

Effect of post harvest treatment with γ -irradiation on storage behaviour of guava (*Psidium guajava*) fruits

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ABSTRACT

An experiment was carried out during 2007–08 at Department of Horticulture, Allahabad Agricultural Institute in collaboration with National Botanical Research Institute, Lucknow to see the effect of irradiation on physio-chemical quality and shelf-life of 'Lalit' guava (*Psidium guajava* L.). The treatments comprised 5 doses of γ -irradiation (0, 50, 75, 100, 125 Gy) and 4 levels of Waxol (0, 4, 6, 8%). All the 20 treatment combinations were laid out in a 5 × 4 factorial randomized block design with 3 replications. Observations were recorded at different interval of storage periods, viz 4, 8, 12, 16 days. The treatment combination G₃W₂ (100 Gy + 6% waxol) was found better in terms of physiological loss in weight, total soluble solid, acidity, ascorbic acid, reducing sugar and total sugar, i.e. minimum physiological loss in weight (3.44%), highest TSS (8%), lowest acidity (0.13%), highest total sugar (8.46%) and maximum retention of ascorbic acid (148.56 mg/100 g), reducing sugar (4.64%) respectively, followed by G₂W₂ (75 Gy + 6% waxol), G₁W₂ (50 Gy + 6% waxol), G₄W₂ (125 Gy + 6% waxol), G₀W₂ (0 Gy + 6% waxol) were recorded after 16 days of storage period at ambient temperature. The amount of γ -irradiation used did not have any residual effect.

Key words: Guava, γ -irradiation, Quality, Shelf-life

'Lalit' guava (*Psidium guajava* L.) is a new and export potential variety in terms of fruit quality but its keeping quality is not good. Hence, use of γ -irradiation on guava fruits for extending the shelf-life and retention of fruit quality will be very useful for export. FAO/IAEA/APEDA/WHO expert committee on food irradiation (JECFI) in 1980 and Ministry of Health and Family Welfare in 2001 have also permitted the use of γ -irradiation in horticultural produces at certain limits, i.e. 10 KGy.

Guava is an evergreen sub-tropical fruit crop belongs to the family Myrtaceae. In India, it occupies an area of 0.16 million ha with an annual production of 1.68 million tonnes and accounting for 5.26% and 3.73% of area and production, respectively (NHB 2009).

It is rich in vitamin 'C' (300 mg/100 g) and good source of calcium, phosphorous, pantothenic acid, riboflavin, thiamine and niacin. Fruits of guava are best for jelly making as they are rich source of pectin. It can be canned with sugar or used for making fruit butter. Guava is available during the period when important fruits like mango, apple etc. are not available in the market. It is also known as the apple of tropics.

It is a climacteric fruit and highly perishable in nature

and should be marketed immediately after harvest. The short post-harvest life of horticultural crop is due to their highly perishable nature and physiological break-down during handling, transport, storage and these losses are further enhanced by infection of post-harvest diseases. Various viable technologies for improving shelf-life and storage of horticultural commodities have evolved during the past decades, like use of fungicides, cold storage, controlled atmospheric storage, anti transpirants, wax coating, growth retardants and different type of packing material etc.

Ionizing radiations can play a significant role in the control of biotic factors of spoilage of fruits. Radiation processing involves controlled application of the energy of ionizing radiations, such as gamma rays, X-rays and accelerated electrons to fruits for achieving control of sprouting, delay in ripening, disinfestation, shelf-life extension, hygienization and sterilization.

Irradiated foods are wholesome and nutritious. All known methods of food processing and even storing food at room temperature for a few hours after harvesting can lower the content of some nutrients, such as vitamins. At low doses of radiation, nutrient losses are either not measurable or if they can be measured are not significant. Sometimes higher doses are used to extend shelf-life or control harmful bacteria.

