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# Effect of organic based post-harvest treatments on biochemical changes of Sapota fruit (*Manilkara zapota* (L.) P. Royen) at ambient storage

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**Abstract**
To study the effect of post-harvest treatments such as chitosan (0.5%), chitosan (1.0%), carnauba wax (25%), carnauba wax (50%), *Aloe vera* gel: Distilled water (V/V) (1:1) and *Aloe vera* gel: Distilled water (V/V) (2:1) on biochemical changes of different varieties of sapota. Post-harvest treated fruits were stored at ambient storage condition. Traits such as fruit weight, fruit diameter, fruit length, Titratable acidity (%), Reducing sugar (%), Total sugars (%), Non-reducing sugar (%) and Ascorbic acid (mg/100 g) were measured. Among the six post-harvest treatments, *Aloe vera* gel: Distilled water (V/V) (1:1) fruits were superior in maintaining better physical and bio-chemical parameters even upto 10 days of storage. The maximum acidity, ascorbic acid and minimum of total sugar, reducing sugar and non-reducing was observed in V3C5 (Kalipatti treated with *Aloe vera* gel: Distilled water (V/V) (1:1)), V3C3 (Carnauba wax 25%), V3C4 (*Aloe vera* gel: Distilled water (V/V) (2:1)) and V3C4 (Carnauba wax 50%) on most of the days during storage. From the experiment, it can be concluded that, post-harvest treatment of sapota varieties Kalipatti and Cricket Ball with *Aloe vera* gel: Distilled water (V/V) (1:1) and Carnauba wax 25% maintained better physico-chemical characters parameter at ambient conditions. Therefore, application of postharvest *Aloe vera* gel in the ratio of 1:1 is recommended for improving quality of sapota varieties.

**Keywords:** Sapota, *Aloe vera*, carnauba wax. physical, Kalipatti

## 1. Introduction
Sapota (*Manilkara zapota* (L.) P. Royen) belongs to Sapotaceae family. It is a delicious fruit native to humid tropical and subtropical regions. It is a tropical American native that has spread to almost all tropical countries around the world. Other names include chikku, sapota plum, sapodilla, and prickly pear. Fully ripened fruit is delicious and is commonly served as dessert fruit. The pulp is sweet and creamy. It is customary to consume only the pulp. The fruit skin can also be eaten because it contains more nutrients than the pulp. Sherbets and halvas are also made from the pulp.

Sapota fruit is high in digestible sugar, which ranges from 12 to 20%, as well as minerals like iron and calcium. The fruits are high in protein, fat, fibre, phosphorus, carotene, and vitamin C. It also contains bio-iron, which is necessary for the formation of haemoglobin (Sudha *et al*., 2007) [19]. It also has a high concentration of phenolics such as gallic acid, catechin, chlorogenic acid, leucodelphinidin, leucocyanidin, and leucopelargonidin (Asghari *et al*., 2013). Sapota is used to make a variety of indigenous medicines. Because of the higher tannin content of the fruits, a decoction made by boiling sapota fruits is used to treat diarrhoea. To relieve pulmonary complaints, an infusion of young fruits and flowers was drunk.

Presently, there are only few known cultivars, *viz*., Kalipatti, Cricket Ball, DHS-1, DHS-2, CO-1, CO-2, Calcutta Round, Oval and Pala, which are being commercially grown. All the varieties have merits and demerits in their performance.

## 2. Materials and Methods
Present investigation was carried out at Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad. The fruit of different sapota varieties were harvested at optimum stage of maturity. The fruits were dipped for 5 min. in solution of chitosan (0.5%), chitosan (1.0%), carnauba wax (25%), carnauba wax (50%), *Aloe vera* gel: Distilled water (V/V) (1:1) and *Aloe vera* gel: Distilled water(V/V) (2:1) and the fruits kept under control were dipped in distilled water for 5 minutes. Fruits were than air dried and placed in plastic

trays and kept at room storage. The fruits were assessed at 2nd, 4th, 6th, 8th and 10th day of storage for titratable acidity (%), reducing sugar (%), total sugars (%), non-reducing sugar (%) and ascorbic acid (mg/100 g). The experimental data was analyzed in factorial completely randomized block design with three replications.

### 2.1 Materials
Ten varieties *viz*. Kalipatti, Cricket Ball and Pala grown at Horticultural Research Station, Konda Mallepally, Nalgonda were selected for the study.

### 2.2 Methodology for preparation of different post-harvest dipping Solutions
#### 2.2.1 Chitosan solution
Chitosan solution (0.5%) was prepared by dissolving 5 g of chitosan in 1000 ml of distilled water added with 2.5 ml glacial acetic acid. The mixture was heated with continuous stirring to facilitate proper dilution. Chitosan solution (1.0%) was prepared by dissolving 10 g of chitosan in 1000 ml of distilled water added with 2.5 ml glacial acetic acid. The mixture was heated with continuous stirring to facilitate proper dilution.

#### 2.2.2 Wax solution
Carnauba wax formulation (25%) was prepared by diluting the 250 g carnauba wax flakes in 1000 ml of ethyl acetate and heated at 82-86 °C to dissolve properly. Carnauba wax formulation (50%) was prepared by diluting the 500 g carnauba wax flakes in 1000 ml of ethyl acetate and heated at 82-86 °C to dissolve properly.

