Available online at www.sciencedirect.com

ScienceDirect

Journal of Food Engineering 88 (2008) 193–201

JOURNAL OF FOOD ENGINEERING

www.elsevier.com/locate/jfoodeng

Post-harvest damage and performance comparison of sweet tamarind packaging

Bundit Jarimopas [a,*], Dolhathai Rachanukroa [b], Sher Paul Singh [c], Rungsinee Sothornvit [d]

[a] Department of Agricultural Engineering, Faculty of Engineering at Kamphaengsaen, Kasetsart University, 1 Malaiman Road, Kamphaengsaen, Nakohnpathom, Thailand

[b] The Postgraduate and Research Development Project of Postharvest Technology, Graduate School, Kasetsart University, Kamphaengsaen, Nakohnpathom, Thailand

[c] School of Packaging, Michigan State University, East Lansing, MI, USA

[d] Department of Food Engineering, Faculty of Engineering at Kamphaengsaen, Kasetsart University, Kamphaengsaen, Nakohnpathom, Thailand

Received 24 July 2007; received in revised form 12 December 2007; accepted 5 February 2008
Available online 10 March 2008

Abstract

The sweet tamarind is a pod, harvested ripe and usually consumed fresh. The pod consists of a shell and pulp, which encloses the seeds. The main problem with fresh sweet tamarind is the damage caused by packaging which deteriorates the fruit quality and reduces the consumable amount of fruit. This research attempts to quantitatively evaluate the damage of the sweet tamarind packaged in current wholesale and retail containers and to propose an appropriate new package. The proposed packaging is of a sleeve design, 15 cm in diameter by 20 cm in height, containing a mixture of 5 mm foam balls and sweet tamarind inserted vertically. This packaging imparts $\frac{1}{5}$ to $\frac{1}{6}$ of the damage of conventional packaging and costs half the price.

Keywords: Post-harvest; Sweet tamarind; Packaging; Vibration test; Drop test

1. Introduction

Mechanical injury is one of the major causes of perishable product quality loss (Mohsenin, 1996). The damage is sustained during harvesting, post-harvest handling, transportation and cold storage (Ruiz Altisent, 1991). For tropical fruit like mangosteen and rose apple, that are characterized by a high respiration rate, Pushpariksha et al. (2006) found that 86% of the wholesale mangosteen were afflicted by defects including cracking, hard rind, rough surface and internal abnormalities. In addition, rose apples at a wholesaler were shown to have suffered a considerable loss as result of abrasion (72.2%) and bruising (123.3%) (Toonsaengthong et al., 2006).

The experience with sweet tamarind (*Tamarindus indica* L.), which is one of the most popular fruit types in Thailand, is similar. The tamarind "fruit" (which is actually a pod) is harvested ripe and usually consumed fresh. The pod consists of a shell and flesh, which encloses the seeds. The shell easily separates from the flesh when the fruit is mature. The sweet tamarind is high in phosphorus and potassium, and also in vitamins such as thiamin and niacine (Gunasena and Hughes, 2000). The two most popular cultivars are "Sitong" (curved pod) and "Srichompoo" (straight pod) (Fig. 1). Jaisin and Jarimopas (2007) applied the image processing technique to analyze the curvature of the sweet tamarind of both varieties in terms of curvature index. The index characterizing Sitong and Srichompoo were valued 75.8% and 51.1% respectively. Sitong was physically larger and heavier than Srichompoo (Jarimopas et al., in press-b) because Sitong took a longer time to mature than Srichompoo. Harvested Sitong and Srichompoo have a low moisture content of 18.7% and 18.5%, respectively (Jarimopas et al., in press-b).

* Corresponding author. Tel.: +66 34 281099; fax: +66 34 351842.
E-mail address: jarimopas@yahoo.com (B. Jarimopas).

