

Defense Mechanisms of Insects Against Pathogens

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Introduction

Together, plants and insects have coexisted for over 350 million years. Both have developed ways to get over each other's defence mechanisms through co-evolution. Because of this evolutionary arms race between plants and insects, plants have evolved an elegant defence mechanism that, like that of animals, can identify nonself molecules or signals from damaged cells and trigger the plant's immune response against herbivores. Plants create certain morphological features, secondary metabolites, and proteins that are poisonous, repulsive, or have antinutritional effects on herbivores in order to fend off their onslaught. In order to defend themselves against herbivores, plants engage in two main strategies: indirect defence, which involves using other species as natural enemies of insect pests, and direct defence, which involves influencing host plant choice, survival, and reproductive success. Plant features that influence the biology of the herbivore, such as mechanical defences on the surface (hairs, trichomes, thorns, spines, and thicker leaves), or the production of toxic chemicals (terpenoids, alkaloids, anthocyanins, phenols, and quinones) that either kill or impede the growth of the herbivore, are examples of plants that mediate direct defences. By releasing a mixture of volatiles that attract the herbivores' natural enemies, as well as by offering food (such as additional floral nectar) and shelter to increase the efficacy of these foes, indirect defences against insects are mediated.

All insects are potential prey or host to many kinds of predators, parasitoids or less often parasites.

- ✚ **Insectivores:** - Organisms that rely almost on a diet of insects.
- ✚ **Parasite:** - Organisms that lives in or on body of its host without killing the host.
- ✚ **Parasitoid:** - Organism that during its development consumes single host

individual, ultimately kills its host.

- ✚ **Predator:** - Organism that during its development consumes more than one host individual to complete its lifecycle.

Types of insect defenses

1. Primary defense: -

A. Cryptic defense: -

- **Homochromism** :- Color is similar – Preying mantis
- **Homomorphism:** - Form is similar – Cow bug

Homotypism: - Both color and form are similar – Leaf insect



B. Camouflage: -

Resembling the general background.



C. Mimicry: -

- ❖ Similarity of one species to another which protects one or both.
- ❖ It is a situation in which one species called the mimic resembles in color, form, behavior from another species called the model.
- ❖ This similarity can be in appearance, behavior, sound, scent, and even location with the mimic found in similar places to their models.
 - i. **Batesian mimicry:** - " False advertising ". It was discovered by Henry Walter Bates, 1861. Edible species looks like distasteful one. The mimic shares similar signals to the model and gets protection.

- ii. **Mullerian mimicry:** - Fritz Muller in 1879. Both mimic and model are unpalatable. Ingestion of either by a predator result in the avoidance of both the species. Advantageous to both mimic and model.



Model: Monarch butterfly



Mimic: Viceroy butterfly

2. Secondary defense

A. Morphological defence: -

i. Eye Spots: -

- ❖ Some caterpillars have eyespots that make them look like a bigger, more dangerous animal, like a snake.
- ❖ An eye spot is a circular, eye like found on body of some caterpillars.
- ❖ These eye spot scare away some predators



Danaus chrysippus



Danaus genetua

ii. Poisons: -

- ❖ Some caterpillars are poisonous to predators.
- ❖ These caterpillars get toxicity from the plants they eat.
- ❖ Generally bright colored larva are poisonous; their color is reminder to predators about their toxicity.
- ❖ Monarch and Pipevine swallowtail.

B. Structural Defense: -

- i. **Horny integument:** - Hard and heavily sclerotized , it can resist break, penetration by insectivores birds – Jewel beetle , Rhinoceros beetle

- ii. **Sclerotized cerci** – Earwigs
- iii. **Raptorial legs** – Preying mantis
- iv. **Tentacles** – Danaidae larva
- v. **Double vision** - Whirling beetle



C. Behavioral defense: -

- **Jumping:** - Effective form of escape from enemies.
- **Reflex Dropping:** - Caterpillars often drop from their food on a strand of silk when disturbed and reel themselves back up when the danger has passed.
- **Thanatosis:** - Many beetles and weevils feign dead which is form of defense against predator.
- **Hiding:** - Some caterpillars encase themselves in folded leaves or other hiding places.
- **Cycloalexy:** - It is ring defense behaviour.



D. Mechanical defense: -

- **Wax and powder secretion:** - Entangles the mouthparts of potential predator.
- **Cockroaches** have a permanent slimy coat.

- Aphids secrete lipids to gum up mouthparts of arthropod predator.
- Many termites secrete chemicals that harden upon contact with air that impair movements of predator.
- Autotomy: - Detachable body parts.

