

## Supporting Information

### Cytotoxic and NF- $\kappa$ B Inhibitory Constituents of *Artocarpus rigida*

Yulin Ren,<sup>†</sup> Leonardus B. S. Kardono,<sup>‡</sup> Soedarsono Riswan,<sup>§</sup> Heebyung Chai,<sup>†</sup> Norman R. Farnsworth,<sup>⊥</sup> Djaja D. Soejarto,<sup>⊥</sup> Esperanza J. Carcache de Blanco,<sup>†,||</sup> and A. Douglas Kinghorn<sup>\*,†</sup>

*Division of Medicinal Chemistry and Pharmacognosy and Division of Pharmacy Practice and Administration, College of Pharmacy, The Ohio State University, Columbus, Ohio 43210, Program for Collaborative Research in the Pharmaceutical Sciences and Department of Medicinal Chemistry and Pharmacognosy, College of Pharmacy, University of Illinois at Chicago, Chicago, Illinois 60612, Research Center for Chemistry, Indonesian Institute of Science, Serpong, Tangerang 15310, Indonesia, and Herbarium Bogoriense, Research Center for Biology, Indonesian Institute of Science, Bogor 16122, Indonesia*

\* To whom correspondence should be addressed. Tel.: +1 614 247 8094; fax: +1 614 247 8081.

E-mail: [kinghorn.4@osu.edu](mailto:kinghorn.4@osu.edu)

<sup>†</sup> Division of Medicinal Chemistry and Pharmacognosy, College of Pharmacy, The Ohio State University.

<sup>‡</sup> Indonesian Institute of Science, Serpong.

<sup>§</sup> Indonesian Institute of Science, Bogor.

<sup>⊥</sup> University of Illinois at Chicago.

<sup>||</sup> Division of Pharmacy Practice and Administration, College of Pharmacy, The Ohio State University.

## Table of contents

**Figure S1-S5.** Mass and  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectra of compounds **1-5**.

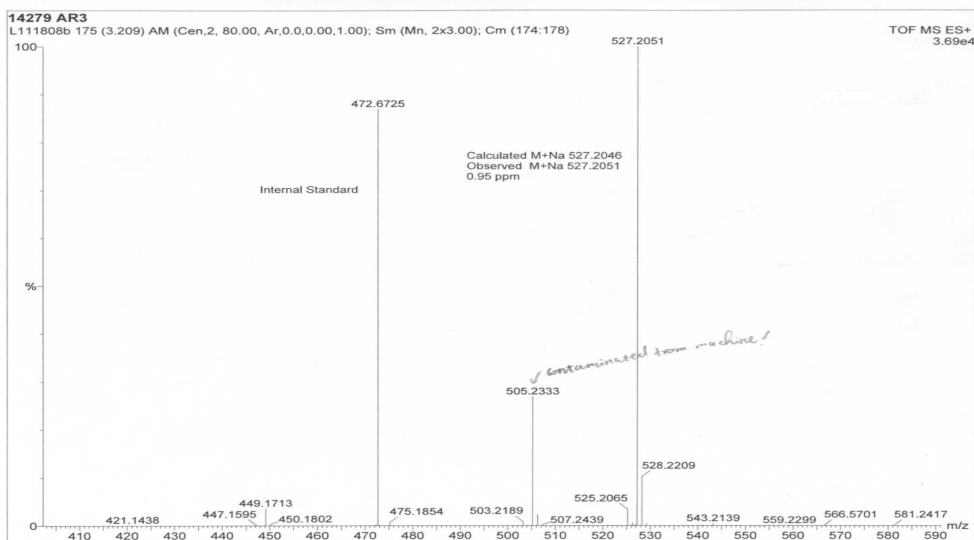
Physical and spectroscopic data of known prenylflavonoids from *A. rigida*.

**Table S1-S2.** The  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectroscopic data of known prenylflavonoids and stilbene from *A. rigida*.

