

Values of kerckering → villi → microvilli

glycocalyx

Neelgagan

Date:

Page No.

Intestine : Intestine is characterised by the presence of permanent folds known as Plicae circulares formed of mucosa and (values of kerckering) submucosa.

* [Brush border is formed by numerous microvilli] They are similar to rugae but formed by rather than longitudinal folds. They are most developed in jejunum and characterised of this part. They cannot be completely flattened out by distension of intestine unlike stomach. In addⁿ, small leaf like or finger like villi are seen which are projections of mucous membrane villi are covered with the ~~epith~~ and have

Central core of lamina propria. They are leaf-shaped in duodenum, clubbed-shaped in jejunum and finger-like in ileum.

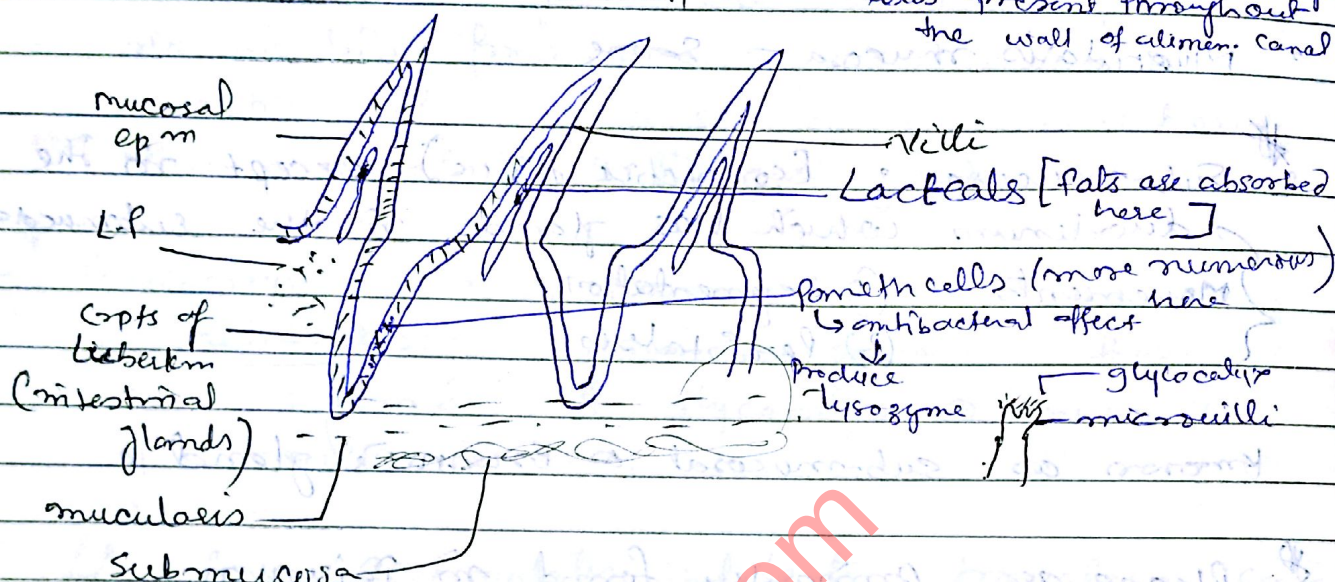
Below the bases of villi are small openings of intestinal glands also called crypts of Lieberkuhn. These glands extend through the thickness of muscularis almost ~~reach~~ the ~~base~~ of muscularis mucosa but do not penetrate it except duodenum where they extend to submucosa to form submucosal glands known as Brunner's patch gland. These glands not so closely packed as gastric glands. To further the S.A, microvilli are present, forming a brush or striated border on the apical region of individual columnar cells. Each microvilli has dense glycocalyx that contains several enzymes for the final process of digestion.

Intestine: Types of cells found in mucosal epm :-

- ① Enterocytes or intestinal cells (most numerous) → columnar
- ② Goblet cells → produce mucus → fat
- ③ Paneth cells → control intestinal microbial flora
- ④ Argentaffin cells or Enterochromaffin cells → produce hormone

Lumen

cells present throughout the wall of alimentary canal



- G-cells or Gastric cells → pyloric stomach
 [pyloric antrum] → produce gastrin which stimulates parietal for HCl production

- S-cells — produce hormone secretions found in duodenum and rest of small intestine.
 They stimulate pancreas to secrete HCO_3^- and enzyme (alkaline secretions)

- CCK → found in small intestine or alimentary canal
 → cholecystokinin → stimulate pancreas to produce the secretion which is rich in digestive enzymes

- lamina propria (L.P) is rich in lymphoid tissue.

