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Optimizing Sustainability Through Environmentally Friendly Metabolic Engineering

Jamil Hassan*

Department of Industrial Engineering, IIT Kanpur, Kanpur, Uttar Pradesh,India

Description

With estimated stable economic growth, industrial biotechnology is one of the most innovative and labor-productive industries, allowing for the expansion of existing value chains and their improvement. In addition, biotechnology clearly outperforms the chemical industry in terms of its impact on the environment. However, the societal aspects of biotechnology are frequently overlooked, and the contribution that biotechnology makes to the environment is sometimes viewed with controversy. As we learn more about the complicated and interconnected effects of various human activities, the sustainability of various bioprocesses on society, the economy, and the environment takes on an ever-increasing significance. In the process of developing novel solutions, ignoring sustainability issues may result in suboptimal biotechnological production, resulting in negative environmental and societal issues proportional to production volumes.

The sustainable metabolic engineering (SME) concept, which can be derived from the metabolic characteristics of the exploited organism, is proposed in the paper to evaluate and maximize the sustainability of biotechnological production. Optimization of metabolism is the SME concept, which takes into account economic, environmental, and societal sustainability parameters for all incoming and outgoing fluxes and produced biomass of the organisms being used. The biotechnological production design can be improved right from the start thanks to the addition of sustainability estimation to the defining characteristics of strains created using metabolic engineering techniques.

Chemicals, energy, materials, food, and other products have been produced in new ways thanks to industrial biotechnology. The use of renewable bioresources rather than non-renewable petroleum-based resources is one clear environmental advantage of biotechnology over the chemical industry. 2) Producing biodegradable goods as opposed to nondegradable and/or nonrecyclable goods; 3) avoiding toxic industrial gases and waste, among other things. Nevertheless, the environmental benefit of biotechnology is occasionally regarded with controversy. Biomass is used in biotechnology as the fermentation feedstock, assuming that it is renewable and carbon-neutral. However, in order to assess the total environmental burden, it is necessary to take into consideration the resource inputs that are required to obtain and process the biomass feedstock, particularly in its pure form (such as glucose), for its use in the biotechnological production process. The conflict between growing food and maintaining biodiverse forests, which act as a global carbon sink, and growing biomass for fuel or chemical feedstock production is another topic of discussion.

By value added, the expanding biotechnology sector is one of the bioeconomy's most innovative and labor-productive sectors. The bioeconomy has gained traction as a force behind environmentally conscious and smart growth. In the bioeconomy sector, more than 40 nations are investing and promoting strategies and policies. More than 417 thousand people were employed in the production of bio-based chemicals, pharmaceuticals, plastics, rubber, and liquid biofuels in the EU's bio economy sector in 2017, which generated 63,528 million euros in value-added, or roughly 10% of the bioeconomy sector's total value-added. With climate neutrality, the bioeconomy, the circular economy, sustainable development, and bioeconomy high on the international agenda, it is anticipated that the creation of "green jobs" and revenue based on innovative biotechnological solutions will be further actively promoted. Biotechnological solutions will expand in size and number as a result of this agenda. In the process of developing novel solutions, it could result in suboptimal biotechnological production, resulting in negative environmental and societal issues proportional to the volume of production. Due to the growing pressure from society and the government to reduce environmental impact on ecosystems, human health, and resource availability, it is anticipated that a comprehensive economic, environmental, and societal sustainability assessment and optimization of a biotechnological process will soon become the industry standard.

The UN's Sustainable Development Goals are prominently displayed, giving priority to the research directions that are required for a sustainable future. Even though researchers agree on a common definition of sustainability, seventeen interconnected goals cover agriculture, climate change, industry, innovations, and other sectors, and bioindustry has a role to play. However, sustainability remains a contentious topic. The aim, boundaries, and stakeholder participation in the evaluation all play a role in how various sustainability aspects are evaluated. This leads to a lack of consensus among stakeholders regarding the means by which sustainability can be achieved and the sustainable development goals can be implemented. In the context of industrial biotechnology, sustainability can be defined as optimizing the economic, environmental, and social benefits of production through the effective use of renewable resources, the avoidance of toxic substances, the elimination of gaseous, liquid, or solid waste generation, and compliance with ethical standards in order to produce profitable bio-based products. [1-5].

Acknowledgement

The sustainability of different bioprocesses becomes increasingly important parameter due to the growing understanding about consequences of different human activities. The intention of EU and other regions is to develop stimulating mechanisms to facilitate implementation of industrial sustainability. That is the point where sustainability shifts business models and impacts profit along with classic parameters of bioprocess as yield and productivity and others making the assessment of competitiveness of a particular solution even more complicated.

Conflict of Interest

The Author declares there is no conflict of interest associated with this manuscript.

***Address for Correspondence:** Jamil Hassan, Department of Industrial Engineering, IIT Kanpur, Kanpur, Uttar Pradesh, India, E-mail: jamilhassan345@edu.in*

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