

Abstract

Unlocking Bioethanol Production Potential: A Computational Exploration of Agri-Food Waste Valorization in Circular Bioeconomy Using Metagenomic Mining and Process Prediction Tools [†]

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In the pursuit of a sustainable approach to agri-food waste valorization, this paper delves into the realm of computational techniques to enhance our understanding and harness the potential for bioethanol production in a circular bioeconomy. Leveraging the power of metagenomic mining, we employed MG-RAST open-source web application server and MetaPhlAn 4.1 to unravel the functional and taxonomic intricacies of environmental microbial communities, shedding light on their roles in waste conversion. Complementing this exploration, we delved into the predictive realm with process prediction tools. Pathway Tools emerges as a key player, utilizing genomic information to forecast metabolic pathways and providing valuable insights into the metabolic potential of microorganisms involved in the waste valorization process. The RAVEN 2.0 Toolbox joins the ensemble, offering a robust platform for the reconstruction and analysis of genome-scale metabolic models, further enhancing our ability to predict and optimize bioethanol production.

In conclusion, our exploration of the sustainable valorization of agri-food waste for bioethanol production within the circular bioeconomy has been significantly enriched by the integration of cutting-edge computational tools. As we chart the course towards a circular bioeconomy, these computational tools emerge as indispensable allies, offering a data-driven and systematic approach to address the challenges of agri-food waste valorization. The convergence of metagenomic insights and predictive modeling marks a paradigm shift in our ability to harness the untapped potential of waste streams for bioethanol production, contributing to a more sustainable and eco-friendly future.

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