

Chapter

12

NUTRITION

Q.1 *What is Nutrition?*

Ans. Definition: “The process of acquiring energy and materials for cell metabolism is known as nutrition”. (OR) “The process of taking of nutrients and assimilating and utilizing them for maintenance of life, growth and repair of cells is called nutrition.”

All living organisms work like machine, so continuous supply of energy is essential for working.

This energy is obtained from nutrients of food etc.

Q.2 *What are nutrients?*

Ans. Nutrients are components of food. These components are carbohydrates, proteins and fats etc. These provide energy. They are used as raw material for the synthesis of protoplasm (cytoplasm + nucleoplasm).

The other nutrients such as water, electrolytes, minerals and vitamins are also essential to metabolic process or metabolism. (making + breaking of molecules).

Q.3 *Describe autotrophic and heterotrophic methods of nutrition.*

Ans. On the basis of nutrition, animals are divided into two categories (classes):

- (i) Autotroph (or) Autotrophic organism
- (ii) Heterotroph (or) Heterotrophic organism

(i) **Autotrophic**

(Auto=self, troph=nourishing)

Autotrophs (or) Autotrophic organisms have ability to produce their organic food (carbohydrates, lipids and proteins) from inorganic molecules (CO₂ and H₂O) Plants are an example of autotrophic organisms. They use CO₂ and H₂O as raw materials. They take their raw material from surroundings or environment.

Definition: “An organism able to build organic compounds from CO_2 , H_2O and inorganic salts is called autotrophic organism.

(ii) **Heterotrophic**

Definition: “The organism incapable to build organic compounds from inorganic compounds which obtains organic molecules from other organisms is called heterotrophic organism”.

Man and other animals, majority of bacteria and fungi are heterotrophic organisms. They depend on plants and other organisms for organic compounds or molecules.

Q.4 (a) Which elements are needed for plants for synthesis of organic molecules?
(b) Which are the main sources of elements for plant nutrition?

Ans. (a) **ELEMENTS NEEDED BY PLANTS**

Elements means primary part of a substance (or) thing. In other words, element is made up of similar atoms which cannot be decomposed.

Plants are autotrophs. Generally autotrophs are photosynthetic organisms. All plants need C, O_2 and H_2 for the synthesis of organic compounds. In this case, these predominant elements (CO_2 and H_2) are taken from inorganic source i.e. CO_2 and H_2O .

There are many other elements which enter in the composition of plants:

- (i) **Nitrogen:** It is an important part of protein.
- (ii) **Phosphorus:** It is present in ATP, Nucleic acids i.e. DNA and RNA and other compounds.
- (iii) **Magnesium:** It is a very important component of chlorophyll.
- (iv) **Iron:**

Cytochromes have iron.

(b) **Source of Nutrients: (SOIL)**

The major source of nutrients is soil. These nutrients are essential for growth and life of plants.

- (i) Crops fail to grow if we grow again and again in the same field without adding the nutrients i.e. fertilizers etc.
- (ii) Farmers use animal manure, sewage sludge or artificial fertilizers for nutrition of plants.

- (iii) Urea, super phosphate and ammonium nitrates like chemical fertilizers are commonly used in Pakistan.

Common deficiency diseases/symptoms:

Deficient Elements	Symptoms
<i>Nitrogen (N)</i>	(i) <u>Stunted growth</u> (ii) Chlorosis in old leaves.
<i>Phosphorus (P)</i>	(i) Stunted growth in roots
<i>Potassium (K)</i>	(i) Margins of premature leaves become Yellow and Brown. (ii) Ultimately death of plant.
<i>Magnesium (Mg)</i>	(i) Chlorosis

Chlorosis: A disease by which plant becomes unhealthy and yellow or of pale colour is appeared by fall of chlorophyll.

Q.5 Describe different methods of feeding in plants.

Ans. **METHODS OF FEEDING IN PLANTS**

The plants generally make their own food material, however some special methods of nutrition are also present which are given below:

(1) Saprophytic Nutrition

A kind of nutrition in which food is obtained from non-living matter is called saprophytic nutrition.

(i) Feed on Dead Organic Matter:

The saprophyte feed on dead matter like dead leaves in the soil or rotting tree trunks.

(ii) Production of Extracellular Enzymes:

These plants produce extracellular enzymes, which digest the decaying matter and absorb the soluble product back into their cells.

(iii) Bacterial Breakdown:

Some bacteria break down the protein of dead plants and animals and release nutrients which are taken up by the plant roots and thus help in nitrogen cycle e.g. *Mushrooms* and *Rhizopus*, etc.

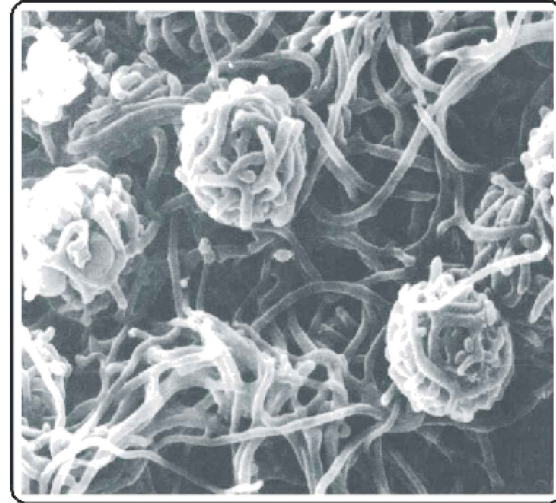


Fig. Lichens

(2) Parasitic Nutrition

A kind of nutrition in which food is obtained from living organisms is called parasitic nutrition. The organisms that feed on living organisms and also cause diseases in them are called parasite.

The parasites attach themselves with the host for their nourishment e.g. *Puccinia* is a parasitic fungus that destroys the wheat plants.

(3) Symbiotic Nutrition

A kind of nutrition in which mutual beneficial relationship occur between two different species for achievement of food is called symbiotic nutrition. Each partner of mutual beneficial association is called symbiont. Lichens and Mycorrhizae are famous example of symbiosis.

Lichens:

The lichens are compound organisms which are made up of a fungus and algal cells. *The alga make food and the fungus supply water and minerals*, and also protection *against desiccation*.

Mycorrhiza:



Fig. Nodules of Leguminous Plant Roots

Mycorrhiza is a mutual relationship between a fungus and roots of higher plants. The plant provides food to fungus because plant is photosynthetic partner. On the other hand, the long *hyphae of fungus collect minerals* and chemicals like P from soil and then supply to root of plants. Thus both exchange benefits in case of mycorrhizae.

(4) **Insectivorous: Nutrition in Autotrophs**

Such type of nutrition in which an autotroph fulfills its organic need by trapping and digesting insects is called insectivorous nutrition, in autotroph.

Actually, all of the insectivorous plants are true autotrophs, but when they capture prey, their growth becomes rapid. Usually these plants grow in such soil, where the amount of nitrogen is less. So by digesting these animals, they especially obtain nitrogen from them. *In some plants insects are decomposed by bacteria, but many of them are decomposed by enzymes which are secreted by the leaves* e.g. pitcher plant, venus fly trap etc.

(a) **Pitcher Plant (Sarcenia pupurea):**

Pitcher plant in which *leaves are modified into a sac or pitcher* like structure which are partly filled with water. The end of the leaf is modified to form a *hood* which partly covers the open mouth. Small insects that fall into the pitcher are prevented from climbing out of means of numerous *stiff hairs*. The insects are decomposed by the inner surface of the pitcher.

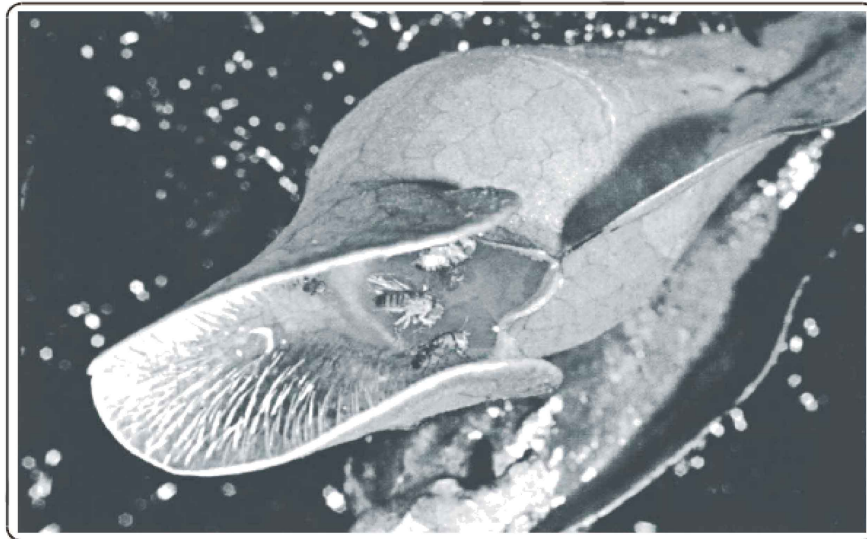


Fig. Pitcher plant (*Sarcenia pupurea*). Several fruit flies are entrapped within the leaf.

(b) **Venus Fly Trap (Dionaea muscipula):**

The leaf is *bilobed* and midrib is present between two lobes. There is a row of long stiff bristles along the margin of each lob.

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 and absorbed by the surface of leaves.

