

QIAXcel®: Novel 12-channel capillary electrophoresis system for high-throughput protein separation



Udo Roth¹, Karen Kowalewski¹, Mirjana Kozulic², and Marion Egli²

¹ QIAGEN GmbH, QIAGEN Strasse 1, 40724 Hilden, Germany

² QIAGEN Instruments AG, Garstligweg 8, 8634 Hombrechtikon, Switzerland

Introduction

Denaturing capillary gel electrophoresis (CGE) is widely used for protein analysis. In contrast to traditional SDS-PAGE, it is much faster, automatable, and provides immediate digital data output for precise determination of protein size, quantity, and purity. However, most commercially available CGE instruments do not allow high-throughput and high-quality analyses due to long run times or provide only limited resolution for protein separation in the typical mass range.

To make CGE an attractive tool for high-throughput protein analysis, it is necessary to find a technical solution for the simultaneous analysis of numerous protein samples. Here, we present the QIAGEN QIAXcel 12-capillary gel electrophoresis system for the detection and analysis of proteins. The system performs parallel analysis of protein samples in a mass range from 10–200 kD, with a detection limit of 2.5 ng/µl (carbonic anhydrase) using LED-induced fluorescence.

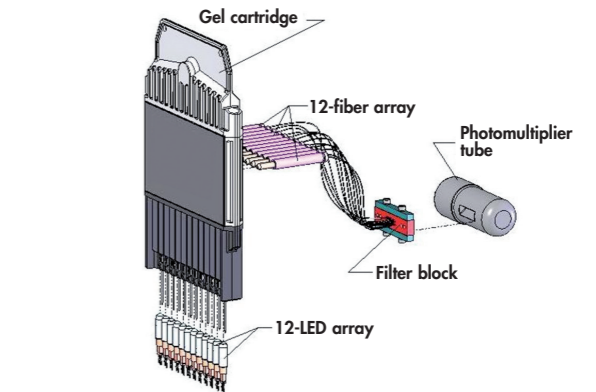
We illustrate separations of purified recombinant proteins, intact or cleaved antibodies, and cleared cell lysates. The QIAXcel can be readily used to meet the requirements of high-throughput applications, e.g., in biopharmaceutical or protein expression laboratories.



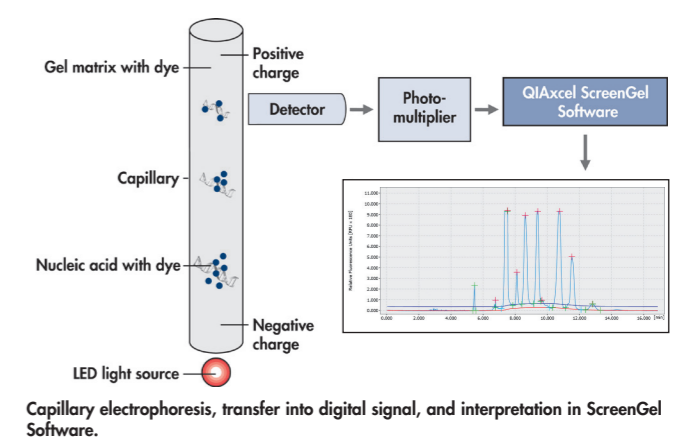
The QIAXcel Advanced System.

QIAXcel capillary electrophoresis system principle

- QIAXcel Advanced instruments include an array of light-emitting diodes and micro-optical collectors that latch to capillaries within QIAXcel gel cartridges.
- One-step sample preparation uses covalent protein labeling of lysine residues with fluorescent dye in a denaturing sample buffer (SDS, DTT).
- Parallel analysis is achieved using 12 capillaries arrayed in a cartridge, with a running time of 15 min.
- With one gel cartridge, 100 runs (1200 samples) can be performed and 96 samples are analyzed in 2 h without manual intervention.
- Proteins that migrate through a physical gel within the capillary pass an excitation and detection spot. The signal is transmitted through a photomultiplier tube to the QIAXcel ScreenGel Software for data interpretation.
- Data output is available either as a classical electropherogram, XML export of data, or as a virtual, SDS PAGE-like image.



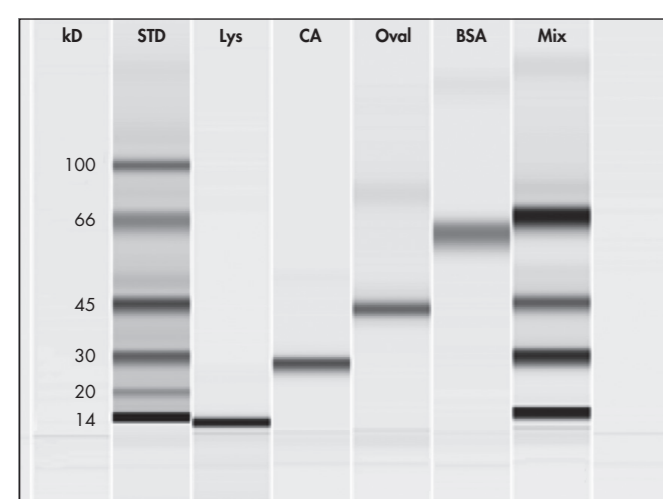
The QIAXcel Cartridge and optical sections of the instrument.



