THE PREPARATION OF 1-METHYL- (AND ETHYL)-1,4-DIHYDRO-4-OXO- AND 4-THIOXO-3-QUINOLINESULFONAMIDES FROM 4-AMINO-3-QUINOLINESULFONAMIDES *

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Abstract - Basic hydrolysis of 1-methyl or 1-ethyl-4-amino-3-aminosulfonylquinolinium alkyl sulfates (**4**) obtained from 4-amino-3-quinolinesulfonamides (**2**) yields 1-methyl- and 1-ethyl-1,4-dihydro-4-oxo-3-quinolinesulfonamides (**5**). Salts (**4**) reacted with sodium hydrosulfide to give sulfur analogs of the compounds (**5**), i.e., 1-alkyl-1,4-dihydro-4-thioxo-3-quinolinesulfonamides (**7**).

INTRODUCTION

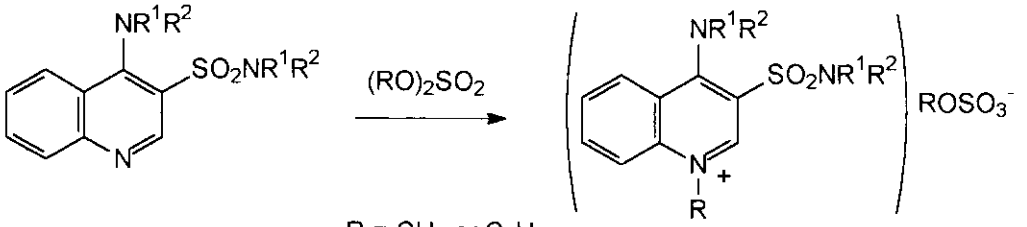
Antihypertensive activity [1,2] of 1,4-dihydro-4-oxo-3-quinolinesulfonamides (**5**) resulted in a considerable interest in the effective synthetic methods facilitating these compounds. We reported previously a synthesis of 1-nonsubstituted and 1-alkyl-1,4-dihydro-4-oxo-3-quinolinesulfonamides (**5**) from 4-chloro-3-quinolinesulfonamides (**1**).[3] The compounds (**5**) can be obtained by the hydrolysis of the quinolinium salts (**3**) resulting from the quaternization of 4-chloro-3-quinolinesulfonamides (**1**) or by acid hydrolysis of chloroquinoline (**1**).[3] 1-Nonsubstituted 1,4-dihydro-4-oxo-3-quinolinesulfonamides were also synthesized from 4-amino-3-quinolinesulfonamides (**2**).[4]

The reactants for the synthesis of 4-chloro- and 4-amino-3-quinolinesulfonamides (**1**, **2**) were obtained in a three step process starting from quinoline *via* thioquinanthrene and 4-chloro-3-quinolinesulfonyl chloride.[5] Till now some 1-alkyl-1,4-dihydro-4-thioxo-3-quinolinesulfonamides (**7**) were synthesized in the reaction of salts (**3**) with hydrogen sulfide.[2]

Because the majority of 4-amino-3-quinolinesulfonamides (**2**) can be synthesized directly from 4-chloro-3-quinolinesulfonyl chloride providing higher yields than respective 4-chloro-3-quinolinesulfonamides (**1**),[3,4] a synthetic route is planned to obtain 4-quinolinone-3-sulfonamides (**5**) and 4-quinolinethione-3-sulfonamides (**7**) *via* quinolinium salts (**4**) deriving from 4-amino-3-quinolinesulfonamides (**2**).

