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ORIGINAL ARTICLE

Influence of gamma-irradiation, growth retardants and coatings on the shelf life of winter guava fruits (*Psidium guajava* L.)

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Abstract Experiment was conducted to study the effect of gamma irradiation, growth retardants and coatings (coconut oil, mustard oil and liquid paraffin) on shelf life of winter guava fruits during storage. The results revealed that the superiority of coconut oil coating over other post harvest treatments. Physiological loss in weight (7.1%), marketable fruits retained over control (86.7%), total soluble solid (16.1%), ascorbic acid (195 mg/100 g pulp) and total sugar (10%) of fruit were positively influenced by coconut oil coating up to 12 days of storage. The treatment was found significantly effective in increasing the post harvest life of fruits for 12 days over control without adversely affecting the fruit quality. Coconut oil coating gave highest consumer acceptability while, maintaining sufficient level of total soluble solids and sugar content in fruits.

Keywords: Guava · Gamma irradiation · Growth retardants · Coatings · Shelf life

Introduction

Guava is one of the most common and major fruit of India and considered the fourth most important fruit in the area and production. In India it occupies an area of 10, 02,000 hectares with and annual production of 10.15 lakh tons (NHB 2007). It is climacteric fruit and highly perishable in nature and should be marketed immediately after harvest. Therefore, certain measures for increasing its shelf life has to be done for its availability in distant markets while maintaining the quality of fruits. India accounts for more than 10% of the total world production of fruits but, in tropical and subtropical regions, about 25–40% of the harvested fruits are lost due to faulty post harvest handling and microbial attack after harvest. Various viable technologies for improving shelf life and storage of horticultural commodities have evolved during the past decades, like the use of antitranspirants (Chahal and Bal 2003), wax coatings (Mahajan et al. 2005), growth retardants (Bisen and Pandey 2008), irradiation (Baghel et al. 2005) and different type of storage facilities to increase the longetivity of harvest fruits. In places where refrigeration and storage facilities are not available, protective skin coating is one of the methods for increasing shelf-life of fresh guava fruits. Irradiation proved to be extremely beneficial in terms of prolonging the fruit and vegetable shelf-life by 3–5 times.

Ionizing radiation in food processing reduces microbial load and as a result extend shelf life. Thus looking to future prospects of irradiation was also incorporated to study the influence along with coating. Keeping these in view, the present investigation was conducted for comparative study to find out suitable doses of radiation, growth retardants and coating material on shelf life and delayed ripening of winter guava fruits.

Materials and methods

Fresh good looking and uniform size guava fruits were procured from fruit research station, Imalia, Department of Fruit Science, JNKVV, Jabalpur. The fruits were washed and graded by density gradation method to select fruits having uniform maturity. Only water sinkers were taken for storage studies. The fruits were treated with gamma- radiation dosage in Gy, 50 (T_2), 100 (T_3), 150 (T_4) and 200 (T_5) growth retardants (Cycocel CC)–250 (T_6), 500 (T_7) and 750 (T_8) ppm and maleic hydrazide (MH)–250 (T_9), 500 (T_{10}) and 750 (T_{11}) ppm and coatings (mustard oil 100%, T_{12}), coconut oil 100% (T_{13}) and liquid paraffin 100% (T_{14}).

The physiological weight loss (PLW), physico-chemical composition and organoleptic value of fruits were taken after 4, 8 and 12 days of storage at ambient conditions

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(24–29°C, 60–70 % RH). The total soluble solids (TSS) of fruits were determined with the help of Hand Refractometer of 0–32° Brix range. The acidity, sugar and vitamin 'C' contents were determined as per the method of AOAC (2002). The appearance, taste, flavour and texture of each sample were evaluated organoleptically by a panel of 5 judges, giving score out of ten.

Statistical analysis: The treatments were replicated 3 times and experiment was laid in a completely randomized design and results analysed statistically (Cochran and Cox 1957). Twenty fruits were taken for each treatment in each replication.

Results and discussion

PLW: The lowest PLW of 1.4, 2.9 and 7.1% after 4, 8 and 12 days of storage, respectively, were recorded when guava fruits were coated with coconut oil and were found to be significantly superior to all the other treatments followed by liquid paraffin coating (Table 1). Coconut coating closed the opening of stomata and lenticels thereby, reducing the transpiration and respiration rates and also reduced microbial activity. The composite oil coating preserves the quality of fruit retarding ethylene emission and hence reduce PLW in pineapple fruits (Thomas et al. 2005). Similar results were also reported by Jagadeesh et al. (2001) in guava fruits.

