

Original Research Article

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Effect of Potassium Permanganate and Silver Nitrate Chemicals on the Shelf Life of Guava Fruits

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ABSTRACT

The experiment on post-harvest dipping of guava fruits to increase the shelf life and quality of fruits was done with the concentrations of Potassium permanganate (KMnO_4) and silver nitrate (AgNO_3). The harvested fruits were dipped in 0.5%, 1% and 1.5% of silver nitrate and 300, 600 and 900 ppm of potassium permanganate for 10 minutes and packed in CFB boxes. Analysis was done in terms of physical and chemical characteristics of fruits. The results indicated that the minimum physical loss in weight (1.53%) was observed in the fruits treated with Silver nitrate (1.5%). Maximum specific gravity (0.92) was recorded in fruits treated with KMnO_4 @600 ppm while maximum ascorbic acid (254.16mg) was observed in fruits treated with AgNO_3 @1.5%. Potassium permanganate and silver nitrate was helpful in maintaining the quality of fruits up to 9 days while fruits under control were spoiled on the 9th day of storage.

Keywords

Guava, AgNO_3 ,
 KMnO_4 , shelf life.

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Introduction

Guava (*Psidium guajava* L.), is native of tropical America, which is very important fruit crop of the *Myrtaceae* family and it's a cheapest and good source of vitamin C. Guava is highly perishable fruit (1,2,3).

Under ambient conditions, fruit quality is maintained only for 2 to 3 days after harvest because of high moisture content, soft skin. Guava fruits have higher rate of respiration, transpiration, ripening and other biological activities even after harvest which deteriorate the quality of fruits in a short period of time which makes them unmarketable. Hence it is

necessary to reduce rates of these physiochemical changes in order to enhance the shelf life of guava fruits. Various methods of extending shelf life of the fresh guava fruits have been experimented and recommended for different varieties viz. cold storage, temperature modification, skin coating with wax, use of plant growth regulators, chemical treatments, packaging materials and ethylene absorbent. The response of the guava fruits to these treatments varies with different varieties and conditions to be stored. Hence it may be necessary to find out a suitable technology for

extending shelf life of guava fruits. The main purpose of storage of guava fruits is to extend their shelf life to ensure their availability through the year in the market. Scientific method of post-harvest handling of fruits and vegetables not only facilitate proper care of agricultural produce but also help in enhancing the shelf life of produce (4,5). Huge post-harvest losses of horticulture produce in our country point towards the need for proper handling of produce in scientific manner (6,7). Under Indian conditions there is an urgent need to develop suitable techniques for guava fruits for their availability for fresh fruit markets. Silver nitrate (AgNO_3) and Potassium permanganate (KMnO_4) chemical treatments can reduce the extent of post-harvest losses in guava fruits and extend the shelf life.

Materials and Methods

The present investigations were carried out at the orchard of Lovely Professional University, Punjab, from December, 2016. Lovely Professional University, Phagwara, Punjab, is located at latitude 31.25 and longitude 75.70 as per Google map coordinates along with altitude of above 232 m above sea level. Generally Soil is alkaline in reaction with pH range from 7.5 to 8.3.

Experimental materials

The fruits of guava were harvested, collected in polythene bags and were taken to laboratory for analysis. Fruits were selected for uniformity of size, colour and diseased fruits were discarded. Prior to the application of post-harvest treatments, destalking of fruits was done by retaining only 0.5 cm long pedicle in each fruit.

Pre cooling

Guava fruits were sorted and pre cooled in running water for 10 minutes.

Methodology

Harvested fruits of guava were dipped in different chemicals with different concentrations like Potassium permanganate @ 300ppm, 600ppm, 900ppm and Silver nitrate @ .5%, 1% and 1.5% for 1-2 minutes.

After dipping, fruits were exposed in air for few minutes for drying.

The dried fruits were packed in 2-5 kg Cardboard boxes.

After treatment with different chemicals (Potassium permanganate and Silver nitrate), they were stored at ambient temperature.

The guava fruits were kept at room temperature $25 \pm 1^\circ\text{C}$. 75% RH and were taken out on 3rd, 6th and 9th day for the analysis of physical and chemical characters.

