Synthesis of Pyridyl- and Quinolyl-Substituted 2-Aminothiazoles (1)

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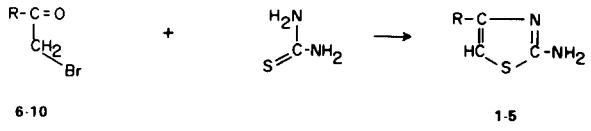
Five 2-amino-4-(x-pyridyl)- and 2-amino-4-(x-quinolyl)thiazoles have been synthesized by the condensation of thiourea with bromoacetylpyridines and -quinolines. The reaction of pyridyl pyridylmethyl ketones with thiourea and halogens produced four 2-aminothiazoles possessing pyridyl substituents in 4- and 5-positions on the thiazole ring. Treatment of *N*-(3-pyridyl)- and *N*-(3-quinolyl)thiourea with α-bromoketones gave seven new 2-(3-pyridyl)amino- and 2-(3-quinolyl)aminothiazoles. The ultraviolet spectra of the pyridyl- and quinolyl- substituted 2-aminothiazoles were recorded.

In the search for new therapeutic agents, several thiazoles have been synthesized (2) possessing quinolyl substituents in the 2-position of the thiazole ring. Also four pyridylthiazoles have been previously reported (3,4,5). Several quaternary thiazolylpyridinium salts have been prepared and tested for their hypoglycemic activity (6). The objective of this work was to synthesize 2-aminothiazoles with pyridyl or quinolyl substituents in 4 and 5 positions, and also a series of thiazoles possessing these substituents in the 2-amino group.

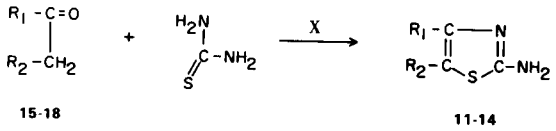


6-10 1-5

1, 6 R = 2-Pyridyl
2, 7 R = 3-Pyridyl
3, 8 R = 4-Pyridyl
4, 9 R = 2-Quinolyl
5, 10 R = 4-Quinolyl

Reaction Scheme 1

Condensation of Bromoacetylpyridines and Quinolines with Thiourea

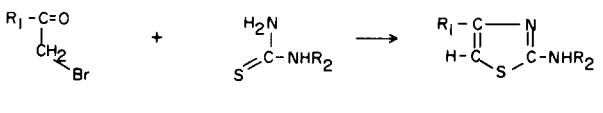


15-18 11-14

11, 15 $R_1 = R_2$ = 2-Pyridyl
12, 16 R_1 = 4-Pyridyl; R_2 = 2-Pyridyl
13, 17 R_1 = 2-Pyridyl; R_2 = 4-Pyridyl
14, 18 $R_1 = R_2$ = 4-Pyridyl
X = bromine or iodine

Reaction Scheme 2

Condensation of Pyridyl Pyridylmethyl Ketones with Thiourea and Halogens



20, 22 23-29

20 R_2 = 3-Pyridyl
22 R_2 = 3-Quinolyl
23 $R_1 = CH_3$; R_2 = 3-Pyridyl
24 $R_1 = C_6H_5$; R_2 = 3-Pyridyl
25 $R_1 = R_2$ = 3-Pyridyl
26 R_1 = 4-Pyridyl; R_2 = 3-Pyridyl
27 $R_1 = CH_3$; R_2 = 3-Quinolyl
28 $R_1 = C_6H_5$; R_2 = 3-Quinolyl
29 R_1 = 4-Pyridyl; R_2 = 3-Quinolyl

Reaction Scheme 3

Condensation of Bromomethyl Ketones with 3-Pyridyl- and 3-Quinolylthiourea

The first group of these compounds with pyridyl or quinolyl groups in the 4 position of the thiazole ring (**1-5**) were prepared by the condensation of hydrobromides of appropriate bromoacetylpyridines or -quinolines with thiourea in polar solvents, and decomposing the resulting hydrobromides with ammonium hydroxide (Reaction Scheme 1). The method by Dornow *et al*, (7) for the preparation of 3-bromoacetylpyridine hydrobromide (**7**) was applied for the synthesis of 2- (**6**) (8) and 4-bromoacetylpyridine hydrobromide (**8**) (8). 4-Bromoacetylquinoline (**10**), an unreported compound, was prepared by a method (9) similar to that for the synthesis of 2-bromoacetylquinoline (**9**).

