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Study Post - Harvest about Impact and Compression Mechanical in the Cell Quality of Guava Fruit (CV. Paluma)

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Abstract: Information about the development and anatomy of *Psidium guajava L*. (Myrtaceae) is very important the for proper management of harvested fruits. The goal of this study was to evaluate the quality of cell guava produced at the Centenary small farm in the County of Mandaguaçu and delivered in local markets. Ripe fruit guavas of control treatment were collected in the morning at the Centenary small farm in the County of Mandaguaçu in the commercial maturation, defined by skin color yellowish and guavas with possible cell injuries were collected from boxes of the local market. After harvest, the fruits were taken to the laboratory at University, where were made the analyses of the morphology of fruits of guava (cv. Paluma). The experiment was conducted in a completely randomized design with three replications of five fruit per treatment. Analysis made showed that the guavas were presenting order in the cellular structures. The fruits showed large cell expansion and the presence of thin fragile sclereids that occurs due to the process of ripening of fruit. In this sense, it can be conclude that the handling during harvesting and transportation of fruits was appropriate for this phase. The fruits showed great physical and cell characteristics which are desirable for the consumer.

Keywords: guava, cv. 'Paluma', mechanical injury, pericarp anatomy

INTRODUCTION

Species of guava belong to the family Myrtaceae, genus Psidium. The most commonly cultivated species are Psidium guajava L. which has pear-shaped fruits with yellow smooth skin, and pulp that is red, firm and thick (1.3 to 2.0 cm) (Rodriguez et al., 2010). Native to tropical America, this species adapts to different climatic and soil conditions, producing fruits for local consumption and for the commercial food industry (PADILLA-RAMIREZ, J.S. AND GONZALEZ-GAONA, 2010).

Brazil is one of the largest producers of guava, along with India, Pakistan, Mexico, Egypt and Venezuela (Pommer and Murkami, 2009), and in 2009 it produced 297.377 tons; the State of São Paulo produced 79.705 tons alone (AGRICULTURAL CENSUS, 2011).

Fruit development goes through three important phases. In the first phase, the development is marked by a period of rapid cell division and elongation of the ovary. This involves intense meristematic activity that varies according to the region of the ovary. In the second phase, maturation starts occurring cell elongation and maturation among several structural and functional changes of the cells characterized by physical and chemical changes of the fruit (sensorial quality of fruit). In the third phase, cells continue to mature and expand until the fruit reaches its final size. This is considered the most conspicuous and physiologically important phase, due to the activity exerted and is also when the fruit becomes fit for consumption because of desirable changes in its appearance, flavor, aroma, texture and consequent senescence (CHITARRA; CHITARRA, 2005; QUADROS et al., 2008; KAREEM et al., 2013).

It is important to understand each developmental phase of the fruit in order to apply adequate management techniques that provide desirable commercial characteristics, such as quantity, quality and nutritional value. The nutritional attributes vary according to stage of maturity, which determines the behavior and hence the final quality of the fruit (COSER ET AL., 2012; RITTER 2012).

