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8-OXOERYTHRININE: AN ALKALOID FROM *ERYTHRINA BRUCEI*

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Key Word Index—*Erythrina brucei*; Leguminosae; flowers; alkaloids; 8-oxoerythrinine; erythrinine; erythraline; erysodine; 8-oxoerythraline; crystamidine.

Abstract—The flowers of *Erythrina brucei* afforded, in addition to known compounds, a new erythrina alkaloid, 8-oxoerythrinine. Its structure was elucidated by spectroscopic investigations as well as by chemical transformations.

INTRODUCTION

Erythrina brucei is a tree growing to 15–20 m with colourful flowers which is widely distributed only on the highlands of Ethiopia [1]. The plant has been used in Ethiopian folk medicine among other things for the treatment of ear infection. Games *et al.* [2] investigated the seeds by GC/MS and found the two very common erythrina alkaloids, erysodine and erysovine, present in almost all *Erythrina* species, along with small amounts of erysopine.

We now wish to report the isolation and characterization of a new alkaloid, 8-oxoerythrinine (**1**), and the known alkaloid, erythrinine (**2**), from the flowers of *E. brucei*, a part of the plant not studied before. Furthermore, from the seeds of this plant we were able to isolate the known alkaloids erythraline (**3**), erysodine (**4**), 8-oxoerythraline (**5**) and crystamidine (**6**). From the bark of *E. brucei* we were able to identify erythraline, erysodine and erythrinine, and to isolate an as yet uncharacterized fourth alkaloid, $C_{18}H_{21}NO_5$.

RESULTS AND DISCUSSION

The powdered, air-dried flowers of *E. brucei* were first extracted with hexane and then with methanol, and the alkaloids subsequently isolated by treating the crude extracts with 1% hydrochloric acid, followed by basification and extraction with chloroform. The alkaloidal fraction obtained from the methanol extract was fractionated by column chromatography on Sephadex LH 20 to yield a crystalline substance, $C_{18}H_{19}NO_4$, mp 200–201°. The mass spectral fragmentation pattern $[M-15-18-31]^+$ was suggestive of the presence of a hydroxyl group in addition to the typical dienoid erythrina skeleton. Based on this and in particular on the ^{1}H NMR spectrum, the compound was identified as erythrinine (**2**), a compound first isolated and characterized by Ito *et al.* [3,4] from *E. indica* and subsequently identified in other *Erythrina* species [5].

Very recently, Chawla *et al.* [6] and earlier Sarragiotto *et al.* [7] published the ^{13}C NMR spectral data of a number of erythrina alkaloids but not that of erythrinine. Table 1 shows the ^{13}C NMR data of erythrinine.

The mother liquor after isolation of erythrinine was further purified by preparative TLC using MeOH–$CHCl_3$ (1.5:8.5) and yielded a pale yellow oily compound, **1**, $C_{18}H_{17}NO_5$, with a mass spectral fragmentation pattern $[M-15-18-31-32-33]^+$ characteristic of a 1,6-dienoid erythrina alkaloid [8].

The 400 MHz ^{1}H NMR spectrum of **1** in $CDCl_3$ indicated the presence of a methoxyl group at δ 3.36, a methylenedioxy group appearing as an AB system at δ 5.92 and 5.96, two aromatic protons at δ 6.83 and 7.02, three vinylic protons at δ 6.03, 6.34 and 6.85 and six other aliphatic protons. H-7 was a singlet appearing at *ca* 0.3 ppm downfield relative to the chemical shift of H-7 in erythrina alkaloids not possessing an oxo group at C-8. This further indicated the presence of a carbonyl group at the adjacent C-8. The ^{13}C NMR spectrum was also in good agreement with the proposed structure **1** (Table 1).

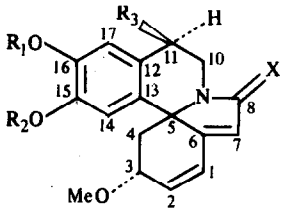
Final structural proof was obtained by the transformation of erythrinine (**2**) into **1**. For this purpose, **2** was converted into its acetate **7**, which on oxidation with CrO_3–pyridine yielded the lactam **8**. Alkaline hydrolysis of **8** afforded a compound identical in all respects (mass spectrum, NMR, IR, R_f) with **1**. Because the configuration of the 11-hydroxy group in **2** has been recently defined by El-Olemy *et al.* [5] as β, **1** must therefore have the same stereochemistry.

