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EFFECT OF DIFFERENT POST-HARVEST CHEMICAL TREATMENTS ON THE SHELF LIFE AND QUALITY ATTRIBUTES OF GUAVA (*PSIDIUM GUAJAVA* L.).

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ABSTRACT

In India overall loss of major fruits ranged from 6.7 per cent to 15.88. The overall loss was as high as 15.88 per cent in guava, 10.39 per cent in apple, 9.73 per cent in *sapota*, 9.69 per cent in citrus, and 9.16 per cent in mango. The highest post-harvest fruit losses were recorded in the guava. So, it can be reduced by post-harvest treatment of chemicals. Thus, the present study was conducted to Study the effect of different post-harvest chemical treatments on the shelf life and quality attributes of guava (*Psidium guajava* L.) at Horticulture Research Lab, Department of Horticulture, School of Agriculture, ITM University, Gwalior (M.P.) during the year 2022. Different chemicals such as calcium chloride and sodium benzoate were used, individually. The experiment was laid out in completely randomized block design along with three replications and seven treatments. The results revealed that the fruit physical parameters i.e. maximum fruit weight (58.24 g), fruit length (3.98 cm) and fruit diameter (4.14 cm) were observed under the treatment T_3 (Calcium Chloride @ 3.0% dip for 5 minutes) at 15 days after treatment. However, the maximum physiological loss in weight (27.02 %) and fruit Decay (22.36 %) was recorded in the treatment T_0 (Control) 15 days after treatment. The fruit quality traits *viz.,* maximum total Soluble Solids (10.94°Brix), acidity (0.55 %), TSS/Acidity (23.69 %) and ascorbic acid (133.40 mg/100g) were observed in the treatment T_3 (Calcium Chloride @ 3.0% dip for 5 minutes). However, the fruit sensory traits i.e. maximum visual appearance (4.45), flavour (4.12) and taste (4.04) were found better in the T_3 (Calcium Chloride @ 3.0% dip for 5 minutes) at 15 days after treatment while the maximum shelf life of guava fruits was recorded up to 15 days after experiment with treatment T_3 (Calcium Chloride @ 3.0% dip for 5 minutes). Thus, it had been concluded that the treatment T_3 (Calcium Chloride @ 3.0% dip for 5 minutes) best for increasing fruit the physical, chemicals and sensory characters as well as shelf life.

Keywords **:** Calcium Chloride ($CaCl_2$), Guava, Post-Harvest, Sodium Benzoate ($C_7H_5NaO_2$), Sensory Parameters.

Introduction

Guava (*Psidium guajava* L.), commonly known as Poor Man's Apple, belongs to the family *Myrtaceae* and is considered to be originated in the Southern part of Mexico and Central America, where from it was introduced to Asian countries in the 17th century. The common guava is a diploid with 2n = 22 but natural and artificial triploid (2n = 33) and aneuploidy also exist in nature. In India, guava is cultivated in an area of 286000 hectare with a production of 4345000 metric tonnes (NHB-2021-2022). Andhra Pradesh has highest area and highest production followed by Uttar Pradesh, Madhya Pradesh and Bihar. In Madhya Pradesh, it is grown in an area of 375.45 ha with a production of 7757.18 metric tonnes (NHB-2021-2022). The ripe fruit contains calories 77-86g, 2.8-5.5g of moisture, ash of 9.5-10 mg, pectin of 1.15%, vitamin-C (260 mg/100g), Calcium (17.8-30 mg/100g), crude protein (0.82-1.45%) and crude fibre (2.0-7.2%) per 100g of fruit (Parvez *et al.,* 2018). Guava is a climacteric fruit that had peak respiration and ethylene production during ripening. It is highly perishable and ripens quite quickly immediately after harvest due to its high metabolic activity. The fruit become over ripe and loses its texture and quality within 3-4 days after harvest at room temperature (Singh and Pal, 2007; Mitra *et al.,* 2012). Maturity stage of guava at harvest is a critical factor for determining shelf life and quality (Azzolini *et al.,* 2004; Cavalini *et al.,* 2006). Skin colour is a measure of maturity and ripeness in guava. Fruit attaining maturity show signs of colour break stage from pale green to yellowish green (Asery *et al.,* 2008). Guava is a perishable fruit and highly susceptible to bruising and mechanical injuries. It attributed that 18-20% post-harvest loss in guava. To reduce percent losses in guava by adopting technologies for keeping quality through proper harvesting, post-harvest handling, proper packaging, treatments with chemicals (post-harvest treatment), and storage technology (Mahajan *et al.,* 2004).

