13

Nutrition in Plants and Animals

- The sum total of all the processes from taking the food upto its utilisation by the organisms is called nutrition.
- On the basis of different modes of nutrition, organisms are categorised into three major types, i.e.
  (i) **Autotrophs** (*Auto*-self, *trophos*-nourishment) These organisms make their own food from simple substances (e.g., CO_2 and H_2O) by the process of photosynthesis. Therefore, plants are called autotrophs.
  (ii) **Heterotrophs** (*Heteros*-other) These organisms which cannot prepare their own food and take food from green plants or animals. The mode of nutrition is called heterotrophic nutrition, e.g., humans.
  (iii) **Saprotrophs** These organisms derive nutrition from dead or decaying organic matter, e.g., fungi, yeast, bacteria, etc.

Nutrition in Plants

- The process by which autotrophic plants make their food is called **photosynthesis**.
- **Site of photosynthesis** It takes place in green leaves that contain chlorophyll pigment.
- This pigment helps green parts of the plant to capture energy from sunlight to perform photosynthesis.
- The cactus or desert plants modify their leaves into spines to reduce water loss from them by transpiration and photosynthesis occurs through their modified green stem.

Raw Materials Used for Photosynthesis

- It includes simple inorganic substances like carbon dioxide and water.
- Tiny pores on the leaves surface help to take in CO_2 from air. These are called stomata.
- The whole process of photosynthesis can be given by the following equation

$$\underset{\text{(From air)}}{\text{Carbon dioxide}} + \underset{\text{(From soil)}}{\text{Water}} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \underset{\text{Carbohydrate (food)}}{\text{Glucose}} + \underset{\text{(Released in air)}}{\text{Oxygen}}$$

Products of Photosynthesis

- The food material produced by photosynthesis is glucose (a carbohydrate).
- It later gets converted into starch. Strong form of carbohydrate.
- The presence of starch in leaves indicates the occurrence of photosynthesis.
- Starch containing leaves give blue-black colour with iodine solution.
- Starch or glucose is rich in seeds of wheat, rice and various parts like potato tuber.
- In sunflower seeds, starch is stored in the form of oil.
- Plants also synthesise proteins and fats.

Other Modes of Nutrition in Plants

- Some plants do not contain chlorophyll and cannot prepare their own food.
- These plants are heterotrophic in nature and they obtain nutrition from other plants or animals.

Types of Plant	Characteristics and Example
Parasitic plants	Non-green, take nutrition from host organism through sucking roots, *e.g., Cuscuta.*
Insectivorous plants	Green plants but lack nitrogen, trap insects and digests them in specialised leaves-pitcher, *e.g.,* Sundew, venus flytrap, bladder wort.
Symbiotic plants	Plants of different species live together (symbiosis), *e.g.,* lichens and *Rhizobium.*

Animal Nutrition

- It includes nutrient requirement, mode of intake of food and its utilisation in the body.
- Different animals show different modes of nutrition.
- These variations exhibit due to the presence of different structures that help in taking food inside the body.
- It also depends upon the type of food, body organisation, etc.

Various Modes of Feeding in Different Animals

Name of the animal	Kinds of food	Modes of feeding
Snail	Algae	Scraping from rocks
Ant	Plant material and other animals	Biting and chewing
Eagle	Flesh of prey	Tearing
Humming bird	Nectar from flower	Sucking
Lice	Blood from skin of scalp	Sucking
Mosquito	Blood from animals	Sucking
Butterfly	Nectar from flower	Siphoning
Housefly	Filth and refuses	Sucking
Amoeba	Tiny aquatic animals	Capturing and swallowing
Snake (python)	Animal as a whole	Swallowing

Digestive System of Human

- For the digestion and absorption of food, humans posses a continuous canal running from mouth to anus.
- This tract or canal is known as alimentary canal (digestive tract).

- Digestive system of humans consists of digestive tract along with glands.

