Chemistry of Heterocyclic Compounds, Vol. 36, No. 4, 2000

INTERACTION OF AMINOQUINOLINES WITH UNSATURATED CARBOXYLIC ACIDS. 1. SYNTHESIS OF N-QUINOLYL-β-ALANINES AND THEIR BIOLOGICAL ACTIVITY

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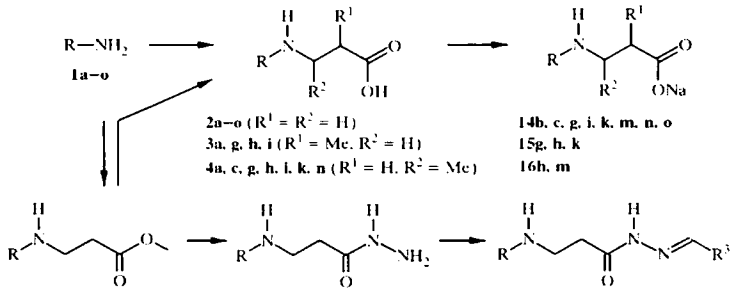
N-Quinolyl-β-alanines, and α-methyl- and β-methyl-N-quinolyl-β-alanines were prepared by reaction of aminoquinolines and acrylic, methacrylic, and crotonic acids. The corresponding hydrazides and benzylidenehydrazides were obtained. 4-Aminoquinoline with unsaturated acids in water gave betaines. The biological activity of sodium salts of β-alanines was investigated.

Keywords: aminoquinolines, N-quinolyl-β-alanines, hydrazides, biological activity.

For the first time N-quinolyl-β-aminopropionic acid was synthesized by heating 4,7-dichloroquinoline with β-alanine [1]. In the search for potential anticancer agents N-(6-methoxy-8-quinolyl)-β-alanine [2] was obtained by interaction of 6-methoxy-8-aminoquinolines with 3-propanolide. All possible nonsubstituted N-quinolyl-β-alanines were obtained [3] by hydrolysis of the corresponding esters, which were synthesized from 3-, 4-, 5-, 6-, 7-, or 8-aminoquinolines and methyl acrylate. Interaction of aminoquinolines with acrylic acid and its homologues has not been investigated so far to the best of our knowledge.

Starting from aminoquinolines **1** and acrylic, methacrylic, and crotonic acids in refluxing toluene, N-quinolyl-β-alanines **2** and their methyl homologues **3** and **4** were prepared. Compounds 2-4 were extracted from the reaction mixtures with 10% aqueous solution of NaOH and isolated after acidification of the extracts with acetic acid. It should be noted that the yields of β-alanines **2** were much higher (~80%) than those of their methyl homologues **3** and **4**.



a R = 3-C_9H_6N; b R = 4-C_9H_6N; c R = 5-C_9H_6N; d R = 2-Me-5-C_9H_5N; e R = 4,6-Me_2-5-C_9H_4N; f R = 8-Cl-5-C_9H_5N; g R = 6-C_9H_6N; h R = 2-Me-6-C_9H_5N; i R = 8-C_9H_6N; k R = 2-Me-8-C_9H_5N; l R = 4-Me-8-C_9H_5N; m R = 5-MeO-8-C_9H_5N; n R = 5-Br-8-C_9H_5N; o R = 5-Cl-8-C_9H_5N

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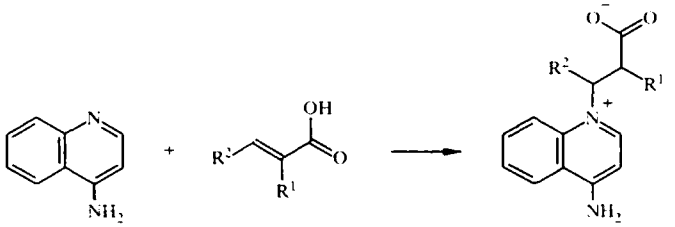
 0009-3122/00/3604-0432$25.00

N-Quinolyl-β-alanines **2f,h,k,n,o** were obtained by hydrolysis of the corresponding methyl esters of N-quinolyl-β-alanines **5**, which were synthesized from aminoquinolines **1** and methyl acrylate in refluxing acetic acid. Esters **5** were extracted from the reaction mixture.