**Figure S6.** Structures of known literature compounds in comparison to **2, 3, 6, and 8**.

**Figure S1-S5. Mass and <sup>1</sup>H and <sup>13</sup>C NMR spectra of compounds 1-5**

**Figure S1a. Mass spectrum of 1**



**Figure S1b. <sup>1</sup>H NMR spectrum of 1**

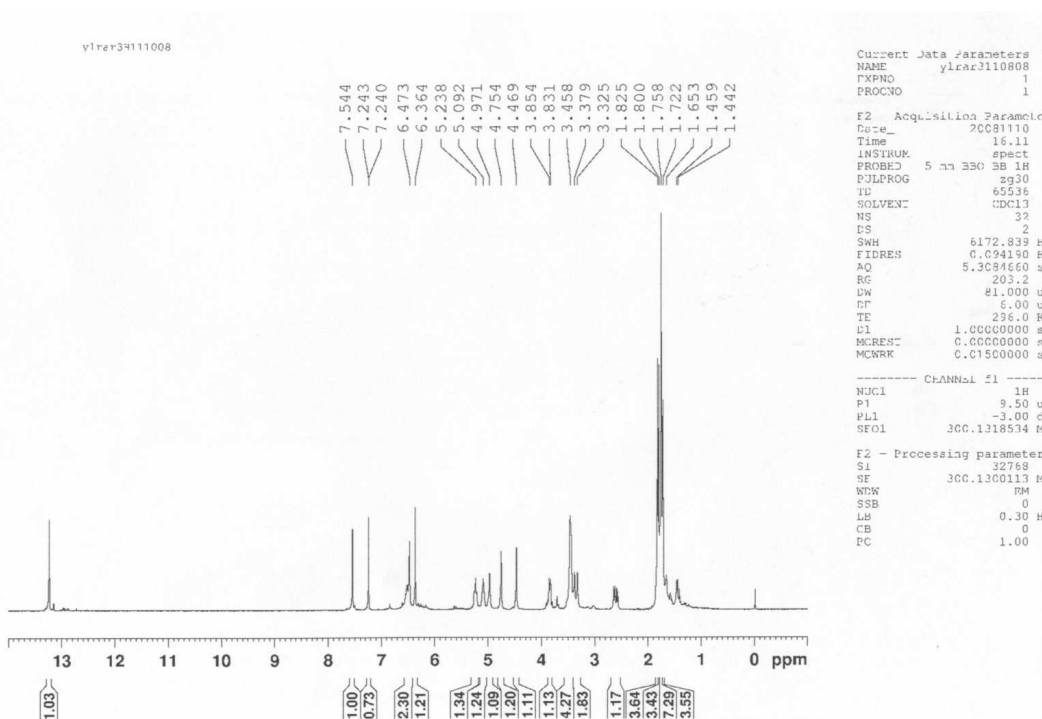


