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FIVE 10-PHENYL-[11]-CYTOCHALASANS FROM A *DALDINIA* FUNGAL SPECIES

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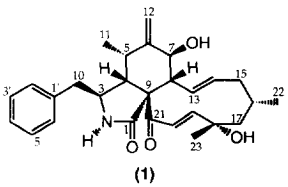
Key Word Index—*Daldinia*; fungus; Ascomycetes; Xylariaceae; 10-phenyl-[11]-cytochalasans; cytochalasins.

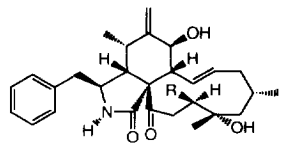
Abstract—Five new 10-phenyl-[11]-cytochalasans have been isolated from an unidentified *Daldinia* species. Their structures were established by spectroscopic methods, especially by high field NMR spectroscopy.

INTRODUCTION

Chemical investigation of the ethyl acetate extract of an unidentified *Daldinia* species belonging to the Xylariaceae has led to the isolation of five new 10-phenyl-[11]-cytochalasans (**1–5**). In the chemical literature, cytochalasins are accepted as the trivial names of the 10-phenyl compounds in the group. The cytochalasans are a group of fungal secondary metabolites which have a wide range of biological activities [1–3], but are best known for their various effects on mammalian cells [4]. The most unusual of their properties is their ability to cause cells to extrude their nuclei, leading to the formation of nuclei-free cells. At lower concentrations they interfere with cell division by preventing cytoplasmic division leading to binuclear or polynuclear cells and also inhibit cell movement. The cytochalasans were first isolated and characterized by Aldridge and Turner [5] and independently by Tamm [6] and since then they have been identified as metabolites of diverse fungal sources [2, 3, 7–14]. In this paper, we report the isolation and characterization of these five new cytochalasins (**1–5**) which belong to the 10-phenyl-[11]-class.



(1)



(2) R = H
(3) R =OH
(4) R = OMe
(5) R = OAc

RESULTS AND DISCUSSION

The ethyl acetate extract of the *Daldinia* species was chromatographed on silica gel and prep. HPLC to give five new cytochalasins (**1–5**). Cytochalasin **1** was obtained as needles after recrystallization from EtOAc. Its HR-mass spectrometry revealed a molecular formula of $C_{28}H_{35}O_4N$. The IR spectrum showed the presence of hydroxyl, amidic and enone groups. The occurrence of two major fragments at *m/z* 358 and 91 in its MS suggested the presence of a benzyl group. The ^{1}H NMR spectrum (Table 1) confirmed the presence of amide NH [δ_H 6.29 (*br s*)], hydroxyl (δ_H 2.37 (*br s*, 2H), benzyl [δ_H 7.31 (*m*, 2H), 7.23 (*m*), 7.12 (*m*, 2H)], secondary alcohol [δ_H 4.06 (*br d*, J = 10.0 Hz)] and two olefinic proton signals belonging to an enone system [δ_H 7.08 (*d*, J = 15.9 Hz), 6.59 (*d*, J = 15.9 Hz)]. There are also two exomethylene protons [δ_H 5.26, 5.07 (both *br s*)], two further olefinic proton signals [δ_H 5.76 (*ddd*, J = 15.4, 10.0, 1.6 Hz), 5.20 (*ddd*, J = 15.4, 11.0, 4.9 Hz)], two secondary methyls at δ_H 1.05 (*d*, J = 7.1 Hz) and 0.94 (*d*, J = 6.6 Hz) and a tertiary methyl group [δ_H 1.38 (s)] attached to an oxygenated carbon, in addition to several other well defined signals (Table 1). The two endocyclic disubstituted double bonds are *trans*-orientated as indicated by their coupling constants. Homonuclear decoupling experiments established a vicinal relationship between the amide NH [δ_H 6.29 (*br s*)] and the proton signal at δ_H 3.32 (*m*). The ^{13}C NMR spectrum (Table 2), analyzed with the aid of DEPT, indicated the presence of 28 carbons: two carbonyl carbons [δ_C 198.9 (enone), 174.0 (amide)], six aromatic carbons [δ_C 136.9 (*s*), 129.2 (*d*, 2C), 128.7 (*d*, 2C),