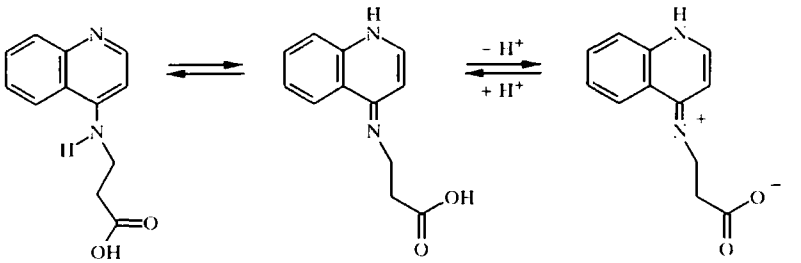
Contrary to the other aminoquinolines, 4-aminoquinoline with acrylic, methacrylic, and crotonic acids in water gave 4-amino-1-(2-carboxylatoethyl)quinolinium betaine **6** and its homologues **7** and **8**. Reaction of 4-aminoquinoline **1b** with methyl acrylate afforded ester 5 [3].



6b $R^1 = R^2 = H$
7b $R^1 = Me$, $R^2 = H$
8b $R^1 = H$, $R^2 = Me$

The structures of the synthesized N-quinolyl-β-alanines **2-4** were confirmed using ^1H NMR spectroscopy. The characteristic triplets due to the α- and β-CH_2 groups of β-alanines **2** were located at 2.56-2.72 and 3.42-3.80 ppm. Signals of the methyl groups of β-alanines **3** and **4** were observed as doublets at 1.03-1.25 ppm, and the multiplets of the methyne groups were at 2.65-3.05 and 3.50-4.30 ppm respectively. The characteristic signals of methyne and methylene groups in the ^1H NMR spectra of betaines **6-8** were shifted to the lower field in comparison with the signals of the corresponding groups of β-alanines **2-4**.

The IR absorptions at 1400 and 1000 cm^{-1} in betaines **6-8** correspond to the carboxylate ion. The same absorption observed in the spectrum of β-alanine **2b** can be explained by dissociation with the formation of the carboxylate ion.



Maxima at 216, 232, 329, and 340 nm were observed in the UV spectrum of N-(4-quinolyl)-β-alanine (**2b**) and at 217, 240, and 330 for betaines **6-8**. The UV spectra of 4-aminoquinoline derivatives **2b**, **5b**, as well as that of 4-aminoquinoline, differed from the spectra of the other aminoquinoline derivatives due to the absence of maxima with longer wavelengths.

The characteristic IR absorptions of the NH group of β-alanines **2a-i** were observed at 3450-3150 cm^{-1}, and the valence =C–H vibrations of quinoline gave signals at 3100-3000 cm^{-1}. The absorption signals at 3020-2800 cm^{-1} were due to the valence and deformation vibrations of the C–H and CH_2 groups. The absorption peaks at 1730-1680 cm^{-1} can be ascribed to the C=O group and they overlap the signals of the C=C valence vibrations at 1600 cm^{-1} of quinoline.

Under mild conditions in refluxing ethanol, methyl esters **5** as well as β-alanines **2-4** gave hydrazides **9**. Some of them were transformed to benzylidenehydrazides **10-13** on treatment with benzaldehyde or its derivatives. The ^1H NMR spectra of hydrazides **9-11** showed signals of the hydrazine group protons consisting of the amino group signal at 3.92-4.63 ppm and that of the imino group at 8.93-9.19 ppm. The absence of amino group signals of the hydrazine fragment and the presence of methyne group signals seen at 2.93-3.12 ppm proved the structure of benzylidenehydrazides. The imine group signals were shifted to the lower field and were situated at 10.90-11.72 ppm.

