

## PHYSIOLOGY OF DIGESTION.

Introduction:- With the purpose of Normal acceleration of all the vital activities of the body. the energy is required. The requirement of energy is filled by the tissues of plants and animals. The tissues undergo breakage and their constituents undergo oxidation. In the oxidative process the energy is released and utilized.

To enable the body to maintain the regular supply of energy, a bulk of plant and animal tissues is provided again and again with an adequate gap. The plant and tissue supplied intermittently is considered as food. the supply of which is necessary otherwise the efficiency of body will suffer.

In addition to those, the food is also available in the form of milk and vitamins supplied from outside.

Digestion:- Food after ingestion is in the complex form and not able to be assimilated. But unless and until the food is transformed into similar form and made able to be assimilated. The purpose of ingestion, not to be fulfilled. So the food is broken into smaller pieces and made assimilable. In the process involving the chemical breakdown of complex, not assimilable food result into similar assimilable food stuff is called digestion.

Physiology of digestion:-

Digestion involves both mechanical and chemical process. The former being performed by the movement of alimentary canal and latter by means of organ catalysts known as enzyme.

Ⓐ MECHANICAL PROCESS:-

Movement of alimentary canal:-

In the presence of tissue in the alimentary canal

indicates that some sorts of movements must be present in the gastrointestinal tract. Because gastrointestinal tract will not be able to perform its functions (secretion and absorption) properly due to lack of movement.

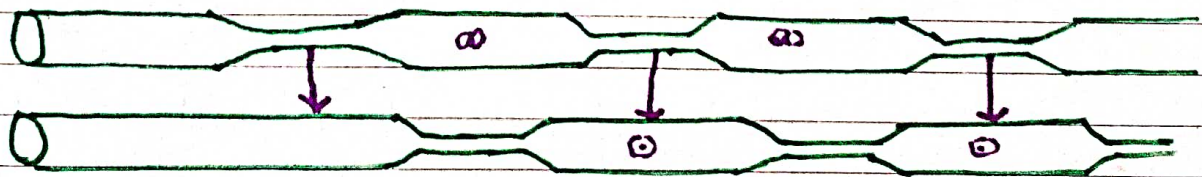
### Movement of stomach:-

The fundus and body part of the stomach show tonic contraction while the pyloric part shows peristaltic-like movement. The tonic contraction maintains a constant pressure upon the contents. The part of stomach sends out more and more food into pyloric. When the pyloric sphincter does not open the food mass is reflected backward after sometime strong waves force open the sphincter and consequently a part of the gastric contents is pushed out into the duodenum. It churns and mixes the food mass thoroughly with digestive juices.

### (B) MOVEMENT OF INTESTINE:-

The intestinal movement is of different types:-

- (1) Segmentation:- These are local contractions immediately followed by relaxation. The contraction takes place at the site of maximum ~~distend~~ distension. It performs the proper mixture of food with the digestive juice in helping absorption by bringing the mucous membrane into closer contact with food and



Segmentation in Intestine  
increase in vascular and lymphatic circulation through the wall of the gut.

(ii) Peristalsis: It consists of a wave of relaxation followed by a wave of contraction. Its chief function is the propagation of food onwards.

(iii) Pendular: It is a side to side movement of individual loops of intestine. Its purpose is to rearrange the peritoneal space of the abdominal cavity.

[c] MOVEMENT OF VILLI: The villi are found in constant movement during digestion and absorption. Generally two kinds of movements in villi are seen.

(i) Side to Side Movement:-

In this type of movement, the villi bend to one side which may be in any direction. The function of this movement is to help in absorption by bringing the villi in contact with the different portion of food mass.

