Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.1385
*Biol. Clin. Sci. Res. J., Volume, **2024**: 1385*
Original Research Article

ENHANCING THE SHELF LIFE OF BELL PEPPERS THROUGH DIFFERENT NATURAL EXTRACTS

ASLAM I[1], ANEES M[1], ANJUM S*[2], ABBAS G[3], ABBAS T*[4], MAQSOOD S[5], TALHA M[1], SARWAR, M[1], GULRAIZ CZ[1], ASHRAF MI[6], UZAIR M[7]

[1]*Department of Horticulture, University of the Punjab, Lahore, 54590, Pakistan*
[2]*Institute of Botany, University of the Punjab, Lahore, 54590, Pakistan*
[3]*Bari Research Institute Chakwal, Pakistan*
[4]*Department of Horticulture, Faculty of Agricultural Sciences & Technology, University of Layyah, Layyah, Pakistan*
[5]*Department of Environmental Sciences, Kohsar University, Murree, Pakistan*
[6]*Institute of Horticultural Sciences, University of Agriculture, Faisalabad. Pakistan*
[7]*Department of Plant Breeding and Genetics, University of the Punjab, Lahore, 54590, Pakistan*
*****Corresponding author email address: sumreen38@gmail.com*

(Received, 14th May 2024, Revised 24 August 2024, Published 28th August 2024)

Abstract *Bell pepper is a highly valued vegetable for its rich nutritional profile, containing essential vitamins. Similar to other perishable items, it starts to degrade after being harvested. For the improvement of the quality and shelf life of bell pepper vegetables, this experiment was conducted at the "Postharvest Lab. of Department of Horticulture, University of the Punjab, Lahore" study was comprised of various edible coatings of natural extracts, including aloe vera gel, neem leaf extract, garlic extract, ginger extract, and lemongrass leaf extract applied on capsicum vegetable at room temperature for 8 days, and data was recorded regularly. Various parameters such as weight loss, firmness, total soluble solids (TSS), total phenolics, ash content, pH, color, and appearance were measured. Bell pepper treated with edible aloe vera gel extract and ginger extract coatings showed significant improvements in firmness and minimum weight loss compared to untreated (control T0). The data were analyzed using a two-factor factorial ANOVA, and treatment means were compared using the LSD test at the 5% probability level.*

Keywords*:* *Bell pepper; postharvest management; shelf life; quality traits; edible coatings; natural extracts*

Introduction

Bell pepper is commonly referred to as "Shimla mirch" in Pakistan. *Capsicum annuum*, as it is known botanically, was first cultivated in Central and South America in approximately 7000 B.C. (Bosland, 2012). Nowadays, bell peppers are grown in more than 60 countries due to their global growth (FAO, 2019). Bell peppers belong to the family of flowering plants named Solanaceae, which also includes 2500 species and more than 90 genera including commercially significant vegetables like eggplant, tomato, and potato (Hunziker 2001). They are valued for their culinary uses as well as their high vitamin content (Chuah et al., 2008; Howard et al., 2000). Fresh bell pepper has a high ascorbic acid content. Vegetables retain their common color orange or red due to the presence of carotenoids and flavonoids. Bell peppers are green because of chlorophyll and carotenoids, which are typical chloroplast components and have antioxidant properties Marin et al. (2004). They are available in an extensive array of flavors, colors, forms, and sizes, and can be used in both raw and cooked versions (Bosland & Votava, 2012).

