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Effect of rice starch based edible coating loaded with onion peel extract on post-harvest and sensory quality of green bell peppers

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Abstract

The scope of this study was to enhance the shelf life of green bell peppers via application of rice starch based edible coating incorporated with onion peel extract (OPE). The physicochemical properties of uncoated (control) and coated bell peppers were evaluated at different intervals during storage at refrigeration temperature (4 ± 0.5°C) for 15 days. The results indicated that rice starch based edible coating considerably decreased the physiological weight loss while maintaining titratable acidity, total soluble solids, and pH of stored bell peppers. The coated bell peppers also had higher total phenolic content, total flavonoid content, and antioxidant activity when compared with control. The texture analysis after 15 days revealed that the coated samples were firmer (4.77 N) than the control (2.95 N). Also, the treated bell peppers received better sensory scores in terms of freshness, color, taste, and hardness leading to higher overall acceptability (5.2) in comparison to control sample (1.0). Consequently, the findings of this study suggested that preservation of green bell peppers with OPE enriched rice starchbased coating could delay the senescence process leading to their reduced postharvest loss.

Keywords: Onion waste; aqueous coating; shelf life; fresh produce

1.INTRODUCTION

Green bell peppers (Capsicun annuum L.) generally known as capsicum which belongs to the Solanaceae family, is one of the most important crop in Pakistan. In 2022, the annual production of bell pepper in Pakistan was 144160 tonnes (FAOSTAT, 2022). It is commonly used in salad, pasta, pizza and as principle topping ingredient in many South Asian cuisines. Bell pepper is also a rich source of many nutraceutical compounds such as flavonoids, carotenoids, phenolic acid and ascorbic acid (Deepa et al., 2007; Zhuang et al., 2012). These compounds are known to have some antioxidant activities against neurological and cardiovascular diseases (de Jesús Ornelas-Paz et al., 2013).

Being perishable in nature, post-harvest loss of bell pepper is a matter of great concern in Pakistan (Manoj et al., 2016). Bell peppers cannot be stored for longer periods due to higher respiratory rate and thus required proper care to prolong the post harvest life. In order to achieve this goal, various storage techniques are carried out to keep up the quality of fresh produce. For instance, Sahoo et al. (2015) studied the effect of modified atmosphere (MA) storage and gamma irradiation on shelf-life quality of gourd. Similarly, Firouz et al. (2021) studied the MA packaging effect on lettuce along with cold storage to maintain the shelf life of lettuce. Such storage techniques are costly, hectic and hard to carry out. So, it is necessary to find out the alternate solution which is ecofriendly and less

expensive. In recent years, edible coatings are widely used to reduce the post-harvest losses of fresh produce. Edible coating enables the control of moisture loss and reduces exchange of gases (O2 and CO2), by acting as a physical barrier and thereby retains freshness of fruits and vegetables (Ju et al., 2019). Many biopolymers are used in the formulation of edible coatings but among them, starch is widely used due to its easy availability, bland taste and good film forming properties (Versino et al., 2016). Functional properties of edible coating can be further improved by impregnation of antioxidant and antimicrobial agents such as essential oils and plant extracts. Plenty of researches have now focused on the formation of active food packaging loaded with natural antioxidants derived from agricultural by products. Jridi et al. (2019) successfully developed the gelatin coating loaded with blood orange peel extract and found the enhanced physicochemical, mechanical and antioxidant properties which were significantly comparable to control ones. Improved shelf life of tomato was obtained by Kumar et al. (2021) by the fabrication of chitosan-pullulan composite loaded with pomegranate peel extract.

Onion peel, a major by product of processing, is rich in antioxidant compounds such as quercetin, ferulic acid, kaempferol and gallic acid which tend to show immense antioxidative properties (Kumar et al., 2022). The used of onion peel powder and its extract has been exploited in many food products as a resource of dietary fiber and antioxidants.

Optimization of yellow onion peel extract was carried out by Piechowiak et al. (2020), which was further incorporated in making of bread. Similarly, onion peel powder as a source of dietary fiber and antioxidants was incorporated in the making of wheat pasta and showed elevated levels of total phenolic content, antioxidant activity and extended shelf life followed by acceptable sensory traits (Michalak-Majewska et al., 2020). Furthermore, purple onion peel extract was used in the fabrication of sodium-alginate based active

which films showed physical, increased mechanical. antioxidant and antimicrobial properties (Santos et al., 2021). It is important for starches to be incorporated with preservatives as starch coating itself has short shelf life being hydrophilic. So, it would be a rational approach to add some extracts antioxidant/antimicrobial activity so as to see the impact of such starch coatings on the quality of fresh produce.

