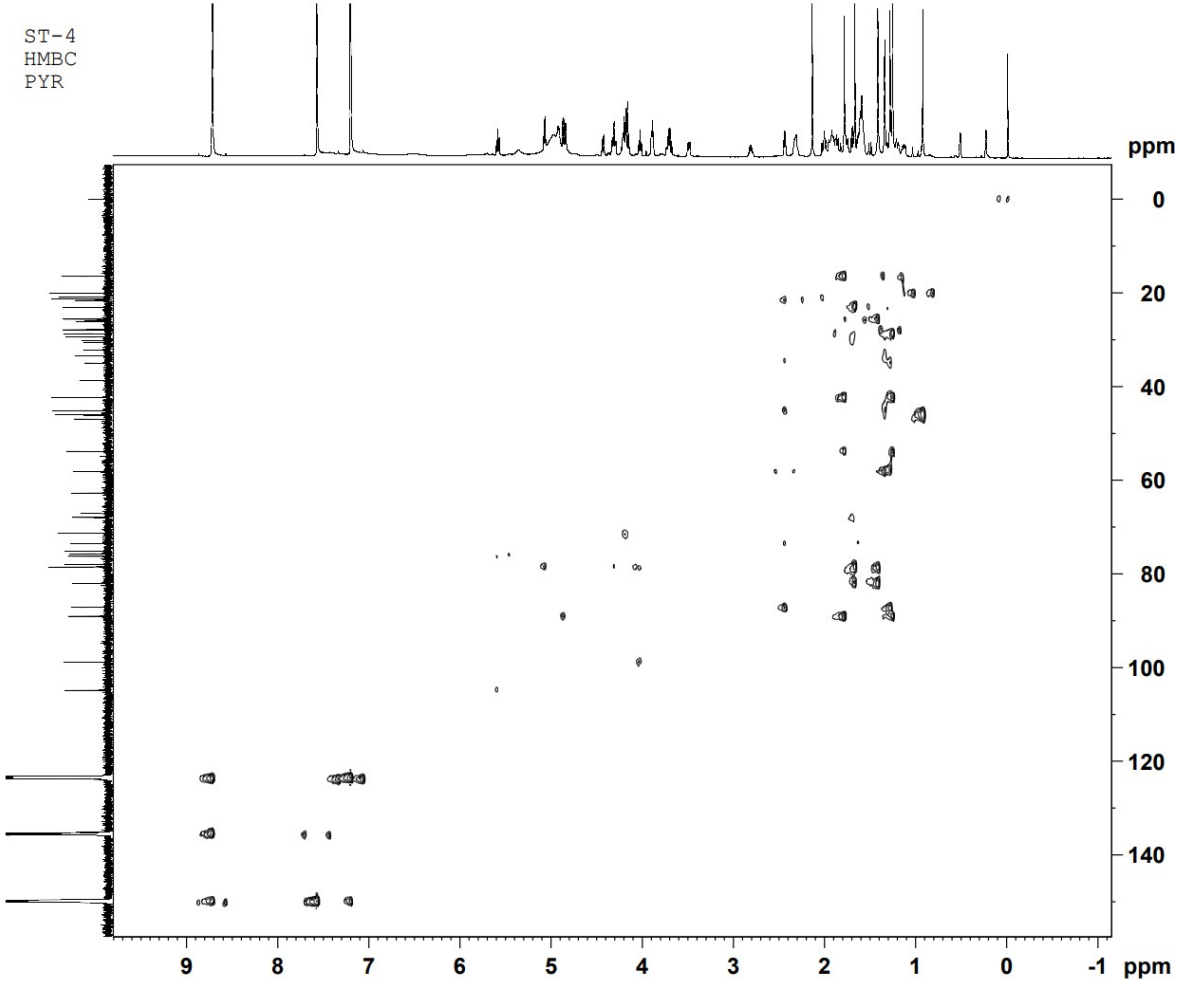

Figure S8. NOESY spectrum of **1**.

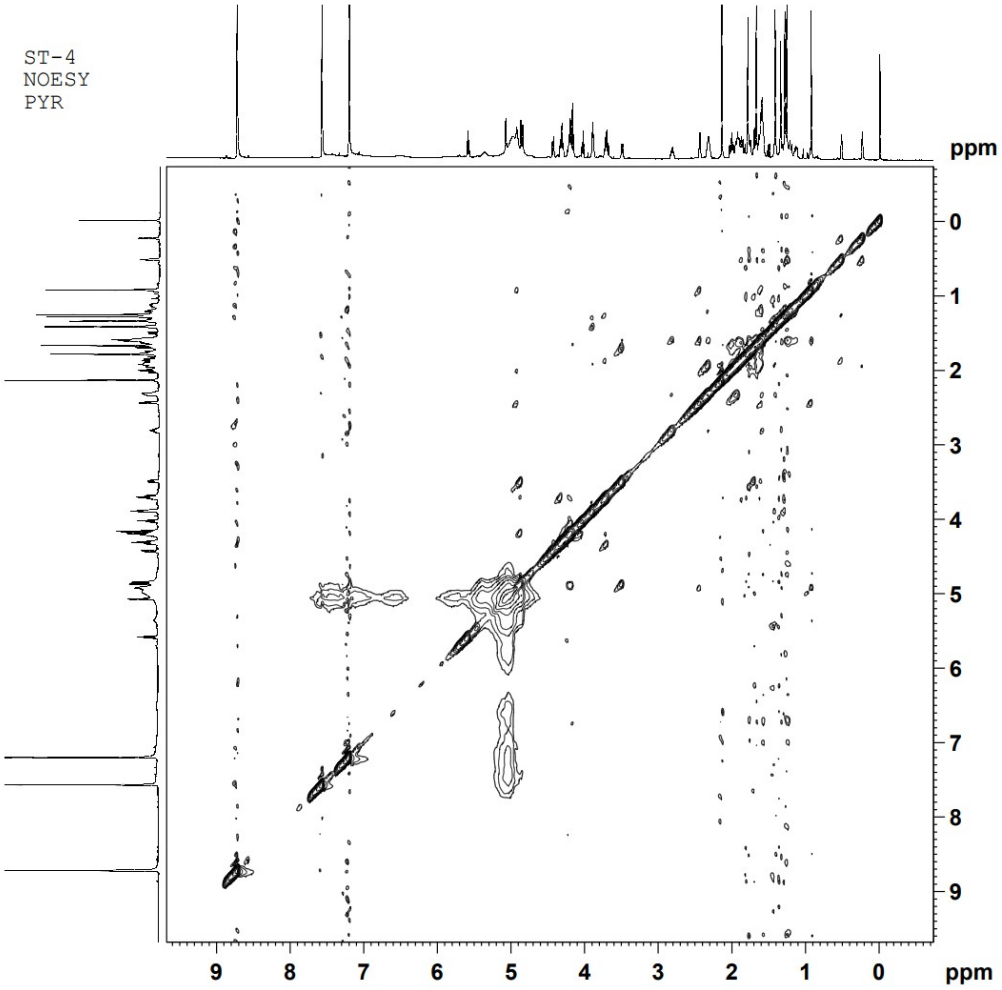

Figure S9. HR-ESI-MS spectrum of **2**

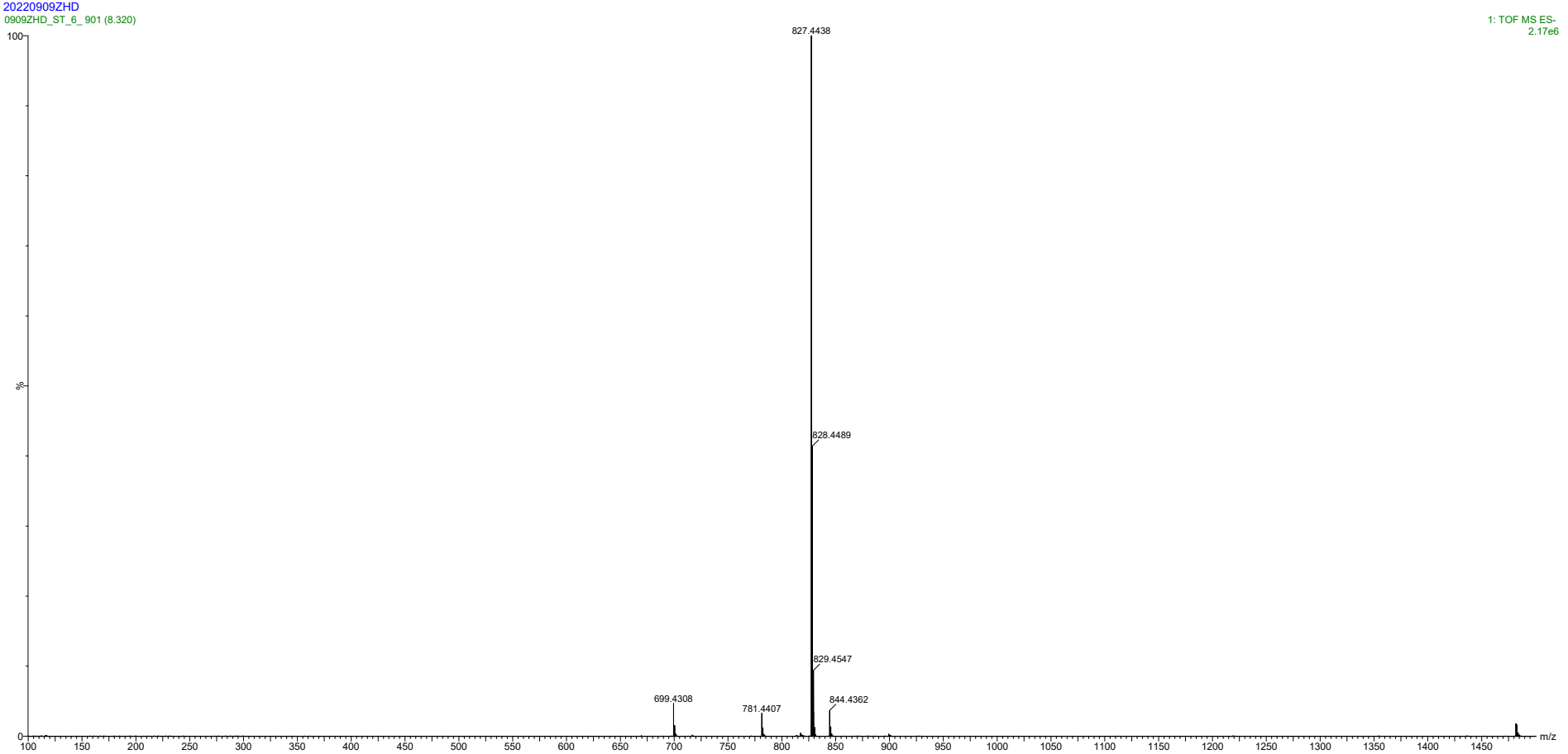

Figure S10. ^{1}H NMR spectrum of **2**.

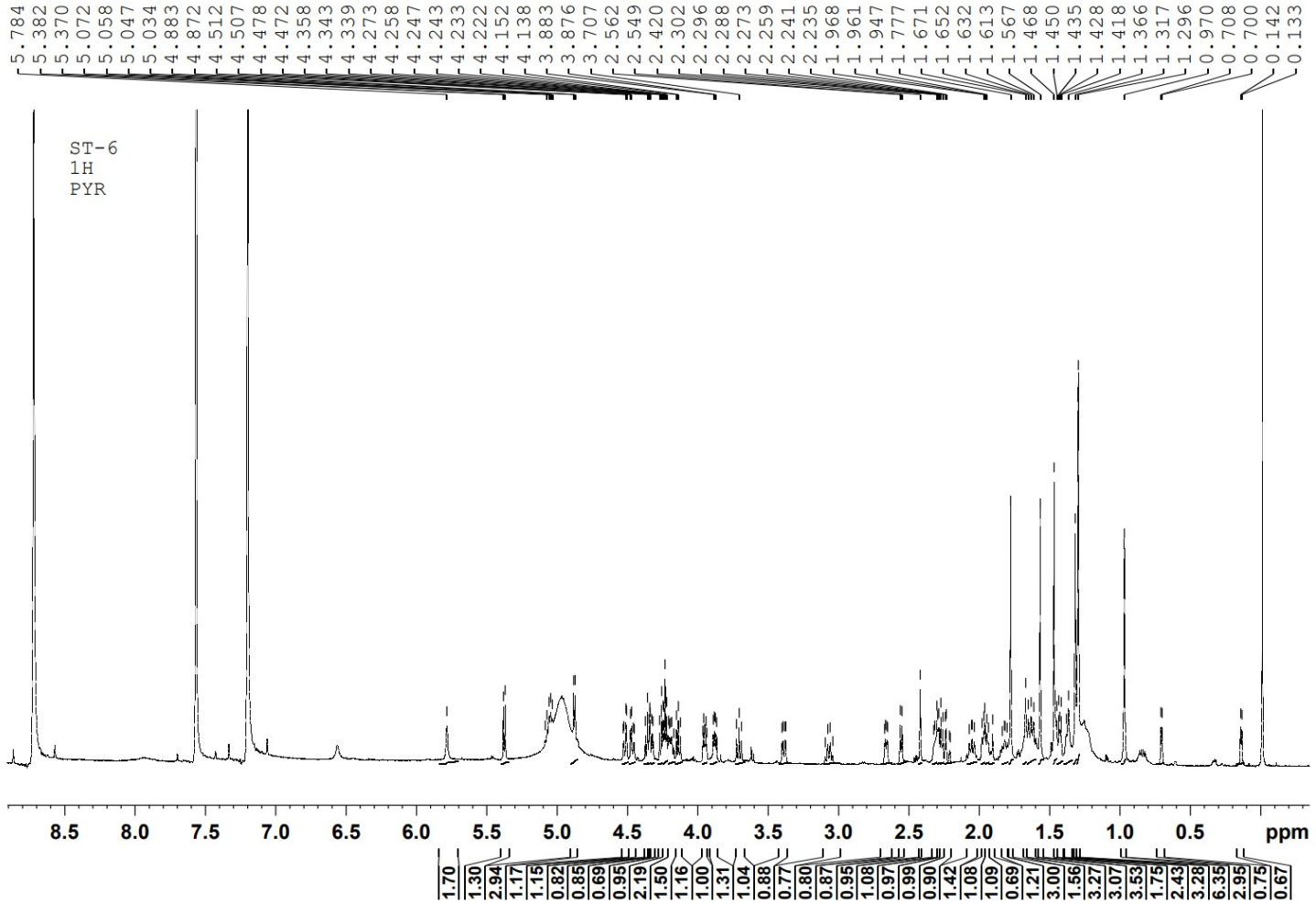

Figure S11. ^{13}C NMR spectrum of **2**.

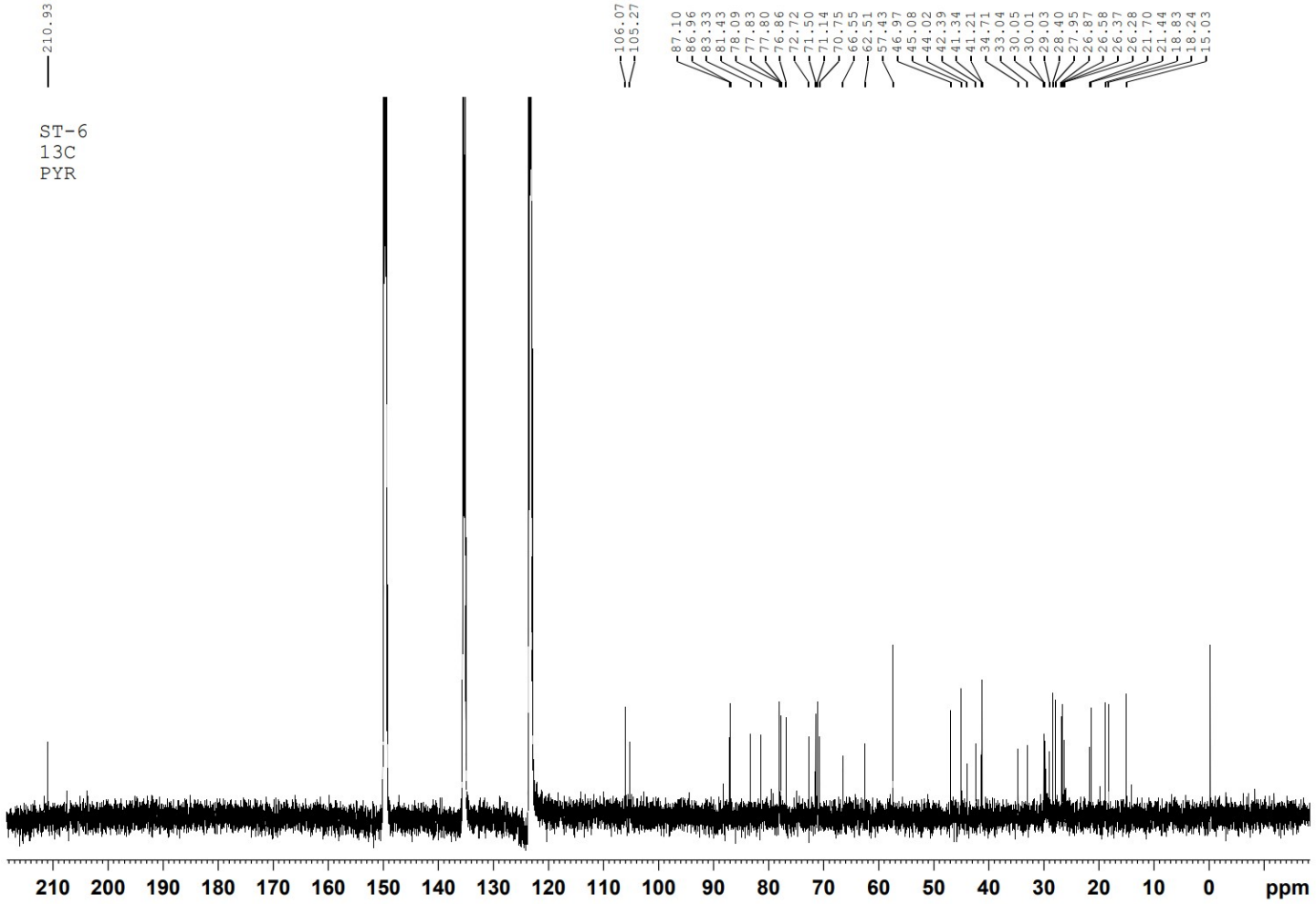

Figure S12. DEPT 135 spectrum of **2**.

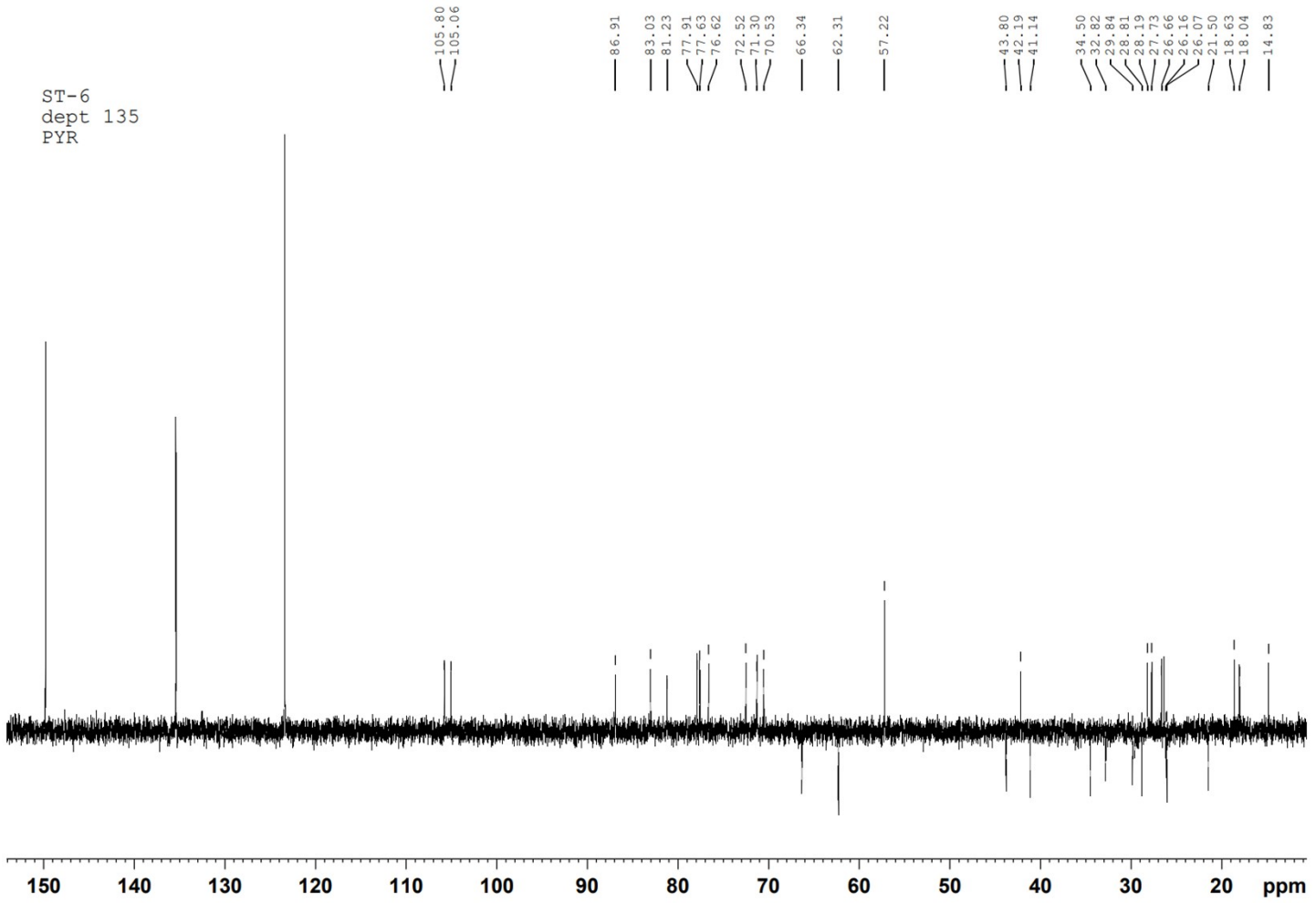

Figure S13. HSQC spectrum of **2**.

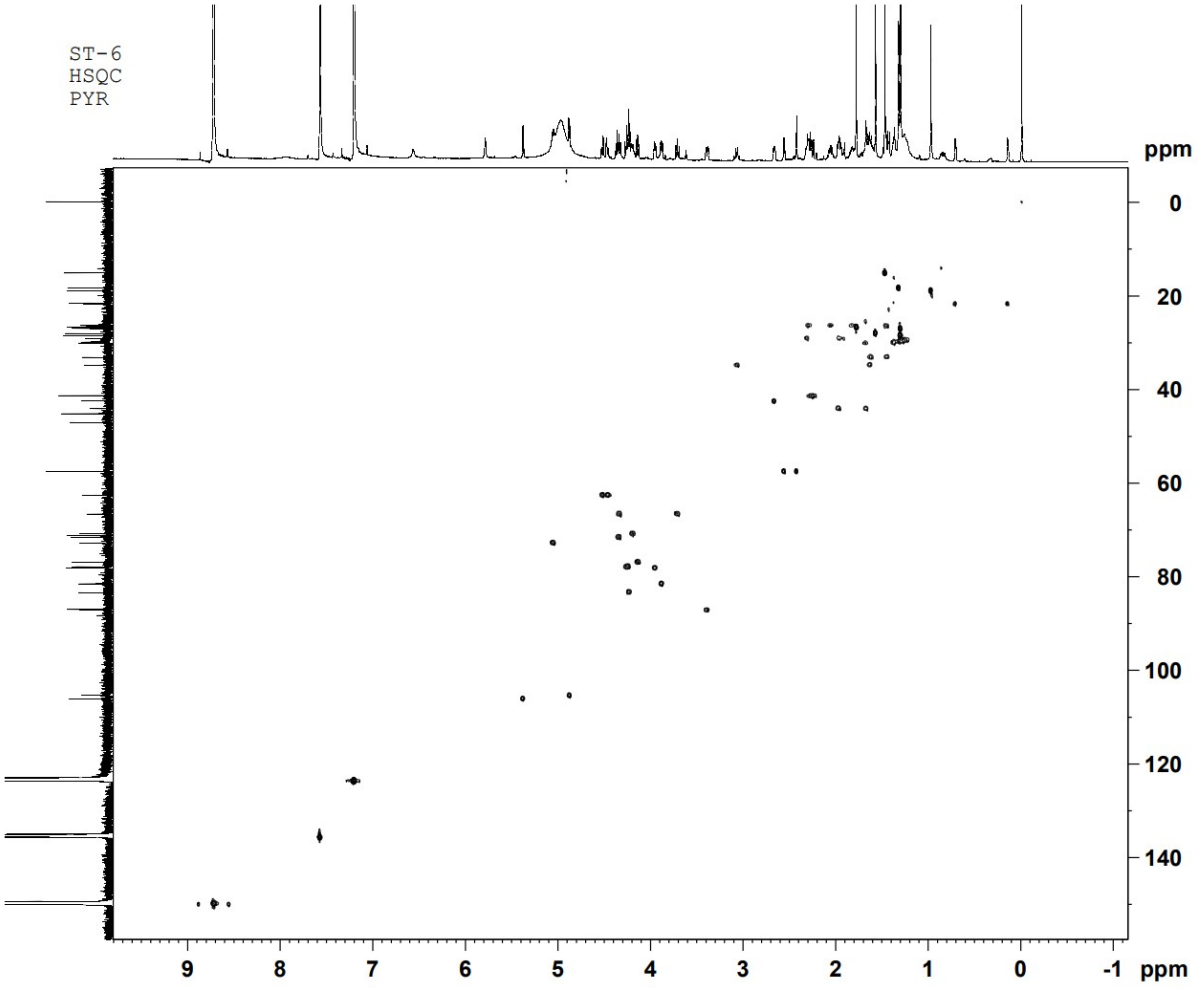

Figure S14. ^{1}H-^{1}H COSY spectrum of **2**.

