Iminium Carbonic Acid Derivative Salts. IX [1]. Synthesis of *N,S*-Containing Heterobicycles from *N*-Protected 2-Methylthio-1,3-thiazinium and 2-Methylthiothiazolium Salts Part 1. Preparation of *N*-Protected 2-Methylthio-1,3-thiazinium and 2-Methylthiothiazolium Salts and their Reaction with CH-Acidic Compounds

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Dedicated to Professor Dr. G. Seitz on the occasion of his sixtieth birthday.

N-Boc-protected 1,3-thiazine-2-thiones and thiazolidin-2-thiones were transformed into the corresponding 2-methylthio-1,3-thiazinium and 2-methylthiothiazolium salts by methyl iodide or trimethyloxonium tetrafluoroborate. This activated species were reacted with CH-acidic compounds forming ketene-*N,S*-acetals. The protection group was removed with trifluoracetic acid to yield the *N*-unsubstituted ketene-*N,S*-acetals.

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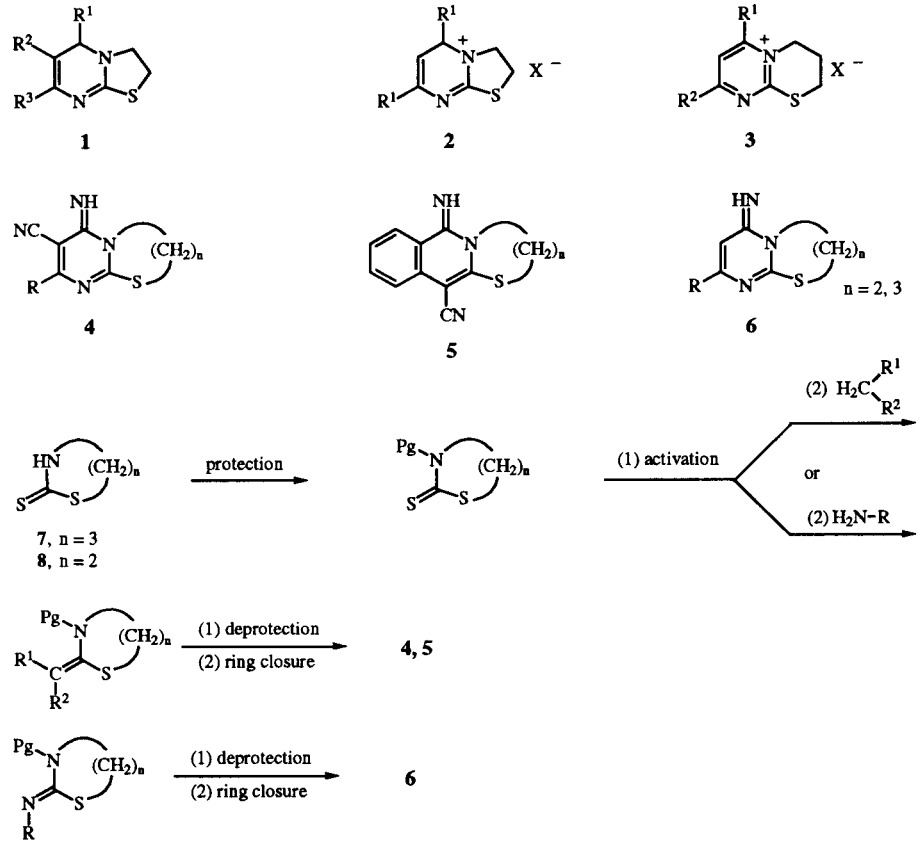
Heterocycles of the thiazolo[3,2-*a*]pyrimidine type **1** have received considerable interest during the past two decades due to their interesting pharmacological activities. Psychotropic [2-5], immuno stimulating [6,7], anticancerogenic [4,8], antiinflammatoric [9], analgesic [10,11], positive inotropic and antihypertensive [9] activi-

Scheme 1



ties were reported. Thiazolopyrimidinium- **2** and pyrimido-1,3-thiazinium salts **3** displayed analgesic and antiinflammatoric effects together with low toxicity [12].

It was our intention to develop a convenient and straightforward strategy for the synthesis of a large number of compounds of the general structures **4-6** in order to provide the material for further pharmacological examination of this class of compounds.

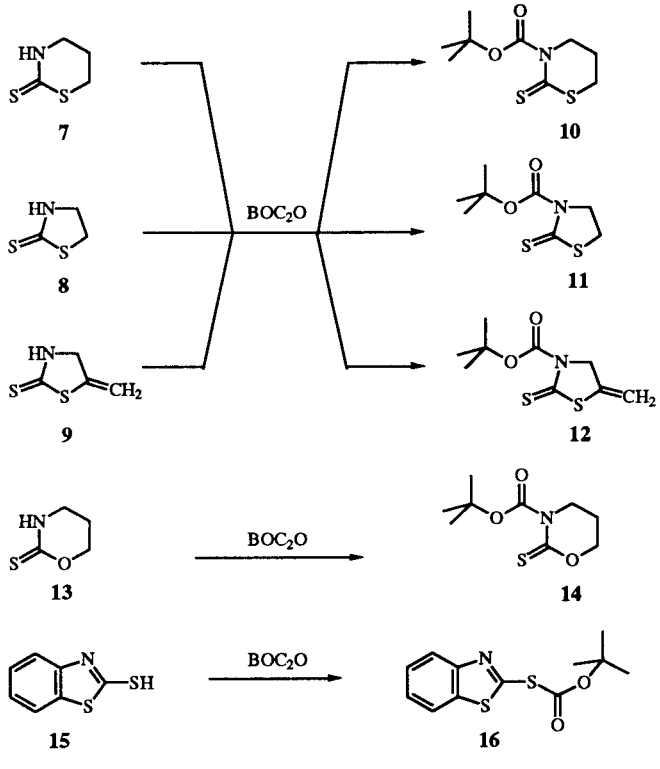
Literature synthesis of **1-3** normally used an appropriately substituted pyrimidine as starting material and carried on with the subsequent formation of the thiazine ring. We decided to use 1,3-thiazine- **7** and thiazolidine-2-thiones **8,9** as starting materials and to construct the pyridine or pyrimidine ring in a subsequent sequence of reactions depicted in Scheme 1.

