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Application of Calcium Salts and Organic Acid Dip Treatments to Improve Quality of Fresh-Cut Potatoes

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Abstract

Fresh-cut potatoes are a highly perishable food product due to enzymatic browning, moisture loss, tissue softening and rapid metabolic activity caused by wounding during cutting. The present research was designed to assess the effect of four different dipping treatments: 2% calcium lactate combined with 2% ascorbic acid (T_1), 2% calcium lactate combined with 2% citric acid (T_2), 2% calcium chloride combined with 2% ascorbic acid (T_3), and 2% calcium chloride combined with 2% citric acid (T_4), along with an untreated control (T_0), on the physicochemical quality of fresh-cut potatoes during refrigerated storage of 21 days. Slices were dipped in the dipping solutions for 3 minutes followed by packaging in sealed polyethylene bags and storage at 5 ± 1 °C. Samples were analyzed for titratable acidity (TA), pH, total soluble solids (TSS), firmness, weight loss % and color after every 7 days of storage. T_1 gave the best overall balance of firmness, acidity retention and surface color, being the only treatment that significantly increased firmness over the control, whereas T_4 was more effective in limiting changes in pH and TSS. However, weight loss was higher in all treated samples than in control. These findings suggest that application of calcium lactate combined with ascorbic acid can prove to be a promising approach for maintaining the quality of fresh-cut potatoes in refrigerated storage.

1. Introduction

Fresh produce has become popular among people globally due to its nutritional value, convenience, and health benefits (Qadri *et al*., 2015; Singla *et al*., 2020). Fruits and vegetables, physically modified by trimming, peeling, or chopping without losing their freshness are considered fresh-cut products, according to International Fresh-cut Produce Association (IFPA) (Asghar *et al*., 2022; Qadri *et al*., 2015). Fresh-cut potatoes are essential for potato dishes where restaurants have less time for preparing meals. The increased market requirement for potato chips, French fries, and baked potatoes made fresh-cut potatoes an attractive and important commodity for consumers, necessitating proper processing procedures to preserve their wholesomeness (Rashid *et al*., 2021).

Potato (*Solanum tuberosum*) is the 4th most popular staple food globally, with around 5,000 cultivars globally available (Zaheer & Akhtar, 2016). Despite being usually classified as a carbohydrate-laden, calorie-rich insignificant portion of the human diet, potato is one of the world's most nutritious vegetable food crops, with a higher concentration of vital human nutrients than most other vegetables. These include proteins, carbohydrates, and fiber, as well as major, secondary, and trace elements, vitamins, antioxidants, and

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phytochemicals. Potatoes is also rich in vitamin C and potassium (K), both of which are essential nutrients for optimal health (Gupta & Gupta, 2019).

During standard fresh-cut processing, fruits and vegetables are typically washed, peeled, cut, and treated with food additives before being packed in sterilized packing material and stored at refrigerated temperatures (Perera, 2020). However, because of their exposed or damaged tissues and absence of protective skin, fresh-cut potatoes are extremely perishable (Levaj *et al*., 2023). Shelf stability of fresh-cut potatoes is traditionally maintained by application of chemical or synthetic food additives such as sulfur dioxide, ascorbic acid, citric acid, calcium chloride, calcium lactate, calcium phosphate, and L-cysteine (De Corato, 2020; Levaj *et al*., 2023).

Calcium salts contribute to the preservation of cell wall rigidity, whereas ascorbic and citric acids mitigate browning by reducing surface pH and reducing polyphenol oxidase activity. The two commonly used calcium sources (lactate and chloride) have not, as far as we know, been directly compared with both organic acids on fresh-cut potatoes; instead, most research has tested these compounds separately or on other products. The current study, therefore, compared different dipping treatments namely calcium chloride, calcium lactate, ascorbic acid and citric acid in combinations followed by refrigerated storage for 21 days and physicochemical quality evaluation after every week.

2. Materials and Methods

The research was performed in the Post-Harvest Research Centre, Ayub Agricultural Research Institute, Faisalabad.

2.1 Procurement of raw material

Fresh potatoes were procured from the local market of Faisalabad, Pakistan.

2.2 Preparation of fresh-cut potatoes

Potatoes of uniform size and maturity (cv. LR-Lady Rosetta) were washed with running water, peeled and cut into longitudinal slices (~50 mm length and ~4-5 mm thick) with sharp knife. The slices were washed again with clean running water and evenly allotted (8 Nos) to each treatment group prepared in three independent replicates.

