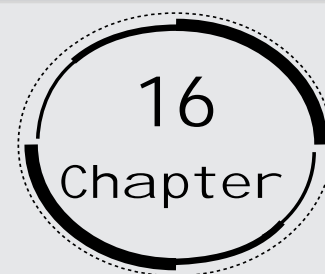


Digestion and Absorption



1. Choose the correct answer among the following:

- (a) Gastric juice contains
 (i) pepsin, lipase, and rennin
 (ii) trypsin lipase and rennin
 (iii) trypsin, pepsin, and lipase
 (iv) trypsin, pepsin, and renin

Ans: (i) Gastric juice contains pepsin, lipase, and rennin. Gastric juice contains pepsin, lipase, and rennin. Pepsin is secreted as pepsinogen, an inactive form that gets activated by HCl. Pepsin breaks or digests proteins into peptones. Lipase breaks down fats into fatty acids. Rennin present in gastric juice is a photolytic enzyme that helps in the coagulation of milk.

- (b) Succus entericus is the name given to
 (i) a junction between the ileum and large intestine
 (ii) intestinal juice
 (iii) swelling in the gut
 (iv) appendix

Ans: (ii) Succus entericus is the name assigned to intestinal juice. It contains a variety of enzymes such as maltase, lipases, nucleosidases, dipeptidases, etc., and is secreted by the intestinal gland.

2. Match column I with column II

Column I	Column II
(a) Bilirubin and biliverdin	(i) Parotid
(b) Hydrolysis of starch	(ii) Bile
(c) Digestion of fat	(iii) Lipases
(d) Salivary gland	(iv) Amylases

Ans:

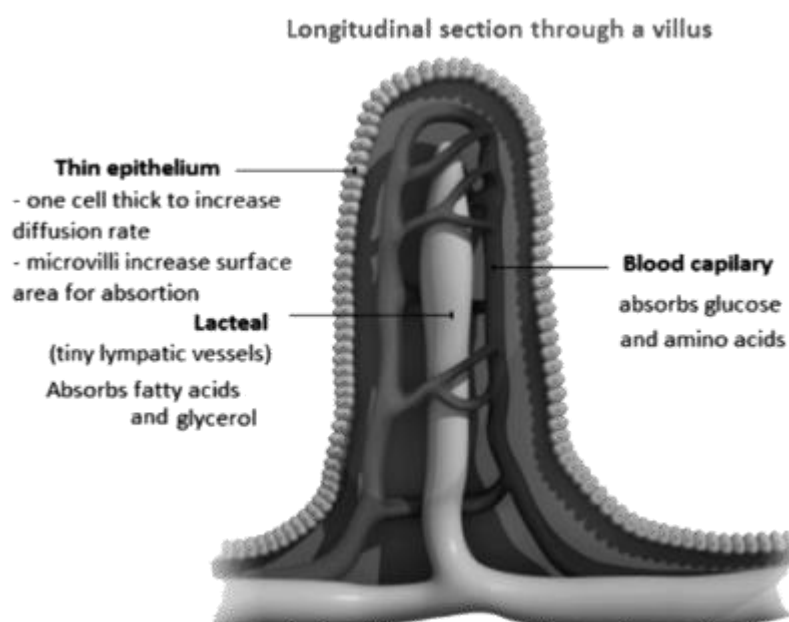
Column I	Column II
(a) Bilirubin and biliverdin	(ii) Bile

(b) Hydrolysis of starch	(iv) Amylases
(c) Digestion of fat	(iii) Lipases
(d) Salivary gland	(i) Parotid

3. Answer briefly:

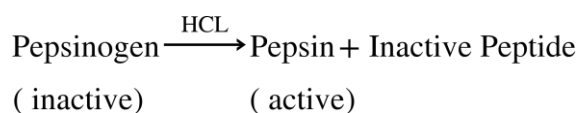
(a) Why are villi present in the intestine and not in the stomach?

