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NOVEL EXCHANGE REACTION OF 2-IMINO OR 2-THIONO DERIVATIVES OF 1,3-THIAZINES AND 1,3-OXAZINES WITH p-TOLUENESULFONYL ISOCYANATE

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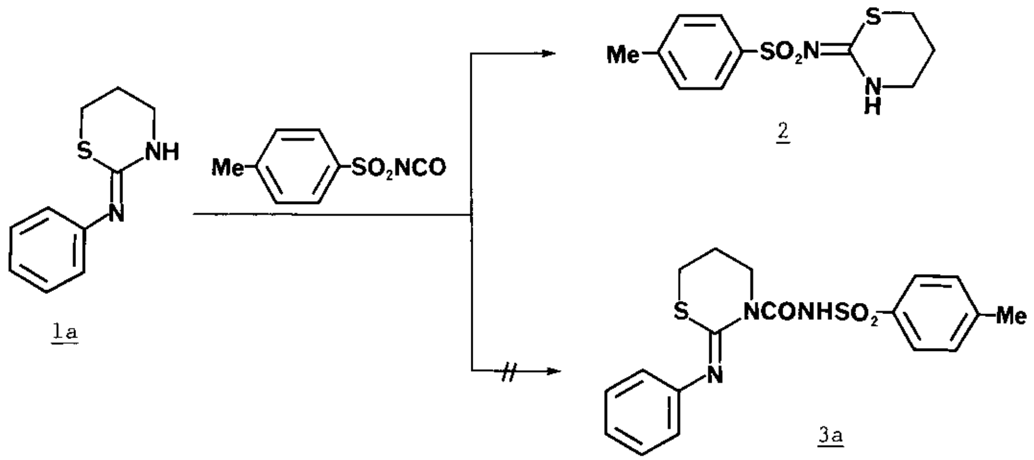
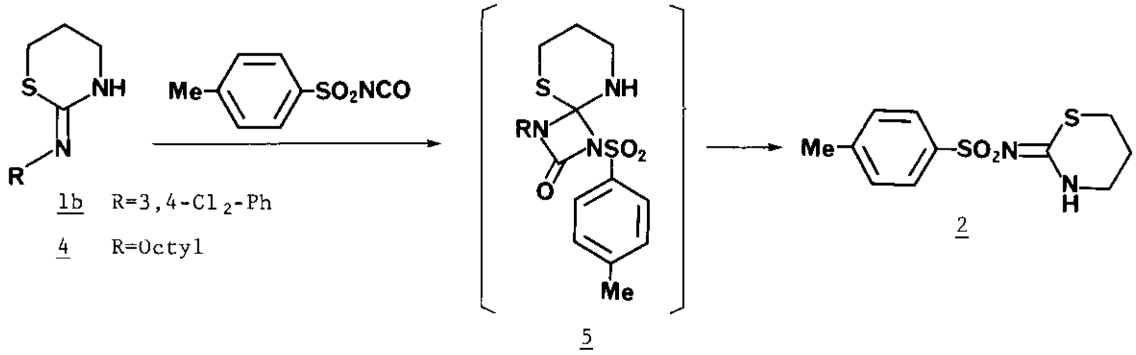
Abstract ——— The reaction of 2-arylimino-1,3-thiazine with p-toluenesulfonyl isocyanate led to the formation of 2-(p-toluenesulfonyl)imino-1,3-thiazine. A similar reaction carried out with 1,3-thiazine-2-thione and 1,3-oxazine-2-thione gave 2-(p-toluenesulfonyl)imino-1,3-thiazine or 1,3-oxazine, respectively.

In the course of our study on the synthesis of 1,3-thiazine derivatives 1,[1,2] N-sulfonyl carbamoyl derivatives 3 had to be prepared. We found that 2-phenylimino-1,3-thiazine 1a readily underwent cycloaddition with p-toluenesulfonyl isocyanate to give p-toluenesulfonylimino-1,3-thiazine 2. We report here on the cycloaddition reaction of 1,3-thiazine and 1,3-oxazine derivatives with p-toluenesulfonyl isocyanate. Reaction of 2-phenylimino-1,3-thiazine 1a, which was prepared from phenyl isothiocyanate according to the reported procedure,[3] with p-toluenesulfonyl isocyanate in benzene or toluene did not give the desired product 3a, but the product 2 (Scheme 1).