2.3 Application of dipping materials

2% w/v solutions of each chemical compound namely, calcium chloride, calcium lactate, ascorbic acid and citric acid were prepared. The prepared solutions were mixed in such a combination that each combined treatment solution contained 2% (w/v) of the calcium salt and 2% (w/v) of the organic acid, dissolved together in the same volume of distilled water according to the treatment plan and fresh-cut potato slices were dipped in these solutions for 3 minutes. Control was prepared without dipping in any solution. Following were the treatments prepared with different combinations of dipping materials:

T_o = Control

T_1 = 2% Calcium lactate + 2% Ascorbic acid

T_2 = 2% Calcium lactate + 2% Citric acid

T_3 = 2% Calcium chloride + 2% Ascorbic acid

T_4 = 2% Calcium chloride + 2% Citric acid

2.4 Packaging and storage

Dipped treatments were dried with paper cloth and packed in zip lock polyethylene bags. Excess air was removed from the bags which were then stored in refrigerator at 5 ± 1 °C.

2.5 Physicochemical quality assessment

2.5.1 Titratable acidity (TA)

TA was determined using the protocol described by Tabassum and Khan (2020). 40 mL of distilled water was used to mix and homogenize 10 g of sample. Phenolphthalein was used as an indicator for titrating the resulting samples with 0.1 N NaOH. The results were presented as % of citric acid using following formula:

$$\text{TA (\%)} = \frac{T \times N \times V1 \times E}{V2 \times W \times 1000} \times 100$$

where T indicates the titer (volume of NaOH utilized), N is the normality of NaOH, V_1 is the prepared volume, E is the equivalent weight of citric acid (64.04 g mol^{-1}), V_2 is the volume of aliquot, and W is the weight of the sample.

2.5.2 pH

Digital pH meter (Spectrum Technologies, INC. Illinois, USA) was used to measure the pH of each sample. 100 ml of distilled water was used to homogenize 10 g of fresh-cut potatoes. The results were noted on each analysis day and expressed as a pH unit (Waghmare & Annapure, 2013).

2.5.3 TSS

On each analysis day, TSS of each sample was measured using a digital refractometer (HI 96801, 0-85 °Brix, Hanna Instruments, Woonsocket, USA) by crushing a small portion of the sample and obtaining its juice. The reading was noted in degree brix (˚B) (Tabassum & Khan, 2020).

2.5.4 Color

Color of the samples was measured throughout the storage study using a portable colorimeter (Chroma meter CR-400, Konica Minolta, Japan). The instrument was previously calibrated to measure sample color against black and white

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Table 1. Effect of dipping treatments on pH, titratable acidity, TSS and weight loss (%) of fresh-cut potatoes during refrigerated storage (5 ± 1 °C)

Parameter	Treatment	Days of storage				Mean
		0	7	14	21	
Titratable acidity (%)	$T_\circ$	1.10 ± 0.04	0.68 ± 0.03	0.54 ± 0.02	0.39 ± 0.00	0.68^{d}
	T_1	1.34 ± 0.03	1.07 ± 0.04	0.94 ± 0.04	0.81 ± 0.06	1.04^{a}
	T_2	1.39 ± 0.05	1.03 ± 0.04	0.89 ± 0.02	0.80 ± 0.04	1.03^{a}
	T_3	1.22 ± 0.03	0.73 ± 0.04	0.52 ± 0.02	0.42 ± 0.02	0.72^{c}
	T_4	0.99 ± 0.06	0.93 ± 0.02	0.87 ± 0.02	0.77 ± 0.02	0.89^{b}
	Mean	1.21^{a}	0.89^{b}	0.75^{c}	0.64^{d}	
pH	$T_\circ$	6.81 ± 0.28	6.54 ± 0.19	6.31 ± 0.23	6.13 ± 0.18	6.45^{b}
	T_1	6.97 ± 0.38	6.79 ± 0.22	6.66 ± 0.29	6.61 ± 0.29	6.76^{ab}
	T_2	6.99 ± 0.29	6.67 ± 0.12	6.49 ± 0.45	6.26 ± 0.23	6.60^{ab}
	T_3	7.05 ± 0.31	6.92 ± 0.29	6.82 ± 0.39	6.70 ± 0.30	6.87^{a}
	T_4	6.93 ± 0.43	6.88 ± 0.26	6.84 ± 0.17	6.77 ± 0.24	6.86^{a}
	Mean	6.95^{a}	6.76^{ab}	6.62^{b}	6.49^{b}	
TSS (°Brix)	$T_\circ$	4.05 ± 0.24	4.68 ± 0.18	6.05 ± 0.25	6.94 ± 0.19	5.43^{cd}
	T_1	4.36 ± 0.11	5.15 ± 0.17	6.01 ± 0.25	6.88 ± 0.19	5.60^{c}
	T_2	5.02 ± 0.23	6.08 ± 0.14	7.41 ± 0.26	8.12 ± 0.28	6.66^{a}
	T_3	4.97 ± 0.09	5.44 ± 0.27	6.18 ± 0.23	6.92 ± 0.33	5.88^{b}
	T_4	4.71 ± 0.14	5.06 ± 0.21	5.57 ± 0.24	5.93 ± 0.22	5.32^{d}
	Mean	4.62^{d}	5.28^{c}	6.24^{b}	6.96^{a}	
Weight loss (%)	$T_\circ$	0.00	3.52 ± 0.17	4.03 ± 0.10	5.28 ± 0.15	4.28^{b}
	T_1	0.00	3.88 ± 0.11	3.99 ± 0.11	7.02 ± 0.21	4.96^{a}
	T_2	0.00	3.43 ± 0.17	4.64 ± 0.19	6.84 ± 0.36	4.97^{a}
	T_3	0.00	3.51 ± 0.21	4.79 ± 0.17	6.61 ± 0.03	4.97^{a}
	T_4	0.00	3.78 ± 0.08	4.97 ± 0.24	6.38 ± 0.11	5.04^{a}
	Mean	0.00^{d}	3.62^{c}	4.48^{b}	6.43^{a}	

