ISSN: 2455-6939

Volume:03, Issue:01

TEMPERATURE AND MODIFIED ATMOSPHERE IN POSTHARVEST JAMBOLAO CONSERVATION

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ABSTRACT

The aim of this study was to evaluate temperature and modified atmosphere in the postharvest conservation of jambolão. The experiment was conducted at the Laboratory of Plant Physiology at the Universidade Tecnológica Federal do Paraná - Campus Dois Vizinhos. The fruits at harvest point were collected manually and placed in a shaded container. After, they were taken to the laboratory where were separated into groups, part received biofilm application, part were coated with 10µm thick PVC film, and the rest were not treated. Second, all were weighed to obtain initial weight and stored at 25 ± 5°C, 15°C and 5°C. All treatments were placed in expanded polystyrene trays. The experimental design was completely randomized with factorial 3 x 3 (storage temperature x modified atmosphere), totaling 9 treatments with 4 replicates of 20 experimental units. Every two days the treatments were weighed and evaluated visually by the same person to verify percentage of rottenness and wilting of the fruits. After 10 days, the trays with the fruits were discarded. For postharvest preservation of jambolan it is recommended to pack it in trays with PVC film stored at a temperature of 5°C.

Keywords: Biofilm, fruitcuture, Syzygium cumini, Myrtaceae

INTRODUCTION

In Brazil, fruticulture covers a wide variety of species, mainly tropical, subtropical and temperate. Being a country with a diverse climate and soil, it shows potential for the planting of

ISSN: 2455-6939

Volume:03, Issue:01

the most varied specimens. In addition, the population's demand for healthier food drives growth in this sector, aggregating more and more in agribusiness (Deretti et al., 2015).

According to IBRAF (2013) Brazil is ranked as the third largest fruit producer in the world, with an estimated production of 43 million tons, losing only to countries like China and India, showing a scenario of almost self-sufficiency in the area, even concentrating the production of a few species. This demonstrates the existence of market niches, through the use of species such as jambolão.

This exotic fruit tree native to Asia, belonging to the Myrtaceae family, is popularly known as jambolão, jamelão, cherry, jalão, kambol, jambú, among others. For this purpose, we used the classification as *Eugenia jambolana* and *Eugenia cumini*, both of which are accepted as synonyms (Veigas et al., 2007; Vizzotto & Fetter, 2009), but the most widely used is *Syzygium cumini* (L.) Skells.

The fruits have an intense black pericarp measuring about 3 to 4 cm in length and 2 cm in diameter, being fleshy of the berry type, elliptical, with only a seed of oval aspect and dark brown coloration. The mesocarp is fleshy and juicy, presenting an acidic and sweet taste, thus having an intense astringency effect (Morton, 1987; Ross, 1990; Oliveira & Akisue, 2000; Alberton et al., 2001; Migliato, 2005).

There are few commercial plantations of this species, but it has many forms of commercialization, ranging from the market of fresh fruits to liqueurs, vinegar, jellies, pies and sweets (Benherlal, 2007). In addition, the fruit has a high content of anthocyanins, such as delphinidin-3-glycoside (Reynertson et al., 2008), petunidine-3-glycoside and malvidin-3-glycoside (Veigas et al., 2007).

However, what is visualized is a great waste in the harvests, since these fruits are highly perishable, associated to the lack of technologies for their postharvest management (Lago et al., 2006). Thus, it is necessary to carry out studies with the application of postharvest techniques to increase shelf life of these fruits, which can consequently encourage their cultivation.

The modified atmosphere through the use of flexible plastic films (polyvinyl chloride - PVC and low density polyethylene) is one of the techniques recommended to maintain the quality of the fruits, usually perishable, for a longer period of time, since they modify the quantity of gases in the packaging reducing respiration and ethylene production (Oliveira-Jr et al., 2006) and preventing the packaging against mechanical damages. The use of this, together with the optimum storage temperature, makes the management more efficient for conserving plant products (Lownds et al., 1994), by reducing metabolic activity and water loss (Vila, 2007) and by providing low levels of O_2 And high CO_2 (Fakhouri, et al., 2007).

