Ring Transformation of 1,1-Dioxo-1,2-thiazine-6-carbaldehydes with Nitrogen Nucleophiles to Substituted Pyridine-3-sulfonanilides

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Received 26 February 1996; revised 9 May 1996

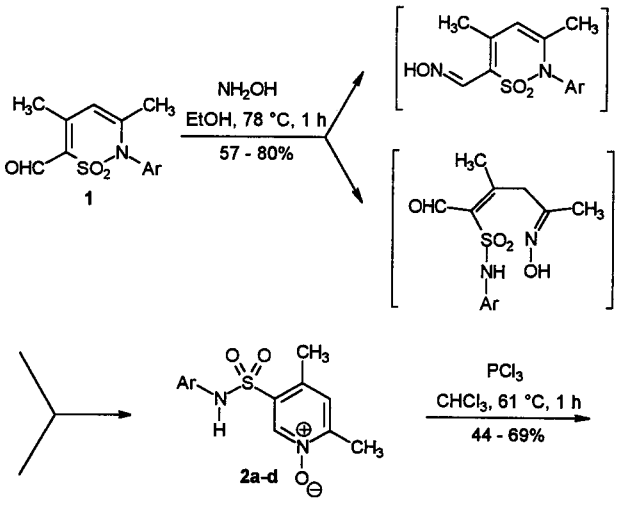
1,1-Dioxo-1,2-thiazine-6-carbaldehydes **1** possessing a masked 1,5-dicarbonyl structure react with hydroxylamine with ring transformation to form the pyridine *N*-oxides **2**. These can be deoxygenated with PCl_3 to give the corresponding pyridine-3-sulfonanilides **3**, which are available by the reaction of **1** with ammonia as well. The ring transformation of **1** with methylamine, benzylamine and hydrazine produces *N*-substituted mesoionic pyridinium salts **6–8**. The cyclohexane-fused thiazine-6-carbaldehyde **9** can be transformed with ammonia to the 5,6,7,8-tetrahydoquinoline **10**. Reaction of **2** with $NaNO_2$/HCl enables the introduction of the nitro group into the anilide part of the molecule.

Ring transformations are competitive synthetic principles for the structural modification of heterocyclic compounds.[1–5] In six-membered heterocycles with one heteroatom ring transformations generally start by the nucleophilic attack of suitable bases on a heterocyclic salt. The new and more stable cyclic system is formed by ring opening followed by ring closure. Examples are the conversion of pyrylium salts into benzenes[5] or pyridines[6] by keeping up the ring size or the transformation of pyridinium-3-diazonium salts into β-(1,2,3-triazol-4-yl)acroleins under ring contraction.[7] The SO_2-extrusion to pyrroles[8,9] as well as the nitrosating cleavage of the cyclic sulfonamide structure to mesoionic pyridazinium salts[10] are known as ring transformations of 1,1-dioxo-1,2-thiazines.

In this paper we describe the synthetic potential of 2-aryl-1,1-dioxo-1,2-thiazine-6-carbaldehydes **1** as masked, unsaturated 1,5-dicarbonyl compounds, which react with nitrogen nucleophiles in a one-pot reaction to produce the so far unknown substituted pyridine-3-sulfonanilide derivatives. In order to check the generalization of this new type of ring transformation, we changed the substituent in the aryl group of the 2-aryl-1,1-dioxo-1,2-thiazine-6-carbaldehydes **1** from a donor (OCH_3, CH_3) into a weak acceptor substituent (Cl). By changing the nitrogen nucleophiles, pyridines and pyridine *N*-oxides are available, as well as mesoionic *N*-alkyl and *N*-aminopyridinium salts.

The pharmacological significance of pyridine derivatives[11,12] and the easy accessibility of 1,1-dioxo-1,2-thiazines[13] are reasons for studying this new synthetic pathway for substituted pyridine-3-sulfonanilides (2,4-lutidine-5-sulfonanilides), which are normally obtainable only by a multistep synthesis.

