

NCERT Solutions for Class-XI Biology

Chapter-16

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

1. (a) (i) Pepsin, lipase and rennin
(b) (ii) Intestinal juice

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

2.

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?
- (b) How does pepsinogen change into its active form?
- (c) What are the basic layers of the wall of alimentary canal?
- (d) How does bile help in the digestion of fats?

3. (a) The absorptive surface area of small intestine is enormously increased by microvilli and as maximum absorption of digested food takes place in small intestine as compared to other organs, therefore, villi are present in small intestine and not in stomach. Moreover, stomach is primarily associated with temporary storage of food.
- (b) The proenzyme pepsinogen, on exposure to hydrochloric acid, secreted by oxyntic cells of gastric glands gets converted into the active enzyme pepsin, the proteolytic enzyme of the stomach.

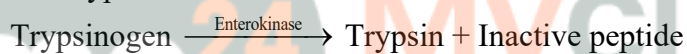
(c) The wall of alimentary canal from oesophagus to rectum possesses four layers, namely serosa, muscularis, sub-mucosa and mucosa. Serosa is the outermost layer and is made up of a thin mesothelium with some connective tissues. Muscularis is formed by smooth muscles. The sub-mucosal layer is formed of loose connective tissues containing nerves, blood and lymph vessels. In duodenum, glands are also present in sub-mucosa. The innermost layer lining the lumen of the alimentary canal is the mucosa. This layer forms irregular folds (rugae) in the stomach and small finger-like foldings called villi in the small intestine.

(d) Bile has no enzymes but contains bile salts, namely, sodium bicarbonate, sodium glycocholate and sodium taurocholate that reduce the surface tension of large fat droplets and break them into many small droplets by a process known as emulsification. These small fat droplets present large surface area for lipase (fat digesting enzyme) to act upon them. Moreover, bile also activates lipases.

4. State the role of pancreatic juice in digestion of proteins.
4. Pancreatic juice contains a variety of inactive enzymes such as trypsinogen, chymotrypsinogen, and carboxypeptidases. These enzymes play an important role in the digestion of proteins.

Physiology of protein-digestion

The enzyme enterokinase is secreted by the intestinal mucosa. It activates trypsinogen into trypsin.

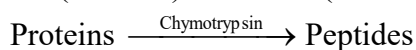


Trypsin then activates the other enzymes of pancreatic juice such as chymotrypsinogen and carboxypeptidase.

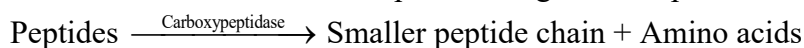
Chymotrypsinogen is a milk-coagulating enzyme that converts proteins into peptides.



(Inactive) (Active)



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



Thus, in short, we can say that the partially-hydrolysed proteins present in the chyme are acted upon by various proteolytic enzymes of the pancreatic juice for their complete digestion.

Proteins, peptones Dipeptides and proteases

5. Describe the process of digestion of protein in stomach.
5. The stomach is the first organ where the digestion of proteins starts while the small intestine is the part where protein digestion ends. The stomach possesses gastric glands which secrete gastric juices containing enzymes that act on the food. Gastric juice mainly contains hydrochloric acid, pepsinogen, mucus, and rennin. Firstly, the food that enters

the stomach becomes acidic when it mixes with the gastric juice. The function of these components in protein digestion is as follows:

1. Hydrochloric acid dissolves the food particle and creates an acidic medium inside the stomach. Acidic medium is a prerequisite for the conversion of inactive enzyme pepsinogen into active pepsin.
2. Pepsin is a protein-digesting enzyme that converts proteins into proteases and peptides.
3. Rennin which plays an important part in the coagulation of milk is a proteolytic enzyme that is released as prorenin i.e. inactive renin.

6. Given the dental formula of human beings
6. The dental formula expresses the arrangement of teeth in each half of the upper jaw and the lower jaw. The entire formula is multiplied by two to express the total number of teeth.

The dental formula for milk teeth in humans is: $\frac{2102}{2102} \times 2 = 20$

Each half of the upper jaw and the lower jaw has 2 incisors, 1 canine, and 2 molars. Premolars are absent in milk teeth.