Ans: Villi are present in the intestine and not in the stomach because it increases the surface area for absorption of food in the small intestine more efficiently.



(b) How does pepsinogen change into its active form?

Ans: Pepsinogen is a precursor of pepsin and it remains stored in the stomach walls. By the action of hydrochloric acid, pepsinogen is converted into pepsin. Activation of pepsin is done in the form of pepsinogen.

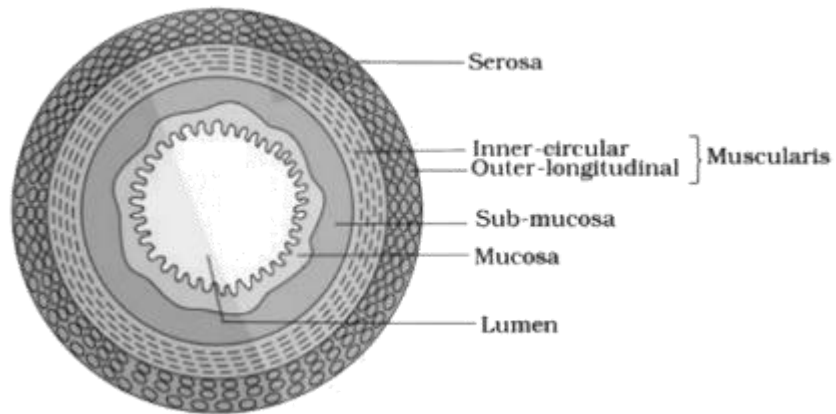


(c) What are the basic layers of the wall of the alimentary canal?

Ans: The four basic layers of walls of the alimentary canal are as follows:

- (i) The outermost layer of the human alimentary canal is named serosa. A thin layer of secretory epithelial cells, with some connective tissues underneath together, constitute the serosa.
- (ii) A thin layer of smooth muscles arranged into an outer longitudinal layer and an inner circular layer is muscularis.

- (iii) A layer of loose connective tissues, containing nerves, blood, and lymph vessels is a submucosa layer that supports the mucosa.
- (iv) The innermost lining of the lumen of the alimentary canal is mucosa which is mainly involved in absorption and secretion.



(d) How does bile help in the digestion of fats?

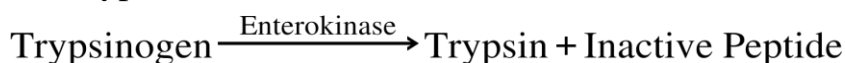
Ans: A digestive juice secreted by the liver and stored in the gallbladder is bile juice. The bile salts such as bilirubin and biliverdin remain present in bile juice. For the breakdown of large fat globules into smaller globules, the bile juice is responsible. This breakdown is essential so that the pancreatic enzymes can easily act on fat globules. The process of breakdown of fat is known as the emulsification of fats. Bile juice also activates lipase and makes the medium alkaline.

4. State the role of pancreatic juice in the digestion of proteins.

Ans: Pancreatic juice contains various kinds of inactive enzymes such as trypsinogen, chymotrypsinogen, pro carboxypeptidases, amylases, lipases, and nucleases. In the digestion of proteins, these enzymes play a very important role.

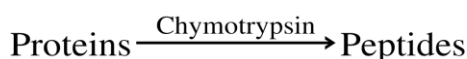
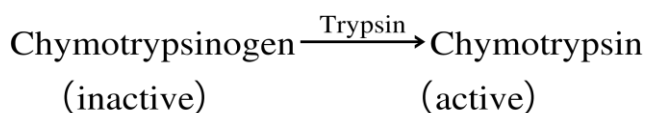
Physiology of protein-digestion

The intestinal mucosa secretes the enzyme enterokinase which activates trypsinogen into trypsin.



The other enzymes of pancreatic juice such as chymotrypsinogen and procarboxypeptidase are then activated by Trypsin.

