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POSTHARVEST QUALITY OF LITCHI cv. CHINA AS INFLUENCED BY EDIBLE COATING

Naorem Bidiyarani Devi, Akali Sema, Laishram Hemanta, R. Kreditsu, Chandan Suravi Maiti, Abhijit Rongpi, Lovely Mazumdar, Manish Kumar, Alemla Imchen and Animesh Sarkar*

Department of Horticulture, School of Agricultural Sciences, Nagaland University, Medziphema Campus, Nagaland-797106, India.

*Corresponding author E-mail : asarkar@nagalanduniversity.ac.in

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ABSTRACT

The experiment was conducted to evaluate the effect of different organic edible coatings on the postharvest quality, shelf life and sensory attributes of litchi cv. china during storage. The study was carried out at the Department of Horticulture, School of Agricultural Sciences (SAS), Nagaland University, Medziphema Campus, Nagaland, during 2023. Seven treatments were evaluated, viz., T₀ (control), T₁ (beeswax emulsion @ 5.0%), T₂ (Aloe vera gel @ 75%), T₃ (chitosan @ 1.0%), T₄ (virgin coconut oil @ 0.92% [gravity]), T₅ (starch @ 4%) and T₆ (leaf extract of mint and tulsi @ 10%). The experiment was laid out in a completely randomized design (CRD) with three replications in litchi fruits cv. China. Among the treatments, virgin coconut oil @ 0.92% (gravity), recorded the highest fruit firmness (1.06 N) and ascorbic acid content (27.67 mg/100 g), lowest browning index (2.00%), less physiological loss in weight (18.67%), high TSS: acid ratio (53.32), total sugar (9.22%), reducing sugar (5.89%) and pH (6.66) in final day of storage (8 days after storage). In contrast, starch @ 4% recorded the highest sensory scores for colour (3.2), flavour (3.6), taste (3.6) and overall acceptability (3.46) throughout the storage period. Based on the overall postharvest quality and sensory evaluation, virgin coconut oil @ 0.92% (gravity) and starch @ 4% may be recommended as an edible coating for extending the shelf life and maintaining acceptable eating fruit quality during storage.

Key words : Litchi, cv. china, Edible coating, Biochemical changes, Sensory evaluation.

Introduction

Litchi (*Litchi chinensis* Sonn.) is a subtropical fruit that originated in China and Vietnam, but it is now cultivated commercially in over 20 countries. China holds the title of the largest litchi producer, followed closely by India. Due to its exquisite flavour and significant nutritional content, it is referred to as “King of the Fruits” in China. Litchi is a member of the sapindaceae family, also recognized as the soapberry family. The subspecies *chinensis* is the sole subspecies cultivated for commercial purposes (Soni and Agrawal, 2017). Main chemical constituents of fruit include sugars (11.9%), protein (0.9%), fat (0.3%), pectin (0.43%), vitamin C (40 mg/100mg) and organic acids (0.2-0.64%). Organic acid present in the fruit is malic (80% of the total acids) citric, succinic, levulinic, phosphoric, glutaric, malonic and lactic acid. Mineral content amounts to about 0.7% comprising

mainly calcium, phosphorus and iron (Nayak *et al.*, 2024). Typically, litchi's shelf-life does not extend beyond 24 to 72 hours under normal conditions (Kumar, 2020), with its appealing bright red hue potentially fading within just 48 hours. After harvest, there is desiccation in fruits causing loss of red colour and pericarp turning brown. The postharvest browning of litchi fruit is typically attributed to the rapid degradation of anthocyanins catalysed by polyphenol oxidase, resulting in the formation of brown compounds. These issues have presented substantial challenges in terms of storage, transportation and marketing (Huang *et al.*, 2023). The occurrence of browning in litchi fruit diminishes its visual appeal, influencing consumers' purchasing decisions (Zhang *et al.*, 2021). Edible coating stands out as a natural treatment, upholding treated fruit quality and consumer safety. It boasts eco-friendliness and biodegradability. This