As stated earlier, pure rice starch coating does not possess significant antioxidant activity. Therefore, the focus of this research idea was to enhance the antioxidant nature of rice starch based edible coating by adding OPE extract (a good source of antioxidant compounds) and to evaluate the efficacy of this active coating in maintaining the post harvest quality and shelf life of green bell peppers.

2.MATERIALS AND METHOD

2.1. Preparation of onion peels extract (OPE)

Onion peels were first washed to remove dirt and debris and dried at 45°C in forced air oven. Dried onion peels were then crushed for preparation of extract. A 10% (w/v) aqueous extract of onion peels was prepared in conical flask. The mixture was then placed in shaking water bath at 60°C for 2 h followed by filtration. The filtrate was considered as onion peel extract (OPE).

2.2. Preparation of OPE enriched coating

OPE rich coating was prepared by following the method of Menezes & Athmaselvi (2016). Before coating, bell peppers were disinfected with chlorinated water (200 ppm) and dried for 30 min under ambient conditions (25 \pm 1 $^{\circ}$ C). Coating solution with OPE (15%) was prepared by mixing 4.5 g of starch as biopolymer, 144.15 g of distilled water and 22.5 g of onion peel extract (OPE). The prepared coating solution was kept in water bath at 90oC for 30 min with vigorous shaking for starch

gelatinization. After 30 min, the coating solution was removed from water bath and allowed to cool until the temperature dropped to 60oC. When the temperature reached 60oC the calculated amount of glycerol (1.35 g) was added and shaken for 20 min at 60oC in water bath.

2.3. Bell pepper coating and storage

Bell peppers were divided into two slots (control and coated) with 60 bell peppers in each slot. One slot was dipped into coating solution for 2 min and dried for 12 h. The other slot (control) was dipped in deionized water. Both slots (control and coated) were stored at refrigeration condition (4 ± 0.5 °C, RH: 90-95%) for 15 days. The bell pepper's physiochemical and sensorial study were carried out on 0, 3, 6, 9, 12 and 15 days of storage.

2.4. Preparation of bell pepper extract for analysis

The bell pepper extract (BPE) was prepared by using methodology of Nair et al. (2018b), in which 10 g of control and coated bell peppers were homogenized with 50 mL of distilled water. The obtained slurry was then filtered through muslin cloth to remove insolubles and finally centrifuged at 4520 xg. Supernatant was then used as an extract of bell pepper for chemical analysis such as percent titratable acidity, flavanoid content, phenolic content, and antioxidant activity

2.5. Determination of weight loss of bell peppers

Weight loss of coated and uncoated bell peppers was determined using analytical balance (Model, Sartorius CP324S). Cumulative weight losses were determined as % weight loss and calculated by the following formula:

% Weight loss =
$$\frac{Wi-Wf}{Wi}x100$$

Where, Wi is the weight of the bell pepper at O day. Wf is the weight of the bell pepper at different storage days (0, 3, 6, 9, 12 and 15).

2.6. Determination of titratable acidity (%), pH and total soluble solids expressed as °Brix (TSS) of bell peppers

Titratable acidity of bell peppers (coated and uncoated) was analyzed as per AOAC (1990). 25 mL of bell pepper extract (BPE) of each sample was titrated against standardized O.1 N NaOH solution using phenolphthalein as an indicator. The titratable acidity was calculated as % citric acid using the following formula

$$\%TA = \frac{\textit{Eq.wt.of acid*N of NaOH*100}}{\textit{Vol.of sample taken*1000}}$$

The pH of bell peppers extracts was measured using digital pH meter. Before taking readings, pH meter was calibrated against standard buffer solutions of 4.0, 7.0 and 10.0 pH. The 'Brix of coated and uncoated bell peppers was measured by AOAC (2000) method which involved maceration of green bell peppers with distilled water followed by measurement of brix using refractometer. Before taking readings, lens of refractometer was properly cleaned and calibrated against distilled water.

2.7. Determination of firmness of bell peppers

The firmness of the treated and untreated bell pepper was determined as per the method described by Nair et al. (2018a) by Universal Testing Machine (Zwick/Roell, GmbH, Germany) with a load cell of 1 kN at five different equatorial position of the bell pepper and the result was expressed in terms of force (N). The one-cycle penetration test was conducted using a pointed probe of 2 mm diameter. The Fmax was considered the measure of firmness of bell-peppers.

