Available online at www.sciencedirect.com
SCIENCE DIRECT®
Phytochemistry 65 (2004) 2577–2581
PHYTOCHEMISTRY
www.elsevier.com/locate/phytochem

Diterpenoid glucosides from *Salvia greggii*

Nobuo Kawahara [a,*], Toru Tamura [a], Mayumi Inoue [a], Tomoo Hosoe [b], Ken-ichi Kawai [b], Setsuko Sekita [a], Motoyoshi Satake [c], Yukihiro Goda [a]

[a] *National Institute of Health Sciences (NIHS), Kamiyoga 1-18-1, Setagaya-ku, Tokyo 158-8501, Japan*
[b] *Faculty of Pharmaceutical Sciences, Hoshi University, Ebara 2-4-41, Shinagawa-ku, Tokyo 142-8501, Japan*
[c] *Institute of Environmental Science for Human Life, Ochanomizu University, Otsuka 2-1-1 Bunkyo-ku, Tokyo 112-8610, Japan*

Received 2 April 2004; received in revised form 23 June 2004

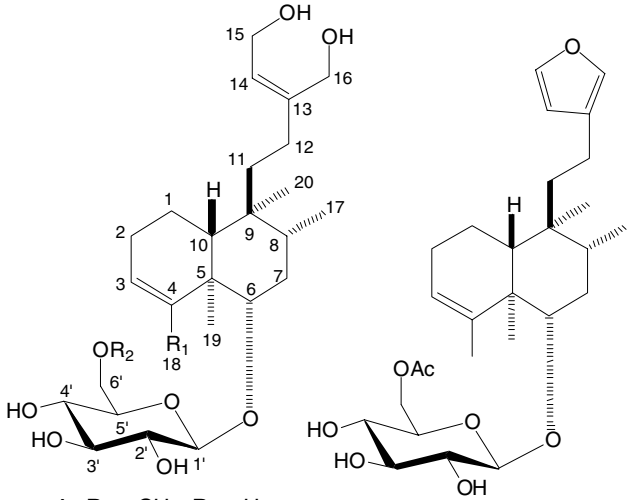
Abstract

The structure of four diterpenoid glucosides, designated as salvigresides A–D (**1**–**4**), isolated from the aerial parts of *Salvia greggii*, have been confirmed by spectroscopic and chemical investigation.

Keywords: Salvigreside; *Salvia greggii*; Labiatae; Autumn sage; Diterpenoid glucoside

1. Introduction

Salvia greggii (Labiatae) is a biennial plant originating in both Mexico and Texas (USA), which is commonly known as "Autumn Sage". Recently, the Ministry of Health, Labour and Welfare of Japan began to study the classification and evaluation of herbal medicines, and a number of herbs were investigated for their toxicity and secondary metabolites. As part of this study, a diterpenoid, salvigresin (**7**), was isolated from the CH_2Cl_2 extract of the aerial parts of *S. greggii* (Kawahara et al., 2003). In this ongoing investigation of the plant, four new diterpenoid glucosides, designated salvigresides A–D (**1**–**4**), as well as eugenyl-*O*-β-glucopyranoside (**5**, Fujita and Nakayama, 1992; Takeda et al., 1998) and eugenyl-*O*-β-apiofuranosyl-(1″ → 6′)-β-glucopyranoside (**6**, Machida et al., 1991; Takeda et al., 1998) were isolated. The structural elucidation of compounds **1**–**4** is reported herein and this is our final report of the plant mentioned above.

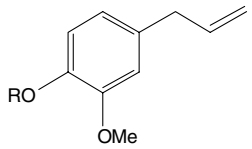


1 : $R_1 = CH_3$, $R_2 = H$
2 : $R_1 = CH_3$, $R_2 = Ac$
3 : $R_1 = CH_2OH$, $R_2 = Ac$

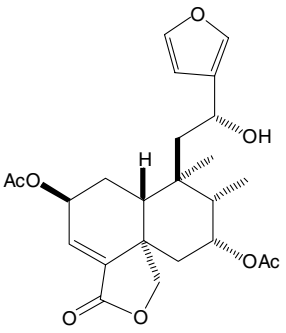
4

* Corresponding author. Tel.: +81 3 3700 9165; fax: +81 3 3707 6950.
E-mail address: kawahara@nihs.go.jp (N. Kawahara).