Table 1. ^{1}H NMR data for cytochalasins **1–5**

H	1	2	3	4	5
2 (NH)	6.29 (*br s*)	5.89 (*br s*)	5.91 (*br s*)	6.11 (*br s*)	5.91 (*br s*)
3	3.32 (*m*)	3.31 (*m*)	3.33 (*m*)	3.33 (*m*)	3.32 (*m*)
4	3.17 (*dd*, 5.6, 2.4)	2.96 (*dd*, 6.0, 2.3)	3.03 (*dd*, 5.6, 2.4)	2.83 (*dd*, 6.1, 2.2)	2.93 (*dd*, 5.6, 2.7)
5	2.79 (*br qd*, 6.6, 5.6)	2.83 (*br qd*, 6.8, 6.0)	2.81 (*br qd*, 6.8, 5.6)	2.88 (*br qd*, 6.8, 6.1)	2.84 (*br qd*, 6.8, 5.6)
7	4.06 (*br d*, 10.0)	4.12 (*br d*, 10.0)	4.09 (*br d*, 10.0)	4.15 (*br d*, 10.0)	4.08 (*br d*, 10.0)
8	2.45 (*t*, 10.0)	2.46 (*t*, 10.0)	2.43 (*t*, 10.0)	2.60 (*t*, 10.0)	2.51 (*t*, 10.0)
10a	2.64 (*dd*, 13.4, 5.9)	2.64 (*dd*, 13.4, 5.4)	2.70 (*dd*, 13.7, 5.1)	2.64 (*dd*, 13.4, 5.6)	2.71 (*dd*, 13.7, 4.9)
10b	2.54 (*dd*, 13.4, 8.0)	2.47 (*dd*, 13.4, 7.8)	2.48 (*dd*, 13.7, 7.3)	2.52 (*dd*, 13.4, 7.8)	2.45 (*dd*, 13.7, 7.6)
11-Me	0.94 (*d*, 6.6)	0.99 (*d*, 6.8)	1.03 (*d*, 6.8)	0.98 (*d*, 6.8)	1.03 (*d*, 6.8)
12*Z*	5.26 (*br s*)	5.25 (*br s*)	5.28 (*br s*)	5.25 (*br s*)	5.29 (*br s*)
12*E*	5.07 (*br s*)	5.06 (*br s*)	5.10 (*br s*)	5.07 (*br s*)	5.09 (*br s*)
13	5.76 (*ddd*, 15.4, 10.0, 1.6)	6.06 (*ddd*, 15.4, 10.0, 1.2)	6.08 (*ddd*, 15.4, 10.0, 1.2)	5.98 (*ddd*, 15.4, 10.0, 1.2)	6.04 (*ddd*, 15.4, 10.0, 1.2)
14	5.20 (*ddd*, 15.4, 11.0, 4.9)	5.35 (*ddd*, 15.4, 11.0, 4.6)	5.33 (*ddd*, 15.4, 11.1, 4.5)	5.28 (*ddd*, 15.4, 11.0, 4.6)	5.46 (*ddd*, 15.4, 11.0, 4.6)
15*R*	2.02 (*m*)	2.03 (*m*)	2.05 (*m*)	2.00 (*m*)	2.08 (*m*)
15*S*	1.82 (*br q*, 11.0)	1.80 (*br q*, 11.0)	1.84 (*br q*, 11.1)	1.74 (*br q*, 11.0)	1.80 (*br q*, 11.0)
16	1.33 (*m*)	1.13 (*m*)	1.29 (*m*)	1.18 (*m*)	1.44 (*m*)
17*S*	1.93 (*br dd*, 13.2, 3.0)	1.93 (*br d*, 13.6)	1.80 (*br d*, 12.7)	1.78 (*br d*, 13.2)	1.85 (*br d*, 14.4)
17*R*	1.65 (*dd*, 13.2, 3.9)	1.09 (*br ddd*, 13.6, 5.0, 1.5)	1.26 (*m*)	1.17 (*m*)	1.26 (*dd*, 14.4, 5.1)
19	6.59 (*d*, 15.9)	1.65 (*m*, 2H)	3.66 (*d*, 7.8)	3.34 (*dd*, 5.6, 1.7)	5.14 (*d*, 8.1)
20	7.08 (*d*, 15.9)	*S* 3.70 (*ddd*, 18.8, 8.8, 1.7)	4.22 (*d*, 18.8)	4.20 (*dd*, 20.0, 1.7)	4.16 (*d*, 18.8)
		R 1.82 (*dt*, 18.8, 9.3)	1.74 (*dd*, 18.8, 7.8)	1.88 (*dd*, 20.0, 5.6)	1.85 (*dd*, 18.8, 8.1)
22-Me	1.05 (*d*, 7.1)	1.03 (*d*, 6.8)	1.04 (*d*, 6.8)	1.04 (*d*, 6.3)	1.04 (*d*, 6.6)
23-Me	1.38 (*s*)	1.19 (*s*)	1.28 (*s*)	1.26 (*s*)	1.11 (*s*)
2′,6′	7.12 (*m*)	7.08 (*m*)	7.09 (*m*)	7.10 (*m*)	7.08 (*m*)
3′,5′	7.31 (*m*)	7.30 (*m*)	7.30 (*m*)	7.31 (*m*)	7.29 (*m*)
4′	7.23 (*m*)	7.24 (*m*)	7.25 (*m*)	7.25 (*m*)	7.25 (*m*)
OMe				3.50 (*s*)	
OAc					2.16 (*s*)
OH	2.37 (*br s*, 2H)	1.92 (*br s*)	2.72 (*br s*)	2.10 (*br s*)	1.94 (*br s*)
		1.83 (*br s*)	1.97 (*br s*)	1.84 (*br s*)	1.89 (*br s*)
			1.88 (*br s*)		

