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# Effect of different packaging materials on the shelf life of passion fruits during ambient and low temperature storage

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## ABSTRACT

Passion fruit is generally considered to have a short storage life, because it is a very delicate, perishable fruit. The objective of this work was to study the post-harvest conservation of Passiflora setacea fruit packed in PVC packages 12μm and 30μm thick, LDPE bags 100μm and 200μm thick, and without packaging (control), stored under ambient conditions at an average temperature of 21.3ºC and average relative humidity of 77.8%, and in refrigerated conditions in a cold room at 10ºC and 90% relative humidity for 14 days. At the beginning of storage and at three, seven, 10 and 14 days of storage the fruits were analyzed for titratable acidity, soluble solids, Ratio, fresh weight loss, hue angle and post-harvest diseases. The experiment had a completely randomized design with three replicates. The 12μm PVC package, under refrigeration, was the most efficient in the conservation of P. setacea fruit. It presented low fresh weight loss; Null percentage of fungal infestation; soluble solids above 11% until the tenth day of storage; Titratable acid content above 2.5% throughout the experiment. Besides, the fruit, at the end of 14 days of storage, did not show evidence of fermentation and no water condensation inside the packages.

**Keywords:** *Passiflora setacea;* storage condition; quality; physico-chemical analysis; postharvest disease

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## INTRODUCTION

Brazil is the world´s largest yellow passion fruit producer (Cavichioli et al., 2014), yielding 700 thousand tons in 51 thousand hectares planted in 2015, mainly in the Northeast region (IBGE, 2016). The state of Bahia was the main producer, with around 300 thousand tons of passion fruit in 2,400 hectares (IBGE, 2016). The Midwest region of Brazil has the fourth largest passion fruit production in the country (Agrianual, 2015).

The species *Passiflora edulis* Sims is cultivated in more than 90% of the orchards in Brazil, being practically the only species with a productive chain duly established at national level. However, recent research and development findings in Brazil have evidenced the agronomic and commercial potential of other wild species of Passiflora, such as *Passiflora setacea* DC. (Cerqueira-Silva et al., 2014, Faleiro et al., 2014). *Passiflora setacea* has medicinal properties and can be marketed as

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fresh fruit, candy or ice cream (Ataide et al., 2012). It is native to the Brazilian Cerrado and presents great potential for consumption "*innatura*" due to the pleasant aroma, and to the exotic and sweet flavor of the fruits. A breeding program of *P. setacea* conducted by Embrapa and partners, which started 20 years ago, culminated with the release of the commercial cultivar BRS Pérola do Cerrado (BRS PC) in 2013 (Embrapa, 2015).

With BRS Pérola do Cerrado, the species *P. setacea* has gradually been disseminated among Brazilian producers and consumers and the production chain is being established and strengthened every year (Embrapa, 2015). Thus, it is extremely important to deepen the information about the quality and post-harvest conservation of *Passiflorasetacea* fruits produced and marketed in Brazil.

In the commercialization of fruits, in general, there is a growing demand for packaging due to product presentation improvement and greater mechanical and physiological protection, reducing damage and helping to prolong the storage life, especially for export (Arruda et al., 2011). The use of PVC and LDPE plastic films is practical and inexpensive, and has been widely used in the storage of fruits and vegetables, especially when associated with refrigerated storage (Rotili et al., 2013). Mota et al. (2003) evaluated the use of wax emulsions and plastic film in the shelf life of yellow passion fruit stored at room temperature and found that the plastic film (Cryovac D-955) was the most efficient in reducing fresh matter loss and wilting of the fruits.

In addition, there are other post-harvest studies, involving the genus Passiflora, related to several topics such as: phytosanitary control of diseases using different fungicides (Benato et al., 2002; Arruda et al., 2011; Moura et al., 2016); the influence of environmental temperature on the quality, fruit life and disease occurrence (Junqueira et al., 2001 and 2003), and studies related to the physicochemical characterization of fruits, as well as several reports on post-harvest diseases (Lutchmeah, 1992 and 1993; Muniz et al., 2003; Fischer et al., 2007; Tozze-Júnior et al., 2010; Riascos et al., 2012). All these works have targeted only two species, *Passiflora alata* (sweet passion fruit) and *Passiflora edulis* (yellow passion fruit).

