



Master project 2024-2025

Personal Information

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Project

Computational systems biology

Project Title:

The neuroactive potential of the human gut microbiome and its role in mental health

Keywords:

Microbiome, gut-brain axis, metagenomics

Summary:

The human gut microbiome plays a key role in maintaining our health. Through the microbiota-gut-brain axis (a bidirectional communication system between the gut microbiome and the brain) the microorganisms residing in our gut can influence mental health and well-being. One of the ways they do so is by metabolizing a wide range of neuroactive compounds (e.g. serotonin, GABA, or dopamine). Metagenomic sequencing provides insight into both species composition and their functional potential, but dedicated tools are crucial for gut-brain axis systematic analysis and interpretation. To this end, we assembled the first reference catalogue of neuroactivity of human gut microorganisms, which allowed us to perform the first population-level study on the link between the gut microbiome and quality of life and depression (Valles-Colomer et al, 2019). In addition, we found that a large fraction of the microbiome is transmitted through social contact (Valles-Colomer et al, 2023). While metagenomics is rapidly evolving, a wide diversity of the human microbiome remains unexplored, and their metabolic capabilities are understudied. However, they hold potential for development of therapeutic strategies such as probiotics. The aims of this project are 1) to expand the neuroactivity framework (gut-brain modules) to recently-described microbiota-derived compounds influencing mental health, 2) to assemble a reference catalogue of neuroactivity of so far uncharacterized members of the microbiome, and 3) to perform an association study between microbiome neuroactivity and mental health on a set of publicly-available and host lab datasets. The project will be carried out under supervision of Dr Mireia Valles-Colomer at the Microbiome Research Group (MELIS-UPF) in the PRBB, an international and multidisciplinary work environment with access to high-performance computing resources and cutting-edge data.

References:

Valles-Colomer, M. et al. The neuroactive potential of the human gut microbiota in quality of life and depression. *Nat. Microbiol.* (2019). doi:10.1038/s41564-018-0337-x. Valles-Colomer, M. et al. The person-to-person transmission landscape of the gut and oral microbiomes. *Nature* (2023). doi: 10.1038/s41586-022-05620-1.

Expected skills:

Familiarity with Python and R programming. Interest in working with metagenomic data.

Possibility of funding:

Yes

Possible continuity with PhD:

To be discussed