OXIDATION OF 3-METHOXYCARBONYLMETHYLENE-2-OXO-1,2,3,4-TETRAHYDRO-QUINOXALINE WITH m-CHLOROPERBENZOIC ACID

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Abstract — The reaction of 3-methoxycarbonylmethylene-2-oxo-1,2,3,4-tetrahydroquinoxaline (Ia) with m-chloroperbenzoic acid gave 3-(1-hydroxy-1-methoxycarbonyl)methylene-2-oxo-1,2,3,4-tetrahydroquinoxaline and 2,3-dioxo-1,2,3,4-tetrahydroquinoxaline. The equilibrium between the tetrahydro form (Ia type) and the dihydro form (Ib type) was exhibited, together with the ^{1}H-NMR data.

In a previous paper,[1] we reported that the reaction of 3-methoxycarbonylmethylene-2-oxo-1,2,3,4-tetrahydroquinoxaline (Ia) with H_2O_2 in AcOH gave 2,3-dioxo-1,2,-3,4-tetrahydroquinoxaline (II), neither epoxide (III) from Ia nor N-oxide (IV) from (Ib),[2] as shown in Scheme 1. However, m-chloroperbenzoic acid (MCPBA) was expected to convert I to III or IV, and hence the reaction of Ia with MCPBA was undertaken.

Refluxing of Ia with MCPBA in $CHCl_3$ precipitated colorless crystals, whose structure was clarified to be II.[1] From the mother liquor, yellow needles (Va) were obtained, whose structure was assigned as 3-(1-hydroxy-1-methoxycarbonyl)methylene-2-oxo-1,2,3,4-tetrahydroquinoxaline on the basis of the analytical and spectral data. Treatment of Va with 10% NaOH afforded 3-hydroxymethylene-2-oxo-1,2,3,4-tetrahydroquinoxaline (VIa). Its structure was supported by the analytical and spectral data. These results were exhibited in Scheme 2-A, and the mechanism for the formation of Va was shown in Scheme 2-B. The route (i) mechanism is most plausible, but the route (ii) via N-oxide and then O-migration to (VII) may also be taken into consideration.[3]

Although ^{1}H-NMR spectral data of Ia in DMSO-d_6 showed the presence of the tauto-

mer Ib,[2] the tautomers (Vb and VIb) (Scheme 3) were not involved in the NMR spectra of Va and VIa in DMSO-$\underline{d}_6$. However, the NMR spectral data of Va and VIa in trifluoroacetic acid (TFA) supported the presence of their tautomers Vb and VIb.[2] On addition of D_2O to these solutions, the NH and OH protons disappeared, while the methine protons were observed as well as the aromatic and methyl protons. Interestingly, however, the NMR spectra of Ia and VIa in TFA-$\underline{d}_1$ lacked the methine protons, while the NMR spectrum of Va in TFA-$\underline{d}_1$ showed the methine proton. From these data, the mechanism of the isomerization and D-H exchange were summarized in Scheme 3. The NMR data are exhibited in Table I, and the possibility of the tautomers (Vd and VId) were excluded.

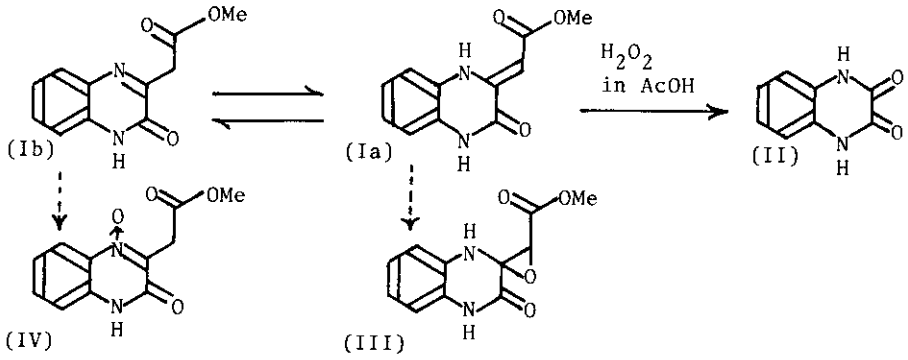
EXPERIMENTAL

All melting points are uncorrected. IR spectra were recorded on a JASCO IRA-1 spectrophotometer as KBr discs. ^{1}H-NMR spectra were obtained on a EM-390 spectrometer at 90 MHz using TMS as an internal standard. Mass spectra (MS) were determined with a JMS-D100 spectrometer (JEOL).

