Enzymatic Hydrolysis of Alkaline Pretreated Coconut Coir

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Abstract **:**

The purpose of this research is to study the effect of concentration and temperature on the cellulose and lignin content, and the reducing sugars produced in the enzymatic hydrolysis of coconut coir. In this research, the coconut coir is pretreated using 3%, 7%, and 11% NaOH solution at 60°C, 80°C, and 100°C. The pretreated coir were assayed by measuring the amount of cellulose and lignin and then hydrolysed using Celluclast and Novozyme 188 under various temperature (30°C, 40°C, 50°C) and pH (3, 4, 5). The hydrolysis results were assayed for the reducing sugar content. The results showed that the alkaline delignification was effective to reduce lignin and to increase the cellulose content of the coir. The best delignification condition was observed at 11% NaOH solution and 100°C which removed 14,53% of lignin and increased the cellulose content up to 50,23%. The best condition of the enzymatic hydrolysis was obtained at 50°C and pH 4 which produced 7,57 gr/L reducing sugar.

Keywords **:** coconut, enzyme, hydrolysis, lignocellulose

1. Introduction

The lignocellulosic biomass is represented by the high-level crop, hard wood and soft wood with cellulose, hemicellulose and lignin as the main component. One of the lignocellulosic biomass available in Indonesia is coconut coir. Coconut productivity in Indonesia is very high, reaching 15.5 billion coconuts per year, which is equivalent to 3.02 million tons of copra, 3.75 million tons of water, 0.75 million tons of shell, 1.8 million tons of coir fiber, and 3.3 million tons of coir dust. The coconut manufacturing industries are still largely focused on coconut meat manufacturing, while the manufacturing industry of its byproducts such as coconut water, coconut coir and coconut shell is still in small scale and traditional **[1]**. Whereas the potential of the byproduct is very large, especially the coconut coir.

Coconut coir is composed of cellulose, lignin, pectin, hemicellulose, and ash. Cellulose is a component of coconut coir that can be processed and converted into energy sources. Lignin is a component of coconut coir that is rigid and prevent the cellulose degradation **[2]**. The lignin degradation is necessary to increase the rate of the hydrolysis of lignocellulosic materials. This can be done by physical, chemical, and biological method. One method of chemical delignification is pretreatment using some kind of alkaline solutions such as NaOH and $Ca(OH)_2$ **[3]**.

The delignification can be carried out using NaOH solution that can attack the structure of lignin and disrupt the crystalline structure of cellulose **[3]**. In addition, the NaOH is relatively cheap, easily obtained and also more soluble in water than $Ca(OH)_2$ **[4]**.

This research studied the alkaline pretreatment using NaOH solution and the enzymatic hydrolysis of coconut coir. The hydrolysate as intended to be used as biohydrogen fermentation substrate.

2. Materials and Methods

2.1. Materials Preparation

The coconut coir was soaked for 24 hours, then washed with flowing water for 1 hour and dried. The dried coconut coir was cut (± 5 x 5 cm), and then milled using a disc mill (FFC type 23 A, with a speed of 5800 rpm, power 3kW, Shandong Ji Mu Disk Mill Machinery). Finally it was sieved (Retsch 5657 test sieve, no. mesh 40, a hole the size of 0.425 mm, stainless steel, W Haan, Germany) to obtain the particle size of 40 mesh.