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STEROIDAL SAPONINS FROM *SANSEVIERIA TRIFASCIATA*

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Key Word Index—*Sansevieria trifasciata*; Agavaceae; steroidal saponins; spirostanol saponins.

Abstract—The methanol extract of the whole plant of *Sansevieria trifasciata* has yielded 12 steroidal saponins, 10 of which are new constituents. The respective structures of the new compounds have been shown by the spectroscopic evidence, and alkaline- and acid-catalysed degradation. This is the first report of the isolation of steroidal saponins from *S. trifasciata*. Copyright © 1996 Elsevier Science Ltd

INTRODUCTION

Plants belonging to the family Agavaceae are well known as rich sources of steroidal saponins [1, 2]. Previously, we have isolated a series of new polyhydroxylated steroidal saponins, one of which is very unique in structure having a fructose as the carbohydrate component [3], and polyhydroxylated cholestane bisdesmosides [4] from the stems of *Nolina recurvata*, an Agavaceae plant indigenous to Mexico.

As part of our program of the chemical investigation of Agavaceae plants, we have now examined the fresh whole plant of *Sansevieria trifasciata* which is native to the subtropical regions of the African Continent. This paper describes the structural assignment of 10 new steroidal saponins from *S. trifasciata* based on spectroscopic analysis, and alkaline- and acid-catalysed hydrolysis.

RESULTS AND DISCUSSION

The fresh whole plant of *S. trifasciata* was extracted with hot methanol. The crude extract was partitioned between 1-butanol and water. A series of chromatographic separations of the 1-butanol-soluble phase using silica gel, octadecylsilanized (ODS) silica gel, Sephadex LH-20 and Diaion HP-20 furnished compounds **1**–**12**.

The structures of **1** and **2** were identified by comparison of their spectral data (Table 1 and Experimental) and physical properties with literature values as (23*S*)-spirosta-5,25(27)-diene-β,3β,23-triol-1-*O*-{*O*-α-L-rhamnopyranosyl-(1 → 2)-*O*-{β-D-xylopyranosyl-(1 → 3)]-α-L-arabinopyranoside} and (23*S*,24*S*)-spirosta-5,25(27)-diene-1β,3β,23,24-tetrol 1-*O*-{*O*-α-L-rhamno-pyranosyl-(1 → 2)-*O*-[β-D-xylopyranosyl-(1 → 3)]-α-L-arabinopyranoside}, respectively [3].

Compound **3**, $C_{45}H_{68}O_{18}$ (negative FAB-mass spectrum *m/z* 895 $[M-H]^-$), $[\alpha]_D$ −62.5° (methanol), was obtained as an amorphous solid. The ^{1}H NMR spectrum of **3** contained two tertiary methyl proton signals at δ 1.35 and 1.06 (each *s*), a secondary methyl proton signal at δ 1.12 (*d*, *J* = 7.0 Hz), an olefinic proton signal at δ 5.62 (*br d*, *J* = 5.5 Hz), exo-methylene proton signals at δ 4.84 and 4.82 coupled to each other with a *J* value of less than 0.5 Hz and three anomeric proton signals at δ 6.47 (*br s*), 4.94 (*d*, *J* = 7.5 Hz) and 4.70 (*d*, *J* = 7.6 Hz). The above data were indicative of **3** being a steroidal saponin closely related to **1**. In addition, the presence of an acetyl group in **3** was shown by the IR (ν_{max} 1730 cm^{-1}), ^{1}H NMR [δ 2.00 (3H, *s*)] and ^{13}C NMR [δ 170.8 (C) and 21.1 (Me)] spectra. In the negative FAB-mass spectrum, the fragment ion peak at *m/z* 853 was assignable to $[M-MeCO]^-$. Alkaline hydrolysis of **3** with 4% potassium hydroxide gave **1**. Therefore, compound **3** was confirmed to be a monoacetate of **1**. On comparison of the ^{1}H NMR spectrum of **3** with that of **1**, the signal assignable to 4-H of the rhamnose was shifted downfield by 1.51 ppm to appear at δ 5.78 (*dd*, *J* = 9.7, 9.7 Hz), accounting for the ester linkage to the C-4 hydroxyl group of the rhamnose. The structure of **3** was formulated as (23*S*)-spirosta-5,25(27)-diene-1β,3β,23-triol 1-*O*-{*O*-(4-*O*-acetyl-α-L-rhamnopyranosyl)-(1 → 2)-*O*-[β-D-xylopyranosyl-(1 → 3)]-α-L-arabinopyranoside}.

The ^{1}H and ^{13}C NMR spectra of **4** ($C_{47}H_{70}O_{19}$, negative FAB-mass spectrum *m/z* 938 $[M]^-$) showed the presence of two acetyl groups in the molecule [δ_H 1.96 and 1.94 (each 3H, *s*); δ_C 170.7 (C), 170.4 (C), 21.0 (Me) and 20.9 (Me)]. Alkaline hydrolysis of **4** gave **1**. The ester linkages in the rhamnose C-2 and C-3 hydroxyl groups of **4** were formed from acetic acid, as was evident in the ^{1}H NMR paramagnetic chemical

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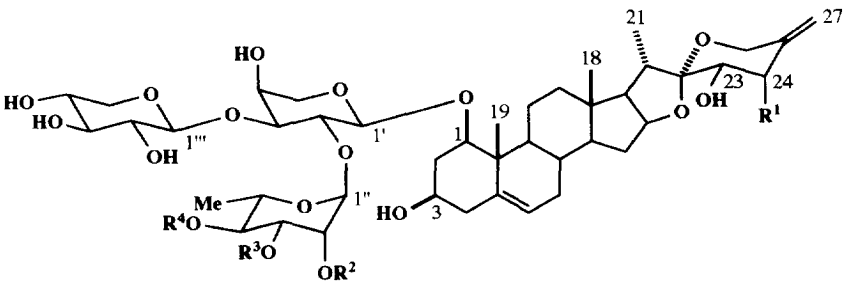
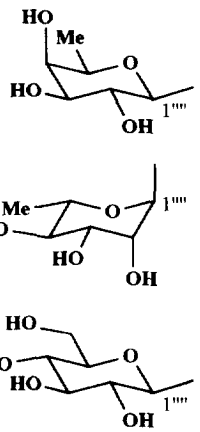


	R^1	R^2	R^3	R^4
1	H	H	H	H
2	OH	H	H	H
3	H	H	H	Ac
4	H	Ac	Ac	H
5	OH	H	H	Ac
6	OH	Ac	Ac	H
7	OH	Ac	Ac	Ac
8	O-Fuc	H	H	Ac
8a	O-Fuc	H	H	H
9	O-Fuc	Ac	Ac	H
10	O-Fuc	Ac	Ac	Ac
11	O-Rha	Ac	Ac	Ac
12	O-Glc	Ac	Ac	Ac



shifts due to acylation: the 2-H and 3-H protons of the rhamnose were moved to lower fields by 1.36 and 1.30 ppm, respectively, as compared with those of **1**, to be observed at δ 6.14 (*dd*, J = 3.4, 1.4 Hz) and 5.98 (*dd*, J = 9.9, 3.4 Hz). The structure of **4** was characterized as (23*S*)-spirosta-5,25(27)-diene-1β,3β,23-triol 1-*O*-{*O*-(2,3-*O*-diacetyl-α-L-rhamnopyranosyl)-(1$\rightarrow$2)-*O*-[β-D-xylopyranosyl-(1$\rightarrow$3)]-α-L-arabinopyranoside}.

