

**PRODUKSI ETANOL DARI BUBUR SINGKONG DENGAN PROSES  
SILMULTAN SAKARIFIKASI MENGGUNAKAN CO-ENZIM,  $\alpha$ -AMYLASE  
AND GLUCOAMYLASE, DAN FERMENTATSI DENGAN  
SACCHAROMYCES CEREVISIAE TISTR 5339**

**INTISARI**

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Kesadaran akan perubahan iklim global dan ketidakpastian ketersediaannya bahan bakar fosil memicu perkembangan pada energi terbarukan. Salah satu energi terbarukan ialah etanol. Dalam produksi etanol dikenal proses simultan antara sakarifikasi dan fermentasi yang dapat menghasilkan etanol yang lebih banyak dan tidak memerlukan perlakuan suhu tinggi. Sementara itu, Thailand merupakan negara dengan produksi pati singkong yang tinggi sehingga bubur singkong sebagai hasil sampingan selalu terbentuk. Bubur singkong tersebut masih mengandung pati sehingga dapat digunakan sebagai biomasa untuk produksi etanol. Studi ini ditujukan untuk mempelajari produksi etanol dari bubur singkong dengan proses simultan sakarifikasi dengan co-enzim,  $\alpha$ -amylase and glucoamylase, dan fermentasi dengan *Saccharomyces cerevisiae* TISTR 5339.

Mula-mula, bubur singkong dihaluskan dengan ukuran 0,5-1 mm. Kemudian suspensi singkong dibuat dan dilakukan pre-sakarifikasi selama 2 jam pada 50°C *waterbath*, dan kemudian *S. cerevisiae* TISTR 5339 diinokulasikan kedalamnya. Incubasi selanjutnya di 30°C 100 rpm *shaker incubator* dan diinkubasi hingga total waktu 74 jam. Pengambilan sample dimulai dari 2, 6, 10, 14, 20, 26, 38, 50, 62, and 74 jam inkubasi. Kemudian, konsentrasi gula reduksi dan etanol, jumlah sel, serta aktivitas enzim dianalisis. Hasil yang diperoleh ialah konsentrasi etanol 27.35 g/L, ekuivalen dengan 75.8% dari teori, dengan produktivitas etanol 0.37 g/L.h<sup>-1</sup> dan efektivitas fermentasi 89.27%.

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***Kata kunci:***  $\alpha$ -amylase, bubur singkong, etanol, glucoamylase, *Saccharomyces cerevisiae* TISTR 5339, simultan sakarifikasi dan fermentasi

**ETHANOL PRODUCTION FROM CASSAVA PULP BY  
SIMULTANEOUSLY SACCHARIFICATION USING CO-ENZYMES,  $\alpha$ -  
AMYLASE AND GLUCOAMYLASE, AND FERMENTATION WITH  
SACCHAROMYCES CEREVISIAE TISTR 5339**

**ABSTRACT**

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Awareness of global climate change and the uncertainty of fossil fuel have thus caused to the renewable energy development. The possible alternative is using renewable fuel, such as ethanol. Ethanol in the USA has been blended with gasoline with 10% ethanol by volume. To produce ethanol, the simultaneous saccharification and fermentation (SSF) is recognized as one of the method which does not need high-temperature treatment and yield higher ethanol. In another hand, in Thailand, as the country with a massive production of cassava starch, the cassava pulp is timely produced as the by-product of cassava starch industry. It contains high starch so it can be used as biomass for ethanol production. This study has the aim to study the ethanol production from cassava pulp by SSF with co-enzyme,  $\alpha$ -amylase and glucoamylase, and *Saccharomyces cerevisiae* TISTR 5339.

At first, the cassava pulp was powdered to the size of 0.5-1 mm. The cassava suspension was made and pre-saccharified for 2 hours at 50°C water-bath, and then the *S. cerevisiae* TISTR 5339 was inoculated into it. The next incubation was undertaken in 30°C 100 rpm shaker incubator until the total incubation time was 74 hours. All method was under sterile condition. The sampling was started from at 2, 6, 10, 14, 20, 26, 38, 50, 62, and 74 hours of incubation. The reducing sugar and ethanol concentration, cell number and enzyme activity were analyzed. By the research, the final ethanol concentration that was acquired is 27.35 g/L equivalent to 75.8% of theoretical. Ethanol productivity is 0.37 g/L.h<sup>-1</sup> and fermentation effectivity is 89.27%.

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**Keywords:**  $\alpha$ -amylase, cassava pulp, ethanol, glucoamylase, *Saccharomyces cerevisiae* TISTR 5339, simultaneous saccharification and fermentation