## **Supporting Information**

# MycophenolicAcidDerivativeswithImmunosuppressiveActivityfromtheCoral-Derived FungusPenicillium bialowiezense

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Figure S1. <sup>1</sup>H NMR spectrum of compound 1 (Recorded in CD<sub>3</sub>OD)

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Figure S2. <sup>13</sup>C NMR spectrum of compound 1 (Recorded in CD<sub>3</sub>OD)

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**Figure S3.** DEPT spectrum of compound **1** (Recorded in CD<sub>3</sub>OD)

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Figure S4. HSQC spectrum of compound 1 (Recorded in CD<sub>3</sub>OD)



**Figure S5.** HMBC spectrum of compound **1** (Recorded in CD<sub>3</sub>OD)



Figure S6. <sup>1</sup>H–<sup>1</sup>H COSY spectrum of compound 1 (Recorded in CD<sub>3</sub>OD)

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Figure S8. IR spectrum of compound 1

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Figure S9. UV spectrum of compound 1



Figure S10. <sup>1</sup>H NMR spectrum of compound 2 (Recorded in CD<sub>3</sub>OD)

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**Figure S11.** <sup>13</sup>C NMR spectrum of compound **2** (Recorded in CD<sub>3</sub>OD)

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Figure S12. DEPT spectrum of compound 2 (Recorded in CD<sub>3</sub>OD)



Figure S13. HSQC spectrum of compound 2 (Recorded in CD<sub>3</sub>OD)



Figure S14. HMBC spectrum of compound 2 (Recorded in CD<sub>3</sub>OD)



Figure S15. <sup>1</sup>H–<sup>1</sup>H COSY spectrum of compound 2 (Recorded in CD<sub>3</sub>OD)

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Figure S16. HRESIMS spectrum of compound 2

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Figure S17. IR spectrum of compound 2

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Figure S18. UV spectrum of compound 2

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Figure S19. <sup>1</sup>H NMR spectrum of compound 3 (Recorded in CD<sub>3</sub>OD)

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**Figure S20.** <sup>13</sup>C NMR spectrum of compound **3** (Recorded in CD<sub>3</sub>OD)

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**Figure S21.** DEPT spectrum of compound **3** (Recorded in CD<sub>3</sub>OD)



Figure S22. HSQC spectrum of compound 3 (Recorded in CD<sub>3</sub>OD)



**Figure S23.** HMBC spectrum of compound **3** (Recorded in CD<sub>3</sub>OD)



**Figure S24.** <sup>1</sup>H–<sup>1</sup>H COSY spectrum of compound **3** (Recorded in CD<sub>3</sub>OD)

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Figure S26. IR spectrum of compound 3

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Figure S27. UV spectrum of compound 3

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Figure S28. <sup>1</sup>H NMR spectrum of compound 4 (Recorded in CD<sub>3</sub>OD)

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**Figure S29.** <sup>13</sup>C NMR spectrum of compound **4** (Recorded in CD<sub>3</sub>OD)

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**Figure S30.** HSQC spectrum of compound **4** (Recorded in CD<sub>3</sub>OD)



**Figure S31.** HMBC spectrum of compound **4** (Recorded in CD<sub>3</sub>OD)



Figure S32. <sup>1</sup>H–<sup>1</sup>H COSY spectrum of compound 4 (Recorded in CD<sub>3</sub>OD)
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Figure S34. IR spectrum of compound 4

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Figure S35. UV spectrum of compound 4

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**Figure S36.** <sup>1</sup>H NMR spectrum of compound **5** (Recorded in CD<sub>3</sub>OD)

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**Figure S37.** <sup>13</sup>C NMR spectrum of compound **5** (Recorded in CD<sub>3</sub>OD)

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Figure S38. DEPT spectrum of compound 5 (Recorded in CD<sub>3</sub>OD)

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Figure S39. HSQC spectrum of compound 5 (Recorded in CD<sub>3</sub>OD)



Figure S40. HMBC spectrum of compound 5 (Recorded in CD<sub>3</sub>OD)



Figure S41. <sup>1</sup>H–<sup>1</sup>H COSY spectrum of compound 5 (Recorded in CD<sub>3</sub>OD)

