ETHANOL PRODUCTION FROM SIWALAN JUICE 
*(Borassus flabellifer L.)* BY EXTRACTIVE 
FERMENTATION PROCESS OF THE CELL 
IMMOBILIZATION IN THE PACKED BED 
BIOREACTOR

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Abstract

Energy demand of fuel oil (BBM) fossil-based such as diesel, gasoline and kerosene in various countries in the world in recent years has increased sharply, while the availability of backup fuel sources become more limited. To overcome this, the government has encouraged the development of alternative energy sources, one of which is the production of ethanol. Siwalan juice can be used as raw material for the manufacture of ethanol since the amount is abundant and can optimize the utilization of siwalan juice because all this time siwalan juice is only used as a raw material of palm wine and palm sugar. Efforts to improve the productivity of ethanol from siwalan juice in continuous process because there are constraints on conventional fermentation process, those are low product ethanol concentration and low productivity. Continuous fermentation with cell immobilization technique followed by the extraction process beside to increase productivity and yield, is also to reduce energy demand in the distillation process. Therefore, a research needs to be done with excellence for the integration of ethanol production process and low energy that can then be used as the design basis for engineering small-scale industry.

Studies of ethanol production from siwalan juice in continuous process carried out by a combination of cell immobilization fermentation in packed bed bioreactor and continued
with extraction process by using the solvent that does not poison the fermenting microorganisms in an effort to get high productivity and yield. This research is done for compare the effect of microorganisms and recycle process that integrated with extractive fermentation system. From the research that has been done can be concluded that the extractive fermentation process without recycle which using Saccharomyces cerevisiae deliver ethanol productivity and yield better when compared with the use of mutated Zymomonas mobilis, which amounted to 17.31 g/L.hr and 5.33% for each. While the extractive fermentation with 50% recycle system using mutated Zymomonas mobilis provide the best results of ethanol productivity and yield, which amounted to 161.02 g/L.hr and 33.63% for each.

**Keywords:** Ethanol, extractive fermentation, cell immobilization, siwalan juice, mutated Zymomonas mobilis, yield.