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Analysis of Biomolecules in Clinical Diagnostics

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ABSTRACT

It is understood that our bodies, as well as those of plants and other animals, consist of numerous chemical substances. Certain complex organic molecules serve as the foundation of life, contributing to the formation, growth, and maintenance of living organisms. These molecules are referred to as biomolecules. The primary categories of biomolecules include carbohydrates, proteins, lipids, nucleic acids, enzymes, and hormones, among others. In this lesson, you will explore the structures and functions of several key biomolecules. The study of biomolecules is crucial across various fields, including clinical diagnostics, food safety assessment, environmental monitoring, and pharmaceutical development.

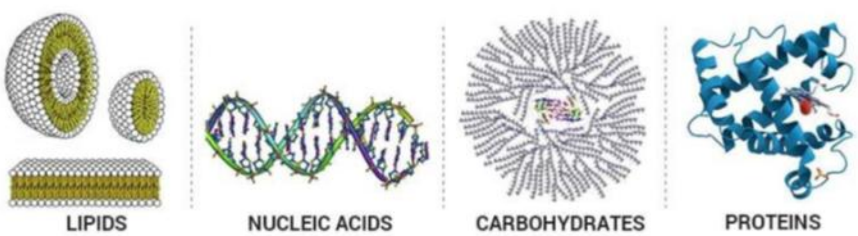
Keywords – biomolecules types, classification ,analaysis of biomolecules,diagnosis of biomolecules

INSTRODUCTION:

A biomolecule, often referred to as a biological molecule, is fundamentally a molecule synthesized by living organisms that is essential for numerous biological processes. These biomolecules can vary in size, encompassing large entities such as proteins, carbohydrates, lipids, and nucleic acids, as well as smaller molecules like vitamins and hormones. Collectively, they are known as biological materials. Biomolecules are integral to the structure and function of living organisms, with the majority being produced internally; however, certain biomolecules must be acquired from the environment, such as specific nutrients, to sustain life. The exploration of biomolecules and their interactions is encompassed within the disciplines of biology, biochemistry, and molecular biology. Predominantly, biomolecules are organic, with four elements—oxygen, carbon, hydrogen, and nitrogen—constituting approximately 96% of the human body's mass. Nonetheless, other elements, including various biometals, are present in trace amounts. A notable feature among diverse life forms is the consistency of specific biomolecule types and metabolic pathways, which supports the concept of "biochemical universals" or the "theory of material unity of living beings," a foundational principle in biology, alongside cell theory and the theory of evolution.

TYPES OF BIOMOLECULES:

There are four major classes of Biomolecules –Carbohydrates, Proteins, Nucleic acids and Lipids. Each of them is discussed below.



CARBOHYDRATES:

Carbohydrates are chemically classified as polyhydroxy aldehydes or ketones, or as substances that produce these compounds through hydrolysis. They are often recognized as sugars or sweet-tasting substances and are collectively referred to as saccharides, derived from the Greek word "sakcharon," meaning sugar. Sugars are categorized according to the number of sugar units present after hydrolysis: those with a single unit are termed monosaccharides, those with two to ten units are called oligosaccharides, and those with more than ten units are classified as polysaccharides.

Carbohydrates fulfill various functions and are the main source of energy in our diets, playing an essential role in the structural composition of many organisms; for example, cellulose serves as a vital structural fiber in plants.

CLASSIFICATION OF CARBOHYDRATES :

Carbohydrates are primarily categorized into two types: simple and complex, based on their chemical structure and the number of sugar units they contain.

Simple carbohydrates, which include monosaccharides, disaccharides, and oligosaccharides, are composed of one or two sugar molecules. They are rapidly digested and absorbed by the body, resulting in a swift rise in blood sugar levels. Common sources of simple carbohydrates include milk, beer, fruits, refined sugars, and candies. These carbohydrates are often labeled as empty calories due to their lack of fiber, vitamins, and minerals.

Plants are classified as producers because they synthesize glucose ($C6H12O6$) using fundamental components such as carbon dioxide and water, facilitated by sunlight. This process, known as photosynthesis, converts solar energy into chemical energy. In contrast, consumers derive energy by consuming plants, utilizing the energy stored in the chemical bonds of the compounds produced by these plants.

1. Monosaccharides

Glucose is a type of carbohydrate monomer, also known as a monosaccharide. Other examples of monosaccharides are mannose, galactose, and fructose, among others. The way monosaccharides are structured can be described like this: Monosaccharides can also be categorized based on how many carbon atoms they have.

