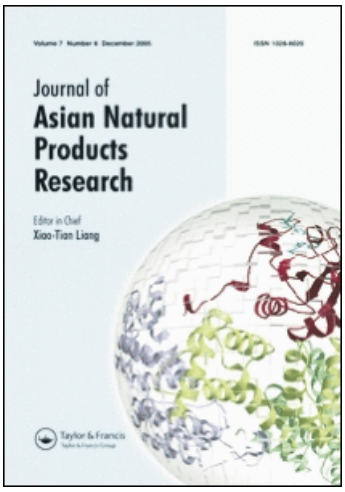

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Flavonoids from the leaves of *Pleioblastus argenteastriatus*

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A new flavonoid, 5,7,3′-trihydroxy-6-*C*-β-D-digitoxopyranosyl-4′-*O*-β-D-glucopyranosyl flavonoside (**1**), along with four known flavonoids 5,7,4′-trihydroxy-3′,5′-dimethoxy flavone (**2**), 5,3′,4′-trihydroxy-7-*O*-β-D-glucopyranosyl flavonoside (**3**), 5,4′-dihydroxy-3′,5′-dimethoxy-7-*O*-β-D-glucopyranosyl flavonoside (**4**), 5,3′,4′-trihydroxy-6-*C*-[β-D-glucopyranosyl-(1 → 6)]-β-D-glucopyranosyl flavonoside (**5**) were isolated from 95% EtOH extract of the leaves of *Pleioblastus argenteastriatus*. Their structures were determined on the basis of spectroscopic techniques and chemical methods.

Keywords: *Pleioblastus argenteastriatus*; flavonoids; 5,7,3′-trihydroxy-6-*C*-β-D-digitoxopyranosyl-4′-*O*-β-D-glucopyranosyl flavonoside

1. Introduction

Bamboo comprises over 1300 species, and more than 500 bamboo species have been found in China. *Pleioblastus argenteastriatus* is one of the bamboo species found in China. Chinese people realized the medical and health care effects of bamboo leafs long ago, and used it or its extract as a traditional Chinese medicine and food additive. The leaves of *Pleioblastus amarus*, the same genus bamboo species as *P. argenteastriatus*, had been used for the treatment of insomnia and diabetes and had the effects of improving eyesight and relieving alcoholism [1]. Previous phytochemical research on bamboo leaves showed the presence of orientin, homoorientin, vitexin, isovitexin, and flavonoids [2–4]. Flavonoids showed significant anti-inflammatory and anti-oxidant activities, and had the effects of treating cardiovascular diseases [5–7] and different types of cancer [8]. The leaves of *P. argenteastriatus* were rich in flavonoids, [9,10] which prompted us to further investigate the flavonoids in this species. Extensive chromatography of the EtOH extract of the leaves of *P. argenteastriatus* had led to the isolation of a new flavonoid and four known flavonoids reported from this species for the first time. This paper deals with the isolation and structural elucidation of the new compound (**1**).

2. Results and discussion

Compound **1** was obtained as a yellow amorphous powder, mp 180.3–181.0□, $[\alpha]_D^{20}$ + 20.3 (*c* 0.15, MeOH). The molecular formula, $C_{27}H_{29}O_{14}$, was deduced from the negative HRESIMS at *m/z* 577.1513 $[M\text{-}H]^-$. The ESIMS (negative) showed ion peaks at *m/z* 577.2 $[M\text{-}H]^-$ and 1155.3 $[2M\text{-}H]^-$. It was recognized as a flavonoid from a positive test with Mg–HCl and Molish reagents. The IR spectrum displayed characteristic absorption bands for hydroxyl (3413.6 cm^{-1}), carbonyl (1655.0 cm^{-1}), and aromatic rings (1627.0, 1508.3, 1491.3, 1439.3 cm^{-1}). The UV spectrum showed absorption maxima at 212.3,

