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EVALUATION OF THE IMPACT OF AN EDIBLE COATING ON THE CONSERVATION OF GUAVA (*Psidium guajava*)

EVALUACIÓN DEL IMPACTO DE UN RECUBRIMIENTO COMESTIBLE EN LA CONSERVACIÓN DE LA GUAYABA (*Psidium guajava*)

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ABSTRACT

Edible coatings are described as a thin, transparent and edible layer that surrounds a food, usually by immersing it in a solution that forms the coating in order to contribute to the preservation of the quality of the food matrix and in turn, provide packaging. The objective of the present study was to evaluate the efficiency of edible coatings on the shelf life of immature green guava (Psidium guajava L), for which K-carrageenan and glycerol were used as coating material and plasticizing material, respectively, as well as the CIE L*A*B, DeltaE coordinates for the determination of color changes as

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a function of maturity and storage conditions at room temperature (30°C) for 10 years. days. As a result, the coating made with K-carrageenan managed to maintain the properties of the fruit for longer, which allows us to verify that the use of this coating is a feasible preservation method that helps to delay ripening and, therefore, increase the shelf life of fruits such as guavas.

Key words: Fruits, guava, coating, shelf life.

RESUMEN

Los recubrimientos comestibles se describen como una capa delgada, transparente y comestible que envuelve un alimento, generalmente mediante su inmersión en una solución que forma el recubrimiento con la finalidad de contribuir en la preservación de la calidad de la matriz alimentaria y a su vez, proporcionar un empaque. El objetivo del presente estudio, consistió en evaluar la eficiencia de recubrimientos comestibles sobre la vida útil de la guayaba (Psidium guajava L) verde inmadura, para lo cual, se utilizó K-carragenato y glicerol como material de recubrimiento y material plastificante, respectivamente, así como las coordenadas CIE LAB, DeltaE para la determinación de los cambios de color en función de la madurez y las condiciones de almacenamiento a temperatura ambiente (30 °C) durante 10 días. Se obtuvo como resultado que el recubrimiento elaborado con K-carragenato, logró mantener por más tiempo las propiedades de la fruta, lo cual permite constatar que el uso de este recubrimiento es un método de conservación factible que ayuda a retardar la maduración y, por ende, a aumentar el tiempo de vida útil de frutas como guayabas.

Palabras clave: Frutas, guayaba, recubrimiento, vida útil.

INTRODUCTION

Guava (*Psidium guajava* L.) is characterized by being an important source of vitamins and minerals (Gallo et al., 2018), which makes it a fruit of great commercial value, but since it presents a climacteric physiology, which means, that it continuous with metabolic processes of maturation (respiration and transpiration) until its senescence and decomposition, it is highly perishable.

With the aim of avoiding or minimizing the adverse effects for the above-mentioned factors and jointly extending the shelf life of fruit and vegetable products, several technologies have been implemented, such as biological control, controlled atmosphere preservation, the use of films and the application of edible coatings, among others (Núñez et al., 2012; Peñaloza y Hernández, 2018; Calsada-Uribe et al., (2022).

This last one reveals a significant role in the shelf life of food products due to its ability to reduce water, regulate the respiration process, slow down the aging process and improve the quality and commercial value of food products, keeping intact their quality attributes and nutritional value (Vargas et al., 2007). These coatings are especially valuable due to their antimicrobial properties, ability to regulate the permeability of gases such as CO_2 and O_2, good mechanical properties and biodegradability (Durango et al., 2011). In addition, they are safe for consumption, eco-friendly and cost-effective (Bezerra et al., 2014).

The composition of edible coatings is highly diverse. Polysaccharides and proteins stand out as excellent materials for coating formation due to their remarkable mechanical and structural properties (Andrade et al., 2014). However, these materials tend to have a por moisture barrier, which can result in a reduction in the respiration rate of fruits and vegetables (Guerreiro et al., 2014). In contrast, especially those with high melting points, are hydrophobic and do not present the problem of moisture, although their mechanical properties may be por, often requiring the addition of additives to counteract this limitation (Guerreiro et al., 2014).

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Therefore, the objective of this research consisted of evaluating the impact of an edible coating base on k-carrageenan and glycerol on the conservation of guava (*Psidium guajava*) during its storage.

MATERIALS AND METHODS

Harvest and preliminary treatment of Plant Material.