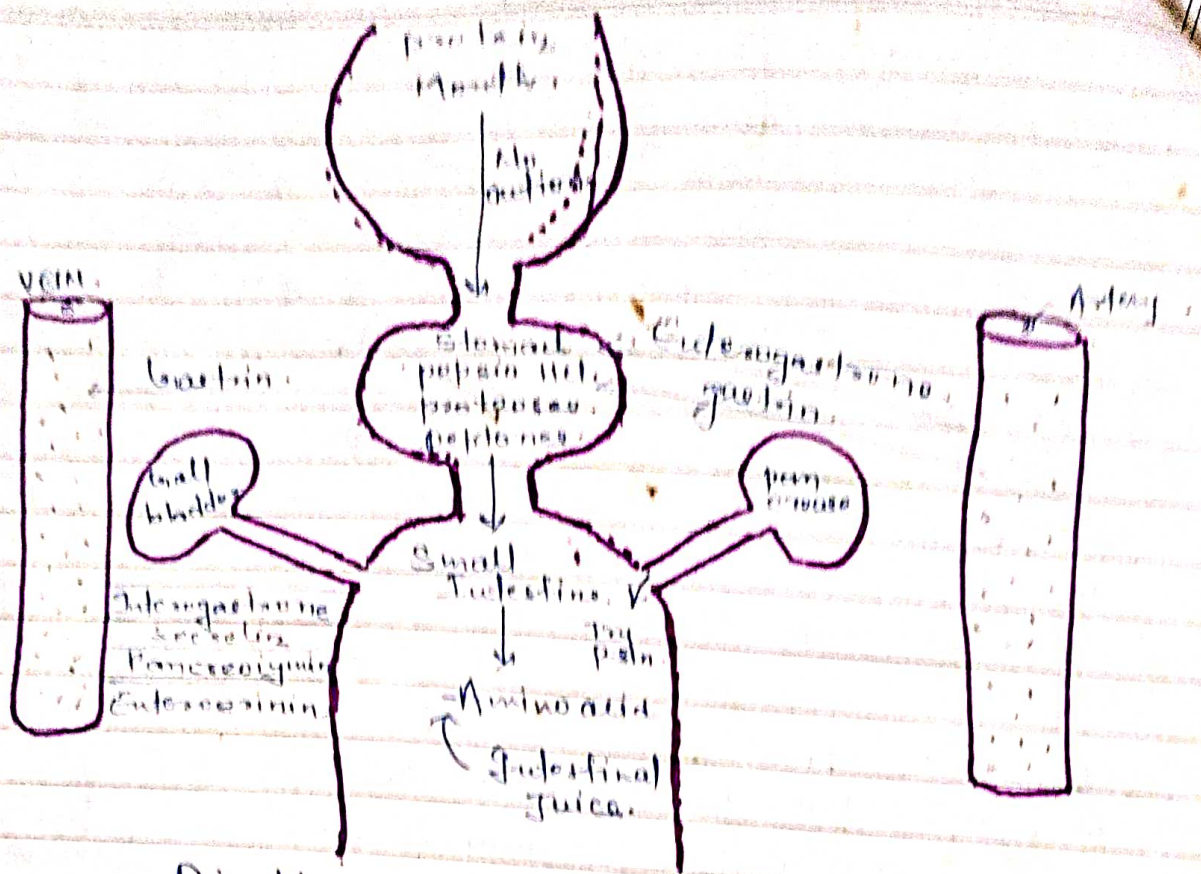
(ii) Pumping Movement:- In this type of movement all the muscular strips around the villus contract simultaneously and the villus shorten in length as a whole. Its aim is to propel the contents of lumen into the large lymphatics of submucous coat.

The submucous nerve plexus seems to control this activity. 'Vilkinin' a specific hormone is claimed to be responsible for the movement of villi. This hormone is liberated by the acid from the stomach acting on the duodenal mucus.

