Synthesis of 2-Alkyl-4,5-aryl-2*H*-[1λ⁶,2,3,6]-thiatriazine-1,1-dioxides

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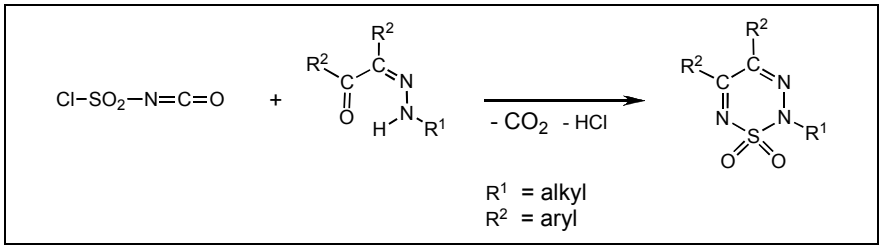

Sulphamoyl chlorides and chlorosulphonyl isocyanate react with monosubstituted hydrazones and alkylhydrazonates to sulphamoyl hydrazones and sulphamoyl hydrazonates respectively. Reaction of benzil monoalkylhydrazones with chlorosulphonyl isocyanate results in formation of 2-alkyl-4,5-aryl-2*H*-[1λ⁶,2,3,6]-thiatriazine-1,1-dioxides.

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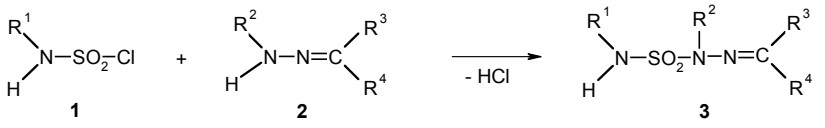
INTRODUCTION

1,2,4,6-Thiatriazine and its derivatives are a well investigated class of sulphur-containing azacycles and have been described in several publications as well as patents [1-7]. They mainly possess herbicidal activity but in some cases have also been identified as pharmacologically active compounds [1,8-12]. However, only few publications are found in the literature concerning the isomeric 2*H*-1,2,3,6-thiatriazines. The 2*H*-1λ²,2,3,6 isomers were first synthesized by Spasov *et al. via* reduction of dehydrophenylosazones with hydrogen sulphide [13]. It turned out that these compounds are not stable under acidic conditions thus giving rise to 1*H*-2,3-triazoles through elimination of elemental sulphur [13]. 2*H*-1λ⁶,2,3,6-Thiatriazine-1,1-dioxides, representing the oxidized analogue of 2*H*-1λ²,2,3,6-thiatriazines, have hitherto been completely unknown. This as well as the fact that the related isomeric benzo-1λ⁶,2,3,4-thiatriazine-1,1-dioxides are known to exhibit diuretic activity [14] prompted us to embark on the synthesis of novel thia-azacycles such as the 1λ⁶,2,3,6-thiatriazine-1,1-dioxide derivatives as putative biologically active compounds utilizing differently substituted hydrazones as building block.

According to Scott and Barry [15], only benzoylhydrazide and 2-hydrazinopyridine react with disubstituted sulphamoyl chlorides in the presence of triethylamine to sulphamoyl hydrazide. The reaction of methyl- or 1,1-dimethylhydrazine renders, according to a radical mechanism, sulphonamides whereas phenylhydrazine gives rise to benzenesulphonic acid hydrazide.

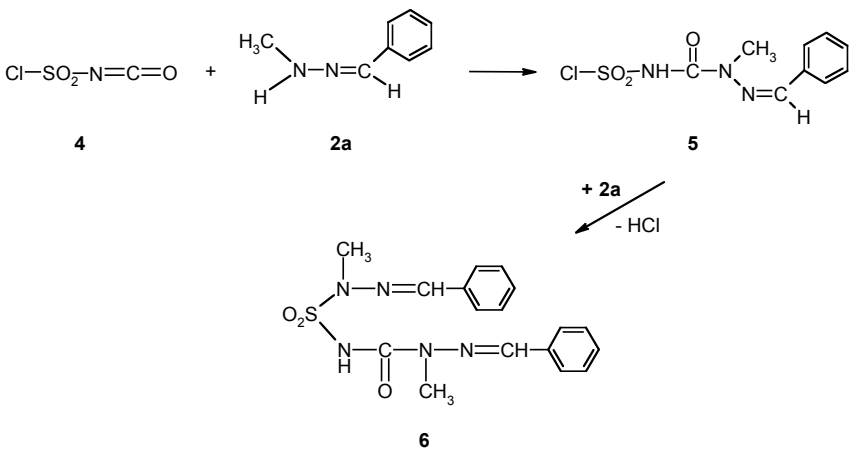
Scheme 1



1 **2** **3**

3	R^1	R^2	R^3	R^4	yield
a	CH_3	CH_3	H	Ph	89
b	CH_3	Ph	H	Ph	90
c	H	CH_3	H	Ph	47
d	CH_3	Ph	Ph	OCH_3	18
e	CH_3	Ph	CH_3	OC_2H_5	9
f	H	Ph	CH_3	OC_2H_5	41

