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ENHANCING THE STORAGE LIFE AND MARKETABILITY OF ORANGE CAPE GOOSEBERRY FRUIT: MELATONIN TREATMENT BOOSTS THE ENZYMATIC ANTIOXIDANT SYSTEM

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Abstract: The cape gooseberry fruit (*Physalis peruviana* L.) is a climacteric fruit that experiences significant color and texture changes during storage due to increased ethylene synthesis. While its storage life with its calyx is one month, it only lasts 4 to 5 days without it. Therefore, strategies to reduce postharvest losses and extend storage life are essential. In this study, entirely ripe orange cape gooseberry fruits with yellow calyces were harvested and transferred to the laboratory. After washing, the fruits were immersed in melatonin solutions at concentrations of 100, 200, and 300 µM for 5 minutes, with distilled water as a control. The fruits were stored at 10°C and 90 ± 5% relative humidity for 21 days and evaluated weekly. The results showed that all melatonin treatments significantly controlled weight loss and fruit softening. Melatonin-treated fruits also had a comparable taste index and performed better than the controls. Melatonin treatment improved the antioxidant enzymatic system, with fruits treated with 300 µM melatonin showing the highest activities of superoxide dismutase, catalase, ascorbate peroxidase, and peroxidase enzymes, and the lowest hydrogen peroxide content, indicating reduced oxidative stress. Additionally, the lowest decay (17.4%) was observed in fruits treated with 300 µM melatonin, while the highest decay (43.83%) occurred in control fruits. Melatonin treatment proved to be effective in improving the quality and extending the shelf life of cape gooseberry fruits, acting as a valuable and environmentally friendly postharvest preservation method by delaying ripening, enhancing enzymatic antioxidant activity, and preserving taste index.

Key words: ascorbate peroxidase, cape gooseberry, free radicals, melatonin treatment, taste index, tissue firmness, weight loss.

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Introduction

Physalis peruviana L., commonly known as cape gooseberry, is a non-native plant with significant economic potential. Its fruit is classified as a superfruit due to its exceptional flavor and aroma, as well as its nutritional and medicinal properties (Fischer et al., 2011). Cape gooseberry grows at various altitudes and tolerates cold temperatures, but it is damaged by subzero temperatures and grows optimally at 18°C. The plant requires adequate sunlight, protection from strong winds, and moderate irrigation during its growth. It prefers well-drained, slightly acidic soils. The productive lifespan of the plant ranges from 9 to 11 months, and it reaches the harvest stage about nine months after seed germination (Puente et al., 2011).

Colombia is the world's largest producer of cape gooseberry, with an annual production of about 18,134 tons, of which approximately 80% is exported as fresh produce. There are also commercial farms in India, the United States, Portugal, France, Bulgaria, Brazil, and South Africa (dos Santos et al., 2023). In recent years, cape gooseberry cultivation has expanded in Iran, both in open fields and greenhouses, although precise statistics are not available.

While the yield of cape gooseberry in Colombia varies between 9 and 28 tons per hectare, yields in other regions are typically lower, usually between 2 and 6 tons per hectare (dos Santos et al., 2023). Additionally, countries other than Colombia often produce fruits with lower quality indices that cannot compete with Colombian produce. The primary challenge in expanding production in these regions is the lack of improved cultivars. In other words, few commercial varieties are currently available, most of which have been selected for Colombian conditions and may not be suitable or adaptable to other regions (dos Santos et al., 2023).

Cape gooseberry fruit is highly perishable and exhibits a climacteric ripening pattern characterized by increased ethylene synthesis and significant changes in color and texture during storage. The storage life of cape gooseberry fruit is about one month when kept with its calyx, but only 4 to 5 days without it (Oliveira et al., 2015).

These abovementioned challenges require the development of strategies to reduce waste and extend the storage life of fruits. Therefore, maximizing benefits for producers and exporters relies on genetic improvements of the plant and postharvest management strategies. These strategies aim to develop genotypes with higher yield and quality, along with enhanced postharvest quality and extended storage life.