0031-9422/$ - see front matter © 2004 Elsevier Ltd. All rights reserved.
doi:10.1016/j.phytochem.2004.08.012



5 : R = β-D-glucopyranoside
6 : R = β-D-glucopyranosyl-(6'-1")-β-D-apiofuranoside



7

2. Results and discussion

Salvigreside A (**1**) formed a colorless amorphous powder and was determined by high resolution time of flight mass spectrometry (HR-TOF-MS) to have the molecular formula $C_{28}H_{44}O_8$, with a quasimolecular ion at *m/z* 507.2935 (calc. 507.2934) $(M + Na)^+$. The ^1H NMR spectrum of **1** exhibited 38 non-exchangeable protons, including three tertiary (δ 0.74, 1.09 and 1.86) and a secondary (δ 0.84) methyl group as well as two olefinic protons (δ 5.17 and 5.44). The ^{13}C NMR spectrum of **1** showed four methyls (δ 16.2, 16.9, 18.4 and 23.8), eight methylenes with three oxygenated carbons, eight methines with six oxygenated carbons, two quaternary carbons (δ 39.3 and 45.5), two tertiary (δ 122.7 and 127.3) and two quaternary (δ 143.7 and 145.9) carbon atoms that could be assigned to double bonds. An oxygenated methylene carbon (δ 62.9) and five oxygenated methine carbons (δ 71.8, 75.7, 77.7, 78.7 and 104.3) suggested the presence of a hexosyl moiety in the molecule. The olefinic carbons accounted for two of the five unsaturations, thus implying that **1** consisted of a three-ring system. The hexosyl moiety was determined to be a β-D-glucopyranoside by enzymatic hydrolysis of **1**.

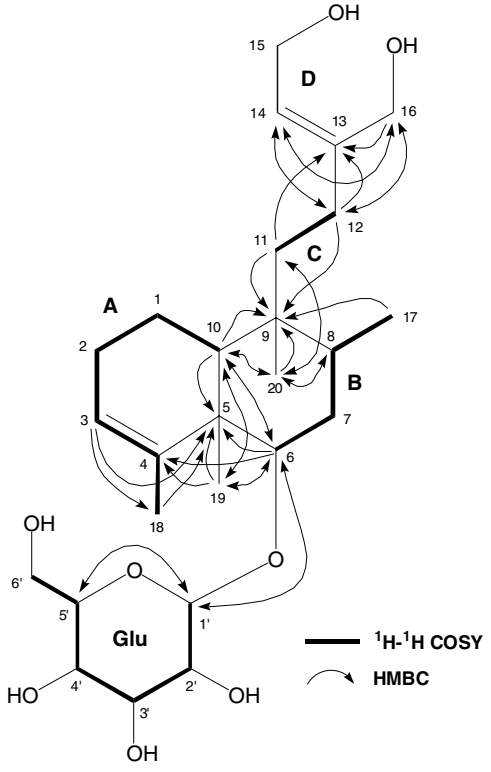


Fig. 1. ^1H–^1H and selected long-range ^{13}C–^1H correlations of salvigreside A (**1**).

Interpretation of the ^1H–^1H COSY and HMQC spectra of **1** suggested the presence of four partial structures **A**–**D** (Fig. 1), in addition to two quaternary carbons (δ 39.3 and 45.5), two methyl groups (δ 16.2 and 18.4) and glucose. The connectivity of these partial structures was deduced from the HMBC spectrum (Fig. 1). The singlet methyl group (H_3-20) showed correlations to the quaternary carbon at (C-9), the methine carbon (C-10) of segment **A**, the methine carbon (C-8) of segment **B** or the methylene carbon (C-11) of segment **C**. The methine proton (H-10) and the olefinic proton (H-3) of segment **A**, the methine proton (H-6) of segment **B** and the methyl protons (H_3-19) were both correlated to the quaternary carbon (C-5).

In addition, the methylene protons (H_2-12) of segment **C** showed correlations to olefinic carbons (C-13 and C-14) and the methylene carbon (C-16) of segment **D**. The correlations observed between H-6 and an anomeric carbon at δ 104.3 indicated that glucose was attached at C-6.

