# Quality Changes of Litchi (*Litchi chinensis* Sonn.) Fruit by PE and PVC Modified Atmosphere Packaging (MAP)

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**Abstract**

Litchi (*Litchi chinensis* Sonn. cv. Hong Hauy) fruits were packed in tray and wrapped with polyethylene (PE) and polyvinyl chloride (PVC) films. The trays were then stored at 5°C and determined for quality changes at 3 days interval. The results showed that litchi wrapped with PE had slight change in weight loss during 12 days storage, whereas 6% weight loss were found on 9$^{th}$ day by using PVC wrapping. The red colour of litchi peels was retained better in PE than PVC except on 12$^{th}$ day of storage, while there was no significant difference in litchi flesh. The firmness of litchi fruits was decrease sharply from 0 to 3 days in both PE and PVC. There were no significant differences in titratable acidity and total soluble solids content of litchi fruits treatments wrapped with PE and PVC. In addition, the sensory evaluation was also evaluated and the general acceptance and sweetness were scored higher in PVC than PE. Moreover, the fruit decay was found in PE rather than PVC. Therefore, it can be concluded that modified atmosphere packaging (MAP) using PVC film wrapping might be more effective for extending the shelf life of litchi fruits.

*Keywords: fruit quality, firmness, colour change, browning, sensory evaluation*

## INTRODUCTION

Litchi (*Litchi chinensis* Sonn. cv. Hong Huay) is commercially grown in the northern part of Thailand (Subhadrabandhu, 1990). Litchi fruits have a short postharvest life after harvesting for 2 or 3 days, the red pericarp becomes desiccated and rapidly turns brown and brittle. The cracking pericarp provides entry to fungal pathogens and causes rapid decay (Kaiser, 1994), consequently, its flavour is lost (Wong et al., 1991). The browning of litchi fruit pericarp after harvest is due to cellular breakdown leading to mixing of browning-related enzymes, polyphenol oxidase, and substrates, desiccation, changes in anthocyanins, attack by pathogens, and other unknown factors (Scott et al., 1982; Chen, 1984; Tan and Zhou, 1987; Zhang and Quantick, 1997). The appearance and quality of litchi fruit can be maintained by rapid cooling after harvest and storage at low temperatures with high humidity, treating with fungicides and other preservatives, modifying the atmosphere surrounding the fruit, and a appropriate packaging (Zauberman et al., 1991).

Storage under modified atmosphere packaging (MAP) results in elevation of $CO_2$ and reduction of $O_2$ levels and has been found to be beneficial in many tropical fruit (Kader, 1994). MAP has been reported to be beneficial for litchi in maintenance of the high humidity essential for prevention of water loss and browning of the pericarp (Paull and Chen, 1987). Storage at 27°C, perforated low density PE and PVC were able to reduce the rate of browning compared to the

control treatment, with 15.6% and 5% incidence of dark fruits 8 days after harvest. (Fontes et al., 1999).

The objective of this research was to compare the effect of modified atmosphere packaging (MAP) by PE and PVC on quality changes and sensory evaluation of litchi fruit.

## MATERIALS AND METHODS

### Fruits and Treatments

Litchi (*Litchi chinensis* Sonn.) fruits were harvested in local farms, Payao province, Thailand and transported to laboratory within 5 h. The study was perform using 2x5 factorial in CRD experiment in order to investigate the effect of wrapping film (polyethylene and polyvinyl chloride) and storage time (0, 3,6, 9, and 12 days) on the quality attributes of Litchi. Fruits of uniform sizes with 80% maturity, free of physical damage, injury caused by insects and fungal infection were selected and distributed into groups of 20 fruits. Each group represented one replicate, and for each treatment three replicates were used. Fruits were packed in trays sealed with polyethylent (PE) and polyvinyl chloride (PVC) and then stored in controlled temperature room at 5°C. Ten fruits from each replication were then taken for determine changes of weight loss, colour changes, firmness, titratable acidity, total soluble solid content, and sensory evaluation after 0, 3, 6, 9, and 12 days of storage.

