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Iridoid Glucosides from *Lamium amplexicaule*

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The iridoid glucosides lamioside (**1**), lamalbid (**8**), shanzhiside methyl ester (**9**) and barlerin (**10**) were isolated from the whole plant of *Lamium amplexicaule* L. The preferred conformations of the cyclopentane ring of the acetates (**1a**, **8a**, **9a** and **10a**) in solution were deduced from extensive proton nuclear magnetic resonance spectral analyses.

Keywords—*Lamium amplexicaule*; Labiatae; iridoid glucoside; lamioside; lamalbid; shanzhiside methyl ester; barlerin

In previous papers,^{1–4} we reported the isolation and structural determination of iridoid glucosides and phenyl propanoid glycosides from *Campsis chinensis* (Bignoniaceae). As a continuation of our studies on the constituents of iridoid glycosides, we examined the constituents of iridoid glycosides of *Lamium amplexicaule* (Labiatae). There are reports of the isolation of various iridoid glucosides, lamioside (**1**),⁵ lamiol (**2**),⁵ lamiide (**3**),⁶ ipolamiide (**4**),^{6,7} ipolamiidoside (**5**),⁷ 5-deoxylamioside (**6**)⁸ and 6-deoxylamioside (**7**)⁹ from this plant. Careful reinvestigation of a methanol extract of the whole plant of *L. amplexicaule* led to the isolation of lamalbid (**8**), shanzhiside methyl ester (**9**) and barlerin (**10**), together with **1**.

We describe here the preferred conformations of the cyclopentane ring in the acetates of these compounds in solution, as well as the identification of the four iridoid glycosides, **1** and **8–10**.

The four iridoid glucoside, L-sides I–IV, were isolated as described in Experimental.

L-side I (**1**), a white powder, $[\alpha]_D - 58.4^\circ$ (MeOH), gave D-glucose and a black product (derived from the aglycone) on acid hydrolysis, and gave a pentaacetate (**1a**), mp 204–206°C, on acetylation with acetic anhydride and pyridine. L-side I was established to be lamioside (**1**),⁵ by comparison of the physical and spectral data for **1** and **1a** with reported values.⁵

L-side II (**8**) was isolated as a white powder, $[\alpha]_D - 101.5^\circ$ (MeOH), and gave a hexaacetate (**8a**), mp 150–151°C, on acetylation with acetic anhydride and pyridine. The infrared (IR) and proton nuclear magnetic resonance (¹H-NMR) spectral data for **8** and **8a** were identical with those for lamalbid and its hexaacetate from *Lamium album* L. (Labiatae).¹⁰

L-side III (**9**) was isolated as a white powder, $[\alpha]_D - 81.0^\circ$ (MeOH), and gave a pentaacetate (**9a**), mp 177–179°C, and a hexaacetate (**9b**), mp 184–187°C, on acetylation with acetic anhydride and pyridine at 50°C. The physical and spectral data of **9** and **9a** were identical with those of shanzhiside methyl ester and its pentaacetate from *Mussaenda parviflora* (Rubiaceae).¹¹

L-side IV (**10**) was obtained as a white powder, $[\alpha]_D - 81.0^\circ$ (MeOH), which gave D-glucose together with a black product due to decomposition of the aglycone on acid hydrolysis. The IR and ¹H-NMR spectral data showed the presence of a typical iridoid structure¹² possessing an α , β unsaturated methoxycarbonyl group [IR(KBr): 1710,

Chart 1

1630 cm^{-1} ; $^1\text{H-NMR}$ (CD_3OD) δ : 3.68 (s)], a deshielded tertiary methyl group [δ 1.84 (s)], an acetyl group [1720 cm^{-1} ; δ 1.96 (s)] and a β -D-glucopyranosyl moiety [3400 cm^{-1} ; δ 4.57 (d, $J=8.0\text{ Hz}$)]. Acetylation of **10** with acetic anhydride and pyridine gave a pentaacetate (**10a**), mp 187–189°C, $[\alpha]_D -147.4^\circ$ (CHCl_3), which did not contain a hydroxyl group, judging from its IR spectrum. The above results and the $^1\text{H-NMR}$ spectral data (see Table II and Experimental) on **10a** indicated the presence of a β -hydroxyl group at C-6, and an acetoxyl and a tertiary methyl group at C-8 in **10**. The configurations of the acetoxyl and tertiary methyl groups at C-8 were concluded to be β and α , respectively, for the following reasons. As seen in other C-8 β -acetoxyl substituted/C-8 β -hydroxyl substituted pairs of iridoid glucosides,^{4,13)} the signals of H-1, H-9, and Me-8 in **10** were 0.25, 0.45 and 0.20 ppm downfield from the corresponding signals of **9**. Similarly, comparison of the $^1\text{H-NMR}$ spectral data on **10a** (**9b**) with those on **9a**, revealed that the signals due to H-1, H-9 and Me-8 of **10a** were shifted +0.45, +0.36 and +0.16 ppm, respectively.

