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# α-Amino Azoles in the Synthesis of Heterocycles: VI.* Synthesis and Structure of Cycloalkane-Annulated Pyrazolo[1,5-*a*]pyrimidines

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**Abstract**—Reactions of 4-aryl-1*H*-pyrazol-5(3)-amines with 2-acylcycloakanones and 2-acyl-5,5-dimethylcyclohexane-1,3-diones led to the formation of regioisomeric 6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazoline, 5,6,7,8-tetrahydropyrazolo[5,1-*b*]quinazoline, and 7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine derivatives. The product structure was determined by X-ray analysis and $^{1}$H and $^{13}$C NMR spectroscopy.

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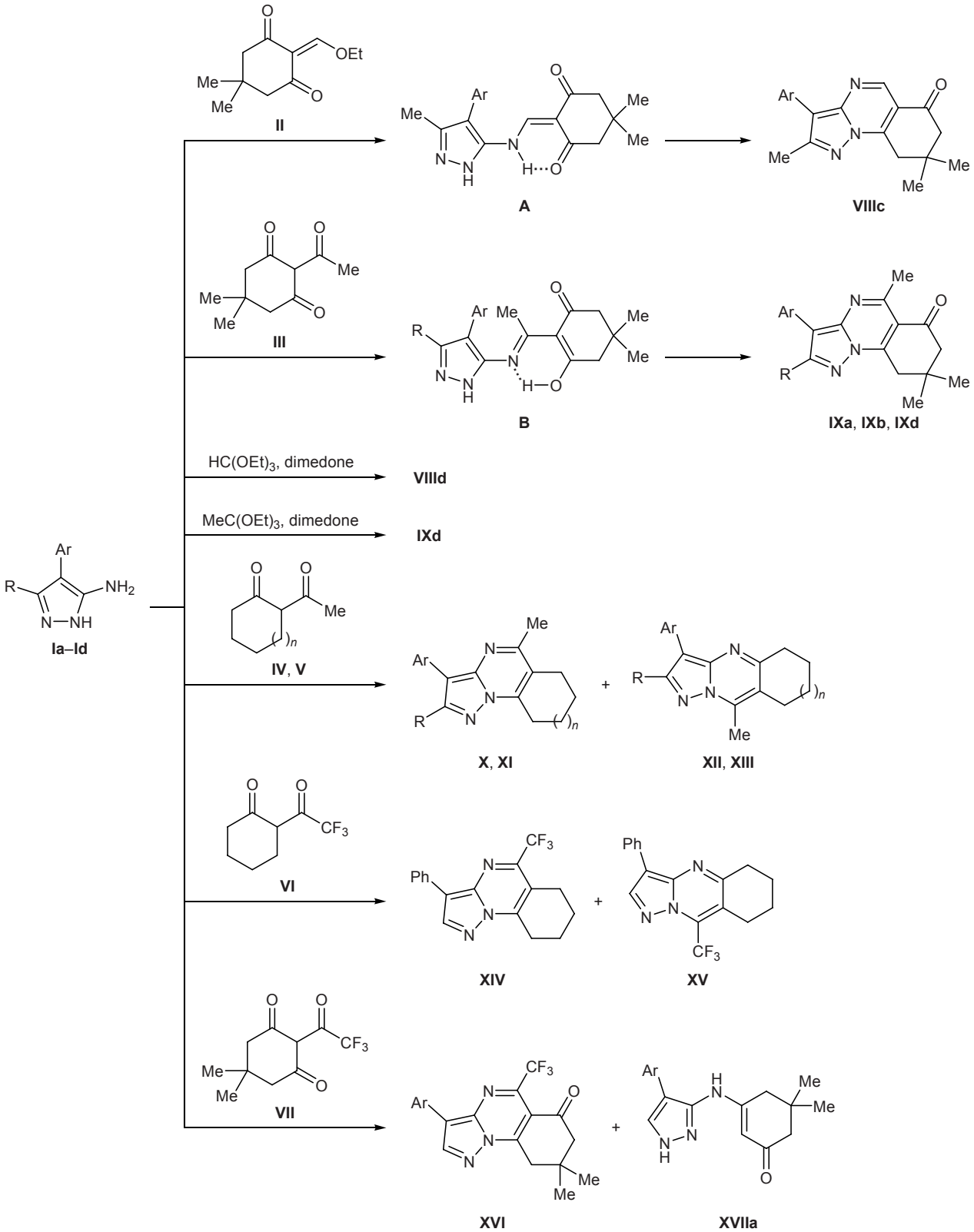
Extensive development of synthetic approaches to polyfunctional pyrazolo[1,5-*a*]pyrimidine derivatives is stimulated by the fact that compounds possessing pyrazole and pyrimidine fragments are promising as potential biologically active substances. Several efficient medical agents exhibiting sedative and soporific activity (such as Zaleplon [2], Indiplon [3], and Ocinaplon [4]) are known; some compounds of this series have been patented as antidiabetic [5] and antiphlogistic agents [6], antidepressants [7], and analgesics [8, 9]. Pronounced biological activity of pyrazolo[1,5-*a*]pyrimidine derivatives was noted in [10–17].

The goal of the present work was to study regioselectivity in the formation of cycloalkane-annulated pyrazolo[1,5-*a*]pyrimidines and determine characteristic $^{13}$C NMR spectral parameters of particular regioisomers. We examined reactions of 5(3)-amino-4-aryl-1*H*-pyrazoles **Ia**–**Id** with 2-acylcycloalkanones **III**–**VII** and three-component condensation of 5(3)-amino-4-aryl-1*H*-pyrazoles **Ia** and **Id** with dimedone and aldehydes.

Aminopyrazoles **I** reacted with 2-ethoxymethylidene-5,5-dimethylcyclohexane-1,3-dione (**II**) and 2-acetyl-5,5-dimethylcyclohexane-1,3-dione (**III**) to give only substituted 6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazolines which may be regarded as pyrazolopyrimidines fused at the $C^6$–$C^7$ bond to cyclohexene ring. The reaction begins with nucleophilic attack by the amino nitrogen atom of pyrazole **I** at the carbon atom of the ethoxymethylidene or acetyl group in **II** or **III**, respectively. In the first case, the primary linear adduct, 5,5-dimethyl-2-{[(3-methyl-4-phenyl-1*H*-pyrazol-5-yl)amino]methylidene}cyclohexane-1,3-dione (**A**), was isolated as individual substance, while in the second case, 3-hydroxy-5,5-dimethyl-2-{1-[(4-phenyl-1*H*-pyrazol-3-yl)imino]ethyl}cyclohex-2-en-1-one (**B**) was detected as intermediate product by $^{1}$H NMR (Scheme 1). The formation of an analogous intermediate compound was observed previously in the reaction of 5-methoxymethylidene-2,2-dimethyl-1,3-dioxane-4,6-dione with 5(3)-aminopyrazoles [18]. In the $^{1}$H NMR spectrum of compound **A**, the NH proton in the pyrazole ring resonated at δ 12.82 ppm, and the exocyclic CH= and NH protons gave doublets at δ 8.65 and 12.76 ppm, respectively, with a coupling constant $^{3}J$ of 13.1 Hz. The downfield position of the latter NH signal indicates formation of intramolecular hydrogen bond NH···O. The structure of intermediate **B** was determined by $^{1}$H NMR monitoring of the reaction of aminopyrazole **Id** with acetyldimedone **III** in DMSO-$d_6$ at 20°C. After 2 days, the $^{1}$H NMR spectrum of the reaction mixture contained signals belonging to the initial compounds and those assignable to structure **B**; in particular, signals from the pyrazole

* For communication V, see [1].

**Scheme 1.**




**I**, **VIII**, **IX**, R = H, Ar = Ph (**a**), 4-$ClC_6H_4$ (**b**); R = Me, Ar = Ph (**c**), 4-$ClC_6H_4$ (**d**); **X**, **XII**, R = H, Ar = 4-$ClC_6H_4$; **XI**, **XIII**, R = Me, Ar = 4-$ClC_6H_4$; **XVI**, **XVIIa**, Ar = 4-$ClC_6H_4$; **IV**, **X**, **XII**, $n = 0$; **V**, **XI**, **XIII**, $n = 1$.

NH proton (δ 12.85 ppm) and hydroxy proton involved in OH···N hydrogen bonding (δ 14.85 ppm) were present. Intermediate compounds **A** and **B** undergo thermal intramolecular cyclization with formation of tetrahydropyrazolo[1,5-*a*]quinazolines **VIIIc** and **IXa**, **IXb**, and **IXd**.

