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Petrochemicals and Microbial Processes: In Search of Safe Alternative

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Abstract

Microbial cells as factories can offer exciting and energetically viable option to meet the increased demand of alternate methods which can minimize usage of petrochemicals. Microbial processes, however, pose challenges of process optimization which are being explored globally by employing development and advances in microbiological methods and interdisciplinary coalition of mathematical, chemical and physical sciences; but undoubtedly it can provide economic and efficient alternate to petrochemicals for safer and cleaner environment.

Keywords: Petrochemicals; Microbial Processes; Biofuels; Fermentation; Microbial Fuel cells

Introduction

Petrochemicals are extensively used organic compounds which have wide application in most of the industries as fuel, industrial intermediates, and processed products and contribute as major driver of global economy. With ever increasing globalization and industrialization during the last two decades, various environmental challenges have emerged which can be largely implicated to the inadvertent use of petrochemicals. The alternate methods and processes are urgently needed that can replace either petrochemical based methods at industrial scale or can even replace the petrochemical products like fuel and chemical intermediates. The major challenge for the policy makers, industry and the scientific community is to thoroughly look for sequential development of processes which can substitute and divest usage of petrochemicals leading to safer and cleaner environment. In recent times, the field of microbial technology has emerged as a boon for replacing most of the petrochemical products, mostly due to scientific and technical advancements in area of chemical and physical engineering. The microbiological sciences as an interdisciplinary research has paved the way for the development of biofuels, bimolecular, and green chemistry based microbial methods and bio-based products to resolve this issue

The central idea of microbial technology is utilizing the microbial cellular machinery and harvest the biochemical and physiological process for product development. As most of the metabolic processes are thermodynamically viable; replicating and engineering those metabolic pathways in microbial systems for development of products holds significance. The bio-prospection of microbes from the environmental sources like soil and water has been elemental in finding environmentally safe and healthy alternatives to almost every challenge. From antibiotics to synthesizing bioplastics, from producing biosurfactans to developing microbial fuel cells, from making biofuels to efficient oil recovery from petroleum refinery reservoirs, from cleaning soil /water contaminated with polyaromatic hydrocarbons (PAHs) and organo chlorines (OCs) to synthesis of fine chemicals; microbes have served the human need and environmental issues to the safest and highest concordance.

With advancement in computational biology and bio-informatics applications, the major contribution of microbes in our day to day life has become clearer than before as data analysis of met genomes and genomes has provided extensive predictions and understanding of ecology and environment related issues. The mining of soil meta-genome for the discovery for industrial enzymes like proteases, amylases, cellulases among others hold significance as they are main stay for microbial catalytic process which generate petrochemical equivalents and other microbial enzymes like dehydrogenases, oxygenases, hydrolases which catalyses methods for synthesis of industrial intermediates and fine chemicals.

Another major application of microbial process which can circumvent petrochemical usage involves solid waste treatment for generation of biofuels which has fascinated the biotechnology research for past two decades. Due to ever increasing demand of fuel globally, besides solar and nuclear energy as a substitute, microbial reactions based on carbohydrate processing enzymes that utilize lignocellulosic waste, and starch and sugar content of waste via fermentation process to produce bioethanol has successfully been used as alternate fuels in recent times. Also, biochemical fuel cells including hydrogen fuel cells employing bacteria catalysed reactions are being thoroughly investigated worldwide for replacing chemicals for waste treatment and sustainable development. Various microbial processes based on dark fermentation, fermentative hydrogen production, photo fermentation, electrohydrogenesis, electro ethnogenesis are being explored for production of energy through microbial fuel cells and for biofuels production.

Conclusion

The wide applications of microbe based methods which are being employed to minimize excessive usage of petrochemicals are described. A microbial process offers alternate technological advancements as environmentally safe, clean and sustainable methods.

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