

**Growth inhibitory activity of biflavonoids and  
diterpenoids from the leaves of the Libyan *Juniperus  
phoenicea* against human cancer cells**

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## Supplementary data

**Supplementary Table 1:**  $^1\text{H}$  NMR data for the biflavonoids, cupressoflavone (**1**), amentoflavone (**2**) and sumafavone (**3**)

Position	Chemical Shift $\delta$ (ppm), multiplicity and $J$ in Hz		
$^1\text{H}$	1* (300 MHz)	2** (600 MHz)	3** (300 MHz)
3	6.78 (s)	6.66 (s)	6.78 (s)
5	13.22 (s) (OH)	-	13.01 (s) (OH)
6	6.45 (s)	6.22 (br s)	6.16 (d, 2.0)
7	10.33 (s) (OH)	-	13.06 (s) (OH)
8		6.42 (br s)	
2`	7.49 (d, 8.9)	8.00 (d, 2.3)	8.17 (s)
3`	6.74 (d, 8.9)	-	
4`	10.33 (s) (OH)	-	
5`	6.74 (d, 8.9)	7.96 (dd, 8.5, 2.2)	7.0 (d, 8.6)
6`	7.49 (d, 8.9)	7.16 (d, 8.6)	7.92 (d, 8.8)
3``	6.78 (s)	6.64 (s)	6.71 (s)
6``	6.45 (s)	6.40 (s)	
2'''	7.49 (d, 8.9)	7.58 (d, 8.8)	7.63 (d, 8.7)
3'''	6.74 (d, 8.9)	6.74 (d, 8.8)	6.61 (d, 8.6)
5'''	6.74 (d, 8.9)	6.74 (d, 8.8)	6.61 (d, 8.6)
6'''	7.49 (d, 8.9)	7.58 (d, 8.8)	7.63 (d, 8.7)

\*= (DMSO- $d_6$ ), \*\*= (CD $_3$ OD)

**Supplementary Table 2:**  $^{13}\text{C}$  NMR data of biflavonoids **1** and **2**

Position			Position		
$^{13}\text{C}$	Chemical Shift $\delta$ (ppm),		$^{13}\text{C}$	Chemical Shift $\delta$ (ppm)	
	1* (75 MHz)	2** (150 MHz)		1* (75 MHz)	2** (150 MHz)
2	163.9	166.0	2''	163.9	166.2
3	103.0	103.5	3''	103.0	100.3
4	182.5	184.0	4''	182.5	184.4
5	161.5	163.4	5''	161.5	163.4
6	99.3	100.3	6''	99.3	95.3
7	164.1	166.2	7''	164.1	162.7
8	98.9	95.3	8''	98.9	105.5
9	155.2	159.6	9''	155.2	159.6
10	104.0	105.5	10''	104.0	105.5
1'	121.7	123.2	1'''	121.7	123.4
2'	128.4	133	2'''	128.4	129.0
3'	116.3	122.0	3'''	116.3	117.0
4'	161.3	161.5	4'''	161.3	163.4
5'	116.3	129	5'''	116.3	117.0
6'	128.4	117.0	6'''	128.4	129.0

\*= (DMSO- $d_6$ ), \*\*= (CD $_3$ OD)

**Supplementary Table 3:**  $^1\text{H}$  NMR (600 MHz,  $\text{CDCl}_3$ ) for diterpenes, 13-*epi*-cupressic acid (**4**), imbricatolic acid (**5**) and 3-hydroxy sandaracopimaric acid (**6**)

Position	Chemical Shift $\delta$ (ppm), multiplicity and $J$ in Hz		
$^1\text{H}$	4	5	6
1	1.05 (br s), 1.71(m)	0.95 (m); 1.86 (m)	1.07 (m), 1.21 (m)
2	1.50 (m), 1.71 (m)	1.45 (m); 1.86 (m)	1.38 (m), 1.45 (m)
3	1.04 (dd; 4.8; 13.9) 1.97, (br s)	1.06 (dd; 4.2; 13.3) 2.14 (br s)	4.02 (dd; 4.6, 11.8)
5	1.32 (m)	1.32 (m)	1.53 (m)
6	1.83 (m), 1.89 (m)	1.85 (m), 1.87 (m)	0.92 (m), 1.25 (m)
7	1.86, (m), 2.40 (br s)	1.88 (m), 1.99 (m)	1.86 (m), 2.23 (m)
9	1.50, m	1.91 (m) 2.40 (dd, 2.8, 8.8)	
11	1.32 (m), 1.45, (m)	1.36 (m)	1.38 (m), 1.50 (m)
12	1.32 (m), 1.57, (m)	1.29 (m)	1.2 (m), 1.24 (m)
13		1.34 (m)	-
14	5.91, dd, 10.2, 17.6	1.34 (m)	5.24 (s)
15	5.21, dd, 1.3. 17.2 5.06, dd, 10.7, 0.8	3.67 (m)	5.76 (dd; 10.4, 17.7)
16	1.27, s	0.90 (d, 6.5)	4.89 (d, 10.6), 4.90 (d, 17.5)
17	4.49 (s), 4.83 (s)	4.83 (s), 4.49(s)	1.04
18	1.24 (s)	1.24 (s)	-
19	-	-	1.18 (s)
20	0.59 (s)	0.60 (s)	0.83 (s)

**Supplementary Table 4:**  $^{13}\text{C}$  NMR (150 MHz,  $\text{CDCl}_3$ ) for diterpenes: 13-*epi*-cupressic acid (**4**), imbricatolic acid (**5**) and 3-hydroxy sandaracopimaric acid (**6**)

Position    Chemical Shift $\delta$ (ppm)				Position    Chemical Shift $\delta$ (ppm)			
$^{13}\text{C}$	<b>4</b>	<b>5</b>	<b>6</b>	$^{13}\text{C}$	<b>4</b>	<b>5</b>	<b>6</b>
1	39.4	39.1	38.5	11	18.1	21.5	28.1
2	20.2	20.2	20	12	41.6	40.0	35.9
3	38.2	36.8	76.6	13	74.1	29.4	38.7
4	44.5	44.5	54.9	14	145.8	41.0	130.6
5	56.7	56.7	52.0	15	112.0	61.6	150.0
6	26.4	26.4	25.7	16	28.3	21.5	111.0
7	39.0	38.4	36.7	17	107.1	106.6	26.7
8	148.2	148.6	137.8	18	29.2	30.6	181.5
9	56.7	57.0	51.6	19	183.2	183.4	11.9
10	40.9	39.5	38.7	20	12.9	13.1	15.8