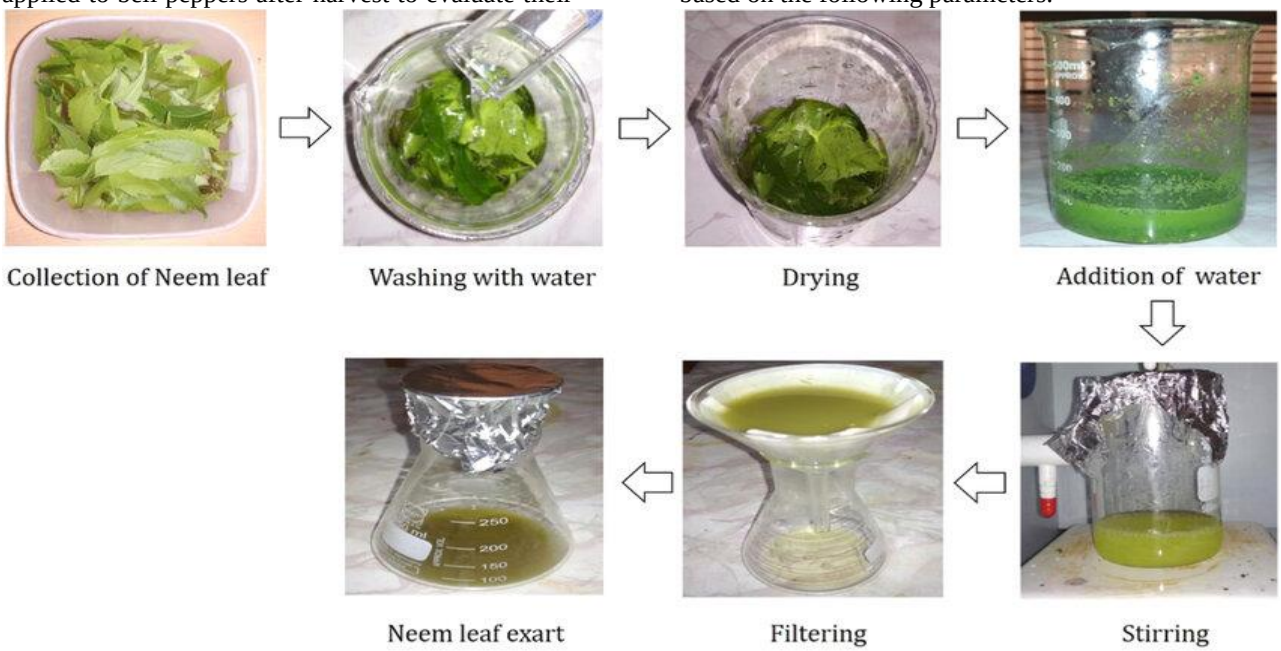
Bell peppers in Pakistan confront many postharvest problems that have a serious economic impact. Bell peppers play an essential role in Pakistani agriculture, however, their high perishability and susceptibility to quality degradation make efficient postharvest management difficult. Inefficient production techniques, insufficient fertilization, poor pest and disease control, and late harvesting are the primary causes of postharvest losses (Kader 2002). The biggest post-harvest issue with pepper vegetables is excessive softness, which can result in shrinkage, drying, and pathological problems, reducing product quality and acceptance, and resulting in large losses (Nyanjage et al., 2005). Edible coatings have been investigated as a feasible and sustainable approach for bell peppers, providing a layer while maintaining the food's nutritional value and appearance (Oyom et al., 2022). The use of natural extracts like aloe vera, ginger, garlic, neem, and lemongrass in edible coatings is

[Citation: Aslam, I., Anees, M., Anjum, S., Abbas, G., Maqsood, S., Talha, M., Gulraiz, C.Z., Ashraf, M.I., Uzair, M. (2024). Enhancing shelf life of bell peppers through different plant extracts. *Biol. Clin. Sci. Res. J.*, **2024***: 1385*. doi: https://doi.org/10.54112/bcsrj.v2024i1.1385]

proposed to enhance not only the quality but also the post-harvest life of bell peppers. However, a comprehensive and detailed work about the impact of the natural extract on bell pepper vegetables in Pakistan has not been reported yet. So, the objective of the present work was to investigate the impact of natural edible coating on the quality of bell pepper under room temperature.

Materials & Methods

The research was conducted at the Postharvest lab of the Department of Horticulture Sciences, Faculty of Agricultural Sciences, University of the Punjab, Lahore, following all relevant guidelines and regulations. This study aimed to investigate the effects of various edible coatings, including Distill water, Garlic extract, Ginger extract, Aloe vera gel, Neem leaf extract, and Lemon-grass leaf extract applied to bell peppers after harvest to evaluate their potential to extend shelf life. After sorting, grading, and washing uniform bell peppers were selected for this study. The dipping technique was used to apply the painstakingly prepared treatments. This method made it possible to apply the extract evenly and completely on every bell pepper, the vegetables were dipped into the solutions, making sure that the treatment covered every vegetable completely for reliable and efficient outcomes. The temperature is kept between 32 degrees Celsius. Throughout the experiment, the bell peppers were kept in this condition. The study was comprised with following treatments, T0= Control, T1= Distilled water, T2=lemon grass leaf extract, T3=Neem leaf extract, T4= Ginger extract, T5= Garlic extract, T6= Alovera gel, and each treatment was replicated four time to overcome the study error. The study was evaluated based on the following parameters.



