CHAPTER I

INTRODUCTION

1.1 Background

Consumption of fruit and vegetables are highly associated with a healthy lifestyle. International organization such as World Health Organization (WHO) encourage a daily intake of at least 400 g of fruit and vegetables in one day. It is said that eating minimum amount of fruit and vegetables might prevent several chronic disease such as heart disease, cancer, diabetes, and obesity. However, most of this produce are consumed raw or with minimal processing and the increase of foodborne disease associated with raw fruits and vegetables has increased and become a major food safety issue (Lynch *et al*., 2009; Olaimat and Holley, 2012).

There are so many factors that might cause contamination of fresh produce by microbial pathogens. It might occur during production, harvest, processing, transporting, as well as in retail and foodservice or even in the home kitchen. Most foodborne diseases are caused by Gram negative bacteria such as *Salmonella* and *Esherichia coli* and also Gram positive bacteria, *Staphylococcus aureus* and *Bacillus cereus* that are present on the surface of fresh produce (Mostafa *et al.*, 2017). Moreover, according to Nzeako *et al.* (2006), fungi might also present on the surface of raw fruits and vegetables.

In order to eliminate pathogenic organisms as much as possible, washing of raw fresh produce are usually done. However, washing with only water is not

enough to eliminate those pathogen. Thus, it has been a concern to find a suitable washing agent that is capable of eliminating most pathogenic organisms on the surface of fresh produce. Most disinfecting agents that are commonly used are chemical based. Many food sanitizers that are commercially sold are chemical based. However, the accumulation of chemical residue left on the surface of the food has become a concern. Moreover, it is known that several strains of microorganisms might become resistant to the chemical substances from the sanitizers (Davidson and Harrison, 2002).

There are many studies that studied regarding the antimicrobial agents present in plants including herbs and spices. Plants extracts are widely used in food technology industries because majority of plants extracts are considered as a healthier choice compared to chemical sources (Dorman and Deans, 2000). Clove was chosen as the raw material in this research because of the high availability in Indonesia as Indonesia is the number one producer of clove in the world. Moreover, clove extract has already been known to have a strong antimicrobial activity on a wide spectrum of microorganisms (Nzeako *et* al., 2006). Hence, the use of clove extracts might be used to produce a food sanitizers with natural antimicrobial agent.

In this research, two different extraction method were done to extract different compounds in clove. The extraction methods used were distillation to produce clove essential oil and maceration that produced clove ethanolic extract. Clove oil is also known to contain high amount of eugenol that is effective against other bacteria including *Listeria monocytogenes*, *Esherichia coli*, *Salmonella enterica*, *Salmonella enteritidis*, *Campylobacter jejuni*, and *Staphylococcus aureus*.

Both clove extract and clove oil are known to be able to inhibit or kill a wide spectrum of bacteria, including fungi. However, to be considered as a good sanitizer, a sanitizer have to be able to reduce 99.999% or 5 log reduction of microorganisms (Grab and Bennett, 1999). In this research the clove sanitizer were used to reduce 99.9% or 3 log reduction of microorganisms as the target.

1.2 Research Problem

In this research, clove was applied in food sanitizer formulation as the antimicrobial agents. Although it is known that clove extracts has the ability to inhibit the growth of pathogenic bacteria in raw foods, such as fresh fruits and vegetables, the effectiveness of clove oil and clove extract application as natural antimicrobial agent in sanitizer have not been explore much. Thus in this research two type of extractions are applied to a sanitizer base and their efficiency in reducing the number of pathogenic organisms is observed.

1.3 Objectives

1.3.1 General Objective

The general objective of this research was to produce a food sanitizers using clove (*Syzygium aromaticum*) extracts as the source of natural antimicrobial agents.

1.3.2 Specific Objectives

The specific objectives of this research was to:

1. Determine the effect of different extraction methods on the antimicrobial activity of clove (*Syzygium aromaticum*) extracts as a natural food sanitizers.

2. Determine the effectiveness of clove extract as antimicrobial agent in natural food sanitizers applied to food products.