(i)Trioses ($C3H6O3$): These have three carbon atoms per molecule. Example: Glyceraldehyde

(ii)Tetroses ($C4H6O4$): These monosaccharides have four carbon atoms per molecule. Example: Erythrose.

(iii) pentoses,

(iv)hexoses

(v) heptoses

2. Disaccharides

When two monosaccharides join together, they create a disaccharide. Some examples of carbohydrates made up of two monomers are sucrose, lactose, and maltose.

3. Oligosaccharides:

1. Oligosaccharides are carbohydrates created by connecting 2 to 9 monomers. This means that trioses, pentoses, and hexoses are all classified as oligosaccharides.

• Complex Carbohydrates (Polysaccharides)

• Complex carbohydrates are made up of two or more sugar molecules, which is why they are often referred to as starchy foods.

• They are digested and absorbed more slowly compared to simple carbohydrates. You can find complex carbohydrates in foods like lentils, beans, peanuts, potatoes, peas, corn, whole-grain bread, and cereals.

• Polysaccharides are a type of complex carbohydrate formed by linking many monomers together.

• Polysaccharides include carbohydrates such as starch, glycogen, and cellulose. These substances are known for their extensive branching and are classified as homopolymers since they are made entirely of glucose units.

1. Starch consists of two main parts: amylose, which creates a straight chain, and amylopectin, which has a highly branched structure.

2. Glycogen is often referred to as animal starch because its structure resembles that of starch, but it features even more branching.

3. Cellulose is a carbohydrate that is essential for the structure of plant cell walls. It is a fibrous polysaccharide recognized for its high tensile strength. Unlike starch and glycogen, which have branched forms, cellulose forms a straight-chain polymer.

FUNCTIONS OF CARBOHYDRATES:

Carbohydrates primarily serve to supply energy and nourishment to the body, particularly supporting the nervous system. They are fundamental components of our diet, encompassing sugars, starches, and fibers, which are plentiful in grains, fruits, and dairy products. Carbohydrates can be categorized into various forms, including starches, simple sugars, and complex carbohydrates. Additionally, they play a crucial role in fat metabolism and help prevent ketosis. By serving as the main energy source, carbohydrates also inhibit the catabolism of proteins for energy. The enzyme amylase facilitates the conversion of starch into glucose, ultimately generating energy for metabolic processes.

EXAMPLES OF CARBOHYDRATES:

Following are the important examples of carbohydrates: • Glucose • Galactose • Maltose • Fructose • Sucrose • Lactose • Starch • Cellulose • Chitin

diagnosis of carboyadrate in biomolecules

Carbohydrates are really important when it comes to diagnosing different diseases. Here are some main points about how carbohydrates are used in diagnostics:

Glycosylation Patterns: 1. Unusual changes in how proteins are glycosylated can signal health issues like cancer, diabetes, and genetic disorders. Studying these patterns is important for early detection and tracking how diseases develop over time.

Blood Glucose Levels: 1. Checking blood sugar levels is really important for figuring out and controlling diabetes. Tests such as fasting blood glucose and HbA1c give valuable information about how a person's body processes glucose.

Glycated Hemoglobin (HbA1c): This test measures the average blood glucose levels over the past 2-3 months and is used to diagnose and monitor diabetes.

Lactose Tolerance Test: Used to diagnose lactose intolerance by measuring blood glucose levels after lactose ingestion.

Fructosamine Test: Measures glycated proteins in the blood, providing an indication of average blood glucose levels over the past 2-3 weeks.

These diagnostic methods help in understanding the metabolic state of carbohydrates in the body and are essential for diagnosing and managing various diseases.

PROTEINS:

Proteins are vital biomolecules that constitute approximately 50% of the dry mass of cells. They are composed of lengthy chains of amino acids, referred to as polypeptides. The organization of proteins can be classified into four distinct levels: primary, secondary, tertiary, and occasionally quaternary, depending on the complexity of the polypeptide chain's folding. Proteins fulfill both structural and functional roles within the body. For instance, myosin is a protein responsible for facilitating muscle movement through contraction. Additionally, the majority of enzymes are proteins. Broadly, protein molecules can be divided into two primary categories: fibrous and globular. Fibrous proteins are elongated and insoluble, whereas globular proteins are more compact and soluble. Each type can exhibit one to four structural forms, encompassing primary, secondary, tertiary, and quaternary structures.

