

THE REACTION OF QUATERNARY SALTS OF PYRIDAZINE N-OXIDES WITH POTASSIUM CYANIDE.
FORMATION OF β -ETHYNYLACRYLONITRILE¹.

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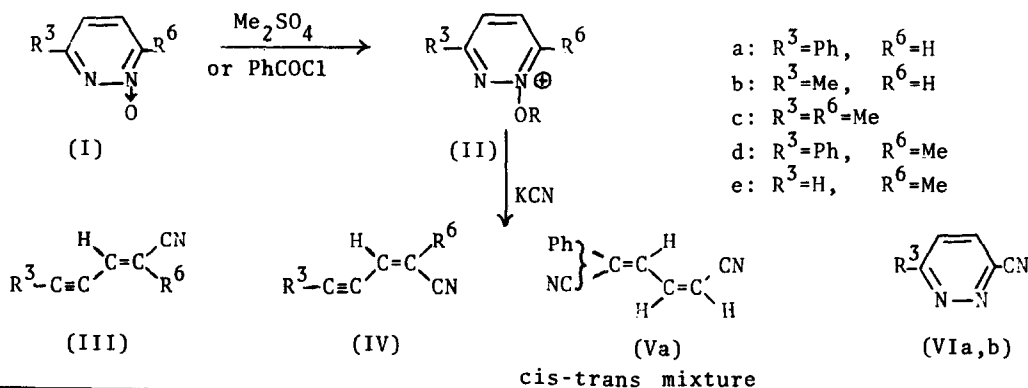
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We have already reported^{2,3} that the reaction of 1-methylpyridazinium salts with KCN afforded 4-cyano-1,4-dihydro compounds along with the dimers having cyclobutane rings and various kinds of cyano substituted pyridazines, indicating Υ -position to the quaternary nitrogen atom was sensitive.

Concerning the reaction of pyridazine N-oxides with KCN, α -position to the N-oxide group was proved to be sensitive to give 6-cyanopyridazines from pyridazine 1-oxides.^{4,5}

On the other hand, it has been reported⁶ that in the reaction of pyridazine N-oxides with Grignard reagents, ring fission of the pyridazine ring occurred, followed by elimination of molecular nitrogen. Therefore, in expectation of similar reaction course, the reaction of the N-oxides with KCN was carried out to afford β -ethynylacrylonitriles as expected.

The quaternary salt (II), prepared from pyridazine 1-oxide (I) with dimethyl sulfate or benzoyl chloride, was allowed to react with KCN in water-tetrahydrofuran at 0-5° for ca. 15 min, followed by extraction with methylene chloride. Every quaternary salt gave a mixture of trans(III)- and cis(IV)- β -ethynylacrylonitrile derivatives in 20-30% and 2-3% yields in cases of Ia-d, and in 3% and 2% yields in case of Ie, respectively.



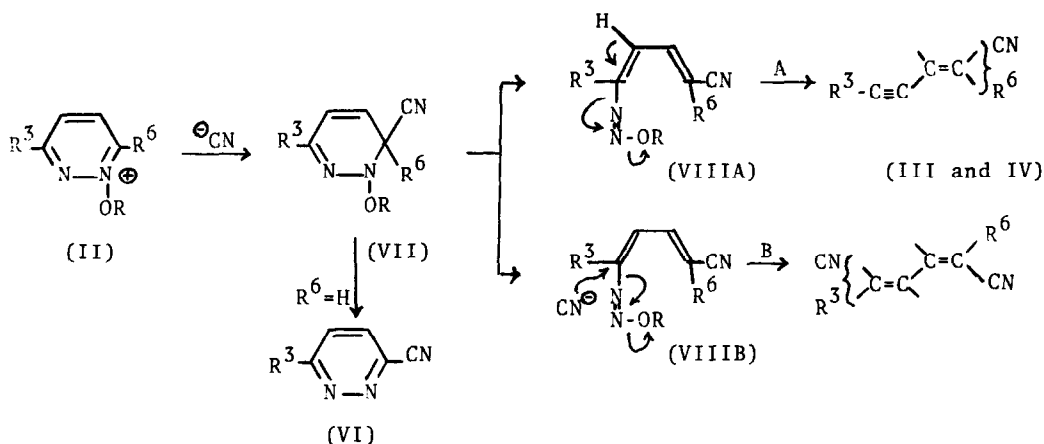
Besides, in case of Ia, 1-phenyl-1,4-dicyano-1,3-butadiene (Va), $\nu_{\text{CN}}^{\text{KBr}}$; 2116 cm^{-1} , $\Sigma(\text{CD}_3\text{OD})$; 6.12 and 6.16(d, $J=11.0$, 2:3, $\text{C}_4\text{-H}$), 7.3-7.8(7H, unassigned), was obtained in ca. 1% yield as a mixture (3:2) of cis- and trans-isomers. Moreover, in cases of Ia and Ib, whose R^6 represented H, 3-phenyl-6-cyanopyridazine⁵ (VIa) and 3-methyl-6-cyanopyridazine⁵ (VIb) were obtained in 2-3% yields, respectively.

