Chapter-3

Human Biology

1. Digestive System

Digestive system is also called alimentary canal or glastro intestinal track begins with mouth from where food enter & end with anus. The digestive system of human consist of alimentary canal and digestive gland

1) Alimentary canal

In human, alimentary canal is long, tubular digestive track of different diameter extending from mouth to anus. It measure about 8 to 9m length. It consist of following part

a. Mouth

It is transverse opening & consist of vestibule & buccal cavity.

Vestibule is small opening or space which is externally bounded by non-motile upper lip & motile lower lip.

Buccal cavity is also called oral cavity in which mouth is open. Buccal cavity is lined with non-derathhiztise stratified epithelium. It consist of three parts.

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1. Palate

Palate forms the roof of buccal cavity & anterior palate is formed hard & conic that hold the food during mastication. The posterior palate is soft & fleshly that helps for the to swallowing the food.

2. Tongue

Tongue is large, muscular, prostusible, motile organ. It lies on the floor of buccal cavity. The tongue is incompletely divided by inverted V-shaped furrow sulcus terminalis. There are small projection located at the upper surface of tongue called papillae. There are two type of gland present in tongue that secrete enzyme:

i) Evners gland, It produce lipase enzyme
ii) Webners gland, It produce mucus

Papillae contain cell called taste bud that are sensitive to chemical nature of food such as sweet salt, sour and bitter which are not fully developed in children. The main function of tongue is that it play important role in mastication of food swallowing food & speech it manopulate the food so that food is mixed with saliva. It is also an origin of taste.

3. Teeth

In human teeth are present in both jaw. There are basically three type of teeth present in human.

(a) Thecodont teeth: These type of teeth are fixed in jaw socket.

(b) Diphyodont teeth: Human has two set of teeth i.e. milky teeth & deciduous teeth.

Human has two set of teeth. Milky teeth or deciduous appears at first. The 1st set of milky teeth are fall out & replaced by 32 permanent teeth between the age of 6-18. Third molar teeth appears after the age of 20. These molar teeth are called wisdom teeth. But sometimes they maynot appear in some person.

(c) Heterodont teeth: In human teeth have different shape and size and consist of 32 permanent teeth in which 8 are incisor, 4 are canines, 8 are premolar & 12 are molar teeth.

The number, shape & size of teeth are related to diet. On the basis of structure & function of each type of teeth. Four different type of teeth are found

1) Incisor (I): They are situated at front of buccal cavity. They have flat & sharp edge which are used for cutting & bitting of food. Upper jaw consist 4 incisor teeth & lower jaw consist 4 incisor teeth i.e there are total 8 incisor teeth.

2) Canines (C): They are broad & strong having one or two root which are used for crushing & grinding of food. Premolar in lower jaw have 1 root whereas premolar in upper jaw have 2 root. There are total 8 premolar teeth.

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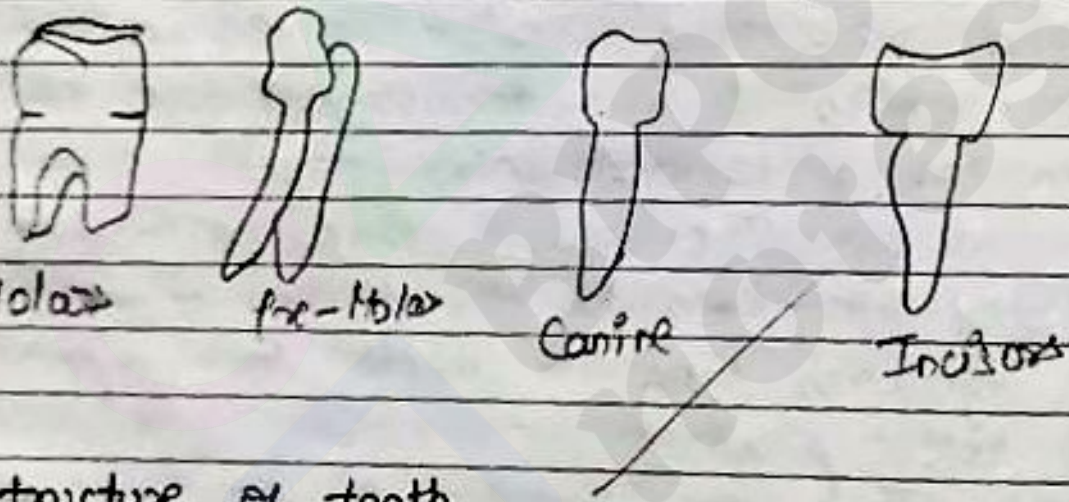
3) Pre-Molar (PM):- They are broad & strong having one or two root which are used for crushing & grinding of food. Premolar in lower jaw have 1 root whereas premolar in upper jaw have 2 root. There are total 8 premolar teeth.