approach involves degradable coatings derived from polysaccharide, protein and lipid polymers. Applied as thin layers, these coatings offer an added protective layer on the fruit surface. Similar to modified atmosphere storage, they alter internal gas composition, forming an effective barrier that ultimately minimizes weight loss, delays ripening and preserves quality (Mahajan *et al.*, 2018). This technique enhances appearance, prolongs shelf life and manages postharvest diseases (Pham *et al.*, 2023). Furthermore, it mitigates chilling injury symptoms during storage (Valenzuela *et al.*, 2017). Application methods encompass dipping, spraying or brushing to create a shielding barrier around the product. When integrated with bioactive compounds and antimicrobial agents, edible coatings can even enhance biochemical quality and diminish fruit decay (Popyrina *et al.*, 2023).

Materials and Methods

This experiment was conducted in the postharvest laboratory, Department of Horticulture, Nagaland University, SAS, Medziphema Campus during 2023. Fully matured uniform ripen fruits were randomly harvested from each direction of canopy at early morning attached to the pedicel to maintain the keeping quality from 30 years litchi plant cv. China. The experiment was laid out in Completely Randomized Design with seven treatments replicated thrice and observation was taken at 2 days interval. The treatments consist of: T₀ (control), T₁ (beeswax emulsion @ 5.0%), T₂ (*Aloe vera* gel @ 75%), T₃ (chitosan @ 1.0%), T₄ (virgin coconut oil @ 0.92% [gravity]), T₅ (starch @ 4%) and T₆ (leaf extract of mint and tulsi @ 10%). Right after harvest, the fruits were placed in ice water for pre-cooling and fan dried thereof. These were then arranged in batches to be treated using various coating materials. The cleaned fruits were kept in trays and edible coating materials were applied into the fruits by means of dipping and brushing in continuous manner. The uncoated fruits were taken as control and coated fruits were again precooled in air and kept in ambient temperature for further analysis as follows.

Fruit firmness : Fruit firmness was measured by using penetrometer, measuring the force required to push a plunger tip (of a certain size) into fruits.

Browning index (%) : Severity of browning was assessed visually measuring the extend of the total brown area on each fruit pericarp using 10 fruits, in a 0-4 scale (Ramma 2003), where 0 is no browning (excellent quality), 1 is slight browning, 2 is < ¼ pericarp browning, 3 is ¼ to ½ pericarp browning, 4 is > ½ pericarp browning (poor quality).

Physiological loss in weight (%) : The physiological loss in weight was calculated as the difference between the initial weight and the final weight of the fruits. It was calculated as given below.

$$PLW\% = \frac{W_1 - W_2}{W_1} \times 100$$

Where, W₁ and W₂ are the initial and final weight of the fruits in gram (Mangaraj and Goswami, 2011).

Total Soluble Solid (p Brix): The TSS content of fruit was determined by extracting the fruit juice and with the help of EMRA hand refractometer (0-32 °Brix) calibrated at 20°C (AOAC, 1984).

Titrate acidity (%) : Titrate acidity was estimated by titrating the diluted fruit juice against 0.1N NaOH solution using phenolphthalein as an indicator (AOAC, 1984).

TSS: Acid ratio (%) : The ratio of TSS: acid was determined by dividing the values of TSS with the value of acid content of the fruit.

Total Sugar (%) : Total sugar content of the fruit was estimated by titrating the fruit juice against Fehling 'A' and Fehling 'B' reagents using methylene blue as indicator (AOAC, 1984).

Juice pH : Ten grams of aril was crushed in a grinder and volume was made to 50ml with distilled water. The pH of dispersed material was measured using a digital glass electrode pH meter (Electronic Corporation of India, Ltd.).

Reducing Sugar (%) : Reducing sugar of fruit juice was estimated by titrating Fehling A and Fehling B reagents using methylene blue as indicator. Precipitation of deep brick red colour of the solution indicated the end point and the titratable values were used for calculation (AOAC, 1984).

