

PHOTOLYSIS OF QUINOLYL AND ISOQUINOLYL AZIDES IN ALCOHOLS
CONTAINING SULFURIC ACID

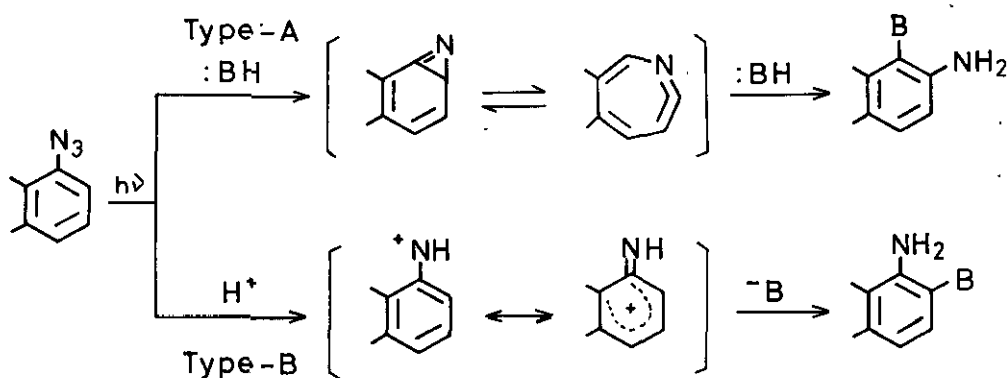
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Abstract — Photolysis of 3-azidoquinoline, 4-azidoisoquinoline, and 4-azidoquinoline *N*-oxide in alcohols containing sulfuric acid gave the corresponding α -alkoxy amino compounds (2,3,5,7) via nitrenium ion intermediates. In contrast, 3-azidoquinoline *N*-oxide, 5-azido- and 8-azidoquinoline, and 5-azidoisoquinoline, upon irradiation under similar conditions, gave the different type of α -alkoxy amino compounds such as 9 and 13 via azirine or azacycloheptatetraene intermediates.

It is known that the photolyses of aryl azides in the presence of bases such as alkoxides and amines give the corresponding ortho-substituted amino derivatives and/or ring-expansion products via azirine or azacycloheptatetraene intermediates derived from the initially formed nitrenes as shown in Scheme 1 (Type-A).^{1,2}

