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# Digestive System

Biology

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## Digestive system

- The assemblage of organs associated with
  - ingestion of food
  - digestion
  - absorption
  - assimilation
  - egestion

## Components of digestive system

Digestive system consists of

- alimentary canal
- associated digestive glands
- physiology of digestion.

## Alimentary canal

- Alimentary is a long
- **Anatomy of alimentary canal:** Alimentary canal is complex coiled tube
- **Location of alimentary canal:** Alimentary canal extends from mouth to anus.
- **Length of alimentary canal:** The length of alimentary canal is
  - ( 8-10 ) meters.

## Part of alimentary canal

Alimentary canal consists of following parts:

- Buccal cavity
- Pharynx

- Oesophagus
- Stomach
- Small intestine
- Large intestine

## Mouth

- Mouth is a small and transverse aperture
- **Location of mouth:**
  - Mouth is present at face below the nose.

## Contents of mouth

Mouth consists of

- vestibule
- buccal cavity.

## Vestibule

- Vestibule is slit like space .
- Vestibule is externally bounded by lips
- Vestibule is laterally bounded by cheeks
- Vestibule is internally the teeth and the gums.

## Lips

- There is the presence of two lips.
- The depression in the upper lip is called philtrum.

## Buccal cavity

- The another term for buccal cavity is oral cavity.
- **Location of buccal cavity:**
  - Buccal cavity is present between upper jaw and lower jaw.

## Histology of buccal cavity

- Buccal cavity is lined by mucus membrane.

## Parts of buccal cavity

- Palate
- Tonsils
- Tongue
- Teeth

## Palate

### Types of palate

The type of palate are:

- anterior palate
- posterior palate

### Character of anterior palate

- The anterior hard palate is bony
- The anterior hard palate is made up of bones of:
  - maxilla
  - palatine bone
- Anterior palate contains rugae.

**Functions of anterior palate**

- Anterior palate separates buccal chamber from nasal chamber.
- Rugae of anterior plate helps to hold food during mastication

**Character of posterior palate**

- Posterior palate is
  - soft
  - fleshy
  - smooth

**Functions of posterior palate**

- The soft palate forms uvula
- The other term for uvula is velum palatine.
- **Function of uvula:**
  - Uvula closes internal nostril during swallowing of food.

**Tonsils****Histology of tonsils**

- Tonsils are lymphoid tissue.

**General location of tonsils**

- Tonsils are located at
  - pharynx
  - oral cavity

## **Types of tonsils**

The types of tonsils are:

- Nasopharyngeal tonsils
- Tubal tonsils
- Lingual tonsils
- Palatine tonsils

## **Location of nasopharyngeal tonsils**

- Nasopharyngeal tonsils are present in the nasopharynx.

## **Location of tubal tonsils**

- Tubal tonsils located posterior to the opening of Eustachian tube

## **Location of lingual tonsils**

- Lingual tonsils are situated on the posterior part of the tongue

## **Location of palatine tonsils**

- Palatine are present in the oropharynx.

## **Tonsillitis**

- Tonsillitis is the inflammation of palatine tonsils.

## **Tongue:**

### **Structure of tongue**

The tongue is described as a structure featuring characteristics of :

- large
- muscular
- highly mobile

### **Location of tongue**

Tongue is present in the floor of buccal cavity.

### **Terms related to tongue**

- **Frenulum Linguae :**
  - The tongue is attached to the floor of mouth cavity by a fold called frenulum linguae.
- **Ebners / Weber glands:**
  - Ebners glands are the glands present on the surface of tongue.
- **Sulcus terminalis:**
  - Structure dividing tongue into two parts as:
    - \* pharyngeal
    - \* papillary part.

### **Papillae in tongue**

#### **Location of papillae in tongue**

- The dorsal surface of tongue has the presence of lingual papillae.

### **Types of papipplae**

- The types of papillae are:
  - vallate papillae
  - filiform papillae
  - fungiform papillae

## **Vallate papillae**

### **Location of vallate papillae**

Vallate papillae is located at the base of the tongue.

### **Structure of vallate papillae**

- Vallate papillae are the largest.
- They are arranged in an inverted V manner.

### **Number of vallate papillae**

- Vallate papillae are 8-12 in number.

## **Fungiform papillae**

### **Location of fungiform papillae**

Fungiform papillae is situated at the + tip of the tongue + lateral edges of tongue

### **Structure of fungiform papillae**

- Fungiform papillae are
  - mushroom shaped structures

## **Filiform papillae**

- Filiform papillae are the smallest of all papillae.

### **Quantity of filiform papillae**

- Filiform papillae are present on two third of tongue.

## Functions of tongue

- The functions of tongue are:
  - Tongue assists in mastication
  - Tongue assists in swallowing
  - Tongue assists in speech.
  - Tongue helps to find taste.