Nutritional losses are less than or about the same as

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cooking and freezing. Irradiation, at the levels normally used in food processing, destroys most, but not necessarily every single microorganism present; it does not sterilize the food. Recently, only irradiated dried spices and enzyme were marketed in the United States. In January 1992, irradiated Florida strawberries were sold at North Miami Supermarket. Sales of irradiated products ongoing in several grocery stores. Poultry irradiation began commercially in 1993.

Irradiation of food has been approved in 37 countries for more than 40 products. The largest marketers of irradiated food are Belgium and France. They irradiated about 10000 tonnes of food/year and the Netherlands irradiates about 20000 tonnes/year. Hence, keeping the above facts in view the present investigation was carried out to study the effect of irradiation on physico-chemical quality and shelf-life of guava fruits.

MATERIALS AND METHODS

The present experiment was carried out at Post Harvest Laboratory, Department of Horticulture, Allahabad Agricultural Institute-Deemed university in collaboration with National Botanical Research Institute, Lucknow during 2007 and 2008. The treatments comprised 5 doses of γ -irradiation (0, 50, 75, 100, 125 Gy) and 4 levels of waxol (0, 4, 6, 8%). All the 20 treatment combinations were laid out in a 5×4 factorial randomized block design with 3 replications. The freshly harvested fruits were treated with different dose of γ -irradiation and coated with waxol. For treating the fruits, first fruits were kept inside the irradiation chamber after that γ -rays were passed through that chamber for different time period because doses were totally based on time duration. The γ -rays has to pass through chamber for a period of 14 sec. for giving one Gy dose, i e 700 sec for 50 Gy, 1050 second for 75 Gy, 1400 sec for 100 Gy, 1750 second for 125 Gy. The equipment name was Gamma Chamber 900 Model Cobalt-60 source. This equipment is fabricated in Bhabha Atomic Research Centre, Mumbai. After treatment of all the fruits were packed in polyethylene bag and kept for storage at ambient temperature. Observations were recorded at different interval of storage periods, viz 4, 8, 12, 16 days for different qualitative and quantitative fruit characters.

RESULTS AND DISCUSSION

Minimum physiological loss in weight (3.44%) was recorded with the treatment combination G_3W_2 [gamma radiation (100 Gy) + waxol (6%)], followed by G_2W_2 (4.42%), G_1W_2 (5.21%), G_4W_2 (6.17%), and maximum physiological loss in weight (9.61%) was with the treatment combination G_0W_0 [gamma radiation (0 Gy) + waxol (0%)](Table 1). This may be due to the reasons that wax coating closing the opening of stomata and lenticels, thereby reducing the transpiration and respiration rate and also reduce the microbial activity (Das and Medhi 1996). Thus prevented the damage of tissue and ultimately the physiological weight

loss. Similar results were recorded by Jagdeesh (1994) and Jagdeesh *et al.* (2001).

The treatment G_3W_2 [gamma radiation (100 Gy) + waxol (6%)] showed better retention of total soluble solid (8.00° brix), followed by G_2W_2 (6.40° brix), G_1W_2 (5.00° brix), G_4W_2 (4.00 ° brix), and minimum TSS (3.40 ° brix) was recorded with the treatment combination G_0W_0 [gamma radiation (0 Gy) + waxol (0%)] (Table 1). The increase in TSS in fruits under wax coating was reported by Jagdeesh (1994) and Das and Medhi (1996) in pineapple.

The gradual decrease in acidity was recorded in all the treatments during different storage periods (Table 1). The maximum decreasing trend was recorded in control and least decreasing trend in G_3W_2 . Minimum titrable acidity (0.13%) was recorded with the treatment combination G_3W_2 [gamma radiation (100 Gy) + waxol (6%)], followed by G_2W_2 (0.15%), G_1W_2 (0.18%), G_4W_2 (0.18%), and maximum acidity (0.22%) was recorded with the treatment combination G_0W_0 [gamma radiation (0 Gy) + waxol (0%)]. The minimum acidity was observed in liquid paraffin at each stage of storage. Acidity of fruits during storage followed a linear declining trend on account of the use of organic acids in respiration or either due to dilution effect of hydrolysis of acid into sugars. This result is also in confirmation with Mahajan *et al.* (2005) in Kinnow.

