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EFFECT OF ANTIOXIDANTS ON SHELF LIFE OF GUAVA (*PSIDIUM GUAJAVA* L.) CV. ALLAHABAD SAFEDA

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Abstract

An experiment was conducted to study the effect of antioxidants on shelf life of guava cv. Allahabad Safeda. The fruits were treated with antioxidants, ascorbic acid (500 & 1000ppm), benzyl adenine (50 & 100 ppm) and sodium benzoate (500 & 1000ppm). Among antioxidants, benzyl adenine 100 ppm recorded lower physiological loss in weight (10.71%) compared to control (19.75%). Highest fruit firmness was observed in fruits treated with benzyl adenine 100 ppm (2.84 kg/cm$^{2)}$ over control (1.32 kg/cm$^{2)}$. Fruits treated with benzyl adenine 100 ppm recorded significantly maximum TSS (12.88^o brix), Brix- acid ratio (20.72) and ascorbic acid content (195.52 mg/100 gm) compared to untreated fruits. Lowest acidity was observed in fruits treated with benzyl adenine 100 ppm (0.60%) compared to control (0.70%). Least reducing and total sugars content was found in untreated fruits, while benzyl adenine 100 ppm recorded highest reducing sugars (4.31%) and total sugars (7.67%). Among the days of storage it was observed that the physiological loss in weight increased and fruit firmness, ascorbic acid, acidity decreased irrespective of the treatments. Total Soluble Solids, brix acid ratio, reducing sugars and total sugars increased initially and then decreased towards the end of the storage period.

Key words : Guava, antioxidants, shelf life, TSS, Brix-acid ratio and ascorbic acid.

Introduction

Guava is an important fruit crop in international trade and it belongs to family myrtaceae. It ranks fifth in area and production after mango, citrus, banana and apple fruits in our country. It is estimated that in India, it is grown in about 1.62 lakh ha with a total production of 16.85 lakh tonnes (CMIE, 2005). The guava is one of the important, highly productive, delicious and nutritious fruits of India. The fruit is an excellent source of vitamin C, pectin, calcium and phosphorus (Tamil selvan and Bal, 2005). In most of the fruits, ripening occurs due to the ethylene biosynthesis via, the following path way: L-methionine….>S-adenosyl methionine (SAM)….>1 amino cyclopropane-1-carboxylic acid (ACC)…… ethylene (Kende, 1993). The conversion of ACC to ethylene involves the action of free radicals and it has been established that free radical scavengers will inhibit ethylene production (Apelbaum *et al*., 1981a, 1981b).

Antioxidants help in extending the shelf life of fruits. These are the compounds, which prevent the free radical formation and cell membrane disintegration which occurs by lipoxygenase and lipid peroxidation reactions. These compounds could extend the shelf life of fruits by minimizing the onset of ripening and ethylene production which is mediated by lipid peroxidation reactions. Various commercial antioxidants are being used in post harvest sectors as well as in food industries, like ascorbic acid, sodium benzoate, benzyl adenine, butylated hydroxytoulene, di-phenylamine etc. These antioxidants will prevent or delay the formation of free radicals and different degenerative pathways like lipoxygenase reactions which would enhance the production of ethylene that may lead to the ripening. Direct evidence for the participation of Lipoxygenase was provided by Bousquet and Thimann (1984), who showed that an *in vitro* soybean Lipoxygenase system free of membrane components could oxidize ACC to ethylene. The shelf life of fruits can be extended by delaying the ripening and inhibiting the post harvest diseases occurrence.

Materials and Methods

The guava fruits were harvested at colour break stage *i.e.* skin of the fruit changes from dark green to light

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Table 1 : Effect of post-harvest application of antioxidants on physiological loss in weight (%) and fruit firmness (kg/cm^2) of Guava cv. Allahabad Safeda during storage.

Treatment	Physiological loss in weight (%)				Mean	Fruit firmness (kg/cm^2)				Mean
	Storage period (days)					Storage period (days)				
	3	6	9	12		3	6	9	12	
Ascorbic acid 500ppm	7.74	13.00	18.04	23.97	15.70	3.43	2.60	1.93	0.57	2.13
Ascorbic acid 1000ppm	6.76	12.56	16.21	22.41	14.48	3.63	2.83	2.00	0.87	2.33
Benzyl adenine 50ppm	6.60	9.83	14.11	17.74	12.07	3.77	2.93	2.13	1.87	2.68
Benzyl adenine 100ppm	5.93	7.63	12.05	17.23	10.71	4.03	3.13	2.27	1.93	2.84
Sodiumbenzoate 500ppm	6.83	12.86	15.23	22.49	14.36	3.77	2.80	2.00	1.07	2.41
Sodiumbenzoate1000ppm	6.57	13.57	16.16	22.99	14.82	3.63	2.67	1.97	1.03	2.33
Control	10.27	17.28	23.07	28.39	19.75	3.03	1.87	0.37	0.00	13.2
Mean	7.24	12.40	16.41	22.17		3.62	2.69	1.81	1.05	
	S.Ed		CD at 5%			S.Ed		CD at 5%		
Treatment	0.10		0.20			0.05		0.10		
Days	0.08		0.15			0.04		0.88		
Treatment x Days	0.21		0.41			0.11		0.21		

Table 2 : Effect of post-harvest application of antioxidants on TSS (^{O}Brix) and brix-acid ratio of Guava cv. Allahabad safeda during storage.