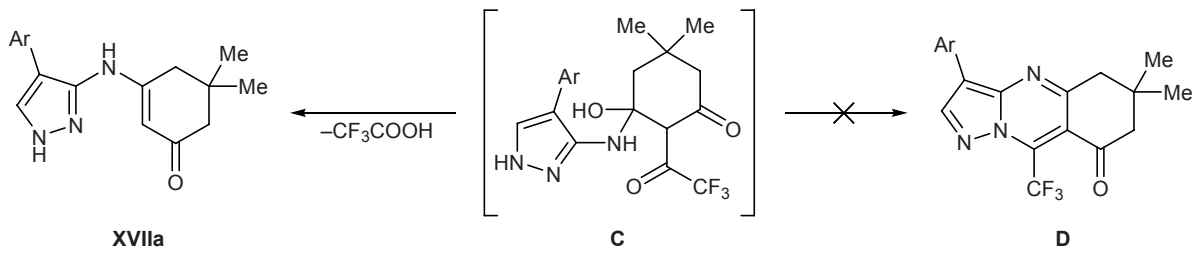
An alternative approach to compounds **VIII** and **IX** is based on three-component condensation of aminopyrazoles **I** with ortho esters (triethyl orthoformate and triethyl orthoacetate) and dimedone (Scheme 1). Analogous three-component cyclocondensation of 5(3)-amino-3(5)-methyl-1*H*-pyrazole with formaldehyde and dimedone under microwave irradiation was reported to afford 2,8,8-trimethyl-6,7,8,9-tetrahydropyrazolo-[1,5-*a*]quinazolin-6-one [19].

We found that the regioselectivity of the reaction of aminopyrazoles **I** with 2-acylcycloalkanones is determined by the nature of the acyl group and ring size. Aminopyrazoles **I** reacted with 2-acetylcycloalkanones **IV** and **V** under different conditions (on heating in boiling acetic acid or ethanol or in ethanol at room temperature in the presence of a catalytic amount of trifluoroacetic acid) to produce a mixture of pyrazolopyrimidines fused at the $C^6$–$C^7$ (**X**, **XI**) or $C^5$–$C^6$ bond (**XII**, **XIII**) to carbocycle (Scheme 1). For instance, the reaction of aminopyrazole **Ib** with 2-acetylcyclohexanone (**V**) in boiling acetic acid gave a mixture of 3-aryl-5-methyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]-quinazoline **XI** and 3-aryl-9-methyl-5,6,7,8-tetrahydropyrazolo[5,1-*b*]quinazoline **XIII** at a ratio of 3:2, whereas the isomer ratio was 1:1 when the reaction was carried out in ethanol at 17°C in the presence of a catalytic amount of trifluoroacetic acid. We failed to isolate compounds **XI** and **XIII** from the reaction mixture by multiple crystallization or chromatographically, and their ratio was estimated by $^1$H NMR. In analogous reaction with 2-acetylcyclopentanone (**IV**) the major product (~95%) was 3-aryl-5-methyl-7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine (**X**).

Different regioselectivity was observed in the reaction of cyclic diketone, 2-(trifluoroacetyl)cyclohexanone (**VI**) with 5(3)-aminopyrazole **Ia**. The reaction in acetic acid at 15°C afforded 3-(4-chlorophenyl)-9-(trifluoromethyl)-5,6,7,8-tetrahydropyrazolo[5,1-*b*]quinazoline (**XV**) as the only product. In this case, the cyclohexane ring is fused at the $C^5$–$C^6$ bond of pyrazolo-[1,5-*a*]pyrimidine, and the $CF_3$ group is attached to $C^9$ (Scheme 1). When the reaction was carried out in DMSO at 20°C or by fusion, the products were compound **XV** and 18–30% of 3-(4-chlorophenyl)-5-trifluoromethyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazoline (**XIV**), the latter being formed via cyclohexane annulation at the $C^6$–$C^7$ bond of pyrazolo[1,5-*a*]pyrimidine. 5,5-Dimethyl-2-(trifluoroacetyl)cyclohexane-1,3-dione (**VII**) reacted with aminopyrazole **Ib** under different conditions to produce a mixture of compounds **XVI** and **XVIIa** (Scheme 1). In this case, nucleophilic attack by the amino nitrogen atom of pyrazole **Ib** is directed at the carbonyl carbon atom of the trifluoroacetyl group in triketone **VII**, and subsequent intramolecular cyclization and dehydration yield 3-(4-chlorophenyl)-8,8-dimethyl-5-trifluoromethyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazolin-6-one (**XVI**). Presumably, intermediate **C** formed as a result of nucleophilic attack by the exocyclic nitrogen atom of aminopyrazole **I** on the endocyclic carbonyl carbon atom of triketone **VII** does not undergo intramolecular cyclization to give structure **D** but decomposes into 3-[4-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-3-ylamino]-5,5-dimethylcyclohex-2-en-1-one (**XVIIa**) and trifluoroacetic acid (Scheme 2). It should be noted that initial 2-(trifluoroacetyl)dimedone (**VII**) also decomposes during the process to give dimedone and trifluoroacetic acid. Table 1 contain the product ratios **XVI**:**XVIIa** obtained under different conditions.

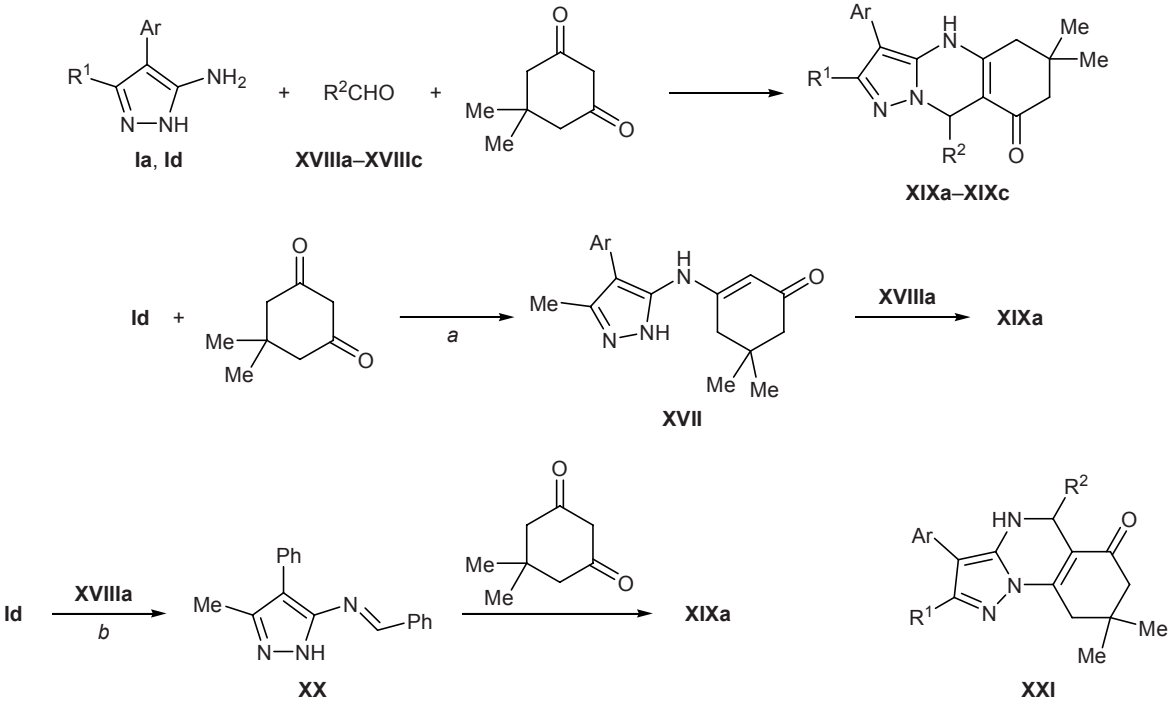
Three-component condensation of dimedone with aldehydes **XVIIIa**–**XVIIIc** and aminopyrazoles **Ia** and **Id** in acetic acid with simultaneous mixing of the components, as well as two-component reaction of 3-[4-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-3-ylamino]-5,5-dimethylcyclohex-2-en-1-one (**XVIIb**) with benzaldehyde (**XVIIIa**), in 5 h produced only the cor-

**Scheme 2.**




**XVIIa** **C** **D**

**Scheme 3.**




**I**, $R^1$ = H, Ar = Ph (**a**), $R^1$ = Me, Ar = 4-$ClC_6H_4$ (**d**); **XVII**, Ar = 4-$ClC_6H_4$; **XVIII**, $R^2$ = Ph (**a**), Et (**b**), *i*-Pr (**c**); **XIX**, $R^1$ = Me, Ar = 4-$ClC_6H_4$, $R^2$ = Ph (**a**); $R^1$ = H, Ar = Ph, $R^2$ = Et (**b**), *i*-Pr (**c**).

responding 9-substituted 6,6-dimethyl-3-phenyl-5,6,7,9-tetrahydropyrazolo[5,1-*b*]quinazolin-8(4*H*)-ones **XIXa**–**XIXc** (Scheme 3; cf. [20]). It might be expected that the reaction of Schiff base **XX** with dimedone would give rise to isomeric 5-substituted 8,8-dimethyl-3-phenyl-5,7,8,9-tetrahydro-4*H*-pyrazolo-[1,5-*a*]quinazolin-6-one **XXI**; however, the only product was compound **XIXa** (Scheme 3).