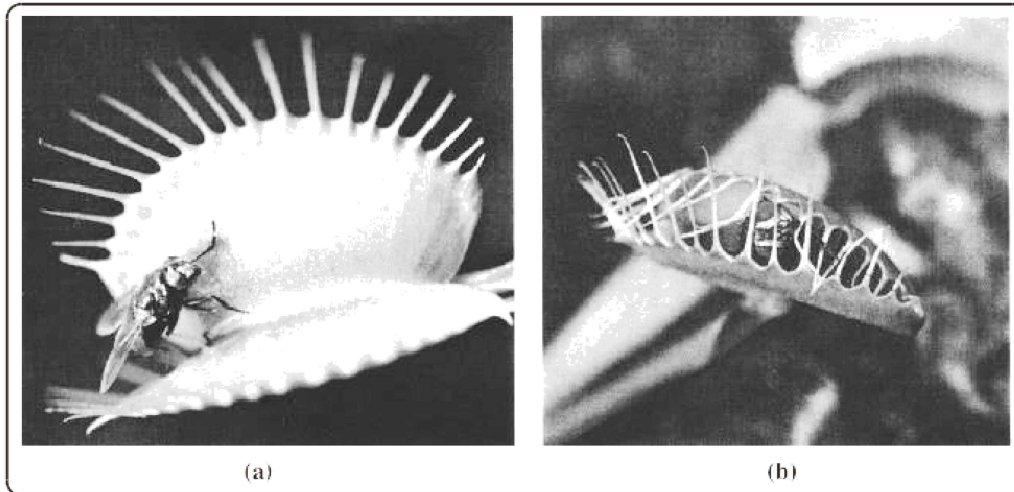


Fig. Leaf of Venus fly trap (Dionaea muscipula) (a) Fly is about to trigger the hair. (b) The two halves of the leaf trapping the fly.

Sundew (Drosera intermedia):

The leaves of sundew possess hair-like structures i.e. *Tentacles*.

There are glands at the tip of its *Tentacles*.

The insects are attracted by the plant odour and then entrapped ultimately. The insects are digested and the products are absorbed.

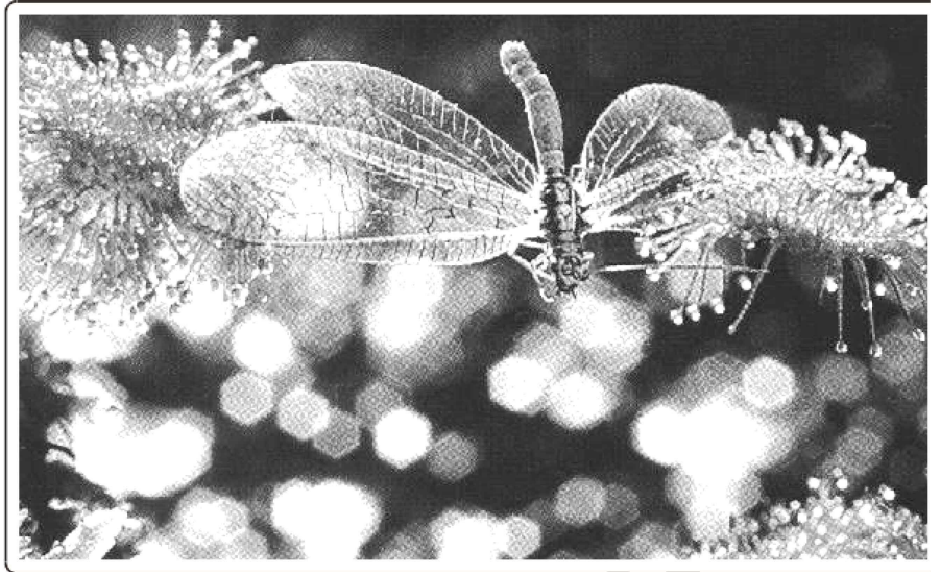


Fig. Leaf of Sundew (*Drosera intermedia*) a dragonfly is caught in the sticky fluid on the ends on the leaf of the glandular hair.

Q.6 Describe different method of animal nutrition.

Ans. **NUTRITION OF ANIMALS**

In large animals every cell need nourishment for living, yet most of the cells cannot leave their position. So the food must be delivered to them. To do this the digestive system is specialized to ingest the food, propel it throughout the digestive tract and digest it. The digested food is then absorbed in the lumen of the digestive tract, and undigested matter is removed from the digestive tract.

On the basis of method of nutrition, the animals are classified into the following:

(1) Detritivores:

“The animals which *feed on* detritus or *organic debris* are called detritivores”.

The detritus is organic debris obtained from decomposing plants and animals e.g. *Earthworm* is a common example of *detritus feeder*.

(2) Herbivores:

“The *plant eater animal* are called herbivores” i.e. reptiles, birds and mammals.

The latter are huffed grazing animals. The herbivores contain premolars and molars with large surface e.g. *horse, deer, sheep* etc.

(3) Carnivores:

“The meat eater or animals eater are called carnivores”.

They have large canine teeth for catching and tearing the prey. Incisors, premolars and molars are also present e.g. *lion, dog, cat* etc.

(4) Omnivores:

“*Plant eater plus meat eater* animals are called omnivores”.

(OR)

“The animal which eat both plant and animal food are called omnivores” e.g. *crows, red fox and rats* etc.

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

In aquatic animals following methods of nutrition are present.

(5) Filter Feeders

“The aquatic animals that obtain their food by filtering the water are called filter feeders”.

A common *mussel* possesses **two large gills covered with cilia**. The movement of cilia cause a current of water to enter animal via an inhalent *siphon*. The water which enters contain the food such as microscopic alga etc. The trapped food particles are then swept towards the mouth. Certain types of *whales* are also filter feeders.

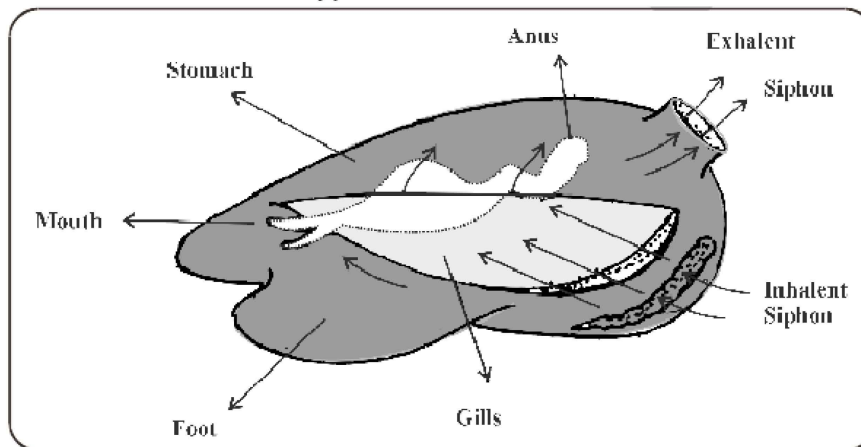


Fig. Filter feeding in mussel

(6) Fluid Feeders:

“Those animals which ingest the food in liquid form are called fluid feeders”.

Examples:

Aphids and mosquitoes are such type of organisms that get their food in liquid form. Aphid suck the phloem juices out of the green stem by inserting their delicate stylets. Mosquitoes are also fluid feeder because they suck the blood from the skin capillaries by piercing the skin.

(7) Macrophagous Feeders:

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

The animals which take in food in the form of large pieces like the *Hydra*, *Snail* etc. Snail feed by using rasping organ, the radula, leaves are held by the lips of snail. The radula moves back and forth over the leaves with its teeth scraping the food. In this way tiny fragments of leaves are pushed toward the mouth. *Spotted dogfish* feed macrophagous particles of food by swallowing.

Q.7 Write a short note on different types of parasitic nutrition.

Ans. **PARASITIC NUTRITION**

Following types of parasitic nutrition are present in different parasites:

(1) **Ectoparasite:** "A parasite that lives upon the host is called ectoparasite".

Flea and Lice: Flea and lice live in the fur or feathers of mammals and birds and suck blood from their skin. *Aphids* in plants are the ectoparasites. *Leech* is also an example of ectoparasite.

(2) **Endoparasite:** "A parasite that lives inside the body of host is called endoparasite".

Examples: *Entamoeba histolytica*, *tapeworm* and *round worms* are the endoparasites. In many cases the host may be weakened by the presence of parasite or its metabolism may be upset by the excretory product of the parasite.

(3) **Obligate Parasite:** The parasite that *cannot live without their host* is called obligate parasite e.g. *viruses*.

(4) **Facultative Parasite:** "The parasite which may *live independently* is called facultative parasite". e.g. *leech* etc.

Q.8 Describe the general method of digestion and absorption in the animals.

Ans. **DIGESTION AND ABSORPTION**

All animals have similar requirements, although these requirements differ in detail. The characteristics processes involved in the nutrition are given below:

(i) **Ingestion:** Taking in food is called ingestion.

(ii) **Digestion:** The break down of large complex and indiffusible molecules into small, simple and diffusible molecules with the help of enzymes is called digestion.

There are two types of digestion.

(a) **Intracellular Digestion:** The digestion which takes place inside the cell is called intracellular digestion.

- (b) **Extracellular Digestion:** The digestion which takes place outside the cell of body is called extracellular digestion.
- (iii) **Absorption:** The uptake or intake of the diffusible food molecules from the digestive tract into the blood stream is called absorption.
- (iv) **Assimilation:** When digested food becomes part of protoplasm.
- Egestion:** The elimination of undigested matter from the body is called egestion.

Q.9 Write a short note on digestion in Amoeba.

Ans. **DIGESTION IN AMOEBIA**

Ingestion of Tiny Organisms:

Amoeba feeds on tiny organisms which live with it in fresh water. Food may be ingested at any point by pseudopodia which fuse together, forming the food vacuole.

Digestion: Amoeba has intracellular digestion. Food vacuole play important role in digestion.

- (i) **Vacuole:** The food vacuole undergoes many changes as the digestion proceeds.
- (ii) **Lysosomes:** Lysosomes which *contain hydrolytic enzymes fuse* with the food vacuole and enzymes are secreted into it.
- (iii) **Killing and Softening Food:** The first phase is killing and softening the food in the acidic medium and later it becomes alkaline.

