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Study of Regioselectivity of Reactions between 3(5)-Aminopyrazoles and 2-Acetylcycloalkanones

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Abstract—Regioselectivity was examined of reactions between nine 3(5)-aminopyrazoles and 2-acetylcyclopentanone and 2-acetylcyclohexanone under various conditions. A series of cyclopenta[*e*]pyrazolo-[1,5-a]pyrimidines was obtained. The highest regioselectivity of the reaction was observed in alcohol at 20°C in the presence of a catalytic quantity of trifluoroacetic acid. The regiostructure of compounds was established by ^{1}H and ^{13}C NMR spectroscopy.

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Derivatives of pyrazolo[1,5-*a*]pyrimidines, purine analogs, are an important class of fused heterocyclic compounds exhibiting a wide range of physiological activity depending on the nature and the position of substituents in the molecule [1]. Pyrazolo[1,5-*a*]pyrimidines are a privileged structure, among their derivatives substances have been found exhibiting anxiolytic activity [2], they are inhibitors of tyrosine kinase [3], antagonists of serotonin receptor 5-HT_3 [4], neuropeptide Y1 receptor [5], cyclin-dependent kinase 1, 2, and 9 [6]. Several efficient drugs are known of the depressant and hypnotic action (zaleplon [7], indiplon [8], ocynaplon [9]).

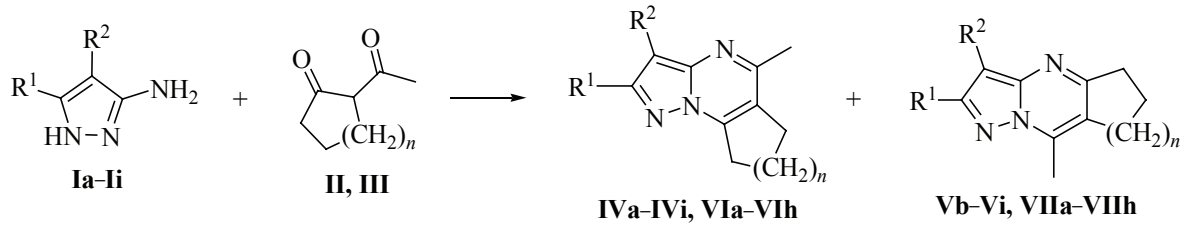
In the last two decades various methods of synthesis were published of pyrazolo-[1,5-*a*]pyrimidine derivatives, the principal among which was the two-component cyclocondensation of 5(3)-aminopyrazoles with 1,3-dielectrophilic reagents like 1,3-dicarbonyl compounds, α,β-unsaturated carbonyl compounds, alkoxymethylene-1,3-dicarbonyl compounds, β-enaminoketones, acetylene ketones [10–13]. Among the applied procedures multicomponent reactions, reactions without solvents, reactions with nonclassic activation (microwave, ultrasound) should be mentioned [14, 15]. The use of cyclic reagents provides a possibility to obtain fused pyrazolo[1,5-*a*] pyrimidines [16–24]. The development of a method permitting the introduction of the fused cyclopentane or cyclohexane fragment to the pyrazolopyrimidine frame appears to be practically important for the synthesis of new biologically active compounds [21–23].

In the synthesis of substituted pyrazolo[1,5-*a*] pyrimidines several isomeric products may form as a result of the attack of the nucleophilic sites of the 3(5)-aminopyrazole (NH_2, N^1) at several electrophilic centers of polyfunctional compounds.

In the present study we investigated the regioselectivity of the reaction between 3(5)-aminopyrazoles **Ia–Ii** and 2-acetylcycloalcanones containing five-and six-membered rings (Scheme 1).

The reactions were carried out under various conditions: at the room or lower temperature in alcohol using as catalyst trifluoroacetic acid (procedures *a*, *b*), in tradition way by boiling in butanol and acetic acid (procedure *c*), by fusion without solvent (procedure *d*), at microwave activation (procedure *e*), and also in dimethyl sulfoxide (procedure *f*) (see EXPERIMENTAL). The yields of products were sufficiently high in all cases (74–92%), the regioisomers content in the reaction mixture was monitored by ^{1}H NMR spectroscopy; therewith the spectra showed the practical absence of impurities (Table 1). The conclusions on the regiostructure of the reaction products were done based on the analysis of the data of ^{1}H and ^{13}C NMR spectra.

Scheme 1.



Ia–Ii **II, III** **IVa–IVi, VIa–VIh** **Vb–Vi, VIIa–VIIh**

I, IV–VII, R^1 = Me, R^2 = H (**a**); R^1 = 4-MeC_6H_4, R^2 = H (**b**); R^1 = H, R^2 = CN (**c**), Ph (**d**), 4-ClC_6H_4 (**e**), 4-$MeOC_6H_4$ (**f**); R^1 = Me, R^2 =Ph (**g**), 4-$MeOC_6H_4$ (**h**), 2-$MeOC_6H_4$ (**i**). n = 1 (**II, IV, V**), 2 (**III, VI, VII**).

As seen from the data of Table 1 the 3(5)-amino-4-phenylpyrazole reacts with 2-acetylcyclopentanone with a high regioselectivity. The highest regioselectivity was observed in the reaction carried out in alcohol at low temperature in the presence of a catalytic amount of trifluoroacetic acid. In the reaction proceeding at a high temperature (boiling in butanol or acetic acid, fusion, microwave activation) the relative fraction of minor product **Vd** grows. The nature of the substituent in the pyrazole ring also somewhat affects the ratio of the reaction products: The fraction of compound **IV** is maximum for pyrazoles containing a methyl group in the position *5* (*3*) or a *p*-methoxyphenyl group in the position *4* (Table 2). We succeeded to isolate the prevailing isomers **IVc–IVg, IVi** by recrystallization from DMF.

At the same time in the reaction of 3(5)-amino-4-phenylpyrazole with 2-acetylcyclohexanone always a mixture is obtained of pyrazolopyrimidines fused to a cyclohexane ring at the bonds C^6=C^7 (**VIa–VIi**) and C^5–C^6 (**VIIa–VIIi**), and the opposite effect of the reaction conditions on the regioisomers ratio is observed: The highest yields of compound **VId** is obtained in the reaction proceeding at higher temperature (60–67%) (Table 1). The application of DMSO as a solvent changes the regioselectivity of the reaction leading the a considerable increase of the compound **VIId** fraction (Table 1). Similar increase in the fraction of the regioisomer containing a cycloalkane ring fused at the C^5–C^6 bond we observed at the use of 2-trifluoroacetylcycloalkanone as dielectrophile. This fact is related to the change in the ratio of the intermediate hydroxy forms at prolonged keeping the solution in DMSO [18].

