Kadcoccilactones A−J, Triterpenoids from *Kadsura coccinea*

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Ten new highly oxygenated triterpenoids, kadcoccilactones A−J (**1**−**10**), and two known triterpenoids, kadsuphilactone A and micrandilactone B, were isolated from the stems of the evergreen climbing plant *Kadsura coccinea*. The structures of the new compounds were elucidated by spectroscopic evidence, with that of **1** confirmed by single-crystal X-ray diffraction analysis. This is the first report on nortriterpenoids (**2**, **4**−**6**, **8**−**10**) from the genus *Kadsura*.

The plant family Schisandraceae comprises two genera, *Kadsura* and *Schisandra*. Previously, a series of highly oxygenated triterpenoids with unusual norcycloartane skeletons was isolated from plants of the genus *Schisandra*.[1−7] Phytochemical investigations of plants belonging to the genus *Kadsura* have revealed that it is a rich source of lignans and triterpenoids, in which some have shown antitumor,[8] anti-HIV,[9] antilipid peroxidative,[10] cytotoxic,[11,12] and antihepatitis activities.[13] Recently, several triterpenoids with three new carbon skeletons, kadlongilactones A and B,[14] longipedlactones A−I,[15] and kadsuphilactone A,[16] were isolated from the genus *Kadsura*.

Kadsura coccinea (Lem.) A. C. Smith is used in traditional Chinese medicine for treating gastroenteric disorders and rheumatoid arthritis.[17] Previous chemical investigations of this plant led to the isolation of a number of dibenzocyclooctadiene lignans and triterpenoids.[18−21] With the aim of searching for new natural compounds from medicinal plants, we have investigated the stems of *K. coccinea* and isolated 10 new triterpenoids (**1**−**10**) and two known triterpenoids, kadsuphilactone A[16] and micrandilactone B.[4] The isolation and structure elucidation of compounds **1**−**10** are reported herein. Nortriterpenoid derivatives (**2**, **4**−**6**, **8**−**10**) are reported from the genus *Kadsura* for the first time.

Results and Discussion

A 70% aqueous acetone extract prepared from the stems of *K. coccinea* was partitioned between EtOAc and H_2O. The EtOAc layer was subjected repeatedly to column chromatography over silica gel, Sephadex LH-20, and RP-18 and by HPLC to afford 10 new triterpenoids, kadcoccilactones A−J (**1**−**10**), together with two known triterpenoids, kadsuphilactone A[16] and micrandilactone B.[4]

Compound **1** was obtained as a white powder. Its molecular formula was established as $C_{30}H_{44}O_7$ by HRESIMS at *m*/*z* 515.2998 $[M - H]^-$ (calcd 515.3008), suggesting nine degrees of unsaturation. The ^1H and ^{13}C NMR data of **1** (Tables 1 and 3) showed the presence of six methyls, nine methylenes, six methines (one olefinic and two oxygenated), and nine quaternary carbons (one olefinic, four oxygenated, and two carbonyls). In addition, the IR spectrum showed the presence of hydroxy groups (3417 cm^{-1}) and two lactone groups (1776 and 1702 cm^{-1}). Apart from one double bond and two carbonyls, the remaining elements of unsaturation in **1** were assumed to be representative of a hexacyclic skeleton.

Since the NMR data of **1** were similar to those of the known micrandilactone B,[4] the possible structure was established by a detailed comparison of its NMR data with those of this known compound, which suggested a similar structure for rings A−E in both compounds. However, different carbon and proton chemical shifts for C-22, C-23, C-24, C-25, and C-26 indicated that the structure of **1** differed from micrandilactone B[4] in ring F. A detailed analysis of its HSQC, HMBC, and $^1H-^1H$ COSY spectra revealed that compound **1** contains a six-membered lactone ring (F) instead of a five-membered lactone ring in micrandilactone B.[4] This six-membered α-methyl-α,β-unsaturated-δ-lactone ring was elucidated by the deshielding signals of C-23 and C-26 (δ 28.5 and 166.9), as well as HMBC correlations of H-24 with C-22, C-23, C-26, and C-27 (Figure 1). The presence of this lactone ring was also supported by the mass spectrometric fragment at *m*/*z* 111 ($[C_6H_7O_2]^-$). The HMBC correlations of H_3-21 with C-17 and C-22 suggested that rings E and F were connected through C-20. This was confirmed by the COSY correlations of H-20/H_3-21 and H-20/H-22/H_2-23/H-24 (Figure 1). The planar structure of **1** was finally confirmed by X-ray crystallographic analysis (Figure 2).

The relative configuration of **1** was determined by a ROESY NMR experiment and by X-ray crystallographic analysis (Figure 2). Except for OH-17 and Me-28, the relative configurations of the other stereocenters in **1** were the same as those of micrandilactone B.[4] The ROESY correlations of OH-17 with H-16β and H-23β and of H_3-28 with H-11α and OH-9 suggested a β-oriented OH-17 and an α-oriented Me-28, which was confirmed by X-ray crystallographic analysis (Figure 2). Accordingly, the structure of **1** was established as shown.

Kadcoccilactone B (**2**) was obtained as a white, amorphous solid. The molecular formula of **2** was determined to be $C_{29}H_{42}O_7$ by HRESIMS at *m*/*z* 501.2839 $[M - H]^-$ (calcd 501.2852). The ^{13}C NMR spectrum of compound **2** showed 29 carbon signals. Comparison of the ^{13}C NMR data between **2** and **1** indicated that they are analogous (Table 3). The major differences were one more methyl group in **1** than in **2** and a hydroxy group substituted at C-14 (δ 84.6) in **2** instead of at C-17 in **1**. The HMBC correlations of OH (δ 5.00) with C-8, C-13, and C-14 and of Me-18 with C-12, C-13, C-14, and C-17 confirmed the above deduction, which indicated the absence of an angular methyl (Me-28) in the case of **2**. Except for OH-14, the relative configurations of all stereocenters in **2** were consistent with those in **1** from their similar ROESY correlation patterns. The ROESY correlations of H-17 with H-20β,

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Table 1. ^{1}H NMR Data for Kadcoccilactones A−E (**1**−**5**) in C_5D_5N[a]