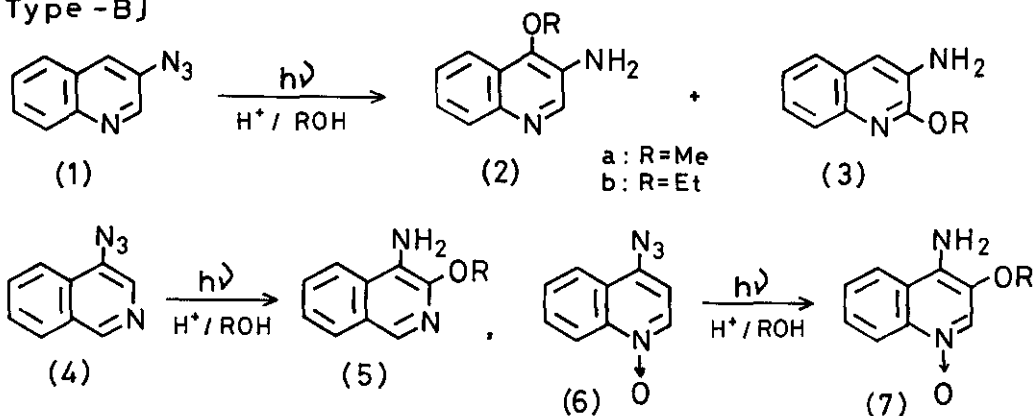


Scheme 1

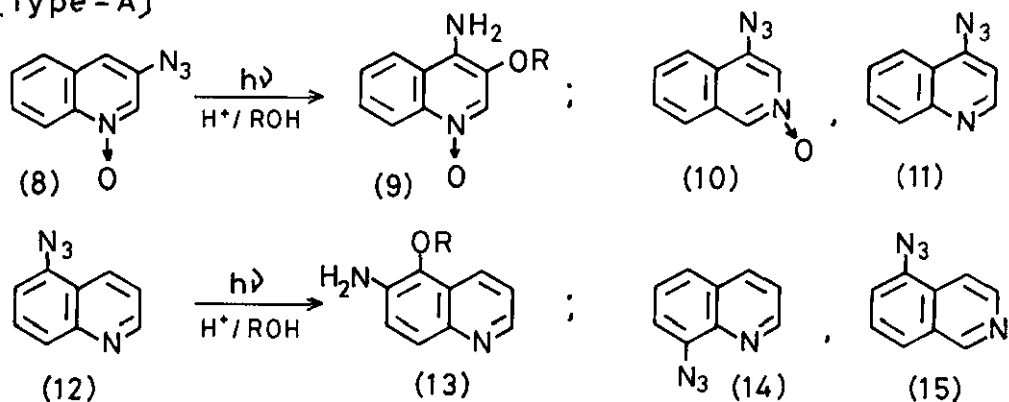
We have recently reported that irradiation of pyridyl, quinolyl, and isoquinolyl azides having the azido group in either the benzene or the pyridine ring in hydrohalogenic acids showed a different behavior to give the α -halogeno amino compounds via nitrenium ion intermediates as also illustrated in Scheme 1 (Type-B).³ These results prompted us to examine the photolysis of the title azides in alcohols containing sulfuric acid and we now report our new results.

Irradiation (200 W, halogen lamp, Pyrex filter) of 3-azidoquinoline (1)⁴ in methanol or ethanol containing ca. 5% of conc. sulfuric acid at room temperature for 5-6 h gave 4-alkoxy- (2a: 61%; 2b: 41%) and 2-alkoxy-3-aminoquinolines (3a: 21%; 3b: 15%),⁵ which are the type-B products. Similarly, 4-azidoisoquinoline (4) and 4-azidoquinoline N-oxide (6) gave the corresponding type-B products (5) and (7) in 30-40% yields, respectively.

[Type - B]



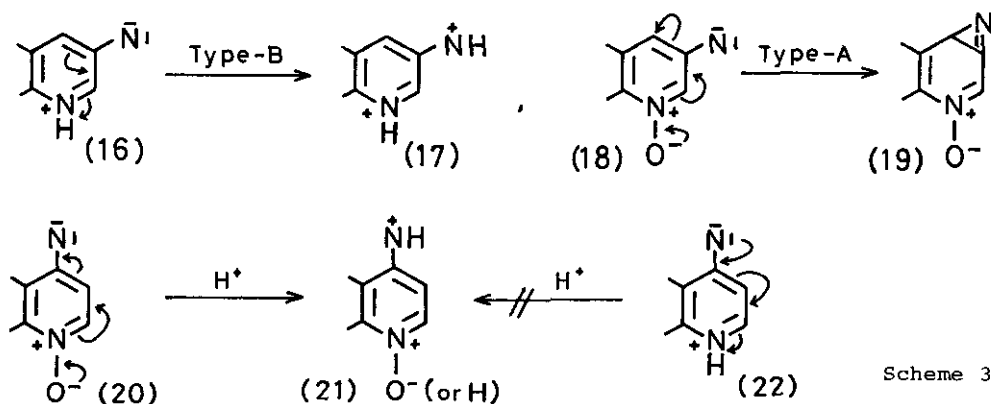
[Type - A]



Scheme 2

In contrast, 3-azidoquinoline N-oxide (8), upon irradiation under similar conditions, gave 3-alkoxy-4-aminoquinoline N-oxides (9a: 76%; 9b: 68%) which are the type-A products. However, similar reactions of 4-azidoisoquinoline N-oxide (10) and 4-azidoquinoline (11) gave complex mixtures of products presumably derived from initially formed azirines or diazepines by decomposition under the acidic reaction condition.⁶ On the other hand, 5-azidoquinoline (12) gave 5-alkoxy-6-aminoquinolines (13a: 67%; 13b: 70%) and the benzopyridines having an azido group in the benzene ring such as 14 and 15 also gave the corresponding type-A products in 50-70% yields. Similar results were obtained when perchloric acid, trifluoromethanesulfonic acid, or trifluoroacetic acid was used as an acid instead of sulfuric acid, but acetic acid gave no such results.