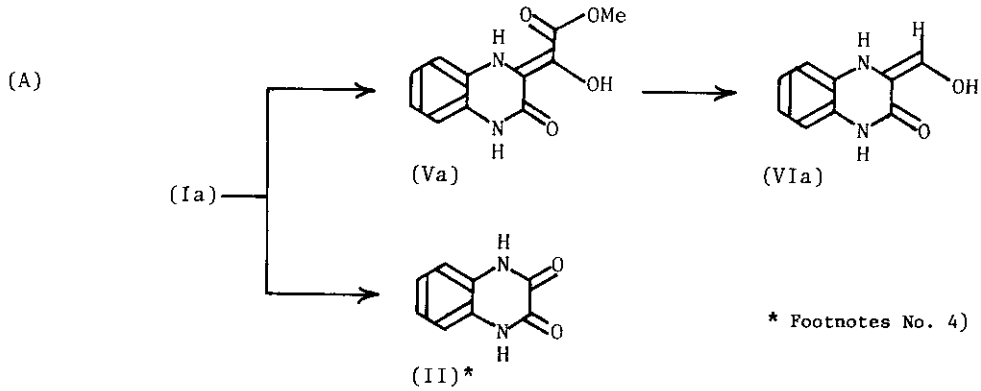
Reaction of Compound Ia with MCPBA —— To a suspension of Ia (5 g, 23.0 mmol) in $CHCl_3$ (200 ml) was added MCPBA (4.6 g, 1 eq. for Ia). The solution was refluxed on a boiling water bath for 3 hr. Colorless crystals (II) precipitated during the reaction, which were collected by suction filtration (0.33 g, 9.0%).

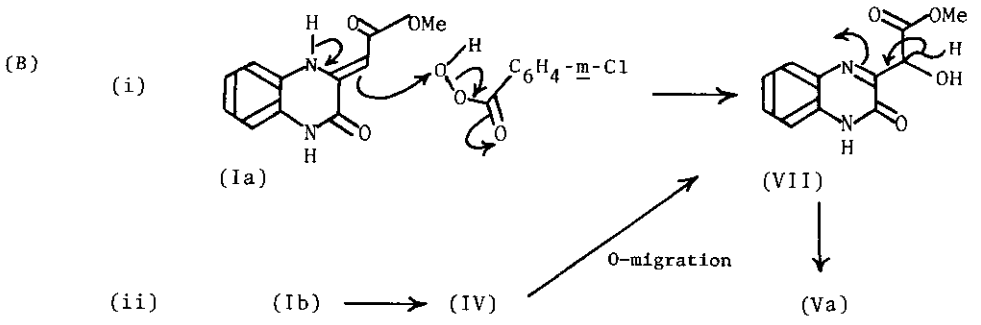
Evaporation of the above filtrate gave a yellow mixture, which was treated with a small amount of EtOH with heating to exclude m-chlorobenzoic acid and residual MCPBA. Insoluble compound (Va) was collected by suction filtration. Recrystallization from EtOH-$CHCl_3$ afforded yellow needles (2.14 g, 40%), mp 216-217°C. IR ν_{max} cm^{-1}: 1650 (C=O). MS m/e: 234 (M^+). Anal. Calcd for $C_{11}H_{10}N_2O_4$: C, 56.41; H, 4.30; N, 11.96. Found: C, 56.31; H, 4.21; N, 11.87.

