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Manipulation of Ripening Period in Guava

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ABSTRACT

During the peak period of guava production, there is a heavy glut in the fruit market which results in lowering the revenue of growers. Moreover, guava can't be stored for longer periods due to its short shelf life. Therefore, the present experiment was carried out to adjust desired ripening time of guava. The experiment was laid out in a two-factor factorial randomized block design. Pre-harvest spray of various chemicals viz., SA @ 200, 400 and 600 ppm; kinetin @ 5, 10 and 15 ppm; GA_3 @ 25, 50 and 75 ppm and $CaCl_2$ @ 1, 2 and 3% was applied twice (on 6th November and 21st November). Fruits were harvested in the 3rd week of December, stored and analyzed at weekly intervals. From present investigation, it was concluded that delay in guava ripening was possible up to 28 days with application of kinetin @ 5 ppm/GA_3 @ 75 ppm/$CaCl_2$ @ 2%. Significant results were found in retaining physico-chemical traits during storage. Application of $CaCl_2$ @ 2-3% proved to be the best treatment pertaining to fruit weight, total sugars along with reducing sugars, while the firmness and vitamin C were the best in GA_3 @ 75 ppm. Improved acidity, TSS and minimum physiological weight loss were recorded best with application of gibberellic acid @ 25-75 ppm.

Key words: Ambient storage, guava, pre-harvest spray, ripening, shelf life

INTRODUCTION

Guava fruit is also known as the "Apple of the tropics" because of its availability and lower cost in tropics. It has excellent nutritional value, pleasant taste, pharmacological active constituents which are responsible for several biochemical actions like antidiabetic, antimicrobial and hepatoprotective properties (Kaur *et al.,* 2018). In India, UP state stands first in its production which contributes 22.93%, while Punjab comes at 7th position with a share of 4.83% in India's total production (Anon., 2018). Fruit ripening is a genetically programmed and complicated process resulting in a change in taste, colour, texture and other characteristics of the fruit. At the initiation of ripening, respiration is at its peak due to high productivity of ethylene which exhibits decline towards senescence. During respiration complex molecules are generally broken into simpler ones, resulting in energy supply that causes growth and development. Due to its climacteric nature, guava exhibits a typical increase in respiration ripening phase. Under ambient conditions, the shelf life of guava is very short, which limits its marketability. Perish ability is decided by the presence of moisture and also one of the issues considered during post-harvest handling and marketing. Numerous technologies have been developed to extend the shelf-life viz., modified atmospheres packing, use of polymeric films, irradiation technique, or chemical treatments. Concerning fruit ripening advanced techniques like genome editing, etc. are difficult to adopt at the field level. However, the role of DR technology (delayed ripening) can't be ignored in sustainable fruit production.

MATERIALS AND METHODS

Present experiment was carried out in four years old guava plantations cv. Hissar Safeda, with 13 treatments and three replications viz., T_1 (SA @ 200 ppm), T_2 (SA @ 400 ppm), T_3 (SA @ 600 ppm), T_4 (Kinetin @ 5 ppm), T_5 (Kinetin @ 10 ppm), T_6 (Kinetin @ 15 ppm), T_7 (GA_3 @ 25 ppm), T_8 (GA_3 @ 50 ppm), T_9 (GA_3 @ 75 ppm), T_{10} ($CaCl_2$ @ 1%), T_{11} ($CaCl_2$ @ 2%), T_{12} ($CaCl_2$ @ 3%) and T_{13} was considered as control. These studies were conducted at Jind, Haryana in association with the Department of Horticulture, Lovely Professional University, Phagwara (2020-21) and orchard maintained by Tarkha Farmers' Producers Company Ltd.

Total 39 plants were selected for the experiment. After the second spray, fruits were harvested when they attained proper colour size. They were packed in CFB boxes (capacity, 4 kg and size, 32 × 16 × 16 cm), stored under ambient conditions and evaluated at 0, 7th, 14th and 21st day. Fruit was weighed with weighing balance and firmness was noted with a penetrometer having 8 mm stainless steel probe and expressed as kg/cm^2. TSS content of guava was estimated using a temperature-compensated digital hand held refractometer. The titratable acidity, sugars and vitamin C were assessed using standard procedures. Recorded data were analyzed through OPSTAT software and a two-factor factorial randomized block design was applied to assess and interpret the results at P<0.05 significance level.