4) Molar (M):- They are broad & strong having 2-3 root. Each molar root have 4-5 cusps they are used to crush and grind food. Molars in lower jaw has 2 roots whereas molar in upper jaw has 3 roots.



* Structure of teeth

A typical teeth consist of 3 part

i. Crown

It is exposed part of teeth which is covered by hard substance called enamel. It is relatively resistance to decay below the enamel there is layer of hard called dentine.

ii. Neck

Neck is short part present in upper gum.

iii. Root

Root is present in bonely jaw that hold the teeth. Root is covered by protective & supportive layer called Cement or Cementum produced by cement toblast - It has also lining of vascular membrane.

Pharynx or Throat

Pharynx or Throat is situated at soft palete which measures about 5 inch long & lie with membrane. It is divided into 3 parts

(1) NasoPharynx (2) oropharynx (3) Laryngopharynx

(1) NasoPharynx → It is upper part of pharynx that communicate with major apertures through the internal nostril & with ear through Eustachian tube. It extend upto level of soft palete.

(2) oropharynx → Oropharynx is middle part of pharynx that serve as common passage of air travelling from nose to the trachea and the food travelling from oral cavity to Oesophagus. It extend from level of soft palete to level of 3rd cervical.

(3) ~~Lower~~ Laryngopharynx → It is lower part of pharynx. It consist of 2 opening; one opening is for passage of food which is called Glottis & another opening is called passage of food called Gullet. Both openings are separated by elastic cartilage called Epiglottis. Epiglottis cover glottis so that food can't enter into trachea.

The main function of pharynx is it acts as common passage for food & air.

Oesophagus

Oesophagus is called Food Pipe which is long, narrow structure measuring about 25cm long. Its wall is lined by stratified squamous & columnar

epithelium. The oesophagus runs straight down the neck behind & along with trachea. The food is propelled down the oesophagus towards the stomach by rhythmic contractions of muscles in wall of Oesophagus. Such type of contraction is called Peristalsis. The oesophagus serves to convey the food from pharynx to the stomach by peristalsis movement.

Stomach: Stomach of human is large, curve and J shaped in structure which is situated just below the diaphragm on the left side of abdominal cavity. It measures about 30cm long and 15cm wide. stomach is divided into 2 parts:- Cardiac part and pyloric part.

The cardiac part is divided into fondus & body.

* Fundus - It is upper part of stomach present near the heart. The oesophagus opens into fondus.
* Body - Body is middle part of stomach present in the centre.

Pyloric part = It is present in the lower region near the duodenum. Human stomach consist of 2 opening, the entrance & exit. Both these opening of stomach is guarded by rings of muscles ina sphincteres. The cardiac end has his cardiac sphincters to control the opening between oesophagus of stomach whereas pyloric end has pyloric sphincters to control the opening between stomach and duodenum. These sphincter prevent the backflow of food.

The stomach wall consist of

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3 muscular layer · out of them, outer layer is longitudinal fibre, middle layer is circular fibre and inner layer consist of oblique fibre. Internally, the stomach coall consist of gastric gland which secrete gastric juice that contain hydrochloric acid, pepsinogen enzyme & mucus. The food is mixed with gastric juice which serve for partial digestion. Then the food is changed into semi-digested food called chyme.

* Function of stomach:-

i. Stomach play an important role in storage of food.

ii. Stomach help in partial digestion of food.

iii. Stomach help in limited absorption of water & some lipid soluble drugs.

Intestine: Human intestine is divided into 2 parts, Small Intestine & Large Intestine

* Small Intestine = It is longest & coiled part of alimentary canal which measures about 6.5 m. It is divided into duodenum, jejunum Ilieum.

