CHAPTER I
INTRODUCTION

1.1 Background

Edible film is a stand-alone film used for food separation layer, wrap or casing and pouch formed either by wet casting or dry molding methods (Pletney, 2007). It is generally formed from film forming materials in the form of biopolymers such as protein, polysaccharides, lipids and resins, to which plasticizer is often added in order to keep the film from becoming brittle (Embuscado and Huber, 2009; Han, 2014). Edible film's function is to protect food product from physical, chemical and biological deterioration (Han, 2014). Starch-based edible film has been commonly used due to the advantages of having tasteless, odorless, flexible and transparent properties. There have been various researches regarding starch-based edible film as carriers of active substances such as antimicrobial substances, one of them being essential oils (Suput *et al*., 2016).

In this research, cinnamon essential oil was used as an antimicrobial agent in edible film. Cinnamon (*Cinnamomum verum* or *Cinnamomum zeylanicum*) is one of the earliest and most popular spices used worldwide. It is included in the genus *Cinnamomum* and family Lauraceae, which is a native of Sri Lanka and South India (Parthasarathy *et al*., 2008). The related species, *Cinnamomum burmannii* is cultivated in Indonesia, hence is sometimes known as 'Indonesian cassia'. The bark oil of cinnamon is known to be a part with important value. The bark oil is usually obtained by distillation process with the yield of around 0.5-2.0% of oil obtained.

The oil is colorless to brownish-yellow with an agreeable aromatic odor and sweet, pungent taste. The major constituent of cinnamon bark oil is cinnamaldehyde which may be as high as up to 80% and 12% phenols. The minor constituents are of α-terpineol, coumarin and benzaldehyde (Weiss, 2002; Parthasarathy *et al*., 2008). Cinnamon oil possesses various biological activities such as antioxidant, antipyretic, analgesic, insecticidal, nematicidal, antibacterial and antifungal activities (Parthasarathy *et al*., 2008). According to Li *et al*. (2014), it is proven that cinnamon oil has antibacterial activity towards both Gram-positive and Gram-negative bacteria such as *Staphyloccocus aureus* and *Escherichia coli*, respectively, as well as antifungal activity towards *Penicillium* sp. and *Aspergillus* sp. Sukatta e*t al*. (2008) also reported cinnamon essential oil's antifungal activity towards *Rhizopus stolonifer a*nd *Alternaria alternata*.

However, due to the polar nature of starch-based edible film, the non-polar nature of cinnamon oil will be modified into other form in order to increase the compatibility, to which this can be achieved through double emulsion. Double emulsions or multiple emulsions are formed by emulsifying a single emulsion into another phase, forming either water-in-oil-in-water or oil-in-water-in-oil, to which these kinds of emulsion are primarily used for the controlled release of sensitive and active ingredients from the inner to the outer phase (Pulatsü e*t al*., 2017). Other benefit of double emulsion is as entrapment reservoirs to mask undesirable or unpleasant flavor perception of certain compounds. It is also able to protect sensitive compounds from external environmental reactivity such as oxidation, light

and enzymes, with protection of essential oils being one of the potential use for food applications (Petsev, 2004; Peredo-Luna e*t al*., 2016).

1.2 Research Problem

Studies done so far have proven that edible coating or film is one of the new and simple methods of preserving food products, and addition of natural food additive will increase its benefit. However, different cinnamon essential oil concentrations and double emulsion concentrations may have different physical properties such as its viscosity and stability, which may affect the effectivity of the antimicrobial activity as well as the physicochemical properties of the edible film. Therefore, further research needs to be conducted towards different concentrations of cinnamon essential oil made into double emulsion and different concentrations of double emulsion incorporated into edible film in order to know their suitability in the edible film and in terms of their antimicrobial activity.

1.3 Objectives

1.3.1 General Objectives

The general objective of this study was to characterize edible films using double emulsions of cinnamon essential oil.

1.3.2 Specific Objectives

The specific objectives of this research were:

1. To obtain cinnamon oil from cinnamon bark using distillation method and determine its antimicrobial activity in terms of its minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) or

minimum fungicidal concentration (MFC) towards *Escherichia coli*, *Staphylococcus aureus*, *Rhizopus stolonifer* and *Aspergillus niger* as the test microorganisms

2. To determine the characteristics of double emulsions made from different concentrations of cinnamon essential oil.
3. To determine the characteristics of edible films produced from the incorporation of different concentrations of double emulsions.