Alimentary Canal ①

The Digestive system is represented by a tube, the alimentary canal or gut of variable diameter and length which extends from mouth to anus. It is supplemented by a pair of labial or salivary gland in many insects, gastric caeca in some insects and MT in allmost all insects. ⊛ Note ①

Note-2 ▲ The Diffn parts of AC may become modified anatomically or physiologically to perform various functions. The foregut is commonly concerned with the storage of food and sometimes helps to fragment the food before it passes to the midgut.

The MG is lined by a delicate membrn is Primarly concerned with the production of enzymes and the absorption of the product of digestion.

The HG conducts the undigested food materials to the exterior via the anus, but also help in other functions. In particular rectum is involved in salts and H_2O regulation.

① ⊛ General Structure. The AC in insect is divided into 3 regions –

→ the foregut or Stomodaeum
→ the Midgut or Mesenteron
→ the Hindgut or Proctodaeum.

In many insects these regions are sub-divided into various functional parts. such as – Pharynx, Oesophagus, crop or proventriculus in

Foregut, Caeca, ventriculus in MG and pylorus, ileum, Rectum in HG. Next → 2

Usually the gut is a continuous tube running from the mouth to anus. In fluid feeding insects the connection betn the MG & HG is occulated. This is case in some plant sucking hymenoptera and larvae of neuroptera which digest their prey - extra-orally. A similar modification occurs in the larvae of social hymenoptera. The length of alimentary canal is roughly corelated with diet. Insects feeding on a largely protein diet tend to have a shorter gut than those feeding largely on Carbohydrates.

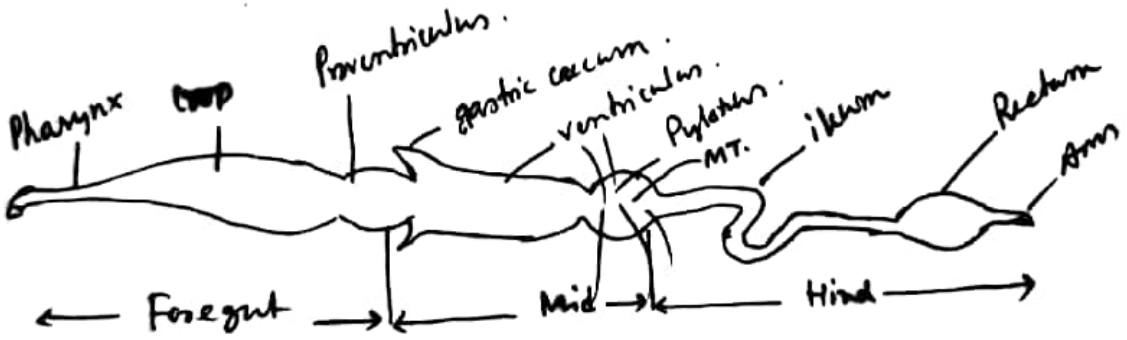


Fig - Subdivisions of AG (Snodgrass 1935)

A) Structure of FG -

The FG is ectodermal in origin. It is lined with a layer of cuticle, known as intima, which is shed at each moult in the same way as the rest of the cuticle. The FG epithelium consist of flattened cells and outside it is a large layer of longitudinal muscles and a layer of circular muscle.

The circular muscles are relatively well developed. The circular muscles are not inserted into the epithelium but are continuous all ~~the~~ round the gut. So that their construction leads to the development of even longitudinal foldings. When the gut is distended with food these folds are flattened out. Specially, in the proventriculus, there may be 6/8 permanent infoldings of the wall. Longitudinal muscles may be inserted into the circular muscles or into the epithelium. Outside the muscle layers is a delicate connective tissue sheath.

