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WELCOME

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APPLICATIONS OF BIOLOGY IN LIFE

BGS 1210



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FOOD AND NUTRITION

Food is any material other than oxygen (or air) which is taken by an animal into its body for the purpose of providing energy to the body, building material for making new tissues, and also to repair the old ones.

So, it is necessary for the physiological activities of life.

Food consists of:

- Carbohydrates
- Proteins
- Lipids (fats)
- Vitamins
- Minerals
- Water.

Carbohydrates

- Carbohydrates are composed of **carbon, hydrogen, and oxygen**.
- They include **sugars, starches and cellulose**.
- Carbohydrates are **main sources of energy** for most of the animals.

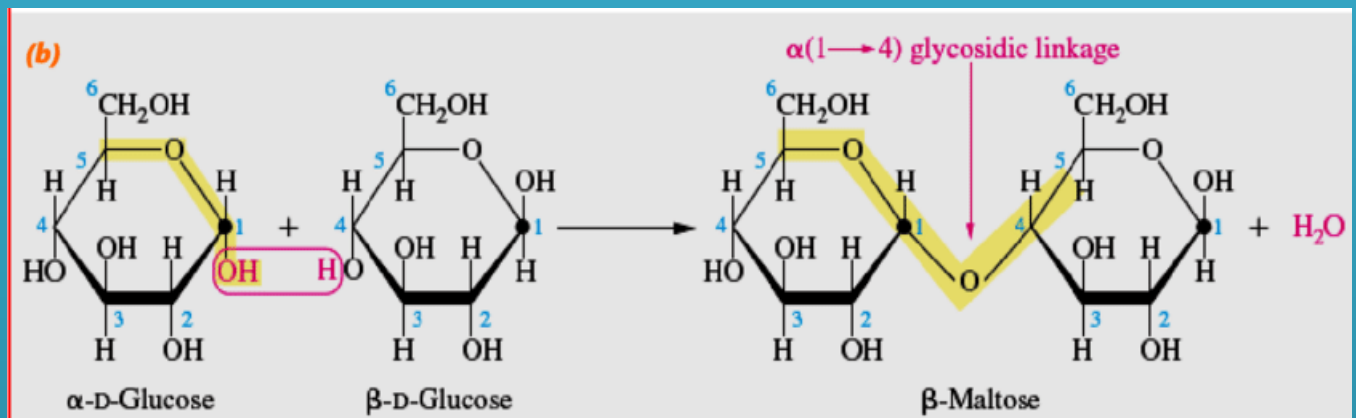
Carbohydrates are distinguished into:

- 1) Monosaccharides: sugars that can not be hydrolyzed into simpler sugars.
 - They are named according to **the number of carbon atoms present in the molecule**:
 - **Hexoses** (6 C): glucose, fructose, mannose, and galactose.
 - **Pentoses** (5 C): ribose.
 - **Trioses** (3 C): dihydroxy-acetone and dihydroxy-acetone phosphate.