Fresh weight loss (%)

Used an extremely accurate, gram-calibrated weighing scale to precisely measure the weight, which is a crucial component in assessing vegetable's quality. Maintaining the accuracy of our data required this degree of precision.

Fresh weight loss Fresh weight loss was assessed at each sampling interval, and calculated with the following formula. Fresh weight loss (%) = Initial weight - Final weight/ Initial weight × 100

Fruit firmness

For this, a portable digital penetrometer (FR-5120 PENETOMETER, Tokyo, Japan) was used to measure the bell pepper vegetable's firmness. To guarantee consistency, measurements of bell pepper firmness were made from the equatorial region's opposing sides. After testing each vegetable twice, the average of the two measurements was determined. As is customary, the mean values were given in SI units, namely newtons (Hasan et al., 2016).

Organoleptic Parameters

Fruits from each replication were sliced into pieces and given at random to a panel of three experts to assess the organoleptic parameters. Taste, flavour, scent, colour, and general acceptability were among the important sensory qualities evaluated by the panel. Using a scale from 1 to 9, the assessment was carried out following the procedure described by Peryam & Pilgrim (1957). A score of 1 on this scale meant that the quality was low and undesirable, a score of 3 meant that the quality was somewhat good but limited, a score of 5 meant that the quality was good and marketable, a score of 7 meant that the quality was the best, and a score of 9 meant that the quality was superb. The panel was given a standardized evaluation form to record their evaluations of the organoleptic features.

[Citation: Aslam, I., Anees, M., Anjum, S., Abbas, G., Maqsood, S., Talha, M., Gulraiz, C.Z., Ashraf, M.I., Uzair, M. (2024). Enhancing shelf life of bell peppers through different plant extracts. *Biol. Clin. Sci. Res. J.*, **2024***: 1385.* doi: https://doi.org/10.54112/bcsrj.v2024i1.1385]

Total soluble solids (TSS) measurement

Total soluble solids (TSS), an indicator of the quantity of dissolved solids in the vegetable's liquid component, a refractometer, a precise device made especially for measuring TSS, was used in this experiment. Bell pepper samples were taken from each treatment and replication, and the TSS content was examined. The refractive index of the extracted vegetable juice, which is directly correlated with the TSS content, was measured using a refractometer.

pH measurement

pH measurement, a critical metric that establishes the vegetable's acidity or alkalinity, provides insight into any alterations in the internal environment of the bell pepper. Using a mortar and pestle, the bell pepper samples' juice was first extracted, and then the clear liquid was obtained by filtering. After that, the pH of this juice was determined, yielding important details about the vegetable's interior makeup. Following a rigorous routine, measurements were taken on the third, fourth, fifth, tenth, and fifteenth days.

Ash contents measurement

By burning the dried bell pepper samples at a high temperature and leaving behind the mineral residue, the amount of ash was ascertained. This methodical technique made it possible to thoroughly examine the effects of ambient storage conditions on the amount of ash in bell peppers coated with environmentally friendly edible coatings.

Total phenolic contents

Total phenolic contents were estimated by the method of Ozgen et al. (2006). The extraction solution consisted of 70% methanol, 28% anhydrous ethanol, and 2% formic acid (v/v). A 0.2 g sample was ground with liquid nitrogen and placed in a centrifuge tube. Subsequently, 5 mL of the extraction solution was added, followed by 30 min of ultrasonic extraction. After shaking at 250 rpm at 30°C for 2 h, the extract was centrifuged at 8000 rpm for 10 min at 4°C. The supernatant was then filtered through a 0.45 mm needle tube filter for analysis of phenolic. All procedures were conducted in the dark.