✓**Primary Structure:** It is a specific sequence of amino acids. The order of amino acids bonded together is detected by information stored in genes.

✓**Secondary Structure:** . It is a 3D shape of a specific part of proteins. This shape is created by hydrogen bonds that connect the atoms in the backbone of the polypeptide chain.

✓**Tertiary Structure:** The R-groups play a key role in this process. The shape of a protein is three-dimensional. Multiple tertiary structures can come together to create a Quaternary Structure.

✓**Quaternary Structure:** It is the arrangement of multiple folded protein subunits in a multi-subunit complex.

PROTEIN SYNTHESIS:

Protein synthesis happens through a process known as translation. This process occurs in the cytoplasm of the cell. During translation, the genetic codes are interpreted. Ribosomes are essential in this process as they turn these genetic codes into a sequence of amino acids, which is called a polypeptide chain. However, these polypeptide chains need to go through specific changes before they can become active proteins.

SOURCES OF PROTEIN:

FUNCTIONS OF PROTEINS:

1. **Enzymes:** Enzymes play a crucial role in many chemical reactions that take place within a cell. They are essential for creating and fixing DNA molecules and are involved in handling various complex processes.

2. **Hormones:** Proteins are really important because they help create various hormones that keep our body's systems working properly. For example, insulin helps control blood sugar levels, and secretin is key for digestion. Additionally, proteins are involved in making digestive juices, which are necessary for breaking down the food we eat.

3. **Antibody:** Antibodies, also known as immunoglobulins, are essential proteins that significantly contribute to the immune system's functionality. They assist the body in healing and recovering from infections triggered by foreign bacteria. By collaborating with other immune cells, antibodies identify and target antigens, inhibiting their proliferation until white blood cells can effectively eradicate them.

4. **Energy:** Proteins are vital as a key energy source that facilitates our body's movements. It is important to intake an appropriate amount of protein to efficiently convert it into energy. Conversely, excessive protein consumption leads our bodies to transform the surplus into fat, which is subsequently stored in fat cells.

Diagnosis of protrins in biomolecules

Proteins play a crucial role as biomolecules in diagnosing different diseases. Here are some important methods and uses:

1. **Mass Spectrometry (MS)**: This method is commonly used to identify and measure proteins in biological samples. It provides great sensitivity and accuracy, which makes it better than older immunoassays.
2. **Enzyme-Linked Immunosorbent Assay (ELISA)**: A popular technique for identifying and measuring particular proteins in a sample. It's frequently utilized for diagnosing infections, autoimmune disorders, and allergies.
3. **Western Blotting**: Used to detect specific proteins in a sample based on their size and antibody binding. It's commonly used in research and clinical diagnostics.
4. **Protein Microarrays**: These allow the simultaneous analysis of multiple proteins in a sample, useful for biomarker discovery and disease diagnosis.
5. **Immunohistochemistry (IHC)**: This technique uses antibodies to detect specific proteins in tissue sections, aiding in the diagnosis of cancers and other diseases.

These techniques are important for figuring out how proteins contribute to diseases, and they play a key role in diagnosing conditions early, predicting outcomes, and tracking how well treatments are working.

NUCLEIC ACIDS:

Nucleic acids are the genetic materials located in cells that hold all the hereditary information passed down from parents to their offspring. There are two main types of nucleic acids: deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). The primary role of nucleic acids is to transfer genetic information and help in protein synthesis through processes called transcription and translation. The basic building block of nucleic acids is the nucleotide, which consists of a nitrogenous base, a pentose sugar, and a phosphate group. Nucleotides are connected by phosphodiester bonds between the 3’ and 5’ ends. The specific nitrogen base linked to the pentose sugar gives each nucleotide its unique identity.

In DNA, there are four key nitrogenous bases: adenine, guanine, cytosine, and thymine. In RNA, thymine is swapped out for uracil. The structure of DNA is often described as a double helix, resembling a twisted ladder, formed by hydrogen bonds between the bases of two antiparallel strands of nucleotides.

