

MASTER'S THESIS

Fundamental studies and methods development for the determination of cationic surfactants in capillary electrophoresis

So, Shi Kit

Date of Award:
1999

[Link to publication](#)

General rights

Copyright and intellectual property rights for the publications made accessible in HKBU Scholars are retained by the authors and/or other copyright owners. In addition to the restrictions prescribed by the Copyright Ordinance of Hong Kong, all users and readers must also observe the following terms of use:

- Users may download and print one copy of any publication from HKBU Scholars for the purpose of private study or research
- Users cannot further distribute the material or use it for any profit-making activity or commercial gain
- To share publications in HKBU Scholars with others, users are welcome to freely distribute the permanent URL assigned to the publication

**Fundamental Studies and Methods Development for
the Determination of Cationic Surfactants
in Capillary Electrophoresis**

SO Shi Kit

**A thesis submitted in partial fulfillment of the requirements
for the degree of
Master of Philosophy**

December 1999

Hong Kong Baptist University

Abstract

The use of α - and β -cyclodextrin (CD) to understand and to improve the separation of a series of cationic surfactants, homologues of alkylbenzyltrimethyl ammonium compounds (ABDACs) with an alkyl chain of varying length (C_{10} to C_{18}), in capillary electrophoresis (CE) is reported for the first time. Similar to organic solvents, the presence of α - or β -CD in the running buffer was found to reduce peak tailing/loss for the longer-chain ABDACs. Based on fluorescence measurements, it was found that formation of host-guest complexes occurred between α - or β -CD and various ABDACs, with the likelihood that the hydrophobic alkyl chain including into the CD cavity and the positively charged ammonium group remaining outside the cavity. The effects of α - or β -CD can be interpreted in terms of a shift away from the formation of 1) micelles in the buffer system and 2) surfactant aggregates at the fused-silica capillary walls, as a result of the formation of inclusion complexes between α - or β -CD and ABDACs.

For many years the salting-out effect has been exploited for the extraction of a wide range of chemical species such as metal ions and proteins, as well as the preconcentration of trace analytes prior to analysis by various chromatographic techniques, such as high performance liquid chromatography. Surprisingly, the possible use of the salting-out method to increase concentration sensitivity in CE has never been reported. In the second part of this thesis, the feasibility of taking advantage of the salting-out effect for the

preconcentration of trace amounts of ABDACs prior to CE analysis is demonstrated. The effects of the concentration of salt and organic solvent on the preconcentration factor were investigated. The usefulness of this new approach was demonstrated for the CE determination of BAC present in real samples such as eye drop solutions.

Table of contents

	Pages
<i>Declaration</i>	i
<i>Acknowledgements</i>	ii
<i>Abstract</i>	iii
<i>Table of Contents</i>	v
<i>List of Figures</i>	viii
<i>List of Tables</i>	xii
<i>List of Diagrams</i>	xiii
<i>List of Appendices</i>	xiv
<i>List of Abbreviations</i>	xvi
<i>List of Symbols</i>	xvii
<i>Chapter 1 Introduction</i>	
1.1 Background	1
1.2 Instrumentation	2
1.3 Principles of capillary electrophoresis	7
1.3.1 Electrophoretic mobility	7
1.3.2 Electroosmotic flow	10
1.4 Aim of the project	13

**Chapter 2 Separation of ABDAC homologues in capillary
Electrophoresis**

2.1	Review on the separation of ionic surfactants	19
2.2	Experimental	22
2.1.1	Apparatus	22
2.1.2	Chemicals	23
2.1.3	Procedures	23
2.3	Results and discussion	25
2.3.1	Separation of the ABDAC homologues	25
2.3.1.1	Effect of organic solvents in the running buffer sample solution	25
2.3.1.2	Effect of α -cyclodextrin in the running buffer	33
2.3.1.3	Effect of α -cyclodextrin in the sample solution	45
2.3.1.4	Effect of β -cyclodextrin and organic solvents	51
2.3.2	Fluorescence measurements: evidence for the formation of inclusion complexes between CDs and ABDACs	52
2.3.2.1	Formation of host-guest complexes between α -CD/ C_{16} homologues	55
2.3.2.2	Formation of host-guest complexes between α -CD/ C_{18} homologues	57
2.3.2	A proposed model for the effect of CDs on the improved CE separation of ABDACs	59

Chapter 3	<i>Salting-out preconcentration and CE separation of ABDAC homologues</i>	
3.1	Review on the salting out preconcentration in analytical chemistry	68
3.2	Experimental	70
3.2.1	Apparatus	70
3.2.2	Procedures	70
3.3	Results and discussion	71
3.3.1	Effect of sodium chloride on salting out preconcentration	71
3.3.2	Effect of acetonitrile on salting out preconcentration	74
3.3.3	Applications of salting-out preconcentration of commercial products	75
Chapter 4	<i>Summary of the Project</i>	80
Chapter 5	<i>Future Work</i>	83
Chapter 6	<i>References</i>	84
Chapter 7	<i>Appendices</i>	91
	<i>Curriculum Vitae</i>	97