

Biology

NTSE Foundation

Food

Food

- Food is one of the most basic requirements of life.
- Food supplies us with energy.
- Energy is needed for all our activities. Energy is also needed for the thousands of chemical changes that take place throughout the body every second.
- Food is required for the proper growth and development of cells, for providing energy, replacement of worn out tissues and for protecting the body against various diseases.
- Food is made up of several kinds of energy – rich substances called nutrients. There are five types of nutrients-carbohydrates, fats, proteins, vitamins and minerals.

(a) Function of food:

The important function of food are:

- Food provides energy.
- Food helps in growth and development.
- Food helps in the replacement of worn out tissues, repair of damaged cells and healing of wounds.
- Food protects the body against diseases.
- Basal metabolic rate (BMR): The smallest amount of energy that body needs to keep alive is called basal metabolic rate (BMR).

(b) Basic constituents of food:

(i) Carbohydrates: Carbohydrates are organic compounds of carbon, hydrogen and oxygen.

- They gram of carbohydrate yields about 4 kilojoules of heat energy.
- A major portion of our food consists of carbohydrates, e.g., rice, chapattis.
- If excess amount of carbohydrates are present in the body, They are converted into fats and stored under the skin and around various organs of the body.
- Cellulose: It is the chief constituent of the frame work of plant cell. It is a linear and unbranched homopolysaccharide of about 6000 to 10,000 $\beta - D$ Glucose molecules.
- Mammals do not have cellulose enzyme and therefore cannot digest wood and vegetable

fibers. Cellulose only acts as a source of fibre or roughage in our food.

- Purest form of cellulose is found in cotton which is about 90%.
- Starch: It is the most important food source of carbohydrates and is found in cereals, potatoes, legumes and other vegetables. Natural starch is insoluble in water and gives a blue colour with iodine solution.
- Glycogen: The counterpart of starch in the animal body is glycogen that's why it is also called as animal starch, which occurs in significant amount in liver and muscles. Glycogen is non-reducing sugar which gives red colour with iodine. It is a branched homopolysaccharide formed of about 30,000 $\alpha - D$ Glucose molecules.
- Sources of carbohydrates: The carbohydrates in our food are obtained mainly from the plant sources like wheat, rice, maize, potato, sago (sabu-dana), peas, beans, and fruits. Milk also contains a sugar called lactose.
- Biological significance of carbohydrates:
- Carbohydrates serve as an important structural material in some animals and in all plants, where they constitute the cellulose framework.
- Carbohydrates are essential for life, almost all animals use them as respiratory fuel. In animal cells, carbohydrates are in the form of glucose and glycogen, which serve as an important source of energy for the vital activities.
- Carbohydrates play a key role in the metabolism of amino acids and fatty acids.
- Some carbohydrates have highly specific functions e.g. ribose in the nucleoprotein of the cells, the lactose of milk, starch and sugars are the two carbohydrates which provide most of the energy to our body. During the process of digestion, starch and sugars get hydrolysed to glucose.
- (ii) Fats: Fats are composed of carbon, hydrogen and oxygen.
- They have a lower oxygen content than carbohydrates.
- They are very important sources of energy.
- One gram of fat yields 9 kilojoules of energy.

- A layer of fat under the skin helps to reduce the amount of heat lost from the body in cold weather conditions.
- The fatty layer surrounding the body organs help to keep them in correct position.
- Fats are esters of long chain fatty acids and glycerol.
- Every fat molecule consists of three molecules of fatty acids and one molecule of glycerol.
- The difference lies in fact that fats contain less proportion of oxygen as compared to carbohydrates.
- Fats are insoluble in water but soluble in organic solvents like alcohol, ether, benzene, etc.
- Animal fats include butter, ghee, milk, meat, etc. vegetable fats include oils from groundnut, coconut, mustard, etc. animal fats are more easily digestible than vegetable fats and contain vitamins A and D in greater proportions.
- During the process of digestion, the fats are hydrolysed (or split) slowly into simple substances like fatty acids and glycerol. The hydrolysis of fats takes place in the small intestine by the action of an enzyme called lipase, which is secreted by pancreas.

