

Structure of Gemin A, a New Dimeric Ellagitannin having α - and β -Glucose Cores

Takashi Yoshida,^a Takuo Okuda,^{*a} M. Usman Memon,^b and Tetsuro Shingu^b

^a Faculty of Pharmaceutical Sciences, Okayama University, Tsushima, Okayama 700, Japan

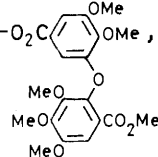
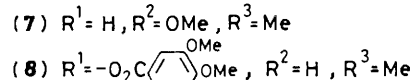
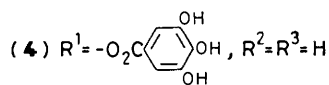
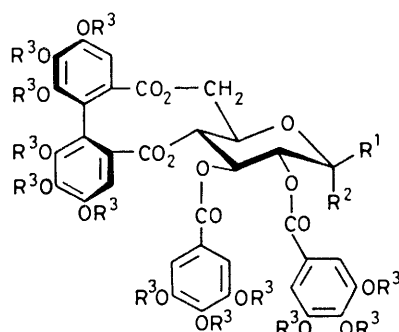
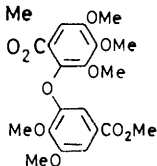
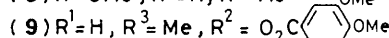
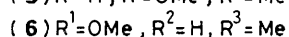
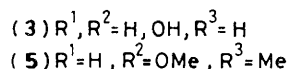
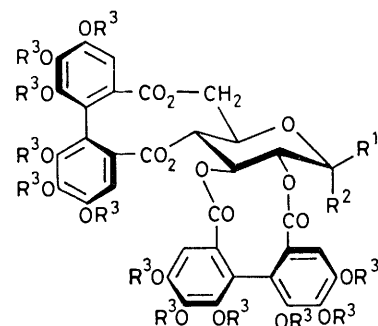
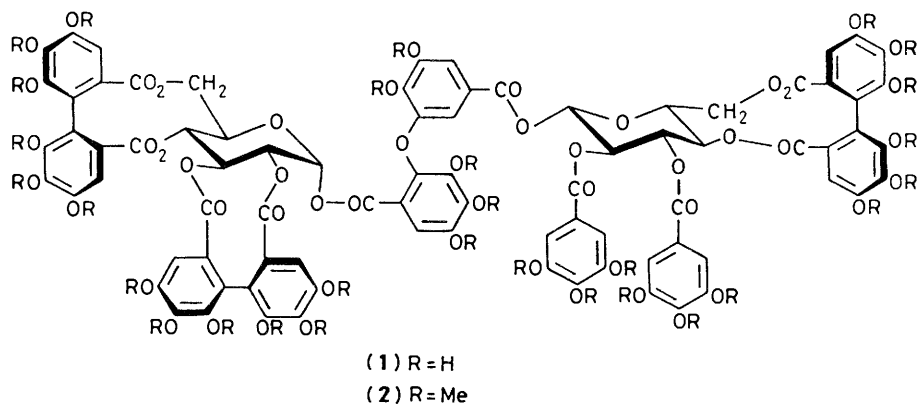
^b Faculty of Pharmaceutical Sciences, Kobe Gakuin University, Ikawadani, Tarumi-ku, Kobe 673, Japan

A dimeric ellagitannin, gemin A (**1**), has been isolated from *Geum japonicum* Thunb., and its structure, which contains α - and β -glucose cores, has been elucidated.

We recently reported¹ the isolation of agrimoniin from *Agrimonia pilosa* Ledeb. and *Potentilla kleiniana* Wight et Arn., the first dimeric ellagitannin encountered in nature. We have now isolated another new tannin of this class,

named gemin A, from *Geum japonicum* Thunb. (Rosaceae) which has been used as a diuretic in Japan and China.

Fractionation of the BuⁿOH-soluble portion from the aqueous acetone homogenate of the leaves by droplet counter-



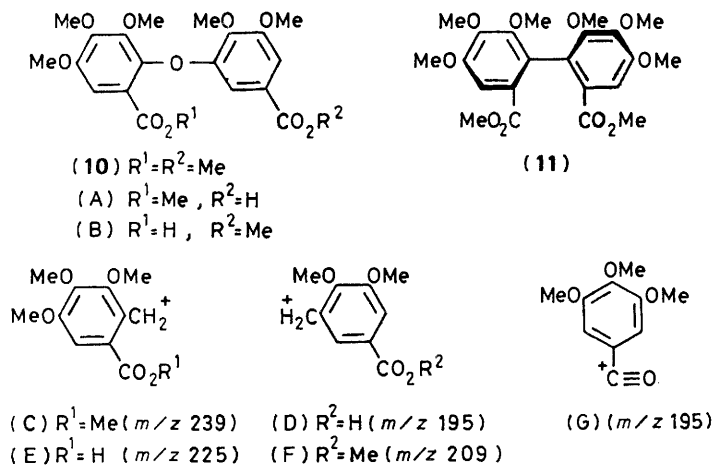
current chromatography (BuⁿOH-PrⁿOH-H₂O, 2:1:3, ascending method) followed by column chromatography on Sephadex LH-20 led to the isolation of gemin A (1), and also pedunculagin (3)² and tellimagrandin-II (4).²⁻⁴