## Teeth

### Characteristics of human teeth

- The human teeth is characterized as:
  - Thecodont
    - \* Thecodont is a term for teeth embedded in jaw socket.
  - Bunodont
    - \* Bunodont are teeth having low cups.
  - Heterodont
    - \* Heterodont are those having different types of teeth.
  - Diphyodont
    - \* Diphyodont are those having two sets of teeth.

### Shape of teeth of humans

- The teeth of human are:
  - incisors
    - \* Incisors are characterized with with sharp, chisel-like cutting edges.
  - canine
    - \* Canine are characterized with with pointed dagger-shaped structures.
  - premolar and molar
    - \* Premolar and molar are structures with broad and grooved cusps.



## Dental formula

Dental formula is the arrangement of teeth in respective jaw.

- The dental formula for human milk teeth is:
  - I 2/2
  - C 1/1
  - PM 0/0
  - M 2/2
- The dental formula for arrangement of human permanent teeth is:
  - I 2/2
  - C 1/1
  - PM 2/2
  - M 3/3

## Structure of tooth

Tooth consists of following three parts - Crown - Neck - Root

### Crown

- Crown is the exposed part of tooth.
- Crown is covered with hardest shining substance called enamel.
- A layer of dentine is present below enamel.

### Neck

Neck is the part surrounded by gum.

## Root

- Root is the part embedded in bony socket.
- Root is covered by a protective and supportive hard layer called cementum.
- There is the presence of pulp cavity
- Pulp cavity is filled with nerve fibres, blood vessels .
- Pulp cavity is lined by odontoblasts.
- Enamel is secreted by ameloblasts
- Ameloblasts are of ectodermal origin.
- Dentine is secreted by odontoblasts.
- Odontoblasts are of mesodermal origin.

## Facts about teeth

- Third molar is called wisdom tooth.
- Third molar erupts between 17-25 years.

## Function of teeth

- Teeth help in mastication
- Teeth help in speech production.

## Pharynx

### Dimension of pharynx

- Pharynx is about 12 cm long.
- **Location of pharynx** : Pharynx is a vertical canal beyond the soft palate.

## Types of Pharynx

- Nasopharynx
- Oropharynx
- Laryngopharynx

## Nasopharynx

- Nasopharynx is the upper part of pharynx.
- Nasopharynx has internal nares in the roof.
- Nasopharynx has a pair of Eustachian opening on lateral side.

## Oropharynx

- Oropharynx is the lower part of the pharynx.
- The function of oropharynx is for the passage for food.

## Laryngopharynx

- Laryngopharynx is the lowest part of the pharynx.
- Laryngopharynx has two apertures-anterior slit-like glottis.
- Laryngopharynx posterior gullet.
- Glottis bears epiglottis.
- Epiglottis is a leaf like cartilaginous flap.

## Function of pharynx

- Pharynx passages the food from mouth cavity to the oesophagus.

## **Oesophagus:**

### **Structure of Oesophagus**

- Oesophagus is a
  - muscular
  - long
  - narrow
  - elastic tube

### **Dimensions of Oesophagus**

The oesophagus is about 25cm in length.

### **Location of Oesophagus**

- The oesophagus passes through the diaphragm .
- The oesophagus opens in the stomach in the abdomen.
- Oesophagus pierces the diaphragm at hiatus.

### **Histology of Oesophagus**

- Oesophagus is lined with stratified squamous epithelium.
- Oesophagus contains goblets cells.
- Oesophagus does not contain digestive glands.

### **Anatomy of Oesophagus**

- The upper end of oesophagus is closed by circo oesophageal sphincter.
- The lower end of oesophagus id closed by oesophageal sphincter.

## Functions of Oesophagus

- Oesophagus passes food from the pharynx to the stomach.
- The passage of food from pharynx to stomach is done by peristalsis.

## Stomach

### Location of stomach

Stomach is situated on the left side of abdominal cavity.

### Structure of stomach

- Stomach is the broadest part of alimentary canal.
- Stomach is J-shaped structure.
- Stomach has lesser and greater curvatures.

### Parts of stomach

- Stomach is divided into two parts.
- The parts of stomach are:
  - cardiac
  - pyloric

## Cardiac

### Parts of cardiac portion

- The larger cardiac part is further subdivided into two parts.
- The two parts of the cardiac portion are:
  - fundus
  - body

**Fundus**

- Fundus is the upper convex dome- shaped part.
- Fundus is situated above the level of cardiac orifice.

**Body**

Body lies between fundus and pyloric antrum.

**Pyloric**

- Pyloric part is divided into two parts.
- The parts of the pyloric portion of the stomach are:
  - pyloric antrum
  - pyloric canal

**Pyloric canal**

- Pyloric canal is a narrow and tubular structure.
- The right end of the pyloric canal ends at the pylorus.

