Chapter 13

BIOCHEMISTRY

Conceptual Linkage

Before reading this chapter, the student must know the:

- Basic properties of Organic Compounds
- Structure of Organic Compounds
- Isomerism concept

Time Allocation

Teaching periods	= 15
Assessment periods	= 03
Weightage	= 06%

LEARNING OUTCOMES

Students will be able to:

- Distinguish between mono-,di- and trisaccharides. (Understanding)
- Describe the bonding in a protein molecule. (Understanding)
- Explain the sources and uses of carbohydrates, proteins, and lipids. (Understanding)
- Differentiate between fats and oil. (Applying)
- Describe the importance of nucleic acids. (Understanding)
- Define and explain vitamins and their importance. (Understanding)

Introduction

Chemistry is the science of matter and we discuss and try to understand the matter while studying chemistry. A great part of our world is consisting of the matter we call living organism. *The matter that the living bodies are made up of is studied in the branch of chemistry called the biochemistry or in simple words.* Biochemistry is the branch of chemistry which deals with the composition, structure and properties of matter present in the living organisms.

Biochemistry is actually a branch of organic chemistry as all the bio material is organic in nature. But in addition the organic compounds also include the compounds of carbon and hydrogen which are artificially

synthesized and show properties like that of other hydrocarbons. Such artificially prepared chemical compounds include different types of plastics and synthetic rubber which have same properties like natural organic compounds. But in the biochemistry such chemical compounds are not studied. Only those material are under consideration which is present in the living organisms. Even the hydrocarbon fuel matter is not studied in this field.

The biochemistry also deals with the study of the chemical processes and transformations taking place in the living organisms. The structure and function of cellular components, such as proteins, carbohydrates, lipids, nucleic acids, and other biomolecules. These biomolecules are indeed very complex in nature and giant in structure.

Although the living organisms show too much diversity in their behaviour, structure and form. But they are composed of generally same type of elements. Such types helps greatly in understanding the life.

The most common types of compounds that the livings organism contain are:

- The carbohydrates
- The proteins
- The lipids
- Nucleic acids
- The vitamins

In the subsequent sections we will study each of these type of compounds in detail.

The principles set up by the biochemistry helps us to increase the standard of our life, to fight against the diseases by developing and understanding the systems in living organisms. Generation of new and better types of crops using genetic engineering procedures and many more applications.

13.1 The Carbohydrates

The term carbohydrate is very common word in our daily life

especially when we talk about the food we eat. It is the class of bio organic compounds having general formula normally '$C_x(H_2O)_y$', that is why the term carbohydrate was originally used to describe compounds that were literally "hydrates of carbon" .e.g. the most common simple carbohydrate for us is the glucose, having molecular formula $C_6H_{12}O_6$, and the formula shows that it has the empirical formula as CH_2O. Although in many cases this relation does not exists, e.g. in the table sugar, the sucrose, which has the molecular formula $C_{12}H_{22}O_{11}$.

Carbohydrates are the most abundant bio compounds, and they are used mostly as a source of energy for the living systems. In nature the carbohydrates are formed by the plants using the process of photosynthesis, which is performed by using the energy of sun and plant pigment 'Chlorophyll'.

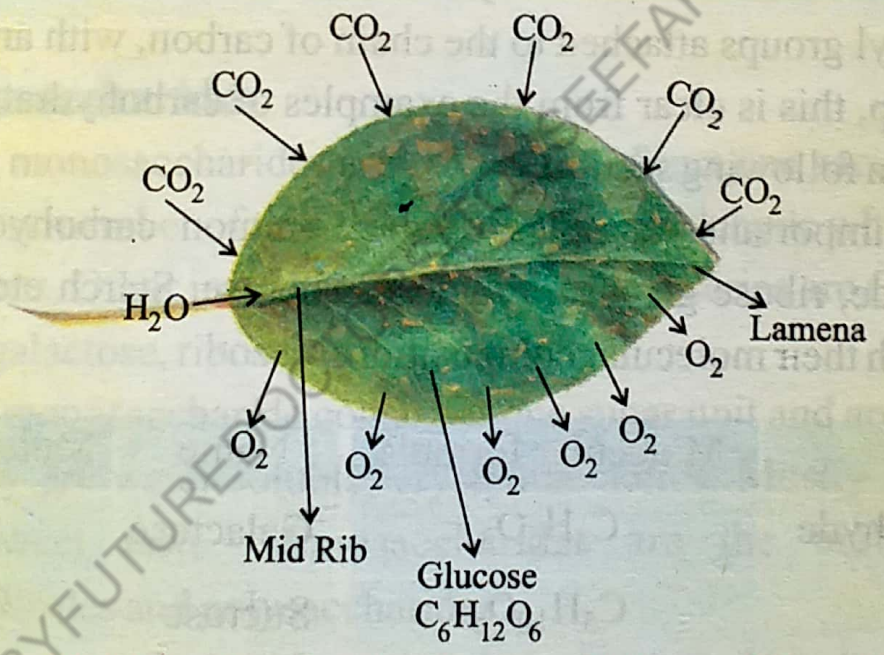


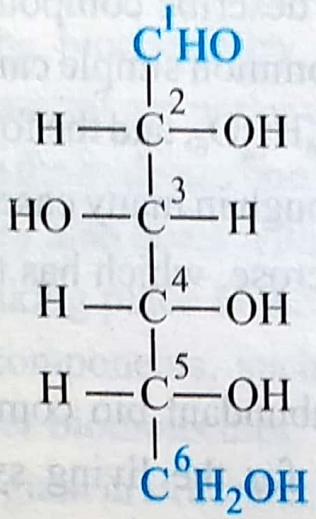
Figure-13.1: The plant leaf is a factory which uses CO_2 and H_2O as raw materials and produces Glucose and Oxygen

