frontiers | Frontiers in Chemical Engineering

TYPE Editorial
PUBLISHED 30 January 2025
DOI 10.3389/fceng.2025.1545573

OPEN ACCESS

EDITED BY
Fengqi You,
Cornell University, United States

REVIEWED BY
Madan L. Verma,
Indian Institute of Information Technology, Una, India
Olatunde Dahunsi,
Bowen University, Nigeria

*CORRESPONDENCE
Antoni Sánchez,
antoni.sanchez@uab.cat

RECEIVED 15 December 2024
ACCEPTED 17 January 2025
PUBLISHED 30 January 2025

CITATION
Sánchez A (2025) Editorial: Biorefineries: current configurations, sustainability and economy.
Front. Chem. Eng. 7:1545573.
doi: 10.3389/fceng.2025.1545573

Editorial: Biorefineries: current configurations, sustainability and economy

Antoni Sánchez*

Department of Chemical, Biological and Environmental Engineering, Universitat Autònoma de Barcelona, Barcelona, Spain

KEYWORDS

organic waste, bioproduct, bioenergy, anaerobic digestion, biogas, solid-state fermentation

Editorial on the Research Topic
Biorefineries: current configurations, sustainability and economy

The objective of this Research Topic was to collect high quality contributions related to the development of biorefineries, regarding both its global concept and the operations that constitute the entire facilities. Among the papers published, we can found original research papers, reviews and perspective papers on different issues showing the last advances in this topic from the point of view of Environmental Chemical Engineering.

In an overall framework of Circular Bioeconomy, a concept that addresses critical global challenges, including climate change and resource depletion, aligning with the United Nations' Sustainable Development Goals (Mesa et al., 2024), biorefineries have gained a prominent role. In the early 2000s, it occurred the first transition from end-of-pipe waste disposal technologies (such as landfill or incineration) to biological treatments with the aim to recover sources from waste as renewable energy (biogas from anaerobic digestion) and new materials (recycled products and compost). Today, waste treatment plants are moving towards complex facilities, called biorefineries, which can provide a wide range of bioproducts and bioenergy, using raw organic waste as feedstock and thus substituting fossil fuels and non-renewable materials.

The current and future development of biorefineries involves the use of new and existing technologies working in a synergistic way to maximize the production of bioenergy and bioproducts. The interaction and close relationship between well-consolidated processes such as anaerobic digestion with an emerging biotechnology for organic waste as solid-state fermentation is the main topic of one of the papers published: Artola et al. This study explores the combination of technologies, which is in the fundamentals of the biorefinery's concept. Similarly, another original paper of the Research Topic: Bühlmann et al. explores the integration between anaerobic digestion and lactic acid fermentation by highlighting two of the main challenges that can be found for the implementation of biorefineries: economic viability and a difficult downstream of certain bioproducts to be marketable. These are, by far, the main obstacles to progress in this topic and make its commercial implementation attractive (Calvo-Flores and Martin-Martinez, 2022). In the field of biofuels, another original paper (Whistance et al.) emphasises the importance of having locally available renewable energy sources for the achievement of some Sustainable Development Goals. In this sense, the boost of anaerobic digestion is completely aligned with this trend (Kusch-Brandt et al., 2023).

Alternative routes for obtaining renewable energy from organic waste are the topic of the other two papers included in this Research Topic. They are related to cellulose, which is the most abundant organic polymer on Earth, where is typically found in the form of lignocellulosic biomass. The hydrolysis of this type of biomass results in simple sugars that can be easily transformed into ethanol through fermentation processes, becoming a clean and renewable source of energy. However, this hydrolysis is not straightforward, and a high number of works of recent research have been focused on finding environmentally friendly and low cost technologies to overcome the challenges that this hydrolytic process (Zoghlami and Paës, 2019). In this framework, the first paper (García-Negrón et al.) explores the use of alkaline pre-treatments and enzymatic hydrolysis for sweet sorghum bagasse biomass with an increase of sugar recovery. In the second paper (Park et al.), the authors use an innovative approach by evaluating chitosan-coated enzyme magnetic nanoparticles for cellulose hydrolysis, with excellent results in the reuse of this catalyst after 20 cycles.

In summary, and in a current situation of scarcity of raw materials and energy, the use of organic waste in complex scenarios to maximize its benefits has a promising future, as well as it poses a challenge to scientists and engineers, who have a wide range of technologies and biotechnologies to be used in novel biorefineries.

Author contributions

AS: Writing–original draft, Writing–review and editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Publisher's note

References

Calvo-Flores, F. G., and Martin-Martinez, F. J. (2022). Biorefineries: achievements and challenges for a bio-based economy. *Front. Chem.* 10, 973417. doi:10.3389/fchem.2022.973417

Kusch-Brandt, S., Heaven, S., and Banks, C. J. (2023). Unlocking the Full potential: new Frontiers in anaerobic digestion (AD) processes. *Processes* 11, 1669. doi:10.3390/pr11061669

Mesa, J. A., Sierra-Fontalvo, L., Ortegon, K., and Gonzalez-Quiroga, A. (2024). Advancing circular bioeconomy: a critical review and assessment of indicators. *Sustain. Prod. Consum.* 46, 324–342. doi:10.1016/j.spc.2024.03.006

Zoghlami, A., and Paës, G. (2019). Lignocellulosic biomass: understanding recalcitrance and predicting hydrolysis. *Front. Chem.* 7, 874. doi:10.3389/fchem.2019.00874