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Effect of edible coatings based on mango peel powder (Varieties *Mangifera indica* L., Kent and Amelie) on the post-harvest quality and storage stability of Kent mangoes

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ABSTRACT

The shelf life of mangoes is limited by their rapid ripening, which leads to deterioration of physicochemical and organoleptic properties, thereby increasing postharvest losses. To propose a sustainable alternative, this study evaluated the effectiveness of edible coatings formulated from Amélie (A) and Kent (K) mango peels on the postharvest quality of fresh Kent mangoes, compared with uncoated controls (T). After harvest and cleaning, fruits were coated and stored at ambient temperature (25 ± 2 °C) for 20 days, with analyses conducted every 5 days. The results showed that coatings significantly reduced mango losses during storage. Ascorbic acid (vitamin C) content decreased over the 20 days, dropping from 237.51 to 61.75 mg/100 g in control mangoes, compared with 237.51 to 155.54 mg/100 g and 237.51 to 157.00 mg/100 g in mangoes coated with gels A and K, respectively. Titratable acidity, pH, and soluble solids increased during storage. Sensory profiles indicated good preservation of organoleptic properties, with pleasant aroma, sweet taste, and satisfactory firmness. Overall, the peel-based coating technique helped preserve most physicochemical and sensory characteristics of Kent mangoes during 20 days of storage at ambient temperature, demonstrating its potential as a sustainable postharvest preservation method.

Contribution/Originality: This study contributes to the existing literature by valorizing mango byproducts for postharvest preservation. Unlike previous research focused on conventional polymers, it proposes an innovative methodology based on edible coatings derived from mango peel. Rare among studies examining Kent mangoes, it demonstrates that such coatings reduce losses, extend shelf life, and sustainably support the mango sector.

1. INTRODUCTION

The mango tree (*Mangifera indica* L.), a large tropical tree belonging to the Anacardiaceae family, is one of the world's major fruit crops. Mango, the fruit of the mango tree (*Mangifera indica*), is available worldwide in numerous varieties (more than 1,000). Among these, only a few are cultivated on a commercial scale (Solís-Fuentes & Durán-De-Bazúa, 2011). Also known as the "king of fruits," mango is the second most economically important tropical fruit crop worldwide (Ooi, 2016). In West Africa, mango provides significant nutritional benefits and represents an essential source of income (Díaz-Montes & Castro-Muñoz, 2021). Côte d'Ivoire is one of the leading mangoproducing countries in West Africa, with an estimated annual production of about 180,000 tons (Inter-Mangue, 2025). It is the top African exporter and the third largest exporter globally of mangoes to the European market, after Brazil and Peru, with exports reaching 32,000 tons in 2024 (International Trade Centre, 2024). Ivorian exports mainly concern the 'Kent,' 'Keitt,' and 'Amélie' varieties (Touré, 2012). The 'Kent' variety is the most favored for export due to its organoleptic and physicochemical qualities. Each year, the sector generates approximately 10 billion CFA francs, of which 1.5 billion directly benefits Ivorian producers (CNRA, 2025). Despite its nutritional and economic importance, mango production worldwide faces significant postharvest losses. In Côte d'Ivoire, these losses are estimated at between 30% and 40% of national production (Kouamé, Silué, & Kassé, 2020). They are largely due to the lack of adequate postharvest technologies for stabilizing and preserving the fruit in its fresh state (Njantou, 2006). This situation undermines food and nutritional security and represents a considerable financial loss for stakeholders in the value chain. To reduce these losses, various postharvest technologies have been developed, such as the use of chemical fungicides, modified atmosphere packaging, refrigeration, irradiation, and coating techniques (Ahmed, Shivhare, & Singh, 2009; Castillo, Fissore, & Gerschenson, 2010; Swart, Labuschagne, & Combrinck, 2009). Although effective, these methods present certain limitations, including chilling injuries, the development of undesirable characteristics, high operational costs, implementation difficulties, and environmental and consumer health concerns (Tavassoli-Kafrani, Shekarchizadeh, & Masoudpour-Behabadi, 2016). However, environmental considerations and new consumer market trends have driven the food industry toward the development of eco-friendly materials with reduced environmental impact (Lorevice, Moura, & Mattoso, 2014). In recent years, edible and biodegradable packaging has attracted considerable interest in the food industry due to its advantages over non-edible packaging. These materials generally enhance the visual appearance of fruits to which they are applied; they are non-toxic, can be consumed along with the product, are inexpensive, and have little to no environmental impact (Botrel, Soares, Geraldine, Pereira, & Fontes, 2007). When produced from industrial by-products, they further contribute to environmental preservation.

In this context, mango peel powder, rich in polysaccharides, antioxidant phenolic compounds, and natural antimicrobial properties, represents an abundant, low-cost local resource that is compatible with the fruit's organoleptic quality, offering an innovative solution for the postharvest preservation of mangoes. However, scientific literature on the use of mango peel powder in edible coatings remains limited. As part of the search for sustainable solutions for the preservation of fresh and perishable products, edible coating formulations based on Kent and Amelie mango peels have been developed. These formulations combine 5 g of Kent mango peel powder with 2 g of starch and 20% glycerol, as well as 5 g of Amelie mango peel powder with 2 g of starch and 15% glycerol.

They exhibit favorable characteristics for maintaining postharvest quality. The objective of this study was to evaluate whether composite coatings based on mango peel powder possess properties that allow them to be used as edible coatings to preserve the physicochemical parameters of Kent mangoes and extend their postharvest shelf life. This article is divided into three main sections, in addition to the introduction, abstract, conclusion, and perspectives. The first section provides a literature review on edible coatings and mango by-products. The second section describes the materials and methods used. The third section presents the results, which are then discussed.

2. LITERATURE REVIEW

Edible coatings based on biopolymers have been widely studied for extending the shelf life of fruits and vegetables. Among the most commonly used are starch, chitosan, and carboxymethylcellulose (CMC). However, each presents specific advantages and limitations.

2.1. Starch-Based Coatings

Starch-based coatings provide good transparency and act as effective oxygen barriers. However, their low resistance to moisture and limited antimicrobial activity restrict their effectiveness in postharvest preservation of fruits (Shanbhag et al., 2023; Singh, Singh, Sane, & Nath, 2013).

2.2. Chitosan-Based Coatings

Chitosan is well recognized for its antimicrobial activity. Nevertheless, its effectiveness is highly dependent on pH and may negatively affect fruit texture (Ali, Maqbool, Alderson, & Zahid, 2020). To overcome these limitations, (Pham, Nguyen, & Le, 2024) enriched chitosan with rutin and cyclodextrins, though the use of costly additives limits its large-scale application.

2.3. Carboxymethylcellulose (CMC) Based Coatings

CMC is effective in reducing enzymatic browning and improving texture. However, its weak antimicrobial activity limits its role in fruit preservation (Panahirad et al., 2021).

2.4. Incorporation of Mango Peel Powder into Coatings

Table 1 presents the incorporation of mango peel powder into different coating systems. Unlike conventional polymers, mango peel powder is rich in polyphenols, flavonoids, and fibers. Incorporating mango peel powder into edible films significantly reduces microbial load and delays oxidation (Kučuk, Primožič, Kotnik, Knez, & Leitgeb, 2024). According to Farouk (2024), its antimicrobial effectiveness against *E. coli* and *Aspergillus niger* surpasses that of starch- and chitosan-based films. Table 1 presents the incorporation of mango peel powder into different coating systems.

Table 1. Comparison of coating systems.

