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Cyanoselenoacetamide in a New Synthesis of Propane-bis(thioamide), the Promising Reagent for Heterocyclizations

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Abstract—Cyanoselenoacetamide reacts with hydrogen sulfide to form propane-bis(thioamide), which can be used to produce thiazoles (the Hantzsch synthesis) and 3-thioxo-1-phenyl-2,3,5,6,7,8-hexahydroisoquinoline-4-carbonitrile. From the latter compound, 2-alkylsulfanyl-1-phenyl-5,6,7,8-tetrahydroisoquinoline-4-carbonitriles and 1-amino-*N*-(4-bromophenyl)-5-phenyl-6,7,8,9-tetrahydrothieno[2,3-*c*]isoquinoline-2-carboxamide can be prepared.

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Cyanoselenoacetamide (**I**), first prepared via the reaction of hydrogen selenide with malononitrile [1], readily undergoes dimerization to form 4,6-diamino-2-selenoxo-1,2-dihydronicotinenitrile. In spite of this, it can be used in the synthesis of various 2-selenoxo-1,2-dihydronicotinenitriles [3–6]. Selenoazoles are smoothly prepared from **I** derivatives, aryl(hetaryl)methylidene-cyanoselenoacetamides [7].

Searching for synthetic selenium blocks capable of heterocyclization is a topical issue due to high biological activity of organoselenium compounds [8]. One of the promising candidates is 3-amino-3-selenoxopropanetioamide **A**, not yet described in the literature. In this work, we aimed to prepare this compound in the reaction of cyanoselenoacetamide **I** with hydrogen sulfide at room temperature in pyridine in the presence of equimolar amount of triethylamine. However, instead of **A**, its dithio analogue, propan-bis (thioamide) **II**, was formed in that reaction. Apparently, even under those mild conditions, the interaction did not stop at the stage of nitrile group conversion to thioamide, but further addition of hydrogen sulfide to the C=Se group occurred to form intermediate **B**, which was stabilized by hydrogen selenide elimination.

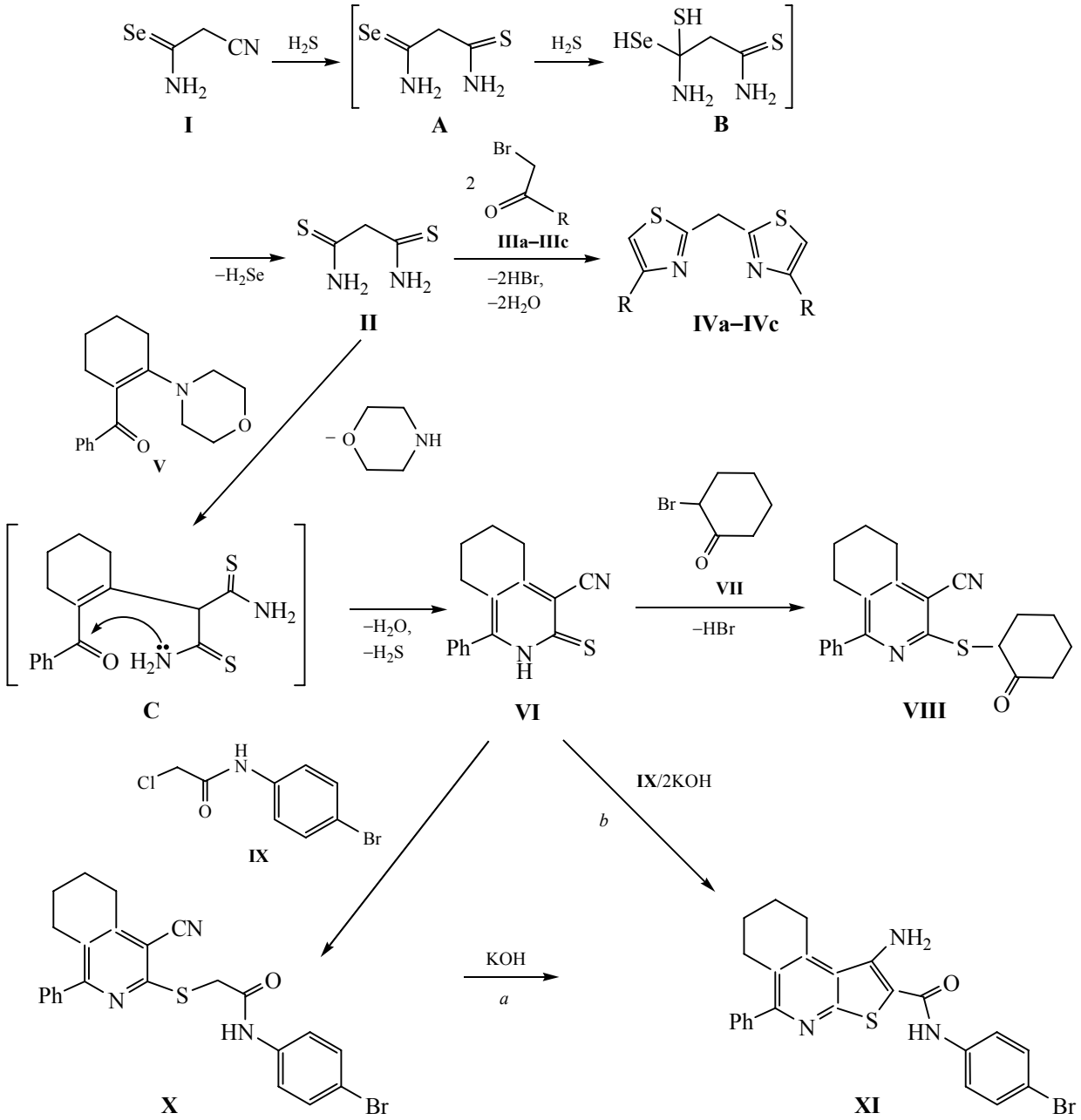
The studied reaction could be considered as a new approach to preparation of the promising polyfunctional propane-bis(thioamide) **II**. Previously, for its synthesis the amidation of diethyl tetrathiomalonate [9] or thionation of malonamide [10, 11] were used.

