Chapter: Digestion and Absorption

Exercise

Question 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 the ileum and large intestine

(ii) intestinal juice

(iii)swelling in the gut

(iv)appendix

Answer:
(a): (i) Pepsin, lipase, and rennin
The gastric juices have pepsin, lipase, and rennin. The pepsin is secreted in an inactive form as pepsinogen; it is activated with the help of HCl. The pepsin digestion converts proteins into peptones. The lipase is responsible for breaking down fats into fatty acids. Rennin is a photolytic enzyme found in gastric juice. It helps in the process of coagulation of the milk. Hence the correct answer is an option (i).
(b): (ii) Intestinal juice
The succus entericus is another name for intestinal juice. The intestinal glands are responsible for its secretion. This intestinal juice contains a number of enzymes including maltase, lipases, nucleosidases, dipeptidases, etc. Hence the correct answer is an option (ii).

Question 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**

Answer:

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

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

Answer:
(a) The mucosal wall present in the small intestine is responsible for the formation of millions of tiny finger-like projections called the villi. These villi help to increase the surface area for more efficient food absorption. Inside these villi, there are n-number of blood vessels that help to absorb the digested products of proteins and carbohydrates by carrying them to the bloodstream. The villi also have lymph vessels for absorbing the products of fat digestion. The absorbed food from the bloodstream is finally delivered to every cell of the body. The mucosal walls inside the stomach form irregular folds called the rugae. These help by increasing the surface area to volume ratio of the expanding stomach.

(b) The pepsinogen is a precursor of the pepsin stored in the stomach walls. It is converted into pepsin with the help of hydrochloric acid. The pepsin is activated in the form of the pepsinogen.

$$\text{Pepsinogen (Inactive)} \xrightarrow{\text{HCl}} \text{Pepsin (active)} + \text{Inactive peptide}$$

(c) The walls of the alimentary canal are consisting of four layers which are as follows:
a. The serosa is the outermost layer of the human alimentary canal. It is made up of a thin layer of secretory epithelial cells, with some of the connective tissues underneath.
b. The muscularis is a thin layer of the smooth muscles that are arranged into an outer longitudinal layer and an inner circular layer.
c. The submucosa is a layer of loose connective tissues. They include nerves, blood, and lymph vessels. It also helps to support the mucosa.
d. The mucosa is the innermost lining of the lumen of the alimentary canal. It is involved in the absorption and secretion process.

(d) The bile is a digestive juice secreted by the liver and is stored in the gallbladder. The bile juice contains bile salts namely, bilirubin and biliverdin. These help in breaking down large fat globules into smaller-sized globules so that the pancreatic enzymes can easily act on them. This entire process is called the emulsification of fats. The bile juice also helps to make the medium alkaline and activates lipase.

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

Answer:

The pancreatic juice has inactive enzymes as trypsinogen, chymotrypsinogen, and carboxypeptidases. These enzymes play a vital role in the digestion process of proteins.

The physiology of protein digestion is as follows:

The secretion of enzyme enterokinase takes place in the mucosa of the intestine. It is also responsible for activating the trypsinogen and converting it into trypsin.

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

Then the trypsin activates the other enzymes of the pancreatic juice such as the chymotrypsinogen and the carboxypeptidase. The chymotrypsinogen is a milk-coagulating enzyme that helps to convert the proteins into peptides.

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

Inactive active

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

The carboxypeptidase acts on the carboxyl end of the peptide chain and then helps to release the last amino acids. Therefore it helps in the digestion of proteins.

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

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

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

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

Answer:

The process of digestion of the proteins begins in the stomach and is completed in the small intestine. The digestive juice secreted in the gastric glands is present on the stomach walls and is known as gastric juice. The food that enters the stomach becomes acidic after mixing with the gastric juice. The main constituents of gastric juice are hydrochloric acid, pepsinogen, mucus, and rennin. The hydrochloric acid helps to dissolve the bits of food and creates an acidic medium so that the pepsinogen is converted into pepsin. Pepsin is a protein-digesting enzyme. It is secreted in its inactive form which is known as pepsinogen, which after it gets activated by the hydrochloric acid. The activated pepsin then converts the proteins into proteases and peptides.