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Figure S43. IR spectrum of compound 5

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Figure S44. UV spectrum of compound 5

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**Figure S45.** <sup>1</sup>H NMR spectrum of compound **6** (Recorded in CD<sub>3</sub>OD)

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**Figure S46.** <sup>13</sup>C NMR spectrum of compound **6** (Recorded in CD<sub>3</sub>OD)

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Figure S47. DEPT spectrum of compound 6 (Recorded in CD<sub>3</sub>OD)



Figure S48. HSQC spectrum of compound 6 (Recorded in CD<sub>3</sub>OD)

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Figure S49. HMBC spectrum of compound 6 (Recorded in CD<sub>3</sub>OD)

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**Figure S50.** <sup>1</sup>H–<sup>1</sup>H COSY spectrum of compound **6** (Recorded in CD<sub>3</sub>OD)





Figure S52. IR spectrum of compound 6

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Figure S53. UV spectrum of compound 6

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**Figure S54.** <sup>1</sup>H NMR spectrum of compound 7 (Recorded in CD<sub>3</sub>OD)

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**Figure S55.** <sup>13</sup>C NMR spectrum of compound 7 (Recorded in CD<sub>3</sub>OD)

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Figure S56. DEPT spectrum of compound 7 (Recorded in CD<sub>3</sub>OD)



Figure S57. HSQC spectrum of compound 7 (Recorded in CD<sub>3</sub>OD)



Figure S58. HMBC spectrum of compound 7 (Recorded in CD<sub>3</sub>OD)



Figure S59. <sup>1</sup>H–<sup>1</sup>H COSY spectrum of compound 7 (Recorded in CD<sub>3</sub>OD)

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Figure S61. IR spectrum of compound 7

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Figure S62. UV spectrum of compound 7

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Figure S63. <sup>1</sup>H NMR spectrum of compound 8 (Recorded in CD<sub>3</sub>OD)

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**Figure S64.** <sup>13</sup>C NMR spectrum of compound **8** (Recorded in CD<sub>3</sub>OD)

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**Figure S65.** DEPT spectrum of compound **8** (Recorded in CD<sub>3</sub>OD)

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Figure S66. HSQC spectrum of compound 8 (Recorded in CD<sub>3</sub>OD)



**Figure S67.** HMBC spectrum of compound **8** (Recorded in CD<sub>3</sub>OD)



Figure S68. <sup>1</sup>H–<sup>1</sup>H COSY spectrum of compound 8 (Recorded in CD<sub>3</sub>OD)


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Figure S70. IR spectrum of compound 8

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Figure S71. UV spectrum of compound 8

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Figure S72. <sup>1</sup>H NMR spectrum of compound 9 (Recorded in CD<sub>3</sub>OD)

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**Figure S73.** <sup>13</sup>C NMR spectrum of compound **9** (Recorded in CD<sub>3</sub>OD)

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**Figure S74.** DEPT spectrum of compound **9** (Recorded in CD<sub>3</sub>OD)

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Figure S75. HSQC spectrum of compound 9 (Recorded in CD<sub>3</sub>OD)



Figure S76. HMBC spectrum of compound 9 (Recorded in CD<sub>3</sub>OD)



**Figure S77.** <sup>1</sup>H–<sup>1</sup>H COSY spectrum of compound **9** (Recorded in CD<sub>3</sub>OD)

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Figure S79. IR spectrum of compound 9

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Figure S80. UV spectrum of compound 9

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Figure S81. <sup>1</sup>H NMR spectrum of compound 10 (Recorded in CD<sub>3</sub>OD)

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**Figure S82.** <sup>13</sup>C NMR spectrum of compound **10** (Recorded in CD<sub>3</sub>OD)

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Figure S83. DEPT spectrum of compound 10 (Recorded in CD<sub>3</sub>OD)

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Figure S84. HSQC spectrum of compound 10 (Recorded in CD<sub>3</sub>OD)



**Figure S85.** HMBC spectrum of compound **10** (Recorded in CD<sub>3</sub>OD)



Figure S86. <sup>1</sup>H–<sup>1</sup>H COSY spectrum of compound **10** (Recorded in CD<sub>3</sub>OD)



