

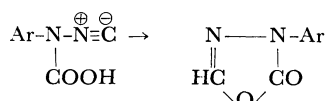
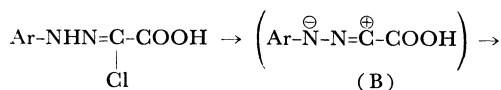
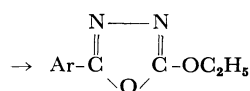
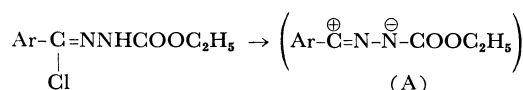
Studies of Heteroaromaticity. XLVI.¹⁾ Syntheses of 2,5-Disubstituted 1,3,4-Oxadiazoles Containing Nitrofuran Nucleus

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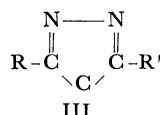
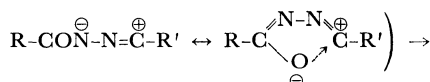
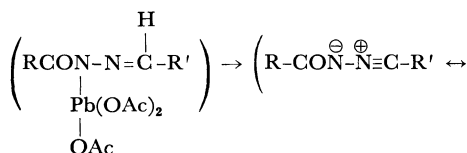
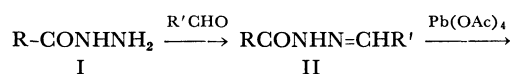
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In a previous paper, we reported that aroyl and aryl nitrile oxides have a similar reactivity in the 1,3-dipolar cycloaddition.²⁾ In continuation of our studies on similar reactivity of the nitrile imines,³⁾ this paper describes our attempts to prepare *N*-aroyl nitrile imines. 1- α -chlorobenzylidene-2-ethoxycarbonylhydrazine is reported to cyclize by triethylamine to 2-phenyl-5-ethoxy-1,3,4-oxadiazole⁴⁾ and in a similar manner, aryldrazonochloroacetic acids cyclize to 4-aryl-5-oxo-1,3,4-oxadiazol-2-ines.⁵⁾ Both cyclization reactions might be explained by postulating intermediate *N*-ethoxycarbonyl benzonitrile imine (A) and *C*-carboxynitrile imine (B), respectively.



As in the preparation of the nitrile imines,³⁾ lead tetraacetate-oxidation of the readily available aroylhydrazones (II) from aroylhydrazines (I) was carried out at room temperature. The products were characterized as 2,5-disubstituted 1,3,4-oxadiazoles (III), simple oxidation products of aroylhydrazones which provide general procedure

for the preparation of 2,5-disubstituted 1,3,4-oxadiazoles.⁶⁾ The recent appearance of an article on a similar subject⁷⁾ prompted us to write this note. A sequence of the reaction and the mechanism postulated for the preparation of III are given below.



The results are summarized in Tables 1 and 2.

Experimental⁸⁾

Starting Materials. Aroylhydrazines (Ia:⁹⁾ 5-nitro-2-furoyl, Ib:¹⁰⁾ 5-nitro-2-furylacroyl, and Ic:¹¹⁾ benzoylhydrazine) and 5-nitro-2-furylacrolein¹²⁾ were prepared by the known procedures. All the other aldehydes were commercial products.

General Procedure. *Conversion of I to II.* A mixture of 0.6 g (3.5 mmol) of 5-nitro-2-furoylhydrazine

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8) The melting points were measured on a micro hot stage and are not corrected. The microanalyses were carried out with a Perkin-Elmer Model 240 Elemental Analyzer. The ultraviolet spectra were obtained on a Jasco ORD/UV-5 and the infrared spectra on a Jasco IR-S spectrometer.

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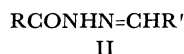
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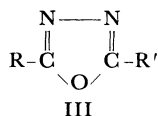
TABLE 1. ACYLHYDRAZONES



R	R'	Product	Mp. °C	Yield %	Found (Calcd)			UV $\lambda_{\text{max}}^{\text{EtOH}}$ ($\epsilon \times 10^{-4}$)	IR $\nu_{\text{CO}}^{\text{KBr}}$ cm ⁻¹
					C%	H%	N%		
NF-*	C ₆ H ₅ -	IIa	212—214	85	55.58 (55.60)	3.58 3.50	16.35 16.21	322 (1.7), 298 (1.58), 280 (1.7)	1665
NF-	<i>p</i> -Cl-C ₆ H ₄ -	IIb	226—229	80	48.95 (49.08)	2.75 2.72	14.25 14.31		1665
NF-	<i>p</i> -CH ₃ -C ₆ H ₄ -	IIc	210—214	70	57.20 (57.14)	4.15 4.06	15.45 15.38		1670
NFCH=CH-	C ₆ H ₅ -	IIId	218—220	90	58.85 (58.94)	3.95 3.89	14.80 14.73		1660
C ₆ H ₅ -	NF-	IIe	215—219	90	55.55 (55.60)	3.65 3.50	16.15 16.21		1660
C ₆ H ₅ -	NFCH=CH-	IIIf	233—235	90	59.05 (58.94)	3.78 3.89	14.75 14.73		1640

* NF: 5-nitro-2-furyl

TABLE 2. OXADIAZOLES



R	R'	Product	Mp °C	Yield %	Found (Calcd)			UV $\lambda_{\text{max}}^{\text{EtOH}}$ ($\epsilon \times 10^{-4}$)	IR $\nu_{\text{C=N}}^{\text{KBr}}$ cm ⁻¹
					C%	H%	N%		
NF-	C ₆ H ₅ -	IIIa	231—232	80	56.15 (56.03)	2.85 2.74	16.45 16.34	332 (1.55) 266 (1.14)	1610
NF-	<i>p</i> -Cl-C ₆ H ₄ -	IIIb	216—217	75	49.35 (49.42)	2.15 2.06	14.55 14.41	330 (1.8) 268 (1.4)	1615
NF-	<i>p</i> -CH ₃ -C ₆ H ₄ -	IIIc	180—182	85	57.65 (57.56)	3.45 3.34	15.55 15.49	336 (1.68) 268 (1.29)	1610
NFCH=CH-	C ₆ H ₅ -	IIId*	216—218	40	59.45 (59.36)	3.35 3.20	14.95 14.84	368 (2.34) 292 (1.06) 233 (1.16)	1605
C ₆ H ₅ -	NF-	IIIa	227—231	70					1610
C ₆ H ₅ -	NFCH=CH-	IIId	215—217	30					1605

* A. Sugihara and M. Ito, *Yakugaku Zasshi*, **85**, 744 (1965); mp 205—206°C.

(Ia) and 0.4 g (3.5 mmol) of benzaldehyde was refluxed in 40 ml of ethanol for 7 hr. After cooling, the precipitates were collected and recrystallized from ethanol to give 0.85 g (85%) of 1-benzylidene-2-(5-nitro-2-furyl)-hydrazine (IIa). The results of similar reactions using several aroyhydrazines and aromatic aldehydes are summarized in Table 1.

Conversion of II to III. To a stirred suspension of 0.5 g (2 mmol) of IIa in 100 ml of dichloromethane

was added 1.3 g (3 mmol) of lead tetraacetate at room temperature. The mixture was stirred at room temperature for 2 days. After filtering off the undissolved materials, the solvent was removed under reduced pressure. The residue was recrystallized from ethanol-benzene-tetrahydrofuran to afford 0.38 g (80%) of 2-(5-nitro-2-furyl)-5-phenyl-1,3,4-oxadiazole (IIIa), 231—232°C (decomp.). Analytical and spectral data are summarized in Table 2.