#### 2.2.3 *Aloe vera* gel
The *Aloe vera* gel: Distilled water (V/V) (1:1) solution was prepared by dissolving commercial *Aloe vera* gel (1 litre) with 1 litre distilled water as a coating material. The *Aloe vera* gel: Distilled water (V/V) (2:1) solution was prepared by dissolving commercial *Aloe vera* gel (2 litre) with 1 litre distilled water as a coating material.

## 3. Results and Discussion
### 3.1 Titratable acidity (%)
The titratable acidity was expressed in terms of malic acid as percentage on fresh pulp weight basis of sapota fruits. As evident from the treatment means, titratable acidity was a decreasing trend with the increase in storage period irrespective of the treatments. The initial titratable acidity of sapota fruits for V1= 0.22%, V2= 0.23%, V3=0.19% (Table 1).

The results indicate that there were significant differences between the treatments with respect to days after storage (DAS) of sapota fruits. Among the 7 different post-harvest treatments, significantly minimum titratable acidity was recorded in treatment C7 (0.19% and 0.18%), whereas significantly maximum titratable acidity was observed in the treatment C5 (0.24% and 0.22%) after 2 and 4 DAS respectively. Among the varietal treatments (V1=Kalipatti, V2=Cricket Ball and V3=Pala), significantly minimum titratable acidity was recorded in treatment V3 (0.19% and 0.17%), whereas significantly maximum titratable acidity was observed in the treatment V2 (0.24% and 0.22%) after 2 and 4 DAS respectively.

After 10 DAS, one variety (V3) completely got spoiled irrespective of post-harvest treatment and among other combinations highest titratable acidity was noted in V2 (0.19%) in combination with C3 and lowest titratable acidity was noted in V1 (0.17%) in combination with C6. General declining trend in titratable acidity was noticed in sapota in all the treatments with advancement in storage period. The decrease in acidity in the fruits during the storage is because of the fact that organic acid might be utilized rapidly in respiration or conversion of acid into sugar. These results are in parallel to the findings of Sihag *et al*. (2005) in peach and Mahajan *et al*. (2005) in kinnow. The maximum acidity was observed in C5 (*Aloe vera* gel: Distilled water (V/V) (1:1)), C3 (Carnauba wax 25%), C4 (*Aloe vera* gel: Distilled water (V/V) (2:1)) and C4 (Carnauba wax 50%) on most of the days during storage. However, the untreated fruits recorded rapid decrease in titratable acidity at the end of 8 DAS. While, fruits treated with *Aloe vera* gel and carnauba wax recorded minimum decreased in the titratable acidity. This is because of the slow ripening changes in the treated sapota fruits during the storage. Similar results of slower decrease in acidity were recorded by application of wax during the storage by Sariful *et al*. (2001) in banana.

### 3.2 Ascorbic acid (mg/100 g)
A gradual decrease in ascorbic acid content was observed in sapota during storage period (Table 1). The initial ascorbic acid of sapota fruits for V1= 13.08 mg/100 g, V2=12.52 mg/100 g, V3=13.15 mg/100 g (Table 2). The results indicate that there were significant differences between the treatments with respect to days after storage (DAS) of sapota fruits. Among the 7 different post-harvest treatments, significantly minimum ascorbic acid was recorded in treatment C7 (11.20 and 9.46 mg/100 g), whereas significantly maximum ascorbic acid was observed in the treatment C5 (12.28 and 11.22 mg/100 g) after 2 and 4 DAS respectively.

Among the varietal treatments (V1=Kalipatti, V2=Cricket Ball and V3=Pala), significantly minimum ascorbic acid was recorded in treatment V3 (11.51 and 9.82 mg/100 g), whereas significantly maximum ascorbic acid was observed in the treatment V1 (12.44 and 11.08 mg/100 g) after 2 and 4 DAS respectively. After 2 and 4 DAS, interaction between post-harvest treatments and varieties was found significant. The minimum ascorbic acid was recorded in the treatment V2 (10.94 and 8.78 mg/100 g) in combination with C7. The maximum ascorbic acid was noted in V1 (12.93 and11.87 mg/100 g) in combination with C5.

After 10 DAS, one variety (V3) completely got spoiled irrespective of post-harvest treatment and among other combinations highest ascorbic acid was noted in V1 (8.88 mg/100 g) in combination with C3 and lowest ascorbic acid was noted in V2 (6.98 mg/100 g) in combination with C3. Normal declining trend in ascorbic acid was noticed in sapota in all the treatments with advancement in storage period. The decrease in ascorbic acid in the fruits during the storage is because of the fact that organic acid might be utilized rapidly in respiration or conversion of acid into sugar. These results are similar to the findings of Paull (1982) in soursop and Swati and Bisen (2012) in custard apple. The maximum ascorbic acid was observed in C5 (*Aloe vera* gel: Distilled water (V/V) (1:1)), C3 (Carnauba wax 25%), C4 (*Aloe vera* gel: Distilled water (V/V) (2:1)) and C4 (Carnauba wax 50%) on most of the days during storage. However, the untreated fruits recorded rapid decrease in ascorbic acid at the end of 8

DAS. While, fruits treated with *Aloe vera* gel and carnauba wax recorded minimum decreased in the titratable acidity. This is because of the slow ripening changes in the treated sapota fruits during the storage. The authors Shweta *et al.* (2014) [18] in grape berries and Ergun and Satici, (2012) [4] in 'Granny Smith' observed delayed decrease in acidity in *Aloe vera* treated fruits

