ISSN 1070-4280 Russian Journal of Organic Chemistry, 2006, Vol. 42, No. 5, pp. 752–756. © Pleiades Publishing, Inc. 2006.
Original Russian Text © L.A. Shemchuk, V.P. Chernykh, O.S. Krys'kiv, 2006, published in Zhurnal Organicheskoi Khimii, 2006, Vol. 42, No. 5, pp. 768–771.

Synthesis of 2-R-3-Hydroxy[1,2,4]triazino[6,1-*b*]-quinazoline-4,10-diones

L.A. Shemchuk, V.P. Chernykh, and O.S. Krys'kiv

Ukrainian Pharmaceutical University, Kharkiv, 61002 Ukraine

Received January 17, 2005

Abstract—A preparation method was developed for [1,2,4]triazino[6,1-*b*]quinazoline-4,10-diones using isatoic anhydride, carboxylic acids hydrazides, ethyl oxalyl chloride, and hydroxylamine.

DOI: 10.1134/S1070428006050186

Application of anthranilic and dicarboxylic acids derivatives for building up a quinazolinone ring furnishes structures that open wide opportunities for constructing thereon new heterocyclic systems, in particular, those with fused heterocyclic rings [1].

The simplest methods suggested nowadays for the synthesis of compounds from the triazinoquinazolinone series are based mainly on the application as an initial substance of ethyl 3-amino-4-oxo-3,4-dihydroquinazoline-2-carboxylate [2] which is commonly obtained by reaction of the anthranilohydrazide with the diethyl oxalate [3].

We report here on the synthesis of 2-R-3-hydroxy-[1,2,4]triazino[6,1-*b*]quinazoline-4,10-diones **VIIa–VIIf**, a new group of substances with a potential biologic action (see the scheme). First the presumed initial synthons for their preparation were 3,1-benzoxazin-4-ones derivatives, isatoic anhydride (**I**) or 3,1-benzoxazin-4-on-2-carboxylic acid *N*-hydroxyamide (**VIII**).

From the two assumed synthetic procedures the one involving isatoic anhydride (**I**) proved to be more successful. Its reaction with carboxylic hydrazides provided 2-*N*-acylanthranilohydrazides **IIa–IIf**. The hydrazinolysis was carried out in DMF; the reaction occurred cleaner in the presence of triethylamine. A similar condensation with arylcarboxylic hydrazides in the presence of the *p*-toluenesulfonic acid was formerly applied to the one-stage preparation of 2-aryl-3-aminoquinazolin-4-ones [4].