These data determined the planar structure of **1**, as shown in Fig. 1. The assignments of the NMR spectroscopic data are given in Tables 1 and 2.

The relative stereochemistry of **1** was identified by the NOE difference experiments, as shown in Fig. 2. Irradiation of H_3-20 gave clear NOEs with H_3-17 and H_3-19, while irradiation of H-6 gave NOEs with H-8 and H-10. These data indicated that the configuration between the C-17 and C-20 methyl groups took the *cis* configuration, whereas the C-19 methyl group and H-6, and the AB-ring junction took the *trans* configuration. These results enabled us to elucidate the structure of salvigreside A (**1**) as 6α-*O*-(β-D-glucopyranosyl)-15, 16-dihydroxycleroda-3, 13(14)-dien.

Salvigreside B (**2**) formed a colorless amorphous powder and was determined by HR-TOF-MS to have the molecular formula $C_{28}H_{46}O_9$, with a quasimolecular ion at *m/z* 549.2997 (calc. 549.3040) $(M + Na)^+$. The ^1H NMR and ^{13}C NMR spectroscopic data of **2** showed almost the same signal patterns as those of **1** with the exception of the presence of an acetyl group [δ 2.06 (3H, *s*) by ^1H NMR and δ 20.9, 172.6 by ^{13}C NMR]. The deacetyl moiety was identified as salvigreside A (**1**) by alkaline hydrolysis of **2**. The downfield-shift of

Table 1
^{1}H NMR chemical shifts of salvigresides A–D (1–4) in CD_3OD

H	1[a]	2[a]	3[a]	4[b]
1 (α)	1.55 *m*	1.54 *m*	1.60 *m*	1.58 *m*
(β)	1.65 *m*	1.65 *m*	1.70 *m*	1.66 *m*
2	2.00 *m* (2H)	2.00 *m* (2H)	2.11 *m* (2H)	1.98 *m*
				2.01 *m*
3	5.17 *br. s*	5.18 *br. s*	5.54 *br. t* (3.2)	5.19 *br. d* (1.5)
6	3.51 *dd* (4.4, 11.0)	3.46 *dd* (4.6, 11.0)	3.79 *dd* (4.6, 11.0)	3.49 *dd* (4.6, 11.0)
7 (α)	1.62 *m*	1.56 *m*	1.64 *m*	1.56 *m*
(β)	2.10 *m*	2.03 *m*	1.96 *m*	2.05 *m*
8	1.63 *m*	1.62 *m*	1.62 *m*	1.65 *m*
10	1.38 *br. d* (12.4)	1.37 *br. d* (11.9)	1.44 *br. d* (12.8)	1.42 *br. d* (11.6)
11	1.42 *dt* (2.7, 11.8)	1.42 *dt* (4.6, 12.8)	1.43 *dt* (4.6, 12.8)	1.53 *m*
	1.52 *dt* (4.6, 11.8)	1.52 *dt* (4.6, 12.8)	1. 54 *dt* (4.6, 12.8)	1.64 *m*
12	1.91 *dt* (4.6, 11.8)	1.92 *dt* (4.6, 12.8)	1.92 *dt* (4.6, 12.8)	2.18 *dt* (4.9, 12.5)
	1.99 *m*	1.99 *m*	2.00 *dt* (4.6, 12.8)	2.28 *dt* (4.5, 12.5)
14	5.44 *t* (6.9)	5.44 *t* (6.9)	5. 45 *t* (6.8)	6.26 *dd* (0.6, 1.5)
15	4.12 *d* (2H, 6.9)	4.12 *d* (2H, 6.9)	4.12 *d* (2H, 6.8)	7.36 *t* (1.5)
16	4.08 *s* (2H)	4.09 *s* (2H)	4.09 *s* (2H)	7.24 *dd* (0.6, 1.5)
17 (3H)	0.84 *d* (6.4)	0.84 *d* (6.4)	0.88 *d* (6.4)	0.85 *d* (6.7)
18	1.86 *d* (3H, 1.8)	1.84 *d* (3H, 1.8)	3.83 *d* (11.9)	1.85 *d* (3H, 1.5)
			4.40 *d* (11.9)	
19 (3H)	1.09 *s*	1.10 *s*	1.10 *s*	1.11 *s*
20 (3H)	0.74 *s*	0.74 *s*	0.74 *s*	0.75 *s*
1′	4.41 *d* (7.8)	4.41 *d* (7.8)	4.43 *d* (7.8)	4.42 *d* (7.6)
2′	3.19 *dd* (7.8, 8.9)	3.19 *dd* (7.8, 9.2)	3.26 *dd* (7.8, 9.2)	3.20 *dd* (7.6, 9.2)
3′	3.32 *t* (8.9)	3.32 *t* (9.2)	3.35 *t* (9.2)	3.33 *dd* (8.9, 9.2)
4′	3.28 *t* (8.9)	3.24 *t* (9.2)	3.23 *t* (9.2)	3.24 *dd* (8.9, 9.8)
5′	3.25 *ddd* (2.3, 5.5, 8.9)	3.44 *ddd* (1.8, 6.9,9.2)	3.47 *ddd* (1.8, 7.3, 9.2)	3.44 *ddd* (2.1, 7.0, 9.8)
6′	3.66 *dd* (5.5, 11.9)	4.17 *dd* (6.9, 11.9)	4.12 *dd* (7.3, 11.9)	4.18 *dd* (7.0, 11.9)
	3.84 *dd* (2.3, 11.9)	4.40 *dd* (1.8, 11.9)	4.41 *dd* (1.8, 11.9)	4.41 *dd* (2.1, 11.9)
Ac (3H)		2.06 *s*	2.06 *s*	2.06 *s*