Observations Recorded

Physical and chemical parameters determination

For the physical and chemical parameters determination fruits were randomly collected from each sides of the trees under treatments and both physical characteristics [Physical loss in weight(%), Fruit length (cm), Fruit width (cm), specific gravity and palatability rating] and chemical characteristics [TSS ($^{\circ}\text{B}$), Acidity (%) and Vitamin C (mg/100g pulp)] were determined by the methods described by AOAC.

Experimental design

The experiment was laid out in Complete Randomized Design (CRD), having 7 treatments and 3 replications each for storage of fruits at ambient temperature.

Results and Discussion

The analysed pooled data regarding physical and chemical parameters are given in table 1, tables 2 and 3. And all parameter data was founded significant except fruit length, width and palatability rating.

Physical characters

Results regarding the maximum physical loss in weight were observed in case of untreated fruits. The maximum values are noted in T₀ (2.72% (on 3rd day), 4.03% (on 6th day) and 5.72% (on 9th day). These values are not so high in case of rest treatments. The minimum was recorded in T₃ (1.53%) on 3rd day of storage in case of AgNO₃ (1.5%). This could probably due to reduction or interruption in fruit respiration rate by AgNO₃ and its stimulatory effect on fruit metabolism. These results are in conformity with the studies conducted by Rana *et al.*, (2015) in mango fruits and Bairwa and Dashora (1999) in banana. In this study the maximum fruit length (5.9 cm) was observed in AgNO₃ 1% on 3rd day of storage followed by AgNO₃ 1% (5.86 cm) on the same day and the minimum fruit length (5 cm) was seen in KMnO₄ 300 ppm on 9th day of storage. The similar

findings are reported by Duenas *et al.*, (2009). And the maximum fruit width (5.93 cm) was observed in KMnO₄ @600ppm on 3rd day of storage followed by AgNO₃ @1% (5.9 cm) on the same day while it was minimum (5.46 cm) with KMnO₄ @900ppm on 9th day of storage. The decrease in fruit width was due to application of KMnO₄ 900 ppm which may be due to its stimulatory effect on fruit metabolism. These results are in conformity with the studies conducted by Rana *et al.*, (2015) in mango. Treated fruits have higher value of specific gravity in storage. The maximum specific gravity was found with KMnO₄ @600 ppm (0.99) on 3rd day of storage. The minimum specific gravity was found in control (0.78) on 3rd, 6th and 9th day of storage highest decrease was noted in T₀ and T₅ was found at par with T₃ and T₂. This alteration in specific gravity may be due to loss of weight, volume and due to conversion of starch into sugar. The highest mean palatability rating (16 out of 20) was noted in the fruits treated with KMnO₄ 600 ppm and 900 ppm and lowest mean palatability rating (10 out of 20) was noted in control. The fruits were rated as excellent (16) and very good (14.66) and good (11.66) after 3rd day of storage. There was rapid decrease in score (below 10- poor) on 9th day of storage.

Table.1 Effect of chemicals on the physical loss in weight, length, width of guava at the time of storage

| Treatments / Days | Physical loss in weight (%) | | | Length (cm) | | | Width (cm) | | |
|-------------------|-----------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | 3 rd Day | 6 th Day | 9 th Day | 3 rd Day | 6 th Day | 9 th Day | 3 rd Day | 6 th Day | 9 th Day |
| T ₀ | 2.72 ^a | 4.03 ^a | 5.72 ^a | 5.9 | 5.76 | 5.7 | 5.9 | 5.76 | 5.6 |
| T ₁ | 1.87 ^c | 2.62 ^b | 3.89 ^b | 5.53 | 5.36 | 5.23 | 5.83 | 5.7 | 5.6 |
| T ₂ | 1.66 ^c | 2.83 ^b | 4.1 ^{bc} | 5.9 | 5.76 | 5.6 | 5.9 | 5.83 | 5.63 |
| T ₃ | 1.53 ^c | 2.14 ^b | 3.71 ^c | 5.86 | 5.76 | 5.6 | 5.86 | 5.76 | 5.6 |
| T ₄ | 2.31 ^b | 3.56 ^{ab} | 4.55 ^b | 5.33 | 5.2 | 5 | 5.8 | 5.7 | 5.5 |
| T ₅ | 1.97 ^{bc} | 2.85 ^b | 4.32 ^{bc} | 5.7 | 5.56 | 5.43 | 5.93 | 5.8 | 5.7 |
| T ₆ | 1.68 ^c | 2.75 ^b | 4.29 ^{bc} | 5.4 | 5.23 | 5.03 | 5.7 | 5.6 | 5.46 |
| Mean | 1.96 | 2.96 | 4.36 | 5.66 | 5.51 | 5.37 | 5.84 | 5.73 | 5.58 |
| C.D | 0.393 | 0.728 | 0.815 | N/S | N/S | N/S | N/S | N/S | N/S |
| SE(m) | 0.128 | 0.238 | 0.266 | 0.202 | 0.181 | 0.185 | 0.209 | 0.25 | 0.246 |
| SE(d) | 0.181 | 0.336 | 0.376 | 0.286 | 0.256 | 0.262 | 0.296 | 0.353 | 0.347 |
| C.V. | 11.29 | 13.853 | 10.538 | 6.191 | 5.684 | 5.971 | 6.245 | 7.539 | 7.616 |