The hypothesis of the present study is that BRS Pérola do Cerrado passion fruit has an extended shelf life in the post-harvest when properly packed, compared to the fruit stored without the use of any packaging, both at room temperature and under refrigerated conditions. So, the objective of this work was to determine the phytosanitary condition and post-harvest conservation of *Passiflora setacea* fruits by packing them in PVC and LDPE plastic films, stored under ambient and refrigerated conditions, in comparison to unpackaged fruit.

## MATERIALS AND METHODS

The fruits of *Passiflora setacea* DC. cv. BRS Pérola do Cerrado were harvested at commercial maturity, rinsed in tap water and dried with paper towels. Afterwards, they were packaged in styrofoam trays with PVC film 12µm and 30µm thick, and LDPE bags 100µm and 200µm thick. The control treatment consisted only of washing the fruits in running water with subsequent drying on paper towels. The fruits were stored under ambient conditions, at a mean temperature of 21.3ºC and 77.8% RH, and in a cold room at 10ºC and 90% relative humidity for 14 days.

At the beginning of storage (day zero) and at three, seven, 10 and 14 days of storage the fruits were analyzed for titratable acidity, soluble solids and Ratio according to the methodology described by Carvalho et al. (1990).

The color (L*, a*, b*) was determined in the HunterSab® MiniScan® EZ spectrophotometer, with five readings per fruit. The a* and b* values were used to calculate the hue angle (color angle: red 0°, 90° yellow, 180° green, 270° blue and 360°

black) by means of the formula: hue angle [tangent arc (b/a)] for a* positive and [tangent arc (b*/a*) (-1) + 90] for a* negative, as recommended by Hunterlab (2008). Percentage of fresh weight loss was also calculated using the weight difference between fruit mass at the beginning of the trial and fruit mass at each evaluation date.

The experiment was in a completely randomized design, with three replicates of each treatment, and each replicate consisted of five fruits of *Passiflora setacea*. For the color analyzes all five fruits per treatment were used, being five readings per fruit in each date. Data were submitted to analysis of variance using the F test and the means were compared using Tukey´s test ($p < 0.05$). All statistical analyses were performed with the assistance of the software Assistat version 7.7 (Silva, 2014).

In the phytosanitary evaluation, the fruits were separated and packed, following the same design, the same treatments and storage conditions already mentioned. Evaluations of fungal incidence occurred at three, seven, 10 and 14 days after the start of the experiment. At the end, the average incidence of fungi per replicate/per treatment/per evaluation was calculated. Statistical analysis was performed using Tukey´s test ($p < 0.05$) with the aid of the software Assistat version 7.7 (Silva, 2014).

## RESULTS AND DISCUSSION

### Physical-chemical quality

The physical-chemical quality of the fruits was affected by the types of packaging, temperature, and time of storage. All variables evaluated underwent significant changes throughout the experiment. The titratable acidity varied from 3.72 to 1.56, and the most significant decrease over the duration of the experiment was in the PVC treatment 30µm at room temperature (Table 1). Among the packages, the 200µm LDPE treatment had the lowest reduction in acid content throughout the experiment, both at room temperature and at 10°C, probably due to the thickness of the plastic, which made fruit respiration difficult and, consequently, caused a lower consumption of organic acids (Silva et al., 2009).

**Table 1: Changes in titratable acidity in *Passiflora setacea* fruits cv. BRS Pérola do Cerrado during storage**

| Treatments | At ambient storage | | | | |
|---|---|---|---|---|---|
| | **0 d** | **3 d** | **7 d** | **10 d** | **14 d** |
| Without packaging | 3.72 aA | 1.91 eD | 2.30 cC | 2.45 cB | 2.47 aB |
| PVC 12µm | 3.72 aA | 2.61 dB | 2.36 cC | 2.27 dCD | 2.20 bD |
| PVC 30µm | 3.72 aA | 2.91 bB | 1.84 dC | 1.86 eC | 1.56 cD |
| LDPE 100µm | 3.72 aA | 2.71 cB | 2.60 bC | 2.65 bBC | 2.25 bD |
| LDPE 200µm | 3.72 aA | 3.14 aB | 2.77 aD | 2.91 aC | 2.40 aE |
| | **At low temperature (10ºC) storage** | | | | |
| Without packaging | 3.72 aA | 2.87 bB | 2.94 aB | 2.68 cC | 2.23 dD |
| PVC 12µm | 3.72 aA | 2.66 cC | 2.95 aB | 3.02 bB | 2.72 bC |
| PVC 30µm | 3.72 aA | 3.16 aB | 2.71 bC | 2.46 dD | 2.22 dE |
| LDPE 100µm | 3.72 aA | 2.69 cBC | 2.53 cD | 2.76 cB | 2.55 cCD |
| LDPE 200µm | 3.72 aA | 3.06 aC | 3.01 aC | 3.30 aB | 2.99 aC |

Same lowercase letters in the column do not differ significantly at the 5% level in Tukey test.
Same capital letters, on the line, do not differ significantly at the 5% level in Tukey test.