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Figure S88. IR spectrum of compound 10



Figure S89. UV spectrum of compound 10

## Structure elucidation of compounds 1, 2, and 8–10

Compound **1** was isolated as a white powder, and its molecular formula was assigned as C<sub>18</sub>H<sub>22</sub>O<sub>7</sub>, based on the HRESIMS data at *m*/*z* 373.1259 ([M + Na]<sup>+</sup>, calcd for 373.1263) and <sup>13</sup>C NMR data, requiring eight indices of hydrogen deficiency. Detailed analysis of the <sup>1</sup>H and <sup>13</sup>C NMR data (Table S1) of **1** and **11** suggested that both compounds possessed the similar structural features, with the only difference that a methyl group at C-8 in **11** was replaced by a –CH<sub>2</sub>OCH<sub>3</sub> group in **1**, as supported by the HMBC correlations from H<sub>2</sub>-8 to C-3a ( $\delta$ c 147.2), C-4 ( $\delta$ c 119.1), C-5 ( $\delta$ c 164.5), and the methoxyl carbon ( $\delta$ c 58.7). Moreover, the planar structure was defined by the 2D NMR analysis, including HMBC and <sup>1</sup>H–<sup>1</sup>H COSY correlations. Thus, the structure of **1** was identified and named 8-*O*-methyl mycophenolic acid.

Compound **2** was also isolated as a white powder. Its molecular formula C<sub>17</sub>H<sub>20</sub>O<sub>7</sub> was determined by the HRESIMS *m/z* 359.1092 [M + Na]<sup>+</sup> (calcd for C<sub>17</sub>H<sub>20</sub>O<sub>7</sub>Na, 359.1107). The <sup>1</sup>H and <sup>13</sup>C NMR data (Table S1) showed high similarity to those of **11**, differing in that the C-3 methylene in **11** was hydroxylated in **2**, as verified by its molecular formula and the chemical shift values of CH-3 ( $\delta$ H 6.58;  $\delta$ C 100.2). This conclusion was further confirmed by the HMBC correlations from H-3 to C-1 ( $\delta$ C 171.6), C-3a ( $\delta$ C 145.7), C-4 ( $\delta$ C 120.3), and C-7a ( $\delta$ C 108.7). Compound **2** was optically inactive and no apparent Cotton effects were observed in its experimental CD spectrum despite the presence of an  $\alpha$ , $\beta$ -unsaturated carbonyl chromophore, suggesting that it was a racemic mixture. Moreover, an attempt to separate the two enantiomers was failed. Thus, the structure of **2** was defined and named 3-hydroxy mycophenolic acid.

Compound 8 was determined to have the molecular formula C<sub>22</sub>H<sub>29</sub>NO<sub>7</sub>, according to its HRESIMS *m*/*z* 442.1851 [M + Na]<sup>+</sup> (calcd for C<sub>22</sub>H<sub>29</sub>NO<sub>7</sub>Na, 442.1842). The <sup>1</sup>H and <sup>13</sup>C NMR data (Table S2) were similar to those of **11**, except for the presence the value residue which formed an amide bond with C-6', as supported by the COSY correlations from H-2" ( $\delta_{\rm H}$  4.24) to H-4" ( $\delta_{\rm H}$  2.10) and from H-4" to H-5" ( $\delta_{\rm H}$  0.90) and H-6" ( $\delta_{\rm H}$  0.90) and HMBC correlations from H<sub>2</sub>-2" to C-6' and C-3" and from H-4" to C-3". The specific rotation of **8** {[ $\alpha$ ]<sub>D</sub><sup>23</sup> : +5.3 (*c* 0.08, MeOH)} was dextrorotatory, the same to that of the synthetic product *N*-mycophenoyl-L-valine {[ $\alpha$ ]<sub>D</sub><sup>25</sup> : +2.0 (*c* 1, acetone)} [1], suggesting the presence of a *L*-valine in **8**. Thus, the structure of **8** was identified as *N*-mycophenoyl-L-valine.