Statistical Analysis

The experiment was carried out under the factorial experimental layout of a completely randomized design. The factors were sampling intervals and applied treatments. The data were analyzed with two-way analysis of variance and means were differentiated with the least significant difference (LSD) test. The graphs were prepared by using the data of interaction effect (treatments × storage days). The differences were considered statistically significant at a 5% probability level.

Results

Fresh weight loss (%)

Fresh weight loss of treated and non-treated bell pepper vegetables substantially ($P \leq 0.05$) increased as the storage period progressed from the 2nd to the 8th day (Figure 1). The weight loss of untreated vegetables excessively increased as the days under storage progressed especially from the 2nd day onwards. On day 8th, control showed a maximum 63.96% decrease in fresh weight, and the lowest weight reduction on the 8th day was seen in T6= Aloe vera gel extract with 56.71% fresh weight loss. Overall edible coating reduced the weight loss in bell pepper fresh weight compared with the control (Figure 2).

Vegetable Firmness

Randomly chosen bell pepper vegetables were used to gather data on their firmness, statistical analysis showed significant ($P \leq 0.05$) differences among the treatments (Table 1) T6= Aloe vera gel coated, had the maximum firmness (36.36). The distilled water treatment T1 recorded the lowest bell pepper vegetable firmness (27.78) as shown in Table 3.1 and the use of all other edible coatings improved bell pepper firmness.

Bell pepper color

Statistical analysis regarding bell pepper vegetable color showed a non-significant difference between treatments. The LSD test was used to compare the means of treatments at a 5% level of probability (Table 1). The bell peppers coated with T4= Ginger extract presented the maximum rating in terms of color (7.6259). Whereas, the control treatment gets the lowest rate in terms of color.

Bell pepper appearance

The collected data on bell pepper vegetable appearance was subjected to statistical analysis, findings showed the difference between treatments and non-coated treatments (Table 1) T4= Ginger extract showed the highest vegetable look (7.050) whereas, T0= Control presented the lowest value of appearance i.e., (4.300). All other coated treatments have a little bit of difference in terms of appearance.

Total soluble solids (TSS)

Statistical analysis on vegetable Total soluble solids (TSS) showed a significant difference, the results showed significant differences between all the studied treatments (Table 2). The LSD test was used to compare the treatment means at the 5% probability level. T6= Aloe vera gel extract exhibited a maximum vegetable TSS (4.950) followed by (1.850) in T0 control treatment.

pH of bell pepper vegetable

The findings of the statistical analysis of the data recorded on the pH of bell peppers showed a non-significant difference between all treatments (Table 2) The LSD test was used to compare the treatment means at the 5% probability level presented a similar group for all the studied treatment.

Bell pepper ash contents

The data regarding bell pepper vegetable ash contents was analyzed by statistical analysis;

[Citation: Aslam, I., Anees, M., Anjum, S., Abbas, G., Maqsood, S., Talha, M., Gulraiz, C.Z., Ashraf, M.I., Uzair, M. (2024). Enhancing shelf life of bell peppers through different plant extracts. *Biol. Clin. Sci. Res. J.*, **2024***: 1385.* doi: https://doi.org/10.54112/bcsrj.v2024i1.1385]

findings presented a significant difference ($P \leq 0.05$) between the treatments as seen in Table 2. T6= Aloe vera gel extract revealed the maximum ash contents of bell pepper vegetables (24.205) followed by T5= Garlic extract coating (22.403).

Bell pepper's total phenolic contents

The data regarding the vegetable's total phenolic contents were subjected to statistical analysis and presented a significant ($P \leq 0.05$) variation among treatments (Table 1). Data were compared by using the LSD test at the 5% probability level. T4= Garlic extract presented a maximum value of bell pepper vegetable total phenolic contents (65.410) and the lowest contents were noted in the T0 control treatment (55.303). Whereas T1, T2, T3, T5, and T6 presented 58.455, 61.195, 62.702, 63.340, and 60.240, respectively.

