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STUDY ON BASIC BIOMOLECULES WITH SPECIAL REFERENCE TO THEIR ROLE IN LIVING SYSTEM

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ABSTRACT

Biomolecules are not limited to, proteins, carbohydrates, nucleic acids, and lipids. These molecules are the basic building blocks of life and by controlling, creating, and manipulating their form and function there are many new avenues and advantages available to society. Since every biomolecule is different, there are a number of techniques used to manipulate each one respectively. Proteins are polymers that are made up of amino acid chains linked with peptide bonds. They have four distinct levels of structure: primary, secondary, tertiary, and quaternary. Carbohydrates are another important biomolecule. These are polymers, called polysaccharides, which are made up of chains of simple sugars connected via glycosidic bonds. These monosaccharides consist of a five to six carbon ring that contains carbon, hydrogen, and oxygen - typically in a 1:2:1 ratio, respectively. Nucleic acids are macromolecules that consist of DNA and RNA which are biopolymers consisting of chains of biomolecules. These two molecules are the genetic code and template that make life possible. Manipulation of these molecules and structures causes major changes in function and expression of other macromolecules. Nucleosides are glycosylamines containing a nucleobase bound to either ribose or deoxyribose sugar via a beta-glycosidic linkage.

Common fatty acids include lauric acid, stearic acid, and oleic acid. The study and engineering of lipids typically focuses on the manipulation of lipid membranes and encapsulation. Cellular membranes and other biological membranes typically consist of a phospholipid bilayer membrane, or a derivative thereof.

Key words: *building blocks, primary, secondary, tertiary, monosaccharides, phospholipid bilayer.*

INTRODUCTION

Biomolecular engineering is the application of engineering principles and practices to the purposeful manipulation of molecules of biological origin. Biomolecular engineers integrate knowledge of biological processes with the core knowledge of chemical engineering in order to focus on molecular level solutions to issues and problems in the life sciences related to the environment, agriculture, energy, industry, food production, biotechnology and medicine. Biomolecular engineers purposefully manipulate carbohydrates, proteins, nucleic acids and lipids within the framework of the relation between their structure, function and properties and in relation to applicability to such areas as environmental remediation, crop and life stock production, biofuel cells and biomolecular diagnostics. Fundamental attention is given to the thermodynamics and kinetics of molecular recognition in enzymes, antibodies, DNA hybridization, bio-conjugation / bio-immobilization and bio separations.

Attention is also given to the rudiments of engineered biomolecules in cell signaling, cell growth kinetics, biochemical pathway engineering and bioreactor engineering. Biomolecular engineers are leading the major shift towards understanding and controlling the molecular mechanisms that define life as we know it.

REVIEW OF LITERATURE

During World War II, the need for large quantities of penicillin of acceptable quality brought together chemical engineers and microbiologists to focus on penicillin production. This created the right conditions to start a chain of reactions that lead to the creation of the field of biomolecular engineering. Biomolecular engineering was first defined in 1992 by the National Institutes of Health as ―research at the interface of chemical engineering and biology with an emphasis at the molecular level‖. Although first defined as research, biomolecular engineering has since become an academic discipline and a field of engineering practice. Herceptin, a humanized Mab for breast cancer treatment, became the first drug designed by a biomolecular engineering approach and was approved by the FDA. Also, Biomolecular Engineering was a former name of the journal "New Biotechnology"

Bio-inspired technologies of the future can help explain biomolecular engineering. Looking at the Moore’s law ―Prediction‖, in the future quantum and biology-based processors are ―big‖ technologies. With the use of biomolecular engineering, the way our processors work can be manipulated in order to function in the same sense a biological cell work. Biomolecular engineering has the potential to become one of the most important scientific disciplines because of its advancements in the analyses of gene expression patterns as well as the purposeful manipulation of many important biomolecules to improve functionality. Research in this field may lead to new drug discoveries, improved therapies, and advancement in new bioprocess technology. With the increasing knowledge of biomolecules, the rate of finding new high-value molecules including but not limited to antibodies, enzymes, vaccines, and therapeutic peptides will continue to accelerate. Biomolecular engineering will produce new designs for therapeutic drugs and high-value biomolecules for treatment or prevention of cancers, genetic diseases, and other types of metabolic diseases. Also, there is anticipation of industrial enzymes that are engineered to have desirable properties for process improvement as well the manufacturing of high-value biomolecular products at a much lower production cost. Using recombinant technology, new antibiotics that are active against resistant strains will also be produced.

MATERIAL AND METHOD

Basic Biomolecules

Biomolecular Engineering deals with the manipulation of many key biomolecules. These include, but are not limited to, proteins, carbohydrates, nucleic acids, and lipids. These molecules are the basic building blocks of life and by controlling, creating, and manipulating their form and function there are many new avenues and advantages available to society. Since every biomolecule is different, there are a number of techniques used to manipulate each one respectively.

