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Two new oligostilbenes from *Caragana sinica*

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TWO NEW OLIGOSTILBENES FROM *CARAGANA SINICA*

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A new resveratrol dimer, carasiphenol A (**1**), and a new resveratrol trimer, carasiphenol B (**2**), have been isolated from the aerial parts of *Caragana sinica*. Their structures have been elucidated from spectroscopic evidence, especially HMBC and NOE experiments. The relative configuration of the known dimer pallidol (**6**) was confirmed by X-ray diffraction.

Keywords: *Caragana sinica*; Resveratrol; Carasiphenol A; Carasiphenol B; Pallido; X-ray diffraction

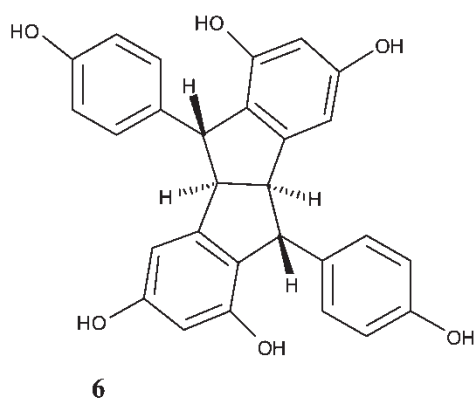
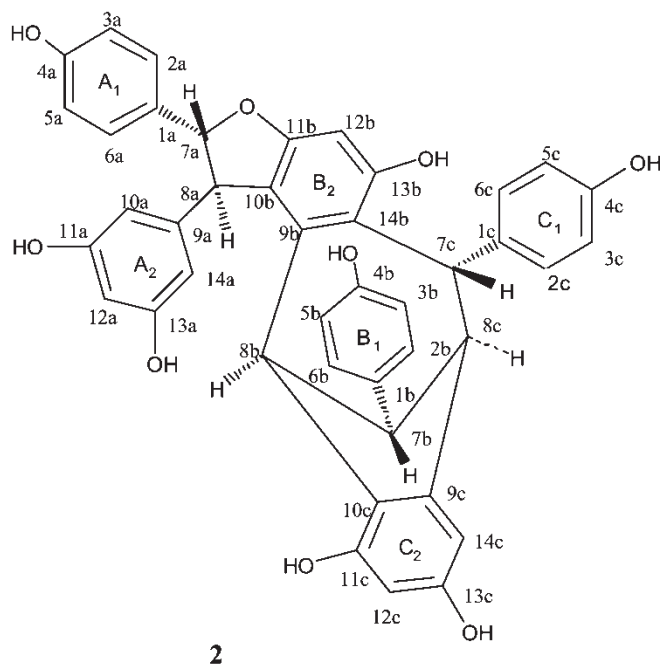
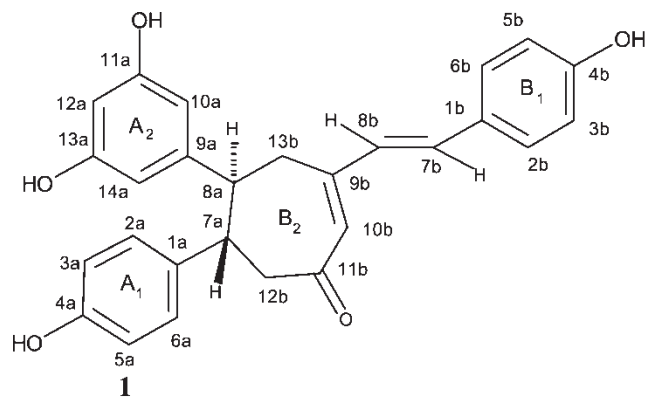
INTRODUCTION