Structure	Characteristics and Functions
Oral or Buccal cavity	• Ingestion occurs, food is tasted by the taste buds, moistened with mucus and saliva, masticated by grinding teeth to smaller particles and swallowed. • Saliva contains salivary amylase which digests starch into maltose. • Tongue is muscular organ that helps in mixing saliva with food.
Oesophagus	• Oral cavity leads through pharynx into tube-like oesophagus (food tube). • Food is pushed through the oesophagus by involuntary muscular movement called peristalsis. • No digestion occurs here.
Stomach	• Widest organ of the alimentary canal, acts as food reservoir. • The gastric glands of the stomach secrete gastric juice which is thoroughly mixed with food. • Mostly protein digestion occurs in stomach, carbohydrate digestion gets inhibited due to highly acidic medium. • HCl secreted by its inner lining makes the medium acidic. It kills harmful bacteria in food.
Small intestine	• Largest, narrow, tubular part of the alimentary canal. • Here, complete digestion of food takes place. • Its inner walls contain villi which help in absorption of food.
Large intestine	• It is wider and shorter than small intestine. • It absorbs water from undigested food. • The waste faecal matter is removed through anus.
Liver	• It is the largest gland of the body. • It secretes bile. • Bile helps in the digestion of fats in the small intestine by emulsification.
Pancreas	• It is located just below the stomach. • Pancreatic juices breakdown fats into simpler form.

Food and its Components

The material, which is required by all living organisms for the production of energy, growth, repairing of tissues and regulation of other life processes.

Balanced Diet

- Diet that contains all the components in the optimum proportions and quantity required for maintaining the body in perfect state of health, activity and development.
- Various components of balanced diet are carbohydrates (60%), fats (25%), proteins (15%), vitamins, mineral, roughage and water.

Components of Food

The following components of food we require daily in adequate amount to stay healthy.

1. Carbohydrate
2. Protein
3. Fat
4. Minerals
5. Vitamin
6. Roughage
7. Water

Carbohydrates

- They can be monosaccharides (*e.g.*, glucose), disaccharides (*e.g.*, sucrose, lactose, maltose), oligosaccharides and polysaccharides (*e.g.*, glycogen, starch, cellulose).
- Its 1.0 gm gives 4 kcal energy.

- Living cells receive carbohydrate from blood mostly as glucose.
- Excess of glucose is stored in liver and muscles as glycogen, *i.e.,* glycogenesis.
- When level of blood glucose fall, glycogen of liver is hydrolysed to produce it, *i.e.,* glycogenolysis.
- Cereals (wheat, rice and maize), sugarcane, milk (lactose, sugar), fruits, honey, beet, etc are the source of carbohydrates.
- Daily requirement of an adult is 500 g, while growing child, nursing mother and sport persons needed more carbohydrates.

Proteins

- Play a vital role in growth, development and repair of the body.
- Proteins are polymers of amino acids.
- Amino acids are of two types
  (i) **Essential** These cannot synthesised in the body and must be taken in diet, *e.g.,* lysine, methionine, valine tryptophan, phenylalanine, etc.
  (ii) **Non-essential** Synthesised in the body and do not need to be taken from outside, *e.g.,* alanine, arginine, aspartic acid, glutamine, cysteine, proline, serine, hystidine, tyrosine.
- Proteins first broken down in amino acids then are digest.
- 1.0 g of proteins may yield 5.65 kcal energy.
- Daily requirement of protein is 70-100 g 1 to 1.5g/kg body weight.
- They build up various protoplasmic structures including cell membrane.
- Haemoglobin, visual pigments and cytochromes, all are proteins.
- Blood contains proteins for different functioning including blood clotting and antibodies, *e.g.,* gamma globulins.
- Main sources are groundnuts, soybean, meat, pulses, fish, eggs, etc.

Lipids

- Lipids are of two types simple (*e.g.,* fat and oil) and compound (*e.g.,* lecithin, glycolipid).
- Provides two times more energy (9 kcal/g) than carbohydrates.
- Fat is the major stored food kept in adipose tissue.
- Stored food is used as fuel when glucose is not available.
- Lipase enzyme digests fats and break it into fatty acids and glycerol.
- There are two types of fatty acids saturated (solid at room temperature) and unsaturated (liquid at room temperature).
- Our diet should contain less saturated fats (butter, ghee, hydrogenated vegetable oils, etc) in comparison to unsaturated fats (simple vegetable oil).
- Excess of saturated fats in diet may lead to heart attack as they increase blood cholesterol and the disease known as hypercholestrocemia.
- Human diet should have more unsaturated fatty acids as they cannot be synthesised in the body itself. Such fatty acids are called essential fatty acids (*e.g.,* linoleic acid, linolenic acid, etc).
- Fat functions as a cushion and shock absorber for eye balls, gonads, kidney, etc.
- Excess of lipids causes obesity, blood pressure and a number of cardiac problems.
- Daily requirement of an adult is 50 g.