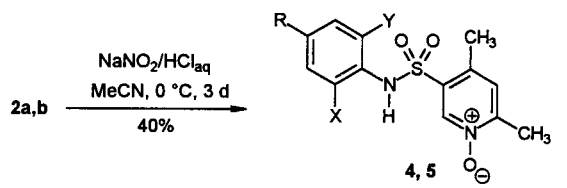
1,1-Dioxo-1,2-thiazine-6-carbaldehydes **1** are synthesized by Vilsmeier-Haack formylation of the 2-aryl-3,5-dimethyl-1,1-dioxo-1,2-thiazines.[14,15] The aldehydes **1** react with hydroxylamine to produce high melting compounds, which were characterized as pyridine *N*-oxides **2** by means of spectroscopic data and chemical reactions. The *N*-oxides **2** are deoxygenated with PCl_3 to give the corresponding pyridines **3**. Until now it has not been decided whether the first step of the reaction of **1** with hydroxylamine is the formation of an aldoxime or the ring opening to an aldo-ketoxime.



1,2,3	Ar
a	C_6H_4-OCH_3(p)
b	C_6H_4-CH_3(p)
c	C_6H_5
d	C_6H_4-Cl(p)

Scheme 1

Reaction of **2b** with $NaNO_2$/hydrochloric acid affords a well crystallizing compound **4b** from which monocrystals could be grown. The X-ray crystallographic analysis of **4b** (Figure) and the ^1H NMR data confirm the transformation of **1b** to the pyridine *N*-oxide **2b** and the nitration of the sulfonanilide part of the molecule. The MS data of **4b** additionally verify that a nitro group and not a nitroso substituent is introduced into the molecule. The



	R	X	Y
4a	OCH_3	NO_2	H
4b	CH_3	NO_2	H
5a	OCH_3	NO_2	NO_2

Scheme 2

nitrosation of **2a** results in the formation of the mono- (**4a**) and dinitro-substituted (**5a**) anilidosulfonyl pyridine *N*-oxide which depends on the ratio of **2a**: $NaNO_2$.

The position of the nitro group in **4** and **5a** was determined by NMR spectroscopic data and the calculation of the chemical shift by increments.[16,17] A significant *ortho*-directing effect of the $NHSO_2$ structural element can be observed. Similar nitrations with $NaNO_2$/acetic acid are described for aryl sulfonanilides (see Ref. 18).

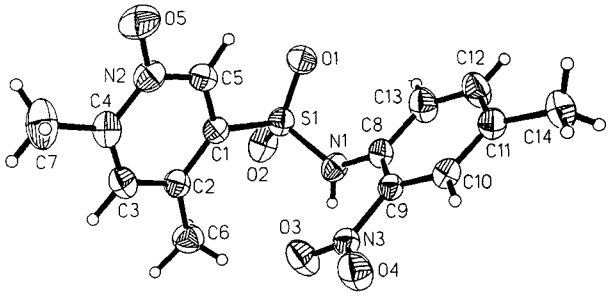
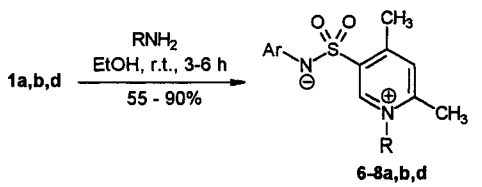


Figure. Molecular Struture of **4b**

The ring transformation of **1** with hydroxylamine could be generalized. The aldehydes **1** react with ammonia to produce the pyridines **3**, which are accessible also from the pyridine *N*-oxides **2** (Tables 1,2). The transformation of the aldehydes **1** into the corresponding *N*-methyl-, *N*-benzyl- and *N*-aminopyridinium salts **6–8** proceeds by reaction with methylamine, benzylamine and hydrazine, respectively, in ethanol. These mesoionic compounds are salt-like in their behavior and show the absence of a counterion.