**3.3 Reducing sugar (%)**

Changes in reducing sugars content in sapota fruits as influenced by post-harvest treatments under ambient storage are presented in table 3. The perusal of data on reducing sugars content indicated significant differences among the treatments and this biochemical parameter increased linearly as the storage period increased. The initial reducing sugar of sapota fruits for V1= 3.56%, V2= 3.27%, V3=4.18%. The results indicate that there were significant differences between the treatments with respect to days after storage (DAS) of sapota fruits. Among the 7 different post-harvest treatments, significantly minimum reducing sugar was recorded in treatment C5 (4.17% and 4.91%), whereas significantly maximum reducing sugar was observed in the treatment C7 (5.23% and 6.39%) after 2 and 4 DAS respectively. Among the varietal treatments (V1=Kalipatti, V2=Cricket Ball and V3=Pala), significantly minimum reducing sugar was recorded in treatment V2 (4.32% and 5.17%), whereas significantly maximum reducing sugar was observed in the treatment V3 (5.02% and 5.89%) after 2 and 4 DAS respectively.

Among the varietal treatments, maximum reducing sugar was recorded in V1 (6.67%) and minimum reducing sugar was recorded in the V2 (5.59%) at 8 DAS. Interaction between post-harvest treatments and varieties was found significant at 8 DAS. The minimum reducing sugar was recorded in the treatment V2 (5.16%) in combination with C6. The maximum reducing sugar was noted in V1 (7.18%) in combination with C4. All these treated fruits were found to have the lowest reducing sugar as compared to others at all the days of recording. Comparatively, delayed increase in reducing sugar over the storage period in the *Aloe vera* gel and carnauba wax treated fruits could be attributed to delayed conversion of starch to sugars which in turn is due to the effect of surface coatings. Similar results were reported by Nakhasi *et al.* (1991) [14] in tomatoes, Shirin and Asghar (2014) [17] in grapes and Marpudi *et al.* (2013) in fig. Further, similar results with wax application were noticed by Sariful *et al.* (2001) in banana; Waskar and Gaikwad (2005) and Singh *et al.* (2012) in mango; Bishnoi *et al.* (2008) in apple fruits and Sidhu *et al.* (2009) in pear fruits; Mahajan *et al.* (2013) and Mahajan and Rupinder (2014) in kinnow mandrin.

**3.4 Total sugars (%)**

Total sugars content increased as the storage period progressed and then decreased. The initial total sugar of different sapota varieties were V1= 7.63%, V2= 7.19%, V3= 8.74% (Table 4). The results indicate that there were significant differences between the treatments with respect to days after storage of sapota fruits.

Among the 7 different post-harvest treatments, significantly minimum total sugar was recorded in treatment C5 (7.51% and 8.40%), whereas significantly maximum total sugar was observed in the treatment C7 (8.52% and 9.55%) after 2 and 4 DAS respectively. Among the varietal treatments (V1=Kalipatti, V2=Cricket Ball and V3=Pala), significantly minimum total sugar was recorded in treatment V2 (7.25% and 8.13%), whereas significantly maximum total sugar was observed in the treatment V3 (8.92% and 9.95%) after 2 and 4 DAS respectively.

After 10 DAS, one variety (V3) completely got spoiled irrespective of post-harvest treatment and among other combinations highest total sugar was noted in V1 (10.39%) in combination with C5 and lowest total sugar was noted in V2 (8.21%) in combination with C5. The minimum total sugars at all the days of storage was observed in the treatment C5 (*Aloe vera* gel: Distilled water (V/V) (1:1)), C3 (Carnauba wax 25%), C4 (*Aloe vera* gel: Distilled water (V/V) (2:1)) and C4 (Carnauba wax 50%) when compared to all other treatments. All these treated fruits were found to have the lowest total sugars as compared to others at all the days of recording. Comparatively, delayed increase in total sugars over the storage period in the *Aloe vera* gel and carnauba wax treated fruits could be attributed to delayed conversion of starch to sugars which in turn is due to the effect of surface coatings. Similar results with *Aloe vera* coating created a modification of the internal atmosphere, as modified atmosphere packaging resulted in delayed ripening changes and sugar synthesis in fruits (Martinez *et al*., 2006). Similar results were reported by Nakhasi *et al*. (1991) in tomatoes, Shirin and Asghar (2014) [17] in grapes and Marpudi *et al.* (2013) [10] in fig. Further, similar results with wax application were noticed by Sariful *et al.* (2001) in banana; Waskar and Gaikwad (2005) and Singh *et al.* (2012) in mango; Sidhu *et al.* (2009) in pear fruits; Mahajan *et al.* (2013) and Mahajan and Rupinder (2014) in kinnow mandrin.

**3.5 Non reducing sugar (%)**

The data on non-reducing sugars content of sapota fruits as influenced by post-harvest treatments under ambient storage is presented in Table 5. In general, non-reducing sugars of sapota fruits increased as the storage duration progressed irrespective of the treatments. The initial non reducing sugar of different sapota varieties were V1= 3.86%, V2= 3.72%, V3= 4.33%.

After 6 DAS, interaction between post-harvest treatments and varieties was found significant. The minimum non reducing sugar was recorded in the treatment V1 (2.55%) in combination with C2. The maximum non reducing sugar was noted in V3 (3.48%) in combination with C4. After 8 DAS, among 7 post-harvest treatments, 3 treatments were spoiled *viz.*C1, C2 and C7. Among 4 remaining treatments, minimum non reducing sugar was recorded in the treatment C4 (2.63%), whereas maximum non reducing sugar was recorded in the treatment C5 (3.58%) at 8 DAS.