ISSN: 2455-6939

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Agricultural enterprises of fruits exportation commonly use plastic films along ith low temperatures, the use PVC is also common practice in the coating of sensitive fruits such as cashew nuts (Morais et al., 2002).

However, the use of edible and biodegradable films is a promising option for the conservation of fruits and vegetables, since it does not cause pollution to the environment, it increases the quality of the products (Fakhouri et al., 2007; Amariz et al., 2010; Castricini et al., 2012).

In this way, many studies are being carried out to extend fruits shelf life using films or coatings based on natural polymers such as polysaccharides (starch, carrageenan, alginates, among others) and proteins (gelatin, casein, wheat gluten and other materials), together with plasticizers (glycerol, sobitol, sucrose, etc.) that reduce the brittleness of the polymers (Davanço et al., 2007; Fakhouri et al., 2009; Fakhouri et al., 2012). Such materials could be tested with jambolão, since it is a fruit tree that urgently needs to preserve its useful postharvest life for a longer period.

The objective of this study was to evaluate the temperature and modified atmosphere forms in the postharvest conservation of jambolão.

MATERIAL AND METHODS

The experiment was conducted at the Laboratory of Plant Physiology, at the Universidade Tecnológica Federal do Paraná - Campus Dois Vizinhos. There were used jabolão trees from the arboretum of the same institution.

The fruits at maturation stage were collected manually and placed in a shaded container. After, they were selected so that there was no injury or damage and separated to receive the treatments. One part of the fruits were treated with cassava starch biofilm (3%), the second one was coated with polyvinyl chloride (PVC) film 10 µm thick, and the third one received no treatment. All treatments were placed in trays of expanded polystyrene (14 x 21 x 2,5 cm), weighed to obtain the initial weight and stored at room temperature, 15°C and 5°C.

The experimental design was completely randomized, in factorial 3 x 3 (storage temperature x modified atmosphere), with 4 replicates of 20 experimental units.

Every two days the treatments were weighed to evaluate the weight loss and visually evaluated the percentage of rottenness and wilting of the fruits, until completing the period of 10 days.

The data of the evaluated variables were previously submitted to the normality test of Lilliefors, confirming the need to transform the data of the three variables, being rottenness and wilting transformed by sine arc $\sqrt{x} + 1$ and the variable weight loss by $\sqrt{x} + 1$. Afterwards, they were submitted to analysis of variance and the Duncan averages comparison test ($p \leq 0.05$), using SANEST® software.

ISSN: 2455-6939

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RESULTS AND DICUSSION

The results presented significant interaction for temperature x modified atmosphere for wilting (Table 1) and rottenness (Table 3), as well as for factors in isolation with loss of mass (Table 2).

The percentage of wilting (Table 1) of the fruits was lower using PVC film at all temperatures evaluated. It is surprising that this may have caused the reduction of fruit perspiration and consequently decreased water loss, maintaining them longer without damage (Sanches et al., 2011).

Table 1. Fruit wilting (%) of jamboleiro according to the type of modified atmosphere and storage temperature

	Modified atmosphere		
Temperature	Without film	PVC film	Biofilm
5 ± 2°C	96,31 a B	79,73 b A	99,68 a B
15 ± 2°C	100,00 a B	16,91 a A	100,00 a B
Environment	100,00 a B	17,31 a A	100,00 a B
C.V. (%)	8,50		

*Averages with different capital letters in the row and lowercase in the column differ significantly at the 5% probability level by the Duncan test

Analyzing treatment with PVC film, it was possible to verify that the temperature of 15°C and environment were higher when compared to 5°C, since they presented smaller averages of wilting. This may have occurred due to the jamboleiro being a tropical species and its fruits do not tolerate cold storage, causing tissue injury, as occurs with buriti, a species originating in tropical regions, in which the storage of the fruits at 8°C causes cold injury (Santelli, 2005). In the other treatments (with film and without film) there were no statistical differences between the analyzed temperatures (Table 1).

