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RESPONSE OF GUAVA FRUITS TO POST HARVEST TREATMENTS OF 'CHITOSAN' UNDER COLD AND AMBIENT STORAGE CONDITIONS

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Abstract: The fruits of guava are highly perishable in nature and require strategies to enhance post harvest life for extended fresh fruit market. The fruits of guava cv. Shweta harvested at horticultural maturity were subjected to the treatments of Chitosan @ 0.5, 1.0, 1.5 per cent, packed in CFB boxes and stored under cold (6-8 ^{o}C temperature and 90-95 % RH) as well as ambient conditions. The physiological and biochemical parameters of fruits were analyzed at weekly interval. Under both the storage conditions, all the treatments exhibited potential to maintain the post harvest life of fruits as compared to untreated fruits. These were found effective in reducing the PLW, fruit spoilage and maintained the fruit firmness and quality attributes such as TSS, sugars, and palatability rating of fruits. The Chitosan resulted discoloration of fruit surface which lead to reduction in organoleptic value of fruits. The winter season guava fruits can be stored up to 14th day under cold storage and up to 7th day under ambient condition without deteriorating the fruit quality. However, further investigations are needed to maintain the visual value of fruits along with phyico-chemical characteristics of fruits.
Keywords: Guava, Chitosan, Post Harvest, Storage.

Introduction

Guava (*Psidium guajava* L.) is very important fruit crop of the subtropical as well as tropical regions of the world. It is usually known as 'Apple of Tropics'. Inspite of being an introduced crop in India, considerable genetic diversity of guava is available in Indo-gangetic plains (Rajan *et al* 2007). India is the world's largest producer of guava followed by China, Thailand, Indonesia, Pakistan, Mexico, Brazil, Bangladesh, Nigeria, Philippines, Vietnam, Kenya and Egypt (FAO, 2011). Although, it is very rich nutritionally, still world trade of guava fruits is limited owing to its highly perishable nature, limited post-harvest life and susceptibility to chilling injury (Rai *et al,* 2010). Due to perishable nature, its fruits undergo rapid post-harvest ripening in under ambient conditions (Bashir and Abu-Goukh 2003). The guava, being a climacteric fruit exhibit respiratory and ethylene peaks during ripening. Owing to high metabolic activities there is rapid degradation of quality of guava fruits during storage. To reduce respiration rate,

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ethylene production and to extend the post harvest life, cold storages are widely used for fruits crops (Fattahi *et al* 2010). Under ambient conditions, the fruits of guava become over-ripe and mealy within few days, while, under cold storage, the shelf life can be extended up to two weeks at 6-8 °C and 90-95% RH (Tandon *et al* 1989). However, uncongenial storage conditions may result in accumulation of fermentative metabolites, which cause development of off-flavors rendering unacceptability of fruits to the consumer (Ke *et al* 1991 and Beaudry, 1993). Hence, immediate marketing and utilization of guava fruits after harvesting is generally practiced in India. Studies have shown that we can increase the longevity of harvested fruits by following different strategies i.e. the use of antitranspirants (Chahal and Bal 2003), wax coatings (Mahajan *et al* 2005), ethylene inhibitor & irradiation (Pandey *et al* 2010). There are many techniques meant for enhancing the post-harvest life of fruits with the aim at reducing the respiration rate and thereby the catabolism. Chitosan (poly β-(1-4) N-acetyl-d-glucosamine) a natural compound of crustacean shells (crabs, shrimp, crayfishes etc.) has been known to reduce the transpiration, respiration and maintaining the textural quality of perishables, hence, protect from deterioration (Krishna and Rao 2014). Hong *et al* (2012) also reported the beneficiary effects of Chitosan coating in 'pearl' guava. Therefore, the objective of present study was to ascertain the influence Chitosan coating on quality and shelf life of guava fruit cv. Shweta under cold and ambient storage condition.

