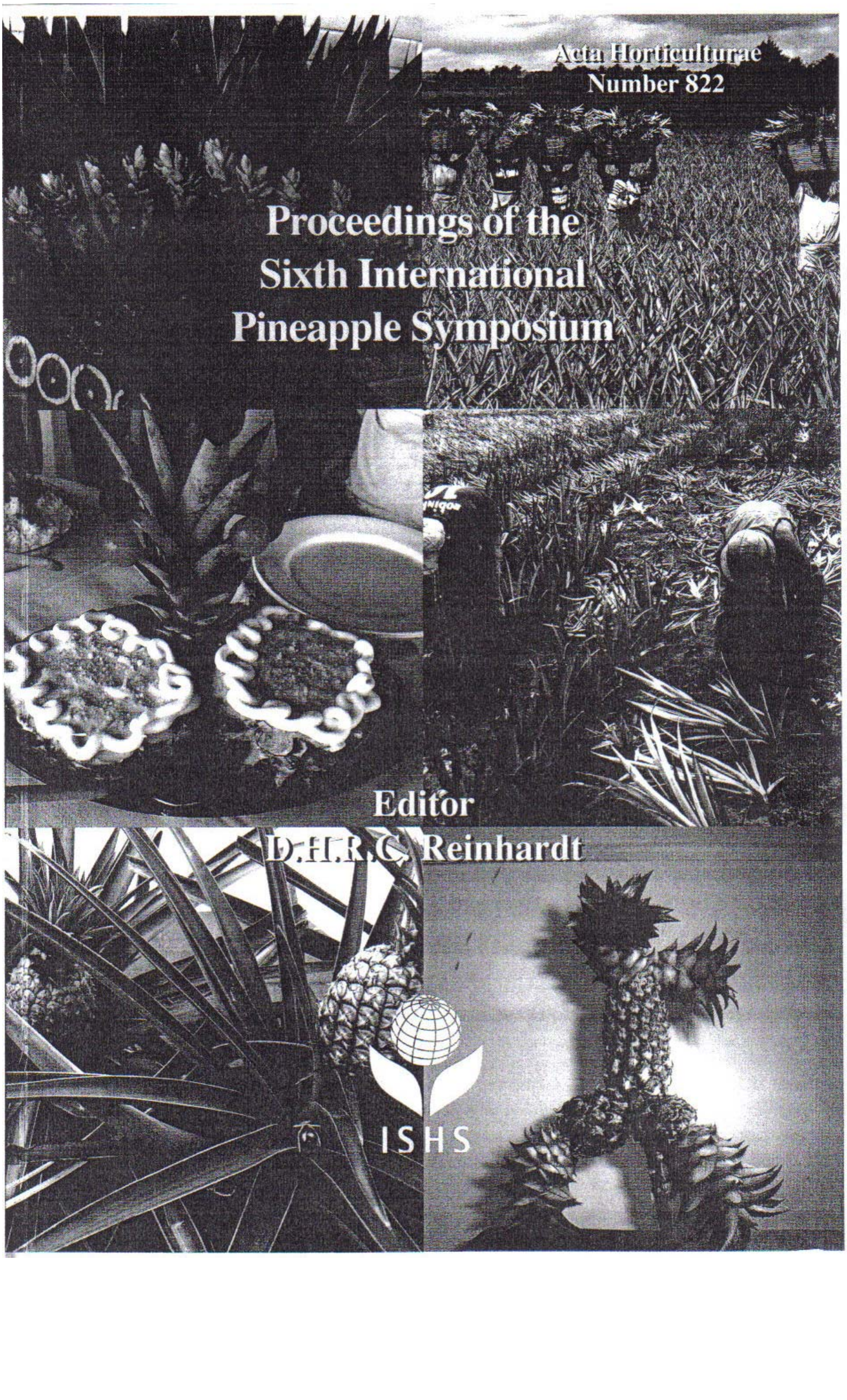
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Physicochemical Changes of Pineapple Submitted to Different Mechanical Injuries

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Abstract

The pineapple sensorial qualities and high dietary value are dependent upon physicochemical changes. The changes in some of 'Pérola's' physicochemical properties were determined after simulating the mechanical injuries experienced from harvest to commercialization. Fruit was submitted to the following treatments: T1: non-injured fruit (control); T2: one 60-cm free fall; T3: four longitudinal cuts (70 mm long and 2 mm deep); T4: eight perforations (3 x 2 mm) of the fruit base; and T5: compression for 30 minutes (equivalent to 160 Newton). After the application of the treatments, fruit was stored for 15 days at 11°C and 85% RH. Every five days fruit was evaluated for mass loss (%), pulp translucency (scale of 0 to 4, where 0 = opaque pulp and 4 = 100% of translucent pulp), juice percentage (%), acidity (% citric acid) and skin colour (L*, *a and *b**). Fruit exposed to the compression treatment showed significant mass loss during storage losing 7.2% in 15 days. No differences were found in translucency of the fruit subjected to the different treatments. The juice percentage declined from 48.6% to between 38 and 41% after 15 days of storage. The initial acidity was of 0.49% citric acid and increased to 0.76%. Colour L *, *a** and *b** showed no differences among the treatments. Compression was the most harmful postharvest mechanical injury for 'Pérola' pineapples. Compression injury was observed to occur during lorry transport to the markets.**