Ascorbic acid (mg 100g⁻¹ pulp) : For determining the ascorbic acid, 10g pulp was ground by adding 3% metaphosphoric acid (HPO₃) solution and titrated against the dye (2,6-dichlorophenol-indophenol) till the pink colour appeared as end point. The titrated values were recorded and calculated according to the method described by (Ranganna, 1995). It was calculated as under:

$$= \frac{\text{Titrate value} \times \text{dye factor} \times \text{Vol. made up (25 ml)} \times 100}{\text{Aliquot up (5 ml)} \times \text{Vol. of sample (25 ml)}}$$

Sensory evaluation : Sensory evaluation was done to evaluate for taste, colour and flavour of the litchi by using the hedonic scale. A panel of 5 judges were selected

on their consistency and reliability of judgement. Panellists were asked to rate the difference between samples by using 5-point hedonic scale (Amerine *et al.*, 1965). Overall acceptability score was calculated as average of whole sensory attributes.

Results and Discussion

Physical parameters

There was a significant influence in fruit firmness among different treatments in progress of storage period. A gradual decline in the observed values was recorded across the storage period as depicted in Table 1. Among the treatments, virgin coconut oil @ 0.92% showed the highest fruit firmness (1.06 kgcm^{-2}) followed by chitosan @1.0% and *Aloe vera* gel @ 75% with 1.03 kgcm^{-2} and 1.00 kgcm^{-2} , respectively while, the lowest was obtained in control (0.70 kgcm^{-2}) followed by leaf extract of mint and tulsi @10% (0.80 Kgcm^{-2}) at 8 DAS. The higher firmness in coated fruits might be due to a reduced respiration rate, which in turn, decreases the degradation of water-insoluble calcium pectate (Ca-pectate), a substance that contributes to fruit firmness. Lower respiration rates could also reduce the activity of hydrolysis enzymes, slowing down fruit softening. These findings align with (Nasrin *et al.*, 2020), who showed the impact of MAP and edible coating on lemon firmness during ambient storage. Browning index of the fruit as cited in Table 1 was significantly affected by edible coatings during storage period. A general increasing trend in browning index was observed in all treatments. The lowest value of browning index (2.00%) was recorded in virgin coconut oil @ 0.92%, which was statistically at par with chitosan @1.0% (2.33%) and *Aloe vera* gel @75% (2.66%) while, the highest was noted in control (4.00%) at 8 DAS. The breakdown of cell membrane usually induces the oxidation of phenols, thus, leading the rapid browning process in litchi during storage (Huang *et al.*, 2024). Edible coatings likely retain anthocyanins, explaining reduced browning. These results align with (Marak *et al.*, 2023), who reported that exogenous melatonin delays oxidative browning and improves postharvest quality of litchi fruits. Data depicted in Table 1 showed that there was a significant influence in physiological loss in weight among the treatments during storage period from 2 DAS to 8 DAS. A gradual increase of fruit weight loss was noted throughout the storage period. The lowest fruit weight loss was recorded in virgin coconut oil @0.92% (18.67%) which was statistically at par with chitosan @1.0% (19.16%) and *Aloe vera* gel @75% (20.53%) whereas, the highest fruit weight loss was recorded in control (27.67%) followed by leaf extract



Fig. 1 : Effect of edible coating treatments of litchi at initial and final days of storage period.

of mint and tulsi @10% (27.54%) at 8 DAS. Edible coatings likely reduce weight loss by preventing moisture loss, act as barriers to fruit respiration after harvest, limiting O_2 and CO_2 diffusion, impacting metabolism (Parven *et al.*, 2020). These findings align with (Bilawal *et al.*, 2017), who reported a minimum decrease in physiological loss in weight in guava fruits coated with calcium lactate (2%), xanthan gum (2%) and glycerin (4%) during the 30 days of storage period. For identification of pathogen, less growth of pathogen was

observed in virgin coconut oil whereas control showed the highest growth of pathogen. During observation, the pathogens like *Trichoderma*, *Rhizopus*, *Aspergillus* and *Fusarium* were found to infect litchi fruits during storage.

