

"Biochemical Resolution and Generation of Planar Chirality in Formyl Substituted (Diene)Fe(CO)₃ Complexes"

James A.S. Howell*, Michael G. Palin

Chemistry Department, Keele University, Keele, Staffordshire, ST5 5BG, Great Britain

Hassane El Hafa, Siden Top, Gérard Jaouen

Ecole Nationale Supérieure de Chimie, 11 Rue Pierre et Marie Curie, 75231 Paris Cedex 05, France

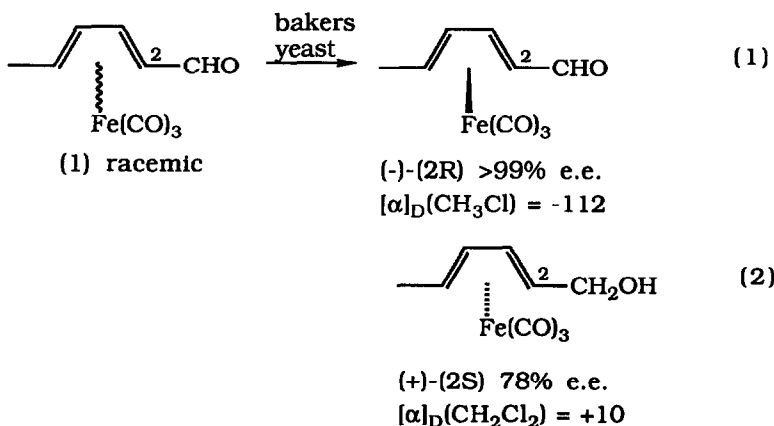
(Received 14 August 1992; accepted 22 September 1992)

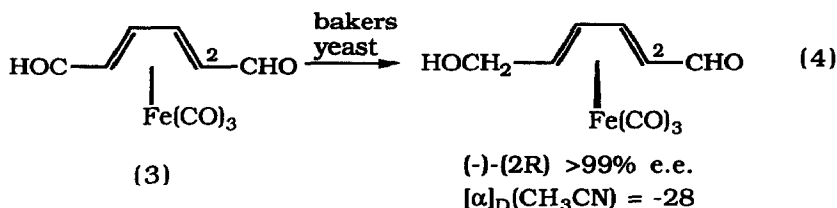
Abstract: Kinetic resolution of (2,4-hexadien-1-yl)Fe(CO)₃ and asymmetric reduction of (2,4-hexadien-1,6-dial)Fe(CO)₃ using bakers yeast proceed with high efficiency and enantioselectivity.

(Diene)Fe(CO)₃ complexes continue to attract attention as chiral synthons in asymmetric synthesis,⁽¹⁾ and in particular, formyl substituted complexes have been applied recently to the preparation of leukotriene analogues.⁽²⁾ Though homochiral materials have been prepared by conventional resolution procedures,⁽³⁾ we are aware of only one example of an enzymatic kinetic resolution,⁽⁴⁾ namely the pig liver esterase catalysed hydrolysis of (2-ethoxycarbonylbuta-1,3-diene)Fe(CO)₃. We wish to report here the first examples of reductive kinetic resolution and generation of planar chirality in the (diene)Fe(CO)₃ series using bakers yeast, a reagent which interacts selectively with a wide range of substrates⁽⁵⁾ and which has recently been applied to kinetic resolution in the (arene)Cr(CO)₃ series.⁽⁶⁾

The results are presented in Scheme 1. Thus, reduction of (1) to ca. 60% completion⁽⁷⁾ provides homochiral aldehyde together with the alcohol (2) of 78% enantiomeric excess. The alcohol may be reconverted to aldehyde in good yield by Swern oxidation. Reduction of the meso complex (3)⁽⁸⁾ with bakers yeast⁽⁹⁾ provides the hemialcohol (4) in good yield and high enantiomeric excess. This type of generation of planar chirality (chemical⁽¹⁰⁾ or enzymatic⁽¹¹⁾) is rare in organometallic chemistry.

Scheme 1





The absolute configurations are those shown in Scheme 1, and are based on a comparison of optical rotation and circular dichroism spectra with samples of known configuration.⁽¹²⁾

The results thus demonstrate the possibility of efficient bioconversion in the (diene)Fe(CO)₃ series; extension of this work to other substrates and other enzymatic systems is currently under investigation.

We thank the British Council (Alliance) and the C.N.R.S. for support of this work.

REFERENCES

- Grée, R., *Synthesis*, 1989, 5, 341.
- Nunn, K., Mosset, P., Grée, R., Saalfrank, R.W., *J. Org. Chem.*, 1992, 57, 3359.
- (a) Monpert, A., Martelli, J., Grée, R., Carrié, R., *Tetrahedron Lett.*, 1981, 22, 1961; (b) Franck-Neumann, M., Martina, D., Heitz, M.P., *J. Organomet. Chem.*, 1986, 301, 61; (c) Xu, M., Tran, C.D., *J. Chromatography*, 1991, 543, 233.
- Alcock, N.W., Crout, D.H.G., Henderson, C.M., Thomas, S.E., *J. Chem. Soc., Chem. Commun.*, 1988, 746.
- Csuk, R., Glanzer, B.I., *Chem. Rev.*, 1991, 91, 49.
- Top, S., Jaouen, G., Baldoli, C., del Buttero, P., Maiorana, S., *J. Organomet. Chem.*, 1991, 413, 125.
- To degassed water (100 ml) was added bakers yeast (10 g) and glucose (2.5 g). After equilibration at 25°C for 30 minutes, complex (1) (280 mg, 1.2 mmol) dissolved in ethanol (2 ml) was added and the mixture stirred for 1.5 hours until tlc indicated approximately 50% conversion. The mixture was extracted with diethyl ether (5 x 200 ml) and dried over MgSO₄. After removal of solvent, preparative tlc yielded (1) (90 mg, 32%) and (2) (150 mg, 53%). The optical purity of (1) was judged to be >99% (aldehyde resonance, tris[3-(heptafluoropropylhydroxymethylene)-(+)-camphorato]europium(III) while (2) was analysed using chiral hplc (Chiralcell O.J. 0.5 column).
- Prepared from (dimethylmuconate) Fe(CO)₃ by DIBAL reduction and Swern oxidation.
- Complex (3) (250 mg, 1 mmol) dissolved in ethanol/dioxane (2:1, 3 ml) was added to bakers yeast prepared as above and stirred at 25°C for 3 hours. The reaction was stopped at the first appearance of (2,4-hexadien-1,6-diol)Fe(CO)₃. Purification as above yielded (4) (200 mg, 80%) whose e.e. was judged by nmr (aldehyde resonance, tris[3-(heptafluoropropylhydroxymethylene)-(+)-camphorato]europium(III). A single crystallization yields homochiral material.
- Rousch, W.R., Park, J.C., *Tetrahedron Lett.*, 1990, 31, 4707.
- Malezieux, B., Jaouen, G., Salaun, J., Howell, J.A.S., Palin, M.G., McArdle, P., O'Gara, M., Cunningham, D., *Tetrahedron: Asymmetry*, 1992, 3, 375.
- (a) Djedani, F., Grée, D., Martelli, J., Grée, R., Leroy, L., Bolard, J., Toupet, L., *Tetrahedron Lett.*, 1989, 30, 3781; (b) Howell, J.A.S., Tirvengadam, M.C., Squibb, A.D., Walton, G., McArdle, P., Cunningham, D., *J. Organomet. Chem.*, 1988, 347, C5.