Chemistry

1962

SovietRxiv

Abstract

Full Text

Chemistry

V. M. Berezovskii and G. D. Glebova

A New Reaction of *o*-Phenylenediamines with Violuric Acid

(Presented by Academician B. A. Kazanskii, January 12, 1962)

When heated in a neutral or acetic-acid medium, primary or primary-secondary *o*-phenylenediamines, as we have shown, react with violuric acid to form compounds of the ureide type of 2-hydroxyquinoxaline-3-carboxylic acid. Thus, in the interaction of violuric acid with 4,5-dimethyl-1,2-diaminobenzene (I) or 3,4-dimethylphenyl-6-amino-*D*-ribitylamine (III), we obtained the ureide of 6,7-dimethyl-2-hydroxyquinoxaline-3-carboxylic acid (II) and the ureide of 6,7-dimethyl-N-(1′-*D*-ribityl)-1,2-dihydro-2-oxoquinoxaline-3-carboxylic acid (IV), respectively. As a result of nucleophilic attack by the nitrogen atom of the primary amino group of the carbocyclic compound on the electrophilic carbon atom at position 5 of violuric acid, the isonitroso group is displaced in the form of hydroxylamine, with formation of a $> \mathrm{C{—}N = C} <$ bond between the two reacting compounds.

$$(\mathrm{I}) + \text{violuric acid} \longrightarrow (\mathrm{II})$$

$$(\mathrm{III}) + \text{violuric acid} \longrightarrow (\mathrm{IV})$$

The structures of compounds II and IV were established by us from their elemental composition and by their complete identity with substances obtained by us by the method of (4) condensation in an aqueous-alcoholic medium of alloxan with 4,5-dimethyl-1,2-ami-

benzoxazole (I) or 3,4-dimethylphenyl-6-amino-*D*-ribitylamine (III) (1-3, 5), respectively, by the absence of melting-point depression in a mixed sample, by the absorption spectrum (Fig. 1), and also by paper chromatography and determination of R_f, corresponding to the R_f values of known substances used as standards.

It could be assumed that in the condensation reaction violuric acid is desoximated to alloxan, which then enters into interaction with the aromatic *o*-diamine. However, no intermediate formation of alloxan occurs, and it is precisely isonitrosobarbituric acid that reacts with the *o*-diamine. Indisputable proof of this was found in control experiments, which were carried out under

Fig. 1. Absorption spectrum (in alcohol). 1 —ureide of 6,7-dimethyl-2-oxychinoxalinecarbonic-3 acid, 2 —ureide of 6,7-dimethyl-N-(1′-*D*-ribityl)-1,2-dihydro-2-oxochinoxalinecarbonic-3 acid

Figure 1: Fig. 1. Absorption spectrum (in alcohol). 1 —ureide of 6,7-dimethyl-2-oxychinoxalinecarbonic-3 acid, 2 —ureide of 6,7-dimethyl-N-(1′-*D*-ribityl)-1,2-dihydro-2-oxochinoxalinecarbonic-3 acid

the same conditions and with the same reagents, but in the absence of the amine. With the same duration of the experiment, formation of alloxan from violuric acid was not observed even in an insignificantly small amount, which was monitored by an especially sensitive test detecting 2—3 γ of alloxan; at such sensitivity alloxan would have been detected upon cleavage of $3 \cdot 10^{-4}$ part of the total amount of violuric acid taken for the experiment.

Fig. 1. Absorption spectrum (in alcohol). 1 —ureide of 6,7-dimethyl-2-oxychinoxalinecarbonic-3 acid, 2 —ureide of 6,7-dimethyl-N-(1′-*D*-ribityl)-1,2-dihydro-2-oxochinoxalinecarbonic-3 acid

For the development of a method for microdetermination of alloxan we used the reaction of its solutions with *o*-phenylenediamines, proceeding with formation of a yellow-green precipitate of the ureide of oxychinoxalinecarbonic acid ([4]). Alloxan is stable under the reaction conditions; its deliberately very small amounts (concentration 0.001%) were completely detected at the end of the experiment.

The samples examined for the presence of alloxan were subjected by us to paper chromatography, which was then treated with a solution of *o*-phenylenediamine; the alloxan spot with R_f 0.43 (in the system *n*-butanol—water—acetic acid, 4 : 5 : 1) and R_f 0.83 (isobutanol—pyridine—water—acetic acid, 33 : 33 : 33 : 1) was detected by the formation of a condensation product fluorescing with intense yellow-green fluorescence in ultraviolet light.

It is known that ureides of oxychinoxalinecarbonic acids under alkaline treatment readily lose the ureide grouping ([2], [4], [6], [7]) and undergo decarboxylation ([4], [7]). Thus, the new reaction discovered by us for obtaining ureides of oxychinoxalinecarbonic acids by the interaction of *o*-phenylenediamines with violuric acid serves as a new method for the synthesis of oxychinoxaline acids and 2-oxychinoxalines.

Experimental Part

Ureide of 6,7-dimethyl-2-oxychinoxalinecarbonic-3 acid (II). 1.57 g (0.01 g-mol.) of violuric acid, 1.62 g (0.012 g-mol.) of 4,5-dimethyl-1,2-diaminobenzene, and 40 ml of a mixture of glacial acetic-

acetic acid and alcohol (1:1) is heated at reflux for 4 h. The precipitate that separates is filtered off and washed with boiling water and alcohol (2 × 20 ml). This gives 1.1 g of ureide of 6,7-dimethyl-2-oxohinoxalinecarboxylic acid-3 (II), 70% according to the content determined by spectrophotometry (yield 30%). Lemon-yellow crystals (from glacial acetic acid; recrystallization ratio 1:50), mp 255–257° (with decomposition). Absorption spectrum (in alcohol): $\lambda_{\max}$ 239 mμ (ε $2.40 \cdot 10^4$), 326 mμ (ε $1.11 \cdot 10^4$), and 403 mμ (ε $0.71 \cdot 10^4$); R_f 0.65 (in the ascending flow, in the system *n*-butanol—acetic acid—water, 4:1:5, paper grade M).