Absorption: The product of *digestion are passed into the canals* and finally into the *surrounding cytoplasm* and subsequently utilized in various metabolic reactions.

Egestion: The undigested matter is removed from the organisms in the surrounding water by egestion.

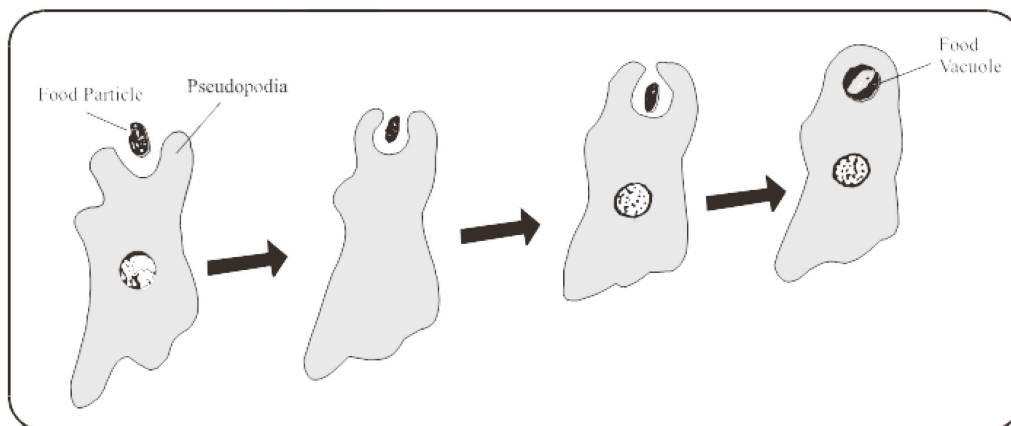


Fig. Amoeba ingesting food by pseudopodia

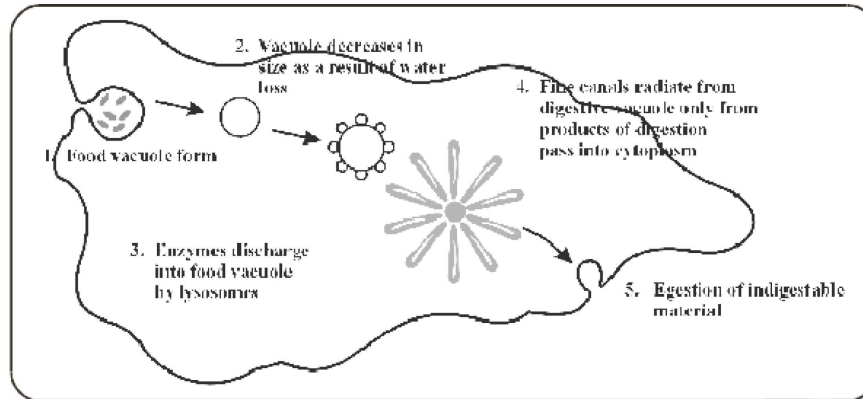


Fig. Ingestion, digestion and absorption in Amoeba

Q.10 Describe the digestion in Hydra.

Ans. **DIGESTION IN HYDRA**

Hydra is an aquatic animal. It belongs to phylum coelenterata. It has only one opening which is called mouth. This single opening also acts as anus. The digestive system of Hydra is called *gastro vascular* digestive system. The digestive cavity of Hydra is called *coelenteron*.

Nematocysts: Tentacles have numerous *stinging cells* called nematocysts. Each nematocyst consists of *a hollow thread coiled* within a capsule and *a tiny hair like trigger projecting* outside.

Process of Digestion: When a prey (such as Daphnia or Cyclops) comes in contact with the trigger, the hollow thread of the nematocyst turns inside out, ejects its poison and the prey is paralysed. With the tentacles the prey is pushed into the digestive cavity.

Digestion: The endodermis has glandular cells and digestive cell. In glandular cells of gastroderm extracellular digestion occur. Digestive cells of gastoderm ingest food and becomes the reason of intracellular digestion.

Flagellate cells and contraction of the body cavity help in breaking food into particles.

Absorption: The small particles of food are then engulfed by phagocytic action of gastrodermal cells.

Indigestible food is expelled out from the gastrovascular cavity via mouth. Such a type of digestive system is called *sac like digestive system*, in which only one opening is present.

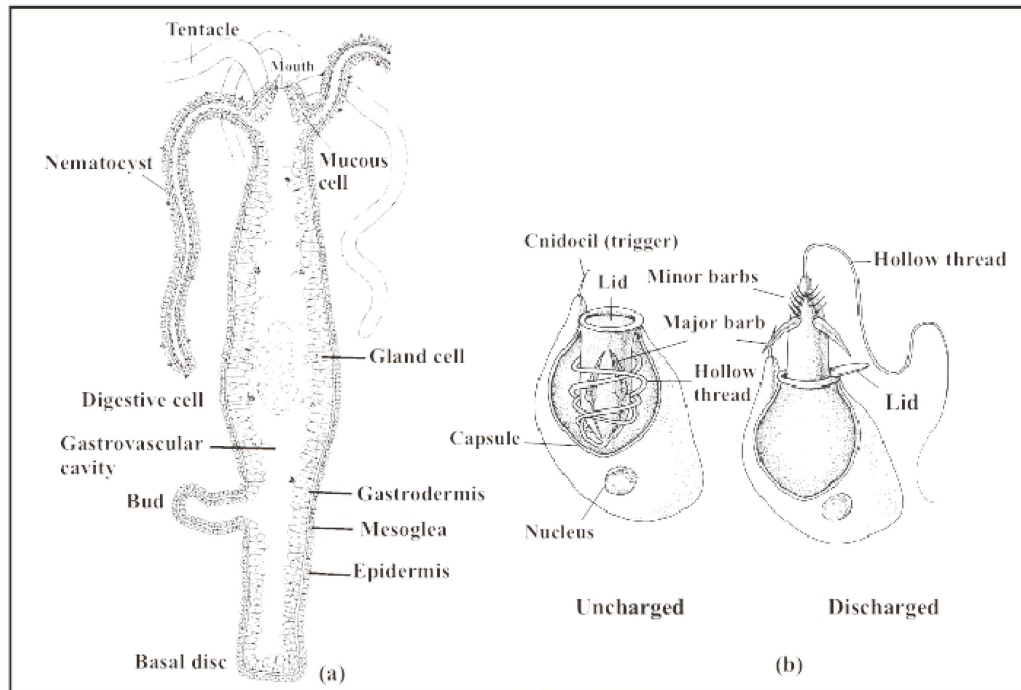


Fig. Hydra: (a) Longitudinal section showing the detail of wall and the gastrovascular cavity (b) nematocysts (discharged and un-discharged)

Q.11 Describe digestion in planaria.

Ans. **DIGESTION IN PLANARIA**

Planaria is a flatworm. It belongs to phylum *platyhelminthes*. There is only *one opening* for ingestion and egestion in planaria.

Mouth: It is present on the ventral surface near the middle of the body.

Pharynx: The mouth leads into a *tubular* and *muscular* structure which is pharynx.

Intestine: The pharynx leads to intestine. The intestine is then divided into three branches. A branch extending forward. Two lateral branches are extending backward. There are caecal on intestine. Caecal increases the absorbing surface.

PROCESS OF DIGESTION:

Ingestion: Planaria engulfs the prey by protruding pharynx through the mouth and pushes it into the Gastrovascular Cavity.

Digestion: Food is digested in the intestine by extracellular digestion. The food is broken down by enzymes. The small particles of food are then engulfed by the *phagocytic cells*.

Absorption: So both *extracellular* and *intracellular* digestion is found in planaria. Absorption takes place by diffusion. Branched intestine also facilitate diffusion.

Egestion: Undigested food is egested through the mouth.

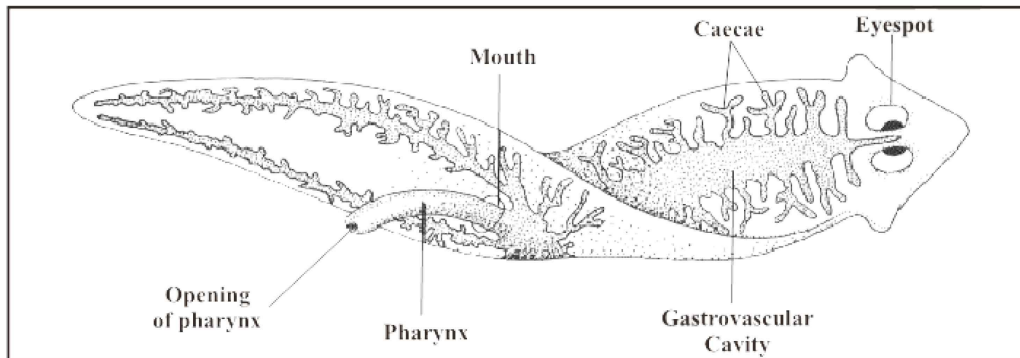


Fig. Planaria showing much branched gastrovascular cavity and extruded pharynx

Q.12 Describe digestion in cockroach.

Ans. **DIGESTION IN COCKROACH**

Cockroach has **tubular** type of digestive system. It is divided into three parts.