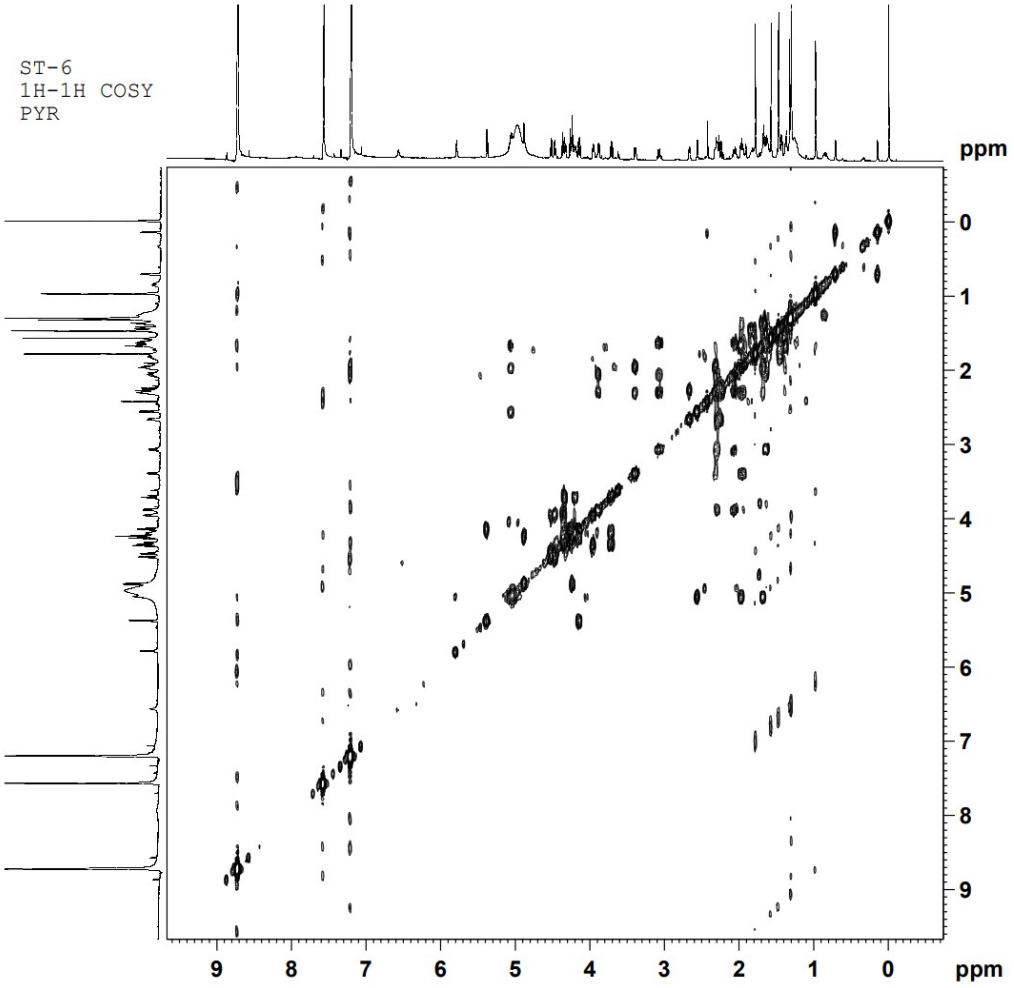

Figure S15. HMBC spectrum of **2**.

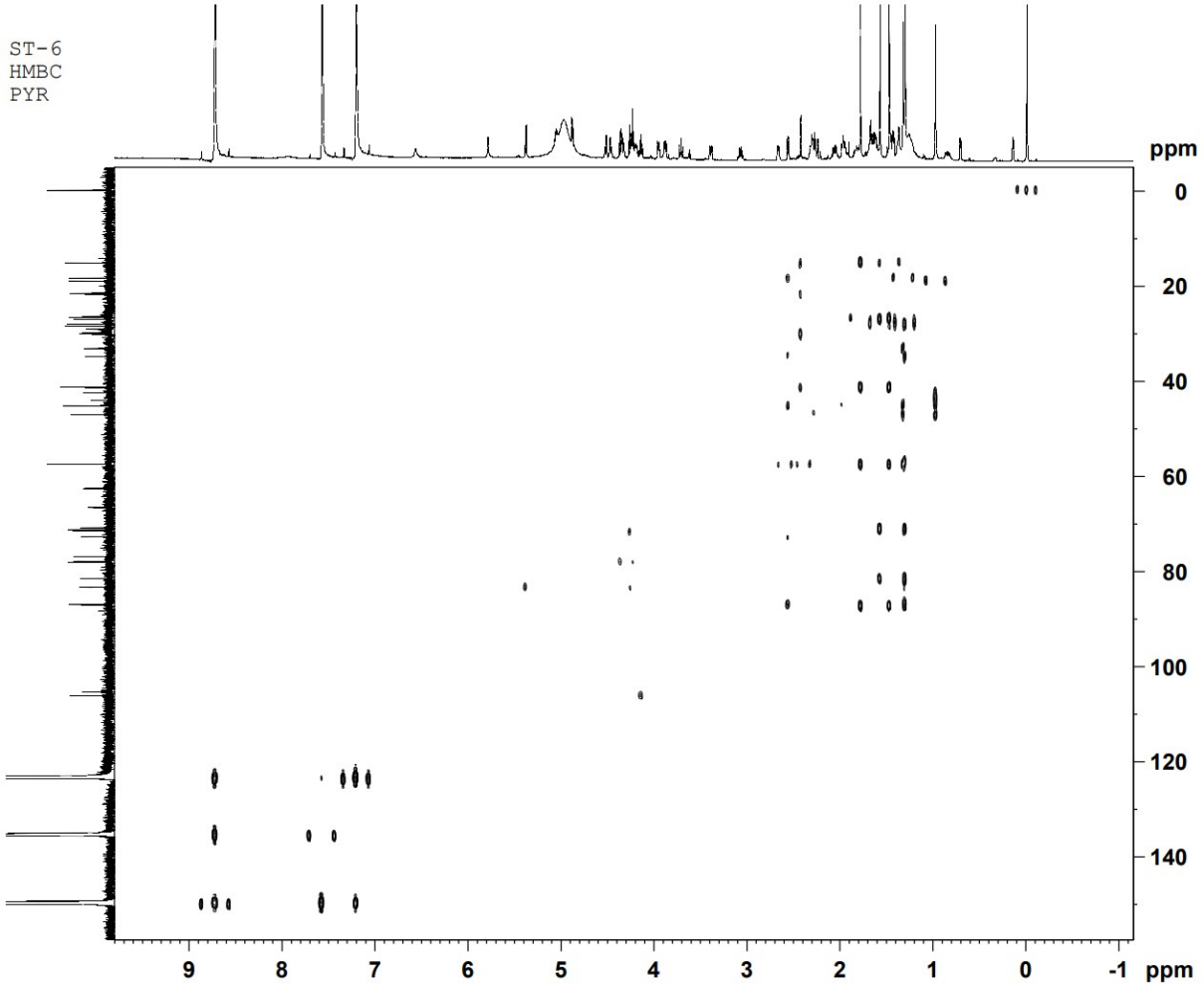

Figure S16. NOESY spectrum of **2**.

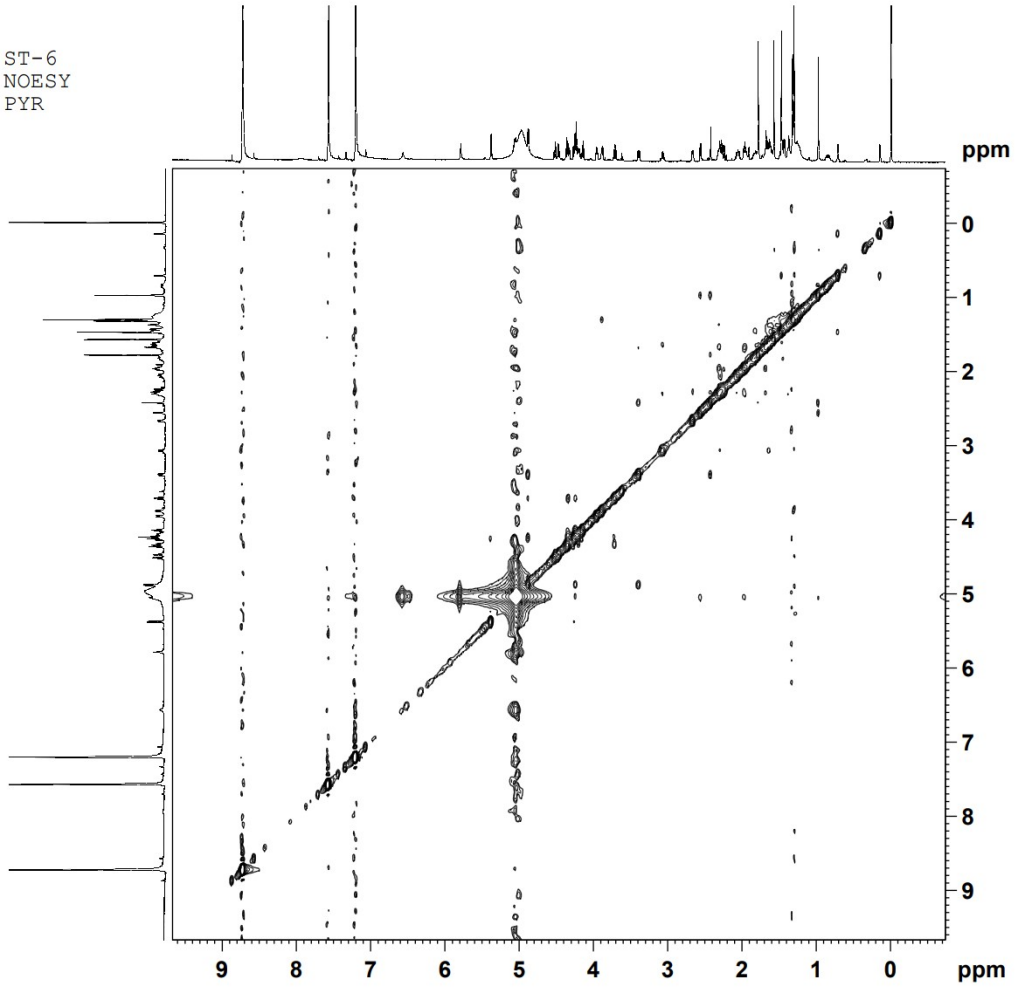

Figure S17. HR-ESI-MS spectrum of **3**

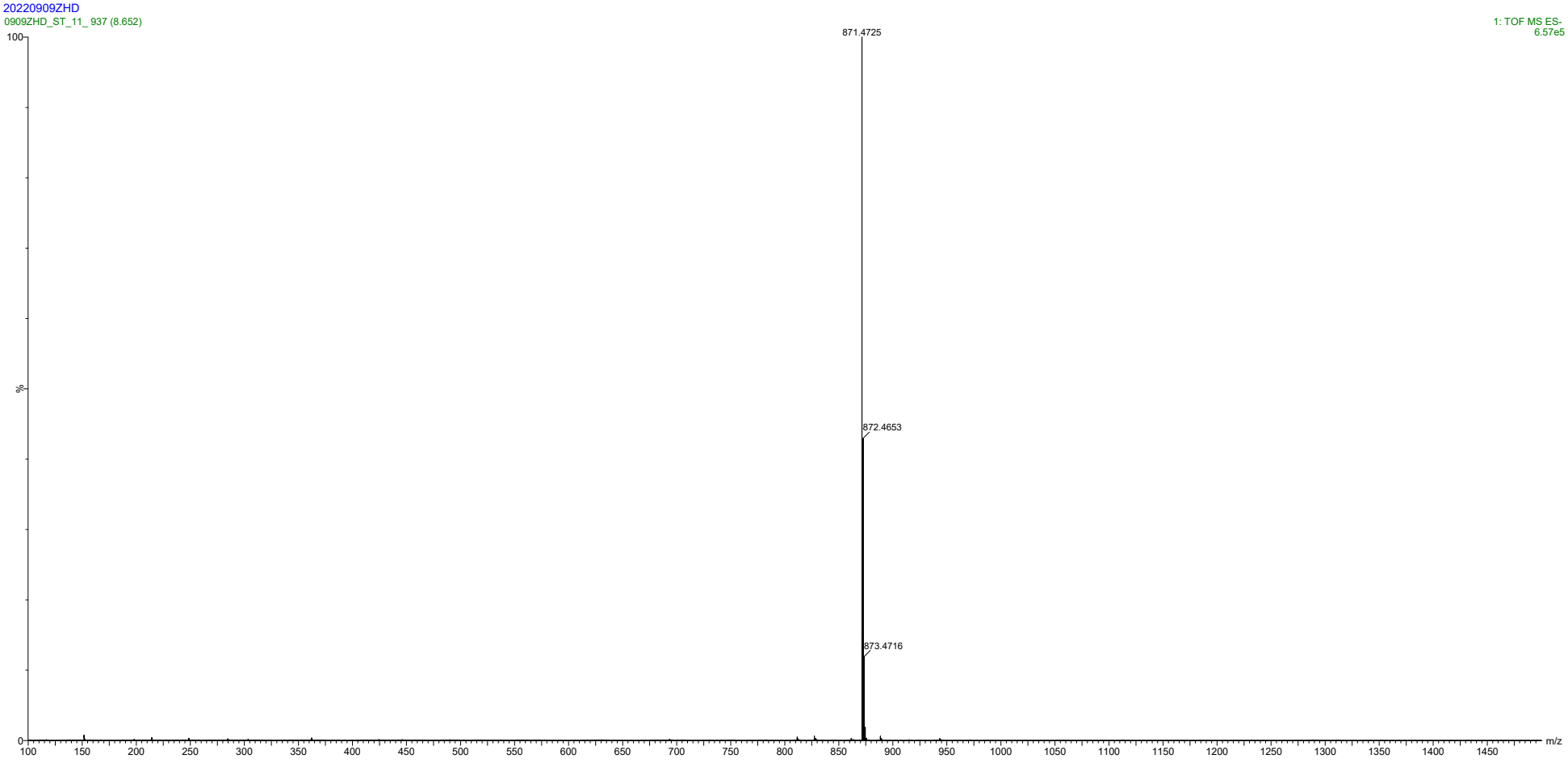

Figure S18. ^{1}H NMR spectrum of **3**.

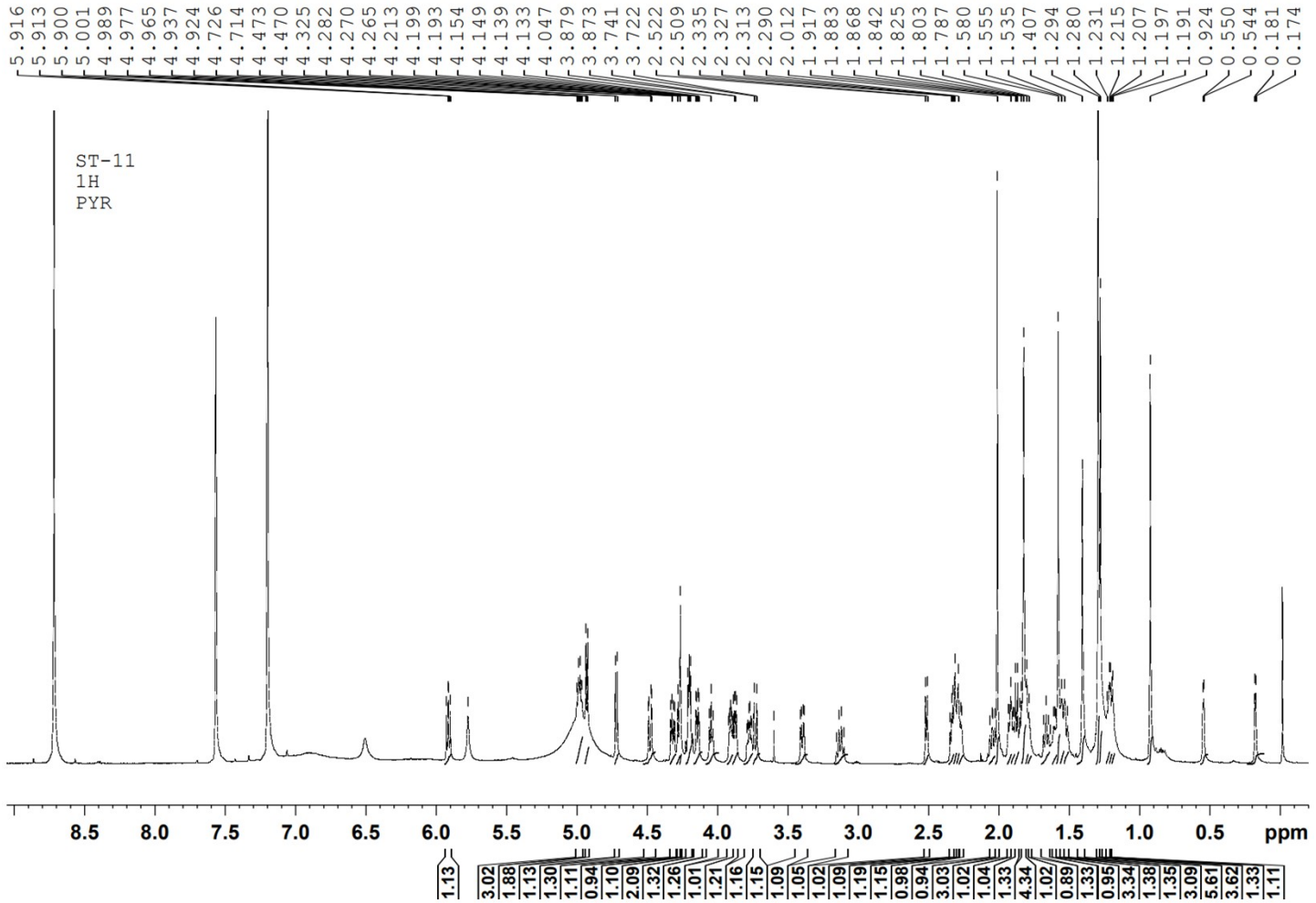

Figure S19. ^{13}C NMR spectrum of **3**.

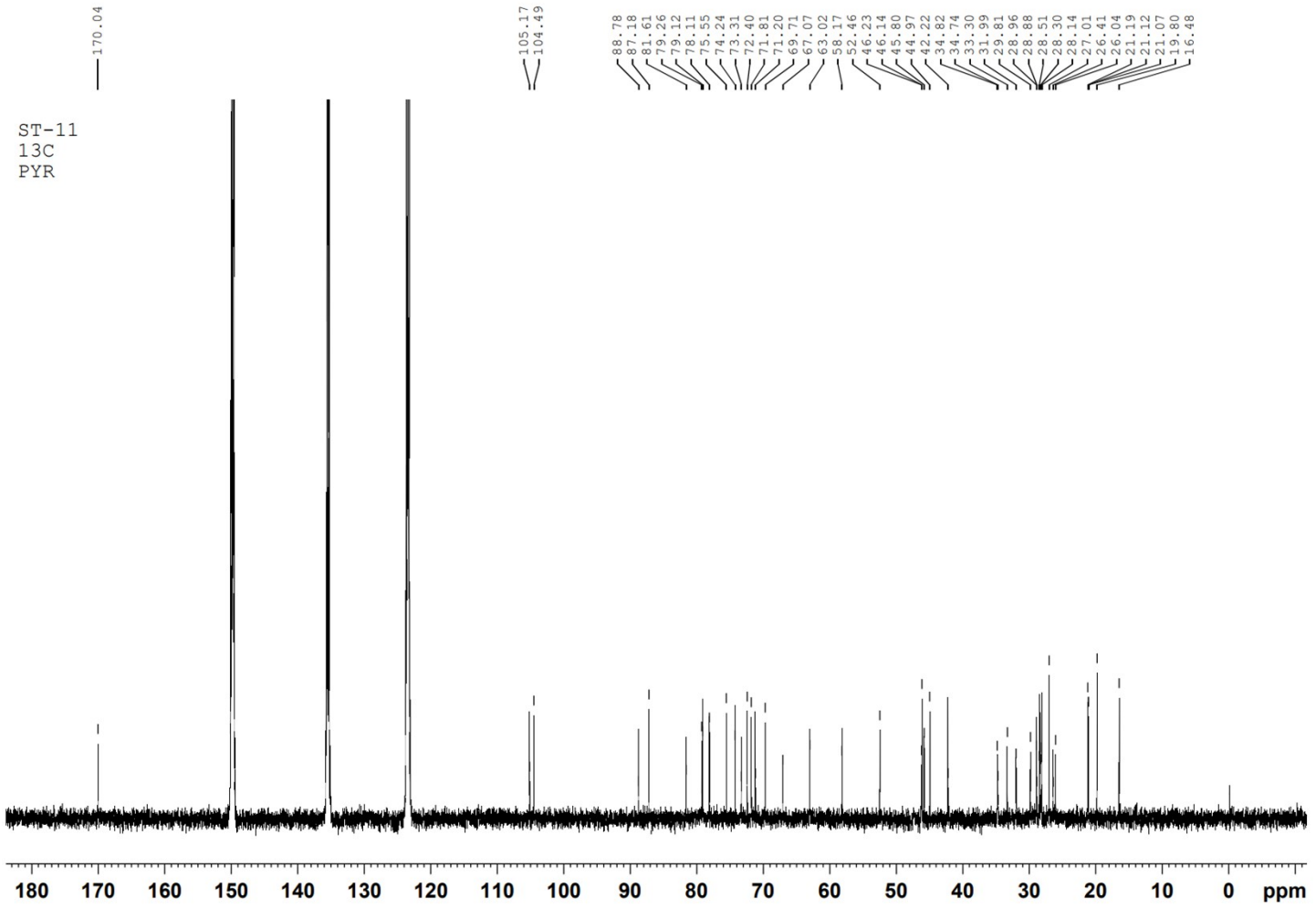

Figure S20. DEPT 135 spectrum of **3**.

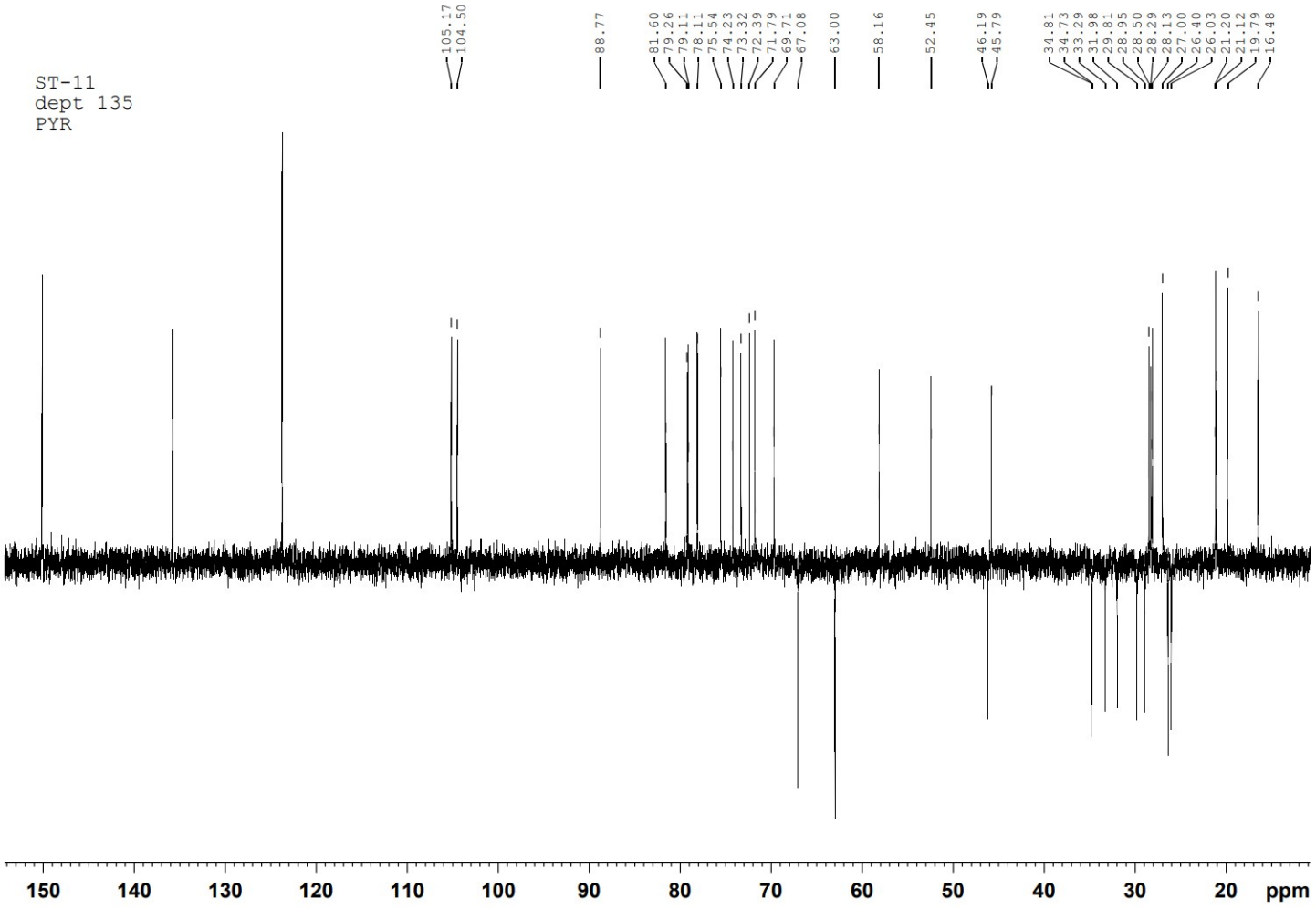

Figure S21. HSQC spectrum of **3**.

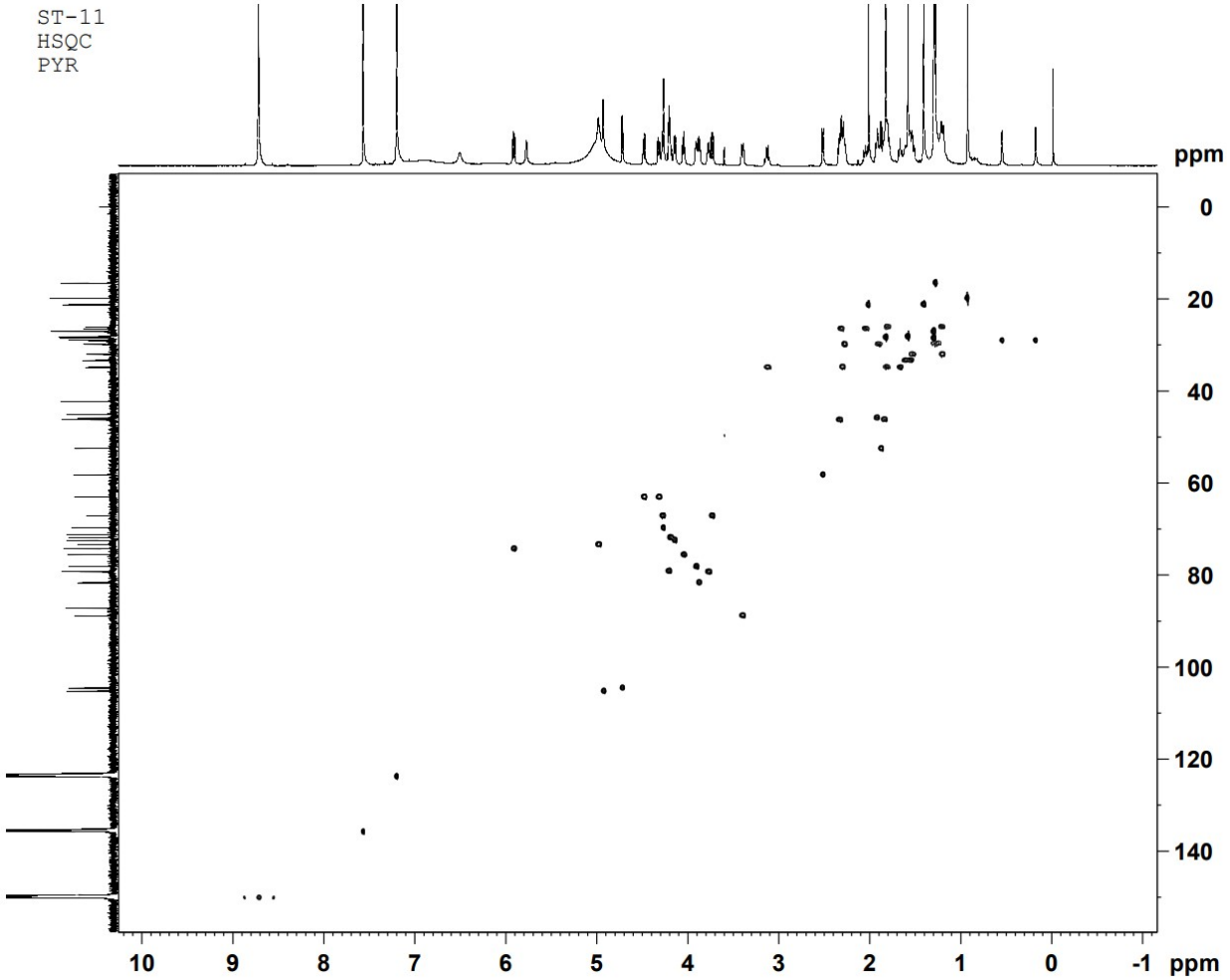

Figure S22. ^{1}H-^{1}H COSY spectrum of **3**.