Figure S1c. <sup>13</sup>C NMR spectrum of 1

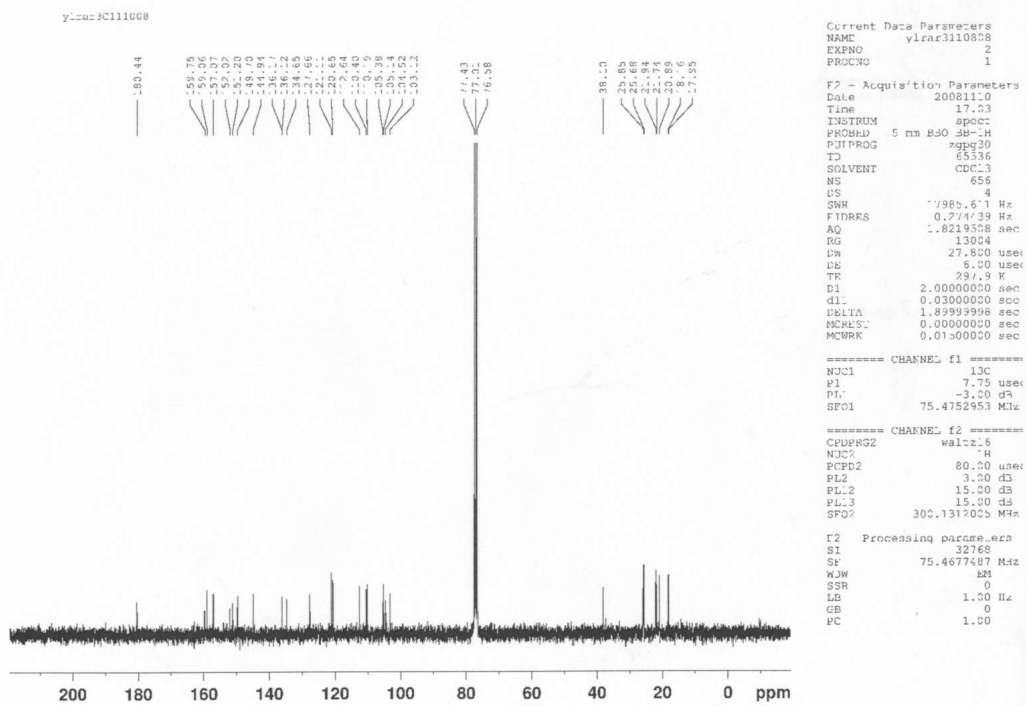


Figure S2a. Mass spectrum of 2

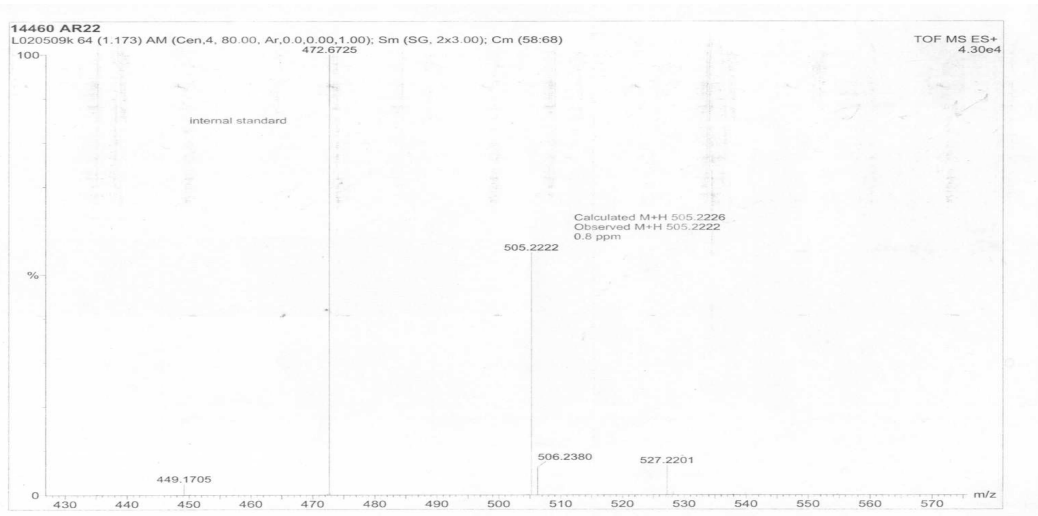


Figure S2b. <sup>1</sup>H NMR spectrum of 2

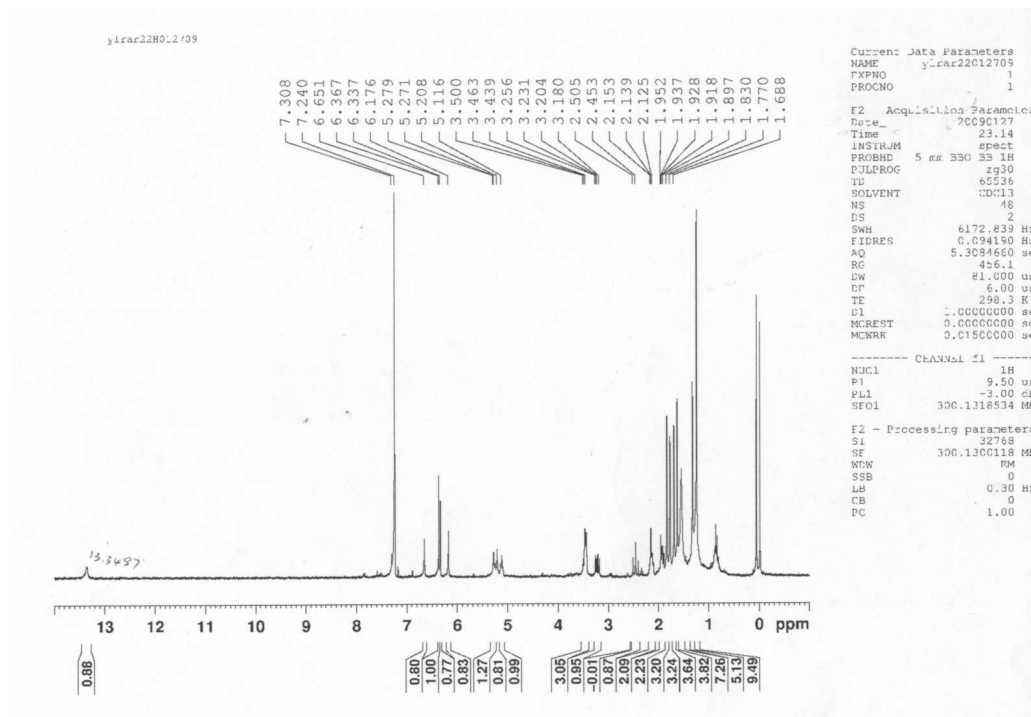
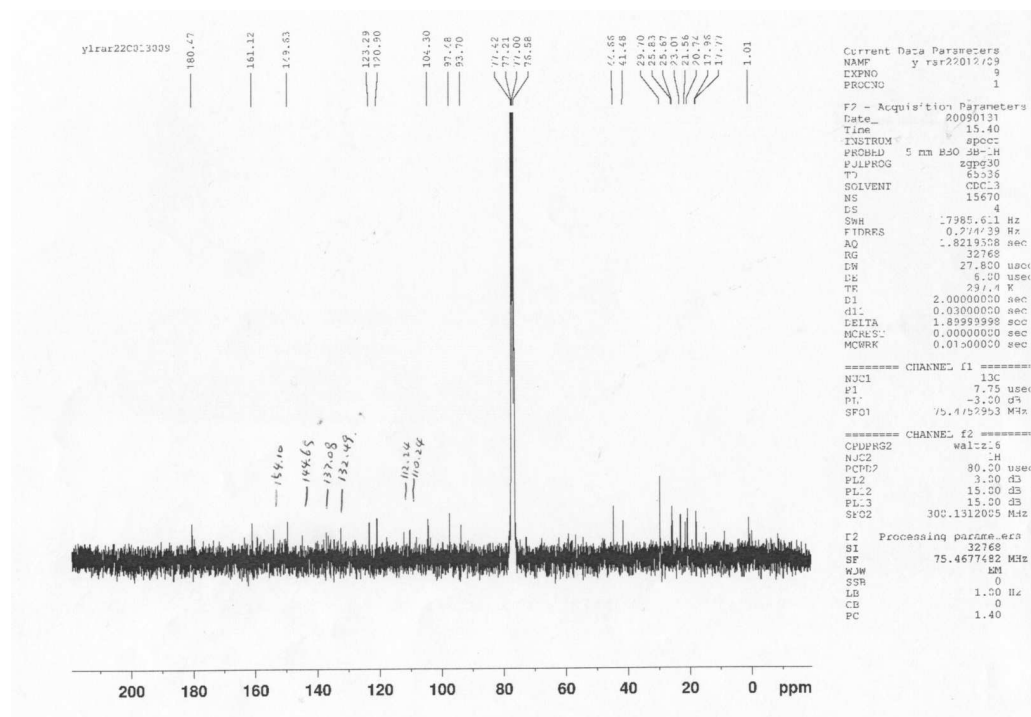
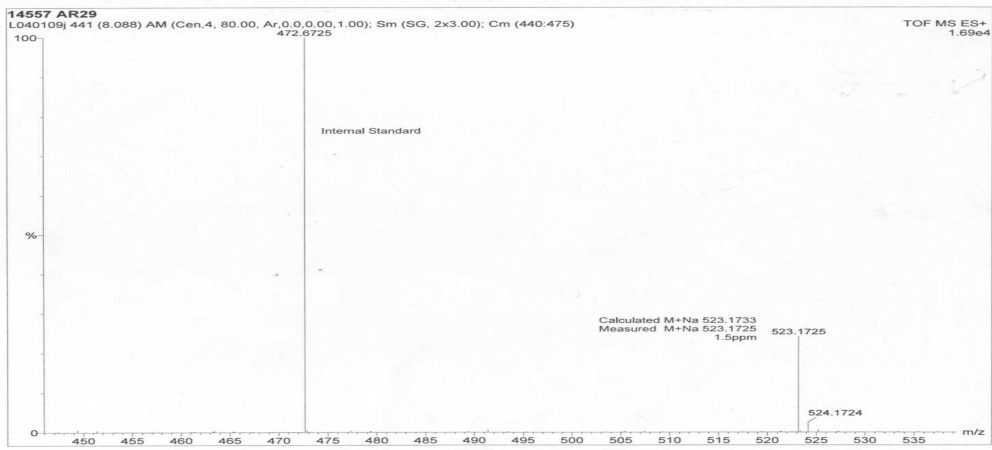