The use of dithioamide **II** for synthesis of the transition metal complexes [12] and **II** application as a nucleophilic substrate for preparation of 1,3-dithiyne [13], 1,2,3-thiadiazole [10], and naphthothiazole [14] have been described. To date, the Hantzsch condensation of **II** with α-halogenated carbonyl compounds has been limited to a few examples [15, 16], although it seems to be an efficient approach to prepare methylene-bis(thiazoles), the unusual ligands for complexation [12]. Using the reaction of **II** with two-fold excess of α-bromoketones **IIIa–IIIc** in DMF we demonstrated the general nature of that approach allowing to prepare dithiazolylmetanes **IVa–IVc** with yield of 71–82%.

Another synthetic application of **II**, a CH-acidic component in heterocyclizations, was demonstrated by the condensation with enaminoketone **V**. That reaction proceeded smoothly in anhydrous ethanol at 20ºC in the presence of sodium ethylate and gave 3-thioxo-1-phenyl-2,3,5,6,7,8-hexahydroisoquinoline-4-carbonitrile

VI. Most likely, it proceeded via nucleophilic vinyl substitution (S_NVin) [17–19] through formation of intermediate **C** that further underwent cyclization accompanied by elimination of hydrogen sulfide from the exocyclic thioamide group.

The structure of **VI** was confirmed by comparing its physical, chemical, and spectral characteristics with those of the reaction of 2-benzoylcyclohexanone with cyanothioacetamide product [20], as well as by studies of **VI** chemical transformations. In particular, alkylation of **VI** with α-bromocyclohexanone **VII** in DMF in alkaline medium resulted in the corresponding thioester **VIII**. With alkylating agent being *N*-(4-bromophenyl)-2-chloroacetamide **IX,** under similar conditions S-alkylation occurred as well [21, 22], leading to *N*-(4-bromophenyl)-2-(1-phenyl-4-cyano-5,6,7,8-tetrahydroisoquinoline-3-yl)acetamide **X**. Given the fact that 3-alkylsulfanyl-4-cyano-5,6,7,8-tetrahydroisoquinoline derivatives exhibit neurotropic [23] and antibacterial properties [24], compounds **VIII** and **X** are promising for the design of new bioactive substances.



III, IV, R = Ph (**a**), 4-MeC_6H_4 (**b**), and coumarin-3-yl (**c**).