Mineral Nutrients

- These are metals, non-metals and their salts other than the four elements—carbon, hydrogen, nitrogen and oxygen and constitute about 4% of total body weight.
- Milk, eggs, meat, fruit, food, vegetables, etc are the sources of minerals.

Minerals are of two types

1. **Macronutrients** These are required in large amount, e.g. Calcium (Ca), phosphorus (P), potassium (K) etc.
2. **Micronutrients** These are required in very small amount (less than 1 g), e.g. Iodine (I), iron (Fe), zinc (Zn) etc.

Vitamins

- These are accessory food factors, required in small quantity for controlling metabolism and body functioning. They do not provide energy.
- Term vitamin was coined by in 1912.
- Vitamins are of two types fat soluble (A, D, E and K) and water soluble (B and C).

Roughage

- It is fibrous matter present in food.
- These fibrous matters cannot be digested hence, do not take part in growth.
- It maintains water proportion inside the body.
- Its sources are salad, outer layer of grains.
- Vegetables and porridge (dalia).

Water

- Human body contains about 60-80% water.
- It regulates body temperature by sweating and evaporation.
- It also helps in digestion, transportation and excretion.

Vitamin	Common source	Function	Deficiency symptom
Vitamin-A (Retinol)	Milk, butter, eggs, fish oil and vegetables.	Forms retinol pigments (rhodopsin of rod cells and iodopsin of cone cells of eye).	Nightblindness (no vision in dim light).
Vitamin-B_1 (Thiamine)	Yeast, wheat germ, peanuts, beans.	Essential for normal carbohydrate metabolism and functioning of nervous system.	Beri-beri (weakness of limb muscles).
Vitamin-B_2 (Riboflavin)	Liver, milk, cheese, leafy vegetables.	Part of coenzymes, maintains healthy skin and oral mucosa.	Cheilosis (fissures in skin).
Vitamin-B_5 (Pantothenic acid)	Yeast, milk, groundnut, tomatoes, liver, kidneys, egg yolk.	Main component of coenzyme-A, play various metabolic roles especially in pyruvate into acetyl Co-A for Krebs cycle.	Deficiency is rare due to its abundance
Vitamin-B_3 (Niacin)	Wheat, meat, peanuts, yeast.	Carbohydrate metabolism.	Pellagra (swollen lips and pigmented skin).
Vitamin-B_9 (Folic acid)	Liver, green vegetables, banana.	Nucleic acid metabolism, maturation of RBCs.	Macrocytic anaemia.
Vitamin-B_{12} (Cyanocobalamin)	Eggs, fish, liver.	Promote DNA synthesis, maturation of RBCs.	Pernicious anaemia.
Vitamin-C (Ascorbic acid)	Citrus fruits, tomatoes, leafy vegetables.	Formation of collagen.	Scurvy (bleeding of gums, teeth falling).
Vitamin-D (Calciferol)	Fish, liver oil, sunlight, milk, eggs yolk.	Ca and P deposition in bones and teeth.	Rickets in children (bent and weak bones), while osteomalacia in adults.
Vitamin-E (Tocopherol)	Leafy vegetables, vegetable oil, cereal grain.	Keeps skin healthy, maintains RBCs.	Destruction of RBCs, reproductive failure.
Vitamin-K (Phylloquinone)	Leafy vegetables, soybean oil.	Normal blood clotting.	Delayed blood clotting.