**Pyloric antrum**

Pyloric antrum is the right narrow lower portion of the stomach.

**Anatomy of stomach**

Stomach has two openings The openings of the stomach are : The cardiac orifice The cardiac orifice is guarded by cardiac sphincter

and pyloric orifice guarded by pyloric sphincter. **Gastric Rugae:** + Gastric rugae is the folds of the muscosa. + Gastric rugae is seen only in empty stomach.

## **Histology of Stomach**

- The mucosal lining of the stomach has gastric glands.

## **Functions of stomach**

- Stomach acts as storage of food.
- Stomach processes mechanical churning of food.
- Stomach conducts partial digestion.
- Stomach conducts the limited absorption of water, alcohol etc.

## **Intestine**

### **Location of intestine**

- Intestine is the longest and coiled part of alimentary canal.
- Intestine is located behind the stomach.

### **Parts of intestine**

- Intestine is divided into two parts .
- The two parts of intestine are :
  - small intestine
  - large intestine.

## **Small intestine:**

### **Structure of small intestine**

Small intestine is the longest and coiled part of intestine

**Parts of small intestine**

- The small intestine is divisible into three parts
- The three parts of the small intestine are:
  - duodenum
  - jejunum
  - ileum

**Structure of Duodenum**

Duodenum is C shaped curved tube.

**Anatomy of Duodenum**

- Duodenum receives bile from gall bladder
- Duodenum receives pancreatic juice from pancreas
- The bile and pancreatic juice are received through a common hepatopancreatic duct.
- The opening of hepatopancreatic ampulla is guarded by sphincter of Oddi.
- The wall of duodenum contains crypts of Lieberkuhn
- The wall of duodenum contains branched Brunner's glands.

**Structure of Jejunum**

- Jejunum is the middle part of small intestine.
- Jejunum is narrower than duodenum.

**Anatomy of Jejunum**

- The jejunum has larger but thick walled villi.
- The villi of jejunum does not absorb digested food.



**Structure of Ileum**

- The ileum is the longest part of the small intestine.
- The ileum is the highly coiled part of small intestine

**Anatomy of Ileum**

- The wall of ileum is thinner and less vascular
- The inner surface is provided with numerous villi.
- Villi greatly increase the surface area for absorption.
- Lamina propria of ileum contains granular masses of lymph nodules
- The granular masses of lymph nodules in the lamina propria of ileum called Peyer's patches.

**Functions of small intestine**

Functions: Small intestine serves two main functions; i) - Small intestine completes the digestion of food. - Small intestine absorbs the digested food.

**Large intestine****Dimensional properties of large intestine**

- Large intestine is thicker than small intestine.
- Large intestine is wider than small intestine.

**Location of large intestine**

- Large intestine surrounds the small intestine.
- Large intestine is present in the lower abdominal cavity.

**Shape of large intestine**

- Large intestine has general shape of an inverted U.

**Parts of large intestine**

- Large intestine has three parts .
- The parts of large intestine are:
  - caecum
  - colon
  - rectum

**Caecum:****Structure of caecum**

- Caecum is a dilated sac like structure.

**Ileo Caecal valve**

- The junction of ileum with caecum is called ileo-caecal junction.
- The ileo caecal junction is guarded by ileo-caecal valve.

**Vermiform appendix**

- Vermiform appendix is a short, slender worm -like projection.
- Vermiform appendix is present in the caecum.

**Colon:****Structure of colon**

- Colon is long and ucoiled tube.

**Shape of colon**

- The shape of colon is inverted U shaped tube.

## Parts of colon

- Colon is divided into 4 parts.
- The parts of colon are:
  - ascending colon
  - transverse colon
  - descending colon
  - sigmoid colon.

## Histology of colon

- The wall of colon has three longitudinal bands
- The bands of wall of colon are called taeniae coli.

## Rectum

### Composition of rectum

- Rectum is made up of muscles.

### Functions of rectum

- Rectum stores undigested food.
- The time of storage of food is for short period.

## Functions of large intestine

- The functions of large intestine are:
  - absorption of water
  - defaecation
  - synthesis of vitamin K
  - synthesis of vitamin B complex.

**Anus:**

- Anal sphincter guard the anus.
- Anal sphincter are two in number.

**Types of anal sphincter**

- The types of anal sphincter are:
  - Internal anal sphincter
  - External anal sphincter
- Internal anal sphincter is made up of smooth muscles.
- External anal sphincter is made up of striated muscles.

**Digestive Glands**

- Based in the nature of action of digestive glands they are divisible into :
  - associated digestive glands
    - \* Associated digestive glands interact with digestion by producing ducts
  - glands at the alimentary canal.