Numbers in parentheses are coupling constants (*J*) in Hz.
Assignments confirmed by 2D experiments (phase-sensitive DQF-COSY, HMQC, HMBC and NOESY).

Table 2. ^{13}C NMR data for cytochalasins **1–5**

C	1	2	3	4	5
1	174.0 *s*	174.1 *s*	173.2 *s*	174.4 *s*	173.7 *s*
3	53.1 *d*	52.6 *d*	52.6 *d*	52.9 *d*	52.6 *d*
4	45.4 *d*	46.2 *d*	45.2 *d*	46.9 *d*	45.8 *d*
5	31.5 *d*	31.7 *d*	31.8 *d*	31.7 *d*	32.0 *d*
6	148.7 *s*	148.8 *s*	148.4 *s*	148.9 *s*	148.7 *s*
7	71.5 *d*	71.6 *d*	71.4 *d*	71.7 *d*	71.2 *d*
8	51.7 *d*	51.3 *d*	51.4 *d*	51.1 *d*	51.7 *d*
9	63.5 *s*	63.8 *s*	63.8 *s*	63.5 *s*	63.8 *s*
10	43.8 *t*	43.7 *t*	43.6 *t*	43.5 *t*	43.6 *t*
11	12.9 *q*	12.9 *q*	13.1 *q*	12.8 *q*	13.1 *q*
12	113.9 *t*	114.2 *t*	114.4 *t*	114.3 *t*	114.4 *t*
13	127.5 *d*	128.3 *d*	128.9 *d*	128.8 *d*	128.9 *d*
14	137.2 *d*	135.6 *d*	135.9 *d*	135.5 *d*	135.7 *d*
15	43.2 *t*	42.9 *t*	43.0 *t*	42.5 *t*	42.8 *t*
16	28.8 *d*	30.4 *d*	29.8 *d*	29.3 *d*	29.5 *d*
17	54.6 *t*	45.0 *t*	45.1 *t*	43.8 *t*	45.6 *t*
18	72.8 *s*	73.1 *s*	75.3 *s*	76.1 *s*	75.4 *s*
19	154.7 *d*	31.1 *t*	71.4 *d*	80.0 *d*	72.8 *d*
20	130.5 *d*	34.3 *t*	42.8 *t*	43.1 *t*	39.1 *t*
21	198.9 *s*	211.1 *s*	212.3 *s*	211.3 *s*	209.0 *s*
22	25.6 *q*	25.4 *q*	25.6 *q*	24.9 *q*	25.2 *q*
23	25.1 *q*	28.0 *q*	23.0 *q*	23.7 *q*	22.8 *q*
1′	136.9 *s*	136.6 *s*	136.4 *s*	136.7 *s*	136.4 *s*
2′,6′	129.2 *d*	129.5 *d*	129.6 *d*	129.5 *d*	129.6 *d*
3′,5′	128.7 *d*	128.7 *d*	128.8 *d*	128.6 *d*	128.7 *d*
4′	126.9 *d*	127.0 *d*	127.1 *d*	127.0 *d*	127.0 *d*
OMe				58.8 *q*	
OAc					170.3 *s*
					21.2 *q*

Assignments confirmed by 2D experiments (HMQC and HMBC).