Means followed by different letters within a row or column are significantly different ($p \leq 0.05$) based on Tukey's HSD test. $T_\circ$ = Control; T_1 = 2% Calcium lactate + 2% Ascorbic acid; T_2 = 2% Calcium lactate + 2% Citric acid; T_3 = 2% Calcium chloride + 2% Ascorbic acid; T_4 = 2% Calcium chloride + 2% Citric acid.

plates. The results were shown as color coordinates L* (lightness), a* (green-red), and b* (yellow-blue) on the instrument's display screen (Yousuf *et al*., 2020).

2.5.5 Weight loss (%)

The weight loss of both treated and untreated fresh-cut potatoes during storage was measured with a precision of 0.01 g using a weighing balance (PA4102, Ohaus Corporation, USA) by following the protocol of Chen *et al*. (2016). The weight loss % in relation to 0 day were used to express the results using following formula:

$$\text{Weight loss (\%)} = \frac{Wi - Wf}{Wi} \times 100$$

Where wi is the initial weight at 0 day and wf is the weight of sample at analysis day.

2.5.6 Firmness

Firmness (kg) of the samples was determined using penetrometer (PCE-FM200, PCE Instruments UK Ltd.) with 6mm plunger and taking average values from different sides of the fresh-cut potato strips (Lee *et al*., 2017).

2.6 Statistical analysis

Collated data in triplicate statistically analyzed in order to compute significant differences among means and to analyze the interaction between storage days and applied treatments. The two-way analysis of variance (ANOVA) under factorial layout was employed to observe statistical significance and mean separation was performed using Tukey's Honestly Significant Difference (HSD) test at a 5% significance level (Montgomery, 2017).

3. Results and Discussion

3.1 Titratable acidity

Statistically significant results were obtained for titratable acidity of fresh-cut potatoes during storage (table 1). Acidity decreased among all treatments with the highest value recorded at 0 day and the lowest value at 21 days of storage.

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T_4 showed the minimum changes in titratable acidity closely followed by T_1 during entire storage duration.

The highest decline in titratable acidity was observed in T_3 (65.6%) followed by control (64.5%) whereas the lowest drop in acidity was observed in T_4 (22.2%) followed by T_1 (39.6%) and T_2 (42.4%). The utilization of organic acids as respiration substrates may have contributed to the lower titratable acidity of samples after storage. Tissue wounding due to cutting accelerates the metabolic activity and respiration resulting in depletion of organic acids which contributes to observed reduction in titratable acidity (Baldwin & Bai, 2011; Faisal *et al*., 2025).

3.2 pH

pH values of different treatments of fresh-cut potatoes showed statistically significant ($p<0.05$) results (table 1). A slight decrease in pH of all treatments was observed throughout the storage with maximum and minimum values at 0 and 21 days of storage. Overall better stability of pH was observed in T_4 throughout the storage.

pH does not necessarily follow the same trend as titratable acidity since it measures the concentration of free hydrogen ions rather than the total acid content (Barrett *et al*., 2010; Etienne *et al*., 2015). pH dropped by 0.68 units in control and by 0.73 units in T_2. However, drop of only 0.36 units was observed in T_1, 0.35 in T_3 and 0.16 in T_4 over the course of storage. Cheng *et al*. (2022) also reported a similar decline in pH of fresh-cut potatoes during storage.

3.3 TSS

Table 1 indicates gradual increase in TSS during storage period. The results showed that increase in TSS was statistically significant ($p<0.05$) in all treatments. The higher increase in TSS mean value was observed in T_2 while minimal changes were observed in T_4.

