CHAPTER I
INTRODUCTION

Energy consumption has increased steadily over the last century as the world population has grown. Alternative energy sources have become a great interest in exploring. Unlike fossil fuels, bioethanol is a renewable energy source produced through fermentation of sugars (Ye Sun, 2002). Ethanol is highly soluble in water and biodegradable which is friendly to environment (McMillan, 1996). However, the cost of ethanol as an energy source is relatively high compared to fossil fuels. A potential way to reduce ethanol production cost is to utilize lignocellulosic materials such as crop residues, grasses, sawdust, wood chips, and solid animal waste (Ye Sun, 2002). Since lignocellulosic materials are less expensive than conventional agricultural feedstocks (Alvira *et al.*, 2009).

Lignocelluloses are composed of cellulose, hemicelluloses, lignin, extractives, and several inorganic materials (Sjöström 1993). Cellulose or β-1-4-glucan is a polymer of glucose made of cellobiose units with about 2,000 to 27,000 glucose residues (Delmer and Amor, 1995; Morohoshi, 1991). These chains are packed by hydrogen bonds in so-called 'elementary fibrils' originally considered being 3 to 4 nm wide and containing about 36 chains, although larger crystalline fibrils up to 16 nm were also discovered (Ha *et al.,* 1998). These elementary fibrils are then packed in so-called microfibrils, where the elementary fibrils are attached to each other by hemicelluloses, amorphous polymers of different sugars as well as other polymers such as pectin and covered by lignin. The microfibrils are often associated in the form of bundles or macrofibrils (Delmer and Amor, 1995). There are several lignocellulosic materials that have been used for conversion to ethanol. One of the major lignocellulosic materials is sugarcane bagasse, the fibrous residue remaining after the extraction of juice from the crushed stalks of sugar cane (Martín *et al.*, 2007).

The conversion of lignocellulosic materials to ethanol includes two processes: hydrolysis of cellulose in the lignocellulosic materials to fermentable reducing sugars, and fermentation of the sugars to ethanol. The hydrolysis is usually catalyzed by cellulase enzymes, and the fermentation is carried out by yeasts or bacteria.

Enzymatic hydrolysis of cellulose consists of the cellulase adsorption onto the surface of the cellulose, the biodegradation of cellulose to fermentable sugars, and desorption of the cellulase. Enzymatic degradation of cellulose to glucose is generally accomplished by synergistic action of at least three major classes of enzymes: endo-glucanases, exoglucanases, and ß-glucosidases. These enzymes are usually called together cellulase or cellulolytic enzymes (Wyman, 1996). Cellulase can be secreted extracellularly by several microbes, including bacteria from higher termites (Bakaldou *et al.*, 2002; Schafer *et al.*, 1996; Wenzel *et al.*, 2002).

The purpose of this research was to study and optimize the production of glucose and other fermentable sugars through microbial hydrolysis of bagasse. Effects of various types of bacteria, particle sizes, and concentration of secondary carbon source for microbial hydrolysis were investigated. Then, glucose production from microbial hydrolysis using bacterial strains were compared with that using commercial cellulase produced from *Aspergillus niger*.