Scheme 2

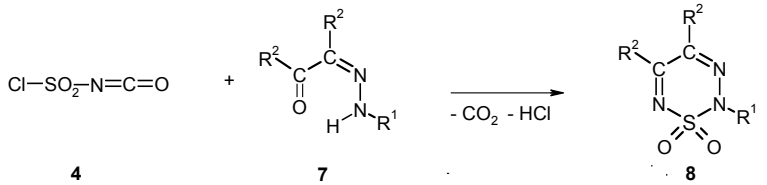


RESULTS AND DISCUSSION

We found that also hydrazones **2a-c** [16] and hydrazonates **2d-f** are attacked by mono- and unsubstituted sulphamoyl chlorides of type **1** thereby resulting in crystalline and stable compounds representing sulphamoyl hydrazones and sulphamoyl alkylhydrazonates **3a-f*** respectively. Alkylhydrazonates **3d-f** were obtained by the reaction of hydrazonates **2d-f** with sulphamoyl chlorides of type **1**. Due to the fairly susceptible imidoester functionality present in derivatives **3d-f**, they could only be purified *via* their sodium-salts. Therefore, the yields in this series are significantly lower. Ethyl *N*-(aminosulphonyl)-*N*-phenylethanehydrazonoate **3f** could additionally be converted into the analogous methyl *N*-(aminosulphonyl)-*N*-phenylethanehydrazonoate (see experimental for **3g**) by standing it in methanol at room temperature acidified with sulphuric acid. Due to the presence of an imidoester function in products **3d-f**, these structures were first envisioned to serve as building blocks for the synthesis of novel five-membered thiaazacyclic ring systems. However, under the applied reaction conditions, the cyclic condensation to the desired 2,5-dihydro-1λ⁶,2,3,5-thiatriazole-1,1-dioxide did not succeed.

As an alternative to sulphamoyl chlorides **1**, chlorosulphonyl isocyanate **4** was chosen as substrate to react with hydrazone derivatives. Subjecting one equivalent of 1-benzylidene-2-methylhydrazine **2a** to chlorosulphonyl isocyanate resulted in formation of [(2-benzylidene-1-methylhydrazino)-carbonyl]sulphamoyl chloride **5** *via* nucleophilic addition of the mono-substituted hydrazone **2a** to the highly reactive isocyanate function. The reaction of a second equivalent of **2a** in presence of triethylamine as base gave 2-benzylidene-*N*-[(2-benzylidene-1-methylhydrazino)-carbonyl]-1-methyl-hydrazinesulphonamide **6** (Scheme 2). Since intermediate **5** still bears reactive functionalities, it can be considered as an interesting synthon for further synthetic transformations.

Scheme 3



8	R^1	R^2	yield (%)
a	CH_3	Ph	72
b	CH_3	2-Pyridine	62
c	CH_3	4-$PhOCH_3$	49
d	CH_3	4 -$PhCH_3$	93
e	C_2H_5	Ph	38

The reaction of benzil monoalkylhydrazones of type **7**, which were obtained by reaction of aromatic diketones with mono-substituted aliphatic hydrazines according to a known procedure [17] (see experimental section for compounds **7a-e**), with chlorosulphonyl isocyanate finally led to the stable 2-alkyl-4,5-aryl-2*H*-[1λ^6,2,3,6]thiatriazine-1,1-dioxides **8** in moderate to good yields (Scheme 3). Interestingly, in this case the initial nucleophilic attack of hydrazones of type **7** happened to take place at the sulphur atom of **4** thus leading after subsequent intramolecular cyclization and concomitant carbon dioxide extrusion to the title compounds of type **8**.

The proposed structural constitution of this new class of heterocycles could be confirmed by X-ray-analysis of 4,5-diphenyl-2-methyl-2*H*-[1λ^6,2,3,6]-thiatriazine-1,1-dioxide **8a** [18].

Analogous to unsubstituted sulphamoyl hydrazones, which are generally fairly unstable, reactions with unsubstituted benzilhydrazones also did not form any definite product. Benzilmonoarylhydrazones did not react at all, which might either be due to its weaker nucleophilicity or to steric effects. 1,2-Diphenyl-2-(phenylhydrazono)ethanone (benzil-*N*-phenylhydrazone) should exist as its *E*-isomer [19].

EXPERIMENTAL

Infrared spectra were obtained as potassium bromide pellets from a Perkin–Elmer 257 spectrometer; ^{1}H nmr spectra were measured on a Varian T 60 spectrometer (60 MHz). The chemical shift (δ) values are reported as parts per million (ppm) relative to tetramethylsilane as internal standard, s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad; EI-MS spectra were recorded on a Varian MAT 111 spectrometer, Bremen; CH elemental analyses were performed according to F. Salzer, CWH-Labormatic-Wösthoff; N by a CHN-Analyzer 185, Hewlett-Packard; S according to the Schöniger method. Commercially available solvents and chemicals were used as pure or synthetic grade without further purification; solvents were dried according to general methods.