Marketable fruits retained: All marketable fruits were retained in 100% marketable condition with coconut oil coating after 4, 8 and 12 days of storage followed by liquid paraffin and the least (13.3%) was recorded under control (Table 1). The cause of extending shelf life in coconut oil treated fruits may be due to reduced rate of water loss and lesser availability of oxygen within the fruits which, slowed down the rate of ripening of fruits as well as colour change. Similar findings were reported by Singh and Shaffat Mohammed (1997) in guava and Mahajan et al. (2005) in kinnow fruits. Mustard oil, coconut oil and liquid paraffin coatings retained highest (60%) marketable fruits as compared to control up to 8 days of storage. However, after 12 days of storage the highest (86.7%) retention of marketable fruits over control was in coconut oil coating. Similar findings were also reported by Dhemre and Waskar (2003) in mango fruits.

TSS: The TSS of fruits gradually increased up to 8 days in all treatments and decreased after that irrespective of treatments (Table 2). The maximum (16.1%) TSS was recorded in coconut oil coating followed by CC-500 (T_7) ppm and were found to be significantly superior to control while, the least TSS was recorded in gamma radiation 200 Gy after 12 days of storage. This corroborates the findings of Chandra (1995) that the physico-chemical parameters increase up to 8 days in guava fruits under storage. The increase in TSS up to 8 days may be attributed to the hydrolysis of acid and deposition of polysaccharides during storage. The increase in TSS due to coating was reported by Das and Medhi (1990) in pineapple fruits.

Vitamin C and total sugars: The vitamin C content of fruits irrespective of treatments increased up to 8 days storage and they declined on 12 days storage (Table 2). Irradiation with 100 Gy gamma radiation recorded highest (210 mg/100 g) vitamin C content up to 8 days of storage and was found significantly superior to all other treatments. The increase in vitamin C content in earlier stages of storage may be due to the increasing rate of phenols whereas,

Table 1 Effect of different post-harvest treatments on the physical parameters of guava fruits

Treatments	Physiological weight loss, %			Marketable fruits retained, %			Marketable fruits over control, %		
	4D	8D	12D	4D	8D	12D	4D	8D	12D
Control	5.4	22.4	27.7	80.0	40.0	13.3	-	-	-
50 Gy	5.4	14.2	29.1	93.3	83.3	36.6	13.3	43.3	23.3
100 Gy	4.8	12.7	24.7	100.0	93.4	53.3	20.0	53.3	40.0
150 Gy	6.0	13.6	28.8	86.7	63.3	26.6	6.6	23.3	13.3
250 Gy	6.7	12.8	29.6	86.7	53.4	20.0	6.6	13.3	6.7
CC-250 ppm	5.8	12.3	24.4	100.0	80.0	50.0	20.0	40.0	36.7
CC-500 ppm	5.5	12.2	22.9	100.0	90.0	60.0	20.0	50.0	46.7
CC-750 ppm	6.3	12.0	24.0	93.4	73.3	40.0	13.4	33.3	26.7
MH-250 ppm	5.0	12.0	24.8	100.0	83.5	30.0	20.0	43.5	16.7
MH-500 ppm	5.5	12.0	25.9	100.0	86.7	43.3	20.0	46.7	30.0
MH-750 ppm	7.1	14.9	29.7	90.0	76.7	23.3	10.0	36.7	10.0
Mustard oil	3.3	7.5	17.3	100.0	100.0	60.0	20.0	60.0	46.7
Coconut oil	1.4	2.9	7.1	100.0	100.0	100.0	20.0	60.0	86.7
Liquid paraffin	3.2	7.5	14.1	100.0	100.0	83.4	20.0	60.0	70.1
SEm ±	0.55	1.0	1.01	-	-	-	-	-	-
CD at 5%	1.61	3.00	3.28	-	-	-	-	-	-

n = 3, D: Days after treatment, CC: Cycocel, MH: Maleic hydrazide

Table 2 Effect of different post harvest treatments on the chemical parameters of guava fruits