- (i) **Foregut:** The foregut has mouth cavity, *pharynx*, *crop* and *gizzard*. A pair of salivary glands is present in the thorax region. *Salvia* is secreted by salivary glands which is poured into the mouth cavity.
- (ii) **Midgut:** The midgut is short and narrow tube. It is called stomach. *The hepatic caecae open into the anterior end of the midgut.*
- (iii) **Hindgut:** The hindgut is a long coiled tube, the terminal part of which is a thick walled chamber, *the rectum which open to the exterior through anus.*

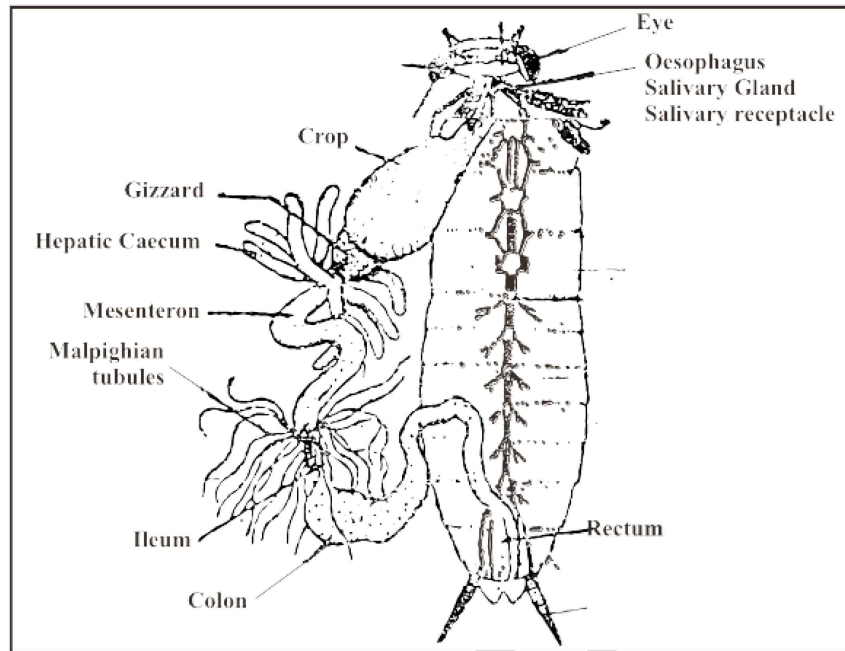


Fig. Cockroach digestive system

PROCESSES OF DIGESTION

Ingestion: Cockroach ingests all types of food.

Digestion: The mandibles help in cutting and mixing the food with saliva and then partially digested food is stored in the crop. The enzymatic secretions of hepatic caecae and midgut digest the food completely.

Crop: The partly digested food is stored in crop.

Gizzard: Food leaves the crop chunk by chunk and after being ground in the gizzard it moves into the midgut.

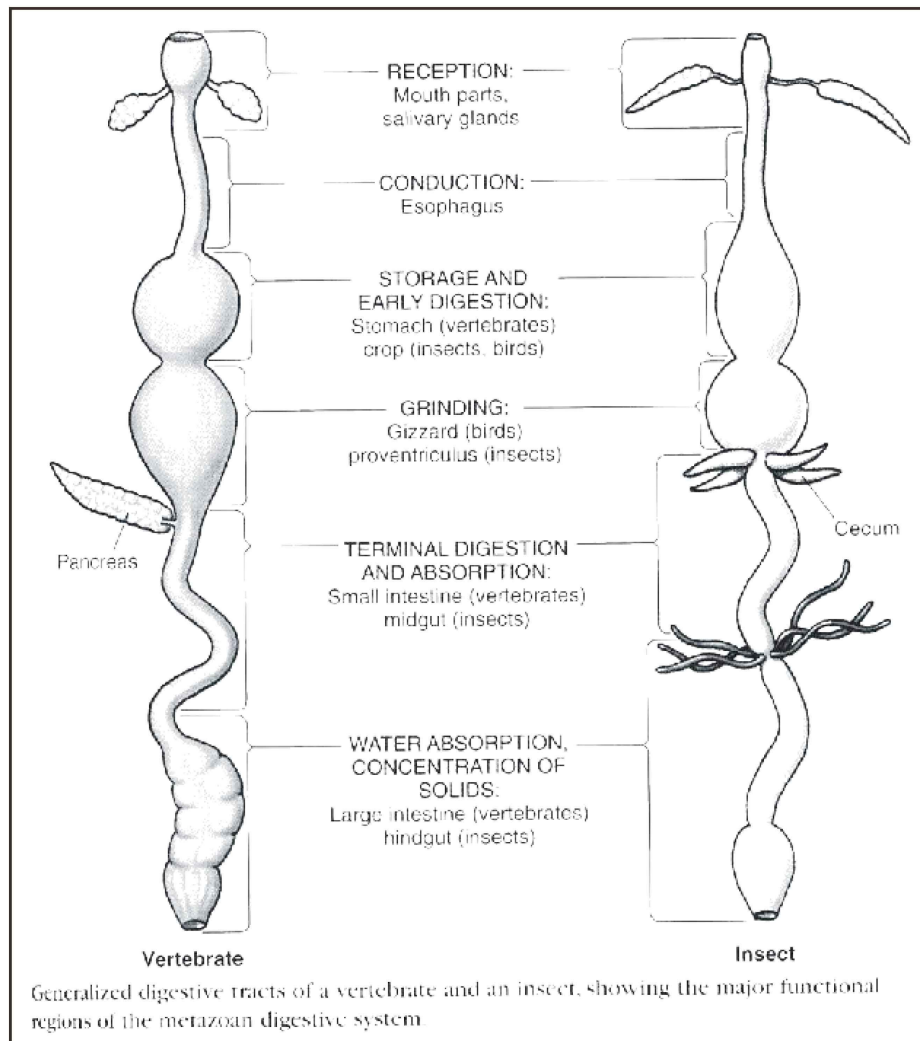
Hepatic Caecae: The enzymatic secretion of hepatic caecae and midgut digest the food completely.

Rectum: The indigested food after temporary storage in the rectum, as fecal matter is then egested out through anus.

Tubular Digestive System: Cockroach has a tubular digestive system having mouth for ingestion and anus or **Cloacal Aperture** for egestion.

More Efficient than Sac Digestive System: It is more efficient system than sac like digestive system having specialized organs or partitions for efficient digestion and absorption of food.

THINK ABOUT IT



CONCEPTUAL

Table Path of Food	
Organ	Function
Mouth	Reception and chewing of food; digestion of starch
Esophagus	Passageway
Stomach	Storage and mechanical breakdown of food; acidity kills bacteria; digestion of protein
Small intestine	Digestion of all foods; absorption of nutrients
Large intestine	Absorption of water (and some vitamins); storage of nondigestible remains
Anus	Defecation

Q.12.1 How is digestion occur in oral cavity of man?

- | | |
|-----------------------|-------------------------------|
| (i) Selection of food | (ii) Grinding or mastication. |
| (iii) Lubrication | (iv) Digestion. |

Ans. (i) **SELECTION OF FOOD**

When food enters the oral cavity, it is tasted, smelled and felt. If the taste or smell is unpleasant or if hard objects like bone are present in the food, it is rejected. Tongue being sensory and muscular organ plays the most important role through its taste buds.

(ii) **GRINDING OR MASTICATION**

After selection the food is ground by molar teeth. This is useful for:

- The esophagus allows relatively small pieces to pass through it.
- Small pieces have much more surface for enzymes to attack.

(iii) **LUBRICATION**

Secretion of Saliva: Saliva is secreted by three pairs of glands.

- Sublingual Glands:** These are situated below the tongue.
- Sub maxillary Glands:** These are situated behind the jaw.
- Parotid Glands:** These are situated in front of internal ear.

(iv) PRODUCTION OF SALIVA

Saliva produced by these glands contains three important ingredients:

- (i) Water and mucus.
- (ii) Sodium bicarbonate and some other salts.
- (iii) Carbohydrate digesting enzyme amylase (or) ptyalin.

(v) DIGESTION (Role of Amylase):

Digestion of glucose and starch take place in mouth or oral cavity with the help of amylase.

Q.13 Draw the digestive system of man.

Ans. The digestive system of man is of tubular type which extends from the mouth to the anus. The digestive system of man has the following parts:

- | | |
|---------------------|----------------------|
| (i) Oral cavity | (ii) Oesophagus |
| (iii) Stomach | (iv) Small intestine |
| (v) Large intestine | (vi) Rectum |