RESULTS AND DISCUSSION

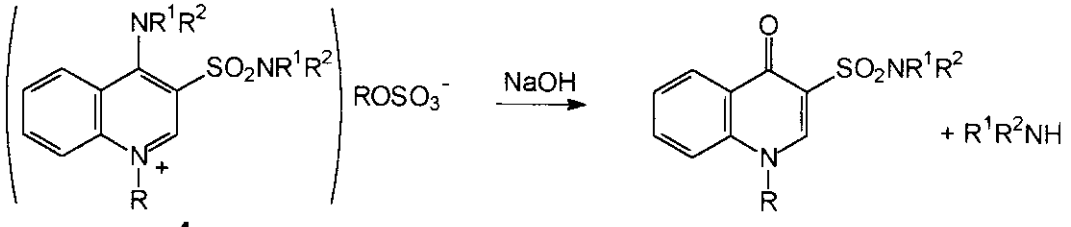
1-Alkyl-4-amino-3-aminosulfonylquinolinium alkyl sulfates (**4**) were obtained similarly as the salts (**3**)[3] i.e., in a reaction of 4-amino-3-quinolinesulfonamides (**2**) with the excess of dialkyl (dimethyl or diethyl) sulfate. After the removal of the excess of dialkyl sulfate the salts (**4**) were reacted further without purification. The higher basicity of 4-amino-3-quinolinesulfonamides (**2**), in comparison to the respective chloro analogs (**1**) allows one to perform quaternarization with full consumption of reactants.



2 **4**

Synthesis of 1-alkyl-1,4-dihydro-4-oxo-3-quinolinesulfonamides (5).

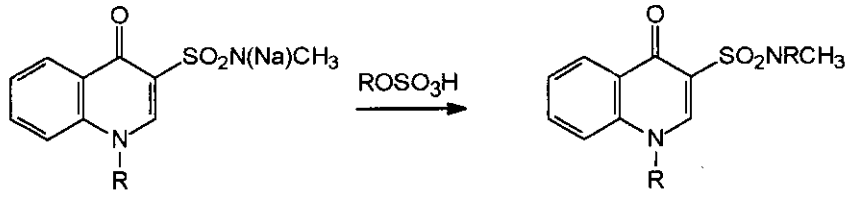
Salts (**4**) derived from the primary and secondary aliphatic (methyl or dimethyl) amines or primary aromatic amine (aniline) were hydrolyzed in basic solution to form 1-alkyl-1,4-dihydro-4-oxo-3-quinolinesulfonamides (**5**). Basic hydrolysis has been applied before to transform the 2- or 4-dimethylaminopyridynium salts into the substituted 2- or 4-pyridones.[6,7] Acid hydrolysis of salts (**4**) seemed improper because it has been found that *N*-monosubstituted 4-amino-3-quinolinesulfonamides (**2**) do not react in the reaction conditions.[4] As expected a hydrolysis of salts (**4**) derived from aliphatic amines gives quinolonesulfonamides (**5**) in a good yield.



4 **5**

R^1, R^2 = H and methyl, or dimethyl

N,N-Disubstituted quinolones (**5b** and **5d**) were also isolated in the reaction of derivatives (**4a** and **4b**) of methylamine, respectively. A partial alkylation of the formed sodium salt of 1-alkyl-1,4-dihydro-*N*-methyl-4-oxo-3-quinolinesulfonamides (**5a** and **5c**) by alkyl hydrogen sulfate can probably explain that fact, because till now the alkylation of sulfonamide group has not been observed during a formation of salt (**3**).[3]



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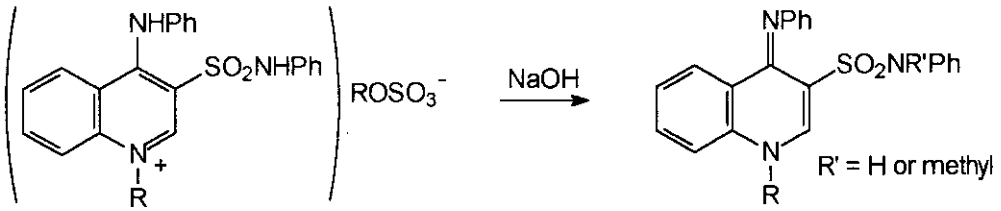
In contrast with the aliphatic amine derivatives, hydrolysis of salts (**4e** and **4f**) derived from aniline terminated on the imine (**6**) level:



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Moreover, the methylated product (**6b**) in the sulfonanilide group in imine (**6a**) was observed in a moderate amount. Compounds (**6a** and **6c**) were practically insoluble in alkaline solutions. Imines (**6**) were not hydrolyzed even if heated for long periods with 18% hydrochloric or 50% sulfuric acid, which complies with the results of the acidic hydrolysis of 4-phenylamino-3-quinolinesulfonanilide.[4]

The results of the reactions performed are given in Table 1.

