CHAPTER I

INTRODUCTION

Currently, 270 million tons of petroleum and gas are globally used every year for the manufacturing of plastics. The impact of these activities on the environment is considerable for two reasons: firstly, petroleum is not a renewable product and, secondly, certain plastics are not recycled. Synthetic polymers are vital to economy and quality of life but their waste is becoming a serious ecological problem. Nowadays the products of synthetic polymers such as polyethylene, polypropylene, polystyrene, and etc. are discarded everywhere. They badly pollute the river, lakes, and land. To solve this problem researchers have examined various materials that can be biodegraded to substitute for synthetic polymers [1, 2].

The natural macromolecule is thought to be the best selection. Cellulose is one of the most abundant of naturally occurring polymers. It can form plastics after modification. Plastics obtained from plant sources could be good candidates for replacement of synthetic plastics, if they are biodegradable and poss similar physical properties. However, they have to offer comparable quality, such as barrier and mechanical properties, low cost, and etc [3]. In particular, cellulose derivatives are widely used by various industries (food, textiles, adhesive, etc.) [4] and cellulose based-films have been extensively studied because of their efficient oxygen and hydrocarbon barrier properties. These polymers are convenient for packaging, which represents approximately 40 % of the conventional use of plastics.

Hence, modification of this polysaccharide is of great interest because this compound is found in abundance in agricultural wastes. The esterification of cellulose by fatty acid has been widely studied and used in several industries (textile, films, resin, etc.). However, there are only few studies on long-chain fatty acid esters of cellulose, although they have interesting filmogenic properties and their biodegradability. In this way, fatty acid cellulose esters could be a good solution to alleviate of these environmental problems [5].

Normally, derivatization of cellulose can be performed under both heterogeneous and homogeneous reaction system. In heterogeneous reaction system, reaction rates and final degree of substitution are hindered by low accessibility of

cellulose to the esterification reagents. Therefore, the derivatization of cellulose under homogeneous solution condition is more considering due to several advantages such as the degree of substitution (DS) of the cellulose derivative can be effectively controlled by derivatizing agent to cellulose, the substituent groups are introduced regularly along the natural polymer backbone and the physio-chemical properties of products thus obtained are much better controlled than those that are prepared under heterogeneous solution conditions. These features are of prime importance for applications of cellulose derivatives [6]. Besides, solvent is much more important for these systems because cellulose has a strong hydrogen bonding and its hard to be dissolve. Partically, solvent is used for diluting hydrogen bonded of the cellulose. The widely used solvent for heterogeneous system is DMF (dimethylformamide). However, solvent consisting of lithium chloride/dimethylacetamide (LiCl/DMAc) has been proven to be the most suitable solvent for preparation of a wide variety of cellulose derivatives for either system.

In general, esterification reaction of cellulose given energy by conventional heating takes a long reaction time such as from 5 hours to 1 day or 2 days. Therefore, development energy by using energy from microwave oven to reduce the reaction time of esterification reaction is of prime interest. In addition to this advantage, cleaner reaction and better yields can be obtained [7, 8, 9].

In this research, paper mulberry was utilized as the main material with some assistant esterifying agent to produce a plastic film. The scientific name of paper mulberry is Broussonetia papyrifera in the family of Moraceae. However, this chemistry composition depends on the age of paper mulberry. Generally, the best cultivation is 6-12 months [10]. Nowadays, trend of paper mulberry production decrease because the lack of good seed of paper mulberry, competitive cost, and quality. However, paper mulberry is very cheap agricultural by-products. It costs 30 baht / 1 kg.

Therefore, the aim of this research was to investigate the feasibility to obtain cellulose film from this agricultural by-product. After delignification and pulping paper mulberry by sodium hydroxide, the pulp was bleached with hydrogen peroxide and then hydrolyzed by hydrochloric acid in order to obtain paper mulberry powder. After that, the esterification reaction of paper mulberry was carried out by using DMAc/LiCl as a solvent, lauroyl chloride as a modifying or esterifying agent, and 4-dimethylamino-pyridine as a catalyst under microwave energy activation. The

optimum condition for esterification of paper mulberry in terms of microwave power, irradiation time, temperature, amount of catalyst (DMAP), and amount of esterifying agent (lauroyl chloride) was investigated. After that, the properties of esterified-paper mulberry powder were characterized in terms of its surface morphology, thermal properties, % esterification, and chemical structure. Finally, the paper mulberry laurate films were prepared by casting method. Their properties including physical, mechanical, thermal, and degradability were also characterized.