

SAMBACOSIDES A, E AND F, NOVEL TETRAMERIC IRIDOID GLUCOSIDES  
FROM *JASMINUM SAMBAC*

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Abstract: Structures of three tetrameric iridoid glucosides, sambacosides A, E and F isolated from the leaves of *Jasminum sambac* (L.) Ait. were elucidated as 2, 3 and 4 by chemical and spectrometric means. They represent the first tetrameric iridoid glucosides.

In the preceding paper,<sup>1)</sup> we reported the structure elucidation of sambacolignoside, a lignan linked secoiridoid glucoside isolated from the fresh leaves of *Jasminum sambac* (L.) Ait. (Japanese name, Maturika) (Oleaceae) together with seven new oligomeric iridoid glucosides, sambacosides A - G and oleoside 11-methyl ester (1). This paper deals with the structure elucidation of three tetrameric iridoid glucosides, sambacosides A (2), E (3) and F (4).

Sambacoside A (2) was obtained as a white powder,  $C_{61}H_{86}O_{34}$ ,  $[\alpha]_D -226.6^\circ$  (MeOH). The UV and IR spectral data of 2 ( $\lambda_{max}$  (MeOH): 237 nm ( $\log \epsilon$  4.55);  $\nu_{max}$  (KBr): 3440, 1720 and 1640  $cm^{-1}$ ) revealed the presence of the chromophore  $O=C-C=CH-O-$  characteristic of iridoids in addition to hydroxy groups. Its  $^1H$ -NMR spectrum (200 MHz,  $CD_3OD$ ) exhibited triplicate signals for protons of the above mentioned chromophore ( $\delta$  7.53, 3H, s), ethylidene groups ( $\delta$  1.75, 9H, br d,  $J=7.0$  Hz; 6.09, 3H, br q,  $J=7.0$  Hz), carbomethoxy groups ( $\delta$  3.72, 9H, s), acetal protons ( $\delta$  5.93, 3H, br s) and anomeric protons ( $\delta$  4.81, 3H, d,  $J=8.0$  Hz) along with signals for a methyl group ( $\delta$  1.06, 3H, d,  $J=7.0$  Hz) and a methine proton attached to an acyloxy group ( $\delta$  4.65, 1H, m), suggesting the presence of three oleoside methyl ester moieties and a non-oleoside methyl ester portion in the molecule. The former moieties were further confirmed to be the 11-methyl ester (1) units based on the chemical shift of their carbomethoxy groups. In accord with the above findings, the  $^{13}C$ -NMR signals of 2 (Note 2 and Table I) indicated the presence of three sets of carbon signals corresponding to 1 as well as those due to a  $C_{10}$  unit having one methyl, one methylene, four methines, three oxygenated methylenes and one methine bearing O-functional group. On alkaline hydrolysis followed by treatment with  $CH_2N_2-Et_2O$ , 2 afforded oleoside dimethyl ester (5) and tetraol (6), the latter of which, on acetylation, gave tetraacetate (7). As shown in Table I, the

$^{13}\text{C}$ -NMR spectra of 6 and triol (8), which was obtained by hydrolysis of jasminin (9)<sup>3)</sup>, an iridoid-secoiridoid glucoside from *J. mesnyi* Hance, showed nearly identical chemical shifts for C-1", 2", 4", 5", 6" and 7". However, along with significant differences between chemical shifts for C-3", 8" and 10" of compounds 6 and 8, a remarkable variance of 47.2 ppm was observed between the chemical shifts for C-9" of both compounds. Thus, tetraol (6), the central structural component, which exists esterified with three moles of 1 in glucoside 2, was assumed to be the 9-hydroxy derivative of triol (8) possessing the iridane skeleton. As regards the positions of the three ester linkages on tetraol (6), two were assigned respectively to C-5" and 7", since the signals due to those carbons of 2 appeared in lower field compared with the corresponding signals of 6. The remaining esterified position of 2 was decided to be 10" in correlation with the structure of sambacoside F (4) (*vide infra*).