Thus, L-side IV was deduced to be 8-acetyl shanzhiside methyl ester (**10**). This assignment was supported by the carbon-13 nuclear magnetic resonance ($^{13}\text{C-NMR}$) spectrum of **10** compared with that of **9**: the signals of **10** showed a downfield shift for C-8 ($\Delta\delta=10.12\text{ ppm}$)¹⁴⁾ and upfield shifts for C-9 ($\Delta\delta=-3.01\text{ ppm}$) and C-10 ($\Delta\delta=-2.45\text{ ppm}$), as seen in other C-8 β -acetoxyl substituted/C-8 β -hydroxyl substituted pairs of iridoid glucosides.¹⁵⁾

Consequently, the stereochemistry of L-side IV was established as **10**, the same as that of

TABLE I. ^{13}C -NMR Spectral Data for **1** and **8–10**
(50.10 MHz; TMS as an Internal Standard, CD_3OD , δ)

Carbon atom	1	8	9	10
1	94.08 d	94.96 d	94.87 d	95.71 d
3	138.55 d	152.95 d	152.74 d	153.56 d
4	113.15	111.45	111.31	109.88
5	74.69	37.84 d	41.46 d	42.28 d
6	74.49 d ^{a)}	76.48 d	77.47 d	76.03 d
7	45.84 t	78.87 d ^{a)}	47.92 t	47.62 t
8	87.36	78.69	79.61	89.73
9	56.62 d	49.35 d	51.86 d	48.85 d
10	22.16 q ^{b)}	22.28 q	24.67 q	22.22 q
11	12.38 q	169.47	169.65	169.83
		51.97 q	51.77 q	51.77 q
Acetyl	172.89			173.81
	22.05 q ^{b)}			22.22 q
1'	99.39 d	99.80 d	99.77 d	100.39 d
2'	74.20 d ^{a)}	74.57 d	74.57 d	74.66 d
3'	77.61 d ^{c)}	77.96 d ^{c)}	77.93 d ^{c)}	77.90 d ^{c)}
4'	71.68 d	71.60 d	71.60 d	71.65 d
5'	78.02 d ^{c)}	78.25 d ^{c)}	78.25 d ^{c)}	78.28 d ^{c)}
6'	62.81 t	62.81 t	62.84 t	62.98 t

a—c) Assignments with the same sign may be interchanged in each column. Unmarked signals are singlets.

TABLE II. Coupling Constants for the Protons of the Cyclopentane
Ring in **1**, **1a**, **8**, **8a**, **9a** and **10a**

Compound	$J_{1\alpha,9\beta}$	$J_{3,5\beta}$	$J_{5\beta,6\alpha}$	$J_{5\beta,9\beta}$	$J_{6\alpha,7\alpha}$	$J_{6\alpha,7\beta}$
Measured value						
1 ^{a)}	0.5	—	—	—	4.0	d)
1a ^{a)}	0.5	—	—	—	4.5	0.5
8 ^{a)}	1.7	0.5	3.0	10.0	4.6	—
8a ^{b)}	1.5	1.5	2.7	10.6	4.6	—
9a ^{a)}	1.5	0.5	d)	10.0	6.0	3.0
9a ^{b)}	2.9	1.5	1.0	9.2	6.0	3.0
10a ^{b)}	1.5	1.5	0.5	8.8	4.9	1.6
Calculated values ^{c)}						
⁶ V	0.5		1.5	8.0	4.0	1.5
V ₇ (⁶ T ₇)	0.5		0.5	9.4	5.0	1.5
⁷ V	1.0		6.0	9.4	4.5	6.0
V ₈ (⁷ T ₈)	2.5		3.0	9.4	6.0	8.0
⁸ V	0.4		3.0	7.0	7.0	0.5
V ₆ (⁷ T ₆)	1.0		10.0	7.5	5.0	8.5
⁵ V	0.8		8.0	5.5	7.0	8.5

a) Run in CD_3OD . b) Run in CDCl_3 . c) The values were calculated from the equation $J = 9.5 \cos^2 \theta - 0.5 \cos \theta + 0.4$.¹⁷⁾ d) Obscured signal.