The dental formula for permanent teeth in humans is: $\frac{2123}{2123} \times 2 = 32$

Each half of the upper jaw and the lower jaw has 2 incisors, 1 canine, 2 premolars, and 3 molars. An adult human has 32 permanent teeth.

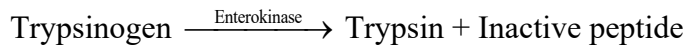
7. Bile juice contains no digestive enzymes, yet it is important for digestion. Why?
7. The bile juice secreted by the liver does not contain any digestive enzymes, however, it plays an important role in the digestion of fats. It contains bile salts such as bilirubin and biliverdin which break down large fat globules into smaller globules. This makes sure that the pancreatic enzymes can easily act on the fat globules. This process is known as the emulsification of fats. Bile juice also makes the medium alkaline and activates lipase. Hence, bile juice contains no digestive enzymes, yet it is important for digestion.
8. Describe the digestive role of chymotrypsin. What two other digestive enzymes of the same category are secreted by its source gland?
8. The enzyme trypsin (present in the pancreatic juice) activates the inactive enzyme chymotrypsinogen into chymotrypsin.

Chymotrypsinogen $\xrightarrow{\text{Trypsin}}$ Chymotrypsin
(Inactive) (Active)

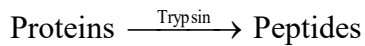
The activated chymotrypsin plays an important role in the further breakdown of the partially-hydrolysed proteins.

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

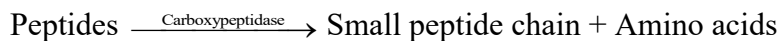
The other digestive enzymes of the same category are trypsinogen and carboxypeptidase. These are secreted by the same source-gland, pancreas. Trypsinogen is present in an inactive form in the pancreatic juice. The enzyme enterokinase – secreted by the intestinal mucosa – activates trypsinogen into trypsin.



The activated trypsin then further hydrolyses the remaining trypsinogen and activates other pancreatic enzymes such as chymotrypsinogen and carboxypeptidase. Trypsin also helps in breaking down proteins into peptides.



Carboxypeptidases act on the carboxyl end of the peptide chain and help in releasing the last amino acids.



9. How are polysaccharides and disaccharides digested?
9. The process of digestion of carbohydrates occurs in the mouth and small intestine. Digestion of carbohydrates in the mouth- After entering into the mouth, the food gets mixed with saliva which breaks down the starch into maltose, isomaltose, and limits dextrins. Saliva contains an enzyme called salivary amylase which is involved in the break down of starch into its constituents at a particular pH of 6.8. This enzyme continues to act in the esophagus, but its action stops in the stomach as the contents become acidic. Therefore, carbohydrate digestion stops in the stomach. Digestion in the small intestine- In the small intestine, carbohydrate digestion resumes. The food is acted upon by pancreatic juice and intestinal juice. Pancreatic juice contains the pancreatic amylase that hydrolyses the polysaccharides into disaccharides. On the other hand, intestinal juice contains a variety of enzymes (disaccharidases such as maltase, lactase, sucrase, etc.) that help in the digestion of disaccharides. The digestion of carbohydrates is completed in the small intestine.
10. What would happen if HCl were not secreted in the stomach?
10. Hydrochloric acid is secreted by the glands present on the stomach walls. It dissolves bits of food and creates an acidic medium. The acidic medium allows pepsinogen to be converted into pepsin. Pepsin plays an important role in the digestion of proteins. Therefore, if HCl were not secreted in the stomach, then pepsin would not be activated. This would affect protein digestion. A pH of about 1.8 is necessary for proteins to be digested. This pH is achieved by HCl.
11. How does butter in your food gets digested and absorbed in the body?
11. Butter is a fat-based product. Digestion of fats: Fats are digested in the small intestine. The liver secretes bile juice which contains bile salts such as bilirubin and biliverdin. These break down large fat globules into smaller globules, to increase their surface area for the action of lipase. This process is called the emulsification of fats. Later, 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 finally into glycerol. Absorption of fats: During the digestion of fats, the fats are broken down into fatty acids and glycerol. These are water-insoluble substances, hence, they cannot be directly absorbed by the blood. Therefore, they are first incorporated into small droplets called micelles and then transported into the villi of the intestinal mucosa. These are then converted into small microscopic particles called chylomicrons, which are small, protein-coated fat globules. These chylomicrons are transported to the lymph vessels in the villi. From the lymph vessels, the absorbed food is finally released into the bloodstream and from the bloodstream, to each and every 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.