### Determination of Quality Changes

**1. Weight loss.** The percentage of weight loss was calculated using equation below:

$$\% \text{ total weight loss} = \frac{(\text{initial weight of fruit} - \text{final weight of fruit}) \times 100}{\text{initial weight of fruit}}$$

**2. Fruit firmness.** It was determined by hand penetrometer with 5 mm diameter plunger.

**3. Colour change.** The peel colour was measured using a tristimulus colorimeter (Hunter Color difference Meter, Model CR-100, Minolta) and the results were expressed as L*, a*, b*, and hue angle ($H°$). The L value corresponds to the human visual response to light or brightness ranging from no reflection (L*=0) to perfect diffuse reflection (L*= 100). The a* value corresponds to red-green scales and ranges from negative values of green color to positive values of red color. The b* value corresponds to yellow-blue scales in which the positive and negative values indicate a yellow and a blue color, respectively. Hue angle can be calculated by the following equation.

$$H° = \tan^{-1} (a^*, b^*) \times 180\pi$$

**4. Titratable acidity and soluble solids content.** Litchi juice was extracted by squeezing manually through filter paper and titratable acidity was determined by titration with 0.1 N NaOH and calculated as citric acid equivalent. Total soluble solids content was determined using hand refractometer (Atago, Japan).

**5. Sensory evaluation.** The sensory evaluation of litchi fruits after storage by MAP was also studied and scored using 1-5 scale by ten untrained panelists. General acceptance were 1, dislike very much; 5, like very much, sweetness: 1, not sweet; 5, very sweet, browning: 1, best-red and undamaged pericarp colour; 5, worst-brownish pericarp colour.

## RESULTS AND DISCUSSION

### Weight Loss

The result showed that PVC wrapping caused 0.68% and 6.85% weight loss on $9^{th}$ and $12^{th}$ day during storage, respectively. While, there was no weight loss found in PE film. This due to water condensation in the internal face of the PE film (Fig. 1A). It implied that PVC effectively reduced fresh weight loss without the inconvenience of water condensation.

### Firmness

Firmness was sharply decrease about 40% from 0 to 3 days of both PE and PVC wrapping and PE film can keep firmness constantly until 12 days storage. In the case of PVC, there was slightly change in firmness during $3^{th}$ to $9^{th}$ day and significantly decrease on $12^{th}$ day. However, there was non-significant different in firmness of litchi fruits wrapping with PE and PVC (Fig. 1B).

### Colour Change

There was slightly different in Hue angle ($H°$) and L* values in peel colour of litchi fruits wrapped with PE and PVC. The red colour of litchi fruits peel in PE packaging which was expressed by a* value can be maintained until 9 days storage and started to pale on $12^{th}$ day. On the other hand, a value of litchi fruits sealed with PVC was gradually increase throughout storage (Fig. 2).

The values of Hue angle, L* and a* of the arils showed no difference between litchi fruits stored with PE and PVC packaging. (data not shown).

### Titratable Acidity and Soluble Solids Content

Titratable acidity of litchi fruits stored under PE and PVC were decreased, while total soluble solids content were increased during 12 days storage. However, they were not significantly different (Fig. 3). This indicates that type of plastic film for modified atmosphere packaging do not affect the changes in acidity and sweetness in litchi fruits stored in low temperature.

### Sensory Evaluation

The litchi fruits packed under PVC film were more acceptable than those in PE, particularly after 12 days of storage. Although, general acceptance and sweetness of litchi fruits wrapped with PE and PVC was decrease from the beginning to $12^{th}$ day. Browning can be more effectively prevented by PVC wrapping than that of PE at the last day of storage (Fig. 4).

## CONCLUSIONS

The comparison study of two types of plastic films, Polyethylene and polyvinylchloride, in MAP showed that there were slightly difference in quality change of litchi fruit stored at 5$^{o}$C. The results showed that fresh weight of litchi fruits was lost only in PVC wrapping. It was also found that PVC can maintain the red colour of litchi peel better than PE, however there was no difference in colour changes expressed by Hue angle, L*, and a* values in the arils of litchi fruits. In addition, there was no effect of wrapping film types on the quality of litchi fruits in terms of firmness, titratable acidity and total soluble solids content. However, litchi fruits packed with PVC showed better scores of general acceptance, sweetness and less browning than PE. Therefore, cold storage of litchi fruits under MAP by PVC is more effective in extending the quality of litchi fruits than packing with PE.

