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Effect of maturity accelerants on the postharvest behavior of avocado (*Persea americana* Mill.) cv. Lorena

Efecto de acelerantes de madurez en el comportamiento poscosecha de aguacate (*Persea americana* Mill.) cv. Lorena

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Fruiting avocado plant.

Photo: G. Fischer

ABSTRACT

The global demand for avocados has grown in recent years. In Colombia, the Lorena variety is widely accepted in the market but the challenge for consumers is determining when the fruits should be consumed. However, there are no studies on this matter because most research is done on the Hass variety, which dominates global production. Therefore, the objective was to evaluate ripening treatments in Lorena variety avocado fruits to establish the postharvest behavior, avoid quality losses, and maintain organoleptic characteristics, facilitating commercialization of the product. A randomized complete block design was used with two blocks (maturity I and maturity II), five maturation treatments, three ethylene applications (2, 4 and 6 mL L^{-1}), fruits wrapped in unprinted newspaper, and a control. The fruits reached 16 days after harvest (dah) with commercial quality. The application of 6 mL L^{-1} of ethylene presented the greatest mass loss. At 6 dah, the climacteric peak presented with the highest values of soluble solids, maturity index (MI), and loss of firmness and the lowest percentage of total titratable acidity (TTA). The TTA had higher values for the control treatment during storage. The MI registered two maximums during postharvest: the first in the climacteric peak, and the second during fruit senescence.

Additional key words: ethylene; senescence; firmness; acumulated mass loss; tropical fruits.

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RESUMEN

La demanda por el fruto de aguacate en el mundo ha crecido en los últimos años. En Colombia, un cultivar que tiene una amplia aceptación en el mercado es la variedad Lorena, la cual tiene frutos que generan dificultad en los consumidores a la hora de identificar el momento adecuado de consumo, sin que haya estudios al respecto, debido a que la mayoría de investigación se realiza en la variedad Hass cuya producción es dominante en el mundo. Por lo anterior, el objetivo fue establecer tratamientos de maduración en frutos de aguacate variedad Lorena, con el fin de conocer el comportamiento poscosecha, para evitar pérdidas de calidad y mantener las características organolépticas, facilitando la comercialización del producto. Para lo cual, se llevó a cabo un diseño de bloques completos al azar, con dos bloques (madurez I y madurez II) y cinco tratamientos de maduración así: tres aplicaciones de etileno (2, 4 y 6 mL L^{-1}), frutos envueltos en papel periódico sin imprimir y un testigo. Los frutos alcanzaron 16 días después de cosecha (ddc) con calidad comercial. La aplicación de 6 mL L^{-1} de etileno presentó la mayor pérdida de masa. A los 6 ddc se presentó el pico climatérico con los mayores valores de sólidos solubles, índice de madurez (IM) y pérdida de firmeza y los más bajos porcentajes de acidez total titulable (ATT). La ATT mostró mayores valores para el tratamiento testigo durante el almacenamiento. El IM registró dos máximos durante la poscosecha, el primero en el pico climatérico y el segundo durante la senescencia del fruto.

Palabras clave adicionales: etileno; senescencia; firmeza; pérdida de masa acumulada; frutos tropicales.

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INTRODUCTION

The avocado is a promising climacteric fruit, considered the fifth most important tropical fruit in the world. There is high demand in the markets because of the commercial value, and it is considered a healthy food (Almanza *et al*., 2019). The cultivated area in 2019 in Colombia was 67,599 ha, with a production of 824,386 t and a yield of 12.2 t ha^{-1} (Agronet, 2021). There are five departments account for most of the cultivated area: Antioquia, Tolima, Caldas, Santander and Valle del Cauca, with 19.7, 17.6, 12.9, 7.2 and 6.0%, respectively (Agronet, 2021).

