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Phenylpropanoid glucosides from leaves of *Coussarea hydrangeifolia* (Rubiaceae)

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Abstract

Phenylpropanoid glycosides, 1′-*O*-benzyl-α-L-rhamnopyranosyl-(1″ → 6′)-β-D-glucopyranoside (**1**) and α-L-xylopyranosyl-(4″ → 2′)-(3-*O*-β-D-glucopyranosyl)-1′-*O*-*E*-caffeoyl-β-D-glucopyranoside (**2**), together with the known derivatives, 1,6-di-*O*-caffeoyl-β-D-glucopyranoside (**3**), 1-*O*-(*E*)-caffeoyl-β-D-glucopyranoside (**4**) and 1-*O*-(*E*)-feruloyl-β-D-glucopyranoside (**5**), were isolated from leaves of *Coussarea hydrangeifolia*. Their structures were determined by IR, HRESIMS, and 1D and 2D NMR experiments, and their antioxidant activities, evaluated by assaying the free radical scavenging capacity using the DPPH (1,1-diphenyl-2-picrylhydrazyl) radical as substrate. The antioxidant activities of **3** and **4** (IC_{50} values of 15.0 and 19.2 μM, respectively) were comparable to that of the standard positive control caffeic acid, whilst **2** and **5** were only weakly active and **1** was inactive.

Keywords: *Coussarea hydrangeifolia*; Rubiaceae; Phenylpropanoid glycosides; Antioxidant activity

1. Introduction

Although *Coussarea* is considered to be only a small genus within the taxon Rubiaceae, it is well represented in the main Brazilian biomes including the Amazônia and the Cerrado. *Coussarea hydrangeifolia*, commonly know as "falsa-quina", is characteristic of the vegetation of the Cerrado and of the semi-deciduous forests of Brazil, where it is considered to be a pioneer species (Correa, 1974). In the course of our studies concerning the bioactive principles of Brazilian plants, with special emphasis on the vegetation of the State of São Paulo (Pauletti et al., 2003; Hamerski et al., 2003), we found that the aqueous extract of the leaves of *C. hydrangeifolia* showed antioxidant activity, as determined by a preliminary test with β-carotene, and strong free radical scavenging activity against 1,1-diphenyl-2-picrylhydrazyl radical (DPPH). Fractionation of this extract provided five phenylpropanoid glycosides including two new compounds, **1** and **2**, which had their structures determined by spectroscopic methods.

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2. Results and discussion

Compound **1** was isolated from the aqueous extract of *C. hydrangeifolia* as an amorphous powder with an $[\alpha]_D^{30}$ of −44.3°. A quasimolecular ion peak $[M-H]^-$ for **1** was observed at *m/z* 415.1610 in the high-resolution electrospray ionisation mass spectrum (HRESIMS; negative mode) suggesting a molecular formula of $C_{19}H_{28}O_{10}$. The IR spectrum exhibited strong absorption bands at 3430 and 1042 cm^{-1} suggesting the presence of hydroxyl groups. The ^1H NMR spectrum (Table 1) displayed signals that could be attributed to a monosubstituted benzene ring [δ 7.54 (*d*, $J = 7.5$ Hz, H-2,6), 7.30 (*m*, H-3,5), 7.23 (*m*, H-4)], a β-D-glucosyl moiety [δ 4.90 (*d*, $J = 7.5$ Hz, H-1′), 4.06 (*dd*, $J = 7.5$, 8.0 Hz, H-2′), 4.19 (*t* like, $J = 8.0$ Hz, H-3′), 4.12 (*m*, H-4), 4.20 (*ddd*, $J = 9.5$, 7.5, 2.5 Hz, H-5′), 4.18 (*dd*, $J = 11.0$, 7.5 Hz, H − $6'_a$), 4.64 (*dd*, $J = 11.0$, 2.5 Hz, H − $6'_b$), and a rhamnosyl group [δ 5.55 (*d*, $J = 1.0$ Hz, H-1″), 4.62 (*m*, H-2″), 4.55 (*dd*, $J = 3.5$, 9.0 Hz, H-3″), 4.26 (*t* like, $J = 9.0$ Hz, H-4″), 4.97 (*m*, H-5), 1.62 (*d*, $J = 6.0$ Hz, H-6″). Additionally, the signals at δ 4.85 (*d*, $J = 11.5$ Hz) and 5.15 (*d*, $J = 11.5$ Hz) could be ascribed to benzylic oxymethylene hydrogens, thus characterising the aromatic portion of **1** as a benzylic system. The ^{13}C NMR spectrum (Table 1) showed signals at δ 137.8, 128.2 (2×), 127.9 (2×), 127.2 and 70.9, which were consistent with the presence of a monosubstituted benzylic ring. Two anomeric methine carbons at δ 103.7 and 102.6, several hydroxymethines, one hydroxymethylene carbon at δ 68.4 and one methyl group at δ 18.7 resembled those of glucose and rhamnose, respectively, and clearly suggested that **1** possessed glucopyranosyl and rhamnopyranosyl units. Data from COSY and TOCSY experiments revealed the hydrogen sets belonging to the glucosyl and rhamnosyl moieties. The complete assignment of hydrogen and carbon signals and the positions of the bonds of the sugar moieties in **1** were determined by an HMBC experiment which showed long-range correlations between H-6′ and C-4′ and the anomeric C-1″, between H-1″ and the methylene C-6′, and between H-7 of the benzylic system and C-1′

