

## Electronic Supplementary Information (ESI)

### Long-term stability of novel double rhodanine indoline dyes having one and two anchor carboxyl group(s) in dye-sensitized solar cell

Masaki Matsui,<sup>a,\*</sup> Nagisa Tanaka,<sup>a</sup> Yasuhiro Kubota,<sup>a</sup> Kazumasa Funabiki,<sup>a</sup> Jiye Jin,<sup>b</sup> Shinji Higashijima<sup>d</sup>, and Hidetoshi Miura<sup>d</sup>, Kazuhiro Manseki<sup>d</sup>

<sup>a</sup>*Department of Chemistry and Biocmolecular Science,  
Faculty of Engineering, Gifu University, Yanagido, Gifu 501-1193, Japan*

<sup>b</sup>*Department of Chemistry, Faculty of Science, Shinshu University,  
3-1-1 Asahi, Matsumoto, Nagano 390-8621, Japan*

<sup>c</sup>*Research Center of Organic Electronics Yamagata University, 4-3-16, Jonan, Yonezawa,  
Yamagata 992-8510, Japan*

<sup>d</sup>*Chemicrea. Inc., 1-133 Ohtsurugi, Shimogawa, Izumi-machi, Iwaki, Fukushima  
971-8183, Japan*

Figure S1 Fluorescence lifetime of **GU115**, **GU116**, and **GU117** ( $1.0 \times 10^{-5}$  mol dm<sup>-3</sup>) in chloroform.

Figure S2 Cyclic voltammogram of **GU115**, **GU116**, and **GU117** in the presence of ferrocene. Measured in DMF vs AgQRE at scan rate 100 mV s<sup>-1</sup>.

Table S1 Fluorescence lifetime of **GU115**, **GU116**, and **GU117**

Figure S3. <sup>1</sup>H NMR spectrum of **4**.

Figure S4. <sup>13</sup>C NMR spectrum of **4**.

Figure S5. <sup>1</sup>H NMR spectrum of **6a**.

Figure S6. <sup>13</sup>C NMR spectrum of **6a**.

Figure S7. <sup>1</sup>H NMR spectrum of **6b**.

Figure S8. <sup>13</sup>C NMR spectrum of **6b**.

Figure S9. <sup>1</sup>H NMR spectrum of **6c**.

Figure S10. <sup>13</sup>C NMR spectrum of **6c**.

Figure S11. <sup>1</sup>H NMR spectrum of **7a**.

Figure S12. <sup>13</sup>C NMR spectrum of **7a**.

Figure S13. <sup>1</sup>H NMR spectrum of **7b**.

- Figure S14.  $^{13}\text{C}$  NMR spectrum of **7b**.  
 Figure S15.  $^1\text{H}$  NMR spectrum of **7c**.  
 Figure S16.  $^{13}\text{C}$  NMR spectrum of **7c**.  
 Figure S17.  $^1\text{H}$  NMR spectrum of **11**.  
 Figure S18.  $^{13}\text{C}$  NMR spectrum of **11**.  
 Figure S19.  $^1\text{H}$  NMR spectrum of **GU115**.  
 Figure S20.  $^{13}\text{C}$  NMR spectrum of **GU115**.  
 Figure S21.  $^1\text{H}$  NMR spectrum of **GU116**.  
 Figure S22.  $^{13}\text{C}$  NMR spectrum of **GU116**.  
 Figure S23.  $^1\text{H}$  NMR spectrum of **GU117**.  
 Figure S24.  $^{13}\text{C}$  NMR spectrum of **GU117**.

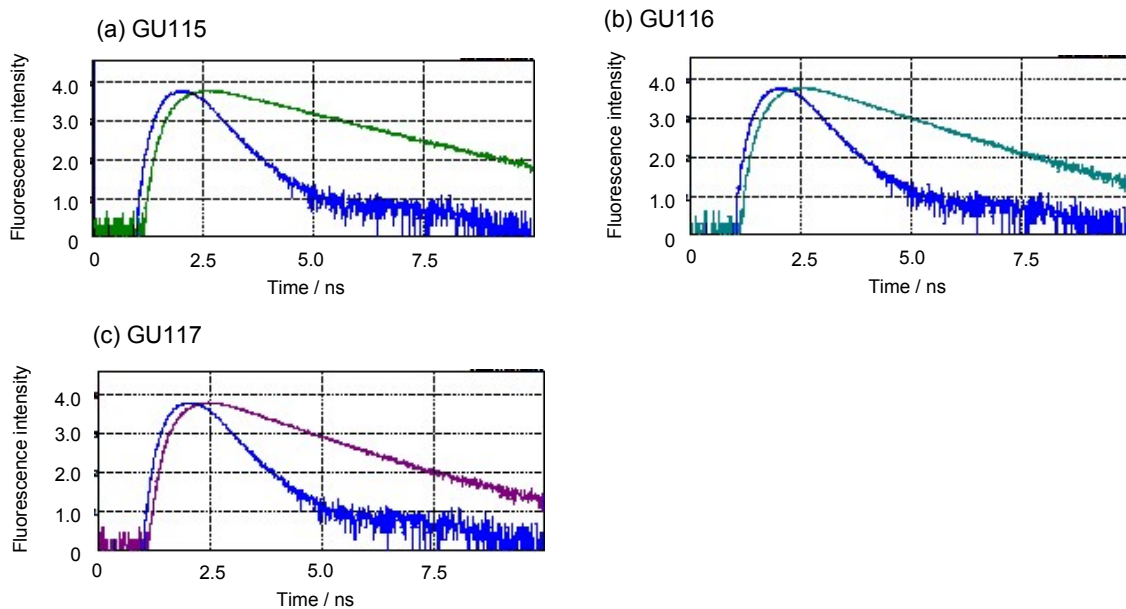


Figure S1 Fluorescence lifetime of **GU115**, **GU116**, and **GU117** ( $1.0 \times 10^{-5} \text{ mol dm}^{-3}$ ) in chloroform.

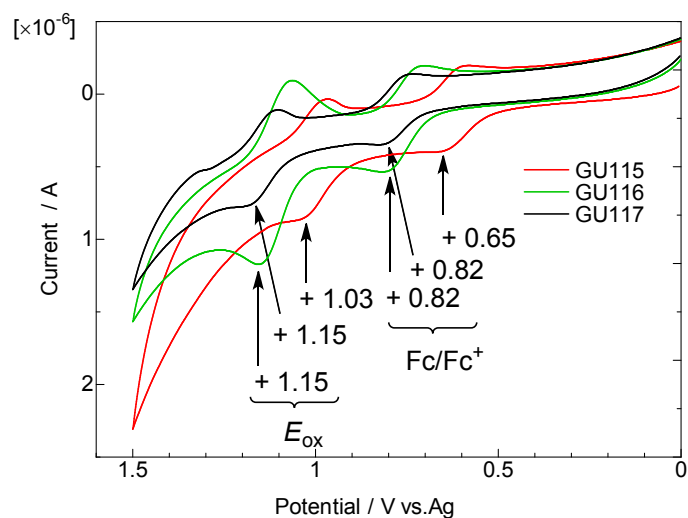


Figure S2 Cyclic voltammogram of **GU115**, **GU116**, and **GU117** in the presence of ferrocene. Measured in DMF vs AgQRE at scan rate  $100 \text{ mV s}^{-1}$ .