Compounds **9** and **10** were also identified as the natural mycophenolic acid-amino acid conjugates. And their molecular formulas were determined to be C<sub>26</sub>H<sub>29</sub>NO<sub>7</sub> and C<sub>20</sub>H<sub>25</sub>NO<sub>7</sub>, respectively, based on the HRESIMS analysis as well as <sup>13</sup>C NMR data. Detailed analysis of the 1D and 2D NMR data (Table S2) of **9** and **10** with those of **8** revealed the obvious differences that **9** had a phenylalanine amide unit and **10** had an alanine amide unit, as supported by the key 2D NMR analysis. Compound **9** was measured with a specific rotation,  $[\alpha]_D^{23}$ : +2.5 (*c* 0.1, MeOH), which was identical to that of the synthetic product *N*-mycophenoyl-L-phenyloalanine { $[\alpha]_D^{25}$ : +2.0 (*c* 1, MeOH)} [1], suggesting the presence of a *L*-phenylalanine amide unit

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in **9**. Similarly, comparing the specific rotation of **10** { $[\alpha]_{D}^{23}$ : -6.4 (*c* 0.08, MeOH)} with that of the synthetic product *N*-mycophenoyl-L-alanine { $[\alpha]_{D}^{25}$ : -2.0 (*c* 1, acetone)} [1], the similar negative values indicated the presence of a L-alanine amide unit in **10**. Thus, the structures of **9** and **10** were defined and named *N*-mycophenoyl-L-phenyloalanine and *N*-mycophenoyl-L-alanine, respectively.



Figure S90. Key <sup>1</sup>H–<sup>1</sup>H COSY (pink lines) and HMBC (blue arrows) correlations of 1–2 and 8–10.

Ref: [1] Iwaszkiewicz-Grzes, D.; Cholewinski, G.; Kot-Wasik, A.; Trzonkowski, P.; Dzierzbicka, K. Synthesis and biological activity of mycophenolic acid-amino acid derivatives. *Eur. J. Med. Chem.* **2013**, *69*, 863–871.

## The physical and chemical constants of compounds 1, 2, and 8–10

**8-O-Methyl mycophenolic acid** (1): white powder; UV (MeOH) λ<sub>max</sub> (log ε): 219 (4.57), 253 (3.81), and 305 (3.51) nm; IR (ν<sub>max</sub>): 3424, 2924, 2853, 1738, 1618, 1453, 1421, 1381, 1273, 1109, 1028, 969, 674 cm<sup>-1</sup>; HRESIMS *m*/*z* 373.1259 [M + Na]<sup>+</sup> (calcd for C<sub>18</sub>H<sub>22</sub>O<sub>7</sub>Na, 373.1263); <sup>1</sup>H and <sup>13</sup>C NMR data, see Table S1.

**3-Hydroxy mycophenolic acid** (**2**): white powder; [*α*]<sup>23</sup><sub>D</sub>: 0 (*c* 0.15, MeOH); UV (MeOH) λ<sub>max</sub> (log ε): 218 (4.41), 251 (3.73), and 311 (3.56) nm; IR (ν<sub>max</sub>): 3436, 2947, 1737, 1626, 1460, 1408, 1276, 1138, 1092, 1024, 595 cm<sup>-1</sup>; HRESIMS *m*/*z* 359.1092 [M + Na]<sup>+</sup> (calcd for C<sub>17</sub>H<sub>20</sub>O<sub>7</sub>Na, 359.1107); <sup>1</sup>H and <sup>13</sup>C NMR data, see Table S1.

*N*-Mycophenoyl-L-valine (8): white powder;  $[\alpha]_D^{23}$ : +5.3 (*c* 0.08, MeOH); UV (MeOH)  $\lambda_{max}$  (log  $\varepsilon$ ): 217 (4.24), 251 (3.49), and 307 (3.16) nm; IR ( $\nu_{max}$ ): 3430, 2924, 2853, 1738, 1633, 1463, 1416, 1384, 1136, 1078, 1030, 973, 673 cm<sup>-1</sup>; HRESIMS *m*/*z* 442.1851 [M + Na]<sup>+</sup> (calcd for C<sub>22</sub>H<sub>29</sub>NO<sub>7</sub>Na, 442.1842); <sup>1</sup>H and <sup>13</sup>C NMR data, see Table S2.

