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Perspective

Management of Waste Material in Bioconversion Procedure using Invertebrates

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ABOUT THE STUDY

Bioconversion, additionally referred to as biotransformation, is the biological process or agent that converts organic resources, such as animal or plant waste, into useable goods or energy sources. One example is the commercial manufacturing of cortisone, in which rhizopus nigricans bioconverts progesterone to 11-alpha-hydroxyprogesterone. A further instance is the biological conversion of glycerol to propanediol, which has been studied for decades.

When compared to chemical synthetic reactions, bioconversions are typically low productivity processes. This disadvantage is linked to the low solubility of many organic substrates in aqueous solutions, as well as inhibition phenomena towards biocatalysts, which necessitates the use of bioconversion media with low substrate and product concentrations.

A bioconversion's productivity can be maximized if it is performed in the presence of substrate/product concentrations at which the biocatalyst exhibits optimum activity and stability. One approach is to create a method that involves continuous addition of the substrate and selective removal of the product. For example, by combining liquid/liquid extraction and membrane permeation, an effective extractive microbial bioconversion can be established. Solvent extraction takes advantage of differences in component partitioning between two immiscible solvents, while inserting a suitable membrane stops contact between the biocatalyst and the extractant.

A freshly isolated Gluconobacter oxydans strain has recently been reported to oxidise isoamyl alcohol to isovaleraldehyde. In batch mode, high conversion yields (>90%) and good rates (maximum yield after 90 minutes) were achieved. Although aldehyde dehydrogenase(s) leading to acid formation are present in this strain, further oxidation of the aldehyde to acid is considerably slower, allowing for transient accumulation of the aldehyde. These findings were satisfactory, but relatively low substrate concentrations (5g L-1) were used because higher concentrations inhibited microorganism activity due to substrate inhibition. Evaporation also lost a substantial amount of the aldehyde due to its high volatility. The output of this bioconversion can be increased by establishing a continuous process with substrate addition at an appropriate flow rate.

Nonetheless, *in situ* removal of the aldehyde is critical not only to prevent acid production but also to reduce product evaporation. The goal of this research was to evaluate a membrane-based extractive procedure for *in situ*, non-dispersive aldehyde recovery. The constant extractive bioconversion was carried out in a hydrophobic hollow fiber membrane reactor.

Bioconversion of solid organic wastes into value-added products is a viable and low-cost waste management alternative. Solid organic wastes comprising contaminants, such as biosolids, animal manures, food wastes, and crop residues, pose a challenge to the biological decomposition process and the environmental safety of the resulting compost. Insect larvae have recently emerged as a viable method for decomposing hazardous organic residues, including plastic waste.

We investigate and contrast the impacts of vermicomposting and insect-based bioconversion on heavy metal removal, legacy and emerging organic pollutants, and pathogens, including antibiotic-resistant genes. The ultimate goal of using vermicomposting and insect-based bioconversion as bioeconomy alternatives for hazardous organic waste management is to produce pollutant-free or nontoxic composts. In addition, the incorporation of biochar (carbonaceous material produced by the pyrolysis of biomass) into these biotransformation processes accelerates the decomposition of organic matter and enhances the quality of the resulting carbonaceous-rich composts as fertilizers.

Both biotechnologies are thought to be nature-based remedies for at least three major soil threats: soil organic matter decline, contamination, and soil biodiversity loss.

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