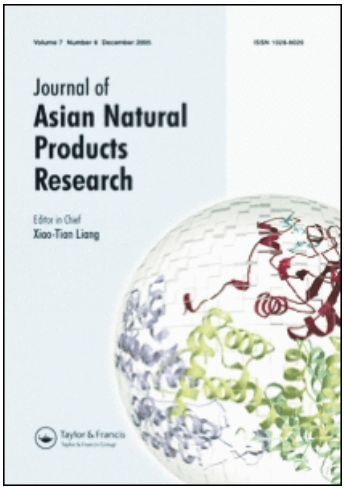

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FLAVONOL GLYCOSIDES FROM *LYSIMACHIA CAPILLIPES*

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Two new compounds, capilliposide I and capilliposide II, together with a known compound quercetin-3-*O*-(2,6-di-α-L-rhamnopyranosyl)-β-D-galactopyranoside were isolated from the extracts of the whole herbs of *Lysimachia capillipes*. Their structures were established through their spectral data and chemical properties.

Keywords: *Lysimachia capillipes*; *Lysimachia*; Flavonol glycoside; Capilliposide I; Capilliposide II

INTRODUCTION

Lysimachia capillipes Hemsl is widely distributed in southern China as a Chinese folk medicine. The whole herb is used for the treatment of coughs, rheumatalgia, menstrual disorder and neurasthenia etc. For its effect in promoting blood circulation, it could be developed as a drug for angiocardiopathy [1].

In this paper we report the isolation and structure elucidation of two new tetrasaccharide flavonol glycosides together with a known trisaccharide flavonol glycoside.

RESULTS AND DISCUSSION

An ethanol extract of the whole plant was separated into petroleum ether, chloroform, acetone and methanol fractions. The methanol fraction was passed through a Diaion 101 column, and the water–ethanol (1:1) fraction from the column was chromatographed on a Sephadex-LH20 column to separate the flavone fraction from other composition. The flavone fraction on repeated chromatographic purification led to the isolation of compounds **1**, **2** and **3** (Fig. 1).

Compound **1** was obtained as yellow crystals; positive reactions to the α-naphthol and Mg–HCl tests showed that it was a flavonoid glycoside. β-D-galactose and α-l-rhamnose were detected in the hydrolysis test [4], a quasi-molecular ion at m/z: 757(M^++1), and

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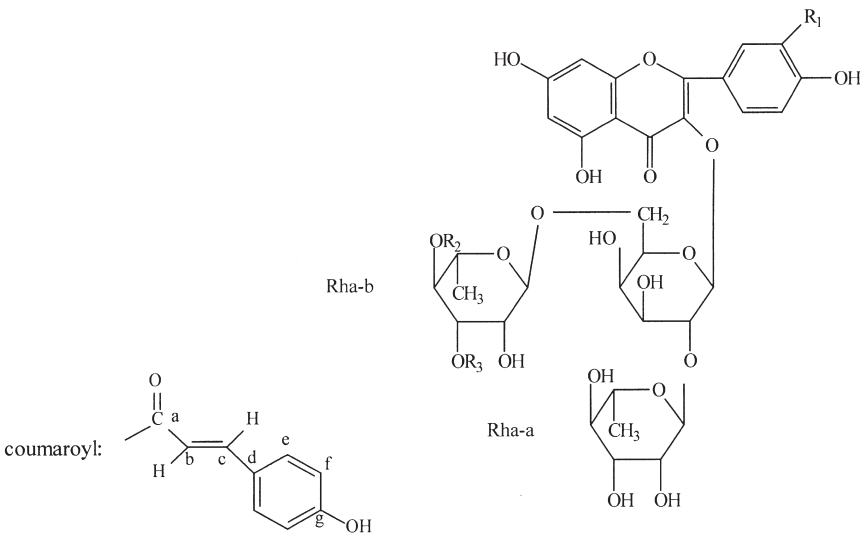

