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# APPLICATION OF ALOEVERA GEL BASED EDIBLE COATING TO MAINTAIN POSTHARVEST QUALITY OF TOMATOES

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To address the major issue of postharvest losses (20-50%) of a productive crop like tomatoes, a novel aloevera gel based edible coating was developed as postharvest treatment. The objectives of this study were to develop and optimize aloevera gel based edible coating and to study the effect of storage on physicochemical parameters related to tomato quality and safety. For this purpose, an edible coating from aloevera gel was developed, analyzed and applied to tomatoes. There were five treatments ($A_0$, $A_{20}$, $A_{40}$, $A_{60}$, $A_{80}$) varying in aloevera gel concentration from 0 to 80%. Samples having different percentages of aloevera gel were analyzed for their, physiochemical, textural and microstructural parameters during storage period of 30 days at refrigerated conditions with an interval of 10 days. Control treatment ($A_0$) showed rapid deterioration with an estimated shelf life of 14 days as compared to $A_{80}$ treatment with extended shelf life of 35 days. Percent weight loss, Size modification, decay percentage, color changes and decrease in firmness was higher for $A_0$ (control) 20, 13, 92, 31.69 and 37%, respectively, whilst the minimum in $A_{80}$ (Tomatoes coated with 80% aloevera gel) as 4, 0.4, 7.69, 19.73 and 11.46%, accordingly. A significant decrease in acidity value of control tomatoes was observed from 4.56±0.32 to 4.28±0.03 as compared to $A_{80}$. Microstructural analysis showed that coating tomatoes with coating solution having 40% aloevera gel gave uniformity and continuity on the surface of tomatoes It was concluded that aloevera gel could be an excellent edible coating material and should be used commercially as a technologically viable postharvest preservation technique for fresh produces.
**Keywords:** Tomatoes, aloevera, food preservation, shelf life, edible coatings, anaerobiosis, microbial contamination.

## INTRODUCTION

Tomato is productive and protective crop worldwide in terms of its nutritional, therapeutic and economic status. Global production and trade of tomato increased considerably since 2000. Fresh tomatoes can be kept refrigerated (below 40°F) but spoil over time due to microbial contamination. Tomato has a long array of nutrients and functional components (Kotikova *et al.,* 2011). Tomato has gained the status of functional food also as it is rich in bioactive components that are effective against certain health issues, especially cancer (Canene-Adams *et al*.,2005). During storage and transportation, functional components of tomato fruit decrease gradually. Fungal infections, physiological disorders and physical injuries are considered major causes for postharvest losses in tomatoes. To reduce postharvest losses and to extend shelf life of fresh tomatoes many techniques have been developed, ranging from cold storage to modified atmosphere packaging (MAP). These methods have also shown some ineffectiveness such as chilling injury caused by cold storage and fermentation in MAP. There is an immense need to develop desirable methods that could improve or compliment current techniques. Edible coating seems to be one of the approaches to increase the shelf life of the produce by preventing anaerobiosis in delicate and soft textured fruit like tomato (El Ghaouth *et al*., 1992).

*Aloevera,* a plant species of Asphodelaceae family, has a long history to be used as a medicinal plant with diverse therapeutic applications. The origin of its name "aloe" is derived from the Arabic "alloeh" meaning bitter shiny substance. Due to its extensive uses in pharmaceutical, cosmetics and food, aloevera gel processing has become a widespread industry. Aloevera gel is claimed to have biological and pharmacological activities such as antioxidant, gastroprotective, hepatoprotective, antimicrobial, Immuno-modulatory, hypolipidemic and hypoglycemic (Hamman, 2008). After careful evaluation of its toxicology, aloevera has a high potential source to be used on a large scale especially in food industry (Eshun and He, 2004).

Consumer demand is increasing day by day for food that is microbiologically safe, convenient and has a long shelf life especially in case of fresh produce. New processing and preservation strategies are being developed to ensure food quality, safety and to enhance shelf life. Use of edible coating was initiated in 12$^{th}$ Century as wax coatings. in addition to natural coating, that is ripped off during harvesting and transporting and makes produce an easy target to microbial and mechanical damage (Vieira *et al.,* 2016).

The edible coatings are directly applied to surface of fruits and vegetables to slow down the respiration rate and ripening process. A perfect edible coating material should be nontoxic, ecofriendly, semipermeable, stable, digestible and with good adhesion ability enriched with functional ingredients for extra health benefits and structural integrity. The most commonly used edible coating material are polysaccharides, proteins and lipids based with some additives and sometimes composite films are also prepared using two types of compounds in one formulation. Now trend has shifted towards using natural ingredients which are inherently enriched with some functional compounds; for example, antimicrobial agents. Polysaccharides in coating formulations serve many purposes in favor of shelf life stability due to their hydrophilic nature, gas barrier properties and high water vapor permeability (Vogler and Ernst, 1999). The major part of aloevera gel is composed of polysaccharides rendering it one of the best coating materials.

Aloevera gel is a biologically safe coating material due to its biodegradability, film forming properties and antimicrobial action. A number of constituents present in aloevera gel are believed to function in antimicrobial activity against various microorganisms. Aloevera gel based edible coatings are green alternative to already existing synthetic coating materials with rich antimicrobial agents (Alemdar and Agaoglu, 2009).

Papaya fruits were treated with aloevera gel along with citric acid and ascorbic acid and coated fruits shelf life was extended up to 15 days from 5 days (Marpudi *et al.*, 2011). Oranges were treated with aloevera gel in combination with ascorbic acid and citric acid and then stored for 8 weeks and it was concluded that coated oranges shows better quality characteristics (Arowra *et al.*, 2013). Juan *et al*. (2005) and Valverde *et al*. (2005) used aloevera gel based edible coating to maintain quality and safety of table grapes. They dipped a group of common table grapes (Crimson Seedless) into aloevera gel which resulted in reduction of rachis browning, berry decay and microbial proliferation. Shelf life was also extended up to 29 days. Untreated grapes appeared to deteriorate rapidly in 7 days and gel coated grapes were well-preserved for up to 35 days and were Firmer and had less weight and color loss. Ergun and Saticis (2012) Studied effect of aloevera gel (0, 1, 5 and 10 %) coating on green colored 'Grany smith' and red color'Red chief apples. Result showed that higher concentration of aloevera was more effective. Yulianingish *et al*. (2013) developed and tested an aloevera gel based edible coating for minimally processed cantaloups. Coated fruits show reduced weight loss and color changes and retained maximum firmness. Athmaselvi *et al.* (2013) investigated effect of aloevera based coating on quality parameters of tomatoes. Shelf life was extended up to 39 days. It was evaluated that particular solid percentage of aloevera gel promotes quality attributes. Combined effect of nitric oxide (at 0, 1, 5 and 10 µmol L-1) and aloevera gel (at 25 and 33 %) on postharvest life and quality of sweet cheery (Prunus avium cv. Napoleon) fruit was investigated by Asghari *et al.* (2013). A novel edible coating based on aloevera gel was used as postharvest treatment to maintain quality and safety of sweet cherry (Bernalte *et al*., 2013). Treatment of fruit with 5 and 10µmol nitric oxide and 33% Aloevera gel significantly maintained fruit quality during 30 days of cold storage.

The aim of this work was to develop, analyze and evaluate aloevera gel based edible coating and then optimize its suitable concentration in coating solutions that are effective for shelf life extension and quality retention of tomatoes. To study the effect of functional ingredients of aloevera gel based edible coating on physicochemical, textural, microstructural changes in tomatoes during refrigerated storage.

## MATERIALS AND METHODS

The research was conducted in the fruits and vegetable processing laboratory of National Institute of Food Science and Technology (NIFSAT), University of Agriculture Faisalabad, and Dr. Chen lab, Department of Horticultural Science, College of Food, Agriculture and Natural Resources, University of Minnesota.

***Procurement of raw material***: Freshly harvested tomatoes (Aquila) at pink stage were purchased from King Produce wholesale Texas. Fresh Aloevera (*Aloe barbadensis Miller*) leaves were purchased from San Rey Produce Inc. Mcallen Fruits and Vegetable store, Texas. Chemicals were purchased from Alfa Aesar and Sigma Aldrich companies. Selected tomatoes were graded and washed with sodium hypochlorite solution (0.05%) to loosen the dirt on the surface to facilitate coating. Later, tomatoes were divided into 5 batches and were stored at 4-10$^{o}$C to avoid browning and undesirable biochemical changes.

***Gel preparation*:** Fresh aloevera leaves were washed with 25% chlorine solution and aloevera gel was separated from leaves by cutting spiky margins carefully and removing outer rind of leaves. Colorless hydro parenchyma gel matrix was blended in high speed blender for 15min at 25°C followed by filtration through filter cloth to remove any coarse rind particles and to obtain homogenous mixture. After that aloevera gel was pasteurized at 70°C for 40 min and then stabilized by cooling.