Materials and Methods

The present study was entitled "Study the effect of different post-harvest chemical treatments on the shelf life

and quality attributes of guava (*Psidium guajava* L.)" conducted at Horticulture Research Lab, Department of Horticulture, School of Agriculture, ITM University, Gwalior (M.P.) during the year 2022. The experiment was laid out in Completely Randomized Block Design with three replication and seven treatments *viz.,* T_0 (Control), T_1 (Calcium Chloride @ 1.0% dip for 5 minutes) T_2 (Calcium Chloride @ 2.0% dip for 5 minutes) T_3 (Calcium Chloride @ 3.0% dip for 5 minutes) T_4 (Sodium benzoate @ 1.0% dip for 5 minutes) T_5 (Sodium benzoate @ 2.0% dip for 5 minutes) and T_6 (Sodium benzoate @ 3.0% dip for 5 minutes). The fresh, fully mature, uniform sized and free from any injury/ infection fruits were harvested at the colour break stage taken from ten year old trees of guava for this study. Guavas were dipped in solution of different chemicals combination with different concentrations separately each for 5 minutes. The observations were recorded on fruit physical parameters *viz.,* fruit weight (g), fruit length (cm), fruit diameter (cm), physiological loss in weight (%) and fruit decay (%) fruit. Fruit bio-chemical parameters i.e. total soluble solids (°Brix), titrable acidity (%), TSS/Acid ratio, ascorbic acid (mg/100 g) and fruit sensory quality evaluation i.e. appearance, flavour and taste and shelf-life were recorded as per standard procedure. The fruit weight was measured by digital balance and fruit size (length and diameter) was measured with the help of Vernier callipers (Metitiyo Japan). The total soluble solids (°Brix) was measured with the help of an Erma hand refractometer and were corrected using standard reference table and express in terms of (°Brix) at 20°C, ascorbic acid (mg/100g) content was determined by diluting the known volume of juice with 3% meta phosphoric acid and titrating with 2,6-dichlorophenol-indo-phenol solution.

The ten people were selected for sensory evaluation of guava fruits, all from Department of Horticulture, School of Agricultural Sciences and Technology, ITM University. All members of the panel were familiar with guava fruit and had previous sensory evaluation experience. Following a training period, a score sheet was developed for 3 identifiable attributes of guava fruit i.e. visual appearance flavour and taste. For evaluation of various sensory attributes, the method discussed and adopted using a nine-point hedonic scale basis (Amerine *et al.,* 1965).

Statistical Analysis

The data on various physical characters were recorded and statistically analysed. The qualitative characters were analyzed by the analysis of variance (ANOVA) technique. The data to be recorded will be analyzing using MS-excel and OPSTAT as per the design of experiment for working out the values. The critical difference values were calculated at 1 per cent level of significance.

Results and Discussion

1. Physical Parameters

The results indicated that the effect of post-harvest treatment of chemicals on physical parameters of fruits is presented in table-1 at different day's interval. Among the physical parameters of fruit, the fruit weight (g), fruit length (cm) and fruit diameter (cm) was gradually decreased with the storage period. However, at 15 days of experiment the maximum fruit weight (58.24 g), fruit length (3.98 cm) and fruit diameter (4.14 cm) are recorded in the treatment T_3 (calcium chloride 3.0% dip for 5 min.) while the minimum fruit weight (48.62 g), fruit length (3.37 cm) and fruit diameter (2.92 cm). The probable reason for decrease fruit weight by chemical treatment might be due to evaporation and transpiration processes. The higher weight loss in guava fruits harvested at colour turning stage could be due to higher rates of respiration and transpiration with the rise of harvest maturity (Elgar *et al.,* 1999). True to these findings, calcium application has been reported to be effective in terms of membrane functionality and integrity maintenance with lower losses of phospholipids and proteins with reduced ion leakage (Kumar *et al.,* 2012). This perhaps might be responsible for the lower fruit weight loss in calcium treated fruits (Bharathi and Srihari, 2004). The reduction in fruit length and fruit diameter during storage period might be due to shrinking of fruits caused by transpiration. Chemical of calcium chlorite might have decreased the rate of transpiration and resultant in retaining of superior size fruits during storage. The investigation result was conformity with (Kumar *et al.,* 2012; Gangwar *et al.,*-2012).