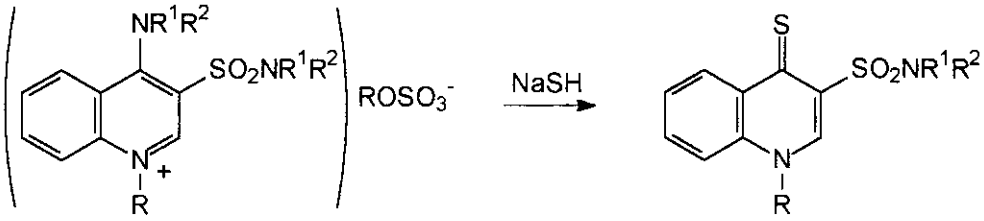
Table 1

Substrate	Salt 4	R	R^1	R^2	Yield (%) of alkylation product	
					Monoalkylation product	Dialkylation product
2a	**4a**	CH_3	H	CH_3	**5a** 62	**5b** 26
2a	**4b**	CH_2CH_3	H	CH_3	**5c** 87	**5d** 3
2b	**4c**	CH_3	CH_3	CH_3	**5b** 73	-
2b	**4d**	CH_2CH_3	CH_3	CH_3	**5e** 84	-
2c	**4e**	CH_3	H	C_6H_5	**6a** 38	**6b** 53
2c	**4f**	CH_2CH_3	H	C_6H_5	**6c** 87	0

The results of hydrolysis of salts (**4**) obtained from the selected 4-amino-3-quinolinesulfonamides (**2**) indicate that 1,4-dihydro-4-oxo-3-quinolinesulfonamides (**5**) can be synthesized only from the primary and secondary aliphatic amines.

Synthesis of 1-alkyl-1,4-dihydro-4-thioxo-3-quinolinesulfonamides (7)

The hydrolysis of 1-alkyl-4-amino-3-aminosulfonylquinolinium alkyl sulfates (**4**) shows that salts (**4**) should react with nucleophiles stronger than those containing nucleophilic oxygen. Therefore, it is decided to investigate the reaction of compounds (**4**) with sodium hydrosulfide which in comparison to hydrogen sulfide is a reactant much more convenient to handle. Positive results will provide a new synthetic method facilitating 1-alkyl-1,4-dihydro-4-thioxo-3-quinolinesulfonamides (7): [3]



4 **7**

Moreover, the investigation should answer a question how salts (**5**) deriving from aniline, which hydrolysis terminated on the imine (**6**) level, would react with sodium hydrosulfide. A reaction of 1-methyl-4-methylamino-*N*-methyl-3-aminosulfonylquinolinium methyl sulfate (**4a**), forms a model for the investigation performed in boiling water, pyridine, 1-propanol and dioxane as well as DMSO at 100 °C.

The expected 1-methyl-1,4-dihydro-*N*-methyl-4-thioxo-3-quinolinesulfonamide (**7a**) was isolated selectively with very high yields in water (dielectric constant 80.2) and DMSO (dielectric constant 46.7). Quinolinethione (**7a**) is formed also in pyridine (dielectric constant 12.4), but in this particular case it was very difficult to purify the product obtained. Salt (**4a**) reacted with sodium hydrosulfide in 1-propanol (dielectric constant 20.3) to form not only the expected thione (**7a**) (26%), but also dealkylated product - the substrate (**2a**) was isolated (58%). Salt (**4a**) does not react with sodium hydrosulfide in dioxane probably because of the lower polarity of the solvent (dielectric constant 2.24).

It has been decided to investigate the reactivity of salts (**4**) deriving from the broader spectrum of aliphatic amines and aniline. The reaction was performed in DMSO. It could have been used for reacting salts (**3**) resulted from the reaction of chloro derivatives (**1**) with sodium hydrosulfide, which would eliminate a treatment with hydrogen sulfide. Water if used could have promoted hydrolysis of salt (**3**). Table 2 gives the results of the reaction of quinolinium salts (**4**) with sodium hydrosulfide in DMSO at 100 °C.