C.D. = Critical Difference, SE (m) = Standard Error mean, SE (d) = Standard Error deviance, C.V. = Correlation of Variance, NS = Non-Significant.

Table.2 Effect of chemicals on the specific gravity, palatability rating, acidity (%) of guava at the time of storage

| Treatments / Days | Specific gravity | | | Palatability rating | | | Acidity (%) | | |
|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | 3 rd Day | 6 th Day | 9 th Day | 3 rd Day | 6 th Day | 9 th Day | 3 rd Day | 6 th Day | 9 th Day |
| T ₀ | 0.83 ^c | 0.8 ^c | 0.78 ^c | 15 | 14.66 | 10 | 0.58 ^b | 0.53 ^c | 0.5 ^b |
| T ₁ | 0.97 ^a | 0.95 ^a | 0.9 ^{ab} | 15.66 | 13.66 | 11.66 | 0.62 ^a | 0.6 ^a | 0.57 ^a |
| T ₂ | 0.92 ^b | 0.89 ^b | 0.87 ^b | 14.33 | 12 | 11.33 | 0.61 ^a | 0.58 ^b | 0.54 ^{ab} |
| T ₃ | 0.98 ^a | 0.95 ^a | 0.91 ^a | 15.66 | 13.66 | 10.33 | 0.63 ^a | 0.6 ^a | 0.56 ^a |
| T ₄ | 0.87 ^c | 0.84 ^c | 0.82 ^c | 15.66 | 13.66 | 11 | 0.61 ^a | 0.59 ^{ab} | 0.56 ^a |
| T ₅ | 0.99 ^a | 0.96 ^a | 0.92 ^a | 16 | 11.66 | 10.66 | 0.63 ^a | 0.61 ^a | 0.57 ^a |
| T ₆ | 0.91 ^b | 0.88 ^b | 0.86 ^b | 16 | 12.33 | 9.33 | 0.61 ^a | 0.59 ^{ab} | 0.53 ^b |
| Mean | 0.92 | 0.89 | 0.86 | N/S | 1.89 | N/S | 0.61 | 0.58 | 0.54 |
| C.D | 0.038 | 0.036 | 0.038 | 0.701 | 0.617 | 0.864 | 0.016 | 0.015 | 0.024 |
| SE(m) | 0.012 | 0.012 | 0.013 | 0.992 | 0.873 | 1.222 | 0.005 | 0.005 | 0.008 |
| SE(d) | 0.018 | 0.017 | 0.018 | 7.851 | 8.164 | 14.088 | 0.007 | 0.007 | 0.011 |
| C.V. | 2.325 | 2.261 | 2.497 | 15 | 14.66 | 10 | 1.46 | 1.483 | 2.507 |

C.D. = Critical Difference, SE (m) = Standard Error mean, SE (d) = Standard Error deviance, C.V. = Correlation of Variance, NS = Non-Significant.