The data on physiological loss in weight (%) and fruit decay (%) is presented in table 2. The physiological loss in weight (%), in overall increase with the storage period and fruit decay per cent was reported after 6th day of experiment. Therefore, the lowest physiological loss in weight (19.94 %) was noted with in the treatment T_3 (calcium chloride 3.0% dip for 5 min.) and the highest physiological loss in weight (27.02%) was found under the treatment T_0 (control) at 15 days of experiment. The possible reason for increase physiological loss in weight (%) by chemical influence is due to evaporation and transpiration processes and the higher physiological loss in guava fruits harvested at colour turning stage could be due to higher rates of respiration and transpiration with the rise of harvest maturity (Elgar *et al.,* 1999). True to these findings, calcium application has been reported to be effective in terms of membrane functionality and integrity maintenance with lower losses of phospholipids and proteins with reduced ion leakage (Lester and Grusak, 1999) which perhaps might be responsible for the lower fruit weight loss in calcium treated fruits (Bharathi and Srihari, 2004). However, the fruit decay start at 6th day of experiment, the maximum fruit decay (22.36 %) was observed in the treatment T_0 (control) while the minimum fruit decay (0.00%) was recorded in the treatment T_2, T_3, T_4 and T_5 respectively. The present study correlated with the study of (Cheour *et al.,* 1990) observed that concentration of calcium chloride has excellence in reducing fruit decay (%) in guava fruits which may be due to their helpful role in decaying the senescence of fruits by sustaining cell wall integrity and thus lowering the spoilage. Beneficial effects of calcium against post-harvest decay have been presented for various fruit species. The role of post-harvest calcium application decreased decay incidence has been described in guava by (Pathmanaban *et al.,* 1995).

2. Biochemical Parameters

The table 3 and 4 showed effect of post-harvest treatment of chemicals on biochemical parameters of guava fruits. Among the biochemical parameters the gradual increment was recorded in total soluble solid (TSS °Brix) at different days of experiment. However, the maximum total soluble solid (10.94° Brix), acidity (0.55%), TSS/Acidity (23.69%) and ascorbic acid (mg/100g) were recorded in the treatment T_3 (calcium chloride 3.0% dip for 5 min.) while the minimum total soluble solid (7.52°Brix), acidity (0.34%),

TSS/Acidity (19.41%) and ascorbic acid (85.70 mg/100g) was noted in the treatment T_0 (control) at 15th day of experiment. Similar results were reported by (Selvan and Bal, 2009) in guava and (Mahajan *et al.,* 2004) in Asian pear. Higher total soluble solids level was recorded by 3% $CaCl_2$ preserved fruits through storage and shelf-life. This was due to the role of $CaCl_2$ in keeping the minimum metabolic activity through storage of fruits. Hydrolysis of starch or conversion of acids to sugars could be the reason for improved total soluble solids with improvement of storage periods. The increased in total soluble solids during storage period up to 6 days was due to the breakdown of complex polymers in to simple substances by hydrolytic enzymes, which at advanced storage period got utilized through respiration. Similar findings have been reported by (Bhalerao *et al.,* 2010; Gangwar *et al.,* 2012) in aonla. $CaCl_2$ treatments improved the ascorbic acid content of fruits compared to control fruits. This might be a result of continued synthesis of L-ascorbic acid from its precursor glucose-6 phosphate and additive effect of slow rate oxidation in respiration process. The decrease in ascorbic acid with $CaCl_2$ has also been reported in guava by (Patra and Sadhu, 1992). Similar findings had also been reported by (Jayachandran *et al.,* 2004; Mahajan *et al.,* 2003) in litchi.

3. Sensory Evaluation of Guava Fruits

The sensory evaluations of guava fruits are presented in table 5. The fruit lost their visual appearance, flavour and taste during at slower rate in different interval storage periods compared to those at control. At 15 days interval after experiment the highest score of fruit appearance (9.0 to 4.45 out of 10), flavour (8.98 to 4.12 out of 10) and taste (8.97 to 4.04 out of 10) were recorded in the treatment T_3 (Calcium Chloride 3.0% dip for 5 minutes). The lowest score of fruit appearance (9.0 to 3.01 out of 10), flavour (8.95 to 2.46 out of 10) and taste (8.96 to 2.23 out of 10) were observed in the treatment T_0 (control) after 15 day of experiment. It may be due to effect of calcium chloride on reduction on weight loss, moisture and significant effect on the fruit firmness. The reason for lower flavour score was due to increase in ripening and rotting at the end of storage. (Gangwar *et al.,*- 2012) Observed delay in ripening due to calcium chloride which indirectly supports delay in deterioration of flavour and reason for lower flavour score was due to increase in ripening and rotting at the end of storage (Gangwar *et al.,* 2012) aonla.

