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PHENOLIC GLYCOSIDES FROM THE FRUIT OF *STRYCHNOS NUX-VOMICA*

NORMAN G. BISSET,* ABDUL K. CHOUDHURY† and PETER J. HOUGHTON*

*Pharmacognosy Research Laboratories, Chelsea Department of Pharmacy, King's College London, Manresa Road, London SW3 6LX, U.K.; †B.C.S.I.R. Laboratories, P.O. Bayazied Bostami, Chittagong, Bangladesh

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Key Word Index—*Strychnos nux-vomica*; Loganiaceae; phenolic glycosides; salidroside; cuchiloside; phenylethyl glycosides; 1-[2′-(*p*-hydroxyphenyl)-ethyl], 6-xylopyranosyl-β-D-glucopyranoside.

Abstract—Two glycosides previously isolated from the fruit pulp of *Strychnos nux-vomica* were shown to be the known compound salidroside and a novel compound consisting of salidroside and an attached xylose unit. This compound was named cuchiloside from the Bengali name of the plant. The structures were determined by spectral techniques and comparison with known substances. Phenolic glycosides of this type have not previously been reported from *Strychnos*.

INTRODUCTION

A previous chemical investigation of the fruit pulp of *Strychnos nux-vomica* L. resulted in the isolation of several alkaloids and iridoids [1]. The major iridoid was loganin and it was accompanied by four minor related iridoids, isolated from the mother liquor after crystallization of the loganin. It was noted that other substances were present whose structure could not be determined at that time [1]. This paper reports the identification of two of these compounds as phenolic glycosides and not iridoids as was previously proposed.

RESULTS AND DISCUSSION

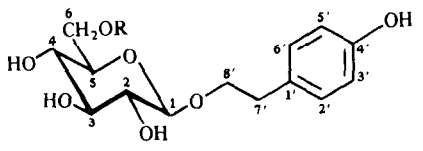
Compound **1** (AKC 35) was identified as salidroside on the basis of the ^{1}H and ^{13}C NMR spectra of its acetate. Mild alkaline hydrolysis of the acetate yielded a product identical in TLC behaviour with the alkaline hydrolysis product of 6-caffeoylsalidroside isolated from *Prunus grayana* [2]. The NMR spectral features of this product were also identical with those reported for salidroside [2].

Compound **2** (AKC 38) was identified as salidroside with xylose attached 1–6 to the glucose moiety of the molecule. The ^{1}H NMR spectrum of both the parent compound and acetate of AKC 38 showed the signals in the aromatic region and at δ4.10, 3.65 and 2.90 which correspond to the 2′-(*p*-hydroxyphenyl)-ethyl portion of the molecule. Similar values are observed for AKC 35 and other related compounds [2–5]. The chemical shifts of the signals in the ^{13}C NMR spectra also agree with such a structure (see Table 1).

The ^{1}H NMR spectrum of the acetate indicates that two anomeric sugar protons are present at δ4.54 and 4.45. The presence of an extra sugar compared to AKC 35 is also demonstrated by the presence of more carbinol signals in both the ^{1}H and ^{13}C NMR spectra, the lower R_f value of AKC 38 on TLC and also the six aliphatic acetate signals observed in the spectrum of AKC 38 acetate. The extra sugar is a pentose since only five signals extra to those recorded for AKC 35 are seen in the ^{13}C NMR spectrum. The identity of the extra sugar as xylose was shown by its detection together with glucose on TLC of the products obtained by hydrolysis of AKC 38. The extra signals in the ^{13}C NMR spectrum also agree with those assigned to xylose in the similar glycoside calceolarioside C [6].

The xylose is linked through C-6 of the glucose portion of the molecule. If this position were free then the signal in the ^{13}C NMR spectrum for C-6 would be at *ca* δ62.5 [7]. However, the two methylene carbon atoms observed give signals at a lower field and calceolarioside C and echinacoside, which also have a sugar attached at C-6, show a signal at δ68.1 [6, 7]. This value agrees well with the signal at δ69.5 given by AKC 38. If attachment were at any other of the other C atoms of the glucose a signal would be seen at *ca* δ80 as is also present in the spectrum of echinacoside [7]. No such signals are observed (see Table 1).

This is the first report of the occurrence of this type of phenolic glycoside in *Strychnos*. Caffeoyl and feruloyl esters of phenylethyl glycosides have been isolated from *Buddleja* [8, 9]. This genus is usually included in the Loganiaceae to which *Strychnos* belongs. Salidroside was



1 (AKC35) R = H

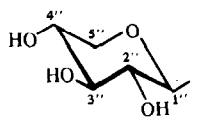
2 (AKC38) R = 

Table 1. ^{13}C NMR spectral data for the *Strychnos nux-vomica* compounds

C	Chemical shift (δ ppm from TMS) AKC35AC	AKC38AC	AKC38
1	100.7	100.5	104.5
2	71.8	71.1	74.0
3	72.8	72.7	75.8
4	68.4	68.7	70.6
5	71.1	71.1	76.6
6	61.9	61.9	69.5
1′	136.0	136.0	131.5
2′	129.9	129.9	130.9
3′	121.4	121.3	116.3
4′	149.2	149.1	154.8
5′	121.4	121.3	116.3
6′	129.9	129.9	130.9
7′	35.3	35.2	35.2
8′	70.4	70.2	72.1
1″	—	100.4	103.2
2″	—	73.2	73.9
3″	—	70.4	76.6
4″	—	69.0	70.3
5″	—	67.6	66.1
Acetates	170.7	170.1	—
	170.3	169.9	
	169.5	169.8	
	169.4	169.5	
	169.3	169.4	
		169.3	
		169.3	

AKC35AC and AKC38AC were run in $CDCl_3$, AKC38 was run in D_2O.

first isolated from *Salix triandra* [10], but related compounds as well as salidroside itself have since been reported to occur in a variety of other plant families, e.g. Rosaceae, Orobanchaceae, Verbenaceae, Lamiaceae, Fagaceae, Asteraceae and Scrophulariaceae [11].

