# CHAPTER I
# INTRODUCTION

## 1.1 Rationale

Energy can be generally classified as non-renewable and renewable. Most developed nations are depending on non-renewable energy resources such as fossil fuels especially oil. Besides the possibility of high oil prices there is some urgency to look for alternate energy because of environmental concern of greenhouse gases produced by burning of fossil fuels, which have caused changes in the global climate. In recent years, growing attention has been devoted to the conversion of agricultural crops into fuel ethanol, which is considered as the cleanest liquid fuel alternative to fossil one.

Ethanol can be produced from any material that contains sugar. Carbohydrate-rich raw materials suitable for ethanol production are conveniently classified into three groups: sugar, starch, and cellulose materials. Sugars, refer to sugarcane, sugar beets, molasses, and sorghum, can be directly converted into ethanol. Starches such as corn, cassava and potatoes must first be hydrolyzed to fermentable sugars by the acid or enzymatic hydrolysis. Lignocelluloses covered waste materials from the harvesting of agricultural crops such as rice straw, corn cob, sugarcane waste, and paper mills must likewise be converted into sugars, generally by the action of mineral acids. Once simple sugars are formed, enzymes from microorganisms can readily ferment them to ethanol. However, due to diminishing fossil fuels, new sustainable sources of energy are needed.

Jerusalem artichoke (*Helianthus tuberosus* L.) is one of the most interesting materials among unconventional crops. It contains nearly 20% of carbohydrates, 70–90% of which is inulin. Inulin consists of linear chains of β (2→1) linked D-fructose units. Each chain is terminated by a D-glucose residue linked to fructose by an α (1→2) bond (Ge and Zhang, 2005), which has potential for ethanol fermentation, fructose syrup production and inulooligosaccharide (IOS) production (Chi et al., 2009; Zhao et al., 2010).

The conventional techniques for the production of ethanol from Jerusalem artichoke tubers and juice consist of the acid or enzymatic hydrolysis of inulin, followed by fermentation of the resulting hydrolysates into ethanol (Onsoy et al., 2007; Thuesombat et al., 2007). These processes, however, have some disadvantages, including by-product formation, product inhibition during hydrolysis, and subsequently, high production cost.

Traditionally, ethanol is produced at the optimum temperature ranging from 25-30°C. However, during ethanol production temperature may raise up to 5-10°C above the normal temperature. Therefore it is generally necessary to avoid the overheating problem in the fermentation process. To solve this problem, high temperature fermentation by using thermotolerant yeast that can tolerate high temperature is necessary. (Kiran et al., 2000; Limtong et al., 2007). Ethanol fermentation process at high temperature using thermotolerant yeasts have several advantages such as reduce cost for cooling system, reduce risk of contamination, and increase the speed of catalytic reactions related to fermentation. In this study, isolation and selection of thermotolerant yeasts for ethanol production at high temperature from Jerusalem artichoke (*Helianthus tuberosus* L.) juice without pretreatment process were investigated.

## 1.2 The objectives of the research

1.2.1 To isolate, screen and select for the thermotolerant yeast capable of producing ethanol from Jerusalem artichoke tubers juice.

1.2.2 To investigate the ethanol production efficiency of selected yeast at high temperature by using Jerusalem artichoke tubers juice as substrate.

1.2.3 To investigate the influence of some fermentation parameters on the ethanol batch fermentation from Jerusalem artichoke tubers juice by selected yeast.

1.2.4 To investigate the ethanol production efficiency from Jerusalem artichoke tubers juice by selected yeast in 2L fermenter using batch fermentation.

## 1.3 Scope and limitation of the research

The scopes of this research were as following:

1.3.1 Samples for isolation of yeast include soil collected from the Jerusalem artichoke plantation, Jerusalem artichoke tubers, Jerusalem artichoke juice, sugar cane juice decayed fruits such as rambutan, longan, pear, grape, and mangosteen.

1.3.2 Jerusalem artichoke tubers (cultivar KKU AC001) used as raw material for ethanol production were obtained from the Plant Breeding Research Center for Sustainable Agriculture, Faculty of Agriculture, Khon Kaen University, Thailand.

1.3.3 The effect of fermentation parameters on ethanol production from Jerusalem artichoke tubers juice was carried out using batch fermentation, and the following parameter were investigated;

1.3.3.1 The incubation temperature.

1.3.3.2 The initial pH of fermentation medium.

1.3.3.3 The initial cell number of starter.

1.3.3.4 The nutrient composition, including sugar concentrations, sources of nitrogen and magnesium supplementation.

1.3.4 Batch fermentations of Jerusalem artichoke tubers juices are conducted in 500 ml Erlenmeyer flasks and 2L fermenter.

## 1.4 The anticipated outcome

1.4.1 The high efficient thermotolerant yeast for ethanol production from Jerusalem artichoke tubers juice will be obtained.

1.4.2 The optimal conditions for ethanol batch fermentation from Jerusalem artichoke tubers juice by selected yeast will be obtained, in which its can be applied for future work for ethanol production in a large scale production.

1.4.3 This research will provide useful information for development of ethanol production capacity of the industry.