barlerin reported by Damtoft *et al.*¹⁶⁾ Its pentaacetate (**10a**) was identified as shanzhiside methyl ester hexaacetate (**9b**) by direct comparison with an authentic sample (mixed mp, IR, ^1H -NMR and thin layer chromatography (TLC)).

The preferred conformations of the cyclopentane ring of **1a**, **8a**, **9a** and **10a** in solution,

deduced from the extensive ^1H -NMR spectral analyses of these compounds, were as follows. As shown in Table II, comparison of the measured values of the coupling constants of the H-5, H-6, H-7 and H-9 signals of **1a**, **9a** and **10a** with the calculated values, and observations of the nuclear Overhauser effect (NOE) increments (**1a**, 10%; **9a**, 7%; **10a**, 13%) between H-1 and Me-8, indicated that the cyclopentane rings in **1a**, **9a** and **10a** exist as $V_7(^6T_7)$ or 6V forms; that of **10a** was definitely in the 6V form, since long-range coupling (W rule) was observed between protons $\beta\text{H-5}$ and $\beta\text{H-7}$ (see the chart). The cyclopentane ring in **8a** was deduced to be in the $V_8(^7T_8)$ form from the coupling constants (see Table II) of the H-5, H-6, H-7 and H-9 signals, as we reported previously,²⁾ and from the NOE increments (**8a**: 13, 8 and 13%) for $\alpha\text{H-1}$, $\alpha\text{H-6}$ and $\alpha\text{H-7}$ from Me-8. Namely, the above results showed that the conformations of **1a**, **8a**, **9a** and **10a** are decided by the bulk of the substituent at C-7.

In this work, **9** and **10** were isolated for the first time from a Labiatae plant.

Experimental

All melting points are uncorrected. IR spectra were measured with a Hitachi IR-215 spectrometer. NMR spectra were measured on a JEOL JNN-PS-100 (^1H : 100 MHz) or an FX-100 (^1H : 200 MHz; ^{13}C : 50.10 MHz) spectrometer with tetramethylsilane (TMS) as an internal standard. TLC and preparative thin-layer chromatography (PTLC) were performed with Merck Kieselgel GF₂₅₄ and PF₂₅₄, respectively. Spots were located under ultraviolet (UV) illumination or by spraying with 1% $\text{Ce}(\text{SO}_4)_2$ –10% H_2SO_4 and then heating.

Isolation of Iridoid Glucosides—Fresh whole plants (8 kg) of *L. amplexicaule* L. collected at the Botanic Garden of the Faculty of Pharmaceutical Sciences, Tokushima University, were extracted three times with MeOH. The MeOH extract was evaporated *in vacuo* to give a residue (413 g), part of which (207 g) was chromatographed over a celite 535 (100 g) column with water (2 l) as the eluent. The eluate was evaporated *in vacuo* to give a residue (160 g). A part (35 g) of the residue was chromatographed on active charcoal (150 g) with H_2O –MeOH (1:1) until fraction 3 (500 ml each), and then with MeOH. Fractions 5–9 (500 ml each) were concentrated to leave a residue (618 mg), which was then subjected to PTLC(CHCl_3 –MeOH– H_2O =65:35:10, lower layer) to give crude L-side I (**1**) (80 mg, R_f =0.52), L-side II (**8**) (207 mg, R_f =0.20), L-side III (**9**) (59 mg, R_f =0.37) and L-side IV (**10**) (49 mg, R_f =0.59). The crude L-sides I–III (**1**, **8** and **9**) were purified further by PTLC(CHCl_3 –MeOH–AcOEt=3:1:1, each developed five times) to obtain pure L-side I (**1**) (33.7 mg, R_f =0.49), L-side II (**8**) (70 mg, R_f =0.24) and L-side III (**9**) (34 mg, R_f =0.44). The crude L-side IV (**9**) was purified by PTLC(CHCl_3 –MeOH–AcOEt=4:1:2, developed seven times) to afford pure L-side IV (**10**) (33.7 mg, R_f =0.33).