In general, fruits under refrigerated conditions maintained the highest values of titratable acidity, due to their lower metabolic activity in this condition (Chitarra and Chitarra, 2005). The same was reported by Arruda et al. (2011) for passion fruit, where fruit stored at 25ºC showed significantly lower acidity levels than fruits stored at 15ºC. There was also a significant reduction in titratable acidity over the storage period in all treatments (Table 1). The same was also reported by Arruda et al. (2011) and Gama et al. (1991) for passion fruit.

**Table 2: Changes in soluble solids in *Passiflora setacea* fruits cv. BRS Pérola do Cerrado during storage**

| Treatments | At ambient storage | | | | |
|---|---|---|---|---|---|
| | **0 d** | **3 d** | **7 d** | **10 d** | **14 d** |
| Without packaging | 14.40 aA | 12.90 bB | 10.73 cC | 10.93 cC | 12.80 aB |
| PVC 12µm | 14.40 aA | 12.33 cB | 11.90 aBC | 12.03 bBC | 11.87 bC |
| PVC 30µm | 14.40 aA | 12.33 cB | 11.50 abC | 11.70 bC | 9.77 dD |
| LDPE 100µm | 14.40 aA | 12.57 bcC | 10.53 cD | 13.10 aB | 9.53 dE |
| LDPE 200µm | 14.40 aA | 13.67 aB | 11.43 bC | 10.93 cD | 10.77 cD |
| | **At low temperature (10ºC) storage** | | | | |
| Without packging | 14.40 aA | 12.90 bBC | 13.10 cB | 12.57 cdCD | 12.43 bD |
| PVC 12µm | 14.40 aB | 12.90 bC | 15.47 aA | 12.83 bcC | 10.43 cD |
| PVC 30µm | 14.40 aA | 13.23 bB | 12.10 dC | 13.13 bB | 9.67 dD |
| LDPE 100µm | 14.40 aAB | 14.27 aAB | 14.57 bA | 14.13 aAB | 14.07 aB |
| LDPE 200µm | 14.40 aA | 13.97 aA | 12.33 dB | 12.23 dB | 12.67 bB |

Same lowercase letters in the column do not differ significantly at the 5% level in Tukey test.
Same capital letters, on the line, do not differ significantly at the 5% level in Tukey test.

According to the Quality and Identity Standards (PIQ) for passion fruit pulp (Ministry of Agriculture, 2000), the minimum value for titratable acidity is 2,5%. Thus, under ambient conditions, only 100µm and 200µm LDPE treatments maintained titratable acidity levels within the standard and only up to 10 days of storage (Table 1). At 10°C, again 100µm and 200µm PEBD treatments, together with the 12µm PVC, maintained the titratable acidity values above PIQ standards during the 14 days of storage (Table 1).

Soluble solids content is of great importance for fruit quality, both for "*innatura*" consumption and for industrial processing, since high concentrations of these metabolites in the raw material means less sugar to be added, increasing product yield, and reducing processing costs (Pinheiro et al., 1984). Gama et al. (1991) reported that there was no significant change in soluble solids levels in passion fruit stored at 6ºC for up to 42 days. More recently, Arruda et al. (2011) evaluated fruits of *P. edulis* f. *flavicarpa* on expanded polystyrene trays (21cm x 14cm) packed in PVC 17µm and stored at 15ºC and 25ºC for 10 days and verified that the soluble solids content of the fruit was not influenced by any factor studied, remaining stable throughout the whole experiment. Contrary to the above reports, soluble solid values of *P. setacea* fruit ranged from 15.47% to 9.53% throughout storage time, both in ambient and refrigerated conditions (Table 2). The concentration of soluble solids decreased significantly over the 14 days of storage in almost all treatments, which is associated with the consumption of these compounds in the respiratory process (Chitarra and Chitarra, 2005).

