14. Human Nutrition

Can you recall?

1. What is nutrition?
2. Enlist life processes that provide us energy to perform different activities.

Nutrition is the sum of the processes by which an organism consumes and utilises food substances. WHO (World Health Organisation) defines nutrition as the intake of food, considered in relation to the body's dietary needs. The dietary needs of a healthy human being include carbohydrates, proteins, fats, vitamins, minerals, water and fibres in adequate amounts. The term nutrition includes the processes like ingestion, digestion, absorption, assimilation and egestion. Food provides energy and organic material for growth and tissue repair. Vitamins and minerals are also required in small quantities for nutrition. The food that is consumed needs to be processed before it is utilised.

Think about it

Our diet includes all necessary nutrients. Still we need to digest it. Why is it so?

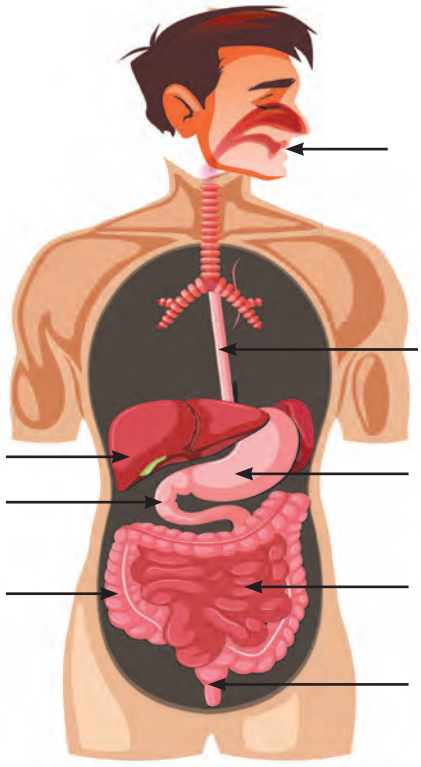
Digestion is defined as the process by which the complex, non-diffusible and non-absorbable food substances are converted into simple, diffusible and assimilable substances.

14.1 Human Digestive System : Digestive system of man consists of alimentary canal and associated digestive glands.

Alimentary canal : It is a long tubular structure starting from mouth and ending with anus. It is about 8-10 meters long and consists of following organs :

Mouth : Also called as oral or buccal cavity

Label the diagram



is bounded by fleshy lips. It's side walls are formed of cheeks, roof is formed by palate and floor by tongue. It is internally lined by a mucous membrane. Salivary glands open into the buccal cavity.

Teeth : 32 teeth are present in the buccal cavity of an adult human being. Human dentition is described as thecodont, diphyodont and heterodont. It is called thecodont type because each tooth is fixed in a separate socket present in jaw bones by gomphosis type of joint. In our life time, we get only two sets of teeth, milk teeth and permanent teeth. This is called diphyodont dentition. We have four different type of teeth hence we are heterodont. Types of teeth are incisors (I) canines (C) premolars (PM) and molar (M). Each half of each jaw has two incisors, one canine, two premolars and three molars.

Thus, dental formula of adult human can be represented as.

$$I\frac{2}{2}, C\frac{1}{1}, PM\frac{2}{2}, M\frac{3}{3} = \frac{2,1,2,3}{2,1,2,3}$$

i.e. 8 × 2=16 teeth in each jaw. =32 teeths

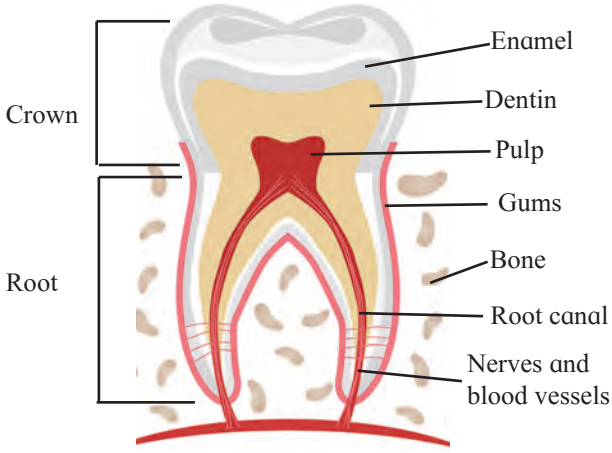


Fig. 14.1 Tooth Anatomy

Find out

1. What will be the dental formula of a three years old child?
2. What is dental caries and dental plaque? How can one avoid it ?

Internet my friend

1. Find out the role of orthodontist and dental technician.
2. What is root canal treatment?

A tooth consists of the portion that projects above the gum called crown and the root that is made up of two or three projections which are embeded in gum. A short neck connects the crown with the root. The crown is covered by the hardest substance of the body called enamel. Enamel is made up of calcium phosphate and calcium carbonate. Basic shape of tooth is derived from dentin, a calcified connective tissue. The dentin encloses a cavity called pulp cavity. It is filled with connective tissue pulp. Pulp cavity contains blood vessels and nerves. Pulp cavity has extension in the root of the tooth called root canal. The dentin of the root of tooth is covered by cementum, a bone like substance that attaches the root to the surrounding socket in the gum.