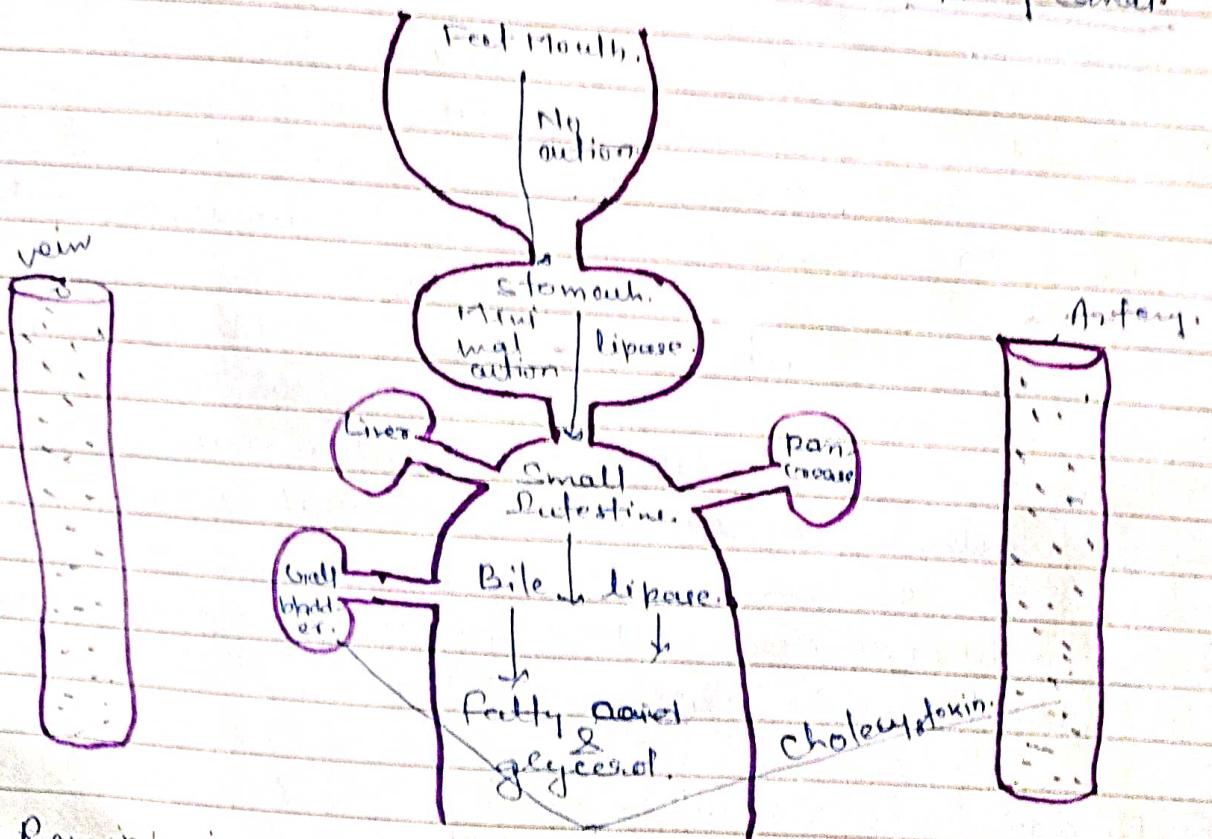
(b) CHEMICAL PROCESS:- The physiology of digestion under chemical process can be studied as follows:-

(a) Digestion in stomach:- The gastric juice contains HCl, pepsin, rennin, and lipase.

(b) Pepsin:- hydrolyses proteins into protease and peptones.



Digestion of proteins in Alimentary Canal.



- (i) Rennin:- is responsible for collecting of milk.
- (ii) Lipase:- It is responsible for hydrolysis of fat.

Many enzymes are formed in the pancreatic secretion.

(i) Trypsin, Chymotrypsin and Elastase:-

The proteolytic action of pancreatic secretion is due to the three endopeptidases - Chymotrypsin, Trypsin, and Elastase.

These are secreted in the form of Zymogens i.e. Chymotrypsinogen, Trypsinogen, proelastase and proCarboxy peptidase. Trypsinogen is activated by the enterokinase secreted by the intestinal mucosa. This hydrolyzes a lysine peptide bond in the zymogen releasing an active trypsin. Trypsin activates other zymogens as chymotrypsin elastase and Carboxy peptidase.

Trypsin is specific for peptide bonds of basic amino acids and chymotrypsin is specific for peptide bonds containing uncharged amino acids residues which elastase is responsible for attacking on bonds next to small amino acid residues.

(ii) Carboxypeptidase:-

The further attack on the polypeptides produced by the action of endopeptidases is carried on by the exopeptidase - Carboxypeptidase which attacks the Carboxy-terminal peptide bond liberating single amino acid.

(iii) Lipase:- The pancreatic lipase acts at the oil-water interface of the finely emulsified lipid droplets formed by mechanical agitation in the gut in the presence of production of lingual lipase activity bile salt Colipase (a protein present in pancreatic secretion) phospholipase and phospholipase A<sub>2</sub> (also present in the pancreatic secretion). Pancreatic lipase is specific for the hydrolysis of primary ester linkage i.e. at the position 1 and 3 of triacylglycerols.

Because of the difficulty of hydrolysis of the secondary ester linkage in the triacylglycerol.

It is probably that the digestion of triacylglycerols proceeds by removal of the terminal fatty acid to produce 2-Monoacylglycerol and free (1/4th) of triacylglycerol (ingested) is completely broken down to glycerol and fatty acids.

I Under the condition within the lumen of intestine this enzyme catalyses the hydrolysis of cholesterol esters.

ii phospholipase A<sub>2</sub>:- phospholipase A<sub>2</sub> hydrolyzes the ester bond in the 2-position of glycerol phospholipids of both biliary and dietary origin to form lysophospholipid.

