Master's degree in Biology – Chemistry-Biology Department

Master 2 internship project
Year 2021-2022

Laboratory/Institute: TIMC (CNRS UMR 5525-Université Grenoble Alpes).

Director: Alexandre Moreau-Gaudry
Team: TRanslational microbial Evolution & Engineering (TREE).
Head of the team: Prof. Dominique Schneider and Prof. Bertrand Toussaint
Name and status of the scientist in charge of the project: Béatrice Schaack and Corinne Mercier. **HDR:** yes
Address: Jean Roget Building, Health Campus, 38700 La Tronche
e-mail addresses: beatrice.schaack@ibs.fr; corinne.mercier@univ-grenoble-alpes.fr

Program of the Master's degree in Biology:

X Immunology, Microbiology, Infectious Diseases
☐ Physiology, Epigenetics, Differentiation, Cancer
X Structural Biology of Pathogens
☐ Neurosciences and Neurobiology

Title of the project: Evolution of the function and structure of extracellular vesicles during a long-term experiment with bacteria

Abstract (up to 10 lines): Many living organisms including bacteria produce extracellular vesicles involved in cell-cell communication and molecular transport. However, many of these vesicles' traits are still poorly characterized including their structure, function, regulation, and dynamics. We will use the long-term evolution experiment (LTEE) with *Escherichia coli* to study the dynamics and function of outer membrane vesicles (OMVs). The LTEE consists in 12 populations that are propagated since > 70,000 generations from a common *E. coli* ancestor in a glucose-limited environment. Our preliminary results have shown that 1/ OMVs are produced by both the ancestor and evolved clones over time; 2/ the biochemical traits of OMVs markedly differ between the ancestor and evolved clones sampled at 50,000 generations; 3/ the composition of the OMV membrane differs from that of the producing bacterial cells, suggesting a regulated secretion process. The goal is to investigate both the function of the different types of OMVs produced by the ancestor and evolved clones and their impact on bacterial evolution.

Objectives (up to 3 lines):

- Investigate the fusion capability of OMVs produced by the LTEE-derived strains with bacterial cells
- Investigate the type of information that is potentially exchanged between the LTEE strains via OMVs
- Investigate the properties of recipient cells upon integration of OMVs.

Methods (up to 3 lines):

Bacterial cultures, fluorescence assays, dynamic light scattering, high-performance thin layer chromatography, fluorescence activating cell sorting, microscopy (light, confocal, transmission electron microscopy), genome analyses, molecular cloning.

Up to 3 relevant publications of the team:

1/ Cell-free expression of the outer membrane protein OprF of *Pseudomonas aeruginosa* for vaccine purposes. Mayeux G, Gayet L, Liguori L, Odier M, Martin DK, Cortès S, **Schaack B**, Lenormand JL. Life Sci Alliance. 2021 May 10;4(6):e202000958.
2/ Physicochemical evidence that *Francisella* FupA and FupB proteins are porins. Siebert C, **Mercier C**, Martin DK, Renesto P, **Schaack B**. Int J Mol Sci. 2020 Jul 31;21(15):E5496.
3/ Mutator genomes decay, despite sustained fitness gains, in a long-term experiment with bacteria. Couce A, Caudwell LV, Feinauer C, Hindré T, Feugeas JP, Weigt M, Lenski RE, Schneider D, Tenaillon O. 2017. Proc Natl Acad Sci U S A. 114: E9026-E9035.

Requested domains of expertise (up to 5 keywords):

biochemistry, microbiology, cell biology, molecular biology, statistics