REDUCTION OF NITRO DERIVATIVES OF 1, 3, 4-OXADIAZOLE

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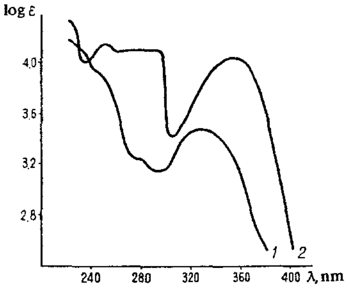
A method for the synthesis of amino derivatives of 1, 3, 4-oxadiazole by the reduction of the corresponding nitro compounds with hydrazine hydrate in the presence of Raney nickel in dioxane-ethanolic solution has been developed.

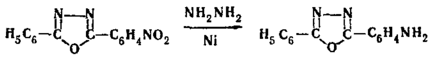
At the present time, amino derivatives of 1, 3, 4-oxadiazole are used in the production of dyes and polymeric materials, in scintillation techniques, etc.



UV spectra in ethanol at a concentration of 3×10^{-5} M: 1) 1-(o-aminobenzoyl)-2-benzoylhydrazine; 2) 2-(o-aminophenyl)-5-phenyl-1, 3, 4-oxadiazole.

A series of methods for the synthesis of amino derivatives of 1, 3, 4-oxadiazole has been described in the literature, but in some cases these methods are partial in nature and cannot be used as general routes for their preparation [1, 2].

In this work we have studied the possibility of synthesizing amino derivatives of 1, 3, 4-oxadiazole by the reduction of the corresponding nitro compounds with hydrazine hydrate in the presence of Raney nickel in accordance with the equation



It is known [3] that 2-aryl-substituted 1, 3, 4-oxadiazoles decompose under the action of Raney nickel. We have found that 2, 5-diaryl-substituted oxadiazoles are considerably more stable under these conditions: when small amounts of Raney nickel were used, the reduction products were isolated from the reaction mixture quantitatively.

The reduction of 5-aryl-2-nitrophenyl-1, 3, 4-oxadiazoles takes place readily in accordance with the above equation in the mixed solvents dioxane—ethanol or dioxane—methanol, which readily dissolve both the initial nitro compounds and the intermediate reaction products. Thus, for example, the 2-(p-aminophenyl)- and 2-(m-aminophenyl)-5-phenyl-1, 3, 4-oxadiazoles obtained by the reduction of the corresponding nitro compounds with hydrazine hydrate in the presence of Raney nickel proved to be identical with the substances synthesized by reduction with phenylhydrazine [4, 5]. When 2-(o-nitrophenyl)-5-phenyl-1, 3, 4-oxadiazole was reduced by this method, the previously unknown 2-(o-aminophenyl)-5-phenyl-1, 3, 4-oxadiazole was obtained. The substance to which the structure of 2-(o-aminophenyl)-5-phenyl-1, 3, 4-oxadiazole was previously ascribed is actually 1-(o-aminobenzoyl)-2-benzoylhydrazine, since it has been found that in the reaction of phenylhydrazine with 2-(o-nitrophenyl)-5-phenyl-1, 3, 4-oxadiazole, in addition to the reduction of the nitro group, the cleavage of the oxadiazole ring takes place with the formation of the corresponding 1-(o-aminobenzoyl)-2-benzoylhydrazine. The analogous product is obtained in the reduction of 1-benzoyl-2-(o-nitrobenzoyl)hydrazine with hydrazine hydrate in the presence of Raney nickel. These compounds were identified by their melting points, UV spectra (see figure), and other properties.

In the reduction of the nitro derivatives of 1, 3, 4-oxadiazoles containing halogen atoms (chlorine, bromine) in the benzene rings, no dehalogenation took place. Thus, 2-(m-aminophenyl)-5-(p-chlorophenyl)- and 2-(m-aminophenyl)-5-(o-bromophenyl)-1, 3, 4-oxadiazoles were obtained.

The reduction of nitro derivatives of oxadiazole with hydrazine hydrate in the presence of Raney nickel may also be used successfully for the preparation of diamino-substituted 1, 3, 4-oxadiazoles. For example, the dinitro derivative of bis-1, 3, 4-oxadiazole gave a quantitative yield of the corresponding diamine which was identical with the compound obtained by reduction using phenylhydrazine [6].

EXPERIMENTAL

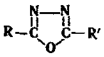
The 1, 2-diaroylhydrazines required for the synthesis of the 1, 3, 4-oxadiazole derivatives were obtained from the corresponding hydrazides and acid chlorides by a method similar to that described previously [4, 5].

1-(o-Bromobenzoyl)-2-(m-nitrobenzoyl)hydrazine, after crystallization from dioxane, formed colorless needles with mp 200–201° C. Found, %: N 11.60. Calculated for $C_{14}H_{10}BrN_3O_4$, %: N 11.54.

1-(p-Chlorobenzoyl)-2-(m-nitrobenzoyl)hydrazine formed needles with mp 252–253° C (from dioxane). Found, %: Cl 11.08; N 13.05. Calculated for $C_{14}H_{10}ClN_3O_4$, %: Cl 11.09; N 13.14.

The 1, 3, 4-oxadiazole derivatives were obtained as described previously [4, 5] by boiling the corresponding 1, 2-diaroylhydrazines with phosphorus oxychloride (see table).

Reduction of the nitro derivatives of 1, 3, 4-oxadiazole. A 100-ml flask was charged with 2 g of a nitro compound, 30 ml of dioxane, 5 ml of ethanol or methanol, 3 ml of hydrazine hydrate (98%), and a pinch of Raney nickel. The mixture was heated in the boiling water bath until the evolution of bubbles of gas ceased. After the end of the reaction, the colorless or pale green liquid was filtered and the filtrate poured into an excess of water. The white crystalline product

2,5-Diaryl-1,3,4-oxadiazoles 

R	R′	Mp, °C	Solvent for crystallization	Empirical formula	N, %		Yield, %	Amino groups found [7]
					found	calcu-lated		
m-$NO_2C_6H_4$	*o*-BrC_6H_4	200—201	Benzene, toluene	$C_{14}H_8BrN_3O_3$	12.17	12.14	94	—
m-$NO_2C_6H_4$	*p*-ClC_6H_4	252—253	Chlorobenzene, dioxane	$C_{14}H_8ClN_3O_3$*	13.89	13.93	96	—
o-$NH_2C_6H_4$	C_6H_5	165—166	Methanol, benzene	$C_{14}H_{11}N_3O$	17.68	17.71	97	0.99
m-$NH_2C_6H_4$	*o*-BrC_6H_4	140—141	Methanol	$C_{14}H_{10}BrN_3O$	13.34	13.29	94	0.98
m-$NH_2C_6H_4$	*p*-ClC_6H_4	183—184	Toluene, ethanol	$C_{14}H_{10}ClN_3O$**	—	—	98	0.97

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*Found, %: Cl 11.92. Calculated, %: Cl 11.75.

**Found, %: Cl 12.94. Calculated, %: Cl 13.05.

that precipitated was separated off, washed with water, and dried (see table).

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