H atom	1	2	3	4	5
1	4.25 (d, 4.4)	4.24 (d, 4.8)	4.31 (d, 4.4)	4.20 (d, 5.0)	4.26 (d, 4.4)
2α	2.73 (d, 17.8)	2.75 (d, 17.9)	2.76 (d, 17.6)	2.70 (d, 18.0)	2.74 (d, 17.6)
2β	2.94 (dd, 17.8, 4.4)	2.98 (dd, 17.9, 4.9)	3.01 (dd, 17.6, 4.4)	2.93 (dd, 18.0, 5.1)	2.98 (dd, 17.6, 4.9)
5	2.55 (dd, 13.5, 4.0)	2.55 (dd, 13.4, 4.2)	2.55 (dd, 13.6, 4.0)	2.31 (dd, 13.4, 4.5)	2.51 (dd, 13.2, 3.9)
6α	1.60−1.62 (m)	1.72−1.76 (overlap)	1.64−1.69 (m)	1.61−1.65 (m)	1.63−1.66 (overlap)
6β	1.29−1.33 (overlap)	1.25−1.28 (overlap)	1.33−1.38 (overlap)	1.29−1.33 (m)	1.34−1.37 (m)
7α	1.98−2.03 (overlap)	2.59−2.62 (m)	2.07−2.10 (overlap)	1.78−1.80 (m)	1.98−2.03 (overlap)
7β	1.51−1.54 (m)	1.91−1.94 (m)	1.55−1.60 (m)	1.94−1.96 (m)	1.98−2.03 (overlap)
8	1.75−1.80 (overlap)	1.72−1.76 (overlap)	1.78−1.83 (overlap)	2.10−2.13 (overlap)	2.12−2.13 (m)
11α	1.75−1.80 (overlap)	1.48−1.50 (m)	1.33−1.38 (overlap)	2.77 (dt, 14.4, 3.0)	1.63−1.66 (overlap)
11β	1.93−1.95 (m)	1.77−1.80 (m)	1.85−1.88 (overlap)	1.75−1.78 (m)	1.92−1.96 (m)
12α	2.59−2.63 (overlap)	2.17 (dd, 13.7, 3.0)	2.91−2.95 (m)	1.47 (dd, 14.0, 3.8)	2.33−2.36 (overlap)
12β	1.66 (dd, 12.3, 4.0)	1.42−1.45 (m)	1.10−1.12 (m)	1.56−1.60 (m)	2.18−2.22 (m)
15α	1.57−1.60 (m)	1.95−1.98 (m)	1.46−1.50 (m)		
15β	1.31−1.33 (overlap)	1.62−1.68 (m)	1.33−1.38 (overlap)	5.33 (brs)	5.39 (brs)
16α	2.59−2.63 (overlap)	2.64−2.69 (m)	1.81−1.86 (overlap)	2.14−2.16 (overlap)	2.24−2.27 (m)
16β	1.89−1.91 (m)	1.84−1.87 (m)	1.33−1.38 (overlap)	1.97−1.99 (m)	1.84−1.90 (m)
17		1.50−1.53 (m)	1.92−1.96 (overlap)	1.50−1.54 (m)	2.07−2.12 (overlap)
18	1.34 (s)	1.36 (s)	0.87 (s)	0.91 (s)	1.05 (s)
19α	1.98 (ABd, 5.2)	2.00 (ABd, 6.1)	2.12 (ABd, 9.6)	2.97 (ABd, 15.7)	2.06−2.09 (overlap)
19β	2.00 (ABd, 5.2)	2.02 (ABd, 6.1)	2.14 (ABd, 9.6)	2.06 (ABd, 15.7)	2.06−2.09 (overlap)
20	2.89−2.91 (m)	2.34−2.38 (m)	2.04−2.07 (m)	2.10−2.13 (overlap)	2.33−2.36 (overlap)
21	1.24 (d, 7.2)	1.08 (d, 6.5)	0.99 (d, 6.8)	0.91 (d, 6.4)	1.38 (d, 6.8)
22	5.16 (dd, 12.7, 2.8)	4.74 (dt, 12.9, 3.6)	4.46 (dt, 12.7, 3.2)	4.36 (dt, 13.2, 3.4)	4.04 (brs)
23α	2.45−2.51 (m)	2.22−2.26 (m)	2.07−2.10 (overlap)	2.14−2.16 (overlap)	5.06 (brs)
23β	2.77−2.81 (m)	2.03−2.07 (m)	1.92−1.96 (overlap)	1.81−1.84 (m)	
24	6.44 (d, 6.4)	6.46 (d, 6.4)	6.42 (d, 6.4)	6.40 (d, 6.4)	7.19 (brs)
27	1.87 (s)	1.89 (s)	1.92 (s)	1.90 (s)	1.82 (s)
28	1.28 (s)		3.88 (s)		
29	1.12 (s)	1.06 (s)	1.14 (s)	1.06 (s)	1.12 (s)
30	1.29 (s)	1.26 (s)	1.29 (s)	1.24 (s)	1.28 (s)
OH-9	4.78 (s)	4.65 (s)	6.33 (s)		4.65 (s)
OH-14		5.00 (s)			
OH-17	5.44 (s)				
OH-22					6.63 (d, 5.9)
OH-28			6.55 (brs)		
CHO				8.37 (s)	

[a] Data were recorded with a Bruker DRX-500 MHz spectrometer; chemical shifts (δ) are in ppm, *J* in Hz.

H-22β, and H-23β and of OH-14 with H-7β, H-8β, H-15β, and Me-18 suggested that both H-17 and OH-14 have a β-orientation in **2**. Therefore, the structure of **2** was established as a nortriterpenoid derivative, as shown.

Kadcoccilactones C (**3**) and D (**4**) were obtained as white, amorphous solids. HRESIMS analysis of **3** demonstrated that it has the molecular formula $C_{30}H_{44}O_7$ (*m*/*z* for $[M - H]^-$; found 515.3009, calcd 515.3008), the same as that of **1**. The ^{1}H and ^{13}C NMR data of **3** and **4** were similar to those of **1** and **2**, indicating that all four compounds are based on the same carbon skeleton. In contrast, the only difference between **3** and **1** was that the hydroxy group was substituted at C-28 in **3** instead of C-17 in **1**. This conclusion was supported by the presence of an oxygenated methylene signal at H_2-28 (δ 3.88), C-28 (δ 64.1), and OH-28 (δ 6.55) and the absence of any oxygenated quaternary carbon in **3**. The HMBC correlations of H_2-28 with C-8, C-13, C-14, and C-15 and of OH-28 with C-28 confirmed the above deduction. The ROESY correlations of H_2-28 with H-12α and H-16α were used to position $HOCH_2$-28 in an α-orientation (Figure 3). Kadcoccilactone D (**4**) gave the molecular formula $C_{30}H_{40}O_7$, as revealed by its HRESIMS at *m*/*z* 535.2662 $[M + Na]^+$ (calcd 535.2671). The NMR spectra of **4** showed different substituents at C-9, C-14, and C-15 on comparing with those of **1**−**3**. The methine signal at δ 162.0 and HMBC correlation from δ 8.37 to C-9 was consistent with the presence of a formyloxy group at C-9. The two olefinic signals at δ 151.2 and 120.4 and HMBC correlations of H-15 (δ 5.33) with C-13, C-16, and C-17 and of H-12, H-16, and H_3-18 with C-14 (δ 151.2) suggested a double bond between C-14 and C-15. The formyloxy group at C-9 was assigned with an α-orientation on the basis of biogenetic considerations.[6] According to the observed ROESY correlations and comparison of ^{1}H and ^{13}C NMR data with those of **1** and **2** (Tables 1 and 3), the relative configurations of **3** and **4** were established as being the same as that of **1**. Consequently, the structures of compounds **3** and **4** were established as shown.