The synthesis of 2-amino-4,5-di-(x-pyridyl)thiazoles (**11-14**) involved the treatment of the appropriate pyridyl pyridylmethyl ketones (**15-18**) with thiourea and halogens (Reaction Scheme 2). 2-Amino-4,5-di-(2-pyridyl)thiazole (**11**) was prepared by heating 2-pyridyl 2-pyridylmethyl ketone (**15**) (10) with thiourea in the presence of iodine. 2-Pyridyl 2-pyridylmethyl ketone (**15**) and 4-pyridyl

TABLE I

Ultraviolet Spectra of 4-Substituted 2-Aminothiazoles

No.	Name	β		ρ		α	
		λ mμ	ε	λ mμ	ε	λ mμ	ε
1.	2-Amino-4-(2-pyridyl)-	204	9580	224 243	12400 17230	309	6760
2.	2-Amino-4-(3-Pyridyl)-	204.5	10000	233	17800	294	7010
3.	2-Amino-4-(4-pyridyl)-	204	13000	233.5	21880	310.5	7750
4.	2-Amino-4-(2-quinolyl)-	210	25000	242.5 265 (a)	45000	346	9070
5.	2-Amino-4-(4-quinolyl)-	207	31150	232 265 (a)	35900	320	6940

(a) Inflection.

TABLE II

Ultraviolet Spectra of 4,5-Disubstituted 2-Aminothiazoles

No.	Name	β		ρ		α	
		λ mμ	ε	λ mμ	ε	λ mμ	ε
11.	2-Amino-4,5-di(2-pyridyl)-	206	13390	247	12560	339	12080
12.	2-(Amino-4-(4-pyridyl)-5-(2-pyridyl)-	205	18530	243	14600	343	9930
14.	2-Amino-4,5-di(4-pyridyl)-	205	16410	243	14610	348	8680

TABLE III

Ultraviolet Spectra of 2-(Pyridyl- and Quinolyl-substituted amino)-4-substituted Thiazoles

No.	Name	β		ρ		α	
		λ mμ	ε	λ mμ	ε	λ mμ	ε
23.	2-(3-Pyridyl)amino-4-methyl-	204	5990	225	4800	292	18120
24.	2-(3-Pyridyl)amino-4-phenyl-	206	17310	237	18420	290	18790
25.	2-(3-Pyridyl)amino-4-(3-pyridyl)-	204	17680	244	16880	283	20860
27.	2-(3-Quinolyl)amino-4-(4-pyridyl)-	216.5 234 (a)	30200 16480	278 297 308.5	18750 18400 21100	357	8760
28.	2-(3-Quinolyl)amino-4-phenyl-	218	45300	271 310	22210 21210	354	9050
29.	2-(3-Quinolyl)amino-4-(4-pyridyl)-	217.5 240 (a)	39150 23270	272 297 307.5	19880 20220 22800	350	10000

(a) Inflection.

2-pyridylmethyl ketone (**16**) (10) were prepared by treating an ethereal solution of 2-picolyllithium with the appropriate methyl pyridinecarboxylate. 2-Pyridyl 4-pyridylmethyl ketone (**17**), previously unreported, was obtained by acylating 4-picoline with methyl 2-pyridinecarboxylate using sodamide as the condensing agent. 4-Pyridyl 4-pyridylmethyl ketone (**18**) (11) was obtained by the condensation of 4-picoline with methyl 4-pyridinecarboxylate in liquid ammonia in the presence of sodamide.