The application of MW activation significantly accelerated the process but did not improve the selectivity of the reaction as compared with the boiling of the reagents in butanol (Table 1). In Table 2 the data are presented on the effect of the structure of 3(5)-aminopyrazoles **Ia–Ih** on the regioisomers ratio: The contcnt of reaction prod-

Table 1. The ratio of products **IVd–Vd** of reaction of 3(5)-amino-4-phenylpyrazole (**Id**) with 2-acetylcyclopentanone and products **VId–VIId** of reaction with 2-acetylcyclohexanone

Reaction conditions	Ratio of (**IVd**)–(**Vd**), %[a]	Overall yield, %	Ratio of (**VId**)–(**VIId**), %[a]	Overall yield, %
–20°C, C_2H_5OH, cat CF_3COOH, 3 days	95 : 5	86	–	–
0°C, CH_3OH, cat CF_3COOH, 3 days	94 : 6	92	44:56	90
20°C, C_2H_5OH, cat CF_3COOH, 1 days	93 : 7	88	44:56	90
120°C, CH_3COOH, 3 h	91 : 9	80	67:33	82
120°C, BuOH, 3 h	85 : 15	86	60:40	76
Fusion, 160°C, 2 min	86 : 14	77	62:38	80
MW activation, 800 W, 2 min	86 : 14	82	64:36	76
20°C, DMSO, 8 days	81 : 19	88	32:68	86

[a] The relative content of regioisomers was estimated from ^{1}H NMR spectra based on the intensity of the methyl and methylene protons.

Table 2. The ratio of obtained regioisomers (**IVa–IVi**)–(**Va–Vi**) and (**VIa–VIi**)–(**VIIa–VIIi**) in reactions of 3(5)-aminopyrazoles **Ia–Ii** and 2-acetylcycloalkanones **II, III**

Amino-pyrazole no.	2-Acetylcyclopentanone (**II**)			2-Acetylcyclohexanone (**III**)		
	C_2H_5OH, CF_3COOH,[a] 20°C	Yield, %[c]	Fusion, 160°C	C_2H_5OH, CF_3COOH,[a] 20°C	Yield, %[c]	Fusion, 160°C
	Ratio (**IV**)–(**V**), %[b]		Ratio (**IV**)–(**V**), %[b]	Ratio (**VI**)–(**VII**), %[b]		Ratio (**VI**)–(**VII**), %[b]
Ia	100 : 0	82	100 : 0[d]	35 : 65	74	48 : 52
Ib	88 : 12	74	87 : 13	30 : 70	78	40 : 60
Ic	84 : 16	88 (38)	87 : 13	33 : 67	83	46 : 54
Id	93 : 7	90 (44)	86 : 14	44 : 56	85	62 : 38
Ie	91 : 9	90 (52)	85 : 15	38 : 62	85	49 : 51
If	93 : 7	84 (54)	86 : 14	39 : 61	82	50 : 50
Ig	93 : 7	82 (50)	87 : 13	44 : 56	82	50 : 50
Ih	>99 : 1	86	85 : 15	36 : 64	80	58 : 42
Ii	95 : 5	82 (50)	83 : 17	–	–	–

[a] Catalyst.
[b] The relative content of regioisomers was estimated from ^{1}H NMR spectra based on the intensity of the methyl and methylene protons..
[c] Yield of regioisomers mixture. The yield of prevailing isomer after recrystallization from DMF is given in parentheses.
[d] Our own and published data [17].

ucts **VI, VII** is comparable, and we have failed to isolate individual compounds **VIa–VIh, VIIa–VIIh** either by repeated crystallization, or by chromatography.

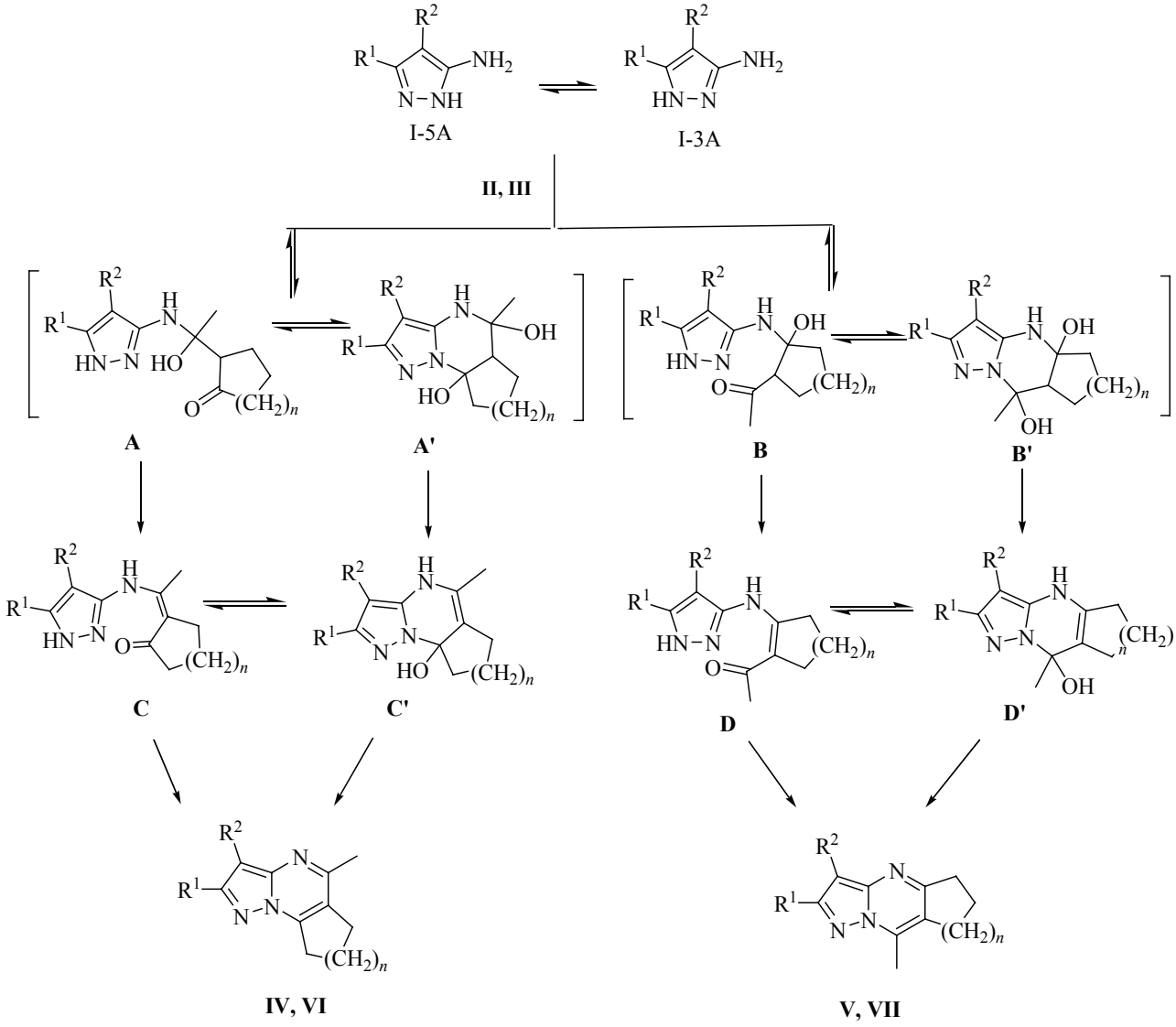
Hence the reaction of aminopyrazoles with 2-acetylcyclopentanone is far more regioselective than the reaction with 2-acetylcyclohexanone: In the former case in the reaction mixture the regioisomer prevails containing a cycloalkane ring fused at the C^6=C^7 bond, in the latter the content of regioisomers is comparable. The observed products ratio is well consistent with the data on the heats of formation of compounds obtained calculated by MNDO/3 method: The difference in the heats of formation is considerably greater for the regioisomers with the fused cyclopentane ring than those with the fused cyclohexane ring [–1.860 (**IVd, Vd**), –0.755 kcal mol^{-1} (**VId,VIId**)].

