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ALKALOID CONSTITUENTS FROM *ERYTHRINA XBIDWILLII* FLOWERS

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Key Word Index—*Erythrina xbidwillii*; Leguminosae; flowers; alkaloids; erythristemine-*N*-oxide.

Abstract—The alkaloids present in the flowers of *Erythrina xbidwillii* have been screened by GC-MS. A novel alkaloid, erythristemine-*N*-oxide has been isolated and its structure established by spectroscopic methods.

INTRODUCTION

A series of studies on the alkaloid content of different parts of some 70 species of *Erythrina* have been undertaken in our laboratories and in that of Rinehart at Illinois [1]. These have been screened for alkaloids using GC/MS as the primary analytical tool to facilitate chemotaxonomic studies. Erythrinine [2] and erybidine [3] have been earlier isolated from the leaves of *E. xbidwillii*. We now report our studies on the flowers of *E. xbidwillii* which has led to the characterization of a new natural product, erythristemine-*N*-oxide (**1**), in addition to other known alkaloids.

RESULTS AND DISCUSSION

The GC and GC-MS examination of the petrol-soluble and methanol-soluble free alkaloid fractions of *E. xbidwillii* showed the presence of erysotrine (57 and 21%) and erythrartine (43 and 70%), respectively. The latter fraction also indicated the presence of erythristemine (9%). The liberated fraction afforded only erythrartine (16%).

Preparative scale isolation of the petrol-soluble alkaloid fraction by chromatography over alumina afforded two fractions identified as erysotrine and erythrartine. The structural assignment of erythrartine (**3**) was achieved by high field ^{1}H NMR spectroscopy (360 MHz); the chemical shifts of all resonances and coupling constants are given in Table 1. The ^{13}C NMR data is also consistent with the structure for erythrartine. Sarragiotto *et al.* [4] have assigned C-1 and C-2 resonances at δ125.3 ppm and 131.2, respectively. However, a two-dimensional ^{13}C-^{1}H NMR chemical shift correlation experiment revealed these resonances at δ131.4 and 125.5, respectively [5]. The EI mass spectrum of the base showed significant peaks at *m/z* 329 $[M]^+$ (69), 314 $[M-Me]^+$ (33), 311 $[M-H_2O]^+$ (20), 298 $[M-OMe]^+$ (100), 296 (30) and 280 (24).

A new natural product, erythristemine-*N*-oxide (**1**) (0.008%) as well as the known erysotrine-*N*-oxide (**2**) (0.01%) [4] were isolated in addition to erysotrine, erythrartine and erysotramidine from the methanol-soluble free alkaloid fraction. This is the first reported occurrence of **1** from a natural source although it is known as a synthetic compound [4]. A complete study of their spectral characteristics and comparison with their parent compounds is summarized in the Experimental and in Table 1.

The ^{1}H NMR spectrum of erythristemine-*N*-oxide yielded a H_e-4 resonance at a high field (δ2.02), whereas the H_a-4 was shifted downfield (δ3.23). The H-8 (δ5.10, 4.34) and H-10 (δ4.34, 3.84) resonances were 1 ppm downfield as compared to those of the parent compound. The H-11 proton also resonated downfield (0.5 ppm). The presence of a $[M-16]^+$ peak in the EI mass spectrum, characteristic of *N*-oxides [6] identified **1** as erythristemine *N*-oxide. Similar features have also been observed for erysotrine-*N*-oxide. The identity of both the N-oxide alkaloids was confirmed by treating the parent alkaloids with *m*-chloroperbenzoic acid. The resulting *N*-oxides were identical in all respects to the natural products. Earlier erysotrine-*N*-oxide and erythrartine-*N*-oxide have been isolated from *E. mulungu* flowers [4]; the investigators also emphasized that the *N*-oxides are in fact natural products and not artifacts.

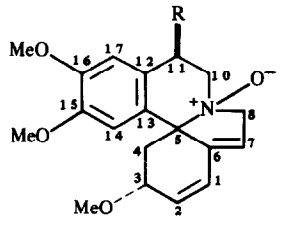
EXPERIMENTAL

Flowers of *E. xbidwillii* Lindley were collected from Chandigarh (India) and their authenticity was certified by Dr Rupert C. Barneby (Curator, New York Botanical Garden, U.S.A.). A voucher specimen is deposited in the herbarium, Department of Pharmaceutical Sciences, Panjab University, Chandigarh. The dried flowers were reduced to a moderately coarse powder before extraction.

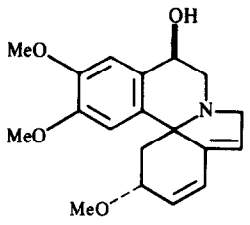
Analysis of alkaloids. Alkaloids were extracted from a small sample of flowers (10 g) by the same method as used previously [7] and MS were determined with a GC via a two-stage Watson Biemann separator. The ion source was maintained at 220°, and the accelerating and ionising voltages were set at 3 and 70 eV, respectively.

Isolation of alkaloids. Prep. scale isolation of the petrol-sol alkaloid fr. (1.4 g) obtained from flowers (800 g) [7] on

†Deceased.