1: R1=OH, R2=R3=H
2: R1=OH, R2=Coumaroyl, R3=Glc
3: R1=H, R2=Coumaroyl, R3=Glc

FIGURE 1 Structures of compounds **1**, **2** and **3**. **1**: R1=OH, R2=R3=H; **2**: R1=OH, R2=Coumaroyl, R3=Glc; **3**: R1=H, R3=Coumaroyl, R3=Glc.

fragment ions at m/z: 611 (M^++1 − 146), 465 (M^++1 − 146 − 146), 303 (465 − 162), 302 (aglycone) in FABMS, typical quercetin and sugar signals in the ^{1}HNMR and ^{13}CNMR data obviously suggested this compound to be quercetin-3-*O*-(2,6-di-α-rhamnose)-β-D-galactose, the same as the compound isolated from another species of this genus [2].

Compound **2** was obtained as a yellow powder, the α-naphthol and Mg–HCl tests were positive, but besides D-galactose and L-rhamnose, D-glucose was also detected in the hydrolysis experiment [4]. This evidence suggested that this compound was also a flavonoid glycoside. The FAB-MS gave a quasimolecular ion at m/z 1065 (M^++1) and aglycone ion at m/z 302. Compared with the ^{1}HNMR spectrum of compound **1**, compound **2** also showed two groups of coupling peaks at δ 7.68 (1H, dd, J = 8.4, 1.9 Hz), 7.49 (1H, d, J = 1.9 Hz), 6.81 (1H, d, J = 8.4 Hz) and 6.37 (1H, d, J = 1.9 Hz), 6.18 (1H,d, J = 1.9 Hz) in the low field which indicated the existence of a quercetin. In addition, two doublets at δ 7.51 (1H, d, J = 15.7 Hz), 6.33 (1H, d, J = 15.7 Hz) of trans olefinic protons and a pair of doublets at δ 7.53 (2H, d, J = 8.5 Hz), 6.79 (2H, d, J = 8.5 Hz) belonging to a *p*-disubstituted benzene were also found in this region; these signals do not exist in compound **1**. In the middle field, besides three anomeric proton signals of a galactose at δ 5.59 (1H, d, J = 7.7 Hz) and two rhamnose at δ 5.04 (1H, s) and 4.51 (1H, s), one more signal of a glucose was found at δ 4.24 (1H, d, J = 7.7 Hz). In the high field, two significant methyl signals of rhamnose also appeared at δ 0.95 (3H, d, J = 6.1 Hz) and 0.78 (3H, d, J = 6.1 Hz), slightly different from those of compound **1** at δ 1.04 (3H, d, J = 6.2 Hz) and 0.79 (3H, d, J = 6.2 Hz).

The ^{13}CNMR data of compound **2** overlapped perfectly with those of compound **1**, except for some additional signals in compound **2**. In the HMBC spectrum of compound **2** (Fig. 2) the signal of galactose anomeric proton at δ 5.59 was correlated with that of quercetin C-3 at δ 132.6; the signals of rhamnose anomeric protons at δ 5.05 (rha-a) and 4.53 (rha-b) were correlated with that of the galactose C-2 at δ 74.8 and C-6 at 65.2, respectively, suggesting that the galactose was connected with the quercetin at C-3, the rhamnose-a connected with

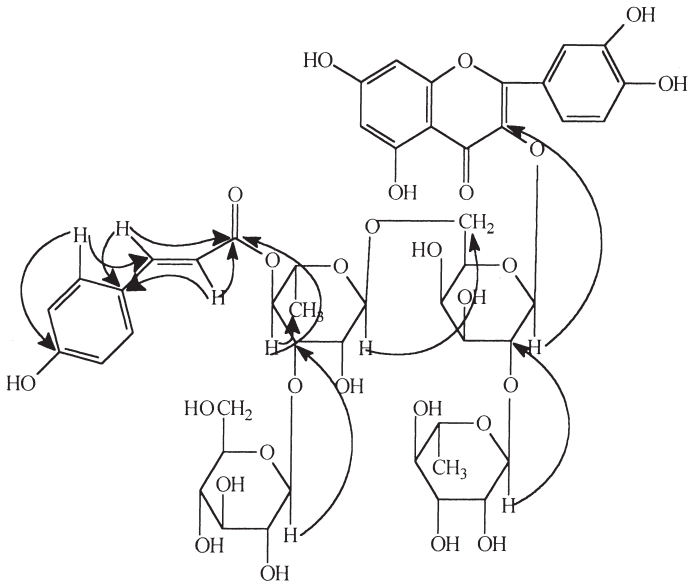

FIGURE 2 Some key HMBC correlations observed in compound **2**.