Kadcoccilactone E (**5**) was obtained as a white, amorphous solid. The HRESIMS at *m*/*z* 523.2682 $[M + Na]^+$ (calcd 523.2671) revealed a quasi-molecular ion consistent with a molecular formula of $C_{29}H_{40}O_7$. The strong IR bands at 3424, 1752, 1661, and 1640 cm^{-1} indicated the presence of hydroxy, carbonyl, and double-bond absorptions. The ^{1}H and ^{13}C NMR data for **5** were similar to those of micrandilactone B,[4] with differences being that a double bond between C-14 (δ 153.2) and C-15 (δ 119.4) occurred in **5** instead of an epoxy ring in micrandilactone B. The HMBC correlations of H-15 (δ 5.39) with C-14, C-15, and C-16 and the molecular formula of **5** confirmed the above deduction. ROESY correlations suggested the same relative stereochemistry as that of micrandilactone B.[4] Therefore, compound **5** was assigned as a nortriterpenoid, as shown.

The NMR spectra of **6** and **7** were quite similar to those of **5**, indicating the same skeleton for all three compounds. Kadcoccilactone F (**6**) was obtained as a white, amorphous solid. It was assigned the molecular formula $C_{31}H_{44}O_{10}$ by its HRESIMS data at *m*/*z* 599.2830 $[M + Na]^+$ (calcd 599.2832). Noteworthy in the ^{13}C NMR spectrum for **6** were the downfield-shifted signal for C-26 (δ 180.8), C-13 (δ 138.6), and C-17 (δ 132.1) and the upfield-shifted signals for C-24 (δ 33.2) and C-25 (δ 34.7), suggesting a double bond between C-13 and C-17 and the reduction of $\Delta^{24,25}$ in **6**. The HMBC correlations of H-15 with the acetate carbonyl and of H_3-18 with C-8, C-13, C-14, and C-15 were used to locate an acetoxy group at C-15 and a methyl at C-14 (Figure 1). According to the downfield-shifted signal of C-1 (δ 109.0) and the molecular formula, a hydroxy group was located at C-1.

Kadcoccilactone G (**7**), obtained as a white, amorphous solid, was designated the molecular formula $C_{30}H_{42}O_8$ by its HRESIMS data at *m*/*z* 553.2774 $[M + Na]^+$ (calcd 553.2777). In the ^{13}C NMR spectrum of **7**, the signal of an oxygenated methylene (δ 73.7) was

Table 2. ^{1}H NMR Data for Kadcoccilactones F−J (**6**−**10**) in C_5D_5N[a]

H atom	6	7	8	9	10
1		4.30 (d, 4.3)	4.35 (d, 4.8)	4.37 (d, 4.1)	4.22−4.24 (overlap)
2α	3.10 (s)	2.74 (d, 17.7)	2.80 (d, 18.0)	2.75 (d, 17.6)	2.75 (d, 18.0)
2β	3.10 (s)	2.95 (dd, 17.7, 4.4)	3.06 (dd, 18.0, 5.0)	3.00 (d, 17.6, 4.2)	3.03 (dd, 18.0, 5.6)
5	2.54 (dd, 9.6, 3.4)	2.61 (dd, 13.4, 3.4)	2.90 (dd, 13.7, 3.8)	2.95 (dd, 11.2, 2.4)	3.16 (dd, 13.2, 4.7)
6α	1.74−1.76 (m)	1.64−1.67 (overlap)	2.36−2.41 (m)	1.97−1.99 (m)	1.98−1.99 (m)
6β	1.45−1.48 (m)	1.64−1.67 (overlap)	1.70−1.73 (m)	1.66−1.70 (overlap)	1.45 (t, 13.9)
7α	1.77−1.80 (m)	1.60−1.64 (overlap)			
7β	1.81−1.84 (overlap)	1.60−1.64 (overlap)	5.95 (d, 7.8)	4.45 (brd, 8.8)	4.38 (brd, 6.0)
8	1.69−1.72 (m)	1.38−1.40 (overlap)	1.98−2.00 (m)	1.82 (d, 10.4)	2.61−2.63 (overlap)
11α	1.72−1.74 (m)	1.71−1.74 (m)	1.76−1.79 (overlap)	2.17−2.21 (m)	2.14−2.18 (overlap)
11β	1.81−1.84 (overlap)	1.71−1.74 (m)	1.54−1.56 (m)	1.94−1.97 (m)	2.20−2.23 (overlap)
12α	2.42−2.45 (m)	2.49−2.51 (m)	2.56−2.62 (m)	1.70−1.76 (m)	
12β	1.89−1.92 (m)	1.37−1.39 (overlap)	1.90−1.93 (m)	1.34−1.37 (m)	4.22−4.24 (overlap)
15α		1.19−1.22 (m)			
15β	5.18 (d, 4.0)	1.19−1.22 (m)	3.98 (brs)	6.15 (d, 3.2)	3.75 (brs)
16α	2.49−2.52 (overlap)	1.26−1.29 (m)	1.76−1.79 (overlap)	1.88−1.91 (m)	2.00−2.02 (m)
16β	3.16 (brd, 17.1)	1.62−1.65 (overlap)	1.76−1.79 (overlap)	1.63−1.68 (m)	1.63 (dd, 14.2, 8.1)
17			2.84−2.86 (m)	2.45−2.49 (m)	2.94 (dd, 14.2, 8.1)
18	1.11 (s)	0.90 (s)	1.10 (s)	1.55 (s)	
19 α	2.34 (ABd, 15.9)	2.00 (brs)	2.08 (ABd, 15.6)	1.80 (ABd, 15.6)	2.18−2.20 (overlap)
19 β	2.49−2.53 (overlap)	2.00 (brs)	2.28 (ABd, 15.6)	2.06 (ABd, 15.6)	2.18−2.20 (overlap)
20	3.01−3.03 (m)	2.46−2.48 (m)	2.49−2.54 (m)	2.50−2.54 (m)	2.61−2.63 (overlap)
21	1.20 (d, 7.2)	1.39 (d, 7.2)	0.85 (d, 7.0)	0.84 (d, 6.4)	0.87 (d, 6.8)
22	3.58 (dd, 7.2, 2.8)	4.64 (brd, 1.8)	3.62 (brd, 9.8)	3.59 (d, 9.5)	3.90 (dd, 10.2, 3.0)
23	4.64 (dt, 8.6, 3.6)	5.76 (brd, 1.8)	4.42 (brd, 8.8)	4.45 (brd, 8.8)	4.99 (overlap)
24α	2.45−2.48 (m)	7.34 (brs)	2.32−2.34 (m)	2.39−2.43 (m)	7.19 (overlap)
24β	1.85−1.88 (overlap)		1.93−1.97 (m)	1.99−2.02 (m)	
25	2.98−3.01 (m)		3.02−3.05 (m)	3.13−3.18 (m)	
27	1.20 (d, 7.2)	1.85 (s)	1.24 (d, 7.2)	1.24 (d, 7.2)	1.80 (s)
28α		5.30 (dd, 7.2, 3.8)			
28β		3.49 (d, 7.2)			
29	1.44 (s)	1.32 (s)	1.15 (s)	1.14 (s)	1.00 (s)
30	1.35 (s)	1.15 (s)	1.30 (s)	1.18 (s)	1.20 (s)
OAc	2.09 (s)		2.12 (s)	2.11 (s)	
OH-1	9.14 (brs)				
OH-7					5.90 (brd, 3.2)
OH-9	3.75 (s)	5.07 (s)	6.04 (s)	4.51 (s)	5.71 (s)
OH-12					5.24 (d, 10.6)
OH-15			6.03 (s)		
OH-22		7.04 (brd, 4.4)			

[a] Data were recorded with a Bruker DRX-500 MHz spectrometer; chemical shifts (δ) are in ppm, *J* in Hz.

assigned for C-28 according to HMBC correlations of H_2-28 with C-13, C-14, and C-15. Furthermore, the HMBC correlation of H_2-28 with C-17 and the molecular formula suggested C-28 to be connected with C-17 through an oxygen atom. The HMBC correlations of H_3-18 with C-12, C-13, C-14, and C-17 were consistent with a methyl group at C-13 (Figure 1).

