

1. Choose the correct answer from 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

Solution:

The correct answers are as follows:

- a. Gastric juice contains (i) pepsin, lipase and renin. Lipase disintegrates fats into fatty acids. Renin brings about the coagulation of milk as it is a photolytic enzyme present in gastric juice. Pepsin is produced in an inactive form, pepsinogen, that is activated by HCl. Pepsin digests proteins into peptones.
- b. Succus entericus is the name given to (ii) Intestinal juice. Intestinal juice is also known as succus entericus, which is produced by the intestinal gland. Succus entericus contains different enzymes, such as maltase, lipases, dipeptidases, and nucleosides, to name a few.

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

Solution:

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:

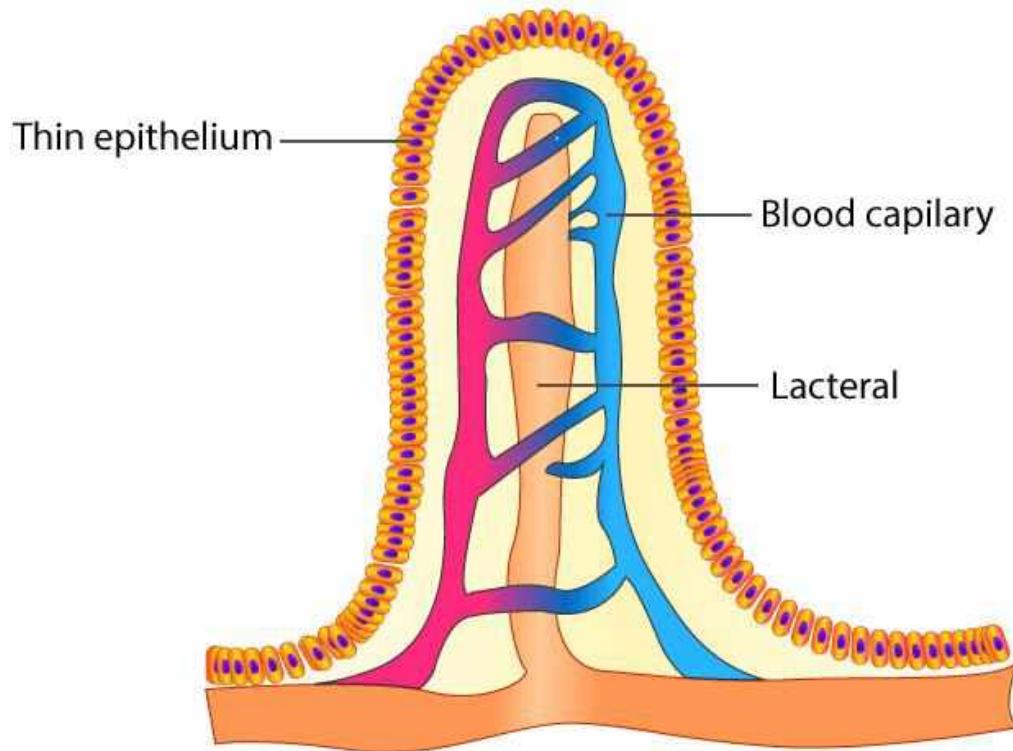
- (a) Why are villi present in the intestine and not in the stomach?
- (b) How does pepsinogen change into its active form?
- (c) What are the basic layers of the wall of the alimentary canal?
- (d) How does bile help in the digestion of fats?

Solution:

- a. In the small intestine, the presence of villi causes an increase in the surface area for further efficient absorption of food. Since absorption of food mainly occurs in the small intestine, villi are found to be present in the

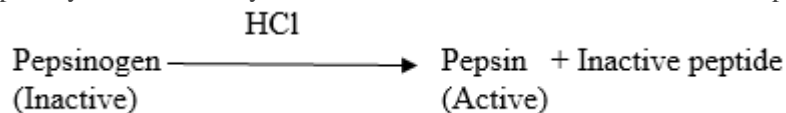
intestine and not in the stomach.