The formation of the same products in the two- and three-component reactions led us to propose two possible ways of formation of 5,6,7,9-tetrahydropyrazolo-[5,1-*b*]quinazolin-8(4*H*)-ones **XIX**. Following path *a*, initially formed enaminoketone **XVII** reacts with aldehyde, and subsequent intramolecular cyclization yields final product **XIX**. According to path *b*, the reaction of aminopyrazole with aldehyde gives Schiff base **XX**, and attack by the α-carbon atom of dimedone molecule on the electron-deficient CH=N carbon atom in **XX**, followed by closure of pyrimidine ring, leads to final product **XIX**.

The reaction of Schiff base **XX** with dimedone is likely to involve intermediate formation of structure **E** (Scheme 4) which can be converted into the second intermediate **G** in two ways. The first of these consists of decomposition of **E** into aminopyrazole **I** and 2-$R^2$-methylidenecyclohexane-1,3-dione **E** which give rise to adduct **G**, while the second pathway is the rearrangement **E** → **G**. Analogous schemes were proposed for the reaction of 2-aminobenzimidazole with aldehydes and cyclohexane-1,3-dione in water under microwave activation [21] and for the three-component condensation of aldehydes with aromatic amines and dimedone [22].

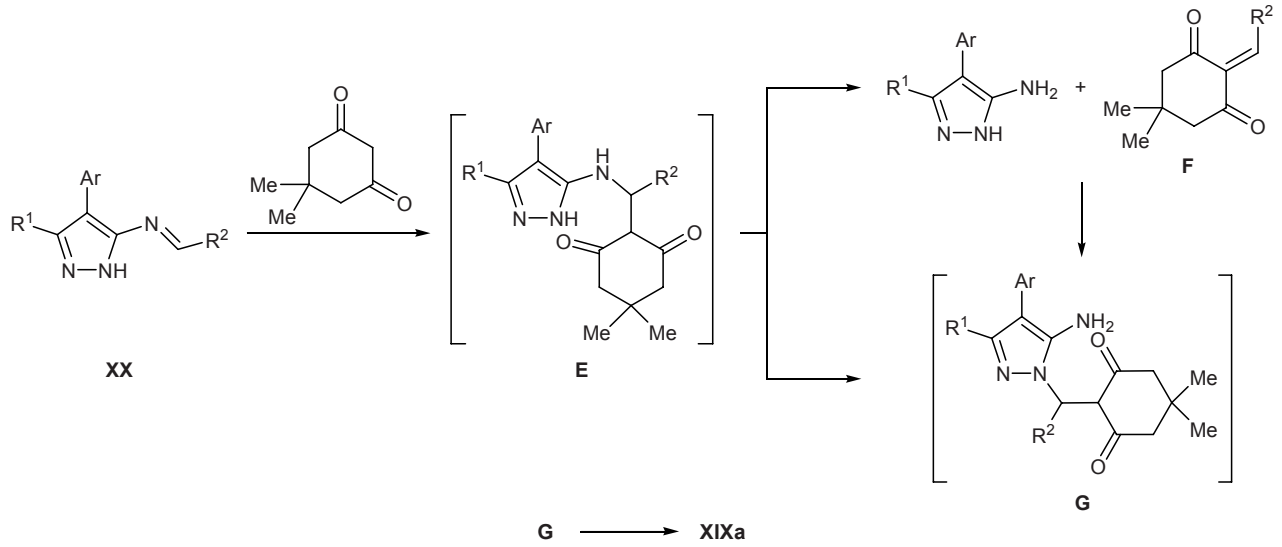
Unlike three-component condensations with formaldehyde [19], the dihydropyrimidine fragment in

**Table 1.** Product ratios in the reaction of aminopyrazole **Ib** with 2-(trifluoroacetyl)dimedone (**VII**) under different conditions

| Solvent (catalyst) | Temperature, °C | Ratio **XVI**:**XVIIa** |
|---|---|---|
| Butanol (AcOH) | 118 | 1:4 |
| AcOH | 118 | 2:1 |
| AcOH | 20 | 99:1[a] |
| Ethanol (AcOH) | 20 | –[b] |
| DMSO | 20 | 1:9 |

[a] According to the $^1$H NMR data, the major product was dimedone formed as a result of decomposition of initial compound **VII**; overall yield of **XVI** and **XVIIa** ~20%.
[b] Dimedone was the only product.

**Scheme 4.**




**XIXa**–**XIXc** does not undergo dehydrogenation during the synthesis, regardless of the aldehyde nature (the reactions were performed with both aliphatic and aromatic aldehydes). We failed to effect oxidation of compounds **XIXa**–**XIXc** according to procedures commonly used for analogous structures, such as bromination–dehydrobromination with bromine or *N*-bromosuccinimide in acetic acid, treatment with sodium nitrite in acetic acid or with tetrachloro-1,4-benzoquinone in THF, or carrying out the reaction in the presence of nitrobenzene. In all cases, either complex mixtures of products were obtained or the initial compound remained unchanged. It should be noted that 5(3)-amino-3(5)-methyl-1*H*-pyrazole having no substituent in position *4* reacts with dimedone and aldehydes in boiling ethanol with high regioselectivity to produce tricyclic compounds with different structure, 4,7,8,9-tetrahydro-2*H*-pyrazolo[3,4-*b*]quinolin-5(6*H*)-ones [23]; here, the reaction centers in the initial pyrazole molecule are nitrogen atom in the exocyclic amino group and $C^4$. On the other hand, three-component condensation of 5(3)-amino-3(5)-phenyl-1*H*-pyrazole with a cyclic 1,3-diketone and aromatic aldehydes in ethanol at 20°C under ultrasonic activation afforded 9-aryl-2-phenyl-4,5,6,7,8,9-hexahydropyrazolo[5,1-*b*]quinazolin-8-ones in good yields [24]. Mixtures of tricyclic dihydropyrimidine and dihydropyridine derivatives were obtained by heating 5(3)-aminopyrazole with cyclic 1,3-diketones and aldehydes in boiling ethanol, and the product ratio strongly depended on the structure of the dicarbonyl compound [20].

The structure of the synthesized compounds was determined on the basis of their elemental analyses, $^1$H and $^{13}$C NMR spectra, and X-ray diffraction data. The chemical shifts of carbon nuclei in the pyrimidine ring and methyl group were compared with the data reported by us previously [25–27] and those given in [28] (Table 2). The $^{13}$C NMR spectra of **VIIIc** and **VIIId** contained doublet signals in the region $\delta_C$ 146 – 147 ppm ($^1J_{CH}$ = 188 Hz). Comparison with the data for model pyrazolopyrimidines [25–28] possessing N=$C^5$H–C ($\delta_C$ 148.5–149 ppm) and N–$C^7$H=C fragments ($\delta_C$ 134.2–135 ppm) showed that molecules **VIIIc** and **VIIId** possess an N=$C^5$H–C fragment and a cyclohexene ring fused at the $C^6$–$C^7$ bond of the pyrazolo[1,5-*a*]pyrimidine core. The structure of compounds **IXa**–**IXc** and **X**–**XIII** unambiguously followed from the chemical shifts of carbon nuclei in the pyrimidine ring and methyl group and the corresponding data for the N–C($CH_3$)=C and N=C($CH_3$)–C fragments given in Table 2.

The other independent criterion for structural assignment of regioisomers **X**–**XIII** is the difference in the coupling constants $^5J_{HH}$ between methylene protons in the fused cycloalkane ring. The coupling constant $^5J_{HH}$ for the $CH_2$–C=C–$CH_2$ fragment in **X** and **XI** was ~1.5 Hz, whereas the corresponding coupling constant for the $CH_2$–C–C–$CH_2$ fragment in regioisomers **XII** and **XIII** is considerably smaller (no coupling was observed).

