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Effect of Pre-Cooling Packaging Material on Chemical and Sensory Quality of Guava Fruits [*Psidium guajava* (Linn.)] Cv Allahabad Safeda

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Abstract Guava is the fifth largest fruit commodity in the world, which is grown throughout the tropical area of India. However, excellent qualities of guavas are grown in Allahabad region of UP (India). In guava three flushes occur in tropical regions among these mrig bahar results in excellence quality of fruits which are harvested in December to January. The storage life of guava is very short which a major hurdle in long distance transportation. Considering these aspects it is very important to enhance the shelf life of guava. Research was planned to enhance of storage life of guava through pre-cooling (pre-cooling for 10°C for 8 h and without pre-cooling), packaging (LDP pouch of 200 and 400 gauge of 1.2% vent and without vent) and storage (10°C, 12°C and 15°C in cold chamber). Pre-cooling at 10°C, packing in LDPE bags of 200 gauge thickness without vents followed by storage at 10°C resulted in optimum quality and minimal spoilage.

Keywords Guava, Pre-cooling, Packaging, Storage, TSS.

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Introduction

Guava (Psidium guajava L.) has been aptly called the "Apple of Tropics" which belongs to family Myrtaceae and originated from Tropical America. Guava is the fourth most important commercial fruit in India in area and production after mango, banana and citrus [1]. Guava was introduced in the 17th century and has been distributed to Asia [2]. Nutritional quality of guava is as comparable with apple particularly vitamin C, pectin and minerals [3]. Guava is the fourth most important commercial fruit crop grown in India with respect of area and production after mango, banana and citrus. It is grown over an area of about 268 thousand hectare with an average production of 3668 thousand MT and productivity of 13.7 MT per hectare area in India [4].

Guava is a commercial crop of tropical India famous for it's delicious taste, flavor and other sensory properties. Likewise guava is rich in chemical

properties such as vitamins, minerals and amino acids. Guava fruit contains 87.79% moisture, pulp recovery (per kg) 60%, juice recovery (kg) 41%, specific gravity-1.125, T.S.S (°B)- 9.6, titratable acidity (%C.A)- 0.30, pH- 3.9, ascorbic acid (mg/100g)-207 and total sugar-4.3% [5]. It is considered as an excellent source of vitamin-C (260 mg/100g) and pectin (1.15%). The fruit has an appreciable amount of minerals such as phosphorus (23 to 37 mg/100g), calcium (14 to 30 mg/100g), iron (0.6 to 1.4 mg/100 g) as well as vitamins like niacin, thiamine, riboflavin and vitamin-A [6]. Excellent salad, pudding, jam, jelly, cheese, canned fruit, RTS, nectar, squash, ice cream and toffees can be made from guava fruit [7].

Guava is a highly perishable and climacteric fruit with a shelf life of one week only [8]. Owing to its perishable nature, guava ripens quickly and goes into senescence which leads to post harvest losses. These losses may also be due to improper post harvest handling and lack of cold chain management. It attributed that 22% post harvest losses in guava [9]. These losses can be overcome by proper harvesting, post harvest handling, cold chain management and using proper packaging and storage technology. Hence the objectives of this investigation were: (1) To know the effects of pre-cooling, packaging treatments and temperature on shelf life and quality of guava fruits cv Allahabad Safeda (2) To maintain the quality of guava fruits cv Allahabad Safeda for distant market and (3) To minimize the post harvest losses in guava fruits cv Allahabad Safeda.