Biochemical parameters

TSS was not significantly affected by edible coatings during storage period as cited in Table 1. The TSS content was found to vary between 17.80° B and 18.46° B at 8 DAS. The highest value on TSS (18.46° B) was recorded in leaf extract of mint and tulsi @ 10%, which was followed by bee wax emulsion @5.0% (18.40°B) at 8 DAS. The TSS content rise due to metabolic processes, starch converting to soluble sugars. Edible coating delayed TSS increased by reducing water loss, slower hydrolysis of starch and polysaccharides into soluble sugars. The eventual decrease could arise from consumption in evapo-transpiration (Kaur *et al.*, 2017). Low sugar utilization rates align with virgin coconut oil-coated fruits was noticed by Barsha *et al.* (2021), who reported the low value of TSS in 50% paraffin wax and other edible coating materials as compared to control during storage. Data depicted in Table 1 indicated that there was a significant influence in titratable acidity content of fruits among the different treatments. A general decreasing trends was noted irrespective of all the edible coatings from 2 DAS to 8 DAS. Virgin coconut oil @0.92 showed the lowest titratable acidity (0.34%), which was statistically at par with chitosan @1.0% (0.36%) followed by *Aloe vera* gel @ 75% (0.38%) while, the highest titratable acidity (0.44%) was recorded in control. Acid content decreases are attributed to acids being energy sources, converting into sugars (Mendy *et al.*, 2019). Treated fruits show gradual acidity decrease, possibly due to edible coatings that slow respiration. Similar findings were observed by Hazarika *et al.* (2019), who also reported in paraffin wax treated fruits, due to lesser availability of oxygen to the fruits in later stages of storage may lead to higher acidity in the fruits. TSS: acid content of the fruits was significantly affected by edible coatings as cited in Table 2. A gradual increasing trend in TSS: acid was observed during storage period from 2DAS to 8 DAS. The fruits treated with virgin coconut oil @ 0.92% showed the highest TSS: acid (53.32%) followed by chitosan @1.0% (50.55%) and *Aloe vera* gel @75% (48.05%) while, the lowest was noticed in control (40.45%) at 8 DAS. This might be attributed to greater moisture loss, concentrating juice and boosting sugar levels, while reduced acidity results from heightened respiration and increased acid utilization in biochemical processes, depleting organic acids. As TSS rises, water content in fruits decreases and cell wall components like hemicellulose, pectin, protein

Table 1 : Effect of edible coating on fruit firmness, browning index, physiological loss in weight, TSS and titratable acidity of litchi cv. China.

Treatment	Fruit firmness (N)				Browning index (%)				Physiological loss in weight (%)				TSS (°B)				Titratable acidity (%)			
	2DAS	4DAS	6DAS	8DAS	2DAS	4DAS	6DAS	8DAS	2DAS	4DAS	6DAS	8DAS	2DAS	4DAS	6DAS	8DAS	2DAS	4DAS	6DAS	8DAS
T ₀	1.46	1.33	0.96	0.70	1.33	2.66	3.33	4.00	6.42	16.94	20.86	27.67	17.66	18.16	18.60	17.80	0.61	0.55	0.46	0.44
T ₁	1.56	1.40	1.06	0.86	1.00	2.00	3.00	3.33	6.15	16.29	18.67	21.84	17.40	17.80	18.16	18.40	0.59	0.53	0.44	0.42
T ₂	1.70	1.50	1.13	1.00	1.00	1.66	2.33	2.66	5.93	12.53	16.89	20.53	17.30	17.66	18.00	18.26	0.55	0.48	0.40	0.38
T ₃	1.76	1.53	1.16	1.03	0.66	1.33	2.00	2.33	5.92	12.29	15.28	19.16	17.26	17.56	17.90	18.20	0.53	0.46	0.38	0.36
T ₄	1.80	1.60	1.20	1.06	0.66	1.00	1.66	2.00	5.36	10.75	13.15	18.67	17.20	17.50	17.83	18.13	0.51	0.44	0.36	0.34
T ₅	1.63	1.43	1.10	0.90	1.00	2.00	2.66	3.00	6.00	13.15	16.94	21.78	17.33	17.73	18.06	18.33	0.57	0.51	0.42	0.40
T ₆	1.50	1.36	1.03	0.80	1.00	2.33	3.00	3.66	6.25	16.68	19.40	27.54	17.53	17.90	18.26	18.46	0.59	0.54	0.47	0.42
SEm±	0.03	0.05	0.08	0.04	0.22	0.25	0.25	0.25	0.29	3.07	3.10	3.44	0.28	0.40	0.38	0.40	0.02	0.02	0.02	0.02
CD(5%)	0.10	0.14	NS	0.12	NS	0.77	0.77	0.77	NS	NS	NS	NS	NS	NS	NS	NS	0.05	0.05	0.05	0.05