The structure of compound **IXa** was also proved by X-ray analysis of a single crystal (Fig. 1). The methyl group in molecule **IXa** is attached to $C^5$, and the cyclohexane fragment is fused to the pyrazolopyrimidine core at the $C^{5a}$–$C^{9a}$ bond. The heterocyclic fragment

**Table 2.** Characteristic $^{13}C$ chemical shifts of pyrazolo[1,5-*a*]pyrimidines [25–28] and compounds **VIII–XVI**

| Fragment | $\delta_C$, ppm (published data) | Carbon atom | $\delta_C$, ppm (compound no.) |
|---|---|---|---|
| N=CH–C | 148.5–149.0 | $C^5$ | 146.2–146.9 (**VIII**) |
| N–CH=C | 134.2–135.0 | $C^7$ | – |
| N–C($CH_3$)=C | 148.0–149.0 | $C^9$ | 142.0 (**XIII**) |
| N–C($CH_3$)=C | 17.0–17.6 | 8-$CH_3$, 9-$CH_3$ | 14.1 (**XII**), 14.9 (**XIII**) |
| N=C($CH_3$)–C | 158.0–159.0[a] | $C^5$ | 156.1 (**IX**), 158.2–159.0 (**X**, **XI**) |
| N=C($CH_3$)–C | 24.5–25.5 | 5-$CH_3$ | 22.8 (**IX**), 25.5–26.7 (**X**, **XI**) |
| N=C($CF_3$)–C | 145.2–146.0 | $C^5$ | 144.5 (**XIV**), 142.1 (**XVI**) |
| N–C($CF_3$)=C | 131.5–134.5 | $C^9$ | 129.9 (**XV**) |

[a] If a strong electron-withdrawing substituent (e.g., CN group) is present in position *3*, the chemical shift is ~163–165 ppm [27].

$N^1C^2C^3C^{3a}N^4C^{4a}C^{8a}C^9N^{10}$ is almost planar: the largest deviation from the mean-square plane is 0.041 Å ($C^3$). The cyclohexene ring adopts a distorted *chair* conformation with the $C^7$ and $C^8$ atoms deviating most from planar structure (by –0.379 and 0.391 Å, respectively). All formally single C–C, C–N, and N–N bonds in the pyrazolopyrimidine system (Table 3) are appreciably shorter than the corresponding standard bonds (1.54, 1.47, and 1.45 Å, respectively [29]), indicating essential delocalization of π and *n* electrons.

Molecules **IXa** in crystal are linked to form cyclic centrosymmetric dimers $R_2^2$ (6) (Fig. 2) via shortened $C^2$–H···$N^{10}$ contacts [C···N 3.238(2) Å, ∠CHN 142.8(2)°]. The dimers form a three-dimensional network through weaker C–H···π and C–H···H–C contacts, the minimal C···C distances being 3.344(2) and 3.525(2) Å.

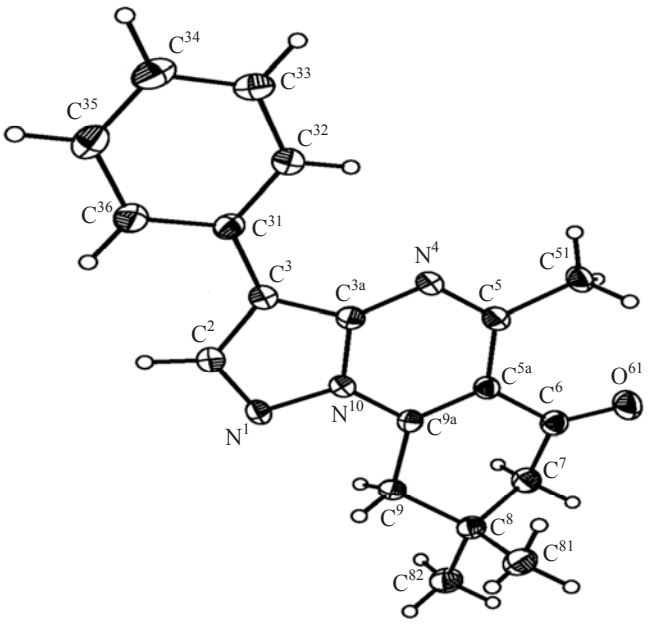



**Fig. 1.** Structure of the molecule of 5,8,8-trimethyl-3-phenyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazolin-6-one (**IXa**) according to the X-ray diffraction data; non-hydrogen atoms are shown as thermal ellipsoids with a probability of 50%.

The position of the trifluoromethyl group in **XIV**–**XVI** was unambiguously determined by comparing the chemical shifts of carbon nuclei in the C–$CF_3$ fragment with those reported in [25, 30] for the N=C–$CF_3$ and N–C($CF_3$)=C fragments in pyrazolopyrimidine derivatives (Table 2). Compounds **XIV** and **XVI** displayed in the $^{13}C$ NMR spectra quartet signals at $\delta_C$ 144.46 and 142.06 ppm, respectively, indicating that the trifluoromethyl group is attached to $C^5$. The $CF_3$ group in isomer **XV** is located at $C^9$, for the corresponding quartet signal was observed in a stronger field ($\delta_C$ ~130 ppm).

The structure of the condensation products of aminopyrazoles **Ia** and **Id** with dimedone and benzaldehyde (**XVIIIa**) or aliphatic aldehydes **XVIIIb** and **XVIIIc** was assigned on the basis of their $^1H$ NMR spectra. The spectra contained multiplet signals from aromatic protons, *AB* pattern from diastereotopic methylene protons, and signals from alkyl and NH groups and 9-H. The NH proton appeared as a singlet at δ 9.5–10 ppm (DMSO-$d_6$), and its position was typical of dihydroazolopyrimidine structures having an –NHC=C– fragment [31]. Therefore, compounds **XIXa**–**XIXc** were identified as 4,5,6,7,8,9-hexahydropyrazolo[5,1-*b*]quinazolin-8-ones. Isomeric 5-$R^2$-8,8-dimethyl-3-phenyl-8,9-dihydropyrazolo[1,5-*a*]quinazolin-6(7*H*)-one **XXI** having an –NHC–C< fragment are characterized by more upfield position of the NH signal (by 2–3 ppm) [31]. Unambiguous proof for the assumed structure of **XIXa**–**XIXc** was obtained by analysis of two-dimensional $^1H$ NMR spectra which revealed coupling between the NH proton and methylene protons on $C^5$ (δ 2.55 ppm). No such coupling is possible in

**Table 3.** Bond lengths and bond angles in the molecule of 5,8,8-trimethyl-3-phenyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazolin-6-one (**IXa**)

| Bond | *d*, Å | Angle | ω, deg | Angle | ω, deg |
|---|---|---|---|---|---|
| $N^1$–$C^2$ | 1.337(2) | $C^2N^1N^{10}$ | 102.9(1) | $N^{10}C^{3a}C^3$ | 105.8(1) |
| $N^1$–$N^{10}$ | 1.366(1) | $C^{3a}N^4C^5$ | 118.4(1) | $C^{9a}C^{5a}C^5$ | 119.4(1) |
| $C^2$–$C^3$ | 1.412(2) | $N^1N^{10}C^{3a}$ | 112.9(1) | $C^6C^{5a}C^{9a}$ | 117.4(1) |
| $C^3$–$C^{3a}$ | 1.396(2) | $N^1N^{10}C^{9a}$ | 124.5(1) | $C^5C^{5a}C^6$ | 123.2(1) |
| $C^{3a}$–$N^4$ | 1.352(2) | $C^{3a}N^{10}C^{9a}$ | 122.6(1) | $C^{5a}C^{9a}N^{10}$ | 116.7(1) |
| $C^{3a}$–$N^{10}$ | 1.397(2) | $N^1C^2C^3$ | 114.4(1) | $N^{10}C^{9a}C^9$ | 117.0(1) |
| $N^4$=$C^5$ | 1.322(2) | $C^2C^3C^{3a}$ | 103.8(1) | $C^{5a}C^{9a}C^9$ | 126.3(1) |
| $C^5$–$C^{5a}$ | 1.448(2) | $N^4C^{3a}N^{10}$ | 120.9(1) | $N^4C^5C^{5a}$ | 122.0(1) |
| $C^{5a}$–$C^{9a}$ | 1.377(2) | $N^4C^{3a}C^3$ | 133.2(1) | | |
| $C^{9a}$–$N^{10}$ | 1.362(2) | | | | |

alternative structure **XXI**. In addition, no coupling was observed between the NH proton and proton on the carbon atom bearing the $R^2$ substituent. The structure of **XIXb** was also confirmed by the COLOC spectrum which also allowed us to assign signals from quaternary carbon atoms in the $^{13}C$ NMR spectrum. The key $^1H$–$^{13}C$ correlations in the spectrum of compound **XIXb** (DMSO-$d_6$) were the following: NH (δ 9.70 ppm)/$C^{8a}$ ($\delta_C$ 103.05 ppm), $C^{3a}$ ($\delta_C$ 34.12 ppm); 9-H (δ 5.30 ppm, t)/$C^{8a}$ ($\delta_C$ 103.05 ppm), $C^{3a}$ ($\delta_C$ 134.12 ppm), $C^{4a}$ ($\delta_C$ 151.26 ppm); $CH_2$ (2.20 ppm, *AB*)/$C^{8a}$ ($\delta_C$ 103.05 ppm), $C^{4a}$ ($\delta_C$ 151.26 ppm).

