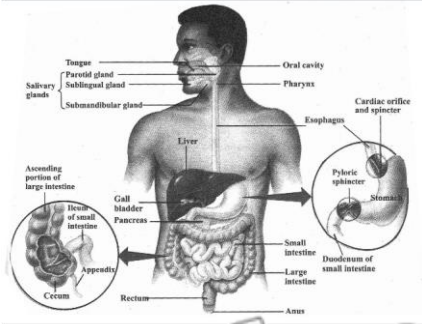


Chapter 12 Nutrition

12.0 INTRODUCTION

All organisms need nutrients for the maintenance of their lives. Signatures

Nutrient

Nutrient is the food or any substance that supplies the body with elements, necessary for metabolism.

Importance of Nutrients

Certain nutrients (carbohydrates, fats and proteins) provide energy and also raw materials for protoplasm synthesis. Other nutrients (water, electrolytes, minerals and vitamins) are essential to the metabolic process.

Nutrition

The sum total of all the processes involved in the taking in and utilization of elements by which growth, repair and maintenance of activities in the organism are accomplished is called nutrition.

Modes of Nutrition

Organisms can be divided into two classes on the basis of their method of nutrition.

Autotrophic

Autotrophic organisms can exist in an exclusively inorganic environment because they can manufacture their own organic compounds from the inorganic raw material taken from the surrounding media. This means that they produce their own sugars, lipids, proteins etc from carbon dioxide, water and nitrates.

Heterotrophic

Heterotrophic organisms are incapable of manufacturing organic compounds from simple inorganic nutrients and so they obtain organic molecules from the environment in the form of food.

12.1 AUTOTROPHIC NUTRITION

12.1.1 Mineral Nutrition in Plants

Generally, all autotrophic or photosynthetic organisms need carbon dioxide and water, which supply the carbon, oxygen and hydrogen. These are the predominant elements, the plant needs for the synthesis of organic molecules.

Minor Elements

There are many other elements that enter into the composition of plants. Some of these are;

- ***Nitrogen***, which is part of proteins.
- ***Phosphorous***, which is present in ATP, nucleic acid and many other compounds.
- ***Magnesium***, which is part of chlorophyll.
- ***Iron***, which is present in cytochromes.

These are mainly obtained from soil. These are essential for growth and life of the plant. Crops fail to flourish, if grown repeatedly in the same field unless soil is replenished with these nutrients. The farmers replace these by spreading animal manure, sewage sludge or artificial fertilizers in measured quantities over the field. Some chemical fertilizers that are commonly used in Pakistan are urea, super phosphates, ammonium nitrate etc.

12.1.2 Mineral Element Deficiencies

It is very difficult or not possible to ascertain the effects of individual minerals in both plants and animals. However, the deficiencies of some elements cause serious diseases showing clear symptoms. For example:

- ***Nitrogen deficiency*** in soil results in ***stunted growth*** and ***strong chlorosis*** (lack of chlorophyll) particularly in old leaves.
- ***Phosphorous deficiency*** causes ***stunted growth of roots.***
- ***Potassium deficiency*** causes leaf margins to become yellow and brown in colour and premature death of plant.
- ***Magnesium deficiency*** results in ***chlorosis.***

Many economically important plant diseases due to mineral deficiency are now catalogued with the help of colour photography, enabling rapid diagnosis.

QUESTION RELATED TO ABOVE ARTICLE

Define nutrition. Describe role of different elements in plant nutrition.

(Exercise Question i)

12.2 HETEROTROPHIC NUTRITION METHODS OF PLANT NUTRITION

The plants generally obtain their food from the air or the water in which they grow. There are, however, some special methods of nutrition, which are described below.

12.2.1 Saprophytic Nutrition

Definition

Feeding on dead and decaying matter such as dead leaves in the soil or rotting tree trunks is called saprophytic nutrition and derives its nutrients from host plants.

Mechanism

- These produce ***extracellular enzymes***, which digest the decaying matter and then absorb the soluble products back into their cells.
- Some bacteria break down the proteins of dead plants and animals and release nitrates, which are taken up by the plant roots and then built into new amino acids and proteins, thus helping in nitrogen cycles.

12.2.2 Parasitic Nutrition

Definition

Feeding by living in or on other living organisms (host) belonging to different species is called parasitic nutrition.

Mechanism

Parasites attach themselves to living things or host for their nourishment. For obtaining nourishment from higher plant, the parasite penetrates its suckers in the conducting tissue of the host.

Examples

- *Puccinia* is a parasitic fungus that destroys the wheat plant.
- Dodder (*Cuscuta*) is a leafless plant that lives as a twining parasite.

12.2.3 Symbiotic Nutrition

Definition

It is mutual nutrition between organisms living in association with one another.

These organisms belong to two different species.

Examples

Some important examples are lichen, mycorrhiza and root nodules with nitrogen fixing bacteria.

- The ***lichen*** is a symbiotic association between a fungus and algal cells. The alga makes food by photosynthesis and provides some amount to fungus, while fungus supplies water and minerals and also protection against desiccation.
- The ***mycorrhiza*** is an association between a fungus and roots of higher plants. The fungus depends upon the photosynthate of the plant. The benefit driven by mycorrhizal plant is not properly understood. However it is known that the plants with mycorrhizal association show better growth than those without fungal partner.

Possibly the mycorrhizal fungus benefits the plant by decomposing organic matter in the soil and providing water and minerals such as phosphorus to plant.

- ***Leguminous plants*** have nodules on their roots, which contain nitrogen-fixing bacteria. The bacteria live on the plant material and fix nitrogen, converting it into nitrates, which the plant uses.

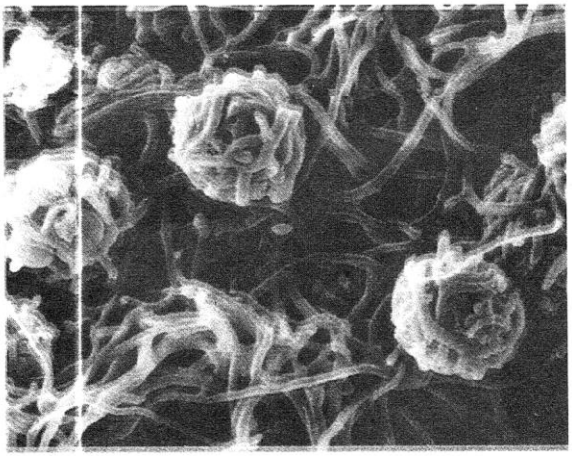


Fig 12.1. Lichens

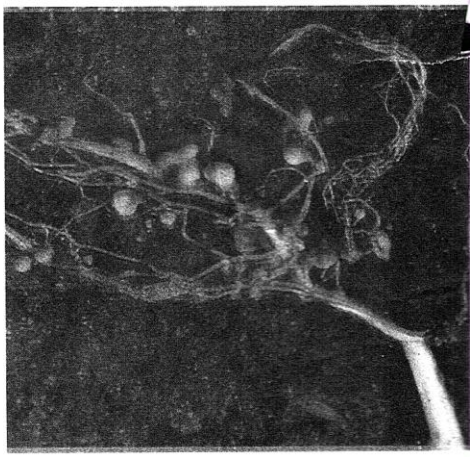


Fig 12.2. Nodules on leguminous plant roots

12.2.4 Nutrition in Insectivorous Plants

There are a few that supplement their inorganic diet with organic compounds. These organic compounds are obtained by trapping and digesting insects and small animals. All of the insectivorous plants are true autotrophs, but when they capture prey, their growth becomes rapid. Apparently, nitrogenous compounds of animal body are of benefit to these plants. In some plants, the trapped insects are decomposed by bacteria. In others the trapped insects are digested by enzymes secreted by the leaves. The plants absorb the nitrogenous compounds thus formed.

Examples

Pitcher Plant

- Pitcher plant ***(Sarracenia purpurea)*** has leaves modified into a sac or a ***pitcher***, partly filled with water.
- The end of the leaf is modified to form a ***hood***, which partly covers the open mouth of the pitcher.
- Small insects that fall into the pitcher are prevented from climbing out by numerous ***stiff hairs***.
- The proteins of trapped insects are decomposed by ***bacteria*** or ***enzymes*** and the products of this decay are absorbed by the inner surface of the pitcher leaf.

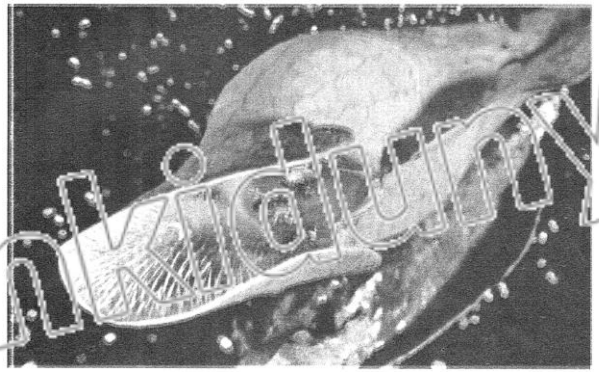


Fig. 12.3. Pitcher plant (*Saracenia pupurea*). Several fruit flies are entrapped within the leaf.

Venous-Fly Trap

- In venous-fly trap (***Dionaea muscipula***), the ***leaf is bilobed*** with midrib between them.
- There is a row of long ***stiff bristles*** along the margins of each lobe.
- When an insect touches small sensitive hairs on the surface of the leaf, the lobes quickly come together with their bristles interlocked.
- The trapped insect is then digested by the enzymes secreted from the glands on the leaf surface and the products are then absorbed.