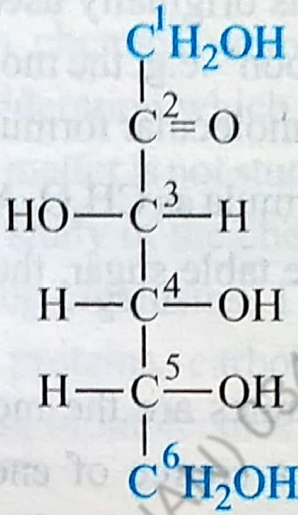
$$6CO_{2(g)} + 6H_2O_{(l)} \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} \underset{\text{Glucose}}{C_6H_{12}O_{6(aq)}} + 6O_{2(g)}$$

As by the sense of chemistry, the carbohydrates are the polyhydroxy aldehydes or ketones. Recall your knowledge that Aldehydes are the compounds that have –CHO linkage and the ketones are the organic

compounds that have the linkage of R—CO—R , while the hydroxyl group is the –OH group.

Glucose sugar which contains addhydic functional group





Fructose Sugar which has ketonic functional group

Figure-13.2: Basic carbohydrate units showing aldehydic / ketonic groups

This means that the carbohydrates are the compounds which have many hydroxyl groups attached to the chain of carbon, with an Aldehydic or Ketonic group, this is clear from the examples of carbohydrates which have been written in following section.

Some important examples of the common carbohydrates include glyceraldehyde, ribose glucose, Fructose, Sucrose, Starch etc are shown in table 13.1 with their molecular composition.

Name	Molecular formula	Name	Molecular formula
Glyceraldehyde	$C_3H_6O_3$	Galactose	$C_6H_{12}O_6$
Ribose	$C_5H_{10}O_5$	Sucrose	$C_{12}H_{22}O_{11}$
Glucose	$C_6H_{12}O_6$	Starch	$(C_6H_{10}O_5)_n$
Fructose	$C_6H_{12}O_6$	Cellulose	$(C_6H_{10}O_5)_n$

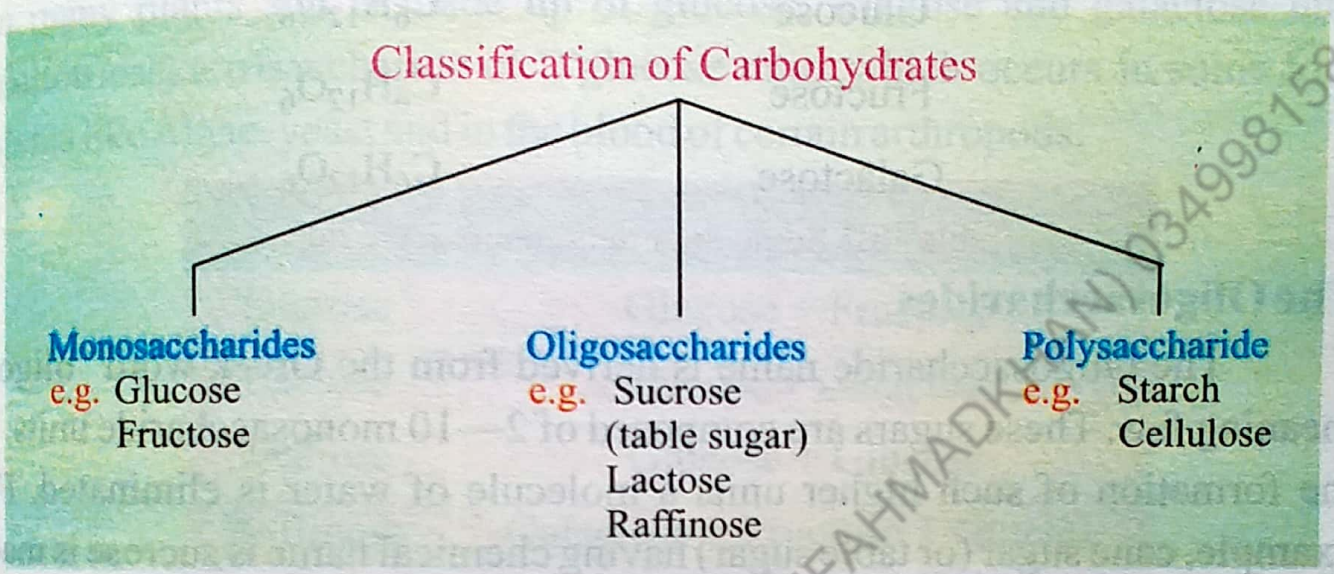
Table 13.1 Some important carbohydrates

13.1.1 Classification of Carbohydrates

The carbohydrates are classified according to the number of sugar units presents in them, thus the carbohydrates containing only one sugar unit are

called **monosacharides**, (saccharides-Greek-sakcharon meaning "sugar"). Thus they are classified into 3 main groups, i.e.

