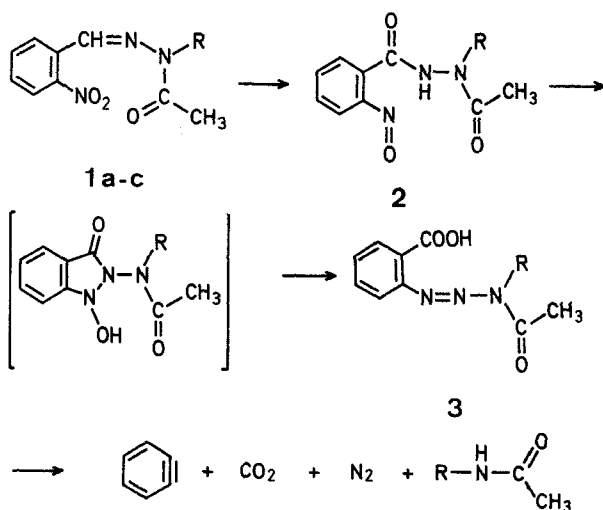


**Photolysis of *o*-Nitrobenzaldehyde *N*-Acylhydrazones.
A New Preparative Method for 1-Substituted 5-Nitrophthalazines.**

Yoshifumi MAKI*, Takashi FURUTA

Gifu College of Pharmacy, Mitahora, Gifu, Japan

In a recent article¹ we have shown that the photolysis of *o*-nitrobenzaldehyde *N*-acetyl-*N*-alkylhydrazones (1) gave benzyne *via* *N'*-(*o*-nitrosobenzoyl)-*N*-acetyl-*N*-alkylhydrazides (2) and *o*-(*N*-alkyl-*N*-acetyltriazeno)-benzoic acids (3).



a R = CH₃

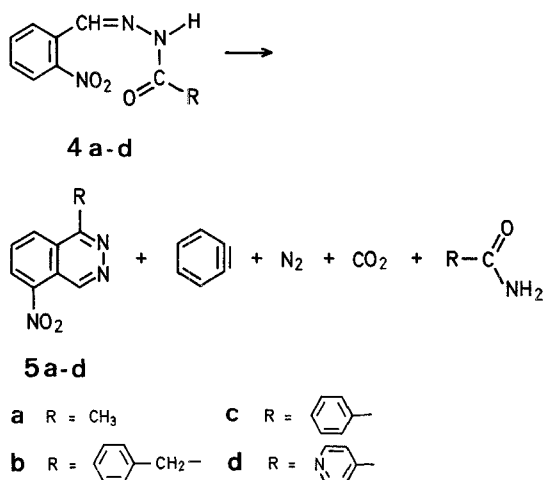
b R = C₂H₅

c R = CH₂

Scheme A

By analogy we expected that *o*-nitrobenzaldehyde *N*-acylhydrazones (4) should be photolysed to form benzyne. How-

ever, it was found that photolysis of the hydrazones **4** causes the photocyclization leading to 1-substituted 5-nitrophthalazines (**5**) in preparative yields, and benzyne generation takes place only as a minor process. This result provides a convenient preparative method for 1-substituted 5-nitrophthalazines which have previously been tedious to prepare². We believe that this type of photoreaction is the first example of nonoxidative photo-electrocyclization of the six-electron system involving an acylhydrazone moiety.