Figure S2c. <sup>13</sup>C NMR spectrum of 2



**Figure S3a.** Mass spectrum of **3**



**Figure S3b.**  $^1\text{H}$  NMR spectrum of **3**

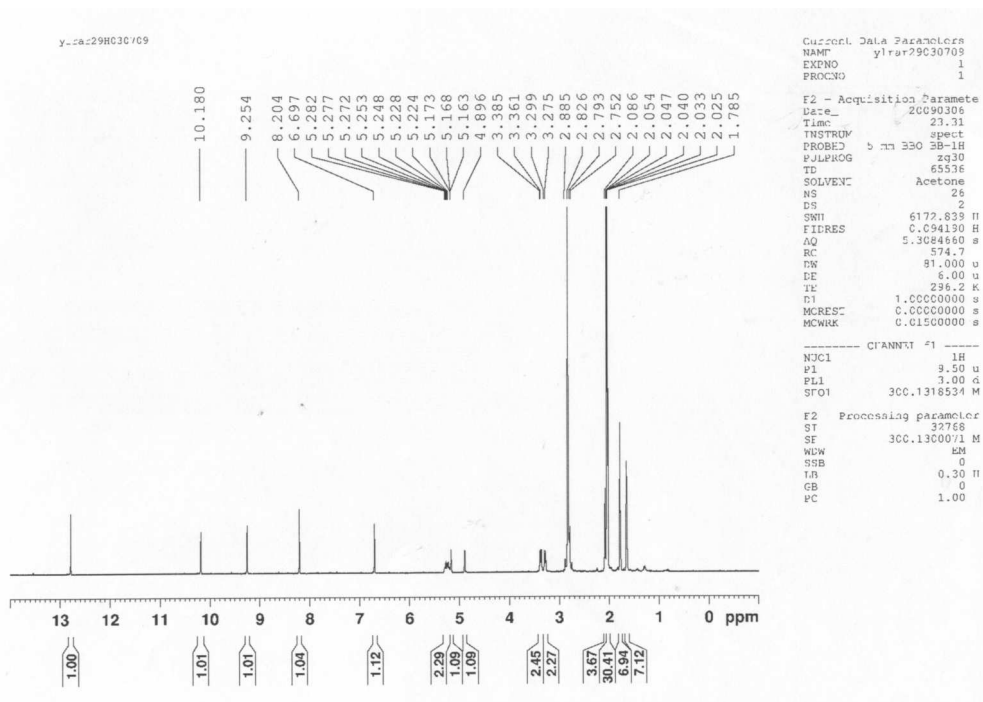


Figure S3c.  $^{13}\text{C}$  NMR spectrum of 3

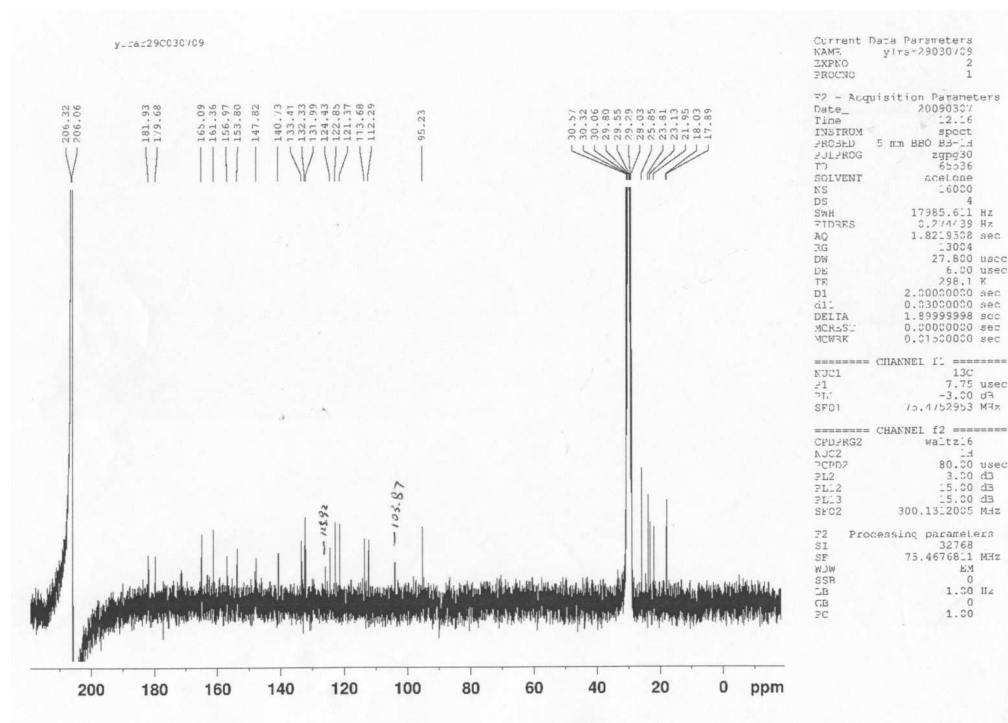


