Photochemical Synthesis of 3-Heteroarylpyridines

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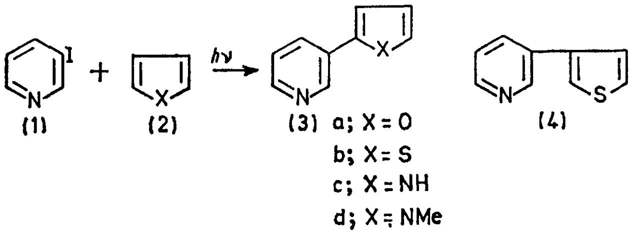
Summary Photolysis of 3-iodopyridine in the presence of five-membered aromatic heterocycles such as furan, thiophen, pyrrole, or 1-methylpyrrole provides a simple and potentially general preparation of 3-heteroaryl derivatives of pyridine.

While heteroaryl derivatives of pyridine are of considerable organic and pharmaceutical interest,[1] their preparation is difficult. We report here a new and simple preparation of 3-heteroarylpyridines, by photolysis of 3-iodopyridine (**1**).[2]

Irradiation of (**1**) in the presence of (**2a**—**d**) with a 350 W high-pressure mercury lamp through a Pyrex filter gave the corresponding 3-heteroarylpyridines (**3a**—**d**) and (**4**), whose structures were assigned on the basis of their u.v., i.r., mass, and n.m.r. spectra, and elemental analysis.†



(1) (2) (3) a; X = O
b; X = S
c; X = NH
d; X = NMe
(4)

The reaction proceeded with high or exclusive positional selectivity. Only one product substituted at the 2-position of the five-membered heterocycle was isolated except for the case of (**2b**) where both (**3b**) and (**4**) were obtained (7:1) and separated by chromatography over silica gel. The yields and physical properties of the products are listed in the Table.

For (**2c**), the yield was lower than in the other cases. The formation of (**3a**) was effectively quenched by (**2c**), but not by (**2d**), probably indicating that the lower yield for (**2c**) was due to its *N*-hydrogen atom.

Products from photolysis of 3-iodopyridine

Substrate	Product	B.p. or m.p. (°C)	Yield (%)
(**2**; X = O)	(**3a**)	B.p. 83—84 at 5 mmHg	64
(**2**; X = S)	(**3b**) (**4**)	B.p. 122—123 at 5 mmHg M.p. 73—74	42[b]
(**2**; X = NH)	(**3c**)	M.p. 102	12
(**2**; X = NMe)	(**3d**)	B.p. 100 at 0·5 mmHg	72

[a] Based on 3-iodopyridine consumed. [b] Combined yield. (**3b**):(**4**) = 7:1 calculated from g.l.c. analyses of distilled mixture.

The reaction may occur *via* homolytic substitution on the aromatic heterocycles by a 3-pyridyl radical. However, in view of the influence of solvents on the reaction in preliminary experiments[3] we are investigating the reaction in detail in order to establish the precise mechanism.

(*Received*, 13*th March* 1972; *Com.* 418.)

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† Satisfactory elemental analyses were obtained for all compounds reported herein.

‡ The rate of formation of the products was accelerated in MeCN or CH_2Cl_2, whereas the reverse was observed for CCl_4.

[1] (a) L. E. Tenenbaum, 'Pyridine and Its Derivatives,' Interscience, New York, 1961, p. 155; (b) R. A. Abramovitch and J. G. Saha, *Adv. Heterocyclic Chem.*, 1966, **6**, 229; (c) J. Firl, *Chem. Ber.*, 1968, **101**, 218; (d) H. Wynberg, T. J. van Bergen, and R. M. Kellogg, *J. Org. Chem.*, 1969, **34**, 3175.

[2] For reports on the photolysis of aromatic iodides, see (a) R. K. Sharma and N. Kharasch, *Angew. Chem.*, 1968, **80**, 69, and references cited therein; (b) L. Benati and M. Tiecco, *Boll. Sci. Fac. Chim. Ind. Bologna*, 1966, **24**, 45 (*Chem. Abs.*, 1966, **65**, 8710g); (c) S. M. Kupchan, J. L. Moniot, R. M. Kanojia, and J. B. O'Brien, *J. Org. Chem.*, 1971, **36**, 2413.