Melatonin, a compound naturally found in plants, animals, and humans, shows significant potential in maintaining postharvest quality and extending the storage life of fruits and vegetables. The exogenous application of melatonin has been shown to slow down the decay rate, reduce weight loss and respiration rate, and preserve tissue firmness and quality indices (Feng et al., 2014). The exogenous

treatment of this compound enhances endogenous melatonin levels and activates antioxidant enzymes, thereby increasing antioxidant capacity, reducing oxidative stress, and delaying senescence (Gurjar et al., 2022). These findings demonstrate the potential of melatonin as a safe and effective postharvest treatment. Several studies have investigated the effects of melatonin on fruits during the postharvest period, reporting varying results across different species and cultivars, indicating the need for further research on various horticultural products (Wang et al., 2020; Ze et al., 2021).

The maturity index of cape gooseberry fruit, commonly used by most farmers and traders, is the visual determination of the maturity stage based on the color of the calyx, which correlates with the fruit color. Typically, a change in the calyx color from green to yellow, with fruits being yellow or orange, indicates the optimal harvest time for export and local markets, respectively. These changes are easily detectable and are, therefore, usually considered by farmers (Balaguera-López et al., 2016).

Given that the fruits are usually harvested at the orange stage for fresh consumption and local markets, the present study aimed to investigate the effects of exogenous melatonin application on preserving and enhancing the quality and storage life of orange-colored cape gooseberry fruits.

Material and Methods

Plant material

Entirely orange cape gooseberry fruits with completely yellow calyxes were harvested from a commercial greenhouse in Pasargad (Fars Province, Iran). The fruits were immediately transported to the laboratory using cardboard boxes. Suitable fruits were selected through visual inspection, focusing on uniformity in size and color and the absence of damage or contamination. The selected fruits were washed with deionized water and dried at room temperature.

Treatments

Initially, melatonin (Sigma-Aldrich, Madrid, Spain) was dissolved in ethanol and then diluted with distilled water to achieve the desired concentrations of 100, 200, and 300 μM. Immediately following washing and air drying of fruits, sixty fruits per treatment were immersed in the melatonin solutions for 5 minutes, with distilled water as a control. The treated fruits were air-dried at room temperature for 30 minutes and then packaged in 0.03-mm polyethylene fresh-keeping bags (10 × 5 × 20 cm^3) with a 3% perforation ratio. The fruits were stored at 10 ± 1°C and 90 ± 1% relative humidity (RH) for 21 days. The fruits were removed from storage weekly for evaluation during 21 days. Additionally, the parameters were assessed

for informational purposes and not for statistical comparison on the initial day of the experiment, before the start of the storage period.

Experimental design

The experimental design was a completely randomized design (CRD) using a factorial arrangement comprising 12 treatments with three replications per treatment (20 fruits per replicate). The experimental factors included immersing the fruits in four melatonin solutions (0 µM [distilled water as a control], 100 µM, 200 µM, and 300 µM) and sampling at three intervals on days 7, 14, and 21 of storage.

Fruit weight loss

The mass variation was measured using an FZ-300iWP precision scale (A&D Co.). The weight loss was calculated as the difference between the initial mass and the mass at each time point (Taghipour and Assar, 2022), expressed as a percentage of the initial mass using Equation (1) (Hayati et al., 2023a):

Weight loss (%) = [(initial weight of each sample (g) − final weight of each sample (g))/ initial weight of each sample (g)] × 100 [1]

Fruit decay rate

The decay rate was calculated as a percentage by examining the number of decayed fruits and using Equation (2) (Hayati et al., 2023b):

Decay rate (%) = (the number of decayed fruits/the total number of fruits) × 100 [2]

Fruit firmness

This parameter was measured using a hand-held penetrometer (I-OSK-10576). For each fruit, the firmness was measured at two opposite points of its equatorial area using a 3-mm probe. The results were expressed as mN (Hayati et al., 2023a).

