Modeling and Optimization of Reducing Sugar Concentration of SternEnzym Hydrolyzed Fruit Peels via Response Surface Methodology.

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Abstract

Processing of fruits in Ghana leads to the generation of tonnes of waste such as peels, seeds, cores and crowns. Handling this waste tends to be a major challenge. The usual practice is to discard these wastes in drainages, water bodies and in landfills. However, if these wastes are used as feedstock to produce enzymes, bioethanol, and specialty chemicals instead of being dumped in landfills or put in the ocean, this unwanted environmental pollution can be avoided. Utilizing these wastes as a resource for energy production such as bioethanol, which is produced from the fermentation of reducing sugars is a means of addressing the sanitation issue while valorizing the waste. The main aim of this work was to use Response Surface Methodology, to estimate conditions for the optimal production of reducing sugars from fruit wastes via hydrolysis using enzymes. The substrate used compromised of pineapple peels, pawpaw peels, mango peels and a blend of these three fruit peels. Fruit waste samples were pulverized and aliquots of 2.5% w/v, 5% w/v, 6% w/v and 7.5% w/v substrate concentration made for analyses. Fruit waste samples were saccharified with commercial enzyme procured from the market and samples taken from 12 to 72 hours to determine reducing sugar yield. Central Composite Design, a statistical design tool in Response Surface Methodology was used to investigate the effect of two significant independent variables, hydrolysis time and substrate concentration on the response variable, reducing sugar yield in the hydrolysis process. Results indicated that cellulose and hemicellulose were highest in pawpaw peels, 25.8% and 25.1%, respectively. Saccharification with commercial enzymes showed that blend had the highest concentration of reducing sugars at 7.5% substrate concentration after 48 hours. Optimisation of process parameters gave optimal conditions for pineapple peels to be time of 32.8 hours, substrate concentration of 3.5% w/v, TRS yield of 16.6 mg/mL. That of mango were optimal time of 34.2 hours, substrate concentration of 4.7% w/v, a TRS yield of 27.8 mg/mL. Pawpaw peel had optimal conditions of 67.6 hours, substrate concentration of 5.1% w/v, TRS yield of 25.5 mg/mL. Peels blend had time of 61.7 hours, substrate concentration of 5.9% w/v and TRS yield of 45.4 mg/mL. These optimal conditions can be followed for effective hydrolysis of fruit peels while cutting down on time and cost associated with hydrolysis.

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