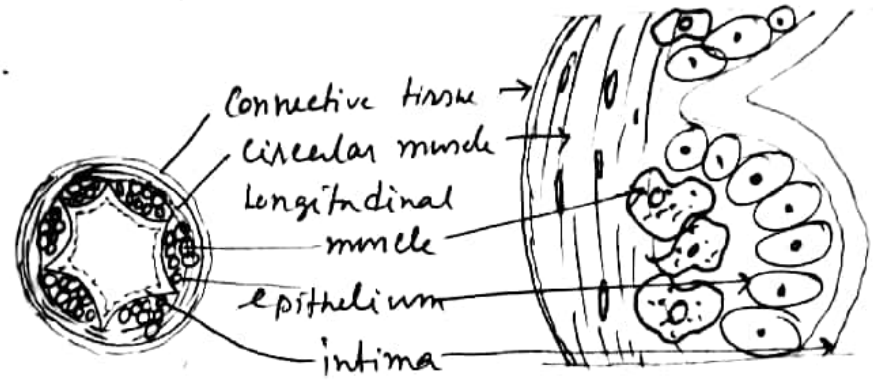


Fig- Section of Foregut

a) Pharynx- The pharynx is the first part of the foregut. Pharynx has a series of dilator muscles inserted into it. These arises ventrally on the tentorium and dorsally on the fronts and are best developed in sucking insects (Lepi; hymenoptera). They are also present in biting and chewing insects.

B) Oesophagus:- The oesophagus is an undifferentiated part of the FG serving to pass food back from the pharynx to the crop.

c) Crop:- The crop is an enlargement part of the FG in which food is stored. In some fluid feeders it is a lateral diverticulum. The crop is folded longitudinally and transversly when empty becoming distended when the insect feeds. The crop is lined by a intima and secretion and digestion do not occur in the crop.

D) Proventriculus:- The proventriculus is variously modified in diff insects. In fluid feeders it is absent except for a simple valve at the origin of the midgut. A valve is also present in many insects and often the circular muscles form a sphincter at the entrance to the midgut.

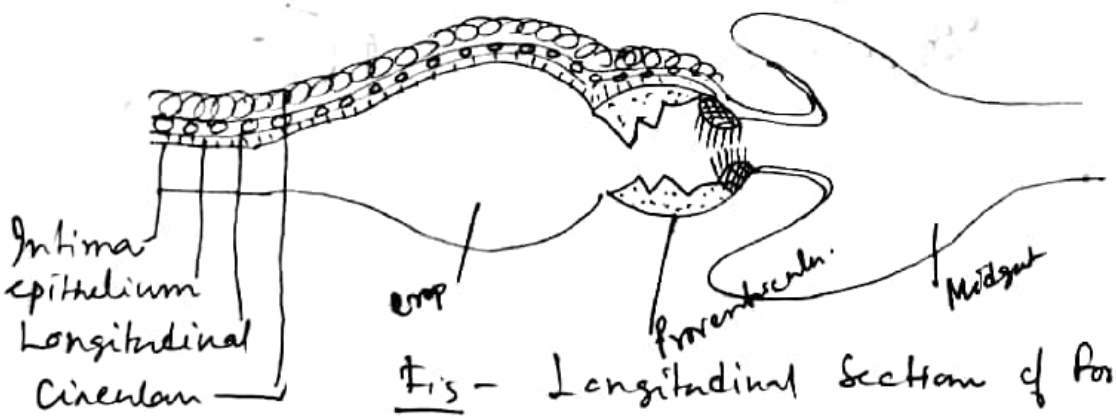


Fig - Longitudinal Section of Foregut (Periplaneta)

In Cockroach and Cricket the intima in the proventriculus is developed into 6 strong plates/teeth, which serve to break up the food. In Acrididae, there are 6 longitudinal folds with small cuticular teeth, and here the proventriculus serves simply as valve.

The proventriculus of the bee is very →

→ specialised. An anterior invagination into the crop ends in 4 mobile lips each armed with a number of spines. Again the proventriculus controls the movement of food from the crop to the midgut. It is also able to remove pollen from a suspension of nectar in the crop, while nectar is retained in the crop. Writhing movements of the crop keep the pollen dispersed while the tips of the proventriculus makes snapping movements in such a way that the spines strain off the grains of pollen and retain them. In this way bolus of pollen is formed and then to the midgut. Nectar is retained in the crop for regurgitation and processing to form honey.

crop (suspension of nectar + pollen)