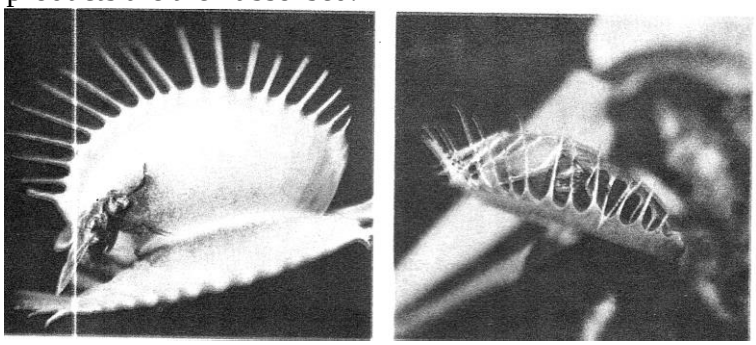


Fig. 12.4. Leaf of Venus fly trap (*Dionaea muscipula*) (a) Fly is about to trigger the hair. (b) The two halves of the leaf trapping the fly.

Sundew

Sundew **(*Drosera intermedia*)** shows another type of modification of leaf for insectivorous activity.

- The ***tiny leaves*** bear numerous ***hair like tentacles***, each with a gland at its tip.
- The insects, attracted by the plant's odour are entangled.
- Proteins of insects are digested by enzymes and the products are absorbed.

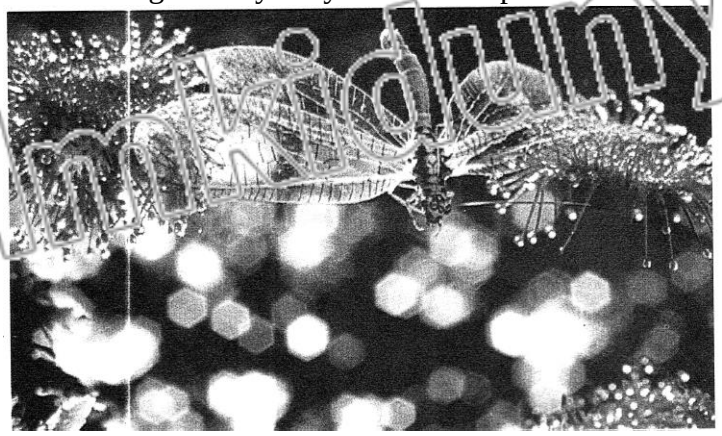


Fig. 12.5 Leaf of Sundew (*Drosera intermedia*) A dragonfly is caught in the sticky fluid on the ends on the leaf of the glandular hair.

QUESTION RELATED TO ABOVE ARTICLE

Explain the different mode of nutrition in plants.
Describe the Nutrition in Insectivorous plant at least with two examples. (GRW 2015)
Discuss the process of nutrition in insectivorous plants. (LHR 2017)
Write a note on four methods of nutrition in plants. (DGK 2019)
How insectivorous plants meet their demands of organic compounds? Describe three methods (GRW 2019)
Discuss nutrition in insectivorous plants (Any two). (LHR 2021)
Distinguish between. (Exercise Question ii)
(a) Saprophytic and parasitic modes of life.
(b) Name one parasitic plant
(c) Describe its method of nutrition, explaining why normal nutrition is not possible.
What are heterotrophs? Describe different methods of nutrition. (Exercise Question iii)

12.2.5 Methods of Animal Nutrition

In large animals, due to large number of cells, digestive system is involved, which provides the body with water, electrolytes and other nutrients. For this, digestive system is specialized to ingest food, propel it through the digestive tract, digest the food and absorb water, electrolyte and nutrients from the lumen of the digestive tract. Undigested matter from the food is moved out of the digestive tract.

In animals, there is ***more variety of nutrition*** than plants. On the basis of nutrition, animals may be classified as follows.

DETRITIVORES

The animals, which feed on detritus (organic debris from decomposing plants and animals) are called detritivores.

Examples

Earthworm is the common example of detritus feeder. It ingests fragments of decaying organic matter especially vegetation either at the soil surface or during burrowing activity.

HERBIVORES

The animals, which feed on plants, are called herbivores.

Examples

Typical herbivores include insects, reptiles, birds and mammals. Two important groups of herbivorous mammals are rodents and ungulates. The later are hoofed grazing animals, such as horses, cattle and sheep.

Features

- In herbivorous mammals, the ***premolars and molars*** have *large* grinding surfaces.
- There is a ***large gap*** between the incisors and premolars.
- ***Canines*** are ***missing***.
- In grazing and browsing herbivores i.e. deer and sheep, there are ***no upper incisors***.

CARNIVORES

The animals, which feed on other animals, are called carnivores.

Examples

Cats, dogs, lions and tigers are common examples of carnivores.

The predator-prey interaction helps in maintaining ecosystem stable. A species in the area without its natural predator leads to disastrous results. The introduction of rabbits into Australia without the predator multiplied to enormous number and proved a menace to the farmers.

Features

- They have ***large canine*** teeth for catching and tearing the prey.
- Incisors, premolars and molars are all adapted for cutting flesh, cracking bones and reducing the chunks to sizes suitable for swallowing.

Predator-Prey Interaction

A ***predator*** is an animal, which captures and readily kills live animal for its food. The animal, which is eaten, is the ***prey***.

OMNIVORES

The animals, which eat both plant and animal as food, are called omnivores.

Examples

Example of omnivores are crows, rats, red fox, bear, pig and man.

Feature

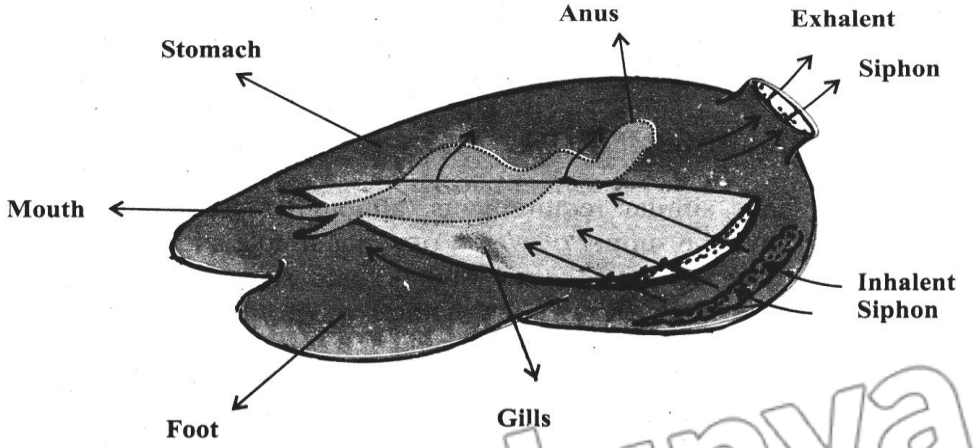
They have the ***teeth*** structurally and functionally ***intermediate*** between the extremes of specialization attained by the teeth of herbivores and carnivores.

FILTER FEEDERS

The animals, which filter food from water, are called filter feeders.

Mechanism

A common mussel possesses two large gills covered with cilia. The movement of cilia causes a current of water to enter animal via an inhalant siphon. The water, which enters, contains the food, such as microscopic algae and protozoa. Secretory cells scattered among cilia produce sticky mucus which entangles food particles. The trapped food particles are then swept towards the mouth by the ciliary movement. Certain types of whales are also filter feeder.



Filter feeding in mussel
Fig. 12.6 Filter feeding mussel

FLUID FEEDER

The animals, which ingest liquid food, are called fluid feeders.

Examples

Aphids and mosquitoes are examples.

Features

- ***Aphids*** suck the phloem juices out of the green stems by inserting their delicate stylist.
- The ***female mosquitoes*** are also fluid feeders because it suck blood from the skin capillaries by piercing the skin with the help of tubular mouth parts.

MACROPHAGOUS FEEDERS

The animals, which take in food in the form of large pieces, are called macrophagous feeders.

Type

Tentacular, scraping and seizing prey are the common methods of macrophagous feeding.

Examples

- ***Tentacular*** feeding occurs in hydra.
- ***Scraping*** type of feeding occurs in the garden snail (*Helix*). It feeds by using rasping organ, the radula. Leaves are held by the lips of the snail. The radula moves back and forth over the leaves with its teeth scraping the food.
- ***Seizing*** and ***swallowing*** type of macrophagous feeding is found in spotted dogfish.

PARASITIC NUTRITION

A ***parasite*** is an organism that lives upon or within another organism, called the host, for obtaining its food.

Types

Parasites can be classified according to two different ways.

- According to location into Ectoparasite and Endoparasite.
- According to extent into obligate and facultative parasites.

Ectoparasite

The parasites, which live upon the surface of host, are called ectoparasites

Examples

- ***Flea and lice*** are ectoparasites that live in the fur or feathers of mammals and birds and suck blood from their skin.
- ***Ticks and mites*** are common parasites in non-human mammals.
- In plants, ***aphid*** is a parasite that sucks food from leaves or stems.
- ***Leech*** is another common example of ectoparasite attacking both aquatic and terrestrial animals.

Endoparasite

The parasites, which live within the host are called Endoparasite.

Examples

Endoparasites occur in both aquatic and terrestrial animals. These are most common in intestine of vertebrate host, including man, where they absorb hosts digested food.

Entamoeba histolytica, tape worm and round worms are common examples of endoparasites.

Obligate Parasite

The parasites, which totally depend on their host for their food are called obligate parasites.

Facultative Parasites

The parasites, which are capable of living independently of their host at times are called facultative parasites.

In certain cases the host may be weakened by the presence of parasite or its metabolism may be upset by the excretory product of parasite.

QUESTION RELATED TO ABOVE ARTICLE

Explain the various method of nutrition in animals.

How does the digestive tract of herbivores differ from that of carnivores?