Juice total soluble solids/titratable acidity (TSS/TA) ratio (taste index)

Juice TSS was measured with a hand-held refractometer (ATAGOB933475) and expressed as a percent. Titration was performed to determine titratable acidity (TA) using 0.1 N NaOH to reach a pH of 8.2. The results were expressed as a percent of citric acid. The TSS/TA ratio was calculated by dividing TSS by TA (Hayati et al., 2023a).

Juice hydrogen peroxide (H_2O_2) content

The hydrogen peroxide content was measured following the method outlined by Velikova et al. (2000). In this procedure, 500 mg of fruit tissue was homogenized in 5 mL of 0.1% (w/v) TCA in an ice bath. The homogenate was then centrifuged at 12,000×g for 15 minutes, and 0.5 mL of the resulting supernatant was mixed with 0.5 mL of 10 mM potassium phosphate buffer (pH 7.0) and 1 mL of 1 M KI. The absorbance was recorded at 390 nm using a spectrophotometer. The H_2O_2 concentration was calculated using a standard curve and expressed as µmol H_2O_2 per gram of fresh weight (FW) of the fruit.

Juice superoxide dismutase (SOD), catalase (CAT), ascorbate peroxidase (APX), and peroxidase (POD) activity

The antioxidant enzyme activities in the juice were determined according to the method described by Taghipour et al. (2021). Briefly, 1 g of tissue was homogenized in 4 mL of ice-cold 50 mM potassium phosphate buffer (pH 7.0) containing 1% (w/v) polyvinylpyrrolidone (PVP) and 2 mM ethylenediaminetetraacetic acid (EDTA). The homogenate was centrifuged at 10,000 × g for 10 minutes at 4 °C, and the supernatant was stored in vials at -80 °C for several days until the enzymatic assays were performed.

SOD activity was measured by observing the decrease in absorbance of the superoxide-nitro blue tetrazolium complex. The reaction mixture (1 mL) consisted of 50 mM potassium phosphate buffer (pH 7.8), 50 µL enzyme extract, 13 mM L-methionine, 0.1 mM EDTA, 75 µM nitro-blue tetrazolium (NBT), and 2 µM riboflavin, which was added last. The reaction was initiated by exposing the tubes to light from a 15 W fluorescent lamp for 15 minutes. The tubes were then covered with a black cloth. Control tubes without enzyme extract and blank tubes without light exposure were used as references. One unit of SOD activity was defined as the enzyme amount required to reduce the absorbance at 560 nm by 50% relative to the control, with the specific activity expressed as units per gram of fresh weight.

CAT activity was assessed by mixing 950 µL of reaction solution (50 mM phosphate buffer, pH 7.0, and 15 mM H_2O_2) with 50 µL enzyme extract. The decrease in absorbance at 240 nm was used to quantify CAT activity, with specific activity expressed as units per gram of fresh weight.

POD activity was measured by monitoring the increase in absorbance at 470 nm due to guaiacol oxidation in the presence of H_2O_2. The reaction mixture (1 mL) included 50 mM potassium phosphate buffer (pH 7.0), 33 µL enzyme extract, and 13 mM guaiacol, with the reaction initiated by adding 5 mM H_2O_2. The specific activity was expressed as units per gram of fresh weight.

APX activity was determined by measuring the decrease in absorbance at 290 nm due to ascorbate oxidation. The reaction mixture (1 mL) consisted of 50 mM

potassium phosphate buffer (pH 7.0), 50 µL enzyme extract, 0.5 mM ascorbate, 0.15 mM H_2O_2, and 0.1 mM EDTA. The specific activity was expressed as units per gram of fresh weight.

Statistical analysis

Data were analyzed using analysis of variance (ANOVA) at a significance level of $P < 0.05$, and mean comparisons were carried out with the least significant difference (LSD) test. All statistical analyses were conducted using SAS software version 9.4.

