CHAPTER I

INTRODUCTION

The world population has grown rapidly and more countries have been industrial prosperity, energy consumption has thus increased inevitably. The fossil fuels, such as crude oil, coal and natural gas have been the major resource to respond the increased energy demand (Sun and Cheng, 2002). However, they were estimated the decline in worldwide crude oil production will begin before 2010 (Campbell and Laherrere, 1998), that showed in crude oil prices inflated. Long-term economic and environmental concerns have resulted in a great amount of research on renewable source of biomass-based fuels to replace fossil fuels (Kumar *et al.*, 2009).

Unlike fossil fuels, biomass-based fuels are bioenergy that can contribute to sustainable development. Their resources are often locally available and conversion is feasible without high capital investments. Moreover, biomass energy can reduce greenhouse gas emissions like CO_2. Besides, biofuels may also create new employment opportunities in rural areas for social sustainability (Hoogwijk *et al.*, 2003).

Biofuels, such as bioethanol, biomethanol, vegetable oils, biodiesel, biogas, biohydrogen and etc. are generally used for liquid fuels for transportation sector (Balat, 2011). Bioethanol is an attractive alternative fuel because it is a renewable bio-based resource and it is oxygenated, accordingly providing the potential to reduce particulate emissions in compression-ignition engines (Hansen *et al.*, 2005).

Commonly, the ethanol production is produced from cassava, molasses, sugar cane, corn and maize whereas it maybe affects the future demand for food, determined by population growth in long term. Lignocellolusic raw materials are extensively researched about conversion to ethanol by reason of their chemical composition based on sugars and other compounds of interest. Furthermore lignocellolusic biomass, such as forestry, agricultural residues, herbaceous biomass, cellulose waste, etc. is abundant, renewable and inexpensive energy source (Mussatto *et al.*, 2010).

Herbaceous biomass like switchgrass, miscanthus grass, napier grass, mission grass, bermuda grass, and etc. is attractive resource due to their rapidly growth, plenty growth, shortly growth period, low production cost (Yoshida *et al.*, 2008; Heaton *et al.*, 2008; Bai *et al.*, 2008). Mainly potential herbaceous biomass like switchgrass, miscanthus grass is native to US and Europe.

Ethanol production process from lignocellulosic biomass mainly consists of pretreatment (first hydrolysis), saccharification (second hydrolysis), detoxification, fermentation, and separation (Piarpuzán *et al.*, 2011). The pretreatment step is essentially required for efficiently hydrolysis of cellulose to its constituent sugars. The hydrolysis is usually catalyzed by acids or cellulase enzymes. The detoxification reduces inhibition by enzymes. The fermentation is carried out by yeast or bacteria and the separation is derived from distillation or adsorption (Kumar *et al.*, 2009).

The objectives of this research are to evaluate the potential of herbaceous biomass in Thailand as lignocellulosic materials using the two-stage pretreatment with dilute alkaline/microwave and dilute acid/microwave pretreatments, to compare the monomeric sugar yield to be obtained from different lignocellulosic materials, and to determine the optimal types and conditions of yeast for fermenting monomeric sugar to ethanol.