RESULTS AND DISCUSSION

Fruit weight exhibited a declining trend with the advancement of the storage period (Fig. 1) irrespective of treatments. Maximum fruit weight was retained in T_{11} ($CaCl_2$ @ 2%, 166.417 g), while the lowest weight was recorded in T_{13} (control, 82.917 g). Statistically significant results and interaction between treatments and storage were found during analysis. Various applications of $CaCl_2$ have been supposed to influence integrity maintenance and membrane functionality. As a result, they lower weight loss in treated fruits. Similar results were submitted by Qasim *et al.* (2020) in guava with the application of $CaCl_2$.

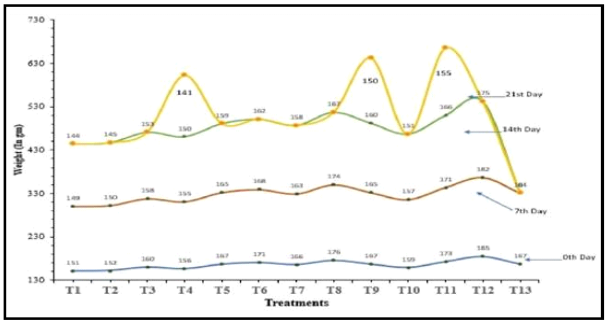

Fig. 1. Effect of different chemicals on fruit weight of guava under ambient storage.

The highest fruit firmness was retained in T_9 treatment (GA_3 @ 75 ppm, 3.500) during commencement of storage but it continued to decrease towards the end of the storage (Fig. 2). Lowest fruit firmness was seen in control (T_{13}, 1.300). In all storage intervals, it showed a gradual declining trend. From statistical analysis, it was clear that all treatments had resulted in significant influence. Moreover, interaction between treatments and storage intervals was found to be significant. It was observed that improved firmness might be due to action of $CaCl_2$. Moreover, during the ripening of climacteric fruits, firmness was generally credited to loss of turgor pressure in tissues due to water and decomposition of the cell wall (Reddy *et al.,* 2020). Similar outcomes in guava were submitted by other researchers. On the contrary, maximum guava fruit firmness was retained with the application of salicylic acid @ 200 ppm in the same crop.

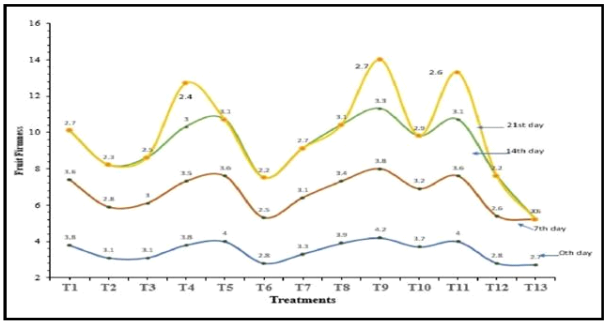

Fig. 2. Effect of different chemicals on fruit firmness of guava under ambient storage.

Irrespective of treatments studied, PLW increased towards the end of storage. During experimentation, maximum PLW was recorded in T_{11} ($CaCl_2$ @ 2%) which was at par with T_4 and T_9 treatment. On the contrary, least physiological weight loss was documented in T_7 (1.48). It is important to note that in T_4, T_9 and T_{11} treatments, fruits were available during 14th to 21st day, while in all other treatments, no fruits were available for analysis. Hence, variable results were noted as in these treatments (Fig. 3). Up to the second interval of storage (7 to 14th), three treatments (T_4, T_9 and T_{11}) showed excellent results and they were at par with each other. Calcium maintained membrane integrity and ion leakage declined which ultimately resulted in less weight loss. Similarly, results were observed with application of GA_3 on guava (Mahajan *et al.*, 2017). Similar results were also obtained by using salicylic acid in guava (Singh and Bal, 2020).

Total soluble solids (TSS) content of guava fruits exhibited variable trends during different

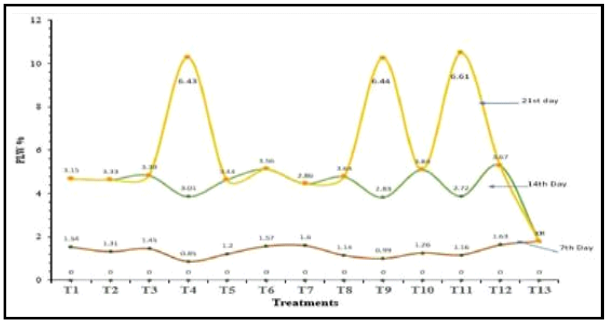

Fig. 3. Effect of different chemicals on PLW of guava under ambient storage.

phases of storage. According to statistical analysis of collected data, among different treatments, the highest TSS occurred throughout the storage period in T_9 (GA_3 @ 75 ppm) to the tune of 11.78 (Fig. 4), while lowest TSS was found in control (T_{13}). It was seen that TSS increased during 0 to 7th day (11.15 to 11.62) and then showed a declining trend during 7th -14th day (10.54). It exhibited a very low value (2.40) towards the end of storage. Above all, results (treatment, storage and interaction) were found significant. Inclination in TSS may be due to hydrolysis of starch into sugars and when reaction was complete, there was no further increase and as a result, afterwards, a decrease was recorded. Similar results were reported in plum (Harman and Sen, 2016).