The key step of our synthetic sequence was the conversion of the dithiourethane partial structure of the thiazine **7** and thiazolidines **8,9** to ketene-*N,S*-acetal or isothiourea structures in **4-6**. Our group has already developed a method for such conversions using phosgene or thionyl chloride to convert thiazine and thiazolidine-2-thiones into the corresponding chloroiminium salts which in a subsequent reaction reacted as activated species with amines or CH acidic compounds [1,13-16]. Recently we reported a considerable improvement of this methology using 2-methylthiothiazinium and -thiazolium salts as activated species [17]. These were obtained by the action of an excess of methyl iodide on 1,3-thiazine- and thiazolidine-2-thiones. Because those two methods proved to be effective only with *N*-substituted thiazines and thiazolidines, we first looked for a suitable protection group to temporarily block the free NH-function of the thiazine and thiazolidine we needed for the final formation of the bicyclic systems **4-6**. The *tert*-butyloxycarbonyl (Boc) group proved to be the appropriate protecting group. The *N*-protected thiazines and thiazolidines **10-12** were obtained by using di-*tert*-butyl dicarbonate with pyridine as a catalyst. In order to explore the scope of the method 3,4,5,6-tetrahydro-2*H*-1,3-oxazine-2-thione (**13**) and 2-mercaptobenzothiazole (**15**) were included. Whereas the former yielded the desired *N*-protected species **14** the last one reacted with the mercapto function yielding **16**.

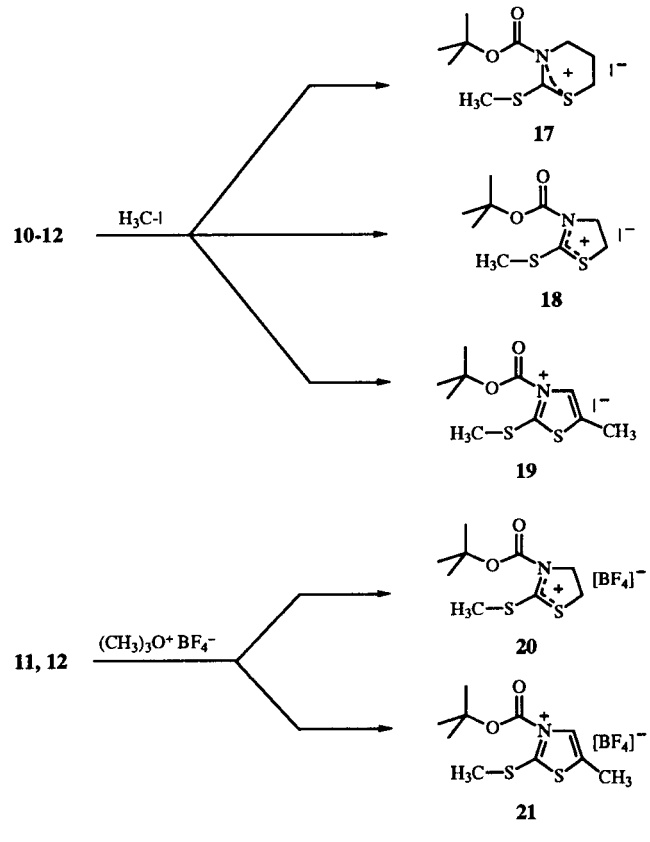
On treatment with exessive methyl iodide the *N*-Boc-thiazines and -thiazolidines **10-12** formed the activated thiouronium iodides **17-19** in 90-97% yield as crystalline solids (Method A). As an alternative method **11** and **12** were treated with trimethyloxonium tetrafluoroborate in dichloromethane yielding the corresponding methylthiouronium tetrafluoroborates **20, 21** (method B).

The activated species **17-21** were used without further characterization for a series of model reactions with simple or phenylogous CH-acidic compounds. In these reactions the addition of lead(II)nitrate proved to be essential. Whereas in most cases the desired condensation forming

Scheme 2

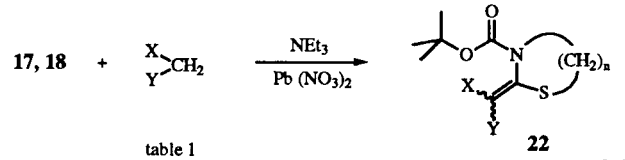


Scheme 3



ketene-*N*,*S*-acetals **22a-i** took place the reaction of **18** with 2-(2-cyanophenyl)acetonitrile yielded the addition product **23a** together with the condensation product **22k**. From the reaction of **17** with 2-(2-cyanophenyl)-acetonitrile and **21** with anthrone only the addition products **23b,c** were obtained.