the galactose at C-2 and the rhamnose-b connected with the galactose at C-6, so fragments of compound **2** were exactly the same as compound **1**.

The ^{13}CNMR data between δ 180 and 190 of compound **2** showed that besides 13 aglycone and 3 sugar anomeric carbon signals, there were additional signals of 4 *p*-substituted benzene carbons at δ 159.7, 144.6, 125.2 and 115.8, 2 olefinic carbons at δ 130.3 and 114.4, 1 carbonyl carbon at δ 166.2 and 1 glucose anomeric carbon at δ 103.3, which were coincident with ^{1}HNMR and ^{1}H–^{13}C COSY spectra. In the HMBC spectrum, the olefinic proton signals at δ 7.51 and 6.32 were correlated with the carbonyl carbon signal and the *p*-substituted benzene carbon signal at δ 125.2, suggesting the existence of a coumaroyl group; the correlation between the *p*-substituted benzene proton signal at δ 7.53 and the olefinic carbon signal at δ 130.3 also supported this suggestion. Thus, the structure of compound **2** was composed of a quercetin, a coumaroyl group, glucose, galactose and two rhamnoses.

From the HMBC spectrum, the proton at δ 4.98 had long-range correlation with the methyl carbon of rhamnose-b, indicating that it should be the H-4 of this rhamnose. This proton also correlated with the carbonyl carbon of the coumaroyl group. This evidence showed that the coumaroyl group connected with the rhamnose-b at C-4. The low field shift of rhamnose-b C-4 for 0.3 ppm compared with the same carbon in compound **1** supported this conclusion.

A long-range correlation was also observed between the anomeric proton of the glucose and C-3 of rhamnose-b, suggesting that the glucose was connected at this location. The fact that the signal of rhamnose-b C-3 shifted downfield for 5.5 ppm compared with C-3 of rhamnose in compound **1** supported this inference. The glucose carbon signals were similar to that of a terminal sugar [3]. All this evidence demonstrated that the glucose was attached to the rhamnose-b at C-3.

Thus, the structure of compound **2** was quercetin-3-*O*-[β-D-glucopyranosyl (1–3)-(4-coumaroyl)-α-L-rhamnopyranosyl (1–6)]-[α-L-rhamnopyranosyl (1–2)]-β-D-galacto-pyranoside, named capilliposide I.

Compound **3** was obtained as yellow powder; the α-naphthol and Mg–HCl tests were positive, as with compound **2**, and D-glucose, D-galactose and L-rhamnose were detected in the hydrolysis test [4]. The ^{1}HNMR spectrum of compound **3** was similar to that of

compound **2**, except for one group of coupling peaks at δ 8.06 (2H, d, $J = 8.9$ Hz), 6.85 (2H, d, $J = 8.9$ Hz) instead of an ABX system in compound **2**, which indicated that the aglycone of compound **3** was kaempferol instead of quercetin. The ^{13}CNMR data coincided with the ^{1}HNMR data. FAB-MS gave a very good illustration of how the sugars and the substituent group were connected with the aglycone: m/z 1049 $[M+H]^+$ 887 $[1049 - 162]^+$, 741 $[887 - 146]^+$, 595 $[741 - 146]^+$, 449 $[595 - 146]^+$, 287 $[449 - 162$, aglycone$]^+$. The structure of compound **3** was kaempferol-3-*O*-[β-D-glucopyranosyl (1–3)–(4-coumaroyl)-α-L-rhamnopyranosyl (1–6)]–[α-L-rhamnopyranosyl (1–2)]-β-D-galactopyranoside, named capilliposide II. Compound **2** and compound **3** were isolated from plants for the first time with new structures.