TABLE 1. The Influence of the Sodium Salts **14-16** on Proliferation of Isolated Simian Kidney Cells, 4647 Line, in Igla MEM Nutrient Medium with 5% of Cattle Blood Serum

Compound	Relative medium yield of cells in comparison with control (concentration, %)						
	$1\cdot10^{-1}$	$1\cdot10^{-2}$	$1\cdot10^{-3}$	$1\cdot10^{-4}$	$1\cdot10^{-5}$	$1\cdot10^{-6}$	$1\cdot10^{-7}$
14g	1.0	1.7	1.7	1.3	1.0	1.0	1.0
15g	0.8	1.0	2.2	1.6	1.2	1.2	1.0
14h	1.0	1.0	0.9	1.0	1.0	1.0	1.0
15h	1.3	1.0	1.1	0.8	1.0	1.0	1.0
16h	1.2	1.8	2.4	2.1	2.0	1.8	1.7
14i	0.8	1.0	1.0	1.4	1.6	1.8	2.2
14k	1.3	1.9	2.0	3.4	2.1	1.6	1.4
16k		0.8	1.2	1.0	1.0	1.0	
14m	1.0	1.3	1.3	1.4	1.5	1.5	1.3
14n	0.2	1.2	1.8	1.8	1.2	1.0	1.0
14o	0.2	1.0	1.4	1.7	1.3	1.0	1.0

TABLE 2. Characteristics of Compounds **2-12**

Compound	Empirical formula	mp, °C solvent	^{1}H NMR spectra, chemical shifts, δ/ppm*, J, Hz	Yield, %
1	2	3	4	5
2a	$C_{12}H_{12}N_2O_2$	190 ethanol	2.65 (t, CH_2CO); 3.46 (t, NCH_2); 6.50-8.71 (m, 6H, arom.)	50
2b	$C_{12}H_{12}N_2O_2$	260-260.5 ethanol	2.63 (t, CH_2CO); 3.60 (t, NCH_2); 6.25-8.65 (m, 6H, arom.)	74
2c	$C_{12}H_{12}N_2O_2$	194.5-195 ethanol	2.64 (t, CH_2CO); 3.46 (t, NCH_2); 6.50-8.88 (m, 6H, arom.)	39
2d	$C_{13}H_{14}N_2O_2$	144-145 2-propanol	2.60 (s, CH_3); 2.69 (t, CH_2CO); 3.48 (t, NCH_2); 6.38-8.38 (m, 5H, arom.)	43
2e	$C_{14}H_{16}N_2O_2$	199.5-200.5 2-propanol	2.56 (s, 4-CH_3); 2.96-3.29 (m, 6-CH_3, CH_2CO); 3.64 (m, NCH_2); 7.54-8.75 (m, 4H, arom.)	21
2f	$C_{12}H_{11}N_2O_2Cl$	209.5-210.5 ethanol	2.74 (t, CH_2CO); 3.51 (t, NCH_2); 6.38-9.08 (m, 5H, arom.)	48
2g	$C_{12}H_{12}N_2O_2$	210.5-211 1,4-dioxane	2.44 (t, CH_2CO); 3.88 (t, NCH_2); 7.68-9.00 (m, 5H, arom.)	77
2h	$C_{13}H_{14}N_2O_2$	184-185 ethanol	2.74 (s, CH_3); 2.57-3.25 (m, CH_2CO); 3.74 (t, NCH_2); 7.53-8.85 (m, 5H, arom.)	74
2i	$C_{12}H_{12}N_2O_2$	147.2-148 benzene	2.68 (t, CH_2CO); 3.54 (t, NCH_2); 6.60-8.72 (m, 6H, arom.); 10.30 (s, NH)	67
2k	$C_{13}H_{14}N_2O_2$ ·HCl	207.5-209 ethanol-ether	2.62-3.00 (m, CH_2CO); 2.78 (s, 2-CH_3); 3.50-3.75 (m, NH_2); 7.36-8.58(m, 5H, arom.)	27
2l	$C_{13}H_{14}N_2O_2$	158-159 2-propanol	2.58 (s, CH_3); 2.62 (t, CH_2CO); 3.50 (t, NCH_2); 6.63-8.63 (m, 5H, arom.); 9.33 (s, NH)	78
2m	$C_{13}H_{14}N_2O_3$	166-167 ethanol	2.89 (t, CH_2CO); 3.79 (t, NCH_2); 3.94 (s, CH_3O); 6.94-9.38 (m, 5H, arom.)	78
2n	$C_{12}H_{11}N_2O_2Br$	225 (dec) ethanol	2.65 (t, CH_2CO); 3.42 (t, NCH_2); 7.12-9.14 (m, 5H, arom.)	85
2o	$C_{12}H_{11}N_2O_2Cl$	124.5-125.5 2-propanol	2.68 (t, CH_2CO); 3.46 (t, NCH_2); 7.25-9.14 (m, 5H, arom.)	68
3a	$C_{13}H_{14}N_2O_2$	212-213 ethanol	1.01 (d, J = 7, CH_3); 2.55-2.97 (m, CH); 3.13-3.53 (m, CH_2); 7.05-8.53 (m, 6H, arom.)	14
3g	$C_{13}H_{14}N_2O_2$	148.5-150 ethanol	1.03 (d, J = 6, CH_3); 2.70-3.05 (m, CH); 3.43-3.60 (m, CH_2); 7.63-9.00 (m, 6H, arom.)	32
3h	$C_{14}H_{16}N_2O_2$	180-181 ethanol	1.08 (d, J = 6, CH_3); 2.75 (s, 2-CH_3); 2.88-3.18 (m, CH); 3.50-3.78 (m, CH_2); 7.59-8.78 (m, 5H, arom.)	53