The study of teeth with respect to their number, arrangement, development etc is known as dentition.

Tongue : It is a muscular, fleshy organ and roughly triangular in shape. It lies along the floor of the buccal cavity. The upper surface of the tongue bears numerous projections called papillae. Some papillae bear sensory receptors called taste buds.

Do you know ?

1. Who controls the deglutition?
2. Is deglutition voluntary or involuntary?

Pharynx : The buccal cavity leads to a short pharynx. Pharynx is a common passage for food and air. The upper region of pharynx is called trachea. The pharynx opens into trachea through an opening called glottis. The glottis is guarded by a cartilaginous flap called epiglottis. The epiglottis closes during the swallowing (deglutition) action and prevents entry of food into the trachea. The lower region of pharynx is called oropharynx. Oropharynx opens into oesophagus through gullet.

Oesophagus : The oesophagus is a thin, muscular tube. It lies behind the trachea. This ≈25cm long tube passes through the neck, central aspect of rib cage, pierces the diaphragm and joins the stomach. It is lined by mucus cells. Mucus lubricates the passageway of food. Histologically, oesophagus is made up of longitudinal and circular muscles. The rhythmic wave of contraction and relaxation of these muscles is called peristalsis that helps in passage of food through oesophagus.

Stomach : The stomach is located in the upper left portion of the abdominal cavity. It is a muscular sac-like 'J' shaped organ, around 25 to 30cm in length. It is divided into upper cardiac region and lower pyloric region.

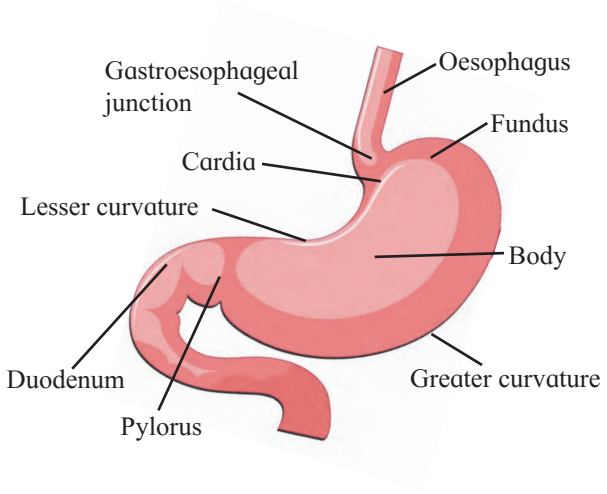


Fig. 14.2 Stomach

Cardia or Cardiac : It is first part in which oesophagus opens. The cardia surrounds the band of circular muscles present at the junction of oesophagus and stomach called cardiac sphincter. The cardiac sphincter prevents back flow or regurgitation of food from stomach to oesophagus.

Fundus : It is the dome shaped region above and left of cardia.

Body : It forms the large central portion of stomach that stores the food.

Pylorus : It is a narrow posterior region of stomach. It opens into duodenum, the initial part of small intestine. This opening is guarded by a set of sphincter muscles called pyloric sphincter. It regulates the flow of food from stomach to small intestine.

The stomach temporarily stores the food and gives the feeling of satiety. It churns the food and helps in mixing the food with gastric juice.

Small Intestine : In human, it is about 6 meters long and 2.5 cms broad tube coiled within abdominal cavity. The coils are held together by mesenteries, supporting the blood vessels, lymph vessels and nerves. It is divided into three parts.

Duodenum : It is about 26 cm long 'U' shaped structure. The duodenum turns towards left side of abdominal cavity below the stomach.

Jejunum : It is about 2.5 meters long, coiled middle portion of small intestine. It is narrower than the duodenum.

Ileum : It is about 3.5 meters long. It is highly coiled and little broader than jejunum. The ileum opens into the caecum of large intestine at ileocaecal junction.

Large Intestine : Ileum opens into large intestine. It is 1.5 meters in length. It is wider in diameter and shorter than small intestine. It consists of caecum, colon and rectum.

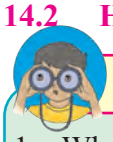
Caecum : Caecum is a small, blind sac present at the junction of ileum and colon. It is 6cm in length. It hosts some symbiotic micro-organisms. An elongated worm like vermiform appendix arises from the caecum. Appendix is vestigial organ in human beings and functional in herbivorous animals for the digestion of cellulose.

Colon : Caecum opens into colon. Colon is tube like-organ consist of three parts, ascending colon, transverse colon and descending colon. The colon is internally lined by mucosal cells.

Rectum : It is posterior region of large intestine. It temporarily stores the undigested waste material called faeces till it is egested out through anus.

Anus : Anus is the terminal opening of alimentary canal. It is guarded by sphincter. It expels faecal matter by a process called egestion or defaecation.