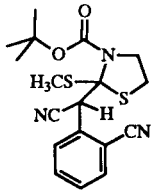
Scheme 4



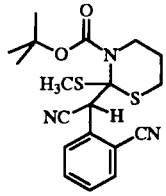
22

table 1

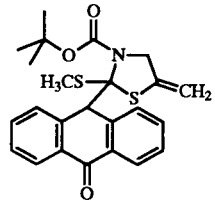
22	X	Y	n
a	CN	CN	3
b	CN	CN	2
c	CN	SO_2-Ph	3
d	CN	SO_2-Ph	2
e	CN	CO-Ph	3
f	CN	CO-Ph	2
g	CO-NMe-CO-NMe-CO		3
h	EtOOC	*p*-C_6H_4-NO_2	2
i	CN	*p*-C_6H_4-NO_2	3
k	CN	*o*-C_6H_4-CN	2



23a



23b

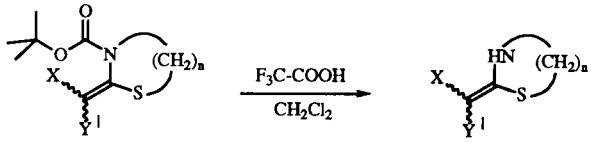


23c

When two different electron withdrawing groups were used in the CH-acidic compounds, a mixture of *cis/trans* isomers was formed as was revealed by the doubling of the signal set in the nmr spectra. The ratio of the two different isomers was strongly dependent on the substitution pattern of the CH-acidic compound employed.

With some examples of ketene-*N*,*S*-acetals **22** the deprotection using trifluoroacetic acid in dichloromethane was tested successfully. In the case of **22a** the additional hydrolysis of one of the two nitrile functions to an amide **24c** was

Scheme 5



22 **24**

24	X	Y^1	n
a	CN	SO_2Ph	3
b	CN	SO_2Ph	2
c	CN	$CO-NH_2$	3
d	CN	CO-Ph	3
e	CO-NMe-CO-NMe-CO		3

observed. With the removal of the *N*-protecting group the doubling of the nmr signals disappeared. We suggest a proton catalysed isomerisation of the less stable isomer into the more stable one as an explanation for this observation.

With this sequence the necessary methology for the synthesis of our target structures **4-6** had been established. The use of vinylogous CH-acidic compounds for the formation of **4** and **5** will be reported in the following paper.

EXPERIMENTAL

Melting points were determined on a Leitz HM Lux apparatus. Microanalyses were obtained on a Hewlett Packard CHN-Autoanalyser (N only) and a Labormatic CH-Analyser. Mass spectra were recorded on a Vacuum Generators Spectrometer 7070H with EI (70eV). The infra red spectra were run using a Perkin Elmer PE 398 instrument. The ^1H and ^{13}C nmr spectra were recorded on a Jeol JNM-GX 400 instrument. Column chromatography was performed with columns of 60 cm length and 3 cm inner diameter on silica gel 0.063-0.100 mm Merck.

tert-Butyl 2-Thioxo-3,4,5,6-tetrahydro-2*H*-1,3-thiazine-3-carboxylate (**10**).

To a suspension of 2.66 g (0.02 mole) of 3,4,5,6-tetrahydro-2*H*-1,3-thiazine-2-thione (**7**) [18] in 30 ml of dry toluene were added 2.0 g (0.02 mole) of triethylamine, 4.5 g (0.02 mole) of di-*tert*-butyl dicarbonate and 0.005-0.01 g of pyrrolidinopyridine. The resulting mixture was stirred for 60 minutes at room temperature. The solvent was evaporated *in vacuo* and the residue was separated by column chromatography (dichloromethane). This compound was obtained as yellow crystals, 1.8 g (38%), mp 92-95°; ir (potassium bromide): ν 2980, 1760, 1330, 1290, 1140, 1060 cm^{-1}; ^1H nmr (deuterioacetone): δ 3.83-3.80 (t, 2H), 3.10-3.07 (t, 2H), 2.31-2.26 (m, 2H), 1.52 (s, 9H); ^{13}C nmr (deuterioacetone): δ 197.3, 153.8, 85.3, 49.4, 32.3, 27.7, 23.1; ms: m/z 233 (3, M^+), 133 (48).

Anal. Calcd. for $C_9H_{15}NO_2S_2$ (233.35): C, 46.32; H, 6.48; N, 6.00; S, 27.48. Found: C, 46.23; H, 6.36; N, 5.91; S, 27.21.

tert-Butyl 2-Thioxothiazolidine-3-carboxylate (**11**).

To a solution of 2.7 g (0.023 mole) of thiazolidine-2-thione (**8**) in 30 ml of dry dichloromethane were added 2.3 g (0.023 mole) of triethylamine, 5.0 g (0.023 mole) of di-*tert*-butyl dicarbonate and 0.005-0.01 g of pyrrolidinopyridine. The resulting mixture was stirred for 60 minutes at room temperature. The solvent was evaporated *in vacuo* and the residue was separated by column chromatography (dichloromethane).This compound was obtained as yellow crystals, 4.9 g (97%), mp 88-89°; ir (potassium bromide): ν 2990, 1740, 1370, 1280, 1160, 1140, 1050 cm^{-1}; ^1H nmr (deuteriochloroform): δ 4.48 (t, 2H), 3.28 (t, 2H), 1.56 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 199.9, 149.7, 84.8, 55.9, 28.0, 28.0; ms: m/z 219 (9, M^+), 119 (54).