During storage, TSS increased by 71.4% in control, 61.8% in T_2 and 57.8% in T_1. An increase of 39.2% and 25.9% was observed in T_3 and T_4 respectively during 21 days of storage. Aslam *et al*. (2018) also reported an increase in TSS of fresh-cut papaya during storage with lower increase observed in Calcium lactate with ascorbic acid treatment. The increase in TSS during storage can be attributed to the disintegration of polymeric polysaccharides and/or decrease in moisture resulting in increase in concentration of solutes (Dai *et al*., 2023; Silva *et al*., 2018).

3.4 Weight loss (%)

A significant difference ($p<0.05$) in weight loss (%) was observed between control and other treatments while non-significant mean values of weight loss % were observed between all treated samples. As storage progressed, increase in weight loss (%) was observed in all treatments (Table 1).

Weight loss % is the combination of moisture loss and weight reduction, which occurs due to the physiological processes including transpiration and respiration, respectively (Lufu *et al*., 2024). In current study, increase in weight loss % was observed in all treatments during storage

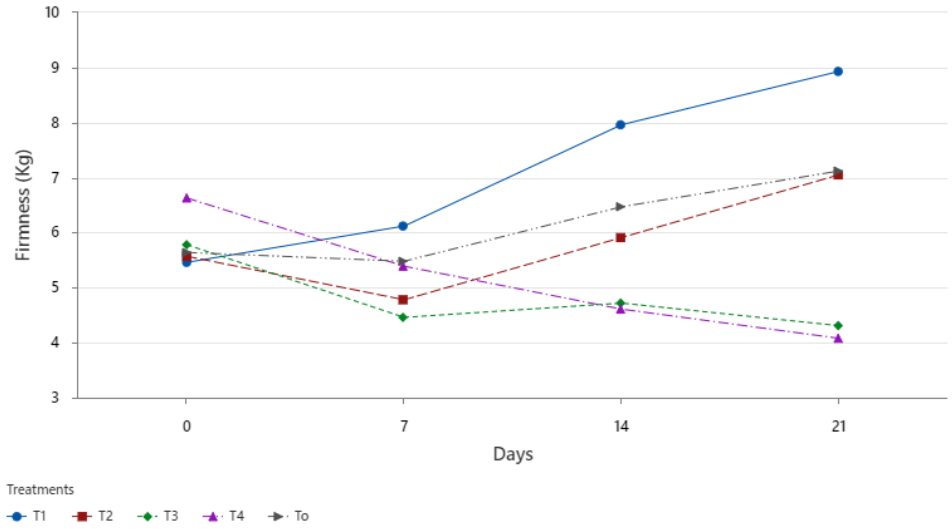


Figure 1. Effect of dipping treatments on firmness (kg) of fresh-cut potatoes during refrigerated storage (5 ± 1 °C). $T_\circ$ = Control; T_1 = 2% Calcium lactate + 2% Ascorbic acid; T_2 = 2% Calcium lactate + 2% Citric acid; T_3 = 2% Calcium chloride + 2% Ascorbic acid; T_4 = 2% Calcium chloride + 2% Citric acid.

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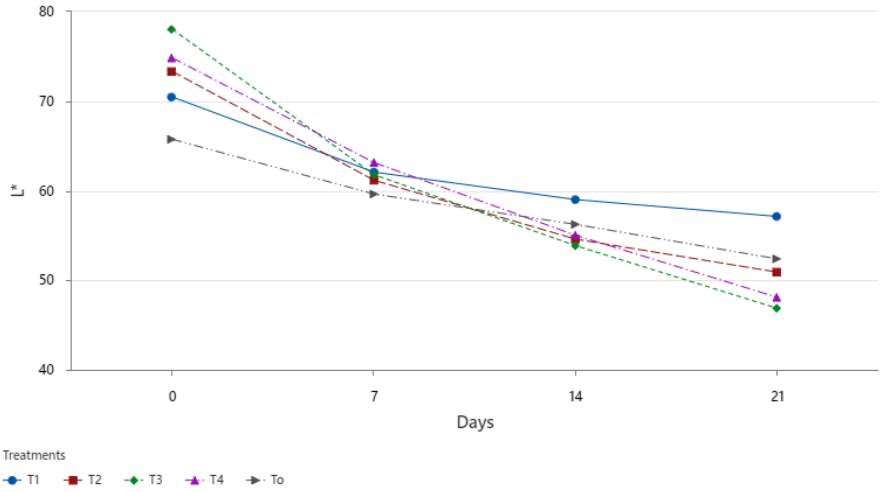


Figure 2a. Effect of dipping treatments on color (L* value) of fresh-cut potatoes during refrigerated storage (5 ± 1 °C). $T_{\circ}$ = Control; T_1 = 2% Calcium lactate + 2% Ascorbic acid; T_2 = 2% Calcium lactate + 2% Citric acid; T_3 = 2% Calcium chloride + 2% Ascorbic acid; T_4 = 2% Calcium chloride + 2% Citric acid.

