CHAPTER I
INTRODUCTION

Due to global warming problem and continuous decrease of fossil fuel source, alternative energy such as gasohol or bio-diesel has been increasingly consumed. Therefore, bio-ethanol serving as gasohol additive has been consecutively produced and improved as well. At present, bio-ethanol production is based on sugar (from sugar cane) or flour (from maize or cassava) as substrates. Biomass feedstock represents about 40% of bio-ethanol production cost (Hamelinck *et al.*, 2005) and makes the price of ethanol produced from those substrates much higher than those comparing to fossil fuel. Therefore, reducing cost of ethanol production by using lignocellulosic materials such as bagasse, wood scraps, corncob or rice straw as an alternative feedstock becomes a very interesting topic for researchers nowadays. (Chandel *et al.*, 2007).

Lignocelluloses consist mainly of cellulose, hemicellulose and lignin; these components build up about a 90% of dry matter in lignocelluloses, with the rest consisting of e.g. extractive and ash (Dehkhoda, 2008). Lignocellulosic materials such as rice straw are one of the most abundant agricultural by-products in Thailand. It generally contains approximately 39% cellulose, 27% hemicellulose and 12% lignin (Kaur *et al.*, 1998). Rice straw is a widely propagated lignocellulosic waste material in the world. Its worldwide annual production is estimated to be 600 million tons per year (Karii *et al.*, 2005). Unlike wheat straw, high silica content and low digestibility prevents rice straw from being suitable cattle feed. Bioethanol, which has a great worldwide importance nowadays, can be produced from rice straw. The cellulose and hemicellulose of the rice straw can be converted to ethanol by liberating the monomer sugars by hydrolysis followed by fermentation with microorganisms (Chandrakant *et al.*, 1998; Palmqvist *et al.*, 2000; Sues *et al.*, 2005).

Hydrolysis of lignocellulosic materials is usually carried out by enzymatic or acid hydrolysis. In the enzymatic method, the lignocellulosic materials are first exposed to a pretreatment, where the cellulose structure is opened up for enzymatic attack, and depending on the hydrolysis method, the hemicellulose might be hydrolyzed to simple sugars (Taherzadeh, 1999).The pretreatment process can be performed by physical, chemical or biological processes (Fan *et al.*, 1982). Cellulose and hemicellulose, when hydrolyzed by chemical or enzymatic hydrolysis, are converted by microorganisms into glucose and other fermentable sugars for ethanol production (Boonmee, 2009).Lignin is one of the drawbacks of using lignocellulosic-biomass materials in fermentation, as it makes lignocellulose resistant to chemical and biological degradation (Taherzadeh *et al.*, 2008).

Cellulase, which is secreted extracellularly by several microbes, including bacteria from higher termites (Bakaldou *et al.*, 2002; Schafer *et al.*, 1996; Wenzel *et al.*, 2002), has been widely investigated to hydrolyze cellulose. Cellulases comprise of at least three different enzymes with different specificities, i.e., endo-acting endoglucanase that cleaves chains in the cellulose interior, exo-acting exoglucanases or cellobiohydrolases that cleaves cellobiose units from the cellulose chain ends, and β-glucosidase that cleaves cellobiose to two glucose molecules. All of these enzymes can cleave cellulose and hemicellulose to simple sugars, including glucose.

The purpose of this research was to study and optimize the production of glucose and other fermentable sugars through the microbial hydrolysis of rice straw. Effects of various types of bacteria and concentration of secondary carbon source for the microbial hydrolysis were investigated.