Alkaline hydrolysis of **5** ($C_{45}H_{68}O_{19}$, positive FAB-mass spectrum *m/z* 951 $[M+K]^+$, 935 $[M+Na]^+$, 913 $[M+H]^+$), **6** ($C_{43}H_{70}O_{20}$, negative FAB-mass spectrum *m/z* 954 $[M]^-$) and **7** ($C_{49}H_{72}O_{21}$, negative FAB-mass spectrum *m/z* 995 $[M-H]^-$) yielded a spirostanol triglycoside, identified as **2**. The ^1H and ^{13}C NMR spectra indicated that **5**–**7** were monoacetyl [δ_H 2.01 (3H, *s*); δ_C 170.8 (C) and 21.1 (Me)], diacetyl [δ_H 1.96 and 1.94 (each 3H, *s*); δ_C 170.7 (C), 170.4 (C), 21.1 (Me) and 20.9 (Me)] and triacetyl [δ_H 2.13, 2.03 and 1.88 (each 3H, *s*); δ_C 170.5 (C), 170.4 (C), 170.2 (C), 20.8 (Me), 20.7 (Me) and 20.6 (Me)] derivatives of **2**, respectively. The following downfield ^1H NMR shifts due to acetylation in comparison with **2** were observed for each of the compounds: 4-H of the rhamnose [δ 5.78 (*dd*, J = 9.7, 9.7 Hz), + 1.51 ppm] in **5**, 2-H and 3-H of the rhamnose [δ 6.14 (*dd*, J = 3.4, 1.5 Hz, 2-H), + 1.36 ppm; δ 5.90 (*dd*, J = 9.9, 3.4 Hz, 3-H), + 1.32 ppm] in **6**, and 2-H, 3-H and 4-H of the rhamnose [δ 6.10 (*br d*, J = 3.4 Hz, 2-H), + 1.32 ppm; δ 5.93 (*dd*, J = 10.2, 3.4 Hz, 3-H), + 1.35 ppm; δ 5.63 (*dd*, J = 10.2, 10.2 Hz, 4-H), + 1.36 ppm] in **7**. The respective structures of **5**–**7** were thus assigned as 1-*O*-{*O*-(4-*O*-acetyl-α-L-rhamnopyranosyl)-(1$\rightarrow$2)-*O*-[β-D-xylopyranosyl-(1$\rightarrow$3)]-α-L-arabinopyranoside}, 1-*O*-{*O*-(2,3-*O*-diacetyl-α-L-rhamnopyranosyl)-(1$\rightarrow$2)-*O*-[β-D-xylopyranosyl-(1$\rightarrow$3)]-α-L-arabinopyranoside} and 1-*O*-{*O*-(2,3,4-*O*-triacetyl-α-L-rhamnopyranosyl)-(1$\rightarrow$2)-*O*-[β-D-xylopyranosyl-(1$\rightarrow$3)]-α-L-arabinopyranoside} of (23*S*,24*S*)-spirosta-5,25(27)-diene-1β,3β,23,24-tetrol.

The ^1H NMR spectrum of **8** ($C_{51}H_{78}O_{23}$, positive FAB-mass spectrum *m/z* 1081 $[M+Na]^+$) displayed four anomeric proton signals at δ 6.45 (*br s*), 5.16 (*d*, J = 7.8 Hz), 4.93 (*d*, J = 7.5 Hz) and 4.68 (*d*, J = 7.4 Hz) in addition to signals arising from the aglycone for two tertiary methyl groups at δ 1.37 and 0.95 (each *s*), a secondary methyl group at δ 1.07 (*d*, J = 7.0 Hz), an olefinic proton at δ 5.63 (*br d*, J = 5.5 Hz) and exomethylene protons at δ 5.23 and 5.09 coupled to each other with a J value of 1.1 Hz. The presence of an acetyl group in **8** was showed by the IR (ν_{max} 1730 cm^{-1}), ^1H NMR [δ 2.01 (3H, *s*)] and ^{13}C NMR [δ 170.8 (C) and 21.1 (Me)] spectra. Alkaline hydrolysis of **8** gave a bisdesmosidic steroidal saponin (**8a**), identified as 24-*O*-β-D-fucopyranoside of **2**, which was previously isolated by us from the stems of *Nolina recurvata* [3]. In the ^1H NMR spectrum of **8**, the downfield-shifted ^1H NMR signal at δ 5.77 (*dd*, J = 9.7, 9.7 Hz) was assigned to 4-H of the rhamnose, which was moved to lower field by 1.52 ppm as compared with that of **8a**. The structure of **8** was thus shown to be (23*S*,24*S*)-spirosta-5,25(27)-diene-1β,3β,23,24-tetrol 1-*O*-{*O*-(4-*O*-acetyl-α-L-rhamno-

