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Potential application of edible coating for maintaining tomato and brinjal shelf life

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Abstract
This study investigates the impact of *Aloe vera* gel as an edible coating on the physicochemical properties and storage characteristics of tomatoes (*Solanum lycopersicum*) and brinjals (*Solanum melongena*) under room temperature conditions. The *Aloe vera* gel was applied at varying concentrations (0.1%, 0.5%, and 1%) to assess its effectiveness in reducing weight loss, maintaining moisture content, and preserving the quality of the fruits. The results showed that *Aloe vera* coating helped in minimizing weight loss and enhancing moisture retention, with 0.5% concentration proving most effective. The pH, titratable acidity, and total soluble solids (TSS) did not significantly vary between treated and untreated fruits, indicating the mild effect of *Aloe vera* on these parameters. However, the gel coating contributed to preserving the color of the brinjal stems, which deteriorated less in treated fruits. Overall, *Aloe vera* gel demonstrated its potential as an eco-friendly and functional edible coating, maintaining the quality of tomatoes and brinjals during storage and offering an alternative to conventional postharvest treatments.

Keywords: *Aloe vera* gel, edible coating, shelf life

Introduction

Pakistan produces large amounts of fresh horticultural crops, but sadly, fruit losses after harvesting can reach 25% to 30% because of inadequate post-harvest technologies, careless harvesting practices, and a lack of infrastructure. Poor handling not only degrades the quality of produce but also reduces farmers' profitability (Ahmad *et al*., 2005) [2]. One of the most important vegetable crops cultivated worldwide is brinjal (*Solanum melongena* L.). With 90% of production coming from around the world, brinjal production is quite intense. When brinjal fruits are physiologically immature, they are harvested. 588 g of carbs, 3.53 g of sugar, 3% vitamin C, 3% phosphorus, 1% calcium, 4% magnesium, and 2% zinc are included in 100 g of brinjal. (anonymous, 2010) [6]. One type of vegetable with a short shelf life is brinjal. Its storage quality deteriorates after harvesting due to physical changes and water loss. The sugar content and skin hardness of fruits (*Solanum melongena L.*) are essential factors that affect the fruits' sensory qualities (Jha and Matsuoka, 2002) [17]. The sugar content and skin hardness of brinjal fruits diminish with storage (Gajewski, 2002) [11]. The purpose of the study was to examine the internal changes that occur in brinjal fruits as they ripen and mature.

The tomato's commercial significance has made it the model species for climate-induced fruit ripening. After harvesting, tomato quality is constantly changing. The quality of fresh tomatoes is based on their flavor, firmness, color, and appearance. Skin color, which is influenced by lycopene concentration and connected to fruit ripening, is the primary quality indicator (Artés,2004) [7]. The total soluble solids-total acidity ratio attained at harvest. Fruit firmness is also an important quality attribute and is directly related to enhancement of storability potential and induction of greater resistance to decay and mechanical damage (Kader,2000) [18]. Tomato fruits do not reach consumers in the best possible condition since they decay quickly after harvest and occasionally after transportation and marketing. Weight loss, color changes, softening, surface pitting, and loss of acidity are the primary causes of tomato deterioration; minor fluctuations in total soluble solids also happen. Edible coatings are a typical application of these technologies to enhance the appearance and preservation of food (Aguiar *et al*., 2011) [1]. Different substances, including as wax, milk protein's, cellulose, lipids, starch, zein, alginate, and chitosan, have mostly been employed as edible coatings to stop commodity weight loss (García *et al*,2008) [12]. *Aloe vera* gel is currently gaining popularity in the food business as a source of functional foods for ice creams, drinks, and other beverages (Moore *et al.*,1995) [21]. An inventive and intriguing method for commercial use and a substitute for postharvest chemical treatments would be the use of *Aloe vera* gel as an edible coating for fruit. Our study's objective was to assess how *Aloe vera*, when used as an edible coating, affected the alterations in tomato-related physicochemical characteristics. Fruit quality in ambient storage and its function in preventing microbial deterioration.

Materials and Methods

Plant materials

Fresh tomatoes and brinjals were procured from local market; chosen on the basis of uniformity in size, shape, optimum color and absence of physical damage, abrasion or any evidence of fungal infection. Tomato and brinjal fruits were graded on the basis of physical appearance to have a uniform distribution. Later tomatoes and brinjals were soaked, washed to loosen the dirt and grits adhered to the surface.

