

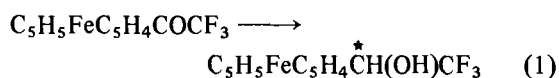
The Reduction of Trifluoroacetylferrocene by Fermenting Baker's Yeast

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There is considerable current interest in the use of optically active ferrocene derivatives as ligands attached to metal centres to catalyze reactions such as the asymmetric hydrogenation of olefins [1, 2] and ketones [3] and the cross-coupling of Grignard reagents [4]. In this field resolution of suitable diastereomers is the usual way of obtaining chiral compounds. Thus the report [5] of the stereoselective reduction of trifluoroacetylferrocene by fermenting yeast to the optically active alcohol (–)-1-ferrocenyl-2,2,2-trifluoroethanol in 50% yield was of interest; although the optical yield was not given, eqn. 1. We now report that in our hands the reduction proceeds in 80% chemical yield but only 33% optical yield.



Experimental

Trifluoroacetylferrocene was prepared from ferrocene and trifluoroacetic anhydride [6]. (^{19}F NMR: 7.6 ppm (singlet) upfield of CFCl_3). This carbonyl compound was reduced with LiAlH_4 to 1-ferrocenyl-2,2,2-trifluoroethanol [6] mp 74–75 °C. *Anal.* Calc. for $\text{C}_{12}\text{H}_{11}\text{F}_3\text{FeO}$: C, 50.53; H, 3.86. Found: C, 50.94; H, 3.97. ^{19}F NMR: doublet 74.0 ppm upfield from CFCl_3 ($J(\text{F}, \text{H}) = 5.6$ Hz).

Reduction of Trifluoroacetylferrocene with Fermenting Yeast

Dry baker's yeast* (20 g), dextrose (20 g), and water (80 ml) were mixed and left for 20 min at 33 °C. The ferrocene compound (0.3 g) in ethanol (5 ml) was added in 1 ml batches over 20 min with

stirring. After 120 h continuous stirring at 33 °C the mixture was extracted with diethyl ether (3 × 200 ml). The extract was dried (Na_2SO_4), evaporated, and the oily residue was chromatographed on Bio-sil A. The yellow product identified as 1-ferrocenyl-2,2,2-trifluoroethanol eluted with ether (80% yield). *Anal.* Calc. for $\text{C}_{12}\text{H}_{11}\text{F}_3\text{FeO}$: C, 50.53; H, 3.86. Found: C, 50.70; H, 3.72. $[\alpha]_{546} = -19.8$; $[\alpha]_{578} = -15.3$; $[\alpha]_{\text{D}} = -13.2$ [0.01 M in benzene]. The ^1H and ^{19}F NMR spectra were identical with an authentic sample.

Discussion

The optical rotations found in this study for the alcohol are greater than those reported previously [5]. When the chiral shift reagent tris-[3-(heptafluoropropyl-hydroxymethylene)-*d*-camphorato]europium (III) is added in a 1:1 mole ratio to a solution of the racemic alcohol, the ^{19}F NMR spectrum alters from a doublet to a triplet composed of two equal-area overlapping doublets. When the spectrum of the alcohol obtained from the fermentation reaction is determined under the same conditions two overlapping doublets, area ratio 2:1, are seen. Thus the optical purity of the alcohol is 33%.

The fermenting yeast did not reduce acetylferrocene or benzoylferrocene as has been observed by others [5]. It is unusual that the natural CH_3CO -functionality should be rejected yet the reduction of the fluorinated analogue proceeds easily and with moderate stereoselectivity.

Acknowledgment

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*Fleischmann's baker's yeast obtained from Safeway Stores Ltd.