CHAPTER I

INTRODUCTION

1.1 Background

In recent years, the potential of edible coatings to improve food quality and to prolong shelf life has received increasing attention from researchers and industry due to it being environmentally friendly and effective. The term edible film can be defined as thin layered structures of biopolymer composition that can be consumed and are usually applied onto the surface of food products by dipping, spraying, or brushing (Bourtoom, 2018). Edible film and coating enhances the quality of food products, protect them from physical, chemical and microbial deterioration. Edible coating acts as barrier against gases and is also able to act as carriers of active ingredients such as antioxidants, flavours, colorants, spices, or antimicrobial agents (Guilbert *et al*., 1996).

Antimicrobial agents are those substances that have the ability to kill or inhibit the growth of microorganisms. Essential oils are among many natural antimicrobial agents that have been widely incorporated into edible films. When tested against food borne bacteria, clove is one of the essential oils that exhibited strong antimicrobial activity followed by cinnamon and thyme (Sheeladevi and Ramanathan, 2012). Clove is also abundant in Indonesia as the country contributes to 71% of total clove production worldwide with an average of 79.25 thousand tons per year (Siagian, 2014).

It has been previously reported that clove essential oil contains high content of eugenol which contributes to wide spectrum of antibacterial and antifungal properties. Many researches have shown that clove essential oil is effective in inhibiting the growth of bacteria and fungi such as *Listeria monocytogenes, Campylobacter jejuni, Salmonella enteridis, Escherichia coli, Candida* strains and *Aspergillus.* (Packyanathan and Prakasa, 2017). Essential oil, however, has low solubility and high volatility. Due to its hydrophobicity, essential oil needs to be converted into emulsion to be incorporated into hydrophilic starch based edible film suspension for homogenous distribution as well as to protect the bioactive compounds in essential oil.

Double emulsion or sometimes known as multiple emulsion emerges as developing group of emulsions that are likely to find increasing utilization within food industry due to their potential benefits over conventional emulsions (McClements, 2016). Aside from its broad use in reducing fat content, double emulsion might also act as encapsulation of bioactive compounds such as vitamins, minerals, or flavoring agents. However, it is suggested that the problem with double emulsion is the instability (Yildrim, 2015).

Considering the promising use of clove essential oil as antimicrobial agent, it is expected that by making it into conventional or single emulsion and double emulsion and incorporating the emulsions into starch based edible film suspension would enhance the characteristics of edible films in terms of antimicrobial activity. Corn starch was used in this research as it is one of the most promising candidates for edible films due to its low cost, abundance,

odorless, tasteless, and non-toxic properties. It is also preferred as base to emulsion-based films (Radha-Krishnan *et al*., 2015 and Suput *et al*., 2016).

1.2 Research Problem

Clove essential oil has been proven to have antimicrobial activity, which can be incorporated to the edible film. However, to improve the solubility and stability of essential oil, it needs to be converted into emulsion to be incorporated into edible film formulation. Double emulsions have been known to have potential benefits in food industry. Single and double emulsions might have different stability, solubility, dispersion, and migration rate of active compounds, hence will likely influence the characteristics of the edible film produced and its antimicrobial activity. Therefore, in this research two types of emulsions are characterized, and both would be incorporated into edible film formulation with different concentrations. The resulting edible films would be characterized and compared to know whether double emulsion is suitable to be utilized for edible films.

1.3 Research Objectives

The objective of this research was divided into general objective and specific objectives.

1.3.1 General Objective

The general objective of this research was to characterize edible films using two types of emulsions from clove oil.

1.3.2 Specific Objectives

1. To extract clove essential oil using distillation method and to determine its potential antimicrobial activity.
2. To determine the characteristics of single and double emulsion from clove oil including stability, particle size, and viscosity.
3. To determine the characteristics of corn-starch based edible films made from different formulations of both types of emulsions including physical characteristics (thickness, opacity, swelling index), mechanical properties (tensile strength and elongation), water vapor transmission rate and antimicrobial activity.