TABLE 2 (continued)

1	2	3	4	5
3i	$C_{13}H_{14}N_2O_2$	110-111 2-propanol	1.14 (d, J = 7, CH_3); 2.65-2.98 (m, CH); 3.28-3.58 (m, CH_2); 6.45-6.63 (m, NH); 6.65-8.75 (m, 6H, arom.)	16
4a	$C_{13}H_{14}N_2O_2$	193-194 ethanol	1.25 (d, J = 7, CH_3); 2.57 (d, J = 6, CH_3); 3.75-4.15 (m, CH); 6.85-8.07 (m, 6H, arom.); 8.45 (s, 1H, NH)	32
4c	$C_{13}H_{14}N_2O_2$	201-202 1,4-dioxane	1.12 (d, J = 5, CH_3); 2.90 (d, J = 6, CH_2CO); 3.80-4.25 (m, CH); 7.65-9.45 (m, 5H, arom.)	26
4g	$C_{13}H_{14}N_2O_2$	160-161 ethanol	1.25 (d, J = 6, CH_3); 2.83 (d, J = 5, CH_3); 3.93-4.35 (m, CH); 7.71-9.14 (m, 6H, arom.)	42
4h	$C_{14}H_{16}N_2O_2$	183-184 ethanol	1.18 (d, J = 6, CH_3); 2.55-3.12 (m, CH_2); 2.75 (s, 2-CH_3); 3.88-4.25 (m, CH); 7.59-8.85 (m, 5H, arom.)	73
4i	$C_{13}H_{14}N_2O_2$	113-114 ethanol	1.15 (d, J = 7, CH_3); 2.80 (m, CH_2); 3.22-3.55 (m, CH); 6.43-8.70 (m, 7H, NH, arom.)	11
4l	$C_{14}H_{16}N_2O_2$	107-108 ethanol	1.34 (d, J = 6.2, CH_3); 2.41 and 2.83 (J_{AB}=15, J_{AX} = 6, J_{BX} = 5, CH_2); 2.53 (s, 4-CH_3); 3.90-4.30 (m, CH); 6.60-8.55 (m, 5H, arom.); 8.55-9.18 (m, NH)	29
4o	$C_{13}H_{13}N_2O_2Cl$	122-123 2-propanol	1.04 (d, J = 6, CH_3); 2.61 (d, CH_2); 3.49-3.91 (m, CH); 7.24-9.20 (m, 5H, NH, arom.)	36
5d	$C_{14}H_{16}N_2O_2$	84-85 ether hexane	2.64 (s, CH_3); 2.72 (t, J = 6, CH_2CO); 3.65 (s, CH_3); 4.59-4.93 (m, NH); 6.40-8.03 (m, 5H, arom.)	30
5f	$C_{13}H_{13}N_2O_2Cl$	113-113.5 hexane	2.65 (t, J = 6, CH_2CO), 3.45 (t, J = 6, NCH_2); 3.65 (s, CH_3); 5.30 (s, NH); 6.35-8.91 (m, 5H, arom.)	30
5h	$C_{14}H_{16}N_2O_2$	95-96 ether	2.25-2.80 (m, CH_2CO); 2.51 (s, CH_3); 3.55 (s, CH_3O); 3.82-4.66 (m, NCH_2); 6.50-7.90 (m, 5H, arom.)	67
5i	$C_{14}H_{16}N_2O_2$	56-56.5 petrolether	2.50 (s, 2-CH_3); 2.53 (t, J = 7, CH_2CO); 3.46 (t, J = 7, CH_2); 3.50 (s, CH_3O); 6.35-7.78 (m, 5H, arom.)	40
5n	$C_{13}H_{13}N_2O_2Br$	45-46 ether hexane	2.61 (t, J = 6, CH_2CO); 3.50 (t, J = 6, CH_2); 3.63 (s, CH_3O); 6.34-8.60 (m, 5H, arom.)	37
5o	$C_{13}H_{13}N_2O_2Cl$	99.5-101 hexane	2.13 (s, CH_3O); 3.05 (t, J = 5, CH_2CO); 3.58 (t, J = 6, CH_2); 7.33-9.35 (m, 5H, arom.)	21
6b	$C_{12}H_{12}N_2O_2$	233-234 ethanol	2.89 (s, CH_2CO); 4.63 (s, NCH_2); 6.45-8.19 (m, 6H, arom.)	62
7b	$C_{13}H_{14}N_2O_2$	190-191 ethanol	1.06 (d, J = 6, CH_3); 2.80-3.23 (m, CH); 4.10-4.80 (m, CH_2); 6.43-8.18 (m, 6H, arom.)	26
8b	$C_{13}H_{14}N_2O_2$	173.5-174 ethanol	1.39 (d, J = 7, CH_3), 2.84 (d, J = 6, CH_2); 5.19-5.54 (m, CH); 6.50-8.05 (m, 6H, arom.)	55
9b	$C_{12}H_{11}N_3O$	180-181 ethanol–ether	2.70-3.00 (m, CH_2CO); 3.10-3.38 (s, NH_2); 3.46-3.78 (m, NCH_2); 6.43-8.53 (m, 7H, NH, arom.); 9.50-9.98 (s, CONH)	45
9d	$C_{13}H_{16}N_3O$	99.5-101 ethanol–ether	2.46 (t, J = 7, CH_2CO), 2.58 (s, CH_3); 3.20-3.60 (m, NCH_2); 3.92 (s, NH_2); 6.34 (t, J = 7, NH); 6.40-8.48 (m, 5H, arom.); 9.06 (s, CONH)	87
9f	$C_{12}H_{11}N_3OCl$	189-189.5 ethanol–ether	2.43 (t, J = 7.5, CH_2CO); 3.25-3.59 (m, NCH_2); 4.00-4.42 (m, NH_2); 6.48-8.99 (m, 6H, NH, arom.); 9.07 (s, CONH)	69
9g	$C_{12}H_{11}N_3O$	177-178 ethanol	2.38 (t, J = 7.2, CH_2CO); 3.18-3.58 (m, NCH_2); 4.22 (s, NH_2); 6.14 (t, J = 6, NH); 6.62-8.50 (m, 6H, arom.); 9.03 (s, CONH)	90
9h	$C_{13}H_{16}N_3O$	171-172 2-propanol	2.40 (t, J = 7, CH_2CO); 2.51 (s, CH_3); 3.18-3.52 (m, CH_2); 4.00-4.63 (s, NH_2); 5.82-6.15 (s, NH); 6.58-7.95 (m, 5H, arom.); 8.93-9.10 (s, CONH)	79

