



FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES

ENT-121: Fundamentals of Entomology

Lecture 17: Insect Anatomy: Excretory and Circulatory System:

Malpighian tubules: Thin, blind-ending tubules, originating near the junction of mid and hindgut, predominantly involved in regulation of salt, water and nitrogenous waste excretion. This structure was discovered by Marcello Malpighi.

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

Nephrocytes: Cells that sieve the haemolymph for products that they metabolize (pericardial cells).

Fat bodies: A loose or compact aggregation of cells, mostly trophocytes, suspended in the haemocoel, responsible for storage and excretion.

Oenocytes: These are specialized cells of haemocoel, epidermis or fat body with many functions. One of the function is excretion.

Integument: The outer covering of the living tissues of an insect.

Tracheal system: The insect gas exchange system, comprising tracheae and tracheoles.

Rectum: The posterior part of hind gut.

Among the above organs, malpighian tubules are the major organ of excretion.

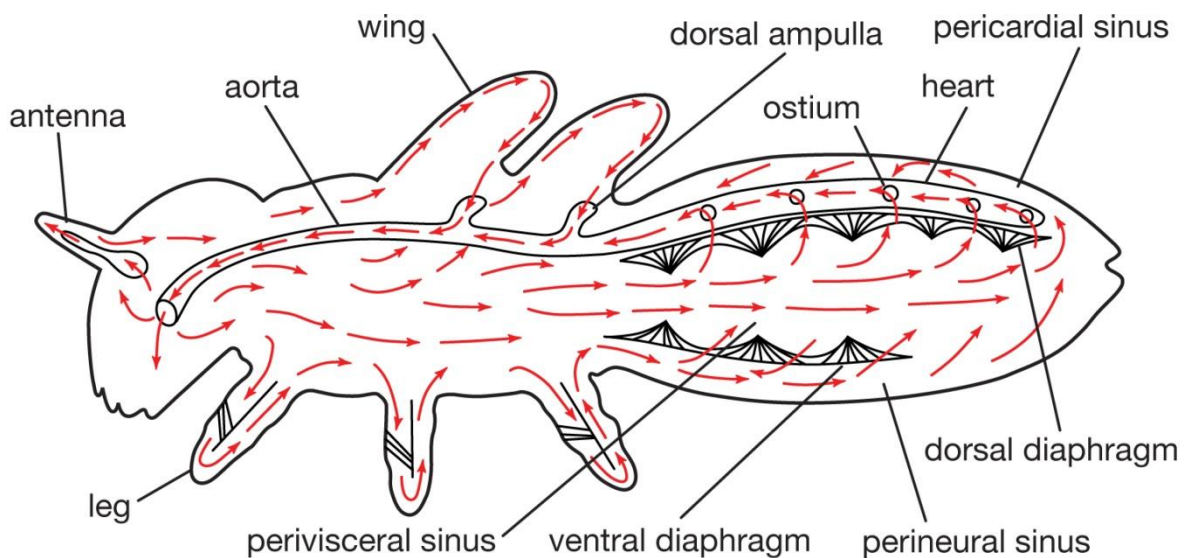
Nitrogenous excretion: Terrestrial insects excrete waste products as uric acid or certain of its salts called urates, which were water insoluble and requires less amount of water for waste product removal. This type of excretion is known as **Uricotelism**. In aquatic insects ammonia is the excretory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

Circulatory System:

Circulation in insects is maintained by a system of muscular pumps moving haemolymph through compartments separated by fibromuscular septa or membranes. The main pump is the pulsatile dorsal vessel. The anterior part may be called aorta and the posterior part the heart. The dorsal vessel is a simple tube, generally composed of one layer of myocardial cells and with

segmentally arranged openings called ostia. The ostia permit the one-way flow of haemolymph into the dorsal vessel due to valves that prevent backflow. There may be up to three pairs of thoracic ostia and nine pairs of abdominal ostia. The dorsal vessel lies in the pericardial sinus, a compartment above a dorsal diaphragm (a fibromuscular septum - a separating membrane) formed of connective tissue and segmental pairs of alary muscles. The alary muscles support the dorsal vessel but their contractions do not affect heartbeat.

Haemocytes: The blood cells or haemocytes are of several types and all are nucleate. Different types of haemocytes are as follows:



a. Prohaemocyte : Smallest of all cells with largest nucleus.

b. Plasmatocyte (Phagocyte) aids in phagocytosis etc.

Functions of haemolymph

1. Lubricant: Haemolymph keeps the internal cells moist and the movement of internal organs is also made easy.

2. Hydraulic medium : Hydrostatic pressure developed due to blood pumping is useful in the following processes.

a) Ecdysis (moulting)

b) Wing expansion in adults

- c) Ecolosion in diptera (adult emergence from the puparium using ptilinum)
- d) Eversion of penis in male insects
- e) Eversion of osmeteria in papilionid larvae
- f) Eversion of mask in naiad of dragonfly
- g) Maintenance of body shape in soft bodied caterpillars.

3. Transport and storage : Digested nutrients, hormones and gases (chironomid larva) were transported with the help of haemolymph. It also removes the waste materials to the excretory organs. Water and raw materials required for histogenesis is stored in haemolymph.

4. Protection: It helps in phagocytosis, encapsulation, detoxification, coagulation, and wound healing. Non cellular component like lysozymes also kill the invading bacteria.

5. Heat transfer: Haemolymph through its movement in the circulatory system regulate the body heat (Thermoregulation).

6. Maintenance of osmotic pressure: Ions, amino acids and organic acids present in the haemolymph helps in maintaining osmotic pressure required for normal physiological functions.

7. Reflex bleeding: Exudation of haemolymph through slit, pore etc. repels natural enemies. e.g. Aphids.

8. Metabolic medium: Haemolymph serves as a medium for ongoing metabolic reactions (trahalose is converted into glucose).