Compound (VIa) —— To a solution of Va (300 mg) in EtOH (10 ml) was added 10% NaOH (10 ml), and the solution was refluxed on a boiling water bath for 30 min. The solution was neutralized with 10% HCl, and the reaction product was extracted with $CHCl_3$. After the solution was dried over Na_2SO_4, the solvent was evaporated *in vacuo* to dryness to give colorless crystals (VIa). Recrystallization from EtOH brought about colorless powder (150 mg, 70.4%), mp 225-226°C. IR ν_{max} cm^{-1}: 1670 (C=O). MS m/e: 176 (M^+). Anal. Calcd for $C_9H_8N_2O_2$: C, 61.36; H, 4.58; N, 15.90. Found: C,

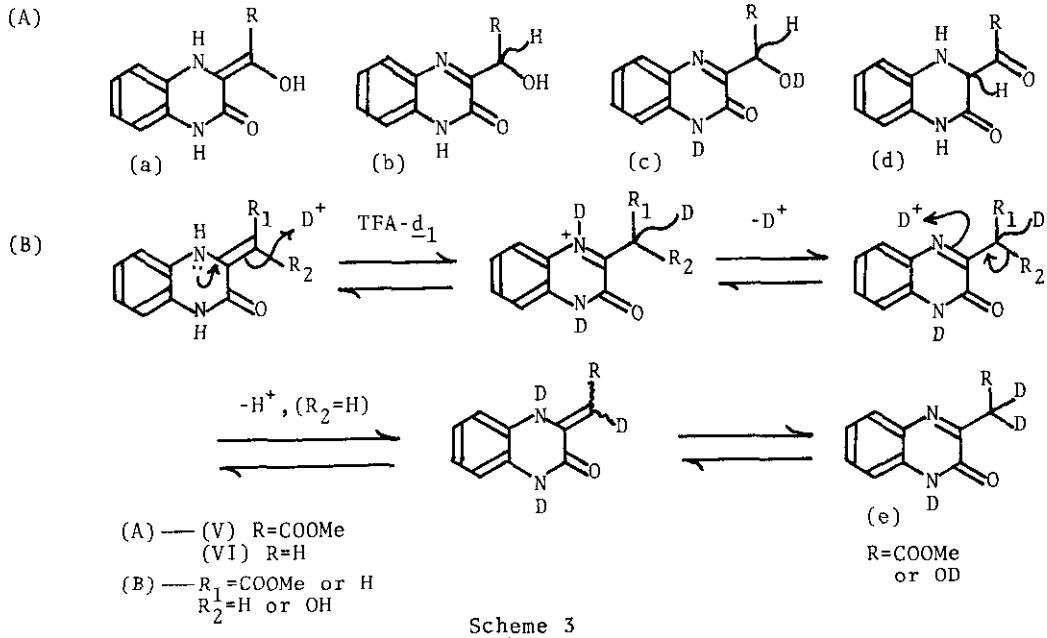


Scheme 1





Scheme 2



Scheme 3

Table I

Compound	Solvent	Chemical Shift (δ)
Va	DMSO-d_6	11.80(1-NH),11.47(4-NH),9.58(OH),7.20-6.67(arom.),3.77(Me)
Vb	TFA	8.33-7.00(arom.),6.14(OH),* 4.23(methine),3.97(Me)**
Vc	TFA-d_1	8.27-7.13(arom.),4.22(methine),3.96(Me)
VIa	DMSO-d_6	12.33(1-NH),9.97(4-NH),9.15(OH),8.00-6.33(arom.),4.63(vinyl)
VIb	TFA	8.67-7.33(arom.),5.53(OH),3.08(CH_2)**
VIe	TFA-d_1	8.43-7.20(arom.)
Ie	TFA-d_1	8.30-7.60(arom.),3.96(Me)

* D-H exchange was very slow.
** NH protons were not observed.

61.23; H, 4.26; N, 15.63.

REFERENCES AND FOOTNOTES

1) Y. Kurasawa and A. Takada, Heterocycles, 1980, 14, 333.

2) R. Mondelli and L. Merlini, Tetrahedron, 1966, 22, 2356.

3) M. J. Haddadin and C. H. Issidorides, Tetrahedron Lett., 1968, 4609.

4) The reaction mechanism was postulated to be similar to that described in the previous paper.[1]

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