Coating System	Main Properties	Limitations	Authors
Starch	Transparent film with effective oxygen barrier properties	Limited antimicrobial effectiveness and high sensitivity to moisture	Singh et al. (2013).
Chitosan	Exhibits antimicrobial activity and reduces enzymatic browning	Its effectiveness is pH-dependent and requires costly additives	Ali et al. (2020) and Pham et al. (2024).
CMC	Maintains good texture and reduces browning	Limited antimicrobial activity	Panahirad et al. (2021).
Mango peel	Antimicrobial and antioxidant, sustainable	Variability by origin	Kučuk et al. (2024) and Farouk (2024).

3. MATERIALS AND METHODS

For the present study, the methodological approach consisted of applying coatings formulated from mango by-products (varieties Kent and Amelie), followed by comparative monitoring of selected physicochemical parameters during the storage of Kent mangoes.

Unlike previous studies that relied on coatings based on conventional biopolymers such as chitosan or cassava starch, the approach adopted here introduces the direct use of mango peel powder as a functional agent.

3.1. Plant Material

Healthy mangoes (*Mangifera indica* L., cv. Kent) of category 1 and uniform size (size 9) were harvested from a commercial orchard located in Korhogo, in northern Côte d'Ivoire, and then transported to Abidjan. The fruits were harvested at commercial maturity with intact peduncles approximately 1 cm in length. They were then packed in cartons and sent to the Biocatalysis and Bioprocesses Laboratory (LBB) at NANGUI ABROGOUA University.

3.2. Methods

3.2.1. Sampling

A total of 285 mangoes of uniform size and shape, at the same stage of maturity, and free from mechanical damage or any kind of blemish, were selected, carefully washed with water, and air-dried in the shade. They were then divided into three different batches and stored at laboratory room temperature (25 ± 2 °C).

- A first batch of 60 untreated mangoes, serving as the control.
- A second batch of 60 mangoes coated with a gel formulated from Kent mango peel powder (Gel K).
- A third batch of 60 mangoes coated with a gel prepared from Amélie mango peel powder (Gel A).

Physicochemical parameters were evaluated every five days on five fruits per batch, while sensory analysis was conducted on three fruits per batch.

In addition, for the study of loss rate, three supplementary batches of 30 mangoes each were set up:

- Mangoes coated with Gel A.
- Mangoes coated with Gel K.
- A control batch of uncoated mangoes.

These samples were used to compare postharvest losses between coated and uncoated mangoes.

Finally, the evaluation of mass loss (weight loss) was carried out using the following batches.

- A batch of five mangoes coated with Gel K.
- A batch of five mangoes coated with Gel A.
- A control batch of five uncoated mangoes.

These different batches allowed quantification of the mass loss of coated and uncoated fruits during storage.

3.2.2. Production of Mango Peel Powder

Kent and Amelie mangoes were sorted to select fruit in good condition, then washed with distilled water and left to drain. The peels of the two (2) mango varieties were obtained by peeling the fruit with a knife.

The peels obtained were dried separately in a VENTICELL ventilated oven at 50 °C for 72 hours (Njantou, 2006). After drying, the peels were finely ground using an IKA Mill (Germany/Deutschland). The ground material was sieved using a 250 µm mesh sieve. The powders obtained were packaged in labelled airtight containers and stored in the laboratory before testing.

3.2.3. Extraction of Cassava Starch

The wet extraction process described in Banks and Greenwood (1975) was used to extract the starch. Six kilograms of cassava roots were peeled, washed, and cut into chips. The chips were then ground in a blender (Binatone, Italy) at laboratory temperature (28 ± 2 °C). The resulting pulp was soaked in distilled water. The pulp was then passed successively through sieves with decreasing mesh sizes of 500 µm, 250 µm, and 100 µm, respectively, to produce starch milk. The starch milk obtained was left to settle for 2 hours in basins. The sediment was recovered, left to dry in the open air for 24 hours, and then finely ground using a grinder (BLENDOR, France). The starches obtained were packaged in hermetically sealed glass bottles and stored at room temperature (30 to 35 °C).

3.2.4. Preparation of the Coating Gel

Two distinct coating gel formulations (A and K) were prepared from mango peel powder and cassava starch, with glycerol as a plasticizer: Gel A was prepared by mixing 100 g of Amélie mango peel powder, 40 g of cassava starch, 15% glycerol (by weight relative to the powder/glycerol mixture), and 2 litres of distilled water. Gel K was obtained from 100 g of Kent mango peel powder, 40 g of Yacé cassava starch, and 20% glycerol (by weight relative to the powder/glycerol mixture), diluted in 2 L of distilled water. Each solution was subjected to constant magnetic stirring at 750 revolutions per minute at a temperature of 90°C for 30 minutes to ensure the homogeneity of the mixture and the gelation of the components. The gels obtained were then left to cool to room temperature before being applied to the mangoes.

3.2.5. Mango Coating Process

The selected mangoes were carefully washed with distilled water and then dried in the open air at room temperature. Only fruits with a sturdy stalk were selected for coating. Each mango was immersed for 30 seconds in the peel gel-based coating solution (K or A), depending on the treatment applied. After immersion, the fruit was drained and then dried for 12 hours at room temperature (±25 °C), in accordance with the adapted method from (Kouadio, Silué, & Kassé, 2022).

The samples were stored in the laboratory at room temperature (±25 °C), in accordance with standard post-treatment storage conditions.

3.2.6. Physicochemical Properties of Mangoes

3.2.6.1. The Mass Loss of Mangoes

The Mass Loss of Mangoes was evaluated using the method described by Athmaselvi, Sumitha, and Revathy (2013). For each experimental group (coated mangoes and uncoated controls), five (5) fruits were selected and stored at room temperature. The mangoes were weighed immediately after the application of the coating (initial time T_0), and subsequently at regular five-day intervals during the storage period, specifically on days D0, D5, D10, D15, and D20.

Cumulative mass losses were calculated using the following formula.

$$\Delta M\ (\%) = \frac{Mi - Mf}{Mf} \text{x}\ 100 \qquad (1)$$

Where:

ΔM: Mass loss (%).

Mi: Initial mass (g).

Mf: Final mass (g).

3.2.6.2. Determination of Mango Loss Rates

Mangoes were visually inspected to detect infections and deterioration in order to assess the effects of coating on postharvest losses during 20 days of storage at room temperature. Postharvest losses were defined as the ratio of the number of infected fruits to the initial number of fruits (30). Loss rates were expressed as percentages (%). The effectiveness of the coating in reducing losses was determined using 30 mangoes per group. Loss rates were calculated using the following formula.

$$P(\%) = \frac{F_x}{F_i} \times 100 \qquad (2)$$

Where:

P: Loss rate (%).

Fx: Number of infected fruits.

Fi: Initial number of fruits.

3.2.6.3. Determination of Mango Pulp Moisture Content

The moisture content of the samples was determined according to the method described by AOAC International (2000). For this purpose, 5 g of the sample (Pe) were weighed into a crucible previously dried in an oven, cooled in a desiccator, and weighed (Pv). The crucible containing the sample was then placed in an oven at

105 °C for 24 hours. After drying, the crucibles were removed, cooled in a desiccator for 30 minutes, and weighed again to obtain the final weight (Pf). The moisture content was calculated using the following formula.

$$H(\%) = \frac{P_{e} - (P_f - P_0)}{P_e} \times 100 \quad (3)$$

Where:

H: Moisture content (%).

Po: Empty crucible weight (g).

Pe: Sample weight before drying (g).

Pf: Final weight after drying (g).

