



DIGESTION AND ABSORPTION

MAJOR COMPONENTS OF FOOD

- Carbohydrate
- Proteins
- Fats
- Vitamins & minerals (Small quantities)

FOOD PROVIDES

Energy and organic materials for growth & repair of tissues

ROLE OF WATER

Metabolic processes & prevents from dehydration

DIGESTION

Both mechanical and biochemical process in which bio macromolecules are broken down in simple absorbable substance.



DIGESTIVE SYSTEM

ALIMENTARY CANAL / GUT

Buccal cavity / Oral cavity

Contains teeth and muscular tongue.

TEETH

THECODONT

Teeth are embedded in the socket of jaw bone

DIPHYODONT

- Present in majority of mammals
- Two sets of teeth in life span

HETERODONT

> Different types of teeth
(1) Incisor (3) Premolar
(2) Canine (4) Molar

Temporary/deciduous
(For children)

Permanent (For adult)

Dental formula = $\frac{2102}{2102}$

Dental formula = $\frac{2123}{2123}$

Hard chewing surface of teeth made up of enamel helps in mastication of food.

DIGESTIVE GLANDS

MUSCULAR TONGUE

Freely movable; attached to floor by frenulum & upper surface of tongue have projections called as papillae (have taste buds)

For air (Glottis or wind pipe)

Epiglottis prevents entry of food into wind pipe during swallowing

Pharynx

- Common passage for food & air.

- Gullets for food, posterior to glottis.

Oesophagus

- Food move by special muscular movement called peristalsis.

Stomach

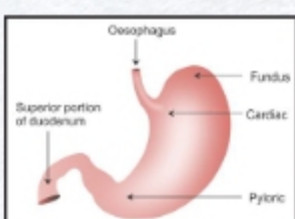
- J shaped organ at upper left portion of abdominal cavity.

- Pyloric sphincter guards the opening of stomach into 1st part of small intestine

Small Intestine

- Help in further digestion & absorption of nutrients.

3 parts:- duodenum (c shaped), middle jejunum (long coiled), ileum (highly coiled)





ILEUM OPENS INTO LARGE INTESTINE

Caecum

- Small blind sac which hosts symbiotic microorganisms.
- Vermiform appendix (narrow finger like tubular projection) arises from here which is vestigial in nature.

Colon

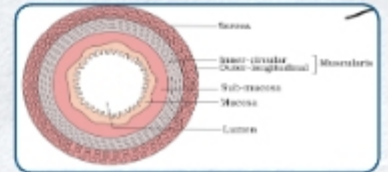
1. Ascending
2. Transverse
3. Descending
4. Sigmoid

Rectum

And then it leads finally to anus

Walls of Alimentary Canal

All 4 layers show modification in different parts of alimentary canal.



Serosa

- Outermost layer, made of thin mesothelium with some connective tissue
- **Mesothelium is the epithelium of visceral organs.**

Muscularis

- Inner circular layer.
- Oblique in some regions.
- Outer longitudinal layer.
- Made of smooth muscles.
- Responsible for peristalsis.

Sub mucosa

- With nerves, blood, lymph vessels.
- Made of loose connective tissue.

Mucosa

- Inner most lines the lumen of canal.
- It contains irregular folds in stomach & villi in small intestine.

Villi have no. of capillaries & large lymph vessels called lacteals

- Mucosal epithelium has goblet cells which secrete mucus & helps in lubrication.
- Mucosa forms glands in stomach i.e. gastric glands.
- And crypts b/w base of villi in intestine is called crypts of lieberkuhn.
- In duodenum some glands are present in submucosa.

Microvilli

- Formed by cells lining villi. Gives brush border appearance and increase surface area.

Digestive glands

Salivary glands

Three pairs

- Parotid- largest; 25% saliva.
- Sub maxillary/submandibular - mid size; 70% saliva.
- Sublingual - small; 5% saliva,
- Outside the buccal cavity & secrete salivary juice.

Liver

- Largest gland (1.2-1.5kg) Just below diaphragm (abdominal cavity); It has 2 hepatic lobes.
- Hepatic lobules are structural & functional unit of liver.
- It has hepatic cells in the form of cords.
- Each lobule is covered by thin connective tissue sheath called as glisson's capsule.
- Hepatic cell in hepatic cord, secrete bile in hepatic duct which is stored in gall bladder which is thin muscular sac.
- Cystic duct from gall bladder joins with.
- Hepatic duct to form common bile duct and which further joins with pancreatic duct to form hepatopancreatic duct which enters duodenum guarded via sphincter of oddi.

Pancreas

- Leaf shaped, compound gland, situated between limbs of duodenum.
- Its endocrine part releases alkaline pancreatic juice containing enzymes & endocrine part secretes hormones insulin, glucagon.

