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[4+2]-CYCLOADDITIONS OF THIONES WITH NITROSOALKENES: SYNTHESIS OF DERIVATIVES OF 4H-1,5,2-OXATHIAZINE, A NEW HETEROCYCLIC SYSTEM.

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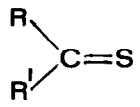
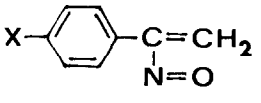
Summary: Conjugated nitrosoalkenes, generated in situ via dehydrobromination of α-bromoketoximes, undergo an easy [4+2]-cycloaddition with thiocarbonyl compounds to give very high yields of the new heterocycles 4H-1,5,2-oxathiazines. The thermolysis and the behaviour to oxidation of these adducts were tested.

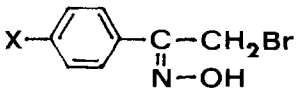
Cycloaddition reactions between heterodienes and heterodienophiles have shown their great potentiality for synthetic approaches in heterocyclic chemistry. Many thiones[2-8] are reported to act as heterodienophiles in cycloadditions with 1,3-dienes. We have recently reported one of the few examples of cycloaddition of thiones with heterodienes, i.e. the reaction of thiofluorenone with stable azoalkenes.[9,10] Nitrosoalkenes are known to act as 1,3-heterodienes in [4+2]-type cycloaddition reactions with nucleophilic alkenes leading to the formation of 5,6-dihydro-4H-1,2-oxazines.[11,12] We used successfully α-nitrosoalkenes (**2**) and thiones (**1**) in order to obtain the first representatives of the 4H-1,5,2-oxathiazine ring. The heterodienes were generated in situ by dehydrobromination of α-bromoketoximes (**3**) with Na_2CO_3 in CH_2Cl_2[11] in the presence of a molar amount of a thione. The reaction mixture was stirred at room temperature for 20-30 hrs; removal of the solvent and chromatography of the residue on silica gave regiospecifically the pure crystalline adducts 3,6,6-triaryl-4H-1,5,2-oxathiazines (**4a-p**) in very high yields (Table).



(1)



(2)



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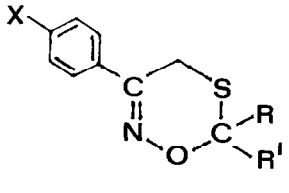
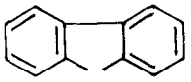
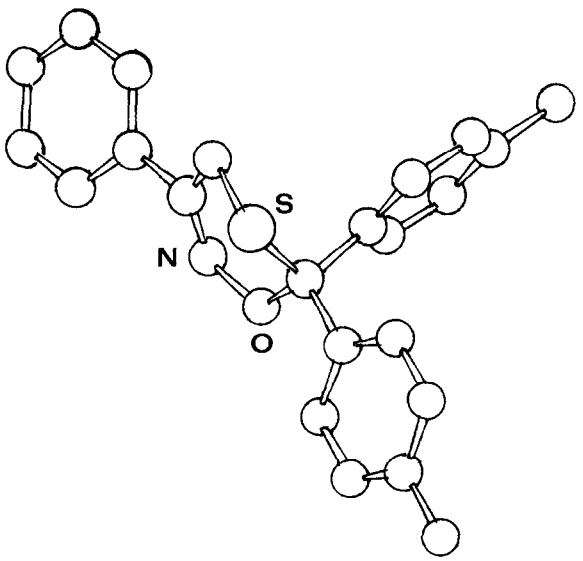


(4)

Table

(4)	X	R	R'	Yield %	m.p. C°
a	H			97	140-1
b	H	Ph	Ph	76	137-8
c	H	p-Tol	p-Tol	91	152-3
d	H	C_6H_4-OCH_3-p	C_6H_4-OCH_3-p	92	142-3
e	H	C_6H_4-NO_2-p	C_6H_4-NO_2-p	97	172-3
f	H	PhS	PhS	93	124-5
g	H	p-Tol	PhS	98	158-9
h	H	Ph	Ph_3Si	91	165-7
i	H	Ph	Me_3Si	60	74-6
l	OCH_3	Ph	Ph	75	142-3
m	OCH_3	p-Tol	p-Tol	91	141-2
n	NO_2	Ph	Ph	75	150-1
o	NO_2	p-Tol	p-Tol	94	187-8
p	NO_2	C_6H_4-NO_2-p	C_6H_4-NO_2-p	99	218-9

The structures of the adducts (**4**) were supported by analytical and spectral data and by an X-ray analysis carried out on crystals of (**4c**) (see figure).