Just below the epm, there's a zone rich in antibody producing lymphoid cells which form MALT (mucosa associated lymphoid tissue) → acts as a barrier for the infection or bacteria invasion.

- Muscularis mucosa — same

* Sub-mucosa : [connective tissue] except in the duodenum which has glands in the submucosa

Movements —

- (1) Segmentation
- (2) Peristalsis

known as sub-mucosal or Brunner's gland.

* Plicae are primarily found in jejunum.

- Ileum — Peyer's patches [group of lymphoid nodules]

↓
in submucosa or sometimes in

lamina propria

— in Peyer's patches — abt. 10-70 lymphatic nodules in Peyer's patch and takes ovoid shape.

- External muscle layer — same.

MMC - migratory motility Complex

↳ related to peristalsis

↳ responsible for passage of food from oesophagus to stomach, intestine etc.

- These are ducts from the liver and pancreas. alkaline bile from pancreas and duodenum secretion also produce alkaline secretion which neutralise the acidic food.

↓
- Glycocalyx produce enzyme → which are dissacharidases and peptidases these enzymes found on glycocalyx or microvilli of small intestine.

Liver :- accumulates nutrients, transforms and stores.

• Bile is a excretory product of liver
↳ emulsification of fats

• fats are absorbed in lacteals not in microvilli.
(lipids)

Pancreas :- Two paths — Pancreatic acini

↓
Islet of Langerhans
(ductless gland)

↓
Pancreatic juice
rich in HCO_3^- and enzymes

↳ come in duodenum through pancreatic duct it coiled
Opens in duodenum papilla

Two ducts — main
Duct of Wirsung

↳ Accessory - duct of Santorini

main duct bind with the duct from liver

Left + Right

Liver

Hepatic ducts

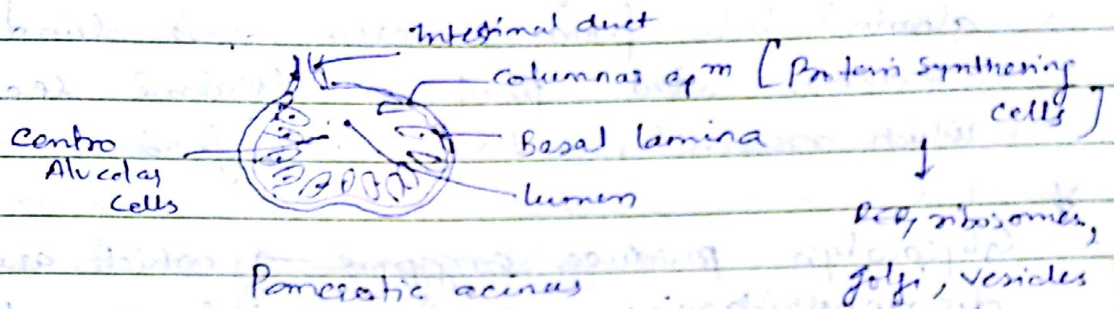
Cystic duct

Common bile duct
or ductus choledochus

Dist of
intestine

duodenum
papilla

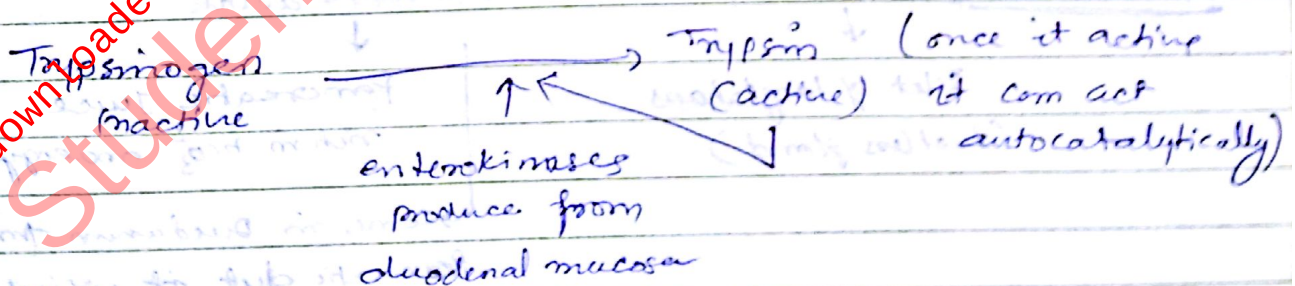
HCO_3^- to neutralise acidic chyme from
stomach and make medium alkaline.