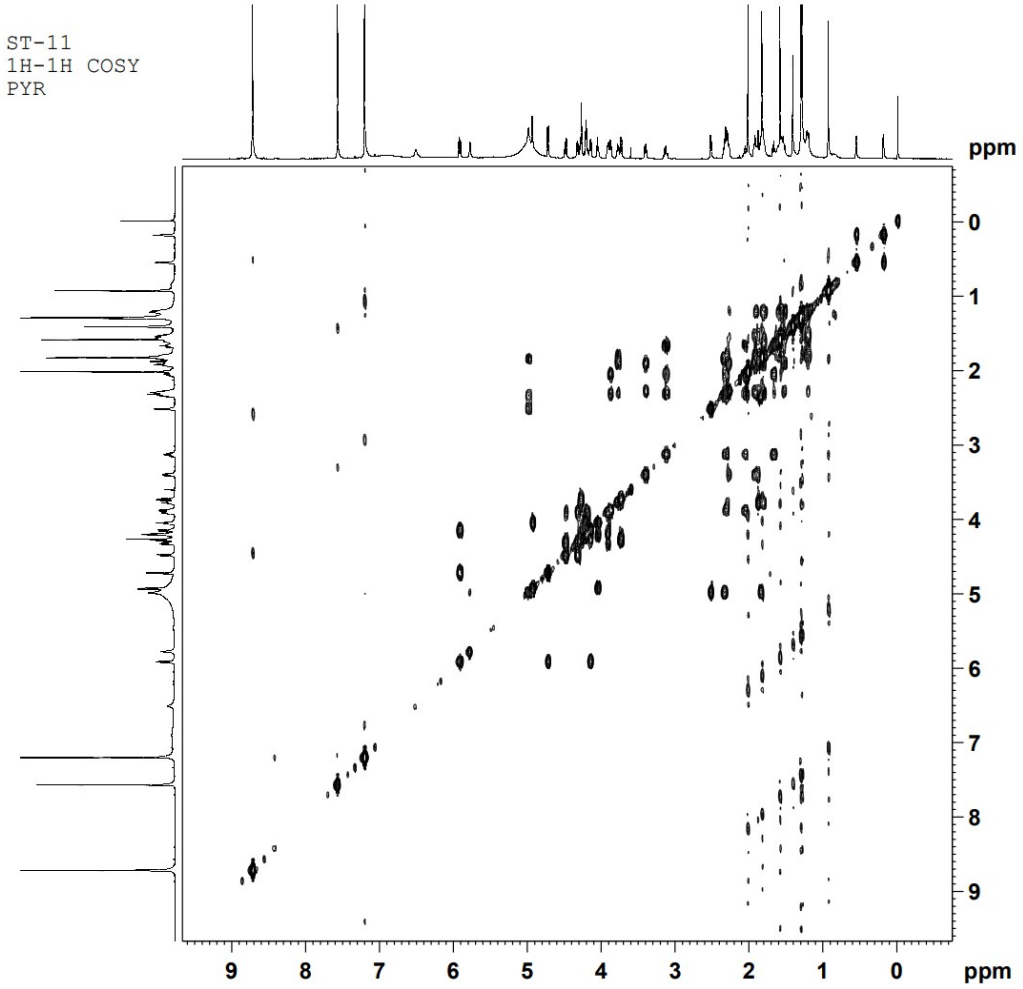

Figure S23. HMBC spectrum of **3**.

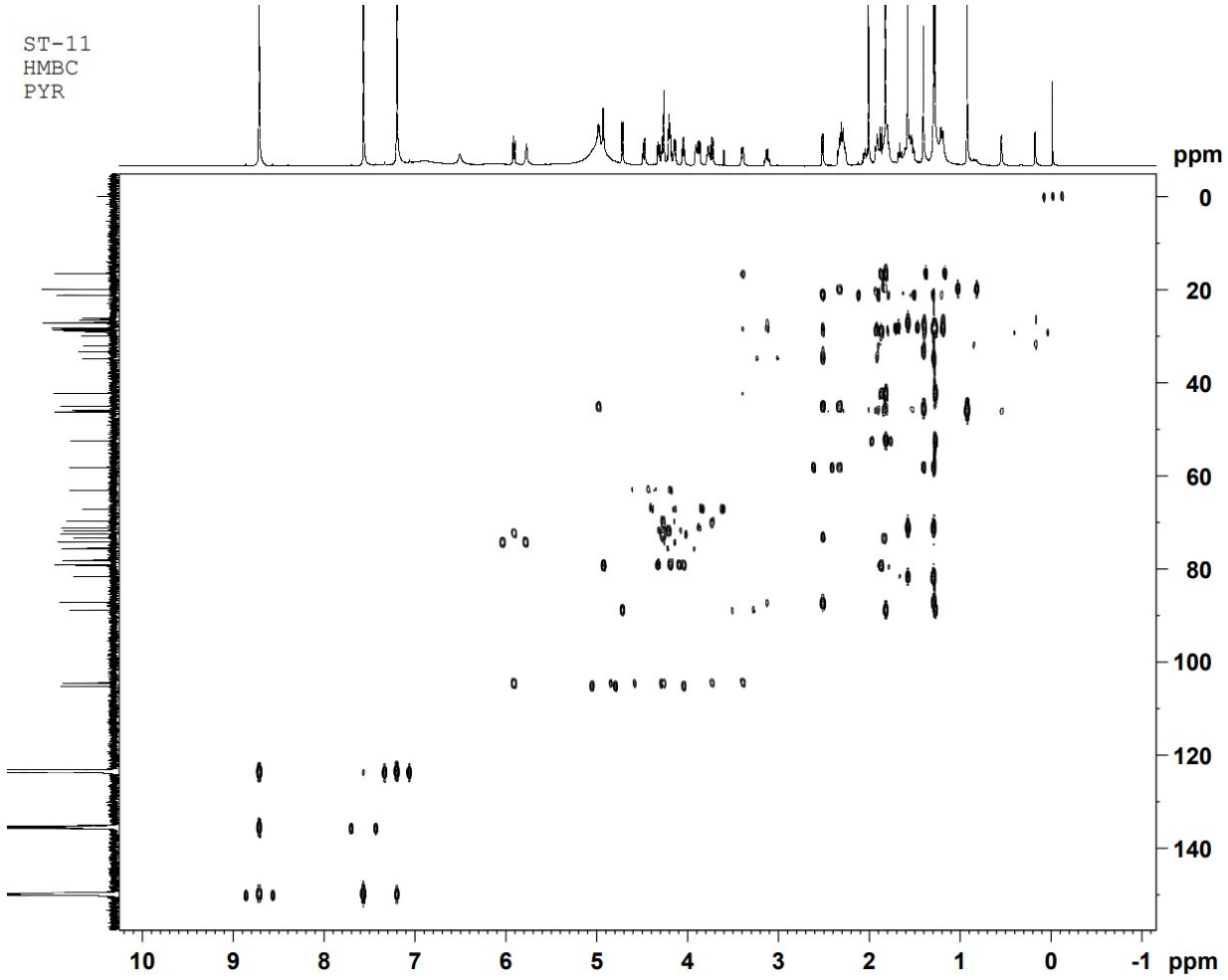

Figure S24. NOESY spectrum of **3**.

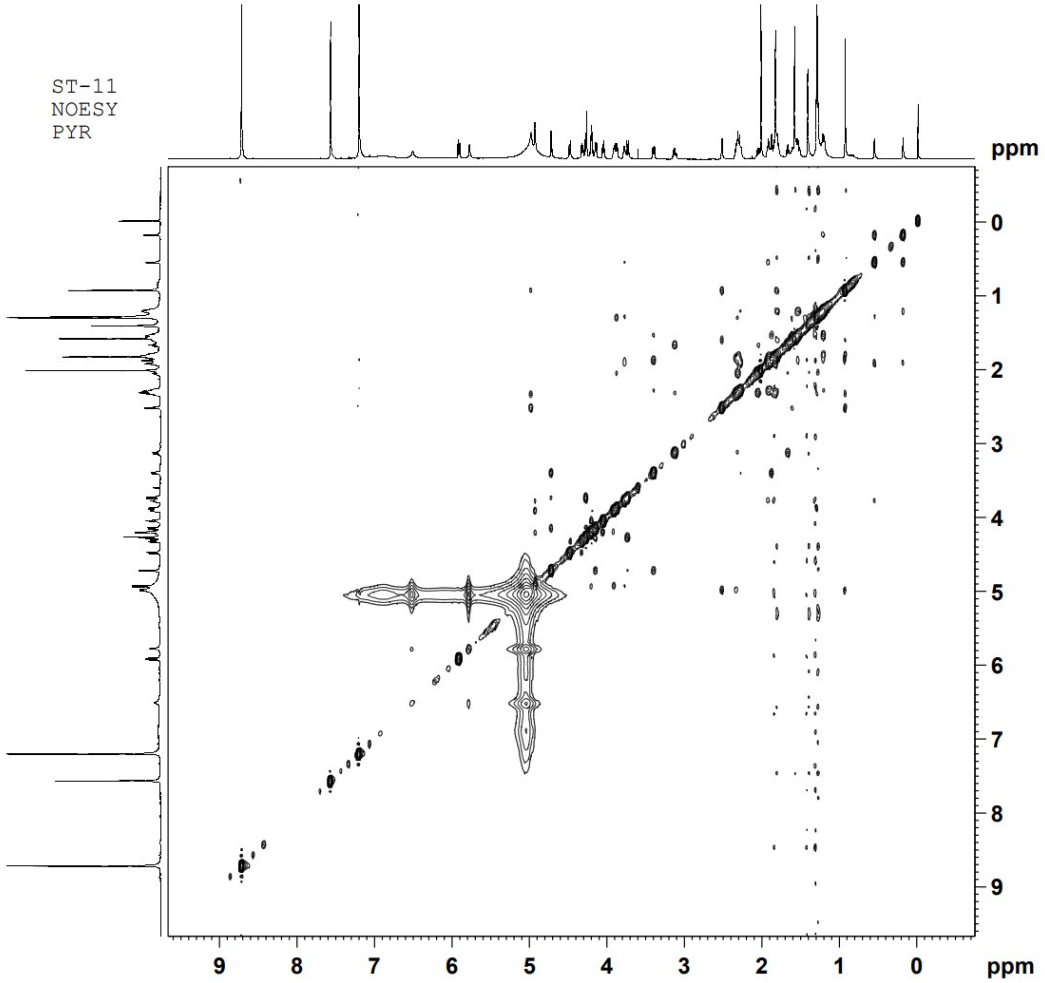

Figure S25. HR-ESI-MS spectrum of **4**

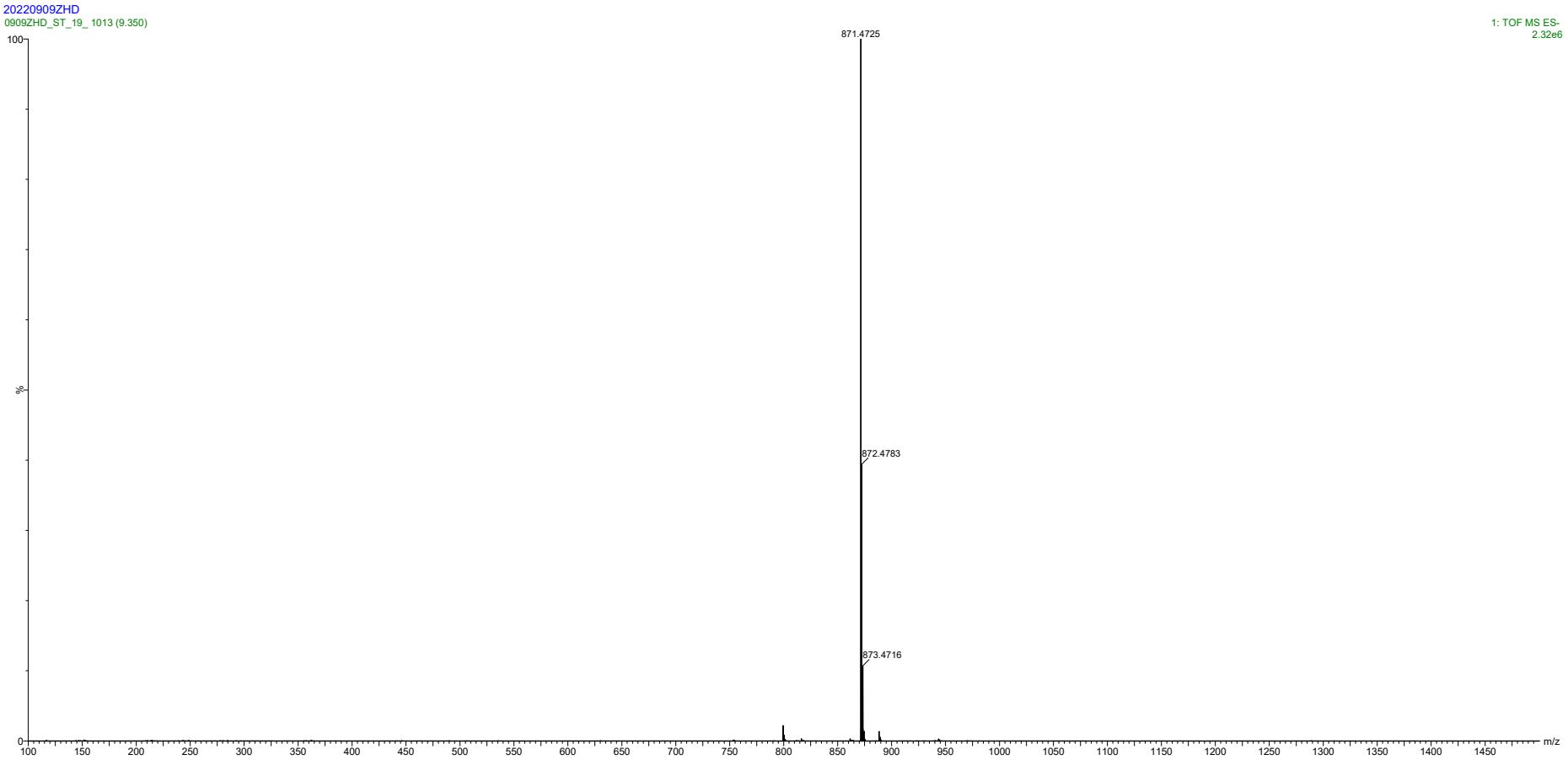

Figure S26. ^{1}H NMR spectrum of **4**.

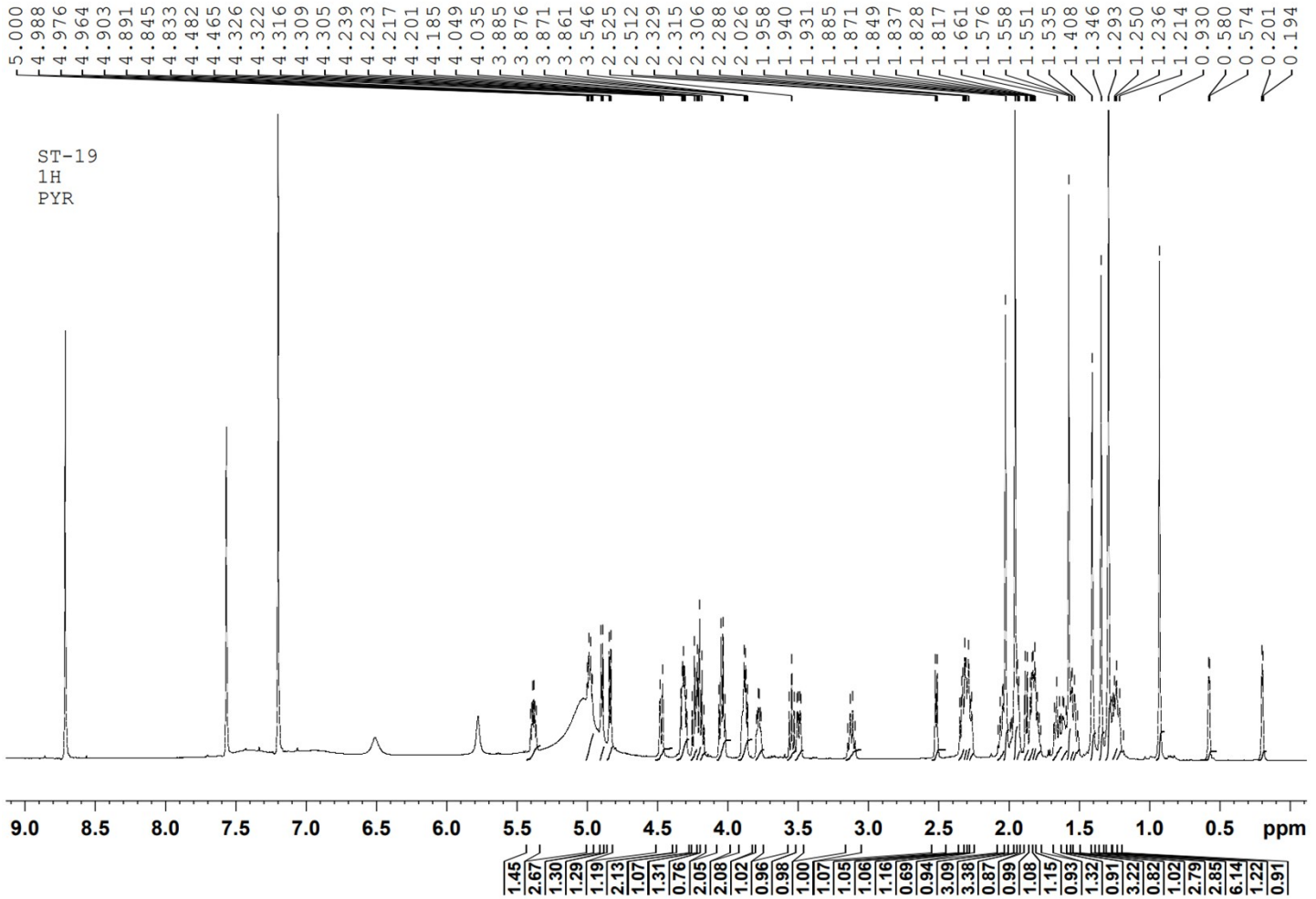

Figure S27. ^{13}C NMR spectrum of **4**.

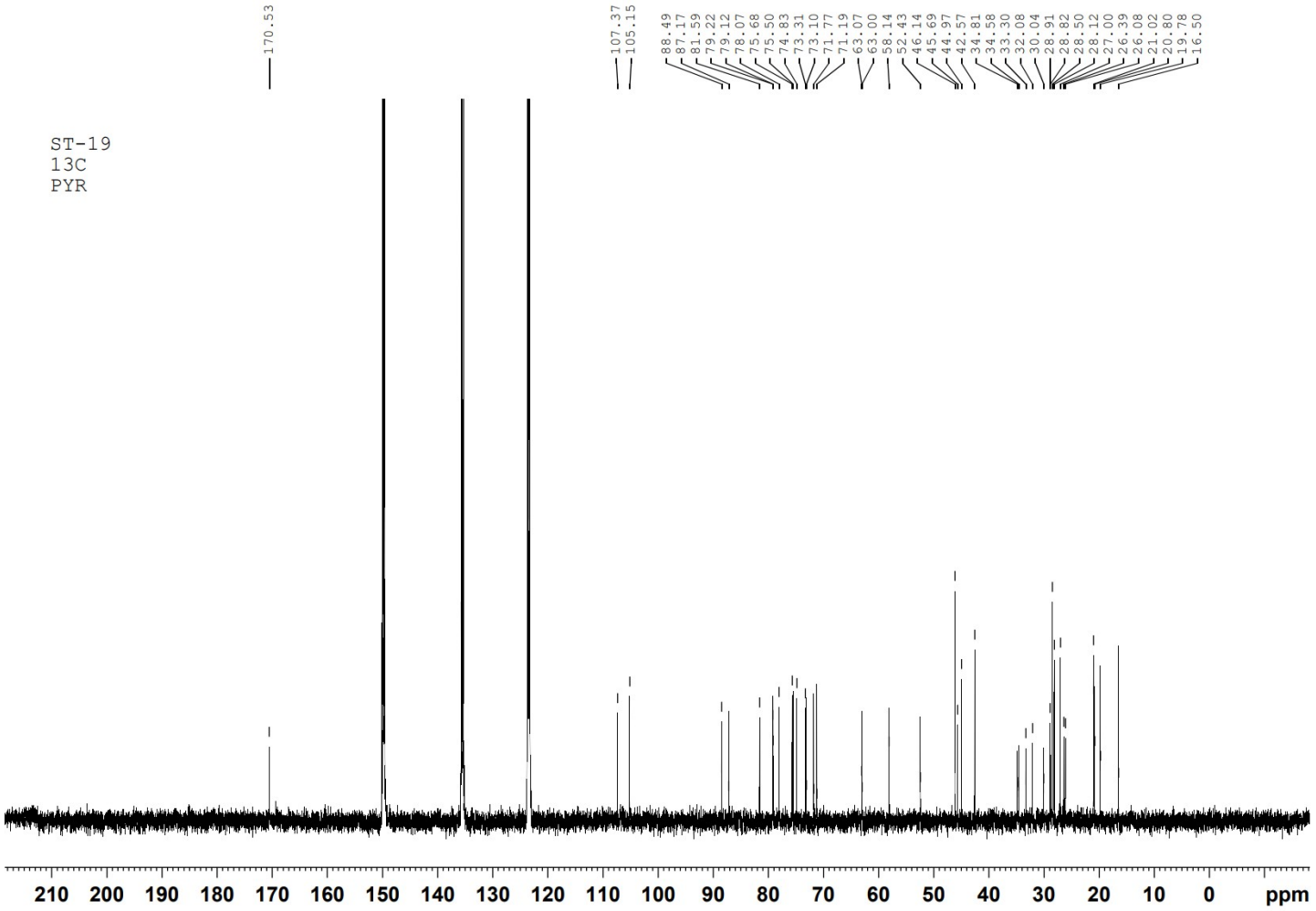

Figure S28. DEPT 135 spectrum of **4**.

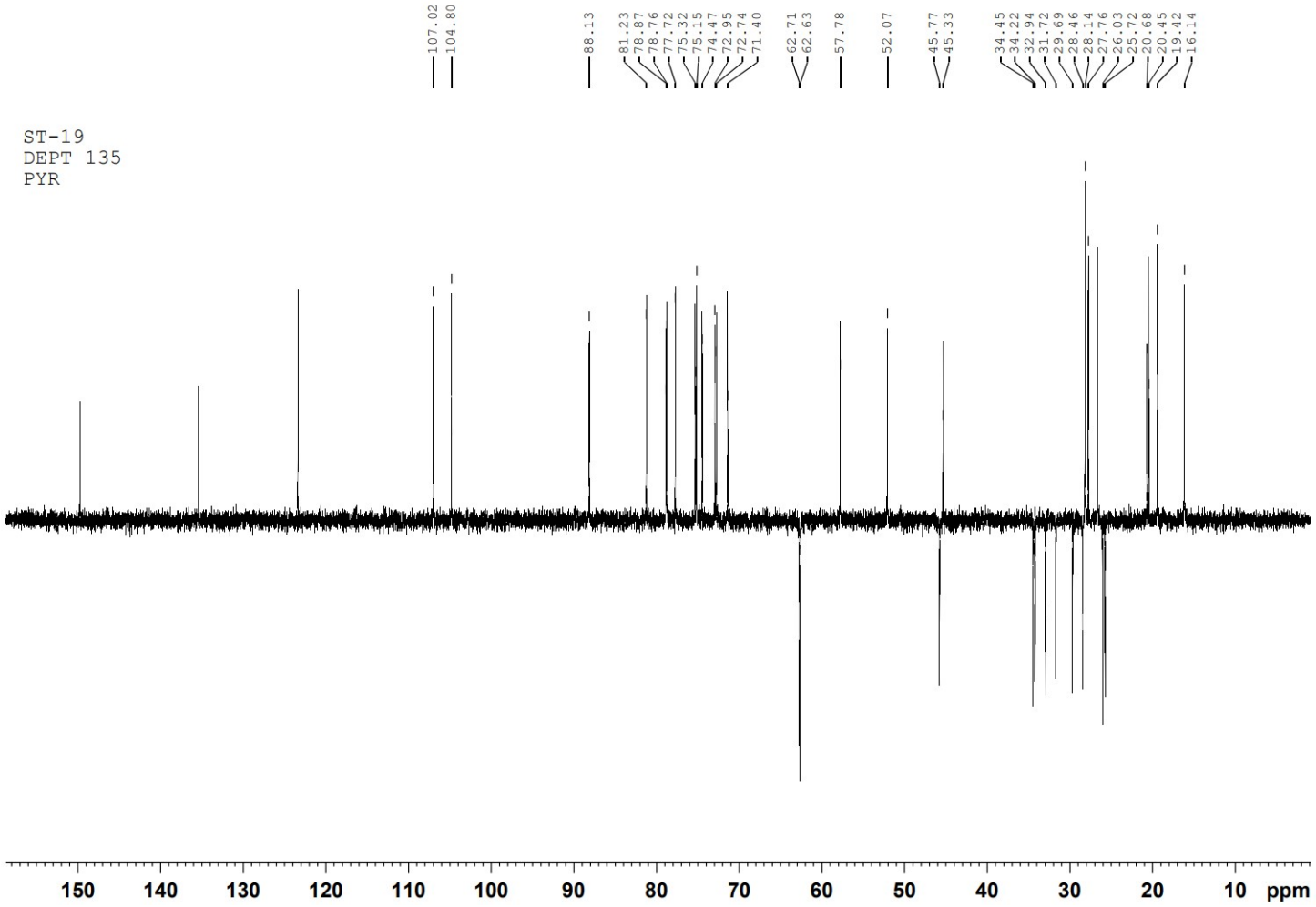

Figure S29 HSQC spectrum of **4**.

