CHAPTER I. INTRODUCTION

1.1 Introduction

Food packaging is one of the crucial aspects of food preservation due to preserves, protection, and ease of product distribution (Díaz-Montes,& Castro-Muñoz, 2021). While being stored, food undergoes a quality degradation process, which is a challenge for food producers, and considerably increases food waste (Sridhar *et al*., 2020). Different plastic materials have been used in conventional food packaging, such as polyethylene, polyvinyl chloride, polypropylene, polystyrene, and others. (Moeni *et al*., 2022). However, besides their dozens of value in terms of performance, mechanical, and physical properties, the main concern with conventional fossil-based packaging is their end of life and their effect on the environment (Díaz-Montes,& Castro-Muñoz, 2021). The statistical analysis demonstrated that packaging waste accounts for over one-third of plastic consumption worldwide, and only one-fourth could be recycled (Moeni *et al*., 2022). Moreover, plastic packaging used in food preservation does not contain antimicrobial properties to protect the food from microbial attacks that could cause food deterioration and foodborne illness. According to (WHO, 2015), infection from contaminated food accounts for more than 50% of diarrhea cases, which sickens 550 million people worldwide and results in 230,000 fatalities. Hence, developing alternative biodegradable packaging that can act as microbial protection is exceptionally significant and unavoidable.

The topics of bio-based and natural polymers are gaining much interest in both academia and industry due to their potential for usage in food packaging and preservation. Biodegradable polymers can be originated from various sources, including microorganisms, plants, and proteins, such as polysaccharides, polyhydroxyalkanoates, and polylactic acid. In food preservation, protein and polysaccharides-based film are widely used (Moeni *et al.*, 2022). The edible film is one of the alternative food packaging due to its preservation properties which inhibit oxygen penetration, are convenient, and can prevent moisture and aroma loss. Besides being considerably eco-friendly, the edible film is in high demand due to its capability to replace traditional food preservation methods, such as heat and salting, that disturb the food odors, appearance, and flavors (Yaldagard *et al.*, 2008; Moeni *et al*., 2022). Among various edible films, gelatin is the most commonly used material in the food industry due to its high concentration of proline, hydroxyproline, and glycine, which provide gelatin with great film-forming capacity and thus aid in the construction of the flexible film. Another consideration for using gelatin as biodegradable film material is due to suitable properties such as biodegradability, edibility, abundance, transparency, and strong barrier capability (Wang *et al.*, 2021). However, gelatin application may be hindered due to its hygroscopicity and relatively poor mechanical properties.

Previous studies have found that combining pure gelatin with a polysaccharide such as chitosan could improve the properties of the film. Chitosan is the most commonly used material because of its hydrophilic nature, non-toxicity, biodegradability, considerably low cost, industrially scalable, a potent antioxidant, and antimicrobial properties against free radicals and food-borne pathogens, which could effectively control food deterioration (Nagarajan *et al*., 2021; Nowzari *et al.*, 2013). Chitosan is a cationic polysaccharide with a high molecular weight obtained from the alkaline hydrolysis of the N-acetyl group of chitin (Moeni *et al.*, 2022). Several previous studies documented that chitosan film has shown a remarkable ability to extend the shelf-life of food including bell pepper (Poverenov *et al*., 2014), shrimp (Nagarajan *et al*., 2021), and papaya (Ali *et al*., 2011). Previous studies reported that the combination of the gelatin with the chitosan in the edible film formulation resulted in the increased shelf life of the shrimp (Nagarajan *et al.,* 2021), bell pepper (Poverenov *et al.*, 2014), fish (Nowzari *et al.*, 2013), and beef (Cardoso *et al*., 2014)

Despite its numerous beneficial properties for preservation, the pure film lacks sufficient defense against autoxidation and microbiological deterioration, which can lead to food decay. Such secondary active compounds derived from plants could be the solution by incorporating them into the edible coating, thus enhancing the food products' safety (Yuan *et al.*, 2016; Yu *et al.*, 2016). Regarding active ingredients that could be integrated into edible film and coating, plant extracts have drawn much attention as potential bioactive components due to their antimicrobial and antioxidant properties. The demand for natural herbs is increasing due to the avoidance of synthetic chemicals, which are possibly hazardous to human health (Meenatchisundaram *et al*., 2016). The idea of incorporating the active compound within the edible film is to create so-called “active packaging”.

Polygonum minus Huds, also known as Kesum plant, is one of West Borneo’s biodiversity, and it is frequently used as a flavoring component in regional cuisine (Lestari *et al*., 2020; Lestari *et al.*, 2020). Besides its properties as a flavoring agent, Kesum extract has been reported to have a high amount of natural antioxidant and antibacterial properties as it contains phenolic compounds, flavonoids, and terpenoids (Christopher *et a*l., 2015). Previous studies conducted by Wibowo *et al.* (2009) reported that the n-hexane fraction in the Kesum leaf extract could effectively inhibit the growth of *Escherichia coli* and *Bacillus subtilis*.

Although the incorporation of plant extract, especially Kesum extracts, into the edible film to increase the shelf life of food has been reported, no studies have been performed to examine the effect of Kesum extracts incorporation on the physical and mechanical properties of gelatin-chitosan edible film. Thus, this study aimed to evaluate the physical and mechanical properties of gelatin-chitosan edible film incorporated with Kesum extracts and its antimicrobial properties. We hypothesized that the addition of Kesum extract could affect the physical and mechanical properties of the film as well as its antimicrobial activity.

1.2 Research Objectives

The objective of this study is to investigate the physical and mechanical properties of the chitosan-gelatin edible film with the addition of Kesum extracts. The mechanical analysis consists of tensile strength, elongation at break, and Young Modulus. The physical analysis includes color, transparency, film solubility, water vapor permeability, scanning electron microscopy, and thickness. In addition, the antimicrobial activity of Kesum extracts also was investigated.