

THE CYCLOADDITION REACTION OF ISONITRILES
(THE REACTION OF ISONITRILE WITH DIAZOALKANE)

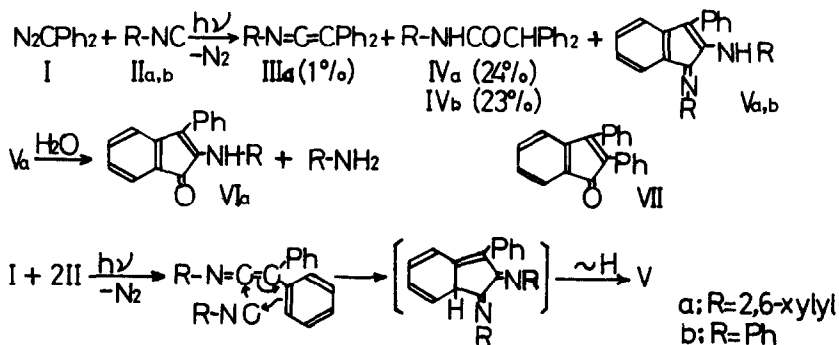
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Isonitriles react with carbenes to give α -adducts, keteneimines.¹⁾ Further cycloaddition of isonitriles to keteneimines is expected when the substituents of them are aromatic. From this point of view, reaction of several aromatic isonitriles with diazoalkanes as the precursors of carbene was examined.

Photolysis of diphenyldiazomethane (I), in the presence of equimolar 2,6-dimethylphenyl-(IIa) or phenylisonitrile (IIb) in n-hexane at room temperature, gave keteneimine (IIIa, mp 60-1°C), acetamide (IVa, mp 210-1°C: IVb, mp 177-8°C), a hydrated product of III, and small amounts of violet crystals (Va, mp 197-8°C: Vb, mp 179-80°C). (Scheme I). The structures of IIIa and IVa were established by direct comparison with the authentic samples prepared by a modification of the Stevens' method.²⁾ Hydrolysis of Va with hydrochloric acid gave an indone deriva

(Scheme I)



tive (VIa, mp 133-4°C), whose UV absorption pattern was similar to that of 2,3-diphenylindone (VII),³⁾ and 2,6-xylidine. From this result and the spectral and analytical data, Va was identified as 1-(2,6-dimethylphenylimino)-2-(2,6-dimethyl-

anilino)-3-phenylindene. The structures of IVb and Vb were determined by comparison of spectral and analytical data with those of IVa and Va.

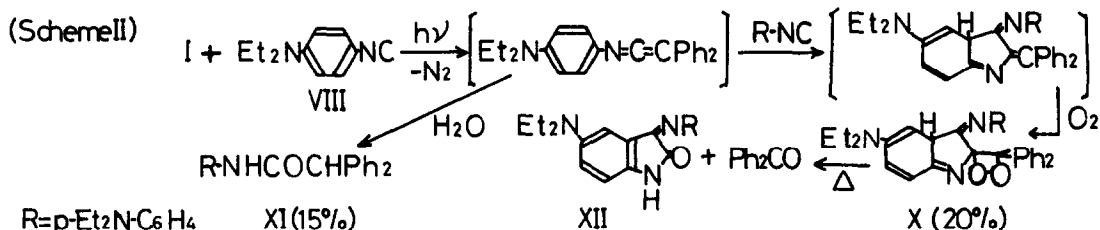
When another molar equivalent of IIa was added to the reaction mixture after the photolysis of I and was refluxed, Va was obtained in a higher yield.

Accordingly, the formation of V in the photoreaction should be due to the thermal cycloaddition reaction of II to the primary product III.

In the cycloaddition reaction of isonitriles to triaryl-substituted keteneimine such as IIIb, two fashions of cyclization are possible, i.e., cyclization to N-substituted phenyl ring of keteneimine to give indole skeleton and to C-substituted one to give indene skeleton. In the reaction mentioned above, cyclization occurred in the latter fashion.

However, cyclization in the former mode took place in the reaction of I with p-diethylamino-(VIII) or p-nitrophenylisonitrile (IX).

Four hrs irradiation of a molar equivalent mixture of I and VIII gave two kinds of solid, unstable violet precipitate (X, mp 131-3°C) and N-(p-diethylaminophenyl)-diethylacetamide (XI, mp 145-6°) as colorless needles. (Scheme II). On heating at 80°C for 3 hrs, X (no N-H signals in IR and NMR spectra) decomposed into 3-(p-diethylaminophenylimino)-6-diethylaminoisatine (XII, reddish violet solid, mp 174-5°C) and benzophenone in a 80% yield respectively. Therefore, compound X was assumed to be an oxetane derivative as shown in Scheme II. These results indicate that the primary intermediate was unisolable keteneimine and

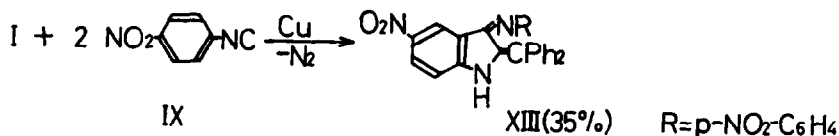


that successive cyclization of VIII would occur to the N-substituted phenyl ring to form indolenine intermediate, which was oxygenated to X.⁴⁾

