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DISTRIBUTION OF ALKALOIDS IN *ANTHOCERCIS LITTOREA* AND *A. VISCOSA*

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Abstract—The distribution of tropane alkaloids in organs of *Anthocercis littorea* and *A. viscosa* is reported. The following alkaloids have been isolated: atropine (hyoscyamine), apoatropine, noratropine (norhyoscyamine), littorine, hyoscine, norhyoscine, meteloidine, 3α, 6β-ditigloyloxytropan-7β-ol, 6β-tigloyloxytropan-3α-ol, 3α-tigloyloxytropane, tigloidine, tropine, ψ-tropine, (−)-tropan-3α-6β-diol, cuscohygrine and unknown bases.

INTRODUCTION

THE GENUS *Anthocercis* (Family Solanaceae, Tribe Salpiglossideae) embraces some 20 species, all indigenous to Australia. *A. littorea* Labill. and *A. viscosa* R.Br. are shrubs of Western Australia and, although their poisonous properties have long been recognized, it was demonstrated only relatively recently that the toxicity was due to tropane alkaloids. Cannon *et al.*[1] identified (−)-hyoscyamine as the principal alkaloid of the aerial parts of *A. viscosa* (and *A. fasciculata* F. Muell.), and the aerial parts of *A. littorea* were shown to contain a new tropane alkaloid, littorine [*R*(−)-3α-(2-hydroxy-3-phenylpropionyloxy)tropane], together with meteloidine and trace amounts of partly racemized hyoscyamine. Rutin and ursolic acid were also isolated by these investigators from *A. viscosa*; the triterpene acids of *A. littorea*, *A. odgersii* F. Muell. and *A. intricata* F. Muell. have also been studied.[2]

As a continuation of our studies on the tropane alkaloids in the Solanaceae, we record here the characterization and distribution of the minor alkaloids of the roots and aerial parts of *A. littorea* and *A. viscosa*.

RESULTS AND DISCUSSION

The characterization of alkaloids isolated by chromatography from the aerial parts and roots of *A. littorea* and *A. viscosa* is given in Table 1. The results confirm previous work[1] on the identity of the principal alkaloids of the aerial parts of both species. In both cases atropine is the predominant alkaloid of the roots and hyoscyamine or atropine of the flowers of *A. littorea*. A wide spectrum of tropane alkaloids is present, not unlike that found in *Datura* and *Solandra*. The association of littorine with hyoscyamine (atropine) and the presence of cuscohygrine with tropane alkaloids is in keeping with observations on a number of other genera of the family.[3] Unlike *Duboisia*, another Australian woody genus of the Salpiglossideae, of which some species are commercial sources of tropane alkaloids,

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[1] CANNON, J. R., JOSHI, K. R., MEEHAN, G. V. and WILLIAMS, J. R. (1969) *Australian J. Chem.* **22**, 221.
[2] ANSTEE, J. R., ARTHUR, M. R., BECKWITH, A. L., DOUGALL, D. K., JEFFERIES, P. R., MICHAEL, M., WATKINS, J. C. and WHITE, D. E. (1952) *J. Chem. Soc.* 4065.
[3] EVANS, W. C., GHANI, A. and WOOLLEY, V. A. (1972) *Phytochemistry* **11**, 469, 470, 2527; (1972) *Bangladesh Pharm. J.* **1**, 12.

Anthocercis contains mono- and di-esters of tropan-3α, 6β, 7β-triol. An investigation of the root alkaloids of two collections of *A. littorea* from different localities in Western Australia gave no suggestion of chemical races, a feature characteristic of *Duboisia* with regard to leaf alkaloids.

TABLE 1. CHARACTERIZATION OF ALKALOIDS OF *Anthocercis*

	A. littorea			*A. viscosa*	
	Aerial parts	Roots	Flowers	Aerial parts	Roots
Total alkaloids (as hyoscyamine, % dry wt.)	0·16	0·10	0·15	0·11	0·12
Atropine/hyoscyamine	P, IRP, C3	B, P, IRB, IRP, C, H, N, C2, C3	C2, C3	B, P, IRB, IRP, C2, C3	P, IRP, C2, C3
Apoatropine	P, IRP, MS, C1–C3	P, IRP, MS, C1, C2		C1	C1, C2
Noratropine/norhyoscyamine	P, IRP, C2, C3	P, IRP, C2, C3	C2, C3	P, IRP, C2, C3	C2–C5
Littorine	P, IRP, C3	P, C3	C3	C2, C3	C2, C3
Hyoscine	P, IRP, C2	P, IRP, C, H, N, C2, C3	C2, C3	(?) C2, C3	C1, C2
Norhyoscine	P, C2	P, IRP, C, H, N, C2, C3			
Meteloidine	P, IRP, C2, C3	P, IRP, C, H, N, C2, C3	C2, C3	C2, C3	C2, C3
3α,6β-Ditigloyloxytropan-7β-ol		P, IRP, C1, C2			C1, C2
6β-Tigloyloxytropan-3α-ol	PI, HBr, IRPI, IRHBr, C2				
3α-Tigloyloxytropane	P, IRP, C2	(?) P, C2, C3		C2, C3	C2, C3
Tigloidine		P, IRP, C, H, N, C1, C2			C1, C2
Tropine	PT, IRPT, C1–C5*	PT, IRPT, C2–C5*		C1–C5*	C2–C5*
ψ-Tropine	C1–C5*	PT, IRPT, C2–C5*		C1–C5*	C2–C5*
Tropan-3α, 6β-diol				(?) C1,* C2*	
Cuscohygrine		P, IRP, C2, C3			(?) C2–C5
Unknown base i		P, IRP, MS, C1, C2, NMR			C1
Unknown base ii		P, IRP, MS, C1, C2, NMR			
Unknown base iii	P, IRP, MS, C2, C3				

(?) Tentative identification. * For base or its tigloyl ester.

