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Effects of pre-storage pectin, cellulose acetate, and sodium alginate coatings on the preservation of papaya (*Carica papaya* L.)

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ABSTRACT

Purpose: The current study examined the impacts of postharvest treatments with different coating solutions to enhance the shelf life of papaya at the least nutrient loss. **Research method:** The study was carried out with mature and fresh shahi papayas (BARI Papaya-1) using Complete Randomized Design. The experiment comprised four treatments namely control (T_1), coating with 2% pectin solution (T_2), 2% cellulose acetate solution (T_3), and 2% sodium alginate solution (T_4). **Findings:** Significant variations among the treatments regarding physicochemical characteristics like color, weight loss (%), moisture content (%), pH, titratable acidity, total soluble solids (°Brix), vitamin C content, and biological parameters like total viable count (TVC), and shelf life were observed for the 12 day storage periods. It was observed that vitamin C content, moisture content, and titratable acidity gave higher values in the treated samples (T_2, T_3, T_4) with the lowest color score, weight loss, total soluble solids, and pH. Among the samples, the papaya treated with 2% sodium alginate solution obtained the longest shelf life with the lowest TVC value. Conversely, the control papaya had the highest microbial load with the shortest shelf life. **Research limitations:** There was no limitation. **Originality/Value:** Among the treatments, 2% sodium alginate solution increased the shelf life of papaya by 16% and decreased post-harvest loss. Therefore, 2% sodium alginate solution treatment seems to be a good substitute for preservation and an effective way to retain the quality of papaya.

INTRODUCTION

The most significant species of Caricaceae is the papaya (*Carica papaya* L.), which is widely produced for use as fresh fruit, as well as for beverages, jams, and candies, and the leaves and flowers may also be used as cooked vegetables (Tamma et al., 2018). It is known as the common man's fruit due to its reasonable price (Dev et al., 2019). It is also a good source of calcium, phosphorus, iron, fair quantities of vitamin C, riboflavin, and niacin (Chukwuka et al., 2013). Papaya is rich in papain and chymopapain, which are often used to soften meat, clarify beer, and treat dyspepsia (Brishti et al., 2013; Chukwuka et al., 2013). Papaya pastes can also be applied topically to heal burns and skin wounds.

Approximately 5.83% of the papaya grown in Bangladesh spoils because of the country's prevailing high temperature and humidity (Bhuyan & Raju, 2018). Once it is fully ripe, the edible and marketing quality deteriorates rapidly. Papaya fruits are prone to numerous fungal infections, which significantly reduces the quality of fruit (Kahawattage et al., 2023). Post-harvest losses can be reduced by increasing the shelf life of papaya. It may be done with packaging material, physical and chemical measures by using modified atmosphere packaging, ethylene scavenging compounds, etc (Josalia et al., 2013).

The use of edible coatings is an emerging technique for extending the shelf life of fruits and is increasingly gaining popularity. These coatings act as barriers to microbial contamination, thereby mitigating detrimental effects on minimally processed fruits (Soliva-Fortuny & Martiin-Belloso, 2003; Correa-Betanzo et al., 2011; Moreira et al., 2011). Thin layers of biopolymers are applied swiftly on the surface of fruits to reduce water loss and the rate of respiration (Hamzah et al., 2013). Several biopolymers have been used as edible coatings, such as alginate, starch, methylcellulose, carboxymethyl cellulose, soy protein, pectin gelatin, and chitosan (Rojas-Grau et al., 2009; Moradinezhad & Firdous, 2025). Since pectin is hydrophilic and forms strong gels when it reacts with multivalent metal cations like calcium, it is a popular ingredient for edible coatings. However, it has a low water vapor barrier and good oxygen and carbon dioxide barrier qualities (Ferrari & Sarantoulos, 2013). Acevedo et al. (2012) stated that due of sodium alginate's special colloidal properties—which include thickening, suspension forming, gel-forming, and emulsion—it is a hydrophilic biopolymer with a coating function. In addition to being cheap, non-toxic, and biodegradable, cellulose acetate can also be used to stop microbial growth and physiological weight loss in agricultural produce after harvesting. Therefore, this study was designed to i) treat papaya fruits with 2% pectin, 2% cellulose acetate, and 2% sodium alginate solution, ii) compare the effect of these coating formulations in the physicochemical parameters of papaya, and iii) enhance the shelf life of papaya.

MATERIALS AND METHODS

The experiment was conducted in the laboratory of the Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh-2202. The pectin, cellulose acetate, sodium alginate, and other chemicals and solvents used in the study were of analytical grade and supplied by the Department of Food Technology and Rural Industries. The water used in sampling was collected from the Central Laboratory (BAU, Mymensingh).

Preparation of plant samples

Papaya fruits (BARI Papaya-1) were purchased from Boiragram, located in the Mymensingh division of Bangladesh, approximately at the geographic coordinates of 24.7470° N latitude and 90.4120° E longitude having a suitable climate for harvesting papaya. In this investigation, papaya fruits were harvested between late spring to early summer at maturity stage 1, defined as a yellow stripe near fruit apex (70%–80% of yellow surface), pulp almost completely orange except near peduncle and still hard (Albertini et al., 2016). The number of papaya fruits was fifty. All fruits were similar in size and without any apparent physical damage.

