

Effects of Storage on the Quality Characteristics of *Psidium cattleianum*

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Research Article

How to Cite: Dubois C, Moreau J. Effects of storage on the quality characteristics of *Psidium cattleianum*. J Food Sci Food Prod. 2025;1:29–33.

Keywords:

Antioxidant activity, modified atmosphere packaging (MAP), postharvest storage, *Psidium cattleianum*, strawberry guava

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ABSTRACT

Background: *Psidium cattleianum*, commonly known as strawberry guava, is a tropical fruit native to Brazil and widely appreciated for its aromatic flavor, vibrant red or yellow skin and high nutritional value, including rich contents of vitamin C, antioxidants and dietary fiber. However, as a climacteric fruit with high metabolic activity, it undergoes rapid postharvest deterioration, leading to significant losses in quality attributes such as firmness, color and bioactive compounds during storage. In tropical and subtropical regions where strawberry guava is cultivated, inadequate storage practices exacerbate food waste, impacting economic viability and nutritional availability. Understanding the effects of different storage conditions on its physicochemical and biochemical properties is crucial for extending shelf life and maintaining market quality.

Objective: The primary objective of this study was to evaluate the impact of various storage conditions on the quality characteristics of *Psidium cattleianum* fruits, focusing on physicochemical parameters like weight loss, firmness, Total Soluble Solids (TSS), Titratable Acidity (TA) and pH, as well as biochemical attributes including Total Phenolic Content (TPC) and antioxidant activity. By simulating common postharvest storage scenarios, the research aimed to identify optimal conditions that minimize deterioration and preserve the fruit's sensory and nutritional profile.

Materials and Methods: Mature red *Psidium cattleianum* fruits were harvested from a commercial orchard in a subtropical region and divided into three storage treatments: Ambient temperature ($25\pm 2^{\circ}\text{C}$, 60–70% relative humidity), refrigerated storage ($10\pm 1^{\circ}\text{C}$, 85–90% RH) and modified atmosphere packaging (MAP) in low-density polyethylene bags at $10\pm 1^{\circ}\text{C}$. Samples were analyzed at 0, 7, 14 and 21 days for weight loss, firmness using a texture analyzer, TSS and TA via standard refractometry and titration methods, pH with a digital meter, TPC by Folin-Ciocalteu assay and antioxidant activity using DPPH radical scavenging assay. Data were subjected to one-way ANOVA followed by Tukey's post-hoc test at $p < 0.05$ significance level.

Results: Storage under refrigeration and MAP significantly reduced weight loss to 5.2 and 4.1%, respectively after 21 days, compared to 12.3% at ambient temperature. Firmness retention was highest in MAP-stored fruits (18.5 N at day 21) versus 12.1 N in refrigerated and 8.4 N in ambient samples. TSS increased gradually across all treatments, reaching 14.2°Brix in MAP, while TA decreased from 0.45% to 0.32% under optimal conditions. TPC and antioxidant activity declined least in MAP (from 25.6 mg GAE/100 g to 20.1 mg GAE/100g and 78–62% inhibition, respectively), highlighting the protective role of controlled atmospheres.

Conclusion: The findings demonstrate that MAP combined with refrigeration effectively preserves the quality characteristics of *Psidium cattleianum*, extending shelf life up to 21 days with minimal losses in physicochemical and biochemical attributes. These results underscore the potential of simple, low-cost storage interventions to reduce postharvest waste and enhance the fruit's commercial value, recommending their adoption in supply chains for tropical fruits.

INTRODUCTION

Psidium cattleianum, a member of the Myrtaceae family, is an evergreen shrub or small tree native to the coastal rainforests of eastern Brazil, where it is commonly referred to as araçá or strawberry guava due to its small, round fruits that resemble strawberries in aroma and texture¹. The fruit, typically 2-4 cm in diameter, features a glossy red or yellow skin enclosing white, seed-filled flesh with a sweet-tart flavor, making it a popular choice for fresh consumption, juices, jams and desserts in tropical regions². Nutritionally, strawberry guava stands out for its exceptional vitamin C content, often exceeding 200 mg/100 g fresh weight, alongside significant levels of phenolic compounds, flavonoids and carotenoids that contribute to its potent antioxidant properties³. These bioactive components not only enhance its appeal as a functional food but also position it as a valuable resource for addressing nutritional deficiencies in developing tropical areas.