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Guava presents high acceptance for "in natura" consumption or in the processed form. It is rich in nutrients and is considered one of the best vitamin C sources, with values 6 to 7 times higher than those of the citric fruits. It also presents vitamins A and B, such as thiamine and niacin, besides containing good levels of P, Fe, and Ca (PADILLA-RAMIREZ AND GONZALEZ-GAONA, 2010). Guava is a fruit with high respiration rates and very short postharvest shelf life, a result of the loss of pulp firmness, which limits transportation and storage period. Highly perishable, due to its intense metabolism during ripening, guava has a shelf life of about 3 to 5 days at room temperature (DURIGAN, 1997; AZZOLINI, 2005). This aspect that makes it difficult or even impossible to send the fruits to distant consumer markets. Among all of these factors, firmness is the most important attribute since besides defining the quality of the fruit for "in natura" consumption and for processing, it also contributes to postharvest life of the fruit by offering protection during transportation and resistance to microorganism attack. The decrease in firmness during ripening has been attributed to modifications and degradation of the components of the cell wall, as well as to the decrease of the fruit integrity (CHITARRA; CHITARRA, 2005). Shocks and vibrations during harvesting, transporting and classifying can cause mechanical damages, which are responsible for considerable quality losses in the production chain from producer to consumer (DINTWA et al., 2008). The impact injury is usually caused by the collision of the fruit against solid surfaces or against other fruits during the stages of harvesting, handling and transportation. It can cause external damage, they are easily viewed on the surface, with no breakage or epidermal lesions and formation of aqueous translucent and softening. Furthermore, these injuries are responsible for withdrawal of the first line of defense harvested fruit, allowing entry of pathogens. In this sense, the impact damage occurred in the fruits may not appear as visible symptoms. Although the occurrence of impacts may cause effect later reflecting end due to the production of internal injury. In relation to the structure of the guava fruit mesocarp, the pulp was found to be constituted mainly by parenchyma cells, sclereids and vascular strands (CABRINI, 2009). Injuries, defined as visible or measurable symptoms (CHITARRA; CHITARRA, 2005), are commonly observed after harvesting of agricultural products in various stages of commercialization. Mechanical injuries and post-harvest diseases are the major cause of reduction in fruit quality in the commercial chain. The mechanical injuries, in addition to changing the appearance of fruits, stimulate the production of ethylene, thus speeding up the ripening and, consequently, reducing their time in the market. The mechanical damage during handling at harvest and post-harvest, are major causes of losses during distribution and marketing, directly affecting the external appearance that is one of the most important quality attributes of fruit, and is the main factor rejection by the consumer. The damage by impact can cause external damages easily viewed on the surface, with rupture of the epidermis, causing the formation of translucent aqueous lesions, tissue softening and loss of the first line defense (epidermis) of the fruit harvested, which allows the entry of pathogens (SANCHEZ et al., 2008). Some experiments were carried out with fruits such as guava (MATTIUZ et al., 2001b), apples cv. 'Gala' (STEFFENS et al., 2008), acid lime cv. 'Tahiti' (DURIGAN et al., 2005) and others. However, there are few studies comparing the different types of mechanical damage or mentioning the intensities of damage. Aiming to improve management during harvesting and post-harvesting of guavas produced in the region of Mandaguaçu - PR, sought to analyze the cell quality of guavas produced at the Centenary small farm in the County of Mandaguaçu and delivered to the local market.

MATERIAL AND METHODS

The guavas used in this study belonged to the cultivated variety 'Paluma', a clone derived from the variety Rubi-Supreme grown from open-pollinated seeds, which were originally from FCAV-UNESP, Jaboticabal County, São Paulo State (Pereira & Nachtigal, 2002). Ripe fruits of guava (*Psidium guajava* L.) were harvested on small farm in Mandaguaçu county (23º 20' 42" S, 52° 05' 42" W; 580 m elevation), in the state of Paraná. The climate of this region is classified as subtropical with an undefined dry season and an average temperature of 22°C. The average annual rainfall in this region ranges from 1. 400 to 1. 600 mm. (CAVIGLIONE et al., 2000).

The control treatment were collected in the morning at the Centenary small farm in the County of Mandaguaçu and guavas with possible cell injuries were randomly selected from the boxes that were sold later. All fruits were in the commercial maturation, defined by skin color yellowish. After that, the fruits went taken to the Biochemistry of food laboratory, at the State University of Maringá – UEM and were stored under ambient condition (25 ± 1 °C and 60 ± 6% UR). Following five days of storage, when fruits were fully ripe, but still firm texture, preceded to the analysis of tissue by means of histological analyses which were compared the morphology of ripe guava fruit with possible cell injuries of guava fruits collected from boxes of the local market. The experiment was carried out in a completely randomized design, with 3 repetitions and 5 fruits per treatment. For the anatomical study cross section of the fruits were made in the median region of the pericarp. The samples were placed in small glass flasks containing FAA (a 90 mL solution of formalin, 50% aceto and ethyl alcohol, 5 mL of glacial acetic acid and 5 mL of formaldehyde). The fragments of fruits remained in the solution for three days at room temperature. After this, the sections were dehydrated at room temperature in ethanol (70%, 90% and 100%) for about two hours. Para-infiltration was then performed, where the sections were immersed in a solution of

100% ethanol and embedded in hydroxyethyl-methacrylate Leica TM following the procedures recommended by the manufacturer, after that were subjected to the removal of air from inside the fruit cells in a desiccator under vacuum for about three minutes (modified by JOHANSEN, 1940). In the next stage, a new solution called Medium A was utilized (100 mL of liquid resin and 1.0 g of powder activator); the material was deposited in this solution for about 24 hours, which was followed by polymerization.

The polymerization or Medium B consisted of a mixture of 20 mL of Medium A with 1 mL of a hardener (called Hardner) to fix the fruits in polyethylene molds, while respecting the orientation of cuts (horizontal). The polyethylene plate containing the sections was wrapped in paper film and placed in a refrigerator for 24 hours. The plate was then removed, the sections finished hardening at room temperature, were glued to blocks of wood, sectioned with a rotatary microtome (model AO-820) with a C-type steel disposable razor. Cell sections were clarified in sodium hypochlorite, washed in distilled water and immediately place on histological slides. The slides were dried with a heat plate, stained with; toluidine blue, covered with coverslips and observed under an optical microscope Olympus BX50 that was coupled with a digital camera (Leica model Wild MPSS 52). The digital images were processed using Adobe Photoshop and the scales followed the same scale of magnification. The experiment was conducted in accordance with the methodology of Johansen (1940) and Berlyn and Miksch, (1976) with some modifications.