Experimental design

The trial was set up in a Complete Randomized Design (CRD) with a combination of two factors and three replications. The two factors were 0, 3, 6, 9, and 12 days of storage periods and coating treatments (T_1: Control; T_2: 2% pectin coating; T_3: 2% cellulose acetate coating; T_4: 2% sodium alginate coating).

Coating treatments of Papaya

The experiment was done using the concentration of 2% pectin, 2% cellulose acetate, and 2% sodium alginate solution in three replications. Coating solutions were prepared by dissolving 40g powder separately in 2 liters of hot water and then heating up to 70º C for 2 hours and cooling to 25ºC (Poverenov et al., 2014). Then the Selected papayas were immersed in pectin and cellulose acetate solutions for 2 minutes separately. For 2% sodium alginate coating, papayas were submerged in the alginate solution for two minutes and then submerged in 5% $CaCl_2$ solution to form the gel of alginate molecules (Sigma-Aldrich Co., Steinhein, Germany) and induce cross-linking reaction. The samples were then allowed to air dry for half an hour at room temperature (Valentina & Giovanna, 2016). For control fruits, the samples were washed in water followed by drying for 30 minutes at room temperature.

Storage Conditions

After coating treatments, fruits were dried in the air and further stored at ambient temperature on trays placed on the lab floor. Using a digital monitor, the storage room's temperature and relative humidity were monitored every day of the study period. The minimum and maximum temperatures and relative humidity of the storage room during the study were 26.8 °C, 31.6 °C, 58%, and 86%, respectively.

Physicochemical Quality

Color, weight loss, moisture content, dry matter content, pH, titratable acidity, total soluble solids, vitamin C, total viable count, and shelf life of control and treated papaya were analyzed and observed.

Color

Color of the fresh and treated papayas during the study was determined objectively using a numerical rating scale of 1-7, where 1 = green, 2 = mild green, 3 = one-quarter-yellow (< 25%), 4 = two-quarter fruit skin yellow (<50%), 5 = three-quarter yellow (<75%), 6 = fully yellow (75-100%), and 7 = blackened/rotten (fully yellow & black) (Hassan & Gilani, 2006).

Weight loss (%)

Weight loss was determined according to Sharmin et al. (2016). The papayas were weighed using an electric balance, and the data was recorded at every 3-day intervals. The Weight loss of papaya was estimated using the formula (1):

$$\% \text{ Weight loss (WL)} = \frac{\text{IW}-\text{FW}}{\text{IW}} \times 100 \qquad (1)$$

Where, WL = Weight loss (%), IW = Initial weight of papaya (g), FW = Final weight of papaya (g)

Moisture content

AOAC (2009) technique was utilized to determine the moisture content. At first, the weight of 3 empty dry crucibles was taken and 5g of each papaya sample was taken in each dried crucible. The crucibles with the samples were dried in an air oven at 105°C for 24 hrs or more to get constant weight. The crucibles were cooled in desiccators and weighed soon after reaching room temperature. The losses in weight were taken as the moisture loss of the samples and the percent of moisture in the samples was calculated (2) as:

$$\%\text{Moisture} = \frac{\text{Loss in weight}}{\text{Weight of samples}} \times 100 \qquad (2)$$

pH, titratable acidity, and TSS

pH was determined by a PerkinElmer Merion-V pH meter where pure juice was extracted from papaya then put the electrode in juice and the values were recorded in triplicate (Sultana et al., 2020). TSS of papaya was measured according to AOAC (2005) by dropping juice into the prism of a hand refractometer (MASTER-M, Model No 2313and finally, the reading was recorded as ˚Brix. Titratable acidity was also determined using the AOAC (2005) method. 5 g of papaya and distilled water were blended and homogenized. The volume was adjusted to 100 ml and the solution was filtered. Phenolphthalein was used as an indicator and 10 ml of aliquot was titrated against 0.1 N of NaOH. The titratable acidity was calculated from the following formula (3):

$$\%\text{ Titratable acidity} = \frac{T \times V1 \times N \times E}{V2 \times W \times 1000} \times 10 \qquad (3)$$

Where, T = Titre value; N = Normality of NaOH; V_1 =Volume of the sample; E = Equivalent weight of acid; V_2 = Volume of the sample; W = Weight of sample.