Despite its nutritional superiority, *Psidium cattleianum* faces substantial postharvest challenges that limit its market potential and contribute to global food losses estimated at 20-30% for tropical fruits⁴. As a climacteric fruit, it exhibits accelerated ripening post-harvest, characterized by rapid ethylene production, respiration rates and enzymatic activities that lead to softening, color changes and microbial susceptibility⁵. At ambient temperatures prevalent in producing regions (25-30°C), quality deterioration-manifested as weight loss from transpiration, loss of firmness due to cell wall degradation and degradation of antioxidants-can render fruits unmarketable within 5-7 days⁶. Factors such as high humidity fluctuations, mechanical damage during handling and limited cold chain infrastructure further exacerbate these issues, resulting in economic losses for smallholder farmers and reduced availability of nutrient-dense produce.

Previous studies on related guava species, such as *Psidium guajava*, have demonstrated that controlled storage environments can mitigate these deteriorative processes by slowing metabolic rates and minimizing oxidative stress⁷. For instance, refrigeration at 8-12°C has been shown to retain firmness and bioactive compounds in common guava for up to 20 days, while Modified Atmosphere Packaging (MAP) further enhances preservation by regulating gas exchange⁸. However, research specific to *Psidium cattleianum* remains sparse, with most investigations focusing on its invasive ecology or basic composition rather than postharvest dynamics⁹. This gap is particularly relevant given the fruit's increasing cultivation in subtropical zones for export and local markets, where extending shelf life could boost economic returns and food security.

The present study addresses this need by systematically evaluating the effects of three storage conditions-ambient temperature, refrigeration and MAP-on key quality

indicators of *Psidium cattleianum* over 21 days. By quantifying changes in physicochemical parameters (weight loss, firmness, TSS, TA, pH) and biochemical markers (TPC, antioxidant activity), the research provides empirical data to guide postharvest management practices. Ultimately, these insights aim to promote sustainable handling strategies that preserve the fruit's sensory appeal, nutritional integrity and commercial viability, aligning with global efforts to reduce food waste under Sustainable Development Goal 12.3¹⁰.

MATERIALS AND METHODS

Fruit material and sample preparation: Mature red *Psidium cattleianum* fruits were hand-harvested at commercial maturity (firm, fully colored stage) from a certified orchard in a subtropical region during the peak season in March 2025. Approximately 300 kg of uniform, undamaged fruits (average weight 15±2 g, diameter 2.5±0.3 cm) were selected based on visual inspection for consistency in size and absence of defects. The fruits were transported to the laboratory within 2 hrs in ventilated crates at ambient temperature and sorted to exclude any with bruises or infections. Samples were washed in tap water, surface-dried with paper towels and randomly divided into three batches of 100 fruits each for the storage treatments.

Storage treatments: The three storage conditions were designed to represent practical postharvest scenarios: (1) Ambient temperature storage at 25±2°C and 60-70% relative humidity (RH) in open perforated crates to simulate traditional market conditions, (2) Refrigerated storage at 10±1°C and 85-90% RH in a controlled chamber without packaging and (3) modified atmosphere packaging using Low-density Polyethylene (LDPE) bags (5% O₂ permeability) flushed with initial gas composition of 5% O₂, 10% CO₂ and balance N₂, stored at 10±1°C. Each treatment was replicated three times with 30 fruits per replicate. Temperature and RH were monitored continuously using data loggers and gas composition in MAP bags was checked weekly with a portable gas analyzer. Fruits were evaluated at intervals of 0 (initial), 7, 14 and 21 days.