2-Benzylidene-*N*,1-dimethylhydrazinesulphonamide* [102276-32-4] (3a) [16]. To the stirred solution of 1-benzylidene-2-methylhydrazine (**2a**) [20] (26.8 g, 0.2 mol) and triethylamine (20.2 g, 0.2 mol) dissolved in diethyl ether (150 ml) was added dropwise a solution of methylsulphamoyl chloride (25.9 g, 0.2 mol) (**1a**) [21] dissolved in the same solvent (150 ml) under ice-cooling. After stirring over night at room temperature, the resulting precipitate was separated by filtration, the filtrate set aside, and triethylammonium chloride removed by washing the precipitate with water. Further product was obtained by evaporation of the filtrate. Product (**3a**) was obtained as colorless needles, yield: 89 %; m.p. 93 °C (benzene); soluble in ethanol; sodium hydroxide forming an acid-labile salt; ir: 3300, 3003, 2994, 2933, 2825, 1475, 1456, 1427, 1422, 1414, 1364, 1333, 1319, 1229, 1195, 1166, 1159, 1133, 1103, 1070, 1022, 946, 921, 911, 874, 850, 772, 741, 700, 649 cm^{-1}; ^{1}H nmr ($CDCl_3$): δ = 2.71 (d, *J* = 6 Hz, 3H), 3.28 (s, 3H), 5.26 (q, *J* = 6 Hz, br, 1H), 7.15-7.78 (m, 6H). *Anal.* Calcd. for $C_9H_{13}N_3O_2S$: C, 47.56; H, 5.76; N, 18.49; S, 14.11. Found: C, 47.57; H, 5.87; N, 18.28; S, 14.31.

1-Phenyl-2-benzylidene-*N*-methylhydrazinesulphonamide* [102276-33-5] (**3b**) [16]. To the stirred solution of 1-benzylidene-2-phenylhydrazine (**2b**) [22] (19.3 g, 0.1 mol) and triethylamine (10.1 g, 0.1 mol), dissolved in tetrahydrofuran (75ml), was added dropwise a solution of methylsulphamoyl chloride (**1a**) [21] (13.0 g. 0.1 mol) in the above solvent (75 ml) under ice-cooling and protection of light. Through stirring over night at room temperature, precipitated triethylammonium chloride was removed by filtration. The filtrate was evaporated giving a greenish black oil, which solidified after some hours. After washing with water and drying, the product (**3b**) was obtained as colorless to pale yellow crystals, yield: 90 %; mp 143 °C (ethanol, several times); ir 3356, 3067, 3040, 1603, 1592, 1585, 1488, 1447, 1433, 1414, 1348, 1218, 1155, 1136, 1081, 1070, 1010, 973, 948, 917, 860, 838, 779, 760, 723, 703, 695, 646 cm^{-1}; ^{1}H nmr ($CDCl_3$) δ: = 2.72 (d, J = 6 Hz, 3H), 3.28 (s, 3H), 5.29 (q, J = 6 Hz, br, 1H), 7.17-7.84 (m, 6H). *Anal.* Calcd. for $C_{14}H_{15}N_3O_2S$: C, 58.11; H, 5.22; N, 14.52; S, 11.08. Found: C, 58.29; H, 5.19; N, 14.59; S, 10.97.

2-Benzylidene-1-methylhydrazinesulphonamide* [102276-28-8] (3c) [16]. To the stirred solution of chlorosulphonyl isocyanate (**4**) [23] (14.2 g, 0.1 mol) in anhydrous diethyl ether (25 ml), a solution of water (1.8 g, 0.1 mol) in diethyl ether/acetonitrile (35:15, 50 ml) was added dropwise at -40 °C. Through warming up to room temperature and addition of diethyl ether (25 ml), the solution was added dropwise within 90 min to a solution of 1-benzylidene-2-methylhydrazine (**2a**) [20] (13.4 g, 0.1 mol) and triethylamine (10.1 g, 0.1 mol) in diethyl ether (50 ml). After stirring over night at room temperature, the resulting precipitate was filtered off and the filtrate evaporated. The remaining residue was washed with benzene and dried. (**3c**) was obtained as colorless to pale yellow-colored crystals; yield 47%; m.p. 153 °C (ethanol/water, 1:1); ir: 3367, 3279, 3135, 1575, 1466, 1451, 1416, 1366, 1314, 1295, 1236, 1200, 1164, 1151, 1116, 1022, 950, 932, 904, 882, 759, 695 cm^{-1}; ^{1}H nmr (CD_3CN): δ = 3.23 (s, 3H), 5.62 (s, br, 2H), 7.32-7.90 (m, 6H). Anal. Calcd. for $C_8H_{11}N_3O_2S$: C, 45.06; H, 5.20; N, 19.70; S, 15.03. Found: C, 44.95; H, 5.20; N, 19.76; S, 14.83.

Methyl *N*-[(methylamino)sulphonyl]-*N*-phenylbenzenecarbohydrazonoate* (3d). To a stirred solution of methyl *N*-phenylbenzenecarbohydrazonoate (**2e**) [24] (2.26 g, 0.01 mol) in anhydrous pyridine (50 ml) was added dropwise a solution of methylsulphamoyl chloride (**1a**) [21] (1.55 g, 0.012 mol) in anhydrous acetonitrile (25 ml) within 10 min at 0°C. After allowing the mixture to stand over night, water (1000 ml) was added and the mixture acidified to a pH of 5 by addition of diluted hydrochloric acid. The mixture was washed three times with diethyl ether (25 ml each portion), the organic layer separated and dried over calcium chloride. Through addition of a solution of sodium methanolate (1.08 g, 0.02 mol) in methanol (20 ml) and light petroleum (300 ml), the sodium salt (**3dNa**) was precipitated and obtained after filtration; yield 23%.