To conclude, we have synthesized regioisomeric tetrahydropyrazolo[1,5-*a*]quinazoline and tetrahydropyrazolo[5,1-*b*]quinazoline derivatives by reactions of 5(3)-amino-4-arylpyrazoles with cyclic di- and triketones.

## EXPERIMENTAL

The $^1H$ and $^{13}C$ NMR spectra were recorded at 22°C on a Bruker DPX-300 spectrometer with an operating frequency of 300.13 and 75.47 MHz, respectively. The chemical shifts were measured relative to the residual proton and carbon signals of deuterated solvents ($CHCl_3$, δ 7.28 ppm; DMSO-$d_5$, δ 2.50 ppm; $CDCl_3$, $\delta_C$ 76.90 ppm; DMSO-$d_6$, $\delta_C$ 39.50 ppm). The COLOC spectra were recorded using a pulse sequence (Bruker software) optimized for a coupling constant $J_{CH}$ of 8 Hz. Microwave-assisted reactions were performed in a Lyumeks Minotavr-2 reactor at a power of 200 W.

5,5-Dimethyl-2-trifluoroacetylcyclohexane-1,3-dione was synthesized according to the procedure reported in [32], 2-acetylcyclohexanone was prepared as

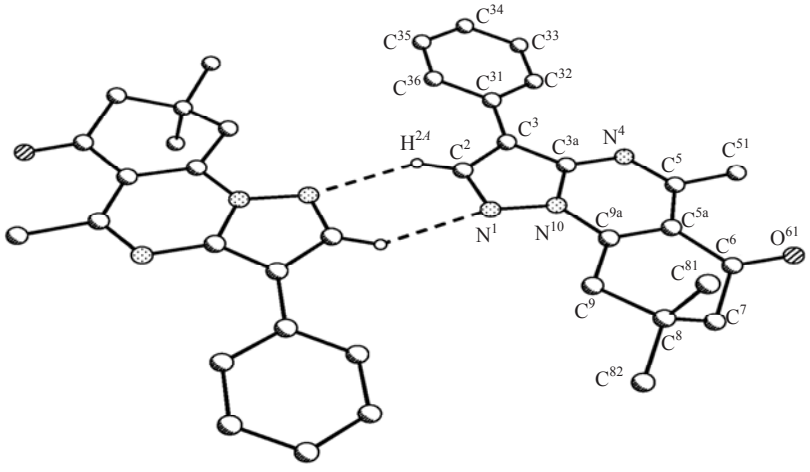



**Fig. 2.** Centrosymmetric $R_2^2$ (6) dimer formed by molecules of 5,8,8-trimethyl-3-phenyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazolin-6-one (**IXa**) in crystal.

described in [33], and 2-trifluoroacetylcyclohexanone was obtained according to [34].

**5,5-Dimethyl-2-[(3-methyl-4-phenyl-1*H*-pyrazol-5-ylamino)methylidene]cyclohexane-1,3-dione (A).** A mixture of 5 mmol of 3(5)-methyl-4-phenyl-1*H*-pyrazol-5(3)amine and 5 mmol of 2-ethoxymethylidene-5,5-dimethylcyclohexane-1,3-dione (**II**) in diethyl ether was left to stand overnight. The precipitate was filtered off, washed with diethyl ether, and dried under reduced pressure (the product underwent cyclization to **VIIIa** on heating). Yield 75%. $^1$H NMR spectrum (DMSO-$d_6$), δ, ppm: 0.96 s (6H, $CH_3$), 2.27 s (3H, $CH_3$), 2.30 s (2H, $CH_2$), 2.34 s (2H, $CH_2$), 7.33–7.50 m (5H, Ph), 8.65 d (1H, CH, $J$ = 13.1 Hz), 12.76 d (1H, NH, $J$ = 13.1 Hz), 12.82 br.s (1H, NH). $^{13}$C NMR spectrum (DMSO-$d_6$), $\delta_C$, ppm: 9.96 (3′-$CH_3$), 28.02 ($CH_3$), 30.67 [**C**$(CH_3)_2$], 50.61 and 50.73 ($CH_2$), 108.31 ($C^{4'}$), 108.38 (C=CH), 129.93 ($C^p$), 128.37 ($C^m$), 129.37 ($C^o$), 130.67 ($C^i$), 138.10 ($C^{3'}$), 144.23, ($C^{5'}$), 148.70 (CH=NH), 194.93 and 199.40 (C=O). Found, %: C 70.41; H 6.69. $C_{19}H_{21}N_3O_2$. Calculated, %: C 70.57; H 6.55.

**2-{1-[4-(4-Chlorophenyl)-3-methyl-1*H*-pyrazol-5-yl)imino]ethyl}-3-hydroxy-5,5-dimethylcyclohex-2-en-1-one (B).** A mixture of aminopyrazole **Ic** and 2-acetyldimedone (**III**) in DMSO-$d_6$ was kept for 20 days in an NMR ampule. $^1$H NMR spectrum, δ, ppm: 1.02 s (6H, $CH_3$), 2.32 s (3H, $CH_3$), 2.27 br.s (2H, $CH_2$), 2.36 br.s (2H, $CH_2$), 2.45 s (3H, $CH_3$), 7.24 d and 7.30 d (2H each, $H_{arom}$), 12.87 br.s (1H, NH), 14.84 s (1H, OH).

**2,8,8-Trimethyl-3-phenyl-8,9-dihydro-7*H*-pyrazolo[1,5-*a*]quinazolin-6-one (VIIIc).** *a*. A mixture of aminopyrazole **Id** and 2-ethoxymethylidene-5,5-dimethylcyclohexane-1,3-dione (**II**) was stirred for 5 h at room temperature and was then heated for 30 min under reflux. The precipitate was filtered off and recrystallized. Yield 80%, mp 196°C (from ethanol).

*b*. Compound **A** was heated at 100°C over a period of 10 min. Yield 100%. $^1$H NMR spectrum (DMSO-$d_6$), δ, ppm: 1.15 s (6H, $CH_3$), 2.57 s (2H, $CH_2$), 2.60 s (3H, $CH_3$), 3.35 s (2H, $CH_2$), 7.31–7.73 m (5H, Ph), 8.80 s (CH). $^{13}$C NMR spectrum (DMSO-$d_6$), $\delta_C$, ppm: 14.32 ($CH_3$); 27.82 (8-$CH_3$); 32.24 and 36.37 ($C^8$, $C^9$); 50.09 ($C^7$); 110.38 ($C^3$); 112.90 ($C^{5a}$); 126.53, 128.34, 128.55, 131.11 ($C_{arom}$); 145.63 ($C^{3a}$); 146.25 ($C^5$); 152.28 ($C^{9a}$); 154.88 ($C^2$); 194.48 (C=O). Found, %: C 74.53; H 6.37. $C_{19}H_{19}N_3O$. Calculated, %: C 74.73; H 6.27.

**3-(4-Chlorophenyl)-2,8,8-trimethyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazolin-6-one (VIIId).** Each of the reactants, 0.4 mmol of aminopyrazole **Id**, 0.4 mmol of dimedone, and 2.4 mmol of triethyl orthoformate, was applied to 1.5 cm$^3$ of silica gel, the supported reactants were mixed together, and the mixture was irradiated in a microwave oven over a period of 10 min at a power of 180 W. Two drops of acetic acid were added to the mixture, and MW irradiation was continued for 7 min more. The mixture was extracted with 15 ml of methylene chloride, the solvent was removed, and the residue was recrystallized. Yield 45%, mp 211–212°C (from butanol). $^1$H NMR spectrum ($CDCl_3$), δ, ppm: 1.22 s (6H, $CH_3$), 2.57 s (2H, $CH_2$), 2.64 s (3H, $CH_3$), 3.34 s (2H, $CH_2$), 7.42–7.64 m (4H, $C_6H_4$), 8.94 s (CH). $^{13}$C NMR spectrum ($CDCl_3$), $\delta_C$, ppm: 14.33 ($CH_3$), 28.37 (8-$CH_3$), 32.56 ($C^8$), 37.07 ($C^9$), 50.73 ($C^7$), 110.59 ($C^3$), 113.10 ($C^{5a}$), 128.64 and 129.91 ($C^o$, $C^m$), 129.58 ($C^p$), 132.55 ($C^i$), 146.13 ($C^{3a}$), 146.91 ($C^5$), 151.56 ($C^{9a}$), 155.49 ($C^2$), 194.48 ($C^6$). Found, %: C 67.07; H 5.41. $C_{19}H_{18}ClN_3O$. Calculated, %: C 67.16; H 5.34.