- Duodenum: Duodenum is C shaped in structure which measures about 25cm. It receive the bile from gall bladder & pancreatic juice from pancreas through a hepato-pancreatic duct. Internally, It contain numerous intestinal gland which secrete intestinal juice. The wall of duodenum contain crypts of Liebenkehun & brunners gland. These gland secrete the mucus and only present in duodenum part. Duodenum is main site

where all complex food are digested into simpler form of food.

- Jejunum: Jejunum is narrower than duodenum which is middle part of small intestine. It measures about 2.5m long. It's wall has larger and thick villai for absorption of fat. Jejunum conduct the food from duodenum to Ileum.

- Ileum: Ileum is longest & highly coiled structure of small intestine which measures about 3.5m long. It's inner surface posses small, thin, finger like projection called villai which increase the surface area for absorption. The villi are richly supplyied with blood capillary
mucus membrane of Ileum which act as defensive organ against the injection produced by lymphocyte. The main function of Ileum is absorption of simpler food material.

- Large Intestine = It is short but wider than small Intestine which measures about 1.5m long. It is divided into caecum, colon & rectum.

- Caecum = Caecum is pouch like structure measures about 6cm in length. It is connected to Ileum by Ileo-caecal junction. The ileo-caecal junction is guarded by ileo-caecal valva which prevents the backflow of food with small intestine. Attached to the caecum there is cylinder vermiform appendix. Its

present which is about 8-10cm long. In human being, vermiform appendix act as vestigial organ but it is functional in herbivores animal.

- Colon = Colon is U shaped tube measuring about 1.2m in length & divided into four region; Ascending colon, descending colon, transverse & sigmoid colon. The wall of colon consist of 3 longitudinal band of muscle fibre called taenia coli, small pouches.
- Rectum = The colon finally open into rectum. It is muscular & terminal part. which measures about 15cm. It leads outside through the anus. The terminal anal opening is guarded by two anal sphincters mainly external & internal sphincters that prevent leakage of stool

* Function of large intestine :-

i. Large Intestine absorb large amount of water.
ii. Egestion of undigested food material from gastro intestinal track which is called de
iii. Absorption of vitamin K & vitamin B complex produced by bacteria present in colon.

- Digestive Gland

Various type of digestive gland are involved in physiology of human digestion which are as follow :-

i. Salivary gland - They are present in oral cavity. They are highly branched structure & consist of numerous lobules made up of small acini lined with ~~segment~~ secretory cell. They secrete saliva and in human digestion there are 3 type of salivary gland present.

* Parotid gland

⇒ They are largest salivary gland present at the base of ear. Their ducts are open into oral cavity near the upper second molar teeth. The duct of parotid gland is called Stenson's duct.

* Sub maxillary gland

⇒ They are medium sized gland present at the angle of lower jaw. The duct of sub maxillary gland is called Whorton's duct which opens at the side of frenulum of tongue.

* Sub-lingual gland

⇒ They are small salivary gland located beneath the tongue. Their duct open into floor of buccal cavity & the duct of sub-lingual gland is called Rivini's duct.

- Saliva :- It is viscous & colourless fluid. The average pH value of saliva is & it contain 98.5 to 99% water and 1 to 1.5% resi. Saliva contain enzyme called Salivary amylase or ptyline which is used for digestion of starch. Saliva also contain lingual & lypase from Evrees gland, Mucus, lysozyme & mineral salt like Sodium, Calcium, Potassium & Immuno globulin A normal person secrets 1-1.5 litre of saliva daily.

Date: / /

* Function of saliva:-

i. It contain digestive enzyme called salivary amylase or ptyline which is used for digestion of starch.
ii. Saliva makes the food easier to swallow
iii. It dissolve substance like sugar
iv. It keeps mouth & teeth clean.
v. It also estimulates taste buds.
vi. It makes the food delicious.
vii. It contain anti-bacterial enzyme called ysozyme to destroy bacteria.

* Gastric gland

→ Gastric gland is a gland, tubular gland found in mucosa of stomach wall. They secrete gastric juice. A normal person secrete about 2-3 litre of gastric juice daily. There are 3 types of gastric gland:

i. Parietal gland - They secrete HCl & intrinsic factor for absorption of vitamin B-12
ii. Chief or peptide - These gland secrete pro enzyme pepsinogen & pro rennin
iii. Mucous (Goblet) - They secrete mucus cells

* Composition of gastric juice :- It is light colour, thin & transparent fluid. It contain 90% water, 0.5-1% HCl & the rest are mineral, potassium, chloride, phosphate & other element are mucus & various pro enzyme. Gastric juice is highly acidic in nature having pH value 1.8 in adult & 5 in infants.