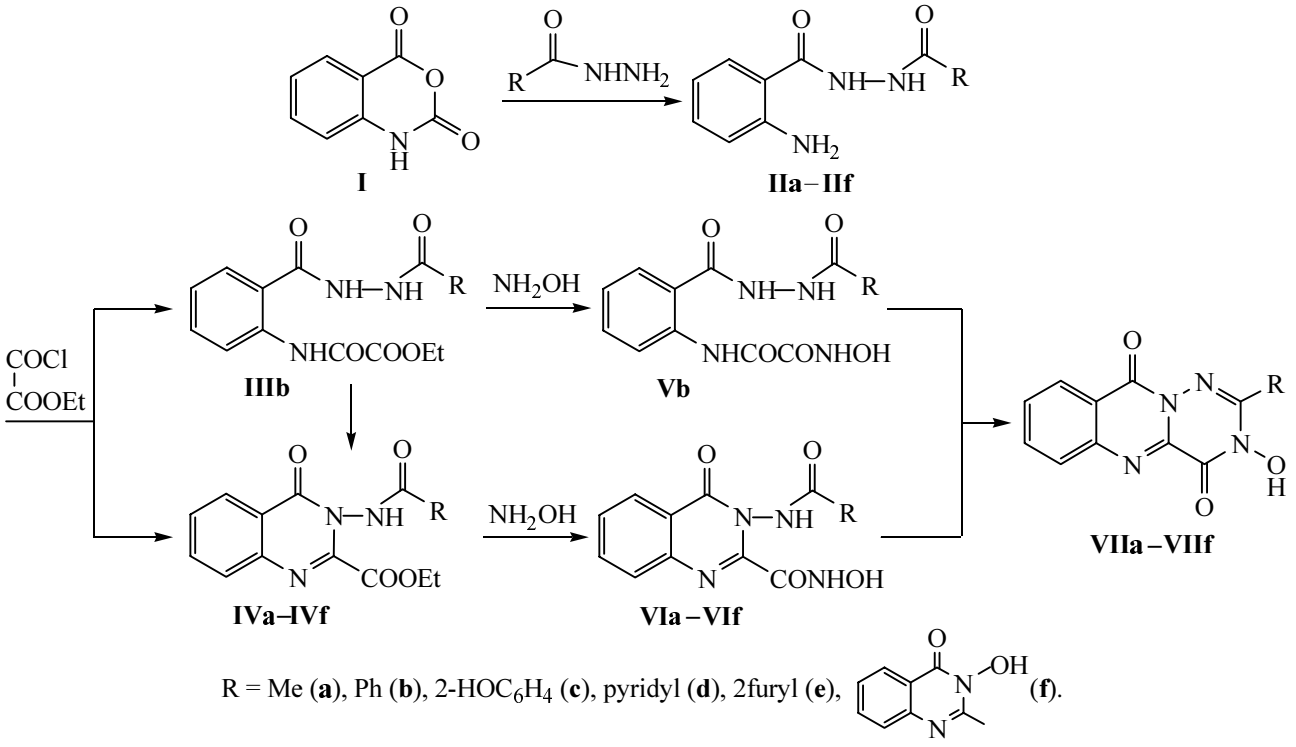
Acylhydrazides **IIa–IIf** obtained were treated with ethyl oxalyl chloride in DMF or acetic acid in the presence of triethylamine. Different products were isolated depending on the reaction temperature. The reaction carried out at 0°C afforded ester **IIIb**, and without cooling the reaction mixture self-heated and alongside the acylation occurred also cyclodehydration furnishing 3-acylamino-2-ethoxycarbonylquinazolin-4-ones **IVa–IVf**. A short (4–6 min) heating of ester **IIIb** also results in formation of quinazolinone **IVb**. In the ^{1}H NMR spectrum of ester **IVb** lack the signals from two NH groups existing in the ^{1}H NMR spectrum of ester **IIIb**.

Considering that the yields of acylhydrazides are virtually quantitative and that the hydrazinolysis and acylation can be performed under similar conditions (DMF in the presence of triethylamine) we have decided to prepare esters **IIIb**, **IVa–IVf** omitting the isolation of intermediate products **IIa–IIf**. This reduced the experimental time due to decreasing the number of stages involving separation and purification of the reaction products, and also improved the yields of esters **IIIb**, **IVa–IVf** calculated on the initial anhydride.

The reaction of esters **IIIb**, **IVa–IVf** with hydroxylamine furnished in good yields the corresponding hydroxamic acids **Vb**, **VIa–VIf** which readily underwent cyclization at heating in acetic anhydride. In both cases the reaction products were diones **VIIa–VIIf**. In reaction of hydroxamic acid **Vb** quinazoline and triazine rings close simultaneously. We failed to stop the reaction at the stage of the quinazoline ring closure (we did not succeed in hydroxyamide **VIb** isolation). The ease of the closure of both rings apparently is due to the enhanced nucleophilic properties of the hydrazide and N-hydroxyamide groups (α-effect) [5].

In keeping with the second scheme we planned to synthesize the triazinoquinazoline system proceeding from

Scheme.



N-hydroxyamide **VIII**; however this route turned out to be less favorable because of complications in the preparation of compound **VIII** by cyclization of 2-carboxyoxanilic acid *N*-hydroxyamide in acetic anhydride by method [6]. The target products were obtained in a low yield with impurity of acetylation products.

EXPERIMENTAL

^{1}H NMR spectra were registered on a spectrometer Varian M200, operating frequency 200 MHz, from solutions in DMSO-d_6 with TMS as internal reference. Elemental analyses were performed on an analyzer Carlo Erba CHNS-O EA 1108.