Diagnosis of NUCLEIC ACIDS in biomolecules:

Nucleic acids, like DNA and RNA, play a crucial role in identifying various diseases. Here are some important diagnostic techniques that use nucleic acids:

1. **Polymerase Chain Reaction (PCR)**: This technique amplifies specific DNA sequences, making it possible to detect even small amounts of genetic material. It's widely used for diagnosing infectious diseases, genetic disorders, and cancer.
2. **Real-Time PCR (qPCR)**: An advanced form of PCR that quantifies DNA or RNA in real-time, providing both qualitative and quantitative data. It's used for viral load testing, gene expression analysis, and more.
3. **Next-Generation Sequencing (NGS)**: This high-throughput method sequences entire genomes or specific regions, allowing for comprehensive genetic analysis. It's used in cancer genomics, rare disease diagnosis, and pathogen identification.
4. **Microarrays**: These are used to analyze gene expression patterns and detect genetic variations. They are useful in cancer diagnostics, pharmacogenomics, and personalized medicine.
5. **In Situ Hybridization (ISH)**: This technique uses labeled probes to detect specific nucleic acid sequences within tissue sections. It's used for diagnosing viral infections, chromosomal abnormalities, and certain cancers.

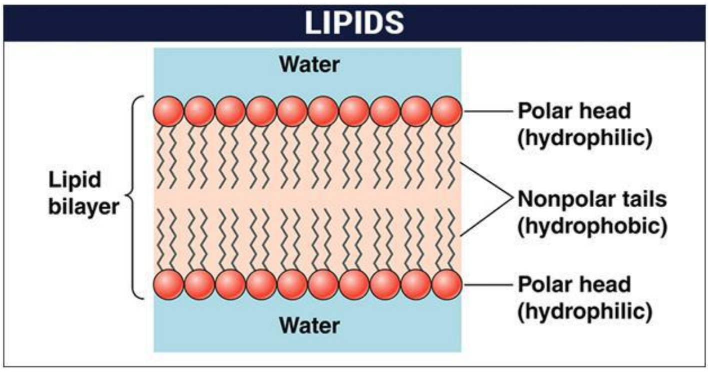
6. **CRISPR-based Diagnostics**: Emerging technologies like CRISPR-Cas systems are being developed for rapid and precise detection of nucleic acids, offering potential for point-of-care diagnostics.

These techniques are essential for grasping genetic data and its effects on health and illness, allowing for early detection, tailored treatments, and improved results for patients.

LIPIDS:

Lipids are organic substances that are insoluble in water but can dissolve in organic solvents. They are associated with fatty acids and play a vital role in living organisms. This category encompasses fats, waxes, sterols, fat-soluble vitamins, as well as various forms of triglycerides and phospholipids. In contrast to carbohydrates, proteins, and nucleic acids, lipids do not consist of repeating units. They are essential for maintaining cell structure and act as a key energy source.

These organic compounds are nonpolar, which means they can only dissolve in nonpolar solvents and not in water because water is polar. In our bodies, these molecules can be produced in the liver and can also be found in foods such as oil, butter, whole milk, cheese, fried foods, and some types of red meat.



PROPERTIES OF LIPIDS:

Lipids constitute a category of organic compounds that encompasses fats and oils. They serve as a significant source of energy and fulfill multiple functions within the human body. Below are some essential characteristics of lipids.

1. Lipids are nonpolar substances that are oily or greasy, and they are found stored in the body's fat tissue.

2. Lipids consist of a diverse range of compounds, primarily made up of hydrocarbon chains.

3. These energy-dense organic molecules supply energy for various life functions.

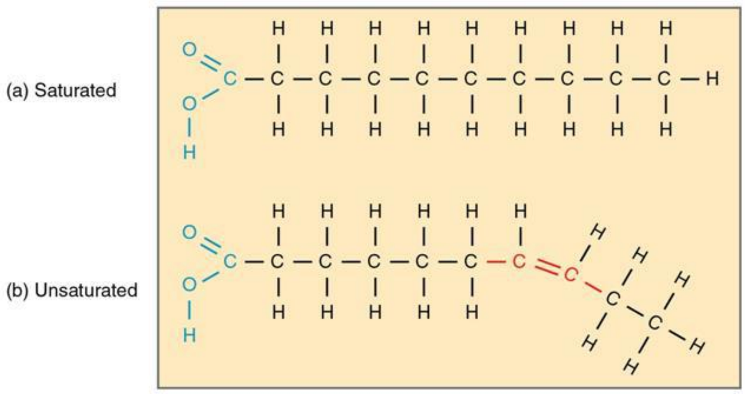
4. Lipids are defined by their ability to dissolve in nonpolar solvents while being unable to dissolve in water.

5. In biological systems, lipids play a crucial role by creating a protective barrier that separates a cell from its surroundings, which is known as the cell membrane.

