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Oxidation of 3-Sulfanyl-alcohols with Sodium Metaperiodate: New Synthesis of Sultines

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Abstract: **A simple and highly efficient method for preparation of sultines by oxidation of 3-sulfanyl-alcohols with sodium metaperiodate is described.**

There are no reports available about sultines as natural products, except from Rochard's[1] work which showed the presence of the 3-propyl-1,2-oxathiolane-2-oxide in the yellow passion fruit. Nevertheless, many synthetic routes have been investigated from hydroxysulfoxydes upon reaction with SO_2Cl_2[2], sulfones[3] and chloration of sulfanyl-alcohols[4]. In this latter case, Givens et al.[4a] suggested that the sultines were formed via a disulfide intermediate. Their electrophilic cleavage was facilitated by neighboring nucleophilic species to give alkylsulfonates[5a] or intramolecular cyclisations[5b].

We report herein a new synthetic route to sultines with sodium metaperiodate oxidation of 3-sulfanyl-alcohols. This synthesis first forms a disulfide compound which was isolated. The sultines can be obtained easily in a short time (4 hours) with good yields using excess of oxidizing agent (Table 1).

Table 1

3-sulfanyl-alcohols[a] (10 mmol)	$NaIO_4$ (mmol)	Reaction Time	Ratio of disulfides (%)	Ratio of sultines[b] (%)	Structure of sultines
CH_3-CH(SH)-CH_2-CH_2-OH	20	4h	0*	80*	1
	10	30 min	50▲	39▲	
		24h	31▲	54▲	
	1.4	30 min	89▲	0▲	
		24h	84▲	3▲	
CH_3-CH(SH)-CH_2-CH_2-OH	20	4h	0*	98*	2
	10	30 min	36▲	64▲	
		24h	22▲	76▲	
CH_3, CH_3-C(SH)-CH_2-CH(CH_3)-OH	20	4h	0*	75*	3
	10	30 min	32▲	57▲	
		24h	32▲	57▲	

[a]The 3-sulfanyl-alcohols were obtained as described in note 6. [b]Mixture of 40/60 diastereomers cis/trans.
*Isolated yields. ▲Ratio established by GC.

Sultines **2** and **3** have never been described. Attempts to synthetise **3** according to the method of King et al.[4b], by chloration of the 4-methyl-4-sulfanylpentan-2-ol in aqueous solution, were unsuccessful. The Table 1 shows that we are able to obtain either disulfide, sultine or a mixture of both depending of the amount of oxidizing agent.

Together with the formation of disulfide and sultine, the presence of iodine was observed. This suggests a change in the oxidation number of iodine from +7 to 0. The presence of iodine is confirmed by sodium thiosulfate titration.

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We have established that 1/7 mol of $NaIO_4$ is necessary to oxidize one mole of 3-sulfanyl-alcohol in disulfide according to the equation (**1**):

$$14\ RSH + 2\ IO_4^- + 2\ H_3O^+ \rightarrow 7\ RSSR + I_2 + 10\ H_2O \qquad (1)$$

Iodine is also involved in the formation of sultines by reaction with the disulfide but this reaction is very slow: only 3% were formed in 24 hours (Table 1). Further addition of 6/7 mol of $NaIO_4$ gave the sultines according to the equation (**2**):

$$7\ RSSR + 6\ IO_4^- + 6\ H_3O^+ \rightarrow 14\ \text{sultines} + 3\ I_2 + 16\ H_2O \qquad (2)$$

Conclusion

The oxidation of 3-sulfanyl-alcohols with $NaIO_4$ represents a new suitable route to sultines. This method proceeds under very simple reaction conditions and can be performed with sodium metaperiodate, a cheap and safe oxidizing agent. A detailed mechanistic study of this oxidation reaction is in progress.

General procedure for oxidation reactions

A solution of $NaIO_4$ (20 mmol) in water (40 ml) was added to a solution of 3-sulfanyl-alcohol (10 mmol) in acetonitrile (20 ml) at room temperature. The mixture was stirred for 4 hours and then extracted with Et_2O (3 x 20 ml). The combined organic solutions were washed with a solution of sodium thiosulphate (0.1M) and dried over Na_2SO_4. The sultines were obtained as a yellow oil with a purity up to 95%, after evaporation of the solvent under reduced pressure. No further purification is required. The sultines were identified by FTIR, GC/MS and multinuclear NMR spectroscopy[7].