Discussion

The edible coatings of natural extracts have essential ingredients that alter the environment of the produce by reducing respiration activities and microbial growth of organisms which reduces the chances of browning. According to the studies, the coated samples retained the firmness of vegetables when applied with natural extracts. However, there were reduced rates of firmness in control samples, and samples also became crumpled compared to coated samples of vegetables after a few days. The results revealed that the coated samples retained the weight of capsicum vegetables. Coatings can also help to limit tissue softening (Ali et al., 2011). Previous research has shown that coatings can efficiently maintain the firmness of different fruits and vegetables (Han et al. 2014; Gao et al. 2013; Ali et al. 2011). Coatings also have beneficial effects on fruits by reducing weight loss and adjusting their atmosphere (Aloui et al. 2014). Control samples showed a significantly higher physiological loss in weight than treated samples after a few days of storage and their weight loss had risen to approximately 14.17% in control, compared to CHE, CH, ALE, and AL samples. Similarly, in our research, there was a decrease in weight loss in capsicum samples treated with different edible coatings of natural extracts as compared to the control. Additionally, capsicum has an impermeable outer surface that prevents it from water loss as compared to other fruits and vegetables (Guerra et al. 2011). Edible coatings also have such type of features that make the surface of the sample resistant to any microbial and respiratory activities thus maintaining the structure and overall appearance of the vegetables. (Báez et al., 2001) revealed such type of results that samples that were applied with wax coating had the lowest percentage of weight loss; restricting water vapor transport from pepper vegetables. Phenolics are chemical compounds that are produced by plants in response to stress. They reduce the chances of cell degradation and deterioration. (Zhang et al.) discovered that a mixture of chitosan with banana peel extract developed a structure with outstanding anti-inflammatory properties and was high in yield strength. Studies revealed that the fruits coated and treated with starlight wax emulsion and Aloe vera gel showed significant results in retaining the phenolic contents (Yamaguchi et al., 2003). This suggests that phenolic compounds act as potential additives in edible coatings, and antioxidant agents to prevent fruit and vegetable rotting. Another study's findings are consistent with prior research on other vegetables, such as carrots and green beans, where edible coatings assisted in preserving mineral content and act as a shield for air and moisture exchange, hence minimizing nutrient degradation (Maqbool et al., 2011). Studies exposed that the coatings of red chilies did not show a significant impact on pH of the vegetables. Overall, there were minimal changes in the pH of coated red chilies that were stored for 15 days as compared to uncoated red chilies. This suggests that the edible coverings could help in maintaining the pH of vegetables with the smallest fluctuations. The results are consistent with several previous articles on fruit coatings. Qamar et al., 2018 found that strawberries coated with aloe vera gel extract and stored for 12 days had the slightest change in pH. Similar results were discovered by (Vieira et al) that a mixture of chitosan and Aloe vera gel applied to blueberries retained the pH of berry fruits. Coatings protect the total soluble solids content of the vegetables when applied on their surface. However, studies show that the edible coatings retained the soluble solid contents of red chili vegetables for 15 days of storage without drastic change. The statistical data also revealed that there were no substantial changes in soluble solid content values for coated as compared to uncoated ones whereas all treatments have ranged values from 0.7 to 0.8%. However, similar findings were revealed by (Qamar et al., 2018) that the soluble solid content of both coated and uncoated strawberries dropped with time, while uncoated samples had minimum values of TSS. Another study revealed that the TSS level for the treatment in which 2% chitosan was applied as the coating was found to be higher than that of all other treated bell pepper vegetables (Hamid Salarietal., 2012). The sensory index is the most realistic indicator of how vegetable quality, such as capsicum, has evolved. This index is calculated by analyzing capsicum's commercial and culinary value for its appearance, color, taste, texture, and total appeal throughout storage. In this study, we discovered that Capsicum coated with edible coatings such as Aloe Vera gel, Neem extract, Lemon grass extract, Ginger and Garlic extract scored higher on all sensory attributes

[Citation: Aslam, I., Anees, M., Anjum, S., Abbas, G., Maqsood, S., Talha, M., Gulraiz, C.Z., Ashraf, M.I., Uzair, M. (2024). Enhancing shelf life of bell peppers through different plant extracts. *Biol. Clin. Sci. Res. J.*, **2024***: 1385.* doi: https://doi.org/10.54112/bcsrj.v2024i1.1385]

than the non-coated or control group. Similar findings have been reported for other crops such as carrots and tomatoes, where edible coverings greatly improved sensory properties after storage (Ali et al., 2010). The beneficial impact of these edible coatings on capsicum shows that they efficiently preserve sensory properties, making them more desirable.

