CHAPTER 1

INTRODUCTION

1.1 Principles, rationale and hypothesis

Harvested longan fruit faces rapid discoloration due to desiccation and reaction of polyphenol oxidase within 2 days of storage at ambient temperature and other disorders due to chilling injury including fruit rot. Sulfur dioxide fumigation has demonstrated that it can solve all these problems, but these fumigated fruits were detected to have residue levels exceeding the allowable standard when exported to China. Alternative treatments are needed. Recently, many reports of alternatives to SO_2 in both pericarp browning and decay inhibition have been suggested. However, their effectiveness needs to be demonstrated.

Only chemical dipping with organic acids can create some problems such as active substance in pericarp may be either cause gradual degradation by itself or the pH in pericarp and water loss after dip may increase during storage. Therefore, pericarp browning and/or bleaching injury may appear within a few days of storage (Lichanporn *et al*., 2002; 2003; Sapers and Miller, 1995; Buta *et al*., 1999; Son *et al*., 2001). Chitosan, an edible-based coating on fruit produce, can be mixed with organic acid solvent like citric acid, because of its good biocompatibility and carrier quality (Lin and Zhao, 2007; Hamdine *et al*., 2005).

The mixture of chitosan and citric acid can inhibit pericarp browning. Chitosan reduced water loss while the citric acid maintained a lower pH of the pericarp (Caro and Joas, 2005; Joas *et al*., 2005). However, the mixture still has some limitations to control fruit decay, in addition of preservatives like potassium sorbate may effectively inhibit the decay in fresh longan fruits (Chartupos and Kongbangkerd, 2002; Kheuenmenee *et al*., 2005). The coating mixture of chitosan and potassium sorbate has produced favorable results in fresh strawberry (Park *et al*., 2005). The addition of potassium sorbate into the mixtures can efficiently inhibit fruit decay by slow diffusion of sorbic acid active component from the coating to the fruit surface at lower pH (Dhamvithee *et al*., 2002; Franssen, 2002). It disturbs the cell membrane of yeasts, fungi and bacteria (Meyer *et al*., 2002).

In addition, the chitosan component has a mechanism to enable it to be antimicrobial: 1) By itself, the polycationic amine groups of chitosan can react with electronegative charges on the cell wall (No *et al.,* 2002) and cause morphological changes in the mycelium (Ait Barka *et al*., 2004); 2) Chitosan has been shown to elicit the production of pathogenesis-related protein (PR-protein) such as chitinase and ß-1,3-glucanase in plant tissue that are resistant to pathogens (Bautissa-Banos *et al*., 2006; Zhang and Quantick, 1998). The PR-protein may be also led to increased chilling tolerance and resistance to pathogens, thereby decreasing the incidence of decay as reported in tomato by Ding *et al*., 2002.

Consequently, the technology of an edible coating incorporated with organic acid and some preservatives for delaying pericarp browning, chilling injury and fruit decay is very interesting. The research on mechanisms of delaying pericarp browning and decay are needed.

1.2 Research objective

1. To compare the efficacy of citric acid mixed in chitosan-based coating on delaying pericarp browning.

2. To find the suitable concentration of potassium sorbate mixed in chitosan-based coating to delay fruits decay.

3. To study the effects of coating components on disease severity, fungal growth and mode of reaction of components in *Lasiodiplodia theobromae.*

4. To study the effects of coating material on chilling injury tolerance and disease incidence through the accumulation of pathogenesis-related protein (PR-protein) and sorbic acid content in pericarp at low temperature and the evaluation of market shelf life.

1.3 Research scope

An alternative to SO_2 fumigation to delay pericarp browning, chilling injury and decay of longan fruits will be investigated in a trial. Initially, the suitable concentration of citric acid mixed in a chitosan-based coating that delays pericarp browning during storage at ambient temperature will be examined. The experiment will further examine the optimum concentration of potassium sorbate in chitosan-based coating to delay decaying fruits.

The best treatment from the previous experiment will be studied to examine the effects of the coating on disease severity, fungal growth and mode of chemical reaction to *Lasiodiplodia theobromae*. *In vivo* study will be analyzed for the disease severity during storage at 20-25°C, microscopic study and the defense reaction mechanism in the fruit's tissue will be examined. The effect of the components will be confirmed *in vitro* on fungal growth and spore production, including morphological change. The elicitation effects of the coating material on chilling injury tolerance and disease incidence by accumulation of pathogenesis-related protein (PR-protein) in pericarp at low temperature will also be evaluated. The market shelf life of longan fruits coated with chitosan+citric acid+potassium sorbate will be also examined. The concentration of sorbic acid degradation in the pericarp and pulp in relation to disease incidence during storage will be also determined.

1.4 Usefulness of the research

This new technology of chitosan-based coating incorporated with citric acid and potassium sorbate has the potential to become the alternative treatment to SO_2 fumigation.

1.5 Research locations

- Postharvest Technology Institute, Chiang Mai University, Chiang Mai 50200, Thailand.