Treating of **X** with equimolar amount of potassium hydroxide led to the formation of the product containing thiophene cycle, 1-amino-*N*-(4-bromophenyl)-5-phenyl-6,7,8,9-tetrahydrothieno[2,3-*c*]isoquinoline-2-carboxamide **XI**, (method *a*). That product could be potentially used to create antitumor [25] and analeptic (corazolum type) [26] drugs. A one-pot variant of **XI** preparation was a reaction of isoquinolinethione **VI** with chloroacetanilide **IX** in the presence of a double excess of alkali (method *b*).

IR spectrum of **X** contained characteristic absorption bands assigned to stretching vibrations of conjugated cyano group 2218 cm^{-1}) and amide fragment (1680 cm^{-1}). In the IR spectrum of **XI,** the absorption band of cyano group stretching vibrations disappeared, and the bands assigned to stretching (3195–3412 cm^{-1}) and bending (1646 cm^{-1}) vibrations of the amino group appeared. In the ^{1}H NMR spectrum of **X,** in addition to the signals of the protons of tetramethylene fragment, aromatic substituents, and NH group, there was a singlet of SCH_2 protons at 4.14 ppm. The latter signal disappeared in the spectrum of **XI**, instead, the signal of amino protons appeared as a broad singlet at 7.18 ppm. ^{13}C NMR spectra of substituted tetrahydroisoquinolines **VIII, X,** and **XI** contained signals of all carbon atoms with the respective chemical shifts. Mass spectrum of dithiazolyl-substituted methane **IVb** contained a peak of $[M + 2]^+$, indicating the presence of sulfur atoms in the molecule [27], while the signal $[M]^+$ was in accordance with the nitrogen rule [28].

EXPERIMENTAL

^{1}H NMR spectra were recorded with Varian Mercury 400 spectrometer (399.97 MHz) in DMSO-d_6, with TMS as internal reference. ^{13}C NMR spectra were recorded with Varian VXR-300 spectrometer (125.74 MHz) in DMSO-d_6, with TMS as internal reference. Mass spectra were recorded with Kratos MS-890 spectrometer (70 eV) using a direct inlet of the material into the ion source (compounds **II, IVb**) and with Crommas GC/MS (Hewlett-Packard) 5890/5972 instrument, with HP-5MS (70 eV) column, in CH_2Cl_2 (compounds **IVa, IVc, VIII, X,** and **XI**). IR spectra of the KBr pellets were recorded with "SPEKTRUM ONE" (Perkin Elmer) spectrometer. Elemental analysis was performed with Perkin-Elmer C,H,N-analyzer. Melting points were determined with a Kofler bench. The reaction course and the purity of the individual compounds were monitored by thin-layer chromatography with Silufol UV-254 plates, acetone-hexane 3:5 was used as eluent, and color developers were iodine vapor and UV radiation.

Propane-bis(thioamide) (II). 14 ml (0.1 mol) of triethylamine was added to a solution of 14.7 g (0.1 mol) of cyanoselenoacetamide **I** in 50 ml of pyridine at 20ºC, and a moderate flow of hydrogen sulfide was bubbled during 4 h under argon. Then, the reactor was sealed and left in the refrigerator for 24 h. Next day, the reaction mixture was diluted with an equal volume of water and left in the refrigerator for 5 days. The resulting precipitate was filtered off, washed with water (20 ml), ethanol (20 ml), and hexane (20 ml), then dried and crystallized from ethanol. Yield 8.86 g (66%), yellow powder, mp 188–190°C (published [9]: 190°C). Elemental analysis, IR spectrum and ^{13}C NMR spectrum were in agreement with the published ones [9]. ^{1}H NMR spectrum, δ, ppm: 3.79 s (2H, CH_2), 9.32 br.s (2H, NH_2), 9.62 br.s (2H, NH_2). Mass spectrum, *m*/*z* (I_{rel}, %): 136 (8) $[M + 2]^+$, 135 (5) $[M + 1]^+$, 134 (100) $[M]^+$, 133 (6) $[M – 1]^+$, 117 (2) $[M – NH_3]^+$, 101 (14) 75 (10) 60 (44) 42 (38) 30 (15). $C_3H_6N_2S_2$. *M* 134.222.