Explain different processes involved in digestion and absorption in animals. (GRW 2017)

What are heterotrophs? Give methods of animal nutrition. (SWL 2019)

Differentiate between carnivores and omnivores. (RWP 2019)

What are advantages and disadvantages of the parasitic mode of life compared with that of a free living organism? (Exercise Question iv)

How do the digestive tract of herbivores differ from that of carnivores? (Exercise Question x)

12.3 DIGESTION AND ABSORPTION

- All animals have similar requirements, although these requirements differ in detail. Animals must have the supply of water, oxygen, simple sugars, amino acids, fatty acids, vitamins and many other inorganic and organic substances. These substances, except oxygen and water, are rare in the natural environment and are not directly available to the organisms.
- In nature these substances are available in the form of proteins, starches, fats, vitamins and minerals.
- As such these molecules are of no use unless they are broken down or digested into simple molecules such as amino acids, sugars and fatty acids so that they may pass through the cell membrane and be used by the body.

Processes of Holozoic Nutrition

The characteristic processes involved in holozoic nutrition are defined as:

a) Ingestion

Taking in of food is called ingestion.

b) Digestion

Breakdown of complex organic compounds of food into simpler diffusible molecules by the action of enzymes is called digestion.

Digestion may be intracellular or extracellular.

- Digestion of food inside the cell is called ***intracellular digestion***.
- Digestion of food outside the cell i.e. in cavity or lumen is called ***extracellular digestion***.

c) Absorption

It is the uptake of diffusible food molecules from the digestive region across the membrane into the cell or into the blood stream.

d) Assimilation

It is the utilization of the products of digestion for production of energy or synthesis of cellular material.

e) Egestion

It is the elimination of undigested matter from the body.

QUESTION RELATED TO ABOVE ARTICLE

Discuss characteristic processes involved in holozoic nutrition (DGK 2021)

What is holozoic nutrition? Describe the characteristic processes involved in holozoic nutrition giving the example of amoeba. (Exercise Question vi)

12.3.1 Digestion in Amoeba

- *Amoeba proteus* has intracellular mode of digestion and feeds on many kinds of tiny organisms which live with it in freshwater ponds and shallow lakes.
- Amoeba also feed son particulate organic matter. Food may be ingested at any points on the surface of the body.
- When Amoeba comes in contact with food particle, it immediately puts out pseudopodia around it.
- These pseudopodia fuse together around the food particle forming the food vacuole.
- If the food particle is too big, such as Paramecium, Amoeba encircles it, thus forming a large food vacuole.
- The food vacuole undergoes many changes as digestion proceeds.
- First it grows smaller, then larger and again smaller. Lysosomes, which contain hydrolytic enzymes, fuse with the food vacuole and enzymes are secreted into it.

- The first phase of digestion is killing and softening of food that take place in the acidic medium (approximately pH 5.6) and later it becomes alkaline (about pH 7.3) during which digestion is completed.
- Then digestion is complete, in food vacuole membrane is drawn in to numerous fine canals.
- The products of digestion are passed into the canals and finally into the surrounding cytoplasm and subsequently utilized in various metabolic reactions of the animal Undigested matter is voided from the organism in the surrounding water by egestion at any point of its surface.

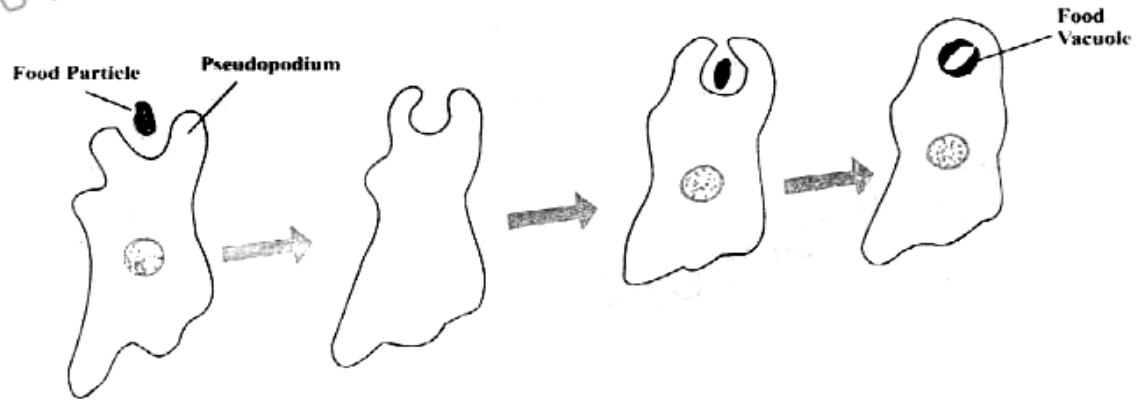


Fig. 12.7 Amoeba ingesting food by pseudopodia

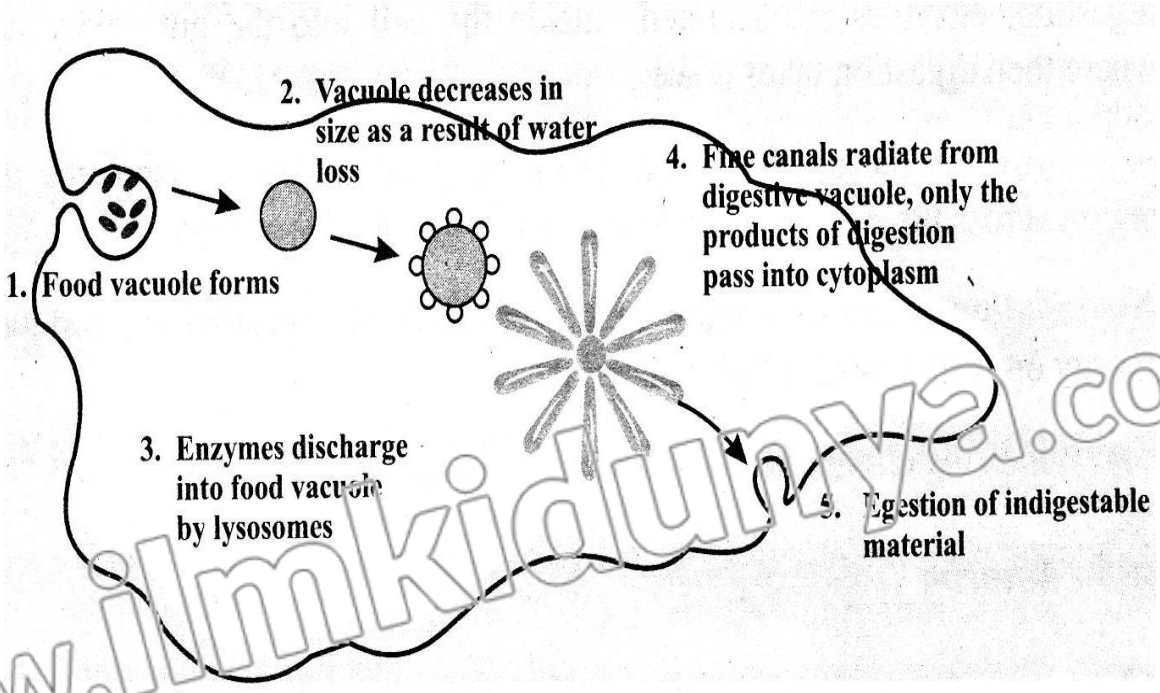


Fig. 12.8 Ingestion, digestion and absorption in Amoeba

QUESTION RELATED TO ABOVE ARTICLE

Explain the process of digestion in amoeba.

Explain digestion in amoeba. **(LHR 2018, BWP 2019, FSD 2019)**

12.3.2 Digestion in Hydra

Introduction

Hydra is an aquatic, diploblastic coelenterate.

Mode and Structures for Digestion

- It has ***vase-like body*** composed of ***two principal layers*** of cell.
- ***Some*** of the digestion in hydra is ***extracellular*** but ***most*** of the digestion is ***intracellular***.
- The central cavity of the body functions as a digestive cavity.
- The animal has only one opening to the outside called ***mouth***, which is surrounded by mobile ***tentacles***. This digestive cavity is also called gastrovascular cavity or ***coelenteron***.
- Its digestive system is called ***sac-like*** (having single opening for ingestion and egestion).
- Numerous stinging cells called ***nematocysts*** are present on tentacles. Each nematocyst consists of a hollow thread coiled within a capsule and a tiny hair-like trigger projecting outside.

Food of Hydra

Hydra mainly feeds on crustaceans such as *Daphnia* or *Cyclops*.

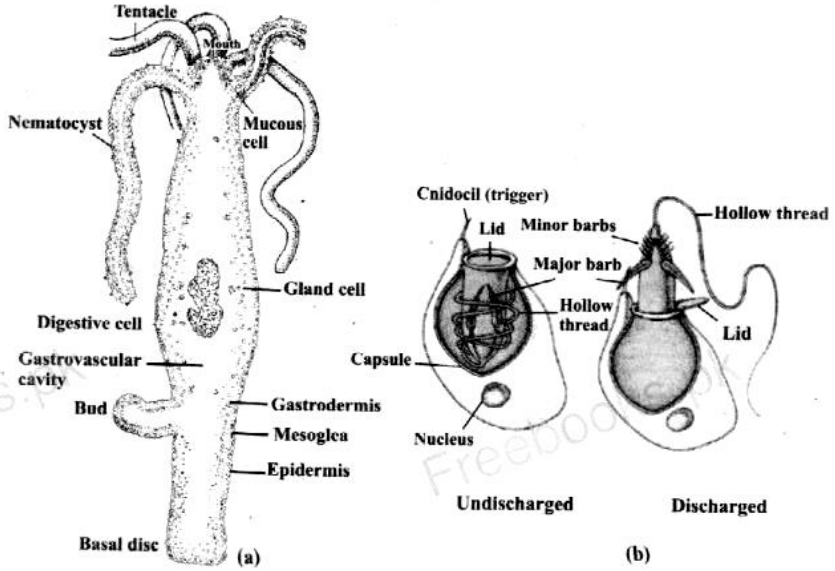


Fig 12.9. Hydra: (a) Longitudinal section showing the detail of wall and the gastro vascular cavity
(b) Nematocysts (discharged and un-discharged)

Mechanism of Digestion

Ingestion

When a prey comes in contact with trigger, the hollow thread of the nematocyst turns inside out ejects poison and prey is paralyzed or sometimes killed.

