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Effect of Blanching Pre-treatment and GA_3 Coating on Shelf-life of Green Chillies (*Capsicum frutescens* L.)

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ABSTRACT

Blanching treatment was intended to inactivate the endogenous enzymes of vegetables during storage and is common pre-treatment method which alters nutritional and sensory attributes. The present study was conducted to study the effect of blanching treatment followed by GA_3 coating on quality and sensory attributes during storage of the green chillies. The experiment was laid out in the completely randomized design with three replications. The treatments given were 0, 5, 10 and 15 second blanching followed by dipping in 1, 2 and 3 ppm gibberellic acid. The use of different edible coatings significantly influenced the shelf-life and quality of green chillies. It was recorded that edible coating treatment T_3 (gibberellic acid @ 3 ppm) was found the most superior treatment as compared to other edible coating treatments and it gave the maximum physical and biochemical parameters. However, the minimum physical and biochemical parameters were recorded under control treatment T_0. Therefore, on the basis of the present study, it may be concluded that the gibberellic acid @ 3 ppm was best for the improving shelf-life and quality of green chillies.

Key words: Coating, physico-chemical parameters, organoleptic evaluation, storage

INTRODUCTION

Capsicum frutescens L. belongs to Solanaceae family and its fruit (green chilli) has sharp acidic flavour and colour with distinctly pungent taste. It is used in India as a principal ingredient of various curries and chutneys. It is also used for vegetable spices, condiments, sauces and pickles. It is mainly grown as a cash crop owing to non-climacteric fruits, enriched with vitamins and minerals. Chillies are excellent source of vitamin A, B, C and E with minerals like molybdenum, manganese, folate, potassium, thiamine and copper (Batiha *et al.*, 2020; Rohitha *et al.*, 2022). Green chillies are highly perishable (Panigrahi *et al.*, 2017), and sometimes farmers get very less profit due to the glut in the market during the main seasonal harvests. The fruits undergo gradual deterioration due to desiccation, oxidative reactions, microbial growth and other biochemical changes. Such rapid deterioration in the form of softening, wrinkling, wilting and decaying of the harvested produce during storage and transportation, fail to provide the anticipated profit, consumer-acceptance or to even meet the actual cultivation cost (Singh *et al.*, 2018a). A huge amount of green chillies is found to be wasted due to lack of proper preservation techniques.

External coating(s) act as partial barrier to water vapour, gases and restricting rapid metabolism, might be helpful to preserve the texture, quality and external appearance of harvested fruits, and in due course may also improve their storage-life, significantly influencing the functions of storage associated biochemicals and antioxidants (Relhan *et al.*, 2021). There are several reports on post-harvest storage-life of green chillies published till date that include semper fresh edible coating, shellac-based surface coating, essential oil (cinnamon) coating and gibberellic acid coating (Salehi, 2020; Wibowo *et al.*, 2021). However, there is no report that addresses the efficacy of blanching followed by gibberellic acid

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coating. Therefore, the present study was planned to study the effect of blanching treatment followed by GA_3 coating on quality and sensory attributes during storage of the green chillies.

MATERIALS AND METHODS

The present investigation was carried out during May, 2022 at Post-harvest Management Laboratory, School of Agriculture, ITM University, Gwalior. Green chillies were brought in a single lot and were sorted for uniform size, disease and injury free. After sorting the green chillies were washed with tap water to remove impurities present on the surface. Chillies were further divided into four groups and three groups were blanched @ 75±5°C for 5, 10 and 15 seconds. Gibberellic acid solution 1, 2 and 3 ppm was prepared for coating on the blanched green chillies. Blanched and unblanched chillies were dipped in the prepared gibberellic acid solution for 2-3 min. The treatment given to the unblanched chillies was dipped in gibberellic acid @ 1 ppm (T_1), gibberellic acid @ 2 ppm (T_2) and gibberellic acid @ 3 ppm (T_3). The different blanched chillies were dipped in gibberellic acid solutions and the treatments were 5 second blanched with gibberellic acid @ 1 ppm (T_4), 5 second blanched with gibberellic acid @ 2 ppm (T_5), 5 second blanched with gibberellic acid @ 3 ppm (T_6), 10 second blanched with gibberellic acid @ 1 ppm (T_7), 10 second blanched with gibberellic acid @ 2 ppm (T_8), 10 second blanched with gibberellic acid @ 3 ppm (T_9), 15 second blanched with gibberellic acid @ 1 ppm (T_{10}), 15 second blanched with gibberellic acid @ 2 ppm (T_{11}), 15 second blanched with gibberellic acid @ 3 ppm (T_{12}) and control (T_0). The data recorded for various parameters were assessed on 0, 3, 6, 9 and 12 days during the period of experimentation.