The fruits of *P. guajava* L. were collected in the city of Cartagena (Coordinates 10°25′25″N 75°31′31″O) considering their quality and degree of ripeness.

The selected fruit were washed by immersing them in distilled water and sodium hypochlorite at 100 ppm during 10 minutes in order to avoid the growth of microorganisms. Then, they were rinsed with abundant distilled water and exposed to the air to be dried at room temperature and subsequently, to carry out the determination of the color coordinates CIELAB, DeltaE.

Determination of the CIE L*A*B, DeltaE color coordinates.

In the first instance, the colorimeter was calibrated to obtain the color coordinates, establishing the reference values for an accurate measurement of the colors and ensuring that the instrument was correctly adjusted.

The simples, previously conditioned, were placed in the colorimeter and readings were taken in triplicate and the values obtained were averaged. The external fruit color changes were monitored by measuring the lightness (L*) (lightness), (a*) (red-green component), (b*) (yellow-blue component) during 10 days of storage.

Finally, DeltaE was determined, which is a measure of color difference that compares two simples or a sample with a reference, using formula 1:

Formula 1. $\Delta E = \sqrt{(\Delta L)2 + (\Delta a)2 + (\Delta b)2}$

Where, ΔL, Δa and Δb are the differences in L*, a* and b* values respectively between samples.

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Elaboration of the Edible Coating.

To elaborate the coating, 0.5% P/V de K-carrageenan was dissolved in distilled water under constant stirring with the aid of a heating plate with the aim of avoiding the separation of the phases. Once the solution was dissolved, glycerol was incorporated as plasticizing material and the resulting solution was subjected to heating until reaching a temperature of 80 °C during 10 minutes. Afterwards, this temperature was decreased in order to carry out the coating of the plant material.

Application of Edible Coating on Guavas (Psidium guajava L).

The application of the coating on the previously sanitized fruits was carried out through the immersion method for approximately 40 seconds, due to the fact that this method produces a homogeneous coating as a consequence (Fernández et al., 2017). Then, the fruits were taken to storage at 30 °C and a controlled relative humidity, during 10 days (Figure 1).

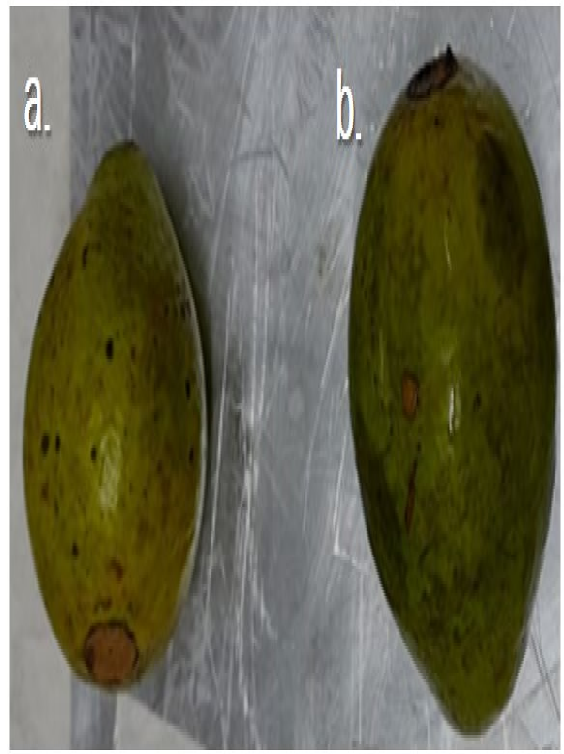

Figure 1. Control and coated simples at 0 time.

The experimental testing was carried out by measuring at regular times the change in color and firmness of the fruit with the application of coating solutions and control treatment (without any treatment), during 10 days of storage.

Sensory evaluation

In order to carry out the evaluation, a total of fifty judges participated. The evaluation was carried out subsequent to ten days of follow-up time, during which time the behavior of the samples was observed. Next, a description of the tests performed is given below:

Preference test: In this test, judges evaluated samples based on several characteristics, including brightness, color, texture and overall appearance. Each judge provided their opinion on which sample they preferred for each of these characteristics. The results of this test were used to determine which of the samples (coated guava or control) was preferred in the above terms by the majority of the judges.

Interval scale placement test: In this test, the judges evaluated the odor of the guava samples through an interval scale that consisted of four points. Each point on the scale represented a different level of odor quality. Judges assigned a value based on their perception of the door of the samples.