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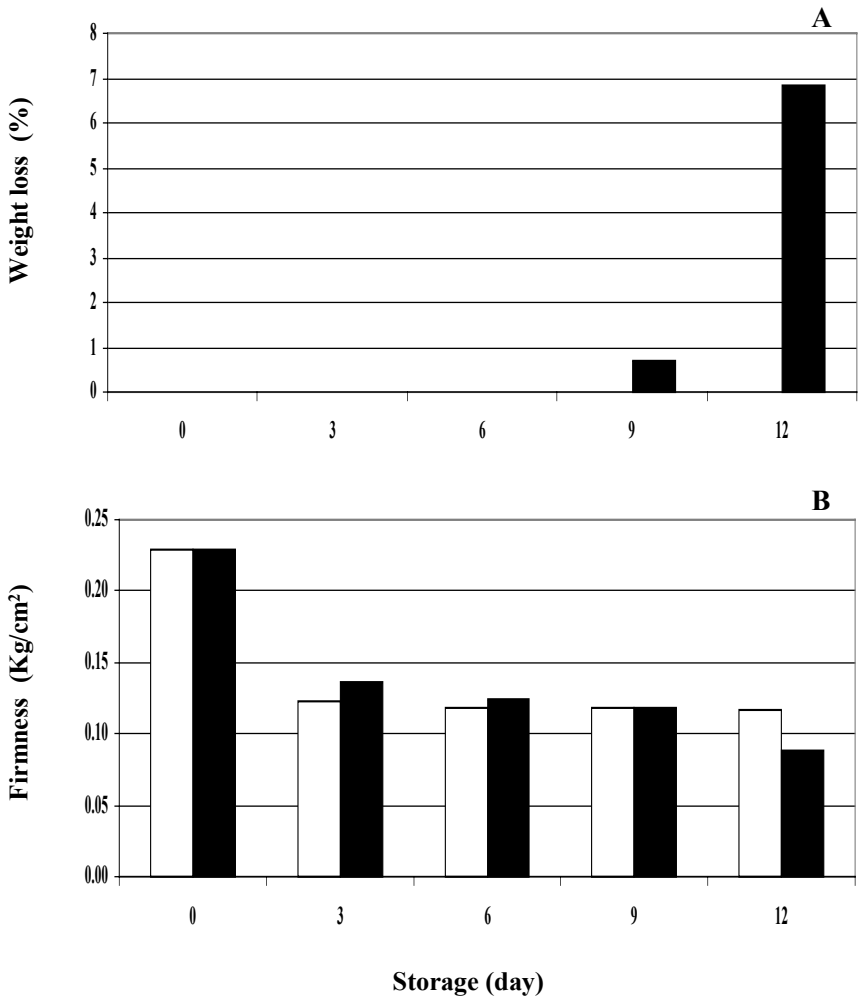


