

Notes

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Masakazu Aritomi : Chemical Constituents in Aceraceous Plants. III.*¹
Flavonoid Constituents in Leaves of *Acer cissifolium* K. Koch.(Faculty of Education, Kumamoto University*²)

In a series of this study, chemical examination was made on flavonoid constituents in the leaves of *Acer cissifolium* K. Koch (Japanese name "Mitsude-kaede"), a deciduous tree of Aceraceae, which is distributed throughout Japan.

As described in the experimental part, a flavonoid glycoside (I) was isolated in pure form from its leaves, and the present paper describes and discusses the result of experiments carried out for the elucidation of its unequivocal structure.

I was obtained as pale yellow needles, m.p. 243~244° (decomp.), and its analytical values suggested the formula $C_{21}H_{20}O_{11} \cdot 3H_2O$.

Acid hydrolysis of I gave one mole each of luteolin (II) (tetra-O-acetate, m.p. 228~229°) and D-glucose, indicating that I should be formulated as one of the mono-D-glucosides of luteolin.

Methylation of I with diazomethane yielded tri-O-methyl ether (III), m.p. 216°, which gave no coloration with ferric chloride, and exhibited no significant bathochromic shift of ultraviolet absorption maxima on addition of aluminum chloride.

Acid hydrolysis of III gave 4'-hydroxy-3',5,7-trimethoxyflavone¹⁾ (IV), m.p. 191~191.5°, which was identified as such by comparison with a synthetic specimen.

These facts indicate that the sugar moiety in I is located at the 4' position of luteolin. As listed in Table I, ultraviolet spectral data also furnished strong support for this view.^{2~4)}

TABLE I. Ultraviolet Absorption Maxima of I~IV (λ_{\max} m μ (log ϵ))

	EtOH	EtOH-AcONa	EtOH-EtONa	EtOH-AlCl ₃	EtOH-H ₃ BO ₃ -AcONa
I	245 (4.21)		239 (4.33)	259 (4.12)	
	271 (4.29)	274 (4.42)	277 (4.43)	282 (4.27)	271 (4.25)
		322 (4.15)	320 (4.07) ^{a)}	290 (4.25) ^{b)}	
	340 (4.27)	356 (4.16)	372 (4.14)	343 (4.09)	340 (4.21)
II				382 (4.09)	
	258 (4.31)	237 (4.29)		270 (4.25)	
	268 (4.29) ^{b)}	270 (4.33)	268 (4.39)	292 (4.05) ^{b)}	262 (4.43)
	296 (4.05) ^{a)}	296 (4.04) ^{a)}	340 (4.04) ^{a)}	361 (4.20)	296 (3.99) ^{a)}
III	354 (4.36)	381 (4.27)	405 (4.47)	389 (4.21)	377 (4.43)
	241 (4.31)	242 (4.34)	242 (4.34)	243 (4.32)	
	267 (4.28)	267 (4.33)	267 (4.33)	267 (4.33)	
	330 (4.36)	329 (4.35)	329 (4.37)	330 (4.36)	
IV	243 (4.31)	242 (4.32)	256 (4.28)	243 (4.31)	
	265 (4.19)	265 (4.22)	288 (3.96) ^{a)}	265 (4.23)	
	333 (4.36)	340 (4.27)	400 (4.48)	338 (4.36)	

^{a)} Barely discernible maximum in a minimum.^{b)} Shoulder.*¹ Part II : Yakugaku Zasshi, 84, 360 (1964).*² Kurokami-machi, Kumamoto (有富正和).

1) C. G. Nordström, T. Swain : J. Chem. Soc., 1953, 2764.

2) L. Jurd : Arch. Biochem. Biophys., 63, 376 (1956).

3) L. Jurd, R. M. Horowitz : J. Org. Chem., 22, 1618 (1957).

4) L. Jurd : "Spectral Properties of Flavonoid Compounds" in "The Chemistry of Flavonoid Compounds" ed. T. A. Geissman, 108, Pergamon Press, Oxford (1962).

On enzymic hydrolysis of I with emulsin, paper chromatography revealed the presence of luteolin.