Anal. Calcd. for $C_8H_{13}NO_2S_2$ (219.33): C, 43.81; H, 5.97; N, 6.39; S, 29.24. Found: C, 43.82; H, 5.91; N, 6.44; S, 29.31.

tert-Butyl 5-Methylene-2-thioxothiazolidine-3-carboxylate (**12**).

To a solution of 6.0 g (0.046 mole) of 5-methylene-1,3-thiazolidine-2-thione (**9**) [19] in 50 ml of dry dichloromethane were

added 4.6 g (0.046 mole) of triethylamine, 10 g (0.046 mole) of di-*tert*-butyl dicarbonate and 0.005-0.01 g of pyrrolidinopyridine. The resulting mixture was refluxed for 4 hours. After cooling to room temperature the solvent was evaporated *in vacuo* and the residue was separated by column chromatography (dichloromethane). This compound was obtained as yellow crystals, 10.0 g (94%), mp 49-52°; ir (potassium bromide): ν 2980, 1750, 1620, 1370, 1280, 1140, 1050 cm^{-1}; ^1H nmr (deuteriochloroform): δ 5.22-5.21 (t, 2H), 5.05-5.04 (t, 2H), 1.56 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 196.3, 148.9, 104.5, 85.3, 61.2, 28.0; ms: m/z 231 (7, M^+), 131 (54).

Anal. Calcd. for $C_9H_{13}NO_2S_2$ (231.34): C, 46.73; H, 5.66; N, 6.05; S, 27.72. Found: C, 46.87; H, 5.55; N, 6.03; S, 27.69.

tert-Butyl 2-Thioxo-3,4,5,6-tetrahydro-2*H*-1,3-oxazine-3-Carboxylate (**14**).

To a suspension of 2.0 g (0.017 mole) of tetrahydro-2*H*-1,3-oxazine-2-thione (**13**) [20] in 30 ml of dry toluene were added 1.7 g (0.02 mole) of triethylamine, 7.4 g (0.34 mole) of di-*tert*-butyl dicarbonate and 0.005-0.01 g of pyrrolidinopyridine. The resulting mixture was stirred for 15 minutes at room temperature. The solvent was evaporated *in vacuo* and the residue was separated by column chromatography (dichloromethane). This compound was obtained as a yellow powder, 2.1 g (56%), mp 69-70°; ir (potassium bromide): ν 2970, 1745, 1370, 1290, 1210, 1160, 1130, 1100, 1060 cm^{-1}; ^1H nmr (deuteriochloroform): δ 4.33 (t, 2H), 3.72 (t, 2H), 2.20 (m, 2H), 1.57 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 187.9, 153.2, 85.0, 68.0, 45.1, 27.7, 22.0; ms: m/z 217 (2, M^+), 117 (81).

Anal. Calcd. for $C_9H_{15}NO_3S$ (217.20): C, 49.75; H, 6.96; N, 6.45; S,14.76. Found: C, 49.96; H, 6.93; N, 6.45; S, 14.74.

2-*tert*-Butoxycarbonylthiobenzothiazole (**16**).

To a suspension of 1.8 g (0.01 mole) of 2-mercaptobenzothiazole (**15**) in 30 ml of dry dichloromethane were added 1.0 g (0.01 mole) of triethylamine, 2.3 g (0.01 mole) of di-*tert*-butyl dicarbonate and 0.005-0.01 g pyrrolidinopyridine. The resulting mixture was refluxed for 60 minutes. Afler cooling to room temperature the solvent was evaporated *in vacuo* and the residue was crystallized by the addition of diethyl ether. This compound was obtained as white crystals, 0.16 g (6%), mp 78-79°; ir (potassium bromide): ν 3000, 1740, 1620, 1600, 1380, 1210, 1140, 1100, 1040 cm^{-1}; ^1H nmr (deuteriochloroform): δ 8.02-7.86 (2H), 7.48-7.40 (2H), 1.58 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 164.1, 159.1, 126.3, 125.4, 122.9, 121.0, 88.2, 28.2; ms: m/z 267 (0.5, M^+), 167 (100).

Anal. Calcd. for $C_{12}H_{13}NO_2S_2$ (267.37): C, 53.91; H, 4.90; N, 5.24; S, 23.98. Found: C, 53.92; H, 4.82; N, 5.30; S, 23.90.

General Procedure for the Formation of 2-Methylthio-3,4,5,6-tetrahydro-2*H*-1,3-thiazinium and -thiazolidinium Iodides **17-19** using Methyl Iodide (Method A).

Ten mmoles of the *N*-protected perhydrothiazine or thiazolidine derivative **10-12** were refluxed for two hours in 15 ml of iodomethane with protection from moisture. After cooling to room temperature, 30 ml of dry diethyl ether were added whereupon the product cyrstallized. The crystals were separated, washed several times with diethyl ether and used after a short drying period *in vacuo* without further characterization.

General Procedure for the Formation of 2-Methylthiothiazolium Tetrafluoroborates **20, 21** using Trimethyloxonium Tetrafluoroborate (Method B).

