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Manufacture of ethanol from food waste

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Ethanol is a renewable biofuel, hence it is more sustainable than natural energy resources such as fossil fuels and can be manufactured by either hydration of ethylene or fermentation of biomass. Fermentation of biomass is the most widely used technique and the substrates used for fermentation include agricultural resources, such as sugarcane, molasses and corn or lignocellulosic biomass, such as rice straw, wheat straw and wood. Currently, food waste is being explored as a possible alternative as it is rich in carbohydrates, proteins, lipids and minerals which make it an ideal raw material. Production of ethanol involves three essential steps: (a) preparation of the substrate, (b) hydrolysis and (c) fermentation of the biomass. The first step involves the pretreatment of the substrate which is necessary to increase the rate of production and total yield of monosaccharides. This is followed by the hydrolysis of biomass which results in the generation of fermentable sugars that can be converted to ethanol through the action of microbes. Saccharomyces cerevisiae (yeast) which is the commonly used microbe for stable ethanol fermentation can be supplemented with Zymomonas mobilis using co-immobilisation technology to increase the retention time in the bioreactor along with their improved growth and enhanced ethanol production. The co-immobilisation of microbes can be done with the help of sodium alginate or calcium chloride solutions.

Although food waste can easily be converted to fermentable sugars, there are some challenges, such as variation in its composition and high moisture content which depends on its sources.Food waste does not require complex pretreatment processes; however, the high moisture content can lead to rapid decomposition of the organic matter present in it. Hence, it can be dehydrated to lower its moisture content. Enzymatic hydrolysis is one of the techniques used to break down the complex polysaccharides present in food waste into fermentable monosaccharides. Enzymes, such as amyloglucosidase and carbohydrase can be used for hydrolysis of biomass containing starch and cellulose. Since enzymes are expensive, the on-site production of enzymes from organisms, such as Aspergillus or Penicillium species is a possible solution. The enzymes produced can therefore be used in strategies, such as simultaneous saccharification and fermentation (SSF) or separate hydrolysis and fermentation (SHF) for efficient ethanol production. Utilisation of a substrate such as food waste would help in lowering the overall cost of the manufacture of ethanol. Additionally, it would ensure ecological and sustainable disposal of food waste which is a major problem across the world. Hence, further studies need to be carried out to optimise these strategies and facilitate the production of ethanol from food waste on a larger scale.

Keywords: Ethanol, Food waste, Microbes, Fermentation, Enzymes

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