Enzymes produced in pancreatic secretion

- 1) Digestion of proteins — a) Trypsin
b) chymotrypsin
c) carboxy peptidases

• Acute pancreatitis — in which inactive form of enzyme becomes active within the glands and it starts digesting its own cells.



Trypsin acts on protein to convert it into proteoses and peptones

• Chymotrypsinogenes $\xrightarrow[\text{trypsin}]{\text{By the action of}}$ Chymotrypsin (active)
(inactive)

• Procarboxylase procarboxypeptidase $\xrightarrow{\text{Trypsin}}$ Carboxypeptidase (active)
By the action of (inactive)
brush border enzyme i.e. amino
aa & peptides (small) $\leftarrow$ cleaves the peptide bonds from carboxyl end.

HCO_3^- produced by the cells lining of pancreatic ducts
These enzyme in the inactive form produce in
pancreatic cells and pass to duodenum
where duodenal mucosa produce enterokinases and
activate them.

HCO_3^- $\leftarrow$ Bile $\leftarrow$ Liver
 $\leftarrow$ Pancreatic acini
 $\leftarrow$ Duodenal glands

Protein digestion

Stomach
 $\downarrow$ chief cells
pepsinogen
 $\downarrow$ HCl — Produced from oxyntic cells
Pepsin
 $\downarrow$
proteins into proteoses + Peptones
 $\downarrow$ Trypsin, chymotrypsin
Peptides of various sizes

Carbohydrate

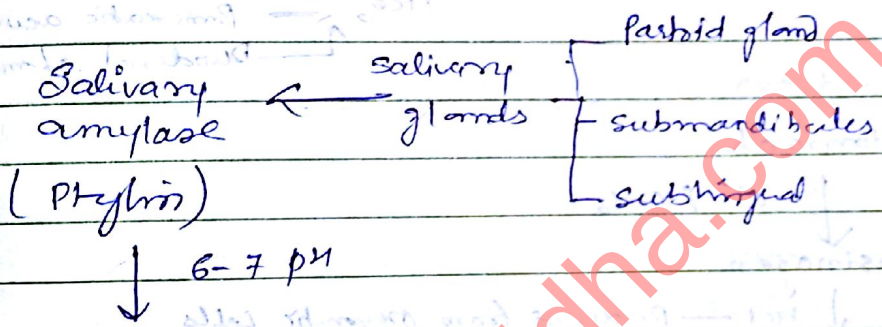
pancreatic amylase

Polysacc. like starch

Disacc. → like sucrose

absorb in the form of monosacc. like glucose, fructose & Galactose

Starts in mouth by the action of salivary amylase produced by salivary glands — there are 3 glands
 ① parotid, they produce secretions rich in amylase.
 ② submandibular gland produce enzymes and mucus.
 ③ sublingual gland produce mucus and very less amt of enzyme.



Starch → maltose + polymers of glucose → duodenum (Disaccharidases)

It starts in small intestine by pancreatic amylase which is almost same identical as salivary amylase but much more powerful — within 10-15 min after the chyme empties from the stomach into duodenum and mixed with. Virtually all the Carbo. become digested. The Carbo^t are totally converted into maltose and smaller polymer of glucose before passing into upper jejunum or duodenum.

Carbohydrate $\xrightarrow{\text{Maltase}}$

maltose $\rightarrow$ Glucose + Glucose

Lactase

Lactose $\rightarrow$ glucose + galactose

Sucrase

sucrose $\rightarrow$ glucose + fructose

Digestion of fat

- ① Pancreatic lipase $\rightarrow$
- ② cholesterol esterase $\rightarrow$ hydrolysis fats into fatty acids & glycerol
- ③ Phospholipases

- Glucose & galactose transported in same manner through Na-co-transporter mechanism which is from lumen to cell (absorptive) • (Glucose from lumen to cell)

Glucose (lumen) $\xrightarrow{\text{Na-co-transporter mechanism}}$ cell cytoplasm $\xrightarrow{\text{facilitated diffusion}}$ Blood

Transporter protein can bind to 2 Na⁺ ions and 1 glucose molecule, when all the sites are filled then it moves to cell cytoplasm. Inside the cell Na⁺ ion concⁿ will be $\downarrow$.