Except for Me-18, Me-27, and CH_2-28, the relative configurations of compounds **6** and **7** were deduced to be the same as that of **5** from their similar ^{1}H and ^{13}C NMR data and ROESY correlations (Tables 1–3). The ROESY correlations of H_3-18 with H-8β, H-15β, and H-16β, of H_3-27 with H-24β, and of H-25 with H-23α and H-24α were used to place both Me-18 and Me-27 in a β-orientation in **6**, indicating that the Me-18 group shifted from C-13 to C-14.[6] ROESY correlations from H_2-28 to H-12α enabled the placement of CH_2-28 in an α-orientation in **7**. On the basis of biosynthetic considerations, Me-18 should be β-oriented in **7**. Thus, OH-1 was determined to be β-oriented, by comparison of the chemical shifts, splitting patterns, and coupling constants of H_2-2 and H-1 with those of schindilactone A.[7] Accordingly, the structures of **6** and **7** were established as shown.

Kadcoccilactones H and I (**8** and **9**) were isolated as white, amorphous powders. They showed very similar NMR data to those obtained for wuweizidilactone C,[6] which suggested that they have similar structures. The molecular formula, $C_{31}H_{44}O_{10}$, was assigned to compound **8** on the basis of its HRESIMS data at *m*/*z* 599.2826 $[M + Na]^+$ (calcd 599.2832). It differed structurally from wuweizidilactone C only at C-24 and C-25, as determined by comparison of their NMR data.[6] In the ^{13}C NMR spectrum of **8**, the downfield-shifted signal for C-26 (δ 180.7) and the upfield-shifted signals for C-24 (δ 34.1) and C-25 (δ 34.1) suggested reduction of $\Delta^{24,25}$ in **8**. The molecular formula of **9** was determined to be the same as that of **8** from HRESIMS at *m*/*z* 599.2833 $[M + Na]^+$ (calcd 599.2832). The HMBC correlation of H-15 with the acetate carbonyl in **9** was used to support an acetoxy group at C-15. Considering the signal for C-7 (δ 71.6) and the molecular formula of **9**, a hydroxy group was located at C-7. Thus, the differences between **8** and **9** were the substituents at C-7 and C-15. Except for Me-27, the relative configurations of compounds **8** and **9** were both established as being identical to that of wuweizidilactone C from their similar carbon and proton chemical shifts and ROESY correlations.[6] As a result, the structures of compounds **8** and **9** were established as shown.

Kadcoccilactone J (**10**) was assigned the molecular formula $C_{28}H_{36}O_{10}$ by HRESIMS at *m*/*z* 555.2193 $[M + Na]^+$ (calcd 555.2206). The NMR data of **10** were quite similar to those of wuweizidilactone B,[6] except for the substituents at C-7 and C-12. Thus, the angeloyloxy group at C-7 and the acetoxy group at C-12 in wuweizidilactone B were replaced by two hydroxy groups in **10**. The presence of these hydroxy groups was confirmed by the appropriate ^{13}C NMR signals for C-7 (δ 69.2) and C-12 (δ 70.2) and the molecular formula of **10**. Moreover, ROESY correlations indicated that the corresponding substituents in this compound had the same orientations as those in wuweizidilactone B.[6] The α-oriented hydroxy groups at C-7 and C-12 were confirmed by comparison of the chemical shifts, splitting patterns, and coupling constants of H-7 (δ 4.38), H_2-6 (δ 1.98−1.99 and 1.45, H-12 (δ

Table 3. ^{13}C NMR Data for Kadcoccilactones A−J (**1**−**10**) in C_5D_5N[a]

C atom	1	2	3	4	5	6	7	8	9	10
1	81.9 d	81.8 d	82.0 d	81.9 d	82.2 d	109.0 s	81.9 d	82.1 d	82.2 d	81.9 d
2	36.7 t	36.3 t	36.7 t	35.6 t	36.3 t	43.0 t	37.0 t	36.2 t	37.7 t	35.7 t
3	175.3 s	175.3 s	175.6 s	175.1 s	175.2 s	173.6 s	175.4 s	175.0 s	175.9 s	175.0 s
4	85.1 s	84.7 s	85.0 s	84.6 s	84.8 s	85.0 s	85.2 s	84.7 s	85.5 s	84.3 s
5	59.6 d	60.0 d	59.5 d	60.6 d	59.8 d	61.3 d	58.4 d	52.1 d	52.8 d	52.5 d
6	28.3 t	28.7 t	28.9 t	27.0 t	27.4 t	28.1 t	28.5 t	31.6 t	30.0 t	33.2 t
7	25.1 t	23.9 t	26.0 t	25.9 t	26.6 t	25.9 t	25.4 t	70.2 d	71.6 d	69.2 d
8	54.5 d	55.9 d	53.3 d	49.6 d	48.9 d	57.2 d	50.3 d	58.5 d	62.3 d	46.7 d
9	73.1 s	73.4 s	73.2 s	83.6 s	73.2 s	73.4 s	72.7 s	72.3 s	69.6 s	78.6 s
10	100.0 s	100.1 s	99.9 s	98.0 s	99.8 s	99.7 s	100.2 s	99.2 s	99.8 s	98.6 s
11	39.7 t	38.4 t	39.3 t	33.2 t	39.2 t	40.7 t	38.7 t	39.8 t	42.2 t	42.6 t
12	26.9 t	39.2 t	30.0 t	36.4 t	35.9 t	18.0 t	27.1 t	35.1 t	39.2 t	70.2 d
13	52.5 s	47.3 s	47.1 s	47.0 s	47.6 s	138.6 s	49.9 s	94.2 s	93.9 s	92.1 s
14	48.3 s	84.6 s	53.5 s	151.2 s	153.2 s	53.3 s	52.2 s	55.5 s	53.8 s	70.8 s
15	34.8 t	27.6 t	30.8 t	120.4 d	119.4 d	81.5 d	32.8 t	79.3 d	83.5 d	55.2 d
16	36.5 t	34.0 t	28.2 t	35.0 t	36.9 t	39.4 t	34.3 t	33.4 t	30.4 t	27.2 t
17	84.9 s	54.3 d	46.3 d	54.8 d	56.2 d	132.1 s	89.7 s	52.7 d	53.3 d	43.0 d
18	18.8 q	17.2 q	17.2 q	16.8 q	16.7 q	24.0 q	15.8 q	24.5 q	27.0 q	
19	48.1 t	47.0 t	47.7 t	39.8 t	45.8 t	44.8 t	47.7 t	47.0 t	49.3 t	46.6 t
20	43.9 d	38.7 d	39.4 d	37.6 d	40.6 d	35.0 d	40.3 d	35.0 d	34.1 d	36.4 d
21	11.3 q	15.4 q	13.6 q	13.5 q	15.4 q	16.5 q	10.9 q	12.1 q	11.4 q	11.6 q
22	81.2 d	80.7 d	80.4 d	80.3 d	73.4 d	76.3 d	72.0 d	91.7 d	90.6 d	84.4 d
23	28.5 t	24.6 t	23.6 t	23.5 t	81.9 d	79.2 d	84.6 d	76.3 d	75.5 d	81.1 d
24	142.0 d	140.3 d	140.1 d	140.1 d	148.9 d	33.2 t	148.6 d	34.1 t	34.5 t	147.0 d
25	127.4 s	128.0 s	128.0 s	128.0 s	130.3 s	34.7 d	130.3 s	34.1 d	34.8 d	130.6 s
26	166.9 s	166.4 s	166.3 s	166.2 s	175.0 s	180.8 s	174.7 s	180.7 s	180.9 s	174.2 s
27	17.0 q	17.2 q	17.2 q	17.2 q	10.7 q	16.4 q	10.7 q	16.5 q	16.6 q	10.7 q
28	20.3 q		64.1 t				73.7 t			
29	23.1 q	22.6 q	23.2 q	22.0 q	22.7 q	26.2 q	23.7 q	23.1 q	24.7 q	22.2 q
30	29.6 q	29.2 q	29.7 q	28.7 q	29.3 q	30.9 q	30.1 q	29.1 q	30.8 q	28.4 q
CHO				162.0 d						
OAc						169.7 s		170.8 s	170.3 s	
						21.6 q		21.0 q	21.6 q	