Vitamin C content

Vitamin C content was measured by titration using a 2,6-dichlorophenol indophenol indicator, as described by Ranganna (2004). 5 g of papaya was blended and homogenized with distilled water, and then the volume was increased to 100 ml and filtered. A 10 ml aliquot was pipetted into the beaker and 50 ml of oxalic acid was added. The solution was then titrated with 2,6-dichlorophenol indophenol until the equivalence point. The ascorbic acid content was estimated by the following formula (4) and expressed as mg/100 g fresh weight.

$$\text{Ascorbic acid content (mg/100 ml)} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{volume made up}}{\text{Aliquit taken} \times \text{Weight of sample}} \times 100 \qquad (4)$$

Total viable count (TVC)

The total viable count of papaya was assessed using the method described by Waghmare and Annapurna (2013). For the determination of TVC, 10 µl of each tenfold dilution was transferred and spread on the plate count agar media. The plates were incubated at 35°C for 12 hr. Following the incubation, plates exhibiting 30-300 colonies were counted. The TVC value was calculated as follows (5) and expressed as CFU/ml of the sample (ISO, 1995):

$$\text{TVC} = \frac{\text{Number of colonies x Dilution factor}}{\text{Volume of culture plate}} \qquad (5)$$

Shelf life

The shelf life was estimated by counting the days required to be fully ripe and acceptable for the consumers. The papaya was considered the final stage of ripening when it became soft and wrinkles developed on the surface. Papaya with flaws or mechanical damage was believed to deteriorate during storage.

Statistical analysis

The collected data on various parameters were statistically subjected to Two-way analysis of variance (ANOVA) using Microsoft Excel 10 and univariate analysis of variance (General Linear Model) following Tukey Paired Comparison Test using IBM SPSS statistics 2022 software with homogeneous subsets of Post Hoc Tests.

RESULTS AND DISCUSSION

Color

A crucial sensory characteristic for customer appeal is color. Fig. 1 depicts the gradual transition from a mostly green to a yellow color. The color of the control and coated samples changed significantly ($P \leq 0.05$) during storage which indicated ripening. Over 12 days, the papaya coated with 2% sodium alginate showed the least color change (1.68), next to the 2% cellulose acetate solution (2.0), 2% pectin solution (2.58), and the control sample (4.14). In the case of treated papaya, no significant ($P \leq 0.05$) differences were found until the 6th day of the storage period. Probably due to reduced respiration, which caused delayed ripening, alginate coating had a positive impact on preserving the papaya's original color, as evidenced by the less dramatic increase in color values near 2% alginate (Narsaiah et al., 2014). As chlorophyll degraded over time, the color altered primarily from green to yellow (Hamzah et al., 2013). By analyzing the color of papaya, it was determined that coating application caused papaya to ripen more slowly, maturing for eating after 12 days as opposed to 3 days for control fruits.

Weight Loss (%)

A vital indicator for evaluating the fruit's shelf life is weight reduction. When fresh plant tissues are kept at a constant temperature with dry air, they often lose moisture and, therefore, gain less weight (Liplap et al., 2013). Fig. 2 shows a difference in the total weight loss among treatments and storage intervals during the observation periods.

The coatings used in this research exhibited less pronounced effects on papaya’s total weight loss throughout the storage periods. Fig. 2 shows that as storage time rose, the percentage of weight loss increased significantly in all treatments. Throughout the experimental periods, the maximum weight loss was found in the control sample, which was 17.56%. Among the treatments, the minimum weight loss was found in the 2% sodium alginate treated sample, which was 0.56%, followed by 2% pectin solution and 2% cellulose acetate solution, which were 0.94% and 1.88%, respectively. Slightly ripe fruit lost more weight compared with less ripe fruit handled likewise. Due to respiration, a carbon atom is lost from the fruits in each cycle in the form of CO_2 and the weight loss happens (Parven et al., 2020). The different water vapor permeability of the polysaccharides is the reason for variations in their ability to inhibit weight loss (Chien et al., 2007). On the contrary, the treated papaya showed the lowest weight loss compared to the control on the 12th day because coatings act as a barrier that reduces the moisture loss from the pulp (Alharaty &

Ramaswamy, 2020). A similar outcome in total weight loss was reported by Parven et al. (2020) for aloe vera gel coating on papaya. In this research, the 2% sodium alginate treatment offered a better water barrier property than the other treatments because it acts as a semipermeable barrier against oxygen, carbon dioxide, and moisture. This reduced respiration, water loss, and oxidation reactions, resulting in decreased weight loss for coated papayas during storage.

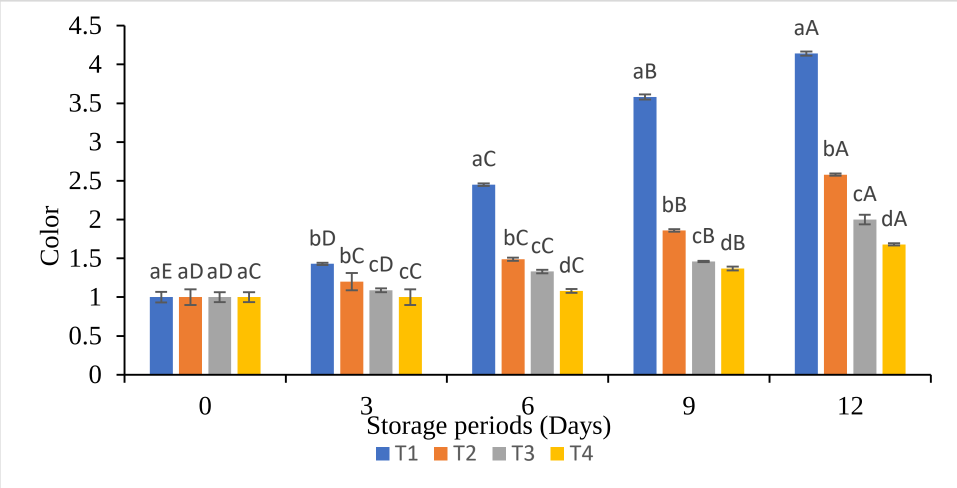

Fig. 1. Effect of coating treatments on the color of papaya during storage. Values followed by different small letters (a-d) in particular storage period indicate differences among the treatments and different capital letters (A-E) in particular treatments indicate differences among the storage intervals (P≤0.05). T_1: Control; T_2: 2% pectin coating; T_3: 2% cellulose acetate coating; T_4: 2% sodium alginate coating.

