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ALOE VERA GEL COATING EMPHASIZED THE POST-HARVEST LIFE AND QUALITY OF GUAVA FRUITS (*PSIDIUM GUAJAVA* L.)

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ABSTRACT

The research-study was conducted on effect of Aloe vera gel coating on the post harvest performance of guava (*Psidium guajava* L.) fruit at Horticulture Department, The University of Agriculture, Peshawar. The research was counducted in completely randomized design (CRD) replicated three times. Aloe vera gel coating, guava cultivars and storage days were considered as three factors for the study. Experimental outcome revealed that coating of gel of Aloe vera at 15% have significant effect on post harvest quality of guava fruit on cultivar Safeda Allahabadi. Results presented that high appearance score (8.32), high taste score (8.30), greatest fruit firmness (3.43 kg cm^{-2}), high TSS (9.69 $Brix^{o}$), high pH (4.71), greatest ascorbic acid (140.90 mg $100g^{-1}$), less titratable acidity (0.74 %), less weight loss (8.60 %), less decay incident (19.36%), was noted on fruit coated with 15% Aloe vera gel, while in guava cultivar, highhest desirable score for the studied traits were noted on cultivar Safeda Allahabadi. In storage days, greatest fruit firmness (4.03 cm^{-2}), less TSS (7.75 ^{o}Brix), less pH (4.42), high ascorbic acid (187.10 mg $100g^{-1}$), high titratable acidity (0.96 %), less weight loss (0.00) and less decay incidence (0.00) was noticed on fresh day while high appearance score (8.42) and taste score (8.42) was noted at 6 days of storage. From the above finding it is concluded that guava cultivar Safeda Allahabadi coated with 15% Aloe vera gel when stored up to 6 days showed better results on shelf-life and post-harvest quality of guava fruit.

Keywords: Aloe vera, Edible coating, Chitosan, postharvest quality, Guava, coating.

INTRODUCTION

Guava (*Psidium guajava* L.) is a member of Myrtaceae family and is widely grown in the world tropics and sub tropics. It is originated from Central America and the southern part of Mexico, and later on it was distributed all over the world (Somogyi *et al*., 1996). The guava cultiated area in Pakistan is approximately 62,300 ha, which produce 512,300 t yield yearly. On the production area basis, guava took 4th rank in Pakistan after citrus, mango and apple (Shah *et al*., 2019). In Khyber Pakhthunkhwa qulaity guava of 489,1000 tons is produce from an area of 656,000 ha (GOP, 2015). Fruit and vegetable postharvest losses vary from 25 to 40% globally, and in developing nations, postharvest losses for perishable goods can reach 60%, costing farmers a staggering amount of money (Ahmed et al., 2013). An emerging strategy to combat these losses is the application of an edible coating, which is affordable, easily accessible and successful in extending the store life of food commodities. The asphodeleceae liliaceae family includes the small-stemmed watery plant species known as Aloe vera. It commonly grows in arid areas of the most of the continents, including Asia, Europe, America, and Africa (Misir, *et al.*, 2014). As stated by Vega-Galvez *et al*., (2011), due to the wide range of anti-inflammatory and antimicrobial properties of aloe vera gel, it is believed to be biologically active. The antibiotic and antifungal properties of aloe vera gel can prevent the formation of a range of bacteria that induce diseases and food degradation. Aloe vera gel can be used as a consumable covering to lengthen the shelf life of certain fruits and vegetables (Lin and Zhao, 2007). Newly, aloe vera gel coating for fruits has been studied by a number of researchers. Their results suggest that aloe vera gel makes a modified atmosphere of internal gases, which lowers respiration rate, moisture loss, oxidative browning, softening of tissues, and microbial growth in fruits, including nectarines (Martinez-Romero et al., 2016).

MATERIALS AND METHODS

The research work entitled “Effect of Aloe vera gel coating on the postharvest performance of Guava (*Psidium guajava* L.) fruit” at the Department of Horticulture, Postharvest Horticulture Lab, The University of Agriculture, Peshawar. The current research was conducted between December 2021 and January 2022, in Pakistan. This research was implemented using CRD having three factors replicated three times. A-

Factor was Aloe vera gel concentration ,factor B was two cultivars of guava (Safeda Allahabadi and Surkha Allahabadi) and factor C was different days of storage i.e., 0, 3, 6, 9, 12 and 15 days' interval (Table a). Fruits were kept at room temprature (23^{o}C, RH = 63 ±1).