***Aloevera gel analysis***: Antibacterial/Antifungal activity of aloevera gel was conducted by disc diffusion method (DDT) as described by Arunkumar and Muthuselvam (2009). DPPH radical scavenging activity was determined by following the procedure of Yun Hu *et al.* (2003). Total soluble solids were determined by digital refractometer. Acidity and pH of aloevera gel was determined by in motion flex Mettler Toledo Titrator. USS-DVT4 digital rotatory viscometer was used to determine viscosity of aloevera gel.

***Preparation of coating solution***: Coating solutions containing different concentrations of aloevera gel (0, 20, 40, 60 and 80%) were prepared by adding additives calcium

chloride (2%) as crosslinking agent, ascorbic acid (4%) as an antioxidant, carboxy methyl cellulose (CMC) (3%) as thickener and glycerol 2% to avoid precipitation. Rest of the volume was made up by adding distilled water and homogenizing all the additives, aloevera gel and water together to get homogeneous and smooth mixture of coating gel solutions approximately 4 L of coating solution was prepared for each batch. Table 1 shows formulation of aloevera gel coating solutions with different aloevera gel percentages.

***Analysis to determine coating gel efficiency***: Coating thickness was determined by drying and making films of coating solutions as described by Daniel and Yanyun, (2007). Tabletop scanning electron microscopic (TM3030) analyses were conducted to examine microstructure of coating solutions. TSS, pH, acidity and viscosity were determined by following the same method as for aloevera gel. The coating was applied on tomatoes by immersion method.

***Application of coating*:** Tomatoes that were already divided into 5 lots were washed with distilled water and then dipped into coating solution for 15 min followed by drying for 15-20 min on wire racks at room temperature to drip any excess solution. The coated tomatoes were stored at refrigeration temperature of 9±1°C in baskets for 30 days for further analysis. Different physicochemical, microstructural, textural and statistical tests were performed at regular intervals of 10 days within 30 days of storage.

**Physicochemical Analysis:**

***Acidity and pH*:** Titratable acidity and pH of tomatoes were measured by in motion flex Mettler Toledo Titrator.

***Physiological loss in weight (PLW)/ percent loss in weight*:** Physiological loss in mass was calculated according to the procedure by Valverde *et al*. (2005). Tomatoes from each batch were taken and the mass of individual tomatoes was recorded on the day of coating and at every 10 days' interval for 30 days' storage period. Cumulative weight losses were calculated.

***Fruit size*:** The mean size of tomatoes was measured by Digital Vernier caliper vertically (length) and horizontally (diameter) and average value was calculated according to Marpudi *et al*. (2011).

***Fruit disease index (FDI)/ rate of fruit spoilage*:** FDI/ degree and rate of fruit spoilage was calculated as described by Marpudi *et al*. (2011). The differently coated fruits were visually observed for fungal spoilage and rots. The number of tomatoes infected or spoiled was recorded periodically to assess the effect of different coating solutions on retarding tomato spoilage by using following formula:

$$\text{FDI (\%)} = \frac{(0xa) + (1xb) + (2xc) + (3xd) + (4xe)}{a + b + c + d + e} \times \frac{100}{X}$$

Where, (0, 1, 2, 3, 4, 5) = Infected categories (0= no lesion, 1=5-15%, 2=15-25%, 3=25-50%, 4=50-75%, 5=75-100%); (a, b, c, d, e) = Number of tomatoes fall into infectious categories; X = Maximum number of infection categories

***Decay (%)*:** Decay percent of all tomato samples was determined by following the method of Asgar *et al.* (2010).

***Texture (firmness, hardness, and cutting efficiency)*:** For measuring hardness of tomatoes GY-4 Fruit Penetrometer was used. Two different probes of different diameters 3.42mm and 7.87mm were used and mean values in Force (N) were recorded. TA.XT plus texture analyzer (Texture Technologies, Hamilton, MA) interfaced to a personal computer was used to measure cutting efficiency (force (N) needed to cut slices of tomatoes) and firmness of tomatoes by a cutting blade and flat steel plate by applying a force 1KN (Romero *et al.*, 2006).

***Color*:** Color of tomatoes from each batch was inspected by following the method of Andres *et al.* (2014) using chroma meter CR-400/ 410 (Konica Minolta). Total color differences, Chroma value and Hue angle were determined by the following formula:

$$\Delta E = \sqrt{\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2}}$$

Where, ΔE = Total color difference; ΔL* = L* sample- L* standard; Δa* = a* sample- a* standard; Δb* = b* sample- b* standard

$$\text{Chroma value (C)} = \sqrt{a^{*2} + b^{*2}}$$

$$\text{Hue angle (H*)} = tan^{-1} b^*/_{a^*}$$

***Total soluble solids*:** Total soluble solids were determined by Digital refractometer Atago 3810 (PAL-1).

***Microstructural analysis*:** Tabletop Scanning electron microscope (TM3030) was used for examining all aspects of microstructural changes in tomato skin during storage.

***Statistical analysis*:** Data for the physicochemical parameters were subjected to descriptive statistical analysis of variance (ANOVA) under two-way factorial design with interaction. Sources of variation were time of storage and variance and interaction treatment × storage. Mean multiple all pairwise comparisons were performed using HSD Tukey's test to examine if difference between treatment and storage time

**Table 1. Aloevera gel based edible coatings formulation: (Total 4 L (4000 mL) quantity for 1 batch of tomatoes).**

| | Aloevera gel (mL) | Glycerol (2%) (mL) | Ascorbic acid (4%) (mL) | CMC (3%) (mg) | $CaCl_2$ (2%) (mg) | Distilled water (mL) |
|---|---|---|---|---|---|---|
| $A_0$ | 0 | 80 | 160 | 120 | 120 | 3520 |
| $A_{20}$ | 800 | 80 | 160 | 120 | 120 | 2720 |
| $A_{40}$ | 1600 | 80 | 160 | 120 | 120 | 1920 |
| $A_{60}$ | 2400 | 80 | 160 | 120 | 120 | 1120 |
| $A_{80}$ | 3200 | 80 | 160 | 120 | 120 | 320 |

were significant at $P \leq 0.05$. All analyses were performed with Statistics 8.1 software.

## RESULT AND DISCUSSION

***Aloevera gel analysis*:** Antibacterial and antifungal activity of aloevera gel was analyzed against *Staphylococcus aureus*, *Escherchia coli* and *Aspergillus niger* by disc diffusion test (DDT). Zones of inhibition (mm) were measured by Vernier caliper as diameter of zones is directly proportional to effectiveness against pathogens. Undiluted aloevera gel was compared to diluted aloevera gel, control (distilled water) and reference antibiotic agent (Ampicillin and Clotrimazole). The results and percentage decrease in zone of inhibition after 96hours are presented in Table 2 aloevera gel exhibit maximum zone of inhibition against *Escherchia coli* and *Aspergillus niger* and minimum zone inhibition was shown against *Staphylococcus aureus*. Maximum decrease was also shown by *Staphylococcus aureus.* Maximum percentage decrease was also shown by *Staphylococcus aureus* that was 18.51% and for *Escherchia coli* and *Aspergillus niger*, it was 3.84 and 3.51%, respectively. Figure 1 shows that aloevera gel exhibit excellent antifungal properties as even diluted aloevera gel shows positive results against fungal strain. Antifungal activity of aloevera gel is more than clotromazole.

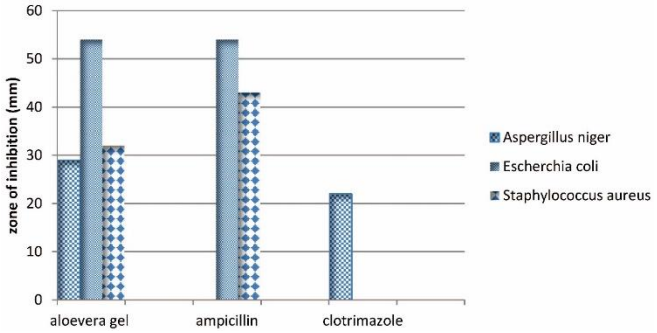


**Figure 1. Comparison of zone of inhibition of aloevera gel as compared to reference antibiotics.**

The radical scavenging activity of aloevera gel was determined by DPPH radical scavenging method. The antioxidant activity of aloevera gel was compared to reference antioxidants butylated hydroxy toluene (BHT) and α-tocopherol and Table 3 shows that antioxidant activity of aloevera gel is closer to vitamin E (α-tocopherol) in terms of percent inhibition. Percent inhibition is measured by observing the absorbance and using the following formula.

$$\% \text{ Inhibition or DPPH radical scavenging activity} = \frac{A0-A1}{A0} \times 100$$

Where, $A_0$ = Absorption of control (0.56), $A_1$ = Absorption of (BHT, α-tocopherol and aloevera gel) measured at 60 min

Figure 2 shows decrease in absorbance (wavelength = 517nm) for two reference antioxidants. Aloevera gel and values of absorbance were calculated at 60minutes interval. The values of absorbance for BHT, α-tocopherol and aloevera gel were 0.359, 0.417 and 0.456.

