Single-stage conversion of lignocellulosic materials to ethanol in single-strain and co-culture systems

Tran, Dang-Thuan、吳忠信、林啟文

E-mail: 9805369@mail.dyu.edu.tw

ABSTRACT

New diverse development in producing ethanol from lignocelluloses will be a potential and cheap way for the liquid-fuel. In addition, consolidated bioprocessing is a single process in which a dedicated process step for the production of cellulase enzyme with high cost is not necessary. Pennisetum Alopecoider (Napiergrass Taishigrass No.2, Taiwan) had been used as a main carbon source in this study for ethanol production. This study has been focused on direct conversion of lignocellulosic materials to ethanol using mesophilically native strains. Three cellulolytic strains Bacillus sp. THLA0409, Klebsiella pneumoniae THLB0109, and Klebsiella oxytoca THLC0109 were isolated from their original lignocelluloses-degrading microflora which was constructed from Napiergrass and sheep ' s dung compost. The three strains can utilize well various lignocelluloses (avicel, α-cellulose, original bamboo, purified bamboo, corncob, Napiergrass, rice straw). At optimal condition (pH 7.0 ± 0.2 and temperature of 31 – 33 oC), ethanol yields on Napiergrass by single cultures of THLA0409, THLB0109, and THLC0109 are 0.13, 0.21, and 0.21 g/g, respectively. The two strains of THLB0109 and THLC0109 grew well on two xylan sources (oat-extracted and corncob-extracted xylan) and various sugars (arabinose, cellobiose, glucose, and xylose). The strain of THLA0409 grew well on cellobiose and glucose but less on these xylans, arabinose, and xylose. The co-culture of THLA0409 and THLC0109 enhances ethanol productions on natural lignocelluloses. Ethanol concentrations were produced on original bamboo, Napiergrass, and rice straw reached maximum values of 323.37, 576, and 379.28 ppm corresponding to ethanol yields of 0.323, 0.576, and 0.379 g/g which are increased 45 – 66, 63 – 78, and 55 – 65%, respectively, compared to those produced by a single culture.

Keywords : Lignocelluloses ; Consolidated bioprocessing ; Co-culture ; Ethanol

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