Preparation and application of edible coating

Aloe vera gel was collected from fresh leaves of Aloe plant, the matrix was sorted out from outer coverage of leaves and colorless material of gel was homogenized in a blender. The resulting combination was filtered using Whatman filter paper number 100 to remove the impurity and fibers. The gel was pasteurized at 70°C for 45 min. For stabilizing, gel was cooled immediately to an ambient temperature and then 4.5 g of citric acid was added to regulate pH 4. Polysaccharide based coatings solution of *Aloe vera* was applied to tomatoes and brinjal fruits. The fruits were dipped at ambient temperature for 10 min in different concentrations (0.1%, 0.5% and 1%) of *Aloe vera*. The treated tomatoes and brinjals were kept at room temperatures for a period of two weeks.

Physical parameters

Weight loss (%)

The coated samples kept at room temperatures were weighed every 3 days interval to determine weight loss (%) during storage. Weight loss (%) was calculated by the following equation: (A. O. A. C, 2003) [22].

$$\text{Weight loss (\%)} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100 \quad \ldots\ldots 1$$

Stem color of brinjal

Stem color was tested by visible sign of color. Stem color was scored as 1=green, 2=75% green, 3=50% green, 4=25% green and 5=100% brown/black.

Chemical analysis

pH

Tomatoes and brinjals were cut into small pieces and homogenized in a grinder, and 10 g of ground tomato, brinjals were suspended in 100 mL of distilled water and then filtered. The pH of the samples was assessed using a pH meter (Anon, 2001) [5].

Titratable Acidity

Tomatoes and brinjals were cut into small pieces and homogenized in a grinder, and 10 g of ground tomato and brinjals were suspended in 100 mL of distilled water and then filtered and titrated using 0.1 N NaOH. Titratable acidity was expressed as g citric acid.100 g-1 of tomato weight (Anon,2001) [5].

TSS

The total soluble solids were checked by digital refractometer (ATAGO, RX-5000, made in Japan) at 3 days' time interval.

Moisture content

Moisture content was determined gravimetrically by drying 2.5 g of tomato samples in an oven at 105 °C until a constant weight was measured (Anon, 2003) [4].

Results and Discussions

Table 1: Physicochemical analysis of brinjal and tomato at room temperature

Sample	Control	T1 (0.1%)	T2(0.5%)	T3(1%)
Brinjal				
pH	5.63±0.01	5.46±0.03	5.36±0.02	5.36±0.01
Acidity	0.28±0.02	0.24±0.02	0.25±0.01	0.27±0.01
TSS	0.26±0.04	0.25±0.03	0.26±0.01	0.24±0.01
Weight loss	15.8±0.02	11.6±0.02	8.5±0.01	13.8±0.01
Moisture content	87.1±0.03	90.5±0.01	92.5±0.03	90.7±0.04
Tomato				
pH	3.68±0.01	3.43±0.01	3.53±0.04	3.61±0.04
Acidity	0.45±0.01	0.39±0.02	0.42±0.01	0.42±0.03
TSS	3.8±0.02	3.05±0.01	2.69±0.01	2.87±0.02
Weight loss	6.5±0.03	5.95±0.01	3.91±0.01	5.52±0.03
Moisture content	90.5±0.02	86.2±0.02	92.6±0.03	92.5±0.02

Weight loss and moisture (%)

The weight loss of untreated and treated brinjals are of 0,0.1%,0.5%,1% conc (15.8% and 11.6%,8.5%,13.8%), tomatoes are 0,0.1%,0.5%,1% conc (6.5% and 5.45%,3.91%,5.53%) (Table 3 &4). Among the treated samples 0.5% resulted in better moisture retention during the storage period. The moisture content of the untreated and treated brinjals are (87.1% and 90.5%, 92.5%, 90.7%), tomatoes are (90.5% and 86.3%, 93.6%, 92.5%). Among the treated samples 0.5% resulted in better moisture content than the other samples. It is evident that the application of Aloevera aqueous extract did not postpone ($p \leq 0.05$) the loss of moisture; this impact is comparable to that of other edible coatings (García, 2009) [13]. Since a physiological weight loss of 10% in tomatoes and brinjals is considered an indicator of the end of their shelf life, the values of this parameter did not, in any of the cases, impact the quality of fruits that were stored, even though the *Aloe vera* coatings did not lessen the weight loss. (Pal *et al.*, 1997; Getinet *et al.*, 2008) [23, 14]. Contrary to our findings on weight loss during storage, it was said that the *Aloe vera* gel coating worked well as a physical barrier, which decreased weight loss and respiration rate in tomatoes and brinjals, respectively, during postharvest storage (Martínez *et al.*, 2006; Valverde *et al.*, 2005) [20, 27].