MATERIALS AND METHODS

The disease free and uniform sized fruits of guava cv. Shweta harvested at their horticultural maturity during first week of December were subjected to different treatments. The treatments of Chitosan 0.5, 1.0 and 1.5 per cent were given to 2.0 kg fruit in each replication. The Chitosan was applied as wax coating. To make 1 litre of 0.5, 1.0 and 1.5 % (w/v) Chitosan solution, 2.5, 5.0 and 7.5 g of Chitosan was dispersed in 100 ml of galacial acetic acid, respectively, before 800 mL of double distilled water was added to further dissolve the Chitosan. Then, 1 mL Tween 80 was added to the solution to improve the wettability. The pH of the solution was adjusted to pH 6.0 with 1 M NaOH and the solution made up to one liter solution. The control fruits were dipped in water for the same period. The treated fruits packed in corrugated fiber board (CFB) boxes (5 % ventilation) with lining of newspaper was kept in a walk-in-cold room (6-8 °C temperature and 90-95 % RH) as well as under ambient condition for 7, 14 and 21 days after storage and analyzed for various physico-chemical attributes after each week of storage period. The physiological loss in weight (PLW) of the

fruit was recorded on the basis of initial fruit weight and subsequent loss of weight occurred during storage. Penetromete' (Model FT-327, QA Supplies, Norfolk, VA, USA) was used to record fruit firmness and the pressure (lbf) required to insert a stainless steel probe of 8 mm diameter into guava flesh was recorded. On the basis of colour and taste of fruits, palatability rating was determined by a panel of 10 judges as per Hedonic scale (1-9 points) as described by Amerine *et al* (1965). The number of fruits spoiled during storage was counted to access the decay incidence. Total Soluble Solids (TSS) content was determined with hand-held refractometer (Erma Japan) and expressed in per cent after making the temperature correction at 20°C. Similarly, total sugar was also estimated by titration procedures (AOAC 2005).

RESULTS AND DISCUSSION

Physiological loss in weight (PLW), irrespective of treatments was increased during the storage period (Table 1). Under cold storage condition, minimum average PLW (3.11 %) was recorded in Chitosan 1.5 % treated fruits followed by 3.41 % in 1.0 % treatment. Similarly, under ambient storage condition minimum mean PLW (9.22 %) was recorded in Chitosan 1.0 % followed by 9.36 % in 1.5 % treatment. The maximum mean PLW (5.82 and 13.08 %) was registered in the control fruits under both the respective storage conditions. After 7 days, the minimum average PLW of (1.72 %) was recorded in Chitosan under cold storage conditions. During the storage period fruit in all the treatments registered increment in PLW per cent but at slower rate as compare to control fruits. Chitosan treated fruits maintained acceptable limits for 14 days under cold storage, as against control fruits in which fruit remained acceptable for 7 day under ambient condition. The loss in weight of fresh horticultural crops is mainly due to transpirational water loss (Zhu *et al* 2008).

The fruit firmness is an important physical parameter to monitor the ripening progress. The fruits treated with chitosan 1.0 and 1.5 % recorded maximum firmer fruits (18.43 lbf), while in control it was minimum (15.05 lbf) under cold storage conditions. Similarly, under ambient conditions, fruits remained firmer for longer period with Chitosan treatments. Cold storage condition exhibited slow rate of loss of fruit firmness as compared to ambient conditions. The present findings are in accordance with work of Krishna and Rao (2014) in guava fruits.

The fruits treated with Chitosan 1.5 % were maximum palatable with 7.36 mean organoleptic rating followed by 7.14 in Chitosan 0.5 % under cold storage condition. The organoleptic rating of fruits increased significantly up to 7^{th} day of cold storage. Although, it was However, it was highest (8.20) in control fruits on 7^{th} day, due to the fact that in all the

treatments ripening process of guava was restricted which resulted slow ripening in the initial days of storage. The reduction in organoleptic rating in Chitosan coated fruits was due to Chitosan induced discoloration of fruits. Under ambient condition the fruit remained palatable up to 7th day of storage and afterwards it decreased considerably, particularly in control fruits. Control fruits exhibited drastically reduction in palatability from 7th day (8.43) to 14th day (4.23) of ambient storage and upto the 21st day, fruits in all the treatments including control got spoiled. Slow rate of biochemical activities resulting from reduced transpiration and respiration under cold storage conditions resulted maintenance of organoleptic rating of fruits (Bal 1982). The storage conditions and treatments significantly affect the fruit spoilage. The highest average mean spoilage (41.72 %) was recorded in control fruits. On the 21st day of ambient storage, all the treated as well as untreated fruits got shriveled or spoiled including control fruits. After harvest there is a continuous biochemical change in fruits which leads to fruit softening and spoilage which ultimately deteriorates the quality of fruits.

