OXIDATIVE AMINOARYLATION OF ACRIDINES

V. A. Trofimov, O. N. Chupakhin,
and Z. V. Pushkareva

UDC 547.835.9:542.95

A method is described for the oxidative aminoarylation of protic and quaternary salts of acridine in the presence of air oxygen; the reaction gives high yields of diverse aminoarylacridines.

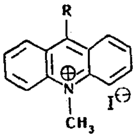
A new method for the aminoarylation of acridines was reported in [1] and consisted in the reaction of acridine, as well as its protic and quaternary salts, with aromatic amines in the presence of sulfur. An investigation of the mechanism of this reaction indicated that the formation of a charge-transfer complex (CTC) between acridine and arylamine molecules precedes nucleophilic substitution of a hydrogen in the acridine ring [2]. Sulfur oxidizes the intermediates formed to aminoarylacridines and is itself reduced to sulfide ions in the process.

It was natural to assume that the aminoarylation of acridines would also be possible when other oxidizing agents were used. Experiments indicated that the most convenient of the investigated oxidizing agents

TABLE 1. Effect of Temperature on the Reaction of Acridine Methiodide with Dimethylaniline

Solvent	Reaction temp.	Reaction time, h	Yield, %
Dimethylformamide	130	3	90
" "	105	1,5	96
" "	75	5,5	75
" "	50	5,5	55
n-Butanol	105	1,5	96

TABLE 2.



Compound	mp	Empirical formula	Found, %			Calc., %			Yield, %
			C	H	N	C	H	N	
4-Dimethylaminophenyl	215—216*	—	—	—	—	—	—	—	95,5
4-Aminophenyl	232—233†	—	—	—	—	—	—	—	97,0
4-Diethylaminophenyl	‡	$C_{24}H_{25}N_2I$	59,1	5,5	6,0	59,2	5,2	5,8	75,0
2-Aminonaphthyl	‡	$C_{24}H_{19}N_2I$	61,1	4,3	5,7	61,1	4,3	5,9	98,0
2,4-Diaminophenyl	202—205 (dec.)	$C_{20}H_{18}N_3I$	56,3	4,4	9,9	56,2	4,2	9,8	92,0
2-Methyl-4-aminophenyl	‡	$C_{21}H_{19}N_2I$	59,0	5,0	6,4	59,1	5,5	6,6	65,0

*According to [1], mp 216°.

†According to [1], mp 234°.

‡This product did not have a sharp melting point.

S. M. Kirov Ural Polytechnical Institute, Sverdlovsk. Translated from Khimiya Geterotsiklicheskikh Soedinenii, No. 5, pp. 653-654, May, 1971. Original article submitted July 6, 1970.

is air oxygen. It was found that the reaction of a mixture of acridine salts and arylamine with air oxygen is observed at room temperature, but the reaction proceeds very slowly and its products can be detected only spectrophotometrically. A long-wave absorption band at 640 nm, which characterizes the CTC, is observed in the spectrum of a dimethylformamide solution of an equimolecular mixture of acridine methiodide and aniline (or dimethylaniline); new absorption bands, which are characteristic for the substitution products, viz., 10-methyl-9-(p-aminophenyl)- and 10-methyl-9-(p-dimethylaminophenyl)acridinium iodides, respectively (Fig. 1), develop in the spectra when the solution is allowed to stand in air at room temperature. Transformations of this sort are not observed at 0°.

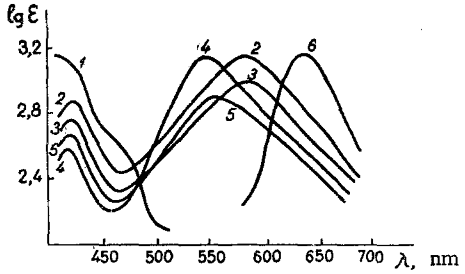


Fig. 1. Electronic absorption spectra in dimethylformamide: 1) methylacridinium iodide; 2) 10-methyl-9-(p-dimethylaminophenyl)acridinium iodide; 3) a mixture of methylacridinium iodide and dimethylaniline held at 20° for 30 min; 4) 10-methyl-9-(p-aminophenyl)acridinium iodide; 5) a mixture of methylacridinium iodide with aniline held at 20° for 30 min; 6) complex of methylacridinium iodide and dimethylaniline. (The spectrum was obtained immediately after mixing the solutions at 0°.)

The optimum conditions for the oxidative aminoarylation were found experimentally. The reaction is carried out in dimethylformamide or butanol with constant bubbling in of air. As seen in Table 1, the optimum conditions should be considered to be a temperature of 105° and a reaction time of 1.5 h (in the presence of sulfur the process is carried out at 120-135°). The yields of aminoarylacridines are 65-95%. Both protic and quaternary acridine salts can be subjected to oxidative aminoarylation.

The use of air for the aminoarylation makes the process more preparatively convenient and also makes it possible to obtain some derivatives, for example, 10-methyl-9-(p-diethylaminophenylacridinium) iodide, which could not be synthesized when sulfur was used.

EXPERIMENTAL

Aminoarylacridine Methiodides (Table 2). A mixture of 0.01 mole of the methylacridinium iodide, 0.01 mole of arylamine, and 30 ml of n-butanol was heated at 105° for 1.5 h with constant bubbling of air through the reaction mixture by means of a water aspirator. A tenfold volume of ether was then added to the cooled solution, and the precipitate was filtered and crystallized from ethanol.

9-(p-Dimethylaminophenyl)acridine. This was similarly obtained in 91% yield from acridine hydrochloride and dimethylaniline. The ether-precipitated product was dissolved in boiling water, and the solution was treated with 20% alkali to pH 7.5-8. The precipitated base was filtered, dried, and crystallized from ethanol to give 91% of product with mp 279° (mp 279° [3]).

LITERATURE CITED

1. O. N. Chupakhin, V. A. Trofimov, and Z. V. Pushkareva, Dokl. Akad. Nauk SSSR, 188, 376 (1969).
2. O. N. Chupakhin, V. A. Trofimov, and Z. V. Pushkareva, Khim. Geterotsikl. Soedin., 954 (1969).
3. F. Ullmann, W. Bader, and H. Labhardt, Ber., 40, 4795 (1907).