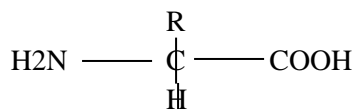
(A) Types of Fats: Fats are two types

- Saturated fats: Fats containing saturated fatty acids are solid at room temperature. The fats containing saturated fatty acids are called saturated fats. Saturated fatty acids occur in animal fats. Vanaspati ghee (like Dalda) and butter. Saturated fats are more stable due to which they go on accumulating under the skin.
- Unsaturated fats: Fats containing unsaturated fatty acids are in the liquid form (oil form) at the room temperature. The fats containing unsaturated fatty acids are called unsaturated fats or oils. The unsaturated fats and oils have comparatively low melting points. Due to their low melting points, the unsaturated fats and oils exist in liquid form at room temperature.
- Essential fatty acids: Those fatty acids which cannot be synthesized with our body from carbohydrates, are called essential fatty acids. Essential fatty acids are unsaturated fatty acids. For example linoleic acid.

(B) Biological significance of fats:

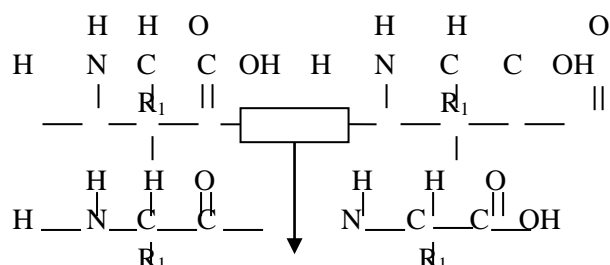
- The main function of fats in the body is to provide a steady source of energy, and for this purpose they are deposited in various “fat depots” within the body, under the skin.
 - Fats also help in forming the structural materials of cells and tissues such as cell membranes and other organelles.
 - They help in transportation of fat-soluble vitamins in our body.
 - Fats can also be stored in the body for subsequent use.
 - Growing children, persons engaged in hard physical work, pregnant women, lactating mothers (who breast-feed their babies), sportsmen, persons recovering from illness, and persons working in cold weather, require more energy in proportion to their body weight. This is because of their special needs.
 - Women, in general, require less energy than men of the same age group, because their average body weight is less than of men.
- (C) Sources of fats: Fats are supplied to our body by different foods like butter, ghee, cheese, milk, egg-yolk, meat, nuts, ground-nut etc. All the cooking oils (like ground-nut oil, coconut oil) provide us fats. The fats which we eat in our food or diet are called dietary fats.
- In butter: The major fatty acids present in butter is butyric acid and palmitic acid.
 - In coconut oil: Octanoic acid is present.
 - In animal fat (Mutton fat): Stearic acid is present.
 - In plant fat (Vegetable oils): Oleic acid is present.
- (iii) Proteins: The name protein was coined by Berzelius in 1838.
- Chemically proteins are polymers of molecular units called as amino acids.
 - Amino acids contain carbon, oxygen and hydrogen nitrogen atoms. Sulphur & phosphorus also present in small amount in some amino acids.
 - Proteins are needed for the growth of cells.
 - They help in replacing and repairing worn out and damaged tissues.
 - All enzymes are made up of proteins.

- The amino acids are linked together by a peptide bonds. The general structure of a amino acid is represented by the following formula:



The R group is variable in different amino acids. Amino acids can react with acid and base both, this is due to the presence of fcarboxy and amino groups in them. There are about 20 amino acids that take part in the formation of proteins. The 20 amino acids are further divided into three group:

- Essential amino acids: They are 8 in number. They are not synthesized in a human body and are obtained from food etc are called as essential amino acids. E.g., Methionine., Leucine and tryptophan.
- Non- essential amino acids: They are also 10 in number. They are synthesized in a human body & are termed as non-essential amino acids. E.g. Alanine, Asparagin, Aspartic and cystine.
- Semi- essential amino acids: They are two in number and needed by growing children and lactating and pregnant women. E.g. Arginine & Histidine.
- Peptide bond: Polypeptide and simple protein consist entirely of long chain of amino acids linked together by peptide bonds formed between the carboxyl group of one amino acid and the amino group of other amino acid. A molecule of water is released out during bond formation.