2-*N*-Benzoylanthranilohydrazide (IIb). In 3 ml of DMF was dissolved 0.01 mol (1.63 g) of isatoic anhydride (**I**), thereto was added 0.01 mol (1.4 ml) of triethylamine and a solution of 0.01 mol (1.36 g) of benzoic hydrazide in 3 ml of DMF. After 4 h the mixture was diluted with cold water. Yield 2.51 g, mp 210–212°C (from AcOH). ^{1}H NMR spectrum, δ, ppm: 6.45 br.s (2H, NH_2), 6.55–7.65 m (9H_{arom}), 10.45 br.s (2H, NHNH). Found, %: C 65.62; H 4.95; N 16.51. $C_{14}H_{13}N_3O_2$. Calculated, %: C 65.87; H 5.13; N 16.46.

Hydrazides **IIa**, **IIc–IIf** were obtained in the same way.

2-*N*-Acetylanthranilohydrazide (IIa). Yield 80%, mp 235–237°C. ^{1}H NMR spectrum, δ, ppm: 2.55 s (3H, CH_3), 6.30 br.s (2H, NH_2), 7.16 t (1H_{arom}), 7.28 t (1H_{arom}), 7.42 d (1H_{arom}), 7.76 d (1H_{arom}), 10.60 br.s (2H, NHNH). Found, %: C 56.23; H 5.57; N 21.69. $C_9H_{11}N_3O_2$. Calculated, %: C 55.95; H 5.74; N 21.75.

2-*N*-(2-Hydroxybenzoyl)anthranilohydrazide (IIc). Yield 95%, mp 208–210°C. ^{1}H NMR spectrum, δ, ppm: 6.40 br.s (2H, NH_2), 6.50–7.80 m (8H_{arom}), 10.30 br.s (2H, NHNH), 11.05 br.s (1H, OH). Found, %: C 62.40; H 5.01; N 15.52. $C_{14}H_{13}N_3O_3$. Calculated, %: C 61.99; N 15.49; H 4.83.

2-*N*-(4-Isonicotinoyl)anthranilohydrazide (IId). Yield 71%, mp 195–197°C. ^{1}H NMR spectrum, δ, ppm: 6.30 br.s (2H, NH_2), 6.25–7.55 m (8H_{arom}), 10.30 br.s (2H, NHNH). Found, %: C 60.65; H 4.84; N 21.91. $C_{13}H_{12}N_4O_2$. Calculated, %: C 60.93; H 4.72; N 21.86.

2-N-(2-Furoyl)anthranilohydrazide (IIe). Yield 78%, mp 285–287°C. ^{1}H NMR spectrum, δ, ppm: 6.45 br.s (2H, NH_2), 6.65–8.10 m (7H_{arom}), 10.40 br.s (2H, NHNH). Found, %: C 59.07; H 4.43; N 17.05. $C_{12}H_{11}N_3O_3$. Calculated, %: C 58.77; H 4.52; N 17.13.

3-Hydroxy-4-oxo-3,4-dihydroquinazoline-2-carboxylic 2-*N*-(2-aminobenzoyl)hydrazide (IIf). Yield 67%, mp 186–188°C. ^{1}H NMR spectrum, δ, ppm: 6.50 br.s

(2H, NH_2), 7.45–8.60 m (8H_{arom}), 10.35 br.s (2H, NHNH), 12.20 br.s (1H, OH). Found, %: C 56.51; H 3.98; N 20.59. $C_{16}H_{13}N_5O_4$. Calculated, %: C 56.64; H 3.98; N 20.64.