Hydra then grasps its prey with its tentacles and pushes it into the digestive cavity through open mouth.

Digestion

- The glandular cells in the gastrodermis secret enzymes, which start extracellular digestion.
- Gastrodermal flagellated cells and contraction of body cavity help in mixing food with enzymes and breaking it up into fine particles.
- These fine particles are then engulfed by phagocytic action of gastrodermal cells where digestion is completed intracellularly in the digestive vacuoles.

Absorption and Assimilation

Digested food is absorbed and utilized in the cells. Ectodermal cells depend on endodermal cells for their food.

Egestion

Indigestible food is expelled out from the gastrovascular cavity through open mouth.

QUESTION RELATED TO ABOVE ARTICLE

Describe digestion in hydra. (LHR 2017)

Describe ingestion, digestion absorption and egestion in hydra.
(SGD 2019, FSD 2021)

12.3.3 Digestion in Planaria

Introduction

Planaria is free-living, flatworm found in freshwater streams and ponds.

Mode and Structures for Digestion

In planaria, there are both intracellular and extracellular digestions.

- Digestive system is ***sac-like*** with single opening i.e. mouth located on the ventral surface near the middle of the animal.
- The mouth opens into a muscular tubular ***pharynx***, which leads into the intestine.
- ***Intestine*** then immediately divides into three branches i.e. an anterior one, extending forward and two lateral branches.
- Each of these main branches gives off numerous small branches, which end blindly called ***caeca***.

Mechanism of Digestion

Ingestion

Planaria engulfs the prey by protruding eversible pharynx through the mouth and pushes it into the gastrovascular cavity.

Digestion

Food is digested into the intestine. Enzymes are secreted by the gland cells of the intestine and continue the process of extracellular digestion. Small particles of food are finally engulfed by phagocytic vacuole. Digestion is completed intracellularly.

Transportation

Products of digestion pass to the rest of the body by the process of diffusion. Branched intestine also facilitates diffusion of materials to body cells.

Egestion

Undigested food is egested through the mouth.

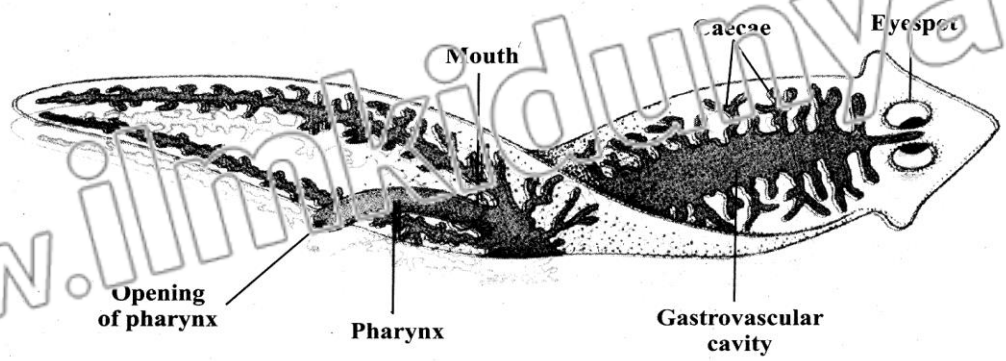


Fig. 12.10. Planaria showing much branched gastrovascular cavity and extruded pharynx.

QUESTION RELATED TO ABOVE ARTICLE

How the digestion is take place in planaria and explain it.

12.3.4 Digestion in Cockroach

Digestive System and Mechanism of Digestion

The digestive system of cockroach is of tubular type.
It can be divided into three parts.

- Foregut
- Mid gut
- Hindgut

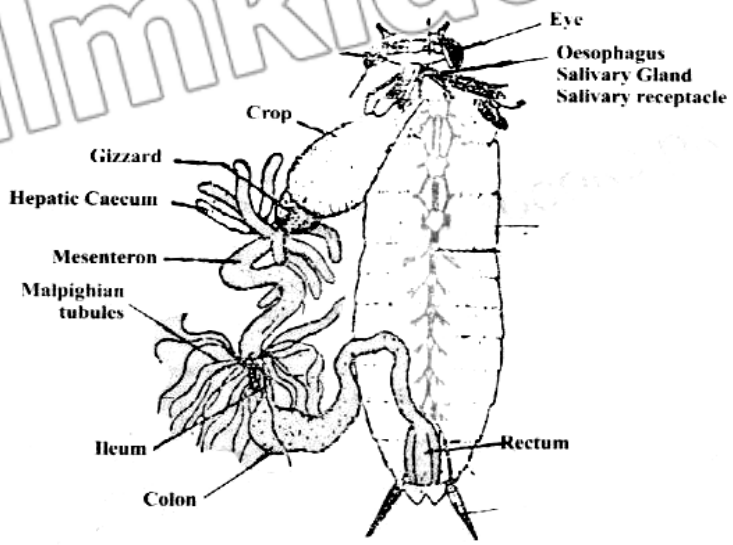


Fig 12.11. Cockroach digestive system

Foregut

The foregut includes mouth cavity, pharynx, crop and gizzard.

- A ***pair of salivary glands*** are present in the thorax region of the animal. They secrete saliva, which is poured into the mouth cavity.
- ***Mandibles*** of mouth cut food into small pieces.
- Saliva hydrolyzes the starchy matter contained in food.
- ***Crop*** stores partly digested food. Food leaves the crop chunk by chunk and enters in gizzard.
- ***Gizzard*** causes grinding of food and food is transported to midgut.

Midgut

The midgut is a short narrow tube called ***stomach***. Short finger-like hollow tubes, the ***hepatic caecae*** open into the anterior end of the midgut.
The enzymatic secretions of hepatic caecae and midgut digest the food completely.

Hindgut

The hindgut is a long coiled tube, the terminal part of which is a thick walled chamber, the ***rectum***, which opens to the exterior through anus.
The indigestible food after temporary storage in the rectum as fecal matter is then egested out through anus.
The digestive system of cockroach is of tubular type having mouth for ingestion and anus or cloacal aperture for egestion.
It is more efficient than sac-like digestive system having specialized organs or partitions for efficient digestion and absorption of food.

QUESTION RELATED TO ABOVE ARTICLE

Describe the digestion in cockroach.
Explain the process of digestion in cockroach. (RWP 2021)
Make a labelled diagram of the alimentary canal and digestive glands in cockroach. What are the functions of the gland you sketch? (Exercise Question viii)

12.4 Digestion in Man

The digestive system of man consists of a long coiled tube that extends from the mouth of the anus. The main parts in the direction of passage of food, are the oral or buccal cavity,

- Esophagus,
- Stomach,
- Small intestine (duodenum, jejunum and ileum)
- Large intestine (ascending colon, transverse colon, descending colon, caecum and rectum).
- Associated with the various regions are the glands, especially salivary glands, liver and pancreas.

There are three sites of digestion in the digestive system of man-oral cavity, stomach and small intestine.

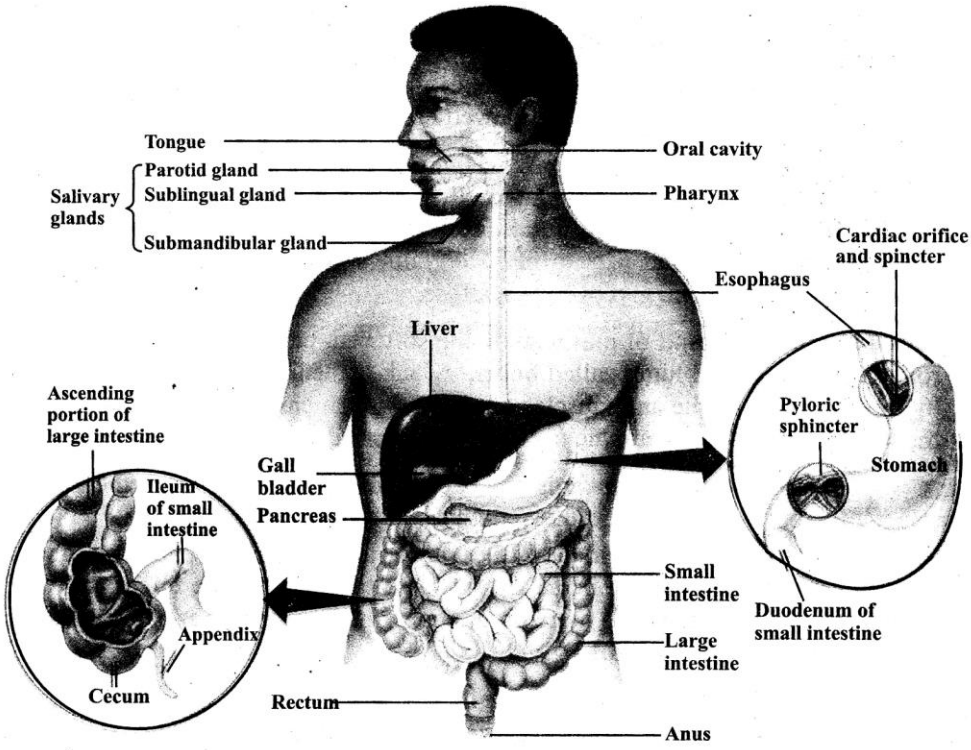


Fig 12.12. The digestive system of man.