[a] 800 MHz.
[b] 500 MHz.

the oxygenated methylene protons at δ 4.17 and 4.40 (H_2-6′) suggested that the acetyl group was attached to C-6′ of **2**. The acetyl group was determined to be located at C-6 in the glucose unit, due to the correlation between the H_2-6′ and carbonyl signal at δ 172.6 observed in the HMBC spectrum. Thus, salvigreside B (**2**) was determined to be 6α-*O*-(6-*O*-acetyl-β-D-glucopyranosyl)-15, 16-dihydroxycleroda-3, 13(14)-dien.

Salvigreside C (**3**) formed a colorless amorphous powder and was determined by HR-TOF-MS to have the molecular formula $C_{28}H_{46}O_{10}$, with a quasimolecular ion at *m*/*z* 565.2996 (calc. 565.2989) $(M + Na)^+$. The ^{1}H NMR and ^{13}C NMR data of **3** were quite similar to those of **2**, including an acetyl group, with the exception of a signal for a hydroxymethyl group in **3** [δ 3.83 (1H, *d*, *J* = 11.9 Hz), 4.40 (1H, *d*, *J* = 11.9 Hz) by ^{1}H NMR and δ 66.0 by ^{13}C NMR]; instead of the disappearance of a vinyl methyl group (C-18) seen in the spectra of **2**. This finding suggested that a hydroxymethyl group was located at C-18 of **3**. The hydroxymethyl protons at δ 3.83 and 4.40 showed CH– correlations to the trisubstituted olefinic carbon at δ 129.1 (C-3) and the quaternary carbon at δ 44.8 (C-5) in the HMBC spectrum. The relative stereochemistry of **3** was determined by the NOE difference experiments, as in the case of **1**. Therefore, the structure of salvigreside C (**3**) was determined to be 6α-*O*-(6-*O*-acetyl-β-D-glucopyranosyl)-15, 16, 18-trihydroxy-cleroda-3, 13(14)-dien.

Salvigreside D (**4**) formed a colorless amorphous powder and was determined by HR-TOF-MS to have the molecular formula $C_{28}H_{42}O_8$, with a quasimolecular ion at *m*/*z* 529.2787 (calc. 529.2777) $(M + Na)^+$. The ^{1}H NMR and ^{13}C NMR data of **4** were in good agreement with those of **2,** with the exception of the appearance of signals for three coupled olefinic protons [δ 6.26 (1H, *dd*, *J* = 0.6, 1.5 Hz), 7.24 (1H, *dd*, *J* = 0.6, 1.5 Hz) and 7.24 (1H, *t*, *J* = 1.5 Hz)] instead of the disappearance of two hydroxymethyl groups (C-15 and C-16). These data indicated that a β-substituted furan ring as in **7** also exists in compound **4**. The attachment of the β-substituted furan ring to C-12 was based on HMBC spectral analysis. The olefinic protons (H-14 and H-16) showed correlations to the methylene carbon (C-12). The relative stereochemistry of **4** was determined by the NOE difference experiments, as in the case of **1**. Thus, the structure of salvigreside D (**4**) was determined to be 6α-*O*-(6-*O*-

