

PAT-Driven Bioprocess Development for Sustainable Food Systems and Circular Bioeconomy Materials

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The transition to sustainable food and biomaterial production requires data-driven approaches to optimise complex bioprocesses. This talk discusses the use of Process Analytical Technologies (PAT) and digital twins to enable efficient development, monitoring, and optimisation of bioprocesses. Discussions include the valorisation of food co-products, such as brewer's spent grain for lactic acid production, and the development of functional food ingredients. By integrating design of experiments, real-time sensing, and predictive modelling, improved process performance and product consistency are achieved. This work highlights how PAT enables more sustainable, scalable, and robust bioprocessing solutions.



Dr. Brian Freeland is an Associate Professor of Bioprocess Engineering at Dublin City University and Head of the Microbial Bioprocessing Facility. His work centres on the application of Process Analytical Technologies (PAT), real-time monitoring, and digital-twin methodologies to optimise complex bioprocesses, including microbial fermentation and nanoparticle synthesis. With over €4.5 million in research funding, he has a strong track record in translating advanced process control strategies into industrial applications across the food, biopharma, and bioeconomy sectors. He currently leads the SERKEL.bio project and co-leads Grain-4-Lab, advancing sustainable bioprocessing solutions from waste-derived feedstocks.