STUDIES ON ZOAPATLE, III. FLAVONOID GLYCOSIDES FROM *MONTANOA TOMENTOSA* SSP. *TOMENTOSA*[1]

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The ethnomedical use of the tea prepared from the leaves of the zoapatle plant, *Montanoa tomentosa*, for the induction of menses and labor in the past 400 years in Mexico, the clinical evaluation of this preparation in human volunteers, the isolation, structural elucidation, and biological evaluation of zoapatanol, an oxepane diterpene claimed to be responsible for the action of the tea, as well as the synthesis of zoapatanol analogues and derivatives, have been the subjects of numerous reports. Summaries of these have recently been presented in review form (2-5).

As part of our continuing studies on potential fertility regulating agents from plants, we undertook a phytochemical investigation of the leaves of *Montanoa tomentosa* Cerv. ssp. *tomentosa* (Compositae) for the purpose of re-isolating zoapatanol and related oxepane derivatives for additional biological evaluation. In this process, the flavonoids nicotiflorin (kaempferol 3-rutinoside) (0.005%) and isoquercitrin (0.0018%) were isolated from the polar fraction of the MeOH extract through repeated column chromatography on silica gel and polyamide. This represents the first report on the isolation of flavonoids from a *Montanoa* species.

EXPERIMENTAL

PLANT MATERIAL.—The plant material of *M. tomentosa* ssp. *tomentosa* used in this investigation was cultivated at our Pharmacognosy Field Station, Lisle, IL, in the summer of 1982. An herbarium specimen has been deposited at the Field Museum of Natural History, Chicago, IL.

EXTRACTION AND ISOLATION.—Air-dried, ground leaves (10 kg) were exhaustively extracted with MeOH at room temperature, and the residue, after evaporation of the solvent, was partitioned between EtOAc and H_2O. Partition of the aqueous fraction with *n*-BuOH resulted in a fraction, which after column chromatography on silica gel and polyamide, yielded two flavonoids.

FLAVONOID IDENTIFICATIONS.—The identification of the isolates as nicotiflorin (6,7) and isoquercitrin (7,8) was based on the interpretation of their mp, uv, ir, ^{1}H-nmr, ^{13}C-nmr, and mass spectral data, and comparison with authentic samples. Acid hydrolysis afforded quercetin and rutinose, and kaempferol and glucose, respectively.

Full details of the isolation and identification are available from the authors on request.

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FLAVONOIDS OF *ASANTHUS*, A SEGREGATE GENUS OF *BRICKELLIA*

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Asanthus R.M. King and H. Robinson (Family Compositae, Tribe Eupatorieae, subtribe Alomiinae), a group of three Chihuahuan desert species defined by King and Robinson on the basis of stylar and other micromorphological features (1), has been chemically examined in conjunction with our systematic investigation of the genus *Brickellia* Ell. (2) and its relatives. B.L. Robinson originally included *Asanthus* in *Brickellia* while King and Robinson, in their sweeping reorganization of the Eupatorieae, segregated *Asanthus* from *Brickellia*. Recently, two of the species in *Asanthus*, *A. thrysiflora* Gray and *A. solidaginifolia* Gray, have been treated as one taxon (3).

Our previous chemical studies have shown flavones, flavonols, flavonol glycosides and sulfates, all with 6-methoxylation, to be characteristic of the main evolutionary line in *Brickellia* (4-10), and these chemical characters, when used in conjunction with morphology and cytology, have aided in assessing the affinities of taxa within the group. For example, chemical data were important in supporting the new genera *Flyriella* R.M. King and H. Robinson (11) and *Brickelliastrum* R.M. King and H. Robinson (12), previously associated with *Brickellia*, where the absence of 6-methoxylation in flavonoids (13, 14) coupled with other taxonomic evidence supported their separate generic status.

In our present study, we found that *Asanthus* not only produces 6-methoxylated flavones like those of *Brickellia* but also produces non 6-methoxylated flavonol mono and diglycosides, similar to those from *Flyriella* and *Brickelliastrum*. Eleven flavonoids were isolated from *A. solidaginifolia*, including 6-methoxyapigenin and its 4′ methyl ether; 6-methoxyluteolin and its 4′-methyl ether; kaempferol and its 3-*O*-β-D-glucoside; quercetin, its 3-*O*-β-D-galactoside, 3-*O*-β-D-rhamnogalactoside, and 3-methyl ether 7-*O*-β-D-glucoside; and isorhamnetin 3-*O*-β-D-glucoside. *A. thrysiflora* afforded five compounds which were also present in *A. solidaginifolia*, namely, 6-methoxyapigenin, 6-methoxyluteolin, quercetin and its 3-*O*-β-D-galactoside and 3-*O*-β-D-rhamnogalactoside.

These chemical results support earlier conclusions that *A. solidaginifolia* is not only closely related to *A. thrysiflora* but adds weight to their treatment as a single species, in agreement with McVaugh (3). Moreover, the data suggest that *Asanthus* is chemically distinct from the core group of *Brickellia* and may occupy an intermediate position between it and other members of the Alomiinae.

EXPERIMENTAL

PLANT MATERIAL.—*A. solidaginifolia* (Sundberg and Lavin #2743) was collected in the State of Chihuahua, 19.2 miles W. of Hwy 45 and 1.0 mile E. of Cumbres de Majalca, Mexico in September 1984. Material of *A. thrysiflora* (Norris #48) was collected in January 1982, in Mexico, State of Aguascalientes, about 18 miles W. of Ciudad Aguascalientes on Hwy. 70 to Cavillo. Voucher materials are deposited in The Plant Resources Center at The University of Texas at Austin, Austin, Texas.

EXTRACTION AND ISOLATION OF FLAVONOIDS.—Dried leaves and stems (900 g) of *A. solidaginifolia* were extracted with 85% and 50% aqueous MeOH. The combined extracts were concentrated to an aqueous layer under reduced pressure, and the concentrate was partitioned against CH_2Cl_2 and EtOAc. The concentrate from the CH_2Cl_2 (15 g) and the EtOAc (28 g) extracts were chromatographed over Polyclar AT (GAF Corp.) columns packed initially in toluene and gradually altered in 10% increments to 100% MeOH and finally concluded with Me_2CO-MeOH (1:1). Fractions, which were collected by monitoring the column with uv light, were further separated by paper chromatography using 15% HOAc on Whatmann 3MM paper. The EtOAc fraction yielded kaempferol, quercetin, transilin 7-*O*-glucoside, and isorhamnetin 3-*O*-glucoside while pectolinarigenin, 6-methoxyluteolin 4′-methyl ether, and quercetin 3-*O*-β-D-galactoside were isolated from the CH_2Cl_2 extract. Dinatin, 6-methoxyluteolin, kaempferol 3-*O*-β-D-glucoside, and quercetin 3-*O*-β-D-rhamnogalactoside were detected in both the CH_2Cl_2 and EtOAc fractions.

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