

DIVISIONS OF THE ELEMENTARY CANAL

Division of the elementary canal

It is divisible into 3 primary regions according to the embryonic development/ origin:-

- a) foregut :- from anterior invagination (stomodaeum)
- b) hind gut :- from posterior invagination(Protodaeum).
- c) Mid gut:- it connects the foregut and hindgut as an ectodermal sac (mesenteron).

FOREGUT:-

It consist of the following layers:

- Inner cuticle lined layer- **Intima**.
- Thin epithelial layer, secreting the intima.
- Basal membrane, supporting the epithelial layer.
- Longitudinal muscles.
- Circular muscles.
- Outside the muscle layer, delicate connective tissue bearing nerves and tracheae.

Regions of Foregut

- Pre oral cavity(buccal cavity): situated in between M.P. and labrum, in mandibulates this space is divided by hypopharynx into an anterior cibarium and posterior salivarium. The cibarium may form a small sac for temporary storage of food or modified into sucking pump in thysanoptera, Hemiptera.

The salivarium modified into salivary syringe of Hemiptera and silk regulation of Lepidoptera larvae.

- **Pharynx:** It is a muscular structure responsible for ingestion of the food, highly developed in Lepidoptera, Hymenoptera, neuroptera, where pharynx modified into sucking pump.
- **Oesophagus :-** between pharynx and crop.
- **Crop :-** enlarged part of the posterior part of the oesophagus. It acts as a food reservoir, digestion may occur when its contents are mixed with the salivary enzymes and some lipid may be absorbed here(Eisner,1955).
- In Periplaneta, its movement is under the control of nervous system and empty of the crop is under osmotic pressure, in absence of food it is filled up with air(Davey and Treherne,1963).

- In Dipterans, Isopterans, Coleopterans the crop develops as dilation of the oesophagus and connected with it by a narrow tube.
- Proventriculus:- situated behind the crop, highly developed in Orthoptera, Coleopterans, Macoptera, Isoptera and Hymenoptera with the exception of honey bee where it is reduced to a valve (retaining the food in the crop).
- In Cockroach and Cricket, the intima in the proventriculus is developed into six strong plates or teeth, serves to broke the food materials.

Midgut :-

- It is lined with epithelial cells devoid of the cuticle. The epithelial cells are protected from the gut by a delicate detached sheath, the peritrophic membrane. In the epithelial layer Three main types of cells may be distinguished :-
 - columnar (cylindrical) cells:- enzymes
 - Regenerative cells from synthesis of new cells.
 - Goblet cells for pumping excessive potassium(k).

- ❑ **Columnar cells**:- concerned with enzyme secretion and with the absorption of the products of digestion
- ❑ Goblet cells are distributed between columnar cells in caterpillars and Ephemeroptera and Plecoptera (Wigglesworth, 1965). It helps to pump excess K, derived from food, out of the haemolymph (Smith, 1968, Wood et al. 1969).

In *Rhodnius*, midgut cells help in excretion. Here respiratory pigments are broken down into haematin and biliverdin.

In Lepidoptera, metals and dyes accumulate in the goblet cavity. These substances are discharged during molting

- **Ultra structure of the columnar epithelial cells:-**

It is studied on Calliphora by De Preister, 1971 and on the larvae of Hyalophora by Andensen and Haevery, 1966. The cytoplasm is divided basically into compartments by deep folding of plasma membranes and produced towards the lumen in the array of microvilli, microtubules and mitochondria.

The epithelial layer is followed by the muscle layers which is differentiated into an inner circular muscle layers and an outer longitudinal muscle layers. The muscle layers are bonded by a delicate connective tissue sheath.

Anatomy of Midgut:-

- It is a simple tube, presence of 4,6 or 8 caeca at the anterior end. In Dipterans, the midgut is differentiated into; anterior cardiac chamber and along ventriculus (Snoedgrass,1935).

In Heteroptera, there are 4 regions, the last give rise to numerous caeca which harbor bacteria.

The remaining parts of midgut is composed of 2 segments, Anterior- cells are absorptive.

Posterior- cells are secretory

- In Hemiptera- feed on plant sap
- In Lepidopteran, Hymenoptera and Diptera which feed on nector, some modification occur in midgut for the elimination of excess water, this is due to avoid excessive dilution of haemolymph & to concentrate the food so as to facilitate enzyme activities. The fluid is stored in crop & from which small quantities are passes to the midgut when required.

According to Marshall and Cheungm, 19074 in plant sucking insects the extensive elaboration of midgut , to remove the excessive water.

In Homoptera, the terminal region of midgut comes into close contact with the anterior part of midgut & proximal part of the Malpigean tubules connectively from a chamber, known as **Filter Chamber** .

These arrangements are supposed to enable the excess fluid in the food to pass directly from the first part to the last of intestine, without dilution of Haemolymph.

Function Differentiations:

With respect to the absorption of nutrients, secretion of enzymes and histochemical grounds the midgut is functionally differentiated into different parts-

In *Anopheles*, *Culex* the zone is followed by a group of caeca in which both secretion and absorption may takes place.

In the larvae of *Aedes* after feeding on Carbohydrates and certain amino acids, there is a massive deposition of glycogen in the epithelium of the posterior part of mid gut and small amounts in the cells of gastric Caeca. In *Glossina*, the blood is thickened to a suitable consistency by the absorption of water in the anterior part of midgut, the blood is black in color by the enzyme action secreted from the middle parts and the narrow posterior part is responsible for absorption.



THE END