Progress in liquid biofuel and biohydrogen from agro-industrial wastes by clostridia

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Abstract:

The increase in prices of petroleum based fuels, future depletion of worldwide petroleum reserves and environmental policies to reduce CO2 emissions have stimulated research into the development of biotechnology to produce chemicals and fuels from renewable resources. The most commonly used metabolically derived biofuels are hydrogen, acetone, butanol and ethanol. Biofuel is produced biologically from renewable biomass by Clostridium spp. under strictly anaerobic condition. Substrate costs can make up to about 63% of the total cost of biofuel production. This is not because of the expense of the substrate itself, but mainly because of the low efficiency of Clostridium to convert substrate into biofuel, i.e. the yield of biofuel is often low, and this together with the formation of by-products leads to a high cost for butanol recovery. In addition, the maintenance of strict anaerobic conditions for Clostridium requires special conditions e.g. addition of costly reducing agents, and flushing with N2 gas, which increase the cost of the fermentation process. Hence, substrates such as agricultural residues, including wheat straw, barley straw, maize stover, wood hydrolysate, and switchgrass as well as dairy industry waste offer potential alternatives. To reduce the costs of producing hydrogen and ABE from fermentation, include using a low cost fermentation substrate and/or optimizing the fermentation conditions to improve the efficiency of converting substrate to biofuel. The facultative anaerobes are able to consume O2 in a medium and so a steady anaerobic condition in a fermentor was attained without addition of any reducing agent. Significant progress has been made towards genetically engineering clostridia to utilize a variety of substrates, and to reduce the need for pretreatment processes as well as reduce the application of reducing agents for creation anaerobic conditions. Among the cheap and readily available substrates for biohydrogen and liquid biofuel production, agro-industrial wastes are possibly one of the better choices. The possibility of using cheaper resources, such as lignocelluloses, whey cheese or any agro-industrial and domestic organic wastes, as the alternative substrates for biofuel production over more expensive substrates. Selection of cellulolytic clostridia in applying biotechnology to acetone-butanol fermentation revived interest in research on solvent production by fermentation.

Keywords:

Biofuel, Biohydrogen, clostridia, agro-industrial wastes

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