LIPID STRUCTURE:

Lipids are composed of fatty acids and feature a lengthy hydrocarbon chain that is primarily non-polar, along with a tiny polar part that contains oxygen. The diagram below shows the structure of lipids.

Lipid Structure – Saturated and Unsaturated Fatty Acids



CLASSIFICATION OF LIPIDS:

Lipids can be classified into two main classes:

• Nonsaponifiable lipids

• Saponifiable lipids

Nonsaponifiable Lipids :

A nonsaponifiable lipid refers to a category of fat that cannot be decomposed into smaller components through the process of hydrolysis. Cholesterol and prostaglandins serve as examples of nonsaponifiable lipids.

Saponifiable Lipids :

A saponifiable lipid is a type of fat that has one or more ester groups, which means it can break down through a process called hydrolysis when it comes into contact with a base, acid, or enzymes. This group includes things like waxes, triglycerides, sphingolipids, and phospholipids.

These lipids can be further classified into two main types: non-polar and polar lipids.

Non-polar lipids, such as triglycerides, serve as energy sources and storage.

On the other hand, polar lipids are important for forming membranes because they can create a barrier against water. Examples of polar lipids include sphingolipids and glycerophospholipids.

Fatty acids are essential building blocks for all these types of lipids.

TYPES OF LIPIDS:

There are two primary types of lipids, and each of these includes various specific kinds that are crucial for life, like fatty acids, triglycerides, glycerophospholipids, sphingolipids, and steroids. Overall, lipids can be categorized into two main groups: simple lipids and complex lipids.

Simple Lipids : Esters of fatty acids with various alcohols.

1. **Fats:** Esters of fatty acids with glycerol. Oils are fats in the liquid state

2. **Waxes**: Esters of fatty acids with higher molecular weight monohydric alcohols

Complex Lipids : Esters of fatty acids containing groups in addition to alcohol and a fatty acid.

1. **Phospholipids**: Lipids are made up of fatty acids and alcohol, along with a part called phosphoric acid. Often, they also include bases that have nitrogen and other groups attached. For example, in glycerophospholipids, the alcohol used is glycerol, while in sphingophospholipids, the alcohol is sphingosine.

2. Glycolipids (glycosphingolipids): Lipids containing a fatty acid, sphingosine and carbohydrate.

3. **Other complex lipids**: Lipids such as sulfolipids and amino lipids. Lipoproteins may also be placed in this category.

Precursor and Derived Lipids :

Lipids are composed of a range of elements, including fatty acids, glycerol, steroids, various alcohols, fatty aldehydes, ketone bodies, hydrocarbons, lipid-soluble vitamins, and hormones. Acylglycerols (also referred to as glycerides), cholesterol, and cholesteryl esters are categorized as neutral lipids due to their lack of charge. These compounds are produced through the hydrolysis of both simple and complex lipids. In the following sections, we will examine the various categories of lipids in greater detail.

Fatty Acids:

Fatty acids belong to the category of carboxylic acids, which are classified as organic acids. These compounds usually feature long chains referred to as aliphatic tails and can exist in either saturated or unsaturated forms.

• Saturated fatty acids

The lack of carbon-carbon double bonds indicates that the fatty acid is saturated. Saturated fatty acids exhibit higher melting points compared to their unsaturated counterparts of equivalent size, as their molecular structure allows for closer packing, leading to a straight, rod-like formation.

• Unsaturated fatty acids

An unsaturated fatty acid is characterized by the presence of multiple double bonds within its structure. Generally, naturally occurring fatty acids possess an even number of carbon atoms and are composed of straight, unbranched chains. In contrast, unsaturated fatty acids feature cis-double bonds, which introduce a curvature in their configuration, thereby inhibiting their ability to align in a linear, rod-like manner.

ROLE OF FATS :

Fats have several important functions in our bodies. Here are some key roles that fats play:

• Having the right amount of fats is essential for our body to work properly.

• Certain vitamins that dissolve in fat need fats to be absorbed effectively by our bodies.

• Fats help keep our bodies insulated.

• They are a great way to store energy for extended periods.

Waxes :

Waxes belong to a category of organic compounds known as "esters," formed when the hydrogen atom in an acid is substituted with an alkyl or another organic group. These compounds are synthesized from long-chain alcohols and long-chain carboxylic acids.