Statistical analysis

The tests were carried out in triplicate with the aim of ensuring reliable analytical results by using the GraphPad Prism 8 program. Results were expressed as mean ± EEM (standard error of the mean).

RESULTS AND DISCUSSION

In the same way that occurs in most fruits, the color transition from green to yellow in guava is characterized by the decrease of chlorophyll and the emerging presence of carotenoid pigments (Maldonado, 2013). The loss of green color in fruits such as guava is because, as it ripens, chlorophyll is gradually degraded due to ripening processes and the action of enzymes (Guavita et al., 2018).

It is evident that the control sample and the coated sample presented a progressive change in this characteristic, however, this was more perceptible in the uncoated sample. The variation of pigments was accompanied by a successive ripening of the fruit and with it, an increase in the colorimetric values a* (red-green component) and b* (yellow-blue component), and in turn, the decrease in lightness (L*) (Table 1).

Table 1. CIELAB, h, C, DeltaE, color coordinates of the control and coated samples.

Coordinate	Sample control		Coated samples	
	Day 1	Day 10	Day 1	Day 10
L*	49.8±0.3	33.6±0.1	42.4±0.2	39.2±0.3
a*	1.5±0.5	11.2±0.1	-2.8±0.1	3.6±0.2
b*	36.6±0.1	55.6±0.1	30±0.2	46±0.1
DeltaE.	87.9±0.1	100.4±0.2	75.2±0.2	88.8±0.1

In the case of a* coordinate, when the guava is green and unripe, often it Will have a negative value in this coordinate because of the green hue of tits skin. As it ripens and the green decreases, the value of a* is likely to approach zero or even become positive if the fruit becomes more red or yellow in color (Talens, 2017).

Regarding the b* coordinate, as the guava ripens and the green decreases, it is possible that the value of b* moves towards more positive or higher values, indicating a change towards yellow or orange tones (Talens, 2017).

The coating acts as a protective barrier that helps reduce moisture loss from the guava, which in turn can slow down the degradation of chlorophyll. Moisture loss can accelerate the breakdown of chlorophyll in the skin cells of the fruit, which causes a change in color.

There was evidence of a delay in ripening due to the fact that the application of physical barriers such as coatings on the fruit surface can regulate the permeability to O_2, CO_2 and water vapor, slowing the natural ripening process. The coating can provide some protection against light, which can also degrade chlorophyll, which can help maintain the green color of guava.

However, in other cases, especially if the fruit already has a reddish or yellowish color before the application of the coating, it is possible that major changes in the a* and b* coordinates may be produced as the fruit ripens and deteriorates. These changes could be similar to those occurring in uncoated fruit, although they could potentially be attenuated or delayed due to the presence of the coating, in this case, carrageenan-based.

The DeltaE coordinate always considers the differences in the L*, a* and b* coordinates between two colors. As the coordinates a* and b* increase, the change in these components can contribute to an increase in the DeltaE coordinate. This indicates that the colors had greater difference between each other in terms of hue and saturation in the control fruit, which is due to the aspects mentioned above.

In figure 2, it is shown the control sample and the coated sample at 10 days of storage.

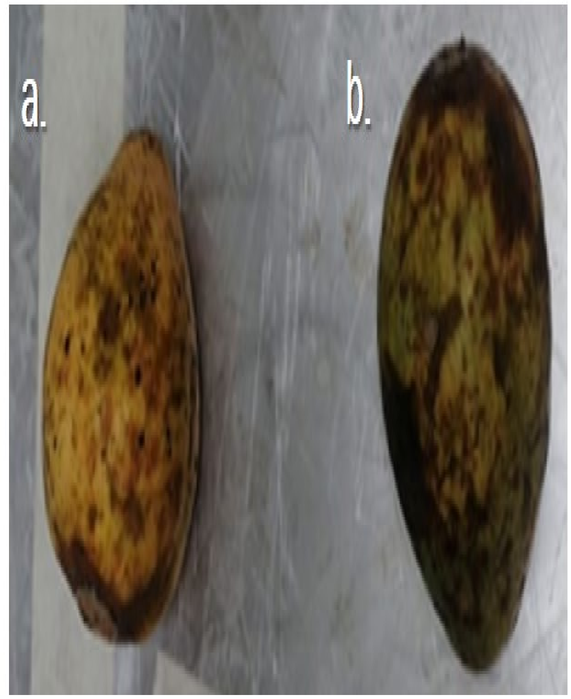

Figure 2. Control and coated sample at 10 days of storage.

