CHAPTER I

INTRODUCTION

During recent decades there has been a continuous increase in the use of plastics and it has become the major new materials replacing the traditional ones such as paper, steel and aluminum in many applications. Thus, the total volume of plastic production nowadays exceeds that of steel [1]. Their main advantages are that they are easy to formulate, light weight, cheap to produce and require low energy for their transportation and production. The ever-growing production and use of synthetic polymers have led to a waste disposal problem because they can not degrade when exposed to environment. Furthermore, plastic waste may represent an undesirable pollutant in many ecosystems (i.e., to soil, fresh water and marine habitats) because, in general, they are inherently inert to attack by microorganisms or by chemicals in the environment [2]. It has been found that the resistance of conventional plastics into microorganisms is primarily due to their relative impermeability of water into plastic films and the very high molecular weight of the plastic materials. Therefore, in order to make plastics disintegrate, it is necessary first to break them down into very small particles with large surface area and secondly to reduce their molecular weight [3].

Conventional garbage disposal methods such as incineration, landfill and recycling have serious limitations as follows: (1) incineration needs high temperatures more than 800°C [4], which makes it rarely used nowadays, (2) landfill has some problems about odor and the scattering of light weight waste materials by the wind and (3) recycling has not yet gained widespread acceptance because it is difficult to classify and separate used plastics. The use of unseparated recycled polymers leads to the production of materials with very poor mechanical properties and therefore unusable [2].

For the above reasons, conventional methods of waste disposal are not so attractive. As a result, there has been an increased interest in the production and use of fully biodegradable polymers replacing nonbiodegradable plastics, especially those used in packaging materials. This is because, as seen in Figure 1.1, the municipal solid waste of packaging accounts for approximately one third of the waste stream by weight [5]. Such biodegradable plastics are polycaprolactone, poly(hydroxy alkanoates), poly (vinyl alcohol), poly(ethylene glycol), etc. However, they are not widely used because these polymers are much more expensive than polyethylene (PE) or polypropylene (PP), which are commonly used for packaging applications [2]. Many research have been focused on the use of natural biopolymers such as starch, cellulose, lignin, chitin and chitosan, which are also fully biodegradable [6]. They are produced from renewable and natural sources.

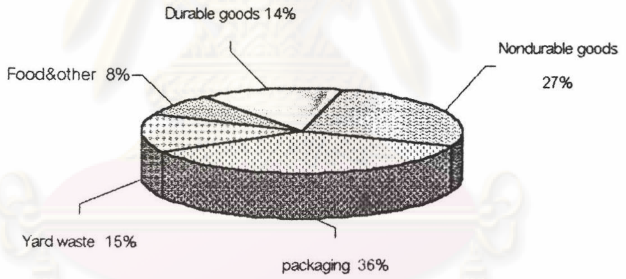

Figure 1.1 Product categories of municipal solid waste in the U.S. in 1994, by weight.

Starch has attracted significant interest in the preparation of biodegradable plastics. It is abundantly produced by photosynthetic plants and therefore is renewable and cheap. The addition of starch to synthetic plastics has been reported to enhance its biodegradability. When the plastic blend is placed in a biologically active environment, starch is thought to accelerate the degradation rate by microbial attack on the polysaccharide molecules. In the process, the microbes subsequently invade the plastic by consuming starch and creating pores. This provides greater surface area between microbes and polymer, resulting in easier disintegration of the blends into small pieces. The greater surface also increases the accessible to oxygen and moisture. Then, the oxidative degradation of polymer matrix are facilitated. In blends of starch with synthetic polymers such as low-density polyethylene (LDPE), polystyrene (PS) and polypropylene (PP), because the hydrophilic of starch leads to poor adhesion with the synthetic polymers, which are hydrophobic. The addition of starch to these polymers was reported to reduce the mechanical properties. Compatibility between starch and synthetic polymers is improved by using the compatibilizer that can react with the hydroxyl group of starch and form hydrogen bond or covalent bond with synthetic polymers. In the case of starch/polyethylene blends, we look for functional groups on the synthetic polymer that can react with the hydroxyl groups of starch. For example, PE copolymerized with acrylic acid, vinyl acetate and vinyl alcohol was used for compatibilization between starch and LDPE.

Banana is one of the most important fruits in Thailand. It is inexpensive and rich in starch content (14 – 23 % on a fresh weight basis or 62% on a dry weight basis) [7,8]. In Thailand, there are abundant of banana in everywhere because it can grow all year long. Furthermore, banana is easy to ripe. Therefore, in the present study we used starch from banana. This research focuses on the addition of low cost, biodegradable banana starch to LDPE as a route to improve the value-added of raw material in the country. This study report on the biodegradability, tensile and thermal properties of LDPE / starch composite film containing up to 20% banana starch by weight. At first, the starch was extracted from green banana. After film formation, physical, thermal and tensile properties of the blend films were characterized. Finally, the biodegradation of LDPE/banana starch films was assessed by activated sludge and enzymatic degradation methods.