Table a: The detailed of factors concidered for the study.

Factor A (Aloe Vera gel concentrations)					
T_1=control	T_2=5%	T_3=15%	T_4=25%		
Factor B (Cultivars)					
V_1=Safeda Allahabadi		V_2=Surkh Allahabadi			
Factor C (Storage days)					
S_1= Fresh	S_2= 3 days	S_3= 6 days	S_4= 9 days	S_5= 12 days	S_6= 15 days

Aloe vera leaves collection and its gel preparation

Aloe vera mature leaves were gathered from the department of horticulture's ornamental nursery at The University of Agriculture, Peshawar. In t he Post-harvest Horticulture Laboratory new leaves were brought. Mature Aloe vera leaves were used to extract the gel. There are four strata in each aloe vera leaf. The sap was drained out of the leaves by holding them vertically for 15 minutes. Slices of the gel from the basal layer of the skin were removed and put in a jar for storage. Aloe vera gel lattice was removed from the leaf's outer cortex and blended. The pure aloe vera pulp was extracted after being filtered through a soft-netted cloth to exclude the fibers.

T_1= Distilled water (taken as control)
T_2= 5gm Aloe vera gel mixed in 95ml distilled-water (5% W/V)
T_3= 15gm Aloe vera gel mixed in 85ml distilled-water (15% W/V)
T_4= 25gm Aloe vera gel mixed in 75ml distilled-water (25% W/V)

Data was collected on appearance, taste, fruit firmness (kg cm^{-2}**),** total soluble solids (°brix), Juice pH, titratable acidity (%), ascorbic acid (mg $100g^{-1}$), decay percentage (%) and Weight loss (%).

All of the samples of fruits were evaluated for look and flavor using the hedonic-scale (Larmond, 1987). Ten people were assembled into a team of experts depending on the reliability of their judgment.

Grades	**Appearance**	**Taste**
0-2	Green	Dislike
2-4	Light green	Fair
4-6	Light Yellow	Good
6-8	Yellow	Very good
8-10	Full yelow	Excellent

Firmness of fruits were determined by penetrometer. The fruit was being penetrated by the penetro-meter's probe. Once the pressure was released, the figures appeared on the screen. Every sample had minimum three values obtained, and the average was then

calculated. Total soluble solids (TSS) were calculated by a refracto-meter and the typical AOAC (2012) procedure in terms of percentage or ^{0}brix. The pH of the guava fruit's juice was measured using a pH metre. The titrimetric procedure outlined in AOAC (2012) was used to assess the percentage of titratable acidity and ascorbic acid percentage.

Weight loss was calculatied from the difference of intiatl weight before storage and last weight after storage using high performance digital balance. The below formula will be used to compute the % weight reduction.

$$Weight\ loss(\%) = \frac{Wi - Ws}{Wi} x100$$

Where;

Wi = preliminary weight prior to storage

Ws= last weight after storage

At conclusion of the study, the number of rotting fruits in every treatment was recorded and decay percentage was computed using below formula employing the AOAC (2012) procedure.

$$Decay\ percentage = \frac{No.\ of\ rotten\ fruits}{Total\ no.of\ fruits} \times 100$$

STATISTICAL ANALYSIS

The ANOVA (Analysis of Variance) method was used to conduct the statistical analysis of the data for the CRD with three factor research. In order to calculate the ANOVA and LSD value, statistical software Statistix (8.1) was used to evaluate the Means using Least Significant Differences (LSD) at the 5% level of significance (Jan *et al*., 2009).

RESULTS

Research entitled on “Effect of Aloe vera gel coating on the postharvest performance of Guava (*Psidium guajava* L.) fruit” were conducted at the Department of Horticulture, Postharvest Horticulture Lab, The University of Agriculture, Peshawar. Mean squares detected that all the post-harvest traits of guava fruit including appearance, taste, fruit firmness (kg cm^{-2}), total soluble solids (^{o}brix), Juice pH, fruit's titratable acidity (%), ascorbic acid (mg $100g^{-1}$), weight loss (%) and decay incident (%) were influenced significantly by various levels of Aloe vera gel coating and cultivar. The interaction of storage with aloe vera gel was found significant for all the studied traits except pH and ascorbic acid, while the interaction between cultivar and coating was found non-significant for all the studied traits (Table 1). Maximum mean score has been observed

