# CHAPTER I



# INTRODUCTION

Petrochemical-based plastic films have many benefits to mankind as they are used in many diverse fields such as plastic bag, film packaging, and household applications. This is owing to their advantages such as light weight, high strength, easier to manufacture, and low price. However, the large drawback of plastic film is non-degradable resulting in an environmental problem [1]. Hence, many methods to manage the plastic wastes are required; for example, recycling, incineration, landfill, and preparation of biodegradable plastics. Nevertheless, these methods have their own advantages and limitations. For instance, recycled polymer generally has low strength; moreover, it can not be degraded and is still needed to be eradicated with other ways eventually. Subsequently, the remaining plastic wastes are either incinerated to obtain heating energy or deposited on to landfills. The cost of disposing plastic wastes is high and has some effects on the environment such as greenhouse emissions and toxic gases.

Up to now, it is believed that biodegradation is potentially the most environmentally friendly approach to manage plastic wastes. For example, unlike incineration, there is no emission of toxic gases. When disposed in the soil, it can be completely resolved into water and carbondioxide by the action of the microorganism. So an interest and activity in the area of biodegradable plastic is increasing, and there is an urgent requirement to develop environmentally biodegradable and benign materials in order to reduce high environmental load. The synthesis of biodegradable plastics such as poly(hydroxybutyrate) (PHB), poly lactic acid (PLA), and poly(hydroxylvalerate) (PHV) was expected to replace non biodegradable plastic films. However, these polymer are more expensive due to so they are not widely used for film packaging . Therefore, there is currently a wide interest in using biopolymers from renewable or natural resources such as starch, cellulose, lignin, chitin, chitosan, etc.

Cassava starch is a natural biopolymer. It is an environmentally friendly materials since it can be completely biodegraded in a natural environment. Cassava starch is abundant in Thailand and its price is low because Thailand is one of the major countries who can produce cassava starch producing in the world. Cassava starch in Thailad is produced about two million tons per year. So cassava starch is the most widely used as a raw material for biodegradable film preparation in Thailand. Generally, starch is not a true thermoplastic but it is presented in a plasticized form by the addition of plasticizer such as water, glycerol, sorbitol for fabrication. Therefore, cassava starch film can be made by various techniques, such as thermoplastic processing and casting, via plasticized starch form. However, disadvantage of plasticized starch film is its low mechanical properties such as tensile strength; young are modulus, and its sensitivity to water when compared to common plastics. Hence, biocomposite film is one of the methods for improving the mechanical properties of biodegradable plastic film. Crystalline cellulose has interesting properties for reinforcing starch film, especially because of its low cost, renewability, biodegradability, and nontoxicity. In fact, many studies indicated superior mechanical properties of starch biocomposite film with increasing cellulose content at the suitable volume. Crystalline cellulose is usually produced from cellulose, which is mostly found in plants. Many Researches interested in native plants and agricultural waste as a source of crystalline cellulose. Generally, cultivation of cotton, ramie, corn, sugar cane, banana, and coconut are widely used as sources to produce native cellulose. As a result of their cheap price and biodegradability, they are suitability for using as starting materials to produce crystalline cellulose.

Sugarcane and banana can grow well in the tropical countries such as Philippines, Indonesia, India, and Thailand. About 50 tones of sugarcane is annually produced in Thailand. Sugarcane bagasse or bagasse is residues from processing of sugarcane. For banana, it can grow in all regions and all year-round in Thailand. All parts of it can be used such as fruit, leaves, and pseudo stem. Similar to bagasse, dried banana pseudo stem or dried banana stem is agricultural waste after harvest. These agricultural wastes are cheap and abundant; moreover, they are rich in cellulose component. Approximately 40% and 55 % of cellulose can be found in bagasse and banana stem, respectively. Accordingly, these agricultural wastes are of interest to be used as raw materials to prepare crystalline cellulose.

Therefore, the objective of this work is to prepare biodegradable composite films between plasticized cassava starch and crystalline cellulose from agricultural wastes. Two types of agricultural wastes, bagasse and banana stem, were transform in to prepare crystalline cellulose by acid hydrolysis using HCl and $H_2SO_4$. After that, the crystalline cellulose was blended with plasticized starch from 0-30% wt and then the biocomposite films were prepared by casting. The suitable condition for preparing crystalline cellulose was determined according to results obtained from a Macbetch color-eye 7000 spectrophotometer, a particle size analyzer, and a scanning electron microscope (SEM). Subsequently, the effects of particle size, type, and amount of crystalline cellulose on mechanical, thermal, and degradation properties were investigated. The mechanical properties, in terms of tensile strength and young's modulus of biocomposite films were studied by tensile testing. The thermal properties of the biocomposite films were characterized by a differential scanning calorimeter (DSC) and a thermogravimetric analyzer (TGA). The determination of biodegradability was performed by soil burial test and then the biodegradation behavior was followed by observing the changes in weight loss and morphology of the biocomposite films.