

PhD course: Food Science

Title: Development of functional foods with postbiotic and symbiotic properties for the modulation of the gut microbiome.

Tutor supervisor: Prof. Francesca De Filippis

Co-supervisor: Dr. Marco Pane (Probiotical SpA)

Objectives of the research project and interdisciplinary collaborations:

Post-biotics can be defined as inactivated microbial strains or growth media that exert a positive action on human health, despite the microorganism being dead or absent. Symbiotics are products in which beneficial microorganisms (probiotics) are provided in combination with prebiotics, mainly fibers, which promote the development of the microorganism and at the same time are a substrate that can be used by the intestinal microbiome.

This project will be carried out in collaboration with the company Probotical SpA (Novara, IT). The research activity will concern the optimization of formulations for the development of postbiotics and symbiotics. In particular, the activity will be divided into two tasks:

- i) Optimization of fermentation processes for the development of a postbiotic that exerts beneficial activities for the gut-brain axis. Using different combinations of microorganisms and raw materials, prototypes of postbiotic products with potential beneficial activity for the modulation of the gut-brain axis will be developed.
- ii) Optimization of symbiotic formulations (different combinations of strains of the *Bifidobacterium* spp. genus with oligosaccharides of various origins, including synthetic oligosaccharides that reproduce those of human milk) for the development of an infant product. Through comparative genomic analyses, the most promising strain/carbohydrate combinations will be identified and tested in vitro and in gastrointestinal models.

Innovation and originality of the project in relation to the state of the art:

The food and pharmaceutical industries are continuously searching for new microorganisms for the development of functional foods capable of promoting health directly or through modulation of the activity of the intestinal microbiome. While there are dozens of functional foods enriched with probiotics on the market, the use of postbiotics or symbiotic is still limited. Through fermentation, it is possible to exploit microbial metabolism for the production of metabolites beneficial to health, avoiding the administration of live microbial strains, which could be inadvisable for some categories of consumers (e.g. immunosuppressed), as well as reducing conservation problems and extending shelf-life. On the other hand, the combination of *Bifidobacterium* spp. with useful substrates for its metabolism, it favors the rooting and dominance of this microorganism in the intestinal microbiome of children, limiting the development of pathogens and promoting a situation of eubiosis.

Through a comparative genomics approach, it will be possible to identify the most interesting strains for specific use, identifying the presence of genes coding for the enzymes of interest and reducing the number of in vitro tests to be carried out to only the most promising microorganisms.

Funding availability (funding for the research activities):

- Project PRIN 2022 PNRR - HOLOGRAM - *Exploiting autochthonous microbial resources from traditional Italian fermented foods for gut-brain axis modulation*, granted by NextGenerationEU (P2022X8A9M).
- Project PNRR National Biodiversity Future Center (NBFC) – Spoke 6 (CN_00000033)
- Funding from Probiotical SpA

Collaboration with foreign institutions:

The PhD student will spend a period of 6 months at the Teagasc Food Research Centre, Moorepark, Fermoy (Ireland) supervised by Dr Olivia McAuliffe, in order to optimize the fermentation processes.

Collaboration with industry:

The PhD student will spend a period of 6 months at Probiotical SpA (Novara, IT), that is co-funding the PhD fellowship (DM 630).