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Synthesis and Alkylation of New 3-Functionally Substituted Carbo[*c*]fused Pyridin-2-ones(thiones)

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Abstract—By condensation of 2-acyl-1-(morpholin-4-yl)cycloalkenes with CH-acids new 3-functuinally substituted carbo[*c*]fused pyridin-2-ones(thiones) were synthesized. *N*, 1-Diphenyl-5, 6, 7, 8-tetrahydroisoquinoline-3-thione under the action of acrylonitrile and alkyl halides suffered a selective S-alkylation.

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The interest to the derivatives of carbo[*c*]fused pyridines originates from the presence in their series of compounds with wide range of biological actions: anticorosolic [1], analgesic [2], cardiotonic [3], fungicidal [4], and antimicrobial [5]. Compounds of this type are inhibitors of cytomegalovirus [6] and HIV-1 reverse transcriptase [7], antagonists of neutral acetylcholine receptors [8], and also can be applied as chromophores in manufacturing light-sensitive diodes [9]. The preparation of versatile carbo[*c*]fused pyridines is performed by the condensation of 1-acylcyclohexanones with cyano(thio)acetamides [10], by the recyclization of 6-amino-3, 4-tetramethylene-2-thioxothiopyrans with amines [11], by the reaction of 4, 6-dimethyl-3-cyanopyridine-2(1*H*)-thione with tetracyanoethylene [12], of cycloalkylidenecyanoacetic ester with aromatic aldehydes and ammonium acetates [13], or of cycloalkylidenemalononitriles with arylmethylidene(cyano)thioacetamides[14].

We report here on the new approach to the synthesis of previously unknown 3-functionally substituted carbo[*c*] fused pyridines underlain by the cyclocondensation involving enamines of 2-acylcycloalkenes. 2-Acyl-1-(morpholin-4-yl)cycloalkenes **Ia–Ig** [15] cleanly react with *N*-(furan-2-ylmethyl)-2-cyanoacetamide (**II**) and *N*-substituted monothiomalonodiamides **IIIa–IIIe** at room temperature in anhydrous ethanol in the presence of sodium ethylate leading to the formation of carbo[*c*] fused 2-oxopyridine-3-carbonitriles **IVa–IVd** and 3-carbamoylpyridine-2-thiones **Va–Vk** in high yields. Most probably the transformation sequence includes the corresponding intermediates of the nucleophilic vinyl substitution [16] **A** and **B** that undergo the intramolecular cyclization into the target products (Scheme 1).

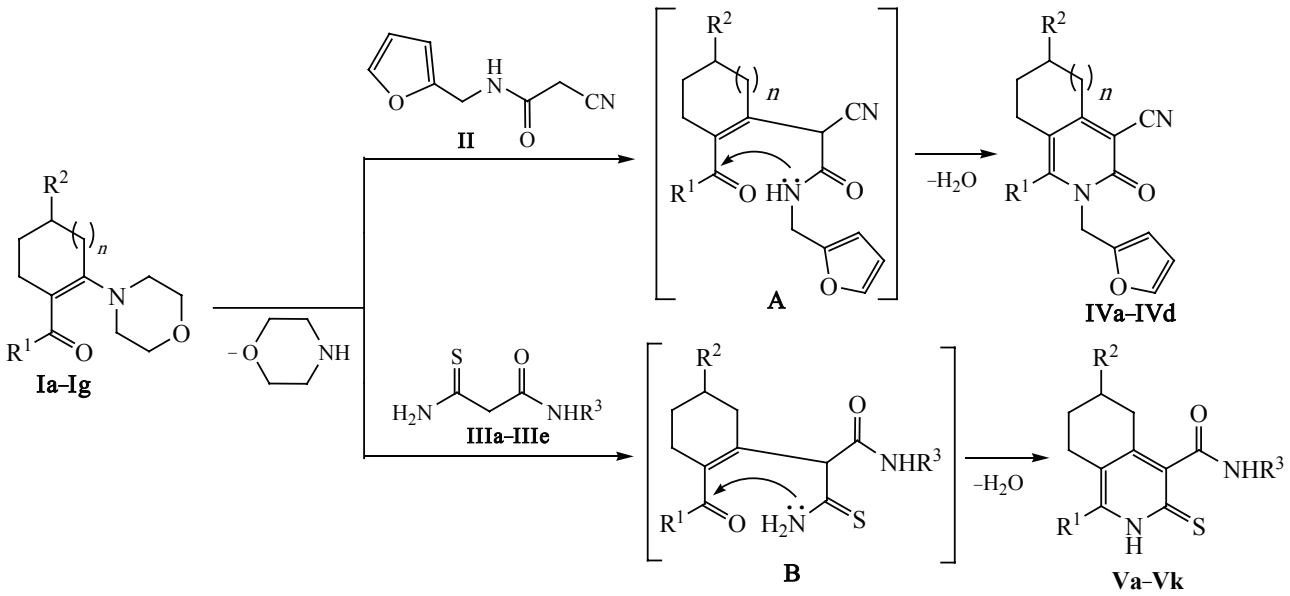
The advantage of this method is the use of more available than 1-acylcycloalkanones[17] enaminoketones **I**[18], and also the mild reaction conditions not requiring elevated temperature.

The heterocyclization of intermediate **B** occurs chemoselectively; the nitrogen atom of the thioamide and not the amide fragment plays the role of the nucleophilic site. This fact is confirmed both by the complex of the spectral data and by the chemical reactions. In particular, the cyanoethylation of compound **Vg** with acrylonitrile in boiling ethanol in the presence of triethylamine afforded *N*, 1-diphenyl-3-(2-cyanoethylsulfanyl)-5, 6, 7, 8-tetrahydroisoquinoline-4-carboxamide (**VI**) (Scheme 2).

The alkylation of 2-thioxo-*N*, 1-diphenyl-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (**Vg**) with alkyl halides **VIIa, VIIb** provided the corresponding thioethers **VIIIa, VIIIb**.

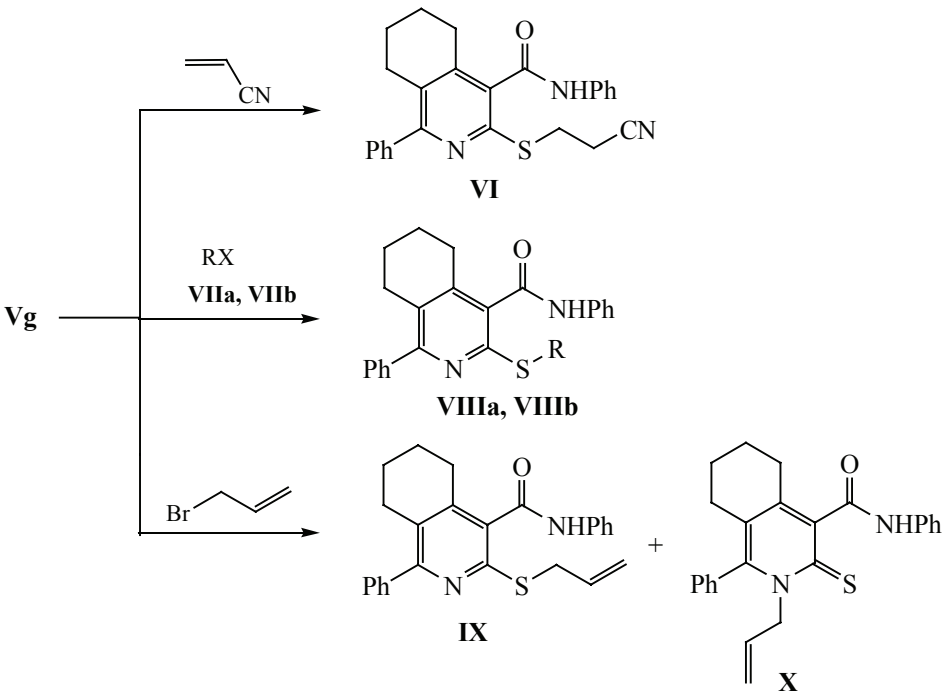
The reaction with allyl bromide was ambiguous: A mixture formed of S-(**IX**) and N-(**X**) allyl derivatives in the ratio 3 : 1. This conclusion was derived from the date of ^{1}H NMR and mass spectra and the chromatographic findings: ^{1}H NMR spectra contains double set of signals of protons from S(N)CH_2 and NH groups, in

Scheme 1.