T₀: Control, T₁: Bee wax emulsion @ 5.0%, T₂: *Aloe vera* gel @ 75%, T₃: Chitosan @1.0%, T₄: Virgin coconut oil @ 0.92%, T₅: Starch @4%, T₆: Leaf extract of mint and tulsi @ 10%

and starches convert into simple soluble sugars during storage (Haseeb *et al.*, 2021). The total sugar of the fruits as depicted in Table 2 indicated that there was a significant influence among different treatments. A general increasing trend was noticed irrespective of the edible coating treatments. The highest total sugar (9.23%) was recorded in virgin coconut oil @0.92% followed by leaf extract of mint and tulsi @10% (9.09%) and bee wax emulsion @5.0% (8.82%) at 8 DAS and the lowest value of total sugar was recorded in control (8.22%). Higher sugar content may be due to faster hydrolysis processes (Bhuyan *et al.*, 2018). This finding is in close agreement with (Qamar *et al.*, 2018) who reported positive effects of *Aloe vera* gel coating, which effectively preserved the sugar content in strawberries. The results obtained in Table 2 showed that edible coatings had significant effect on reducing sugar. A gradual increasing trend was observed among different treatments during storage period. The highest reducing sugar was noticed in virgin coconut oil @0.92% (5.89%) which was followed by leaf extract of mint and tulsi @10% (5.13%) at 8 DAS. Increase in reducing sugar may be due to increase in water and evapotranspiration losses (Ahlawat *et al.*, 2018). Similar finding was reported with guar gum which significantly improved the storage life of litchi maintaining sugar content and to reduce postharvest losses (Shubham *et al.*, 2020). The data depicted in Table 2 showed that edible coatings had significant effect on pH of the fruit. A gradual increase in pH was observed during storage. Maximum pH (6.66%) was noticed in virgin coconut oil @0.92, which was statistically at par with chitosan @1.0% (6.50%) and *Aloe vera* gel @ 75% (6.38%) while, the minimum was found in control (5.96%) followed by leaf extract of mint and tulsi @10% (6.03%) at 8 DAS. Control fruits exhibited less pH values, possibly due to reduce acid oxidation, while coated fruits had the highest pH, likely because of a faster respiration rate. These results align with Eshetu *et al.* (2019), who reported the pH of the litchi fruits decreasing with increasing titratable acidity during the storage period due to increased respiration rate and delaying utilization of organic compounds. Vitamin-C content of the fruits was significantly affected by edible coatings as cited in Table 2. A gradual decreasing trend in vitamin-C was observed during storage period. The fruits treated with virgin coconut oil @0.92% showed the highest vitamin-C content (27.67mg/100g pulp) in fruits followed by chitosan @1.0% (27.11 mg/100g pulp) and *Aloe vera* gel @75% (26.54mg/100g pulp) and the lowest (22.59 mg/100g pulp) was noticed in control followed by leaf extract of mint and tulsi @10% (23.72 mg/100g pulp) at 8 DAS.