R
1 OMe
2 H



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chromatography over neutral alumina yielded erysotrine (0.43 g) and another alkaloid fr., mp 159–160°, characterized as erythrartinc (3, 0.34 g). $\nu_{max}^{CHCl_3}$ cm^{-1}: 3220 (O–H), 1600 (C=C). ^1H NMR (360 MHz, $CDCl_3$): Table 1. ^{13}C NMR ($CDCl_3$): δ131.4 (*d*, C-1), 125.5 (*d*, C-2), 75.8 (*d*, C-3), 40.7 (*t*, C-4), 66.2 (*s*, C-5), 142.0 (*s*, C-6), 123.7 (*d*, C-7), 58.8 (*t*, C-8), 50.8 (*t*, C-10), 64.5 (*d*, C-11), 129.3 (*s*, C-12), 129.5 (*s*, C-13), 108.1 (*d*, C-14), 146.2 (*s*, C-15)[a], 145.4 (*s*, C-16)[a], 113.1 (*d*, C-17), 57.5, 55.8 (*q*, OMe). [a]Signals of C-15 and C-16 may be reversed. MS see text. Found: C, 69.32; H, 7.00; N, 4.61. $C_{19}H_{23}O_4N$ requires: C, 69.28; H, 7.04; N, 4.25.

The MeOH-sol. free alkaloid fr. (11.1 g) on repeated chromatography over neutral alumina afforded five alkaloids; three were identified as erysotrine (0.22 g), erythrartine (3.1 g) and erysotramidine (0.38 g) by comparison with authentic samples. The other two were characterized as erythristemine-*N*-oxide (**1**, 0.06 g), and erysotrine-*N*-oxide (**2**, 0.09 g).

Erythristemine-N-*oxide*. $[\alpha]_D^{25}$ −3.8° ($CHCl_3$; *c* 0.01). UV (MeOH) λ_{max} nm (log ε) 255 (3.52), IR ν_{max}^{film} cm^{-1}: 1610 (C=C). ^1H NMR: Table 1. MS *m/z* (rel. int.): 359 (3) $[M]^+$, 343 (17) $[M-16]^+$, 328 (9) $[M-31]^+$, 313 (14) $[M-46]^+$ and 312 (49) $[M-47]^+$.

Preparation of erythristemine N-*oxide*. NaH (20 mg) was added in small portions to a cold, stirred soln of **3** (50 mg) (5°) in THF (10 ml) followed by addition of MeI ($\simeq$0.05 ml) and the mixt. left at room temp. for 24 hr. MeOH was added to destroy excess NaH. The contents were then poured into ice-cold H_2O (50 ml), extracted with $CHCl_3$ (5 × 10 ml), washed, dried and solvent removed to leave an oily residue (30 mg). To the stirred soln (0°) of this residue in $CHCl_3$ (5 ml) was added *m*-chloroperbenzoic acid (40 mg). The reaction was carried out at room temp. for 4 hr. The mixt. was then poured into cold H_2O and processed as usual to give an oily residue. This was chromatographed over alumina (10 g). Elution with $CHCl_3$ gave the desired pure *N*-oxide (20 mg) which was found to be identical with the natural product **1**.

Erysotrine-N-*oxide*. IR ν_{max}^{film} cm^{-1}: 1605 (C=C). ^1H NMR: Table 1. MS *m/z* (rel. int.): 329 (3) $[M]^+$, 313 (48) $[M-16]^+$, 311 (55) $[M-18]^+$, 298 (52) $[M-31]^+$, 296 (52) $[M-33]^+$ and 282 (100) $[M-47]^+$.

Preparation of erysotrine-N-*oxide*. *m*-Chloroperbenzoic acid (70 mg) was added to a stirred mixt. (0–2°) of erysotrine (100 mg) in $CHCl_3$ (5 ml) and the mixt. left at room temp. for 4 hr. The $CHCl_3$ soln was evapd and the residue purified by prep. TLC in $CHCl_3$–MeOH (1:1), affording 48 mg of erysotrine-*N*-oxide (**2**) which was identical (IR, ^1H NMR) with the natural product **2**. The liberated alkaloid fr. (0.9 g) on chromatographic resolution over neutral alumina yielded erythrartine (70 mg) and an intractable mixt. (10 mg). The remaining aq layer afforded hypaphorine as the H_2O-sol base.

Table 1. ^1H NMR spectral data of *Erythrina* alkaloids (δ values: in $CDCl_3$)

	H-1	H-2	H-3	H_a-4	H_e-4	H-7	H-8	H_a-10	H_e-10	H-11	H-14	H-17	OMe
1	6.17 *d*	6.68 *dd*	4.34 *m*	3.23 *t*	2.02 *dd*	5.78 *br s*	5.10 *d*, 4.34 *m*	4.34 *m*	3.84 *dd*	4.48 *d*	6.70 *s*	6.80 *s*	3.92 (*s*, OMe-16), 3.77 (*s*, OMe-15), 3.62 (*s*, OMe-11), 3.36 (*s*, OMe-3)
2	6.18 *d*	6.78 *dd*	4.24 *m*	3.24 *t*	2.14 *dd*	5.80 *br s*	4.43 *br s*	4.07 *m*	3.92 *m*	3.66 *m*	6.62 *s*	6.68 *s*	3.88 (*s*, OMe-16), 3.76 (*s*, OMe-15), 3.36 (*s*, OMe-3)
3	6.02 *d*	6.61 *dd*	4.06 *m*	1.81 *t*	2.42 *dd*	5.75 *br s*	3.97 *d*, 3.87 *dd*	3.59 *dd*	3.10 *dd*	4.70 *t*	6.85 *s*	6.99 *s*	3.90 (*s*, OMe-16), 3.78 (*s*, OMe-15) 3.32 (*s*, OMe-3)
	Coupling constants (Hz)												
	1, 2	2, 3		3a, 4a	3a, 4e	4a, 4e	7, 8α, 8β		8α, 8β	10a, 10e	10a, 11e	10e, 11e	
1	10.0	2.5		11.0	6.0	11.0	2.0		15.0	15.0	—	2.5	
2	10.0	2.5		11.0	5.5	11.0	—		—	—	—	—	
3	10.0	2.5		11.0	5.5	11.0	3.5		14.5	14.5	4.0	2.5	

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