Table 1. ^{13}C NMR spectral data for compounds **1–8**, **8a** and **9–12***

C	1	2	3	4	5	6	7	8	8a	9	10	11	12
1	83.7	83.7	84.0	84.1	84.0	84.0	84.0	83.9	83.7	84.0	84.0	84.0	84.0
2	37.4	37.5	37.7	37.7	37.6	37.6	37.7	37.6	37.5	37.6	37.7	37.8	37.8
3	68.3	68.2	68.0	68.2	68.0	68.2	67.9	68.0	68.2	68.2	68.0	68.0	68.0
4	43.9	43.8	44.0	43.8	44.0	43.8	43.8	44.0	43.9	43.8	43.9	43.9	43.9
5	139.6	139.5	139.4	139.5	139.4	139.5	139.2	139.5	139.7	139.6	139.4	139.3	139.3
6	124.7	124.7	125.0	124.7	124.9	124.7	125.0	124.9	124.6	124.7	125.0	125.0	125.0
7	32.1	32.0	32.1	32.0	32.0	32.0	32.0	32.0	31.9	32.0	32.0	32.0	32.0
8	33.1	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
9	50.4	50.4	50.4	50.3	50.4	50.3	50.3	50.3	50.4	50.2	50.3	50.3	50.3
10	42.9	42.9	42.9	42.9	42.9	42.9	42.8	42.9	42.9	42.9	42.9	42.9	42.9
11	24.1	24.1	24.0	24.0	24.0	24.1	24.0	23.9	24.0	24.0	24.0	24.0	24.0
12	40.6	40.6	40.6	40.6	40.5	40.5	40.5	40.4	40.5	40.4	40.4	40.5	40.4
13	40.8	40.7	40.8	40.8	40.7	40.7	40.6	40.7	40.8	40.7	40.8	40.7	40.8
14	56.9	56.9	56.8	56.9	56.9	56.9	56.8	56.7	56.8	56.7	56.7	56.8	56.7
15	32.4	32.3	32.4	32.4	32.3	32.3	32.3	32.4	32.3	32.4	32.4	32.5	32.5
16	82.0	83.3	82.0	82.0	83.2	83.3	83.2	82.1	82.2	82.2	82.1	82.5	82.5
17	62.5	61.4	62.5	62.5	61.4	61.4	61.3	61.5	61.5	61.5	61.5	61.5	61.5
18	16.9	16.8	16.9	16.9	16.9	16.9	16.9	16.8	16.8	16.8	16.8	16.8	16.9
19	15.0	15.0	14.9	15.0	14.9	15.0	14.8	15.0	15.1	15.1	14.9	14.9	15.0
20	35.8	37.1	35.8	35.8	37.1	37.1	37.1	37.4	37.5	37.4	37.5	37.5	37.5
21	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.8	14.7	14.8	14.8	14.8	14.8
22	111.8	112.7	111.9	111.8	112.7	112.7	112.6	111.8	111.8	111.7	111.8	111.8	111.8
23	68.6	69.6	68.6	68.6	69.6	69.7	69.6	70.3	70.4	70.3	70.4	70.2	70.4
24	38.9	74.2	38.9	38.9	74.1	74.2	74.1	83.0	83.0	83.0	83.0	83.0	83.0
25	144.4	146.4	144.4	144.4	146.4	146.4	146.4	143.9	144.0	143.9	144.0	144.0	143.7
26	64.3	60.8	64.3	64.3	60.8	60.8	60.8	61.5	61.5	61.5	61.5	61.5	61.5
27	109.3	112.3	109.4	109.3	112.4	112.4	112.4	113.7	113.7	113.8	113.8	113.7	114.1
1′	100.5	100.5	100.7	100.4	100.7	100.4	100.3	100.7	100.5	100.4	100.3	100.3	100.3
2′	74.3	74.2	72.9	73.7	72.9	73.7	72.7	72.9	74.3	73.7	72.7	72.8	72.8
3′	84.4	84.5	85.2	84.7	85.2	84.7	85.1	85.2	84.4	84.7	85.1	85.1	85.1
4′	69.6	69.6	70.0	69.9	70.0	69.9	69.9	69.9	69.5	69.9	69.9	69.9	69.9
5′	67.1	67.1	67.2	67.1	67.2	67.1	67.1	67.1	67.1	67.1	67.1	67.2	67.2
1″	101.9	101.8	100.9	98.3	100.9	98.3	97.7	100.9	101.8	98.2	97.7	97.7	97.7
2″	72.5	72.5	72.3	70.8	72.3	70.8	70.6	72.2	72.5	70.8	70.6	70.6	70.6
3″	72.6	72.6	69.9	73.2	69.9	73.2	70.1	70.0	72.6	73.2	70.1	70.1	70.1
4″	74.3	74.2	76.5	69.3	76.5	69.3	71.9	76.5	74.2	69.3	72.0	72.0	72.0
5″	69.6	69.6	66.6	70.8	66.6	70.8	66.3	66.6	69.5	70.8	66.4	66.4	66.4
6″	19.1	19.1	18.5	18.9	18.5	18.9	18.2	18.5	19.1	18.9	18.2	18.3	18.2
1‴	106.5	106.5	106.8	106.5	106.8	106.5	106.7	106.7	106.4	106.5	106.7	106.7	106.7
2‴	74.7	74.6	74.6	74.6	74.6	74.6	74.6	74.5	74.6	74.6	74.6	74.6	74.6
3‴	78.5	78.3	78.5	78.3	78.5	78.3	78.4	78.5	78.2	78.2	78.4	78.4	78.4
4‴	71.0	71.0	71.0	71.1	71.0	71.1	70.9	70.9	71.0	71.0	71.0	71.0	71.0
5‴	66.9	67.0	67.4	67.4	67.4	67.4	67.5	67.3	66.9	67.3	67.5	67.5	67.5
1⁗								106.3	106.3	106.3	106.3	106.3	106.1
2⁗								73.1	73.1	73.1	73.1	72.6	75.9
3⁗								75.4	75.4	75.4	75.4	73.3	78.6
4⁗								72.8	72.8	72.8	72.9	74.3	71.6
5⁗								71.6	71.6	71.6	71.6	70.7	78.6
6⁗								17.3	17.2	17.3	17.3	18.7	62.7
Ac			170.8	170.7	170.8	170.7	170.5	170.8		170.7	170.5	170.5	170.5
			21.1	170.4	21.1	170.4	170.4	21.1		170.4	170.4	170.4	170.4
				21.0		21.1	170.2			21.0	170.3	170.3	170.3
				20.9		20.9	20.8			20.9	20.9	20.9	20.9
							20.7				20.8	20.8	20.8
							20.6				20.7	20.7	20.7

*Spectra were measured in pyridine-d_5.

pyranosyl)-(1→2)-*O*-[*β*-D-xylopyranosyl-(1→3)]-*α*-L-arabinopyranoside} 24-*O*-*β*-D-fucopyranoside.