The Lorena variety between the Antillean or West Indian race, originated in the Valle del Cauca, Colombia, enjoying the highest consumption and the largests planted area in Colombia (Ruiz, 2018). It is found in areas between 0 and 1,500 m a.s.l., with temperatures of 18 to 26°C, and is the most cold-sensitive variety, with damage occurring at temperatures below 12°C (Romero, 2012). Flowering to harvest takes 5 to 8 months. The weight of the fruit is between 250 and 500 g, with a fatty acid content close to 9% (Bernal and Díaz, 2008). The fruit presents sigmoid growth, with three distinguished growth phases: cell division (linear and slow), cell elongation (exponential and accelerated) and ripening, 61, 116 and 143 days after anthesis (daa), respectively (Granados, 2013).

The avocado, unlike other climacteric fruits, does not ripen while it is on the tree. This fruit is characterized by a high production of ethylene (80 to 100 μL L^{-1}) when ripening, accompanied by biochemical changes (synthesis of flavor and aroma substances, softening of the fruit and changes in the color of the pulp) (Bill *et al*., 2014). Normally, the farmer harvests avocado fruits in a state of early maturity, in order to ensure a longer postharvest life, however, a common practice carried out by consumers of 'Lorena' avocado is to cover the fruit with newspaper for several days after it has been purchased to soften the fruit and accelerate ripening for immediate consumption with better organoleptic characteristics.

This practice generates a modified atmosphere around the fruit with high concentrations of ethylene, which stimulate the degradation of the cell wall and favor pigment biosynthesis, as well as the conversion of saturated to unsaturated fatty acids (Ruiz, 2018), however, generates alterations in the duration of postharvest life and little-known effects on the properties such as flavor, texture and aroma in the Lorena variety which, unlike the Hass variety, is a larger fruit, with greater firmness, and less oil concentration.

Therefore, the objective of the present study was to evaluate ripening treatments in Lorena variety avocado fruits to establish post-harvest behavior, diminish quality losses, and maintain organoleptic characteristics, facilitating commercialization of the product.

MATERIALS AND METHODS

Localization

This test was carried out in the plant physiology laboratory of the Universidad Pedagógica and Tecnológica de Colombia (Boyaca, Colombia) with avocado fruits that were harvested from a commercial crop on the La Esperanza farm in the Alto el Tigre village in the municipality of Lejanias, with coordinates the 3° 29' 39" N and 73° 59' 47" W, an annual average temperature of 23°C, and a relative humidity that oscillates around 59%.

Plant material

Avocado fruits of the Lorena variety, commonly known as *Papelillo*, were used, harvested from the middle third of the plant and classified in such a way that were in physiological maturity, free of mechanical damage, with good size (462 g on average), good appearance and marketable. Fruits were taken the same day of the harvest to the laboratory to start the measurements. The fruits were obtained from a 3-year-old crop whose plants were grafted on a so-called 'common' or 'criollo' rootstock, and which are planted in a soil characterized as Inceptisol. The crop receives ten applications per year of "Triple 18" as base fertilization, with an average dose of 1 kg per tree in each fertilizer, it also has a drip irrigation system of five drippers per plant of 4 L h^{-1}.

The fruits were classified in the laboratory according to the hardness of the epidermis into two degrees of maturity (maturity I: fruits with more hardness to the touch according to the Icontec standard [2003] NTC 5209; maturity II: fruits with less hardness to the touch), of which, none were in a mature state of consumption.

Experiment design

An experiment design with complete random blocks (BCA) was used, since this is the statistical arrangement that uses the least amount of experimental units (UE). The blocking criterion was the state of maturation of the fruits, with two blocks (maturity I and maturity II), five maturation treatments, three ethylene applications (2, 4 and 6 mL L^{-1}), fruits wrapped in unprinted newspaper and a control, for a total of 10 EU. Each UE had 24 fruits, for a total of 240.

For the ethylene applications, Ethrel® was used as a 50% commercial product, from which the concentrations in 4 L buckets were calculated using 16 mL of ethrel® to achieve a concentration of 2 mL L^{-1} of ethylene, 32 mL of ethrel for the concentration of 4 mL L^{-1}, and 48 mL of ethrel for the concentration of 6 mL L^{-1}. In all cases, the avocado fruits were completely immersed in the ethylene solution for 10 min.