Waxes are ubiquitous in the natural world. Numerous plants possess fruits and leaves that are enveloped in a waxy layer, which serves to protect them from small herbivores and to minimize moisture loss.

Additionally, certain animals, including specific mammals and birds, exhibit a waxy coating on their fur and feathers, which aids in maintaining dryness. Carnauba wax is particularly renowned for its durability and water resistance, rendering it a favored option for automotive wax applications.

EXAMPLES OF LIPIDS :

Lipids exist in many different types. Some examples include butter, ghee, vegetable oil, cheese, cholesterol, and various steroids. There are also waxes, phospholipids, and fat-soluble vitamins. What’s cool about these substances is that they all have similar traits, like being unable to dissolve in water but can dissolve in organic solvents.

Clinical diagnosis of biomolecules:

The process involves identifying and measuring various biomolecules such as enzymes, proteins, nucleic acids, antibodies, and hormones to assist in recognizing and monitoring diseases. Here are some key points:

1. Proteins and Enzymes: These biomolecules play essential roles in numerous biological processes and are often used as markers for disease diagnosis. For example, mass spectrometry-based proteomics is a powerful technique for detecting and quantifying proteins in biological samples, which aids in the early identification and monitoring of health issues.

2. Nucleic Acids: Techniques like PCR (polymerase chain reaction) and next-generation sequencing are used to detect genetic alterations and identify genes linked to diseases.

3. Hormones and Antibodies: Measuring hormones and antibodies is crucial for assessing bodily functions, which helps in diagnosing a range of health problems, including hormonal imbalances and autoimmune diseases.

4. Lipids and Carbohydrates: Changes in the metabolism of lipids and carbohydrates can indicate metabolic disorders, making their analysis vital for accurate diagnosis and treatment.

5. Vitamins and Minerals: Keeping track of vitamin and mineral levels is important because deficiencies or excesses can lead to health issues, and this information is essential for clinical diagnosis.

Understanding these biomolecules is fundamental for grasping health conditions and making informed decisions about treatment.

diagnosis of lipids in biomolecules:

Lipids are essential components in numerous biological processes, and their analysis is critical for the diagnosis of a range of health conditions. The following are key methodologies employed in the assessment of lipid-related disorders:

1. Lipid Profiles: This technique quantifies various lipid types in the bloodstream, including cholesterol, triglycerides, HDL (high-density lipoprotein), and LDL (low-density lipoprotein). It is frequently utilized to assess the risk of cardiovascular diseases.

2. Lipidomics: This sophisticated method investigates the complete lipid composition within biological systems, aiding in the identification of biomarkers associated with diseases such as cancer, diabetes, and neurodegenerative disorders.

3. Fatty Acid Analysis: This approach evaluates the types of fatty acids found in tissues and blood, providing valuable information regarding metabolic disorders and nutritional deficiencies.

4. Lipoprotein Subfraction Testing: This assessment offers detailed insights into the size and density of lipoprotein particles, potentially yielding a more precise evaluation of cardiovascular risk than conventional lipid profiles.

5. Oxidized LDL: Measuring the levels of oxidized LDL can be instrumental in diagnosing and forecasting the risk of atherosclerosis and other cardiovascular diseases.

These diagnostic methods are vital for comprehending the impact of lipids on health and for the timely identification and management of various medical conditions.

Analyzing biomolecules

There are several methods used to identify, measure, and explore the structure and function of biological molecules. Here are some popular techniques for analyzing biomolecules:

1. Spectroscopy:

- UV-Vis Spectroscopy: Helps determine the concentration of proteins and nucleic acids.
- Infrared (IR) Spectroscopy: Used to identify functional groups and structures within biomolecules.
- Nuclear Magnetic Resonance (NMR) Spectroscopy: Offers detailed insights into the structure, dynamics, and interactions of biomolecules.

2. Chromatography:

- High-Performance Liquid Chromatography (HPLC): Separates, identifies, and measures components in a mixture.
- Gas Chromatography (GC): Analyzes gases and volatile compounds.
- Affinity Chromatography: Isolates proteins and other molecules based on specific interactions.

3. Mass Spectrometry:

- Identifies and measures biomolecules by assessing their mass-to-charge ratio.
- Commonly used in proteomics to study protein structure, function, and interactions.

4. Electrophoresis:

- Gel Electrophoresis: Separates DNA, RNA, and proteins according to their size and charge.
- Capillary Electrophoresis: Separates molecules in a capillary tube using an electric field.