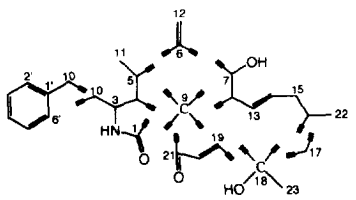


Fig. 1. Partial structures of cytochalasin **1**.

Table 3. Long-range correlations observed in the HMBC spectrum of cytochalasin 1

H	Correlated C
2 (NH)	9
3	9
10*a*	2′, 6′
10*b*	2′, 6′
12*Z*	7, 5
12*E*	7, 5
22-Me	17
23-Me	19, 17

126.9 (*d*)], six olefinic carbons {[δ_C 154.7 (*d*), 130.5 (*d*), enone], [148.7 (*s*), 113.9 (*t*), exomethylene], 137.2 (*d*), 127.5 (*d*)}, two oxygenated carbons [δ_C 72.8 (*s*), 71.5 (*d*)], one quaternary carbon, five methines, three methylenes and three methyls.

The partial structures shown in Fig. 1 were derived from the above information together with the analysis of phase-sensitive DQF–COSY [15] and HMQC [16] spectra. The joining of these partial structures was permitted by the long-range correlations observed in the HMBC [17] spectrum and all relevant correlations for this purpose are given in Table 3. The starting point for the connection of the partial structures is the tertiary methyl group (Me-23). These methyl protons show correlations with the methylene carbon C-17 (δ_C 54.6) and the olefinic carbon C-19 [δ_C 154.7 (*d*)] thus establishing the 17/18 and 18/19 bonds. The C-17 methylene carbon also correlates with the secondary methyl at δ_H 1.05 (Me-22) and therefore must form its other bond with C-16 [δ_C 28.8 (*d*)]. The exomethylene protons [H-12*Z* (δ_H 5.26), H-12*E* (δ_H 5.07)] show correlations with the carbinol carbon (C-7) and C-5 [δ_C 31.5 (*d*)] and so establishes the 5/6 and 6/7 bonds. The C-10 methylene protons [δ_H 2.64, 2.54] both show correlations with C-2′ and C-6′ [δ_C 129.2 (*d*, 2C)] indicating that C-10 is bonded to the

phenyl group. Closure of the γ-lactam ring follows from ^3J CH correlations between the quaternary carbon C-9 (δ_C 63.5) and both NH and H-3 (δ_H 3.32). The 8/9 and 9/21 bonds fall by default. The foregoing information leads to a cytochalasan structure for **1** with a 3-benzyl-perhydroisoindol-1-one residue attached to an 11-membered macrocyclic ring and containing an enone moiety, an exomethylene group, another disubstituted double bond, a secondary alcohol and a tertiary alcohol.

The relative stereochemistry of cytochalasin **1** was established from NOESY [18] and NOE difference experiments. These were recorded using more than one solvent so that previously overlapping signals could be clearly seen and thus spectra more easily interpreted. The relevant NOEs are given in Table 4. From these results the relative stereochemistry of cytochalasin **1** (Fig. 2) can be explained as follows. The six-membered ring has a boat conformation in which C(5)–H and C(8)–H are eclipsed. The hydroxyl group at C-7 is β-orientated and this is confirmed by the coupling pattern of H-7 [δ_H 4.06 (*br d*, J = 10.0 Hz)] which indicates an H-7/H-8 dihedral angle close to 180°. The γ-lactam ring is *cis*-fused and α-orientated on the six-membered ring and its benzyl substituent at C-3 is β-orientated. The eleven-membered ring running from C-8 to C-9 is *trans*-fused with the six-membered ring and has the preferred conformation represented in Fig. 2 in which its substituents are orientated as depicted. The two double bonds in this macrocyclic ring are orientated roughly parallel to each other. The stereochemistry of the perhydroisoindol-1-one nucleus is in accord with those of other cytochalasans whose structures have been determined by X-ray analysis [1, 19–21]. From the preceding spectral data **1** was identified as [11]-cytochalasa-6(12), 13, 19-triene-1, 21-dione-7,18-dihydroxy-16,18-dimethyl-10-phenyl-(7*S**, 13*E*, 16*S**, 18*S**, 19*E*) using the systematic nomenclature adopted [3, 22].