Alkaline hydrolysis of **9** ($C_{53}H_{80}O_{24}$, negative FAB-mass spectrum *m/z* 1099 $[M-H]^-$) and **10** ($C_{55}H_{82}O_{25}$, negative FAB-mass spectrum *m/z* 1141 $[M-H]^-$) gave **8a**. The ^1H and ^{13}C NMR spectra indicated that **9** and **10** were diacetyl [δ_H 1.96 and 1.94 (each 3H, *s*); δ_C 170.7 (C), 170.4 (C), 21.0 (Me) and

20.9 (Me)] and triacetyl [δ_H 2.13, 2.03 and 1.88 (each 3H, *s*); δ_C 170.5 (C), 170.4 (C), 170.3 (C), 20.9 (Me), 20.8 (Me) and 20.7 (Me)] derivatives of **8a**, respectively. The following downfield ^{1}H NMR shifts due to acetylation in comparison with **8a** were observed for each of the compounds: 2-H and 3-H of the rhamnose [δ 6.13 (*dd*, J = 3.5, 1.5 Hz, 2-H), + 1.37 ppm; δ 5.89 (*dd*, J = 9.9, 3.5 Hz, 3-H), + 1.32 ppm] in **9**, and 2-H, 3-H and 4-H of the rhamnose [δ 6.09 (*dd*, J = 3.4, 1.5 Hz, 2-H), + 1.33 ppm; δ 5.93 (*dd*, J = 10.2, 3.4 Hz, 3-H), + 1.36 ppm; δ 5.63 (*dd*, J = 10.2, 10.2 Hz, 4-H), + 1.38 ppm] in **10**. The respective structures of **9** and **10** were thus assigned as 1-*O*-{*O*-(2,3-*O*-diacetyl-α-L-rhamnopyranosyl)-(1→2)-*O*-[β-D-xylopyranosyl-(1→3)]-α-L-arabinopyranoside} and 1-*O*-{*O*-(2,3,4-*O*-triacetyl-α-L-rhamnopyranosyl)-(1→2)-*O*-[β-D-xylopyranosyl-(1→3)]-α-L-arabinopyranoside} of (23*S*,24*S*)-spirosta-5,25(27)-diene-1β,3β,23,24-tetrol 24-*O*-β-D-fucopyranoside.

The NMR data of **11** ($C_{55}H_{82}O_{25}$, negative FAB-mass spectrum *m/z* 1141 $[M-H]^-$) showed that it was identical to **10** in terms of the structures of the aglycone and the triacetyltriglycoside attached to C-1 of the aglycone, but differed from it in the monosaccharide structure attached to C-24. In the ^{1}H NMR spectrum of **11**, the signal due to the anomeric proton of the monosaccharide attached to C-24, which was observed at δ 5.16 (*d*, J = 7.9 Hz) in **10**, was displaced by the signal at δ 4.97 (*br s*). Furthermore, in the ^{13}C NMR spectrum, the six signals appearing at δ 106.3 (CH), 72.6 (CH), 73.3 (CH), 74.3 (CH), 70.7 (CH) and 18.7 (Me) were assigned to C-1–C-6 of an α-L-rhamnopyranoside by comparing them with those of an authentic methyl α-L-rhamnopyranoside [5, 6]. Total acid hydrolysis of **11** with 1 M hydrochloric acid in dioxane–H_2O (1:1) at 100° for 2 hr yielded D-xylose, L-arabinose and L-rhamnose, and partial hydrolysis with 0.2 M hydrochloric acid at 95° for 30 min gave **7** and L-rhamnose. Accordingly, the structure of **11** was determined to be (23*S*,24*S*)-spirosta-5,25(27)-diene-1β,3β,23,24-tetrol 1-*O*-{*O*-(2,3,4-*O*-triacetyl-α-L-rhamnopyranosyl)-(1→2)-*O*-[β-D-xylopyranosyl-(1→3)]-α-L-arabinopyranoside} 24-*O*-α-L-rhamnopyranoside.

Compound **12** ($C_{55}H_{82}O_{26}$, negative FAB-mass spectrum *m/z* 1157 $[M-H]^-$) was also different from **10** in terms of the structure of the monosaccharide linked to C-24 of the aglycone. The ^{1}H NMR spectrum of **12** contained signals for four anomeric protons at δ 6.55 (*br s*), 5.40 (*d*, J = 7.9 Hz), 4.80 (*d*, J = 7.6 Hz) and 4.65 (*d*, J = 7.6 Hz). Total acid hydrolysis of **12** yielded D-glucose, D-xylose, L-arabinose and L-rhamnose, and partial acid hydrolysis gave **7** and D-glucose. The structure of **12** was revealed to be (23*S*,24*S*)-spirosta-5,25(27)-diene-1β,3β,23,24-tetrol 1-*O*-{*O*-(2,3,4-*O*-triacetyl-α-L-rhamnopyranosyl)-(1→2)-*O*-[β-D-xylopyranosyl-(1→3)]-α-L-arabinopyranoside} 24-*O*-β-D-glucopyranoside.

Compounds **3**–**12** are new steroidal saponins. The occurrence of steroidal saponins in certain Agavaceae plants, especially those belonging to the representative genera *Agave* and *Yucca*, is well documented [1, 2]. However, a survey of literature showed that no steroidal saponins have been detected previously in *S. trifasciata*, one of the most common Agavaceae plants.

EXPERIMENTAL

General. NMR (ppm, *J* Hz): Bruker AM-400 (400 MHz for ^{1}H NMR). CC: silica gel (Fuji-Silysia Chemical), ODS silica gel (Nacalai Tesque), Diaion HP-20 (Mitsubishi-Kasei) and Sephadex LH-20 (Pharmacia). TLC: precoated Kieselgel 60 F_{254} (0.25 mm thick, Merck) and RP-18 $F_{254}S$ (0.25 mm thick, Merck). HPLC: a Tosoh HPLC system (pump, CCPM; controller, CCP controller PX-8010; detector, UV-8000) equipped with a TSK-gel ODS-Prep column (Tosoh, 4.6 mm i.d. × 250 mm, ODS, 5 μm).

Plant material. Sansevieria trifasciata was purchased from Exotic Plants, Japan, and the plant specimen is on file in our laboratory.

