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Evolutionary Ecology of Parasitic Fungus and the Insects: A Brief Report

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Introduction

When interacting species place selection pressure on one another, a series of synchronous mutual adaptations ensues, which is known as coevolution? It is challenging to understand the molecular processes that underlie such reciprocal adaptations. The genetic reconstruction of reciprocal adaptations has been made possible by the study of host-parasite coevolution, and one particularly potent model is the interaction between parasitic fungi and their insect hosts, which has revealed surprising and novel information about the rivalry between these two species [1].

Eukaryotic and heterotrophic fungi can break down almost all naturally occurring organic materials, including insect corpses. If they were not effectively decomposed, insects' corpses would cover the globe due to their high global biomass. Specialized enzymes are needed to break down the exoskeleton of dead insects, which is primarily made of chitin and protein. Dead insects' integuments can be penetrated by fungus hyphae that produce cuticle-degrading enzymes and develop inside the corpse [2,3]. A component of the pre-adaptive plateau that facilitates soil-borne fungi's transition from a saprotrophic to a parasitic existence is the development of proteinases and chitin-degrading enzymes. The genera *Beauveria* and *Metarhizium's* entomopathogenic fungi have become effective biological pest and vector control agents as well as models for analysing fungus-insect interactions.

This study examines current developments in our knowledge of the evolutionary ecology of insect-fungus interactions, which are based on research employing the larger wax moth *Galleria mellonella* caterpillars, which is a commonly used model host for *Beauveria* and *Metarhizium* species. Since the genomes for both species have become available, the relevance of G. *mellonella* and many *Metarhizium* species as models to research insect-fungus interactions has increased.

When spores of sexual or asexual (conidia) origin stick to the cuticle or are consumed with food, insects become infected by fungi. Hydrophobic coatings of fungus conidia encourage adhesion to insect exoskeletons, which promotes germination. As part of this process, germ tubes and appressoria, invasive structures that produce enzymes to break down proteins, chitin, and lipids, are formed. By triggering the prophenoloxidase cascade, the breakdown of cuticle proteins triggers a first-line defence response in the host, which eventually results in the production of melanin [4].

The injection of fungal cells into *G. mellonella* induces the expression of a broad spectrum of immunity-related effector molecules including numerous proteins with direct antifungal activity or the ability to inhibit virulence-associated proteinases produced by *Beauveria* and *Metarhizium* species.

Entomopathogenic fungi have evolved a number of ways to reduce or prevent the antifungal immune responses in their insect hosts as an adaptation to their parasitic lifestyle. By generating so-called protoplasts or hyphal structures, which, in contrast to conidia and hyphae, lack a completely established cell wall, such fungi are able to circumvent immunological reactions in the hemolymph of the infected host. When penetrating hyphae enter the hemocoel shortly after infection, immunological competent hemocytes circulating in the hemocoel, such as plasmatocytes, phagocytose but do not destroy these hyphal entities [5].

The reasons and effects of individual gene expression are unclear, but the abundance of genes linked to either fungal virulence or host resistance may encode proteins that interact with one another. As mentioned above, antifungal defence mechanisms in insects have been thoroughly researched, showing sensors that detect fungi that are invading as well as various immunity-related effector chemicals such antifungal peptides and inhibitors of fungal proteases [6].

Conclusion

There is growing evidence that parasitic fungi and the insects they parasitize have coevolved, leading to mutual adaptations. This shows that entomopathogenic fungi may recognise and block host immune responses.

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Conflict of Interest

There is no conflict of interest by author.

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