Benzoic 2-*N*-[2-(ethoxalylamino)benzoyl]-hydrazide (IIIb). *a*. In 3 ml of the glacial acetic acid (or DMF) was dissolved 0.01 mol (2.55 g) of acylhydrazide **IIb**, 0.01 mol (1.4 ml) of triethylamine was added, the mixture was cooled to 0°C, and 0.01 mol (1.2 ml) of ethyl oxalyl chloride was added. After 3 h the reaction mixture was diluted with cold water. Yield 3.42 g, mp 101–103°C (from acetic acid).

b. In 3 ml of DMF was dissolved 0.01 mol (1.63 g) of isatoic anhydride (**I**), thereto was added 0.01 mol (1.4 ml) of triethylamine and a solution of 0.01 mol (1.36 g) of benzoic hydrazide in 3 ml of DMF. After 4 h the mixture was cooled to 0°C, and 0.01 mol (1.2 ml) of ethyl oxalyl chloride was added. After 3 h the reaction mixture was diluted with cold water. Yield 3.46 g, mp 102–104°C (from AcOH). ^{1}H NMR spectrum, δ, ppm: 1.15 t (3H, $CH_2\underline{CH_3}$), 4.10 m (2H, $\underline{CH_2}CH_3$), 6.80–7.95 m (9H_{arom}), 9.50 br.s (1H, NH), 10.95 br.s (2H, NHNH). Found, %: C 61.19; H 5.02; N 11.89. $C_{18}H_{17}N_3O_5$. Calculated, %: C 60.84; H 4.82; N 11.82.

Ethyl 3-(benzoylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylate (IVb). *a*. In 3 ml of the glacial acetic acid (or DMF) was dissolved 0.01 mol (2.55 g) of acylhydrazide **IIb**, 0.01 mol (1.4 ml) of triethylamine and 0.01 mol (1.2 ml) of ethyl oxalyl chloride was added. After 3 h the reaction mixture was diluted with cold water. Yield 3.29 g, mp 118–120°C (from ethanol).

b. In 3 ml of the glacial acetic acid 0.01 mol (3.55 g) of ester **IIIb** was boiled for 5 min and on cooling was diluted with cold water. Yield 3.33 g, mp 118–120°C (from ethanol).

c. In 3 ml of DMF was dissolved 0.01 mol (1.63 g) of isatoic anhydride (**I**), thereto was added 0.01 mol (1.4 ml) of triethylamine and a solution of 0.01 mol (1.36 g) of benzoic hydrazide in 3 ml of DMF. In 4 h 0.01 mol (1.2 ml) of ethoxalyl chloride was added. After keeping the mixture for 3 h it was diluted with cold water. Yield 3.35 g, mp 117–119°C (from AcOH). ^{1}H NMR spectrum, δ, ppm: 1.10 t (3H, $CH_2\underline{CH_3}$), 4.00 m (2H, $\underline{CH_2}CH_3$), 6.95–7.80 m (9H_{arom}), 12.05 br.s (1H, NH). Found, %: C 63.88; H 4.32; N 12.52. $C_{18}H_{15}N_3O_4$. Calculated, %: C 64.09; H 4.48; N 12.46.

Esters **IVa**, **IVc–IVf** were obtained by similar procedures.

Ethyl 3-(acetylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylate (IVa). Yield 65%, mp 141–143°C. ^{1}H, δ, ppm: 1.05 t (3H, $CH_2\underline{CH_3}$), 4.05 m (2H, $\underline{CH_2}CH_3$), 2.55 s (3H, $COCH_3$), 7.00 t (1H_{arom}), 7.30 d (1H_{arom}), 7.55 t (1H_{arom}), 7.80 d (1H_{arom}), 11.50 br.s (1H, NH). Found, %: C 57.01; H 4.63; N 15.20. $C_{13}H_{13}N_3O_4$. Calculated, %: C 56.73; H 4.76; N 15.27.

Ethyl 3-(2-hydroxybenzoylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylate (IVc). Yield 93%, mp 132–134°C. ^{1}H NMR spectrum, δ, ppm: 1.15 t (3H, $CH_2\underline{CH_3}$), 4.05 m (2H, $\underline{CH_2}CH_3$), 6.40–7.55 m (8H_{arom}), 11.55 br.s (1H, NH), 11.20 br.s (1H, OH). Found, %: C 61.26; H 4.20; N 11.97. $C_{18}H_{15}N_3O_5$. Calculated, %: C 61.19; H 4.28; N 11.89.

