



GSA Biological Sciences

Carbohydrates

A carbohydrate is a macronutrient which consist of carbon, hydrogen and oxygen. It is one of the three main way by which our body gets its energy. It is an essential nutrient which include sugar, fibers and starch. Our body breaks down carbohydrates into sugar/Glucose which is the main source of energy in our body's cells, tissues and organs. Glucose can be use immediately or stored in liver or muscles for later use. Carbohydrates are central to nutrition and are found in a wide variety of natural and processed foods. They are mainly found in plant goods, dairy products and food having high content of carbohydrates include bread, pasta, beans, potatoes, rice and cereals.

It is generally recommended that people consume between 45% to 65% of their total calories in the form of carbohydrates per day. However carbohydrate needs depends on several factors like age, sex, size, activity level and blood sugar control.

The food and drug administration (FDA) recommend that people get 275g of carbohydrates each day in a 2000-calorie diet, including dietary fibers, total sugar and added sugar.

Types of foods in carbohydrates:

Carbohydrates in foods occur in various forms including

* Dietary fibers

* Total sugar

Dietary fibers:

A type of carbohydrates that the body cannot easily digest. It occurs naturally in fruits, vegetables, nuts, seeds

beans and whole grains.

Benefits of Dietary fibers:

It helps to promote regular bowel movement, lower blood sugar and cholesterol.

The FDA recommended that people get 28g of dietary fiber per day in a 2000-calorie diet.

2 - Total sugars:

Sugars that occur naturally, such as dairy products, as well as added sugars, which are common in baked items, sweets and deserts. The body easily absorbs and digests sugars.

Most people in USA exceed the recommended daily limit of sugar which cause increase in

cardiovascular diseases

Dental cavities.

American Heart Association recommend that those assigned female at birth (AFAB) limit added sugar to less than 6 teaspoons (25g) per day and those assigned male at birth (AMAB) limit

their intake to less than 9 teaspoon (36g) per day.

Classification

The carbohydrates are further classified into simple and complex which is mainly base on their structure and degree of polymerization.

→ Monosaccharides

→ oligosaccharides

⇒ Polysaccharides

Monosaccharides:

"Mono" means single and "Saccharides" means sugar. They have single unit of sugar. They are simple sugar which cannot be hydrolyzed. They are sweet in taste and soluble in water.

Examples:

Glucose: It is the main source of energy.

Galactose: which is most readily available in milk and dairy product

Fructose: Mostly occur in fruits and vegetable.

Sources: Their sources are grapes, sugar, blood sugar, sweet fruits and honey.

Oligosaccharides:

They are formed when 2 to 9 monosaccharide units combine through a bond (Glycosidic bond)

Common disaccharides are Sucrose, lactose and maltose.

while trisaccharides are raffinose

LACTOSE: found in milk, which is made up of glucose and galactose.

SUCROSE: or Table sugar made up of glucose and fructose.

oligosaccharides are collectively called as sugar because they are sweet in taste, soluble in water and crystalline solids.

Date _____

Day _____

Sources: their sources are sugar cane, sugar beet, mango, apricot, almond, coffee and honey.

Polysaccharides:

"poly" means many and "saccharid" means sugar, so polysaccharides are the chain of many sugar molecules. They can consist of 100's or 1000's of monosaccharides.

They are insoluble in water and tasteless. They are non-sugar. They are used as energy storage compound in animal and plants in the form of glycogen and starch respectively.

Glycogen: It stores energy in the liver and muscles.

Starches: It is abundant in potatoes, rice and wheat.

cellulose: one of the main structural component of plants.

Date _____

Day _____

High or low Carbs diet:

many people have turned to low carbohydrate diet, such as keto diet, for their potential health benefits and weight loss. However, some types of carbohydrates have substantial health benefits. According to "physician committee for responsible medicine", those who eat the most carbs - especially from natural sources such as bean, whole grains and vegetables have lower risk for obesity, type 2 diabetes and heart diseases.

Added sugars can have an adverse effect on health. Eating large amount of carbohydrates containing added sugar can contribute to obesity, T2DM and cardiovascular diseases.

How body uses Carbohydrates:

1- The body break down carbohydrates into glucose to use them as

- a steady source of energy for bodily function.

- a quick and instant source of energy when exercising.

- a reserve of energy body stores in muscle or liver and release when necessary.

If a body already storing enough energy then this glucose will be convert into fats, which can lead to weight gain.

2- After a person eats the pancreas release insuline to help move glucose into the body's cells, which can use or store it.

Insuline prevent blood sugar levels from getting too high.

Example:

There are several examples of carbohydrates.

⇒ Glucose

⇒ Galactose

⇒ Maltose

⇒ Fructose

⇒ Sucrose

⇒ Lactose

⇒ Starch

⇒ Cellulose

⇒ Chitin

Protein

Protein is made up of chemical building blocks of Amino Acids.