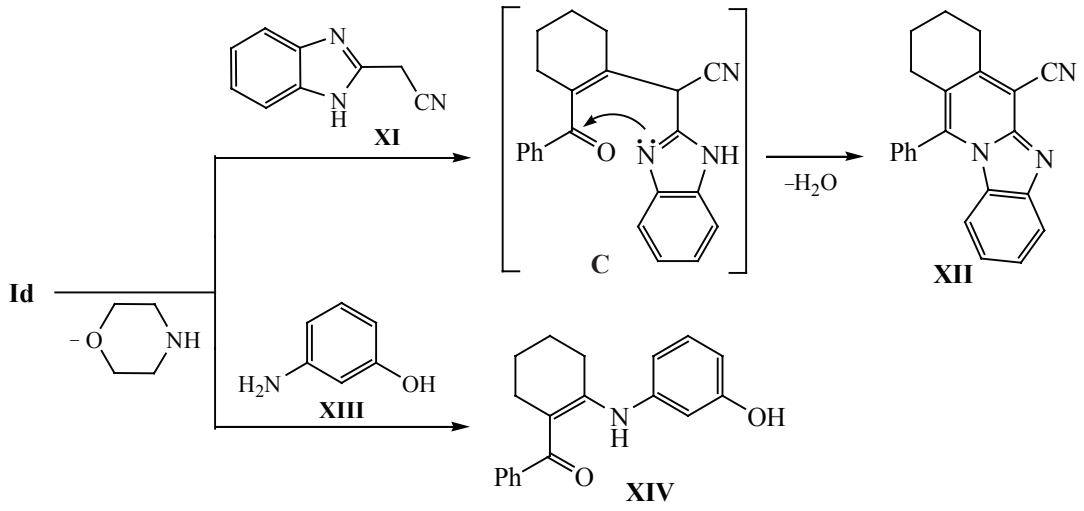
I, $n = 0$, R^1 = Ph, R^2 = H (**a**); $n = 1$: R^1 = Me, R^2 = H (**b**), R^1 = *i*-Pr, R^2 = H (**c**); R^1 = Ph, R^2 = H (**d**); R^1 = 2-ClC_6H_4, R^2 = H (**e**);R^1 = Ph, R^2 = Me (**f**); $R^1 = R^2$ = Me (**g**); **III**, $R^3 = PhCH_2$ (**a**), cyclo-C_3H_5 (**b**), Ph (**c**), 2-MeC_6H_4 (**d**), furan-2-ylmethyl (**e**); **IV**, $n = 0$, R^1 = Ph, R^2 = H (**a**); $n = 1$: R^1 = Ph, R^2 = H (**b**); R^1 = 2-ClC_6H_4, R^2 = H (**c**); R^1 = Ph, R^2 = Me (**d**); **V**, R^1 = Me, R^2 = H, R^3 = cyclo-C_3H_5 (**a**); R^1 = Me, R^2 = H, R^3 = Ph (**b**); $R^1 = R^2$ = Me, $R^3 = PhCH_2$ (**c**); $R^1 = R^2$ = Me, R^3 = Ph (**d**); R^1 = *i*-Pr, R^2 = H, R^3 = furan-2-ylmethyl (**e**); R^1 = Ph, R^2 = H, $R^3 = PhCH_2$ (**f**); R^1 = Ph, R^2 = H, R^3 = Ph (**g**); R^1 = Ph, R^2 = H, R^3 = 2-MeC_6H_4 (**h**); R^1 = Ph, R^2 = H, R^3 = furan-2-ylmethyl (**i**); R^1 = Ph, R^2 = Me, R^3 = Ph (**j**); R^1 = Ph, R^2 = Me, R^3 = furan-2-ylmethyl (**k**).

Scheme 2.



VII, R = Me, X = I (**a**); R = $PhCH_2$, X = Cl (**b**); **VIII**, R = Me (**a**), $PhCH_2$ (**b**).

Scheme 3.



the GC-MS spectrum a single peak of the molecular ion $[M + 1]^+$ is observed, and the chromatogrphy indicates the presence of two compounds. The assignment of the proton signals of the SCH_2 group was done accounting for the data of [19] where an *S*-allyl pyridine derivative had been characterized.

Bringing into the S_NVin reaction with enaminoketone **Id** of 2-(1*H*-benz[*d*]imidazol-2-yl)acetonitrile (**XI**) rysulted in the formation of 11-phenyl-7, 8, 9, 10-tetrahydrobenzo[4, 5]imidazole[1, 2-*b*]isoquinoline-6-carbonitrile (**XII**), most probably via intermediate **C** (Scheme 3).

Taking into consideration the data on the possibility to use *m*-aminophenol **XIII** as the CH-component in the Michael reaction [20] we carried out its condensation with enaminoketone **Id** by boiling in anhydrous ethanol in the presence of sodium ethylate. However this reaction resulted in transamination giving [2-(3-hydroxyphenylamino) cyclohex-1-enyl]phenylketone (**XIV**).

Spectral characteristics confirm the structure of compounds **XII, XIV**. IR spectrum of compound **XII** contains the absorption band of the stretching vibrations of the conjugated cyano group in the region 2223 cm^{-1}. In the ^1H NMR spectrum proton signals of the tetramethylene fragment and of the aromatic substituents are observed. In the IR spectrum of enaminoketone **XIV** the characteristic absorption bands of the stretching vibrations of OH, NH, and C=O groups are present at 3154, 2934, and 1713 cm^{-1}. ^1H NMR spectrum contains the proton signals of cyclohexene ring and of aromatic substituents, and also broadened singlets of the protons of NH and OH groups in the region δ 9.64 and 13.39 ppm. In the ^{13}C NMR spectrum of compound **XIV** all signals of carbon atoms are present taking into account the superposition of two pairs of symmetric carbon atoms of the phenyl substituent in the region 126.76 and 128.39 ppm.

EXPERIMENTAL

IR spectra of compounds obtained were recorded on a spectrophotometer FIR-spectrometer Spectrum One (Perkin Elmer) from pellets with KBr, ^1H NMR spectra were registered on a spectrometer Bruker DR-500 (500.13 MHz) in DMSO-d_6, internal reference TMS. ^{13}C NMR spectra were taken on a spectrometer Varian VXR-300 (125.74 MHz) in DMSO-d_6, internal reference TMS. Mass spectra were registered on instruments Varian L GC/MS (70 eV) with a direct admission of the sample into the ion source (compound **XII**) and HP Chrommass GC/MC 5890/5972, column HP-5 MS (70 eV), eluent CH_2Cl_2. Melting points were measured on a Koeffler heating block. The reaction progress was monitored and the purity of compounds obtained was checked by TLC on Silufol UV-254 plates, eluent acetone–hexane, 3 : 5, development in iodine vapor and under UV irradiation.

