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RESEARCH ARTICLE

Bhartiya Krishi Anusandhan Patrika

Enhancement of Shelf Life of Tomato using Edible Coating

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ABSTRACT

Background: Tomato (*Solanum lycopersicum*) is one of the major nutrient-rich food widely consumed in India and being perishable in nature, it cannot be stored for longer periods. Edible coatings based on natural ingredients is now a days being widely used to extend the shelf life of perishable fruits and vegetables. In the present study the impact of aloevera gel and corn starch coatings on quality attributes and shelf life of tomato was assessed.

Methods: Two lots of tomatoes -one coated with aloevera gel and the other coated with corn starch coating were stored for 21 days under refrigerated condition. Physio-chemical characteristics of tomatoes were assessed at 3, 5, 7, 14 and 21 days during storage.

Result: The retention of moisture content, colour and firmness were observed better for coated tomatoes than the uncoated ones. The physiological weight loss, ascorbic acid content and total soluble solid content decreased at a higher rate in case of uncoated tomatoes compared to the coated ones. The decay percentage of tomatoes for uncoated, corn starch coated and aloevera coated tomatoes were found as 92%, 10% and 5% respectively. Hence, it can be inferred that both the coating materials have potential to enhance the shelf life of tomatoes.

Key words: Aloevera, Corn starch, Edible coating, Physico-chemical properties, Shelf life, Tomatoes.

INTRODUCTION

Application of edible coating on fruits and vegetables is a healthy and eco-friendly post-harvest treatment which is very demanding now a days. Edible coatings create a modified atmosphere around the fruits by providing a semi permeable barrier to water vapor and gases. They prevent loss of firmness and moisture from fruits and vegetables. Edible coating facilitates the transportation, storage and display of fresh and processed commodities (Tavassoli-Kafrani *et al*., 2020). Apart from that several active ingredients can be combined into the polymer matrix and consumed with the food, thus enhancing safety or even nutritional and sensory quality (Dhall, 2013). Edible coatings can be prepared by using polysaccharides, proteins, lipids or from the composite of these materials (Singh and Packirisamy, 2022). As demand for healthy foods is increasing rapidly, various novel materials from herbal sources are extensively being explored as raw materials for edible films/coatings (Maan *et al*., 2021).

Aloevera is a popular herbal plant and has been extensively investigated for application in food, pharmaceutical and cosmetic applications (Maan *et al*., 2018). Aloevera gel is considered as one of the best coating materials, which is edible, safe, and biodegradable (Sarker and Grift, 2021). Aloevera gel has been reported to have lots of beneficial properties like wound healing, preventing bacterial, fungal and viral growth. Over the last decade, it has received considerable attention as edible film/coating owing to its effectiveness towards shelf life extension of various perishable food commodities. Several studies have reported about the effectiveness of aloevera gel coating to prolong the shelf life of various fruits and vegetables (Sophia *et al*., 2015; Mani *et al*., 2017, Mendy *et al*., 2019, Maan *et al*., 2021).

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Starch is a promising polysaccharide used for food coating because of its easy availability and low cost. Starch-based materials show higher permeability to carbon dioxide than to oxygen which is useful to control the respiration rate of fruits and vegetables (Versino *et al*., 2016). The starch world market can mainly be divided into four raw materials: corn, potato, sweet potato and cassava, although the predominant source used to obtain biodegradable coatings has been corn starch. Materials based on corn starch exhibited a more homogeneous and compact structure than films obtained from tuberous starches (Lopez and Garcia, 2012). The effect of corn starch coating on ber and Assam lemon and plum fruit were studied by Mani *et al*. (2017), Ghosh *et al*. (2015) and Bhowmick *et al*. (2017).

Tomato (*Solanum lycopersicum*) is one of the most widely cultivated and widely consumed vegetable in India. The total production of tomato was reported as 21.173 million tonne from 811 thousand ha area in the year 2020-21 (Singh *et al*., 2021). Tomato has a short shelf life at ambient condition. Storage at low temperature effectively delay fruit ripening and senescence but the beneficial effect may be limited by the development of chilling injury associated disorders like internal browning, flesh translucency etc. (Manganaris *et al*., 2007). Post harvest treatments like edible coatings on the surface of fruits and vegetables in refrigerated storage are used to minimize the loss of fresh produce as well as to maintain the quality. Keeping this in view, the present work was undertaken to study the effect of aloevera and corn starch coating on the shelf life of tomato.

