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LONGAN POST-HARVEST PROBLEM ASSESSMENT AND TREATMENT REVIEWS IN THE NORTH OF VIETNAM

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ABSTRACT

Longan (Dimocarpus longan Lour.) is a non climatic subtropical plant but well adapted to tropical areas. In Vietnam, longan is one of 12 high profitable fruit crops with a total of about 60,000-65,000 of hectares being grown throughout the country. Longan can be grown from North to South of Vietnam with no limitation in climatic. Recently, with the support policy from Vietnamese government and the opening of trade relation of Vietnam to other markets, longan production in Vietnam is predicted to be increased significantly in the future. The expansion of longan fruit from the domestic market to a significant export market has led to enhancing research on longan post harvesting and handling for a long storage life. A number of studies on longan fruit postharvest have been undertaken, but the research results have not been widely published and applied. This review summarises the current longan post harvesting treatments and chooses three treatment methods to analyse thoroughly according to the effectiveness of reducing water loss, pericarp browning and fruit decay with minimal effect on fruit eating quality.

Keywords: post-harvest treatment, pericarp browning, fruit decay, eating quality, commercial market, fruits' dipping

1. INTRODUCTION

Longan (Dimocarpus longan Lour.) is considered as Vietnamese traditional fruit crop with a total production of about 600,000 tons per year (Vietnamese Agriculture Jounal 2015). Longan fruit have pleasant flavor, but they are less well recognized or appreciated in the worldwide market.

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The longan market limitations are the short storage life and the perishability of harvested fruit. Pericarp browning and fruit decay are major problems that heavily affect the commercial value and the fruit eating quality of longan fruit (Tongdee 1994; Yueminh, 1999; Jiang et al. 2002; Le et al. 2011). This paper focuses on current longan post harvesting treatments to preserver exported fruit eating quality. Of all the post harvest treatments reviewed, three treatments were chosen to discuss in more details. The chosen treatments were (1) using sulphur dioxide fumigation (Tongdee 1994; Ji et al. 1999); (2) dipping fruit in nitric oxide (NO) (Duan et al. 2006); and (3) dipping longan fruit in acids (Apai et al. 2009, Apai 2010).

2. BOTANICAL CHARACTERISTICS OF LONGAN FRUIT

Longan fruit size at the maturity stage is about 1.5-2 cm diameter. The maturity of longan fruit is determined by the fruit size and weight or by the fruit skin color or fresh sugar or acid concentration. The fruit shape and color varies among cultivars. However, the majority of fruit shapes are conical, heart-shaped or spherical. Longan fruit contains a skinny, leathery and indehiscent pericarp around a juicy, edible white aril. Inside the edible white aril there is a small dark brown seed (Menzel et al. 2005). Regardless of the genotype, the postharvest life of longan fruit is very short, about 3-4 days at ambient temperatures. This is the biggest constraint for longan producers (Liu and Ma 2001). However, longan fruit can be served as canned, frozen and dried (Huang et al. 2005). There are three layers in the mature longan fruit pericarp. The outermost layer or the exocarp consists of a continuous cuticle, the middle layer or mesocarp is formed from parenchymatous tissue. The inner layer or endocarp is formed from tiny, thin-walled epidermal cells (Qu et al. 2001). Longan fruit pericarp differs among varieties. According to Lin et al. (2002) the variety with thick pericarp had less diseases and longer storage time than varieties with thinner pericarp.

3. HARVESTED LONGAN FRUIT PHYSIOCHEMICAL CHARACTERISTICS

Lin et al. (2001) indicated that after having picked and stored at 2 to 80C, the respiration rate and the ethylene production of longan fruit reduced constantly. However, when the fruit started to decay the respiration rate and ethylene production were increased The respiration rates were measured at 3, 7, 10, and 250C and were 8 mg CO2/kg/h, 12 mg CO2/kg/h, 54 mg CO2/kg/h, and 86 mg CO2/kg/h respectively (Zhang et al. 2005). Tongdee (1997) found out that the ethylene concentration in longan fruit was less in low-temperature storage conditions. Lin et al. (2002) reported that the total soluble solids of longan fruit reduced constantly after being harvested. During the storage period, if the total soluble solids of longan increased, this might be related to the degradation of cell wall substances such as pectin, cellulose and other polysaccharides. Han et al. (1999) indicated that after harvest, the titratable acidity (TA) in the

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longan pulp also reduced, and the TA increase was the consequence of pulp rot disease. Lin et al. (2002) confirmed that while the ascorbic acid concentrations in longan decreased, the activity of pectin methyl esterase and polygalacturonase increased during the storage period.

4. HARVESTED LONGAN FRUIT PROBLEMS

Pericarp browning is a serious problem in storing and handling longan fruit. It is one of the biggest problems of post harvesting in longan production. Pericarp browning is associated with desiccation, chilling, heat stress and diseases (Lin et al. 2002; Jiang et al. 2002). According to Lin et al. (2002) pericarp browning was the result of the interaction of these factors that disrupted the cellular compartmentation and led polyphenol oxidase (PPO) concentrated in the chloroplasts and plastids. These PPO react with phenolic substrates located in the vacuole and forming the brown polymers. The browning pericarp in longan fruit occurred within a day at 25^0C, and was serious at ambient temperature storage for 5-6 days (Qu et al. 2001).