12.4.1 Digestion in oral Cavity

There are several functions of the oral cavity, the most obvious being the;

(a) Selection of food
(b) Grinding or mastication
(c) Lubrication and
(d) Digestion

Selection of food.

When food enters the oral cavity (the cavity bounded by palate, tongue, teeth and cheeks), it is tasted, smelled and felt.

- If the taste or smell is unpleasant or if hard objects like bone or dirt are present in the food, it is rejected.
- Oral cavity is aided in selection by the senses of smell, taste and sight.
- Tongue being ***sensory*** and ***muscular organ*** plays the most important role in selection of food through its taste buds.

Grinding or Mastication

After selection, food is ground by means of ***molar teeth*** into smaller pieces.

This process is useful due to following reasons:

i) The esophagus allows relatively small pieces to pass through.

ii) Small pieces have much more surface for the enzyme to attack.

Lubrication and Digestion of Food

These are the main functions of oral cavity accomplished by saliva.

Saliva

Saliva is secreted by three pairs of salivary glands namely **sublingual glands** situated below the tongue; **sub maxillary glands** behind the jaws and **parotid glands** in front of the ears.

Composition of Saliva

Saliva contains three important ingredients.

i) Water and mucous

ii) Sodium bicarbonate and some other salts

iii) Amylase or ptyalin

i) Water and Mucous

Water and mucous together make a slimy liquid, which serves to moisten and lubricate the food so that it can be chewed efficiently and passed through the oesophagus smoothly.

ii) Sodium Bicarbonate and Other Salts

Sodium bicarbonate and some other salts perform following functions:

- They are slightly ***antiseptic***.
- They ***stabilize pH*** of food in buccal cavity
- Fresh saliva is alkaline with a ***pH nearly 8***, quickly loses carbon dioxide and gets to pH 6.

iii) Ptyalin

Ptyalin or ***salivary amylase*** is a carbohydrate-digesting enzyme. It digests starch and glycogen to maltose.

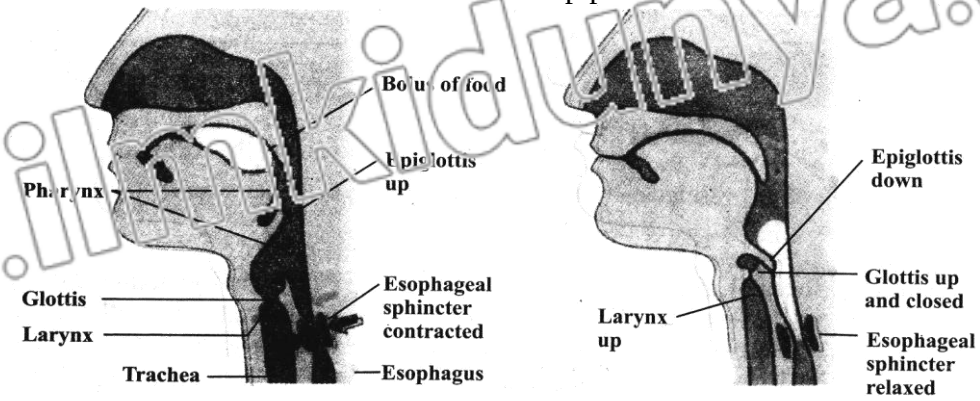
Bolus

As a result of mastication and digestion in oral cavity, the softened, partly digested, slimy food mass is rolled into small oval lump called ***bolus***.

Swallowing

Transfer of bolus from buccal cavity to oesophagus is called swallowing.

It is usually pushed back of the mouth by the action of tongue and muscles of pharynx, which ensure that the food does not enter the windpipe.



Swallowing in man

Fig. 12.13 swallowing in man

Events of Swallowing

Following are the events, which occur during swallowing.

i. Tongue moves upwards and backwards against the roof of the mouth, forcing the bolus to the back of the mouth cavity.

ii. Backward movement of tongue pushes the soft palate up and closes the nasal opening at the back. At the same time tongue pushes the soft palate up and closes the epiglottis (flap of cartilage) into more or less horizontal position thus closing the opening of the windpipe (glottis)

iii. Larynx moves upward under the back of the tongue.

iv. Glottis is partly closed by the contraction of a ring of muscle.

v Food does not enter the partly open glottis, because the epiglottis diverts the food mass to one side of the opening and safely down the esophagus. The beginning of swallowing action is voluntary, but once the food reaches the back of the mouth, swallowing becomes automatic. The food is then forced down the esophagus by peristalsis.

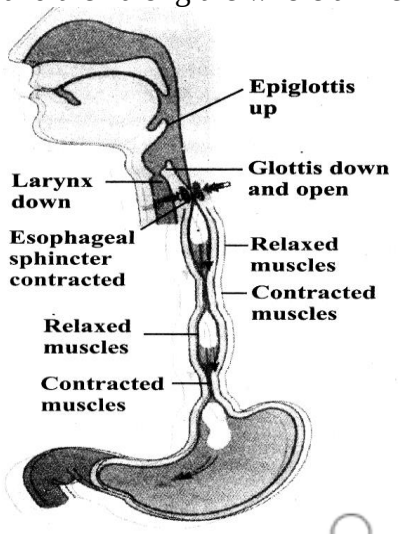
Peristalsis

These are characteristic movements of the digestive tract by which food is moved along the cavity of the canal.

Mechanism

Peristalsis mainly consists of the wave of contraction of the circular and longitudinal muscles preceded by the wave of relaxation thus squeezing the food down the canal.

It starts just behind the mass of food from the buccal cavity along the esophagus to the stomach and then along the whole alimentary canal.



Gravity assist the movement of material through the esophagus, especially when liquids are swallowed. However, the peristaltic contractions that move material through the esophagus are sufficiently forceful to allow a person to swallow, even while dong a headstand.

Fig. 12.14 Different stages of peristaltic movement in the esophagus.

Antiperistalsis

Sometimes peristaltic movements are reversed due to which food is passed from the intestine back into the stomach and even in mouth. This movement is called antiperistalsis.

It may lead to vomiting.

Hunger Pangs

Hunger contractions are peristaltic contractions, which are increased by ***low blood glucose*** levels and are sufficiently strong to create an uncomfortable sensation often called a 'hunger pang'.

Hunger pangs usually beginning ***12 to 24 hours*** after the previous meat or in less time in some people.

12.4.2 Digestion in stomach

It is an elastic muscular bag that stores food form meals for some time, making ***discontinuous feeding*** possible. It also ***partly digests the food.***

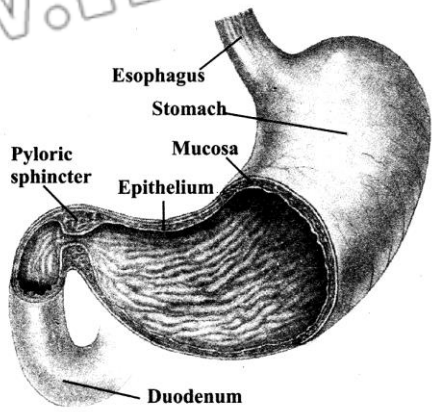
Location of stomach

The stomach is situated below the diaphragm on the left side of the abdominal cavity.

Cardiac sphincter

At the junction between esophagus and the stomach there is a special ring of muscles called cardiac sphincter.

When the sphincter muscles contract, the entrance to the stomach closes and thus prevents the contents of the stomach from moving back into the esophagus. It opens when a wave of peristasis coming down the esophagus reaches it.



Heart burn, or Pyrosis is a painful burning sensation in the chest usually associated with the back flush of acidic chime into the esophagus. This is due to overeating, eating fatty food, lying down immediately after a meal, consuming too much alcohol, caffeine or smoking.

Fig. 12.15 (a) Sagittal section of human stomach showing internal ridges and sphincters

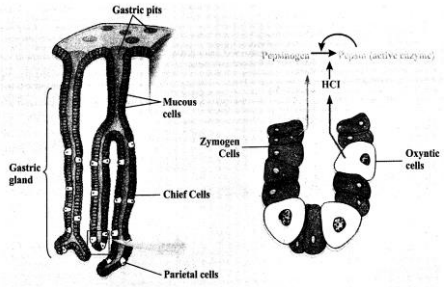


Fig 12.15. (b) Section through stomach wall (c) Detail of gastric gland in the stomach wall

Wall of Stomach

The stomach wall is composed of three principle layers:

(i) An ***outer layer of connective tissue***.

(ii) A ***middle layer of smooth muscles***. This layer consists of outer longitudinal and inner circular muscles.

(iii) An *inner layer (mucosa)* of connective tissue with many glands.

These muscular layers help in churning and mixing the food with the stomach secretions.

Gastric glands

The mucosa of the stomach possesses numerous tubular gastric glands, which are composed of three kinds of cells:

(a) ***Mucous cells*** that secrete mucous.

(b) ***Parietal or oxyntic cells*** that secrete HCl.

(c) Zymogen cells or chief cells **that secrete pepsinogen.**

The secretion of all these cells is collectively called gastric juice. The secretion of the gastric juice is regulated by smell, sight and quality of food

If more protein is present in the food it stimulates the production of gastrin hormone form the gastric endocrine lining, which is carried by blood to the gastric glands and stimulates them to produce more gastric juice. Thus more proteins more gastrin and more gastric juice for digestion.

Mucous

Mucous is thick secretion that covers the inside of the stomach. It prevents the underlying walls from being digested.

Hydrochloric Acid

It is secreted in concentrated form.

- It adjusts the ***pH*** of stomach contents ranging from ***2-3***.
- It provides ***acidic medium*** for the action of pepsin.
- It often ***softens*** the ***food*** and ***kills*** many ***microorganisms***.
- It converts inactive ***pepsinogen into active pepsin***.