The fruit quality in terms of TSS was also influenced significantly with days of stirage conditions and treatments. The average maximum TSS content (10.11 %) was recorded in chitosan 1.5 % under cold storage and 9.51 % under 1.0 % treatment. The minimum mean TSS (9.48 % and 8.48 %) was recorded in control fruits under cold and ambient conditions, respectively. Increment in TSS was registered in guava fruits up to 21st day under cold and upto 7th day under ambient conditions, afterwards it declined considerably under ambient condition. This increase in TSS in fruits might be due to reduction of the activities of various enzymes and by delaying the senescence, disorganization of cellular structure and checking of microbial activities (Lougheed *et al* 1979).

The total sugars of the guava fruits increases till the end of the storage period except untreated fruits under cold storage condition. The maximum mean total sugars (6.43 %) were recorded in chitosan 1.5 % followed by 6.26 under 1.0 % treatment. Under ambient storage total sugars declined after 7th day of storage in 0.5 % treatments and control, but there was quick decline in untreated fruits. The increase in total sugars in all treatments under cold storage was probably due to dehydration, because fruits exhibited highest physiological losses in weight in most of the treatments resulting higher proportion of total sugars. Stahl and Champ (1971) had reported that during prolong storage period certain cell wall material such as pectin and hemicelluloses might be converted into reducing substances. The total soluble solids (TSS) and sugars increase during storage may be due to hydrolysis of

starch into sugars as on complete hydrolysis of starch no further increase occurs and subsequently a decline in TSS is predictable as they along with other organic acids are primarily substrate for respiration (Wills *et al* 1980). The investigation concluded that, although, the Chitosan coating has potential to maintain the fruit quality but further investigations are needed to sustain the marketable fruit quality after storage.

Table 1: Effect of Chitosan treatments and storage intervals on physiological loss in weight (%) in guava cv. Shweta under cold storage and ambient conditions

Treatments (T)		**STORAGE INTERVAL DAYS (D)**									
		COLD STORAGE					**AMBIENT STORAGE**				
		0	**7**	**14**	**21**	**Mean**	**0**	**7**	**14**	**21**	**Mean**
Chitosan	0.5%	0.00	3.95	5.57	6.55	4.02	0.00	6.97	12.54	20.44	9.99
	1.0%	0.00	2.39	5.05	6.20	3.41	0.00	6.89	11.08	18.93	9.22
	1.5%	0.00	1.72	4.91	5.83	3.11	0.00	6.42	10.32	20.71	9.36
Control		0.00	4.22	8.12	10.94	5.82	0.00	8.55	15.48	28.31	13.08
LSD (p≤0.05)		Treatment (T) = 0.43 Days (D) = 0.28 T×D = 0.88					Treatment (T) = 0.37 Days (D) = 0.24 T×D =0.76				

Table 2: Effect of Chitosan treatments and storage intervals on fruit firmness (lbf) in guava cv. Shweta under cold storage and ambient condition

TREATMENTS		**STORAGE INTERVAL (Days)**									
		COLD STORAGE					**AMBIENT STORAGE**				
		0	**7**	**14**	**21**	**Mean**	**0**	**7**	**14**	**21**	**Mean**
Chitosan	0.5%	24.00	19.90	15.40	13.63	18.23	24.00	12.27	10.47	FS	15.58
	1.0%	24.00	21.90	15.23	12.60	18.43	24.00	13.67	11.10	FS	16.26
	1.5%	24.00	21.90	15.23	12.60	18.43	24.00	12.83	10.53	FS	15.79
Control		24.00	16.67	10.53	9.00	15.05	24.00	10.03	7.57	FS	13.86
LSD (p≤0.05)		Treatment (T) = 0.85 Days (D) = 0.53 T×D = 1.64					Treatment (T) = 1.16 Days (D) = 0.66 T×D = 2.10				