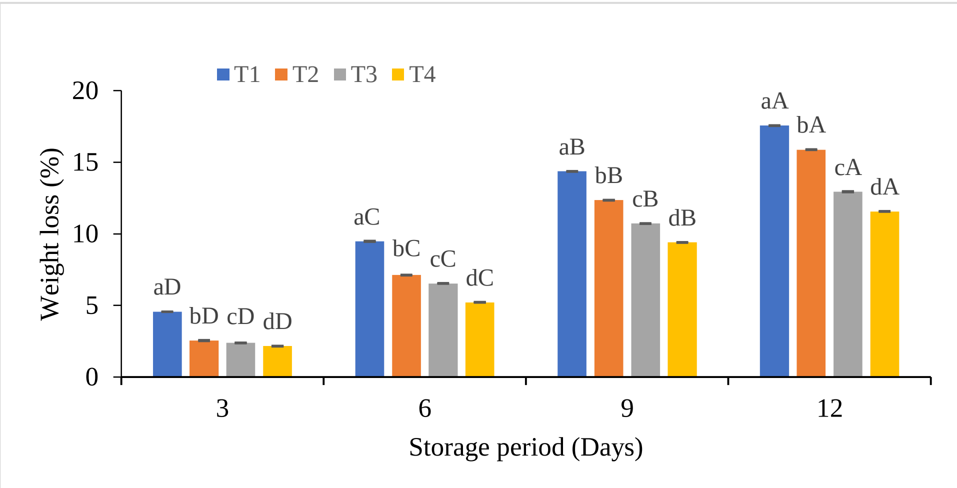

Fig. 2. Effect of postharvest treatments on the weight loss (%) of papaya during storage. Values followed by different small letters (a-d) in particular storage period indicate differences among the treatments and different capital letters (A-E) in particular treatments indicate differences among the storage intervals (P≤0.05). T_1: Control; T_2: 2% pectin coating; T_3: 2% cellulose acetate coating; T_4: 2% sodium alginate coating.

Moisture content (%)

Moisture content is an important parameter of postharvest-treated fruits and vegetables that indicates the shelf life of the product. Figure 3 depicts a significant ($P \leq 0.05$) decrease in moisture content throughout the treatment periods. No significant ($P \leq 0.05$) difference was found between the 9th and 12th days of treatment periods except for the control and 2% sodium alginate-treated papaya. Among the treatments, the highest moisture content was found in 2% sodium alginate-treated papaya, which was 89.77%, followed by 2% cellulose acetate and 2% pectin solution-treated papaya, which were 87.98% and 86.78%, respectively, and the lowest moisture content was found in control papaya, which was 85.63% over the treatment periods. Throughout the storage periods, moisture content decreased by 7.95% for the control papaya and 3.73% for the 2% sodium alginate-treated papaya, which was about two times lower than the control papaya. The same result was found by Sharmin et al. (2016) for aloe vera-treated papaya. Pathmanaban et al. (1995) also reported on the decrease in moisture content during storage. The decrease in moisture content was most likely brought on by starch hydrolysis as well as transpiration and evaporation loss. These edible coatings serve as primary packaging which is directly in contact with the fruit surface, wrapping it to form a gas and moisture barrier to hold moisture content. Compared to other treatments, sodium alginate film acts as a water-permeable membrane due to the addition of calcium chloride salts and less water evaporates from the surface ultimately leading to held moisture content (Senturk Parreidt et al., 2018).

