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Endocrine System and Insect Hormones

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Endocrine ?

• The endocrine organs and hormones together referred as endocrine system in insects.
• The endocrine organs produce hormones which travel usually in blood to various organs of the body coordinating their activities.

Endocrine System ?

• The endocrine system is thus complimentary to the nervous system.
• **Endocrine system helps to maintain homeostasis, coordinate behavior, and regulate growth, development, and other physiological activities.**
• A hormone is a chemical signal sent from cells in one part of an organism to cells in another part (or parts) of the same individual. Hormones are often regarded as chemical messengers. Although typically produced in very small quantities, hormones may cause profound changes in their target cells. Their effect may be stimulatory or inhibitory. In some cases, a single hormone may have multiple targets and cause different effects in each target.

Role of Endocrine System in Insects

Endocrine organs are of two types:
(1) Neurosecretory cells in the central nervous system
(2) **Specialized endocrine glands** (such as corpora cardiac, corpora allata and prothoracic glands).
The neurosecretary cells are modified motorneurons.
• Both types of organs produce hormones which are generally released directly or indirectly via storage organs (neurohaemal organs), into blood, but in some instances the hormones produced by neurosecretaory cells are conveyed to the target organs along the axons of the cells.
• Nervous stmuli commonly lead to the release of the hormones.

(1.) Neurosecretory Cells

- The secretion is granular, synthesized in cell bodies and pass down to axons.
- The neurosecretary cells normally occur in the ganglia of the CNS. They generally resemble typical bipolar nerve cells, but are characterized by showing cytological evidence of secretion.
- It is possible that the visible secretion is only a carrier (possibly a large protein), to which the smaller hormone molecule is attached. When hormone is finally released it becomes separated from the carrier (protein) and is then free into blood.
- NSC in dorsal part of protocerebrum produce a hormone called Prothoracicotropic Hormone (PTTH) or BRAIN HORMONE which activates **prothoracic glands.**

- NSC in brain secretes **BURSICON** which is involved in hardening and darkening of cuticle.
- Neurosecretory cells scattered in the ventral nerve cord produce Diuretic Hormone**.**
- In insects, the **NEUROSECRETORY CELLS** are responsible for production of hormones, **except Ecdysone and Juvenile hormones**, which are produced from **Non-neural Tissues** like **Prothoracic Glands** and **Corpora Allata.**
- Insect NSCs shows **Excitatory and Inhibitory post- synaptic potentials.**
- The release of hormone is mediated through the **influx of Ca^{2+} ions**.

(2.) Specialized endocrine glands

(i). Corpora Cardiaca: Found in most of insects except **COLLEMBOLA**. Lies on **each side of aorta behind brain.**Connected to protocerbrum and hypocerbral ganglion. It acts as a **conventional storage** and release organ for neurosecretory cells. It **controls heart beat and regulate trehalose level in haemolymph.**

(ii). Corpora Allata: The corpora allata are glandular bodies, usually one on either side of oesophagus. In addition, a fine nerve connects each corpus allatum with suboesophageal ganglion.

• They are fused to a single organ in diptera. Each is connected with corpus cardiacum of the same side by a nerve which carries fibres from NS cells of the Brian.

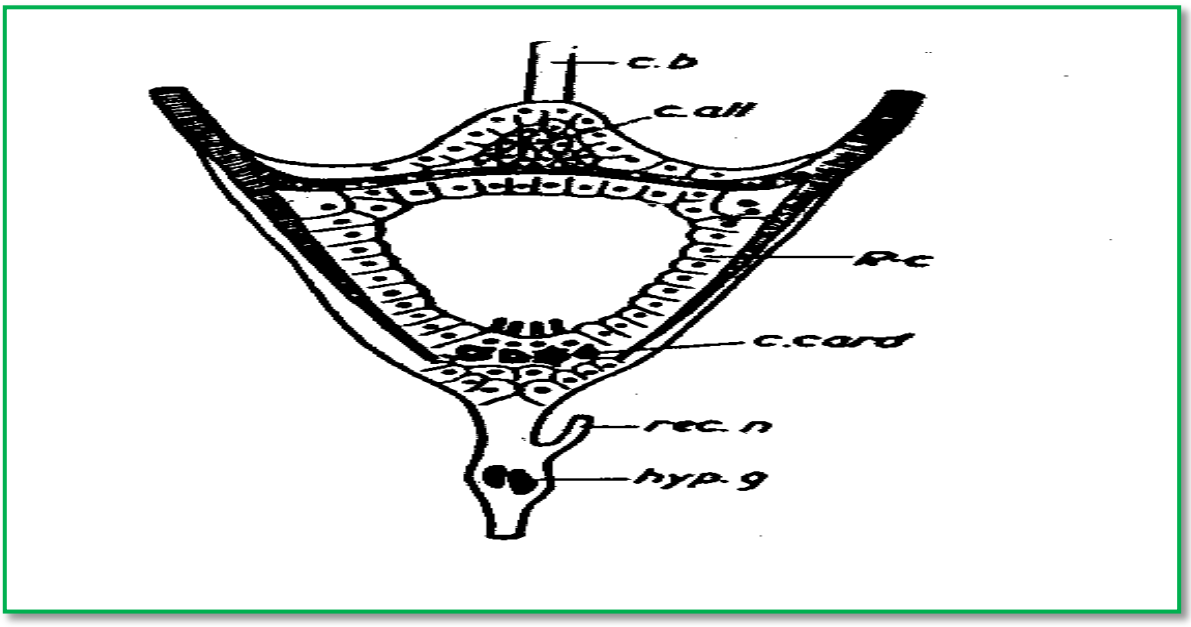
• The **corpora allata produce Juvenile Hormone (JH) which regulate metamorphosis and yolk deposition in eggs**. Changes in the volume of corpora allata or in the sizes of the cells within gland are not necessarily correlated with JH activity in the haemolymph

(iii). Prothoracic Glands (PTG): The prothoracic, or thoracic, glands are a pair of diffuse glands at the back of the head or in the thorax. Each gland has a rich tracheal supply and often nerve supply.