2.8. Determination of total phenolic content (TPC) in bell peppers

Total phenolic content was measured by Folin-Ciocaltaeu (FC) spectrophotometric method as per description of Deepa et al. (2007).

2.9. Determination of total flavonoid content (TFC) in bell peppers

Total flavonoid content of bell pepper extract was measured as per protocol described by Özkok et al. (2010).

2.10. Determination of free radical scavenging activity in bell peppers

Free radical scavenging activity was measured by using protocol described by Marinova et al. (2011).

2.11. Statistical analysis

Each test was performed using at least three replicates. One-way ANOVA (Analysis of variance) and Duncan's test at $p \le 0.05$ were used to calculate means using SPSS software (Version 17, SPSS Inc., USA).

3.RESULTS AND DISCUSSION

3.1. Effect of rice starch edible coating on weight loss

It is a well-known fact that the consumer expects a certain level of quality, safety, and convenience for any product. Same is the case with fruits and vegetables (Ramady et al., 2015). Weight loss in fruit and vegetable due to physiological processes is a direct result of water loss through the epidermis during respiration. The pressure gradient that tissues experience affects the rate of dehydration. This rate plays a considerable role in determining how long fruits and vegetables can be stored after

being harvested (Brasil & Siddiqui, 2018). The rationale of this study was to assess the effect of edible coating containing onion peel extract (at 4 °C) on the physiological weight loss of bell peppers for a span of 15 days. A control experiment under same conditions was also set simultaneously to observe the percentage weight loss for uncoated bell peppers. According to (Fig. 1), edible coating had a significant effect (P<0.05) on reducing physiological weight loss of the bell pepper in comparison to the control set up during the storage period. The highest weight loss percentage amongst the edible coated bell peppers kept at 4 $^{\circ}$ C was recorded at the end of 15th day (34.4 \pm 0.02%). However, this was less than the physiological weight loss observed in the uncoated bell peppers which demonstrated the highest weight loss of (39.89 ± 0.06%). The weight loss of a commodity during storage is mainly attributed to water molecules escaped through the surface (transpiration). The edible coating developed in this study formed a physical barrier between the produce surface and the external environment leading to a longer pathway for water molecules to diffuse out in the environment which resulted in reduced weight loss values. Our research findings confirm to previous research studies carried out by Nath et al. (2018) and Santos et al. (2021) stating that onion peel extract has the potential to retard weight loss by reducing rate of evaporation and respiration as well as control enzymatic PPO (Polyphenol oxidase/Peroxidase) activity

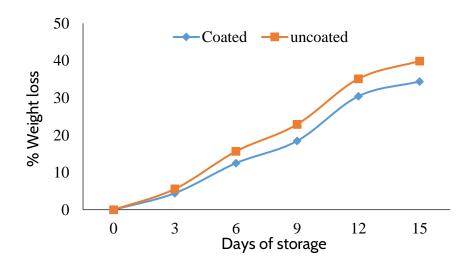


Figure 1: Effect of rice starch edible coating enriched with onion peel extract on weight loss (%) of bell pepper during storage at 4 °C.

3.2. Effect of rice starch edible coating on total soluble solids ("Brix)

The amount of total soluble solids (TSS) in vegetables and fruits affects how well they are percieved by consumers (Rao et al., 2011). Due to enzymatic hydrolysis complex of polysaccharides to monosaccharides, the conversion of pectic compounds, and the elevation in juice concentration, the TSS content of the fruit gradually changes (increases) as the time goes on (Moreno-Reséndez et al., 2016; Villaseñor-Aguilar et al., 2020). In the current study (Fig. 2), both coated and uncoated bell peppers that had been maintained at 4 °C for 15 days showed an increasing trend of TSS. The soluble solids increment is the outcome of metabolic processes mentioned above. The coated bell pepper maintained under cold storage condition showed the least rise in TSS at day 9 (3.46 ± 0.03 °Brix), while the control exhibited significant percent rise in TSS from 0 (0%) to 15th (12.01%) day over storage period. The findings showed that compared to coated bell pepper, the degree of TSS increase was greater in the control bell pepper owing to higher rates of enzymatic reactions and mass transfer processes in the absence of any coating barrier. The TSS of the coated bell peppers was contrasted to the control setup during storage settings for 15 days. The coated bell peppers showed lower TSS because of reduction in metabolic functions, dehydration, enzymatic hydrolysis, and conversion of carbohydrates in water & carbon dioxide (Tiwari et al., 2022). The slow rate of metabolic activity and respiratory action caused a decrease in TSS because the rate at which other carbohydrates are converted to sugars is reduced. Similar results about bell peppers have been documented by the numerous researchers (Jiang et al., 2021; Shikoli et al., 2022).