Since I did not decompose on irradiation in the presence of IX, copper catalysed decomposition of I was carried out. To the mixture of copper powder of commercial grade and large excess of IX in a small amount of xylene, I was

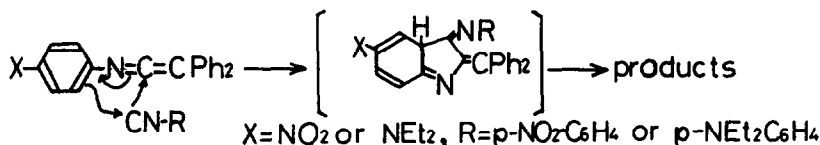
added dropwise at 100°C, and then the reaction mixture was chromatographed on silica gel to give 2-diphenylmethylindene-3-(p-nitrophenylimino)-6-nitroindole (XIII, mp 214.5-6°C) as brown needles. (Scheme III). The structure of XIII was determined on the basis of analytical and NMR spectral data (signals of phenyl protons were as following: δ 8.36-7.74 (AB quartet, 4H, protons of phenylimino group), 7.36-6.98 (multiplet, 10H, protons of diphenylmethylidene group) and 6.60-6.34 (multiplet, 3H, protons on indole skeleton)).

(Scheme III)



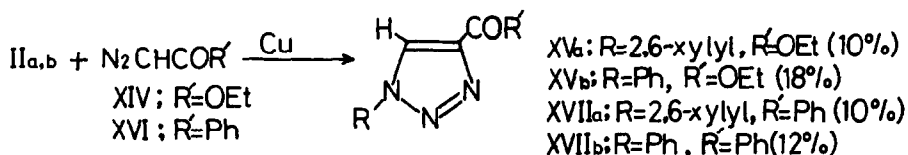
In the reaction of I with VIII or IX, cyclization of isonitrile occurred preferentially in the N-substituted phenyl ring of initially formed keteneimine to give indole derivative. (Scheme IV).

(Scheme IV)



Photolysis of ethyldiazoacetate (XIV) in the presence of isonitriles was unsuccessful, then copper catalysed degradation of XIV with IIa or IIb was examined at 80°C. However, contrary to expectation, appreciable N₂ gas evolution was not observed and colorless needles of 1-aryl-4-ethoxycarbonyl-1,2,3-triazole (XVa, mp 72-3°C: XVb, mp 75-6°C) were obtained. In the quite like manner IIa or IIb and diazoacetophenone (XVI) gave corresponding triazoles (XVIIa, mp 116-7°C: XVIIb, mp 113-4°C). (Scheme V).

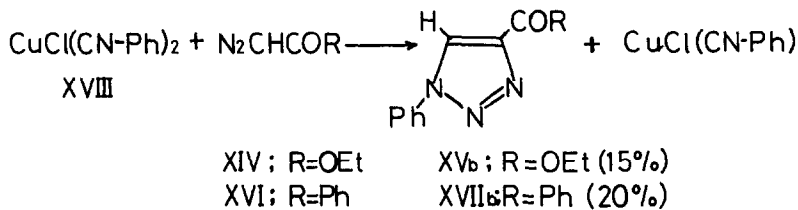
(Scheme V)



Copper isonitrile complex as the initial intermediate in the formation of triazoles was supported by the facts that no triazoles were obtained in the absence of copper and that cuprouschloridebisphenylimino complex (XVIII) with

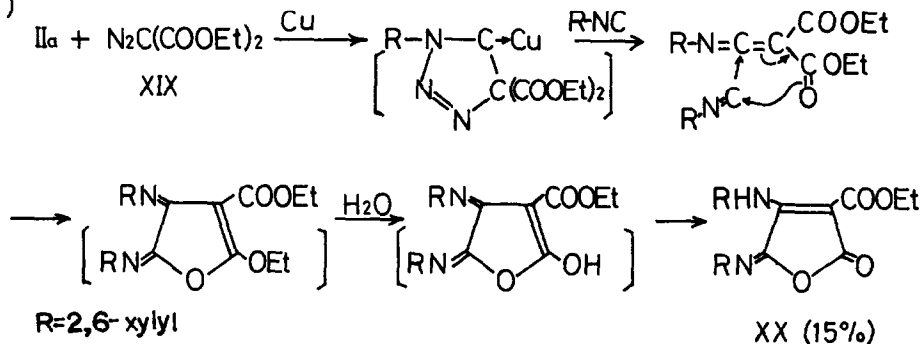
XIV and XVI gave triazoles XVb and XVIIb respectively. (Scheme VI).

(Scheme VI)



Ethyldiazomalonate (XIX) decomposed quantitatively in the presence of copper and reacted with IIa to produce yellow needles of 2-(2,6-dimethylphenylimino)-4-ethoxycarbonyl-5-oxofuran (XX, mp 159-60°C). (Scheme VII). This suggests that the α -hydrogen of diazocompounds substituted with electron-withdrawing groups seems to be essential for the formation of triazoles as final products.

(Scheme VII)



References

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- (2) C. L. Stevens and J. C. French, *J. Am. Chem. Soc.*, 76, 4398 (1954).
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