
Preface

Capillary electrophoresis (CE) is a relatively new separation technique suitable for handling small amounts of sample very important in bioanalytical research and in various clinical, diagnostic, genetic, and forensic applications. CE offers several similarities to high-performance liquid chromatography (HPLC) such as ease of use, high resolution, speed, online detection, and full automation capability. CE encompasses a family of related separation techniques that use narrow-bore fused-silica capillaries to separate a complex array of large and small molecules. High electric field strengths are used to separate molecules with differences in charge, size, and hydrophobic properties. CE may be utilized according to several separation techniques:

1. Capillary zone electrophoresis (CZE) is the simplest form of CE where the separation mechanism is based on differences in the charge-to-mass ratio of the analytes.
2. Capillary gel electrophoresis (CGE) is the adaptation of traditional gel electrophoresis into the capillary by using soluble polymers to create a replaceable molecular sieve allowing size separations.
3. Capillary isoelectric focusing (CIEF) allows amphoteric molecules, proteins, to be separated in a pH gradient generated between the cathode and anode.
4. Isotachopheresis (ITP) is a focusing technique based on the migration of compounds between leading and terminating electrolytes.
5. Micellar electrokinetic capillary chromatography (MECC or MEKC) is a mode of separation in which surfactants are added to the buffer solution at concentrations that form micelles. This technique is useful to resolve both charged and neutral compounds.
6. Microemulsion electrokinetic chromatography (MEEKC) is a technique in which solute partition takes place between moving oil droplets and the aqueous buffer. This allows the separation of both aqueous and water-insoluble compounds.
7. Nonaqueous capillary electrophoresis (NACE) involves the separation of analytes in nonaqueous media that allow additional selectivity options in method development. It is valuable for separations of water-insoluble compounds and for hyphenation with MS detection.
8. Capillary electrochromatography (CEC) is a hybrid separation method that couples the high separation efficiency of CZE with HPLC and uses an electric field rather than hydraulic pressure to propel the mobile phase through a packed bed.

Due to its high resolving power and sensitivity, CE has been applied in the analysis of simple and complex (macro) molecules providing concentration and structural characterization data essential for understanding their biological functions. Although CE technology may be applied to many different types of research, it has gained its reputation from the study of molecules that have traditionally been difficult to separate. In general, CE should be considered first when dealing with highly polar, charged analytes. In fact, CE excels in

the analysis of ions when rapid results are desired, and has become the predominant technique for the analysis of both basic and chiral pharmaceuticals. This technology is replacing traditional electrophoresis for the characterization and analysis of macromolecules such as nucleic acids, proteins, and carbohydrates, and promises to be a valuable tool in tackling the characterization challenges posed by proteome-wide analysis and DNA sequencing and genotyping.

This volume on the capillary electrophoresis of biomolecules provides the reader with the latest breakthroughs and improvements in CE and CE techniques applied to several classes of bio(macro)molecules, in particular simple and complex carbohydrates (polysaccharides), amino acids, peptides and proteins, enzymes, and nucleic acids. Along with practical procedures, reviews discussing CE applications related to bio(macro)molecules are also included.

I would like to thank all the contributors for their articles, able to provide a better understanding of the analytical phenomena related to CE and by widening the scope of their possible applications. Acknowledgement is due to Humana Press Editors for their assistance in bringing this issue to publication.

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Methods and Protocols

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