Maximum ascorbic acid (148.56 mg/100 g of fruit) was recorded with the treatment combination G_3W_2 [gamma radiation (100 Gy) + waxol (6%)], followed by G_2W_2 (112.32 mg/100 g of fruit), G_1W_2 (110.14 mg/100 g of fruit), G_4W_2 (99.64 mg/100 g of fruit), and minimum ascorbic acid (50.73 mg/100 g of fruit) was recorded with the treatment combination G_0W_0 [gamma radiation (0 Gy) + waxol (0%)] (Table 1).The increase in ascorbic acid in earlier stages of storage may be due to the inactivation of ascorbic acid oxidase enzyme or due to increasing rate of phenols. Whereas, during later stages (8days of storage) the decrease is due to conversion of L-ascorbic acid. Similar results have also been stated by Chandra (1995) and Mahajan *et al.* (2005).

Maximum reducing sugar (4.64%) was recorded with the treatment combination G_3W_2 [gamma radiation (100 Gy) + waxol (6%)], followed by G_2W_2 (3.66%), G_1W_2 (3.32%), G_4W_2 (2.84%), and minimum reducing sugar (2.40%) was recorded with the treatment combination G_0W_0 [gamma radiation (0 Gy) + waxol (0%)] (Table 1). Similar result was also recorded by Jagadeesh (1994) that fruit coated with 6% waxol shows the higher content of reducing sugars.

Maximum non-reducing sugar (3.82%) was recorded with the treatment combination G_3W_2 [gamma radiation (100 Gy) + waxol (6%)], followed by G_2W_2 (3.01%), G_1W_2 (2.56%), G_4W_2 (2.36%), and minimum non-reducing sugar (0.83%) was recorded with the treatment combination G_0W_0 [gamma radiation (0 Gy) + waxol (0%)] (Table 1).

Maximum total sugar (8.46%) was recorded with the treatment combination G_3W_2 [gamma radiation (100 Gy) +

Table 1 Effect of different levels of Gamma radiation, Waxol and their interaction on physiological weight loss (%), acidity (%), total soluble solids (%), vitamin C (mg/100 g) reducing sugar (%), non-reducing sugar (%) and total sugar (%)