Table 2
^{13}C NMR chemical shifts of salvigresides A–D (1–4) in CD_3OD

C	1[a]	2[a]	3[a]	4[b]
1	19.0	19.0	18.7	19.0
2	27.7	27.7	27.5	27.7
3	122.7	122.8	129.1	122.7
4	145.9	145.8	148.0	145.8
5	45.5	45.5	44.8	45.6
6	87.0	87.1	87.1	87.0
7	36.6	36.7	36.7	36.6
8	35.6	35.7	35.6	35.6
9	39.3	39.3	39.3	39.3
10	47.3	47.3	46.9	47.3
11	38.4	38.4	38.3	40.0
12	28.9	28.9	28.9	18.8
13	143.7	143.7	143.6	126.8
14	127.3	127.3	127.4	111.8
15	58.8	58.8	58.8	143.9
16	60.2	60.2	60.2	139.6
17	23.8	23.8	66.0	23.8
18	16.9	16.8	18.4	16.3
19	16.2	16.3	16.5	16.8
20	18.4	18.4	18.3	18.2
1′	104.3	104.3	103.4	104.3
2′	75.7	75.6	75.7	75.6
3′	78.7	78.5	78.6	78.4
4′	71.8	72.0	71.8	71.9
5′	77.7	75.1	75.1	75.0
6′	62.9	65.0	65.0	64.9
Ac		20.9	20.9	20.8
		172.6	172.6	172.5

[a] 200 MHz.
[b] 125 MHz.

acetyl-β-D-glucopyranosyl)-15, 16-epoxycleroda-3, 13(16), 14-trien.

In conclusion, four neoclerodane diterpenoid glucosides, designated salvigresides A–D, as well as two phenylpropanoid glycosides were isolated from the aerial parts of *S. greggii*, and their structures determined. Furthermore, salvigreside D (**4**) was determined to show antibacterial activity against *Bacillus subtilis* ATCC6633 in the agar diffusion paper disk method at 8 μg/disk. Recently, six neoclerodane diterpenoids, salvinorins D–F and divinatorins A–C, were isolated from *Salvia divinorum* (Bigham et al., 2003; Munro and Rizzacasa, 2003). Those compounds possessed a furan ring substructure in the molecule, whereas a 15, 16-dihydroxy moiety existed in salvigresides A–C. On the other hand, the neoclerodane diterpenoid glucoside, amarisolide, was isolated from *S. amarissima* (Maldonado et al., 1996). To the best of our knowledge, this is the first report about the occurrence of the 15, 16-dihydroxy type of **6** neoclerodane diterpenoids and the second example of this type of glucoside from the genus *Salvia*. Among the members of the genus *Salvia*, *S. greggii* is considered to be abundant in neoclerodane diterpenoid glucosides.

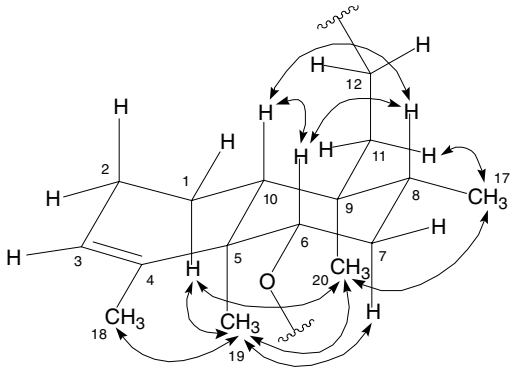


Fig. 2. Selected NOEs of salvigreside A (**1**).