- **Monosaccharides**
- **Oligosaccharides**
- **Polysaccharides**



The Monosaccharides

The monosaccharides are composed of just one saccharide (or sugar) unit, the first member of this class is the Glyceraldehyde which has only three carbon atoms. Other important members of this series are Glucose, fructose, mannose, galactose, ribose etc.

The monosaccharide consist of one sugar unit and are usually white in colour, they are water-soluble, crystalline solids. Mostly monosaccharides have a sweet taste. Monosaccharides are the building blocks of Oligosaccharides and polysaccharides.

The monosaccharides are the simplest but important type of carbohydrate which among other properties contains carbon, hydrogen, and oxygen in the same ratio (1:2:1) as described by the general formula of carbohydrate class, $(C_n(H_2O)_n)$. Glucose, one of the most important and well known monosaccharide carbohydrate is very common in nature. The fructose, also called the fruit sugar, as it is the sugar that gives fruits their sweet taste in most is also a monosaccharide. Some important

monosaccharides are shown in table 13.2.

Name	Molecular formula
Glyceraldehyde	$C_3H_6O_3$
Ribose	$C_5H_{10}O_5$
Glucose	$C_6H_{12}O_6$
Fructose	$C_6H_{12}O_6$
Galactose	$C_6H_{12}O_6$

Table 13.2 Some important monosaccharides

The Oligosaccharides

The Oligosaccharide name is derived from the Greek word "oligos" meaning few. These sugars are composed of 2—10 monosaccharide units. In the formation of such higher units a molecule of water is eliminated. For example, cane sugar (or table sugar) having chemical name is sucrose is made from glucose and fructose, similarly milk sugar (lactose) is made from glucose and galactose.

$$\text{Glucose} + \text{Fructose} \longrightarrow \text{Sucrose} + \text{Water}$$

Similarly the milk sugar "Lactose" is the disaccharide of Glucose and Galactose.

$$\text{Galactose} + \text{Glucose} \longrightarrow \text{Lactose} + \text{Water}$$

The disaccharides are important to us in the sense that most of the energy drinks we take contains these carbohydrates, and so they serve for us as a source of quick energy, their cheap sources are available in nature in abundance, and they also take less time to digest in our body due to having lesser monosaccharide units.

Interesting Information

The disaccharides provide us a quick energy as they are digested easily in no time. That is why a sugar patient when suffers hypoglycemia, a condition resulting from low blood sugar, is advised to take sucrose (a disaccharide sugar) in a little quantity, or a candy containing sugar. The sugar is readily digested even in the mouth by the action of saliva, increasing blood sugar of the patient.

The oligosaccharides are further divided into several types depending upon the number of units present in. The oligosaccharides consisting of '2' units are called disaccharides, (sucrose, maltose, lactose are disaccharides), The oligosaccharides that consists of three sugar units are called trisaccharides, the examples of these include raffinose, a trisaccharide found in many plants and is made up of glucose, fructose and galactose units, maltotriose, a trisaccharide of '3'glucose units which occurs in some lower plants like Algae, yeast and in the blood of certain arthropods.

Name	Monosaccharide Units
Sucrose	Glucose + Fructose
Lactose	Glucose + Galactose
Maltose	Glucose + Glucose
Raffinose	Galactose + Fructose + Glucose
Maltotriose	Glucose + Glucose + Glucose

Table 13.3 Some important oligosaccharides

The Polysaccharides

The polysaccharides, as the name indicates contain a large number of saccharide units, (more than '10' to several hundreds.) The important examples of polysaccharides are, starch, glycogen, cellulose. All these three polysaccharides are made up of glucose units but differ in the sequence of units.

13.1.3 Sources and uses of Carbohydrates

Carbohydrates are the most abundant organic compounds in nature. They are synthesized and consumed by nearly all plants and animals. They are essential constituents of all living things. Carbohydrates are formed by green plants from carbon dioxide and water during the process of photosynthesis.

$$nCO_2 + nH_2O + \text{energy} \longrightarrow C_nH_{2n}O_n + nO_2$$

In the animals, glucose is oxidized to carbon dioxide and water to provide metabolic energy. Which is used in life processes. Plants and animals

store energy in the carbohydrate form as starch and glycogen respectively. Cellulose constructs the cell walls and provides the structural framework of plants. In addition to the use of carbohydrates as a source of energy in foods. Thus the plant products are good source of carbohydrates and cereals, wheat, maize, rice, potatoes, banana and other fruit are good source of carbohydrates. In table 13.4 some of important carbohydrates and their derivatives are written.

Carbohydrate	Sources
Glucose	Grapes
Fructose	Fruits, honey
Sucrose	Sugar cane, beet root
Lactose	Milk and dairy products
Starch	Potato, cereals like wheat, rice, maize etc.
Glycogen	Animal liver

Table-13.4: Some important carbohydrates and their sources

The carbohydrates are also used in many other fields of life, e.g. as building materials (wood and glues) in construction, in paper and paper products, in clothing (cotton) and many more.