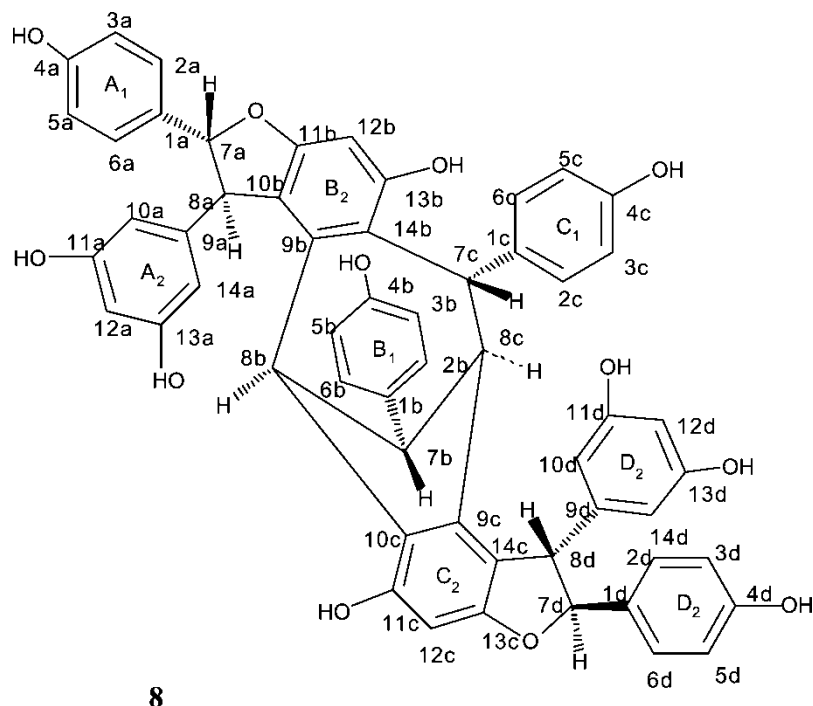
Caragana sinica (Buc'hoz) Rhed. is widely distributed in China. Its dried root has been used as a folk medicine named "Jinquegen" [1]. In a previous paper we reported that the EtOAc extract of the root of *Caragana sinica* stimulates the proliferation, differentiation and maturation of cultured osteoblasts *in vitro* [2]. In our laboratory, many oligostilbenes, some of which exhibit estrogenic activity, have been found in the plant [3]. The aerial part of the plant has been scarcely used, being considered as waste product. However, our recent studies on the aerial part of the plant showed that it could be a rich resources of oligostilbenes. We report here the isolation and structure elucidation of the two new oligostilbenes carasiphenol A (**1**) and carasiphenol B (**2**), together with five known compounds, (+)- ϵ -viniferin (**3**) [4], (+)- α -viniferin (**4**) [5], miyabenol C (**5**) [6], pallidol (**6**) [7] and kobophenol A (**7**) [8] from the EtOAc extract of the aerial part of *Caragana sinica*. Among them, (+)- ϵ -viniferin (**3**) is obtained from this genus for the first time, and the structure of (**6**, Fig. 1) has been determined by X-ray crystallographic analysis.

RESULTS AND DISCUSSION

Carasiphenol A (**1**) has been isolated as a yellowish amorphous powder, $[\alpha]_D^{20} = -24.1$ (*c* 0.356, MeOH). Its molecular formula of $C_{27}H_{24}O_5$ was established by HRFAB-MS *m/z*

