Basra University
pharmacy collage

Lecture 2
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1st stage : *Human biology*

# Biological Molecules AND NUTRIENTION

## INTRODUCTION TO FOODS

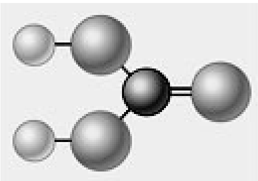
We need firstly to say what we mean by a food. Foods can be solid or liquid. That is they are eaten. or drunk. These foods have something in common. They all contain nutrients. The nutrients presents in these foods are: carbohydrates, mineral elements proteins, vitamins, fats and water (table 1)

Composition of human body (approximate percent)

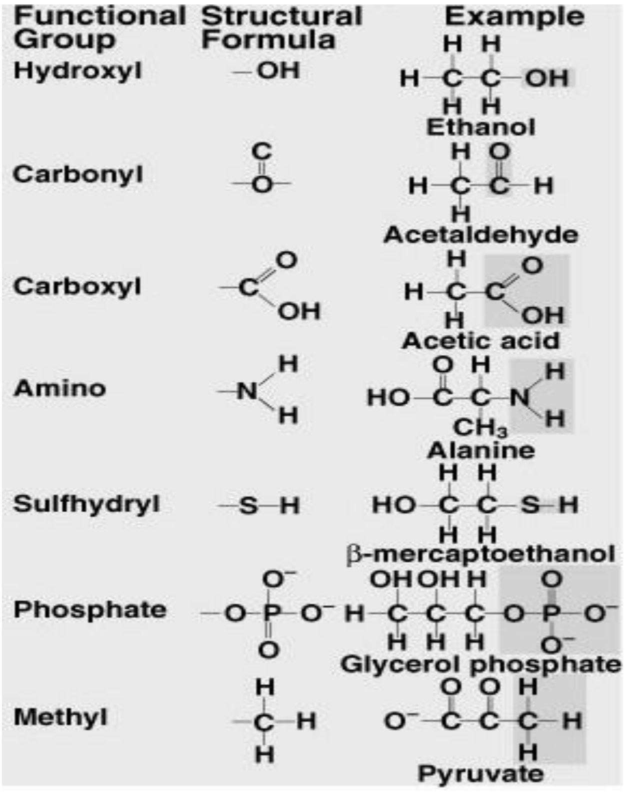
Composition of the human body (approximate per cent)

| | *Male adult* | *Female adult* |
|---|---|---|
| Water | 60·00 | 60·00 |
| Protein | 15·00 | 15·00 |
| Minerals | 5·00 | 5·00 |
| Fats | 15·00 | 20·00 (or more) |
| Carbohydrates | 00·50 | 00·50 |
| Vitamins | Part of 1% | Part of 1% |

All important biological molecules contain carbon .
All molecules that contain carbon are called **organic** (except for$CO_2$).
Carbon forms 4 covalent bonds. This allows carbon to form molecules with many different shapes.



Most biological molecules have a core made of carbon and hydrogen. Molecules
differ in structure and function, in part, because of different **functional groups**




The major classes of biological molecules that are important for all living things are **carbohydrates**, **lipids**, **proteins**, and **nucleic acids.** Large biological molecules are called **macromolecules**.

Macromolecules are built by combining smaller building blocks into polymers.

| Macromolecule | | Subunit | Function | Example |
| --- | --- | --- | --- | --- |
| **Proteins** |  | | | |
| Functional | | Amino acids | Catalysis; transport | Hemoglobin |
| Structural | | Amino acids | Support | Hair; silk |
| **Nucleic Acids** |  | | | |
| DNA | | Nucleotides | Encodes genes | Chromosomes |
| RNA | | Nucleotides | Needed for gene expression | Messenger RNA |
| **Lipids** |  | | | |
| Fats | | Glycerol and three fatty acids | Energy storage | Butter; corn oil; soap |
| Phospholipids | | Glycerol, two fatty acids, phosphate, and polar R groups | Cell membranes | Lecithin |
| Prostaglandins | | Five-carbon rings with two nonpolar tails | Chemical messengers | Prostaglandin E (PGE) |
| Steroids | | Four fused carbon rings | Membranes; hormones | Cholesterol; estrogen |
| Terpenes | | Long carbon chains | Pigments; structural | Carotene; rubber |
| **Carbohydrates** |  | | | |
| Starch, glycogen | | Glucose | Energy storage | Potatoes |
| Cellulose | | Glucose | Cell walls | Paper; strings of celery |
| Chitin | | Modified glucose | Structural support | Crab shells |

