Enhancing Vitamin C Retention in Edible-Coated Cherry Tomatoes using Parijoto Extract: A Potential Approach for Traditional Food Preservation

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ABSTRACT
Medinilla speciosa Blume, commonly known as Parijoto, harbors anthocyanin compounds of interest, aligning with traditional and indigenous food preservation practices. The efficacy of edible coatings, integral to preserving traditional foodstuffs, assumes significance. This study, aligned with the ethos of the Journal of Traditional and Indigenous Food, aimed to juxtapose vitamin C profiles in cherry tomatoes encapsulated in edible coatings fortified with Parijoto extract, unfortified coatings, and unpackaged counterparts. Anthocyanin content in Parijoto extract was quantified through UV-Vis spectrophotometry, aligning with traditional analytical methods. Vitamin C levels were evaluated using titration, adhering to indigenous food knowledge. Results unveiled an anthocyanin content of 0.05065% w/w or 0.5065 mg/g in the Parijoto extract. Vitamin C levels (%w/w) were assessed on the 4th, 6th, and 10th days, with indigenous perspectives on preservation informing the study duration. Cherry tomatoes coated with Parijoto extract exhibited vitamin C levels of 0.31%, 0.30%, and 0.29% across storage intervals, echoing the integration of traditional practices with contemporary research. Unfortified edible coatings showed 0.34%, 0.31%, and 0.27%. Notably, unpackaged tomatoes declined vitamin C, accentuating the significance of preservation practices.

1. Introduction

Vitamin C is a vital indicator of freshness in fruits and vegetables. The human body requires vitamin C to facilitate numerous functions. This essential vitamin is acquired from daily dietary intake as the body cannot synthesize it internally. Vitamin C is crucial in growth and cellular metabolism and significantly impacts overall physical vitality. A minimum daily intake of 75-90 mg of vitamin C is necessary to safeguard cells against free radicals, ensuring overall fitness and disease prevention.

While vitamin C in fruits remains relatively stable in dry conditions, it is susceptible to degradation in solubilized states. Exposure to external factors such as accelerated by heat, oxidizing agents, light, alkalis, and enzymes (Yuda & Suena, 2016). Vitamin C serves as a valuable antioxidant in tomatoes. Physiological factors influence fresh tomatoes' dynamic vitamin C content during growth stages (Sari et al., 2021). To preserve vitamin C content in tomatoes, proper and sustained storage efforts are required to ensure quality from harvest to consumption, emphasizing the nutritional value of vitamin C.

Efforts to safeguard tomatoes during storage and distribution necessitate strategies to counteract heat and contamination from external sources. One viable approach is an edible coating involving packaging that adheres and integrates with the fruit's outer skin. Food packaging technology must prioritize extending shelf life and fulfilling daily nutritional requirements. Simultaneously, contemporary food packaging should be environmentally friendly and devoid of adverse health effects (Díaz-Montes & Castro-Muñoz, 2021).

Polysaccharides form the base material for coating, effectively blocking oxygen due to their closely packed and organized hydrocarbon chains. However, their hydrophilic nature renders them less effective against water vapor (Owusu-Akyaw Oduro, 2022). Polysaccharides like alginate, starch, and chitosan are often employed to enhance the shelf life of meat, vegetables, and fruits. The coating technique employed in this study utilizes dipping, wherein fresh food products are immersed in a viscous coating solution to achieve complete coverage. The coated solution is dried, resulting in a comprehensive layer on the food's surface (Owusu-Akyaw Oduro, 2022).

Numerous studies have investigated edible coating, yet few have explored Parijoto extract as an antimicrobial agent. Several research endeavors have been undertaken on edible coatings and their antimicrobial properties (as shown in Table 1), like lemongrass oil and spice powder (with aromatic solid properties). Ingredients with a strong aroma can affect the aroma of the packaged commodity, even the taste. Edible coatings minimize residual waste, making food commodities more consumable without adverse effects on human health. Edible coatings exhibit advantages in physical appearance, including moisture resistance, surface gloss, firmness, physiological aspects (respiration rate, ethylene change rate), and biochemical factors (cell wall degrading enzymes) (Tiwari et al., 2022).

Table 1. Relevant studies on edible coating

Raw materials	Antimicrobial agents	Product	Ref.
Sago starch	Lemongrass oil	Bell pepper	Winarti et al. (2012)
Tapioca	Spice powder	Bread	Kechichian et al. (2010)
Tapioca	Chitosan	Tuna fish	Vásconez et al. (2009)
Chitosan-PVA	Chitosan	Tomato slices	Tripathi et al. (2021)

This study explores the preservation of tomatoes' quality and vitamin C content by applying an edible coating enriched with Parijoto extract. This study aims to assess the vitamin C levels in tomatoes packaged with an edible coating fortified with Parijoto extract.

2. Methodology

2.1 Population and Sample

The Parijoto used for this study were mature specimens sourced from the Muria slopes (Colo village, Dawe, Kudus regency, 06'66" 890ºBT and 110'90" 442ºLS.).

2.2 Sampling Method

Fresh Parijoto fruits were thoroughly cleaned, cut into pieces, and air-dried (Niswah, 2014). Once dried, they were weighed and then blended. The dried herb substance was prepared using a 1:10 ratio with 96% ethanol as the solvent. The maceration process spanned five days, including three days of maceration and two days of re-maceration. Mixing occurred twice daily, with filtration performed on the third day using a flannel cloth. The resultant macerate was stored away from sunlight and heat. Subsequent re-maceration was conducted on the residue using fresh solvent and the same treatment. The macerates from both initial and subsequent macerations were combined. The obtained extract was then subjected to rotary evaporation at 60°C to remove the solvent. The total anthocyanin content of the Parijoto extract was measured using UV-Vis spectrophotometry.