Bis(4-phenylthiazol-2-yl)methane (IVa). A mixture of 1.34 g (10 mmol) of malonic dithioamide **II** and 4.0 g (20 mmol) phenacyl bromide **IIIa** in 25 ml of DMF was stirred for 5 h, left overnight at room temperature and diluted with an equal volume of water. The resulting precipitate was filtered off, washed with water (20 ml), ethanol (20 ml), and hexane (20 ml), then dried and crystallized from methanol. Yield 2.57 g (77%), yellow powder, mp 117–118°C (published [16]: 119–120°C). ^{1}H NMR spectrum, δ, ppm: 4.92 s (2H, CH_2), 7.15–7.64 m (6H, H_{arom}), 7.82–8.23 m (6H, H_{arom}). Mass spectrum, *m*/*z* (I_{rel}, %): 335 (100) $[M + 1]^+$. Found, %: C 68.11, H 4.17, N 8.33. $C_{19}H_{14}N_2S_2$. Calculated, %: C 68.23, H 4.22, N 8.38. *M* 334.465.

Bis(4-*p*-tolylthiazol-2-yl)methane (IVb) was prepared similarly to **IVa** using 4.26 g (20 mmol) of α-bromoketone **IIIb**. Yield 2.97 g (82%), yellow powder, mp 132–133°C (MeOH). ^{1}H NMR spectrum, δ, ppm: 2.34 s (6H, 2Me), 4.83 s (2H, CH_2), 7.22 d (4H, H_{arom}, *J* 7.72 Hz), 7.82 d (4H, H_{arom}, *J* 7.72 Hz), 7.88 s (2H, thiazole). Mass spectrum, *m*/*z* (I_{rel}, %): 364 (10) $[M + 2]^+$, 363 (23) $[M + 1]^+$, 362 (100) $[M]^+$, 181 (31), 149 (15) 148 (63), 147 (82), 115 (26), 104 (14), 91 (28) $[MeC_6H_4]^+$, 77 (10) $[Ph]^+$, 69 (8), 45 (10), 39 (6). Found, %: C 69.41, H 4.97, N 7.63. $C_{21}H_{18}N_2S_2$. Calculated, %: C 69.58, H 5.00, N 7.73. *M* 362.518.

3,3'-[2,2'-Methylene-bis(thiazol-4,2-diyl)]-bis(2*H*-chromen-2-one) (IVc) was prepared similarly to **IVa**

using 5.34 g (20 mmol) of α-bromoketone **IIIc**. Yield 3.1 g (71%), yellow crystals, mp 183–185°C (BuOH). IR spectrum, ν, cm^{-1}: 1714 (C=O). ^1H NMR spectrum, δ, ppm: 4.91 s (2H, CH_2), 7.33–7.49 m (4H, H_{arom}), 7.58–7.72 m (2H, H_{arom}), 7.85 d (2H, H_{arom}, *J* 7.42 Hz), 8.37 s (2H, thiazole), 8.80 s (2H, H^4, coumarine). Mass spectrum, *m*/*z* (I_{rel}, %): 439 (100) $[M + 1]^+$. Found, %: C 68.30, H 3.15, N 6.26. $C_{25}H_{14}N_2O_4S$. Calculated, %: C 68.48, H 3.22, N 6.39. *M* 438.466.

3-Thioxo-1-phenyl-2,3,5,6,7,8-hexahydroquinoline-4-carbonitrile (VI). A solution prepared of 0.23 g (10 mmol) of sodium and 10 ml of absolute ethanol was added to a stirred mixture of 2.71 g (10 mmol) of **V** and 1.34 g of **II** in 15 ml of absolute ethanol at 20°C. The mixture was stirred for 4 h and left for 24 h. The reaction mixture was diluted with 10% hydrochloric acid to pH 5 and left for 2 days. The resulting precipitate was filtered off, washed with water (20 ml), ethanol (20 ml), and hexane (20 ml), and then recrystallized from glacial acetic acid. Yield 1.84 g (68%), yellow powder, mp 248–250°C (at 195°C sublimates) (published [20]: 259–262°C). IR spectrum, ν, cm^{-1}: 3348 (NH), 2222 (C≡N), 1195 (C=S). ^1H NMR spectrum, δ, ppm: 1.58–1.65 m (2H, CH_2), 1.75–1.84 m (2H, CH_2), 2.32 t (2H, CH_2, *J* 4.5 Hz), 2.87 t (2H, CH_2, *J* 6.0 Hz), 7.42 d (2H, Ph, *J* 7.0 Hz), 7.51–7.56 m (3H, Ph), 13.94 br.s (1H, NH). ^{13}C NMR spectrum, δ_C, ppm: 20.65, 20.90, 25.19, 28.86, 114.85, 115.84, 121.10, 128.22 (2C), 128.83 (2C), 129.95, 131.45, 151.24, 156.69, 174.74. Mass spectrum, *m*/*z* (I_{rel}, %): 267 (100) $[M + 1]^+$. Found, %: C 71.98, H 5.22, N 10.39. $C_{16}H_{14}N_2S$. Calculated, %: C 72.15, H 5.30, N 10.52. *M* 266.365.