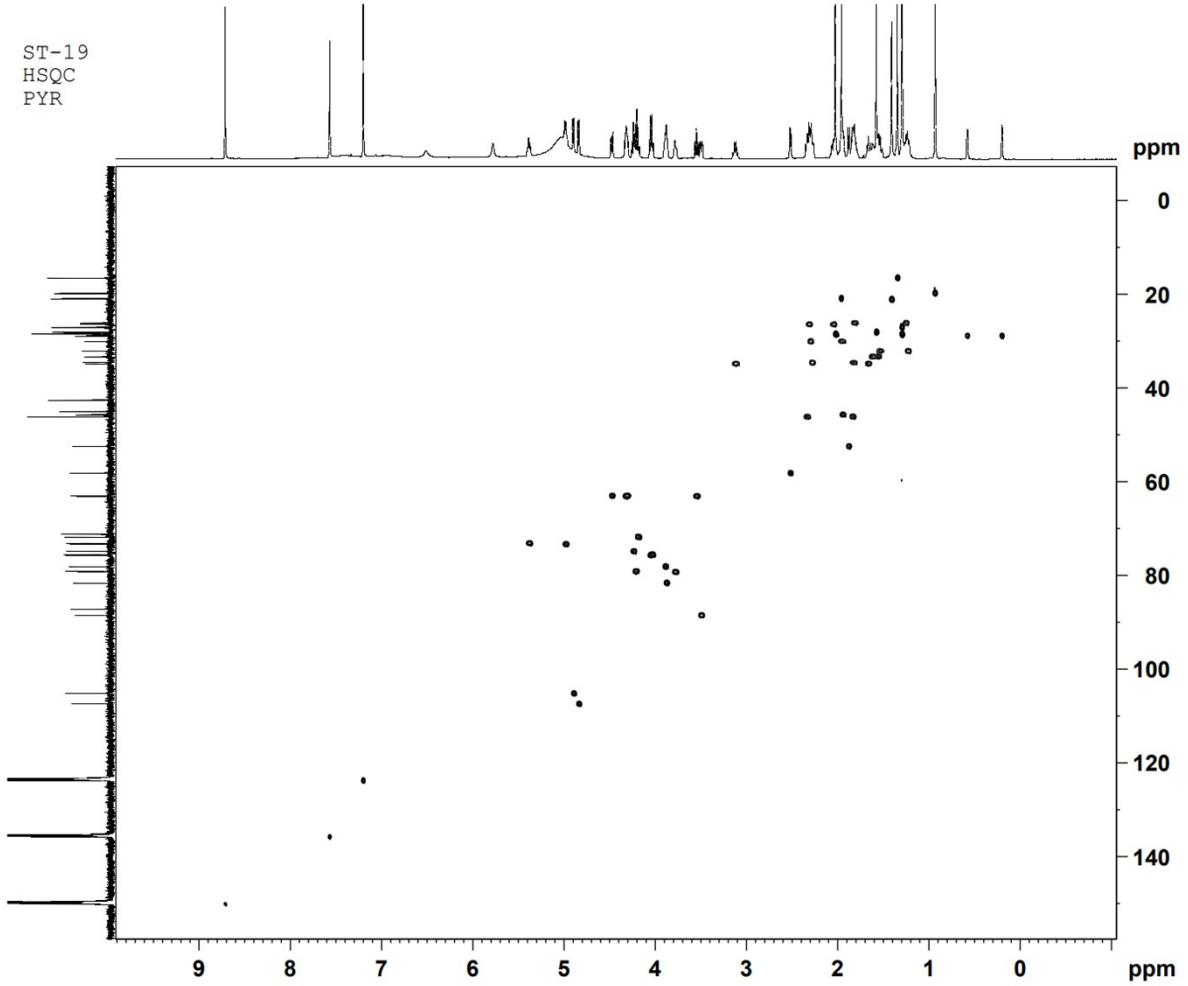

Figure S30. ^{1}H-^{1}H COSY spectrum of **4**.

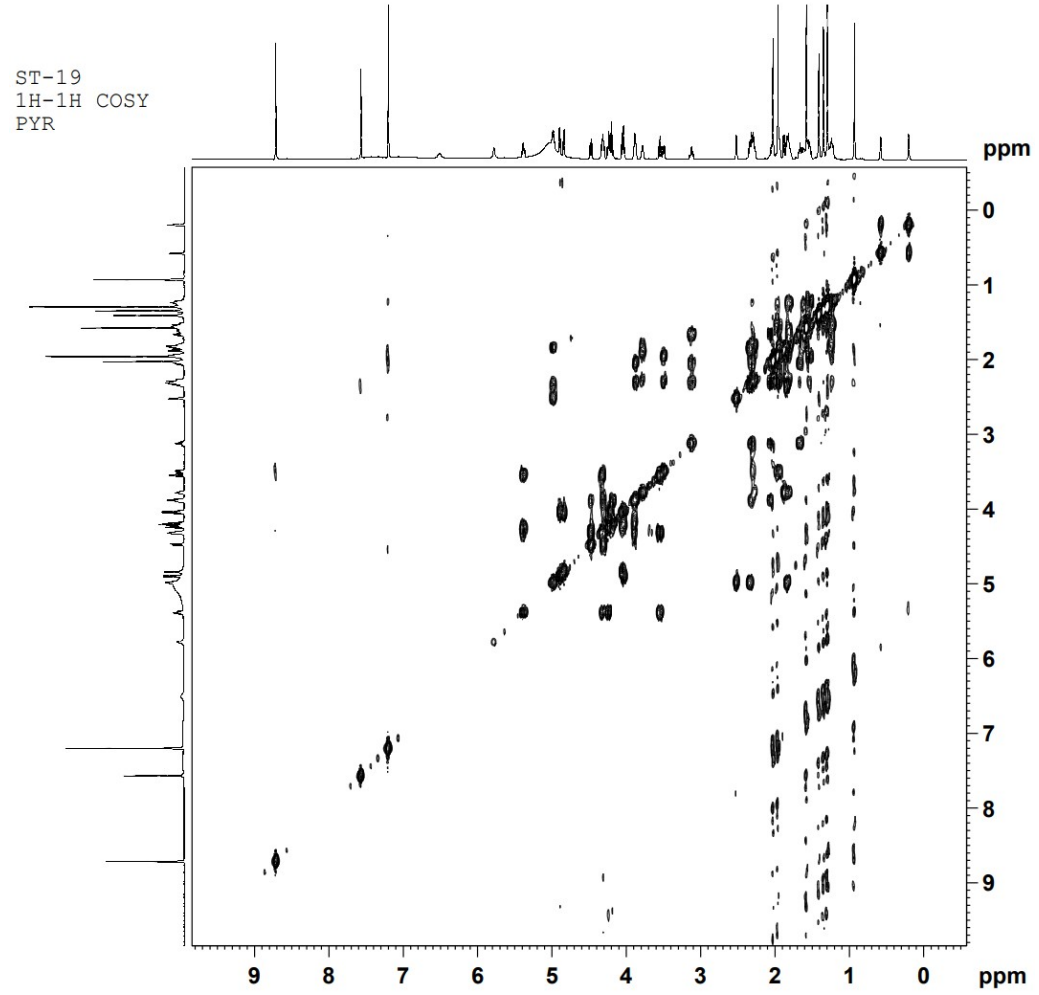

Figure S31. HMBC spectrum of **4**.

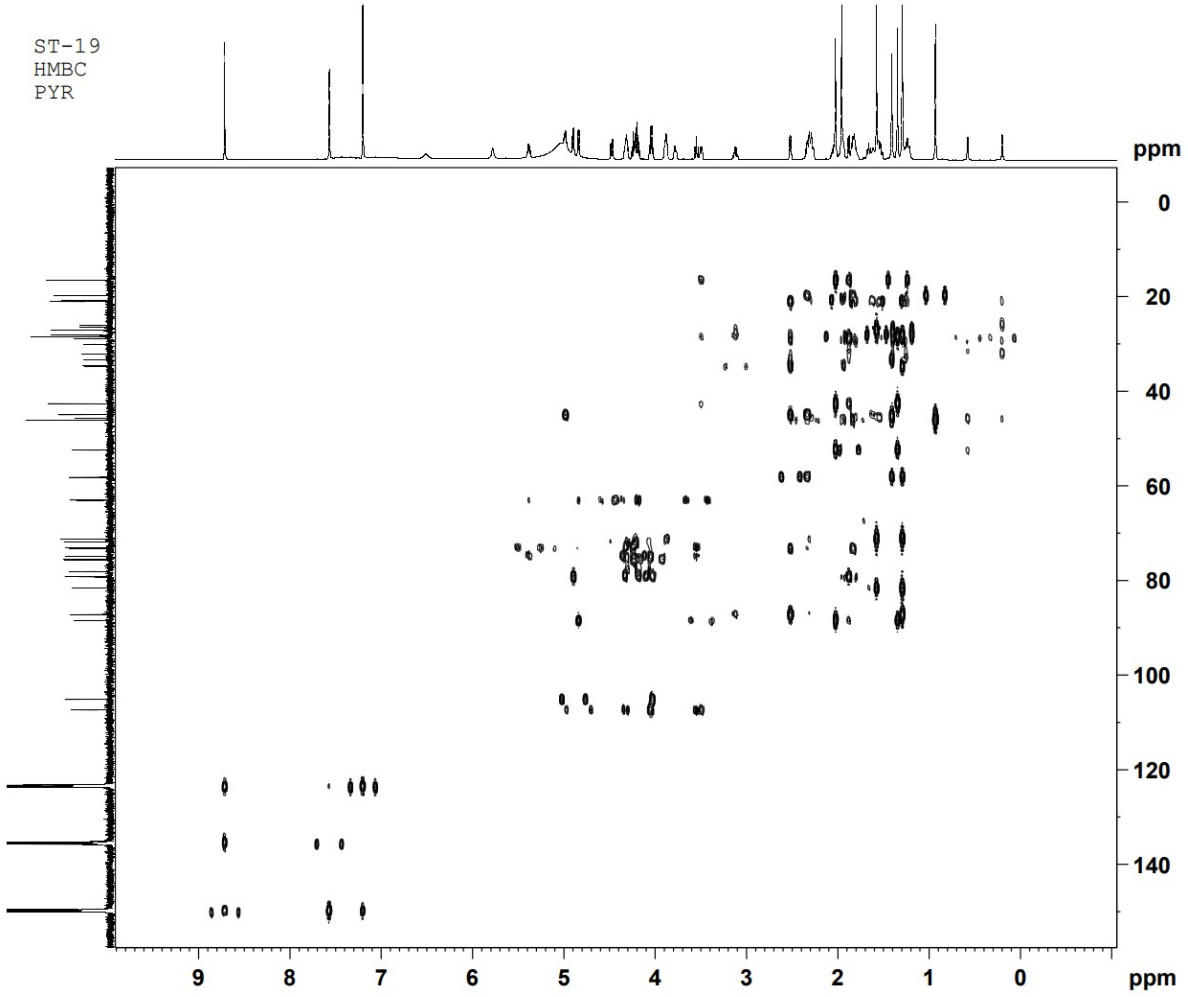

Figure S32. NOESY spectrum of **4**.

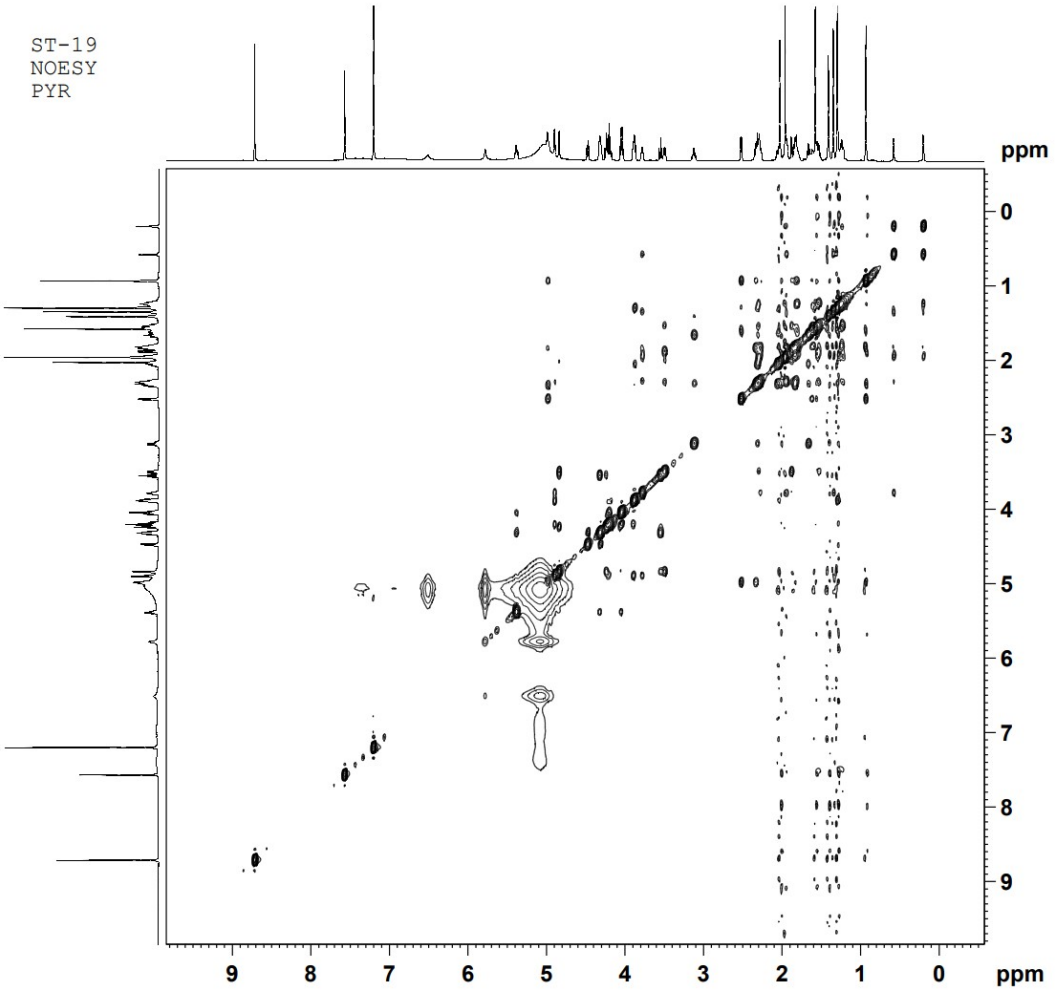

Figure S33. HR-ESI-MS spectrum of **5**

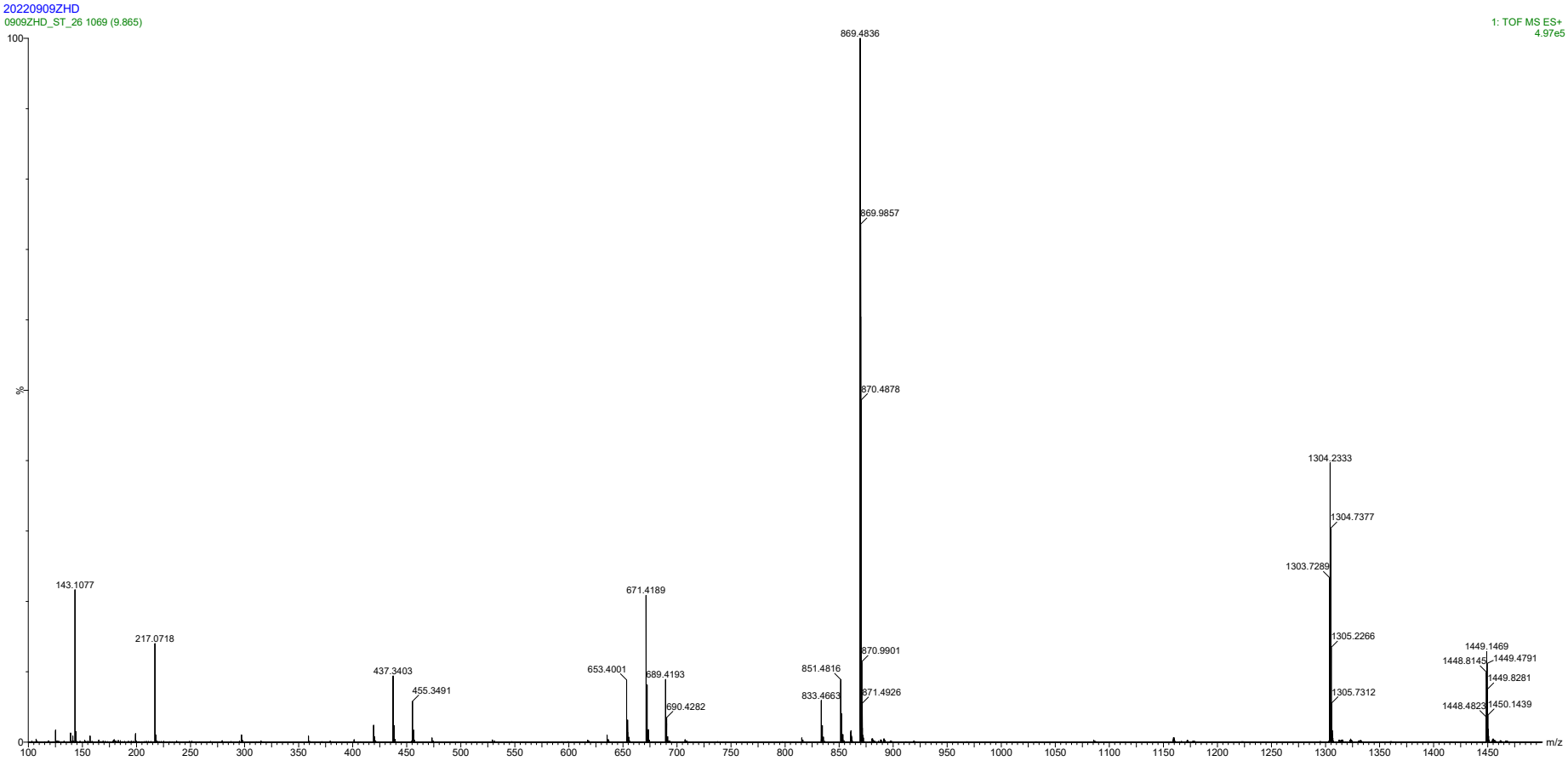

Figure S34. ^{1}H NMR spectrum of **5**.

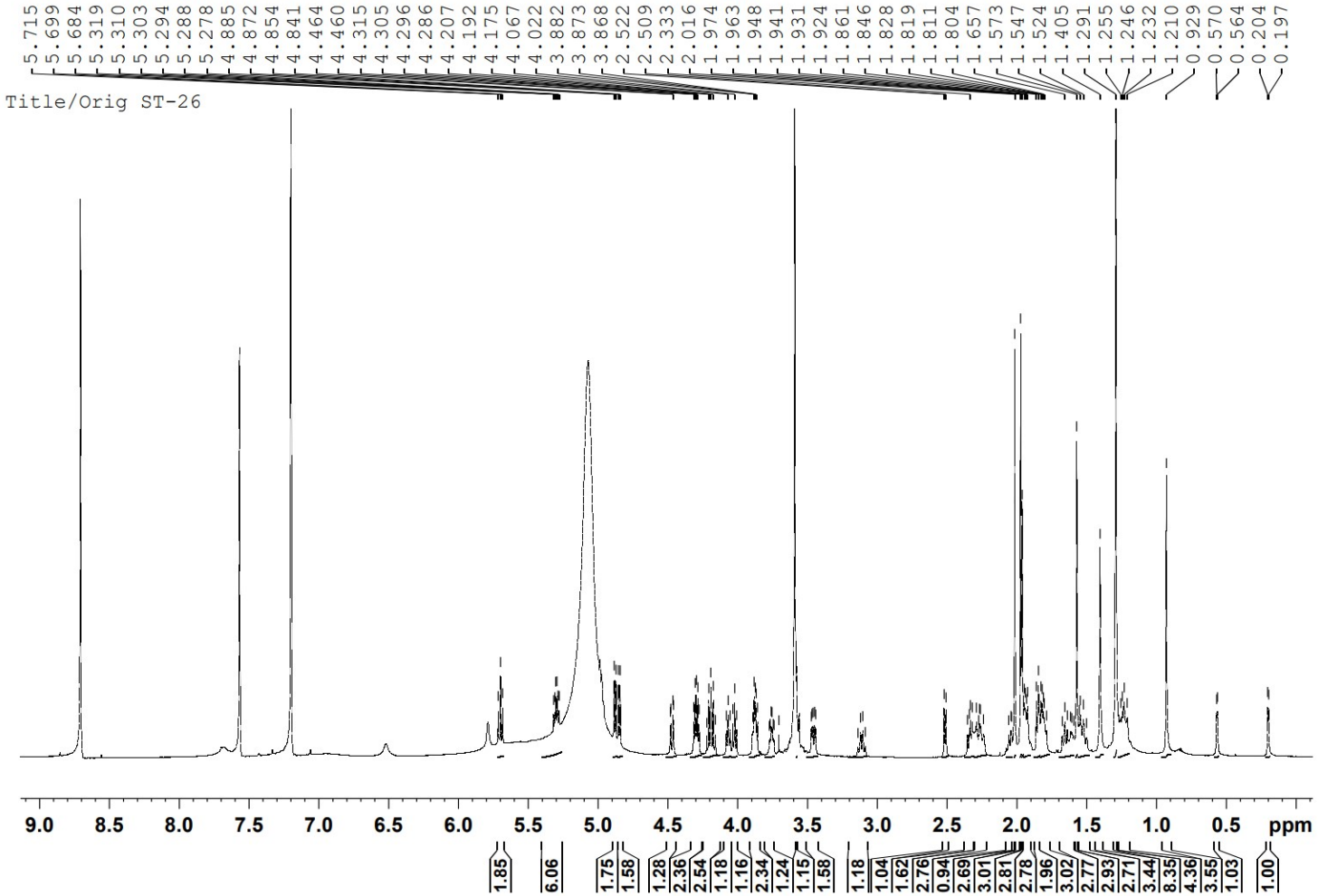

Figure S35. ^{13}C NMR spectrum of **5**.

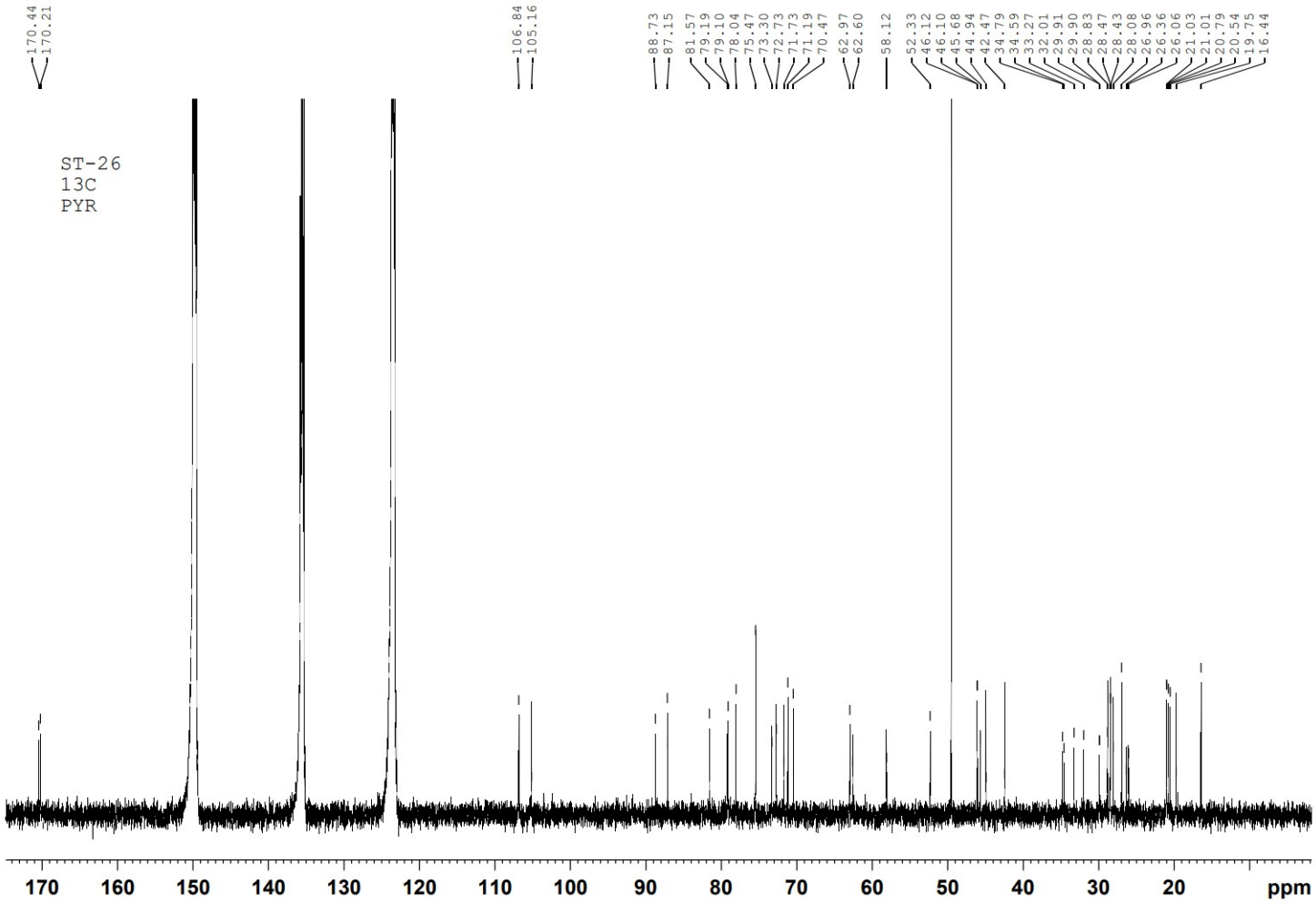

Figure S36. DEPT 135 spectrum of **5**.

