Dealkylation of Some Hydrazinium Salts bearing ω-Haloalkyl Substituents by Diazacrown Ethers

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The reactions of some hydrazinium salts bearing ω-haloalkyl substituents with diazacrown ethers gave the hydrazine derivatives and *N*-monoalkylated diazacrown ether salts; dealkylation of the hydrazinium salts occurred.

Host–guest interactions have an important role in relation to many biological processes such as the transport of substrates through organic membranes and enzyme catalysis.[1,2] Interactions between crown ethers and organic ammonium cations are particularly interesting; the functionality of the cosystem (coreceptor, cocarrier or cocatalyst) has been clarified by complexation studies of the crown ether and ammonium cation.[3–5] We have investigated the electronic structure[6–9] and applications[10] of aminimides, which were synthesized from hydrazinium salts. In order to synthesize functionalized diazacrown ether–aminimide carriers for organic membranes,[10–13] we tried the alkylation of diazacrown ethers by the ω-halogenated alkyl group of hydrazinium salts. However, the diazacrown ether–hydrazinium salt, which was formed by the alkylation of the diazacrown ether, was not isolated as dealkylation of the hydrazinium salt had occurred. Generally, dealkylation reactions proceed under severe conditions. However, this dealkylation occurred in refluxing methanol. Detailed studies of the reactions of hydrazinium salts with diazacrown ethers have now been carried out.

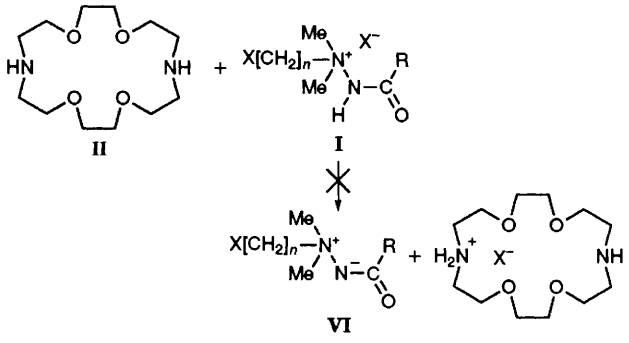
The hydrazinium salts used were prepared by the reactions of hydrazine derivatives with alkyl dihalides or *p*-xylylene dibromide in methanol or benzene. The reactions of hydrazinium salts **I** with diazacrown ether **II** (1,7,10,16-tetraoxa-4,13-diazacyclooctadecane) were performed in methanol. A 1×10^{-4} mol dm^{-3} solution of the hydrazinium salt in methanol (10 ml) was added to a 1×10^{-4} mol dm^{-3} solution of diazacrown ether **II** in methanol (10 ml). The reaction mixture was heated under reflux for 10 h and then cooled. The methanol solution was evaporated to dryness and diethyl ether was added. The salt of *N*-monoalkylated diazacrown ether, which was insoluble in the diethyl ether, precipitated and was collected by filtration. This salt was the same as the reaction product of diazacrown ether with alkyl dihalide in methanol. The diethyl ether filtrate solution was evaporated to give another product, a hydrazine derivative. The structures of the hydrazine derivatives and *N*-monoalkylated diazacrown ether salts were confirmed by 270 MHz NMR (JEOL GX270), IR (Hitachi 260-10) and mass spectroscopy and elemental analysis.

The results of the reaction of various hydrazinium salts **I** with diazacrown ether **II** are summarized in Table 1. As shown in Table 1 and Scheme 2, the ω-halogenated group ($-[CH_2]_3I$, $-[CH_2]_6I$, $-CH_2C_6H_4CH_2Br$) was transferred from the hydrazinium salt to the diazacrown ether, and the hydrazine derivative **III** and *N*-monoalkylated diazacrown ether salt **IV**

Table 1 Products from the reactions of hydrazinium salt **I** with diazacrown ether **II**[a]

Hydrazinium salt **I**		Hydrazine derivative (%)[b]	*N*-Monoalkylated diazacrown ether salt (%)[b]
1a	$Me_2N^+([CH_2]_3I)NHCOPh\ I^-$	95	92
1b	$Me_2N^+([CH_2]_6I)NHCOPh\ I^-$	90	91
1c	$Me_2N^+([CH_2]_3I)NHCOC_6H_4OC_6H_{13}\ I^-$	92	89
1d	$Me_2N^+(CH_2C_6H_4CH_2Br)NHCOPh\ Br^-$	88	90

[a] *Reaction conditions*: hydrazinium salt : diazacrown ether = 1 : 1, reflux in methanol for 10 h. [b] The structures of the hydrazine derivatives and *N*-monoalkylated diazacrown ether salts produced are shown in Scheme 2. The yields (%) of the hydrazine derivative and *N*-monoalkylated diazacrown ether salt are based on the amount of starting materials (hydrazinium salt = diazacrown ether = 1×10^{-4} mol dm^{-3}).



