CHAPTER I
INTRODUCTION

Energy availability has become a big issue during the past few years because fossil fuels becoming depleted, so new sources of energy are being introduced. New sources of energy include solar, wind, geothermal, nuclear, and other forms of renewable energy (Demers *et al.*, 2009). Ethanol is one of a renewable energy source, which is widely used as a partial gasoline replacement in many countries and reduces greenhouse gas emission.

However, the cost of ethanol as an alternative energy source is relatively high compared to fossil fuels (Sun and Cheng, 2002). Therefore, one of the effective ways for low-cost ethanol production is the conversion of cellulose-based (lignocellulosic) material into reducing sugars and further fermented to ethanol. These lignocellulosic materials can be wheat, corncob, sugarcane bagasse, waste paper, switchgrass, sorghum, and barley, among others. The major lignocellulosic materials found in great quantities to be considered, especially in tropical countries are sugarcane bagasse (SCB) and corncob residues (Cardona *et al.*, 2009).

The enzymatic hydrolysis of cellulose biomass is a key process that can overcome the advancement of biofuels technology. First, the cellulose is obtained from plants and lignin present in the mixture is separated. The cellulose is then broken down into 5 or 6 carbon sugars. Enzymatic hydrolysis of cellulose to glucose depends on the synergism of three enzymes in cellulase system, i.e., β-1,4-engoglucanase (EC 3.2.1.1), β-1,4-exoglucanase (EC 3.2.1.91) and cellobiose (EC 3.2.1.21) (Chen *et al.*, 2007). These cellulases can be produced by bacteria in higher termite's gut. Taechapeompol *et al.* (2011) obtained strains with high specific activity for the cellulase. Furthermore, enzymatic hydrolysis can be performed under lower conditions (pH around 5 and temperature less than 50 °C) compared to acid hydrolysis, which help to bring down the utility costs of the process. Other advantages of using enzymatic hydrolysis are low energy consumption and environmental friendly.

In 2010, Worasamutprakarn studied on the pretreatment process by using an ionic liquid, 1-butyl-3-methylimidazolium [BMIM]Cl, which can reduce the crystallinity and increase the accessibility of cellulose. The effects of cellulose-to-[BMIM]Cl ratio, temperature, and time on the dissolution of cellulose were studied. Eourarekullart (2011) studied on the conversion of corncob to sugars by microbial hydrolysis. The effects of particle size, hydrolysis temperature, hydrolysis time, and strains of bacteria isolated from Thai higher termites (A002 and M015) were also studied. Wongskeo *et al.*(2012) studied the production of glucose from the hydrolysis of cassava residue using bacteria isolated from Thai higher termites. The results indicated that the maximum glucose concentration can be obtained at 37 °C using bacteria strain A002 and 60 mesh of the cassava residue.

Currently, lignocellulosic biomass is not susceptible to enzyme attack, which makes the pretreatment an essential step to increase the reactivity to cellulose by disruption of its close association with hemicellulose and lignin (Taherzadeh and Karimi, 2007; Martin *et al.*, 2008). In 2006, Ballesteros *et al.*(2006) studied ethanol production from steam-explosion pretreated wheat straw. The best operational conditions for steam-explosion pretreatment of wheat straw for ethanol production by a simultaneous saccharification and fermentation (SSF) process were studied, using diluted acid and water as preimpregnation agents. The results showed the best pretreatment conditions to obtain high conversion yield to ethanol of cellulose-rich residue after steam-explosion were 190 °C and 10 min or 200 °C and 5 min, in acid-impregnated straw. Amores *et al.* (2013) studied the steam-explosion pretreatment at different temperatures (200, 215, and 230 °C) for 5 min of sugarcane bagasse for ethanol production by simultaneous saccharification and fermentation (SSF). The results revealed that the ethanol yields exceeded 0.30 g per gram of glucose in all the conditions tested. The results demonstrate the effectiveness of steam explosion in the treatment of sugarcane bagasse fiber.

In this research, the effects of steam-explosion pretreatment time and preimpregnation agents on the conversion of SCB and corncob to sugars were investigated in batch cultivations. The optimum conditions for a maximum sugar production were studied. In addition, the compositional and structural changes of SCB and corncob before and after the pretreatment process were examined in order to understand the mechanism of the degradation.