**Associated digestive glands**

- The types of associated digestive glands are:
  - salivary glands
  - liver
  - pancreas

**Glands at the alimentary canal**

- The glands at the alimentary canal are:

- intestinal glands
- gastric glands

### **Role of digestive glands**

- Digestive glands secrete digestive juices.
- Digestive juices contain enzymes.
- Digestive enzymes are necessary for the chemical digestion of the food.

## **Salivary Glands**

### **Location of salivary glands**

- Salivary glands are located at the mouth cavity.

### **Types of salivary glands**

- The types of salivary glands are:
  - parotid glands
  - submaxillary glands
  - sublingual glands

### **Parotid glands**

- Parotid glands are the largest salivary glands.
- The secretion of parotid glands is called Stensen's duct.
- Stensen's duct opens in the mouth cavity.
- Stensen's duct opens in the upper second molar tooth.

### **Location of parotid glands**

- Parotid glands are present on each side of the face.
- Parotid glands are present just below and in front of the ears.

**Submaxillary glands**

- The secretion of submaxillary glands is Wharton's duct.
- Wharton's duct is poured at the side of frenulum of the tongue.

**Location of submaxillary glands**

- Submaxillary glands are located at the angles of the lower jaw.

**Sublingual glands**

- Sublingual glands are the smallest salivary glands.
- Sublingual glands secrete ducts.
- The duct of sublingual glands is called duct of Rivinus.

**Location of sublingual glands**

- Sublingual glands are located beneath the tongue.

**Saliva**

- Saliva is a fluid.
- Saliva is viscous.
- Saliva is colourless.
- Saliva is cloudy.

**Contents of saliva**

The contents of saliva are:

- salivary amylase
- lysozyme
- lingual lipase

## **Functions of saliva**

The functions of saliva are:

- Saliva moistens dry food.
- Saliva facilitates swallowing action by lubrication of food.
- Saliva keeps the mouth clean.
- Saliva keeps the teeth clean.
- Saliva dissolves sugar.
- Saliva dissolves salts.

## **Gastric glands**

### **Location of gastric glands**

- The gastric glands are present at the wall of stomach.

### **Types of gastric glands**

The types of gastric glands present at the wall of stomach are: - simple branched - simple tubular

### **Types of cells present in gastric glands**

The types of cells present in gastric glands are:

- parietal cells
- chief cells
- mucous cells

### **Functions of parietal cells**

- Parietal cells secrete Castle's intrinsic factor.
- Parietal cells secrete

**Role of castle's intrinsic factor**

- castle's intrinsic factor absorbs Vitamin

**Functions of chief cells.**

- Chief cells secrete proenzymes.
- The proenzymes secreted by chief cells are:
  - pro renin
  - gastric lipase

**Functions of mucous cells**

- Mucous cells secrete mucus.

**Gastric Juice**

- All the secretion of gastric glands is called gastric juice.
- There is the presence of Argentaffin cells.
- Argentaffin cells are also called entero-endocrine cells.

**Argentaffin cells**

- Argentaffin cells consists of
  - D - cells
  - G Cells

**Contents of D-cells secretion**

- D-cells are composed of following secreted constituents:
  - somatostatin
  - enterocrinin



- Somatostatin and enterocrinin cell secrete enzymes.
- The enzymes / ducts secreted by somatostatin and enterocrinin are:
  - serotonin
  - histamine

### **Contents of secretion of G-cells**

- G-cells secrete hormones.
- The hormones secreted by G-cells is :
  - gastrin

## **Liver**

- Liver is the largest gland.

### **Location of liver**

- Liver is located behind the right side of abdominal cavity
- Liver is located behind the diaphragm
- Colour of liver is reddish brown

### **Lobes of liver**

- Liver has two lobes:
- Caudate lobe is a lobe of the liver
- Quadrate lobe is a lobe of the liver

## **Gall bladder**

- Gall bladder is a pear shaped structure.
- Gall bladder is located under the surface of right lobe

**Functions of gall bladder**

- Gall bladder acts as reservoir.
- Gall bladder stores bile secreted by liver.
- Gall bladder produces cystic duct
- Cystic duct of gall bladder joins with bile ducts.
- This combination of the ducts is a common hepatic duct.
- The common hepatic duct opens in the duodenum

**Histological structure of liver**

- Liver lobes are formed by hexagonal lobules.
- Hexagonal lobules are surrounded by sheath of connective tissue.
- The sheath of connective tissue that surrounds the hexagonal lobules are called Glisson's capsule.

**Histological structure of lobules of liver**

- Each lobule of liver is formed by hepatocytes
- Hepatocytes are hepatic cells.
- The shape of hepatocytes is polyhedral.