14.2 Histological structure of alimentary



Find out

1. What is heart burn? Why do we take antacids to control it?
2. You must have heard of appendicitis. It is inflammation of appendix. Find more information about this disorder.

Activity :

Make a model of human digestive system in a group.

canal :

The entire gastrointestinal tract is lined by four basic layers from inside to outside namely, mucosa, submucosa, muscularis and serosa. These layers show modification depending on the location and function of the organ concerned.

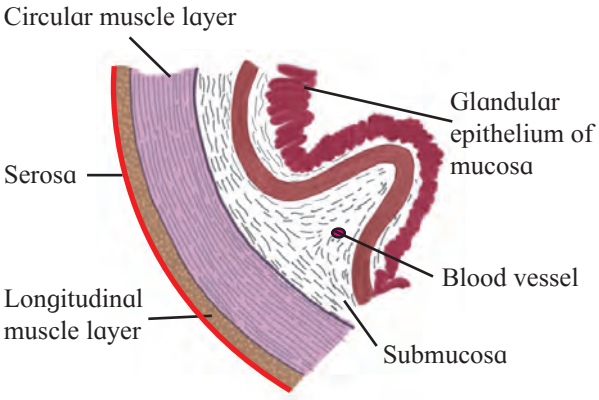


Fig. 14.3 Histology of alimentary canal

Serosa : It is the outermost layer. It is made up of a layer of squamous epithelium called mesothelium and inner layer of connective tissue.

Muscularis : This layer is formed of smooth muscles. These muscles are usually arranged in three concentric layers. Outermost layer shows longitudinal muscles, middle circular muscles and inner oblique muscles. This layer is wider in stomach and comparatively thin in intestinal region. The layer of oblique muscles is absent in the intestine.

Submucosa : It is formed of loose connective tissue containing blood vessels, lymph vessels and nerves. Duodenal submucosa shows presence of glands.

Mucosa : The lumen of the alimentary canal is lined by mucosa. Throughout the length of alimentary canal, the mucosa layer shows presence of goblet cells that secrete mucus. This lubricates the lumen of alimentary canal. This layer shows modification in different regions of alimentary canal. In stomach, it is thrown into irregular folds called rugae. In stomach mucosa layer forms gastric glands that secrete gastric juice.

Mucosa of small intestine forms finger like foldings called villi. The intestinal villi are lined by brush border or epithelial cells having microvilli at the free surface. Villi are supplied with a network of capillaries and lymph vessels called lacteals. Mucosa forms crypts in between the bases of villi in intestine called crypts of Lieberkuhn. These are intestinal glands.

12.3 Digestive Glands :

The digestive glands associated with the alimentary canal include the salivary glands, liver and pancreas.

Salivary glands : There are three pairs of salivary glands which open in buccal cavity. Parotid glands are present in front of the ear. The submandibular glands are present below the lower jaw. The glands present below the tongue are called sublingual. Salivary glands are made up of two types of cells. Serous cells secrete a fluid containing digestive enzyme called salivary amylase. Mucous cells produce mucus that lubricates food and helps swallowing.

Liver : This dark reddish-brown coloured gland is present just below the diaphragm. It occupies the right upper portion of the abdominal cavity. It is the largest gland of the body. It weighs about 1.2 to 1.5 kg in an adult human being. Each lobe of this bilobed gland is covered by thin covering called Glisson's capsule. This capsule is made up of connective tissue. Each lobe is divided into several structural and functional units of liver called hepatic lobules. Each hepatic lobule is polygonal in shape. At the junction of adjacent lobules a triangular portal area is present. In this portal area a branch of each of hepatic artery, hepatic portal vein and bile duct is present.

A lobule consist of cords of hepatic cells which are arranged around a central vein. In between the cords of hepatic cells, spaces called sinusoids are present through which the blood flows. In the sinusoids, phagocytic cells called Kupffer cells are present.

These cells destroy toxic substances, dead and worn-out blood cells and microorganisms. Hepatic cells produce bile juice. It is collected and carried through bile duct and stored in sac like gall bladder. The duct of the gall bladder and hepatic duct together form common bile duct. Liver is a vital organ. Bile juice secreted by liver emulsifies fats and makes food alkaline.

Liver stores excess of glucose in the form of glycogen. Deamination of excess amino acids to ammonia and its further conversion to urea takes place in liver. It is also involved in synthesis of vitamins A, D, K and B_{12}. Liver also produces blood proteins like prothrombin and fibrinogen. During early development, liver acts as haemopoietic organ. Kupffer cells help in detoxification process and destruction of old RBCs.