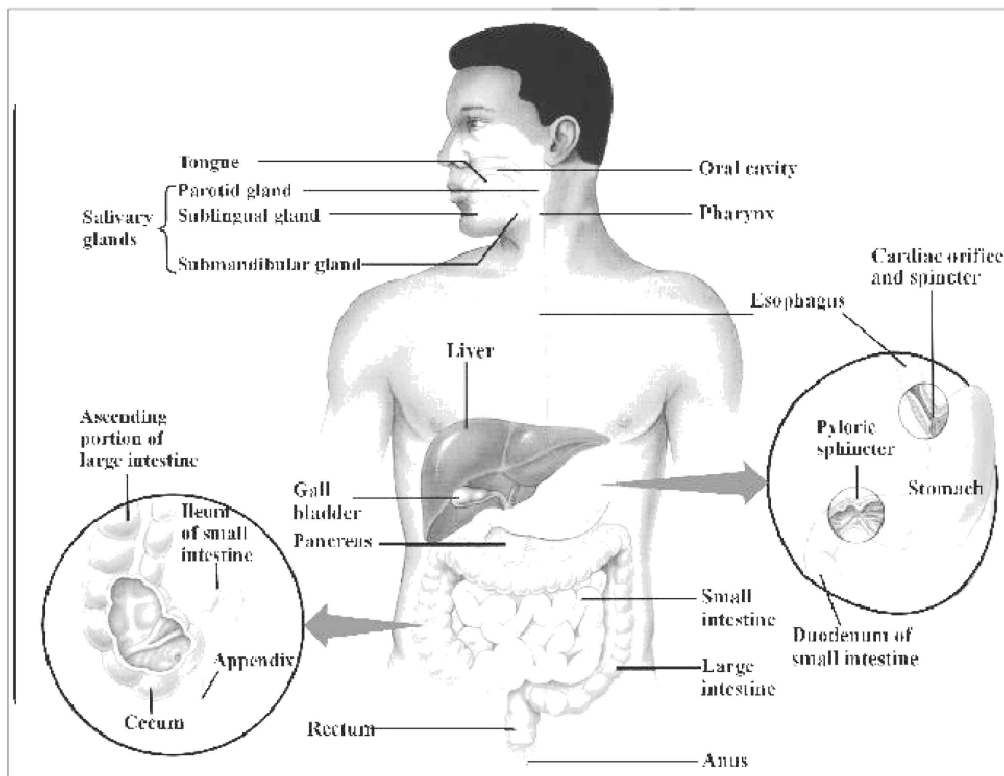


Fig. The digestive system of man

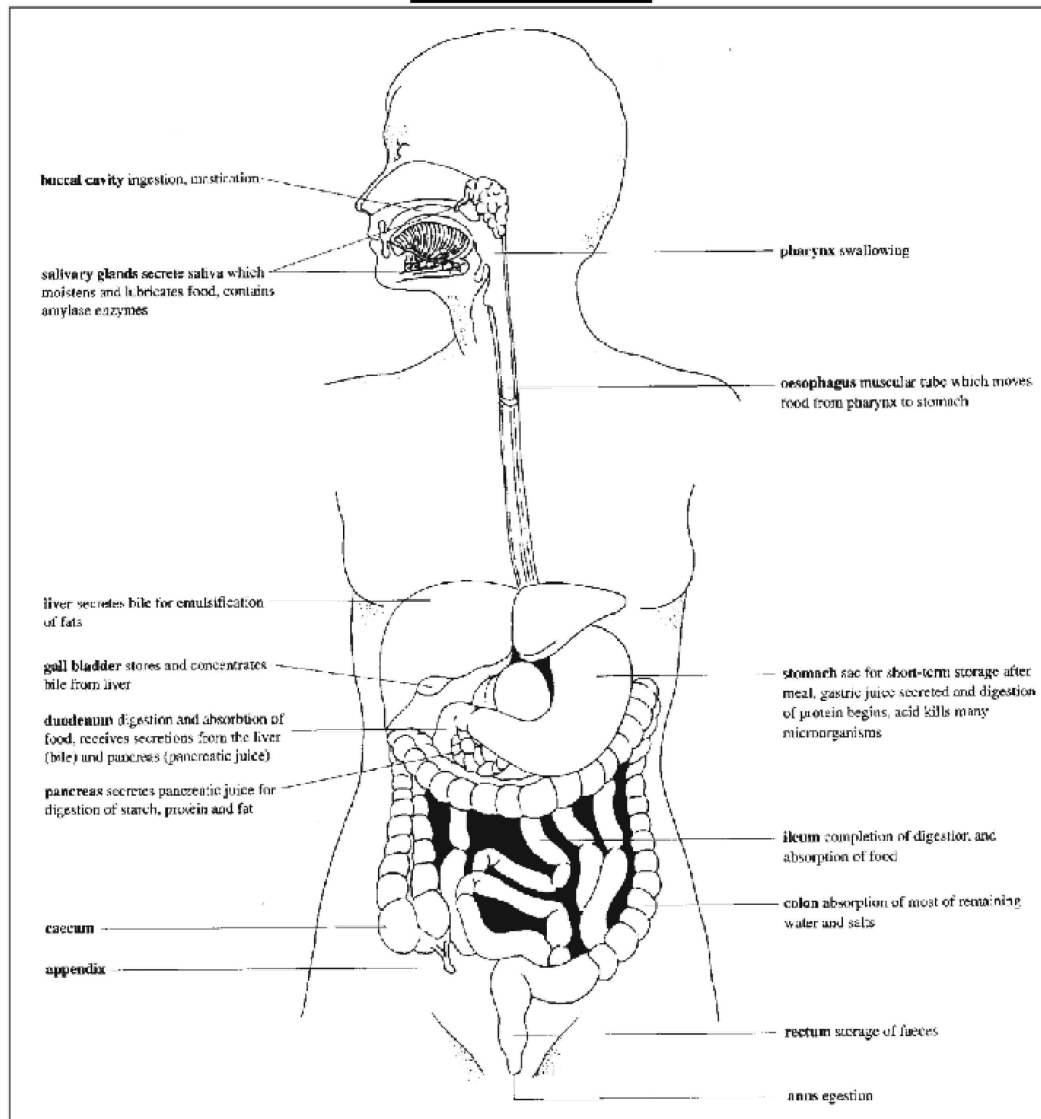
EASY TO DRAW

Fig. Digestion in man

Q.14 What is saliva? Give its function.

Ans. **SALIVA**

Saliva is a viscous liquid:

- (i) It contains water and mucus.
- (ii) It has sodium bicarbonate and other salts.
- (iii) Amylase or ptyalin (carbohydrate digesting enzymes) are present in saliva.

Functions:

- (i) Saliva *moistens* dry food.
- (ii) It helps swallowing by *lubricating* action.
- (iii) It provides enzyme i.e. amylase or ptyalin for the *digestion of starch*.
- (iv) It keeps mouth and teeth *clean*.
- (v) Sodium bicarbonate and other salts are *antiseptic*. Fresh saliva is *alkaline* with a pH of nearly “8”. It quickly loses carbondioxide and gets pH 6.

Q.15 How is swallowing of food take place in the alimentary canal?

- Ans.** (1) As a result of mastication, the softened, partly digested, slimy food is rolled into small oval lump called bolus.
- (2) Bolus is then pushed to the back of the mouth by the action of tongue and muscles of pharynx which ensure that the food does not enter the windpipe.

Following are the events that take place in the swallowing of food:

- (i) **Tongue:** The tongue moves in the mouth and forces the bolus to the back of the mouth cavity.
- (ii) **Closing of Nasal Opening:** The movement of the tongue helps in closing the nasal opening and opening of windpipe.
- (iii) **Larynx Cartilage:** The larynx cartilage round the top of the windpipe moves upward.
- (iv) **Glottis:** The glottis is partly closed by the contraction of a ring muscle.
- (v) **Epiglottis:** The food does not enter the partly open glottis, because epiglottis diverts the food mass to one side of the opening and safely down the oesophagus.

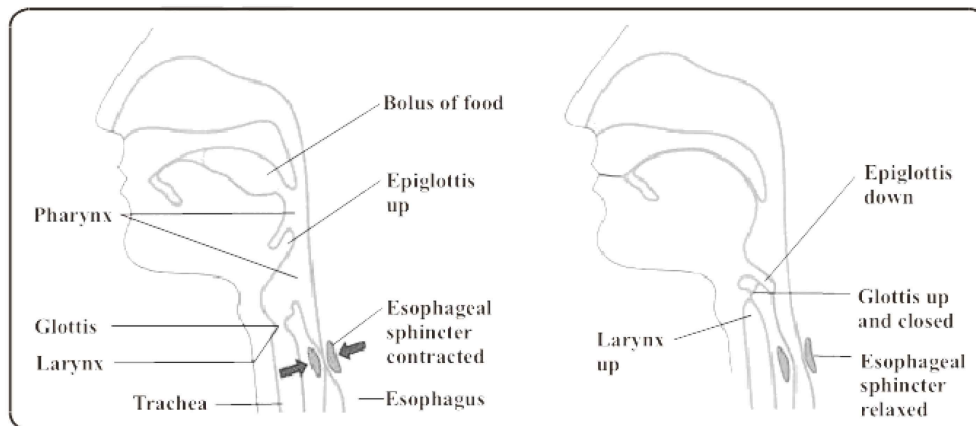


Fig. Swallowing in man

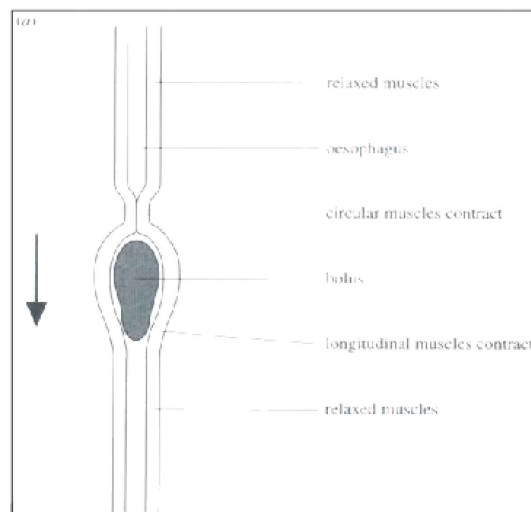
Q.16 What is peristalsis? How it causes the food to pass through the oesophagus?

Ans. **PERISTALSIS**

The digestive tract has the characteristic movement by which food moves along the cavity of the canal called peristalsis. (Passing of alternate waves of contraction and relaxation along a hollow viscous).

Explanation: It consists of the wave of contraction of the circular and longitudinal muscles proceeded by the wave of relaxation thus squeezing the food down along the canal. Peristalsis starts just behind the food from the buccal cavity *along the oesophagus to the stomach* and then the whole alimentary canal.

JUST A CONCEPT



Q.17 What is antiperistalsis and why it is caused?

Ans. **ANTIPERISTALSIS**

Occasionally the food may be passed from intestine back into the stomach and even in the mouth which is called antiperistalsis.

CAUSES OF ANTIPERISTALSIS:

Hunger Contractions:

Hunger contractions are peristaltic contractions which are increased by low blood glucose level and are sufficiently strong to create an uncomfortable sensation often called Hunger Pangs. Hunger pangs occur usually 12-24 hours after previous meal or in less time in some people.

Q.18 Describe the main steps of structure and function of stomach and how the stomach digest the food. (OR) Describe the digestion in stomach of man in detail. (GRWOS)

Ans. **DIGESTION IN STOMACH**

The stomach is “j” shaped bag like structure situated below the diaphragm on the left side of the abdominal cavity.

