eJBio

Electronic Journal of Biology, 2022, Vol. 18(3):1-2

Structure and Function of Macromolecules and their Interaction

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Citation: Irfan M (2022) Structure and Function of Macromolecules and their Interaction. Electronic J Biol, 18(3): 1-2

Received date: February 14, 2021, Manuscript No. IPEJBIO-22-12993; **Editor assigned date:** February 17, 2021, PreQC No. IPEJBIO-22-12993 (PQ); **Reviewed date:** February 28, 2021, QC No. IPEJBIO-22-12993; **Revised date:** March 7, 2022, Manuscript No. IPEJBIO-22-12993 (R); **Published date:** March 14, 2022, DOI: 10.36648/1860-3122.18.3.012

Description

The living body contains 92 natural elements. Out of which, most essentials and common with many natural molecules are carbon, hydrogen, oxygen, nitrogen, sulfur and phosphorous. The fundamental building blocks of life are primarily made of these elements. There are 19 trace elements which are available and required in smaller quantities in living organisms. Of all these, carbon is considered most important as major organic structures such as carbon chains are formed out of carbon atoms and which are back bone of carbohydrates and fatty acids.

European Centre for Disease Prevention and Control

To fast track the Covid-19 research, World Health Organization (WHO) is bringing together renowned scientists and health professionals from across the globe and steps taken to mobilize diagnostics, vaccines and therapeutics for the coronavirus pandemic. WHO is in the process of gathering knowledge gained from Covid-19 research being done at multiple nations? This will serve as up-to-date exclusive literature on the topic. Apart from WHO, there are other resources also available for giving latest information on Covid-19 research. They are BMJ, Cambridge University Press, Chinese Medical Association, Centers for Disease Control and Prevention, European Centre for Disease Prevention and Control (ECDC), JAMA Network, Oxford University Press, Science etc.

Most of the life's structure and function depends on four important macromolecules which are major building blocks in any living organism. They are Carbohydrates, Proteins, Lipids and Nucleic Acids. Different polymers structures of these macromolecules and their interaction with each other decide regulate organism's structure and function.

A novel coronavirus (nCoV) has been identified to be cause of outbreak of respiratory illness in Wuhan City, China in 2019. This Novel Coronavirus Disease (Covid-19) has almost affected public health and economy all over the world. Hence, the research to find the sources of cause and developing stable vaccine and covid-19 health products to contain wide spread of virus and to extend help to the already infected has become a need of the moment.

Coronavirus investigators who have been involved in research from past 30 years are familiar with many features of coronavirus biology, genetics and pathogenesis. This has led to the great understanding of their adaptations to new environments and emergence of new diseases. Advances in cellular and molecular biology techniques and with the availability of reverse genetics methods from past 5 years is helping scientists in gaining increased understanding of replication of virus inside the cell. Identification of the unique properties of coronavirus infection and interpreting critical points which can be targets for antivirals or vaccines is now possible with the recent technical advancements.

From across the globe, more than 160 vaccines are under development for novel coronavirus. As per reports from WHO, 25 vaccine candidates are in human clinical trials stage and 139 are under pre-clinical stage. Some of the companies are showing great promise and excited the world with their research so far. Modern Therapeutics is one such company whose Phase-I trials started very early in Mid-march 2020. Now, it successfully finished Phase-I and Phase-II trials and planning to conduct phase-III trails with 30000 volunteers.

Many private Indian pharmaceutical and biotechnology companies are now involved in laboratory research and field trials. Currently in India, two vaccines are being tested and many more are to come. India is involved majorly in Covid-19 research for global supply of vaccine. The nation would play a major role in vaccine production and marketing. Serum Institute of India being a largest manufacturer of vaccines in the world collaborated with Oxford University and AstraZeneca in developing and production of Coronavirus vaccine.

Of all the organic molecules, proteins or polypeptides are most abundantly found in living organisms, comprising of 50% of cell dry weight. This vaccine candidate will surely bet other investigators and is currently undergoing Phase-III trials. Indian companies, Bharat Biotech and Zydus are also involved in developing vaccine. Their vaccine candidates are currently under one of the three stages of human clinical trials. Gennova biopharmaceuticals is currently

conducting pre-clinical trials for its mRNA vaccine candidate and about to start phase-I clinical trials in coming October 2020. India is likely to produce large amounts of vaccine irrespective of who develops vaccine first.

All carbohydrates contain carbon, hydrogen and oxygen in the ratio 1:2:1. Carbohydrates can be monosaccharaides, Disaccharides, Polysaccharides. Monosaccharaides like glucose and fructose are simplest form of monosaccharaides contains single sugar molecule. Disaccharides have two monosaccharide molecules united by glycoside bond. Maltose is a Disaccharide (Two glucose molecules united together). Polysaccharides are formed when three or more monosaccharaides are linked together. These are the complex in nature and common examples are cellulose, glycogen and starch.

Proteins are polymers made out of amino acids. The common structure of amino acid has carbon atom linked to carboxyl group and amino group, hydrogen atom and variable R group. The functional protein attains its final structure in four levels i.e., primary, secondary, tertiary and quaternary strictures. Primary structure forms from a single polypeptide which is a simple chain of amino acids and are part of protein that are directly coded by DNA. The interactions between carboxyl groups and amino groups of amino acids in primary structure make up secondary structure. There are two common forms of secondary structures called α-helix and β-pleated sheet. Because of strength and density of these structures, they are mostly found in biological proteins.

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Tertiary Structures

Tertiary structures are formed from further interactions between aqueous environment, R group and amino acid side chains. Tertiary structure defines individual conformation of polypeptide. Multiple interactions between different polypeptides make up quaternary structure. Quaternary interactions happen in proteins which are formed out of several polypeptides. Proteins play major role in biochemical catalysis, defense against foreign bodies, signalling ad transport, responses to stimuli, storage and providing structural support. Lipids are made up of fatty acids. Lipids present in body as unsaturated, saturated and trans fats. They play role in cellular membrane structures, energy storage and functions like signaling in the body cells. Lipids are classified into 8 categories viz., fattu acids, glycerolipids, glycerophospholipids, sphingolipids, sterols, prenols, saccharolipids, and polyketides. Nucleic acids are composed of monomer molecules called nucleotides. A nucleotide contains 5-carbon sugar, phosphate group and nitrogenous base. If sugar is ribose then the polymer is called RNA (ribonucleic acid) and if sugar is deoxyribose derived from ribose, then the polymer is called DNA (deoxyribonucleic acid). They create and encode genetic information in all living cells inside and outside of nucleus.