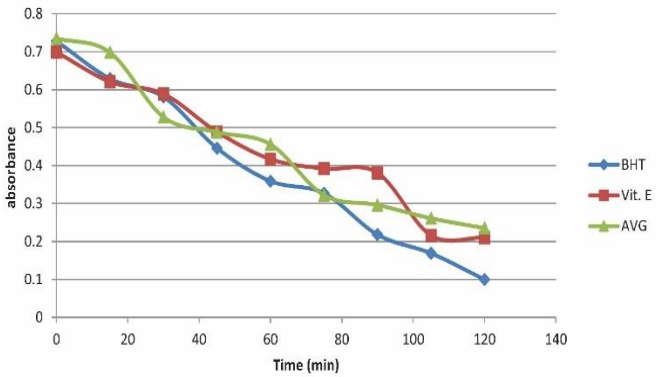


**Figure 2. Antioxidant potential of aloevera gel.**

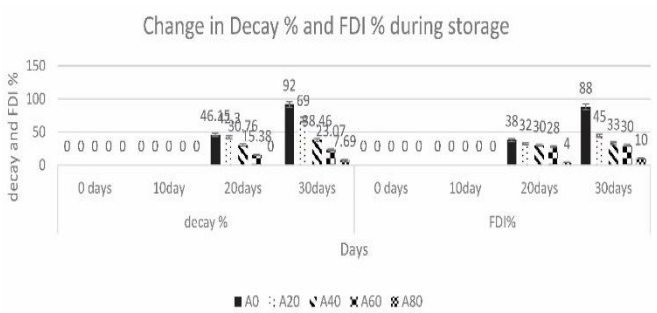


**Figure 3. Decay % and fruit disease indices during storage.**

**Table 2. Antimicrobial potential of raw aloevera gel.**

| Bacterial/Fungal Strain | Zone of inhibition (mm) Aloevera gel | | | | Zone of inhibition (mm) Reference Antibiotic | | | |
|---|---|---|---|---|---|---|---|---|
| | Undiluted gel | | Diluted gel (20%) | | Ampicillin (Antibacterial) | | Clotrimazole (Antifungal) | |
| | 48h | 96h | 48h | 96h | 48h | 96h | 48h | 96h |
| *Aspergillus niger* | 29 | 28 | + | + | – | – | 22 | 22 |
| *Escherchia coli* | 54 | 52 | – | – | 54 | 54 | – | – |
| *Staphylococcus aureus* | 32 | 27 | – | – | 43 | 43 | – | – |

–, No inhibition: +, Zone of inhibition ≤ 8mm

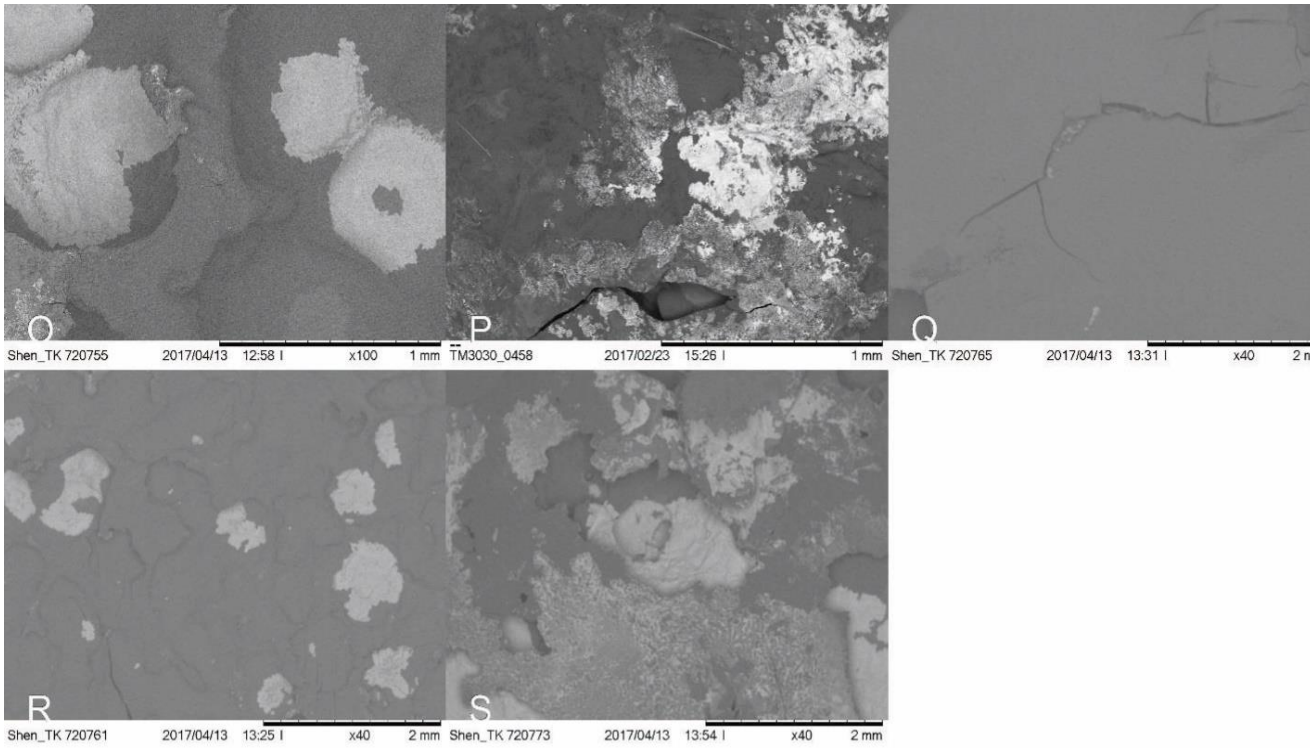


**Figure 4. Microstructural (SEM) images of dried aloevera gel coating alone.**
O= Coating with 0% aloevera gel, P= Coating with 20% aloevera gel, Q= Coating with 40% aloevera gel, R= Coating with 60% aloevera gel, S= Coating with 80% aloevera gel

It can be concluded that phenolic components present in aloevera gel are responsible for its remarkable antioxidant potential. Microstructure of coating solutions (Fig. 4) with different aloevera gel concentration depicts noticeable changes in appearance under microscope. Mehyar *et al.* (2014) also examined edible coatings consisting of pea starch, whey protein isolates and carnuba waxes under scanning electron microscope. Coating solution with 0% aloevera gel shows most porous structure and large pores can be seen throughout the dried film. Coating solution with 40 and 60% of aloevera gel were most homogenous and uniformly distributed without any pores, ridges and cracks.

**Table 3. Antioxidant potential of aloevera gel.**

| Antioxidant | % Inhibition |
|---|---|
| BHT | 35.9 |
| A-tocopherol | 25.6 |
| Aloevera gel | 18.5 |

**Table 4. Other parameters of pure aloevera gel.**

| | |
|---|---|
| Total soluble solids | 16.48 |
| Acidity | 4.89 g/L |
| pH | 6.8 |
| Viscosity | 1074 m.Pa |

All these results are in accordance with Arunkumar and Muthuselvam (2009) who analyzed physicochemical constituents of aloevera gel.

***Coating gel solution analysis*:** Coating thickness was determined by forming cast films after spreading the films on craft paper and drying them. Ten cast films were stacked on each other and thickness was measured by using Vernier caliper. The values given in Figure 5 are mean ± SD.

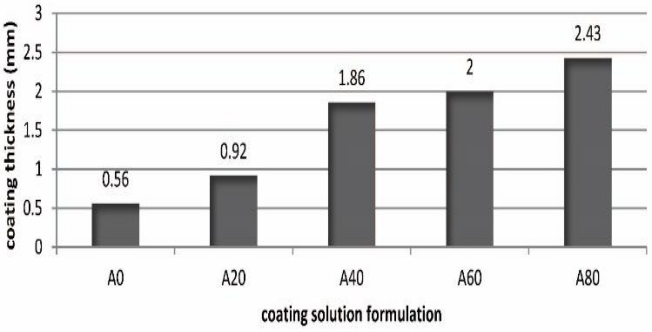


**Figure 5. Coating thickness of different coating solutions.**

It is concluded from the result that coating thickness varies with viscosity, density and draining time of solution. Daniel and Yanyun (2007) states that it relates to square root of

viscosity and inverse square root of draining time. Coating thickness can affect the internal gas composition of fruit that is a crucial factor in determining shelf life of fresh produce. The results shown in Figure 5 depict that with increasing aloevera gel concentration upto 80% the coating thickness also increased. The results of coating thickness are in accordance with Garcia *et al*. (2009). Thicker coating creates hindrance in migration of gases and moisture, thus ensures reduction in respiration rate and moisture loss that affects shelf life and quality of tomatoes. Extra thick coating can induce anaerobiosis that leads to rapid quality deterioration. Figure 6 shows relation between viscosity and coating thickness. Viscosity values are in m.Pa and determined by rotatory viscometer using specific spindle and rotation per second (rpm).

