# Flavonoids of *Oenothera* (Onagraceae) in Taiwan

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## Abstract

A survey of foliar flavonoids in four species of *Oenothera* (Onagraceae) from Taiwan revealed ten flavonol-O-glycosides based on kaempferol, quercetin, and myricetin. Each species can be distinguished by its own characteristic complement of these compounds. Infraspecific variation in flavonoid profile is apparent in *O. stricta* and *O. tetraptera* when literature is consulted and compared. Our analyses on the flavonoids of *O. glazioviana* and *O. laciniata* represent first reports.


## Introduction

*Oenothera* is an Onagraceous genus of some 123 species native to North and South America (Stubbe & Raven, 1979). Four species have been introduced to Taiwan. Except for *O. laciniata*, which is naturalized in northern coast of Taiwan (Peng & Huang, 1986), plants of *Oenothera* usually occur in middle elevations of this island as escapes from cultivation (Raven, 1977). As part of the comprehensive survey of the flavonoids of the Onagraceae in Taiwan, we report the isolation and identification of ten flavonol-O-glycosides based on kaempferol, quercetin, and myricetin in *Oenothera*.

## Materials and Methods

Foliar flavonoids of four species of *Oenothera*, namely *O. glazioviana* Mich., *O. stricta* Ledeb. ex Link, *O. laciniata* Hill, and *O. tetraptera* Cav., collected from Taiwan were studied. Voucher information is provided in Table 1.

Experimental techniques for

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Tabie 1. Herbarium vouchers of *Oenothera* used in the study of the distribution of flavonoids. All are deposited in the Herbarium, Academia Sinica, Taipei (HAST).

| Taxa | Vouchers |
|---|---|
| *O. glazioviana* Mich. | Ilan Co. : Ssy-yuan, *Huang 1591*, *Peng 8348* |
| *O. stricta* Ledeb. ex Link | Ilan Co. : Taipingshan, *Huang 1212*, *Peng 7836*. |
| *O. laciniata* Hill | Taoyuan Co. : Shalun, *Peng & Huang 7721*. |
| *O. tetraptera* Cav. | Nantou Co. : Wushe, *Peng 7884*. |

chromatographic and spectral analyses of flavonoids largely follow those presented by Mabry *et al.* (1970), Becker *et al.* (1978), and are briefly outlined below.

The material was ground and extracted overnight in 85% MeOH. The resulting extract was examined by 2D-PC in *t*-BuOH-HOAc-$H_2O$ (3:1:1) and 15% HOAc. For structural elucidation, replicate paper chromatograms were run and isolated compounds cut from the paper for further purification and analyses. Identification of the glycosides and their aglycones was accomplished by standard spectroscopic, acid hydrolytic and circular TLC chromatographic techniques.

## Results and Discussions

Ten flavonol glycosides bared on kaempferol, quercetin and myricetin are found in four species of *Oenothera* from Taiwan. They include kaempferol 3-0-glucoside, kaempferol 3-0-rutinoside, quercetin 3-0-glucoside, quercetin 3-0-galactoside, quercetin 3-0-rhamnoside, quercetin 3-0-arabinoside, quercetin 3-0-glucuronide, quercetin 3-0-rhamnoglucoside, quercetin 3,7-0-diglucoside and myricetin 3-0-glucoside (Table 2). Of these ten compounds, kaempferol 3-0-glucoside, quercetin 3-0-glucoside and quercetin 3,7-0-diglucoside are common to all four species. Variations both in flavonol basic structures and in glycosylations among these four species are marked. Each species is unique in its specific complement of the flavonoids.

Our analyses reveal the presence of kaempferol 3-0-glucoside, quercetin 3-0-glucoside, quercetin 3-0-glucuronide, quercetin 3-0-rhamnoglucoside, quercetin 3,7-0-

Table 2. Flavonoids in four species of *Oenothera* from Taiwan

| | kaempferol 3-0-glucoside | kaempferol 3-0-rutinoside | quercetin 3-0-glucoside | quercetin 3-0-galactoside | quercetin 3-0-rhamnoside | quercetin 3-0-arabinoside | quercetin 3-0-glucuronide | quercetin 3-0-rhamnoglucoside | quercetin 3,7-0-diglucoside | myricetin 3-0-glucoside |
|---|---|---|---|---|---|---|---|---|---|---|
| *O. laciniata* | + | | + | | | | + | + | + | |
| *O. tetraptera* | + | | + | + | + | | | | + | |
| *O. stricta* | + | | + | | | + | | | + | |
| *O. glazioviana* | + | + | + | | | + | + | | + | + |

diglucoside in *O. laciniata* and kaempferol 3-0-glucoside, kaempferol 3-0-rutinoside, quercetin 3-0-glucoside, quercetin 3-0-arabinoside, quercetin 3-0-glucuronide, quercetin 3,7-0-diglucoside, myricetin 3-0-glucoside in *O. glazioviana*. *Oenothera glazioviana* can be distinguished from the other species studied by the presence of myricetin compounds and kaempferol 3-0-rutinoside (Table 2). The foliar flavonoids of this species and *O. laciniata* are here reported for the first time.

A comparison of our data on *O. stricta* from Taiwan with those from the United States ( Howard, Mabry & Raven, 1972 ) shows that they are similar in flavonol nucleus, differing only in some of the sugar moeities.

Infraspecific variation is also found in the flavonoid profile of *O. tetraptera* when data from Howard *et al.* ( 1972 ) were compared ( Table 4 ). Myricetin compounds which are generally considered as a primitive marker (Harborne, 1967 ) are present in South African materials but are completely lacking in the population from Taiwan studied. It is of interest to note such a marked difference in the flavonoid composition of populations of the same species. Further studies on populations of *O. tetraptera* are apparently needed.

Table 3. Distribution of flavonoids detected in populations of *O. stricta*

| Compound | Population from Taiwan | USA (Howard *et al.*, 1972) |
|---|---|---|
| kaempferol 3-0-glucoside | + | + |
| quercetin 3-0-glucoside | + | + |
| quercetin 3-0-arabinoside | + | |
| quercetin 3,7-0-diglucoside | + | |
| quercetin 3-0-galactoside | | + |

Table 4. Distribution of flavonoids detected in *O. tetraptera*.

| Compound | Population from Taiwan | South Africa (Howard *et al.*, 1972) |
|---|---|---|
| kaempferol 3-0-glucoside | + | |
| quercetin 3-0-glucoside | + | + |
| quercetin 3-0-galactoside | + | + |
| quercetin 3-0-rhamnoside | + | + |
| quercetin 3,7-0-diglucoside | + | |
| myricetin 3-0-galactoside | | + |
| myricetin 3-0-rhamnoside | | + |

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# 臺灣的月見草屬植物（柳葉菜科）類黃素化合物之分類學研究

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## 摘　要

月見草屬植物目前在臺灣發現有四種，即月見草(*Oenothera tetraptera* Cav.)、裂葉月見草(*O. laciniata* Hill)以及*O. glazioviana* Mich., *O. stricta* Ledeb, ex Link. 本文分析了這四種植物葉中所含之類黃素色素，發現總共有 10 種化合物，其化合物組成因種而異。另外比對了 Howard 等氏1972年之報告，發現本省之後兩種月見草與其他地區之各該種植物的類黃素組成，有着明顯的族群間差異存在。

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