CHAPTER I
INTRODUCTION

This chapter contains research background rationale, objectives of the research, scope and limitation of research and anticipated outcomes, respectively.

1.1 Research background and rationale

According to, synthetic plastics derived from petroleum are become important and extensively used in daily life. There are several advantages in their physical and chemical properties such as strength, light weight and resistant to corrosion or degradation. Increasing of plastics demand particularly both in industries and households. It is used to replace for glass or paper packaging. However, plastics are difficult to degrade. They would take many years to degrade and cause the accumulation of non-degradable plastic in the environment. Typically, some practical choices as the reducing of production, burning and reuse have been used to solve and manage the environmental problem (Khanna, Srivastava, 2005). Attempt to use biopolymer that can degradable perhaps is used to solve this problem (Ojumu et al., 2004). In 1926, M. Lemoigne, the France microbiologist who firstly found biopolymers in form of polyhydroxyalkanoates (PHAs) accumulated as inclusion bodies in *Bacillus megaterium* (Jacquel et al., 2008). Convincingly, many researchers have interested and played attention to study the potential applications of the PHAs.

Polyhydroxyalkanoates are a kind of polyester group which are produced and accumulated as a storage carbon in various microorganisms mostly by bacteria under nutrient imbalance condition, with excess carbon source but limited some nutrients such as nitrogen, sulphur, phosphorus and etc. (Madison, Huisman, 1999; Kim, Lenz, 2001; Reddy et al., 2003). The properties of PHAs are closely to petrochemical-derived polypropylene (PP) (Evan, Sikder, 1990) and can degradable in short period (6 months-1 year) (Steinbuchel, Lutke-Eversloh, 2003).

Presently, cost of PHAs production is limiting factor for producing in an industrial scale. Especially, the cost of raw materials is considered to a great extend up to 50% of the entire production cost. The production of PHAs by employing cheap carbon sources such as molasses, starch or cassava mill were studied (Koller et al., 2010). But some nutrients or substances were affected to the growth of microbial that are toxic or the carbon source not suitable for the microbial growth. Considering, the low cost of carbon source approach to industrial-scale production of PHAs. Sugarcane juice is used in the current production of ethanol. When considered the amount of sugar in juice and its cost. It is possible to use as a raw material in the fermentation for PHAs production. Sugarcane juice is rich of sugar especially sucrose that is sufficient for the growth of microbial growth. Suitable microbial producer is important for the fermentation to production of PHAs and sugarcane juice is feasible to produce PHAs in the industries.

Many PHAs microbial producer strains can use different carbon sources such as glycerol, glucose, sucrose, fructose and/or xylose (Chen, 2010). There are some gram-negative and gram-positive strains such as *Alcaligenes latus*, *A. eutrophus and Azotobacter vinelandii* that can be utilized sucrose which is main sugar found in sugarcane juice. Moreover, it is one main crops planted in north-eastern areas of Thailand. Typically, its juice usually use for sugar production and the by-product known as molasses are produced ethanol for both industries of alcoholic beverage and bioenergy. Therefore, in this research work focuses on the production of PHAs biopolymer from sugarcane juice via batch fermentation by a pure bacterial strain and compare to the PHAs producing strain isolated from environments. The efficient of PHAs production in term of yield and productivity are evaluated. In addition, statistic optimization of the fermentation is carried out in a large scale of 5 L fermentor.

1.2 Objectives of the research

Main objective:

1.2.1 To produce a biopolymer of polyhydroxyalkanoates (PHAs) from sugarcane juice by pure and isolated bacterial strains under optimal condition via batch fermentation.

Minor objectives:

1.2.1 To characterize the physical and chemical properties of sugarcane juice being as raw material in PHAs production.

1.2.2 To isolate and screen the PHAs producing bacteria from environments.

1.2.3 To investigate capability of the isolated and the pure strains in both production and accumulation of PHAs.

1.2.4 To investigate the process optimization using statistic response surface methodology (RSM) during batch fermentation of sugarcane juice in shake flask.

1.2.5 To apply the optimized condition obtained from the flask scale for the production of PHAs in a scale up of 5 L fermentor.

1.2.6 To evaluate the performance of the batch fermentation of sugarcane juice in the production of biopolymer PHAs in terms of productivity and yield.

1.3 Scope and limitation of the research

1.3.1 The main compositions of sugarcane juice, as a raw material in the production of PHAs, were characterized.

1.3.2 The PHAs production from sugarcane juice as a sole carbon source was investigated by pure and isolated strains under controlled condition of temperature in flask scale during batch fermentation.

1.3.3 The optimization of PHAs production was investigated in the efficient PHAs producing strain.

1.3.4 The large scale of batch fermentation was investigated in a 5 L fermentor.

1.4 Anticipated outcomes

1.4.1 To obtain the microorganisms isolated and screened from water/soil environments that can be produced and accumulated PHAs when sugarcane juice is used as a carbon source during batch fermentation

1.4.2 To obtain the optimal condition for the production of PHAs by the efficient PHAs producing strain selected by statistic methodology

1.4.3 To get PHAs from intracellular PHAs producing strain

1.4.4 To get the PHAs yield and their productivity produced by pure and isolated strains

1.4.5 To obtain the potential use of sugarcane juice as a sole carbon source for PHAs production by the PHAs producing strains