Stem color

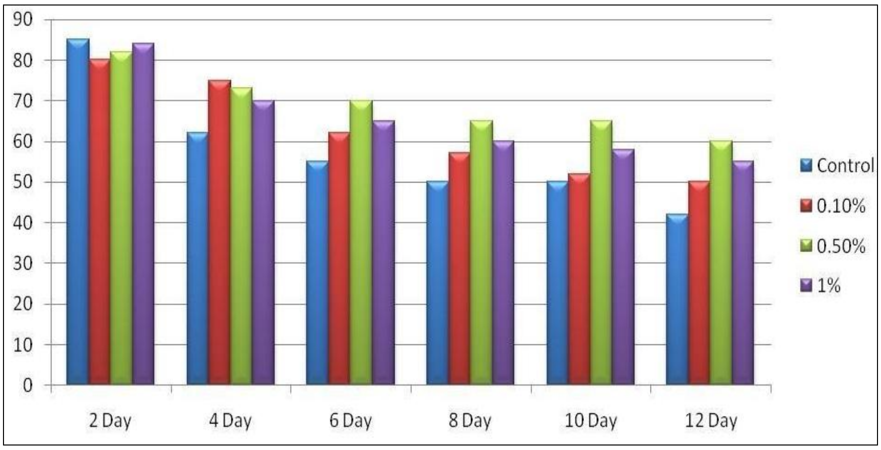

Figure 1: illustrates the impact of *Aloe vera* coating at room temperatures on the color of brinjals' stems over the course of storage. Brinjals' stem color steadily decreased during the course of storage, and the *Aloe vera* coating prevented this from happening

pH, titratable acidity and TSS

The pH values showed a significant increase ($p \leq 0.05$) during the first two weeks of the experiment; a decrease in these values toward the end of the storage period took place, while no significant differences ($p \leq 0.05$) were observed among treatments. The obtained pH values for tomatoes are between 5.3 and 5.6 and brinjals are between 3.4 and 3.6(Table1 &2). For changes in titratable acidity values, no significant differences ($p < 0.05$) were found across coated samples; nevertheless, these samples differed considerably ($p \leq 0.05$) from the values obtained for uncoated samples. It is evident that the behavior of the pH and titratable acidity values during storage corresponded with one another. Despite being the ripest, the uncoated tomatoes and brinjals had greater titratable acidity levels than coated tomatoes, which is consistent with previous authors' findings (García, 2009) [13].

Since titratable acidity is expressed as a percentage of citric acid per tomato and brinjal wet weight, the little variations in pH and titratable acidity readings between coated and uncoated tomatoes, brinjals during storage may be caused by sample water loss. When tomato products and brinjals are being developed, the index that has the biggest impact on yield is the soluble solids concentration. However, it has been noted that this indication rises as tomato fruits ripen, but not much (García,2009) [13]. The total soluble solids content of untreated and treated brinjals of 0,0.1,0.5,1% conc (0.26% and 0.25%,0.25%,0.24%), untreated and treated tomatoes of 0,0.1%,0.5%,1% conc (3.8% and 3.05%, 2.69%, 2.87%) (Table 1).

Variations in the soluble solids content of tomatoes and brinjals over the course of storage revealed an increase ($p < 0.05$), with uncoated tomatoes, brinjals, and those coated with diluted *Aloe vera* extract having considerably higher ($p \leq 0.05$) levels. The variations in the ripening state that have been noted may be related to this observation. Changes in the cellular wall, particularly the pectic compounds and hemicellulose, are linked to variations in the firmness of tomato and brinjal fruits, which in turn are linked to a rise in the soluble solids content of these fruits. The number of soluble solids in samples coated with pure *Aloe vera* extract increased less. Additionally, the number of soluble solids in the coated and control tomatoes and brinjals increased (Giovannoni, 2004; Park *et al* 1994; Beckles *et al*.,2012) [15, 24, 8].

For citric fruits, the [soluble solids content / titratable acidity] ratio is regarded as a ripening index; however, in tomatoes and brinjal, this index is employed as a flavor indication (Artés *et al*.,2004) [7]. In this instance, the soluble solids content values had the biggest impact on this ratio because the titratable acidity barely changed between treatments while being stored. These findings align with those of other writers (García, 2009; Santa-Cruz,2007) [13, 26].

Conclusion

The application of *Aloe vera* gel as an edible coating on tomatoes and brinjals proved to be beneficial in maintaining fruit quality during storage at room temperature. While the coating did not significantly reduce weight loss, it played a crucial role in preserving moisture content, with the 0.5% *Aloe vera* solution showing the most promising results. Additionally, *Aloe vera* gel helped preserve the visual appeal of brinjal stems, delaying the typical deterioration observed in untreated fruits. Although no substantial differences were observed in the pH, acidity, and TSS of treated and untreated fruits, the *Aloe vera* coating exhibited potential as a natural and functional treatment for postharvest preservation. These findings suggest that *Aloe vera* could serve as a viable, environmentally friendly alternative to conventional chemical coatings for enhancing the shelf life and quality of fresh horticultural products.

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