CHAPTER 1 INTRODUCTION

1.1 Rational

Most of plastics are petroleum-based plastic. It's non renewable. The pollution of these plastic leads to serious environmental problem. Therefore, the development of bioplastics to substitute synthetic polymer has become an important challenge [3]. In addition, bioplastics are environmental friendly products. It can be degraded in a relatively short period of time. Its by-products are water, carbon dioxide and biomass. Biodegradable plastics from agricultural resources such as carbohydrates, starch, and proteins have become the potential replacements for petroleum plastic [2-4].

Polymer blend is one of the effective methods for providing new desirable polymeric materials for a variety of applications. Polymer blend contains mixture of polymer at least two components in order to produce materials with better properties compared to similar materials made from the respective pure polymers [5].

Thailand is one of the largest surimi producers in Southeast Asia [6]. Surimi production was estimated to be 140,000 metric tons and generates 2.8 million liters of wastewater. Protein contents in waste water are 4.8-5.4% [7]. In addition, fish processing operations produce waste in a solid (fish carcasses, viscera, skin, heads, dark muscle) [8]. Therefore, protein from fish waste led to one of the most attractive for bioplastic production as a result to value-added industrial wastes. Also the reduced amounts of waste in water help improve the environment.

Proteins are natural, complex hetero-polymers offering a variety of functional properties. Protein-based bioplastic could be defined as a three-dimensional macromolecular network stabilized and strengthened by hydrogen bonds, hydrophobic interactions and disulfide bonds [4]. Interaction of proteins can be formed and stabilized by new inter-molecular and intra-molecular interactions.

A main drawback of protein-based bioplastics is a narrow window processing on using conventional methods such as extrusion and injection molding due to its high viscosity. The problem of protein-based in extrusion process when using high screw speed caused extrudate rupture was reported [9, 10]. During thermal processing, protein has aggregation via sulfhydryl-disulfide interchange reactions, leading to an increase of the covalent bonds and high viscosity. Ullsten et al. [10] reported that salicylic acid allowed an enlargement of protein extrusion window. To delay protein aggregation, free radical scavenger actions of salicylic acid were proposed and were confirmed by electron spin resonance analysis. However, in terms of functional properties, protein-based bioplastic has low water resistance and moderate mechanical properties [9], therefore requiring much research to fully understand how to manipulate final material properties.

Lignin is a natural polymer and a main component in plants [11]. Beside, Kraft lignin is the byproduct of the alkaline pulping process from pulp and paper industry. It is a polyphenolic thermoplastic compound which is known for its radical scavenging properties [12, 13]. Kraft lignin may interfere the protein aggregation and may decrease viscosity of protein due to its free radical scavenging properties. In addition, Kraft lignin is relatively hydrophobic and high water resistant [14]. The use of lignin as a filler in materials have been reported [15] [16]. Therefore, blending fish protein (FP) and Kraft lignin (KL) may be an effective method to produce a new value-added product with better properties. Therefore, this research was aimed to study the effect of Kraft lignin on rheological properties and functional properties of fish protein-based biomaterials.

1.2 Objective

1. To study the effect of Kraft lignin on rheological and functional properties of fish protein based-biomaterial.

1.3 Scopes

1. Fish protein powder from threadfin bream was prepared by drying method. Then, chemical compositions of fish protein were characterized.
2. Materials containing a mixture of protein: Kraft lignin: glycerol in a weight ratio ranging from 70:0:30 to 0:70:30 were prepared by mixing and compression molding methods.
3. Rheological properties in term of viscosity, viscoelastic properties of plasticized fish protein/ Kraft lignin blends were determined by capillary rheometer and Dynamic Mechanical Analyzer (DMA), respectively.
4. Chemical bonds, protein aggregation, protein molecular weight and free radical of plasticized fish protein/ Kraft lignin blends were determined by Fourier Transform Infrared Spectrometer (FTIR), protein solubility in Sodium dodecyl sulfate, Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) and electron spin resonance (ESR) in order to study the radical scavenging properties of Kraft lignin on protein aggregation.
5. Functional properties in term of mechanical properties and water absorption of plasticized fish protein/ Kraft lignin biomaterials were determined by texture analyzer and water immersion.

1.4 Expected Benefit

1. To reduce wastewater treatment and added-value of fish protein on surimi industry.
2. To improve processability of protein blend and functional properties of bioplastics.
3. To understand influence of Kraft lignin on protein aggregation during processing.