**Anatomical structure of liver**

- There is the presence of portal triad at the periphery of each lobule.
- Portal triad consists of:
  - portal vein
  - hepatic artery
  - bile duct
- Bile canaliculi are the spaces between hepatic cells.
- Bile canaliculi unite to form bile duct.
- Bile duct of lobules unite to form common hepatic duct.

## Functions of liver

### Secretion of bile

- The chemical property of bile is alkaline .
- The colour of bile' is dark green.
- The physical state of bile is a fluid.

### Contents of bile

- Bile contains bile salts
- Bile contains bile pigments.
- Bile contains some waste substances.
- The contents of bile salts are:
  - sodium bicarbonate c sodium glycolate
  - sodium tauro chlorate

### Contents of bile pigment

- The contents of bile pigments are:
  - bilivirdin
  - bilirubin

### Functions of bile

- Bile acts as antiseptic.
- Bile stimulates peristalsis.
- Bile neutralizes chyme.

### Carbohydrate metabolism.

- Liver regulates sugar level.
- Liver regulates sugar level by glycogenesis .and glycolygenesis.

**Glycogenesis**

- Glycogenesis is the conversion of excess glucose into glycogen.
- Glycogenesis is done by liver cells.
- Glycogenesis is done in the presence of insulin.

**Glycoly genesis**

- Glycoly genesis the conversion of glycogen into glucose.
- Glycogenesis is done by liver cells.
- Glycoly genesis is done in the presence of glucagon.

**Protein metabolism.**

- Liver decomposes amino acids into ammonia.
- Ammonia is converted into urea.
- The process of conversion of ammonia in to urea is deamination

**Lipid metabolism**

- Liver controls lipogenesis.
- Lipogenesis is the conversion of excess glucose and amino acids into fats.

**Production of plasma proteins**

- Liver produces fibrinogen liver produces prothrombin

**Immunity**

- Liver does phagocytosis
- Phagocytosis is done by Kupffer cells.
- Kupffer cells eat dead cells and bacteria.

## Storage

- Liver stores minerals.
- Liver stores vitamins .
- The minerals stored by liver are. copper and iron.
- The vitamins stored by liver are *A, D E, K*, and

## Production

- Liver produces anticouglatory chemical
- The anticoagulatory chemical is heparin.
- Liver acts as erythropoetic organ in foetus.
- Liver produces RBC in foetus.

## Pancreas

- Pancreas is the second largest organ .
- Structure of pancreas is a long and lobe like.
- The colour of pancreas is yellow.
- The mass of pancreas is ( 60gm ).
- **Location of pnacreas:** Pancreas is located at the loop of duodenum. Pancreas extends upto the spleen behind the stomach
- **Parts of Pancreas:** Pancreas contains head , body and tail.
- **Type of Gland:** Pancreas is a heterocrine gland.

## Exocrine part of pancreas

- The exocrine part of pancreas is formed by pancreatic lobules.
- The pancreatic lobules contain aciner glandular cells.
- The aciner glandular cells are triangular.
- **Functions of exocrine cells:**

- Exocrine cells of pancreas secrete pancreatic juice.
- Pancreatic juice is poured in the duodenum.
- The pouring of pancreatic juice is done through hepatopancreatic ampulla.

### **Endocrine part of pancreas**

- The endocrine part of pancreas contains a group of cells.
- The group of cells on the endocrine part of pancreas are called islets of Langerhans.

### **Islets of langerhans**

- The islets of langerhans contain four types of cells.
  - ( $\alpha$ ) cells.
  - ( $\beta$ ) cells.
  - ( $\delta$ ) cells.
  - (F) cells.

### **Secretion of cells in islets of langerhans**

- Alpha cells secrete glucagon.
- Beta cells secrete insulin.
- Delta cells secrete somatostatin.
- F cells secrete pancreatic polypeptide.

### **Functions of secretion of cells of islets of langerhans**

- Insulin helps in carbohydrate metabolism.
- Glucagon helps in carbohydrate metabolism.
- Somatostatin inhibit the secretion of insulin and glucagon.
- Pancreatic polypeptide inhibit the secretion of pancreatic juice.

## Intestinal glands

### Location of intestinal glands

- Intestinal glands are located at the mucosa of small intestine.
- The intestinal glands are of two types.
- The types of intestinal glands are:
  - crypts of lieberkhun
  - brunner's gland

### Crypts of lieberkhun

- Crypts of lieberkhun are located at the villi of small intestine.
- Crypts of lieberkhun are simple tubular glands.

### Function of crypts of lieberkhun

- Crypts of lieberkhun collectively secrete succus entericus.
- The enzymes present at the succus entericus are:
  - amino peptidase
  - dipeptidase
  - intestinal lipase
  - enterokinase
  - maltase
  - iso maltase
  - dextrinase
  - lactase
  - sucrase
  - nucleotidase
  - nucleosidase

## **Brunners gland**

- Brunners gland are branched tubular glands.
- Brunners gland are present at the submucosa of duodenum.