3.2.6.4. Determination of Mango Color

The skin and flesh color of the fruit was determined using a Konica Minolta chromameter (Chromameter CR-10 Plus, Japan). The fruit color was measured at the midpoint of the cheek (skin) and the inner surface (stem) after a longitudinal section of the cheek. The average of the L*, a*, and b* values was measured, and the chroma value (ΔE) was calculated using the formula shown below (Andres, Tenorio, & Reche, 2004; Silue, 2022).

$$(\Delta E) = \sqrt{(L^*)^2 + (a^*)^2 + (b^*)^2} \quad (4)$$

Where:

ΔE: Color difference.

L*: Transition from black to white.

a*: Transition from green (negative values) to red (positive values).

b*: Transition from blue (negative values) to yellow (positive values).

3.2.6.5. Determination of Mango Firmness

Fruit firmness (skin and pulp) was measured using a digital penetrometer (FC GAUGE PCE – FM 200, Milan, Italy) according to the manufacturer's instructions. For skin firmness, the probe (8 mm diameter) of the penetrometer, equipped with an electronic force indicator, was placed on the median part of one cheek of each fruit. The force required to penetrate the fruit skin was recorded and expressed in newtons (N). Pulp firmness was measured at the center of the inner surface of the opposite cheek after a longitudinal cut.

3.2.6.6. Determination of Soluble Solids Content (SSC) and Titratable Acidity

The peel of two fruits from each treatment was removed, and the pulp juice was extracted separately using a juice extractor (Kuvings D9900, Marseille, France). Soluble solids content (SSC) and titratable acidity were measured with a dual-scale digital Brix-acid refractometer (PAL-BX-ACID91, ATAGO, Japan) at 25°C, following the manufacturer's instructions.

3.2.6.7. Determination of pH

The pH was determined using the potentiometric method (Athmaselvi et al., 2013). It was determined directly in the solution used for the determination of titratable acidity using a pH meter (Consort multi-parameter analyzer C3020, sourced from Belgium).

3.2.6.8. Determination of Ascorbic Acid Content

The vitamin C content of mango pulp was determined by titration according to the method described in Pongracz, Weiser, and Matzinger (1971). Ten (10) g of crushed pulp juice was soaked for 10 min in 40 mL of metaphosphoric acid-acetic acid solution (2%, w/v). The mixture was centrifuged at 3000 rpm for 20 min, and the supernatant obtained was diluted and adjusted with 50 mL of distilled water. Ten (10) mL of this mixture was titrated to the endpoint with dichlorophenolindophenol (DCPIP) 0.5 g/L.

$$\text{vitamine C (mg/100g)} = \frac{(C_{DCPIP} \times V_{eq}) \times 5 \times 10^2}{me} \quad (5)$$

Where:

Veq: Volume (mL) of 2.6 DCPIP added to equivalence.

CDCPIP: DCPIP concentration (g/L): 0.5.

me: Mass (g) of the fresh-tomato sample.

3.2.6.9. Extraction and Measurement of Sugars in the Pulp of Coated and Control Mangoes

The extraction of water-soluble sugars was carried out according to the protocol described by Agbo, Kouadio, and Yao (1985). Fifty milliliters of distilled water, heated to 60°C, were added to five (5) grams of crushed mango pulp placed in a 200-millilitre flask. The mixture was stirred until completely cooled and filtered through Whatman filter paper with a porosity of 0.45 µm. The filtrate obtained was collected in a 100 mL volumetric flask and made up to the mark with distilled water.

3.2.6.9.1. Total Sugar Content Measurement in Coated and Control Mango Pulp

The total sugar content was determined using the phenol-sulphuric acid method described by Dubois, Gilles, Hamilton, Rebers, and Smith (1956). This method allows Oses to be measured using phenol and concentrated sulphuric acid. In the presence of these two reagents, the Oses produce a red color, the intensity of which is proportional to the sugar concentration in the medium. In a series of test tubes, 100 µL of water-soluble sugar extract from mango pulp was introduced, followed by 1 mL of concentrated sulphuric acid (H_2SO_4) (95–97%) and 200 µL of 5% phenol (w/v). After cooling in the dark for 15 min, 2.7 mL of distilled water was added to the mixture, and the optical density was read at 490 nm using a spectrophotometer against a control prepared under the same conditions as the tests. A standard range was prepared from a 1 mg/mL glucose stock solution. The total carbohydrate content of each sample was determined using the regression line equation obtained from the calibration. The tests were performed in triplicate.

3.2.6.9.2. Measurement Of Reducing Sugars in the Pulp of Coated and Control Mangoes

The quantification of reducing sugars was carried out using the Bernfeld method (Bernfeld, 1955), which is based on the reducing properties of sugars. In fact, in the presence of an alkaline medium and at high temperatures, the reducing function of sugars forms a complex with DNS, reducing it to 3-amino-5-nitrosalicylic acid. This reaction manifests itself in the appearance of a brick-red color, the intensity of which is directly related to the concentration of reducing sugars in the solution. A volume of 100 µL of water-soluble sugar extract from the pulp was placed in a test tube to which 200 µL of DNS was added. The mixture was homogenized using a vortex mixer, then heated in a boiling water bath at 100 °C for 5 minutes. After cooling, 2 mL of distilled water was added, and the optical density of the solution was measured at a wavelength of 540 nm using a spectrophotometer against a control. The tests were performed in triplicate. The control without water-soluble sugar was treated under the same conditions as the tests. A standard range was established under the same conditions from a glucose stock solution with a concentration of 1 mg/mL. The amount of reducing sugars was determined from the regression line equation established using the standard range (Bernfeld, 1955).

3.2.6.10. Analysis of Sensory Characteristics

Sensory evaluation has been defined as a scientific method used to evoke, measure, analyze, and interpret the organoleptic properties of products through the senses, namely sight, smell, touch, taste, and hearing (Bernfeld, 1955).

3.2.6.10.1. Sensory Evaluation Test

As part of this study, descriptive sensory tests were conducted to monitor changes in the organoleptic characteristics of coated mangoes stored at room temperature, compared with uncoated control samples. A panel of 20 evaluators, all regular mango consumers, was recruited and trained before the analysis according to the method described by Lateur (2001). The descriptors selected for evaluation included: skin aging, pulp color, pulp texture, acidic taste, sweet taste, aftertaste, odor, and overall assessment. The perceived intensity of each attribute was rated on a structured 9-point scale. Samples, coded with three-digit numbers, were presented on disposable plates. Panelists indicated the perceived intensity of each attribute by marking the appropriate point on the scale. Spring water was provided for mouth rinsing, and paper towels were used for cleaning between evaluations. These attributes were considered adequate to describe quality changes in mangoes during storage. The evaluation was carried out in a laboratory room illuminated with natural daylight.

3.2.6.11. Statistical Analyses

The physico-chemical analyses were carried out in trials of 3. The values are means ± standard deviations. The results of the analyses were subjected to an analysis of variance (ANOVA) at a significance level of 0.05 with the STATISTICA 7.1 software. In case of significant differences in the samples, Tukey's test was used to determine which samples differed from each other.

