The Synthesis of a Proerythrinadienone System by Phenol Oxidation

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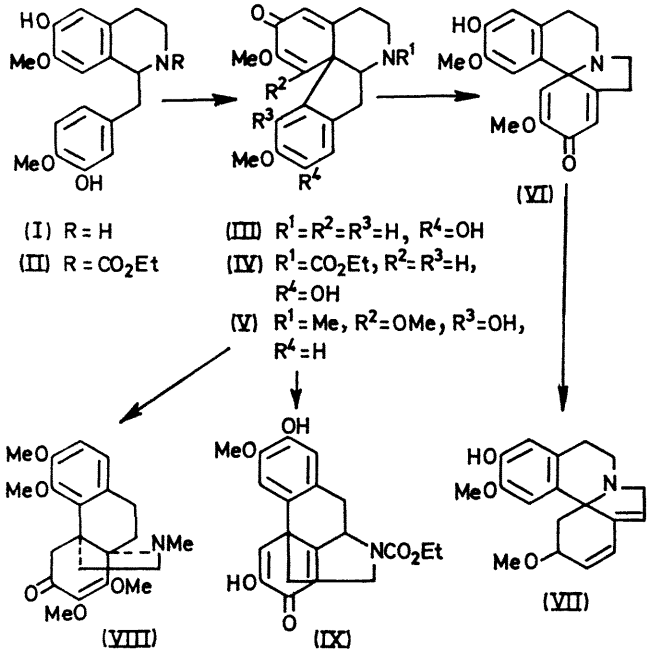
Summary Phenol oxidation of 2-ethoxycarbonylnorprotosinomenine (II) afforded the proerythrinadienone (IV), which had a basic skeleton of the key intermediate in the biogenesis of *Erythrina* alkaloids.

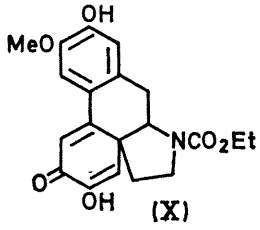
BARTON has suggested a new biogenetic theory of the *Erythrina* alkaloids, in which the dienone (III), derived from norprotosinomenine (I) by phenol oxidation, would be converted into erythraline (VII) through the erythrinadienone (erysodienone) (VI).[1] The dienone (V) was also suggested as a precursor to hasubanonine (VIII) by



SCHEME

Battersby.[2] We have investigated the biogenetic synthesis of these alkaloids,[3] and now report the results of *in vitro* experiments which are analogous to the biogenetic route to (IV) which is named tentatively as proerythrinadienone.

2-Ethoxycarbonylnorprotosinomenine (II) was oxidised with potassium ferricyanide in the presence of ammonium acetate and ammonia (pH 9·2) at room temperature for 1 h in a current of nitrogen. The product (*ca.* 2% yield) can be assigned the proerythrinadienone structure (IV) ($C_{21}H_{23}NO_6$ by mass spectrometry) on the basis of the following evidence. The i.r. [ν_{max} ($CHCl_3$) 1660, 1639, and 1615 cm^{-1} in addition to *N*-ethoxycarbonyl band at 1675 cm^{-1}], u.v. [λ_{max} (MeOH) 287 and 240 nm (log ϵ 3·88 and 4·23)], and mass (*m/e* 370, 357, and 324) spectra were in accordance with a cross-conjugated α-methoxycyclohexadienone. The n.m.r. spectrum (τ in $CDCl_3$) revealed two aromatic and two olefinic protons at 3·18, 3·69, 3·76, and 4·29 as singlets in addition to the two *O*-methyl (6·21 and 6·39) and ethyl groups (8·76 and 5·87), unambiguously confirming the structure (IV). Moreover, rearrangement of (IV) with conc. H_2SO_4 at room temperature for 1 h in a current of nitrogen gave the morphinandienone (IX),† which showed a hydroxy band at 3410, an ethoxycarbonyl band at 1683, and an enone band at 1635 and 1620sh cm^{-1} in the i.r. spectrum,[4] in good yield. Two aromatic and two olefinic protons were observed at 3·00, 3·25, 3·37, and 3·71 as singlets, an aromatic methoxy-group at 6·05 and the ethyl group at 8·68 and 5·78 in the n.m.r. spectrum. Moreover, the mass spectrum showed a molecular ion at *m/e* 371 and the ions 342 ($M^+ - H - CO$) and 314 ($M^+ - H - CO - CO$) supported the presence of a morphinandienone system.



Thus, we have accomplished in the laboratory one part of the proof of Barton's theory on the biogenesis by *Erythrina* alkaloids.

We thank Professor B. R. Pai, Presidency College, Madras, India, for help.

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† *Added in proof:* The spectroscopic data described here support the dienone system (X). *Cf.* A. R. Battersby, A. K. Bhatnagar, P. Hackett, C. W. Thornber, and J. Staunton, *Chem. Comm.*, 1968, 1214.

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[2] A. R. Battersby, 'Oxidative Coupling of Phenols', eds. W. I. Taylor and A. R. Battersby, Marcel Dekker, Inc., New York, 1967, p. 117.
[3] T. Kametani, K. Fukumoto, M. Kawazu, and M. Fujihara, *J. Chem. Soc.* (*C*), 1970, 92.
[4] D. E. Rearick and M. Gates, *Tetrahedron Letters*, 1970, 507.