**N-Mycophenoyl-L-phenyloalanine** (9): white powder;  $[\alpha]_D^{23}$ : +2.5 (*c* 0.1, MeOH); UV (MeOH)  $\lambda_{max}$  (log  $\varepsilon$ ): 215 (4.39), 253 (3.64), and 308 (3.17) nm; IR ( $\nu_{max}$ ): 3423, 2924, 2853, 1737, 1633, 1452, 1412, 1330, 1136, 1079, 1031, 971, 702, 583 cm<sup>-1</sup>; HRESIMS *m*/*z* 490.1875 [M + Na]<sup>+</sup> (calcd for C<sub>26</sub>H<sub>29</sub>NO<sub>7</sub>Na, 490.1842); <sup>1</sup>H and <sup>13</sup>C NMR data, see Table S2.

*N*-Mycophenoyl-L-alanine (10): white powder,  $[\alpha]_D^{23}$ : -6.4 (*c* 0.08, MeOH); UV (MeOH)  $\lambda_{max}$  (log  $\varepsilon$ ): 218 (4.29), 253 (3.58), and 307 (3.16) nm; IR ( $\nu_{max}$ ): 3427, 2924, 2853, 1738, 1631, 1458, 1414, 1383, 1136, 1080, 1031, 972 cm<sup>-1</sup>; HRESIMS *m*/*z* 414.1501 [M + Na]<sup>+</sup> (calcd for C<sub>20</sub>H<sub>25</sub>NO<sub>7</sub>Na, 414.1529); <sup>1</sup>H and <sup>13</sup>C NMR data, see Table S2.

## <sup>1</sup>H and <sup>13</sup>C NMR data for compounds 1, 2, and 8–10

**Table S1.** <sup>1</sup>H and <sup>13</sup>C NMR data for **1** and **2** in CD<sub>3</sub>OD ( $\delta$  in ppm, *J* in Hz).

No.	1		2		
	$\delta$ н $^{a,b}$	δc <sup>c</sup>	$\delta_{\mathrm{H}}$ $^{a,b}$	δc <sup>c</sup>	
1	-	173.6 CO	-	171.6 CO	
3	5.33 (2H, s)	71.4 CH2	6.58 (1H, s)	100.2 CH	
3a	-	147.2 C	-	145.7 C	
4	-	119.1 C	-	120.3 C	
5	-	164.5 C	-	165.2 C	
6	-	123.8 C	-	125.5 C	
7	-	156.6 C	-	154.4 C	
7a	-	108.3 C	-	108.7 C	
8	4.52 (2H, s)	68.1 CH <sub>2</sub>	2.25 (3H, s)	11.1 CH <sub>3</sub>	
3-OMe	-	-	-	-	
5-OMe	3.78 (3H, s)	63.0 CH3	3.76 (3H, s)	61.5 CH3	
8-OMe	3.39 (3H, s)	58.7 CH <sub>3</sub>	-	-	
1'	3.39 (2H, m)	23.5 CH2	3.39 (2H, br d, <i>J</i> = 6.9 Hz)	23.7 CH2	
2'	5.26 (1H, t, <i>J</i> = 7.0 Hz)	124.0 CH	5.25 (1H, t, <i>J</i> = 6.9 Hz)	124.1 CH	
3'	-	135.4 C	-	135.2 C	
4'	2.27 (2H, m)	36.0 CH2	2.26 (2H, m)	35.8 CH2	
5'	2.34 (2H, m)	34.4 CH2	2.35 (2H, m)	33.9 CH2	
6'	-	178.1 C	-	177.3 C	
7'	1.81 (3H, s)	16.3 CH <sub>3</sub>	1.81 (3H, s)	16.3 CH₃	
6'-OMe	-	-		-	

<sup>*a*</sup> Recorded at 400 MHz; <sup>*b*</sup> "m" means overlapped or multiplet with other signals; <sup>*c*</sup> Recorded at 100 MHz.

