A NEW FLAVONOL DERIVATIVE FROM *Fagopyrum dibotrys*

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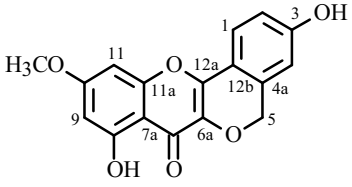
*A new flavonol derivative 3, 8-dihydroxy-10-methoxy-5-*H*-isochromeno[4, 3-b]chromen-7-one (**1**) together with four known compounds, glutinone (**2**), luteolin (**3**), acacetin 7-*O*-α-L-rhamnopyranosyl- (1→6)-β-D-glucopyranoside (**4**), and rutin (**5**) were isolated from the dried roots of* Fagopyrum dibotrys. *Their structures were determined by UV, IR, MS, ^{1}H, and ^{13}C NMR spectroscopic analysis, including 2D NMR.*

Key words: *Fagopyrum dibotrys*, flavonol derivative, 3,8-dihydroxy-10-methoxy-5-*H*-isochromeno[4,3-*b*]chromen-7-one.

Fagopyrum dibotrys (D. Bon) Hara, belonging to the *Fagopyrum* genus in the Polygonaceae family, is widely distributed in China. The root of *Fagopyrum dibotrys* is a traditional Chinese medicine used for the treatment of dysenteria, diarrhea, dyspeptic disease of the intestine and stomach, swelling of throat, and rheumatalgia [1]. Modern pharmacological research indicates that *Fagopyrum dibotrys* possesses various activities such as anti-tumor, blood-sugar and fat reducing activities, anti-rheumatism, anti-oxidation, analgesia, and antifebrile [2]. Some flavonoids, terpenoids, steroids, and organic acids have been isolated and reported from this plant [3]. In the search for its biologically active constituents, we investigated the constituents in the ethanol extract of the plant. In this paper, we report the isolation and structure elucidation of a new compound **1** along with four known compounds: glutinone (**2**) [4], luteolin (**3**) [4], acacetin 7-*O*-*α*-L-rhamnopyranosyl-(1→6)-*β*-D-glucopyranoside (**4**) [5], and rutin (**5**) [6].



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Compound **1** was obtained as yellow needles, mp 236–238°C; UV (MeOH, λ_{max}, nm): 275, 323, 376. The ESI-MS afforded the molecular ion $[M]^+$ at *m/z* 312, consistent with the molecular formula of $C_{17}H_{12}O_6$, which was confirmed by the HRESI-MS exhibiting a *quasi*-molecular ion $[M+H]^+$ at *m/z* 313.0718 (calcd 313.0712). The IR spectrum (KBr, cm^{-1}) showed absorptions at 3200 (O-H), 1657 (C=O), 1650 (C=C), 1600, 1500 (phenyl). The ^{13}C NMR spectrum showed the presence of 17 carbons. The ^{1}H NMR spectrum of **1** was similar to 10-dihydroxy-5-isochromeno[4,3-*b*] chromen-7-one [7] except for the substituted pattern of the aromatic ring B. The ^{1}H NMR spectrum displayed the 1,3,4-substituted pattern of the aromatic ring B (δ 6.76, 6.91, 7.67 due to H-4, H-2 and H-1). The signals at δ 6.36 and 6.70 (each 1H, d, J = 2.2 Hz) were attributed to H-9 and H-11, supported by the singlet of a chelated hydroxyl proton at δ 12.76 in position 8 of the A-ring. The singlet at δ 5.17 corresponding to two protons can be assigned to a methylene group at δ_C 67.2 in the ^{13}C NMR spectrum. Furthermore, the ^{1}H NMR spectrum inhibited the singlet of the methoxyl group at δ_H 3.86 corresponding to the ^{13}C NMR signal at δ_C 55.9. The ^{13}C NMR spectrum of compound **1** revealed signals for the corresponding carbon. The full assignments of ^{1}H and ^{13}C NMR signals were accomplished by a combination of ^{13}C NMR DEPT, HSQC and HMBC, and NOESY data (Table 1).