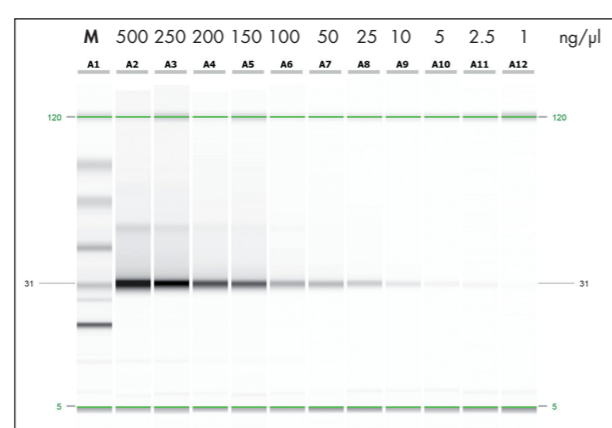
Capillary electrophoresis, transfer into digital signal, and interpretation in ScreenGel Software.

High resolution and sensitivity with the QIAXcel Protein Cartridge

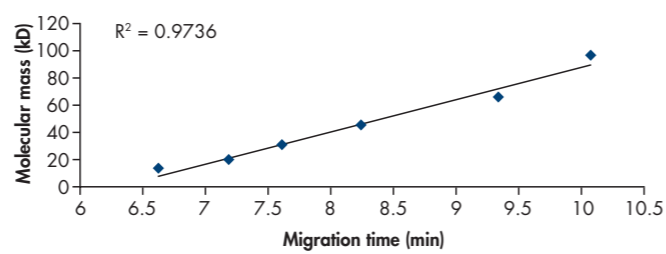
The proprietary matrix, in combination with fluorescence labeling, allows a size-based separation like SDS-PAGE and sensitive detection of protein samples.



Size analysis. Separation of different proteins and a protein mass ladder (STD). Using the QIAXcel Protein Cartridge, proteins in a mass range between 10 and 200 kD can be separated. BSA: Bovine serum albumin; CA: Carbonic anhydrase; Lys: Lysozyme; Mix: Mixture of all 4 proteins; Oval: Ovalbumin



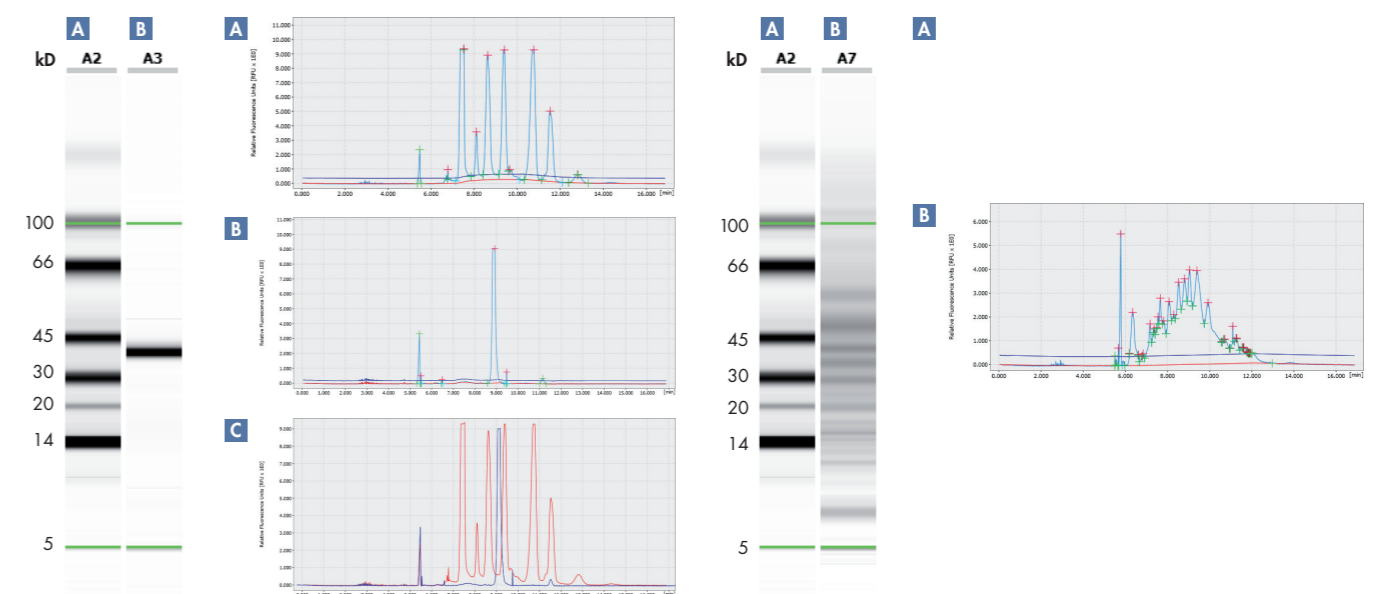
Dilution series of bovine carbonic anhydrase analyzed on a QIAXcel Protein Cartridge. Limit of detection: 2.5 ng/µl. M: Size marker.