Scheme 1

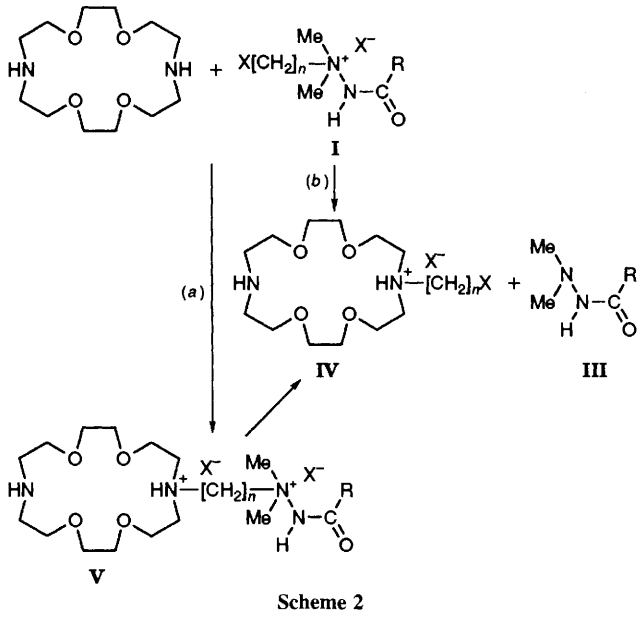
were obtained; that is, dealkylation of the hydrazinium salt **I** had occurred. This reaction proceeded quantitatively and did not depend on the ω-halogenated group or the aryl substituent. Several mechanisms may be considered for the dealkylation. If the diazacrown ether reacts as the base to form the corresponding aminimide **VI** in the first step, the intramolecular alkylation by the ω-halogenated group should occur on either the oxygen or the nitrogen atom.[11,14] However, the products of intramolecular alkylation of the aminimide were not observed. When an excess of diazacrown ether was used, the same result was obtained. In addition, even if an unfavourable geometry exists for the intramolecular alkylation (as with the linear substituent, $-CH_2C_6H_4CH_2Br$) where the intramolecular alkylation should not occur, the hydrazine derivative and *N*-monoalkylated diazacrown ether salt are still obtained. In order to examine the possibility of formation and subsequent reaction of aminimide, the aminimide, synthesized by the published method, was added to methanol. This solution was then refluxed for 10 h[11,13,15] but the aminimide remained unchanged. This suggests that the aminimide is not formed, and therefore that the hydrazine derivative is not formed *via* the aminimide (Scheme 1).

Smith *et al.* reported that *N,N*-dibenzyl-*N*-phenylhydrazinium chloride gives the debenzylation product in refluxing ethanol.[16] Ziegler *et al.* showed that *N*-methyl-2,4,6-triphenylpyridinium salts undergo thermal decomposition giving methyl derivatives and triphenylpyridine.[17] In order to examine the possibility of thermal decomposition of this type, the ethanol solutions containing the hydrazinium salts were heated under reflux for 10 h. The hydrazine derivatives were not formed.

Having confirmed that the hydrazine derivatives are not formed from either the aminimide or by thermal decomposition, we suggest that these derivatives are formed by the direct transfer of the ω-halogenated group from the hydrazinium salt to the diazacrown ether. Two ways were considered (Scheme 2).

The first (*a*) involves the formation of the diazacrown ether–hydrazinium salt **V** as the intermediate; that is, the terminal carbon of the halogenated group of the hydrazinium salt attacks the nitrogen of the diazacrown ether and the quaternary ammonium salt of the diazacrown ether is formed.† After formation of this intermediate, the elimination of the *N*-monoalkylated diazacrown ether moiety from the hydrazinium moiety occurs. Another way (*b*) involves the attack on the carbon of the halogenated group by the anion X^-, and after cleavage of the carbon–nitrogen bond, the halogenated group attacks the nitrogen of the diazacrown ether and an *N*-monoalkylated diazacrown ether salt is formed. Katritzky *et al.* reported that the *N*-substituents of 2,4,6-triphenylpyridinium salts are transferred to tertiary amines by heating with pyridine or its 2- or 4-Me derivatives.[18–20] However, as the hydrazinium salts used in this study are very stable under reflux conditions, it seems unlikely that the route (*b*) would occur. Thus, mechanism (*a*) is reasonable.

A mild dealkylation thus results from the formation of this intermediate and this convenient dealkylation will be applied to other examples.



Scheme 2

Intermediate = Diazacrown ether–hydrazinium salt

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† This intermediate was not isolated. Therefore it is considered to be unstable in refluxing methanol.