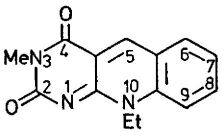
Dehydrogenation of Alcohols by Pyrimido[4,5-*b*]quinoline-2(3*H*),4(10*H*)-dione (5-Deazaflavin)

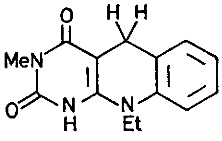
By Fumio Yoneda* and Yoshiharu Sakuma
(*Faculty of Pharmaceutical Sciences, Kumamoto University, Oe-honmachi, Kumamoto* 862, *Japan*)
and Peter Hemmerich
(*Fachbereich Biologie, Universität Konstnaz,* D-775 *Konstanz, West Germany*)

Summary Pyrimido[4,5-*b*]quinoline-2(3*H*),4(10*H*)-dione (5-deazaflavin) oxidizes alcohols under alkaline conditions in the dark to yield the corresponding carbonyl compounds, while it is itself hydrogenated to 1,5-dihydro-5-deazaflavin.

Pyrimido[4,5-*b*]quinoline-2(3*H*),4(10*H*)-dione (5-deazaflavin) where N-5 of the flavin is replaced by CH, can be considered structurally as a model not only of flavin nucleotide[1] but also of nicotinamide nucleotide protected by annelation. Hückel M.O. calculations indicate that the 5-position of the 5-deazaflavin ring system is very π-electron deficient (net charge $+0{\cdot}204$) in the same way as the 4-position of nicotinamide nucleotide (net charge $+0{\cdot}210$). Therefore it would be expected that the 5-deazaflavin might abstract hydrogen equivalents from hydrogen donors under certain conditions. This paper describes oxidation of alcohols by 5-deazaflavin under alkaline conditions.



(I)



(II)

10-Ethyl-3-methyl-5-deazaflavin (I)[2] (0·002 mol) and potassium hydroxide (0·009 mol) were added to a mixture of benzyl alcohol (3 ml), dimethylformamide (DMF) (3 ml), and water (2 ml), and the mixture was heated at 90 °C for 2 h in the dark. The reaction mixture was diluted with water and neutralized with hydrochloric acid. The crystals which separated were filtered off, washed with water, and recrystallized from acetic acid to give 10-ethyl-3-methyl-1,5-dihydroflavin (II),† m.p. 285 °C, in 99% yield. The filtrate

---

† Satisfactory analytical and spectral data were obtained for (II).

TABLE. Dehydrogenation of alcohols by (I) under alkaline conditions.

Alcohol	Catalyst	Reaction conditions		Products/%		
		Temp/°C	Time/min			(II)
EtOH	EtONa	R.T.	60	[c]		88
EtOH	KOH	80	60	[c]		83
EtOH	KOH (H_2O)[a]	80	20	[c]		95
$PhCH_2OH$	KOH	90	20	PhCH=O[d]	70	87
$PhCH_2OH$	KOH (H_2O + DMF)[b]	90	120	PhCH=O[d]	82	99
Ph_2CHOH	KOH	90	60	Ph_2C=O[e]	81	88
Cyclohexanol	KOH	90	60	Cyclohexanone[f]	70	82

[a] In the presence of water. [b] In the presence of water and DMF. [c] Acetaldehyde was polymerized. [d] Isolated as benzaldehyde 4-phenylsemicarbazone, m.p. 181° C. [e] Isolated as benzophenone oxime, m.p. 140 °C. [f] Isolated as cyclohexanone 4-phenylsemicarbazone, m.p. 193 °C.

was extracted with ether and the ether extracts were treated with 4-phenylsemicarbazide to precipitate benzaldehyde 4-phenylsemicarbazone, m.p. 181 °C, in 82% yield.

Other alcohols were similarly oxidized by (I) to give the corresponding carbonyl compounds (see Table). In the case of ethanol, acetaldehyde was not isolated because of its polymerization under alkaline conditions; however, (II) was obtained in high yield.

It is noteworthy that 5-deazaflavin oxidizes benzyl alcohol to benzaldehyde even in the absence of alkali under more drastic conditions (*ca.* 200 °C); the reaction is, however, slow in this case.

F. Y. thanks the Ministry of Education of Japan for financial support.

(*Received, 8th August* 1977; *Com.* 832.)

[1] D. E. Edmondson, B. Barman, and G. Tollin, *Biochemistry*, 1972, **11**, 1133; M. Brüstlein and T. C. Bruice, *J. Amer. Chem. Soc.* 1972, **94**, 6548; S. Shinkai and T. C. Bruice, *ibid.*, 1973, **95**, 7526; M. S. Jorns and L. B. Hersh, *ibid.*, 1974, **96**, 4012.

[2] F. Yoneda, Y. Sakuma, S. Mizumoto, and R. Ito, *J.C.S. Perkin I*, 1976, 1805.