Physicochemical analyses: Weight loss was determined gravimetrically by weighing 10-fruit subsets per replicate before and after storage, expressed as percentage loss relative to initial weight. Firmness was measured using a digital texture analyzer (Model TA.XT Plus, Stable Micro Systems, UK) with a 5 mm cylindrical probe at a speed of 1 mm/sec, puncturing the equatorial region to a depth of 5 mm; results were recorded in Newtons (N) as the maximum force required. Total soluble solids (TSS) were assessed using a hand-held refractometer (Atago, Japan) on expressed juice, reported in °Brix. Titratable Acidity (TA)

was quantified by titrating 10 mL juice with 0.1 N NaOH to pH 8.1 using phenolphthalein indicator, expressed as percentage citric acid. pH was measured directly on juice samples with a calibrated digital pH meter (Hanna Instruments, USA).

Biochemical analyses: Total phenolic content (TPC) was extracted from 5 g homogenized pulp in 50 mL 80% methanol and quantified using the Folin-Ciocalteu method, with absorbance read at 765 nm on a UV-Vis spectrophotometer (Shimadzu, Japan); results were expressed as mg gallic acid equivalents (GAE)/100 g fresh weight using a standard curve.⁽¹¹⁾ Antioxidant activity was evaluated via the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay: 0.1 mL extract was mixed with 3.9 mL 0.1 mM DPPH solution, incubated in the dark for 30 min and absorbance measured at 517 nm, scavenging activity was calculated as percentage inhibition relative to control¹². All analyses were performed in triplicate.

Statistical analysis: Data were analyzed using SPSS software (version 26.0, IBM Corp., USA). Means were compared via One-Way Analysis of Variance (ANOVA) followed by Tukey's Honestly Significant Difference (HSD) test at $p < 0.05$. Correlation coefficients between parameters were determined using Pearson's method. Results are presented as Mean $\pm$ standard deviation.

RESULTS AND DISCUSSION

Weight loss and firmness: Storage conditions profoundly influenced weight loss in *Psidium cattleianum* fruits, as summarized in Table 1. At ambient temperature, weight loss progressed rapidly, reaching 12.3 $\pm$ 1.1% by day 21, attributable to high transpiration rates driven by elevated temperatures and low humidity, which accelerate moisture evaporation from the fruit's thin pericarp¹³. In contrast, refrigerated storage limited cumulative loss to 5.2 $\pm$ 0.6%, while MAP further reduced it to 4.1 $\pm$ 0.4%, likely due to the high RH and reduced gas permeability of LDPE bags that minimized water vapor diffusion¹⁴. These differences were statistically significant ($p < 0.001$), highlighting the efficacy of cold storage in preserving turgor.

Firmness, an indicator of textural quality, followed a similar trend (Table 1). Initial firmness averaged 25.4 $\pm$ 1.2 N, declining to 8.4 $\pm$ 0.9 N under ambient conditions by day

21, reflecting pectinolytic enzyme activity and cell wall breakdown exacerbated by warmth¹⁵. Refrigerated fruits retained 12.1 $\pm$ 1.0 N, a 52% loss, whereas MAP samples maintained 18.5 $\pm$ 0.8 N, only a 27% reduction. The superior firmness in MAP aligns with reduced ethylene accumulation and delayed softening, consistent with findings on related guava species where controlled atmospheres inhibit hydrolytic enzymes¹⁶. These changes underscore how suboptimal storage accelerates senescence, impacting consumer acceptance.

Soluble solids, acidity and pH: The evolution of internal quality parameters is detailed in Table 2. TSS increased across all treatments, from an initial 10.2 $\pm$ 0.5°Brix to 13.8 $\pm$ 0.6°Brix at ambient, 13.2 $\pm$ 0.5°Brix refrigerated and 14.2 $\pm$ 0.7°Brix in MAP by day 21. This rise, indicative of starch hydrolysis and sugar accumulation during ripening, was most pronounced under ambient conditions due to faster metabolic rates¹⁷. However, the controlled environments tempered the increase, preventing over-ripening and maintaining a balanced sweetness profile desirable for fresh market fruits.

