

## Preface

---

Since the advent of the clinical laboratory in the 20th century, the need to report more accurate results, faster, and at a lower cost has driven technology. One area that has lagged behind the rest of the laboratory is electrophoretic separations of analytes that are clinically relevant. Because of this, electrophoresis has been relegated to the very specialized sections of the laboratory, limiting its use in patient care.

Electrophoresis, as we use it today, was first described by Tiselius in his PhD thesis in 1937. In pioneering experiments that have led to the methods used today, he used a U-shaped quartz tube to show the zonal separation of serum in free solution using Schlieren optics to monitor the migration of the protein bands. Driven by the desire to make electrophoresis easier, a number of matrixes—such as paper, cellulose acetate, agarose, starch gel, and polyacrylamide—were investigated and, in one form or another, are still used today. From the basic method described by Tiselius a number of innovative electrophoretic methods have now been developed, including immunoelectrophoresis, isoelectric focusing (IEF), isotachopheresis (ITP), and size separation by gradient electrophoresis.

Tiselius's basic concept of using a tube for electrophoretic separation received little notice until the late 1960s when Hjerten described the first capillary electrophoresis (CE) apparatus. In spite of the pioneering work by Hjerten, CE remained relatively unknown until 1981 when Jorgenson and Lukacs described the separation and fluorescent detection of amino acids, peptides, and urine proteins by capillary zone electrophoresis. Since then, all of the classical separation techniques—IEF, ITP, zone electrophoresis, and micellar electrokinetic chromatography (MEKC)—have allowed CE to rival the versatility of high pressure liquid chromatography (HPLC). MEKC, which in its simplest form is the addition of detergent to the buffer, has enabled CE to be used in an area once thought impossible for electrophoresis techniques, the separation of small, electrically neutral molecules.

CE has come a long way since it was first described. Current methods are capable of being automated, and, because it is a microtechnique, the method conserves precious samples and minimizes the use of hazardous organic chemicals. Although CE has not made inroads into the clinical

laboratory that many anticipated, we expect that, in the future, it will find its “proper” place. Because this “proper” place may surprise everyone involved in the clinical applications of CE, this book is not meant to give an in-depth methodological description of the use of CE in the clinical laboratory, but to give an overview of its current use.

We arranged *Clinical and Forensic Applications of Capillary Electrophoresis* into six main sections. Section I covers the history and some of the potential applications of CE. This section also covers the principles necessary for the clinical laboratory scientist to understand the basics of CE. Section II covers the separation of proteins, probably the first use of CE in the clinical laboratory. The section describes the potential problems and solutions when using CE to separate proteins, along with outlining how CE has been used to separate serum and CSF proteins, detect serum and urine paraproteins, and separate lipoproteins and hemoglobin variants. Section III covers metabolic diseases, which are usually detected by abnormalities in small molecules, such as amino acids, organic acids, or steroids. Section IV covers the use of CE in immunoassay, where CE is used as a separation method. Although this may seem trivial at first glance, it opens up the possibility of simple, yet highly sensitive, analysis at the point of care. Section V describes what may be the future of CE in the clinical laboratory, the use of CE in molecular diagnostics, both for the detection of diseases and quantiation of viral loads and its use in the forensic DNA identification laboratory. Finally, Section VI describes how CE can be used in conjunction with mass spectrometry, its potential use in detection of heavy metal poisoning, therapeutic drug monitoring, and clinical and forensic toxicology.

**John R. Petersen**  
**Amin A. Mohammad**



<http://www.springer.com/978-0-89603-645-1>

Clinical and Forensic Applications of Capillary  
Electrophoresis

Petersen, J.; Mohammad, A.A. (Eds.)

2001, X, 454 p., Hardcover

ISBN: 978-0-89603-645-1

A product of Humana Press