A suspension of 10 mmoles trimethyloxonium tetrafluoroborate in 20 ml of dry dichloromethane was added dropwise under nitrogen to a solution of 10 mmoles of the *N*-protected thiazolidine derivative **11** or **12** in 20 ml of dry dichloromethane at 0°. The mixture was stirred for 30 minutes at 0° and for an additional 22 hours at room temperature. The product precipitated upon the addition of dry diethyl ether. The precipitate was collected, washed several times with diethyl ether and used after a short drying period *in vacuo* without further characterization.

General Procedure for the Condensation of the 2-Methylthio-3,4,5,6-tetrahydro-2*H*-thiazinium and thiazolium Salts **17-21** with CH-acidic Compounds.

To a solution of equimolar quantities of the 2-methylthio-3,4,5,6-tetrahydro-2*H*-thiazinium and -thiazolium salts **17-21** and the CH-acidic compound in 30 ml of dry dichloromethane were added 2 equivalents of triethylamine and 1.5 equivalents of lead(II)nitrate under protection from moisture. The mixture was refluxed for the time indicated below. After cooling to room temperature the solids were filtered off and the filtrate evaporated *in vacuo*. The residue was treated as described below.

tert-Butyl 2-Dicyanomethylene-3,4,5,6-tetrahydro-1,3-thiazine-3-carboxylate (**22a**).

This compound was obtained as a yellow powder, 1.0 g (66%), mp 102°; ir (potassium bromide): ν 2210, 1720 cm^{-1}; ^1H nmr (deuterioacetone): δ 3.89 (t, 2H), 3.18 (t, 2H), 2.30-2.27 (m, 2H), 1.56 (s, 9H); ^{13}C nmr (deuterioacetone): δ 177.8, 150.4, 113.6, 113.5, 85.7, 72.2, 45.5, 27.9, 27.6, 24.1; ms: m/z 265 (1, M^+), 165 (100).

Anal. Calcd. for $C_{12}H_{15}N_3O_2S$ (265.34): C, 54.32; H, 5.70; N, 15.84; S, 12.08. Found: C, 54.30; H, 5.59; N, 15.78; S, 11.92.

tert-Butyl 2-Dicyanomethylenethiazolidine-3-carboxylate (**22b**).

This compound was obtained as white crystals, 0.3 g (27%), mp 150-151°; ir (potassium bromide): ν 2220, 2200, 1740 cm^{-1}; ^1H nmr (deuteriochloroform): δ 4.36 (t, 2H), 3.26 (t, 2H), 1.60 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 172.3, 148.2, 114.4, 112.4, 87.4, 63.2, 55.4, 28.9, 27.9; ms: m/z 251 (1, M^+), 151 (71).

Anal. Calcd. for $C_{11}H_{13}N_3O_2S$ (251.31): C, 52.54; H, 5.21; N, 16.72; S, 12.76. Found: C, 52.54; H, 5.23; N, 16.66; S, 12.75.

tert-Butyl 2-(1-Cyano-1-phenylsulfonylmethylene)-3,4,5,6-tetrahydro-2*H*-1,3-thiazine-3-carboxylate (**22c**).

This compound was obtained as white crystals, 1.1 g (88%), mp 130-131°; ir (potassium bromide): ν 2210, 1720 cm^{-1}; ^1H nmr (deuteriochloroform): δ 8.06-8.04 (m, 2H), 7.92-7.91 (m, 2H*), 7.70-7.56 (m, 3H, 3H*), 3.73-3.72 (flat Signal, 2H, 2H*), 2.90 (t, 2H*), 2.75 (t, 2H), 2.24 (m, 2H, 2H*), 1.59 (s, 9H*), 1.27 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 171.9, 151.1, 149.9*, 140.3, 140.0*,135.4-127.8, 113.9*, 113.4, 107.3, 85.2*, 84.6,42.9, 42.7*, 27.8*, 27.6, 26.6*, 26.4, 24.0*, 23.8; ms: m/z 280 (1), 77 (100).

Anal. Calcd. for $C_{17}H_{20}N_2O_4S_2$ (380.48): C, 53.67; H, 5.30; N, 7.36; S, 16.85. Found: C, 53.64; H, 5.19; N, 7.36; S, 16.92.

tert-Butyl 2-(1-Cyano-1-phenylsulfonylmethylene)thiazolidine-3-carboxylate (**22d**).

This compound was obtained as yellow crystals, 0.9 g (56%), mp 143-144°; ir (potassium bromide): ν 2210, 1745 cm^{-1}; ^1H nmr (deuteriochloroform): δ 8.03-8.00 (m, 2H), 7.64-7.56 (m, 3H), 4.20 (t, 2H), 3.07 (t, 2H), 1.44 (s, 9H); ^{13}C nmr (deuterio-

chloroform): δ 167.6, 148.6, 140.7, 134.0-127.6, 113.7, 98.2, 86.4, 52.6, 28.8, 27.7; ms: m/z 266 (100).

Anal. Calcd. for $C_{16}H_{18}N_2O_4S_2$ (366.46): C, 52.44; H, 4.95; N, 7.64; S, 17.50. Found: C, 52.48; H, 4.95; N, 7.61; S, 17.20.

tert-Butyl 2-(1-Cyano-2-oxo-2-phenylethylidene)-3,4,5,6-tetrahydro-1,3-thiazine-3-carboxylate (**22e**).

