CHAPTER 1

INTRODUCTION

1.1 Project Background

Breadfruit, *Artocarpus altilis* [Parkinson] Forsberg or also known as *Artocarpus communis,* is a seedless, starchy tropical fruit native to the Pacific Islands. Breadfruit was domesticated over millennia where over one hundred documented cultivars persist to this day (Carrington, Maharaj and Sankat, 2011). Recently, there is renewed interest in breadfruit utilization as nutritious food for food security. Traditionally, breadfruit is well known as staple foods in Oceania. Breadfruit is an energy-rich food due to high complex carbohydrates. Besides, breadfruit also serves as a good source of fiber and minerals with low fat content. Hence, breadfruit is an excellent dietary staple and compares favorably with other starchy crops commonly eaten in the tropics (Ragone, 2018).

The peaking interest of breadfruit is also observed in Indonesia; Directorate General of Horticulture had initiated breadfruit planting since 2002. This resulted in fluctuating annual production of breadfruit over one decade (2007-2017) from 92,014 tonnes to 104,966 tonnes (BPS-Statistics Indonesia, 2017). The central production sites of breadfruit are located in West and Central Java. Furthermore, several studies from Widowati (2009) and Supriati (2015) had focused on utilizing breadfruit as Indonesian staple food alternative besides rice. Looking at the potential of breadfruit as a staple food alternative, it is essential to initiate breadfruit commercialization, especially in Indonesia.

According to Supriati (2015), culinary practices of breadfruit in Indonesia are obtained through minimal processing for direct consumption by either boiling, frying or roasting. Besides, breadfruit has also been processed into flour to extend the shelf life as well as cut down the distribution cost. However, greater utilization of breadfruits such as processing into chips and other value-added products is hindered by its perishability. Based on the fruit physiology, breadfruit is a highly perishable climacteric fruit with short postharvest life of 2-5 days (Ragone, 2018). This is due to its high postharvest rate of respiration and the presence of polyphenol oxidase which results in rapid quality deterioration and skin browning respectively (Carrington, Maharaj and Sankat, 2011). Based on the Food and Agriculture Organization Report in 2019, fruits and vegetables was positioned as the second-highest commodity which contributed to postharvest food loss after roots and tubers. However, the data for breadfruit food loss is unavailable. Therefore, effective postharvest treatment is needed to reduce food loss.

Various postharvest treatments have been applied to extend the storage life of postharvest fruit and vegetables with some effective measures such as low temperature, modified atmosphere packaging, dipping, and coating. One simple postharvest treatment used is ascorbic acid dipping which is commonly used to prevent enzymatic browning by reducing o-quinones to diphenols (Ding et al., 2007). However, Oms-Oliu et al. (2006) found that ascorbic acid alone did not seem to completely prevent browning in pear after a certain storage period.

Edible coating can be an alternative postharvest preservation method since it is one of the promising methods due to its particular properties which are convenient, safe, inhibit oxygen penetration, and could avoid moisture and aroma loss. One example of edible coating that could be used as a preservative coating material is chitosan, a high molecular weight cationic polysaccharide originating from deacetylated derivative of chitin. Chitosan is known for its non-toxicity, biodegradability as well as strong antimicrobial and antifungal activities that could effectively control fruit decay (Jianglian and Shaoying, 2013). Previous studies by several researchers showed that chitosan coating has been successfully used in many postharvest fruits and vegetables such as papaya (Ali et al., 2011), fresh-cut lotus root (Xing et al., 2010) and grape (Santos et al., 2012). On the other hand, Worrell, Carrington, and Huber (2002) had conducted the effect of four types of coatings including chitosan on breadfruit quality. Despite the advantages to preserve postharvest fruit and vegetables, single chitosan coating sometimes demonstrates a certain defect such as limited inhibition to special microorganism and poor coating structure which leads to fruit decay. A certain defect was observed specifically in breadfruit chitosan coating study in which the coating had successfully delayed fruit softening and depressing respiration rate but induced flesh discoloration (Worrell, Carrington and Huber, 2002). In consequence, chitosan based composite coating may be applied to effectively preserve postharvest fruits and vegetables (Jianglin and Shaoying, 2013).

Chitosan combined with essential oil is on the increase since it offers relatively safe status, wide acceptance by consumers, and exploitation for potential multi-purpose functional uses (Jianglin and Shaoying, 2013). Essential oils or oleoresins are natural plant extracts that consist of a mixture of terpenes, terpenoids, and other aromatic and aliphatic constituents that exhibit antioxidant and antimicrobial properties (Bakkali et al., 2008). Rosemary (*Rosmarinus officinalis* L.) extract is one of the commercial aromatic and medicinal plants used as a good source of antioxidants to prevent oxidative degradation in foods. Rosemary extracts are natural and non-toxic which contain carnosic acid, rosmarinic acid, and carnosol which have strong anti-senescence, antiseptic, and antibacterial properties. Those beneficial properties especially the antioxidant properties are associated with the presence of phenolic diterpenes which has the mechanism of hydrogen donation to break free radical chain reactions (Stefanovits-Banyai et al., 2003). Considering the superior properties of rosemary extract and chitosan coating, this chitosan based composite coating had been successfully applied in fresh-cut pears (Xiao et al., 2010) and butternut squash (Ponce et al., 2008) which improved the antioxidant protection, sensory qualities, and reduction of browning. Referring to the aforementioned effect of rosemary, it is hypothesized that the flesh discoloration drawback of single chitosan coating in breadfruit can be overcome by the incorporation of rosemary extract.

1.2 Objectives

The objective of this research is to investigate the protective potential of chitosan coating and rosemary essential oil incorporated to chitosan coating on physicochemical properties of breadfruit (*Artocarpus altilis*). Furthermore, the effects of those coatings were be investigated on breadfruit quality throughout the 9 days storage period.

1.3 Scope of Work

In this study, chitosan coating as postharvest treatments was applied to breadfruit. Furthermore, the chitosan coating applied is optimized by incorporating rosemary essential oil as an antioxidant source. All of the treated breadfruit were stored in air-conditioned temperature for nine days. During the storage period, physicochemical properties of the breadfruit such as physical appearance which encompasses color and firmness, weight loss, total soluble solids, and total antioxidant capacity were analyzed. It is expected that the aforementioned postharvest treatments maintained the overall quality of breadfruit as well as prolonging the shelf life.

1.4 Importance of the research

The findings of this study will contribute to the improvement of postharvest handling techniques for breadfruit since it is still limited. It is also expected that the outcomes will be able to enhance the production and utilization of breadfruit to increase food diversification in Indonesia.