© DIGESTION BY INTESTINAL SECRETION:- The intestinal juice secreted by the glands of Brunner and Lieberkuhn etc. contains digestive enzymes including the following-

I Aminopeptidase:- which is an exopeptidase attacking peptide bonds next to N-terminal amino acids of polypeptides and oligopeptides and dipeptidases of various specificity. Some of which may be within the intestinal epithelium. The latter completes digestion of dipeptide to free amino acids.

ii A phosphatase:- which removes phosphate from certain organic phosphates such as hexose phosphate, glycerophosphate and the nucleotides derived from diet and the digestion of nucleic acids by nucleases.

iii Pro-nucleotidase:- split nucleic acids into nucleotides.

iv Nucleosidase:- (Nucleoside phosphorylase) one of which attacks only guanine and hypoxanthine. Containing nucleosides. The pyrimidine nucleosides (uridine, cytidine and thymidine) are broken down by another enzyme that differs from the purine nucleoside phosphorylase.

I The intestinal secretion is also said to contain a phospholipase that attacks phospholipids to produce glycerol, fatty acids, phosphoric acid and bases such as choline.

## Absorption of digestive products:-

The small intestine is the main digestive and absorptive organ. About 90% of the ingested food stuffs is absorbed at the same time. Considerably more water is absorbed after the food stuffs pass into the large intestine so the contents which were fluid in the small intestine gradually become more solid in the colon.

### (b) Absorption of lipids:-

The two monoacylglycerols, fatty acid and small amounts of 1-monoacylglycerol leave the oil phase of lipid emulsion and diffuse into the mixed micelles containing bile salts, lecithin and cholesterol furnished by the bile. Because the micelles are soluble, they allow the products of digestion to be transported through the aqueous environment of the intestinal lumen to the brush border of the mucosa cells where they are absorbed into the intestinal epithelium. The bile salts pass on to the ileum where most are absorbed into the enterohepatic circulation. Phospholipids of dietary and biliary origin (lecithin) are hydrolyzed by phospholipase A<sub>2</sub> of the pancreatic secretion, which are also absorbed from the micelles. Cholesterol esters are hydrolyzed by cholesterol ester hydrolase of the pancreatic juice and free cholesterol together with most of the biliary cholesterol is absorbed through the brush border after transportation in the micelles. Over 90% dietary lipid is normally absorbed through lacteals.

### (c) Absorption of Amino Acids and proteins:-

Under normal circumstances the dietary proteins are almost completely digested to their constituent amino acid and their end products of protein digestion are then rapidly absorbed from the intestine into portal blood.

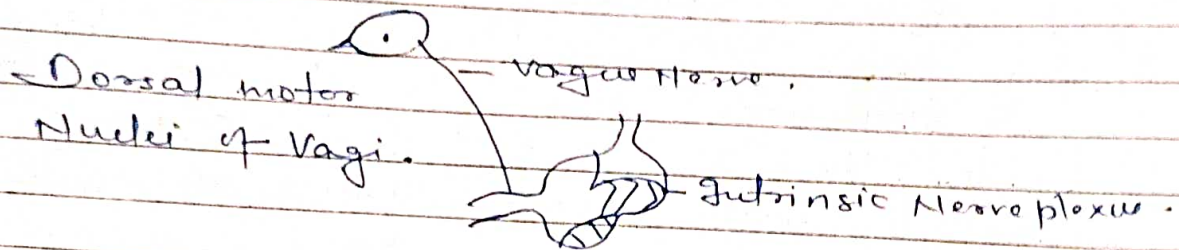
## Regulation of Alimentary Canal Secretion of Nervous

### Hormonal mechanism:

(A) Gastric Secretion: - It is regulated by both Nervous and hormonal mechanism.

(B) Nervous Mechanism: -

The nervous signals originate in the dorsal motor nuclei of the vagi and pass via the vagus nerve to the intrinsic nerve plexus of the stomach and then to the gastric glands. In response these glands start their secretion.



Hormonal Mechanism: - Arrival of food causes the central protein of the stomach mucosa to secrete the gastrin hormone by gastric cells also known as G-cells. These G-cells are found in the pyloric glands and to a lesser extent the proximal glands of duodenum.

The food causes release of this hormone in two ways - The bulk of food and certain food extraction such as alcohol and coffee etc. increase (pH 2.0) in acidity of gastric juice causes the gastric secretion blocked. It results probably due to two factors - (a) acidity to release an inhibitor hormone which blocks gastric secretion.

(b) Increased acidity blocks release of gastrin hormone