Among the varietal treatments, maximum non reducing sugar was recorded in V3 (3.68%) and minimum non reducing sugar was recorded in the V2 (2.80%) at 8 DAS. Interaction between post-harvest treatments and varieties was found significant at 8 DAS. The minimum non reducing sugar was recorded in the treatment V2 (2.56%) in combination with C4. The maximum non reducing sugar was noted in V1 (4.07%) in combination with C3. After 10 DAS, one variety (V3) completely got spoiled irrespective of post-harvest treatment and among other combinations highest non reducing sugar was noted in V1 (3.71%) in combination with C5 and lowest non reducing sugar was noted in V1 (2.66%) in combination with C3. The minimum total sugars at all the days of storage

was observed in the treatment C5 (*Aloe vera* gel: Distilled water (V/V) (1:1)), C3 (Carnauba wax 25%), C4 (*Aloe vera* gel: Distilled water (V/V) (2:1)) and C4 (Carnauba wax 50%) when compared to all other treatments. All these treated fruits were found to have the lowest non reducing sugars as compared to others at all the days of recording.

Comparatively, delayed increase in non-reducing sugars over the storage period in the *Aloe vera* gel and carnauba wax treated fruits could be attributed to delayed conversion of starch to sugars which in turn is due to the effect of surface coatings. Similar results with *Aloe vera* coating created a modification of the internal atmosphere, as modified atmosphere packaging resulted in delayed ripening changes and sugar synthesis in fruits (Martinez *et al*., 2006). Similar results were reported by Nakhasi *et al*. (1991) [14] in tomatoes, Shirin and Asghar (2014) [17] in grapes and Marpudi *et al*. (2013) [10] in fig. During storage, the accumulated starch hydrolyses as a result of amylase activity leading to the formation of sugars. Glucose, fructose and sucrose constitute most of the monosaccharides with sucrose being the predominant sugar (Ganjyal *et al*., 2003).

**Table 1:** Effect of post-harvest treatments on titratable acidity (%) of different varieties under ambient storage condition

| Treatments | 2 DAS | | | | 4 DAS | | | | 6 DAS | | | | 8 DAS | | | | 10 DAS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $C_1$ | 0.22 | 0.23 | 0.21 | 0.22 | 0.21 | 0.21 | 0.19 | 0.20 | 0.20 | 0.20 | * | 0.24 | * | * | * | * | * | * | * | * |
| $C_2$ | 0.21 | 0.22 | 0.21 | 0.22 | 0.19 | 0.20 | 0.20 | 0.20 | 0.18 | 0.19 | 0.19 | 0.19 | * | * | * | * | * | * | * | * |
| $C_3$ | 0.24 | 0.26 | 0.19 | 0.23 | 0.22 | 0.25 | 0.17 | 0.21 | 0.21 | 0.23 | 0.16 | 0.20 | 0.19 | 0.22 | 0.14 | 0.18 | 0.18 | 0.19 | * | 0.18 |
| $C_4$ | 0.23 | 0.24 | 0.18 | 0.22 | 0.21 | 0.22 | 0.16 | 0.20 | 0.19 | 0.21 | 0.15 | 0.18 | 0.17 | 0.19 | * | 0.18 | * | * | * | * |
| $C_5$ | 0.25 | 0.26 | 0.20 | 0.24 | 0.23 | 0.24 | 0.18 | 0.22 | 0.22 | 0.23 | 0.17 | 0.21 | 0.20 | 0.20 | 0.15 | 0.19 | 0.18 | 0.18 | * | 0.18 |
| $C_6$ | 0.24 | 0.25 | 0.18 | 0.22 | 0.22 | 0.23 | 0.17 | 0.21 | 0.20 | 0.22 | 0.16 | 0.20 | 0.19 | 0.20 | * | 0.19 | 0.17 | * | * | 0.17 |
| $C_7$ | 0.20 | 0.21 | 0.17 | 0.19 | 0.19 | 0.20 | 0.15 | 0.18 | 0.17 | 0.19 | * | 0.18 | * | * | * | * | * | * | * | * |
| Mean | 0.23 | 0.24 | 0.19 | | 0.21 | 0.22 | 0.17 | | 0.21 | 0.21 | 0.17 | | 0.19 | 0.20 | 0.14 | | 0.18 | 0.18 | * | |
| For comparing the means | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | |
| Treatments (C) | 0.002 | | 0.006 | | 0.002 | | 0.006 | | 0.002 | | 0.005 | | 0.001 | | 0.004 | | - | | - | |
| Varieties (V) | 0.001 | | 0.004 | | 0.001 | | 0.004 | | 0.001 | | 0.003 | | 0.001 | | 0.002 | | - | | - | |
| Interactions (C×V) | 0.003 | | 0.010 | | 0.003 | | 0.010 | | 0.003 | | 0.009 | | 0.002 | | 0.007 | | - | | - | |

Initial value of titrable acidity: $V_1$=0.22%, $V_2$=0.23%, $V_3$=0.19%

* No observation was recorded as the fruits lost their keeping quality.