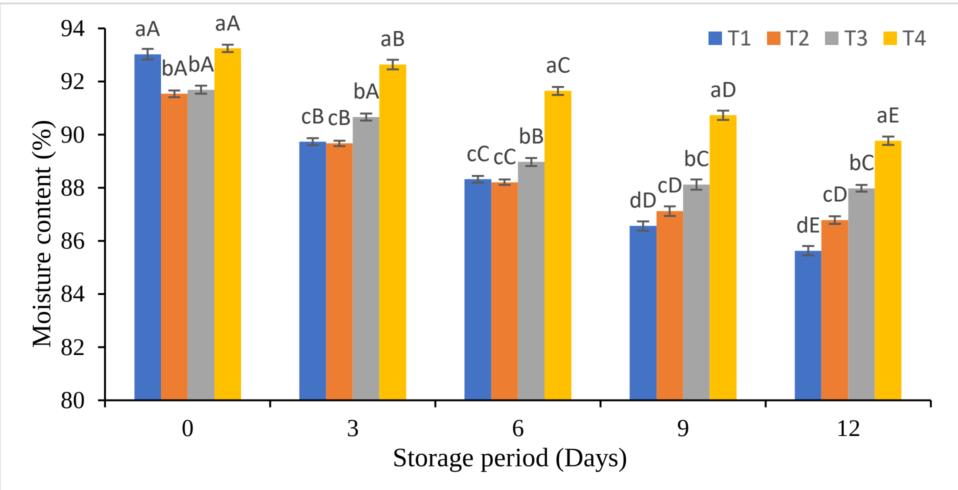

Fig. 3. Effect of postharvest treatments on the moisture content (%) of papaya during storage. Values followed by different small letters (a-d) in particular storage period indicate differences among the treatments and different capital letters (A-E) in particular treatments indicate differences among the storage intervals ($P \leq 0.05$). T_1: Control; T_2: 2% pectin coating; T_3: 2% cellulose acetate coating; T_4: 2% sodium alginate coating.

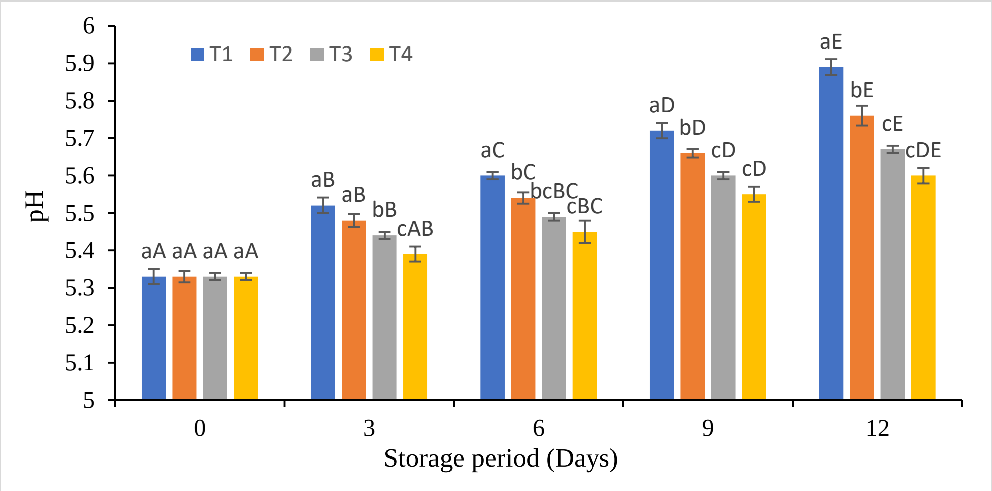

Fig. 4. Effect of postharvest treatments on the pH of papaya during storage. Values followed by different small letters (a-d) in particular storage period indicate differences among the treatments and different capital letters (A-E) in particular treatments indicate differences among the storage intervals (P≤0.05). T_1: Control; T_2: 2% pectin coating; T_3: 2% cellulose acetate coating; T_4: 2% sodium alginate coating.

pH

pH is an indication of the maturity of fruits and vegetables. Figure 4 depicts a significant (P≤0.05) increasing trend in the pH of papayas during the experiment. During the storage periods, the control papaya showed a higher pH (5.89) than the treated samples. Among the treatments, 2% sodium alginate-treated papaya showed a lower pH (5.6) followed by 2% cellulose acetate (5.67) and 2% pectin treated (5.76) papaya. Throughout the storage periods, the control papaya was increased by 10.51% and the 2% sodium alginate-treated papaya was increased by 5.07% which was half of the control papaya. Vieira et al. (2016) observed a comparable response when they coated blueberries with aloe vera gel to maintain their pH as opposed to non-coated ones. According to Ahmed et al. (2013), strawberries treated with alginate maintained their pH during storage. The fruits that were not treated, on the other hand, saw a higher pH shift.

Titratable acidity

An important indicator of the ripening stage is a change in the acidity level. Figure 5 shows a decline in acidity with storage periods. Titratable acidity started to decrease from 3rd day of storage. On the 12th day, the control papaya showed significantly (P≤0.05) lower acidity (0.21%) than the treated papaya. Among the treatments, the 2% sodium alginate-treated papaya showed the highest acidity (0.32%), followed by 2% cellulose acetate (0.3%) and 2% pectin solution-treated papayas (0.27%). Fruit loses acid during ripening and senescence because acids are crucial substrates for respiratory mechanisms (Narsaiah et al., 2015). Valero et al. (2013) reported that the decrease in fruit acidity would increase with increased metabolic respiration and vice versa. According to Alharaty and Namaswamy (2020), the changes in CO_2 and O_2 levels indicate a decrease in the rate of respiration. The alginate coating reduced the acidity by delaying the respiration rate. Acidity decreases at the late stages of fruit ripening due to the use of organic acids during respiration. On the contrary, edible coating reduced the loss of organic acids by reducing oxygen diffusion and respiration rates thus enabled to have higher acid levels than the control fruits at the end of the storage period. Alginate coating delays the utilization of organic acids (Yaman et al., 2002). Similar trends in the total acid level were also noted by Olivas et al. (2007) in alginate-coated gala apples.