EXPERIMENTAL SECTION

General Experimental Procedures

Optical rotations were determined on a Perkin–Elmer 241 polarimeter. The NMR spectra were measured in DMSO-d_6 and were recorded at 400 MHz for ^{1}HNMR and 100 MHz for ^{13}CNMR on a Bruker AM-400 apparatus, using TMS as internal standard. UV spectra were obtained on a Philips PYE Union PU8800 spectrophotometer and IR spectra on a Perkin–Elmer 983G instrument. FABMS data were determined on a VG ZAB-2F mass spectrometer. Mps are uncorrected and were taken on a Fisher–John hot-stage apparatus. A Waters HPLC system consisting of an LC 600 pump, 996 photodiode array detector and a spherisorb S10ODS1 250 × 4.6 mm column with a flow rate of 1.0 ml/min of solvent MeOH–H_2O (6:4) for the detection of the purity of the compounds.

Plant Material

The herbs of *Lysimachia capillipes* Hemsl. were collected in the Guizhou province, China. A voucher specimen was identified by Dr BaoLin Guo and kept in the laboratory of the Institute of Medicinal Plant Development, Beijing.

TABLE I ^{1}HNMR data of compounds **1**, **2** and **3** (400 MHz in DMSO-d_6)

1	**2**	**3**
7.69 (1H, dd, $J = 2.1$, 8.5Hz, H-6′)	7.68 (1H, dd, $J = 8.4$, 1.9 Hz.H-6′)	8.06 (2H, d, $J = 8.9$ Hz, H-2′6′)
	7.53 (2H, d, $J = 8.5$ Hz, H-e)	7.53 (2H, d, $J = 8.6$ Hz, H-e)
	7.51 (1H, d, $J = 15.7$ Hz, H-c)	7.51 (1H, d, $J = 15.8$ Hz, H-c)
7.47 (1H, d, $J = 2.1$ Hz, H-2′)	7.49 (1H, d, $J = 1.9$ Hz, H-2′)	
6.80 (1H, d, $J = 8.5$ Hz, H-5′)	6.81 (1H, d, $J = 8.4$ Hz, H-5′)	6.85 (2H, d, $J = 8.9$ Hz, H-3′5′
	6.79 (2H, d, $J = 8.5$ Hz, H-f)	6.79 (2H, d, $J = 8.6$ Hz, H-f)
6.38 (1H, d, $J = 2.0$ Hz, H-8)	6.37 (1H, d, $J = 1.9$ Hz, H-8)	6.41 (1H, d, $J = 2.0$ Hz, H-8)
	6.33 (1H, d, $J = 15.7$ Hz, H-b)	6.32 (1H, d, $J = 15.8$ Hz, H-b)
6.18 (1H, d, $J = 2.0$ Hz, H-6)	6.18 (1H, d, $J = 1.9$ Hz, H-6)	6.18 (1H, d, $J = 2.0$ Hz, H-b)
5.57 (1H, d, $J = 7.7$ Hz, galH-1)	5.61 (1H, d, $J = 7.6$ Hz, galH-1)	5.59 (1H, d, $J = 7.7$ Hz, galH-1)
5.04 (1H, s, rha-aH-1)	5.05 (1H, s, rha-aH-1)	5.04 (1H, s, rha-aH-1)
	4.98 (1H, t, $J = 9.6$ Hz, rha-bH-4)	4.98 (1H, t, $J = 9.6$ Hz, rhabH-4)
4.37 (1H, s, rha-bH-1)	4.53 (1H, s, rha-bH-1)	4.51 (1H, s, rha-bH-1)
	4.24 (1H, d, $J = 7.7$ Hz, glcH-1)	4.24 (1H, d, $J = 7.7$ Hz, glcH-1)
1.04 (3H, d, $J = 6.2$ Hz, rha-bH-6)	0.95 (3H, d, $J = 6.1$ Hz, rha-bH-6)	0.95 (3H, d, $J = 6.2$ Hz, rha-bH-6)
0.79 (3H, d, $J = 6.2$ Hz, rha-ah-6)	0.78 (3H, d, $J = 6.1$ Hz, rha-aH-6)	0.75 (3H, d, $J = 6.2$ Hz, rha-aH-6)