This compound was obtained as yellow crystals, 0.7 g (32%), mp 86-88°; ir (potassium bromide): ν 2210, 1720, 1650, 1630 cm^{-1}; ^1H nmr (deuteriochloroform): δ 7.91-7.90 (m, 2H), 7.82-7.80 (m, 2H*), 7.57-7.54 (m, 1H), 7.48-7.45 (m, 2H), 2.75 (t, 2H), 2.96 (t, 2H*), 2.31 (m, 2H), 2.21-2.16 (m, 2H*), 1.62 (s, 9H), 1.31 (s, 9H*); ^{13}C nmr (deuteriochloroform): δ 188.3, 186.7*, 177.0, 150.6, 137.2, 136.9*, 132.8, 128.8, 128.4, 132.8*, 128.8*, 128.6*, 128.2*, 117.4, 117.7*, 102.6, 84.2, 84.3*, 43.5, 44.1*, 28.1, 27.9*, 26.3, 26.6*, 24.5, 24.0; ms: m/z 344 (1, M^+), 244 (76), 243 (100).

Anal. Calcd. for $C_{18}H_{20}N_2O_3S$ (344.44): C, 62.77; H, 5.85; N, 8.13; S, 9.31. Found: C, 62.53; H, 5.68; N, 8.06; S, 9.33.

tert-Butyl 2-(1-Cyano-2-oxo-2-phenylethylidene)thiazolidine-3-carboxylate (**22f**).

This compound was obtained as white crystals, 1.6 g (72%), mp 133°; ir (potassium bromide): ν 2220, 1730, 1640 cm^{-1}; ^1H nmr (deuteriochloroform): δ 7.91-7.88 (m, 2H), 7.54-7.52 (m, 1H), 7.47- 7.44 (m, 2H), 4.34 (t, 2H*), 4.25 (t, 2H), 3.19 (t, 2H*), 3.03 (t, 2H), 1.65 (s, 9H), 1.33 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 188.8, 173.5, 149.0, 137.3, 132.4-128.2, 117.9, 92.7, 85.9, 52.4, 28.6, 28.0; ms: m/z 330 (4, M^+), 230 (58), 229 (100).

Anal. Calcd. for $C_{17}H_{18}N_2O_3S$ (330.41): C, 61.80; H, 5.49; N, 8.48; S, 9.70. Found: C, 61.64; H, 5.47; N, 8.75; S, 9.61.

tert-Butyl 2-(1,3-Dimethyl-2,4,6-trioxohexahydropyrimidin-5-ylidene)-3,4,5,6-tetrahydro-1,3-thiazine-3-carboxylate (**22g**).

This compound was obtained as white crystals, 1.5 g (53%), mp 168-169°; ir (potassium bromide): ν 1730, 1720, 1660, 1640 cm^{-1}; ^1H nmr (deuteriochloroform): δ 3.87 (t, 2H), 3.34 (s, 6H), 2.80 (t, 2H), 2.28 (m, 2H), 1.41 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 179.7, 179.6, 161.3, 151.2, 151.0, 108.1, 83.1, 43.2, 28.1, 28.0, 27.2, 25.3; ms: m/z 355 (2, M^+), 256 (13), 255 (100).

Anal. Calcd. for $C_{15}H_{21}N_3O_5S$ (355.42): C, 50.69; H, 5.96; N, 11.82; S, 9.02. Found: C, 50.66; H, 5.83; N, 11.84; S, 9.00.

tert-Butyl 2-[1-Ethoxycarbonyl-1-(4-nitrophenyl)methylene]thiazolidine-3-carboxylate (**22h**).

This compound was obtained as yellow crystals, 1.3 g (49%), mp 138°; ir (potassium bromide): ν 1740, 1700, 1600, 1560, 1520 cm^{-1}; ^1H nmr (deuteriochloroform): δ 8.21-8.19 (m, 2H*), 8.17- 8.14 (m, 2H), 7.53-7.51 (m, 2H*), 7.42-7.40 (m, 2H), 4.26-4.21 (q, 2H), 4.17-4.08 (m, 4H*), 4.06 (t, 2H), 3.03-2.97 (m, 2H, 2H*), 1.51 (s, 9H*), 1.26-1.20 (m, 3H, 3H*), 1.11 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 166.5, 165.0*, 157.5, 151.0*, 149.0, 147.0*, 146.0, 145.3*, 144.6, 131.3-122.9*, 114.0*, 113.6, 83.0, 61.2, 60.6*, 51.7*, 51.2, 29.7, 29.2*, 28.1*, 27.5, 14.3, 14.2*; ms: m/z 394 (4, M^+), 294 (80).

Anal. Calcd. for $C_{18}H_{22}N_2O_6S$ (394.45): C, 54.81; H, 5.62; N, 7.10; S, 8.13. Found: C, 54.87; H, 5.54; N, 7.02; S, 8.01.

tert-Butyl 2-[1-Cyano-1-(4-nitrophenyl)methylene]-3,4,5,6-tetrahydro-1,3-thiazine-3-carboxylate (**22i**).

This compound was obtained as yellow crystals, 0.65 g (45%), mp 133-134°; ir (potassium bromide): ν 1700, 1600, 1590, 1540 cm^{-1}; ^1H nmr (deuteriochloroform): δ 8.28-8.25 (m, 2H), 8.22-8.20 (m, 2H*), 7.73-7.71 (m, 2H), 7.58-7.56 (m, 2H*), 4.46 (broad, 4H), 2.96 (m, 2H), 2.84 (m, 2H*), 2.20-2.17 (m, 2H, 2H*), 1.57 (s, 9H), 1.09 (s, 9H, *tert*-butyl*); ^{13}C nmr (deuteriochloroform): δ 158.5 (N-C-S*), 157.4 (N-C-S), 151.5 (O-CO-N), 150.3 (O-CO-N*), 147.4 ,146.5, 140.5, 138.8, 129.6, 127.6, 127.5, 124.2, 124.0, 117.3, 117.0, 104.6, 101.6, 83.5, 83.4, 43.6, 28.0, 27.6, 26.8, 26.6, 23.3, 23.2; ms: m/z 361 (0.8, M^+), 261 (100).