12. The digestion of proteins begins in the stomach and is completed in the small intestine. The enzymes that act on proteins are known as proteases.

Digestion in the stomach:

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

The acidic medium converts inactive pepsinogen into active pepsin. The active pepsin then converts proteins into proteases and peptides.

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

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

Digestion in the small intestine:

The food from the stomach is acted upon by three enzymes present in the small intestine – pancreatic juice, intestinal juice (known as succus entericus), and bile juice.

Action of pancreatic juice

Pancreatic juice contains a variety of inactive enzymes such as trypsinogen, chymotrypsinogen, and carboxypeptidases. The enzymes are present in an inactivated state. The enzyme enterokinase secreted by the intestinal mucosa activates trypsinogen into trypsin.

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

The activated trypsin then activates the other enzymes of pancreatic juice.

Chymotrypsinogen is a proteolytic enzyme that breaks down proteins into peptides.

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

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

Carboxypeptidases act on the carboxyl end of the peptide chain and help in releasing the last amino acids.

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

Action of bile juice

Bile juice has bile salts such as bilirubin and biliverdin which break down large, fat globules into smaller globules so that pancreatic enzymes can easily act on them. This process is known as emulsification of fats. Bile juice also makes the medium alkaline

and activates lipase. Lipase then breaks down fats into diglycerides and monoglycerides.

Action of intestinal juice

Intestinal juice contains a variety of enzymes. Pancreatic amylase digests polysaccharides into disaccharides. Disaccharidases such as maltase, lactase, sucrase, etc., further digest the disaccharides.

The proteases hydrolyse peptides into dipeptides and finally into amino acids.

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

Pancreatic lipase breaks down fats into diglycerides and monoglycerides.

The nucleases break down nucleic acids into nucleotides and nucleosides.

13. Explain the term thecodont and diphyodont.

13. Thecodont: It refers to a type of dentition in which the teeth are embedded in the deep sockets of the jaw bone. This type of dentition is common in mammals.

Diphyodont: It refers to a specialized kind of dentition in which two successive sets of teeth are developed during the lifetime of the organism. The first set of teeth is deciduous and the other set is permanent. The deciduous set of teeth is replaced by permanent adult teeth. This type of dentition can be seen in humans.

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

14. There are four different types of teeth in an adult human. They are as follows:

(i) Incisors

The eight teeth in the front are incisors. There are four incisors each in the upper jaw and the lower jaw. They are meant for cutting.

(ii) Canines

The pointy teeth on either side of the incisors are canines. They are four in number, two each placed in the upper jaw and the lower jaw. They are meant for tearing.

(iii) Premolars

They are present next to the canines. They are eight in number, four each placed in the upper jaw and the lower jaw. They are meant for grinding.

(iv) Molars

They are present at the end of the jaw, next to the premolars. There are twelve molars, six each placed in the upper jaw and the lower jaw.

Hence, the dental formula in humans is $\frac{2123}{2123} \times 2 = 32$

This means each half of the upper jaw and the lower jaw has 2 incisors, 1 canine, 2 premolars, and 3 molars. Hence, an adult human has 32 permanent teeth.

15. What are the functions of liver?

15. Functions of the liver are as follows:

1. The liver secretes bile juice which plays an important role in the digestion of fats.
2. Conversion of poisonous ammonia to urea, to clear the blood of drugs and other poisonous substances.

3. Conversion of excess glucose into glycogen for storage, which can later be converted to glucose for energy.



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