**Fig. 1.** Weight loss (A) and firmness (B) of litchi fruits wrapped with PE (□) and PVC (■) during storage at 5°C.

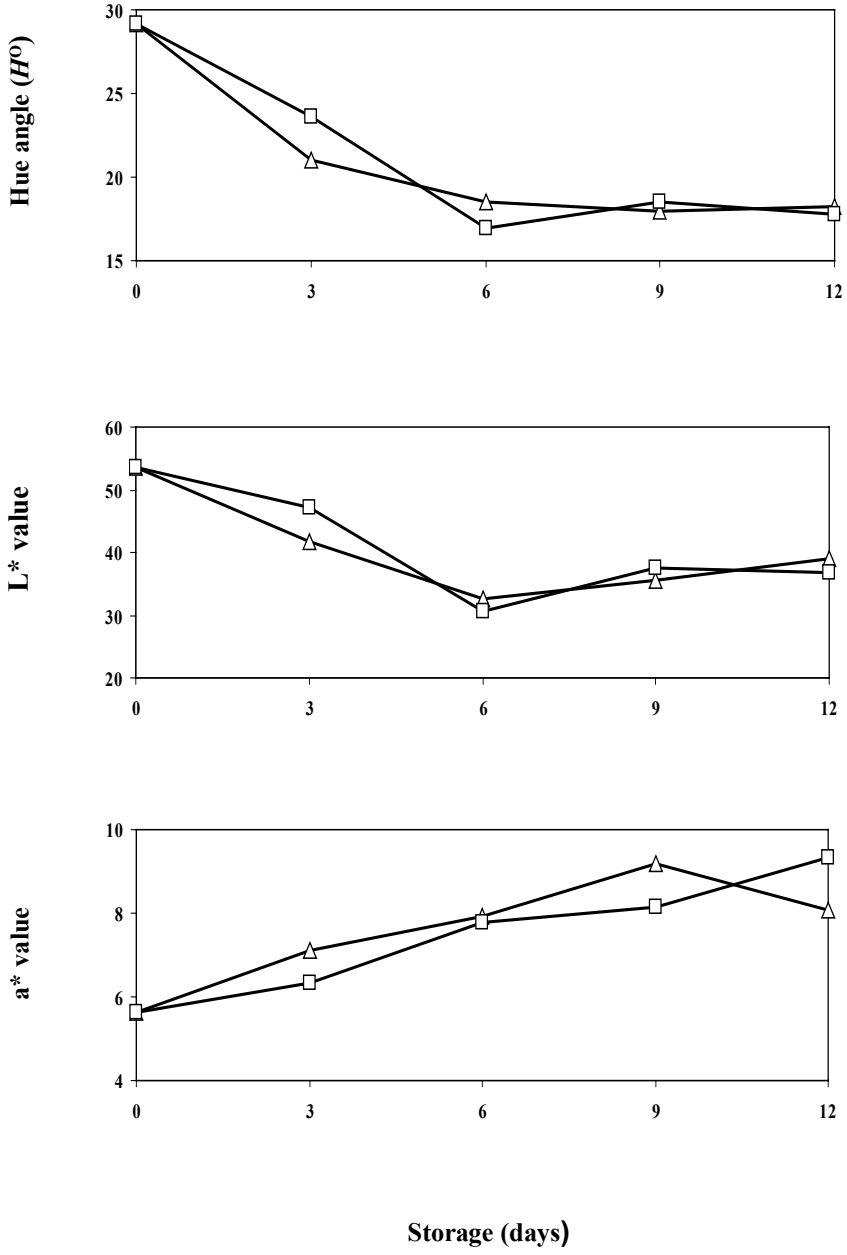


**Fig. 2.** Colour change expressed by Hue angle ($H^o$), 'L', and 'a' values of litchi fruits wrapped with PE (△) and PVC (□) during storage at 5°C.

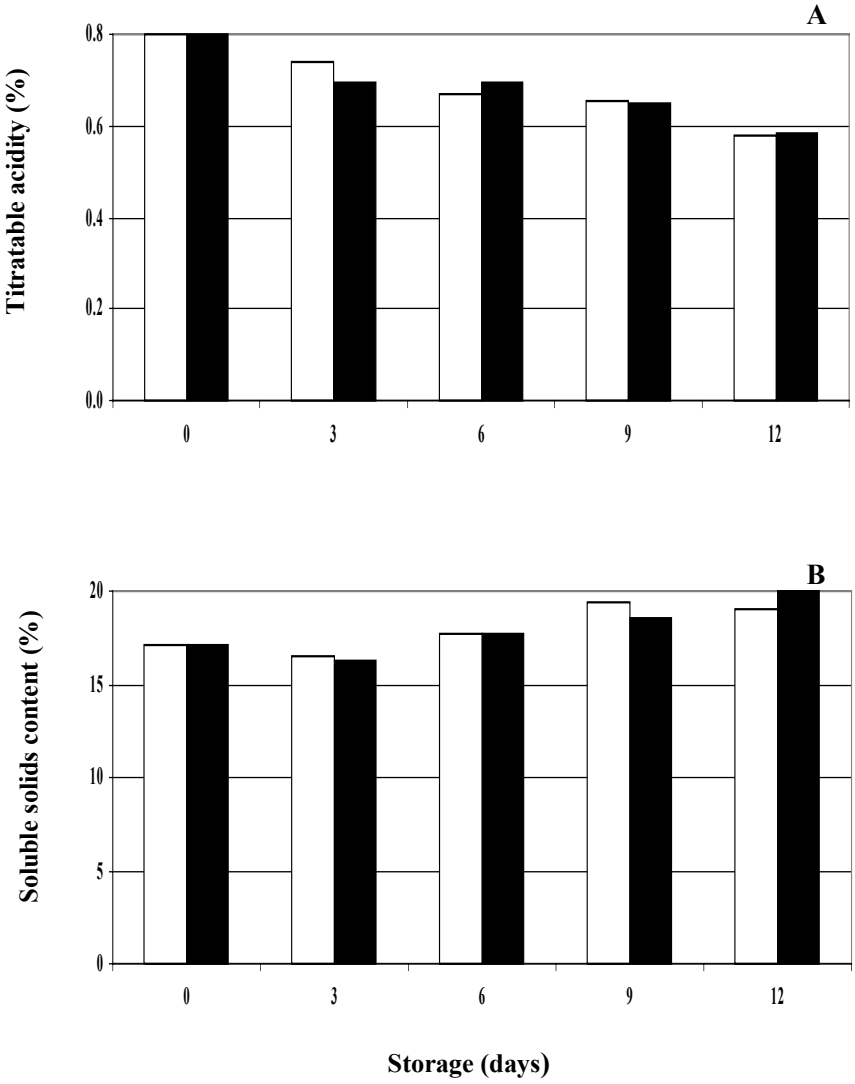


**Fig. 3.** Titratable acidity (A) and soluble solids content (B) of litchi fruits wrapped with PE (□) and PVC (■) during storage at 5°C.