4. RESULTS AND DISCUSSION

4.1. Loss Rates of Coated and Uncoated Mangoes

Postharvest losses of mangoes and their seasonal nature have generated interest in developing strategies to extend their shelf life. On day 0 and day 5, no fruit was lost in the coated batches (A and K), whereas the control already showed a 10% loss by day 5. By day 10, the loss rates reached 13.33% for Gel A, 3.33% for Gel K, and 30% for the control. This trend continued through day 20, with 30% for Gel A, 26.67% for Gel K, and 100% for the control, indicating a complete loss of commercial quality in the uncoated mangoes (Figure 1). In fact, postharvest losses in mangoes generally result from excessive ripening, softening, and deterioration. The reduction in losses observed during storage with mango peel-based coatings may be attributed to the ability of the coating gel to delay ripening and deterioration. Literature reports indicate that postharvest losses in mangoes are mainly associated with high respiration and transpiration rates, as well as susceptibility to microorganisms. The application of edible coatings acts as a semi-permeable barrier, reducing gas exchange and limiting dehydration and microbial contamination. Similar findings were reported by Sapper, Wilcaso, Santamarina, Roselló, and Chiralt (2018), who showed that cassava starch-based coatings significantly reduced losses in tomatoes and apples during storage. Likewise, Santacruz (2021) observed that Tommy Atkins mangoes coated with cassava starch gel enriched with essential oils exhibited reduced postharvest losses. In addition, Silue (2022) demonstrated that unprotected Kent mangoes underwent rapid deterioration, with substantial losses during the early days of storage, which corresponds to the results obtained for the control in this study.

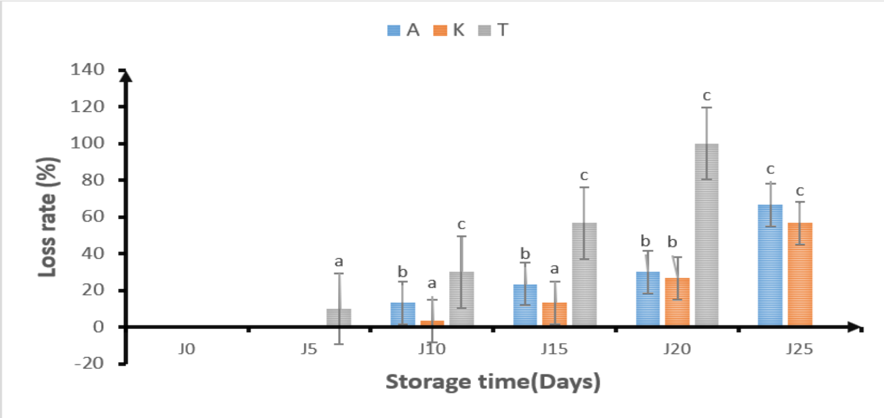

Figure 1. Change in mango loss rate.

Note: Values followed by different superscript letters (a, b, c) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups
A: Mango coated with gel A; K: Mango coated with gel K; T: Uncoated mango (control).

4.2. Mass Loss of Coated and Control Mangoes

Mass loss is a critical factor in determining the shelf life and quality of mangoes, as with other fruits. In this study, the results revealed a significant variation in mass loss depending on the treatment. On day 5, coated mangoes recorded a mass loss of 5.14% for Gel A and 4.76% for Gel K, compared with 8.62% for uncoated mangoes. By day 10, the weight loss of the uncoated control stored at room temperature reached 14.48%, while mangoes coated with Gel K and Gel A showed losses of 10.7% and 11.83%, respectively (Figure 2). In contrast, the uncoated control mangoes consistently exhibited higher mass losses than the coated fruits. Consequently, the coatings acted as semi-permeable barriers against the movement of O_2, CO_2, moisture, and solutes, thereby reducing respiration rates, water loss, and oxidation. The reduction in weight loss of mangoes coated with peel-powder gels may also be related to the thickness and water vapor permeability of the gels, which are important factors influencing mass transfer rates. Indeed, the basic mechanism of weight loss in fresh fruits and vegetables is linked to vapor diffusion driven by differences in water vapor pressure, as well as respiration, which also contributes to weight reduction. Furthermore, several studies have confirmed that the application of edible coatings reduces weight loss in fruits and vegetables (Ali, Maqbool, Ramachandran, & Alderson, 2011; Vásconez, Flores, Campos, Alvarado, & Gerschenson, 2009).

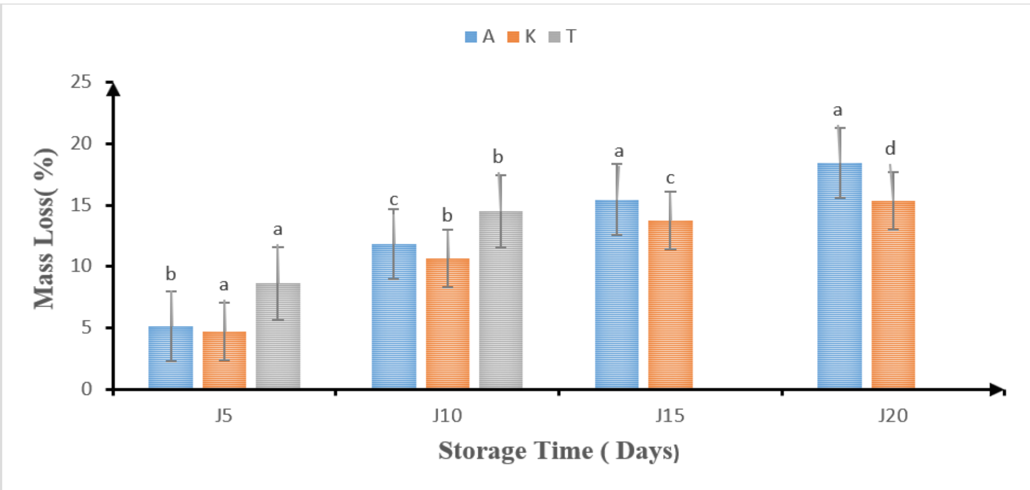

Figure 2. Evolution of mass loss in mangoes.

Note: Values followed by different superscript letters (a, b, c, d) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups.
A: Mango coated with gel A; K: Mango coated with gel K; T: Uncoated mango (Control).

4.3. Water Content of Coated and Control Mangoes

Water is the main component of mangoes and plays a crucial role in their appearance, texture, and taste. Variations in water content during storage directly influence the quality and postharvest shelf life of the fruit. The water content of both coated and uncoated mangoes increased progressively during storage. On day 0, the values were identical across all treatments. By day 10, the water content had increased to 68.72 ± 0.82% for the control, 66.55 ± 2.45% for Gel A, and 64.44 ± 0.16% for Gel K. At the end of storage, the water content of coated mangoes reached 69.63 ± 0.08% and 69.36 ± 0.25% for Gel A and Gel K, respectively (Figure 3). Water loss in mangoes during storage can be attributed to several factors, including transpiration and gas exchange with the environment (Nordey, 2014). Mangoes continue to respire after harvest, consuming their sugar and water reserves, which accelerates dehydration. The application of cassava starch-based coatings has been shown to significantly limit water loss in fruits compared with controls, both at room and low temperatures. Similar results have been reported by other authors for fruits and vegetables such as tomatoes and apples (Sapper et al., 2018).

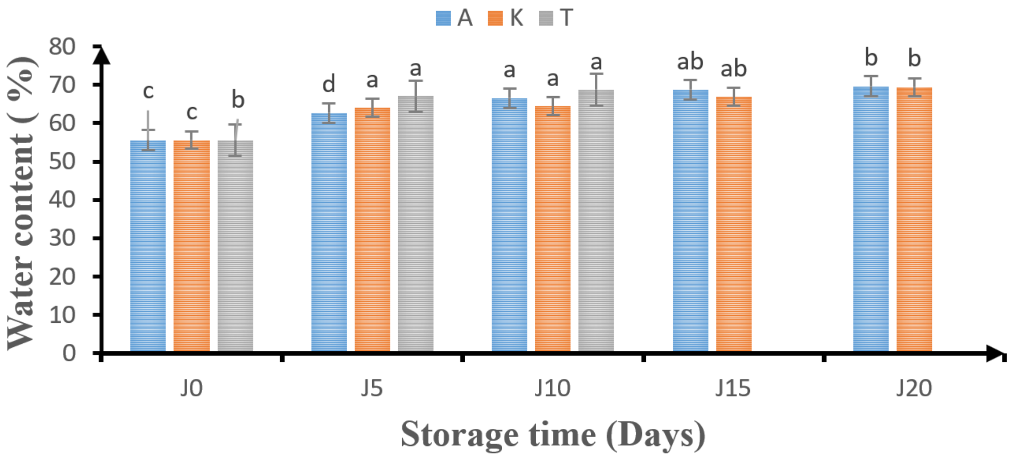

Figure 3. Change in the water content of mangoes.