Gamma radiation (G)	4 DAYS				8 DAYS				12 DAYS				16 DAYS								
	Waxol (W)				Waxol (W)				Waxol (W)				Waxol (W)								
	W ₀ (0%)	W ₁ (4%)	W ₂ (6%)	W ₃ (8%)	Mea. (G)	W ₀ (0%)	W ₁ (4%)	W ₂ (6%)	W ₃ (8%)	Mean (G)	W ₀ (0%)	W ₁ (4%)	W ₂ (6%)	W ₃ (8%)	Mean (G)	W ₀ (0%)	W ₁ (4%)	W ₂ (6%)	W ₃ (8%)	Mean (G)	
G ₀	2.4	1.98	1.8	2.01	2.05	4.8	3.97	3.61	4.03	4.1	7.23	5.96	5.42	6.05	6.16	9.61	7.72	7.24	7.95	8.13	
G ₁	1.37	1.31	1.29	1.33	1.33	2.74	2.59	2.54	2.62	2.62	4.11	3.88	3.81	4	3.95	5.49	5.27	5.21	5.36	5.33	
G ₂	1.27	1.16	1.09	1.21	1.18	2.42	2.19	2.15	2.33	2.27	3.63	3.29	3.27	3.49	3.42	5.08	4.66	4.42	4.86	4.76	
G ₃	1.07	0.91	0.85	1.02	0.96	2.14	1.82	1.71	2.14	1.95	3.21	2.73	2.57	2.81	2.83	4.4	3.65	3.44	4.36	3.96	
G ₄	1.7	1.66	1.54	1.68	1.65	3.4	3.08	2.8	3.37	3.16	5.12	4.63	4.12	5.08	4.74	6.84	6.66	6.17	6.77	6.61	
Mean (W)	1.56	1.4	1.31	1.45	1.65	3.1	2.73	2.56	2.9	3.16	4.66	4.1	3.84	4.29	—	6.28	5.59	5.3	5.86	—	
<i>Physiological weight loss (%)</i>																					
G ₀	4	4.8	5	4	4.45	4	5.2	5.4	4	4.65	5.2	6.2	6.6	5.6	5.9	3.4	3.6	4	3.4	3.6	
G ₁	7	7.8	7.8	7.6	7.55	7.6	8.2	8.4	8	8.05	8.2	8.6	9	8.53	8.58	4.6	5	5	5	4.9	
G ₂	8	8.2	8.4	8.2	8.2	8.4	9	9	8.6	8.75	9	9.4	9.8	9.2	9.35	5.2	5.4	6.4	5.4	5.6	
G ₃	8.6	9.6	10.2	8.8	9.3	9	10	11.6	9.6	10.05	10	11.2	11.8	10.4	10.9	7.07	7.4	8	7	7.37	
G ₄	5.2	6.8	7	6.53	6.38	5.4	7	7.4	6.2	6.5	7	7.13	7.53	7.07	7.18	4	4	4	4	4	
Mean (W)	6.56	7.44	7.68	7.03	6.88	6.88	7.88	8.36	7.28	7.88	7.88	8.51	8.95	8.16	7.18	4.85	5.08	5.48	4.96	—	
<i>Total soluble solid (%)</i>																					
G ₀	4	4.8	5	4	4.45	4	5.2	5.4	4	4.65	5.2	6.2	6.6	5.6	5.9	3.4	3.6	4	3.4	3.6	
G ₁	7	7.8	7.8	7.6	7.55	7.6	8.2	8.4	8	8.05	8.2	8.6	9	8.53	8.58	4.6	5	5	5	4.9	
G ₂	8	8.2	8.4	8.2	8.2	8.4	9	9	8.6	8.75	9	9.4	9.8	9.2	9.35	5.2	5.4	6.4	5.4	5.6	
G ₃	8.6	9.6	10.2	8.8	9.3	9	10	11.6	9.6	10.05	10	11.2	11.8	10.4	10.9	7.07	7.4	8	7	7.37	
G ₄	5.2	6.8	7	6.53	6.38	5.4	7	7.4	6.2	6.5	7	7.13	7.53	7.07	7.18	4	4	4	4	4	
Mean (W)	6.56	7.44	7.68	7.03	6.88	6.88	7.88	8.36	7.28	7.88	7.88	8.51	8.95	8.16	7.18	4.85	5.08	5.48	4.96	—	
<i>Acidity (%)</i>																					
G ₀	0.38	0.32	0.32	0.32	0.32	0.32	0.28	0.28	0.28	0.29	0.26	0.24	0.24	0.24	0.25	0.22	0.22	0.2	0.22	0.22	
G ₁	0.3	0.28	0.28	0.3	0.29	0.28	0.28	0.28	0.28	0.28	0.22	0.22	0.22	0.22	0.22	0.18	0.18	0.18	0.18	0.18	
G ₂	0.28	0.26	0.26	0.28	0.27	0.28	0.24	0.24	0.26	0.26	0.22	0.2	0.2	0.2	0.21	0.15	0.15	0.15	0.15	0.15	
G ₃	0.24	0.24	0.24	0.24	0.24	0.22	0.22	0.22	0.22	0.22	0.2	0.18	0.15	0.18	0.18	0.15	0.13	0.13	0.15	0.14	
G ₄	0.32	0.3	0.3	0.3	0.31	0.28	0.28	0.28	0.28	0.28	0.24	0.24	0.24	0.24	0.24	0.2	0.18	0.18	0.2	0.19	
Mean (W)	0.29	0.28	0.28	0.29	0.28	0.27	0.26	0.26	0.26	0.28	0.23	0.22	0.22	0.22	0.24	0.18	0.17	0.17	0.18	—	
<i>Vitamin C (mg/100 g)</i>																					
G ₀	81.53	99.64	101.4	97.83	95.11	67.03	86.96	88.77	86.95	82.43	57.97	72.47	81.53	59.79	67.9	50.7	72.47	81.53	58.79	65.88	
G ₁	121.39	126.82	126.8	126.82	125.5	114.7	116.8	120.6	114.96	116.8	112.3	113.69	113.99	112.3	113	101	106.9	110.1	106.89	106.3	
G ₂	130.44	134.06	137.7	130.44	133.2	128.6	131.3	135.9	130.88	131.7	114.3	120.31	123.19	116.49	119	111	112.3	112.3	110.57	111.4	