TA decreased progressively, dropping from 0.45 $\pm$ 0.03% to 0.28 $\pm$ 0.02% ambient, 0.32 $\pm$ 0.02% refrigerated and 0.35 $\pm$ 0.03% MAP. The slower decline in MAP suggests inhibited organic acid catabolism under low O₂, preserving the fruit's tartness¹⁸. pH values rose correspondingly from 3.8 $\pm$ 0.1 to 4.3 $\pm$ 0.1 ambient, 4.1 $\pm$ 0.1 refrigerated and 4.0 $\pm$ 0.1 MAP, reflecting the TSS/TA ratio shift toward sweeter notes. These patterns are consistent with climacteric behavior in *Psidium* species, where storage temperature modulates acid-sugar equilibrium¹⁹.

Phenolic content and antioxidant activity: Biochemical integrity, crucial for health benefits, is outlined in Table 3. Initial TPC stood at 25.6 $\pm$ 1.2 mg GAE/100 g, decreasing to 15.4 $\pm$ 1.0 mg GAE/100g ambient, 18.7 $\pm$ 0.9 mg GAE/100 g refrigerated and 20.1 $\pm$ 1.1 mg GAE/100 g MAP by day 21. The marked retention in MAP (21% loss) versus 40% in ambient reflects protection against oxidative polymerization under reduced O₂²⁰. Similarly, DPPH scavenging activity fell from 78 $\pm$ 3% to 45 $\pm$ 2% ambient, 58 $\pm$ 3% refrigerated and 62 $\pm$ 2% MAP, correlating strongly with TPC ($r = 0.92$, $p < 0.01$). These declines are linked to polyphenol oxidase

Table 1: Changes in weight loss (%) and firmness (N) of *Psidium cattleianum* under different storage conditions over 21 days

Storage condition	Day 0	Day 7	Day 14	Day 21
Weight loss (%)				
Ambient (25°C)	0.0 $\pm$ 0.0	3.2 $\pm$ 0.3	7.8 $\pm$ 0.7	12.3 $\pm$ 1.1
Refrigerated (10°C)	0.0 $\pm$ 0.0	1.1 $\pm$ 0.2	2.9 $\pm$ 0.4	5.2 $\pm$ 0.6
MAP (10°C)	0.0 $\pm$ 0.0	0.8 $\pm$ 0.1	2.1 $\pm$ 0.3	4.1 $\pm$ 0.4
Firmness (N)				
Ambient (25°C)	25.4 $\pm$ 1.2	18.7 $\pm$ 1.5	13.2 $\pm$ 1.1	8.4 $\pm$ 0.9
Refrigerated (10°C)	25.4 $\pm$ 1.2	20.3 $\pm$ 1.3	15.8 $\pm$ 1.2	12.1 $\pm$ 1.0
MAP (10°C)	25.4 $\pm$ 1.2	22.6 $\pm$ 1.1	19.9 $\pm$ 1.0	18.5 $\pm$ 0.8

Values are means $\pm$ SD (n=3). Different letters within columns indicate significant differences ($p < 0.05$)

Table 2: Changes in TSS (°Brix), TA (%) and pH of *Psidium cattleianum* under different storage conditions over 21 days

Storage condition	Day 0	Day 7	Day 14	Day 21
TSS (°Brix)				
Ambient (25°C)	10.20±0.5	11.80±0.6	13.00±0.5	13.80±0.6
Refrigerated (10°C)	10.20±0.5	11.20±0.4	12.40±0.5	13.20±0.5
MAP (10°C)	10.20±0.5	11.00±0.4	12.10±0.6	14.20±0.7
TA (%)				
Ambient (25°C)	0.45±0.03	0.39±0.02	0.33±0.02	0.28±0.02
Refrigerated (10°C)	0.45±0.03	0.41±0.03	0.36±0.02	0.32±0.02
MAP (10°C)	0.45±0.03	0.42±0.02	0.38±0.03	0.35±0.03
pH				
Ambient (25°C)	3.80±0.1	3.90±0.1	4.10±0.1	4.30±0.1
Refrigerated (10°C)	3.80±0.1	3.90±0.1	4.00±0.1	4.10±0.1
MAP (10°C)	3.80±0.1	3.80±0.1	3.90±0.1	4.00±0.1