3-(2-Oxocyclohexylthio)-1-phenyl-5,6,7,8-tetrahydroisoquinoline-4-carbonitrile (VIII). 5.6 ml (10 mmol) of 10% aqueous KOH solution and 1.77 g (10 mmol) of **VII** were added sequentially to a stirred solution of 2.66 g (10 mmol) of **VI** in 15 ml of DMF**.** The mixture was stirred for 4 h and left for a day. The reaction mixture was diluted with an equal volume of water; tar product was separated by decantation and rubbed up in 20 ml of MeOH. The precipitate formed was separated and washed with water (20 ml), methanol (20 ml), and hexane (20 ml), and recrystallized from butanol. Yield 2.43 g (67%), colorless crystals, mp 124–126°C. IR spectrum, ν, cm^{-1}: 2219 (C≡N), 1714 (C=O). ^1H NMR spectrum, δ, ppm: 1.51–1.65 m (3H, CH_2), 1.68–1.84 m (5H, CH_2), 1.89–2.02 m (1H, CH_2), 2.29–2.48 m (3H, CH_2) , 2.55–2.64 m (2H, CH_2), 2.81–2.96 m (2H, CH_2C=O), 4.68–4.77 m (1H, SCH), 7.39–7.58 m (5H, Ph). ^{13}C NMR spectrum, δ_C, ppm: 21.37, 22.34, 25.12, 27.13, 27.34, 28.52, 34.47, 41.68, 54.19, 105.71, 115.25, 127.69, 128.55 (2C), 129.36 (2C), 129.42, 139.04, 152.62, 156.93, 160.22, 205.41. Mass spectrum, *m*/*z* (I_{rel}, %): 363 (100) $[M + 1]^+$. Found, %: C 72.83, H 6.02, N 7.69. $C_{22}H_{22}N_2OS$. Calculated, %: C 72.90, H 6.12, N 7.73. *M* 362.496.

***N*-(4-Bromophenyl)-2-(1-phenyl-4-cyano-5,6,7,8-tetrahydroisoquinolin-3-ylthio)acetamide (X)**. 5.6 ml (10 mmol) of 10% aqueous KOH solution and 2.48 g (10 mmol) of **IX** were added sequentially to a stirred solution of 2.66 g (10 mmol) of **VI** in 15 ml of DMF**.** The mixture was stirred for 4 h and left for a day. The reaction mixture was diluted with an equal volume of water and the resulting precipitate was filtered off, washed with water (20 ml), ethanol (20 ml), and hexane (20 ml), and recrystallized from butanol. Yield 3.68 g (77%), colorless crystals, mp 194–196°C. IR spectrum, ν, cm^{-1}: 3312 (NH), 2218 (C≡N), 1680 (CONH). ^1H NMR spectrum, δ, ppm: 1.53–1.65 m (2H, CH_2), 1.72–1.80 m (2H, CH_2), 2.53–2.69 m (2H, CH_2), 2.81–2.93 m (2H, CH_2), 4.14 s (2H, SCH_2), 7.18–7.26 m (2H, H_{arom}), 7.38 t (1H, Ph), 7.39–7.59 m (6H, H_{arom}), 10.36 h. with (NH). ^{13}C NMR spectrum, δ_C, ppm: 21.35, 22.34, 27.32, 28.49, 35.25, 105.17, 115.23, 115.29, 121.28 (2C), 127.85, 128.37 (2C), 129.36, 129.61 (2C), 132.00 (2C), 138.85, 138.97, 152.71, 157.49, 160.40, 166.55. Mass spectrum, *m*/*z* (I_{rel}, %): 479 (100) $[M + 1]^+$. Found, %: C 60.15, H 4.11, N 8.69. $C_{24}H_{20}BrN_3OS$. Calculated, %: C 60.26, H 4.23, N 8.78. *M* 478.414.