Treatment	TSS (^{O}Brix)				Mean	Acidity (%)				Mean
	Storage period (days)					Storage period (days)				
	3	6	9	12		3	6	9	12	
Ascorbic acid 500ppm	12.33	12.47	12.23	11.40	12.11	0.74	0.67	0.65	0.61	0.67
Ascorbic acid 1000ppm	12.43	12.57	12.23	11.10	12.08	0.72	0.64	0.62	0.59	0.64
Benzyl adenine 50ppm	13.10	13.07	12.83	11.97	12.74	0.72	0.63	0.60	0.58	0.63
Benzyl adenine 100ppm	13.23	13.30	12.87	12.13	12.88	0.70	0.62	0.59	0.57	0.62
Sodiumbenzoate 500ppm	12.40	12.50	11.60	11.10	11.90	0.72	0.66	0.61	0.61	0.65
Sodiumbenzoate1000ppm	12.47	12.57	11.67	11.37	12.02	0.72	0.66	0.62	0.60	0.65
control	11.87	11.93	11.50	10.00	11.33	0.75	0.70	0.67	0.66	0.70
Mean	12.55	12.63	12.13	11.30		0.72	0.65	0.62	0.60	
	S.Ed		CD at 5%			S.Ed		CD at 5%		
Treatment	0.06		0.11					0.004 0.007		
Days	0.04		0.08			0.003		0.006		
Treatments x Days	0.11		0.22			0.008		0.010		

green. Then they were packed in corrugated fibre board boxes with paper shred cushioning to prevent from bruising and damage during transportation. In the laboratory, the fruits free from bruises and other damages were selected and washed with potable water. The fruits were then allowed to dry in shade prior to imposition of treatments. Each treatment was replicated thrice in FCRD and twenty five fruits were included in each replication during year 2009. The treatments included three antioxidant chemicals, *viz.*, ascorbic acid (500 and 1000 ppm), benzyl adenine (50 and 100 ppm) and sodium benzoate (500 and 1000 ppm). Fruits were dipped in a given solution containing 0.1 per cent Tween as an adhesive for 10 minutes and air dried. Observations on physical and quality parameters were recorded at an interval of 3 days. Pocket penetrometer was used to record the fruit firmness, total soluble solids were determined by using ERMA hand refractometer and expressed as per cent TSS (^{o}Brix) (Ranganna, 1986). Ascorbic acid and titrable acidity were determined as per method described by (Ranganna, 1986). Reducing and total sugars were determined as per AOAC.

Results and Discussion

The Physiological loss in weight was significantly least the fruits treated with Benzyl adenine 100 ppm (10.71%), followed by Benzyl adenine 50 ppm (12.07) over control and other treatments. (19.75%) (table 1).

Table 3 : Effect of post-harvest application of antioxidants on Brix-acid ratio and Ascorbic acid (mg/100 mg) ratio of Guava cv. Allahabad Safeda during storage.

Treatment	Brix-acid ratio Storage period (days)				Mean	Ascorbic acid (mg/100g) Storage period (days)				Mean
	3	6	9	12		3	6	9	12	
Ascorbic acid 500ppm	16.59	18.61	18.91	18.69	18.20	221.63	164.30	129.70	86.47	150.53
Ascorbic acid 1000ppm	17.35	19.74	19.73	18.82	18.91	225.40	190.23	157.93	102.40	168.99
Benzyl adenine 50ppm	18.28	20.85	21.34	20.63	20.29	229.44	220.03	168.70	139.33	189.38
Benzyl adenine 100ppm	18.82	21.45	21.07	21.54	20.72	232.33	227.13	178.24	144.38	195.52
Sodiumbenzoate 500ppm	17.34	18.95	18.81	18.30	18.35	225.16	202.51	160.94	104.98	173.40
Sodiumbenzoate1000ppm	17.32	19.04	18.92	18.84	18.53	218.21	204.79	168.01	107.11	174.53
control	15.82	16.97	17.09	15.07	16.24	204.18	159.42	100.98	80.56	136.29
Mean	17.36	19.37	19.42	18.84		222.53	195.49	152.07	109.32	
	S.Ed		CD at 5%			S.Ed		CD at 5%		
Treatment	0.17		0.33			0.30		0.59		
Days	0.13		0.25			0.23		0.45		
Treatments x Days	0.33		0.65			0.60		1.18		

Table 4 : Effect of post-harvest application of antioxidants on reducing sugars (%), total sugars (%) and shelf –life of Guava cv. Allahabad Safeda during storage.