**6,7,8,9-Tetrahydropyrazolo[1,5-*a*]quinazolin-6-ones IXa–IXd (*general procedure*).** *a*. A mixture of 0.4 mmol of aminopyrazole **Ia** and 0.4 mmol of 2-acetyldimedone (**III**) in 0.5 ml of acetic acid was heated for 3 h under reflux. The solvent was removed under reduced pressure, and the residue was washed with water and recrystallized from butanol.

*b*. A solution of 0.4 mmol of aminopyrazole **Ib** and 0.4 mmol of 2-acetyldimedone (**III**) in 1.5 ml of methanol was heated for 4 h under reflux. The mixture was cooled, and the precipitate was filtered off and washed with methanol.

*c*. A solution of 0.4 mmol of aminopyrazole **Ia**, **Ib**, or **Id** and 0.4 mmol of triketone **III** in 1.5 ml of methanol was stirred for 5 h at room temperature, and the mixture was left overnight. The precipitate was filtered off and washed with methanol.

*d*. A mixture of 0.5 mmol of aminopyrazole **Id**, 0.5 mmol of dimedone, and 0.5 mmol of triethyl orthoacetate in 1.5 ml of butanol was heated for 5 h under reflux. Acetic acid, 0.3 ml, was then added, and the mixture was heated for 6 h under reflux. The solvent was removed under reduced pressure, and the residue was washed with water and recrystallized from butyl alcohol.

**5,8,8-Trimethyl-3-phenyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazolin-6-one (IXa).** Yield 76% (*a*),

mp 172–173°C (from butanol). $^1$H NMR spectrum (DMSO-$d_6$), δ, ppm: 1.10 s (6H, 8-$CH_3$), 2.54 s (2H, 9-H), 2.78 s (3H, 5-$CH_3$), 3.32 s (2H, 7-H), 7.24–8.15 m (5H, $C_6H_5$), 8.85 s (1H, 2-H). $^{13}$C NMR spectrum (DMSO-$d_6$), $\delta_C$, ppm: 26.48 (5-$CH_3$), 27.74 (8-$CH_3$), 31.66 ($C^8$), 37.29 ($C^9$), 51.88 ($C^7$), 109.47 ($C^3$), 112.63 ($C^{5a}$), 125.68, and 128.61 ($C^o$, $C^m$), 126.19 ($C^p$), 131.44 ($C^i$), 142.76 ($C^{3a}$), 145.31 ($C^2$), 153.44 ($C^{9a}$), 158.01 ($C^5$), 195.67 (C=O). Found, %: C 74.62; H 6.37. $C_{19}H_{19}N_3O$. Calculated, %: C 74.73; H 6.27.

**X-Ray diffraction data for compound IXa.** A 0.40×0.20×0.20-mm single crystal of **IXa** was examined. $C_{19}H_{19}N_3O$. $M$ 305.37. Triclinic crystal system, space group $P$-1; unit cell parameters (120 K): $a$ = 6.1618(4), $b$ = 10.1137(6), $c$ = 13.5510(8) Å; α = 110.901(5), β = 93.235(5), γ = 96.122(5)°; $V$ = 780.34(9) Å$^3$; $Z$ = 2 ($Z'$ = 1); $F(000)$ = 324; $d_{calc}$ = 1.300 g/cm$^3$; μ = 0.082 mm$^{-1}$. The unit cell parameters and intensities of 14449 reflections were measured on a SMART 1000 CCD diffractometer at 120 K (Mo$K_\alpha$ irradiation, graphite monochromator, ω-scanning, $2\theta_{max}$ = 58°). The structure was solved by the direct method and was refined by the least-squares procedure in full-matrix anisotropic approximation with respect to $F^2_{hkl}$. The positions of hydrogen atoms were calculated from geometry considerations and were refined in isotropic approximation using the riding model. The final divergence factors were $R_1$ = 0.0472 [3130 independent reflections with $I > 2\sigma(I)$] and $wR_2$ = 0.1106 (all 4157 independent reflections). All calculations were performed using SHELXTL PLUS (Version 5.10) [35]. The complete set of crystallographic data for compound **IXa** (coordinates of atoms, bond lengths, bond angles, and anisotropic temperature factors) was deposited to the Cambridge Crystallographic Data Centre (entry no. CCDC 706950).

**3-(4-Chlorophenyl)-5,8,8-trimethyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazolin-6-one (IXb).** Yield 82%, mp 193–194°C (from ethanol). $^1$H NMR spectrum ($CDCl_3$), δ, ppm: 1.21 s (6H, 8-$CH_3$), 2.59 s (2H, 9-H), 2.92 s (3H, 5-$CH_3$), 3.34 s (2H, 7-H), 7.37 d (2H, *m*-H), 8.00 d (2H, *o*-H), 8.44 s (2-H). $^{13}$C NMR spectrum ($CDCl_3$), $\delta_C$, ppm: 26.71 (5-$CH_3$), 28.23 (8-$CH_3$), 31.92 ($C^8$), 37.99 ($C^9$), 52.57 ($C^7$), 109.65 ($C^3$), 113.02 ($C^{5a}$), 127.15 and 128.65 ($C^o$, $C^m$), 129.83 ($C^p$), 131.87 ($C^i$), 143.35 ($C^{3a}$), 144.77 ($C^2$), 152.75 ($C^{9a}$), 159.02 ($C^5$), 195.46 (C=O). Found, %: C 67.09; H 5.40. $C_{19}H_{18}ClN_3O$. Calculated, %: C 67.16; H 5.34.

**3-(4-Chlorophenyl)-2,5,8,8-tetramethyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazolin-6-one (IXd).** Yield 78% (*a*), mp 204–205°C (from ethanol). $^1$H NMR spectrum ($CDCl_3$), δ, ppm: 1.23 s (8-$CH_3$), 2.60 s (2H, 9-H), 2.64 s (3H, $CH_3$), 2.88 s (3H, $CH_3$), 3.37 s (2H, 7-H), 7.44 d (2H, *m*-H), 7.69 d (2H, *o*-H). $^{13}$C NMR spectrum ($CDCl_3$, without decoupling from protons), $\delta_C$, ppm: 14.50 q (2-$CH_3$), 26.66 q (5-$CH_3$), 28.26 q.m ($CH_3$), 31.97 m ($C^8$), 38.09 t.m ($C^9$), 52.69 t.m ($C^7$), 108.93 m ($C^3$), 112.71 s ($C^{5a}$), 128.58 d.d and 130.05 d.d ($C^o$, $C^m$), 129.87 t ($C^p$), 132.24 t.t ($C^i$), 144.61 s ($C^{3a}$), 152.00 t ($C^{9a}$), 155.29 q ($C^2$), 159.04 q ($C^5$), 195.52 t (C=O). Found, %: C 67.81; H 5.79. $C_{20}H_{20}ClN_3O$. Calculated, %: C 67.89; H 5.70.

**3-(4-Chlorophenyl)-5-methyl-7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine (X).** A mixture of 2 mmol of aminopyrazole **Ib** and 2 mmol of 2-acetylcyclopentanone (**IV**) in 3 ml of ethanol containing a catalytic amount of trifluoroacetic acid was kept for 15 h. The precipitate was filtered off and recrystallized. Yield 90%, purity >97%, mp 192–193°C (from acetonitrile). $^1$H NMR spectrum ($CDCl_3$), δ, ppm: 2.28 m (2H, $CH_2$); 2.55 s (3H, $CH_3$); 2.96 m (2H, $CH_2$); 3.35 m (2H, $CH_2$); 7.24 t, 7.44 t, and 8.11 d (5H, $H_{arom}$); 8.37 s (1H, CH=). $^{13}$C NMR spectrum ($CDCl_3$), $\delta_C$, ppm: 21.58 ($C^7$), 22.82 ($CH_3$), 29.37 and 29.51 ($C^6$, $C^8$), 108.89 ($C^3$), 121.95 ($C^{5a}$), 125.57 ($C^p$), 125.78 and 128.43 ($C^m$, $C^o$), 132.51 ($C^i$), 141.76 ($C^2$), 144.84 ($C^{3a}$), 148.19 ($C^{8a}$), 156.14 ($C^5$). Found, %: C 67.49; H 5.21. $C_{16}H_{14}ClN_3$. Calculated, %: C 67.72; H 4.97.