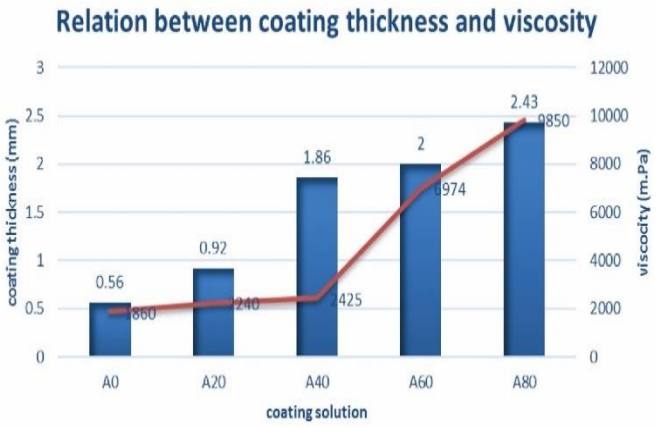


**Figure 6. Relationship between coating thickness and viscosity.**

Viscosity is increased in coating solution with increasing aloevera gel concentration thus coating thickness is also increased. The values of TSS, pH and acidity are given in following Table 5 shows that with increasing aloevera gel concentration acidity were decreased and pH and TSS values were increased. Figure 4 shows microstructural analysis of different coating solutions through scanning electron microscope depicting more homogenous and uniform coating of aloevera coating solution with40% and 60% aloevera gel.

**Table 5. Analysis of different coating solutions.**

| | TSS (Brix) | pH | Acidity (g/L) |
|---|---|---|---|
| A0 | 9.3±0.01 | 3.72±0.33 | 4.30±0.19 |
| A20 | 11.0±0.01 | 3.90±0.10 | 4.03±0.13 |
| A40 | 12.3±0.01 | 4.01±0.02 | 3.75±0.25 |
| A60 | 12.9±0.01 | 4.27±0.28 | 3.42±0.05 |
| A80 | 15.2±0.01 | 4.58 ±0.01 | 3.20±0.14 |

Number of replicates for each value= 3

***Physicochemical analysis of tomatoes after application of coating*:**

***Physiological loss in weight*:** Weights of tomatoes were significantly affected by storage time and not by treatments. Means Table 6 exposed that weight loss of tomatoes without aloevera gel coating solution was gradually increased as compared to aloevera gel based coating treated tomatoes. It was revealed that tomatoes coated with formulation without aloevera gel showed weight loss up to 20% while the formulation with the highest concentration of aloevera showed only 4% loss in physiological weight. With the 20, 40 and 60% aloevera gel coating solutions, weight loss of treated tomatoes was 11.41, 8.51 and 5.00%, respectively. Weight loss was most obvious between 20 and 30 days of storage due to adverse conditions created by microbial contamination. Maximum weight loss was shown by treatment $A_0$ that is 23g and minimum was shown by $A_{80}$ due to thick coating layer that is only 5g. Thicker coating resulted in less moisture migration and valuable components are reserved and weight loss minimized. Main reasons for rapid weight loss are transpiration and loss of carbon reserves during respiration (Volger and Ernst, 1999). Water loss rate depends upon water pressure gradient across fruit skin and surrounding atmosphere. These results are in accordance with a study conducted by Velverde *et al.* (2005) who dipped grapes in aloevera gel-based coating and found that the shelf life of grapes was improves due to decreased moisture loss. Coating tomatoes with aloevera gel-based edible coating creates a physical barrier that reduces transfer of moisture from the inside of the fruit to the outside, and vice versa. In this way dehydration and tomato shriveling can be controlled. This property of aloevera gel is due to its hygroscopic nature, presence of hydrophobic compounds and higher

**Table 6. Change in physiological weight (g) of tomatoes.**

| Treatments | Storage days | | | | Mean |
|---|---|---|---|---|---|
| | 0 | 10 | 20 | 30 | |
| $A_0$ | 115.50a | 107.44a | 101.60a | 92.37a | 104.23±0.34a |
| $A_{20}$ | 115.59a | 111.26a | 107.88a | 102.40a | 109.98±0.65a |
| $A_{40}$ | 108.73a | 104.26a | 101.98a | 99.47a | 103.61±0.43a |
| $A_{60}$ | 118.27a | 117.14a | 114.46a | 112.35a | 115.55±0.01a |
| $A_{80}$ | 123.01a | 121.72a | 120.26a | 118.11a | 118.26±0.02a |
| Mean | 116.22±0.34a | 112.36±0.43a | 109.22±0.23a | 105.94±0.12a | |

polysaccharide content which creates a water barrier between tomato skin and outside environment (Morillon *et al*., 2002).

***Fruit size*:** Diameter and length of tomatoes were first measured, and then average values were calculated. Data presented in Table 7 show that there was no change in size of tomatoes treated with $A_{80}$ during storage, but tomatoes treated with the basic coating formulation without aloevera gel showed change in size of tomatoes up to 7.87mm over time. Differences among treatment means are due to amount, adherence, viscosity, formulation and thickness of coatings. The coating formulation with 80% aloevera gel tends to form a thicker layer around tomatoes compared to the other treatments, so tomato size with the $A_{80}$ treatment is larger to some extent. Only 0.4% change in size is observed in case of $A_{80}$ as compared to 13% size modification in $A_0$. A thick coating of aloevera causes less moisture loss so shrinkage does not occur and size remains constant (Sai *et al.*, 2011). Size and surface area of tomatoes also changes during storage. Change in size of tomatoes may be attributed to moisture loss, shivering and loss of other compounds as well. Sometimes microbial contamination or environmental changes can also affect the size of fruits and vegetables by inducing certain biochemical reactions. Size also plays a significant role in sensory perception of fresh produce that ultimately affects consumer acceptability. It is a general perception that smaller tomatoes are firmer then large ones. Tissue density in cell walls of small fruit is higher because of large cell size in small fruits (Sams, 1999).

***Fruit disease index (FDI), decay% and rate of fruit spoilage*:** External appearance, softening, textural changes and macroscopic fungal growth of each batch of tomatoes were visually examined. Decay was calculated by counting the number of decayed fruits divided by the initial number of fruits for a storage period of 30 days. Decay was not evident until 20 days after storage Figure 3. Tomatoes coated with the basic coating solution without aloevera gel showed 92% decay while tomatoes coated with 80% aloevera gel showed only 7.69% decay at day 30. Sign of fungal infection were visible in treatment $A_0$ just after 10 days of storage. The data indicate that coatings with higher concentration of aloevera gel significantly reduced decay of tomatoes. Coating acts like a barrier and the anti-fungal activity of aloevera gel makes it a difficult target for pathogenic attack, so cellular integrity remains intact. The results presented here are in accordance with Tanada and Grosso (2005) and Sanchez *et al.* (2015) who used different edible coating materials with different fruits. Fruit disease index is a measure of pathogenic attack and disease evaluation of fruits during postharvest storage. It provides information about the microbial quality of fruits. FDI was only calculated two times during 30 days of storage at $20^{th}$ and $30^{th}$ day of storage. FDI readings were calculated by applying a formula that covers many infectious categories, but final readings were taken as FDI %. Results showed that $A_{80}$ aloevera gel coated tomatoes showed very low disease index (10%) at $30^{th}$ day of storage while other formulation without aloevera gel coating showed a 38% rate of spoilage at the $20^{th}$ day. No tomatoes show disease indexes upto the $15^{th}$ day of storage.