Table 2

Product 7				Yield (0.5 h)	Yield (3 h)
	R	R_1	R_2	%	%
7a	CH_3	H	CH_3	73	-
7b	CH_2CH_3	H	CH_3	76	-
7c	CH_3	CH_2CH_3	CH_2CH_3	85	-
7d	CH_2CH_3	CH_2CH_3	CH_2CH_3	89	-
7e	CH_3	$-CH_2CH_2-O-CH_2CH_2-$		33	65
7f	CH_2CH_3	$-CH_2CH_2-O-CH_2CH_2-$		42	71
7g	CH_3	H	C_6H_5	57	81
7h	CH_2CH_3	H	C_6H_5	56	73

Slightly lower yields for the morpholine and aniline derivatives (33%-57%) can result from the fact that relatively large groups can form a steric hindrance blocking the access of the hydrosulfide anion to the position 4 of quinoline ring. This explanation can be proved by extending the reaction time from 0.5 h to 3 h, which results in the significant higher yield of thiones (**7e - 7h**) (65%-81%).

The results of the reaction of primary amines with sodium hydrosulfide indicating the lack of alkylation of the sulfonamide group prove that such alkylation does not proceed during a formation of salts (**4**).

In this particular case alkyl hydrogen sulfides formed probably, react with the excess of sodium hydrosulfide, which prevents alkylation of the products (**7a**, **7b**, **7g** and **7h**) formed. It is worth noticing that salts (**4**) derived from aniline react with sulfur nucleophile (SH^- anion) to liberate aniline in contrast to hydrolysis reaction (OH^- anion) which terminated on the imine level.

EXPERIMENTAL

Melting points were determined in open capillary tubes on a Boetius mp apparatus and are uncorrected. The ^1H NMR spectra were recorded on a Bruker MSL 300 (300 MHz) spectrometer with tetramethylsilane as the internal standard. Chemical shifts are reported in ppm (δ) and J values in Hz. EIMS were run on a LKB GC 2091 spectrometer at 70 eV and 15 eV. CIMS spectra were recorded on a Finnigan MAT 95 spectrometer using isobutane as a reagent and temperature of ion source of 180 °C.

1-Alkyl-4-amino-3-sulfonylaminoquinolinium alkyl sulfates (**4**). General procedure:

4-Amino-3-quinolinesulfonamides (**2**) (2 mmol) and dimethyl sulfate (0.57 mL, 6 mmol) or diethyl sulfate (0.66 mL, 6 mmol) was heated at 94 °C for 1.5 h (dimethyl sulfate) or 20 h (diethyl sulfate). The mixture was then cooled down to rt. An excess of dialkyl sulfate was removed by three-fold trituration with ether

(4 mL) followed by decantation. The resulted salts (**4**) were reacted further without purification.

1-Alkyl-1,4-dihydro-4-oxo-3-quinolinesulfonamides (5). General procedure:

1-Alkyl-4-amino-3-aminosulfonylquinolinium alkyl sulfates (**4a - 4d**) (~2 mmol) were dissolved in water (20 mL) and sodium hydroxide (2 g, 50 mmol) was added. The solution obtained was refluxed for 0.5 h or 3 h. After cooling to rt quinolones (**5b**, **5d** and **5e**) were filtered off and washed with water. The filtrate was acidified with 10% hydrochloride acid to pH 4-6 and products formed were filtered off. The compounds (**5a**, **5c**) obtained were crystallized from aqueous ethanol. The results of the experiments are given in Table 1.

1,4-Dihydro-1-alkyl-4-phenylimino-3-quinolinesulfonanilides (**6a**, **6b** and **6c**).

1-Alkyl-4-phenylamino-3-anilinosulfonylquinolinium alkyl sulfates (**4e** and **4f**) (~2 mmol) were treated with 10% sodium hydroxide (20 mL, 55 mmol). The resulted suspension was refluxed for 0.5 h. After cooling to rt the mixture is acidified with 15% hydrochloride acid and the products (**6a** and **6b**) were extracted of chloroform (2x 10 mL) and separated on chromatographic column (neutral aluminium oxide/chloroform), while the product (**6c**) was filtered off. The obtained products were recrystallized from ethanol. The results of the experiments are given in Table 1.