LONGITUDINAL SECTION THROUGH A VILLUS

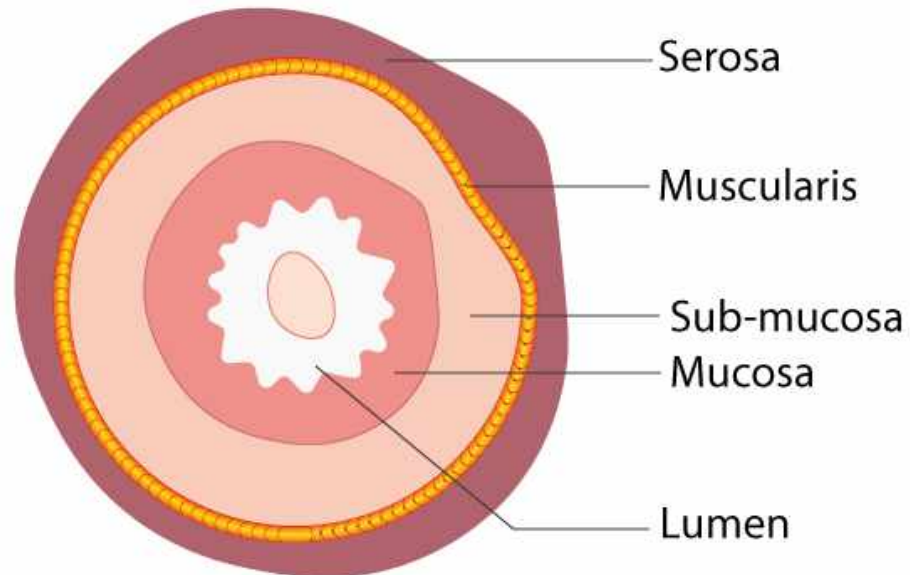


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- b. Pepsinogen is accumulated in the stomach walls and is a precursor of pepsin. Pepsinogen is converted into pepsin by the action of hydrochloric acid. Hence, the activated form of pepsinogen is pepsin.



- c. There are four basic layers of the walls of the alimentary canal, as listed below:
- Serosa – The outermost layer of the human alimentary canal, it consists of a fine layer of secretory epithelial cells with a few underlying connective tissues.
 - Muscularis – It is a layer of thin, smooth muscles, which is arranged into an outer layer that is longitudinal, and an inner layer that is circular.
 - Sub-mucosa – It is a layer of loose connective tissue that contains lymph vessels, nerves and blood. The sub mucosa supports the mucosa.
 - Mucosa – It is the innermost lining of the lumen of the alimentary canal, which is chiefly involved in the processes of absorption and secretion.



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- d. Bile brings about the digestion of fats. It is a digestive juice that is produced by the liver and accumulates in the gall bladder. The bile juice contains bile salts such as biliverdin and bilirubin, which disintegrates large fat globules into smaller globules for pancreatic enzymes to act on them easily. This phenomenon is termed as emulsification of fats. The bile juice is also known to make the medium alkaline and activate lipase.

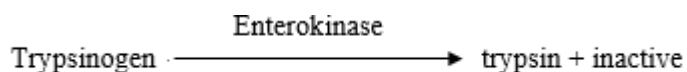
4. State the role of pancreatic juice in the digestion of proteins.

Solution:

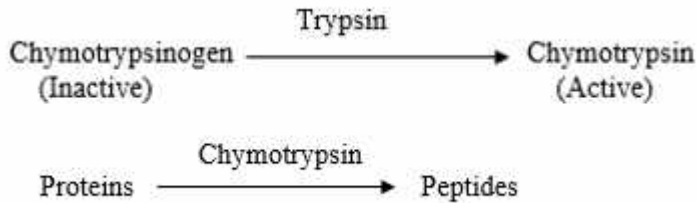
Pancreatic juice consists of several inactive enzymes, to name a few, chymotrypsinogen, trypsinogen, pro carboxypeptidases, lipases, nucleases and amylases, which play a crucial role in the process of protein digestion.

Digestion of proteins:

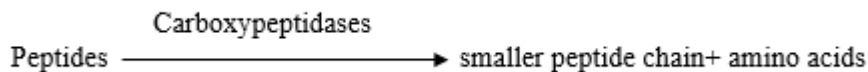
Enterokinase, an enzyme, is produced by the intestinal mucosa. This enzyme activates trypsinogen into trypsin.



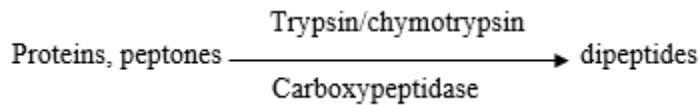
Subsequently, trypsin activates other enzymes of the pancreatic juices, such as pro carboxypeptidase and chymotrypsinogen. Chymotrypsinogen is an enzyme that coagulates milk and converts proteins into peptides.



Carboxypeptidases act on the carboxyl part of the peptide chain, which promotes the release of the last amino acids. Therefore, it enables in the protein-digestion



Therefore, the partially hydrolysed proteins that are found in chyme are acted upon by different proteolytic enzymes of the pancreatic juice for complete digestion.



