中央研究院生物多樣性研究中心
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Evolutionary Genetics and Genomics

# Queen Discrimination Behavior:
## Investigation of Worker's Chemical and Molecular Cues in the Fire Ant, *Solenopsis invicta*

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**Venue:** Auditorium, 1st Floor
Interdisciplinary Research Building
跨領域科技研究大樓一樓演講廳

**Host:** Dr. John Wang 王忠信副研究員

~Doctoral Dissertation Defense Presentation~

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## Abstract

Social polymorphism is an intriguing area of research in social insects, but the mechanisms that stabilize alternative social organizations are not fully understood. In the red imported fire ant, *Solenopsis invicta*, we observe a social polymorphism with monogyne (single queen) and polygyne (multiple queens) colonies, which is associated with variation in a supergene. This thesis aims to identify and validate the molecular and chemical mechanisms underlying queen discrimination from the workers' perspective.

First, I developed and validated a new supergene genotyping method based on polymorphic insertion-deletion (indels) markers within the social supergene. These assays offer a reliable and adaptable alternative for determining colony social structure and facilitate future functional molecular experiments on candidate genes to explain queen discrimination behavior.

Second, I characterized the developmental change in the worker surface chemical profile during the first month of adulthood. While cuticular hydrocarbons (CHCs) showed complex developmental changes, piperidines (venom alkaloids) increased significantly over time and also displayed a social form difference in the proportion of saturated to unsaturated piperidine. Importantly, analyses of individual workers and venom sacs indicated that the saturated-to-unsaturated piperidines were influenced by social environment rather than by worker supergene genotype.

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Finally, I explored the feasibility of functional genetic manipulation in *S. invicta* through CRISPR-Cas9 mutagenesis and *piggyBac*-mediated transgenesis. We showed that knocking out *Gp-9* was not lethal during development, did not cause worker discrimination from wild-type, nor alter the surface chemical profile. *PiggyBac*-mediated transgenesis results demonstrated that this method is feasible in fire ants but also challenging.

Together, these results demonstrated that the social supergene plays a crucial role in maintaining social polymorphism in *S. invicta* while enabling phenotypic plasticity at the individual level. Therefore, chemical analysis and molecular tools used to study gene function, as presented in this thesis, added another important step in understanding queen discrimination behavior in fire ants.