Results and Discussion

The maturity stage of fruit at harvest is a critical factor influencing postharvest behavior and quality, closely tied to commercial demand and consumer preferences. Fruits harvested at immature or overripe stages are significantly more susceptible to physiological damage and generally exhibit lower quality than those picked at optimal maturity. Harvesting at the optimal stage ensures the desirable flavor while preventing excessive softening associated with overripening (Proebsting and Murphey, 1987). Immature fruits are more prone to physical damage and quality degradation due to internal water loss, resulting in a weaker flavor upon ripening. Conversely, overripe fruits rapidly become soft, tasteless, and mealy after harvest (Proebsting and Murphey, 1987). These conditions are also relevant to cape gooseberry fruits, leading to reduced quality, sensory attributes, nutritional value, and profitability within the production and supply systems.

Four maturity stages are defined for harvested cape gooseberry fruits: S1 (25% yellow and 75% green with a green calyx), S2 (50% yellow and 50% orange with a yellow-green calyx), S3 (100% orange with an entirely yellow calyx), and S4 (100% orange with a dry brown calyx) (Balaguera-López et al., 2016). Storage of cape gooseberry fruits at various maturity stages and without calyx at 18°C and 60% relative humidity for 15 days showed that fruits harvested at stage S1 exhibited the lowest postharvest quality, the highest weight loss, the least firmness, and inconsistent color development. Consequently, stage S1 was identified as an unsuitable maturity stage for harvesting. It was also recommended that cape gooseberry fruits should be harvested at maturity stages S2 and S3 for export and the local market supply, respectively, due to their more favorable postharvest behavior. In contrast, fruits at stage S4 should only be harvested for immediate consumption and are unsuitable for commercial purposes (Balaguera-López et al., 2016).

Based on the abovementioned findings, the authors decided to harvest and treat cape gooseberry fruits at stage S3 to enhance postharvest quality and storage

life to meet the requirements of the local market and fresh consumption, as previously mentioned in the introduction section.

Our results on the analysis of variance (Table 1) indicated a significant effect of all experimental factors and their interactions on all evaluated traits, except for the lack of the interaction effect on catalase enzyme activity. Moreover, mean comparisons, as shown in Figures 1, 2, and 3, demonstrated that postharvest melatonin treatment generally reduced fruit weight loss and decay, decreased hydrogen peroxide content, and maintained or improved the other indices, including tissue firmness, TSS/TA ratio, and antioxidant enzyme activities in the juice.

The results indicated that weight loss and decay rates in cape gooseberry fruits increased significantly over the storage period. However, this trend was slower in melatonin-treated fruits compared to the control (Figures 1a and 1b). After 21 days of storage, the weight loss in fruits treated with different concentrations of melatonin was similar and significantly lower than that of the control fruits (Figure 1a). At this point, the fruits treated with higher concentrations of melatonin exhibited the lowest decay rate, which was significantly lower than that of the fruits treated with 200 μM melatonin (Figure 1b).

At each sampling point, a significant decrease in fruit firmness was observed compared to the previous sampling. After seven days of storage, the treatments with the two higher concentrations of melatonin showed the highest fruit firmness. After 14 days, this was observed in the treatment with the highest concentration, and after 21 days, all three concentrations maintained the highest fruit firmness. Throughout the storage period, control fruits consistently exhibited lower firmness compared to melatonin-treated fruits (Figure 1c).

The taste index of both the control and treated fruits showed a significant increase by the end of the storage period. At each sampling point, there was no difference in the taste index among the treated fruits, and their index was lower than that of the control fruits (Figure 1d).

The changes in hydrogen peroxide levels in all experimental groups showed a significant increase. However, fruits treated with higher concentrations of melatonin had statistically lower levels of hydrogen peroxide compared to other groups at each sampling point (Figure 2a).

The activity of the SOD enzyme increased until the seventh day of storage and then decreased until the end of the storage period. A significant reduction in enzyme activity was observed at each sampling time compared to the previous sampling, with fruits treated with higher concentrations of melatonin showing higher enzyme activity than those in other groups at each sampling point (Figure 2b).

CAT enzyme activity increased with the increase in melatonin concentration (Figure 2c). On the other hand, enzyme activity levels were higher on day 7

compared to the start of the experiment, but a significant decrease was observed over time during the storage period (Figure 2d).

