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DIHYDROFLAVONOL GLYCOSIDES FROM *RHODODENDRON FERRUGINEUM*

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Key Word Index—*Rhododendron ferrugineum*; Ericaceae; dihydroflavonol; acetylated flavonoids.

Abstract—Chemical investigation of the leaves and the flowers of *Rhododendron ferrugineum* afforded six known flavonoids: hyperoside, myricetin 3-*O*-*β*-galactopyranoside, kaempferol 3-*O*-(6″-*O*-acetyl)-glucoside, quercetin 3-*O*-(6″-*O*-acetyl)-glucoside, quercetin 3-*O*-(6″-*O*-acetyl)-galactoside, quercetin 3-*O*-(3″,6″-*O*-diacetyl)-galactoside and two new dihydroflavonol glycosides: *trans*-taxifolin 3-*O*-α-arabinopyranoside and *cis*-taxifolin 3-*O*-α-arabinopyranoside. © 1998 Elsevier Science Ltd. All rights reserved

INTRODUCTION

Rhododendron ferrugineum, commonly known as rosage, is a small shrub widespread in European mountains. Popularly known to be medicinal and toxic, its leaves are used against rheumatism in Germany [1]. Chemical studies of the Ericaceae have shown this family to be a rich source of polyphenols [2]. We report here the isolation and the structure determination of two new dihydroflavonoids and six other flavonoids, four of which are acetylated.

RESULTS AND DISCUSSION

The ^{13}C NMR data of **1** exhibited typical signals of flavanonol-type skeletons (Table 1): C-2 value at 83.77 ppm and C-3 value at 76.33 ppm. The saturated bond between C-2 and C-3 was confirmed by the presence of 2 doublets at 4.78 ppm (H-3) and 5.13 ppm (H-2) in the ^{1}H NMR spectrum. Thus, the aglycone moiety was identified easily as the known dihydroquercetin [3]. The OH group attached to C-3 was assigned to the *trans* configuration in relation to the B-ring because H-2/H-3 system showed a high coupling constant ($J = 10.6$ Hz) [4]. Two main fragments were observed in the mass spectrum, m/z 437 and m/z 305; the latter was obtained by losing the sugar indicating that it is a pentose. Hydrolysis of **1** yielded dihydroquercetin and arabinose, determined by TLC vs authentic samples. Close similarities of chemical shifts from C-2″ to C-5″ with reported values for the same carbons indicated that the sugar was arabinopyranose [5]. It can be deduced from the anomeric proton coupling constant ($J = 3.9$ Hz) that it is the α-anomer [4]. Therefore, the structure of **1** is the novel *trans*-taxifolin 3-*O*-α-L-arabinopyranoside. NMR spectra showed that the structures of **1** and **2** were very similar. In ^{1}H NMR spectrum, **2** showed signals which were in agreement with those of **1** except for the H-2/H-3 coupling constant ($J = 3$ Hz). These data suggested **2** to be an isomer of **1** with the *cis* configuration [4]. On this basis, **2** was identified as the novel *cis*-taxifolin 3-*O*-α-L-arabinopyranoside. Dihydroflavonoids are widespread in Ericaceae and *Rhododendron*, especially glucosides and galactosides of dihydroflavonols [6], but arabinosides seem to be much rarer [7]. **3** was recognized as hyperoside by cochromatography. Compounds **4**–**8** were identified by ^{13}C NMR data comparison with literature as myricetin 3-*O*-*β*-D-galactopyranoside, kaempferol 3-*O*-(6″-*O*-acetyl)-glucoside, quercetin 3-*O*-(6″-*O*-acetyl)-glucoside, quercetin 3-*O*-(6″-*O*-acetyl)-galactoside and quercetin 3-*O*-(3″,6″-di*O*-acetyl)-galactoside [8–12]. Since about 1980, descriptions of natural occurring acetylated compounds have increased. In the Ericaceae, acetylated flavonoids have been described in only two species: *Ledum palustre* [11] and *Calluna vulgaris* [13–15]. Thus we report here the first isolation of acetylated flavonoids in *Rhododendron*. Except **7** known in *Ledum palustre*, acetylated flavonoids from *Rhododendron ferrugineum* are all new in the Ericaceae; they are all known in the Asteraceae, however [12, 16, 17].

