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FLAVONOIDS OF *BRICKELLIA VERNICOSA*

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Key Word Index—*Brickellia vernicosa*; Compositae; Eupatorieae; Alomiinae; flavanones; flavonols; 6-methoxy-flavonoid glycoside.

Abstract—Thirteen 6-methoxy-flavonoids and four flavanones were isolated from *Brickellia vernicosa*. This is the first isolation of flavanones from a member of *Brickellia* and of the previously unreported 3-rhamnoside of 6-methoxykaempferol.

INTRODUCTION

Earlier investigations have revealed that most members of the New World genus *Brickellia* Ell. produce highly methoxylated and hydroxylated flavones, flavonols, flavonol glycosides and sulphates [1–7]. As part of our continuing biochemical systematic study of this genus, we investigated the flavonoids of *Brickellia vernicosa* B. L. Robins. [8]. We report here seventeen compounds including the isolation and characterization of the previously unreported 6-methoxykaempferol 3-O-α-L-rhamnoside, and of four flavanones, namely naringenin 7-methyl ether, eriodictyol and its 4'-monomethyl and 7,3'-dimethyl ethers, respectively. Several compounds in *B. vernicosa* are typical of *Brickellia*: 6-methoxykaempferol, 6,7-dimethoxykaempferol 3-*O*-L-rhamnoside, 6-methoxy-quercetin 3-*O*-α-L-rhamnoside, and 3-*O*-β-D-glucoside, quercetagetin 6,7-dimethyl ether 3-*O*-β-D-galactoside, and 3-*O*-α-L-rhamnoside. These 6-methoxy compounds, common in sections *Bulbostylis* (subsections Parvulae and Baccharideae) and *Macrobrickellia* [1–7], relate *B. vernicosa* to the more typical members of the genus. Of particular interest to this study are apigenin 7-methyl ether, kaempferol and its 3,7-dimethyl ether, the 3- and 7-methyl ethers of quercetin, and kaempferol 3-*O*-β-D-glucoside because they lack 6-methoxylation. Recently, the absence of this chemical character, in conjunction with morphological and cytological evidence, was used to support the segregation of variant *Brickellia* species into the new genera *Flyriella* K.&R. and *Brickelliastrum* K.&R. [9, 10]. However, we have shown *B. coulteri* Gray [unpub.] and *B. diffusa* (Vahl.) Gray [unpub.] also lack this feature suggesting the phenomenon may be more widespread in *Brickellia* than previously suspected, possibly representing a derived chemical condition for certain members of the genus. These data suggest that *B. vernicosa* is chemically intermediate between the more ancestral elements of *Brickellia* and those which may have lost the biosynthetic step for 6-methoxylation.

EXPERIMENTAL

Plant material. Aerial portions of *B. vernicosa* B. L. Robins. were collected in Mexico, State of Durango, 21 miles west of Durango City in March, 1982. Voucher material (B. L. and G. Turner #15081) is on deposit in the Plant Resources Center at The University of Texas at Austin, Austin, TX.

Extraction, isolation and identification of flavonoids. Air dried material of *B. vernicosa* (450 g) was extracted three times each with 80% and 50% aq. MeOH. The extracts, combined and concd, were chromatographed over Polyclar AT (GAF Corp.) eluted first with H_2O and then with increasing amounts of MeOH. The glycosides, eluting with 20% and 30% MeOH, were further purified utilizing PC (Whatman 3MM) with TBA (*t*-BuOH–HOAc–H_2O, 3:1:1) and BAW (*n*-BuOH–HOAc–H_2O, 4:1:5, upper phase) as the solvent systems. The flavanones, eluting in 60% and 80% MeOH, were chromatographed on silica gel (60-GF-254, E. Merck) using CH_2Cl_2–*iso*-PrOH (15:1) and CH_2Cl_2–*iso*-PrOH (10:2). The remaining compounds were purified by PC and prep TLC. All compounds were cleaned over Sephadex LH-20 prior to analysis by UV, ^{1}H NMR and mass spectral techniques [11]. Acid hydrolysis of glycosides (0.1 N TFA, 2 hr) yielded the sugar residues and the aglycones, all of which co-chromatographed with standard samples.