Ethyl 3-(2-isonicotinoylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylate (IVd). Yield 82%, mp 128–130°C. ^{1}H NMR spectrum, δ, ppm: 1.10 t (3H, $CH_2\underline{CH_3}$), 4.10 m (2H, $\underline{CH_2}CH_3$), 6.35–7.80 m (8H_{arom}), 11.70 br.s (1H, NH). Found, %: C 60.48; H 4.26; N 16.48. $C_{17}H_{14}N_4O_4$. Calculated, %: C 60.35; H 4.17; N 16.56.

Ethyl 3-(2-furoylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylate (IVe). Yield 89%, mp 220–222°C. ^{1}H NMR spectrum, δ, ppm: 1.10 t (3H, $CH_2\underline{CH_3}$), 4.15 m (2H, $\underline{CH_2}CH_3$), 6.80–8.10 m (7H_{arom}), 11.90 br.s (1H, NH). Found, %: C 58.92; H 4.00; N 12.84.

Ethyl 3-(3-hydroxy-4-oxo-3,4-dihydro-quinazolin-2-ylcarbonylylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylate (IVf). Yield 87%, mp 118–120°C. ^{1}H NMR spectrum, δ, ppm: 1.10 t (3H, $CH_2\underline{CH_3}$), 4.05 m (2H, $\underline{CH_2}CH_3$), 7.35–8.60 m (8H_{arom}), 11.00 br.s (1H, NH), 12.35 br.s (1H, OH). Found, %: C 56.84; H 3.72; N 16.70. $C_{20}H_{15}N_5O_6$. Calculated, %: C 57.01; H 3.59; N 16.62.

Preparation of the methanol solution of hydroxylamine. In a minimal volume of methanol was dissolved 0.012 mol (0.28 g) of sodium, and at cooling a solution of 0.012 mol (0.84 g) hydroxylamine hydrochloride was added. After 15 min the precipitate was removed, and the filtrate was used in further reactions.

Benzoic *N*'-[2-(ethoxalylamino)benzoyl]-hydrazide *N*-hydroxyamide (Vb). In 5 ml of methanol was dissolved 0.01 mol (3.55 g) of ester **IIIb**, and 0.012 mol of hydroxylamine in methanol solution was added. The mixture was stirred for 30 min at 50°C. After 6 h the precipitate formed was separated. Yield 3.27 g, mp 183–185°C (from AcOH). ^{1}H NMR spectrum, δ, ppm: 6.95–8.20 m (9H_{arom}), 9.50 br.s (1H, NH), 10.90 m (2H, NHNH), 11.85 br.s (1H, $\underline{NH}OH$), 12.15 br.s (1H, $NH\underline{OH}$). Found, %: C 55.78; H 4.22; N 16.40. $C_{16}H_{14}N_4O_5$. Calculated, %: C 56.14; H 4.12; N 16.37.

3-(Benzoylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylic acid *N*-hydroxyamide (VIb). In 5 ml of methanol was dissolved 0.01 mol (3.37 g) of ester **IVb**, and 0.012 mol of hydroxylamine in methanol solution was added. The mixture was stirred for 30 min at 50°C. After 6 h the precipitate formed was separated. Yield 3.19 g, mp 205–207°C (from acetic acid). ^{1}H NMR spectrum, δ, ppm: 6.95–8.05 m ($9H_{arom}$), 10.15 br.s (1H, NNH), 10.40 br.s (1H, NHOH), 11.50 br.s (1H, NHOH). Found, %: C 59.41; H 3.52; N 17.20. $C_{16}H_{12}N_4O_4$. Calculated, %: C 59.26; H 3.69; N 17.28.

N-Hydroxyamides **VIa**, **VIc–VIf** were obtained by the same procedure.

