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Commentary

The Role of Capillary Electrophoresis in Carbohydrates Analysis and their Applications

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DESCRIPTION

Since 2014, capillary electrophoresis has emerged as an effective method for carbohydrate analysis. The approach has a high resolution and can separate carbs based on charge-to-size ratio. The primary applications are largely focused on N-glycans, which are extremely important in biological treatments and biomarker research. Advances in N-glycan structure identification techniques include migration time indexing, exoglycosidase and lectin profiling, and mass spectrometry. Capillary electrophoresis techniques have been developed to separate glycans with the same monosaccharide sequence but distinct positional isomers, as well as to determine if the monosaccharides forming a glycan are alpha or beta linked.

Carbohydrates have critical roles in signalling, structure, and energy. These compounds are crucial in renewable energy, illness, ageing, food, and treatments. The importance of glycans in signalling lends support to their application in disease diagnosis, prognosis, and therapeutic intervention. Glycoscience spans a wide range of applications, such as identifying glycopeptides in protein targets and determining the function of glycosylation in signalling and ligand–receptor interaction. Understanding the pathways that contribute to alterations in glycosylation is becoming increasingly relevant in medical research and biopharmaceutical production. Glycosylation modifies biological activity and has a significant impact on antibody effector function. This has the potential to significantly increase medication performance, but it necessitates the use of supporting technologies, such as Capillary Electrophoresis (CE), to monitor micro heterogeneity throughout the production process.

The current increased activity in published reviews in 2016 and 2017 alone demonstrates the interest in CE for glycoscience applications. Several industrial and academic laboratories took part in an inter laboratory test in 2015 that featured an N-glycan mapping exercise using a protein test sample and revealed high repeatability in area and migration time. Commercial kits have now made the technique more common in industry by easing sample preparation for better throughput. The developments are advantageous, since the antibody pharmaceutical industry is predicted to increase at a healthy rate, reaching a worldwide value of $125 billion USD in 2020. This generates an even greater requirement for high throughput analysis, which CE can provide.

CE has a number of advantages. In the absence of Joule heating, a strong electric field leads in short separation periods and great efficiency. Injected sample quantities range from femtoliters to nanoliters. For a 24-hour period, only a few millilitres of running buffer are necessary. Separations on commercial devices are fully automated. Laser-induced fluorescence detection limits are in the femtomolar range. Typical instruments have a single capillary with temperature control over both the capillary and the solutions. To boost throughput, many capillaries might be employed in a single instrument. DNA sequencing devices, for example, may store up to 96 capillaries. Injections can also be multiplexed to deliver sample packets in a single pass, eliminating dwell periods.

CONCLUSION

Innovations in equipment and methodological applications continue, and may be seen as a drive to make the approach more accessible to researchers through commercially available solutions for connecting CE with a mass spectrometer, as well as databases and software that make data analysis easier. Analytical methods are constantly evolving to address the ever-increasing problems of carbohydrate analysis, and CE plays a particular role in glycoscience research.

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