

## LECTURE 4. Malpighian Tubules

**Malpighian Tubules:** The main organ of excretion and osmoregulation in insects are the malpighian tubules, acting in association with rectum or ileum. Malpighian tubules are outgrowths of the alimentary canal and consist of long thin tubules formed of a single layer of cells surrounding a blind-ending lumen, they are absent in spring tail and aphids, 2 numbers in scale insects, 4 in bugs, 5 in mosquitoes, 6 in moths and butterflies, 60 in cockroach and more than 200 in locusts. Generally they are free, waving around in the haemolymph where they filter out solutes. Each tubule is externally covered by peritonal coat and supplied with muscle fibres (aiding in peristalsis) and tracheoles. Functional differentiation of the tubules was seen, with the distal secretory region and proximal absorptive region.

**Physiology:** The malpighian tubules produce a filtrate (the primary urine) which is isosmotic but ionically dissimilar to the haemolymph and selectively reabsorbs water and certain solutes, but eliminates others. The malpighian tubules produces an iosmotic filtrate which is high in K and low in Na with Cl as major anion. The active transport of ions especially K into the tubule lumen generates an osmotic pressure gradiant for the passive flow of water. Sugars and most amino acids are also passively filtered from the haemolymph via junctions between the tubule cells, where as amino acids and non-metabolizables and

toxic organic compounds are actively transported into the tubule lumen. Sugar is resorbed from the lumen and returned to the haemolymph. The continuous secretory activity of each malpighian tubule leads to a flow of primary urine from its lumen towards and into the gut. In the rectum, the urine is modified by removal of solutes and water to maintain fluid and ionic homeostasis of the body.

**Nitrogenous excretion:** Terrestrial insects excrete waste products as uric acid or certain of its salts called urates, which were water insoluble and requires less amount of water for waste product removal. This type of excretion is known as **Uricotelism**. In aquatic insects ammonia is the excretory product, which is freely soluble in water and requires more amount of water for waste product removal. This type of excretion is known as **Ammonotelism**.

**Cryptonephry:** The distal ends of the Malpighian tubules are held in contact with the rectal wall by the perinephric membrane, which is concerned either with efficient dehydration of faeces before their elimination or ionic regulation. (e.g. Adult Coleoptera, larval Lepidoptera and larval symphyta).

**Functions of malpighian tubule:** Excretory in function, mainly concerned with removal of nitrogenous wastes. The other accessory functions are as follows:

1. Spittle secretion in spittle bug
2. Light production in *Bolitophila*
3. Silk production in larval neuroptera

**Storage Excretion:** The excretory waste materials are retained within the body in different sites.

- i. Uric acid is stored as urates in the cells of **fat body** e.g., American cockroach.
- ii. Uric acid is stored in the **body wall**, giving white colour. e.g. Red cotton bug.
- iii. Uric acid is stored in the **male accessory glands** to produce the outer coat of spermatophore, which is excreted during copulation.
- iv. Uric acid is stored in the **wing scales** giving white colour. e.g., Pierid butterflies.
- v. Waste products of pupal metabolism (**Meconium**) is stored and released during adult emergence.

## **Sources**

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