Interesting Information

The carbohydrates are the instant source of energy: In hospitals 5% glucose solution marketed as 5% dextrose is used frequently in the form of drips for parenteral nutrition to treat the patients who can not take food or have some problems in eating food.

This saves lives of thousands of humans:

13.2 The Proteins

Proteins are the giant bio-organic compounds, which are composed of by joining of the amino acids.(remember that the amino acids are the organic molecules containing both the amino group "• $\ddot{N}H_2$" and the carboxyl group "•COOH").

The word protein has its origin from the Greek **proteios**, meaning first. So this class of organic compounds which are present in living organisms and vital to every living cell. In the form of skin, hair, cartilage, muscles, tendons and ligaments, proteins hold together, protect, and provide structure to the body of a multi cellular organism. In the form of enzymes, hormones, antibodies, and globulins. They catalyze, regulate, and protect the body chemistry. In the form of hemoglobin, myoglobin and various lipoproteins, they effect the transport of oxygen and other substances within an organism. In human body the proteins are formed by joining '20' different amino acids, of which '10' amino acids are synthesized by our body, and remaining '10' must be taken through food sources. The amino acids that are needed in food are called essential amino acids.

13.2.1 Amino acids as building blocks of Proteins

As already discussed that proteins are formed by joining amino acids. Amino acids are actually such organic compounds in which two types of functional groups, the amino group and the carboxyl group are present simultaneously in a single compound.

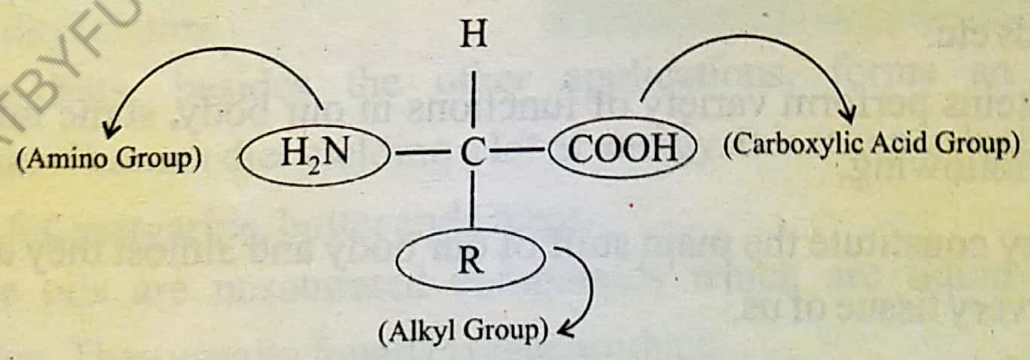


Fig 13.3 General representation of an amino acid.

The 'R' here represents chain of carbon.

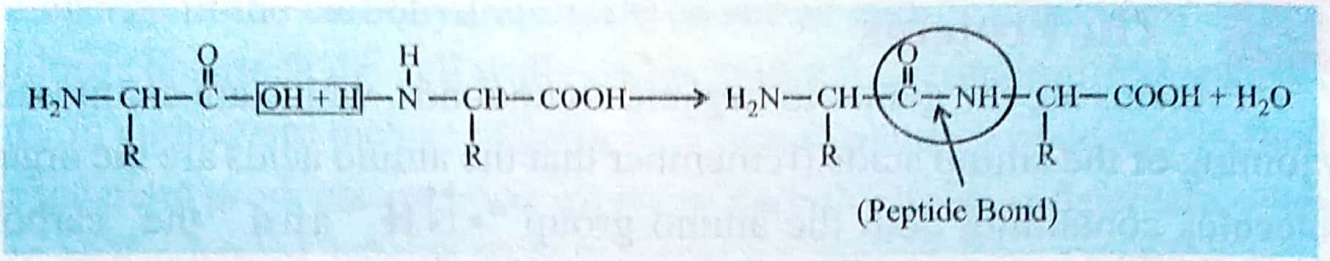


Fig 13.4: Formation of peptide bond

These amino acids when combine to form a bigger molecule, a water molecule is eliminated in this reaction.

The bond that joins two amino acids is called peptide bond. A protein is formed when thousands of such amino acids are linked with each other through peptide bonds. This is to be remembered that when hydrolysis of a protein is carried out, the amino acids that form that protein are regained.

Proteins are giant molecules so to reduce the occupied space they form a folded structure.

13.2.2 Sources and uses of Proteins

Protein make the basic body stuff of not only the humans but also of other animals and to some extent of plants too. The dry mass of animals constitute about 50% of the proteins. The plants are able to prepare their own protein using simple elements, but the animals mostly form their proteins by eating amino acids in their food. Although they can form some of the amino acids by themselves.

We can obtain required proteins or the amino acids through different sources for example by eating meat, eggs, beans, fruits, lentils, pulses, dry fruits, seeds etc.

Proteins perform variety of functions in our body, some important of which are following,

- They constitute the main stuff of our body and almost they are present in every tissue of us.
- Proteins serve as the carrier to carry many substances from one place to another in our body.
- As a catalyst these protein catalyze reactions in our body, without

which all functions in our body stop.

- They also serve as hormone, and thus run the tissue systems well in our body.
- The protein are also used in many field other than food, for example leather which is also a protein is used in making shoes, cloths, and sports articles.