TABLE 2 (continued)

1	2	3	4	5
9k	$C_{13}H_{16}N_4O$	103-104 ethanol	2.40 (t, J = 6.8, CH_2CO); 2.58 (s, CH_3); 3.25-3.63 (m, NCH_2); 3.93-4.38 (s, NH_2); 6.33-6.53 (s, NH); 6.58-8.13 (m, 5H, arom.); 9.07 (s, CONH)	72
10a	$C_{21}H_{23}N_4O$	198-199 ethanol	2.58-2.78 (m, CH_2CO), 2.94 (s, $N(CH_3)_2$); 3.10-3.25 (m, CH); 3.48-3.75 (m, NCH_2); 6.45-8.52 (m, 11H, NH, arom.); 11.30 (d, J = 6, CONH)	88
11d	$C_{22}H_{25}N_4O$	162-163 ethanol	2.50-2.75 (m, CH_2CO), 2.55 (s, CH_3); 2.93 (d, J = 2, $N(CH_3)_2$); 3.02-3.20 (m, CH); 3.41-3.78 (m, CH_2); 6.38-8.18 (m, H, arom.); 11.05 (d, J = 6, CONH)	98
12g	$C_{19}H_{17}N_4O_3$	238-239 ethanol	2.62 (t, J = 7.8, CH_2CO); 3.09 (d, J = 6, CH); 3.28-3.68 (m, NCH_2); 6.28 (t, J = 6, NH); 6.68-8.58 (m, H, arom.); 11.61 (d, J = 5.5, CONH)	96
13g	$C_{19}H_{18}N_4O_2$	254.5-256 ethanol	2.55 (t, J = 6, CH_2CO); 2.92-3.12 (m, CH); 3.28-3.67 (m, NCH_2); 6.29 (t, J = 6, NH); 6.73-8.60 (m, 10H, arom.); 9.86 (s, OH); 11.20 (q, J = 4.2, CONH)	77

