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**#424356**

**Topic:** Types of nutrition

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Distinguish between intracellular and extracellular digestion?

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**Solution**

Intercellular Digestion:

1. Digestion occurs in the food vacuoles within cells.
2. Lysosomal enzymes are secreted into the food vacuole.
3. Products of digestion diffuse into the cytoplasm through the vacuolar membrane.
4. Ingestion occurs through pinocytic vesicle, e.g. protozoans, sponges and coelenterates.

Extracellular Digestion:

1. Digestion occurs outside of cells in the lumen of the alimentary canal.
2. Salivary, gastric pancreatic and intestinal enzymes are secreted into the digestive cavity.
3. Digested food materials are absorbed into the blood through gut epithelia.
4. Ingestion occurs through the mouth, e.g. coelenterates to chordates.

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**#424962**

**Topic:** Physiology of digestion

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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 neck
  - (iv) appendix

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**Solution**

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

Intestinal juice :

Succus entericus is another name for intestinal juice. It is secreted by the intestinal gland. Intestinal juice contains a variety of enzymes such as maltase, lipases, nucleosidases dipeptidases, etc.

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**#424965**

**Topic:** Alimentary canal

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What is succus entericus?

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**Solution**

The intestinal juice or succus entericus is secreted by crypts of Lieberkuhn. Succus entericus is the alkaline secretion produced by glands in the wall of the duodenum, consisting of water, mucoproteins and hydrogen carbonate ions. It helps to counteract the highly acidic and proteolytic chyme entering the small intestine from the stomach, and thus protects the duodenum from damage.

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**#424974**

**Topic:** Digestive glands

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

**A** a- i, b- ii, c- iii, d- iv

**B** a- ii, b- i, c- iv, d- iii

**C** a- ii, b- iv, c- iii, d- i

**D** a- iv, b- iii, c- ii, d- i

#### Solution

- A) Bile pigments are the breakdown products of the blood component haemoglobin. The two most important bile pigments are bilirubin, which is orange or yellow, and its oxidized form biliverdin, which is green. They are excreted through faeces and give colour to the faecal matter.
- B) A carbohydrate consisting of a large number of glucose units is called starch. The process of hydrolysis or breakdown of starch into constituent sugars requires enzymes known as amylases. The pancreas and salivary gland produce amylase.
- C) Lipase is an enzyme used to break down fats in food so they can be absorbed in the intestines. It is produced in the pancreas, mouth, and stomach.
- D) The salivary glands are exocrine glands that produce saliva. There are four pairs of salivary glands: Parotid glands, Submandibular glands, Sublingual glands and Buccal glands.
- Hence, the correct match is a- ii, b- iv, c- iii, d- i.

#### #424979

**Topic:** Alimentary canal

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?

#### Solution

- (a) The mucosal wall of the small intestine forms millions of tiny finger-like projections known as villi. These villi increase the surface area for more absorption of nutrients.
- (b) The gastric gland secretes gastric juice which contains pepsinogen, HCl, and mucus. HCl mixed with food and make it acidic when pepsinogen comes in contact with acidic food it gets activated and converts into the pepsin an active enzyme.
- (c) The wall of the alimentary canal is made up of four layers serosa, muscularis, submucosa and mucosa.
- (d) Bile is secreted by the liver it emulsifies the fats and activates the lipase enzyme for further digestion of fat.

#### #424982

**Topic:** Physiology of digestion

How does pepsinogen change into its active form?

#### Solution

Pepsinogen is a precursor of pepsin stored in the stomach walls. It is converted into pepsin by hydrochloric acid. It is the activated in the form of pepsinogen.

Pepsinogen -----HCL-----> Pepsin + Inactive peptide

(Inactive) (Active)

#### #424986

**Topic:** Physiology of digestion

How does bile help in the digestion of fats?

#### Solution

Bile is a digestive juice which helps in the digestion of fats. It is secreted by the liver. It has bile salts such as bilirubin and biliverdin. These break down large fat globules into smaller globules so that the pancreatic enzymes can easily act on them. This process is known as emulsification of fats. It also makes the medium alkaline and activates lipase.