The alkaloidal fractions of the hexane and methanol extracts of the seeds of *E. brucei* also contained several

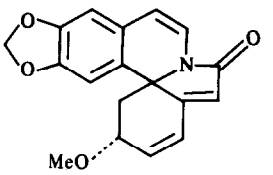
Table 1. ^{13}C NMR spectral data of compounds **1** and **2** measured at 100 and 22.6 MHz, respectively

Carbon	1	2	Carbon	1	2
1	124.3	124.6 (*d*)	11	66.8	62.9 (*d*)
2	136.8	131.2 (*d*)	12	128.8	130.7 (*s*)
3	74.6	75.5 (*d*)	13	130.3	132.3 (*s*)
4	41.5	41.5 (*t*)	14	104.5	104.5 (*d*)
5	66.0	66.8 (*s*)	15	147.6	145.8 (*s*)
6	157.1	141.5 (*s*)	16	147.4	145.7 (*s*)
7	120.1	123.3 (*d*)	17	109.1	106.7 (*d*)
8	171.1	55.4 (*t*)	OCH_2O	101.4	100.5 (*t*)
10	44.0	53.0 (*t*)	OMe	56.5	55.4 (*q*)

Solvents: **1**, $CDCl_3$; **2**, DMSO-d_6.



	R_1	R_2	R_3	X
1	—CH_2—		OH	O
2	—CH_2—		OH	H_2
3	—CH_2—		H	H_2
4	H	Me	H	H_2
5	—CH_2—		H	O
7	—CH_2—		OAc	H_2
8	—CH_2—		OAc	O



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alkaloids, among which erythraline (**3**), erysodine (**4**), 8-oxoerythraline (**5**) and crystamidine (**6**) were identified; their respective mass spectra and NMR spectra were in good agreement with those in the literature [3]. An additional alkaloid with molecular formula $C_{18}H_{19}NO_4$ was detected but its structure has not yet been elucidated.

The bark of this plant was also studied in a similar way and was found to contain erythraline, erysodine, erythrinine and an unknown alkaloid, $C_{18}H_{19}NO_5$, with principal mass spectral fragments at $[M-17]^+$ (18%) and $[M-31]^+$ (100%). Work on these unknown compounds is in progress.

EXPERIMENTAL

General. Mps are uncorr. ^{1}H NMR spectra were measured at 90 or 400 MHz and chemical shifts are given in δ values with TMS as int. standard. MS were determined at 70 eV. TLC was performed on silica gel using $CHCl_3$–MeOH (8.5:1.5) and spots were visualized by their fluorescence at 254 nm or by spraying with Dragendorff's reagent.

Plant material. Flowers, seeds and bark were collected from *E. brucei* Schweinf. trees in the Science Faculty Campus of the Addis Ababa University, Ethiopia in Jan.–March 1982 and during the same period in 1983. The plant was identified by Ato Zerihun Woldu of the same university and a voucher sample has been deposited at the National Herbarium, Addis Ababa, under the cipher Zerihun-400.

Extraction and isolation of alkaloids. Powdered plant material (800 g in each case) was subjected to continuous Soxhlet extraction using hexane; the extractives were 10.0, 1.3 and 2.6% for the seeds, bark and flowers, respectively. The marc was further exhaustively extracted with MeOH to yield 14.0, 8.7 and 17.6% crude extracts from the seeds, bark and flowers, respectively. The hexane and MeOH extracts were separately treated with 1% HCl followed by basification with conc. NH_3 or K_2CO_3 and extraction with $CHCl_3$. The hexane extractives gave a total alkaloid content of 0.02% (seeds), 0.001% (bark) and 0.015% (flowers). TLC analysis of all the extracts showed several alkaloids and the maximum number was shown by the MeOH flower extract, which had at least 12 alkaloids.

