CONDENSED AND BONDED QUINOXALINES

IV.* NEW ROUTE TO ARYLAMIDES OF (1,2-DIHYDRO-2-OXO-3-QUINOXALYL)ACETIC ACID

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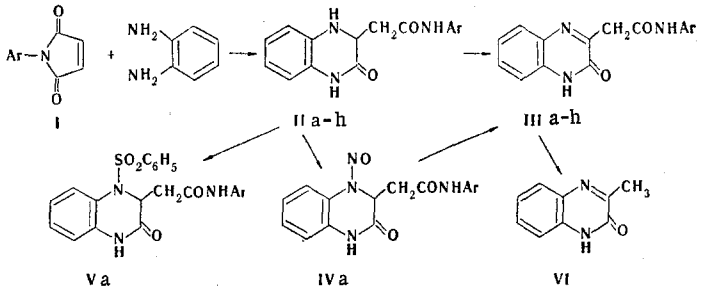
Arylamides of (1,2,3,4-tetrahydro-2-oxo-3-quinoxalyl)acetic acid were obtained by reaction of N-arylmaleinimides with o-phenylenediamine and were converted to the corresponding quinoxalones by dehydrogenation with chloranil. The structures of the compounds obtained were confirmed by chemical transformations and IR spectroscopy.

Arylamides of (1,2-dihydro-2-oxo-3-quinoxalyl)acetic acid (IIIa-h) have not been described. The readily accessible N-arylmaleinimides (I) [2] were used as starting substances for the synthesis of IIIa-h. Condensation of I with o-phenylenediamine in aqueous alcohol media gave arylamides of (1,2,3,4-tetrahydro-2-oxo-3-quinoxalyl)acetic acid (IIa-h), which were converted to IIIa-h by dehydrogenation with chloranil:

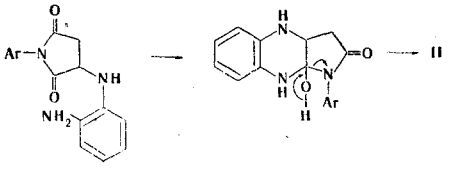


I IIa-h IIIa-h

Va IVa VI

a Ar = C_6H_5; b Ar = p-$CH_3C_6H_4$; c Ar = p-$CH_3OC_6H_4$; d Ar = p-$C_2H_5OC_6H_4$; e Ar = $C_6H_5CH_2$; f Ar = o-$NO_2C_6H_4$; g Ar = o-ClC_6H_4; h Ar = 2-CH_3O-5-ClC_6H_3

The structures of IIa-h were confirmed by chemical properties, in particular by the formation of a phenylsulfonyl derivative (Va) and an N-nitroso derivative (IVa). The latter, on brief refluxing in acetic acid, is converted to IIIa, the alkaline hydrolysis of which gives 2-hydroxy-3-methylquinoxaline, identical to the compound obtained from pyruvic acid [3]. The reaction of I with o-phenylenediamine apparently proceeds through the intermediate formation of 3-(o-aminophenyl)-1-arylpyrrolidine-2,5-diones, which undergo intramolecular acylation to give II:



*See [1] for communication III.

†Deceased.

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TABLE 1. Arylamides of (1,2,3,4-Tetrahydro-2-oxo-3-quinoxalyl)-acetic Acid*

Compounds II	Ar	mp, °C	IR spectr., cm^{-1}		Empirical formula	Found, %			Calc., %			Yield, %
			amide I	C=O		C	H	N	C	H	N	
a	Phenyl	220—223	1690	1675	$C_{16}H_{15}N_3O_2$	68,0	6,7	15,2	68,3	5,4	14,9	79
b	p-Tolyl	251—253	1690	1665	$C_{17}H_{17}N_3O_2$	69,2	5,7	14,5	69,1	5,8	14,1	72
c	p-Methoxyphenyl	212—215	1700	1660	$C_{17}H_{17}N_3O_3$	65,9	5,9	13,4	65,6	5,5	13,5	70
d	p-Ethoxyphenyl	219—221	1700	1668	$C_{18}H_{19}N_3O_3$	66,8	6,2	13,2	66,5	5,9	12,9	72
e	Benzyl	244—245	1700	1660	$C_{17}H_{17}N_3O_2$	69,2	6,1	14,3	69,1	5,8	14,2	75
f	o-Nitrophenyl	208—209	1700 Broad		$C_{16}H_{14}N_4O_4$	59,1	4,8	17,2	58,9	4,3	17,2	80
g	o-Chlorophenyl	234—236	1700	1680	$C_{16}H_{14}ClN_3O_2$	60,4	4,8	13,4	60,9	4,5	13,3	70
h	2-Methoxy-5-chlorophenyl	214—216	1700	1680	$C_{17}H_{16}ClN_3O_3$	58,7	4,8	12,4	59,1	4,7	12,2	78

*The substances were purified by crystallization from aqueous dimethylformamide.