Response variables

The following variables were evaluated every 3 d in 3 fruits per EU as follows: the pH was measured in 1 mL of avocado fruit juice graduated to 50 mL with distilled water using a Hanna HI8424 potentiometer (Hanna Instruments, Woonsocket, RI) calibrated with pH 7.0 and 4.0 buffer solutions; the respiratory intensity (IR) was recorded using 2 L SEE BC-2000 hermetic chambers (Vernier Software & Technology, Beaverton, OR, USA); and the CO_2 concentration was determined using the infrared sensor VER CO2-BTA (Vernier Software & Technology, OR, USA) and a Labquest2 interface (Vernier Software & Technology, Beaverton, OR, USA) for 5 min, expressed in mg of CO_2 kg^{-1} h^{-1} and calculated using Equation (1):

$$RR = \frac{3.6*(Cv-M)*m}{M} \tag{1}$$

Where, *RR* was respiratory intensity, *Cv* chamber volume (2 L), *M* mass of the fruits (kg) and *m* slope of the linear regression in Labquest2.

The total soluble solids (SST) were measured with a Hanna HI 96803 digital refractometer (Hanna Instruments, Woonsocket, RI) with a scale from 0 to 85% and precision of 0.1 °Brix. The total titratable acidity (ATT) was quantified by measuring the volume of sodium hydroxide (NaOH) incorporated in 10 mL of fruit juice, brought to 50 mL with distilled water and adding 5 drops of phenolphthalein in potentiometric titration until a pH of 8.2, and was calculated using Equation (2):

$$TTA(\%) = \frac{(A^*A^*C)^*100}{M} \quad (2)$$

Where, A was volume of NaOH spent, B normality of NaOH (0.1 N), C equivalent mass expressed in grams of predominant acid in the fruit (tartatic acid 0.075 g meq^{-1}) and M mass in grams of the sample used.

The fruit firmness (N) was determined using a PCE-PTR200 digital penetrometer (PCE Iberica, Spain) with a precision of 0.05 N. The accumulated mass loss (PM) was evaluated using an Acculab VIC 612 electronic balance with 0.01 g precision (Sartorius Spain SA, Madrid) during the postharvest phase, taking six fruits for each UE, measured over time and calculated using Equation (3):

$$ML(\%) = \frac{(Mi–Mf)}{Mi} \ {}^*100 \quad (3)$$

Where, ML was percentage of accumulated mass loss, Mi initial mass of the fruit and Mf mass of the fruit at each moment.

The epidermis color was measured with a Minolta CR 300 digital colorimeter (Minolta Co., Osaka, Japan), considering the parameters luminosity (L*), chromaticity from green to red (a*) and chromaticity from blue to yellow (b*), always using the same measurement point as a reference.

Analysis of the data

The data were analyzed using a Kolmogorov-Smirnov normality test. Then, an analysis of variance and a Tukey test ($P\leq0.05$) were performed with SAS v 9.2e (Sas Institute Inc., Cary, NC).

RESULTS AND DISCUSSION

Accumulated mass loss

No significant differences were observed between the maturity stages (Fig. 1) or between the accelerating ripening treatments. The maturity II stage presented a greater mass loss (30.21%) than the maturity I stage, which had 25.76% at 16 days after harvest (dah). All treatments, on average, lost mass as the storage time elapsed because of the ripening process of the avocado fruits; however, a greater loss of mass was observed in the fruits treated with 6 mL L^{-1} of ethylene (30.94%) than in the fruits without applications (23.55%) at 16 dah, which was higher than the 10% mass loss reported by Ruiz (2018) in Lorena variety fruits without treatments at 14 dah.

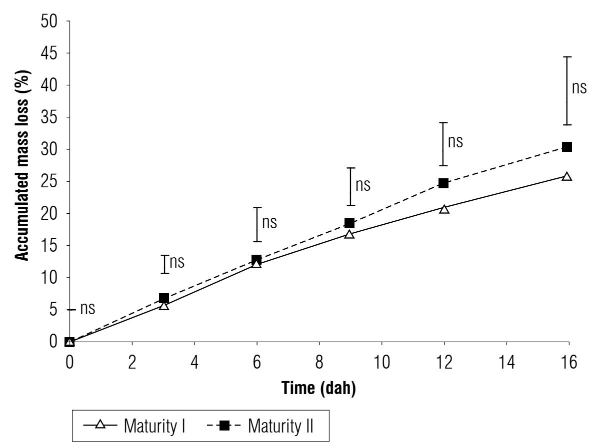

Figure 1. Accumulated mass loss in 'Lorena' avocado fruits harvested in two stages of maturity. Maturity I: fruits with more hardness to the touch; Maturity II: fruits with less hardness to the touch; ns: no significant effect between treatments according to the Anova ($P\leq$0.05). Vertical bars indicate the Tukey range test.