Figure S4a. Mass spectrum of 4

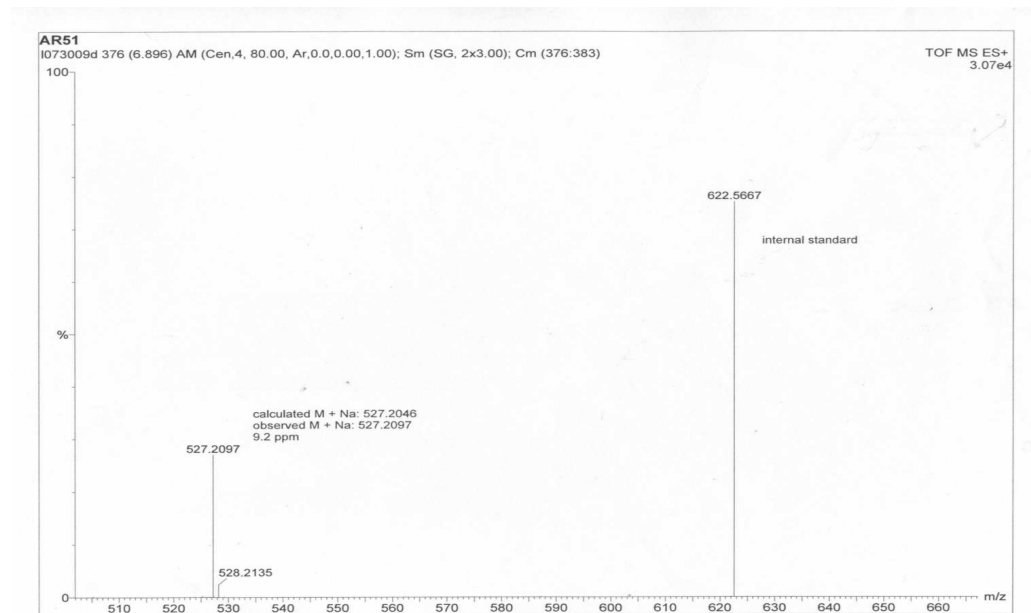


Figure S4b. <sup>1</sup>H NMR spectrum of 4

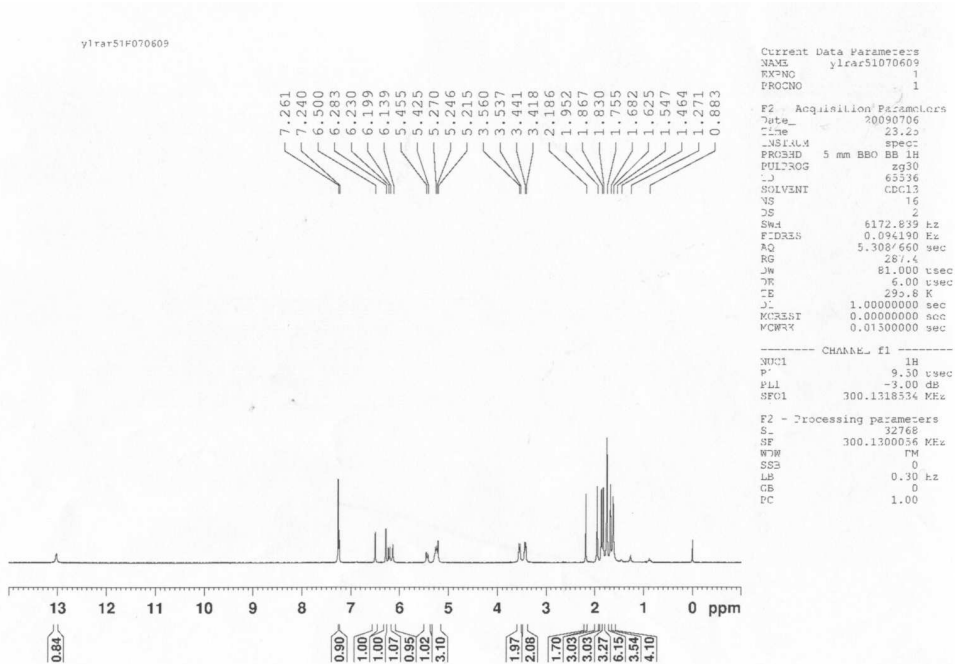
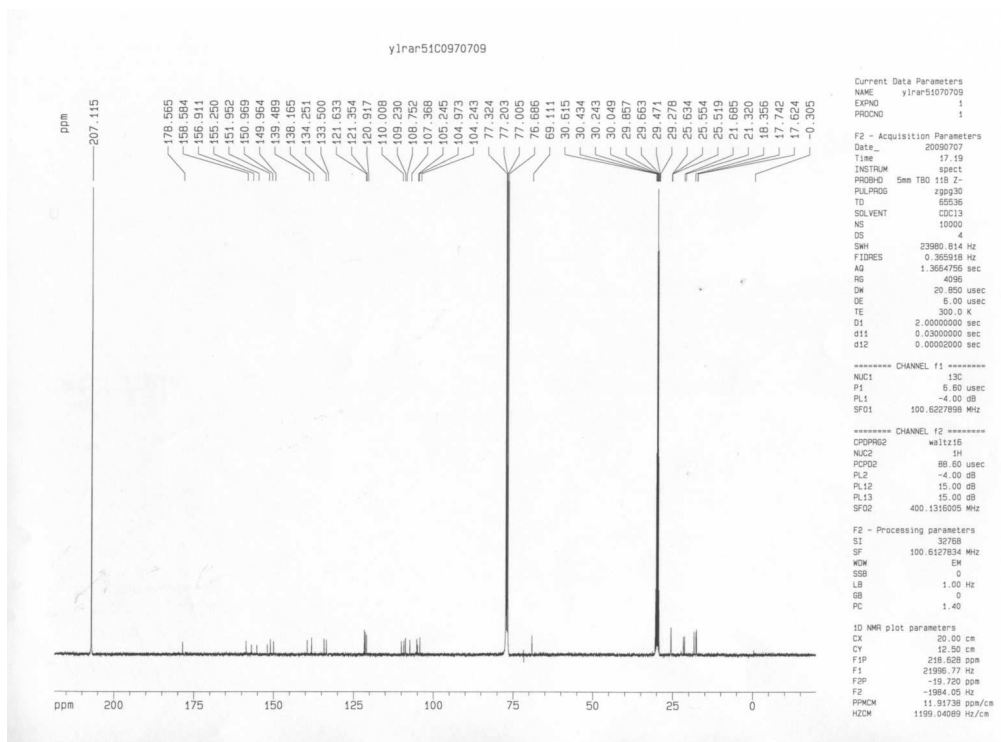
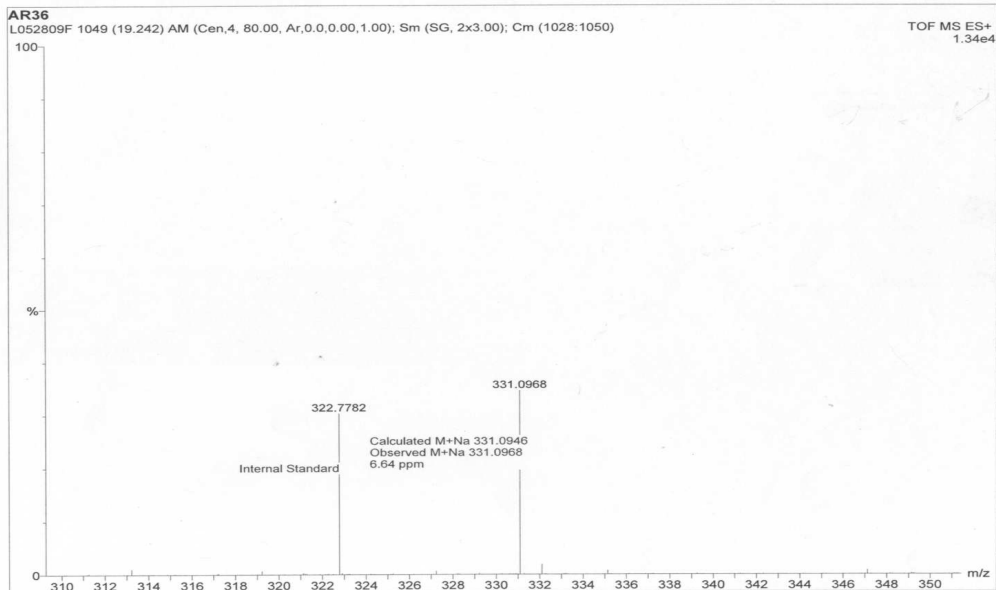