3. Experimental

3.1. General

IR spectra were recorded on a JASCO FT/IR-5300 spectrophotometer. Optical rotation were measured on a JASCO DIP-370 polarimeter and is given in units of 10^{-1} deg cm^2 g^{-1}. ^1H and ^{13}C NMR spectra were recorded in CD_3OD on Jeol ECA-800 and A-500 spectrometers, respectively, with *J* values reported in Hz. TOF mass (TOF-MS) and HR-TOF-MS spectra were recorded on a Jeol JMS-T100LC spectrometer.

3.2. Plant material

Salvia greggii was cultivated at Wakayama Experimental Station for Medicinal Plants, National Institute of Health Sciences. A voucher specimen (No. SY001) was deposited at the National Institute of Health Sciences, Japan.

3.3. Extraction and isolation

The aerial parts of *S. greggii* (700 g) were crushed and extracted with MeOH (31 × 3) to give crude extract (111.5 g), which was partitioned between CH_2Cl_2, EtOAc, *n*-BuOH and H_2O. The CH_2Cl_2-soluble fraction (17.8 g) was separated on activated charcoal CC into three fractions: MeOH, MeOH–$CHCl_3$ (7:3) and $CHCl_3$. The MeOH–$CHCl_3$ (7:3) fraction (2.9 g) was subjected to silica gel CC and eluted with *n*-hexane–EtOAc (1:5) to afford salvigreside D (**4**, 6.1 mg). The EtOAc-soluble fraction (2.9 g) was separated by Sephadex LH-20 with $CHCl_3$–MeOH (2:1) followed by silica gel CC with $CHCl_3$–MeOH (5:1) to afford salvigreside B (**2**, 6.3 mg) and $CHCl_3$–MeOH (2:1) to afford salvigreside C (**3**, 2.8 mg). The BuOH-soluble fraction (3.8 g) was separated by silica gel CC with $CHCl_3$–MeOH (5:1) to afford eugenyl-*O*-β-glucopyranoside (**5**, 5.6 mg) and $CHCl_3$–MeOH (1:1) followed by silica gel CC and separated into three fractions: $CHCl_3$–MeOH–

H_2O (10:2:0.1), $CHCl_3$–MeOH–H_2O (10:5:0.1) and MeOH. The $CHCl_3$–MeOH–H_2O (10:2:0.1) fraction (94 mg) was subjected to low-pressure liquid chromatography (LPLC) with 60% MeOH to afford salvigreside A (**1**, 7.2 mg) and the $CHCl_3$–MeOH–H_2O (10:5:0.1) fraction (219 mg) was subjected to LPLC with 50% MeOH to afford eugenyl-*O*-β-apiofuranosyl(1″ → 6′)-β-glucopyranoside (**6**, 3.6 mg).

3.4. Salvigreside A (*1*)

Colorless amorphous powder, $[\alpha]_D^{20}$ −17.8° (MeOH; *c* 0.09). IR ν_{max}^{KBr} cm^{-1}: 3431(OH). HR-TOF-MS (ESI positive) *m/z*: 507.2935 $[M + Na]^+$; calc. for $[C_{26}H_{44}O_8 + Na]^+$: 507.2934. For ^1H NMR and ^{13}C NMR spectra, see Tables 1 and 2.

3.5. Salvigreside B (*2*)

Colorless amorphous powder, $[\alpha]_D^{25}$ −17.2° (MeOH; *c* 0.61). IR ν_{max}^{KBr} cm^{-1}: 3409(OH), 1730(CO). HR-TOF-MS (ESI positive) *m/z*: 549.2997 $[M + Na]^+$; calc. for $[C_{28}H_{46}O_9 + Na]^+$: 549.3040. For ^1H and ^{13}C NMR spectra, see Tables 1 and 2.

3.6. Salvigreside C (*3*)

Colorless amorphous powder, $[\alpha]_D^{25}$ −12.5° (MeOH; *c* 0.28). IR ν_{max}^{KBr} cm^{-1}: 3412(OH), 1732(CO). HR-TOF-MS (ESI positive) *m/z*: 565.2996 $[M + Na]^+$; calc. for $[C_{28}H_{46}O_{10} + Na]^+$: 565.2989. For ^1H and ^{13}C NMR spectra, see Tables 1 and 2.

