

## FLAVONOID ANALYSES OF *PYROLA* (PYROLACEAE) IN TAIWAN<sup>1</sup>

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### Abstract

A survey of foliar flavonoids in the two species of Taiwanese *Pyrola*, *P. morrisonensis* (Hayata) Hayata and *P. decorata* Andres, revealed four flavonol glycosides, i. e., kaempferol 3-0-glucoside, quercetin 3-0-glucoside, quercetin 3-0-galactoside, and quercetin 3-0-rhamnoside. Kaempferol 3-0-glucoside and quercetin 3-0-glucoside are common to both species. The presence of either galactose or rhamnose on quercetin marks the difference between the two species.

**Key words:** *Pyrola morrisonensis*; *Pyrola decorata*; flavonoids; kaempferol; quercetin; chemotaxonomy.

### Introduction

*Pyrola*, a small genus of Pyrolaceae, comprises about 20 species in the temperate regions of the northern hemisphere (Airy Shaw, 1973). Two species inhabiting the forests of mid- to high elevations are found in Taiwan. *Pyrola morrisonensis* (Hayata) Hayata is an endemic, while *P. decorata* Andres is distributed also in southern part of the Mainland China (Hsieh, 1978).

The two species are distinguished from each other mainly by the leaf shape and surface appearance. The leaves of *Pyrola morrisonensis* are rotund-ovate to rhomboid-ovate with rounded apex and impressed veins on the upper surface. The leaves of *P. decorata* are ovate to oblong with acute apex and pale nerves on the deep green upper surfaces (Hsieh, 1978). Previous flavonoid studies in *Pyrola* (Bate-Smith, 1962; Harborne & Williams, 1973; Haber, 1983; Averett & Bohm, 1986) showed that kaempferol and quercetin are common compounds. Furthermore, the

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work of Harborne & Williams (1973) revealed the presence of dihydroquercetin in four of the six species of *Pyrola* studied. Averett & Bohm (1986) reported rhamnetin in two North American species. The present study was undertaken to determine the flavonoid profiles in the two closely related eastern Asiatic species of *Pyrola* that have not been analyzed previously.

### Materials and Methods

Foliar flavonoids of *Pyrola morrisonensis* (Hayata) Hayata and *P. decorata* Andres collected from Taiwan were studied. Voucher information is provided in Table 1. Unless otherwise indicated, vouchers are deposited at the herbarium of the Department of Biology, National Taiwan Normal University.

**Table 1.** Herbarium vouchers and distribution of flavonoids of *Pyrola morrisonensis* and *P. decorata*

Locality and elevation	Collector's number	Flavonoid compounds detected			
		1	2	3	4
<i>Pyrola morrisonensis</i>					
ILAN County:					
Nanhutashan, 2,500-3,500 m.	<i>Peng 5714</i> (HAST)	+	+	+	
Taipingshan, ca. 2,000 m.	<i>Peng 7900</i> (HAST)	+	+	+	
TAICHUNG County:					
Hsuehshan, ca. 3,000 m.	<i>Huang 1360</i>	+	+	+	
NANTOU County:					
Patungkwan, ca. 3,000 m.	<i>Huang 1530</i>	+	+	+	
Tungpu, ca. 2,700 m.	<i>Huang 1743</i>	+	+	+	
HUALIEN County:					
Piluhsi, ca. 2,100 m.	<i>Lu 16949</i> (TAIF)	+	+	+	
<i>Pyrola decorata</i>					
ILAN County:					
Nanhutashan, ca. 2,400 m.	<i>Peng 5626</i> (HAST)	+	+		
Taipingshan, ca. 2,000 m.	<i>Huang 1233</i>	+	+		+
TAIPEI County:					
Peichatienshan, ca. 1,900 m.	<i>Peng 7472</i> (HAST)	+	+		
MIAOLI County:					
Tapachienshan, ca. 2,000 m.	<i>Huang 1601</i>	+			+
HUALIEN County:					
Piluhsi, ca. 2,100 m.	<i>Lu 16947</i> (TAIF)	+			+

Key: 1=kaempferol 3-0-glucoside      3=quercetin 3-0-galactoside  
 2=quercetin 3-0-glucoside      4=quercetin 3-0-rhamnoside  
 HAST=Herbarium, Institute of Botany, Academia Sinica, Taipei.  
 TAIF=Herbarium, Taiwan Forestry Research Institute, Taipei.

Experimental techniques used for chromatographic and spectral analyses of flavonoids in this study are largely those advanced by Mabry *et al.* (1970), Becker *et al.* (1977), and Markham (1982), outlined as follows.

The materials were ground and extracted overnight in 85% MeOH. The resulting extracts were examined by 2D-PC in t-BuOH-HOAc-H<sub>2</sub>O (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 Discussion

Results of this study are summarized in Table 1. The foliar flavonoids of *Pyrola morrisonensis* (Hayata) Hayata are based on kaempferol and quercetin. Three flavonol monoglycosides, namely, kaempferol 3-0-glucoside, quercetin 3-0-glucoside and quercetin 3-0-galactoside, were recognized. The samples studied were collected from six different localities (Table 1). Intraspecific variation in flavonoid profile was not found among the populations.

Leaf samples of *Pyrola decorata* Andres from five populations were studied. Monoglycosides of both kaempferol and quercetin were also found in this species. Some minor variation in the sugar moieties on quercetin, however, was observed. Populations of *P. decorata* from forest margins of Nanhutashan (*Peng 5626*) and Peichatienshan (*Peng 7472*) respectively exhibited an identical flavonoid profile, both containing kaempferol 3-0-glucoside and quercetin 3-0-glucoside. Populations from shady forest floors of Tapachienshan (*Huang 1601*) and Piluhsi (*Lu 16947*) also contained kaempferol 3-0-glucoside, but are distinguishable from the aforementioned populations by the presence of quercetin 3-0-rhamnoside. The population from exposed, sunny ground of Taipingshan (*Huang 1233*), however, exhibited an additive flavonoid pattern: it contained kaempferol 3-0-glucoside, quercetin 3-0-glucoside and quercetin 3-0-rhamnoside. The observed diversity in the flavonoid profile in the populations studied thus appears to correlate to the plant habitats, more specifically, to the light intensity the plants received. The role that light intensity plays in the accumulation of foliar flavonoids in plants has been amply discussed by Hahlbrock (1981), Hahlbrock *et al.* (1971), Hösel (1981), and McClure (1970, 1975).

The results outlined above show that *Pyrola morrisonensis* is characterized by the accumulation of galactose on quercetin as one of the secondary compounds, while in *P. decorata*, galactose is substituted by rhamnose. Dihydroquercetin and rhamnetin reported by Harborne & Williams (1973) and Averett & Bohm (1986) respectively in some species of *Pyrola* were not detected in either of the above taxa.

The difference in the flavonoid profile between the two species is not marked, which suggests that they are closely related, at least from the chemical point of view.

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## 臺灣的鹿蹄草屬 (鹿蹄草科) 植物之化學分類研究

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玉山鹿蹄草與斑紋鹿蹄草是臺灣產的兩種鹿蹄草科植物，分析這兩種植物葉內所含的類黃素，共獲得四種黃醇類化合物即：(1)葡萄糖薑葉醇，(2)葡萄糖槲皮素，(3)半乳糖槲皮素，(4)鼠李糖槲皮素。其中(1)、(2)兩種化合物為兩種植物所共有，(3)僅見於玉山鹿蹄草中，(4)僅存於斑紋鹿蹄草中；其間化學差異顯示臺灣產之兩種鹿蹄草為親緣關係相近之獨立種。