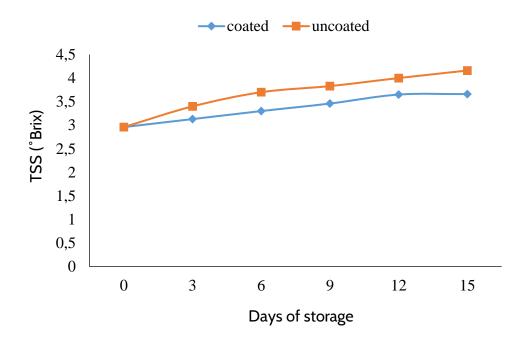


Figure 2: Effect of rice starch edible coating enriched with onion peel extract on Total soluble solids (°Brix) of bell pepper during storage at 4 °C

3.3. Effect of rice starch edible coating on titratable acidity and pH

With the advancement of storage time, the titratable acidity of observed bell peppers demonstrated an increase in acidity and a decrease in pH for both the control and coated samples (Fig. 3 and Fig. 4). The study demonstrated the ability of the edible covering enriched with OPE to reduce acidity level in peppers. In this study, the pH of bell pepper declined as titratable acidity increased during storage at 4°C temperature as a result of a delay in respiratory mechanism and enzymatic activity (Kumar et al., 2021).

Throughout the 15-day storage period, the titratable acidity of the bell peppers under observation at 4 $^{\circ}$ C temperature gradually increased. The control sample kept under same conditions showed the highest rise in titratable acidity (0.21 \pm 0.01% to 0.88 \pm 0.05%), whereas coated sample showed increase from 0.23 \pm 0.01% to 0.73 \pm 0.02% after 15 days' storage.

According to the findings, the edible coating treatment considerably prevented the pH of bell pepper from dropping when compared to the control. With the lengthening of the storage period, the pH of all bell peppers gradually decreased. The pH was measured at day 0 as (6.1 ± 0.05) in coated

samples and (6.06 ± 0.05) in control samples. The control bell pepper showed higher pH reduction after 15 days of storage $(6.06 \pm 0.05 \text{ to } 4.5 \pm 0.1)$ compared to coated bell peppers $(6.1\pm0.05 \text{ to } 5.16 \pm 0.05)$, respectively).

In comparison to control samples, the edible coating with onion peel extract demonstrated better titratable acidity and pH maintenance at refrigeration temperature. This is likely because of the buffering property showed by the antioxidant and organic acid constituents in the coating. The rise in pH could be rearded to the buildup of dry matter and depolymerization content polysaccharides during cold storage of bell peppers (Rico et al., 2010). Meanwhile, the uncoated bell pepper showed increased level of membrane leakage as compared to the coated sample upon storage. It could be assumed that the coating polysaccharides developed a barrier shield around the cell membranes that prevented the leakage of bell pepper membrane (Ullah et al., 2017). Khaliq et al. (2016) and Xing et al. (2011) also reported the reduced leakage of membrane during cold storage of coated mango and sweet pepper fruits, respectively. Low temperature storage cause the alteration in fatty acid composition of produce which subsequently prompted the leakage of fresh produce membrane (Antunes & Sfakiotakis, 2008)

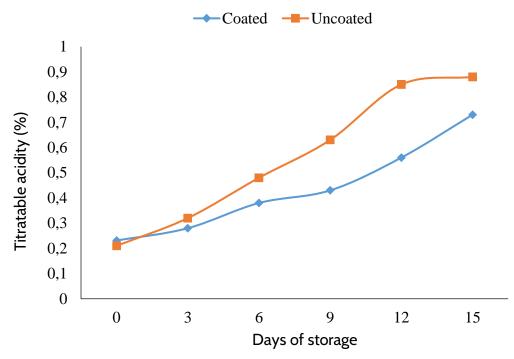


Figure 3: Effect of rice starch edible coating enriched with onion peel extract on titratable acidity (%) of bell pepper during storage at 4 °C.