- Facilitated diffusion takes place with the help of carrier protein

11th Proteases and a/c are also absorbed by Na-co⁺ transport mechanism or 2^o active transport mechanism and at basal by facilitated diffusion.

Fructose is transported by facilitated diffusion or active transport only.

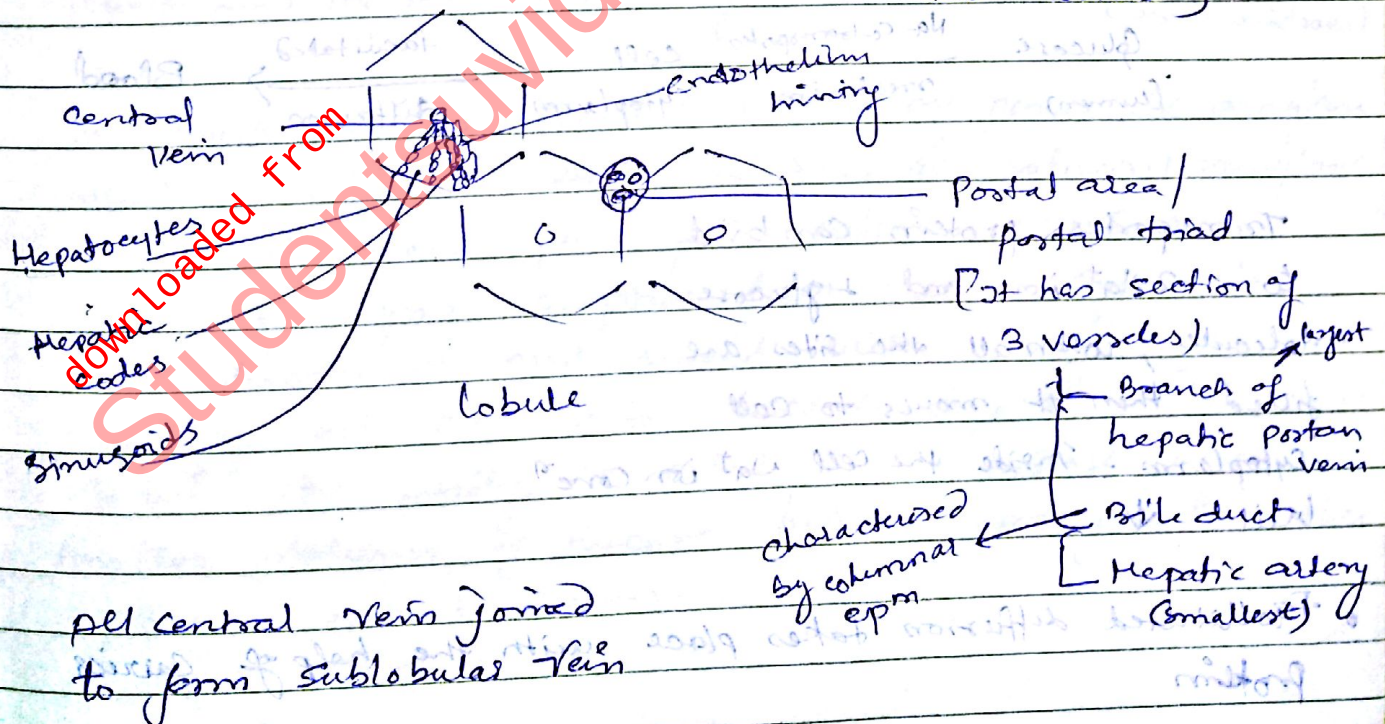
Fat digestion and absorption

- Occurs in intestine

Triglyceride $\Rightarrow$ 1 glycerol + 2 fatty acid
or
monoglycerides

Triglyceride $\xrightarrow{\text{Pancreatic lipase}}$ 2 fatty acid + monoglyceride

① Emulsification $\leftarrow$ Bile salts $\leftarrow$ Liver is [divided into lobes and each lobes divided into lobule]