$C_1$: Chitosan 0.5% $C_4$: Carnauba wax 50% $C_7$: Control $V_1$: Kalipatti

$C_2$: Chitosan 1% $C_5$: *Aloe vera* gel: Distilled water (V/V) (1:1) $V_2$: Cricket Ball

$C_3$: Carnauba wax 25% $C_6$: *Aloe vera* gel: Distilled water (V/V) (2:1) $V_3$: Pala

**Table 2:** Effect of post-harvest treatments on ascorbic acid (mg/100g) of different varieties under ambient storage condition

| Treatments | 2 DAS | | | | 4 DAS | | | | 6 DAS | | | | 8 DAS | | | | 10 DAS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $C_1$ | 12.33 | 11.52 | 11.50 | 11.79 | 10.57 | 10.43 | 9.71 | 10.24 | 8.93 | 9.25 | * | 9.09 | * | * | * | * | * | * | * | * |
| $C_2$ | 12.23 | 11.35 | 11.46 | 11.68 | 9.73 | 10.12 | 9.67 | 9.84 | 8.41 | 9.57 | 9.36 | 9.11 | * | * | * | * | * | * | * | * |
| $C_3$ | 12.71 | 12.03 | 11.54 | 12.09 | 11.73 | 11.34 | 10.06 | 11.04 | 10.64 | 9.16 | 8.55 | 9.45 | 9.52 | 7.87 | 8.18 | 8.52 | 8.88 | 6.98 | * | 7.93 |
| $C_4$ | 12.83 | 11.75 | 11.34 | 11.97 | 11.81 | 11.17 | 9.79 | 10.92 | 9.84 | 8.97 | 8.28 | 9.03 | 7.68 | 7.53 | * | 7.60 | * | * | * | * |
| $C_5$ | 12.93 | 12.13 | 11.77 | 12.28 | 11.87 | 11.65 | 10.15 | 11.22 | 10.07 | 9.88 | 9.63 | 9.86 | 9.00 | 8.25 | 7.87 | 8.37 | 8.13 | 7.13 | * | 7.63 |
| $C_6$ | 12.70 | 11.95 | 11.63 | 12.09 | 11.73 | 11.27 | 9.85 | 10.95 | 9.63 | 9.42 | 9.38 | 9.48 | 8.51 | 7.96 | * | 8.23 | 7.88 | * | * | 7.88 |
| $C_7$ | 11.33 | 10.94 | 11.32 | 11.20 | 10.07 | 8.78 | 9.53 | 9.46 | 8.83 | 7.52 | * | 8.17 | * | * | * | * | * | * | * | * |
| Mean | 12.44 | 11.67 | 11.51 | | 11.08 | 10.68 | 9.82 | | 9.48 | 9.11 | 9.04 | | 8.68 | 7.90 | 8.02 | | 8.30 | 7.05 | * | |
| For comparing the means | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | |
| Treatments (C) | 0.074 | | 0.211 | | 0.002 | | 0.006 | | 0.002 | | 0.006 | | 0.001 | | 0.004 | | - | | - | |
| Varieties (V) | 0.048 | | 0.138 | | 0.001 | | 0.004 | | 0.001 | | 0.004 | | 0.001 | | 0.003 | | - | | - | |
| Interactions (C×V) | 0.127 | | 0.365 | | 0.004 | | 0.011 | | 0.004 | | 0.010 | | 0.002 | | 0.007 | | - | | - | |

Initial value of ascorbic acid: $V_1$=13.68 mg/100g, $V_2$=12.52 mg/100g, $V_3$=13.15 mg/100g

* No observation was recorded as the fruits lost their keeping quality.

Note: DAS – Days After Storage $C_1$: Chitosan 0.5% $C_4$: Carnauba wax 50% $C_7$: Control $V_1$: Kalipatti $C_2$: Chitosan 1% $C_5$: *Aloe vera* gel: Distilled water (V/V) (1:1) $V_2$: Cricket Ball $C_3$: Carnauba wax 25% $C_6$: *Aloe vera* gel:Distilled water (V/V) (2:1) $V_3$: Pala

**Table 3:** Effect of post-harvest treatments on reducing sugar (%) of different varieties under ambient storage condition