The fruit width (mm) and height (cm) were analyzed by using vernier calliper in each treatment, respectively. The physiological loss in weight of the fruits was recorded at each interval during storage. The observations were taken from all the three replications and the average values were statistically analyzed. The chillies were weighed and this weight was termed as final weight on the particular date of observation. The per cent loss in weight for each treatment was calculated following Dahiya and Singh (2018) as:

$$\text{PLW (\%)} = \frac{\text{(Initial weight - Final weight)}}{\text{Initial weight}} \times 100$$

Decay loss was calculated on weight basis. Weight of decayed fruits included the total weight of fruits decayed up to that date of observation. The per cent decay loss was calculated by following Singh *et al.* (2018b).

$$\text{Decay loss (\%)} = \frac{\text{Weight of decayed fruit}}{\text{Initial weight of fruits at the time of packaging}} \times 100$$

Biochemical parameters viz., pH, TSS (°Brix), moisture content (%) and ascorbic acid (mg/100 g) content were analyzed as suggested by Singh *et al.* (2018c).

Sensory parameters such as firmness, colour, texture and overall acceptability of the chilli were evaluated by a panel of five judges using Hedonic Rating tests out of 9-point scale (Bhalerao *et al.*, 2020). The sensory evaluation was done at 03rd day after the treatment. The scoring was done 9 to 2 for like very much to dislike extremely, respectively. The results obtained during the investigation were statistically analyzed through analysis of variance at 5% level of significance (Bender, 2020).

RESULTS AND DISCUSSION

The reduction in size of fruits accompanied with moisture loss during storage was significantly influenced by the various treatments (Table 1). The moisture content ranged between 85.02 to 88.02% and was reported to be important parameter to determine the freshness of green chillies. During the storage under different treatments, a regular loss in moisture level was reported which was correlated with the fruit size (Fig. 1). The moisture loss might be responsible for shrinkage of chillies during storage and is accountable to utilization of water during breakdown of larger biomolecules into simple sugar and other molecules (Anmol and Singh, 2018). The highest level of moisture with minimum shrinkage at 12 days after storage (DAS) was reported in T_{12}, T_9, T_6 and T_3 which was associated with the application of 3 ppm of GA_3, while minimum moisture level was

Table 1. Physical parameters, physiological loss in weight (PLW) and decay of green chillies after application of GA_3 and blanching