So in view of all these we can say that protein are an essential part of our life.

13.3 The Lipids

The lipids are long chained esters of fatty acids and glycerol (Glycerine). They form an important class of organic compounds. These are widely distributed among the living organisms. One of a member of which you are well familiar is the Fat. The other members of the lipids include steroids, terpenes and waxes. The Fats are triesters of glycerol and long-chained carboxylic acids, they are generally represented by the general formula shown in figure-13.5, where R_1, R_2 and R_3 represents three different alkyl chains.

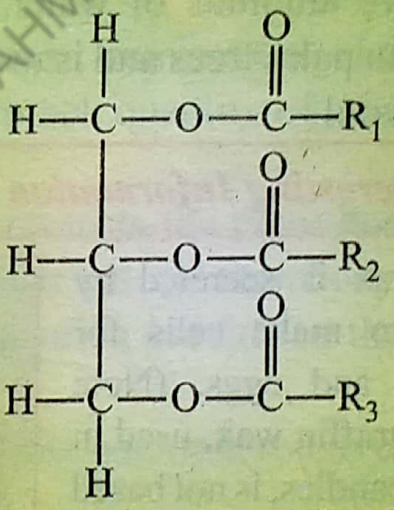


Fig. 13.5: General Formula of Fats

The Fats, besides the other applications, forms an important constituent of human diet yielding a lot of energy. It is taken in by the humans as animal fat, margarine, butter and cream.

The oils are unsaturated compounds which are liquid at normal temperature. They usually found in plant products.

The Steroids are the lipids that have a characteristic four condensed rings structure as shown in figure-13.6.

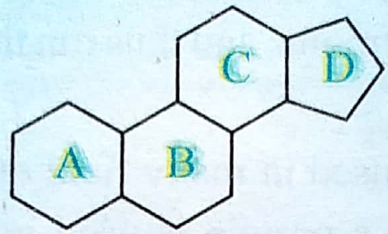
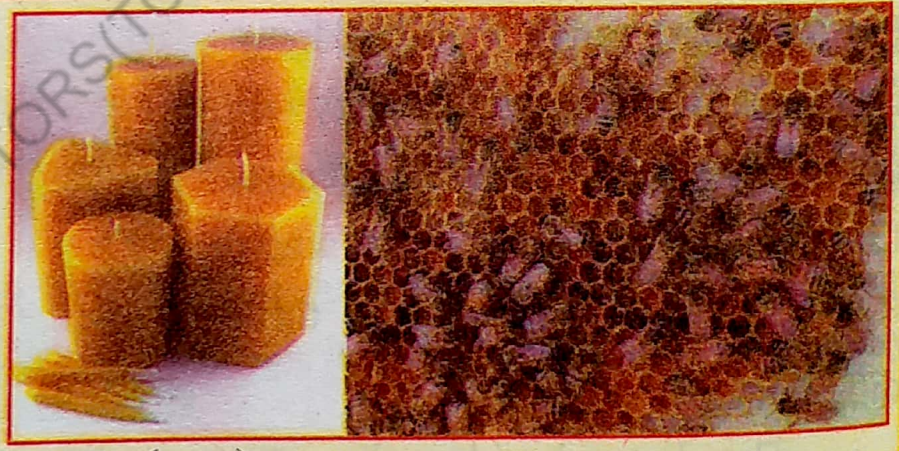


Fig-13.6: Four condensed ring nucleus of steroids

The steroids also play an important role in our life especially as hormones, e.g the male and female sex hormones, the Testosterone and progesterone are steroids in nature, moreover the bile juices also contain some steroidal compounds which are important in digestion process.

Another form of lipids are the waxes, which are found in nature as coatings on leaves and stems, and serves to prevents the plant from losing excessive amounts of water. e.g Corunda wax is found on the leaves of Brazilian palm trees and is used in floor and automobile waxes, lanolin coats lambs wool.

Interesting Information



Beeswax is secreted by bees to make cells for honey and eggs. (Note that paraffin wax, used in some candles, is not based upon the ester functional group, but is a mixture of high molecular weight alkanes which is obtained from petroleum).

Waxes have a variety of functions including lubrication, protection, structure, and energy storage. Many of the waxes are used in ointments, hand creams, and cosmetics

13.3.1 The Fatty acids

Fatty acids are the bio-organic compounds that form lipids. They consist of a carboxylic acids that contain a carboxyl group and a long chain of

unbranched carbons as a tail. For example palmitic acid ($C_{15}H_{31}COOH$), stearic acid ($C_{17}H_{35}COOH$) etc.