The sequence of the cyclocondensation stages of 3(5)-aminopyrazoles **I** with 2-acetylcycloalcanones **II, III** is shown in Scheme 2. In the first stage the exocyclic NH_2 group of aminopyrazole reacts with the acetyl or carbonyl group of the dicarbonyl compound forming intermediates **A** (**A'**) or **B** (**B'**). Then in succession two water molecules are eliminated with the formation of final products **IV–VII**. The presence of the intermediate compound **C** (and/or **C'**) alongside products **IVd,Vd** was detected by high-resolution mass spectrometry: In a solution in DMSO of a mixture of aminopyrazole **Id** and 2-acetylcyclopentanone **II** after 3 days masses [M + H]$^+$ 250.1339 and 268.1446 were found.

The proof of the regiostructure of compounds we synthesized was based on the comparison of the chemical shifts of protons and carbon atoms of the methyl groups in the ^{1}H (δ 2.44–2.64, 2.72–2.76 ppm) and ^{13}C (δ 22.5–23.0, 12.8 ppm) NMR spectra with the characteristic chemical shifts of the corresponding protons and carbon atoms in the spectra of previously studied compounds [11, 12, 18, 25, 26], and also on the XRD data [27]. The additional independent criterion of the regioisomers assignment was the difference in the values of $^5J_{HH}$ between the methylene protons of the fused cycloalkanes. The homoallyl constant of the fragment CH_2–C=C–CH_2 in compounds **IVa–IVi, VIa–VIh** is $^5J_{HH}$ ~1.5 Hz, whereas in the regioisomeric compounds **Va–Vi, VIIa–VIIh** the constant $^5J_{HH}$ of the fragment CH_2–C–C–CH_2 is essentially smaller, and we have not observed it.

Therefore the method was developed for the preparation of 7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*] pyrimidines. The reaction of 3(5)-aminopyrazoles with 2-acetylcyclohexanone gave a mixture of 6,7,8,9-tetrahyd ropyrazolo[1,5-*a*]quinazolines and 5,6,7,8-tetrahydropyr

Scheme 2.



azolo[5,1-*b*]quinazolines with the predominant formation of one of the regioisomers depending on the structure of 3(5)-aminopyrazole and the reaction conditions.

EXPERIMENTAL

^{1}H and ^{13}C NMR spectra were registered on a spectrometer Bruker DPX-30 (300.13 and 75.47 MHz) at 22°C, solvents DMSO-d_6 (for aminopyrazoles), $CDCl_3$ (for reaction products). Chemical shifts were measured with respect to the residual protons of the deuterated solvent: $CDCl_3$ (7.28, 77.00 ppm), DMSO-d_6 (2.50, 39.50 ppm). Elemental analyses were determined with the use of high resolution mass spectrometry on an instrument Bruker Daltonics microTOF at the positive electrospray ionization (ESI). 3(5)-Amino-5(3)-methyl-1*H*-pyrazole (**Ia**), 3(5)-amino-4-cyano-1*H*-pyrazole (**Ic**), and 2-acetylcyanoalcanols were purchased from Acros Organics.

3(5)-Amino-1*H*-pyrazoles Ia–Ii. General procedure. To a solution of 25 mmol of ketonitrile in 50 ml of ethanol and 5 ml of acetic acid was added dropwise 50 mmol of hydrazine hydrate. The reaction mixture was stirred at 50°C for 2 h, another 10 ml of acetic acid was added, and the mixture was boiled for 5 h more. On cooling to room temperature the formed mixture was poured into 200 ml of ice water, neutralized with a solution of ammonium hydroxide to pH 9. The formed precipitate was filtered off,

dried in air, crystallized from acetonitrile or ethyl acetate.

5-Amino-3-(4-methylphenyl)-1*H*-pyrazole (Ib). Yield 72%, mp 146–148°C (acetonitrile) (147–150°C [28]). ^{1}H NMR spectrum, δ, ppm: 2.29 s (3H, CH_3), 4.75 br.s (2H, NH_2), 5.72 s (1H, CH=), 7.17 d (2H, C_6H_4, *J* 8.0 Hz), 7.52 d (2H, C_6H_4, *J* 8.0 Hz). Found [*M* + H]$^+$ 174.1046. $C_{10}H_{12}N_3$. Calculated [*M* + H]$^+$ 174.1026.

3(5)-Amino-4-phenyl-1*H*-pyrazole (Id). Yield 75%, mp 173–174°C (acetonitrile) (174–176°C [29]). ^{1}H NMR spectrum, δ, ppm: 4.76 s (2H, NH_2), 7.11 t (1H, Ph), 7.32 t (2H, Ph), 7.49 d (2H, Ph), 7.67 s (1H, CH), 11.69 s (1H, NH). Found [*M* + H]$^+$ 160.0882. $C_9H_{10}N_3$. Calculated [*M* + H]$^+$ 160.0869.

3(5)-Amino-4-(4-chlorophenyl)-1*H*-pyrazole (Ie). Yield 80%, mp 146–147°C (acetonitrile) (141–143°C [29]). ^{1}H NMR spectrum, δ, ppm: 4.85 s (2H, NH_2), 7.34–7.55 m (4H, C_6H_4), 7.71 (1H, CH), 11.78 s (1H, NH). Found [*M* + H]$^+$ 194.0493. $C_9H_9ClN_3$. Calculated [*M* + H]$^+$ 194.0480.

3(5)-Amino-4-(4-methoxyphenyl)-1*H*-pyrazole (If). Yield 70%, mp 202–203°C (acetonitrile) (200°C [30]). ^{1}H NMR spectrum, δ, ppm: 3.74 (3H, CH_3O), 4.52 br.s (1.4H, NH_2-3A), 4.98 br.s (0.6H, NH_2-5A), 6.89–7.43 (4H, C_6H_4), 7.61 br.s (1H, CH), 11.65 br.s (1H, NH). Found [*M* + H]$^+$ 190.0998. $C_{10}H_{12}N_3O$. Calculated [*M* + H]$^+$ 190.0975.