Table S1 Fluorescence lifetime of **GU115**, **GU116**, and **GU117**

Dyes <sup>a</sup>	$\lambda_{\text{ex}}$ <sup>b</sup> nm	$F_{\text{max}}$ <sup>c</sup> nm	CHI <sup>2</sup>	$\tau_f$ <sup>d</sup> ns
<b>GU115</b>	470	656	1.03	1.48
<b>GU116</b>	470	641	1.02	1.15
<b>GU117</b>	470	645	1.02	1.09

<sup>a</sup>Measured on  $1.0 \times 10^{-5} \text{ mol dm}^{-3}$  of substrate in chloroform.

<sup>b</sup>Excited wavelength.

<sup>c</sup>Fluorescence maximum.

<sup>d</sup>Fluorescence lifetime.

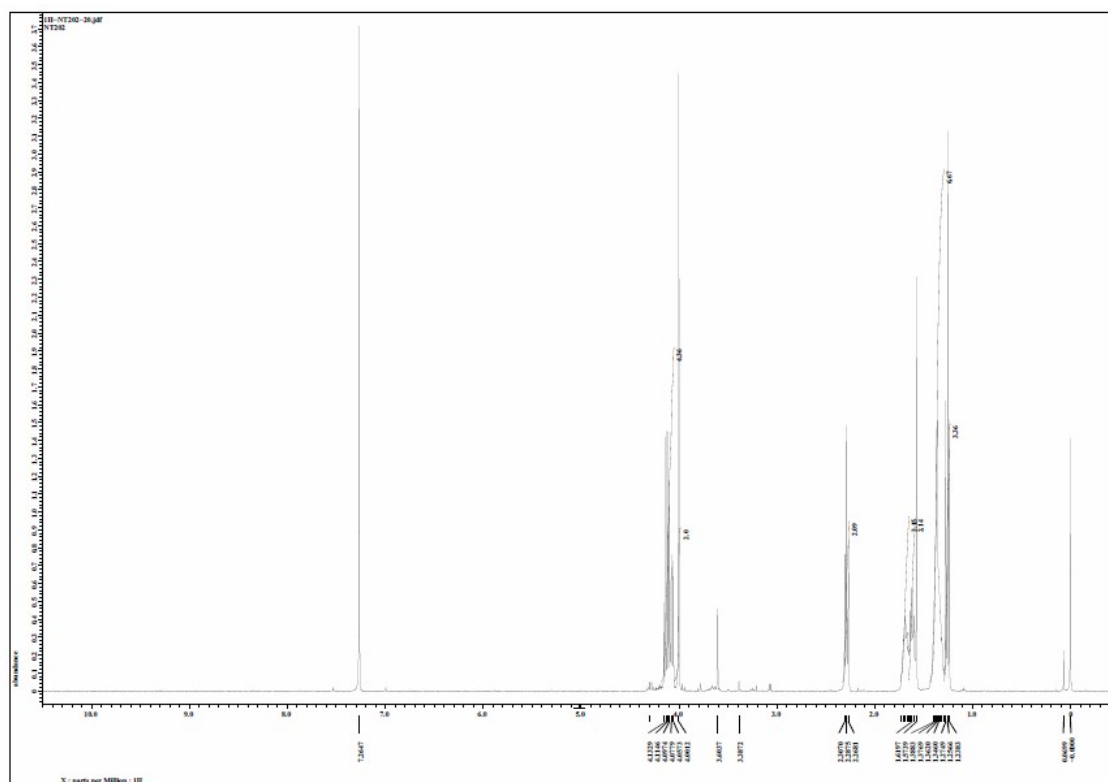


Figure S3. <sup>1</sup>H NMR spectrum of **4**.

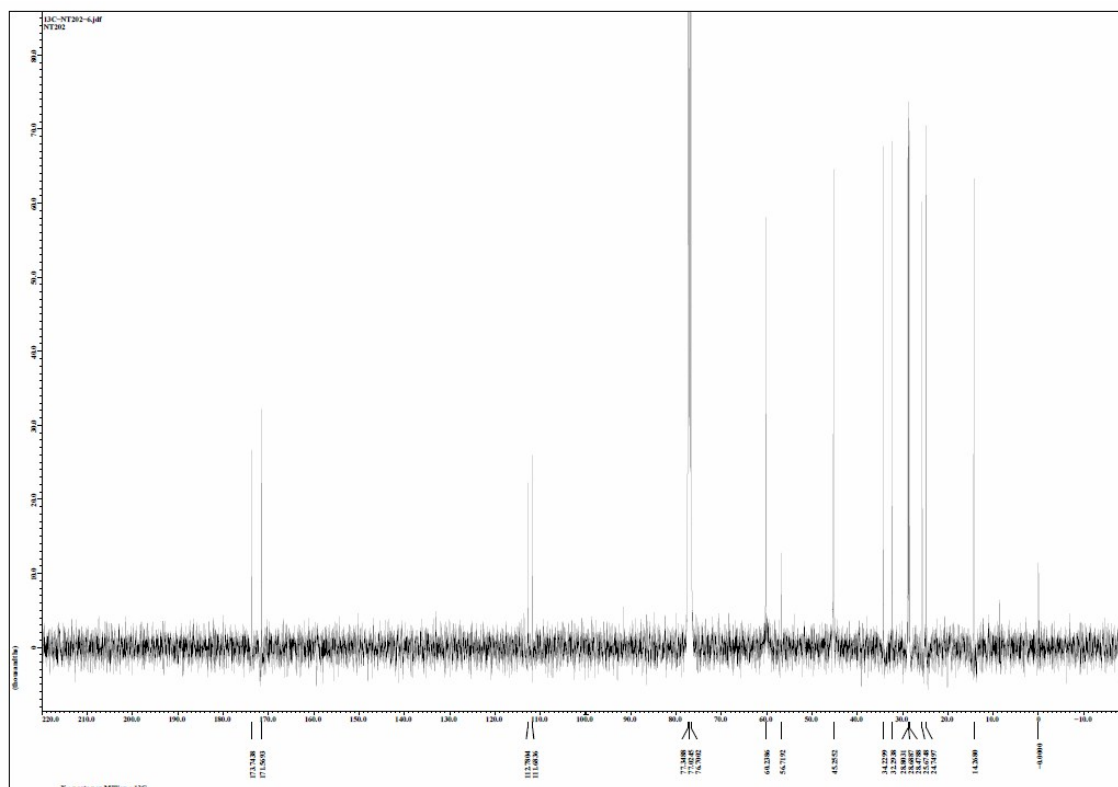


Figure S4. <sup>13</sup>C NMR spectrum of **4**.