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Table 1. ^{1}H and ^{13}C NMR chemical shift assignments of compounds **1** and **2** in CD_3OD

	1			**2**		
Position	^{1}H	*J* (Hz)	^{13}C	^{1}H	*J* (Hz)	^{13}C
2	5.13 *d*	10.6	83.77	5.45 *d*	3.0	81.98
3	4.78 *d*	10.6	76.33	4.55 *d*	3.0	76.65
4			196.07			194.45
5			165.41			165.89
6	5.90 *d*	2.1	97.39	5.89 *d*	2.1	97.28
7			168.98			168.79
8	5.92 *d*	2.1	96.39	5.93 *d*	2.1	96.38
9			164.26			164.24
10						
1′			128.78			128.41
2′	6.96 *d*	1.8	115.65	7.04 *d*	1.9	115.99
3′			146.52			146.02
4′			147.42			146.63
5′	6.79 *d*	8.1	116.28	6.72 *d*	8.2	116.14
6′	6.85 *dd*	8.2, 1.9	120.75	6.82 *dd*	8.2,1.9	120.46
1″	3.83 *d*	3.9	102.36	4.57 *d*	5.9	102.85
2″	3.59 *dd*	6.0, 3.9	73.09			72.02
3″	3.55 *dd*	6.1, 3.3	66.78			73.64
4″	3.79 *m*		71.09			68.57
5″	ax: 3.92 *dd*	11.7, 7.4	63.39			65.69
	eq: 3.37 *dd*	11.7, 3.6				

EXPERIMENTAL

Plant material

See Ref. [18]

General

See Ref. [18], TLC: polyamide DC6 (Macherey-Nagel), cellulose MN 301 (Macherey-Nagel). hydrolyses and sugar analyses: HCl 2N for 30 min at 100°; TLC examination on silica gel (Merk), AC_2O–H_2O (9:1).

Extraction and isolation

Flowers: see Ref. [18]; 400 g of dried and powdered leaves were extracted with MeOH at room temp. The conc. methanolic soln was extracted successively with hexane, CH_2Cl_2, and EtOAc. The EtOAc soluble phase (43 g) was applied to a Sephadex LH20 column; MeOH elution gave 4 frs (I–IV). Fr. I, chromatographed over polyamide with EtOAc containing increasing amount of MeOH, gave 8 frs. Frs 1, 3 and 8 were purified by preparative TLC, respectively on cellulose [HOAc–H_2O (2:98)], polyamid [toluene–MeOH–MeCOEt (4:3:3)], cellulose [HOAc–H_2O (15:85)]. Fr. 1 yielded **5** and **6**, fr. 3 afforded **7** and fr. 8 gave **8**.

trans-taxifolin 3-*O*-α-L-arabinopyranoside (**1**). λ^{MeOH} 291, 319 *sh*; ($AlCl_3$): 314, 381; (NaOAc): 320, 365 *sh*. Negative FAB-MS: *m/z* 435 $[M-H]^-$. Positive FAB-MS: *m/z* 459 $[M+Na^+]^+$; *m/z* 437 $[M+H]^+$; 305 $[(M+H)\text{-}\ C_5H_8O_4]^+$. ^{1}H NMR and ^{13}C NMR. See Table 1.

cis-taxifolin 3-*O*-α-L-arabinopyranoside (**2**). λ^{MeOH} 293, 381 *sh*; ($AlCl_3$): 314, 384; (NaOAc): 322, 365 *sh*. Negative FAB-MS: *m/z* 435 $[M-H]^-$. Positive FAB-MS: *m/z* 459 $[M+Na^+]^+$; *m/z* 437 $[M+H]^+$. ^{1}H NMR and ^{13}C NMR. See Table 1.

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