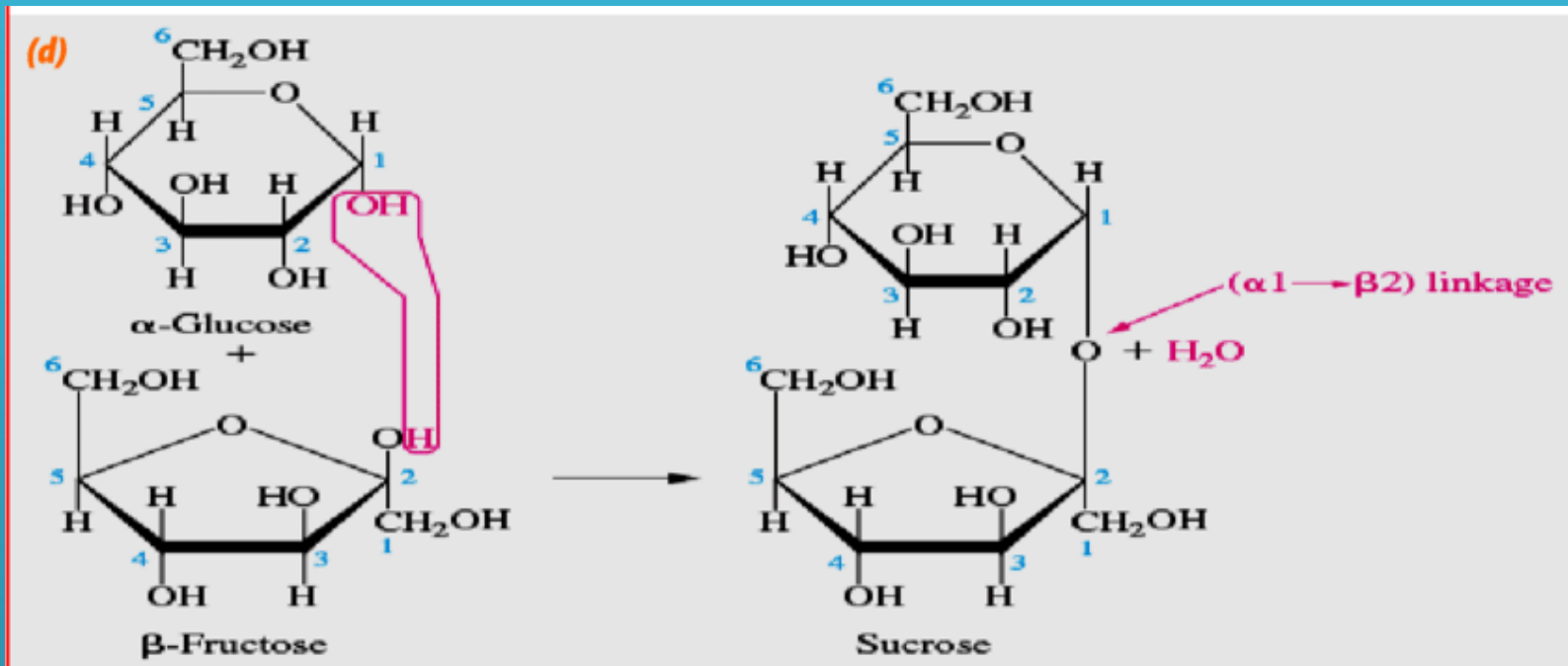
2) Disaccharides: their chemical formula is $(C_{12}H_{22}O_{11})$ On hydrolysis a disaccharide yields two molecules of monosaccharides.

Examples: maltose, sucrose, lactose, cellobiose, isomaltose.

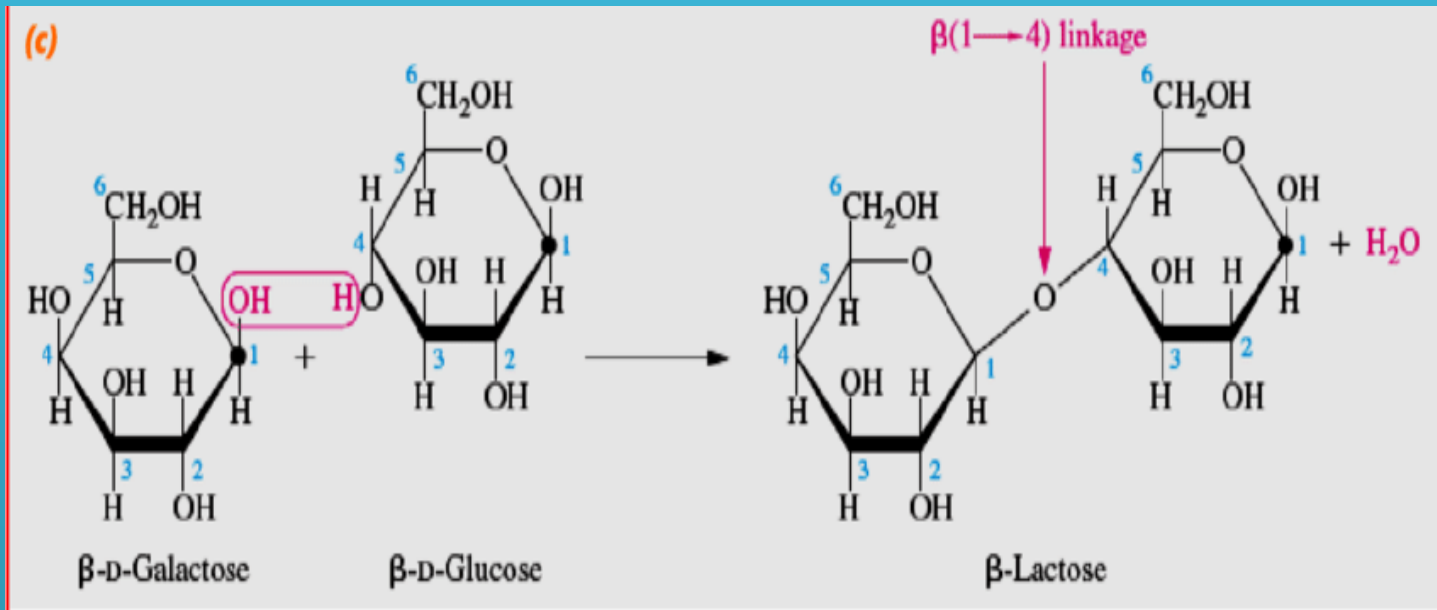
➤ **Maltose** composed of two glucose molecules linked together by α 1-4 glucosidic linkage. It is a reducing sugar, formed by degradation of starch.