In the final stage of this work, seven 2-substituted aminothiazoles (**23-29**), having also groups in the 4 position of the thiazole ring, were synthesized (Reaction Scheme 3). The required *N*-(3-pyridyl)- (**20**) and *N*-(3-quinolyl)thiourea (**22**) were prepared in two steps by the reaction of benzoyl isothiocyanate (12) with 3-aminopyridine or 3-aminoquinoline to yield 1-benzoyl-3(3-pyridyl)- (**19**) and 1-benzoyl-3-(3-quinolyl)thiourea (**21**), respectively, and hydrolysis of the latter with sodium hydroxide solution to give **20** and **22**. The 4-substituted 2-(3-pyridyl)- and 2-(3-quinolyl)aminothiazoles are yellow, insoluble in non-polar solvents, but slightly soluble in polar solvents and have relatively high melting points.

EXPERIMENTAL

The melting points below 250° were determined in a Thiele-Dennis melting point tube containing Dow-Corning silicone fluid No. D.C. 550. Those above 250° were taken in a melting point block constructed according to the specifications of Fieser (13). All melting points were corrected. The microanalyses were carried out by W. Manser, Zurich, Switzerland.

The infrared spectra were recorded in potassium bromide pellets using a Perkin-Elmer Model 521, and the spectra were compatible with the structures proposed. The ultraviolet spectra were obtained with Unicam spectrometer using absolute ethanol as the solvent.

2-Amino-4-(2-pyridyl)thiazole (**1**).

2-Bromoacetylpyridine hydrobromide (**6**) (4.2 g., 0.015 mole) was dissolved in water (18 ml.) and a solution of thiourea (1.18 g., 0.015 mole) in water (4.5 ml.), was added with stirring. The crystalline product was dissolved in water (50 ml.) and made alkaline by adding 7% aqueous ammonium hydroxide. 2-Amino-4-(2-pyridyl)thiazole (**1**) (2.4 g., 90.8% yield) formed colorless needles, m.p. 175.6-176° (ethanol).

Anal. Calcd. for $C_8H_7N_3S$: C, 54.23; H, 3.98: N, 23.72; S, 18.08. Found: C, 54.3; H, 4.0; N, 23.7; S, 18.1.

2-Amino-4-(3-pyridyl)thiazole (**2**).

3-Bromoacetylpyridine hydrobromide (**7**) (5.62 g., 0.02 mole) and thiourea (1.52 g., 0.01 mole) produced 3.21 g. of **2** (90.6% yield), pale yellow crystals, m.p. 204-204.6° (ethanol).

Anal. Calcd. for $C_8H_7N_3S$: C, 54.23; H, 3.98; N, 23.72; S, 18.08. Found: C, 54.3; H, 3.9; N, 23.7; S, 18.2.

4-Bromoacetylpyridine Hydrobromide (**8**).

4-Acetylpyridine (18.2 g., 0.15 mole) was dissolved in 48% hydrobromic acid (25 ml.) and bromine (24.0 g., 0.15 mole) dissolved in the same acid (4 ml.) was added dropwise with vigorous stirring at 70°, and the reaction was continued for 3 hours. The crystalline material was filtered, washed with 4 portions of 5 ml. of a methanol-petroleum ether (b.p. 60-75°) mixture (1:1), and dried *in vacuo* (yield 23.2 g.). Crystallization from 20% hydrobromic acid provided 4-bromoacetylpyridine hydrobromide (**8**), m.p. 209-210° dec.

Anal. Calcd. for $C_7H_7Br_2NO$: C, 29.92; H, 2.50; N, 4.99. Found: C, 29.8; H, 2.4; N, 5.3.

2-Amino-4-(4-pyridyl)thiazole (**3**).