Plausible explanations for these variant results are as follows. Singlet aryl nitrenes are known to undergo intramolecular addition to give azirines under



either neutral or basic conditions^{1,2,7a} and to undergo protonation to give nitrenium ions under strong acidic conditions.^{1,2,7b} In the case of the photolysis of azine azides in 6-10 N hydrohalogenoic acids, the formation of nitrenium ions predominates over that of azirines to give type-B products.³ In contrast, the present results for the benzopyridines with an azido group in the benzene ring indicate that the formation of azirines takes place predominantly under the present reaction conditions. However, in the cases of 3-azidoquinoline (1) and 4-azidoisoquinoline (4), the electron density of the C₃-C₄ double bond is decreased by the electron-withdrawing effect of the protonated ring nitrogen, thus the addition of the singlet nitrenes to such electron-deficient olefins is unfavorable and the protonation might occur predominantly to give the type-B products as illustrated

in the structures (16) and (17). On the contrary, in the case of 3-azidoquinoline N-oxide (8), the electron-donating effect of the N-oxide group may increase the electron density of the double bond, consequently, the addition of the nitrenes occurs preferentially as shown in the structures (18) and (19). In the case of 4-azidoquinoline N-oxide (6), the electron-donating effect of the N-oxide group may accelerate the protonation of the nitrene, whereas the electron-withdrawing effect of the protonated ring nitrogen may inhibit the protonation in the case of 4-azidoquinoline (11), as indicated in the structures (20) and (22).

The present results are in any event useful for the introduction of an alkoxy group to aromatic rings and studies on applications of these results to the other systems are in progress.

REFERENCES AND FOOTNOTES

1. A. Reiser and H.M. Wagner, "The Chemistry of the Azido Group", ed. by S. Patai, Interscience, N.Y., 1971, p.441; R.A. Abramovitch and E.P. Kyba, *ibid.*, p. 221.
2. For examples: J. Rigaudy, C. Igier, and J. Barcelo, *Tetrahedron Lett.*, 1975, 3845; S.E. Carrol, B. Nay, E.V. Scriven, and H. Suschitzky, *Synthesis*, 1975, 710; O.L. Chapman and J.P. Le Roux, *J. Am. Chem. Soc.*, 1978, 100, 292.
3. H. Sawanishi, T. Hirai, and T. Tsuchiya, *Heterocycles*, 1982, 19, 1043.
4. The starting azido compounds used in the present reactions were prepared from the corresponding chloro compounds by treatment either with sodium azide or with hydrazine hydrate followed by diazotization, according to the reported method [cf., T. Itai and S. Kamiya, *Chem. Pharm. Bull.*, 1961, 9, 871].
5. The structures of the products reported were confirmed by comparison with authentic samples or by NMR spectral analyses of the alkoxy compounds obtained by deamination of these products.
6. Benzodiazepines are known to be susceptible to decomposition by acids [cf., T. Tsuchiya, M. Enkaku, and S. Okajima, *Chem. Pharm. Bull.*, 1980, 28, 2602; *idem*, *ibid.*, 1981, 29, 3173; T. Tsuchiya, S. Okajima, M. Enkaku, and J. Kurita, *J. Chem. Soc. Chem. Commun.*, 1981, 211].
7. a) P.A.S. Smith, "Nitrenes", ed. by W. Lowowski, Interscience, N.Y., 1970, p. 99; b) P.T. Lansbury, *ibid.*, p. 405.

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