(**3dNa**) (0.68 g, 2 mmol) was re-dissolved in 1 *M* sodium hydroxide (20 ml) and acidified by addition of 2 *M* acetic acid at 0° C adjusting the mixture to pH 5. (**3d**) was obtained as nearly colorless crystals after recrystallisation from ligroin (activated carbon), yield 77%; ^{1}H nmr (CCl_4): δ = 2.56 (d, *J* = 5 Hz, 3H), 4.00 (s, 3H), 4.86 (q, *J* = 5 Hz, 1H), 6.93-7.57 (m, 10H). *Anal.* Calcd. for $C_{15}H_{17}N_3O_3S$: C, 56.41; H, 5.36; N, 13.16; S; 10.04. Found: C, 56.65; H, 5.43; N, 13.01; S, 9.90.

Ethyl *N*-[(methylamino)sulphonyl]-*N*-phenylethanecarbohydrazonoate* (**3e**). To a solution of ethyl *N*-phenylethanehydrazonoate (**2e**) [24] (17.8 g, 0.1 mol) and triethylamine (10.1 g, 0.1 mol) in diethyl ether (75ml) was added dropwise a solution of methylsulphamoyl chloride (**1a**) [21] (13.0 g, 0.1 mol) in anhydrous diethyl ether (75 ml) within 45 min at 0°. Through stirring over night at room temperature, the precipitated triethylammonium chloride was filtered and thoroughly washed with diethyl ether (100ml). A solution of sodium ethanolate (6.8 g, 0.1 mol) in ethanol (50 ml) was added to the filtrate. After evaporation to dryness, the remaining residue was dissolved in hot cyclohexane and filtered. The sodium salt (**3eNa**) was obtained after cooling the solution to room temperature rendering colorless crystals (acetonitrile); yield 11%; ^{1}H nmr (CD_3OH): δ = 1.29 (t, *J* = 8 Hz, 3H), 1.96 (s, 3H), 2.71 (s, 3H), 4.32 (q, *J* = 8Hz), 7.04-7.64 (m, 5H). *Anal*. Calcd. for $C_{11}H_{16}N_3NaO_3S$: C, 45.04; H, 5.50; N, 14.33; S, 10.93. Found: C, 44.95; H, 5.30; N, 14.26; S, 10.83.

(**3eNa**) (2.93 g, 0.01 mol) was re-dissolved in water (20 ml) and acidified with 0.1 M hydrochloric acid giving rise to (**3e**) as colorless crystals; yield 78%; ^{1}H nmr (CCl_4): δ = 1.35 (t, J = 7 Hz, 3H), 2.01 (s, 3H), 2.63 (d, *J* = 5 Hz, 3H), 4.27 (q, *J* = 7 Hz, 2H), 4.82 (q, *J* = 5 Hz, 1H) 7.03-766 (m, 5H). *Anal*. Calcd. for $C_{11}H_{17}N_3O_3S$: C, 48.69; H, 6.31; N, 15.49; S, 11.82. Found: C, 48.95; H, 6.20; N, 15.71; S, 11.70.

Ethyl *N*-(aminosulphonyl)-*N*-phenylethanehydrazonoate* (**3f**). To the solution of ethyl *N*-phenylethanehydrazonoate (**2e**) [24] (17.8 g, 0.1 mol) and triethylamine (10.1 g, 0.1 mol) in diethyl ether (50 ml) was added dropwise a solution of sulphamoyl chloride (**1c**) (11.6 g, 0.1 mol) - preparation see 2-benzylidene-1-methylhydrazinesulphonamide (**3c**) - in a mixture of acetonitrile and diethyl ether (3:17, 100 ml) within 1 hour at 0° C. Through stirring for 2 hours at room temperature, the precipitated triethylammonium chloride was filtered off and thoroughly washed with diethyl ether (100 ml). A solution of sodium ethanolate (6.8 g, 0.1 mol) in ethanol (50 ml) and diethyl ether (50 ml) was added to the filtrate thus precipitating the sodium salt (**3fNa**), which subsequently was washed with light petroleum yielding 39% of product. After evaporating the filtrate to dryness, the remaining residue was extracted several times with small quantities of acetone yielding a further amount of sodium salt providing a total yield of 50% (**3fNa**); ir: 3448, 3311, 3236, 3058, 2994, 2941, 1637, 1595, 1582, 1488, 1451, 1397, 1379, 1353, 1300, 1258, 1212, 1170, 1148, 1134, 1117, 1078, 1053, 998, 971, 921, 907, 871, 841, 778, 739, 731, 698, 650 cm^{-1}; ^{1}H nmr (D_2O): δ = 1.43 (t, *J* = 7 Hz, 3H), 2.10 (s, 3H), 4.42 (q, *J* = 7 Hz, 2H), 4.82 (s, 1H) 7.19-7. 76 (m, 5H). *Anal*. Calcd. for $C_{10}H_{14}N_3$ NaO_3S: C, 43.01; H, 5.05; N, 15.05; S, 11.48. Found: C, 43.23; H, 5.15; N, 15.25; S, 11.69.