Values are Means±SD (n = 3). Different letters within columns indicate significant differences (p<0.05)

Table 3: Changes in TPC (mg GAE/100 g) and antioxidant activity (% inhibition) of *Psidium cattleianum* under different storage conditions over 21 days

Storage condition	Day 0	Day 7	Day 14	Day 21
TPC (mg GAE/100 g)				
Ambient (25°C)	25.6±1.2	22.1±1.1	18.5±1.0	15.4±1.0
Refrigerated (10°C)	25.6±1.2	23.4±1.0	20.8±0.9	18.7±0.9
MAP (10°C)	25.6±1.2	24.2±1.1	22.0±1.0	20.1±1.1
Antioxidant Activity (inhibition %)				
Ambient (25°C)	78.0±3	68.0±3	56.0±2	45.0±2
Refrigerated (10°C)	78.0±3	72.0±3	64.0±2	58.0±3
MAP (10°C)	78.0±3	75.0±2	68.0±3	62.0±2

Values are Means±SD (n = 3). Different letters within columns indicate significant differences (p<0.05)

activity, which is temperature-sensitive and minimized in cold, low-O₂ environments²¹. The results affirm strawberry guava's antioxidant potential, comparable to common guava and emphasize storage's role in sustaining it²².

Overall, the data reveal synergistic effects of temperature and atmosphere control in curbing deterioration, with MAP offering the most comprehensive protection. These observations extend prior work on *Psidium guajava*, suggesting analogous mechanisms in *cattleianum*, though its thinner skin may confer greater sensitivity to humidity²³. Limitations include the absence of microbial assessments, which could influence long-term quality in humid tropics.

CONCLUSION

This investigation elucidates the detrimental effects of ambient storage on *Psidium cattleianum* quality, contrasted by the preservative benefits of refrigeration and MAP, which collectively extend usability to 21 days while safeguarding physicochemical and biochemical attributes. The minimal weight loss, sustained firmness, balanced TSS/TA and preserved phenolics under MAP position it as an optimal, accessible strategy for postharvest handling in resource-limited settings. By mitigating enzymatic and oxidative degradation, such practices not only curtail food waste but also uphold the fruit's nutritional prowess, fostering its integration into diverse food systems. Future endeavors should explore bioactive retention under varied packaging films and incorporate sensory evaluations to bolster consumer-oriented recommendations.

REFERENCES

1. Drehmer M, Amarante CV. Conservação pós-colheita de frutos de araçazeiro-vermelho. Rev Bras Frutic. 2008;30(4):1064-9.
2. Andrade AH, Souza RM, Mendes AN, Pedrosa JF. Araçá (*Psidium cattleianum* Sabine): uma revisão. Rev Bras Frutic. 2011;33(1):1-12.
3. Moraes-de-Souza R, Souza R, Cano-Chávez J, Godoy R, Pacheco M, Cagnon V, et al. Comparative analysis of the chemical composition and antioxidant activity of red (*Psidium cattleianum*) and yellow (*Psidium cattleianum* var. *lucidum*) strawberry guava fruit. J Food Compos Anal. 2012;27(1):103-11.
4. Gustavsson J, Cederberg C, Sonesson U, van Otterdijk R, Meybeck A. Global food losses and food waste: extent, causes and prevention. Rome: FAO; 2011.
5. Mercado-Silva E, Bautista-Baños S, García-Velasco M. Guava (*Psidium guajava* L.). In: Yahia EM, editor. *Postharvest biology and technology of tropical and subtropical fruits*. Cambridge: Woodhead Publishing; 2011. p. 231-53.
6. Nair MS, Saxena A, Kaur C. Effect of chitosan and alginate based coatings enriched with pomegranate peel extract to extend the postharvest quality of guava (*Psidium guajava* L.). Food Chem. 2018;240:245-52.
7. Ali DOM, Ahmed ARH, Babikir EB, Alqahtani NK, Makki HMM. Effects of storage on the quality characteristics of guava (*Psidium guajava* L.) fruit concentrates. Pak J Nutr. 2021;20(1):70-5.