Regarding APX enzyme activity, as the storage period progressed, the difference in enzyme activity levels between fruits treated with 300 µM melatonin and other experimental groups became more pronounced. Between the 7th and 14th days of storage, the enzyme activity in the fruits treated with 100 µM melatonin showed a significant decrease, while no significant change was observed with 200 µM melatonin. From the 14th to the 21st days, enzyme activity remained unchanged with 100 µM, but significantly increased with 200 µM. In contrast, fruits treated with 300 µM melatonin consistently showed a significant increase in enzyme activity throughout the storage period, with levels always higher than those in the other groups (Figure 3a).

The activity of the POD enzyme in the control fruits decreased consistently, with a significant reduction observed at each sampling point compared to the previous one. Fruits treated with melatonin exhibited higher enzyme activity levels throughout storage compared to the start of the experiment. However, a significant decrease in enzyme activity was noted between the 7th and 14th days, followed by a significant increase in the final 7-day period of the experiment. At all sampling points, fruits treated with higher concentrations of melatonin showed higher enzyme activity levels compared to those treated with lower concentrations (Figure 3b).

Table 1. Analysis of variance of the effect of exogenous melatonin treatment on the physicochemical properties of *Physalis peruviana* L. fruit during storage.

Source of variation	df	Fruit weight loss	Fruit decay rate	Fruit firmness	Juice taste index	Juice hydrogen peroxide	Juice superoxide dismutase activity	Juice catalase activity	Juice ascorbate peroxidase activity	Juice peroxidase activity
Dip in melatonin	3	35.73**	624.95**	21630.75**	3.60**	46.15**	5.07**	7.42**	21.59**	10.98**
Time	2	87.36**	996.91**	71951.62**	6.44**	4.63**	2.33**	4.96**	17.07**	2.55**
Dip in melatonin × time	6	3.00**	48.97**	1908.02**	0.38**	6.82**	0.02*	0.01^{ns}	1.32**	0.27**
Error	24									
CV (%)		6.77	14.29	1.42	2.18	3.71	1.92	3.61	3.80	4.18

**, *, and ns: significantly different at 1%, 5% and no significant differences, respectively.

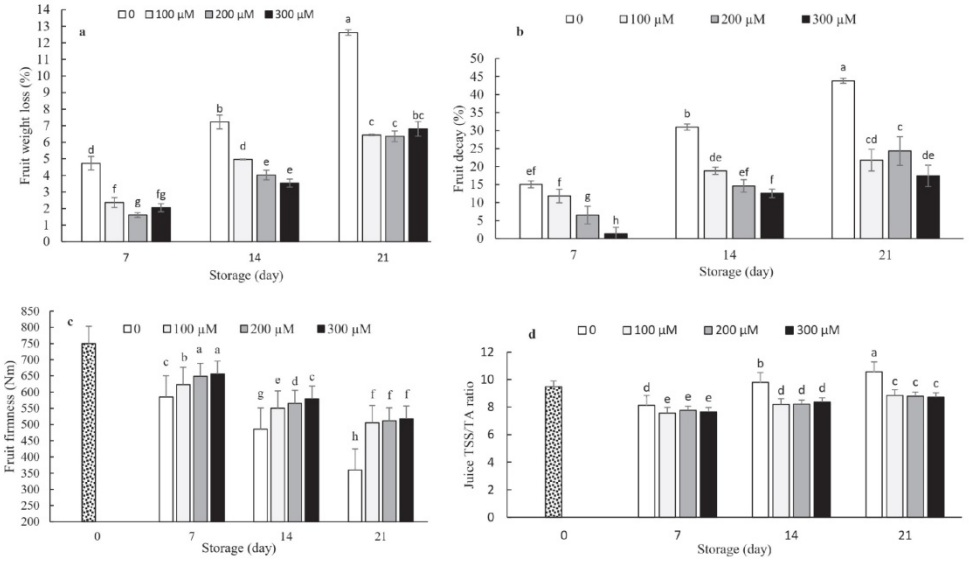

Figure 1. Effects of exogenous melatonin treatment on selected properties of *Physalis peruviana* L. fruits during 21 days of storage. For each property, similar letters indicate no significant difference between the experimental groups at the 5% level, based on the least significant difference (LSD) test.

