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Optimization of microwave-assisted alkali pretreatment followed by acid hydrolysis of sugarcane straw for production of acetone-butanol-ethanol

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Abstract

The production of acetone-butanol-ethanol (ABE) calls for effective pretreatment and hydrolysis techniques to maximize reducing sugar yields. In this study, optimized microwave-assisted alkali (MAA) pretreatment followed by acid hydrolysis was assessed for the production of reducing sugars from sugarcane straw (SCS). To evaluate effects of MAA pretreatment on SCS composition, response surface methodology (RSM) was employed upon subjecting SCS to 320, 640, and 960 W microwave power, using 1–3% (w/v) NaOH, and residence time of 5, 15, and 25 min. The pretreated SCS was made to undergo acid hydrolysis at 121 °C temperature and reaction time of 10–60 min to release reducing sugars. ABE was produced by anaerobic fermentation of reducing sugars using Clostridium beijerinkii. After pretreatment, maximum responses of 76.3% lignin removal, 21.1% hemicellulose, and 71.9% cellulose were achieved at 640 W microwave power, 2.8% NaOH concentration, and 19 min. The maximum reducing sugar concentration was 46.2 g/L while 18.7 g/L of ABE was produced. The results revealed that optimized MAA pretreatment followed by acid hydrolysis can enhance the yield of reducing sugars for ABE production with no need for costly enzymes.

KEYWORDS: Acetone-butanol-ethanol, reducing sugars, microwave-assisted alkali pretreatment, acid hydrolysis, response surface methodology