2-Acyl-1-(*N*-morpholinyl)cycloalkenes Ia–Ig were obtained by procedure [15]. Compound **Ia**, yield 71%, orange oily substance, bp 180–190°C (6–7 mm Hg). Compound **Ib**, yield 83%, orange oily substance, bp 120–130°C (1–2 mm Hg) {bp 90–110°C (0.2–0.3 mm Hg)

[15]}. Compound **Ic**, yield 79%, yellow oily substance, bp 128–135°C (2 mm Hg). Compound **Id**, yield 77%, orange oily substance, bp 160°C (2 mm Hg). Compound **Ie**, yield 64%, orange oily substance, bp 200°C (2 mm Hg). Compound **If**, yield 73%, orange oily substance, bp 180–190°C (6–7 mm Hg). Compound **Ig**, yield 70%, yellow oily substance, bp 140°C (2 mm Hg).

Monothiomalonodiamides **IIIa–IIIe** were obtained by method [21].

3-Amino-*N*-benzyl-3-thioxopropanamide (IIIa). Yield 16.70 g (80%), colorless crystals, mp 98°C (EtOH) (mp 110–111°C [22]). ^{1}H NMR spectra, δ, ppm: 3.53 s (2H, CH_2), 4.32 d (2H, NCH_2, *J* 6.0 Hz), 7.21–7.43 m (5H, Ph), 8.49 br.s (1H, CONH), 9.29 br.s and 9.55 br.s (1H each, NH_2). ^{13}C NMR spectra, δ, ppm: 42.25, 51.55, 126.73, 127.18 (2C), 128.17 (2C), 139.04, 166.62, 200.00. Mass spectrum, *m/z*(I_{rel}, %): 209 (100) $[M + 1]^+$. Found, %: C 57.58; H 5.06; N 13.33. $C_{10}H_{12}N_2OS$. Calculated, %: C 57.67; H 5.18; N 13.45. M 208.284.

3-Amino-3-thioxo-*N*-cyclopropylpropanamide (IIIb). Yield 10.92 g (69%), white crystalline powder, mp 143–145°C (EtOH). ^{1}H NMR spectra, δ, ppm: 0.38–0.45 m (2H, CH_2 cyclopropyl), 0.58–0.66 m (2H, CH_2 cyclopropyl), 2.54–2.62 m (1H, C^{1}H cyclopropyl), 3.34 d (2H, CH_2, ^2J 12.6 Hz), 8.12 br.s (1H, CONH), 9.28 br.s and 9.58 br.s (1H each, NH_2). Found, %: C 45.41; H 6.20; N 17.68. $C_6H_{10}N_2OS$. Calculated, %: C 45.55; H 6.37; N 17.71.

3-Amino-3-thioxo-*N*-phenylpropanamide (IIIc). Yield 15.0 g (77%), light-brown crystals, mp 105–107°C (AcOH) (mp 96–98°C [18]). ^{1}H NMR spectra, δ, ppm: 3.68 s (2H, CH_2), 7.05 t (1H, Ph, *J* 7.5 Hz), 7.29 t (2H, Ph, *J* 7.5 Hz), 7.61 d (2H, Ph, *J* 8.0 Hz), 9.33 br.s and 9.60 br.s (1H each, NH_2), 10.05 br.s (1H, CONH). Mass spectrum, *m/z*(I_{rel}, %): 195 (100) $[M + 1]^+$. Found, %: C 55.49; H 5.06; N 14.37. $C_9H_{10}N_2OS$. Calculated, %: C 55.65; H 5.19; N 14.42. M 194.256.

3-Amino-3-thioxo-*N*-(2-methylphenyl) propanamide (IIId). Yield 14.6 g (70%), yellow crystals, mp 102–105°C (EtOH). ^{1}H NMR spectra, δ, ppm: 2.28 s (3H, Me), 3.73 s (2H, CH_2), 7.10 t (1H$_{arom}$, *J* 7.5 Hz), 7.18 t (1H$_{arom}$, *J* 7.5 Hz), 7.22 d (1H$_{arom}$, *J* 7.5 Hz), 7.46 d (1H$_{arom}$, *J* 8.0 Hz), 9.45 br.s and 9.70 br.s (1H each, NH_2), 9.53 br.s (1H, CONH). ^{13}C NMR spectra, δ, ppm: 17.76, 51.97, 124.51, 125.09, 125.81, 130.17, 131.36, 135.99, 165.28, 200.01. Mass spectrum, *m/z*(I_{rel}, %): 209 (100) $[M + 1]^+$. Found, %:C 57.50; H 5.75; N 13.30. $C_{10}H_{12}N_2OS$. Calculated, %: C 57.67; H 5.81; N 13.45. M 208.284.

3-Amino-3-thioxo-*N*-(furan-2-ylmethyl)propanamide (IIIe). Yield 14.67 g (74%), light-yellow crystals, mp 89–91°C (EtOH) (mp 130–132°C [18]). ^{1}H NMR spectra, δ, ppm: 3.50 s (2H, CH_2), 4.28 d (2H, NCH_2, *J* 5.0 Hz), 6.29 s (1H, furan), 6.40 s (1H, furan), 7.58 s (1H, furan), 8.51 br.s (1H, CONH), 9.31 br.s and 9.61 br.s (1H each, NH_2). Mass spectrum, *m/z*(I_{rel}, %): 199 (100) $[M + 1]^+$. Found, %: C 48.30; H 4.95; N 14.02. $C_8H_{10}N_2O_2S$. Calculated, %: C 48.47; H 5.09; N 14.13. M 198.245.

Compounds IVa–IVd. General procedure. To a mixture of 10 mmol of an appropriate enaminoketone **Ia–Ig** and 1.64 g (10 mmol) of *N*-(furan-2-ylmethyl)-2-cyanoacetamide (**II**) in 15 ml of anhydrous ethanol was added while stirring at 20°C a solution obtained from 0.23 g (10 mmol) of sodium and 10 ml of anhydrous ethanol, the mixture was stirred for 1 h and left standing for 24 h. The formed precipitate was filtered off, washed with ethanol and hexane.

3-Oxo-1-phenyl-2-(furan-2-ylmethyl)-3, 5, 6, 7-tetrahydro-2*H*-cyclopenta[*c*]pyridine-4-carbonitrile (IVa). Yield 2.2 g (69%), dark-brown crystals of cubic form, under UV irradiation fluoresce, mp 191–193°C (AcOH). IR spectrum, ν, cm^{-1}: 2213(C≡N), 1660 (C=O). ^{1}H NMR spectra, δ, ppm: 1.81–2.12 m (2H, CH_2), 2.36–2.48 m (2H, CH_2), 2.84–3.15 m (2H, CH_2), 4.92 s (2H, NCH_2), 5.97 br.s (1H, C^{3}H furan), 6.32 br.s (1H, C^{4}H furan), 7.26–7.58 m (6H, Ph and C^{5}H furan). ^{13}C NMR spectra, δ, ppm: 24.48, 30.56, 33.84, 40.30, 42.76, 97.47, 108.66, 111.03, 116.08, 123.04, 128.62, 129.35, 130.31, 132.99, 142.81, 148.54, 149.47, 160.11, 167.48. Mass spectrum, *m/z*(I_{rel}, %): 315 (100) $[M - 1]^+$. Found, %:C 75.85; H 9.99; N 8.71. $C_{20}H_{16}N_2O_2$. Calculated, %: C 75.93; H 5.10; N 8.85. M 316.354.