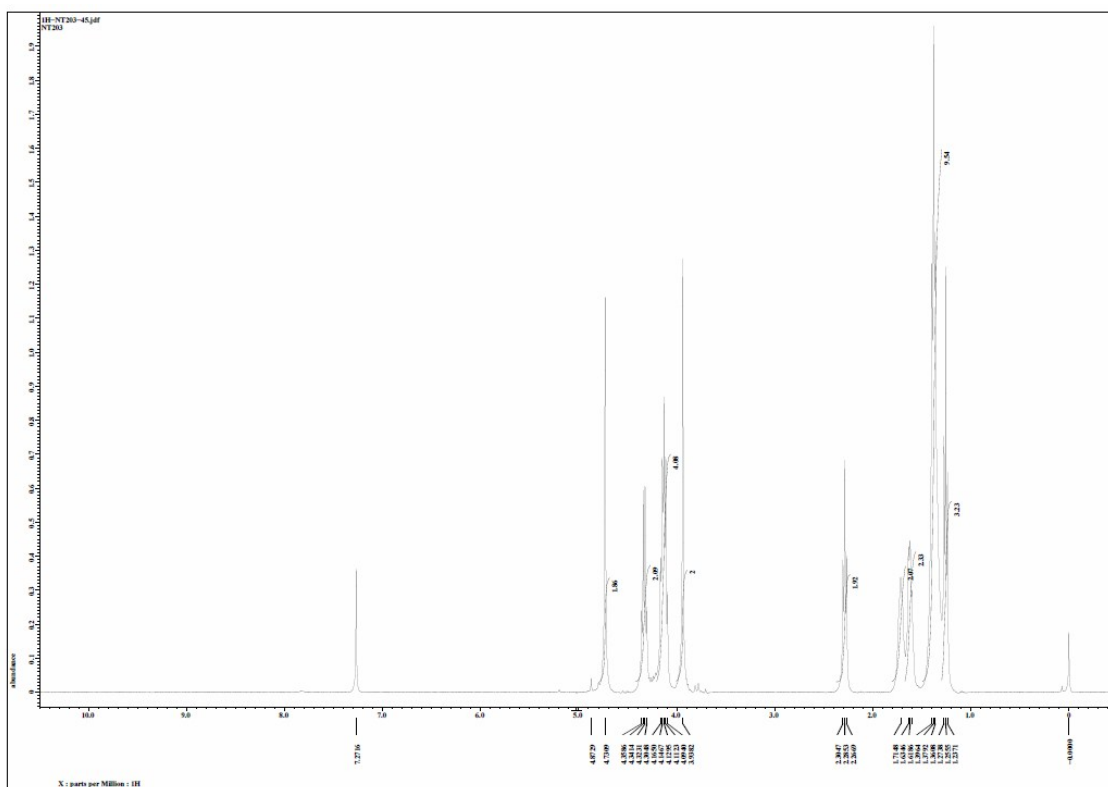


Figure S5. <sup>1</sup>H NMR spectrum of **6a**.

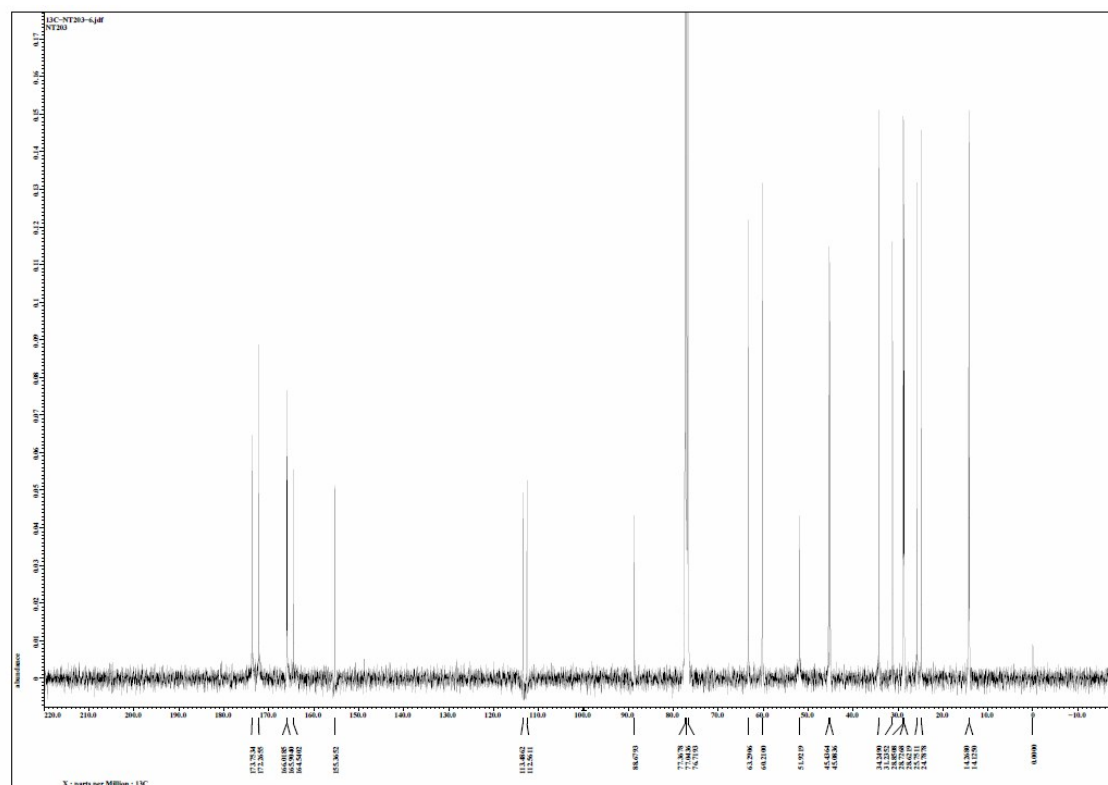


Figure S6. <sup>13</sup>C NMR spectrum of **6a**.





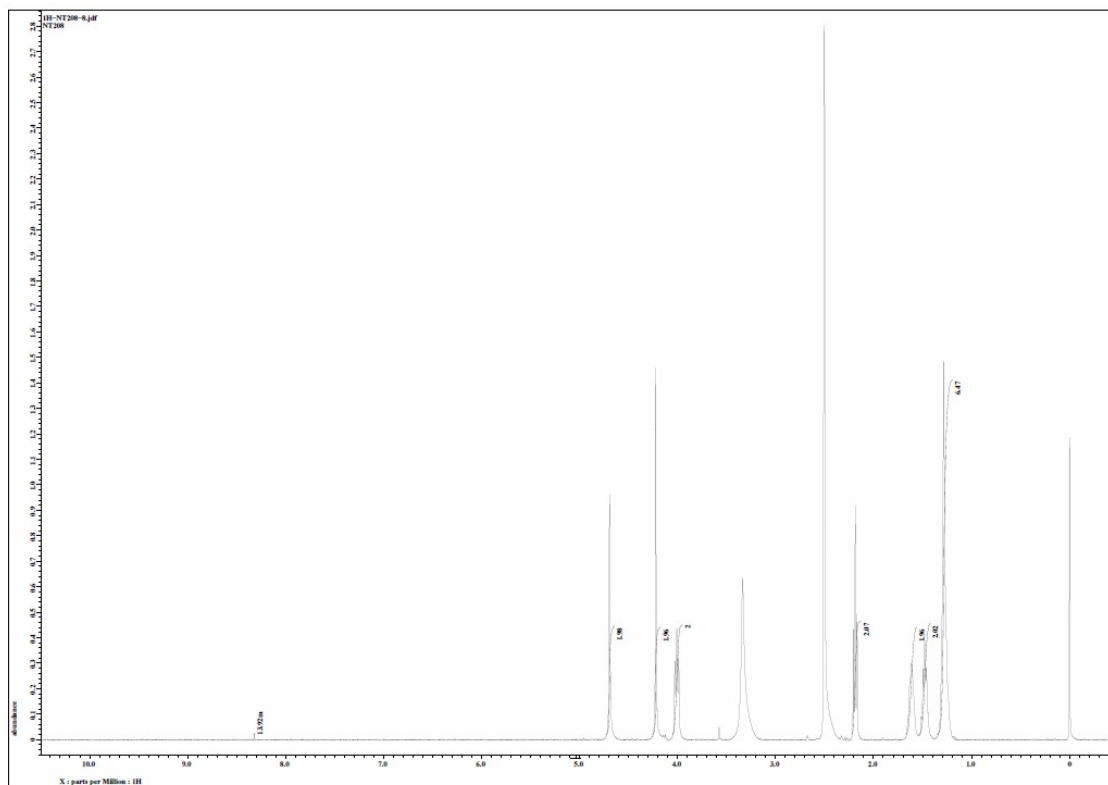


Figure S11.  $^1\text{H}$  NMR spectrum of **7a**.