Anal. Calcd. for $C_{17}H_{19}N_3O_4S$ (361.42): C, 56.50; H, 5.30; N, 11.63; S, 8.87. Found: C, 56.41; H, 5.30; N, 11.58; S, 8.90.

tert-Butyl 2-[1-Cyano-1-(2-cyanophenyl)methylene]thiazolidine-3-carboxylate (**22k**).

This compound was obtained as white powder, 1.0 g (26%), mp 119°; ir (potassium bromide): ν 1710, 1590, 1575, 1560, 1490 cm^{-1}; ^1H nmr (deuteriochloroform): δ 7.63-7.50 (m, 3H), 7.36-7.34 (m, 1H), 4.33 (t, 2H), 3.22 (t, 2H), 1.18 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 158.9, 148.6, 139.2, 133.3, 133.2, 129.6, 127.7, 118.9, 117.9, 110.8, 88.8, 83.9, 52.8, 29.3, 27.4; ms: m/z 327 (5, M^+), 227 (100).

Anal. Calcd. for $C_{17}H_{17}N_3O_2S_2$ (327.23): C, 62.35; H, 5.24; N, 12.84; S, 9.80. Found: C, 62.45; H, 5.13; N, 12.89; S, 9.61.

tert-Butyl 2-[1-Cyano-1-(2-cyanophenyl)methyl]-2-methylthiothiazolidine-3-carboxylate (**23a**).

This compound was obtained as white crystals, 0.10 g (7%), mp 99-101°; ir (potassium bromide): ν 2230, 1700 cm^{-1}; ^1H nmr (deuteriochloroform): δ 8.20-8.18 (m, 1H), 7.72-7.65 (m, 2H), 7.54-7.47 (m, 1H), 6.24 (bs, 1H), 4.30-4.26 and 3.99 (2m, 2H), 3.37-3.30 and 3.08-3.02 (2m, 2H), 2.15 (s, 3H), 1.58 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 152.0, 135.4, 133.3, 132.5, 131.5, 129.8, 117.7, 117.1, 115.2, 84.7, 82.8, 54.4, 46.0, 28.7, 28.4, 15.3; ms: m/z 328 (7), 228 (100).

Anal. Calcd. for $C_{18}H_{21}N_3O_2S_2$ (375.33): C, 57.60; H, 5.60; N, 11.20; S, 17.06. Found: C, 57.35; H, 5.53; N, 11.49; S, 16.84.

tert-Butyl 2-[1-Cyano-1-(2-cyanophenyl)methyl]-2-methylthio-3,4,5,6-tetrahydro-1,3-thiazine-3-carboxylate (**23b**).

This compound was obtained as white crystals, 0.39 g (23%), mp 141-142°; ir (potassium bromide): ν 2220, 1680 cm^{-1}; ^1H nmr (deuteriochloroform): δ 8.23-8.21 (m, 1H), 7.69-7.62 (m, 2H), 7.51-7.47 (m, 1H), 6.28 (s, 1H), 3.73-3.70 (m, 2H), 3.21-3.13 and 2.65-2.59 (2m, 2H), 2.39 (s, 3H), 1.93-1.88 and 1.75-1.70 (2m, 2H). 1.48 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 153.9, 135.7, 133.3, 132.3, 131.8, 129.4, 117.7, 117.1, 114.7, 83.0, 78.2, 47.4, 43.8, 26.8, 28.1, 23.5, 17.1; ms: m/z 243 (18), 242 (100).

Anal. Calcd. for $C_{19}H_{23}N_3O_2S_2$ (389.53): C, 58.59; H, 5.95; N, 10.79; S, 16.46. Found: C, 58.30; H, 5.71; N, 11.09; S, 16.19.

tert-Butyl 5-Methylene-2-methylthio-2-(10-oxo-9,10-dihydroanthracen-9-yl)thiazolidine-3-carboxylate (**23c**).

This compound was obtained as white crystals, 1.0 g (44%), mp 162-163°; ir (potassium bromide): ν 1710, 1670, 1630, 1600 cm^{-1}; ^1H nmr (deuteriochloroform): δ 8.19-7.80 (m, 8H), 7.45-7.35 (m, 8H), 5.74 (s, 1H), 4.56 (m, 2H*), 4.48-4.44 (m, 2H), 4.25-4.21 (m, 1H*), 4.16-4.12 (m, 1H), 3.52-3.48 (m, 1H*), 3.34-3.31 (m, 1H), 2.05 (s, 3H), 1.77 (s, 9H*), 1.62 (s, 9H); ^{13}C nmr (deuteriochloroform): δ 185.3, 151.2, 139.4-135.0, 131.3-126.7, 104.1, 103.5, 93.6, 82.7, 81.5, 60.0, 59.3, 52.4, 51.3, 28.5, 13.7; ms: m/z 195 (16), 194 (100).