3(5)-Amino-5(3)-methyl-4-phenyl-1*H*-pyrazole (Ig). Yield 73%, mp 138–139°C (acetonitrile) (138–140°C [31]). ^{1}H NMR spectrum, δ, ppm: 2.17 s (3H, Me), 4.45 s (2H, NH_2), 7.17–7.39 m (4H, C_6H_4), 11.29 c (1H, NH). Found [*M* + H]$^+$ 174.1041. $C_{10}H_{12}N_3$. Calculated [*M* + H]$^+$ 174.1026.

3(5)-Amino-5(3)-methyl-4-(4-methoxyphenyl)-1*H*-pyrazole (Ih). Yield 71%, mp 139–140°C (ethyl acetate). ^{1}H NMR spectrum, δ, ppm: 2.14 s (3H, Me), 3.76 s (3H, CH_3O), 4.42 s (2H, NH_2), 6.93–7.27 m (4H, C_6H_4), 11.09 s (1H, NH). Found [*M* + H]$^+$ 204.1144. $C_{11}H_{14}N_3O$. Calculated [*M* + H]$^+$ 204.1131.

3(5)-Amino-5(3)-methyl-4-(2-methoxyphenyl)-1*H*-pyrazole (Ii). Yield 71%, mp 67–68°C (acetonitrile). ^{1}H NMR spectrum, δ, ppm: 2.03 s (3H, Me), 3.77 s (3H, CH_3O), 4.16 s (2H, NH_2), 6.93–7.27 m (4H, C_6H_4), 11.29 s (1H, NH). Found [*M* + H]$^+$ 204.1142. $C_{11}H_{14}N_3O$. Calculated [*M* + H]$^+$ 204.1131.

Reaction of 5-amino-1*H*-pyrazoles Ia–Ii with 2-acetylcycloalkanones II, III. *a*. 1 mmol of aminopyrazole and 1 mmol of acetylcycloalkanone was mixe at 0°C (or –20°C) with 2 ml of alcohol containing 2 drops of trifluoroacetic acid, after 72 h the separated precipitate was filtered off, washed with alcohol, dried, and analyzed.

b. 1 mmol of aminopyrazole and 1 mmol of acetylcycloalkanone was mixed at 20°C with 2 ml of alcohol containing 2 drops of trifluoroacetic acid, after 24 h the separated precipitate was filtered off, washed with alcohol, dried, and analyzed.

c. A mixture of 1 mmol of aminopyrazole and 1 mmol of acetylcycloalkanone was added to 5 ml of acetic acid or butanol, the solution obtained was boiled for 3 h, cooled to room temperature, evaporated to dryness at a reduced pressure, the residue was washed in succession with water and alcohol, dried, and analyzed.

d. A mixture of 1 mmol of aminopyrazole and 1 mmol of acetylcycloalkanone was heated on an oil bath at 160°C for 2 min. On cooling the reaction mixture to room temperature the solid product was treated with alcohol (5 ml), the precipitate was filtered off, dried, and analyzed.

e. 1 mmol of aminopyrazole and 1 mmol and acetylcycloalkanone was subjected to microwave irradiation at 800 W for 2 min. Then the reaction mixture was treated with alcohol, the solid precipitate was filtered off, dried, and analyzed.

f. 1 mmol of aminopyrazole and 1 mmol of acetylcycloalkanone was dissolved in 5 ml of dimethyl sulfoxide, the mixture was kept at 20°C for 8 days, afterwards it was poured into 50 ml of water, the separated precipitate was filtered off, washed with alcohol, dried, and analyzed.

2,5-Dimethyl-7,8-dihydro-6*H*-cyclopenta[*e*]-pyrazolo[1,5-*a*]pyrimidine (IVa) was synthesized by procedure *b*, light-brown crystals, mp 160–161°C (acetonitrile) (mp 168–169°C [17]). ^{1}H NMR spectrum, δ, ppm: 2.32 pentet (2H, C^7H_2), 2.52 s (6H, 2 CH_3), 3.01 t.t (C^6H_2, ^3J 7.3, ^5J 1.4 Hz), 3.36 t.t (2H, C^8H_2, ^3J 7.6, ^5J 1.4 Hz), 6.36 s (1H, CH=). ^{13}C NMR spectrum, δ, ppm: 14.46 (2-CH_3), 21.91 (C^7H_2), 22.54 (5-CH_3), 29.36 (C^6H_2), 29.61 (C^8H_2), 94.49 (C^3H), 120.72 (C^{5a}), 147.78, 149.44 (C^{3a}, C^{8a}), 154.32 (C^2), 155.41 (C^5). Found [*M* + H]$^+$ 188.1217. $C_{11}H_{14}N_3$. Calculated [*M* + H]$^+$ 188.1182.

5-Methyl-2-(4-tolyl)-7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine (IVb) and 8-methyl-2-(4-tolyl)-6,7-dihydro-5*H*-1,4,8a-triaza-*s*-indacene (Vb) were synthesized by procedure *b*. Found [*M* + H]$^+$ 264.1501. $C_{17}H_{18}N_3$. Calculated [*M* + H]$^+$ 264.1495. Chemical shifts of signals of regioisomers are extracted

from the ^{1}H NMR spectrum of the reaction mixture .

Regioisomer **IVb**. ^{1}H NMR spectrum, δ, ppm: 2.35 pentet (2H, C^{7}H$_2$), 2.41 s (3H, C$\underline{H}_3$C$_6$H$_4$), 2.54 s (3H, CH$_3$), 3.00 t.t (C^{6}H$_2$, ^3J 7.3, ^5J 1.4 Hz), 3.44 t.t (2H, C^{8}H$_2$, ^3J 7.6, ^5J 1.4 Hz), 6.84 c (1H, CH=), 7.27 d (2H, H$^m_{arom}$, J 8.0 Hz), 7.89 d (2H, H$^o_{arom}$, J 8.0 Hz). ^{13}C NMR spectrum, δ, ppm: 21.29 (4-$\underline{C}$H$_3$C$_6$H$_4$), 21.93 (7-CH$_2$), 22.65 (5-CH$_3$), 29.51 (C^{6}H$_2$), 29.75 C^{8}H$_2$), 91.81 (C^{3}H), 121.54 (C^{5a}), 126.27 (C^o), 129.31 (C^m), 130.42 (C^u), 138.42 (C^p), 148.27, 149.82 (C^{3a}, C^{8a}), 155.75 (C^2, C^5).

Regioisomer **Vb**. ^{1}H NMR spectrum, δ, ppm: 2.24 pentet (2H, C^{6}H$_2$), 2.41 s (3H, C$\underline{H}_3$C$_6$H$_4$), 2.76 s (3H, CH$_3$), 2.98 t (2H, C^{7}H$_2$, ^3J 7.4 Hz), 3.44 t (2H, C^{5}H$_2$, ^3J 7.6 Hz), 6.80 s (1H, CH=), 7.27 d (2H, C$_6$H$_4$, J 8.0 Hz), 7.89 d (2H, C$_6$H$_4$, J 8.0 Hz).