Pepsin

It is an enzyme secreted in an inactive form called pepsinogen. Pepsinogen is activated to pepsin when exposed to the acidic medium or to some already activated pepsin.

Pepsin *hydrolyzes proteins* to yield peptones and polypeptides.

Chyme

The muscles of stomach wall thoroughly mix up the food with gastric juice and eventually convert it to semi-solid mass called **chyme.**

Pyloric sphincter

Gradually the stomach empties into the duodenum through the relaxed **pyloric sphincter**.

QUESTION RELATED TO ABOVE ARTICLE

Write note on digestion in stomach of man. (GRW 2018)

Why is digestion necessary? Describe what happens to a meal containing fats, carbohydrates and proteins while it is in the stomach of man. (Exercise Question v)

How do (a) the saliva (b) the pancreas (c) the liver help in the digestion of the food of man? (Exercise Question vii)

Describe the structure and functions of human stomach. (Exercise Question ix)

What prevents the wall of stomach from being digested? (Exercise Question xi)

How gastric juice production is regulated? (Exercise Question xv)

12.4.3 Digestion in small intestine

Small intestine in man consists of **duodenum**, **jejunum** and **ileum.**

Role of duodenum

Duodenum is first part of small intestine and is about ***20-25 cm long***. It further leads to jejunum and ileum.

When chyme passes from stomach into duodenum, its acidity stimulates the release of secretions from pancreas, liver and duodenal cells.

Control of Hepatic and Pancreatic Secretions

Hepatic and pancreatic secretions are also stimulated by a hormone called secretin, which is produced by the intestinal mucosa on the entry of acidic food form stomach. The acidity stimulates secretin production in duodenum and secretin is carried by blood to pancreas which is stimulated to produce pancreatic juice. Secretin also inhibits gastric secretion.

12.4.3 (a) Pancreas

Pancreas is a large gland whose exocrine tissue secretes a juice that flows through pancreatic duct into the duodenum.

Components of Pancreatic Juice

Pancreatic juice contains enzymes for the digestion of all principal components of food i.e. carbohydrates, fats and proteins.

Amylase

Amylase also called ***amylopsin*** is ***carbohydrate-digesting*** enzyme and digests starch into maltose.

Lipase

Lipase is ***fat digesting*** enzyme and hydrolyzes a small percentage of fats into fatty acids and glycerol.

Trypsin

Trypsin is ***protein-digesting*** enzyme. It is secreted in an inactive form called trypsinogen, which is activated by ***enterokinase*** (an enzyme secreted by the lining of the duodenum). Trypsin splits proteins into peptones and polypeptides.

Sodium Bicarbonate

It partly ***neutralizes*** the chyme coming from stomach. This is necessary because enzymes of the pancreas do not work well in acid conditions.

12.4.3 (b) LIVER

Liver secretes bile, which is stored in gall bladder and then transported to duodenum by bile duct.

Secretion

- ***Bile*** is green, watery fluid. It contains no enzyme but its green colour is due to bile pigments, which are formed from the breakdown of hemoglobin in the liver.
- It also contains bile salts, which act on fats and emulsify them. They break down fats into small globules, which are then easily digested by water-soluble lipase.

Functions of Liver

- It produces *bile*, which is involved in digestion.
- Liver converts toxic substance ammonia, which is a waste product of amino acid metabolism to less toxic compound, ***urea***, which is then excreted by kidneys.
- It is also involved in ***breakdown of dead and worn out RBCs***.

Problems related to Liver

Jaundice

If bile pigments are prevented from leaving digestive tract, they may accumulate in blood, causing a condition known as jaundice.

Gall Stones

Cholesterol, secreted by the liver, may precipitate in the gall bladder to produce gallstone, which may block release of bile.

The liver is easily ruptured because it is large, fixed in position, and fragile or it may lacerate by a broken rib. Liver rupture or laceration may result in severe internal bleeding. The liver may become enlarged as a result of heart malfunctioning, hepatic cancer or may be damaged due to hepatitis or being alcoholic.

12.4.3 (c) Jejunum

Jejunum is the second while ileum is the third part of small intestine.

- ***Jejunum*** is about ***2.4 meter*** in length comprising about ***2/5th of the small intestine***. It starts from duodenum and ends at ileum.
- ***Ileum*** constitutes about ***3/5th of small intestine***. It starts after jejunum and ends at large intestine.

Enzymes

The food, which escapes undigested from the duodenum, is completely digested in the jejunum and ileum by a group of enzymes contained in the intestinal juice. The overall picture of enzymes in the human digestive system their substrates and final products is as follows:

ENZYME	SUBSTRATES	PRODUCTS
Amino peptidase	Polypeptides	Dipeptides
Erypsin	Dipeptides	Amino acids
Lipase	Fats	Fatty acids and glycerol
Maltase	Maltose	Glucose
Lactase	Lactose	Glucose and galactose

Many humans develop intestinal gas and diarrhoea from consuming milk products, because they lack the enzymes for digesting lactose in milk.

12.4.4 Absorption of food

The small intestine consists of duodenum, jejunum and ileum.

Nearly all the absorption of digested products takes place in the ileum.

Villi

The internal surface of ileum has many folds, which exhibit velvety appearance due to presence of numerous finger like projections called villi.

Structure of a Villus

Each villus has;

i) An outer covering of ***epithelial cells***

ii) ***Blood capillaries***

iii) Lymph vessels called ***lacteal***

Electron microscope view of epithelial cells reveals that they have countless closely packed cylindrical processes called ***micro villi***.

- The total area of absorption becomes incredibly large due to the enfolding, villi and micro villi.

Many humans develop intestinal gas and diarrhoea form consuming milk product, because they lack the enzymes for digesting lactose in milk.

The epithelial cells of villi are constantly shed into intestine. These cells are replaced by the new cells moving up due to rapid cell division in crypts

Function of villi.

- Simple Sugars and amino acids are absorbed by ***diffusion*** or ***active transport*** into the blood capillaries through the micro villi.
- Some of the fatty acids and glycerol are also absorbed into blood stream. However, a large proportion of fatty acids and glycerol enter the epithelial cells of villi, where they recombine into fats. These fats then enter the lacteals.
- Proteins present in lymph vessels combine with fat molecules to form lipoprotein droplets. These pass into blood stream via thoracic lymphatic duct.
- The lipo-proteins are subsequently hydrolysed by blood plasma enzyme and enter body cells, where they may be used in respiration or stored as fat in the liver, muscle of under the skin.
- The intestinal contents are pushed along the alimentary canal by normal peristaltic activity. At the end of ileum, there is an **ileocolic sphincter** that opens and closes time to time to allow a small amount of residue form the ileum to enter the large intestine.

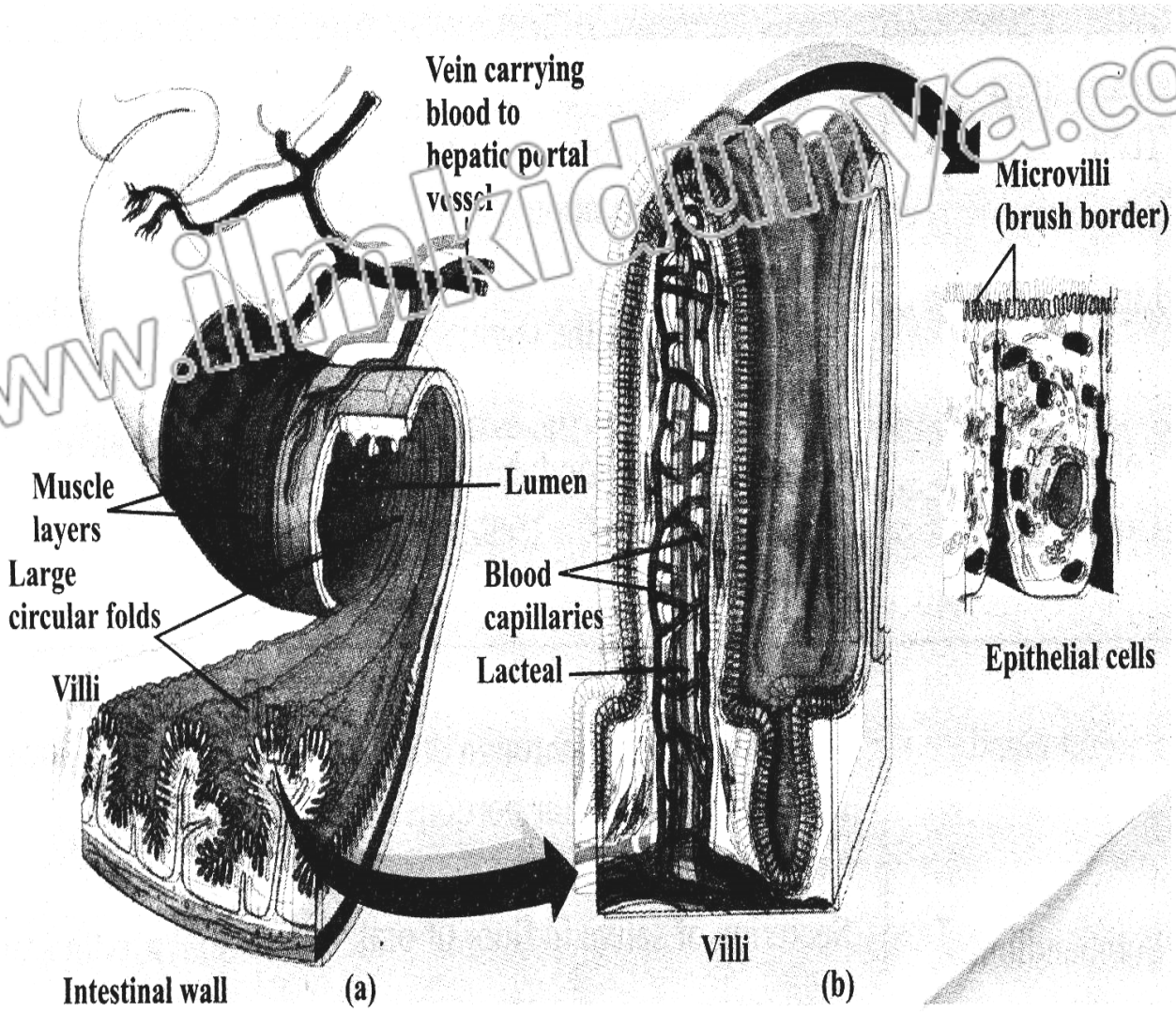


Fig12.17. (a) Part of wall of small intestine showing glands and villi.
(b) Detail of villus structure.