Note: Values followed by different superscript letters (a, b, c,d) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups.
A: Mango coated with gel A; K: Mango coated with gel K; T: Uncoated mango (Control).

4.4. External and Internal Firmness of Coated and Control Mangoes

Firmness is an important parameter for determining the degree of ripening. Postharvest treatment of mangoes with formulations based on mango peel powder significantly reduced firmness loss compared with the control during storage, both at the skin and pulp levels. External firmness values decreased progressively from 102.91 N to 37.20 N in uncoated mangoes, from 102.91 N to 54.71 N in mangoes coated with Gel A, and from 102.91 N to 64.17 N in mangoes coated with Gel K (Figure 4). For internal firmness, the initial value was 13.83 N. This value decreased gradually to 3.76 N, 6.08 N, and 8.87 N for uncoated mangoes and those coated with Gel A and Gel K, respectively (Figure 5). The loss of fruit firmness can be attributed to several factors, particularly the degradation of pectin in the cell wall. These observations are consistent with those of Nunes, Brecht, and Baldwin (2007), who reported a progressive decrease in internal firmness of Tommy Atkins and Palmer mangoes during storage, associated with cell wall degradation and pectin solubilization. The reduction in firmness loss due to coating application may be explained by its ability to limit water loss and reduce respiration. Indeed, lower O_2 levels and higher CO_2 concentrations restrict enzymatic activity, thereby maintaining firmness during storage. Similar results have been reported by several authors regarding cassava starch-based coatings, which reduced firmness loss in fruits and vegetables such as tomatoes and apples (Sapper et al., 2018). Furthermore, Ali et al. (2011) confirmed that chitosan-based coatings slowed the loss of internal firmness in mangoes, demonstrating the protective effect of edible films on fruit texture.

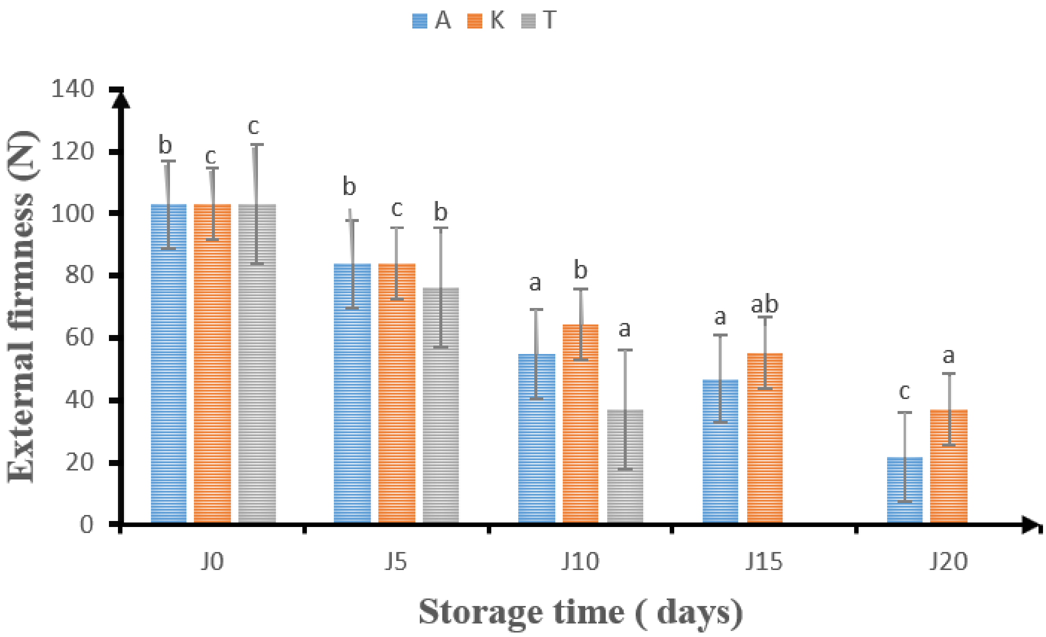

Figure 4. Change in the external firmness of mangoes.

Note: Values followed by different superscript letters (a, b, c) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups.
A: Mango coated with gel A; K: Mango coated with gel K; T: Uncoated mango (control).

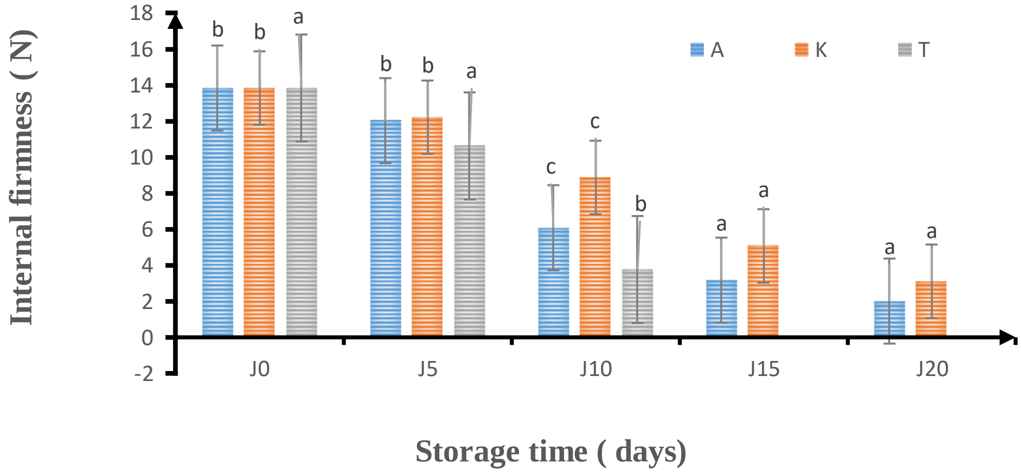

Figure 5. Change in the internal firmness of mangoes.

Note: Values followed by different superscript letters (a, b, c) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups. A: Mango coated with gel A; K: Mango coated with gel K; T: Uncoated mango (control).

4.5. pH and Titratable Acidity of Coated and Control mangoes

A progressive and significant increase in pH and a decrease in titratable acidity were observed during storage. Unlike pH, titratable acidity decreased over time for both the control and coated mangoes, but the reduction was more pronounced in the uncoated fruits. From day 0 to day 10, the pH increased from 3.38 to 4.48 in the control, from 3.38 to 3.82 in mangoes coated with Gel A, and from 3.38 to 3.57 in mangoes coated with Gel K. The initial titratable acidity was 7.50. By day 10, it had decreased considerably to 3.13 in the control, 6.03 in Gel A, and 5.70 in Gel K (Table 2). This decrease in titratable acidity in uncoated fruits is likely related to ripening. During ripening, organic acids are metabolized and serve as substrates for the synthesis of phenolic compounds, lipids, and volatile aroma compounds (Kassé, Kouadio, Kouassi, & Ahou, 2020). The less pronounced reduction in titratable acidity in coated mangoes indicates the effectiveness of edible films in reducing ethylene production, which accelerates fruit ripening.

Table 2. Evolution of pH and titratable acidity during storage of Kent mangoes.

