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Preharvest bagging of litchi fruits influence their storage potential

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Abstract

Litchi fruit has a very short shelf life after harvest. To determine the potential of fruit bagging for extending storage life, litchi fruits were enclosed in 0.05 mm white polyethylene bags 0, 1, 3, 5 and 7 days before normal harvest. At commercial maturity, bagged and unbagged litchi fruit were picked and then held individually in closed but vented containers for 6 days at 20 °C and 95-100 % relative humidity in the dark. Bagging of fruits before normal harvest markedly delayed skin browning and reduced rot development of litchi fruit during storage. The best inhibition of the browning and disease development of litchi fruit was observed when the fruit was bagged 3 days before normal harvest. Bagged fruit had lower levels of total soluble solids (TSS) and titratable acidity (TA), but no significant differences in the TS and TA between bagged and unbagged fruit after 6 days of storage were recorded for flesh tissues. Thus, bagging fruit before normal harvest had the potential to reduce rots, maintain physical quality and extend storage life of harvested litchi fruit.

Key words: *Litchi chinensis*, bagging, fruit quality, harvest, rot, storage life

Introduction

Litchi (*Litchi chinensis* Sonn.) is a tropical and subtropical fruit of high commercial value for its white, translucent aril and attractive fruit colour (Ray, 1998; Holcroft and Mitcham, 1996). Litchi production has been increasing rapidly in the last few years (Jiang *et al.*, 2003). However, the fruit deteriorate rapidly once harvested due to rapid peel browning and decay (Huang and Scott, 1985; Zauberman *et al.*, 1991; Underhill, 1992; Jiang *et al.*, 1997; Ray, 1998).

Postharvest treatments, such as sulphur fumigation and acid dip, in combination with low temperature storage can effectively delay the loss of red skin colour of litchi fruit (Paull and Chen, 1987; Underhill, 1992), while application of fungicides, such as thiabendazole and prochloraz, exhibits effective control of spoilage pathogens (Wong *et al.*, 1990; Jiang *et al.*, 2001; 2003). However, because of concerns for food safety and restrictions in the use of chemicals, alternative means of colour and decay control in litchi fruit are needed (Korsten *et al.*, 1993; Jiang *et al.*, 2001).

Bagging of fruit during development can reduce disease and physical damage, and improve colour at harvest in a number of fruit (Bentley and Viveros, 1992; Hofman *et al.*, 1995; Joyce *et al.*, 1997). This approach is used to produce high-quality, unblemished fruits in Japan (Kitagawa *et al.*, 1992). Wrapping of fruit in newspaper is used in several Asian countries for fruit fly control. Bagging is also used on a limited scale on litchi fruit (John *et al.*, 1998). It is clear that bagging of fruit can affect several aspects of fruit quality such as colour and flavour (Hofman *et al.*, 1995; John *et al.*, 1998). The objective of this study was to evaluate the effect of pre-harvest fruit bagging with polyethylene bags on storage potential and quality of harvested litchi fruit.

Materials and methods

Twelve uniform 12-year-old litchi (*Litchi chinensis* Sonn.) var. Huangzhi trees, with an average height of about 3.5 m, were growing on a commercial farm at Zhonghua (lat 23°S and long 113°E), Guangdong Province were used for the study. Fifty uniform panicles per tree were selected at the base of the tree. Fifteen trees were used to allocate bagging treatments. Whole panicles were either unbagged or bagged with 0.05 mm thick and 55 × 40 cm long white polyethylene bags (produced by Guangzhou Plastic Factory), 1, 3, 5 and 7 days before normal harvest. The panicles without bagging treatments were used as the control. The bags were removed at fruit harvest. At harvest, each fruit was selected based on commercial grade standards (Underhill and Wong, 1990). Fruit with uniform shape and color were held in the dark at 25 °C and 95–100 % relative humidity in individual closed but vented containers (Terry and Joyce, 1993).