Glucoside (4), a white powder,  $[\alpha]_{\text{D}} -215.7^{\circ}$  (MeOH) is an isomer of 2. It showed UV, IR and  $^1\text{H}$ -NMR spectral features<sup>4)</sup> closely similar to those of 2. Furthermore, the  $^{13}\text{C}$ -NMR spectrum of 4 was in good accord with that of 2 except for the signals of C-9" and 10" (Table I). These data, together with the fact that oleoside (10) and tetraol (6) were obtained by hydrolysis of 4, suggested that 2 and 4 differ only in the position of the third ester linkage between C-9" and C-10". Thus, the following series of reactions were carried out: Sambacoside A (2) was subjected to mesylation with  $\text{MsCl-Py}$ , followed by  $\text{LiAlH}_4$  reduction in  $\text{Et}_2\text{O}$  and benzylation with  $\text{C}_6\text{H}_5\text{COCl-Py}$ , to give rise to tribenzoate (11). On the other hand, sambacoside F (4) was led to tribenzoate (12) in the same way. Whereas 11 and 12 were appreciably different in  $^1\text{H}$ -<sup>5)</sup> and  $^{13}\text{C}$ -NMR spectra (Table I), the benzoate of triol (8) derived from jasminin (9) was completely identical with 11 ( $^1\text{H}$ - and  $^{13}\text{C}$ -NMR data and  $[\alpha]_{\text{D}} -38.9^{\circ}$  ( $\text{CHCl}_3$ )). Accordingly, it was concluded that 2 and 4 possess a free hydroxy group at C-9" and C-10", respectively.

The third glucoside, sambacoside E (3) was obtained as a white powder,  $[\alpha]_{\text{D}} -208.5^{\circ}$  (MeOH). Spectral data of this compound<sup>6)</sup> indicated that it was another isomer of 2 and 4. The  $^1\text{H}$ -NMR spectrum of 3 resembled that of 2, except for the lack of the signal due to one acyloxy bearing methine around 4.65 ppm, suggesting the existence of a free hydroxy function at C-5". This was further supported by the chemical shift of C-5" in the  $^{13}\text{C}$ -NMR spectrum of 3, which was consistent with that of the corresponding carbon in tetraol (6). A comparative study of the  $^{13}\text{C}$ -NMR spectra of 3 and tetraacetate (7) showed that the signals due to C-7", 8", 9" and 10" of both compounds respectively appeared at the proximate positions, indicating that the hydroxy groups at C-7", 9" and 10" in sambacoside E were acylated. Thus, the structure 3 was assigned to sambacoside E.

Glucosides 2, 3 and 4 are the first examples of tetrameric iridoid glucosides, though several dimeric iridoid glucosides have been isolated.<sup>7,8)</sup>