| Treatments | 2 DAS | | | | 4 DAS | | | | 6 DAS | | | | 8 DAS | | | | 10 DAS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $C_1$ | 4.78 | 4.43 | 5.21 | 4.81 | 6.17 | 5.26 | 6.31 | 5.91 | 6.07 | 5.74 | * | 5.90 | * | * | * | * | * | * | * | * |
| $C_2$ | 4.84 | 4.61 | 5.33 | 4.93 | 6.24 | 5.58 | 6.56 | 6.12 | 6.16 | 5.84 | 6.27 | 6.09 | * | * | * | * | * | * | * | * |
| $C_3$ | 4.21 | 3.96 | 4.71 | 4.30 | 5.13 | 4.83 | 5.25 | 5.07 | 6.00 | 5.15 | 6.52 | 5.89 | 6.35 | 5.74 | 6.27 | 6.12 | 6.32 | 5.47 | * | 5.89 |
| $C_4$ | 4.32 | 4.28 | 4.96 | 4.52 | 6.00 | 5.05 | 5.74 | 5.60 | 6.99 | 5.82 | 6.85 | 6.56 | 7.18 | 6.13 | * | 6.65 | * | * | * | * |
| $C_5$ | 4.12 | 3.85 | 4.54 | 4.17 | 4.98 | 4.63 | 5.13 | 4.91 | 5.98 | 5.04 | 6.34 | 5.79 | 6.51 | 5.32 | 5.48 | 5.77 | 6.49 | 5.12 | * | 5.80 |
| $C_6$ | 4.25 | 4.13 | 4.83 | 4.40 | 5.52 | 4.95 | 5.43 | 5.30 | 6.12 | 5.36 | 6.71 | 6.07 | 6.63 | 5.16 | * | 5.89 | 6.57 | * | * | 6.57 |
| $C_7$ | 5.17 | 4.94 | 5.57 | 5.23 | 6.52 | 5.87 | 6.78 | 6.39 | 6.15 | 5.56 | * | 5.85 | * | * | * | * | * | * | * | * |
| Mean | 4.53 | 4.32 | 5.02 | | 5.80 | 5.17 | 5.89 | | 6.21 | 5.50 | 6.54 | | 6.67 | 5.59 | 5.87 | | 6.46 | 5.29 | * | |
| For comparing the means | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatments (C) | 0.002 | 0.006 | 0.002 | 0.006 | 0.003 | 0.008 | 0.001 | 0.004 | - | - |
| Varieties (V) | 0.001 | 0.004 | 0.001 | 0.004 | 0.002 | 0.005 | 0.001 | 0.002 | - | - |
| Interactions (C×V) | 0.004 | 0.011 | 0.003 | 0.010 | 0.005 | 0.014 | 0.002 | 0.007 | - | - |

Initial value of reducing sugar: $V_1$=3.56%, $V_2$=3.27%, $V_3$=4.18%
* No observation was recorded as the fruits lost their keeping quality.
Note: DAS – Days After Storage $C_1$: Chitosan 0.5% $C_4$: Carnauba wax 50% $C_7$: Control $V_1$: Kalipatti $C_2$: Chitosan 1% $C_5$: *Aloe vera* gel: Distilled water (V/V) (1:1) $V_2$: Cricket Ball $C_3$: Carnauba wax 25% $C_6$: *Aloe vera* gel: Distilled water (V/V) (2:1) $V_3$: Pala

**Table 4:** Effect of post-harvest treatments on total sugar (%) of different varieties under ambient storage condition

| Treatments | 2 DAS | | | | 4 DAS | | | | 6 DAS | | | | 8 DAS | | | | 10 DAS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $C_1$ | 8.03 | 7.34 | 8.97 | 8.11 | 9.26 | 8.36 | 10.11 | 9.24 | 9.08 | 8.45 | * | 8.76 | * | * | * | * | * | * | * | * |
| $C_2$ | 8.17 | 7.52 | 9.22 | 8.31 | 9.15 | 8.54 | 10.14 | 9.28 | 8.85 | 8.92 | 10.08 | 9.28 | * | * | * | * | * | * | * | * |
| $C_3$ | 7.42 | 6.91 | 8.68 | 7.67 | 8.67 | 7.68 | 9.75 | 8.70 | 9.35 | 8.12 | 10.12 | 9.20 | 10.64 | 8.77 | 9.87 | 9.76 | 9.12 | 8.43 | * | 8.77 |
| $C_4$ | 7.91 | 7.27 | 8.83 | 8.01 | 8.93 | 8.14 | 10.06 | 9.04 | 9.75 | 8.62 | 10.53 | 9.63 | 10.04 | 8.83 | * | 9.43 | * | * | * | * |
| $C_5$ | 7.25 | 6.74 | 8.52 | 7.51 | 8.42 | 7.51 | 9.27 | 8.40 | 9.07 | 7.83 | 9.86 | 8.92 | 10.42 | 8.56 | 9.63 | 9.54 | 10.39 | 8.21 | * | 9.30 |
| $C_6$ | 7.74 | 7.13 | 8.75 | 7.87 | 8.79 | 7.97 | 9.98 | 8.91 | 9.42 | 8.25 | 10.37 | 9.35 | 10.17 | 8.03 | * | 9.10 | 9.82 | * | * | 9.82 |
| $C_7$ | 8.26 | 7.85 | 9.46 | 8.52 | 9.57 | 8.72 | 10.35 | 9.55 | 9.25 | 8.46 | * | 8.85 | * | * | * | * | * | * | * | * |
| Mean | 7.83 | 7.25 | 8.92 | | 8.97 | 8.13 | 9.95 | | 9.25 | 8.38 | 10.19 | | 10.32 | 8.55 | 9.75 | | 9.77 | 8.32 | * | |
| For comparing the means | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | |
| Treatments (C) | 0.002 | | 0.006 | | 0.002 | | 0.005 | | 0.003 | | 0.008 | | 0.001 | | 0.004 | | - | | - | |
| Varieties (V) | 0.001 | | 0.004 | | 0.001 | | 0.003 | | 0.002 | | 0.005 | | 0.001 | | 0.002 | | - | | - | |
| Interactions (C×V) | 0.003 | | 0.010 | | 0.003 | | 0.009 | | 0.005 | | 0.014 | | 0.002 | | 0.007 | | - | | - | |

Initial value of total sugar: $V_1$=7.63%, $V_2$=7.19%, $V_3$=8.74% * No observation was recorded as the fruits lost their keeping quality.
Note: DAS – Days After Storage $C_1$: Chitosan 0.5% $C_4$: Carnauba wax 50% $C_7$: Control $V_1$: Kalipatti $C_2$: Chitosan 1% $C_5$: *Aloe vera* gel: Distilled water (V/V) (1:1) $V_2$: Cricket Ball $C_3$: Carnauba wax 25% $C_6$: *Aloe vera* gel:Distilled water (V/V) (2:1) $V_3$: Pala