Sodium ethyl *N*-(aminosulphonyl)-*N*-phenylethanehydrazonoate (**3fNa**) (2.8 g, 0.01 mol) was re-dissolved in water (25 ml) and slowly acidified by addition of diluted hydrochloric acid. (**3f**) was obtained as nearly colorless crystals; m.p. 90 °C (cyclohexane); yield 82%; ir: 3378, 3289, 3135, 3012, 2994, 2941, 2915, 1626, 1590, 1490, 1484, 1456, 1445, 1406, 1383, 1370, 1361, 1302, 1176, 1156, 1074, 1049, 1040, 1026, 1004, 929, 898, 843, 779, 760, 694, 657; ^{1}H nmr (CCl_3D): δ = 1.35 (t, *J* = 8 Hz, 3H), 2.05 (s, 3H), 4.33 (q, *J* = 8 Hz, 2H), 4.65 (s, br, 2H), 7.21-7.77 (m, 5H). *Anal*. Calcd. for $C_{10}H_{15}N_3O_3S$: C, 46.68; H, 5.88; N, 16.33; S, 12.46. Found: C, 46.71; H, 5.75; N, 16.57; S, 12.69.

Methyl *N*-(aminosulphonyl)-*N*-phenylethanehydrazonoate* (**3g**). To the solution of ethyl-*N*-(aminosulphonyl)-*N*-phenylethanehydrazonoate (**3f**) (1.29 g, 5 mmol) in methanol (50 ml) was carefully added conc. sulphuric acid (0.05 ml, 0.9 mmol) at room temperature. After 20 min, the solution was neutralized with a solution of sodium methanolate (49 mg, 0.9 mmol) in methanol (2 ml). The mixture was evaporated to dryness and the remaining residue dissolved in diethyl ether (25 ml). The sodium salt (**3gNa)** was obtained by further addition of a solution of sodium methanolate (270 mg, 5 mmol) in methanol (25 ml); yield 51%. Applying an excess of sodium methanolate resulted in a red-colored contamination of the product! *Anal*. Calcd. for $C_9H_{12}N_3NaO_3S$: C, 40.75; H, 4.56; N, 15.84; S, 12.09. Found: C, 40.58; H, 4.62; N, 15.65; S, 11.89.

The sodium salt of methyl *N*-(aminosulphonyl)-*N*-phenylethanehydrazonoate (**3gNa**) (0.53 g, 2 mmol) was re-dissolved in water (20ml) and the solution slowly acidified with diluted hydrochloric acid to pH 5. (**3g**) was obtained as colorless crystals; yield 86%; ^{1}H nmr ($CDCl_3$): δ = 2.05 (s, 3H), 3.89 (s, 3H), 4.71 (s, 2H), 7.13-7.73 (m, 5H). *Anal*. Calcd. for $C_9H_{13}N_3O_3S$: C, 44.43; H, 5.39; N, 17.27; S, 13.18. Found: C, 44.23; H, 5.25; N, 17.15; S, 13.29.

2-Benzylidene-*N*-[(2-benzylidene-1-methylhydrazino)carbonyl]-1-methylhydrazinesulphonamide* (**6**) To a solution of 1-benzylidene-2-methylhydrazine (**2a**) [20] (4.03 g, 0.03 mol) in diethyl ether (25 ml) was added dropwise a solution of chlorosulphonyl isocyanate (**4**) [23] (4.25 g, 0.03 mol) in diethyl ether (25 ml) within 20 min at room temperature. A colorless precipitate of [(2-benzylidene-1-methylhydrazino)carbonyl]-sulphamoyl chloride (**5**) was immediately formed. After stirring over night, the residue was dissolved in tetrahydrofuran (75 ml) and further 1-benzylidene-2-methylhydrazine (**2a**) [20] (4.03 g, 0.03 mol) and triethylamine (3.04 g, 003 mol), dissolved in tetrahydrofuran (25 ml), was added dropwise within 20 min. Through stirring for 3 hours at room temperature, the mixture was partially concentrated under vacuum giving rise to a precipitate, which was separated by filtration and washed with water. After drying under vacuum, analytically pure 2-benzylidene-*N*-[(2-benzylidene-1-methylhydrazino)carbonyl]-1-methylhydrazine-sulphonamide (**6**) was obtained as colorless crystals, yield 25%; m.p. 200°C. When the filtrate was evaporated to dryness, a smudgy, yellow-colored residue remained. After dissolving it in acetone and addition of a twofold amount of water, only significantly contaminated (**6**) could be obtained; total yield 64%; ir: 3320, 3045, 3022, 3000, 2936, 1706, 1609, 1573, 1483, 1436, 1418, 1408, 1388, 1369, 1352, 1329, 1317, 1298, 1258, 1237, 1215, 1173, 1159, 1148, 1089, 1072, 1021, 998, 950, 945, 930, 908, 902, 881, 858, 762, 756, 748, 697, 690, 626 cm^{-1}; ^{1}H nmr (CD_3CN): δ = 3.23 (s, 3H) 3.46 (s, 3H), 7.14-8.13 (m 13H). *Anal*. Calcd. for $C_{17}H_{19}N_5O_3S$: C, 54.68; H, 5.13; N, 18.75; S, 8.59. Found: C, 54.47; H, 5.00; N, 18.87; S, 8.74.