Table 4. NOEs of cytochalasin 1

H	NOE at H
3	2 (NH), 10*a*, 11
4	5, 10*a*, 10*b*, 11, 2′
5	4, 8
7	12*Z*, 13
8	5, 14
11	4, 5, 12*E*
13	7, 15*S*, 20
14	8, 15*R*, 16
16	14, 15*R*, 19, 23
19	16, 23
20	13, 17*S*
22	15*R*, 17*R*
23	16, 17*R*, 19

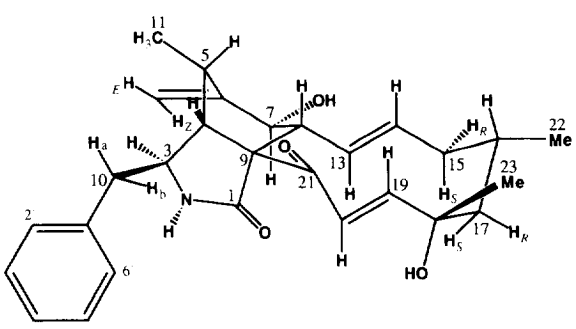


Fig. 2. Conformation of cytochalasin **1**.

The HR-MS of cytochalasin **2** gave the molecular formula $C_{28}H_{37}O_4N$ ($[M]^+$ at *m/z* 451.2717) corresponding to the dihydro derivative of **1**. Its NMR data (Tables 1 and 2) contained signals for two methylene groups [δ_H 1.65 (*m*, 2H); δ_C 31.1 *t* and δ_H 3.70 (*ddd*, J = 18.8, 8.8, 1.7 Hz); 1.82 (*dt*, J = 18.8, 9.3 Hz); δ_C 34.3 *t*] and a saturated ketone (δ_c 211.1) instead of the proton and carbon signals belonging to the enone moiety in **1**. Furthermore, the IR absorption band attributable to the enone group of **1** was no longer present in the spectrum of **2**. The above spectral data indicates that **2** is the 19/20-dihydro-derivative of **1**. NOESY and NOE difference experiments reveal that the macrocyclic ring in cytochalasin **2** has the same conformation as **1**. Thus NOEs involving the protons attached to C-19 and C-20 were observed between (i) H-19 and H-16 (ii) H-19 and Me-23 (iii) H-20*S* and H-17*S* and (iv) H-20*S* and H-13. The structure of **2** is therefore represented as [11]-cytochalasa-6(12), 13-diene-1, 21-dione-7,18-dihydroxy-16,18-dimethyl-10-phenyl-(7*S**, 13*E*, 16*S**, 18*R**).

Cytochalasin **3** has the molecular formula $C_{28}H_{37}O_5N$ ($[M]^+$ at *m/z* 467.2669). Its NMR data (Tables 1 and 2) is similar to **2** except for the presence of an oxygenated methine [δ_H 3.66 (*d*, J = 7.8 Hz); δ_C 71.4 *d*] in replace of a methylene group. This difference was attributed to a hydroxyl group attached to C-19 in **3**. The NOEs observed between (i) H-19 and H-14 and (ii) H-19 and H-16 indicate the configuration at C-19 is *R*. On the basis of these findings cytochalasin **3** is [11]-cytochalasa-6(12), 13-diene-1, 21-dione-7, 18, 19-trihydroxy-16,18-dimethyl-10-phenyl-(7*S**,13*E*,16*S**,18*S**,19*R**).

Cytochalasin **4** is an amorphous solid as are cytochalasins **2** and **3**. Its HR-MS gave a molecular ion peak at *m/z* 481.2830 corresponding to $C_{29}H_{39}O_5N$. Its spectral data is very similar to cytochalasin **3**, except for the presence of methoxyl group [δ_H 3.50(s), δ_C 58.8(q)]. This was explained by the hydroxyl group at C-19 in **3** being replaced by a methoxyl group in **4**. As for **3** the configuration at C-19 in **4** is also *R* as NOEs were observed between (i) H-19 and H-14 and (ii) H-19 and H-16. Thus cytochalasin **4** is [11]-cytochalasa-6(12), 13-diene-1, 21-dione-7, 18-dihydroxy-16,18-dimethyl-19-methoxy-10-phenyl-(7*S**,13*E*,16*S**,18*S**,19*R**).