Treatment	Length of fruits (cm)					Width of fruits (cm)					Moisture content (%)				
	0 DAS	3 DAS	6 DAS	9 DAS	12 DAS	0 DAS	3 DAS	6 DAS	9 DAS	12 DAS	0 DAS	3 DAS	6 DAS	9 DAS	12 DAS
T_0	5.30	5.25	5.10	5.02	4.90	1.50	1.40	1.32	1.20	1.10	85.02	79.04	70.00	62.00	59.20
T_1	5.47	5.35	5.19	5.15	5.03	1.59	1.48	1.39	1.27	1.16	85.45	79.37	70.70	62.91	60.16
T_2	5.76	5.75	5.61	5.47	5.35	1.72	1.64	1.58	1.48	1.37	86.53	80.52	72.42	64.55	61.80
T_3	6.32	6.22	6.10	5.90	5.79	1.89	1.83	1.74	1.65	1.53	87.64	81.98	73.85	66.90	64.10
T_4	5.51	5.46	5.33	5.20	5.13	1.65	1.51	1.42	1.31	1.20	85.86	79.62	71.55	63.35	60.56
T_5	5.89	5.80	5.69	5.49	5.37	1.75	1.69	1.61	1.52	1.41	86.81	80.66	72.98	65.03	62.23
T_6	6.20	6.09	6.00	5.76	5.63	1.93	1.85	1.77	1.70	1.61	87.75	82.48	74.09	67.58	64.79
T_7	5.57	5.52	5.46	5.28	5.16	1.65	1.55	1.47	1.37	1.26	86.03	79.90	71.69	63.75	60.95
T_8	6.02	5.83	5.73	5.53	5.43	1.79	1.73	1.64	1.53	1.42	87.12	81.02	73.46	65.25	62.45
T_9	6.25	6.19	6.06	5.80	5.68	2.04	1.92	1.84	1.75	1.62	87.79	82.85	74.52	67.84	65.04
T_{10}	5.66	5.65	5.52	5.36	5.26	1.69	1.63	1.55	1.40	1.29	86.43	80.05	72.17	64.03	61.23
T_{11}	6.11	5.90	5.76	5.62	5.50	1.83	1.79	1.70	1.61	1.50	87.45	81.40	73.76	65.70	63.09
T_{12}	6.13	6.01	5.89	5.64	5.54	2.10	2.00	1.92	1.80	1.65	88.02	83.02	75.02	68.10	65.33
S. Em(±)	0.04	0.054	0.047	0.04	0.038	0.034	0.036	0.029	0.033	0.031	0.093	0.088	0.115	0.169	0.155
C. D. (P=0.05)	0.122	0.167	0.144	0.122	0.117	0.103	0.11	0.089	0.101	0.095	0.285	0.272	0.354	0.52	0.477

DAS: Days after storage of treated green chillies.

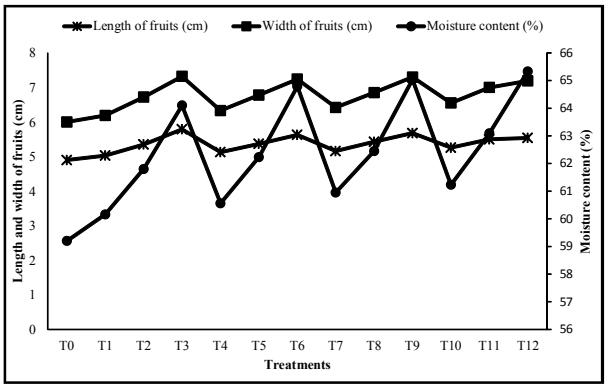

Fig. 1. Trend of change in moisture content and fruit size (length and width) of green chillies during storage (12 DAS) after application of GA_3 and blanching.

reported in T_0 (control) which confirmed the role of GA_3 in metabolic balance of green chillies (Fig. 1).

It is evident from Table 2 that there was no physiological loss in weight and decay or spoilage (%) at 0 day. Whereas the minimum physiological loss in weight and decay or spoilage at 3 and 6 days after storage was recorded in treatment T_3 (unblanched chillies with gibberellic acid @ 3 ppm) and it was found the best edible coating treatment as compared to other treatments. However, the maximum physiological loss in weight and decay or spoilage at 3 and 6 days after storage was observed in treatment T_0 (control). The difference was observed with the different concentrations of gibberellic acid which effectively degraded microbial cell wall and also boosted plant's immunity by enhancing defence enzymes activities and also used to coat fruits and vegetables to control microbial infection during post-harvest storage and

Table 2. Physiological loss in weight (PLW) and decay of green chillies after application of GA_3 and blanching

