Direct utilization of kitchen waste for bioethanol production by separate hydrolysis and fermentation (SHF) using locally isolated yeast

ABSTRACT

Kitchen wastes containing high amounts of carbohydrates have potential as low-cost substrates for fermentable sugar production. In this study, enzymatic saccharification of kitchen waste was carried out. Response surface methodology (RSM) was applied to optimize the enzymatic saccharification conditions of kitchen waste. This paper presents analysis of RSM in a predictive model of the combined effects of independent variables (pH, temperature, glucoamylase activity, kitchen waste loading, and hydrolysis time) as the most significant parameters for fermentable sugar production and degree of saccharification. A 100 mL of kitchen waste was hydrolyzed in 250 mL of shake flasks. Quadratic RSM predicted maximum fermentable sugar production of 62.79 g/L and degree of saccharification (59.90%) at the following optimal conditions: pH 5, temperature 60°C, glucoamylase activity of 85 U/mL, and utilized 60 g/L of kitchen waste as a substrate at 10 h hydrolysis time. The verification experiments successfully produced 62.71 ± 0.7 g/L of fermentable sugar with 54.93 ± 0.4% degree of saccharification within 10 h of incubation, indicating that the developed model was successfully used to predict fermentable sugar production at more than 90% accuracy. The sugars produced after hydrolysis of kitchen waste were mainly attributed to monosaccharide: glucose (80%) and fructose (20%). The fermentable sugars obtained were subsequently used as carbon source for bioethanol production by locally isolated yeasts: Saccharomyces cerevisiae, Candida parasilosis, and Lanchancea fermentati. The yeasts were successfully consumed as sugars hydrolysate, and produced the highest ethanol yield ranging from 0.45 to 0.5 g/g and productivity between 0.44 g Lï 1 hï 1 and 0.47 g Lï 1 hï 1 after 24-h incubation, which was equivalent to 82.06ï 98.19% of conversion based on theoretical yield.

Keyword: Bioethanol; Enzymatic hydrolysis; Fermentable sugars; Kitchen waste; Response surface methodology (RSM)