Figure S4c. <sup>13</sup>C NMR spectrum of 4





**Figure S5a.** Mass spectrum of **5**



**Figure S5b.**  $^1\text{H}$  NMR spectrum of **5**

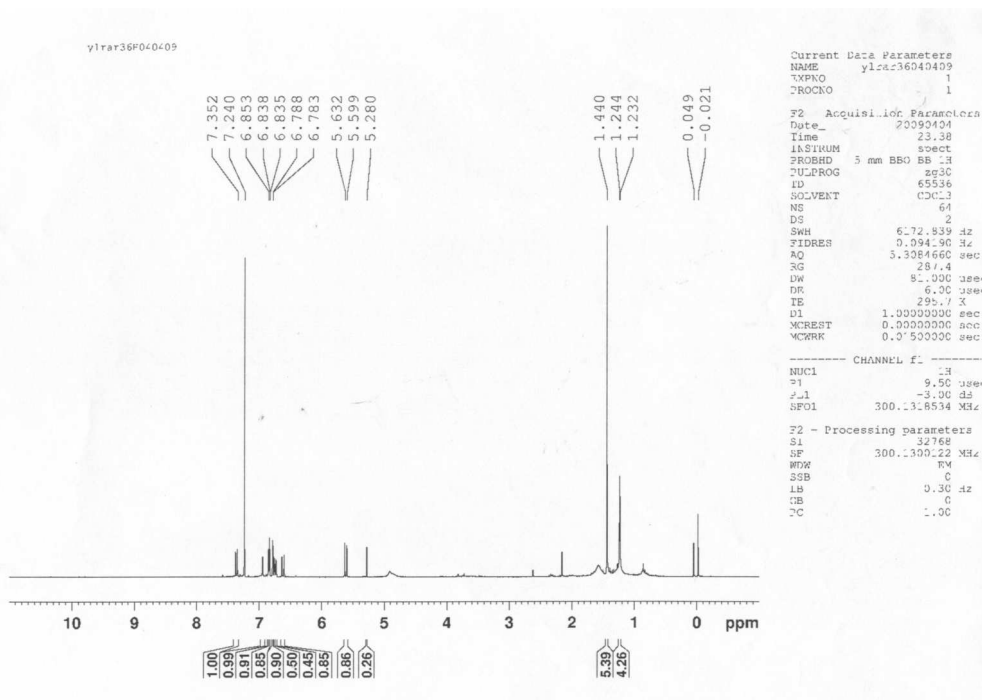
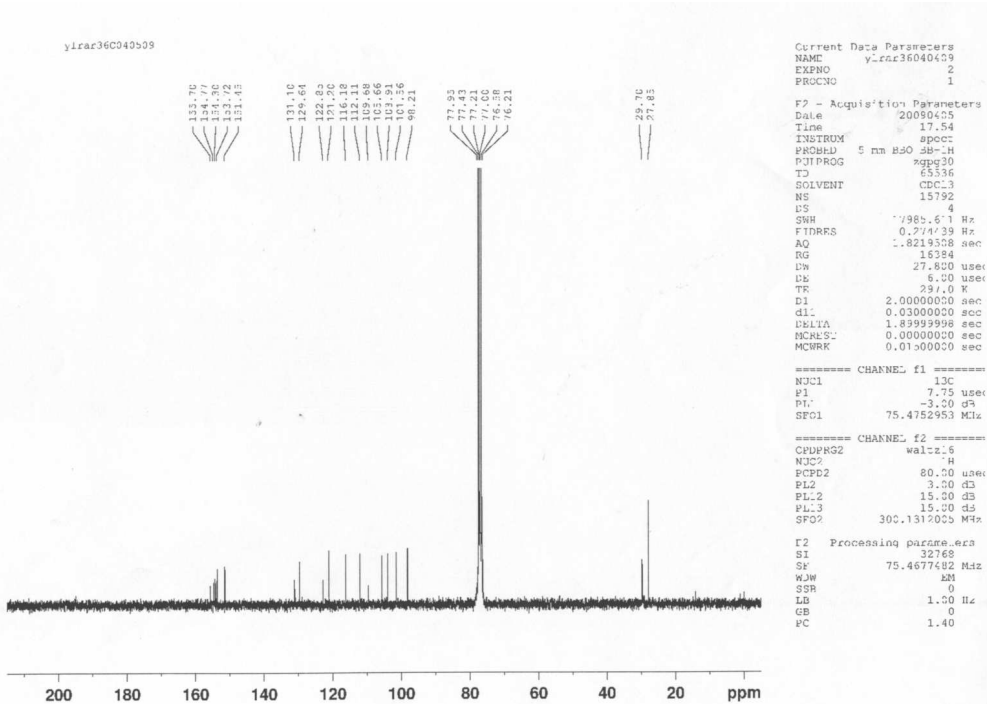


Figure S5c. <sup>13</sup>C NMR spectrum of **5**



Physical and spectroscopic data of known prenylflavonoids and stilbene from *A. rigida*

### **Artonin O (6)**

Amorphous red powder (*n*-hexane) showing a purple color under UV light at 365 nm;  $[\alpha]_D^{20} + 20$  (*c* 0.2, CH<sub>2</sub>Cl<sub>2</sub>); UV (CH<sub>2</sub>Cl<sub>2</sub>)  $\lambda_{\max}$  (log  $\epsilon$ ) 263 (4.38), 317 (4.04), 371 (3.83) nm; IR (dried film)  $\nu_{\max}$  3362, 2969, 2918, 1652, 1550, 1456, 1361, 1280, 1231, 1124, 1063, 919 cm<sup>-1</sup>; <sup>1</sup>H and <sup>13</sup>C NMR data, see Tables S1 and S2; positive ESIMS *m/z* 525.0 [M + Na]<sup>+</sup> for C<sub>30</sub>H<sub>30</sub>O<sub>7</sub>Na.