4. Shelf Life of Guava Fruit

The data on shelf life of guava fruit are presented in table 6 and figure 6. The shelf life of guava fruit was significantly influenced by various post-harvest chemical treatments. The maximum (15.0 days) shelf life of guava fruit was recorded with the treatment T_3 (Calcium Chloride 3.0% dip for 5 minutes). However, the minimum (7.00 days) shelf life of guava fruit was found in the treatment T_0 (control). Among the Calcium salts studied in the present experiment, post-harvest application of calcium chloride (2% and 3%) extending the storage life of guava fruits. The observed difference between the two calcium salts might be due to differential absorption of calcium by the fruit from different sources (Bhagwan-1998). Similar reports were by (Bharathi and Srihari, 2004).

Conclusion

On the basis of present study it may be concluded that the treatment T_3 (calcium chloride 3.0% dip for 5 minutes) best for the fruit weight (g), physiological loss in weight (%), fruit length (cm), fruit diameter (cm), fruit volume (ml), total soluble solids (°Brix), acidity, TSS: acid ratio, ascorbic acid (mg/100g), visual appearance, flavour, and taste. The shelf-life of guava fruit was found up to 15thday after experiment. Therefore, on the basis of present study, I will suggest to guava growers, after harvesting guava fruits treat with the calcium chloride @ 3.0% dip for 5 minutes for enhancing fruit morphological and quality parameters as well as shelf life of guava fruits.

Table 1: Effect of post-harvest treatments of chemical on fruit weight (g), fruit length (cm) and fruit diameter (cm) of guava (*Psidium guajava* L.) fruits at different days of interval.

Treat-ments	Fruit weight (g)						Fruit length (cm)						Fruit diameter (cm)					
	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days
T_0	66.5	61.97	59.27	56.62	52.56	48.62	4.07	4.00	3.94	3.85	3.73	3.37	3.97	3.94	3.88	3.84	3.78	2.92
T_1	71.97	68.67	66.87	63.97	61.12	57.51	4.66	4.52	4.47	4.37	4.25	3.87	4.63	4.59	4.55	4.47	4.4	3.98
T_2	66.63	63.46	61.70	58.6	56.35	52.99	4.67	4.54	4.49	4.39	4.3	3.81	4.60	4.55	4.51	4.45	4.34	3.95
T_3	73.30	69.87	67.59	65.08	62.21	58.24	4.86	4.63	4.55	4.43	4.38	3.98	4.73	4.71	4.68	4.63	4.52	4.14
T_4	69.60	66.40	64.39	61.93	59.47	55.71	4.57	4.50	4.45	4.37	4.28	3.38	4.57	4.52	4.35	3.96	3.78	3.63
T_5	72.23	68.96	66.93	64.77	61.67	57.55	4.68	4.62	4.51	4.42	4.34	3.83	4.47	4.44	4.36	4.31	4.26	3.98
T_6	68.27	65.23	63.01	60.82	58.57	54.47	4.50	4.44	4.36	4.26	4.16	3.62	4.07	4.02	3.97	3.94	3.87	3.62
SE (m±)	1.90	1.90	1.75	1.69	1.76	1.51	0.13	0.14	0.19	0.16	0.091	0.14	0.12	0.12	0.11	0.12	0.16	0.10
CV	4.73	4.97	4.72	4.77	5.1	4.76	5.28	5.40	5.33	6.76	3.76	6.74	5.04	4.74	4.77	5.06	4.87	5.07
CD at 1%	8.02	8.00	7.38	7.15	7.41	6.37	0.58	0.58	0.56	0.69	0.38	0.60	0.54	0.50	0.50	0.52	0.49	0.46

Table 2: Effect of post-harvest treatments of chemical on physiological loss in weight (%) and fruit decay (%) of guava (*Psidium guajava* L.) fruits at different days of interval.