13.3.2 Sources and uses of lipids:

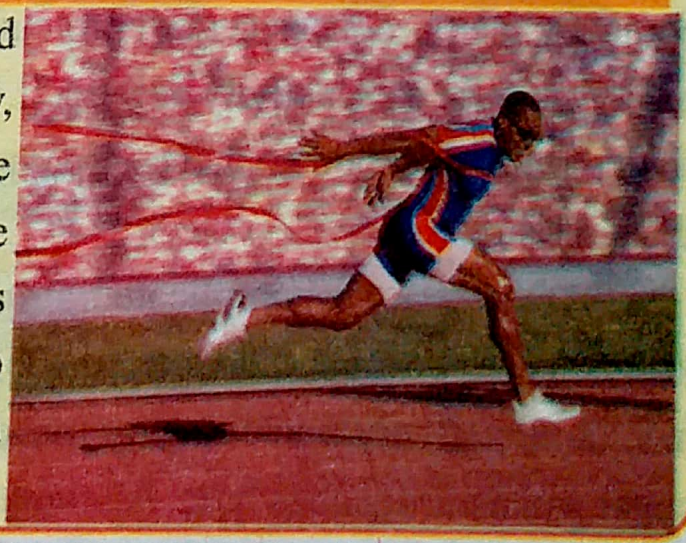
The lipids are obtained through both of plant and animal kingdom. In animals these are found as fats and in the milk, while in plants they are found as oils, and we purify them from these sources mostly by using specialized chemical techniques.

The lipids act as the source of large energy in our food, they are also used in many other fields too, some important of which are in the following,

- The lipids are used to increase the taste of food, for this purpose use of butter, ghee, different oils is very common.
- The animals that undergo hibernation use the stored fats of their body.
- The fatty tissues keep safe the humans and the animals from severe cold.
- In plants the oily lipids serves to protect them from severe cold strokes, that is why the cold region plants have much quantity of oils in their structure.
- The desert area plants these oily layer protects the plant body from excessive transpiration and helps to store the water in their body.
- In order to protect from cold, the humans often use fats on their open skin areas.
- Many of the oils and fats are used as drugs, for example cod liver oil, oil from seeds, steroids etc.

Interesting Information

The athletes often use steroid based drugs to increase the muscular activity, and to reduce the effect of wounds. The use of such steroids increases the anabolic activity of their body and thus the performance of the athlete also increases, that is why the used of such therapy has been declared illegal.



13.4 The Nucleic Acids

You may have heard the phenomenon of heredity many times in your life. This heredity character is due to some special type of biopolymers in our body these biopolymers are called DNA (Deoxyribose nucleic acid) and RNA (Ribose nucleic acid), which form the unit of heredity and also determines who we are among the other living organisms.

The DNA and RNA carry the genetic information in the sequence of their subunits, which is called the Nucleotide. This nucleotide is responsible for the production of a specific type of protein and these proteins actually run the cells of our body, and hence our body acts under the command of these DNA and RNA built Genes.

Not only the running of our body is under the command of these DNA and RNA but also the diversity of life we see is actually due to small differences in sequences of subunits that make up a part of each DNA molecule. Relatively small structural differences determine whether an organism is a flower, an ant, or a human being, can you imagine that the genetic material of humans and of Chimpanzees differ only just 3%. Now we take a look separately the two basic units of these genetic material building units, called DNA and RNA.

13.4.1 The DNA or Deoxyribose nucleic acid

DNA or Deoxyribose nucleic acid is the basic unit that give us only the identity but they also control the cell functioning. It is the DNA under whose command cell produces certain proteins and these proteins run cell and are responsible for each activity of the cell. It is the instruction of these DNA that each tissue of our body behaves separately, although they are produced from the same single cell.

DNA bears a complicated structure which was discovered by two scientists J-Watson and F-crick in 1953. The unit of their structure is called 'nucleotide'. Every nucleotide is made up of a phosphate group, a pentose sugar and a nitrogenous base. All these groups are linked with each other in a

special manner, and they form a big chain. This chain consists of 4 types of nitrogenous bases, the Adenine, Cytocine, Thiamine and Guanine. These bases are well known by the abbreviations of first alphabet of their name, i.e A,T,C and G. The sequence of these 4 bases forms the code of DNA, each gene has its distinct code. The giant structural chain formed by linking of these is called DNA strand. In DNA two strands run parallel so DNA forms a double stranded giant structure. This is shown if fig-13.6.

13.4.2 The RNA or Ribose nucleic acid:

This is second type of nucleic acid . It has the structure like DNA but only consists of single strand. The nucleotide structure contains 3 basic groups like of DNA but there are few differences as compared to DNA.

The pentose sugar of RNA is ribose instead of Deoxyribose and the nitrogenous base uracil replaces thiamine. The pentose sugar of RNA is ribose instead of Deoxyribose and the nitrogenous base uracil replaces thiamine.

The functions of RNA are also different from that of DNA. The RNA performs a variety of functions among which include the massaging from DNA, it forms different protein in the command of DNA and these protein catalyze and control the reactions and processes of cells.

The structure of both DNA and RNA has been shown and compared in fig-13.6.

