

Study of the biorreduction of halogenated enones by supported microorganisms

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Abstract

The catalytic efficiency of enzymes from *Saccharomyces cerevisiae* can be applied to biocatalysis¹. The main enzymes found in *S.cerevisiae* are Alcohol Dehydrogenases (ADH) and Old Yellow Enzymes (OYE). ADH and OYE rapidly reduce compounds such as 3-bromo-4-phenyl-3-buten-2-one thus complicating the acquisition of their reaction intermediates, such as α -bromoketone. Through the use of biphasic systems and immobilisation techniques it is possible to increase the chemoselectivity of these reactions in order to obtain α -bromoketone by preferential olefin reduction by OYE.

Key words: Immobilisation, Saccharomyces cerevisiae, 3-bromo-4-phenyl-3-buten-2-one.

Introduction

Biocatalysis involving *S.cerevisiae* is largely employed in organic synthesis due to the efficiency of the enzymes² ADH and OYE. Carbonyl compounds with an electron-withdrawing group, e.g. 3-bromo-4-phenyl-3-buten-2-one (**1**), are rapidly reduced by the actions of ADH and OYE, which complicates the process of obtaining the α -bromoketone intermediate (**2**). Immobilisation of the *S.cerevisiae* in a calcium alginate gel allows for the confinement of the cells inside a physical structure which not only decreases the amount of available 3-bromo-4-phenyl-3-buten-2-one, but also isolates the reduction pathway and the number of purification steps of the product.

Results and Discussion

Biphasic systems of water-solvent resulted in the best rates of olefin reduction and decreased the reaction velocity of ketone reduction (Fig. 1). In order to optimise the production of α -bromoketone, the following conditions were optimised: mass of cells, proportion water-solvent and volume of solvent.

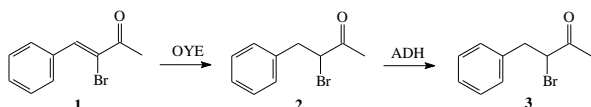


Figure 1. Reduction of 3-bromo-4-phenyl-3-buten-2-one by *Saccharomyces cerevisiae*

The optimum condition was that of a biphasic system of water-ionic liquid [bmim(PF₆)] at a ratio of 5:1 with 5g of cells. This resulted in an

increase of α -bromoketone and near total consumption of 3-bromo-4-phenyl-3-buten-2-one in 24 hours (Fig. 2). These data were tested by scaling up the reaction (5x) to assess its reproducibility. The substrate and products were analysed by gas chromatography–mass spectrometry.

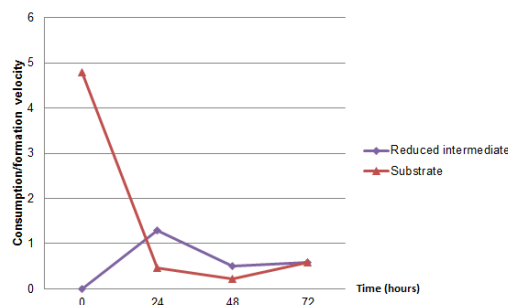


Figure 2. Profile of 3-bromo-4-phenyl-3-buten-2-one reduction by *S.cerevisiae* immobilized in calcium alginate gel using water-[bmim(PF₆)] (5:1) as solvent

Conclusions

The desired α -bromoketone was obtained through immobilisation of the yeast in calcium alginate gel using water-[bmim(PF₆)] (5:1) as solvent, allowing the isolation of α -bromoketone in appropriate quantity for analyses.

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¹ Nelson, D. L.; Cox, M. M.; Lehninger: Principles of biochemistry, 3rd Ed., 2002, 189.

²Zampieri, D.S.; de Paula, B.R.S.; Zampieri L.A.; Vale, J.A.; Rodrigues, J.A.R.; Moran, P.J.S. *J. Mol. Catal. B Enzym.* 2013, 85, 61.