Table 1
^1H and ^{13}C NMR spectroscopic data of hydrangeifolin I (**1**), hydrangeifolin II (**2**) and 1,6-di-*O*-caffeoyl-β-D-glucopyranose (**3**) in pyridine-d_5

Position	**1**		**2**		**3**	
	δ ^1H	δ ^{13}C	δ ^1H	δ ^{13}H	δ ^1H	δ ^{13}C
1	–	137.8 (*s*)	–	126.6 (*s*)	–	127.6 (*s*)
2	7.54 *d* (7.5)	128.2 (*d*)	7.53 *d* (2.0)	115.8 (*d*)	7.05 *m*	111.7 (*d*)
3	7.30 *m*	127.9 (*d*)	–	147.0 (*s*)	–	148.8 (*s*)
4	7.23 *m*	127.2 (*d*)	–	148.7 (*s*)	–	149.5 (*s*)
5	7.30 *m*	127.9 (*d*)	7.16 *d* (8.0)	116.7 (*d*)	6.80 *m*	116.2 (*d*)
6	7.54 *d* (7.5)	128.2 (*d*)	7.10 *dd* (2.0; 8.0)	122.2 (*d*)	6.99 *m*	124.1 (*d*)
7	4.85 *d* (11.5)	70.9 (*t*)	7.97 *d* (15.5)	145.5 (*d*)	6.64 *d* (16.0)	114.8 (*d*)
	5.15 *d* (11.5)					
8			6.56 *d* (15.5)	114.4 (*d*)	7.93 *d* (16.0)	147.4 (*d*)
9			–	165.3 (*s*)	–	169.6 (*s*)
1′	4.90 *d* (7.5)	103.7 (*d*)	6.20 *d* (8.0)	96.1 (*d*)	4.48 *d* (7.4)	104.3 (*d*)
2′	4.06 *dd* (7.5)	75.1 (*d*)	4.27 *t* (9.0)	78.8 (*d*)	4.04 *t* (9.0)	74.4 (*d*)
3′	4.19 *t* (8.0)	77.2 (*d*)	4.34 *m*	78.5 (*d*)	3.95 *t* (9.0)	76.9 (*d*)
4′	4.12 *m*	71.9 (*d*)	4.36 *m*	71.1 (*d*)	3.93 *t* (9.0)	71.0 (*d*)
5′	4.20 *ddd* (9.5, 7.5, 2.5)	78.5 (*d*)	4.08 *m*	79.5 (*d*)	4.10 *m*	77.5 (*d*)
6′	4.18 *dd* (11.0, 7.5)	68.4 (*t*)	4.40 *d* (12.0)	62.3 (*t*)	4.29 *m*	66.5 (*t*)
	4.64 *d* (11.0, 2.5)		4.60 *d* (12.0)		4.39 *m*	
1″	5.55 *d* (1.0)	102.6 (*d*)	5.90 *d* (3.5)	94.2 (*d*)	–	127.5 (*s*)
2″	4.62 *m*	72.3 (*d*)	4.20 *dd* (3.5; 9.0)	74.6 (*d*)	7.05 *m*	111.7 (*d*)
3″	4.55 *dd* (3.5; 9.0)	72.8 (*d*)	4.08 *m*	72.7 (*d*)	–	148.8 (*s*)
4″	4.26 *t* (9.0)	74.1 (*d*)	4.75 *t* (9.0)	75.5 (*d*)	–	149.4 (*s*)
5″	4.97 *m*	69.8 (*d*)	4.54 *dd* (2.5; 11.5)	63.1 (*t*)	6.80 *m*	116.2 (*d*)
			4.42 *dd* (5.5; 11.5)			
6″	1.62 *d* (6.0)	18.7 (*d*)			6.99 *m*	124.1 (*d*)
7″					6.52 *d* (15.5)	114.7 (*d*)
8″					7.87 *d* (15.5)	147.1 (*d*)
9″					–	169.7 (*s*)
1‴			5.35 *d* (7.5)	99.6 (*d*)		
2‴			4.29 *t* (8.5)	74.3 (*d*)		
3‴			4.14 *t* (8.5)	76.9 (*d*)		
4‴			4.25 *t* (8.5)	72.2 (*d*)		
5‴			4.03 *ddd* (2.5; 5.5; 9.0)	78.6 (*d*)		
6‴			4.39 *d* (11.5)	63.3 (*t*)		
			4.58 *d* (11.5)			