Conclusion

The edible coating was effective in delaying the ripening/decay of bell pepper vegetables and maintaining quality for eight days under room temperature during summer. Edible coating reduced weight loss, inhibited disease occurrence and increased the phenolic contents. In conclusion, this study demonstrated that natural edible coatings, particularly ginger extract, and aloe vera gel extract, effectively increased the storage life and sustained the physical parameters of bell peppers under ambient conditions. These results highlight the use of these coatings as sustainable solutions for reducing post-harvest losses and enhancing the commercial viability of bell peppers.

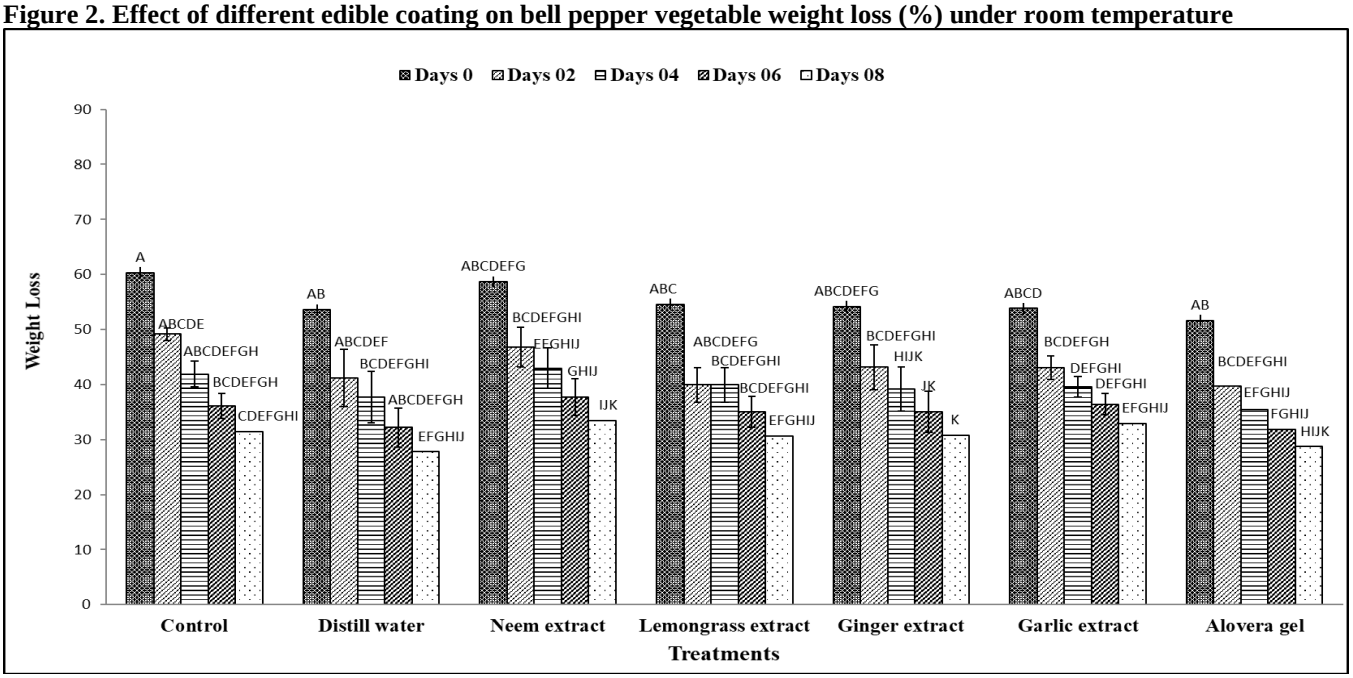
Table 1. Effect of different edible coatings on bell pepper vegetable's firmness, color, appearance, and total soluble solids under room temperature