Likewise, Márquez *et al*. (2014) found an increasing behavior in the loss of mass during the postharvest stage with final values that ranged between 22.4 and 23% for avocado cv. Hass, similar to Herrera-González *et al.* (2017), who reported mass losses of 21.5% in avocado cv. Hass, and Vallejo-Pérez *et al.* (2015), who obtained values of 26.1 and 23% for fruits of cv. Vigorous and sunspot viroid (ASBVd) infected 'Hass', respectively. Water loss is the main cause of deterioration in the postharvest quality of fruits and is associated with a greater loss of mass when fruits mature (Vallejo-Pérez *et al.*, 2015). Cell membranes, being semi-permeable, allow water to exit via transpiration, which depends on the vapor pressure (DPV) of water between the fruit and the environment. So, the longer the storage time is, the greater the loss of water is (Díaz-Pérez, 2019).

Firmness

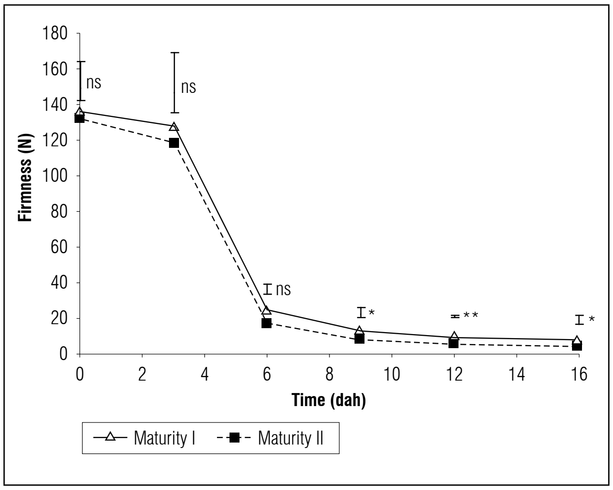

Figure 2. Firmness in 'Lorena' avocado fruits harvested in two stages of maturity. Maturity I: fruits with more hardness to the touch; Maturity II: fruits with less hardness to the touch; ns: no significant, * and ** indicate significant effect between treatments according to the Anova (*P*≤0.05 and *P*≤0.01, respectively). Vertical bars indicate the Tukey range test.

There were significant differences between the maturity stages at 9, 12 and 16 dah. The fruits harvested in maturity stage I presented the highest firmness values throughout storage, which agrees with the initial classification by stages since they were the hardest to touch. After 3 dah, a significant loss of firmness was observed in the avocado fruits, which decreased from 123.1 N to 20.82 N at 6 dah, followed by values of 6.38 N at 16 dah, on average for all treatments and maturity stages (Fig. 2). This agrees with Ruiz (2018), who found values of 101.2, 24.5 and 10.6 N in preclimateric, climacteric and postclimacteric fruits, respectively, which confirmed a drastic decrease in firmness during storage similar to that obtained by González-Cuello *et al*. (2017) in the first week of postharvest for avocado 'Hass'. Likewise, Caparrota *et al.* (2015) reported that, in avocado fruits, firmness is a good indicator of the ripening stages, and Benítez (2018) found a range of harvest maturity between 3 to 9 dah, a consumption maturity that ranged between 9 to15 dah, and an overripeness between 15 and 21 dah.

The treatments only showed significant differences at 12 dah. The fruits without applications of the ripening accelerator maintained higher firmness values (55.34 N) during storage, followed by the treatment wrapped with newsprint paper (52.24 N), as compared to the fruits treated with 6 mL L^{-1} of ethylene (47.41 N). These results agree with Vallejo-Pérez *et al*. (2015), where firmness showed a drastic reduction at 7 dah and presented an average value of 47.7 N at the end of postharvest. Likewise, these results are within the range of 37 to 45 N for ripe fruit consumption reported by Icontec (2003) in NTC 5209.