3-Oxo-1-phenyl-2-(furan-2-ylmethyl)-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carbonitrile (IVb). Yield 2.54 g (77%), orange crystals, under UV irradiation fluoresce, mp 165–167°C (AcOH). IR spectrum, ν, cm^{-1}: 2216(C≡N), 1663 (C=O). ^{1}H NMR spectra, δ, ppm: 1.55 m (2H, CH_2), 1.67 m (2H, CH_2), 1.97 t (2H, CH_2, *J* 6.0 Hz), 2.85 t (2H, CH_2, *J* 6.0 Hz), 4.90 s (2H, NCH_2), 6.00 d (1H, C^{3}H furan, *J* 2.4 Hz), 6.32 br.s (1H, C^{4}H furan), 7.27 d (1H, C^{5}H furan, *J* 3.2 Hz), 7.48–7.59 m (5H, Ph). ^{13}C NMR spectra, δ, ppm: 20.64, 21.64, 25.90, 28.86, 42.66, 100.66, 108.09, 110.50, 114.96, 115.52, 128.08, 128.92, 129.59, 132.28, 142.21, 148.68, 151.57, 158.69, 159.71. Mass spectrum, *m/z*(I_{rel}, %): 331 (100) [*M*

+ 1]$^+$. Found, %: C 76.21; H 5.29; N 8.35. $C_{21}H_{18}N_2O_2$. Calculated, %: C 76.34; H 5.49; N 8.48. M 330.389.

3-Oxo-2-(furan-2-ylmethyl)-1-(2-chlorophenyl)-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carbonitrile (IVc). Yield 2.5 g (68%), white powder, under UV irradiation fluoresce, mp 131–133°C (AcOH). IR spectrum, ν, cm^{-1}: 2222(C=N), 1658 (C=O). ^{1}H NMR spectra, δ, ppm: 1.42–1.61 m (2H, CH_2), 1.65–1.74 m (2H, CH_2), 1.82–1.98 m (2H, CH_2), 2.83–2.94 m (2H, CH_2), 4.70 d and 5.08 d (1H each, NCH_2, ^2J 15.2 Hz), 5.96 d (1H, C^{3}H furan, J 2.4 Hz), 6.31 d (1H, C^{5}H furan, J 1.2 Hz), 7.36 d (1H$_{arom}$, J 7.6 Hz), 7.47 br.s (1H, C^{4}H furan), 7.52 t (1H$_{arom}$, J 7.6 Hz), 7.66 t (1H$_{arom}$, J 7.6 Hz), 7.66 d (1H$_{arom}$, J 7.6 Hz). ^{13}C NMR spectra, δ, ppm: 20.60, 21.44, 25.06, 28.79, 42.17, 101.48, 108.52, 110.52, 115.26, 115.39, 127.90, 129.78, 130.56, 130.70, 131.85, 131.91, 142.41, 148.15, 148.17, 158.73, 160.00. Mass spectrum, *m/z*(I_{rel}, %): 365 (100) [M + 1]$^+$. Found, %: C 69.02; H 4.58; N 7.57. $C_{21}H_{17}ClN_2O_2$. Calculated, %: C 69.14; H 4.70; N 7.68. M 364.834.

6-Methyl-3-oxo-1-phenyl-2-(furan-2-ylmethyl)-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carbonitrile (IVd). Yield 2.9 g (84%), yellow crystals, under UV irradiation fluoresce, mp 149–151°C (AcOH). IR spectrum, ν, cm^{-1}: 2212(C≡N), 1656 (C=O). ^{1}H NMR spectra, δ, ppm: 1.01 d (3H, Me, J 4.0 Hz), 1.13–1.24 m (1H, CHMe), 1.65–1.81 m (2H, CH_2), 1.82–2.18 m (2H, CH_2), 2.42 d.d (1H, CH_2, J 8.0 and 20.0 Hz), 2.97 d.d (1H, CH_2, J 4.0 and 16.0 Hz), 4.87 d and 4.94 d (2H, NCH_2, ^2J 16.0 Hz), 6.99 d (1H, C^{3}H furan, J 4.0 Hz), 6.32 m (1H, C^{4}H furan), 7.21–7.32 m (2H, Ph), 7.41–7.62 m (4H, Ph and C^{5}H furan). ^{13}C NMR spectra, δ, ppm: 21.62, 26.33, 27.54, 30.33, 37.53, 43.20, 101.03, 108.69, 111.05, 115.04, 116.08, 128.38, 128.83, 129.48, 129.50, 130.15, 132.90, 142.76, 149.22, 152.09, 159.30, 159.99. Mass spectrum, *m/z*(I_{rel}, %): 345 (100) [M + 1]$^+$. Found, %: C 76.61; H 5.72; N 8.00. C22H20N2O2. $C_{22}H_{20}N_2O_2$. Calculated, %:C 76.72; H 5.85; N 8.13. M 344.416.

***N*, 1-Dialkyl(aryl, hetaryl)-3-thioxo-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamides Va–Vk. General procedure**. To a mixture of 10 mmol of an appropriate enaminoketones **Ia–Ig** and 10 mmol of monothiomalonodiamides **IIIa–IIIe** in 15 ml of anhydrous ethanol was added while stirring at 20°C a solution obtained from 0.23 g (10 mmol) of sodium and 10 ml of anhydrous ethanol, the mixture was stirred for 10 min and left standing for 24 h. The reaction mixture was diluted with 10% hydrochloric acid till pH 5 and left standing for 48 h. The formed precipitate was filtered off, washed with ethanol and hexane.

1-Methyl-3-thioxo-*N*-cyclopropyl-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (Va). Yield 1.7 g (64%), dark-brown powder, mp 215–218°C (AcOH). IR spectrum, ν, cm^{-1}: 3300(NH), 1664 (CONH), 1155 (C=S). ^{1}H NMR spectra, δ, ppm: 0.52 m (2H, CH_2 cyclopropyl), 0.62 m (2H, CH_2 cyclopropyl), 1.51–1.79 m (4H, $2CH_2$), 2.28 s (3H, Me), 2.51 m (4H, $2CH_2$), 2.61–2.79 m (1H, NCH), 7.90 br.s (1H, CONH), 13.09 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 5.45, 15.91, 21.16, 21.58, 22.25, 23.85, 26.57, 120.31, 136.70, 145.57, 146.22, 167.58, 169.71. Mass spectrum, *m/z*(I_{rel}, %): 263 (100) [M + 1]$^+$. Found, %: C 63.95; H 6.80; N 10.52. $C_{14}H_{18}N_2OS$. Calculated, %: C 64.09; H 6.91; N 10.68. M 262.375.