According to the PIQ for passion fruit pulp (Ministry of Agriculture, 2000) the minimum value for soluble solids is 11%. Thus, of the treatments stored under ambient condition, only the PVC 12µm and the unpacked treatment were in accordance with the established standard after 14 days (Table 2). In the storage at 10ºC, treatments PVC 12µm and 30µm showed soluble solids below 11%, all others were above. The food industry uses soluble solids content as an indicator of fruit quality, with preference for fruits with levels above 13% (Bruckner et al., 2002). Only the 100µm LDPE treatment at 10°C maintained this concentration over the 14 days of storage (Table 2).

**Table 3: Changes in TSS: acid ratio in *Passiflora setacea* fruits cv. BRS Pérola do Cerrado during storage**

| Treatments | At ambient storage | | | | |
|---|---|---|---|---|---|
| | **0 d** | **3 d** | **7 d** | **10 d** | **14 d** |
| Without packaging | 3.87 aD | 6.76 aA | 4.67 cC | 4.47 dC | 5.17 bB |
| PVC 12µm | 3.87 aD | 4.73 bC | 5.05 bB | 5.30 bAB | 5.40 bA |
| PVC 30µm | 3.87 aC | 4.23 cB | 6.24 aA | 6.31 aA | 6.26 aA |
| LDPE 100µm | 3.87 aD | 4.64 bB | 4.05 dCD | 4.94 cA | 4.24 cC |
| LDPE 200µm | 3.87 aCD | 4.36 cAB | 4.13 dBC | 3.76 eD | 4.49 cA |
| | **At low temperature (10ºC) storage** | | | | |
| Without packaging | 3.87 aC | 4.49 cB | 4.45 cB | 4.69 bB | 5.57 aA |
| PVC 12µm | 3.87 aD | 4.86 bB | 5.24 bA | 4.26 cC | 3.84 cD |
| PVC 30µm | 3.87 aC | 4.19 dC | 4.47 cB | 5.35 aA | 4.35 bBC |
| LDPE 100µm | 3.87 aD | 5.31 aBC | 5.76 aA | 5.11 aC | 5.51 aAB |
| LDPE 200µm | 3.87 aCD | 4.56 cA | 4.10 dBC | 3.71 dD | 4.24 bB |

Same lowercase letters in the column do not differ significantly at the 5% level in Tukey test.
Same capital letters, on the line, do not differ significantly at the 5% level in Tukey test.

The values of soluble solids to titratable acidity are generally an indicative of flavor, which gives a good idea of the balance between these two components (Fernandes et al., 2010). So, it is an important parameter to be considered in the selection of varieties for *in natura* consumption. During maturation, the relationship between soluble solids content and fruit acidity increases, promoting the characteristic sweet taste, that is, the higher the Ratio, the sweeter the fruit (Gonçalves 2009). Gama et al. (1991) and Arruda et al. (2011) reported an increase in soluble solids/titratable acidity Ratio over the fruit storage period.

In the present experiment, it was verified that the value of Ratio increased significantly, in the majority of the treatments, in the two environments, during the experiment, corroborating the reports of Gonçalves (2009), Gama et al. (1991) and Arruda et al. (2011). At the end of the 14 days, the treatment PVC 30µm in the ambient condition and the treatments without packaging and LDPE 100µm at 10°C presented the highest Ratio values, which were statistically different from the others (Table 3).

**Table 4: Changes in weight loss in *Passiflora setacea* fruits cv. BRS Pérola do Cerrado during storage**

| Treatments | At ambient storage | | | | |
|---|---|---|---|---|---|
| | **0 d** | **3 d** | **7 d** | **10 d** | **14 d** |
| Without packaging | 0.00 aE | 22.69 aD | 40.86 aC | 47.52 aB | 52.91 aA |
| PVC 12µm | 0.00 aD | 7.53 bC | 18.07 bB | 16.59 bB | 34.44 bA |
| PVC 30µm | 0.00 aB | 1.19 cAB | 2.75 cAB | 3.82 cAB | 5.29 cA |
| LDPE 100µm | 0.00 aA | 0.73 cA | 1.46 cA | 1.37 cA | 2.81 cA |
| LDPE 200µm | 0.00 aA | 0.46 cA | 0.81 cA | 1.00 cA | 1.34 cA |
| | **At low temperature (10ºC) storage** | | | | |
| Without packaging | 0.00 aE | 4.31 aD | 9.93 aC | 13.81 aB | 19.52 aA |
| PVC 12µm | 0.00 aC | 0.56 bBC | 1.29 bAB | 1.78 bA | 2.47 bA |
| PVC 30µm | 0.00 aA | 0.12 bA | 0.30 bA | 0.45 cA | 0.66 cA |
| LDPE 100µm | 0.00 aA | 0.10 bA | 0.24 bA | 0.33 cA | 0.48 cA |
| LDPE 200µm | 0.00 aA | 0.04 bA | 0.12 bA | 0.17 cA | 0.24 cA |