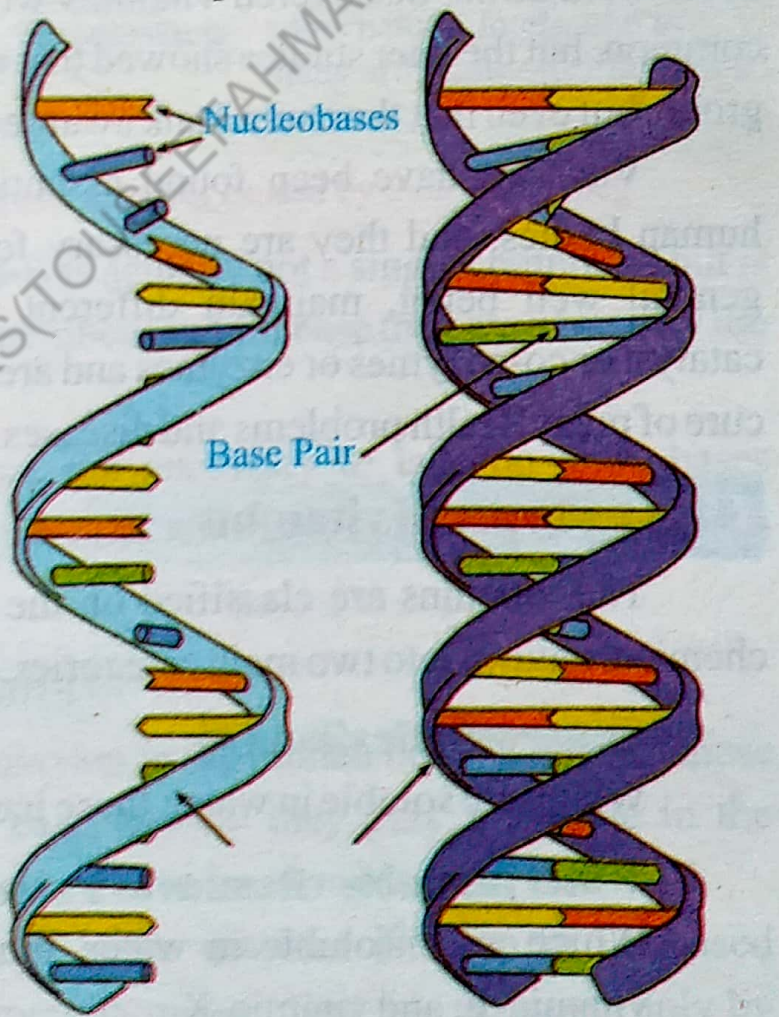


Fig 13.6 Structure of DNA and RNA

Interesting Information

You may have heard about DNA test actually coding in DNA is not only different in various organisms but each human being has its own characteristic sequence inherited from his parents. In DNA test this characteristic sequence is matched and hence many problems can be resolved.

13.5 Vitamins

Vitamins are the certain organic compounds which are needed in our diet for normal body health. The word "vitamin" has its origin from "vita" a Latin word meaning "life", and "amin" from "amine" as the initially studied of the members of this class were known to contain the amino group. This name was given by the Polish biochemist Kazimierz Funk in 1912, who observed that the discovered vitamins were containing the amino group in common, but the later studies showed that not all the vitamins have this amino group, but even that the name Funk awarded stuck and is still used.

Vitamins have been found essential for the normal functioning of human bodies, and they are necessary for normal growth, vitality, health, general well being, maintain different biochemical processes acting as catalyst or co-enzymes or enzymes and are responsible for the prevention and cure of many health problems and diseases.

13.5.1 Types of vitamins

The vitamins are classified on the basis of their solubility (i.e. their chemical nature) into two main categories,

- **Water soluble vitamins**

  Which are soluble in water, these include vitamin-B and vitamin-C.

- **Water insoluble vitamins or Fat soluble vitamins**

  Which are insoluble in water, these include vitamin-A, vitamin-D, vitamin-E, and vitamin-K.

The water soluble vitamins are necessary to take in on daily basis because due to their solubility in water they are excreted through urine even if

Vitamin name	Solubility	Daily requirement	Deficiency disease	Sources
Vitamin-A	Fat	900 µg	Night-blindness	Present in many animal tissues, especially fish and liver.
Vitamin-B	Water	1.2-1.5 mg	Beriberi, anemia	meats, leafy green vegetables, grains and legumes.
Vitamin-C	Water	90.0 mg	Scurvy	fruits and vegetables. Rich sources include citrus fruits, strawberries, tomatoes and leafy green vegetables.
Vitamin-D	Fat	5.0 µg-10 µg	Rickets and Osteomalacia	Synthesized in the skin when exposed to sunlight. Also present at low concentration in some natural foods, and in many artificially-fortified food products.

Table 13.5: Source of vitamins and diseases caused by their deficiency

extra amount is taken. The vitamin-B is actually not a single compound but is a group consisting of a number of members and for ease they are named by the numbers, such as B_1, B_2 etc.

The fat soluble vitamins are not necessary to take on daily bases because they are stored in the body tissues and can be used from there when required by the body.

13.5.2 Importance of Vitamins

The requirement dose and function in the human body of each of these vitamins may vary from case to case; mostly they play their role in the metabolic pathways.

The vitamins can also induce some diseases if taken in increased amount, this condition is called hypervitaminosis but this is caused only by the fat soluble vitamins for example vitamin-A. The common symptoms of such hypervitaminosis is the nausea and vomiting.

Interesting Information

In addition to the essential nutrients present in our food, there is also the need of some material that is non-ingestible and should be used to carry out the undigested products. This material is called dietary fibre. Its recommended quantity is 20-30 grams per day for a normal human. Fibre is an important part of a healthy diet. A diet high in fibre has many health benefits. The dietary fibre not only acts as the laxative but it also helps to prevent heart disease by lowering blood cholesterol, diabetes, weight gain, some cancers, and it improves digestive health.