for appearance (8.32), taste (8.30), fruit firmness (3.43 kg cm^{-2}), total soluble solids (9.69 ^{o}brix), pH (4.71) and ascorbic acid (140.90 mg $100g^{-1}$) in guava fruit coated with 15% Aloe vera gel. while appearance (7.03), taste (6.25), fruit firmness (3.03 kg cm^{-2}), total soluble solids (9.02 ^{o}brix), pH (4.46) and ascorbic acid (135.10 mg $100g^{-1}$) of guava showed minimum mean values for uncoated fruit (Table 2a & 2b). In contrast of the above traits, favourable lowest mean values for titratable acidity (0.74 %), weight loss (8.60%) and decay incident (19.36 %) were noted in fruit coated with 15% Aloe vera gel. However, maximum titratable acidity (0.78 %), weight loss (10.43%) and decay incident (39.30%) was observed in uncoated fruit of guava (Table 2a & 2b). Considering the cultivar potential for post-harvest life, maximum score for appearance (7.70), taste (7.37), fruit firmness (3.28 kg cm^{-2}), total soluble solids (9.36 ^{o}brix), pH (4.59), titratable acidity (0.77 %) ascorbic acid (138.70 mg $100g^{-1}$) was recorded in Safeda Allahabadi compared to Surkha Allahabadi, which showed minimum mean values for these traits. On the other hand, Safeda Allahabadi showed minimum weight loss (9.42%) and decay incident (26.56%) compared to Surkha Allahabadi which showed highest weight loss (9.70%) and decay incident (30.61%) in post-harvest performance (Table 2a & 2b). Performance of fruit shelf life is directly affected by storage. The results of mean values showed that maximum score for appearance (8.42) and taste (8.42) was noted after 6 days of storage. Maximum score for fruit firmness (4.03 kg cm^{-2}), total soluble solids (10.97 ^{o}brix), Juice pH (4.78), titratable acidity (0.96%), ascorbic acid (187.10 mg $100g^{-1}$) was noted on fresh day. Whereas, in storage days' maximum weight loss (15.03%) and decay incident (67.92%) was noted at 15 days of storage (Table 2a & 2b).

DISCUSSION

The internal gas composition of fruit's changes because of the barrier properties of edible coatings, which limit a fruit's surface-permeability to O_2 and CO_2 thus lengthen the fruit's shelf life. The most important characteristics for consumers that attributes to shelf life and indicates the post-harvest performance of fruits are appearance, taste, firmness (kg.cm-2), TSS (^{o}brix), pH, titratable acidity (%), ascorbic acid (mg. 100 g-1), weight loss and decay incidence. Fruits need to preserve for a longer storage of time which required post-harvest factors including pH, total soluble solids (TSS), titratable acidity and ascorbic acid, all play a major role in preventing degradation and premature ripening (Ergun and Satici, 2012). Likewise, to our results, Guava fruit quality and maturity is affected by their surface appearance because of chlorophyll pigments that give green hue to the fruits. Strawberry fruits having Aloe-vera gel coating were well capable to retain their range of physio-chemical characteristics, particularly colour and firmness (Sogvar *et al*., 2016). Serrano *et al*., (2006) discovered that non-coated fruits had an odd flavour and disagreeable smell after 21 days of storage, but grapes coated in Aloe vera gel were still marketable and fragrant. Hayat et al. (2017), Mirdeghan *et al*., (2006), and Valverde *et al.,* (2017) all reported findings that were similar to our results in terms of colour, flavour and general acceptance. When examining the level of fruit maturity and softness in a post-harvest study, fruit firmness is a potential and important indication. Aloe vera gel serves as a barrier to O_2 absorption by lowering metabolic rate

