Enhancement of Cellulolytic Activity through Biofilm Action for Bioethanol Production

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Cellulosic biomass is a biopolymer with great potential for bioconversion to value-added products. However, efficient degradation of cellulose is a problem in many industries including bioethanol production. Although a variety of microorganisms are capable of degrading cellulose, few of them produce significant quantities of enzyme fractions which hydrolyze cellulose to simple sugars. Extensive studies on bio-degradation by cellulolytic mixed microbial cultures would be beneficial in cellulosic biofuel production. Thus, this study was focused to evaluate the efficiency of cellulolytic activity of mono and mixed microbial cultures. Microbial isolations were carried out using soil samples obtained from a land at Kuliyapitiya, in Kurunegala district, Sri Lanka. They were streaked on Cellulose-Congo red Agar medium to screen for potential cellulolytic microorganisms. The selected microorganisms were inoculated on Carboxy Methyl Cellulose Agar medium to screen the most effective cellulolytic fungi and bacteria. Fungal-bacterial biofilms (FBB) were developed from the selected cellulolytic fungi and bacteria using Combine Carbon Broth. The efficiency of cellulolytic activity of the selected microbial combinations was evaluated using the production of reducing sugar through 3,5-Dinitro Salicylic acid after treating with cellulose powder. Two fungal (F1 and F2) and three bacterial isolates (B1, B2 and B3) were selected as the best cellulolytic microorganisms. Out of the selected cellulolytic microorganism, F2 and B1 showed the significantly highest cellulolytic activities ($P < 0.05$). This mean reducing sugar level (113.90 ppm) was observed with the F2B1 combination after twenty three days of incubation. In addition, F2, B1 and B2 mono cultures showed significantly higher yield of reducing sugar than that of the other mono and mixed cultures, except F2B1. Thus, the selected FBB combination can be used to enhance the hydrolysis efficiency of cellulose for bioethanol production.

Keywords: Cellulose, Cellulolytic activity, Fungal-bacterial biofilms, Reducing sugar