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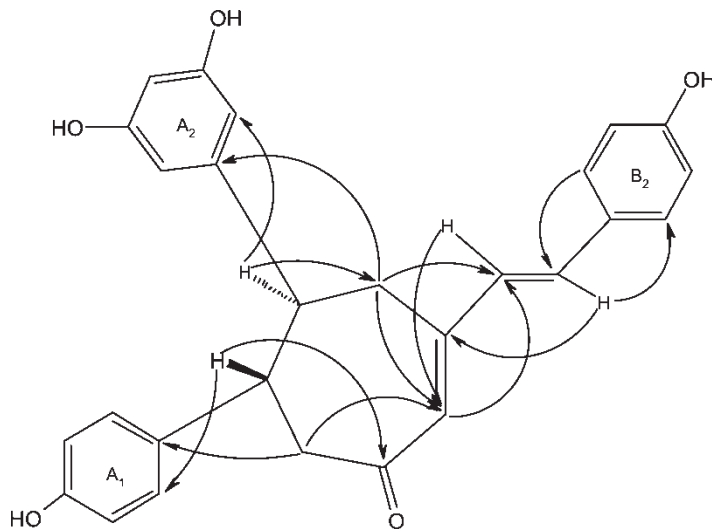


8

FIGURE 1 Structure of 1, 2, 6, and 8.

429.1721 [MH]⁺. The intense UV (MeOH) absorption of **1** (λ_{\max} : 359 nm, $\log \epsilon$ 3.5) reveals a strongly conjugated system in the structure. The IR spectrum (KBr) shows hydroxyl groups (3375 cm^{-1}), an α,β -unsaturated ketone group (1690 cm^{-1}), aromatic and olefinic groups ($1655, 1610, 1528, 1500 \text{ cm}^{-1}$) and prominent 1,4-disubstituted benzene groups (846 cm^{-1}). The ¹H NMR spectrum exhibits signals for two 4-hydroxy-1-substituted phenyl groups at δ 6.64 (2H, d, $J = 8.6 \text{ Hz}$) and 6.91 (2H, d, $J = 8.6 \text{ Hz}$), 6.81 (2H, d, $J = 8.6 \text{ Hz}$) and 7.31 (2H, d, $J = 8.6 \text{ Hz}$), one 3,5-dihydroxy-1-substituted phenyl group at δ 6.14 (2H, d, $J = 2.1 \text{ Hz}$) and 6.12 (H, t, $J = 2.1 \text{ Hz}$), two aliphatic methine protons at 3.15 (1H, brs) and 3.33 (1H, dd, $J = 2.3, 6.1 \text{ Hz}$), two aliphatic methylene protons at δ 3.16 (2H, brs) and 3.01 (2H, d, $J = 5.9 \text{ Hz}$), and two mutually coupled olefinic protons δ 6.75 (1H, d, $J = 16.7 \text{ Hz}$) and 6.89 (1H, d, $J = 16.7 \text{ Hz}$). The ¹³C NMR spectrum reveals one carbonyl carbon (δ 202.4) and four aliphatic carbons as well as 23 unsaturation carbons. All these data suggest that **1** could be a resveratrol dimer. In HMBC, significant correlations between H-7a/C-11b, H-7a/C-13b, H-8a/C-9b, H-8a/C-12b, H-13b/C-10b, H-10b/C-12b, H-10b/C-13b, together with the ¹H-¹H COSY NMR data, H-8a/H-7a, H-7a/H-12b, H-8a/H-13b, indicate a seven-membered ring B₂, and correlations between H-10b/C-8b, H-13b/C-8b, H-2b/C-7b, and H-6b/C-7b indicate that ring B₁ is attached to C-7b and ring B₂ is attached to C-8b. Therefore, the planar structure of **1** is established as shown in Fig. 2. The stereochemistry of **1** was established on the basis of the NOESY experiment. The NOE signals between H-8a/H-2(6)a, H-7a/H-10(14)a indicate that H-7a and H-8a are situated in a *trans* orientation.