Constipation is the most common disease caused in absence of dietary fibre.

Summary of the C hapter

- The branch of chemistry that deals with the study of matter found in living organisms is called biochemistry.
- In biochemistry we study specially carbohydrates, proteins, lipids, nucleic acids and vitamins.
- Carbohydrates are the chemical compounds that give instant energy to living organisms upon eating.
- The carbohydrates are actually such ketones or aldehydes that have many hydroxyl groups too.
- Carbohydrates are of three types, monosaccharides, oligosaccharides and polysaccharides.
- A monosaccharide consists of one sugar unit, the oligosaccharide has 2-10 saccharide or sugar units and polysaccharide has more than 10 to several thousand saccharide units.
- The basic source of carbohydrates is the plant kingdom that make these by the process of photosynthesis.
- Proteins are the bio-organic compounds that form the body stuff of animals. These are formed by the union of amino acids.
- Important sources of proteins are meat, egg, milk, lentils etc.

- The lipids are the bio-molecules that are formed by union of fatty acids, we use these as food.
- The lipids are found in both animals and plants.
- The animals have the lipids called fats.
- In plants the lipids are found in the form of oils which is in liquid state at normal temperature.
- Lipids not only give body structure to animals but performs as blanket to save animals from severe cold, various lipids also acts as hormones in the form of steroids.
- Nucleic acids are of two types DNA and RNA.
- DNA are double stranded and give instructions to run the cell.
- RNA are single stranded and perform various functions among which important are, conveying commands from DNA to a specific site, preparation of certain protein.
- For normal body growth certain compounds are needed in small amounts, these are called vitamins.
- Vitamins are of two types, water soluble and fat soluble.
- Vitamin-B and vitamin-C are water soluble vitamins and we have to take them on daily basis to meet our requirements.
- Vitamin-A, D, E and K are fat soluble. They are stored up in the body.

Exercise

Q1: Fill in the blanks with suitable words.

i) Biochemistry deals with the study of matter derived from ..... .

ii) Vitamin-D is the ..... soluble vitamin.

iii) Carbohydrates are classified according to ..... units.

iv) Lactose is a ..... carbohydrate.

v) There are ..... essential amino acids in number.

vi) Glyceraldehyde is the first member of carbohydrates containing ..... carbon atoms.

vii) Sucrose is common name of ..... .

viii) Proteins are the polymers of ..... .

ix) There are ..... types of nucleic acids.

x) Deficiency of Vitamin-C causes ..... .

Q2. Encircle the correct answer.

i) Plants mainly composed of:

(a) Carbohydrates (b) Proteins

(c) Lipids (d) All of these

ii) The general formula of monosaccharide is:

(a) C_nH_{2n+2} (b) C_nH_{2n+0}

(c) C_nH_{2n-2} (d) $C_n(H_2O)_n$

iii) Monosaccharides are the carbohydrates that are composed of:

(a) 1 glucose unit (b) 2 glucose units

(c) 3 glucose units (d) Many glucose units

iv) Amino acids contain the functional group.

(a) Carboxyl (b) Amino

(c) Aldehydic group (d) Both amino and carboxyl groups

v) Lipids are:

(a) Long chained fatty acids
(b) Long chained esters of fatty acids
(c) Polymer of amino acids
(d) Monomer of PVC.

vi) The number of essential amino acids are:

(a) 10 (b) 20 (c) 30 (d) 40

vii) DNA is the nucleic acid responsible for:

(a) Metabolism functions of Glucose
(b) Heredity characters
(c) Controlling diseases in body
(d) All these functions

viii) Fats perform the function of:

(a) A source of dietary energy
(b) As energy reservoir
(c) Protects vital organs
(d) Perform all these functions

ix) Deficiency of Vitamin-A causes

(a) Night blindness (b) Scurvy
(c) Bone diseases (d) Anemia

x) Vitamin-D is found in:

(a) Tomatoes
(b) Potatoes
(c) Synthesized when body is exposed to sun light
(d) Citrus fruits

Q3: Write short answers of the following.

i) Comment that carbohydrates are hydrates of carbon.
ii) What functional groups are found in carbohydrates?
iii) Does the nucleic acids contain any sugar unit?
iv) What are functions of Oligosaccharides?
v) What are the functional group in amino acids?

vi) Write a note on Essential amino acids?

vii) What is meant by Fatty acids?

viii) Describe biological roles of Steroids.

ix) What are vitamins? How they are classified?

x) How Vitamin-D is produced in body?

Q4: Explain following with reasoning.

i) Lipids provide more energy than carbohydrates.

ii) Carbohydrates constitute the plant body and proteins constitute animal's body?

iii) Cellulose is not digested by Humans but easily digested by Cows?

iv) Beef provides more proteins than the Beans?

v) The water soluble vitamins are required to take daily but fat soluble are not?

Q5. What are the carbohydrates? Write a brief note on their classification and importance?

Q6. Write a note on chemistry of proteins.

Q7. What are the Lipids? How they are important to us?

Q8. What are vitamins? How vitamins affect our life?.

Q9: Describe the nature of Nucleic acids, describe their role in living organisms.

Q10: What are the diseases caused by deficiency of vitamins?

Q11: Name the important sources of the Vitamins.