Treatments	Total soluble solids ,%			Vitamin C, mg/100 g pulp			Total sugars, %		
	4D	8D	12D	4D	8D	12D	4D	8D	12D
Control	14.2	14.8	13.1	188.0	197.0	190.0	8.7	9.0	7.2
50 Gy	14.5	16.2	14.0	195.7	205.0	195.3	9.0	10.2	8.1
100 Gy	15.0	16.5	14.3	206.7	210.0	201.3	9.6	10.6	9.4
150 Gy	14.4	15.1	11.3	186.0	180.3	176.3	8.6	9.8	6.9
250 Gy	14.2	15.0	11.1	183.0	177.7	165.6	8.3	9.3	6.1
CC-250 ppm	15.1	16.5	15.2	198.3	201.7	194.0	9.1	9.7	8.6
CC-500 ppm	15.5	17.1	15.8	202.3	204.4	201.0	9.7	10.0	9.0
CC-750 ppm	15.2	16.7	14.7	195.0	197.7	192.6	9.3	9.5	9.0
MH-250 ppm	14.0	16.6	14.8	200.7	204.0	200.3	9.4	10.8	9.2
MH-500 ppm	14.5	16.8	15.4	201.0	204.4	201.7	10.1	11.2	9.4
MH-750 ppm	14.7	16.2	14.2	191.3	197.4	187.7	9.7	10.6	9.4
Mustard oil	15.8	17.1	15.1	197.0	203.0	193.0	10.2	11.2	9.3
Coconut oil	16.1	17.2	16.1	199.0	204.0	195.0	10.7	11.5	10.0
Liquid Paraffin	16.0	17.0	15.1	193.3	202.7	194.7	10.3	11.2	9.4
SEm ± CD at 5%	0.11 0.34	0.11 0.32	0.16 0.47	1.53 4.45	1.16 3.36	1.40 4.07	0.15 0.45	0.13 0.40	0.16 0.46

n = 3, D, CC, MH: As in Table 1

Table 3 Effect of different post harvest treatments on the Sensory scores of guava fruits

Treatments	Appearance, %			Taste, %			Texture, %			Flavour, %		
	4D	8D	12D	4D	8D	12D	4D	8D	12D	4D	8D	12D
Control	87	52	30	90	76	40	72	50	40	75	67	43
50 Gy	90	76	32	85	92	54	80	60	45	68	80	42
100 Gy	92	80	42	86	94	55	82	62	47	72	87	48
150 Gy	85	65	25	77	72	37	77	50	40	67	60	42
250 Gy	77	42	22	70	47	37	70	47	37	62	45	35
CC-250 ppm	95	82	62	85	92	55	82	78	57	75	82	58
CC-500 ppm	95	85	66	87	95	58	82	79	57	76	87	63
CC-750 ppm	95	78	33	85	90	52	80	76	56	74	85	60
MH-250 ppm	94	78	32	82	76	50	79	64	57	75	71	51
MH-500 ppm	94	80	37	84	78	51	78	62	55	75	75	53
MH-750 ppm	94	75	32	80	75	49	75	61	47	74	70	48
Mustard oil	95	89	79	88	96	76	85	80	78	74	88	82
Coconut oil	98	92	82	90	98	79	87	82	80	75	90	86
Liquid paraffin	96	90	80	89	97	77	86	80	77	75	89	85

n = 5 panelists, D, CC, MH: As in Table 1

during storage (after 8 days), the increase may be due to conversion of L–ascorbic acid into dehydroascorbic acid. Similar results have also been stated by Mahajan et al. (2005) in guava fruits. Increasing trend of total sugars of fruits was observed (Table 2) up to 8 days of storage and then decreased under all treatments. This may be due to rapid conservation of polysaccharides into sugars in the earlier stage and later to utilization of sugars in respiration. These findings are in conformation with El- Monem et al. (2003) in custard apple.

Firmness: It is apparent from Table 3 that coconut oil coating retained maximum texture (80%) up to 12 days of storage whereas , the values for texture decreased in all treatments up to 50% or below except oil coatings. Edible oil coatings preserve the quality of fruits, retard ethylene emission and enhance texture. These results corroborate the findings of Dashora et al. (1999) in ber fruits.