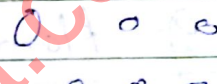
- Endothelium is the flat squamous lining of blood vessels
- mesothelium is a serous membrane which lines the body cavity like (serosa)
- Bilirubin is the excretory part of liver which is a haem part when Fe^{+} molecule goes for its work

Emulsification

- ① Lipid droplets
- ② micelles (4-7mm) contain monoglyceride, phospholipid
- ③ chylomicrons

④ Leathin is a phospholipids


fat molecule


fat droplets

(to inc SA so that lipase can act upon it)

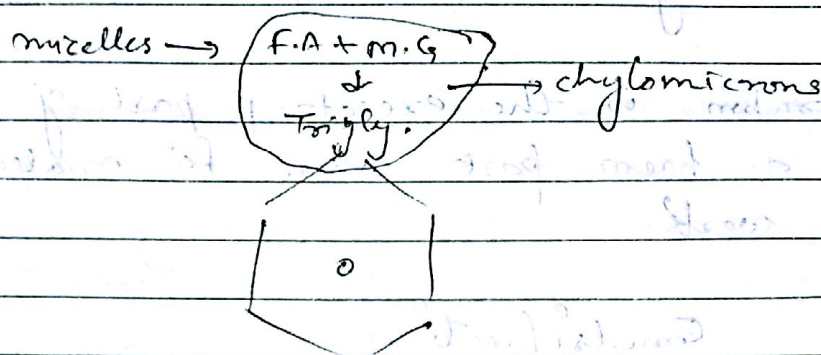
Bile helps to prevent the formation of fat molecule again from fat droplets.

Lipase : attaches to lipase from one end & attaches to fat molecule from another end.

Fatty acid & monoglyceride forms the core of micelle. It is not a permanent structure.

within the cell there is enzyme which again form triglycerides from fatty acids & monoglycerides which are called chylomicrons which are triglycerides

chyle which are absorbed by lacteals.



Composition of Bile :

- Bile salt
- Bile acid
- Bilirubin (excreted as stercobilin)
- Phospholipids
- H_2O & ions

Neural & Humoral

- ① motility
- ② Glandular Secretion

Enteric reflex [enteric means within]

Stimulation can be of two types

long and short

regulate the motility within the cells by themselves.

Organs and organ system

organs are composed of the four kinds of tissues -

- ① Epithelial cells
- ② blood vessels, whose walls contain varying quantities of smooth muscle and connective tissue.
- ③ extensions from nerve cells that end near the muscle and ep^l cells
- ④ a loose network of connective tissue elements.

Organ	Exocrine Secretions	Functions
① Mouth & Pharynx		• chewing begins; initiation of swallowing reflex.
② Salivary gland	• Salt & water, • mucus • Amylase	• moisten food • lubrication • Polysac. - digesting enzyme
③ Esophagus	• mucus	• move food to stomach by peristaltic waves • lubrication
④ Stomach	• acid • HCl • Pepsins • Mucus	• store, mix, dissolve & continue digestion of food, regulate emptying of dissolved food into small intestine • solubilization of food particles, kill microbes, activation of pepsinogens • Protein - digesting enzyme • lubricate & protect ep^l surface
⑤ Pancreas	• Enzymes • Bicarbonate	• Secretion of enzymes & bicarbonate; also has nondigestive endocrine fun^{ct} • Digest carbohydrates, fats, proteins and nucleic acid • Neutralize HCl entering small intestine from stomach.

⑥ Liver

- Secretion of bile; many other nondigestive functions
- Bile Salts
- Bicarbonate
- Neutralize HCl entering small intestine from stomach
- Organic waste products & trace metals
- Elimination in feces

⑦ Gallbladder

- Store & Concentrate bile b/w meals.