Extraction and isolation. The plant material (fresh weight 5.4 kg) was extracted with hot MeOH. The MeOH extract was concd under red. pres., and the viscous concentrate was partitioned between H_2O and *n*-BuOH. CC of the *n*-BuOH-soluble phase on silica gel and elution with a gradient mixt. of $CHCl_3$–MeOH, and finally with MeOH, gave six frs (I–VI). Fr. II was further sepd by a silica gel column eluting with $CHCl_3$–MeOH into three frs (IIa–IIc). Fr. IIa was subjected to ODS silica gel CC eluting with MeOH–H_2O (4:1) to give compound **7** (48.4 mg). Fr. IIb was subjected to CC on ODS silica gel eluting with MeOH–H_2O (4:1, 2:1) and MeCN–H_2O (5:6), and silica gel with $CHCl_3$–MeOH–H_2O (180:20:1) to furnish **4** (33.3 mg), **6** (24.4 mg), **10** (498 mg) and **11** (7.7 mg). Fr. IIc was chromatographed on Sephadex LH-20 eluting with MeOH, ODS silica gel with MeOH–H_2O (2:1) and MeCN–H_2O (5:6), and on silica gel with $CHCl_3$–MeOH–H_2O (60:10:1) to yield **9** (62.9 mg). Fr. III was chromatographed on Sephadex LH-20 eluting with MeOH, ODS silica gel with MeOH–H_2O (2:1) and MeCN–H_2O (2:5), and on silica gel with $CHCl_3$–MeOH–H_2O (60:10:1) to give **3** (14.2 mg) and **12** (4.5 mg). Fr. IV was purified by CC on Sephadex LH-20 eluting with MeOH, ODS silica gel with MeOH–H_2O (2:1), and on silica gel with $CHCl_3$–MeOH–H_2O (40:10:1) to give **1** (26.5 mg) and **5** (19.5 mg). Fr. V furnished **2** (20.2 mg) and **8** (42.2 mg) on purification by CC on Sephadex LH-20 eluting with MeOH, ODS silica gel with MeOH–H_2O (2:1), and on silica gel with $CHCl_3$–Et_2O–MeOH–H_2O (5:5:4:1, 14:8:7:1).

Compound **1**. Amorphous solid, $[\alpha]_D^{26}$ −62.9° (MeOH; *c* 0.25). Negative FAB-MS *m/z* 853 $[M-H]^-$; IR ν_{max}^{KBr} cm^{-1}: 3420 (OH), 2900 (CH), 1035; ^{1}H NMR (pyridine-d_5): δ 6.32 (1H, *br s*, 1″-H), 5.56 (1H,

br d, J=5.4 Hz, 6-H), 4.98 (1H, *d*, J=7.5 Hz, 1‴-H), 4.83 and 4.82 (each 1H, *br s*, 27-H_2), 4.78 (1H, *br d*, J=3.5 Hz, 2″-H), 4.77 (overlapping, 5″-H), 4.73 (1H, *d*, J=7.3 Hz, 1′-H), 4.59 (1H, *dd*, J=9.6, 3.5 Hz, 3″-H), 4.41 and 3.99 (each 1H, *d*, J=12.1 Hz, 26-H_2), 4.27 (1H, *dd*, J=9.6, 9.6 Hz, 4″-H), 1.71 (3H, *d*, J=6.1 Hz, 6″-Me), 1.38 (3H, *s*, 19-Me), 1.12 (3H, *d*, J=7.0 Hz, 21-Me), 1.03 (3H, *s*, 18-Me).

Compound **2**. Amorphous solid, $[\alpha]_D^{26}$ −60.0° (MeOH; *c* 0.36). Negative FAB-MS *m/z* 869 $[M-H]^-$; IR ν_{max}^{KBr} cm^{-1}: 3420 (OH), 2905 (CH), 1040; ^1H NMR (pyridine-d_5): δ 6.32 (1H, *br s*, 1″-H), 5.55 (1H, *br d*, J=5.6 Hz, 6-H), 5.09 and 4.99 (each 1H, *d*, J=1.3 Hz, 27-H_2), 4.98 (1H, *d*, J=7.7 Hz, 1‴-H), 4.82 and 4.01 (each 1H, *d*, J=12.3 Hz, 26-H_2), 4.78 (1H, *br d*, J=3.4 Hz, 2″-H), 4.77 (overlapping, 5″-H), 4.73 (1H, *d*, J=7.3 Hz, 1′-H), 4.58 (1H, *dd*, J=9.4, 3.4 Hz, 3″-H), 4.27 (1H, *dd*, J=9.4, 9.4 Hz, 4″-H), 1.72 (3H, *d*, J=6.2 Hz, 6″-Me), 1.38 (3H, *s*, 19-Me), 1.11 (3H, *d*, J=7.0 Hz, 21-Me), 1.01 (3H, *s*, 18-Me).

Compound **3**. Amorphous solid, $[\alpha]_D^{26}$ −62.5° (MeOH; *c* 0.25). Negative FAB-MS *m/z* 895 $[M-H]^-$, 853 $[M-Ac]^-$; IR ν_{max}^{KBr} cm^{-1}: 3430 (OH), 2925 (CH), 1730 (C=O), 1450, 1375, 1250, 1135, 1035, 980; ^1H NMR (pyridine-d_5): δ 6.47 (1H, *br s*, 1″-H), 5.78 (1H, *dd*, J=9.7, 9.7 Hz, 4″-H), 5.62 (1H, *br d*, J=5.5 Hz, 6-H), 4.94 (1H, *d*, J=7.5 Hz, 1‴-H), 4.90 (1H, *dq*, J=9.7, 6.2 Hz, 5″-H), 4.84 and 4.82 (each 1H, *br s*, 27-H_2), 4.73 (1H, *br d*, J=3.4 Hz, 2″-H), 4.70 (1H, *d*, J=7.6 Hz, 1′-H), 4.67 (1H, *dd*, J=9.7, 3.4 Hz, 3″-H), 4.42 and 4.00 (each 1H, *d*, J=12.2 Hz, 26-H_2), 2.00 (3H, *s*, Ac), 1.43 (3H, *d*, J=6.2 Hz, 6″-Me), 1.35 (3H, *s*, 19-Me), 1.12 (3H, *d*, J=7.0 Hz, 21-Me), 1.06 (3H, *s*, 18-Me).

Compound **4**. Amorphous solid, $[\alpha]_D^{26}$ −62.4° (MeOH; *c* 0.25). Negative FAB-MS *m/z* 938 $[M]^-$, 707 $[M-rhamnosyl-Ac\times2]^-$; IR ν_{max}^{KBr} cm^{-1}: 3435 (OH), 2920 (CH), 1730 (C=O), 1445, 1375, 1265, 1135, 1045, 980; ^1H NMR (pyridine-d_5): δ 6.46 (1H, *d*, J=1.4 Hz, 1″-H), 6.14 (1H, *dd*, J=3.4, 1.4 Hz, 2″-H), 5.89 (1H, *dd*, J=9.9, 3.4 Hz, 3″-H), 5.56 (1H, *br d*, J=5.4 Hz, 6-H), 4.98 (1H, *dq*, J=9.9, 6.1 Hz, 5″-H), 4.84 (1H, *d*, J=7.5 Hz, 1‴-H), 4.83 and 4.82 (each 1H, *br s*, 27-H_2), 4.62 (overlapping, 1′-H), 4.42 and 3.99 (each 1H, *d*, J=12.4 Hz, 26-H_2), 4.23 (1H, *dd*, J=9.9, 9.9 Hz, 4″-H), 1.96 and 1.94 (each 3H, *s*, Ac), 1.73 (3H, *d*, J=6.1 Hz, 6″-Me), 1.38 (3H, *s*, 19-Me), 1.12 (3H, *d*, J=7.0 Hz, 21-Me), 1.04 (3H, *s*, 18-Me).