Proteins

Proteins are polymers that are made up of amino acid chains linked with peptide bonds. They have four distinct levels of structure: primary, secondary, tertiary, and quaternary. Primary structure refers to the amino acid backbone sequence. Secondary structure focuses on minor conformations that develop as a result of the hydrogen bonding between the amino acid chains. If most of the protein contains intermolecular hydrogen bonds it is said to be fibrillar, and the majority of its secondary structure will be beta sheets. However, if the majority of the orientation contains intramolecular hydrogen bonds, then the protein is referred to as globular and mostly consists of alpha helixes. There are also conformations that consist of a mix of alpha helices and beta sheets as well as a beta helixes with an alpha sheets. The tertiary structure of proteins deal with their folding process and how the overall molecule is arranged. Finally, a quaternary structure is a group of tertiary proteins coming together and binding. With all of these levels, proteins have a wide variety of places in which they can be manipulated and adjusted. Techniques are used to affect the amino acid sequence of the protein (site directed mutagenesis), the folding and conformation of the protein, or the folding of a single tertiary protein within a quaternary protein matrix. Proteins that are the main focus of manipulation are typically enzymes. These are proteins that act as catalysts for biochemical reactions. By manipulating these catalysts, the reaction rates, products, and effects can be controlled. Enzymes and proteins are important to the biological field and research that there are specific subsets of engineering focusing only on proteins and enzymes. See protein engineering.

Carbohydrates

Carbohydrates are another important biomolecule. These are polymers, called polysaccharides, which are made up of chains of simple sugars connected via glycosidic bonds. These monosaccharides consist of a five to six carbon ring that contains carbon, hydrogen, and oxygen - typically in a 1:2:1 ratio, respectively. Common monosaccharides are glucose, fructose, and ribose. When linked together monosaccharides can form disaccharides, oligosaccharides, and polysaccharides: the nomenclature is dependent on the number of monosaccharides linked together. Common dissacharides, two monosaccharides joined together, are sucrose, maltose, and lactose. Important polysaccharides, links of many monosaccharides, are cellulose, starch, and chitin.

Cellulose is a polysaccharide made up of beta 1-4 linkages between repeat glucose monomers. It is the most abundant source of sugar in nature and is a major part of the paper industry. Starch is also a polysaccharide made up of glucose monomers; however, they are connected via an alpha 1-4 linkage instead of beta. Starches, particularly amylase, are important in many industries, including the paper, cosmetic, and food. Chitin is a derivation of cellulose, possessing an acetamide group instead of an –OH on one of its carbons. Acetimide group is deacetylated the polymer chain is then called chitosan. Both of these cellulose derivatives are a major source of research for the biomedical and food industries. They have been shown to assist with blood clotting, have antimicrobial properties, and dietary applications. A lot of engineering and research is focusing on the degree of deacetylation that provides the most effective result for specific applications.

Nucleic Acids

Nucleic acids are macromolecules that consist of DNA and RNA which are biopolymers consisting of chains of biomolecules. These two molecules are the genetic code and template that make life possible. Manipulation of these molecules and structures causes major changes in function and expression of other macromolecules. Nucleosides are glycosylamines containing a nucleobase bound to either ribose or deoxyribose sugar via a beta-glycosidic linkage. The sequence of the bases determine the genetic code. Nucleotides are nucleosides that are phosphorylated by specific kinases via a phosphodiester bond. Nucleotides are the repeating structural units of nucleic acids. The nucleotides are made of a nitrogenous base, a pentose (ribose for RNA or deoxyribose for DNA), and three phosphate groups. See, Site-directed mutagenesis, recombinant DNA, and ELISAs.

Lipids

Lipids are biomolecules that are made up of glycerol derivatives bonded with fatty acid chains. Glycerol is a simple polyol that has a formula of C3H5(OH)3. Fatty acids are long carbon chains that have a carboxylic acid group at the end. The carbon chains can be either saturated with hydrogen; every carbon bond is occupied by a hydrogen atom or a single bond to another carbon in the carbon chain, or they can be unsaturated; namely, there are double bonds between the carbon atoms in the chain. Common fatty acids include lauric acid, stearic acid, and oleic acid. The study and engineering of lipids typically focuses on the manipulation of lipid membranes and encapsulation. Cellular membranes and other biological membranes typically consist of a phospholipid bilayer membrane, or a derivative thereof.

CONCLUSION

Along with the study of cellular membranes, lipids are also important molecules for energy storage. By utilizing encapsulation properties and thermodynamic characteristics, lipids become significant assets in structure and energy control when engineering molelecules. While Nucleotides are nucleosides that are phosphorylated by specific kinases via a phosphodiester bond. Nucleotides are the repeating structural units of nucleic acids. Carbohydrates have been shown to assist with blood clotting, have antimicrobial properties, and dietary applications. A lot of engineering and research is focusing on the degree of deacetylation that provides the most effective result for specific applications.

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