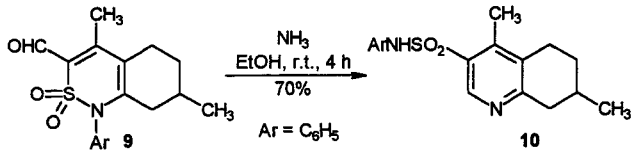


1, 6-8	Ar
a	C_6H_4-OCH_3(p)
b	C_6H_4-CH_3(p)
d	C_6H_4-Cl(p)

	R
6	CH_3
7	CH_2-C_6H_5
8	NH_2

Scheme 3

The ring transformation found is not limited to the 3,5-dimethylthiazine-6-carbaldehydes **1a–d**. In a similar way, the tetrahydroquinoline **10** is formed from the cyclohexane-fused 1,1-dioxo-1,2-thiazinecarbaldehyde **9** by reaction with ammonia.



Scheme 4

The ring transformation fails when the basicity of the nitrogen nucleophile is low and the reaction medium is acidic. The aldehyde **1b** reacts with semicarbazide hydrochloride to give its semicarbazone as evident by ^1H NMR spectroscopic data. The chemical shift of the ring proton H-4 ($\delta = 6.02$) in the obtained semicarbazone of **1b** corresponds to the shifts observed for 1,1-dioxo-1,2-thiazines ($\delta = 6.1$).[19] The protons of the pyridine derivatives **6–8** are found at lower field ($\delta = >7$).

Ring transformations of both the 6-acyl-substituted 1,1-dioxo-1,2-thiazines and 1,1-dioxothiazine-4- and -5-carbaldehydes are under investigation.

NMR spectra were measured using a Varian Gemini 300 spectrometer (^1H NMR 300 MHz, ^{13}C NMR 75 MHz). The NMR data are gathered in Tables 1–4. IR spectra were recorded on a Philips PU 9426 FTIR spectrometer as KBr (Fluka Chemical Co.) pellets. Mass spectra (EI) were obtained using an AMD 402 spectrometer. Microanalyses were performed on a Leco CHNS-932 analyser. Satisfactory microanalyses were obtained for all new substances (C, H, N, S, O ± 0.5%).

5-Anilidosulfonyl-2,4-dimethylpyridine *N*-Oxides 2, General Procedure:

The appropriate aldehyde **1**[14] (1.8 mmol) was suspended in EtOH (10 mL), and a solution of $NH_2OH \cdot HCl$ (188 mg, 2.7 mmol) and Na_2CO_3 (268 mg, 2.7 mmol) in water (6 mL) was added. The mixture was heated under reflux for 1 h. After cooling, the alcohol was removed under vacuum and the aqueous solution was mixed with water (15 mL). The insoluble solid was filtered and the filtrate was neutralized with dil HCl. The precipitate was isolated by suction, washed with water (2 × 5 mL), dried and recrystallized from EtOH (Table 1).

5-Anilidosulfonyl-2,4-dimethylpyridines 3; General Procedure:

Method A: The appropriate pyridine *N*-oxide **2** (0.33 mmol) was suspended in $CHCl_3$ (5 mL), and PCl_3, (200 μL, 2.3 mmol) was added. The mixture was heated under reflux for 1 h. The mixture was filtered and the filtrate extracted, after addition of $CHCl_3$ (10 mL), with aq 10% Na_2CO_3 solution (3 × 5 mL). The aqueous layers were neutralized by adding 2 M HCl and were extracted by $CHCl_3$ (3 × 5 mL). The combined organic layers were dried ($MgSO_4$) and concentrated under vacuum to 3 mL. The resulting solution was mixed with hexane (10 mL) and the precipitated **3** was separated by suction and dried.

Method B: The appropriate aldehyde **1** (0.18 mmol) was suspended in EtOH (5 mL). Then concentrated NH_4OH (10 mL) was added. The mixture was stirred at r.t. for 24 h. The reaction can be followed by the dissolution of the aldehyde. Evaporation of the solvent at reduced pressure provided **3** (Table 2).