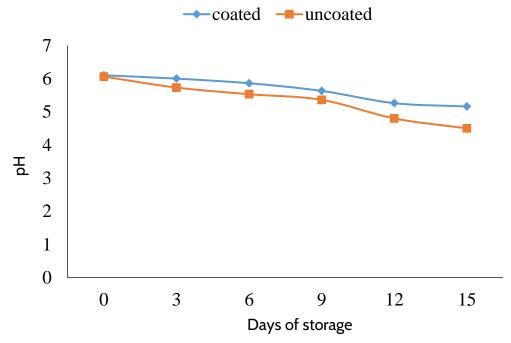


Figure 4: Effect of rice starch edible coating enriched with onion peel extract on pH of bell pepper during storage at 4 °C.

3.4. Effect of rice starch edible coating on firmness

Lipid oxidative stress, water transpiration, and pectin hydrolysis are important processes which affect the firmness of vegetables and fruits during storage. The firmness values of bell pepper (Fig. 5) throughout storage revealed that the rice starch coating enriched with OPE significantly delayed the decline in firmness when compared to control samples of bell pepper. The reduction in firmness of untreated control samples was comparatively greater after 15 days of storage (8.14 \pm 0.5N to 2.95 \pm 0.05N) than its treated counterparts. This could be explained by a higher transpiration rate in the fruit tissues, which led to a loss of turgor pressure in cells and, as a result, tissue stiffness decreases. When coated samples were compared with control samples, treated samples retained more firmness. On 3rd day, the firmness of coated bell pepper was recorded as 6.04 \pm 0.4 N, however, the uncoated bell pepper showed lower firmness value (5.57 \pm 0.3 N) at same day of storage. Similarly, the firmness of coated bell pepper was higher (4.77 \pm 0.1 N) at 15th day as compared to the uncoated sample (2.95 \pm 0.05 N).

The findings of this investigation demonstrated that an edible coating coated with onion peel

extract considerably (p \leq 0.05) reduces the extent of reduction in firmness of bell peppers due to better barrier qualities against gases and water loss via transpiration, hence retaining cell turgor, firmness, and texture. Previously, it was reported that edible coating with onion peel extract maintained the firmness of bell peppers. Similar results are reported in previous studies of Sathiyaseelan et al. (2021) and Stoica et al. (2022), in which application of edible coating maintained the firmness of bell peppers due to barrier property against water and gas transmission. Also, reduction in respiration rates reduces enzymatic activities responsible for decline in firmness of the fresh produce.

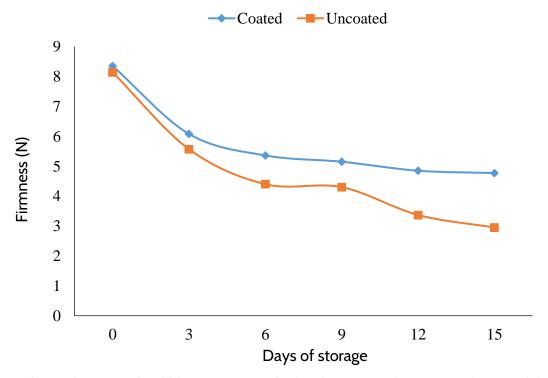


Figure 5: Effect of rice starch edible coating enriched with onion peel extract on firmness (N) of bell pepper during storage at 4 °C.

3.5. Effect of rice starch edible coating on total phenolic content (TPC)

Plant materials' phenolic compounds exhibit biological activity, such as anti-inflammatory and antibacterial activity, and have the capability to neutralize free radicals and mitigate the possibility of disease. The rice-starch based

edible coating with onion peel extract has a beneficial effect on the phenolic activity of bell pepper at 4 °C for 15 days. The incorporation of onion peel extract into the edible coating aids in the retention of the phenolic content of the produce (Oladzadabbasabadi et al., 2022).

The Fig. 6 depicts the phenolic content levels after 0, 3, 6, 9, 12, and 15 days of storage. The rising phenolic activity of the extract-treated samples can be attributed to the onion peel extract present in coating which contains high concentration of natural phenolic antioxidants. The TPC for both the control and coated bell peppers decreased with storage in the ongoing investigation. Due to the greater PPO and POD enzymatic activity, the control sample showed a quick decline in phenolic activity when compared to the treated samples. During the storage time from 0 to 15 days, the highest degradation of TPC

was observed in control (229.12 ±0.56 to 124.98 ± 0.4 mg/g), followed by coated (226.72 ±0.7 to 171.23 ±0.51 mg/g) bell pepper. Similar findings are reported in earlier investigations of Kerdchoechuen et al. (2011), Kumar et al. (2021) and Shabir et al. (2022) on edible coating of different fruits and vegetables. These researches reported that applying edible coating to bell peppers can reduce the loss of phenolic chemicals during storage, most likely by decreasing lipid oxidation, postponing ethylene generation, and controlling enzyme activity.