Carasiphenol B (**2**) was isolated as yellowish amorphous powder, $[\alpha]_{\text{D}}^{20} = -18.4$ (c 0.274, MeOH). Its molecular formula of C₄₂H₃₂O₉ was established by HRFAB-MS m/z 681.2130 [MH]⁺. The UV (MeOH) absorption (λ_{\max} 263 nm, $\log \epsilon$ 1.8) shows

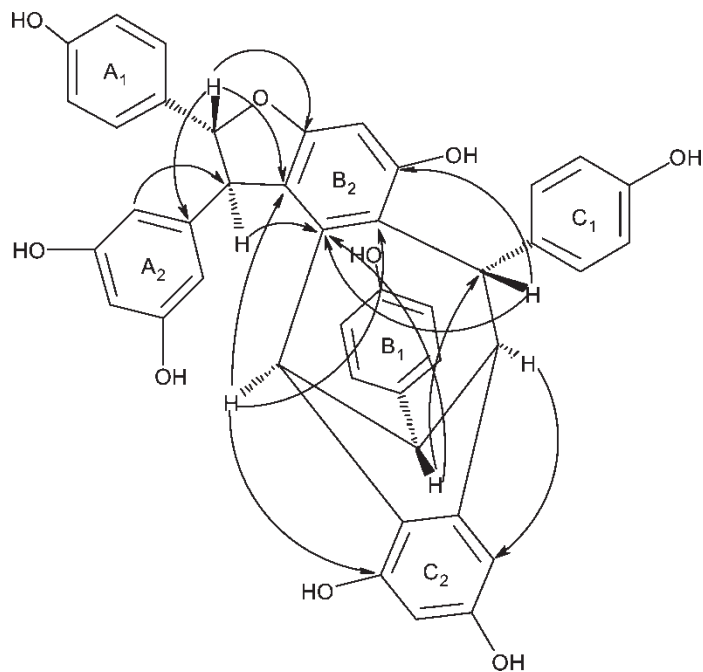
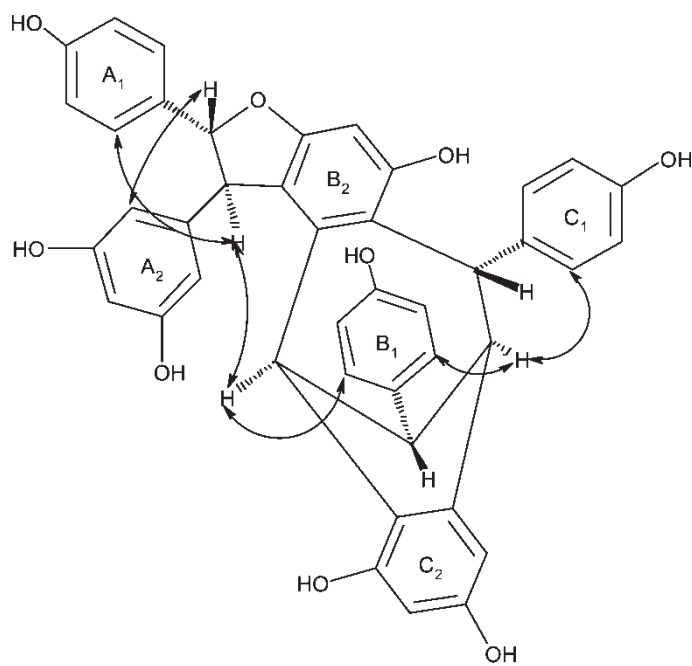
FIGURE 2 Important HMBC correlations of **1**.