Treatment	Time (Days)	pH (Mean ± SD)	Titratable acidity (Mean ± SD)
Gel A	0	3.38 ± 0.02^{a}	7.50 ± 0.08^{f}
	5	3.50 ± 0.04^{b}	6.23 ± 0.49^{bcd}
	10	3.82 ± 0.49^{c}	5.70 ± 0.82^{bcd}
	15	4.2 ± 0.03^{d}	4.33 ± 0.12^{bcd}
	20	4.52 ± 0.42^{e}	2.37 ± 0.05^{a}
Gel K	0	3.38 ± 0.02^{a}	7.50 ± 0.08^{f}
	5	3.50 ± 0.03^{b}	7.03 ± 0.48^{ef}
	10	3.57 ± 0.48^{b}	6.03 ± 0.17^{def}
	15	4.21 ± 0.13^{d}	5.23 ± 0.47^{cd}
	20	4.48 ± 0.462^{e}	3.73 ± 0.48^{abc}
Control	0	3.38 ± 0.02^{a}	7.50 ± 0.08^{f}
	5	3.88 ± 0.16^{c}	5.97 ± 0.40^{def}
	10	4.48 ± 0.08^{e}	3.13 ± 0.33^{ab}
	15	nd	nd
	20	nd	nd

Note: Values followed by different superscript letters (a, b, c, d, e, f) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups. Values are means of three replicates, accompanied by standard deviations.

4.6. Total Soluble Solids Content of Coated and Uncoated Mangoes

The results show a progressive increase in total soluble solids (TSS) during storage, reflecting the conversion of starch reserves into soluble sugars (glucose, fructose, sucrose) during ripening. The control sample exhibited the highest increase in TSS, rising from 10.54 to 20.13 °Brix between day 0 and day 10. In contrast, mangoes coated with gels (A and K) showed a lower increase. The values ranged from 10.54 to 19.26 °Brix and from 10.54 to 17.23 °Brix for mangoes coated with gel A and gel K, respectively (Table 3). This increase during storage may be attributed to the hydrolysis of polysaccharides into soluble solids in the form of simple sugars such as glucose, fructose, and sucrose, leading to significant changes in flavor (enhanced sweetness) (Silva, Almeida, Santos, & Oliveira, 2017). The coatings likely reduced the respiration rate. Indeed, lower respiration slows down the synthesis and utilization of metabolites, resulting in reduced TSS (Beck & Ziegler, 1989; Giovannoni, 2001). This reduction in metabolic activity decreases the expression and activity of amylolytic enzymes responsible for starch hydrolysis (Beck & Ziegler, 1989). In mangoes, as in other climacteric fruits, this slowdown maintains starch longer in the tissues, delaying sugar accumulation and the perception of sweetness (Seymour, Taylor, & Tucker, 1993). This phenomenon, therefore, indicates that gel coatings are effective in delaying ripening and extending fruit shelf life (Baldwin, Nisperos-Carriedo, & Shaw, 1999). These observations are consistent with those of Santacruz (2021), who reported that Tommy Atkins mangoes coated with a cassava starch-based gel containing essential oils exhibited significant regulation of °Brix evolution, reflecting delayed ripening.

Table 3. Changes in °Brix during the storage of *Kent* mangoes.

Treatment	Time (Days)	°Brix
Gel A	0	10.54 ± 0.33^{b}
	5	14.43 ± 0.76^{c}
	10	19.26 ± 0.78^{a}
	15	19.41 ± 0.52^{a}
	20	20.19 ± 0.37^{a}
Gel K	0	10.54 ± 0.33^{b}
	5	14.91 ± 0.98^{a}
	10	17.23 ± 3.54^{a}
	15	17.26 ± 0.40^{a}
	20	18.34 ± 1.68^{a}
Control	0	10.54 ± 0.33^{a}
	5	13.63 ± 0.45^{b}
	10	20.13 ± 0.26^{c}
	15	nd
	20	nd

Note: Values followed by different superscript letters (a, b, c) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups. A: Mango coated with Gel A; K: Mango coated with Gel K; C: Uncoated mango (control); nd: not determined.

4.7. Total and Reducing Sugars in Coated and Control Mangoes

During storage, total and reducing sugars followed a parallel and interdependent progression. On day 0, all treatments showed identical concentrations of total sugars at 164.10 ± 8.16 mg/100 g. By day 10, levels increased significantly, reaching 253.63 ± 8.33 mg/100 g for gel A, 249.62 ± 8.16 mg/100 g for gel K, and 271.68 ± 2.30 mg/100 g for the control. Reducing sugars followed the same trend, starting at 6.97 ± 0.82 mg/100 g for all treatments on day 0 and increasing markedly by day 10 (Table 4). This increase may be attributed to the enzymatic conversion of starch into glucose and fructose. Indeed, reserve polysaccharides (starch, pectins) are hydrolyzed into simple sugars under the action of enzymes such as amylase and invertase. The gel coating slows respiration and transpiration but does not completely block fruit metabolism. In climacteric fruits, ethylene continues to stimulate these biochemical transformations (Wills, McGlasson, Graham, & Joyce, 2007). The accumulation of reducing sugars (glucose, fructose) also reflects the breakdown of sucrose during ripening (Baldwin et al., 1999). This phenomenon was reported by Nunes et al. (2007), who demonstrated that the content of total and reducing sugars progressively increased in Tommy Atkins and Palmer mangoes, in association with carotenoid synthesis and pulp color development.

Table 4. Evolution of Reducing and Total Sugars during Storage of Kent Mangoes.

Treatment	Time (Days)	Reducing sugars (mg/100 g)	Total sugars (mg/100 g)
Gel A	0	6.97 ± 0.82^{c}	164.10 ± 8.16^{c}
	5	7.80 ± 0.86^{bc}	217.33 ± 8.16^{d}
	10	9.81 ± 0.78^{ab}	253.63 ± 8.33^{a}
	15	10.07 ± 1.63^{ab}	271.41 ± 2.45a^{b}
	20	10.75 ± 0.82^{b}	291.41 ± 0.82^{b}
Gel K	0	6.97 ± 0.82^{a}	164.10 ± 8.16^{c}
	5	7.75 ± 1.56^{ab}	200.63 ± 8.16^{b}
	10	8.34 ± 2.62^{ab}	249.62 ± 8.16^{c}
	15	10.03 ± 0.88^{ab}	270.65 ± 6.53^{d}
	20	10.71 ± 0.79^{c}	296.37 ± 2.45^{e}
Control	0	6.97 ± 1.59^{a}	164.10 ± 8.16^{b}
	5	8.12 ± 1.63^{ab}	248.99 ± 8.32^{a}
	10	10.65 ± 0.01^{b}	271.68 ± 2.30^{a}
	15	nd	nd
	20	nd	nd

Note: Values followed by different superscript letters (a, b, c, d) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups. Values are means of three replicates, with standard deviations. A: Mango coated with gel A; K: Mango coated with gel K; C: Uncoated mango (control); nd: not determined.