4-Bromoacetylpyridine hydrobromide (**8**) (11.2 g., 0.04 mole) and thiourea (3.04 g., 0.04 mole) gave 6.4 g. (90% yield) of **3**; colorless crystals, m.p. 269.8-271.5° (ethanol).

Anal. Calcd. for $C_8H_7N_3S$: C, 54.23; H, 3.98; N, 23.72. Found: C, 54.5; H, 3.9; N, 23.6. Dipicrate, m.p. 246.5°.

Anal. Calcd. for $C_{20}H_{13}N_9O_{14}S$: N, 19.85. Found: N, 19.7.

2-Amino-4-(2-quinolyl)thiazole (**4**).

2-Bromoacetylquinoline hydrobromide (**9**) (6.62 g., 0.02 mole) was dissolved in a mixture of ethanol (30 ml.), hydrobromic acid (2 ml.) and 15 ml. of water. A solution of thiourea (1.52 g., 0.02 mole) in water (10 ml.) was added dropwise at 60-65° with stirring. Six g. (61% yield) of **4** was obtained; pale yellow crystals, m.p. 218.5-219° (50% ethanol).

Anal. Calcd. for $C_{12}H_9N_3S$: C, 63.42; H, 3.99; N, 18.49; S, 14.10. Found: C, 63.2; H, 3.9; N, 18.6; S, 13.9.

4-Bromoacetylquinoline Hydrobromide (**10**).

In a 100 ml. flask, were placed 23.1 g. (0.1 mole) of 4-acetylquinoline acetate and 50 ml. of 40% hydrobromic acid. A solution of 16.0 g. (0.1 mole) of bromine in 20 ml. of 40% hydrobromic acid was added at 65° in the course of ten minutes. The mixture was stirred for one hour and then chilled in an ice bath. The precipitate was filtered off and washed with 15 ml. of acetone and 10 ml. of ether. The dried product (**10**) weighed 30 g. (90.8%) and had a melting point 224-225.6°. It was used immediately without any recrystallization for the preparation of compound **5**.

2-Amino-4-(4-quinolyl)thiazole (**5**).

4-Bromoacetylquinoline hydrobromide (**10**) (3.31 g., 0.01 mole) was added to water (23 ml.) and the mixture was heated at 60° while thiourea (0.76 g., 0.01 mole) dissolved in water (5 ml.) was added. Stirring was continued for one hour, then the precipitate was filtered and dissolved in 10% hydrobromic acid (200 ml.). Compound **5** was precipitated with 10% ammonium hydroxide, yield 1.98 g. (87.4%); light yellow crystals, m.p. 268-269° (methanol).

Anal. Calcd. for $C_{12}H_9N_3S$: C, 63.42; H, 3.99; N, 18.49; S, 14.10. Found: C, 63.6; H, 4.0; N, 18.5; S, 13.8.

2-Pyridyl 4-Pyridylmethyl Ketone (**17**).

To a stirred suspension of sodamide in liquid ammonia, 4-picoline (18.6 g., 0.2 mole) was added over a period of 15 minutes. The mixture was stirred for an additional 20 minutes, then methyl pyridine-2-carboxylate (13.73 g., 0.1 mole) dissolved in anhydrous ether (20 ml.) was added slowly during 30 minutes. Stirring was continued for another hour before the reaction was quenched by the addition of solid ammonium chloride (11.0 g., 0.21 mole). The liquid ammonia was replaced by anhydrous ether (310 ml.) and the mixture was warmed gently to the reflux point. After being cooled, the solution was poured onto ice (200 g.), made acidic with concentrated hydrochloric acid, and washed with ether. The acid solution was rendered basic by means of sodium carbo-

nate and extracted with ether. When the solvent and 4-picoline had been removed from the ethereal extract, the residual material was allowed to stand overnight. 2-Pyridyl 4-pyridylmethyl ketone (**17**) (9.8 g., 49.5% yield) formed yellow crystals, m.p. 86-87° (petroleum ether).