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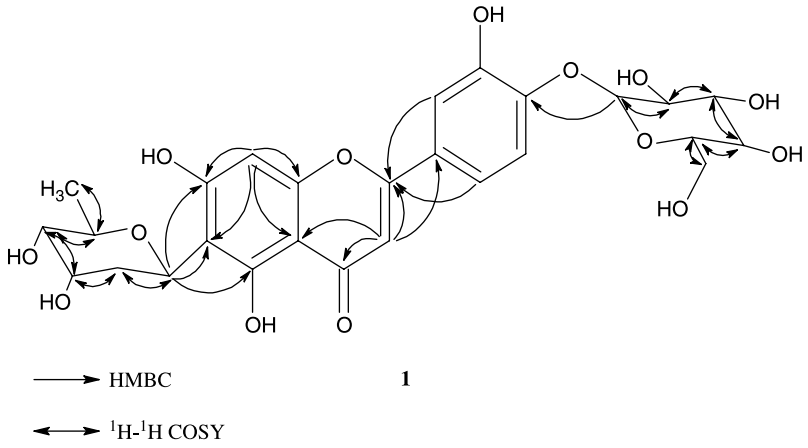

Figure 1. Significant HMBC and $^{1}H-^{1}H$ COSY correlations of **1**.

272.4, 340.2 nm, characteristic for the flavonoid. Besides the characteristic signal for A,C-rings of the flavone skeleton at δ 6.57 (1H, s) and 6.85 (1H, s), the ^{1}H NMR spectrum of compound **1** displayed signals of a 1',3',4' tri-substituted phenyl moiety (B-ring) at δ 7.50 (1H, d, $J = 1.8$ Hz), 7.23 (1H, d, $J = 9.0$ Hz), and 7.52 (1H, dd, $J = 1.8$, 9.0 Hz), as well as nine oxygenated proton signals at δ 3.17–3.73, one methyl group at δ 1.17 (3H, d, $J = 6.6$ Hz), and one methylene group at δ 1.59 (1H, m), 2.03 (1H, dd, $J = 12.0$, 2.4 Hz). Two anomeric proton signals at δ 4.98 (1H, dd, $J = 12.0$, 3.0 Hz) and 4.80 (1H, d, $J = 7.8$ Hz) suggested the presence of two sugar units in compound **1**, which were identified as glucose and digitoxose by ^{13}C NMR and ^{1}H NMR analyses. Acid hydrolysis of compound **1** affording only glucose indicated that the digitoxose was linked to the aglycone with C—C bond. This assignment was also proved by the ^{13}C NMR signals at δ 70.2, which was the characteristic signal of anomeric carbon of C-digitoxose. In the HMBC spectrum (see Figure 1), long-range correlations from H-1 of digitoxose to C-5, C-6, and C-7 of the flavone nucleus showed that the digitoxose was linked to C-6 of the flavone nucleus. The ^{13}C NMR signal at δ 101.0 was assignable to the anomeric carbon of glucose. In the HMBC spectrum (see Figure 1), long-range correlations from H-1 of glucose to C-4' of the flavone nucleus and its $\delta_{c\text{-}1}$ 101.0 showed that glucose was linked to C-4' of the flavone nucleus by C—O—C bond. All the proton and carbon signals were assigned by HSQC, DEPT, ^{1}H-^{1}HCOSY, and HMBC experiments. The coupling constants of anomeric protons indicated that glucosyl and digitosyl linkage were

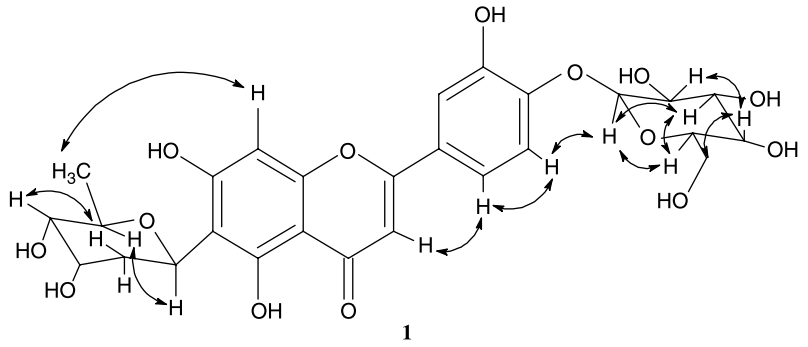

Figure 2. Significant NOESY correlations of **1**.