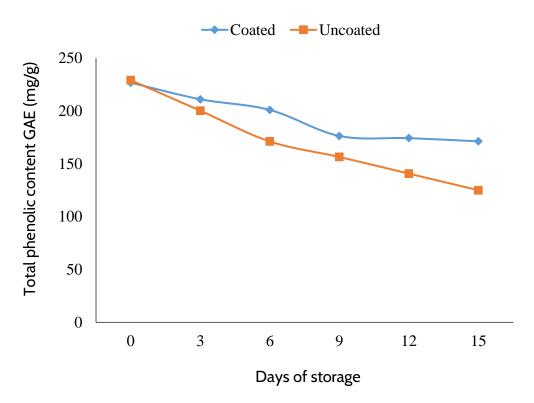


Figure 6: Effect of rice starch edible coating enriched with onion peel extract on total phenolic content GAE (mg/g) of bell pepper during storage at 4 °C.

3.6. Effect of rice starch edible coating on total flavonoid content (TFC)

Flavonoids are the principal compounds found in vegetables and fruits that can be used as a colorant owing to the presence of carotenoids and chlorophyll (Sharma et al., 2021). It could be seen from Fig. 7 that both coated and uncoated bell peppers showed a decline in flavonoid content with storage. However, the depletion of

flavonoid content in bell peppers coated with rice starch occurred very slowly than in the control sample. The quick reduction of flavonoid concentration in control bell pepper from 339.31 ± 2.98 mg/g to 208.69 ± 1.8 mg/g was likely due to the greater respiratory rate and eventually quicker breakdown of flavonoid compounds (Genzel et al., 2021). But, the flavonoid concentration in treated samples decreased from 335.98 ± 2.09

mg/g to only 264.59 ± 5.08 mg/g which was much less compared to control samples. This outcome suggested that the rice starch coating played a crucial role in retaining flavonoid compounds in bell peppers due to formation of a physical barrier resulting in restricted exposure to environmental oxygen that ultimately delayed the breakdown of these compounds. Consequently, it is postulated that higher TFC in coated bell

peppers would contribute to their enhanced antioxidant activity and nutritional quality. The acquired results are consistent with the findings of prior investigations of (Kumar et al., 2021), in which he claimed the less decrease of flavonoid content in coated mango as compared to the control one. Similar results were also derived for fresh cut red bell peppers when coated and stored up to 18 days (Sathiyaseelan et al., 2021).

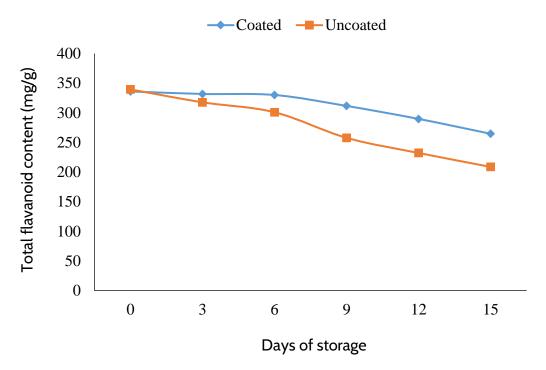


Figure 7: Effect of rice starch edible coating enriched with onion peel extract on total flavonoid content (mg/g) of bell pepper during storage at 4 $^{\circ}$ C.

3.7. Effect of rice starch edible coating on antioxidant activity (%DPPH)

The findings of scavenging free radicals (antioxidant activity) of control and treated bell peppers during 15 days of storage at refrigeration temperature (4 °C) are shown in Fig.8. The plant material's flavonoid and phenolic components have the potential to provide antioxidant properties against oxidative stress through radical neutralization (Akbari et al., 2022). Antioxidant compounds in food components inhibit, regulate, and delay numerous oxidation events caused by free radicals, minimizing the risk of dietary and functional property loss (Dhalaria et al., 2020). Concerning the influence of the edible coating on

antioxidant activity of bell peppers, decreasing trends were identified during a storage period of 0–15 days. However, the antioxidant activity was reduced the least (p \leq 0.05) in coated bell pepper samples (84.56% to 61.54%) throughout the storage period. On the other hand, a drastic drop from 83.78% to 42.45% in % DPPH was observed in uncoated bell peppers from 0 to 15 days of storage, respectively. These findings showed that an edible coating of rice starch and onion peel extract could aid to minimize bell pepper deterioration during storage by maintaining phenolic and free radical scavenging properties. As stated earlier, phenolic compounds including flavonoids are greatly responsible for the