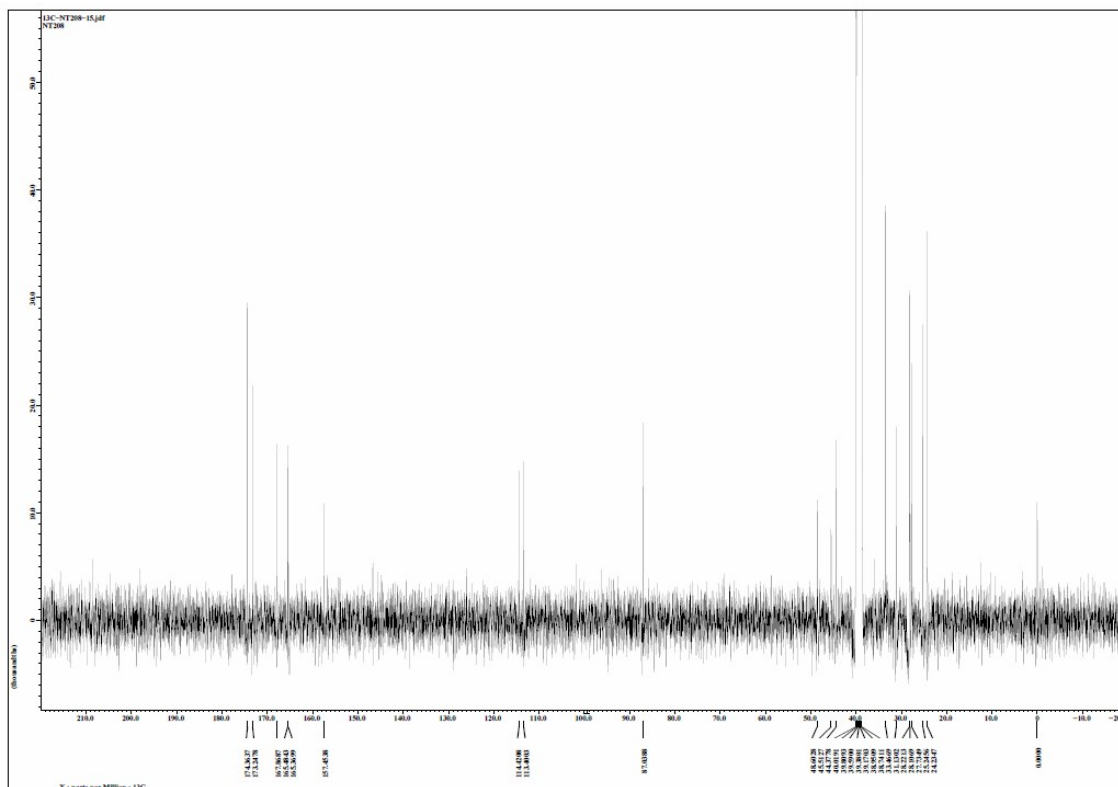


Figure S12.  $^{13}\text{C}$  NMR spectrum of **7a**.



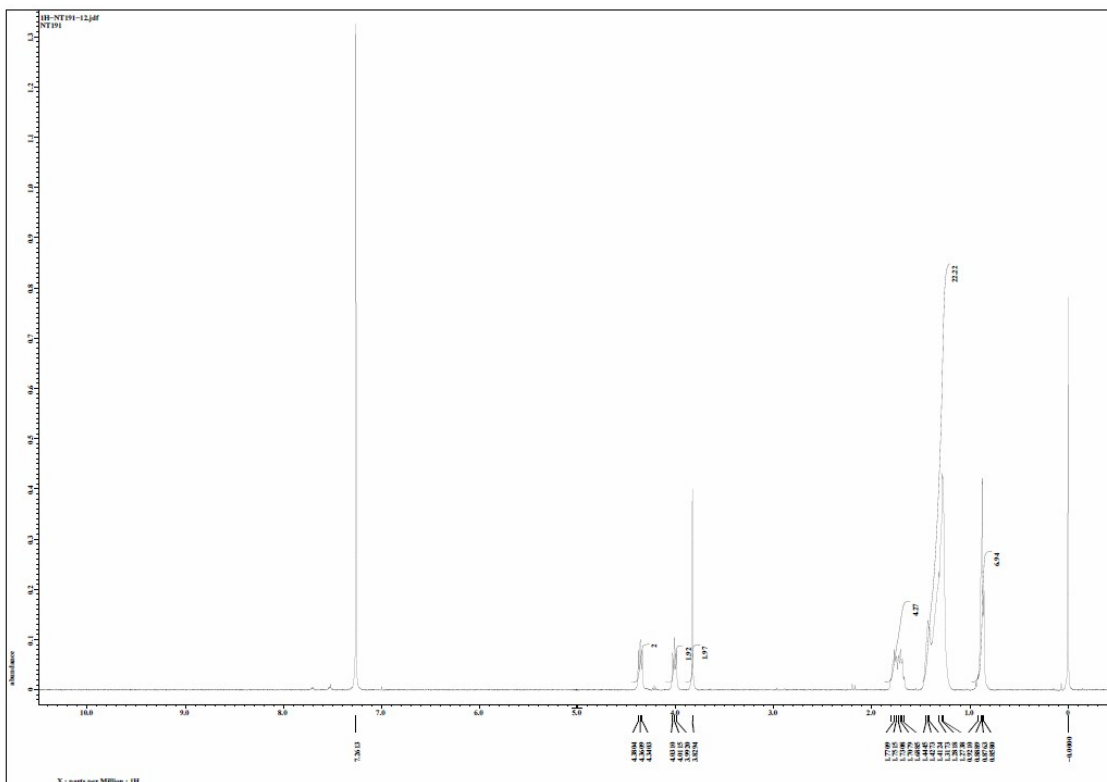
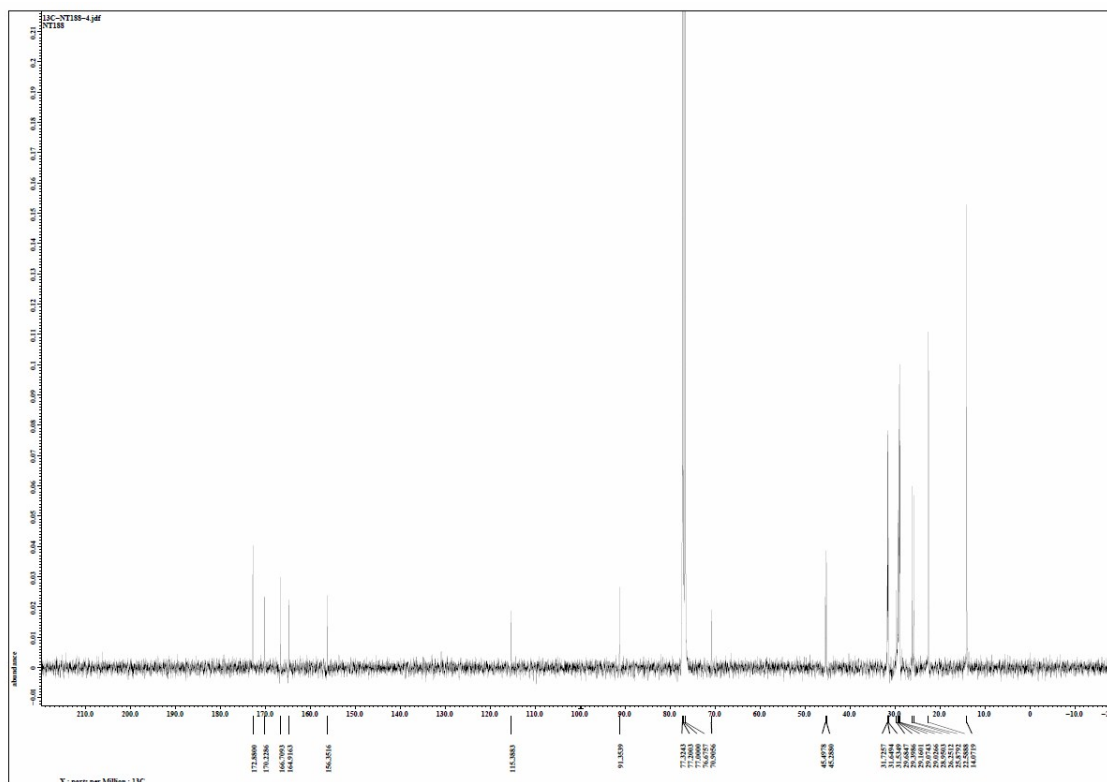


Figure S13.  $^1\text{H}$  NMR spectrum of **7b**.