EXPERIMENTAL

The source of the plant material and the extraction procedure have been published previously [1]. AKC35 and AKC38 were isolated from the mother liquor after crystallization of loganin by prep. TLC to give 35 mg of AKC35 and 60 mg of AKC38. The acetates were prepared by conventional means.

AKC35 corresponded in all respects with the physical data published for salidroside [2].

AKC35AC. Amorphous white solid, mp 162–164°. UV λ_{max}^{MeOH} (log ε): 214 (4.57), 250 (4.49), 290 (4.04); IR ν^{Nujol} cm^{-1}: 1760, 1640, 1555, 1530, 1370, 1250, 1220; MS FABMS (glycerol) 510 (M^+); ^1H NMR (δ ppm from TMS, run in $CDCl_3$); 7.20 (2H, *d*, $J = 12$, 2′-H, 6′-H), 7.00 (2H, *d*, $J = 12$, 3′-H, 5′-H), 5.25–4.90 (*m*, 3H, 2-H, 3-H, 4-H), 4.48 (1H, *d*, $J = 7.8$, 1-H), 4.27 (2H, *dd*, 6-H_2), 4.10 (1H, *m*, 8′-Ha), 3.65 (2H, *m*, 5-H, 8′-Hb), 2.90 (2H, *m*, 7′ -CH_2), 2.29 (3H, *s*, 4′–OAc), 2.09–1.91 (4 × 3H, *s*, sugar acetates).

AKC38. Amorphous white solid mp 178–180°. UV λ_{max}^{MeOH} (log ε): 227 (3.7), 276 (3.1); 5% NaOH: 242 (3.9), 295 (3.20); IR ν^{Nujol} cm^{-1}: 3410 (OH), 1640 (C=C), 1170, 1075, 1040. MS FABMS (glycerol) 432 (M^+); ^1H NMR, δ ppm from TMS (D_2O): 7.18 (2H, *d*, $J = 12$, 2′-H, 6′-H), 6.92 (2H, *d*, $J = 12$, 3′-H, 5′-H), 4.45 (2H, *m*, 1-H, 1″-H), 4.10 (2H, *m*, 6-Ha, 8′-Hb), 4.0–3.3 (9H, *m*, 3-H, 4-H, 3-H″, 4-H″, 5-H, 5″-H_2, 6-Hb, 8′-Hb), 3.25 (2H, *m*, 2-H, 2″-H), 2.90 (2H, *t*, 7-H_2).

AKC38AC. White crystals from MeOH, mp 126–128°. UV λ_{max}^{MeOH} (log ε): 229 (3.6), 278 (3.0); IR ν^{Nujol} cm^{-1}: 1750, 1510, 1250, 1220. MS FABMS (glycerol): 726 $[M]^+$; ^1H NMR (δ ppm from TMS, run in $CDCl_3$); 7.21 (2H, *d*, $J = 12$, 2′-H, 6′-H), 6.98 (2H, *d*, $J = 12$, 3′-H, 5′-H), 5.16–4.90 (6H, *m*, 2-H, 3-H, 4-H, 2″-H_2, 4″-H), 4.54 (1H, *d*, $J = 6.7$, 1″-H), 4.45 (1H, *d*, $J = 8.0$, 1-H), 4.10 (2H, *m*, 6-Ha, 8′-Ha), 3.85 (1H, *d*, $J = 9.3$, 5″-Ha), 3.65 (2H, *m*, 5″-Hb, 8′-Hb), 2.88 (2H, *m*, 7-H_2), 2.28 (3H, *s*, 4′-OAc), 2.09–1.91 (6 × 3H, *s*, sugar acetates).

Alkaline hydrolysis of compounds. Compounds were hydrolysed by leaving for 3 hr at room temp. in a 5% soln of Na in MeOH. The reaction mixture was then passed through Amberlite IR-120 cation-exchanger and taken to dryness. The products formed were analysed and separated using TLC.

Hydrolysis to determine sugars present. 10 mg of AKC38 were heated with 10% aq. HCl for 30 min. The reaction mixture was neutralized with $BaCO_3$ and concd to low vol. before being applied to the TLC plate.

TLC. Layers: (a) silica gel GF_{254} (Merck), for examination of the glycosides; (b) kieselguhr (Merck) prepared with 0.02 M NaOAc for analysis of the sugars. Solvents: (i) $CHCl_3$–MeOH 19:1; (ii) EtOAc–MeOH 19:1; (iii) EtOAc–*iso*-PrOH: H_2O 13:5:2. Visualization: UV light 254 nm, anisaldehyde 0.5% in H_2SO_4–HOAc–MeOH 1:2:17 (followed by heating at 105° for 10 min) for the phenolic compounds; 0.5% aniline phthalate in *n*-BuOH (followed by heating at 105° for 10 min) for the sugars.

Instrumentation. UV spectra were run in MeOH. ^1H NMR: TMS as int. ref. MS: inlet probe at 130°.

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