Same lowercase letters in the column do not differ significantly at the 5% level in Tukey test.
Same capital letters, on the line, do not differ significantly at the 5% level in Tukey test.

The storage conditions interfered directly with the percentage of fresh weight loss, where the fruits stored at 10ºC had the lowest values (Table 4). The reduction of temperature is still one of the most effective ways of maintaining fruit quality, since it decreases respiratory activity and perspiration, as well as slows metabolic activity (Chitarra and Chitarra, 2005).

According to Fonseca et al. (2000), the use of plastic films in fruit packaging reduces the loss of fresh weight, as it promotes a decrease in respiration rate and minimizes water loss. Mota et al. (2003) reported that the plastic film (Cryovac D-955) was the most efficient treatment in reducing fresh weight loss and wilting of *P. edulis* f. *flavicarpa* fruit stored at room temperature for 21 days. In the present experiment, the percentage of fresh weight loss of *P. setacea* fruit varied between 0.04% and 52.91% (Table 4). The treatments PVC 30µm, and LDPE 200µm and 100µm were the most efficient in maintaining fruit weight in both environments. However, after 14 days of storage, there was a great condensation of water inside the packages of these three treatments, with exudation of a transparent liquid on the surface of the fruit and a characteristic alcohol odor, possibly ethanol, indicating the occurrence of anaerobic conditions typical of fermentation. These facts demonstrated that the packages prevented the exchange of gases minimally necessary to maintain adequate fruit shelf life (Oliveira et al., 2014). The PVC12µm packaging had fresh weight losses of 34.44% in the ambient condition and 2.47% in the refrigerated condition, although there was a greater loss of fresh weight when compared to the other packages, there was no water condensation inside and no characteristic symptoms of fruit fermentation (Table 4).

The hue angle is defined as starting at axis + a and is expressed in degrees, where 0° corresponds to + a (red), 90° corresponds to + b (yellow), 180° corresponds to -a (green), and 270° corresponds to -b (blue) (Tibola et al., 2005). Therefore, the fruit in the experiment remained yellowish during the 14 days of storage (Table 5). Hue angle values ranged from 71.73 to 91.34. Storage temperature significantly influenced fruit color; where in the ambient condition significant change occurred except for the fruit kept in the 30µm PVC packaging. However, in general, in the two storage conditions, the 12µm PVC packaging was the only one to preserve the initial fruit color throughout the 14 days of storage (Table 5).

**Table 5: Changes in mean values of hue angle in *Passiflora setacea* fruits cv. BRS Pérola do Cerrado during storage**

| Treatments | At ambient storage | | | | |
|---|---|---|---|---|---|
| | 0 d | 3 d | 7 d | 10 d | 14 d |
| Without packaging | 91.34 aA | 91.00 aA | 84.09 cB | 73.64 cC | 71.73 cC |
| PVC 12µm | 91.34 aA | 91.15 aA | 91.21 aA | 90.13 aAB | 86.46 aB |
| PVC 30µm | 91.34 aA | 91.13 aA | 90.35 abA | 89.88 aA | 89.23 aA |
| LDPE 100µm | 91.34 aA | 89.90 aAB | 86.93 bcB | 81.65 bC | 79.05 bC |
| LDPE 200µm | 91.34 aA | 88.90 aA | 78.34 dB | 75.43 cB | 75.56 bcB |
| | At low temperature (10ºC) storage | | | | |
| Without packaging | 91.34 aA | 91.25 aA | 91.18 aA | 90.59 aA | 90.65 aA |
| PVC 12µm | 91.34 aA | 91.18 aA | 91.25 aA | 91.08 aA | 90.68 aA |
| PVC 30µm | 91.34 aA | 91.31 aA | 91.29 aA | 91.12 aA | 90.46 aA |
| LDPE 100µm | 91.34 aA | 91.19 aA | 91.33 aA | 91.10 aA | 89.98 aB |
| LDPE 200µm | 91.34 aA | 91.29 aA | 90.42 aA | 90.72 aA | 85.72 bB |

Same lowercase letters in the column do not differ significantly at the 5% level in Tukey test.
Same capital letters, on the line, do not differ significantly at the 5% level in Tukey test.