Table 1. NMR spectral data (δ, ppm) for compound **1** in DMSO-d_6.[a]

Aglycone moiety					Sugar moiety				
No.	δ_H	δ_{OH}	δ_C	DEPT	No.	δ_H	δ_{OH}	δ_C	DEPT
2			163.4	C	Dig				
3	6.85 (1H, s)		103.9	CH	1″	4.98 (1H, dd, 12.0, 3.0)		70.2	CH
4			182.0	C	2″	1.59 (1H, m), 2.03 (1H, q, 12.0, 2.4)		32.4	CH_2
5		13.4 s	157.4	C	3″	3.45 (1H, m)	4.69 brs	69.6	CH
6			110.1	C	4″	3.71 (1H, d, 12.6)	4.76 brs	68.5	CH
7		9.1 brs	162.4	C	5″	3.64 (1H, dd, 6.6, 12.6)		74.5	CH
8	6.57 (1H, s)		94.8	CH	6″	1.17 (3H, d, 6.6)		17.4	CH_3
9			156.2	C	Glu				
10			103.5	C	1″	4.80 (1H, d, 7.8)		101.0	CH
1′			124.6	C	2″	3.34 (1H, m)	5.39 brs	73.2	CH
2′	7.50 (1H, d, 1.8)		113.6	CH	3″	3.32 (1H, m)	5.12 brs	75.8	CH
3′		9.7 brs	146.9	C	4″	3.17 (1H, m)	5.07 brs	69.8	CH
4′			148.6	C	5″	3.40 (1H, m)		77.3	CH
5′	7.23 (1H, d, 9.0)		116.0	CH	6″	3.73 (1H, m), 3.48 (1H, m)	4.62 t (5.9)	60.7	CH_2
6′	7.52 (1H, dd, 1.8, 9.0)		118.6	CH					

[a]The ^1H and ^{13}C NMR spectral data were measured at 600 MHz, and the *J* values (parentheses) are in hertz.

β-configurations [11,12]. This assignment was also proved by the significant NOESY correlations (see Figure 2). On the basis of the above evidence, the structure of compound **1** was determined as 5,7,3′-trihydroxy-6-*C*-β-D-digitoxopyranosyl-4′-*O*-β-D-glucopyranosyl flavonoside.

3. Experimental

3.1 General experimental procedures

Melting points were determined with Shenguang WRX-1S thermal values analyzer with microscope and are uncorrected. The optical rotation was measured with a Perkin-Elmer 343 Polarimeter. UV spectra were obtained on Waters 2695 HPLC with photodiode array detector. IR spectra were taken on a Thermo Nicolet FT-IR NEXUS 670 spectrophotometer with KBr pellets. NMR spectra were recorded on Varian System-600. HRESIMS spectra were performed on AutoSpec Ultima-TOF mass spectrometer and ESIMS data were obtained with an Agilent 1100 Series mass spectrometer.

3.2 Plant material

The leaves of *P. argenteastriatus* were collected from Anji County, Zhejiang Province, China in November 2005, and identified by Professor Yulong Ding, Bamboo Research Institute, Nanjing Forestry University, Nanjing, China. A voucher specimen (200511-04) is deposited at the International Centre for Bamboo and Rattan (ICBR), Beijing, China.