Peptide bond formation

- (A) Sources of proteins: Pulses, peas, beans, nuts, cheese, milk are the important sources of proteins.
- (B) Biological significance of proteins:

- They act as a structural components of cell. They are essential for growth and repair of the body.
- They help to catalyze various reactions occurring in our body.
- They play important roles as hormones, antibodies, etc.
- All the enzymes are made up of proteins.
- Haemoglobin, the respiratory pigment of animals is a conjugated protein composed of globin and haem (pigment).

(iv) Vitamins: Vitamins are organic compounds essential for the growth of the body. They are required by the body in very small quantities. They keep the body healthy and prevent it from diseases. Vitamins are classified into two types.

- Fat soluble' vitamins A, D, E, K.
- Water soluble vitamins B and C.

If the diet does not contain the required amount of vitamins, it results in vitamin deficiency diseases.

(v) Minerals: Human body requires about fifteen different kinds of minerals, eg,

- Calcium and phosphorus are needed for the growth of bones and teeth.
- Iron is needed for the formation of haemoglobin in blood.
- Iodine, sodium, potassium and zinc are necessary for a good healthy body.
- Minerals are required by the body in trace amounts and are essential for growth, repair and replacement processes. They form a major part of many body chemicals and tissues. Meat, eggs, milk, green vegetables and fruits are rich in minerals.

(vi) Roughage: It is a plant fibre found in vegetables, fruits peas, beans maize and in the barn which surrounds wheat grains.

- Cellulose forms the fibre conteint in food and is called roughage. Roughage Keeps the digestive system in good working condition.
- It absorbs water and poisonous waste from food during digestion.
- Food without roughage forms hard dry lumps of waste which get stuck in the gut causing constipation.

- (vii) Water: The human body contains 70% of water. It has no food value but it is still one of the essential components of living matter. Water performs the following functions in our body:

1. It transports food materials within the body.
2. It helps in the formation of urine and faeces.
3. It regulates the body temperature.
4. It is an essential part of blood and digestive juices.

Test for carbohydrates, fats & proteins

(a) Test for carbohydrates:

Substance Boiled rice/ potato.

Add iodine solution to boil rice or potato. The formation of blue-black colour confirms the presence of starch (carbohydrate).

(b) Test for fats:

Ghee/butter—Rub ghee / butter on white paper. A portion of that paper turns translucent indicating the presence of fats.

(c) Test for proteins:

Take the few drops of egg albumin in a test tube and add a few drops of concentrated nitric acid to it.

- The white colour of the albumin changes to yellow. Now, pour the acid out of the test tube but keep the white of the egg in the test tube.
- Add a few drops of ammonium hydroxide to it.
- The colour changes to violet which shows the presence of proteins.

Classification of Food

- Food can be classified under three different categories on the basis of its functions:
- Energy giving food carbohydrates and fats, eg, cereals, sugars, oils etc.
- Body building food proteins, minerals and fats, eg, pulses, beans, milk fish, etc.
- Protective food Vitamins and minerals, eg, vegetables, fruits, milk, etc.

Balanced Diet

- A balanced diet is one which provides proper amount and proportion of fats, carbohydrates, proteins, vitamins and minerals needed for the growth and maintenance of the body. A balanced diet should have three main qualities:

1. It should be rich in essential nutrients like minerals and vitamins.
2. It should provide the exact amount of raw materials needed for growth, development, repair and replacement of body tissues.
3. It should provide the right amount of energy required by the body.

Food Preservation

- Food is an excellent medium for the growth of micro-organisms which decay the food materials.
- The affected food not only becomes unpalatable but also poisonous. There are different ways of preserving food. Some of them are described below:

(a) Canning and bottling:

They involve heat treatment. The heat kills the bacteria on the food and in the can, jar or bottle. The food is then packed without any air.

(b) Dehydration:

This removes moisture which is necessary for the growth of bacteria and other micro-organisms.

