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A PHOTOCHEMICAL REACTION OF 3,6-DICHLOROPYRIDAZINES

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During our continuing studies$^{1)}$ on the photo-induced oxygenation reactions with pyridazine N-oxides, we have found an interesting photochemical reaction of pyridazine derivatives.

Irradiation of 3,6-dichloropyridazine (I) in methanol containing HCl, resulted in the formation of methylated compounds (II) and hydroxymethylated compounds (III) as the primary products. However, the prolonged irradiation resulted in the formation of methyl paraconates (V) and dimethyl succinates (VI) <u>via</u> the pyridazones (IV) derived by hydrolysis of these primary irradiation products (II) as well as the starting pyridazines (I)*.

3,6-Dichloropyridazine (Ia) was irradiated$^{2)}$ in methanol containing 5% HCl, and the reaction mixture was evaporated to dryness. The residue was extracted with Et_2O and then made alkaline with aq. ammonia, followed by extraction with CH_2Cl_2. From the CH_2Cl_2 extract, 4-methyl-3,6-dichloropyridazine (IIa)$^{3)}$, 4,5-dimethyl-3,6-dichloropyridazine (IIb)$^{4)}$, 4-hydroxymethyl-3,6-dichloropyridazine (IIIa), mp 128-130°, NMR(DMSO-d_6) δ:4.55(d.,2H, 0.6 cps), 7.79(s.,1H, broad), 6-chloro-3(2H)-pyridazone (IVa)$^{5)}$, 4,5-dimethyl-6-chloro-3(2H)-pyridazone (IVb)$^{4)}$ were obtained. From the ethereal extract, methyl paraconate (Va)$^{6)}$, its β-methyl

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*) The formation of II-VI from I was first observed in the photolysis in methanol without HCl in very low yields. The observation of the formation of HCl in the reaction mixturem derived by the decomposition of the starting dichloropyridazine under these conditions, prompted us to carry out the present investigation.

derivative (Vb), an α,β-dimethyl derivative (Vc), dimethyl succinate (VIa), and its methyl derivative (VIb)[7] were obtained. The yields varied with the irradiation time. Thus, a short time irradiation resulted in the formation of the pyridazines (II-IV) as main products, whereas a prolonged irradiation afforded the lactone esters (V) and the succinates (VI) in main.

For example, irradiation[2] for 6 hr afforded IIa (20-25%), IIb (8-10%), IIIa (5-6%), IVb (2-3%), and Va (2-3%). On the other hand, irradiation for 24-30 hr afforded the lactone esters and the succinates instead of the pyridazines, namely, Va (15%), Vb (7-8%), Vc (10%), VIa (20%), and VIb (1-2%) were obtained. These findings were also confirmed by the examination of G.L.-Chromatography.

Similarly, 4-methyl-3,6-dichloropyridazine (IIa) afforded Vb, Vc, and VIb as main products by the irradiation for a long time.

Except for IIIa, Vb, and Vc, the structures of the products were confirmed by the identity with authentic samples. Analytical and spectral data of IIIa supported the structure, and were reasonably accounted for 4-hydroxymethylpyridazines.[8]

The structures of the compounds (Vb and Vc) were determined by comparison of the NMR and IR data (Table I).

The acid catalyzed photo-induced methylation of pyrimidines[9] has already been reported, and the photo-induced hydroxymethylation in MeOH has also been known in various cases.[10] And the formation of II and III groups, described in the present paper, might be due to a similar mechanism to them.

Concerning the formation of V, the following mechanism can be proposed as the most reasonable one (Chart 2).

Hydrolysis of the dichloro compounds (VII) affords pyridazones (VIII). The photo-excited species of the latter may be represented as IX. The coupling of the excited species with the hydroxymethyl radical, derived from MeOH, affords X, which then forms lactone ring by intramolecular cyclization. The fission of the bond between carbon and nitrogen atoms, followed by the elimination of hydrazine, leads to the esters (V group).

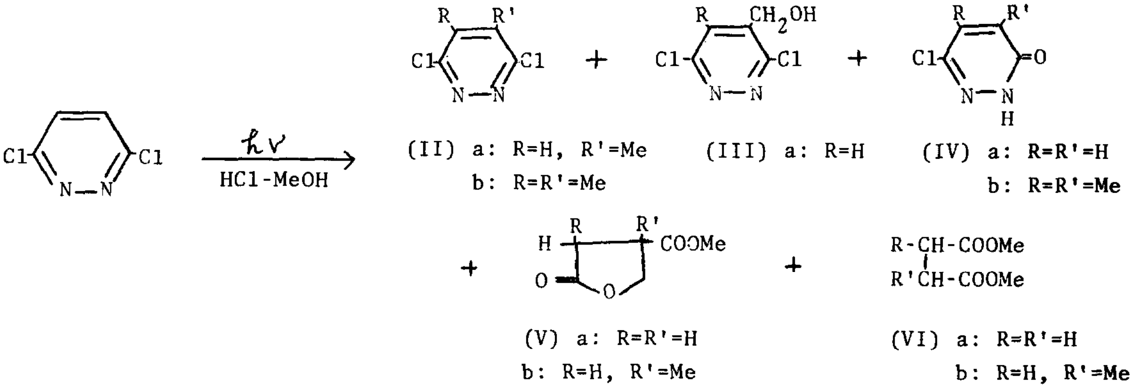
In order clarify this mechanism, an irradiation was carried out under a similar condition, using 6-chloro-3(2H)-pyridazone and maleic hydrazide as model compunds, which have analogous structures to the compounds (VIII). As was expected, Va and VIc were obtained as sole products in moderate yields.

