

Enzymatic saccharification with sequential-substrate feeding and sequential-enzymes loading to enhance fermentable sugars production from sago hampas

ABSTRACT

Sago hampas composed of a high percentage of polysaccharides (starch, cellulose and hemicellulose) that make it a suitable substrate for fermentation. However, the saccharification of sago hampas through the batch process is always hampered by its low sugar concentration due to the limitation of the substrate that can be loaded into the system. Increased substrate concentration in the system reduces the ability of enzyme action toward the substrate due to substrate saturation, which increases viscosity and causes inefficient mixing. Therefore, sequential-substrate feeding has been attempted in this study to increase the amount of substrate in the system by feeding the substrate at the selected intervals. At the same time, sequential-enzymes loading has been also evaluated to maximize the amount of enzymes loaded into the system. Results showed that this saccharification with sequential-substrate feeding and sequential-enzymes loading has elevated the solid loading up to 20% (w/v) and reduced the amount of enzymes used per substrate input by 20% for amylase and 50% for cellulase. The strategies implemented have enhanced the fermentable sugar production from 80.33 g/L in the batch system to 119.90 g/L in this current process. It can be concluded that sequential-substrate feeding and sequential-enzymes loading are capable of increasing the total amount of substrate, the amount of fermentable sugar produced, and at the same time maximize the amount of enzymes used in the system. Hence, it would be a promising solution for both the economic and waste management of the sago hampas industry to produce value-added products via biotechnological means.

Keyword: Sago hampas; Amylase; Cellulase; Substrate feeding; Saccharification; Biomass