FS – fruit spoiled

Table 3: Effect of Chitosan treatments and storage intervals on organoleptic rating (Hedonic scale) in guava cv. Shweta under cold storage and ambient condition

TREATMENTS		STORAGE INTERVAL (Days)									
		COLD STORAGE					AMBIENT STORAGE				
		0	7	14	21	Mean	0	7	14	21	Mean
Chitosan	0.5%	7.33	7.67	6.83	6.73	7.14	7.33	7.20	6.93	FS	7.16
	1.0%	7.33	7.77	7.23	6.17	7.13	7.33	7.67	6.90	FS	7.30
	1.5%	7.33	7.83	7.77	6.50	7.36	7.33	7.22	6.60	FS	7.05
Control		7.33	8.20	6.97	5.07	6.89	7.33	8.43	4.23	FS	6.67
LSD (p≤0.05)		Treatment (T) = 0.19 Days(D) = 0.12 T×D = 0.36					Treatment (T) = 0.15 Days (D) = 0.083 T×D = 0.25				

FS – fruit spoiled

Table 4: Effect of Chitosan treatments and storage intervals on spoilage (%) in guava cv. Shweta under cold storage and ambient condition

TREATMENTS		STORAGE INTERVAL (Days)									
		COLD STORAGE					AMBIENT STORAGE				
		0	7	14	21	Mean	0	7	14	21	Mean
Chitosan	0.5%	0.00	0.00	6.05	13.00	4.76	0.00	7.80	13.38	100.00	30.29
	1.0%	0.00	0.00	5.44	10.38	3.95	0.00	6.65	12.53	100.00	29.79
	1.5%	0.00	0.00	4.38	10.88	3.81	0.00	7.40	13.56	100.00	30.24
Control		0.00	0.00	16.50	31.87	12.09	0.00	24.38	42.50	100.00	41.72
LSD (p≤0.05)		Treatment (T) = 0.80 Days (D) = 0.54 T×D = 1.56					Treatment (T) = 0.63 Days (D) = 0.40 T×D = 1.30				

Table 5: Effect of Chitosan treatments and storage intervals on total soluble solids (%) in guava cv. Shweta under cold storage and ambient condition

TREATMENTS		STORAGE INTERVAL (Days)									
		COLD STORAGE					AMBIENT STORAGE				
		0	7	14	21	Mean	0	7	14	21	Mean
Chitosan	0.5%	8.60	9.03	9.90	11.03	9.64	8.60	10.17	9.43	FS	9.40
	1.0%	8.60	9.73	10.60	10.77	9.93	8.60	10.17	9.77	FS	9.51
	1.5%	8.60	9.60	10.80	11.43	10.11	8.60	10.37	9.47	FS	9.48
Control		8.60	10.60	10.03	8.67	9.48	8.60	10.57	7.07	FS	8.74
LSD(p≤0.05)		Treatment (T) = 0.75 Days (D) = 0.50 T×D = 1.60					Treatment (T) = 0.20 Days (D) = 0.12 T×D= 0.36				

FS – fruit spoiled

Table 6: Effect of Chitosan treatments and storage intervals on total sugars (%) in guava cv. Shweta under cold storage and ambient condition

TREATMENTS		STORAGE INTERVAL (Days)									
		COLD STORAGE					AMBIENT STORAGE				
		0	7	14	21	Mean	0	7	14	21	Mean
Chitosan	0.5%	4.87	6.06	6.32	6.71	5.99	4.87	6.28	5.88	FS	5.68
	1.0%	4.87	6.43	6.51	7.24	6.26	4.87	5.98	6.08	FS	5.64
	1.5%	4.87	6.67	6.89	7.29	6.43	4.87	5.89	6.09	FS	5.62
Control		4.87	6.62	6.42	4.40	5.58	4.87	6.32	4.18	FS	5.12
LSD(p≤0.05)		Treatment (T) = 0.20 Days (D) = 0.14 T×D=0.43					Treatment (T) = 0.27 Days (D) = 0.15 T×D = 0.43				

FS – fruit spoiled

References

[1] A.O.A.C. 2005. Official methods of analysis, 18th edn. Association of Official Analytical Chemists, Washington DC.