Our body uses amino acids to build and repair muscles and bone. They are also used as energy source. Proteins are most abundant molecule present in our body and

and form 60% of the dry weight of cells. Aside from cells, proteins also make up the majority of the body's structural, regulatory and enzyme components. They are therefore crucial for an individual's growth and development.

Structure:

Protein is made up of a polymeric chain of amino acids. The arrangement and placement of amino acid gives a proper structure to protein, and certain characteristics. All amino acids contain an amino ($-NH_2$) and a carboxyl ($-COOH$) functional group.

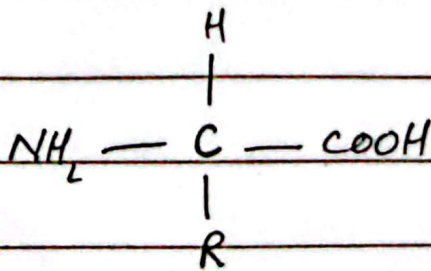


Fig : Amino Acid

polypeptide chains synthesized by linking of amino acids. A protein is formed when one or more of these chains fold in a specific way.

Types on the basis of structure:

The structure of protein is classified at 4 level.

- ⇒ Primary structure
- ⇒ Secondary structure
- ⇒ Tertiary structure
- ⇒ Quaternary structure

Primary structure:

The primary structure of protein is the linear polypeptide chain formed by the amino acid in a particular sequence. Changing in the position of even a single amino acid result into different protein

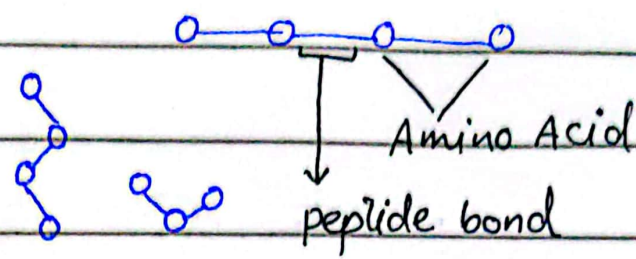
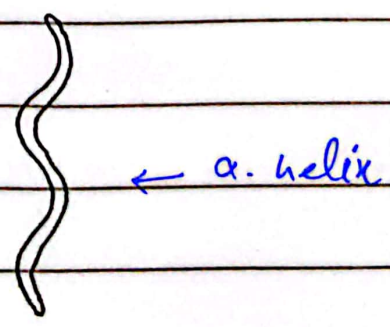


Fig:

Secondary structure:

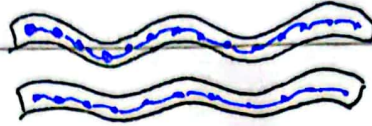
The secondary structure of protein formed by hydrogen bonding in the polypeptide (bond) chain. These bonds cause the chain to fold and coil in two different conformation known as α -helix or β -pleated sheets.

The α -helix is formed by hydrogen bonding between every 4th amino acid. It is a single spiral.



The β -pleated sheets is formed by hydrogen bonding after b/w two or more adjacent poly-

-peptide chain.



β -pleated sheets

Tertiary structure:

The tertiary structure is the final 3-dimensional shape acquired by the polypeptide chains under the attractive and repulsive forces of different R-groups of each amino acid.

Quaternary structure:

This structure is only for those proteins which have multiple polypeptide chains combined to form a large complex. The individual chains then called subunits.

Types on the basis of molecular shape:

⇒ Fibrous protein

⇒ Globular protein

Fibrous protein:

These are water insoluble protein and formed when a polypeptide chain run parallel and are held together by hydrogen bond and disulphid bond then a fiber like structure is formed called fibrous protein.

Example:

- keratin (present in hair, wool and silk)
- myosin (muscle) etc.

Globular Protein:

Globular protein are soluble in water. they are formed when the chains of polypeptides coil arround to give a spherical shape called

Date _____ Day _____

globular protein.

Example:

- insulin
- Albumins etc.

Functions

Our body uses protein for multiple purpose and their arrangement of amino acids determine how they will work. Several notable functions include.

i - Digestion:

Proteinaceous carry out digestion

ii - Movement:

Myosin helps in movement

iii - Structure and support:

keratin gives human and other animal hair, nail and horns.

iv - cellular communication:

Receptors helps in cellular communication.

v - Act as messenger:

Act as chemical messenger that facilitate communication among cells.

Lipids

Lipid word derived from word "lipos" means fat. Primary building blocks of lipids are fatty acids, Glycerol and sterols. They are organic compound composed of C, H and O and serve as an energy storage, structural support and cell membrane composition in living organisms.

lipids include fats, oil, phospholipids and steroids.

Characteristics:

They are heterogeneous group of substance.

They are insoluble in water while soluble in non-polar solvents, water is a polar molecule that's why they are insoluble in water.

Fats, oil and steroids are most important lipids found in nature.