3.3 Extraction and isolation

The shade-dried leaves of *P. argenteastriatus* (0.96 kg) were extracted with 95% EtOH by cold percolation for three times. A residue of 98.0 g was obtained after removal of the solvent by evaporation. The residue was suspended in H_2O and extracted with petroleum ether. The fraction after being extracted with petroleum ether was subjected to macroporous absorption resin (AB-8) and eluted with H_2O, 20% EtOH, 40% EtOH, 60% EtOH, 80% EtOH, and acetone. The 20% EtOH fraction (11.9 g) was then chromatographed over Sephadex LH-20 and eluted with MeOH repeatedly, to yield compound **5** (449.3 mg). The 40% EtOH fraction (33.2 g) was then chromatographed over Sephadex LH-20 and eluted with MeOH repeatedly, to yield compounds **1** (29.6 mg) and **4** (10.0 mg). The 60% EtOH fraction (7.3 g) was then chromatographed over Sephadex LH-20 and eluted with MeOH repeatedly, to yield compounds **2** (107.4 mg) and **3** (5.0 mg).

3.3.1 5,7,3′-Trihydroxy-6-C-β-D-digitoxopyranosyl-4′-O-β-D-glucopyranosyl flavonoside (1)

Yellow amorphous powder (MeOH), mp 180.3–181.0□ $[\alpha]_D^{20} + 20.3$ (*c* 0.15, MeOH); UV λ_{max} (nm): 212.3, 272.4, 340.2; FT-IR (KBr) ν_{max} (cm^{-1}): 3413.6, 1655.0, 1627.0, 1508.3, 1491.3, 1439.3; ^1H and ^{13}C NMR data (see Table 1); HRESIMS, *m/z* 577.1513 $[M-H]^-$ (calcd for $C_{27}H_{29}O_{14}$, 577.1557); Negative ion ESIMS *m/z* 577.2 $[M-H]^-$, 1155.3 $[2M-H]^-$.

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References

[1] S.Z. Li, *Compendium of Materia Medica*, Vol. 3, (People's Medical Publishing House, Beijing, 1978), (in Chinese) p. 1684.
[2] Y. Zhang, B.L. Bao, B.Y. Lu, Y.P. Ren, X.W. Tie, and Y. Zhang, *J. Chromatogr. A.* **1065**, 177 (2005).
[3] J. Burns, P.T. Gardner, J.O. Neil, S. Crawford, I. Morecroft, D.B. McPhail, C. Lister, D. Matthews, M.R. MacLean, M.E. Lean, G.G. Duthie, and A. Crozier, *J. Agric. Food Chem.* **48**, 220 (2000).
[4] T. Kaneko and N. Baba, *Biosci. Biotechnol. Biochem.* **63**, 323 (1999).

[5] M.G. Hertog, D. Kromhout, C. Aravanis, H. Blackburn, R. Buzina, F. Fidanza, S. Giampaoli, A. Jansen, A. Menotti, and S. Nedeljkovic, *Arch. Intern. Med.* **155**, 381 (1995).
[6] P. Knekt, R. Jarvinen, A. Reunanen, and J. Maatela, *Br. Med. J.* **312**, 478 (1996).
[7] L. Yochum, L.H. Kushi, K. Meyer, and A.R. Folsom, *Am. J. Epidemiol.* **149**, 943 (1999).
[8] L.L. Marchand, S.P. Murphy, J.H. Hankin, L.R. Wilkens, and L.N. Kolonel, *J. Natl. Cancer Inst.* **92**, 154 (2000).
[9] X.F. Guo, Y.D. Yue, F. Tang, J. Wang, and X. Yao, *Spectrosc. Spect. Anal.* **28**, 1600 (2008).
[10] X.F. Guo, Y.D. Yue, F. Tang, J. Wang, and X. Yao, *Spectrosc. Spect. Anal.* **28**, 1800 (2008).
[11] N. Wang, J.H. Wang, X. Li, J.H. Ling, and N. Li, *J. Asian Nat. Prod. Res.* **8**, 753 (2006).
[12] Z.G. Zheng, R.H. Liu, L.Y. Kong, and W.D. Zhang, *Chin. Chem. Lett.* **17**, 919 (2006).