

Principles, Practice, and Evolution of Capillary Electrophoresis as a Tool for Forensic DNA Analysis

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ABSTRACT: Capillary electrophoresis (CE) is a versatile and widely used analysis platform with application in diverse areas such as analytical chemistry, chiral separations, clinical, forensics, molecular biology, natural products, organic chemistry, and the pharmaceutical industry. Forensic applications of CE include fragment analysis, DNA sequencing, SNP typing, and analysis of gunshot residues, explosive residues, and drugs. Fragment analysis is a widely used method for short tandem repeat (STR) profiling for human identification (HID) due to the single-base resolution capability of CE. This approach circumvents the tedious and expensive approach of DNA sequencing for STR typing. The high sizing precision, ability to detect fluorescence emitted from multiple dyes, automated electrophoretic runs, and data collection software are key factors in the worldwide adoption of CE as the preferred platform for forensic DNA analysis. The most common CE systems used in forensic DNA analysis include the ABI PRISM® 310, 3100, 3100 Avant, 3130, 3130xl, 3500, and 3500xL Genetic Analyzers (GAs). The 3500 series GAs are developed with features useful for forensic scientists, including a normalization feature for analysis of the data designed to reduce the variation in peak height from instrument to instrument and injection to injection. Other hardware and software features include improved temperature control, radio frequency identification (RFID) tags for monitoring instrument consumables, HID-focused software features, and security and maintenance.

KEY WORDS: Capillary electrophoresis, capillary-array electrophoresis, forensic DNA analysis, fragment analysis, genotyping, human identification, mitochondrial DNA sequencing, SNP typing, STR profiling.