Kluge & Jorge (1992) have shown that the use of packaging, mainly polyethylene film, drastically reduces fruit and vegetable mass losses in both storage and marketing.

However, when analyzing the behavior of fruit wilting between the packages at each temperature, PVC film was superior in relation to biofilm use in all conditions (Table 1), demonstrating the advantage of using PVC film in reducing moisture changes with the external environment, keeping the fruit with better appearance.The reduction of the mass loss is directly related to the water vapor transmission rate of the package, that is, the lower the rate, the lower the water vapor pressure deficit and greater the relative humidity inside the package, reducing the rate of transpiration of the fruits (Sanches et al., 2011; Malgarim et al., 2007; Fonseca et al., 2000; Sousa et al., 2000).

The fruits presented lower loss of fresh matter mass (Table 2) when stored at 5°C, which was already expected, because with this lower temperature the favorable conditions for water loss are reduced. Amarante and Megguer (2008) working with butiazeiro fruits harvested in a stage of green-yellow maturation verified that when stored at 0°C, they presented a higher conservation of postharvest quality.

Table 2. Loss of fruit mass (%) of jamboleiro in relation to storage temperature and modified atmosphere type

Temperature/Moified atmosphere	Mass loss (%)
5 ± 2°C	6,99 a
15 ± 2°C	10,12 b
Environment	21,31 c
Without film	18,49 b
PVC film	4,74 a
Biofilm	15,64 b
C.V. (%)	12,36

*Averages with different letters differ significantly at the 5% probability level by the Duncan test

Using the PVC film coating resulted in less mass loss (Table 2). Souza et al. (2009) studying postharvest of eggplant found that the use of plastic film was efficient in maintaining external appearance and reducing mass loss. However, the use of cassava starch was not efficient when compared to the plastic film, but presented good results when compared to the control.

In the present study, there was only efficiency for greater maintenance of fruit weight with the PVC film, control and biofilm had similar averages statistically to each other.

Vicentini et al. (1999) and Lemos et al. (2007) verified a negative effect of cassava starch, presenting an efficient barrier against water loss. Machado et al. (2007) and Agostini et al. (2009), when analyzing jabuticabas stored under different packaging conditions and temperatures, also observed greater loss of mass in fruits not coated by plastic films. Such facts have been proven in the referring work.

ISSN: 2455-6939

Volume:03, Issue:01

According to Chitarra & Chitarra (2005), the use of hydrophilic coatings, such as starch, has limitations on water vapor barrier properties. To remedy such limitation, some lipid or protein could be added to the edible film.

The fruits without PVC film and those coated with biofilm showed no rottenness at temperatures of 5°C, 15°C and 25°C (Table 3). The same does not occur with the PVC film that presented the highest incidence in all the temperature conditions. This is because the water content of the packaging should be null, but it is not, and this moisture, modulates the water exchanges of the packaging with the product and with the atmosphere (Luengo & Calbo, 2009), which may have caused the fruits to rotten, because it had higher humidity, favoring the emergence of latent fungi.

Table 3. Fruit rottenness (%) of jamboleiro according to the type of modified atmosphere and storage temperature

	Modified atmosphere		
Temperature	Without film	PVC film	Biofilm
5 ± 2°C	0,00 a A	33,63 a B	0,00 a A
15 ± 2°C	0,00 a A	73,68 b B	0,00 a A
Environment	0,00 a A	63,87 b B	0,00 a A
C.V. (%)	23,99		

*Averages with different capital letters in the row and lowercase in the column differ significantly at the 5% probability level by the Duncan test

On the other hand, in this condition of use of the PVC film the lowest occurrence of rottenness occurred in temperature of 5°C. This result suggests that the use of this package be associated with refrigeration, since it provided a lower transpiracy rate of fruits by maintaining a higher relative humidity in the environment and less respiratory activity in the fruits. This result was also found by Scalon et al. (2004) working with uvaia, evidencing the effect of the packaging in the reduction of fruit mass loss.

CONCLUSIONS

For postharvest preservation of jambolão it is recommended to pack it in trays with PVC film stored at a temperature of 5°C.

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