**3-(4-Chlorophenyl)-2,5-dimethyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazoline (XIc) and 3-(4-chlorophenyl)-2,9-dimethyl-5,6,7,8-tetrahydropyrazolo[5,1-*b*]quinazoline (XIIIc).** A mixture of 1.3 mmol of aminopyrazole **Id** and 1.3 mmol of 2-acetylcyclohexanone (**V**) in 3 ml of ethanol containing a catalytic amount of trifluoroacetic acid was heated for 15 h under reflux. The precipitate was filtered off and recrystallized from ethanol. Yield of isomer mixture **XIc**/**XIIIc** 70%. Found, %: 69.21; H 5.95. $C_{18}H_{18}ClN_3$. Calculated, %: C 69.34; H 5.82.

Major isomer **XIc**. $^1$H NMR spectrum ($CDCl_3$), δ, ppm: 1.89 m (4H, $CH_2$), 2.50 s ($CH_3$), 2.62 s (2-$CH_3$), 2.70 t.d (2H, 6-H, $J$ = 5.8, 1.5 Hz), 3.13 t.d (2H, 9-H, $J$ = 5.8, 1.5 Hz), 7.42 d and 7.70 d (2H each, $H_{arom}$). $^{13}$C NMR spectrum ($CDCl_3$), $\delta_C$, ppm: 14.22 (2-$CH_3$), 20.78 ($C^7$), 21.94 ($C^8$), 22.80 ($CH_3$), 24.12 and 24.34 ($C^6$, $C^9$), 106.48 ($C^3$), 115.62 ($C^{5a}$), 128.35 and 129.63 ($C^m$, $C^o$), 131.19 ($C^p$), 131.42 ($C^i$), 142.46 ($C^{9a}$), 144.15 ($C^{3a}$), 150.26 ($C^2$), 158.21 ($C^5$).

Minor isomer **XIIIc**. $^1$H NMR spectrum ($CDCl_3$), δ, ppm: 1.95 s (4H, $CH_2$), 2.62 (2-$CH_3$), 2.73 s ($CH_3$),

2.77 s (2H, 8-H), 2.96 m (2H, 5-H), 7.42 d and 7.70 d (2H each, $H_{arom}$). $^{13}C$ NMR spectrum ($CDCl_3$), $\delta_C$, ppm: 12.73 (9-$CH_3$), 14.30 (2-$CH_3$), 22.27 and 22.57 ($C^6$, $C^7$), 24.74 ($C^8$), 33.66 ($C^5$), 105.83 ($C^3$), 114.93 ($C^{8a}$), 128.35 and 129.63 ($C^m$, $C^o$), 131.08 ($C^p$), 131.49 ($C^i$), 142.01 ($C^9$), 144.42 ($C^{3a}$), 150.72 ($C^2$), 158.77 ($C^{4a}$).

**5-Trifluoromethyl-3-phenyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazoline (XIV).** $^1H$ NMR spectrum ($CDCl_3$; in a mixture with **XV**), δ, ppm: 1.94 m, 2.07 m, 2.99 m, and 3.29 m (8H, $CH_2$); 7.42–8.04 m (5H, Ph); 8.52 (1H, 2-H). $^{13}C$ NMR spectrum ($CDCl_3$), $\delta_C$, ppm: 21.31 and 22.01 ($C^7$, $C^8$); 22.65 q ($C^6$, $^4J_{CF}$ = 1.5 Hz); 24.68 ($C^9$); 111.08 ($C^3$); 114.40 ($C^{5a}$); 121.23 q (5-$CF_3$, $^1J_{CF}$ = 276.2 Hz); 127.22, 128.60, 129.94, 131.75 ($C_6H_5$); 141.98 ($C^2$); 141.98 ($C^{3a}$); 144.46 q ($C^5$, $^2J_{CF}$ = 33.5 Hz); 146.67 ($C^{9a}$).

**9-Trifluoromethyl-3-phenyl-5,6,7,8-tetrahydropyrazolo[5,1-*b*]quinazoline (XV).** A solution of 5.5 mmol of 2-(trifluoroacetyl)cyclohexanone was mixed at 15°C with 5.0 mmol of aminopyrazole **Ia**. The mixture was kept for 24 h and poured into water, and the precipitate was filtered off and recrystallized. Yield 89%, mp 188°C (from ethanol). $^1H$ NMR spectrum ($CDCl_3$), δ, ppm: 1.95 m and 3.07 m (8H, $CH_2$), 7.40–8.00 m (5H, Ph), 8.40 s (1H, 2-H). $^{13}C$ NMR spectrum ($CDCl_3$), $\delta_C$, ppm: 21.31, 22.85 ($C^6$, $C^7$); 24.46 q ($C^8$, $^4J_{CF}$ = 4.5 Hz), 34.37 ($C^5$), 108.41 ($C^3$), 118.82 ($C^{8a}$), 121.03 q (9-$CF_3$, $^1J_{CF}$ = 278.2 Hz), 129.86 q ($C^9$, $^2J_{CF}$ = 35.5 Hz); 127.22, 128.60, 129.94, 131.75 ($C_6H_5$); 141.03 ($C^2$); 143.56 ($C^{3a}$); 160.21 ($C^{4a}$). Found, %: C 57.93; H 3.90. $C_{17}H_{13}ClF_3N_3$. Calculated, %: C 58.05; H 3.73.

**3-(4-Chlorophenyl)-8,8-dimethyl-5-trifluoromethyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazolin-6-one (XVI).** A solution of 0.65 mmol of aminopyrazole **Ib** in 0.5 ml of acetic acid was heated to the boiling point, 2-(trifluoroacetyl)dimedone (**VII**) was slowly added, and the mixture was heated for 3 h under reflux. The solvent was removed under reduced pressure, and the residue (a mixture of compounds **XVI** and **XVIIa**) was washed with water, dried, and recrystallized. Yield of **XVI** 28%, mp 256–259°C (from ethanol). $^1H$ NMR spectrum (DMSO-$d_6$–$CCl_4$, 1:2), δ, ppm: 1.15 s (6H, $CH_3$), 2.68 s (2H, $CH_2$), 3.49 s (2H, $CH_2$), 7.53 d and 8.14 d (2H each, $H_{arom}$), 9.00 s (1H, CH=). $^{13}C$ NMR spectrum (DMSO-$d_6$; without decoupling from protons), $\delta_C$, ppm: 27.75 q ($CH_3$), 31.93 s ($C^8$), 39.22 t ($C^9$), 51.55 t ($C^7$), 111.61 s ($C^{9a}$), 112.21 d.t ($C^3$), 120.59 q ($CF_3$, $J$ = 275.2 Hz), 127.60 d.d and 128.89 d.d ($C^o$, $C^m$), 129.20 t ($C^p$), 131.69 t.t ($C^i$), 140.96 d ($C^{3a}$, $J$ = 6.0 Hz), 142.06 q (5-$CF_3$, $J$ = 36.9 Hz), 146.46 d ($C^2$, $J$ = 189.0 Hz), 156.10 s ($C^{5a}$), 192.29 t (C=O, $J$ = 6.2 Hz). Found, %: C 57.83; H 4.01. $C_{19}H_{15}ClF_3N_3O$. Calculated, %: C 57.95; H 3.84.

**3-[4-(4-Chlorophenyl)-1*H*-pyrazol-3-ylamino]-5,5-dimethylcyclohex-2-en-1-one (XVIIa)** was isolated from mixture **XVI**/**XVIIa**. Yield 10%, mp 262–263°C (from ethanol). Compound **XVIIa** was also synthesized by independent method according to the procedure described in [23]. Yield 80%, mp 262–263°C (from ethanol). $^1H$ NMR spectrum (DMSO-$d_6$–$CCl_4$, 1:2), δ, ppm: 1.05 s (6H, $CH_3$), 1.97 s (2H, $CH_2$), 2.33 s (2H, $CH_2$), 4.95 s (1H, CH=), 7.28–7.48 m (4H, $H_{arom}$), 7.94 br.s (1H, NH), 12.60 br.s (1H, NH). Found, %: 64.45; H 5.96. $C_{17}H_{18}ClN_3O$. Calculated, %: C 64.66; H 5.75.