Table.3 Effect of chemicals on the ascorbic acid, TSS of guava at the time of storage

| Treatments / Days | Ascorbic acid (mg/100g) | | | TSS (^o brix) | | |
|-------------------|-------------------------|----------------------|----------------------|--------------------------|---------------------|---------------------|
| | 3 rd Day | 6 th Day | 9 th Day | 3 rd Day | 6 th Day | 9 th Day |
| T ₀ | 252.54 | 225.91 ^b | 165.98 ^d | 10.1 ^a | 10.4 ^a | 10.86 ^a |
| T ₁ | 254.16 | 234.54 ^{ab} | 176.9 ^b | 9.63 ^b | 9.9 ^{bc} | 10.1 ^{bc} |
| T ₂ | 253.52 | 240.04 ^a | 176.08 ^b | 9.26 ^c | 9.73 ^c | 9.9 ^c |
| T ₃ | 253.54 | 233.51 ^b | 181.84 ^a | 9.23 ^c | 9.63 ^c | 9.83 ^c |
| T ₄ | 253.14 | 235.71 ^{ab} | 175.09 ^b | 9.6 ^b | 9.93 ^{bc} | 10.23 ^c |
| T ₅ | 253.39 | 233.78 ^{ab} | 179.95 ^{ab} | 9.73 ^b | 10 ^b | 10.3 ^b |
| T ₆ | 253.93 | 229.18 ^b | 171.39 ^c | 9.66 ^b | 10.06 ^b | 10.26 ^b |
| Mean | 253.46 | 233.23 | 175.31 | 9.60 | 9.95 | 10.21 |
| C.D | N/S | 6.507 | 3.657 | 0.228 | 0.215 | 0.225 |
| SE(m) | 0.524 | 2.125 | 1.194 | 0.075 | 0.07 | 0.073 |
| SE(d) | 0.741 | 3.005 | 1.689 | 0.105 | 0.049 | 0.104 |
| C.V. | 0.358 | 1.578 | 1.18 | 1.344 | 1.221 | 1.246 |

C.D. = Critical Difference, SE (m) = Standard Error mean, SE (d) = Standard Error deviance, C.V. = Correlation of Variance, NS = Non-Significant.

Treatments Details

| Sr. No. | Treatments | Chemical used |
|----------|----------------|----------------------------------|
| 1 | T ₀ | Control |
| 2 | T ₁ | Silver nitrate @ .5% |
| 3 | T ₂ | Silver nitrate @ 1% |
| 4 | T ₃ | Silver nitrate @ 1.5% |
| 5 | T ₄ | Potassium permanganate @ 300 ppm |
| 6 | T ₅ | Potassium permanganate @ 600 ppm |
| 7 | T ₆ | Potassium permanganate @ 900 ppm |

Chemical characters

The variation range of acidity was found 0.50% to 0.63%. The highest value of acidity (0.63 %) was observed in case of KMnO₄ @600 ppm followed by AgNO₃ @0.5% (0.62 %) on 3rd day and lowest (0.50 %) in control on 9th day. T₁, T₃ and T₅ were found significant among all other treatments. Acidity percentage of guava fruit might have been augmented due to higher synthesis of nucleic acids, on account of maximum availability of plant metabolism. Tanwar *et al.*, (2004) have reported similar results on custard apples. And the variation ranged of vitamin C from 254.16 to 165.98 mg/100g. The highest value was observed in AgNO₃ @0.5% (254.16 mg/100g) on 3rd day while it was at its lowest on 9th day (165.98 mg/100g) in control. The data was found to be non-significant on 3rd day of storage. On 9th day of storage T₀ showed the significant difference than all other treatments.

The loss in ascorbic acid (vitamin C) in fruits might be associated with inhibition of enzymatic loss of ascorbic acid during fruit ripening. Chaves *et al.*, (2007) and Gautam *et al.*, (2003) have reported similar results in sugar apple and sapota. TSS range was 9.23 to 10.86 °brix. It was highest (10.86) in control on 9th day whereas minimum value was recorded in AgNO₃ @1.5% (9.23 °brix) on 3rd day of storage. T₂ and T₃ were found with lowest TSS on each day of storage than all other treatments. The high range of Total Soluble Solids might be due to efficient translocation of photosynthesis to the fruit by regulation of KMnO₄. The results are similar to the findings of Kadu and Gajipara (2009) in sapota fruits and Tanwar *et al.*, (2004). In the present investigation the post-harvest treatments of fruits with Silver nitrate and Potassium permanganate was helpful in maintaining the quality of fruits up to 9 days having proper size, colour and taste than the

untreated fruits which were spoiled on the 9th day of storage.

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