Table 1 concluded

	G ₃	G ₄	Mean (W)	139.5	170.3	170.3	141.31	155.4	137.7	166.7	170.3	148.22	155.7	123.2	139.5	154.29	125.09	136	118	119.6	148.6	119.5	126.4		
	100 Gy	125 Gy	Mean (W)	105.08	115.96	121.4	108.7	112.8	90.51	113.4	114.1	112.32	107.6	85.95	106.53	112.18	103.27	102	83.8	97.83	99.64	90.59	92.96		
	115.6	129.4	132	121	108	123	126	118.7	108	123	126	118.7	107.6	98.7	110.5	117	103.39	92.9	102	110	97.27	92.96			
	F-	S	NS	NS	F-	S	F-	S	F-	S	F-	S	F-	S	F-	S	F-	S	F-	S	F-	S	CD		
	test	test	test	test	test	test	test	test	test	test	test	test	test	test	test	test	test	test	test	test	test	test	test	(±) (P=0.05)	
	S	S	NS	NS	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	0.264	
	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.534	
	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.211	
	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.427	
	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.057	
	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.135	
Reducing sugar (%)																									
G ₀	2.32	2.85	3.09	2.69	2.74	2.66	3.32	3.16	2.66	3.32	3.5	3.14	3.16	3.37	3.79	4.07	3.5	3.68	2.4	2.47	2.74	2.46	2.52		
G ₁	3.34	3.56	3.58	3.34	3.46	4.23	4.4	4.35	4.23	4.4	4.46	4.31	4.35	4.82	4.88	4.93	4.86	4.87	2.97	3.21	3.32	3.05	3.14		
G ₂	3.68	3.73	3.75	3.72	3.72	4.54	4.61	4.59	4.54	4.61	4.61	4.61	4.59	4.95	5.05	5.1	4.95	5.01	3.38	3.56	3.66	3.56	3.54		
G ₃	3.76	3.96	4.15	3.8	3.92	4.63	4.7	4.71	4.63	4.7	4.8	4.69	4.71	5.14	5.39	5.51	5.39	5.36	3.67	3.84	4.64	3.82	3.99		
G ₄	3.13	3.26	3.33	3.15	3.22	3.61	4.09	3.94	3.61	4.09	4.16	3.91	3.94	4.12	4.48	4.55	4.21	4.34	2.77	2.84	2.84	2.8	2.81		
Mean (W)	3.25	3.47	3.58	3.34	3.34	3.94	4.22	4.13	3.94	4.22	4.31	4.13	4.13	4.48	4.72	4.83	4.58	3.04	3.18	3.44	3.44	3.14			
Non-reducing sugar (%)																									
G ₀	1.2	1.38	1.97	1.33	1.47	2.03	2.2	2.31	2.03	2.2	2.84	2.17	2.31	2.87	3.54	3.56	3.05	3.26	0.83	1.45	1.5	1.21	1.25		
G ₁	2.91	3	3.15	2.94	3	3.24	3.7	3.53	3.24	3.7	3.79	3.39	3.53	4.51	4.61	4.8	4.54	4.62	2.36	2.53	2.56	2.51	2.49		
G ₂	3.32	3.42	3.61	3.32	3.42	3.87	4.04	4.03	3.87	4.04	4.2	4	4.03	4.84	4.93	4.94	4.9	4.9	2.66	2.96	3.01	2.68	2.83		
G ₃	3.77	3.9	3.66	3.81	3.79	4.31	4.77	4.64	4.31	4.77	5.09	4.39	4.64	4.95	5.3	5.79	5.12	5.29	3.16	3.54	3.82	3.29	3.45		
G ₄	2.07	2.26	2.86	2.18	2.34	2.93	3.03	2.99	2.93	3.03	3.05	2.96	2.99	4.05	4.11	4.49	4.07	4.18	2.1	2.27	2.36	2.26	2.25		
Mean (W)	2.65	2.79	3.05	2.72	2.72	3.28	3.55	3.38	3.28	3.55	3.8	3.38	3.38	4.24	4.5	4.72	4.34	2.22	2.55	2.65	2.65	2.39			
Total sugar (%)																									
G ₀	3.53	4.23	5.06	4.02	4.21	4.7	5.52	5.47	4.7	5.52	6.34	5.31	5.47	6.24	7.33	7.63	6.55	6.94	3.23	3.92	4.24	3.67	3.77		