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References and Notes

1. Rochard, S. Doctorat ès Sciences Chimie, Université de Nice Sophia-Antipolis, **1994**.
2. Sharma, N. K.; De Reinach-Hirtzbach, J. F.; Durst, T. *Can. J. Chem.* **1976**, 54, 3012-25. Connolly, T. J.; Durst, T. *Tetrahedron Lett.* **1997**, 38, 1337-40.
3. Durst, T.; Charlton, J. L.; Mount, D. B. *Can. J. Chem.* **1986**, 64, 246-49. Harpp, D. N.; Gleason, J. G.; Ash, D. K. *J. Org. Chem.* **1971**, 36, 322-26. Dodson, R. M.; Hammen, P. D.; Davis, R. A. *J. Org. Chem.* **1971**, 36, 2693-98.
4. (a) Givens, E. N.; Hamilton, L. A. *J. Org. Chem.* **1967**, 32, 2857-60. (b) King, J. F.; Rathore, R. *Tetrahedron Lett.* **1989**, 30, 2763-66. (c) King, J. F.; Skonieczny, S.; Khemani, K. C.; Stothers, J. B. *J. Am. Chem. Soc.* **1983**, 105, 6514-15.
5. (a) Oae, S.; Takata, T. *Tetrahedron Lett.* **1980**, 21, 3213-16. (b) Doi, J. T.; Luehr, G. W.; Musker, W. K. *J. Org. Chem.* **1985**, 50, 5716-19.
6. The 3-sulfanyl-alcohols were prepared via the reaction of thioacetic acid with crotonaldehyde, *trans*-2-hexenal and mesityl oxide. Reduction with $LiAlH_4$ gave 3-sulfanylbutan-1-ol, 3-sulfanylhexan-1-ol and 4-methyl-4-sulfanylpentan-2-ol in 65% yield after purification.
7. Spectroscopic data for the selected compounds are given below. ^1H and $^{13}C\{^1H\}$ NMR were run on Brucker AC-200 spectrometer with $CDCl_3$ as solvent. COSY 2D NMR experiments were used for the assigments of signals.
   3-methyl-1,2-oxathiolane-2-oxide: IR: 1121 cm^{-1}. *Cis isomer:* ^1H NMR: δ(ppm) 4.88-4.73 (m, 1H), 4.46-4.25 (m, 1H), 3.19-2.96 (m, 1H), 2.39-2.19 (m, 2H), 1.41 (d, 3H, J=6.5 Hz); $^{13}C\{^1H\}$ NMR: δ 75.3 (C-5), 62.7 (C-3), 29.7 (C-4), 11.1 (CH_3); MS (70eV): 39 (34), 41 (84), 42 (18), 43 (15), 48 (13), 50 (26), 55 (M^+, 100), 56 (23),78 (59), 90 (7), 120 (36), 121 (1), 122 (1). *Trans isomer*: ^1H NMR: δ(ppm) 4.88-4.73 (m, 2H), 4.58-4.25 (m, 1H), 3.46-3.27 (m, 1H), 2.86-2.62 (m, 1H), 1.99-1.83 (m, 1H), 1.23 (d, 3H, J=7.5 Hz); $^{13}C\{^1H\}$ NMR: δ 74.7 (C-5), 66.6 (C-3), 30.1 (C4), 13.1 (CH_3); MS (70eV): 39 (32), 41 (76), 42 (16), 43 (15), 48 (12), 50 (23), 55 (M^+, 100), 56 (22), 78 (54), 90 (6), 120 (37), 121(<1), 122 (<1).
   3, 3-dimethyl, 5-methyl-1, 2-oxathiolane-2-oxide: IR: 1117 cm^{-1}. *Cis isomer:* ^1H-NMR: δ(ppm) 4.90-4.70 (m, 1H), 2.42-1.95 (m, 2H), 1.54 (d, 3H, J=6.2 Hz), 1.39 (s, 3H), 1.25 (s, 3H); $^{13}C\{^1H\}$ NMR: δ 86.7 (C-5), 43.3 (C-4), 23.5 (C-5), 21.4 (C-3), 20.5 (C-3); MS (70eV): 41 (70), 42 (7), 43 (71), 55 (89), 56 (28), 69 (55), 83 (M^+, 100), 92 (43), 104 (14), 133 (8), 148 (3). *Trans isomer*: ^1H-NMR: δ(ppm) 5.31-5.09 (m, 1H), 2.42-1.95 (m, 2H), 1.44 (d, 3H, J=6.4 Hz), 1.36 (s, 3H), 1.35 (s, 3H); $^{13}C\{^1H\}$ NMR: δ 84.1 (C-5), 44.3 (C-4), 24.3 (C-5), 21.2 (C-3), 20.1 (C-3) MS (70eV): 41 (70), 42 (7), 43 (91), 55 (M^+, 100), 56 (32), 69 (48), 83 (99), 92 (60), 104 (17), 133 (<1), 148 (2).