### **Artobiloxanthone (7)**

Amorphous yellow powder (*n*-hexane) showing a purple color under UV light at 365 nm;  $[\alpha]_D^{20} + 60$  (*c* 0.2, CH<sub>2</sub>Cl<sub>2</sub>); UV (CH<sub>2</sub>Cl<sub>2</sub>)  $\lambda_{\max}$  (log  $\epsilon$ ) 236 (4.08), 273 (4.08), 283 (4.08), 375 (3.89) nm; IR (dried film)  $\nu_{\max}$  3383, 1652, 1557, 1506, 1468, 1339, 1285, 1176, 1113 cm<sup>-1</sup>; <sup>1</sup>H and <sup>13</sup>C NMR data, see Tables S1 and S2; positive ESIMS *m/z* 457.1 [M + Na]<sup>+</sup> for C<sub>25</sub>H<sub>22</sub>O<sub>7</sub>Na.

### **Cycloartobiloxanthone (8)**

Amorphous yellow powder (*n*-hexane) showing a purple color under UV light at 365 nm;  $[\alpha]_D^{20} + 80$  (*c* 0.2, CH<sub>2</sub>Cl<sub>2</sub>); UV (CH<sub>2</sub>Cl<sub>2</sub>)  $\lambda_{\max}$  (log  $\epsilon$ ) 235 (4.02), 275 (4.05), 284 (4.05), 384 (3.81) nm; IR (dried film)  $\nu_{\max}$  3343, 2923, 1652, 1634, 1557, 1539, 1471, 1456, 1346, 1275 cm<sup>-1</sup>; <sup>1</sup>H and <sup>13</sup>C NMR data, see Tables S1 and S2; positive ESIMS *m/z* 457.1 [M + Na]<sup>+</sup> for C<sub>25</sub>H<sub>22</sub>O<sub>7</sub>Na.

### **3-Hydroxy-5,3',4'-trimethoxystillene (9)**

Amorphous white powder (*n*-hexane); <sup>1</sup>H and <sup>13</sup>C NMR data, see Tables S1 and S2; positive ESIMS *m/z* 309.1 [M + Na]<sup>+</sup> for C<sub>17</sub>H<sub>18</sub>O<sub>4</sub>Na.

### **Artonin G**

Amorphous yellow powder (*n*-hexane) showing a purple color under UV light at 365 nm;  $[\alpha]_D^{20} + 80$  (*c* 0.2, CH<sub>2</sub>Cl<sub>2</sub>); UV (CH<sub>2</sub>Cl<sub>2</sub>)  $\lambda_{\max}$  (log  $\epsilon$ ) 235 (4.23), 270 (4.23), 325 (4.04), 376 (4.21) nm; IR (dried film)  $\nu_{\max}$  3363, 2972, 1645, 1615, 1558, 1456, 1360, 1271 cm<sup>-1</sup>; <sup>1</sup>H and <sup>13</sup>C NMR data, see Tables S1 and S2; positive ESIMS  $m/z$  527.1 [M + Na]<sup>+</sup> for C<sub>30</sub>H<sub>32</sub>O<sub>7</sub>Na.

### **Artonin K**

Amorphous yellow powder (*n*-hexane) showing a purple color under UV light at 365 nm; <sup>1</sup>H and <sup>13</sup>C NMR data, see Tables S1 and S2; positive ESIMS  $m/z$  405.2 [M + Na]<sup>+</sup> for C<sub>21</sub>H<sub>18</sub>O<sub>7</sub>Na.

### **Artonin N**

Amorphous yellow powder (*n*-hexane) showing a purple color under UV light at 365 nm;  $[\alpha]_D^{20} + 100$  (*c* 0.2, CH<sub>2</sub>Cl<sub>2</sub>); UV (CH<sub>2</sub>Cl<sub>2</sub>)  $\lambda_{\max}$  (log  $\epsilon$ ) 273 (4.28), 378 (4.12) nm; IR (dried film)  $\nu_{\max}$  3544, 2924, 1652, 1615, 1558, 1541, 1488, 1456, 1361, 1270, 1126, 1112, 1085, 890 cm<sup>-1</sup>; <sup>1</sup>H and <sup>13</sup>C NMR data, see Tables S1 and S2; positive ESIMS  $m/z$  525.1 [M + Na]<sup>+</sup> for C<sub>30</sub>H<sub>30</sub>O<sub>7</sub>Na.

**Table S1.** <sup>1</sup>H NMR data of known prenylflavonoids and stilbene from *A. rigida*

position	6 <sup>a</sup>	7 <sup>a</sup>	8 <sup>b</sup>	9 <sup>a</sup>	artonin G <sup>b</sup>	artonin K <sup>c</sup>	artonin N <sup>a</sup>
2				6.63 m			
3							
4				6.36 d (2.4)			
5	12.90 s (OH)	13.00 s (OH)				13.30 s (OH)	13.30 s (OH)
6				6.37 d (2.4)		6.27 s	
7	6.41 s (OH)		6.12 s	6.94 dd (5.7, 16.2)			
8	6.50 s			7.25 dd (6.3, 16.7)	6.36 s	6.52 s	6.34 s
9							
10				6.65 d (2.4)			
1'							
2'		7.45 s (OH)					7.73 s (OH)
3'						6.34 s	
4'	6.93 s (OH)		6.22 s				
5'							6.21 s (OH)
6'							
11	2.65 dd (8.7, 17.4) 3.43 d (8.4)	2.60 dd (7.2, 16.5) 3.36 dd (1.8, 16.2)			2.18 t (15.3) 3.04 dd (7.2, 15.3)	2.33 t (16.5) 3.10 dd 7.0, 16.5)	2.56 dd (7.2, 16.5) 3.42 dd (1.8, 16.5)
12	3.76 d (8.4)	3.89 d (6.9)	2.39 t (15.3) 3.18 dt (6.9, 15.3)		3.26 m	3.15 d (7.0)	3.95 d (6.6)
13			3.43 dd (7.2, 15.3)	7.41 dd (2.1, 8.7)			
14a	4.53 s	4.41 s		6.53 dd (2.7, 8.7)	1.21 s	1.24 s	4.33 s
14b	4.76 s	4.74 s					4.68 s
15	1.81 s	1.76 s	1.30 s		1.54 s	1.71 s	1.78 s
16	3.41 d (7.2)	6.54 d (9.9)	1.65 s		3.22 m		3.45 d (7.2)
17	5.17 t (7.2)	5.62 d (10.2)	6.91 d (10.2) 5.63 d (9.9)		5.16 t (5.7)		5.28 t (7.2)
18							
19	1.74 s	1.44 s			1.56 s		1.75 s
20	1.75 s	1.44 s	1.45 s		1.69 s		1.82 s
21	3.23 d (7.2)		1.45 s		3.24 m		6.74 d (10.2)
22	5.25 t (7.2)				5.16 t (5.7)		5.62 d (10.2)
23							
24	1.68 s				1.56 s		1.50 s
25	1.79 s				1.67 s		1.47 s
OCH <sub>3</sub> -1				3.81 s			
OCH <sub>3</sub> -11				3.81 s			
OCH <sub>3</sub> -12				3.81 s			