2,4-Dimethyl-5-[(nitrophenylamido)sulfonyl]pyridine *N*-Oxides 4a, b and 5a; General Procedure:

The pyridine *N*-oxide **2a** or **2b** (1 mmol) was dissolved in a mixture of MeCN (7 mL) and conc HCl (0.25 mL). A solution of $NaNO_2$ in water (amounts see below) was added dropwise over 1 h to the iced and stirred mixture. The flask was stored at r.t. for 3 d. The reaction can be monitored by TLC (silica gel, cyclohexane/OAc 1:1). The aqueous layer was separated and the organic layer was

Table 1. Compounds **2a–d** Prepared

Product	Yield (%)	mp (°C)	IR (KBr) ν (cm^{-1})	^1H NMR (DMSO-d_6/TMS) δ, J (Hz)
2a	64	224–226	1155, 1246, 1335, 1508	2.32, 2.43 (s, 3H, Py-CH_3), 3.69 (s, 3H, OCH_3), 6.86, 7.02 (d, 2H, J = 8.9, Ar-H), 7.53, 8.28 (s, 1H, Py-H), 10.4 (s, 1H, NH)
2b[a]	59	202–203	1151, 1250, 1338, 1510	2.17 (s, 3H, Ar-CH_3), 2.29, 2.44 (s, 3H, Py-CH_3), 6.99, 7.07 (d, 2H, J = 8.9, Ar-H), 7.48, 8.36 (s, 1H, Py-H), 10.6 (s, 1H, NH)
2c	57	234–236	1149, 1250, 1348, 1498	2.29, 2.44 (s, 3H, Py-CH_3), 7.07–7.3 (m, 5H, Ar-H), 7.51, 8.39 (s, 1H, Py-H), 10.74 (s, 1H, NH)
2d	80	248–250	1153, 1248, 1329, 1489	2.30, 2.44 (s, 3H, Py-CH_3), 7.12, 7.35 (d, 2H, J = 8.7, Ar-H), 7.52, 8.41 (s, 1H, Py-H), 10.91 (s, 1H, NH)

[a] ^{13}C NMR (DMSO-d_6/TMS): δ = 17.1, 18.3 (Py-CH_3), 20.5 (Ar-CH_3), 121.0 (Ar-C2), 130.1 (Ar-C3), 130.1 (Py-C6), 133.7 (Ar-C4), 133.9 (Py-C2), 134.4 (Py-C4), 134.9 (Ar-C1), 137.9 (Py-C3), 151.7 (Py-C5).

Table 2. Compounds **3a–d** Prepared

Product	Yield[a] (%)	mp (°C)	MS (70 eV) m/z (%)	IR (KBr) ν (cm^{-1})	^1H NMR (DMSO-d_6/TMS) δ, J (Hz)
3a	60 (70)	148–150	292 (M^+, 100)	1153, 1326, 1508, 1597	2.41, 2.48 (s, 3H, Py-CH_3), 3.62 (s, 3H, OCH_3), 6.74, 6.91 (d, 2H, J = 8.8, Ar-H), 7.21, 8.6 (s, 1H, Py-H), 10.3 (s, weak, NH)
3b	69 (85)	186–188	276 (M^+, 40)	1161, 1336, 1508, 1608	2.17 (s, 3H, Ar-CH_3), 2.44, 2.53 (s, 3H, Py-CH_3), 6.98, 7.04 (d, 2H, J = 8.4, Ar-H), 7.25, 8.71 (s, 1H, Py-H), 10.36 (s, 1H, NH)
3c	44	201–203	262 (M^+, 100)	1153, 1342, 1491, 1601	2.44, 2.53 (s, 3H, Py-CH_3), 6.98–7.24 (m, 5H, Ar-H), 7.32, 8.76 (s, 1H, Py-H), 10.56 (s, 1H, NH)
3d	45 (70)	180–181	296 (M^+, 100)	1153, 1333, 1493, 1599	2.43, 2.51 (s, 3H, Py-CH_3), 7.08, 7.29 (d, 2H, J = 8.6, Ar-H), 7.28, 8.73 (s, 1H, Py-H), 10.69 (s, 1H, NH)

[a] Yields given in parenthesis refer to Method B (see experimental).