MATERIALS AND METHODS

Fully mature tomatoes were collected from a local firm and immediately brought to the laboratory of the Department of Post-harvest Technology, Bidhan Chandra Krishi Viswavidyalaya for storage. After washing and drying in the shade for few minutes the fruits were divided into three lots. First lot of tomatoes was preserved without coating. Second lot of tomatoes was subjected to 1% corn starch coating and the third lot was coated with 95% aloevera juice. Corn starch solution (1%) was prepared by dissolving 1 gm of soluble corn starch to 100 ml of boiling distilled water. The aloevera juice was procured from Health Viva and the juice contained 95% aloevera with 5% stabilizer, acidity regulator and preservatives with no added artificial colour and flavour (Roy and Karmakar, 2019). All the samples were stored at a refrigeration temperature of 5°C.

Parameters analysed

Physiological loss in weight was measured with the help of analytical weighing balance and the result was expressed as percentage loss of initial weight. Moisture content of tomato samples were measured with the help of Halogen moisture Analyser. The sample absorbs the infrared radiation of the halogen moisture analyser and as a result, heats up and dries quickly. Total soluble solids were determined by using a digital refractometer. Firmness was measured by a compression test with a texture analyser (TAXT Plus Texture analyser, Stable Microsystem, UK) using a stainless steel cylindrical probe (P/75) with 60 mm diameter. Vitamin C content of the samples was measured using 2, 6- dichlorophenol indophenol method as described by Anonymous (2000).

Colour characteristics of the coated and uncoated samples were measured in terms of tri-stimulus values of L* (from white to black), a* (green to red) and b* (blue to yellow) value using a Hunter Lab Colorimeter. Total colour difference for coated and uncoated samples was calculated using the following equation.

$$\Delta E = \sqrt{[(\Delta L^*)^2 + [(\Delta a^*)^2 + [(\Delta b^*)^2} \quad ....(1)$$

Decay percentage The coated and uncoated tomatoes were visually observed for fungal spoilage and fruit rots. The number of fruits affected or spoiled was recorded at each storage period and reported in percentage as total fruit decay.

RESULTS AND DISCUSSION

Weight loss

Observations during storage of tomatoes (Fig 1) revealed that the physiological loss in weight was increased for both coated and uncoated ones as the storage period progressed. The physiological loss in weight was maximum in case of the uncoated samples, whereas aloevera coated samples showed minimum physiological loss in weight followed by corn starch coated samples. However, no significant difference in weight loss was seen between aloevera coated tomatoes and corn starch coated tomatoes. At the end of the storage period the weight loss percentages for uncoated, aloevera coated and corn starch coated samples were recorded as 7.3%, 6.01% and 6.05% respectively. This may be due to the fact that coating material acts as a semi permeable barrier against oxygen, carbon dioxide, moisture and solute movement and thereby reduces rate of respiration, water loss and oxidation reaction (Ghosh *et al*., 2015; Mani *et al*., 2017).

Similar results were found by Bhowmick *et al*., (2017) during the storage of plums. 1% corn starch coated plums

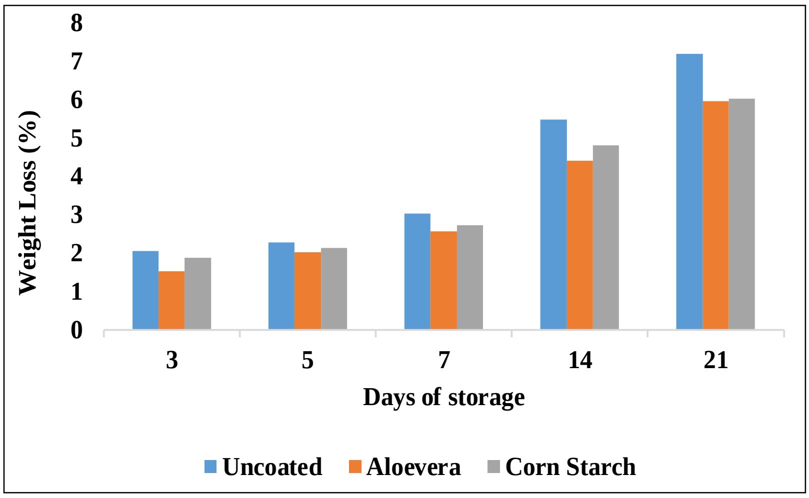

Fig 1: Effect of coatings on weight loss percentage of tomatoes during storage.

showed the lowest physiological loss in weight (10.28%) as compared to uncoated fruits with physiological loss in weight of 32.99%.