[a] Data were recorded with a Bruker DRX-125 MHz spectrometer; chemical shifts (δ) are in ppm. Assignments were confirmed by $^1H-^1H$ COSY, HMQC, and HMBC.

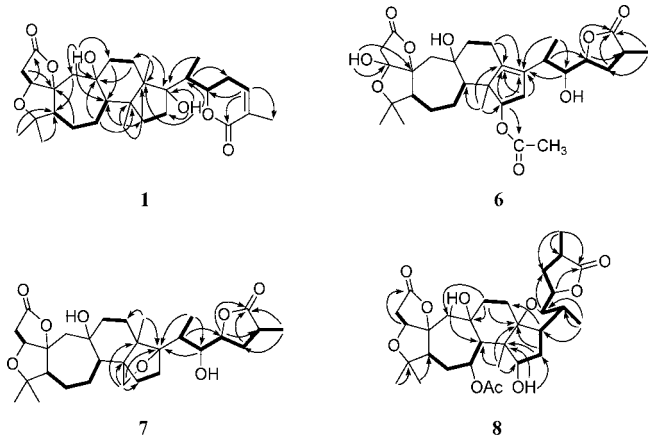


Figure 1. Selected HMBC (→) and $^1H-^1H$ COSY (—) correlations of **1** and **6**−**8**.

4.22−4.24), and H_2-11 (δ 2.20−2.23 and 2.14−2.18) of **10** with those of the literature values reported for wuweizidilactone B.[6] Thus, the structure of **10** was determined as shown.

Compounds **1**−**10** and two known triterpenoids, kadsuphilactone A and micrandilactone B, were tested for cytotoxicity against K562, Bel-7402, and A549 human tumor cells by the SRB and MTT methods, as previously reported.[22,23] All compounds showed no inhibitory activity against the tumor cells used and had IC_{50} values of >5 μg/mL.

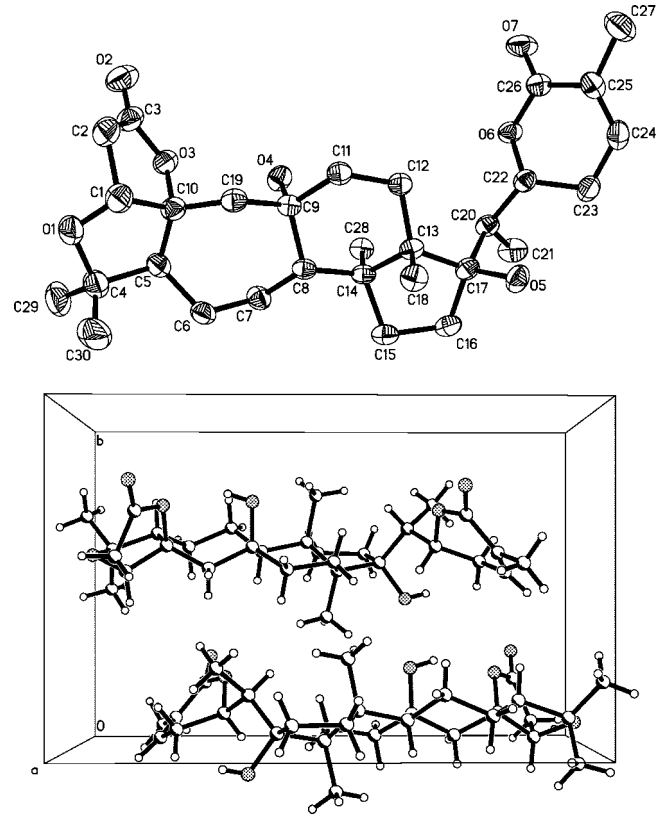
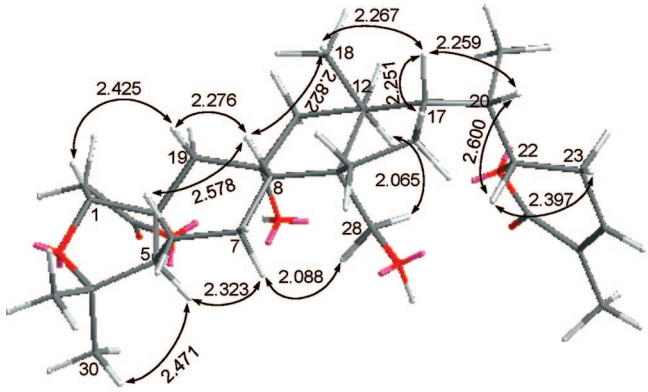


Figure 2. X-ray crystal structure of **1**.