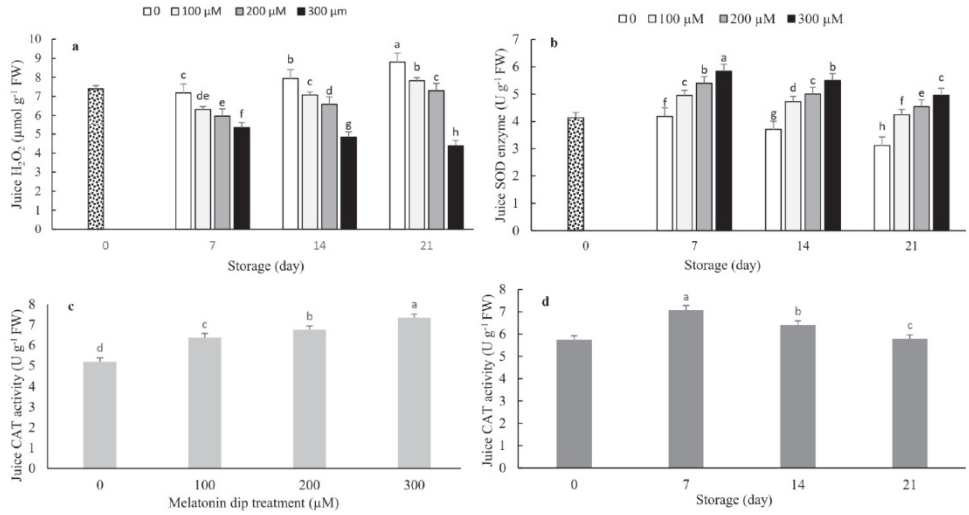

Figure 2. Effects of exogenous melatonin treatment on selected properties of *Physalis peruviana* L. fruits during 21 days of storage. For each property, similar letters indicate no significant difference between the experimental groups at the 5% level, based on the least significant difference (LSD) test.

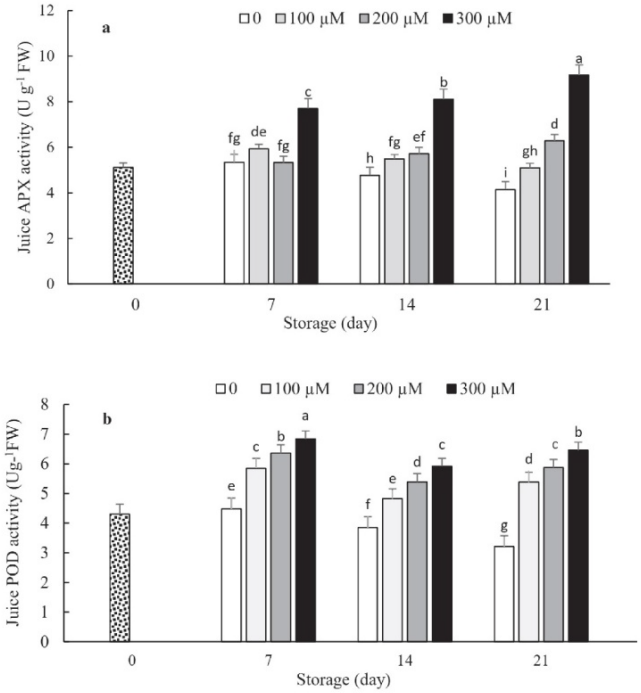

Figure 3. Effects of exogenous melatonin treatment on selected properties of *Physalis peruviana* L. fruits during 21 days of storage. For each property, similar letters indicate no significant difference between the experimental groups at the 5% level, based on the least significant difference (LSD) test.