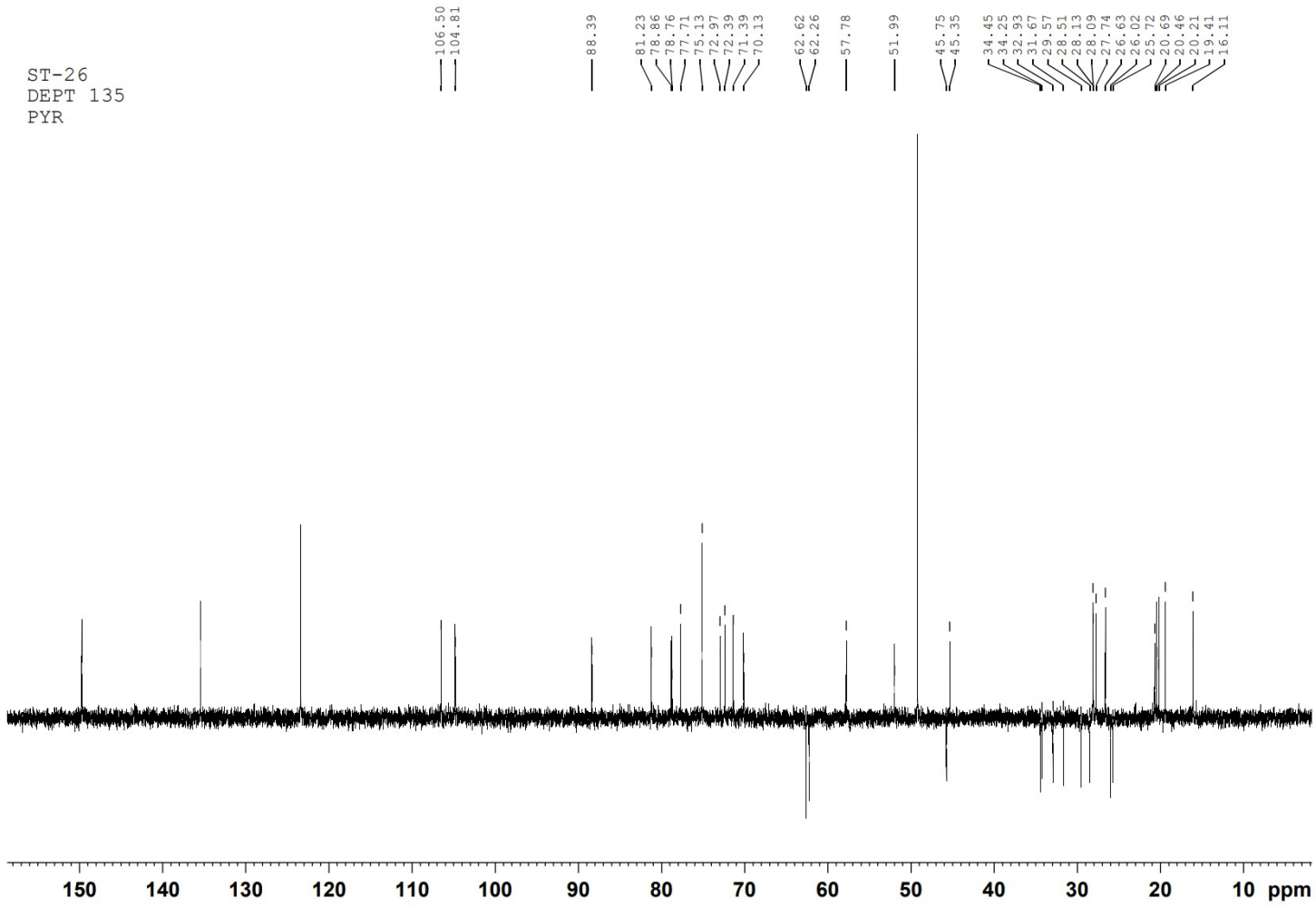

Figure S37. HSQC spectrum of **5**.

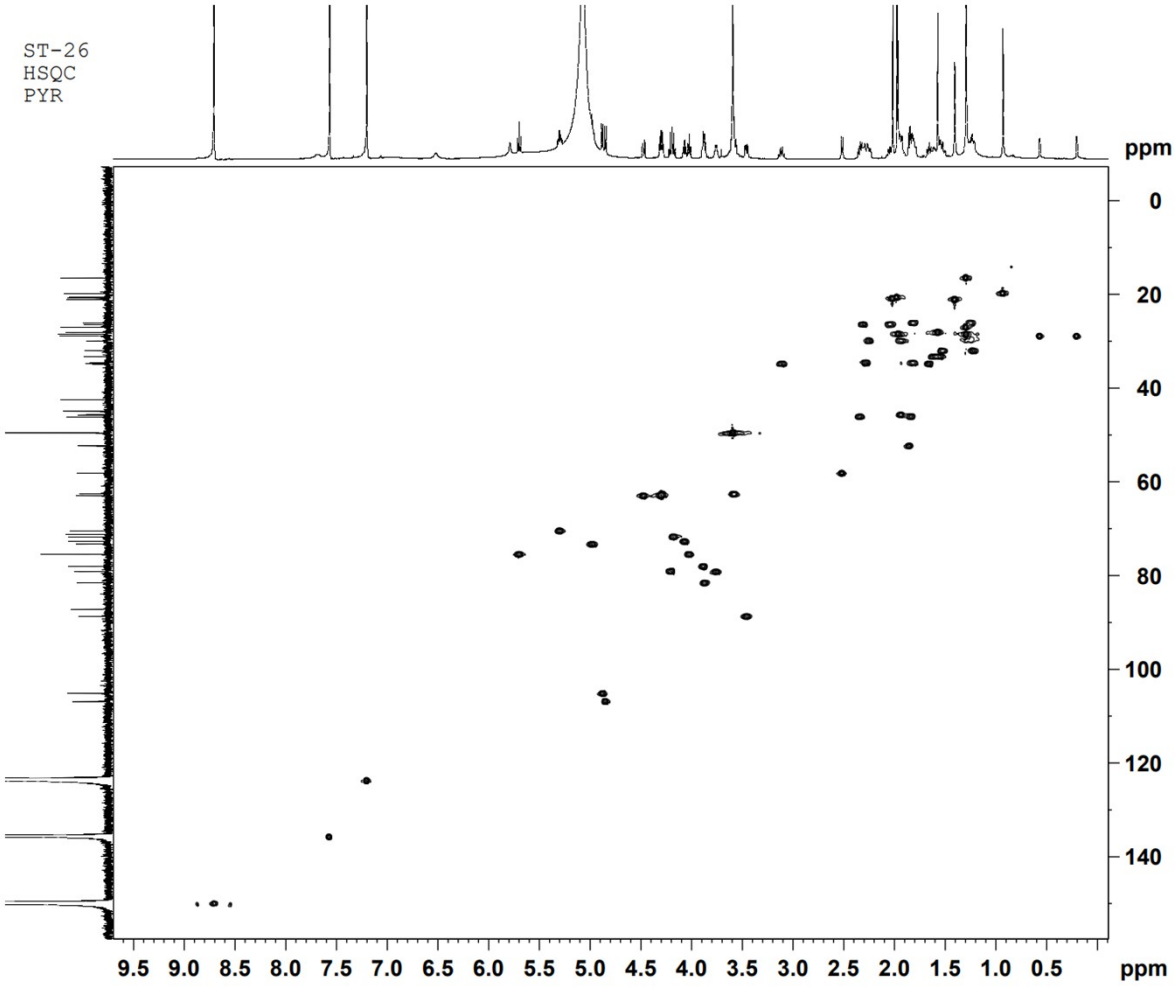

Figure S38. ^{1}H-^{1}H COSY spectrum of **5.**

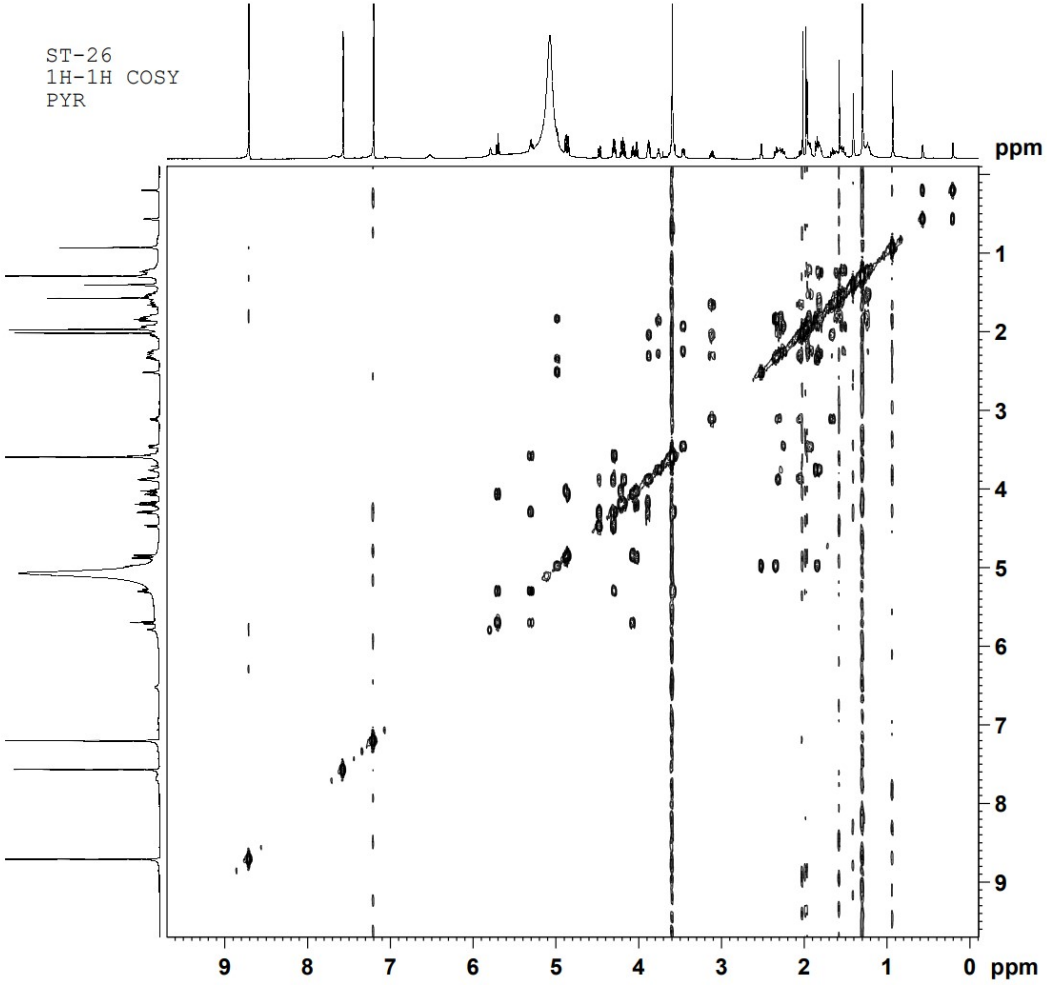

Figure S39. HMBC spectrum of **5.**

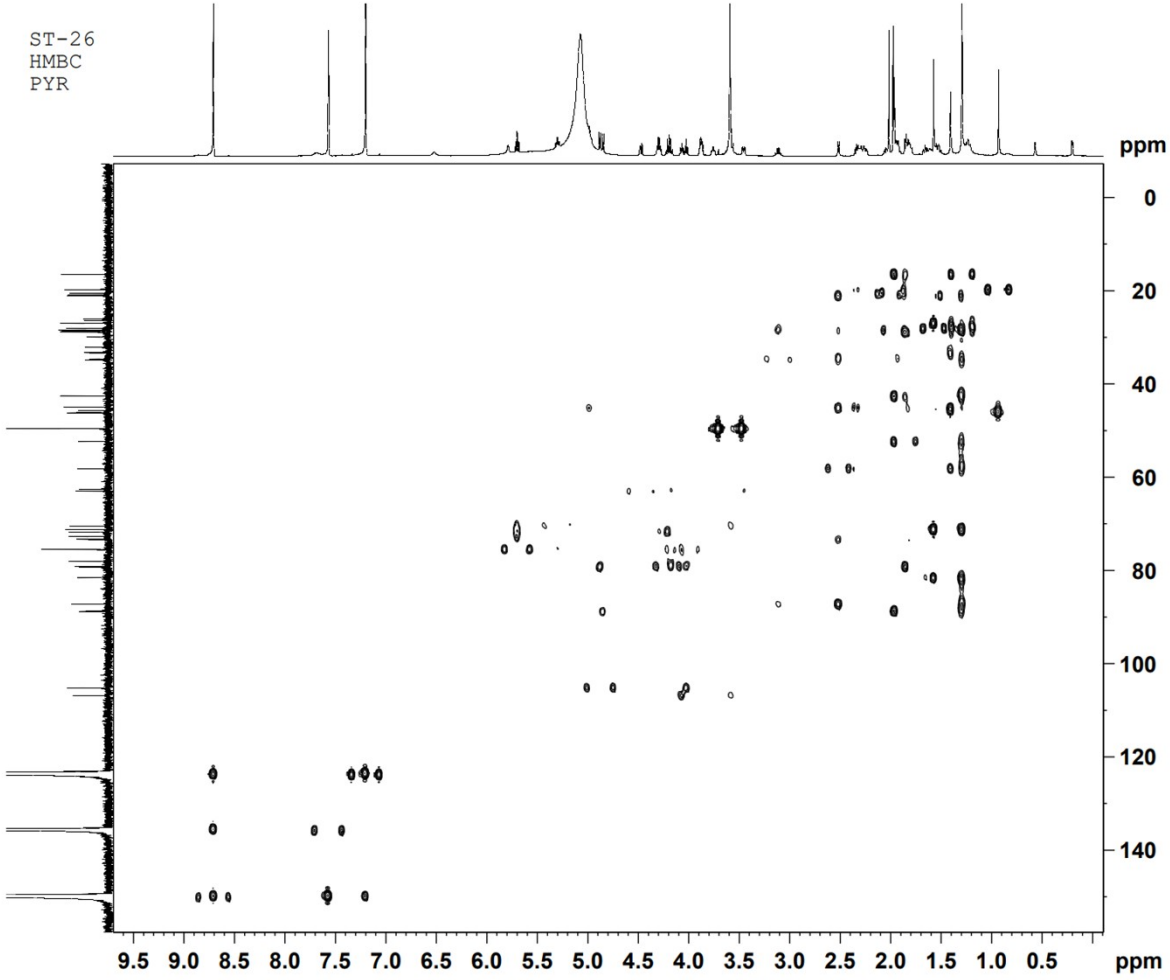

Figure S40. NOESY spectrum of **5**.

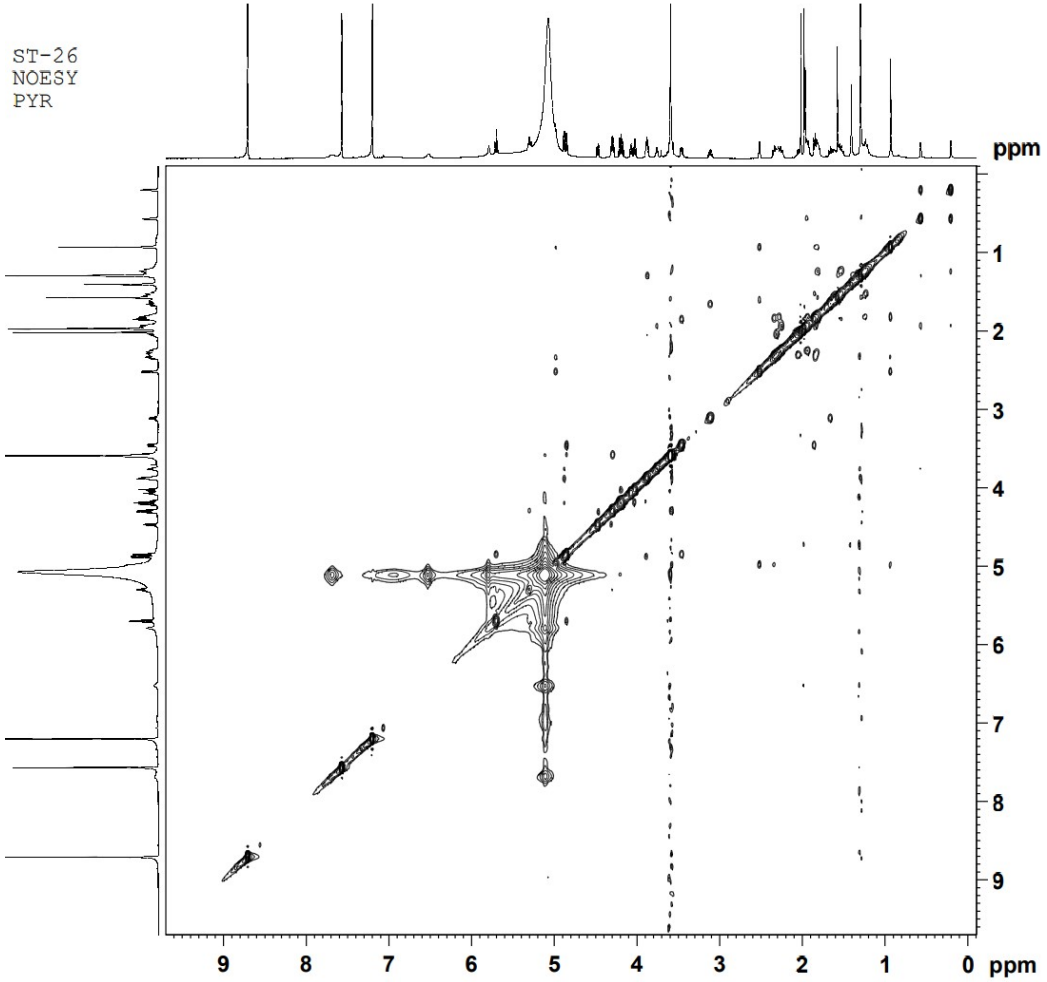

Figure S41. HR-ESI-MS spectrum of **6**

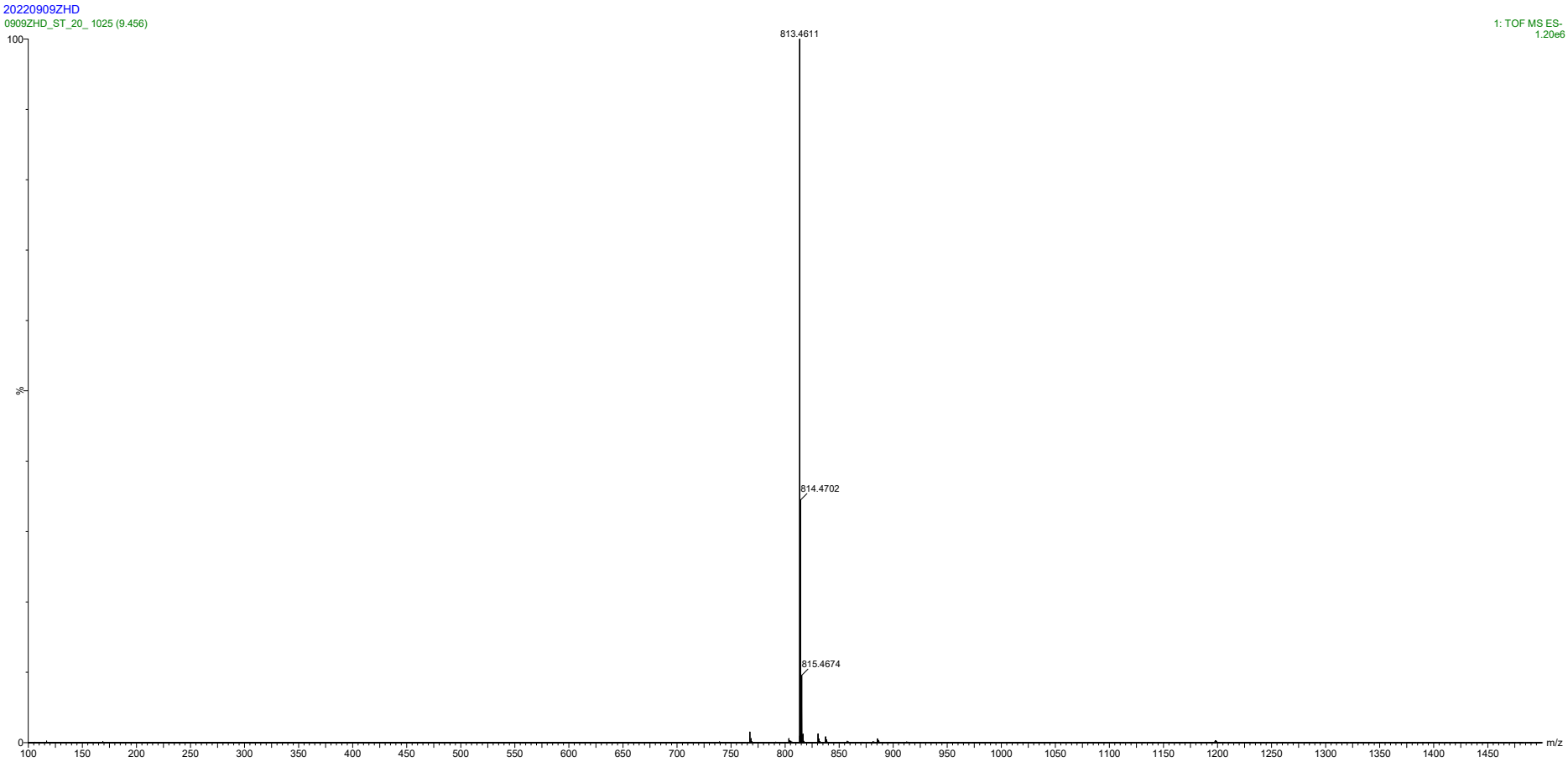

Figure S42. ^{1}H NMR spectrum of **6**.

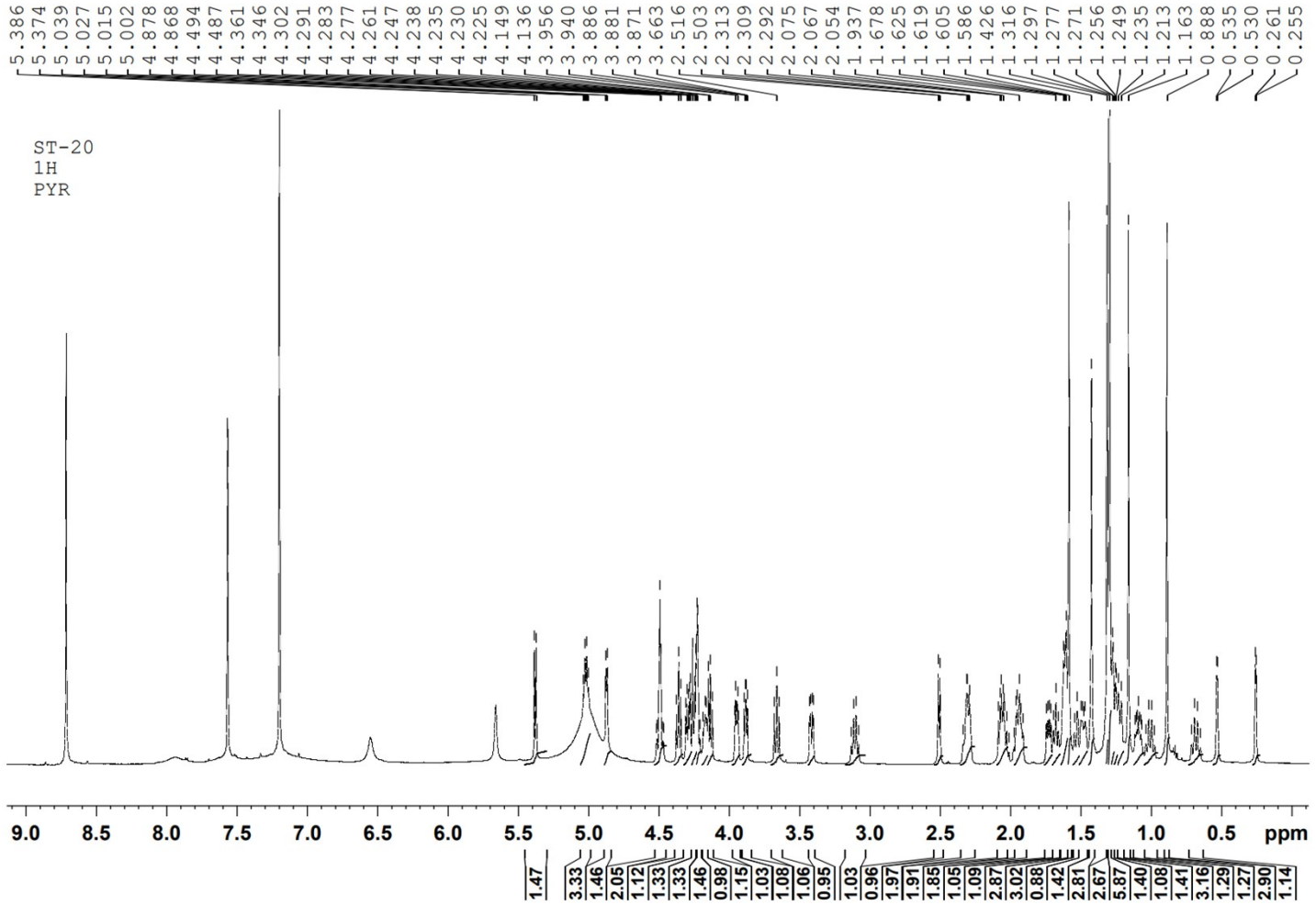

Figure S43. ^{13}C NMR spectrum of **6**.

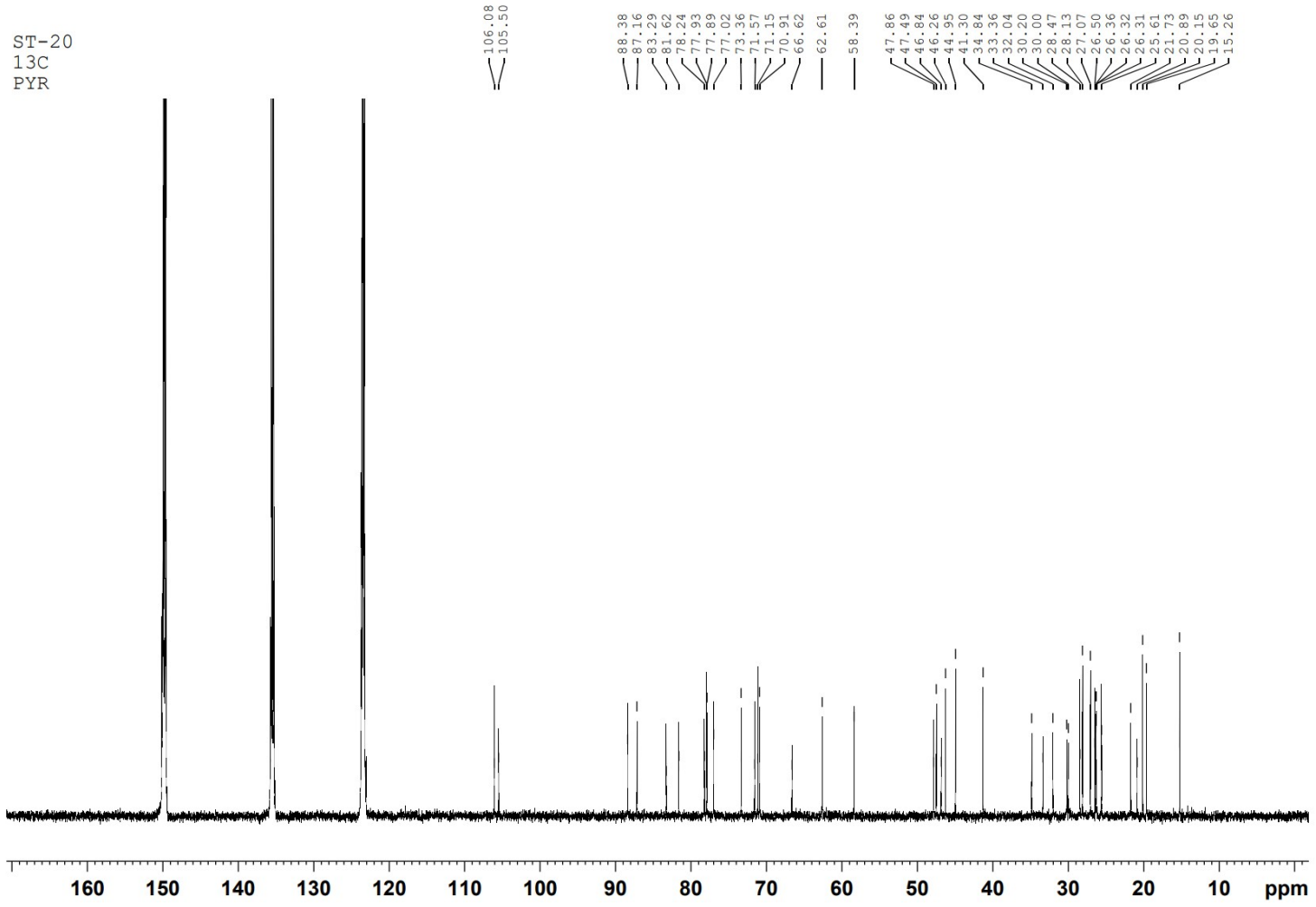

Figure S44. DEPT 135 spectrum of **6**.