Experimental Section

General Experimental Procedures. Optical rotations were measured with a Horiba SEPA-300 polarimeter. UV spectra were obtained using a Shimadzu UV-2401A spectrophotometer. A Tenor 27 spectrophotometer was used for scanning IR spectroscopy with KBr pellets. 1D and 2D NMR spectra were recorded on a Bruker DRX-500 spectrometer



3

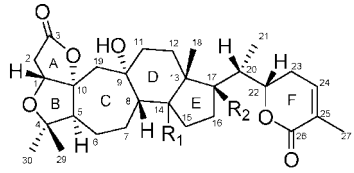
Figure 3. Key ROESY correlations and relative configurations assigned for **3** and their corresponding interatomic distances [Å].

with TMS as internal standard. Chemical shifts (δ) are expressed in ppm with reference to the solvent signals. Mass spectra were performed on an API QSTAR time-of-flight spectrometer. Column chromatography was performed with silica gel (200−300 mesh, Qingdao Marine Chemical, Inc., Qingdao, People's Republic of China). Semipreparative HPLC was performed on an Agilent 1100 liquid chromatograph with a Zorbax SB-C_{18} (9.4 mm × 25 cm) column. Preparative HPLC was performed on a Shimadzu LC-8A preparative liquid chromatograph with a Shimadzu PRC-ODS (K) column (34 mm × 15 cm). Fractions were monitored by TLC, and spots were visualized by heating silica gel plates sprayed with 5% H_2SO_4 in EtOH.

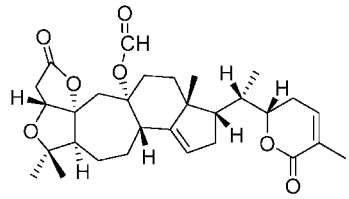
Plant Material. The stems of *K. coccinea* were collected in October 2005 from Honghe Prefecture of Yunnan Province, China. The plant was identified by Prof. Xi-Wen Li. A voucher specimen, no. KIB 2005-10-10, has been deposited at the State Key Laboratory of Phytochemistry and Plant Resources in West China, Kunming Institute of Botany, Chinese Academy of Sciences.

Extraction and Isolation. Air-dried and powdered stems (13 kg) were extracted with 70% aqueous Me_2CO (4 × 50 L) at room temperature and concentrated in vacuo to give a crude extract, which was partitioned between H_2O and EtOAc. The EtOAc-soluble portion (413 g) was chromatographed on a silica gel column eluting with $CHCl_3$−Me_2CO (1:0, 40:1, 9:1, 8:2, 7:3, 1:1, and 0:1) to afford five fractions, I−V. Fraction III (15 g) was then chromatographed on silica gel (petroleum ether−Me_2CO, 20:1−2:1) to give 18 fractions. Fraction III-4 (813 mg) was subjected to a reversed-phase column (RP-18) eluting with MeOH−H_2O (30−90%) to give 17 fractions. Fraction III-4-6 (34 mg) was subjected to semipreparative HPLC (MeOH−H_2O, 60:40) to yield compound **2** (5 mg). Fraction III-4-13 (102 mg) was subjected to preparative HPLC (MeOH−H_2O, 60:40) to yield compounds **1** (12 mg) and **3** (8 mg). Compound **8** (25 mg) was crystallized from fraction III-4-11. Fraction III-5 (127 mg) was separated over Sephadex LH-20 eluting with MeOH and then subjected to semipreparative HPLC (MeOH−H_2O, 60:40) to yield compounds **7** (3 mg) and **9** (2 mg). Fraction III-18 (35 mg) was chromatographed on silica gel (petroleum ether−isopropyl alcohol, 15:1) to give compound **5** (2 mg). Fraction II was chromatographed on silica gel (petroleum ether−Me_2CO, 20:1−2:1) to yield 14 fractions. Fraction II-2 was purified by semipreparative HPLC (MeOH−H_2O, 75:25) to afford compound **4** (3 mg). Kadsuphilactone A (80 mg) was crystallized from fraction II-3. Fraction IV (40 g) was chromatographed on silica gel (petroleum ether−Me_2CO, 20:

Chart 1



	R_1	R_2
1	αMe-28	OH
2	βOH	H
3	αCH_2OH-28	H



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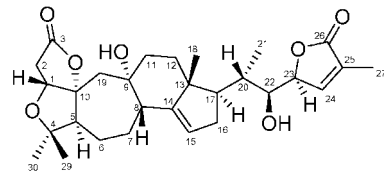

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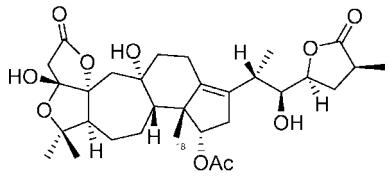
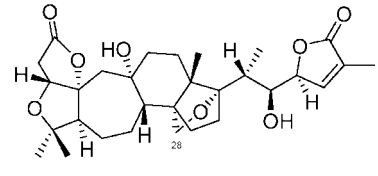


6



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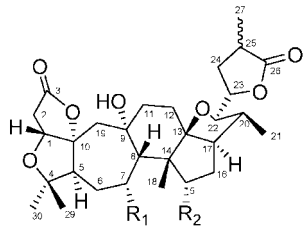
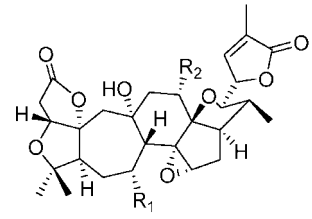


	R_1	R_2
8	OAc	OH
9	OH	OAc



	R_1	R_2
10	OH	OH
wuweizidilactone B	OAng	OAc

1−2:1) to yield fractions 1−4. Compounds **6** (300 mg), **10** (20 mg), and micrandilactone B (10 mg) were crystallized from fractions IV-1-33, IV-2, and IV-1-35, respectively.

Kadcoccilactone A (1): white, amorphous powder; $[\alpha]^{24}_D$ +44.2 (*c* 0.10, MeOH); UV (MeOH) λ_{max} (log ε) 212 (3.51), 191 (3.24) nm; IR (KBr) ν_{max} 3417, 2932, 1776, 1702, 1638, 1459, 1384, 1240, 1198, 1115, 1044, 1007, 916, 860 cm^{-1}; ^{1}H and ^{13}C NMR data, Tables 1 and 3; negative ESIMS *m/z* 515 (50) [M − H]$^-$, 181 (100), 111 (16), 62 (30); negative HRESIMS *m/z* 515.2998 [M − H]$^-$ (calcd 515.3008 for $C_{30}H_{43}O_7$).

Kadcoccilactone B (2): white, amorphous solid; $[\alpha]^{25}_D$ +49.0 (*c* 0.15, MeOH); UV (MeOH) λ_{max} (log ε) 208 (3.58), 255 (2.59), 391 (1.54) nm; IR (KBr) ν_{max} 3574, 3441, 2971, 2934, 1776, 1710, 1640, 1630, 1450, 1400, 1375, 1242, 1195, 1155, 1136, 1068, 1032, 947, 909 cm^{-1}; ^{1}H and ^{13}C NMR data, Tables 1 and 3; negative ESIMS *m/z* 501 (100) [M − H]$^-$, 294 (17), 254 (10), 111 (10), 62 (39); negative HRESIMS *m/z* 501.2839 [M − H]$^-$ (calcd 501.2852 for $C_{29}H_{41}O_7$).