3.7. Salvigreside D (*4*)

Colorless amorphous powder, $[\alpha]_D^{25}$ −16.1° (MeOH; *c* 0.74). IR ν_{max}^{KBr} cm^{-1}: 3402(OH), 1740(CO). HR-TOF-MS (ESI positive) *m/z*: 529.2787 $[M + Na]^+$; calc. for $[C_{28}H_{42}O_8 + Na]^+$: 529.2777. For ^1H and ^{13}C NMR spectra, see Tables 1 and 2.

3.8. Enzymatic hydrolysis of (*1*)

A solution of salvigreside A (**1**) (1.9 mg) in H_2O (1.0 ml) and β-D-glucosidase (10 mg) from almond was incubated at 37 °C for 25 h. The solution was subsequently washed with EtOAc and the aqueous layer was evaporated to yield a residue that showed a spot of glucose (R_f 0.18, $CHCl_3$–MeOH–H_2O 5:2:0.1) on silica gel TLC. The residue was converted into a thiazolidine derivative and analyzed by silica gel TLC (R_f 0.49 and 0.38, $CHCl_3$–MeOH–H_2O 15:6:1) (Miyaichi and Tomimori, 1998). Authentic thiazolidine derivatives obtained from D- and L-glucoses showed spots at R_f 0.49 and 0.38, and 0.45, respectively.

3.9. Alkaline hydrolysis of (*2*)

A solution of salvigreside B (**2**) (0.9 mg) in MeOH (0.5 ml) and 1 N NaOH (0.5 ml) was treated at room temperature (20 °C) for 12 h. The reaction mixture was neutralized with 10% H_2SO_4, evaporated, and the residue then was subjected to TLC analysis. Salvigreside A (**1**) was identified by its silica gel TLC behavior (R_f 0.27, $CHCl_3$–MeOH–H_2O 5:1:0.1).

3.10. Antibacterial activity

The antibacterial activities of each compound were determined by modified the disk spreading method (K–B method) (Bauer et al., 1966), using *B. subtilis* ATCC6633 and *Escherichia coli* NIHJ as test organisms.

Acknowledgements

The authors are grateful to Mr. Y. Shiga of the Wakayama Experimental Station for Medicinal Plants for his assistance in the cultivation of *S. greggii*. This work was supported in part by a Health and Labour Sciences Research Grants from the Ministry of Health, Labour and Welfare of Japan.

References

Bauer, A.W., Kirby, W.M.M., Sherris, J.C., Turck, M., 1966. Antimicrobial susceptibility testing by a standardized single disk method. Am. J. Clin. Pathol. 45, 493–496.

Bigham, A.K., Munro, T.A., Rizzacasa, M.A., Robins-Browne, R.M., 2003. Divinatorins A–C, new neoclerodane diterpenoids from the controlled sage *Salvia divinorum*. J. Nat. Prod. 66, 1242–1244.

Fujita, T., Nakayama, M., 1992. Perilloside A, a monoterpene glucoside from *Perilla frutescens*. Phytochemistry 31, 3265–3267.

Kawahara, N., Inoue, M., Kawai, K., Sekita, S., Satake, M., Goda, Y., 2003. Diterpenoid from *Salvia greggii*. Phytochemistry 63, 859–862.

Machida, K., Nakano, Y., Kikuchi, M., 1991. Phenolic glycosides from *Viburnum dilatatum*. Phytochemistry 30, 2013–2014.

Maldonado, E., Cardenas, J., Bojorquez, H., Escamilla, E.M., Ortega, A., 1996. Amarisolide, a neoclerodane diterpene glycoside from *Salvia amarissima*. Phytochemistry 42, 1105–1108.

Miyaichi, Y., Tomimori, T., 1998. Studies on constituents of *Scutellaria* species XIX. Lignan glycosides of roots of *Scutellaria baicalensis* Georgi. Nat. Med. 52, 82–86.

Munro, T.A., Rizzacasa, M.A., 2003. Salvinorins D–F, new neoclerodane diterpenoids from the *Salvia divinorum*, and an improved method for the isolation of salvinorin A.J. Nat. Prod. 66, 703–705.

Takeda, Y., Ooiso, Y., Masuda, T., Honda, G., Otsuka, H., Sezik, E., Yesilada, E., 1998. Iridoid and eugenol glycosides from *Nepeta cadmea*. Phytochemistry 49, 787–791.