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Function of hydrochloric acid:-

i. It makes food acidic.
ii. It activates the inactive pepsinogen to pepsin & prosemin to rennin.
iii. It destroy micro-organisms & bacteria present in food.
iv. It control the opening & closing of pyloric aperture.

Function of pepsin:-

i. At first, pepsin is released in inactive form i.e pepsinogen which is activated by hydrochloric acid into pepsin. The active pepsin hydrolyses the proteins into proteases and peptones.

Pepsinogen (inactive) + HCl ⟶ Pepsin (active)
Proteins + Pepsin ⟶ Proteases & Peptons

4 Function of Rennin :-

1. Rennin present in infants. It digest milk protein.

Pro-rennin + HCl ⟶ Rennin
(Inactive) (active)

Casin + Rennin ⟶ Para casein
Paracasein + Ca^{++} ⟶ Calcium paracaseinate
Calcium paracaseinate ⟶ Amino acid

4 function of Gastric lipase

1. Lipase ~~—~~ hydrolytes fats into fatty acid & glycerol.

fat + lipase ⟶ fatty acid + Glycerol

4 Function of mucus

1. Mucus forms barrier between stomach lining & gastric juice. It protect stomach wall from self digestion by pepsin or rennin. The function of mucus are

1. It reduce the adding effect of HCl
2. It makes the food slippery
3. It protect the mucus membrane of stomach by HCl

4 Liver

⇒ Liver is largest, reddish brown in colour & weighting about 1.5kg. It is situated below the diaphragm on the right side of abdominal cavity. Liver is divided into 4 lobes; right ~~central~~ central lobe, caudate lobe, quadrate lobe & left central lobe. Each lobe consist of large number of hepatic lobules. Each lobule contain a mass

of polyhedral hepatic cell. These hepatic cell secretes bijuice which drained into ~~regularly~~ Canaliculi which are small site between liver cell. These canaliculi empty into small vessels called ductules that unite to form bile duct. The gall bladder is situated between right lobe & quadrate lobe. The bile juice is carried to duodenum through hepatic duct. The hepatic duct pass doroncward to join pancreatic duct to form hepato-pancreatic ampulla. The ampulla opens into duodenum. The opening is guarded by spchenture. The opening bile duct before joining the pancreatic duct is guarded by boyden.

Histologically, liver consist of many hexagonal hepatic lobules separated from each other by a thin layer of connective tissue called septa. Along the ~~peritoary~~ periphery of hepatic lobules there are regular interval present which is filled with connective tissue. These interval are called portal canal. Each portal canal consist of branches of hepatic portal vein & hepatic artery & inter lobular bile duct. These three structure collectively form portal tribe. Each lobule is composed of liver cell (hepatocytes) in lobe in radial pattern around a central veins. The lobule contain special type of Kupffer's cell which are phagocytic in nature that help in ingestion of RBC, WBC & bacteria.

fig :- Histology of liver

* Function of liver :-

1. Liver is largest organ of human body which perform following function

1. Secretion of bile juice.

→ Hepatic cell secretes bile juice which is store in gall bladder.

2. Metabolic function

→ The liver actively participate in metabolism of carbo

3. Protective function & detoxification

→ The Kupffer cell of liver perform phagocytosis to eliminate compound.

4. Hematological function

→ Liver play important role in formation of blood particularly in embryogenic stage. Liver also participate in synthesis of plasma protein & destruction of erythrocyte.

5. Storage function

→ Liver stores glycogen, fats, Vitamin- A, D & B-12 & traches element like iron.

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4 Bile juice

Bile juice is secreted by liver. It is alkaline ~~in medi~~ fluid with bitter taste. About 500 - 1000 ml bile juice is produced by human per day according to diet. Bile juice contain water & other minerals in the ratio of Water (86%) & other minerals (14%). Minerals are bile salt, bile pigment, cholesterol, lecithin, inorganic salt & alkaline phosphate.

- Function of bile:-

1. It help in breakdown of fod.
2. It contain hydrogen bicarborate ion that help in neutralizing the acidic chyme that enters the intestine from stomach.
3. Bile keeps the bacteria under control so bile act as anti-septic agent.

