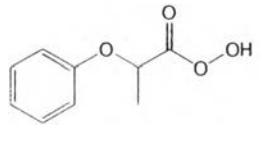
CHAPTER I

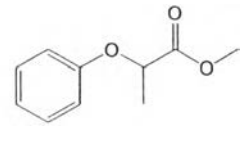
INTRODUCTION

Living creatures are consisted of chiral molecules, molecules with non-superimposable mirror images, such as sugars, amino acids, proteins and nucleic acids. Generally, these biomolecules occur in only one of two possible forms. For example, amino acids are in the L-form and sugars are in the D-form [1]. Both forms of molecules, or enantiomers, have the same physical properties but may have different biological activities. Therefore, purity determination of enantiomers is essential, especially for drug industry which needs purely single enantiomers because two enantiomers of a chiral drug may differ in their toxicity and selectivity for receptors [2].

Analysis of enantiomeric purity is important to agrochemical industry as well. Phenoxy acids are the most common group of herbicides. They are mostly used in the ester forms because of their higher herbicidal activity than the acid forms (Figure 1.1). It has been found that most (*R*)-enantiomers of these compounds are more active than (*S*)-enantiomers. In some cases, only (*R*)-enantiomers have herbicidal activity such as mecoprop-methyl and dichlorprop-methyl (Figure 1.2). Moreover, using purely single enantiomer is eco-friendly and cheap [3-6].

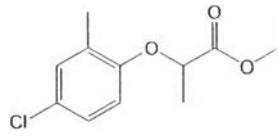


2-phenoxypropionic acid

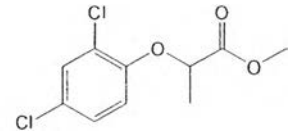


methyl 2-phenoxypropionate

Figure 1.1 Structures of phenoxy herbicide in (left) acid and (right) ester forms



mecoprop-methyl



dichlorprop-methyl

Figure 1.2 Structures of mecoprop-methyl and dichlorprop-methyl

Currently, asymmetric synthesis using chiral auxiliary or catalyst is a common method to obtain purely single enantiomer. However, enantiomeric separation techniques are still required to test the purity of the synthesized products [7]. For enantiomeric separation, researchers usually use chromatography and electrophoresis techniques [8]. Gas chromatography (GC) is the technique used for volatile and thermally stable organic compounds. Advantages of GC are high efficiency, reproducibility, sensitivity, short analysis time and simplicity [9]. Cyclodextrin (CD) derivatives are the most widely used chiral stationary phases (CSPs) for the direct separation of volatile enantiomers by GC. CDs can be derivatized with different functional groups. Enantiomeric separation using CDs depend on several parameters such as size of CDs, type of substituents, position of substituents, concentration of CDs and analyte structures [10].

Phenoxy acid methyl esters (PAMEs) with various types of substituent are selected as analytes of interest since they are popular herbicides in agriculture. Furthermore, they are highly toxic pollutant and have long-term degradation [5, 6]. Previously, enantiomers of PAMEs were directly separated by capillary GC using CD derivatives of different sizes and different types of substituent as chiral selectors, including (2,3-di-*O*-methyl-6-*O*-*tert*-butyldimethylsilyl)-α, -β, and -γ-CDs (ASiMe, BSiMe, and GSiMe, respectively) and heptakis(2,3-di-*O*-acetyl-6-*O*-*tert*-butyldimethylsilyl)-β-CD (BSiAc) [11, 12].

In this work, enantiomers of PAMEs are directly separated by capillary GC using CD derivatives of different size as chiral selectors: hexakis(2,3-di-*O*-acetyl-6-*O*-*tert*-butyldimethylsilyl)-α-CD (ASiAc) and octakis(2,3-di-*O*-acetyl-6-*O*-*tert*-butyldimethylsilyl)-γ-CD (GSiAc). These CD derivatives have never been reported for chiral separation of phenoxy acid methyl esters.

Thus, the purpose of this research is to systematically study the influence of the size of CD derivatives toward enantiomeric separation of phenoxy acid methyl esters. Also, thermodynamic parameters will be calculated through ln k′ versus 1/T plot to evaluate the interaction between analytes and stationary phases. Expectedly, the interpretation of the data obtained from this work will provide the knowledge about the influence of analyte structures and the size of CD on enantioseparation. Moreover, this research would improve the opportunity of choosing the most suitable CSP for enantiomeric analysis of these phenoxy acid methyl esters, including other analytes having similar structure to the studied compounds.