## **Functions of brunners glands**

- Brunners glands secrete thick mucus.
- The thick mucus secreted by brunners gland protects the duodenal mucosa from acidic chyme.

## **Parts of digestion**

The parts of digestion are:

- Ingestion
- Digestion
- Absorption
- Assimilation
- Egestion

## **Ingestion**

- Ingestion is the process of taking food into oral cavity.

## **Digestion**

- Digestion is:
  - The hydrolysis of complex food substances to simplest compounds.
  - The simplest compounds can be absorbed in the alimentary canal.
  - The simplest compounds are absorbed for their utilization.



The location of digestion are:

- Buccal cavity
- Stomach
- Intestine

## Buccal digestion

- **Mastication:**
  - The breaking down of ingested food into smaller pieces is mastication.
  - **Location of mastication:** Mastication is done in the buccal cavity.
- **Role of tongue:**
  - Tongue mixes the small food particles with the saliva.

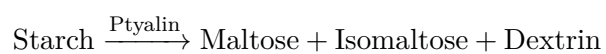
## Contents of Saliva

The saliva consists of the following components:

- salivary amylase
- lingual lipase

## Functions of Saliva

- **Salivary amylase**
  - Salivary amylase converts starch
  - It converts starch into:
    - \* maltose
    - \* isomaltose
    - \* dextrin



- **Lingual lipase**

- Lingual lipase converts lipids
- It converts lipids into:
  - \* lipase Fatty acids
  - \* glycerol



## Post buccal digestion

- **Bolus:**

- Bolus is the food passed from buccal cavity to pharynx.

- **Peristalsis:**

- Peristalsis is a wave like motion.
- **Cause of peristalsis:** Peristalsis occurs by the alternating contraction and relaxation.
  - \* Longitudinal muscles relax and contract.
  - \* Circular muscles relax and contract.

## Gastric digestion

- **Site for gastric digestion:**

- Gastric digestion occurs in the stomach.

- **Component of gastric digestion:**

- Gastric digestion contains gastric juice.

- \* **Contents of gastric juice:**

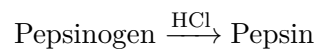
- Gastric juice contains enzymes.

The components of gastric enzymes are:

- pepsin
- renin
- gastric lipase

## Pepsin

- **Secretion:** Pepsin is secreted as pepsinogen.
- **Conversion:**
  - Pepsinogen is converted into pepsin.
  - Pepsinogen is converted into pepsin by



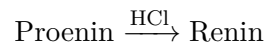
## Function of pepsin

- **Pepsin:**
  - Pepsin hydrolyses protein.
  - Pepsin hydrolyses protein into:
    - \* proteoses
    - \* peptones



## Renin

- **Secretion:**
  - Renin is secreted as prorenin.
- **Conversion:**
  - Prorenin is converted into renin.
  - Prorenin is converted into renin by .

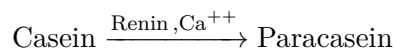


## Function of renin

- **Renin:**

- Renin converts caesin of milk.
- Renin converts casein of milk only in the presence of calcium.
- Renin converts casein of milk into:

- \* Paracaesin



- \* **Post paracasein digestion:**

- Pepsin hydrolyses paracasein.
  - \* Pepsin hydrolyses paracasein into:
    - proteoses
    - peptones



## Function of Gastric lipase

- **Gastric lipase:**

- Gastric lipase converts little of fats.
  - \* This limitation is imposed by the lack of emulsifying chemicals.
- Gastric lipase converts fats into :
  - \* fatty acids
  - \* glycerol



## Post Gastric Digestion:

- **Chyme:**
  - Chyme is the partially digested food of the stomach.
- **Peristalsis:**
  - Peristalsis passes food from stomach to pyloric sphincter.
  - Pyloric sphincter is present in the duodenum.

## Internal digestion

### Pre Internal Digestion

- Bile is poured into the duodenum.
  - Bile is poured by the contraction of gall bladder.

The components of internal digestion are:

- bile
- pancreatic juice
- intestinal juice

## Function of Bile

- **Bile:**
  - Bile salts emulsify fats.
    - \* The emulsification of fats make an environment for action of pancreatic lipase.

## Pancreatic Enzymes

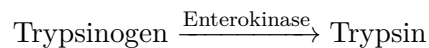
The pancreatic enzymes are:

- trypsin

- chymotrypsin
- carboxypeptidase
- pancreatic amylase
- pancreatic lipase
- ribonuclease
- deoxyribonuclease

## Trypsin

- **Secretion:** Trypsin is secreted as inactive trypsinogen.
- **Conversion:**
  - The inactive trypsinogen is converted into trypsin.
  - The inactive trypsinogen is converted into trypsin by enterokinase.
    - \* Enterokinase is a component of succus entericus.