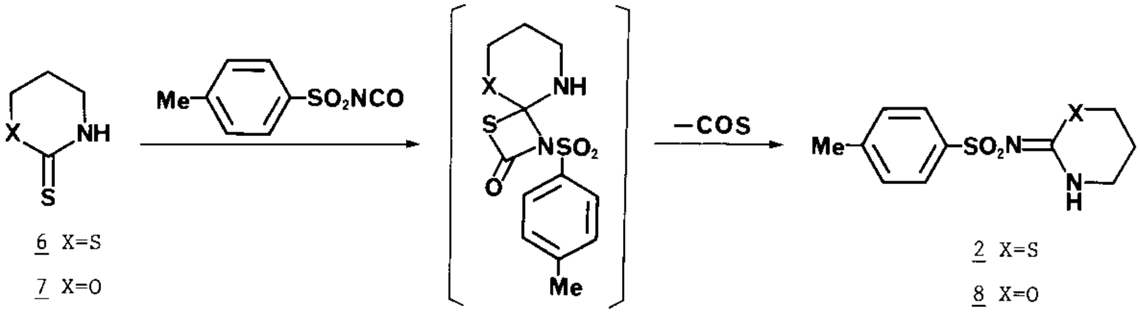


Scheme 1

The structure of 2 was confirmed by spectral data and elemental analysis. In order to examine the generality of our observation, reactions of 1,3-thiazines such as 2-(3,4-dichlorophenyl)imino- 1b and octylimino-1,3-thiazine 4 were studied under similar conditions. In all the cases, *p*-toluenesulfonylimino-1,3-thiazine was obtained as the sole product (Scheme 2). This reaction presumably proceeds *via* the initially formed [2+2]cycloadducts 5 which undergo subsequent elimination of phenyl or alkyl isocyanate. Although the [2+2]cycloaddition reaction of sulfonyl isocyanate with C=C, C=O or the thiocarbamate C=S bond has been reported,[4-6] the reaction with the C=N bond of 2-imino-1,3-thiazines has not yet been reported. It is especially interesting that acidic NH in the thiazine ring did not react with isocyanate. Extension of this reaction to 1,3-thiazine-2-thione 6 or 1,3-oxazine-2-thione 7 in place of a 2-imino such as 1a, 1b and 4 gave the desired product 2 or 8, respectively, in high yield as shown in Scheme 3.



Scheme 2



Scheme 3

The application and limitations of this reaction are under further investigation.

Table 1. Reaction of 1,3-thiazines with p-toluenesulfonyl isocyanate

Compound No.	Solvent	Reaction temp.	Reaction time (h)	Yield (%) 2
1a	toluene	reflux	9	73
1b	benzene-dimethoxyethane	reflux	13	90
4	benzene	r. t.	3	88
6	toluene	reflux	10	69

EXPERIMENTAL

All melting points are uncorrected. ^{1}H Nmr spectra were obtained on a JEOL JNM-PMX 60Si spectrometer with TMS as the internal standard. Ir spectra were measured on a Hitachi 260-10 infrared spectrophotometer. Mass spectra were measured on a Hitachi RMU-8GN mass spectrometer.

Preparation of 2-(p-Toluenesulfonyl)imino-5,6-dihydro-4H-1,3-thiazine (2).

The results are summarized in Table 1. A mixture of 2-phenylimino-1,3-thiazine 1a (0.48 g, 2.5 mmol) and p-toluenesulfonyl isocyanate (0.59 g, 3.0 mmol) in toluene (6 ml) was refluxed for 9 h. The reaction mixture was poured into water and extracted with methylene chloride. The extract was washed with water, dried over anhydrous sodium sulfate and concentrated under reduced pressure. The residue was recrystallized from methylene chloride to afford 0.49 g (73%) of 2, mp 193-194°C; ir (KBr) 1582 (C=N), 1377 (SO_2) cm^{-1}; ^{1}H nmr ($CDCl_3$)δ 1.92 (2H,m), 2.38 (3H,s), 2.99 (2H,t,J=6.2Hz), 3.29 (2H,m), 7.29 (2H,d,J=8Hz), 7.83 (2H,d,J=8Hz), 8.80 (1H,br); ms m/z: 270 (M^+); (Found: C, 48.63; H, 5.21; N, 10.18; S, 23.56. Calcd for $C_{11}H_{14}N_2O_2S_2$: C, 48.87; H, 5.22; N, 10.36; S, 23.72%).

2-(p-Toluenesulfonyl)imino-5,6-dihydro-4H-1,3-oxazine (8).

A mixture of 1,3-oxazine-2-thione (0.47 g, 4.0 mmol) and p-toluenesulfonyl isocyanate (0.95 g, 4.8 mmol) in toluene (8 ml) was treated as described above (refluxed for 4 h) to give 0.90 g (89%) of 8, mp 195-196°C (from benzene); ir ($CHCl_3$) 1630 (C=N), 1310 (SO_2) cm^{-1}; ^{1}H nmr ($CDCl_3$)δ 2.02 (2H,m), 2.41 (3H,s), 3.50 (2H,dt,J=6,5Hz), 4.35 (2H,t,J=5.5Hz), 7.30 (2H,d,J=8Hz), 7.85 (2H,d,J=8Hz), 8.70 (1H,br); ms m/z: 254 (M^+); (Found: C, 51.99; H, 5.55; N, 10.87. Calcd for $C_{11}H_{14}N_2O_3S$: C, 51.95; H, 5.55; N, 11.02%).

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