Cytochalasin **5** crystallized as needles from benzene and has the molecular formula $C_{30}H_{39}O_6N$ ($[M]^+$ at *m/z* 509.2785). The NMR data (Tables 1 and 2) of **5** are also very similar to **3**, but in the case of **5** there is an acetoxyl group [δ_H 2.16(s); δ_C 170.3(s), 21.2(q)] at C-19 in place of the hydroxyl group in **3**. Furthermore, H-19 which is at

δ_H 3.66 (*br d*, $J = 7.8$ Hz) in **3** has shifted to δ_H 5.14 (*d*, $J = 8.1$ Hz) in **5** and the IR spectrum of **5** includes an absorption band characteristic of an acetate carbonyl (1730 cm^{-1}). NOESY and NOE difference experiments again reveal the same conformation for the macrocyclic ring as the other four cytochalasins (**1**–**4**). Thus despite the size of the ring and different functionalities these results suggest that the macrocycle framework is a stable, relatively rigid structural unit and is not as flexible as might be expected. The NOEs observed between (i) H-19 and H-14 and (ii) H-19 and H-16 in **5** confirm the same 19*R* configuration as for cytochalasins **3** and **4**. This evidence reveals cytochalasin **5** as [11]-cytochalasa-6(12),13-diene-1,21-dione-7,18-dihydroxy-16,18-dimethyl-19-acetoxy-10-phenyl-(7*S**,13*E*,16*S**,18*S**,19*R**).

EXPERIMENTAL

General. TLC and PLC: over Merck precoated silica gel 60 F_{254} and visualized under UV light (254 nm) and by spraying with 30% H_2SO_4 and heating. R_f values refer to EtOAc as eluent. Flash CC: silica gel 60 (40–63 μm). HPLC: Chemcosorb 5Si–U 10 × 250 nm (B). Mps uncorrected.

Spectral data. NMR spectra (^1H, 600 MHz; ^{13}C, 150 MHz) were recorded for $CDCl_3$ solutions relative to TMS at $\delta_H 0$ and $CDCl_3$ at δ_C 77.0. NOESY and NOE difference spectra were recorded in $CDCl_3$, C_6D_6 and C_5D_5N solutions. Multiplicities were determined by DEPT experiments. IR spectra and $[\alpha]_D$ were measured for $CHCl_3$ solutions. EIMS were measured at 70 eV.

Fungus. The *Daldinia* species were collected at two separate sites in Tokushima, both samples found growing on the same host plant, *Quercus acutissima*. One sample was collected in June 1992 (259 g) and the other sample in June 1993 (515 g). The *Daldinia* sp. remains unidentified and a voucher specimen is deposited at the Faculty of Pharmaceutical Sciences, Tokushima Bunri University.

Extraction and isolation. The fresh material (259 g and 515 g) was extracted with EtOAc to yield 11.43 g and 22.80 g of crude extract, respectively. Based on TLC and ^1H NMR the two extracts were combined (34.23 g) and then chromatographed by flash CC over silica gel using an *n*-hexane–EtOAc gradient. Fraction 10 (14.53 g), the most polar fraction, was further separated into eight frs by flash CC over silica gel using CH_2Cl_2–MeOH (98:2). Fractions 4 (956 mg), 5 (412 mg), 6 (1.361 g) and 7 (978 mg) were further divided by PLC over silica gel [*n*-hexane–EtOAc (1:9), CH_2Cl_2–EtOAc (1:1)] and flash CC over silica gel [*n*-hexane–EtOAc (1:9)] and final purifaction was by HPLC [CH_2Cl_2–MeOH (24:1), *n*-hexane–CH_2Cl_2–MeOH (17:20:3), *n*-hexane–EtOAc (1:19)] to give cytochalasins **1** (375 mg, R_f 0.40), **2** (487 mg, R_f 0.30), **3** (320 mg, R_f 0.27), **4** (390 mg, R_f 0.31) and **5** (100 mg, R_f 0.33). When analyzed by TLC and upon spraying with 30% H_2SO_4 and heating, compounds **3**–**5** give purple spots.

