Pergamon

Tetrahedron Letters, Vol. 37, No. 20, pp. 3585-3586, 1996

0040-4039/96 $15.00 + 0.00

S0040-4039(96)00628-4

EASY AVAILABILITY OF MORE CONCENTRATED AND VERSATILE DIMETHYLDIOXIRANE SOLUTIONS

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Abstract: Four to five-fold increase in concentration or the possibility of isolation in "acetone-free" medium has become possible for dimethyldioxirane solutions by employing a simple work-up procedure.

Key words: Dimethyldioxirane, preparation.

The advantages of dioxiranes as oxidation reagents in organic synthesis, *i.e.* easy of preparation and manipulation, high reactivity under neutral and mild conditions, broad scope of substrates and simple work-up procedures, account for their numerous applications reported during recent years. Among dioxiranes, dimethyldioxirane (DMD) has been the most widely used reagent, although the reactivity exhibited by methyl(trifluoromethyl)dioxirane (TFMD) has led to remarkable synthetic transformations.[1,2]

Despite the above properties, use of DMD isolated in solution still presents some important drawbacks, particularly for large scale operations. In addition to the poor conversion yields obtained in the generation of DMD from caroate and acetone in buffered medium, the solutions isolated following the distillation procedures reported so far are within the 80 mM concentration range in acetone. [3,4] Often, these solutions are too diluted for working at the multigram scale. Moreover, the distillation procedure makes difficult to control the water contents of the DMD solution, which compels the employment of drying procedures not always reliable for delicate applications. For instance, the stability of dioxiranes in the presence of molecular sieves has been questioned.[5]

On the other hand, Adam et al. reported the isolation of "ketone free" TFMD solutions by means of the dilution of the TFMD distillate with CCl_4 or CH_2Cl_2 followed by water washings, which enabled the study of the thermally and photochemically initiated radical chain decomposition of this dioxirane.[6] However, no related procedure had been reported for the case of DMD solutions, probably due to the higher solubility of acetone in common organic solvents. In the present communication we report simple experimental procedures for obtaining more concentrated and "acetone-free" DMD solutions starting from the DMD solution isolated by distillation.

The extraction of the DMD distillate (80 mM), after diluted with the same volume of water, with small amounts of CH_2Cl_2, $CHCl_3$ or CCl_4, led to the quantitative incorporation of DMD into the organic fraction with a concomitant increase in its concentration (0.14-0.18 M). It is worth of noting that the first CCl_4 extract exhibited a four-fold increase in DMD concentration (0.3 M), and that after 2 extractions, DMD concentration in either $CHCl_3$ or CCl_4 was over 0.2 M with recoveries over 65%. However, these solutions still contained a high amount of acetone (approx. 8-9 M).

Our next goal was the isolation of "acetone-free" DMD solutions, *i.e.*, solutions where DMD concentration would be higher than that of acetone. The simple washing of the organic extracts with phosphate buffer [7] afforded the desired results (table 1). Thus, in all cases lower acetone than DMD concentrations were achieved in the organic extract after a number of washings which depended upon the

solvent. The lowest number of washings corresponded to the CCl_4 extract as expected from its lipophilicity, whereas the highest DMD concentration values were obtained in the CH_2Cl_2 extract (close to 0.4 M). Actually, 5 phosphate washes would afford in this case near 0.6 M DMD solutions (>70% DMD recovery, residual acetone ca. 1.8 M), which can be suitable enough for selected synthetic applications. Another feature from data of table 1 is that acetone values in the organic extracts only represent 1-2% with respect to its contents in the original DMD distillate.[8]

Table 1. Concentration values of DMD and acetone in different chlorinated solvent extracts after washing with 0.1 M phosphate buffer (pH 7) [a].

Solvent	Washes with buffer (N)	DMD		Acetone
		Concn. (mM)	Recovery (%)	Concn. (mM)
CH_2Cl_2	10	346 ± 30	45 ± 7.3	288 ± 32
$CHCl_3$	15	220 ± 31	37 ± 8.3	158 ± 73
CCl_4	3	268 ± 20	41 ± 7.0	155 ± 82

[a] The DMD soln. (80 mM)[4], was diluted with the same volume of water and extracted (4 x 1/40 final volume) with the corresponding chlorinated solvent. Subsequent washes were carried out by using 1.5 volumes of the buffer solution. All glassware and solvents used were previously maintained in the freezer for 15 min. Values are given ± s.d. (n = 3).

The concentrated DMD solutions exhibited a stability comparable to the conventional diluted ones. As anticipated, the drying of these solutions was easier and more reproducible than that observed for the 80 mM solutions in acetone.[9] On the other hand, the availability of DMD solutions in solvents other than acetone makes possible the direct NMR monitoring of reactions in $CDCl_3$, which was formerly unpractical due to the large presence of acetone. Likewise, the IR spectrum of the "acetone-free" DMD solution in CCl_4 could be registered; in this case, the subtraction of the absorptions due to residual acetone afforded the full DMD spectrum, *i.e.*, 3006, 2979, 2937, 1448, 1382, 1350, 1328, 1243 and 1126 cm^{-1} (cf. data from ref. 3).

In summary, a very simple work-up procedure has been developed for obtaining more concentrated DMD solutions or solutions of this reagent in solvents other than acetone. These results broaden the field of DMD application by facilitating, for instance, operations at larger scales. On the other hand, it can be envisaged the possibility of isolating pure dioxiranes if appropriate extraction solvents are used. Investigations along this line are in progress in our laboratory.[10]

Notes and References.

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7. Actually , water could be also used to wash the organic fractions, but phosphate buffer afforded better phase separations, particularly when working with CH_2Cl_2.
8. If convenient, the DMD remaining in the aqueous phase could be almost quantitatively recovered by reextraction.
9. An assay was carried out by extracting a TFMD solution (9 ml, 0.52 M) with CCl_4 (1 ml). The results obtained for the 3 successive extracts carried out, expressed as molar concentration of TFMD, % TFMD recovery and molar concentration of the remaining TFA were, respectively: i) 1.44, 27%, 2.18; ii) 0.29, 7%, 0.22; iii) 0.05, 1%, 0.15. As shown, the first extract was highly concentrated in TFMD although with low recovery yields; also interesting, most of the initial TFA could be removed at the same time, which was not the case for the DMD extractions. This procedure, which is susceptible of optimization, could be particularly useful for specific studies, *i.a.*, reactions in NMR tubes.

10. Financial support from CICYT-Generalitat de Catalunya (Grant QFN-92-4304) and a fellowship from "Direcció General d'Universitats" to one of us (M.G.) are acknowledged.

(*Received in UK* 23 *February* 1996; *revised* 1 *April* 1996; *accepted* 3 *April* 1996)