RESULTS AND DISCUSSION

In the figure 1, is shown the cellular structure of fruit guava 'Paluma' free of lesion. In the cross-sections obtained from samples of guava fruit (Psidium guajava L.), it was found the presence of large amounts of secretory cavities and locule delimited by septa and occupied by placentas with several ovules per locule (FIGURA 1A). Although the guava fruit is also derived from the hypanthium, there was anatomically no distinction between ovary and hypanthium. In Figure 1B, the presence of thick cuticle was observed, and this effect is probably determined by the fruit exposition to the sunlight (Morô et al., 2003). In the pericarp, there were three layers of cells, compact, rounded, polygonal and of different sizes. Cells were related to the function of water reserve and to aromatic compounds of the fruit (QUADROS et al., 2008, ROSSI et al., 2007).

The following layers are composed of polyhedral parenchyma cells, interspersed by well-formed sclereids grouped (stony cells) in vascular bundles and crystals (FIGURE 2A e 2B). The sclereids are highly developed, associated to vascular bundles and with thick secondary walls giving the primary role of mechanical strength to tissues.

The ripe fruit showed a large volume of parenchyma cells of the mesocarp, presence of well-developed sclereids and secretory cavities are also formed in the outer mesocarp (FIGURE 3A e 3B), the ripe fruits also observed that the cell walls were reduced and the sclereids were thin and sensitive which is considered normal to this phase of fruit (FIGURE 3B). Among the reasons for post-harvest loss, mechanical injury is the most common cause of damage to fruits, which devalue and drastically reduces the shelf life of the product. DURIGAN et al. (2005) and TAMURA et al. (2010) evaluated the effects of various mechanical injuries on the quality of acid limes 'Tahiti' and reported no beneficial effect of injured fruit, concluding that damage from impact caused greater nutritional loss in the fruits. Based on cell characteristics observed of fruit guava one can establish that the quality of cell guava produced at the Centenary small farm in the County of Mandaguaçu and delivered in local markets showed great quality, the fruits haven't lost of the conditions to be marketed, because the method of post-harvest are appropriate for delivered in the market, leading to increasing of storage period of fruit.

CONCLUSIONS

This study can be seen that the harvest and transportation of guava fruit held in the few farm centenary Mandaguaçu to market local are being made properly. The anatomical evaluations showed that the fruit guava had your physical characteristics proper to this phase.

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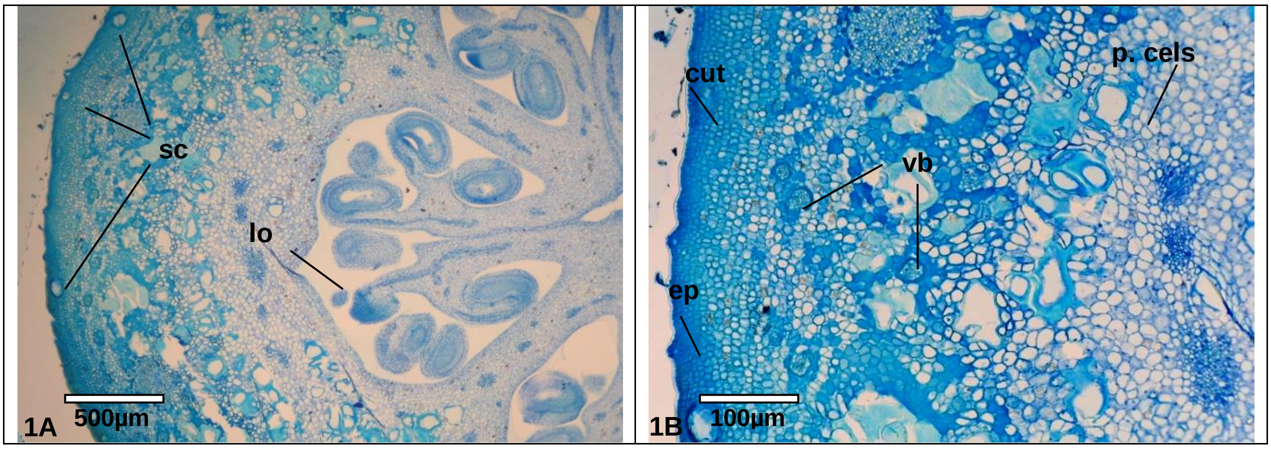

Figure 1. Cross sections of the pericarp of young fruit of *Psidium guajava* L. **1A -** lo: locular region; sc: secretory cavity; **1B -** ep: epicarp; cut: cuticle; p. cels: parenchyma cells; fv: vascular bundle.