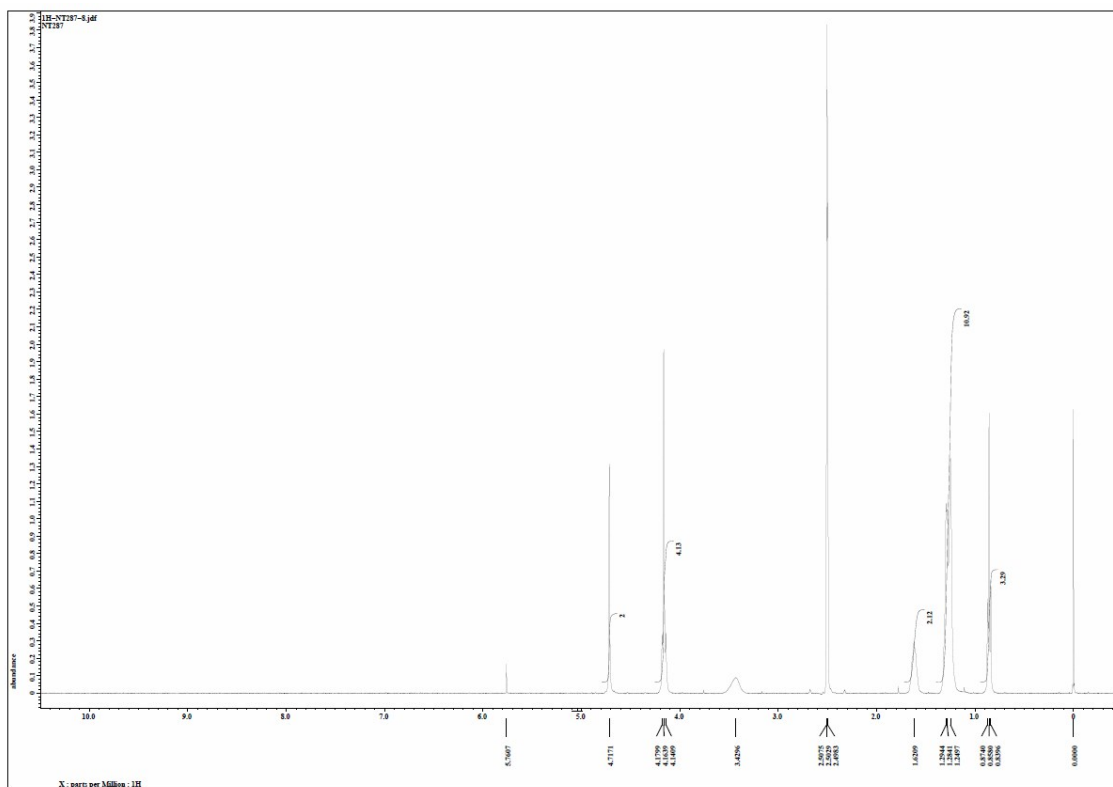


Figure S15.  $^1\text{H}$  NMR spectrum of **7c**.

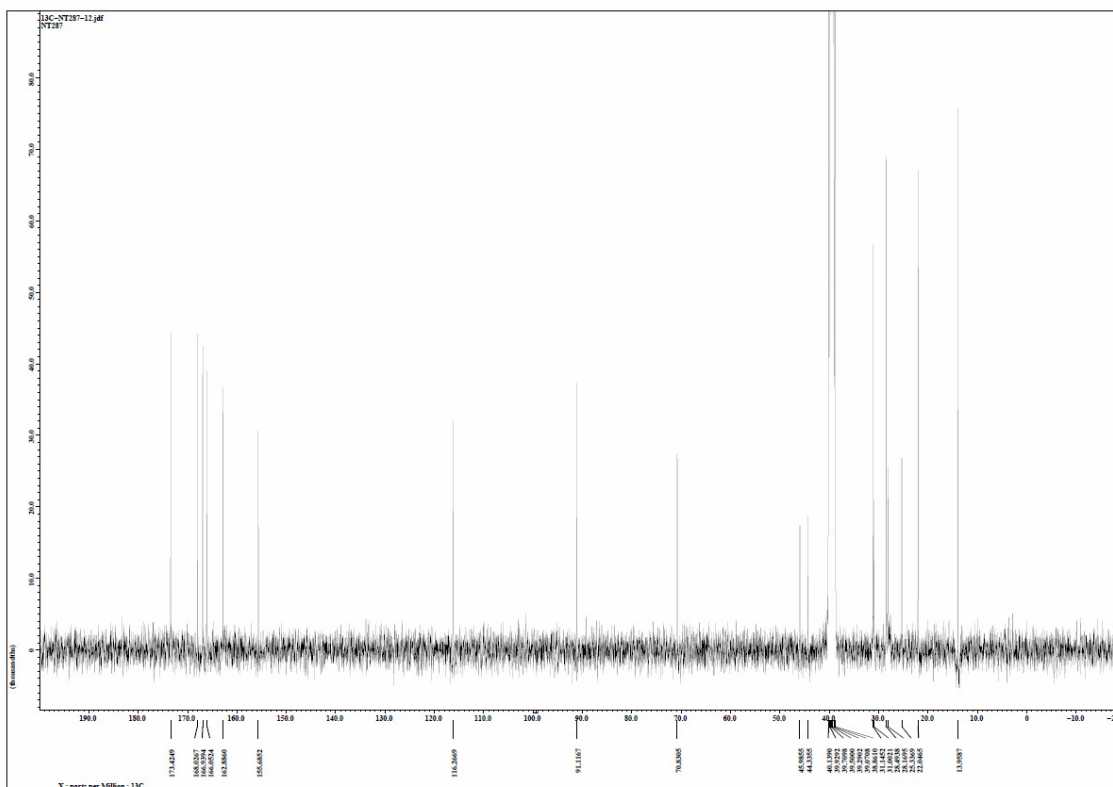


Figure S16.  $^{13}\text{C}$  NMR spectrum of **7c**.