L-side I (1, Lamioside)—White powder, $[\alpha]_D^{25}$ –58.4° (c =0.45, MeOH). IR $\nu_{\text{max}}^{\text{KBr}}$ cm^{-1} : 3350 (OH), 1700 (C=O), 1660 (C=C). ^1H -NMR (CD_3OD) δ : 1.40 (3H, s, Me-8), 1.59 (3H, br s, Me-4), 1.98 (3H, s, AcO-8), 2.04 (2H, m, H_2 -7), 2.78 (1H, br s, $\beta\text{H-9}$), 3.96 (1H, m, $\alpha\text{H-6}$), 4.53 (1H, d, J =8.0 Hz, H-1'), 5.96 (1H, br s, $\alpha\text{H-1}$), 6.08 (1H, br s, H-3). ^{13}C -NMR: see Table I.

Acetylation of 1—**1** (7 mg) was acetylated with Ac_2O –pyridine (0.3 ml–0.3 ml) by the usual method to give **1a** (7 mg).

1a: Colorless needles (from EtOH), mp 204–206°C, $[\alpha]_D^{26}$ –75.3° (c =0.51, CHCl_3). IR $\nu_{\text{max}}^{\text{KBr}}$ cm^{-1} : 3430 (OH), 1760, 1750, 1730, 1720 (C=O), 1660 (C=C). ^1H -NMR (CDCl_3) δ : 1.42 (3H, s, Me-8), 1.65 (3H, br s, Me-4), 1.95–2.08 (AcO $\times$ 6), 3.02 (1H, br s, $\beta\text{H-9}$), 5.13 (1H, m, $\alpha\text{H-6}$), 6.00 (2H, br s, H-1 and H-3). *Anal.* Calcd for $\text{C}_{28}\text{H}_{38}\text{O}_{16}$: C, 53.33; H, 6.07. Found: C, 53.43; H, 5.92.

L-side II (8, Lamalbid)—White powder, $[\alpha]_D^{26}$ –86.1° (c =0.69, EtOH). IR $\nu_{\text{max}}^{\text{KBr}}$ cm^{-1} : 3350 (OH), 1695 (C=O), 1635 (C=C). ^1H -NMR (CD_3OD) δ : 1.20 (3H, s, Me-8), 2.78 (1H, dd, J =10.0, 1.7, $\beta\text{H-9}$), 2.93 (1H, ddd, J =10.0, 3.0, 0.5 Hz, $\beta\text{H-5}$), 3.54 (1H, d, J =4.6 Hz, $\alpha\text{H-7}$), 3.72 (3H, s, MeOOC-4), 3.94 (1H, dd, J =4.6, 3.0 Hz, $\alpha\text{H-6}$), 4.60 (1H, d, J =7.8 Hz, H-1'), 5.62 (1H, d, J =1.7 Hz, $\alpha\text{H-1}$), 7.40 (1H, d, J =0.5 Hz, H-3). ^{13}C -NMR: see Table I.

Acetylation of 8—**8** (7 mg) was acetylated with Ac_2O –pyridine (0.3 ml–0.4 ml) by the usual method to give a hexaacetate (**8a**, 7 mg).

8a: Colorless needles (from EtOH), mp 150–151°C, $[\alpha]_D^{25}$ –57.9° (c =0.35, CHCl_3). IR $\nu_{\text{max}}^{\text{KBr}}$ cm^{-1} : 3500 (OH), 1770, 1720 (C=O), 1640 (C=C). ^1H -NMR (CDCl_3) δ : 1.29 (3H, s, Me-8), 1.90–2.14 (AcO $\times$ 6), 2.88 (1H, dd, J =10.6, 1.5 Hz, $\beta\text{H-9}$), 3.06 (1H, ddd, J =10.6, 2.7, 1.5 Hz, $\beta\text{H-5}$), 3.67 (3H, s, MeOOC-4), 4.93 (1H, d, J =4.6 Hz, $\alpha\text{H-7}$), 5.26 (1H, dd, J =4.6, 2.7 Hz, $\alpha\text{H-6}$), 5.50 (1H, d, J =1.5 Hz, $\alpha\text{H-1}$), 7.30 (1H, d, J =1.5 Hz, H-3). *Anal.* Calcd for $\text{C}_{28}\text{H}_{34}\text{O}_{16}$: C, 58.85; H, 5.80. Found: C, 50.25; H, 5.89.