Total soluble solids (TSS)

The solubilization of more complex carbohydrates into simpler ones causes fruit to mature, which is reflected by an increase in total soluble solids concentration (Waghmare & Annapurna, 2013). Figure 6 revealed that TSS increased significantly (P≤0.05) with the increase of storage periods. At the end of the storage periods, the control papaya showed a higher TSS than the treatments. Among the treatments, 2% sodium alginate treated papaya showed a lower value (9.2 °Brix) followed by 2% cellulose acetate (10.4 °Brix) and 2% pectin solution (11.3 °Brix) treated papaya.

The increase in TSS was 28.26% higher in the control papaya as compared to the 2% sodium alginate-treated papaya. According to Narsaiah et al. (2014), this was caused by enhanced ripening, which is the side effect of greater respiration rate, in control papaya when they are sorted. This result was similar to that of the papaya treated with bacteriocin and alginate which was reported by Narsaiah et al. (2014). Kittur et al. (2001) showed for bananas and mangoes treated with polysaccharide-based coatings, the amount of reducing sugar in the samples showed that the treated papayas produced reducing sugars more slowly than the control and other treatments. According to Jiang (2013) and Guillén et al. (2013), the findings of additional studies on alginate-coated mushrooms and aloe vera-coated peaches were consistent with the trends of change in TSS.

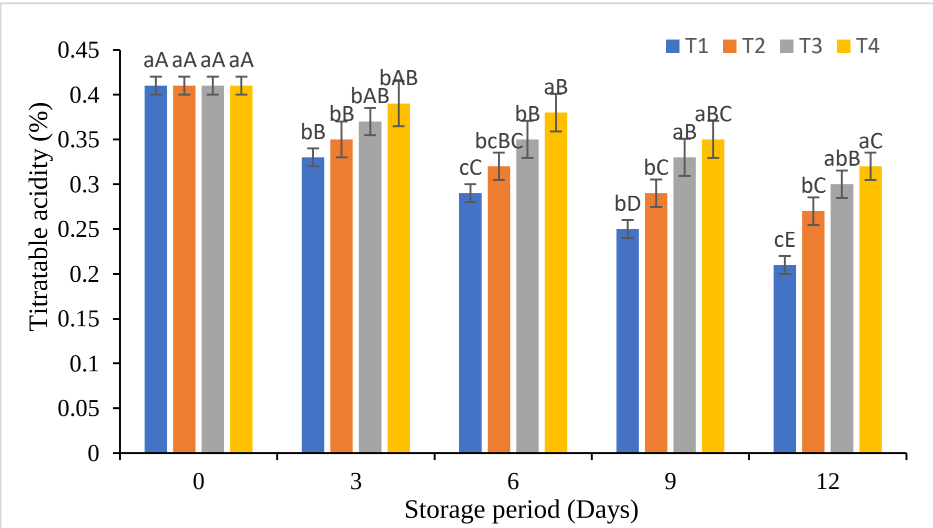

Fig. 5. Effect of postharvest treatments on the titratable acidity (%) of papaya during storage. Values followed by different small letters (a-d) in particular storage period indicate differences among the treatments and different capital letters (A-E) in particular treatments indicate differences among the storage intervals (P≤0.05). T_1: Control; T_2: 2% pectin coating; T_3: 2% cellulose acetate coating; T_4: 2% sodium alginate coating.

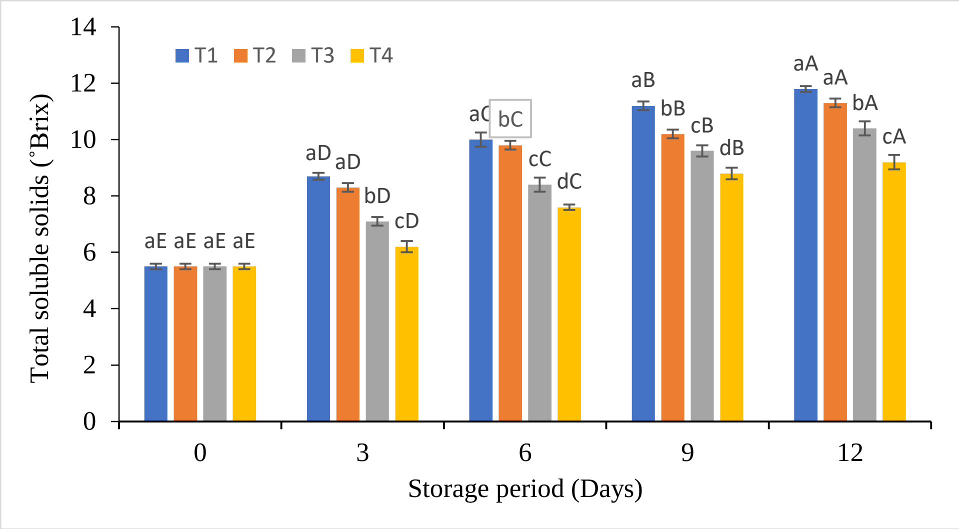

Fig. 6. Effect of postharvest treatments on the total soluble solids (°Brix) of papaya during storage. Values followed by different small letters (a-d) in particular storage period indicate differences among the treatments and different capital letters (A-E) in particular treatments indicate differences among the storage intervals ($P \leq 0.05$). T_1: Control; T_2: 2% pectin coating; T_3: 2% cellulose acetate coating; T_4: 2% sodium alginate coating.