STRUCTURE:

Elastic Muscular Bag:

It is an elastic muscular bag that stores food from meals for some time. The stomach wall is composed of three principal layers:

- (i) **Connective Tissue:** An outer layer (formed by *connective tissue*).
- (ii) **Smooth Muscles:** A middle layer (formed by *smooth muscles*).
- (iii) **Connective Tissue and Mucosa:** An inner most layer mucosa (formed by *connective tissue glands*).

The middle layer consists of an outer longitudinal and an inner circular muscles. These muscular layers helps in digestion.

Gastric Glands:

The inner layer of the stomach possesses numerous tubular glands called gastric glands. These are composed of following kinds of cells:

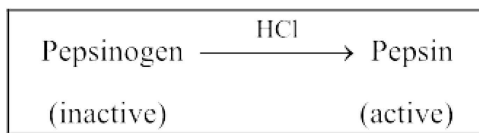
- (i) **Mucous Cells:** These cells produce *mucus*.
- (ii) **Parietal or Oxyntic Cells:** These cells secrete hydrochloric acid (*HCl*).
- (iii) **Zymogen Cells or Chief Cells:** These cells secrete *pepsinogen*. The secretion of all these cells is collectively called gastric juice.

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

Hydrochloric Acid: It is secreted by stomach in concentrated form:

- (i) **Adjusts the pH:** It adjusts the pH of stomach contents ranging from 2-3 pepsin to act on proteins.
- (ii) **Softens the Food:** It also softens the food.
- (iii) **Kills:** It kills many microorganisms in the food.

Pepsin: Pepsin is an enzyme.



It is secreted in an inactive form called pepsinogen. Pepsinogen is activated to pepsin, when exposed to the acidic medium. Pepsin hydrolyses the proteins. After stomach, the food enters into the intestine.

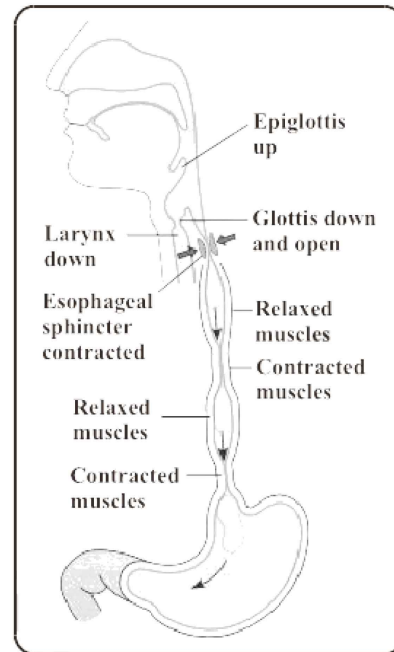


Fig. Different stages of peristaltic movement in the esophagus

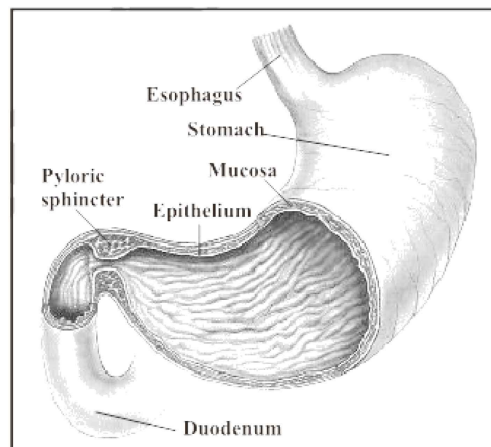
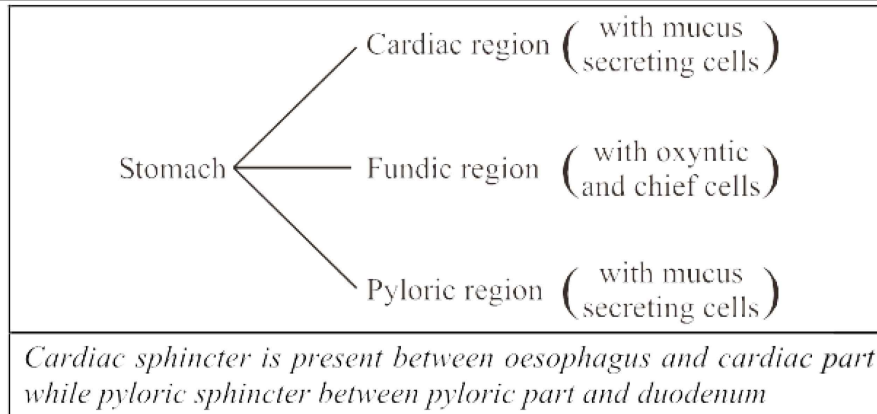


Fig. (a) Sagittal section of human stomach showing internal ridges and sphincters



Q.19 Describe the digestion in small intestine of man in details.

Ans. **DIGESTION IN SMALL INTESTINE**

When the chyme (partially broken food) passes from stomach into duodenum its acidity stimulates the release of secretions. The small intestine has following parts:

- (i) Duodenum (ii) Jejunum (iii) Ileum

Digestion in Duodenum:

Duodenum is *about 20-25 cm long*. When chyme reaches into duodenum, the release of secretions of pancreas and duodenal cells take place.

ENZYME SECRETED BY PANCREAS:

Pancreas:

It is a *pinkish* large gland. It is an *exocrine* tissue which secretes a juice that flows through the pancreatic duct into the duodenum. This *pancreatic juice* digests all types of food i.e. carbohydrates, fats and proteins.

Amylase: This enzyme digests the carbohydrates. It is prepared by pancreas and is also called amylase.

Lipase: It digests the small percentage of fats into fatty acid and glycerol. It is also secreted in inactive form which is activated by the enterokinase.

Trypsin: It digests proteins into peptides. Pancreatic juice also contains sodium bicarbonate which partly neutralized the chyme. It is also secreted in inactive form which is activated by the enterokinase.

Liver:

It secretes bile. Bile may be temporarily stored in the gallbladder. Then it is released into the duodenum through the bile duct. The bile is green watery fluid but without enzymes. Its *green color* is due to the bile pigments, which are formed by the break down of haemoglobin in the liver. Bile contains salts, which acts on fats. They break the fats into globules, which are easily digested by water soluble lipase.

CONCEPTUAL VIEW

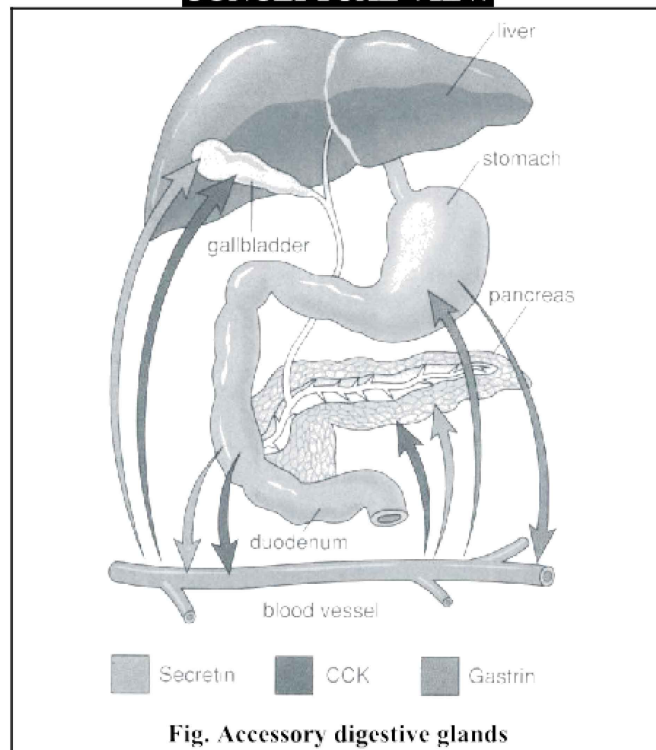


Fig. Accessory digestive glands

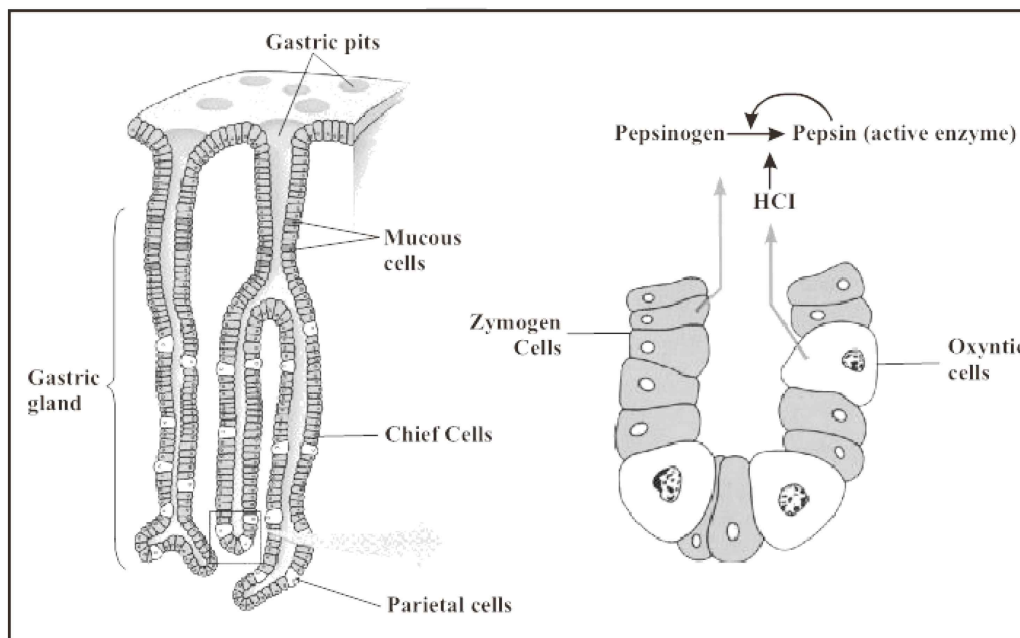


Fig. Section through stomach wall (c) Details of gastric gland in the stomach wall

Jaundice:

If bile pigments are prevented from leaving digestive tract, they may accumulate in blood and cause a condition called jaundice.