TABLE II ^{13}CNMR spectral data of compounds **1**, **2** and **3** (100 MHz in DMSO-d_6)

	1	**2**	**3**
Aglycone moiety			
C-2	156.3	156.2	156.2
C-3	132.8	132.8	132.6
C-4	177.2	177.2	177.3
C-5	161.3	161.2	161.2
C-6	98.7	98.7	98.8
C-7	164.3	164.1	164.4
C-8	93.5	93.5	93.7
C-9	156.2	156.1	156.3
C-10	103.8	103.9	103.8
C-1′	121.1	121.1	120.8
C-2′	115.7	115.7	130.8
C-3′	144.9	144.9	115.1
C-4′	148.4	148.4	159.9
C-5′	115.1	115.1	115.1
C-6′	122.0	122.0	130.8
Sugar mioety at C-3(Gal)			
C-1	99.0	99.0	99.0
C-2	74.8	74.8	74.8
C-3	73.9	73.8	73.7
C-4	68.6	68.4	68.4
C-5	73.3	72.9	72.9
C-6	64.9	65.2	65.3
(Rha-a)			
C-1	100.5	100.5	100.6
C-2	70.6	70.6	70.6
C-3	70.7	70.7	70.7
C-4	71.9	71.9	71.8
C-5	68.3	68.2	68.2
C-6	17.3	17.2	17.2
(Rha-b)			
C-1	100.0	99.9	100.0
C-2	70.6	69.6	69.6
C-3	70.4	76.2	76.2
C-4	71.9	72.2	72.2
C-5	68.2	66.1	66.1
C-6	17.9	17.5	17.5
(Coumaroyl)			
C-a		166.2	166.2
C-b		114.4	114.4
C-c		130.3	130.3
C-d		125.2	125.2
C-e		144.6	144.6
C-f		115.8	115.8
C-g		159.7	159.7
(Glc)			
C-1		103.3	103.3
C-2		73.4	73.4
C-3		76.4	76.4
C-4		69.5	69.5
C-5		76.5	76.5
C-6		60.6	60.7

Extraction and Isolation

Air-dried and powdered herbs (3.5 kg) were extracted with 95 and 50% ethanol three times each under reflux for 1 h and the solvent was evaporated *in vacuo*. The combined ethanol extract (1.05 kg) was adsorbed by silica, eluted with solvent in a Soxhlet apparatus to get petroleum ether, chloroform, acetone and methanol fractions. The methanol fraction (425 g)

was subjected to a Diaion 101 column and eluted with water, 50% ethanol and 95% ethanol. The 50% ethanol fraction was chromatographed on a Sephadex-LH20 column with methanol–water (1:1) to obtain the flavone fraction. Then the flavone fraction was passed through Sephadex-LH20 columns and ODS silica columns repeatedly to afford compounds **1** (19 mg), **2** (10 mg) and **3** (30 mg). Their purity was detected by HPLC.

Quercetin-3-O-(2,6-di-α-L-rhamnopyranosyl)-β-D-galactopyranoside (1)

Quercetin-3-*O*-(2,6-di-α-L-rhamnopyranosyl)-β-D-galactopyranoside (**1**) was obtained as yellow amorphous powder, mp 190–193°C; IR(KBr) ν_{max}: 3430, 1950, 1670, 1620, 1500, 1400, 1360, 1300, 1200, 1130, 1040, 980, 800 cm^{-1}; UV (MeOH) λ_{max} (log ϵ) 250, 350 nm; +NaOMe, 265, 390 nm; +NaOAc, 265, 380 nm; +NaOAc+H_3BO_3, 258, 378 nm; +$AlCl_3$, 270, 425 nm; +$AlCl_3$+HCl, 264, 360, 394 (sh)nm; FABMS m/z $[M+H]^+$ 757 (30), [M+H-rha]$^+$ 611 (10), [M+H − rha − rha]$^+$ 465 (10), [aglycone+H]$^+$ 303 (100), [aglycone]$^+$ 302 (60); ^{1}HNMR data, see Table I; ^{13}CNMR data, see Table II.