Kadcoccilactone C (3): white, amorphous solid; $[\alpha]^{24}_D$ +75.8 (*c* 0.13, MeOH); UV (MeOH) λ_{max} (log ε) 209 (3.64), 195 (3.26) nm; IR (KBr) ν_{max} 3424, 2972, 2932, 1778, 1715, 1640, 1630, 1460, 1452, 1383, 1238, 1199, 1157, 1133, 1119, 1069, 1030, 913, 852 cm^{-1}; ^{1}H and ^{13}C NMR data, Tables 1 and 3; negative ESIMS *m/z* 515 (100) [M − H]$^-$, 181 (13), 128 (10), 111 (8), 62 (67); negative HRESIMS *m/z* 515.3009 [M − H]$^-$ (calcd 515.3008 for $C_{30}H_{43}O_7$).

Kadcoccilactone D (4): white, amorphous solid; $[\alpha]^{27}_D$ +62.2 (*c* 0.42, MeOH−$CHCl_3$, 1:1); UV (MeOH) λ_{max} (log ε) 237 (3.08), 223 (2.54) nm; IR (KBr) ν_{max} 2964, 2923, 2853, 2830, 1780, 1725, 1461, 1386, 1373, 1327, 1237, 1188, 1169, 1122, 1108, 1070, 1038, 967, 915 cm^{-1}; ^{1}H and ^{13}C NMR data, Tables 1 and 3; positive ESIMS *m/z* 535 (100) [M + Na]$^+$, 407 (1), 245 (1), 115 (1); positive HRESIMS *m/z* 535.2662 [M + Na]$^+$ (calcd 535.2671 for $C_{30}H_{40}O_7Na$).

Kadcoccilactone E (5): white, amorphous solid; $[\alpha]^{28}_D$ +28.1 (*c* 0.19, MeOH); UV (MeOH) λ_{max} (log ε) 274 (2.25), 206 (3.60) nm; IR (KBr) ν_{max} 3424, 2978, 2928, 1752, 1661, 1640, 1459, 1384, 1371, 1330, 1253, 1237, 1198, 1174, 1086, 1061, 1044, 983 cm^{-1}; ^{1}H and ^{13}C NMR data, Tables 1 and 3; positive ESIMS *m/z* 523 (100) [M + Na]$^+$, 139 (1), 112 (10), 85 (7); positive HRESIMS *m/z* 523.2682 [M + Na]$^+$ (calcd 523.2671 for $C_{29}H_{40}O_7Na$).

Kadcoccilactone F (6): white, amorphous solid; $[\alpha]^{24}_D$ +68.8 (*c* 0.12, MeOH); UV (MeOH) λ_{max} (log ε) 204 (3.65) nm; IR (KBr) ν_{max} 3546, 3375, 2962, 2926, 1752, 1639, 1454, 1416, 1372, 1286, 1237, 1205, 1185, 1113, 1084, 1046, 1023, 969 cm^{-1}; ^{1}H and ^{13}C NMR data, Tables 2 and 3; positive ESIMS *m/z* 599 (100) [M + Na]$^+$; positive HRESIMS *m/z* 599.2830 [M + Na]$^+$ (calcd 599.2832 for $C_{31}H_{44}O_{10}Na$).

Kadcoccilactone G (7): white, amorphous solid; $[\alpha]^{21}_D$ +46.3 (*c* 0.16, MeOH); UV (MeOH) λ_{max} (log ε) 211 (3.75), 250 (2.64) nm; IR (KBr) ν_{max} 3547, 3422, 2970, 2931, 1762, 1639, 1456, 1374, 1276, 1235, 1201, 1175, 1123, 1076, 1056, 1023 cm^{-1}; ^{1}H and ^{13}C NMR data, Tables 2 and 3; positive ESIMS *m/z* 553 (100) [M + Na]$^+$; positive HRESIMS *m/z* 553.2774 [M + Na]$^+$ (calcd 553.2777 for $C_{30}H_{42}O_8Na$).

Kadcoccilactone H (8): white, amorphous solid; $[\alpha]^{21}_D$ +23.5 (*c* 0.17, Me_2CO); UV (MeOH) λ_{max} (log ε) 212 (2.57) nm; IR (KBr) ν_{max} 3548, 3439, 2974, 2938, 1780, 1743, 1638, 1458, 1442, 1376, 1338, 1324, 1246, 1235, 1167, 1140, 1122, 1069, 1024 cm^{-1}; ^{1}H and ^{13}C NMR data, Tables 2 and 3; positive ESIMS *m/z* 599 (100) [M + Na]$^+$, 577 (21); positive HRESIMS *m/z* 599.2826 [M + Na]$^+$ (calcd 599.2832 for $C_{31}H_{44}O_{10}Na$).

Kadcoccilactone I (9): white, amorphous solid; $[\alpha]^{25}_D$ +66.3 (*c* 0.17, MeOH); UV (MeOH) λ_{max} (log ε) 221 (2.74) nm; IR (KBr) ν_{max} 3530, 2969, 2930, 1773, 1726, 1639, 1456, 1375, 1332, 1250, 1222, 1191, 1141, 1068, 1020, 999 cm^{-1}; ^{1}H and ^{13}C NMR data, Tables 2 and 3; positive ESIMS *m/z* 599 (100) [M + Na]$^+$; positive HRESIMS *m/z* 599.2833 [M + Na]$^+$ (calcd 599.2832 for $C_{31}H_{44}O_{10}Na$).

Kadcoccilactone J (10): white, amorphous solid; $[\alpha]^{22}_D$ +22.1 (*c* 0.21, Me_2CO); UV (MeOH) λ_{max} (log ε) 210 (3.66), 192 (3.24) nm; IR (KBr) ν_{max} 3501, 2976, 2953, 2928, 1775, 1659, 1636, 1437, 1419, 1385, 1375, 1340, 1328, 1225, 1182, 1160, 1113, 1066, 1040, 996, 950 cm^{-1}; ^{1}H and ^{13}C NMR data, Tables 2 and 3; positive ESIMS *m/z* 555 (100) [M + Na]$^+$, 533 (5), 344 (3), 139 (3); positive HRESIMS *m/z* 555.2193 [M + Na]$^+$ (calcd 555.2206 for $C_{28}H_{36}O_{10}$).

X-ray Crystallographic Analysis of 1. $C_{30}H_{44}O_7$; M_r = 516.68; monoclinic; space group: $P2_1$; a = 8.336(1) Å, b = 10.329(1) Å, c = 15.593(1) Å; V = 1373.3 (2) Å^3; Z = 2; β = 91.17(1)°; D_{calcd} =1.249 g cm^{-3}; crystal dimensions 0.05 × 0.15 × 0.60 mm. The total number of independent reflections measured was 2614, of which 2245 were observed ($|F|^2 \geq 2\sigma|F|^2$). The final indices were R_1 = 0.0535, wR_2 = 0.1338, S = 1.056. Crystal structure measurements were made using a MAC DIP-2030 K diffractometer with graphite-monochromated Mo Kα radiation. The data were collected by using the $\omega-2\theta$ scan technique to a maximum 2θ value of 50.0°. The crystal structures were solved by direct methods by using SHELXS-97,[24] expanded by using difference Fourier techniques, and refined by the program and method NOMCSDP[25] and full-matrix least-squares calculations. The non-hydrogen atoms were refined anisotropically and hydrogen atoms were included at their calculated positions. Crystallographic data for the structure of **1** have been deposited in the Cambridge Crystallographic Data Centre (deposition number: CCDC 668603). Copies of these data can be obtained free of charge via www.ccdc.cam.ac.uk/conts/retrieving.html (or from the Cambridge Crystallographic Data Centre, 12 Union Road, Cambridge CB21EZ, UK; fax: (+44) 1223-336-033; or deposit@ccdc.cam.ac.uk).

