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THE FLAVONOIDS OF *STENOSIPHON* (ONAGRACEAE)

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Key Word Index—*Stenosiphon*; Onagraceae; Onagreae; flavonoids; flavonols; kaempferol; quercetin; myricetin; chemosystematics.

Abstract—*Stenosiphon linifolius* is a monotypic genus of the tribe Onagreae of the Onagraceae. The species is widespread in, but restricted to, the Great Plains of the United States. Three flavonol glycosides, kaempferol 3-*O*-rhamnoside, quercetin 3-*O*-rhamnoside and myricetin 3-*O*-rhamnoside, were found to occur in methanolic extracts of *Stenosiphon* leaves. Similar compounds are found in the leaves of such related genera as *Oenothera* and *Gaura*, but in the latter genera, additional flavonols exhibiting greater substitutional variation also are found.

INTRODUCTION

Investigations of the flavonoids of Onagraceae, tribe Onagreae have largely been confined to *Oenothera* [1–3], but a few species of *Calylophus* [1, 3], *Camissonia* [2] and *Gaura* [1] have also been examined. In addition, we have just completed a study of the monotypic genus *Xylonagra* [15]. Outside Onagreae, studies have been completed for Epilobieae [5, 6] and Circaeeae [7] and studies of Jussiaeeae are in progress. As a part of an overall study of the flavonoids in the entire family, we herein report the flavonoids of *Stenosiphon linifolius*.

Stenosiphon is a monotypic genus of the Great Plains of the United States and is included in the tribe Onagreae of the family Onagraceae [8, 9]. Specifically, Raven [8] considered it to be more closely related to *Oenothera* than to *Gaura*, with which it had been associated earlier, or to any other genus.

RESULTS

Methanolic extracts from the leaves of four samples of *Stenosiphon* yielded three flavonol glycosides in relatively equal concentrations. The three compounds were identified as kaempferol 3-*O*-rhamnoside, quercetin 3-*O*-rhamnoside and myricetin 3-*O*-rhamnoside. The three glycosides are well-known and, in fact, are reported in other genera of the family [1–4, 6, 7]. Nonetheless, each compound was identified by UV spectroscopy, appropriate hydrolyses and cochromatography of the aglycones and glycosides. Absorption maxima and R_f values correspond with published reports [10, 11].

DISCUSSION

As noted above, *Oenothera* is the best known genus of the tribe Onagreae with respect to its flavonoid diversity. *Ca* 50 species representing 10 subgenera have been examined. All of the compounds found in *Oenothera*, as well as in the few samples examined of other genera of Onagreae, have been flavonols: 3-mono- and diglycosides and 3,7-diglycosides, and 3- and 3′-methyl ethers are also present, some 15 compounds in all. The flavonoids isolated from the leaves of *Stenosiphon* are of the same type, but kaempferol 3-*O*-rhamnoside has not yet been reported in *Oenothera*. The substitutional diversity apparent in some species of *Oenothera*, however, is absent in *Stenosiphon*.

The flavonoids of *Stenosiphon* neither suggest nor negate a relationship with any particular genus of Onagreae, but are fully consistent with its placement in this tribe.

It is expected that the extension of research throughout the remainder of Onagreae will reveal a greater diversity of flavonoids. For example, a preliminary survey of other Onagreae has revealed the presence of flavones, glycoflavones and a wide array of flavonols. Establishing the flavonoid diversity for this tribe is important in the context of the family as a whole. The biosynthetically distinct glycoflavones occur in the tribes Lopezieae, Circaeeae, Hauyeae and Jussiaeeae [7 and Raven, P. H. and Averett, J. E. unpublished results], but not in Fuchsieae nor Epilobieae. Within the tribe Onagreae, flavonoid data, correlated with other systematic information, should eventually prove valuable both in understanding relationships within genera and perhaps even between genera when a sufficiently extensive base of information has been built.

EXPERIMENTAL

Plant material. Plants were obtained from six populations of *Stenosiphon linifolius*. The material was air-dried and the leaves removed for extraction. Voucher specimens are as follows and, unless otherwise noted, are deposited at the Missouri Botanical Garden (MO). Kansas: Clark Co., *Raven* 26558; Meade Co., *Raven* 26554. Oklahoma: Major Co., *Raven and Gregory* 19476. Texas: Canadian Co., *Antonio* 505; Stephens Co., *Schlegel and Estes* 74; Crosby Co., *Benbow* 83.

Isolation and identification. The flavonoids were extracted overnight from the dried leaf material in 85% MeOH. The resulting extract was examined by 2-D PC in *t*-BuOH–HOAc–H_2O (3:1:1) and 15% HOAc. The compounds were detected in UV light and in the presence of NH_3. Gel filtration [12] was also used in isolating the substances, particularly final purifications. The techniques presented by Mabry *et al.* [11] were used for spectral analysis. Sugars and aglycones were cochromatographed by circular TLC [13] on cellulose precoated plates. Acid hydrolyses to obtain the latter were carried out as described by Harborne [14] in 2 N HCl.

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