Found, %: C 55.46; 55.28; H 4.82; 4.97; N 21.44; 21.26
$C_{12}H_{12}O_3N_4$. Calculated, %: C 55.37; H 4.64; N 21.52

For compound II, obtained by condensation of 4,5-dimethyl-1,2-diaminobenzene and alloxan in an aqueous-alcoholic medium according to (1): lemon-yellow needles, mp 254–256° (with decomposition); absorption spectrum (in alcohol): $\lambda_{\max}$ 239 mμ (ε $2.50 \cdot 10^4$), 326 mμ (ε $1.06 \cdot 10^4$), and 402 mμ (ε $0.69 \cdot 10^4$); R_f 0.65 (in the system *n*-butanol—water—acetic acid, 4:5:1). According to the literature data (1): R_f 0.63 (in the same system).

Found, %: C 55.55; 55.30; H 4.40; 4.68; N 21.20
$C_{12}H_{12}O_3N_4$. Calculated, %: C 55.37; H 4.64; N 21.52

Ureide of 6,7-dimethyl-N-(1′-*D*-ribityl)-1,2-dihydro-2-oxohinoxalinecarboxylic acid-3 (IV). A mixture of 1.57 g (0.01 g-mol) of violuric acid, 3.4 g (0.012 g-mol) of 3,4-dimethylphenyl-6-amino-*D*-ribitylamine, and 40 ml of a mixture of glacial acetic acid and alcohol (1:2.5) is heated at reflux for 4 h. The precipitate that separates is filtered off and washed with boiling water and alcohol (2 × 20 ml). This gives 2.8 g of ureide of 6,7-dimethyl-N-(1′-*D*-ribityl)-1,2-dihydro-2-oxohinoxalinecarboxylic acid-3, 85% according to the content determined by spectrophotometry (yield 71%). Lemon-yellow crystals (from 50% acetic acid; recrystallization ratio 1:70), mp 231–232° (with decomposition). Absorption spectrum (in alcohol): $\lambda_{\max}$ 240 mμ (ε $2.16 \cdot 10^4$), 327 mμ (ε $0.92 \cdot 10^4$), and 401 mμ (ε $0.58 \cdot 10^4$). R_f 0.30 (in the ascending flow, in the system *n*-butanol —acetic acid—water, 4:1:5, paper grade "M").

Found, %: C 52.06; H 5.58; N 14.20; 14.40
$C_{17}H_{22}O_7N_4$. Calculated, %: C 51.77; H 5.62; N 14.21

For compound IV, obtained by condensation of 3,4-dimethylphenyl-6-amino-*D*-ribitylamine with alloxan according to (3, 5): mp 230–232° (with decomposition); R_f 0.30 (in the system *n*-butanol—water—acetic acid, 4:5:1). Absorption spectrum (in alcohol): $\lambda_{\max}$ 240 mμ (ε $2.15 \cdot 10^4$), 328 mμ (ε $0.95 \cdot 10^4$), and 400 mμ (ε $0.55 \cdot 10^4$). According to the literature data: mp 237–240° (with decomposition) (2), R_f 0.40 (in the same system) (1).

Found, %: C 51.62; 51.47; H 5.90; 5.75; N 14.54; 14.58
$C_{17}H_{22}O_7N_4$. Calculated, %: C 51.77; H 5.62; N 14.21

Paper chromatography method. Chromatographic paper grade M (Leningrad) was used. Three to four drops of the reaction mixture are applied at the start and placed in a chamber for ascending flow with the systems: 1) *n*-butanol—water—acetic acid (4:5:1), or 2) isobutanol—pyridine—water—acetic acid (33:33:33:1). To reveal alloxan, the chromatogram is sprayed with a 1% alcoholic solution of 4,5-dimethyl-1,2-diaminobenzene and dried for 30 min. The presence of alloxan is detected by the intense yellow-green fluorescence in ultraviolet light of the condensation product at the site of the alloxan spot. For alloxan, R_f 0.43 in the 1st system and R_f 0.83 in the 2nd system. Sensitiv-

···ity of the method is 2–3 γ. The presence of ureides of quinoxaline-3-carboxylic acid (compounds II′ and IV) is detected by intense yellow-green fluorescence in ultraviolet light without development.

All-Union Scientific-Research
Vitamin Institute

Received
11 I 1962

References

[1] E. Holey, J. Lambooy, *J. Am. Chem. Soc.*, **76**, 2926 (1954).
[2] M. Tishler, J. Wellman, K. Ladenburg, *J. Am. Chem. Soc.*, **67**, 2165 (1945).
[3] R. Kuhn, F. Weygand, *Ber.*, **68**, 1282 (1935).
[4] O. Hinsberg, *Ber.*, **18**, 1228 (1885).
[5] F. King, J. Clark-Lewis, *J. Chem. Soc.*, **1951**, 3379.
[6] H. Rudy, K. Cramer, *Ber.*, **71**, 1234 (1938).
[7] O. Hinsberg, *Ann.*, **292**, 245 (1896).

Note: Figure translations are in progress. See original paper for figures.

Source: Math-Net.Ru and CyberLeninka. Machine translation. Verify with the original.