1-Methyl-3-thioxo-*N*-phenyl-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (Vb). Yield 2.15 g (72%), gray powder, mp 235–238°C (BuOH). IR spectrum, ν, cm^{-1}: 3444, 2945(NH), 1673 (CONH), 1255 (C=S). ^{1}H NMR spectra, δ, ppm: 1.65–1.71 m (4H, $2CH_2$), 2.33 s (3H, Me), 2.57–2.68 m (4H, $2CH_2$), 7.06 t (1H, Ph, J 6.8 Hz), 7.32 t (2H, Ph, J 7.6 Hz), 7.68 t (2H, Ph, J 7.8 Hz), 10.12 br.s (1H, CONH), 11.33 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 15.97, 21.10, 21.53, 23.86, 26.76, 119.19, 120.50, 123.07, 128.50, 136.88, 139.53, 145.72, 146.70, 165.02, 169.72. Mass spectrum, *m/z*(I_{rel}, %): 299 (100) [M + 1]$^+$. Found, %: C 68.33; H 5.95; N 9.18. $C_{17}H_{18}N_2OS$. Calculated, %: C 68.43; H 6.08; N 9.39. M 298.409

***N*-Benzyl-1, 6-dimethyl-3-thioxo-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-3-carboxamide (Vc)**. Yield 2.6 g (79%), white powder, mp 270–272°C (BuOH). IR spectrum, ν, cm^{-1}: 3256, 3198(NH), 1668 (CONH), 1239 (C=S). ^{1}H NMR spectra, δ, ppm: 0.93 d (3H, Me, J 6.5 Hz), 1.22 m (1H, C^{6}H), 1.63 m (1H, CH_2), 1.82 m (1H, CH_2), 2.05 d and 2.08 d (1H, CH_2, J 11.0 and 11.50 Hz), 2.30 s (3H, Me), 7.49 m (1H, CH_2), 2.57 m (2H, CH_2), 4.41 d (2H, NCH_2, J 5.5 Hz), 7.24 t (1H, Ph, J 7.5 Hz), 7.32 t (2H, Ph, J 7.5 Hz), 5.50 d (2H, Ph, J 8.0 Hz), 8.54 t (1H, CONH, J 5.5 Hz), 13.24 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 16.06, 21.39, 23.82, 27.37, 29.71, 35.07, 42.17, 120.02, 126.55, 127.55, 127.95, 136.73, 139.52, 145.59, 146.30, 166.55, 169.75. Mass spectrum, *m/z*(I_{rel}, %): 327 (100) [M + 1]$^+$. Found, %: C 69.81; H 6.66; N 8.41. $C_{19}H_{22}N_2OS$. Calculated, %: C 69.90; H 6.79; N 8.58. M 326.463.

1, 6-Dimethyl-3-thioxo-*N*-phenyl-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (Vd). Yield 2.12 g (68%), yellow powder, mp 285–287°C (BuOH). IR spectrum, ν, cm^{-1}: 3430, 2936(NH), 1668 (CONH), 1252 (C=S). ^{1}H NMR spectra, δ, ppm: 0.97 d (3H, Me, *J* 6.5 Hz), 1.28 m (1H, CH_2), 1.70 m (1H, CH_2), 1.85 m (1H, CH_2), 2.19 m (1H, CH_2), 2.34 s (3H, Me), 7.43 m (1H, CH_2), 2.64 t (2H, CH_2, *J* 4.0 Hz), 7.07 t (1H, Ph, *J* 7.5 Hz), 7.31 t (2H, Ph, *J* 7.5 Hz), 7.69 d (2H, Ph, *J* 8.0 Hz), 10.13 br.s (1H, CONH), 13.35 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 16.10, 21.34, 23.79, 27.35, 29.66, 34.99, 39.50, 119.20, 120.15, 123.12, 128.57, 136.82, 139.58, 145.51, 146.70, 165.04, 169.79. Mass spectrum, *m/z*(I_{rel}, %): 313 (100) [*M* + 1]$^+$. Found, %: C 69.01; H 6.32; N 8.85. $C_{18}H_{20}N_2OS$. Calculated, %: C 69.20; H 6.45; N 8.97. M 312.436.

1-Isopropyl-3-thioxo-*N*-(furan-2-ylmethyl)-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-3-carboxamide (Ve). Yield 2.1 g (63%), white powder, mp 170–172°C (AcOH). IR spectrum, ν, cm^{-1}: 3329, 2955(NH), 1670 (CONH), 1199 (C=S). ^{1}H NMR spectra, δ, ppm: 1.27 d (6H, 2Me, *J* 6.0 Hz), 1.54–1.79 m (4H, $2CH_2$), 2.53–2.77 m (4H, $2CH_2$), 3.01–3.12 m (1H, $\underline{CH}Me_2$), 4.41 d (2H, NCH_2, *J* 7.96 Hz), 6.31 m (1H, C^{4}H furan), 6.42 s (1H, C^{3}H furan), 7.59 s (1H, C^{5}H furan), 8.85 br.s (1H, NH), 9.01 br.s (1H, NH). Mass spectrum, *m/z*(I_{rel}, %): 331 (100) [*M* + 1]$^+$. Found, %: C 65.32; H 6.60; N 8.39. $C_{18}H_{22}N_2O_2S$. Calculated, %: C 65.43; H 6.71; N 8.48. M 330.452.

***N*-Benzyl-3-thioxo-1-phenyl-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (Vf)**. Yield 2.73 g (73%), yellow powder, mp 223–225°C (AcOH). IR spectrum, ν, cm^{-1}: 3336, 2926(NH), 1653(CONH), 1250 (C=S). ^{1}H NMR spectra, δ, ppm: 1.52 m (2H, CH_2), 1.73 m (2H, CH_2), 2.31 t (2H, CH_2, *J* 4.0 Hz), 2.60 t (2H, CH_2, *J* 4.0 Hz), 4.46 d (2H, NCH_2, *J* 5.0 Hz), 7.25 t (1H, Ph, *J* 6.9 Hz), 7.36 t (2H, Ph, *J* 8.1 Hz), 7.34 d (2H, Ph, *J* 8.1 Hz), 7.52 br.s (5H, Ph), 8.57 br.s (1H, CONH), 13.29 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 21.04, 21.57, 25.29, 26.58, 42.14, 120.57, 126.50, 127.44, 127.93, 128.28, 129.04, 129.40, 132.35, 138.58, 139.38, 145.62, 147.19, 166.13, 172.14. Mass spectrum, *m/z*(I_{rel}, %): 375 (100) [*M* + 1]$^+$. Found, %:C 73.68; H 5.88; N 7.30. $C_{23}H_{22}N_2OS$. Calculated, %: C 73.77; H 5.92; N 7.48. M 374.507.

2-Thioxo-*N*, 1-diphenyl-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (Vg). Yield 2.52 g (70%), yellow cotton-like substance, mp 260–262°C (BuOH). IR spectrum, ν, cm^{-1}: 3419, 2928(NH), 1638(CONH), 1250 (C=S). ^{1}H NMR spectra, δ, ppm: 1.57 m (2H, CH_2), 1.68 m (2H, CH_2), 2.33 t (2H, CH_2, *J* 6.0 Hz), 2.67 t (2H, CH_2, *J* 6.0 Hz), 7.07 t (1H, Ph, *J* 7.5 Hz), 7.33 t (2H, Ph, *J* 8.0 Hz), 7.41 m (1H, Ph), 7.53 m (4H, Ph), 7.72 d (2H, Ph, *J* 8.0 Hz), 10.31 br.s (1H, CONH), 13.52 br.s (1H, NH). Mass spectrum, *m/z*(I_{rel}, %): 361 (100) [*M* + 1]$^+$. Found, %: C 73.19; H 5.41; N 7.68. $C_{22}H_{20}N_2OS$. Calculated, %:C 73.30; H 5.59; N 7.77. M 360.480.

