

DOTTORATO DI RICERCA IN BIOLOGIA CELLULARE E DELLO SVILUPPO

42° Cycle

Project proposal for a PhD scholarship

Secondary research line

Title of the research: Inflammation-driven microbial evolution and functional consequences on host interaction

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Summary

Chronic intestinal inflammation profoundly alters the gut ecosystem, yet the evolutionary responses of resident bacteria and their functional consequences for host interaction remain insufficiently understood. This PhD project aims to investigate how inflammatory environments drive adaptive mutations in *Escherichia coli* and how these mutations reshape bacterial stress resistance, metabolic behaviour, and host-cell interaction.

Building on a unique in vivo evolution model developed at the Max Planck Institute for Evolutionary Biology (MPI-EB), where *E. coli* strains evolved in inflamed murine guts, the project will focus on reconstructing inflammation-associated mutations in defined genetic backgrounds and assessing their phenotypic and molecular impact. Using genetic engineering, phenotypic assays, transcriptomics, and advanced in vitro infection models (including epithelial cells, macrophages, and organoids), the candidate will dissect the mechanistic basis of adaptation to inflammatory stressors such as bile salts and oxidative stress.

The project integrates evolutionary medicine with molecular microbiology and translational host–microbe interaction studies. By bridging murine-evolved strains with human-adapted isolates, it aims to identify traits that may enhance persistence, invasion, or survival under inflammatory conditions. The research will be conducted jointly between Sapienza University of Rome and MPI-EB, ensuring access to unique strain collections, sequencing facilities, and interdisciplinary expertise. The results are expected to clarify how inflammation shapes microbial evolution and to provide conceptual foundations for future microbiome-targeted therapeutic strategies.

Pertinent Publications of the proponent (last 5 years)

- Andreani NA*, Unterweger D*, Schreiber S, Baines JF. Evolutionary Medicine for Chronic Inflammatory Diseases of the Gut: More Than a Clinical Fantasy? *Gastroenterology*. 2025.
- Unni R*, Andreani NA*, Vallier M*, et al. Evolution of *E. coli* in a mouse model of inflammatory bowel disease leads to a disease-specific bacterial genotype and trade-offs with clinical relevance. *Gut Microbes*. 2023.