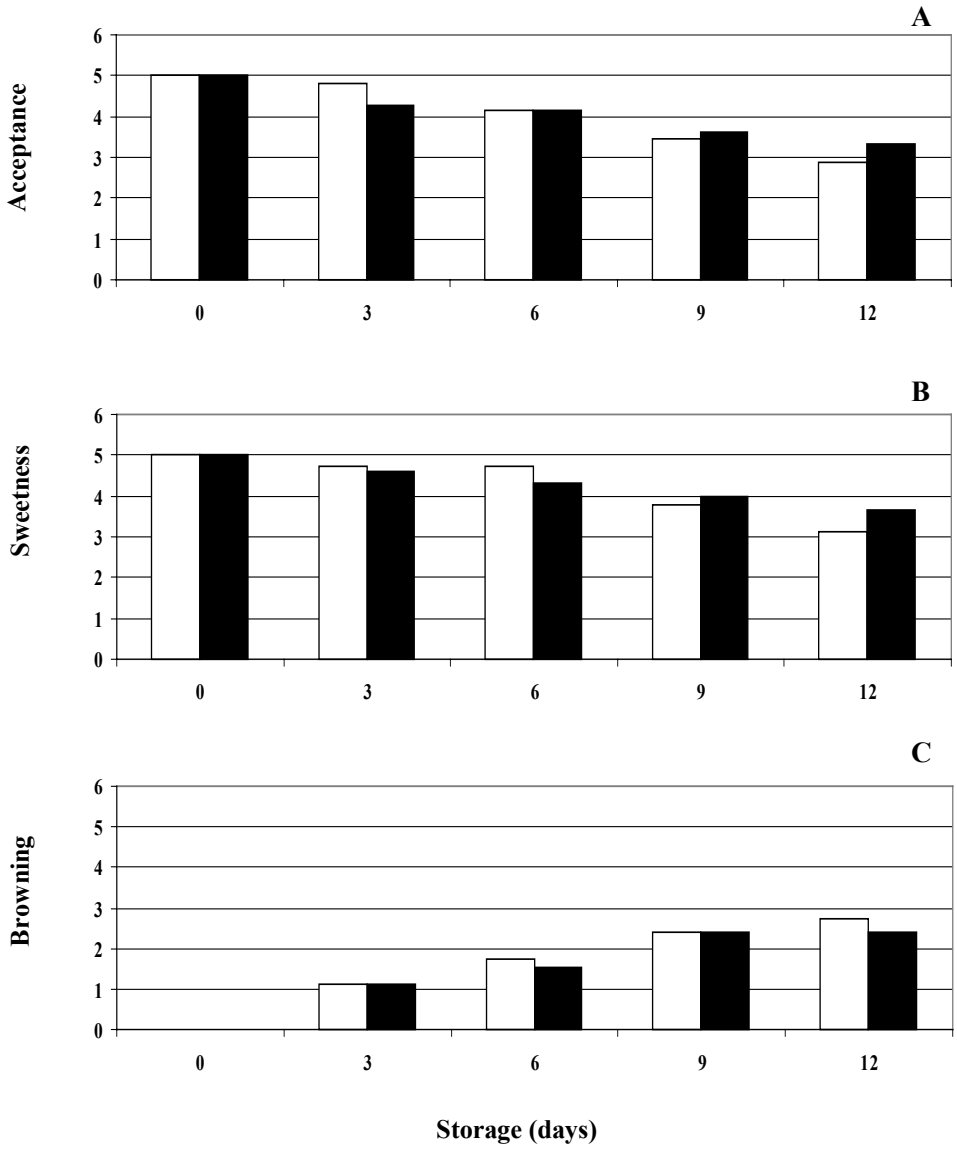


**Fig. 4.** Sensory evaluation of litchi fruits wrapped with PE (□) and PVC (■), stored at 5°C for 12 days. Acceptance (A) and sweetness (B) were scored by 1-5 scale, 1, the least acceptance and sweetness; 5, the most acceptance and sweetness. Browning (C) was graded by 1-5 scale, 1, best-red and undamaged pericarp colour; 5, wost-brownish pericarp colour.