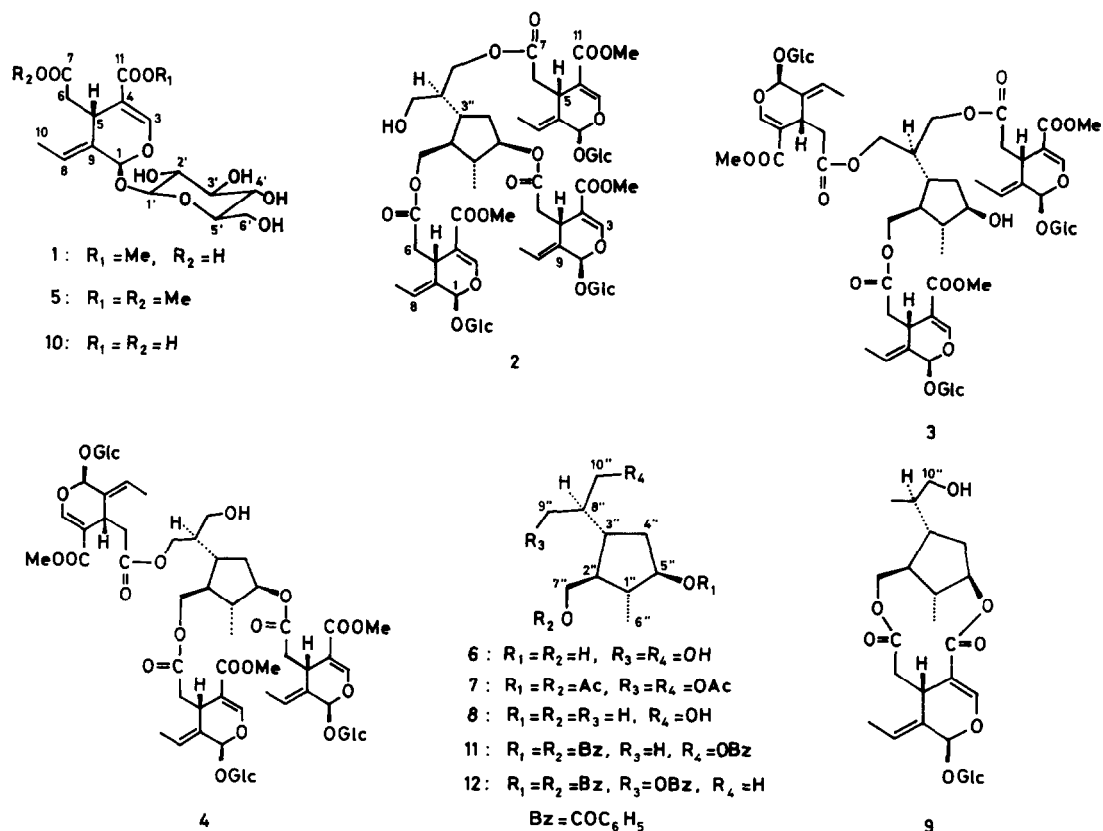


Table I.  $^{13}\text{C}$ -NMR Signals of the Iridane Skeleton in Sambacosides A (2), E (3) and F (4) and Compounds 6, 7, 8, 11 and 12.

	2a,c)	3a,c)	4a,c)	6a)	7a)	8a)	11b)	12b)
C-1"	44.2(d) <sup>d</sup>	46.5(d)	44.3(d)	46.2(d)	44.2(d)	46.5(d)	43.7(d)	43.4(d)
C-2"	49.8(d)	49.8(d)	49.3(d)	51.9(d)	48.9(d)	51.2(d)	47.9(d)	47.7(d)
C-3"	40.0(d)	39.5(d)	40.3(d)	38.3(d)	40.4(d)	41.7(d)	42.9(d)	41.5(d)
C-4"	34.8(t)	37.0(t)	34.9(t)	37.7(t)	34.5(t)	38.4(t)	34.6(t)	31.9(t)
C-5"	83.2(d)	79.4(d)	83.1(d)	79.6(d)	82.4(d)	79.9(d)	81.7(d)	81.8(d)
C-6"	19.0(q)	18.4(q)	18.9(q)	18.7(q)	18.5(q)	18.7(q)	18.8(q)	18.4(q)
C-7"	68.1(t)	68.2(t)	68.2(t)	66.1(t)	67.4(t)	66.4(t)	67.8(t) <sup>f</sup>	68.8(t) <sup>g</sup>
C-8"	44.5(d) <sup>d</sup>	41.8(d)	44.3(d)	48.4(d)	41.5(d)	41.3(d)	36.2(d)	34.2(d)
C-9"	62.5(t)	65.6(t)	65.8(t)	62.9(t) <sup>e</sup>	65.0(t)	15.7(q)	16.3(q)	66.2(t) <sup>g</sup>
C-10"	64.4(t)	64.2(t)	61.0(t)	62.4(t) <sup>e</sup>	63.6(t)	66.7(t)	67.3(t) <sup>f</sup>	12.2(q)

a,b) Measured at 50 MHz in a)  $\text{CD}_3\text{OD}$  or b)  $\text{CDCl}_3$

c) See Note 2 for carbon signals due to oleoside 11-methyl ester moieties.

d-g) Values with the same superscript are interchangeable.