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No.	8		9		10	
	$\delta_{H}$ a,b	δc <sup>c</sup>	$\delta_{\mathrm{H}}$ <sup><i>a,b</i></sup>	δc <sup>c</sup>	δн а,b	δc <sup>c</sup>
1	-	173.8 C		173.9 C	-	173.8 C
3	5.24 (2H, s)	70.8 CH2	5.10 (2H, s)	70.8 CH2	5.24 (2H, s)	70.8 CH2
3a	-	146.6 C	-	146.6 C	-	146.6 C
4	-	117.8 C	-	117.8 C	-	117.8 C
5	-	164.9 C	-	164.8 C	-	164.8 C
6	-	123.7 C	-	123.7 C	-	123.7 C
7	-	154.7 C	-	154.8 C	-	154.6 C
7a	-	107.7 C	-	107.7 C	-	107.7 C
8	2.14 (3H, s)	11.4 CH <sub>3</sub>	2.07 (3H, s)	11.4 CH <sub>3</sub>	2.15 (3H, s)	11.4 CH <sub>3</sub>
5-OMe	3.76 (3H, s)	61.6 CH3	3.71 (3H, s)	61.6 CH3	3.76 (3H, s)	61.5 CH3
1'	3.38 (2H, br d, J = 7.1 Hz)	23.6 CH <sub>2</sub>	3.32 (2H, br d, <i>J</i> = 6.9 Hz)	23.6 CH <sub>2</sub>	3.39 (2H, br d, <i>J</i> = 7.0 Hz)	23.6 CH <sub>2</sub>
2'	5.27 (1H, t, <i>J</i> = 7.1 Hz)	124.4 CH	5.18 (1H, t, J = 6.9 Hz)	124.4 CH	5.26 (1H, t, <i>J</i> = 7.0 Hz)	124.5 CH
3'	-	135.2 C	-	135.1 C	-	135.1 C
4'	2.28 (2H, m)	36.6 CH <sub>2</sub>	2.13 (2H, m)	36.5 CH2	2.27 (2H, m)	36.5 CH2
5'	2.36 (2H, m)	35.5 CH2	2.21 (2H, m)	35.6 CH <sub>2</sub>	2.30 (2H, m)	35.6 CH <sub>2</sub>
6'	-	175.8 C	-	175.4 C	-	175.3 C
7'	1.83 (3H, s)	16.3 CH3	1.73 (3H, s)	16.2 CH <sub>3</sub>	1.82 (3H, s)	16.3 CH3
2"	4.24 (1H, d, J = 5.5 Hz)	59.4 CH	4.51 (1H, dd, J = 5.4, 8.2 Hz)	55.5 CH	4.26 (1H, q, J = 7.2 Hz)	49.9 CH
3"	-	175.8 C	-	175.4 C	-	176.8 C
4''	2.10 (1H, m)	31.8 CH	2.77 (1H, dd, J = 8.2, 13.7 Hz); 3.03 (1H,	38.8 CH <sub>2</sub>	1.30 (3H, d, J = 7.2 Hz)	18.0 CH <sub>3</sub>
			dd, <i>J</i> = 5.4, 13.7 Hz)			
5"	0.90 (3H, d, J = 6.8 Hz)	19.7 CH <sub>3</sub>	-	138.7 C	-	-
6"	0.90 (3H, d, J = 6.8 Hz)	18.4 CH <sub>3</sub>	7.12 (1H, m)	130.3 C	-	-
7''	-	-	7.19 (1H, m)	129.3 C	-	-
8"	-	-	7.14 (1H, m)	127.6 C	-	-
9"	-	-	7.19 (1H, m)	129.3 C	-	-
10''	-	-	7.12 (1H, m)	130.3 C	-	-

<b>Table S2.</b> <sup>1</sup> H and <sup>13</sup> C NMR data for <b>8–10</b> in CD <sub>3</sub> OD ( $\delta$ in ppm, <i>J</i> in	Hz).
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<sup>*a*</sup> Recorded at 400 MHz; <sup>*b*</sup> "m" means overlapped or multiplet with other signals; <sup>*c*</sup> Recorded at 100 MHz.