antioxidant behavior of bell peppers but at the same time these compounds are prone to oxidative and enzymatic breakdown which may lead to gradual reduction in their antioxidant activity. As illustrated in Figures 6 and 7, bell peppers dipped in coating made of rice starch and onion peel extract retained higher phenolic and flavonoid contents due to formation of a physical barrier against external environment that

ultimately slowed down their breakdown. Consequently, these compounds remained in their natural form and contributed to higher antioxidant activity of the coated bell peppers in comparison to the uncoated sample. The findings were in reasonable accord with the prior finding by Jafarzadeh et al. (2021), Tayyar et al. (2020) and Barmanray & Bharti, (2019)

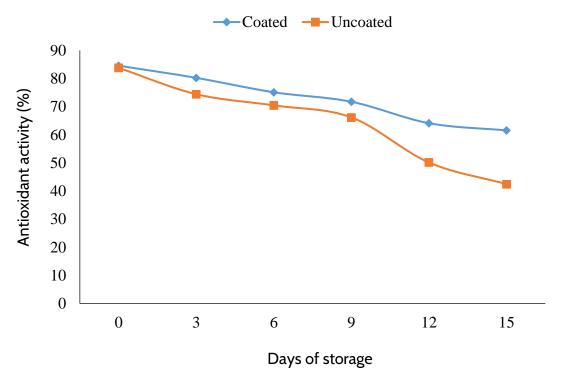


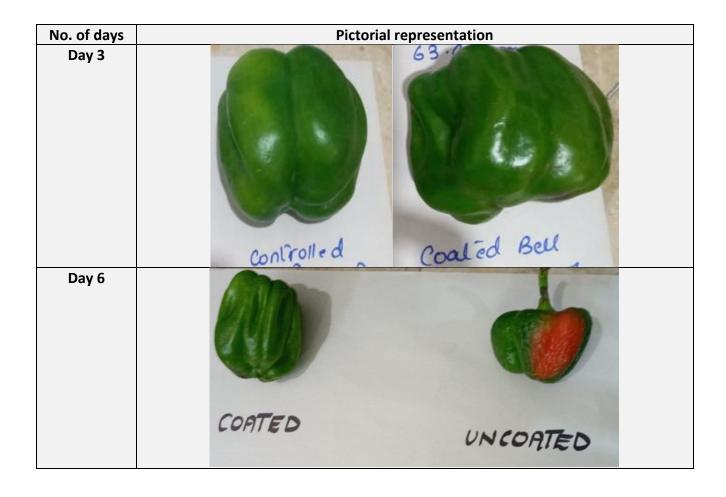
Figure 8: Effect of rice starch edible coating enriched with onion peel extract on antioxidant activity (%) of bell pepper during storage at 4 °C.

3.8. Effect of rice starch edible coating on sensory characteristics

Sensory evaluation of the bell pepper samples was conducted at specific intervals throughout the storage period. The visual state of the bell peppers during 15-days storage is depicted in Fig. 9. The Table 1 displays the findings of the sensory analysis of untreated and treated preserved bell peppers. The sensory parameters (color, freshness, taste, and texture) of bell peppers diminished as the storage period increased. When comparing coated bell peppers to uncoated (control) bell peppers, it was observed that the rice-starch edible covering

combined with onion peel extract successfully retained higher sensory scores for overall acceptability and associated sensory evaluation metrics. The sensory evaluation scores of untreated (control) bell peppers on the 12th day of storage were 3.8 ±1.3 for freshness, 2.4 ±1.1 for color, 1.4± 0.54 for texture, and 2.0 ±1.4 for overall acceptability. The taste parameter on the 9th, 12th, and 15th days was recorded as not available (NA) due to the complete spoilage of the bell peppers (Fig 9). In contrast, the edible coating treated bell