Glucosides possessing iridane alcohol moiety such as 6 and 8 are characteristic of the plants of genus *Jasminum*.<sup>3,9)</sup>

## References and Notes

1. T. Tanahashi, N. Nagakura, K. Inoue, H. Inouye and T. Shingu, *Chem. Pharm. Bull.*, **35**, 5032 (1987).
2. <sup>13</sup>C-NMR data for oleoside 11-methyl ester (1) moieties in 2 δ: 13.8(q, 3xC-10), 31.9(d, 3xC-5), 41.3(t, 3xC-6), 52.1(q, 3xOCH<sub>3</sub>), 62.7 and 62.8(t, 3xC-6'), 71.4 and 71.5(d, 3xC-4'), 74.8(d, 3xC-2'), 77.9(d, 3xC-5'), 78.4 (d, 3xC-3'), 95.2(d, 3xC-1), 100.8(d, 3xC-1'), 109.4(s, 3xC-4), 124.8 and 124.9(d, 3xC-8), 130.7, 130.8 and 130.9(s, 3xC-9), 155.2(d, 3xC-3), 168.6 (s, 3xC-11), 173.0 and 173.2(s, 3xC-7). The corresponding carbon signals in 3 and 4 appeared essentially in the same frequencies as described above.
3. T. Kamikawa, K. Inoue, T. Kubota and M. C. Woods, *Tetrahedron*, **26**, 4561 (1970) and references cited therein.
4. Sambacoside F (4) FABMS m/z 1363 [M+H]<sup>+</sup>; UV λ<sub>max</sub><sup>MeOH</sup> nm(log ε): 237(4.55); IR ν<sub>max</sub><sup>MeOH</sup> cm<sup>-1</sup>: 3440, 1710, 1635; <sup>1</sup>H-NMR (CD<sub>3</sub>OD) δ: 1.06(3H, d, J=7.0 Hz, H<sub>3</sub>-6"), 1.75(9H, br d, J=7.0 Hz, 3xH<sub>3</sub>-10), 2.49(3H, dd, J=9.0, 14.0 Hz, 3xH<sub>A</sub>-6), 2.67(1H, dd, J=5.0, 14.0 Hz, H<sub>B</sub>-6), 2.75(2H, dd, J=5.0, 14.0 Hz, 2xH<sub>B</sub>-6), 3.72(9H, s, 3xCOOCH<sub>3</sub>), 4.66(1H, m, H-5"), 4.82(3H, d, J=8.0 Hz, 3xH-1'), 5.93(3H, br s, 3xH-1), 6.11(3H, br q, J=7.0 Hz, 3xH-8), 7.53(3H, s, 3xH-3).
5. <sup>1</sup>H-NMR (CDCl<sub>3</sub>) of 10 and 11. 10 δ: 1.18(3H, d, J=6.6 Hz, H<sub>3</sub>-6" or 9"), 1.19(3H, d, J=7.1 Hz, H<sub>3</sub>-9" or 6"), 5.04(1H, q, J=4.4 Hz, H-5"), 7.3-8.2 (15H, arom. H); 11 δ: 1.06(3H, d, J=6.8 Hz, H<sub>3</sub>-6" or 9"), 1.22(3H, d, J=7.1 Hz, H-9" or 6"), 5.01(1H, dt, J=5.9, 4.4 Hz, H-5"), 7.3-8.2(15H, arom. H).
6. Sambacoside E (3) FABMS m/z: 1363 [M+H]<sup>+</sup>; UV λ<sub>max</sub><sup>MeOH</sup> nm(log ε): 237(4.55); IR ν<sub>max</sub><sup>MeOH</sup> cm<sup>-1</sup>: 3440, 1730(sh), 1710, 1635; <sup>1</sup>H-NMR (CD<sub>3</sub>OD) δ: 1.05(3H, d, J=6.0 Hz, H<sub>3</sub>-6"), 1.75(9H, br d, J=7.0 Hz, 3xH<sub>3</sub>-10), 2.48(2H, dd, J=9.0, 14.0 Hz, 2xH<sub>A</sub>-6), 2.50(1H, dd, J=9.0, 14.0 Hz, H<sub>A</sub>-6), 2.72(1H, dd, J=5.0, 14.0 Hz, H<sub>B</sub>-6), 2.74(2H, dd, J=5.0, 14.0 Hz, 2xH<sub>B</sub>-6), 3.71(9H, s, 3xCOOCH<sub>3</sub>), 4.81(3H, d, J=8.0 Hz, 3xH-1'), 5.93(3H, br s, 3xH-1), 6.11(3H, br q, J=7.0 Hz, 3xH-8), 7.53(3H, s, 3xH-3).
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(Received in Japan 24 November 1987)