**Table 5:** Effect of post-harvest treatments on non-reducing sugar (%) of different varieties under ambient storage condition

| Treatments | 2 DAS | | | | 4 DAS | | | | 6 DAS | | | | 8 DAS | | | | 10 DAS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $C_1$ | 3.07 | 2.76 | 3.57 | 3.14 | 2.94 | 2.95 | 3.61 | 3.17 | 2.85 | 2.57 | * | 2.71 | * | * | * | * | * | * | * | * |
| $C_2$ | 3.16 | 2.76 | 3.74 | 3.22 | 2.74 | 2.82 | 3.41 | 2.99 | 2.55 | 2.93 | 3.61 | 3.03 | * | * | * | * | * | * | * | * |
| $C_3$ | 3.06 | 2.80 | 3.76 | 3.21 | 3.36 | 2.71 | 4.27 | 3.45 | 3.18 | 2.82 | 3.42 | 3.14 | 4.07 | 2.86 | 3.42 | 3.45 | 2.66 | 2.81 | * | 2.73 |
| $C_4$ | 3.41 | 2.84 | 3.67 | 3.31 | 2.79 | 2.92 | 4.11 | 3.27 | 2.63 | 2.66 | 3.48 | 2.92 | 2.71 | 2.56 | * | 2.63 | * | * | * | * |
| $C_5$ | 2.97 | 2.74 | 3.78 | 3.17 | 3.28 | 2.73 | 3.94 | 3.32 | 2.95 | 2.65 | 3.32 | 2.97 | 3.72 | 3.07 | 3.95 | 3.58 | 3.71 | 2.93 | * | 3.32 |
| $C_6$ | 3.31 | 2.85 | 3.72 | 3.30 | 3.12 | 2.85 | 4.33 | 3.43 | 3.15 | 2.74 | 3.47 | 3.12 | 3.36 | 2.73 | * | 3.04 | 3.08 | * | * | 3.08 |
| $C_7$ | 2.93 | 2.76 | 3.69 | 3.13 | 2.90 | 2.70 | 3.39 | 3.00 | 2.93 | 2.76 | * | 2.84 | * | * | * | * | * | * | * | * |
| Mean | 3.13 | 2.79 | 3.71 | | 3.02 | 2.81 | 3.87 | | 2.89 | 2.73 | 3.46 | | 3.46 | 2.80 | 3.68 | | 3.15 | 2.87 | * | |
| For comparing the means | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | | SEm± | | CD at 5% | |
| Treatments (C) | 0.002 | | 0.006 | | 0.002 | | 0.006 | | 0.002 | | 0.005 | | 0.002 | | 0.004 | | - | | - | |
| Varieties (V) | 0.001 | | 0.004 | | 0.001 | | 0.004 | | 0.001 | | 0.004 | | 0.001 | | 0.003 | | - | | - | |
| Interactions (C×V) | 0.003 | | 0.010 | | 0.003 | | 0.010 | | 0.003 | | 0.010 | | 0.003 | | 0.008 | | - | | - | |

Initial value of non-reducing sugar: V1=7.63%, V2=7.19%, V3=8.74%
* No observation was recorded as the fruits lost their keeping quality.
Note: DAS – Days After Storage
C1: Chitosan 0.5% C4: Carnauba wax 50%
C2: Chitosan 1% C5: *Aloe vera* gel: Distilled water (V/V) (1:1) C3: Carnauba wax 25% C6: *Aloe vera* gel: Distilled water (V/V) (2:1) C7: Control V1: Kalipatti V2: Cricket Ball V3: Pala

## 4. Conclusion

From the experiment it can be concluded that, post-harvest treatment of sapota varieties Kalipatti and Cricket Ball with *Aloe vera* gel: Distilled water (V/V) (1:1) and Carnauba wax 25% maintained better physico-chemical characters parameter at ambient conditions. Therefore, application of postharvest *Aloe vera* gel in the ratio of 1:1 is recommended for improving quality of sapota varieties.

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## 6. References

1. Adetunji CO, Fawole OB, Arowora KA, Nwaubani SI, Ajayi ES, Oloke JK, *et al*., Effects of edible coatings from *Aloe vera* gel on quality and post-harvest physiology of *Ananas comosus* (L.) fruit during ambient storage. Global Journal of Science Frontier Research Bio-Tech & Genetics. 2012;12(5):39-43.
2. Asghari M, Ahadi L, Riaie S. Effect of salicylic acid and edible coating based *Aloe vera* gel treatment on storage life and postharvest quality of grape (*Vitis vinifera* L. cv. Gizel Uzum). International Journal of Agriculture Crop Sciences. 2013;5(23):2890-2898.
3. Brishti FH, Misir J, Sarker A. Effect of biopreservatives

