Gulbenkian Institute *for* Molecular Medicine

Curricular Internship (BSc)

Start date: June 1st, 2026

Project duration: 4-6 months

Supervisors: Ana Barradas and Waldan Kwong

GIMM Lab: Waldan Kwong Lab

GIMM site: Oeiras

Project title: Multi-omics analysis of OMV-mediated host–microbiome interactions in the honey bee gut

Project synopsis:

Despite growing evidence linking the honey bee (Apis mellifera) gut microbiome to host development and physiological homeostasis, the molecular mechanisms underlying microbiome–host communication remain poorly understood. Notably, the role of protein-based signaling, particularly through bacterial outer membrane vesicles (OMVs), has received little attention. OMVs are increasingly recognized as important vehicles for delivering bioactive proteins from bacteria to host cells, yet their contribution to host cellular regulation in insects remains largely unexplored. This project aims to establish a novel framework to investigate OMV-mediated host–microbiome communication in the honey bee by integrating predictive in silico modeling with targeted experimental validation. Previous studies have demonstrated that the vertebrate gut microbiome produces a diverse array of functional molecules and that bacterial products can influence host physiology. Moreover, our own lab has characterized OMVs produced by the bee gut microbiota. Building on this, we hypothesize that OMV-associated proteins act as key effectors that interact with host molecular networks, modulating cellular signaling

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pathways involved in important functions. To address this, this project will combine OMV proteomic characterization with host transcriptomic profiling to identify candidate host–microbe interactions. These data will be integrated into a network biology framework to reconstruct cross-kingdom protein–protein interaction networks and infer downstream signaling pathways affected by OMV exposure. Candidate interactions and pathways will then be validated experimentally using RT-qPCR and confirmatory proteomics. By uncovering how microbial vesicle-associated proteins influence host cellular processes, this project will provide a deeper understanding of microbiome-driven regulation in the honey bee. More broadly, it will shed light on host–microbiome interactions with significant implications for honey bee health.

Application: Applications should include a current CV and a letter of motivation, and must be submitted by email directly to the Supervisor and Co-Supervisor by email: ana.barradas@gimm.pt ; waldan.kwong@gimm.pt