and the ripening process in strawberries as the coating decreases the rate of fruit ripening (Sogvar *et al.,* 2016). Fruit coating helps fruits keep their firmness for an extended period and serves as an obstacle to stop moisture and nutritional loss (Akhtar *et al*., 2010). The outcomes for preventing fruit stiffness are in consistent with those of the mentioned results. With longer periods of storage, the fruit's total soluble solids (TSS) increased. Similar to our results, Chawla *et al*., (2018) coated that the increase in fruit TSS with increasing storage time can be attribute to several factors, together with an increase in the activity of the enzymes that break down starch into sugars. According to Athmaselvi *et al*., (2013), TSS preservation in coated fruits is usually greater than in non-coated fruits, probably because of the breakdown of pectin and carbohydrates as well as half protein hydrolysis. According to Sophia *et al*., (2015), mangoes' TSS was preserve when covered with Aloe vera gel, probably because of the fruit's delayed ripening. In accordance to our findings Ahmed *et al*., (2013), declared that strawberry fruits coated in alginate maintained their pH while being stored. The pH of fruit juice changed significantly in non-coated fruits. The findings are consistent with those of Bentez *et al*., (2013), Vieira *et al*., (2016), and Guillén *et al*., (2013) who discovered the quantity of acidity in numerous fruits. Acidity gradually decreases when being stored at low temperatures, which may be a result of the respiratory process quickly using organic acids and converting acids into sugars (Chulaki *et al*., 2017; Nandaniya *et al*., 2017). Aloe vera gel, however, alters the interior environment (Hernandez-Munoz *et al*., 2008). Our results were strengthened more by Singh *et al*., (2005), who declared that the availability of fruit sugar may be the cause of the synthesis of ascorbic acid content in fruits increasing during the ripening period and decreasing with the passage of time. Due to a decrease in oxidation, Aloe vera efficiently preserved the ascorbic acid levels as compared to non-coated fruits and other treatments. According to Sogvar *et al*. (2016), Aloe vera gel coating can preserve the ascorbic acid concentration because it behaves as a penetrable surface and limits gases flow. Same outcomes for weight reduction by physiological means were seen by (Akhtar *et al*., 2010). The positive effects of the edible Aloe vera gel coatings may explain why the treated fruit observed a greater weight reduction than the control fruit. Edible coatings help strawberries stay fresh longer by acting as a physical obstacle to moisture evaporation, preventing dehydration and fruit senescence (Almenar *et al*., 2007; Moraes *et al*. 2012). Decay is important postharvest factors in reduction the quality of horticultural crops. According to Reynolds and Dweck (1999), Aloe vera gel can stop a variety of germs from growing. Fruits damage less quickly during storage time in the early days of fresh commodities, when respiration is higher and sugar loss is greater, antifungal appearance were less (Hernandez *et al*., 2007) and antimicrobial activities were increase (Gil *et al*., 2004). Anti-decay effects of chitosan edible coating were observing on table grapes (Xu *et al*., 2007), strawberry (Kazemini, 2012) and jujube fruit (Wang *et al*., 2014).

Table 1: Mean square values for Appearance, taste, Firmness (kg.cm^{-2}), TSS (^{o}brix), pH,Titratable acidity (%), Ascorbic acid (mg. 100 g^{-1}), Weight loss, and Decay incidence of Guava fruit as affected by different concentration of Aloe vera gel coating and cultivars during storage.

SOV	df	Appearance	Taste	Firmness (Kg. cm^{-2})	TSS (^{0}brix)	pH	Titratable acidity (%)	Ascorbic acid (mg.100 g^{-1})	Weight loss	Decay incidence
Cultivar	1	0.74 ^{Ns}	3.376**	0.261**	0.584**	0.012 ^{Ns}	0.006**	25.502*	2.742*	592.111*
Storage	5	7.13**	26.687**	8.353**	30.639**	0.559**	0.348**	21329.3**	708.17**	16047.4**
Aleovera	3	10.22**	28.837**	0.988**	3.062**	0.418**	0.014**	206.809**	25.448**	2509.69**
C x S	5	0.26^{Ns}	0.611*	0.017 ^{Ns}	0.311 ^{Ns}	0.033 ^{Ns}	0 ^{Ns}	24.618**	0.746 ^{Ns}	223.694*
S x A	15	1.91**	2.897**	0.061**	0.881**	0.028 ^{Ns}	0.002**	6.89 ^{Ns}	2.109**	384.657**
C x A	3	0.66 ^{Ns}	0.175 ^{Ns}	0.04 ^{Ns}	0.35 ^{Ns}	0.011 ^{Ns}	0 ^{Ns}	0.396 ^{Ns}	0.066 ^{Ns}	38.463 ^{Ns}
C x S x A	15	0.32 ^{Ns}	0.363 ^{Ns}	0.013 ^{Ns}	0.125 ^{Ns}	0.008 ^{Ns}	0 ^{Ns}	4.177 ^{Ns}	0.314 ^{Ns}	65.269 ^{Ns}
Error	96	0.26	0.205	0.015	0.139	0.016	0	4.779	0.417	114.813
CV (%)	--	6.73	6.27	3.8	4.01	2.76	2.07	1.58	6.75	37.49

CV = Coefficient of variation, ** = Significant at 1% probability, * = Significant at 5% probability and Ns = non-significant df = degree of freedom, TSS = Total soluble solid, C = Cultivar, S = Storage and A = Aleo vera.