Compound **5**. Amorphous solid, $[\alpha]_D^{26}$ −66.4° (MeOH; *c* 0.25). Positive FAB-MS *m/z* 951 $[M+K]^+$, 935 $[M+Na]^+$, 913 $[M+H]^+$; IR ν_{max}^{KBr} cm^{-1}: 3430 (OH), 2925 (CH), 1730 (C=O), 1455, 1375, 1250, 1135, 1040, 980; ^1H NMR (pyridine-d_5): δ 6.47 (1H, *br s*, 1″-H), 5.78 (1H, *dd*, J=9.7, 9.7 Hz, 4″-H), 5.61 (1H, *br d*, J=5.6 Hz, 6-H), 5.09 and 4.99 (each 1H, *br s*, 27-H_2), 4.94 (1H, *d*, J=7.5 Hz, 1‴-H), 4.90 (1H, *dq*, J=9.7, 6.2 Hz, 5″-H), 4.83 and 4.01 (each 1H, *d*, J=12.3 Hz, 26-H_2), 4.73 (1H, *br d*, J=3.2 Hz, 2″-H), 4.70 (1H, *d*, J=7.1 Hz, 1′-H), 4.67 (1H, *dd*, J=9.7, 3.2 Hz, 3″-H), 2.01 (3H, *s*, Ac), 1.43 (3H, *d*, J=6.2 Hz, 6″-Me), 1.36 (3H, *s*, 19-Me), 1.11 (3H, *d*, J=7.0 Hz, 21-Me), 1.03 (3H, *s*, 18-Me).

Compound **6**. Amorphous solid, $[\alpha]_D^{26}$ −70.2° (MeOH; *c* 0.25). Negative FAB-MS *m/z* 954 $[M]^-$, 912 $[M-Ac]^-$, 723 $[M-rhamnosyl-Ac\times2]^-$; IR ν_{max}^{KBr} cm^{-1}: 3450 (OH), 2920 (CH), 1740 (C=O), 1445, 1375, 1260, 1140, 1045, 980; ^1H NMR (pyridine-d_5): δ 6.46 (1H, *d*, J=1.5 Hz, 1″-H), 6.14 (1H, *dd*, J=3.4, 1.5 Hz, 2″-H), 5.90 (1H, *dd*, J=9.9, 3.4 Hz, 3″-H), 5.55 (1H, *br d*, J=5.5 Hz, 6-H), 5.09 and 4.99 (each 1H, *d*, J=1.2 Hz, 27-H_2), 4.98 (1H, *dq*, J=9.9, 6.1 Hz, 5″-H_2), 4.84 (1H, *d*, J=7.6 Hz, 1‴-H), 4.82 and 4.01 (each 1H, *d*, J=12.2 Hz, 26-H_2), 4.62 (overlapping, 1′-H), 4.23 (1H, *dd*, J=9.9, 9.9 Hz, 4″-H), 1.96 and 1.94 (each 3H, *s*, Ac), 1.74 (3H, *d*, J=6.1 Hz, 6″-Me), 1.39 (3H, *s*, 19-Me), 1.10 (3H, *d*, J=7.0 Hz, 21-Me), 1.02 (3H, *s*, 18-Me).

Compound **7**. Amorphous solid, $[\alpha]_D^{26}$ −72.0° (MeOH; *c* 0.25). Negative FAB-MS *m/z* 995 $[M-H]^-$, 954 $[M-Ac]^-$, 724 $[M-rhamnosyl-Ac\times3]^-$; IR ν_{max}^{KBr} cm^{-1}: 3450 (OH), 2900 (CH), 1745 (C=O), 1370, 1255, 1225, 1135, 1075, 1040, 980; ^1H NMR (pyridine-d_5): δ 6.54 (1H, *br s*, 1″-H), 6.10 (1H, *br d*, J=3.4, 2″-H), 5.93 (1H, *dd*, J=10.2, 3.4 Hz, 3″-H), 5.63 (1H, *dd*, J=10.2, 10.2 Hz, 4″-H), 5.62 (overlapping, 6-H), 5.10 and 5.00 (each 1H, *br s*, 27-H_2), 5.03 (1H, *dq*, J=10.2, 6.1 Hz, 5″-H), 4.83 and 4.02 (each 1H, *d*, J=12.4 Hz, 26-H_2), 4.80 (1H, *d*, J=7.8 Hz, 1‴-H), 4.65 (1H, *d*, J=7.7 Hz, 1′-H), 2.13, 2.03 and 1.88 (each 3H, *s*, Ac), 1.46 (3H, *d*, J=6.1 Hz, 6″-Me), 1.34 (3H, *s*, 19-Me), 1.11 (3H, *d*, J=6.9 Hz, 21-Me), 1.05 (3H, *s*, 18-Me).

Compound **8**. Amorphous solid, $[\alpha]_D^{26}$ −57.2° (MeOH; *c* 0.25). Positive FAB-MS *m/z* 1081 $[M+Na]^+$; IR ν_{max}^{KBr} cm^{-1}: 3425 (OH), 2930 (CH), 1730 (C=O), 1450, 1375, 1255, 1130, 1040; ^1H NMR (pyridine-d_5): δ 6.45 (1H, *br s*, 1″-H), 5.77 (1H, *dd*, J=9.7, 9.7 Hz, 4″-H), 5.63 (1H, *br d*, J=5.5 Hz, 6-H), 5.23 and 5.09 (each 1H, *d*, J=1.1 Hz, 27-H_2), 5.16 (1H, *d*, J=7.8 Hz, 1⁗-H), 4.93 (1H, *d*, J=7.5 Hz, 1‴-H), 4.89 (1H, *dq*, J=9.7, 6.1 Hz, 5″-H), 4.83 and 3.99 (each 1H, *d*, J=11.9 Hz, 26-H_2), 4.73 (1H, *br d*, J=3.5 Hz, 2″-H), 4.68 (1H, *d*, J=7.4 Hz, 1′-H), 4.67 (1H, *dd*, J=9.7, 3.5 Hz, 3″-H), 2.01 (3H, *s*, Ac), 1.48 (3H, *d*, J=6.4 Hz, 6⁗-Me), 1.42 (3H, *d*, J=6.1 Hz, 6″-Me), 1.37 (3H, *s*, 19-Me), 1.07 (3H, *d*, J=7.0 Hz, 21-Me), 0.95 (3H, *s*, 18-Me).

