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Current Trends in Biogenic Gas and Wastewater Fermentation

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Introduction

Traditional substrate (like carbohydrates) fermentation processes have happened spontaneously in the environment for generations. Examples include the formation of biogas and methane as a result of the biodegradation of organic materials. Humans have long benefited from the ability of microorganisms to generate specialised foods and beverages with enhanced preservation capabilities through fermentation, such as beer, wine, and sauerkraut. The research on valorizing biogenic gases, wastes, or wastewaters to bioconvert their fermentable substrates content into useful biofuels or bioproducts has just lately, since a few decades ago, as a result of increased concern about environmental issues [1]. This enables the creation of valuable items while also solving an environmental issue. In addition to the aforementioned pollutants, sustainable and renewable feedstocks, mostly biomass, have been seen as intriguing substrates for their bioconversion into biobased fuels and goods.

About the Study

Treatments of water and wastewater as well as its later valuation have been explored for many years. Wastewater is likely the source that has been the subject of the most research out of all the numerous types of the most frequent pollutants (such as water, solid waste, gas, and greenhouse gas emissions). Recent trends have shifted the focus away from developing and improving wastewater treatment systems and toward turning soluble pollutants into useful goods that have both environmental and financial benefits. Polluted water and wastewaters may be effectively treated to provide pure water that can be reused and enable the recovery of resources like nutrients or bioproducts. Making fatty acids and later turning them into biopolymers like polyhydroxyalkanoates and other potential metabolites is a recent technique in this sector [2].

In addition to water and solid waste, waste gases are the primary source of pollutants of concern. Because of their impact on climate change, greenhouse gases have gained significant attention in recent years. This primarily applies to CO_2, as well as related gases like CO and H_2. While syngas and other industrial gas emissions, such as those from the steel industry, frequently contain combinations of CO_2, CO, and H_2, the biological removal of carbon dioxide normally requires the presence of hydrogen. Through anaerobic fermentation using acetogenic bacteria, such gases can also be treated and valorized to yield carboxylic acids, ethanol, or higher alcohols, among other things [3,4].Waste and wastewater can both be created short- and medium-chain carboxylic acids, which can subsequently be transformed into biopolymers. On the other hand, through the carboxylate platform, lipids or microbial oils for the synthesis of biofuels (like biodiesel) can also be byproducts from gases like CO and CO_2. Another option is to create biomethane by the biomethanation of CO or CO_2, which is typically researched using mixed or co-cultures. Methane can be utilised as a biofuel even though it is a greenhouse gas, unlike carbon dioxide.

Other authors have also covered the aerobic bioconversion of greenhouse gases like CO_2, in addition to their anaerobic fermentation. The facultative chemolithoautotroph species Cupriavidus necator is the organism that has received the most research in this instance [5]. It has mostly been investigated in relation to the manufacture of biopolymers, such as polyhydroxyalkanoates (PHA). Although it has recently been demonstrated that it can grow in mixotrophic environments using CO_2 and volatile fatty acids as carbon sources, it typically requires the presence of hydrogen. In contrast to heterotrophic or mixotrophic growth circumstances, hydrogen was found to increase PHA synthesis under mixotrophic growth and in the presence of this extra energy source.

Conclusion

One of the key objectives for industrial-scale use in the field of waste valorization using fermentative routes is to establish a high level of quality control to ensure that the produced conversion products meet all requirements and product standards. In addition to the techno-economics of the process, it is important to take into account the product's compatibility with the existing infrastructure components, such as storage, transportation, and distribution, in order to adhere to the rules and regulations set forth by local authorities.

Conflicts of Interest

The authors declare no conflict of interest.

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