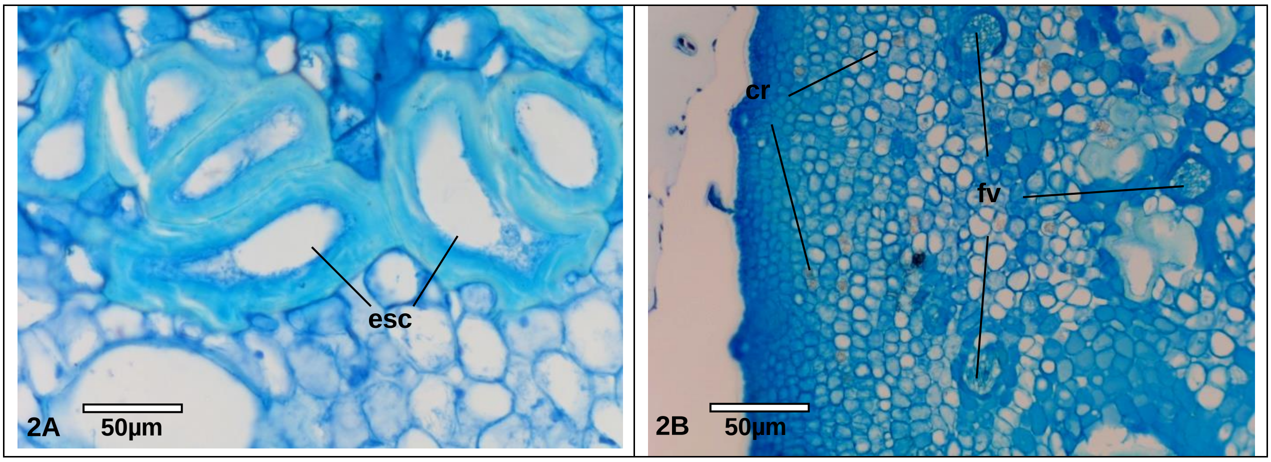

Figure 2. Cross sections of the pericarp of ripe fruit of *Psidium guajava* L. **2A -** sc: sclereids; **2B -** vb: vascular bundle; cr: crystal.

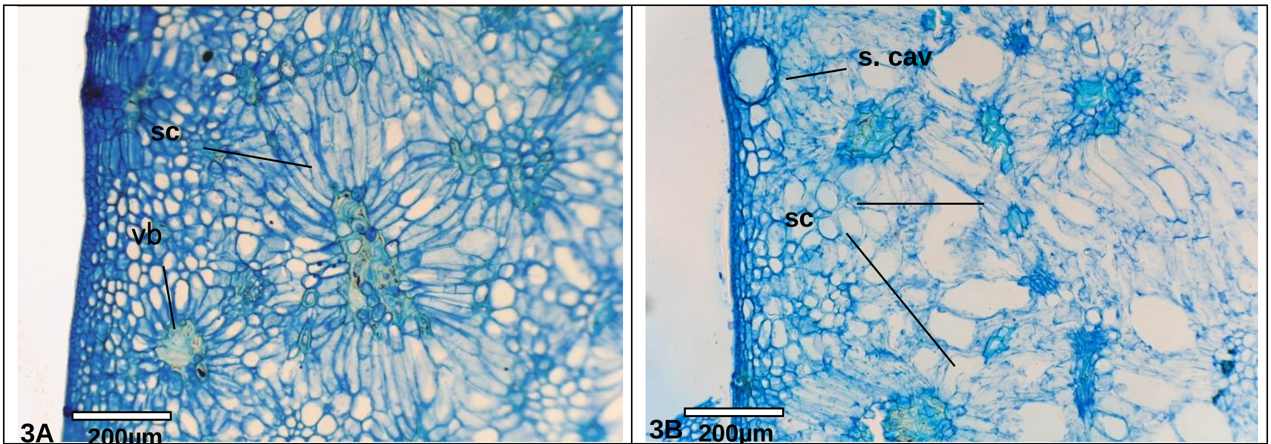

Figure 3. Cross sections of the pericarp of the ripe fruit of *Psidium guajava* L. **3A -** sc: sclereids; vb: vascular bundles. **3B** – sc: sclereídes; s. cav: secretory cavity.