Table 1. Physicochemical parameters evaluated in avocado fruits, subjected to different treatments during postharvest period.

Variable	Value	Time (dah)					
		0	3	6	9	12	16
pH	Mean	6.39±0.00 b	6.42±0.03 b	6.65±0.05 a	6.85+0.04 a	6.68+0.05 a	6.68+0.04 a
	Tukey for maturity	0.01	0.16	0.43	0.31	0.29	0.33
	Tukey for treatments	0	0.40	1.10	0.79	0.75	0.83
TSS	Mean	1.66±0.00 b	1.99±0.17 b	8.38±0.30 a	7.89±0.38 a	7.66±0.41 a	7.41±0.46 a
	Tukey for maturity	0.10	0.53*	0.82	2.68	1.83	1.95*
	Tukey for treatments	0.11	1.34	2.07*	6.78	4.63	4.94
TTA	Mean	0.31±0.00 ab	0.24±0.01 bc	0.26±0.02 bc	0.37±0.02 a	0.37±0.02 a	0.22±0.03 c
	Tukey for maturity	0.03	0.05	0.15	0.08	0.08	0.11
	Tukey for treatments	0.04	0.13	0.37	0.20	0.20	0.27
MI	Mean	5.35±0.00 c	8.16±0.39 c	34.63±2.97 a	21.55±0.83 b	20.87±0.82 b	37.44±4.59 a
	Tukey for maturity	0.70	1.06*	18.76	5.46	3.42	20.87
	Tukey for treatments	0.80	2.70	47.50	13.82	8.66	52.84

TSS: total soluble solids, TTA: total titratable acidity, MI: maturity index. Means followed by different letters in the same row indicate significant statistical differences in postharvest time ($P<0.05$). * indicates significant effect between treatments according to the Tukey range test ($P\leq0.05$).

Once the increase in ethylene synthesis is generated, an increase in respiratory rate occurs, hese processes can be simoultanoeus and promote a decrease in firmness in fruits and a release of available energy through the action of enzymes, such as β-galactosidase, which carry out hydrolysis in the cell wall of terminal galactosyl residues of glycoproteins, galactans and carbohydrates (Sañudo-Barajas *et al.*, 2019). However, Blakey *et al.* (2012) stated that the concentrations of sugars, such as D-mannoheptulose, correlate positively with firmness and are increased in slow-ripening avocado varieties.

pH

The pH did not show differences between the treatments; however, the fruits with applications of 2 mL L^{-1} of ethylene showed the highest values. When analyzing the repeated measurements over time, there were significant differences, and the pH had a slight increase towards 9 dah, followed by a slight decrease after the second week of postharvest, with values between 6.2 and 6.4 (Tab. 1), as reported by Márquez *et al.* (2014), 6.42 to 6.63 for avocado 'Hass' at consumption maturity, and Astudillo-Ordóñez and Rodríguez (2018), who found pH values between 6.58 and 7.14. There was an increase in pH between weeks zero and three of storage, with maximums in the third week, followed by a slight decrease. Likewise, Buelvas-Salgado *et al.* (2012) obtained pH values in three degrees of maturity of 6.26, 6.30 and 6.41 in the green, *pintón* and mature states, respectively. Vargas-Ortiz *et al.* (2016) obtained ranges of 6.8 and 5.5 for the control treatment and 6.3 for avocados heated for 20 min.

The behavior of pH was associated with the content of organic acids present in the fruit since, in the ripening period, they tend to decrease because they are consumed in the different metabolic cycles. In addition, many act as precursors of volatile substances during ripening (Márquez *et al.*, 2014).

Total soluble solids (TSS)

The TSS had significant differences between the maturity stages at three and 16 dah, presenting values for maturity I that ranged from 1.66 to 8.50 °Brix and for maturity II between 1.66 and 8.26 °Brix (Tab. 1). This increase in °Brix was related to the degradation of polysaccharides and organic acids converted into sugars (Caparrotta *et al.*, 2015). According to Buelvas-Salgado *et al.* (2012), the increase in the °Brix content was due to the higher concentration of sugars from respiration and the loss of water in perspiration, making avocados a climacteric fruit with a high increase in concentrations of ethylene at the beginning of ripening.