the presence of aromatic rings in the structure. The IR spectrum (KBr) reveals hydroxyl groups (3275 cm^{-1}), aromatic groups ($1609, 1512\text{ cm}^{-1}$) and prominent 1,4-disubstituted benzene groups (830 cm^{-1}). The ^1H NMR spectrum exhibits signals for three 4-hydroxy-1-substituted phenyl groups at δ 7.20 (2H, d, $J = 8.3\text{ Hz}$) and 6.81 (2H, d, $J = 8.3\text{ Hz}$); 6.56 (2H, d, $J = 8.6\text{ Hz}$) and 6.45 (2H, d, $J = 8.6\text{ Hz}$); δ 7.10 (2H, d, $J = 8.3\text{ Hz}$) and 6.74 (2H, d, $J = 8.3\text{ Hz}$); one 3,5-dihydroxy-1-substituted phenyl group at δ 6.37 (2H, d, $J = 1.8\text{ Hz}$) and 6.31 (H, t, $J = 1.8\text{ Hz}$); one 3,5-dihydroxy-1,2-disubstituted phenyl group at δ 6.09 (H, d, $J = 1.4\text{ Hz}$) and 6.21 (1H, d, $J = 1.4\text{ Hz}$); one aromatic proton at δ 6.15 (1H). The ^{13}C NMR spectrum exhibits the presence of six aliphatic carbons besides 36 aromatic carbons. All these data suggest that **2** could be a resveratrol trimer. ^1H and ^{13}C NMR features of **2** are similar to those of a segment of vatdiospyroidol (**8**) except that **8** is a tetramer [9]. In the HMBC spectrum (Fig. 3), the significant correlations H-8b/C-9c, H-8b/C-14b, H-8c/C-10c, H-8c/C-14b, H-7c/C-9c indicate a seven-membered ring, while those of H-7a/C-10b, H-8a/C-9b, H-8a/C-11b indicate a dihydrobenzofuran ring. Further significant correlations, H-7b/C-9b, H-7b/C-10c, H-7b/C-7c, H-7b/C-9c, indicate that C-7b is connected to C-8b and C-8c. All the above data suggest that the planar structure of **2** is as shown in Fig. 3. The NOE correlations (Fig. 4) H-8c/H-2(6)c, H-8c/H-2(6)b, H-8b/H-2(6)b, H-8a/H-8b, H-7a/H-10(14)a and H-8a/H-2(6) suggest that H-8c and H-7c, H-8c and H-7b, H-8b and H-7b, H-8a and H-7a could be *trans*, and that H-8a and H-7b could be *cis*. The relative configuration of **2** is shown in Fig. 4.

EXPERIMENTAL

General Experimental Procedures

Melting points were determined on a Kofler micro-melting point apparatus and are uncorrected. UV spectra were obtained on a Shimadzu UV-240 spectrophotometer. IR spectra were recorded as KBr pellets on a Perkin-Elmer 783 infrared spectrophotometer.

FIGURE 3 Selected HMBC correlations of **2**.FIGURE 4 Selected NOE interactions of **2**.

Optical rotations were determined on a Perkin-Elmer 241 polarimeter. HR-FABMS was measured with a VG AutoSpec 3000 mass spectrometer. The NMR spectra were recorded on a Bruker AM-400 spectrometer using TMS as internal standard. X-Ray analysis was performed with a SMART APREX CCD diffractometer.

Plant Material

The aerial part of *Caragana sinica* (Buc'hoz) Rhed. was purchased in September 2001 from Zhongxiang County, Hubei Province China. The original plant was identified by Professor Zhi-Jian Feng, Department of Biology, Shanghai East China Normal University. A voucher specimen has been deposited in the herbarium Department of Biology, Shanghai East China Normal University.

Extraction and Isolation

The air-dried and powdered aerial part of *Caragana sinica* (Buc'hoz) Rhed (70 kg) was macerated with 95% ethanol at room temperature. The solvent was then evaporated *in vacuo* to yield a residue (5 kg) that was subsequently successively partitioned between H₂O and light petroleum, EtOAc. The EtOAc extract (230 g) was subjected to a silica-gel column (1.5 kg, 200–300 mesh), eluted with CHCl₃–MeOH (10:1, 9:1, 8:2, 7:3, 6:4) and MeOH, to afford six fractions (A–F). Fraction C was subjected to column chromatography (300–400 mesh), eluted with light petroleum–Et₂O (6:4), to yield **3** (170 mg), **4** (8.7 g), **5** (60 mg) and **7** (6.4 g). From Fraction D, **1** (18 mg) and **6** (120 mg) were obtained by chromatography on silica-gel, eluted with light petroleum–Et₂O (4:6), and then Sephadex LH-20, eluted with CHCl₃–MeOH (1:3); pallidol (**6**) was purified by crystallization in MeOH–H₂O. Compound **2** (12 mg) was obtained from Fraction E by column chromatography on silica gel, eluted