5. Polymerase Chain Reaction (PCR):

- Amplifies specific DNA sequences for further analysis.
- Widely used in genetic testing, forensic science, and research.

6. Next-Generation Sequencing (NGS):

- A high-throughput sequencing technique for analyzing large amounts of DNA or RNA.
- Important for genomics, transcriptomics, and metagenomics research.

7. Enzyme-Linked Immunosorbent Assay (ELISA):

- Detects and measures proteins, antibodies, and hormones.
- Utilized in diagnostics and research.

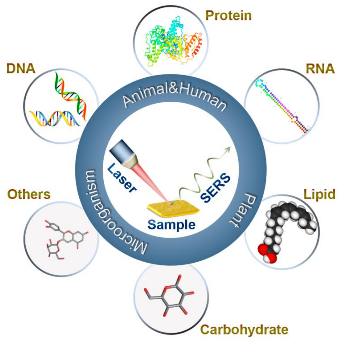
8. Bioinformatics:

- Employs computational tools to analyze and interpret biological data.
- Involves tasks like sequence alignment, protein structure prediction, and data mining.

These techniques are crucial for understanding biological processes, diagnosing diseases, and creating new therapies.

The analysis of biomolecule:

Biomolecules play a crucial role in many areas, including clinical diagnostics, food safety testing, environmental monitoring, and drug development. These substances, found in living organisms, are essential for various chemical and biological functions. They include large molecules like proteins, nucleic acids, carbohydrates, and lipids, as well as smaller ones like primary metabolites and natural products. To identify these biomolecules, scientists use a variety of detection techniques, both in laboratory settings and in living organisms. Some of these methods include chromatography-mass spectrometry, enzyme-linked immunosorbent assays (ELISA), colorimetric and fluorescence detection, polymerase chain reaction (PCR), and vibrational spectroscopy techniques like infrared and Raman spectroscopy. This review highlights the recent progress in surface-enhanced Raman spectroscopy (SERS) for analyzing biomolecules in humans, animals, plants, and microorganisms over the last decade.



Conclusion:

The study of biomolecules is crucial in clinical diagnostics, offering important information for diagnosing, monitoring, and treating various illnesses. Here are some key points to consider:

1. Precise Diagnosis: Methods such as PCR, ELISA, and NGS are essential for detecting genetic changes, protein levels, and other important markers, which leads to accurate diagnoses.

2. Tracking Disease Progress: Regular biomolecule analysis allows healthcare providers to monitor how diseases progress and assess how well treatments are working.

3. Early Disease Detection: Cutting-edge technologies enable the early identification of diseases, which can significantly improve outcomes through prompt treatment.

4. Customized Medicine: By understanding the molecular aspects of diseases, healthcare professionals can create personalized treatment plans that cater to each patient's unique genetic makeup and biomarker levels.

5. Innovation in Research: Continuous research and analysis of biomolecules fuel advancements in diagnostics and therapies, resulting in new treatment options and better patient care.

In summary, incorporating biomolecular analysis into clinical diagnostics greatly improves our understanding of complex diseases, enhances patient outcomes, and pushes the boundaries of medical science.

References:

1]Bunge, M. (1979). Treatise on Basic Philosophy, vol. 4. Ontology II: A World of Systems, p. 61-2. link.

2]^ Voon, C. H.; Sam, S. T. (2019). "2.1 Biosensors". Nanobiosensors for Biomolecular Targeting. Elsevier. ISBN 978-0-12-813900-4.

3]^ endogeny. (2011) Segen's Medical Dictionary. The Free Dictionary by Farlex. Farlex, Inc. Accessed June 27, 2019.

4]^ Green, D. E.; Goldberger, R. (1967). Molecular Insights into the Living Process. New York: Academic Press – via Google Books.

5]^ Gayon, J. (1998). "La philosophie et la biologie". In Mattéi, J. F. (ed.). Encyclopédie philosophique universelle. Vol. IV, Le Discours philosophique. Presses Universitaires de France. pp. 2152–2171. ISBN 9782130448631 – via Google Books.