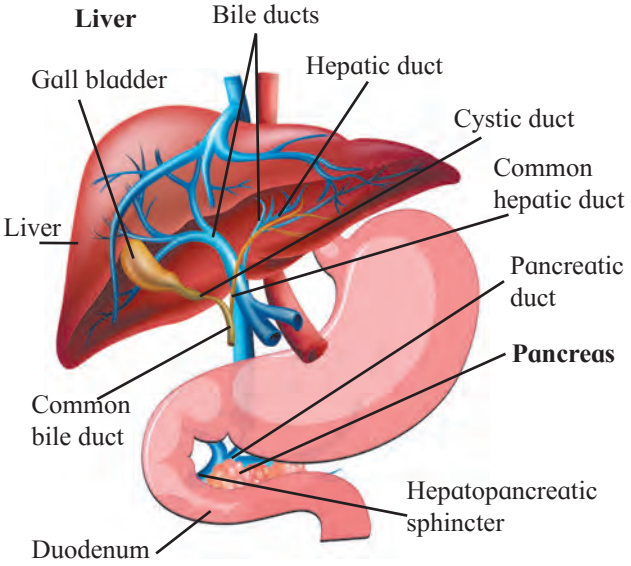


Fig. 14.3 Liver and Pancreas

Pancreas : Pancreas is a leaf shaped heterocrine gland present in the gap formed by bend of duodenum under the stomach. Exocrine part of pancreas is made up of acini. Acinar cells secrete alkaline pancreatic juice that contains various digestive enzymes. Pancreatic juice is collected and carried to duodenum by pancreatic duct. The common bile duct joins pancreatic duct to form hepato-pancreatic duct. It opens into duodenum. Opening of hepato-pancreatic duct is guarded by sphincter of Oddi.

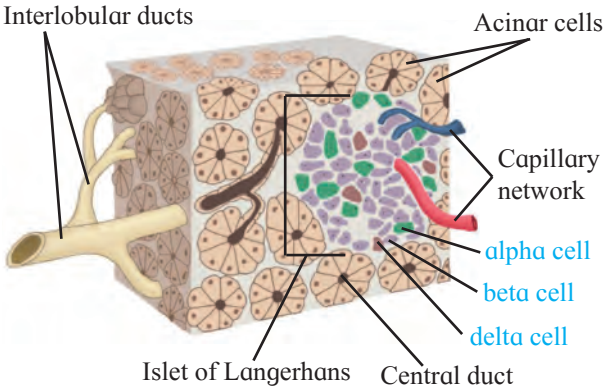


Fig. 14.4 Histological structure of Pancreas

Endocrine part of pancreas is made up of groups of cells called islets of Langerhans present between the acini. Islets contain three types of cells. α-cells secrete glucagon, β-cells secrete insulin and somatostatin hormone is secreted by δ-cells. Glucagon and insulin together control the blood-sugar level. Somatostatin hormone inhibits glucagon and insulin secretion.

Use your brain power

1. Draw a neat labelled diagram of human alimentary canal and associated glands *in situ*.
2. Write a note or human dentition.
3. Liver is a vital organ. Justify.
4. Muscularis layer in stomach is thicker than that in intestine. Why is it so?

12.4 Physiology of digestion :

We are already aware that food we consume needs to be processed in order to utilise it completely. Physiology of digestion includes various processes involved in simplification of food. Digestion process is carried out by both mechanical as well as biochemical methods. Mechanical digestion includes various movements of alimentary canal that help chemical digestion. Mastication or chewing of food by teeth, churning in stomach and peristaltic movements of gastrointestinal tract bring about mechanical digestion in human body.

Chemical digestion is a series of catabolic (breaking down) reactions that hydrolyse the food. Let us now study the process of digestion from the point where it enters the body i.e. mouth.

Digestion in the buccal cavity : Both mechanical and chemical digestion processes take place in mouth. Mastication or chewing of food takes place with the help of teeth and tongue. Teeth crush and grind the food. Tongue manipulates the food. Crushing of food becomes easier when it gets moistened by saliva. Mucus in the saliva lubricates the food as well as it helps in binding the food particles into a mass of food called bolus. The bolus is swallowed by deglutition. The tongue presses against the palate and pushes the bolus into pharynx. Bolus further passes to the oesophagus.

The saliva contains 98% water and 2% other constituents like electrolytes (sodium, potassium, calcium, chloride, bicarbonates), digestive enzyme salivary amylase. The only chemical digestion that takes place in mouth is by the action of salivary amylase. It helps in conversion of starch into maltose. About 30% starch gets converted to maltose in mouth.

$$\text{Starch (Polysaccharide)} \xrightarrow[\text{pH 6.8}]{\text{Salivary amylase}} \text{Maltose (Disaccharide)}$$

Saliva also contains lysozyme. It acts as an antibacterial agent that prevents infections. The bolus further passes down through the oesophagus by peristalsis. Sometimes regurgitation or vomiting takes place due to reverse spasmodic peristalsis. Food from the oesophagus enters the stomach. The gastro-oesophageal sphincter controls the passage of food into the stomach.