(2*Z*)-2-(Methylhydrazono)-1,2-diphenylethanone*, (*Z*)-benzil-*N*-methylhydrazone [34289-86-6] (**7a**) [17]. Benzil (42.0 g, 0.2 mol) was dissolved in ethanol (250 ml) through heating. Methylhydrazine (9.21 g, 0.2 mol) was added to the warmed solution. After allowing the mixture to stand over night, (**7a**) precipitated yielding colorless crystals; yield 73%. Further (**7a**) was obtained by concentrating the filtrate; total yield 84%; m.p. 138 °C (benzene/light petroleum); ir: 3298, 3104, 3086, 3059, 3025, 3004, 2962, 2921, 2869, 2849, 2808, 1972, 1958, 1908, 1890, 1812, 1633, 1603, 1584, 1579, 1540, 1488, 1449,

1442, 1417, 1391, 1337, 1312, 1303, 1283, 1257, 1239, 1207, 1188, 1176, 1165, 1155, 1122, 1088, 1075, 1031, 1028, 995, 986, 968, 929, 924, 869, 854, 847, 802, 778, 733, 708, 698, 769, 625 cm^{-1}; ^1H nmr (CD_3CN): δ = 3.03 (d, *J* = 4 Hz, 3H), 6.73 (s, br, NH, 1H), 7.17-7.98 (m, 10 H). *Anal.* Calcd. for $C_{15}H_{14}N_2O$: C, 75.61; H, 5.92; N, 11.76. Found: C, 75.77; H, 5.88; N, 11.41.

2-Methyl-4,5-diphenyl-2*H*-[1,2,3,6]-thiatriazine-1,1-dioxide (**8a**). To a solution of (2*Z*)-2-(methylhydrazono)-1,2-diphenylethanone (*Z*-benzil-*N*-methylhydrazone) (**7a**) [17] (2.38 g, 0.01 mol) in anhydrous pyridine (50 ml) was added dropwise a solution of chlorosulphonyl isocyanate (**4**) [23] (1.70 g, 0.012 mol) in anhydrous acetonitrile (25 ml). within 10 min at 0° C. After allowing the mixture to stand for 3 hours at room temperature, water (750 ml) was added whereupon (**8a**) precipitated as yellow crystals; yield 72%; m.p. 160 °C (1 x benzene/cyclohexane through addition of Al_2O_3, acidified, Woelm, activity I; 2 x ethanol); ir: 3112, 3092, 3064, 3033, 2965, 1976, 1925, 1903, 1822, 1772, 1720, 1675, 1600, 1588, 1536, 1499, 1463, 1450, 1434, 1407, 1350, 1317, 1314, 1297, 1289, 1224, 1196, 1171, 1159, 1107, 1092, 1080, 1030, 1006, 994, 972, 949, 926, 849, 843, 836, 793, 776, 742, 726, 702, 696, 667 cm^{-1}; ^1H-nmr (CD_3COCD_3): δ = 3.82 (s, 3H), 7.15-7.65 (m 10 H); ms: m/z (%) = 299 $[M]^+$ (26), 192 (24), 132 (49), 131 (23), 112 (24), 95 (17), 82 (21), 80 (21), 79 (9), 69 (23), 61 (20), 53 (8), 48 (15), 47 (9), 43 (11), 42 (22), 41 (12), 40 (100), 39 (15). *Anal.* Calcd. for $C_{15}H_{13}N_3O_2S$: C, 60.19; H, 4.38; N, 14.04; S, 10.71. Found: C, 60.29; H; 4.44; N, 13.94; S, 10.70.

(2*Z*)-2-(Methylhydrazono)-1,2-dipyridin-2-ylethanone* (**7b**). 1,2-Dipyridin-2-ylethane-1,2-dione (α-pyridil) (10.6 g, 0.05 mol) was dissolved in ethanol (250 ml) through heating and methylhydrazine (2.30 g, 0.05 mol) was added. After allowing the mixture to stand over night at room temperature, (**7b**) precipitated as pale, yellow crystals; yield 80%; m.p. 154-155 °C (ethanol or ligroin); ir: 3163, 3100, 3052, 3020, 2992, 2965, 2900, 1694, 1640, 1617, 1570, 1560, 1519, 1501, 1482, 1448, 1387, 1352, 1341, 1322, 1292, 1208, 1203, 1166, 1146, 1132, 1100, 1057, 1047, 1041, 1008, 948, 928, 869, 844, 812, 804, 787, 768, 738, 688, 677, 667 cm^{-1}; ^1H nmr CCl_4): δ = 3.12 (d, *J* = 4 Hz, 3H), 6.73-8.67 (m, 8 H), 13.24 (s, br, NH, 1H). *Anal.* Calcd. for $C_{13}H_{12}N_4O$: C, 64.99; H, 5.03; N, 23.22. Found: C, 64.75; H, 4.94; N, 23.04.

2-Methyl-4,5-di-pyridin-2-yl-2*H*-[1,2,3,6]-thiatriazine-1,1-dioxide (**8b**). To the solution of (2*Z*)-2-(methylhydrazono)-1,2-dipyridin-2-ylethanone (**7b**) (2.40 g, 0.01 mol) in anhydrous pyridine (50 ml) was added dropwise a solution of chlorosulphonyl isocyanate (**4**) [23] (1.70 g, 0.012 mol) in anhydrous acetonitrile (25 ml) within 10 min at room temperature. Through allowing the mixture to stand for 3 days at room temperature, the solvents were removed by evaporation. The remaining residue was purified by column chromatography using methylene dichloride for development and ethyl acetate as eluent (Al_2O_3, acidified, Woelm, activity I). After evaporation of the eluate, (**8b**) was obtained as brownish yellow crystals; yield 62%; m.p. 185 °C (1x benzene/cyclohexane (1:1), 1x acetone); ir: 1592, 1556, 1462, 1438, 1360, 1345, 1318, 1290, 1229, 1192, 1177, 1162, 1153, 1109, 1098, 1055, 1003, 957, 847, 803, 787, 754, 748, 738, 713, 671; ^1H nmr (CD_3COCD_3): δ = 3.85 (s, 3H), 7.12-8.38 (m, 8 H). *Anal.* Calcd. for $C_{13}H_{11}N_5O_2S$: C, 51.82; H, 3.68; N, 23.34; S, 10.64. Found: C, 51.95; H, 3.70; N, 23.50; S, 10.50.