Proventi

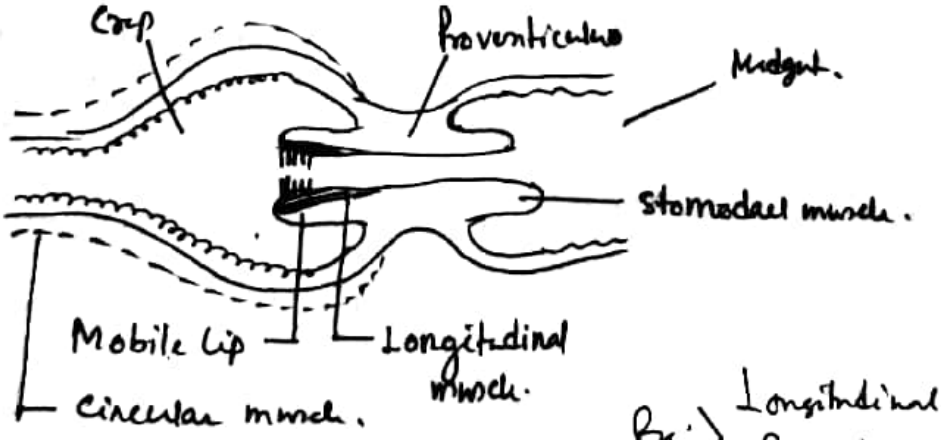


Fig. Longitudinal Section of Proventriculus in Apis

Structure of MG—

The MG does not have a cuticular lining, but in the Majority of insects it is lined by a delicate peritonial membrane. The most characteristic Midgut cells are tall and columnar with regular microvilli forming

a striated boarder adjacent to the lumen.

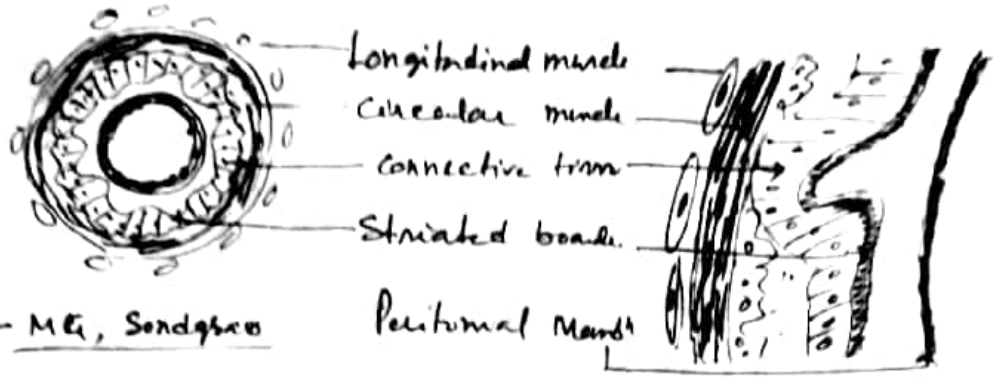
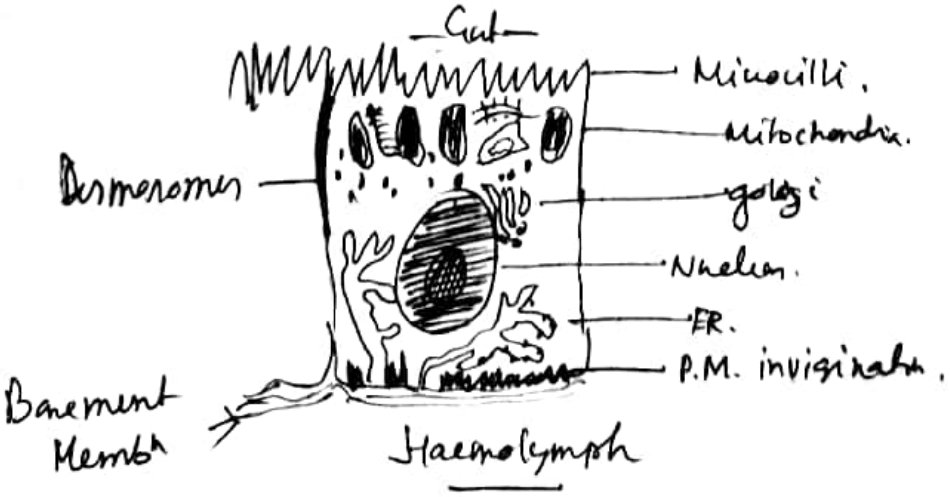