5-Methyl-3-cyano-7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine (IVc) and 8-methyl-3-cyano-6,7-dihydro-5*H*-1,4,8a-triaza-*s*-indacene (Vc) were synthesized by procedure *b*. Regioisomer **IVc**. Light-yellow crystals, mp 163–164°C (DMF). ^{1}H NMR spectrum, δ, ppm: 2.40 pentet (2H, C^{7}H$_2$), 2.64 s (3H, CH$_3$), 3.10 t.t (C^{6}H$_2$, ^3J 7.3, ^5J 1.4 Hz), 3.44 t.t (2H, C^{8}H$_2$, ^3J 7.6, ^5J 1.4 Hz), 8.31 s (1H, CH=). ^{13}C NMR spectrum, δ, ppm: 21.76 (C^{7}H$_2$), 22.85 (5-CH$_3$), 29.43 (C^{6}H$_2$), 29.69 (C^{8}H$_2$), 80.94 (C^3), 113.37 (CN), 125.22 (C^{5a}), 146.79 (C^{2}H), 149.67, 150.13 (C^{3a}, C^{8a}), 160.34 (C^5).

Regioisomer **Vc**. Chemical shifts of signals are extracted from NMR spectra of the reaction mixture. ^{1}H NMR spectrum, δ, ppm: 2.30 pentet (2H, C^{6}H$_2$), 2.76 s (3H, CH$_3$), 3.03 t (2H, C^{7}H$_2$, ^3J 7.4 Hz), 3.15 t (2H, C^{5}H$_2$, ^3J 7.6 Hz), 8.32 s (1H, CH=). Some signals of the ^{13}C NMR spectrum, δ, ppm: 14.28 (8-CH$_3$), 23.41 (C^{6}H$_2$), 27.36 (C^{7}H$_2$), 34.50 (C^{5}H$_2$), 145.79 (C^2). Found [M + H]$^+$ 199.0963. C$_{11}$H$_{11}$N$_4$. Calculated [M + H]$^+$ 199.0978.

5-Methyl-3-phenyl-7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine (IVd) and 8-methyl-3-phenyl-6,7-dihydro-5*H*-1,4,8a-triaza-*s*-indacene (Vd) were synthesized by procedure *b*. Regioisomer **IVd**. Light-brown crystals, mp 188–189°C (butanol). ^{1}H NMR spectrum, δ, ppm: 2.33 pentet (2H, C^{7}H$_2$), 2.59 s (3H, CH$_3$), 3.02 t.t (C^{6}H$_2$, ^3J 7.3, ^5J 1.4 Hz), 3.39 t.t (2H, C^{8}H$_2$, ^3J 7.6, ^5J 1.4 Hz), 7.25 t (1H, H$_{arom}$, J 7.3 Hz), 7.45 t (2H, H$^m_{arom}$, J 7.6 Hz), 8.12 d (2H, H$^o_{arom}$, J 7.6 Hz), 8.39 s (1H, CH=). ^{13}C NMR spectrum, δ, ppm: 21.63 (C^7), 22.91 (CH$_3$), 29.42 (C^6), 29.58 (C^8), 108.90 (C^3), 121.16 (C^{5a}), 125.61 (C^p), 125.81, 128.52 (C^m, C^o), 132.59 (C^u), 141.83 (CH=), 144.90 (C^{3a}), 148.23 (C^{8a}), 156.17 (C^5).

Regioisomer Vd. Chemical shifts of signals are extracted from NMR spectra of the reaction mixture. ^{1}H NMR spectrum, δ, ppm: 2.26 pentet (2H, C^{6}H$_2$), 2.74 s (3H, CH$_3$), 2.97 t (2H, C^{7}H$_2$, ^3J 7.3 Hz), 3.09 t (2H, C^{5}H$_2$, ^3J 7.3 Hz), 7.24 t (1H, H$_{arom}$, J 7.3 Hz), 7.45 t (2H, H$_{arom}$, J 7.6 Hz), 8.06 d (2H, H$_{arom}$, J 7.6 Hz), 8.35 s (1H, CH=). Some signals of the ^{13}C NMR spectrum, δ, ppm: 14.16 (8-CH$_3$), 23.60 (C^{6}H$_2$), 27.24 (C^{7}H$_2$), 34.44 (C^{5}H$_2$), 109.08 (C^3), 140.01 (C^{2}H). Found [M + H]$^+$ 250.1363. C$_{16}$H$_{16}$N$_3$. Calculated [M + H]$^+$ 250.1339.

5-Methyl-3-(4-chlorophenyl)-7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine (IVe) and 8-methyl-3-(4-chlorophenyl)-6,7-dihydro-5*H*-1,4,8a-triaza-*s*-indacene (Ve) were synthesized by procedures *b*, *d*. Regioisomer **IVe**. Light-yellow crystals, mp 176–177°C (DMF). ^{1}H NMR spectrum, δ, ppm: 2.36 pentet (2H, C^{7}H$_2$), 2.61 s (3H, CH$_3$), 3.06 t.t (C^{6}H$_2$, ^3J 7.3, ^5J 1.4 Hz), 3.42 t.t (2H, C^{8}H$_2$, ^3J 7.6, ^5J 1.4 Hz), 7.40 d (2H, H$^m_{arom}$, J 8.7 Hz), 8.07 d (2H, H$^o_{arom}$, J 8.7 Hz), 8.35 s (1H, CH=). ^{13}C NMR spectrum, δ, ppm: 21.72 (C^7), 22.98 (CH$_3$), 29.51 (C^6), 29.65 (C^8), 107.83 (C^3), 122.27 (C^{5a}), 126.96, 128.59 (C^m, C^o), 131.03 (C^u), 131.18 (C^p), 141.72 (CH=), 144.91 (C^{3a}), 148.45 (C^{8a}), 156.50 (C^5).

Regioisomer **Ve**. Chemical shifts of signals are extracted from the ^{1}H NMR spectrum of the reaction mixture synthesized by procedure *d*. ^{1}H NMR spectrum, δ, ppm: 2.30 pentet (2H, C^{6}H$_2$), 2.76 s (3H, CH$_3$), 3.03 t (2H, C^{7}H$_2$, ^3J 7.3 Hz), 3.10 t (2H, C^{5}H$_2$, ^3J 7.6 Hz), 7.40 d (2H, H$_{arom}$, J 8.7 Hz), 8.01 d (2H, H$_{arom}$, J 8.7 Hz), 8.32 s (1H, CH=). Found [M + H]$^+$ 284.0962. C$_{16}$H$_{15}$ClN$_3$. Calculated [M + H]$^+$ 284.0949.