Fruit browning: Skin appearance was assessed by measuring the extent of the total browned area on each fruit pericarp of 30 fruits, using the following scale (Jiang, 2000): 0 = no browning (excellent quality); 1 = slight browning; 2 = < 1/4 browning; 3 = 1/4 -1/2 browning; 4 = > 1/2 browning (poor quality). The browning index was calculated as $\sum$(browning scale × percentage of corresponding fruit within each scale).

Disease incidence: Disease development resulting from natural infection was assessed by observing visible fungal growth or bacterial lesions on the surface. Fruit were checked at 2-day intervals (Jiang *et al.*, 2001).

Postharvest life: Postharvest life was defined as the time from harvest to when fruit reached less than 2.0 browning index, with no symptoms of disease (Jiang *et al.*, 2004).

Measurements of TSS and TA: The contents of TSS and TA of litchi fruit at harvest and after 6 days of storage were analyzed. Pulp (20 g) from 15 fruit without symptoms of disease was homogenized in a grinder and the supernatant phase was collected to analyze TSS and TA. TSS was assayed by using a hand refractometer (J1-3A, Guangdong Scientific Instruments) while TA was determined by titration with 0.1 mol/L NaOH.

Statistical anlysis: The experiments were arranged in completely randomized design. Data were tested by analysis of variance using SPSS version 7.5. Least significant differences (LSDs) were calculated to compare significant effects at P=0.05.

Results and discussion

Effect of pre-harvest bagging on skin browning: The major problem of harvested litchi fruit is deterioration in visual appearance (browning) (Jiang, 2000). Preharvest fruit bagging markedly delayed browning index (Fig. 1). The best inhibition of the browning was observed when litchi fruit were bagged 3 days before normal harvest. However, as fruit bagging time before normal harvest was extended to 5 or 7 days, there was a decreased effect on the browning inhibition. In this study, bagging litchi fruit 5 or 7 days before normal harvest caused anaerobic respiration (data not shown), which may cause damage to compartmentalisation between enzymes and their substrates, resulting in increased enzymatic browning (Pesis *et al.*, 2002).

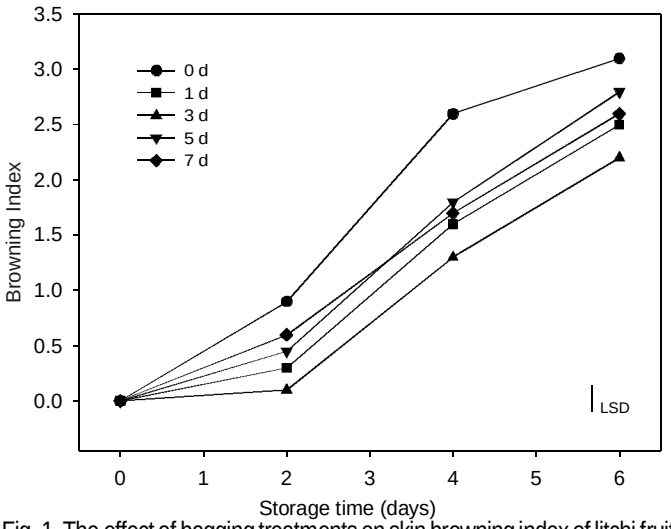

Fig. 1. The effect of bagging treatments on skin browning index of litchi fruit during storage

Effects of preharvest bagging on disease incidence by *Peronophythora litchii*: The principal disease of litchi fruit is caused by *P. litchii* (Jiang *et al.*, 2001). The disease development was markedly reduced by pre-bagging treatments (Fig. 2). Bagging fruit 5 or 7 days before normal harvest accelerated disease development during storage, compared to the bagging 3 days before normal harvest. Thus, bagging fruit with the time from 1 to 3 days before normal harvest tended to progressively enhance postharvest life, judged by skin browning index without disease development (Fig. 3). As bagging of fruits affected ripening characteristic and physiological activities, it was suggested that a suitable bagging time before normal harvest could induce a resistance to postharvest pathogens. However, the underlying mechanism requires further investigation.