⑧ Small intestine

- Digestion & absorption of most substances; mixing and propulsion of contents.
- Food digestion.
- maintain fluidity of luminal contents.
- Lubrication
- Enzymes
- Salt & H_2O
- mucus

⑨ Large Intestine

- Storage & Conctⁿ of undigested matter; absorption of H_2O & salt; mixing and propulsion of contents; defecation.
- Lubrication.
- Mucus

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Large Intestine

① Caecum ② Colon ③ Rectum - anal canal Anus

• Ileum

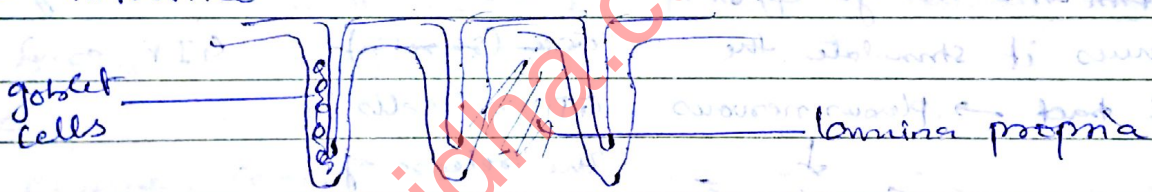
↓ ileocaecal Valve

• have small appendages called Vermiform appendix

has 3 parts

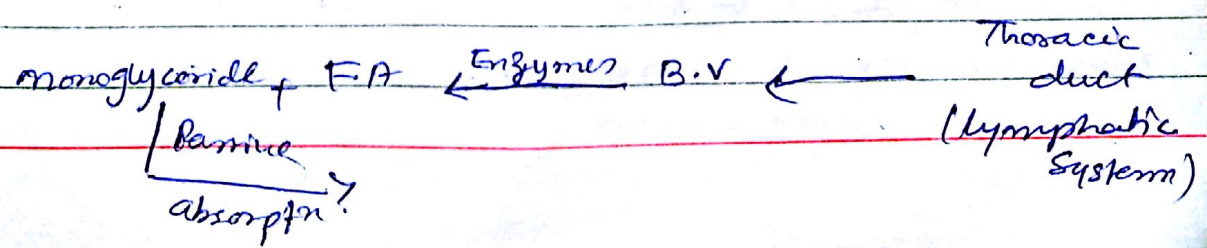
- ascending
- Transverse
- descending

- In large intestine Plicae circularis and villi are absent
- Intestinal glands are more numerous and closely packed in large intestine
- Goblet cells are numerous
- Produces large amt of mucus to lubricate the wall of intestine



- Another function is absorption
- There is no digestion process except colon bacteria digest polysaccharides fibres chain fatty acid into small fatty acids

Chylomicron (Triglyceride) → Lacteal



- Flat thickenings are called Teniae coli or linae coli

- outer longitudinal muscle layer has 3 equidistant flat (muscle) thickenings in which b/w of which are thin strands of muscles. The tonic contraction of these assist in the formation of Haustra. The Haustra movement is imp in large intestine for the movement of faeces faeces

Absorption and certain secretion :

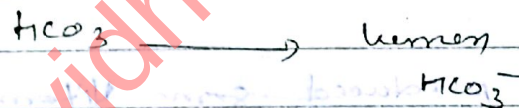
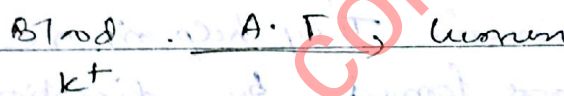
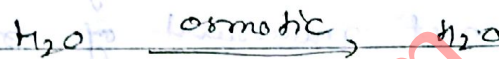
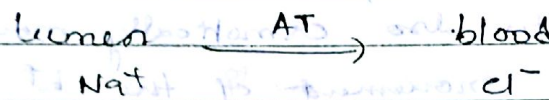
The primary absorptive process is the active transport of the sodium ion from the lumen to the blood and water also osmotically move into it. There is a net movement of the Cl^- ions from the blood to the lumen through active pump. There is also a net movement of bicarbonate ion into the lumen coupled to the Cl^- absorption from the lumen. They help in neutralising the fatty acids that are formed by digestion process by HCO_3^- bacteria.

Bacteria also produced some Vitamin specially Vit K which is absorbed in the blood. Also produce certain gases which are known as flatus mainly CO_2 and H_2 and a small amt of methane and hydrogen sulphide (H_2S).

Movement & motility in large intestine

mass movement - motility
mass movement is a wave of intense contraction where unlike peristaltic wave smooth muscle remains contracted for some time after mass movement

It occurs 3-4 times / day after every meal. It is a segmentation motion of very slow rhythm. The circular muscle may contract after every 30 min. Food remains in large intestine for about 18-24 hrs which provides time for the bacteria to grow and multiply. Parasympathetic Nervous system is the segmentation contraction while sympathetic nervous system is for colonic contraction.



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