Chymotrypsinogen converts proteins into peptides and it is a milk-coagulating enzyme.



Carboxypeptidase acts on the carboxyl end of the peptide chain and helps to release the last amino acids. In this way, it helps in the digestion of proteins.

Peptides $\xrightarrow{\text{Carboxypeptidase}}$ Smaller peptide chain + Amino acids

For their complete digestion, the partially-hydrolyzed proteins present in the chyme are acted upon by various proteolytic enzymes of the pancreatic juice.

Proteins, peptones $\xrightarrow[\text{Carboxypeptidase}]{\text{Trypsin / Chymotrypsin}}$ Dipeptides and proteases

5. Describe the process of digestion of protein in the stomach.

Ans: In the stomach, the digestion of proteins begins and it gets completed in the small intestine. The digestive juice secreted by the gastric glands present on the walls of the stomach is called gastric juice. When the food enters the stomach it gets mixed with the gastric juice and becomes acidic. The main gastric juice mainly consists of hydrochloric acid, pepsinogen, mucus, and rennin. Hydrochloric acid dissolves a bit of food to create an acidic medium so that pepsinogen can easily be converted into pepsin, esophagus digesting enzyme. It is secreted in its inactive form namely pepsinogen, which then gets activated by hydrochloric acid. The activated pepsin then transforms the proteins into proteases and peptides.

Proteins $\xrightarrow{\text{Pepsin}}$ Proteases + Peptides

Rennin is a proteolytic enzyme that plays an important role in the coagulation of milk and is released in an inactive form called prorennin.

Prorennin $\xrightarrow{\text{HCL}}$ Renin

↓

Milkcasein → Paracasein

6. Give the dental formula of human beings.

Ans: The dental formula represents the arrangement of teeth in each half of the upper jaw and the lower jaw. The entire formula is multiplied by two to give the total number of teeth present in different stages of life.

In human beings the dental formula for milk teeth is:

$\left\{ \frac{2102}{2102} \right\} \times 2 = 20$

Here each half of the upper jaw and lower jaw has 2 incisors, 1 canine, and 2 molars.

In milk teeth the premolars are absent.

In humans the dental formula for permanent teeth is:

$\left\{ \frac{2123}{2123} \right\} \times 2 = 32$

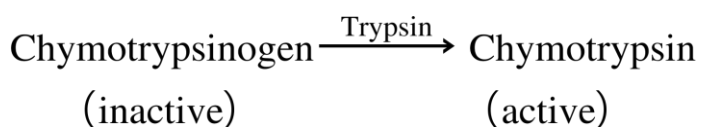
Here each half of the upper jaw and the lower jaw has 2 incisors, 1 canine, 2 premolars, and 3 molars. The total number of permanent teeth present in an adult human is 32.

7. Bile juice contains no digestive enzymes, yet it is important for digestion. Why?

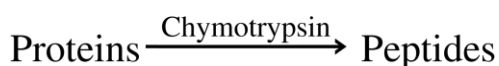
Ans: Bile a digestive juice is secreted by the liver. It does not contain any digestive enzymes but still, it plays a very important role in the digestion of fats. Bile juice consists of bile salts such as bilirubin and biliverdin which are responsible for the breakdown of large fat globules into smaller globules. This breakdown helps the pancreatic enzymes to easily act on them. This process of breakdown of fats is known as the emulsification of fats. Bile juice is responsible for making the medium alkaline and activates the enzyme lipase.

8. Describe the digestive role of chymotrypsin. Which two other digestive enzymes of the same category are secreted by their source gland?

Ans: The enzyme trypsin is present in the pancreatic juice that activates the inactive enzyme chymotrypsinogen into chymotrypsin.



The activated chymotrypsin plays an important role in the further breakdown of the partially hydrolyzed proteins.