It follows that I must have the structure of luteolin 4'- β -D-glucoside. Recently, Hörhammer, *et al.*⁵⁾ first isolated from *Spartium junceum* L. (Leguminosae) a flavonoid glycoside (V), m.p. 177~178°, which was identified as luteolin 4'- β -D-glucoside.

It seems that I is identical with V because of agreement in characteristic properties except for the melting point.*³

Experimental

Flavonoid compounds were run in the solvent systems of BuOH-AcOH-H₂O (4:1:5 by volume) (solvent 1) and 60% AcOH (solvent 2), and the component sugar was run in the solvent system of BuOH-pyridine-H₂O (3:2:1 by volume). UV spectrophotometry was carried out in the same manner as previously reported.⁶⁾

Isolation and Properties of I—The AcOEt extract obtained from the air-dried leaves of *A. cissifolium* K. Koch as described in the preceding paper*¹ was dissolved in MeOH and treated with a saturated solution of (AcO)₂Pb in MeOH. After removal of Pb salt, the non-precipitating fraction was concentrated to a small volume, and chromatographed on a column of Nylon powder using MeOH as an eluant. The fractions giving crystalline solids after evaporation and standing overnight were collected and recrystallized from H₂O to give I as pale yellow needles.

I changed at about 170° to a semifluid and melted at 243~244° (decomp.). I gave an orange-yellow color with Mg-HCl, an orange color with Zn-HCl, and a faint violet color with FeCl₃. *Anal.* Calcd. for C₂₁H₂₀O₁₁·3H₂O: C, 50.38; H, 5.16; H₂O, 10.8. Found: C, 50.57; H, 5.10; H₂O, 10.7.

Hydrolysis of I—a) Acid hydrolysis: A mixture of I and 10% H₂SO₄ solution was refluxed for 8 hr. After standing overnight, the aglucon that separated was collected, washed with H₂O, and recrystallized from MeOH-H₂O to yellow needles, m.p. 322° (decomp.), undepressed on admixture with authentic luteolin. The IR spectrum and R_f values in the solvent systems 1 and 2 were also found to be indistinguishable from those of luteolin. *Anal.* Calcd. for C₁₅H₁₀O₆: C, 62.94; H, 3.52. Found: C, 62.92; H, 3.68.

Acetylation of the aglucon with Ac₂O and AcONa in the usual manner gave an acetate as colorless needles, m.p. 228~229° (from MeOH), undepressed on admixture with authentic luteolin tetra-O-acetate. Its IR spectrum was also found to be superimposable with that of authentic specimen. *Anal.* Calcd. for C₂₃H₁₈O₁₁: C, 60.79; H, 3.99. Found: C, 61.09; H, 4.17.

The acid filtrate freed of the aglucon was neutralized with BaCO₃, concentrated to a small volume *in vacuo*, and chromatographed on paper. Only one spot appeared on the paper chromatogram of a sugar, the running distance of which was found to be the same as that of D-glucose.

b) Enzymic hydrolysis: To a solution of ca. 10 mg. of I in 50 ml. of H₂O was added a solution of emulsin*⁴ in 25 ml. of H₂O. The mixture was allowed to stand at 30° for 12 hr. and treated with 10% aqueous solution of (AcO)₂Pb. The precipitate was collected, washed with H₂O and MeOH, suspended in MeOH, and bubbled with H₂S. After removal of Pb salt, the filtrate was evaporated to a small volume and chromatographed on paper in the solvent systems 1 and 2. R_f values were found to be indistinguishable from those of luteolin.

Methylation of I—To a solution of 0.1 g. of I in MeOH was added under ice cooling a solution of CH₂N₂ in Et₂O prepared from 5 g. of nitrosomethyl urea. After standing overnight at room temperature, the needle crystals that separated were collected, washed with MeOH, and recrystallized from pyridine-H₂O to pale yellow needles, m.p. 216°, with previous softening at 212°. It gave an orange color with Mg- and Zn-HCl, and no color with FeCl₃. *Anal.* Calcd. for C₂₄H₂₆O₁₁·2H₂O: C, 54.75; H, 5.70. Found: C, 55.06; H, 5.74.