***Acidity, pH and total soluble solids*:** During postharvest storage, fruits and vegetables undergo many compositional and physicochemical changes. Tomatoes changed in acidity, TSS and pH values during 30 days' storage (Table 8). Changes in values of these parameters are due to biochemical reactions and metabolite production due to microbial contamination of tomatoes. Differences in values were significant between different treatments and during one month of storage control treatment show a significant increase in pH and TSS and decrease in acidity values occurred. There was no difference in pH values between treatments at 0 day but during storage a significant 36% increase in pH was observed for the control treatment. The $A_{80}$ treatment did not result in an increase in pH value during 30 days storage period, which shows that biochemical reactions leading towards ripening and decay are slowed by aloevera gel-based coating. Acidity and pH are inversely related to each other. The lowest acidic treatment was $A_{80}$ which had the highest concentration of aloevera gel in its coating layer. During 30 days of storage the $A_0$ treatment showed a 20% decrease while the $A_{80}$ treatment showed no decrease in acidity. These results show that edible coating with a higher aloevera percentage hindered ripening and senescence process. Mean values for days across all treatments also showed a significant decrease in acidity values from 4.56 to 4.28. pH increased in a similar ratio as acidity decreased. Analysis of variance p value shows that TSS results were highly significant. Total soluble solids also vary with treatment and during storage a significant increase in TSS values were observed; this increase was up to 40% in the $A_0$ treatment and 27% for the $A_{80}$ treatment which

**Table 7. Physiological size (mm) of tomatoes.**

| Treatments | Storage days | | | | Mean |
|---|---|---|---|---|---|
| | 0 | 10 | 20 | 30 | |
| $A_0$ | 58.42a | 57.40a | 56.64a | 50.54a | 55.62±0.02b |
| $A_{20}$ | 58.92a | 57.91a | 56.13a | 53.34a | 56.54±0.03b |
| $A_{40}$ | 59.43a | 58.92a | 53.59a | 52.57a | 56.13±0.23b |
| $A_{60}$ | 59.43a | 59.18a | 59.18a | 57.91a | 58.92±0.09ab |
| $A_{80}$ | 62.48a | 62.48a | 62.23a | 62.23a | 62.48±0.08a |
| Mean | 59.69±0.09a | 59.18±0.32ab | 57.40±0.02ab | 55.37±0.09b | |

**Table 8. Change in pH, acidity (g/L) and total soluble solids (°Brix) of tomatoes.**

| Treatments | Storage days | | | | Mean |
|---|---|---|---|---|---|
| | 0 | 10 | 20 | 30 | |
| pH $A_0$ | 4.41i | 4.51f | 4.98c | 6.88a | 5.20±0.03a |
| $A_{20}$ | 4.50f | 4.50f | 4.81c | 5.97b | 4.94±0.02c |
| $A_{40}$ | 4.41i | 4.44h | 4.44h | 4.55e | 4.46±0.02d |
| $A_{60}$ | 4.45h | 4.45h | 4.44h | 4.47g | 4.45±0.03d |
| $A_{80}$ | 4.98c | 4.98c | 4.99c | 5.00c | 4.99±0.40b |
| Mean | 4.55±0.09d | 4.58±0.054c | 4.73±0.03b | 5.37±0.04a | |
| Acidity $A_0$ | 4.99a | 4.67ab | 4.26ab | 3.98b | 4.47±0.01a |
| $A_{20}$ | 4.66ab | 4.58ab | 4.37ab | 4.66ab | 4.57±0.02a |
| $A_{40}$ | 4.61ab | 4.60ab | 4.48ab | 4.38ab | 4.52±0.03a |
| $A_{60}$ | 4.58ab | 4.52ab | 4.44ab | 4.42ab | 4.49±0.09a |
| $A_{80}$ | 3.99b | 3.98b | 3.96b | 3.96b | 3.97±0.04b |
| Mean | 4.56±0.32a | 4.47±0.02ab | 4.30±0.002b | 4.28±0.03b | |
| TSS $A_0$ | 6.30m | 7.70k | 8.30j | 10.56a | 8.21±0.56c |
| $A_{20}$ | 6.40m | 8.30j | 8.63h | 9.00f | 8.08±0.09d |
| $A_{40}$ | 6.63l | 9.36d | 9.50c | 9.66b | 8.79±0.50a |
| $A_{60}$ | 6.60l | 8.50i | 8.53hi | 8.76g | 8.10±0.76d |
| $A_{80}$ | 6.60l | 8.93f | 9.00f | 9.16e | 8.42±0.16b |
| Mean | 6.50±0.43d | 8.56±0.08c | 8.79±0.98b | 9.43±0.43a | |

means that the aloevera gel-based edible coating delayed the ripening process by slowing down the reactions that produce complex compounds and increased soluble solids. Maximum increase in TSS value occurred in the control treatment up to 10.56% TSS. Results were in accordance with Javanmardi and Kubota (2006), Ergun and Satici (2012) and Romero *et al.* (2006).

***Color*:** An important criterion for consumer acceptability and quality assessment of tomatoes is its bright red color (Aked, 2000). Lycopene and carotenoids are accumulated during the ripening process and green chlorophyll is degraded, contributing red color to tomatoes (Khudairi, 1972).

Tomato is a climacteric vegetable, so respiration continues even after harvest and elevated levels of $CO_2$ are produced which decreases ethylene synthesis and color changes are delayed (Buescher, 1979). Coating of tomatoes with aloevera gel delayed color change, which was probably due to an increase in $CO_2$ and decrease in $O_2$ levels. L*, a* and b* chromacity values were determined and then total color difference, hue angle and chroma values were calculated and compared from average values. L* represents lightness (black, white) and if a sample is whiter this value will be high. The a* value represents green and red color; if this value is high it means there is more red color. Blue to yellow color is determined by b* values that usually decreased during storage. Chroma value represents intensity and saturation and varies from 0 to 60. A high chroma value depicts colorfulness and intensity. Hue angle represents red-purple range at different angles. Total color difference indicates magnitude of color between standard and sample values and calculated by applying formula.

**Table 9. Hue angle for different colors.**

| Hue angle | Color |
|---|---|
| 0° or 360° | Red |
| 90° | Yellow |
| 180° | Green |
| 270° | Blue |

All treatments of tomatoes resulted in change in color L*, a* and b* values during storage. L* values were higher for $A_{80}$ treatment due to white color of coating that was spread out on tomato skin with higher concentration of aloevera. Smaller L* value shows more red color so $A_0$ was dark red due to invisible coating layer during storage L* values decreased for $A_0$ treatment up to 31.69%, but for the $A_{80}$ treatment it decreased up to only 19.73%. This shows that treatment without aloevera gel coating underwent color changes due to high speed of ripening process but ripening process of tomatoes with 80% aloevera gel coating is slow. Aloevera gel based coating interferes with ethylene production and respiration thus slows down the ripening process (Lin and Zhao, 2007). A higher a* chromacity value shows more red color. Treatment without thick aloevera gel coating shows more red color and it increases abruptly in case of control treatment due to ripening. Value b* also decreases in control treatment. Table 10 shows detailed pattern and rise/fall trend of these values. Table 11 shows values for total color difference (ʌE), chroma value (C) and hue angle (h°). Total color difference of each treatment was compared with control treatment. Total color difference decrease for $A_{20}$ treatment but increased for the rest of the treatments. Chroma values showed that intensity of color and saturation also decreased during storage

**Table 10. Change in L*, a*, b* chromacity values of tomatoes.**

| Treatments | | Storage days | | | | Mean |
|---|---|---|---|---|---|---|
| | | 0 | 10 | 20 | 30 | |
| L* | $A_0$ | 38.35i | 36.71j | 31.08l | 26.83m | 33.24±0.83d |
| | $A_{20}$ | 40.85efg | 39.60ghi | 35.45jk | 29.98l | 36.47±0.98c |
| | $A_{40}$ | 42.91cd | 40.13fgh | 38.69hi | 35.11k | 39.21±0.92b |
| | $A_{60}$ | 45.46b | 43.47c | 41.52def | 39.78ghi | 42.55±0.77a |
| | $A_{80}$ | 48.40a | 41.84de | 39.43ghi | 38.85hi | 42.13±0.86a |
| | Mean | 43.19±0.99a | 40.35±0.03b | 37.23±0.03c | 43.19±0.06a | |
| a* | $A_0$ | 15.71d | 16.54c | 19.39b | 22.31a | 18.49±0.03a |
| | $A_{20}$ | 12.28g | 13.91e | 15.77d | 19.73b | 15.42±0.54b |
| | $A_{40}$ | 11.51h | 12.58fg | 13.76e | 15.37d | 13.30±0.065c |
| | $A_{60}$ | 10.88ij | 11.15hi | 12.57fg | 13.88e | 12.12±0.054d |
| | $A_{80}$ | 10.33j | 11.11hi | 13.03f | 13.87e | 12.08±0.098d |
| | Mean | 12.14±0.03d | 13.06±0.05c | 14.90±0.098b | 17.03±0.001a | |
| b* | $A_0$ | 26.66a | 21.10a-e | 15.84d-g | 12.22g | 18.95±0.09b |
| | $A_{20}$ | 18.94bc-g | 17.09c-g | 14.99efg | 13.69fg | 16.18±0.43c |
| | $A_{40}$ | 25.50ab | 25.03ab | 22.59a-d | 20.62a-f | 23.43±0.093a |
| | $A_{60}$ | 23.96abc | 20.80ab-f | 19.62a-f | 18.49b-g | 20.71±0.934ab |
| | $A_{80}$ | 24.37ab | 22.88a-d | 20.51a-f | 19.44b-g | 21.80±0.54a |
| | Mean | 23.88±0.054a | 21.38±0.43b | 18.71±0.34c | 16.89±0.74c | |