Table 3. Compounds **4a, b** and **5** Prepared

Product	Yield (%)	mp (°C)	MS (70 eV) (M^+, 100) m/z	IR (KBr) ν (cm^{-1})	^{13}C NMR (DMSO-d_6/TMS) δ	^1H NMR (DMSO-d_6/TMS) δ, J (Hz)
4a	65	194–196.5	353	1151, 1240, 1338, 1538	17.1, 18.5 (Py-CH_3), 56.3 (OCH_3), 110.2 (Ar-C3), 119.8 (Ar-C5), 120.3 (Ar-C1), 130.1 (Py-C6), 131.3 (Ar-C6), 134.1 (Py-C2), 135.2 (Py-C4), 137.4 (Py-C3), 147.2 (Ar-C2), 151.8 (Py-C5), 158.5 (Ar-C4)	2.37, 2.42 (s, 3H, Py-CH_3), 3.83 (s, 3H, OCH_3), 7.25 (s, 2H, Ar-H), 7.47 (s, 1H, Ar-H), 7.59, 8.16 (s, 1H, Py-H), 10.68 (s, NH)
4b	55	202–203.5	337	1155, 1236, 1342, 1543	17.0, 18.4 (Py-CH_3), 20.2 (Ar-CH_3), 125.4 (Ar-C6), 125.8 (Ar-C1), 128.6 (Ar-C3), 130.1 (Py-C6), 134.1 (Py-C2), 134.8 (Ar-C5), 135.3 (Py-C4), 137.4 (Py-C3), 138.6 (Ar-C4), 145.1 (Ar-C2), 151.8 (Py-C5)	2.36 (s, 3H, Ar-CH_3), 2.36, 2.42 (s, 3H, Py-CH_3), 7.27, 7.51 (d, 1H, J = 8.0, Ar-H), 7.77 (s, 1H, Ar-H), 7.59, 8.22 (s, 1H, Py-H), 10.8 (s, NH)
5a	47	243–245	398	1153, 1242, 1346, 1546	17.1, 18.4 (Py-CH_3), 57.3 (OCH_3), 113.3 (Ar-C1), 114.5 (Ar-C3), 130.2 (Py-C6), 134.4 (Py-C2), 135.5 (Py-C4), 137.0 (Py-C3), 150.5 (Ar-C2), 151.9 (Py-C5), 159.2 (Ar-C4)	2.36, 2.42 (s, 3H, Py-CH_3), 3.90 (s, 3H, OCH_3), 7.82 (s, 2H, Ar-H), 7.58, 8.01 (s, 1H, Py-H)

concentrated under reduced pressure and mixed with diethyl ether (5 mL). After crystallization, the product was filtered and dried.

Amounts of $NaNO_2$ used in the preparation of **4a,b** and **5**:

4a: 1 mmol (69 mg) $NaNO_2$ in 0.2 mL H_2O. **4b:** 2 mmol (138 mg) $NaNO_2$ in 0.6 mL H_2O. **5a:** 2.5 mmol (173 mg) $NaNO_2$ in 0.7 mL H_2O.

X-ray Investigation of **4b**:[20]

$C_{14}H_{15}N_3O_5S$, M_w = 337.35, monoclinic, space group $P2_1/c$, a = 8.120(1), b = 10.802(2), c = 17.409(3) Å, β = 101.57(1)°, V = 1496.0(4) Å^3, Z = 4, $F(000)$ = 704, MoKα radiation (λ = 0.71073 Å). The structure was solved by direct methods of phase determination and refined by full-matrix-least-squares techniques on F^2. wR_2 = 0.1069 (3303 reflections), R_1 = 0.0377 (2342 reflections with $I > 2\sigma(I)$). Diffractometer: Stoe STADI 4. The computation and drawings were performed by using the programs SHELXS-86, SHELXL-93 and XP/PC.[21]

N-Methyl-2,4-dimethylpyridinium-5-sulfonanilides 6; General Procedure:

The appropriate aldehyde **1** (0.11 mmol) was suspended in EtOH (5 mL). Then a solution of $MeNH_2 \cdot HCl$ (15 mg, 0.22 mmol) and Na_2CO_3 (35 mg, 0.33 mmol) in water (4 mL) was added. After stirring for 6 h, the solvent was evaporated, then the residue was washed with Et_2O (10 mL) and the product dissolved in $CHCl_3$ (10 mL) and precipitated by adding Et_2O. The product was isolated by suction and dried.