* DMSO-d_6 was used as a solvent for **2a-d,f,i,l**, **4a,i**, **9a,d,f,g,h**, **10-13**, $CDCl_3$ for **4l**, **5**, and TFA for **2e,g,h,m,n,o**, **3a,g,h**, **4c,g,h,o** ^{1}H NMR spectra.

Sodium salts **14-16** of the synthesized β-alanines, which are insoluble in water, were prepared for investigation of their biological activity. The sodium salts of β-alanines added to the nutrient medium of simian kidney cells stimulated cell proliferation (Table 1). The biological activity of these compounds depends on their heterocyclic structure and the substituents in the aliphatic side chain. The 8-aminoquinoline derivatives were more active in low concentrations than 6-aminoquinoline derivatives [4]. N-(2-Methyl-8-quinolyl)-β-alanine hydrochloride distinguished itself as the most effective compound in $1 \cdot 10^{-4}$ % concentration. The sodium salt of N-(4-quinolyl)-β-alanine **14b** in $1 \cdot 10^{-3}$% concentration stimulated proliferation of transplantable diploid cells of skin and muscular tissues of human embryo by 125%, whereas hydrazide **9b** inhibited their proliferation.

TABLE 3. Melting Points of the Sodium Salts of N-Quinolyl-β-alanines **14-16**

Compounds	Empirical formula	mp, °C	Solvent
14b	$C_{12}H_{11}N_2O_2Na$	340 dec	Ethanol–ether
14c	$C_{12}H_{11}N_2O_2Na$	245 dec	Ethanol
14g	$C_{12}H_{11}N_2O_2Na$	302-303	Ethanol
14i	$C_{12}H_{11}N_2O_2Na$	198-200	Ethanol
14k	$C_{13}H_{13}N_2O_2Na \cdot H_2O$	187.5-189	Ethanol
14m	$C_{13}H_{13}N_2O_3Na$	200.5-202	Ethanol
14n	$C_{12}H_{10}N_2O_2BrNa$	228-229	Ethanol
14o	$C_{12}H_{10}N_2O_2ClNa$	220-221	2-Propanol–ether
15g	$C_{13}H_{13}N_2O_2Na$	271-272	Ethanol
15h	$C_{14}H_{15}N_2O_2Na$	277-278	Ethanol
15k	$C_{14}H_{15}N_2O_2Na$	206-207	Ethanol–ether
16h	$C_{14}H_{15}N_2O_2Na \cdot H_2O$	162-164	Ethanol
16m	$C_{14}H_{15}N_2O_2Na \cdot H_2O$	150.5-152	Ethanol

EXPERIMENTAL

The ^{1}H NMR spectra were recorded at 80 MHz on a Tesla BS 487 C spectrometer using tetramethylsilane (δ_H 0.0) as reference. UV spectra were recorded on a Specord UV-Vis in water. The concentration of the samples was about $4 \cdot 10^{-5}$ mol/l. IR spectra were recorded on a spectrometer UR-20. Melting points were determined in open capillaries and are uncorrected. Elemental analysis data are in accordance with the calculated values. The data for the synthesized compounds are summarized in Tables 2 and 3.

N-Quinolyl-β-alanines (2). A mixture of aminoquinoline **1** (0.1 mol), acrylic acid (7.9 g, 0.11 mol), and toluene (40 ml) was refluxed for 20 h. An aqueous solution of sodium hydroxide (50 ml, 10%) was added to the reaction mass and the mixture was heated for 20 min. After cooling, the mixture was filtered. The toluene layer was separated and the aqueous solution was extracted with chloroform. The alkaline solution was acidified with acetic acid to pH 5-6. The precipitated crystals of **1** were filtered off and washed with water (characteristics are given in Table 2).