The new compound, 6-methoxykaempferol 3-*O*-α-L-rhamnoside (8 mg), eluting from Polyclar AT in 30% MeOH, showed a high R_f in 15% HOAc (0.55) and in TBA (0.69) and gave 6-methoxykaempferol and rhamnose on hydrolysis. A purple colour on paper under UV light of the glycoside changing to yellow with NH_3 and NA reagent indicated a 5,4'-hydroxyl and a 3-*O*-substituted system. The presence of a Band III (32 nm) in NaOMe supported a free hydroxyl at C-7. A methoxyl function at C-6 was verified by the reduced bathochromic shift (22 nm) of Band I in $AlCl_3$–HCl relative to Band I in MeOH, and the presence of a singlet at δ6.5 in the ^{1}H NMR (as the TMSi ether) for H-8, and a three-proton singlet at δ3.7 for the 6-methoxyl group. Furthermore, the characteristic $[M-15]^+$ and $[A-15]$ fragments for a loss of a methyl moiety in the mass spectrum also supported this substitution. Additional ^{1}H NMR signals included a two proton doublet for H-2' and H-6' at δ7.2 (J = 9 Hz) coupled to another doublet at δ6.9 (J = 9 Hz) for H-3' and H-5'. The anomeric proton (H-1") of rhamnose appeared at δ5.2 and exhibited an equatorial-equatorial coupling (J = 2 Hz) with the H-2" proton, indicative of the α-L-configuration. A 3-proton

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signal for the rhamnose methyl was present upfield at δ0.82 while the remaining sugar protons occurred between δ3.3 and 4.2.

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FLAVONOIDS FROM *ARTEMISIA LANATA**

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Key Word Index—*Artemisia lanata*; Compositae; Anthemideae; flavonoids; 3,5-dihydroxy-7,8,3',4'-tetramethoxyflavone; 5-hydroxy-6,7,3',4'-tetramethoxyflavone; artemetin.

Abstract—A new flavonoid, gossypetin-7,8,3',4'-tetramethyl ether (3,5-dihydroxy-7,8,3',4'-tetramethoxyflavone) was isolated and its structure elucidated by chemical and spectroscopic methods. The known flavonoids 5-hydroxy-6,7,3',4'-tetramethoxyflavone and artemetin were also isolated. Chemical transformations led to the conclusion that the structure previously reported as '8,3',4'-trimethoxyizalpinin' (3,5-dihydroxy-7,8,3',4'-tetramethoxyflavone) must be the isomer quercetagetin 6,7,3',4'-tetramethyl ether (3,5-dihydroxy-6,7,3',4'-tetramethoxyflavone).

INTRODUCTION

The genus *Artemisia*, which comprises several morphologically different sections, is one of the largest and most widely distributed of the approximately sixty genera in the tribe Anthemideae (Compositae). This genus has received considerable attention from the point of view of sesquiterpene lactones content [1, 2].

Flavonoid compounds are another important class of secondary metabolites frequently isolated from *Artemisia* [3–5]. Earlier phytochemical studies have led to the isolation of sesquiterpene lactones of the guaiane type from *A. lanata* Willd [6]; a perennial plant found in the calcareous hills in the south-east and east of the Iberian Peninsula [7]. Continuing the phytochemical investigation of this species, further TLC screening revealed the presence of several flavonoids.

RESULTS AND DISCUSSION

Three flavonoids were isolated from the ethanolic extract of the aerial part of *A. lanata*: gossypetin 7,8,3',4'-tetramethyl ether (**1**), 5-hydroxy-6,7,3',4'-tetramethoxyflavone (**2**) and artemetin (**3**). The structures of the last two compounds were confirmed by comparing physical and

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