6] Mass spectrometry-based proteomics as an emerging tool in clinical laboratories | Clinical Proteomics | Full Text

7]BIOCHEMISTRY-THEORY Prepared by, Dr. RIYA MARIAM Assistant Professor RAMA UNIVERSITY KANPUR

8] Introduction to Clinical Applications of Biomolecules in Disease Diagnosis | SpringerLink

9] Mass spectrometry-based proteomics as an emerging tool in clinical laboratories | Clinical Proteomics | Full Text

10]. Li, L.; Yang, H.J.; Liu, D.C.; He, H.B.; Wang, C.F.; Zhong, J.F.; Gao, Y.D.; Zeng, Y.J. Analysis of biofilms formation and associated genes detection in staphylococcus isolates from bovine mastitis. Int. J. Appl. Res. Vet. Med. 2012, 10, 62–68.

11]. Xie, S.B.; Zhou, J. Harnessing plant biodiversity for the discovery of novel anticancer drugs targeting microtubules. Front. Plant Sci. 2017, 8.

12]. Zhou, L.; Zhou, J.; Feng, Z.; Wang, F.Y.; Xie, S.S.; Bu, S.Z. Immunoassay for tumor markers in human serum based on si nanoparticles and sic@ag sers-active substrate. Analyst 2016, 141, 2534–2541.

13]. Zhang, Z.; Wang, Q.; Han, L.; Du, S.; Yu, H.; Zhang, H. Rapid and sensitive detection of salmonella typhimurium based on the photothermal effect of magnetic nanomaterials. Sens. Actuators B Chem. 2018, 268, 188–194. 14]. Rombout, J.; Yang, G.W.; Kiron, V. Adaptive immune responses at mucosal surfaces of teleost fish. Fish Shellfish Immunol. 2014, 40, 634–643.

15]. Sui, N.; Wang, Y.; Liu, S.S.; Yang, Z.; Wang, F.; Wan, S.B. Transcriptomic and physiological evidence for the relationship between unsaturated fatty acid and salt stress in peanut. Front. Plant Sci. 2018, 9

16]. Hanif, S.; Liu, H.L.; Chen, M.; Muhammad, P.; Zhou, Y.; Cao, J.; Ahmed, S.A.; Xu, J.J.; Xia, X.H.; Chen, H.Y.;

et al. Organic cyanide decorated sers active nanopipettes for quantitative detection of hemeproteins and fe3+ in single cells. Anal. Chem. 2017, 89, 2522–2530.

17]. Black, D.M.; Robles, G.; Lopez, P.; Bach, S.B.H.; Alvarez, M.; Whetten, R.L. Liquid chromatography separation and mass spectrometry detection of silver-lipoate ag29(la)12 nanoclusters: Evidence of isomerism in the solution phase. Anal. Chem. 2018, 90, 2010–2017.

18]. Sun, Z.; Lv, J.; Liu, X.; Tang, Z.; Wang, X.; Xu, Y.; Hammock, B.D. Development of a nanobody-avitag fusion protein and its application in a streptavidin-biotin-amplified enzyme-linked immunosorbent assay for ochratoxin a in cereal. Anal. Chem. 2018.

19]. Deng, Y.Q.; Feng, Z.T.; Yuan, F.; Guo, J.R.; Suo, S.S.;Wang, B.S. Identification and functional analysis of the autofluorescent substance in limonium bicolor salt glands. Plant Physiol. Biochem. 2015, 97, 20–27.

20]. Yuan, F.; Chen, M.; Leng, B.Y.; Wang, B.S. An efficient autofluorescence method for screening Limonium bicolor mutants for abnormal salt gland density and salt secretion. S. Afr. J. Bot. 2013, 88, 110–117.

21]. Guo, F.D.; Liu, C.L.; Xia, H.; Bi, Y.P.; Zhao, C.Z.; Zhao, S.Z.; Hou, L.; Li, F.G.;Wang, X.J. Induced expression of atlec1 and atlec2 differentially promotes somatic embryogenesis in transgenic tobacco plants. PLoS ONE 2013, 8

22]. Li, X.Z.; Yang, T.Y.; Li, C.S.; Jin, L.L.; Lou, H.; Song, Y.T. Prenatal detection of thalassemia by cell-free fetal DNA (cffdna) in maternal plasma using surface enhanced raman spectroscopy combined with pcr. Biomed. Opt. Express 2018, 9, 3167–3176.

23]. Liu, R.M.; Xiong, Y.; Tang, W.Y.; Guo, Y.; Yan, X.H.; Si, M.Z. Near-infrared surface-enhanced raman spectroscopy (nir-sers) studies on oxyheamoglobin (oxyhb) of liver cancer based on pva-ag nanofilm. J. Raman Spectrosc. 2013, 44, 362–369.