## Incidence of *Fusarium* spp.

A large number of pathogenic fungi have already been described on passion fruit (Lutchmeah 1992 and 1993; Benato et al., 2002; Junqueira et al., 2003, Muniz et al., 2003; Fischer et al., 2007; Tozze-Júnior et al., 2010; Arruda et al., 2011;

Riascos et al., 2012), where the fungus *Colletotrichum gloeosporioides*, which causes anthracnose, is considered the main pathogen in the post-harvest period (Silva and Durigan, 2000). However, in the present experiment, the only fungi genus found infesting *P. setacea* fruit was *Fusarium* spp., identified by its cottony white mycelium and the presence of fusiform /sickle shape, multiseptate and hyaline conidia (Moretti, 2009).

**Table 6: Incidence of *Fusarium* spp. on *Passiflora setacea* fruits cv. BRS Pérola do Cerrado during storage**

| Treatments | At ambient storage | | | | |
|---|---|---|---|---|---|
| | **0 d** | **3 d** | **7 d** | **10 d** | **14 d** |
| Without packaging | 0 Aa* | 0 Aa | 0 Aa | 0 Aa | 0Aa |
| PVC 12µm | 0 Aa | 0 Aa | 0 Aa | 0 Aa | 0Aa |
| PVC 30µm | 0 Aa | 0 Aa | 6.6 Aa | 13.3 Bb | 26.6Bc |
| LDPE 100µm | 0 Aa | 0 Aa | 6.6 Aa | 80.0 Cb | 100Cb |
| LDPE 200µm | 0 Aa | 0 Aa | 6.6 Aa | 6.6 Aa | 6.6Aa |

*Means followed by the same capital letter in the columm do not differ statistically according to Tukey test ($p < 0.05$).
Means followed by the same lowercase letter in the line do not differ statistically according to Tukey test ($p < 0.05$).
*1Fruits stored under refrigeration (100C) showed no signs of fungal infestation.

The storage condition had a great influence on the infestation, since none of the fruits stored at 10ºC presented mycelial growth on its surface, regardless of the type of packaging (Table 6). Arruda et al. (2011) reported a significant reduction in the occurrence of passion fruit rot stored at 15°C, when compared to fruit stored at 25°C. According to Junqueira et al. (2003), sweet passion fruits stored in a cold chamber were less affected by anthracnose than fruit kept at room temperature.

When evaluating the experiment maintained at room temperature, we verified that the treatments without packaging and PVC 12µm did not present fruit with signs of infestation by *Fusarium* spp. during the 14 days of evaluation (Table 6). The LDPE 200µm treatment, showed a 6.6% incidence rate, beginning on the seventh day of evaluation, which was maintained for the remainder of the experiment, and which was not statistically different from the treatments without packaging and PVC 12µm (Table 6). On the seventh day, the treatments PVC 30µm and LDPE 100µm showed an increasing incidence of fruit infested by Fusarium spp., reaching, at the end of the evaluation, 26.6%, and 100% of infested fruit, respectively (Table 6).

As previously reported, treatments PVC 30µm, LDPE 100µm and LDPE 200µm showed evidence that, due to the plastic thickness, $CO_2$ accumulation was occurring, which caused fruit fermentation (Oliveira et al., 2014). In the case of the LDPE 200µm package, the $CO_2$ concentration was probably so high that it inhibited the infestation of *Fusarium* spp. (Samapundo et al., 2007). In the treatments PVC 30µm and LDPE 100µm, the accumulation of water inside the packages favored the growth and dispersion of the mycelium of *Fusarium* spp., causing the high fungi incidence on *P. setacea* fruit.

## CONCLUSION

It was concluded that the PVC packaging 12µm, under refrigeration, was the most efficient in the conservation of P. setacea fruit, because it presented: low fresh weight loss; Null percentage of fungal infestation; soluble solids above 11% until the tenth day of storage; Titratable acid content above 2.5% throughout the experiment. Besides, the fruit, at the end of 14 days of storage, did not show evidence of fermentation, and there was no water condensation inside the packages.

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