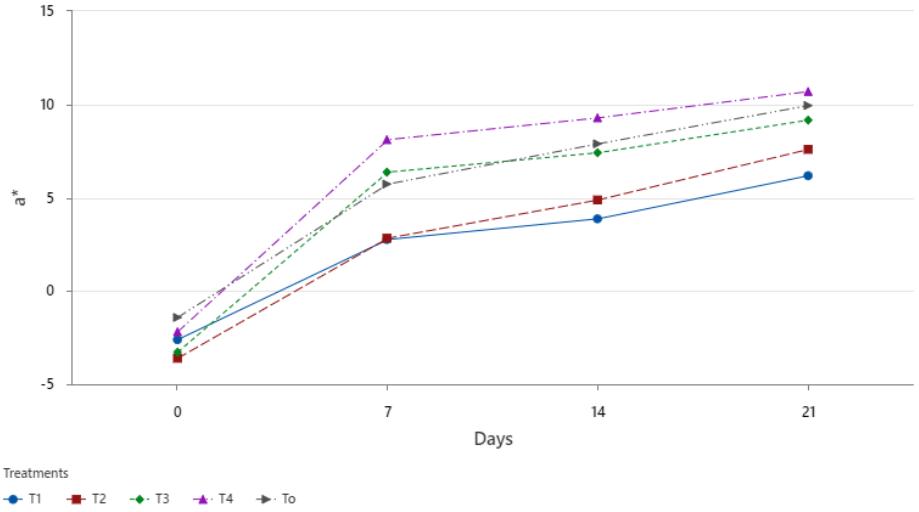


Figure 2b. Effect of dipping treatments on color (a* value) of fresh-cut potatoes during refrigerated storage (5 ± 1 °C). $T_{\circ}$ = Control; T_1 = 2% Calcium lactate + 2% Ascorbic acid; T_2 = 2% Calcium lactate + 2% Citric acid; T_3 = 2% Calcium chloride + 2% Ascorbic acid; T_4 = 2% Calcium chloride + 2% Citric acid

with the highest value of 7.02% in T_1 followed by 6.84% in T_2, 6.61% in T_3, 6.38% in T_4 and 5.28% in control. In a similar study, tomato treated with calcium solutions demonstrated reduced weight % as compared to control. Dipping solutions form a protective layer on surface of the fruit samples, which limits water loss. In addition, calcium coatings also help to delay senescence and reduce the respiration rate (Haleema *et al*., 2020). In a separate study, fresh-cut apples treated with combination of UV-C with citric acid exhibited reduced weight % as compared to control during storage (Chen *et al*., 2016). In contrast to these studies, weight loss was more in treated slices as compared to control probably because slices were dipped and not coated; the solutions did not form any effective moisture barrier.

3.5 Firmness (kg)

The mean data indicated there was statistically significant ($p<0.05$) difference among firmness values of treatments.

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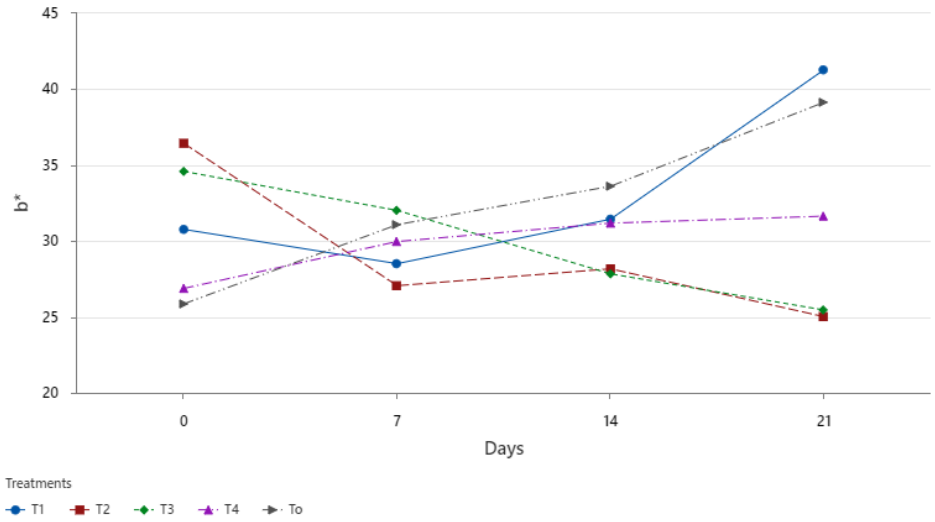


Figure 2c. Effect of dipping treatments on color (b* value) of fresh-cut potatoes during refrigerated storage (5 ± 1 °C). $T_{\circ}$ = Control; T_1 = 2% Calcium lactate + 2% Ascorbic acid; T_2 = 2% Calcium lactate + 2% Citric acid; T_3 = 2% Calcium chloride + 2% Ascorbic acid; T_4 = 2% Calcium chloride + 2% Citric acid.