3-(Acetylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylic acid *N*-hydroxyamide (VIa). Yield 96%, mp 210–212°C. ^{1}H NMR spectrum, δ, ppm: 2.60 s (3H, CH_3), 6.85 t ($1H_{arom}$), 7.05 d ($1H_{arom}$), 7.25 t ($1H_{arom}$), 7.60 d ($1H_{arom}$), 10.35 br.s (1H, NNH), 11.00 br.s (1H, NHOH), 11.95 br.s (1H, NHOH). Found, %: C 50.27; H 3.99; N 21.31. $C_{11}H_{10}N_4O_4$. Calculated, %: C 50.38; H 3.84; N 21.37.

3-(2-Hydroxybenzoylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylic acid *N*-hydroxyamide (VIc). Yield 92%, mp 192–194°C. ^{1}H NMR spectrum, δ, ppm: 6.65–7.80 m ($8H_{arom}$), 10.20 br.s (1H, NNH), 10.80 br.s (1H, NHOH), 11.05 br.s (1H, OH), 11.45 br.s (1H, NHOH). Found, %: C 56.57; H 3.42; N 16.51. $C_{16}H_{12}N_4O_5$. Calculated, %: C 56.47; H 3.55; N 16.46.

3-(Isonicotinoylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylic acid *N*-hydroxyamide (VId). Yield 81%, mp 208–210°C. ^{1}H NMR spectrum, δ, ppm: 6.55–8.25 m ($8H_{arom}$), 10.30 br.s (1H, NNH), 10.50 br.s (1H, NHOH), 11.65 br.s (1H, NHOH). Found, %: C 54.93; H 3.32; N 21.47. $C_{15}H_{11}N_5O_4$. Calculated, %: C 55.39; H 3.41; N 21.53.

3-(2-Furoylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylic acid *N*-hydroxyamide (VIe). Yield 91%, mp 264–266°C. ^{1}H NMR spectrum, δ, ppm: 6.90–8.20 m ($7H_{arom}$), 10.35 br.s (1H, NNH), 11.55 br.s (1H, NHOH), 11.55 br.s (1H, NHOH). Found, %: C 53.07; H 3.14; N 17.89. $C_{14}H_9N_4O_5$. Calculated, %: C 53.51; H 3.21; N 17.83.

3-(3-Hydroxy-4-oxo-3,4-dihydroquinazoline-2-carbonylamino)-4-oxo-3,4-dihydroquinazoline-2-carboxylic acid *N*-hydroxyamide (VIf). Yield 93%, mp 188–190°C. ^{1}H NMR spectrum, δ, ppm: 7.20–8.00 m ($8H_{arom}$), 10.75 br.s (1H, NNH), 11.20 br.s (1H, NHOH), 12.05 br.s (1H, NOH), 12.30 br.s (1H, NHOH). Found, %: C 53.16; H 3.08; N 20.51. $C_{18}H_{12}N_6O_6$. Calculated, %: C 52.95; H 2.96; N 20.58.

3-Hydroxy-2-phenyl[1,2,4]triazino[6,1-*b*]quinazoline-4,10-dione (VIIb). *a*. In 5 ml of acetic anhydride 0.01 mol (3.42 g) of N-hydroxyamide **Vb** was heated for 15 min. On cooling the mixture was diluted with cold water. Yield 2.97 g, mp 272–274°C (from AcOH). ^{1}H NMR spectrum, δ, ppm: 7.0–8.40 m ($9H_{arom}$), 11.45 br.s (1H, OH). Found, %: C 62.43; H 3.16; N 18.34. $C_{16}H_{10}N_4O_3$. Calculated, %: C 62.75; H 3.29; N 18.29.

b. In 5 ml of acetic anhydride 0.01 mol (3.24 g) of *N*-hydroxyamide **VIb** was heated for 5 min. On cooling the mixture was diluted with cold water. Yield 3.01 g, mp 273–275°C (from AcOH).

Compounds **VIIa**, **VIIc–VIIf** were prepared similarly.