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

Rennin is a proteolytic enzyme that is released in an inactive form known as prorenin. The rennin plays a vital role in the coagulation of the milk.

$$\text{Prorenin} \xrightarrow{\text{HCl}} \text{Rennin} \rightarrow \text{Paracasein} \rightarrow \text{Milk casein}$$

Question 6: Given the dental formula of human beings.

Answer:

The arrangement of the teeth in each half of the upper jaw and the lower jaw is expressed by the dental formula. This formula is multiplied by two to express the total number of teeth.

The dental formula to represent the milk teeth in humans is: [2102/2102*2=20]

Each half of the upper jaw and the lower jaw has two numbers incisors, a single canine, and two numbers molars.

There are no premolars present in the milk teeth.

The dental formula for permanent teeth in humans is: [2123/2123*2=32]

Each half of the upper jaw and the lower jaw has two numbers of incisors, single canine, two numbers of premolars, and three numbers of molars. In an adult human, there are thirty-two permanent teeth.

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

Answer:

Bile is a digestive juice that is secreted by the liver. It does not have any digestive enzymes but it plays a vital role in the process of digestion of fats. The bile juice contains bile salts such as bilirubin and biliverdin. These are responsible for the breakdown of large fat globules into smaller globules because of this the pancreatic enzymes can easily act on them. This process is the process of emulsification of fats. The bile juice also helps to make the medium alkaline and is responsible for activating lipase.

Question 8: Describe the digestive role of chymotrypsin. What two other digestive enzymes of the same category are secreted by its source gland?

Answer:

The enzyme trypsin which is present in the pancreatic juice activates the inactive enzyme chymotrypsinogen into the chymotrypsin. The activated chymotrypsin plays a vital role in the further breakdown of the partially-hydrolyzed proteins.The trypsinogen and carboxypeptidase are the other enzymes of this category. These are secreted by the same source-gland which is the pancreas. The enzyme trypsinogen is present in an inactive form in the pancreatic juice that is it doesn't act upon substrate by itself.. The enzyme enterokinase – secreted by the intestinal mucosa – activates the trypsinogen into the trypsin. Then the activated trypsin further hydrolyses the remaining trypsinogen and also helps to activate other pancreatic enzymes such as the chymotrypsinogen and the carboxypeptidase. Trypsin is also used in breaking down proteins into peptides.The carboxypeptidases act on the carboxyl end of the peptide chain and it also helps in releasing the last amino acids.

Question 9: How are polysaccharides and disaccharides digested?

Answer:

The process of digestion of carbohydrates takes place inside the mouth and the small intestine region of the alimentary canal. The enzymes that act on the carbohydrates are called carbohydrates. The

digestion in the mouth: As food enters the mouth, it gets mixed with saliva. The saliva secreted by the salivary glands contains a digestive enzyme known as salivary amylase. The enzyme, salivary amylase has the property to break down starch molecules into sugar at pH 6.8 value. The salivary amylase continues to act in the esophagus but this action stops in the stomach as the contents become acidic. Therefore digestion of carbohydrates stops in the stomach. The digestion in the small intestine: The digestion of carbohydrates is resumed in the small intestine. During this the food gets mixed with the pancreatic juice and the intestinal juice. The pancreatic juice has the pancreatic amylase that hydrolyses the polysaccharides into the disaccharides. The intestinal juice or succus entericus contains a variety of enzymes such as maltase, lactase, sucrose, etc. These disaccharidases help in the digestion of the disaccharides. The process of digestion of carbohydrates is completed inside the small intestine.

Maltose	Glucose
Lactose	Glucose + Galactose
Sucrose	Glucose + Fructose

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

Answer:

The hydrochloric acid is secreted by the glands present on the stomach walls. It dissolves the bite of the food and creates an acidic medium. The acidic medium allows the pepsinogen to be converted into pepsin. The pepsin plays a vital role in the process of digestion of proteins. Therefore if the secretion of HCl were not taking place in the stomach, then pepsin would not be activated. This would affect protein digestion. A pH of about 1.8 is necessary for the proteins to be digested. This pH is achieved with the help of HCl.

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

Answer:

The digestion of fats: Butter is a fat product and gets 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 the lipase. This process is the process of 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 the triglycerides, diglycerides, monoglycerides, and ultimately into the glycerol.