- Pancreas

Pancreas is elongated, soft, lobulated, yellowish, membranous and leaf like gland situated behind the stomach & measures about 12 - 15cm long & 60 gram in weight. Pancreas are both exocrine & endocrine.

Exocrine part consist of many small branching pancreatic lobules called pancreatic acini. Acini are exocrine portion of pancreas that secrete enzyme called pancreatic juice.

Endocrine part contain Islets of ~~Langerhans~~ Langerhans which are endocrine in

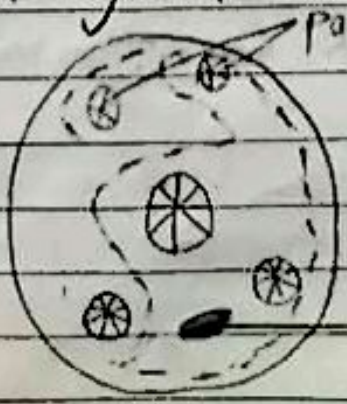
function. They are responsible for secreting hormones like glucagon by alpha cell & insulin hormone by β-cell. Both glucagon & insulin regulates carbohydrate metabolism.

- Pancreatic juice

Pancreatic juice contain all digestive enzyme to hydrolise all types of food. A normal person can secrete about 500-800ml pancreatic juice regularly. It consist of 98%, water and 2% solid substance.

- Function of pancreatic juice:-

1. Trypsin is protein hydrolysi enzyme which is present in inactive form called Trypsinogen which is activated by enzyme kinase & produce trypsin in active form. Trypsin digest proteins into amino-acid.
2. Amylase is most important starch splitting enzyme which digest starch, glycogen & glucose
3. Lypase & Maltase are important as fat hydro enzyme. fats into fatty acid & glycerol whereas Maltase convert Maltose into glucose.
4. Lactase react with lactase & convert into glucose & glactose



5) Intestinal glands

There are numerous, ~~inter~~ microscopic glands present on mucosal wall of small intestine which are of 2 type:-

i) Crypts of Lieberkuhn

→ They are simple, tubular gland present between villi throughout the small intestine. Their wall consist of columnar epithelial cell, peptic cell, other cell which produce hormones like secretin, pancreozymin etc. Secretin results in secretion of pancreatic juice. other epithelium cell present in these gland secretes the intestinal juice called succus entericus. The pH value of this juice is about 7.6.

ii) Brunner's gland

→ They are compound, tubular gland present only in sub-mucosal layer of duodenum. This type of gland is absent in Ileum. They secrets enzyme in numerous amount & mucus in large amount. Intestinal juice consist of following enzyme:

1. Erepsin

→ It is complex proteolytic enzyme that convert peptone into amino acid.

2. Lipase

→ Lipase is convert fats into fatty acid & glycerol so it help in fat digestion.

3. Enterokinase

→ It simply activate the inactive trypsinogen to convert into active trypsin.

4) Maltase, Lactase & sucrase

→ These enzyme act on maltose & form monosaccharides

5) Isomaltase

→ It converts limit dextrine & Isomaltase to ~~com~~ glucose.

6) Nudeose & Nucleotidase

→ They act on nucleic acid components of nucleoprotein & finally leads into breakdown of nucleoprotein into purins & pyrimidines

Physiology of digestion

Digestion is a process of hydrolysis of large & complex food particles into smaller, simpler, diffusable form which can be easily absorbed by gastrointestinal tract. Human food mainly consist of carbohydrates, fats, minerals, vitamins, water etc. The minerals, vitamins & water are simple food which don't require digestion but carbohydrates, proteins & fats are complex food that require digestion to convert them into simpler, soluble form of food like sugar, amino acid & fatty acid respectively.

The whole process of digestion takes place in different region of alimentary canal. The process of digestion of food takes place in mouth, stomach & finally into small intestine.

1. Digestion of food in mouth

The digestion of food start from mouth. As the food enters into mouth, it undergoes mastication with the help of

teeth & tongue. The teeth break the food into small piece. During the process of mastication food is mixed with saliva secreted by salivary gland. Saliva contain digestive enzyme called salivary amylase that help in digestion of starch into maltose.

ii. Digestion of food in stomach

After swallowing the food (bolus), the food pass into Oesophagus to the stomach. The stomach firstly store the food for several hours for partial digestion of food. Secondly, the stomach wall provide typical musculator that musculator reduce the size of food. Thirdly, the stomach wall secrete gastric juice which contain various enzyme.