1-Amino-*N*-(4-Bromophenyl)-5-phenyl-5,6,7,8-tetrahydrothieno[2,3-*c*]isoquinoline-2-carboxamide (XI). *a*. 5.6 ml (10 mmol) of 10% aqueous KOH solution was added to a stirred solution of 4.8 g (10 mmol) of **X** in 20 ml of DMF, the mixture was stirred for 4 h and then diluted with an equal volume of water. Tar product was separated by decantation and rubbed up in 20 ml of MeOH. The resulting precipitate was separated and washed with water (20 ml), methanol (20 ml), and hexane (20 ml), and then crystallized from methanol. Yield 3.3 g (69%), yellow powder, mp 269–272°C. IR spectrum, ν, cm^{-1}: 3195–3412 (NH_2, NH), 1677 (CONH), 1646 [δ(NH_2)]. ^1H NMR spectrum, δ, ppm: 1.54–1.69 m (2H, CH_2), 1.76–1.81 m (2H, CH_2), 2.64–2.73 m (2H, CH_2), 3.39–3.45 m (2H, CH_2), 7.18 br.s (2H, NH_2), 7.31–7.73 m (9H, H_{arom}), 10.77 br.s (CONH). ^{13}C NMR spectrum, δ_C, ppm: 21.94, 22.13, 27.04, 28.37, 79.67, 115.30, 123.66 (2C), 123.99, 126.95, 128.50 (2C), 128.63, 129.28

(2C), 131.59 (2C), 139.50 , 140.43, 145.27, 149.78, 156.71, 160.04, 164.94. Mass spectrum, *m*/*z* (I_{rel}, %): 479 (100) $[M + 1]^+$. Found, %: C 60.19, H 4.17, N 8.72. $C_{24}H_{20}BrN_3OS$. Calculated, %: C 60.26, H 4.23, N 8.78. *M* 478.414.

b. 5.6 ml (10 mmol) of 10% aqueous KOH solution and 2.48 g (10 mmol) of **IX** were added sequentially to a stirred solution of 2.66 g (10 mmol) of **VI** in 15 ml of DMF**.** The mixture was stirred for 4 h, and 5.6 ml (10 mmol) of 10% aqueous KOH solution was added once again. The reaction mixture was diluted with an equal volume of water; tar product was separated by decantation and rubbed up in 20 ml of MeOH. The resulting precipitate was separated and washed with water (20 ml), methanol (20 ml), and hexane (20 ml), and then recrystallized from methanol. 3.54 g (74%) of compound **XI** was obtained, identical (as from mp and chromatography data) to the synthesized via the method *a*.