Gallstone:

Cholesterol secreted by the liver may block the release of gall bladder's secretion.

Deammonification:

Liver converts toxic substance ammonia (which is a waste product of amino acids metabolism) to less toxic compound urea which is then excreted by kidneys.

Jejunum:

It is the second portion of the small intestine extending from the duodenum to the ileum. It is *2.4 meter in length* comprising about *two fifth of the small intestine*. The food which escapes undigested from the duodenum is completely digested in this part.

Ileum:

The undigested food passes through the ileum and enters the large intestine.

ATTENTION

Differences among duodenum, jejunum and Ileum:		
Duodenum	Jejunum	Ileum
More		
(i) Circular folds	(i) Numerous and larger circular folds	(i) Less circular folds
(ii) —	(ii) Less villi	(ii) Abundant villi
(iii) Thicker wall	(iii) —	(iii) Less thick wall

Q.20 Give a detailed note on the absorption of food particles in the small intestine.

Ans. **ABSORPTION IN SMALL INTESTINE**

The small intestine consists of *duodenum*, *jejunum* and *ileum*. Nearly all absorption of the products of digestion takes place in the ileum.

Structure of Ileum: The surface of the ileum has *many folds*, which exhibit *velvety appearance* due to the presence of numerous finger like outgrowths called **villi**.

(b) Detail of Villus Structure:

Each villus is richly supplied with *blood capillaries* and a vessel called *lacteal* of lymphatic system with a covering of *epithelial cells*. The electron microscope reveals that these cells have countless closely packed cylindrical processes called *micro-villi*.

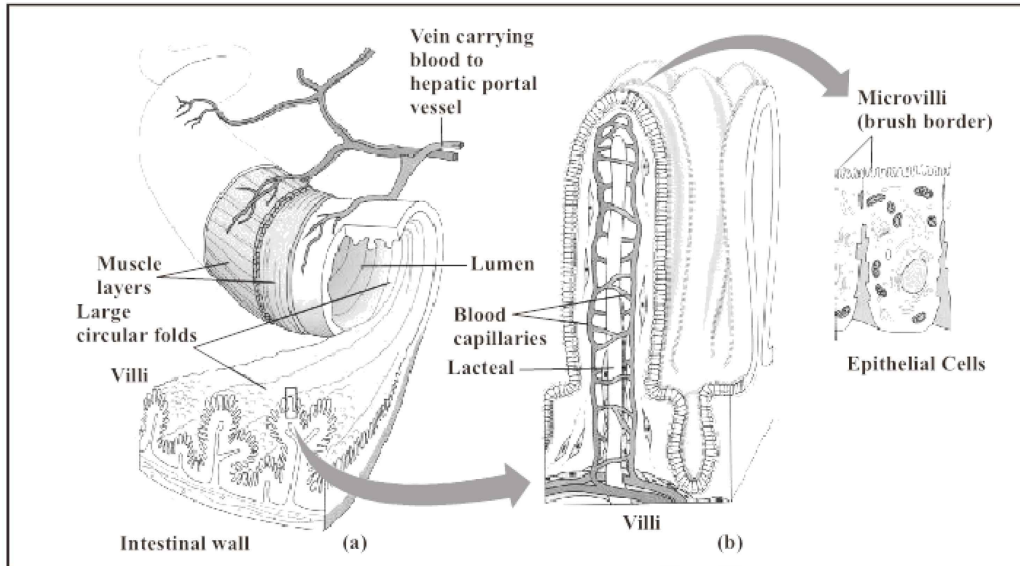


Fig. (a) Part of wall of small intestine showing glands and villi.
(b) Detail of villus structure.

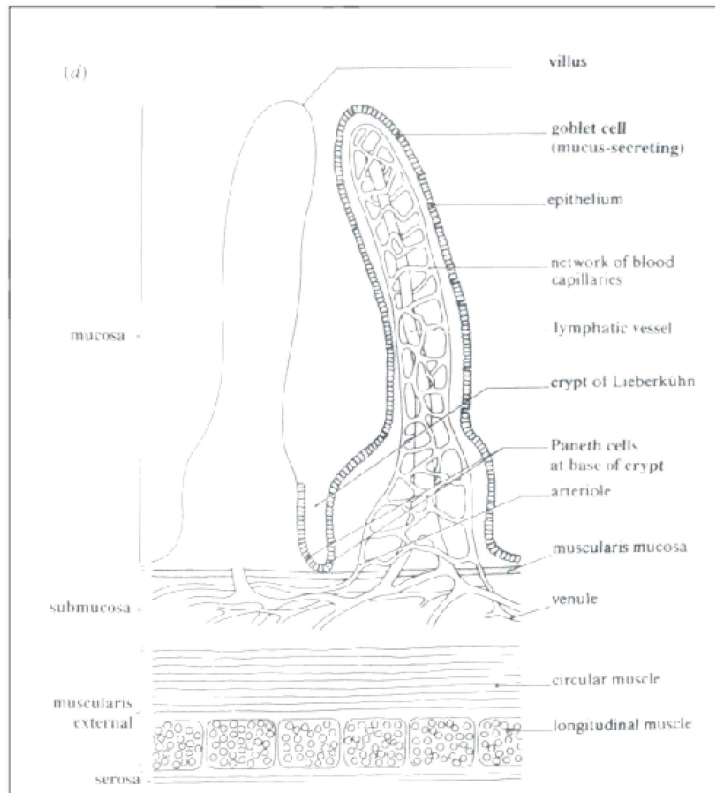
Absorption of Sugars and Amino Acids:

Simple sugars and amino acids are absorbed into the blood capillaries through the microvilli by diffusion. Some fatty acids and glycerol are also absorbed into blood stream.

Absorption of fatty acids and glycerol:

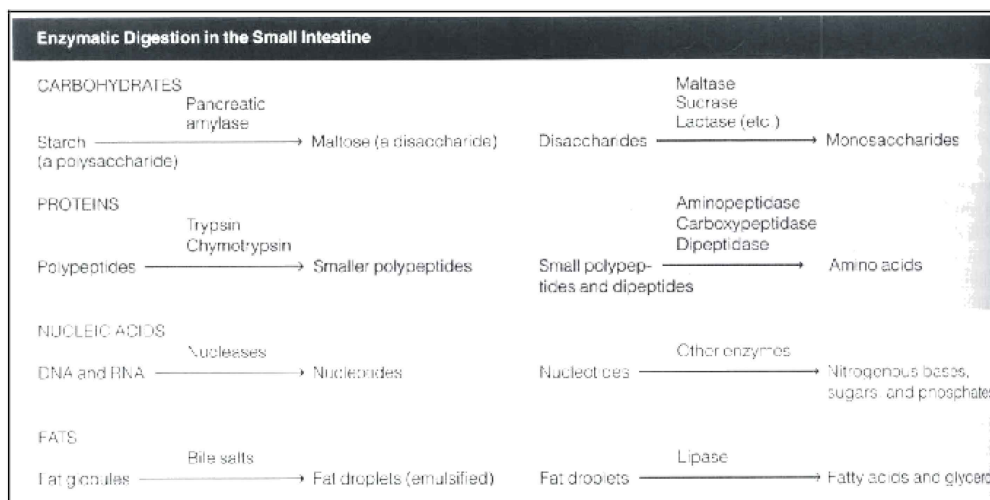
A large proportion of fatty acids and glycerol enters the epithelial cells of villi, where they recombine into fats. These fats then enter the lacteals.

Protein present in the lymph vessels combine with the fat molecules to form lipo protein droplets. These pass into the blood stream.



Gathering of Waste Product:

The intestinal contents are pushed along the alimentary canal by normal peristaltic activity. At the end of the ileum, there is an *ileocolic sphincter* that opens and closes time to time and allow a small amount of residue from the ileum to enter the large intestine.



Q.21 Give a detailed note on structure function and malfunction of large intestine.

Ans. **LARGE INTESTINE**

The large intestine is a part of alimentary canal that starts after the small intestine.

Structure: The large intestine is composed of the following parts:

- (i) Caecum (ii) Colon (iii) Rectum

(i) **Caecum:** It is a blind sac that projects from the large intestine between ileum and colon. It is pouch that is beginning of large intestine.

(ii) **Colon:** It is the part of large intestine that exists between the caecum and rectum.

(iii) **Rectum:** The last part of the large intestine is called rectum.

Appendix: From the blind end of the caecum, there arises a finger like process called appendix.

Appendicitis: The appendix some time get inflammed due to entrapping and then putrifaction of food causing appendicitis.

FUNCTIONS OF LARGE INTESTINE:

The material that reaches the large intestine contains large amount of *water and salts* which are *absorbed into the blood*. The undigested material also contains large amount of bacteria which are also absorbed in the large intestine.

MALFUNCTIONS OF LARGE INTESTINE:

Due to malfunctioning, the absorption of water and salts does not take place and cause the following diseases:

(a) Diarrhoea:

When water and salts are not absorbed due to drug action or infection, a condition known as diarrhea occurs.

(b) Constipation:

When excessive absorption of water takes place a condition known as constipation occurs.

Rectum:

It is the part where feces are temporarily stored and ejected through anus at intervals.