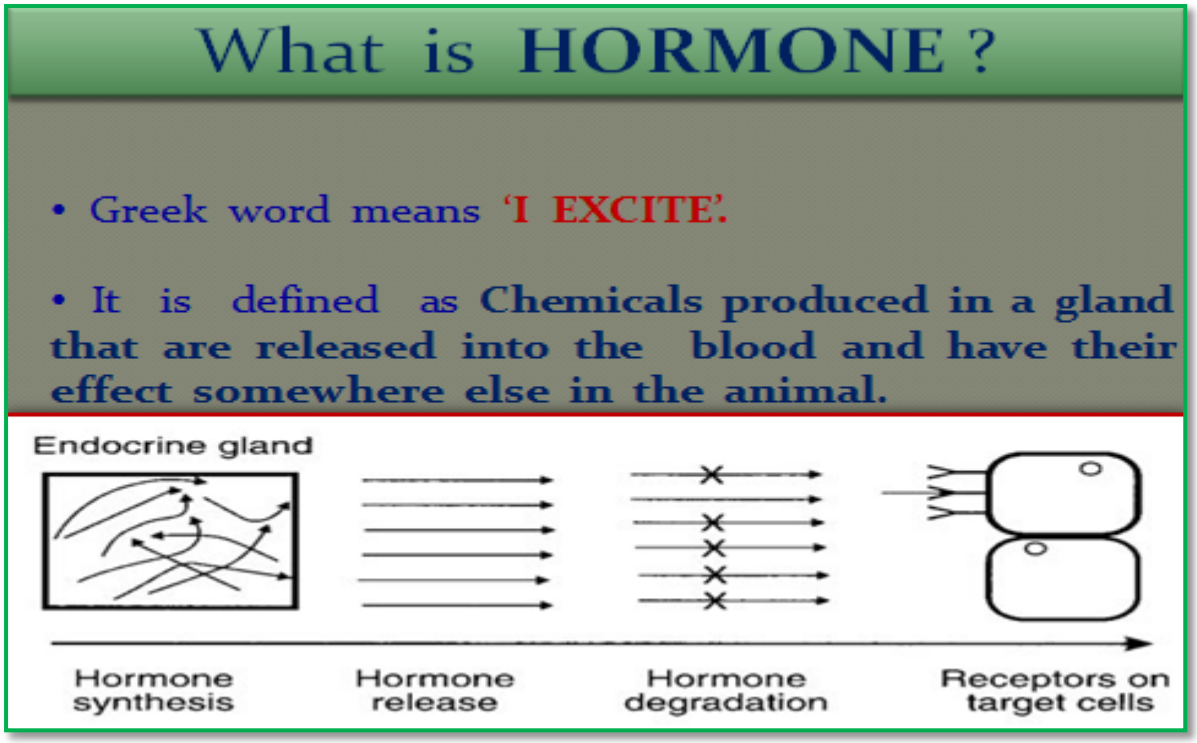
• The glands show cycles of development associated with secretion. At rest, the nuclei are small and oval, but in active gland, they become enlarged and lobulated and the cell has more extensive and deeply staining cytoplasm. During active phase, the number of mitochondria increase and endoplasmic reticulum becomes more extensive. This reflects the production of enzumes engaged in synthesis of ecdysone.

• The prothoracic glands produce moulting hormone, ecdysone, and except in thysanura, which moult as adults, the prothoracic glands breakdown soon after the final moult to adult.

(iv). Weismann's ring/ Ring gland: Present in **Cyclorrophous Diptera**. Formed by the **fusion of Carpora cardiaca, Carpora allata, Prothoracic glands and Hypocerebral ganglion**. Occur as **small ring like tissue** supported by **trachea around aorta**. It Secrete **puparium hardening hormone** and Controls **metamorphosis in flies.**



Role and function of Hormones



• In immature insects, juvenile hormone is secreted by the corpora allata prior to each molt. This hormone inhibits the genes that promote development of adult characteristics (e.g. wings, reproductive organs, and external genitalia), causing the insect to remain "immature" (nymph or larva). The corpora allata become atrophied (shrink) during the last larval or nymphal instar and stop producing juvenile hormone. This releases inhibition on development of adult structures and causes the insect to molt into an adult (hemimetabolous) or a pupa (holometabolous).

• At the approach of sexual maturity in the adult stage, brain neurosecretory cells release a brain hormone that "reactivates" the corpora allata, stimulating renewed production of juvenile hormone. In adult females, juvenile hormone stimulates production of yolk for the eggs. In adult males, it stimulates the accessory glands to produce proteins needed for seminal fluid and the case of the spermatophore. In the absence of normal juvenile hormone production, the adult remains sexually sterile.

• Although the role of hormones in the physiology of molting was first described by V. B. Wigglesworth in the 1930's, there is still much about the process that we do not fully understand. Insect endocrinology is currently an active area of research because it offers the potential for disrupting the life cycle of a pest without harm to the environment.