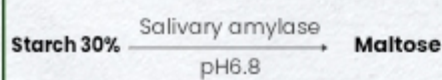


DIGESTION OF FOOD

It is both mechanical & biochemical.

In buccal cavity

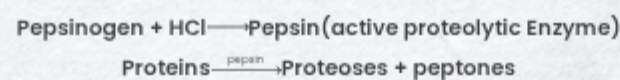
- Mastication of food with teeth & tongue • facilitation of swallowing.
- Digestion is initiated. • Saliva contains electrolytes (Na^+ , K^+ , Cl^- , HCO_3^-), Enzymes, salivary amylase, lysozyme (antibacterial agent and prevents infection)



Gastric glands

- Mucus neck cells secrete mucus.
- Peptic/chief cell secrete proenzyme pepsinogen.
- Parietal/oxyntic cell secrete HCl & castle intrinsic factor (needed for absorption of vit B_{12}).

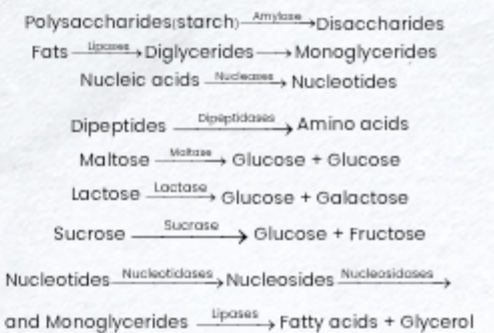
- Food in stomach is stored for 4-5 hours & then called **chyme**. Food is mixed with acidic gastric juice via churning movement of its muscular walls.



- Mucus & bicarbonate provides lubrication & protection of mucosal epithelium from excoriation (pH of stomach = 1.8).
- Rennin (proteolytic enzyme) in infants help in milk proteins digestion. Small amount of lipase also secreted by gastric glands but no amylase.

Small intestine

- Various types of movements by muscularis & mixes bile juice, pancreatic juice & secretion from small intestine with the food.
- The pancreatic juice contains inactive enzymes, trypsinogen, chymotrypsinogen, procarboxypeptidase, amylase, lipase nucleases.
- Trypsinogen in presence of enterokinase (by intestinal mucosa) is converted into trypsin which further activates other enzymes.
- Bile juice contains bile pigments bilirubin & biliverdin, bile salts, cholesterol, phospholipids no enzymes! It activates lipases & perform emulsification of fat in small micelles.
- Intestinal juice:- mucosal epithelium have goblet cells and forms the **succus entericus or intestinal juice**. It have disaccharidases dipeptidases, lipases, nucleosidases, mucus & bicarbonate (pancreas) protect intestinal mucosa & provide alkaline medium (pH 7.8) for enzymes. Submucosal brunners gland also help in this.



The food is absorbed in jejunum & ileum and undigested & unabsorbed food is sent to large intestine. Large intestine doesn't have significant digestive activity hence absorption of water, minerals & drugs take place. It also secrete mucus which adheres waste for easy passage.

Regulation

It is under both neural & hormonal control.

- Sight smell presence of food secretes saliva.
- gastric and intestinal tract are under neural signals.
- muscular activities of different Parts are under neural mechanism (local or by CNS).
- Digestive juices are controlled by hormones.
- local hormones = gastric and intestinal mucosa.

ABSORPTION OF DIGESTED PRODUCTS

End products of digestion are absorbed into blood/lymph via intestinal mucosa; Maximum absorption takes place in small intestine.

ABSORPTION

Passive

- According to Conc. gradient
 - Glucose, amino acids
 - Some electrolytes like Cl^-
- Wall

Active

- Requires energy
 - Amino acids, glucose
 - Na^+
- Into blood

Facilitated

- Carrier proteins
- Glucose
- Amino acids

- Transport of water depends on osmotic gradient.
- Fatty acids and glycerol (insoluble) can't be absorbed into blood.
- incorporated into small droplets called as micelles.
- Micelles in intestinal mucosa reformed into chylomicrons (very small protein coated fat globules) which are further transported into lacteals via villi which further deport them into blood stream.

The summary of absorption in different parts of digestive systems

Mouth	Stomach	Small Intestine	Large Intestine
Certain drugs coming in contact with the mucosa of mouth and lower side of the tongue are absorbed into the blood capillaries lining them.	Absorption of water simple sugars, and alcohol etc. takes place.	Principal organ for absorption of nutrients. The digestion is completed here and the final products of digestion such as glucose, fructose, fatty acids, glycerol and amino acids are absorbed through the mucosa into the blood stream and lymph.	Absorption of water, some minerals and drugs takes place.



ASSIMILATION

The absorbed substance reaches tissues which utilizes them.

The rectum produces neural reflex & thus egestion of faeces through anal opening (defaecation) takes place. It is a voluntary process carried out by mass peristalsis movement.