***N*-(2-Methylphenyl)-3-thioxo-1-phenyl-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (Vh)**. Yield 2.8 g (75%), yellow powder, mp 215–218°C (AcOH). IR spectrum, ν, cm^{-1}: 3435, 3283(NH), 1652 (CONH), 1269 (C=S). ^{1}H NMR spectra, δ, ppm: 1.62 m (2H, CH_2), 1.75 m (2H, CH_2), 2.37 m (5H, CH_2 and Me), 2.80 m (2H, CH_2), 7.12 t (1H$_{arom}$, *J* 7.5 Hz), 7.23 m (2H$_{arom}$), 2.43 m (2H$_{arom}$), 7.54 m (3H$_{arom}$), 7.59 d (1H$_{arom}$, *J* 8.0 Hz), 9.58 br.s (1H, CONH), 13.37 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 18.13, 21.13, 21.66, 25.39, 26.68, 120.75, 125.15, 125.38, 125.65, 128.36, 129.07, 129.49, 130.13, 132.32, 132.37, 136.13, 138.64, 144.44, 145.70, 165.11, 172.15. Mass spectrum, *m/z*(I_{rel}, %): 373 (100) [*M* – 1]$^+$. Found, %: C 73.59; H 5.88; N 7.33. $C_{23}H_{22}N_2OS$. Calculated, %: C 73.76; H 5.92; N 7.48. M 374.507.

3-Thioxo-1-phenyl-*N*-(furan-2-ylmethyl)-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (Vi). Yield 2.5г (66%), yellow powder, mp 225–227°C (AcOH). IR spectrum, ν, cm^{-1}: 3348, 2966 (NH), 1655 (CONH), 1250 (C=S). ^{1}H NMR spectra, δ, ppm: 1.38–1.55 m (2H, CH_2), 1.56–1.71 m (2H, CH_2), 2.30 t (2H, CH_2, *J* 8.0 Hz), 2.58 t (2H, CH_2, *J* 8.0 Hz), 4.40 d (2H, NCH_2, *J* 4.0 Hz), 6.41 br.s (1H, C^{3}H furan), 6.49 br.s (1H, C^{4}H furan), 7.38–7.50 m (5H, Ph), 7.57 br.s (1H, C^{5}H furan), 8.59 br.s (1H, CONH), 13.19 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 21.57, 22.10, 25.82, 27.03, 36.33, 107.32, 110.90, 121.10, 128.83, 129.57, 129.95, 132.90, 138.87, 142.21, 146.26, 147.79, 152.80, 166.78, 171.76. Mass spectrum, *m/z* (I_{rel}, %): 365 (100) [*M* + 1]$^+$. Found, %: C 69.07; H 5.44; N 7.59. $C_{21}H_{20}N_2O_2S$. Calculated, %: C 69.21; H 5.53; N 7.69. M 364.469.

6-Methyl-*N*, 1-diphenyl-3-thioxo-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (Vj). Yield 2.62 g (70%), yellow powder, mp 249–251°C (AcOH). IR spectrum, ν, cm^{-1}: 3318, 2911(NH), 1668 (CONH), 1248 (C=S). ^{1}H NMR spectra, δ, ppm: 0.97 d (3H, Me, *J* 8.0 Hz), 1.16 m (1H, C^{6}H), 1.74 m (2H, CH_2), 2.23 m (2H, CH_2), 2.79 t (2H, CH_2, *J* 4.0 Hz), 7.09 t (1H, Ph, *J* 8.0 Hz), 7.34 t (2H, Ph, *J* 8.0 Hz), 7.41 m (2H, Ph),

7.53 m (3H, Ph), 7.72 d (2H, Ph, *J* 8.0 Hz), 10.27 br.s (1H, CONH), 13.58 br.s (1H, NH). Mass spectrum, *m/z*(I_{rel}, %): 375 (100) [*M* + 1]$^+$. Found, %: C 73.65; H 5.80; N 7.33. $C_{23}H_{22}N_2OS$. Calculated, %: C 73.77; H 5.92; N 7.48. M 374.507.

6-Methyl-3-thioxo-1-phenyl-*N*-(furan-2-ylmethyl)-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (Vk). Yield 3.26 g (86%), yellow powder, mp 227–231°C (AcOH). IR spectrum, ν, cm^{-1}: 3345, 2946(NH), 1653 (CONH), 1251 (C=S). ^{1}H NMR spectra, δ, ppm: 1.00 d (3H, Me, *J* 8.0 Hz), 1.06–1.15 m (1H, CHMe), 1.58–1.71 m (2H, CH_2), 2.11–2.18 d.d (1H, CH_2, *J* 8.0 and 16.0 Hz), 2.38–2.43 m (2H, CH_2), 2.68 d (1H, CH_2, *J* 20.0 Hz), 4.42 d (2H, NCH_2, *J* 8.0 Hz), 6.33 s (1H, C^{4}H furan), 6.46 c (1H, C^{3}H furan), 7.36 c (1H, C^{5}H furan), 7.43–7.52 m (5H, Ph), 8.4 br.s (1H, CONH), 13.24 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 22.10, 25.75, 27.93, 30.43, 35.51, 36.25, 107.33, 110.86, 120.53, 128.60, 128.81, 129.52, 129.87, 133.25, 138.64, 142.15, 145.96, 147.98, 152.87, 166.86, 171.75, 194.59. Mass spectrum, *m/z*(I_{rel}, %): 379 (100) [*M* + 1]$^+$. Found, %: C 69.70; H 5.92; N 7.34. $C_{22}H_{22}N_2O_2S$. Calculated, %: C 69.81; H 5.86; N 7.40. M 378.496.

***N*, 1-Diphenyl-3-(2-cyanoethylsulfanyl)-5, 6, 7, 8-tetrahydroisoquinoline-4-carboxamide (VI)**. To a mixture of 3.6 g (10 mmol) of substituted isoquinolinethione **Vg** and 0.66 ml (10 mmol) of acrylonitrile in 20 ml of anhydrous ethanol was added 3 drops of triethylamine, and the mixture was boiled for 2 h. After 24 h the formed precipitate was filtered off, washed with ethanol and hexane. Yield 2.85 g (69%), colorless needle crystals, mp 160–162°C (BuOH). IR spectrum, ν, cm^{-1}: 3434 (NH), 2252(C≡N), 1662(CONH). ^{1}H NMR spectra, δ, ppm: 1.66 m (2H, CH_2), 1.76 m (2H, CH_2), 2.68 t (2H, CH_2, *J* 4.0 Hz), 2.77 t (2H, CH_2, *J* 4.0 Hz), 2.94 t (2H, CH_2, *J* 4.6 Hz), 3.73 t (2H, CH_2, *J* 4.6 Hz), 7.14 t (1H, Ph, *J* 7.0 Hz), 7.37 t (2H, Ph, *J* 8.0 Hz), 7.45–7.57 m (5H, Ph), 7.72 d (2H, Ph, *J* 8.5 Hz), 10.64 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 17.98, 21.20, 22.08, 25.19, 26.08, 26.95, 119.33, 119.51, 123.90, 127.24, 128.11, 128.17, 128.74, 128.76, 130.94, 138.75, 139.60, 144.30, 148.79, 157.51, 164.39. Mass spectrum, *m/z*(I_{rel}, %): 414 (100) [*M* + 1]$^+$. Found, %: C 72.50; H 5.49; N 9.99. $C_{25}H_{23}N_3OS$. Calculated, %: C 72.61; H 5.61; N 10.16. M 413.545.

