Tetrahedron Letters No.17, pp. 1151-1153, 1965. Pergamon Press Ltd.
Printed in Great Britain.

A GENERAL METHOD FOR THE PREPARATION OF α-FLUOROALDEHYDES.

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(Received 6 February 1965; in revised form 5 March 1965)

Whilst α-fluoroalkanoic acids are available by halogen exchange in the corresponding α-chloroacids (1), from the p-toluenesulfonates of cyanohydrins and potassium fluoride (2), and by the reaction of diazoalkanes with ethyl fluoroformate (3), in the series of the corresponding α-fluoroaldehydes, only fluoroacetaldehyde has been prepared so far, and in very unsatisfactory yield at that (4-6). Reduction of α-fluoroacids of their derivatives by the usual methods is often accompanied by hydrogenolysis of the C-F bond. However, the reduction of α-fluoroacyl chlorides with lithium aluminium tri-(t-butoxy)-hydride (7) at -70° proved to be generally applicable.

In an atmosphere of nitrogen and at -80°, the reducing agent (0.1 mole), dissolved in tetrahydrofuran (100 ml.), was added to a solution of the α-fluoroacyl chloride (0.1 mole) in the same solvent (100 ml.). Care was taken that during the addition the temperature did not rise above -70°. Then the mixture was permitted to reach slowly room temperature. In order to ascertain the yields of the very volatile products, the reaction mixture was added to an excess of a solution of 2,4-dinitrophenylhydrazine in 2N hydrochloric acid. Thus were obtained the 2,4-

dinitrophenylhydrazones of

fluoroacetaldehyde, m.p. 150° (from ethanol) (lit. (4,6) : between 141.5 and 147°); yield, 52%.

Anal. Calcd. for $C_8H_7FN_4O_4$: C, 39.7; H, 2.9; F, 7.9.
Found : C, 40.0; H, 3.2; F, 7.7.

α-fluoropropionaldehyde, m.p. 135° (from ethanol); yield, 60%.

Anal. Calcd. for $C_9H_9FN_4O_4$: C, 42.2; H, 3.5; F, 7.4.
Found: C, 42.1; H, 3.4; F, 7.0.

α-fluorobutyraldehyde, m.p. 108° (from butanol); yield, 65%.

Anal. Calcd. for $C_{10}H_{11}FN_4O_4$: C, 44.4; H, 4.1; F, 7.0.
Found : C, 44.4; H, 4.2; F, 7.0.

For the preparation of α-fluorobutyryl chloride, the unknown *ethyl α-fluorobutyrate* was obtained by slow addition of ethyl α-bromobutyrate to a well-agitated mixture of potassium fluoride and acetamide (1), kept at 140° and in a vacuum of 150 mm, so that the fluoroester formed distilled off continuously and the temperature at the head of the column never exceeded 80°. Redistillation gave a yield of 39% ; b.p. 136° (690 mm). *α-Fluorobutyryl chloride* was prepared from potassium α-fluorobutyrate and benzoyl chloride; it boiled at 103-104° (690 mm.) and gave an anilide, m.p. 60° (from petroleum ether).

Anal. Calcd. for $C_{10}H_{12}FNO$: C, 66.4; H, 6.6; F, 10.5
Found: C, 66.5; H, 6.4; F, 10.4.

The α-fluorinated aldehydes which have thus become easily available, permit many interesting syntheses which are now being investigated.

After this study had been completed, Elkik (8) reported a similar method for the preparation of α-fluoroaldehydes, *viz.* the reduction of the N-methylanilides of α-fluoroacids by lithium aluminium hydride at -30° to -40°. The yields reported for α-fluorobutyraldehyde and α-fluorovaleraldehyde were 26 and 31% , respectively.

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