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Bioconversion of Kitchen Waste to Bio-Ethanol for Energy Security and Solid Waste Management

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Abstract : The approach of utilizing zero cost kitchen waste residues for growing suitable strains of fungi for the induction of a cocktail of hydrolytic enzymes and ethanol generation has been validated in the present study with the objective of developing an indigenous biorefinery for low cost bioethanol production with the generation of zero waste. Solid state fermentation has been carried out to evaluate the potential of various steam pretreated kitchen waste residues as substrates for the co-production of multiple carbohydrases including cellulases, hemicellulases, pectinase and amylases by a locally isolated strain of Aspergillus niger C-5. Of all the residues, potato peels induced the maximum yields of all the enzyme components corresponding to 64.0±1.92 IU of CMCase, 17.0±0.54 IU of FPase , 42.8±1.28 IU of β-glucosidase, 990.0±28.90 IU of xylanase, 53.2±2.12 IU of mannanase, 126.0±3.72 IU of pectinase, 31500.0±375.78 IU of α-amylase and 488.8±9.82 IU of glucoamylase/g dry substrate respectively. Saccharification of various kitchen refuse residues using inhouse produced crude enzyme cocktail resulted in the release of 610±10.56, 570±8.89, 435±6.54, 475±4.56, 445±4.27, 385±4.49, 370±6.89, 490±10.45 mg of total reducing sugars/g of dried potato peels, orange peels, pineapple peels, mausami peels, onion peels, banana stalks, pea pods and composite mixture respectively revealing carbohydrate conversion efficiencies in the range of 97.0-99.4%. After fermentation of released hexoses by Saccharomyces cerevisae, ethanol yields ranging from 80-262 mL/ kg of dry residues were obtained. The study has successfully evaluated the valorization of kitchen garbage, a highly biodegradable component in Municipal Solid Waste by using it as a substrate for the in-house co-production of multiple carbohydrases and employing the steam treated residues as a feed stock for bioethanol production. Such valorization of kitchen garbage may reduce the level of Municipal Solid Waste going into land-fills thus lowering the emissions of greenhouse gases. Moreover, the solid residue left after the bioconversion may be used as a biofertilizer for improving the fertility of the soils.

Keywords : kitchen waste, bioethanol, solid waste, bioconversion, waste management
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