3-Alkylsulfanyl-1-phenyl-5, 6, 7, 8-tetrahydroisoquinoline-3-carboxamides VIIIa, VIIIb. General procedure. To a solution of 3.6 g (10 mmol) of isoquinolinethione **Vg** in 15 ml of DMF was added in succession at stirring 5.6 ml (10 mmol) of 10% water solution of KOH and 10 mmol of an appropriate alkyl halide **VIIa, VIIb**, the mixture was stirred for 1 h and left standing for 24 h. The reaction mixture was diluted with an equal volume of water, the formed precipitate was filtered off, washed in succession with water, ethanol, and hexane.

3-Methylsulfanyl-*N*, 1-diphenyl-5, 6, 7, 8-tetrahydroisoquinoline-4-carboxamide (VIIIa). Yield 2.8 g (75%), colorless crystals, mp 235–237°C (AcOH). IR spectrum, ν, cm^{-1}: 3300(NH), 1666(CONH). ^{1}H NMR spectra, δ, ppm: 1.65 m (2H, CH_2), 1.74 m (2H, CH_2), 2.48 s (3H, Me), 2.67 t (2H, CH_2, *J* 5.6 Hz), 2.76 t (2H, CH_2, *J* 6.0 Hz), 7.13 t (1H, Ph, *J* 7.5 Hz), 7.37 t (2H, Ph, *J* 8.0 Hz), 7.45–7.57 m (5H, Ph), 7.75 d (2H, Ph, *J* 7.5 Hz), 10.61 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 12.60, 21.26, 22.14, 25.97, 26.93, 119.46, 123.75, 126.46, 128.02, 128.70, 128.75, 130.80, 138.88, 139.82, 143.57, 150.60, 157.25, 162.18, 164.75. Mass spectrum, *m/z*(I_{rel}, %): 375 (100) [*M* + 1]$^+$. Found, %:C 73.65; H 5.81; N 7.32. $C_{23}H_{22}N_2OS$. Calculated, %: C 73.76; H 5.92; N 7.48. M 374.507.

3-Benzylsulfanyl-*N*, 1-diphenyl-5, 6, 7, 8-tetrahydroisoquinoline-4-carboxamide (VIIIb). Yield 4.0 g (89%), colorless cotton-like substance, mp 144–146°C (AcOH). IR spectrum, ν, cm^{-1}: 3322(NH), 1664(CONH). ^{1}H NMR spectra, δ, ppm: 1.66 m (2H, CH_2), 1.75 m (2H, CH_2), 2.66 t (2H, CH_2, *J* 4.0 Hz), 2.79 t (2H, CH_2, *J* 4.0 Hz), 4.40 s (2H, SCH_2), 7.12 t (1H, Ph, *J* 7.0 Hz), 7.21 t (1H, Ph, *J* 6.5 Hz), 7.26 t (2H, Ph, *J* 8.5 Hz), 7.35 m (4H, Ph), 7.48 m (1H, Ph), 7.52 m (4H, Ph), 7.71 d (2H, Ph, *J* 7.5 Hz), 10.56 br.s (1H, NH). ^{13}C NMR spectra, δ, ppm: 21.20, 22.06, 26.01, 26.86, 33.14, 119.44, 123.78, 126.73, 126.82, 128.03, 128.05, 128.10, 128.70, 128.94, 130.42, 138.33, 138.77, 139.68, 143.68, 143.91, 149.75, 157.25, 164.53. Mass spectrum, *m/z*(I_{rel}, %): 451 (100) [*M* + 1]$^+$. Found, %: C 77.18; H 5.77; N 6.09. $C_{29}H_{26}N_2OS$. Calculated, %: C 77.30; H 5.82; N 6.22. M 450.606.

3-Allylsulfanyl-*N*, 1-diphenyl-5, 6, 7, 8-tetrahydroisoquinoline-4-carboxamide (IX) and **2-allyl-3-thioxo-*N*, 1-diphenyl-2, 3, 5, 6, 7, 8-hexahydroisoquinoline-4-carboxamide (X)** were obtained analogously to compounds **VIIIa, VIIIb** using 0.85 ml (10 mmol) of allyl bromide. Yield 3.0 g (74%), white powder, mp 155–158°C (EtOH). IR spectrum, ν, cm^{-1}: 3440(NH),

1661(CONH), 1244(C=S). ^{1}H NMR spectra, δ, ppm: 1.66 m (2H, CH_2), 1.75 m (2H, CH_2), 2.67 m (2H, CH_2), 2.76 m (2H, CH_2), 3.58 d (0.6H, NCH_2, *J* 7.0 Hz) and 3.81 d (1.4H, SCH_2, *J* 6.5 Hz), 5.04 d (1H, CH_2=, J_{cis} 10.0 Hz), 5.22 d (1H, CH_2=, J_{trans} 17.0 Hz), 5.90 m (1H, =CH), 7.13 m (1H, Ph), 7.36 m (2H, Ph), 7.39–7.55 m (5H, Ph), 7.72 d (2H, Ph, *J* 7.5 Hz), 10.59 br.s (0.7H, CONH), 10.67 br.s (0.3H, CONH). Mass spectrum, *m/z*(I_{rel}, %): 401 (100) $[M+1]^+$. Found, %: C 74.88; H 5.92; N 6.80. $C_{25}H_{24}N_2OS$. Calculated, %: C 74.97; H 6.04; N 6.99. M 400.546.

11-Phenyl-7, 8, 9, 10-tetrahydrobenzo[4, 5]imidazo[1, 2-*b*]isoquinoline-6-carbonitrile XII). To a mixture of 2.71 g (10 mmol) of enaminoketone **Id** and 1.57 g (10 mmol) of benzimidazol-2-ylacetonitrile (**XI**) in 15 ml of anhydrous ethanol was added while stirring a solution obtained from 0.23 g (10 mmol) of sodium and 10 ml of anhydrous ethanol. Then the reaction mixture was brought to boiling and left standing for 24 h. The crystals precipitated on cooling were filtered off and washed in succession with ethanol and hexane. Yield 3.0 g (93%), yellow crystals, under UV irradiation fluoresce, mp 353–355°C (AcOH), at 240°C undergo sublimation. IR spectrum, ν, cm^{-1}: 2223(C≡N). ^{1}H NMR spectra, δ, ppm: 1.51–1.99 m (4H, $2CH_2$), 3.09–3.34 m (4H, $2CH_2$), 5.98–6.17 m ($1H_{arom}$), 6.81–7.02 m ($1H_{arom}$), 7.27–7.86 m ($7H_{arom}$). Mass spectrum, *m/z*(I_{rel}, %): 324 (21) $[M+1]^+$, 323 (100) $[M]^+$, 322 (11) $[M-1]^+$, 294 (10), 231 (2), 165 (4), 140 (13), 102 (8), 77 (21) $[Ph]^+$, 75 (7), 41 (5). Found, %: C 81.66; H 5.22; N 13.12. $C_{22}H_{17}N_3$. Calculated, %: C 81.71; H 5.30; N 12.99. M 323.4.