L-side III (9, Shanzhiside Methyl Ester)—White powder, $[\alpha]_D^{26}$ –101.5° (c =0.33, MeOH). IR $\nu_{\text{max}}^{\text{KBr}}$ cm^{-1} : 3400 (OH), 1690 (C=O), 1645 (C=O). ^1H -NMR (CD_3OD) δ : 1.28 (3H, s, Me-8), 1.92 (2H, m, H_2 -7), 2.60 (1H, m, $\beta\text{H-9}$), 3.00 (1H, m, $\beta\text{H-5}$), 3.74 (3H, s, MeOOC-4), 4.85 (1H, d, J =8.0 Hz, H-1'), 5.59 (1H, d, J =1.5 Hz, $\alpha\text{H-1}$), 7.42 (1H, s,

H-3). ^{13}C -NMR: see Table I.

Acetylation of 9—9 (38 mg) was acetylated with Ac_2O -pyridine (0.3 ml–0.3 ml) at 50°C for 4 h to give a pentaacetate (**9a**, 20 mg) and a hexaacetate (**9b**, 8.8 mg).

9a: Colorless needles (from EtOH), mp $177\text{--}179^\circ\text{C}$, $[\alpha]_{\text{D}}^{26} -150.0^\circ$ ($c=0.30$, EtOH). IR $\nu_{\text{max}}^{\text{KBr}}$ cm^{-1} : 3540 (OH), 1740, 1730, 1700 (C=O), 1640 (C=C). ^1H -NMR (CDCl_3) δ : 1.33 (3H, s, Me-8), 1.86 (1H, dd, $J=14.9$, 3.0 Hz, $\beta\text{H-7}$), 2.07 (1H, dd, $J=14.9$, 6.0 Hz, $\alpha\text{H-7}$), 2.69 (1H, dd, $J=9.2$, 2.9 Hz, $\beta\text{H-9}$), 3.19 (1H, ddd, $J=9.2$, 1.5, 1.0 Hz, $\beta\text{H-5}$), 3.71 (3H, s, MeOOC-4), 4.86 (1H, d, $J=8.1$ Hz, H-1'), 5.27 (1H, dd, $J=6.0$, 3.0 Hz, $\alpha\text{H-6}$), 5.43 (1H, d, $J=2.9$ Hz, $\alpha\text{H-1}$), 7.38 (1H, d, $J=1.5$ Hz, H-3). Anal. Calcd for $\text{C}_{27}\text{H}_{36}\text{O}_{16}$: C, 52.59; H, 5.89. Found: C, 52.48; H, 6.03.

9b: Colorless needles (from EtOH), mp $185\text{--}187^\circ\text{C}$, $[\alpha]_{\text{D}}^{26} -140.5^\circ$ ($c=0.67$, CHCl_3). IR $\nu_{\text{max}}^{\text{KBr}}$ cm^{-1} : no OH, 1760, 1740, 1710 (C=O), 1640 (C=C). ^1H -NMR (CDCl_3) δ : 1.49 (3H, s, Me-8), 1.97 (1H, dd, $J=14.9$, 4.9 Hz, $\alpha\text{H-7}$), 2.33 (1H, ddd, $J=14.9$, 1.6, <0.5 Hz, $\beta\text{H-7}$), 3.05 (1H, dd, $J=8.8$, 1.5 Hz, $\beta\text{H-9}$), 3.12 (1H, dddd, $J=8.8$, 1.5, 0.5, <0.5 , $\beta\text{H-5}$), 3.70 (3H, s, MeOOC-4), 4.85 (1H, d, $J=8.3$ Hz, H-1'), 5.30 (1H, ddd, $J=4.9$, 1.6, 0.5, $\alpha\text{H-6}$), 5.88 (1H, d, $J=1.5$ Hz, $\alpha\text{H-1}$), 7.39 (1H, d, $J=1.5$ Hz, H-3). Anal. Calcd for $\text{C}_{29}\text{H}_{38}\text{O}_{17}$: C, 52.88; H, 5.82. Found: C, 52.84; H, 5.69.