Acid Hydrolysis of III—A solution of 0.1 g. of III in a mixture of 5 ml. of dioxane and 5 ml. of 10% H₂SO₄ was refluxed for 4 hr. After evaporation of dioxane in steam, the reaction mixture was allowed to stand in an ice-box overnight. The solid separated was collected, washed with H₂O, and

*³ As the original specimen of Hörhammer was unavailable to the author, direct comparison could not be carried out.

*⁴ Prepared from Semen Pruni Armeniacae (T. Miwa, H. Suzuki: "Kôso Kenkyuhô" ed. S. Akabori, II, 93, Asakura Shoten, Tokyo (1956)).

5) L. Hörhammer, H. Wagner, H. S. Dhingra: *Naturwiss.*, **45**, 13 (1958).

6) M. Aritomi: *Yakugaku Zasshi*, **83**, 737 (1963).

recrystallized from MeOH to white needles, m.p. 191~191.5° (with previous softening at 187.5°), undepressed on admixture with synthetic *N*. The superimposable IR and UV spectra also established identity of the two specimens. *Anal.* Calcd. for $C_{18}H_{16}O_6 \cdot H_2O$: C, 62.42; H, 5.24. Found: C, 62.71; H, 5.35.

Acetylation of the product with Ac_2O and $AcONa$ in the usual manner gave an acetate as colorless needles, m.p. 227.5~228.5° (from EtOH), undepressed on admixture with 4'-acetate of synthetic *N*.

4'-Hydroxy-3',5,7-trimethoxyflavone (IV)—*N* was synthesized according to Nordström and Swain¹⁾ via 4'-benzyloxy-3',5,7-trimethoxyflavone, m.p. 192~193° (reported¹⁾ m.p. 208~209° (corr.)). *Anal.* Calcd. for $C_{25}H_{24}O_6$: C, 71.41; H, 5.75. Found: C, 71.44; H, 5.24.

N crystallized from MeOH as pale yellow needles, m.p. 186° (monohydrate), and m.p. 217° (anhydrous) (reported¹⁾ m.p. 223~224° (corr.)). UV λ_{max}^{EtOH} $m\mu$ (log ϵ): 242 (4.39), 265 (4.23), 338 (4.37), unchanged on addition of $AcONa$ and $AlCl_3$. UV $\lambda_{max}^{EtOH-EtONa}$ $m\mu$ (log ϵ): 256 (4.28), 289 (3.93), 400 (4.49). *Anal.* Calcd. for $C_{18}H_{16}O_6 \cdot H_2O$: C, 62.42; H, 5.24. Found: C, 62.38; H, 5.25. *Anal.* Calcd. for $C_{18}H_{16}O_6$: C, 65.85; H, 4.91. Found: C, 65.75; H, 5.01.

Acetylation of *N* with Ac_2O and $AcONa$ in the usual manner gave 4'-acetoxy-3',5,7-trimethoxyflavone as colorless needles, m.p. 228~229° (from EtOH), a compound unrecorded in the literature. *Anal.* Calcd. for $C_{20}H_{18}O_7$: C, 64.86; H, 4.90. Found: C, 64.85; H, 4.94.

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Summary

A flavonid glycoside (I), $C_{21}H_{20}O_{11} \cdot 3H_2O$, m.p. 243~244° (decomp.), was isolated in pure form from the leaves of *Acer cissifolium* K. KOCH, and identified as luteolin 4'- β -D-glucoside, first isolated by Hörhammer, *et al.*⁵⁾ from *Spartium junceum* L. (Leguminosae).

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Takashi Seki*¹ and Tomio Segawa*²: The Relation between Chemical Structures and Hypnotic Effects of Some Imidazolidinone Derivatives.

(Pharmacological Section, Research Department, Pharmaceutical
Division, Sumitomo Chemical Co., Ltd.*¹)

In the course of our investigation on a series of synthetic imidazolidinone derivatives we have found that some of these substances had central nervous system depressant properties in experimental animals. These compounds are 4,5-bis-alkyloxy or -alkenyloxy derivatives of 2-imidazolidinone with the following chemical structures: for the sake of convenience, they are referred to by their code numbers (Table I).

The alkenyloxy derivatives of 2-imidazolidinone are new substances which have never been disclosed in any printed articles. They are colorless, white needle, stable crystalline which are insoluble in water, soluble in methanol, chloroform and benzene.

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