B, P, PI, HBr, PT: m.p. and m.m.p. of base, picrate, picrolonate, hydrobromide, picrate of tigloyl ester respectively. IRB, IRP, IRPI, IRHBr, IRPT: IR spectra (KBr disc) of base, picrate, picrolonate, hydrobromide, picrate of tigloyl ester respectively. MS, NMR: mass and nuclear magnetic resonance spectra respectively. C, H, N: elemental analysis of picrate for carbon, hydrogen and nitrogen respectively. C1–C5: chromatographic systems–C1, alumina (Et_2O); C2, alumina (Et_2O–EtOH, 1:1), both visualized with I_2 in CCl_4; C3, silica ($CHCl_3$–$NHEt_2$, 9:1), visualized with iodoplatinate reagent; C4, silica (Me_2CO–strong NH_3 soln, 4:1) visualized with iodoplatinate reagent; C5, paper chromatography (light petrol. b.p. 60–80°, glacial HOAc, Amyl OH, H_2O (1:3:3:3), visualized with modified Dragendorff's reagent.

EXPERIMENTAL

Plant material. Anthocercis littorea, aerial parts and roots collected in coastal regions around Perth, Western Australia, supplied by Dr. J. R. Cannon, University of Western Australia. *A. littorea* roots collected from dry district 160 km inland from Perth, supplied by Mr. R. D. Royce, Curator, West Australian Herbarium, Perth. *A. viscosa*, aerial parts and roots from plants grown under glass in Nottingham, England from seeds supplied by the Director, King's Park and Botanic Gardens, Perth.

Extraction of bases. (a) *A. littorea*, aerial parts and roots: In typical experiments, the powdered plant material (1 kg) was mixed with $Ca(OH)_2$ (200 g) and moistened with H_2O (400 ml). Alkaloids were exhaustively extracted with Et_2O and the evaporated extract, in Et_2O, passed through kieselguhr (50 g) supporting 1 N H_2SO_4 (20 ml). Pigments and other extraneous materials were removed from the column with Et_2O, and $CHCl_3$-soluble alkaloid sulphates recovered in $CHCl_3$ (fraction A). The extruded, air-dried column, made alkaline with conc. NH_4OH, was continuously treated with $CHCl_3$ until free of alkaloids (fraction B). The original vegetable marc was percolated with EtOH (8 l.) and the extract concentrated; separated inorganic material was removed by filtration leaving a basic solution (fraction C). (b) *A. viscosa*, aerial parts: A similar procedure using powdered leaf (85 g). (c) *A. littorea* flowers and *A. viscosa* roots: Powdered flowers (10 g) and powdered roots (6 g) exhausted with Et_2O by the above method and the solvent removed from the total extract.

Fractionation and isolation of alkaloids (a) *A. littorea* aerial parts and roots: Alkaloids were recovered from the sulphates of fraction A and submitted to chromatography at pH 5·6. Columns were eluted with light petrol. (b.p. 60–80°), Et_2O and $CHCl_3$. 3,6-Ditigloyloxytropan-7-ol was obtained from light petrol. eluates and apoatropine from $CHCl_3$ eluates. A base (MW 321, picrate m.p. 146–149°; base i in Table 1) having some characteristics of 3,6-ditigloyloxytropane was obtained from the early light petrol. fractions (roots) but lack of material prevented a more complete study of this compound. Fraction B was partially resolved by fractional liberation of bases from a solution of their sulphates and collection in $CHCl_3$. Further resolution to give the principal bases of Table 1 was effected by chromatography at pH 6·8. Two other uncharacterized bases were obtained; one from the roots (Table 1, base ii) had the same chromatographic characteristics as 3,6-ditigloyloxytropan-7-ol (systems 1 and 2), MW 337, and formed a picrate m.p. 178–180°, which was depressed on admixture with 3,6-ditigloyloxytropan-7-ol picrate; differences were apparent between the IR spectra of the unknown base and that of the authentic alkaloid; the NMR spectrum suggested a di-ester of teloidine. The other unknown base (Table 1, base iii) was eluted from the aerial parts with norhyoscyamine; it formed a picrate m.p. 224–226°, depressed with authentic noratropine picrate; MS suggested it to be a derivative of nortropine. TLC indicated the principal components of fraction C to be tropine and ψ-tropine which were isolated by chromatography at pH 6·8 as their tigloyl esters. (b) *A. viscosa* aerial parts: The bases of fractions A and B were resolved by column chromatography at pH 5·6 and 6·8 respectively. (c) *A. littorea* flowers: Total extract was chromatographed on kieselguhr (10 g) loaded with 0·25 M phosphate buffer solution (3·2 ml, pH 6·0) with light petrol., Et_2O and $CHCl_3$ as eluants. (d) *A. viscosa* roots: As above with kieselguhr (5 g), 0·5 M phosphate buffer solution (2·5 ml, pH 6·8). The extent to which it was possible to characterize the separated alkaloids is given in Table 1.

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