L-side IV (10, Barlerin)—White powder, $[\alpha]_{\text{D}}^{26} -81.0^\circ$ ($c=0.38$, MeOH). IR $\nu_{\text{max}}^{\text{KBr}}$ cm^{-1} : 3400 (OH), 1710 (C=O), 1640 (C=C). ^1H -NMR (CD_3OD) δ : 1.48 (3H, s, Me-8), 1.96 (3H, s, AcO-8), 2.12 (2H, m, $\text{H}_2\text{-7}$), 2.98 (2H, brs, $\beta\text{H-5}$ and $\beta\text{H-9}$), 3.68 (3H, s, MeOOC-4), 3.80 (1H, m, $\alpha\text{H-6}$), 4.57 (1H, d, $J=8.0$ Hz, H-1'), 5.84 (1H, d, $J=2.0$ Hz, $\alpha\text{H-1}$), 7.38 (1H, brs, H-3). ^{13}C -NMR: see Table I.

Acetylation of 10—10 (33 mg) was acetylated with Ac_2O -pyridine (0.3 ml–0.3 ml) at 50°C for 3 h to give a pentaacetate (**10a**, 19 mg) as colorless needles (from EtOH), mp $187\text{--}189^\circ\text{C}$, $[\alpha]_{\text{D}}^{26} -147.4^\circ$ ($c=0.67$, CHCl_3). This product was identical with an authentic sample of hexaacetylshanzhiside methyl ester (**9b**) on the basis of TLC, IR, ^1H -NMR comparisons and mixed mp determination.

References and Notes

- 1) S. Kobayashi, Y. Imakura, Y. Yamahara, and T. Shingu, *Heterocycles*, **19**, 1475 (1981).
- 2) Y. Imakura, S. Kobayashi, K. Kida, and M. Kido, *Phytochemistry*, **23**, 2263 (1984).
- 3) Y. Imakura, S. Kobayashi, and A. Mima, *Phytochemistry*, **24**, 139 (1985).
- 4) Y. Imakura, S. Kobayashi, Y. Yamahara, M. Kihara, M. Tagawa, and F. Murai, *Chem. Pharm. Bull.*, **33**, 2220 (1985).
- 5) M. L. Scarpatti and M. Guiso, *Tetrahedron*, **23**, 4709 (1967).
- 6) M. L. Scarpatti and M. Guiso, *Gazz. Chim. Ital.*, **99**, 1150 (1969).
- 7) A. Bianco, M. Guiso, C. Iavarone, R. Marini-Bettolo, and C. Trogolo, *Gazz. Chim. Ital.*, **106**, 947 (1976).
- 8) A. Agostini, M. Guiso, R. Marini-Bettolo, and G. Martinazzo, *Gazz. Chim. Ital.*, **112**, 9 (1982).
- 9) M. Guiso and M. Carmela, *J. Nat. Prod.*, **46**, 157 (1983).
- 10) C. H. Brieskorn and R. Ahlborn, *Tetrahedron Lett.*, **1973**, 4037.
- 11) Y. Takeda, H. Nishimura, and H. Inouye, *Phytochemistry*, **16**, 1401 (1977).
- 12) J. M. Bobbit, and K.-P. Segebarth, "Cyclopentanoid Terpene Derivatives," ed. by W. I. Taylor and A. R. Battersby, M. Dekker, New York, 1969, p. 1 and references cited therein.
- 13) C. R. Narayanan and M. R. Sarma, *Tetrahedron Lett.*, **1968**, 1553.
- 14) Similar downfield shifts ($\Delta\delta=10.84\text{--}11.91$ ppm) between C-8 signals in some known 8β -acetoxyl- 8α -methyl iridoid compounds and those of the corresponding 8β -hydroxyl- 8α -methyl iridoid compounds have already been observed.¹⁵⁾
- 15) A. Bianco, P. Caciola, M. Guiso, C. Iavarone, and C. Trogolo, *Gazz. Chim. Ital.*, **111**, 201 (1981).
- 16) S. Damtoft, S. R. Jensen, and B. J. Nielsen, *Tetrahedron Lett.*, **1982**, 4155.
- 17) H. Steyn, *Tetrahedron*, **27**, 4429 (1971).