As for the mechanism of the formation of the compound (VI), one possible explanation is that V is oxidized by photo-sensitized oxygenation to give the hydroperoxide (XII), which is then converted into VI, <u>via</u> XIII.

An alternative pathway, involving the photo-reduction of the excited species (IX) to give XIV can not be excluded at present.

Detailed investigations on the formation of the esters and their stereochemistry are now underway.

Chart 1



(II) a: R=H, R'=Me
b: R=R'=Me

(III) a: R=H

(IV) a: R=R'=H
b: R=R'=Me

(V) a: R=R'=H
b: R=H, R'=Me

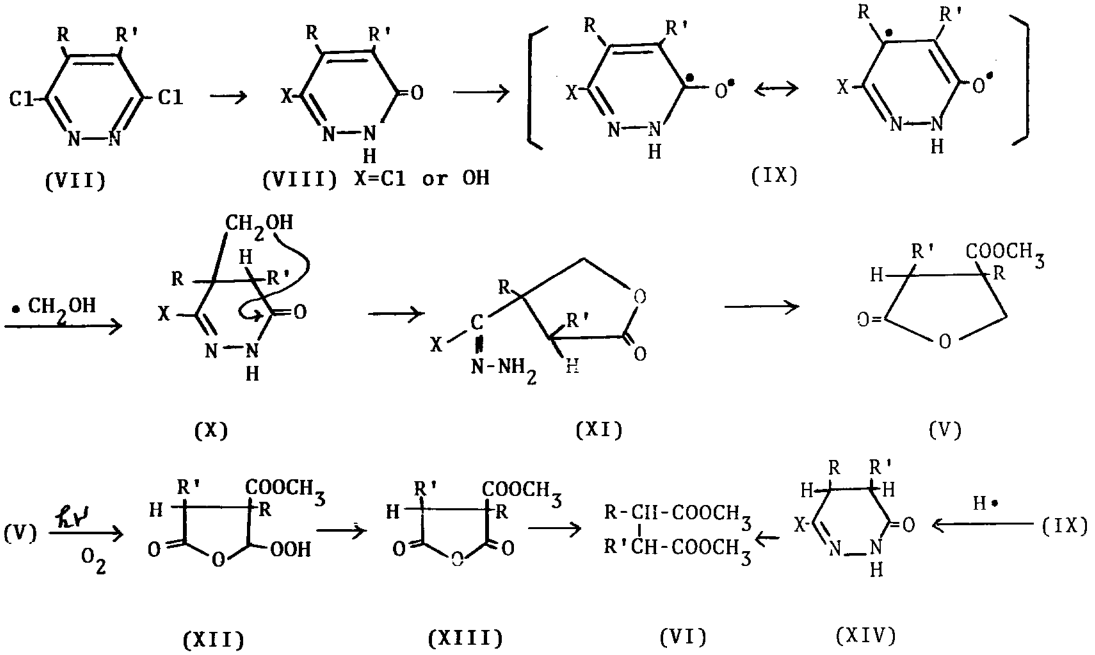
(VI) a: R=R'=H
b: R=H, R'=Me

Table I Spectral Data for the Compounds (V)

	IR(liquid)	NMR($CDCl_3$)		δ	J=cps	
	C=O, cm^{-1}	H_α	H_β	H_γ	$C-CH_3$	$COOCH_3$
Va	1740	2.77(d.,J=9.6)	3.50	4.45(d.,J=6.0)	---	3.76
	1785	2.97(d.,J=7.0)	(multiplet)*	4.46(d.,J=8.0)	---	
Vb	1740	2.38(d.,J=17.7)	---	4.05(d.,J=9.0)	1.46(s.)	3.77
	1785	3.07(d.,J=17.7)		4.55(d.,J=9.0)	1.31(s.)	
Vc	1735	3.00(q.,J=7.2	---	4.03(d.,J=9.0)	1.31(s.)	3.77
	1785	and 15.0)		4.41(d.,J=9.0)	1.23(d.,J=7.2)	

*) Low field signals are hidden under methyl signal.

Chart 2



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