The TSS had significant differences over time and showed a constant behavior between days one and three of postharvest. Then, there was a strong increase up to 6 dah, going from 1.99 to 8.38 °Brix, after which they remained almost constant with a slight downward trend until 16 dah (7.41 °Brix) when storage ended. These maximum values at 6 dah coincided with the increase in CO_2 concentration in the avocado fruits, which was possibly due to an increase in metabolic activity, which involves the enzymes α-amylase and β-amylase, which hydrolyze starch to the simpler compounds of disaccharides and monosaccharides during maturation (Yahia *et al.*, 2019).

Likewise, Astudillo-Ordóñez and Rodríguez (2018) found values of 7.26, 6.22 and 5.90 °Brix, for avocado 'Hass' in three harvest indices (early, intermediate and late, respectively), in which the TSS were higher in the early stages of maturity, as observed by Benítez *et al.* (2021), who reported decreases from 7.4 to 5.1% in fruits with consumption ripeness.

Total titratable acidity (TTA)

The TTA did not show differences between the degrees of harvest maturity or between the treatments. The highest values were presented in the fruits that received the control treatment (0.44%), and the lowest values were in those that received 4 mL L^{-1} of ethylene (0.33%) at 9 dah (Tab. 1).

The TTA had significant differences over time and presented a decrease at the beginning of postharvest up to 3 dah, with values between 0.31 to 0.24%, followed by an increase up to 9 dah (0.37%). After 12 dah, it began to decrease, indicating senescence, going from 0.37 to 0.22%. These values are similar to Márquez *et al.* (2014), who found decreases in acidity from 0.25 to 0.16% during 21 dah in storage for avocado 'Hass' fruits grown in El retiro and El Carmen de Viboral municipalities in Antioquia (Colombia).

This decrease in TTA is attributed to the consumption of organic acids in the metabolism of the avocado fruits (product of the increase in respiratory intensity or in response to senescence), in which tartaric acid predominates, which provides energy for ripening (Caparrotta *et al.*, 2015).

Maturity index (MI)

The MI did not show significant differences between the maturity stages or between the treatments. The fruits that received 2 mL L^{-1} of ethylene at 16 dah had a higher MI value, 57.84, than the other treatments (Tab. 1). In this regard, Buelvas-Salgado *et al.* (2012) found MI values of 15.38 in the green state, 24.55 in the *pintón* state and 38.80 in the ripe state in 'Hass' avocado fruits.

Over time, the MI had significant differences, with an increase from 3 to 6 dah, from 8.16 to 34.63, and then decreased, meaning the fruits can be consumed in that state. Towards day 16, the MI increased to 37.44 with senescence, and, despite the fact that sugars remained constant, the TTA decreased as a result of the consumption of acids in respiration (Yahia *et al.*, 2019), raising the MI. Márquez *et al.* (2014) found MI values that oscillated between 6.4 and 5.2 at harvest and between 15 and 10 at 21 dah for fruits harvested in the municipalities of El Retiro and El Carmen, respectively.

Respiratory rate (RR)

Although the RR did not show significant differences for the maturity stages or for the ripening treatments, the avocado fruits that received the application of 4 mL L^{-1} of ethylene showed higher values, 62.79 mg CO_2 kg^{-1} h^{-1}, than the control (38.73 mg CO_2 kg^{-1} h^{-1}) at 16 dah, which suggests the effect of ethylene in increasing respiratory metabolism.