Materials and Methods

The present investigation was carried out at the Center of Excellence on Post Harvest Technology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during December-2010. The experiment was laid out in a factorial concept with completely randomized design with three repetitions and thirty treatment combinations which comprises of two pre-cooling treatments [P_1–pre-cooling (10°C for 8 h) and P_2–without pre-cooling], five packaging materials [M_1–without packaging, M_2–LDPE 200 gauge with vents, M_3–LDPE 200 gauge without vents, M_4–LDPE 400 gauge with vents and M_5–LDPE 400 gauge without vents] and two storage temperatures [T_1–10°C, T_2–12°C and T_3–15°C]. For experimentation, fully mature, healthy and fruits of uniform shape and size were collected from a guava orchard in Bharuch district of Gujarat. Freshly harvested fruits were immediately transported to Navsari Agricultural University, Navsari and the treatments were imposed. Total soluble solids and ascorbic acid were estimated as per the Lane and Eynon method described [10]. Spoilage (%) and shelf life of fruits were decided based on visual observations. Roughly two kg of fruits were weighed on the day of harvesting. Thereafter fruits were weighted at every interval of observation and physiological loss in weight was calculated based on the below mentioned formula

$$\text{PLW (\%)} = \frac{\text{Initial weight–Weight loss at intervals}}{\text{Initial weight}} \times 100$$

Results and Discussion

Guava is categorized as climacteric due to the presence of climacteric peak. Initial respiration and ripening is slow but after that climacteric peak occurs in which most of cells produce ethylene and due to that senescence starts within short time simultaneously, which reduces the storability. Therefore experiment was planned to enhance the storage life of produce by creating a modified environment around the fruit during the storage. In the present investigation, effect of pre-cooling, packaging material and storage temperature significantly helped to improve the shelf life of guava. Pre-cooling at 10°C for 8 hour's (P_1) followed by packaging in LDPE (200 gauge) without vents (M_3) followed by storage at 10°C (T_1) had maximum shelf life. In treatment combination $P_1M_3T_1$ (Tables 1 and 2) limited physiological loss in weight, better firmness and maximum days for ripening of fruits was found which might be due to the fact that pre-cooling removed field heat and simultaneously affected the rate of biochemical reactions or catabolic reactions (respiration and transpiration) and rate of ethylene production at initial stage. After pre-cooling guava was packed in different primary packaging material amongst them LDPE (200 gauge) without vents was found to be best due to generation of microclimate

Table 1. Effect of pre-cooling, packaging material and storage temperature on physiological loss in weight (%) and shelf life of guava fruits cv Allahabad Safeda.

Treatments	Physiological loss in weight (%) 2	10	20	30	Shelf life (Days)
Pre-cooling (P)					
P_1	1.92 (1.132)	2.041 (4.864)	2.829 (9.899)	1.602 (3.706)	24
P_2	1.189 (1.255)	2.285 (6.971)	2.792 (10.56)	1.650 (3.575)	23
SEm±	0.004	0.002	0.0018	0.0018	0.049
CD at 5%	NS	0.007	0.005	0.005	0.017
Packaging Material (M)					
M_1	1.509 (1.945)	3.399 (12.35)	4.002 (17.612)	1.793 (5.081)	18
M_2	1.448 (2.091)	2.422 (6.301)	3.234 (11.315)	1.745 (4.713)	23.99
M_3	0.829 (0.250)	1.125 (1.385)	1.6878 (4.805)	1.207 (1.028)	25.56
M_4	1.448 (1.668)	3.082 (9.418)	4.104 (16.868)	1.727 (4.63)	23.66
M_5	0.717 (0.015)	0.787 (0.127)	1.026 (0.560)	1.658 (2.75)	24.66
SEm±	0.006	0.004	0.002	0.002	0.027
CD at 5%	0.019	0.011	0.008	0.008	0.077
Storage temperature					
T_1	1.126 (0.986)	1.656 (2.864)	2.284 (5.852)	3.034 (10.03)	25.13
T_2	1.322 (1.7)	2.305 (6.402)	2.831 (10.1)	0.976 (0.574)	23.13
T_3	1.123 (0.896)	2.529 (8.487)	3.317 (14.73)	0.868 (0.314)	20
SEm±	0.005	0.003	0.002	0.002	0.021
CD at 5%	0.015	0.008	0.006	0.006	0.060
CV %	2.46	0.78	0.44	0.74	2.49

