Inorganica Chimica Acta, 46 (1980) L85

The Reduction of Trifluoroacetylferrocene by Fermenting Baker's Yeast

WILLIAM R. CULLEN and MARTIN FISHMAN

Chemistry Department, University of British Columbia, Vancouver, B.C. V6T 1Y6, Canada

Received April 15, 1980

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.

$$C_5H_5FeC_5H_4COCF_3 \longrightarrow C_5H_5FeC_5H_4\overset{*}{C}H(OH)CF_3 \qquad (1)$$

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 $C_{12}H_{11}F_3FeO$: 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(F, 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.* Calcd. for $C_{12}H_{11}F_3FeO$: C, 50.53; H, 3.86. Found: C, 50.70; H, 3.72. $[\alpha]_{546}$, –19.8; $[\alpha]_{578}$, –15.3; $[\alpha]_D$ = –13.2 [0.01 *M* in benzene]. The ^{1}H 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

The authors wish to thank NSERC Canada for financial assistance.

References

1 W. R. Cullen, F. W. B. Einstein, E.-S. Yeh and A. W. Willis, *J. Am. Chem. Soc., 102,* 988 (1980).
2 T. Hayashi, A. Katsumura, M. Konishi and M. Kumada, *Tet. Lett.,* 425 (1979).
3 T. Hayashi, T. Mise and M. Kumada, *Tet. Lett.,* 4351 (1976).
4 T. Hayashi, M. Tajika, K. Tamao and M. Kumada, *J. Am. Chem. Soc., 98,* 3718 (1976).
5 A. Ratajczak and B. Misterkiewicz, *Chem. Ind. (London), 902 (1976).*
6 E. B. Sokolova, G. P. Chalykh, T. A. Malikova, L. B. Sevost'yanova and O. A. Nemchinovax, *Zh. Obshch. Khim., 43,* 1333 (1973).

---

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