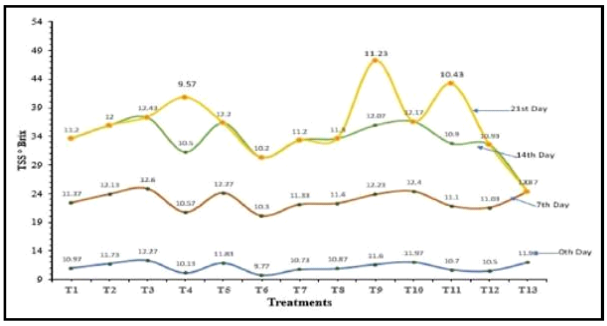

Fig. 4. Effect of different chemicals on TSS of guava under ambient storage.

During experimentation acidity declined regularly in all stages of storage irrespective of treatments (Fig. 5). Highest titratable acidity was noted in T_{10} ($CaCl_2$ @ 1%; 0.269) but these fruits were not available up to 21st day of storage. Least acidity was recorded in T_7 (GA_3 @ 25 ppm; 0.211). It was interesting to note that up to the end of storage, fruits were available only in three treatments viz., T_4, T_9 and T_{11}, while in all other treatments, fruits were rotten. These treatments exhibited

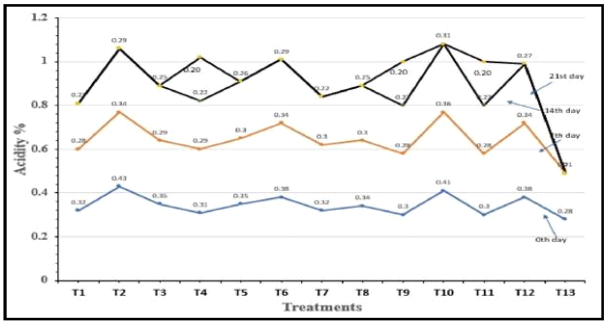

Fig. 5. Effect of different chemicals on acidity of guava under ambient storage.

values 0.256, 0.251 and 0.256, respectively, and these were at par with each other. This decrease might be due to quick consumption of various organic acids in respiration. The highest acidity was in GA_3-300 ppm which was closely followed by benzyl adenine treatments in guava fruit (Deepthi *et al.*, 2015). The similar results in case of guava were reported by Kaushik *et al.* (2021).

Nevertheless, ascorbic acid content of guava fruits declined successively during different phases of storage (Fig. 6). It may be concluded that maximum amount of vitamin C occurred in T_4 (Kinetin @ 5 ppm, 219.33 mg/100 g) which was at par with T_9 (GA_3 @ 75 ppm, 219.16 mg/100 g) and closely followed by T_{11} ($CaCl_2$ @ 2%, 217.66 mg/100 g). Lowest ascorbic acid was recorded in T_{13} (control, 116.16 mg/100 g). The various oxidizing enzymes like polyphenol oxidase and ascorbic acid oxidase are accountable for the reduction in ascorbic acid during ripening of fruit. The above findings are similar to the results submitted by other researchers in guava fruit (Javed *et al.*, 2017; Kaushik *et al.*, 2021).

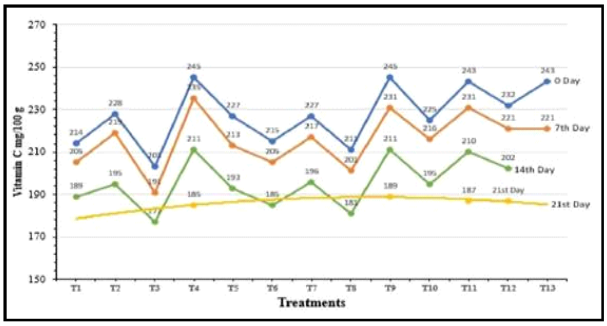

Fig. 6. Effect of different chemicals on vitamin C content of guava under ambient storage.