around the commodities (modified atmosphere) which helped to lower down the gaseous exchange and also reduced the temperature inside the packaging material which contributed to lower moisture loss. After packaging, guava was stored at three different storage temperatures (10°C, 12°C and 15°C). Of the different storage temperatures, 10°C was found significantly the best. At higher temperature, the catabolic activity (respiration) increases and commodity need energy to reduce the effect of temperature for that faster consumption of carbohydrate and ripening process is faster. With concern to bio-chemical changes treatment combination $P_1 M_3 T_1$ is significantly found to be best. Present investigation is in agreement with the study carried out by other species also such as in mango [11, 12], purple passion fruit [13], guava [14, 15], banana [16—18], sapota [19, 20] and papaya [20].

Significant differences were found amongst treatments with regard to various physico-chemical parameters. Perusal of data revealed, minimum per cent physiological loss in weight when guava fruits were pre-cooled at 10°C for 8 hours (on 30th day of storage only 1.6% loss were recorded), when packed in LDPE bags of 200 gauge without vents (on 30th day of storage only 1.207% loss were recorded) and when fruits were stored at 10°C temperature (on 28th day of storage only 3.034% loss were recorded) (Table 1 and Fig. 1).

Guava fruits pre-cooled at 10°C temperature for 8 hours had maximum shelf life at the end of the study 24 days. Also, fruits packed in low density polyethylene (200 gauge) without vents had maximum shelf life on the 30th day of storage 25.66 days. Between the three different storage temperatures, storage at 10°C temperature resulted in higher shelf life on the 30th day of storage 25.13 days (Table 1 and Fig. 1).

Result revealed that treatments did not have a

Table 2. Effect of pre-cooling, packaging material and storage temperature on TSS and ascorbic acid of guava fruits cv Allahabad Safeda.

Treatments	TSS (°Brix)				Ascorbic acid (mg/100g)			
	2	10	20	30	2	10	20	30
Pre-cooling (P)								
P_1	3.794	3.970	4.227	1.956	11.744	10.207	7.979	3.076
	(13.90)	(15.27)	(17.38)	(6.453)	(138.04)	(104.53)	(64.533)	(17.60)
P_2	3.808	3.982	4.228	2.208	11.228	9.730	7.037	2.587
	(14.00)	(15.37)	(17.38)	(7.760)	(126.31)	(95.289)	(53.511)	(13.422)
SEm±	0.002	0.018	0.017	0.010	0.052	0.046	0.059	0.060
CD at 5%	0.005	NS	NS	0.028	0.148	0.131	0.168	0.171
Packaging material (M)								
M_1	3.827	4.009	4.259	1.325	10.794	8.363	5.622	0.707
	(14.150)	(15.589)	(17.650)	(3.1667)	(117.11)	(78.667)	(36.444)	(0.000)
M_2	3.801	3.979	4.227	1.311	11.839	10.454	8.305	4.511
	(13.950)	(15.350)	(17.383)	(3.050)	(140.00)	(109.33)	(69.333)	(27.556)
M_3	3.788	3.954	4.209	3.841	12.172	10.833	8.782	3.827
	(13.850)	(15.150)	(17.233)	(16.233)	(148.00)	(117.33)	(77.333)	(24.000)
M_4	3.788	3.960	4.213	1.950	11.130	9.711	7.206	2.637
	(13.850)	(15.200)	(17.267)	(6.4000)	(123.78)	(94.667)	(53.333)	(14.000)
M_5	3.803	3.977	4.227	1.982	11.495	9.980	7.625	2.481
	(13.967)	(15.333)	(17.383)	(6.6833)	(132.00)	(99.556)	(58.667)	(12.000)
SEm±	0.003	0.029	0.027	0.016	0.082	0.073	0.094	0.096
CD at 5%	0.008	NS	NS	0.045	0.234	0.207	0.266	0.271
Storage temperature								
T_1	3.780	3.954	4.228	3.327	12.140	10.757	8.684	5.424
	(13.790)	(15.150)	(17.390)	(13.530)	(147.20)	(115.73)	(75.733)	(34.800)
T_2	3.796	3.969	4.213	1.842	11.417	9.988	7.650	2.364
	(13.910)	(15.270)	(17.260)	(5.9100)	(130.26)	(100.00)	(59.467)	(11.733)
T_3	3.828	4.004	4.241	1.075	10.801	9.160	6.190	0.707
	(14.160)	(15.550)	(17.500)	(1.880)	(119.07)	(84.000)	(41.867)	(0.000)
SEm±	0.002	0.023	0.021	0.012	0.064	0.056	0.073	0.074
CD at 5%	0.006	NS	NS	0.035	0.181	0.160	0.206	0.210
CV %	0.35	3.16	2.80	3.26	3.06	3.13	5.33	14.40