1,4-Dihydro-4-thioxo-3-quinolinesulfonamides (7). General procedure:

The obtained 1-alkyl-4-amino-3-aminosulfonylquinolinium alkyl sulfates (**4**) (~2 mmol) were dissolved in DMSO (10 mL) and hydrated sodium hydrosulfide (1 g) (NaSH x nH_2O) was added. The mixture was heated at 100 °C for 0.5 h. After cooling the solution was poured into water (100 mL) and products (**7**) were filtered off and washed with water and ethanol (5 mL). 1,4-Dihydro-4-thioxo-3-quinolinesulfonamides (**7**) were crystallized from acetic acid. The results of the experiments are given in Table 2.

1,4-Dihydro-1,*N*-dimethyl-4-oxo-3-quinolinesulfonamide (**5a**) mp 258-259 °C, lit.,[3] mp 258-260 °C.

1,4-Dihydro-1,*N*,*N*-trimethyl-4-oxo-3-quinolinesulfonamide (**5b**) mp 239-240 °C. EI MS (70 eV), (m/z): 266(M^+, 1.1%), 159(100%). CI MS (m/z): 267(M^++1, 100%). ^{1}H NMR, δ: 2.80[s, 6H, N(CH_3)$_2$]; 3.96(s, 3H, CH_3); 7.52-7.58(m, 1H, **H**6); 7,78-7,81(m, 1H, **H**8); 7,84-7,94(m, 1H, **H**7); 8.24-8.27(m, 1H, **H**5); 8.62(s, 1H, **H**2). *Anal.* Calcd for $C_{12}H_{14}N_2O_3S$: C 54.12, H 5.30, N 18.02, S 12.04. Found: C 54.41, H 5.52, N 17.92, S 12.14.

1-Ethyl-1,4-dihydro-*N*-methyl-4-oxo-3-quinolinesulfonamide (**5c**) mp 194-195 °C, lit.,[3] mp 196-197 °C.

1,*N*-Diethyl-1,4-dihydro-*N*-methyl-4-oxo-3-quinolinesulfonamide (**5d**) oil, EI MS (70 eV), (m/z): (M^+, 0.3%). ^{1}H NMR, δ: 1.13(t, *J*=7.1 Hz, 3H, NCH$_2$$CH_3$); 1.44(t, *J*=7.1 Hz, 3H, 1-CH$_2$$CH_3$); 2.87(s, 3H, N$CH_3$); 3.28(q, *J*=7.1 Hz, 2H, NCH_2CH$_3$); 4.52(q, *J*=7.1 Hz, 2H, 1-CH_2CH$_3$); 7.56-7.64(m, 1H, **H**6); 7.88-7.91(m, 2H, **H**7, **H**8); 8.30-8.33(m, 1H, **H**5); 8.71(s, 1H, **H**2).

1-Ethyl-1,4-dihydro-*N*,*N*-dimethyl-4-oxo-3-quinolinesulfonamide (**5e**) mp 144-145 °C. EI MS (70 eV),

(m/z): 280(M^+, 0.5%), 173(100%). ^{1}H NMR, δ: 1.47(t, *J*=7.2 Hz, 3H, CH_2CH_3); 2.89[s, 6H, $N(CH_3)_2$]; 4.23(q, *J*=7.2 Hz, 2H, CH_2CH_3); 7.58-7.65(m, 1H, **H**6); 7.85-7.91(m, 2H, **H**7, **H**8); 8.30-8.34(m, 1H, **H**-5); 8.68(s, 1H, **H**2). *Anal.* Calcd for $C_{13}H_{16}N_2O_3S$: C 55.70, H 5.75, N 9.99, S 11.44. Found: C 55.88, H 5.60, N 10.18, S 11.51.

1,4-Dihydro-1-methyl-4-phenylimino-3-quinolinesulfonanilide (**6a**) mp 213-214 °C. EI MS (70 eV), (m/z): 389(M^+, 100%). ^{1}H NMR, δ: 3.71(s, 3H, CH_3); 6.69-6.71(m, 2H, **H**arom.); 6.86-6.92(m, 1H, **H**arom.); 6.97-7.02(m, 2H, **H**arom.); 7.21-7.35(m, 7H, **H**arom.); 7.46-7.53(m, 2H, **H**arom.); 8.30(s, 1H, **H**2); 9.41(s, 1H, N**H**Ph). *Anal.* Calcd for $C_{22}H_{19}N_3O_2$: C 67.85, H 4.92, N 10.79, S 8.23. Found: C 67.98, H 4.74, N 10.55, S 8.41.