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TABLE 1. ^{1}H NMR and ^{13}C NMR and HMBC Spectral Data of Compound **1** (DMSO-d_6, δ, ppm, J/Hz)

Position	δ_C	δ_H	HMBC	Position	δ_C	δ_H	HMBC
1	123.8	7.67 (d, J = 8.5)	-	9	97.6	6.36 (d, J = 2.2)	H-11, 8-OH
2	115.8	6.91 (dd, J = 2.3, 8.5)	H-4	10	164.6	-	H-9, H-11, $OC\underline{H}_3$
3	161.1	-	H-1, H-2	11	92.3	6.70 (d, J = 2.2)	H-9
4	111.8	6.76 (d, J = 2.3)	H-2, H-5	11a	155.6	-	H-11
4a	134.9	-	H-1, H-5	12a	149.1	-	H-1
5	67.2	5.17 (s)	H-4	12b	114.9	-	H-2, H-4, H-5
6a	133.2	-	H-5	OCH_3	55.9	3.86 (s)	-
7	174.0	-	-	3-OH	-	10.44	-
7a	105.4	-	H-9, H-11, 8-OH	8-OH	-	12.76	-
8	161.2	-	H-9, 8-OH				

In the HMBC spectrum, correlation signals between the proton of the methoxyl group (δ_H 3.86) and C-10 (δ_C 164.6) were observed, as well as between H-5 (δ_H 5.17) with C-4 (δ_C 111.8), C-4a (δ_C 134.9), C-6a (δ_C 133.2), and C-12b (δ_C 114.9). The above assignments were confirmed by the NOESY experiment. The methylene proton (δ_H 5.17) showed a correlation to proton H-4 (δ_H 6.76). Based on the above spectral analysis, the structure of compound **1** was determined as 3, 8-dihydroxy-10-methoxy-5-*H*-isochromeno[4,3-*b*]chromen-7-one, it is a new compound.

EXPERIMENTAL

General Experimental Procedures. Melting points (mp) were determined using an X-4 micromelting-point apparatus (Beijing, China) and were uncorrected. UV spectra were measured on a Shimadzu UV-2450 spectrometer (Kyoto, Japan). IR spectra were obtained on KBr pellets using a Nicolet Impact 410 spectrometer (Madison, USA). The ^{1}H and ^{13}C NMR spectra were obtained on a Bruker AV-500 spectrometer (Bruker, Falladen, Switzerland) with TMS as an internal standard. ESI-MS and HR-ESI-MS measurements were undertaken on an Agilent-1100-LC/MSD-Trap and Micro-Q-TOF spectrometer (Agilent, USA). TLC and column chromatography were performed on plates precoated with silica gel GF254 and silica gel (200–300 mesh; Qingdao Marine Chemical Ltd., Qingdao, China), respectively.

Plant Materials. *Fagopyrum dibotrys* was collected from Bozhou, Anhui Province, China in September 2005 and was identified by Pr. S. H. Qian in the Jiangsu Provincial Academy of Traditional Chinese Medicine. A voucher specimen was deposited in the Herbarium of the Jiangsu Provincial Academy of Traditional Chinese Medicine, Nanjing.

Extraction and Isolation. The dried aerial parts of *Fagopyrum dibotrys* (5 kg) were extracted three times with 80% ethanol under reflux. After removal of the solvent by evaporation, the extract was suspended in H_2O and then successively extracted with peltroleum ether, EtOAc, and *n*-BuOH. The petroleum ether extract was chromatographed on a silica gel (100–200 mesh; 600 g) column, eluting with a petroleum ether–EtOAc (100:5–60:40) mixture to afford compound **2**. The EtOAc extract was chromatographed on a silica gel (100–200 mesh; 850 g) column, eluting with a $CHCl_3$–MeOH gradient (10:1–6:4) to afford compounds **1** and **3**. The *n*-BuOH extract was separated over a silica gel (100–200 mesh; 1000 g) column eluted with $CHCl_3$–MeOH gradient (10:2–5:5) to afford compounds **4** and **5**.

Compound 1: yellow needles, mp 236–238°C ($CHCl_3$). UV (MeOH, λ_{max}, nm): 275, 323, 376. IR (KBr, cm^{-1}): 3200, 1657, 1650, 1600, 1500. ESI-MS $[M]^+$ *m/z* 312; HRESI-MS ($[M+H]^+$ 313.0718, calcd. 313.0712). ^{1}H NMR, ^{13}C NMR spectral data are given in Table 1.