G ₁	6.25	6.56	6.73	6.28	6.46	7.47	8.1	7.88	7.47	8.1	8.25	7.7	7.88	9.33	9.49	9.73	9.4	9.49	5.33	5.74	5.88	5.56	5.63		
G ₂	7	7.15	7.36	7.04	7.14	8.41	8.65	8.62	8.41	8.65	8.81	8.61	8.62	9.79	9.98	10.04	9.85	9.91	6.04	6.52	6.67	6.24	6.37		
G ₃	7.53	7.86	7.82	7.61	7.7	8.94	9.47	9.35	8.94	9.47	9.89	9.08	9.35	10.1	10.69	11.3	10.51	10.7	6.83	7.38	8.46	7.11	7.45		
G ₄	5.2	5.52	6.19	5.33	5.56	6.54	7.12	6.94	6.54	7.12	7.21	6.87	6.94	8.17	8.59	9.04	8.28	8.52	4.87	5.1	5.2	5.06	5.06		
Mean (W)	5.9	6.26	6.63	6.06	6.06	7.21	7.77	7.51	7.21	7.77	8.1	7.51	7.51	8.7	9.21	9.55	8.92	5.3	5.73	6.09	6.09	5.53			
Gamma radiation (G)																									
G ₀	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₁	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₂	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₃	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₄	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Mean (W)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Waxol (W)																									
G ₀	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₁	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₂	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₃	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₄	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Mean (W)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Interaction (G x W)																									
G ₀	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₁	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₂	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₃	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
G ₄	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Mean (W)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	

waxol (6%)], followed by G_2W_2 (6.67%), G_1W_2 (5.88%), G_4W_2 (5.20%), and minimum total sugar (3.23%) was recorded with the treatment combination G_0W_0 [gamma radiation (0 Gy) + waxol (0%)] (Table 1). Increasing trend in total sugar was observed in all treatments up to 8 days of storage, however at 12 days of storage the sugar content decreased irrespective of treatments. This may be due to rapid conversion of polysaccharides into sugar in the former stage and then due to utilization of sugar in respiration a decrease in sugars was noted in the later stage. These findings are in close confirmation with that of Chandra (1995).

Thus it may be concluded that fruits irradiated with 100 Gy gamma rays and coated with 6% waxol gave the better result in terms of acidity (%), ascorbic acid (mg/100 g), reducing and non-reducing sugar (%) and total soluble solid (%) and keeps the fruits at marketable stage up to 16 days.

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