5-Methyl-3-(4-methoxyphenyl)-7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine (IVf) and 8-methyl-3-(4-methoxyphenyl)-6,7-dihydro-5*H*-1,4,8a-triaza-*s*-indacene (Vf) were synthesized by procedures *b*, *d*. Regioisomer **IVf**. Light-brown crystals, mp 149–150°C (acetonitrile). ^{1}H NMR spectrum, δ, ppm: 2.35 pentet (2H, C^{7}H$_2$), 2.59 s (3H, CH$_3$), 3.05 t (2H, C^{6}H$_2$, ^3J 7.3 Hz), 3.40 t (2H, C^{8}H$_2$, ^3J 7.6 Hz), 3.87 s (3H, MeO), 7.02 d (2H, H$^m_{arom}$, J 8.7 Hz), 8.03 d (2H, H$^o_{arom}$, J 8.7 Hz), 8.32 s (1H, CH=). ^{13}C NMR spectrum, δ, ppm: 21.71 (C^7), 22.94 (CH$_3$), 29.48, 29.59 (C^6, C^8), 55.23 (MeO), 108.89 (C^3), 114.05 (C^o), 121.81 (C^{5a}), 125.31 (C^u), 127.12 (C^m), 141.46 (CH=), 144.62, 148.14 (C^{3a}, C^{8a}), 155.83 (C^5), 157.78 (C^p).

Regioisomer **Vf**. Chemical shifts of signals are extracted from the ^{1}H NMR spectrum of the reaction mixture, synthesized by procedure *d*. ^{1}H NMR spectrum, δ, ppm: 2.30 pentet (2H, C^{6}H$_2$), 2.76 s (3H, CH$_3$), 3.03 t

(2H, C^7H_2, ^3J 7.3 Hz), 3.10 t (2H, C^5H_2, ^3J 7.6 Hz), 7.40 d (2H, H_{arom}, J 8.7 Hz), 8.01 d (2H, H_{arom}, J 8.7 Hz), 8.32 s (1H, CH=). Found $[M + H]^+$ 280.1447. $C_{17}H_{18}N_3O$. Calculated $[M + H]^+$ 280.1444.

2,5-Dimethyl-3-phenyl-7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine (IVg) and 2,8-dimethyl-3-phenyl-6,7-dihydro-5*H*-1,4,8a-triaza-*s*-indacene (Vg) were synthesized by procedures *b*, *d*. Regioisomer **IVg**. Light-brown crystals, mp 172–173°C (DMF). ^{1}H NMR spectrum, δ, ppm: 2.34 pentet (2H, C^7H_2), 2.54 s (3H, CH_3), 2.66 s (3H, CH_3), 3.03 t.t (C^6H_2, ^3J 7.3, ^5J 1.4 Hz), 3.39 t.t (2H, C^8H_2, ^3J 7.6, ^5J 1.4 Hz), 7.29 t (1H, H^p_{arom}, J 7.3 Hz), 7.45 t (2H, H^m_{arom}, J 7.6 Hz), 7.77 d (2H, H^o_{arom}, J 7.6 Hz). ^{13}C NMR spectrum, δ, ppm: 14.27 (Me), 21.63 (C^7), 22.91 (Me), 29.39, 29.59 (C^6, C^8), 107.77 (C^3), 121.45 (C^{5a}), 125.75 (C^p), 128.30, 128.65 (C^m, C^o), 132.91 (C^u), 146.25, 147.57 (C^{3a}, C^{8a}), 151.60 (C^2),155.87 (C^5).

Regioisomer Vg. Chemical shifts of signals are extracted from the ^{1}H NMR spectrum of the reaction mixture synthesized by procedure d ^{1}H NMR spectrum, δ, ppm: 2.22 pentet (2H, C^6H_2), 2.64 s (3H, CH_3), 2.72 s (3H, CH_3), 2.97 t (2H, C^7H_2, ^3J 7.3 Hz), 3.03 m (2H, C^5H_2), 7.24 m (1H, H_{arom}), 7.45 m (2H, H_{arom}), 7.71 d (2H, H_{arom}, J 7.6 Hz). Found $[M + H]^+$ 264.1492. $C_{17}H_{18}N_3$. Calculated $[M + H]^+$ 264.1495.

2,5-Dimethyl-3-(4-methoxyphenyl)-7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine (IVh) were synthesized by procedure *b*. Light-brown crystals, mp 162–163°C (butanol). ^{1}H NMR spectrum, δ, ppm: 2.34 pentet (2H, C^7H_2), 2.54 s (3H, 5-Me), 2.63 s (3H, 2-CH_3), 3.03 t (2H, C^6H_2, ^3J 7.3 Hz), 3.39 t (2H, C^8H_2, ^3J 7.6 Hz), 3.87 s (3H, CH_3O), 7.03 d (2H, H^m_{arom}, J 8.7 Hz), 7.67 d (2H, H^o_{arom}, J 8.7 Hz). ^{13}C NMR spectrum, δ, ppm: 14.13 (Me), 21.90 (C^7), 22.85 (Me), 29.42, 29.59 (C^6, C^8), 107.56 (C^3), 113.91 (C^m), 121.28 (C^{5a}), 125.35 (C^u), 129.85 (C^o), 146.15, 147.50 (C^{3a}, C^{8a}), 151.35, 155.63 (C^2, C^5), 157.84 (C^p). Found $[M + H]^+$ 294.1609. $C_{18}H_{20}N_3O$. Calculated $[M + H]^+$ 294.1601.

2,8-Dimethyl-3-(4-methoxyphenyl)-6,7-dihydro-5*H*-1,4,8a-triaza-*s*-indacene (Vh). Chemical shifts of signals are extracted from the ^{1}H NMR spectrum of the reaction mixture synthesized by procedure *d*. ^{1}H NMR spectrum, δ, ppm: 2.19 pentet (2H, C^6H_2), 2.72 s (3H, CH_3), 3.00–3.04 m (4H, C^7H_2, C^5H_2), 3.82 s (3H, CH_3O), 7.01–7.47 (4H, H_{arom}).

2,5-Dimethyl-3-(2-methoxyphenyl)-7,8-dihydro-6*H*-cyclopenta[*e*]pyrazolo[1,5-*a*]pyrimidine (IVi) was synthesized by procedure *b*. Light-brown crystals, mp 200–201°C (acetonitrile). ^{1}H NMR spectrum, δ, ppm: 2.34 pentet (2H, C^7H_2), 2.44 s (3H, Me), 2.50 s (3H, Me), 3.02 s (2H, C^6H_2, ^3J 7.3, ^5J 1.4 Hz), 3.39 t (2H, C^8H_2, ^3J 7.6, ^5J 1.4 Hz), 3.82 s (3H, CH_3O), 7.02 d (1H, H_{arom}, J 8.0 Hz), 7.08 t (1H, H_{arom}, J 7.3 Hz), 7.35 t (1H, H_{arom}, J 8.0 Hz), 7.45 d (1H, H_{arom}, J 7.3 Hz). ^{13}C NMR spectrum, δ, ppm: 13.78 (Me), 21.96 (C^7), 22.78 (Me), 29.40, 29.59 (C^6, C^8), 105.06 (C^3), 111.08 (C^o), 120.55 (C^m), 120.99, 121.30 (C^{5a}, C^u), 128.28 (C^o), 132.41 (C^m), 146.75, 147.52 (C^{3a}, C^{8a}), 153.29, 155.57 (C^2, C^5), 157.20 (C^p). Found $[M + H]^+$ 294.1616. $C_{18}H_{20}N_3O$. Calculated $[M + H]^+$ 294.1601.