TABLE I ¹H (400 MHz) and ¹³C NMR (100 MHz) spectral data for **1** in acetone-d₆ (δ in ppm, J in Hz)

Position	<i>I</i>	
	δ _H (J)	δ _C
1a		137.1
2a (6a)	6.91 (d, 8.6)	129.7
3a (5a)	6.64 (d, 8.6)	116.1
4a		156.9
7a	3.33 (brs d, 5.6)	46.7
8a	3.15 (brs)	52.8
9a		149.0
10a (14a)	6.14 (d, 2.1)	107.3
11a (13a)		159.5
12a	6.12 (d, 2.1)	101.8
1b		129.9
2b (6b)	7.31 (d, 8.7)	130.1
3b (5b)	6.81 (d, 8.7)	116.8
4b		159.6
7b	6.75 (d, 16.0)	136.0
8b	6.89 (d, 16.0)	129.7
9b		155.9
10b	6.18 (s)	131.9
11b		202.4
12b	3.01 (d, 6.0)	50.8
13b	3.16 (m)	35.1

All assignments were confirmed by HMQC and HMBC spectra.

with light petroleum–Et₂O (4:6), and then reversed-phase silica gel (RP-18) eluted with MeOH–H₂O (4:6).

Carasiphenol A (1)

A yellowish amorphous powder, mp 265–268°C (CHCl₃–MeOH), $[\alpha]_D^{20} = -24.1$ (*c* 0.356, MeOH); UV (MeOH) λ_{\max} : 359 (log ϵ 3.5) nm; ¹H and ¹³C NMR data are shown in Table I; IR (KBr) ν (cm⁻¹): 3375, 1690, 1655, 1610, 1528, 1500, 1475, 1327, 1050, 960, 846; HRFAB-MS *m/z* 429.1721 [MH]⁺ (C₂₇H₂₅O₅ calcd for 429.1702).

TABLE II ¹H (400 MHz) and ¹³C NMR (100 MHz) spectral data for **8** and **2** in acetone-d₆ ((in ppm, *J* in Hz)

Position	8		2	
	δ_H	δ_C	δ_H	δ_C
1a		134.2		134.4
2a (6a)	7.23 (d, 8.5)	128.1	7.20 (d, 8.3)	128.9
3a (5a)	6.84 (d, 8.5)	116.0	6.81 (d, 8.5)	116.4
4a		158.1		158.1
7a	5.52 (d, 6.5)	94.1	5.38 (d, 6.3)	94.7
8a	4.93 (d, 6.5)	56.8	4.93 (d, 6.3)	56.9
9a		148.3		148.7
10a (14a)	6.40 (d, 2.0)	107.4	6.37 (d, 1.8)	107.6
11a (13a)		159.9		160.1
12a	6.36 (d, 2.0)	101.8	6.31 (t, 1.8)	102.2
1b		134.2		135.4
2b (6b)	6.35 (d, 8.4)	129.4	6.56 (d, 8.6)	129.6
3b (5b)	6.45 (d, 8.4)	115.9	6.45 (d, 8.6)	115.7
4b		155.7		156.3
7b	3.38 (s)	49.6	3.51 (s)	49.9
8b	4.00 (s)	47.5	4.01 (s)	46.9
9b		144.0		144.4
10b		114.6		115.0
11b		157.8		158.1
12b	6.16 (s)	95.8	6.15 (s)	96.0
13b		159.8		160.0
14b		117.8		118.0
1c		138.3		139.0
2c (6c)	7.01 (d, 8.5)	129.9	7.10 (d, 8.2)	130.2
3c (5c)	6.65 (d, 8.5)	115.5	6.74 (d, 8.2)	116.0
4c		156.0		156.4
7c	4.17 (brs)	45.5	4.20 (brs)	48.1
8c	3.10 (brs)	52.0	3.37 (brs)	56.8
9c		143.1		148.7
10c		128.2		127.0
11c		153.4		153.7
12c	6.12 (s)	95.9	6.09 (d, 1.4)	102.0
13c		160.9		158.5
14c		118.5	6.56 (d, 1.4)	104.0
1d		133.4		
2d (6d)	7.24 (d, 8.5)	128.5		
3d (5d)	6.83 (d, 8.5)	116.1		
4d		156.0		
7d	5.61 (d, 7.7)	94.1		
8d	4.56 (d, 7.7)	57.7		
9d		145.9		
10d	6.55 (d, 2.5)	108.1		
11d		159.8		
12d	6.32 (d, 2.5)	102.2		
13d		159.8		
14d	6.55 (d, 2.5)	108.1		