Digestion in the stomach : Both mechanical and chemical digestion takes place in stomach. The stomach stores the food for 4-5 hours. The physical digestion happens by churning of food. Thick muscular wall of stomach helps churning process. Churning further breaks down the food particles and also helps in thorough mixing of gastric juice with food.

The mucosa layer of stomach has gastric gland. Each gastric glands has three major types of cells namely, mucus cells, peptic or chief cells and parietal or oxyntic cells. Mucus cells secrete mucus. Peptic cells secrete proenzyme pepsinogen. Parietal cells secrete HCl and intrinsic factor which is essential for absorption of vitamin B_{12}. Thus, gastric juice contains mucus, inactive enzyme pepsinogen, HCl and intrinsic factor. In infants, stomach also secretes rennin. Mucus protects the inner lining of stomach from HCl present in gastric juice.

HCl in gastric juice makes the food acidic and stops the action of salivary amylase. It kills the germs that might be present in the food. Pepsinogen gets converted into active enzyme pepsin in the acidic medium provided by HCl. In presence of pepsin, proteins in the food get converted into simpler forms like peptones and proteoses.

$$\text{Pepsinogen (Inactive enzyme)} \xrightarrow[\text{pH (1.8)}]{\text{HCl}} \text{Pepsin (Active enzyme)}$$

$$\text{Proteins} \xrightarrow[\text{Acidic medium}]{\text{Pepsin}} \text{Peptones} + \text{Proteoses}$$

Always Remember

Food remains for a very short time in mouth but action of salivary amylase continues for further 15 to 30 minutes till gastric juice mixes with food in the stomach. Why do you think it stops after the food gets mixed with gastric juice?

Rennin found in gastric juice of infants acts on casein, a protein present in milk. It brings about curdling of milk proteins with the help of calcium. The coagulated milk protein is further digested with the help of pepsin. Rennin is absent in adults. At the end of gastric digestion, food is converted to a semifluid acidic mass of partially digested food is called chyme.

The chyme from stomach is pushed in the small intestine through pyloric sphincter for further digestion.

Internet my friend

1. What is lactose intolerence?
2. How are bile pigments formed?

Digestion in the small intestine : In the small intestine, intestinal juice, bile juice and pancreatic juice are mixed with food. Peristaltic movements of muscularis layer help in proper mixing of digestive juices with chyme. Bile juice and pancreatic juice are poured in duodenum through hepato-pancreatic duct.

Bile juice is dark green coloured fluid that contains bile pigments (bilirubin and biliverdin), bile salts (Na- glycocholate and Na-taurocholate), cholesterol and phospholipid. Bile does not contain any digestive enzyme. Bile salts neutralise the acidity of chyme and make it alkaline. It brings about emulsification of fats. It also activates lipid digesting enzymes or lipases. Bile pigments impart colour to faecal matter.

Pancreatic juice secreted by pancreas contains pancreatic amylases, lipases and inactive enzymes trypsinogen and chymotrypsinogen. Pancreatic juice also contains nucleases- the enzymes that digests nucleic acids. The intestinal mucosa secretes digestive enzymes. The goblet cells of mucosa produce mucus. Mucus plus intestinal enzymes together constitute intestinal juice or succus entericus. The intestinal juice contains various enzymes like dipeptidases, lipases, disaccharidases etc.

Both pancreatic and intestinal lipases initially convert fats into fatty acid and diglycerides.

Diglycerides are further converted to monoglycerides by removal of fatty acid from glycerol. The mucus and bicarbonates present in pancreatic juice protect the intestinal mucosa and provide alkaline medium for enzymatic action. Sub-mucosal Brunner's glands help in the action of goblet cells. Most of the digestion gets over in small intestine. Let us study the action of pancreatic and intestinal secretion in sequential manner.

Think about it

How can I keep my pancreas healthy? Can a person live without pancreas?

Do you know ?

Why do we feel hungry? Ghrelin is a hormone that is produced mainly by the stomach and small intestine, pancreas and brain. It is known as the 'hunger hormone' because it stimulates appetite, increases food intake and promotes fat storage.

Action of pancreatic juice :

Pancreatic amylase acts on glycogen and starch and convert those to disaccharides. Lipases hydrolyse fat molecules into fatty acids and monoglycerides. Inactive trypsinogen present in pancreatic juice is converted to its active form, trypsin. This conversion is brought about by enterokinase present in intestinal juice. Trypsin converts proteins as well as proteoses and peptones to polypeptides. It also converts chymotrypsinogen to active chymotrypsin. Chymotrypsin converts polypeptides to dipeptides.

Do it yourself

You have studied the representation of enzymatic actions in the form of reactions. Write the reactions of pancreatic enzymes.

Nucleases present in pancreatic juice help in digestion of nucleic acids to pentose sugar and nitrogenous base.

Nucleic acids $\xrightarrow{\text{Nucleases}}$ Nucleotides

Nucleotides $\xrightarrow{\text{Nucleotidases}}$ Nucleosides + phosphate

Nucleosides $\xrightarrow{\text{Nucleosidases}}$ Sugar + base

Action of intestinal juice :

Do it yourself

Observe the following reactions and explain in words.