2,8-Dimethyl-3-(2-methoxyphenyl)-6,7-dihydro-5*H*-1,4,8a-triaza-s-indacene (Vi). Chemical shifts of signals are extracted from the ^{1}H NMR spectrum of the reaction mixture synthesized by procedure *d*. ^{1}H NMR spectrum, δ, ppm: 2.19 pentet (2H, 7-CH_2), 2.72 s (3H, CH_3), 3.00–3.04 m (4H, C^6H_2, C^8H_2), 3.82 c (3H, CH_3O), 7.01–7.47 (4H, H_{arom}).

2,5-Dimethyl-6,7,8,9-tetrahydropyrazolo[1,5-*a*]-quinazoline (VIa) and 2,9-dimethyl-5,6,7,8-tetrahydro-pyrazolo[5,1-*b*]quinazoline (VIIa) were synthesized by procedures *b, d*. Chemical shifts of signals of regioisomers are extracted from the ^{1}H NMR spectrum of the reaction mixture .

Regioisomer **VIa**. ^{1}H NMR spectrum, δ, ppm: 1.90 m (4H, C^7H_2, C^8H_2), 2.51 s (3H, 2-Me), 2.58 s (3H, 5-Me), 2.68 t (2H, C^6H_2, J 5.8 Hz), 3.17 t (2H, C^9H_2, J 5.8 Hz), 6.47 s (CH=).

Regioisomer **VIIa**. ^{1}H NMR spectrum, δ, ppm: 1.90 m (4H, C^6H_2, C^7H_2), 2.51 s (3H, 2-Me), 2.78 s (3H, 9-Me), 2.81 br.t (2H, C^8H_2,), 3.08 br.t (2H, C^5H_2), 6.48 s (CH=). Found $[M + H]^+$ 202.1343. $C_{12}H_{16}N_3$. Calculated $[M + H]^+$ 202.1339.

5-Methyl-2-*p*-tolyl-6,7,8,9-tetrahydropyrazolo-[1,5-*a*]quinazoline (VIb) and 9-methyl-2-*p*-tolyl-5,6,7,8-tetrahydropyrazolo[5,1-*b*]quinazoline (VIIb) were synthesized by procedures *b, d*. Chemical shifts of signals of regioisomers are extracted from ^{1}H NMR spectrum of the reaction mixture .

Regioisomer **VIb**. ^{1}H NMR spectrum, δ, ppm: 1.91 m (4H, C^7H_2, C^8H_2), 2.41 s (3H, $\underline{Me}C_6H_4$), 2.51 s (3H, 5-Me), 2.68 t (2H, C^6H_2, J 5.8 Hz), 3.21 t (2H, C^9H_2, J 5.8 Hz), 6.79 (CH=), 7.26 d (2H, H^m_{arom}, J 8.0 Hz), 7.89 d (2H, H^o_{arom}, J 8.0 Hz).

Regioisomer **VIIb**. ^{1}H NMR spectrum, δ, ppm: 1.92 m (4H, C^6H_2, C^7H_2), 2.41 s (3H, $\underline{Me}C_6H_4$), 2.77 s (3H, 9-Me), 2.78 br.t (2H, C^8H_2), 2.97 br.t (2H, C^5H_2), 6.76 (CH=), 7.26 d (2H, H^m_{arom}, *J* 8.0 Hz), 7.91 d (2H, H^o_{arom}, *J* 8.0 Hz). Found $[M + H]^+$ 278.1658. $C_{18}H_{20}N_3$. Calculated $[M + H]^+$ 278.1652.

5-Methyl-3-cyano-6,7,8,9-tetrahydropyrazolo-[1,5-*a*]quinazoline (VIc) and 9-dimethyl-5,6,7,8-tetra-hydropyrazolo[5,1-*b*]quinazoline (VIIc) were synthesized by procedures *b*, *d*. Chemical shifts of signals of regioisomers are extracted from ^{1}H NMR spectrum of the reaction mixture .

Regioisomer **VIc**. ^{1}H NMR spectrum, δ, ppm: 1.95 m (4H, C^7H_2, C^8H_2), 2.62 s (3H, 5-Me), 2.75 br.t (2H, C^6H_2), 3.18 br.t (2H, C^9H_2), 8.27 s (CH=).

Regioisomer **VIIc**. ^{1}H NMR spectrum, δ, ppm: 1.94 m (4H, C^6H_2, C^7H_2), 2.77 s (3H, 9-Me), 2.84 br.t (2H, C^8H_2), 3.07 br.t (2H, C^5H_2), 8.29 s (CH=). Found $[M + H]^+$ 213.1140. $C_{12}H_{13}N_4$. Calculated $[M + H]^+$ 213.1135.

5-Methyl-3-phenyl-6,7,8,9-tetrahydropyrazolo-[1,5-*a*]quinazoline (VId) and 9-methyl-3-phenyl-5,6,7,8-tetrahydropyrazolo[5,1-*b*]quinazoline (VIId) were synthesized by procedures *b*, *d*. Chemical shifts of signals of regioisomers are extracted from ^{1}H NMR spectrum of the reaction mixture.

Regioisomer **VId**. ^{1}H NMR spectrum, δ, ppm: 1.92–2.03 m (4H, $2CH_2$), 2.59 s (Me), 2.72 t.t (2H, C^6H_2, *J* 5.8, *J* 1.5 Hz), 3.13 t.d (2H, C^9H_2, *J* 5.8, *J* 1.5 Hz), 7.23 t (1H, H^p_{arom}, *J* 7.3 Hz), 7.44 t (2H, H^m_{arom}, *J* 7.6 Hz), 8.10 d (2H, H^o_{arom}, *J* 7.6 Hz), 8.34 s (2H, CH=). ^{13}C NMR spectrum, δ, ppm: 20.84 (C^8), 21.95 (C^7), 23.02 (CH_3), 24.09 (C^9), 24.40 (C^6), 109.09 (C^3), 116.17 (C^{5a}), 125.58 (C^p), 125.81, 128.54 (C^m, C^o), 132.69 (C^u), 140.82 (CH=) 143.05 (C^{3a}, C^{9a}), 158.38 (C^5).

Regioisomer **VIId**. ^{1}H NMR spectrum, δ, ppm: 1.92–2.03 m (4H, $2CH_2$), 2.75 s (Me), 2.83 m (2H, C^8H_2), 3.06 m (2H, C^5H_2), 7.23 t (1H, H^p_{arom}, *J* 7.3 Hz), 7.44 t (2H, H^m_{arom}, *J* 7.6 Hz), 8.10 d (2H, H^o_{arom}, *J* 7.6 Hz), 8.37 s (2H, CH=). ^{13}C NMR spectrum, δ, ppm: 12.83 ($C^9\underline{C}H_3$), 22.35 (C^6), 22.62 (C^7), 24.86 (C^8), 33.88 (C^5), 108.46 (C^3), 115.45 (C^{8a}), 125.48 (C^p), 125.81, 128.54 (C^m, C^o), 132.73 (C^u), 141.23 (C^2), 142.67, 143.35 (C^{3a}, C^9), 158.99 (C^{4a}). Found $[M + H]^+$ 264.1492. $C_{17}H_{18}N_3$. Calculated $[M + H]^+$ 264.1495.