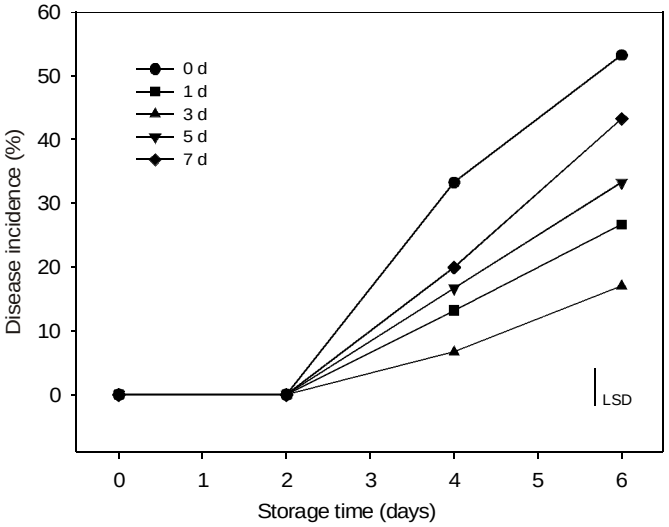

Fig. 2. The effect of bagging treatments on litchi fruit rot during storage

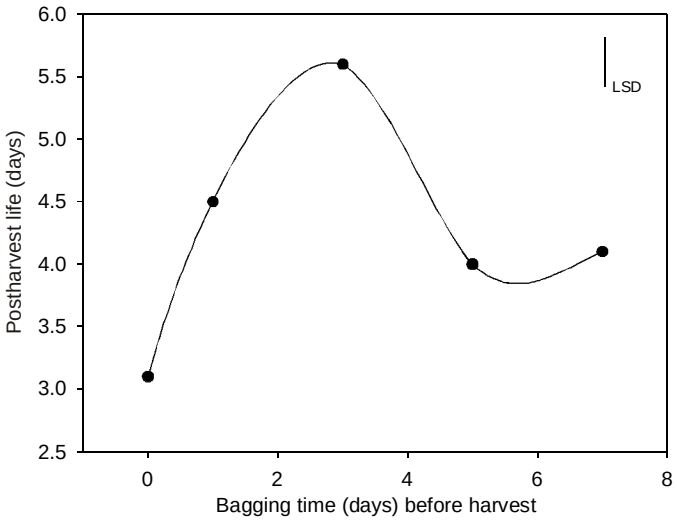

Fig. 3. The effect of bagging treatments on postharvest life of litchi fruit

Effects of pre-harvest bagging on TSS and TA: TSS and TA are important factors in flavour of litchi fruit (Jiang *et al.*, 2003). Bagging affected TSS and TA of litchi fruit at harvest, with all bagged fruit having lower contents than controls (Table 1). The contents of TSS and TA of litchi flesh decreased during storage but no significant difference in the TSS and TA of bagged and unbaged fruit after 6 days of storage was observed.

This research has shown that bagging of litchi panicles has the potential to improve fruit storability. The efficacy of pre-harvest

Table 1. Effects of bagging treatments on total soluble solids and titratable acidity of litchi fruit at harvest and after 6 days of storage at 25°C

Bagging treatment*	Total soluble solids(%)		Titratable acidity(%)	
	0	6	0	6
0	16.8a	15.2a	0.12a	0.07a
1	16.4b	14.9a	0.11a	0.07a
3	16.2b	15.0a	0.10ab	0.06a
5	15.9b	15.0a	0.08b	0.06a
7	16.1b	15.2a	0.08b	0.06a

* Bagging before normal harvest (days)

Each value is the mean for nine replicates. Means within a column followed by the same letter are not significantly different at the P=0.05..

bagging evidently depends upon the length of application. Bagging fruit 3 day before normal harvest can be an effective means of reducing rots while maintaining the physical quality and overall taste of the fruit. This non-chemical and inexpensive treatment deserves further development and application, especially under commercial distribution conditions or in developing countries such as China where refrigeration is inadequate. Further assessments are necessary to determine economic viability of this practice.

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