Treatment	PLW (%)				Decay (%)			
	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS
T_0	15.03	25.13	37.02	49.34	3.00	7.03	17.00	21.87
T_1	11.50	20.51	31.92	44.24	2.33	6.32	13.23	17.19
T_2	9.34	17.39	29.10	41.42	1.80	5.46	10.53	14.42
T_3	8.00	14.02	26.02	37.9	1.03	4.00	8.04	11.93
T_4	13.48	23.24	35.14	47.47	2.73	6.54	15.35	19.24
T_5	10.43	18.16	30.26	42.58	2.00	5.98	11.01	15.00
T_6	9.03	15.81	28.24	40.68	1.57	5.00	9.34	13.23
T_7	12.25	21.42	33.40	45.72	2.57	6.43	14.03	18.09
T_8	10.07	17.78	29.78	42.02	1.91	5.76	10.89	14.90
T_9	8.63	14.89	27.37	39.63	1.34	4.69	8.54	12.43
T_{10}	14.23	24.17	36.10	48.42	2.85	6.76	16.76	20.65
T_{11}	10.70	19.48	31.47	43.79	2.23	6.05	12.85	17.17
T_{12}	9.05	16.93	28.50	40.95	1.67	5.24	9.70	13.59
S. Em(±)	0.113	0.345	0.304	0.323	0.053	0.068	0.236	0.226
C. D. (P=0.05)	0.348	1.063	0.937	0.995	0.163	0.21	0.728	0.697

DAS: Days after storage of treated green chillies.

decreased the physiological loss in weight of fruits and decay or spoilage percentage in fruits (Dahiya and Singh, 2018; Bhople *et al.*, 2020; Wibowo *et al.*, 2021).

It is evident from observations that treatment T_3 (unblanched chillies with gibberellic acid @ 3 ppm) was found significantly superior edible coating treatment for enhancing the shelf-life of green chillies as compared to other treatments and no significant difference was found at 0 day after storage (Table 3). The pH, TSS and ascorbic acid content ranged between 5.14 to 5.20, 3.01 to 3.09 and 121 to 140.92 mg/100 g. It may be due to the variability related to the ripening stage. It was reported that different edible coatings or packaging created a semipermeable film on fruit surface which limited fruit respiratory metabolism and thereby slowed the decline of ascorbic acid (Kumar *et al.*, 2019; Anmol and Singh, 2020).

On 03rd day of the storage, the maximum firmness, colour, texture and overall acceptability score was recorded in treatment T_3 (GA_3 @ 3 ppm) (Table 4). It was noted that blanching treatment negatively influenced the sensory attributes viz., the firmness, colour and texture at different storage periods. T_3 was found the best treatment among all the treatments for influencing different sensory parameters in chilli fruits and treatment T_0 (Control). The consistency in sensory value was highest in T_3 and T_0 followed by T_2 with value ranging from 7 to 8, while T_1, T_5, T_7, T_9 and T_{12} were reported with score of 6 to 7 (Fig. 2; Singh, 2018; Anmol *et al.*, 2022).

Table 4. Sensory attributes of green chillies (3 DAS) after application of GA_3 and blanching

Treatment	Firmness	Colour	Texture	Overall acceptability
T_0	9	9	9	9
T_1	6	6	7	6
T_2	8	7	8	7
T_3	9	9	9	9
T_4	6	6	5	7
T_5	6	6	7	6
T_6	5	7	7	5
T_7	7	6	6	6
T_8	7	7	5	7
T_9	7	6	6	7
T_{10}	5	7	7	6
T_{11}	7	6	7	5
T_{12}	6	7	6	6

DAS: Days after storage of treated green chillies.