Oxidative damage during postharvest storage of horticultural products such as fruits and the destructive effects of reactive oxygen species (ROS) on macromolecules such as nucleic acids, lipids, and proteins, ultimately leading to decreased quantity, quality, and storage life, is a well-known phenomenon (Zhang et al., 2018). Fruits have developed enzymatic antioxidant systems, including superoxide dismutase (SOD), catalase (CAT), ascorbate peroxidase (APX), and peroxidase (POD), to combat ROS. These systems reduce ROS accumulation and lipid peroxidation, enhancing cellular integrity and prolonging postharvest storage life (Zhang et al., 2018).

Melatonin is an eco-friendly and safe compound naturally present in various fruits and vegetables, including tomatoes, bananas, oranges, strawberries, cherries, and apples (Feng et al., 2014). It acts as a primary signaling molecule during biotic and abiotic stresses, helping regulate many plant functions, and is recognized as a potent free radical scavenger (Arnao and Hernández-Ruiz, 2014; Tan et al., 1993).

Melatonin synthesis is mediated by several key enzymes, including serotonin N-acetyltransferase (SNAT) and hydroxyindole-O-methyltransferase (HIOMT).

Exogenous melatonin application has been demonstrated to upregulate the expression of genes encoding these enzymes, thereby enhancing the melatonin biosynthetic pathway and increasing endogenous melatonin levels (Kumari et al., 2023). This increase in melatonin aids in quality maintenance under postharvest stress conditions (Hu et al., 2017; Dubbels et al., 1995).

It has been reported that as the maturity stage progresses and the storage duration of cape gooseberry fruits increases, ethylene production, weight loss, and TSS content increase while tissue firmness and titratable acidity decrease (Balaguera-López et al., 2016). Maintaining membrane integrity, limiting lipid peroxidation, reducing malondialdehyde levels, and decreasing membrane leakage in horticultural products treated with melatonin are evidence of improved stress tolerance and postharvest quality preservation (Gao et al., 2016; Jimenez et al., 2002). Consequently, delayed fruit senescence, better retention of fruit firmness, and slower weight loss rates occur (Onik et al., 2021; Rastegar et al., 2020). As shown in previous studies on melatonin application, melatonin's ability to inhibit respiration and ethylene production, along with inhibiting polyphenol oxidase (PPO) activity, helps preserve quality indices such as firmness, TA, and TSS, and prevent browning and color changes in the peel and flesh (Kumar et al., 2014; Zhang et al., 2018). In this study, the stability of the TSS/TA ratio, as an indicator of fruit taste, demonstrates the efficacy of melatonin treatment in maintaining fruit marketability throughout the storage period.

Melatonin stimulates the expression of antioxidant-related genes and enhances ROS scavenging mechanisms, effectively limiting hydrogen peroxide production as a primary indicator of oxidative stress (Jannatizadeh et al., 2019; Saxena et al., 2016). A significant reduction in hydrogen peroxide content was observed in fruits treated with 300 μM melatonin while an increasing trend was seen in fruits treated with 200 μM. However, after 21 days of storage, the hydrogen peroxide levels in the treated fruits were lower than at the start of the experiment. This indicates that melatonin treatment effectively stimulates antioxidant system activity and controls hydrogen peroxide levels, which is consistent with the results of this study regarding antioxidant enzyme activity.

Similarly, in a study examining the effect of melatonin treatment on improving the storage life, quality, and antioxidant enzyme activity of papaya fruits, the effects of 1.5 mM exogenous melatonin were evaluated during 28 days of storage at 10 ± 2°C. The researchers reported that the treatment significantly delayed postharvest senescence, preserved higher titratable acidity levels, and reduced weight loss compared to control fruits (Wang et al., 2022). Moreover, the treatment not only enhanced the activity levels of superoxide dismutase, peroxidase, and catalase enzymes, but also significantly inhibited hydrogen peroxide accumulation. Additionally, the treated fruits showed a better taste index than the controls.