The coated fruit shows a delay in the ripening process compared to the control sample, maintaining its green color for a longer period of time. This promising result is mainly related to the effect that these coatings act as a barrier to water loss that affects its structure and turgor and controls the gas exchange that influences the chemical and microbiological stability (Solano-Doblado et al., 2018) increasing its shelf life (Paz, 2018), therefore, edible coatings based on k-carrageenan are an effective alternative for post-harvest preservation of fruits and vegetables (Mee et al., 2018).

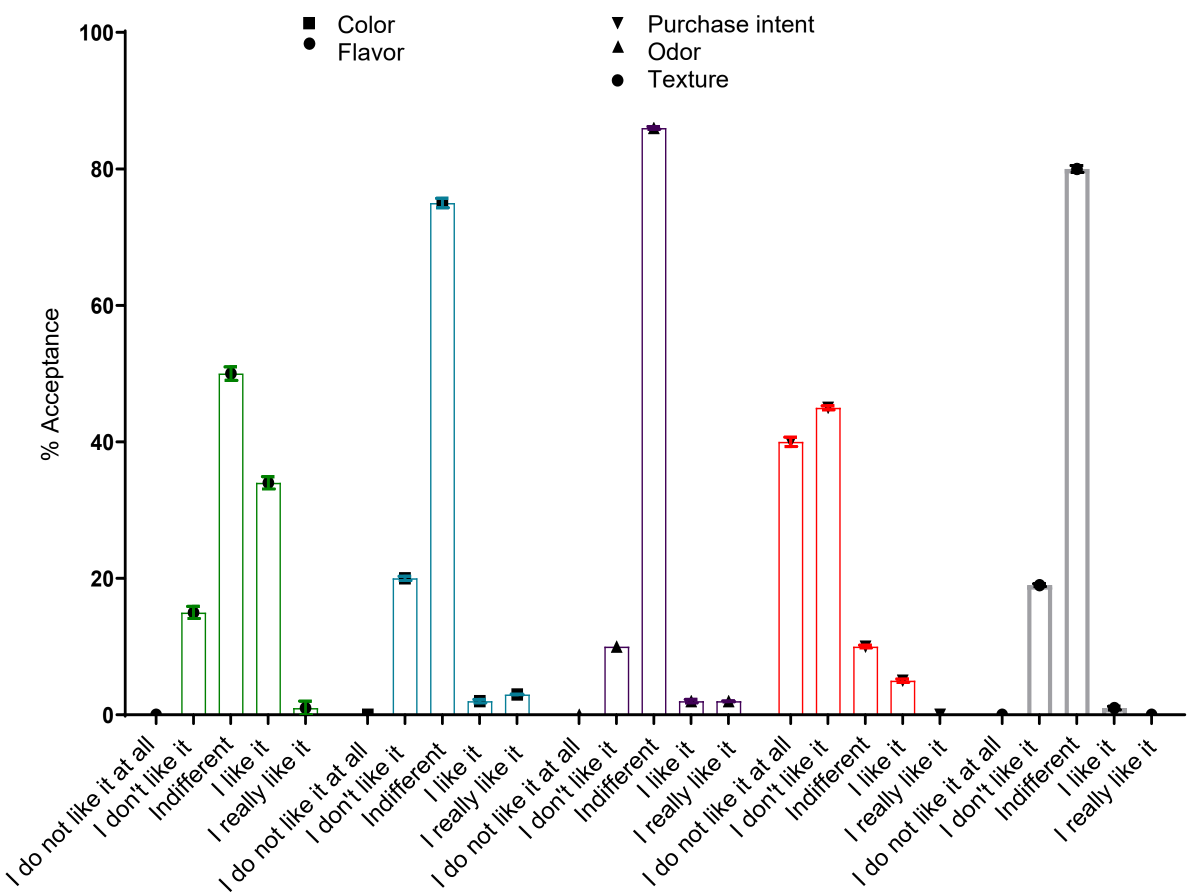

Figure 3. Sensory evaluation of the uncoated sample at 10 days of storage.

In figures 3 and 4 the results of the sensory test carried out to determine if there was acceptability by the panelists, during the time of the trial, are shown.