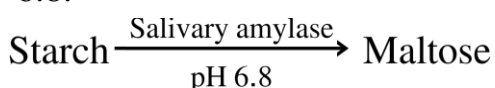
The other digestive enzymes of the same category are trypsinogen and carboxypeptidase. These are secreted by the same source-gland, the pancreas.

9. How are polysaccharides and disaccharides digested?

Ans: The digestion of carbohydrates takes place in the mouth and the small intestine region of the alimentary canal. The collective name for the enzymes that act on carbohydrates is carbohydrases.

Digestion in the mouth:

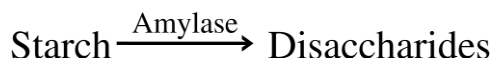
As soon as the food enters the mouth, it gets mixed with saliva. Saliva is secreted by the salivary glands that contain a digestive enzyme called salivary amylase. This enzyme salivary amylase is responsible for the breakdown of starch into sugar at pH 6.8.



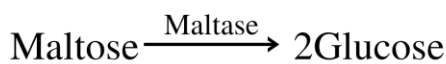
Salivary amylase continues to act in the oesophagus, but its action stops in the stomach as the contents become acidic. Hence, the digestion of carbohydrates stops in the stomach.

Digestion in the small intestine:

In the small intestine, the digestion of carbohydrates is resumed. As soon as the food enters the small intestine it gets mixed with the pancreatic juice and the intestinal juice. In pancreatic juice, the enzyme pancreatic amylase is present that hydrolyses the polysaccharides into disaccharides.



Similarly, in intestinal juice, a variety of enzymes or disaccharidases such as maltase, lactase, sucrase, etc. are present that helps in the digestion of disaccharides. Thus, in this way, the digestion of carbohydrates is completed in the small intestine.



10. What would happen if HCl were not secreted in the stomach?

Ans: Hydrochloric acid is secreted by the gastric glands present on the walls of the stomach. It dissolves bits of food and creates an acidic medium. The acidic medium allows pepsinogen to be converted into pepsin. Pepsin plays a very important role in the digestion of proteins. Therefore, if HCl weren't secreted in the stomach, then pepsin wouldn't be activated. This would affect protein digestion. A pH of about 1.8 is important for proteins to be digested. This pH is achieved by HCl.

11. How does butter in your food get digested and absorbed in the body?

Ans: Butter is fat content and it is completely digested in the small intestine. The bile juice secreted by the liver contains bile salts that break down large fat globules into smaller globules, to increase their surface area for the action of lipase. This process of breakdown of fats is known as the emulsification of fats. After this, the pancreatic lipase present in the pancreatic juice and the intestinal lipase present in the intestinal juice hydrolyzes the fat molecules into triglycerides, diglycerides, monoglycerides, and ultimately into glycerol.



Absorption of fats: The process of absorption of fats is an active process where fats are hydrolyzed or converted into fatty acids and glycerol. However, since these are water-insoluble, they cannot be directly absorbed by the blood. So, at first, they are incorporated into small droplets called micelles and then transported towards the intestinal mucosa villi developed during the organism's lifetime. They are then transformed into small microscopic particles called chylomicrons. These are small, protein-coated fat globules that are transported to the lymph vessels in the villi. The absorbed food is finally released into the bloodstream from the lymph vessels and from there to each cell of the body.

12. Discuss the main steps in the digestion of proteins as the food passes through different parts of the alimentary canal.

Ans: Proteins digestion begins in the stomach and it gets completed in the small intestine. The enzyme proteases act on protein digestion.

Digestion proteins in the stomach:

The digestive juice secreted in the gastric glands situated on the walls of the stomach is called gastric juice. HCl, pepsinogen, and rennin are the main constituents of gastric juice. The food that enters the stomach becomes acidic when mixed with this gastric juice.

The inactive pepsinogen is converted into active pepsin in the acidic medium. This active pepsin then converts proteins into proteases and peptides.

Proteins $\xrightarrow{\text{Pepsin}}$ Proteases + Peptides

The enzyme rennin plays a very important role in the coagulation of milk.