INTRODUCTION

The pineapple (*Ananas comosus* (L) Merr.), is a non-climacteric fruit and known as pineapple, piña, ananas or abacaxi (in the Portuguese language). There are many named clones, classed in 5 groups including 'Cayenne', 'Spanish', 'Queen', 'Pernambuco or Abacaxi', and 'Maipure', which may represent botanical varieties. The 'Pernambuco' group is not considered suitable for canning or for fresh-fruit export, but the juicy, sweet flavour of the fruit is favoured in the local markets 'Perola' is the principal clone in Brazil.

Postharvest mechanical injuries are a major problem for Brazilian pineapples during the postharvest handling chain of this fruit (Chitarra, 1998).

Mechanical injuries may be defined as plastic deformations, surface rupture and destruction of tissues caused by external factors. Such injuries lead to physical damages and physiological, chemical and biochemical alterations that alter colour, aroma, flavour and texture of fruits and vegetables (Mohsenin, 1986). Injuries can be classified as compression, impact or cut. Impact is generally caused by the collision of the fruit against solid surfaces or against other fruits during harvest, handling and transport. Compression injuries are caused by a variable pressure on the fruit surface exerted by an adjacent fruit or by the container holding the fruits. Cut injuries are generally due to the collision of the fruit against a sharp surface that ruptures the epidermis, or due to the pressure exerted by

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uneven surfaces, such as the container edges, against the fruit (Mattiuz and Durigan, 2001).

Limited published information is available on the effect of mechanical injury on harvested pineapple. The purpose of this experiment was to evaluate the effect of different mechanical injuries on the physicochemical parameters of stored fruit.

MATERIAL AND METHODS

'Pérola' pineapples were harvested from farms located in Piracicaba, São Paulo State, Brazil. Fruits were selected for firmness, absence of mechanical injuries and visible disease. After harvest the fruit was returned to the laboratory in São Paulo within 2 hours and subjected to mechanical injury treatments within 3 hours.

Fruits were submitted to the following treatment: T1 = non-injured fruits (control); T2 = 60-cm free fall (one impact per fruit at the middle of the fruit's side); T3 = four longitudinal cuts (70 mm long and 2 mm deep) at the middle of the fruit's side; T4 = eight perforations (3 x 2 mm) on the fruit base; and T5 = compression of the fruit's side for 30 minutes (equivalent force of 160 Newton (N)). Injured areas were demarked, the fruits were placed in polystyrene trays and stored for 15 days at 11°C and 85% RH.

A completely randomized experimental design was used, with 6 replicates for treatments (each replicate = one fruit). Every five days, fruits were evaluated for mass loss (%), pulp translucency (scale of 0 to 4, where 0 had opaque pulp and 4 had 100% translucent pulp), juice percentage (%), acidity (% citric acid) and skin colour (L*, a^* and b^*). Data on physicochemical evaluations were submitted to Analysis of Variance and means were compared by the Tukey test at 5% probability, using the SAS statistic software.

RESULTS AND DISCUSSION

Mass loss increased during storage in all treatments, and the compression treatment had the greatest mass loss during storage. Fruit subject to simulated compression lost 7.2% mass in 15 days. The mass loss from the control, impact, cutting, perforations and compression were 4.23%, 4.38%, 4.43%, 4.28% and 7.20%, respectively (Fig. 1). Harvesting removed the fruit's water supply making subsequent water loss responsible for product quantitative and qualitative losses. Mass loss is a consequence of fruit transpiration and related to the surface area to mass ratio and cuticle integrity; mechanical injury would disrupt the cuticle and increases mass loss. Losses of between 5 and 10% can reduce the quality of most fruits and vegetables (Finger and Vieira, 1997).

No significant differences in pulp translucency were observed among treatments (Fig. 2). This disorder appears to be related to the increase of membrane permeability and fruit maturation (Chen and Paull, 2001). The juice percentage was initially 48.6% and declined to between 38 and 41% after 15 days of storage (Fig. 3).