Table 2 : Effect of edible coating on TSS: acid ratio, total sugar, reducing sugar, pH and ascorbic acid content of litchi cv. China.

Treatment	TSS: acid ratio (%)			Total sugar (%)			Reducing sugar (%)			pH (%)			Ascorbic acid (mg/100g pulp)		
	2DAS	4DAS	6DAS	8DAS	2DAS	4DAS	6DAS	8DAS	2DAS	4DAS	6DAS	8DAS	2DAS	4DAS	8DAS
T ₀	28.95	33.01	40.43	40.45	7.81	7.89	8.18	8.22	4.66	4.76	5.00	5.13	30.50	28.24	22.59
T ₁	29.49	33.58	41.27	43.80	8.14	8.33	8.58	8.82	4.82	5.17	5.27	5.40	31.63	29.93	24.85
T ₂	31.45	36.79	45.00	48.05	7.97	8.11	8.36	8.45	4.74	4.87	5.18	5.26	32.76	31.06	26.54
T ₃	32.56	38.17	47.10	50.55	7.80	8.00	8.26	8.33	4.68	4.79	5.08	5.22	33.33	31.63	27.11
T ₄	33.72	39.77	49.52	53.32	8.34	8.57	8.82	9.23	4.88	5.27	5.68	5.89	33.89	32.20	27.67
T ₅	30.40	34.76	43.00	45.82	8.07	8.22	8.51	8.70	4.79	4.92	5.23	5.30	32.19	30.50	25.42
T ₆	29.71	33.14	38.85	43.95	8.23	8.46	8.70	9.09	4.85	5.17	5.35	5.50	31.06	29.37	23.72
SEmt	0.88	1.58	1.79	1.99	0.41	0.12	0.39	0.13	0.20	0.09	0.18	0.11	1.30	0.48	0.42
CD(5%)	2.69	4.84	5.47	6.09	NS	0.37	NS	0.39	NS	0.27	NS	0.37	NS	1.46	1.31

T₀: Control, T₁: Bee wax emulsion @ 5.0%, T₂: *Aloe vera* gel @ 75%, T₃: Chitosan @1.0%, T₄: Virgin coconut oil @ 0.92%, T₅: Starch @4%, T₆: Leaf extract of mint and tulsi @10%

Sensory parameters

The results obtained in Table 3 showed that edible coating had significant effect on colour, flavour, taste and overall acceptability of litchi fruits. There was a gradual decreasing trend in extrinsic quality of litchi in advancement of storage period among different treatments. The highest retention of colour (3.20%) showed in starch @4% which was statistically at par with chitosan @1.0% (3.00%) followed by *Aloe vera* gel @75% (2.80%) and the lowest (1.60%) was noticed in control followed by virgin coconut oil @0.92% (1.80%) at 8 DAS. Comparatively the less colour changes on starch coating may be due to the effect of starch properties that helped to retard in ripening of fruits in advance of storage. This outcome aligns with papaya (Parven *et al.*, 2020) and in strawberries (Qamar *et al.*, 2018), where *Aloe vera* gel (AVG) coatings helped in minimizing colour changes during storage. Data depicted in Table 3 illustrated that there was a significant influence in flavour content of fruits. A general decreasing trends was noted among different treatments as storage progressed. Fruits coated with starch @4.0% showed the highest flavour value (3.60%) followed by bee wax emulsion @ 5.0% (3.40%) and chitosan @ 1.0% (3.20%) and the lowest was recorded in control (2.00%) at 8 DAS. The reduction in flavour value was minimal in treated fruits which might be due to inhibition of the exchange of gases and water. Similar result was reported by Hayat *et al.* (2017) in which citrus wax proved to be the best treatment for enhancing the shelf life and maintaining quality in kagzi lime. Taste of fruits was significantly affected by edible coatings during storage period as cited in Table 3. A gradual decreasing trends was noted among the treatments. The highest taste (3.60%) was noticed in starch @4.0%, which was statistically at par with bee wax emulsion @ 5.0%) (3.40%) and chitosan @1.0% (3.20%) and the lowest was noticed in control (2.00%) at 8 DAS. Reduction of taste occurred in control may be due to possible alcoholic fermentation. Starch edible

Table 3 : Effect of edible coating on colour, flavour, taste and overall acceptability of litchi cv. China.