QUESTION RELATED TO ABOVE ARTICLE

Discuss digestion and absorption in small intestine. **(LHR 2018)**

Describe events that occur during the process of swallowing **(MTN 2019)**

How absorption of food takes place in small intestine? **(GRW 2021)**

Write down food absorption in small intestine of man. **(GRW 2021)**

Discuss the absorption of food in small intestine. **(LHR 2019, DGK 2021)**

Write a note on digestion in oral cavity in man **(RWP 2021)**

What specialized features of your small intestine account for the efficient absorption of digested foodstuffs? **(Exercise Question xii)**

What are the contribution to digestion of the liver and pancrease? **(Exercise Question xiii)**

12.4.5 Large intestine

It is last part of alimentary canal.

Structure

The large intestine is composed of three parts:

- Caecum
- Colon
- Rectum

Caecum

It is a blind sac that projects from ileum and continues upto colon. From the blind end of caecum, there arises finger-like process called ***appendix***. The appendix sometimes gets inflamed due to entrapping and then putrification of food causing ***appendicitis***. Appendix is surgically removed due to appendicitis.

Function of large intestine

- The material that passes form the small intestine to the large intestine contain a large amount of water, dissolved salts and undigested material. Water and salts are absorbed into blood, while undigested material is rejected as feces.
- The fecal matter contains a large number of bacteria, plant fibers, and sloughs off mucosal cells, mucus, cholesterol, bile pigments and water.
- Large intestine also harbors a large population of useful bacteria that synthesize some vitamins especially ***vitamin K,*** which are absorbed in blood.
- If the absorption of water and salts does not take place due to infection, drug action or emotional disturbance, a condition known as ***diarrhoea*** occurs.
- If this condition is unchecked, dehydration develops that may prove to be fatal. The other extreme condition is ***constipation***, which is caused by the excessive absorption of water.

12.4.6 Rectum

Rectum is the last part of large intestine, where feces are temporarily stored and rejected through anus, at intervals.

- Anus is surrounded by two sphincters, the ***internal is of smooth*** and ***outer of striped muscles.***
- Under normal conditions, as the rectum is filled up with feces, it gives rise to defection reflex.
- This reflex can be consciously inhibited in individuals other than infants. Gradually the child learns to bring this reflex under control.

Organ	Function	Secretion
Oral Cavity		
Teeth	Mastication(cutting and grinding of food); communication,	None
Lips and cheeks	Manipulation of food; hold food in position between the teeth, communication.	Saliva from buccal Glands (mucus only).
Tongue	Manipulation of food; holds food in position between the teeth; cleansing teeth; taste.	Some mucus; small amount of serous fluid.
Salivary Glands		
Parotid gland	Secretion of saliva through ducts to Superior and posterior portions of oral cavity.	Saliva with amylase
Submandibular gland	Secretion of saliva in floor of oral cavity.	Saliva, with amylase mucus
Sublingual glands	Secretion of saliva in floor of oral cavity.	Saliva mucus only.
Pharynx	Swollowing	Some mucus
Esophagus	Movement of food by peristalsis from pharynx to stomach	Mucus
Stomach	Mechanical mixing of food; enzymatic digestion; storage; absorption.	
Mucous cells	Protection of stomach wall by mucus production	Mucus
Parietal cells	Decrease in stomach pH.	Hydrochloric acid.
Zymogen cells	Protein digestion.	Pepsinogen
Endocrine cells	Regulation of secretion and motility.	Gastrin
Accessory Glands		
Liver	Secretion of bile into duodenum	Bile
Gallbladder	Bile storage; absorbs water and electrolytes to concentrate bile.	No secretions of its own, stores and concentrates bile.
Pancreas	Secretion of several digestive enzymes and bicarbonate ions into duodenum.	Trypsin, chymotrypsin, pancreatic amylase, pancreatic lipase, bicarbonate ions.
Small Intestine		
Duodenal glands	Protection	Mucus
Goblet cells	Protection	Mucus
Absorptive cells	Secretion of digestive enzymes and absorption of digested materials.	Enterokinase, amylase, peptidases, sucrase, maltase, lactase, lipase.
Endocrine cells	Regulation of secretion and motility.	Gastrin, secretin,
Large intestine	Absorption, storage, and food movement,	Mucus
Goblet cells	Protection	

QUESTION RELATED TO ABOVE ARTICLE

Discuss process of absorption in large intestine. (LHR 2019)
Describe structure and function of large intestine of man. (LHR 2021, MTN 2021)
Describe functions of large intestine. (MUN 2021)
Give the role of large intestine in digestion of Man. (BWP 2021)

12.5 SOME COMMON DISEASES RELATED TO NUTRITION

12.5.1 Dyspepsia

Definition

Incomplete or imperfect digestion is called dyspepsia.
This is not a disease in itself but symptomatic of other disorders or diseases.

Symptoms

This is characterized by;

- Abdominal Discomfort
- Flatulence
- Heartburn
- Nausea
- Vomiting

These symptoms may occur irregularly and in different pattern from time to time.

Causes

Dyspepsia may occur due to;

- ***Acidity*** in stomach
- ***Faulty function*** of stomach and intestine
- ***Insufficient*** quality or quantity of ***bile secretions***

12.5.2 Food poisoning

Definition

It is an illness from indigestion of food containing toxic substances.

Symptoms

The symptoms of food poisoning are

- Diarrhea
- Vomiting
- Abdominal pain

These symptoms usually occur from 12-24 hours after eating contaminated food.

Causes

One of the commonest causes of food poisoning are the toxins produced by bacteria, ***Salmonella*** and ***Campylobacter***.

These bacteria live in the intestines of cattle, chicken and duck without causing symptoms there. If humans drink milk or eat meat or egg of such infected animals, they develop food poisoning.

Infection is most likely if ***unpasteurized milk*** is drunk or if meat is not properly cooked.

Treatment

The liquid that escapes during defrosting frozen meat contains Salmonella bacteria. The dishes and utensils while the meat is defrosting, must not be allowed to come in contact with any other food.

Botulism

A severe form of food poisoning is called botulism. It is caused by toxins of ***Clostridium botulinum***. These toxins have selective action on central nervous system causing fatigue, dizziness, double vision, headache, nausea, vomiting, diarrhoea and abdominal pain.
It usually develops from improperly canned or otherwise preserved foods.

12.5.3 Obesity

Definition

It is the term employed when a person has abnormal amount of fat on the body and a person with this condition is called obese.

Causes

It is mainly due to overeating and eating fatty food.

Hormonal causes may also considered to be involved. Best example is that some people eat very less fat but become fatty. On the other hand, some eat too much fat but do not become fatty.

Mechanism

Certain cells accumulate fat drops in cytoplasm. As these drops increase in size and number, they join together to form one large fat globule in the middle of the cell, pushing cytoplasm into thin layer and nucleus to one side. Groups of fat cells join to form ***adipose tissue***.

Adipose tissue usually develops in the abdomen around the kidneys and under the skin.

Complications

An obese person is much more likely to suffer from;

- High blood pressure
- Heart diseases
- Diabetes mellitus
- Stomach disorders

Control

Obesity can be controlled by reducing fatty food, by eating balanced food. In case of hormonal disturbance, hormonal therapy can be used.

12.5.4 Anorexia Nervosa

Definition

This term is employed to the ***loss of appetite*** due to the fear of becoming obese.

Such feelings develop in human females between the ages of ***12-21 years.***

Causes

It usually affects girls after onset of puberty. It is characterized by loss of appetite due to fear of becoming obese. Such girls are often immature and are unable to cope with the challenges of puberty and emerging sexuality.

Treatment

- ***Psychiatric therapy*** is required to treat anorexic girls.
- Patient is often ***fed through any route*** other than alimentary canal which may be intramuscularly or intravenously.
- Recovery is very slow and it may take 2-4 years and in some cases longer.

12.5.5 Bulmimia Nervosa

Definition

It is ***neurotic disorder*** in slightly older girls. It is characterized by bouts of overeating fattening food such as fried food or cream cakes.

Symptoms

Too much eating is usually followed by;

- Self-induced vomiting
- Fasting
- Purgatives

Complications

The frequent vomiting and purging may cause physical effect including;

- Serum electrolyte imbalance
- Recurring infection

Treatment

Treatment is likely to be prolonged. Initially treatment is to overcome the effects of weight loss and malnutrition. Treatment should be in hospital under strict supervision.

12.5.6 Piles

Definition

Piles or ***hemorrhoids*** are masses of dilated, tortuous veins in the anorectal mucosa.

Symptoms

- Sometimes, these masses start ***bleeding*** during bowel movement.
- Situation may aggravate when the patient suffers from ***constipation***.
- The urge to defecate is depressed and it becomes difficult to expel feces.

Complications

Physical distention of rectum may cause other symptoms of ill health.