Treatment	Firmness	Color	Appearance	TSS
T0= Control	31.512	6.1500	4.3000	1.8500
T1= Distill water	27.782	7.1750	5.0500	2.1750
T2= Lemongrass leaf extract	33.348	6.2750	6.1750	2.3750
T3= Neem leaf extract	31.360	7.2000	6.1750	3.4500
T4= Ginger extract	31.888	7.6250	7.0500	3.2500
T5= Garlic extract	32.588	7.5000	6.7250	3.0375
T6= Aloevera gel	36.365	6.7750	6.5500	4.9500

Table 3.2. Effect of different edible coatings on bell pepper vegetable's pH, ash contents, and total phenolics under room temperature

Treatment	pH	Ash contents	Total phenolics
T0= Control	4.9325	21.742	55.303
T1= Distill water	4.9700	20.210	58.455
T2= Lemongrass leaf extract	5.3650	19.088	61.195
T3= Neem leaf extract	5.2800	18.795	62.702
T4= Ginger extract	5.4125	18.658	65.410
T5= Garlic extract	5.6025	22.403	63.340
T6= Aloevera gel	5.3675	24.205	60.240

Figure 2. Effect of different edible coating on bell pepper vegetable weight loss (%) under room temperature



[Citation: Aslam, I., Anees, M., Anjum, S., Abbas, G., Maqsood, S., Talha, M., Gulraiz, C.Z., Ashraf, M.I., Uzair, M. (2024). Enhancing shelf life of bell peppers through different plant extracts. *Biol. Clin. Sci. Res. J.*, **2024***: 1385.* doi: https://doi.org/10.54112/bcsrj.v2024i1.1385]

References

Bosland, P. W., & Votava, E. J. (2012). Peppers: Vegetable and Spice Capsicums**.** CABI Publishing

FAO. (2019). FAOSTAT Statistical Database**.** Food and Agriculture Organization of the United Nations.

Hunziker AT (2001) Genera Solanacearum: the genera of Solanaceae illustrated, arranged according to a new system. Gantner, Ruggell

Chuah, A. M., Lee, Y. C., Yamaguchi, T., Takamura, H., Yin, L. J., & Matoba, T. (2008). Effect of cooking on the antioxidant properties of coloured peppers.

Howard, L. R., Talcott, S. T., Brenes, C. H., & Villalon, B. (2000). Changes in phytochemical and antioxidant activity of selected pepper cultivars (Capsicum species) as influenced by maturity**.** *Journal of Agricultural and Food Chemistry*.

Marin, A.; Ferreres, F.; Tomas-Barberan, A.; Gil, M.I. (20024). Characterization and quantification of antioxidant constituents of sweet pepper (Capsicum annuum L.). *Journal of Agriculture and Food Chemistry*, **52**, 3861–3869.

Bosland, P. W., & Votava, E. J. (2012). Peppers: Vegetable and Spice Capsicums**.** CABI Publishing

Kader, A. A. (2002). *Postharvest technology of horticultural crops* (3rd ed.). University of California, Agriculture and Natural Resources.

Nyanjage, M. O., Wainwright, H., Bishop, C. F. H., & Cullum, F. J. (2005). A comparative study of the effects of modified atmosphere packaging and storage conditions on the shelf life of mangoes. *Postharvest Biology and Technology*

W. Oyom, Y.C. Li, D. Prusky, Z. Zhang, Y. Bi, R. (2022). Tahergorabi, Recent advances in postharvest technology of Asia pears fungi disease control: a review, Physiol. Mol. Plant Pathol. **117**, 101771.

Hasan IH, El-desouky MA, Abd-elaziz GM, et al., 2016. Protective effects of zingiber officinale against carbon tetrachloride induced liver fibrosis. *Int J Pharm Pharm Sci*, **8**:377–381.

Ozgen M, Reese RN, Tulio AZ Jr, Miller AR, Scheerens JC (2008). Modified 2,2-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS) method to measure antioxidant capacity of selected small fruits and comparison to ferric reducing antioxidant power (FRAP) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) methods. *Journal of Agricultural and Food Chemistry*, **56**(11): 4921–4927.

Declaration

Acknowledgement

Not applicable

Ethics Approval and Consent to Participate

Not applicable.

Consent for Publication

The study was approved by authors.

Funding Statement

Not applicable

Authors' Contribution

All authors contributed equally.

Conflict of interest

There is no conflict of interest among the authors of the manuscript.