Compound **9**. Amorphous solid, $[\alpha]_D^{26}$ −57.2° (MeOH; *c* 0.25). Negative FAB-MS *m/z* 1099 $[M-H]^-$, 1057 $[M-Ac]^-$, 869 $[M-rhamnosyl-Ac\times2]^-$, 737 $[M-rhamnosyl-Ac\times2-xylosyl]^-$, 605 $[M-rhamnosyl-Ac\times2-xylosyl-arabinosyl]^-$; IR ν_{max}^{KBr} cm^{-1}: 3425 (OH), 2920 (CH), 1730 (C=O), 1450, 1375, 1255, 1135, 1045; ^1H NMR (pyridine-d_5): δ 6.46 (1H, *d*, J=1.5 Hz, 1″-H), 6.13 (1H, *dd*, J=3.5, 1.5 Hz, 2″-H), 5.89 (1H, *dd*, J=9.9, 3.5 Hz, 3″-H), 5.57 (1H, *br d*, J=5.7 Hz, 6-H), 5.28 and 5.09 (each 1H, *br s*,

27-H_2), 5.15 (1H, *d*, J=7.9 Hz, 1''''-H), 4.97 (1H, *dq*, J=9.9, 6.1 Hz, 5''-H), 4.84 (1H, *d*, J=7.6 Hz, 1'''-H), 4.83 and 3.99 (each 1H, *d*, J=12.3 Hz, 26-H_2), 4.61 (overlapping, 1'-H), 4.22 (1H, *dd*, J=9.9, 9.9 Hz, 4''-H), 1.96 and 1.94 (each 3H, *s*, Ac), 1.72 (3H, *d*, J=6.1 Hz, 6''-Me), 1.48 (3H, *d*, J=6.4 Hz, 6''''-Me), 1.41 (3H, *s*, 19-Me), 1.07 (3H, *d*, J=7.0 Hz, 21-Me), 0.94 (3H, *s*, 18-Me).

Compound **10**. Amorphous solid, $[\alpha]_D^{26}$ −71.2° (MeOH; *c* 0.25). Negative FAB-MS *m/z* 1141 [M−H]$^-$, 1099 [M−Ac]$^-$, 869 [M−rhamnosyl−Ac×3]$^-$, 737 [M−rhamnosyl−Ac×3−xylosyl]$^-$, 605 [M−rhamnosyl−Ac×3−xylosyl−arabinosyl]$^-$; IR ν_{max}^{KBr} cm^{-1}: 3440 (OH), 2970 and 2900 (CH), 1740 (C=O), 1445, 1370, 1230, 1135, 1040; ^{1}H NMR (pyridine-d_5): δ 6.54 (1H, *d*, J=1.5 Hz, 1''-H), 6.09 (1H, *dd*, J=3.4, 1.5 Hz, 2''-H), 5.93 (1H, *dd*, J=10.2, 3.4 Hz, 3''-H), 5.64 (overlapping, 6-H), 5.63 (1H, *dd*, J=10.2, 10.2 Hz, 4''-H), 5.24 and 5.10 (each 1H, *d*, J=1.2 Hz 27-H_2), 5.16 (1H, *d*, J=7.9 Hz, 1''''-H), 5.02 (1H, *dq*, J=10.2, 6.2 Hz, 5''-H), 4.84 and 4.00 (each 1H, *d*, J=12.2 Hz, 26-H_2), 4.79 (1H, *d*, J=7.7 Hz, 1'''-H), 4.64 (1H, *d*, J=7.7 Hz, 1'-H), 2.13, 2.03 and 1.88 (each 3H, *s*, Ac), 1.48 (3H, *d*, J=6.4 Hz, 6''''-Me), 1.44 (3H, *d*, J=6.2 Hz, 6''-Me), 1.36 (3H, *s*, 19-Me), 1.08 (3H, *d*, J=7.0 Hz, 21-Me), 0.98 (3H, *s*, 18-Me).

Compound **11**. Amorphous solid, $[\alpha]_D^{26}$ −69.5° (MeOH; *c* 0.10). Negative FAB-MS *m/z* 1141 [M−H]$^-$, 1099 [M−Ac]$^-$, 869 [M−rhamnosyl−Ac×3]$^-$, 737 [M−rhamnosyl−Ac×3−xylosyl]$^-$, 605 [M−rhamnosyl−Ac×3−xylosyl−arabinosyl]$^-$; IR ν_{max}^{KBr} cm^{-1}: 3440 (OH), 2905 (CH), 1740 (C=O), 1450, 1370, 1255, 1230, 1160, 1135, 1075, 1040, 975; ^{1}H NMR (pyridine-d_5): δ 6.55 (1H, *br s*, 1''-H), 6.11 (1H, *br d*, J=3.4, 2''-H), 5.93 (1H, *dd*, J=10.2, 3.4 Hz, 3''-H), 5.63 (1H, *dd*, J=10.2, 10.2 Hz, 4''-H), 5.63 (overlapping, 6-H), 5.19 and 5.06 (each 1H, *br s*, 27-H_2), 5.02 (1H, *dq*, J=10.2, 6.1 Hz, 5''-H), 4.97 (1H, *br s*, 1''''-H), 4.90 and 4.00 (each 1H, *d*, J=12.0 Hz, 26-H_2), 4.80 (1H, *d*, J=7.7 Hz, 1'''-H), 4.64 (1H, *d*, J=7.9 Hz, 1'-H), 2.14, 2.04 and 1.88 (each 3H, *s*, Ac), 1.52 (3H, *d*, J=6.1 Hz, 6''''-Me), 1.44 (3H, *d*, J=6.1 Hz, 6''-Me), 1.36 (3H, *s*, 19-Me), 1.07 (3H, *d*, J=7.0 Hz, 21-Me), 0.99 (3H, *s*, 18-Me).

