CHAPTER 1
INTRODUCTION

1.1 Principles, rationale and hypothesis

Citrus; one of the major commercial fruit crops, is widely consumed both as fresh fruit and juice. Its global demand is attributed to its high vitamin C content and antioxidant potential (Gorinstine *et al*., 2001). Citrus is mainly cultivated in the subtropical and tropical regions of the world between 40° north and south latitude in over 137 countries on six continents (Ismail and Zhang, 2004)

In the northern part of Thailand, citrus industry comprises about 11,200 ha, of which ‘Sai Nam Phueng’ tangerines (*Citrus reticulata* Blanco) are grown and cover about 96% of this area. In former time, ‘Seethong’, ‘Freemont’, ‘Ocean’, ‘Satsuma’, ‘Sweet orange’, ‘Neck orange’, ‘Acidless orange’ and ‘Pummelo’ were considered as well-known commercial cultivars, latter ‘Sai Nam Phueng’ notably became more important (Office of Commercial Affairs, Chiang Mai, 2008). The majority of citrus produced in Thailand is destined for consumption in the country. The export market demands a high quality product. Citrus is an important fruit crop in an international trade requiring excellent quality and shelf life attributes. Postharvest treatments are applied to citrus fruit before storage in order to delay senescence, minimize spoilage, and improve appearance and marketability. Commonly used postharvest treatments were degreening, curing, wax coating and application of growth regulators. Packing-line operations are treatments to the fruit in packinghouse (Ladaniya, 2008).

Coatings, which are defined as thin layers of wax or other material applied to the surface of a food, have been used for over 800 years. Records dating to the 12th and 13th centuries showed that wax coatings were applied to citrus fruit in China (Hardenburg, 1967). Such coatings decreased the availability of oxygen to the fruit and therefore, induced fermentation. In the United States, wax coatings have been used commercially since the 1930's when oranges were coated with melted paraffin waxes (Kaplan, 1986). These early coatings were used to reduce postharvest water loss. Later, coatings were used to create the appearance of a glossy skin. Moreover, coatings also have been used to preserve attributes associated with fruit and vegetables quality, as well as increase shelf life (Kester and Fennema, 1986).

The purpose of coating fruit and vegetables has changed pending on the types of coatings used. First, when prevention of water loss was the goal, coatings were primarily made of paraffin wax. However, when added glossiness and sheen became the desired characteristics, the coating materials changed to "solvent" type. These solvent coatings were made from petroleum solvents in which resins, plasticizers, and other film forming agents were added (Kaplan, 1986). In the 1950's carnauba waxes were introduced. However, due to the dull appearance that they produced, such waxes were only used in combination with polyethylene and paraffin wax for long term storage of lemons. In the 1960's waxes made of resins and shellacs dissolved in water became popular for using on citrus commodities (Kaplan, 1986). Moreover, waxes and shellacs coatings have been used in citrus fruit and other fruit applications including apples, and pears (Hagenmaier and Baker, 1993a, 1994a, 1995; McGuire and Hagenmaier, 1996, Hagenmaier, 2000; Amarante *et al*., 2001a, b). Wax coatings retarded respiration, inhibited oxygen supply and increased carbon dioxide content within citrus fruit. Early research showed that coatings applied to citrus fruit decreased the diffusion of gases across the skin, increased internal carbon dioxide content, reduced internal oxygen content, reduced the rate of respiration, and delayed ripening changes (Hagenmaier, 2000; Porat *et al*., 2005).

The mechanism in which coatings preserve fruit and vegetables is done by producing a modified atmosphere surrounding the product. This modified atmosphere can serve several purposes, including reducing oxygen availability and increasing the internal carbon dioxide concentration of fruit or vegetables (Smith *et al*., 1987). Modified atmospheres created by coatings are produced by the physical trapping of carbon dioxide gas within the fruit tissues during respiration. The increased levels of carbon dioxide lessened respiration rates, and therefore, delayed senescence. In addition, coatings may have different levels of permeability to oxygen. Decreased oxygen permeability can also reduce respiration and increase shelf life.

In addition to reduction of respiration rates, coatings also act as hydrophobic barriers which prevent water loss from transpiration. Such a feature is highly desirable for fruit and vegetable commodities. Water loss can lead to decrease turgor pressure which results in shriveling and wilting, both of which make the products unsaleable (Kester and Fennema, 1986). Other quality improvements related to coatings include slower softening and texture changes, as well as increase color retention (Lerdthanangkul and Krochta, 1996).

1.2 Research objectives

1.2.1 To study the suitable commercial coatings for tangerine fruit.

1.2.2 To study the effect of coating treatment on physiological and biochemical changes of tangerine fruit in comparison with non-coated control.

1.2.3 To develop the suitable coating materials which can be used for tangerine fruit.

1.2.4 To study the effect of developed coating materials on physiological and biochemical changes of tangerine fruit in comparison with the fruit coated with suitable commercial coating and non-coated control.

1.3 Research scope

1.3.1 To study the effect of commercial coatings on tangerine fruit by physiological and biochemical changes analysis in comparing with non-coated control to evaluate the suitability.

1.3.2 To develop the coating materials by using edible materials and ingredients that available in Thailand.

1.3.3 To study the effect of developed coating materials on suitability for use on tangerine fruit by physiological and biochemical changes analysis in comparison with the fruit that coated with suitable commercial coating and non-coated control.

1.4 Usefulness of the research

The results obtained from this research will help to decide the appropriate commercial coatings for ‘Sai Nam Phueng’ tangerine fruit. Furthermore, this research could be beneficial in developing coating materials for tangerine fruit. Therefore, they also could extend storage life and maintain the quality of tangerine fruit close or equal to the tangerine fruit coating with commercial coatings.

1.5 Research locations

1.5.1 Horticultural Postharvest Laboratory, Department of Plant Science and Natural Resources, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200, Thailand.

1.5.2 Plant Physiology Laboratory, Department of Plant Science and Natural Resources, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200, Thailand.