DESIGN PROCESS OF ETHANOL PRODUCTION BY USING EXTRACTIVE-FERMENTATION AS AN EFFORT TO INCREASE THE PRODUCTIVITY AND YIELD OF ETHANOL

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Abstract

Ethanol is generally produced by batch fermentation process. However, this process will bring about accumulation of ethanol product which can poison the microorganism and lead to low productivity which finally results in an economical disadvantage. This study aims to increase the productivity of ethanol by using continuous fermentation in packed bed bioreactor and the fermentation is integrated by extraction process with recycle from the raffinate to the fermentor as an effort to increase the yield.

This study used immobilization technique by entrapment of mutated Zymomonas mobilis in κ-Carageenan as the porous matrix and the continuous fermentation process was integrated with liquid-liquid extraction. This process used molasses as the raw material and Amyl-alcohol and 1-Dodecanol as the solvent for extraction process. The initial sugar concentration was 160,454g/L (17%). The raw material was prepared by sterilization and adding the nutrient as feed, and 100mLof the feed was added with 10 g yeast extract and then mutated Zymomonas mobilis was inoculated. Starter was incubated during 15 hours before being used to make the immobilization bead from κ-Carageenan solution. Bead was incubated in the incubator shaker during 24 hours before it was used in fermentor. Feed entered the fermentor with flow rate of 10mL/minute, and
broth from the fermentor was flowed to the extractor where the solvent was flowed counter currently. Raffinate was collected and flowed to the fermentor with recycle ratio 40%, 50%, 60% and 70% with respect to the feed. Analysis of sugar reduction residue was performed using Dinitrosalicylic acid (DNS) method, while analysis of ethanol content was performed under Gas Chromatography (GC) method.

From the research, can be concluded that the raffinate recycle can increase the value of yield and productivity. The yield ethanol increase from 16.85% to 32.58% and the productivity increase from 66.25g/L.h to 192.15g/L.h with increasing recycle ratio from 0% (without recycle) to 50%. However, the ethanol yield and productivity decrease with increasing recycle ratio above 50%.

**Keyword:** ethanol, molasses, immobilization cell, packed-bed bioreactor, extractive-fermentation.