data, partial hydrolysis products and its high mobility in aqueous solvents and on electrophoresis compared with other quercetin sulphates (Table 1), suggesting that it is quercetin 3,7,4,'-trisulphate.

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A NEW BENZOPHENANTHRIDINIC BASE FROM *FAGARA MAYU*

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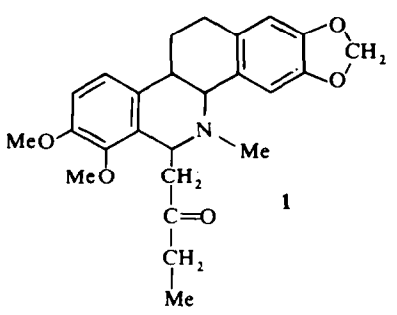
Key Word Index—*Fagara mayu*; Rutaceae; alkaloid; 11-(2'-ketobutane)-dihydrochelerythrine; synthesis.

During an investigation of the chemical constituents of South American *Fagara* species [1], several bases were isolated from an extract of the bark of *F. mayu* (Bert. ex Hook. et Arn.) Engler [2]. From this extract a new base was isolated in low yield (0.001%).

The UV spectrum suggested that it belonged to the 1,2,8,9-tetrasubstituted benzophenanthridinic group [3]. The MS fragmentation was characteristic of 11-substituted benzophenanthridines with a parent peak [4] at *m/e* 348 (100%) (M^+-71). The PMR spectrum confirmed the presence of an 11-substituted dihydrochelerythrine and also established the nature of the substituent. The signal of the proton on C-11 is a quartet centred at δ 5.05 with $J_{AX} = 5$ Hz and $J_{BX} = 10$ Hz, showing that the substituent is a $-CH_2-$ [4], whose signals were overlapped with those corresponding to another $-CH_2-$ at δ 1.9–2.59. Furthermore, a C—Me signal at δ 0.99, together with the IR spectrum (ν_{max} 1700 cm^{-1}) suggested a 2-ketobutane as the substituent on C-11.

The proposed structure **1** was confirmed by comparison with a synthetic sample prepared by reaction between chelerythrine and 2-butanone in an alkaline medium.



1

A closely related base, 11-acetonyldihydrochelerythrine has been isolated from *Toddalia aculeata* [5] and *Zanthoxylum tsihanimposa* [4], a plant belonging to a genera connected with *Fagara* [6]. The possibility that 11-substituted dihydrochelerythrines are an isolation artifact was discussed by Manske *et al.* [7] and by Poisson *et al.* [4]. However, no 2-butanone was used during the isolation procedure in the present work.

EXPERIMENTAL

The sources of the plant material were as previously indicated [2].

Isolation of 11-(2'-*ketobutane*)-*dihydrochelerythrine* **1**. The alkaloid mixture contained in a MeOH extract of the bark was partially resolved by extraction from an aq. soln with $CHCl_3$ at different pHs. The fraction extracted at pH 10 (0.8 g) was transferred to Si gel (40 g). Elution of the column with $CHCl_3$–EtOAc (1:1) afforded 25 mg of **1** from EtOAc, mp 206–208.5°. (Found: C, 71.4; H, 6.15; N, 3.5. $C_{25}H_{25}NO_5$ requires: C, 71.6; H, 6.01; N, 3.37%). MS *m/e*: 419 (12), 349 (22), 348 (100), 333, 332 (17), 318 (12), 304, 290 (15), 276, 261, 247, 233, 218. PMR 60 MHz ($CDCl_3$, TMS int. stand.): δ 0.99 (3H, *t*, *J* = 8 Hz, C-Me), 1.90–2.59 (4H, *m*, $-CH_2-$), 2.63 (3H, *s*, N—Me), 3.9 (3H, *s*, O—Me), 3.93 (3H, *s*, O—Me), 5.05 (1H, *q*, $J_{AX} = 5$ Hz, $J_{BX} = 10$ Hz, C-11), 6 (2H, *s*, $-O-CH_2-O$), 6.92 (1H, *d*, *J* = 8.5 Hz, C-3) 7.09 (1H, *s*, C-7), 7.40 (1H, *d*, *J* = 9.8 Hz, C-6), 7.5 (1H, *s*, C-10), 7.58 (1H, *d*, *J* = 8.5 Hz, C-4), 7.75 (1H, *d*, *J* = 9.8 Hz, C-5). Insufficient material precluded optical rotation measurements.