***Carbohydrates***, such as sugars and starch, supply energy. ***Proteins***, such as meat and eggs. are tissue builders and energy sources. ***Fats***, such as beef  fat or vegetable oils supply energy, insulate and protect the tissues. ***Mineral*** salts provide the structural part of bone and teeth. They aid in regulating the body chemistry.

**Carbohydrates -** compounds made of **C, H, and O** in a ratio of **2:1**
Carbohydrates are used for **energy storage** and **structures**.Carbohydrates have a caloric value of 4.1 kilocalories/gram.

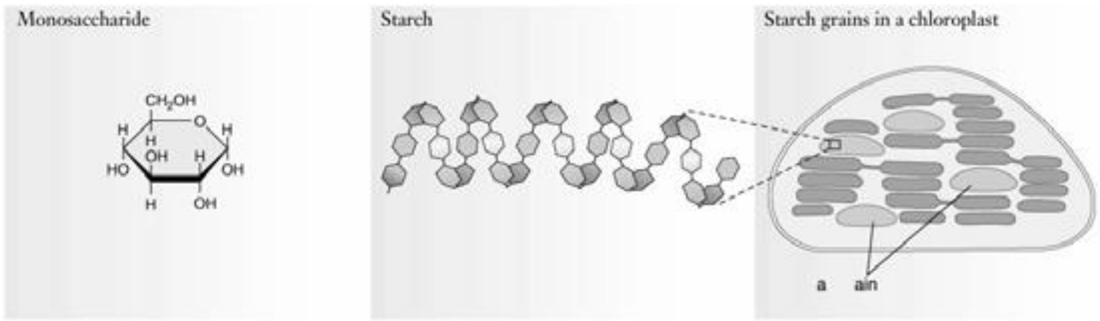
**An aside on calories:**

A **c**alorie is the amount of heat required to raise 1 g of water 1°C.

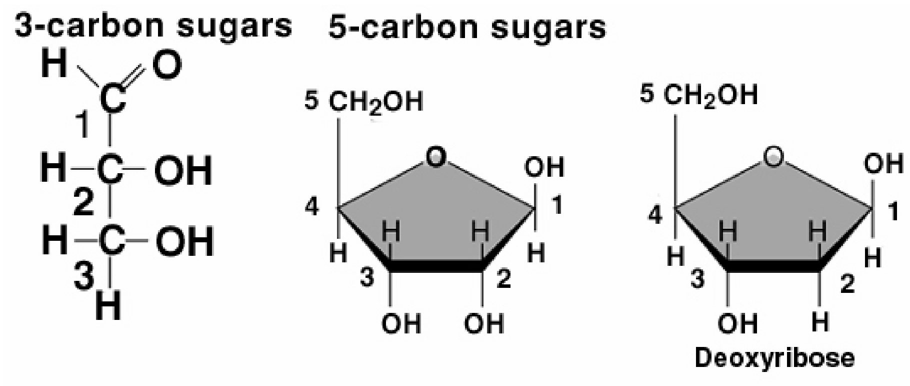
A kilocalorie is the amount of heat required to raise 1 kilogram of water 1°C or 1 gram of water 1000°C.

A Calorie is a dietary unit of energy equal to a kilocalorie.
One gram of sugar has 4.1 Calories and 4.1 kilocalories.