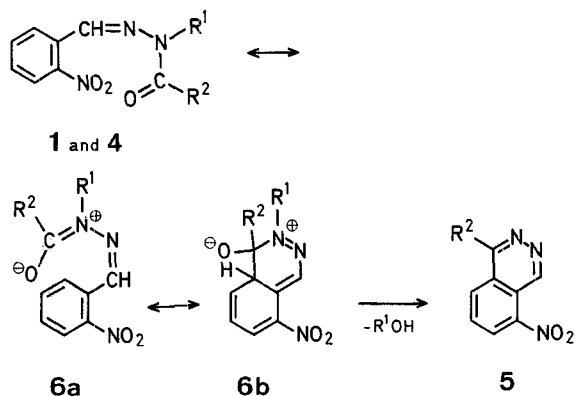


Scheme B

o-Nitrobenzaldehyde *N*-acetylhydrazone (**4a**) in methanol reacted readily under nitrogen when irradiated using a high-pressure mercury lamp through a Pyrex filter. As the reaction proceeds, 1-methyl-5-nitrophthalazine (**5a**) is deposited. The presence of acetamide in the mother liquor was confirmed by gas chromatography and N.M.R. spectroscopy. Irradiation of **4a** in the presence of tetracyclone resulted in the formation of a small amount of 1,2,3,4-tetraphenylnaphthalene, indicating benzyne generation in a similar manner to the case of **1**. The product **5a** was identical in every respect with a sample prepared by nitration of 1-methylphthalazine².

Analogously, phenylacetyl-, benzoyl- and isonicotinylhydrazides (**4b-d**) gave the corresponding 5-nitrophthalazines (**5b-d**) as a major products.

Photocyclization of the six-electron system involving an amide function such as anilides³ and enamides⁴ have been well documented. Analogously, both **1** and **4** appear to undergo a photochemical six-electron electrocyclic reaction in competition with benzyne generation.



Scheme C

In the case of **4**, the resulting cyclic intermediate (**6b**; $R^1 = H$) easily could lose water thermally to give **5** in preparative yields. In the case of **1**, however, the intermediate (**6b**; $R^1 = \text{alkyl}$) could revert to the starting material because of difficulty of the elimination of alcohols. Thus, **1** generates benzyne preferentially.

It is noteworthy that this type of photocyclization is limited to *o*-nitrobenzaldehyde *N*-acylhydrazones (**4**), i.e., the corresponding *N*-acylhydrazones of benzaldehyde and its *p*-nitro, *o*-methoxy, and *o*-cyano derivatives did not give phthalazines on similar irradiation. The role of the *o*-situated nitro group is not clear at present and further studies are now in progress.

Table. Preparation of 1-Substituted 5-Nitrophthalazines (**5**)

Pro-duct	Reaction time	Yield (%)	m.p. (solvent)	Empirical formula ^a	M. S. m/e
5a	7.5 h	50	195–197° (CH ₃ OH)	C ₉ H ₇ N ₃ O ₂ (189.2)	189 (M ⁺)
5b	8.0 h	30	233° (DMF/C ₂ H ₅ OH)	C ₁₃ H ₁₁ N ₃ O ₂ (265.3)	165 (M ⁺)
5c	5.0 h	55	256° (DMF/C ₂ H ₅ OH)	C ₁₄ H ₉ N ₃ O ₂ (251.2)	251 (M ⁺)
5d	5.0 h	60	276° (DMF/C ₂ H ₅ OH)	C ₁₃ H ₈ N ₄ O ₂ (252.3)	252 (M ⁺)

^a All products gave satisfactory elemental analyses (C $\pm 0.10\%$, H $\pm 0.10\%$, N $\pm 0.15\%$).

Preparation of 5-Nitrophthalazine Derivatives (**5a-d**); General Procedure:

o-Nitrobenzaldehyde *N*-acylhydrazone (1 g) in methanol (200 ml) was irradiated with a 100 W high-pressure mercury lamp under nitrogen through a Pyrex filter. After irradiation for the time given in the Table, crystalline 5-nitrophthalazine precipitated was collected by filtration and recrystallized. The mother liquor deposited a further small amount of the product.

Received: December 18, 1975

¹ Y. Maki, T. Furuta, M. Kuzuya, M. Suzuki, *J. Chem. Soc. Chem. Commun.* **1975**, 616.

² S. Kanahara, *Yakugaku Zasshi*, **84**, 489 (1964).

³ Y. Ogata, K. Takagi, I. Ishino, *J. Org. Chem.* **36**, 3769 (1971) and references cited.

⁴ I. Ninomiya, S. Yamauchi, T. Kiguchi, A. Shinohara, T. Naito, *J. Chem. Soc. Perkin Trans. 1* **1974**, 1747 and references cited.