The prolonged reaction time resulted in a decrease of the formation of acetylenes (III and IV) and an increase of the formation of 6-cyanopyridazine (VI). In the event, the reaction at 0-5° for 30 min and then at room temperature for 30 min, followed by extraction, did not afford IV, but gave III in ca. 10% and VI in 20-25% yield, respectively.

Concerning the yields of III and IV in cases of Ia-d, any appreciable difference was not observed between the use of dimethyl sulfate and benzoyl chloride. In case of Ie, the use of the former did not give any characteristic product, but that of the latter gave some products in spite of low yield.

Unsubstituted pyridazine 1-oxide did not afford any characteristic product, presumably due to the unstability of β -ethynylacrylonitrile thus formed and to the rapid polymerization even at room temperature, which was already known⁷.

Only the compound (IIIb) was isolated as crystal, but in other cases, the separation of trans- and cis-isomers (III and IV) was so difficult that their physical data such as elementary analyses, molecular weight determinations (M^+), and spectral data were measured in the state of mixture. The compound (IIIb and IVb) were known substances⁸ and the structures of other compounds (IIIa-e and IVa-e) were confirmed in comparison with spectral data⁸ of analogous



β -ethynylacrylonitrile derivatives, whose data were also taken in the state of mixtures.

IR spectra exhibited common absorptions at around 2220 cm^{-1} due to $-\text{C}\equiv\text{N}$ and $-\text{C}\equiv\text{C}-$ groups. NMR spectral data were collected in Table I. The formation ratio of two kinds of isomers was calculated from the NMR data.

Structures of butadiene derivatives (Va) were confirmed in comparison with spectral data⁹ of the cyano substituted butadienes.

The mechanism of their formation is now considered as follows. 1,6-Dihydro-compound (VII) derived by addition of cyanide anion to II, is converted into the

Table L. NMR Spectral Data

	bp/5mmHg (bath temp.)	(CDCCl ₃), J=cps	
		III	IV
a	135-140°	1-H(5.62, d.), 2-H(6.60, d.), Ph(7.33), J _{1,2} =18.0	1-H(5.52, d.), 2-H(6.40, d.), Ph(7.21), J _{1,2} =11.0
b	45-50°	1-H(5.52, d.), 2-H(6.31, d. q.), CH ₃ (2.02, d.), J _{1,2} =16.0, J _{2,4} =2.5	1-H(5.50, d.), 2-H(6.26, d. d.), CH ₃ (2.04, d.), J _{1,2} =11.0, J _{2,4} =2.5
c	50°	2-H(6.10, mc.), CH ₃ (2.06, mc.),	2-H(5.98, mc.), CH ₃ (2.05, mc.)
d	155-160°	2-H(6.26, mc.), CH ₃ (2.09, d.), J=1.5), Ph(7.30)	2-H(6.08, mc.), CH ₃ (2.00, d.), J=2.0), Ph(7.25)
e	45-50°	2-H(6.05, mc.), 4-H(3.73, b. d.), J=2.5), CH ₃ (2.00, d., J=1.6)	2-H(5.96, mc.), 4-H(3.47, b. d.), J=2.5), CH ₃ (1.93, d., J=2.5)

ring-opened intermediate (VIII), followed by formation of acetylenes (III and IV) via path VIIIA, and of butadienes (V) via path VIIIB.

As stated above, whereas the reaction for short time results in an increase of the formation of III and IV, the prolonged reaction results in a decrease of their formation and in turn, an increase of the formation of VI. The reason might be as follows.

The dihydro intermediate (VII) is relatively stable and is gradually converted into 6-cyanopyridazine (VI) in the reaction mixture. However, in case of the reaction for short time, extraction by methylene chloride results in the movement of unchanged dihydro compound (VII) into organic solvent, followed by formation of acetylenes in the course of the treatment. This is confirmed by the fact that evolution of N₂ is observed during evaporation of the solvent.

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