4.8. Vitamin C Content of Coated and Uncoated Mangoes

The results of this study show a progressive decrease in vitamin C content across all samples. Values declined from 237.51 ± 0.82 mg/100 g to 104.25 ± 1.63 mg/100 g, from 237.51 ± 0.82 mg/100 g to 107.31 ± 2.45 mg/100 g, and from 237.51 ± 0.82 mg/100 g to 61.75 ± 0.82 mg/100 g, respectively, for mangoes coated with gels A and K and for the uncoated control (Table 5). However, the loss of vitamin C was markedly more pronounced in uncoated mangoes compared to those coated with gels A and K. The vitamin C content of both coated (gel A and gel K) and uncoated mangoes decreased significantly over storage time ($p < 0.05$). Values were statistically different between day 0 and day 10 for both coated and control mangoes. This decline can be explained by the sensitivity of ascorbic acid to oxidation and the natural metabolic reactions of the fruit. Vitamin C is easily degraded by oxygen and oxidative enzymes, as well as by intensified respiratory and ripening processes that consume bioactive compounds. Mangoes coated with gels A and K showed a more moderate decline. This can be attributed to the protective role of the coatings, which act as semi-permeable barriers limiting gas exchange. By reducing oxygen entry and promoting an internal atmosphere richer in CO_2, the gels slow down fruit respiration and ethylene synthesis, two key factors in vitamin C degradation. Santacruz (2021) reported that Tommy Atkins mangoes coated with a cassava starch-based gel containing essential oils exhibited greater vitamin C stability. More recently, Parvin, Rahman, and Hossain (2023) confirmed that chitosan-based edible films applied to mangoes significantly reduced vitamin C degradation, while Harsham, Bhagwan, and Sathish (2024) demonstrated that combining chitosan with calcium gluconate improved the stability of bioactive compounds, including vitamin C, by limiting oxidative reactions.

Table 5. Evolution of Vitamin C during the storage of *Kent* mangoes.

Treatment	Time (Days)	Vitamin C (mg/100 g)
Gel A	0	237.51 ± 0.82^{e}
	5	170.50 ± 3.27^{d}
	10	155.54 ± 1.63^{c}
	15	139.33 ± 4.71^{b}
	20	104.25 ± 1.63^{a}
Gel K	0	237.51 ± 0.82^{e}
	5	184.65 ± 1.63^{d}
	10	157.00 ± 1.63^{c}
	15	139.00 ± 0.82^{b}
	20	107.31 ± 2.45^{a}
control	0	237.51 ± 0.82^{e}
	5	90.35 ± 0.82^{b}
	10	61.75 ± 0.82^{a}
	15	nd
	20	nd

Note: Values followed by different superscript letters (a, b, c, d, e) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups. A: Mango coated with Gel A; K: Mango coated with Gel K; C: Uncoated mango (Control); nd: not determined.

4.9. Colorimetric Parameters of Pulp and Peel in Coated and Control Mangoes

Color is a key criterion for evaluating mango maturity and postharvest shelf life, assessed using parameters L*, a*, b*, and ΔE. For the pulp, uncoated mangoes showed a sharp decline in brightness, decreasing from 46.86 ± 0.82 at day 0 to 36.98 ± 1.63 at day 10, with ΔE dropping from 48.47 ± 0.82 to 38.90 ± 0.82.

Mangoes coated with gel K evolved more slowly, with L* decreasing to 30.49 ± 0.82 and ΔE to 34.14 ± 1.63 at day 20. Mangoes coated with gel A followed a similar trend, with L* decreasing to 30.47 ± 0.82 and ΔE to 34.17 ± 1.63 at day 20 (Table 6).

For the peel, the colorimetric parameters of control mangoes changed rapidly, with L* increasing from 41.83 ± 0.86 at day 0 to 47.89 ± 1.63 at day 10, while ΔE rose from 42.33 ± 1.68 to 49.54 ± 0.68. This was accompanied by a shift in a* from -0.61 ± 0.10 to 3.84 ± 0.85 and in b* from 6.43 ± 1.72 to 12.09 ± 0.83 (Table 7). In contrast, coated mangoes exhibited more moderate changes.

Color changes in mangoes correspond to chlorophyll degradation and increased carotenoid synthesis, reflecting the transformation of chloroplasts into chromoplasts. During ripening, the green chlorophyll pigment is broken down, while carotenoids accumulate, giving ripe mangoes their characteristic orange color. Gel coatings based on mango peel acted as effective barriers against oxygen (O_2), maintaining higher CO_2 levels in coated mangoes. Elevated CO_2 levels reduce ethylene synthesis, which can delay color changes during ripening. Similar results were reported for Tommy Atkins mangoes coated with cassava starch-based gel enriched with essential oils (Santacruz, 2021). The delay in color change was attributed to the action of gum arabic coatings, which likely increased CO_2 levels while reducing O_2 availability.

Table 6. Evolution of pulp colorimetric parameters during storage of Kent mangoes.

Treatment	Time (Days)	Colorimetric parameters of the pulp			
		L*	a*	b*	ΔE
Control	0	46.86±0.82^{c}	1.78±0.82^{a}	12.25±1.63^{a}	48.47±0.82^{c}
	5	43.22±0.81^{b}	2.78±0.82^{a}	13.34±0.82^{a}	45.31±0.82^{b}
	10	36.98±1.63^{a}	4.27±0.82^{b}	14.37±1.63^{a}	38.90±0.82^{b}
	15	nd	nd	nd	nd
	20	nd	nd	nd	nd
Gel K	0	46.86±0.82^{a}	1.78±0.82^{a}	12.25±1.63^{a}	48.47±0.82^{a}
	5	44.39±1.63^{a}	1.93 ±0.82^{a}	13.05±2.45^{a}	46.31±0.82^{a}
	10	38.40±0.82^{d}	2.14 ±0.82^{a}	13.71±0.82^{a}	40.65±0.82^{d}
	15	34.09±1.63^{c}	4.62 ±0.82^{b}	14.05±0.82^{a}	37.16±0.82^{c}
	20	30.49±0.82^{b}	5.21 ±0.82^{b}	14.45±0.82^{b}	34.14±1.63^{b}
Gel A	0	46.86±0.82^{d}	1.78 ±0.82^{a}	12.25±1.63^{a}	48.47 ±0.82^{b}
	5	43.84±0.82^{c}	1.96 ±0.82^{a}	13.13±0.82^{a}	45.81±1.63^{b}
	10	38.29±0.82^{b}	2.16 ±0.82^{a}	13.80±0.82^{a}	40.76±0.82^{c}
	15	31.06±0.82^{a}	4.71 ±0.82^{b}	14.07±1.63^{a}	35.42±0.82^{a}
	20	30.47±0.82^{a}	5.32 ±0.82^{b}	14.51±0.82^{a}	34.17±1.63^{a}

Note: The asterisk (*) indicates that L, a, and b are normalized values defined by the International Commission on Illumination L*(lightness), a* (green-red color component), b* (yellow-blue color component), and ΔE* (overall color variation).
Values followed by different superscript letters (a, b, c, d) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups. The values in the table are means of three replicates, accompanied by standard deviations.

Table 7. Evolution of peel colorimetric parameters during storage of Kent mangoes.

