

PhD Program: Food Science

Research Project Title: *Development of healthy, delicious and sustainable plant-based fermented products for gut microbiome modulation*

Supervisor: Prof. Francesca De Filippis

Co-supervisor: Dr Vincenzo Valentino

Reference Academic Discipline (SSD): AGRI-08/A (AGR16)

Research project objectives, methodologies, and interdisciplinary collaborations:

Plant-Based Products (PBPs) have emerged during the last years as sustainable alternatives, but face challenges in establishing on the market due to their organoleptic properties. In addition, they are usually deficient in some vitamins and contain antinutritional compounds. In this context, microbial fermentation is a powerful tool for the de novo creation of flavors and textures and can be exploited to increase the attractiveness of PBPs. The project will be developed in 3 phases:

Phase I-Optimization of microbial consortia for PBP development: Lactic Acid Bacteria (LAB) strains available from UNINA collections will be screened for the presence of desired traits. Analyses will involve phenotypic and genotypic screening. Genome-scale metabolic modelling will be applied to predict which metabolites may be produced by different strain combinations. INNOVAPROT, a company located in Apulia, will provide legume and cereal flours and protein extracts, and different strain combinations will be tested to optimize the production of PBP prototypes. At least 2 prototypes with different properties (1 yogurt-like and 1 beverage) will be developed and fully characterized.

Phase II – Characterization of the PB prototypes: Full characterization will include cytotoxicity and anti-inflammatory potential on intestinal model cells (Caco-2 and HT29) and on gut-on-a-chip model (in collaboration with Prof. R. Isticato, Dept. of Biology, UNINA), textural and sensorial analyses (in collaboration with Dr A. Tarrega, CSIC, Spain), Volatile Organic Compounds, presence of anti-nutritional compounds and vitamins (in collaboration with Prof. L. Oliveira, COFAC, Portugal), impact on gut microbiome and metabolome using a dynamic SHIME model.

Phase III – Clinical trial on elderly: A proof-of-concept clinical trial will be carried out to evaluate the nutritional and health effects of PBPs in elderly (≥ 60 years old). The study will be conducted in collaboration with Prof. P. Vitaglione (DiA, UNINA) and will assess whether the daily consumption of the best PB prototype improves micronutrient status (vitamin D, B12, folate, calcium), reduces inflammatory markers (IL-6, TNF- α), and modulates gut microbiome in vivo.

Innovation and/or originality of the project:

The project aims to leverage microbial genome metabolic modeling approaches to optimize the combination of strains in microbial consortia, to boost the production of metabolites with positive health effects and to modulate the sensorial properties. The product with the best characteristics will be tested in vivo.

Availability of funds: PRIMA-MICROSHIFT: *Microbiome-Driven Solutions to Enhance Sensorial and Nutritional properties of Plant-Based Foods and foster the dietary shift in the Mediterranean area*, co-funded by EU within PRIMA, Budget UNINA: 429.411€. PI: Francesca De Filippis. Start: 1/06/2026.

FIS2 – DOGMA: *Bridging food and gut microbiome: exploring the role of food microbes in the modulation of the gut microbiome and in the improvement of human health* (CUP E53C24003720001). Budget: 1.502.256 euro. PI: Francesca De Filippis

Availability of facilities: The PhD student will be provided with an individual workstation and a personal desktop computer in a shared office, and a shared laboratory workstation fully equipped for the necessary analyses.

Collaborations with International Institutions:

IATA-CSIC, Valencia, Spain (Dr A. Tarrega) for texture and sensorial analyses; COFAC, Lisbon, Portugal (Prof. L. Oliveira) for nutritional analyses and metabolomics; Istanbul Technical University, Istanbul, Turkey (Prof. F. Ortakci) for scale-up of PB prototypes production. It will be possible one or multiple research stays in these institutions participating to the project MICROSHIFT.

Collaborations with External Organizations (outside of UNINA): INNOVAPROT (<https://innovaprot.com>) will provide the PB flours and protein extracts for the development of the fermented PB products.