Table 4. Compounds **6–8** Prepared

Product	Yield (%)	mp (°C)	IR (KBr) ν (cm^{-1})	^1H NMR (DMSO-d_6/TMS) δ, J (Hz)
6a	75	170–180 (dec.)	1224, 1237, 1289, 1505	2.64, 2.77 (s, 3H, Py-CH_3), 3.58 (s, 3H, OCH_3), 4.16 (s, 3H, NCH_3), 6.56, 6.75 (d, 2H, J = 8.8, Ar-H), 7.82, 9.03 (s, 1H, Py-H)
6b	55	189–191	1126, 1230, 1288, 1504	2.07 (s, 3H, Ar-CH_3), 2.63, 2.75 (s, 3H, Py-CH_3), 4.16 (s, 3H, NCH_3), 6.69, 6.73 (d, 2H, J = 8.8, Ar-H), 7.81, 9.04 (s, 1H, Py-H)
6d	90	130–132	1124, 1238, 1286, 1483	2.66, 2.76 (s, 3H, Py-CH_3), 4.19 (s, 3H, NCH_3), 6.85, 6.98 (d, 2H, J = 8.8, Ar-H), 7.87, 9.12 (s, 1H, Py-H)
7a	65	124–125	1126, 1234, 1498	2.8, 2.61 (s, 3H, Py-CH_3), 3.61 (s, 3H, OCH_3), 5.84 (s, 2H, CH_2), 6.54, 6.70 (d, 2H, J = 8.9, Ar-H), 7.05–7.38 (m, 5H, Ar-H), 7.87, 9.10 (s, 1H, Py-H)
7b	60	130–132	1124, 1255, 1504	2.11 (s, 3H, Ar-CH_3), 2.60, 2.78 (s, 3H, Py-CH_3), 5.84 (s, 2H, CH_2), 6.66, 6.73 (d, 2H, J = 8.3, Ar-H), 7.08–7.38 (m, 5H, Ar-H), 7.86, 9.13 (s, 1H, Py-H)
7d	70	105–106	1128, 1251, 1483	2.62, 2.78 (s, 3H, Py-CH_3), 5.84 (s, 2H, CH_2), 6.77, 6.92 (d, 2H, J = 8.6, Ar-H), 7.05–7.39 (m, 5H, Ar-H), 7.89, 9.13 (s, 1H, Py-H)
8a	70	170–175 (dec.)	1124, 1236, 1500	2.57, 2.69 (s, 3H, Py-CH_3), 3.57 (s, 3H, OCH_3), 6.55, 6.71 (d, 2H, J = 8.7, Ar-H), 7.82 (s, 2H, NNH_2), 7.76, 9.0 (s, 1H, Py-H)
8b	60	219–221 (dec.)	1124, 1259, 1504	2.08 (s, 3H, Ar-CH_3), 2.57, 2.69 (s, 3H, Py-CH_3), 6.68, 6.75 (d, 2H, J = 8.7, Ar-H), 7.85 (s, 2H, NNH_2), 7.75, 9.04 (s, 1H, Py-H)
8d	70	192–204 (dec.)	1126, 1255, 1484	2.58, 2.69 (s, 3H, Py-CH_3), 6.79, 6.95 (d, 2H, J = 8.6, Ar-H), 7.84 (s, 2H, NNH_2), 7.78, 9.06 (s, 1H, Py-H)

N-Benzyl-2,4-dimethylpyridinium-5-sulfonanilides 7; General Procedure:

The appropriate aldehyde **1** (0.11 mmol) was suspended in EtOH (5 mL). Then Et_3N (0.03 mL, 0.22 mmol) and benzylamine (0.03 mL, 0.22 mmol) were added and the mixture was stirred for 3 h. The solvent was evaporated to a volume of 2 mL and the product was precipitated by adding Et_2O. It was isolated by suction and dried.