significant influence on Total Soluble Solids (TSS) content in guava except for the 30th day of storage. On the 30th day, maximum total soluble solids (TSS) was noted in guava fruits when they were pre-cooled at 10°C temperature for 8 hours (1.956 °Brix), in fruits packed in low density polyethylene (200 gauge) without vents (3.841 °Brix) and in guava fruits stored at 10°C temperature (3.327°Brix of TSS) (Table 2).

Maximum ascorbic acid content was observed when guava fruits were pre-cooled at 10°C temperature for 8 hrs (on 2nd, 10th, 20th and 30th days of storage (11.744, 10.207, 7.979 and 3.076 mg/100g, respectively), when guava fruits were kept in low density polyethylene (200 gauge) without vents (on 2nd, 10th, 20th and 30th days of storage12.172, 10.833, 8.782 and 3.827 mg/100 g, respectively). Minimum ascorbic acid content was observed when guava fruits kept in unpacked (control) under all storage periods. Maximum ascorbic acid content was observed when guava fruits were stored at 10°C temperature regardless of storage period. Whereas, fruits stored at 15°C temperature had minimum ascorbic acid content throughout the storage period. This can be ascribed to the fact that ascorbic is heat sensitive and may be lost at higher temperature (Table 2).

Organoleptic characteristic of guava during

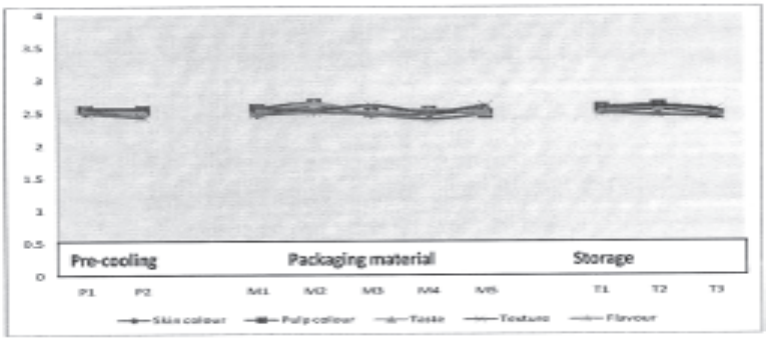

Fig. 1. Effect of pre-cooling, packaging material and storage temperature on organolaptic score of guava fruits cv Allahabad Safeda.

storage showed that treatment combination $P_1M_2T_1$ found organoleptically superior in respect to over all acceptability and organleptic characteristic is check ones when guava fruit is ripen.

Conclusion

From above forgoing discussion it is clear that when guava fruit is pre-cooled at 10°C for 8 hours, packed in LDPE (200 gauge) without vent and stored at 10°C was increased physico-chemical and sensory changes. Pre-cooling at 10°C for 8 hours removed field heat which helped in reduction of internal heat in fruits and accomplished lower physico-chemical changes with increase in sensory quality. LDPE without vent created a microclimate which created a modified climate and storage at 10°C provided cooling effect. Both these treatments proved beneficial for hindering respiration which simultaneously reduced the ripening process and resulted in better shelf life.

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