0260-8774/$ - see front matter © 2008 Published by Elsevier Ltd.
doi:10.1016/j.jfoodeng.2008.02.015

(a) Sitong cultivar (b) Srichompoo cultivar

Fig. 1. The sweet tamarind pod.

Wholesale packaged sweet tamarind is subjected to mechanical loading damage during transportation mainly through vibration (Jarimopas and Sirisawas, 2006). The factors affecting vibration damage are (i) road profile, (ii) truck suspension system, (iii) produce natural frequency and (iv) packaging (Mohsenin, 1996). For developing countries like Thailand, it is difficult to improve roads and trucks in order to alleviate packaged fruit damage because of the limitations associated with national economics and low produce prices. Perishables are typically transported by trucks and pick-up vehicles equipped with steel leaf spring suspensions (Jarimopas et al., 2005). For certain produce, it would be easier to improve the packaging. The damage of sweet tamarind was from direct contact among the pods in a container. The solution might be obtained by using foam balls as a cushioning material in between tamarind contained in a package. Nowadays, foam balls are successfully used as cushioning material protecting packaged pottery for export. Available foam balls are made of expanded polystyrene (EPS) which is 90% comprised of air. The EPS structure characterizes the cushioning properties suitable for packaging applications (Beck, 2000). Physically, sweet tamarind and pottery are of similar fragility.

The sweet tamarind in retail packaging is mainly subjected to manhandling (Rachanukroa et al., 2007). The result of this rough treatment is that most of the tamarind pods appear to be cracked when the retail packages are opened for inspection. Turczyn et al. (1986) reported similar results with potatoes which had been subjected to manhandling. They found that "shatter bruising", involving a break or crack in the potato skin, is predominantly caused by impacts sustained during loading and unloading. Careful design and use of protective packaging materials therefore are important factors in helping to reduce the physical damage that typically occurs during transport and handling (LeBlanc and Hui, 2005).

Several researchers studied damage of packaged fruit subjected to transit vibration (Hinsch et al. 1993; Singh and Xu, 1993; Singh and Marcondes, 1992; Jarimopas et al., 2005). Hinsch et al. (1993) and Jarimopas et al. (2005) conducted the test of real transport using electronic instrumentation measurement. O'Brien et al. (1965), Chonhenchob and Singh (2005), Turczyn et al. (1986) used a simulated vibration test. The real transport test was expensive and rather difficult to manage, especially if instrumentation was broken down or test repetition was required. The simulated test was more easily handled, cheaper and could be performed if the atmospheric environment was poor.

A variety of performance tests and packaging evaluations have already been carried out with regard to tropical fruit like mango, papaya, mangosteen, rose apple and rambutan (Chonhenchob and Singh, 2004, 2005; Chaiyapong and Jarimopas, 2007; Pushpariksha et al., 2006; Jarimopas et al., 2007a; Jarimopas et al., 2006). However, until now, no methodology has been developed for packaging sweet tamarind. Accordingly, this research aimed to (a) determine post-harvest damage sustained by sweet tamarind in wholesale and retail forms of packaging, (b) comparatively test and evaluate the performance of current and new wholesale packaging and (c) comparatively test and evaluate the performance of new retail packaging.

2. Materials and methods

2.1. Post-harvest damage determination

The determination of post-harvest damage of sweet tamarind packaged in wholesale containers was based on Jarimopas et al. (in press-a). The related test used the sweet tamarind of two cultivars, "Sitong" and "Srichompoo", as experimental samples. Regarding grower experience, the sweet tamarind was manually harvested, stored at room temperature (≅15–22 °C) for three weeks and then manually packed by orchard growers into 14 kg regular slot containers (RSC) double walled corrugated paper boxes, the dimensions of which were 27.5 cm (width) × 41 cm (length) × 36.5 cm (height). Five boxes were provided for the samples from each cultivar. The sweet tamarind boxes were transported in a single layer in the truck bed of a pick-up truck from an orchard in Saraburi province to the Agricultural Engineering Laboratory at the Kamphaengsaen