The firmness increased gradually in T_1 whereas an initial drop in firmness was observed in $T_{\circ}$ and T_2 before subsequent increase. T_3 and T_4 reported a continuous decline in firmness values throughout the storage. Maximum firmness (8.93 kg) was recorded in T_1 followed by control (7.12 kg) at the end of storage (Figure 1).

During storage, firmness was retained or increased in calcium lactate treatments (T_1 and T_2) and control but dropped in calcium chloride treatments (T_3 and T_4). Increase in firmness might be attributed to the combined role of calcium lactate and ascorbic acid to strengthen the cell wall integrity of potato. Because the combined inhibitor helps to decrease the activities of peroxidase and polyphenol oxidase during storage which is linked with lowering enzymatic activity or degradation and as a result maintaining structure. Tappi *et al*. (2022) reported comparable findings indicating that the firmness of fresh-cut apples was enhanced with the simultaneous application of calcium lactate and ascorbic acid. Similarly, increase in firmness of fresh-cut jackfruit was also reported during storage after individual application of calcium chloride and ascorbic acid solutions (Zaidi, 2022).

3.6 Color

The results of color measurement are shown in figure 2. The results showed treatments and storage period had significant effects ($p<0.05$) on L*, a* and b* values. The L* values decreased during storage in all treatments (figure 2a) whereas an increase in a* values were observed in all treatments (figure 2b). The lowest (a*) values were noted at 0 day and highest (a*) values were observed at 21st day. Similarly, (b*) values increased significantly in control, T_1 and T_4 and decreased in T_2 and T_3 (figure 2c). The overall results showed that T_1 had better color retention compared to other treatments.

Color is an important parameter and has impact on consumers' decisions regarding any food. It also helps us to know about freshness or degree of ripeness of any fruit and vegetable. Fresh-cut potatoes are expected to have bright surface and free from browning or decay (Yıldız, 2019). Increase in anthocyanins content during storage contributes to increase in a* values of potato (Lachman *et al*., 2012). In a related study, Yıldız (2019) reported that potatoes treated with ascorbic acid and calcium chloride had better color profile and minimal enzymatic browning as compared to untreated samples. In another study, L* and b* values decreased whereas a* values increased in fresh-cut potatoes during 6 days of storage at 4°C after exogenous γ-aminobutyric acid treatment (Gao *et al*., 2018). In current study, similar changes in L* and a* values were observed. Changes in b* values varied among treatments where it increased in T_1, control and T_4 and decreased in T_2 and T_3. Overall, T_1 maintained the highest L* and b* values and the lowest a* value at the end of storage making it the most

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suitable treatment for maintaining the appearance of fresh-cut potatoes at refrigeration temperature.

Conclusion

The findings of current research established that combination of calcium salts with organic acids significantly improve the physicochemical quality characteristics of fresh-cut potato slices during 21 days of refrigerated storage. T_1 (2% calcium lactate + 2% ascorbic acid) retained the highest firmness and the lightest color whereas T_4 reported smallest decline in acidity, pH and TSS in comparison to other treatment combinations with regards to maintaining quality parameters. Calcium-mediated pectin cross-linking, which strengthens cell wall integrity and dual function of ascorbic acid as a polyphenol oxidase inhibitor and reactive oxygen species scavenger, works synergistically to prevent the enzymatic browning, the main cause of deterioration in potatoes. Based on these results, T_1 (2% calcium lactate + 2% ascorbic acid) can be suggested as a promising dipping solution for maintaining the quality of fresh-cut potatoes. Future studies should focus on impact of these treatments in combination with modified atmosphere packaging and their effectiveness in other minimally processed fruits and vegetables.

Author Contributions

Muhammad Hamdan Rashid: Conceptualization, Methodology, Writing original draft, Formal analysis. Hammad Naeem: Validation, Formal analysis. Hafiz Usama Noor: Investigation. Sidra Rashid: Data curation. Rabiya Zulfiqar: Methodology. Bareera Shafiq: Formal analysis. Sharoon Masih: Investigation. Zafar Iqbal: Data curation. Humaira Kausar: Validation. Muhammad Abrar: Supervision.

Conflict of Interest

The authors declare no conflict of interest.

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This research received no external funding.

Data availability

All data supporting the findings of this study are presented within the manuscript.