Practice Exercise

1. Organisms which prepare food for themselves using simple naturally available raw materials are referred to as
   (a) heterotrophs (b) autotrophs
   (c) parasites (d) saprophytes

2. In the process of photosynthesis, which of the following energy conversions occurs?
   (a) Solar energy is changed into chemical energy
   (b) Solar energy is changed into mechanical energy
   (c) Bioenergy is converted into chemical energy
   (d) Chemical energy is changed into light energy

3. The raw materials used by plants during photosynthesis
   (a) N_2 and O_2 (b) O_2, H_2 and CO_2
   (c) CO_2 and water (d) water and minerals

4. In the process of photosynthesis, plants
   (a) take O_2 and released CO_2
   (b) take CO_2 and released O_2
   (c) taken and release O_2
   (d) take O_2 and release water

5. Which of the following raw materials is available in the air for photosynthesis?
   (a) Oxygen (b) Carbon dioxide
   (c) Nitrogen (d) Hydrogen

6. The ultimate source of food on earth is
   (a) plants (b) sunlight
   (c) animals (d) proteins

7. If iodine is dropped on the boiled leaf it gives blue-black colour due to the presence of
   (a) starch (b) protein
   (c) fat (d) vitamin

8. Pitcher plant traps insects because it
   (a) is a heterotroph
   (b) grows in soils which deficient in nitrogen
   (c) does not have chlorophyll
   (d) has a digestive system like human beings

9. Insectivorous plant among the following is
   (a) lichen (b) *Cuscuta*
   (c) pitcher plant (d) bread mould

10. Read the following statement and choose the correct one.
    (a) Simplest form of fat is sugars and glucose
    (b) Nutrition in *Amoeba* is heterotrophic
    (c) Source of energy for all living being is sun
    (d) *Paramecium* is single-celled autotrophic organism

11. The false feet of *Amoeba* are used for
    (a) movement only
    (b) capture of food only
    (c) capture of food and movement
    (d) exchange of gases only

12. Tocopherol is the chemical name of
    (a) vitamin-B (b) vitamin-E
    (c) vitamin-C (d) None of these

13. A good source of vitamins-B group is
    (a) carrot (b) fish oil
    (c) germinated seeds (d) egg yolk

14. Deficiency of vitamin-C causes
    (a) anaemia (b) rickets
    (c) scurvy (d) xerophthalmia

15. The enzymes present in the saliva convert
    (a) fats into fatty acids and glycerol
    (b) starch into simple sugars
    (c) proteins into amino acids
    (d) complex sugars into simple sugars

16. If, by chance, food particles enter the windpipe, we feel
    (a) hiccups and cough
    (b) yawning
    (c) sleep
    (d) None of the above

17. Hydrochloric acid is secreted by
    (a) linings of small intestine
    (b) inner lining of stomach
    (c) pancreas
    (d) lining of liver

18. The acid present in the stomach
(a) kills the harmful bacteria that may enter along with the food
(b) protects the stomach lining from harmful substances
(d) digests starch into simpler sugars
(d) makes the medium alkaline

19. The simplest form of protein is
(a) fatty acids
(b) glucose
(c) glycerol
(d) amino acids

20. The finger-like projections present on the inner lining of small intestine are called
(a) villi
(b) stomach
(c) rumen
(d) diarrhoea

21. The absorption of nutrients or food components in its simpler form takes place in
(a) blood vessels of small intestine wall
(b) large intestine wall
(c) gall bladder
(d) liver

22. Choose the correct statements.
I. Autotrophs II. Heterotrophs
(a) I can synthesise their food while II can not synthesise their food
(b) I use sun as a source of energy, II use chemical energy in the form of food
(c) II type of organisms depend on the I type of organisms for their food
(d) I type of organisms depend on II type of organisms for their food

23. Read the following and fill up the blanks.
..... contains all essential components in the optimum proportion and quantity for maintaining the various body activities and development. .....% carbohydrates, ... fats ..... proteins and vitamins, minerals, roughage and water are various components of a balanced diet.
(a) Balanced diet, 60%, 25%, 15%
(b) Diet, 25%, 60%, 15%
(c) Balanced diet, 15%, 60%, 25%
(d) None of the above

24. Which is the best source for vitamin-B_1?
(a) Code liver oil (b) Egg
(c) Whole wheat bread (d) Curd

Answers

1	*(b)*	2	*(a)*	3	*(c)*	4	*(b)*	5	*(b)*	6	*(a)*	7	*(a)*	8	*(b)*	9	*(c)*	10	*(b)*
11	*(c)*	12	*(b)*	13	*(c)*	14	*(c)*	15	*(b)*	16	*(a)*	17	*(b)*	18	*(a)*	19	*(d)*	20	*(a)*
21	*(a)*	22	*(d)*	23	*(a)*	24	*(c)*												