Digestion of protein in the small intestine:

As soon as the food enters the small intestine from the stomach it is acted upon by three enzymes pancreatic juice, intestinal juice (known as succus entericus), and bile juice that are present in the small intestine.

The action of pancreatic juice:

Pancreatic juice contains various inactive enzymes such as trypsinogen, chymotrypsinogen, and procarboxypeptidase. These enzymes are present in an inactivated state. They are activated by the enzyme enterokinase which is secreted from the intestinal mucosa and converts trypsinogen into trypsin.

Trypsinogen $\xrightarrow{\text{Enterokinase}}$ Trypsin + Inactive peptide

Now the other enzymes of pancreatic juice are activated by active trypsin. Chymotrypsinogen is a proteolytic enzyme that is responsible for the breakdown of proteins into peptides.

Chymotrypsinogen $\xrightarrow{\text{Trypsin}}$ Chymotrypsin

Proteins $\xrightarrow{\text{Chymotrypsin}}$ Peptides

On the carboxyl end of the peptide chain, the carboxypeptidases act and help in releasing the smallest unit of proteins i.e. amino acids.

Peptides $\xrightarrow{\text{Carboxypeptidase}}$ Smaller peptide chain + Amino acids

The action of bile juice:

Bile juice contains bile salts such as bilirubin and biliverdin which is responsible for the breakdown of large, fat globules into smaller globules so that pancreatic enzymes can easily act on them. This process of breakdown is known as the emulsification of fats. Bile juice is responsible for making the medium alkaline and it also activates lipase. The active lipase then breaks down the fats into diglycerides and monoglycerides.

The action of intestinal juice:

Intestinal juice contains a variety of enzymes. Pancreatic amylase digests polysaccharides into disaccharides. Then further digestion of disaccharides is done by the action of enzyme disaccharidases such as maltase, lactase, sucrase, etc. The enzyme proteases hydrolyze or convert peptides into dipeptides and finally into amino acids.

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

By the action of the enzyme pancreatic lipase, the fats get converted into diglycerides and monoglycerides. Similarly, the enzyme nucleases convert the nucleic acids into nucleotides and nucleosides.

13. Explain the terms thecodont and diphyodont.

Ans: Thecodont may be a sort of dentition in which the teeth are embedded within the deep sockets of the jaw bone. Ankylosis is absent and the roots present are cylindrical. The living crocodilians and mammals are examples of codont. Diphyodont type of dentition shows two successive sets of teeth that are developed during the lifetime of the organism. The very first set of teeth is deciduous and the other set is permanent. The permanent adult teeth replace the deciduous set of teeth. This type of dentition is found in humans.

14. Name different types of teeth and their number in an adult human.

Ans: There are four different types of teeth present in the mouth of an adult human.

They are as follows:

(i) Incisors: The eight teeth within the front are incisors. There are four incisors each within the upper jawbone and therefore the mandible. They are meant for cutting.

(ii) Canines: The sharp teeth on either side of the incisors are canines. They are four in number, two each placed within the upper jawbone and therefore the mandible. They are meant for tearing.

(iii) Premolars: Next to the canines the premolars are present. They are eight in number, four each placed within the upper jawbone and therefore the mandible. They are meant for grinding.

(iv) Molars: they're present at the top of the jaw, next to the premolars. There are twelve molars, six each placed within the upper jawbone and therefore the mandible. Hence, the dental formula in humans is $\frac{2123}{2123} \times 2 = 32$

This means each half the upper jawbone and therefore the mandible has 2 incisors, 1 canine, 2 premolars, and three molars. So, the number of permanent teeth in an adult human is 32.

15. What are the functions of the liver?

Ans: The liver is the largest and the heaviest internal organ of the body. It is not directly involved in digestion but secretes digestive juices. It secretes bile which plays a major role in the emulsification of fats.