Moisture content

The rate of water loss depends on the water pressure gradient between the fruit tissue and the surrounding atmosphere, and the storage temperature (Hernandez-Munoz *et al*., 2008). The coating material acts as a barrier to water diffusion between the fruit and the environment. This can be observed from Table 1. The moisture content of the uncoated tomatoes decreased at a rapid rate in comparison to aloevera coated and corn starch coated tomatoes for all the storage periods. Loss of moisture results in shrinkage of the product which ultimately affects the quality of the product. As the loss of moisture was more in case of uncoated tomatoes, they started to develop considerable shrinkage after 9th day of storage whereas the coated samples remained fresh and did not develop any shrinkage. After 21 days the moisture content of uncoated tomatoes decreased to about 90% whereas aloevera coated and corn starch coated tomatoes maintained their moisture content close to 94%.

Total soluble solid content

The TSS of coated and uncoated tomatoes were found to increase up to a certain period during storage and thereafter it decreased as the storage period progressed (Fig 2). On the 7th day TSS was recorded as highest for both the coated and uncoated samples. The increase in total soluble solids may be due to the complete hydrolysis of starch into simple sugars up to the 7th day of storage. After that they along with other organic acids act as substrate for respiration causing a continuous decrease in TSS for rest of the storage period (Kanmani *et al*., 2017). However the rate of change of TSS was more in uncoated tomatoes than the coated ones. This may be due to the fact that the presence of coating slowed down the rate of hydrolysis of carbohydrates which restricted the initial rise of total soluble solid content (Roy and Karmakar, 2019).

Table 1: Change of moisture content of tomatoes during storage.

Days of storage	Moisture content (%)		
	Uncoated	Aloevera coated	Corn starch coated
0	96.25	96.17	96.34
3	95.50	96.07	95.78
5	95.14	95.87	95.67
7	94.37	95.49	95.12
14	92.31	95.05	94.65
21	89.64	93.73	93.47

Table 2: Firmness of tomatoes during storage.

Days of storage	Firmness (N)		
	Uncoated	Aloevera coated	Corn starch coated
0	29.0	29.1	29.2
3	26.9	28.5	27.7
5	26.5	27.9	27.1
7	25.7	27.5	26.8
14	24.6	26.9	26.3
21	23.3	26.2	25.8

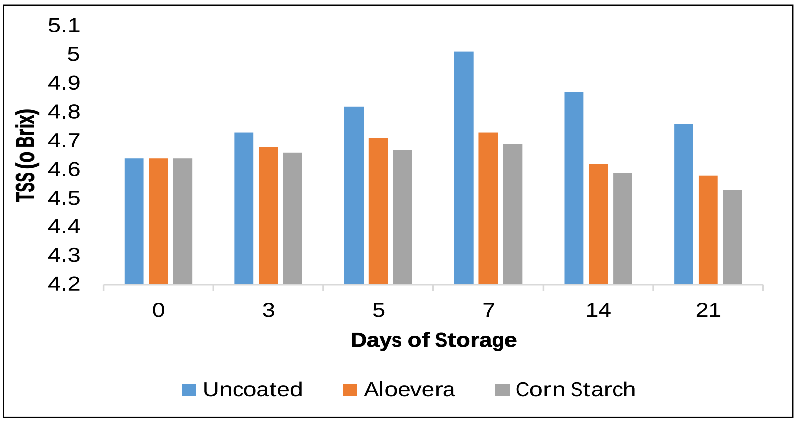

Fig 2: Effect of coatings on total soluble sugar content of tomatoes during storage.

Vitamin C content

Vitamin C acts as an antioxidant and is naturally present in sufficient quantity in most of the fruits and vegetables. The variety, stage of maturity and environmental factor play significant role on the vitamin C content of tomatoes. Vitamin C content of both coated and uncoated tomatoes decreased over the entire storage period (Fig 3). Initially no significant decrease in Vitamin C content was observed for coated samples upto 7th day whereas a gradual decrease was observed for uncoated samples. At the end of the storage period coated tomatoes retained more vitamin C than uncoated ones. This may be due to the fact that aloevera coating and corn starch coating acted as gas barrier, inhibiting oxygen from entering the fruit, thus reducing the oxidation of Vitamin C. Oxidation of food materials can be prevented by eliminating exposure to oxygen by removing oxygen from the packaging headspace and adding antioxidants to films and coatings to enhance the antioxidant properties of food surfaces (Sahraee *et al*., 2019). But at later stage of storage it was lost due to the activities of two enzymes - phenol oxidase and ascorbic acid oxidase (Ghosh *et al*., 2015).