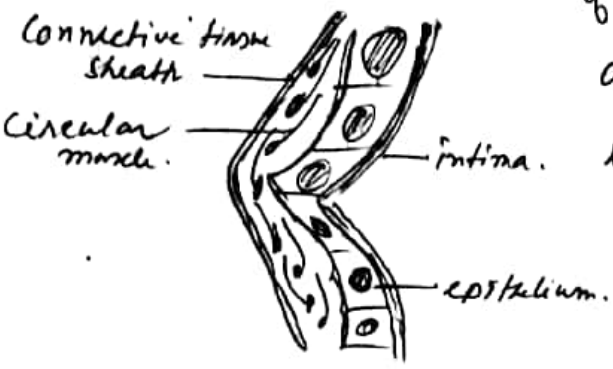
Fig – MG, Sandgrove

The basal memb^n of the cells, adjacent to the haemolymph, are infolded with few openings to the haemolymph, so that the intracellular spaces which they enclosed are relatively isolated. Many mitochondria are enclosed by these folds. The cells generally also contain extensive ER with ribosomes assumed to be concerned with the synthesis of digestive enzymes. Laterally cells are jointed to each other by desmosomes, so that they form a continuous epithelium. These columnar cells are concerned with the enzyme secretion and absorption of the product of digestion.



Structure of HG.

The hindgut is lined by a layer of cuticle which is thinner and more permeable than that of the FG. The epithelium generally is thin, but the cells are more cuboid than in the FG, while those of the rectal pads are tall with a clear cytoplasm. Except round the rectum the musculature is poorly developed but where it is present the longitudinal muscles are usually intended to the circular. Along the rectum the longitudinal muscles often collected into strands opposite the gaps between adjacent rectal pads.



T.S. of Rectum

a) Pylorus:- The midgut opens into the hindgut through the pylorus. The pylorus is the first part of the hindgut and ~~form it~~ from it MT often arises. In some insects it forms a valve betn the MG & HG.

b) Ileum:- In most insects the ileum is an undifferentiated part/tube running back to the rectum, but in termites it forms a pouch in which the flagellates live. In scarabaeoidea there is a comperable fermentation chamber in which the intima is produced into spines. In Heteroptera the ileum is concerned with the removal of H_2O from the haemolymph. In blowfly larvae, certain cells →

are concerned in the excretion of ammonia. The hormone proctodon is secreted by the cells of the ileum of ostrinia.

c) Rectum :- The rectum is often an enlarged sac as is thin walled except for certain regions, the rectal pads, which have columnar epithelium. There are usually six rectal pads and they may extended longitudinally along the rectum or they may be papillaform as in Diptera. The cells of the rectal papillae enclosed extensive intracellular sinuses which as separated from the gut lumen by cell junctions. In odonata and orthoptera each pad consist of a single layer of cells, but in Lepidoptera, Neuroptera and Hymenoptera there are two layers.

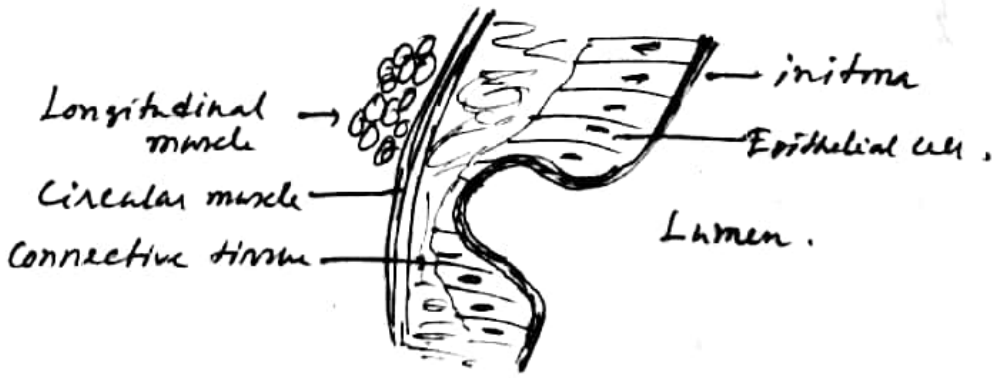


Fig. T.S. of Rectum