Sensory quality: Maximum acceptability in terms of taste was retained by coconut oil coating without any objectionable change up to 8 days of storage followed by liquid paraffin (Table 3). McGuire (1997) reported that waxed fruits did not ripen normally and therefore they observed little difference during 4, 8 and 12 days of storage. Edible oil coating retained good value of taste due to retention of appreciable amount of sugar and a proper TSS/acid ratio up to 8 days of storage. During storage taste scores decreased. Maximum (82%) appearance of fruits was retained under coating with coconut oil after 12 days of storage followed by liquid paraffin. This corroborates the findings of Dhaka et al. (2001) in mango fruits. Flavour of fruits increased with ripening of fruits and attained its peak at 8 days of storage. Thereafter, during storage up to 12 days, the flavour score decreased. The highest value of 75, 90 and 86% for flavour was recorded under coconut oil coating at 4, 8, and 12 days of storage, respectively. The flavour increased due to enhancement in the chemical attributes of fruits like increase in sugars and TSS/acid ratio where, it decreased at 12 days of storage due to degradation of the same. Dashora and Mohammed (1988) reported that wax coated mosambi fruits retained good fruit quality.

Conclusion

Guava fruits coated with coconut oil reduced PLW, retained marketability, TSS, vitamin C, total sugars and firmness of fruits up to later stage of storage. Application of edible oil coating particularly coconut oil retained good value of taste, appearance and flavour for 12 days of storage. Only 100 Gy gamma-radiation maintained vitamin C at highest level up to 8 days of storage. Coating of coconut oil was sufficient to enhance shelf life of guava fruits and proved to be safe and effective at ambient conditions.

References

AOAC (2002) Official methods of analysis. 16th edn, Association of Official Analytical Chemists, Washington DC

Baghel BS, Gupta N, Khare A, Tiwari R (2005) Effect of different doses of gamma-radiation on shelf-life of guava. Indian J Hort 62:129–132

Bisen A, Pandey SK (2008) Effect of post harvest treatment on biochemical composition and organoleptic quality in kagzi lime fruits during storage. J Hort Sci 3:53–56

Cochran WG, Cox GW 1957. Experimental designs. John Wiley and Sons Inc, New York, p 95–100

Chahal S, Bal JS (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

Chandra R (1995) Biochemical changes during maturity and storage in guava fruits. Indian Hill Farming 8:16–21

Das R, Medhi G (1996) Physico-chemical changes of pineapple fruits under certain post harvest treatment. South Indian Hort 44:5–7

Dashora LK, Mohammed S (1988) Effect of 2, 4-D, wax emulsion and their combination on the shelf life of sweet orange (*Citrus sinensis* Osbek) cv. Mosambi. South Indian Flora 36: 172–176

Dashora LK, Meena MC, Mohammed S (1999) Effect of edible oil emulsion on post- harvest shelf-life of ber (*Ziziphus mauritiana,*Lamk) cv. Umran. Adv Hort Forestry 17: 220–225

Dhaka RS, Verma MK, Agarwal MK (2001) Effect of post-harvest treatment on physico-chemical characters during storage of mango cv. Totapari. Haryana J Hort Sci 30:36–38

Dhemre JK, Waskar DP (2003) Effect of post-harvest treatments on shelf-life and quality of mango in evaporative cool chamber and ambient conditions. J Food Sci Technol 40:316–318

El-Monem EAAA, Mostafa A, El-Maged MAA (2003) Effect of some post-harvest treatment on the storage quality of *Annona squamosa* and on its volatile components. Ann Agric Sci 48: 757–775

Jagadeesh SL, Rokhade TS, Lingaraj U (2001) Influence of post-harvest treatments on storage behaviour of guava fruits cv. Sardar. J Maharashtra Agric Univ 26:297–300

Mahajan BV, Dhatt AS, Sandhu KS (2005) Effect of different post-harvest treatment on the storage life of kinnow. Haryana J Hort 20:156–160

McGuire RG (1997) Market quality of guava after hot water treatment and application of carnauba wax coating. Hort Sci 32: 271–274

NHB (2007) Fruit production statistics. National Horticulture Board, India

Singh UB, Shaffat Mohammed (1997) Comparative efficacy of wax emulsion and rice starch on post-harvest shelf-life of fully ripe guava fruits. J Food Sci Technol 34:519–522

Thomas SA, Molina E-Bosques, Stolik S, Sanchez F (2005) Composite oil coating preserves the quality of pineapple fruits. J Physiq IV France 125:889–892