Firmness

The firmness is a textural property that is primarily sensed by touch. The firmness of both coated and uncoated tomatoes decreased progressively during the entire storage period (Table 2). At the end of 21 days storage period coated fruits maintain better firmness than uncoated ones. It was observed that corn starch coated tomatoes showed highest value of firmness. Storage at low temperature is a common practice to slow down the softening of fruit tissue. Further the softening process was found to be slowered down by the application of edible coating. This may probably happened because slower respiration rate of coated tomatoes cause lesser degradation of water insoluble calcium pectate or Calcium Bridge that renders the strength to the fruit skin (Mani *et al*., 2017).

Colour

Colour change values were calculated using Eq. (1) and are presented in Table 3. Colour change values were lowest for the corn starch coated tomatoes at the end of the 21 days storage period. Colour change values were observed as 11.8, 9.59 and 4.39 for uncoated, aloe vera coated and corn starch coated tomatoes, respectively. Misir *et al*, (2014) reported that aloevera gel treatment delayed the green colour loss on the fruit skin of apples stored at 2°C for 6 months. However Khodaei *et al*. (2021) found no change in colour for coated and uncoated strawberries stored at 4°C and 80% RH for 16 days.

Decay percentage

Table 4 reveals that there was no decay for coated tomatoes upto 14 days of storage. The aloevera coated tomatoes showed minimum decay percentage (5%) followed by corn

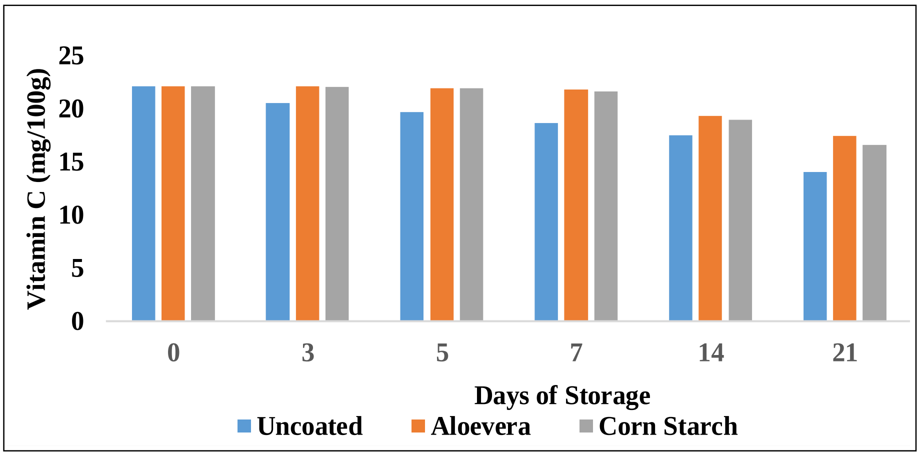

Fig 3: Effect of edible coatings on Vitamin C content of tomatoes during storage.

Table 3: Colour change values of tomatoes during storage.

Days of storage	Colour change values (“E)		
	Uncoated	Aloevera coated	Corn starch coated
0	0.00	0.00	0.00
3	1.73	1.04	1.37
5	3.64	2.76	1.39
7	5.08	3.98	1.68
14	8.75	7.04	2.00
21	11.8	9.59	4.39

Table 4: Decay percentage of tomatoes during storage.

Days of storage	Decay percentage (%)		
	Uncoated	Aloevera coated	Corn starch coated
0	0	0	0
3	0	0	0
5	0	0	0
7	15	0	0
14	50	0	0
21	92	5	10

starch coated tomatoes (10%) and uncoated tomatoes (92%) at the end of 21 days storage period. The decrease in decay percentage was probably due to the fact that coating delayed senescence, which makes the product more resistible to pathogenic infection as a result of cellular or tissue integrity (Ghosh *et al*., 2015). Khodaei *et al*. (2021) reported that uncoated strawberries exhibited the highest level of 59.6% decay at the end of 16 days of storage period while it was the lowest of 32.66% for the strawberries coated with Carboxymethyl Cellulose.

CONCLUSION

The aloevera gel coating and corn starch coating was found useful for extending the shelf life of tomatoes. The change in different properties like TSS content, Vitamin C content, firmness, colour, moisture content, weight loss during storage were less in case of coated tomatoes in comparison to the uncoated ones. Thus the quality of the product was maintained better with the surface coating of tomatoes. The coated tomatoes also showed the lesser percentage of decay.

Conflict of interest: None.

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