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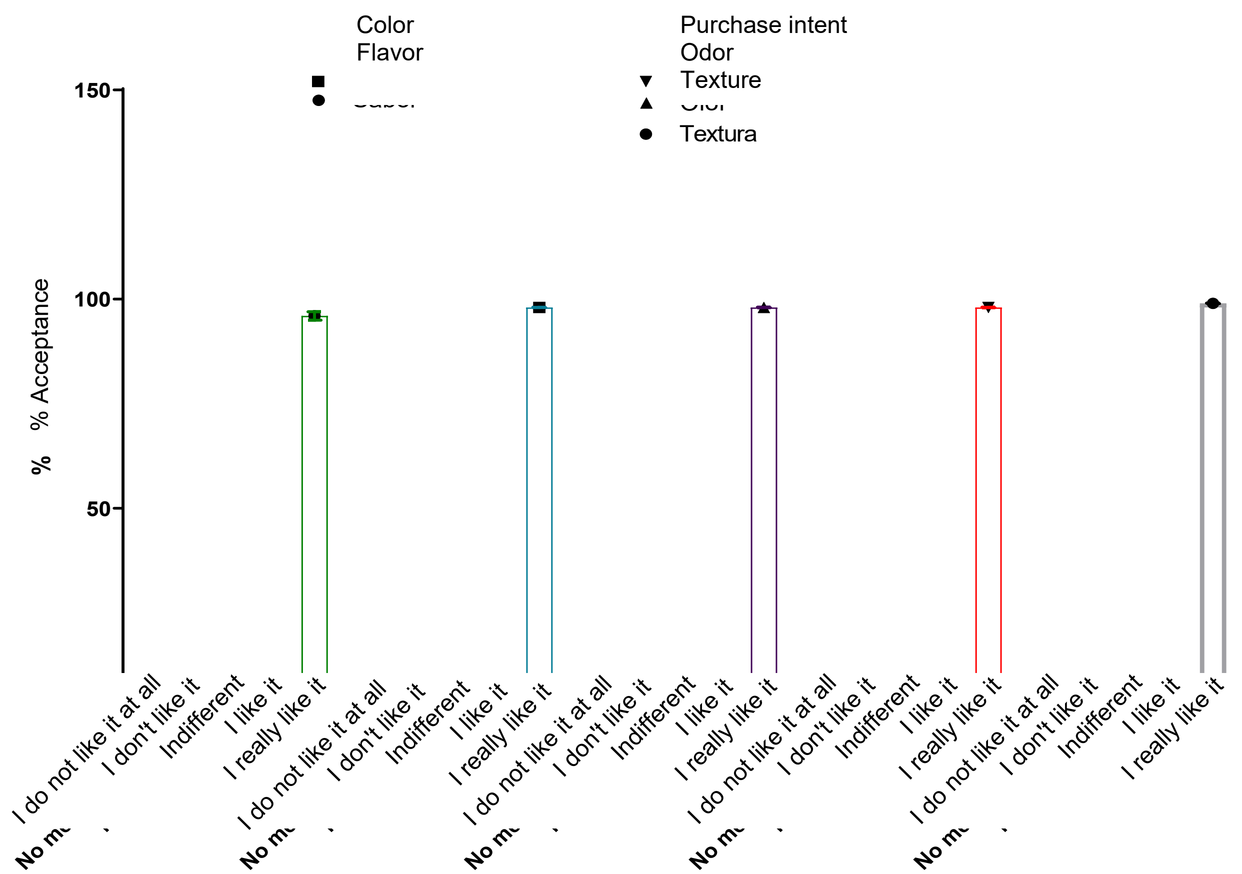

Figure 4. Sensory evaluation of the coated sample

at 10 days of storage.

The use of k-carrageenan as an agent to make the edible coating on guavas has proven to be highly successful. In all the parameters evaluated, the samples coated with k-carrageenan presented a percentage of acceptance higher than 95%, which shows a marked contrast with the control samples, in which the acceptance was significantly lower. This result highlights the effectiveness of k-carrageenan as a coating that improves the quality and appearance of guavas, which makes it a highly promising option in the food industry.

CONCLUSIONS

The use of a K-carrageenan-based coating on fruits can be effective in improving fruit preservation.

The carrageenan is a natural polymer that forms a protective coating on the surface of guava, helping to reduce water loss, minimize oxidation and retard spoilage, in turn to extend the shelf life of the fruit.

In terms of visual appearance, the K-carrageenan-based coating can help to maintain the color of guavas by retarding discoloration and enzymatic browning induced by ripening and storage conditions.

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