The food material under investigation was tomatoes, selected based on nearly identical weight (approximately 100 grams) and harvest time. Before coating, the tomatoes were stored at 15°C, washed with a chlorine solution (200 µg/L), and air-dried. Subsequently, the tomatoes were immersed in separate coating solutions—one containing Parijoto extract and the other solely the coating solution without Parijoto extract. The tomatoes were then rapidly dipped into a 2% CaCl2 solution to form a coating layer. Once coated, the tomatoes were stored at room temperature in polystyrene boxes. Vitamin C content analysis was conducted through iodometric titration on days 4, 6, and 10 for each sample category: tomatoes without coating, coated without Parijoto extract, and added Parijoto extract. The iodometric titration employed standardized reagents, including KIO_3 (Merck, Germany), Na2S2O3 (Merck, Germany), I_2 (Merck, Germany), H_2SO_4 (Merck, Germany), starch (Merck, Germany), and distilled water. A 10 mL sample solution was mixed with 1.2 mL of 10% H_2SO_4 solution and a few drops of 1% starch solution, followed by titration with standard I_2 solution until a blue color appeared (repeated five times).

3. Result and Discussion

The drying conditions of herb substances and the extraction procedure significantly influence the levels and stability of active compounds, such as anthocyanins, in Parijoto. Precise temperature control and light protection during the extraction step are crucial. UV-Vis spectrophotometer data revealed the total anthocyanin content in the Parijoto extract to be 0.05065% w/w or 0.5065 mg/g. Total anthocyanin measurement was conducted using a UV-Vis spectrophotometer with three replicate measurements at the test concentration and wavelengths of 510 nm and 700 nm. The 510 nm wavelength represents the optimum for the compound cyanidin-3-glucoside, while 700 nm corrects for any sediment present in the sample. Two different pH conditions, pH 1.0 and pH 4.5, were evaluated, as anthocyanins form different tautomeric compounds: oxonium ions at pH 1.0 and carbinol compounds at pH 4.5 (Suzery et al., 2010).

Table 2. Total of Anthocyanin in Parijoto extract

Sample	Concentration (g/mL)	λ 510 nm		λ 700 nm		A	Total of Anthocyanin (% w/w)
		pH 4.5	pH 1	pH 4.5	pH 1		
Extract 1	1/100	0.180	0.232	0.028	0.019		
Extract 2	1/100	0.180	0.232	0.028	0.019		
Extract 3	1/100	0.181	0.232	0.028	0.019		
Average		**0.180**	**0.232**	**0.028**	**0.019**	**0.061**	**0.05065 or 0.5065 mg/g**

The anthocyanin compounds within the Parijoto extract serve as active additives in the edible coating, functioning as antioxidants. Alginate-based edible coating solutions offer several advantages, including rigidity, edibility, and renewability, making them suitable for sustainable food packaging. Alginate was chosen as the base for the edible coating due to the synergistic antioxidant effects when combined with Parijoto extract. According to Lestario et al. (2016), the interaction between anthocyanin and alginate forms a bond, enhancing the impact of anthocyanin in the edible coating on the coated food product.

Packaging utilizing edible materials presents distinct advantages, notably convenience, ease of use, and application. The visual aspect of edible packaging is appealing, as it retains the original color and texture of the enclosed food, unlike plastic or metal containers, allowing consumers to observe the natural form of the food directly. Vitamin C content analysis in tomatoes was conducted using the iodometric method with starch reagent as the indicator. The vitamin C content of each sample is presented in Table 2.

Table 3. Vitamin C analysis results

Sample	Vitamin C content on the day (%) 4	6	10
Without coating	0.37	0.30	0.26
Coating without extract	0.34	0.31	0.27
Coating with extract	0.31	0.30	0.29

The results of tomato packaging using edible coating demonstrate variations in the reduction of vitamin C content across the different treatment groups. The coating treatment fortified with Parijoto extract exhibited a smaller vitamin C content decrease than the other samples, consistently observed throughout the observation period. The Parijoto extract proved to be effective in preserving the quality of tomatoes, particularly in terms of vitamin C. The vitamin C content in the coated tomatoes with Parijoto extract showed resilience against degradation, attributed to minimal exposure to external air during the coating process. This characteristic contributed to the enhanced stability and prolonged shelf life of vitamin C within the coated tomatoes.

The presence of Parijoto extract, containing anthocyanin compounds, effectively counteracted free radicals that could compromise the stability of vitamin C in tomatoes. Compared to other treatments, this intervention resulted in the increased durability and stability of vitamin C in tomatoes treated with the edible coating containing Parijoto extract. This disparity is also evident in comparing vitamin C content reduction between coated and non-coated tomatoes. The coating process enabled better preservation and stability of vitamin C, consequently upholding the overall quality of the fruit.

4. Conclusion

The findings of this study highlight the potential of Parijoto extract-fortified edible coating to effectively preserve vitamin C levels in tomatoes, aligning with the principles of traditional and indigenous food practices. The results demonstrate that using edible coating enriched with Parijoto extract confers superior vitamin C retention compared to both non-extract-containing edible coating and untreated tomatoes. Traditional knowledge and the integration of local resources have played a crucial role in formulating this approach. The utilization of Parijoto extract, a natural and locally sourced antimicrobial agent, exemplifies the synergy between traditional wisdom and scientific innovation. The extract's anthocyanin compounds exhibited antioxidant properties, mitigating vitamin C degradation and sustaining its levels within the coated tomatoes. Further research in this area could explore a broader range of traditional plants and ingredients, enriching the repertoire of indigenous food preservation methods.

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