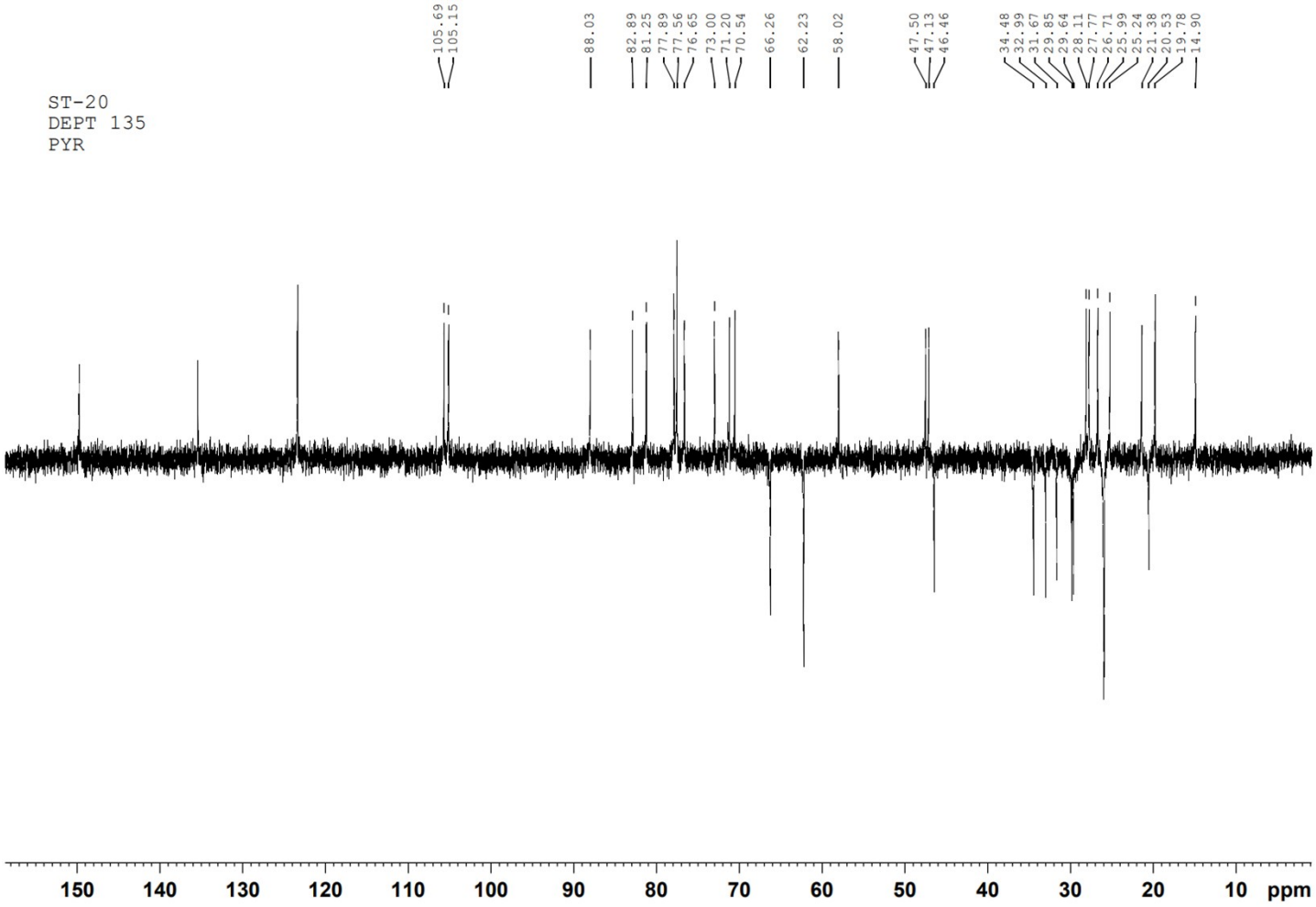

Figure S45. HSQC spectrum of **6**.

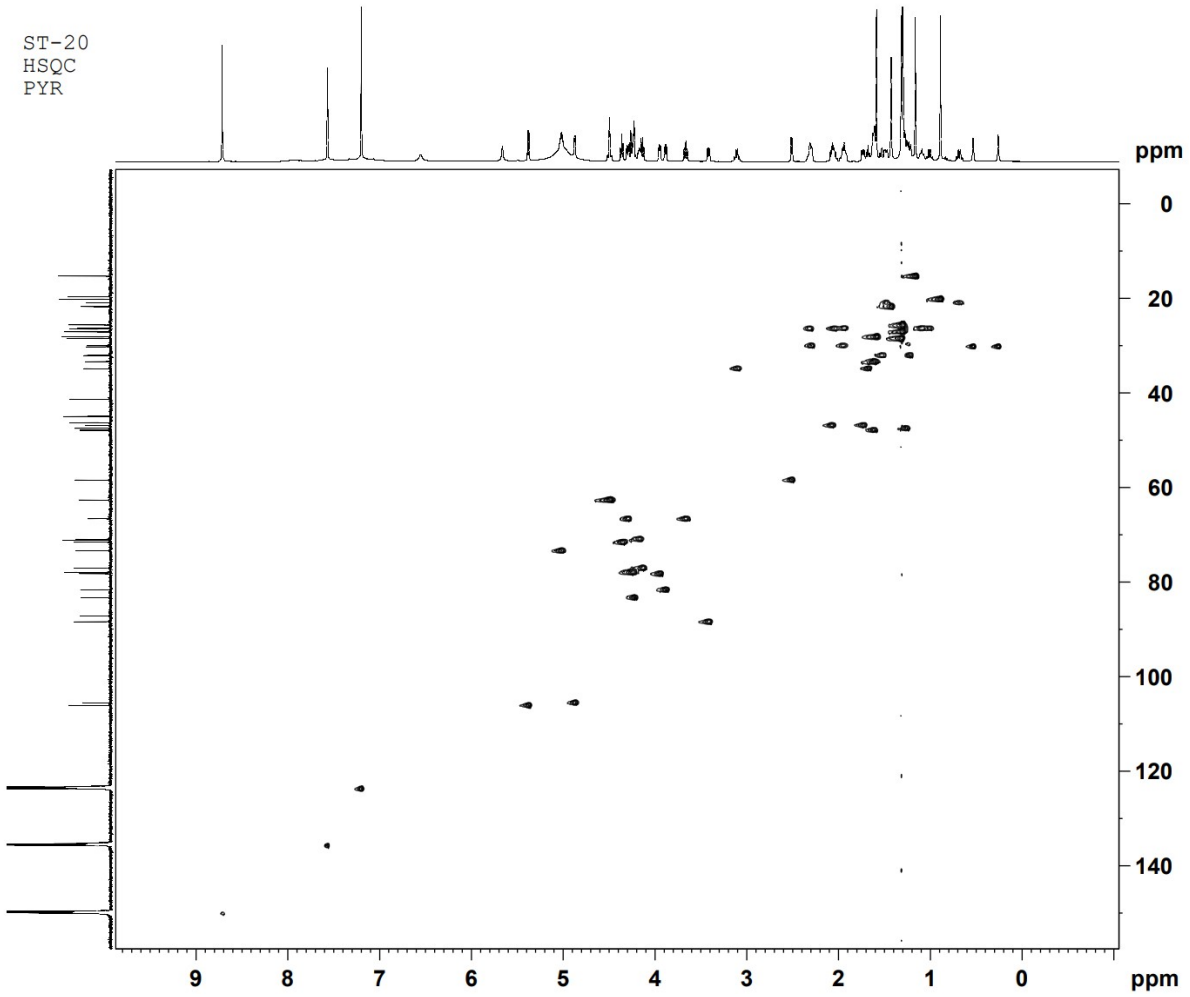

Figure S46. ^{1}H-^{1}H COSY spectrum of **6**.

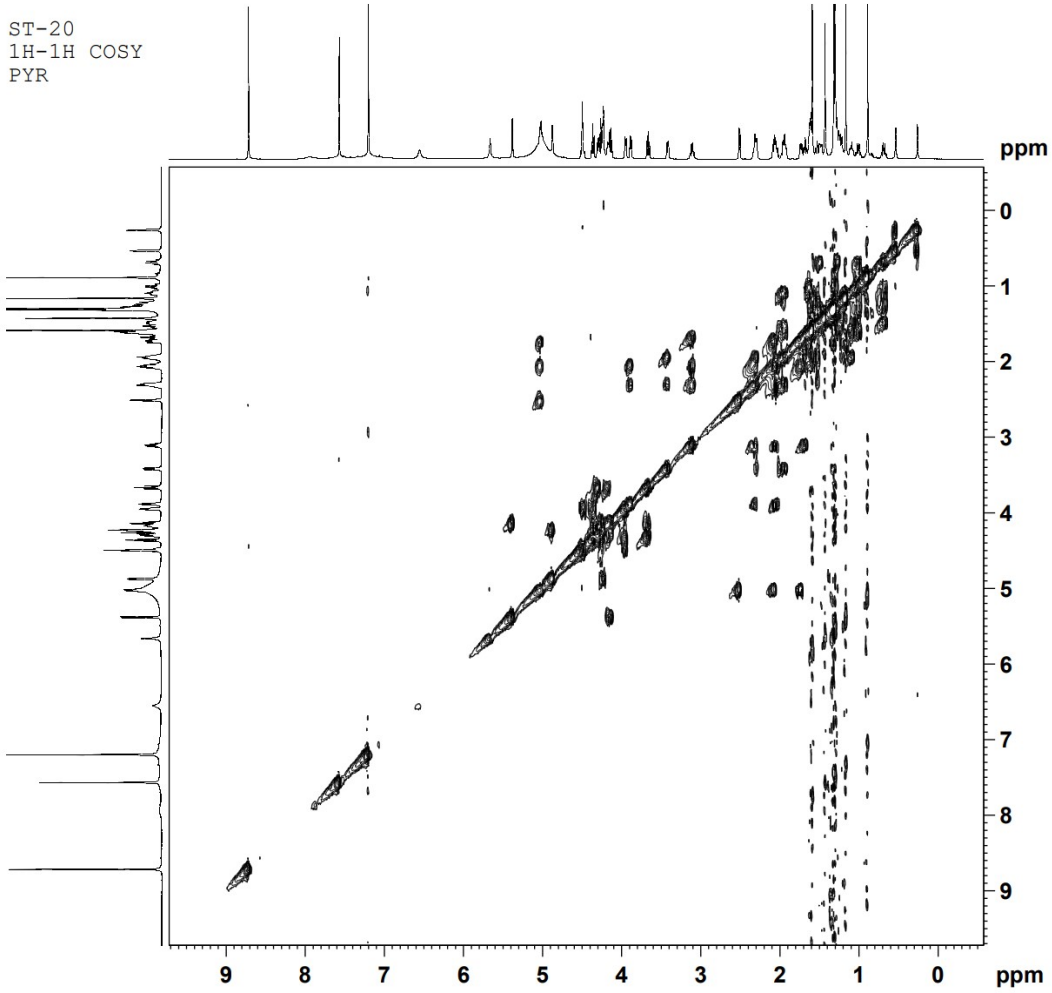

Figure S47. HMBC spectrum of **6**.

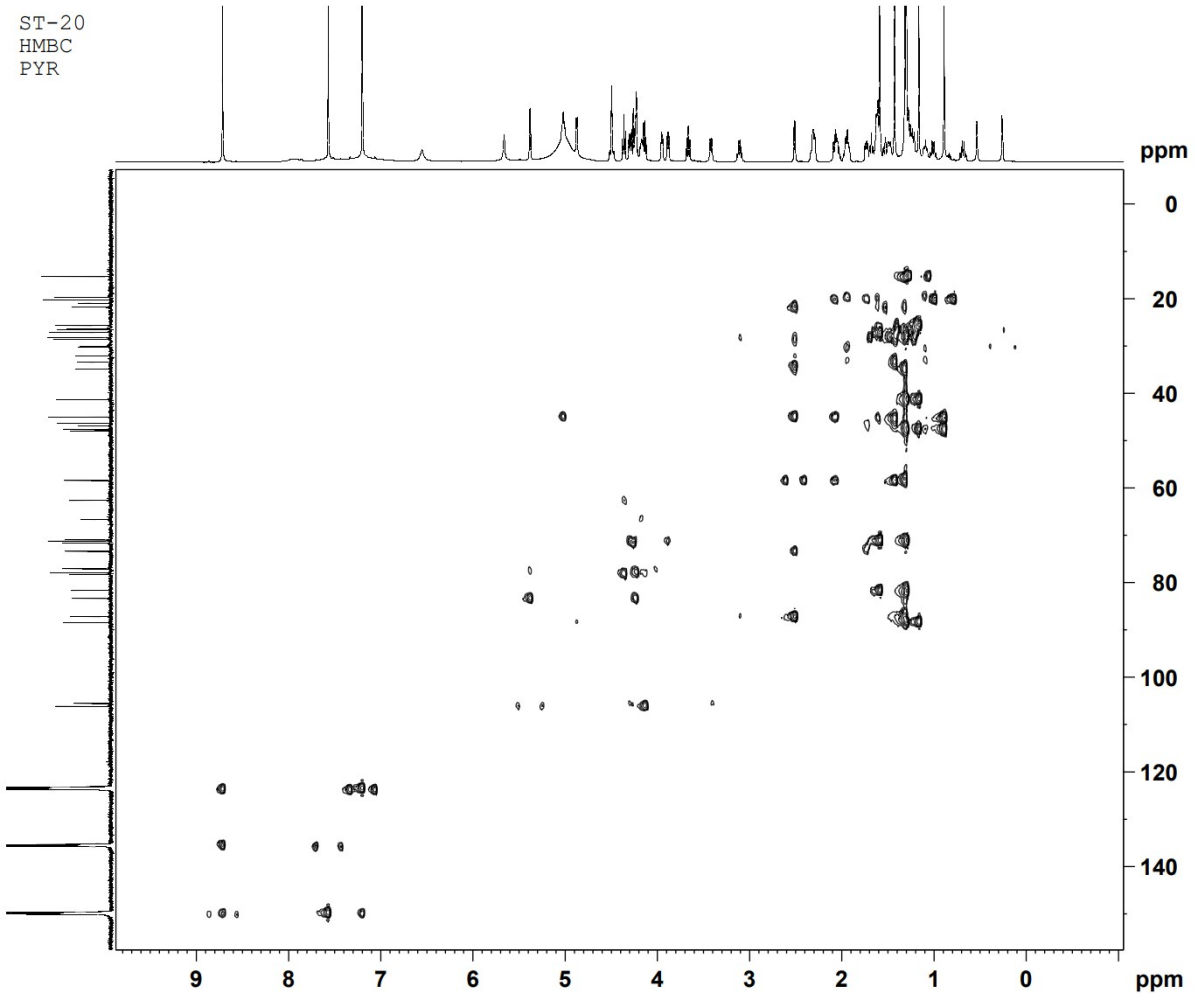

Figure S48. NOESY spectrum of **6**.

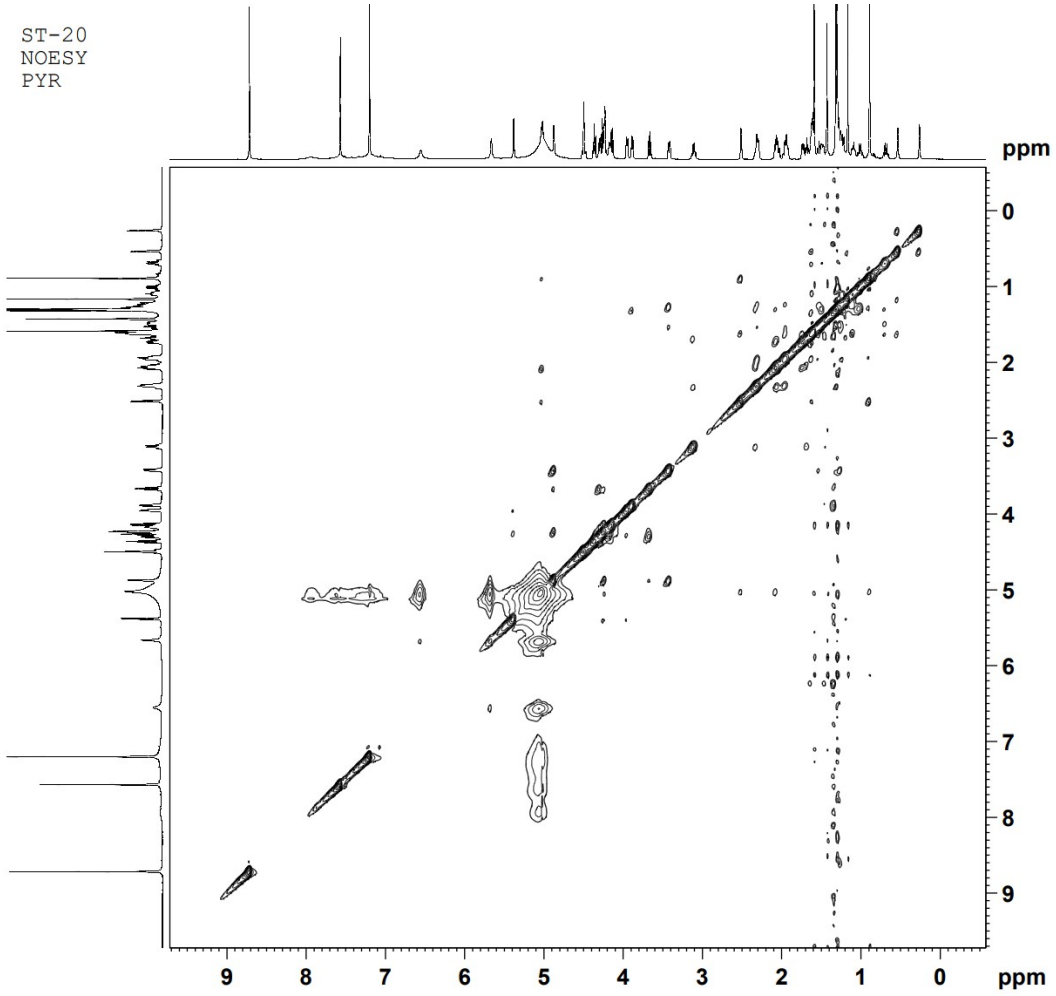

Figure S49. HR-ESI-MS spectrum of **7**

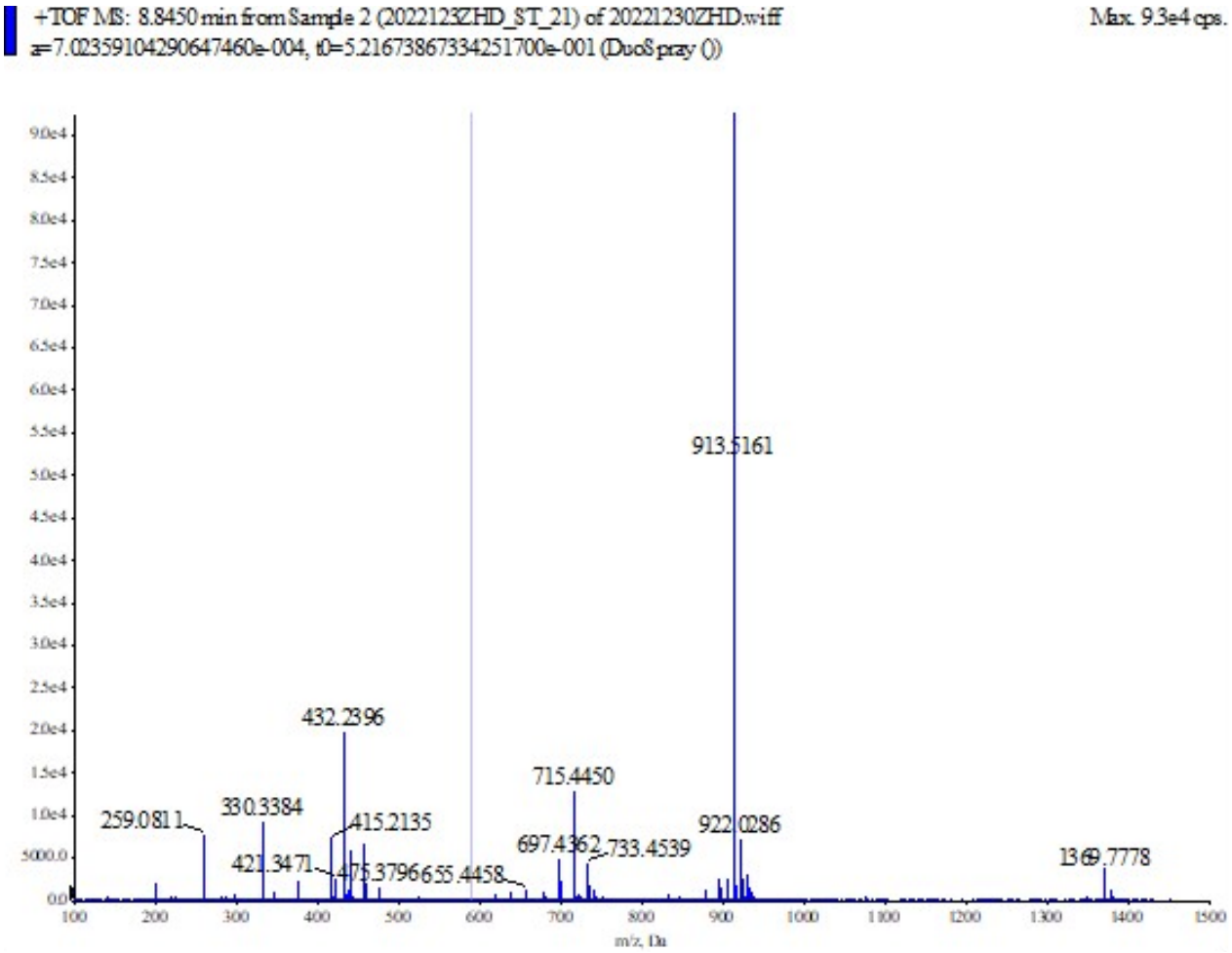

Figure S50. ^{1}H NMR spectrum of **7**.

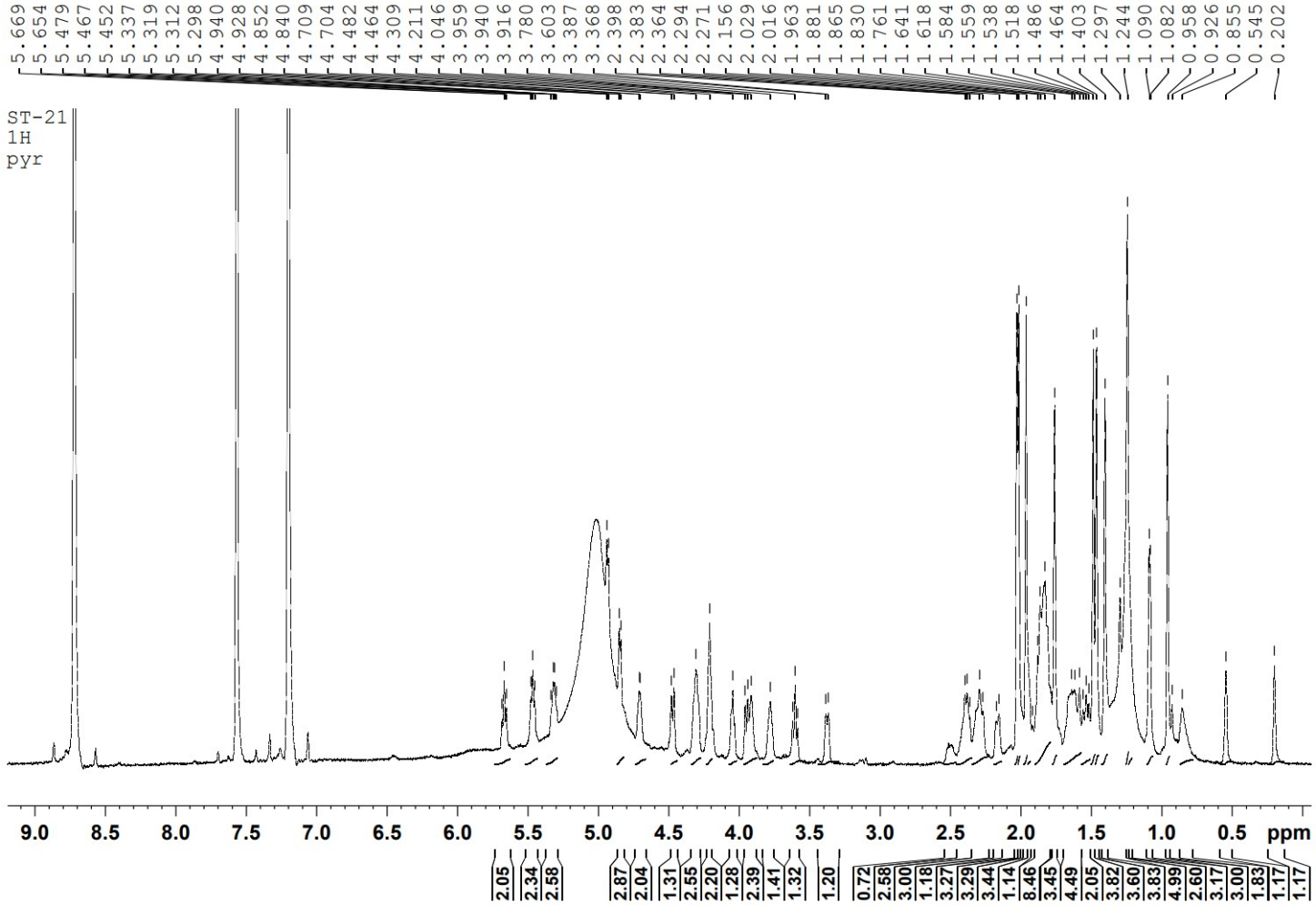

Figure S51. ^{13}C NMR spectrum of **7**.