Treatment	Time (Days)	Peel colorimetric parameters			
		L*	a*	b*	ΔE
Control	0	41.83 ± 0.86^{a}	-0.61 ± 0.1^{a}	6.43 ± 1.72^{a}	42.33 ± 1.68^{a}
	5	43.63 ± 2.45^{ab}	0.92 ± 0.02^{a}	8.51 ± 0.91^{a}	44.46 ± 0.82^{a}
	10	47.89 ± 1.63^{c}	3.84 ± 0.85^{c}	12.09 ± 0.83^{b}	49.54 ± 0.68^{b}
	15	nd	nd	nd	nd
	20	nd	nd	nd	nd
Gel K	0	41.83 ± 0.86^{ab}	-0.61 ± 0.82^{a}	6.43 ± 1.72^{b}	42.33 ± 1.68^{a}
	5	42.63 ± 1.68^{ab}	-0.51 ± 0.86^{a}	7.10 ± 0.82^{b}	43.22 ± 1.63^{a}
	10	46.63 ± 1.63^{a}	1.81 ± 0.14^{c}	11.01 ± 0.82^{a}	47.95 ± 0.82^{b}
	15	47.42 ± 1.63^{a}	3.75 ± 0.14^{b}	11.56 ± 1.53^{a}	48.95 ± 0.82^{b}
	20	46.72 ± 1.63^{b}	4.21 ± 0.80^{b}	11.84 ± 0.08^{a}	48.28 ± 1.63^{c}
Gel A	0	41.83 ± 0.86^{ab}	-0.61 ± 0.1^{a}	6.43 ± 1.72^{b}	42.33 ± 1.68^{a}
	5	42.74 ± 1.63^{ab}	-0.22 ± 0.16^{b}	8.27 ± 0.81^{b}	43.53 ± 2.45^{a}
	10	46.77 ± 8.16^{a}	2.13 ± 0.86^{c}	11.92 ± 1.63^{a}	48.31 ± 0.81^{b}
	15	47.28 ± 1.63^{a}	3.89 ± 0.82^{d}	12.01 ± 1.63^{a}	48.93 ± 0.81^{b}
	20	45.22 ± 3.29^{b}	4.41 ± 0.82^{e}	12.92 ± 1.63^{a}	47.24 ± 1.63^{c}

Note: The asterisk (*) indicates that L, a, and b are normalized values defined by the International Commission on Illumination L*(lightness), a* (green-red color component), b* (yellow-blue color component), and ΔE* (overall color variation).
Values followed by different superscript letters (a, b, c, d, e) indicate significant differences among means ($p < 0.05$). Values sharing the same letter belong to the same homogeneous group and are not significantly different. When a value carries multiple letters, it means that it statistically overlaps with those groups. The values in the table represent means of three replicates, accompanied by standard deviations.

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4.10. Characterization of Organoleptic Parameters in Coated and Control Mangoes

The evolution of sensory characteristics of mangoes stored at ambient temperature (25 ± 2 °C) for 20 days revealed differences between uncoated fruits and those coated with gels K and A (Figures 6, 7, 8). Overall, coated mangoes better preserved their organoleptic qualities, although some physical alterations were observed in all treatments. In uncoated mangoes, skin wrinkling intensified during storage, whereas in coated mangoes, wrinkling became pronounced only at the end of storage. This increase in skin wrinkling is linked to significant fruit weight loss during storage, as reported by Vilvert et al. (2022). These authors, in their work on biodegradable chitosan–graphene oxide bags as an eco-friendly packaging alternative for maintaining postharvest mango quality, noted that high weight loss is associated with poor fruit appearance, leading to wrinkling and reduced consumer acceptance. Regarding texture, uncoated mangoes changed from very firm to soft by day 10, while coated mangoes remained moderately firm at day 10 before becoming soft by day 20. The decrease in firmness is related to irreversible processes caused by carbohydrate metabolism in the cell wall, enzymatic activity, starch hydrolysis, and weight loss (Singh et al., 2013). Sweet taste increased in all treatments, shifting from very mild to strong, while acidity decreased. The increase in sweetness and reduction in acidity are closely linked to the progressive rise in soluble solids during storage, resulting from starch degradation into glucose and the inhibition of amylase and maltase activities (Singh et al., 2013). The pulp color evolved from light green to dark yellow or orange, depending on the treatment. This color change may be due to carotenoid biosynthesis and accumulation, regulated by the expression of structural pathway genes during fruit ripening. These findings are consistent with Ma et al. (2018), who studied carotenoid accumulation and biosynthesis in mango flesh. Finally, aroma improved in all cases, progressing from good to very good, and overall appreciation remained high even as texture deteriorated. Coated mangoes achieved acceptability scores above 7.95, indicating a positive consumer perception despite some physical alterations.

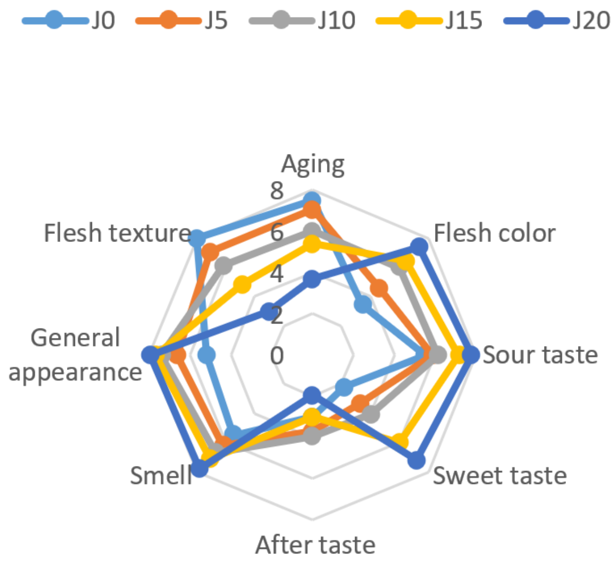

Figure 6. Sensory profile of mangoes coated with gel K.

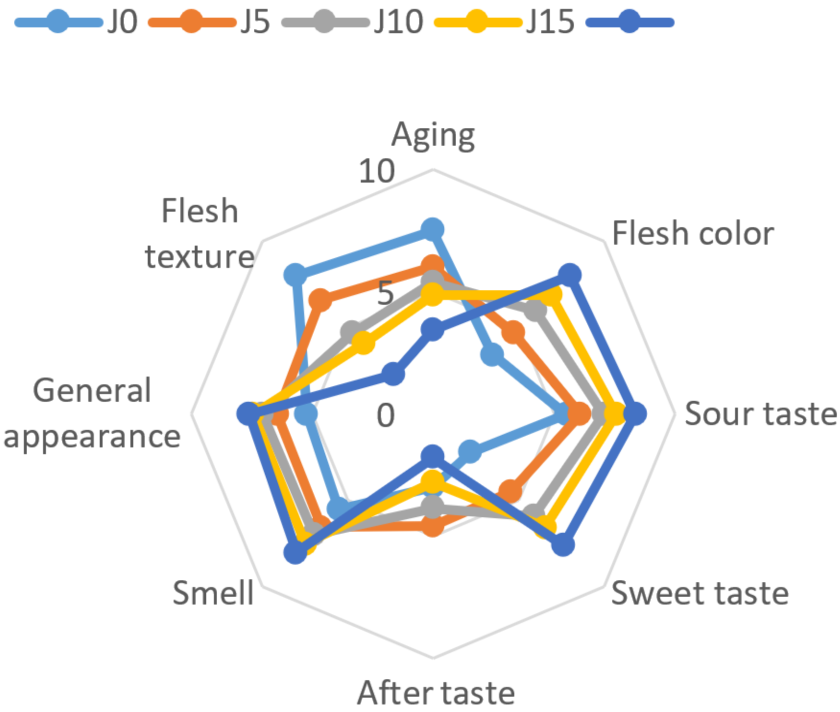

Figure 7. Sensory profile of mangoes coated with gel A.

Figure 8. Sensory profile of control mangoes.

5. CONCLUSIONS

This study evaluated the postharvest quality of Kent mangoes coated with gels formulated from the peels of Amelie and Kent mangoes. The results demonstrated that these coating treatments were effective in extending the shelf life of mangoes stored at ambient temperature (25 ± 2 °C). The coatings significantly reduced postharvest losses, minimized weight and firmness loss, stabilized pH and titratable acidity, moderated the evolution of sugars and soluble solids, and slowed down vitamin C degradation and color changes. In summary, peel-based coatings derived from Amelie and Kent mangoes can be proposed as an alternative and sustainable method for improving the preservation of Kent mangoes. Since mango deterioration is closely linked to microbial spoilage, future research should investigate the action of these gels against spoilage microorganisms to further validate their effectiveness in postharvest management.

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Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

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