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# AN INTRAMOLECULAR DARZENS REACTION OF THE ESTER GROUP WITH THE ACTIVE HALOGEN GROUP. PREPARATION OF 2,7-DIOXABICYCLO[4.1.0]HEPTANES FROM 1-BROMO-4-ACYLOXYBUTANE DERIVATIVES

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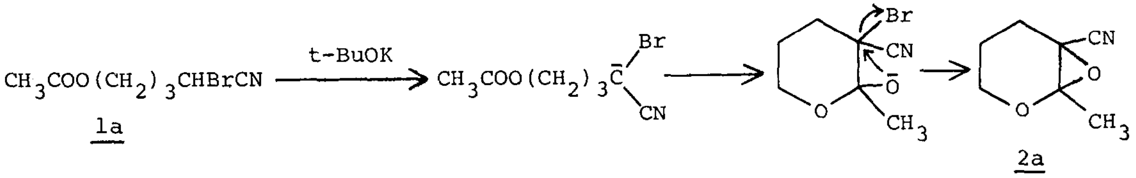
Summary. When 1-bromo-4-acyloxybutanes having electron-withdrawing groups at 1-position, which were obtained by Cu(I)-catalyzed photochemical addition of 1-bromo-2-acyloxyethanes to electron-deficient olefins, were subjected to treatment with potassium t-butoxide, 2,7-dioxabicyclo[4.1.0]heptanes were obtained.

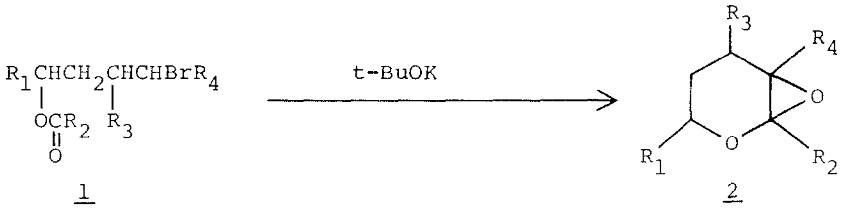
The Darzens reaction has been investigated extensively as an important method for the formation of an oxirane ring.$^{1)}$ However, carbonyl derivatives to form oxirane rings have been limited only to ketones or aldehydes, and formation of 2-alkoxyoxiranes from esters by the Darzens type reaction has not been so far reported to our knowledge although some related reactions have been reported. For example, treatment of α-tosyl lactones with DIBAH has resulted in formation of oxiranes with destruction of the lactone rings$^{2)}$ and 2-alkoxyoxiranes have been obtained by treatment of halomethyl aryl ketones with alkoxides.$^{3)}$ We wish to report here our results that 1-bromo-4-acyloxybutane derivatives having the electron-withdrawing groups at 1-position, which are readily prepared by Cu(I)-catalyzed photochemical addition of 2-acyloxyethyl bromides to electron-deficient olefins,$^{4)}$ afford 2,7-dioxabicyclo[4.1.0]heptane derivatives by potassium t-butoxide via an intramolecular Darzens type reaction

2-Bromo-5-acetoxypentanenitrile (<u>1a</u>) (1.5 mmol) and potassium t-butoxide (2.3 mmol) were stirred in benzene (10 ml) at room temperature for 5 min. Addition of ether, filtration, and evaporation of the solvent gave 1-methyl-6-cyano-2,7-dioxabicyclo[4.1.0]heptane (<u>2a</u>) in 92% yield. This structure was assigned by $^1$H- and $^{13}$C-NMR and IR spectra. This reaction is assumed to proceed via the pathway shown below by taking the traditional Darzens reaction into account.



Various 2,7-dioxabicyclo[4.1.0]heptanes were similarly prepared. These results are shown in Table 1. When the electron-withdrawing group on the carbon bearing a bromine atom is a carbonyl group, the 2,7-dioxabicyclo[4.1.0]heptane derivative could be obtained by the reaction in THF at -35 °C instead of that in benzene at room temperature (Table 1, runs 5,6). This type of reaction did not proceed intermolecularly with esters. For example, 2-bromoheptanenitrile failed to afford an oxirane with ethyl acetate in benzene in the presence of t-BuOK.

Table 1. Preparation of 2,7-dioxabicyclo[4.1.0]heptanes



| Run | 1 | $R_1$ | $R_2$ | $R_3$ | $R_4$ | Solvent | Temp | Yield of 2 / % |
|---|---|---|---|---|---|---|---|---|
| 1 | a | H | $CH_3$ | H | CN | benzene | r.t. | 92 |
| 2 | b | H | $CH_2CH_3$ | H | CN | benzene | r.t. | 91 |
| 3 | c | H | Ph | H | CN | benzene | r.t. | 91 |
| 4 | d | H | $CH_3$ | H | COOEt | benzene | r.t. | 93 |
| 5 | e | H | $CH_3$ | H | COMe | benzene | r.t. | 0 |
| 6 | e | H | $CH_3$ | H | COMe | THF | -35 °C | 45 |
| 7 | f | H | $CH_3$ | H | SOPh | benzene | r.t. | 94 |
| 8 | g | H | $CH_3$ | $CH_3$ | CN | benzene | r.t. | 91 |
| 9 | h | H | $CH_3$ | $CH_3$ | COOEt | benzene | r.t. | 92 |
| 10 | i | H | $CH_3$ | COOEt | COOEt | benzene | r.t. | 54a) |
| 11 | j | $CH_2Br$ | $CH_3$ | H | CN | benzene | r.t. | 90 |

a) $CH_3COO(CH_2)_2C(COOEt)=CHCOOEt$ (41%) was also produced.

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