The protective mechanisms of melatonin against pathogens and pathogen-induced decay in horticultural products are multifaceted. These mechanisms include enhancing the antioxidant defense system by stimulating the activity of enzymatic antioxidants (such as SOD, CAT, POD) and increasing the levels of non-enzymatic antioxidants, strengthening hormonal signaling, and affecting levels of plant hormones such as abscisic acid, jasmonic acid, ethylene, and salicylic acid. They also involve inducing the phenylpropanoid pathway and stimulating activities that lead to synthesizing cell walls, lipids, and waxes in the fruit peel, serving as physical barriers against pathogen invasion (Fan et al., 2022). Similar findings have been reported for cherry fruits (Wang et al., 2019).

Conclusion

The authors believe that this study elucidates the key mechanisms contributing to the extended storage life of orange-colored cape gooseberry fruits and provides valuable insights into postharvest management. The results demonstrate that exogenous melatonin application, particularly at a concentration of 300 µM, serves as a promising postharvest strategy to enhance the commercial potential and marketability of these fruits. This is attributed to the positive effects of melatonin treatments in alleviating weight loss, decay, and softening, while better maintaining the taste index. Furthermore, the 300 µM melatonin treatment showed the most significant impact on enhancing the enzymatic antioxidant system, as evidenced by increased activities of superoxide dismutase, catalase, ascorbate peroxidase, and peroxidase enzymes. This enhancement was accompanied by a substantial reduction in hydrogen peroxide content, indicating an effective mitigation of oxidative stress. However, further research is necessary to fully elucidate the underlying molecular mechanisms and evaluate the feasibility of melatonin treatments under commercial-scale storage conditions.

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PRODUŽAVANJE VEKA SKLADIŠTENJA I POBOLJŠANJE TRŽIŠNE VREDNOSTI PLODOVA NARANDŽASTE PERUANSKE JAGODE: TRETMAN MELATONINOM POJAČAVA ENZIMSKI ANTIOKSIDATIVNI SISTEM

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R e z i m e

Voćka peruanska jagoda (*Physalis peruviana* L.) daje klimakterične plodove koji tokom skladištenja prolaze kroz značajne promene boje i teksture usled povećane sinteze etilena. Dok mu je vek skladištenja sa čašicom jedan mesec, bez nje traje samo 4 do 5 dana. Stoga su strategije za smanjenje gubitaka nakon berbe i produženje veka skladištenja od suštinskog značaja. U ovoj studiji, potpuno zreli plodovi narandžaste peruanske jagode sa žutim čašicama ubrani su i prebačeni u laboratoriju. Nakon pranja, plodovi su potopljeni u rastvore melatonina u koncentracijama od 100, 200 i 300 µM tokom 5 minuta, dok je destilovana voda korišćena kao kontrola. Plodovi su skladišteni na temperaturi od 10°C i relativnoj vlažnosti od 90 ± 5% tokom 21 dana i ocenjivani svake nedelje. Rezultati su pokazali da su svi tretmani melatoninom značajno kontrolisali gubitak mase i omekšavanje plodova. Plodovi tretirani melatoninom imali su uporediv indeks ukusa i pokazali su bolje rezultate od kontrolnih uzoraka. Tretman melatoninom poboljšao je antioksidativni enzimski sistem, pri čemu su plodovi tretirani sa 300 µM melatonina pokazali najveću aktivnost enzima superoksid dismutaze, katalaze, askorbat peroksidaze i peroksidaze, kao i najniži sadržaj vodonik peroksida, što ukazuje na smanjen oksidativni stres. Pored toga, najniži procenat propadanja plodova (17,4%) zabeležen je kod plodova tretiranih sa 300 µM melatonina, dok je najviši procenat propadanja (43,83%) primećen kod kontrolnih plodova. Tretman melatoninom pokazao se kao efikasan u poboljšanju kvaliteta i produženju roka trajanja plodova peruanske jagode, delujući kao vredna i ekološki prihvatljiva postharvest tehnologija, usporavanjem sazrevanja, povećanjem enzimske antioksidativne aktivnosti i očuvanjem indeksa ukusa.

Ključne reči: askorbat peroksidaza, peruanska jagoda, slobodni radikali, tretman melatoninom, indeks ukusa, čvrstoća tkiva, gubitak mase.

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