During the first phase of storage (0-7th day) sugars had shown an inclined trend but during 7-14th and 14-21st day a constant decreasing trend was seen. From the perusal of data, it is

clear that T_{11} (CaCl2 @ 2%, 5.76) exhibited improved reducing sugars followed by T_9 treatment (Fig. 7). On the other hand, lowest sugar was recorded in control T_{13} (control, 2.76). Total sugars may have inclined because of hydrolysis of starch (polysaccharides) and formation of mono and disaccharide sugars but decrease thereafter may happen due to respiration process (Kaur and Singh, 2020).

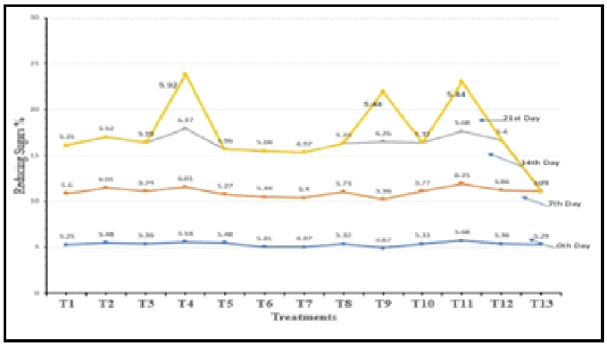

Fig. 7. Effect of different chemicals on reducing sugar of guava under ambient storage.

Total sugars had shown variable trends during different phases of storage. Statistically the highest total sugars were found in T_{11} ($CaCl_2$ @ 2%, 12.46; Fig. 8). This treatment was closely followed by T_9 (GA_3 @ 75 ppm, 11.88). On the other hand, the lowest total sugars were obtained in T_{13} (control). It was noted that from commencement of storage to 7th day of storage, total sugars showed increased value and thereafter continuous declining trend was noted during 14th and 21st day of storage (9.92 and 2.63, respectively). Similar results in pear cv. Nijisseiki were recorded with application of calcium nitrate by Kaur *et al.* (2017). In case of plums, application of calcium nitrate spray retained total sugars in plums (Sinha *et al.* 2019). The outcomes of this research were same as the results of Kaushik *et al.* (2021).

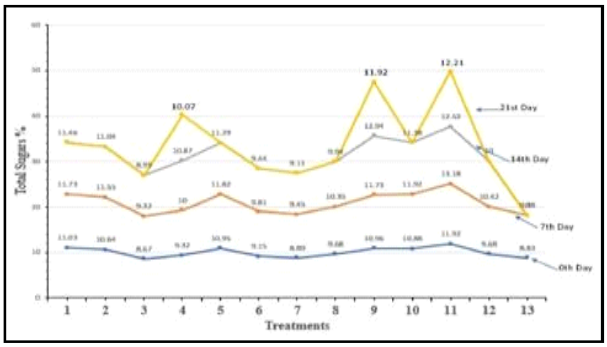

Fig. 8. Effect of different chemicals on total sugars of guava under ambient storage.

It was recorded in the present investigation that T_4, T_9 and T_{11} treatments had shown encouraging significant results over control (T_{13}) in lengthening shelf-life of the fruit (Fig. 9). Extended shelf-life might be due to shifting of climacteric period, deferred biochemical and physiological changes during ripening phase. Over-ripened and decomposed fruits are supposed to minimize consumer appeal. The application of $CaCl_2$ extended the shelf-life of mango fruit up to 24.33 days.

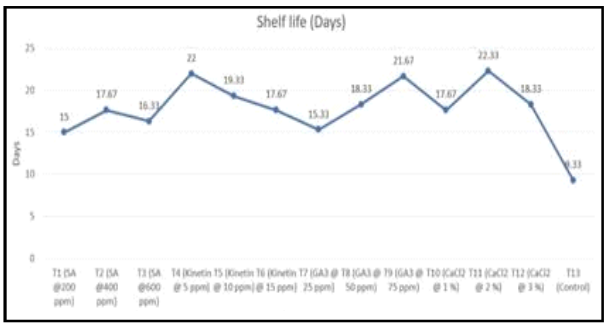

Fig. 9. Effect of different chemicals on shelf-life of guava under ambient condition.

CONCLUSION

Besides lengthening of shelf-life, the lowest PLW was also minimum in T_4, T_9 and T_{11} treatments. Fruits lasted long till the end of storage in these treatments, while in rest of the treatments' fruits were rotten till end of storage. Physical traits like fruit weight (average 150 g) and firmness (average 3.18 kg/cm^2), while biochemical characters like TSS (11.78), acidity (0.25%), vitamin C (219 mg/100 g pulp) and total sugars (12.46) were best in T_9, T_4 and T_{11} treatments under ambient storage conditions. In other words, it may be concluded that the chemicals in T_4, T_9 and T_{11} treatments can be successfully used to defer the ripening as well as to extend the shelf-life of guava fruit.

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