[2-(3-Hydroxyphenylamino)cyclohex-1-enyl]-(phenyl)methanone (XIV). A mixture of 2.71 g (10 mmol) of enaminoketone **Id** and 1.1 g (10 mmol) of *m*-aminophenol (**XIII**) in 20 ml of anhydrous ethanol was boiled for 1 h. On cooling the reaction mixture the separated precipitate was filtered off and washed in succession with ethanol and hexane. Yield 2.3 g (77%), light-red powder, mp 199–202°C (AcOH). IR spectrum, ν, cm^{-1}: 3154(OH), 2934(NH), 1713(C=O). ^{1}H NMR spectra, δ, ppm: 1.51 d (2H, CH_2, *J* 4.0 Hz), 1.56 d (2H, CH_2, *J* 4.0 Hz), 2.18–2.27 m (2H, CH_2), 3.34–3.49 m (2H, CH_2), 6.52–6.68 m ($3H_{arom}$), 7.18 t ($1H_{arom}$, *J* 8.0 Hz), 7.39 br.s (5H, Ph), 9.64 br.s (1H, NH), 13.39 br.s (1H, OH). ^{13}C NMR spectra, δ, ppm: 21.74, 23.14, 27.57, 27.94, 101.95, 112.06, 112.94, 115.87, 126.76 (2C), 128.39 (2C), 129.09, 130.37, 139.87, 142.77, 158.53, 161.79, 194.97. Mass spectrum, *m/z* (I_{rel}, %): 294 (100) $[M+1]^+$. Found, %: C 77.65; H 6.42; N 4.72. $C_{19}H_{19}NO_2$. Calculated, %: C 77.79; H 6.53; N 4.78. M 293.37.

REFERENCES

1. Paronikyan, E.G., Noravyan, A.S., Akopyan, Sh.F., Dzhagatspanyan, I.A., Nazaryan, I.M., and Paronikyan, R.G., *Khim.-Farm. Zh.,* 2007, vol. 41, no. 9, p. 14.
2. Faermark, I.F., Guss, L.T., Ershov, L.V., Shvarts, G.Ya., and Granik, V.G., *Khim.-Farm. Zh.,* 1990, vol. 24, no 5, p. 27; Smetskaya, N.I., Mukhina, N.A., Granik, V.G., Shvarts, G.Ya., Syubaev, R.D., and Mashkovskii, M.D., *Khim.-Farm. Zh.,* 1984, vol. 18, *no.* 8, p. 931.
3. *Azotistye geterotsikly i alkaloidy* (Nitrogen Heterocycles and Alkaloids), Kartsev, V.G. and Tolstikov, G.A., IBS, 2001, vol. 1, p. 435; Kaiho, T., San-nohe, K., Kajiya, S., Suzuki, T., Otsuka, K., Ito, T., Kamiya, J., and Maruyama, M., *J. Med. Chem.,* 1989, vol. 32, p. 351.
4. Hunt, J.C.A., Briggs, E., Clarke, E.D., and Whittingham, W.G., *Bioorg. Med. Chem. Lett.,* 2007, vol. 17, p. 5222.
5. Issac, Y.A., Ali, M.S., and Eian, A.W., *Sci. Pharm.,* 2000, vol. 68, p. 389.
6. Chan, L., Stefanac, T., Turcotte, N., Hu, Z., Chen, Y., Bedard, J., May, S., and Jin, H., *Bioorg. Med. Chem. Lett.,* 2000, vol. 10, p. 1477.
7. Elgemeie, G.E.H., Attia, A.M.E., and Fathy, N.M., *Nucleosides, Nucleotides,* 1997, vol. 16, p. 485.
8. Vernier, J.-M., Holsenback, H., Cosford, N.D.P., Whitten, J.P., Menzaghi, F., Reid, R., Rao, T.S., Sacaan, A.I., Lloyd, G.K., Suto, C.M., Chavez-Noriega, L.E., Washburn, M.S., Urrutia, A., and McDonald, I.A., *Bioorg. Med. Chem. Lett.,* 1998, vol. 8, p. 2173.
9. Ashwell, G.J., Robinson, B.J., Amiri, M.A., Locatelli, D., Quici, S., and Roberto, D., *J. Mater. Chem.,* 2005, vol. 15, p. 4203; Ashwell, G.J., Tyrrel, W.D., Whittem, A.J. *J. Am. Chem. Soc.,* 2004, vol. 126, p. 7102.
10. Dyachenko, V.D., Sukach, S.M., Dyachenko, A.D., Zubatyuk, R.M., and Shishkin, O.V., *Zh. Obshch.Khim.,* 2010, vol. 80, p. 1728; Lozinskii, M.O., Chernega, A.N., and Shelyakin, V.V., *Zh. Org. Khim.,* 2002, vol. 38, p. 1718; Freeman, F., Farquhar, D.K., and Walker, R.L., *J. Org. Chem.,* 1968, vol. 33, p. 3648.
11. Gewald, K., Buchwalder, M., and Peukert, M., *J. Pract. Chem.,* 1973, vol. 315, p. 679.
12. Megm, A.M., El-Aaad, F.A.E.A., Hafez, E.A., Elnagdi, M.H., and Mostafa, Y.M.N. *Phosph., Sulfur, Silicon. Relat. Elem.,* 1995, vol. 106, p. 1.
13. Fadda, A.A., *Indian J. Chem.,* 1991, vol. 30, p. 28; El-Dead, A.M.K., Hafez, A.A.A., and Attallah, H.A., *Phosph., Sulfur, Silicon. Relat. Elem.,* 1989, vol. 46, p. 1.

14. Elgemeie, G.E.H. and Fathy, N.M., *Tetrahedron,* 1995, vol. 51, p. 3345; Elgemeie, G.H., and Ahmed, M.A., *Nucleosides, Nucleotides, Nucleic, acids.,* 2002, vol. 21, p. 837; Elgemeie, G.H., El-Enany, M.M., Ismail, M.M., and Ahmed, E.K., *Nucleosides, Nucleotides, Nucleic Acids.,* 2002, vol. 21, p. 477.
15. Zhang, P. and Li, L. *Synth. commun.,* 1986, vol. 16, p. 957.
16. March, J., *Advanced Organic Chemistry. Reactions, Mechanisms, and Structure*, New York: Wiley-Interscience, 1985. Litvinov, V.P., Yakunin, Ya.Yu., and Dyachenko, V.D., *Khim. Geterotsikl. Soedin.,* 2001, p. 41.
17. Stanetty, P., Purstinger, G. *Monatsh. Chem.,* 1999, vol. 130, p. 441; Al-Omran, F., Elassar, A.-Z.A., and El-Khair, A.A., *Tetrahedron*, 2001, vol. 57, p. 10163.
18. *Organikum. Organisch-Chemisches Grundpraktikum*, Berlin: VEB Deutscher Verlag der Wissenschaften, 1976.
19. Dyachenko, V.D., Tkachev, R.P., *Zh. Org. Khim.,* 2002, vol. 38, p. 765.
20. Dyachenko, V.D. and Kudryavtseva, A.G., *Khim. Geterotsikl. Soedin.,* 2004, p. 1728; Klokol, G.V., Sharanina, L.G., Nesterov, V.N., Shklover, V.E., Sharanin, Yu.A., and Struchkov, Yu.T., *Zh. Org. Khim.,* 1987, vol. 23, p. 412; Abd-El-Aziz, A.S., Egrody, A.M., Bedair, A.H., Corkery, T.C., and Ato, A. *Hetrocycles,* 2004, vol. 63, p. 1793; Al-Mousawi, S.M., Elkholy, Y.M., Mohammed, M.A., and Elnagdi, M.H. *Org. Prep. Proc. Int.,* 1999, 31, p. 305.
21. Sasse, K., *Lieb. Ann. Chem.,* 1976, p. 768.
22. Schaper, W., *Synthesis,* 1985, p. 861.