Table: Functions of the Digestive Organs

Organ	Function	Secretion
Oral Cavity		
Teeth	<i>Mastication (cutting and grinding of food); communication.</i>	None
Lips and cheeks	<i>Manipulation of food; hold food in position between the teeth; communication.</i>	Saliva from buccal glands (mucus only).
Tongue	<i>Manipulation of food; holds food in position between the teeth; cleansing teeth, taste.</i>	Some mucus; small amount of serous fluid.
Salivary Glands		
Parotid glands	<i>Secretion of saliva through ducts to superior and posterior portions of oral cavity.</i>	Saliva with amylase
Submandibular glands	<i>Secretion of saliva in floor of oral cavity.</i>	Saliva mucus only.
Pharynx	<i>Swallowing</i>	Some mucus
Esophagus	<i>Movement of food by peristalsis from pharynx to stomach.</i>	Mucus
Stomach		
Mucous cells	<i>Mechanical mixing of food; enzymatic digestion; storage; absorption. Protection of stomach wall by mucus production.</i>	Mucus

Parietal cells	<i>Decrease in stomach pH.</i>	Hydrochloric acid.
Zymogen cells	<i>Protein digestion.</i>	Pepsinogen
Endocrine cells	<i>Regulation of secretion and motility.</i>	Gastrin
Accessory Glands		
Liver →	<i>Secretion of bile into duodenum</i>	Bile
Gall bladder →	<i>Bile storage; absorbs water and electrolytes to concentrate bile.</i>	No secretions of its own, stores and concentrates bile
Pancreas →	<i>Secretion of several digestive enzymes and bicarbonate ions into duodenum.</i>	Trypsin, chymotrypsin, pancreatic amylase, pancreatic lipase, bicarbonate ions.
Small Intestine		
Duodenal glands	<i>Protection</i>	Mucus
Goblet cells	<i>Protection</i>	Mucus
Absorptive cell	<i>Secretion of digestive enzymes and absorption of digested materials.</i>	Enterokinase, amylase, peptidases, sucrase, maltase, lactase, lipase.
Endocrine cells	<i>Regulation of secretion and motility.</i>	Gastrin, secretin
Large Intestine		
Goblet cells	<i>Absorption, storage, and food movement.</i> <i>Protection</i>	Mucus

Q.22 Write a detailed note on the common diseases related to nutrition? OR

Discuss:

- (a) *Dyspepsia* (b) *Food poisoning* (c) *Botulism*
 (d) *Obesity* (e) *Anorexia Nervosa* (f) *Bulimia nervosa*
 (g) *Piles*

Ans. Following are some of common diseases related to nutrition:

(a) **DYSPEPSIA**

Incomplete or *imperfect digestion* is called dyspepsia. Dyspepsia is not a disease in itself. Actually it is symptomatic of other diseases.

Symptoms: This is characterized by *abdominal discomfort, flatulence, heartburn, nausea* and vomiting. These symptoms may occur irregularly and in different patterns from time to time.

Reasons: Dyspepsia may occur *due to excessive acidity* in stomach or faulty function of stomach and intestine or insufficient quality or quantity of bile secretions.

(b) **FOOD POISONING**

The food poisoning indicates an illness from indigestion of food *containing toxic substances*.

By Bacteria: The commonest causes of food poisoning are the toxins produced by bacteria, Salmonella and Campylobacter. These bacteria live in the intestine of cattle, chicken and duck without causing disease symptoms.

By Contaminated Food:

Human, however, may develop food poisoning if they drink milk, eat meat or eggs which are contaminated with these bacteria.

Symptoms:

The symptoms of food poisoning are diarrhoea, vomiting and abdominal pain. They occur from 12-24 hours after eating contaminated food. Infection is most likely if, unpasteurized milk is used or if meat is not properly cooked.

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.

(c) **BOTULISM (A Severe Food Poisoning):**

A severe form of food poisoning is botulism.

Causing Agents: This is caused by toxins produced by bacteria known as *Clostridium botulinum*.

Reasons: Botulism is developed by the use of improperly canned or otherwise preserved foods, especially meat. The toxin produced by these bacteria is very powerful and have selective action on central nervous system, causing cardiac and respiratory paralysis.

Symptoms: The early symptoms of this disease are fatigue, dizziness, double vision, headache, nausea, vomiting, diarrhoea and abdominal pain.

(d) **OBESITY (Over Weight):**

The obesity is the over weighting in which a person has *abnormal amount* of fat in the body.

- (a) If one eats too much food than body requirement, the surplus is stored as fat so becomes *over weight* or obese.

- (b) There is *fat stored in adipose tissue* in the abdomen around the kidneys and under the skin.
- (c) Certain cells *accumulate drops of fat in their cytoplasm*. As fat drops increase in size and number, they join together to form one globule of fat in the middle of the cell, pushing the cytoplasm into thin layer and the nucleus to one side. Group of fat cells or adipose tissue.
- (d) Some people never seem fat no matter how much they eat, while others lay down fat when their intake only just exceeds their need.
- (e) The explanation probably lies in the balance of hormones which to some extent is determined by heredity.

Effects of Obesity: An obese person is much more likely to suffer from *high blood pressure, heart disease, diabetes mellitus, stomach disorder* than a person who has normal body weight.

(e) **ANOREXIA NERVOSA** (*Loss of appetite by fear*)

“This term is employed to the *loss of appetite due to the fear of becoming obese*”. Such a feeling is common in humans females between the age of 12 and 21 years. Fear does not come to an end even when weight is reduced to dangerous level. If patient refuses to eat, she must be guided and treated psychologically. Anorexia is a disease which affects girls usually from the start of **puberty**.

- (1) The illness is characterized by the loss of appetite due to the fear of becoming obese.
- (2) The anorexic girls over estimate the size of her own body and so insist that she is over weight when in reality her weight has dropped to a dangerous level.
- (3) These girls are often immature mentally. They cannot face the challenges of puberty and growing sexuality.

Harmful Effects: The *loss of feminine characteristics* enable the girl to retreat into a *child like state* in which she feels safe.

Treatments: Psychiatric therapy is usually required to *treat anorexic girls*. Such patients are fed through any other route other than alimentary canal that is intramuscularly or intravenously. The recovery is very slow. It may take 2–4 years and in some cases longer.

(f) **BULIMIA NERVOSA** (*Overeating, then induced vomiting*)

In Older Girls:

The Bulimia Nervosa is *neurotic* in slightly *older girls*.

Reasons: It is due to overeating fattening food such as fried food or cream cakes. This overeating is followed immediately by self induced vomiting, fasting or purgatives. The frequent vomiting and purging may cause physical effects including serum electrolyte imbalance and frequent repeating infections.

Treatment: Treatment of *bulimics* is likely to be prolonged.

The initial treatment is to overcome the effects of weight loss and malnutrition. It is necessary to undertake the treatment in hospital under strict supervision.

(g) **PILES** (*Thickening of Mucus, Anal Fissure*):

The piles or hemorrhoids (٤٤) are masses of dilated, tortuous veins (swelling or bulging) in the anorectic mucosa.

Bleeding During Bowl Movement: These masses may sometimes start bleeding during bowl movement.

Constipation: Situation may aggregate when the patient suffers from constipation.

The urge to defecate is depressed and it becomes difficult to expel the faeces.

Distension of Rectum: This may cause other symptoms of ill health because of the physical distension of the rectum.

Cures: The only therapy required is the improvement of the hygiene and the use of food softness such as roughage in food or *laxatives*.

The patients are advised *not to sit on hard seats*.

Depending on severity of the symptoms, sometimes the hemorrhoids have to be *removed surgically*.

(g) **ULCER**

The inner wall of digestive tract is normally covered with mucous, which protects it from enzymes.

Self Eating of Stomach and Duodenum: When the mucous layer is broken down, the digestive enzymes begin to eat away the walls of stomach or duodenum. This result in a sore called ulcer.

Hole Formations in Wall: An ulcer is so severe that 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 taken.

Peptic Ulcer: The ulcer due to *excessive secretions of gastric acid* is called peptic ulcer. Excess gastric acid secretion is an important factor of peptic ulcer.

Reasons of Peptic Ulcer:

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

+ SOME CONCEPTUAL SHORT QUESTIONS

Q.1 Differentiate the physiology of human liver and pancreas in digestive system.

Ans. **Liver and Pancreas** Liver produces *bile*. Bile is released in duodenum. Bile is without enzymes but it *emulsifies* the fats.

Pancreas secretes several enzymes and bicarbonate ions which come into small intestine for digestive role.

Q.2 Differentiate between tubular and vascular digestive systems.

Ans. **Tubular and Vascular Digestive Systems** *Vascular digestive system* is sac like in structure, it has single opening for mouth and anal function. It is primitive. e.g. Hydra.

Tubular digestive system has anterior end and posterior end-Anterior end of digestive system has mouth and posterior end has anus. It is advance system. e.g. Man etc.

Q.3 What is the main similarity between trypsin and pepsin and what is difference between its?

Ans. **Trypsin and Pepsin** Both trypsin and pepsin are digestive enzymes. Both digest the proteins. *Pepsin* performs its function in stomach because it requires acidic medium.

Trypsin is alkaline loving. So it digests the protein in small intestine. Small intestine has alkaline medium.

Q.4 Differentiate between gastrin and secretin.

Ans. **Gastrin** Gastrin is a *hormone* which is secreted by stimulation of extra proteins in the food. Gastrin is secreted *from secretory cells of gastric lining* (endocrine lining). Ultimately, more gastric juice is produced by extra secretion of gastrin. Gastrin promotes production of gastric juice.

Secretin Secretin is that *hormone* which stimulates pancreatic and hepatic secretions. *Mucosa of intestine* is source of secretin.

Secretin promotes production of pancreatic juice and inhibits gastric juice.

Q.5 Why are caecae and villi important?

Ans. **Caecae** like structures *increase surface area and absorbing area* in the digestive system of organisms. *e.g., planaria.*

Villi are the finger like small projections *which promote, absorption of digested food. e.g., man.*

CONCEPTUAL TOUCH