In human body lipids can be synthesized in liver and store in the adipose tissues of the body.

lipids are energy-rich organic molecules which provides energy for different life purposes.

classification:

lipids are classified into three groups

⇒ Simple lipids

⇒ compound lipids

⇒ Derived lipids

⇒ Simple lipids:⇒

simple lipids are esters of fatty acids with alcohol. they can be sub-divided into

i- Fats

ii- waxes

Fats:

Fats are esters of fatty acids with glycerols. they are solid at room temperature, some are liquid at room temperature are known as oils. physical state depends on the nature of fatty acids. Fats are rich in saturated fatty acid. while oil are rich in unsaturated fatty acids.

Wax:

They are esters of higher fatty acid with higher mono-hydroxy aliphatic alcohols. They have 60-100 carbon atoms chain. They can take up water without getting dissolved in it.

They are use as base in the preparation of cosmetics, ointments, polishes, lubricants and candles.

e.g.:

i- Animal wax

- Bees wax
- chinese wax

ii- Vegetable wax

- soy wax
- Bayberry wax

iii- Petroleum wax

- Paraffin wax
- petroleum jelly

iv- Synthetic wax

- Polyethylene wa

2 - compound lipids:

These are the compounds of fatty acids with glycerol and some other groups.

i- Phospholipids

ii- Glycolipids

i - phospholipid:

These are lipid containing fatty acid, alcohol and phosphate group. They frequently have nitrogen bases and other substituents.

ii - Glycolipid:

lipids containing a fatty acid, sphingosine and carbohydrates.

Fatty Acids

Fatty acids are carboxylic group (acid), usually with long aliphatic tail, either saturated or unsaturated.

Saturated Fatty Acid:

Lack of C-C double bond indicate the fatty acid is saturated. The term "saturated" indicate that max. no. of hydrogen atoms are bounded to each carbon atom in a molecule of fat. They have higher melting point. They are solid at room temperature. They are found in animal fat, butter, meat and whole milk.

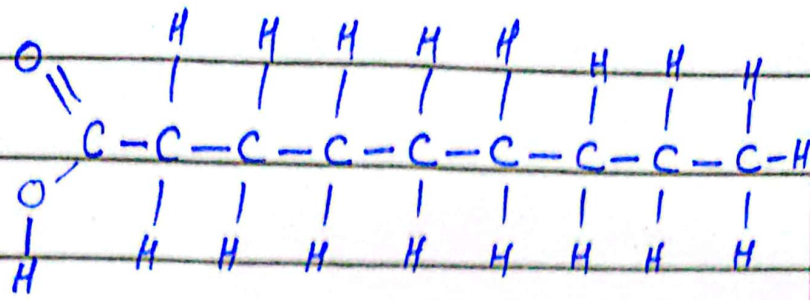
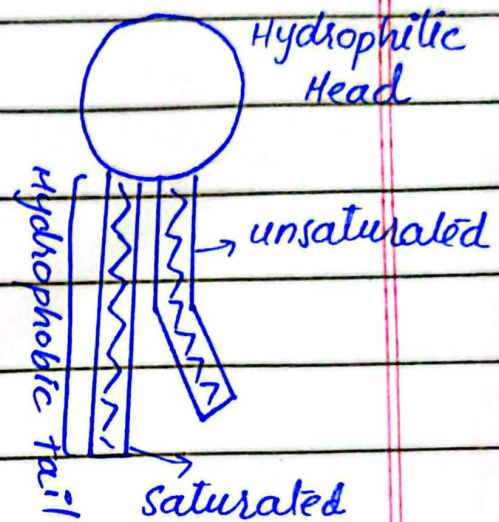


FIG: saturated fatty acid



unsaturated fatty Acid:

unsaturated fatty acids are more complex because of bent hydrocarbon chain linked together one by one and double bond with terminal carboxylic acid group. The term "unsaturated" means the carbon atoms do not have maximum possible hydrogen atoms bound to carbon atom. They are present in human body in cis-conformation. They have lower

melting point. They are liquid at room temperature. Most vegetable oil or fish oil are the source of unsaturated fatty acid.

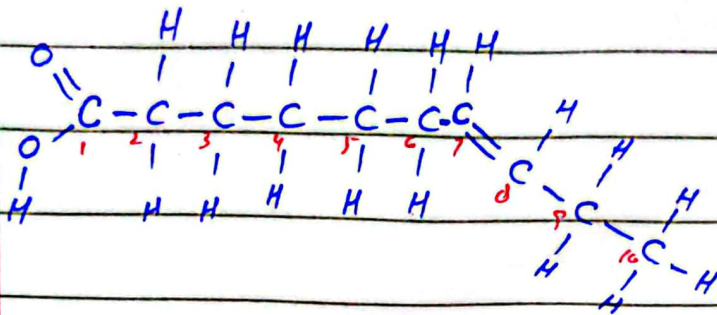


Fig: unsaturated fatty Acid.

Functions of lipids

They serve as a energy source and store in an adipose tissues of body.

phospholipids and sterols are major structural elements of biological membrane.

Fats combine with protein are important constituent of cell membrane and mitochondria of cell.

cholesterol act as the structural precursor to fat soluble vitamins like vitamin D and hormones.

They also provide insulation to the body.

Fats in correct amount are necessary for proper functioning of our body.