The acidity was initially 0.49% citric acid and increased to 0.76% (Fig. 4). Normally fruit acidity declines as the fruit matures and shows little changes postharvest during cold storage. Thé et al. (2001) found that for non-climacteric 'Smooth Cayenne' pineapple the fruit acidity increased during cold storage when the fruit was picked at a less ripe stage and decrease postharvest when the fruit was picked at a riper stage. The total acidity in pineapple is formed mainly by citric (80%) and malic acid (20%). Inside the fruit, the acidity increases of the basal area for the apical, accompanying the maturation gradient. It is observed that the acidity is much more accentuated in the close area to the peel when compared to the one of the cylinder

No significant differences in the values of L*, a^* and b^* were observed among treatments (Fig. 5). The main parameter indicating quality of a vegetable product is its colour, and consumers relate colour with product quality (Kays, 1991).

CONCLUSIONS

Due to higher mass loss compression injury was considered to be the most deleterious post-harvest mechanical injuries for 'Pérola' pineapples. Compression injury occurred most frequently during lorry transport of the fruit to the market. Other types of mechanical injuries also contribute to loss of fruit quality

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Figures

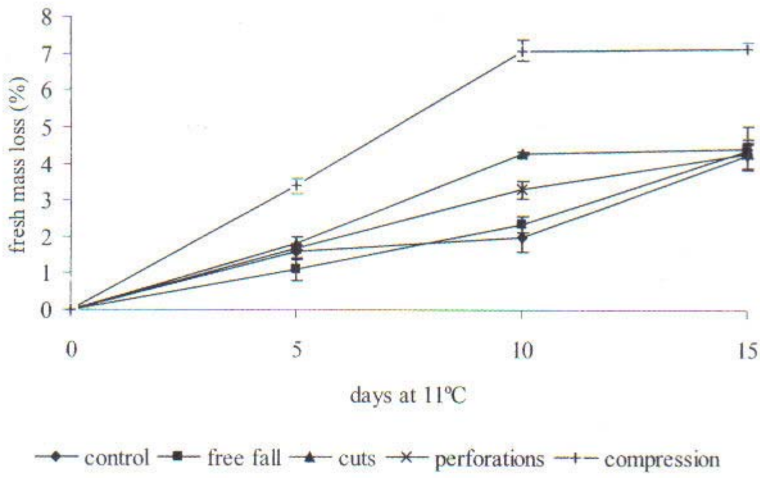

Fig. 1. Fresh mass loss (%) in pineapple fruit under mechanical injuries, during storage at 11°C and 85% RH. Vertical bars represent ±S.D. (n=6).

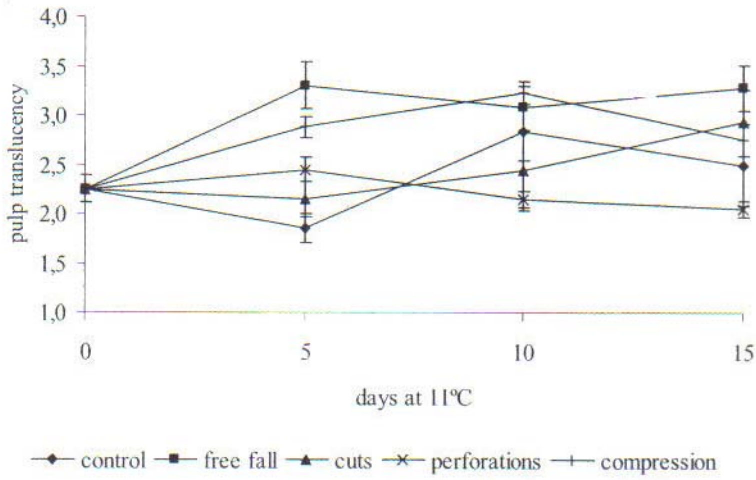

Fig. 2. Pulp translucency (in scale from 0 to 4, where 0 = opaque pulp and 4 = 100% of translucent pulp) (%) in pineapple fruit under mechanical injuries, during storage at 11°C and 85% RH. Vertical bars represent ±S.D. (n=6).

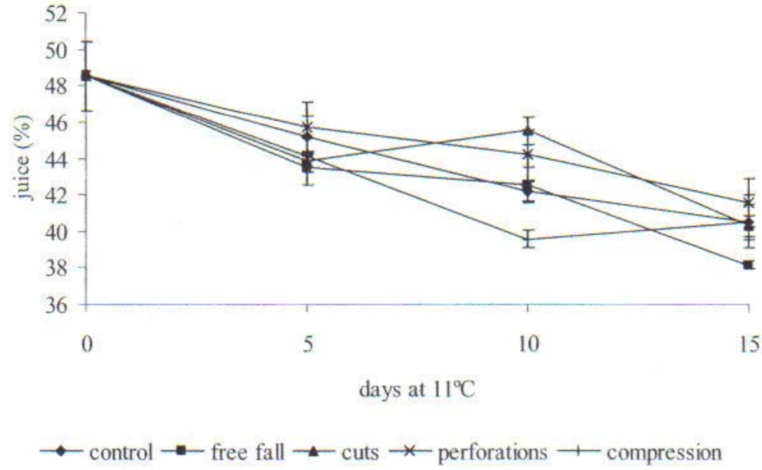

Fig. 3. Percentage of juice (%) in pineapple fruit under mechanical injuries, during storage at 11°C and 85% RH. Vertical bars represent ±S.D. (n=6).

