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ORIGINAL PAPER

Enantioseparation of mandelic acid enantiomers in ionic liquid aqueous two-phase extraction systems

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In the past decade, ionic liquids have received great attention owing to their potential as green solvent alternatives to conventional organic solvents. In this work, hydrophobic achiral ionic liquids (1-butyl-3-methylimidazolium-hexafluorophosphate([bmim][PF_6]), 1-octyl-3-methylimidazolium tetrafluoroborate([omim][BF_4])) were used as solvents in chiral liquid–liquid extraction separation of mandelic acid (MA) enantiomers with β-cyclodextrin (β-CD) derivatives as hydrophilic chiral selectors preferentially forming complexes with (*R*)-enantiomers. Factors affecting the separation efficiency were optimised, namely the type of the extraction solvents and β-CD derivatives, concentrations of the β-CD derivatives and MA enantiomers, pH, and temperature. Excellent enantioseparation of MA enantiomers was achieved in the ionic liquid aqueous two-phase extraction systems under the optimal conditions of pH 2.5 and temperature of 5 °C with the maximum enantioselectivity (α) of 1.74. The experimental results demonstrated that the ionic liquid aqueous two-phase extraction systems with a β-CD derivative as the chiral selector have a strong chiral recognition ability, which might extend the application of ionic liquids in chiral separation.

Keywords: ionic liquids, enantioseparation, mandelic acid enantiomers, extration

Introduction

Life on earth is based on chiral biomolecules such as enzymes, proteins, and DNA (Horvath et al., 2004). Because of the natural asymmetry, chiral enantiomers exhibit different properties in living organisms even though they are indistinguishable in most inanimate environments. Two molecules that are mirror images of each other are called an enantiomeric pair, and they have exactly the same physicochemical properties under all isotropic conditions. Because biochemical systems are not isotropic, two enantiomers of a chirally active drug may have dramatically different pharmacologic effects (Wang et al., 2011). For example, while one enantiomer of a pharmaceutical can be therapeutic, the other can be invalid or even toxic. Therefore, there is a growing demand for optically pure enantiomers in the fragrance, pharmaceutical, and food industries (Miyako et al., 2004).

Separation of racemic compounds is an important method for producing single enantiomer drugs (Fanali et al., 1998; Seo et al., 2000) and many researchers have attempted the separation of optically pure enantiomers (Colera et al., 2005; Kocabas et al., 2006; Tang et al., 2007, 2003; Viegas et al., 2007). As a potential large-scale production technique, chiral solvent extraction has attracted the attention of many researchers in recent years (Zhou et al., 2013; Schuur et al., 2011; Huang et al., 2013; Tang et al., 2009a, 2011, 2012a, 2012b; Steensma et al., 2007a). Though with the advantages of simple operation and low cost, some defects in the chiral solvent extraction still occur, the use of organic solvents being the dominating one, because most traditional organic solvents are volatile and toxic and thus harmful to the environment and

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