Treatments	Physiological Loss in Weight (PLW) (%)					Fruit Decay (%)					
	3 Days	6 Days	9 Days	12 Days	15 Days	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days
T_0	6.86	11.05	15.03	21.09	27.02	0.00	0.00	0.00	6.42	13.21	22.36
T_1	4.56	7.51	11.11	15.07	20.04	0.00	0.00	0.00	4.23	7.11	0.00
T_2	4.75	7.33	11.90	15.33	20.39	0.00	0.00	0.00	0.00	0.00	0.00
T_3	4.44	7.09	10.92	14.22	19.94	0.00	0.00	0.00	0.00	0.00	0.00
T_4	4.53	7.19	10.34	14.63	20.32	0.00	0.00	0.00	0.00	0.00	0.00
T_5	4.71	7.78	11.20	15.13	20.58	0.00	0.00	0.00	0.00	0.00	0.00
T_6	4.58	7.71	11.00	14.56	20.15	0.00	0.00	0.00	5.08	7.67	10.78
SE (m±)	0.58	0.40	0.44	0.56	0.61	0.00	0.00	0.00	0.22	0.23	0.26
CV	20.59	8.78	6.65	6.17	5.02	0.00	0.00	0.00	17.61	10.32	7.30
CD at 1%	2.46	1.69	1.88	2.35	2.58	0.00	0.00	0.00	0.96	1.00	1.11

Table 3: Effect of post-harvest treatments of chemical on total soluble solids (°Brix) and acidity (%) of guava (*Psidium guajava* L.) fruits at different days of interval.

Treatments	Total Soluble Solids (°Brix)						Acidity (%)					
	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days
T_0	11.27	11.34	11.40	10.93	9.47	7.52	0.76	0.73	0.64	0.56	0.46	0.34
T_1	11.33	11.40	12.22	11.93	11.53	10.63	0.76	0.74	0.66	0.60	0.56	0.50
T_2	11.40	11.47	12.22	12.00	11.47	10.74	0.77	0.73	0.68	0.65	0.58	0.49
T_3	11.42	11.48	12.47	12.33	11.60	10.94	0.78	0.75	0.70	0.66	0.61	0.55
T_4	11.37	11.43	12.20	11.84	11.27	10.71	0.77	0.72	0.66	0.63	0.56	0.48
T_5	11.41	11.43	12.21	11.92	11.47	10.56	0.77	0.74	0.66	0.62	0.55	0.46
T_6	11.4	11.47	12.20	11.87	11.27	10.47	0.78	0.74	0.68	0.63	0.56	0.47
SE (m±)	0.064	0.065	0.069	0.068	0.064	0.059	0.007	0.006	0.006	0.005	0.005	0.004
CV	0.98	0.98	0.99	0.99	0.99	1.00	1.60	1.59	1.61	1.61	1.62	1.62
CD at 1%	0.27	0.27	0.29	0.28	0.27	0.24	0.03	0.02	0.02	0.024	0.0021	0.018

Table 4: Effect of post-harvest treatments of chemical on TSS/Acid ratio and ascorbic acid (mg/100g) of guava (*Psidium guajava* L.) fruits at different days of interval.

Treatments	TSS/Acidity ratio						Ascorbic acid (mg/100g)					
	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days
T_0	14.45	15.27	17.53	18.16	18.99	19.41	242	209.9	193.2	120.6	103.9	85.7
T_1	14.59	15.32	17.81	19.52	20.58	22.11	246	225.2	215	189.7	158.5	124.8
T_2	14.83	15.71	18.42	19.05	20.09	21.96	245.3	223.3	216.7	190.3	161	125.1
T_3	15.02	16.03	18.61	19.73	20.78	23.69	246	228.4	217.9	192.4	163.3	133.4
T_4	14.88	15.73	18.48	19.14	20.59	22.49	245.1	226.5	216	190.9	163.2	131
T_5	14.76	15.39	17.87	19.15	20.12	21.10	246	223.7	214.9	191.3	162	128.8
T_6	14.67	15.56	18.56	18.92	20.21	22.37	243	226.7	216	191.7	162.3	128
SE (m±)	0.17	0.18	0.21	0.23	0.24	0.26	1.08	0.95	0.89	0.66	0.56	0.45
CV	2.08	2.07	2.09	2.08	2.00	2.06	0.76	0.74	0.72	0.63	0.63	0.64
CD at 1%	0.74	0.79	0.92	0.96	1.02	1.11	4.55	4.03	3.76	2.79	2.37	1.91

Table 5: Effect of post-harvest treatments of chemical on sensory traits of guava (*Psidium guajava* L.) fruits at different day's interval.