1,4-Dihydro-1,*N*-dimethyl-4-phenylimino-3-quinolinesulfonanilide (**6b**) mp 179-180 °C. EI MS (15 eV), (m/z): 403(M^+, 7.0%), 233(100%). ^{1}H NMR, δ: 3.38(s, 3H, N-CH_3); 3.67(s, 3H, 1-CH_3); 6.69-6.72(m, 2H, **H**arom.); 6.91-7.00(m, 2H, **H**arom.); 7.13-7.18(m, 1H, **H**arom.); 7.28-7.38(m, 7H, **H**arom.); 7.48-7.55(m, 2H, **H**arom.); 8.15(s, 1H, **H**2). *Anal.* Calcd for $C_{23}H_{21}N_3O_2S$: C 68.46, H 5.25, N 10.41, S 7.95. Found: C 68.56, H 5.11, N 10.29, S 8.03.

1-Ethyl-1,4-dihydro-4-phenylimino-3-quinolinesulfonanilide (**6c**) mp 192-193 °C, EI MS (15 eV), (m/z): 403(M^+, 73.3%), 247(100%). ^{1}H NMR, δ: 1.23(t, *J*=7.1 Hz, 3H, CH_2CH_3); 4.22(q, *J*=7.1 Hz, 2H, CH_2CH_3); 6.66-6.68(m, 2H, **H**arom.); 6.83-6.89(m, 1H, **H**arom.); 6.93-6.99(m, 2H, **H**arom.); 7.18-7.33(m, 7H, **H**arom.); 7.43-7.50(m, 2H, **H**arom.); 8.28(s, 1H, **H**2); 9.40(N**H**Ph). *Anal.* Calcd for $C_{23}H_{21}N_3O_2S$: C 68.46, H 5.25, N 10.41, S 7.95. Found: C 68.31, H 5.31, N 10.22, S 7.81.

1,4-Dihydro-1,*N*-dimethyl-4-thioxo-3-quinolinesulfonamide (**7a**) mp 242-243 °C (decomp), lit.,[2] mp 242-243 °C (decomp).

1-Ethyl-1,4-dihydro-*N*-methyl-4-thioxo-3-quinolinesulfonamide (**7b**) mp 237-238 °C (decomp). EI MS (15 eV), (m/z): 282(M^+, 18.7%), 189(100%). ^{1}H NMR, δ: 1.45(t, *J*=7.0 Hz, 3H, CH_2CH_3); 2.38(d, *J*=5.2 Hz, 3H, $NHCH_3$); 4.63(q, *J*=7.1 Hz, 2H, CH_2CH_3); 7.06(q, *J*=5.1 Hz, 1H, $NHCH_3$); 7.64-7.69(m, H, **H**6); 7.92-7.97(m, H, **H**7); 8.04-8.07(m, 1H, **H**8); 8.79(s, 1H, **H**2); 8.92-8.95(m, 1H, **H**5). *Anal.* Calcd for $C_{12}H_{14}N_2O_2S_2$: C 51.04, H 5.00, N 9.92, S 22.71. Found: C 50.89, H 5.21, N 9.68, S 22.60.

N,N-Diethyl-1,4-dihydro-1-methyl-4-thioxo-3-quinolinesulfonamide (**7c**) mp 191-192 °C (decomp), lit.,[2] mp 191-192 °C (decomp).

1,*N,N*-Triethyl-1,4-dihydro-4-thioxo-3-quinolinesulfonamide (**7d**) mp 121-123 °C (decomp). EI MS (15 eV), (m/z): 324(M^+, 1.6%), 99(100%). ^{1}H NMR, δ: 1.05[t, *J*=7.0 Hz, 6H, $(CH_2CH_3)_2$]; 1.43(t, *J*=6.9 Hz, 3H, CH_2CH_3); 3.35[q, *J*=7.0 Hz, 4H, $(CH_2CH_3)_2$]; 4.58(q, *J*= 6.9 Hz, 2H, CH_2CH_3); 7.58-7.65(m, 1H, **H**6); 7.87-7.92(m, 1H, **H**7); 7.98-8.01(m, 1H, **H**8); 8.81(s, 1H, **H**2); 8.89-8.92(m, 1H, **H**5). *Anal.* Calcd for $C_{15}H_{20}N_2O_2S_2$: C 55.53, H 6.21, N 8.63, S 19.76. Found: C 55.41, 6.37, 8.90, S 19.57.