Molecular mass vs. migration time. A linear correlation between the mass and migration time of the proteins in the range from 10–100 kD is shown.

Analysis of different protein samples

The novel QIAXcel Protein Cartridge is suitable for analyzing various protein samples, such as purified proteins and crude cell lysates based on their size differences. The powerful QIAXcel ScreenGel software provides data output in various formats, such as gel view, electropherogram view, or superimposition of electropherograms. Various analysis parameters can be displayed in a table that allow for absolute and relative quantification, direct comparison of peaks of interest, etc.

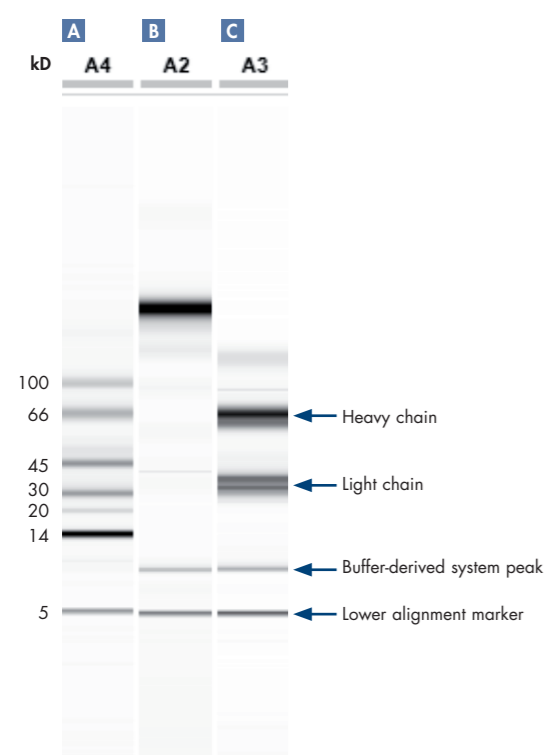


Size analysis of purified protein. A Size marker. B SSB protein. C Superimposed view of both electropherograms.

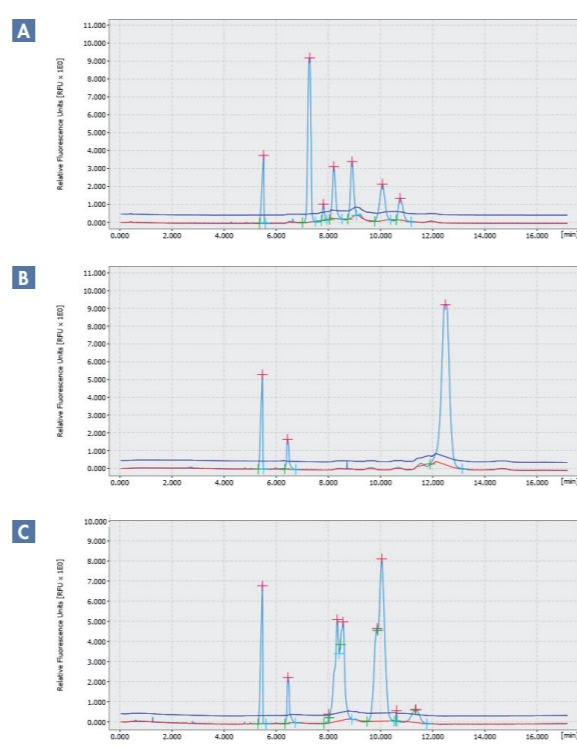
Separation of cell lysates. A Size marker. B E. coli cleared cell lysate.

Analysis of antibodies

QIAXcel offers the capability for high-throughput separation of intact or cleaved antibodies to perform protein QC; comprising analysis of impurities, sample degradation, and ratio of non-glycosylated heavy chain.



Analysis of monoclonal IgG antibodies. A Size marker. B Uncleaved mAb. C Reduced mAb.



Conclusions

The QIAXcel multi-capillary electrophoresis system in combination with the newly developed QIAXcel Protein Cartridge provides:

- Fully automated analysis of up to 96 samples without manual intervention
- Fast separation time of 15 minutes per 12 samples <100 kD
- Separation of up to 200 kD
- A limit of detection of 2.5 ng/µl (carbonic anhydrase)
- A dynamic range of 2.5 ng–250 ng/µl
- One-step sample preparation with only 20 minutes incubation time
- Robust, reproducible results
- Absolute and relative quantification with ScreenGel Software tools

The QIAXcel System is an excellent alternative to SDS-PAGE, microfluidic systems, or other capillary electrophoresis systems, especially for laboratories performing high-throughput protein analysis.

The applications presented here are for research purposes. Not for use in diagnostic procedures.

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