(2*Z*)-1,2-Bis(4-methoxyphenyl)-2-(methylhydrazono)ethanone* (7c). 1,2-Bis(4-methoxyphenyl)ethane-1,2-dione (p-anisil) (0.68 g, 2.5 mmol) and methylhydrazine (0.23 g, 5 mmol) were dissolved in glacial acetic acid (12 g, 0.2 mol) and ethanol (50 ml). After allowing the mixture to stand for 24 hours at room temperature, water (50 ml) was added whereupon (**7c)** precipitated as a yellow colored, smudgy solid; yield 70%; m.p. 119 °C (benzene/ligroin, nearly colorless crystals); ir: 3260, 3096, 3064, 3042, 3024, 3000, 2971, 2936, 2898, 2872, 2840, 2812, 2040, 1937, 1908, 1886, 1871, 1623, 1608, 1602, 1572, 1544, 1539, 1532, 1512, 1506, 1472, 1458, 1452, 1442, 1418, 1343, 1307, 1258, 1248, 1213, 1187, 1172, 1136, 1106, 1082, 1025, 1003, 942, 879, 841, 832, 824, 815, 807, 786, 773, 736, 718, 706, 655, 638; *Anal.* Calcd. for $C_{17}H_{18}N_2O_3$: C, 68.44; H, 6.08; N, 9.39. Found: C, 68.65; H, 6.21; N, 9.65.

2-Methyl-4,5-bis(4-methoxyphenyl)-2*H*-[1,2,3,6]-thiatriazine-1,1-dioxide (8c). To a solution of (2*Z*)-2-(methylhydrazono)-1,2-bis(4-methylphenyl)ethanone (2.98 g, 0.01 mol) (**7c**) in anhydrous pyridine (50 ml) was added dropwise chlorosulphonyl isocyanate (**4**) [23] (1.70 g, 0.012 mol) in anhydrous acetonitrile (25 ml) within 10 min at room temperature. After allowing the mixture to stand for 3 days at room temperature, water (2 l) was added whereupon (**8c**) was obtained as a very amorphous precipitate; yield 49%; m.p. 101 °C, yellow crystals (benzene/cyclohexane, 1:1, addition of Al_2O_3, acidified, Woelm, activity I); ^1H nmr (CCl_4): δ = 3.73 (s, 3H), 3.79 (s, 6H), 6.60-7.65 (m, 8 H). *Anal.* Calcd. for $C_{17}H_{17}N_3O_4S$: C, 56.81; H, 4.77; N, 11.69; S, 8.92. Found: C, 56.91; H, 4.61; N, 11.60; S, 8.79.

(2*Z*)-2-(Methylhydrazono)-1,2-bis(4-methylphenyl)ethanone* (7d). 1,2-Bis(4-methylphenyl)ethane-1,2-dione (p-tolil) (23.8 g, 0.1 mol), methylhydrazine (4.6 g, 0.1 mol) and glacial acetic acid (6.0 g, 0.1 mol) were dissolved in ethanol (1 l). Through heating the mixture to reflux, the resulting solution was diluted with hot water (1 l). and allowed to cool down to room temperature over night whereupon crude (**7d**) precipitated. After washing with a mixture of ethanol and water (1:1, 200ml), (**7d**) was obtained as long pale yellow crystals; yield 73%; m.p.98 °C. ir: 3239, 3016, 2998, 2956, 2933, 2912, 2856, 2800, 1916, 1808, 1618, 1602, 1564, 1557, 1533, 1526, 1519, 1517, 1494, 1440, 1413, 1403, 1333, 1302, 1298, 1285, 1278, 1256, 1212, 1197, 1179, 1173, 1138, 1113, 1103, 1076, 1033, 1021, 1018, 1001, 968, 950, 944, 878, 842, 832, 822, 811, 779, 754, 728, 699, 638, 623. ^1H nmr (CCl_4): δ = 2.37 (d, *J* = 2 Hz, 6H), 3.06 (d, *J* = 8 Hz, 3H), 6.08 (s, br , NH, 1H) 6.93-7.97 (m, 8 H). *Anal.* Calcd. for $C_{17}H_{18}N_2O$: C, 76.66; H, 6.81; N, 10.52. Found: C, 76.53; H, 6.75; N, 10.39.