Treatment

- The only therapy required is ***improvement of hygiene*** and use of food softeners such as roughage in food or laxatives.
- Patients are advised not to sit on hard seats.
- Hemorrhoids are removed ***surgically*** in some cases.

12.5.6 Ulcer

Definition

Sore produced by eating away of the walls of the stomach or duodenum after break down of mucous layer due to digestive enzymes is called ulcer.

Causes

Excess gastric acid secretion is an important factor of peptic ulcer.

Complications

Sometimes a hole develops in the wall of the digestive tract and the contents of the tract spill into the abdominal cavity, leading to severe infections, which may prove to be fatal, if immediate medical care is not sought.

Care

Smoking, spicy food, alcoholic beverages, coffee, tea and stress should be avoided by the patients suffering from ulcer.

QUESTION RELATED TO ABOVE ARTICLE

Explain the disorders which are related to the digestive system.

Write a note on food poisoning. **(SVL 2019)**

How we can control obesity? **(Exercise Question xiv)**

Key points

Types of Tissues:

Epithelial tissues or epithelium

The tissue in which spaces between the cells are absent and the cells are arranged in compact form. E.g. epithelium of skin, stomach.

Connective Tissue:

In these tissues, the spaces between the cells are present and the cells are not arranged in compact forms. These cells are suspended in a matrix. E.g. blood

Adipose Tissues:

The tissues in which cells are modified to store fats.

Types of Teeth:

There are four types of teeth.

(1) Incisors:

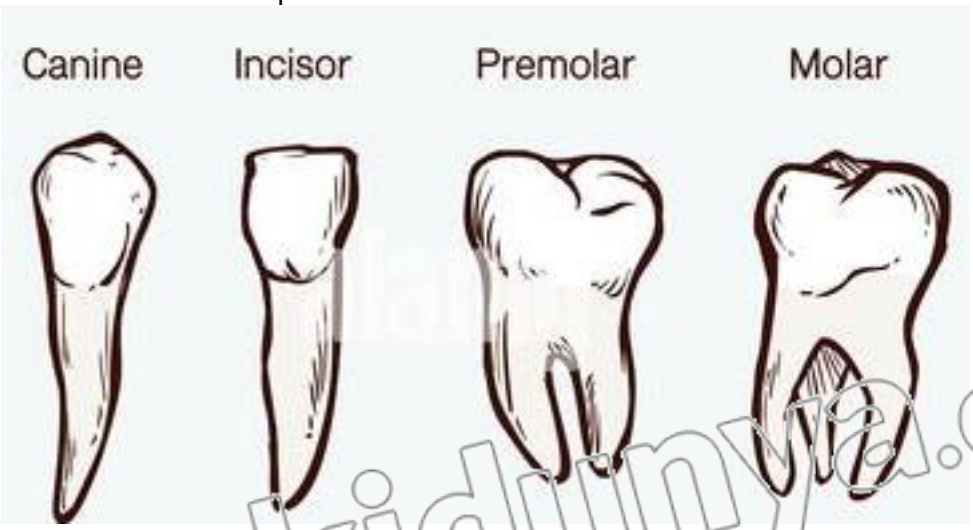
These are chisel shaped teeth. These are present in front of the jaw. These are used for biting or piercing. There are 8 incisors in man, 4 on lower jaw and 4 on upper jaw.

(2) Canines:-

These are sharp teeth. These are present at the side of incisors. These are used for tearing the flesh. There are 4 canines in man, 2 in each jaw

(3) Premolar and molars:

These are collectively called cheek teeth. These teeth have characteristic cusps. These teeth are used for grinding of food. There are not much differences between these teeth. The only difference is in their origin. The molars have no milk teeth. While premolars have milk teeth. There are 8 premolar and 4 molars in man.



Glands:

There are two types of glands.

(1) Endocrine gland:

The glands without any duct are called endocrine glands. These glands transfer their secretions through blood. e.g. thyroid gland.

(2) Exocrine gland:

The glands with duct are called exocrine gland. It transfers its secretion through this duct. e.g. salivary gland, pancreas and liver. Pancreas act as both endocrine and exocrine gland.

EXERCISE

Q.1. Fill in the blanks

i) Plants absorb minerals in their _____ form, as found in the soil _____.

ii) In plants, the most common nutrient deficiencies are of _____, _____ and _____.

iii) A plant requires _____ for holding its cell together.

iv) Most of the organic material in a plant is _____.

v) Chlorosis is usually caused by insufficient _____.

vi) In _____ the trapped insects are decomposed by bacteria.

vii) The structure in the mouth that prevents food from enetering the nasal cavities is the _____.

viii) The stomach functions to _____, _____ and food _____.

ix) _____ is the common example of detritivores.

x) Pancrease produce _____, which stimulates the conversion of glycogen to _____.

xi) Vomiting occurs due to _____ movements.

Ans i) Soluble, Water
ii) Nitrogen, Magnesium, Phosphorus
iii) Water
iv) Carbohydrates or Starch
v) Nitrogen
vi) Pitcher plant
vii) Soft palate
viii) Mix, Digest, Stroage
ix) Earth worm
x) Glucagon, Glucose
xi) Antiperistaltic

Q.2. Encircle the correct answer from the multiple choices.

i) A plant requires nitrogen and sulphur for its:
(a) Cell wall
(b) Enzymes
(c) Starch deposits
(d) DNA replication

ii) A plant requires potassium for:
(a) Synthesizing proteins
(b) Synthesizing chlorophyll
(c) Opening and closing of stomata
(d) All of these

iii) Carnivorous plants live in soil that are deficient in:
(a) Water
(b) Oxygen
(c) Nitrogen
(d) Iron

iv) Most vitamins function as:
(a) Catalyst
(b) High energy compounds
(c) Gastrovascular cavity
(d) Mouth

v) Digestion in hydra and planaria takes place within its:
(a) Coelom
(b) Alimentary canal
(c) Gastrovascular cavity
(d) Mouth

vi) Mucus in saliva is made of:
(a) Glycolipids
(b) Glycoproteins
(c) Phospholipids
(d) Saturated fatty acids

vii) The structure in the mouth that prevent food from entering the nasal cavities is the:
(a) Epiglottis
(b) Soft palate
(c) Tongue
(d) Pharynx

viii) A mammalian herbivore has:
(a) Fewer teeth than carnivores
(b) Flatter teeth than a carnivore
(c) More teeth than a carnivore
(d) More pointed than a carnivore

ix) Many humans become ill from consuming milk and milk products because they lack:
(a) Bacteria in their intestine
(b) Renin
(c) Lactase
(d) Hydrochloric acid

x) Which of the following animals has no need for a gallbladder?

(a) Cat
(b) Man
(c) Lion
(d) Goat

Answers Key:

1	b	6	b
2	c	7	b
3	c	8	b
4	a	9	c
5	c	10	d

Q.3. Short Questions.

i) What is the advantage of a digestive tract as compared with a digestive cavity?

Ans: Digestive tract is comparable to tube like digestive system, which is more beneficial for animals as compared to digestive cavity or sac like digestive systems. Because digestive tract is more adaptive or evolved than that of digestive cavity, and is more advanced in helping ingestion, digestion, absorption, assimilation and egestion.

ii) What are functions of human liver?

Ans: Some important functions related to human liver are as follow;

- Liver act as central metabolic house of human body.
- It produces bile, which is involved in digestion.
- Liver converts toxic substance ammonia, which is a waste product of amino acid metabolism to less toxic compound, urea, which is then excreted by kidneys.
- It is also involved in breakdown of dead and worn-out RBCs.

iii) What measures should be taken to avoid food poisoning?

Ans: Following measures should be taken to avoid food poisoning;

- Food should be properly cooked.
- The dishing utensils should be cleaned properly.
- Keep food away from germ carriers.

iv) Can we get along without large intestine? If not why?

Ans: No we cannot get along without large intestine, because it helps in:

- Absorption of food.
- Storage of food.
- Movement of food.

Q.4. Extensive Questions.

i) Define nutrition. Describe role of different elements in plant nutrition.

Ans: (See article 12.1)

ii) (a) Distinguish between saprophytic and parasitic modes of life. (b) i. name one parasitic plant. Ii. Describe its method of nutrition, explaining why nutrition is not possible.

Ans: (See article 12.2)

iii) What are heterotrophs? Describe different methods of nutrition.

Ans: (See article 12.2)

iv) What are advantages and disadvantages of the parasitic mode of life compared with that of a free-living organism?

Ans: (See article 12.2.5)

v) Why is digestion necessary? Describe what happens to a meal containing fats, carbohydrates and proteins while it is in the stomach of man.

Ans: (See article 12.4.2)

vi) What is holozoic nutrition? Describe the characteristic processes involved in holozoic nutrition giving the example of amoeba.

Ans: (See article 12.3)

vii) How do (a) the saliva (b) the pancrease (c) the liver help in the digestion of the food of man? Draw a diagram of the digestive system to show the position of the pancrease.

Ans: (See article 12.4)

viii) Make a labelled diagram of the alimentary canal and digestive glands in cockroach. What are the functions of the gland you sketch?

Ans: (See article 12.3.4)

ix) Describe the structure and functions of human stomach.

Ans: (See article 12.4.2)

x) How do the digestive tract of herbivores differ from that of carnivores?

Ans: (See article 12.2.5)

xi) What prevents the wall of stomach from being digested?

Ans: (See article 12.4.2)

xii) What specialized features of your small intestine account for the efficient absorption of digested foodstuffs?

Ans: (See article 12.4.4)

xiii) What are the contribution to digestion of the liver and pancrease?

Ans: (See article 12.4.3 &12.4.3 b)

xiv) How we can control obesity?

Ans: (See article 12.5.3)

xv) How gastric juice production is regulated?

Ans: (See article 12.4.2)