

PHENOLIC COMPOUNDS FROM *FORSYTHIA* LEAVES

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Key Word Index—*Forsythia suspensa*; *F. viridissima*; *F. koreana*; Oleaceae; leaves; phenolic compounds; lignans; lignan glucosides; rutin; caffeoyl glycosides of 3,4-dihydroxyphenethyl alcohol.

Abstract—Four lignans, four lignan glucosides, one flavonoid and two caffeoyl glycosides of 3,4-dihydroxyphenethyl alcohol were identified variously in leaves of *Forsythia suspensa*, *F. viridissima* and *F. koreana*. The leaf patterns were broadly similar to those reported earlier for the fruits, except that suspensaside and β -hydroxyacteoside were not detected.

In continuation of our studies on the constituents of *Forsythia* fruits [1–7], this paper deals with phenolic compounds from the leaves of *F. suspensa* Vahl, *F. viridissima* Lindley and *F. koreana* Nakai cultivated in Japan. Four lignans, four lignan glucosides, one flavonoid already reported [8] and two caffeoyl glycosides of 3,4-dihydroxyphenethyl alcohol were respectively identified.

Suspensaside and β -hydroxyacteoside isolated from fruits [6, 7] were not detected in leaves.

The occurrence of phenolic compounds in leaves compared with that in fruits is as summarized in Table 1. Differences in leaf patterns between species follow the differences already noted in fruit constituents. So far, forsythiaside is characteristic in fruit of *F. suspensa* and is known as one of antibacterial principles [5, 6]. (+)-Pinoresinol and (+)-pinoresinol- β -D-glucoside show inhibitory activity against cAMP-phosphodiesterase *in vitro*

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Table 1. The distribution of phenolic compounds in leaves and fruits of *Forsythia* species.

	<i>F. suspensa</i>		<i>F. viridissima</i>		<i>F. koreana</i>	
	Leaf	Fruit*	Leaf	Fruit†	Leaf	Fruit‡§
Lignans						
Phillygenin	+++	+++			++	++
(+)-Pinoresinol	++	++			+	+
Arctigenin			+++	+++	+++	+++
Matairesinol			++	++	+	++
Lignan glucosides						
Phillyrin	+++	+++			++	++
(+)-Pinoresinol- β -D-Glucoside	+	++			+	+
Arctiin			+++	+++	+++	+++
Matairesinoside			+	++	+	++
Flavonoid						
Rutin	++	++	++	++	+++	++
Caffeoyl glycosides of 3,4-dihydroxyphenethyl alcohol						
Forsythiaside	+++	+++			++	
Acteoside			+++	+++	+	
Suspensaside		+++				
β -Hydroxyacteoside				+++		

+++ = major constituent, ++ = present, + = minor constituent.

* See refs [3, 5, 6].

† See refs [3, 7].

‡ See ref. [4].

§ The amount of material obtained for analysis was so small that the isolation and identification of caffeoyl glycosides are not yet done.

[9] and possess antihypertensive activity similar to pinoresinol-di-*O*- β -D-glucoside from *Eucommia ulmoides* Oliv. [10]. It is useful to note from the medicinal viewpoint, that the profile of phenolic compounds from leaves of *F. suspensa* is almost similar to that of the fruits.

EXPERIMENTAL

Plant materials. The plant materials collected were: *Forsythia suspensa* in October 1977 at Medicinal Plant Garden of Nagoya City University, Nagoya and in September 1982 at Medicinal Plant Garden of Toho University, Narashino; *Forsythia viridissima* in October 1977 at Medicinal Plant Garden of Nagoya City University, Nagoya; *Forsythia koreana* in October at Medicinal Plant Garden of Nagoya City University, Nagoya and in October 1978 at Medicinal Plant Garden of Hokkaido University, Sapporo. The specimens used are lodged at the Herbarium of Higashi Nippon Gakuen University.

Isolation. The dry powdered leaves (100 g of each) were extracted $\times 3$ with MeOH. The concd extract plus H₂O was extracted successively with Et₂O, CHCl₃ and BuOH. Each of the extracts was respectively subjected to silica gel CC in the same manner as for that of fruits previously described [3–7]. The Et₂O extract gave lignans. The CHCl₃ extract gave lignan glucosides. The BuOH extract gave flavonoid and caffeoyl glycosides of 3,4-dihydroxyphenethyl alcohol. The compounds isolated were

respectively identified by direct comparison with authentic samples.

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