**#424987**

**Topic:** Digestive glands

State the role of pancreatic juice in digestion of proteins.

**Solution**

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.

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.

**#424989**

**Topic:** Physiology of digestion

Describe the process of digestion of protein in stomach.

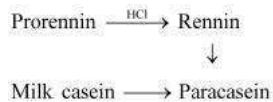
**Solution**

The digestion of proteins begins in the stomach and is completed in the small intestine. The digestive juice secreted by the gastric glands present on the stomach walls is called as gastric juice. The food that enters the stomach becomes acidic on mixing with this gastric juice.

The main components of gastric juice are hydrochloric acid, pepsinogen, mucus, and rennin. Hydrochloric acid dissolves the bits of food and creates an acidic medium so that pepsinogen is converted into pepsin. Pepsin is a protein-digesting enzyme. It is secreted in its inactive form called pepsinogen, which then gets activated by hydrochloric acid.

The activated pepsin then converts proteins into proteases and peptides.

Rennin is a proteolytic enzyme, released in an inactive form called as pro-rennin. Rennin plays an important role in the coagulation of milk.



**#424993**

**Topic:** Alimentary canal

Give the dental formula of human beings.

**Solution**

The dental formula represents the arrangement of teeth in each half of the upper and the lower jaw. The entire formula is multiplied by two to represent the total number of teeth.

The dental formula for milk teeth in humans is:

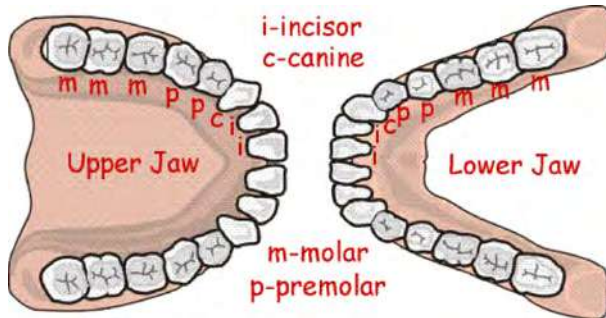
$$\frac{2102}{2102} \times 2 = 20$$

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

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.



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#424995

Topic: Physiology of digestion

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

**Solution**

Bile is a digestive juice secreted by the liver. Although it does not contain any digestive enzymes, it plays an important role in the digestion of fats. Bile juice has bile salts such as bilirubin and biliverdin. These break down large fat globules into smaller globules so that the 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.

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#424998

Topic: Physiology of digestion

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

**Solution**

The enzyme trypsin (present in the pancreatic juice) activates the inactive enzyme chymotrypsinogen into chymotrypsin.

Chymotrypsinogen



Chymotrypsin

(Inactive)

(Active)

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

Proteins



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.

Trypsinogen



Trypsin + Inactive peptide

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.

Proteins



Peptides

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

Peptides



Small peptide chain + Amino acids

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#### #425000

**Topic:** Physiology of digestion

How are polysaccharides and disaccharides digested?

#### Solution

The digestion of carbohydrates takes place in the mouth and the small intestine region of the alimentary canal. The enzymes that act on carbohydrates are collectively known as carbohydrases.

Digestion in the mouth:

As food enters the mouth, it gets mixed with saliva. Saliva secreted by the salivary glands contains a digestive enzyme called salivary amylase. This enzyme breaks down 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, carbohydrate-digestion stops in the stomach.

Digestion in the small intestine:

Carbohydrate-digestion is resumed in the small intestine. Here, the food gets mixed with the pancreatic juice and the intestinal juice. Pancreatic juice contains the pancreatic amylase that hydrolyses the polysaccharides into disaccharides.

Similarly, the intestinal juice contains a variety of enzymes (disaccharidases such as maltase, lactase, sucrase, etc.). These disaccharidases help in the digestion of disaccharides. The digestion of carbohydrates is completed in the small intestine.

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#### #425002

**Topic:** Physiology of digestion

What would happen if HCl was not secreted in the stomach?

#### Solution

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.