Ethical statement

This study did not involve human participants, animal subjects, or any material requiring ethical approval beyond standard laboratory practice.

References

Asghar, A., Rashid, M. H., Ahmed, W., Roobab, U., Inam-ur-Raheem, M., Shahid, A., Kafeel, S., Akram, M. S., Anwar, R., & Aadil, R. M. (2022). An in-depth review of novel cold plasma technology for fresh-cut produce. *Journal of Food Processing and Preservation,46*(7),e16560. https://doi.org/10.1111/jfpp.16560.

Aslam, H. K. W., Inam-ur-Raheem, M., Zahoor, T., & Shahid, M. (2018). Integrated effect of ascorbic acid, citric acid and calcium lactate on quality and shelf-life of fresh-cut papaya cubes. *Pakistan Journal of Agricultural Sciences, 55*(1), 183-189. https://doi.org/10.21162/PAKJAS/18.6126.

Baldwin, E. A., & Bai, J. (2011). *Physiology of fresh-cut fruits and vegetables*. CRC Press, Taylor & Francis Group.

Barrett, D. M., Beaulieu, J. C., & Shewfelt, R. (2010). Color, flavor, texture, and nutritional quality of fresh-cut fruits and vegetables: Desirable levels, instrumental and sensory measurement, and the effects of processing. *Critical Reviews in Food Science and Nutrition, 50*(5), 369-389. https://doi.org/10.1080/10408391003626322.

Chen, C., Hu, W., He, Y., Jiang, A., & Zhang, R. (2016). Effect of citric acid combined with UV-C on the quality of fresh-cut apples. *Postharvest Biology and Technology,111*,126-131. https://doi.org/10.1016/j.postharvbio.2015.08.005.

Cheng, D., Ma, Q., Zhang, J., Jiang, K., Cai, S., Wang, W., Wang, J., & Sun, J. (2022). Cactus polysaccharides enhance preservative effects of ultrasound treatment on fresh-cut potatoes. *Ultrasonics Sonochemistry, 90*, 106205. https://doi.org/10.1016/j.ultsonch.2022.106205.

Dai, Y., Xie, H., Zhao, X., & Zheng, Y. (2023). The effect of sodium nitroprusside treatment on storage ability of fresh-cut potato. *Foods, 12*(1), 221. https://doi.org/10.3390/foods12010221.

De Corato, U. (2020). Improving the shelf-life and quality of fresh and minimally processed fruits and vegetables for a modern food industry: A comprehensive critical review from the traditional technologies into the most promising advancements. *Critical Reviews in Food Science and Nutrition, 60*(6),940-975. https://doi.org/10.1080/10408398.2018.1553025.

Etienne, A., Génard, M., Bancel, D., Benoit, S., Nonone, M., Barre, P., & Bugaud, C. (2015). Modeling changes in pH and titratable acidity during the maturation of dessert banana. *Acta Horticulturae, 1099*, 807-814. https://hal.science/hal-01349167.

Faisal, M., Arshad, N., Wang, H., Li, C., Ma, J., Kong, X., Shi, Y., & Yu, L. (2025). Recent advances in technologies for preserving fresh-cut fruits and

©PagePal. All Rights Reserved.

vegetables. *Foods, 14*(16), 2769. https://doi.org/10.3390/foods14162769.

Gao, H., Zeng, Q., Ren, Z., Li, P., & Xu, X. (2018). Effect of exogenous γ-aminobutyric acid treatment on the enzymatic browning of fresh-cut potato during storage. *Journal of Food Science and Technology, 55*(12), 5035-5044. https://doi.org/10.1007/s13197-018-3442-1.

Gupta, U. C., & Gupta, S. C. (2019). The important role of potatoes, an underrated vegetable food crop in human health and nutrition. *Current Nutrition & Food Science,15*(1),11-19. https://doi.org/10.2174/1573401314666180906113417.

Haleema, B., Rab, A., Hussain, S. A., Sajid, M., Arif, M., Shah, S. T., & Basit, A. (2020). Influence of calcium concentrations and sources on the fruit quality of tomato (*Lycopersicon esculentum* Mill) at different storage conditions. *Fresenius Environmental Bulletin, 29*(3), 1866-1877.

Lachman, J., Hamouz, K., Orsák, M., Pivec, V., Hejtmánková, K., Pazderů, K., Dvořák, P., & Čepl, J. https://doi.org/10.1016/j.foodchem.2012.01.058 (2012). Impact of selected factors-cultivar, storage, cooking and baking on the content of anthocyanins in coloured-flesh potatoes. *Food Chemistry, 133*(4), 1107-1116. https://doi.org/10.1016/j.foodchem.2012.01.058.