5-Methyl-3-(4-chlorophenyl)-6,7,8,9-tetrahydro-pyrazolo[1,5-*a*]quinazoline (VIe) and 9-methyl-3-(4-chloro-phenyl)-5,6,7,8-tetrahydropyrazolo[5,1-*b*]quinazoline (VIIe) were synthesized by procedures *b*, *d*. Chemical shifts of signals of regioisomers are extracted from ^{1}H NMR spectra of the reaction mixture. Regioisomer **VIe.** ^{1}H NMR spectrum, δ, ppm: 1.92–2.02 m (4H, $2CH_2$), 2.60 s (Me), 2.72 t.t (2H, C^6H_2, *J* 5.8, *J* 1.5 Hz), 3.17 t.d (2H, C^9H_2, *J* 5.8, *J* 1.5 Hz), 7.39 d (2H, H^m_{arom}, *J* 8.7 Hz), 8.04 d (2H, H^o_{arom}, *J* 8.7 Hz), 8.31 s (2H, CH=).

Regioisomer **VIIe**. ^{1}H NMR spectrum, δ, ppm: 1.92–2.02 m (4H, $2CH_2$), 2.75 s (Me), 2.83 br.t (2H, C^8H_2), 3.05 br.t (2H, C^5H_2), 7.39 d (2H, H^m_{arom}, *J* 8.7 Hz), 8.04 d (2H, H^o_{arom}, *J* 8.7 Hz), 8.33 s (2H, CH=). Found $[M + H]^+$ 298.1119. $C_{17}H_{17}ClN_3$. Calculated $[M + H]^+$ 298.1096.

5-Methyl-3-(4-methoxyphenyl)-6,7,8,9-tetpa-гидpopyrazolo[1,5-*a*]quinazoline (VIf) and 9-methyl-3-(4-methoxyphenyl)-5,6,7,8-tetrahydropyrazolo-[5,1-*b*]quinazoline (VIIf) were synthesized by procedures *b*, *d*. Chemical shifts of signals of regioisomers are extracted from ^{1}H of the reaction mixture .

Regioisomer **VIf**. ^{1}H NMR spectrum, δ, ppm: 1.93 m (4H, $2CH_2$), 2.58 s (3H, Me), 2.72 t.t (2H, C^6H_2, *J* 5.8, *J* 1.5 Hz), 3.14 t.t (2H, C^9H_2, *J* 5.8, *J* 1.5 Hz), 3.86 s (3H, MeO), 7.00 d (2H, H^m_{arom}, *J* 8.7 Hz), 8.00 d (2H, H^o_{arom}, *J* 8.7 Hz), 8.28 s (2H, CH=).

Regioisomer **VIIf**. ^{1}H NMR spectrum, δ, ppm: 1.93 m (4H, $2CH_2$), 2.74 s (3H, Me), 2.72 br.t (2H, C^8H_2), 3.14 br.t (2H, C^5H_2), 3.86 s (3H, MeO), 7.00 d (2H, H^m_{arom}, *J* 8.7 Hz), 8.00 d (2H, H^o_{arom}, *J* 8.7 Hz), 8.30 s (2H, CH=). Found $[M + H]^+$ 294.1618. $C_{18}H_{20}N_3O$. Calculated $[M + H]^+$ 294.1601.

2,5-Dimethyl-3-phenyl-6,7,8,9-tetrahydro-pyrazolo[1,5-*a*]quinazoline (VIg) and 2,9-dimethyl-3-phenyl-5,6,7,8-tetrahydropyrazolo[5,1-*b*]quinazoline (VIIg) were synthesized by procedures *b*, *d*. Chemical shifts of signals of regioisomers are extracted from ^{1}H NMR spectra of the reaction mixture .

Regioisomer **VIg**. ^{1}H NMR spectrum, δ, ppm: 1.90–2.00 m (4H, $2CH_2$), 2.53 s (3H, 5-Me), 2.66 s (3H, 2-Me), 2.70 t.t (2H, C^6H_2, *J* 5.8, *J* 1.5 Hz), 3.16 t.t (2H, C^9H_2, *J* 5.8, *J* 1.5 Hz), 7.29 t (1H, H^p_{arom}, *J* 7.3 Hz), 7.45 t (2H, H^m_{arom}, *J* 7.6 Hz), 7.77 d (2H, H^o_{arom}, *J* 7.6 Hz).

Regioisomer **VIIg**. ^{1}H NMR spectrum, δ, ppm: 1.90–2.00 m (4H, $2CH_2$), 2.66 s (3H, 2-Me), 2.73 s (9-Me), 2.70 br.t (2H, C^8H_2), 3.16 br.t (2H, C^5H_2), 7.29 t (1H, H^p_{arom}, *J* 7.3 Hz), 7.45 t (2H, H^m_{arom}, *J* 7.6 Hz), 7.77 d (2H, H^o_{arom}, *J* 7.6 Hz). Found $[M + H]^+$ 278.1658. $C_{18}H_{20}N_3$. Calculated $[M + H]^+$ 278.1652.

2,5-Dimethyl-3-(4-methoxyphenyl)-6,7,8,9-tetrahydropyrazolo[1,5-*a*]quinazoline (VIh) and 2,9-dimethyl-3-(4-methoxyphenyl)-5,6,7,8-tetrahydropyrazolo-[5,1-*b*]quinazoline (VIIh) were synthesized by procedures *b*, *d*. Chemical shifts of signals of regioisomers are extracted from ^{1}H NMR spectra of the reaction mixture.

Regioisomer **VIh**. ^{1}H NMR spectrum, δ, ppm: 1.90–1.97 m (4H, $2CH_2$), 2.52 s (3H, Me), 2.69 t.t (2H, C^6H_2, *J* 5.8, *J* 1.5 Hz), 3.15 t.t (2H, C^9H_2, *J* 5.8, *J* 1.5 Hz), 3.87 s (3H, MeO), 7.02 d (2H, H^m_{arom}, *J* 8.7 Hz), 7.67 d (2H, H^o_{arom}, *J* 8.7 Hz).

Regioisomer **VIIh**. ^{1}H NMR spectrum, δ, ppm: 1.90–1.97 m (4H, $2CH_2$), 2.62 s (3H, Me), 2.80 br.t (2H, C^8H_2), 3.15 br.t (2H, C^5H_2), 3.87 s (3H, MeO), 7.02 d (2H, H^m_{arom}, *J* 8.7 Hz), 7.67 d (2H, H^o_{arom}, *J* 8.7 Hz). Found $[M + H]^+$ 308.1771. $C_{19}H_{22}N_3O$. Calculated $[M + H]^+$ 308.1757.

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