

## LECTURE 1. Anatomy: Digestive system

### Digestive system

The **digestive system** (sometimes referred to as the **alimentary canal**) should be easily seen in the dissected specimens. It is a long tube-like structure that runs from the mouth to the anus and is centrally located within the body cavity, or **hemocoel**. The anteriormost region is called the **foregut** (or **stomodeum**) which includes the Buccal cavity, the esophagus, and the crop. The primary function of the foregut is to begin the breakdown of food particles and transport them to the next region, the **midgut** (or **mesenteron**). The midgut is the major area of digestion and absorption. Undigested food particles then pass into the third region, the **hindgut** (or **proctodeum**), which consists of the ileum, colon, **rectum**, and (often) rectal pads. The hindgut functions in water and solute reabsorption and waste excretion.

The three sections of the digestive tract can be easily identified by structures found at the junction of each region. **Gastric caecae**, for example, mark the end of the foregut and beginning of the midgut. It is believed that the purpose of these structures is to increase surface area for greater nutrient absorption. The constriction at the gastric caecae also marks the spot of the cardiac valve (or sphincter).

The alimentary canal of insects is a long, muscular and tubular structure extending from mouth to anus. It is differentiated into three regions viz., Foregut, midgut and hindgut.

1. **Foregut:** It is ectodermal in origin. Anterior invagination of ectoderm forms foregut (Stomodeum). Internal cuticular lining is present. Terminal mouthparts leads into a

preoral cavity. Preoral cavity between epipharynx and hypopharynx is called as Cibarium.

Preoral cavity between hypopharynx and salivary duct is Salivarium.

Behind the mouth a

well muscled organ called Pharynx is present which pushes the food into

oesophagus. Pharynx acts as a sucking pump in sap feeders.

Oesophagus is a narrow

tube which conduct food into crop. Crop is the dilated distal part of oesophagus acting as

food reservoir. In bees crop is called as honey stomach where nectar conversion occurs.

Proventriculus or Gizzard is the posterior part of foregut and is muscled. It is found in

solid feeders and absent in fluid feeders or sap feeders. Food flow from foregut to midgut

is regulated through cardiac or oesophageal valve. The internal cuticle of gizzard is

variously modified as follows.

i. Teeth like in cockroach to grind and strain food.

ii. Plate like in honey bee to separate pollen grains from nectar

iii. Spine like in flea to break the blood corpuscles

2. **Midgut:** It is endodermal in origin and also called as mesenteron. This part contains no

cuticular lining. Midgut is made up of three types of epithelial cells. (i)

Secretory cells

(Columnar cells) (ii) Goblet cells (aged secretory cells), (iii) Regenerative cells which

replaces secretory cells. Important structures present in midgut are as follows:

a. **Peritrophic membrane:** It is the internal lining of midgut, secreted by anterior or

entire layer of midgut epithelial cells. Present in solid feeders and absent in sap feeders.

This layer is semipermeable in nature to digestive juices and digestion products. It

lubricate and facilitate food movement. Envelops the food and protects

the midgut

epithelial cells against harder food particles.

(ii) **Gastric caecae:** (Enteric caecae or Hepatic caecae) Finger like outgrowths found in

anterior or posterior ends of midgut. This structure increases the functional area of

midgut and shelter symbiotic bacteria in some insects.

(iii) **Pyloric valve:** (Proctodeal valve) Midgut opens into hindgut through pyloric valve,

which regulate food flow. In certain immature stages of insects midgut is not connected

to hindgut till pupation. e.g. Honey bee grub.

(iv) **Filter chamber:** It is a complex organ in which two ends of ventriculus and the

beginning of hind gut are enclosed in a sac. This is useful to short circuit excess water

found in liquid food in homopteran insects. This process avoids dilution of digestive

enzymes and concentrates food for efficient digestion. Also helps in osmoregulation by

preventing dilution of haemolymph.

3. **Hindgut:** It is ectodermal in origin and produced by the posterior invagination of

ectoderm. Internal cuticular lining is present, which is permeable to salts, ions,

aminoacids and water. The main functions of hindgut are the absorption of water, salt and

other useful substances from the faeces and urine. Hindgut is differentiated into three

regions viz., **ileum, colon and rectum**. In the larva of scarabids and termites, ileum is

pouch like for housing symbionts and acts as fermentation chamber.

Rectum contains

rectal pads helping in dehydration of faeces and it opens out through anus.

**Gut physiology:** Primary functions of the gut is to digest the ingested food and to absorb

the metabolites. Digestion process is enhanced with the help of enzymes produced by digestive glands and microbes housed in special cells.

## **Sources**

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