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Sustainable Bioprocessing in Food Manufacturing: Improving Process Efficiency and Environmental Performance

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ABSTRACT

Sustainable bioprocessing plays an increasingly important role in addressing waste generation within the food manufacturing sector. A major focus of this approach is the valorisation of food processing waste, where organic by products that are traditionally discarded can be converted into value added products such as bioactive compounds, animal feed ingredients, and bioenergy. These conversions are achieved through microbial and enzymatic pathways, supporting circular economy principles by reducing landfill disposal and improving overall resource utilisation. In parallel, optimised bioprocess design can enhance water and energy efficiency, leading to lower operating costs and reduced greenhouse gas emissions.

Despite these advantages several challenges limit the widespread industrial adoption of sustainable bioprocessing. Key issues include process scalability, economic feasibility, and compliance with regulatory and food safety requirements. Effective process control, robust quality assurance systems, and adherence to established safety standards are

essential to ensure consistent product quality and protect consumer health.

This work highlights the potential of sustainable bioprocessing as a practical strategy for improving the environmental performance of food manufacturing. By integrating engineering design principles with biological processing technologies, the food industry can reduce waste, improve process efficiency, and move towards more sustainable production systems. The outcomes discussed align with the objectives of Chemeca 2026 and emphasise the role of bioprocessing as a key driver of innovation in the food and beverage sector.

KEY WORDS

Bioprocessing, Food Processing, Fermentation, Sustainability, Waste Valorisation, Circular Economy

BIOGRAPHY

Cyril Cecil is an undergraduate student pursuing a Bachelor of Technology in Food Process Engineering. His academic interests focus on bioprocessing, sustainable food manufacturing, and the application of fermentation and enzymatic technologies in food systems. He has gained experience through engineering coursework and project based learning related to process optimisation and sustainability. Cyril is particularly interested in food waste valorisation and improving resource efficiency in food production. He aspires to pursue a career in food science and bioprocess engineering, contributing to the development of innovative and environmentally responsible food processing technologies.

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