Compound 2: white needles, mp 201–203°C ($CHCl_3$). EI-MS *m/z*: 424 $[M]^+$. ^{1}H NMR (500 MHz, $CDCl_3$, δ, ppm, J/Hz): 5.68 (1H, t, J = 2.5, H-6), 1.24 (3H, s), 1.22 (3H, s), 1.16 (3H, s), 1.09 (3H, s), 1.03 (3H, s), 0.99 (3H, s), 0.96 (3H, s), 0.82 (3H, s). ^{13}C NMR ($CDCl_3$, δ, ppm): 215.4 (C-3), 142.4 (C-5), 121.3 (C-6), 50.6 (C-10), 50.0 (C-4), 47.0 (C-8), 43.1 (C-18), 39.3 (C-13), 38.9 (C-22), 38.1 (C-2), 37.9 (C-14), 35.9 (C-16), 35.1 (C-9, C-19), 34.5 (C-29), 34.1 (C-11), 33.1 (C-21), 32.4 (C-30), 32.0 (C-28), 31.9 (C-15), 30.3 (C-12), 30.1 (C-17), 28.5 (C-24), 28.2 (C-20), 24.4 (C-23), 23.6 (C-7), 21.6 (C-1), 19.3 (C-26), 18.4 (C-27), 15.6 (C-25) [4].

Luteolin (3): yellow powder, mp 327–328°C ($CHCl_3$–MeOH 9:1) [4].

Compound 4: yellow powder, mp 248–251°C ($CHCl_3$–MeOH 8:2). UV (MeOH, λ_{max}, nm): 267 333. ^{1}H NMR (DMSO-d_6, δ, ppm, J/Hz): 8.04(2H, d, J = 9.0, H-2′, 6′), 7.15 (2H, d, J = 9.0, H-3′,5′), 6.93 (1H, s, H-3), 6.78 (1H, d, J = 2.1, H-8), 6.45 (1H, d, J = 2.1, H-6), 5.38 (1H, d, J = 6.6, H-1″ of Glc), 5.34 (1H, br.s, H-1‴ of Rha), 3.86 (3H, s, OCH_3), 1.08 (3H, d, J = 6.0, CH_3 of Rha). ^{13}C NMR (DMSO-d_6, δ, ppm): 182.1 (C-4), 164.1 (C-2), 163.1 (C-7), 162.6 (C-5), 161.3 (C-4′), 157.1 (C-9), 128.6 (C-2′, 6′), 122.8 (C-1′), 114.8 (C-3′, 5′), 105.6 (C-10), 103.9 (C-3), 100.6 (C-1″), 100.1 (C-1‴), 99.8 (C-6), 94.9 (C-8), 76.4 (C-5″), 75.8 (C-3″), 73.2 (C-2″), 72.2 (C-4‴), 70.9 (C-2‴), 70.5 (C-4″), 69.8 (C-3‴), 68.4 (C-5‴), 66.2 (C-6″), 55.7 (OCH_3), 17.9 (C-6‴) [5].

Rutin (5): yellow powder, mp 214–216°C (MeOH) [6].

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REFERENCES

1. S. Liu, L. Tian, and L. M. Chen, *Primary J. Chin. Mater. Med.*, **12**, 46 (1998).
2. Y. Peng, Z. M. Sun, and P. G. Xiao, *Res. Chin. Trad. Herb. Drugs*, **27**, 629 (1996).
3. A. H. Guo, *J. Shanxi College Trad. Chin. Med.*, **1**, 56 (2000).
4. M. Shao, Y. H. Yang, H. Y. Gao, B. Wu, L. B. Wang, and L. J. Wu, *J. Shenyang Pharm. Univ.*, **22**, 81 (2005).
5. L. Tian, L. Z. Xu, and S. L. Yang, *Chin. J. Chin. Mater. Med.*, **22**, 743 (1997).
6. C. Q. Hu, K. Chen, Q. Shi, R. E. Kilkuskie, Y. C. Cheng, and K. H. Lee, *J. Nat. Prod.*, **57**, 42 (1994).
7. C. Economides and K. P. Adam, *Phytochemistry*, **49**, 859 (1998).