Table 2a: Appearance, Taste, Firmness (kg.cm^{-2}), TSS (^{o}brix) and pH of Guava fruit as affected by different concentration of Aloe vera coating and cultivars during storage.

Aloe vera Coating (%) (AC)	Parameters				
	Appearance	Taste	Fruit firmness(kg.cm^{-2})	TSS (^{o}brix)	pH
0	7.03 c	6.25 d	3.03 d	9.02 c	4.46 d
5	7.55 b	6.77 c	3.20 c	9.16 bc	4.54 c
15	8.32 a	8.30 a	3.43 a	9.69 a	4.71 a
25	7.61 b	7.55 b	3.28 b	9.32 b	4.59 b
LSD(P≤0.05)	0.24	0.21	0.05	0.17	0.05
Cultivars (C)					
Safeda Allahabadi	7.70 a	7.37 a	3.28 a	9.36 a	4.59
Surkha Allahabadi	7.56 b	7.07 b	3.19 b	9.23 b	4.57
LSD(P≤0.05)	0.17	0.15	0.04	0.12	NS
Storage Days (SD)					
Fresh	7.40 c	7.60 c	4.03 a	7.75 f	4.42 d
3	7.80 b	7.95 b	3.72 b	8.49 e	4.41 d
6	8.42 a	8.42 a	3.37 c	9.04 d	4.54c
9	8.01 b	7.04 d	3.01 d	9.61 c	4.58 c
12	7.20 cd	6.87 d	2.85 e	9.93 b	4.72 b
15	6.96 d	5.42 e	2.43 f	10.97 a	4.78 a
LSD(P≤0.05)	0.29	0.25	0.07	0.21	0.07

Table 2b: Titratable Acidity (%), Ascorbic Acid (mg. 100g^{-1}), weight loss (%) and Decay incidence (%) of Guava fruit as affected by different concentration of Aloe vera gel coating and cultivars during storage.

Aloe vera Coating (%) (AC)	Parameters			
	Titratable Acidity (%)	Ascorbic Acid (mg. 100g^{-1})	weight loss (%)	Decay incidence(%)
0	0.78 d	135.1 c	10.43 a	39.30 a
5	0.75 c	138.1 b	9.98 b	29.83 b
15	0.74 a	140.9 a	8.60 d	19.36 d
25	0.76 b	138.9 b	9.23 c	25.83 c
LSD(P≤0.05)	0.007	1.02	0.30	5.01
Cultivars (C)				
Safeda Allahabadi	0.77 a	138.7 a	9.42 b	26.56 b
Surkha Allahabadi	0.75 b	137.8 b	9.70 a	30.611 a
LSD(P≤0.05)	0.005	0.72	0.21	3.54

Storage Days (SD)				
Fresh	0.96 a	187.1 a	0.00 f	0.00 e
3	0.83 b	157.1 b	7.38 e	0.00 e
6	0.77 c	139.9 c	9.79 d	31.08 d
9	0.70 d	122.3 d	11.31 c	31.87 c
12	0.66 e	115.2 e	13.85 b	40.62 b
15	0.63 f	108.06	15.03 a	67.92 a
LSD(P≤0.05)	0.009	1.25	0.36	6.13

Conclusions and Recommendations

It has been concluded that guava fruit coated with 15% Aloe vera gel showed best desirable score for the studied traits. Safeda Allahabadi outperformed compared to other cultivars in terms of maximum parameter include in the study. Among storage days, control day (Fresh day) showed minimum wieght loss, no diseased incidence, highest ascorbic acid, titratable acidity, fruit frimness and maximum PH axcept TSS while appearance and taste maximum score was noted on 6 day.

It is recommended based on the obtained conclusions that guava cultivar Safeda Allahabadi should be coated with 15% Aloe vera gel for better post-harvest quality and shelf life of guava up to 15 days of storage, but the fruits were still edible beyond 6 days of storage. Further experiment should be conducted on different edible oil and storage duration on different horticulture fruits.

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