TABLE 2. Arylamides of (1,2-Dihydro-2-oxo-3-quinoxalyl) Acetic Acid*

Compounds III	Ar	mp, °C	IR spectr., cm^{-1}		Empirical formula	Found, %			Calc., %			Yield, %
			amide I	C=O		C	H	N	C	H	N	
a	Phenyl	283—285	1680	1660	$C_{16}H_{13}N_3O_2$	69,4	4,9	14,9	68,8	4,7	15,1	92
b	p-Tolyl	278—281	1680 Broad		$C_{17}H_{15}N_3O_2$	69,3	5,5	14,5	69,6	5,2	14,3	95
c	p-Methoxyphen.	282—284	1680	1670	$C_{17}H_{15}N_3O_3$	66,3	5,3	13,8	66,0	4,9	13,6	93
d	p-Ethoxyphenyl	282—285	1700	1668	$C_{18}H_{17}N_3O_3$	66,8	5,6	13,3	66,9	5,3	13,0	91
e	Benzyl	237—240	1680	1650	$C_{17}H_{15}N_3O_2$	69,7	5,4	14,5	69,6	5,2	14,3	92
f	o-Nitrophenyl	243—244	1700	1660	$C_{16}H_{12}N_4O_4$	59,1	3,9	17,2	59,3	3,7	17,3	95
g	o-Chlorophenyl	265—268	1680 Broad		$C_{16}H_{12}ClN_3O_2$	60,9	4,1	13,4	61,2	3,9	13,4	95
h	2-Methoxy-5-chlorophenyl	260—263	1695	1660	$C_{17}H_{14}ClN_3O_3$	59,8	4,4	12,2	59,4	4,1	12,2	90

*Compound IIIe was purified by crystallization from acetic acid, while the remaining compounds were purified by crystallization from dimethylformamide.

Two bands at 1660-1680 and 1680-1700 cm^{-1}, which are, respectively, caused by absorption of the lactam and arylamide carbonyl groups, are observed in the IR spectra of quinoxalones IIa-h and IIIa-h in the region of the C=O stretching vibrations. It should be noted that, in comparison with IIa-h, the shift of the primary amide band to the low-frequency region is absent for IIIa-h, while the ester carbonyl in the spectrum of ethyl (1,2-dihydro-2-oxo-3-quinoxalyl)acetate absorbs in an anomalously low region [4].

In contrast to 1,2,3,4-tetrahydro-2-oxoquinoxaline, IIa-h are not oxidized by hydrogen peroxide and are extremely stable compounds. The use of other inorganic oxidizing agents is less suitable because of the strong complexing of quinoxalone with metal ions.

EXPERIMENTAL

The IR spectra of KBr pellets of the synthesized compounds were recorded with a UR-20 spectrometer.

Arylamides of (1,2,3,4-Tetrahydro-2-oxo-3-quinoxalyl)acetic Acid (IIa-h). A 0.11-mole sample of o-phenylenediamine was dissolved in 300 ml of water by heating on a water bath, and a hot solution of 0.1 mole of N-arylmaleinimide in 100-150 ml of methanol was added with stirring. The mixture was then heated for 1.5-2 h and cooled, and the resulting crystalline substance was separated by filtration, washed on the filter with water, and dried. Data on the yields and physicochemical characteristics of the compounds are presented in Table 1.

Arylamides of (1,2-Dihydro-2-oxo-3-quinoxalyl)acetic Acid (IIIa-h). A 0.01-mole sample of the appropriate II was refluxed in 30 ml of toluene with 0.01 mole of chloranil for 2-3 h. The hot solution was

filtered, and the precipitated III was washed on the filter with toluene. The characteristics of the compounds obtained are presented in Table 2.

Anilide of (1,2,3,4-Tetrahydro-1-phenylsulfonyl-3-oxo-2-quinoxalyl) Acetic Acid (Va). A 2.81-g (0.01 mole) sample of IIa was dissolved in 10 ml of pyridine, and 1.94 g (0.11 mole) of benzenesulfonyl chloride was added. The reaction mixture was heated on a water bath for 1 h, after which it was poured into water. The precipitate was removed by filtration and purified by crystallization from ethanol to give 3.33 g (80%) of colorless needles with mp 200-201°. Found,%: N 10.0; S 7.8. $C_{22}H_{18}N_3O_4S$. Calculated,%: N 10.0; S 7.6.

Anilide of (1,2,3,4-Tetrahydro-1-nitroso-3-oxo-2-quinoxalyl) Acetic Acid (IVa). A 2.81-g (0.01 mole) sample of IIa was dissolved by heating in 50 ml of acetic acid, after which the solution was cooled to room temperature and treated with a solution of 0.83 g (0.012 mole) of sodium nitrite in 10 ml of water. A yellow crystalline product precipitated after a few minutes to give 2.78 g (90%) of a substance with mp 258-259° (from ethanol). Found,%: N 18.2. $C_{16}H_{14}N_4O_3$. Calculated,%: N 18.1.

Anilide of (1,2-Dihydro-2-oxo-3-quinoxalyl)acetic Acid (IIIa) from Nitroso Compound IVa. A 3.10-g (0.01 mole) sample of IVa was refluxed in 30 ml of acetic acid for 5-10 min until the evolution of nitrogen oxides ceased. The mixture was then cooled and treated with water, and the precipitate was separated by filtration. The IR spectrum of the precipitate was identical to the spectrum of the compound obtained by dehydrogenation of IIa with chloranil. The yield of a product with mp 283-285° (from aqueous dimethylformamide) was 1.87 g (67%).

Hydrolysis of (1,2-Dihydro-2-oxo-3-quinoxalyl)acetic Acid Anilide. A 2.81-g (0.01 mole) sample of IIIa was refluxed with 40 ml of 10% aqueous sodium hydroxide solution for 2 h. The solution was then cooled and acidified, and the precipitated crystalline substance was separated by filtration to give 0.96 g (60%) of a product with mp 248-250° (from aqueous dimethylformamide) (mp 245 and 250° [3, 5], respectively).

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