5. POST-HARVEST TREATMENTS

5.1 Sulphur dioxide fumigation

Tongdee (1994) and Ji (1999) examined the effect of sulphur dioxide fumigation in postharvest handling longans and lychees that were to be exported The results showed that sulphur fumigation reduced decay and inhibited pericarp browning significantly. In addition, sulphur bleached the color of longan fruit to a bright yellow, but a high rate of sulphur could turn the aril to dull white. The amount of sulphur used for the fumigation treatment depends on the quantity of fruit, the storage conditions as well as the type of packaging. The recommended minimum time of fumigation is 20 minutes, but the timing starts only when the sulphur has been absolutely burned. The effective fumigation rate of sulphur in longan was 200 to 300 ml SO2kg^{-1} fruit and the sulphur residues should be around 170–400 mg/kg in the entire fruit and 1200–3000 mg/kg in the pericarp after fumigation. This amount reduces greatly in the first few days after the treatment. The residue of sulphur in the aril sometimes was over the domestic and export levels. This created a concern and hindrance to using sulphur in longan post harvest treatment.

5.2 Nitric oxide (NO)

Duan et al. (2006) used exogenous sodium nitroprusside (SNP), a nitric oxide donor, in longan post havest handling and examined its effect on the phenolic metabolism of the fruit. The research was conducted on the longan cv. Shixia in from a commercial orchard in Guangzhou. In the research, the 1mM of SNP used was based on the Duan and his colleagues' previous research (Duan et al. 2006). The harvested fruit were dipped for 5 minutes in 1mM of SNP solution at 280C then air-dried for 30 minutes. 20 fruits were packed in 0.03mm thick polyethylene bags and stored at 280C. The research found that the NO treatment helped to delay the development of pericarp browning, restrain PPO, POD and PAL activities. In addition, the NO treatment preserved the longan fruit's total phenol content during the storage period. Moreover, the research also proved that the NO treatment helped to reduce the pulp breakdown and maintain the considerate levels of soluble solids and ascorbic acid in the fruit.

5.3 Chitosan and citric acid combination and HCL acid

Apai et al. (2009) and Apai (2010) used a combination of chitosan and citric acid and HCL to reduce fruit pericarp browning, and fruit decay for the longan cv. Daw harvested from a commercial Good Agriculture Practice (GAP) orchard in Chiangmai, Thailand. The combination of 1% CA and 1.2% chotosan used in Apai's (2010) research was based on the his previous research result (Apai et al. 2009). In this previous research, the fruits were dipped for 2 minutes in the combination solution of 1% CA and1.2% chitosan, air-dried by an electronic fan, then 20 fruits were packed with 11 µm thick PVC film, and stored at 5^0C and 95% RH (relative humidity). In 2010, Apai et al. did similar research, that the fruit was left over an 8 hour period after being picked or over a 24 hour period before being exposed in treatment. This extra treatment helped to reduce the fruit cracking when dipped in the acid treatment. The fruits were then dipped for 20 minutes in 8 L of 1.5 N HCL (pH 0.21), rinsed in water, drained and packed in perforated plastic baskets and then stored at 3 ± 1^0C, 85%RH for 60 days. These are similar conditions to the sea shipment that was used for investigating pericarp browning and the physiochemical properties. In addition, the fruits were dipped for 0, 10, 15, 20 minutes in 1.5 N HCL and 0.3% SB (sodium benzoate), then rinsed in water, drained and stored at 5 1^0C, 85%RH for 45 days (simulate the sea shipment condition). The browning index, eating quality and physiochemical properties were analysed.

The research results showed that the fruit dipped in HCL, then rinsed in water had a lower pericarp browning rate compared with non treated fruit. While dipping fruits in HCL without rinsing in water decreased juice and pericarp pH and eating quality, the fruit treated with rinsing showed a greater capacity to delay pericarp browning and fruit decay and maintained fruit color and eating quality.

CONCLUSION

Longan is becoming an important horticultural export product in the tropical and subtropical regions. However due to short storage life and fruit decay the commercial value of longan can decline if it has to be transported to long distance markets. Three successful treatment methods in longan post harvest were using sulphur dioxide fumigation, dipping fruit in NO, or dipping the fruit in acid and rinsing with water. Each method has their advantages and limitations but all of

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them improved longan storage life, significantly reduced pericarp browning and had less effect on fruit quality. The sulphur dioxide method is less used now because of the high residuals of sulphur in the aril or in the chamber. Although the cost of each treatment was mention in the researches, it is recommended that the producers should analyse the length of storage time, the transport mean and the place to be transported to in order to choose an appropriate treatment to increase the benefits of the treatment methods. Further research should focus on the response of different longan varieties, different cultivation conditions to different postharvest treatments, and compare the economical benefits or costs of each method before introducing to public.

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