Compound **12**. Amorphous solid, $[\alpha]_D^{26}$ −65.0° (MeOH; *c* 0.10). Negative FAB-MS *m/z* 1157 [M−H]$^-$, 1115 [M−Ac]$^-$, 885 [M−rhamnosyl−Ac×3]$^-$, 621 [M−rhamnosyl−Ac×3−xylosyl−arabinosyl]$^-$; IR ν_{max}^{KBr} cm^{-1}: 3430 (OH), 2905 (CH), 1740 (C=O), 1450, 1370, 1235, 1135, 1040, 980; ^{1}H NMR (pyridine-d_5): δ 6.55 (1H, *br s*, 1''-H), 6.10 (1H, *br d*, J=3.5 Hz, 2''-H), 5.94 (1H, *dd*, J=10.1, 3.5 Hz, 3''-H), 5.64 (1H, *dd*, J=10.1, 10.1 Hz, 4''-H), 5.64 (overlapping, 6-H), 5.40 (1H, *d*, J=7.9 Hz, 1''''-H), 5.20 and 5.03 (each 1H, *br s*, 27-H_2), 5.02 (1H, *dq*, J=10.1, 6.1 Hz, 5''-H), 4.90 and 4.00 (each 1H, *d*, J=12.1 Hz, 26-H_2), 4.80 (1H, *d*, J=7.6 Hz, 1'''-H), 4.65 (1H, *d*, J=7.6 Hz, 1'-H), 2.14, 2.04 and 1.88 (each 3H, *s*, Ac), 1.45 (3H, *d*, J=6.1 Hz, 6''-Me), 1.38 (3H, *s*, 19-Me), 1.08 (3H, *d*, J=6.8 Hz, 21-Me), 1.01 (3H, *s*, 18-Me).

Alkaline hydrolysis of **3**−**10**. Compounds **3** (3.0 mg) and **4**–**10** (each 5.0 mg) were subjected to alkaline hydrolysis with 4% KOH in EtOH (2 ml) at room temp. for 3hr. Each reaction mixt. was neutralized by passing it through an Amberlite IR-120B (Organo) column, and purified by silica gel CC eluting with $CHCl_3$–MeOH–H_2O (30:10:1 for **3** and **4**; 20:10:1 for **5**–**10**). Compounds **3** and **4** yielded **1** (2.5 mg from **3**; 4.1 mg from **4**), **5**–**7** yielded **2** (4.0 mg from **5**; 3.6 mg from **6**; 3.2 mg from **7**), and **8**–**10** yielded **8a** (3.4 mg from **8**; 3.3 mg from **9**; 4.0 mg from **10**). Compound **8a**: amorphous solid, $[\alpha]_D^{26}$ −51.2° (MeOH; *c* 0.29). Negative FAB-MS *m/z* 1015 [M−H]$^-$; IR ν_{max}^{KBr} cm^{-1}: 3390 (OH), 2905 (CH), 1040; ^{1}H NMR (pyridine-d_5): δ 6.29 (1H, *br s*, 1''-H), 5.57 (1H, *br d*, J=5.4 Hz, 6-H), 5.23 and 5.08 (each 1H, *d*, J=1.0 Hz, 27-H_2), 5.14 (1H, *d*, J=7.9, 1''''-H), 4.96 (1H, *d*, J=7.4 Hz, 1'''-H), 4.83 and 3.98 (each 1H, *d*, J=12.1 Hz, 26-H_2), 4.76 (1H, *br d*, J=3.5 Hz, 2''-H), 4.76 (overlapping, 5''-H), 4.71 (1H, *d*, J=7.3 Hz, 1'-H), 4.57 (1H, *dd*, J=9.4, 3.5 Hz, 3''-H), 4.25 (1H, *dd*, J=9.4, 9.4 Hz, 4''-H), 1.70 (3H, *d*, J=6.1 Hz, 6''-Me), 1.47 (1H, *d*, J=6.4 Hz, 6''''-Me), 1.40 (3H, *s*, 19-Me), 1.07 (3H, *d*, J=7.0 Hz, 21-Me), 0.93 (3H, *s*, 18-Me).

Acid hydrolysis of **11** *and* **12**. A soln of **11** (1.0 mg) in 1 M HCl (dioxane–H_2O, 1:1, 1 ml) was heated at 100° for 2 hr under an Ar atmosphere. After cooling, the reaction mixt. was neutralized by passing it through an Amberlite IRA-93ZU (Organo) column, and fractionated by Sep-Pak C_{18} cartridge (Waters) eluting with H_2O–MeOH (4:1) followed by MeOH to give a mixt. of monosaccharides (0.3 mg). The mixt. was diluted with H_2O (1 ml) and treated with (−)-α-methylbenzylamine (5 mg) and $Na[BH_3CN]$ (8 mg) in EtOH (1 ml) at 40° for 4 hr, followed by acetylation with Ac_2O (0.3 ml) in pyridine (0.3 ml). The reaction mixt. was passed through a Sep-Pak C_{18} cartridge with H_2O–MeCN (4:1, 10 ml; 1:1, 10 ml; 1:9, 10 ml). The H_2O–MeOH (1:9) eluate fr. was further passed through a Toyopak IC-SP M cartridge (Tosoh) with EtOH (10 ml) to give a mixt. of 1-[(*S*)-*N*-acetyl-α-methylbenzylamino]-1-deoxyalditol acetate derivatives of the monosaccharides, which was then analysed by HPLC under the following conditions: solvent, MeCN–H_2O (2:3); flow rate, 0.8 ml min^{-1}; detection, UV 230 nm. The derivatives of L-arabinose, D-xylose and L-rhamnose were detected. R_t (min): L-arabinose, 16.05; D-xylose, 16.90; L-rhamnose, 24.54. Compound **12** (1.0 mg) was subjected to acid hydrolysis as in the case of **11**. The monosaccharides obtained were converted to 1-[(*S*)-*N*-acetyl-α-methylbenzylamino]-1-deoxyalditol acetate derivatives and analysed by HPLC. The derivatives of L-arabinose, D-xylose, D-glucose and L-rhamnose were detected. R_t (min): L-arabinose, 15.92; D-xylose, 17.04; D-glucose, 21.49; L-rhamnose, 24.24.

Partial hydrolysis of **11** *and* **12**. A soln of **11** (2.0 mg) in 0.2 M HCl (dioxane–H_2O, 1:1, 1 ml) was heated at 95° for 30 min under an Ar atmosphere. The reaction mixt. was neutralized by passing it through an Amberlite IRA-93ZU column and purified by ODS

silica-gel CC eluting with MeOH–H_2O (2:1) to give a partial hydrolysate, **7** (0.8 mg) and L-rhamnose. L-Rhamnose: TLC, R_f 0.64 (*n*-BuOH–Me_2CO–H_2O, 4:5:1). Compound **12** (1.0 mg) was subjected to partial acid hydrolysis as in the case of **11** to give **7** (0.4 mg) and D-glucose. D-Glucose: TLC, R_f 0.38 (*n*-BuOH–MeOH–H_2O, 4:5:1).

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