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

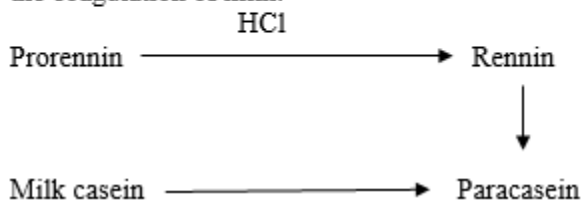
Solution:

The process of digestion of proteins is initiated in the stomach and terminates in the small intestine. The digestive juices that are produced in the gastric glands found on the walls of the stomach are referred to as gastric juice. The food that moves into the stomach turns acidic when it gets mixed with this gastric juice.

The chief components of gastric juices are renin, pepsinogen, mucus and hydrochloric acid. Hydrochloric acid liquefies or dissolves the food bits, generating an acidic medium in order to convert pepsinogen into pepsin. Pepsin is an enzyme that digests proteins and is secreted as pepsinogen, which in its inactive form, gets activated by the action of hydrochloric acid. This activated pepsin then converts proteins into proteases and peptides.



Prorennin is the inactive form of renin. Renin is a proteolytic enzyme which plays an important role in the coagulation of milk.



6. Give the dental formula of human beings.

Solution:

The dental formula of human beings is a way of expressing the teeth arrangement in each of the upper jaw and lower jaw. The whole formula is then multiplied by two in order to get the total number of teeth in human beings.

In humans, the dental formula for milk teeth is given by $\frac{2102}{2102} \times 2 = 20$

To elaborate, each half of the upper and the lower jaws has 2 incisors, 1 canine, zero premolars and 2 molars. Premolars in milk teeth is absent.

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

To elaborate, each half of the upper and lower jaws has 2 incisors, 1 canine, 2 premolars and 3 molars. Hence, an adult human being ideally has 32 permanent teeth.

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

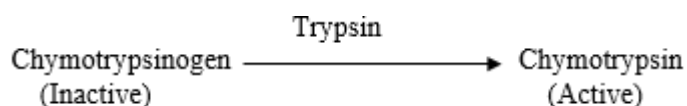
Solution:

Bile juice is important for digestion. It is a digestive juice that is produced by the liver. Even though it has no digestive enzymes, it has a critical role to play in fat digestion. Bilirubin and biliverdin are the two bile salts that are present in bile juice, which disintegrates large globules into smaller globules such that the pancreatic enzymes can act on them easily. This phenomenon is referred to as the emulsification of fats. The bile juice is also known to make the medium alkaline and is involved in the activation of lipase.

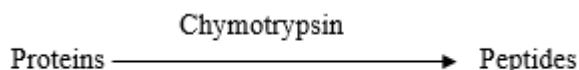
8. Describe the digestive role of chymotrypsin. Which two other digestive enzymes of the same category are secreted by their source gland?

Solution:

Pancreatic juice consists of an enzyme known as trypsin, which activates the inactive enzyme known as the chymotrypsinogen to chymotrypsin.



This activates chymotrypsin, which is critical in further disintegrating the partially-hydrolysed proteins.



Trypsinogen and carboxypeptidase are the two other digestive enzymes belonging to the same group which are secreted by the pancreas.

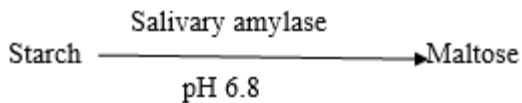
9. How are polysaccharides and disaccharides digested?

Solution:

Carbohydrates are digested in regions of the alimentary canal, the small intestine to be specific and in the mouth. Carbohydrates are acted upon by enzymes which are collectively known as carbohydrases.

Carbohydrate digestion in the mouth:

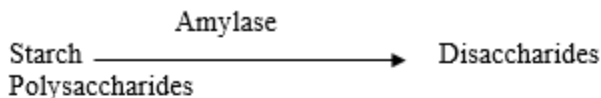
When the food enters the mouth, it gets mixed with saliva, which is produced by the salivary glands. The salivary glands consist of salivary amylase, which is a digestive enzyme responsible for disintegrating starch into sugar at a pH level of 6.8.



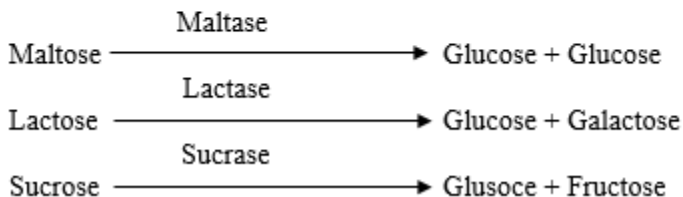
This enzyme, salivary amylase, continues its actions in the oesophagus but remains ineffective in the stomach as the contents turn acidic. This is why the digestion of carbohydrates stops in the stomach.

Carbohydrate digestion in the small intestine:

The small intestine is the site where the digestion of carbohydrates resumes. In this part, the food gets mixed with the intestinal and pancreatic juices. The pancreatic juice consists of pancreatic amylase, which hydrolyses the polysaccharides into disaccharides.