Anal. Calcd. for $C_{12}H_{10}N_2O$: C, 72.72; H, 5.09; N, 14.14. Found: C, 72.9; H, 5.2; N, 14.2.

2-Amino-4,5-di-(2-pyridyl)thiazole (**11**).

A mixture of 2-pyridyl 2-pyridylmethyl ketone (**15**) (1.98 g., 0.01 mole), thiourea (1.52 g., 0.02 mole), and iodine (1.27 g., 0.01 mole) was heated for 10 hours at 85-95° in a tightly stoppered container. Then the solid reaction mixture was boiled for 20 minutes with water (50 ml.). The mixture was filtered, and the filtrate made alkaline with sodium hydroxide. The precipitate was dissolved in 20% hydrochloric acid (50 ml.). The solution was made alkaline with 10% ammonium hydroxide, and **11** (1.32 g., 52.1% yield) was obtained; bright yellow needles, m.p. 246-246.5° (ethanol).

Anal. Calcd. for $C_{13}H_{10}N_4S$: C, 61.40; H, 3.96; N, 22.04; S, 12.60. Found: C, 61.4; H, 4.0; N, 22.1; S, 12.7.

2-Amino-4-(4-pyridyl)-5-(2-pyridyl)thiazole (**12**).

To a stirred solution of 4-pyridyl 2-pyridylmethyl ketone (**16**) (3.96 g., 0.02 mole) in 10% hydrobromic acid (35 ml.) was added bromine (3.2 g., 0.02 mole) dissolved in 20% hydrobromic acid (10 ml.). The mixture was stirred for 2 hours at 55-60°, then a solution of thiourea (1.52 g., 0.02 mole) in water (20 ml.) was added slowly. After two hours the solution was made alkaline with 10% ammonium hydroxide, and the precipitate was isolated (yield 3.65 g., 71.8%); **12** formed yellow crystals, m.p. 277-278° (ethanol).

Anal. Calcd. for $C_{13}H_{10}N_4S$: C, 61.40; H, 3.96; N, 22.04; S, 12.60. Found: C, 61.4; H, 4.2; N, 22.2; S, 12.7.

2-Amino-4-(2-pyridyl)-5-(4-pyridyl)thiazole (**13**).

A similar procedure was used for the preparation of **13**. 2-Pyridyl 4-pyridylmethyl ketone (**17**) (3.96 g., 0.02 mole), bromine (3.2 g., 0.02 mole) and thiourea (1.52 g., 0.02 mole) produced 3.05 g. (60.0% yield) of **13**; yellow crystals, m.p. 216.5-217° (ethanol). This compound crystallized with a molecule of water. It was obtained anhydrous by drying in vacuum (80°) over phosphorus pentoxide.

Anal. Calcd. for $C_{13}H_{10}N_4S$: C, 61.40; H, 3.96; N, 22.04; S, 12.60. Found: C, 61.3; H, 4.1; N, 22.2; S, 12.7.

2-Amino-4,5-di-(4-pyridyl)thiazole (**14**).

4-Pyridyl 4-pyridylmethyl ketone (**18**) (3.96 g., 0.02 mole), bromine (3.20 g., 0.02 mole) and thiourea (1.52 g., 0.02 mole) gave 3.7 g. (72.6%) of **14**; yellow crystals, m.p. 292-293° (ethanol).

Anal. Calcd. for $C_{13}H_{10}N_4S$: C, 61.40; H, 3.96; N, 22.04; S, 12.60. Found: C, 61.7; H, 3.9; N, 21.9; S, 12.8.

1-Benzoyl-3-(3-pyridyl)thiourea (**19**).

To ammonium thiocyanate (6.68 g., 0.088 mole) dissolved in acetone (54 ml.), benzoyl chloride (11.28 g., 0.08 mole) was added dropwise with stirring. The mixture was refluxed for 15 minutes, then 3-aminopyridine (7.52 g., 0.08 mole) in acetone (25 ml.) was added slowly. The reaction mixture was poured into water (700 ml.), and the bright yellow precipitate of **19** was isolated (yield 18.52 g., 90.2%), m.p. 165-165.6° (water).