- **Sucrose:** molecule of glucose + one molecule of fructose.
- It is a chief constituent of beet and cane sugar.

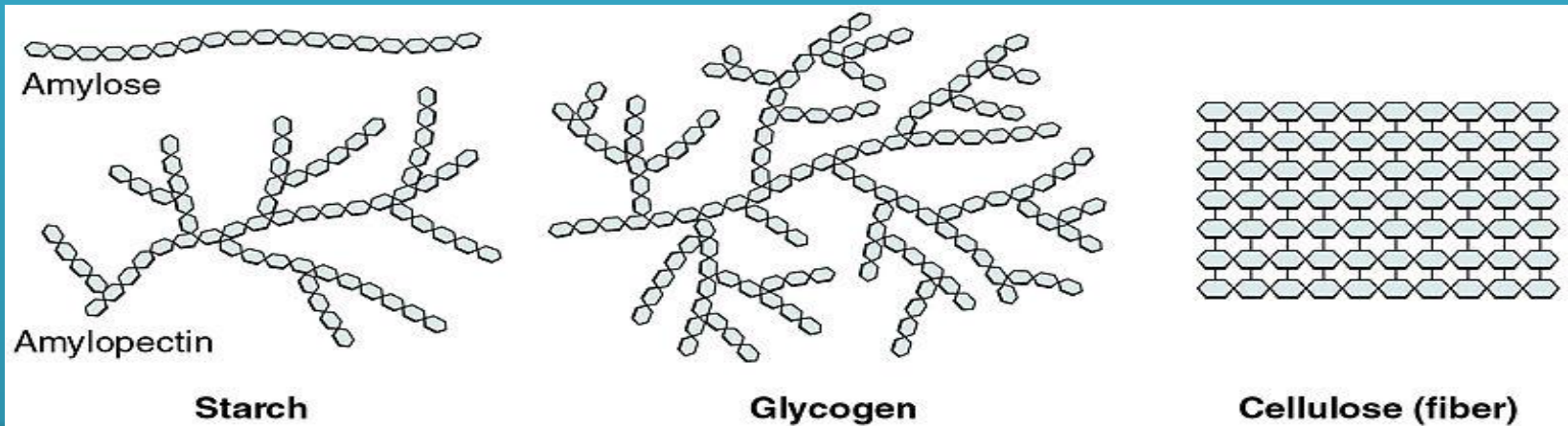


➤ **Lactose:** is a disaccharide present in milk. On hydrolysis it yields one molecule of glucose and one of galactose.



3) Polysaccharides: formed by the combination of a large number of monosaccharides. Glycogen and starch are polymers of glucose.

- **Starch**: is the plant storage product polysaccharide. It consists of two components; **amylose and amylopectin**.
- **Glycogen**: is the animal storage product polysaccharide.
- **Cellulose**: It is a major component of higher plants. It is a polymer of glucose.



Functions of Carbohydrates:

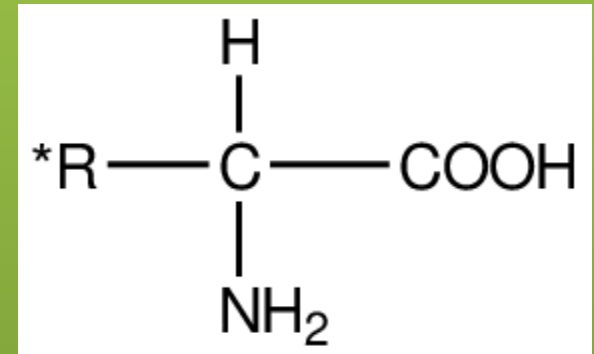
- 1- Carbohydrates provide energy, but less than that provided by fats (one gram of carbohydrates provide about 4.5 Kcal on its oxidation).
- 2- Carbohydrates can be stored in the body in the form of glycogen in the liver or muscles.
- 3- They can be transformed into fats.
- 4- Heparin is an anticoagulant, derivative of glucose (glycoprotein).
- 5- Chitin forming the exoskeleton of some animals.
- 6- Carbohydrates are part of DNA and RNA structure.

Proteins

Proteins are composed of **carbon, hydrogen, oxygen** and **nitrogen**. **Sulfur** and **phosphorus** may also included.

➤ 300 different amino acids have been described in nature, only **20** are commonly found as constituents of mammalian proteins.