Synthesis of **1**. Chelerythrine chloride (5 mg) in 2-butanone (1 ml) containing 1.4 M Na_2CO_3 (0.2 ml) was heated for 6 hr at 80°. After usual work-up, the product was crystallized from EtOAc, giving 3 mg of **1**, mp 206–208°, identical with the alkaloid isolated from *F. mayu*.

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PROTOSTRYCHNINE, A NEW ALKALOID FROM *STRYCHNOS NUX-VOMICA*

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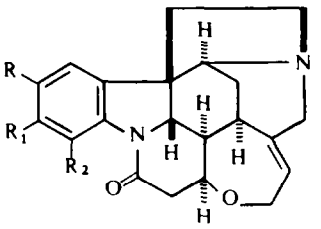
Key Word Index—*Strychnos nux-vomica*; Loganiaceae; indole alkaloids; protostrychnine; prestrychnine; biosynthesis.

Abstract—The tertiary bases from a sample of *Strychnos nux-vomica* contain, as well as the expected strychnine and brucine, an unusually high proportion of 4-hydroxy and 4-hydroxy-3-methoxy compounds. The biosynthetic implications of the isolation of a new alkaloid, 12β,13α-dihydro-12α-hydroxyisostrychnine, named protostrychnine, are discussed.

INTRODUCTION

The major tertiary alkaloids of *Strychnos nux-vomica* L. have usually been found to be strychnine (**1a**) and its 2,3-dimethoxy analogue brucine (**1c**) [1]. The biosynthesis of these two bases has been investigated most recently by Heimberger and Scott [2] who have demonstrated the existence of an aldol-acid (**2a**) as a precursor of strychnine.

Studies in our laboratories on material of Sri Lankan origin allowed isolation from the minor bases of a compound the structure of which represents one stage further in the biosynthesis of strychnine. This substance may thus be considered as the immediate precursor of strychnine and its isolation strongly supports the late stages of the biosynthetic pathway proposed by Heimberger and Scott [2].



1a R = R_1 = R_2 = H
1b R = R_1 = H; R_2 = OH
1c R = R_1 = OMe; R_2 = H
1d R = H, R_1 = OMe; R_2 = OH

DISCUSSION

In the present work, the major tertiary alkaloids present in a root-bark extract of *S. nux-vomica* from Sri Lanka have been isolated and identified, in decreasing order of concentration, as: strychnine (**1a**), 4-hydroxy-3-methoxystrychnine (**1d**), 4-hydroxystrychnine (**1b**)*, brucine (**1c**), isostrychnine I (**3**) and normacusine B (**4**).

Among the minor bases is one, isolated in 0.1% yield, the MS of which has a M^+ corresponding with $C_{21}H_{24}N_2O_3$. The UV spectrum is almost superimposable on that of strychnine, while in the IR spectrum there are bands at 1660 and 1645 cm^{-1} due to a lactam carbonyl group and a broad band at 3350 cm^{-1} due to OH. The PMR spectrum is similar to that of isostrychnine I (**3**) but lacks the signal for the vinyl hydrogen on C-12. It shows, however, the presence of two OH groups by the occurrence of two 1H singlets at δ 2.05 and 1.98, both of which disappear on deuteration. In support of this, a diacetate is formed on acetylation. A doublet of doublets (J = 7 and 2 Hz) at δ 4.13 may be compared with a similar signal at δ 4.25 in the spectrum of isostrychine I and belongs to the methylene hydrogens of

* As much as one-third of the alkaloid mixture consisted of **1d**, not previously known as occurring in *S. nux-vomica*, and **1b**. This suggests that the plant from which the root-bark came, although morphologically indistinguishable from *S. nux-vomica*, could perhaps have been a hybrid between it and *S. wallichiana* Steud. ex DC. [3].