Anal. Calcd. for $C_{13}H_{11}N_3OS$: C, 60.70; H, 4.31; N, 16.34. Found: C, 60.5; H, 4.5; N, 16.3.

N-(3-Pyridyl)thiourea (**20**).

A mixture of 2.5 *N* sodium hydroxide solution (70 ml.) and 1-benzoyl-3-(3-pyridyl)-2-thiourea (**19**) (12.87 g., 0.05 mole) was refluxed for 15 minutes. After being cooled and filtered, this solution was stirred and made basic with ammonium hydroxide and allowed to stand overnight. The colorless precipitate of **20**, m.p. 153.5-154° (water) weighed 5.7 g. (74.6% yield).

Anal. Calcd. for $C_6H_7N_3S$: C, 47.03; H, 4.60; N, 27.43; S, 20.92. Found: C, 47.2; H, 4.6; N, 27.3; S, 21.1.

1-Benzoyl-4-(3-quinolyl)thiourea (**21**).

This compound was prepared from ammonium thiocyanate, benzoyl chloride and 3-aminoquinoline by the procedure outlined for **19** (yield 92%); yellow crystals, m.p. 163.5-164° (50% ethanol.

Anal. Calcd. for $C_{17}H_{13}N_3OS$: C, 66.43; H, 4.26; N, 13.68; S, 10.43. Found: C, 66.5; H, 4.2; N, 13.8; S, 10.6.

N-(3-Quinolyl)thiourea (**22**).

Compound **21** (15.3 g., 0.05 mole) was refluxed for 15 minutes with 70 ml. of 3 *N* sodium hydroxide solution. The reaction mixture was acidified with concentrated hydrochloric acid and then made slightly basic by adding ammonium hydroxide solution. The precipitate (**22**) was filtered off, washed with water and dried. The product weighed 7.9 g. (78%). The compound **22** formed colorless crystals, m.p. 169-169.5° (water).

Anal. Calcd. for $C_{10}H_9N_3S$: C, 59.10; H, 4.46; N, 20.68; S, 15.78. Found: C, 58.8; H, 4.3; N, 20.4; S, 15.5.

2-(3-Pyridyl)amino-4-methylthiazole (**23**).

To a solution of *N*-(3-pyridyl)thiourea (**20**) (6.12 g., 0.04 mole) in 80% methanol (40 ml.) at 60° was added dropwise, and with vigorous stirring, bromoacetone (5.38 g., 0.04 mole) dissolved in methanol (3 ml.). Stirring was continued for 3 hours at 65°. The solution was concentrated to a small volume and water (450 ml.) was added. Ammonium hydroxide (10%) was added until the solution became slightly alkaline. A precipitate of **23** was isolated (5.98 g., 78.2% yield); green-yellow crystals, m.p. 203-204° (60% ethanol).

Anal. Calcd. for $C_9H_9N_3S$: C, 56.53; H, 4.74; N, 21.99; S, 16.76. Found: C, 56.6; H, 4.7; N, 21.9; S, 16.6.

2-(3-Pyridyl)amino-4-phenylthiazole (**24**).

This compound was prepared from *N*-(3-pyridyl)thiourea (**20**) (7.65 g., 0.05 mole) and bromoacetophenone (9.95 g., 0.05 mole) in 60% methanol at 60°; yellow crystals, m.p. 199-199.5° (70% ethanol), yield 87%.

Anal. Calcd. for $C_{13}H_{10}N_4S$: C, 61.40; H, 3.96; N, 22.04; S, 12.60. Found: C, 61.5; H, 3.9; N, 22.1; S, 12.5.

2-(3-Pyridyl)amino-4-(3-pyridyl)thiazole (**25**).