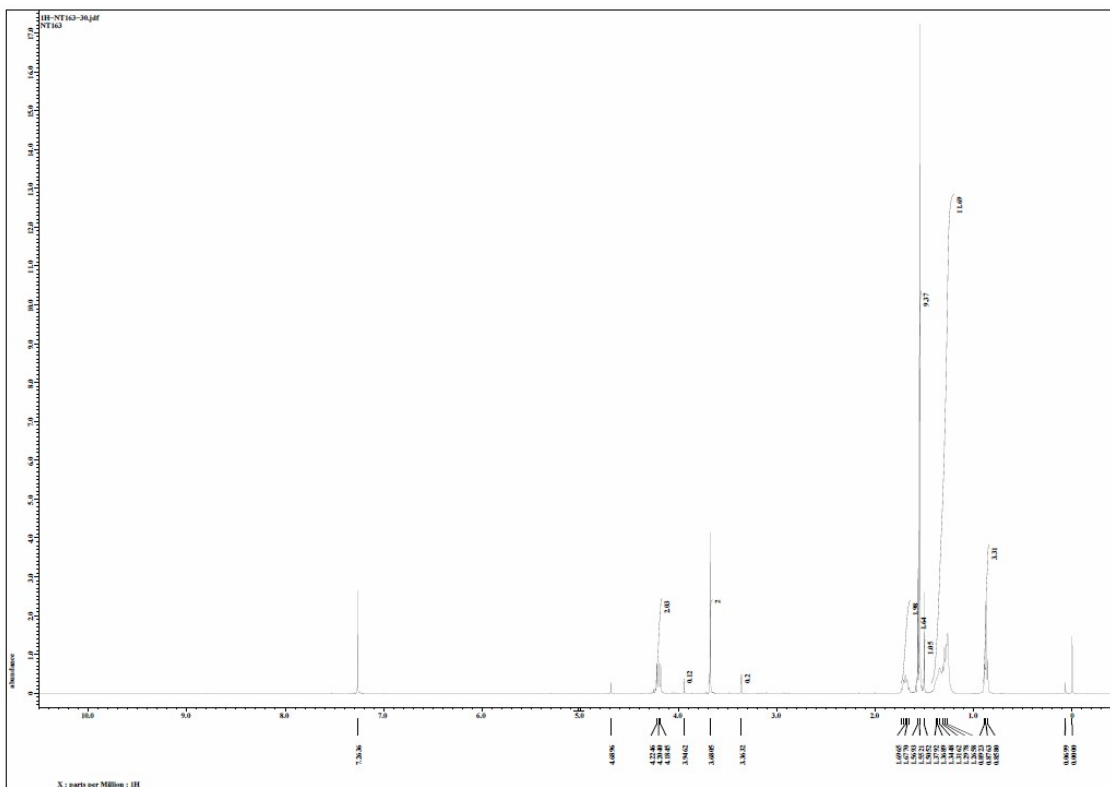


Figure S17. <sup>1</sup>H NMR spectrum of **11**.

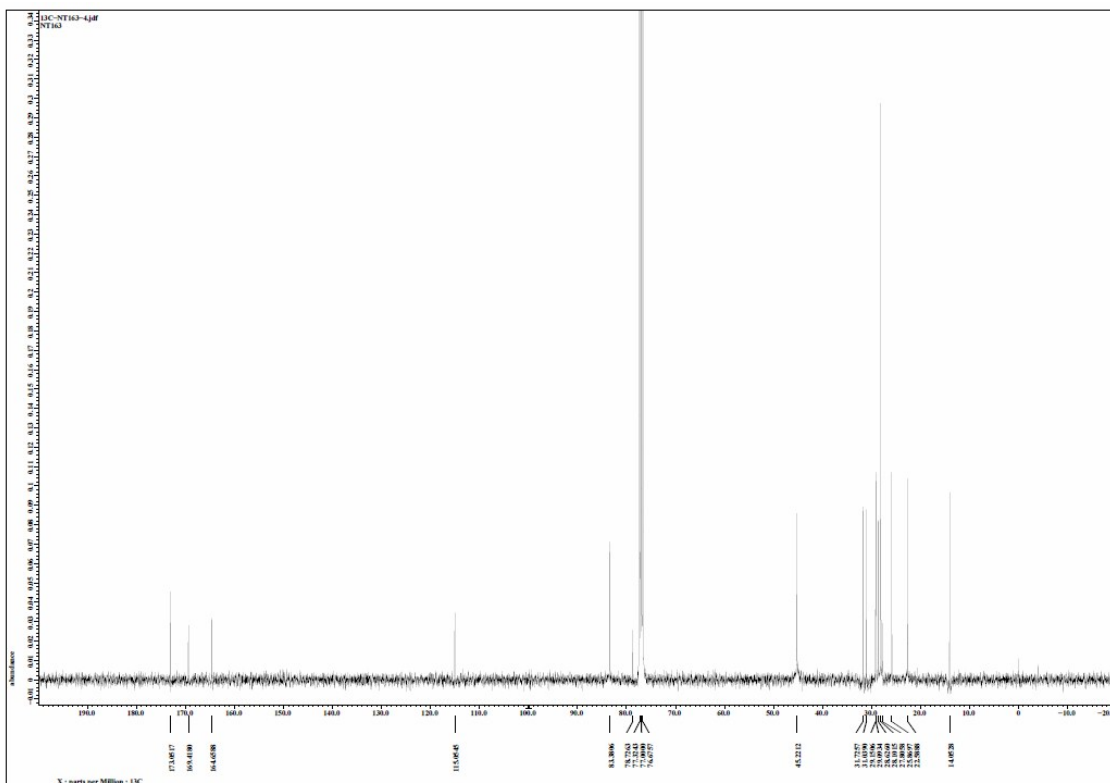


Figure S18. <sup>13</sup>C NMR spectrum of **11**.

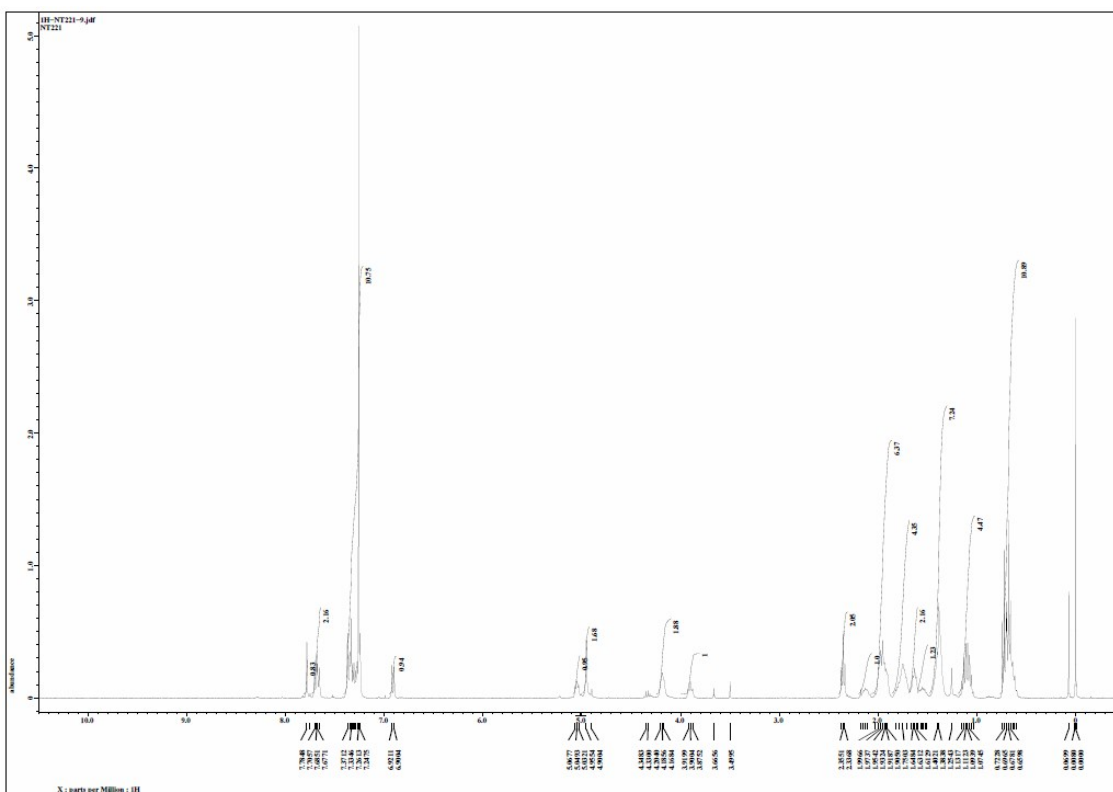


Figure S19. <sup>1</sup>H NMR spectrum of **GU15**.