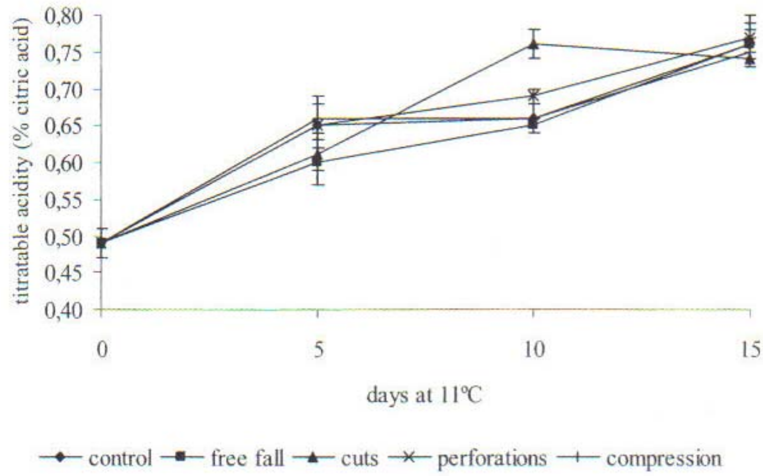

Fig. 4. Tritratable acidity (% citric acid) in pineapple fruit under mechanical injuries, during storage at 11°C and 85% RH. Vertical bars represent ±S.D. (n=6).

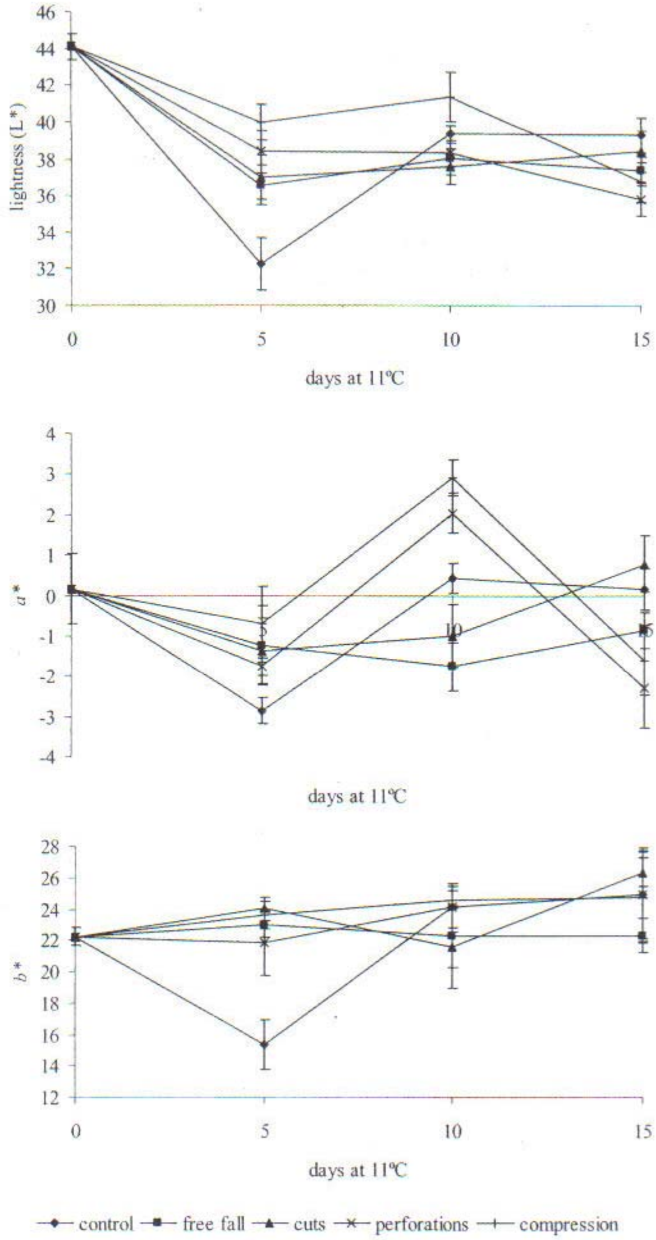

Fig. 5. Luminosity (L*), a^* and b^* in pineapple fruit under mechanical injuries, during storage at 11°C and 85% RH. Vertical bars represent ±S.D. (n=6).