Treatment	Colour (%)				Flavour (%)				Taste (%)				Overall acceptability (%)			
	2DAS	4DAS	6DAS	8DAS	2DAS	4DAS	6DAS	8DAS	2DAS	4DAS	6DAS	8DAS	2DAS	4DAS	6DAS	8DAS
T ₀	4.60	3.20	2.40	1.60	4.40	3.60	2.80	2.00	4.40	3.40	2.80	2.00	4.46	3.39	2.66	1.86
T ₁	4.60	3.40	2.60	2.20	5.00	4.40	3.80	3.40	4.80	4.60	3.80	3.40	4.79	4.13	3.39	2.99
T ₂	4.80	3.80	3.20	2.80	4.80	4.00	3.40	3.00	4.60	4.20	3.60	3.00	4.73	3.99	3.39	2.93
T ₃	4.80	4.00	3.40	3.00	4.80	4.20	3.60	3.20	4.80	4.40	3.60	3.20	4.79	4.19	3.53	3.13
T ₄	4.00	3.40	2.20	1.80	4.60	3.80	3.00	2.40	4.20	3.60	3.20	2.40	4.26	3.59	2.79	2.19
T ₅	4.80	4.20	3.60	3.20	5.00	4.60	4.00	3.60	5.00	4.60	4.00	3.60	4.93	4.46	3.86	3.46
T ₆	4.60	3.00	3.00	2.60	4.40	3.80	3.20	2.60	4.60	4.00	3.40	2.80	4.52	3.79	3.19	2.66
SEm±	0.21	0.21	0.21	0.20	0.19	0.21	0.19	0.20	0.21	0.22	0.24	0.19	0.10	0.12	0.13	0.12
CD (5%)	NS	0.60	0.62	0.58	NS	0.60	0.60	0.58	NS	0.64	0.70	0.56	0.25	0.35	0.37	0.35

T₀: Control, T₁: Bee wax emulsion @ 5.0%, T₂: Aloe vera gel @ 75%, T₃: Chitosan @ 1.0%, T₄: Virgin coconut oil @ 0.92%, T₅: Starch @ 4%, T₆: Leaf extract of mint and tulsi @ 10%

coating showed higher taste values, possibly due to starch's ability to limit lipid oxidation (Kumar *et al.*, 2020). Similarly noted the results of the sensory evaluation confirmed that the treatment of chitosan: pullulan blend edible coating could be effective to prolong the shelf life of litchi at storage condition. Overall acceptability of the fruits as cited in Table 3 indicated that different postharvest treatments was significantly affected by edible coatings as storage progressed. The fruits treated with starch @4.0% showed the highest overall acceptability (3.46%) followed by chitosan @1.0% (3.13%) and bee wax emulsion @ 5.0% (2.99%) while, the lowest was recorded in control (1.86%) at 8 DAS. It may be due to lower levels of dehydration and darkening of the treated fruits. This outcome aligns with Nair *et al.* (2018), who recorded the retention of sensory attributes and overall acceptability of capsicum using application of chitosan-based edible coating enriched with pomegranate peel extract.

Conclusion

From the present investigation, it could be concluded that all the edible coating materials used effectively reduced the loss of physiochemical properties of litchi fruits. Amongst all the treatments, virgin coconut oil was found to show better results in maintaining shelf-life and postharvest quality (TSS, titratable acidity, TSS: acid, total sugar, reducing sugar, ascorbic acid, pH, fruit firmness, PLW, browning index and pathogen growth). However, starch @ 4% was found to be effective for highest colour, flavour, taste and overall acceptability as compared to other treatments.

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Declaration of Competing interest

The authors declare that there is no competing interest

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