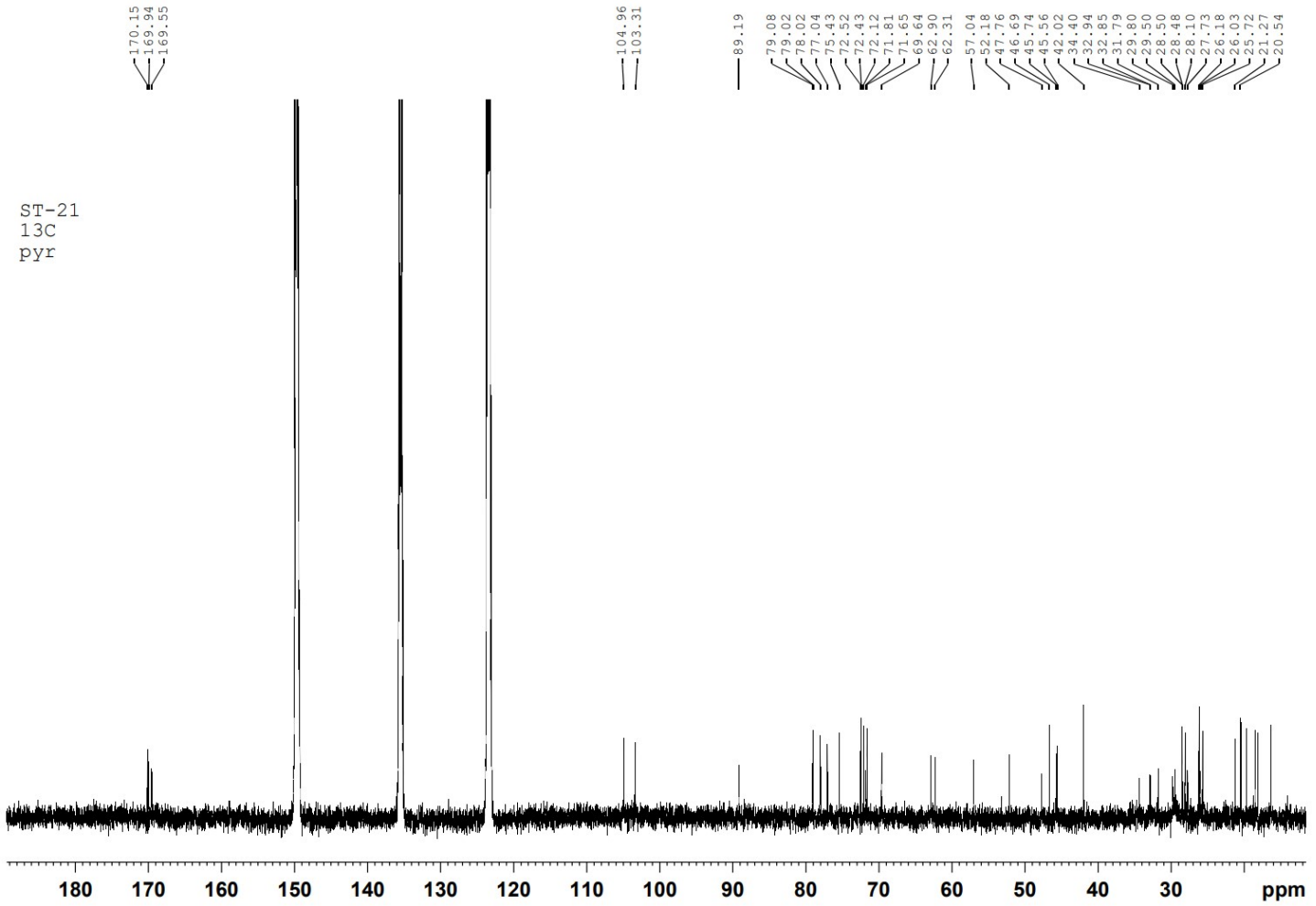

Figure S52. DEPT 135 spectrum of **7**.

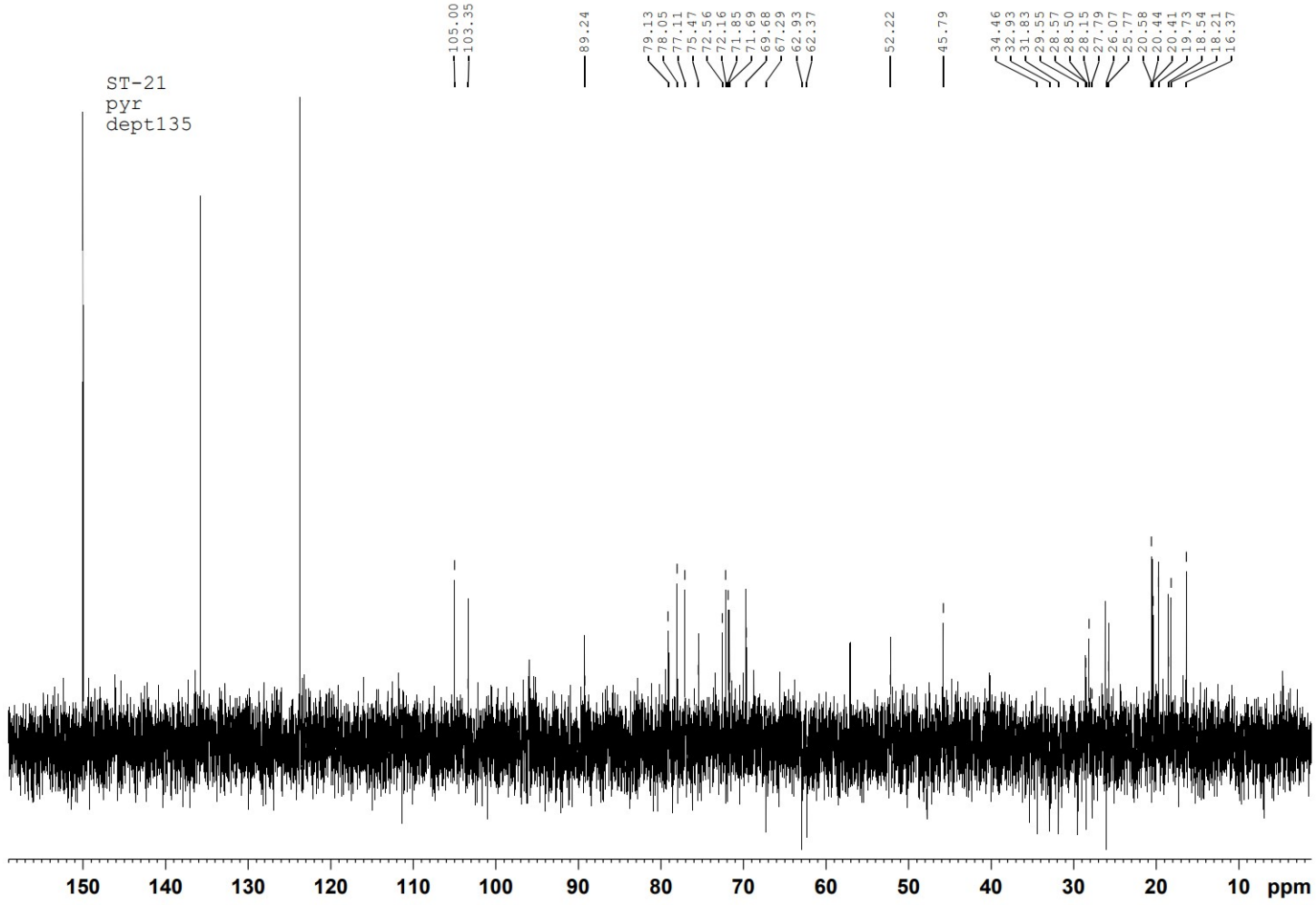

Figure S53. HSQC spectrum of **7**.

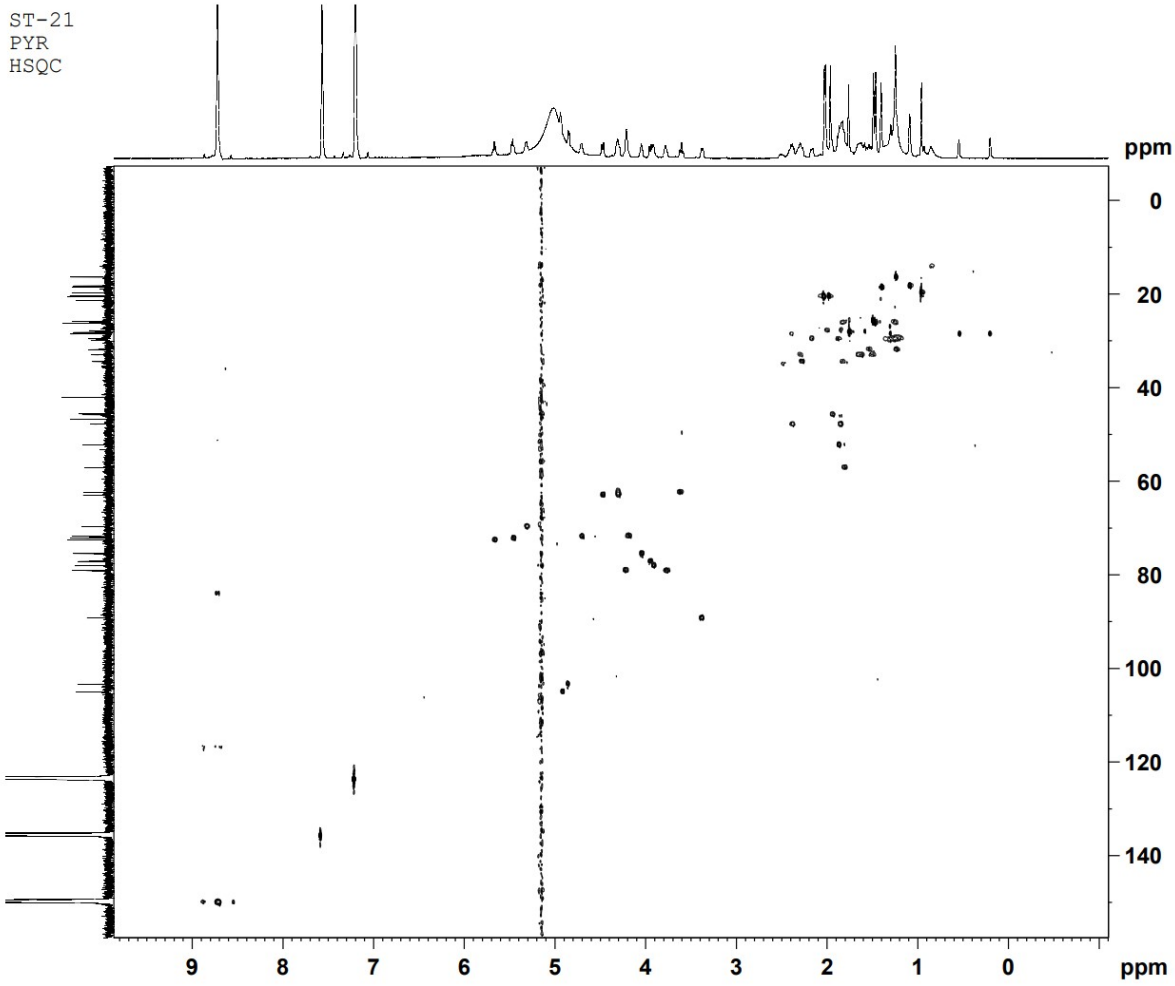

Figure S54. ^{1}H-^{1}H COSY spectrum of **7.**

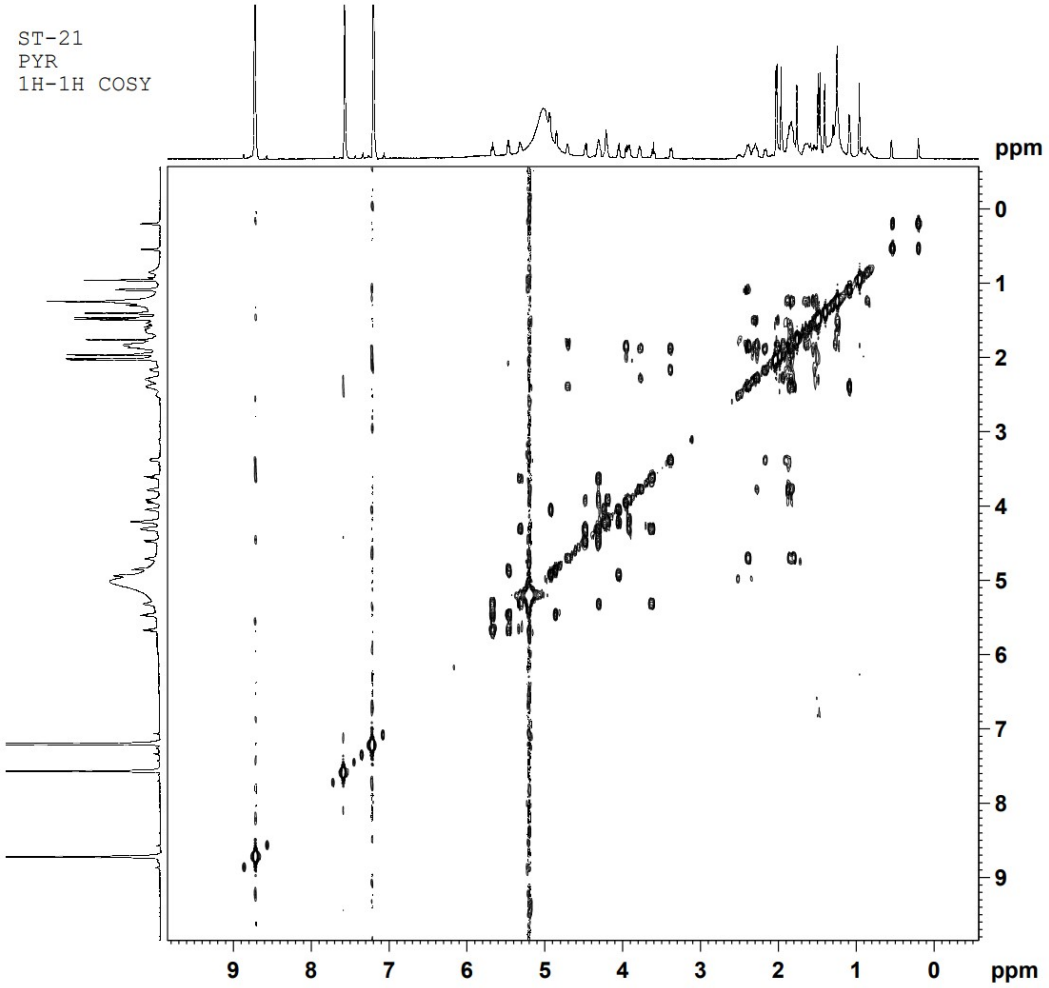

Figure S55. HMBC spectrum of **7**.

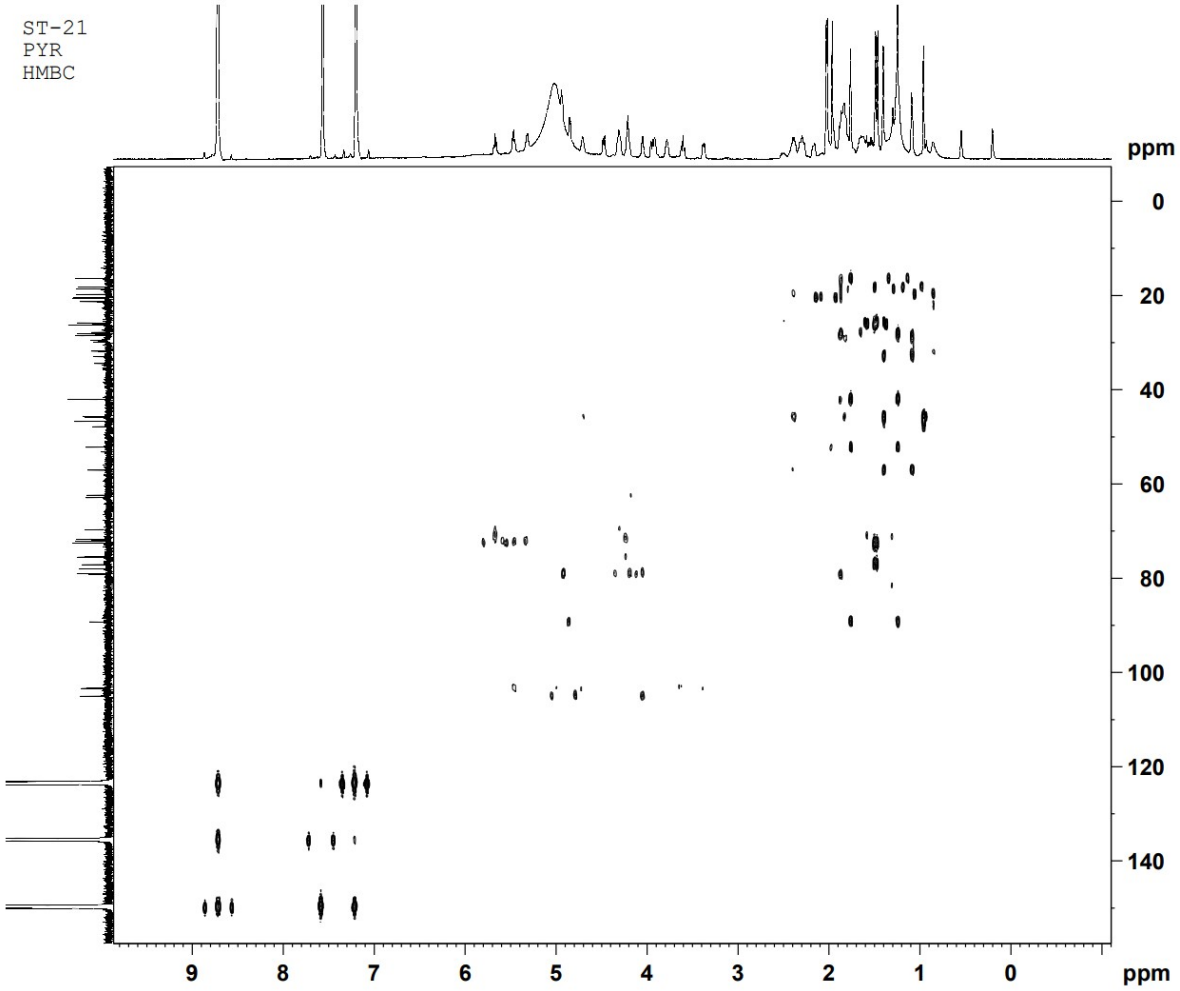

Figure S56. NOESY spectrum of **7.**

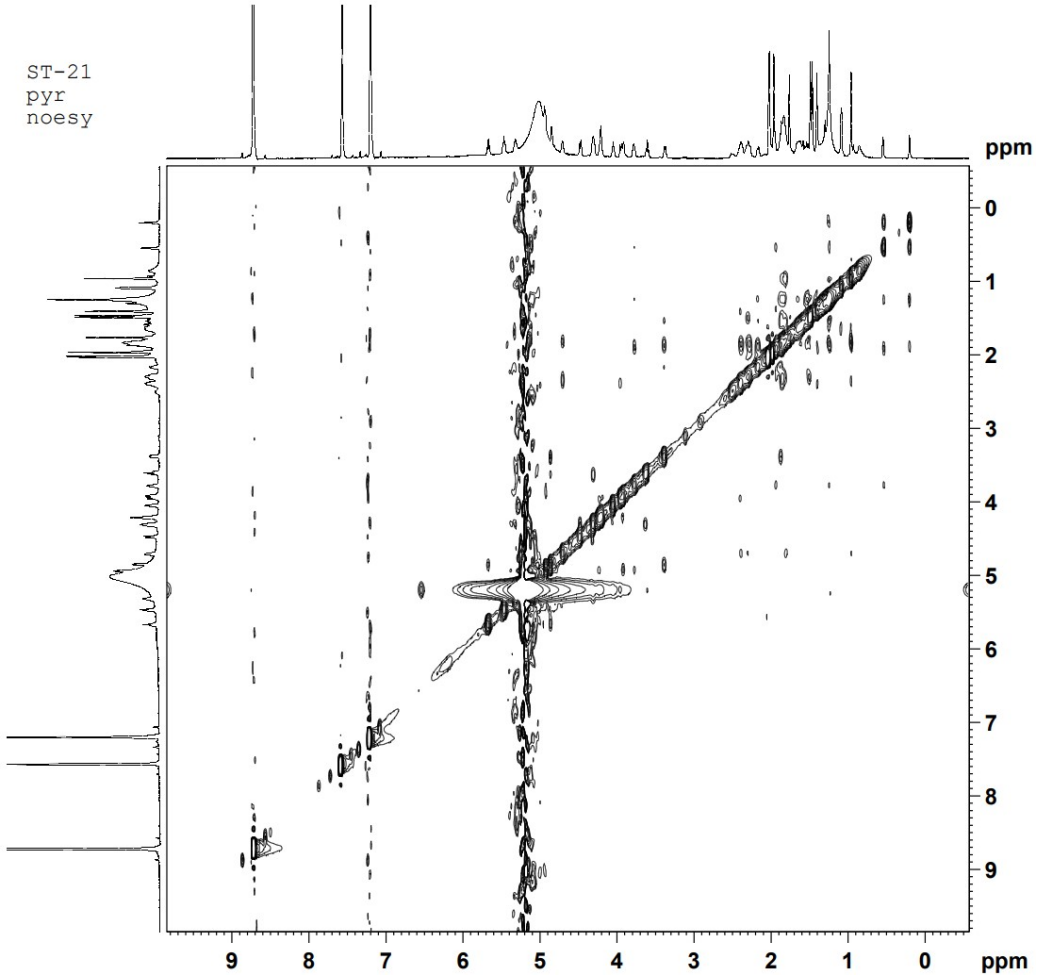

Figure S57. IR spectrums of **1-7**.

Figure S57-1. IR spectrum of **1**.

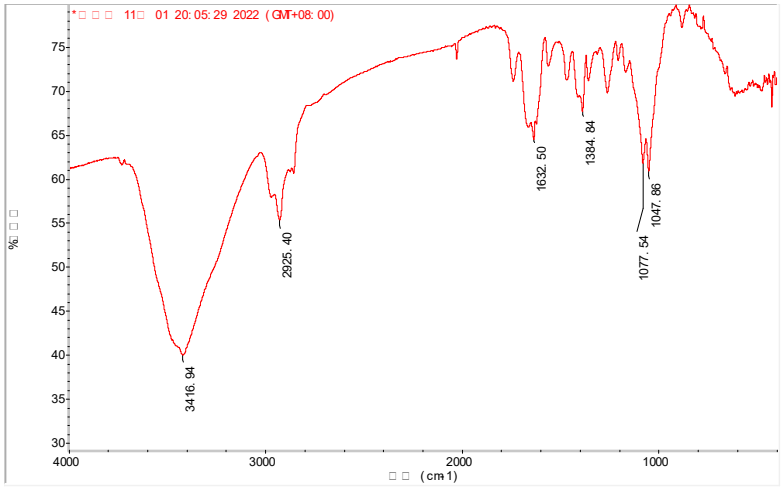

Figure S57-2. IR spectrum of **2**.

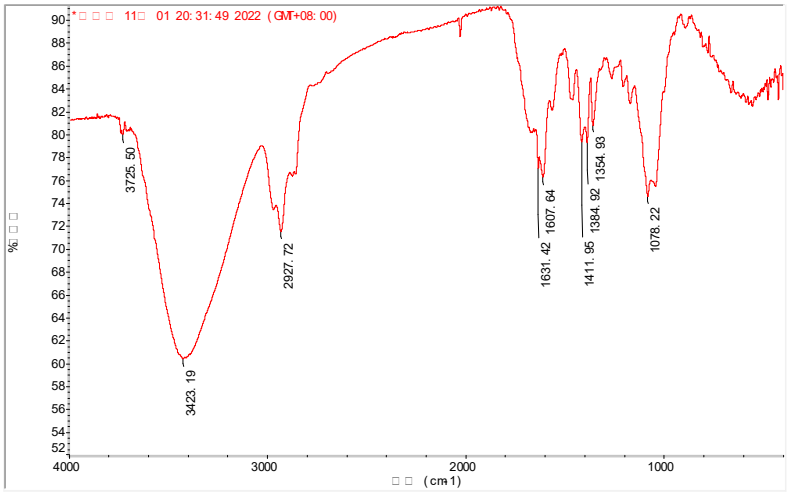

Figure S57-3. IR spectrum of **3**.

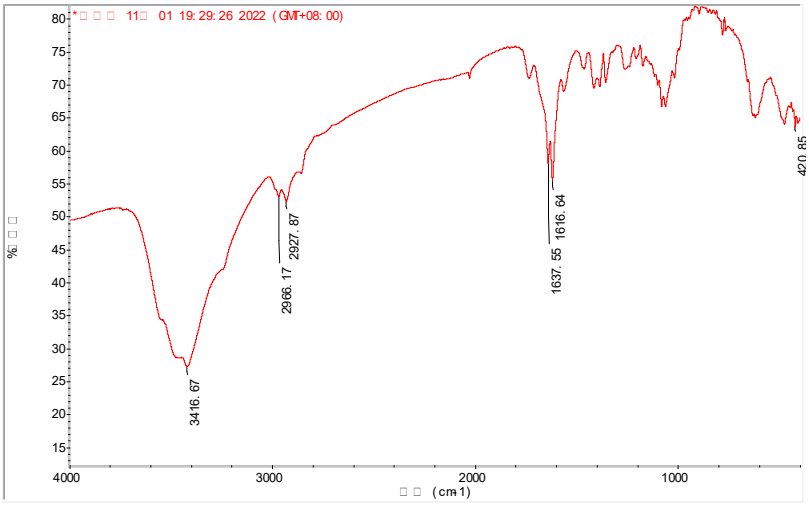

Figure S57-4. IR spectrum of **4**.

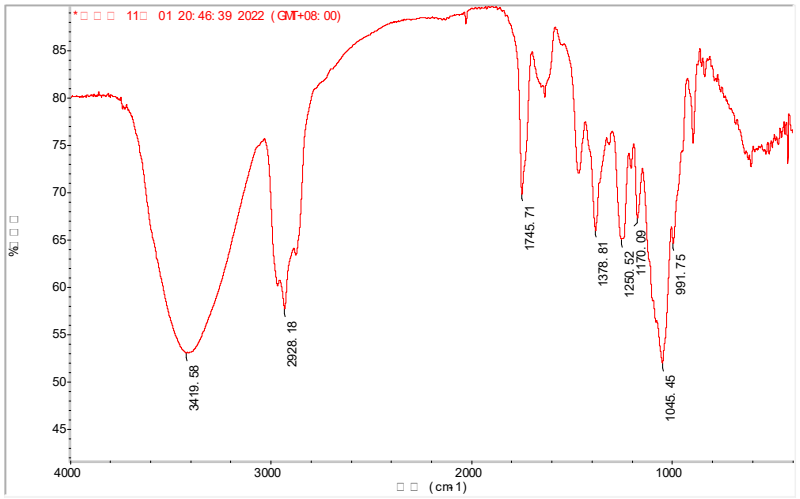

Figure S57-5. IR spectrum of **5**.