α-Methyl-N-quinolyl-β-alanines (3a,g,h,i). A mixture of aminoquinoline **1** (40 mmol), methacrylic acid (4 ml, 46 mmol), and toluene (10 ml) was refluxed for 40 h. A solution of NaOH (20 ml, 10%) was added to the mixture and heated for 20 min. The isolation of the products **3a,g,h,i** was similar to that described above (see Table 2).

β-Methyl-N-quinolyl-β-alanines (4a,c,g,h,i,l,o) were synthesized as α-methyl-N-quinolyl-β-alanines **3a,g,h,j** from the corresponding aminoquinoline **1** and crotonic acid (Table 2).

N-Quinolyl-β-alanine Methyl Esters (5d,f,h,i,n,o). A mixture of aminoquinoline **1** (0.1 mol), methyl acrylate (9.9 ml, 0.11 mol), and acetic acid (0.5 ml) was refluxed for 10-30 h. The liquid fraction was concentrated *in vacuo*. The residue was extracted with hexane or benzene, and the product was isolated on evaporation of the extract.

4-Amino-1-(2-carboxylatoethyl)quinolinium Betaine (6b). A mixture of of aminoquinoline **1b** (1.44 g, 10 mmol), acrylic acid (1 ml, 0.11 mmol) and water (10 ml) was refluxed for 2 h. After cooling the reaction mixture, crystals of **6b** (1.33 g) were filtered off. IR spectrum, cm^{-1}: 3200 (NH); 3020 (quinoline C–H); 1660 (C=O); 1400, 1050 (COO^-). UV spectrum, λ_{max}, nm (log ε): 217 (5.49), 240 (5.53), 331 (5.39).

4-Amino-1-(2-carboxylatoethyl)quinolinium Betaine Hydrochloride (6b·HCl). Mp 230°C (methanol–ether). $C_{12}H_{12}N_2O_2 \cdot HCl$.

N-Quinolyl-β-alanine Hydrazides (9b,d,f,g). β-Alanine methyl ester **5** (25 mmol) was dissolved in ethanol (20 ml), then hydrazine (50%, 20 ml) was added, and the reaction mixture was left at 18-20°C for a day. The precipitated crystals were filtered off and washed with ether.

N-(4-Quinolyl)-β-alanine 4-Dimethylaminobenzylidenehydrazide (10b). Hydrazide **9b** (1.15 g, 5 mmol) was dissolved in ethanol (20 ml), then 4-dimethylaminobenzaldehyde (0.77 g, 5.5 mmol) was added and heated for 6 h at 80°C. The reaction mixture was left for a day at 5°C. The precipitated crystals were filtered off and washed with ether. Yield 1.9 g.

N-(2-Methyl-5-quinolyl)-β-alanine 4-Dimethylaminobenzylidenehydrazide (11d). Hydrazide **11d** was synthesized as hydrazide **10b** from hydrazide **11d** (0.73 g, 3 mmol). Yield 1.1 g.

N-(6-Quinolyl)-β-alanine 4-Nitrobenzylidenehydrazide (12g) was synthesized as hydrazide **10b** by heating hydrazide **9g** (1.15 g, 5 mmol) with 4-nitrobenzaldehyde (0.79 g, 5.2 mmol) for 1 h. Yield 1.75 g.

N-(6-Quinolyl)-β-alanine 4-Hydroxybenzylidenehydrazide (13g) was synthesized as hydrazide **9g** (1.15 g, 5 mmol) with 4-hydroxybenzaldehyde (0.64 g, 5.2 mmol) for 2h. Yield 1,28 g.

Sodium Salts of N-Quinolyl-β-alanine, α-Methyl-N-quinolyl-β-alanine, and β-Methyl-N-quinolyl-β-alanine (14b,c,g,i,k,m,n,o, 15g,h,k, and 16h,m) were prepared from the corresponding β-alanines and the equivalent amount of sodium hydroxide in quantitative yield (Table 3).

Acknowledgements. The authors are gratefully indebted to Professor Liubov Mironova and her colleagues for investigation of the biological activity of the synthesized compounds.

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