Treatment	Reducing sugars (%) Storage period (days)				Mean	Total sugars (%) Storage period (days)				Mean	Mean
	3	6	9	12		3	6	9	12		
Ascorbic acid 500ppm	3.91	4.45	3.79	2.10	3.56	7.18	8.29	6.77	4.81	6.76	7.67
Ascorbic acid 1000ppm	4.33	5.03	4.10	2.33	3.95	7.40	8.68	6.84	5.09	7.00	8.67
Benzyl adenine 50ppm	4.35	4.91	4.54	3.16	4.24	7.93	8.65	7.49	6.03	7.52	10.33
Benzyl adenine 100ppm	4.82	5.15	4.20	3.07	4.31	8.22	8.89	7.54	6.04	7.67	11.00
Sodiumbenzoate 500ppm	3.94	4.32	3.76	3.08	3.77	7.49	8.27	7.45	5.91	7.28	8.33
Sodiumbenzoate1000ppm	3.73	4.52	3.98	2.39	3.66	7.37	8.38	7.09	5.14	7.00	8.00
Control	3.84	4.10	3.38	1.81	3.28	7.21	7.92	6.40	4.30	6.46	4.67
Mean	4.13	4.64	3.97	2.56		7.54	8.44	7.08	5.33		8.38
	S.Ed		CD at 5%			S.Ed		CD at 5%		S.ED	CD at 5%
Treatment	0.06		0.11			0.07		0.13		0.854	1.08
Days	0.04		0.08			0.05		0.10			
Treatments x Days	0.11		0.22			0.13		0.26			

This may be due to the fact that benzyl adenine reduces senescence, rate of respiration, ethylene production and ripening of fruits. The results obtained in the present investigation are in close conformity with those of Bhardwaj *et al*. (2005) in mandarin cv. Nagpur Santra. Benzyl adenine 100 ppm recorded significantly higher firmness (2.84 kg cm^{-2}) followed by Benzyl adenine 50 ppm compared to control and other treatments (1.32 kg cm^{-2}) (table 1). This may be attributed to the retarded nature of ripening as a result of antioxidant treatment.

TSS value was found to increase initially during storage up to 6th and later on decreased as the storage processed. The increase in TSS during the initial stages may be attributed to the conversion of starches and other polysaccharides into soluble forms of sugars (Mukherjee and Dutta, 1967). The subsequent decrease in TSS at advanced stage is owing to the increased rate of respiration in later stages of storage resulting in its faster utilization in oxidation process through Kreb's cycle (Singh, 1980). Benzyl adenine 100 ppm recorded significantly higher total soluble solids (12.88%) over control (11.33%) (table 2). This might be due to the increase in inhibitory effect of these chemicals on enzymes responsible for degradation (Mehta *et al*., 1980). In general, fruits with higher acidity maintained higher shelf life .The acidity was lower in the fruits treated with benzyl adenine 100 ppm (0.62%), than the untreated fruits (0.72) (table 2), but the increase in shelf life due to benzyl adenine might be due to ethylene inhibition or reduced respiration rate or increase in fruit firmness.

Maximum Brix acid ratio was observed in fruits treated with benzyl adenine 100 ppm (20.72) and was followed by benzyl adenine 50 ppm (20.29), whereas lower brix - acid ratio was observed in control (16.24) (table 3). The decline in ratio with prolongation of storage is may be attributed to loss solids due to degradation during respiration.

Ascorbic acid content was declined from 3rd day (222.53 mg/100g) to 12th day (109.32 mg/100g) (table 3). The loss in ascorbic acid on prolonged storage might be due to rapid conversion of L-ascorbic acid into dehydroascorbic acid in the presence of enzyme ascorbinase (Mapson, 1970). Benzyl adenine 100 ppm treated fruits recorded higher ascorbic acid content (195.52 mg/100g), which was significantly higher than other treatments. The delayed ripening by benzyl adenine might have reduced the degradation of ascorbic acid. Delayed ripening and reduction in respiration rate in benzyl adenine treated fruits could also be attributed to the decrease in internal oxygen concentration and increase in carbondioxide level leading to the higher retention of ascorbic acid in the fruits (Bhardwaj *et al*., 2005).

The reducing sugars and total sugars content differed significantly among treatments and storage period. There was initial rise in reducing and total sugars content, which might be due to conversion of starch to sugars, where as the subsequent decrease may be due to utilization of sugars in respiration (Pool *et al*., 1972). Benzyl adenine 100 ppm recorded more reducing sugars content (4.31%) as compared to untreated fruits (3.28%) and total sugar content (7.67%) as compared to untreated fruits (6.46%) (table 4). The reason may be that benzyl adenine quenches free radicals and inhibit ethylene synthesis and thus might have reduced the rate of ripening, resulting in retardation of senescence and gradual build up of sugars (Ahmad, 1998).

Conclusion

It could be concluded that post-harvest application of antioxidants improved the shelf-life of guava fruits by maintaining a superior physico-nutritional status. Benzyl adenine at 100ppm was effective in increasing fruit firmness, TSS, brix-acid ratio, ascorbic acid content and sugars content than all other treatments and increased the shelf life of fruits to 11 days (table 4) and followed by Benzyl adenine at 50 ppm increased the shelf life of fruits to 10.33 days.

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