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A Comparison of Glycomics in Prokaryotes and Eukaryotes

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Abstract

Glycomes are found in organisms in Free State or in complex molecules these are widely distributed in nature. The study of these sugars is Glycomics, it can also be defined as systematic study of glycan structures present in cells and organisms. Proteoglycan, glycoprotein, glycolipid are types of glycoconjugates, the carbohydrate portion found in them is Glycan. Study related to it is called as Glycobiology. Glycobiology involves study of structures and biology of glycans and biosynthesis of it [1,2].

Introduction

Normally glycan cannot be found independently in nature, they will be branched either with proteins known as glycol proteins or branched with lipids called as glycolipids. Glycobiology is an interesting and very complex study when compared to other studies because such complexity cannot be seen in other studies. Molecules for Protein, RNA, DNA, lipids and sugar linkages found in saccharides provide the important structural basis for molecules. These 68 building blocks form an entire life of cell, nucleosides (RNA) or nucleotides (DNA) have four blocks each. Lipids are constituted of 8 categories, which are divided on the basis of Ketoacyl and isoprene. 20 different amino acids and 32 sugar linkages found in saccharides. These all increase the complexity more.

Adding to the complexity many proteins are seen to be involved with glycans, these not only act as carriers of carbohydrates. In some cases these proteins also involves in reacting with carbohydrates [3,4].

To understand glycans better we should understand the roles of glycans, Glycoproteins is one form of glycans these are found on cell surface playing a vital role of recognition. Example: glycoproteins on bacteria and virus acts as receptors. Also plays a part in cell signalling pathways and in way helps regulating cell functions. It also helps in attaining innate immunity, they help in determining cancer development, takes part in programmed cell death, inhibit proliferation, leads to protein structure (helps in folding and stability of protein). Glycomics has role in microbiology as well, since glycans has an important role bacterial physiology, study of these glycans would help in the development of drugs against bacteria, and also creating vaccines [5].

Protein glycosylation in prokaryotes

Many experiments showing that bacterial protein glycosylation continue to progress rapidly. It is now proved that bacteria have both N-linked and O-linked glycosylation pathways. Which have very common similarities with the eukaryotic and archaeaons. It also has some difference too. In prokaryotic organisms, protein glycosylation is not restricted to only pathogens but it also takes place in commensal organisms such as certain Bacteroides sp., both the N-linked glycosylation and O-linked glycosylation pathways can modify many proteins. Manipulation of these pathways in order to change glycoproteins which have potential to act as novel vaccines[6].

Mammalian glycomics

Currently glycosylation is considered as a crucial factor in developing biopharmaceuticals, which can be produced and manufactured by the use of various production vehicles of pharmaceutical industry. There are many hosts like bacteria, bacteriophage, yeast which help in the production of recombinant pharmaceuticals. The use of bacteria (Escherichia coli), yeast are been done due to the short doubling time. As the microbial system have the potential to produce recombinant proteins but the microbial system lack the capacity to produce all the proteins as the prokaryotic cells do not support the post translational modification, have poor solubility.

Majority of eukaryotic proteins such as mammalian protein can be subjected to post-translational modifications. The major protein modification occurring in mammalian cells is Glycosylation. Apweiler et al., 1999 reported that more than 50% of all polypeptides are covalently modified by glycans. Spiro, 2002 reported there are at least 13 different mono-saccharides and 8 amino acids involved in glycoprotein linkages, with a total of 41 (approx.) different chemical bonds known for linking the glycan to the protein. Each of this glycoprotein is different structure and function as protein methylation is from acetylation. Mammalian glycoproteins functions as hormones, cytokines, and antibodies etc. these glycoproteins are widely used as biopharmaceuticals. The sugar chains influences both the physical properties and biological properties of the protein such as solubility and thermo-stability, serum half-life and protein–protein interactions. The glycoproteins behaves as regulatory signals it helps in the interactions with variety of lectins in cells and it also leads in the interactions in extracellular environments and thereby control cellular functions, communications mammalian systems. The carbohydrate-protein interplay systems concerned in those strategies can be novel therapeutic targets. Further, glycosylation profiles of mammalian glycoproteins may be reliable reflections of physiological and pathological conditions at cell, tissue, providing specific biomarkers to mammalian cellular developmental stages and a variety of illnesses and diseases. Subsequently, mammalian glycomics will offer new clues for medical analysis and regenerative remedy [7-9].

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