Vitamin C content

Vitamin C content is the distinguishing element in the maturity stages of papayas that are linked to oxidative degradation (Siriamornpun et al., 2017). Figure 7 reveals the retention of vitamin C content throughout the storage periods. Vitamin C started to decrease from the 3rd day of storage. Vitamin C retention was higher in the treatments than in the control sample. The vitamin C contents on the 12th day of storage periods for all samples were statistically ($P \leq 0.05$) similar to those on the 9th day except control. Over the storage periods, Vitamin C content was lowest in control papaya which was 29.5 mg/100g, and the highest was found in 2% sodium alginate treated papaya which was 38.56 mg/100g followed by 2% cellulose acetate (37.38 mg/100g) and 2% pectin solution (35.67 mg/100g) treated papaya. The vitamin C content in 2% sodium alginate treated papaya was 30.71% higher as compared to control papaya. In the presence of oxygen, ascorbic acid auto-oxidizes spontaneously and that's why vitamin C content degrades (Owusu-Yaw et al., 1988). Qamar et al. (2018) also reported a reduced rate of decrease in ascorbic acid content in the case of sodium alginate-based strawberry coating. However, comparatively, vitamin C content decreased quickly in the control papaya.

Total viable count (TVC)

Microbial quality is the most significant component of food because it directly affects the health of the consumer. Figure 8 shows the total viable count of treated and control papaya fruits. The highest TVC was found in the control papaya (7 log CFU/ml). Here control papaya fruits were significantly ($P \leq 0.05$) different from the treatment papaya. Among the treatments, 2% sodium alginate treated papaya showed the least total viable count (6 log CFU/ml) followed by 2% cellulose acetate (6.5 log CFU/ml), and 2% pectin solution (6.32 log CFU/ml) treated papayas. This decrease in the total viable count was 14.29% lower in 2% sodium alginate-treated papaya as compared to control papaya. This is explained by improved release behavior and higher trapping efficiency (Narsaiah et al., 2015). A similar result was obtained in the chitosan and sodium alginate-based edible coating of fresh-cut nectarines against yeast and molds (Valentina & Giovanna, 2016), and melon incorporated with antimicrobial components (Raybaudi-Massilia et al., 2008).

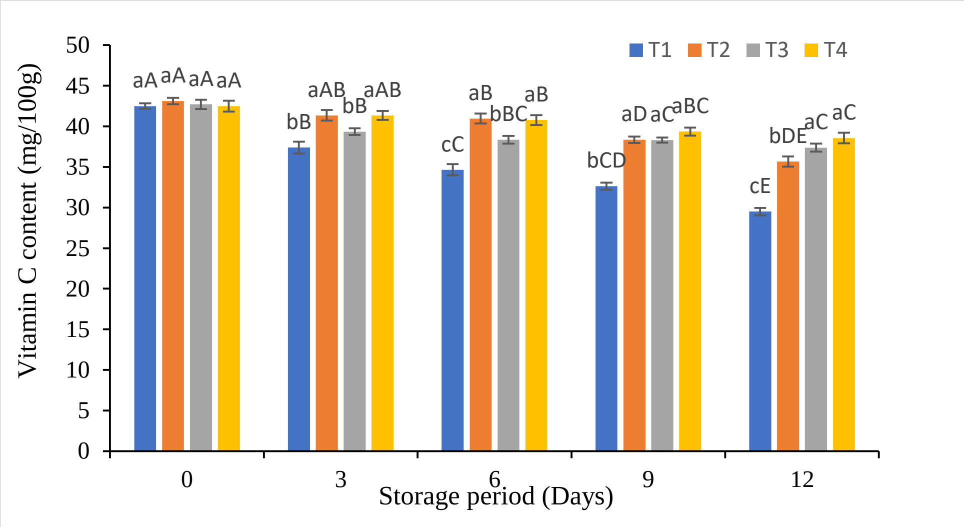

Fig. 7. Effect of postharvest treatments on vitamin C content of papaya during storage. Values followed by different small letters (a-d) in particular storage period indicate differences among the treatments and different capital letters (A-E) in particular treatments indicate differences among the storage intervals (P≤0.05). T_1: Control; T_2: 2% pectin coating; T_3: 2% cellulose acetate coating; T_4: 2% sodium alginate coating.