The crude alkaloidal fraction obtained from the flowers (MeOH extract, 300 mg) was applied to a column packed with Sephadex LH 20 (100 g), eluted with MeOH–$CHCl_3$ (1:9) and 100 fractions (each *ca* 5 ml) were collected in a 24 hr period. TLC analysis showed fractions 10–50 to contain a number of alkaloids, and combination of fractions 30–38 followed by solvent removal yielded a fluffy solid (180 mg) which showed two major spots on TLC with R_f 0.53 and 0.65. The crude solid was taken up in EtOH and on long standing deposited crystals (62 mg), mp 201–202°, identified as erythrinine (**2**), lit. [4], mp 202–204°, which had NMR and MS spectra identical to that reported for **2** [3, 4]. The mother liquor was further purified by prep. TLC to yield the new alkaloid compound **1** (20 mg) with R_f 0.65.

8-Oxoerythrinine (**1**). Pale yellow oil, $[\alpha]_D$ +100° ($CHCl_3$; *c* 0.35). IR $\nu_{max}^{CHCl_3}$ cm^{-1}: 3460 (OH), 3040, 2960, 1680 (C=O), 1505, 1485, 1250, 1100, 1040, 930, 870. UV λ_{max}^{EtOH} nm (ε): 357 (1022), 272 (6740), 238 (12 600). MS *m/z* (rel. int.): 327 $[M]^+$ (93), 312 (72), 296 (85), 295 (68), 294 (100), 282 (49), 238 (64). ^{1}H NMR (400 MHz, $CDCl_3$): δ 1.67 (*dd*, J = 10, 12 Hz, H-4_{ax}), 2.67 (*br dd*, J = 5, 11 Hz, H-4_{eq}), 3.36 (*s*, OMe), 3.66 (*dd*, J = 4.5, 14 Hz, H-10_{eq}), 3.96 (*m*, H-3), 4.22 (*dd*, J = 4.0, 14 Hz, H-10_{ax}), 4.84 (*br t*, J = 5 Hz, H-11), 5.92, 5.96 (AB system, J = 2 Hz, OCH_2O), 6.03 (*s*, H-7), 6.34 (*br d*, J = 11.4 Hz, H-1), 6.83 (*s*, H-14), 6.85 (*br dd*, J = 2, 11.4 Hz, H-2), 7.02 (*s*, H-17). ^{13}C NMR, see Table 1. $C_{18}H_{17}NO_5$ calc.: 327.1107; found 327.1111 (MS).

Isolation of known alkaloids. Other known alkaloids were isolated, following established procedures [2–4], from the flowers, bark and seeds of *E. brucei* and were identified by comparison of their NMR and MS spectra with lit. data.

Erythrinine acetate (**7**). **2** (46 mg) was acetylated with Ac_2O (1 ml) and pyridine (3 drops) in the usual manner to afford the acetate **7** (56 mg), which had the same spectroscopic properties as described in ref. [4].

8-Oxoerythrinine acetate (**8**). A soln of **7** (39 mg) in pyridine (1 ml) was treated with CrO_3 (60 mg) and stirred overnight at room temp. The reaction mixture was neutralized with saturated K_2CO_3 and extracted with $CHCl_3$. The $CHCl_3$ extract was dried (Na_2SO_4) and evapd to yield **8** (20 mg), mp 215–217° (dec.). IR ν_{max}^{KBr} cm^{-1}: 2950, 1730, 1695, 1500, 1480, 1390, 1230, 1100, 1030, 970. MS *m/z* (rel. int.): 369 $[M]^+$ (32), 354 (10), 338 (20), 326 (17), 276 (100). ^{1}H NMR (90 MHz, $CDCl_3$): δ 1.69 (*dd*, J = 10,

12 Hz, H-4_{ax}), 2.08 (*s*, OAc), 2.72 (*dd*, J = 5, 12 Hz, H-4_{eq}), 3.40 (*dd*, J = 5, 14 Hz, H-10_{eq}), 4.00 (*m*, H-3), 4.44 (*dd*, J = 3, 15 Hz, H-10_{ax}), 5.86 (*t*, J = 3 Hz, H-11), 6.00 (*m*, OCH_2O), 6.06 (*s*, H-7), 6.38 (*d*, J = 10 Hz, H-1), 6.82 (*s*, H-14), 6.88 (*dd*, J = 2, 6 Hz, H-2), 6.97 (*s*, H-17).

Alkaline hydrolysis of **8**. Overnight treatment of **8** (12 mg) at room temp. with 1% KOH in MeOH (1 ml) yielded quantitatively a compound identical in all respects (IR, MS, NMR, R_f) with 8-oxoerythrinine (**1**).

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