N-Amino-2,4-dimethylpyridinium-5-sulfonanilides 8; General Procedure:

The appropriate aldehyde **1** (0.11 mmol) was suspended in EtOH (5 mL). Then water (0.12 mL) and $N_2H_4 \cdot H_2O$ (0.01 mL, 0.22 mmol) were added. The mixture was stirred for 3 h. After evaporating the solvent and washing the residue with Et_2O (5 mL) and several times with $CHCl_3$ (3 mL), **8** was obtained analytically pure (Table 4).

4,7-Dimethyl-1,1-dioxo-2-phenyl-1,2-(3,4,5,6-tetrahydrobenzo)[c]-thiazine-8-carbaldehyde (9):

$TiCl_4$ (1.65 mL, 15 mmol) and dichloromethyl methyl ether[22] (0.93 mL, 10 mmol) were added at 0 °C to a stirred suspension of 4,7-dimethyl-1,1-dioxo-2-phenyl-1,2-(3,4,5,6-tetrahydrobenzo) [c]-thiazine (Pulegonsultame)[13] (1.44 g, 5 mmol) in CH_2Cl_2 (15 mL). The stirring was continued at 0 °C for 1 h and the mixture was kept at r.t. for 24 h. The mixture was poured into ice water (20 mL) and stirred for 1 h. The organic phase was separated, washed with water, the organic layer was concentrated at reduced pressure and then to the residue hexane was added. The precipitate was isolated by suction and dried. The crude product was purified by column chromatography (silica gel, EtOAc), yield: 335 mg (21 %); mp 170–174 °C.

^1H NMR ($CDCl_3$/TMS): δ = 0.89 (d, 3H, J = 6.5 Hz, CH_3), 2.56 (s, 3H, CH_3), 1.2–2.5 (m, 7H), 7.36–7.44 (m, 5H, Ar–H), 9.84 (s, 1H, CHO).

^{13}C NMR ($CDCl_3$/TMS): δ = 16.4, 20.9, 25.4, 28.0, 29.8, 37.9, 117.5, 122.3, 129.1, 129.5, 129.7, 133.9, 148.4, 156.2, 182.7 (CHO).

3-Anilidosulfonyl-4,7-dimethyl-5,6,7,8-tetrahydroquinoline (10):

The quinoline **10** was synthesized according to the preparation of the pyridines **3** (method B) from the aldehyde **9** (317 mg, 1 mmol), EtOH (7 mL) and conc. NH_4OH (4 mL); yield: 224 mg (71 %); mp 196–197 °C (EtOH).

^1H NMR (DMSO-d_6/TMS): δ = 1.06 (d, 3H, J = 6.4 Hz, CH_3), 2.44 (s, 3H, CH_3), 1.3–2.6 (m, 7H), 7.03–7.24 (m, 5H, Ar–H), 8.82 (s, 1H, Py–H), 10.5 (s, 1H, NH).

IR (KBr): ν = 1153, 1343, 1489, 1573 cm^{-1}.

3,4-Dimethyl-2-(4-methylphenyl)-1,1-dioxo-1,2-thiazine-6-carbaldehyde Semicarbazone:

The aldehyde **1b** (50 mg, 0.18 mmol) was suspended in EtOH (5 mL), water (1 mL) and conc. HCl was added until the pH reached 2. Semicarbazide hydrochloride (40 mg, 0.36 mmol) was added to this solution, the mixture was stirred for 3 h and the product isolated by suction. The semicarbazone of **1b** was obtained analytically pure; yield: 48 mg (80 %); mp 219–220 °C (EtOH).

^1H NMR (DMSO-d_6/TMS): δ = 1.90 (s, 3H, Ar–CH_3), 2.31 (s, 3H, CH_3), 2,40 (s, 3H, CH_3), 6.02 (s, 1H), 6.28 (s, NH_2), 7.21–7.36 (m, 4H, Ar–H), 7.83 (s, 1H, CH), 10.39 (s, 1H, NH).

IR (KBr): ν = 771, 1390, 1689, 1951 cm^{-1}.

This work was supported by the Hermann-Schlosser-Foundation of the DEGUSSA AG, by the Deutsche Forschungsgemeinschaft, the Fonds der Chemischen Industrie and the Kultusministerium von Sachsen-Anhalt.

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