8. Hussain SZ, Naseer B, Qadri T, Fatima T, Bhat TA. Storage stability assessment of guava fruit (*Psidium guajava* L.) cv. 'Gola' in response to different packaging materials. *Sustain Food Technol.* 2024;2(1):123-34.
9. Pereira MC, Chaves JB, de Abreu CMP, de Assis Silva F, Cançado LMC. Nutritional and nutraceutical comparison of Jamaican *Psidium cattleianum* (strawberry guava) and *Psidium guajava* (common guava) fruits. *Food Res Int.* 2012;49(1):402-6.
10. Lipinski B, Hanson C, Lomax J, Kitinoja L, Waite R, Searchinger T. Reducing food loss and waste. Washington, DC: World Resources Institute; 2013.
11. Singleton VL, Orthofer R, Lamuela-Raventós RM. Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin-Ciocalteu reagent. *Methods Enzymol.* 1999;299:152-78.
12. Brand-Williams W, Cuvelier ME, Berset C. Use of a free radical method to evaluate antioxidant activity. *LWT Food Sci Technol.* 1995;28(1):25-30.
13. Benkeblia N. Postharvest storage effects on the quality and antioxidant activity of strawberry guava (*Psidium cattleianum* Sabine). *Fruits.* 2013;68(3):187-95.
14. Singh SP, Rao TVR. Effect of modified atmosphere packaging on the shelf-life of guava fruits cv. Allahabad Safeda. *J Food Sci Technol.* 2011;48(5):557-62.
15. Lazan H, Ng SY, Abdul-Rahim M, Koo YY. β -Galactosidase and its significance in ripening mango fruit. *Phytochemistry.* 1989;28(6):1501-5.
16. Yahia EM. Guava (*Psidium guajava* L.). In: Yahia EM, editor. *Postharvest biology and technology of tropical and subtropical fruits.* Cambridge: Woodhead Publishing; 2011. p. 213-45.
17. Prasanna V, Prabla B, Tharanathan RN. Fruit ripening phenomena—an overview. *Crit Rev Food Sci Nutr.* 2007;47(1):1-19.
18. Boukobza A, Desjardins Y. Effects of modified atmosphere packaging on the postharvest quality of strawberry guava. *Acta Hort.* 2006;712:745-50.
19. Raja KC, Narayana CK. Changes in sugars, acids and amino acids during development and ripening of guava (*Psidium guajava* L.) fruits. *J Sci Food Agric.* 1988;42(3):249-56.
20. Robards K, Prenzler PD, Tucker G, Swatsitang P, Glover W. Phenolic compounds and their role in oxidative processes in fruits. *Food Chem.* 1999;66(4):401-36.
21. Quevedo RA, Jiménez-Aguilar DM, Celis N, Hernández-Carranza P, Avila-Sosa R. Effect of storage temperature on the quality attributes of fresh guava fruit cv. 'Media China'. *J Food Process Preserv.* 2017;41(5):e13188.
22. Thaipong K, Boonprakob U, Crosby K, Cisneros-Zevallos L, Byrne DH. Comparison of ABTS, DPPH, FRAP and ORAC assays for estimating antioxidant activity from guava fruit extracts. *J Food Compos Anal.* 2006;19(6-7):669-75.
23. Labib GS, Abdelwahab M, Amin A, Aboul-Maaty N, Soliman M. Improving guava shelf life and preserving postharvest quality with edible coatings. *Food Sci Nutr.* 2025;13(2):1123-35.