

Analytical Approaches in Glycobiology

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Abstract

Glycobiology is a study of the structure, chemistry, biosynthesis, and biological functions of glycans and their derivatives. The high complexity of biomolecules necessitates a set of powerful analytical methodologies to reveal functionally critical structural features. Mass spectrometry (MS), with its different ionization techniques, mass analyzers, and detection strategies, has become the most important analytical method in glycomic and glycoproteomic investigations. In combination with MS, microscale separations are based on capillary chromatography and electrophoresis and carbohydrate microchemistry. In this article focuses on Analytical, methodological advances on disease biomarker research, immunology, developmental biology, and measurements of importance to biopharmaceuticals.

Keywords: Mass spectrophotometry; Capillary electrophoresis; Analytical

Introduction

According to Hart GW; Current opinion in cell biology (1992) [1] glycobiology is one of the great frontiers of biochemistry. The development of new technologies for exploring the structures of different sugar chains has opened up a new discipline of Analytical chemistry, Molecular biology and Bioinformatics, etc. is called as glycobiology. Horvath C, said how sweet it is sugar molecule then called as glycobiology. This term coined by Rademacher, Parekh, and Dwek (1988) to recognize the coming together of the traditional disciplines of carbohydrate chemistry and biochemistry with a modern understanding of the cellular and molecular biology of glycans [2-10].

The specific term glycobiology was coined in 1988 by Prof. Raymond Dwek to recognise the coming together of the traditional disciplines of carbohydrate chemistry and advance biochemistry. In fact, creating a cell requires two other major classes of molecules: lipids and carbohydrates. These molecules can serve as intermediates in generating energy, as signalling molecules, or as structural components [11-15]. The structural roles of carbohydrates become particularly crucial in constructing complex multicellular organs and organisms, which requires interactions of cells with one another and with the surrounding matrix. Indeed, all cells and many macromolecules in nature carry a dense and complex array of covalently attached sugar chains it called as oligosaccharides or glycans Feizi (1989) [16-21].

The scientific research community was practice in the development of the necessary tools transform into a roadmap of glycobiology. Glycan play vital role in growth and development and ageing process however glycan are likely to targeted discovery for biomarkers, vaccine and drug for cancer and inflammatory disease. In this article focused glycoscience needs new analytical techniques including method development for separation, purification, characterisation, localisation and structure identification [22-28].

Using analytical approaches newly developed technique the development of mass spectrophotometer, capillary electrophoresis, High-pressure liquid chromatography accumulated resources of the enzymatically synthesised compound to create new avenues for glycoscience [29-32].

Fundamental Principle for Prediction of Glycan

Sugar molecule linked to another type of biological molecule to form glycoconjugates. The enzymatic process of glycosylation creates sugar molecule bound to other particles by the glycosidic bond they producing glycan. Glycoprotein, proteoglycan, and glycolipid are the most abundant glycoconjugate found in mammalian cells. They are located predominantly in the outer cell wall and secreted fluids. It is essential in cell-cell interaction due to the presence on the cell surface of the various glycan-binding receptors to glycoconjugate. Glycan structure is also complicated by lack of a direct template for their biosynthesis in case with protein and lipid is determined by their corresponding gene. For accurate and advanced tool and technique for glycan structure prediction, one such technology is mass spectrometry are potent tools for characterizing complex carbohydrate [33-36].

Analysis Approach

A mixture of carbohydrate can be resolved into their component by many techniques such as differential centrifugation, ion exchange chromatography and gel filtration which are also used in protein and amino acid. Each glycan separated in the first stage of analysis is subjected to the following three analytical approaches for complete characterization.

1. Hydrolysis is firm acid yield mixture of monosaccharides which after conversion to suitable volatile derivative may be separated, identified and quantified by gas-liquid chromatography.

2. For the pure linear polymer, the position of the glycosidic bond between monosaccharide is determined by treating intact polysaccharide with methyl iodide to convert all free hydroxyl to acid stable methyl esters. When the methylated polysaccharide is hydrolysed, only free hydroxyl present in the monosaccharide produced is involved in glycosidic bonds.
3. To determine the stereochemistry at the anomeric carbon, the intact polymer is tested for sensitivity to purified glycosidases known to hydrolyse only α or only β glycosides. Total structure determination for complex heteropolysaccharides is much more difficult. For degradation with highly specific glycosidase followed by isolation and identification of the product by mass spectral analysis and high-resolution NMR spectroscopy are highly powerful analytic tools for carbohydrate.

Working Model of Glycobiology

Glycobiology or glycomics is a discipline of biology and chemistry that deals with the structure and function of an oligosaccharide (chain of sugar). The term glyceimic is derived from the chemical prefix for sweetness or sugar; "glyco". The identity of the entirety of carbohydrate in a cell, tissue or organism thus collectively referred to as the glycome.

To assume fact how creating a cell requires two other major classes of molecules lipid and carbohydrate. This molecule can serve as intermediates in generating energy as signalling molecules or structural components. The cell needs significant types of molecules like carbohydrates and fat.

In an actual way, these molecules can serve as intermediate in generating energy or structural elements. The fundamental roles of sugar molecule like carbohydrate become particularly crucial in complex multicellular organisms and organisms which require the interaction of the cell with another cell with surrounding matrix. All cell and many macromolecules in nature carry a dense and complex array of glycan. All cell and many other macromolecules covalently attached sugar chain of the molecule.

In some instances, these glycan molecules can be free-standing entities. Since most glycans are on the outer surface of cellular and secreted macromolecules, they are in a position to modulate glycome [37-39].

Future Prospectus of Research

It is a study of the structure, biosynthesis, and biology of sugar chain or glycan; Glycan is widely distributed in nature. This glycan is one of the more rapidly growing fields of basic research with relevance to medical science and biotechnology. These structure range from the chemistry of sugar chain and enzymology of glycan modifying the protein to the function of glycan in complex biological system and manipulation by a variety of technologies used several biotechnologies; pharmaceutical has invested in this area [40-42].

It is a study of the structure and biosynthesis of a sugar chain molecule essential component of various role-play in the therapeutic application in the biotechnological and medical field. As a result of an understanding of the cellular and molecular biology of glycan to better understand of sugar chain molecule used modern tool and technique for glycan molecule prediction.

Conclusion

Glycobiology is newer approaches to biotechnology. It is a combination of chemistry and Biotechnology to modifying the range of chemistry of sugar chain in complex biological system and manipulation by a variety of analytical techniques used in a therapeutic application in the biological sciences. As a understand phenomenon of cellular biology to the prediction of the molecule for therapeutic application in the field of pharmaceutical sciences.

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