**3-[4-(4-Chlorophenyl)-5-methyl-1*H*-pyrazol-3-ylamino]-5,5-dimethylcyclohex-2-en-1-one (XVIIb).** A solution of 2 mmol of aminopyrazole **Id** and 2 mmol of dimedone in 10 ml of ethanol was heated for 1 h under reflux. The mixture was cooled, and the precipitate was filtered off and recrystallized [23]. Yield 78%, mp 270–271°C (from ethanol). $^1H$ NMR spectrum (DMSO-$d_6$–$CCl_4$, 1:2), δ, ppm: 1.00 s (6H, $CH_3$), 1.93 s (2H, $CH_2$), 2.24 s (2H, $CH_2$), 2.32 s (3H, $CH_3$), 5.08 s (1H, CH=), 7.26–7.34 m (4H, $H_{arom}$), 8.30 br.s (1H, NH), 12.48 br.s (1H, NH). Found, %: C 65.34; H 6.31. $C_{18}H_{20}ClN_3O$. Calculated, %: C 65.55; H 6.11.

**4,5,6,7,8,9-Hexahydropyrazolo[5,1-*b*]quinazolin-8-ones XIXa–XIXc (*general procedure*).** *a*. A mixture of 0.4 mmol of aminopyrazole **Ia** or **Id**, 0.4 mmol of aldehyde **XVIIIa**–**XVIIIc**, and 0.45 mmol of dimedone in 0.8 ml of acetic acid was heated for 5 h under reflux. The solvent was removed under reduced pressure, and the residue was washed with water and recrystallized.

*b*. A mixture of 0.7 mmol of aminopyrazole **I** and 0.7 mmol of aldehyde **XVIII** in 1.5 ml of ethanol containing one drop of acetic acid was heated for 3 h under reflux. The solvent was removed under reduced pressure, 0.75 mmol of dimedone and 1 ml of acetic acid were added, and the mixture was heated for 5 h under reflux. The solvent was removed under reduced pressure, and the residue was washed with water and recrystallized.

*c*. A mixture of 0.4 mmol of 3-[3-(4-chlorophenyl)-2-methyl-1*H*-pyrazol-5-ylamino]-5,5-dimethyl-2-cyclohex-2-en-1-one (**XVIIb**) and 0.4 mmol of benzalde-

hyde (**XVIIIa**) in 0.8 ml of acetic acid was heated under reflux. The solvent was removed under reduced pressure, and the residue was washed with water and recrystallized.

**3-(4-Chlorophenyl)-2,6,6-trimethyl-9-phenyl-4,5,6,7,8,9-hexahydropyrazolo[5,1-*b*]quinazolin-8-one (XIXa).** Yield 56%, mp 291–292°C (from butanol). $^1$H NMR spectrum (DMSO-$d_6$–$CCl_4$, 1:2), δ, ppm: 0.91 s (3H, $CH_3$), 1.02 s (3H, $CH_3$), 2.05 s (3H, $CH_3$), 2.04 and 2.20 (2H, $CH_2$, *AB* system, $J$ = 16.0 Hz), 2.55 s (2H, $CH_2$), 6.10 s (1H, CH), 7.18–7.47 m (9H, $H_{arom}$), 10.00 s (1H, NH). $^{13}$C NMR spectrum (DMSO-$d_6$), $\delta_C$, ppm: 12.70 (2-$CH_3$); 26.66, 28.78 ($CH_3$); 32.01 ($C^6$), 39.50 ($C^7$), 49.79 ($C^5$), 57.33 ($C^9$), 101.82 ($C^{8a}$), 105.48 ($C^3$); 126.79, 128.07, 128.46, 130.96 ($C^o$, $C^m$); 127.16, 130.55, 130.84, 134.30 ($C^p$, $C^i$); 142.95 ($C^{3a}$), 145.59 ($C^2$), 149.63 ($C^{4a}$), 192.46 ($C^8$). Found, %: C 77.88; H 6.47. $C_{24}H_{23}N_3O$. Calculated, %: C 78.02; H 6.27.

**9-Ethyl-6,6-dimethyl-3-phenyl-4,5,6,7,8,9-hexahydropyrazolo[5,1-*b*]quinazolin-8-one (XIXb).** Yield 60%, mp 129–130°C (from $CCl_4$). $^1$H NMR spectrum, δ, ppm: in $CDCl_3$: 0.68 t (3H, $CH_3$), 1.14 s and 1.17 s (3H each, $CH_3$), 1.98 m and 2.18 m (2H, $CH_2$), 2.32 s (2H, $CH_2$), 2.42 and 2.45 (2H, $CH_2$, *AB* system, $J$ = 16.7 Hz), 5.57 t (1H, CH, $J$ = 3.8 Hz), 6.76 br.s (1H, NH), 7.36–7.43 m (5H, $H_{arom}$), 7.61 s (1H, CH); in DMSO-$d_6$: 0.54 t (3H, $CH_3$), 1.05 s (6H, $CH_3$), 1.78 m and 1.95 m (2H, $CH_2$), 2.16 and 2.25 (2H, $CH_2$, *AB* system, $J$ = 16.0 Hz), 2.54 s (2H, $CH_2$), 5.30 m (1H, CH), 7.24–7.46 m (5H, $H_{arom}$), 7.65 s (1H, CH), 9.70 br.s (1H, NH). $^{13}$C NMR spectrum, $\delta_C$, ppm: in $CDCl_3$: 7.75 (**C**$H_3$$CH_2$), 27.11 ($CH_3$**C**$H_2$), 27.16 ($CH_3$), 29.11 ($CH_3$), 32.29 ($C^6$), 41.13 ($C^7$), 50.26 ($C^5$), 55.31 ($C^9$), 104.65 and 105.07 ($C^{8a}$, $C^3$), 126.18 ($C^p$), 126.75 ($C^o$), 128.70 ($C^m$), 131.87 ($C^i$), 133.80 ($C^{3a}$), 137.90 ($C^2$), 149.60 ($C^{4a}$), 194.14 ($C^8$); in DMSO-$d_6$: 7.61 (**C**$H_3$$CH_2$), 26.81 ($CH_3$**C**$H_2$), 26.87 ($CH_3$), 28.94 ($CH_3$), 31.93 ($C^6$), the $C^7$ signal is overlapped by the solvent, 50.05 ($C^5$), 54.74 ($C^9$), 103.05 ($C^{8a}$), 104.07 ($C^3$), 125.85 ($C^p$), 126.94 ($C^o$), 128.74 ($C^m$), 131.78 ($C^i$), 134.12 ($C^{3a}$), 138.10 ($C^2$), 151.26 ($C^{4a}$), 193.274 ($C^8$). Found, %: C 74.58; H 7.40. $C_{20}H_{23}N_3O$. Calculated, %: C 74.74; H 7.21.

**9-Isopropyl-6,6-dimethyl-3-phenyl-4,5,6,7,8,9-hexahydropyrazolo[5,1-*b*]quinazolin-8-one (XIXc).** Yield 70%, mp 279–280°C (from ethanol). $^1$H NMR spectrum (DMSO-$d_6$–$CCl_4$, 1:2), δ, ppm: 0.56 d (3H, $CH_3$, $J$ = 7.3 Hz), 1.10 t (3H, $CH_3$, $J$ = 7.3 Hz), 1.12 s (6H, $CH_3$), 2.01 m (1H, CH), 2.15 and 2.18 (2H, $CH_2$, *AB* system, $J$ = 16.3 Hz), 2.49 and 2.53 (2H, $CH_2$, *AB* system, $J$ = 16.7 Hz), 5.13 d (1H, CH, $J$ = 1.5 Hz), 7.20–7.42 m (6H, CH, $H_{arom}$), 9.55 s (1H, NH). $^{13}$C NMR spectrum (DMSO-$d_6$), $\delta_C$, ppm: 15.92 ($CH_3$), 21.16 ($CH_3$), 26.47 ($CH_3$), 29.13 ($CH_3$), 31.74 ($C^6$), 35.13 [**C**$H(CH_3)_2$], 39.50 ($C^7$), 49.95 ($C^5$), 58.60 ($C^9$), 104.10 and 104.19 ($C^3$, $C^{8a}$), 125.73 ($C^p$), 126.87 ($C^o$), 128.65 ($C^m$), 131.78 ($C^i$), 134.42 ($C^{3a}$), 137.45 ($C^2$), 151.30 ($C^{4a}$), 193.05 ($C^8$). Found, %: C 75.01; H 7.62. $C_{21}H_{25}N_3O$. Calculated, %: C 75.19; H 7.51.

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