The absorption of fats: Fat absorption is an active process. During the digestion of fat, the fats are hydrolyzed into fatty acids and glycerol. Since these are insoluble, they cannot be directly absorbed by the blood. Therefore they are first incorporated into small droplets known as micelles and then transported into the villi of the intestinal mucosa. They are then reformed into the small microscopic particles known as the chylomicrons, which are small protein-coated fat globules. These chylomicrons are transported to the lymph vessels inside the villi. From the lymph vessels, the absorbed food is finally released into the bloodstream and from the bloodstream, it is released into each cell of the body.

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

Answer:

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

The digestion in the stomach: The digestive juice secreted in the gastric glands present on the stomach walls is known as gastric juice. The HCl, pepsinogen, and rennin are the major components of gastric juices. After entering into the stomach the food becomes acidic when mixed with this gastric juice. The acidic medium helps for the conversion of inactive pepsinogen into active pepsin. The active pepsin then converts the proteins into proteases and peptides.

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

The digestion in the small intestine: The food from the stomach is acted upon by three enzymes present in the small intestine which are pancreatic juice, intestinal juice, and bile juice.

The action of the pancreatic juice: The pancreatic juice includes a variety of inactive enzymes such as trypsinogen, chymotrypsinogen, and carboxypeptidases. The enzymes can be found in an inactivated state. The enzyme enterokinase is secreted by the intestinal mucosa which activates the trypsinogen into the trypsin.

The activated trypsin then activates the other enzymes of the pancreatic juice. The chymotrypsinogen is a proteolytic enzyme that breaks down the proteins into peptides.

The carboxypeptidases act on the carboxyl end of the peptide chain and also help in releasing the last amino acids. The action of bile juice: The bile juice has bile salts as bilirubin and biliverdin which helps in the breakdown of large, fat globules into the smaller globules so that pancreatic enzymes can easily act on them.

This process is called the emulsification of fats. The bile juice also helps to make the medium alkaline and activates the lipase. Ten the lipase breaks down fats into the diglycerides and monoglycerides.

The action of intestinal juice: The intestinal juice contains a variety of enzymes. The pancreatic amylase digests polysaccharides into the disaccharides. The disaccharidases such as maltase, lactase, sucrase, etc. help in the further digestion of the disaccharides. The proteases hydrolysis peptides into the dipeptides and finally into the amino acids. The pancreatic lipase breaks down fats into diglycerides and monoglycerides. The nucleases break down the nucleic acids into the nucleotides and nucleosides.

Question 13: Explain the terms thecodont and diphyodont.

Answer:

It is the dentition in which the teeth are embedded inside the deep sockets of the jaw bone. The ankylosis is absent in this and the roots are cylindrical in shape. Examples of this are living crocodilians and mammals. The diphyodont is a type of dentition in which two successive sets of teeth are developed during the lifetime of the organism. The first set of teeth is called the deciduous and the other set is known as the permanent. The set of deciduous teeth is replaced by the set of permanent adult teeth. In humans, this type of dentition can be seen.

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

Answer:

There are four different types of teeth in an adult human which are as follows:

i. The incisors: The eight teeth in the front are known as the incisors. There are a total of four incisors each in the upper jaw and the lower jaw. They help in cutting the food.
ii. The canines: The pointy teeth present on either side of the incisors are known as the canines. They are four in number, two each placed in the upper jaw and the lower jaw. They help in tearing the food.
iii. The premolars: They are present next to the canines. These are a total of eight in number, four present on each placed in the upper jaw and the lower jaw. They help in grinding the food.
iv. The molars: These are present at the end of the jaw, next to the premolars. There are almost twelve molars, six present on each side in the upper jaw and the lower jaw.

Therefore the dental formula in humans is $\left[\left(2123/2123\right)\times 2=32\right]$

This means each half of the upper jaw and the lower jaw has 2 numbers of incisors, 1 canine, 2 numbers of premolars, and 3 numbers of molars.

Therefore an adult human has a total of 32 permanent teeth.

Question 15: What are the functions of the liver?

Answer:

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

Following are the additional functions of the liver:

- They are responsible for the production of bile, which helps to carry away the waste and break down fats in the small intestine during the process of digestion.
- They help in the production of certain proteins required for the blood plasma.
- They also help in the production of cholesterol and special proteins to carry out the fats through the entire body.