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Editorial: Advances in the sustainable production of biofuels and bioderivatives

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Editorial on the Research Topic
Advances in the sustainable production of biofuels and bioderivatives

Introduction

Carbon dioxide (CO_2), the most impactful molecule in nature is an unamicable impact of utilization of fossil reserves. Amplified CO_2 generation results in increased surface temperature having a share of 30% in global warming (Raheem et al., 2022).

Biomass is an augmented source of convertible sugars with the potential to reshape the world's energy mix. Biomass being the source of energy and chemicals is available globally regardless of any social, political, or economic conflicts (Sajid et al., 2022). It has shortened period of availability as compared to fossil reserves. A flexible choice, gasification technology effectively transforms biomass into syngas while minimizing harmful environmental effects (Radenahmad et al., 2020). Particularly for agricultural communities, biomass has emerged as a very attractive alternative to fossil fuels, and it ranks as the third most important energy source with multiple conversion routes (Figure 1) (Paone et al., 2020). Increasing the contribution of biomass to the energy mix (biofuels, biogas, and many other derivatives) can improve the carbon cycle along with employment opportunities which inturn will raise the living standard for individuals working in the biomass production and technology development industries. Currently, biomass conversion is a highly researched topic and this Research Topic was designed to summarize the latest progress to address the SDG 13 (climate action) and SDG 15 (life on land) (United Nations, 2015). The articles published in this Research Topic are summarized below.

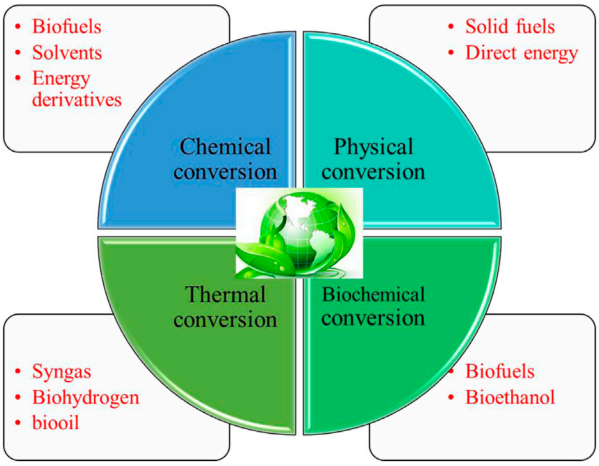

FIGURE 1
Conversion of biomass to biofuels and bioderivatives.

Highlights from articles featured in this Research Topic

Alrawashdeh et al. developed the sustainable production of biogas employing chicken waste and wastewater as feedstock. The process was optimized using iron oxide nanoparticles (IONPs) as the catalyst during anaerobic co-digestion of chicken manure and wastewater from the olive mill. The process optimized the biogas yield by navigating the methane content, total solids (TS) and volatile solids (VS) removal efficiency, and acidic hydrolysis in a mesophilic environment. The results showed that supplementing the anaerobic co-digestion by feeding 20 mg of IONPs per gram of VS had an inhibitory effect on biogas and methane production, as well as hydrolysis. On the other hand, adding 20–30 mg of IONPs per kg of VS improved the process. Results illuminated that the CH_4 yield improved to 4.2% and hydrolysis to 15.1% from 1.3% to 7.20%, respectively. The maximum acidification can be achieved with moderate catalyst loading (20–30 mg/g VS). The study suggests that supplementing the anaerobic co-digestion process with specific concentrations of IONPs significantly enhances inhibitor removal efficiency potentially due to the increased active surface, availability of active sites, and synergetic effects.

Chettri et al. comprehensively summarized the advances in the exploitation of Carbohydrate Active Enzymes (CAZyme) for effective lignocellulosic biomass saccharification as well as the production of various biofuels. The gut of herbivorous animals is an efficient source of microorganisms that can be employed as active species during hydrolytic activities. These microorganisms produce convertible sugars by consuming lignocellulosic biomass. In addition, the carnivore's microbiomes have a special quality to rupture proteins. Interestingly, the gut of Omnivores has bacteria that can produce CAZymes. Although, the process is much more effective; the major concern lies in the process economics and durability of the enzymatic process. The review briefly discussed the concerns and opportunities in this production scheme. Mass utilization of CAZymes, limited availability, production cost, and selectivity are major concerns that have limited the enzymatic production of biofuels from LCB resources.

Ali et al. summarized the potential of various biomass feedstocks to produce renewable energy that can combat climate change and support sustainable development. The four major crops that produce a substantial amount of residue, totaling 112.1 million tons annually, are wheat, rice, sugarcane, and maize. Gasification is a more selective process for biomass conversion into syngas (i.e., methane, carbon dioxide, carbon monoxide, and hydrogen) via oxidation, reduction, pyrolysis, cracking, and drying. The addition of O_2 and/or air increased the gasification temperatures between 700°C and 1,000°C. Pakistan is the 11th largest producer of paddy rice worldwide with a yield of 10 million tons. Hence, Pakistan's potential to generate energy from biomass resources is very high which has not been completely realized due to several factors, including a lack of infrastructure, high capital costs, lack of technology, uncertainty regarding the availability of feedstock, and a lack of government assistance. Only 0.6% of Pakistan's total energy production in 2019 was biomass-based, according to the Pakistan Renewable Energy and Energy Efficiency Status Report 2020. Various measures including infrastructure improvement for the collecting and storage of biomass, assisting in research and development to advance the technology used, and offering incentives for private sector involvement in the industry can shift the energy production scenario.

Alvarado-Ramírez et al. summarized the current scenario and perspective of aquaculture and marine waste for the sustainable production of bioderivatives. The seafood industry is growing rapidly and has already reached 178 MMT (million metric tons) in 2020 of which 49% is through aquaculture. This industry is expanding heavily and still facing ignorance by researchers for waste management. This ignorance is contributing to environmental pollution as well as a waste of convertible resources. The establishment of waste-to-energy processes specifically for aquaculture wastewater can produce plenty of bioderivaties and biofuels. This addition can flourish the scope of the blue economy.

Concluding remarks and future perspectives

The studies contributed by authors from different regions elaborated on the latest progress in biomass conversion technologies. These articles helped to understand the current scenario and future perspectives on the sustainable conversion of biomass. However, still, there are some challenges faced by the bioenergy domain. Alrawashdeh et al. suggested the incorporation of nanoparticles can improve the biogas yield from chicken manure. Furthermore, the co-utilization of papermill wastewater can further improve the process yield along with the mitigation of pollution impact. Chettri et al. suggested the utilization of engineered CAZymes in biomass conversion schemes can improve product selectivity as well as environmental friendliness. Ali et al. suggested that gasification technology is an integrated solution for biomass conversion to syngas. Alvarado-Ramírez et al. highlighted the concerns faced by the aquaculture industry and marine waste management. The development of a scientific waste management proposal can utilize the potential of aqua waste as bio-feedstock.

Author contributions

MS drafted the manuscript and all the co-authors reviewed, edited, and approved the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors AR, JA-P, and MS 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.

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