1,4-Dihydro-1-methyl-4-thioxo-3-quinolinesulfonmorpholide (**7e**) mp 200-202 °C (decomp). EI MS (15 eV), (m/z): 324(M^+, 3.2%), 48(100%). ^{1}H NMR, δ: 3.41-3.44(m, 4H, -C**H**$_2$-N-C**H**$_2$-); 3.41-3.44(m, 4H, -C**H**$_2$-O-C**H**$_2$-); 4.15(s, 3H, 1-C**H**$_3$); 7.71-7.74(m, H, **H6**); 8.00-8.02(m, 2H, **H7, H8**); 8.94(s, 1H, **H2**); 8.98-9.01(m, 1H, **H5**). *Anal.* Calcd for $C_{14}H_{16}N_2O_3S_2$: C 51.83, H 4.97, N 8.64, S 19.76. Found: C 51.98, H 5.12, N 8.45, S 19.91.

1-Ethyl-1,4-dihydro-4-thioxo-3-quinolinesulfonmorpholide (**7f**) mp 180-181 °C (decomp). EI MS (15 eV), (m/z): 338(M^+, 11.2%), 189(100%). ^{1}H NMR, δ: 1.41(t, *J*=7.0 Hz, 3H, CH$_2$C**H**$_3$); 3.29-3.33(m, 4H, -C**H**$_2$-N-C**H**$_2$-); 3.29-3.33(m, 4H, -C**H**$_2$-O-C**H**$_2$-); 4.54(q, *J*=7.0 Hz, 2H, C**H**$_2$CH$_3$); 7.56-7.61(m ,H, **H6**); 7.85-7.91(m, 1H, **H7**); 7.96-7.99(m, 1H, **H8**); 8.75(s, 1H, **H2**); 8.88-8.91(m, 1H, **H5**). *Anal.* Calcd for $C_{15}H_{18}N_2O_3S_2$: C 53.23, H 5.36, N 8.28, S 18.95. Found: C 53.03, H 5.58, N 8.32, S 18.74.

1,4-Dihydro-1-methyl-4-thioxo-3-quinolinesulfonanilide (**7g**) mp 217-218 °C (decomp). EI MS (15 eV), (m/z): 330(M^+, 52.9%), 238(100%). ^{1}H NMR, δ: 4.06(s, 3H, 1-C**H**$_3$); 6.96-7.00(m, 1H, p-C$_6$**H**$_5$); 7.07-7.28(m, 4H, C$_6$**H**$_4$); 7.62-7.68 (m, H, **H6**); 7.87-7.90(m, 2H, **H7, H8**); 8.83(s, 1H, **H2**); 8.83-8.87(m, 1H, **H5**); 9.87(s, 1H, N**H**Ph). *Anal.* Calcd for $C_{16}H_{14}N_2O_2S_2$: C 58.16, H 4.27, N 8.48, S 19.41. Found: C 58.41, H 4.39, N 8.61, S 19.30.

1-Ethyl-1,4-dihydro-4-thioxo-3-quinolinesulfonanilide (**7h**) mp 253-255 °C (decomp). EI MS (15 eV), (m/z): 344(M^+, 51.1%), 252(100%). ^{1}H NMR, δ: 1.43(t, *J*=7.0 Hz, 3H, CH$_2$C**H**$_3$); 4.65(q, *J*=7.0 Hz, 2H, C**H**$_2$CH$_3$); 7.08-7.14(m, 1H, p-C$_6$**H**$_5$); 7.22-7.35(m, 4H, C$_6$**H**$_5$); 7.65-7.70 (m, H, **H6**); 7.96-8.05(m, 2H, **H7**, **H8**); 8.92(s, 1H, **H2**); 8.94-8.97(m, 1H, **H5**); 9.91(s, 1H, N**H**Ph). *Anal.* Calcd for $C_{17}H_{16}N_2O_2S_2$: C 59.28, H 4.68, N 8.13, S 18.62. Found: C 59.50, H 4.81, N 8.01, S 18.90.

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