Maltose $\xrightarrow{\text{Maltase}}$ glucose

Sucrose $\xrightarrow{\text{Sucrase}}$ glucose + fructose

Lactose $\xrightarrow{\text{Lactase}}$ glucose + galactose

Dipeptides $\xrightarrow{\text{Dipeptidase}}$ Amino acids

Emulsified fats $\xrightarrow{\text{Lipase}}$ fatty acids + monoglycerides

Conversion of proteins into amino acids, fats to fatty acids and monoglycerides, nucleic acids to sugar and nitrogenous base and carbohydrates to monosaccharides marks the end of digestion of food. Food is now called chyle. Chyle is an alkaline slurry which contains various nutrients ready for absorption. The nutrients are absorbed and undigested remains are transported to large intestine.

Remember, mucosa of large intestine produces mucus but no enzymes. Some carbohydrates and proteins do enter the large intestine. These are digested by the action of bacteria that live in the large intestine. Carbohydrates are fermented by bacterial action and hydrogen, carbon dioxide and methane gas are produced in colon.

Protein digestion in large intestine ends up into production of substances like indole, skatole and H_2S. These are the reason for the odour of faeces. These bacteria synthesise several vitamins like B vitamins and vitamin K.

It is essential that the digestive enzymes and juices are produced in sequential manner and at a proper time. These secretions are under neurohormonal control. Sight, smell and even thought of food trigger saliva secretion. Tenth cranial nerve stimulates secretion of gastric juice in stomach. Even the hormone gastrin brings about the same effect. You must have experienced hunger pangs at your regular meal times. Can you now reason out why it happens? Intestinal mucosa produces hormones like secretin, cholecystokinin (CCK) and gastric inhibiting peptide (GIP). Secretin inhibits secretion of gastric juice. It stimulates secretion of bile juice from liver, pancreatic juice and intestinal juice. CCK brings about similar action and induces satiety that is feeling of fullness or satisfaction. GIP also inhibits gastric secretion.

Do you know ?

Pancreatitis is inflammation of the pancreas. It may occur due to alcoholism and chronic gallstones. Other reasons include high levels of calcium, fats in blood. However, in 70% of people with pancreatitis, main reason is alcoholism.

Use your brain power

1. Make a flow chart for digestion of carbohydrate.
2. What is a proenzyme? Enlist various pro-enzymes involved in process of digestion and state their function.
3. Differentiate between chyme and chyle.
4. Digestion of fats take place only after the food reaches small intestine. Give reason.

Observe and Discuss Action of digestive juice in your group.

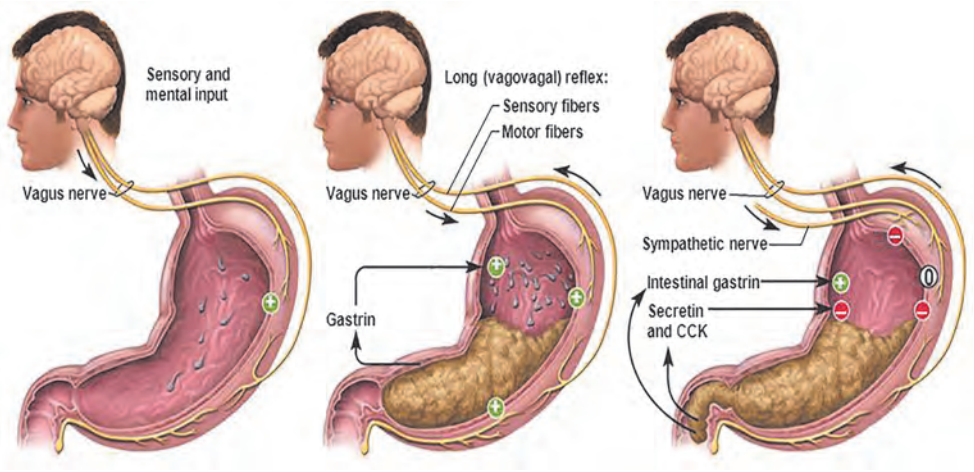


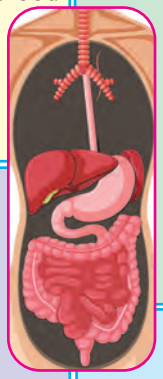
Fig. 14.5 Regulation of gastric function

14.5 Absorption, assimilation and egestion:

The passage of end products of digestion through the mucosal lining of alimentary canal into blood and lymph is called absorption. Absorption takes place by various ways like simple diffusion, osmosis, facilitated transport and active transport. About 90% of absorption takes place in the small intestine and the rest in mouth, stomach and large intestine.

Mouth: Absorption takes place through mucosa of mouth and lower side of tongue into the blood capillaries. e.g. Some drugs like certain painkillers.