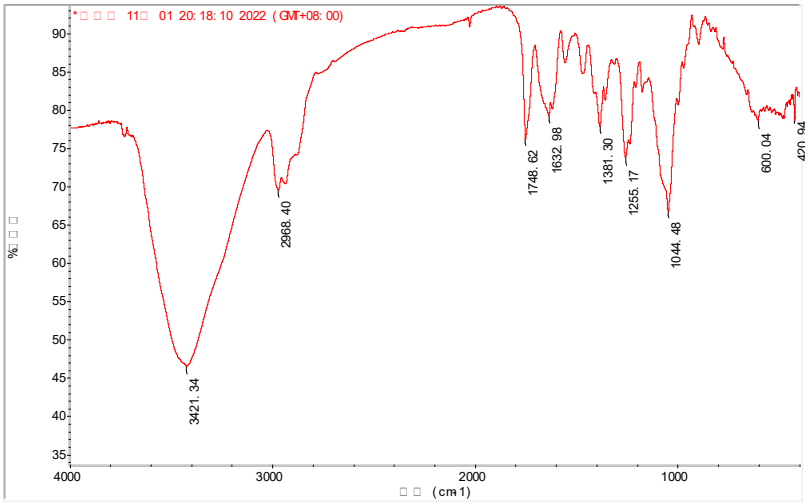

Figure S57-6. IR spectrum of **6**.

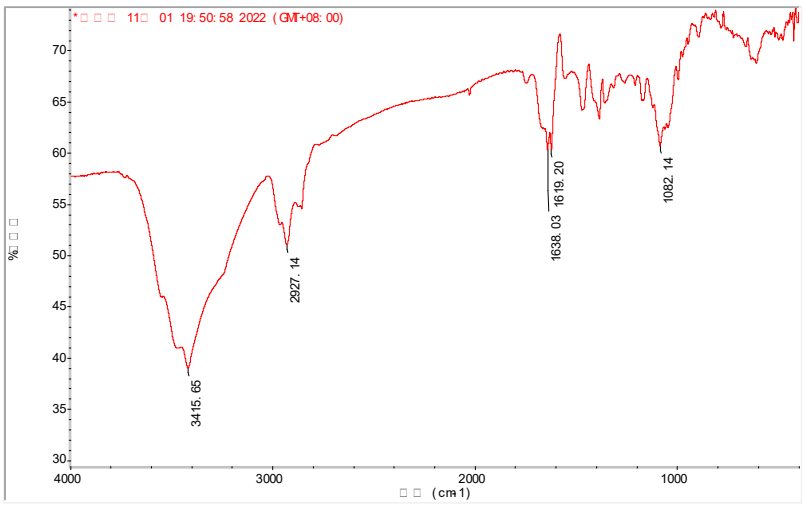

Figure S57-7. IR spectrum of **7**.

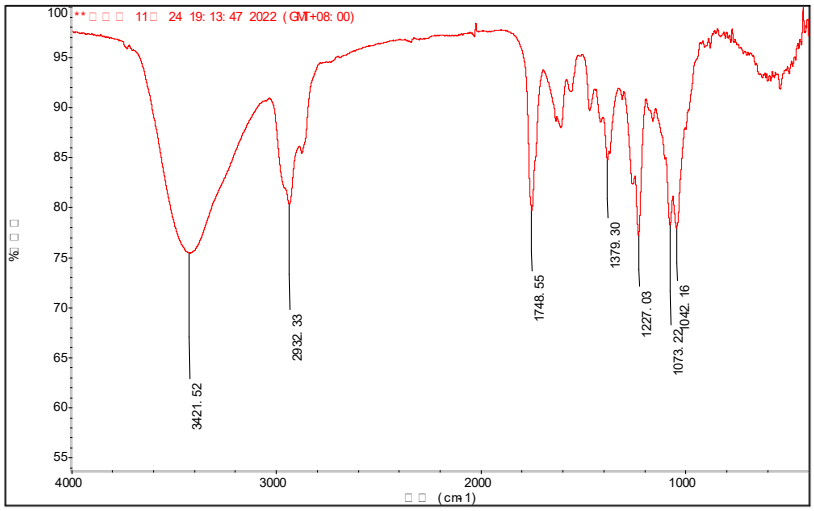

Figure S58. GC-MS chromatogram of the sugars of compounds **1-7** after hydrolysis**.**

Fig.S58-1 the GC chromatogram of hydrolyzed *D*-glucose

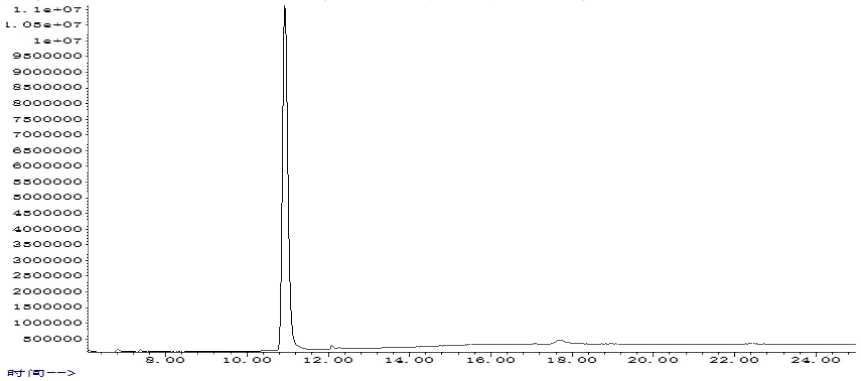

Fig.S58-2 the GC chromatogram of hydrolyzed *D*-xylose

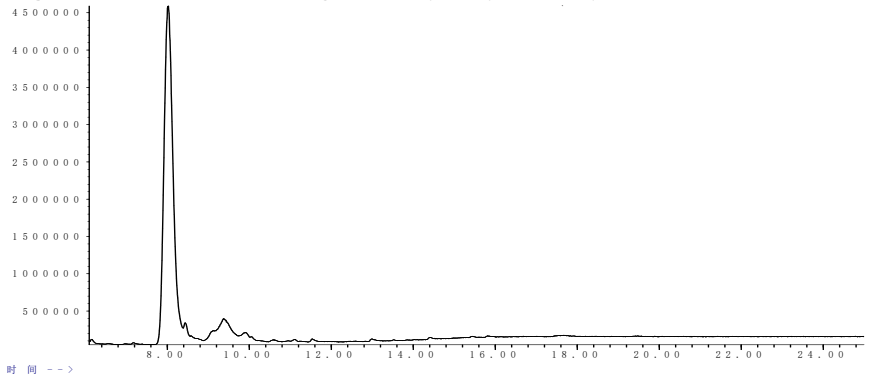

Fig.S58-3 the GC chromatogram of hydrolyzed *L*-arabinose

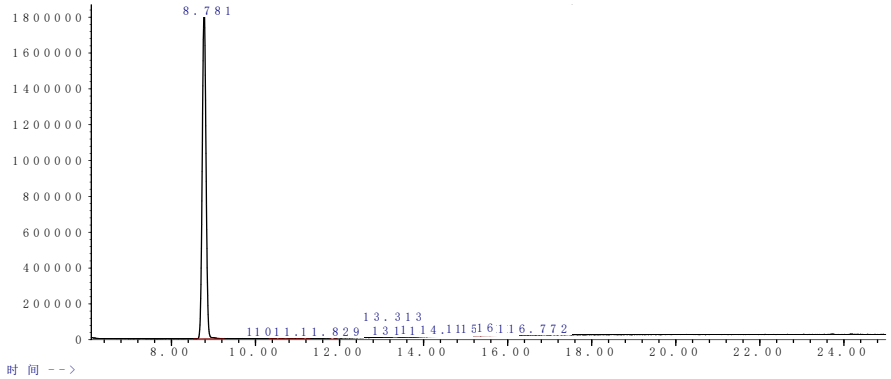

Fig.S58-4 the GC chromatogram of compound **1** after hydrolysis

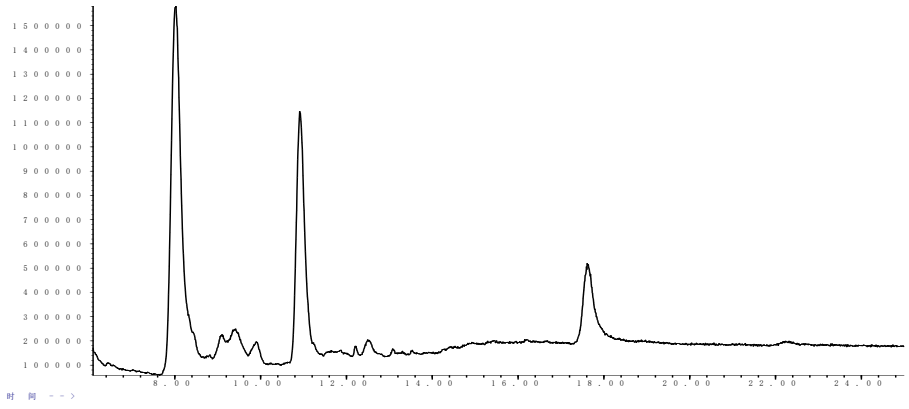

Fig.S58-5 the GC chromatogram of compound **2** after hydrolysis

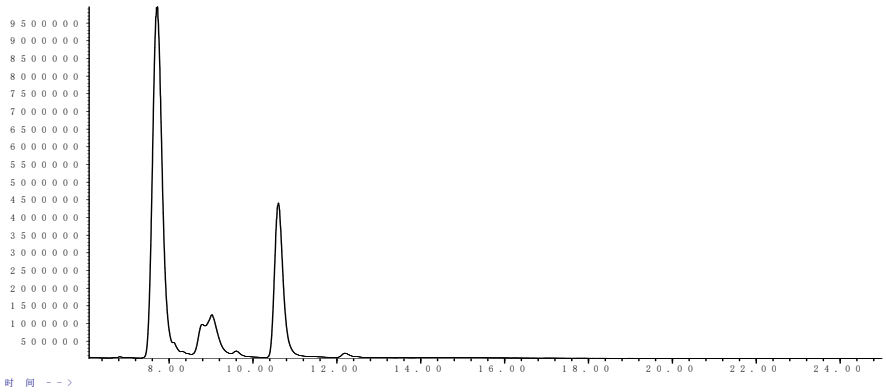

Fig.S58-6 the GC chromatogram of compound **3** after hydrolysis

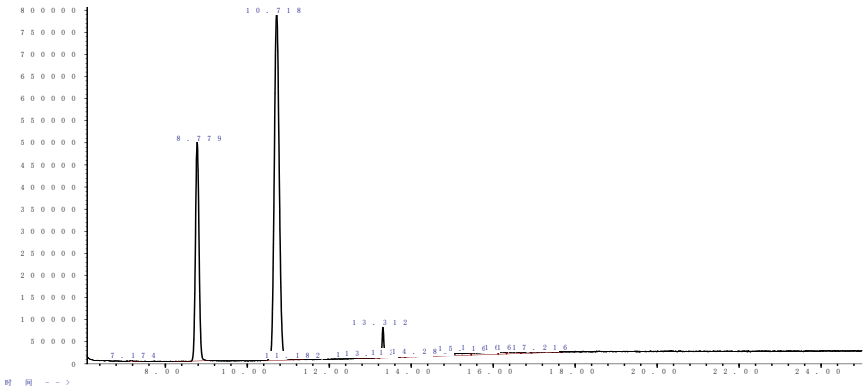

Fig.S58-7 the GC chromatogram of compound **4** after hydrolysis

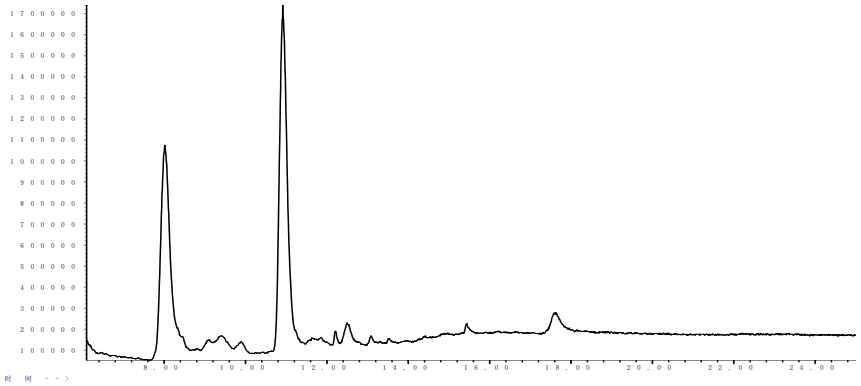

Fig.S58-8 the GC chromatogram of compound **5** after hydrolysis

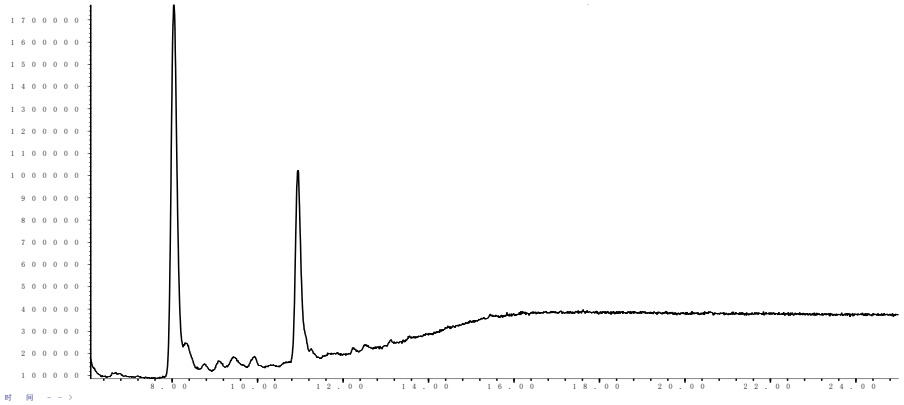

Fig.S58-9 the GC chromatogram of compound **6** after hydrolysis

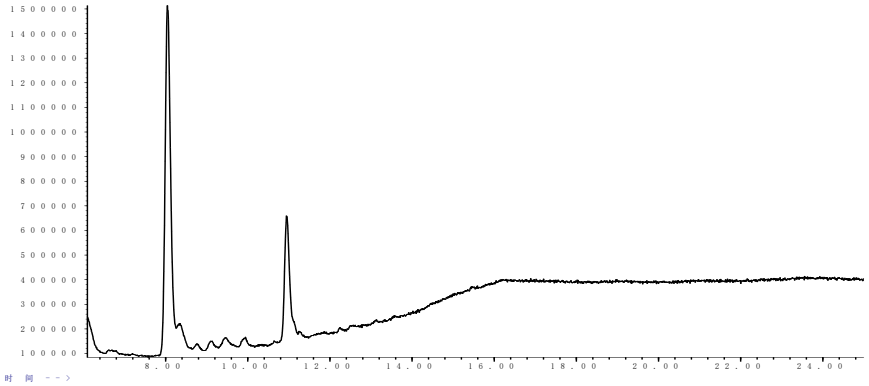

Fig.S58-10 the GC chromatogram of compound **7** after hydrolysis

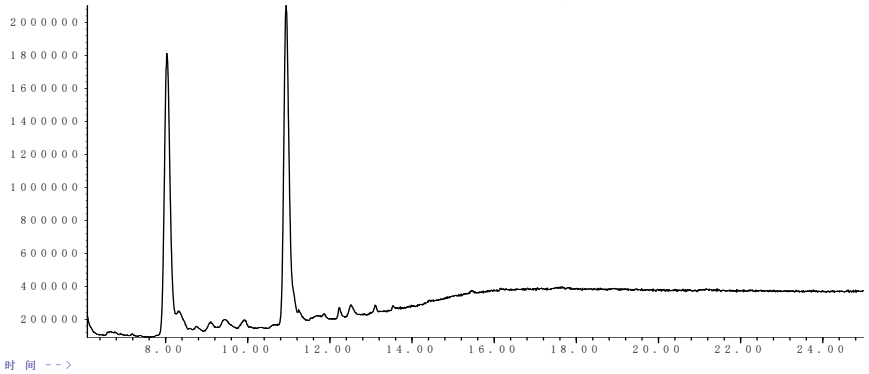

Figure S59. Structure of published compounds **8-22**

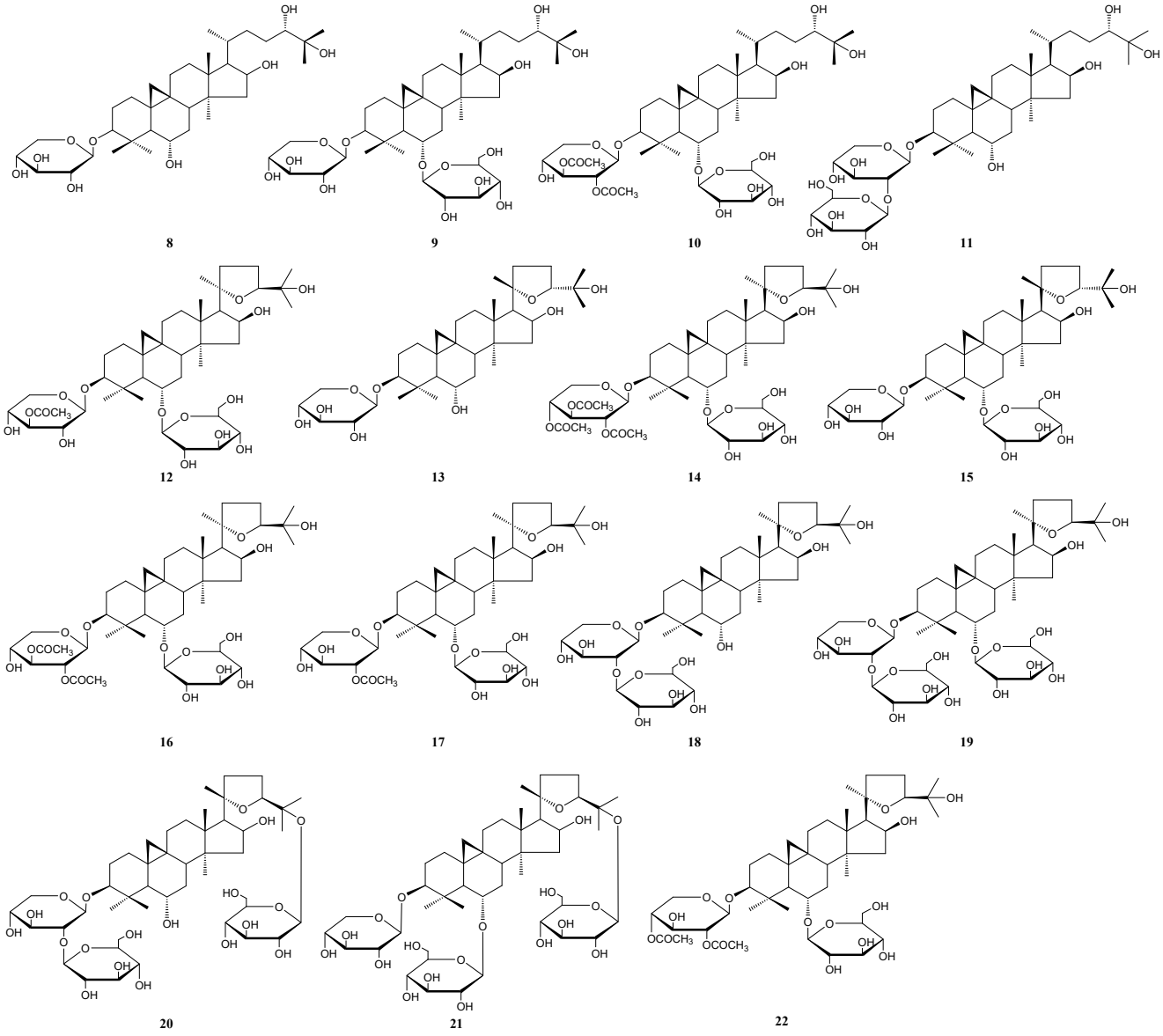

Table S1. ^{13}C NMR data of compounds **8-22** (C_5D_5N, δ in ppm, J in Hz)

No.	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	32.3	32.1	31.9	32.3	32.1	32.4	34.8	31.7	31.9	31.9	32.3	31.9	32.3	32.0	31.8
2	28.4	30.1	29.7	30.3	30.1	30.3	31.8	28.4	29.6	29.8	30.3	30.0	30.2	28.8	29.7
3	88.5	88.4	89.1	88.5	88.7	88.6	89.2	88.2	89.0	88.8	88.5	88.2	88.5	88.4	88.9
4	42.5	42.6	42.1	42.7	42.5	42.6	42.0	42.2	42.1	42.2	42.7	42.5	42.6	42.6	42.1
5	53.9	52.4	52.3	53.9	52.4	54.0	52.3	52.0	52.3	52.4	53.9	52.2	53.8	52.3	52.3
6	67.7	79.0	79.0	67.5	79.3	67.9	79.2	78.9	79.2	79.2	67.7	78.8	67.6	79.2	79.2
7	38.2	34.2	34.4	38.2	34.6	38.6	34.7	34.1	34.8	34.7	38.4	34.8	38.3	34.0	34.7
8	48.1	45.4	45.7	46.6	46.2	47.0	45.9	45.3	45.8	45.7	46.7	45.0	45.9	45.1	45.7
9	21.1	21.3	21.3	21.3	21.1	20.9	21.1	20.7	21.1	21.1	20.9	21.0	20.8	20.9	21.0
10	30.2	28.4	28.5	29.0	28.9	29.4	28.8	28.5	28.8	28.9	29.3	28.7	29.2	30.1	28.7
11	26.2	26.1	26.3	26.2	26.1	26.1	26.4	25.7	26.0	26.0	26.1	26.1	26.1	26.0	26.0
12	32.9	33.0	33.0	33.1	33.3	33.3	33.2	32.9	33.2	33.3	33.3	33.3	33.3	33.3	33.2
13	45.5	45.6	45.6	45.6	45.0	44.9	44.9	44.6	44.9	44.9	44.9	45.0	45.0	45.3	44.9
14	46.6	46.8	46.7	46.7	46.2	46.0	46.2	45.4	46.1	46.1	46.0	46.1	45.9	45.4	46.0
15	46.7	47.7	47.8	48.2	45.6	46.6	46.1	45.8	46.1	46.2	46.5	45.9	46.5	46.0	46.0
16	71.8	71.8	71.8	71.9	73.3	73.4	73.3	73.2	73.3	73.3	73.3	73.3	73.4	73.4	73.3
17	57.1	57.0	57.1	57.2	58.1	58.3	58.1	57.7	58.1	58.1	58.2	58.0	58.0	57.8	58.1
18	18.1	18.3	18.5	18.7	21.1	21.4	20.4	20.7	21.0	21.1	21.3	20.7	21.3	20.9	21.0
19	29.7	28.6	28.4	29.5	28.8	30.5	29.5	29.7	29.0	28.8	30.2	28.5	30.1	28.4	28.9
20	29.0	28.4	28.3	28.5	87.2	87.2	87.1	86.9	87.1	87.1	87.1	87.2	87.1	87.1	87.1
21	18.7	18.2	18.2	18.2	27.0	28.8	27.0	27.6	27.0	27.0	27.0	26.9	27.7	27.6	26.9
22	32.8	32.8	32.8	32.9	34.8	34.8	29.1	34.4	34.7	34.8	34.8	34.1	34.9	34.9	34.7

23	27.6	27.7	27.7	27.8	26.4	26.4	26.0	26.0	26.3	26.4	26.3	26.3	25.8	25.9	26.3
24	76.9	77.0	76.9	77.0	81.6	81.6	81.6	81.3	81.5	81.6	81.6	81.5	81.9	81.9	81.5
25	72.3	72.4	72.4	72.4	71.2	71.2	71.2	71.1	71.2	71.2	71.1	71.2	78.4	78.5	71.2
26	25.5	25.7	25.7	25.6	28.1	27.0	28.1	26.5	28.1	28.1	28.1	28.0	22.9	22.8	28.0
27	26.0	26.3	26.1	26.4	28.5	28.1	28.2	28.1	28.2	28.2	28.4	28.2	25.5	25.6	28.1
28	19.9	28.0	28.1	28.6	28.5	28.5	28.5	28.1	28.5	28.5	28.7	28.1	28.7	28.4	28.4
29	28.7	16.5	16.4	16.5	16.5	16.6	16.3	16.3	16.4	16.5	16.4	16.4	16.4	16.5	16.4
30	16.5	19.7	19.7	20.0	19.8	20.1	19.8	19.4	19.8	19.8	20.0	19.6	19.9	19.6	19.7
3-O-Xyl															
1'	107.4	107.6	103.9	105.5	107.2	107.6	103.4	107.0	103.9	104.6	105.5	106.2	106.0	107.6	104.2
2'	75.5	75.5	73.0	83.3	73.1	75.6	72.2	75.1	72.9	75.5	83.3	83.8	83.3	75.5	75.2
3'	78.4	78.0	76.7	77.8	79.2	78.5	72.6	78.5	76.7	76.2	77.8	77.7	78.1	77.9	72.4
4'	71.1	71.7	68.7	70.9	69.2	71.2	69.7	70.7	68.6	71.8	70.9	70.8	70.9	71.2	72.6
5'	66.9	67.0	66.6	66.6	66.6	67.0	62.4	66.4	66.5	67.0	66.6	66.5	66.5	67.0	62.9
6-O-Glc															
1''		105.1	105.0		105.2		105.1	104.6	105.1	105.1		105.1		104.9	105.0
2''		75.5	75.5		75.5		75.5	75.0	75.4	75.5		75.6		75.5	75.4
3''		79.0	79.0		79.1		79.1	77.8	79.0	79.1		78.8		78.5	79.0
4''		71.1	71.7		71.8		71.7	71.3	71.7	71.2		71.8		71.7	71.7
5''		78.4	78.0		78.1		78.1	77.5	78.0	78.1		77.9		78.1	78.0
6''		63.0	63.0		63.1		62.9	62.4	62.9	63.0		62.9		62.9	62.9
2'-O-Glc															
1'''				106.1	-						106.0	105.3	105.5		
2'''				77.0	-						76.9	76.9	76.9		

3'''		78.1	-			77.9	78.1	78.4		
4'''		71.6	-			71.6	71.8	71.6		
5'''		77.9	-			78.1	78.0	77.9		
6'''		62.7	-			62.7	63.0	62.7		
25-O-Glc										
1''''								98.7	98.8	
2''''								75.1	75.1	
3''''								78.4	78.5	
4''''								71.2	71.2	
5''''								77.8	78.9	
6''''								62.6	62.6	
Ac	169.8		170.7	169.5	169.7	170.0				
	170.4		21.0	169.9	170.4	21.1				
	20.6			170.1	20.7					
	20.7			20.4	20.7					
				20.6						
				21.0						