O-N	1.402(4)
O-C(6)	1.428(6)
N-C(3)	1.276(7)
C(3)-C(4)	1.528(9)
S-C(4)	1.790(5)
S-C(6)	1.810(5)
N-O-C(6)	120.4(4)
O-N-C(3)	121.2(5)
N-C(3)-C(4)	128 (1)
C(3)-C(4)-S	111.3(5)
C(4)-S-C(6)	95.0(3)
O-C(6)-S	109.9(4)
C(6)-O-N-C(3)	-18.6
N-O-C(6)-S	53.3
O-N-C(3)-C(4)	0.0
N-C(3)-C(4)-S	-21.5
C(3)-C(4)-S-C(6)	45.1
C(4)-S-C(6)-O	-61.1

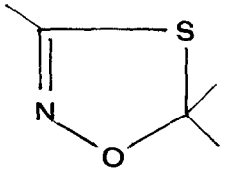
Figure. Crystal structure of (**4c**) and relevant bond distances (Å), bond and dihedral angles (deg.)

Crystal data. $C_{23}H_{21}ONS$, M=359.5, monoclinic, space group $P2_1$, a=11.546(4), b=6.025(2), c=14.252(4) Å, β=110.89(3)°; Z=2, Dc=1.29 g cm^{-3}, U=926.3 $Å^3$, μ=1.45 cm^{-1}, Mo-Kα radiation, λ=0.7107 Å. The structure was solved by direct methods and refined anisotropically, the phenyl rings being excluded. The final R was 0.067.

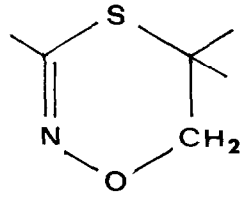
The reaction is completely regiospecific; no trace of the regioisomeric 1,2,6-4H-oxathiazines was detected in the reaction mixtures.

To test the chemical behaviour and the stability of the new 1,5,2-oxathiazine ring, the oxidation and the thermal decomposition of the adduct (**4c**) were performed.

Oxidation of the adduct (**4c**) with 1 mole of MCPBA in diethyl ether at 0°C gave the corresponding S-oxide[13] (**5**) only in low yields due to its high thermal instability. At temperatures above 0°C (**5**) decomposes giving Tol_2CO in nearly quantitative yields together with a complex mixture which we were unable to identify. It should be noted that the similar five-membered sulfoxides 3,5,5-triaryl-1,4,2-oxathiazole-4-oxides[14] (**6**), which differ from (**5**) only for the absence of a methylene group have a higher stability as well as the isomeric 3-aryl-5,6-dihydro-1,4,2-oxathiazine-S-oxides[15] (**7**) in which the methylene group is isolated from the carbon-nitrogen double bond.



(**6**)

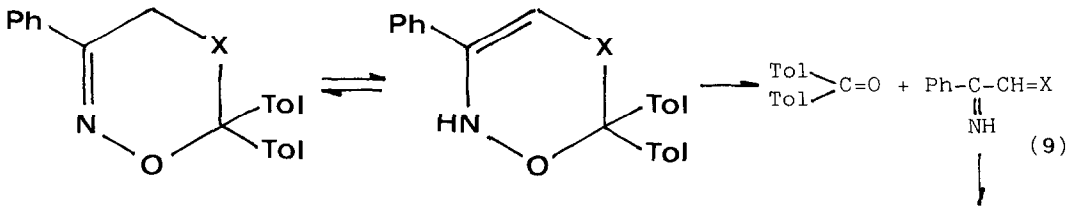


(**7**)

It seems therefore not unlikely that the decomposition of (**5**) could involve a tautomerism from 4H- to 2H-oxathiazine-S-oxide (**8**, X=SO) followed by ring opening leading to the ketone and to the unstable iminosulphine (**9**, X=SO), in agreement with the mechanism proposed for the decomposition of 5,6-dihydro-4H-1,2-oxazines.[16]

The same mechanism can be proposed for the thermal decomposition of (**4c**) in the melt (180°C) or in high boiling solvents at 140-160°C; this gives $Tol_2C{=}O$ quantitatively toghether with many other products not identified.

The higher instability of the sulphoxide (**5**) compared with the sulphide (**4c**) may be due to the presence in (**5**) of more acidic methylene hydrogens



(4c) : X=S

(5) : X=SO

(8)

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