Anal. Calcd. for $C_{24}H_{25}NO_3S_2$ (439.59): C, 65.57; H, 5.73; N, 3.19; S, 14.59. Found: C, 65.09; H, 5.90; N, 3.25; S, 14.31.

General Procedure for the Deprotection of the *N*-Boc-ketene *N,S*-acetals (**22**).

The *N*-protected ketene *N,S*-acetals **22** were dissolved in 10 ml for one mmole of a 1:1 mixture of trifluoracetic acid and dichloromethane and stirred for 1 hour at room temperature. The reaction mixture was extracted with water (2 x 30 ml), dried over sodium sulfate and evaporated *in vacuo*. The residue was further treated as stated below.

Phenylsulfonyl-3,4,5,6-tetrahydro-1,3-thiazin-2-ylideneacetonitrile (**24a**).

This compound was obtained as white crystals, 0.32 g (20%), mp 138°; ir (potassium bromide): ν 3290, 2190, 1580, 1570 cm^{-1}; ^1H nmr (deuteriochloroform): δ 9.07 (s, 1H), 7.91-7.51 (m, 5H), 3.54-3.50 (m, 2H), 3.10 (t, 2H), 2.19-2.13 (m, 2H); ^{13}C nmr (deuteriochloroform): δ 165.8, 142.5, 133.1, 129.3, 126.4, 41.7, 26.6, 21.3; ms: m/z 280 (100, M^+), 216 (30), 159 (29).

Anal. Calcd. $C_{12}H_{12}N_2O_2S_2$ (280.37): C, 51.41; H, 4.31; N, 9.99; S, 22.87. Found: C, 51.39; H, 4.24; N, 9.72; S, 23.05.

Phenylsulfonylthiazolidin-2-ylideneacetonitrile (**24b**).

This compound was obtained as white crystals, 0.18 g (85%), mp 171°; ir (potassium bromide): ν 3320, 2200, 1590, 1570 cm^{-1}; ^1H nmr ([D_6]-DMSO): δ 9.20 (s, 1H), 7.87-7.62 (m, 5H), 3.89 (bs, 2H), 3.38 (t, 2H); ms: m/z 266 (100, M^+), 202 (22).

Anal. Calcd. for $C_{11}H_{10}N_2O_2S_2$ (266.34): C, 49.61; H, 3.78; N, 10.52; S, 24.08. Found: C, 49.76; H, 3.73; N, 10.36; S, 24.07.

2-Cyano-2-(3,4,5,6-tetrahydro-1,3-thiazin-2-yliden)acetamide (**24c**).

This compound was obtained as white crystals, 0.12 g (79%), mp 166-168°; ir (potassium bromide): ν 3480, 3370, 2180, 1620, 1580 cm^{-1}; ^1H nmr ([D_6]-DMSO): δ 11.38 (s, 1H), 6.58 (s, 2H), 3.44-3.41 (m, 2H), 3.13 (t, 2H), 2.02-1.96 (m, 2H); ^{13}C nmr ([D_6]-DMSO): δ 169.3, 166.5, 119.2, 66.7, 40.2, 25.6, 20.8; ms: m/z 183 (100, M^+), 167 (24).

Anal. Calcd. for $C_7H_9N_3OS$: (183.23): C, 45.89; H, 4.95; N, 22.93; S, 17.50. Found: C, 46.01, H, 4.92; N, 23.01; S, 17.39.

3-Oxo-3-phenyl-2-(3,4,5,6-tetrahydro-1,3-thiazine-2-ylidene)propionitrile (**24d**).

This compound was obtained as white crystals, 0.075 g (52%), mp 159-161°; ir (potassium bromide): ν 3400-3360, 2180, 1580, 1570, 1500 cm^{-1}; ^1H nmr (deuteriochloroform): δ 12.94 (s, 1H), 7.77-7.74 (m, 2H), 7.48-7.39 (m, 3H), 3.56-3.52 (m, 2H), 3.14 (t, 2H), 2.19-2.13 (m, 2H); ^{13}C nmr (deuteriochloroform): δ 190.5, 171.4, 139.1, 131.0, 128.1, 127.8, 119.8, 79.9, 41.0, 26.3, 20.5; ms: m/z 244 (72, M^+), 243 (100).

Anal. Calcd. for $C_{13}H_{12}N_2OS$ (244.32): C, 63.91; H, 4.95; N, 11.47; S 13.12. Found: C, 63.98; H, 4.96; N, 11.48; S, 12.96.

1,3-Dimethyl-5-(3,4,5,6-tetrahydro-1,3-thiazine-2-ylidene)hexahydropyrimidine-2,4,6-trione (**24e**).

This compound was obtained as white crystals, 0.20 g (71%), mp 212-213°; ir (potassium bromide): ν 2960, 2940, 2860, 1690, 1640, 1610, 1580 cm^{-1}; ^1H nmr (deuteriochloroform): δ 12.99 (s, 1H), 3.62-3.59 (m, 2H), 3.31 (s, 6H), 3.00 (t, 2H), 2.19-2.16 (m, 2H); ^{13}C nmr (deuteriochloroform): δ 200.9, 173.1, 151.2, 89.3, 41.3, 27.6, 26.7, 19.7; ms: m/z 255 (100, M^+), 240 (15).

Anal. Calcd. for $C_{10}H_{12}N_3O_3S$ (254.29): C, 47.23; H, 4.76; N, 16.52, S, 12.61. Found: C, 46.95; H, 4.94; N, 16.40; S, 12.57.

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