[11]-*Cytochalasa*-6(12),13,19-*triene*-1,21-*dione*-7,18-*dihydroxy*-16,18-*dimethyl*-10-*phenyl*-(7*S**, 13*E*, 16*S**, 18*S**, 19*E*) **(1)**. Needles from EtOAc, mp 179–181°. $[\alpha]_D$ − 14.8° ($CHCl_3$, *c* 0.88). HR-MS: *m/z* 449.2557 $[M]^+$ calculated for $C_{28}H_{35}O_4N$: 449.2566. EI-MS *m/z* (rel. int.): 449 $[M]^+$ (37), 432 (80), 358 (72), 340 (77), 91 (100). IR ν_{max} cm^{-1}: 3488, 3385, 3208, 3115 (NH, OH); 1703 (NHC=O); 1667 (enone). ^1H NMR see Table 1. ^{13}C NMR see Table 2.

[11]-*Cytochalasa*-6(12),13-*diene*-1,21-*dione*-7,18-*dihydroxy*-16,18-*dimethyl*-10-*phenyl*-(7*S**, 13*E*, 16*S**, 18*R**) **(2)**. Amorphous solid, mp 120–122° $[\alpha]_D$ − 12.6° ($CHCl_3$, *c* 1.04). HR-MS: *m/z* 451.2717 $[M]^+$ calculated for $C_{28}H_{37}O_4N$: 451.2723. EI-MS *m/z* (rel. int.): 451 $[M]^+$ (12), 433 (75), 360 (91), 342 (92), 91 (100). IR ν_{max} cm^{-1}: 3395, 3280 (NH, OH); 1692 (C=O). ^1H NMR see Table 1. ^{13}C NMR see Table 2.

[11]-*Cytochalasa*-6(12),13-*diene*-1,21-*dione*-7,18,19-*trihydroxy*-16,18-*dimethyl*-10-*phenyl*-(7*S**, 13*E*, 16*S**, 18*S**, 19*R**) **(3)**. Amorphous solid, mp 217–219°. $[\alpha]_D$ + 2.6° ($CHCl_3$, *c* 2.56). HRMS: *m/z* 467.2669 $[M]^+$ calculated for $C_{28}H_{37}O_5N$: 467.2672. EIMS *m/z* (rel. int.): 467 $[M]^+$ (3), 244 (59), 91 (100). IR ν_{max} cm^{-1}: 3500, 3376, 3250 (NH, OH); 1688 (C=O). ^1H NMR see Table 1. ^{13}C NMR see Table 2.

[11]-*Cytochalasa*-6(12),13-*diene*-1,21-*dione*-7,18-*dihydroxy*-16,18-*dimethyl*-19-*methoxy*-10-*phenyl*-(7*S**, 13*E*, 16*S**, 18*S**, 19*R**) **(4)**. Amorphous solid, mp 124–126°. $[\alpha]_D$ − 24.8° ($CHCl_3$, *c* 1.29). HR-MS: *m/z* 481.2830 $[M]^+$ calculated for $C_{29}H_{39}O_5N$: 481.2828. EIMS *m/z* (rel. int.): 481 $[M]^+$ (2), 377 (100), 258 (96), 91 (65). IR ν_{max} cm^{-1}: 3390, 3270 (NH, OH); 1692 (C=O). ^1H NMR see Table 1. ^{13}C NMR see Table 2.

[11]-*Cytochalasa*-6(12),13-*diene*-1,21-*dione*-7,18-*dihydroxy*-16,18-*dimethyl*-19-*acetoxy*-10-*phenyl*-(7*S**, 13*E*, 16*S**, 18*S**, 19*R**) **(5)**. Needles from benzene, mp 138–140°. $[\alpha]_D$ − 23.7° ($CHCl_3$, *c* 0.38). HR-MS: *m/z* 509.2785 $[M]^+$ calculated for $C_{30}H_{39}O_6N$: 509.2778. EIMS *m/z* (rel. int.): 509 $[M]^+$ (7), 418 (50), 340 (100), 91 (64). IR ν_{max} cm^{-1}: 3407 (NH, OH); 1730 (OAc), 1694 (C=O). ^1H NMR see Table 1. ^{13}C NMR see Table 2.

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