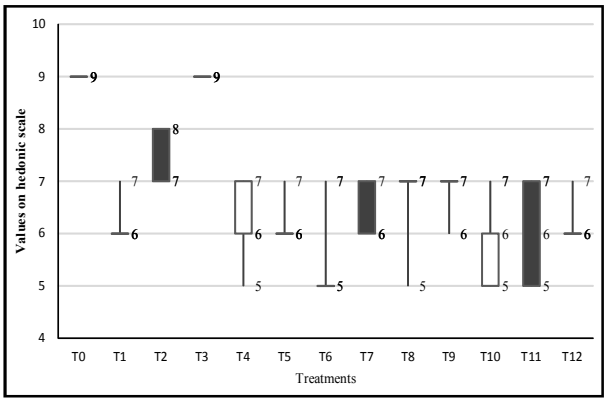

Fig. 2. Consistency in firmness, colour, texture and overall acceptability of green chillies during storage (3 DAS) after application of GA_3 and blanching.

Table 3. Biochemical parameters of green chillies after application of GA_3 and blanching

Treatment	pH					TSS (^{0}Brix)					Ascorbic acid (mg/100 g)				
	0 DAS	3 DAS	6 DAS	9 DAS	12 DAS	0 DAS	3 DAS	6 DAS	9 DAS	12 DAS	0 DAS	3 DAS	6 DAS	9 DAS	12 DAS
T_0	5.14	5.10	5.01	4.95	4.91	3.01	3.10	3.20	3.30	3.43	121.30	117.10	109.02	104.03	101.00
T_1	5.15	5.11	5.02	4.96	4.92	3.02	3.11	3.21	3.31	3.43	123.63	119.43	111.96	105.88	102.89
T_2	5.17	5.12	5.05	4.98	4.93	3.04	3.13	3.23	3.34	3.47	130.14	125.94	119.27	110.17	107.86
T_3	5.18	5.13	5.06	5.00	4.95	3.06	3.15	3.24	3.37	3.48	140.92	137.00	127.02	119.02	115.04
T_4	5.16	5.11	5.03	4.96	4.92	3.03	3.12	3.22	3.32	3.44	125.85	121.65	113.20	108.36	104.33
T_5	5.17	5.12	5.05	4.98	4.93	3.05	3.13	3.23	3.35	3.48	131.39	127.19	121.06	111.12	109.05
T_6	5.18	5.14	5.07	5.01	4.96	3.07	3.15	3.24	3.38	3.49	137.82	133.62	125.26	117.88	112.48
T_7	5.16	5.12	5.04	4.97	4.93	3.04	3.12	3.22	3.33	3.45	128.12	123.92	115.56	108.46	105.62
T_8	5.17	5.13	5.06	4.98	4.94	3.05	3.14	3.23	3.35	3.48	131.85	128.19	121.58	113.41	109.92
T_9	5.19	5.14	5.08	5.02	4.98	3.08	3.16	3.24	3.39	3.51	139.89	135.56	126.06	118.21	114.18
T_{10}	5.16	5.12	5.05	4.97	4.93	3.04	3.13	3.22	3.34	3.46	129.26	125.06	116.74	109.82	106.44
T_{11}	5.17	5.13	5.06	4.99	4.94	3.05	3.14	3.24	3.36	3.48	133.64	129.44	122.2	114.22	111.01
T_{12}	5.20	5.15	5.09	5.03	4.98	3.09	3.17	3.25	3.40	3.51	134.42	130.22	123.82	115.83	111.24
S. Em(±)	0.009	0.009	0.009	0.016	0.016	0.013	0.009	0.009	0.011	0.013	0.834	0.85	0.576	0.448	0.948
C. D. (P=0.05)	0.029	0.029	0.026	0.049	0.048	0.04	0.029	0.027	0.034	0.041	2.569	2.621	1.775	1.381	2.921

DAS: Days after storage of treated green chillies.

CONCLUSION

The use of different edible coatings significantly influenced the shelf-life of green chillies. It was recorded that coating treatment T_3 (unblanched chillies with gibberellic acid @ 3 ppm) was found the superior treatment as compared to blanched treatments and it gave the maximum physical parameters, biochemical parameters and sensory attributes. While the minimum physical and biochemical parameters were recorded under control treatment (T_0) where green chillies were not given any treatment.

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