Stomach: Gastric mucosa is impermeable to most substances hence nutrients reach unabsorbed till small intestine. Little water, electrolytes, alcohol and drugs like aspirin get absorbed in stomach.



Small Intestine: Glucose, fructose, galactose, amino acids, minerals and water soluble vitamins are absorbed in blood capillaries in villi. Lipids and fat soluble vitamins (A, D, E, K) are absorbed in lacteals.

Large intestine: Absorption of water, electrolytes like sodium and chloride, drugs and some vitamins takes place.

Absorption of nutrients in alimentary canal

Absorption of part of glucose, amino acids and some electrolytes like chloride ions are absorbed by simple diffusion depending on concentration gradient.

Some amino acids as well as substances like fructose are absorbed by facilitated transport. In this method, carrier ions like Na^+ bring about absorption. Some ions are absorbed against concentration gradient. It requires energy. This type of absorption of mineral like sodium is called active transport. Water is absorbed along the concentration gradient.

Monoglycerides and fatty acids can not be absorbed in blood. These dissolve in the centre of spherical aggregates formed by bile salts called micelles. Micelles enter into intestinal villi. Here, they are reformed into chylomicrons. Chylomicrons are small protein coated fat globules. They are transported into lymph vessels called lacteals. From here, they are transported to blood stream.

Observe the adjacent chart to find out absorption in various parts of alimentary canal.

Assimilation : The absorbed food material finally reaches the tissue and becomes a part of protoplasm. This is called as assimilation.

Egestion : Undigested waste is converted to faeces in colon and reaches rectum. Faeces contain water, inorganic salts, sloughed of mucosal cells, bacteria and undigested food. Distension of rectum stimulates pressure sensitive receptors that initiate a neural reflex for defecation or egestion. It is a voluntary process that takes place through anal opening guarded by sphincter muscles.

Can you recall?

1. What is balanced diet?
2. Explain the terms undernourished, overnourished and malnourished in details.

Do you know ?

Now a days we talk about calories of food we consume. What is this calorie? The amount of heat liberated by complete combustion of 1g food in a bomb calorimeter is termed as gross calorific (gross energy) value. In animals, the energy content of food is expressed in terms of heat energy. The actual energy produced by 1g food is its physiological value.

Actual energy produced by 1 gm of food.

Sr. No.	Food Component	Gross calorific value (Kcal/g)	Physiological value (Kcal/g)
1.	Fats	9.45	9.0
2.	Proteins	5.65	4.0
3	Carbohydrates	4.1	4.0

14.6 Nutritional disorders and disorders of digestive system :

Nutrition related disorders can be categorised based on the food that an individual consumes and conditions that develop due to malfunctioning of the organ/s or glands associated with digestive system.

You are already aware that little extra or less of nutrition can lead to dietary disorder. Inadequate intake of proteins causes Protein Energy Malnutrition (PEM). It can be associated with inadequacy of vitamins and minerals in diet. PEM can cause diseases like Kwashiorkar and Marasmus.

Kwashiorkar : This protein deficiency disorder is found generally in children between one to three years of age. Children suffering from Kwashiorkar are underweight and show stunted growth, poor brain developement, loss of appetite, anaemia, protruding belly, slender legs, bulging eye, oedema of lower legs and face, change in skin and hair colour.

Marasmus : It is a prolonged protein energy malnutrition (PEM) found in infants under one year of age. In this disease, protein deficiency is coupled with lower total food calorific value. Inadequate diet impairs physical growth and retards mental development, subcutaneous fat disappears, ribs become prominent, limbs become thin, skin becomes dry, thin and wrinkled, loss of weight, digestion and absorption of food stops due to atrophy of digestive glands. There is no oedema.

Major cause of these disorders is unavailability of nutritious food. Poverty, large family size, ill spacing of children, early termination of breast feeding and overdiluted milk are a few causes. Because of malnutrition, infectious diseases become opportunistic and it worsens the condition. Proper diet can help in reversal of symptoms.

Indigestion : Overeating, inadequate enzyme secretion, spicy food, anxiety can cause discomfort and various symptoms. It is called indigestion. Improperly digested food or food poisoning also can cause indigestion. It leads to loss of appetite, acidity (acid reflux), heart burn, regurgitation, dyspepsia (upper abdominal pain), stomach pain.

Avoiding eating large meal, lying down after meal, spicy, oily, junk food, smoking, alcohol are the preventive measures for indigestion.

Constipation : When frequency of defaecation is reduced to less than once per week the condition is called constipation. Difficulty in defaecation may result in abdominal pain distortion, rarely perforation. The causes are, affected colonic mobility due to neurological dysfunction like spinal cord injury, low fibre diet, inadequate fluid intake and inactivity. Roughage, sufficient fluids in diet, exercise can help improve the conditions.

Diarrhoea : Passing loose watery stools more than three times a day is called diarrhoea. Diarrhoea can lead to dehydration. The other symptoms are blood in stool, nausea, bloating, fever depending on cause and severity of the disorder. The causes of diarrhoea are infection through food and water or disorders like ulcer, colitis, inflammation of intestine or irritable bowel syndrome.