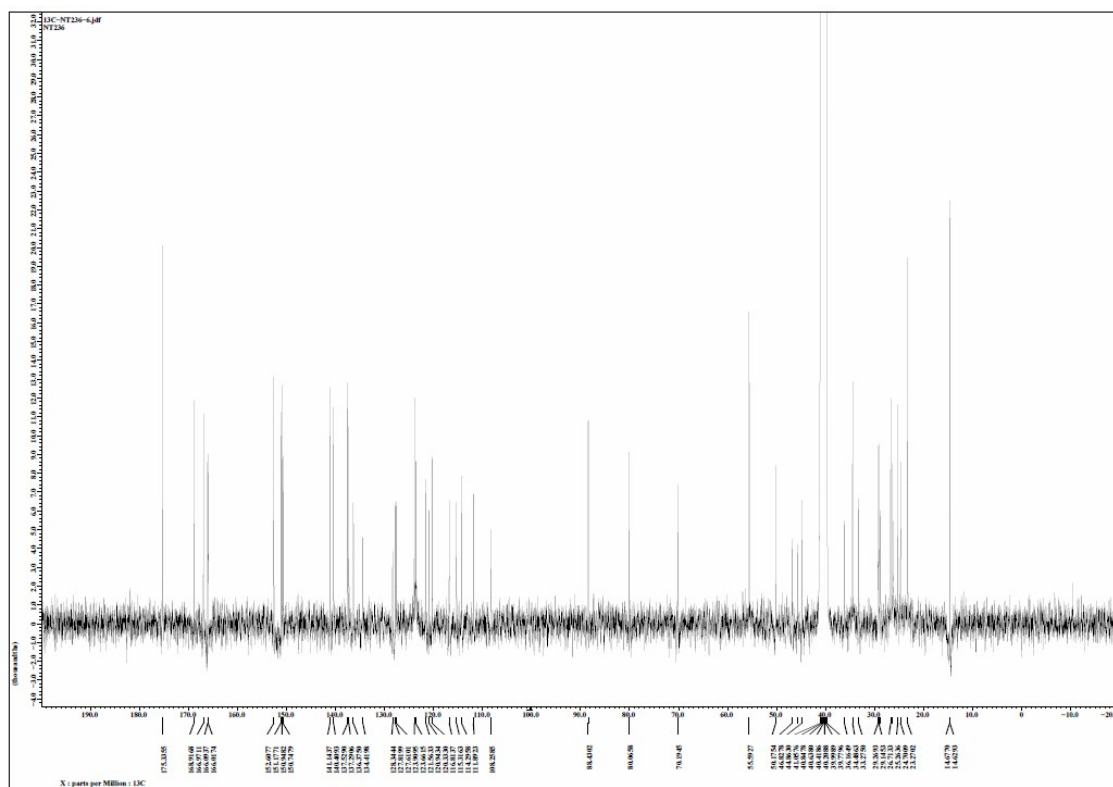


Figure S20. <sup>13</sup>C NMR spectrum of **GU15**.

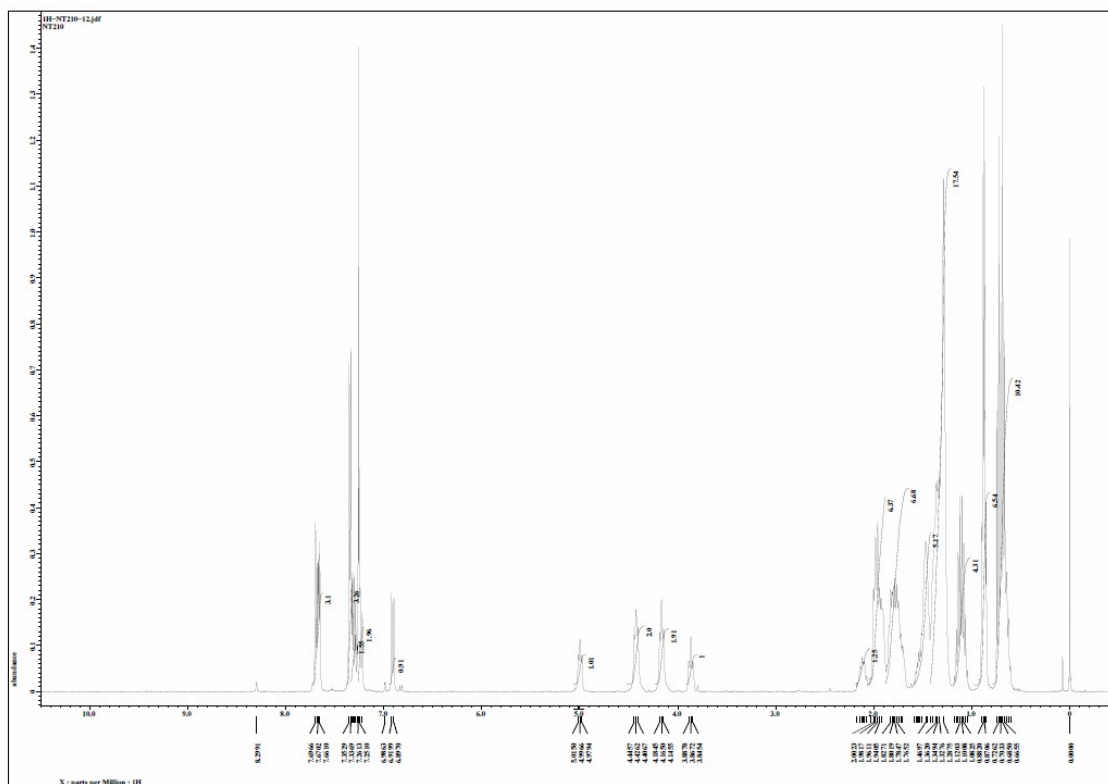


Figure S21.  $^1\text{H}$  NMR spectrum of **GU16**.