As the food enters into stomach, food get mixed with gastric juice. The gastric juice contain HCl, pepsinogen, pro rennin, gastric lipase and mucus. The function of each enzyme is discussed below:-

1) Function of HCl

HCl is released from oxyantic cell of gastric gland that perform following function:-

i. It makes food acidic.
ii. It destroy micro organism present in food.
iii. It activates inactive pepsinogen or pro rennin into active form of pepsin or rennin.

2) Function of pepsin:-

i. Pepsin is a hydrolysin enzyme. It is released in inactive form i.e pepsinogen. The inactive pepsinogen is activated by HCl into active pepsin & then hydrolyse protein into peptons & proteoses

Pepsin + Protein ⟶ Peptone + proteoses
(active)

3) Function of Rennin

It is milk protein digestive enzyme. In infants, it help to digest milk protein.

4) Function of gastric lipase

Lipase hydrolyse fats into fatty acid & glycerol. Lipase is secreted in less amount

Fat $\xrightarrow{\text{lipase}}$ fatty acid + Glycerol

In this way, food is in the form of semi-digested food called chyme which is passed into small intestine for further digestion.

iii. Digestion of food in small intestine

As the food enters into duodenum, it receive bile juice from liver and pancreatic juice from pancreas through a common hepato pancreatic duct.

- Function of bile

i. Bile is an alkaline fluid that neutralize the acidic effect of chyme and makes food alkaline so that the enzyme of pancreatic juice can function as follow:-

Acidic food $\xrightarrow{\text{Bile}}$ Alkaline food

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Similarly, bile also helps in +mot break down of large number of fats into fat globules.

- Function of pancreatic juice

2. Pancreatic juice contain several digesthe enzyme and their function are as follow:-

i. Trypsin & chymo trypsin

These enzyme are protein hydrolysis enzyme that hydrolyse the protein into amino acid.

Trypsinogen + enterokinase ⟶ Trypsin (active)

Chymo trypsinogen + enterokinase ⟶ Chymotrypsin (active)

Protein + trypsin or chymotrypsin ⟶ Amino acid

ii. Peptidases

It is another hydrolysin enzyme that hydrolyse peptons into amino acid.

Peptons $\xrightarrow{\text{Peptidases}}$ Amino acid

iii. Amylase

Amylase is starch hydrolysin enzyme that convert carbohydrates into glucose.

Carbohydrates $\xrightarrow{\text{Amylase}}$ Glucose

- Function of lipase

Lipase is another fat hydrolysin enzyme that converts the fat into fatty acid & glycerol.

fat $\xrightarrow{\text{lipase}}$ fatty acids

- Function of Sucrase
  It convert sucrose into glucose and fructose.
  Sucrose $\xrightarrow{\text{sucrase}}$ Glucose + Fructose

- Function of Maltase
  It converts maltose into glucose.
  Maltose $\xrightarrow{\text{Maltase}}$ Glucose

- Function of lactose
  It converts lactose into glucose and glactose
  Lactose $\xrightarrow{\text{Lactase}}$ Glocose + Glactose

- Function of Ribonuclease & de-oxyribonuckease
  They convert nucleic acid into simple nucleotide.

In this way, all the food particle are completely digested into simpler form in duodenum.

Hormones controlling digestion:-

→ The secretion of digestive juice by stomach and pancreas and release of bile juice from gall bladder are controlled by hormones. These hormones are released from some parts of alimentary canal. The hormones which regulate digestive secretion are:-

1) Gastrin

→ Gastrin is secreted by pyloric region of stomach. It stimulate gastric gland to release gastric juice.

2) Secretin

→ Secretin is secreted by epithelium of duodenum. It stimulate pancreas & gall bladder to release

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Pancreatic juice & bile juice respectively.

3) Chole
→ It is secreted by epithelium of small intestine. It also stimulates gall bladder to release bile juice.