<sup>a</sup>Data were measured in CDCl<sub>3</sub> at 300 MHz. <sup>b</sup>Data were measured in MeOH-d<sub>4</sub> at 300 MHz. <sup>c</sup>Data were measured in DMSO-d<sub>6</sub> at 300 MHz. Chemical shifts (δ) are in ppm from TMS. s = singlet, d = doublet, t = triplet, m = multiplet, dd = double doublet. *J* values are omitted if the signals were overlapped as multiplets.

**Table S2.**  $^{13}\text{C}$  NMR spectroscopic data of known prenylflavonoids and stilbene from *A. rigida*

position	6 <sup>a</sup>	7 <sup>a</sup>	8 <sup>b</sup>	9 <sup>a</sup>	artonin G <sup>b</sup>	artonin K <sup>c</sup>	artonin N <sup>a</sup>
1				161.01 C			
2	155.62 C	159.91 C	162.55 C	104.43 CH	159.82 C	161.07 C	159.35 C
3	117.71 C	110.90 C	112.63 C	139.94 C	113.09 C	111.41 C	111.50 C
4	180.39 C	180.16 C	181.97 C	104.43 CH	181.68 C	179.69 C	180.17 C
5	155.12 C	161.67 C	162.42 C	161.01 C	162.04 C	160.83 C	159.69 C
6	110.47 C	100.65 CH	100.87 CH	99.77 CH	112.70 C	97.73 CH	110.21 C
7	161.68 C	159.19 C	160.10 C	128.28 CH	162.91 C	164.51 C	160.93 C
8	94.65 CH	104.77 C	102.54 C	123.38 CH	94.14 CH	92.25 CH	93.49 CH
9	158.85 C	150.74 C	152.54 C	117.48 C	155.68 C	156.24 C	153.96 C
10	105.48 C	105.19 C	105.01 C	101.88 CH	104.75 C	102.91 C	104.64 C
1'	121.50 C	105.19 C	105.64 C	154.12 C	104.60 C	104.21 C	105.21 C
2'	182.91 C	150.48 C	152.54 C	160.42 C	148.51 C	150.74 C	143.79 C
3'	132.06 C	102.96 CH	105.28 CH	128.32 CH	119.55 C	104.21 CH	108.80 C
4'	150.48 C	149.78 C	147.77 C	107.12 CH	145.51 C	146.42 C	144.38 C
5'	181.96 C	135.10 C	138.01 C		138.84 C	136.22 C	135.56 C
6'	140.79 C	127.71 C	133.84 C		129.43 C	132.25 C	126.63 C
11	21.35 CH <sub>2</sub>	21.79 CH <sub>2</sub>	20.76 CH <sub>2</sub>		21.01 CH <sub>2</sub>	19.44 CH <sub>2</sub>	21.52 CH <sub>2</sub>
12	35.29 CH	37.71 CH	47.93 CH		47.68 CH	46.09 CH	36.61 CH
13	143.15 C	144.58 C	94.28 C		94.32 C	92.01 C	144.97 C
14	113.04 CH <sub>2</sub>	112.51 CH <sub>2</sub>	22.82 CH <sub>3</sub>		22.86 CH <sub>3</sub>	22.47 CH <sub>3</sub>	111.76 CH <sub>2</sub>
15	21.55 CH <sub>3</sub>	21.10 CH <sub>3</sub>	28.44 CH <sub>3</sub>		28.36 CH <sub>3</sub>	27.77 CH <sub>3</sub>	21.58 CH <sub>3</sub>
16	21.52 CH <sub>2</sub>	113.96 CH	116.33 CH		22.33 CH <sub>2</sub>		21.69 CH <sub>2</sub>
17	119.37 CH	128.57 CH	128.07 CH		123.61 CH		120.99 CH
18	135.68 C	77.95 C	79.16 C		131.88 C		136.27 C
19	25.80 CH <sub>3</sub>	28.12 CH <sub>3</sub>	28.44 CH <sub>3</sub>		25.94 CH <sub>3</sub>		25.80 CH <sub>3</sub>
20	17.90 CH <sub>3</sub>	27.92 CH <sub>3</sub>	28.28 CH <sub>3</sub>		17.91 CH <sub>3</sub>		17.93 CH <sub>3</sub>
21	22.34 CH <sub>2</sub>				23.53 CH <sub>2</sub>		116.34 CH
22	121.02 CH				124.16 CH		128.49 CH
23	134.12 C				131.66 C		78.45 C
24	25.73 CH <sub>3</sub>				25.97 CH <sub>3</sub>		28.31 CH <sub>3</sub>
25	17.90 CH <sub>3</sub>				17.99 CH <sub>3</sub>		28.20 CH <sub>3</sub>
OCH <sub>3</sub> -1				55.39 CH <sub>3</sub>			
OCH <sub>3</sub> -11				55.39 CH <sub>3</sub>			
OCH <sub>3</sub> -12				55.39 CH <sub>3</sub>			

<sup>a</sup>Data were measured in CDCl<sub>3</sub> at 75.5 MHz. <sup>b</sup>Data were measured in CD<sub>3</sub>OD at 75.5. <sup>c</sup>Data were measured in DMSO-d<sub>6</sub> at 75.5 MHz. Chemical shifts (δ) are in ppm from TMS.

**Figure S6.** Structures of literature compounds in comparison to **2**, **3**, **6**, **7**, and **8**.