3-Hydroxy-2-methyl[1,2,4]triazino[6,1-*b*]-quinazoline-4,10-dione (VIIa). Yield 92%, mp 268–270°C. ^{1}H NMR spectrum, δ, ppm: 2.50 s (3H, CH_3), 6.85 t ($1H_{arom}$), 7.05 d ($1H_{arom}$), 7.25 t ($1H_{arom}$), 7.60 d ($1H_{arom}$), 11.25 br.s (1H, OH). Found, %: C 53.78; H 3.14; N 22.96. $C_{11}H_{18}N_4O_3$. Calculated, %: C 54.10; H 3.30; N 22.94.

3-Hydroxy-2-(2-hydroxyphenyl)[1,2,4]triazino-[6,1-*b*]quinazoline-4,10-dione (VIIc). Yield 94%, mp 256–258°C. ^{1}H NMR spectrum, δ, ppm: 7.00–8.10 m ($8H_{arom}$), 10.85 br.s (1H, OH), 11.15 br.s (1H, NOH). Found, %: C 59.90; H 3.21; N 17.31. $C_{16}H_{10}N_4O_4$. Calculated, %: C 59.63; H 3.13; N 17.38.

3-Hydroxy-2-(4-pyridyl)[1,2,4]triazino[6,1-*b*]-quinazoline-4,10-dione (VIId). Yield 85%, mp 273–275°C. ^{1}H NMR spectrum, δ, ppm: 6.70–8.05 m ($8H_{arom}$), 11.40 br.s (1H, OH). Found, %: C 58.44; H 2.69; N 22.77. $C_{15}H_9N_5O_3$. Calculated, %: C 58.63; H 2.95; N 22.79.

3-Hydroxy-2-(2-furyl)[1,2,4]triazino[6,1-*b*]-quinazoline-4,10-dione (VIIe). Yield 91%, mp > 290°C. ^{1}H NMR spectrum, δ, ppm: 7.05–8.30 m ($7H_{arom}$), 11.30 br.s (1H, OH). Found, %: C 56.84; H 2.79; N 18.92. $C_{14}H_8N_4O_4$. Calculated, %: C 56.79; H 2.72; N 18.91.

3-Hydroxy-2-(3-hydroxyquinazolin-4-on-2-yl)-[1,2,4]triazino[6,1-*b*]quinazoline-4,10-dione (VIIf). Yield 89%, mp 240–242°C. ^{1}H NMR spectrum, δ, ppm: 7.35–8.15 m ($8H_{arom}$), 12.35 br.s (2H, 2OH). Found, %: C 55.59; H 2.47; N 21.50. $C_{18}H_{10}N_6O_5$. Calculated, %: C 55.39; H 2.58; N 21.53.

REFERENCES

1. Ukrainets, I.V., Bezuglyi, P.O., Treskach, V.I., Turov, A.V., Slobodzyan, S.V., and Gorokhova, O.V., *Khim. Geterotsikl. Soedin.,* 1991, vol. 8, p. 1128; Shemchuk, L.A., Cher-

nykh, V.P., Ivanova, I.L., Snitkovskii, E.L., Zhirov, M.V., and Turov, A.V., *Zh. Org. Khim*., 1999, vol. 35, p. 305.
2. Reddy, P.S.N. and Reddy, V.G., *Ind. J. Chem*., 1992, vol. 31B, p. 193; Reddy, V.G. and Reddy, P.S.N., *Ind. J. Chem*., 1992, vol. 31B, p. 764; Pathak, U.S., Rathod, I.S., Patel, M.B., Shirsath, V.S., and Jain, K.S., *Ind. J. Chem*., 1995, vol. 34B, p. 617.
3. George, T., Mehta, D.V., and Tahilramani, R., *Ind. J. Chem*., 1971, vol. 9(8), p. 755.
4. Gal, M., Tihanyi, E., and Dvortsak, P., *Heterocycles*, 1984, vol. 22, p. 1985.
5. Grekov, A.P. and Veselov, V.Ya., *Fizicheskaya khimiya gidrazina* (Physical Chemistry of Hydrazine), Kiev: Naukova Dumka, 1979, p. 26.
6. Petyunin, P.A., Bulgakov, V.A., and Petyunin, G.P., *Khim. Geterotsikl. Soedin*., 1974, vol. 5, p. 609.