All assignments were confirmed by HMQC and HMBC spectra.

Carasiphenol B (2)

A yellowish amorphous powder (CHCl₃–MeOH), mp >270°C, $[\alpha]_D^{20} = -18.4$ (c 0.274 MeOH); UV (MeOH) λ_{\max} : 263 (log ϵ 1.8) nm; ¹H and ¹³C NMR data are shown in Table II; IR (KBr) ν (cm⁻¹): 3275, 1609, 1512, 1436, 1334, 1175, 1028, 830; HRFAB-MS *m/z*: 681.2130 [MH]⁺ (calcd. for C₄₂H₃₃O₉, 681.2125).

X-ray Crystallographic Analysis

Pallidol (**6**) crystallized in cubic I23 with molecules of composition C₂₈H₂₇O_{8.5} (*Z* = 12), and accurate cell constants of *a* = 20.2020(13) Å, and *v* = 8244.9(9) Å³. All reflections were collected on the CCD area detector diffractometer; MoK_α radiation (λ = 0.71073 Å), maximum 2 θ of 24.97, independent reflections: 2417, observed number of reflections: 1788 [$|F|^2 \geq 2\delta|F|^2$]. The structure was resolved by direct methods (SHELXS-97) and expanded using SHELXS-97/2, refined by full-matrix least-squares calculation. Hydrogen atoms were fixed at calculated positions. The final indices were *R*_f = 0.0769, *R*_w = 0.1966.

References

- [1] Jiangsu New Medical College (1975) The Dictionary of Traditional Medicine (Shanghai Scientific & Technical Press), p 1402.
- [2] Luo, H.F., Zhang, L.P. and Hu, C.Q. (2001), *Tetrahedron* **57**, 4849–4854.
- [3] Tian, C.Y., Hu, C.Ch., Xu, G. and Song, H.Y. (2002), *Acta Pharmacol. Sin.* **23**, 572–576.
- [4] Wen, W.L., Li, Sh., Ding, B., Gang, L. and Yao, Z.Ch. (1996), *Phytochemistry* **42**, 1163–1165.
- [5] Kitanaka, S., Ikezawa, T., Yasukawa, K., Takido, M., Sung, H.K. and Kim, I.A. (1990), *Chem. Pharm. Bull.* **38**, 432–434.
- [6] Ken, S., Tomoko, S., Jun, K. and Junya, M. (1987), *Agric. Biol. Chem.* **51**, 1003–1008.
- [7] Ohyama, M., Tanaka, T., Inuma, M. and Goto, K. (1994), *Chem. Pharm. Bull.* **42**, 2117–2120.
- [8] Kurihara, H., Kawabata, J., Ichikawa, S., Mishima, M. and Mizutani, J. (1991), *Phytochemistry* **30**, 649–652.
- [9] Eun, K.S., Chai, H., Constant, H.L. and Santisuk, T. (1999), *J. Org. Chem.* **64**, 6976–6983.