**#425004**

**Topic:** Physiology of digestion

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

**Solution**

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Butter contains a high percentage of fat in the small intestine. The bile juice secreted by the liver converts the large fat globules into smaller globules, so as to increase their surface area for the action of lipase. This process is referred to as emulsification of fats. The pancreatic lipase present in the pancreatic juice and the intestinal lipase present in the intestinal juice hydrolyses the fat molecules into triglycerides, diglycerides, monoglycerides, and ultimately into glycerol.

Fats----->Triglycerides + Diglycerides

Diglycerides and monoglycerides-----> Fatty acids + Glycerol

Absorption of fats:

Fat absorption is an active process. During fat digestion, fats are hydrolyzed into fatty acids and glycerol. However, since these are water insoluble, they cannot be directly absorbed by the blood. Hence, they are first incorporated into small droplets called micelles and then transported into the villi of the intestinal mucosa.

They are then reformed 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 blood stream and from the blood stream, to each and every cell of the body.

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**#425006**

**Topic:** Physiology of digestion

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

**Solution**

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



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



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



Chymotrypsin

Proteins



Peptides

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

Peptides



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.



Amino acids

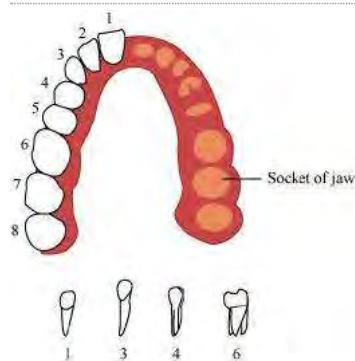
Pancreatic lipase breaks down fats into diglycerides and monoglycerides.

The nucleases break down nucleic acids into nucleotides and nucleosides.

#425008

Topic: Alimentary canal

Explain the term thecodont and diphyodont.

**Solution**

Thecodont is a type of dentition in which the teeth are embedded in the deep sockets of the jaw bone. Ankylosis is absent and the roots are cylindrical.

Examples include living crocodilians and mammals.

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 deciduous and the other set is permanent.

The deciduous set of teeth is replaced by the permanent adult teeth.

This type of dentition can be seen in humans.

#425011

Topic: Alimentary canal

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

**Solution**

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 :

$$\begin{array}{c} 2123 \\ 2123 \end{array} \times 2 = 32$$

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.

#425012

Topic: Alimentary canal

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

**Solution**



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.

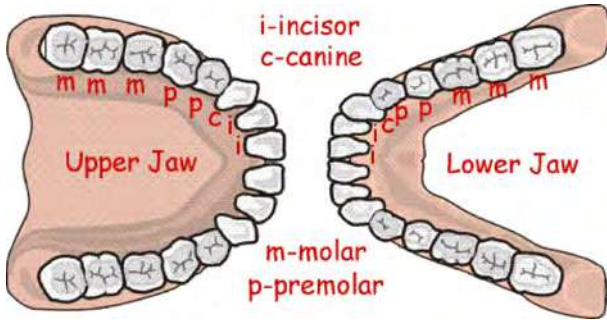
(iv) Molars

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.



#425013

Topic: Alimentary canal

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

**Solution**

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.

#464802

Topic: Alimentary canal

How are fats digested in our bodies? Where does this process take place?

**Solution**

Fat digestion takes place in the small intestine. The alkaline secretion of liver, bile, is carried to the small intestine by bile duct. The process starts with emulsification (break down) of large fat globule by the salt of bile into smaller micelles to facilitate further enzymatic reaction and digestion process. The fat-digesting lipase enzyme in pancreatic juice and intestinal juices digest the fat in micelles into triacylglycerols and then fatty acids and glycerols. These fat digestion products are then absorbed by intestinal mucosa and are carried to tissues by the lymphatic system and blood where they either serve as energy fuel or are stored after re-esterification.

#464803

Topic: Physiology of digestion

What is the role of saliva in the digestion of food?

**Solution**

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Salivary glands are present in the oral cavity that secrete saliva which is released into the mouth. Saliva contains bicarbonate and salivary amylase and serves to initiate the process of starch digestion into simple sugars by breaking the  $\alpha$ -1, 4- glycosidic linkage of starch to release oligosaccharides.