[2] Amerine M A, Pangborn R M and Roessler E B 1965. *Principles of Sensory Evaluation of Food*. Pp 5. Academic Press, London.

[3] Bal J S 1982. A study on biochemical changes during room and refrigerator storage of ber. *Prog Hort* **14:** 158-61.

[4] Bashir H A and Abu-Goukh A B A 2003. Compositional changes during guava fruit ripening. *Food Chem* **80:** 557-63.

[5] Beaudry RM 1993. Effect of carbon dioxide partial pressure on blueberry fruit respiration and respiratory quotient. *Post-harvest Bio Tech* **3:** 249-58.

[6] Chahal S and Bal J S 2003. Effect of post-harvest treatments and packaging on shelf life of Umran ber at cool temperature. *J Res Punjab Agric Univ* **40:** 363-99.

[7] FAO 2011. Food and Agricultural commodities production: Guava, mango and mangosteen. available at *http://faostat.fao.org/site/339/default.aspx*.

[8] Fattahi J, Fifall R and Babri I 2010. Postharvest quality of kiwifruit (*Actinidia deliciosa* cv. Hayward) affected by pre-storage application of salicylic acid. *S West J Hort Bio Environ* **1:** 175-86.

[9] Hong K, Xie J, Zhang L, Sun D and Gong D 2012. Effect of chitosan coating on post harvest life and quality of guava (*Psidium guajava* L.) fruit during cold storage. *Scientia Hort* **144:** 172-78.

[10] Krishna K R and Rao D V S 2014. Effect of chitosan coating on the physiochemical

characteristics of guava (*Psidium guajava* L.) fruits during storage at room temperature. *Indian J Sci Tech* **7:** 554-58.

[11] Lougheed E S, Murr D P and Miller S R 1979. Effect of calcium and daminozide on ethylene production and softening of apple fruits. *Experimentia* **35:** 43-44.

[12] Mahajan B V C, Dhatt A S and Sandhu K S 2005. Effect of different post-harvest treatment on the storage life of kinnow. *Haryana J Hort sci* **20:** 156-60.

[13] Pandey S K, Jean E Joshuaand B and Abhay 2010. Influence of gamma-irradiation, growth retardants and coatings on the shelf life of winter guava fruits (*Psidium guajava* L.). *J Food Sci Tech* **47:** 124-27.

[14] Rai M K, Asthana P, Jaiswal V S and Jaiswal U 2010. Biotechnological advances in guava (*Psidium guajava* L.): recent developments and prospects for further research. *Trees* **24:** 1-12.

[15] Rajan S, Yadava L P, Kumar R A M and Saxena S K 2007. GIS based diversity analysis of guava growing distribution in Uttar Pradesh. *Acta Hort* **735:** 109-13.

[16] Saltveit M E 1999. Effect of ethylene on quality of fresh fruits and vegetables. *Post Harvest Bio Tech* **15:** 279-92.

[17] Stahl A L and Camp A F 1971. Citrus Fruits In: Hulme A C(ed) *The Biochemistry of Fruits and their Products. P*p 107-69.

[18] Tandon D K, Singh B P and Kalra S K 1989. Storage behaviour of specific gravity graded guava fruits. *Scientia Hort* **41:** 35-41.

[19] Wills R B H, Bembridge P A and Scott K J 1980. Use of flesh firmness and other objective tests to determine consumer acceptability of delicious apples. *Aust J Exp Agric Anim* **20**: 252-56.

[20] Zhu X, Wang Q M, Cao J K and Jiang W B 2008. Effects of chitosan coating on postharvest quality of mango (*Mangifera indica* L.cv. Tainong) fruits. *J Food Proc Preser* **32:** 770-84.