N-(3-Pyridyl)thiourea (6.12 g., 0.04 mole) was dissolved in 40 ml. of 50% ethanol and 11.2 g. (0.04 mole) of 3-bromoacetylpyridine hydrobromide (**7**) dissolved in 15 ml. of water was added at 65°. After one hour the mixture was diluted with 350 ml. of water and made slightly alkaline with 10% ammonium hydroxide solution. The precipitate was filtered, washed with water and dried. The yield was 8.4 g. (82.6%). The compound **25** had m.p. 203.5-204° (60% methanol).

Anal. Calcd. for $C_{13}H_{10}N_4S$: C, 61.40; H, 3.96; N, 22.04; S, 12.60. Found: C, 61.5; H, 4.0; N, 22.1; S, 12.5.

2-(3-Pyridyl)amino-4-(4-pyridyl)thiazole (**26**).

A stirred solution of *N*-(3-pyridyl)thiourea (**20**) (6.12 g., 0.04

mole) in 50% aqueous ethanol (40 ml.) was heated to 40-45° and 4-bromoacetylpyridine hydrobromide (**8**) (11.2 g., 0.04 mole) in water (20 ml.) was added dropwise. The reaction was continued for one hour at 50°. The precipitate was dissolved in water (350 ml.) and the solution was made slightly alkaline with 10% sodium hydroxide solution. The precipitate of **26** (9.58 g., yield 92%) formed orange needles, m.p. 228.5-229° (60% aqueous methanol).

Anal. Calcd. for $C_{13}H_{10}N_4S$: C, 61.40; H, 3.96; N, 22.04. S, 12.60. Found: C, 61.5; H, 4.0; N, 22.0; S, 12.7.

2-(3-Quinolyl)amino-4-methylthiazole (**27**).

Bromoacetone (1.37 g., 0.01 mole) dissolved in methanol (6 ml.) was added with stirring to a solution of *N*-(3-quinolyl)-thiourea (**22**) (2.03 g., 0.01 mole) in 60% aqueous methanol (40 ml.) at 60°. Stirring was continued for 3 hours at 80-85°. The precipitate was dissolved in a mixture of methanol-water (3:4) with heating. When cool, the solution was rendered basic with concentrated ammonium hydroxide. The precipitate of **27** (yield 2.17 g., 90.2%) formed green-yellow crystals, m.p. 199.5-200° (50% ethanol).

Anal. Calcd. for $C_{13}H_{11}N_3S$: C, 46.71; H, 4.59; N, 17.42; S, 13.28. Found: C, 64.6; H, 4.5; N, 17.4; S, 13.1.

2-(3-Quinolyl)amino-4-phenylthiazole (**28**).

N-(3-Quinolyl)thiourea (**22**) (2.03 g., 0.01 mole) and bromoacetophenone (1.99 g., 0.01 mole) in 60% methanol at 75-80° (2 hours) produced 2.52 g. (83.3%) of **28**; yellow crystals, m.p. 216.5-217° (60% ethanol).

Anal. Calcd. for $C_{18}H_{13}N_3S$: C, 71.27; H, 4.32; N, 13.85; S, 10.57. Found: C, 71.2; H, 4.5; N, 13.8; S, 10.6.

2-(3-Quinolyl)amino-4-(4-pyridyl)thiazole (**29**).

This compound was prepared from *N*-(3-quinolyl)thiourea (**22**) (2.03 g., 0.01 mole) and 4-bromoacetylpyridine hydrobromide (2.81 g., 0.01 mole) in 60% methanol at 60-65° (2 hours); yield 2.20 g. (73.2%), yellow crystals, m.p. 255-255.5° (40% ethanol). This compound crystallized with a molecule of water, however, it was obtained anhydrous by drying in vacuum (80°) over phosphorus pentoxide.

Anal. Calcd. for $C_{17}H_{12}N_4S$: C, 67.10; H, 3.97; N, 18.40; S, 10.53. Found: C, 66.9; H, 4.1; N, 18.5; S, 10.6.

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