Lee, Y., Wilson, M., Ross, T., Davies, N., & Stanley, R. (2017). Effects of pre- and post-cut storage temperatures on fresh-cut watermelon quality and shelf-life. In *Proceedings of the IV Asia Symposium on Quality Management in Postharvest Systems, Acta Horticulturae, 1210*, 283-290. https://doi.org/10.17660/ActaHortic.2018.1210.35.

Levaj, B., Pelaić, Z., Galić, K., Kurek, M., Ščetar, M., Poljak, M., Dite Hunjek, D., Pedisić, S., Balbino, S., & Čošić, Z. (2023). Maintaining the quality and safety of fresh-cut potatoes (*Solanum tuberosum*): Overview of recent findings and approaches. *Agronomy, 13*(8), 2002. https://doi.org/10.3390/agronomy13082002.

Lufu, R., Ambaw, A., & Opara, U. L. (2024). Mechanisms and modelling approaches to weight loss in fresh fruit: A review. *Technology in Horticulture, 4*(1), e006. https://doi.org/10.48130/tihort-0024-0003.

Montgomery, D. C. (2017). Design and analysis of experiments. John wiley & sons.

Perera, C. O. (2020). Minimal processing of fruit and vegetables. In M. S. Rahman (Ed.), *Handbook of Food Preservation* (3rd ed., pp. 191-206). CRC Press.

Qadri, O. S., Yousuf, B., & Srivastava, A. K. (2015). Fresh-cut fruits and vegetables: Critical factors influencing microbiology and novel approaches to prevent microbial risks-A review. *Cogent Food & Agriculture, 1*(1), 1121606. https://doi.org/10.1080/23311932.2015.1121606.

Rashid, M. H., Khan, M. R., Roobab, U., Rajoka, M. S. R., Inam-ur-Raheem, M., Anwar, R., Ahmed, W., Jahan, M., Ijaz, M. R. A., Asghar, M. M., Shabbir, M. A., & Aadil, R. M. (2021). Enhancing the shelf stability of fresh-cut potatoes via chemical and nonthermal treatments. *Journal of Food Processing and Preservation, 45*(6), e15582. https://doi.org/10.1111/jfpp.15582.

Silva, F. A., Finkler, L., & Finkler, C. L. L. (2018). Effect of edible coatings based on alginate/pectin on quality preservation of minimally processed "Espada" mangoes. *Journal of Food Science and Technology, 55*(12), 5055-5063. https://doi.org/10.1007/s13197-018-3444-z.

Singla, G., Chaturvedi, K., & Sandhu, P. P. (2020). Status and recent trends in fresh-cut fruits and vegetables. In P. Singh & H. K. Sharma (Eds.), *Fresh-Cut Fruits and Vegetables* (pp. 17-49). Elsevier. https://doi.org/10.1016/B978-0-12-816184-5.00002-1.

Tabassum, N., & Khan, M. A. (2020). Modified atmosphere packaging of fresh-cut papaya using alginate based edible coating: Quality evaluation and shelf life study. *Scientia Horticulturae, 259*, 108853. https://doi.org/10.1016/j.scienta.2019.108853.

Tappi, S., Velickova, E., Mannozzi, C., Tylewicz, U., Laghi, L., & Rocculi, P. (2022). Multi-analytical approach to study fresh-cut apples vacuum impregnated with different solutions. *Foods, 11*(3), 488. https://doi.org/10.3390/foods11030488.

Waghmare, R. B., & Annapure, U. S. (2013). Combined effect of chemical treatment and/or modified atmosphere packaging (MAP) on quality of fresh-cut papaya. *Postharvest Biology and Technology, 85*, 147-153. https://doi.org/10.1016/j.postharvbio.2013.05.010.

Yıldız, G. (2019). Control of enzymatic browning in potato with calcium chloride and ascorbic acid coatings. *Food and Health, 5*(2), 121-127. https://doi.org/10.3153/FH19013.

Yousuf, B., Srivastava, A. K., & Ahmad, S. (2020). Application of natural fruit extract and hydrocolloid-based coating to retain quality of fresh-cut melon. *Journal of Food Science and Technology, 57*(10), 3647-3658. https://doi.org/10.1007/s13197-020-04397-3.

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Zaheer, K., & Akhtar, M. H. (2016). Potato production, usage, and nutrition-A review. *Critical Reviews in Food Science and Nutrition, 56*(5), 711-721. https://doi.org/10.1080/10408398.2012.724479.

Zaidi, N. A. F. (2022). Effectiveness of ascorbic acid and calcium chloride on physicochemical properties of fresh-cut jackfruit bulb. *Enhanced Knowledge in Sciences and Technology, 2*(2), 121-128. https://periodical.uthm.edu.my/index.php/ekst/article/view/5592.

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