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Functional aspects of Pheromones

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Introduction

Pheromones are organic chemical compounds produced by an animal or plant which changes the behavior of the same or other animal belonging to same species or opposite sex.^[1] In the case of plants pheromones are produced to attract or repel insects or animals.^[2] Pheromones are synthesized in particular organ or group of cells locally and released outside the body. Their site of action is on neighboring cells, organs or animals. Pheromones identified or synthesized chemically play many roles and are commercially exploited in many functional aspects. In most of the cases pheromones are chemical ligands or small peptides attached to a chemical ligand having specificity towards a particular receptor. Most of the times involved in signal transduction through G-protein coupled receptors (GPCRs) and downstream gene expression.^[1] The following paragraphs describe some of the important aspects of pheromone functions.

Application Aspects

Forest or tree protection

Pheromones have been utilized for forest protection or insects control involved in the deforestation. In the pacific northwest of USA Douglas fir beetle is a menace and due to its bark boring nature many tree species like Douglasfir, *Pseudotsuga menziesii* have been extensively died. A pheromone named methylcyclohexenone (MCH) (3-methylcyclohex-2-en-1-one) has been utilized for segregation and killing of the Douglas fir beetle.^[3]

Crop and Horticulture protection

A patented pheromone has been applied in Asian citrus psyllid control to protect citrus orchards.^[4] and Methyl Eugenol Diluted as a pheromone with Paraffin Oil has been applied for male fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) eradication in Peach.^[5] Pheromone-keromone traps have been used successfully in repelling the red palm weevil, *Rhynchophorus ferrugineus* Oliv., (Coleoptera: Curculionidae).^[6]

Pathogen or vector control

Sand flies communicate through pheromones and acts as vectors or intermediate hosts in the spread of visceral leishmaniasis. This disease is wide spread in the world including India. In Brazil using synthetic pheromones (S-9-methylgermacrene-B and (+/-)-9-methylgermacrene) of sand fly male female mating has been successfully prevented. These types of strategies using pheromones may help in the eradication of the vector borne diseases.^[7]

Functional and developmental Aspects

Cell signaling

Cells communicate, develop or differentiate based on the signals they receive. Its daily universal process of the life to sustain, grow and reproduce. For example vomeronasal organ in the mammals is the site of pheromone binding which results in the activation of hypothalamus and pituitary axis.^[1] Pheromone cell signaling and labor of differentiation is very well developed and understood in honey bees. Within bees categories like queen, workers, male and female drone types are developed by pheromone signaling at the time of larval development. It has been reported that Dufour gland secretes esters and eicosenol pheromones by *Apis mellifera* and *A. cerana* which play vital roles in differentiation.^[8]

Evolution and development

From the experimental studies of the *Bombyx mori* Pheromone glands some of the authors proposed that differential RNA expression and mutations or RNA editing lead to different types of pheromones production and evolution. Closely related pheromones might have evolved from few gene mutations. These mutations may be need based for survival and evolution as per Darwins theory of evolution.^[9]

Fungal Pheromones

The newly identified fungus *Tilletia indica* causing karnal bunt is found to be reproducing and developing by pheromones. The genes and protiens responsible for the synthesis of these pheromones have been cloned expressed and identified.^[10]

Conclusions

Pheromone chemistry is very unique in the life processes. Pheromones can be utilized for agriculture, animal husbandry and treating or preventing some of the deadly diseases. Pheromone research is an open ended problem and further opportunities exist. Excess usage of the pheromones may be detrimental to the environment and may result ecological iblanace and irreversible damage.

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