on storage life of papaya (*Carica papaya* L.). International Journal of Food Studies. 2013;2:126-136.
4. Ergun M, Satici F. Use of *Aloe vera* gel as biopreservative for 'Granny smith' and 'Red chief' apples. Journal of Animal and Plant Sciences. 2012;22(2):363-368.
5. Ganjyal GM, Hanna MA, Devadattam DSK. Processing of sapota (sapodilla): Drying. Journal of Food Sciences. 2003;68:517-520.
6. Joshi GD, Paralkar PS. Effect of ripening media and storage behavior of sapota fruits. National seminar on optimization of productivity and utilization of sapota. Organized by the Horticultural society of India at Gujarat Agricultural University, India; c1991. p. 33.
7. Kishore KYN, Nirujogi BC, Venkata R, Veeranna GP. Effects of growth regulators on quality of sapota (Manilkara achras (Mill.) Fosberg) cv. Kalipatti. Plant Architecture. 2013;13(2):893-896.
8. Lakshminarayana S. Sapodilla and Pickly pear. In: Magy S, Shaw PE (Eds.) Tropical and subtropical fruits. AVI Publishing Connecticut Inc. Wesport; c1979.
9. Martinez RD, Alburquerque N, Valverde JM, Guillen F, Castillo S, Valero D, Serrano M. Postharvest sweet cherry quality and safety maintenance by *Aloe vera* treatments: A new edible coating. Postharvest Biology and Technology. 2006;39:93-100.
10. Marpudi S, Ramachandran P, Srividya N. *Aloe vera* gel coating for post-harvest quality maintenance of fresh fig fruits. Journal of Pharmaceutical, Biology and Chemical Sciences. 2013;4(1):878.
11. Mohamadreza A, Hojjat K, Yusof R, Arash M. Influence of postharvest nitric oxide and *Aloe vera* gel application on sweet cherry quality indices and storage life. International Journal of Agriculture and Plant Production. 2013;4(9):2393-2398.
12. Morais PLD, Oliveira LC, Alves RE, Alves JD, Paiva A. Amadurecimiento de sapoti (*Manilkara zapota* L.) submetido ao 1- metilciclopropeno. Revista Brasileira de Fruticultura. 2006;28:369-373.
13. Morillon V, Debeaufort F, Blond G, Capelle M, Voilley A. Factors affecting the moisture permeability of lipid-based edible films: A review. Critical Reviews in Food Science and Nutrition. 2002;42(1):67-89.
14. Nakhasi S, Schlimme D, Solomos T. Storage potential of tomatoes harvested at the breaker stage using modified atmosphere storage. Journal of Food Sciences. 1991;56(1):55-59.
15. Rehele R, Mahrdad N, Nedu M. Postharvest sour cherry quality and safety maintenance by exposure to hot water or treatment with fresh *Aloe vera* gel. Journal of Food Science and Technology. 2012;28:68-75.
16. Sai LM, Pushpakala R, Srividya N. *Aloe vera* gel coating for post-harvest quality maintainance of fresh fruits, Research Journal of Pharmaceutical Biological Chemical Sciences. 2013;4(1):878-887.
17. Shirin S, Asghar R. Effect of natural *Aloe vera* gel coating combined with calcium chloride and citric acid treatments on grape (*Vitis vinifera* L. cv. Askari) quality during storage. American Journal of Food Science and Technology. 2014;2(1):1-5.
18. Shweta C, Gupta KC, Mukesh A. Application of biodegradable *Aloe vera* gel to control post-harvest decay and longer the shelf life of grapes. International Journal of Current Microbiological Applied Sciences. 2014;3(3):632-642.
19. Sudha R, Amutha R, Muthulaksmi S, Baby RW, Indira K, Mareeswari P. Influence of pre and post-harvest chemical treatments on physical characteristics of Sapota (*Achras sapota* L.) var. PKM 1. Research Journal of Agriculture and Biological Sciences. 2007;3(5):450-452.
20. Taiz LY, Zeiger E. Fisiología Vegetal Publicasions de la University at Jaume. 2006;2:992-1024.
21. Valverde MJ, Valero DR, Guillean FN, Castillo S, Serrano M. Novel edible coating based on *Aloe vera* gel to maintain table grape quality and safety. Journal of Agriculture and Food Chemistry. 2005;53:7807-7813.
22. Sariful MI, Saiful MI, Fazlul KA. Effect of post-harvest treatments with some coating materials on the shelf life and quality of banana, Pakistan Journal of Biological Sciences. 2001;4(9):1149-1152.
23. Sihag RP, Behiwal LS, Mehta PK. Effect of post-harvest application of potassium permanganate on shelf life of Peach fruit. Haryana Journal of Horticultural Sciences. 2005;34(3-4):259-260.
24. Mahajan BVC, Bhatt AS, Sandhu KS. Effect of different post harvest treatment on the storage life of kinnow. Journal of Food Science and Technology. 2005;42(4):296-299.
25. Waskar DP, Gaikwad RS. Effect of various postharvest treatments on extension of shelf life of Kesar mango fruits. Indian Journal of Agricultural Research. 2005;39(2):95- 102.
26. Sidhu GS, Dhillon WS, Mahajan BVC. Effect of waxing and packaging on storage of pear cv. Punjab Beauty. Indian Journal of Horticulture. 2009;66(2):239-244.
27. Mahajan BV, Rupinder S. Influence of coatings on postharvest physiology and shelf life of kinnow fruits under super market conditions. Journal of Postharvest Technology. 2014;2(1):37-44.
28. Singh AK, Singh CP, Kushwaha PS, Chakraborty B. Efficacy of postharvest treatments on fruit marketability and physico-chemical characteristics of Dashehari mango. Progressive Horticulture. 2012;44(2):215-219.