The RR showed significant differences over time throughout postharvest. During the first 6 dah, the RR increased by 170%, which could indicate the climacteric peak. Then, from 6 to 12 dah, it remained constant and, towards the end, had a slight increase, reaching values of 54 mg CO_2 kg^{-1} h^{-1} (Fig. 3). This is similar to the results of Ruiz (2018), who found values of 50.89 mg CO_2 kg^{-1} h^{-1} in the climacteric peak in 'Lorena' avocados at 8 dah. Also, Chen *et al.* (2017) found an ethylene peak of 40.5 and 36 mg CO_2 kg^{-1} h^{-1} after 3 d of storage in avocado fruits treated with exogenous ethylene and from 41 to 38 mg CO_2 kg^{-1} h^{-1} at 6 and 8 dah in naturally ripened fruits. Furthermore, Herrera-González *et al.* (2017) found the climacteric peak in 'Hass' and 'Méndez' avocado fruits at 7 and 8 d after harvest in refrigerated fruits.

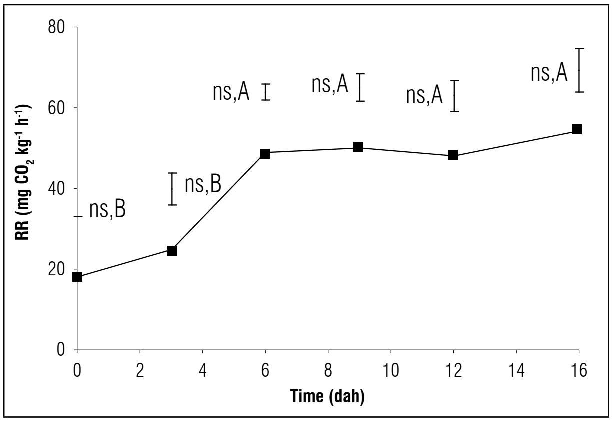

Figure 3. Respiratory rate in 'Lorena' avocado fruits. ns: no significant effect between treatments for the same time according to the Anova ($P\leq0.05$) before the comma and different letters indicate significant differences between the measurements over time according to the Tukey test groupings ($P\leq0.05$) after the comma. Vertical bars indicate the Tukey range test.

These values are lower than those of Márquez *et al.* (2014), who observed a maximum value of 150 mg CO_2 kg^{-1} h^{-1} at 8 d postharvest with an increasing and continuous behavior in 'Hass' avocados, similar to that observed in the present study with 'Lorena' avocados. The climacteric peaks that occur in respiration are probably due to the stress that fruits undergo when removed from the plant, which generates an increase in mitochondrial activity in combination with the degradation of starch through enzymatic action and formation of carbohydrates (Saltveit, 2019).

Color

The color parameters L*, a* and b* did not present significant differences for any of the treatments in the different periods of measurement; however, the epidermis of the fruits that received applications of ethylene wrinkled towards senescence. The L* value had a downward behavior during postharvest, going from 75.6 to 63.54 towards the end of storage, with an average of 72.5±8.7, higher than that reported by Ruiz (2018), of 57.5. This indicates that the fruits lose brightness and luminosity through oxidation of the tissues, perspiration and internal browning as storage increases (Cogo *et al.*, 2011), which indicate a darkening of the avocado.

The b* parameter had a downward behavior and went from 76.1 to 51.8 during postharvest, with an average of 62.8 ± 9.2, which is higher than that obtained for the Lorena variety (47) by Ruiz (2018) at 12 dah. The a* value went from -65.1 to -39.1, which indicated a slight loss in the intensity of the green color. These values are lower and contrast with Ruiz (2018), who reported that the a* value decreased from -20.9 to -22.2 during the postharvest phase and stated that the fruits had a slight gain in the intensity of the green color.

CONCLUSION

The climacteric peak of the 'Lorena' avocado fruits was evident at 6 dah and coincided with the highest values of TSS, MI and loss of firmness and the lowest TTA percentage. The fruits maintained postharvest quality for 16 days, and those that received ethylene applications showed a greater mass loss than those covered with newspaper and the control treatment. The application of 6 mL L^{-1} of ethylene presented the greatest mass loss. The TTA showed higher values for the control treatment during storage. The MI registered two maximums during postharvest: the first in the climacteric peak, and the second during fruit senescence. The effect of maturity accelerators on the postharvest behavior of the avocado fruits was clear; however, the effect of the applications of ethylene was more intense than that of newspaper.

Conflict of interests: the manuscript was prepared and reviewed with the participation of the authors, who declare that there exists no conflict of interest that puts at risk the validity of the presented results.

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