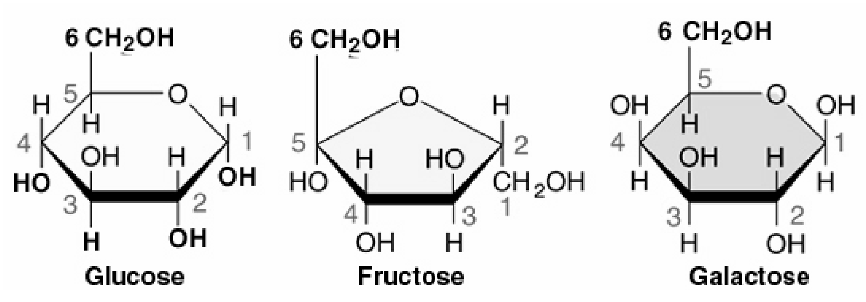
The simplest class of carbohydrates are monosaccharides – simple




sugars - All have 3 to 6 carbons , The six carbon sugars all have the same chemical

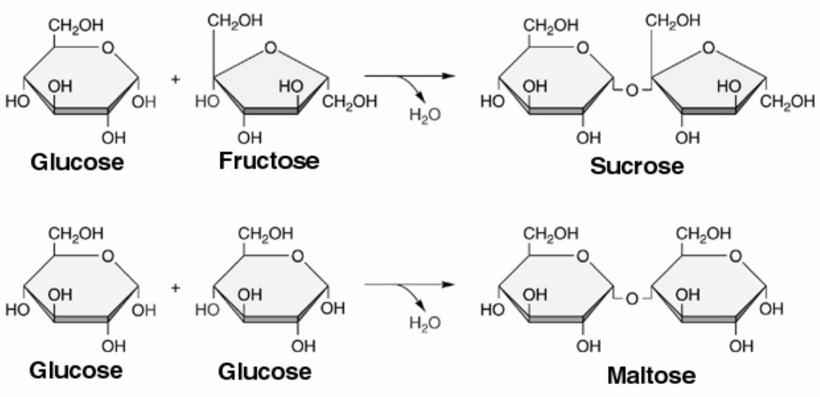



formula: C6H12O6

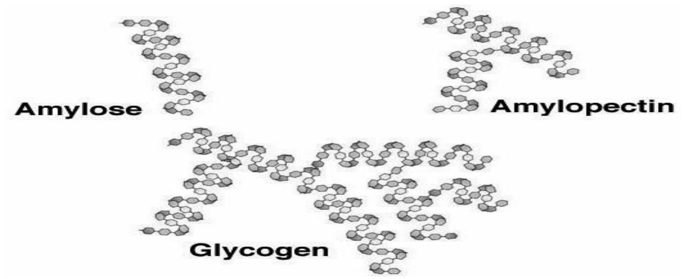



They differ in the placement of functional groups C=O and -OH
Isomers have the same chemical formula. Stereoisomers differ in the arrangement of a functional group at a single carbon.

Monosaccharides are the building blocks of more complex Carbohydrates
Disaccharides are formed by **dehydration synthesis**




**Polysaccharides** are **polymers** of monosaccharides. Polymers are long chain molecules with repeating subunits.




Starches are polymers of glucose **Amylose** is an unbranched chain and is produced by plants. **Amylopectin** is branched and also produced by plants. Glycogen is highly branched and produced by animals.
Polymers of the two stereoisomers of glucose produce polymers with very different properties Starch is a polymer of α-glucose and readily digestible.

Cellulose is a polymer of β-glucose and indigestible .

Cellulose is a **structural** polysaccharide and used for the construction of cell walls in plants.

Another important **structural** polysaccharide is chitin. Chitin is a polymer of β-glucose molecules that have a nitrogen containing functional group. Chitin is also indigestible.
It is used to build cell walls in fungi and to build exoskeletons in arthropods.

Even though chitin does not strictly follow the 1C : 2H : 1O rule for carbohydrates it is still classified as a **structural** polysaccharide.

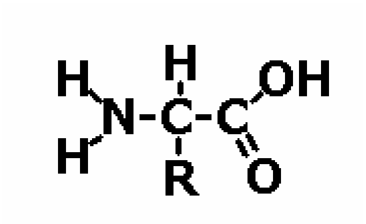
**Proteins**

Proteins are polypeptides - polymers of amino acids.

