STRUCTURE AND PRODUCTS OF OXIDATIVE AMINATION OF 6-HYDROXYQUINOXALINE

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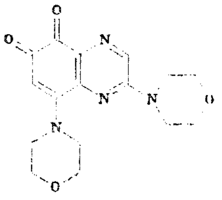
3-Morpholino-6-methoxy-5,8-quinoxalinequinone was synthesized by a method which excludes the formation of isomers, and was used for proving the structure of products of the oxidative amination of 6-hydroxyquinoxaline as 2,8-bis(dialkylamino)-5,6-quinoxalinequinones.

In the presence of a Cu^{2+}–secondary amine complex, 6-hydroxyquinoxaline is readily oxidized into 5,6-quinoxalinequinones, containing dialkylamino groups in the quinone and pyrazine rings (for example, quinone I) [1]. However, the position of the substituent in the heterocyclic part of the molecules has still to be clarified. In the present work, we prove that the products of the oxidative amination of 6-hydroxyquinoxaline have the structure of 2,8-bis(dialkylamino)-5,6-quinoxalinequinones,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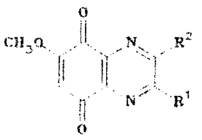
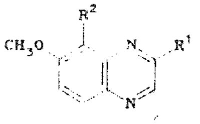

IIa-e


IIIa-e

IIa, IIIb-e $R^1 = N(CH_2CH_2)_2O$; IIb, c $R^1 = H$; IIIa $R^1 = Cl$; IIa, c, IIIa, b $R^2 = H$; IIb $R^2 = N(CH_2CH_2)O$; IIIc $R^2 = NO_2$, d $R^2 = NH_2$, e $R^2 = C_6H_5CONH$.

It is known that methanolysis of quinone I leads to compound IIa. To prove the structure of the last compound, a quinone with an alternative structure IIb was synthesized. The scheme of this synthesis included the formation of isomers. Heating quinoxaline IIIa in morpholine leads to compound IIIb. Nitration of the latter gave compound IIIc, which is converted by catalytic hydrogenation into a labile amino derivative IIId. This was additionally identified in the form of a benzoate IIIe. Quinone II b was obtained from compound IIId by the Tauber reaction [2].

Quinones IIa, b have one and the same empirical formula, but they are not identical in melting point, chromatographic behavior, and IR spectroscopy data {IR spectrum of quinone IIa: 1678 (C_5O), 1659 cm^{-1} (C_8O) [1]. IR spectrum of quinone IIb: 1704 (C_5O), 1648 cm^{-1} (C_8O)}. Hence, in compound IIa, and also in quinone I, the dialkylamino residue in the heterocyclic part is present at $C_{(2)}$.

This structure is also indicated by IR spectroscopy data. Comparison of the spectra of quinones IIa, b and quinone IIc unsubstituted in the pyrazine ring {IR spectrum: 1698 (C_5O), 1660 cm^{-1} (C_8O) [3]} shows that introduction of a donor substituent into the 3-position lowers the vibration frequency of the conjugated carbonyl $C_8{=}O$, while in quinone IIa a similar shift of the carbonyl $C_5{=}O$ vibration band is observed. Hence, the data of IR spectra can be used to reliably differentiate between the 2- and 3-aminoquinoxalinequinones.

EXPERIMENTAL

The IR spectra were run on a UR-20 spectrophotometer in KBr tablets. The course of the reaction and the purity of the products obtained were controlled by TLC on Silufol plates in a 10:1 chloroform–methanol system.

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3-Morpholino-6-methoxyquinoxaline (IIIb). A solution of 1.0 g (5.2 mmoles) of compound IIIa [4] in 5 ml of morpholine is boiled for 2 h, then cooled and poured into 30 ml of 30% acetic acid. The precipitate is filtered, washed with water, and dried. Yield 0.80 g (63%). Colorless crystals, mp 143-144°C (ethanol). Found N 17.2%. $C_{13}H_{15}N_3O_2$. Calculated: N. 17.1%.

3-Morpholino-5-nitro-6-methoxyquinoxaline (IIIc). A 0.71 g portion (7 mmoles) of potassium nitrate is added in the course of 1 h to a solution of 1.5 g (6 mmoles) of compound IIIb in 10 ml of concentrated H_2SO_4. The mixture is stirred for another hour, and then poured into 100 g of ice. The solution is made alkaline with 2 N NaOH, the precipitate is separated, washed with water, and dried. Yield, 1.6 g (90%), pale-yellow crystals, mp 161-162°C (acetic acid—water). Found: N 19.6%. $C_{13}H_{14}N_4O_4$. Calculated: N 19.3%.

3-Morpholino-5-amino-6-methoxyquinoxaline (IIId). A suspension of 1.90 g (10 mmoles) of compound IIIc in 200 ml of methanol is hydrogenated in the presence of nickel until no more hydrogen is absorbed (∿ 3 h). The catalyst is filtered, and the amine solution obtained is used at the next stage.

5-Benzoylamino-3-morpholino-6-methoxyquinoxaline (IIIe). Colorless crystals, mp 234-235°C (ethanol). IR spectrum: 3345 (NH), 1670 cm^{-1} (CO). Found: C 65.9; H 5.8; N 15.3%. $C_{20}H_{20}N_4O_3$. Calculated: C 65.9; H 5.5; N 15.4%.

3-Morpholino-6-methoxy-5,8-quinoxalinequinone (IIb). A methanol solution of compound IIId, obtained in the preceding experiment, is added in the course of 1 h to a solution of 5.9 g (22 mmoles) of potassium iminoxyl disulfonate [2] and 6.9 g (50 mmoles) of NaH_2PO_4 in 500 ml of water. The mixture is allowed to stand overnight. The quinone IIb precipitate is filtered, washed with water, and dried. Yield, 1.0 g (36%) of brown crystals, mp 242-243°C (DMFA). Found: C 57.0; H 5.0; N 15.6%. $C_{13}H_{13}N_3O_4$. Calculated: C 56.7; H 4.8; N 15.3%.

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