4) Absorption of digestived food
→ Absorption is biological process of taking in the digested food by intestinal small. In this process simpler & soluble digested food (glucose, amino acid, fatty acid, vitamins, minerals & are taken up by wall of intestine & then absorbed by blood. The principle site for absorption is Ileum because lining of Ileum consist of numerous finger like projection called villi that increase surface area for absorption. Each villus contain a network of blood capillary. Thus the process of absorption is done by simple diffusion process. Absorption is basically of 2 types ie Passive & Active Absorption.

- Passive Absorption: Nutrient are absorbed along with concentration gradient from higher to lower concentration in passive absorption. Passive absorption is very slow process & energy is not utilized. No complete absorption of nutrient takes place in passive absorption
- Active Absorption: In active absorption, nutrients are absorbed against the concentration gradient from lower to higher concentration. It is very rapid process & energy is completely utilized. In active absorption, complete absorption of nutrients takes place.

- Absorption of fat:-
Digested fat are mixture of mono glycerides, fatty acid & glycerol. Glycerol is water soluble so it is directly absorbed by ~~water soluble fatty acid & monoglyceride~~ mucosal cells. But the long obtain fatty acid & the monoglycerides are insoluble in water. These fatty acid, monoglycerides ~~fatty acid~~ and the bile salts combine together to form water-soluble molecule called micelle. They are absorbed by the lacteal or lymph capillaries but not by blood capillaries.

iii) Assimilation of food
All the digested food are absorbed into blood stream by passing through the wall of small intestine. In this way, simples food are carried to tissue where they are oxidised to release energy. Fatty acid & glyceride are also absorbed by wall of small intestine but they enter into lymphatic vessel rather than blood vessel.

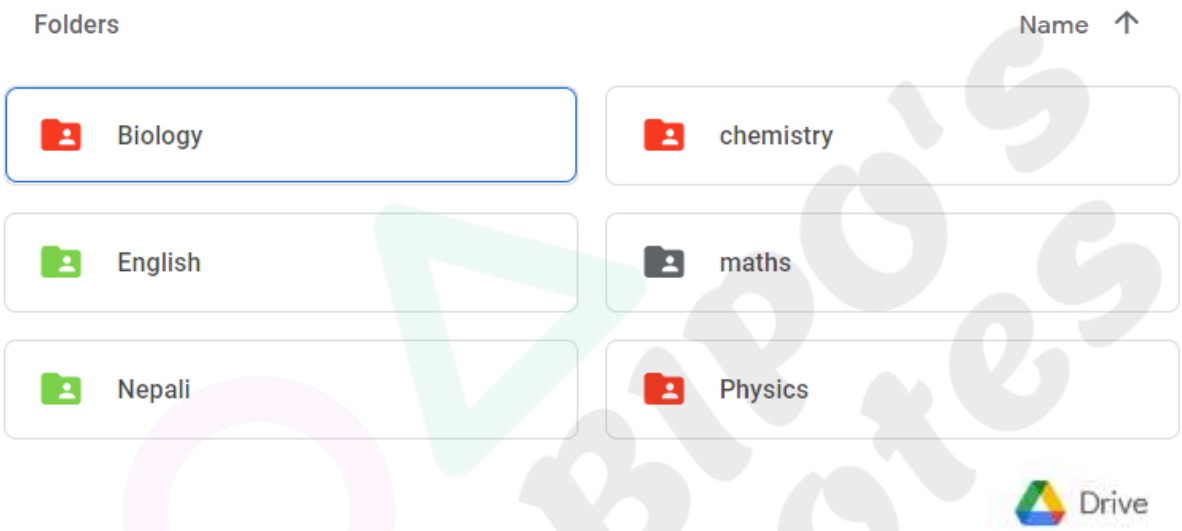
4 Defaecation of egestion
After the absorption of digested product in ileum, undigested food are reached into large intestine The wall of large intestine absorb water & remaining inorganic nutrient like calcium & iron. The water is absorbed by large intestine the remaining semi solid is called faeces or stool. The removal of stool from the body is called Egestion. Due to the accumulation of large quantity of stool, the lower segment of large intestine

contract that result in elimination of stool outside the body. Colour of stool is due to stercobilin pigment which is an oxidation product of bile pigment. Bad smell of faeces is due to toxic amine - Indole and skatol derived from action of bacteria on amino acid. Faeces contain undigested food, dead bacteria, bile pigments and H's derivatives and mucus and dead mucosal cells.

Bipin Khatri

(Bipo)

Class 12 complete notes and paper collection.



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