➤ General formula of amino acids



2 amino acids → dipeptide → tripeptides
→ polypeptides (peptides) → peptones
→ proteoses → proteins.

Classification of proteins based on nutritional value

- 1. Nutritionally rich proteins:** They are also called complete proteins or first-class proteins. They contain all the essential amino acids in the required proportion.
- 2. Incomplete proteins:** They lack one essential amino acid. Proteins from pulses are deficient in methionine, while proteins of cereals lack lysine.
- 3. Poor proteins:** They lack in many essential amino acids.

Classification of proteins based on composition

- 1) **Simple proteins**: which on hydrolysis yield only amino acids. Albumin and globulin are simple proteins.
- 2) **Conjugated proteins**: which the protein molecule is attached with other molecules Like: lipoproteins, glycoproteins or mucoproteins nucleoproteins.
- 3) **Derived proteins**: which are formed by the breakdown of an original protein molecule either by acids or enzymes or by the effect of heat. Like: proteases, peptones, and peptides.

Functions of Proteins:

- 1- Proteins are important in building up processes.
- 2- Some hormones and enzymes are proteins and also hemoglobin.
- 3- Proteins balance the water contents of the body.
- 4- Plasma proteins and hemoglobin act for acid-base balance of blood.
- 5- Antibodies are formed of proteins.
- 6- The blood coagulation is formed of proteins.
- 7- Proteins (mucin) make the mucous secretions.
- 8- Many structures are essentially proteins e.g. hair, nails, fibers.
- 9- Provide energy but less than that provided by carbohydrates.
- 10 - Proteins may be transformed into fats or carbohydrates after deamination.

Lipids

- Fats composed of **carbon, hydrogen** and **oxygen**.
- Fats are sparingly soluble in water and considerably soluble in organic solvents.
- Fats are a main source of energy to the body after carbohydrates.
- Enough fat must be taken to provide the fat-soluble vitamins particularly vitamin A.
- Chemically, fats are **esters of fatty acids** (an ester is the compound that formed by the combination of an acid and an alcohol).

Lipids can be classified into:

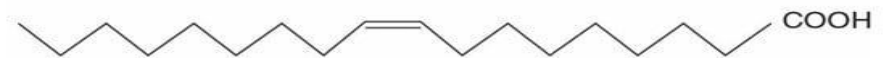
- 1) Simple lipids (or neutral fats):** Esters of fatty acids with various alcohols which have two subtypes.
 - **Neutral fats:** Esters of fatty acids with glycerol.
 - **Waxes:** Esters of long-chain fatty acids and long chain aliphatic alcohols.
- 2) Compound lipids:** are esters of fatty acids and alcohols in combination with some other compounds. They include phospholipids, glycolipids and lipoproteins.
- 3) Derived lipids (or sterols):** These are substances liberated during the hydrolysis of simple and compound lipids which still retain the properties of lipids. Such as sterols, fatty acids, and alcohol.

Classification of fatty acids based on saturation

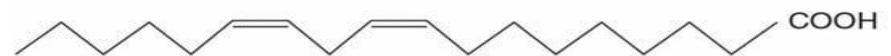
- **Saturated fatty acids:** All the carbon-to-carbon atoms share just single bonds between them.
- **Unsaturated fatty acids:** Some carbon atoms are not bonded to as many hydrogen atoms as possible. Instead, they form double or even triple bonds with other carbon atoms. They can be classified into:
 - 1) **Monounsaturated fatty acids:** They contain one double bond.
 - 2) **Polyunsaturated fatty acids:** They contain more than one double bond.



A saturated fatty acid (palmitic acid, C₁₆)



A monounsaturated fatty acid (oleic acid, C₁₈:1)



A polyunsaturated fatty acid (linoleic acid, C₁₈:2)

Classification of fatty acids based on requirement

- **Essential fatty acids:** Fatty acids which are essential to be taken in our diet because they cannot be synthesized in our body are known as essential fatty acids (eg. linoleic acid).
- **Non-essential fatty acids:** Non-essential fatty acids are those which can be synthesized by the body and which need not be supplied through the diet. Palmitic acid, oleic acid and butyric acid are examples of non-essential fatty acids.

Functions of Lipids:

- 1- Fats are the main source of energy production
- 2- Fats enter in the building of the cell membrane.
- 3- Fats can be stored in the body as a reserve food in the fat depots (adipose tissues under the skin).
- 4- Carbohydrates and proteins can be stored in the body in the form of fats.
- 5- Fats keep the body temperature nearly constant.
- 6- Fats are sources of some vitamins, and help in the absorption of some vitamins.
- 7- Fats form some hormones.



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