**Table 11. Total color difference, Chroma value and Hue angle of tomatoes during storage.**

| | Total color difference $\Delta E = \sqrt{\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2}}$ | | | | Chroma value (C) = $\sqrt{a^{*2} + b^{*2}}$ | | | | Hue (H*) = $tan^{-1} b^*/a^*$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Days** | **0** | **10** | **20** | **30** | **0** | **10** | **20** | **30** | **0** | **10** | **20** | **30** |
| $A_0$ | - | - | - | - | 30.94 | 26.81 | 25.03 | 26.31 | 59.38 | 51.90 | 39.24 | 28.71 |
| $A_{20}$ | 8.80 | 5.62 | 5.73 | 4.32 | 22.57 | 22.03 | 21.75 | 24.01 | 57 | 50.85 | 43.54 | 35.25 |
| $A_{40}$ | 6.30 | 6.54 | 11.62 | 13.68 | 27.97 | 28.01 | 26.45 | 25.71 | 65.65 | 63.31 | 58.65 | 53.29 |
| $A_{60}$ | 9.00 | 8.65 | 13.02 | 16.65 | 26.31 | 23.60 | 23.30 | 23.11 | 65.45 | 61.80 | 57.35 | 53.10 |
| $A_{80}$ | 11.61 | 7.67 | 11.48 | 16.34 | 26.46 | 25.43 | 24.29 | 23.88 | 49.23 | 64.09 | 57.57 | 54.49 |

for all treatments but the highest decrease was shown by the control. $A_{20}$ shows increase in chroma value describing that 20% aloevera gel concentration can give brightness to tomatoes and more concentration can result in dullness and higher L* values. $A_{40}$ chroma value was the highest means this treatment shows brighter color. Hue angle varied from 49.23° to 65.65° showing red to orange color range only. It was highest for $A_{40}$ just like chroma value due to brighter red color. During storage, it decreased for each treatment but increased for the $A_{80}$ treatment. This suggests that thick aloevera gel coatings help to retain color while other treatment color changes during storage towards dullness. Overall complete color analysis shows that during storage period color modifications were slower in coated tomatoes with a high percentage of aloevera gel but thick coatings of aloevera gel can give more lightness and luminosity to tomatoes.

***Texture (hardness, firmness and cutting efficiency)*:** Overall textural attributes of tomatoes directly affect consume acceptability (Sams, 1999). The postharvest ripening process can lead towards softening, over ripening and altered textural properties resulting in loss of quality, sensory properties and restricted shelf life. Basic textural attributes presented in this study are puncture test with two different probes to evaluate hardness in terms of Force (N) applied to puncture the fruit, Firmness determination through flat steel probe measuring deformation (mm) and cutting efficiency through cutting force (g). Two kind of instruments (GY-4 penetrometer and TA.XT plus textural analyzer) and four kinds of probes (cylindrical puncture probes with different diameters, cutting blade and flat plate) were used for whole tomato textural analysis. All of the methods applied for evaluating texture of tomatoes were destructive in nature as degree of deformation was calculated under different probes, except one using a flat plate below 3% strain. The textural quality of tomatoes is influenced by flesh firmness, the ratio between pericarp and locular tissue, and skin. Many kinds of textural modifications occur in tomatoes during storage due to ongoing respiration and ripening (Batu, 1998). Viscoelastic characteristics of tomato changes during storage depend on moisture content, total soluble solids, pectin, cellulose and hemicellulose contents. Other factors affecting texture are variety, degree of

ripeness, hormonal treatment and environmental stress. Results show that firmness was decreased during storage and this ripening-associated softening is due to turgor loss, breakdown of starch, degradation, solubilization and depolymerization of polymer constituents of cell wall for example loss of pectin integrity, metabolism and compositional changes. Addition of calcium chloride in coating solutions and polysaccharide nature of aloevera gel gives structural integrity to tomato fruit (Lin and Zhao, 1999). For measurement of hardness two probes were used with different diameters; probe I had a 3.429 mm diameter while probe II had a 7.874mm diameter to puncture whole tomatoes. Results (Table 12) show significant decrease in hardness during storage. This decreases in hardness is due to polygalacturonase, pectin methyl esterase, endo mannase, cellulases, galactosidase, glucanases induced softening during ongoing ripening process. Force (N) decreased during storage and probe II with the larger diameter exerted more force than probe I. Numeric values for force are recorded and presented in Table 12 with both probes. Force (N) varied from 16.56 N to 23.72 N in the case of probe I but from 35.37 N to 49.93 N in the case of probe II. The probe with the larger diameter tended to exert more force to penetrate the skin tissue. The highest force was recorded for the $A_{80}$ treatment in both cases due to thicker layer of aloevera gel based edible coating on surface of tomatoes. Percent decrease in firmness was highest in the $A_0$ treatment in both cases 37 and 13% for probe I and II, respectively, and for the $A_{80}$ treatment, respectively forces were 11.46 and 5.86%.

Firmness was determined using a flat plate probe pressing method. The weight used was 50 N and the speed was 20 mm/min. Deformation (mm) was calculated for all the treatments and a significant increase in deformation value was recorded for each treatment. The highest deformation value was obtained for the $A_0$ treatment and the percent increase in deformation was also highest for the control treatment. Cutting efficiency of whole tomatoes was measured by increasing the force to 1 KN, and speed was increased to 100 mm/min. The values of force (N) used for cutting the tomatoes in half are presented in Table 13. The deformation value was lowest for the $A_{80}$ treatment and the percent increase in deformation was highest in the $A_0$ treatment up to

**Table 12. Change in hardness (Force N) of tomatoes.**

| Treatments | | Storage days | | | | Mean |
|---|---|---|---|---|---|---|
| | | 0 | 10 | 20 | 30 | |
| Probe I | $A_0$ | 16.56efghi | 14.77hijk | 12.74kl | 10.32l | 13.60±0.03e |
| | $A_{20}$ | 17.78defg | 16.73efghi | 14.36ijk | 13.54jk | 15.60±0.93d |
| | $A_{40}$ | 19.26cde | 17.88defg | 16.25fghij | 15.11ghijk | 17.12±0.01c |
| | $A_{60}$ | 20.91bc | 19.76bcd | 18.07def | 17.18defgh | 18.98±0.04b |
| | $A_{80}$ | 23.72a | 22.25ab | 21.66abc | 21abc | 22.16±0.33a |
| Mean | | 19.64±0.02a | 18.28±0.054b | 16.62±0.054c | 15.43±0.054d | |
| Probe II | $A_0$ | 35.37h | 33.32i | 31.66j | 30.51j | 32.72±0.94e |
| | $A_{20}$ | 37.33g | 35.45h | 33.57i | 31.37j | 34.43±0.04d |
| | $A_{40}$ | 46.11cd | 44.92de | 44.92de | 43.29f | 44.81±0.09c |
| | $A_{60}$ | 47.87b | 46.33c | 45d | 43.66ef | 45.71±0.34b |
| | $A_{80}$ | 49.93a | 49.54a | 48.25b | 47bc | 48.68±0.43a |
| Mean | | 43.32±0.44a | 41.91±0.04b | 40.68±0.43c | 39.16±0.43d | |

**Table 13. Change in Firmness deformation (mm) and cutting efficiency of tomatoes.**

| Treatments | | Storage days | | | | Mean |
|---|---|---|---|---|---|---|
| | | 0 | 10 | 20 | 30 | |
| Firmness | $A_0$ | 2.96de | 3.06cd | 3.30ab | 3.50a | 3.20±0.43a |
| | $A_{20}$ | 2.63fg | 2.86de | 3.06cd | 3.23bc | 2.95±0.54b |
| | $A_{40}$ | 2.36hi | 2.56gh | 2.8ef | 2.96de | 2.67±0.43c |
| | $A_{60}$ | 2.20ij | 2.06jk | 2.20ij | 2.23ij | 2.17±0.54d |
| | $A_{80}$ | 1.73l | 1.93kl | 2.06jk | 2.20ij | 1.98±0.65e |
| Mean | | 2.38±0.34d | 2.50±0.43c | 2.68±0.65b | 2.82±0.5a | |
| C.E | $A_0$ | 52.35hi | 51.69ij | 49.43k | 47.21l | 50.17±0.33e |
| | $A_{20}$ | 53.47gh | 51.74ij | 50.68j | 48.84k | 51.18±0.03d |
| | $A_{40}$ | 56.58de | 55.74e | 54.51fg | 52.11i | 54.73±0.02c |
| | $A_{60}$ | 57.11d | 56.90d | 55.51ef | 54.00g | 55.88±0.03b |
| | $A_{80}$ | 59.77a | 59.17ab | 58.43bc | 57.33cd | 58.68±0.93a |
| Mean | | 55.85±0.03a | 55.05±0.05b | 53.71±0.04c | 51.90±0.09d | |

17.14%. The percent decrease in cutting efficiency was lowest across all storage times (4.08%) for the $A_{80}$ treatment.