Jaundice : We all associate jaundice with yellowness of conjunctiva of eyes and skin and whitish stool. These are the symptoms of condition called jaundice. It is a sign of abnormal bilirubin metabolism and excretion. Jaundice develops if excessive break down of red blood cells takes place along with increased bilirubin level than the liver can handle or there is obstruction in the flow of bile from liver to duodenum. Bilirubin produced from breakdown of haemoglobin is either water soluble or fat soluble. Fat soluble bilirubin is toxic to brain cells. Hence serum bilirubin values have great diagnostic importance. There is no specific treatment to jaundice. Supportive care, proper rest are the treatments given to the patient.

Vomiting : In this condition, the stomach contents are thrown out of the mouth due to reverse peristaltic movements of gastric wall. It is controlled by non-vital vomiting centre of medulla. It is typically associated with nauseatic feeling.

Find out

1. Find out the status of malnutrition among children in Maharashtra and efforts taken by the government to overcome the situation. Search for various NGOs working in this field.
2. Are jaundice and hepatitis same disorders?

Do you know ?

Alcoholism causes different disorders of liver like steatosis (fatty liver), alcoholic hepatitis, fibrosis and cirrhosis.

Collect more information on these disorders and try to increase awareness against alcoholism in society.

Collect information about NGOs working against alcoholism.

Know the scientists

Kamala Sohoni was the first Indian woman to receive Ph.D. in science discipline. She worked under the guidence of Dr. Robert Hill and discovered 'Cytochrome C', the electron carrier in mitochondria from potato.

Dr. Sohoni also worked on nutritional aspects of legumes, milk and neera. Her contribution was significant in terms of India's fight against malnutrition. She had designed a protocol for Aarey dairy to avoid curdling of milk.

Internet my friend

Collect the different videos of functioning of digestive system.

Exercise

1. Choose correct option

A. Acinar cells are present in .....
a. liver b. pancreas
c. gastric glands d. intestinal glands

B. Which type of teeth are maximum in number in human buccal cavity?
a. Incisors b. Canines
c. Premolars d. Molars

C. Select odd one out on the basis of digestive functions of tongue.
a. Taste b. Swallowing
c. Talking d. Mixing of saliva in food

D. Complete the analogy:
Ptyalin: Amylase : : Pepsin : ..... .
a. Lipase b. Galactose
c. Proenzyme d. Protease

2. Answer the following questions

A. For the school athletic meet, Shriya was advised to consume either Glucon-D or fruit juice but no sugarcane juice. Why it must be so?

B. Alcoholic people may suffer from liver disorder. Do you agree? Explain your answer.

C. Digestive action of pepsin comes to a stop when food reaches small intestine. Justify.

D. Small intestine is very long and coiled. Even if we jump and run, why it does not get twisted? What can happen if it gets twisted?

3. Write down the explanation

A. Digestive enzymes are secreted at appropriate time in our body. How does it happen?

B. Explain the structure of tooth. Explain why human dentition is considered as thecodont, diphydont and heterodont.

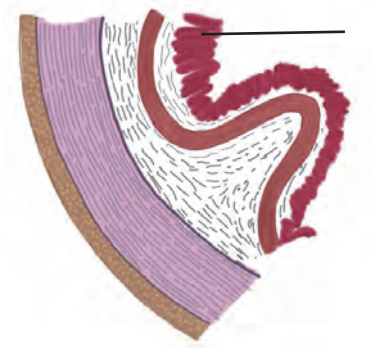
C. Explain heterocrine nature of pancreas with the help of histological structure.

4. Write short note on

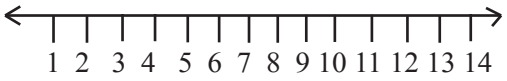
A. Position and function of salivary glands.

B. Jaundice

5. Observe the diagram. This is histological structure of stomach. Identify and comment on significance of the layer marked by arrow

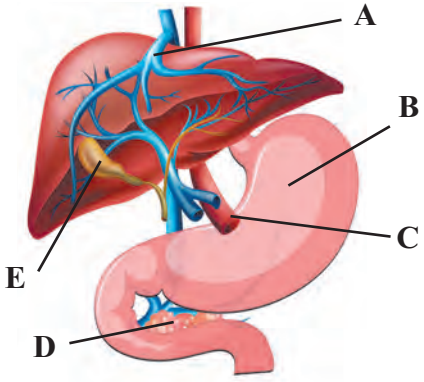


6. Find out pH maxima for salivary amylase, trypsin, nucleotidase and pepsin and place on the given pH scale



7. Write the name of a protein deficiency disorder and write symptoms of it.

8. Observe the diagram given below label the A, B, C, D, E and write the function of A, C in detail.



Practical / Project : **Here are the events in the process of digestion. Fill in the blanks and complete the flow chart.**