2-Methyl-4,5-bis(4-methylphenyl)-2*H*-[1,2,3,6]-thiatriazine-1,1-dioxide (**8d**). To the solution of (2*Z*)-2-(methylhydrazono)-1,2-bis(4-methylphenyl)ethanone (**7d)** (2.66 g, 0.01 mol) in anhydrous pyridine (50 ml) was added dropwise a solution of chlorosulphonyl isocyanate (**4**) [23] (1.70 g, 0.012 mol) in anhydrous acetonitrile (25 ml). within 10 min at 0° C. After allowing the mixture to stand for 3 days at room temperature, water (1 l) was added slowly while stirring whereupon (**8d)** was obtained as yellow crystals; yield 93%; m.p. 89 °C; ir: = 3088, 3054, 2954, 2930, 2854, 1612, 1578, 1548, 1517, 1482, 1450, 1403, 1358, 1344, 1309, 1304, 1285, 1219, 1212, 1187, 1184, 1168, 1118, 1082, 1038, 1024, 993, 969, 950, 854, 848, 841, 816, 791, 762, 727, 711, 702, 678, 648, 637 cm^{-1}; ^1H nmr (CCl_4): δ = 2.33 (s, 6H), 3.72 (s, 3H), 6.80-7.47 (m, 8 H). *Anal.* Calcd. for $C_{17}H_{17}N_3O_2S$: C, 62.37; H, 5.23; N, 12.83; S, 9.79. Found: C, 62.25; H, 5.19; N, 12.99; S 9.63.

(2*Z*)-2-(Ethylhydrazono)-1,2-diphenylethanone*, **(*Z*)-benzil-*N*-ethylhydrazone** (**7e**). To a 50% aqueous ethylamine solution in water (72 g, 0.8 mol) was added dropwise a solution of potassium hydroxide (28 g, 0.5 mol) in water (80 ml). To avoid loss of gaseous ethylamine, the reaction vessel was equipped with a reflux condenser keeping the cooling liquid at 0 °C. After heating the mixture to 60 °C, a solution of hydroxylamine-O-sulphonic acid (22.6 g, 0.2 mol) in water (60 ml) was added dropwise within 30 min. The reaction mixture was heated to reflux for 10 min and then acidified with glacial acetic acid (52 ml, 0.9 mol). Benzil (10.5 g, 0.05 mol), dissolved in ethanol (700 ml) and pyridine (100 ml), was added and the mixture refluxed for 3 hours. The solidified potassium hydrogensulphate was filtered off and the filtrate was concentrated under vacuum to about half of its original volume. The solution was diluted with hot water (500 ml) and cooled to room temperature whereupon **(7e)** was obtained as tiny pale yellow needles; yield 63%; m.p. 126 °C (cyclohexane); ir: 3270, 3075, 3052, 3019, 2983, 2969, 2931, 2916, 2876, 1983, 1963, 1918, 1897, 1815, 1775, 1623, 1597, 1575, 1526, 1520, 1491, 1460, 1444, 1378, 1369, 1332, 1306, 1291, 1255, 1244, 1200, 1175, 1152, 1089, 1076, 1027, 1024, 999, 990, 975, 966, 929, 924, 909, 856, 842, 807, 791, 770, 739, 724, 705, 695, 665, 631 cm^{-1}; ^1H nmr $CDCl_3$): δ = 1.11 (t, *J* = 7.0 Hz, 3H), 3.43 (q, *J* = 7.0 Hz, 2H), 6.48 (s, br, NH, 1H) 7.13-8.16 (m, 10 H). *Anal*. Calcd. for $C_{16}H_{16}N_2O$: C, 76.17; H, 6.39; N, 11.10. Found: C, 76.19; H, 6.26; N, 10.96.

2-Ethyl-4,5-phenyl-2*H*-[1,2,3,6]-thiatriazine-1,1-dioxide (8e). To (2*Z*)-2-(ethylhydrazono)-1,2-diphenylethanone (*Z*-benzil-*N*-ethylhydrazone) (**7e**) (2.52 g, 0.01 mol) in anhydrous pyridine (50 ml) was added within 10 min dropwise at a temperature of about 0°C chlorosulphonyl isocyanate (**4**) [23] (1.70 g, 0.012 mol) dissolved in anhydrous acetonitrile (25 ml). After 3 days at room temperature water (1 l) was slowly added under stirring, whereas (**8e**) was precipitated in smudgy form. Through washing with water and drying the substance was dissolved in methylene dichloride and purified by column chromatography (Al_2O_3, acidified, Woelm, activity I). Methylene dichloride was applied for development and ethyl acetate for elution. After evaporation of the eluate (**8e**) was obtained as yellow crystals; yield 38%; m.p.132 °C (cyclohexane); ir: 3090, 3070, 3060, 3028, 2997, 2984, 2972, 2953, 2940, 2931, 2872, 2851, 1604, 1590, 1556, 1498, 1470, 1449, 1443, 1357, 1349, 1338, 1309, 1288, 1196, 1184, 1162, 1156, 1137, 1092, 1082, 1078, 1032, 1008, 1002, 997, 992, 985, 981, 978, 972, 968, 964, 957, 932, 921, 848, 840, 801, 792, 787, 770, 738, 724, 700, 695, 688, 684, 653 cm^{-1}; ^1H nmr (CCl_4): δ = 1.55 (t, *J* = 6.6 Hz, 3H), 4.08 (q, *J* = 6.6 Hz, 2H), 7.05-7.57 (m 10 H). *Anal*. Calcd. for $C_{16}H_{15}N_3O_2S$: C, 61.32; H, 4.82; N, 13.41; S, 10.23. Found: C, 61.48; H, 4.98; N, 13.37; S, 10.27.

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REFERENCES AND NOTES

* Due to the formation of a hydrogen bridge, benzilalkylhydrazones exist as *Z*-isomers [17] whereas all other hydrazones could not be assigned as *Z* or *E*–isomers.

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