***Microstructural analysis*:** Microstructural analysis of tomato skin shows uniformity, adhesion and spread ability of coating solutions and interaction between skin and coating (Fig. 7). These topographic images taken by scanning electron microscope (TM3030) depict the difference between coating formulations and the changes that occurred on tomato skin during storage. In image description for 0 days for control treatment pores are clearly visible. Even the natural waxy coating on tomatoes is not sufficient to lower respiration rate and water loss that leads to quality deterioration. But images for $A_{80}$ shows very thick coating on tomato surface that helps in extending shelf life by restricting rate of respiration and preventing moisture loss but anaerobic degradation can also occur in this case. $A_{40}$ tends to be more uniformly distributed on the surface. After 10 days (Fig. 8) of storage coatings absorbed into the skin efficiently performing their functions and covering the pores entirely to restrict migration of moisture, gases and volatile components and to create hindrance in microbial entry. After 20 days (Fig. 9) $A_0$ coating due to its less thick nature washed off the surface of tomatoes

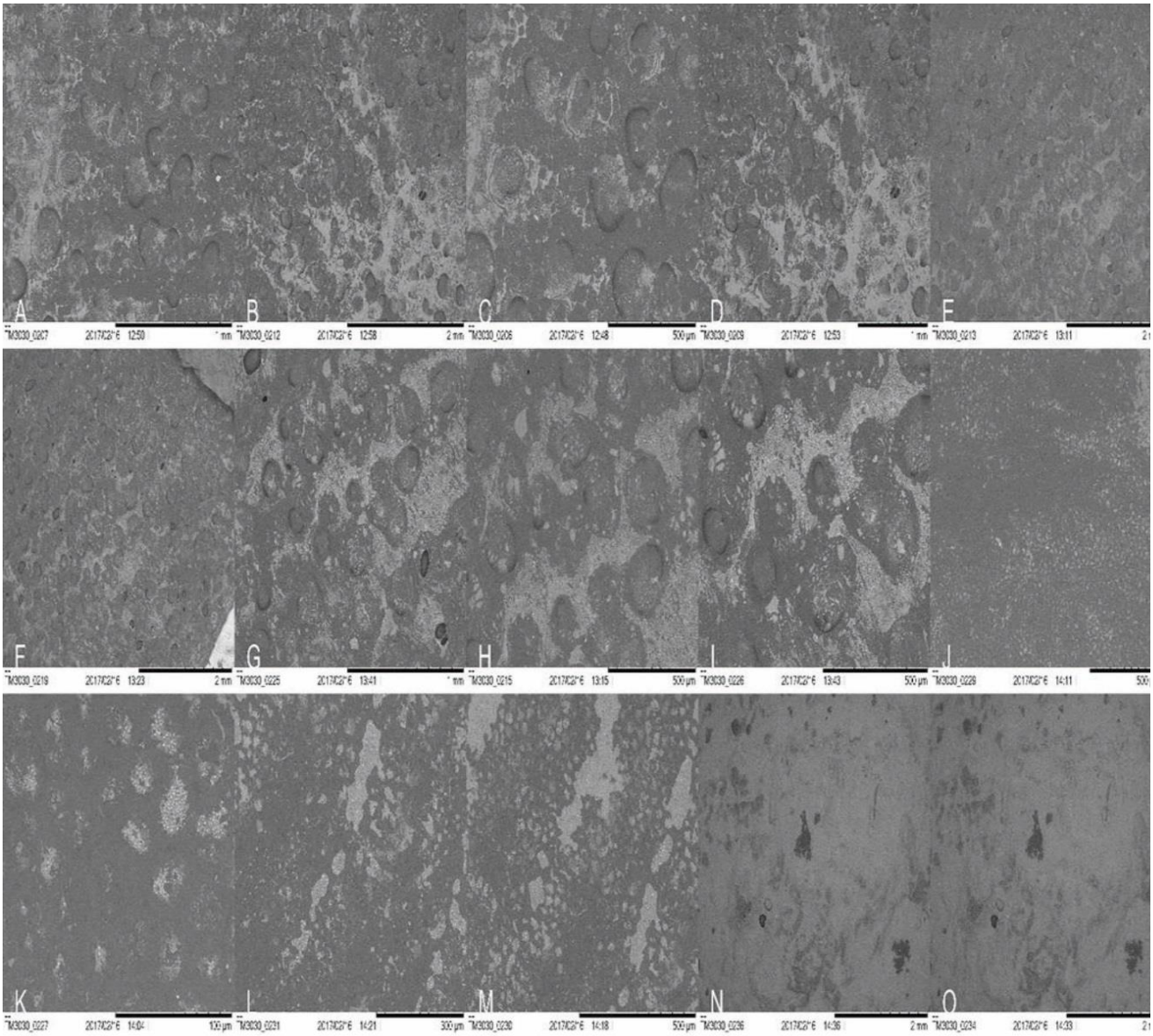


**Figure 7. Microstructural analysis of tomatoes after coating application.**

Image description 0 days: Image A-D: $A_0$ (Tomato skin coated with with 0% aloevera gel concentration; E-I: $A_{20}$ Tomato skin coated with 20% aloevera gel concentration; J-K: $A_{40}$ Tomato skin coated with 40% aloevera gel concentration; L-M: $A_{60}$ Tomato skin coated with 60% aloevera gel concentration; N-O: $A_{80}$ Tomato skin coated with 80% aloevera gel concentration

and pores were again exposed allowing migration in and out of tomatoes. After 30 days' images clearly show fungal mycelia development on $A_0$, $A_{20}$ and $A_{40}$ but $A_{60}$ and $A_{80}$ remains intact (Fig. 10). All microstructural analysis illustrates that coating solution with higher percentage of aloevera gel tends to be more effective in extending shelf life but appearance of $A_{60}$ and $A_{40}$ was best among all. These results were in accordance with Athmaselvi *et al.* (2012).

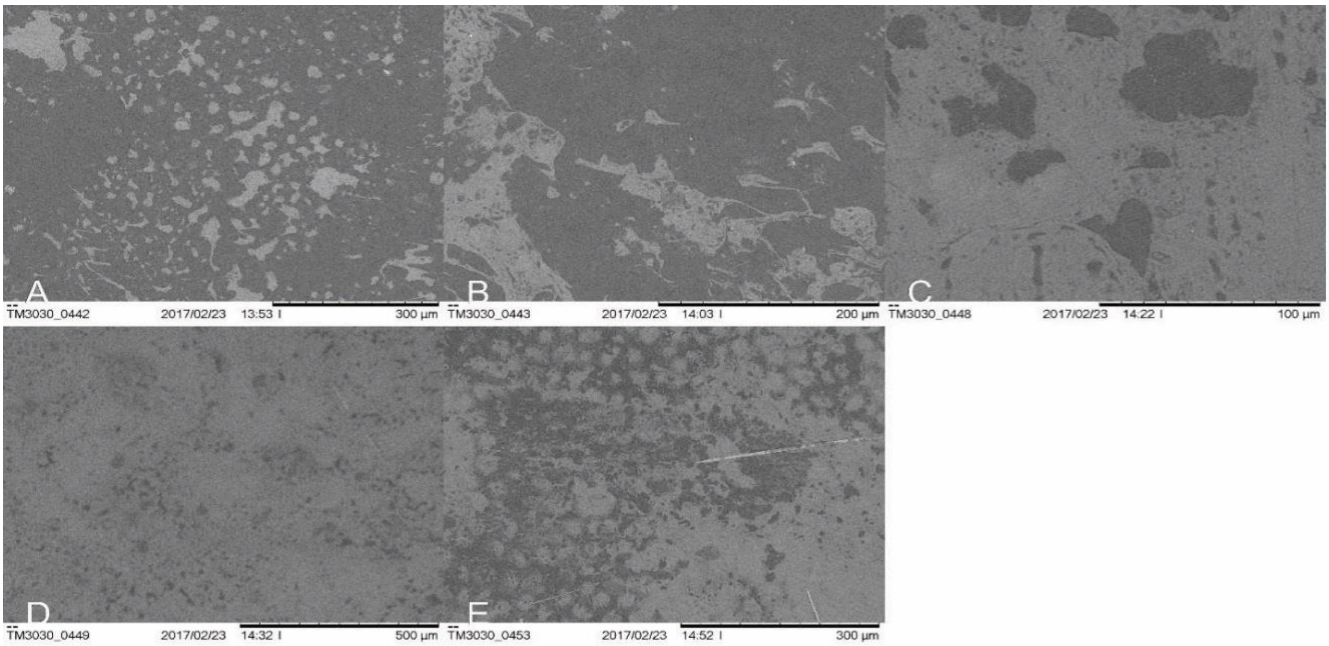


**Figure 8. Image description 10 days: Image A: $A_0$ (Tomato skin coated with 0% aloevera gel concentration.**
Image B: $A_{20}$ Tomato skin coated with 20% aloevera gel concentration; Image C: $A_{40}$ Tomato skin coated with 40% aloevera gel concentration; Image D: $A_{60}$ Tomato skin coated with 60% aloevera gel concentration; Images E: $A_{80}$ Tomato skin coated with 80% aloevera gel concentration

