

CHEMICAL ENGINEERING

MUR DM 117/Probiotal - Emerging technologies for the continuous manufacturing of probiotic strains for the prevention of complex diseases

Funded By	PROBIOTAL RESEARCH S.r.l. [P.iva/CF:02504250032] MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584] Politecnico di TORINO [P.iva/CF:00518460019]
Supervisor	PISANO ROBERTO - roberto.pisano@polito.it
Contact	
Context of the research activity	<p>The present project aligns with Transition 4.0 and the National Recovery and Resilience Plan, supporting nutraceutical industry competitiveness. It aims to develop innovative continuous manufacturing technologies for probiotic strains, focusing on downstream processes. Specifically, low-temperature approaches, e.g., electrostatic spray-drying and spray freeze-drying will be investigated, taking advantage of the collaboration between Politecnico di Torino and an industrial partner. These continuous strategies accelerate new probiotic industrialization, adapting to market demands, and enhance biomedical research, transitioning from batch to continuous production, improving productivity, quality, and competitiveness. Furthermore, because of their modularity, these systems allow large-scale and small-scale production, supporting clinical studies and rare disease treatments.</p> <p>Progetto finanziato nell'ambito del PNRR - DM 117/2023 - CUP E14D23001980004</p>
	<p>This PhD project aims to develop innovative technologies for the continuous production of probiotic strains, with a specific focus on the downstream section and the drying process. Due to the thermolabile nature of these products, unconventional approaches will be employed to carry out the various operations at low temperatures. The final objective is to develop innovative technologies for drying probiotic strains, specifically investigating electrostatic spray drying and spray freeze-drying. In this field, the collaboration between the Politecnico di Torino and the industrial partner represents a suitable combination to meet the diverse demands of the project. Politecnico di Torino has already gained extensive experience in developing continuous processes for producing lyophilized drugs, including technologies for bulk production of active ingredients via spray drying and</p>

Objectives	<p>freeze-drying. In this project, the focus will be on the development of a process that integrates these two technologies for the continuous production of probiotic strains.</p> <p>Within this doctoral project, the issue of in-line monitoring and control, which is necessary for the continuous operation of the aforementioned process, will also be addressed. These activities align with the new Transition 4.0 plan and, more generally, with the first mission of the National Recovery and Resilience Plan, "Digitalization, innovation, competitiveness, culture, and tourism," which aims to improve the competitiveness of industrial sectors, including the nutraceutical sector, which is considered strategic for the Italian economy. In fact, the Italian nutraceutical industry holds a leadership position in Europe, accounting for 25% of the continent's turnover. Despite the economic crisis, the sector has witnessed an annual growth rate of 4.3%, and in 2021, the global turnover of nutraceutical products reached \$210 billion. Therefore, it is one of the fastest-growing sectors in the country.</p> <p>This project also responds to the demands of the sixth mission of the National Recovery and Resilience Plan, "Health: training, scientific research, and technology transfer," particularly to investment line 2.1, "Enhancement and strengthening of biomedical research within the National Health Service (SSN)." The continuous technology under study will be applied to the production of high-value probiotic strains in the portfolio of the industrial partner. These products pave the way for new prevention strategies, addressing a wide range of applications such as skin health and cardiovascular health. However, these products are unstable in liquid form and/or at room temperature and, therefore, need to be stabilized, for example, through freeze-drying. In this context, this doctoral research project would contribute to the transition of the production sector from batch technologies to continuous strategies, enhancing the productivity of probiotic strain facilities and the quality of finished products, strengthening their competitiveness with other actors in the international scenario. The modularity and flexibility of continuous plants would also lend themselves to both large-scale productions and small-scale productions in support of clinical studies or the production of therapeutic agents for the treatment of rare diseases. The investigated continuous production systems would also accelerate the industrialization phases of new probiotics, reducing the time lag between discovery and market introduction of new products, while also adapting to sudden market demand variations for existing probiotics.</p>
Skills and competencies for the development of the activity	<p>The candidates should possess strong analytical and problem-solving skills. They need a solid foundation in biotechnology, chemistry, and engineering principles. Proficiency in data analysis is essential. Excellent communication and technical writing skills are necessary for publishing research findings. Collaboration, adaptability, and a curiosity for innovation are important traits for success in this field.</p>