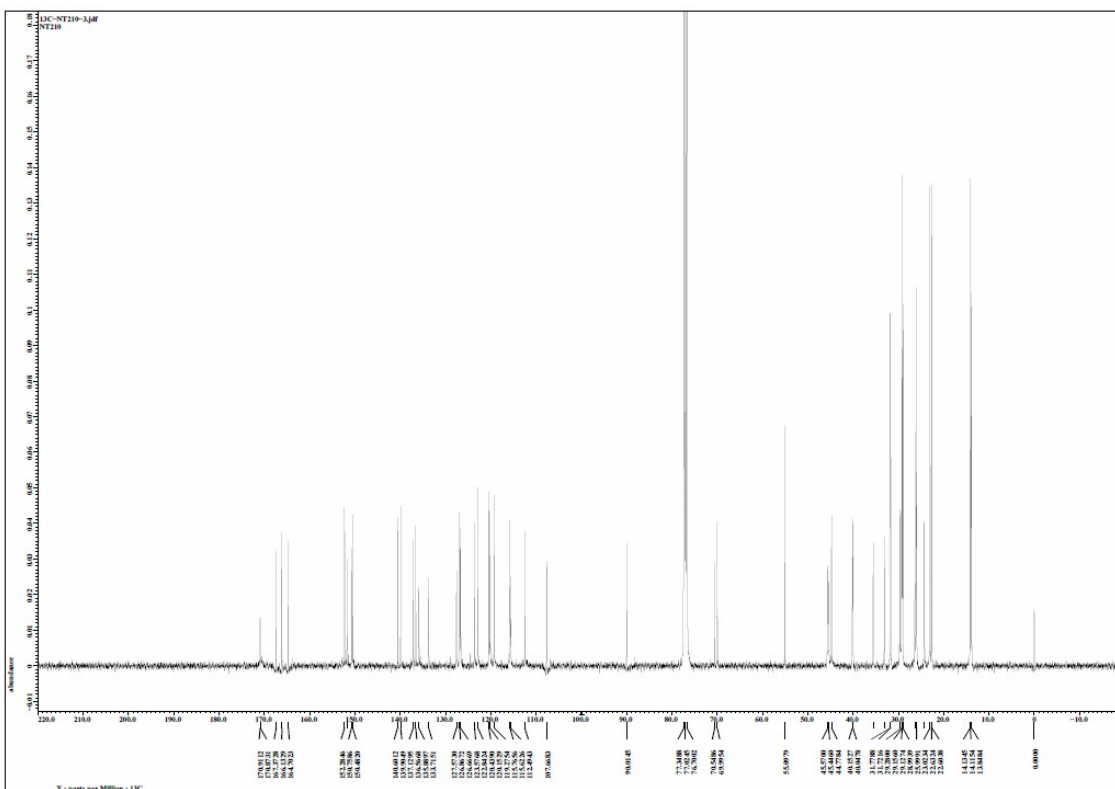


Figure S22.  $^{13}\text{C}$  NMR spectrum of **GU16**.

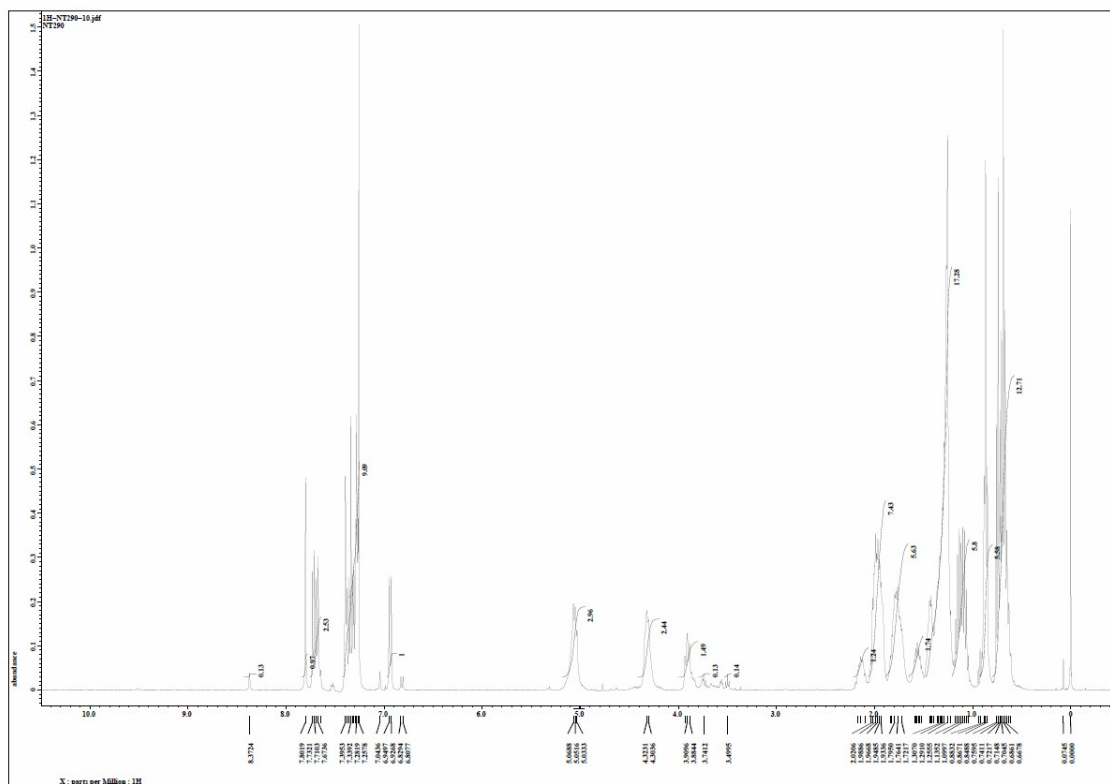


Figure S23. <sup>1</sup>H NMR spectrum of **GU17**.

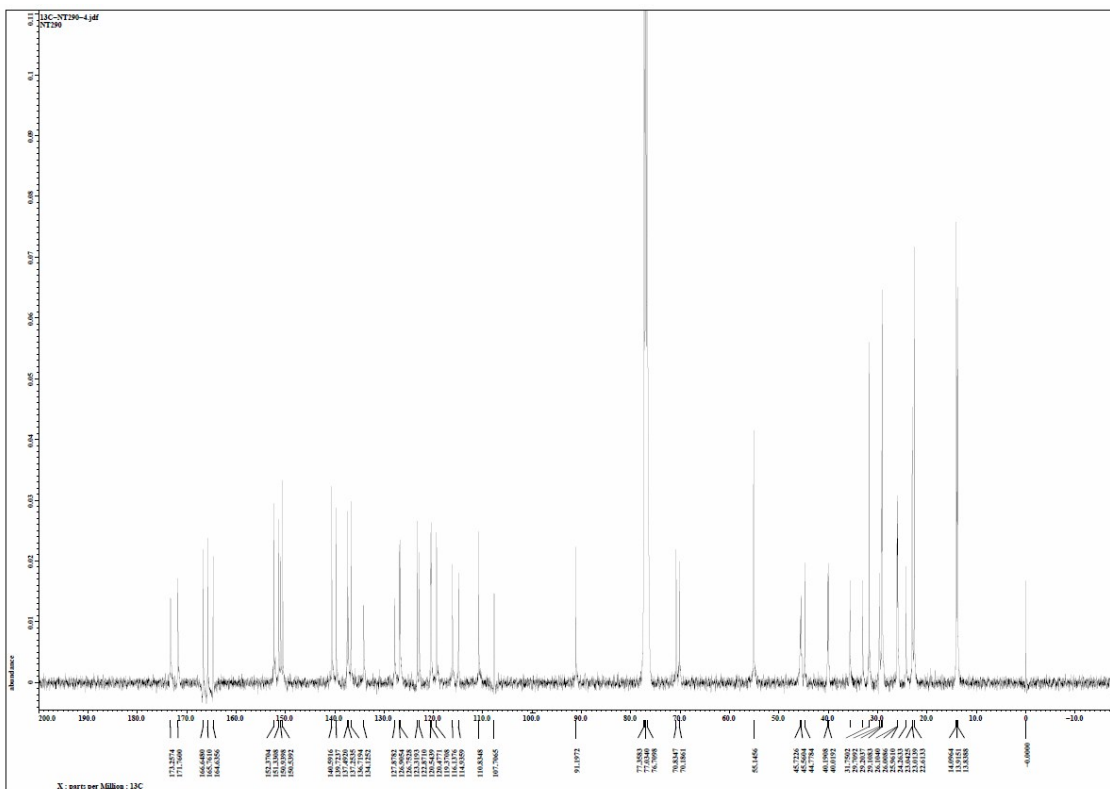


Figure S24. <sup>13</sup>C NMR spectrum of **GU17**.