(c) Pasteurization:

This is done to preserve milk.

(d) Boiling:

Boiling kills bacteria and other germs, thereby preventing food spoilage.

(e) Brining:

This involves addition of adequate amount of common salt to food like pickles.

(f) Addition of sugar:

Sugar is added to jams and jellies to prevent the growth of bacteria.

(g) Addition of chemicals:

Chemicals like benzoic acid, sodium metabisulphite are known as food preservatives. They destroy the micro-organisms in food.

(h) Freezing:

In freezing, the temperature is lowered and the water in the food freezes so that the bacteria and moulds cannot reproduce. Mostly frozen fresh foods can be stored for upto a year, but after that the food starts to lose colour and flavour.

(i) Radiation:

These can also be used to kill bacteria and preserve food.

Food fad

- Incorrect and unscientific ideas about food are called food fads. We have often heard statements like, “eating lot of desi ghee makes you healthy and strong; lady’s finger is good for human brains”. All these are examples of food fads. The main reasons for these food fads are:
1. People do not know the content of food items, importance of essential nutrients and balanced diet.
 2. Expensive food is not good for health.
 3. Some fads arise due to certain customs, traditions and superstitious beliefs.

Food problem in India

- In India, overpopulation, poverty and unemployment are the order of the day. The poorer sections of the society are not able to provide sufficient food for their families.
- This results in undernutrition. Undernutrition is defined as the consumption of less quantity of food than that required by the body. When the diet is devoid of essential nutrients, it results in malnutrition.
- Food problem in India can be overcome by growing more crops and plants. Avoiding wastage of food, controlling human population, eradicating poverty and unemployment.

EXERCISE

1. Bond present between two molecules of carbohydrates is-
 - (a) Hydrogen bond
 - (b) Glycosidic bond
 - (c) Phosphodiester bond
 - (d) Amide bond
2. Stored food of green plants is
 - (a) Glucose
 - (b) glycogen
 - (c) cellulose
 - (d) starch
3. Which of the following lack enzymes?
 - (a) Algae
 - (b) Plants
 - (c) Viruses
 - (d) Bacteria
4. Glucose is stored in an animal body in the form of
 - (a) Glycogen
 - (b) Sucrose
 - (c) fructose
 - (d) all of the above
5. Malnutrition of which causes goiter?
 - (a) Protein
 - (b) Carbohydrate
 - (c) Fat
 - (d) Iodine
6. The sugar present in nucleic acids is
 - (a) Dextrose
 - (b) Glucose
 - (c) Levulose
 - (d) Deoxyribose or ribose
7. Hydrolysis products of protein are
 - (a) Fatty acids
 - (b) amino acids
 - (c) glucose
 - (d) glycerol
8. Which of the following is required for the maturation of erythrocytes.
 - (a) Vitamin-K
 - (b) Vitamin-B₁₂
 - (c) Vitamin-A
 - (d) Vitamin-C
9. The presence of fats in food sample is detected by
 - (a) Greasy spot test
 - (b) Transparent paper test
 - (c) Colour change
 - (d) Precipitate formation
10. The general formula for carbohydrate is
 - (a) $C_n H_{2n} O_{n-1}$
 - (b) $C_n H_{2n} O_n$
 - (c) Both of them are correct
 - (d) None of them are correct
11. Which substance gives maximum energy?
 - (a) Carbohydrate
 - (b) Fat
 - (c) Protein
 - (d) Water
12. Source of carbohydrate is
 - (a) Potato
 - (b) tomato
 - (c) pea
 - (d) tea
13. Sunshine vitamin is
 - (a) Vitamin-A
 - (b) Vitamin-D
 - (c) Vitamin-K
 - (d) Vitamin-E
14. The presence of protein in a food sample is characterized by which colour change?
 - (a) Yellow to violet
 - (b) Orange to red
 - (c) Yellow to red
 - (d) Orange to yellow
15. Chemically enzymes are
 - (a) Fats
 - (b) Carbohydrates

- (A) A, C (B) B,C
(C) A, B (D) A, B and D

[illegible]