Cytotoxicity Bioassays. Cytotoxicity of compounds against K562, Bel-7402, and A549 human tumor cells was determined by the SRB and MTT methods, as previously reported,[22,23] and ADR (IC_{50} values of 0.011, 0.010, and 0.025 μg/mL against K562, Bel-7402, and A549 cells, respectively) was used as the positive control. Cells were plated in 96-well plates 24 h before treatment and continuously exposed to different concentrations of compounds for 72 h. Inhibition rates of cell proliferation after compound treatment were determined by the SRB and MTT methods.[22,23]

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Supporting Information Available: ^{1}H and ^{13}C NMR spectra of kadcoccilactones A−J (**1**−**10**). This material is available free of charge via the Internet at http://pubs.acs.org.

References and Notes

(1) Li, R. T.; Zhao, Q. S.; Li, S. H.; Han, Q. B.; Sun, H. D.; Lu, Y.; Zhang, L. L.; Zheng, Q. T. *Org. Lett.* **2003**, *5*, 1023–1026.
(2) Li, R. T.; Xiang, W.; Li, S. H.; Lin, Z. W.; Sun, H. D. *J. Nat. Prod.* **2004**, *67*, 94–97.
(3) Li, R. T.; Shen, Y. H.; Xiang, W.; Sun, H. D. *Eur. J. Org. Chem.* **2004**, 807–811.
(4) Li, R. T.; Han, Q. B.; Zheng, Y. T.; Wang, R. R.; Yang, L. M.; Lu, Y.; Sang, S. Q.; Zheng, Q. T.; Zhao, Q. S.; Sun, H. D. *Chem. Commun.* **2005**, 2936–2938.
(5) Li, R. T.; Xiao, W. L.; Shen, Y. H.; Zhao, Q. S.; Sun, H. D. *Chem.*−*Eur. J.* **2005**, *11*, 2989–2996.
(6) Huang, S. X.; Yang, L. B.; Xiao, W. L.; Lei, C.; Liu, J. P.; Lu, Y.; Weng, Z. Y.; Li, L. M.; Li, R. T.; Yu, J. L.; Zheng, Q. T.; Sun, H. D. *Chem.*−*Eur. J.* **2007**, *13*, 4816–4822.
(7) Huang, S. X.; Li, R. T.; Liu, J. P.; Lu, Y.; Chang, Y.; Lei, C.; Xiao, W. L.; Yang, L. B.; Zheng, Q. T.; Sun, H. D. *Org. Lett.* **2007**, *9*, 2079–2082.
(8) Chen, D. F.; Zhang, S. X.; Mutsuo, K.; Sun, Q. Z.; Feng, J.; Wang, Q.; Teruo, M.; Yoshitaka, N.; Harukuni, T.; Hoyoku, N.; Wang, H. K.; Morris-Natschke, S. L.; Lee, K. H. *J. Nat. Prod.* **2002**, *65*, 1242–1245.
(9) Chen, D. F.; Zhang, S. X.; Chen, K.; Zhou, B. N.; Wang, P.; Cosentino, L. M.; Lee, K. H. *J. Nat. Prod.* **1996**, *59*, 1066–1068.
(10) Yang, X. W.; Miyashiro, H.; Hattori, M.; Namba, T.; Teiuka, Y.; Kikuchi, T.; Chen, D. F.; Xu, G. J.; Hori, T.; Extine, M.; Mitsuhashi, H. *Chem. Pharm. Bull.* **1992**, *40*, 1510–1516.
(11) Shen, Y. C.; Lin, Y. C.; Cheng, Y. B.; Kuo, Y. H.; Liaw, C. C. *Org. Lett.* **2005**, *7*, 5297–5300.
(12) Wang, W.; Liu, J. Z.; Han, J.; Xu, Z. R.; Liu, R. X.; Liu, P.; Wang, W. X.; Ma, X. C.; Guan, S. H.; Guo, D. *Planta Med.* **2006**, *72*, 450–457.
(13) Kuo, Y. H.; Li, S. Y.; Huang, R. L.; Wu, M. D.; Huang, H. C.; Lee, K. H. *J. Nat. Prod.* **2001**, *64*, 487–490.
(14) Pu, J. X.; Xiao, W. L.; Lu, Y.; Li, R. T.; Li, H. M.; Zhang, L.; Huang, S. X.; Li, X.; Zhao, Q. S.; Zheng, Q. T.; Sun, H. D. *Org. Lett.* **2005**, *7*, 5079–5082.

(15) Pu, J. X.; Li, R. T.; Xiao, W. L.; Gong, N. B.; Huang, S. X.; Lu, Y.; Zheng, Q. T.; Lou, L. G.; Sun, H. D. *Tetrahedron* **2006**, *62*, 6073–6081.
(16) Shen, Y. C.; Lin, Y. C.; Chiang, M. Y.; Sheau, F. Y.; Cheng, Y. B.; Liao, C. C. *Org. Lett.* **2005**, *7*, 3307–3310.
(17) Anonymous. *Chinese Medicinal Herbs*; Shanghai Science and Technology Press: Shanghai, 1999; Vol. 2, pp 895−896..
(18) Li, L. N.; Xue, H.; Tan, R. *Planta Med.* **1985**, *51*, 297–300.
(19) Li, L. N.; Xue, H. *Planta Med.* **1986**, *52*, 492–493.
(20) Liu, J. S.; Li, L.; Yu, H. G. *Can. J. Chem.* **1989**, *67*, 682–684.
(21) Sy, L. K.; Brown, G. D. *Tetrahedron* **1999**, *55*, 119–132.
(22) Monks, A.; Scudiero, D.; Skehan, P.; Shoemaker, R.; Paull, K.; Vistica, D.; Hose, C.; Langley, J.; Cronise, P.; Vaigro-Wolff, A. *J. Natl. Cancer Inst.* **1991**, *83*, 757–766.
(23) Niu, X. M.; Li, M. L.; Zhao, Q. S.; Mei, S. X.; Na, Z.; Wang, S. J.; Lin, Z. W.; Sun, H. D. *Planta Med.* **2002**, *68*, 528–533.
(24) Sheldrick, G. M. *SHELXS-97: Program for Crystal Structure Solution*; University of Göttingen: Germany, 1997.
(25) Lu, Y.; Wu, B. M. *Chin. Chem. Lett.* **1992**, *3*, 637–640.

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