Nucleic acids are polymers of nucleotides.

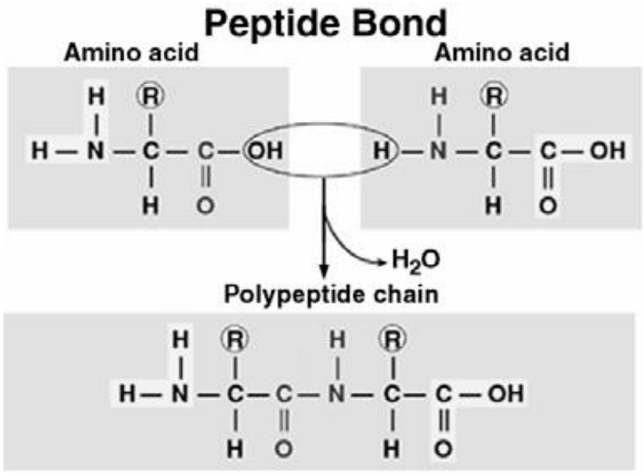
Proteins the most functionally diverse class of biological molecules - Protein diversity is the basis of the diversity of life. Everything that organisms are composed of - all parts - are made of, or by proteins.
Proteins serve as enzymes (biological catalysts), for defense, transport, support, motion, regulation, and storage.
Proteins are the tissue builders and tissue repairers. They also supply energy if carbohydrates and fats are in short supply and aid in regulating our tissue water balance. All our important body defences (antibodies) and all our enzymes are proteins.

Proteins are polymers of amino acids
There are 20 different amino acids used in proteins. All have a similar structure. All have a central carbon, an amino group (NH2) and a carboxyl group (COOH).




The 20 different amino acids each have a different **R group**. Chemically proteins are made up of carbon. hydrogen oxygen and nitrogen. Many proteins also contain the elements sulphur and phosphorus.They are complex organic molecules that are basically chains of amino acids joined by peptide links.

Proteins are polymers of amino acids joined through **peptide bonds**.




A polymer of amino acids is called a **polypeptide**. All proteins are polypeptides. Not all polypeptides are proteins. A protein is a polypeptide that performs a function.

There are 22 amino acids from which a protein molecule can be built. but not all of them are essential to our diet. ***Essential amino acids*** are those that must be in our diet because we are unable to manufacture them in the body. There are at least eight such essential amino acids. Some proteins. called ***complete proteins.*** contain all the essential amino acids and are of high biological

value as foods. Others are lacking in one or more" essential amino acid and are called ***incomplete protein.***

All animal proteins (except gelatin) are complete proteins. All vegetable proteins (except soybean) are incomplete proteins.. This creates a potential problem for those people who never eat food of animal origin *(vegans),* for they must plan their diets and food supplements very carefully if they are not to suffer from malnutrition.

| Essential | Non-essential |
|---|---|
| Isoleucine | Alanine |
| Leucine | Arginine |
| Lysine | Aspartic acid |
| Methionine | Asparagine |
| Phenylalanine | Cysteine |
| Threonine | Glutamic acid |
| Tryptophan | Glycine |
| Valine | Histidine |
| | Hydroxyproline |
| | Proline |
| | Serine |
| | Tyrosine |

***The uses of proteins***

Proteins are digested by the intestinal enzymes called *proteases.* This digestion produces amino acids that are absorbed into the blood stream and distributed around the body for use as outlined below:

(a) New tissues are built old tissues are repaired.

(b) Energy is produced (1 g of protein yields 4 kilocalories). This is an expensive way to produce energy, though, and is only used if we are short of carbohydrates and fats.

(c) The water balance of the body is maintained.This water balance can be upset if there is not enough protein in the blood. The water will accumulate in the tissues causing swelling or *oedema.* This can be seen in cases of *Kwashiokor* or protein starvation.

(d) Antibodies are made. These proteins help us resist disease.

(e) Many secretions Of our bodies. including all enzymes and some hormones, are built up from amino acids.