Likewise, the intestinal juice consists of a variety of enzymes - disaccharidases such as lactase, sucrase, maltase etc, which bring about the digestion of disaccharides. Carbohydrate-digestion is completed in the small intestine.



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

Solution:

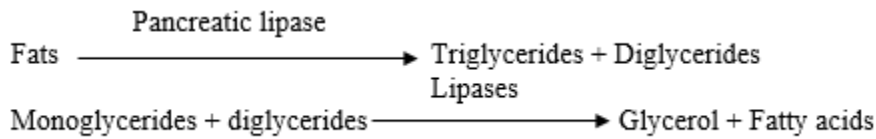
The walls of the stomach secrete hydrochloric acid, which dissolves fragments of food and builds an acidic environment. This medium facilitates the conversion of pepsinogen into pepsin. Pepsin plays a crucial role in protein digestion.

Pepsin would be inactivated if HCl were not to be secreted in the stomach, which would have an effect on the digestion of proteins. In order for the proteins to be digested, a pH of 1.8 is essential, which is provided by HCl.

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

Solution:

Butter is a fat product that gets digested in the small intestine. After the process of emulsification of fats, the pancreatic juice containing pancreatic lipase and the intestinal juice containing intestinal lipase hydrolyses the molecules of fat into diglycerides, triglycerides, and monoglycerides and finally into fatty acids and glycerol.



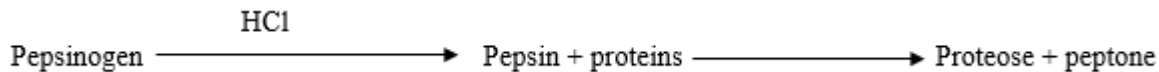
Fat absorption:

It is an active process during which the fats are hydrolysed into glycerol and fatty acids. As these are water soluble, they are directly not absorbed by the blood. They are incorporated first into small droplets known as micelles and then shifted to the villi of the intestinal mucosa, where they reform as chylomicrons, tiny microscopic particles. They are tiny, protein-coated fat globules that are transported to the lymph vessels in the villi. The food that is absorbed from the lymph vessels, ultimately, is liberated into the bloodstream and, furthermore, 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.

Solution:

The process of protein digestion is initiated in the stomach and terminates in the small intestine. Proteases are the enzymes that act on proteins. The proenzyme, pepsinogen in the stomach, gets converted into pepsin, which acts on proteins to bring about its conversion into peptone.



Some of the enzymes found in the pancreatic juice in their inactive form are trypsinogen, procarboxypeptidases and chymotrypsinogen. Enterokinase, an enzyme that activates trypsinogen, is produced by the intestinal mucosa into active trypsin, which further activates other enzymes in the pancreatic juice. Procarboxypeptidases and Chymotrypsinogen are converted into carboxypeptidase and chymotrypsin by the action of trypsin. Chymotrypsin results in the formation of peptides from proteins, and carboxypeptidase converts peptides into tiny peptide chains and amino acids.

13. Explain the terms codont and diphodont.

Solution:

Every tooth in human beings is embedded in a socket of the jaw bone. This attachment of teeth is referred to as codont.

Most mammals and human beings produce two sets of teeth in their lifetime. First, as a set of milk teeth or deciduous teeth, which are temporary and second, a set of adult teeth that are permanent. The temporary milk teeth are replaced by the permanent adult teeth. This dentition is referred to as diphodont.

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

Solution:

In an adult human, there are four different types of teeth. They are:

Type of the Teeth	Location/Characteristic	Total	Occurrence in the Lower Jaw	Occurrence in the Upper Jaw	Function
Incisors	Present in the front	8	4	4	Meant for cutting
Canines	Pointy teeth found on either side of the incisors	4	2	2	Meant for tearing
Premolars	Found next to canines	8	4	4	Meant for grinding
Molars	Found at the end of the jaw, adjacent to the premolars	12	6	6	Chewing and grinding food

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To elaborate, each half of the upper and lower jaws has 2 incisors, 1 canine, 2 premolars and 3 molars. Hence, an adult human being ideally has 32 permanent teeth.

15. What are the functions of the liver?

Solution:

The liver is the largest internal organ of the human body. The functions of the liver are as follows:

- The liver secretes bile which brings about the digestion of fats
- It is responsible for isolating excessive sugar from the blood and accumulating it in cells in the form of glycogen. This phenomenon is referred to as glycogenesis, which is facilitated by the pancreatic hormone known as insulin
- The liver produces heparin, which is an anticoagulant
- The liver secretes angiotensinogen, which is a protein that aids the kidney in maintaining the body fluid osmoregulation

- The liver is crucial in the lymph formation
- The liver secretes red blood cells in the embryo