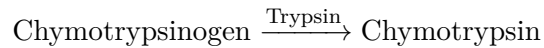
## Function of trypsin

- **Trypsin:**
  - Trypsin acts on protein.
  - Trypsin hydrolyses protein into:
    - \* proteoses
    - \* peptones

## Chymotrypsin

- **Secretion:** Chymotrypsin is secreted as inactive chymotrypsinogen.
- **Conversion:**
  - Chymotrypsinogen is converted into chymotrypsin.

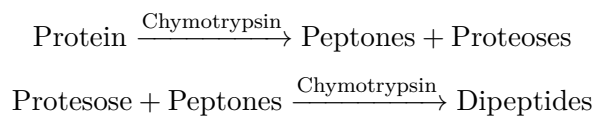
- Chymotrypsinogen is converted into chymotrypsin by the action of trypsin.



## Function of chymotrypsin

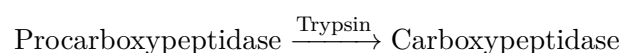
- **Chymotrypsin**

- Chymotrypsin acts on protein.
- Chymotrypsin hydrolyses proteins into:
  - \* peptides



## Carboxypeptidase

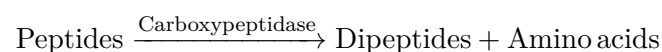
- **Secretion:** Carboxypeptidase is secreted as procarboxypeptidase.
  - Procarboxypeptidase is converted into carboxypeptidase
  - Procarboxypeptidase is converted into carboxypeptidase by the action of trypsin.



## Function of carboxypeptidase

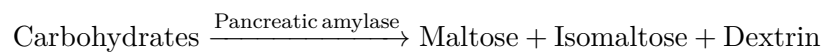
- **Carboxypeptidase:**

- Carboxypeptidase acts on peptides.
- Carboxypeptidase reduces peptides into:
  - \* dipeptides
  - \* amino acids



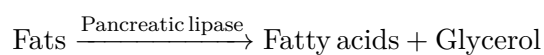
## Function of Pancreatic amylase

- Pancreatic amylase acts on:
  - starch
  - glycogen
- Pancreatic amylase converts carbohydrate into :
  - maltose
  - isomaltose
  - limit dextrin



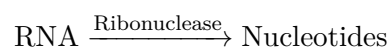
## Function of Pancreatic lipase

- **Pancreatic lipase**
  - Pancreatic lipase acts on dietary fats.
  - Pancreatic lipase converts dietary fats into :
    - \* fatty acids
    - \* glycerol



## Function of Ribonuclease

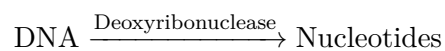
- **Ribonuclease:**
  - Ribonuclease acts on *RNA*.
  - Ribonuclease converts *RNA* into
    - \* Nucleotides





## Function of deoxyribonuclease

- **Deoxyribonuclease:**
  - Deoxyribonuclease acts on *DNA* .
  - Deoxyribonuclease converts *DNA* into:
    - \* Nucleotides



## Intestinal Juice

- **Secretion:**
  - Intestinal juice is also termed as succus entericus.

The enzymes present in the intestinal juice are:

- enterokinase
- aminopeptidase
- dipeptidase
- intestinal lipase
- maltase
- isomaltase
- dextrinase
- sucrase
- lactase
- nucleotidase
- nucleosidase

## Enterokinase

- Enterokinase is a non digestive enzyme.

## Function of Enterokinase

- **Enterokinase**

- Enterokinase acts on trypsinogen.
- Enterokinase converts on inactive trypsinogen into trypsin.

## Function of aminopeptidase

- **Aminopeptidase:**

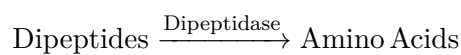
- Aminopeptidase acts on peptides.
- Aminopeptidase acts on amino group of peptides.
- Aminopeptidase peptides into :
  - \* dipeptides
  - \* amino acids



## Function of dipeptidase

- **Dipeptidase**

- Dipeptidase acts on dipeptides.
- Dipeptidase converts dipeptides into :
  - \* Amino acids

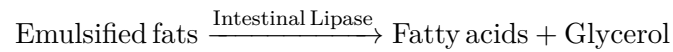


## Function of intestinal lipase

- **Intestinal Lipase**

- Intestinal Lipase acts on emulsified fats.
- Intestinal Lipase hydrolyses emulsified fats into:

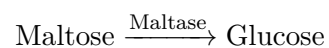
- \* fatty acids
- \* glycerol



## Function of Maltase

- **Maltase**

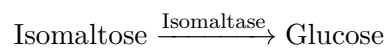
- Maltase acts on maltose.
- Maltase splits maltose into:
  - \* glucose molecules



## Function of Isomaltase

- **Isomaltase**

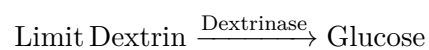
- Isomaltase acts on isomaltose.
- Isomaltase converts isomaltose into:
  - \* glucose



## Function of Dextrinase

- **Dextrinase:**

- Dextrinase acts on dextrins.
- Dextrinase hydrolyses dextrins into:
  - \* glucose



## Function of sucrase

- **Sucrase**
- Sucrase acts on Sucrose.
- Sucrase converts sucrose into:
  - glucose
  - fructose



## Function of Lactase

- **Lactase:**
  - Lactase acts on lactose.
  - Lactase converts lactose into:
    - \* Glucose
    - \* Galactose



## Function of nucleotidase

- **Nucleotidase:**
  - Nucleotidase acts on nucleotides.
  - Nucleotidase hydrolyses nucleotides into:
    - \* nucleosides
    - \* inorganic phosphates



## Function of nucleosidase

- **Nucleosidase**
  - Nucleosidase acts on nucleosides.
  - Nucleosidase hydrolyses nucleosides into:
    - \* nitrogen base
    - \* pentose sugar



## Post Intestinal Digestion

- **Chyle:** Chyle is the fully digested alkaline food.
  - Chyle is present in small intestine.
  - **Contents of chyle:**
    - \* glucose
    - \* fructose
    - \* galactose
    - \* amino acid
    - \* fatty acid
    - \* glycerol

## Absorption

### Definition

- Absorption is a process.
- There is transfer of food in absorption.
- The food transfers from lumen of gut into:
  - blood

- lymph
- **Cause:** Absorption occurs by physicochemical processes.

### Sites of absorption

- **Buccal cavity:**
  - There is no absorption in buccal cavity.
- **Stomach:**
  - There is very little absorption in stomach.
  - The components absorbed are:
    - \* alcohol
    - \* aspirin
- **Small intestine:**
  - There is maximum absorption in small intestine.
  - **Structure of small intestine:**
    - \* The outermost lining of small intestine is mucosa.
    - \* Mucosa is provided with villus.
    - \* Each villus has a network of:
      - blood capillaries
      - lymphatic vessels
    - \* Lymphatic vessels are also termed as lacteals.

### Types of Absorption

The types of absorption are:

- Active absorption
- Passive absorption

## Passive absorption

- **Location:** Passive absorption occurs in between
  - mucosal epithelial cells
  - intestinal lumen
- Passive absorption occurs along the concentration gradient.
- The concentration gradient is from
  - higher concentration
  - to lower concentration
- The higher concentration is present at the intestinal lumen.
- The lower concentration is present at mucosal epithelial cells
- **Rate of absorption:** Passive absorption is very slow.
- **Requirement of Energy:** Passive absorption doesnot require energy.
- **Process of passive absorption:** Passive absorption occurs by:
  - Simple diffusion
  - Facilitated diffusion
  - Endocytosis

### Limitations:

- Passive absorption cannot absorb:
  - \* nutrients from intestinal lumen
- **Examples:**
  - Passive absorption absorbs monosachharaides.
  - Passive absorption absorbs amino acids.

## Active Absorption

- **Location:** Active absorption occurs between
  - mucosal cells

- blood
- Active absorption occurs against the concentration gradient.
- Active absorption occurs from low concentration gradient into high concentration gradient.
- The low concentration gradient is at intestinal lumen.
- The high concentration gradient is at blood.
- **Requirement of Energy:**
  - Active absorption requires energy.
  - Energy for active absorption is provided by the hydrolysis of .
- **Absorption of Fats:**
  - Fatty acids are incorporated into micelles.
  - Micelles are:
    - \* small
    - \* spherical
    - \* water soluble
    - \* droplets
  - Micelles are formed by the help of bile salts.
  - Micelles are absorbed by facilitated diffusion.
  - The components incorporated along with the absorption of Micelles are:
    - \* fatty acids
    - \* glycerol
    - \* fat soluble vitamins
- **Examples:** Active absorption absorbs:
  - 
  - glucose
  - galactose
  - amino acids



## Assimilation

- Assimilation is the process of utilization of absorbed nutrients.
- The nutrients are utilized into:
  - body cells
  - energy
  - growth
  - repair

## Egestion

- Egestion is the process of removal of food stuffs that are:
  - undigested
  - unabsorbed
- Egestion is passed in the form of faeces.
- The colour of faeces is due to stercobilin.
- Stercobilin is a derivative of bilirubin.