peppers scored 6.8± 0.44 for freshness, 6.8 ± 0.83 for color, 6.2 \pm 0.8 for texture, 4.0 \pm 0.7 for taste and 6.6 ± 0.89 for overall acceptability on the 12th day, respectively. It was discovered that edible coating treated bell peppers received higher sensory scores on the 12th and 15th days' of storage in comparison to untreated (control) bell peppers for each sensory characteristic under evaluation. The quality assessment scores in untreated (control) bell peppers seem to have dropped further for the day 15th, obtaining 1.4± 0.54 for freshness, 1.0±0.76 for color, 1.2±0.44 for texture, inapplicable for taste due to complete deterioration of bell pepper, and 1.0±0.05 for overall acceptability. In contrast, the edible coating treated bell peppers scored 4.6 ±0.54 for freshness, 5.8± 1.09 for color, 5.4 ±0.89 for texture, 3.2 ± 0.83 for taste, and 5.2 ± 0.83 for the overall acceptability on the 15th day, respectively. The higher sensory ratings of coated bell peppers throughout the storage period could be related to the protective contribution of the rice starch based edible coating which acted as a barrier against moisture migration from the surface of bell peppers there by maintaining their firmness and juiciness. Additionally, the coating slowed down the phenol oxidation and metabolic reaction rates that bring physiological changes in the fresh produce such as senescence and ultimately contributed to desirable sensory scores (Maringgal et al., 2020; Thakur et al., 2018; Versino et al., 2016). The findings of this study were found to be consistent with those of earlier research done by Fan et al. (2021) and Kumar et al. (2021) in which they claimed that the use of edible coating enriched with pomegranate peel extract preserved the sensory qualities of bell peppers for a longer time frame and increased their shelf life while being stored. Numerous researches have also noted that adding natural antioxidants to edible coatings, like onion peel extract may affect the sensory discriminatory practices of the produce (Jiang et al., 2021; Nxumalo et al., 2021).



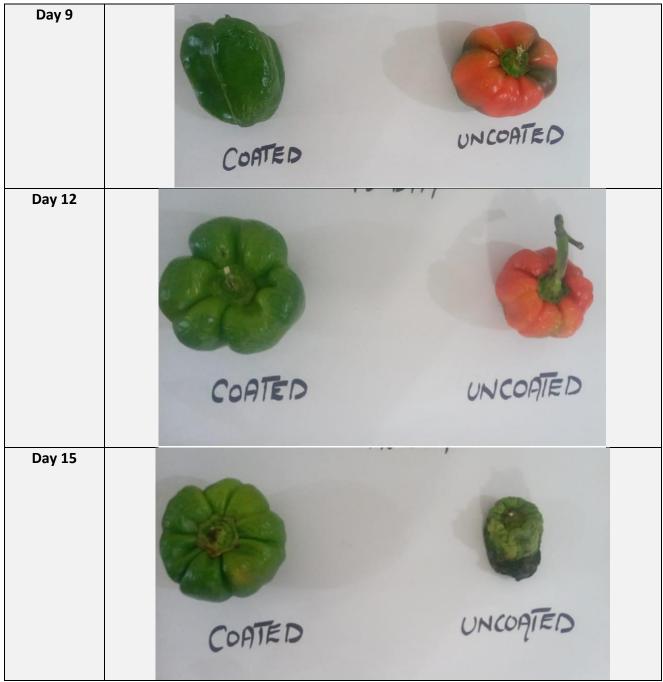


Figure 9: Effect of rice starch edible coating enriched with onion peel extract on visual appearance of bell pepper during storage at 4 °C.

4. CONCLUSION

The study investigated the effect of a rice starch-based edible coating loaded with onion peel extract on the post-harvest sensorial quality of green bell peppers during storage. The coating successfully maintained the physiochemical and sensory quality of green bell peppers over a 15-day storage period compared to control samples stored at 4 °C.

The results showed that the use of the edible coating significantly improved the overall quality and shelf-life of the green bell peppers. The coating prevented moisture and weight loss, reduced the respiration rate, and slowed the depletion of total soluble solids, all of which contribute to spoilage and quality deterioration. The edible coating also exhibited higher antioxidant activity, which helped to slow down the process of oxidation and

maintained the freshness of the green bell peppers while retaining the phenolic and flavonoid content of the bell peppers. In terms of sensory analysis, the green bell peppers coated with the rice starchbased edible coating had a higher overall acceptability score compared to the control group, indicating that the coating had a positive impact on the appearance, texture, and flavor of the produce. The study highlights the potential of using natural ingredients such as onion peel extract in edible coatings to enhance the quality and shelf-life of fresh produce, providing a promising commercial solution for reducing food waste and ensuring food security for perishable horticulture produce during storage. Overall, the study concluded that the use of a rice starch-based edible coating loaded with onion peel extract can effectively improve the post-harvest sensorial quality and shelf-life of green bell peppers.

Ethical Approval

None.

Declaration of Interests

The authors of this study declared no conflict of interests.

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Author Contribution

Concept: TS, MS Design: MS

Data collecting: TS, TMA Statistical analysis: TS, TMA

Literature review: TS Writing: TS, TMA, MS Critical review: MS

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