Gemin A (1)[†] was obtained as an off-white amorphous powder, C₈₂H₅₆O₅₂·9H₂O, [α]_D²⁰ +156° (c 1.6, EtOH), u.v. (MeOH) λ_{max} 222 (log ε 5.26) and 272 nm (4.92), which was chromatographically homogeneous (normal phase and gel permeation h.p.l.c.). Comparison by gel permeation h.p.l.c. showed that its molecular weight was similar to that of agrimoniin. The ¹H n.m.r. spectrum (200 MHz, CD₃OD) showed the presence of a dehydrodigalloyl group (DHDG) [δ 7.23, 6.76 (1H each, d, J 2 Hz), 7.26 (1H, s)], two galloyl groups [δ 6.95, 6.90 (2H each, s)], three hexahydroxydiphenoyl groups (HHDP) [δ 6.63, 6.59, 6.57, 6.46, 6.40, and 6.34 (1H each, s)], and two monosaccharide cores which exhibited anomeric protons at δ 6.50 (d, J 3.5 Hz) and 6.02 (d, J 8 Hz). The presence of these components was confirmed by the ¹³C n.m.r. spectrum and also by production of dimethyl penta-*O*-methyldehydrodigallate (10),⁵ m.p. 113–114 °C, dimethyl (*S*)-hexamethoxydiphenate (11),² [α]_D²⁰ –38° (c 1.3, EtOH), and methyl tri-*O*-methylgallate (12), upon methanolysis of the permethylated derivative of (1)

prepared with diazomethane, which we regard as the nonacosamethyl derivative (2), C₁₁₁H₁₁₄O₅₂. Glucose was identified by g.l.c. of the trimethylsilyl derivative. Methylation of (1) with Me₂SO₄ and K₂CO₃ in refluxing acetone for 12 h yielded (2) and (10)–(12), and also five products of partial hydrolysis, (5)–(9), which were isolated by preparative t.l.c. Three of the five hydrolysates, (5), (6), and (7), were identified as the α- and β-anomers of trideca-*O*-methylpedunculagin,² and the α-anomer of trideca-*O*-methyltellimagrandin-I,^{2,4} respectively, by direct comparison with authentic samples. The ¹H n.m.r. spectrum [90 MHz, (CD₃)₂CO] of the fourth hydrolysate (8), C₆₆H₇₀O₃₁, m/z 936 (M⁺ –422), showed two *meta*-coupled aromatic protons (δ 7.38 and 6.85, 1H each, d, J 2 Hz) and a singlet (δ 7.35, 1H) due to DHDG protons, besides protons of a HHDP group (δ 6.77 and 6.94, 1H each, s) and two galloyl groups (δ 7.21, 4H, s). The mass spectrum (20 eV) of (8) exhibited a peak due to fragment (C) (m/z 239, 4.0%)[‡] which arises by cleavage of the ether linkage of the monomethyl ester ion (A), accompanied by the rearrangement of a methyl group.⁶ These data and the coupling constant (J 8 Hz) of the anomeric proton signal at δ 6.30 in the ¹H n.m.r. spectrum, are compatible with structure

[†] Satisfactory analytical and spectroscopic data were obtained for all new compounds.

[‡] Although the m/z 195 peak which may be assigned to fragment (D) was also observed, this would arise mainly from fragment (G) from the galloyl group; base peak: m/z 212.



(8). The fifth hydrolysate can be assigned the formula (9), $C_{66}H_{68}O_{31}$, based on its 1H n.m.r. spectrum [90 MHz, $(CD_3)_2CO$, δ 6.61, 6.76, 6.91, and 6.97 ($2 \times$ HHDP); 6.89, 7.34 (d, J 2 Hz for each), 7.40 (s) (DHDG); 6.62 (d, J 3.5 Hz, glucose anomeric H)], and its mass spectrum [m/z 1356 (M^+)], which shows peaks at m/z 225 (5.0%, fragment E) and 209 (5.0%, fragment F)§ which are attributable to cleavage of the ion (B).

The structure of gemin A was thus established as (1), which is the second dimeric ellagitannin whose structure has been established, and is also the first example of an ellagitannin dimer possessing both α - and β -glucose cores in the molecule. The occurrence of (1) and agrimoniin may be a part of wide distribution of dimeric ellagitannins of this class in nature.

§ These assignments were verified by the absence of the corresponding peaks in (5) and (6); base peak: m/z 404.

One of us (M.U.M.) is grateful for a scholarship from the Ministry of Education, Science and Culture, Japan.

Received, 5th January 1982; Com. 009

References

- 1 T. Okuda, T. Yoshida, M. Kuwahara, M. U. Memon, and T. Shingu, *J. Chem. Soc., Chem. Commun.*, 1982, 163.
- 2 T. Okuda, T. Yoshida, and M. Ashida, *Heterocycles*, 1981, **16**, 1681.
- 3 C. K. Wilkins and B. A. Bohm, *Phytochemistry*, 1976, **15**, 211.
- 4 T. Okuda, T. Hatano, and T. Yasui, *Heterocycles*, 1981, **16**, 1321.
- 5 T. Ozawa, K. Haga, D. Kobayashi, T. Kamiyama, and Y. Takino, *Agric. Biol. Chem.*, 1977, **41**, 1249.
- 6 Ch. Wünsche, A. Sachs, A. Eiwiller, and W. Mayer, *Tetrahedron*, 1968, **24**, 3407.