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Clostridium thermocellum DBT-IOC-C19, A Potential CBP Isolate for Ethanol Production

Authors : Nisha Singh, Munish Puri, Collin Barrow, Deepak Tuli, Anshu S. Mathur

Abstract : The biological conversion of lignocellulosic biomass to ethanol is a promising strategy to solve the present global crisis of exhausting fossil fuels. The existing bioethanol production technologies have cost constraints due to the involvement of mandate pretreatment and extensive enzyme production steps. A unique process configuration known as consolidated bioprocessing (CBP) is believed to be a potential cost-effective process due to its efficient integration of enzyme production, saccharification, and fermentation into one step. Due to several favorable reasons like single step conversion, no need of adding exogenous enzymes and facilitated product recovery, CBP has gained the attention of researchers worldwide. However, there are several technical and economic barriers which need to be overcome for making consolidated bioprocessing a commercially viable process. Finding a natural candidate CBP organism is critically important and thermophilic anaerobes are preferred microorganisms. The thermophilic anaerobes that can represent CBP mainly belong to genus Clostridium, Caldicellulosiruptor, Thermoanaerobacter, Thermoanaero bacterium, and Geobacillus etc. Amongst them, Clostridium thermocellum has received increased attention as a high utility CBP candidate due to its highest growth rate on crystalline cellulose, the presence of highly efficient cellulosome system and ability to produce ethanol directly from cellulose. Recently with the availability of genetic and molecular tools aiding the metabolic engineering of Clostridium thermocellum have further facilitated the viability of commercial CBP process. With this view, we have specifically screened cellulolytic and xylanolytic thermophilic anaerobic ethanol producing bacteria, from unexplored hot spring/s in India. One of the isolates is a potential CBP organism identified as a new strain of Clostridium thermocellum. This strain has shown superior avicel and xylan degradation under unoptimized conditions compared to reported wild type strains of Clostridium thermocellum and produced more than 50 mM ethanol in 72 hours from 1 % avicel at 60°C. Besides, this strain shows good ethanol tolerance and growth on both hexose and pentose sugars. Hence, with further optimization this new strain could be developed as a potential CBP microbe.

Keywords : Clostridium thermocellum, consolidated bioprocessing, ethanol, thermophilic anaerobes
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