Treatments	Visual appearance						Flavour						Taste					
	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days
T_0	9.00	8.10	7.07	5.40	4.14	3.01	8.95	7.00	5.40	4.53	3.34	2.46	8.96	8.17	5.37	4.24	3.45	2.23
T_1	9.00	8.52	8.33	8.03	6.80	4.31	8.95	8.37	7.87	6.76	6.00	4.08	8.97	8.37	8.00	6.77	6.00	4.00
T_2	9.00	8.50	8.38	7.90	6.70	4.21	8.97	8.33	8.10	6.70	5.92	3.60	8.96	8.33	7.90	6.67	6.00	3.55
T_3	9.00	8.63	8.40	8.13	6.83	4.45	8.98	8.43	8.12	6.80	6.00	4.12	8.97	8.40	8.10	7.97	6.04	4.04
T_4	9.00	8.47	8.37	8.07	6.77	4.40	8.95	8.40	8.08	6.76	5.93	3.68	8.96	8.37	8.02	6.80	5.90	3.58
T_5	9.00	8.57	8.33	7.83	6.67	4.32	8.96	8.37	7.83	6.67	5.90	3.64	8.96	8.33	7.83	7.83	5.90	3.81
T_6	9.00	8.53	8.24	7.94	6.60	4.27	8.95	8.40	8.00	6.73	5.83	3.61	8.96	8.28	7.97	7.9	5.73	3.61
SE (m±)	0.00	0.034	0.033	0.080	0.058	0.11	0.012	0.039	0.067	0.050	0.054	0.11	0.039	0.037	0.095	0.074	0.065	0.10
CV	0.00	1.28	1.30	3.32	2.91	8.85	0.44	1.53	2.79	2.48	3.08	9.99	0.13	1.42	3.95	3.40	3.70	9.66
CD at 1%	0.00	0.12	0.13	0.30	0.21	0.43	0.047	0.14	0.25	0.18	0.20	0.42	0.014	0.14	0.35	0.27	0.24	0.40

Table 6: Effect of post-harvest treatment of chemicals on shelf life (Days) of guava (*Psidium guajava* L.) fruit.

Treatments	Self-life (Days)
T_0	7.00
T_1	8.00
T_2	13.0
T_3	15.0
T_4	12.0
T_5	11.0
T_6	8.00
SE (m±)	**0.15**
CV	**2.45**
CD at 1%	**0.63**

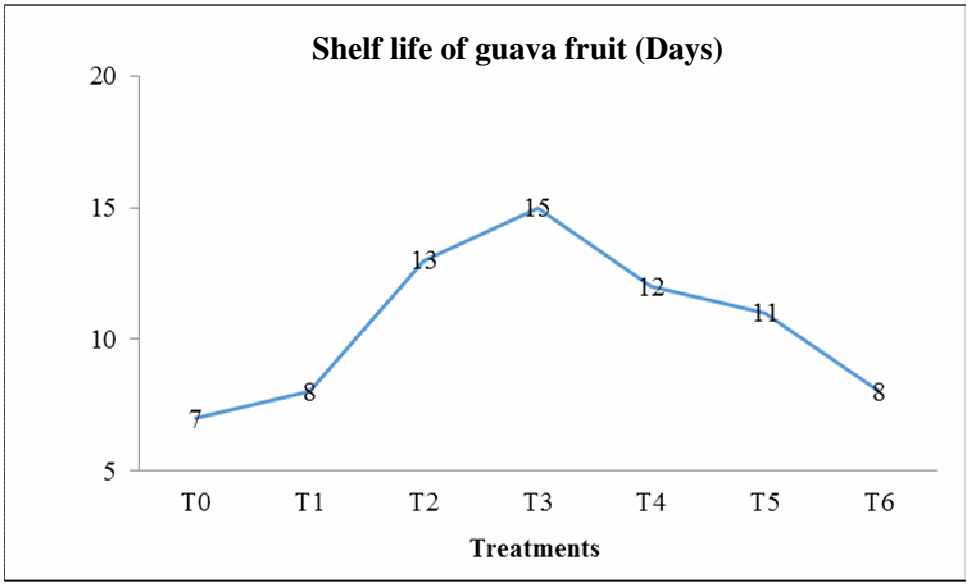

Fig. 1: Effect of post-harvest chemical treatments on shelf life (Days) of guava (*Psidium guajava* L.) fruit.

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