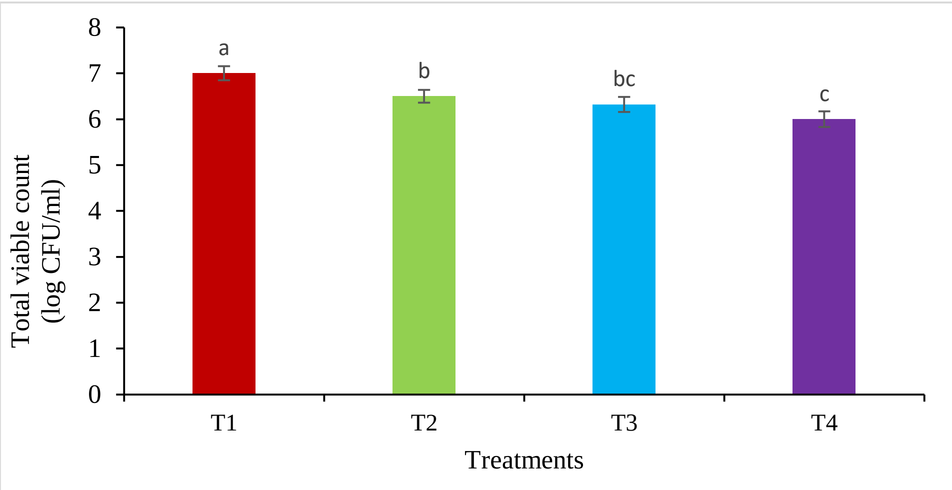

Fig. 8. Effect of postharvest treatments on the total viable count (TVC) of papaya. Values followed by different small letters (a-c) indicate differences among the treatments (P≤0.05). T_1: Control; T_2: 2% pectin coating; T_3: 2% cellulose acetate coating; T_4: 2% sodium alginate coating.

Shelf life

The most crucial factor in the biochemical reaction that causes fruit to rot is its shelf life, which is defined as the time interval from harvesting to the beginning of fruit rotting. Fig. 9 shows the effect of coating on extending the shelf life of papaya and it was statistically significant ($P \leq 0.05$). The maximum shelf life was found in 2% sodium alginate-treated papaya (16^{th} day) and significantly ($P \leq 0.05$) different from the other treatments, whereas the minimum shelf life was found in control papaya (6^{th} day). The addition of calcium chloride salt in sodium alginate coating helps in reducing bacterial growth and physiological disorders. Tabassum and Khan (2020) also reported the extension of shelf life to 12 days in the case of alginate-based edible coating. Delayed fruit ripening, whose changes in weight loss, firmness, total carotenoid, lycopene, and vitamin C were significantly slower than fruit treated with sodium alginate-based coating.

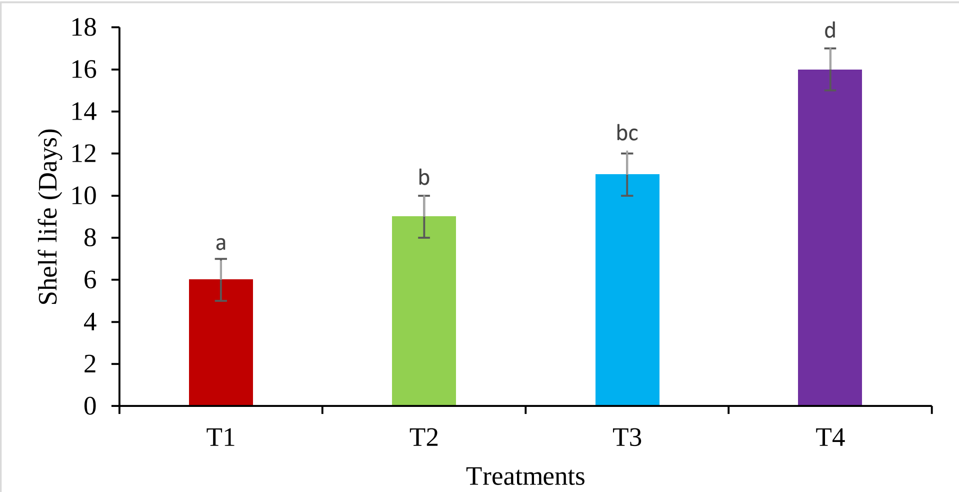

Fig. 9. Effect of postharvest treatments on the shelf life of papaya. Values followed by different small letters (a-c) indicate differences among the treatments ($P \leq 0.05$). T_1: Control; T_2: 2% pectin coating; T_3: 2% cellulose acetate coating; T_4: 2% sodium alginate coating.

CONCLUSION

The current study reported the efficacy of edible polysaccharide coatings such as pectin, cellulose acetate, and sodium alginate solution on papaya fruits to enhance the shelf life of papaya at the least nutrient loss. All the treated papayas showed good results, but 2% sodium alginate solution-coated papaya showed the lowest weight loss, color change, pH, total soluble solids content, and total viable count with the highest moisture content, titratable acidity, vitamin C retention, and shelf life throughout the storage periods followed by 2% cellulose acetate and 2% pectin solution coated papaya. So, 2% sodium alginate Solution coating seems to be a good substitute for preservation and a practical way to increase the quality and shelf life of papaya under commercial circumstances. To determine which edible coatings are optimal for commercial use, more research may be conducted to examine how these coatings affect the texture and sensory qualities of papaya while it is being stored.

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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