Capilliposide I (2)

Capilliposide I (**2**) was obtained as yellow amorphous powder, showed positive reactions with ((α-naphthol and Mg–HCl test. mp 215–217°C, $[\alpha]_D^{20}$ − 56.79 (C0.066, CH_3OH); IR(KBr) ν_{max} cm^{-1}: 3440 (OH), 2950, 1700, 1660 (C=O), 1620, 1520 (benzene ring), 1450, 1360, 1270, 1205, 1180 (–C–O), 1080, 1010, 980, 840 cm^{-1}; UV(MeOH) λ_{max} (log ϵ): 265 (4.22), 313 (4.34) nm; +NaOMe, 270, 308 nm: +NaOAc, 271, 309, 360 (sh) nm; +NaOAc+H_3BO_3, 264, 312 nm; +$AlCl_3$, 225 (sh), 272, 305, 390 (sh) nm; +$AlCl_3$+HCl, 225 (sh), 272, 302, 390 (sh) nm; FABMS m/z $[M+H]^+$1049 (50), [M+H − glc]$^+$887 (5), [887 − rha or coumaroyl]$^+$741 (3), [741 − rha or coumaroyl]$^+$595 (10), [595 − rha]$^+$449 (20), [aglycone+H]$^+$287 (55); ^{1}HNMR data, see Table I; ^{13}CNMR data, see Table II.

Capilliposide II (3)

Capilliposide II (**3**) was obtained as yellow amorphous powder, showed positive reactions with α-naphthol and Mg–HCl test, mp 218–220°C, $[\alpha]_D^{20}$ − 53.65 (C0.049, CH_3OH); IR(KBr) ν_{max} 3430 (OH), 2950, 1700, 1665, 1620, 1520 (benzene ring), 1460, 1370, 1275, 1215, 1180 (–C–O), 1080, 1060, 980, 840, 820 cm^{-1}; UV(MeOH) λ_{max} (log ϵ) 252 (4.04), 310 (4.16), 352 (4.94, sh) nm; +NaOMe, 268, 362, 370 nm; +NaOAc, 267, 313, 373 nm; +NaOAc+H_3BO_3, 261, 311, 373 nm; +$AlCl_3$, 273, 297, 422 nm; +$AlCl_3$+HCl, 271, 310, 393 (sh) nm; FABMS m/z $[M+H]^+$1065 (5), [aglycone+H]$^+$303 (5), [aglycone]$^+$302 (30); ^{1}HNMR data, see Table I; ^{13}CNMR data, see Table II.

Acid Hydrolysis Of 1,2 And 3

Compounds **1**, **2** and **3** were dissolved in methanol, and spotted on a TLC plate together with sugar standards. The plate was put into a beaker containing concentrated HCl, heated on a water bath for half an hour and the acid was then evaporated. The lower layer of chloroform–methanol–water (30:12:4)–glacial acetic acid (9:1) was used for TLC solvent, and 10% H_2SO_4 heated at 120°C as spray reagent. From compound **1** galactose and rhamnose was detected, and from compounds **2** and **3** galactose, rhamnose and glucose were detected.

Acknowledgements

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References

[1] Guo, B.L., Xiao, P.G. and Yang, S.L. (1995), *GuoWaiYiXue, ZhiWuYaoFenCe* **10**, 159–162.
[2] Yasukawa, K., Ogawa, H. and Takido, M. (1990), *Phytochemistry* **29**, 1707–1708.
[3] Yu, D.Q. and Yang, J.S. (1999) Beijing: China Chemical Industry Press; Handbook of Analytical Chemistry NMR spectral analysis, **7**, p. 901.
[4] Zhao, P.P., Li, B.M. and He, L.Y. (1987), *Acta Pharm. Sinica.* **22**, 70–74.