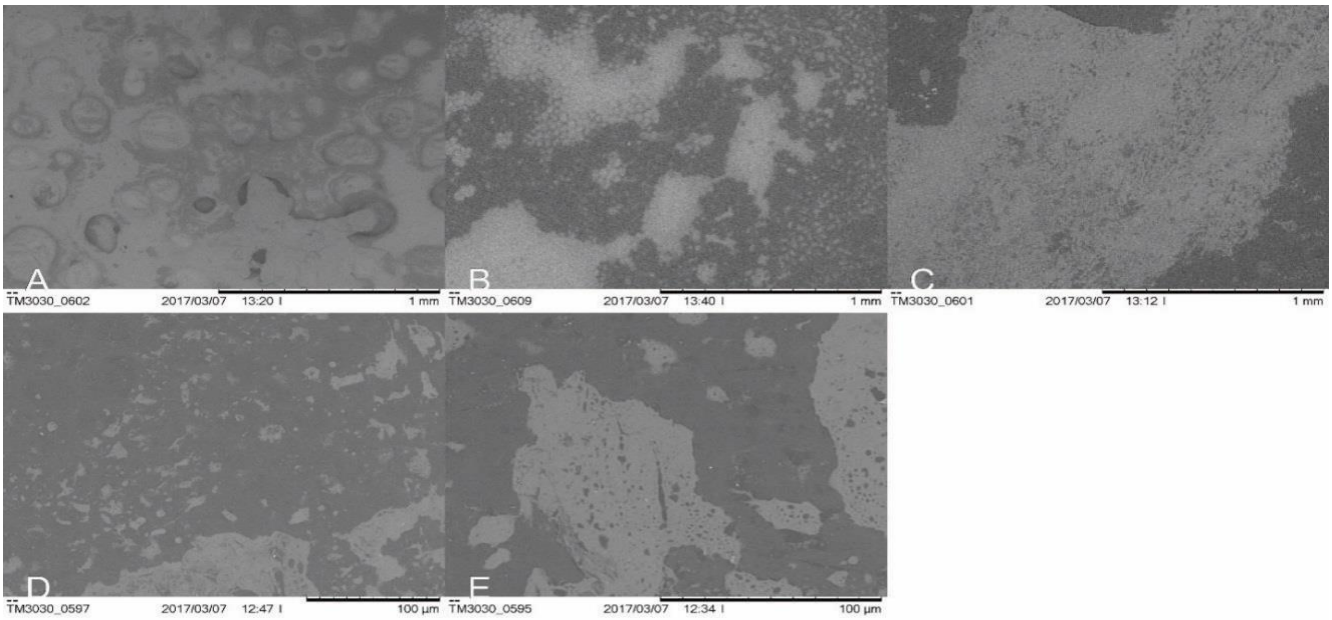


**Figure 9. Image description 20 days: Image A: $A_0$ (Tomato skin coated with 0% aloevera gel concentration.**
Image B: $A_{20}$ Tomato skin coated with 20% aloevera gel concentration; Image C: $A_{40}$ Tomato skin coated with 40% aloevera gel concentration; Image D: $A_{60}$ Tomato skin coated with 60% aloevera gel concentration; Images E: $A_{80}$ Tomato skin coated with 80% aloevera gel concentration

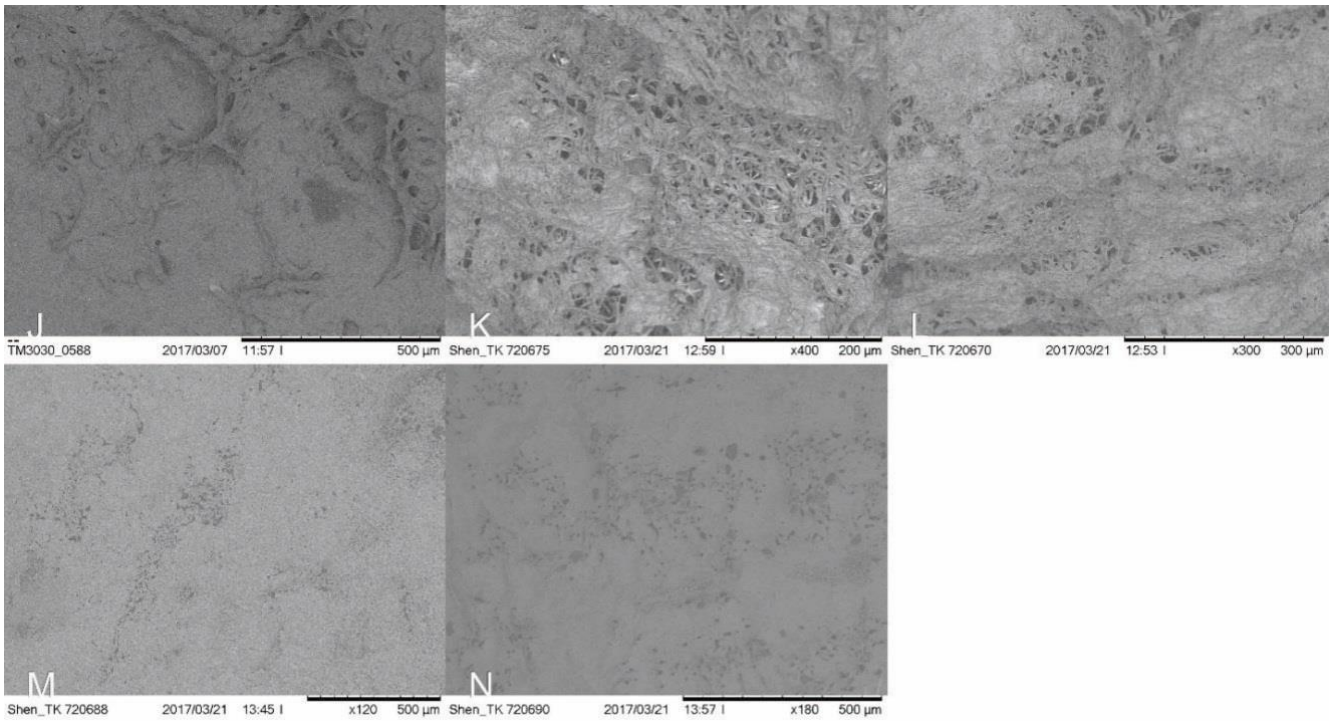


**Figure 10. Image description 30 days: Image J: $A_0$ (Tomato skin coated with 0% aloevera gel concentration.**
Image K: $A_{20}$ Tomato skin coated with 20% aloevera gel concentration; Image L: $A_{40}$ Tomato skin coated with 40% aloevera gel concentration; Image M: $A_{60}$ Tomato skin coated with 60% aloevera gel concentration; Images N: $A_{80}$ Tomato skin coated with 80% aloevera gel concentration

***Conclusion*:** This work recommends aloevera gel as an excellent ecofriendly, nontoxic and technologically viable biopreservative coating material exhibiting antimicrobial and film forming properties. This material can be used to develop aloevera gel-based coating formulations on a commercial scale to replace already present chemical preservatives having many side effects and regulatory formalities. This study shows that treatment of tomatoes with 80% aloevera gel significantly maintained fruit quality during 30days of storage and tomatoes coated with coating solution without aloevera gel deteriorated quickly, in just 12 days while aloevera gel coated tomatoes were well preserved even after 30 days. The shelf life of tomatoes coated with 80% aloevera gel was extended up to 35 days and visual aspects were also maintained. It can be concluded that a higher concentration of aloevera gel was more effective due to reduced weight loss and color changes, and maximum firmness was also retained. All analyses performed in support of the hypothesis depicted the effectiveness of aloevera gel against microbial attack as well to extend shelf life of tomatoes. From the current findings, it is revealed that use of aloevera gel based edible coatings for the preservation of fresh produce is a novel, innovative and promising technology that can improve the quality of fresh products and increase their shelf life, making them more stable.

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