REFERENCES

1. Litvinov, V.P., Mortikov, V.Yu., Sharanin, Yu.A., and Shestopalov, A.M., *Synthesis*, 1985, no. 1, p. 98.
2. Dyachenko, V.D., Sharanin, Yu.A., Litvinov, V.P., Nesterov, V.N., Shklover, V.E., Struchkov, Yu.T., Promonenkov, V.K., and Turov, A.V., *Zh. Obshch. Khim*., 1991, vol. 61, no. 3, p. 747.
3. Sharanin, Yu.A. and Dyachenko, V.D., *Zh. Obshch. Khim*., 1987, vol. 57, no. 7, p. 1662.
4. Dyachenko, V.D., Nesterov, V.N., Struchkov, Yu.T., Sharanin, Yu.A., and Shklover, V.E., *Zh. Obshch. Khim*., 1989, vol. 59, no. 4, p. 881.
5. Litvinov, V.P., Sharanin, Yu.A., Shestopalov, A.M., and Dyachenko, V.D., *Synlett*., 1992, no. 1, p. 87.
6. Dyachenko, V.D., Turov, A.V., and Sharanin, Yu.A., *Ukr. Khim. Zh*., 1990, vol. 56, no. 1, p. 65.
7. Litvinov, V.P. and Dyachenko, V.D., *Dokl. Akad. Nauk*, 1997, vol. 352, no. 5, p. 636.
8. Litvinov, V.P., Dyachenko, V.D., *Russ. Chem. Rew*., 1997, vol. 66, no. 11, p. 923.
9. Afrashteh, A. and Hartke, K., *Arch. Pharm*., 1988, vol. 321, no. 12, p. 909.
10. Bakulev, V.A., Lebedev, A.T., Dankova, E.F., Mokrushin, V.S., and Petrosyan, V.S., *Tetrahedron*., 1989, vol. 45, no. 23, p. 7329.
11. Dankova, E.F., Bakulev, V.A., and Morzherin, Yu.Yu., *Chem. Heterocycl. Comp.,* 1992, no. 8, pp. 931–936.
12. De Beukeller, S.H.J. and Dessey, H.O., *Spectrochim. Acta. (A),* 1995, vol. 51, no. 10, p. 1617.
13. Nisovcheva, T.V., Komarova, T.I., Nakhmanovich, A.S., and Lopyrev, V.A., *Chem. Heterocycl. Comp*. 2002, vol. 38, no. 8, pp. 1134–1135.
14. Katritzki, A.R. and Fan, W-Q., *J. Het. Chem*., 1988, vol. 25, no. 3, p. 901.
15. Hirano, H., Sugiyama, K., Yamashita, M., Inone, M., and Ishida, T., *Chem. Pharm. Bull*., 1988, vol. 321, no. 2, p. 1792.
16. Lehr, H., Guex, W., and Erlenmeyer, H., *Helv. Chim. Acta*., 1944, vol. 27, no. 1, p. 970.
17. Salon, J., Milata, V., Gatial, A., Pronayova, N., Lesko, J., Cernuchova, P., Rappoport, Z., Vo-Thang, G., and Loupy, A., *Eur. J. Org. Chem*., 2005, vol. 22, no. 11, p. 137.
18. Shainyan, B.A., *Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim*., 1990, no. 4, p. 137.
19. Litvinov, V.P., Yakunin, Ya.Yu., and Dyachenko, V.D., *Chem. Heterocycl. Comp.,* 2001, vol. 37, no. 1, pp. 37–76.
20. Sharanin, Yu.A., Shestopalov, A.M., Promonenkov, V.K., and Rodinovskaya, L.A., *Zh. Org. Khim*., 1984, vol. 20, no. 7, p. 1539.
21. Al-Kaabi, S.S. and Elgemeie, G.E.H., *Bull. Chem. Soc. Japan*, 1992, vol. 65, no. 8, p. 2241.
22. *Izbrannye metody sinteza i modifikatsii geterotsiklov. Izokhinoliny. Khimija i biologicheskaya aktivnost'* (Selected Methods for Synthesis and Modification of Heterocycles. Isoquinolines. Chemistry and Biological Activity), Kartsev, V.G., Ed., Moscow: Nauchnoe Partnertstvo, 2008, p. 253.
23. Paronikyan, E.G., Noravyan, A.S., Dzhagaspantan, I.A., and Arzanunts, E.M., Abstarct of Papers, *Trudy II Mezhdunar. konf. "Khimija i biologicheskaja aktivnost' kislorod- i serosoderzhashchikh geterotsiklov"* (Proc. of the II Int. Conf. "The Chemistry and Biological Activity of Oxygen- and Sulfur-Containing Heterocycles"), vol. 1, Moscow, 2003, p. 382.
24. Paronikyan, E.G., Mirzoyan, G.V., Noravyan, A.S., Avikimyan, D.A., and Ter-Zaharyan, Yu.Z., *Pharm. Chem. J*., 1993, vol. 27, no. 11, pp. 759–762.
25. Reichelt, C., Schulze, A., Daghish, M., and Leistner, S., Pat. Appl. EPV 1623987, 2004, *Ref. Zh. Khim.,* 2007, 07.10-19O.115P.
26. Paronikyan, E.G., Noravyan, A.S., Akopyan, Sh.F., Dzhagaspanyan, I.A., Nazaryan, I.M., and Paronikyan, R.G., *Pharm. Chem. J*., 2007, vol. 41, no. 9, pp. 466–469.
27. Pretsch, E., Bühlmann, P., and Affolter, C., *Structure Determination of Organic Compounds: Tables of Spectral Data*, Berlin: Springer, 2000.
28. Zaikin, V.G., Varlamov, A.V., Mikaya, A.I., and Prostakov, N.S., *Osnovy mass-spektrometrii organicheskikh soedinenii* (Fundamentals of Mass Spectrometry of Organic Compounds), Moscow: Nauka, 2001.